Sensor Electronics Corporation

12730 Creek View Avenue
Savage, Minnesota 55378

Gas Detection Systems
Training Manual

August 2017

SEC 3000 Gas Detector

Features

- *Compact low cost design*
- *No field gas calibration required*
- *Intrinsically safe & explosion proof*
- *Universal control board*
- *Interchangeable sensor modules for oxygen and toxic gases*
- *Temperature compensated sensor*
- *Stand alone gas detector with 4-20 mA output*
- *Corrosion resistant 316 stainless steel housing construction*
- *Long life electrochemical sensors*
- *Can be mated with SEC 3100 Transmitter*
- *Optional heater with closed loop temperature control ensures accuracy in low temperature applications*

Industries

- *Petrochemical*
- *Medical*
- *Semi Conductor*
- *Mining*
- *Pulp and Paper*
- *Offshore*
- *Fertilizer*
- *LNG & LPG Processing*
- *Waste Water*
- *Water Treatment*
- *Chemical*
- *Automotive*
- *Pharmaceutical*
- *Refrigeration*

Operation

The SEC 3000 gas detector is a unique design combining intrinsically safe and explosion proof approved standards. This allows for quick and simple field installation of a calibrated sensor module into the gas detector in hazardous locations with power applied.

The SEC 3000 sensor module retains operating parameters and calibration settings. Once the sensor module is plugged into the gas detector, the sensor module automatically uploads current information to the control board in the SEC 3000. Changing to a different type of gas sensor is accomplished by only changing the sensor module board. The existing housing and wiring remains intact.

An industry standard 4-20 mA analog output provides remote alarm, fault and calibration signals. The entire unit utilizes self-diagnostics, identifies problems and continuously transmits status.

The SEC 3000 can be used inconjunction with the SEC 3100 explosion proof transmitter. The SEC 3100 has a backlit LCD display, non-intrusive local calibration, 4-20 mA output, non-intrusive local configuration, optional relays, RS485 interface and intrinsic barrier.

SEC 3000 Gas Detector

SENSOR ELECTRONICS

Specifications

Detection Method:
Electrochemical or Galvanic

Sampling Method:
Diffusion
Optional sample draw (requires 1 liter per minute sample flow rate)

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

Output (Digital):
Interactive Interface Available On The Calibration (White) Wire

Construction:
316 Stainless Steel Explosion Proof

Accuracy:
+/- 5%

Lower Detectable Limit:
1% of Full Scale (Under Ideal Conditions)

Recommended Minimum Alarm Setting:
10% of Full Scale

Temperature Rating:
Toxic gas sensors temperature range may vary.
Please consult with Sensor Electronics.

Operating Voltage:
24 VDC ⎓ Operating range: 8 to 32 VDC measured at the detector head

Power Consumption
1-2 Watt Max.

Max. Current Draw
50 mA (at 24 VDC)

Approvals:
CSA: Class 1, Div 1, Groups B,C,D, T6
CSA: Intrinsically Safe, Groups A,B,C,D,T4

Installation Category:
Cat. I, Pollution Degree 2

Partial Gas List

Oxygen	(O_2)	Carbon Monoxide	(CO)
Hydrogen	(H_2)	Germane	(GeH_4)
Ammonia	(NH_3)	Silane	(SiH_4)
Nitric Oxide	(NO)	Phosphine	(PH_3)
Bromine	(Br_2)	Sulfur Dioxide	(SO_2)
Fluorine	(F_2)	Nitrogen Dioxide	(NO_2)
Arsine	(AsH_3)	Chlorine Dioxide	(ClO_2)
Ozone	(O_3)	Hydrogen Sulfide	(H_2S)
Chlorine	(Cl_2)	Hydrogen Fluoride	(HF)
Phosgene	($COCl_2$)	Hydrogen Chloride	(HCl)
Diborane	(B_2H_6)	Hydrogen Cyanide	(HCN)
Formaldehyde	(HCHO)	Hydrogen Selenide	(H_2Se)
Ethylene Oxide	(ETO)	Hydrogen Peroxide	(H_2O_2)

Current Output		Status
0.0	mA	Unit Fault
0.8	mA	Unit warm up
1.2	mA	Zero drift fault
1.6	mA	Calibration fault
2.0	mA	Unit spanning
2.2	mA	Unit zeroing
4-20	mA	Normal measuring mode
4.0	mA	Zero gas level
5.6	mA	10% Full Scale
8.0	mA	25% Full Scale
12	mA	50% Full Scale
16	mA	75% Full Scale
20	mA	Full scale
>20	mA	Over-range

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SEC 3000 Gas Detector

Instruction and Operation Manual

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Part Number 1460003, Rev A

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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

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.

⚠ WARNING: READ AND UNDERSTAND THE USER'S MANUAL BEFORE OPERATING OR SERVICING

⚠ WARNING: KEEP COVER TIGHT WHILE CIRCUITS ARE LIVE

⚠ CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONEL ONLY

Revision History

Rev	Date	Description of Change	Page
A	Aug 2015	Assign new part number, place under ECO control	All (footer)
		Correct Temp Specifications to align with certifications	4
		Add Caution and Warning Statements	2
		Remove Y2K Disclaimer (obsolete)	1
31015	Oct 2013	Part Number 75-3000 Update Company Address	Cover
091404	Sep 2004	Revision History Undocumented	

Table of Contents

I. SPECIFICATIONS

Model: SEC 3000 Gas Detector
Model Number: SEC3000

Available gases:

Ammonia	Carbon Monoxide	Hydrogen
Nitric Oxide	Oxygen	Phosgene
Bromine	Chlorine	Chlorine Dioxide
Fluorine	Hydrogen Peroxide	Ozone
Hydrogen Chloride	Hydrogen Cyanide	Hydrogen Fluoride
Hydrogen Sulfide	Nitrogen Dioxide	Sulfur Dioxide
Arsine	Diborane	Germane
Hydrogen Selenide	Phosphine	Silane
Formaldehyde		

***Please note** that this list is not all-inclusive. The SEC 3000 sensors can be calibrated for other toxic gases provided a calibration gas is available. For more please contact Sensor Electronics Corporation.*

Detection Method: Electrochemical or Galvanic

Aspiration:
Diffusion
Optional Sample Draw (requires 1 liter per minute sample flow rate)

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

Output (Digital) Interactive Interface Available On The Calibration (White) Wire

Response Time: Varies for type of sensing element

Construction: 316 Stainless Steel Explosion Proof

Accuracy: +/- 5%

Operating Temperature Rating:
-40° to +50°C at 0 to 99% RH (non-condensing)

Operating Voltage:
⎓ 8 to 32 VDC measured at the detector head

Power Consumption: 1 Watt Max.

Max. Current Draw: 40 mA (at 24 VDC)

Approvals:

Explosion Proof	CSA c,us: Class I, Division 1, Groups B,C,D T6						
	IECEx CSA 13.00xx: Ex d IIB+H2 T4 Gb						
Intrinsically Safe	CSAc,us: Cl I, Division 1, Groups	Vmax	Imax	Pmax	Ci	Li	T-Code
	ABCD	10.4V	148mA	1.2W	2.51uF	22.5uH	T4
	CD	16.4V	148mA	1.2W	2.51uF	22.5uH	T4
	D	26.3V	148mA	1.2W	2.51uF	22.5uH	T4
	IECEx CSA 13.00xx: Ex ia IIC T4 Ga						

Installation Category: Cat. I, Pollution Degree 2

II GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement

⎓ VDC (DC Voltage)

SEC 3000

The SEC 3000 toxic gas detector is a microprocessor based intelligent gas detector that continuously monitors toxic gases and vapors ideally suited for use in harsh environments.
The SEC 3000 is a stand-alone device providing a continuous 4 to 20 mA output.
Intrinsically Safe and Explosion Proof versions are available.
When operated with the appropriate Intrinsic Barrier, the IS SEC3000 allows cover removal and sensor replacement without declassifying the area.
Each sensor comes calibrated and carries all operating parameters. Simply plugging the sensor board into any SEC3000 base results in a calibrated fully functional unit.

⚠ WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY

⚠ AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE

Features

- *Compact low cost design*
- *No field gas calibration required*
- *Intrinsically Safe and explosion proof*
- *Universal control board*
- *Interchangeable sensor modules for oxygen and toxic gases*
- *Temperature compensated sensor*
- *Stand alone gas detector with 4-20 mA sourced output*
- *Corrosion resistant 316 stainless steel housing construction*
- *Long life electrochemical sensors*
- *Optional heater with closed loop temperature control ensures accuracy in low temperature applications*

Can Be Coupled With SEC3100 Transmitter to Provide

- *Alarm and Fault Relays*
- *Isolated RS485 Modbus Interface*
- *Lighted LCD Display*
- *Magnetic Switches For Unit Calibration Configuration*

III. OPERATION

Installation and Startup

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC 3000. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC 3000 be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air or for vapors resulting from liquid spills. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.

- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.

- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.

- The sensor should be accessible for maintenance.

- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices.

The SEC 3000 has a ¾" NPT threaded connector for mounting the detector to a junction box. SEC can provide a junction box with terminals for this purpose.

A user-supplied junction box can be used providing it has the appropriate sized NPT conduit entries. The junction box must be suitable for use in the application and location in which it is being installed. After the device has been installed, a calibration is required. Refer to the Calibration section of this manual.

Wiring connections

Red wire: 8 to 32 VDC ⎓
Black wire: DC Common
Blue wire: 4 to 20 mA output
White wire: Smart Calibration Wire (data wire)
Earth Ground: Two (2) grounding screws on SEC 3000 housing.

Wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG
501 to 1000 feet, recommended wire gauge size 14 AWG

Shielded cable is recommended. Wiring should be installed in medal conduit with no other cabling in the same conduit.

Warm-up
When power is applied to the detector, it enters a one (1) minute warm-up mode. The output current will be 0.8 mA during the warm up time period. At the end of the warm-up period with no faults present, the detector automatically enters the normal operating mode (4 mA). If a fault is present after warm-up, the detector current output will indicate a fault. See the following chart for fault code status. Some electrochemical sensors will take up to 24 hours to stabilize. Newly installed sensors should be calibrated after they have been allowed to stabilize.

Normal

In the normal operating mode, the 4 to 20 mA signal levels correspond to the detected gas concentration. The detector continuously checks for system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC 3000 is a non-isolated current source.

Current Output and Corresponding Status

Current Output	Status.
0-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.8 mA	Unit warm up
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4-20 mA	Normal measuring mode
4.0 mA	Zero gas level
5.6 mA	10% Full Scale
8.0 mA	25% Full Scale
12 mA	50% Full Scale
16 mA	75% Full Scale
20 mA	Full scale
>20 mA	Over-range

Once the fault is cleared the SEC 3000 will automatically resume normal operation.

IV. CALIBRATION

The SEC 3000 is factory calibrated, zeroed and spanned with calibration gas. After the SEC 3000 is installed under power for 24 hours it should be calibrated (zeroed and spanned) with calibration gas.

Calibration frequency is dependent on the application and installation requirements. Typical calibration of the gas sensors should be done on a quarterly basis.

The SEC 3000 sensor board is factory programmed with the following parameters. The parameters can be changed using the SEC 3000 PC Link software package. Refer the SEC 3000 PC Link Instruction Manual for additional information.

Gas Type
Range
Calibration Gas
Calibration Date
Sensor Bias Voltage (Not Adjustable)

If the calibration gas concentration is known, the SEC 3000 sensor can be zeroed and spanned in the field. The SEC 3000 can also be calibrated using the SEC 3000 PC Link software package. Refer the SEC 3000 PC Link Instruction Manual for additional information.

Hardwire Calibration Method (For declassified areas)

Before beginning calibration attach the SEC 3000 Calibration Adaptor (PN 1421468) to the SEC 3000 sensor housing. The zero and span gas flow should be regulated to 1.0 liter per minute (LPM).

Zeroing the SEC 3000
Apply clean air or zero air (nitrogen for oxygen sensor).
Connect calibration wire (white wire on SEC 3000) to negative (black wire of SEC 3000, common of the power supply) for ten (10) seconds, upon release the sensor will automatically enter the zero calibration routine. The electronics will automatically adjust the sensor's signal to the new zero reference level. During the zero calibration routine, the current output of the SEC 3000 will briefly go to 2.2 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the zeroing procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from common, the SEC 3000 will ignore the signal and continue operation as normal.

Spanning the SEC 3000
Apply the correct span gas concentration to the sensor (20.9% volume of O_2 for oxygen sensor).
Connect calibration wire (white wire on SEC 3000) to positive (red wire of SEC 3000, +24 VDC of the power supply) for ten (10) seconds; upon release the sensor will automatically enter the span calibration routine. The electronics will automatically adjust the sensor's signal to the new span reference level. During the span calibration routine, the current output of the SEC 3000 will briefly go to 2.0 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the spanning procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from +24 VDC, the SEC 3000 will ignore the signal and continue operation as normal.

V. MAINTENANCE

The SEC 3000 does not normally require routine maintenance other than calibration. The only consumable item on the SEC 3000 is the sensing element. The toxic gas sensing element will typically last for 2 years of operation.

VI. Parts List

Part Number	Description
1420636	SEC 3000 PC Link software package
1091000	Sensor Separation Kit
1421468	Cal Adapter
1421467	Splash Guard
1421467	Sample Draw Adapter

Cross Sensitivity Table

Gas Sensor

Interferring Gas

	NH_3	Cl_2**	HF	HCl	HCN	H_2S	SO_2	CO	H_2	O_2	NO	NO_2	Hydride	SiH_4	$COCl_2$	Form.	ETO
NH_3	-	N	0.05	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CO	0.05	N	N	0.005	N	0.002	N	-	0.1	N	N	0.001	N	N	N	0.5	0.5
H_2	0.02	N	N	0.01	0.01	0.001	0.005	0.1	-	N	0.001	0.001	0.00002	0.001	N	0.05	0.05
NO	N	N	N	1.5	3	0.4	0.04	0.1	N	N	-	N	N	0.3	0.1	0.8	0.8
O_2	*	N	N	*	*	*	*	*	*	-	*	*	*	*	N	N	N
Cl_2**	-0.1	-	1	N	N	N	-0.1	N	N	(1)	N	0.5	N	N	0.1	N	N
HCl	N	N	0.5	-	N	N	N	N	N	N	N	-0.3	N	N	0.05	0.2	0.2
HCN	N	-0.08	-0.1	0.01	-	N	0.15	0.1	N	N	N	-0.07	N	N	0.5	0.1	0.1
HF	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N
H_2S	0.3	-0.1	-0.3	3	N	-	N	N	N	N	N	-2.5	N	N	N	2	2
NO_2	N	0.2	0.2	0.2	0.5	0.1	-0.8	N	N	N	N	-	N	N	-1	0.1	0.1
SO_2	N	-0.01	1	0.5	2.0	0.1	-	N	N	N	N	-1	N	N	0.2	0.4	0.4
Hydride	0.5	N	N	1.5	4.0	0.5	2	N	N	N	1	-2	-	1	N	2	2
SiH_4	0.5	N	N	1.5	4.0	0.5	2	N	N	N	1	-2	1	-	N	2	2
CO_2	N	N	N	N	N	N	N	N	N	(2)	N	N	N	N	N	N	N
CH_4	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CH_3SH	N	-0.04	-0.1	1	N	0.3	N	N	N	N	N	-0.8	N	N	N	1	1
C_2H_2	0.03	N	N	N	0.04	-0.01	0.02	0.1	0.1	N	0.05	N	0.00005	0.005	N	1.2	1.2
C_2H_4	N	N	N	N	N	N	N	0.1	0.1	N	N	N	N	N	N	1	1
C_2H_6O	0.01	N	N	0.01	0.02	0.005	0.05	N	N	N	0.001	0.001	0.00001	0.01	N	2	2

Cross sensitivity data was developed by exposure of sensors to gas concentrations below 100 PPM. Sensors may show either transient or continuous responses different from those listed above if exposed to very high concentrations of gas. The values shown are the equivalent signal generated by the sensor when exposed to 1 PPM of the indicated gas. For instance, exposure of a chlorine (oxidant) sensor to 1 PPM of nitrogen dioxide would produce a sensor signal equivalent to 0.2 PPM chlorine.
Negative numbers indicate gases that can cause low readings when present with the target gas
* Indicates a three electrode sensor that requires a minimum of 5% oxygen for proper operation.
** Data shown for the chlorine sensor refers to the sensor used for bromine, chlorine, chlorine dioxide, fluorine or ozone.
Oxygen sensors will respond to halogen gases at % levels but are unaffected by low PPM levels.
Oxygen sensor response will be affected by % levels of CO2 but unaffected by low PPM levels.

VII. Drawing Section

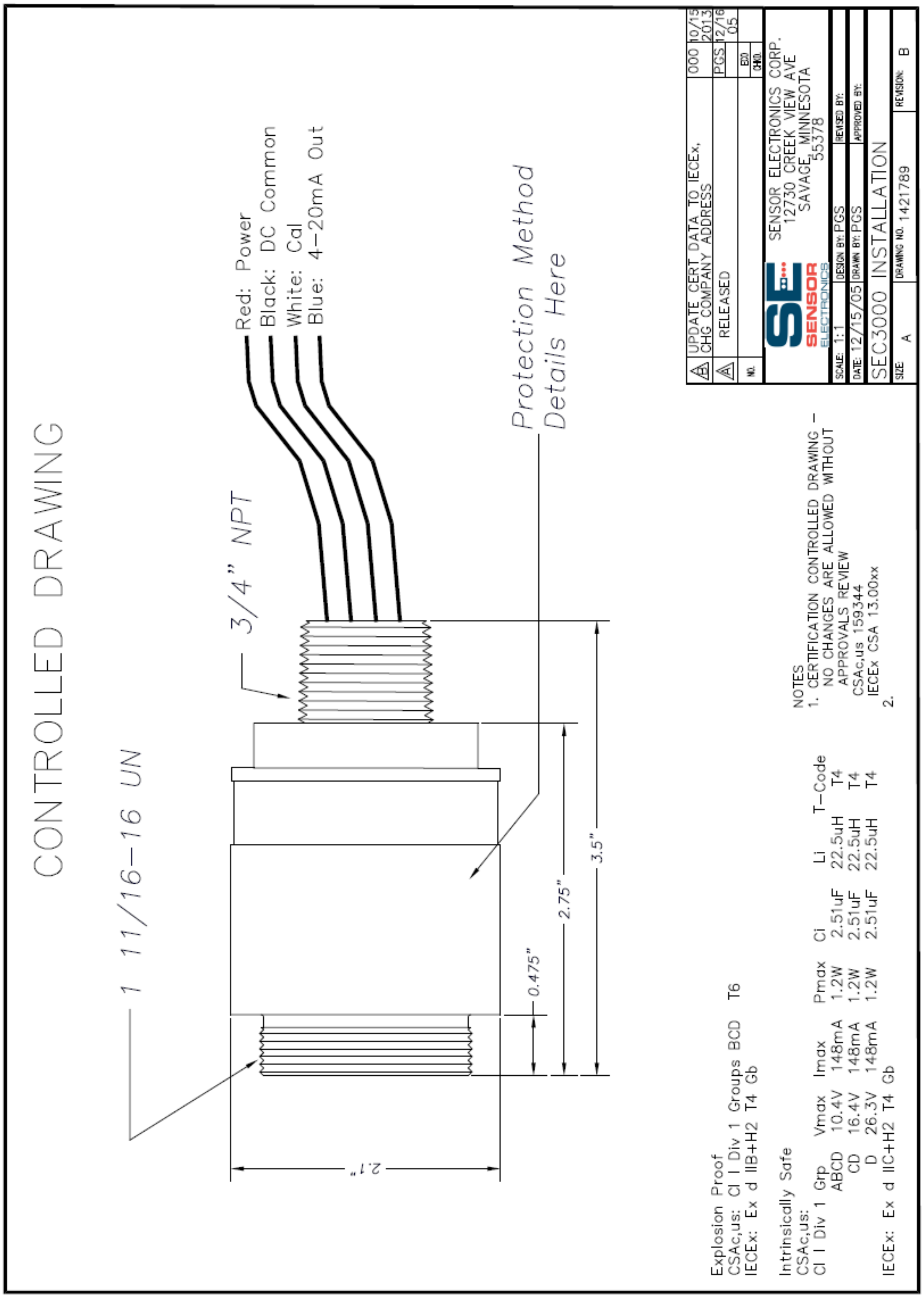
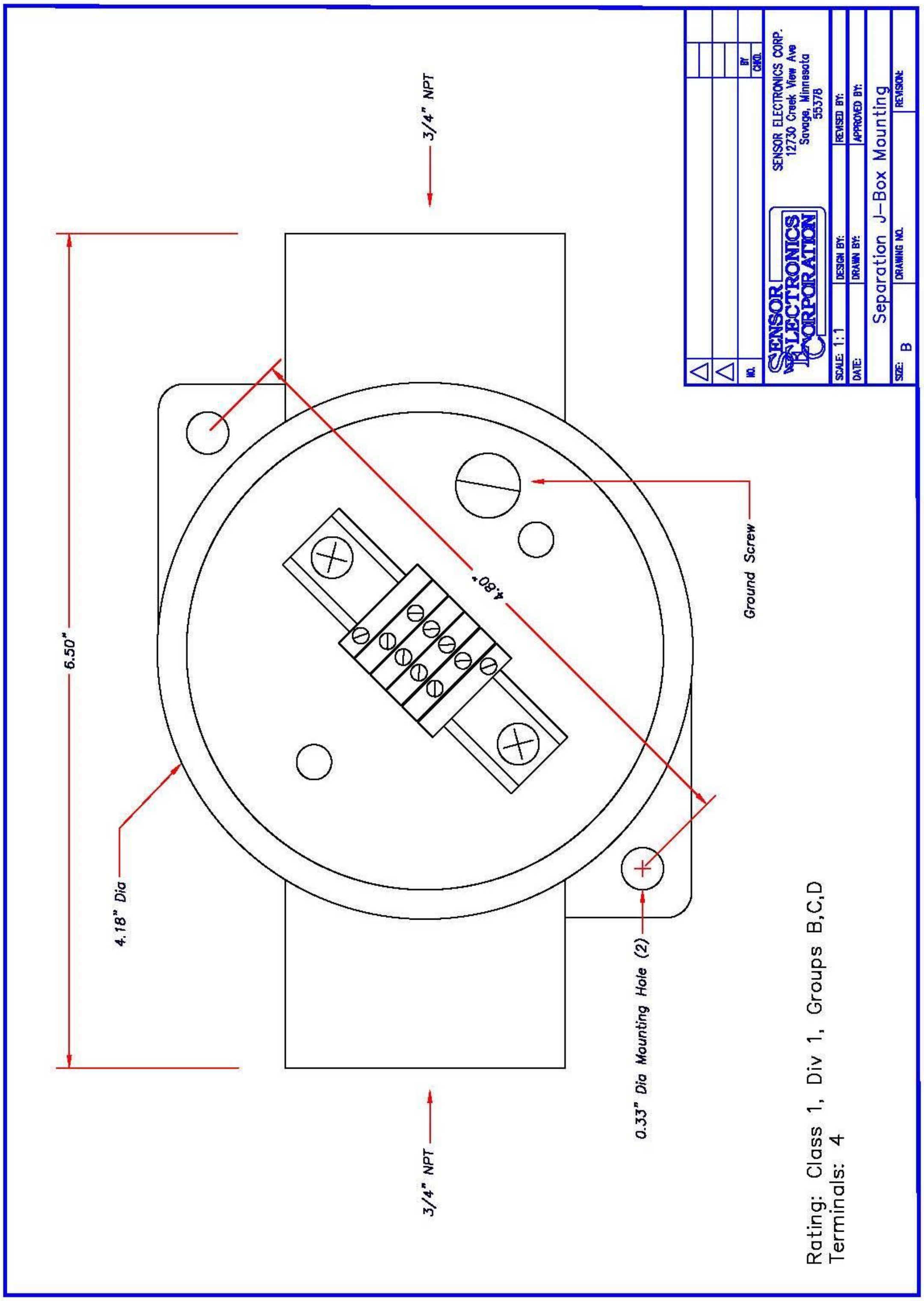


Figure 1


3/4" NPT
6.50"
4.18" Dia
4.80"
Ground Screw
0.33" Dia Mounting Hole (2)
3/4" NPT
Rating: Class 1, Div 1, Groups B,C,D
Terminals: 4
NO.
BY
CHKD.
SENSOR ELECTRONICS CORPORATION
SENSOR ELECTRONICS CORP.
12730 Creek View Ave
Savage, Minnesota
55378
SCALE: 1:1
DESIGN BY:
REVISED BY:
DATE:
DRAWN BY:
APPROVED BY:
Separation J-Box Mounting
SIZE: B
DRAWING NO.
REVISION:

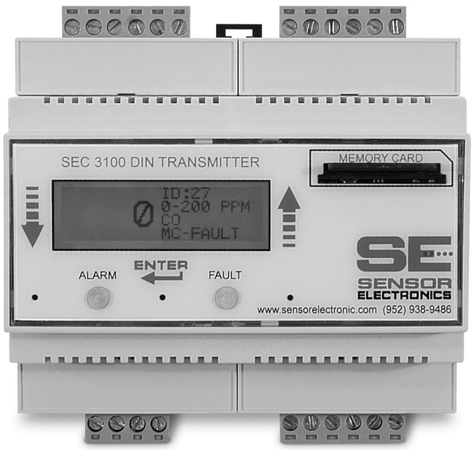
Part Number Construction

	Gas Type	Range	Units	Wire/Cable	Wire Length
30	XX	XXXX	X	X	XXX

	Range Value (4 Places)	M: PPM	0: Wires	Inches Length Or S: Standard Length (24”)
		B: PPB	1: Cable	
		V: %Vol		
		L: %LEL		
B2H6: 32				
AsH3: 32				
BCl3: 21				
BF3: 23				
Cl2: 11				
ClF3: 23				
CO: 16				
DCS: 21				
F2: 13				
H2: 18				
H2S: 24				
HBr: 23				
HCl: 21				
HF: 23				
NH3: 15				
O2: 19				
PH3: 32				
SiH4: 33				
SO2: 27				
TiCl4: 21				
WF6: 23				

Example: 0-100PPM Carbon Monoxide with 36 inches of wire

P/N: 30160100M036



SENSOR ELECTRONICS

SEC 3100 DIN
Digital Gas Transmitter

Features

- *DIN rail mount*
- *Backlit LCD Display*
- *Low Cost*
- *Plug and play toxic, oxygen and combustible gas sensors*
- *Self-check system*
- *4-20 mA output*
- *RS-485 Interface (Isolated)*
- *Optional alarm and fault relays*
- *Push button programming*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging*
- *Digital communication link to SEC 3000 and SEC Millenium Gas Detectors*

Applications

- Petrochemical Refineries
- Compost Facilities
- Semi-Conductor Industry
- Mining
- Pulp and Paper Mills
- Oil Rig Platforms
- Buildings
- Automotive Industry
- Engine Test Rooms
- LNG & LPG Facilities
- Sewage Industry
- Water Treatment Plants
- Parking Garages
- Chemical Industry
- Nuclear Industry
- Fertilizer Industry
- Tunnels
- Medical Facilities

Operation

The SEC3100 provides interface capabilities for the SEC3000 Gas Detector and SEC Millenium Infrared Gas Detectors.
The SEC3100 features:

- Back lit LCD for Gas Level/Unit Parameter display
- Four (4) configurable Alarm/Fault Relays
- An isolated RS485 Modbus interface provides reliable communication in noisy environments and eliminates “Ground Loop” problems.
- Three push button switches for local configuration and calibration
- Time stamped Data logging using a removable non-volatile memory stick module. Module can be removed from the unit to allow remote data downloading and data archiving.

SEC 3100 DIN Digital Gas Transmitter

SPECIFICATIONS

Detection Method
Toxic Gases – Electrochemical
Combustible - Infrared

Gas Sensor Compatibility
SEC 3000 & SEC Millenium

Output (digital)
RS-485 LAN (Isolated)

Output (analog)
4-20 mA (source type), max. 1000 ohm load at 24 VDC supply voltage

Output (optional relays)
(3) Alarm and (1) Fault

Display
Back Lit LCD
LEDs for alarm/status indication

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
125mA Max @ 24VDC

Power Consumption (SEC3100 & Sensor)
Toxic Gases and Oxygen (SEC 3000) – 4W Max
Combustible and CO2 (SEC Millenium) – 9W Max

Temperature Rating
-40°C to +70°C

Humidity
0-99% RH (Non-condensing)

Housing Construction
ABS Plastic

Certification
CSA/NRTL Pending

Housing Dimensions
3.54 (W) x 4.17 (L) x 2.28 (H) inches
90 (W) x 106 (L) x 58 (H) mm

Weight
Approximately 1 lb. {0.9 Kg.}

Partial Gas List

Oxygen	(O_2)	Carbon Monoxide	(CO)
Hydrogen	(H_2)	Germane	(GeH_4)
Ammonia	(NH_3)	Silane	(SiH_4)
Nitric Oxide	(NO)	Phosphine	(PH_3)
Bromine	(Br_2)	Sulfur Dioxide	(SO_2)
Fluorine	(F_2)	Nitrogen Dioxide	(NO_2)
Arsine	(AsH_3)	Chlorine Dioxide	(ClO_2)
Ozone	(O_3)	Hydrogen Sulfide	(H_2S)
Chlorine	(Cl_2)	Hydrogen Fluoride	(HF)
Phosgene	($COCl_2$)	Hydrogen Chloride	(HCl)
Diborane	(B_2H_6)	Hydrogen Cyanide	(HCN)
Formaldehyde	(HCHO)	Hydrogen Selenide	(H_2Se)
Ethylene Oxide	(ETO)	Hydrogen Peroxide	(H_2O_2)
Combustible	(HC)	Carbon Dioxide	(CO_2)
Methyl Mercaptan	(CH_4S)	Ethyl Mercaptan	(C_2H_6S)

Current Output	Status
0.0 mA	Unit Fault
0.8 mA	Unit warm up
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4-20 mA	Normal measuring mode
4.0 mA	Zero gas level
5.6 mA	10% Full Scale
8.0 mA	25% Full Scale
12 mA	50% Full Scale
16 mA	75% Full Scale
20 mA	Full scale
>20 mA	Over-range

TB1 (J1) TB2 (J2)

TB5 (J5) TB6 (J6)

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12730 Creek View Avenue, Savage, MN 55378 U.S.A. • (800) 285-3651 • (952) 938-9486 • FAX: (952) 938-9617
Email: sales@sensorelectronic.com • website: www.sensorelectronic.com

SHOWN WITH SEC MILLENIUM SENSOR

SENSOR
ELECTRONICS

SEC 3100
Digital Gas Transmitter

Features

- *Explosion Proof*
- *Back lighted LCD Display*
- *Low Cost*
- *Plug and play toxic, oxygen and combustible gas sensors*
- *Self-Check system*
- *4-20 mA output*
- *RS-485 Interface (Isolated)*
- *Alarm and fault relays*
- *Non-intrusive configuration*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging memory stick*
- *Optional IS barrier*
- *Digital communication link to SEC 3000 and SEC Millenium Gas Detectors*
- *Multi port housing for easy installation*

Applications

- *Petrochemical Refineries*
- *Compost Facilities*
- *Semi-Conductor Industry*
- *Mining*
- *Pulp and Paper Mills*
- *Oil Rig Platforms*
- *Buildings*
- *Automotive Industry*
- *Engine Test Rooms*
- *LNG & LPG Facilities*
- *Sewage Industry*
- *Water Treatment Plants*
- *Parking Garages*
- *Chemical Industry*
- *Nuclear Industry*
- *Fertilizer Industry*
- *Tunnels*
- *Medical Facilities*

Operation / Description

The SEC 3100 provides interface capabilities for the SEC 3000 Gas Detector and SEC Millenium Infrared Gas Detectors.
The SEC 3100 features:

- Back lighted LCD for Gas Level/Unit Parameter display
- Four (4) configurable Alarm/Fault Relays
- An isolated RS485 Modbus interface provides reliable communication in noisy environments and eliminates “Ground Loop” problems.
- Three magnetic switches for local configuration and calibration
- Time stamped data logging using a removable non-volatile memory module. Module can be removed from the unit to allow remote data downloading and data archiving.

An optional IS barrier allows “hot” sensor replacement in rated locations. This allows the user to install pre-calibrated/pre-configured sensor boards without removing unit power while maintaining EX rating. Removable circuit board stack and detachable connectors facilitate field-wiring installation.

SEC 3100
Digital Gas Transmitter

SENSOR ELECTRONICS

SPECIFICATIONS

Detection Method
Toxic Gases - Electrochemical
Combustible - Infrared

Gas Sensor Compatibility
SEC 3000 & SEC Millenium

Output (digital)
RS-485 LAN (Isolated)

Output (optional relays)
4-20 mA (source type), max. 1000 ohm load
at 24 VDC supply voltage

Display
Back Lighted LCD
LEDs for relay status

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
125mA Max @ 24 VDC

Power Consumption SEC 3100 (Sensor)
Toxic & O2 (SEC 3000) - 4W Max
HC & CO2 (SEC Millenium) - 9W Max

Temperature Rating
-40˚C to +70˚C

Humidity
0-99% RH (Non-condensing)

Housing Construction
Epoxy coated aluminum

Certification
CSA/NRTL: Cl I, Div 1, Groups B,C,D T5
IECEx: Ex d IIB + H2 T5 Gb

Housing Dimensions
5.25 (W) x 5.30 (L) x 4.95 (H) inches
{131 (W) x 132 (L) x 124 (H) mm}

Weight
Approximately 6 lbs. {2.8 Kg.}

Partial Gas List

Oxygen	(O2)	Carbon Monoxide	(CO)
Hydrogen	(H2)	Germane	(GeH4)
Ammonia	(NH3)	Silane	(SiH4)
Nitric Oxide	(NO)	Phosphine	(PH3)
Bromine	(Br2)	Sulfur Dioxide	(SO2)
Fluorine	(F2)	Nitrogen Dioxide	(NO2)
Arsine	(AsH3)	Chlorine Dioxide	(ClO2)
Ozone	(O3)	Hydrogen Sulfide	(H2S)
Chlorine	(Cl2)	Hydrogen Fluoride	(HF)
Phosgene	(COCl2)	Hydrogen Chloride	(HCl)
Diborane	(B2H6)	Hydrogen Cyanide	(HCN)
Formaldehyde	(HCHO)	Hydrogen Selenide	(H2Se)
Ethylene Oxide	(ETO)	Hydrogen Peroxide	(H2O2)
Combustible	(HC)	Carbon Dioxide	(CO2)

Current Output		Status
0.0	mA	Unit Fault
0.8	mA	Unit warm up
1.2	mA	Zero drift fault
1.6	mA	Calibration fault
2.0	mA	Unit spanning
2.2	mA	Unit zeroing
4-20	mA	Normal measuring mode
4.0	mA	Zero gas level
5.6	mA	10% Full Scale
8.0	mA	25% Full Scale
12	mA	50% Full Scale
16	mA	75% Full Scale
20	mA	Full scale
>20	mA	Over-range

SEC 3100 shown with SEC 3000 Sensor

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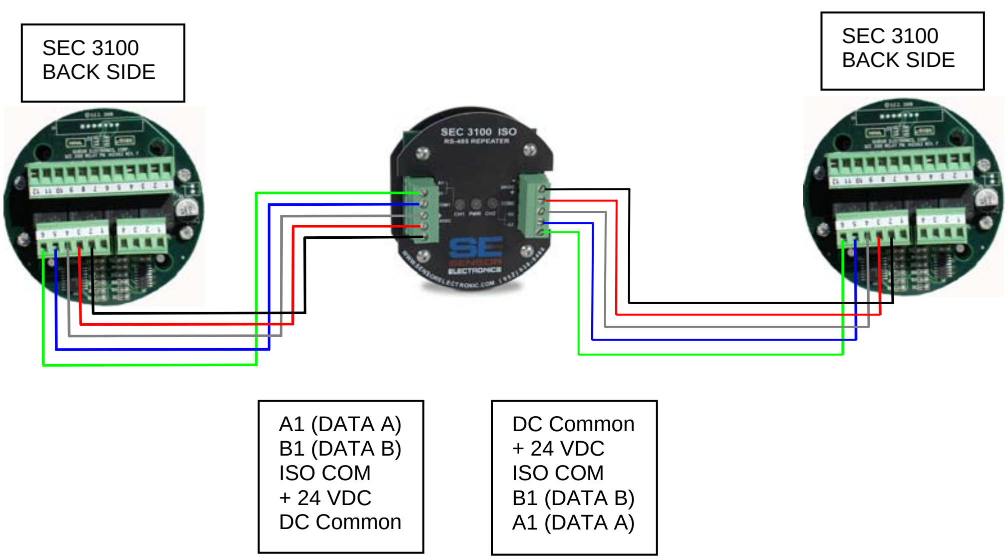
LIT PART NUMBER: 3100DATASHEET

SEC 3100 ISO
RS-485 Repeater Module

Operation

The SEC 3100 ISO RS-485 Repeater Module is used in conjunction with the SEC 3100 transmitters and the SEC 3500 HMI Operator Interface or other MODBUS RS-485 data highway systems. The SEC 3100 ISO RS-485 Repeater Module is used to extend the distance of the RS-485 network and increase the number of devices on the RS-485 network. The SEC 3100 ISO RS-485 Repeater Module provides 1500 volt isolation bidirectional data flow and transient suppression on the RS-485 data lines. An SEC 3100 ISO RS-485 Repeater Module should be installed for every 1000 feet of data highway cable or 32 network devices. The SEC 3100 ISO RS-485 Repeater Module is powered by 24 VDC and wired in line with the SEC RS-485 network devices. A typical wiring diagram is shown below:



Specifications

Operating Voltage
18-32 VDC

Temperature Rating
-40° to + 70°C

Humidity
0-99% RH (non-condensing)

Operating Current
50mA @ 24VDC

Input / Output (digital)
MODBUS RTU

Part Number
3100-000-REPEAT

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Minneapolis, Minnesota 55436 USA
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SEC 3100 LIM
Logic Input Module

Operation

The SEC 3100 LIM is used in conjunction with the SEC 3100 explosion proof transmitter or SEC 3100 DIN transmitter. A non-SEC device with normally open contacts is wired to the SEC 3100 LIM. The SEC 3100 LIM receives a Low and High contact closure from the device, converts the input signal into a digital signal compatible with the SEC 3100 transmitter. The SEC 3100 LIM is factory programmed with the following customer supplied variables:

Device Name
Range
Unit of Measure
Calibration Value

The SEC 3100 visually displays the variables on the LCD the same as if the SEC 3100 had an SEC gas detector connected. The SEC 3100 transmitter reports the foreign device status bidirectional to the SEC 3500 HMI Operator Interface via the MODBUS RS485 communication network. The SEC 3100 LIM can be installed in the SEC 3100 explosion proof transmitter housing using a taller window dome.

The SEC 3100 LIM accepts one device input for Low Alarm and High Alarm. Examples of switch contact devices that can be used with the SEC 3100 LIM are:

Open Path Gas Detectors
Fire Detectors
Temperature Switch
Pressure Switch
Air Flow Switch

SPECIFICATIONS

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
50mA @ 24VDC

Output (digital)
SEC SSP (Smart Sensor Protocol)

Temperature Rating
-40° to + 70°C

Humidity
0-99% RH (non-condensing)

Input
Low Alarm
High Alarm

Device Variable Characters
Device Name: 8
Range: 4
Unit of Measure: 4
Calibration Value: 4
(Standard ASCII Characters)

Part Number
3100-000-000-LIM

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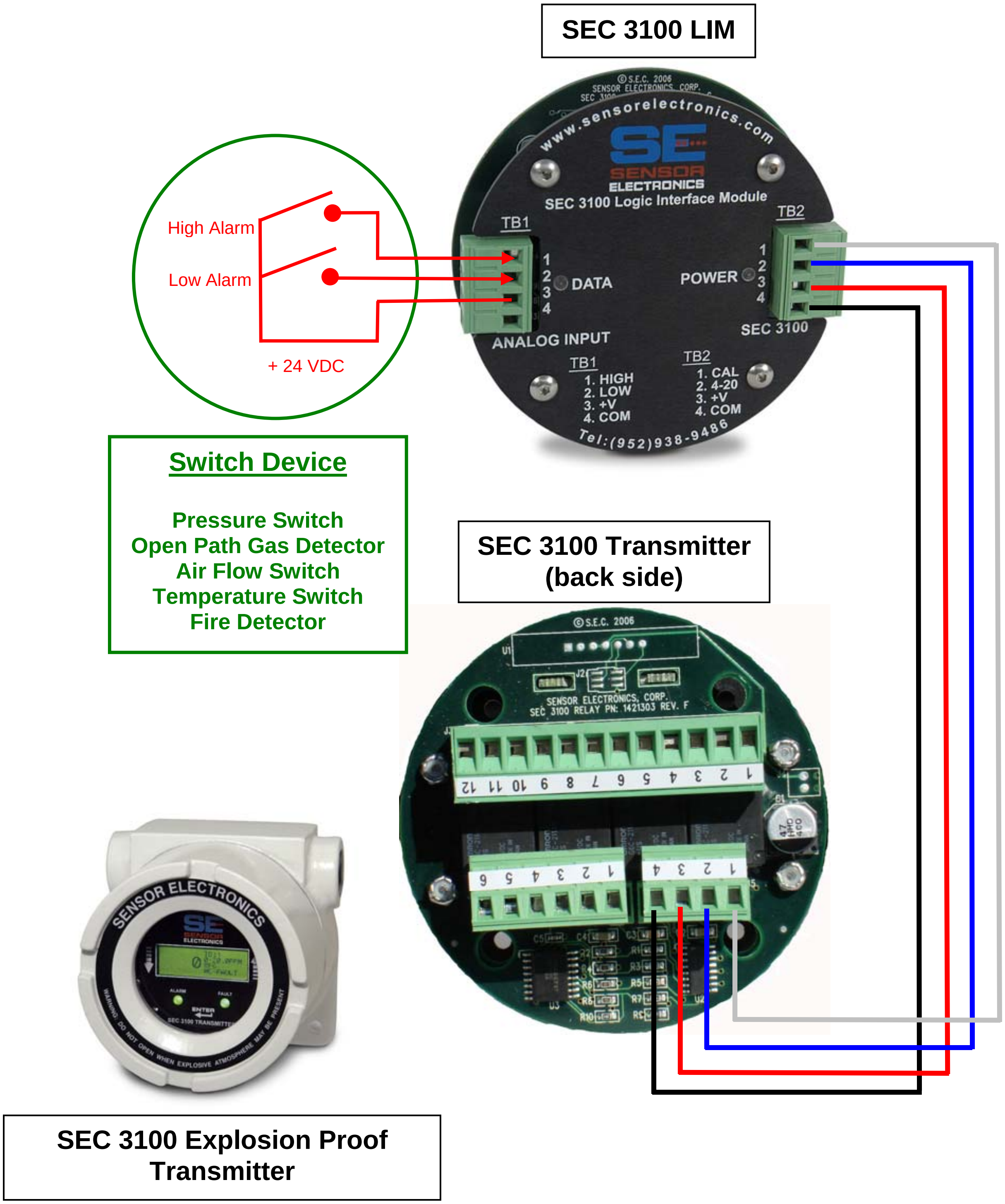
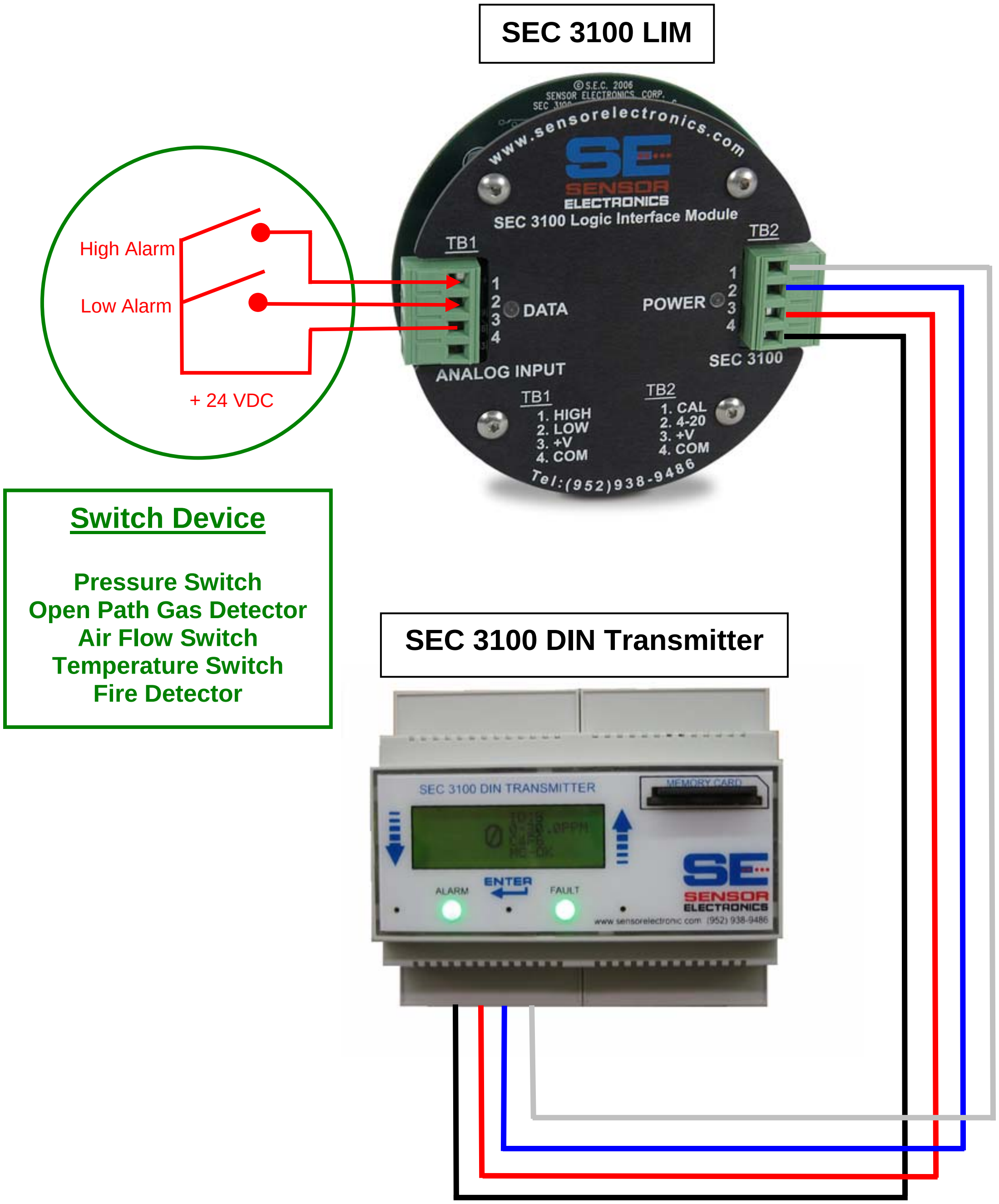
SEC 3100 EXPLOSION PROOF WIRING DIAGRAM



NOTE: Refer to the SEC 3100 Transmitter Instruction Manual for additional wiring connections.

SEC 3100 DIN WIRING DIAGRAM



TB 5

1 DC COMMON
2 +24 VDC
3 4 – 20 mA
4 Communication

NOTE: Refer to the SEC 3100 DIN Transmitter Instruction Manual for additional wiring connections.

SEC 3100 AIM
Analog Input Module

Operation

The SEC 3100 AIM is used in conjunction with the SEC 3100 explosion proof transmitter or SEC 3100 DIN transmitter. A non-SEC device with a conventional analog 4 - 20 mA output is wired to the SEC 3100 AIM. The SEC 3100 AIM receives a sourced 4 - 20 mA signal from the device, converts the analog signal into a digital signal compatible with the SEC 3100 transmitter. The SEC 3100 AIM is factory programmed with the following customer supplied variables:

Device Name
Range
Unit of Measure
Calibration Value

The SEC 3100 visually displays the variables on the LCD the same as if the SEC 3100 had an SEC gas detector connected. The SEC 3100 transmitter reports the foreign device status bidirectional to the SEC 3500 HMI Operator Interface via the MODBUS RS485 communication network. The SEC 3100 AIM can be installed in the SEC 3100 explosion proof transmitter housing using a taller window dome.

The SEC 3100 AIM accepts one device input. Examples of 4 - 20 mA devices that can be used with the SEC 3100 AIM are:

Open Path Gas Detectors
Fire Detectors
Temperature Transmitter
Pressure Transmitter
Pyrolyzers

SPECIFICATIONS

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
50mA @ 24VDC

Output (digital)
SEC SSP (Smart Sensor Protocol)

Temperature Rating
-40° to + 70°C

Humidity
0-99% RH (non-condensing)

Input (analog)
Impedance: 200 Ω
Max applied voltage: 32 VDC

Device Variable Characters
Device Name: 8
Range: 4
Unit of Measure: 4
Calibration Value: 4
(Standard ASCII Characters)

Part Number
3100-000-000-AIM

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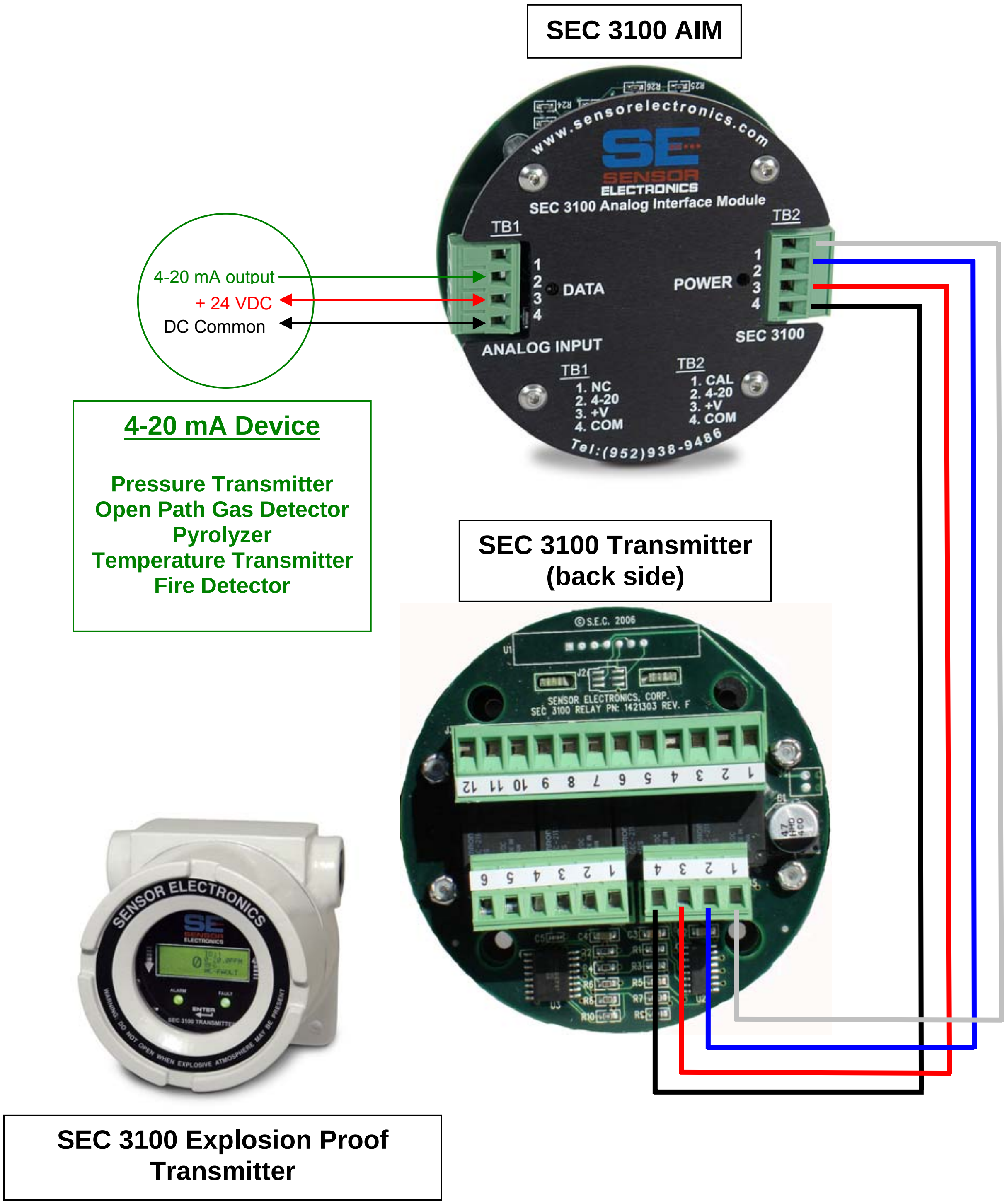
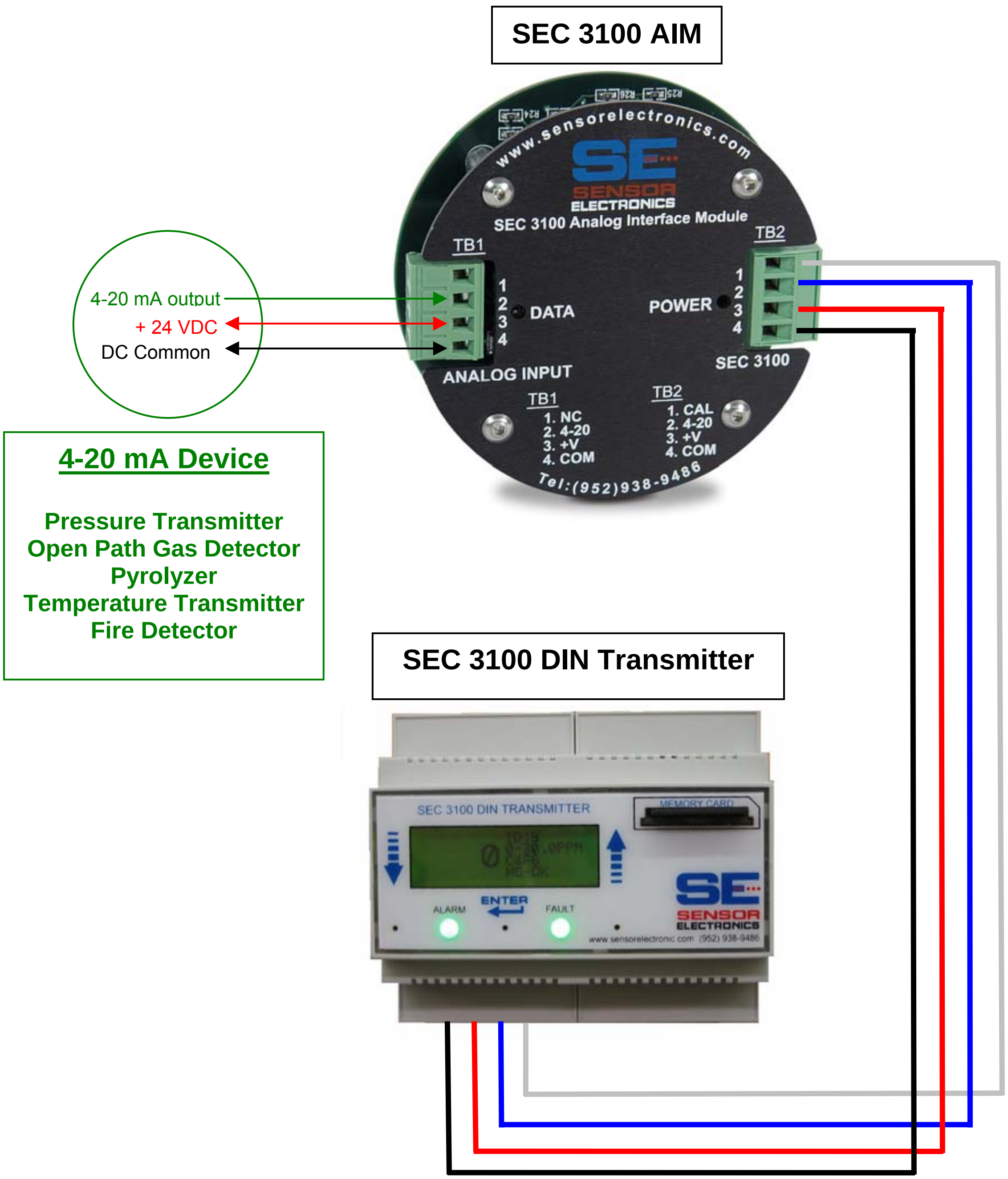
SEC 3100 EXPLOSION PROOF WIRING DIAGRAM



NOTE: Refer to the SEC 3100 Transmitter Instruction Manual for additional wiring connections.

SEC 3100 DIN WIRING DIAGRAM



TB 5

1 DC COMMON
2 +24 VDC
3 4 – 20 mA
4 Communication

NOTE: Refer to the SEC 3100 DIN Transmitter Instruction Manual for additional wiring connections.

SEC 3100 Transmitter

Instruction and Operation Manual

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Part Number 3100-EXP-MANUAL
REV 11, 20141007

Sensor Electronics Corporation

Sensor Electronics Corporation (SEC) designs and manufactures innovative fixed system gas detection equipment, for combustible gases, oxygen, carbon dioxide and toxic gases.

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.

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.

Table of Contents

I. SPECIFICATIONS

Model:
SEC 3100 Transmitter

For use with:
SEC Millenium and SEC Signature series infrared sensors and SEC 3000 Toxic and Oxygen gas sensors.

Part Number: SEC 3100-XXX-XXXXXX

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

Output (digital):
RS485 LAN (isolated)

Output (relays):
Three (3) Alarm, Low, Mid High. One (1) Fault
Rated for 8 Amps 30 VDC or 220VAC

Display:
LCD (backlit)

Construction:
Epoxy coated aluminum

Operating Temperature Rating:
-40° to +140° F at 0 to 99% RH (non-condensing)
(-40° to +60°C)

Operating Voltage:
24 VDC ⎓
Operating range: 18 to 30 VDC measured at the detector head

Max. Current Draw: (at 24 VDC with sensor)
Average: 250 mA
Peak: 500 mA

Approvals:
cCSAus Certificate: 1513912 (LR9549)
Class I, Division 1, Groups B,C,D T5

IECEx Certificate: CSA12.0012
Ex-d IIB+H2, T5 Gb

II GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement

⎓ VDC (DC Voltage)

SEC 3100

The SEC 3100 transmitter is designed to be used with the SEC Millenium, SEC Signature infrared gas sensors or SEC 3000 toxic gas detectors. The SEC 3100 is a microprocessor based intelligent transmitter continuously monitoring information from the gas sensor. The LCD of the SEC 3100 displays the gas concentration and sensor status. The SEC 3100 has one (1) “Alarm” LED and one (1) “Status” LED. The SEC 3100 also has three (3) magnetic switches located around the circumference of the unit. This manual will describe the operation and use of the SEC 3100 transmitter.

Features

- *Explosion Proof*
- *Back lighted LCD Display*
- *Low Cost*
- *Plug and play toxic, oxygen and combustible gas sensors*
- *Self-check system*
- *4-20 mA ouput*
- *RS-485 Interface (Isolated)*
- *Optional alarm and fault relays*
- *Non-intrusive programming*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging*
- *Optional IS barrier*
- *Digital communication link to SEC 3000 and SEC Millenium Gas Detectors*
- *Multi port housing for easy installation*

III. OPERATION

Installation and Startup

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC 3100 transmitter and gas sensor. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC 3100 and gas sensor be properly located enabling it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate gas sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.

- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.

- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.

- The sensor should be accessible for maintenance.

- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices.

The SEC 3100 has three (3) ¾" NPT threaded connectors for mounting and wiring the sensor and transmitter into a permanent installation.

Field wiring connections are made on the backside of the SEC 3100 printed circuit board (PCB). For wiring details refer to Figure 2 in the back of the manual.

Power wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG
501 to 1000 feet, recommended wire gauge size 14 AWG

Shielded cable is recommended. Wiring should be installed in medal conduit with no other cabling in the same conduit.

Warm-up
When power is applied to the SEC 3100, it enters a one (1) minute warm-up mode. The output current will be 0.8 mA during the warm up time period. At the end of the warm-up period with no faults present, the SEC 3100 automatically enters the normal operating mode (4.0 mA with no gas present). If a fault is present after warm-up, the detector current output and LCD will indicate a fault. The Fault LED will also indicate the fault.

Normal

In the normal operating mode, the 4 to 20 mA signal levels correspond to the detected gas concentration. The transmitter continuously checks for and displays system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC 3100 sensor is a non-isolated current source.

Current Output and Corresponding Status

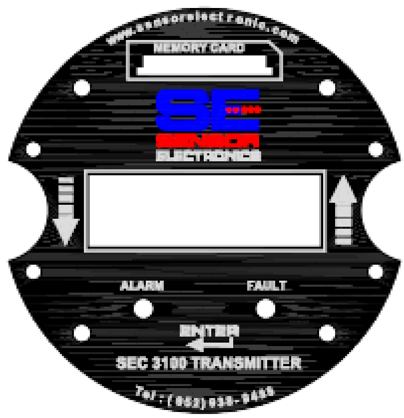
Current Output	Status
0-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4.0 mA	Zero gas level (0% of full scale)
5.6 mA	(10% of full scale)
8.0 mA	(25% of full scale)
12 mA	(50% of full scale)
16 mA	(75% of full scale)
20 mA	Full scale (100% of full scale)
20.1- 23 mA	Over-range (> 100% of full scale)

Once the fault is cleared the SEC 3100 will atomatically resume normal operation.

Flash Rate	Output Current	Unit Status Label	Possible Problem
1	4-20ma	Unit Running	Unit is measuring gas and adjusting 4-20ma output accordingly.
2	2.2ma	Unit Zero Calibrating	Unit going through its *zero calibration* procedure.
3	2.0ma	Unit Spanning	Unit going through its *spanning* procedure.
5	0.8ma	Unit Warm-up	Only for one minute after unit power-up
6	0.0ma	Power-up Fault	Hard Fault (refer to gas sensor manual)
7	1.6ma	Calibration Fault	1. Attempt *Unit Span* with no gas 2. Attempt *Unit Zero* with gas
8	NA	NA	Currently Not Used
9	0.0ma	Unit Fault	Hard Fault (refer to gas sensor manual)
10	1.0ma	Optics Fault	Clean sensor's windows
11	1.2ma	Zero Drift Fault	Hard Fault (refer to gas sensor manual)
12	0.0ma	Configuration Fault	Hard Fault (refer to gas sensor manual)
16	0.2ma	Reference Channel Fault	Hard Fault (refer to gas sensor manual)
17	0.4ma	Active Channel Fault	Hard Fault or *Unit Zero* with gas

IV. MAGNETIC SWITCH OPERATION

The SEC 3100 has three (3) magnetic switch pickups on the Display PCB. The picture below shows the location of the magnetic switches labeled UP, DOWN and ENTER. Placing a magnet in close proximity to one of the switches will cause the following operations to occur.



Switch	Operation
ENTER	Enter Menu Mode, Selects a menu to Enter
UP	Moves up through Menu selections
DOWN	Moves down through Menu selections

For further details on gas sensor calibration refer to the appropriate SEC sensor instruction manual.

The LCD contrast potentiometer, (POT1) is located under the protective faceplate shown above on the front side (LCD side) of PCB to the left of the LCD.

V. MENU OPERATION

Inital Power Up Sequence of the SEC 3100

SYSTEM BOOT PROCESS
--- WAIT FOR SYNC –-

SYSTEM BOOT PROCESS

-WAIT FOR SENSOR -

INITIALIZING

	ID: xx
WARM	SN: xxxxx
UP	TYP: x.x
	VER: x.x

	ID: xx
WARM	0-20.0PPM
UP	WF6
ENT TO ABORT	

0	ID: 1
	0-20.0 PPM
	WF6
	MC - REMOVED

In normal operating mode. Actual gas concentration will be displayed to the left of ID #, Range, Gas Type, MC (Memory Card) status.
During Warm Up, FAULT LED will be solid Blue and ALARM LED will be falshing Yellow – Blue.
MC – REMOVED indicates the MEMORY CARD (MC) in not installed in the SEC 3100. Other MC indications are OK, FAULT, FULL.

Selecting Enter when the SEC 3100 in in normal operating mode will advance to the following display:

```
* EJECT MEMORY CARD
  INFO
  MAIN MENU
  EXIT
```

Selecting Enter will allow the operator to safely remove the Memory Card.

Arrow Down

```
  EJECT MEMORY CARD
* INFO
  MAIN MENU
  EXIT
```

Selecting Enter at UNIT INFO displays the following:

```
    3100 UNIT INFO:

SN- XXXXXXXXXXXXXXX
VER- X      X.XXX.XXX
```

SN is the SEC 3100 serial number. VER is the SEC 3100 software version number. Selecting Enter again will return the display to the main info menu.

Sensor Status Menu

TYP: Sensor type (0.0 is a SEC 3000, 32.0 is SEC Millenium)
SN: Sensor serial number.
VER: Version of sensor software.
CAL: Calibration date of sensor.

Selecting MAIN MENU is covered in the next pages of the manual.

Select Exit to go back to

```
  EJECT MEMORY CARD
  INFO
  MAIN MENU
* EXIT
```

Main Menu and Sub Menus

EJECT MEMORY CARD
INFO
* MAIN MENU

Enter

* CALIBRATION
ALARM
RELAY

Calibration Menu
Used to calibrate the gas sensor.

Down Arrow

CALIBRATION
* ALARM
RELAY

Alarm Menu
Used to set alarm level set points and parameters.

Down Arrow

CALIBRATION
ALARM
* RELAY

Relay Menu
For setting alarm relay On & Off delay & Energized states.

Down Arrow

* NETWORK
HIDE NO

Network Menu
Used to set Zone #, ID # and Select Online

Down Arrow

NETWORK
* HIDE NO

Hide Menu
Hide is used to blank the display up to low alarm setting

Down Arrow

* SELF TEST
DATE TIME

Self Test Menu
Generates a signal on the display, RS485 & 4-20 mA

Down Menu

SELF TEST
* DATE TIME

Date Time Menu
Sets the date and time in the real time clock.

Down Arrow

* 4 – 20 MA CAL
EXIT

4 – 20 MA CAL
Allows user to increase or decrease 4.0 mA current output, or adjust 20 mA current output

Down Arrow

4 – 20 MA CAL
* EXIT

Exit back to normal operation.

Calibration Menu

```
* CALIBRATION
  ALARM
  RELAY
```

Enter

Using the Up and Down arrows allows the operator to move the cursor (*) to select a function.

```
*  ZERO              0
   SPAN
   CAL. VAL
   EXIT
```

To Zero the sensor apply clean air (N2 for an oxygen sensor) and select enter. The following will be displayed.

```
CALIBRATION PROCESS
 -------    WAIT    ----------
```

Then the following will be displayed.

```
CALIBRATION PROCESS
 -------    DONE    ----------
```

Once complete the following will be displayed. The sensor has been successfully zeroed.

```
*  ZERO              0
   SPAN
   CAL. VAL
   EXIT
```

Arrow down to CAL. VAL to verify the span gas calibration value matches the value of the span gas calibration on hand. If not, select Enter and the following screen will appear.

```
   ZERO
   SPAN
*  CAL. VAL    5          *
   EXIT
```

Using the Up and Down arrows will allow the operator to change the calibration gas value of the sensor to match the calibration gas used to span the sensor. Once the correct value is displayed select Enter and the sensor will be uploaded with the new calibration gas value.

To Span the sensor with calibration gas use the Up and Down arrows to select the following display.

```
  ZERO            3
* SPAN
  CAL. VAL
  EXIT
```

Apply span gas to the sensor for the appropriate amount of time in order for the sensor to stabilize. The gas reading is displayed to the right of ZERO. Once stable select Enter. This will go the display:

```
CALIBRATION PROCESS
 -------   DONE   ----------
```

If calibration span gas is still present the display will read:

```
      GAS LEVEL :  5

  CALIB. GAS  PRESENT
   ----     WAIT    ----
```

Apply clean air to the sensor to reduce this reading.
The display will advance to the following:

```
* ZERO            0
  SPAN
  CAL. VAL
  EXIT
```

This completes the calibration and the device can be put back into the normal operating mode.
Arrow Down to

```
  ZERO
  SPAN
  CAL. VAL
* EXIT
```

Enter

```
↑
* EXIT
```

Enter again and the SEC 3100 returns to normal operation.

Alarm Menu

```
  CALIBRATION
* ALARM
  RELAY
  ↓
```

Enter

```
* LOW
  MID
  HI
  ↓
```

```
  ↑
* FAULT
  EXIT
```

Select the Alarm Relay (LOW, MID, HI, FAULT) using the down arrow. Once the cursor is on the alarm relay you wish to configure, hold the magnet over Enter. The example LOW will be used. The same operations can be used to set the MID, HI or FAULT relays.

```
* ALARM LOW  4
  LATCH
  ACTIVE
  EXIT
```

Selecting Enter will display the following screen allowing the alarm set point to be programmed. Using the Up and Down arrows will change the set point. Once the correct set point is displayed select Enter and the new value will be accepted.

```
* ALARM LOW  2          *
  LATCH
  ACTIVE
  EXIT
```

```
CONFIGURING PROCESS
 ------   WAIT   -------
```

```
* ALARM LOW  2
  LATCH
  ACTIVE
  EXIT
```

Arrow Down

```
   ALARM LOW
*  LATCH          NORMAL
   ACTIVE
   EXIT
```

Selecting Enter will allow the operator to change the operation of the relay operation from Non-Latching (NORMAL) to Latching (LATCHING) or to Audible (AUDIBLE).
If the relays are set to Latching or Audible, the magnet can be used to reset (unlatch or silence) the relays by selecting any magnetic pickup switch UP arrow, DOWN arrow or ENTER.

Arrow Down

```
  ALARM LOW
  LATCH
* ACTIVE          HI
  EXIT
```

Selecting Enter will allow the operator to change the operation of the relay operation from Active HI to Active LOW. HI activates the relay on a rising alarm level. LOW actives the relay when the alarm threshold falls below the alarm set point. Once the correct operation is selected, use the Down arrow to advance to the next menu item.

Arrow Down

```
  ALARM LOW
  LATCH
  ACTIVE
* EXIT
```

Selecting Exit will advance to the next menu.

```
* LOW
  MID
  HI
  ↓
```

This menu will allow the operator to select another relay to program. Or select Fault or Exit and the next display will be:

```
  ↑
  FAULT
* EXIT
```

Selecting Enter on this display will put the SEC 3100 back into normal operation.

Relay Menu

```
  CALIBRATION
  ALARM
* RELAY
 ↓
```

Selecting Enter will advance to the following menu.

```
* LOW
  MID
  HI
 ↓
```

Arrow down to the next screen will be

```
 ↑
* FAULT
  EXIT
```

Select the Alarm Relay (LOW, MID, HI, FAULT) that is to be configured using the down arrow. Once the cursor is on the correct alarm relay, hold the magnet over Enter. The example LOW will be used. The same operations can be used to set the MID, HI, or FAULT relays.

```
* LOW
  MID
  HI
 ↓
```

Select Enter

```
* ON  DLY  LOW       0
  OFF DLY
  ENERGIZED
  EXIT
```

Select Enter

```
* ON  DLY  LOW       0     *
  OFF DLY
  ENERGIZED
  EXIT
```

Using the Up and Down arrows the operator can change the ON delay time for the relay to actuate after the alarm threshold has been exceeded. The time is measured in seconds (0-255). Once the correct time is displayed select Enter to accept the new value. Then Exit the menu and proceed on to the next selection.

In this example the Low alarm relay will actuate 30 seconds after the Low set point is exceeded.

```
* ON  DLY  LOW       30
  OFF DLY
  ENERGIZED
  EXIT
```

Select Enter

```
 ON  DLY  LOW
* OFF DLY            0
 ENERGIZED
 EXIT
```

Select Enter

```
 ON  DLY  LOW
* OFF DLY            0    *
 EXIT
```

Using the Up and Down arrows the operator can change the OFF delay time for the relay to turn OFF after the reading has decreased below the alarm point threshold. The time is measured in seconds (0-255). Once the correct time is displayed select Enter to accept the new value. Then Exit the menu and proceed on to the next selection.

In this example the Low alarm relay will stay energized for 60 seconds after the alarm has cleared.

```
 ON  DLY  LOW
* OFF DLY            60
 ENERGIZED
 EXIT
```

Arrow Down

```
 ON  DLY  LOW
 OFF DLY
* ENERGIZED   NO
 EXIT
```

Selecting Enter will allow the operator to change the operation of the relay coil from normally de-energized (ENERGIZED NO) to normally energized (ENERGIZED YES). Once the correct operation is selected, use the Down arrow to advance to the EXIT menu. Select Enter to go back to the Relay Menu

```
* LOW
 MID
 HI
 ↓
```

This menu will allow the operator to select another relay to program. Or select Exit and the next display will be:

```
 ↑
* FAULT
 EXIT
```

Arrow Down to Exit

```
 ↑
 FAULT
* EXIT
```

Enter

```
 ↑
* EXIT
```

Selecting Enter will return the SEC 3100 into normal operation.

Network Menu

```
↑
* NETWORK
  HIDE
↓
```

Select Enter

```
* ZONE     0
  ID
  ONLINE
  EXIT
```

Select Enter to change the Zone number of the SEC 3100.

```
* ZONE     0        *
  ID
  ONLINE
  EXIT
```

Use the Up and Down Arrows change the Zone number (0-255). Once the correct Zone number is displayed select Enter.

Arrow Down to ID. To change the ID number select Enter. Use the Up and Down Arrows to change the ID number (0-255). Once the correct ID number is displayed select Enter.

```
  ZONE
* ID        1           *
  ONLINE
  EXIT
```

Arrow Down to Online.

```
  ZONE
  ID
* ONLINE              YES
  EXIT
```

Using Enter the operator can toggle between Online YES and Online NO. Online YES turns on the MODUS RS485 communication. Online NO turns the MODBUS RS485 communication off.

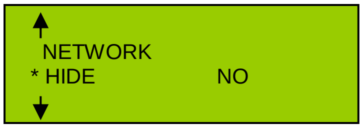
Arrow Down to Exit

```
  ZONE
  ID
  ONLINE
* EXIT
```

Enter

```
↑
* EXIT
```

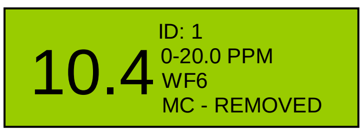
Hide Menu



Using Enter the operator can toggle between Hide YES and Hide NO.
The Hide function allows the operator to not display the gas reading until the Low Alarm threshold is exceeded. All outputs will function as normal when the Hide mode selected to YES.

Self Test Menu

Selecting Enter for the Self Test will make the sensor generate a 4-20 mA input into the SEC 3100 from 4 mA to 20 mA (0-fullscale). In the self test mode the SEC 3100 outputs are fully functional. The SEC 3100 will display the rising gas level, the 4-20 mA output will increase to 20 mA, the relays will actuate and the RS485 information will be transmitted to the control system. The following screen will be displayed



Once the unit reaches full scale the SEC 3100 automatically returns to normal.

Time Date Menu

```
↑
 SELF TEST
* DATE TIME
↓
```

Entering this menu will allow the operator to set the time and date of the SEC 3100 real time clock.

```
* DATE      1  /  30  /  2006
  TIME
  EXIT
```

Selecting Enter will locate a cursor (*) above the number allowing the operator to use the Up Down arrows to increase or decrease the numbers. Once the correct number is displayed, select Enter with the magnet and the cursor will advance to the next number.
Date is MM/DD/YYYY. Time is HH/MM/SS. Below is an example.

Enter from above display.

```
            *
* DATE      1  /  30  /  2006
  TIME
  EXIT
```

Arrow Up one number.

```
            *
* DATE      2  /  30  /  2006
  TIME
  EXIT
```

Enter

```
                  *
* DATE      2  /  30  /  2006
  TIME
  EXIT
```

Continue with the sequence until the correct date appears. Then select Enter and the following will be displayed.

```
* DATE      2  /  15  /  2006
  TIME
  EXIT
```

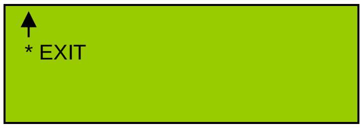
At this point the operator can advance to setting the correct time using the Down Arrow.

```
  DATE
* TIME     14  :  33  :  04
  EXIT
```

Time numbers are changed using the procedure as the Date numbers. Once the correct Time is programmed, select Enter and arrow down to Exit.

```
  DATE
  TIME
* EXIT
```

Select Enter



Selecting Enter again will return the SEC 3100 to normal operation.

4 – 20 MA CAL Menu

```
* 4 – 20 MA CAL
  EXIT
```

The 4 – 20 MA CAL Menu will allow the operator to increase or decrease the 4 to 20 mA output current at 4.0 mA and at 20 mA. *Typically this menu is not often used in the field because the analog signals are set at the factory.*

Selecting Enter will display the following:

```
*  SET 4 MA
   SET 20 MA
   DEFAULTS
   EXIT
```

Selecting Enter will display the following:

```
*  4 MA  PT: 0

  ENT WHEN COMPLETE
```

Using the UP / DOWN arrows will increase (UP arrow) or decrease (DOWN arrow) the number. Increasing the number will raise the 4.0 mA current output, lowering the number will decrease the 4.0 mA number. Note the number can be set to a negative number (-2 etc). Once the correct current output is set, pass the magnet over the ENTER Arrow and this will accept the new settings.

The display will be the following:

```
*  SET 4 MA
   SET 20 MA
   DEFAULTS
   EXIT
```

To adjust the full scale 20 mA current output arrow down and select ENTER:

```
   SET 4 MA
*  SET 20 MA
   DEFAULTS
   EXIT
```

Using the UP / DOWN arrows will increase (UP arrow) or decrease (DOWN arrow) the number. Increasing the number will raise the 20.0 mA current output, lowering the number will decrease the 4.0 mA number. Note the number can be set to a negative number (-2 etc). Once the correct current output is set, pass the magnet over the ENTER Arrow and this will accept the new settings.

Arrow down to this display and select ENTER to clear all user set numbers. Both 4 MA and 20 MA will return to 0

```
   SET 4 MA
   SET 20 MA
*  DEFAULTS
   EXIT
```

Arrow down and select Enter to return to the SEC 3100 to 4-20 MA CAL main menu..

```
   SET 4 MA
   SET 20 MA
   DEFAULTS
*  EXIT
```

V. FIGURES

LCD Display:
Real Time Status
Gas Type
Gas Concentration
Fault Identification
Range
ID Number
Memory Card Status
Interactive Menus
Calibration
Relay Programming
ID & Zone Number

Field Wiring Port (2 x ¾")
- Power
- 4-20 mA
- RS485 (MODBUS)
- Alarm Relays

Memory Data Card Slot

Mounting holes (2)

Magnetic Switch (3)

Alarm LED
Green OK
Yellow Low Alarm
Orange Mid Alarm
Red High Alarm

Fault LED
Green OK
Red Fault

Gas Sensor Port (1 x ¾")
SEC 3000
SEC Millenium

SENSOR ELECTRONICS CORPORATION
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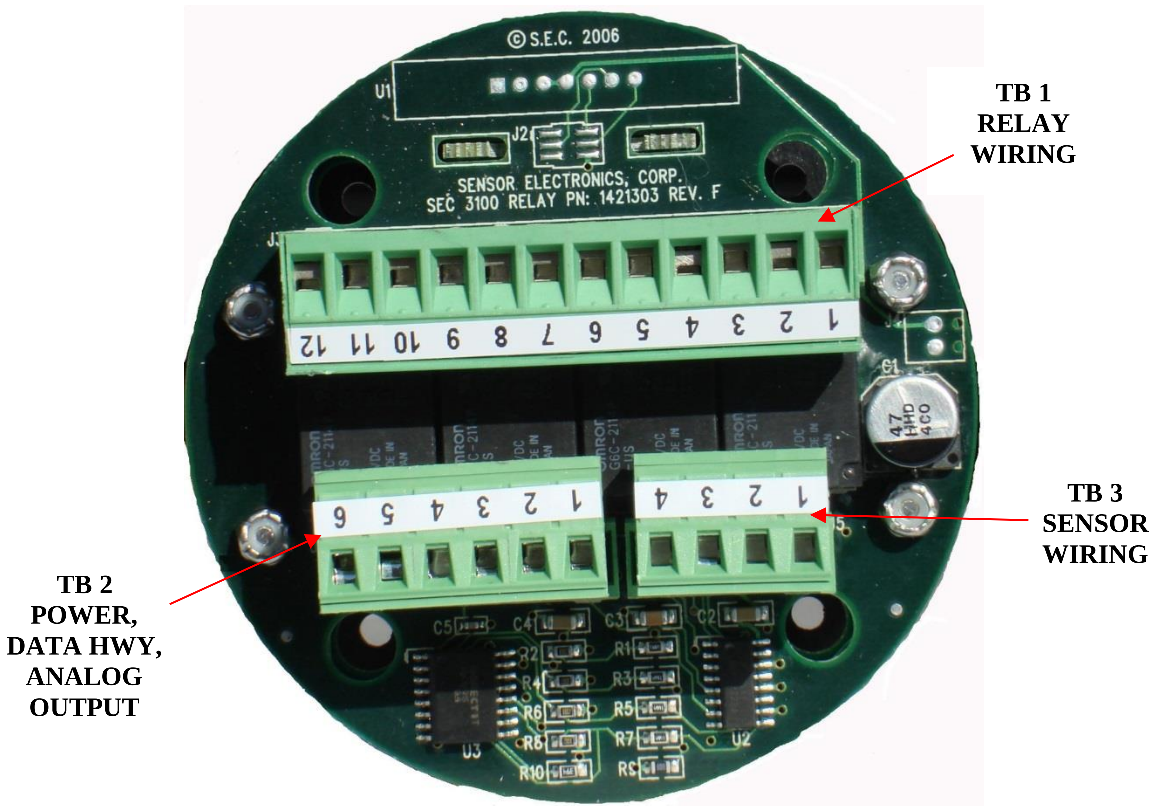
FIGURE 1

SEC 3100 OVERVIEW



TB 1
(12) LOW ALARM N.C.
(11) LOW ALARM COMMON
(10) LOW ALARM N.O.
(9) MID ALARM N.C.
(8) MID ALARM COMMON
(7) MID ALARM N.O.
(6) HIGH ALARM N.C.
(5) HIGH ALARM COMMON
(4) HIGH ALARM N.O.
(3) FAULT (N.E.) N.C.
(2) FAULT (N.E.) COMMON
(1) FAULT (N.E.) N.O.

TB 2
(1) 4-20 mA ANALOG OUTPUT
(2) DC COMMON
(3) +24 VDC
(4) DATA ISO COMMON
(5) RS485 DATA B
(6) RS485 DATA A

TB 3
(1) WHITE (DATA/CAL)
(2) BLUE OR GREEN (4-20 mA)
(3) RED (+24 VDC)
(4) BLACK (DC COMMON)

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FIGURE 2
BACK VIEW OF SEC 3100
SEC 3100 WIRING

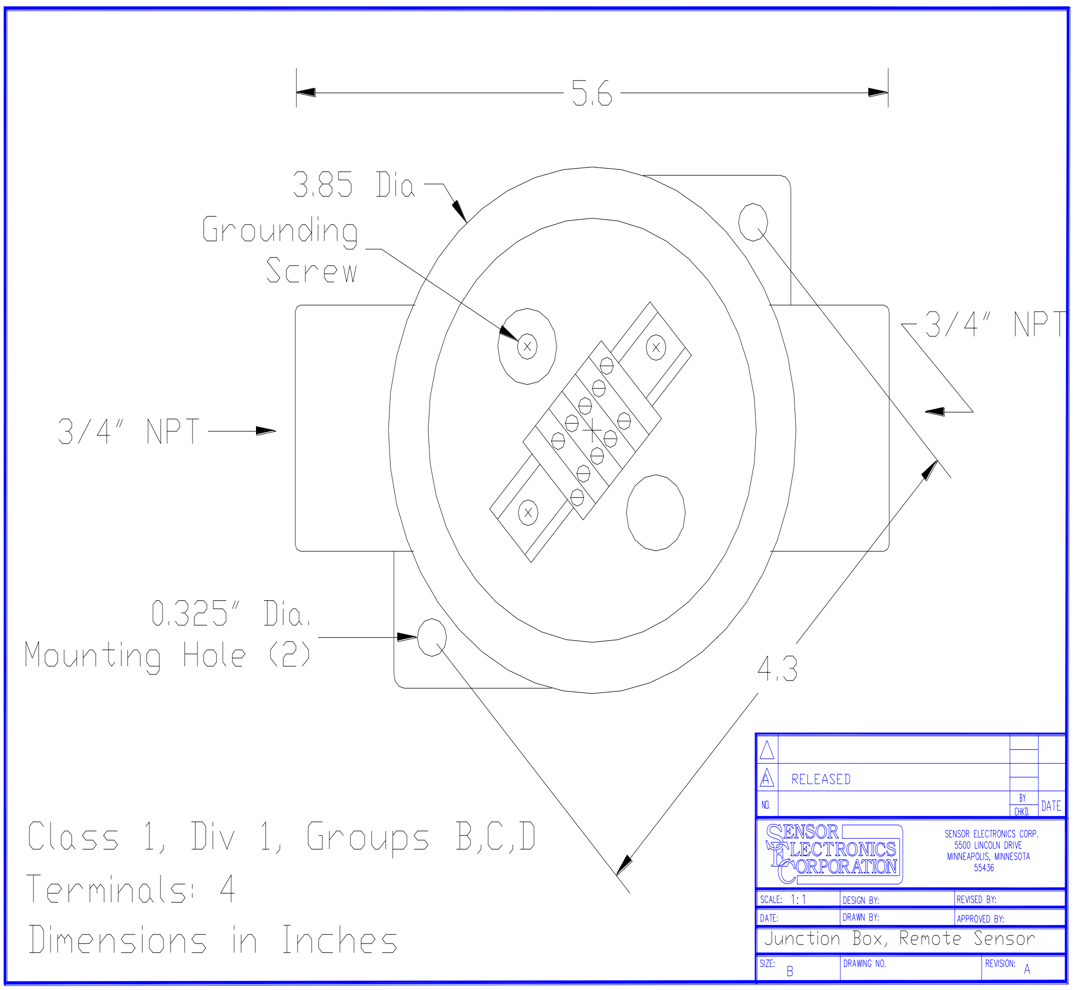

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FIGURE 3
SEC SENSOR SEPARATION KIT

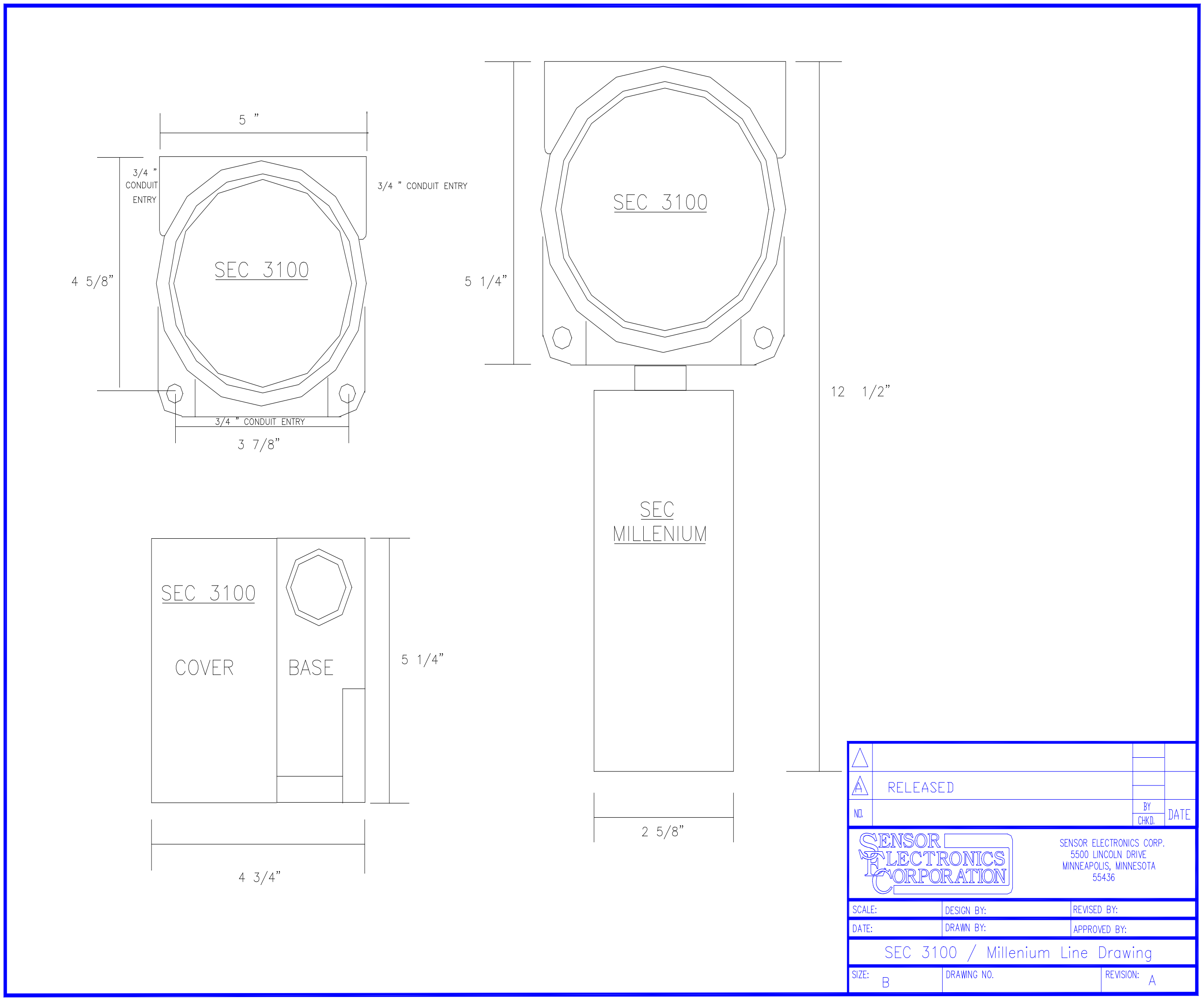

FIGURE 4
SEC 3100 – SEC Millenium Mounting

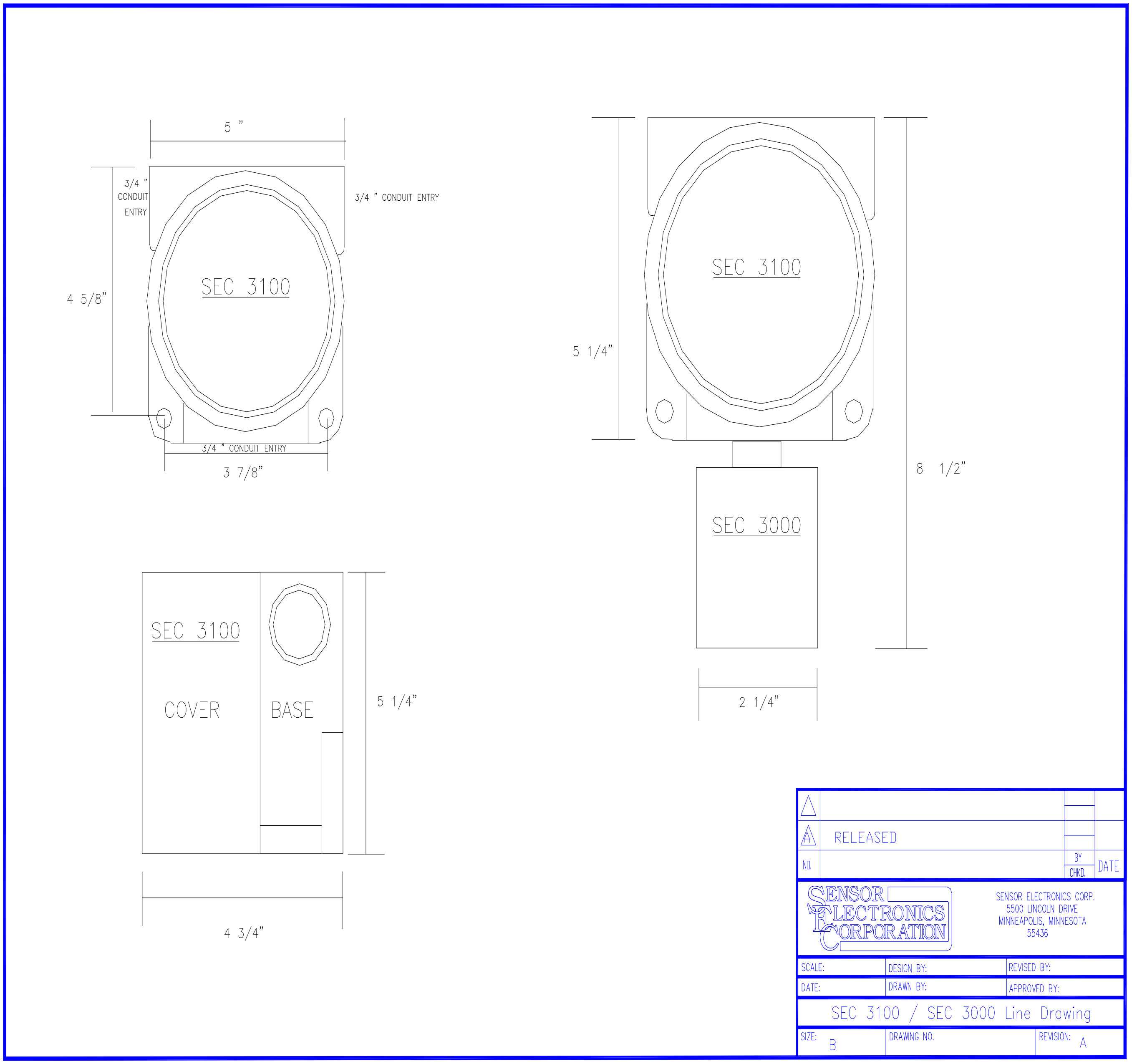

FIGURE 5
SEC 3100 – SEC 3000 Mounting

TB 1 (J1) TB 2 (J2)

1 6 1 6

1 4 1 6

TB 5 (J5) TB 6 (J6)

TB 1 Relay Wiring

1. High Alarm N.C.
2. High Alarm Common
3. High Alarm N.O.
4. Fault N.O.
5. Fault Common
6. Fault N.C.

TB 2 Relay Wiring

1. Low Alarm N.C.
2. Low Alarm Common
3. Low Alarm N.O.
4. Mid Alarm N.C.
5. Mid Alarm Common
6. Mid Alarm N.O.

TB 5 Sensor Wiring

1. DC Common (Black)
2. + 24 VDC (Red)
3. 4-20 mA (Blue or Green)
4. Communication (White)

TB 6 Power / Data Wiring

1. Data A
2. Data B
3. Iso-Common
4. + 24 VDC Input Power
5. DC Common
6. 4-20 mA Output

Housing Dimensions
3.54 (W) x 4.17 (L) x 2.28 (H) inches
{90 (W) x 106 (L) x 58 (H) mm}

SENSOR ELECTRONICS

SEC 3120 Digital Gas Transmitter Dual Sensor

Features

- *Dual Sensor Interface Capability*
- *Explosion Proof*
- *Back lighted LCD Display*
- *Low Cost*
- *Plug-and-Play toxic, oxygen and combustible gas sensors*
- *Self-Check system*
- *4-20 mA output*
- *RS-485 Interface (Isolated)*
- *Alarm and fault relays*
- *Non-intrusive configuration*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging memory stick*
- *Optional IS barrier*
- *Digital communication link to SEC 3000, SEC 5000 and SEC Millenium Gas Detectors*
- *Multi port housing for easy installation*

Applications

- *Petrochemical Refineries*
- *CNG Facilities*
- *Semi-Conductor Industry*
- *Mining*
- *Pulp and Paper Mills*
- *Oil Rig Platforms*
- *Buildings*
- *Automotive Industry*
- *Engine Test Rooms*
- *LNG & LPG Facilities*
- *Sewage Industry*
- *Water Treatment Plants*
- *Parking Garages*
- *Chemical Industry*
- *Nuclear Industry*
- *Compressors*
- *Tunnels*
- *Medical Facilities*

Operation / Description

The SEC 3120 provides dual interface capabilities for the SEC 3000 Gas Detector family, SEC Millenium and SEC 5000 Infrared Gas Detector families.

The SEC 3120 features:

- Dual sensor interfacing to enable like-sensor redundancy or control or dissimilar sensor types
- Back lighted LCD for Gas Level/Unit Parameter display
- Four (4) Alarm/Fault Relays configurable for alarm set points, latching and multi-sensor relay logic
- An isolated RS485 Modbus interface provides reliable communication in noisy environments and eliminates “Ground Loop” problems
- Three magnetic switches for local configuration and calibration without compromising explosion proof protections
- Time stamped data logging using a removable non-volatile memory module. Module can be removed from the unit to allow remote data downloading and data archiving.

An optional IS barrier allows “hot” sensor replacement in rated locations. This allows the user to install pre-calibrated/pre-configured sensor boards without removing unit power while maintaining EX rating. Removable circuit board stack and detachable connectors facilitate field-wiring installation.

SEC 3120 Digital Gas Transmitter - Dual Sensor

Specifications

Compatible Sensors
SEC 3000 / SEC 3300 Toxic Detector
SEC Millenium IR Combustible
SEC 5000 IREvolution IR Combustible & Toxic

Operating Voltage
24 VDC Nom (18-32 VDC Range)

Operating Current (No Sensor)
314mA Max @ 24 VDC
390mA Max @ 32 VDC

Output (digital)
RS-485 LAN (Isolated)

Output (optional relays)
4-20 mA (source type),
max. 1000 ohm load at 24 VDC supply voltage

Display
Back Lighted LCD
LEDs for relay status

Temperature Rating
-40˚C to +70˚C

Power Consumption (SEC 3120 only)

Nominal (no options, 24V):	1.1 W
Relays Option:	Add 0.8 W
Heater option:	Add 5.9 W
Max (all options, 32 V):	12.48 W

Humidity
0-99% RH (Non-condensing)

Housing Construction
Epoxy coated aluminum

Certification
CSA/NRTL Class 1, Div. 1, Groups B,C,D T5
IECEx Class 1, Zone 1, Group IIC
UL 2075

Housing Dimensions
5.25 (w) x 5.30 (L) x 4.95 (H) inches
{131 (W) x 132 (L) x 124 (H) mm}

Weight
Approximately 6 lbs. {2.8 Kg.}

Partial Gas List

Oxygen	(O_2)	Carbon Monoxide	(CO)
Hydrogen	(H_2)	Germane	(GeH_4)
Ammonia	(NH_3)	Silane	(SiH_4)
Nitric Oxide	(NO)	Phosphine	(PH_3)
Bromine	(Br_2)	Sulfur Dioxide	(SO_2)
Fluorine	(F_2)	Nitrogen Dioxide	(NO_2)
Arsine	(AsH_3)	Chlorine Dioxide	(ClO_2)
Ozone	(O_3)	Hydrogen Sulfide	(H_2S)
Chlorine	(Cl_2)	Hydrogen Fluoride	(HF)
Phosgene	($COCl_2$)	Hydrogen Chloride	(HCl)
Diborane	(B_2H_6)	Hydrogen Cyanide	(HCN)
Formaldehyde	(HCHO)	Hydrogen Selenide	(H_2Se)
Ethylene Oxide	(ETO)	Hydrogen Peroxide	(H_2O_2)
Combustible	(HC)	Carbon Dioxide	(CO_2)

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SENSOR ELECTRONICS

SEC 3120 DIN
Digital Gas Transmitter

Features

- *DIN rail mount*
- *Back lighted LCD Display*
- *Low Cost*
- *Plug and play toxic, oxygen and combustible gas sensors*
- *Self-check system*
- *4-20 mA outputs (2) Sensor 1 & Sensor 2*
- *RS-485 Interface (Isolated)*
- *Optional alarm and fault relays*
- *Pushbutton programming*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging*
- *Digital communication link to SEC 3000 and SEC Millenium Gas Detectors*

Applications

- Petrochemical Refineries
- Compost Facilities
- Semi-Conductor Industry
- Mining
- Pulp and Paper Mills
- Oil Rig Platforms
- Buildings
- Automotive Industry
- Engine Test Rooms
- LNG & LPG Facilities
- Sewage Industry
- Water Treatment Plants
- Parking Garages
- Chemical Industry
- Nuclear Industry
- Fertilizer Industry
- Tunnels
- Medical Facilities

Operation

The SEC 3120 DIN provides interface capabilities for the SEC 3000 Gas Detector and SEC Millenium Infrared Gas Detectors.

The SEC 3120 DIN features:

- Back lighted LCD for Gas Level/Unit Parameter display
- Four (4) configurable Alarm/Fault Relays
- An isolated RS485 Modbus interface provides reliable communication in noisy environments and eliminates “Ground Loop” problems.
- Three pushbutton switches for local configuration and calibration
- Time stamped Data logging using a removable non-volatile memory module. Module can be removed from the unit to allow remote data downloading and data archiving.
- Two independent 4-20 mA sensor analog outputs.

SPECIFICATIONS

Detection Method
Toxic Gases – Electrochemical
Combustible - Infrared

Gas Sensor Compatibility
SEC 3000 & SEC Millenium

Output (digital)
RS-485 LAN (Isolated)

Outputs (Two analog)
4-20 mA (source type) max. 1000 ohm load at 24 VDC supply voltage

Output (optional relays)
(3) Alarm and (1) Fault

Display
Back Lighted LCD
LEDs for relay indication

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
125mA Max @ 24VDC

Power Consumption (SEC3120 & Sensor)
Toxic Gases and oxygen (SEC 3000) – 4W Max
Combustible & CO2 (SEC Millenium) – 9W Max

Temperature Rating
-40° to + 70°C

Humidity
0-99% RH (Non-condensing)

RFI
Built in filters reject RFI/EMI

Housing Construction
ABS Plastic (Enclosure color gray)

Certification
CSA/NRTL Pending

Housing Dimensions
3.54 (W) x 4.17 (L) x 2.28 (H) inches
{90 (W) x 106 (L) x 58 (H) mm}

Weight
Approximately 2 lbs. {0.9 Kg.}

Partial Gas List

Oxygen	(O_2)	Carbon Monoxide	(CO)
Hydrogen	(H_2)	Germane	(GeH_4)
Ammonia	(NH_3)	Silane	(SiH_4)
Nitric Oxide	(NO)	Phosphine	(PH_3)
Bromine	(Br_2)	Sulfur Dioxide	(SO_2)
Fluorine	(F_2)	Nitrogen Dioxide	(NO_2)
Arsine	(AsH_3)	Chlorine Dioxide	(ClO_2)
Ozone	(O_3)	Hydrogen Sulfide	(H_2S)
Chlorine	(Cl_2)	Hydrogen Fluoride	(HF)
Phosgene	($COCl_2$)	Hydrogen Chloride	(HCl)
Diborane	(B_2H_6)	Hydrogen Cyanide	(HCN)
Formaldehyde	(HCHO)	Hydrogen Selenide	(H_2Se)
Ethylene Oxide	(ETO)	Hydrogen Peroxide	(H_2O_2)
Combustible	(HC)	Carbon Dioxide	(CO_2)

Current Output	Status
0.0 mA	Unit Fault
0.8 mA	Unit warm up
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4-20 mA	Normal measuring mode
4.0 mA	Zero gas level
5.6 mA	10% Full Scale
8.0 mA	25% Full Scale
12 mA	50% Full Scale
16 mA	75% Full Scale
20 mA	Full scale
>20 mA	Over-range

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SEC3120 Transmitter

Dual-Sensor Display

Instruction and Operation Manual

P/N 1580281 Rev 10, 20150707

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Sensor Electronics Corporation

Sensor Electronics Corporation (SEC) designs and manufactures innovative fixed system gas detection equipment, for combustible gases, oxygen, carbon dioxide and toxic gases.

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.

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.

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement – Consult this manual when this symbol is found on the product or in any related documentation.

⎓ VDC (DC Voltage)

≂ AC or DC Voltage

Revision History

Rev	Date	Description of Change	Page
9	10	ADD REVISION TABLE/FORMATTING CHANGES	ALL
8	9	ADD CHANGES FROM SOFTWARE VERSION 1.2.0175	19-20

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1. GENERAL DESCRIPTION

SEC3120 Dual-Sensor Display

The SEC3120 Dual transmitter is designed to interface with two sensors and can be used with the SEC5000 IREvolution®, SEC Millenium®, SEC Signature® infrared gas sensors or SEC3000 and SEC3300 toxic gas detectors. The SEC3120 is a multi-microprocessor based intelligent transmitter continuously monitoring information from the gas sensor(s). The LCD of the SEC3120 displays the gas concentration(s) and sensor status(s). The SEC3120 has one (1) “Alarm” LED and one (1) “Status” LED. The SEC3120 also has three (3) magnetic switches located around the circumference of the unit. This manual will describe the operation and use of the SEC3120 transmitter.

Features

- *Explosion Proof*
- *Back lighted LCD Display*
- *Low Cost*
- *Plug and play toxic, oxygen and combustible gas sensors*
- *Self-check system*
- *4-20 mA sensor pass-thru output*
- *RS-485 Interface (Isolated), as a Modbus RTU Slave*
- *Optional alarm and fault relays*
- *Non-intrusive programming*
- *Non-intrusive calibration*
- *Removable, non-volatile, time stamped data logging*
- *Optional IS barrier*
- *Digital communication link to SEC Gas Detectors*
- *Multi-port housing for easy installation*

2. APPROVALS / CERTIFICATIONS

North American (c/us) Certificate:	Class I, Division 1, Groups B,C,D, Temp T5
IECEx (International) Certificate:	Ex (d) IIC, T5 Gb; IECEx CSA 13.0026

The SEC3120 is approved to the standards shown in the approvals certificates. In order to maintain compliance to these standards install the SEC3120 per the following instructions and precautions.

3. SPECIFICATIONS

The following specifications are for the SEC3120 display only. Consult the appropriate sensor manuals for their specifications.

For use with (up to two):

- SEC 3000 and 3300 Toxic and Oxygen gas sensors.
- SEC 5000 IREvolution infrared sensors
- SEC Millenium infrared sensors
- SEC Signature Series infrared sensors

Environmental:

The SEC3120 Dual Sensor Display can be installed in indoor, outdoor and wet locations. The housings have ingress protection ratings of IP66. Pollution degree 2 and Overvoltage category II

Operating Temperature and Humidity Rating:

-40° to +40°C (-40 to +104° F) when equipped with the optional LCD heater
0° to +40°C (32° to +104°F) when not equipped with the LCD heater.
The unit will operate below this temperature, but at a reduced function, specifically the LCD may become illegible or damaged.
0 to 99% RH (non-condensing)

Altitude / Elevation:
IEC 61010-1 certified to 2000 meters.

Mechanical:

Construction:
Epoxy Coated Aluminum

Dimensions: (See drawing 3120-XXX for details)
Height: 5 Inches (128 mm) Width: 5 inches (128 mm)
Depth: 4.8 inches (122 mm) Weight: 4.55 lbs (2.0 kg)

Conduit Entry:
Three (3) 3/4 inch NPT

⚠ For hazardous location installations seals must be installed within 18 inches of conduit entries.

Electrical:

Mains Supply (Operating Voltage):
24 VDC ⎓ Nominal (Range: 18 to 32 Vdc) measured at the detector head
Current Draw: (without sensors)
Average: 250 mA (Peak: 500 mA)

Input, Sensor (Digital):
0-5 V, Sensor Electronics Corp. (SEC) Proprietary, Single-Wire, Digital signal from the sensor. This signal is used by the sensor to communicate status and gas data and is used by the display to initiate sensor calibration and query status.

Output (Analog):
4-20 mA (Source Type), max 1000 ohm load at 24 Vdc supply voltage.
The 4-20 mA output is provided by the sensor and is passed through the SEC3120 display. The display can be located at any point in the sensor's output loop. Consult the appropriate sensor manual for 4-20 installation requirements.

Output (Digital):
RS485 LAN (isolated) MODBUS RTU Slave, compatible with Modicon Modbus Specification PI-MBUS-300 Rev. J. Refer to SEC Modbus Technical Sheet (SEC P/N 1580282) for specific configuration and use information.

Output (Relays):
Three (3) Alarms: Low, Mid High. One (1) Fault
Rated for 8 Amps, 30 VDC or 120VAC ∼

4. UNIT INSTALLATION

Warning – If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

[1]**Warning** – Do not open when energized or when an explosive atmosphere is present.

ADVERTISSEMENT - GARDER LE COUVERCLE BIEN FERME TANT QUE LES CIRCUITS SONT SOUS TENSION

Device Location:

The first step in the installation process is to establish a mounting location for the SEC3120 transmitter and gas sensor(s). The most effective number and placement of sensors vary depending on the conditions of the application. Select a sensor location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas. When determining where to locate gas sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.
- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.
- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the downwind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.
- The sensor(s) should be accessible for maintenance.
- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.
- Follow all national and local installation codes and practices.

[1]Mounting:

Mount the SEC3100 to rigid wall (wood based or stronger) or bulkhead structures using 1” or longer fasteners with a minimum 3/16” diameter. Mounting to drywall (wallboard, plasterboard, etc.) or similar material is not recommended.

[1]Wiring:

Wire insulation for relay contacts should have a minimum breakdown voltage of twice that of the working voltage of the signal. E.g. 110v lines should have a minimum insulation breakdown voltage of 220v, 240v signals should have a minimum insulation breakdown voltage of 480v.

Wire insulation should be temperature rated for greater than 100°C.

Wire Sizing (Power):
0 to 500 feet wire length; recommend wire gauge size 16 AWG
501 to 1000 feet wire length; recommend wire gauge size 14 AWG

Safety Interrupt (mains circuit breaker):

A circuit breaker or interrupt switch for overcurrent protection rated for 30 watts located in the mains supply circuit is recommended. It should be located near the device it is protecting and labeled.

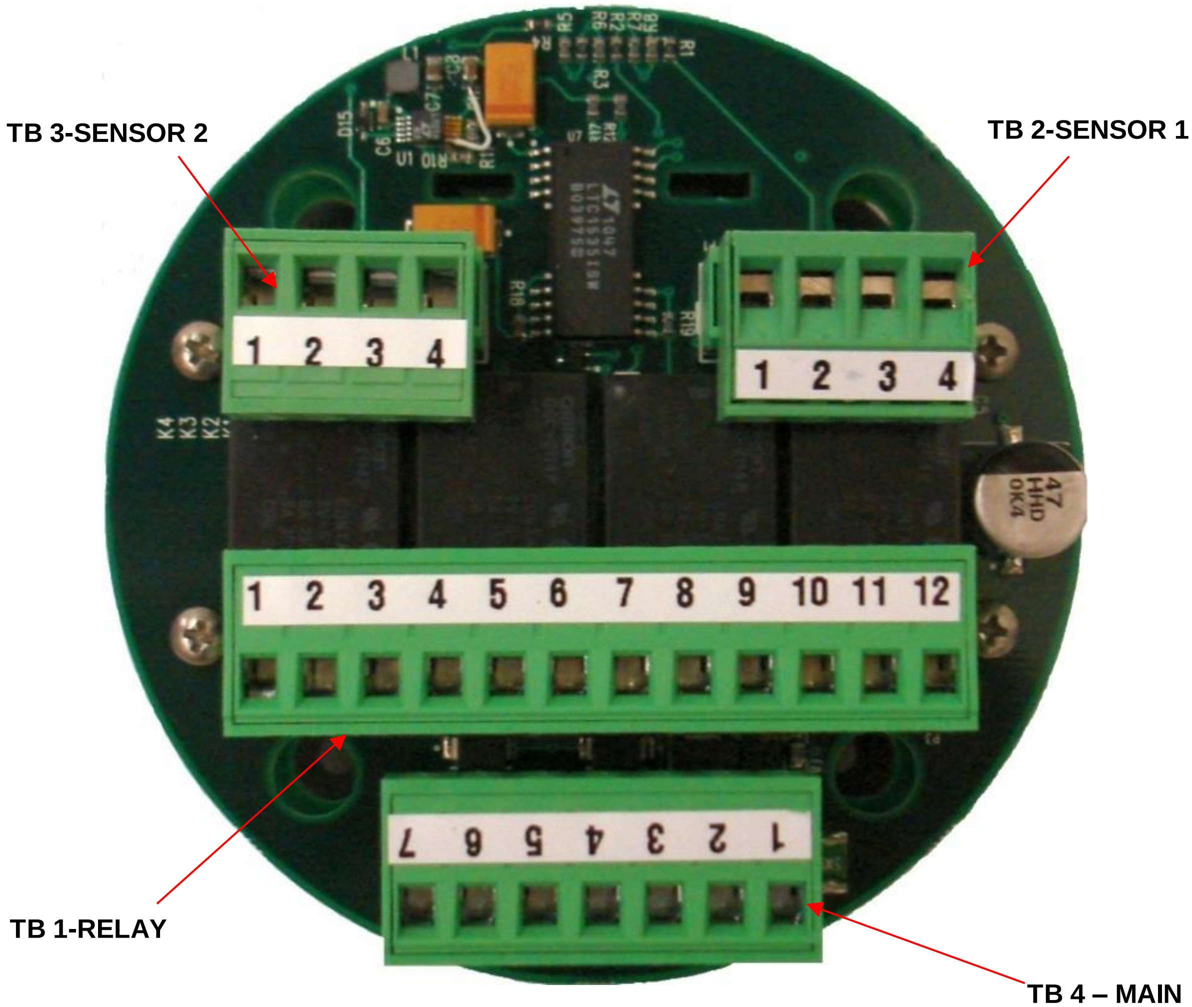
To minimize the length of exposed conductor, strip wires to 3/8 inch. Solder tin the exposed wire to increase durability.

Protective bonding is provided by an internal screw location for connection of a grounding wire. Installation of this wire should include the use of a locking feature (i.e. locking washer).

Conduit:

[1]For hazardous location installations seals must be installed within 18 inches of conduit entries.

The SEC3120 has three (3) ¾" NPT threaded ports for mounting and wiring the sensor(s) and transmitter into a permanent installation.
Field wiring connections are made on the backside of the SEC3120 printed circuit board (PCB). For connection details refer to Figure 1.
Shielded cable is recommended. Wiring should be installed in metal conduit with no other cabling in the same conduit.



TB 1 – RELAYS
- (12) FAULT (N.E) N.C.
- (11) FAULT (N.E.) COMMON
- (10) FAULT (N.E) N.O.
- (9) HIGH ALARM N.C.
- (8) HIGH ALARM COMMON
- (7) HIGH ALARM N.O.
- (6) MID ALARM N.C.
- (5) MID ALARM COMMON
- (4) MID ALARM N.O.
- (3) LOW ALARM N.C.
- (2) LOW ALARM COMMON
- (1) LOW ALARM N.O.

NC = NORMALLY CLOSED
NO = NORMALLY OPEN

TB 2 – SENSOR 1
- (1) WHITE (DATA/CAL)
- (2) BLUE OR GREEN (4-20 mA)
- (3) RED (+24 VDC)
- (4) BLACK (DC COMMON)

TB 3 – SENSOR 2
- (1) WHITE (DATA/CAL)
- (2) BLUE OR GREEN (4-20 mA)
- (3) RED (+24 VDC)
- (4) BLACK (DC COMMON)

TB 4 – MAIN
- (1) +24 VDC
- (2) 4-20 mA SENSOR 2
- (3) DC COMMON
- (4) RS485 DATA B
- (5) RS485 DATA A
- (6) ISOLATED COMMON
- (7) 4-20 mA SENSOR 1

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Figure 1

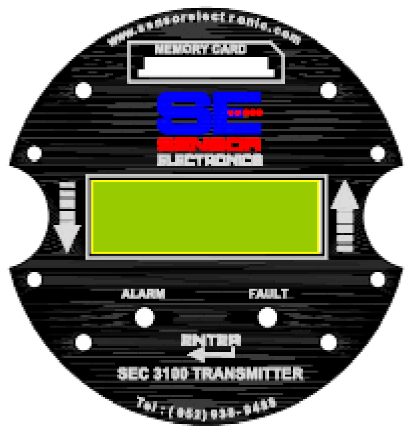
BACK VIEW OF SEC3120
SEC3120 WIRING

5. USER INTERFACE

User Inputs – Magnetic Switches:

The SEC3120 has three (3) magnetic switch pickups on the Display PCB. The picture below shows the locations of the magnetic switches labeled UP, DOWN and ENTER. Placing a magnet in close proximity to one of the switches will cause the following operations to occur.

Switch	Operation
ENTER	Enter Menu Mode, Selects a menu to Enter
UP	Moves up through Menu selections
DOWN	Moves down through Menu selections

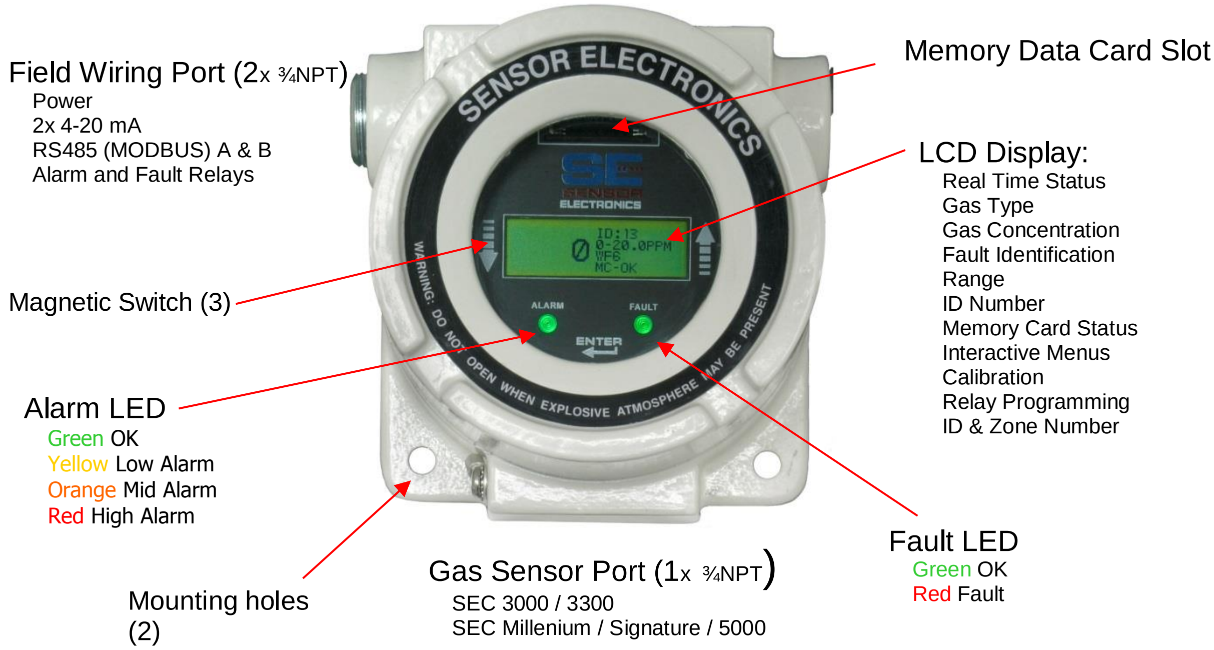


LED Indicators:

There are two multi-color LEDs that indicate Alarm and Fault status. The Alarm LED indicates the current alarm status individually for each sensor, regardless of the Relay Mode. The alarm state LEDs toggle indication for each sensor along with the sensor information display. When sensor one information is displayed, the alarm-state LEDs indicate the alarm status for sensor one. When sensor two’s information is displayed, the alarm-state LEDs indicate the alarm status for sensor two. The color of the Alarm LED indicates the Alarm level; Low Alarm = Yellow, Mid = Amber and High = Red. The fault state LED toggles with the sensor information display as well, except when a SEC3120 Transmitter unit fault exists. In fault condition, this LED is Red.

LCD Screen:

The LCD screen is a grayscale display with a 5/8 inch by 2 inch viewing area. It displays the gas type, range, measured gas concentration and status information for each sensor and the display unit. It has a contrast potentiometer that is accessible behind the faceplate on the Display PCB positioned just above the LCD display. The front faceplate must be removed to access it. This potentiometer allows the user to increase or decrease the display contrast, making it more visible under varying ambient light conditions and personal user preference.



6. Initial Startup

When power is applied to the SEC3120, it enters its power up sequence (approximately sixty seconds), followed by the sensor warm-up mode which can take between one and five minutes depending on the sensor(s). At the end of the warm-up period with no faults present, the SEC3120 automatically enters the normal operating mode.

If a fault is present after warm-up, the LCD and the Fault LED will indicate the fault. See your specific sensor's manual for warm-up and fault current value meanings (less than 4 mA).

NOTE: If your SEC3120 unit is set to operate two sensors in the 'Identical' Role and they are not identical in gas type, range or units, then the SEC3120 unit will display a fault and indicate that the *Sensors Are Not Identical*, and the fault relay on the SEC3120 unit will be engaged.

Inital Power Up Screen Sequence of the SEC3120

SEC3120 TRANSMITTER -STARTING UP FROM BRWN (SOFT RESET) 005	'BRWN' – Brown Out Reset (or 'SOFT RESET' shown on bottom line for a software reset) '005' – Counts down to '000' second startup delay
SEC3120 TRANSMITTER VER X.YY.RRRR 005 08/10/2010 21:15:33	'VER' refers to the Firmware version installed in the display.
SEC3120 TRANSMITTER VER X.YY.RRRR 003 -INIT ROM FROM RAM	'INIT ROM FROM RAM' – permanent parameters transferred from either 'ROM' to NVRAM or from NVRAM to ROM, or 'ROM' and 'RAM' are 'IDENTICAL'.
SEC3120 TRANSMITTER VER X.YY.RRRR -BOOT SENSOR SYSTEM	'BOOT SENSOR SYSTEM' – Starting up sensor controllers

```
SEC3120 TRANSMITTER
INIT MEMORY CARD …

Success
```

'INIT MEMORY CARD ….' – Memory card system Initializing.
'SUCCESS' or 'FAILURE' will show after a few seconds.

```
S1                ID: XXX / YYY
     SENSOR       0-WAITING
     INIT         WAITING
S2
```

'S1' or 'S2' alternates and identifies that the displayed data is for either Sensor 1 or Sensor 2.
'ID: XXX' refers to the user assigned ID for Sensor 1.
'ID: YYY' refers to the user assigned ID for Sensor 2.

```
S1   SENSOR       ID: XXX / YYY
     WARMUP       0-WAITING
   -ENT-  TO      WAITING
S2   ABORT
```

'SENSOR WARMUP' – indicates that the given sensor (S1 or S2) is warming up.

```
S1                ID: XXX / YYY
     SENSOR       0-WAITING
     UPLOAD       WAITING
S2
```

'SENSOR UPLOAD' – Sensor is uploading its parameters to The 3120.

7. Normal Operation

In the normal operating mode, the 4-20 mA signal levels correspond to the detected gas concentration. The transmitter continuously checks for and displays system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4-20 mA output ports of the SEC3120 are non-isolated current source(s), passed through from the attached sensor(s). Their output values are defined by the associated sensor manual(s) (4 – 20 mA normal gas levels, less than (<) 4 mA indicates a status condition such as warm-up, calibration or a sensor fault).

Normal Operation Screen

```
S1           ID: XXX
             (S1 GAS RANGE)
      0      (S1 GAS TYPE)
             (STATUS)
```

```
             ID: YYY
             (S2 GAS RANGE)
      0      (S2 GAS TYPE)
S2           (STATUS)
```

In normal operating mode actual gas concentration will be displayed on the left of the screen. The right side of the screen will display the ID #, Range, Gas Type and Status. The bottom line will scroll through the MC (memory card) status, Date, Time and, if a sensor has a warning code, will display 'WARN: xxx' where 'xxx' is a cell code #.

Example:

```
S1           ID:010
             0-100  %LEL
      0      METHANE
             MC - FAULT
```

```
             ID: 011
             0-200  PPM
      0      AMMONIA
S2           08/15/2010
```

```
S1           ID:010
             0-100  %LEL
      0      METHANE
             23:15:33
```

```
             ID: 011
             0-200  PPM
      0      AMMONIA
S2           WARN: 131
```

The normal display screen will toggle between sensor one and sensor two information at a rate of approximately once every two to three seconds. The alarm and fault LEDs indicate the alarm/fault status for the current sensor displayed at any given time as well. The operator may choose to advance the information displayed to the next sensor's information by selecting either the UP or DN switches. Doing so will immediately toggle the normal display screen information for the sensor not currently displayed (i.e. If display is currently showing sensor one (S1) information, then sensor two (S2) information will be immediately displayed, whereas if the display is currently showing sensor two (S2) information, then selecting UP or DN switch will cause sensor one (S1) information to immediately be displayed). If the 3120 unit is in single sensor mode, then the display will NOT change, and the S1 or S2 indicators will NOT show on the LCD display.

8. Setup – Configuring Operation

Once the SEC3120 is powered up it may have to be configured to run correctly based on the system in which it is intended to be operated. For example it will have to be set up based on whether it has one or two sensors attached, how the alarm relays are intended to operate and the network settings and ID will have to be set for the ModBus communication.

8.1. Required Sequence for Changes to Configuration

There is a very important order to setting Network IDs, sensor and network ID modes/roles and bus line settings. It should be done as follows;

1. Verify that the SEC3120 Unit is off line (turn Modbus mode to 'OFF')
2. Delete this unit from the SEC3500 HMI or equivalent device if it was previously online or 'discovered'. Consult the SEC3500 manual for details.
3. Change the Sensor Role to either Identical or Unique to unlock subsequent adjustments.
4. Set the relay control Latching, Delay and Logic (AND, OR, Sensor 1 or Sensor 2).
5. Assign the Sensor Mode – Identical, Unique or Single
6. Set Alarm Thresholds and Activation Modes.
7. Set the Network ID mode – Unique or Identical.
8. Set the Network and Zone IDs.
9. Set the RS485 Modbus line settings.
10. Place the SEC3120 and its sensors 'online' by activating it on the RS485 Modbus network.

8.2. Date and Time

Entering this menu will allow the operator to set the date, time and day of the week of the SEC3120 real time clock.

```
S1          ID: XXX
            (S1 GAS RANGE)
            (S1 GAS TYPE)
            (STATUS)
```

From normal operation screens select ENTER to show the Initial/Top Menu Screen.

```
  ↑ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ↓ MAIN MENU
```

Move the cursor (*) to Main Menu and select ENTER.

```
  ↑ CALIBRATION
    ALARM
    RELAY
  ↓ NETWORK
```

Move the cursor to 'SET DATE TIME' located on the 2nd page of the Main Menu and select ENTER.

```
  ↑ HIDE LOW GAS
    SELF TEST
*   SET DATE TIME
  ↓ PREVIOUS MENU
```

Set Date

```
* DATE          MM / DD / YYYY
  TIME          HH / MM / SS
  PREVIOUS MENU
```

With the cursor on 'DATE' select ENTER to edit the DATE fields.

```
* DATE:        * MM / DD / YYYY
  TIME:          HH / MM / SS
  PREVIOUS MENU
```

Use the UP and DOWN switches to choose the month, day or year to edit and select ENTER

```
* DATE:        * MM / DD / YYYY *
  TIME:          HH / MM / SS
  PREVIOUS MENU
```

Use the UP and DOWN switches to set the value and select ENTER.
(Edit **Month** is shown in figure.)

```
* DATE:          MM * DD / YYYY
  TIME:          HH / MM / SS
  PREVIOUS MENU
```

Use the UP and DOWN arrows to move between month, day and year.
(Day)

```
* DATE:          MM  / DD * YYYY
  TIME:          HH / MM / SS
  PREVIOUS MENU
```

(Year)

```
* DATE:          MM  / DD / YYYY *
  TIME:          HH / MM / SS
  PREVIOUS MENU
```

You must move cursor to the right of the year and select ENTER to exit changing the date and be able to move on to setting the time or moving to the previous menu.

Set Time

```
  DATE          MM / DD / YYYY
* TIME          HH / MM / SS
  PREVIOUS MENU
```

Select ENTER to edit the TIME field.

```
  DATE:          MM / DD / YYYY
*TIME:          *HH / MM / SS
  PREVIOUS MENU
```

Use the UP and DOWN switches to choose the hour, minutes or seconds to edit and select ENTER

```
  DATE:          MM / DD / YYYY
* TIME:         *HH / MM / SS     *
  PREVIOUS MENU
```

Use the UP and DOWN switches to set the value and select ENTER (edit hour is shown in figure).

```
  DATE:          MM / DD / YYYY
* TIME:         *HH / MM / SS
  PREVIOUS MENU
```

Use the UP and DOWN arrows to move between hours, minutes and seconds.

(Hours)

```
  DATE:          MM  / DD / YYYY
* TIME:          HH * MM / SS
  PREVIOUS MENU
```

(Minutes)

```
  DATE:          MM  / DD / YYYY
* TIME:          HH / MM * SS
  PREVIOUS MENU
```

(Seconds)

DATE:	MM / DD / YYYY	
* TIME:	HH / MM / SS	*
PREVIOUS MENU		

You must move cursor to the right of the seconds and select ENTER to exit changing the hour and be able to move on to the previous menu.

DATE:	MM / DD / YYYY
TIME:	HH / MM / SS
* PREVIOUS MENU	

ENTER on 'PREVIOUS MENU' to exit changing the date and time and return to the Main Menu.

*	SAVE CHANGES
	ABORT CHANGES

ENTER on 'SAVE CHANGES' to keep the new settings or 'ABORT CHANGES' to cancel them. Either choice will return to the Main Menu.

↑	HIDE LOW GAS
	SELF TEST
	SET DATE TIME
* ↓	PREVIOUS MENU

ENTER on 'PREVIOUS MENU' to return back to the Initial / Top Menu.

8.3. Relay Settings – Latching, Delay and Control Logic

The Relay Menu is found in the Main Menu.

S1	ID: XXX
	(S1 GAS RANGE)
	(S1 GAS TYPE)
	(STATUS)

From normal operation screens select ENTER to show the Initial/Top Menu Screen.

↑	EJECT MEMORY CARD
	ABORT WARMUP
	INFO
* ↓	MAIN MENU

Select ENTER on MAIN MENU.

Relay Menu (Selected from the Main Menu)

↑	CALIBRATION
	ALARM
*	RELAY
↓	NETWORK

Move the cursor to RELAY and select ENTER to open the relay menu.

Latching:
Each relay; Low, Mid, High and Fault; can be individually configured to latch when it is activated. Setting a relay to 'latch' will cause it to remain activated after the condition that activated the relay has cleared. This causes the user to acknowledge the activation in order to clear any alarms.

Delay:
Delay can also be applied to the activation (ON) or deactivation (OFF) of the individual relays. The delay can be up to 255 seconds for each setting. If a delay is set to the relay activation (ON DELAY) the alarm or fault associated with that relay will not be triggered until after the alarm condition has remained for the duration of the delay. Similarly, if a delay is applied to the deactivation (OFF DELAY) the alarm will remain engaged for the number of seconds beyond when the alarm condition has cleared. Use caution when applying ON DELAY to the activation of alarm relays as an unsafe atmosphere may be present for up to 255 seconds prior to any alarms being activated.

Setting Relay Latching and Delay Conditions – set individually for each alarm/fault relay

* ↑	LOW
	MID
	HIGH
↓	FAULT

Move the cursor to the desired alarm (LOW, MID, HIGH or FAULT) and select ENTER.

```
▲ LOGIC MODE
▼ PREVIOUS MENU
```

```
* ▲ LATCH          'NORMAL'
    ON   DLY        XXX
    OFF DLY         XXX
  ▼ ENERGIZED       YES / NO
```

Within the LOW, MID, HIGH and FAULT pages the user can set:

- the relay latching style **
- the on delay in seconds (0-255)
- the off delay in seconds (0-255)
- the energized state (NO = relay not energized until activated {resembles normally open contact action}, YES = relay energized until activated { resembles normally closed contact action })

** Latching Mode:
- Normal = relays do not latch.
- Latching = relays remain activated until forced reset.
- Audible = relays can be silenced by user (forced off).

```
* ▼ PREVIOUS MENU
```

ENTER on 'PREVIOUS MENU' to return to the Relay Menu and choose to permanently save or abort the changes.

```
 *  SAVE CHANGES
    ABORT CHANGES
```

ENTER on 'SAVE CHANGES' to retain new settings or 'ABORT CHANGES' to cancel them. Either choice will return to the Relay Menu.

Logic:

A key feature in the SEC3120 is the Sensor Role because only one set of relays is provided to service both attached sensors. Therefore, in determining the sensor mode, a decision regarding how the relays will be used must be considered and a decision concerning what relay mode is used must be made. Below is a list of possible relay modes:

- **Sensor One –** All alarm relays are determined exclusively from the alarm status of sensor one. The fault relay is engaged by either a sensor one fault condition or an SEC3120 unit fault condition. Alarm and fault states of sensor two will NOT cause any relays to be engaged. This relay mode is commonly used in conjunction with the Single Sensor Role, and must be set PRIOR to setting the Single Sensor Role.
- **Sensor Two –** All alarm relays are controlled exclusively from the alarm status of sensor two. The fault relay is engaged by either a sensor one fault condition or an SEC3120 unit fault condition. Alarm and fault states of sensor one will NOT cause any relays to be engaged. CAUTION: Sensor Two relay logic must not be used when the sensor mode is SINGLE.
- **Logical AND –** All alarm relays are controlled by the logical AND condition of BOTH sensors one and two states. This means that for a low-alarm relay to be engaged, BOTH sensors must be reporting low relay alarm states (gas levels above the low alarm threshold). For a mid-alarm relay to be engaged, BOTH sensors must be reporting at least mid-relay alarm states. For a high-alarm relay to be engaged, BOTH sensors must be reporting high alarm states. This relay mode is best utilized in the Identical Sensor Role, and should be set PRIOR to setting the Identical Sensor Role. The fault relay will engage if EITHER sensor is reporting a fault condition, or if the SEC3120 unit is in a fault state. CAUTION: AND or SENSOR TWO relay logic must not be used when the sensor mode is SINGLE.

- **Logical OR –** All alarm relays are controlled by the logical OR condition of BOTH sensor one and sensor two states. This means that for a low-alarm relay to be engaged, EITHER sensor may be reporting a low relay alarm state. For a mid-alarm relay to be engaged, EITHER sensor may be reporting a mid-relay alarm state. For a high-alarm relay to be engaged, EITHER sensor may be reporting a high alarm state. This relay mode is commonly utilized in the Unique Sensor Role, and should be set PRIOR to setting the Unique Sensor Role. The fault relay will engage if EITHER sensor is reporting a fault condition, or if the SEC3120 unit is in a fault state.`

Setting Relay Logic –

```
  ↑ CALIBRATION
    ALARM
*   RELAY
  ↓ NETWORK
```

Move the cursor to RELAY and select ENTER to open the relay menu.

```
* ↑ LOW
    MID
    HIGH
  ↓ FAULT
```

```
* ↑ LOGIC MODE
  ↓ PREVIOUS MENU
```

Move the cursor to LOGIC MODE on the 2nd page of the RELAY menu and select ENTER.

```
*  MODE           'value'
   PREVIOUS MENU
```

Select ENTER with the cursor on MODE to choose the relays' logic. Use the UP and DOWN switches to choose the desired logic option:

- SENSOR ONE; relays respond to sensor one alarm states only.
- SENSOR TWO; relays respond to sensor two alarm states only.
- AND; relays will activate only when both sensor alarm states are at the same action level.
- OR; relays will activate when either sensor's alarm state is active.

```
   MODE           'value'
*  PREVIOUS MENU
```

ENTER on 'PREVIOUS MENU' to return to the Relay Menu and choose to permanently save or abort the changes.

```
*  SAVE CHANGES
   ABORT CHANGES
```

ENTER on 'SAVE CHANGES' to retain new settings or 'ABORT CHANGES' to cancel them. Either choice will return to the Relay Menu.

```
  ↑ LOGIC MODE
* ↓ PREVIOUS MENU
```

ENTER on 'PREVIOUS MENU' to return to the Main Menu.

Resetting Latched Relays (Selected from the Initial / Top Menu, Page 2)

The Reset Relays Menu will allow the operator to reset latched relays. Latched relays will be indicated by a blue flashing Alarm LED.

```
  ↑ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
  ↓ MAIN MENU
```

```
  ↑ SEC DIAGNOSTICS
*    RESET RELAYS
    FORMAT FLASH CARD
  ↓ EXIT
```

Select ENTER and any latched relays will be reset.
The following will be briefly displayed (for about three seconds):

RESETTING LATCHED
RELAYS NOW …

8.4. Sensor Mode – Single, Unique or Identical

The SEC3120, unlike the SEC3100, communicates with two sensors allowing for simultaneous gas measurement, display, transmission and storage. This capability opens up new opportunities for how sensors can be configured to work together in varying roles. The following is a brief look at the three configurations for the two sensor connectors:

- **Single Mode** – In this mode, the SEC3120 unit will only communicate / display / log information from a single sensor connected to the sensor 1 connector (see Figure 1). Any device attached to the sensor 2 connector is ignored. A key feature in this mode is when no sensor is attached to the 2nd connector the SEC3120 does not signal a 'sensor missing' fault. In this mode the display mimics the behavior of the SEC3100, yet retains the advanced features of the SEC3120. The Single Sensor Mode will default the Modbus Network ID mode to 'Single' and change all screens to disallow changing of sensor two parameters or displaying information for a second sensor.

  ⚠ CAUTION: Prior to setting the Sensor Mode to 'SINGLE' the relay logic should be configured to only respond to sensor one or logic OR.

- **Identical Mode** – In this mode, the SEC3120 will require two sensors to be attached to the sensor connector terminals. Both sensors must be of the same device type, measure identical gas types and identical gas value ranges. The distinguishing feature of this mode is if one sensor is not connected or if both sensors are not identical an error screen will be displayed, a UNIT FAULT will be issued and the fault relay will be engaged.

  This mode is commonly used for redundancy- such as two oxygen sensors used to ensure that the actual oxygen levels are truly at the same appropriate value before triggering the associated alarms. In this example the relay mode should be configured in the AND logical configuration for this method to work as described.

  Relay logic modes for Sensor 1, Sensor 2 or logic OR are not prevented in the Identical sensor mode if the user would prefer to configure the relay mode as such. For example, if the user wants added security one could choose logic OR, or if one sensor is faulty the relay mode may be set to the other sensor until repair/replacement can occur.

- **Unique Mode** – In this mode, the SEC3120 will communicate with two sensors attached to the sensor connector terminals. The two sensors can be of different sensor types, different gas types, different concentration ranges or could be identical but in different locations. Modbus IDs may be set to different values or to the same value (if not using an SEC3500 HMI). The relay mode may be set to any configuration. This sensor role allows the SEC3120 to consolidate two sensors to only one transmitter and allows logging of both sensor values to a single storage device. In this mode the SEC3120 will indicate a fault/warning if one sensor is not attached. It will not indicate a fault if the sensors are not identical.

The sensor mode in which the SEC3120 Digital Transmitter operates is chosen by the user and is a key decision that must be made before deploying or changing the sensing/monitoring plan. The choice will be determined by how many sensors are deployed, what gases are measured and how that data is captured.

Change Sensor Mode

S1	ID: XXX (S1 GAS RANGE) (S1 GAS TYPE) (STATUS)

Select ENTER to show the Initial/Top Menu Screen.

```
  ↑ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ↓ MAIN MENU
```

Select ENTER on MAIN MENU.

```
  ↑ CALIBRATION
    ALARM
    RELAY
* ↓ NETWORK
```

Scroll down to NETWORK and select ENTER.

```
    NETWORK ID MENU
*   MODBUS SETTINGS
    PREVIOUS MENU
```

Scroll down and select ENTER on MODBUS SETTINGS to bring up the Modbus Settings Menu.

```
  ↑ ONLINE          YES / NO
*   SENSORS         (MODE)    *
    NET ID          (MODE)
  ↓ 485 BUS MENU
```

Scroll down and select ENTER on SENSORS. Use the UP/DN switches to change the value to one of three possible modes:

- IDENT – where two sensors have exactly the same gas, range and type and are used in a redundant mode,
- UNIQUE – where two sensors have completely different gas, range or types,
- SINGLE – where only ONE sensor is attached to the sensor one plug.

CAUTION: Only one edit is retained when leaving this menu. When making changes to the ‘MODBUS SETTINGS’ menu exit to the ‘SAVE CHANGES’ screen for each field being changed.

```
* ↓ PREVIOUS MENU
```

Scroll down to bring up the next page of the Modbus Settings Menu. Select ENTER on PREVIOUS MENU to return the screen to the Network Menu.

```
    NETWORK ID MENU
    MODBUS SETTINGS
*   PREVIOUS MENU
```

Scroll down to PREVIOUS MENU and select ENTER to return the screen back to the Main Menu.

```
*   SAVE CHANGES
    ABORT CHANGES
```

Select ENTER on SAVE CHANGES to return the screen back to the Main Menu Screen.

```
  ↑ CALIBRATION
    ALARM
    RELAY
* ↓ NETWORK
```

Scroll down to Page 2 of the Main Menu Screen.

```
  ↑ HIDE LOW GAS
    SELF TEST
    SET DATE TIME
* ↓ PREVIOUS MENU
```

Scroll down to and select ENTER on PREVIOUS MENU to return the screen to the Initial/Top Menu Screen.

```
  ↑ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ↓ MAIN MENU
```

Scroll down to bring up Page 2 of the Initial/Top Menu Screen.

```
 ↑ SEC DIAGNOSTICS
   RESET RELAYS
   FORMAT FLASH CARD
*↓ EXIT
```

Scroll down to and select ENTER on EXIT to return the screen to the Normal Operating Display.

8.5. Alarm Settings – Threshold Values and Active Mode

In the ‘ALARM’ menu the user can set the thresholds for the Low, Mid and High alarms for both sensors. The default values for these settings are Low = 20% full scale, Mid = 40% of full scale and High = 60% of full scale. The ‘Active Mode’ of each alarm set point can also be changed in this menu. An Active High setting will trigger the alarm when the gas concentration is rising and crosses the threshold set point. An Active Low setting will trigger the alarm when the gas concentration is falling and crosses the threshold set point. The user can also change the “MUTE ON WARN” setting. This setting determines how the transmitter acts when the attached sensor goes into a warning (only applies to SEC5000 Evolution and SEC3300). The default for this setting is “NO” meaning that if the unit goes into a warning but still senses gas, the transmitter relays will activate (LEDs will also change) and communicate to the SEC3500 when an alarm threshold has been met. Turning the setting “YES” will keep the transmitter relays from activating and the LEDs from changing color when the unit is in a warning.

Alarm Menu (Selected from the Main Menu)

```
  ↑ CALIBRATION
*   ALARM
    RELAY
  ↓ NETWORK
```

Move the cursor to ALARM and select ENTER to open the alarm menu.

```
* ↑ FOR SENSOR:  ONE / TWO
    LOW
    MID
  ↓ HIGH
```

ENTER on ‘FOR SENSOR’ ‘ONE/TWO’ to choose which sensor to perform alarm configuration operations.

DOWN switch to select sensor one
Up switch to select sensor two

```
  ↑ FOR SENSOR:  ONE / TWO
*   LOW
    MID
  ↓ HIGH
```

Move the cursor to the alarm to set (LOW, MID or HIGH) and select ENTER.

```
*  THRESHOLD      ‘value’
   ACTIVE MODE    HIGH/LOW
   PREVIOUS MENU
```

To set the alarm set-point move the cursor to THRESHOLD and select ENTER.

```
*  THRESHOLD      ‘value’    *
   ACTIVE MODE    HIGH/LOW
   PREVIOUS MENU
```

Using the UP and DOWN switches set the desired value then select ENTER.

```
   THRESHOLD      ‘value’
*  ACTIVE MODE    HIGH/LOW*
   PREVIOUS MENU
```

Selecting ACTIVE MODE will allow the operator to change the operation of the alarm activation operation from Active HIGH to Active LOW. Once the correct operation is selected select ENTER.

- HIGH activates the alarm on a rising gas level.
- LOW actives the alarm when the gas level falls below the alarm set point.

```
   THRESHOLD      ‘value’
   ACTIVE MODE    HIGH/LOW
*  PREVIOUS MENU
```

ENTER on ‘PREVIOUS MENU’ to return to the Alarm Menu and choose to save or abort the changes.

```
*  SAVE CHANGES
   ABORT CHANGES
```

ENTER on ‘SAVE CHANGES’ to retain the new settings or ‘ABORT CHANGES’ to discard them.

```
  ↑  FOR SENSOR:  ONE / TWO
*    LOW
     MID
  ↓  HIGH
```

Move cursor down to show next alarm sub menu.

```
* ↓  MUTE ON WARN   YES/NO
     PREVIOUS MENU
```

ENTER on ‘MUTE ON WARN’ to change how the transmitter acts when it goes into a warning. Using up or down the value can be changed from YES to NO.

```
  ↓  MUTE ON WARN   YES/NO
*    PREVIOUS MENU
```

ENTER on ‘PREVIOUS MENU’ to return to the MAIN MENU

8.6. Network ID (Sensor / Display Network Identities)

The SEC3120 may be addressed on Modbus at a specific network ID, as any other Modbus compliant device does. However, it may also be accessed using two network device IDs, one for each sensor if it is so configured. When communicating with the SEC3500 versions less than 4.0.0, one device ID must be assigned sequentially for each sensor attached, allowing the SEC3500 to depict two separate sensors and treat them as individual SEC3100 transmitters. In version 4.0.0 and higher, the SEC3500 will support a single network ID for all sensors attached to the SEC3500 and display all relevant information as a single transmitter, a dual-sensor hub. Likewise, Modbus compliant Master devices may choose to communicate with the SEC3120 Transmitter using a single network ID. Switching between these modes can be very tricky when legacy (versions older than 4.0.0) SEC3500 HMI panels are the master.

The SEC3120 Modbus Network ID Modes are:

- **Legacy 3100 Mode –** This is not a mode that is selected directly by the user interface menus, however this mode can be set by the SEC3500 HMI for communication with older legacy SEC3500 HMI Panels. It is not a mode that should be intentionally set for use with Modbus Master’s other than legacy SEC3500 HMI Panels. In this mode, network IDs are force to be assigned sequentially for two sensors attached to each SEC3120. Sequential IDs can be assigned in UNIQUE mode if desired, but in Legacy 3100 mode sequential IDs are forced.
- **Unique Mode –** This mode can be used for any Modbus Master or SEC3500 HMI version. In this mode, Modbus Network IDs can be assigned to both sensors of any valid value, and do not have to be sequential. When communicating with an SEC3500 of a version less than 4.0.0 however, the network IDs should be set sequentially in this mode.
- **Single Mode –** This mode can be used for any Modbus Master or for an SEC3500 HMI Panel version 4.0.0 or higher. In this mode, only one Modbus Network ID is assigned to the SEC3120 Transmitter and all sensor information for all sensors attached are accessible.

Change Network ID Mode

```
  ↑  EJECT MEMORY CARD
     ABORT WARMUP
     INFO
* ↓  MAIN MENU
```

From the Initial/Top menu screen, move the cursor down to MAIN MENU and select ENTER.

```
  ↑  CALIBRATION
     ALARM
     RELAY
* ↓  NETWORK
```

Move the cursor down to the NETWORK Menu and select ENTER.

```
   NETWORK ID MENU
*  MODBUS SETTINGS
   PREVIOUS MENU
```

Select ENTER on MODBUS SETTINGS to bring up the Modbus Settings Menu Page 1 Screen

```
 ↑ ONLINE         YES / NO
   SENSORS        UNIQUE
*  NET ID         UNIQUE   *
 ↓ 485 BUS MENU
```

The operator may change the Modbus Network ID mode by moving the cursor to NET ID selecting ENTER and using the UP/DN arrows to change the value to one of two modes:

- UNIQUE – where two sensors have different Modbus network ID and zone values and can be addressed independently on Modbus network,
- SINGLE – where one or both sensors share a single Modbus network ID and zone ID and either sensor is accessed by this network ID.

CAUTION: Only one edit is retained when leaving this menu. When making changes to the ‘MODBUS SETTINGS’ menu exit to the ‘SAVE CHANGES’ screen for each field being changed.

```
 ↑ ONLINE         NO
   SENSORS        IDENT
*  NET ID         SINGLE
 ↓ 485 BUS MENU
```

Scroll down to the 2nd page of the Modbus Settings Menu.

```
* ↓ PREVIOUS MENU
```

Select ENTER on PREVIOUS MENU to return the screen to the Network Menu.

```
   NETWORK ID MENU
   MODBUS SETTINGS
*  PREVIOUS MENU
```

Scroll down to and select ENTER on PREVIOUS MENU to return the screen back to the Main Menu Screen.

```
*  SAVE CHANGES
   ABORT CHANGES
```

Select ENTER on SAVE CHANGES to return the screen back to the Main Menu Screen.

```
  ↑ CALIBRATION
    ALARM
    RELAY
* ↓ NETWORK
```

Scroll down to bring up Page 2 of the Main Menu Screen.

```
  ↑ HIDE LOW GAS
    SELF TEST
    SET DATE TIME
* ↓ PREVIOUS MENU
```

Scroll down to PREVIOIUS MENU and select ENTER to return the screen to the Initial/Top Menu Screen.

```
  ↑ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ↓ MAIN MENU
```

Ready for next operation.

Set the Network and Zone IDs

```
  ▲ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ▼ MAIN MENU
```

From the Initial/Top menu screen, cursor down to the Main Menu and select ENTER.

```
  ▲ CALIBRATION
    ALARM
    RELAY
* ▼ NETWORK
```

Move the cursor down to the NETWORK menu and select ENTER.

```
*    NETWORK ID MENU
     MODBUS SETTINGS
     PREVIOUS MENU
```

Select ENTER on NETWORK ID MENU.

```
*    FOR SENSOR:  ONE/TWO *
     ID           XXX
     ZONE         YYY
     PREVIOUS MENU
```

If the ID mode (see Modbus settings menu) is not set to ‘Single’ and Sensor Role (see Modbus settings menu) is not set to ‘Single’, then you may change the ID and Zone number for either sensor one or two by choosing the sensor number. Select ENTER on ‘FOR SENSOR’ item, and use the UP/DN arrows to change between ONE and TWO. Otherwise, if ID mode or Sensor Role is set to ‘Single’ all changes will be made with SENSOR ONE displayed.

```
     FOR SENSOR:  ONE/TWO
*    ID           XXX      *
     ZONE         YYY
     PREVIOUS MENU
```

To set the ID of each sensor move the cursor to ID and select ENTER. The IDs of the sensors may be set in the range 1-254, however they cannot be set to the same value.

Note: Be sure to assign the sensor an ID number not shared by any other sensors in the HMI’s network.

```
     FOR SENSOR:  ONE/TWO
     ID           XXX
*    ZONE         YYY      *
     PREVIOUS MENU
```

To set the Zone of each sensor move the cursor to ZONE and select ENTER. The ZONE can be set in the range 1-254.

```
     FOR SENSOR:  ONE
     ID           13
     ZONE          3
*    PREVIOUS MENU
```

Scroll down and select ENTER on PREVIOUS MENU to return to the Network Menu Screen.

```
     NETWORK ID MENU
     MODBUS SETTINGS
*    PREVIOUS MENU
```

Scroll down to and select ENTER on PREVIOUS MENU to return to the Main Menu.

```
*  SAVE CHANGES
   ABORT CHANGES
```

ENTER on ‘SAVE CHANGES’ to return to the Main Menu.

↑ CALIBRATION ALARM RELAY * ↓ NETWORK	Scroll down to Main Menu page 2.
↑ HIDE LOW GAS SELF TEST SET DATE TIME * ↓ PREVIOUS MENU	Scroll down to PREVIOUS MENU and select ENTER to return the screen to the Initial/Top Menu.
↑ EJECT MEMORY CARD ABORT WARMUP INFO * ↓ MAIN MENU	Ready for next operation.

8.7. ModBus Settings

The SEC3120 Digital Transmitter is capable of speaking to various devices that communicate using standard 16-bit Modbus and every version of the SEC3500 HMI using its various proprietary protocols. (For more details, see the SEC3120 16-bit Modbus Technical Sheet, SEC P/N 1580282) Based on the Modbus register address and function code combinations provided in queries to the Transmitter by a Modbus Master, it is able to determine whether it is communicating with a standard Modbus device or an SEC3500 HMI and further distinguish which HMI protocol is appropriate. The SEC3120 communicates over RS485 as a Modbus RTU Slave (compatible with Modicon Modbus Specification PI-MBUS-300 Rev. J), and does not perform any bus-management functions.

Configuring SEC3120 RS485 Bus Parameters

Since the SEC3120 implements Modbus RTU over RS485, bus communication parameters can be changed to accommodate various line configurations for other Modbus compliant Masters (compatible with Modicon Modbus Specification PI-MBUS-300 Rev. J). SEC3500 HMI Panels communicate using SEC standard RS485 (or default) configuration parameters, as shown below, since they provide the most reliable compromise for speed, distance and error tolerance:

- **Baud Rate:** 9600
- **Parity:** None
- **Stop Bits:** 2
- **Data Bits:** 8

The default parameters (485 Bus Settings Menu Item SEC-DEFAULT) shown above are mandatory for the SEC3500 and are the recommended parameters. However, a different Modbus compliant Master used in place of the SEC3500, such as a Modbus Ethernet Gateway, may choose to use a different configuration. The Most common alternative configuration is as follows (485 Bus Settings Menu Item SEC-ALTERNATE):

- **Baud Rate:** 9600
- **Parity:** None
- **Stop Bits:** 1
- **Data Bits:** 8

The operator may choose to completely configure the communication configuration by setting custom settings (485 Bus Settings Menu Item SEC-CUSTOM):

- **Baud Rates:** 1200, 2400, 4800, 9600, 19200, 38400
- **Parity:** None, Odd, or Even
- **Stop Bits:** 1 or 2
- **Data Bits:** 8 or 9

Though the parameters are customizable, the total frame of bits cannot exceed ten (not including the start bit), hence 8 data bits with 2 stop bits will be valid, but parity cannot be used. Likewise, 8 data bits with parity is valid with only 1 stop bit. Nine data bits can only be valid with one stop bit and no parity. Though the operator may create a configuration greater than ten total bits, the transceivers by default will adapt a replacement frame that remains ten bits in length and will resemble the most common frame format.

Activating ModBus Communication - Put the SEC3120 Unit Online or Offline

```
  ▲ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ▼ MAIN MENU
```

Scroll down to MAIN MENU and select ENTER.

```
  ▲ CALIBRATION
    ALARM
    RELAY
* ▼ NETWORK
```

Move the cursor down to the NETWORK menu and select ENTER.

```
    NETWORK ID MENU
*   MODBUS SETTINGS
    PREVIOUS MENU
```

Select ENTER on MODBUS SETTINGS to bring up the Modbus Settings Menu.

```
* ▲ ONLINE        YES / NO *
    SENSORS       UNIQUE
    NET ID        UNIQUE
  ▼ 485 BUS MENU
```

The operator can place the unit actively on RS485 bus, or take it off by moving the cursor to ONLINE, selecting ENTER and using the UP/DN arrows to change the value between YES and NO.

```
* ▲ ONLINE        YES
    SENSORS       IDENT
    NET ID        SINGLE
  ▼ 485 BUS MENU
```

Scroll down to the Modbus Settings Menu Page 2.

```
* ▼ PREVIOUS MENU
```

Select ENTER on PREVIOUS MENU to exit the Modbus Settings Menu and return to the Network Settings Menu Screen.

```
    NETWORK ID MENU
    MODBUS SETTINGS
*   PREVIOUS MENU
```

Scroll down to and select ENTER on PREVIOUS MENU to return to the Main Menu Screen.

```
*   SAVE CHANGES
    ABORT CHANGES
```

Select ENTER on SAVE CHANGES. The screen will return to the Main Menu.

```
  ▲ CALIBRATION
    ALARM
    RELAY
* ▼ NETWORK
```

Scroll down to Main Menu Page 2.

```
  ▲ HIDE LOW GAS
    SELF TEST
    SET DATE TIME
* ▼ PREVIOUS MENU
```

Scroll down to and select ENTER on PREVIOUS MENU to return to the Initial/Top Menu Screen.

Set RS485 ModBus Line Settings (Data Bits, Stop bits, Parity and BAUD)

```
  ▲ EJECT MEMORY CARD
    ABORT WARMUP
    INFO
* ▼ MAIN MENU
```

Scroll down to MAIN MENU and select ENTER.

```
↑ CALLIBRATION
  ALARM
  RELAY
* ↓ NETWORK
```

Move the cursor down to the NETWORK menu and select ENTER.

```
   NETWORK ID MENU
*  MODBUS SETTINGS
   PREVIOUS MENU
```

Select ENTER on MODBUS SETTINGS to bring up the Modbus Settings Menu.

RS485 Bus Settings Menu

```
  ↑ ONLINE        YES / NO
    SENSORS       UNIQUE
    NET ID        UNIQUE
* ↓ 485 BUS MENU
```

The operator may change the Modbus RS485 settings by selecting ENTER on 485 BUS MENU. The following sub-menu will show:

485 Bus Default Settings

```
*  COMM- DEFAULT
   COMM- ALTERNATE
   COMM- CUSTOM
   PREVIOUS MENU
```

The operator can set the 485 bus to communicate using SEC DEFAULT line values by moving the cursor to COMM-DEFAULT and selecting ENTER. The default values are 9600 baud, 8 data bits, no parity and 2 stop bits. The following display is shown:

```
DEFAULT COMM PARAMS
F BITS: 8      S BITS:  2
PAR: N       RATE:  9600
 -ENT- TO CONTINUE
```

This is just an informational box to indicate what the settings are. The operator may select ENTER to return to the 485 bus menu.

485 Bus Alternate Settings

```
   COMM- DEFAULT
*  COMM- ALTERNATE
   COMM- CUSTOM
   PREVIOUS MENU
```

The operator can set the 485 bus to communicate using SEC ALTERNATE line values by moving the cursor to COMM- ALTERNATE and selecting ENTER. The alternate values are 9600 baud, 8 data bits, no parity and 1 stop bit. The following display is shown:

```
ALT. COMM PARAMS
F BITS: 8      S BITS:  1
PAR: N       RATE:  9600
 -ENT- TO CONTINUE
```

This is just an informational box to indicate what the settings are. The operator may select ENTER to return to the 485 bus menu.

485 Bus Custom Settings Menu

```
   COMM- DEFAULT
   COMM- ALTERNATE
*  COMM- CUSTOM
   PREVIOUS MENU
```

The operator can set the 485 bus to custom communication settings by moving the cursor to COMM- CUSTOM and selecting ENTER. The following screen will show:

```
* ↑ DATA BITS     EIGHT     *
    STOP BITS     TWO
    PARITY        NONE
  ↓ BAUD RATE     9600
```

The operator may change the data bits by moving the cursor to DATA BITS and select ENTER, then using the UP/DN arrows to change the value to either 'EIGHT' or 'NINE'.

```
  ↑ DATA BITS     EIGHT
*   STOP BITS     TWO        *
    PARITY        NONE
  ↓ BAUD RATE     9600
```

The operator may change the stop bits by moving the cursor to STOP BITS and select ENTER, then using the UP/DN arrows to change the value from either 'ONE' or 'TWO'.

```
  ↑ DATA BITS     EIGHT
    STOP BITS     TWO
*   PARITY        NONE       *
  ↓ BAUD RATE     9600
```

The operator may change the parity checking by moving the cursor to PARITY and select ENTER, then using the UP/DN arrows to change the value from 'NONE', 'ODD' or "EVEN'.

```
  ↑ DATA BITS     EIGHT
    STOP BITS     TWO
    PARITY        NONE
* ↓ BAUD RATE     9600       *
```

The operator may change the baud rate by moving the cursor to BAUD RATE and select ENTER, then using the UP/DN arrows to change the value to one of {1200, 2400, 4800, 9600, 19200 and 38400}.

```
* ↓ PREVIOUS MENU
```

Return to the 485 bus menu and save the changes by moving the cursor to the next screen and select ENTER.

```
    COMM- DEFAULT
    COMM- ALTERNATE
    COMM- CUSTOM
*   PREVIOUS MENU
```

Scroll down to PREVIOUS MENU and select ENTER to return to the Modbus Settings Menu Screen.

```
    NETWORK ID MENU
    MODBUS SETTINGS
*   PREVIOUS MENU
```

Scroll down to PREVIOUS MENU and select ENTER to return to the Main Menu Screen.

```
*  SAVE CHANGES
   ABORT CHANGES
```

Select ENTER on SAVE CHANGES to return to the Main Menu Screen.

9. Sensor Calibration

Calibration Menu (Selected from the Main Menu)

```
* ↑ CALIBRATION
    ALARM
    RELAY
  ↓ NETWORK
```

ENTER to select the calibration menu.

* ↑ SELECT SENSOR ONE/TWO ZERO SPAN ↓ CAL. VAL 2.50	ENTER on 'SELECT SENSOR' 'ONE/TWO' to choose which sensor to perform calibration operations. DOWN switch to select sensor one Up switch to select sensor two

Zero Cal

↑ SELECT SENSOR ONE/TWO * ZERO SPAN ↓ CAL. VAL 2.50	To Zero the sensor, move the cursor to ZERO and select enter.
ZERO CAL 'present gas value' SENSOR ONE / TWO ↓ PREV. –ENT– START	Apply clean air (N2 for an oxygen sensor) and wait for the 'present gas value' to indicate a stable value. Select ENTER. The following screens will be displayed.

ZERO CAL
SENSOR ONE
1. WAIT FOR START
-ENT- TO ABORT

ZERO CAL
SENSOR ONE
1. IN PROGRESS
-ENT- TO ABORT

ZERO CAL
SENSOR ONE
1. COMPLETE
DONE, STOPPING…

SETTING CAL. DATE
SENSOR ONE
1. WAIT FOR START
-ENT- TO ABORT

SETTING CAL. DATE
1. IN PROGRESS

ZERO CAL
SENSOR ONE
1. RECORDING CAL DATA

ZERO CAL.
1. COMPLETE

DONE, STOPPING…

↑ SELECT SENSOR ONE/TWO * ZERO SPAN ↓ CAL. VAL 2.50	Once complete the SEC3120 will return to the calibration menu. The sensor has been successfully zeroed if no faults are indicated.

Span Cal (and Calibration Value)

```
  ↑ SELECT SENSOR ONE/TWO
    ZERO
    SPAN
* ↓ CAL. VAL      2.50
```

Arrow down to CAL. VAL to verify the span gas calibration value matches the concentration of the span calibration gas on hand. If not, select Enter and the following screen will appear.

```
  ↑ SELECT SENSOR ONE/TWO
    ZERO
    SPAN
* ↓ CAL. VAL      2.50     *
```

Using the Up and Down arrows will allow the operator to change the calibration gas value of the sensor to match the calibration gas used to span the sensor. Once the correct value is displayed select ENTER.

```
* SAVE CHANGES
  ABORT CHANGES
```

ENTER to select 'SAVE CHANGES' to send the calibration gas value to the sensor, or 'ABORT CHANGES' to return to the previous screen.

The Following screens are displayed:

```
SET CALIBRATION VAL.
1. WAIT FOR START
```

```
SET CALIBRATION VAL.
1. IN PROGRESS
```

```
SET CALIBRATION VAL.
1. COMPLETE

DONE, STOPPING…
```

```
  ↑ SELECT SENSOR ONE/TWO
    ZERO
*   SPAN
  ↓ CAL. VAL      2.50
```

To Span calibrate the sensor, move the cursor to SPAN and select ENTER.

```
SPAN CAL  'present gas value'
SENSOR        ONE / TWO

↓ PREV.    –ENT–   START
```

Apply clean air (N2 for an oxygen sensor) and wait for the 'present gas value' to indicate a stable value.
Select ENTER.

The following screens will be displayed.

```
SPAN CAL
SENSOR ONE
1. WAIT FOR START
         -ENT- TO ABORT
```

```
SPAN CAL
SENSOR ONE
1. IN PROGRESS
         -ENT- TO ABORT
```

```
SPAN CAL
SENSOR ONE
1. COMPLETE
DONE, STOPPING…
```

SETTING CAL. DATE
SENSOR ONE
1. WAIT FOR START
-ENT- TO ABORT

SETTING CAL. DATE
1. IN PROGRESS

SPAN CAL
SENSOR ONE
1. RECORDING CAL DATA

SPAN CAL.
1. COMPLETE

DONE, STOPPING…

PURGE GAS 'present gas val'
SENSOR ONE / TWO

–ENT– TO ABORT

After Span calibration has completed the operator will be prompted to purge the cal gas. The operator can then apply clean air to the sensor

↑ SELECT SENSOR ONE/TWO
ZERO
* SPAN
↓ CAL. VAL 2.50

Once the measured gas value is less than 25% of the LOW alarm set point the SEC3120 will return to the calibration menu. The sensor has been successfully calibrated if no faults are indicated.

* ↓ PREVIOUS MENU

Move cursor down to display final calibration menu option to return to PREVIOUS MENU

ENTER to return to the MAIN MENU

* ↑ CALIBRATION
ALARM
RELAY
↓ NETWORK

10. Diagnostic Functions

The Diagnostics Menu will allow the operator to command the SEC3120 to reboot, toggle the LEDs (typically 'Locator Mode' with alternating flashing red/green alarm/fault lights), and toggle the individual relays on and off to verify operation.

↑ EJECT MEMORY CARD
ABORT WARMUP
INFO
↓ MAIN MENU

*↑ SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓ EXIT

Reboot System

* REBOOT SYSTEM
TOGGLE LEDS ON/OFF
TOGGLE RELAYS
PREVIOUS MENU

By selecting ENTER with the cursor on REBOOT SYSTEM the operator will command the SEC3120 to reboot. This action results in the SEC3120 Transmitter being rebooted and normal power up initialization will occur.

Toggle LEDs (Locator)

```
  REBOOT SYSTEM
* TOGGLE LEDS     ON/OFF
  TOGGLE RELAYS
  PREVIOUS MENU
```

The toggle LEDs function (typically referred to as 'Locator Function') is normally generated by the SEC3500 operator interface. It can be used at the SEC3120 to function as a lamp test. Selecting ENTER will turn the Locator on. The Alarm and Fault LEDs will flash red and green alternately.

Selecting ENTER again will turn the Locator function off.

Toggle Relays

```
  REBOOT SYSTEM
  TOGGLE LEDS
* TOGGLE RELAYS
  PREVIOUS MENU
```

Selecting ENTER will display the toggle relays menu.

```
* ↑ LOW      ON/OFF
    MID      ON/OFF
    HIGH     ON/OFF
  ↓ FAULT    ON/OFF
```

The user can select the desired relay to test and toggle its activation ON or OFF using the UP and DOWN switches.

```
* ↓ PREVIOUS MENU
```

ENTER on 'PREVIOUS MENU' to return to the Diagnostics Menu.

11. Selt-Test Menu (Selected from the Main Menu)

The self-test function will make the sensor generate a 4-20mA current into the SEC3120 from 4mA to 20mA (0-fullscale). In the self-test mode the SEC3120 outputs are fully functional. The SEC3120 will display the rising gas level, the 4-20 mA output will increase to 20 mA, the relays will activate and the RS485 information will be transmitted to the control system.

```
  ↑ HIDE LOW GAS
*   SELF TEST
    SET DATE TIME
  ↓ PREVIOUS MENU
```

Move the cursor to SELF TEST and select ENTER to open the self-test menu.

```
* ON SENSOR:  ONE/TWO/BOTH
  CANCEL REQUEST
  ABORT TEST
  START SELF TEST
```

The self-test can be run on sensor 1, sensor 2 or both sensors simultaneously.

During the self-test the display will be normal with the exception that the bottom line will indicate that self-test is being run.

Example:
Self-test running on both sensors.
SELF TEST will display

```
S1          ID: 001
            0-100     %LEL
10.4        METHANE
            SELF TEST
```

In the status line for the given sensor under test, if only sensor one is in self-test, then the SELF TEST will only appear for SENSOR one. Otherwise if it is sensor two, then the status line will only appear for SENSOR two. If both sensors are in self-test in the example above, then as the display toggles between sensor one and two, the status line will remain indicating SELF TEST for both sensor display updates.

Once the unit reaches full scale the SEC3120 automatically returns to normal and the SELF TEST status will be removed from the display for that sensor.

12. INFO Menu Contents

Using the UP and DOWN magnetic switches move the cursor to the desired field.

```
↑ EJECT MEMORY CARD
  ABORT WARMUP
*  INFO
↓ MAIN MENU
```

Entering the INFO menu will display the initial Info Menu

```
* UNIT INFO
  SENSOR INFO
  PREVIOUS MENU
```

Selecting Enter at 'UNIT INFO' displays the information for the SEC3120 Display, Dual Head Transmitter.

```
 SEC3120 TRANSMITTER
VER:  X.YY.RRRR
UNIT SN: 000035641
        -ENT- TO EXIT
```

'VER' is the SEC3120 software version number.
'UNIT SN' is the SEC3120 unit serial number.

```
  UNIT INFO
* SENSOR INFO
  PREVIOUS MENU
```

Selecting Enter at SENSOR INFO displays the information for both of the sensors.

```
SENSOR INFO DISPLAY
IN:   003   SECONDS
         PRESS
     –ENT- TO EXIT
```

'003' counts down to '000' seconds

```
          -S1 DDD-     -S2 EEE
TYP:      XXX          YYY
FW:       XX.X         YY.Y
SN:       XXXXX        YYYYY
```

'DDD' – Device ID for sensor 1
'EEE' – Device ID for sensor 2
TYP: Sensor type
(00 is a SEC3000, 32 is SEC Millennium)
FW: Version of sensor software.
SN: Sensor serial number.

```
  UNIT INFO
  SENSOR INFO
* PREVIOUS MENU
```

Select PREVIOUS MENU to go back to the initial menu screen.

13. Hide Low Gas

The Hide function allows the operator to not display the gas reading (will always show 0) until the Low Alarm threshold is exceeded. All outputs will function as normal when the Hide mode selected is YES.

```
* ↑ HIDE LOW GAS
    SELF TEST
    SET DATE TIME
  ↓ PREVIOUS MENU
```

By selecting ENTER at HIDE LOW GAS, the operator can choose to hide or not hide gas levels below the low threshold. The following screen will appear:

```
  HIDE LOW GAS:
* YES / NO          *

  PREVIOUS MENU
```

```
* SAVE CHANGES
  ABORT CHANGES
```

By selecting ENTER on YES/NO the user may change the value using the UP/DN arrows. After selecting ENTER after setting the value, the operator may move the cursor to PREVIOUS MENU and select ENTER to go back to the main menu after choosing to SAVE or ABORT the changes.

14. Data Logging (Optional)

The SEC3120 Unit provides event data logging to a flash card. This flash card can be read by any personal computer that can read a FAT16 format file system, similar to cards from digital cameras and other portable devices. It should NEVER be formatted by a personal computer, rather be formatted by the SEC3120 unit itself under the Initial/Top Menu item “Format Flash Card”. Data can be read directly from the flash card or copied to a personal computer. The file is a text file containing comma separated data values, one event per line. The text file (“SEC3100.TXT”) will be the only file on the flash card, and currently will NOT be allowed to grow beyond 16MB (this is considered the memory card “full now” state). After the data is archived from the flash card, it can be re-formatted to start storage over. A flash card will typically not become full for many years.

Note: You cannot use a memory card formatted by an SEC3120 in an SEC3100 Unit! You may, under certain circumstances, use a memory card formatted by an SEC3100, however the SEC3120 will consider it full when it approaches the SEC3100 file size limitation of 4MB. It is best to reformat such a card to make more use of its capacity.

As The Memory Card Fills Up

When a flash card crosses 80% full (approximately 12 MB), the memory card status will change from “MC-OK” to “MC-FULL”, warning the user to copy the contents off to a permanent storage location and reformat the card to start storage over. The SEC3120 will continue to log data to the flash card until it reaches 100% full. At that time, the status will change to “MC-FULLNOW” indicating that there is no more room to store data. At this point data storage has STOPPED and events may be lost that would otherwise be stored. If the card is removed and reinserted, the SEC3120 may eventually display the status as “MC-FAULT”, indicating a memory card fault. The card MUST be formatted at this point.

How Long It May Take To Fill a Memory Card

The absolutely shortest period of time to fill a memory flash data card is approximately 200 – 300 hours. To accomplish this unreasonable feat gas levels must be constantly changing beyond 5% of sensor range and alarm events and other related events must be persistently changing at a highly sustained rate. It is unlikely that this could ever happen under normal circumstances, since alarms would be sounding and intervention would be absolutely necessary. If sensor(s) are properly calibrated, and normal maintenance is performed, the memory card will probably not fill up for ten years or more. Since the operating environment determines the amount of data and frequency for storage, the time it takes to fill a data card will differ for each installation.

Flash Card Removal and Formatting

Removing a data flash card should not occur without selecting the first Top Menu Item “Eject Flash Card”. This prepares the flash card for removal by writing any data cached in memory out to the file system and ensures the file system on the data flash card is not corrupted. Formatting a data flash card allows the card to start over and re-capture space. Caution should be exercised to ensure that any data needed is archived first since this process will erase all data. The file system will be re-started and prepared as if from the factory. Just select the Menu Item on the second page of the Top Menu “Format Flash Card” to begin the process.

Data Log File Contents

Events such as a 5% gas level change, alarm state change, sensor warm-up, calibration, system power on, sensor fault or parameter changes are logged and stored. Data from normal operation is NOT recorded when gas levels do not change beyond a 5% band. Here is the data log format (SEC Filename: "SEC3100.TXT"):

LOG FILE EVENT ENTRY FORMAT:
tt,mm/dd/yyyy,HH:MM:SS,ID- vv

Where:
tt = type, 00 - 99
mm = month, 1 - 12
dd = day, 1 - 31
yyyy = year, 2000 - 2099
HH = hours, 0 - 23
MM = minutes, 0 - 59
SS = seconds, 0 - 59
ID- = Sensor number (S1, S2 or BB for both)
vv = variable data depending on tt

Log Entry Type Table (tt):

Log Entry Type Code (tt)	Description
00	Boot/Power up- 3120 Unit Information Event
01	Sensor Warm-up: New Sensor/Sensor removed and replaced Event
02	Parameter Changes Made Event
03	Alarm High-Level Triggered Event
04	Alarm Mid-Level Triggered Event
05	Alarm Low-Level Triggered Event
06	Change in Gas Level > 5% of Sensor Range Event
07	Sensor Fault/Missing/Not Identical Detected Event
08	Sensor Calibrated Event
09	Flash Cleared/Restarted Event
10	Self-Test Initiated by Operator Event
11	Self-Test Concluded by Operator Event
12	Self-Test Aborted by Operator Event
13	Sensor Cell Warning Event
14	3120 Unit Role Change Event
99	Flash Card Re-inserted Event

Log Entry Data Format For Each Type Table (vv):

Log Entry Type Code (tt)	**Log Entry Event Name** ***Log Variable Data Format (vv)***
00	**3120 Boot/Power Up Event** *Preamble,BB- US,FWVerMaj.Min.Rev*
01	**Sensor Warm-up Event** *Preamble,ID- US,FWVerMaj.Min.Rev*
02	**Parameters Changed Event** *Preamble,ID- NID,ZID,SSN,STP,CD,CV,RNG,LOW,MID,HI,GU,GN*
03	**Alarm High-Level Triggered Event** *Preamble,ID- Gas Value Float*
04	**Alarm Mid-Level Triggered Event** *Preamble,ID- Gas Value Float*
05	**Alarm Low-Level Triggered Event** *Preamble, ID- Gas Value Float*
06	**Change in Gas Level Event** *Preamble, ID- Gas Value Float*

07	**Sensor Fault Event** *Preamble,ID- (SSC,SEC)/SMT*
08	**Sensor Calibration Event** *Preamble,ID- CALTXT*
09	**Flash Cleared Event** *Preamble,BB- "Memory Card Cleared."*
10	**Self-Test Initiated Event** *Preamble,ID- "Self Test Started."*
11	**Self-Test Concluded Event** *Preamble,ID- "Self Test Concluded."*
12	**Self-Test Aborted Event** *Preamble,ID- "Self Test Aborted."*
13	**Sensor Cell Warning Event** *Preamble,ID- CWC*
14	**3120 Unit Role Change Event** *Preamble,BB- RLM,SHR*
99	**Flash Card Re-inserted Event** *Preamble,BB- US,DVID,FWMaj.Min.Rev,RLM,SHR* *- S1: NID,ZID,SSN,STP,CD,CV,RNG,LOW,MID,HI,GU,GN* *- S2: NID, ZID,SSN,STP,CD,CV,RNG,LOW,MID,HI,GU,GN*
Parameter Variables:	
Variable	**Variable Description**
Preamble	tt,mm/dd/yyyy,HH:MM:SS
tt	Log Entry Type Code
mm	Month value (01 – 12)
dd	Day of month (01 – 31)
yyyy	Year (2000 – 2099)
HH	Hours (24 hour format, 00 – 23)
MM	Minutes (00 – 59)
SS	Seconds (00 – 59)
S1-	Literal text for sensor one (S1-)
S2-	Literal text for sensor two (S2-)
BB-	Literal text for both sensors (BB-)
ID-	Replaced with literal text (S1-, S2- or BB-) based on sensor(s) reporting on
US	3120 Unit Serial Number
DVID	Disk Volume ID
FWMaj	Firmware Major Version Number
Min	Firmware Minor Version Number
Rev	Firmware Revision Version Number
RLM	Relay Logic Mode (0 = first, 1 = second, 101 = AND, 102 = OR)
SHR	Sensor Head Role (0 = Identical, 1 = Unique, 2 = Single Sensor)
NID	Network ID
ZID	Network Zone ID
SSN	Sensor Serial Number
STP	Sensor Type Code (see sensor manual for codes)
CD	Sensor Last Calibration Date
CV	Calibration Value (Float)
RNG	Sensor Range Value (Float)
LOW	Alarm Low threshold Point (Float)
MID	Alarm Mid threshold Point (Float)
HI	Alarm High threshold Point (Float)
GU	Gas Units Name (4 text characters)
GN	Gas Name (8 text characters)
(SSC,SEC)/SMT	Either (Sensor Status Code, Sensor Error Code values) OR Sensor Fault Message Text
SSC	Sensor Status Code (see sensor manual for code values)

SEC	Sensor Error Code (see sensor manual for code values)
SMT	Literal text: “Sensor Missing!”, or “Sensors Not Identical!”
CALTXT	Literal text: “Zeroed.” or “Spanned.”
CWC	Sensor Cell Warning Code (see sensor manual for code values)

14.1. Formatting the Flash Card (Selected from the Initial / Top Menu, Page 2)

The Flash Card may be re-formatted by the operator using the SEC3120.
(WARNING: ALL contents WILL be lost!)

```
↑ EJECT MEMORY CARD
  ABORT WARMUP
  INFO
↓ MAIN MENU
```

```
↑ SEC DIAGNOSTICS
  RESET RELAYS
* FORMAT FLASH CARD
↓ EXIT
```

Select ENTER and Flash Card Format Screen will be displayed:

```
 - FORMATTING FLASH -
   PLEASE WAIT …

   -ENT- TO ABORT
```

```
CARD FORMAT
COMPLETE …
```

```
 ↑ SEC DIAGNOSTICS
   RESET RELAYS
   FORMAT FLASH CARD
*↓ EXIT
```

Select ENTER on ‘EXIT’ to remove the Initial / Top menu and restore the Normal operation display.

15. Working With the SEC3500 HMI

The SEC3120 Digital Transmitter is supported by the SEC3500 HMI, most effectively beginning with HMI version 3.5.28 and Transmitter version 1.2.264. SEC3500 HMI versions prior to 4.0.0 treat the SEC3120 as one or two individual SEC3100 single digital transmitters, having separate icons, separate command and control, etc. This requires the SEC3120 to have sequential Modbus network IDs, one assigned for each physical sensor attached to it. If the SEC3500 HMI or its operator attempts to;

- “Discover” an SEC3120 with a single network ID with a sensor role other than single, or
- change from dual network IDs to a single network ID with a sensor role other than single with an already “discovered” and online SEC3120, or
- change the network ID of SEC3120 sensor two to a network ID that is not the next sequential value of sensor one,

the SEC3120 device may cause the SEC3500 HMI to get caught in a constant loop attempting to communicate with both sensors, lose information about the SEC3120, or any other related corruption issue.

Therefore it is crucial that if a SEC3120 is not configured for ‘Single’ Sensor Role, its Modbus Network ID be configured as ‘Unique’ with sequentially assigned IDs if it is intended to be used with an SEC3500 HMI Panel with software versions prior to 4.0.0.

Careful network planning is necessary before deployment concerning Sensor Roles, Modbus Network ID mode, Relay Mode, etc. Paramount would be the consideration of the use of an SEC3500 HMI Panel as the Modbus Master;

- If used in the initial deployment, then the Sensor Role for each SEC3120 must be decided and the correct Modbus Network ID mode defined so that if sequential network IDs are needed to support a dual sensor SEC3120, the assignment of network IDs is planned in advance. Take special care when mixing SEC3100 Digital Transmitters with SEC3120 Dual Digital Transmitters on the same Modbus Network to avoid overlap or potential future overlap as upgrades in the future may occur.
- Plan for future additions and upgrades- the Modbus Network may add more SEC3120 Digital Transmitters, replacement of SEC3100 Single Digital Transmitters with SEC3120 Dual Digital Transmitters, and SEC3120 Digital Transmitters that may initially start out as Single Sensor Role configurations may be upgrade to dual sensor roles through the addition of additional sensors to the Transmitters.
- Make sure that there are enough gaps in the Network ID value planning to accommodate the initial deployment as well as future upgrades.
- If a complete overhaul of the Modbus Network ID layout is planned, it is probably easier to just delete all devices at the SEC3500 HMI Panel and then reconfigure all devices first before rediscovering the changes at the SEC3500 HMI Panel.

Caution: Do not mix an SEC3500 HMI with ANY other Modbus Master of any type! Bus contention, poor performance and corruption can result. If other Modbus gateways are needed in addition to an SEC3500 HMI, then utilizing the SEC3500 HMI Panel's Ethernet Modbus Slave Interface as a gateway interface as a better solution for capturing the sensor data to another network bus or higher level software management function.

APPENDIX A. Supplement – Certification Listed Data

SUPPLEMENT – SEC3120 Dual Display:

CAUTIONS AND INSTALLATION RECOMMENDATIONS

The following supplement contains data and statements required by the approval certificate of this product. No changes are allowed without certification review. This supplement must be included with the manual(s) for this product.

⚠ Under high temperature (+40°C) and high power operation (8A relay current) housing temperatures may be high. Use caution when handling the SEC3120.

Approvals / Certifications

North American (c/us) Certificate:	Class I, Division 1, Groups B,C,D, Temp T5 **(Pending)**
IECEx (International) Certificate:	Ex (d) IIC, T5 Gb **(Pending)**

The SEC3120 is approved to the standards shown in the approvals certificates. In order to maintain compliance to these standards install the SEC3120 per the following instructions and precautions.

Specifications

The following specifications are for the SEC3120 display only. Consult the appropriate sensor manuals for their specifications.

Environmental:

The SEC3120 Dual Sensor Display can be installed in indoor, outdoor and wet locations. The housings used have ingress protection ratings of IP66. Pollution degree 2 and Overvoltage category II

Operating Temperature and Humidity Rating:
-40° to +40°C (-40 to +104° F) at 0 to 99% RH (non-condensing)

Altitude / Elevation:
IEC 61010-1 certified to 2000 meters.

Mechanical:

Construction:
Epoxy Coated Aluminum

Dimensions: (See drawing 3120-XXX for details)

Height: 5 Inches (128 mm)	Width: 5 inches (128 mm)
Depth: 4.8 inches (122 mm)	Weight: 4.55 lbs (2.0 kg)

Conduit Entry:
Three (3) 3/4 inch NPT

⚠ For hazardous location installations seals must be installed within 18 inches of conduit entries.

Electrical:

Mains Supply:
Operating Voltage:
24 VDC ⎓ Nominal (Range: 18 to 32 Vdc) measured at the detector head
Current Draw: (without sensors)
Average: 250 mA (Peak: 500 mA)

Input, Sensor (Digital)
0-5 V, Sensor Electronics Corp. (SEC) Proprietary, Single-Wire, Digital signal from the sensor. This signal is used by the sensor to communicate status and gas data and is used by the display to initiate sensor calibration and query status.

Output (Analog):
4-20 mA (Source Type), max 1000 ohm load at 24 Vdc supply voltage.
The 4-20 mA output is provided by the sensor and is passed through the SEC3120 display. The display can be located at any point in the sensor's output loop. Consult the appropriate sensor manual for 4-20 installation requirements.

Output (Digital):
RS485 LAN (isolated) MODBUS RTU Slave, compatible with Modicon Modbus Specification PI-MBUS-300 Rev. J. Refer to SEC Modbus Technical Sheet (SEC P/N 1580282) for specific configuration and use information.

Output (Relays):
Three (3) Alarms: Low, Mid High. One (1) Fault
Rated for 8 Amps, 30 VDC or 120VAC

Unit Installation and Maintenance

Warning – Do not open when energized or when an explosive atmosphere is present.

Mounting:

Mount the SEC3100 to rigid wall (wood based or stronger) or bulkhead structures using 1" or longer fasteners with a minimum 3/16" diameter. Mounting to drywall (wallboard, plasterboard, etc.) or similar material is not recommended.

Wiring:

Wire insulation for relay contacts should have a minimum breakdown voltage of twice that of the working voltage of the signal. E.g. 110v lines should have a minimum insulation breakdown voltage of 220v.

Wire insulation should be temperature rated for greater than 100°C.

Wire Sizing (Power):
0 to 500 feet wire length; recommend wire gauge size 16 AWG
501 to 1000 feet wire length; recommend wire gauge size 14 AWG

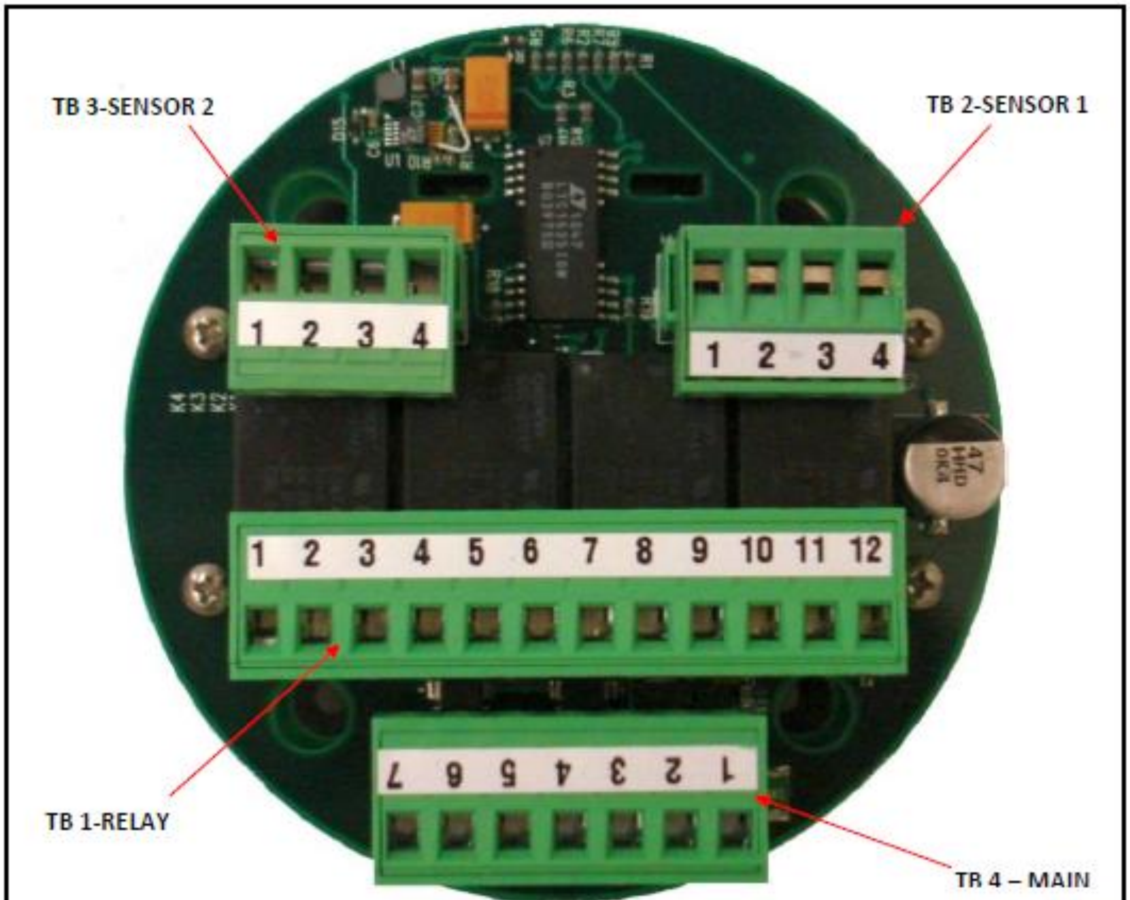
Safety Interrupt (mains circuit breaker):
A circuit breaker or interrupt switch for overcurrent protection rated for 30 watts located in the mains supply circuit is recommended. It should be located near the device it is protecting and labeled.

To minimize the length of exposed conductor strip wires to 3/8 inch. Solder tin the exposed wire to increase durability.

Protective bonding is provided by an internal screw location for connection of a grounding wire. Installation of this wire should include the use of a locking feature (i.e. locking washer).

Conduit:

For hazardous location installations seals must be installed within 18 inches of conduit entries.



TB 1 – RELAYS
(12) FAULT (N.E) N.C.
(11) FAULT (N.E.) COMMON
(10) FAULT (N.E) N.O.
(9) HIGH ALARM N.C.
(8) HIGH ALARM COMMON
(7) HIGH ALARM N.O.
(6) MID ALARM N.C.
(5) MID ALARM COMMON
(4) MID ALARM N.O.
(3) LOW ALARM N.C.
(2) LOW ALARM COMMON
(1) LOW ALARM N.O.

NC = NORMALLY CLOSED
NO = NORMALLY OPEN

TB 2 – SENSOR 1
(1) WHITE (DATA/CAL)
(2) BLUE OR GREEN (4-20 mA)
(3) RED (+24 VDC)
(4) BLACK (DC COMMON)

TB 3 – SENSOR 2
(1) WHITE (DATA/CAL)
(2) BLUE OR GREEN (4-20 mA)
(3) RED (+24 VDC)
(4) BLACK (DC COMMON)

TB 4 – MAIN
(1) +24 VDC
(2) 4-20 mA SENSOR 2
(3) DC COMMON
(4) RS485 DATA B
(5) RS485 DATA A
(6) ISOLATED COMMON
(7) 4-20 mA SENSOR 1

SENSOR ELECTRONICS CORPORATION 29730 CREEK VIEW AVE SAVAGE, MINNESOTA 55378 (T) 952.938.9486 (F) 952.938.9617 sales@sensorelectronic.com	**Figure 1** BACK VIEW OF SEC 3120 **SEC 3120 WIRING**

Supplement – Operator Manual | Supplement Page 4 of 4 | P/N 1580281-SUP
SEC3120 Digital Transmitter | Sensor Electronics Corporation | Rev A, 20131202

16-bit Standard Modbus Technical Use Sheet

For Version 1.2+ SEC 3120 Digital Transmitters

P/N 1580282, Rev 1, 20121228

Sensor Electronics Corporation

December, 2012

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General Description

About The SEC 3120 Digital Gas Transmitter

The SEC 3120 Digital Gas Transmitter is the latest generation Gas Transmitter from Sensor Electronics Corporation, and is fully compatible with its predecessor, the SEC 3100. The SEC 3120 Digital Gas Transmitter allows multiple single and multi-channel SEC sensors to be connected to it and acts as a central communication, control, status and data logging hub for them. While the SEC 3100 did not provide full 16-bit standard Modbus (PI-MBUS-300 Rev. J. compliance) support, the special SEC 3100MB16 does and is compatible with the SEC 3120 which provides full (relevant) compliance and major feature and sensor consolidation capabilities, as well as optional sensor redundancy.

SEC 3120 Modbus Standard Supported

The SEC 3120 Digital Gas Transmitter supports master mode communication as a Modbus RTU slave. While it supports other Modbus interfaces, this document addresses the specific 16-bit standard Modbus protocol as described in the Modicon Modbus Specification PI-MBUS-300 Rev. J. The reader should familiarize themselves with this document to fully understand and utilized this Modbus interface.

16-bit Modbus Supported Features and Functions Overview

Functions Codes -

03 - Read Multiple Holding Registers (supported fully)
06 - Preset Single Holding Register (supported fully)
16 - Preset/Write Multiple Holding Registers (supported fully)
01 - Read Coils **(not supported)**
05 - Force Single Coil **(not supported)**
15 - Force/Write Multiple Coils **(not supported)**
07 - Read Exception Register **(not supported)**

Broadcast (Network ID 0) for all other function codes is ***not supported,*** *except for Preset (code 06) Holding Register 42920 (Listen Only Modbus Mode) and 42921 (Resume from Listen Only Modbus Mode).*

All other function codes are not supported for broadcast mode in this interface.

Overall SEC 3120 Modbus Register Map

Internal Register	Modbus Holding Register	Region Description
00000 - 01999	40001 - 42000	Reserved for coil registers- future
02000 - 02099	42001 - 42100	16-bit Sensor ALL apply region (region 0)
02100 - 02199	42101 - 42200	16-bit Sensor 1 region
02200 - 02299	42201 - 42300	16-bit Sensor 2 region
02300 - 02399	42301 - 42400	16-bit Sensor 3 region
02400 - 02499	42401 - 42500	16-bit Sensor 4 region
02500 - 02599	42501 - 42600	16-bit Sensor 5 region
02600 - 02699	42601 - 42700	16-bit Sensor 6 region
02700 - 02799	42701 - 42800	16-bit Sensor 7 region
02800 - 02899	42801 - 42900	16-bit Sensor 8 region
02900 - 02999	42901 - 43000	16-bit 3120 unit region (region 9)
03000 - 03999	43001 - 44000	Reserved for SEC HMI Legacy
04000 - 04999	44001 - 45000	Reserved for SEC HMI Legacy
05000 - 05499	45001 - 45500	Reserved for SEC 32-bit future
05500 - 05999	45501 - 46000	Reserved for SEC 32-bit future
06000 - 06999	46001 - 47000	Reserved for future use
07000 - 07499	47001 - 47500	Reserved for SEC 32-bit future
07500 - 07999	47501 - 48000	Reserved for SEC 32-bit future
08000 - 08999	48001 - 49000	Reserved for SEC HMI Advanced SID
09000 - 09998	49001 - 49999	Reserved for SEC HMI Legacy

Memory Map – 16-bit Interface Holding Registers Overview

The SEC 3120 implements the 16-bit Modbus interface by breaking the address region into ten classes (unit and sensors) and eight plus one sensor sub-regions (each sensor region repeats the same command set with the same relative offsets) as shown previously.

Region 0 applies a sub-set of written values to ALL logical sensors, while regions 1 ï 8 apply to each individual logical sensor, and region 9 contains 3120 unit specific (non-sensor) information. The entire 16-bit region is shown previously in green.

Within the sensor regions, the same information/register address offsets are repeated, containing gas concentration, alarm set points, sensor status, etc. (relative offsets 42x01 ï 42x99, where x = sensor number 1 ï 8).

Within the unit specific region (9), the holding register addresses are absolute (42901 = operating status, 42902 = fault relay reason code, etc.).

Communication Parameters

- Protocol: Modbus RTU slave.
- Baud rates: 1200, 2400, 4800, 9600, 19200 bps field selectable, Word length 8.
- Parity: Odd, Even, None, field selectable.
- Stop Bits: 1 or 2, field selectable.
- Electrical Interface:
  - RS 485, multi-drop 2-wire positive/negative (using A/B nomenclature).
  - Transmit and Receive: Half Duplex.
  - Useable speed will depend on cable length.
- Modbus addressable: 1-247 (up to 254 if ONLY SEC 3120 units on a single bus).

Modbus Sensor Read Only Registers

- Gas concentration (expressed as an integer scaled up by factor) representing the units of measurement for that specific sensorφs current gas type (PPM, % LEL, %V/V, etc.)
- Operating Status (normal, calibrating, self test, start up, in an alarm (low, mid high) or fault
- Gas category Type (toxic, hydrocarbons, oxygen, etc.)
- Sensor firmware version
- Sensor serial number
- Alarm relay mode (trip above or below threshold, audible or normal action)
- Modbus address (Network ID)
- Sensor Range and Gas Factor
- Sensor Status and Error code, as well as Cell Test Warn code
- ASCII Gas name and Gas Units Name

Modbus Sensor Read/Write Registers

- Alarm thresholds (low, mid and high set points)
- Zone ID (Network Zone ID)
- Execute Self Test

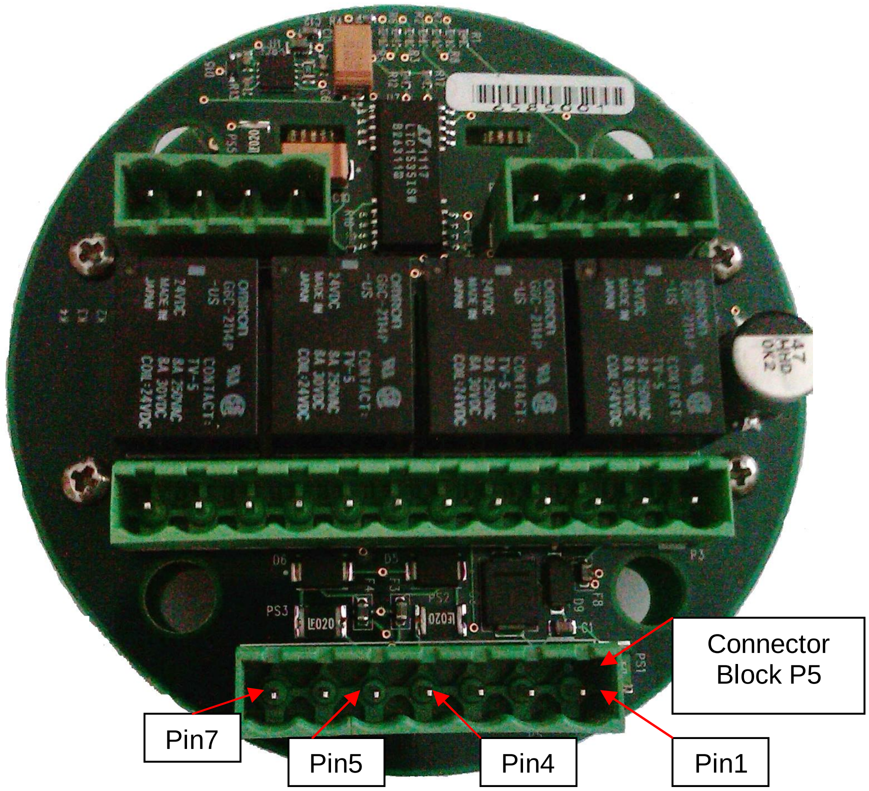
Modbus 3120 Unit Read Only Registers

- Unit Operation Status
- Unit Fault Relay Reason Code
- Unit Serial Number
- Maximum Number of Sensors That Can Be Attached
- Unit Clock- Read Current Time
- Unit Type
- Unit Firmware Version Info

Modbus 3120 Unit Read/Write Registers

- Unit Clock- Write New Time Registers
- Unit Clock- Set New Time Now
- Unit Diagnostics Control (force relays on/off, toggle LEDs to flash)
- Unit- Place into Modbus listen only mode
- Unit- Restore out of Modbus listen only mode

SEC 3120 Setup and Configuration

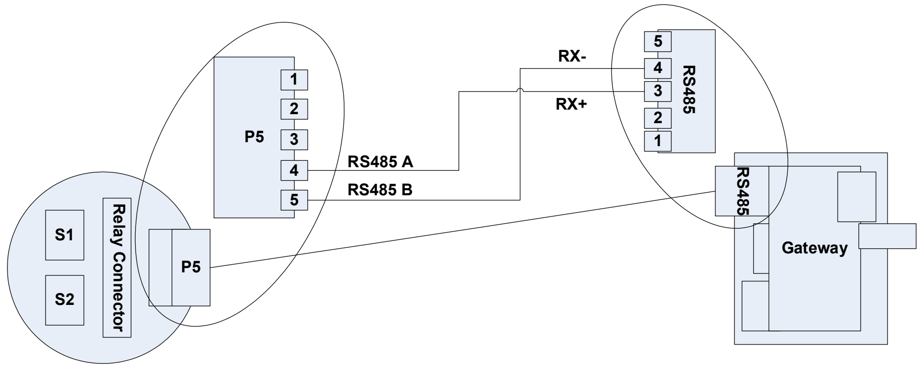


(Bottom View of SEC 3120- Relay Board Connectors)

SEC 3120 Modbus RS-485 Network Connections

- Pin 5 (RS485 B) of the SEC 3120 power and communication connection block P5 is typically connected to a Modbus Master device (RX-) terminal in two-wire connections. For the EGX-100 Gateway, this would be Pin 4 of the RS485 connection block.
- Pin 4 (RS485 A) of the SEC 3120 power and communication connection block P5 is typically connected to a Modbus Master device (RX+) terminal in two-wire connections. For the EGX-100 Gateway, this would be Pin 3 of the RS485 connection block.
- The EGX-100 Gateway is connected to the Ethernet using its Ethernet port and 10/100 base T/TX cable to an Ethernet switch.

Figure 1: Modbus RS485 Connections



First Time Configuration

When SEC 3120 units are first removed from the shipping container, unless otherwise instructed upon ordering, units may arrive configured in the following modes:

1. **Sensor Role: *Unique-*** Multiple sensors can be connected having different gas types, units of measure and ranges. This can be changed to **"Identical"** mode if all attached sensors have identical gas types, ranges and units of measure, thus allowing redundancy of measurement. It can also be changed to **"Single"** mode, where only one sensor is attached to the unit in the sensor 1 connector. In "Single" mode, the unit will ignore anything connected to the sensor 2 connector.
2. **Relay Mode: *OR-*** Sensors control the alarm relay coils in a logical "OR" fashion. Fault relay is always controlled in a logical "OR" fashion (Any sensor fault drives fault relay coil). The alarm relay logic mode can be changed to **"AND"**- forcing both sensor's alarm status to be in agreement before the alarm relay coils are driven (except for fault relay coil). This mode is typically used with the **"Identical"** Sensor Role to provide measurement redundancy.
3. **Modbus Network ID Mode: *Unique-*** One Network ID is assigned to each sensor, typically sensor 2 ID is greater than sensor 1 ID. These ID's can be independently adjusted and are available on the bus and the unit will respond to either ID for all sensors attached (Ex: Sensor 2 ID: 12, Sensor 1 ID 11). This can be changed to "Single" mode, where all sensors are accessed through a single ID and the IDs are identical to all sensors (Sensors 1 and 2 IDs are 5).
4. **RS485 Bus Settings: *SEC Default-*** Baud rate is 9600, stop bits are 2, parity is set to none. This can be changed to **"Alternate:"**- Baud rate 9600, stop bits 1, parity none. The bus settings may also be set to custom values, where the baud rate, stop bits and parity are independently changed (i.e. Baud rate 19200, stop bits 1, parity odd).

To change these settings, you must adjust them using the user interface controls on the SEC 3120 unit. When making changes out of the box, the following order of changes should be made (remove the unit from the communication bus until everything is set the way you desire):

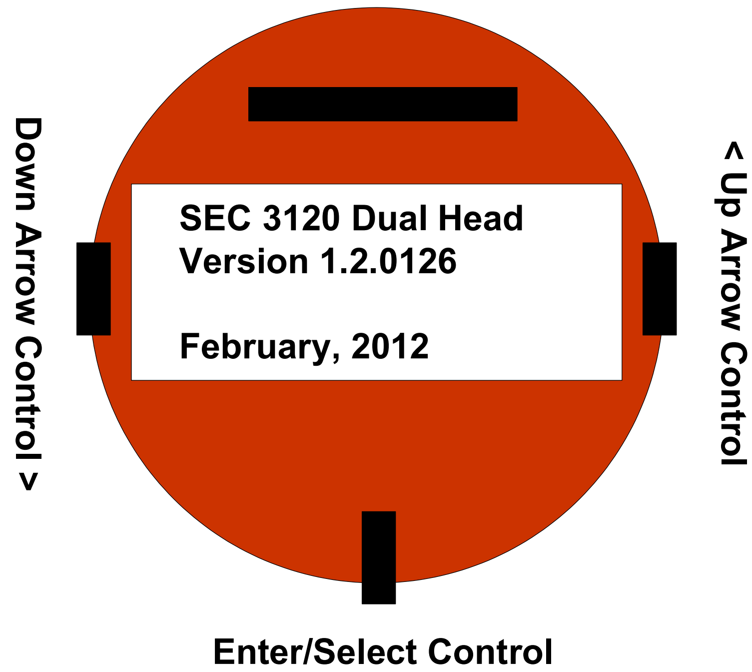
1. **Sensor Role-** Change the sensor role in the Network Modbus Settings menu. Save the changes first and exit the menus before returning to make further changes.
2. **Sensor Relay Mode**- Change the sensor relay mode in the Relay Settings menu. Save the changes first and exit the menus before returning to make further changes.
3. **Modbus Network Mode**- Change the Modbus Network mode in the Network Modbus Settings menu. Save the changes first and exit the menus before returning to make further changes. Do NOT try to change the network IDs or RS485 bus settings without exiting the menus first!
4. **Modbus Network IDs**- Set the Modbus Network ID(s) (Addresses based on the network mode chosen above, using the Network Modbus ID menu. Save the changes first and exit the menus before returning to make further changes.
5. **RS485 Bus Settings**- Set the RS485 Communication Settings to your desired line settings in the Network RS485 Bus Settings Menu. Changes are applied immediately after you choose to save them, therefore make sure these settings are correct before connecting the unit to the bus. Make sure you have no conflicting network IDs with any other Modbus devices on the bus.

Relevant Screens you may see in order of operation, to change the unit to the following settings (example):

- **Sensor Role - Unique**
- **Relay Logic Mode- OR**
- **Modbus Network Mode- Single**
- **Modbus Network IDs**
- **RS485 Bus Settings- SEC Alternate** (9600 baud, 1 stop bits, no parity)

First, we must examine how the user interface works on the 3120, is described on the following pages:

Figure 2: SEC 3120 User Interface



The SEC 3120 User Interface, as depicted above, contains the following key elements:

- The 4-Line LCD Display in the center. This will contain the main status screen (showing gas concentration, gas type, gas units, range, ID, etc.) for one or more sensors by automatically rotating and displaying the values for each sensor, one at a time for a few seconds dwell. The next sensor can be advance by activating either the down (left) or up (right) wand magnet/switches.
- The Down Arrow Control is positioned to the left. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units), the next menu item down the list is moved to, a lower value is chosen, etc.
- The Up Arrow Control is positioned to the right. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units), the previous menu item up the list is moved to, a higher value is chosen, etc.
- The Enter/Select Control is position below the center of the LCD display. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units) from the main status screen, the menu system is entered and displayed. If on a menu item, that item will be chosen. If a value is selected to be changed, it will either enter/exit changing a value.

The first menu displayed after it is brought up by activating the enter key from the main status display, is referred to as the "Top Menu". The top menu requires two full screens to present all of the possible items. The up/down controls allow navigation through the list, where selecting down below the bottom of the first page brings up the second page of the Top Menu. When selecting down below the bottom of the second page (end of the list), the top item of the list and the first page of the Top Menu is displayed. Likewise, if selecting above the top item in the first page of the Top Menu, the last item in the list on the second page will be highlighted and displayed, or if selecting above the top item of the second page then the bottom item of the first page of the Top Menu is displayed.

This is indicated by ŷup and Źdown arrows next to the top and bottom menu items respectively, if this kind of multi-page menu scrolling is available. Not all menus are longer than one page, and therefore do not contain these arrow indicators.

The Top Menu is the first menu that is encountered and the last menu before returning to the status display. Every menu item selected from the Top Menu drives another nested menu or item that must be exited to bring the Top Menu back. Let's examine the Top Menu:

Figure 3: SEC 3120 Top Menu

Top Menu Page 1
*ŷEJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
 ŹMAIN MENU

Top Menu Page 2
 ŷSEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
 ŹEXIT

The asterisk to the left of the menu item row indicates where the cursor is. As you advance the cursor down the list by activating the down (left) arrow control, the asterisk moves to indicate the newly highlighted menu item row, just as the asterisk moves up as you activate the up (right) arrow control. When you activate the Enter/Select control, that menu item is selected and the menu listed on that menu item row is display. This Top Menu will be returned to the display once the newly selected menu is exited.

The purpose of the Top Menu is to place the most important, quick access items up front to the user first. For example, if you want to eject the flash card immediately without incurring data loss or corruption, you would select this. If you want to display information about the SEC 3120 unit or attached sensors, you would select the Information Menu.

To leave the Top Menu and return to the main status screen, simply scroll down to the Exit Menu Item and select it. Menu timer timeôs key activations, and once it expires (typically 30 seconds), the menus are automatically exited and the main status screen is re-displayed.

Figure 4: SEC 3120 Nested Menu Navigation

Shown below, is the menu navigation list. Each new menu is shown indented, indicating that you must back out (or exit) that current menu level to return to the next menu up:

```
TOP MENU PAGE 1:
        EJECT FLASH CARD
        ABORT SENSOR WARMUP
        INFO MENU:
                ABOUT 3120 UNIT
                ABOUT SENSORS
                EXIT MENU ABOUT MENU
        MAIN MENU:
          MAIN MENU PAGE 1:
                CONFIGURATION MENU (CALIBRATION):
                        CONFIGURATION TOP MENU PAGE 1:
                                SELECT SENSOR NUMBER-
                                ZERO CALIBRATION SENSOR
                                SPAN CALIBRATE SENSOR
                                CHANGE CALIBRATION VALUE-
                        CONFIGURATION TOP MENU PAGE 2:
                                EXIT CONFIGURATION MENU
                ALARM CONFIGURATION TOP MENU:
                        ALARM PAGE 1:
                          SELECT SENSOR NUMBER-
                                LOW ALARM SETTINGS MENU:
                                        CHANGE LOW SET POINT VALUE-
                                        CHANGE LOW ACTIVE MODE-
                                        EXIT LOW ALARM SETTINGS MENU
                                MID ALARM SETTINGS MENU:
                                        CHANGE MID SET POINT VALUE-
                                        CHANGE MID ACTIVE MODE-
                                        EXIT MID ALARM SETTINGS MENU
                                HIGH ALARM SETTINGS MENU:
                                        CHANGE HIGH SET POINT VALUE-
                                        CHANGE HIGH ACTIVE MODE-
                                        EXIT HIGH ALARM SETTINGS MENU
                        ALARM PAGE 2:
                          EXIT TOP ALARM CONFIGURATION MENU
                RELAY CONFIGURATION TOP MENU:
                        RELAY PAGE 1:
                                LOW RELAY SETTINGS MENU:
                                    LOW RELAY SETTINGS MENU PAGE 1:
                                        CHANGE LOW LATCHING MODE-
                                        CHANGE LOW ON DELAY TIME-
                                        CHANGE LOW OFF DELAY TIME-
                                        CHANGE LOW COIL ENERGIZE MODE-
                                    LOW RELAY SETTINGS MENU PAGE 2:
                                        EXIT LOW RELAY SETTINGS MENU
                                MID RELAY SETTINGS MENU:
                                    MID RELAY SETTINGS MENU PAGE 1:
                                        CHANGE MID LATCHING MODE-
                                        CHANGE MID ON DELAY TIME-
                                        CHANGE MID OFF DELAY TIME-
                                        CHANGE MID COIL ENERGIZE MODE-
                                    MID RELAY SETTINGS MENU PAGE 2:
                                        EXIT MID RELAY SETTINGS MENU
                                HIGH RELAY SETTINGS MENU:
                                    HIGH RELAY SETTINGS MENU PAGE 1:
                                        CHANGE HIGH LATCHING MODE-
                                        CHANGE HIGH ON DELAY TIME-
                                        CHANGE HIGH OFF DELAY TIME-
                                        CHANGE HIGH COIL ENERGIZE MODE-
                                    HIGH RELAY SETTINGS MENU PAGE 2:
                                        EXIT HIGH RELAY SETTINGS MENU
                                FAULT RELAY SETTINGS MENU:
```

```
                  FAULT RELAY SETTINGS MENU PAGE 1:
                    CHANGE FAULT LATCHING MODE-
                    CHANGE FAULT ON DELAY TIME-
                    CHANGE FAULT OFF DELAY TIME-
                    CHANGE FAULT COIL ENERGIZE MODE-
                  FAULT RELAY SETTINGS MENU PAGE 2:
                    EXIT FAULT RELAY SETTINGS MENU
            RELAY PAGE 2:
                RELAY LOGIC MODE MENU:
                    CHANGE RELAY LOGIC MODE-,
                    EXIT RELAY LOGIC MODE MENU
                EXIT TOP RELAY CONFIGURATION MENU
        NETWORK TOP MENU:
            NETWORK ID MENU:
                SELECT SENSOR-
                CHANGE SENSOR NETWORK ID-
                CHANGE SENSOR NETWORK ZONE ID-
                EXIT NETWORK ID MENU
            MODBUS NETWORK MENU:
             MODBUS NETWORK MENU PAGE 1:
                CHANGE DEVICE ONLINE-
                CHANGE SENSOR ROLE-
                CHANGE NETWORK ID MODE-
                485 BUS SETTINGS MENU:
                    SELECT SEC DEFAULT SETTINGS
                    SELECT ALTERNATE SETTINGS
                    CUSTOM 485 LINE SETTINGS MENU:
                     CUSTOM 485 LINE SETTINGS PAGE 1:
                        CHANGE DATA BITS-
                        CHANGE STOP_BITS-
                        CHANGE PARITY MODE-
                        CHANGE BAUD RATE-
                     CUSTOM 485 LINE SETTINGS PAGE 2:
                        EXIT CUSTOM 485 SETTINGS MENU
                    EXIT 485 BUS SETTINGS MENU
             MODBUS NETWORK MENU PAGE 2:
                EXIT MODBUS NETWORK MENU
            EXIT NETWORK TOP MENU
     MAIN MENU PAGE 2:
        HIDE LOW GAS MENU:
            TOGGLE HIDE MODE ON/OFF-
            EXIT GAS HIDE MENU
        SELF TEST MENU:
            SELECT SENSOR-
            CANCEL SELF TEST MENU
            ABORT OPERATING SENSOR SELF TEST
            START SENSOR SELFT TEST
        DATE AND TIME MENU:
            CHANGE DATE:
                CHANGE MONTH-
                CHANGE DAY-
                CHANGE YEAR-
                EXIT CHANGE DATE
            CHANGE TIME:
                CHANGE HOURS-
                CHANGE MINUTES-
                CHANGE SECONDS-
                EXIT CHANGE TIME
            EXIT DATE AND TIME MENU
        EXIT MAIN MENU
TOP MENU PAGE 2:
    SEC DIAGNOSTICS MENU
        REBOOT SYSTEM
        TOGGLE AND FLASH LEDS
        TOGGLE RELAYS ON/OFF MENU:
         MENU_DIAGNOSTICS_RLY_TOGGLE_t,
            MENU_TOGGLE_LOW,
            MENU_TOGGLE_MID,
            MENU_TOGGLE_HI,
            MENU_TOGGLE_FAULT,
```

MENU_DIAGNOSTICS_RLY_TOGGLE_2,
MENU_TOGGLE_EXIT,
EXIT SEC DIAGNOSTICS MENU
RESET LATCHED RELAYS
FORMAT FLASH CARD
EXIT TOP MENU

Note: When changes are made to values, a **"Save or Abort Changes"** message is displayed forcing you to choose to save the changes or discard them before the previous menu is displayed. If you want to make the changes permanent, choose "Save", if you are not sure, then choose "Abort":

Save or Abort Changes Popup

* SAVE CHANGES
  ABORT CHANGES

Figure 5: Changing the 3120 Sensor Role

After entering the menu system, choose the Main Menu:

Top Menu 1

ŷEJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
*ŹMAIN MENU

Top Menu 2

ŷSEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
ŹEXIT

Then choose the Network Menu:

Main Menu 1

ŷCALIBRATION
  ALARM
  RELAY
*ŹNETWORK

Main Menu 2

ŷHIDE LOW GAS
  SELF TEST
  SET DATE TIME
ŹPREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

NETWORK ID MENU
* MODBUS SETTINGS
PREVIOUS MENU

Then highlight the Sensors Item and activate enter:

Modbus Settings Menu 1

ŷONLINE	YES
* SENSORS	UNIQUE *
NET ID	SINGLE
Ź485 BUS MENU	

Modbus Settings Menu 2

ŹPREVIOUS MENU

Activate the left/right up/down controls until "Unique" (for our example) is shown. Notice the asterisk to the right of the mode- this indicates the value that is changing and that the up/down controls now effect choosing a value up/down. When the correct choice shows, active enter again and the asterisk to the right will disappear. Scroll down the menu and choose "Previous Menu" to back out of the Modus Settings menu, then choose "Previous Menu" to exit the Network Menu (which will bring up the Save or Abort confirmation), then scroll down to and choose the "Previous Menu" item and exit the Main Menu, then scroll down to "Exit" and press enter to return to the Main Status Display.

Figure 6: Changing the 3120 Relay Logic Mode

After entering the menu system, choose the Main Menu:

Top Menu 1

ŷEJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*ŹMAIN MENU

Top Menu 2

ŷSEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
ŹEXIT

Then choose the Relay Settings Menu:

Main Menu 1

ŷCALIBRATION
  ALARM
* RELAY
ŹNETWORK

Main Menu 2

ŷHIDE LOW GAS
  SELF TEST
  SET DATE TIME
ŹPREVIOUS MENU

Then scroll down to and choose the Relay Logic Mode Menu:

Relay Top Menu 1

ŷLOW
  MID
  HIGH
ŹFAULT

Relay Top Menu 2

*ŷLOGIC MODE
ŹPREVIOUS MENU

Then use the up/down keys to select the desired mode:

Relay Logic Mode Menu

* MODE AND *
  PREVIOUS MENU

Change the item to "OR" (for our example). Notice the asterisk to the right disappears. Now scroll down and choose the "Previous Menu" item to return to the Relay Settings menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to return to the Main Menu. Then scroll down to and choose the "Previous Menu" item to return to the Top Menu. Then scroll down to and choose the "Exit" item to return back to the Main Status screen.

Figure 7: Changing the 3120 Network ID Mode

After entering the menu system, choose the Main Menu:

Top Menu 1

ŷEJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
*ŹMAIN MENU

Top Menu 2

ŷSEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
ŹEXIT

Then choose the Network Menu:

Main Menu 1

ŷCALIBRATION
  ALARM
  RELAY
*ŹNETWORK

Main Menu 2

ŷHIDE LOW GAS
  SELF TEST
  SET DATE TIME
ŹPREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

  NETWORK ID MENU
* MODBUS SETTINGS
  PREVIOUS MENU

Then highlight the Net ID item and activate enter:

Modbus Settings Menu 1

ŷONLINE	YES
SENSORS	UNIQUE
* NET ID	SINGLE *
Ź485 BUS MENU	

Modbus Settings Menu 2

ŹPREVIOUS MENU

Using the up/down arrows, change the value to "Single" (for our example). Press enter, and note that the asterisk to the right of the value now disappears. Scroll down to and choose the "Previous Menu" item to exit to the Network Top Menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to exit to the Main Menu. Scroll down to and choose the "Previous Menu" item to exit to the Top Menu. Scroll down to and choose the "Exit" menu item to exit the menu system and return back to the Main Status Screen.

Figure 8: Changing the 3120 Network ID

After entering the menu system, choose the Main Menu:

Top Menu 1

ŷEJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
*ŹMAIN MENU

Top Menu 2

ŷSEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
ŹEXIT

Then choose the Network Menu:

Main Menu 1

ŷCALIBRATION
  ALARM
  RELAY
*ŹNETWORK

Main Menu 2

ŷHIDE LOW GAS
  SELF TEST
  SET DATE TIME
ŹPREVIOUS MENU

Then choose the Network ID Menu:

Network Top Menu

* NETWORK ID MENU
  MODBUS SETTINGS
  PREVIOUS MENU

Then highlight the Network ID item and activate enter (in single sensor role, you cannot change the sensor number so this item cannot be highlighted and the ID should be selected automatically first):

Network ID Menu

FOR SENSOR:	ONE
* ID	12 *
ZONE	4
PREVIOUS MENU	

Using the up/down controls, change the ID value to the desired value. Activate enter. You may also change the Zone value as well. If you are not in Single Sensor Role, you may also scroll up and change the sensor number to TWO and repeat the process if you are choosing to set different network IDs.

Once you are done, scroll down and choose the "Previous Menu" item to exit to the Network Top Menu. Scroll down and choose the "Previous Menu" item to exit to the Main Menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to exit to the Top Menu. Scroll down to and choose the "Exit" menu item to exit and return back to the Main Status Screen.

Figure 9: Changing 3120 485 Bus Settings

After entering the menu system, choose the Main Menu:

Top Menu 1

ŷEJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
*ŹMAIN MENU

Top Menu 2

ŷSEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
ŹEXIT

Then choose the Network Menu:

Main Menu 1

ŷCALIBRATION
  ALARM
  RELAY
*ŹNETWORK

Main Menu 2

ŷHIDE LOW GAS
  SELF TEST
  SET DATE TIME
ŹPREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

 NETWORK ID MENU
* MODBUS SETTINGS
 PREVIOUS MENU

Then highlight the 485 Bus menu and activate enter:

Modbus Settings Menu 1

ŷONLINE	YES
SENSORS	UNIQUE
NET ID	SINGLE
*Ź485 BUS MENU	

Modbus Settings Menu 2

ŹPREVIOUS MENU

Scroll down to and choose "Comm-Alternate" to change from stop bits of 2 to 1 while preserving all other SEC default settings. Press enter, and all of the bus values will be displayed.

485 Bus Settings Menu

COMM-DEFAULT
* COMM-ALTERNATE
COMM-CUSTOM
PREVIOUS MENU

The values will be displayed for all parameters, and when you are done viewing them, press enter to return to the 485 Bus Settings menu. Scroll down to and choose the "Previous Menu" item (which will bring up the Save or Abort confirmation) to exit and return to the Modbus Settings menu. Scroll down to and choose the "Previous Menu" item to exit and return to the Network Top Menu. Scroll down to and choose the "Previous Menu" item (which will bring up the Save or Abort confirmation) to exit and return to the Main Menu. Scroll down to and choose the "Previous Menu" item to exit and return to the Top Menu. Scroll down to and choose the "Exit" menu item to exit and return to the Main Status Screen.

Place the unit on your bus when you are properly configured and ready to test. Navigate through the menus to the Network Menu, Modbus Settings Menu and make sure that the device is set to be "Online".

You may use a Modbus Master device on the bus (such as the WEB interface of a Schneider EGX gateway) or a PC running ModSCan32 to read the network ID by choosing the network ID of the 3120 device, choosing holding register 42110, 1 item. The value read back should be the same value as the network ID.

Modbus 16-bit Holding Register Map

Table 1: Overall 16-bit Holding Register Region Map

Region	Address Range	Description
0	42001 ï 42100	Apply parameter subset to all Sensors
1	42101 ï 42200	Sensor 1 Parameters
2	42201 ï 42300	Sensor 2 Parameters
3	42301 ï 42400	Sensor 3 Parameters
4	42401 ï 42500	Sensor 4 Parameters
5	42501 ï 42600	Sensor 5 Parameters
6	42601 ï 42700	Sensor 6 Parameters
7	42701 ï 42800	Sensor 7 Parameters
8	42801 ï 42900	Sensor 8 Parameters
9	42901 ï 43000	3120 Unit Parameters

Table 2: Region 0: All Sensors- Write only

Holding Register Address Range	ALL Sensor Register Description (Write Only) (See Parameter Tables for specifics)
42004 - 07	Alarm Set Points (Scaled)
42011	Network Zone ID (with password)
42019 - 27	Alarm Set Points (IEE 754 32-bit floating point)
42028 - 39	Calibration Value (IEE 754 32-bit floating point)
42040	Start Self Test

Table 3: Regions 1 - 8: Sensors (x = region/sensor #)

Holding Register Address	Read or Write	Sensor Register Description (See Parameter Table for specifics)
42x01	**Read**	Gas Concentration (Scaled)
42x02	**Read**	Operating Status (bit map)
42x03	**Read**	Sensor Firmware Version
42x04 - x06	**Read/Write**	Alarm Set Points (Scaled)
42x07	**Read/Write**	Calibration Value (Scaled)
42x08	**Read**	Range Value (Scaled)
42x09	**Read**	Gas Factor (Scale value)
42x10	**Read**	Network Address ID
42x11	**Read/Write**	Network Zone ID
42x12	**Read**	Sensor Device Type Code
42x13	**Read**	Sensor Status Code
42x14	**Read**	Sensor Error Code
42x15	**Read**	Sensor Cell Test Warning Code
42x16	**Read**	Sensor Serial Number
42x17 - x18	**Read**	Current Gas (IEEE 754 32-bit float)
42x19 - x27	**Read/Write**	Alarm Set Points (IEEE 754 32-bit float)

Holding Register Address	Read or Write	Sensor Register Description (See Parameter Table for specifics)
42x28 -x 30	**Read/Write**	Calibration Value (IEEE 754 32-bit float)
42x31 -x32	**Read**	Sensor Range (IEEE 754 32-bit float)
42x33	**Read**	Alarm Configuration (bit map)
42x34 - x37	**Read**	Gas Name (ASCII characters eight, 1st left to right)
42x38 - x39	**Read**	Gas Units Name (ASCII characters four, 1st left to right)
42x40	**Write Only**	Start Self Test (with password)

Table 4: Region 9: 3120 Unit Registers

Holding Register Address	Read or Write	3120 Unit Register Description (See Parameter Table for specifics)
42901	**Read**	Unit Operating Status (bit map)
42902 - 03	**Read**	Fault Relay Reason Code (32-bit bit map)
42904 - 05	**Read**	Unit Serial Number (32-bit integer)
42906 - 11	**Read**	Clock Read Registers (real-time)
42912 - 17	**Write Only**	Clock Write Registers (New write hold registers)
42918	**Write Only**	Set Clock from New Clock write hold registers
42919	**Write Only**	Diagnostics (force alarm/fault relays, force LED blinking)
42920	**Write Only**	Set Unit into Listen Only Modbus Mode
42921	**Write Only**	Restore Unit back from Listen Only Modbus Mode
42922	**Read**	Maximum number of sensors that can be attached
42923	**Read**	Unit Type Code
42924 - 25	**Read**	Unit Firmware Version (2- words for major.minor.build)

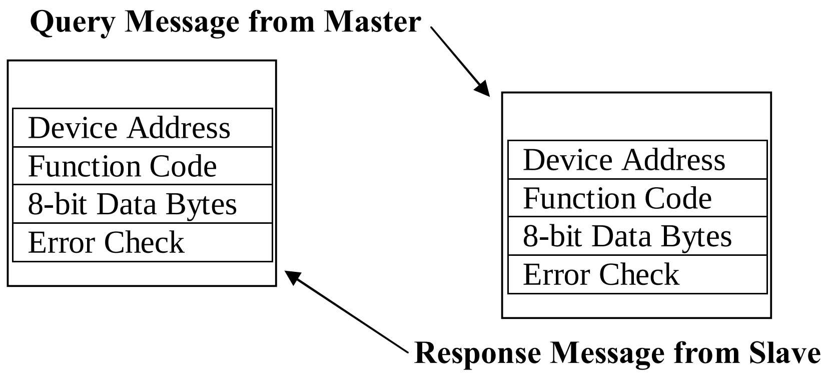
Modbus Protocol

Introducing Modbus Protocol

Modbus communication is based on a masterï slave technique, in which only one device (the master) can initiate transactions (queries). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. The master can address individual slaves or can initiate a broadcast message to all slaves. Slaves return a message (a response) to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus protocol establishes the format for the masterõs query by placing the device (or broadcast) address, a function code defining the requested action, any data to be sent and an error-checking field into the message. The slaveõs response message is also constructed using Modbus protocol. The response contains fields confirming the action taken, any data to be returned and an error-checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as the response.

The Query–Response Cycle



The Query: The function code in the query tells the addressed slave device which kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function. For example, function code 03 will query the slave to read holding registers and respond with their contents. The data field must contain the information telling the slave which register to start at and how many registers to read. The error check field provides a method for the slave to validate the integrity of the message contents.

The Response: If the slave makes a normal response, the function code in the response is an echo of the function code in the query. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response, and the data bytes contain a code that describes the error. The error check field allows the master to confirm that the message contents are valid.

RTU Modbus Message Framing

In RTU serial transmission mode, a Modbus message is placed by the transmitting device into a frame that has a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion, determine which device is addressed (or all devices, if the message is broadcast) and know when the message is completed. Partial messages can be detected and errors can be set as a result.

In RTU mode, messages start with a silent interval of at least 3.5 character times. This is most easily implemented as a multiple of character times at the baud rate that is being used on a network (shown as T1-T2-T3-T4 in Table 5). The first field then transmitted is the device address.

The allowable characters transmitted for all fields are hexadecimal 0-9, A-F. Networked devices monitor the network bus continuously, including during the ñsilentò intervals. When the first field (the address field) is received, each device decodes it to determine if it is the addressed device.

Following the last transmitted character, a silent interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message is shown below:

Table 5: RTU Message Frame

Start	Address	Function	Data	CRC Check	End
T1-T2-T3-T4	8 Bits	8 Bits	n x Bits (high byte to low byte)	16 Bits (low byte then high byte)	T1-T2-T3-T4

The address field of a message frame contains eight bits (RTU). Valid slave devices are assigned addresses in the range of 1ï 247 (if only SEC 3120 devices are on this bus slave addressed may go up to 254). A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in the address field of the response to let the master know which slave is responding.

Address 0 is used for the broadcast address, which all slave devices recognize.

The function code field of a message frame contains eight bits (RTU). For the SEC 3120, valid codes are 1, 3, 5, 6, 15 and 16 (although holding register ranges are currently only established for codes 3, 6, and 16).

When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform. When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to logic 1.

In addition to its modification of the function code for an exception response, the slave places a unique code into the data field of the response message. This tells the master what kind of error occurred or the reason for the exception.

The master deviceôs application program has the responsibility of handling exception responses. Typical responses are to post subsequent retries of the message, to try diagnostic messages to the slave and to notify operators.

The data field of messages sent from a master to slave devices contains additional information that the slave must use to take the action defined by the function code. This can include items such as discrete and register addresses, the quantity of items to be handled and the count of actual data bytes in the field.

For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

The data field can be nonexistent (of zero length) in certain kinds of messages.

CRC Error Checking

In RTU mode, messages include an error-checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message.

The CRC field is 2 bytes, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results. The CRC algorithm uses a polynomial of Hexadecimal A001:

1. Load a 16ï bit register with FFFF hex (all 1ôs). Call this the CRC register.
2. Exclusive OR the first 8ï bit byte of the message with the lowï order byte of the 16ï bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zeroï filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift).
   (If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).
5. Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8ï bit byte will have been processed.
6. The CRC register now contains the check value to be appended to (or compared to the received message check value) the end of the message, low 8-bit CRC byte followed by the high 8-bit CRC byte.

Implemented Functions and Registers Defined

The function code identifies the command being issued to the device. It is one byte in length and has a value of 1, 3, 5, 6, 15 or 16.

Table 6: Function Codes Supported By SEC 3120

Function Code	Description
1	Read Coil Status Registers (not supported)
3	Read Holding Registers
5	Force Single Coil Register (not supported)
6	Preset Single Holding Register
15	Force Multiple Coil Registers (not supported)
16	Preset Multiple Holding Registers

For the current 16-bit version, registers are only mapped for function codes 3, 6, and 16. Otherwise an exception response will be generated.

In most cases, there is no response for a query that contains an invalid slave address, invalid CRC data or a non-supported broadcast mode, etc. In some cases, the unit might issue an Exception 2 as an error response if an invalid register address is requested for a valid function code. However, if invalid function code is issued, such as function 07 were transmitted, then an Exception 1 message would be generated to indicate that the function code is not supported.

Query Coil Status Message

Field Name	Example (Hex)
Slave Address	01
Function Code	03
Address High	01
Address Low	5B
Num Points High	00
Num Points Low	03
CRC Low Byte	75
CRC High Byte	E4

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	83
Exception Code	02
CRC Low Byte	C0
CRC High Byte	F1

Query Exception Status Message

Field Name	Example (Hex)
Slave Address	11
Function Code	07
CRC Low Byte	4C
CRC High Byte	22

Response Exception 1

Field Name	Example (Hex)
Slave Address	11
Function Code	87
Exception Code	01
CRC Low Byte	83
CRC High Byte	F5

Function Code 03 - Read Holding Registers

The following holding registers (4X references) are supported by the SEC 3120 for one or multiple sequential function code 03 read 16-bit binary operations (multiple read operations must be sequential starting at the specified valid holding register address in the read list). Broadcast mode is not supported for this function.

Table 7: Function Code 03 Read Holding Registers

Internal Register Address	Holding Register Address	Function Code 03- Read Sensor Register Description (Data bits and Parameter Specifics)
x = sensor number (1 - 8)		
2x00	**42x01**	*Scaled Sensor Gas Concentration
2x01	**42x02**	Bit-mapped Sensor Operating Status: Bit 0,1: alarm status (0,0 = no alarm, 0,1 = low alarm, 1,0 = mid alarm, 1,1 = high alarm. Bit 2: fault alarm status (1 = fault, 0 = no) Bit 3: self test (1 = testing, 0 = not) Bit 4: cell test warning (1 = have warning, 0 = no) Bit 5: init/warm (1 = init/startup, 0 = idle/run) Bit 6: sensor missing (1 = missing, 0 = ok) Bit 7: calibration (1 = calibrating, 0 = not) Bit 8 - 15: **Sensor Status Code (8 bit integer)
2x02	**42x03**	Sensor Firmware Version (1 ï 255)
2x03	**42x04**	*Scaled Low Sensor Alarm Set Point
2x04	**42x05**	*Scaled Mid Sensor Alarm Set Point
2x05	**42x06**	*Scaled High Sensor Alarm Set Point
2x06	**42x07**	*Scaled Sensor Calibration Value
2x07	**42x08**	*Scaled Sensor Range Value
2x08	**42x09**	Sensor Gas Factor
*These registers are scaled by Sensor Gas Factor (2x08). To obtain the real floating point		

Internal Register Address	Holding Register Address	Function Code 03- Read Sensor Register Description (Data bits and Parameter Specifics)
x = sensor number (1 - 8)		
value in its specific gas units (2x37,38), divide these *register values by the gas factor.		
2x09	**42x10**	Network Address ID (1 ï 254)
2x10	**42x11**	Network Zone ID (1 ï 254)
2x11	**42x12**	Sensor Device Type Code (1/11= toxic, 2/12 = oxygen, 32/33 = infrared combustible, others t.b.d.)
2x12	**42x13**	**Sensor Status Code
2x13	**42x14**	***Sensor Error Code
2x14	**42x15**	Sensor Cell Test Warning Code (128 - to 255 t.b.d)
2x15	**42x16**	Sensor Serial Number
2x16	**42x17**	**** Sensor Current Gas Concentration high word
2x17	**42x18**	**** Sensor Current Gas Concentration low word
2x18	**42x19**	Sensor Low Alarm Set Point Password Register
2x19	**42x20**	****Sensor Low Alarm Set Point high word
2x20	**42x21**	****Sensor Low Alarm Set Point low word
2x21	**42x22**	Sensor Mid Alarm Set Point Password Register
2x22	**42x23**	****Sensor Mid Alarm Set Point high word
2x23	**42x24**	****Sensor Mid Alarm Set Point low word
2x24	**42x25**	Sensor High Alarm Set Point Password Register
2x25	**42x26**	****Sensor High Alarm Set Point high word
2x26	**42x27**	****Sensor High Alarm Set Point low word
2x27	**42x28**	Sensor Calibration Value Password Register
2x28	**42x29**	****Sensor Calibration Value high word
2x29	**42x30**	****Sensor Calibration Value low word
2x30	**42x31**	****Sensor Range Value high word
2x31	**42x32**	****Sensor Range Value low word
2x32	**42x33**	*****Sensor Alarm Configuration
2x33	**42x34**	Sensor Gas Name (ASCII first and second characters)
2x34	**42x35**	Sensor Gas Name (ASCII third and fourth characters)
2x35	**42x36**	Sensor Gas Name (ASCII fifth and sixth characters)
2x36	**42x37**	Sensor Gas Name (ASCII seventh and eighth characters)
2x37	**42x38**	Sensor Gas Units (ASCII first and second characters)
2x38	**42x39**	Sensor Gas Units (ASCII third and fourth characters)

**See Sensor Status Parameter Table 8

***See Sensor Error Code Parameter Table 9

****Value is an IEEE 754 32-bit Floating Point number represented in its associated gas units (2X37, 38). Values are split into two 16-bit register words, high word followed by low word.

*****See Alarm Configuration Parameter Table 10

Sensor Gas Name Example: ASCII text such as "Chlorine", "Oxygen ", etc..

Sensor Gas Units Example: ASCII text such as "PPM ", "%LEL", "%V/V", etc.

Internal Register Address	Holding Register Address	Function Code 03- Read Unit Register Description (Data bits and Parameter Specifics)
2900	**42901**	Bit-mapped Unit Operating Status: Bit 0: In calibration mode. Bit 1: In start-up init mode. Bit 2: Relays and lights under master control. Bit 3: User operating 3120 display menus. Bit 4: Reading sensors. Bit 5: Accessing media. Bit 6: Saving parameters to NVROM. Bit 7: B.I.T. operation in progress. Bit 8: Formatting media. Bit 9: Setting real time clock. Bit 10: Low relay engaged. Bit 11: Mid relay engaged. Bit 12: High relay engaged. Bit 13: Fault relay engaged. Bit 14: One or more relays latched on. Bit 15: 3120 busy/write protected from changes.
2901	**42902**	Bit-mapped Fault Relay On Reason Code, Word 1: Bit 0: Have a fault from sensor 1. Bit 1: Have a fault from sensor 2. Bit 2: Have a fault from sensor 3. Bit 3: Have a fault from sensor 4. Bit 4: Have a fault from sensor 5. Bit 5: Have a fault from sensor 6. Bit 6: Have a fault from sensor 7. Bit 7: Have a fault from sensor 8. Bits 8 - 15: Reserved for future sensor channels.
2902	**42903**	Bit-mapped Fault Relay On Reason Code, Word 2: Bits 7 - 0: Sensor error code of highest faulting sensor. Bits 15 -0: Have a 3120 unit fault (0xFFFF). Bit 15: Alone, sensor is missing. Bits 12,8: Under master control- on (1,0). Bits 12,8: Under master control- off (1,1). Bits 13,14,11,10,9: 0 not defined, t.b.d.
2903	**42904**	Unit Serial Number (32-bit) high 16-bit word
2904	**42905**	Unit Serial Number (32-bit) low 16-bit word
2905	**42906**	Unit Clock Month- Read register (1 - 12)
2906	**42907**	Unit Clock Day- Read register (1 - 31)
2907	**42908**	Unit Clock Year- Read register (2000 - 2150)
2908	**42909**	Unit Clock Hours- Read register (0 - 23)
2909	**42910**	Unit Clock Minutes- Read register (0 - 59)
2910	**42911**	Unit Clock Seconds- Read register (0 - 59)
2917	**42918**	Unit Clock Set Status- Set pending (1), not (0)

Internal Register Address	Holding Register Address	Function Code 03- Read Unit Register Description (Data bits and Parameter Specifics)
2921	**42922**	Maximum number of sensors that can be attached (Allows master to determine if device is a SEC 3100MB16, which only supports one sensor, or an advanced transmitter such as the SEC 3120 which supports at least two sensors)
2922	**42923**	Unit Type Code (0x0100 or 256 decimal)- SEC 3100MB16, (0x0101 or 257 decimal)- SEC 3120 Dual Sensor, (0x0111 or 273 decimal)- SEC 3120 supporting multiple logical sub-channels, other values TBD...
2923	**42924**	Unit Firmware Version Word 1 (Major version- MSB {0 - 255}, Minor version- LSB {0 - 255})
2924	**42925**	Unit Firmware Version Word 2 (Revision/Build number- 16-bit build number increment, 0 - 65535)

Table 8: Sensor Status Code Parameter Table

Value (Hex)	Description
0000	**Sensor is running, normal mode. All is well, OK.**
0001	Not used.
0002	**Sensor Zero Calibrating.**
0003	**Sensor Span Calibrating.**
0004	Sensor 4-20ma Calibrating.
0005	**Sensor in Warm-up.**
0006	Sensor in Power Up Fault.
0007	Sensor in Calibration Fault.
0008	Sensor in Span Fault.
0009	Sensor in Unit Fault.
000A	Sensor in Optics Fault.
000B	**Sensor in Zero Drift Fault.**
000C	Sensor in Configuration Fault.
000D	Sensor in Hot Zero Calibration.
000E	Sensor in Cool Zero Calibration.
000F	Sensor in Self Test Operation.
0010	Sensor in Reference Channel Fault.
0011	Sensor in Active Channel Fault.
0012	Sensor in Power Fault.
0013 - 00FF	Other values t.b.d.

Table 9: Sensor Error Code Parameter Table

Error Code (Hex)	Description
0000	No error, all is well and OK.
0001	EEPROM Header Error.
0002	EEPROM Checksum Error.
0003	Sensor Never Zero Calibrated.
0004	Sensor Never Span Calibrated.
0005	Zero values out of spec.
0006	4-20ma Calibration 1 error.
0007	4-20ma Calibration 2 error.
0008	Signal High Error.
0009	4VDC Reference Low.
000A	4VDC Reference High.
000B	Balance Pot Max.
000C	Balance Pot Min.
000D	AGC Pot Max.
000E	AGC Pot Min.
000F	Span Pot Max.
0010	Span Pot Min.
0011	Sensor Never Hot Zero Calibrated.
0012	Sensor Never Cool Zero Calibrated.
0013	Unit Temperature > +85 degrees Celsius.
0014	Unit Temperature < -35 degrees Celsius.
0015	Insufficient Analytical Range.
0016	No table downloaded.
0017	Span calibration invalidated by new range or calibration value.
0018	Span Pot overflow (not enough span pot range for temperature adjustment or insufficient analog signal).
0019	24VDC Supply Low.
001A	24VDC Supply High.
001B - 00FF	t.b.d.

Table 10: Alarm Configuration Parameter Table

Bit Field	Description
Bit 0	Low alarm relay normally energized (1) or not (0).
Bit 1	Low alarm relay latching mode enabled (1) or not (0).
Bit 2	Low alarm relay audible alarm mode enabled (2) or not (0).
Bit 3	Low alarm on when gas is above low set point (1) or below (0).
Bit 4	Mid alarm relay normally energized (1) or not (0).
Bit 5	Mid alarm relay latching mode enabled (1) or not (0).
Bit 6	Mid alarm relay audible alarm mode enabled (2) or not (0).
Bit 7	Mid alarm on when gas is above mid set point (1) or below (0).
Bit 8	High alarm relay normally energized (1) or not (0).
Bit 9	High alarm relay latching mode enabled (1) or not (0).
Bit 10	High alarm relay audible alarm mode enabled (2) or not (0).
Bit 11	High alarm on w/gas above high set point (1) or below (0).
Bit 12	Fault alarm relay normally energized (1) or not (0).
Bit 13	Fault alarm relay latching mode enabled (1) or not (0).
Bit 14	Fault alarm relay audible alarm mode enabled (2) or not (0).
Bit 15	Fault alarm on when fault code for sensor non-zero (always 0).

Read Holding Registers Query

The query message specifies the starting register and quantity of registers to be read. SEC 3120 internal registers are addressed starting at zero: Modbus holding registers 1ï 16 are addressed as 0ï 15.

Multiple sensors are allowed to be attached to a single 3120 unit; therefore the register map is split into regions as shown previously in Table 1. Each sensor has its own region (a repetition of the same parameter registers that address each specific sensor's parameters), and each region is a multiple of 100, as expressed by its sensor number (i.e. sensor 1 - region 1, or internal register 21xx, sensor 2 - region 2, or internal register 22xx).

Region 0 is reserved for write-only for applying changes to all sensors, therefore ***Region 0 (internal registers 20xx) cannot be read.***

Region 9 is reserved for SEC 3120 unit level information rather than sensor specific information. Region 9 (internal registers 29xx) can be read. The maximum number of sensors that may be attached to the transmitter can be queried from internal registers 2921. This will allow the master to determine if the other regions apply (region 0, 2-8) if it returns a one indicating that it is an SEC 3100MB16 device, or an advanced transmitter such as the SEC 3120 (returning two or more).

Note: An SEC 3120 configure as "Single Sensor" mode, will return a one indicating that only regions 1 and 9 are accessible- requests to read regions outside of this range (2 - 8 or 0) will generate exception 2 messages.

Here is an example of a request to read Modbus holding registers 42104ï 42106 from slave device 17, sensor 1 (region 1 = 21xx):

Read Holding Register Query

Field Name	Example (Hex)
Slave Address	11
Function Code	03
Starting Address High	08
Starting Address Low	37
Num Points High	00
Num Points Low	03
CRC Low Byte	B4
CRC High Byte	F5

Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits, and the second byte contains the low order bits.

Here is an example of a response to the query:

Read Holding Register Response

Field Name	Example (Hex)
Slave Address	11
Function Code	03
Byte Count	06
Data High Byte (Register 42104)	01
Data Low Byte (Register 42104)	2A
Data High Byte (Register 42105)	01
Data Low Byte (Register 42105)	8F
Data High Byte (Register 42106)	03
Data High Byte (Register 42106)	21
CRC Low Byte	04
CRC High Byte	5D

The contents of register 42104 are shown as the two byte values of 01 2A hex or 298 decimal. The contents of registers 42105 and 42106 are 01 8F and 03 21 hex, or 399 and 801 decimal, respectively.

SEC 3120 units support 40+ holding registers for each sensor attached, as well as an additional 12+ holding registers specific to the 3120 unit head itself as listed in Table 7.

If a starting address is not within the range shown in Table 7, the SEC 3120 unit will issue an Exception 2 as a response. If the number of points is too many, the SEC 3120 may issue an Exception 3 as a response.

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	83
Exception Code	02
CRC Low Byte	C0
CRC High Byte	F1

Response Exception 3

Field Name	Example (Hex)
Slave Address	01
Function Code	83
Exception Code	03
CRC Low Byte	01
CRC High Byte	31

Note: <u>SCAN MODE</u>: A crucial feature of the SEC 3120 16-bit Modbus implementation is that it **enables a Modbus Master to gain one or *more* holding register contents at a time.** This allows the master to start at any legal holding register address and retrieve in ***one scan block,*** an ***entire set*** of relevant parameters for a given sensor, such as Gas Concentration, Operating Status and Alarm Set Points or more in ***one read query operation.***

Function Code 06 - Preset Single Holding Register

Description

Presets a value into a single holding register (4x references). Modbus allows a broadcast mode with function presets to the same register reference in all attached slaves, however the SEC 3120 supports multiple sensors attached to a single unit, hence broadcast mode is not allowed, except for one preset register pair 42920 (listen only mode) and 42921 (restore from listen only mode).

To accomplish the same functionality as a broadcast to the same preset reference in the SEC 3120, so long as the sensors attached are truly identical, region 0 of the holding register map (holding register address range 42001 - 42099) may be used. If written to the same relative offsets as the sensor regions (i.e. 42004 for 42x04, 42005 for 42x05, where x = specific sensor number) then the values written to region 0 registers will apply as if written to all sensor relative region offset registers.

The advantage of using a preset function is that it does not have the overhead of an item count or a byte count. It is a very small packet targeted at changing one very specific 16-bit register with a full read-back of the contents to ensure proper communication.

Table 11: Function Code 06 Preset Holding Register

Internal Register Address x = sensor number, or 0 to apply to all sensors.	Holding Register Address	Function Code 06- Preset Sensor Register Description (Data bits and Parameter Specifics)
2x03	**42x04**	*Scaled Integer Sensor Alarm Low Set Point. 4000 Hex must be added as a password to write value.
2x04	**42x05**	*Scaled Integer Sensor Alarm Mid Set Point. 4000 Hex must be added as a password to write value.
2x05	**42x06**	*Scaled Integer Sensor Alarm High Set Point. 4000 Hex must be added as a password to write value.
2x06	**42x07**	*Scaled Integer Sensor Calibration Value. 4000 Hex must be added as a password to write value.
2x10	**42x11**	**Sensor Zone ID. 4000 Hex must be added as a password to write value.
2x39	**42x40**	**Start Sensor Self Test Operation (00FF Hex Start, 0 stop) 4000 Hex must be added as a password to write value.

*The real value must be multiplied by the Gas Factor (2x08).
i.e. 2.12 ppm to set low set point register: scaled low set point = 2.12 X 10 (from 2x08) = 212 (00D4 Hex). When the password is added (4000 Hex) the complete value needed to write the register and change the low set point then is 40D4 Hex.

** Zone ID (2010/42012) and Self Test (2039/42040) may be written to in region zero (apply to all sensors) for a 3120 with two or more sensors attached, when the sensor role is either "Unique" or "Identical" modes, but NOT when in "Single" sensor role- an exception message will be generated and sent back to the master in place of a message echo. If sensor role is "Identical", values must also be identical!

Internal Register Address	Holding Register Address	Function Code 06- Preset Unit Register Description (Data bits and Parameter Specifics)
2911	**42912**	New 3120 Unit Clock Month Value. 4000 Hex must be added as a password to write value.
2912	**42913**	New 3120 Unit Clock Day Value. 4000 Hex must be added as a password to write value.
2913	**42914**	New 3120 Unit Clock Year Value. 4000 Hex must be added as a password to write value.
2914	**42915**	New 3120 Unit Clock Hours Value. 4000 Hex must be added as a password to write value.
2915	**42916**	New 3120 Unit Clock Minutes Value. 4000 Hex must be added as a password to write value.
2916	**42917**	New 3120 Unit Clock Seconds Value. 4000 Hex must be added as a password to write value.
2917	**42918**	Set New 3120 Unit Clock NOW (00FF Hex set, 0 clear). 4000 Hex must be added as a password to write value.

Internal Register Address	Holding Register Address	Function Code 06- Preset Unit Register Description (Data bits and Parameter Specifics)
2918	**42919**	Bit-mapped Diagnostics Force Coils And Toggle LEDs. Bit 0: Force low relay coil (1 = on, 0 = off) Bit 1: Force mid relay coil (1 = on, 0 = off) Bit 2: Force high relay coil (1 = on, 0 = off) Bit 3: Force fault relay coil (1 = on, 0 = off) Bit 4: Toggle LEDs red/green (1 = on, 0 = off) Duration of force will be approximately 30 seconds unless re-written. 4000 Hex must be added as a password to write value.
2919	**42920**	Modbus Listen Only (00FF engages). No response will be given and unit will not respond to any commands addresses to it or broadcast, other than command to restore from listen only (2920). 4000 Hex must be added as a password to write value.
2920	**42921**	Modbus Restore From Listen Only (00FF engages). Response will be given and unit will resume responding to commands addresses to it or broadcast. 4000 Hex must be added as a password to write value.

The SEC 3120 supports sensor preset holding registers as shown in table 11 previously. To avoid accidentally writing to any of these registers, 4000 hex (16384 decimal) must be added to the register value as a password. Parameter registers low, mid, and high alarm set points and calibration value must be less than the full scale (range) of measurement. For example, if the range of measurement is 2000 ppm for Chlorine, then to set 1200 ppm as the high alarm set point, the value of register 42x06 should be 44B0 hex (17584 decimal).

The normal response is an echo of the query, returned after the register contents have been preset.

Query

The query message specifies the register reference to be preset. Registers are addressed starting at zero: register 1 is addressed as 0.

Here is an example of a request to preset register 42106 to set high alarm set point as 1200 in slave device 17, for sensor 1:

Preset One Sensor High Set Point Holding Register Query

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	08
Address Low	39
Data High	44
Data Low	B0
CRC Low Byte	6B
CRC High Byte	83

Preset ALL Sensor High Set Point Holding Registers Query

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	07
Address Low	D5
Data High	44
Data Low	B0
CRC Low Byte	A9
CRC High Byte	62

The normal response is an echo of the query, returned after the register contents have been preset.

Response

Here is an example of a response to the query shown above:

Preset One Sensor High Set Point Holding Register Response

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	08
Address Low	39
Data High	44
Data Low	B0
CRC Low Byte	6B
CRC High Byte	83

Preset ALL Sensor High Set Point Holding Registers Response

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	07
Address Low	D5
Data High	44
Data Low	B0
CRC Low Byte	A9
CRC High Byte	62

If the register address in the query shown previously is not valid for a preset register function, the SEC 3120 unit will issue an Exception 2 as a response. If the preset data in the query does not include the password, the SEC 3120 unit will issue an Exception 8 as a response. If the SEC 3120 unit is not operating in identical sensor role mode (for setting threshold values), it will generate an Exception 3 response.

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	02
CRC Low Byte	C3
CRC High Byte	A1

Response Exception 3

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	03
CRC Low Byte	02
CRC High Byte	61

Response Exception 8

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	08
CRC Low Byte	43
CRC High Byte	A6

Function Code 16 - Write Multiple Holding Registers

Description

Writes a set of values into one or more sequential holding registers (4x references). Modbus does NOT allow a broadcast mode with this function code.

Table 12: Function Code 16 Multiple Write Holding Registers

Internal Register Address	Holding Register Address	Function Code 16- Write Multiple Sensor Registers (Data bits and Parameter Specifics)
x = sensor number, or 0 to apply to all sensors.		
2x03	**42x04**	*Scaled Integer Sensor Alarm Low Set Point. 4000 Hex must be added as a password to write value.
2x04	**42x05**	*Scaled Integer Sensor Alarm Mid Set Point. 4000 Hex must be added as a password to write value.
2x05	**42x06**	*Scaled Integer Sensor Alarm High Set Point. 4000 Hex must be added as a password to write value.
2x06	**42x07**	*Scaled Integer Sensor Calibration Value. 4000 Hex must be added as a password to write value.
2x10	**42x11**	***Sensor Zone ID. 4000 Hex must be added as a password to write value.
2x18	**42x19**	Sensor Low Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x19	**42x20**	**Sensor Low Alarm Set Point Float high word.
2x20	**42x21**	**Sensor Low Alarm Set Point Float low word.
2x21	**42x22**	Sensor Low Alarm Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x22	**42x23**	**Sensor Alarm Mid Set Point Float high word.
2x23	**42x24**	**Sensor Alarm Mid Set Point Float low word.
2x24	**42x25**	Sensor Alarm High Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x25	**42x26**	**Sensor Alarm High Set Point Float high word.
2x26	**42x27**	**Sensor Alarm High Set Point Float low word.
2x27	**42x28**	Sensor Calibration Value Enable Register. This register must be written to first with 4259 Hex as a password.
2x28	**42x29**	**Sensor Calibration Value Float high word.
2x29	**42x30**	**Sensor Calibration Value Float low word.
2x39	**42x40**	***Start Sensor Self Test Operation (00FF Hex Start, 0 stop) 4000 Hex must be added as a password to write value.

Internal Register Address x = sensor number, or 0 to apply to all sensors.	Holding Register Address	Function Code 16- Write Multiple Sensor Registers (Data bits and Parameter Specifics)

*The real value must be multiplied by the Gas Factor (2x08).
i.e. 2.12 ppm to set low set point register: scaled low set point = 2.12 X 10 (from 2x08) = 212 (00D4 Hex). When the password is added (4000 Hex) the complete value needed to write the register and change the low set point then is 40D4 Hex.
**Sensor Float parameters (low, mid and high set points and calibration values) must be written in sequence in at least one multiple item write operation, starting in order with the enable password register, high word then low word. These values are IEEE 754 encoded 32-bit values split into two 16-bit words. Upon a complete write of the triad, the value is saved internally.
***Zone ID (2010/42011) and Self Test (2039/42040) may be written in region 0 (apply to all sensors) when a SEC 3120 is in either "Identical" or "Unique" sensor roles (unlike set point or threshold registers where the sensor role must be "Identical"), however if in the "Single" sensor role, an exception message will be transmitted to the master. If sensor role is "Identical", values must also be identical!

Internal Register Address	Holding Register Address	Function Code 16- Write Multiple Unit Registers (Data bits and Parameter Specifics)
2911	**42912**	New 3120 Unit Clock Month Value. 4000 Hex must be added as a password to write value.
2912	**42913**	New 3120 Unit Clock Day Value. 4000 Hex must be added as a password to write value.
2913	**42914**	New 3120 Unit Clock Year Value. 4000 Hex must be added as a password to write value.
2914	**42915**	New 3120 Unit Clock Hours Value. 4000 Hex must be added as a password to write value.
2915	**42916**	New 3120 Unit Clock Minutes Value. 4000 Hex must be added as a password to write value.
2916	**42917**	New 3120 Unit Clock Seconds Value. 4000 Hex must be added as a password to write value.
2917	**42918**	Set New 3120 Unit Clock NOW (00FF Hex set, 0 clear). 4000 Hex must be added as a password to write value.
2918	**42919**	Bit-mapped Diagnostics Force Coils And Toggle LEDs. Bit 0: Force low relay coil (1 = on, 0 = off) Bit 1: Force mid relay coil (1 = on, 0 = off) Bit 2: Force high relay coil (1 = on, 0 = off) Bit 3: Force fault relay coil (1 = on, 0 = off) Bit 4: Toggle LEDs red/green (1 = on, 0 = off) Duration of force will be approximately 30 seconds unless re-written. 4000 Hex must be added as a password to write value.

The SEC 3120 supports multiple write holding sensor and unit registers as shown in table 12 above. To avoid accidentally writing to any of these registers, a password is required. For most registers (as designated in the table above) 4000 hex (16384 decimal) must be added to the register value as a password.

For floating point register sets, the first register in the trio is the password enable register. This register must have the Hex value 4259 written to it first, followed by the high word and then the low word of the 32-bit IEEE floating point encoded value, using at leas one multiple write operation.

Parameter registers low, mid, and high alarm set points and calibration value must be less than the full scale (range) of measurement.

When setting the new clock time, registers 42912-17 are written first, followed by 42918 to actually set the time (copy new values to clock and run).

The normal response is an echo of the query header (which contains the unit number, function code, starting address and number of registers).

Query

The query message specifies the register reference to be preset. Registers are addressed starting at zero: register 1 is addressed as 0.

Here is an example of a request to write holding registers 42119 - 42121 to set the low alarm set point floats 400.12 (43C8 0F5C Hex) in slave device 17, for sensor 1:

Write Multiple Holding Registers Query

Field Name	Example (Hex)
Slave Address	11
Function Code	10
Address High	08
Address Low	46
Item Count High	00
Item Count Low	03
Num Data Bytes	06
Data High (42119)	42
Data Low (42119)	59
Data High (42120)	43
Data Low (42120)	C8
Data High (42121)	0F
Data Low (42121)	5C
CRC Low Byte	92
CRC High Byte	27

The normal response is an echo of the query header, returned after the register contents have been written.

Response

Here is an example of a response to the query on the previous page:

Write Multiple Holding Registers Response

Field Name	Example (Hex)
Slave Address	11
Function Code	10
Address High	08
Address Low	46
Item Count High	00
Item Count Low	03
CRC Low Byte	61
CRC High Byte	2D

If the register address in the query is not valid for a multiple register write function, the SEC 3120 unit will issue an Exception 2 as a response. If the multiple register write enable password register in the query did not include the proper password, the SEC 3120 unit will issue an Exception 8 as a response. If the SEC 3120 unit is not operating in identical sensor role mode, and an attempt to write to ALL sensors (address range 42001 to 42100, except 42011- Zone ID & 42040- Self Test) it will generate an Exception 3 response.

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	02
CRC Low Byte	C3
CRC High Byte	A1

Response Exception 3

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	03
CRC Low Byte	02
CRC High Byte	61

Response Exception 8

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	08
CRC Low Byte	43
CRC High Byte	A6

Note: <u>SCAN MODE</u>: A crucial feature of the SEC 3120 16-bit Modbus implementation is that it **enables a Modbus Master to update one or *more* holding register contents at a time.** This allows the master to start at any legal holding register address and update in ***one scan block,*** an ***entire set*** of relevant parameters for a given sensor, such as all Alarm Set Points in ***one write operation.***

This is especially useful for updating a sequence of 16-bit registers that need to be written together to be valid and protect against unwanted or accidental write operations. In the case of the IEEE 754 32-bit Floating Point Alarm Set Points, a triad of registers is required to fully change a given set point, all in one action otherwise the operation will be rejected as a password failure. Since a 32-bit floating point value requires two 16-bit registers to hold the entire contents, a set of three registers is designated;

1. Password enable register- must contain the Hexadecimal value 4259.
2. High 16-bit word of IEEE 754 encoded floating point set point value.
3. Low 16-bit word of IEEE 754 encoded floating point set point value.

A state machine ensures that the sequence order is followed and that the password enable register occurs first in the multi-write operation and contains the correct value. If the sequence is not followed correctly or the password is incorrect, the set point will not be updated and an exception generated. This prevents un-intended write operations.

At the same time, it allows multiple-word values or blocks that make up a huge value to be written, without breaking the Modbus 16-bit specification or creating a burdensome long set of 16-bit operations.

In both multiple read and write operations, it allows a low-level Master driver to determine whether it uses a single or multiple register operation, thus enabling better efficiency in the Modbus Master.

Sensor Roles and Modbus

The SEC 3120 allows three major modes or roles of operation regarding attached sensors;

1. **Single Sensor Role-** In this role, the SEC 3120 works much more like the SEC 3100 and 3100MB16, monitoring and reporting on only one attached sensor to its sensor one connector while ignoring any other attached sensors. The effect is a single sensor, single network ID, and total exclusive control of the units relays, screen and LEDs.
    - **Modbus Effects-** since the 3120 (head) operates as if it only has a single sensor attached;
        - The address ALL sensor region (42001 - 42099) will be ignored and generate exception messages if addressed by a master. No reads or writes will be allowed.
        - Sensor region one will only be readable and writeable (42101 - 42199).
        - Sensor regions two through eight (42201 - 42899) will be ignored and if accessed will generate exception messages to the master.
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.
2. **Identical Sensor Role-** In this role, ALL sensors attached (more than one) must have identical gas types, detection types and gas ranges. The purpose of this role is to provide redundancy and reliability to sensitive detection operations where relays should not be activated unless at least two sensors are in agreement as to the actual gas concentration levels independently measured. The relays are controlled in a logical "AND" operation for alarm levels, while faults continue to operate the fault relay in a logical "OR" configuration- meaning ANY sensor with a fault will cause the fault relay to energize.
    - **Modbus Effects-** since the 3120 (head) operates as if it has identical sensors attached;
        - The address ALL sensor region (42001 - 42099) will be allowed to apply thresholds/set points and calibration values to ALL sensors to streamline setup and configuration.
        - All sensor regions in accordance with the number of reported maximum attached sensors (see unit register 42922) are independently readable and writeable (42101 - 42899).
        - A change written in threshold/set point registers in any given sensor region will result in that value being copied to the other corresponding sensor parameter.
        - Writes to Zone ID (42x11) must be identical in all sensors regions, and in fact, the final region written (typically 42211) will set the final value for all sensors.
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.

3. **Unique Sensor Role-** In this role, all sensors attached may have different gas types, ranges and detection types. The purpose of this role is consolidate space and act as a central hub to multiple sensors and logical sub-channels. Alarm relays may be programmed to operate in any fashion, but typically driven in a logical "OR" configuration, thus ANY sensor alarm level drives the respective relay. Sensor faults by any sensor operate the fault relay in a logical "OR" configuration as well.
    - **Modbus Effects-** since the 3120 (head) operates allowing multiple sensors having different gas detection types and ranges and sub-channels;
        - The address ALL sensor region (42001 - 42099) will be ignored and generate exception messages if addressed by a master. No reads or writes will be allowed.
        - All sensor regions in accordance with the number of reported maximum attached sensors (see unit register 42922) are independently readable and writeable (42101 - 42899).
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.

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1-800-285-3651 Toll Free
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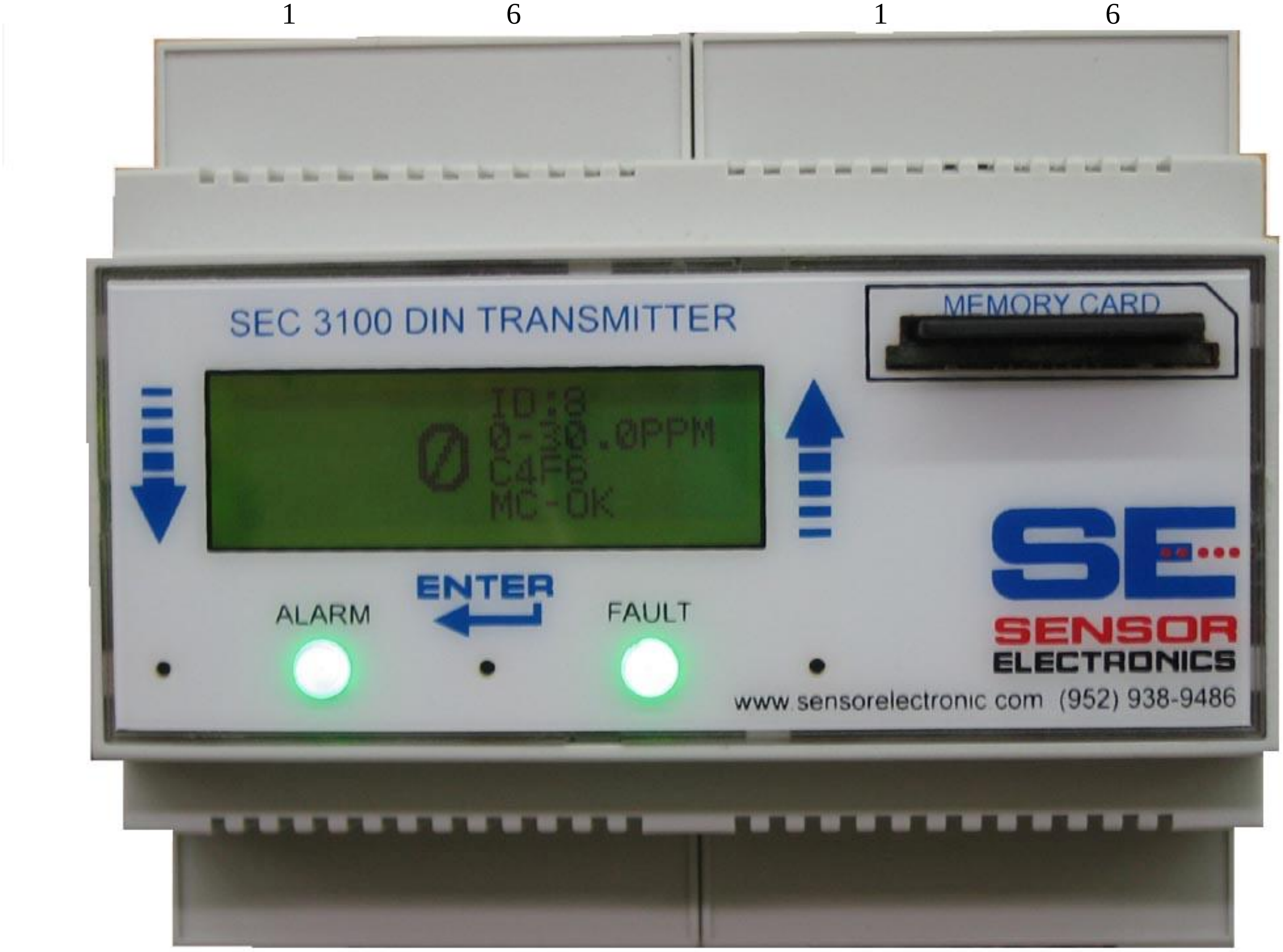
SEC 3120 Wiring

TB 1 (P3) TB 2 (P6)

1 6 1 6



1 2 3 4 1 2 3 4 7 6 5 4 3 2 1

TB 3 (P1) TB 4 (P5)

SEC 3120 Wiring

TB 1 Relay Wiring	**TB 2 Relay Wiring**
1 FLT – NC	1 MID – NC
2 FLT – COM	2 MID – COM
3 FLT – NO	3 MID – NO
4 HI – NC	4 LOW – NC
5 HI – COM	5 LOW – COM
6 HI – NO	6 LOW - NO

TB 3 Sensor Wiring	**TB 4 Power / Data Wiring**
1 DC Common (Black)	1 +24 VDC
2 + 24 VDC (Red)	2 S1 4-20 mA out
3 4-20 mA (Blue or Green)	3 DC Common
4 Communication (White)	4 RS485 Data A
1 DC Common (Black)	5 RS485 Data B
2 + 24 VDC (Red)	6 RS485 ISO Comm
3 4-20 mA (Blue or Green)	7 S2 4-20 mA out
4 Communication (White)	

Housing Dimensions
3.54 (W) x 4.17 (L) x 2.28 (H) inches
{90 (W) x 106 (L) x 58 (H) mm}

SE
SENSOR
ELECTRONICS

SEC 3500 HMI
Operator Interface

Features

- *Intuitive graphical interface*
- *7.7" 256-color 640x480 DSTN Display*
- *RS485 Modbus® RTU Communication to SEC 3100*
- *10-Base-T/100-Base-TX Ethernet Port*
- *Configuration and Firmware are Stored in 8MB of Non-volatile FLASH Memory*
- *CompactFlash® Socket to increase memory capacity*
- *Dedicated MENU Key and 6 Soft-Keys*
- *Power unit from 24VDC ±20% supply*
- *Resistive Analog Touchscreen*
- *Powerful 32-bit Processor*
- *Audible alarm*
- *Remote Web Access and Control Facility*
- *NEMA 4X / IP66 Front Panel*
- *16 Programmable Relays (Expandable to 40)*
- *Interfaces with up to 254 Network Devices*
- *“Stat Cast” RS232 System Status Broadcast*

Operation

The SEC 3500 HMI is an operator interface dedicated to communicating to the SEC 3120 Dual Transmitters, SEC 3100 gas detectors, SEC 3500 Relay Controllers, SEC 3100 AIM, SEC 3100 LIM units. The SEC 3500 has output capabilities to the plant control system. The SEC 3500 uses an industry standard RS485 communication protocol to interrogate up to 254 Network Devices.

Standard display screens are set up for intuitive interaction for the operator and network devices. The primary screens are Main Zone Summary, Alarm Summary, Bus Summary. Individual device screens can be viewed and programmed from the SEC 3500 HMI. Password protected security ensures only authorized access to critical screens.

SEC 3500 HMI
Operator Interface

SENSOR ELECTRONICS

SPECIFICATIONS

Operating Voltage
19 to 29 VDC - - -

Power Consumption
40 Watt Max (Not including relay)
Contact current or 24VDC supplied to external relays

Temperature Rating
Operating: 0° to + 50°C
Storage: -25° to + 60°C

Operation and Storage Humidity
0-80% maximum RH (Non-condensing)
From 0° to + 50°C

Altitude
Up to 2000 meters

Interface
RS485 Port: Interactive "Modbus" (expandable to two)
RS232 Port: "Statcast" System parameter broadcast
Ethernet Port: Remote Screen Access
10 BASE-T / 100 BASE TX
RJ45 jack wired as a NIC (Network Interface Card)
16 Programmable Relays (expandable to 40)

Relay Contacts:
1 NO, 1 NC per Relay
Contact Rating: 8A @ 30VDC, 8A @ 250VAC

Audible Alarm
1 - Alarm and Fault

Display

Type	DSTN
Colors	256 VGA
Pixels	640 X 480
Brightness	120cd/m2
Backlight	40,000 hours typical

Weight
45 lbs (20.7 kg)

Battery
Lithium coin cell

Memory
8 Mbyte non-volatile flash

Memory Card
CompactFlash Type II slot for Type I & Type II CompactFlash cards

Enclosure Construction
Powder Coated Steel

Housing Dimensions
16 (W) x 16 (L) x 10 (D) inches
406 (W) x 406 (L) x 254 (D) mm

System Components
SEC3500 Operator Interface (Master)
SEC3100 Universal Gas Transmitter
SEC 3500 Relay Controller
3100 AIM Interface Module
3100 ISO Repeater
3100 LIM Interface Module
SEC 3120 Dual Transmitter

Approvals
CSA: C22.2 No 0, No 0.4-04,
No14-05, No 142
UL 508
UL 2017

Relay Contacts:
Cat. 1, Pollution Degree 2

Sensor Electronics Corporation

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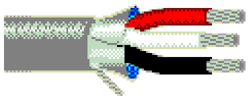
Detailed Specifications & Technical Data

ENGLISH MEASUREMENT VERSION

8618 Multi-Conductor - Audio, Control and Instrumentation Cable



For more Information
please call

1-800-Belden1

General Description:

16 AWG stranded (19x29) tinned copper conductors, conductors cabled, polyethylene insulation, overall Beldfoil® shield (100% coverage), 18 AWG stranded tinned copper drain wire, PVC jacket.

Physical Characteristics (Overall)

Conductor

AWG:

# Conductors	AWG	Stranding	Conductor Material
3	16	19x29	TC - Tinned Copper

Total Number of Conductors: 3

Insulation

Insulation Material:

Insulation Material	Wall Thickness (in.)
PE - Polyethylene	0.032

Outer Shield

Outer Shield Material:

Outer Shield Trade Name	Type	Outer Shield Material	Coverage (%)
Beldfoil® (Z-Fold®)	Tape	Aluminum Foil-Polyester Tape	100

Outer Shield Drain Wire AWG:

AWG	Stranding	Drain Wire Conductor Material
18	16x30	TC - Tinned Copper

Outer Jacket

Outer Jacket Material:

Outer Jacket Material	Nom. Wall Thickness (in.)
PVC - Polyvinyl Chloride	.031

Overall Cable

Overall Cabling Color Code Chart:

Number	Color
1	Black
2	Red
3	Clear

Overall Nominal Diameter: 0.327 in.

Mechanical Characteristics (Overall)

Operating Temperature Range:	-20°C To +80°C
UL Temperature Rating:	80°C (UL AWM Style 20253)
Bulk Cable Weight:	60 lbs/1000 ft.
Max. Recommended Pulling Tension:	110 lbs.
Min. Bend Radius/Minor Axis:	3.500 in.

Applicable Specifications and Agency Compliance (Overall)

Applicable Standards & Environmental Programs

NEC/(UL) Specification: CL3

8618 Multi-Conductor - Audio, Control and Instrumentation Cable

AWM Specification:	UL Style 20253 (600 V 80°C)
EU Directive 2011/65/EU (ROHS II):	Yes
EU CE Mark:	Yes
EU Directive 2000/53/EC (ELV):	Yes
EU Directive 2002/95/EC (RoHS):	Yes
EU RoHS Compliance Date (mm/dd/yyyy):	01/01/2004
EU Directive 2002/96/EC (WEEE):	Yes
EU Directive 2003/11/EC (BFR):	Yes
CA Prop 65 (CJ for Wire & Cable):	Yes
MII Order #39 (China RoHS):	Yes

Flame Test

UL Flame Test:	UL1685 UL Loading

Plenum/Non-Plenum

Plenum (Y/N):	No

Electrical Characteristics (Overall)

Nom. Capacitance Conductor to Conductor:

Capacitance (pF/ft)
26

Nom. Capacitance Cond. to Other Conductor & Shield:

Capacitance (pF/ft)
50

Nom. Conductor DC Resistance:

DCR @ 20°C (Ohm/1000 ft)
4.8

Max. Operating Voltage - UL:

Voltage	Description
600 V RMS	AWM Style 2107
300 V RMS	CL3

Max. Recommended Current:

Current
7 Amps per conductor @ 25°C

Put Ups and Colors:

Item #	Putup	Ship Weight	Color	Notes	Item Desc
8618 060U500	500 FT	31.500 LB	CHROME		3 #16 LDPE FS PVC
8618 0601000	1,000 FT	67.000 LB	CHROME	C	3 #16 LDPE FS PVC
8618 060500	500 FT	33.000 LB	CHROME	C	3 #16 LDPE FS PVC
8618 0605000	5,000 FT	325.000 LB	CHROME		3 #16 LDPE FS PVC

Notes:
C = CRATE REEL PUT-UP.

Revision Number: 3   Revision Date: 08-03-2012

All sales of Belden products are subject to Belden's standard terms and conditions of sale.
Belden believes this product to be in compliance with EU RoHS (Directive 2002/95/EC, 27-Jan-2003). Material manufactured prior to the compliance date may be in stock at Belden facilities and in our Distributor's inventory. The information provided in this Product Disclosure, and the identification of materials listed as reportable or restricted within the Product Disclosure, is correct to the best of Belden's knowledge, information, and belief at the date of its publication. The information provided in this Product Disclosure is designed only as a general guide for the safe handling, storage, and any other operation of the product itself or the one that it becomes a part of. This Product Disclosure is not to be considered a warranty or quality specification. Regulatory information is for guidance purposes only. Product users are responsible for determining the applicability of legislation and regulations based on their individual usage of the product.
Belden declares this product to be in compliance with EU LVD (Low Voltage Directive 73/23/EEC), as amended by directive 93/68/EEC.

VD = Voltage drop at far end of run

I = Current Draw Device X n (n=number of units) (One 3120 + Two Milleniums 0.585) (One 3100 + O

R = r X d r = Ohms per 1000' d = end to end cable length X 2 (multiply by 2 because 2 conductors +2

	Device Current	**# of Devices**	**Total Current Draw**	
(I) Current Draw	0.335	6	2.01	**AMPs**
	Wire AWG OHMs per 1000 feet		**Dead End Distance Feet**	
Resistance	12 AWG 1.7		600	1.2
	Total Current (I)		**Resistance**	
Voltage Drop	**2.01**	**X**	**2.04**	
	Dead End Voltage Drop		**Total Voltage Drop Loo**	
Returning to Power Supply	**4.1004**	**÷ 2**		**2.0502**

Fill in the correct data in the Yellow boxes
The calcualtions will automatically compute

VD = (I x R) / 2*
*Divide by 2 if load is distributed along run

ne 3100 + One Millenium 0.335)

4VDC & DC Common)

istance Feet OHMS **Total**

2.04 **OHMS**

Total Dead End Volatage Drop

4.1004 **Volts**

ge Drop Loop Back Power

Volts

Stran

AWG	Stranding	Approx. O.D. Inches	Approx. O.D. mm
36	7/44	.006	.1524
34	7/42	.0075	.1905
32	7/40	.008	.2032
32	19/44	.009	.2286
30	7/38	.012	.3048
30	19/42	.012	.3048
28	7/36	.015	.3810
28	19/40	.016	.4064
27	7/35	.018	.4572
26	10/36	.021	.5334
26	19/38	.020	.5080
26	7/34	.019	.4826
24	7/32	.024	.6096
24	10/34	.023	.5824
24	19/36	.024	.6096
24	41/40	.023	.5824
22	7/30	.030	.7620
22	19/34	.031	.7874
22	26/36	.030	.7620
20	10/30	.035	.8890
20	19/32	.037	.9398
20	26/34	.036	.9144
20	41/36	.036	.9144
18	7/26	.048	1.2192
18	16/30	.047	1.1938
18	19/30	.049	1.2446
18	41/34	.047	1.1938
18	65/36	.047	1.1938
16	7/24	.060	1.5240
16	65/34	.059	1.4986
16	26/30	.059	1.4986
16	19/29	.058	1.4732
16	105/36	.059	1.4986
14	7/22	.073	1.8542
14	19/27	.073	1.8542
14	41/30	.073	1.8542
14	105/34	.073	1.8542
12	7/20	.096	2.4384
12	19/25	.093	2.3698
12	65/30	.095	2.4130
12	165/34	.095	2.4130
10	37/26	.115	2.9210
10	49/27	.116	2.9464
10	105/30	.116	2.9464
8	49/25	.147	3.7338
8	133/29	.147	3.7338
8	655/36	.147	3.7338

ıded Wire Chart (AWG)

Circular Mil Area	Square Inches	Square mm	Weight Lbs/ 1000 Ft.	Weight KG/KM	D.C. Resistance ohms/ 1000 Ft.	D.C. Resistance ohms/ KM
28.00	—	.0143	.085	,126	371.0	1217.18
43.75	—	.0223	.132	,196	237.0	777.55
67.27	.0001	.0343	.203	.302	164.0	538.05
76.00	.0001	.0388	.230	.342	136.4	447.50
112.00	.0001	.0571	.339	.504	103.2	338.58
118.75	.0001	.0606	.359	.534	87.3	286.4 1
141.75	.0001	.0723	.529	.787	64.9	2 12.92
182.59	.0001	.0931	.553	.823	56.7	186.02
219.52	.0002	.1120	.664	.988	54.47	178.71
250.00	.0002	.1275	.757	1.126	41.48	136.09
304.00	.0002	.1550	.920	1.369	34.43	112.96
277.83	.0002	.1417	.841	1.251	37.3	122.37
448.00	.0004	.2285	1.356	2.018	23.3	76.44
396.90	.0003	.2024	1.201	1.787	26.09	85.60
475.00	.0004	.2423	1.430	2.128	21.08	69.16
384.40	.0003	.1960	1.160	1.726	25.59	83.96
700.00	.0006	.3570	2.120	3.155	14.74	48.36
754.11	.0006	.3846	2.280	3.393	13.73	45.05
650.00	.0005	.3315	1.970	2.932	15.94	52.30
1000.00	.0008	.5100	3.025	4.502	10.32	33.86
1216.00	.0010	.6202	3.680	5.476	8.63	28.31
1031.94	.0008	.5263	3.120	4.643	10.05	32.97
1025.00	.0008	.5228	3.100	4.613	10.02	32.87
1769.60	.0014	.9022	5.360	7.976	5.86	19.23
1600.00	.0013	.8160	4.840	7.202	6.48	21.26
1900.00	.0015	.9690	5.750	8.557	5.46	17.91
1627.29	.0013	.8299	4.920	7.321	6.37	20.90
1625.00	.0013	.8288	4.910	7.307	6.39	20.96
2828.00	.0022	1.4423	8.560	12.738	3.67	12.04
2579.85	.0020	1.3157	7.810	11.622	4.02	13.19
2600.00	.0021	1.3260	7.870	11.711	4.00	13.12
2426.30	.0019	1.2374	7.350	10.938	4.27	14.01
2625.00	.0021	1.3388	7.950	11.830	3.99	13.09
4480.00	.0035	2.2848	13.56	20.179	2.31	7.58
3830.40	.0030	1.9535	11.59	17.247	2.70	8.86
4100.00	.0032	2.0910	12.40	18.452	2.53	8.30
4167.50	.0033	2.1254	12.61	18.765	2.49	8.17
7 168.0	.0057	3.6557	21.69	32.277	1.45	4.76
6087.6	.0048	3.1047	18.43	27.426	1.70	5.58
6500.0	.0051	3.3150	19.66	29.256	1.75	5.74
6548.9	.0052	3.3399	19.82	29.494	1.58	5.18
9353.6	.0074	4.7703	28.31	42.128	1.11	3.64
9878.4	.0078	5.0380	29.89	44.479	1.09	3.58
10,530.0	.0083	5.3703	31.76	47.262	.98	3.22
15,699.6	.0124	8.0068	47.53	70.729	.67	2.20
16,984.1	.0134	8.6619	51.42	76.518	.61	2.00
16,625.O	.0131	8.4788	49.58	73.780	.62	2.03

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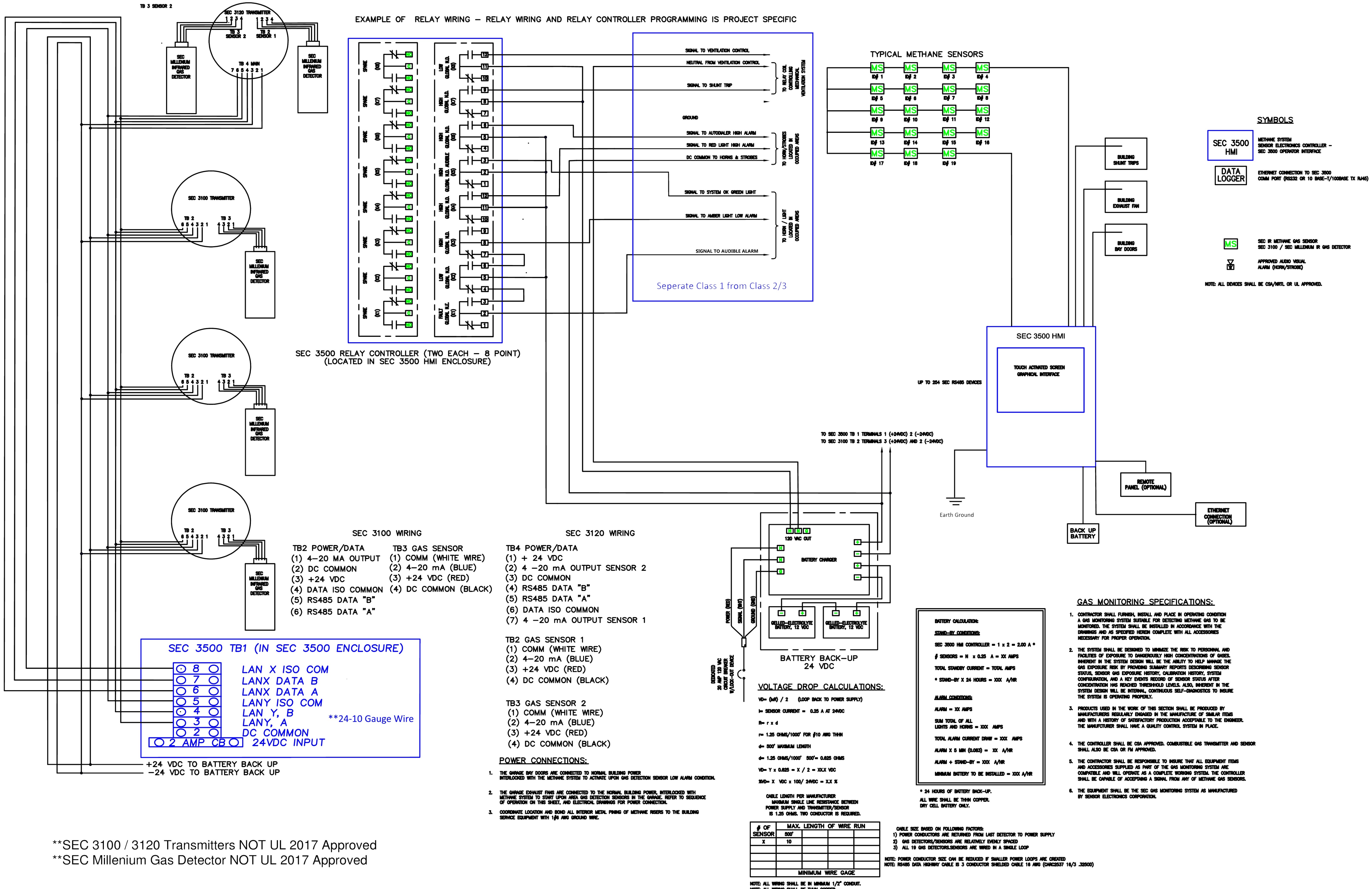


SENSOR ELECTRONICS
12730 CREEK VIEW AVENUE
SAVAGE, MINNESOTA 55378 USA
19 POINT GENERIC SYSTEM

REVISIONS

DATE	REVISION
000209	1

SHEET TITLE
DIAGRAM,SEC3500 WIRING

SHEET NUMBER
1460015
JOB NO. N/A
DATE 09-20-2016

Multi-Conductor, Foil Shield

NEC Type CL2 and CM (UL) c(UL) CMH

Product Construction:

Conductor:

- 24 thru 12 AWG fully annealed solid or stranded tinned copper per ASTM B-33

Insulation:

- Premium-grade, color-coded polyethylene
- Premium-grade, color-coded polypropylene
- Color code: See charts below

Shield:

- 100% Flexfoil® aluminum/polyester, 25% overlap, foil facing out
- Stranded tinned copper drain wire

Jacket:

- PVC, gray
- Temperature range: -20°C to +75°C

Applications:

- Recording studios and sound stages
- Broadcast and sound systems
- Computers
- Industrial equipment control
- Suggested voltage rating: 300 or 600 volts

Features:

- Excellent electrical properties
- Superior shielding effectiveness
- 25% shield overlap provides excellent shielding efficiency
- Good flexibility

Compliances:

- UL Style 2092 (UL: 60°C, 300V)
- UL Style 2093 (UL: 60°C, 300V)
- UL Style 2094 (UL: 60°C, 300V)
- UL Style 2106 (UL: 60°C, 600V)
- UL Style 2107 (UL: 60°C, 600V)
- UL Style 2464 (UL: 80°C, 300V)
- NEC Article 725 Type CL2 (UL: 75°C)
- NEC Article 800 Type CM (UL: 75°C)
- RoHS Compliant Directive 2002/95/EC
- Designed to meet UL 70,000 BTU Vertical Tray Flame Test
- CSA CMH (CSA: 60˚C)
- Passes CSA CMH Flame Test

Packaging:

- Please contact Customer Service for packaging and color options

CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS INCHES	NOM. INSULATION THICKNESS mm	NOM. JACKET THICKNESS INCHES	NOM. JACKET THICKNESS mm	NOMINAL O.D. INCHES	NOMINAL O.D. mm	NOM. CAP.*** pF/ft A	NOM. CAP.*** pF/ft B
UL STYLE 2092, CM (UL) C(UL) CMH, 300V											
C2513A	2	24	7/32	0.016	0.41	0.026	0.66	0.167	4.24	18.0	33.0
C2514A	2	22	7/30	0.016	0.41	0.020	0.51	0.167	4.24	20.0	36.0
C2524A	2	20	7/28	0.016	0.41	0.020	0.51	0.183	4.65	22.5	40.5
C2534A	2	18	16/30	0.016	0.41	0.020	0.51	0.201	5.21	25.5	45.5
Polyethylene Insulation, Color Code Chart #1											
UL STYLE 2093, CM (UL) c(UL) CMH, 300V											
C2526A	3	22	7/30	0.016	0.41	0.030	0.76	0.196	4.98	18.5	33.5
C2528A	3	20	7/28	0.016	0.41	0.030	0.76	0.210	5.34	21.0	37.5
C2525A	3	20	7/28	0.016	0.41	0.030	0.76	0.213	5.41	21.0	37.0
C2535A	3	18	16/30	0.016	0.41	0.020	0.51	0.213	5.56	23.0	41.0
Polyethylene Insulation, Color Code Chart #1											
UL STYLE 2094, CM (UL) c(UL) CMH, 300V											
C2523A	4	22	7/30	0.016	0.41	0.030	0.76	0.213	5.41	18.5	33.5
C2555A	4	20	7/28	0.016	0.41	0.030	0.76	0.234	5.94	20.5	36.5
Polyethylene Insulation, Color Code Chart #1											
UL STYLE 2106, CSA, 600V											
C2536A*	2	16	19/.0117	0.031	0.79	0.032	0.81	0.307	7.80	20.0	36.0
C2538A**	2	14	19/.0147	0.031	0.79	0.032	0.81	0.335	8.51	23.0	42.0
C2539A**	2	12	19/.0185	0.032	0.81	0.032	0.81	0.376	9.55	26.0	46.0
* CM (UL) c(UL) CMH ** CL2 Polyethylene Insulation, Color Code Chart #1											
UL STYLE 2107, CM (UL) c(UL) CMH, 600V											
C2537A	3	16	19/.0117	0.031	0.79	0.032	0.81	0.325	8.26	19.0	34.0
Polyethylene Insulation, Color Code Chart #1											
UL STYLE 2464, CL2/CM (UL) c(UL) CMH, 300V											
C2540A	2	20	7/28	0.013	0.33	0.032	0.81	0.194	4.9	49.7	89.5
PVC Insulation, Color Code Chart #2											
CM (UL) c(UL) CMH, 300V											
C2515A	2	22	Solid	0.007	0.18	0.020	0.51	0.124	3.15	30.0	55.0
C2516A	2	22	7/30	0.008	0.20	0.020	0.51	0.137	3.48	28.0	51.0
C2517A	3	22	7/30	0.008	0.20	0.020	0.51	0.144	3.36	25.0	45.0

Polypropylene Insulation, Color Code Chart #2
***A – Capacitance between conductors
***B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart 1

NO. OF COND.	COLOR
1	Black
2	Natural
3	Red
4	Green

Color Code Chart 2

NO. OF COND.	COLOR
1	Black
2	Red
3	Clear

General Cable   RoHS Compliant Directive 2002/95/EC   Designed to Meet UL Vertical Tray Flame Test Underwriters Laboratories Inc.   CMG Certified Canadian Standard Association   c UL us LISTED   CAROL BRAND

Multi-Conductor, Foil Shield

NEC Type CMP (UL) c(UL) and/or CL2P

Product Construction:

Conductor:
- 22 thru 16 AWG fully annealed stranded tinned or bare copper per ASTM B-3, B-8 or B-33
- Class B stranding per ASTM B-8

Insulation:
- Premium-grade, color-coded Flexguard®
- Color code: See chart below

Shield:
- 100% Flexfoil® aluminum/polyester foil, with 25% overlap
- Stranded tinned copper drain wire

Jacket:
- Fluoropolymer, natural
- Temperature range: -20°C to +75°C
- Sequential footage marked to facilitate installations
- Stranded tinned copper drain wire
- Includes ripcord

Applications:
- Intercom systems
- Background music
- Audio systems
- Power-limited control circuits
- Suggested voltage rating: 150 volts

Compliances:
- NEC Article 725 (UL: 75°C, 150V)
- NEC Article 800 (UL: 75°C, 300V)
- Designed to meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications

Features:
- Abrasion-, chemical- and water-resistant jacket

Packaging:
- Please contact Customer Service for packaging and color options

CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS		NOM. JACKET THICKNESS		NOMINAL O.D.		NOM. CAP.** pF/ft	
				INCHES	mm	INCHES	mm	INCHES	mm	A	B
22 AWG CONDUCTORS											
C3154*	2	22	7/30 TC	0.006	0.15	0.010	0.25	0.103	2.62	51.0	92.0
C3310*	3	22	7/30 TC	0.006	0.15	0.010	0.25	0.116	2.95	45.0	81.0
C3155*	4	22	7/30 TC	0.006	0.15	0.010	0.25	0.130	3.30	45.0	81.0
C3311*	6	22	7/30 TC	0.006	0.15	0.010	0.25	0.152	3.86	40.0	73.0
20 AWG CONDUCTORS											
C3320*	2	20	7/28 TC	0.007	0.18	0.010	0.25	0.120	3.05	53.0	96.0
C3321*	3	20	7/28 TC	0.007	0.18	0.010	0.25	0.136	3.45	46.0	84.0
C3322*	4	20	7/28 TC	0.007	018	0.010	0.25	0.153	3.89	46.0	84.0
18 AWG CONDUCTORS											
C3162	2	18	7/26 BC	0.008	0.20	0.010	0.25	0.152	3.86	54.0	98.0
C3164	3	18	7/26 BC	0.008	0.20	0.010	0.25	0.158	4.01	47.0	85.0
C3163	4	18	7/26 BC	0.008	0.20	0.010	0.25	0.178	4.52	47.0	85.0
C3166	6	18	7/26 BC	0.008	0.20	0.010	0.25	0.212	5.38	43.0	76.0
C3180	8	18	7/26 BC	0.008	0.20	0.010	0.25	0.229	5.82	43.0	76.0
C3181	10	18	7/26 BC	0.008	0.20	0.010	0.25	0.273	6.93	43.0	76.0
C3182	12	18	7/26 BC	0.008	0.20	0.012	0.30	0.285	7.24	43.0	76.0
16 AWG CONDUCTORS											
C3169	2	16	19/.0117 BC	0.008	0.20	0.010	0.25	0.181	4.60	62.0	112.0
C3340	3	16	7/.0192 BC	0.008	0.20	0.010	0.25	0.185	4.70	52.0	93.0
C3341	4	16	7/.0192 BC	0.008	0.20	0.010	0.25	0.210	5.16	52.0	93.0

*CL2P only
**A – Capacitance between conductors
**B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart

NO. OF COND.	COLOR
1	Black
2	White
3	Red
4	Green
5	Brown
6	Blue
7	Orange
8	Yellow
9	Violet
10	Gray
11	Pink
12	Tan

General Cable

Designed to Meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications
Underwriters Laboratories Inc.

c UL us LISTED

CAROL BRAND

Multi-Conductor, Foil Shield

NEC Type CMP (UL) c(UL)

CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS		NOM. JACKET THICKNESS		NOMINAL O.D.		NOM. CAP.* pF/ft	
				INCHES	mm	INCHES	mm	INCHES	mm	A	B
C8106	3	18	19/30 TC	0.007	0.18	0.014	0.36	0.178	4.27	54.0	95.0
C8114	4	18	19/30 TC	0.007	0.18	0.014	0.36	0.185	4.70	30.0	55.0

*A – Capacitance between conductors
*B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart

NO. OF COND.	COLOR
1	Black
2	White
3	Red
4	Green

Product Construction:

Conductor:
- 18 AWG fully annealed stranded tinned copper per ASTM B-33

Insulation:
- Premium-grade, color-coded FEP
- Color code: See chart below

Separator:
- Polyester tape with 25% overlap

Shield:
- 100% Flexfoil® aluminum/polyester foil with 25% overlap
- Stranded tinned copper drain wire

Jacket:
- FEP, red or as requested
- Temperature range: -40°C to +200°C

Applications:
- Computer systems
- Remote control circuits
- Process control and instrumentation
- Suggested voltage rating: 300 volts

Compliances:
- NEC Article 800
- Designed to meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications

Features:
- Fire-retardant, low-smoke jacket
- Suitable for outdoor and direct burial
- Chemical-resistant

Packaging:
- Please contact Customer Service for packaging and color options

CAROL BRAND

c UL us LISTED

Designed to Meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications
Underwriters Laboratories Inc.

General Cable

Multi-Conductor, Foil Shield

UL 2464, NEC Type CM (UL) c(UL), CSA CMG

Product Construction:

Conductor:
- 18 AWG fully annealed stranded tinned copper per ASTM B-33

Insulation:
- Premium-grade, color-coded S-R PVC
- Color code: See chart below

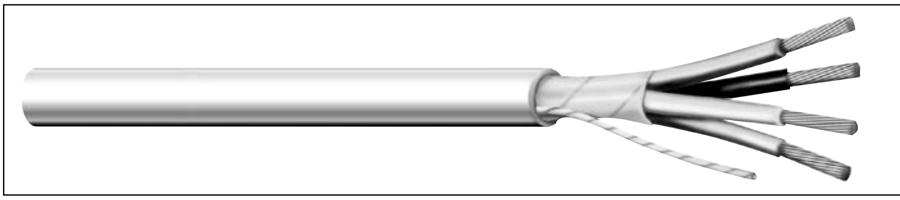
Shield:
- 100% Flexfoil® aluminum/polyester, 25% overlap, foil facing out
- Stranded tinned copper drain wire

Jacket:
- PVC, gray
- Temperature range: -20°C to +80°C

Applications:
- Audio, broadcast, instrumentation and sound systems
- Suggested voltage rating: 300 volts

Compliances:
- NEC Article 800 Type CM (UL: 75˚C)
- UL Style 2464 (UL: 80˚C, 300V)
- CSA CMG (60°C)
- RoHS Compliant Directive 2002/95/EC
- Designed to meet UL 70,000 BTU Vertical Tray Flame Test
- Passes CSA CMG Flame Test

Packaging:
- Please contact Customer Service for packaging and color options



CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS		NOM. JACKET THICKNESS		NOMINAL O.D.		NOM. CAP.* pF/ft	
				INCHES	mm	INCHES	mm	INCHES	mm	A	B
C2543A	4	18	19/30	0.010	0.25	0.032	0.81	0.238	6.05	47	84.5

*A – Capacitance between conductors
*B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart

NO. OF COND.	COLOR
1	Black
2	Red
3	White
4	Green

General Cable RoHS Compliant Directive 2002/95/EC Designed to Meet UL Vertical Tray Flame Test Underwriters Laboratories Inc. CMG Certified Canadian Standard Association c UL us LISTED CAROL BRAND

Multi-Conductor, Foil Shield

UL 2092, NEC Type CM (UL) c(UL) CMH

CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS INCHES	NOM. INSULATION THICKNESS mm	NOM. JACKET THICKNESS INCHES	NOM. JACKET THICKNESS mm	NOMINAL O.D. INCHES	NOMINAL O.D. mm	NOM. CAP.* pF/ft A	NOM. CAP.* pF/ft B
UL STYLE 2092, CM (UL) C(UL) CMH, 300V											
C2518A	2	22	7/30	0.016	0.41	0.026	0.66	0.181	4.60	20.0	36.0
C2519A	2	20	7/28	0.016	0.41	0.028	0.71	0.201	5.11	21.5	38.5
C2521A	2	18	16/30	0.018	0.46	0.028	0.71	0.229	5.82	23.5	43.0
Polyethylene Insulation, Color Code Chart #1											
CM (UL) c(UL) CMH, 300V											
C2520A	2	22	7/30	0.008	0.20	0.020	0.51	0.137	3.48	28.0	50.0

Polypropylene Insulation, Color Code Chart #2
*A – Capacitance between conductors
*B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart 1

NO. OF COND.	COLOR
1	Black
2	Natural

Color Code Chart 2

NO. OF COND.	COLOR
1	Black
2	Red

Product Construction:

Conductor:
- 22 thru 18 AWG fully annealed stranded tinned copper per ASTM B-33

Insulation:
- Premium-grade, color-coded polyethylene or polypropylene
- Color code: See charts below

Shield:
- 100% aluminum/polyester foil “bonded” to jacket, foil facing in
- Stranded tinned copper drain wire

Jacket:
- PVC, gray
- Temperature range: -20°C to +75°C

Applications:
- 100% shielded cable where RF shielding is required
- Control circuits
- Data and signal transmission
- Computer interconnections
- Suggested voltage rating: 300 volts

Features:
- The jacket and shield are “bonded” for ease of removal on automatic stripping equipment

Compliances:
- NEC Article 800 Type CM (UL: 75°C)
- UL Style 2092 (UL: 60°C, 300V)
- Designed to meet UL 70,000 BTU Vertical Tray Flame Test
- CSA CMH (CSA: 60°C)
- RoHS Compliant Directive 2002/95/EC
- Passes CSA CMH Flame Test

Packaging:
- Please contact Customer Service for packaging and color options

Multi-Conductor, Foil Shield

NEC Type CMP (UL) c(UL) and CL3P

CATALOG NUMBER	NO. OF COND.	AWG SIZE	COND. STRAND	NOM. INSULATION THICKNESS		NOM. JACKET THICKNESS		NOMINAL O.D.		NOM. CAP.* pF/ft	
				INCHES	mm	INCHES	mm	INCHES	mm	A	B
22 AWG CONDUCTORS											
C3158	2	22	7/30 TC	0.008	0.20	0.015	0.38	0.127	3.23	51.0	91.0
C3159	4	22	7/30 TC	0.008	0.20	0.015	0.38	0.146	3.71	45.0	81.0
18 AWG CONDUCTORS											
C3060	2	18	Solid BC	0.008	0.20	0.015	0.38	0.148	3.76	67.0	120.0
C3061	4	18	Solid BC	0.008	0.20	0.015	0.38	0.171	4.34	58.0	104.0
C3062	2	18	7/26 BC	0.008	0.20	0.015	0.38	0.164	4.17	61.0	110.0
C3064	3	18	7/26 BC	0.008	0.20	0.015	0.38	0.169	4.29	53.0	96.0
C3063	4	18	7/26 BC	0.008	0.20	0.015	0.38	0.185	4.70	53.0	96.0
C3065	6	18	7/26 BC	0.010	0.25	0.015	0.38	0.230	5.84	48.0	86.0
C3183	10	18	7/26 BC	0.012	0.20	0.015	0.38	0.310	7.87	47.0	84.0
C3184	12	18	7/26 BC	0.010	0.25	0.015	0.38	0.308	7.82	52.5	94.6
16 AWG CONDUCTORS											
C3068	2	16	19/.0117 BC	0.009	0.23	0.015	0.38	0.187	4.75	75.0	134.0

*A – Capacitance between conductors
*B – Capacitance between one conductor and other conductors connected to shield

Color Code Chart

NO. OF COND.	COLOR
1	Black
2	White
3	Red
4	Green
5	Brown
6	Blue
7	Orange
8	Yellow
9	Violet
10	Gray
11	Pink
12	Tan

Product Construction:

Conductor:
- 22 thru 16 AWG fully annealed stranded tinned or bare copper per ASTM B-3, B-8 or B-33

Insulation:
- Premium-grade, color-coded Flexguard® PVC
- Color code: See chart below

Shield:
- 100% Flexfoil® aluminum/polyester foil with 25% overlap, minimum
- Stranded tinned copper drain wire

Jacket:
- Flexguard® PVC, natural
- Temperature range: 0°C to +75°C
- Sequential footage marked to facilitate installation
- Includes ripcord

Applications:
- Intercom systems
- Background music
- Audio systems
- Power-limited control circuits
- Suggested voltage rating: 150 volts

Compliances:
- NEC Article 725 (UL: 75°C, 150V)
- NEC Article 800 (UL: 75°C, 300V)
- Designed to meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications

Features:
- Flexible
- Easy to terminate

Packaging:
- Please contact Customer Service for packaging and color options

CAROL BRAND

c UL us LISTED

Designed to Meet NFPA 262 and CSA FT-6 Steiner Tunnel Fire Tests for Plenum Applications
Underwriters Laboratories Inc.

General Cable

SEC 3500 Email Notification Feature
Basic Setup and Configuration

SEC 3500 Version 3.7.1 and Higher

Version 0.1 DRAFT

September, 2013

Sensor Electronics Corporation

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www.sensorelectronics.com

Contents

Intro

The SEC 3500 Email Notification System is built on a foundation of built-in panel firmware supported email capabilities. Email notifications can be configured to trigger on any combination of alarm events, up to four sets of contacts with individual and unique trigger combinations. Email contacts may be a single email address, or a distribution list name digested and broadcast by a sophisticated email relay service or email gateway inbox rule-set: the target email relay server can be as simple as an email in-box with inbound and outbound rules, or an advanced server. The server or relay service is the customer's choice. All this is needed for the SEC 3500 is network access to the email server by Ethernet IP address and domain name, with basic login authentication.

The server configuration parameters are established on the Email Notification Server Setup Screen. The configuration will be saved to a file on the Compact Flash card (requires a Compact Flash card), and can be restored from this file. Additionally, the configuration is permanently stored in internal memory. The same is true for the email contact list and alarm triggers.

Operation

Once configured, as sensor devices that the SEC 3500 panel are collecting information from (managing), the tally of devices in various alarm states and zones they reside in are then parsed each scan and email triggers are evaluated, if necessary emails are assembled based on any triggers that have been activated according to their individual configuration and placed in the outbound email queue and sent out to the email relay server. The SEC 3500 is NOT an email server, and completely relies on an email relay server or service and a properly configured network and infrastructure to give proper access to the SEC 3500. The SEC 3500 works within your local network infrastructure and functions as well as it provides, as securely as it provides.

An email notification is built by first passing a set of configured alarm triggers for one of four contact sets. It can be any combination of low/mid/high or fault alarms. For each contact set, an email contact is configured as either a single email address or a server-digestible unique distribution list name. Hence the SEC 3500 does NOT hold email distribution lists, just the distribution list names that email relay servers use and understand. The SEC 3500 only sends out up to four different configured emails to up to four different email contacts or in-box distribution lists. Thus any combination of trigger configurations is possible by using the four contact groups in such a fashion. They are named on the Configuration Screens as Panel Administrator, Floor Supervisor, Management, and First Responders. The user may use one or all of them, and in any combination that suits their goals.

An email notification is only sent once for a specific trigger, however when multiple triggers are present, an email notification can be sent multiple times as each alarm is triggered. For example; if a contact is set up to be notified for a low alarm, mid alarm and high alarm, it will be notified as the gas levels rise and triggers each alarm.

An email distribution list name does not mean anything to the SEC 3500, however it may to the targeted relay server (it must be defined by the email relay server or the message will bounce). The relay server is responsible for mapping the provided distribution list name into a distribution list of email addresses and re-broadcasting the email to all on that list. Distributions may not be necessary if the user simply needs up to four different contacts. A good example of an email relay service can be found at Jango SMTP Relay service (JangoSMTP.com). Jango is used by SEC to test its designs.

The email relay service or server must ultimately respond as or actually be a locally accessible SMTP Email Server accessible on a typical Ethernet port such as 25 or 2525. It must either have a local network address, or a properly routed accessible IP address as well as a resolvable domain name through the gateway IP address provided to the SEC 3500 in its Ethernet configuration setup. The email sub-system requires basic login authentication (username and password to the email server), a valid reply email address (but the panel will NOT respond to emails or replies), a unique name for the panel email manager so that emails are identifiable email sources by recipients, and therefore a valid email mail box located on that server.

Setup

Once the Ethernet network is properly connected and tested, and the SEC 3500 has been assigned a proper static local Ethernet IP address and has been properly tested to have access (it will not respond to pings, though it is accessible through a web browser at its IP address with the proper authentication credentials), the email server is proven to be accessible from the subnet that the SEC 3500 is on and is indeed an SMTP server that responds to a specific IP address PLUS domain name that can be resolved through the Ethernet Gateway, the setup screens may be used to setup the SEC 3500 Email Notification System. Testing of the Email Notification System can be done on the final Setup screen to send test emails to configured contacts AFTER the server settings have been configured and the panel has rebooted itself through ACTIVATION.

Example Setup configured using a real Email Relay Service (JangoSMTP):

Server Manager Name:	KV023 SEC 3500
Server IP Address:	209.173.141.250
Server Port Number:	25
Server Domain Name:	relay.jangosmtp.net
Login Name (fictitious):	MyJango_SEC
Login Password (fictitious):	Tud345%78Ftcrow71
Reply Email (fictitious):	MyJango_SCE321@init.jangomail.net

Panel Ethernet Settings:

Gateway Address:	10.100.0.100
Panel IP Address:	10.100.0.233
Subnet Mask:	255.255.255.0
MAC Address:	01:23:45:67:89

Example Email:

SEC 3500 VW: Highest Level is: Fault. Overall Device(s) in alarm:001, fault: 001.
From: Reply Panel Email Add to Contacts
Sent: Fri, Sep 13, 2013 at 4:23 pm
To: Email Test Group

```
SEC 3500 VW (SEC 3500) Reporting at 09/13/2013 16:24:46 that the Highest Level is: Fault. Overall Device(s) in alarm: 001, fault: 001.

Your Filtered Results: (email may be triggered on Low Alarm, or Mid Alarm, or High Alarm, or Fault)
Device(s) in Low Alarm: 001, Mid Alarm: 001, High Alarm: 001, Fault: 001.
Zone(s) in Low Alarm: 001, Mid Alarm: 001, High Alarm: 001, Fault: 001.

Device Alarm(s) Active: Low, Mid, High, Fault.
Zone 01 {My First Zone} Alarm(s) Active: Low, Mid, High.
Zone 02 {My Second Zone} Alarm(s) Active: Fault.
```

Email Notification Setup- Menu Navigation

To setup the Email Notification System, the following menu navigation selections are necessary after pressing the menu button:

1. From the Main Operator Menu-

Select "Supervisor Menu"

2. From the Supervisor Menu-

Select "Configuration"

3. From the Configuration Menu-

Select "More…"

4. From the Second Configuration Menu-

Select "More…"

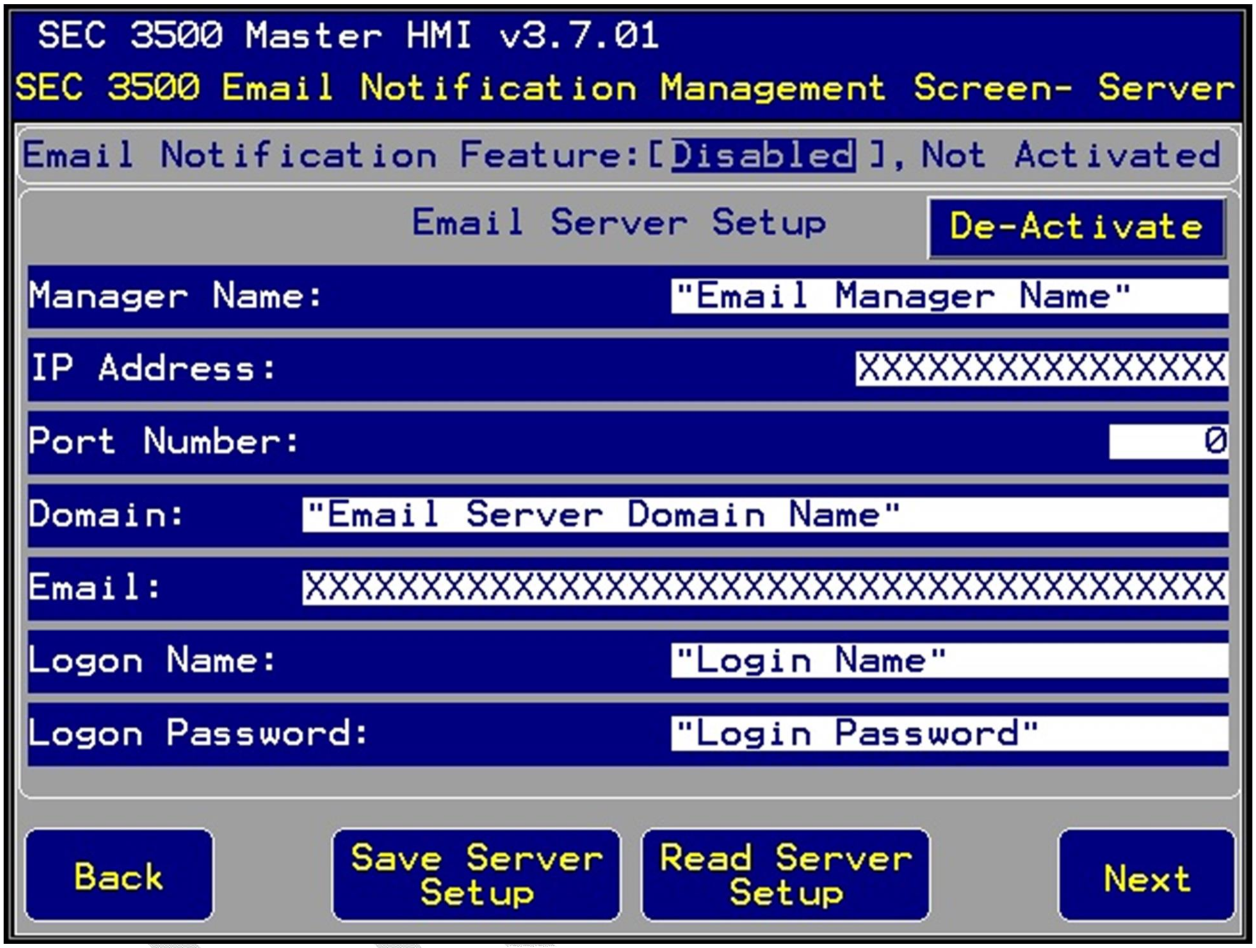
5. From the Configuration Menu 3-

Select “Setup Email Notifications”

Once selected, the Email Notification Setup Screens shown on the following page are displayed, starting with the Email Server Setup Screen.

Email Notification Setup Screens

1. Server Setup Screen (screen one of three)



Screen Contents, From Top to Bottom:

Top Region: **Screen Title, Project Title, Email Notification Functional Status.**

- **Email Notification Feature-** Enabled/Disabled. This field enables or disables the email notification feature, and can be enabled or disabled on any of the Email Notification Setup Screens. Enabling it does NOT automatically allow emails to be sent, however it must be coupled with the Activation field in the activated setting along with proper email server configuration and email list settings established.
- **Activated/Not Activated-** This field is enabled on the Email Test and Activation Screen (third screen of three) by the “Activate Email Notify” button, after the

email server and email lists are properly setup. The panel administrator may de-activate the email notification function from any one of the three Email Notification Setup Screens.

- **De-**Activate Button- By pressing this button, the email notification system will de-activate generating email notifications when alarm triggers are present, allowing the panel administrator to continue setup, send test emails, or simply halt notifications until a later unspecified time. Any time an entry on this screen occurs it will be de-activated automatically as well.

Middle Region: **Editable Email Server-related Setup/Configuration Information Entry Fields**

The following fields in the middle region of this screen allow the Panel Administrator to configure the email notification relay server. ALL fields are required for the email sub-system to function, must be saved and the panel rebooted before the may take effect for the first time. NOTE: You cannot enter only the email server IP address OR the email server domain name- you must enter BOTH.

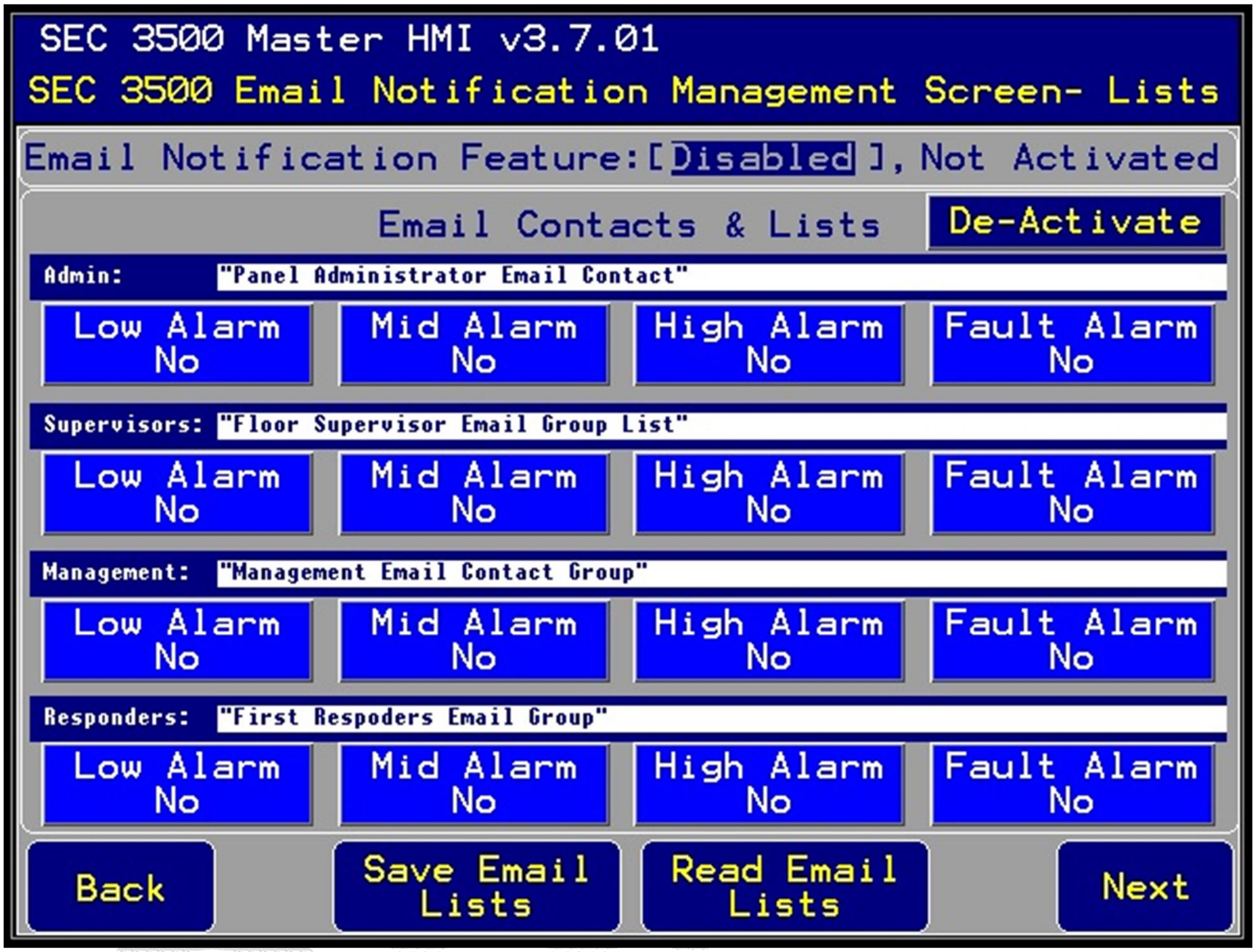
1. **Manager Name-** This is a plain text identifier (up to 24 characters in length) used in both the email subject and email body text to distinguish this panel (SEC 3500) uniquely from any other. The panel administrator assigns this name on this screen. Example (“Facility D856-W23”).
2. **IP Address-** This is the internal Ethernet IP Address (must be in the format of XXX.XXX.XXX.XXX) that this panel must contact to reach the email server that will relay emails from this panel to outside email addresses and break down distribution lists used as email addresses in any of the email contact lists. This Email Server IP address MUST be reachable from this panel inside the local network; therefore it cannot be an outside IP address that cannot ultimately be resolved by the supplied gateway IP addressed to this panel. Example (“192.168.2.233”).
3. **Port Number-** This is the internal Ethernet Port Number that this panel must use to contact and communicate with the email server relay from inside the local network. Example (25).
4. **Domain-** This is the internal Server Domain Name (up to 40 characters in length) that this panel uses to contact the email server relay from inside the local network and is resolvable by the assigned gateway IP address given to this panel. Example (“relay.jangosmtp.net”).
5. **Email-** This is the reply-to email address for this panel (up to 40 characters in length)- it must resolve to a valid email address. This panel will NOT reply to emails sent to it, however the email sub-system and most email relay servers require a valid reply email address to manage SPAM. Example (“panel021@FacilityD856.mycompany.com”).
6. **Logon Name-** This is the email server Login Name (up to 24 characters in length) required to authenticate for the mailbox established on the email server to use for relaying, digesting and matching contact and contact list names provided in the To: email message from the panel, relayed out to the intended target recipients. Example (“Box51_Panel”).

7. **Logon Password-** This is the email server login Password (up to 24 characters in length) required to authenticate for the mailbox established on the email server to use for relaying, digesting and matching contact and contact list names provided in the To: email message from the panel, relayed out to the intended target recipients. Example (“KwGen#$320Wonton”).

Bottom Region: <u>**Screen Navigation and Configuration Save/Restore Buttons**</u>

A. **Back Button-** Shows a popup menu allowing the Panel Administrator to navigate back to either the Main Screen or exit the popup menu.
B. **Save Server Setup-** This button saves or re-saves the displayed information to a configuration file on the compact flash card mounted/inserted into the SEC 3500 panel. It will not save the file if a card is not present or other error condition exists. If the file does not exist, it will create it in the root of the Compact Flash card as “ESERVER.CFG”. NOTE: Saving the configuration is necessary to acknowledge email server setup is accomplished, but does NOT permanently save the settings in memory until the email notification activation button is pressed on the third setup screen.
C. **Read Server Setup-** This button reads a previously saved server configuration from an existing file (“ESERVER.CFG”) located on the compact Flash card. Thus if the panel software is updated and this information is lost, it can still be recovered and reactivated by first reading the contents of the file back into the display fields. A Compact Flash card must be inserted and mounted, as well as containing this file of the proper version. NOTE: Reading the configuration from file does NOT permanently apply the settings in memory until the email notification activation button is pressed on the third setup screen.
D. **Next-** When this button is pressed, the Email List Setup Screen is displayed. If the Server Settings have been changed or have not been saved, a screen will popup requesting if the user would like to save them before switching screens.

2. Email List Setup Screen (screen two of three)



Screen Contents, From Top to Bottom:

Top Region: **Screen Title, Project Title, Email Notification Functional Status.**

The top region of this screen provides the same information and action as the Email Server Setup Screen previously described.

Middle Region: **<u>Editable Email List-related Setup/Configuration Information Entry Fields</u>**

The following fields in the middle region of this screen allow the Panel Administrator to configure the email contacts/lists and alarm triggers. At least one contact and trigger button combination must be entered/setup for the email sub-system to function, must be saved and the panel rebooted before the may take effect for the first time. NOTE: Blank contact entries are ignored even if triggers are configured, and contact names must be four or more characters in length to be accepted as configured.

1. **Admin-** This is a plain text field (up to 75 characters in length) that the Email Relay Server will either recognize as a distribution list to be further broken down into a set of duplicate emails it will relay out, or a single email address to be resolved by other servers on the internet. This contact is intended for those who regularly administer the Panel on site and want to be notified of alarm events generated by the panel on behalf of sensor conditions it manages. Example ("John.Doe@MyCompany.com").
2. **Low/Mid/High/Fault Alarm Buttons-** These buttons when pressed toggle between "Yes" and "No", indicating what panel alarm levels will generate an email for the Administrator Contact. Any time an alarm level reaches this alarm level(s) selected after the Email Notification system is properly configured and activated and enabled, and email will be sent. Any device or entire zone will trigger the email, which will identify the number of devices and zones in this condition or set of conditions. The list of triggers (these buttons) will be enumerated in the email sent so that the recipient is aware of what alarm(s) triggered the email. Example (High Alarm- Yes, Fault Alarm- Yes. This would trigger an alarm only when either a high gas alarm is triggered or a device fault is triggered).
3. **Supervisors-** Same as "Admin", though it has its own set of triggers that can be configured, and a completely different email contact address or list name. This can be used for those considered to be local building/floor/system knowledgeable recipients/staff that would want to know and/or respond to email notifications.
4. **Management-** Same as "Admin", though it has its own set of triggers that can be configured, and a completely different email contact address or list name. This can be used for this considered as management contacts.
5. **Responders-** Same as "Admin", though it has its own set of triggers that can be configured, and a completely different email contact address or list name. This can be used for those considered to be Emergency First Responders.

Bottom Region: **<u>Screen Navigation and Configuration Save/Restore Buttons</u>**

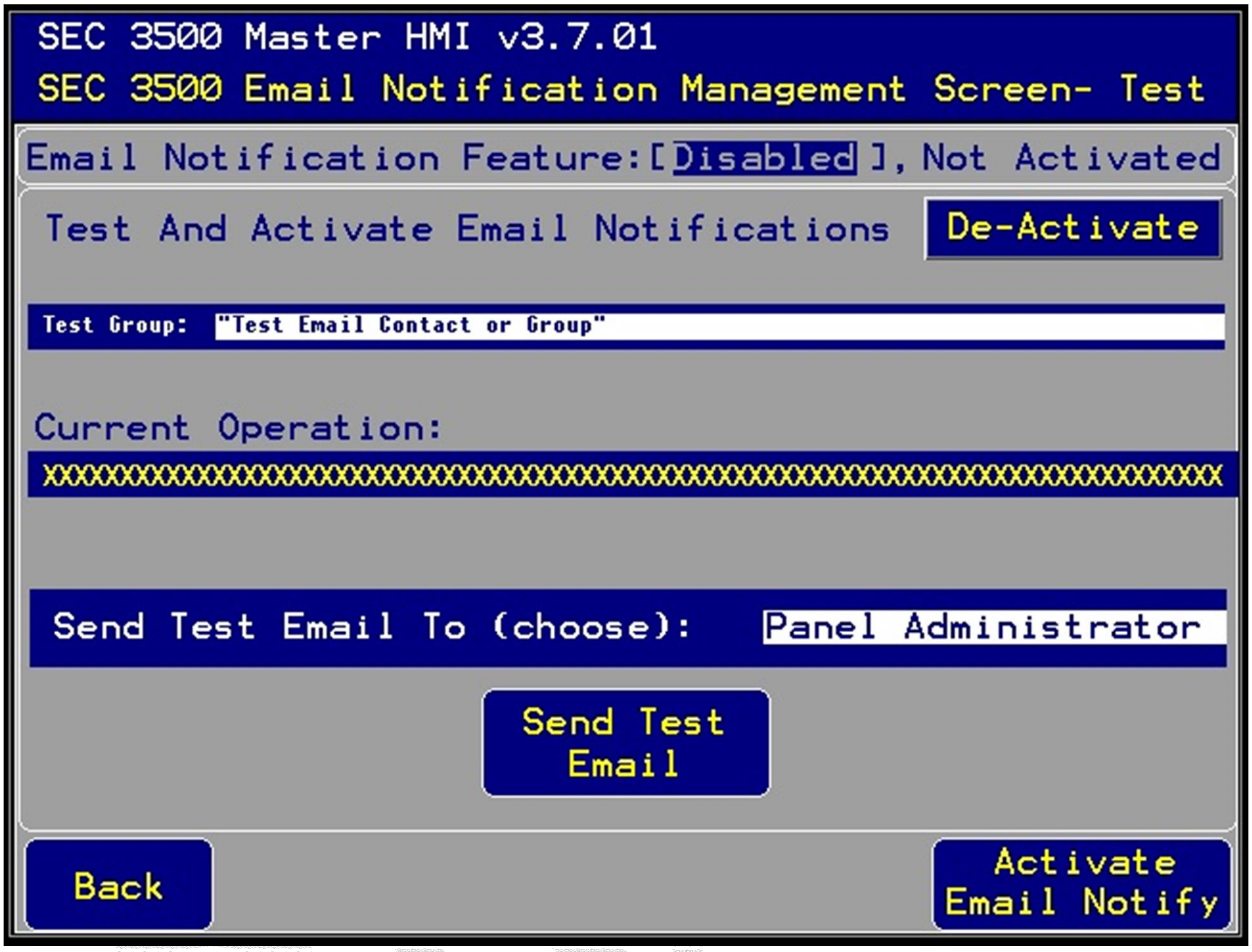
A. **Back Button-** Shows a popup menu allowing the Panel Administrator to navigate back to the Main Screen, Email Server Setup Screen or exit the popup menu.
B. **Save Email Lists -** This button saves or re-saves the displayed information to a configuration file on the compact flash card mounted/inserted into the SEC 3500 panel. It will not save the file if a card is not present or other error condition exists. If the file does not exist, it will create it in the root of the Compact Flash card as "EMLIST.CFG". NOTE: Saving the configuration is necessary to acknowledge that desired email lists and triggers are setup and

accomplished, but does NOT permanently save the settings in memory until the email notification activation button is pressed on the third setup screen.

C. **Read Email List-** This button reads a previously saved email list configuration from an existing file (“EMLIST.CFG”) located on the compact Flash card. Thus if the panel software is updated and this information is lost, it can still be recovered and reactivated by first reading the contents of the file back into the display fields. A Compact Flash card must be inserted and mounted, as well as containing this file of the proper version. NOTE: Reading the configuration from file does NOT permanently apply the settings in memory until the email notification activation button is pressed on the third setup screen.

D. **Next-** When this button is pressed, the Test and Activate Screen is displayed. If the email List Settings have been changed or have not been saved, a screen will popup requesting if the user would like to save them before switching screens.

3. Email Test And Activate Screen (screen three of three)



Screen Contents, From Top to Bottom:

Top Region: **Screen Title, Project Title, Email Notification Functional Status.**

The top region of this screen provides the same information and action as the Email Server Setup Screen previously described.

Middle Region: **<u>Editable Test Contact Email Setup/Test Information Entry Fields</u>**

The following fields in the middle region of this screen allow the Panel Administrator to configure the test email contact/list, select from one of the five contact groups to send a test email to and press the "Send Test Email" button. Testing is not required to activate the email notification system, and is usually performed AFTER the system has been activate at least ONCE before arriving at this screen after the panel has been rebooted so that server settings have had a chance to take effect. NOTE: A blank Test Group Contact will be ignored even if that contact group is chosen to have a test email sent to, and the contact name must be four or more characters in length to be accepted. This is the screen will the Email Notification system does NOT become active UNTIL the "Activate Email Notify" button is pressed and the panel is rebooted.

1. **Test Group-** This is a plain text field (up to 75 characters in length) that the Email Relay Server will either recognize as a distribution list to be further broken down into a set of duplicate emails it will relay out, or a single email address to be resolved by other servers on the internet. This contact is intended for those who may not be part of the alarm notification group(s) but are temporarily on site with a handheld device capable of receiving email to test whether or not the panel is properly configured and sending email notifications. This contact may also be one in the other contacts. ("John.Doe@MyCompany.com").
2. **Current Operation-** This is an informational text line that indicates when a test email is being sent and completed into the outbound queue, or during activation to notify the user of file save events or errors and when the panel is being rebooted.
3. **Send Test Email To (choose)-** Allows the user to select from a list of five contacts configured on the previous screen of email lists (Panel Administrator, Management, Supervisors, First Responders) or this screen's Test Group contact. When the Send Test Email button is pressed, the name shown in this field indicates which contacts will receive a test message. The sixth option is ALL- which will send a test email to all contacts, including the Test Group.
4. **Send Test Email-** when pressed sends a test email to the Contact chosen (including ALL). By pressing this button, the emails are composed for the chosen contact(s) and placed in the panel outbound queue, however if the email server system is not properly configured or up and running and a valid connection is made to the email relay server, test emails may not reach the desired recipients.

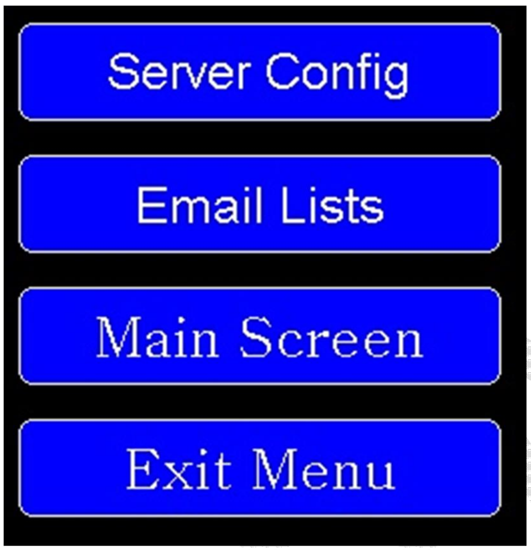
Bottom Region: **<u>Screen Navigation and Configuration Save/Restore Buttons</u>**

A. **Back Button-** Shows a popup menu allowing the Panel Administrator to navigate back to the Main Screen, Email List Screen, Email Server Setup Screen or exit the popup menu.
B. **Activate Email Notify-** This button activates and enables the email notification system. If the server settings or email lists have not been saved, it will save them to the Compact Flash card; therefore a Compact Flash card must be inserted and mounted. NOTE: the final operational step that will be taken will be to reboot the panel. All activities up this point will be displayed in the "Current Operation" status field.

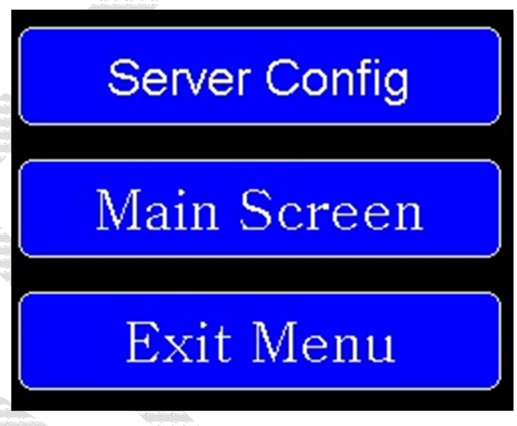
4. Previous Screen Navigation

When the "Back" button is pressed on any of the three Email Notification Setup Screens, one of the following menus will popup, depending on the screen it is pressed from. These back/previous screen menus allow the user to choose which screen they may go back to, depending on how far they are nested into the Email Notification Setup Screen set. See each one below to understand what the back/previous navigation options are for each setup screen:

A. Back Menu (From Test And Activate Screen)



B. Back Menu (From List Setup Screen)



C. Back Menu (From Server Setup Screen)

SEC 3500 OI
Supervisor Operator's
Manual

September, 2007

Sensor Electronics Corporation
5500 Lincoln Drive
Minneapolis, Minnesota 55436 USA
(952) 938-9486

Table Of Contents:

1.0 Purpose

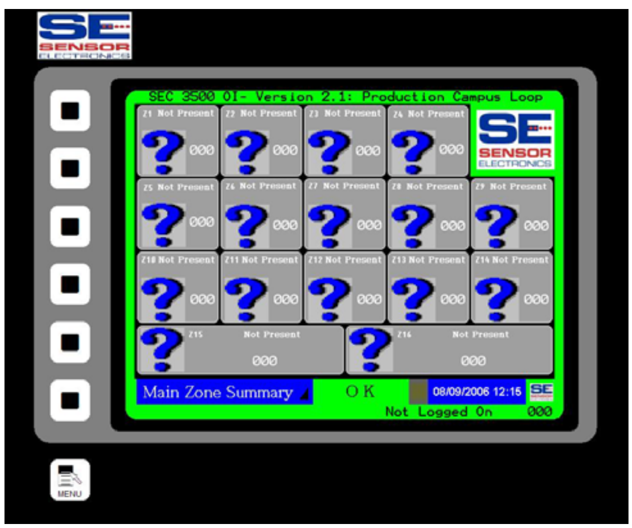
This document describes how to configure the SEC 3500 Operator Interface (OI) Panel. It describes the supervisor level configuration, supervisor screens and supervisor screen/menu navigation. This document is NOT a detailed all-encompassing Technical User's Manual, nor is it a Basic User's Manual (See the Basic Operator Manual).

2.0 Overview

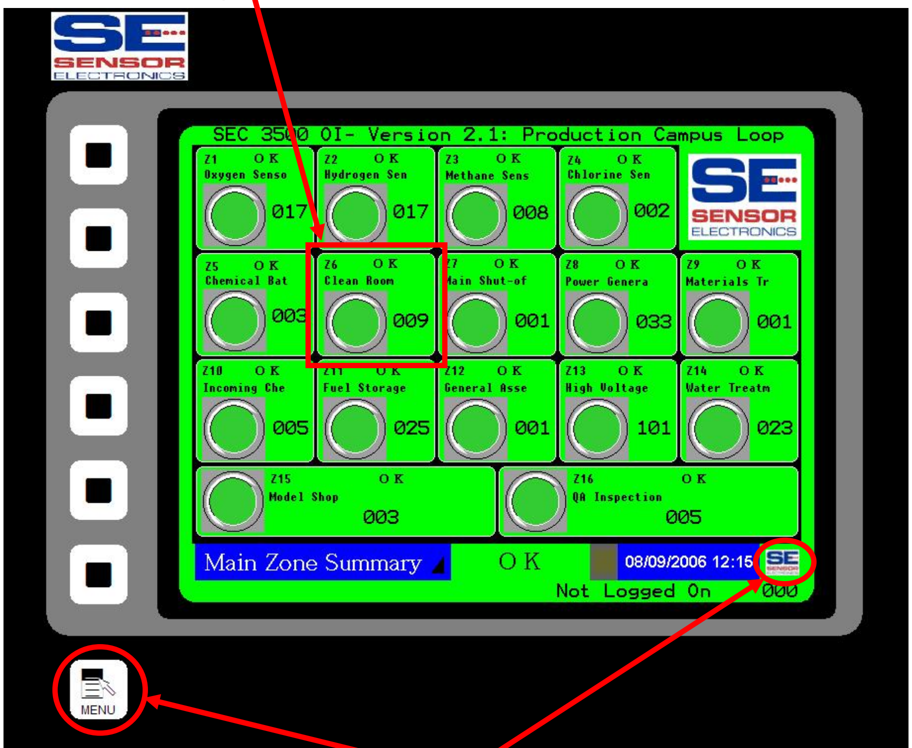
This document is part of a collection of manuals documenting the SEC 3500 OI Panel. Each manual is targeted for a specific audience- the class of operator. As such, each manual builds on the previous operator class manual, and therefore assumes that the reader has read and understood the previous manuals (such as the Basic Operator Manual and Startup Basics Guide).

3.0 First Time Setup/Updating Setup

The very first time you turn on the SEC 3500 with a SEC 3500 Modbus 485 Digital Gas Monitoring loop connected with SEC 3100 Digital Gas Transmitter slave(s) attached, you may have a blank main screen once it is powered up, such as this:



If so, then this is either the first time the 3500 has been powered on, or you do not have the Gas Monitoring loop setup/configured properly, or you have not detected any SEC 3500 compatible devices yet. Otherwise, if at least one compatible device is connected, online and had been setup previously, then at least one of the sixteen zone summary boxes would be green- see below:



(Menu Button Areas)

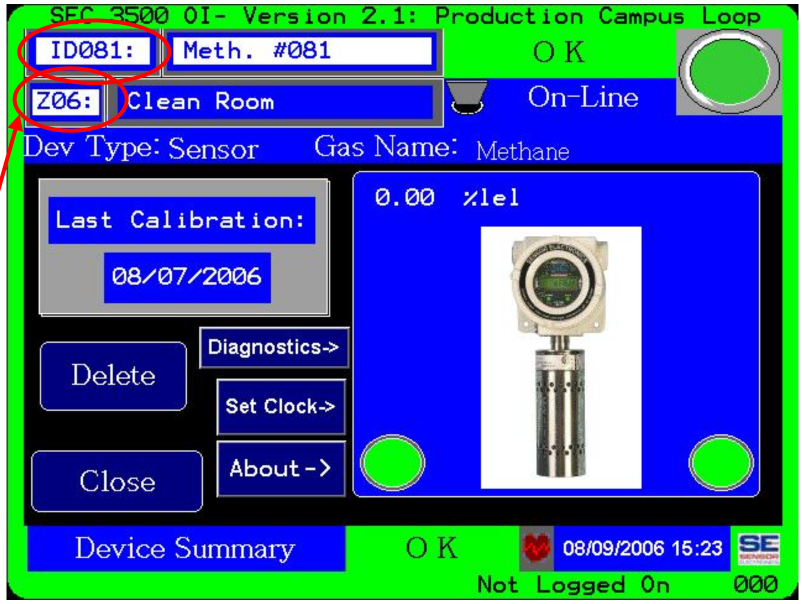
If this is the first time startup, or scanning the loop for new devices, refer to the "Startup Basics Guide" to establish the panel. This manual will cover the specifics for changing Device IDs and so forth.

4.0 Configuring the Device & Zone ID and Names

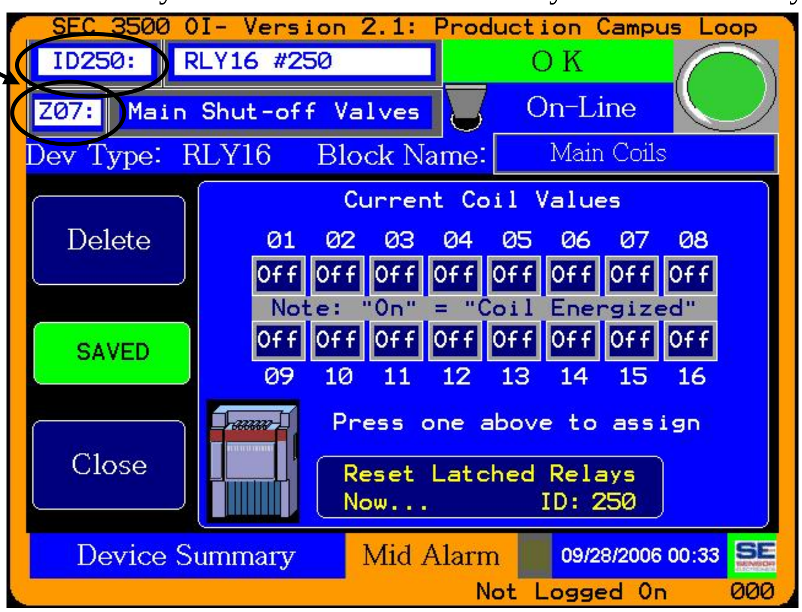
The goal of this section is to describe how to configure the device & zone IDs as well as the device name of both SEC 3100 Gas Transmitters and SEC Relay Modules, and the associated zone name using the SEC 3500 HMI. These values are permanently stored in their flash storage (except for the zone name- this is stored in the HMI only).

4.1 Configuring Device and Zone IDs

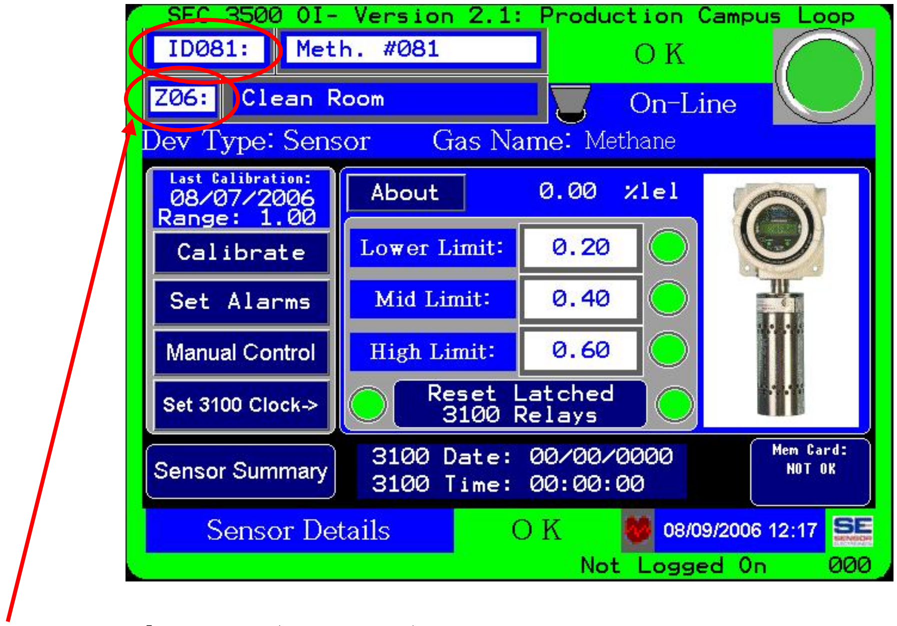
The process is designed to prevent duplicate device IDs, however it is still possible to circumvent it and cause duplications to occur. In such a case, both devices will be inaccessible on the network. Still in other unintentional circumstances, it is possible with the Relay module to wind up with duplicates when adding a new module to the network, since there is no manual configuration method without the HMI. See the Startup Basics Guide regarding this issue. In the case of the SEC 3100, duplicates can be corrected manually by changing the troubled devices at their own menu interface.



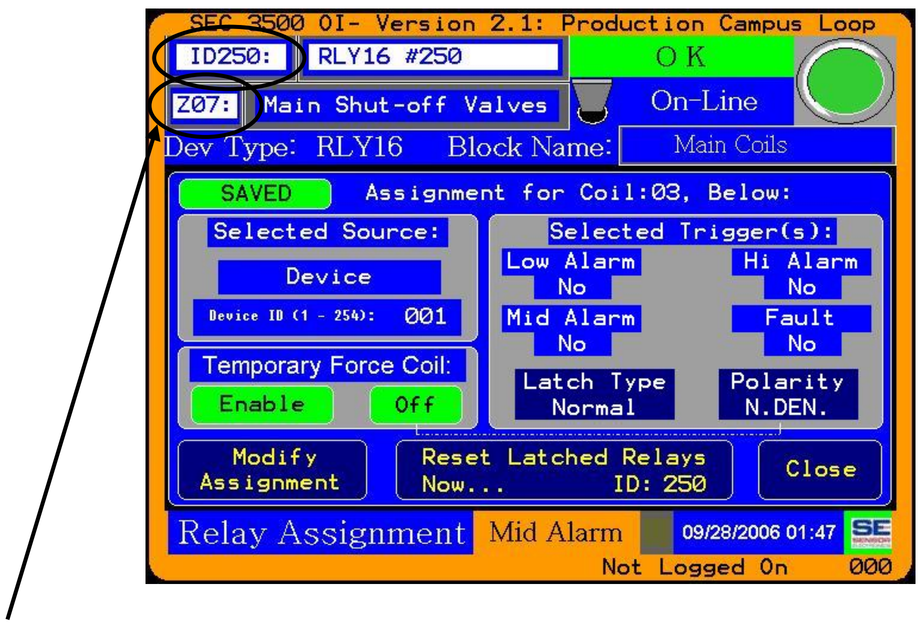
By touching either the zone or device ID labels at the top left corner of any device summary or details screen, the change process can begin. You must be logged in as the Supervisor first. It does not matter if this is a SEC 3100 device or a Relay Module- the same touch zones and labels launch the ID Change screen and process. Shown above is a SEC 3100 device summary screen. Below is a SEC Relay Module Summary Screen:



As well as the device detail screens for both device types, shown on the following page:



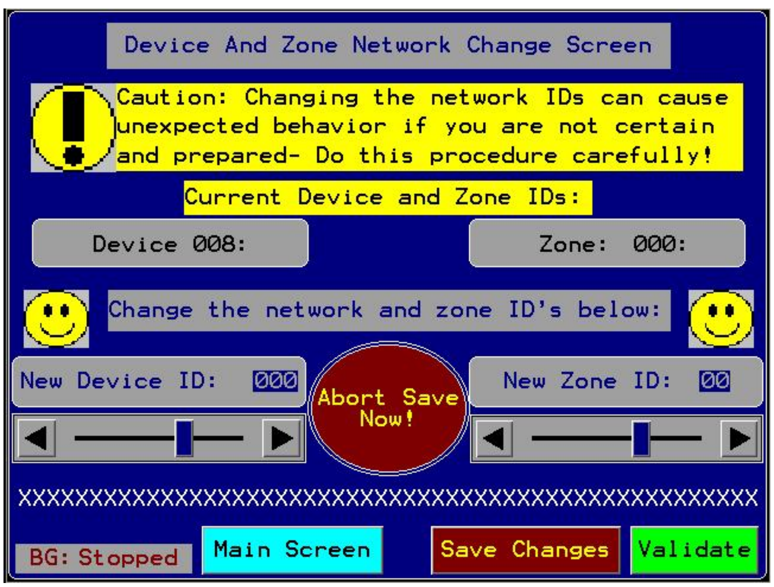
Sensor Details Screen (SEC 3100).



Relay Details (Relay Module Assignment) Screen.

Once any of these touch zones are pressed for zone or device ID and the Supervisor is logged in, the system will transition from operation mode to configuration mode (it will stop measuring devices on the bus), as shown in the following screens on the next page:

Service stop screen (though target screen name shown above would be replaced by the Change Device ID Screen)- This screen appears immediately following a valid activation of the device summary or details screen device or zone ID labels shown previously. If the user presses abort, the service will restart and operation restored. Otherwise, once the service is stopped, the screen will transition to the Device ID Change Screen:

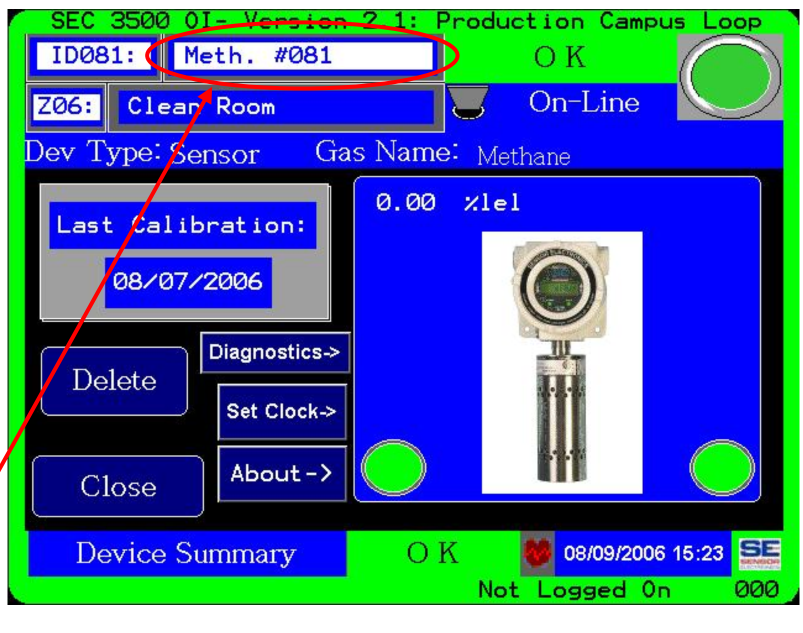


As shown above, both the zone and device IDs can be changed using either the slider bars or the number entry boxes. You will not be able to save the changes though until you press the “Validate” key. During validation, duplicate IDs will be searched both in the database and on the network- if found, changes will not be allowed to be saved and the message above the buttons will display this status. Otherwise, the message will indicate success and the “Save Changes” button will be enabled. To cause the changes to occur, press the "Save Changes" button- the status bar will indicate the progress and status. Once successful, you may press the "Main Screen" button to return to normal operation.

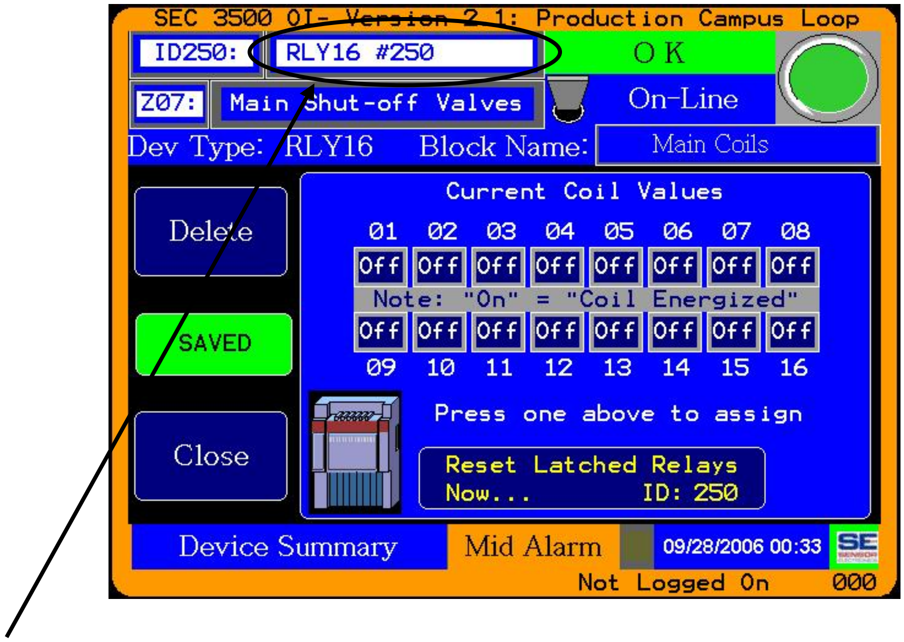
4.2 Changing the Device Name

The process is nearly identical to changing the device IDs, except that the touch area/label is located just to the right of the device ID in the upper left-hand corner of the device summary and detail screens. Touching these areas likewise will stop the normal measurement loop and transition to the Change Device ID screen. Once completed and successfully changed in the device, the operation and screen will revert back to normal operation. The purpose and intent of naming each device is to create a meaningful tag that travels with the device and describes it enough to be distinguished from another similar device on your network. It can be any alpha-numeric text; hence it could be a serial number, a short name of its role, or some other method that you determine.

As in section 4.1 previously, the same screens contain the Device Name labels/touch areas, and if pressed and the Supervisor is logged in, the HMI will transition to the Change Device Name screen. Let's examine the device summary touch zones (refer to the detail screens shown in section 4.1 and locate the Device Name fields- they operate the same and appear the same as the device summary screens):



SEC 3100 Sensor Device Summary Screen- Device Name Touch Zone



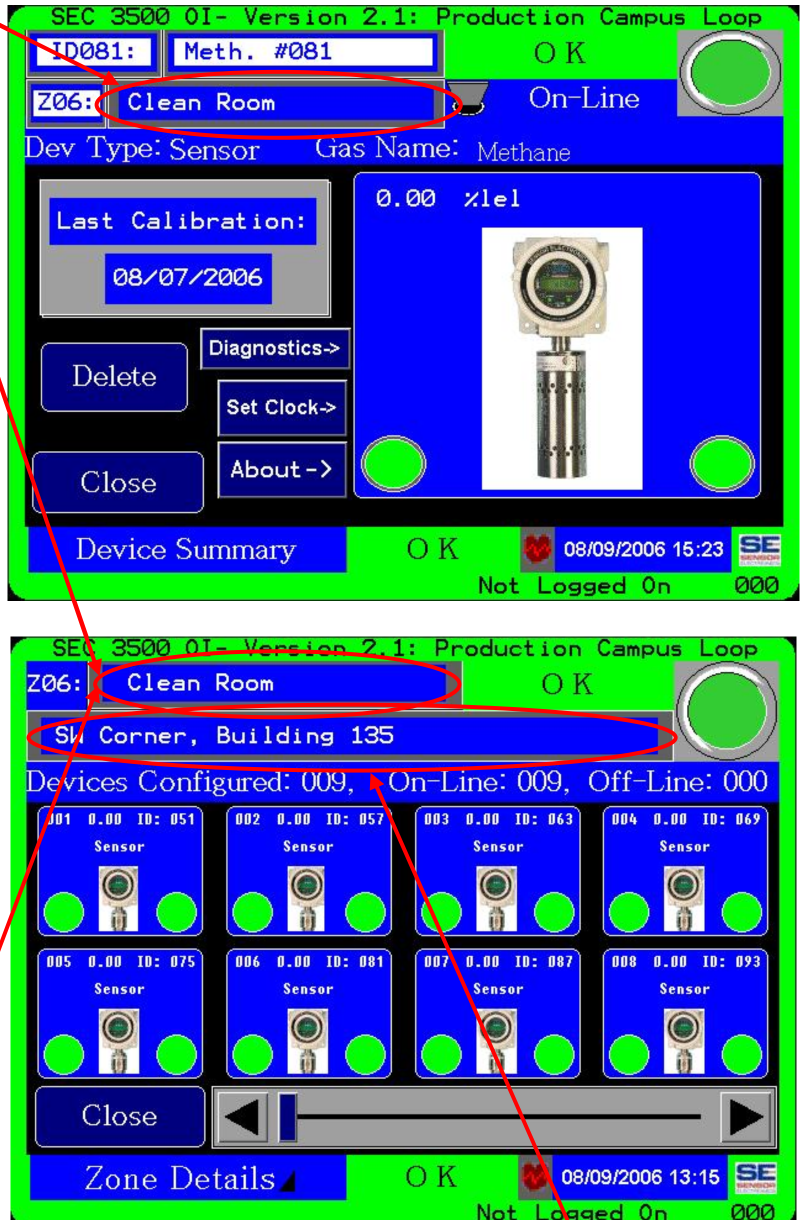
Relay Module Device Summary Screen- Device Name Touch Zone

When pressed, the screen transitions through the stop detection loop process as illustrated in section 4.1, and then the Change Device Name screen appears:

The current Device Name is displayed in the Device Name text box. To change it, simply touch the current name in the text box and a keypad appears; type in the new name and press the "Save Changes" button. As the name is written to the device and confirmed, the status bar provides the progress messages. The "Abort" button may be pressed to skip making the changes and return to normal operation. Once the name is properly saved, it will be permanently saved in the device- you may press the "Main Screen" button to return to normal operation.

4.3 Changing the Zone Name and Zone Description

The Zone Name provides a short title for the particular zone that a set of devices resides in. The SEC 3500 OI allows for up to sixteen separate zones that devices can grouped into. The Zone Name should represent the intent of the grouping. This name can also be changed on the “Zone Details” screen along with a Zone Description. The Zone Name can be changed (just as the zone and device IDs) on all of the device summary and detail screens. Looking at the SEC 3100 Sensor Device Summary Screen:

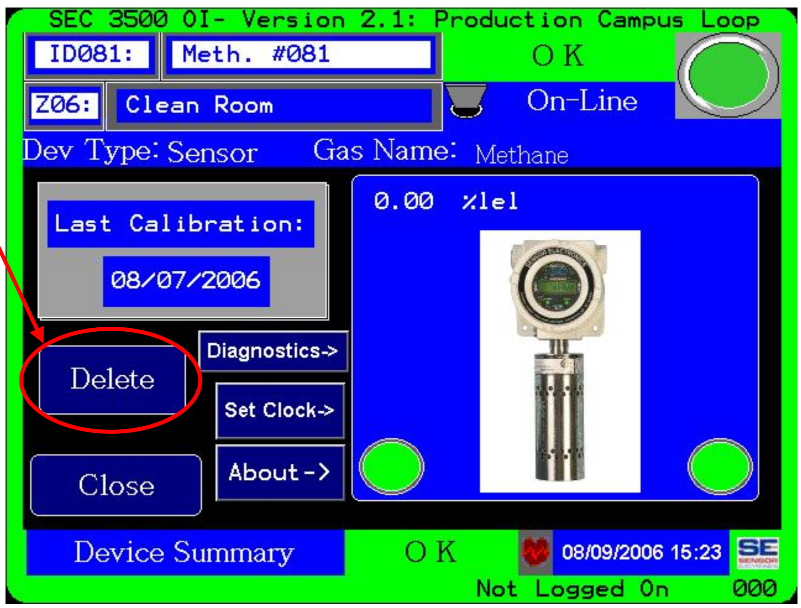


Zone Details Screen- Zone Name Change Text Box
Zone Details Screen- Zone Description Change Text Box

Changing either the Zone Name or the Zone Description is performed in the same manner, and does not require the Supervisor to be logged on. Simple touch the text box, the keypad will popup and you can enter the new text. The operational mode of the SEC 3500 OI does not stop and is not affected. Changes are stored permanently in the OI after about ten minutes or so. To make them remain permanent immediately, reboot the OI (See the Basic Operator's Manual or the Startup Basics Guide).

5.0 Deleting/Removing Devices

Adding devices to the network is as easy as connecting a new one to the Modbus network, and if necessary, changing the device & zone IDs. However deleting them is another matter. If you perform the deletion without removing the device form the Modbus network, it will be re-detected and auto-added next time it is scanned. Therefore, you must first remove the device from the Modbus network and allow it to be declared off-line first. You must be logged on as the Supervisor to perform this operation, then proceed to the associated device summary screen (Sensor or Relay Module) and touch the "Delete" button as show below:



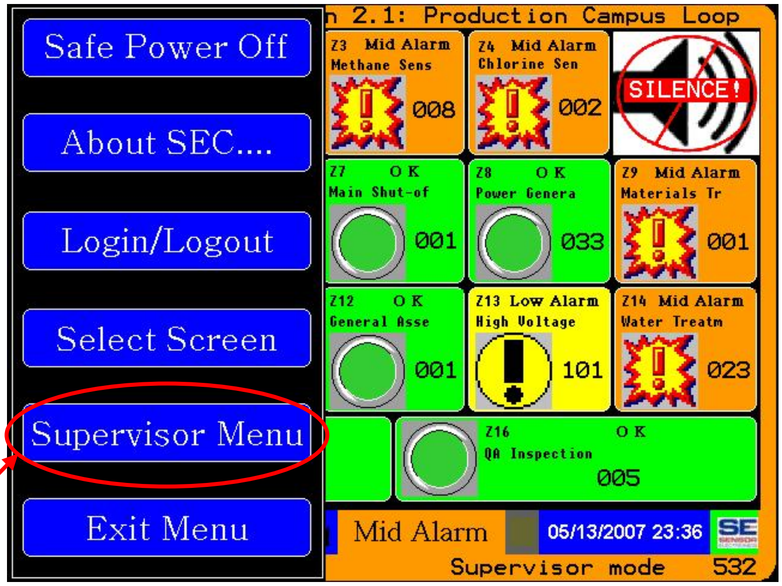
The OI will transition from normal operation through shutting down Modbus communication/measurement (as illustrated previously in section 4.0) and finally to the Device Deletion Screen as shown on the following page:

The above screen will be displayed (similar also for the Delete Relay Module), though each of the message labels above will not be visible at the same time, however you may either begin deletion of the device from the SEC 3500 OI database by pressing the “Delete Now” button or abort the operation by simply pressing the “Go To Main Screen” button to return operation to normal.

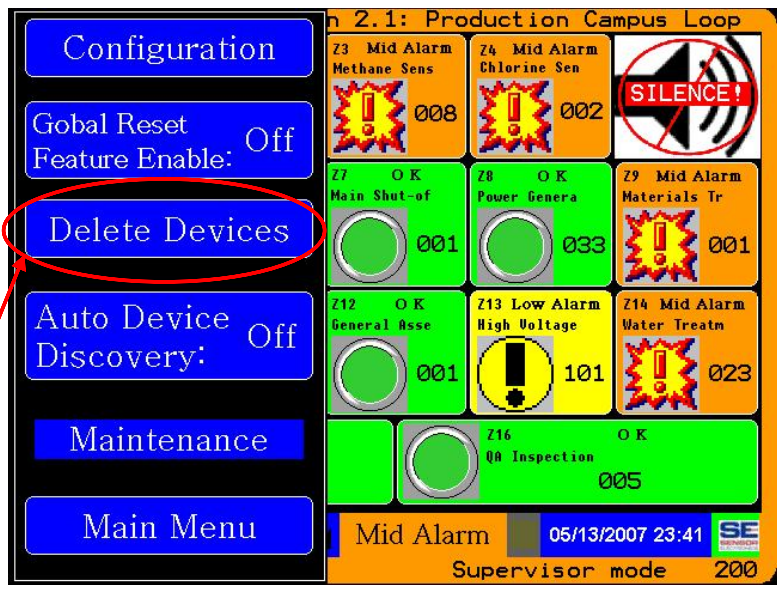
Once you press the “Delete Now” button, the various message labels shown above will appear as appropriate to indicate the current action, and the status bar at the bottom will show the progress stage. Once it is complete and successful, it will reboot the SEC 3500 OI panel to commit the deletion permanently, and normal operation will be restored.

5.1 Deleting All Devices

If you desire to delete all devices from the SEC 3500 OI database, first remove all devices from the Modbus network. You must be logged in as the Supervisor to perform this operation. Navigate to the “Main Menu” (as shown on the next page):



Select the "Supervisor" Menu:

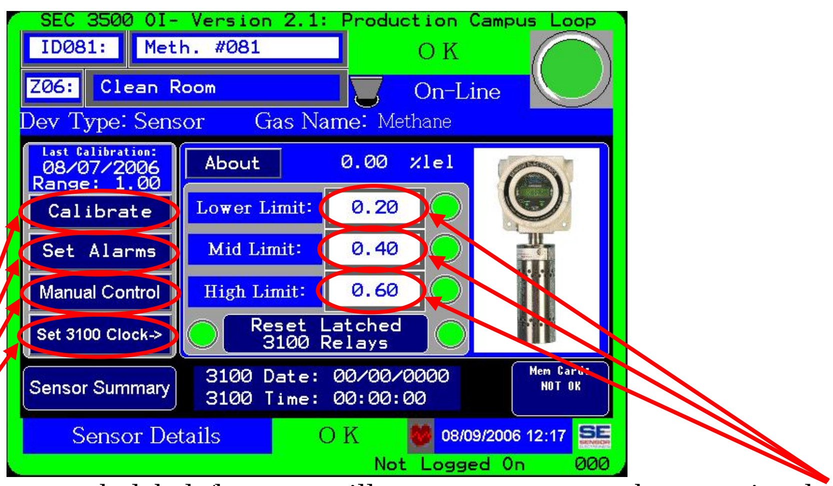


Select the "Delete Devices" Menu button, and the system will transition from normal operation and Modbus communications to the Delete All Devices screen and mode, as shown on the following page:

The operation may be deleted by pressing the “Go To Main Screen” button before pressing any other button. Otherwise, press the “Delete Now” button to begin the deletion process. As devices are deleted from the SEC 3500 OI database, the status label indicates the progress. Once it is complete, it will reboot the OI and then return to normal operation.

6.0 SEC 3100 Configuration

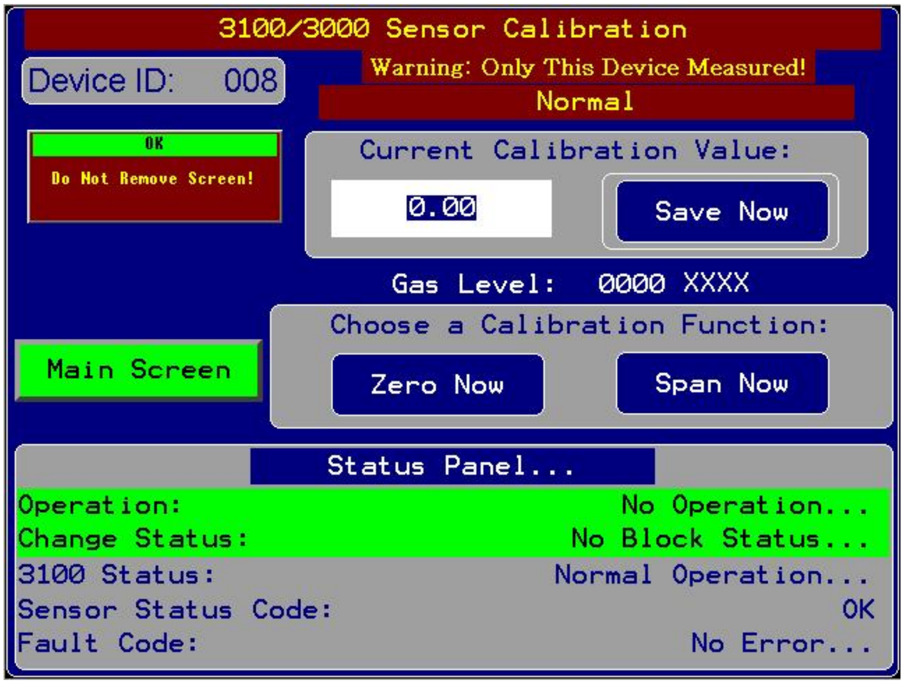
The SEC 3500 OI Panel/HMI contains all of the screens necessary for configuring every parameter for any SEC 3100 Digital Gas Transmitter/SEC 3000 Sensor that is possible at the unit itself, as well as performing full calibration functions for the Sensor. The configuration screens are accessed from the Sensor Detail Screen discussed in the Basic Operator’s Manual, as show below, and allows entry into the configuration screens from the touch label areas shown below if the Supervisor is logged in:



All of these touch labels/buttons will transport you to the associated SEC 3100 configuration/control screen if you are logged in as the Supervisor.

6.1 Calibrating the SEC 3100/3000 Sensor

The Calibration Screen is activated by pressing the “Calibrate” button shown on the previous page of the Sensor Details Screen. When pressed, the system transitions to the Calibration Screen by shutting down the Modbus communications process (as described in previous sections), as shown below:



6.1.1 Setting the Calibration Value

In the Calibration Screen above, inside the “Current Calibration Value” panel, the current calibration value used by the SEC 3000 Sensor is displayed. See the SEC 3000 Sensor documentation for further information regarding this value. To change it and permanently store it in the Sensor, touch the Calibration Value, and enter a new one with the popup keypad. Once changed, press the “Save Now” button to permanently write it to the Sensor; the Status panel will indicate the progress. Press the “Main Screen” button to return to normal operation.

If any error occurs during the calibration process, the error message and condition will be displayed in the Status panel. Refer to the SEC 3000 Sensor documentation for further details on how to correct the problem.

6.1.2 Zero Calibration Procedure

Before performing the Zero Calibration process, you may want to press the “Do Not Remove Screen” button to prevent the screen timeout from occurring while visually monitoring the gas level reported by the Sensor (screen touch inactivity) shown above the

“Calibration Function” panel. When you are satisfied with the level for establishing the zero reference point (Refer to the SEC 3000 Sensor Documentation), press the “Zero Now” button in the “Calibration Function” panel. The Status panel will display the progress information. Press the “Main Screen” button to return to normal operation.

If any error occurs during the calibration process, the error message and condition will be displayed in the Status panel. Refer to the SEC 3000 Sensor documentation for further details on how to correct the problem.

6.1.3 Span Calibration Procedure

As described previously in section 6.1.2, it is advised to press the “Do Not Remove Screen” to prevent screen timeout while watching the Gas level reported from the sensor above the “Calibration Function” panel. See the SEC 3000 Sensor documentation for detailed information regarding the Span Calibration process. The SEC 3500 OI merely facilitates the process through the SEC 3100 Digital Gas Transmitter.

In general though, once the sensor has been properly “Zero Calibrated”, and the proper Calibration Value has been stored in the sensor (see section 6.1.1 previously) representing the Calibration Gas you are about to use in this Span Calibration operation, then it is time to apply the calibration gas to the sensor.

While monitoring the Gas Level reported by the sensor above the “Calibration Function” panel, press the “Span Now” button as soon as the necessary value is achieved. The automated Span Calibration now takes control and the progress information is updated in the Status panel. Once the calibration process is complete, the automated procedure awaits full purging of the Calibration Gas from the sensor, indicated in the Status panel and the current Gas level displayed above the “Calibration Function” panel. When the Calibration Gas is purged and the process completes successfully, you may press the “Main Screen” button to return to normal operation.

If any error occurs during the calibration process, the error message and condition will be displayed in the Status panel. Refer to the SEC 3000 Sensor documentation for further details on how to correct the problem.

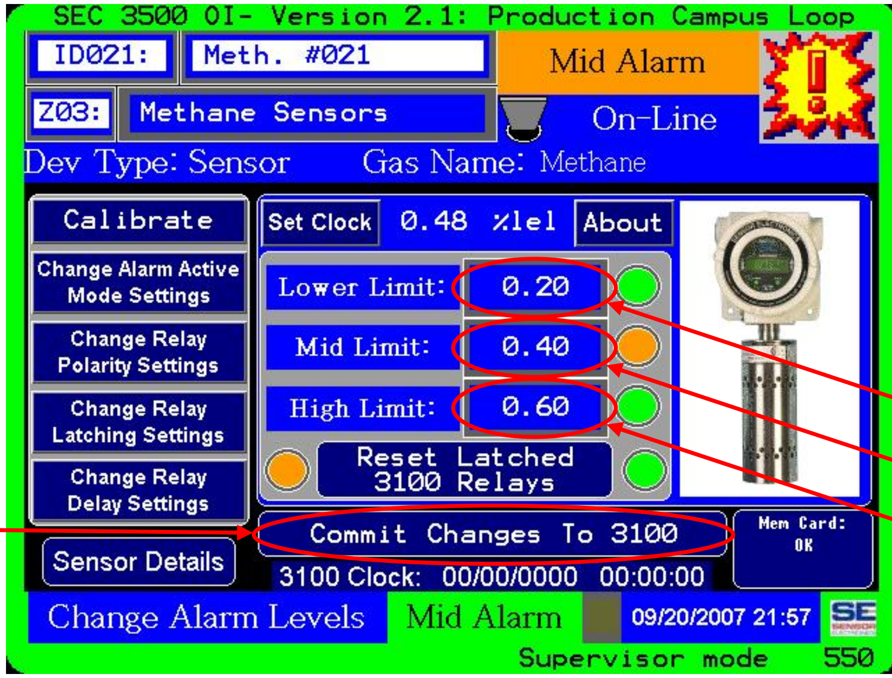
6.2 Setting the Alarm and Relay Parameters

When the "Set Alarms" button is pressed on the "Sensor Details" Screen as shown in section 6.0, the "Change Alarm Levels" Screen will appear if the Supervisor is logged in. Please note that only this SEC 3100 Gas Transmitter and SEC 3000 Sensor are communicated with when on this set of screens. This Screen forms the "Parent" screen for a group of configuration screens as outlined in the special navigation panel to the left of the screen as show below:

The navigation panel is present on all of the Sensor Configuration Screens, with the same screen navigation buttons in the same locations. The bottom-left title bar contains the current screen name as shown above: "Change Alarm Levels". Pressing any of the navigation buttons in the navigation panel will transport the user to the associated configuration screen while in Supervisor mode (Supervisor logged in). Pressing the "Calibrate" button will transition the system to the SEC 3100/3000 Sensor Calibration Process as described in section 6.1, and transitions exactly as it would if pressed from the "Sensor Details" screen.

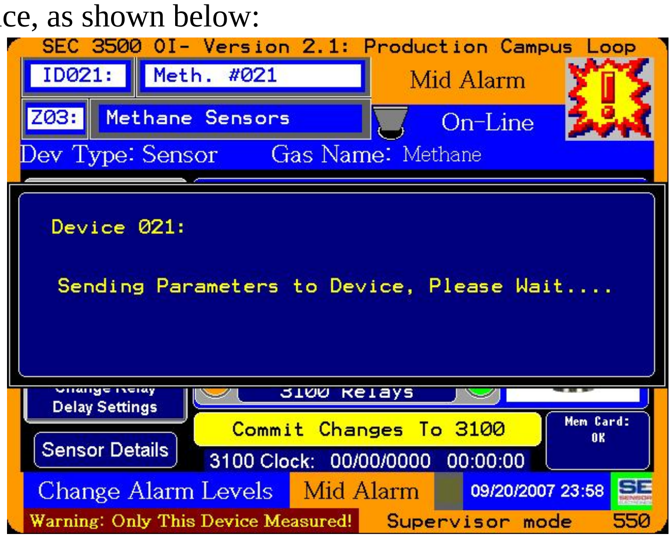
The remaining navigation buttons will transition to the various Sensor configuration screens in the "scoped" Modbus mode: meaning that only this specific SEC 3100 device is being communicated with, and no other on the bus during configuration. A warning will appear indicating this mode, flashing underneath the Screen Title at the bottom-left corner of the screen. On the "Change Alarm Levels" Sensor configuration screen, operation can be returned to normal by pressing the "Sensor Details" button, shown above. On any of the other Sensor configuration screens, this same button, titled "Alarm Levels" returns the user to the "Change Alarm Levels" Screen (the screen shown above).

6.2.1 Changing the Alarm Threshold Levels



The alarm threshold levels are changed in the above fields- just select the desired threshold (low, mid or high) by touching on the associated text field/current value, and entering the new value using the popup keypad. You may continue to change other alarm threshold levels as long as you remain on this screen; however these changed values are not yet committed and written to the SEC 3100 device. You may cancel the changes by merely returning to the “Sensor Details” screen.

To commit the changes to the SEC 3100 device, press the “Commit Changes To 3100” button. A popup status box appears indicating that it is sending the parameters to the SEC 3100 device, as shown below:

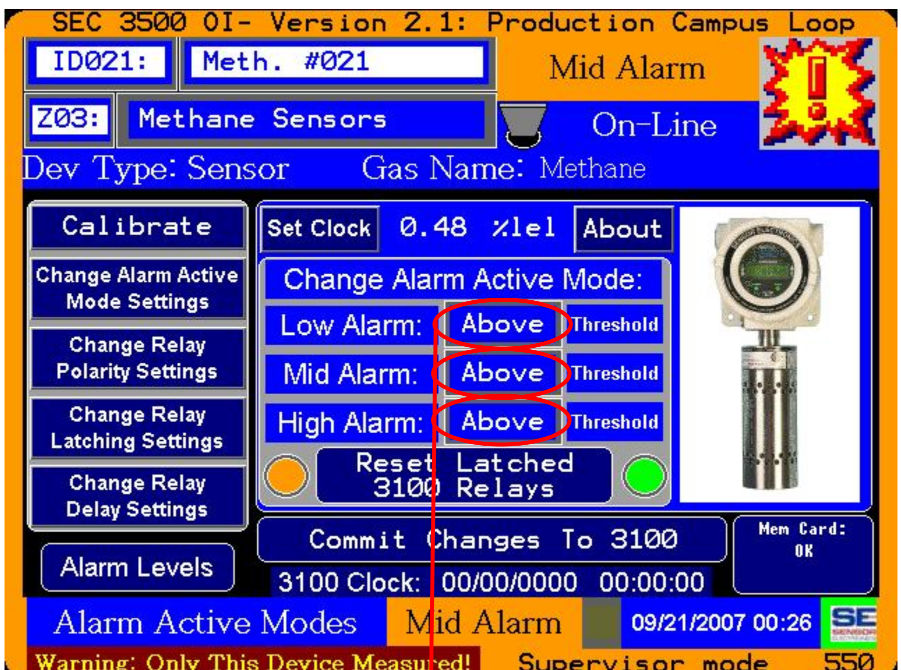


Once it is complete and successful, the popup status is removed and the "Change Alarm Levels" screen returns to its original appearance when it was first displayed, only containing the new alarm threshold level values.

6.2.2 Changing the Alarm Active Mode Settings

Pressing the "Change Alarm Active Mode Settings" button from the Navigation panel on any of the Sensor configuration screens, as shown below:

Will display the "Alarm Active Modes" Screen:



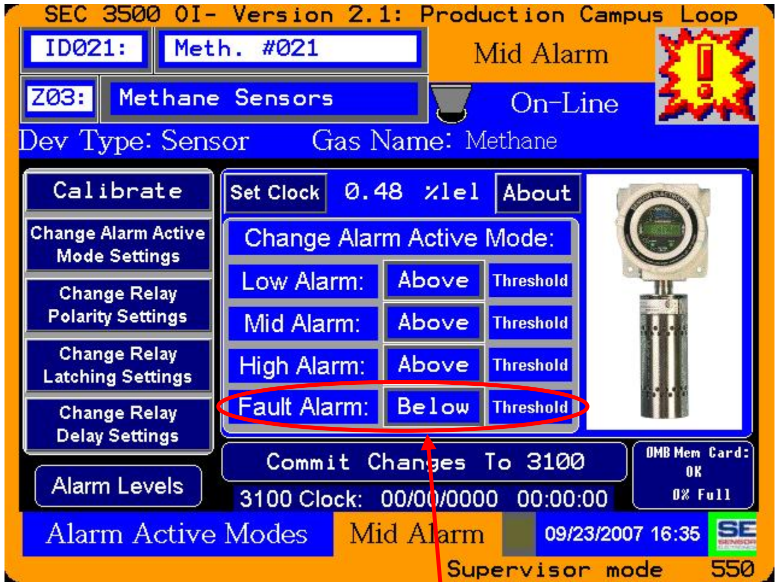
By choosing one of the above alarm threshold active mode text fields/current values (low, mid or high), you can choose to either have the given alarm trigger when the gas value rises above the threshold set point, or trigger when the gas value falls below it.

Just touch the text field for the alarm mode you wish to change, and select the desired mode (above or below) using the popup keypad. You may continue to change the other alarm active mode states as long as you remain on this screen. To cancel the changes, simply return to the "Change Alarm Levels" screen by pressing the "Alarm Levels" button. When you are ready to commit the changes and write them to the SEC 3100 device, simply press the "Commit Changes To 3100" button.

As the changes are written to the 3100, a popup status box appears indicating the process:

Once completed, the "Alarm Active Modes" Screen is re-displayed as it was when first entered before any changes were made; only the new active mode settings will be shown.

Special Note: So far, this manual has described the "Alarm Active Modes" Screen covering all necessary information related to configuration. However; the depicted screen shown relates to SEC 3100 versions earlier than 2.1.0095. Starting in version 2.1.0095, a different set of screens has been added to support Audible Alarm Latch Modes in the SEC 3100 device. The SEC 3500 OI detects the device version and displays the appropriate screens for the feature version of the device. For this screen, what has been described so far is functionally the same, however for device version 2.1.0095 (feature version 6+) and up, the fault alarm may also have its active mode changed instead of hard-coded (as previously shown). This essentially is not very useful, but was added to keep feature-locked with the SEC 3100. The extra alarm selection for Fault Active Mode is shown on the next page:

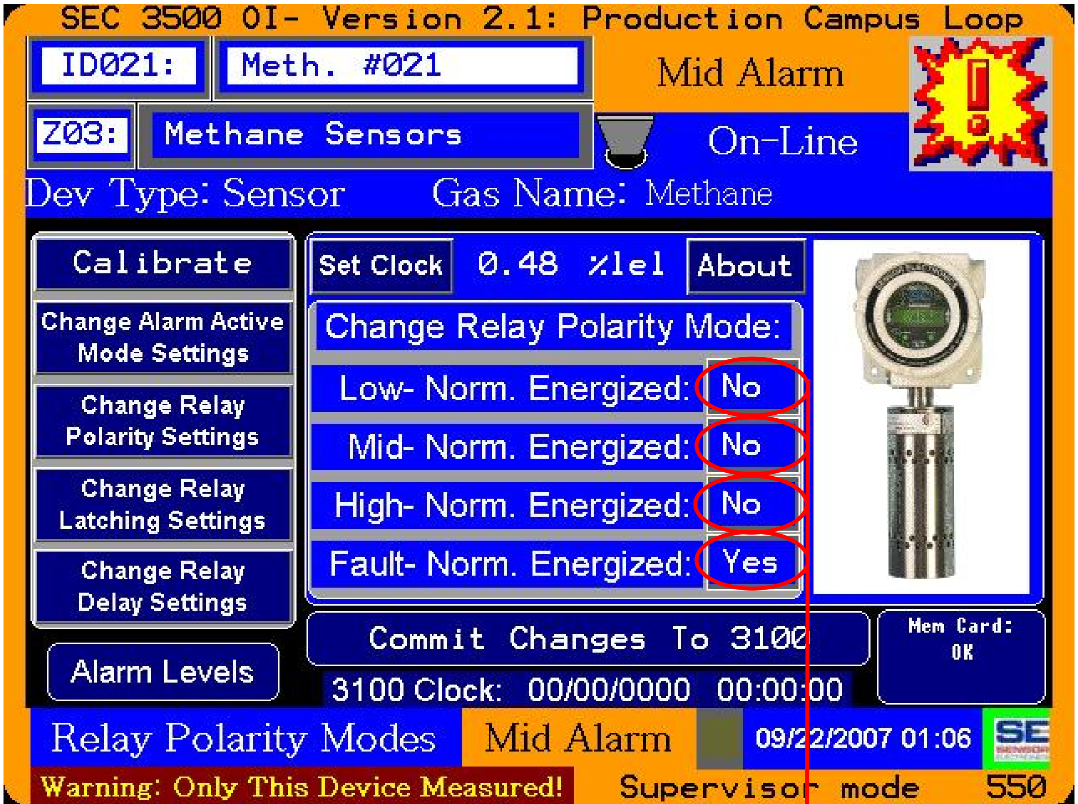


"Alarm Active Modes" Screen for SEC 3100 version 2.1.0095+ Devices, showing the additional Alarm Active Mode setting for the Fault Alarm.

6.2.3 Changing the Relay Polarity Settings

Pressing the "Change Relay Polarity Settings" button from the Navigation panel on any of the Sensor configuration screens, as shown below:

Will display the "Relay Polarity Modes" Screen:



By choosing one of the relay polarity mode text boxes (low, mid, high or fault) touching the associated current value, the new value can be selected using the popup keypad. You may continue to change the other relay polarity modes as long as you remain on this screen. If you wish to cancel the changes, simply press the "Alarm Levels" button to navigate back to the "Alarm Levels" Screen.

This setting changes the behavior of the SEC 3100 relays, such that when normally energized is set to "Yes", the relay coil is always on when the relay is de-activated, but de-energized when the relay is activated. When set to "No", the relay coil is always off when the relay is de-activated, and energized when activated.

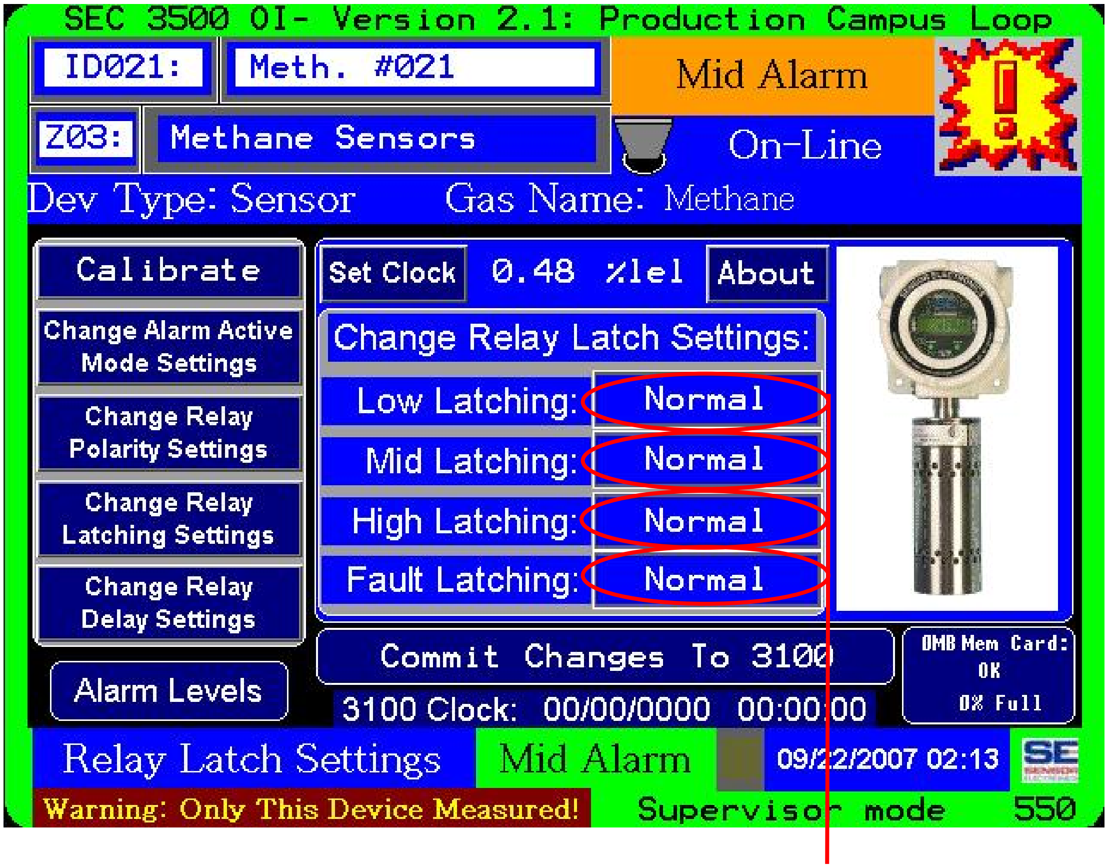
To commit the changes and write them to the SEC 3100, simply press the "Commit Changes To 3100" button. A popup status box then appears, indicating the progress of updating the Relay Polarity Mode settings in the 3100, as shown on the following page. Once the update process is complete, the screen will return back to normal as it was prior to the changes, except it will contain the changed values on the display.

Popup status box displayed when committing the Relay Polarity Mode settings to the SEC 3100 device.

6.2.4 Changing Relay Latch Mode Settings

Pressing the "Change Relay Latching Settings" button from the Navigation panel on any of the Sensor configuration screens, as shown below:

Will display the "Relay Latch Settings" Screen as shown on the following page:

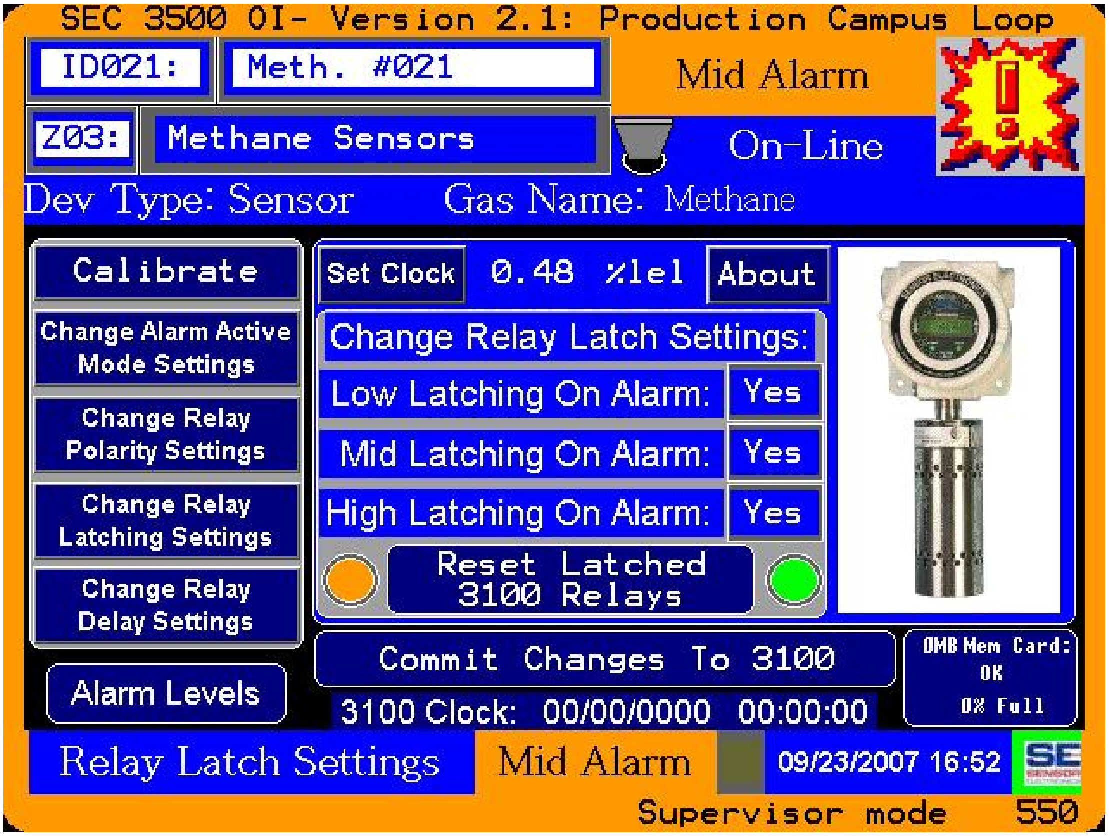


By choosing one of the relay latch mode text boxes (low, mid, high or fault) touching the associated current value, the new value can be selected using the popup keypad. You may continue to change the other relay latch modes as long as you remain on this screen. If you wish to cancel the changes, simply press the “Alarm Levels” button to navigate back to the “Alarm Levels” Screen.

This setting changes the behavior of the SEC 3100 relays, as follows (for version 2.1.0095+);

1. **Normal** Mode- as an Alarm level is triggered, its relay is activated and remains activated until the Gas level drops below the Alarm trigger (threshold) level.
2. **Latching** Mode- as an Alarm Level is triggered, its relay is activated and remains activated regardless of the Gas Level until the relay latch is reset.
3. **Audible** Mode- as an Alarm Level is triggered, its relay is activated and remains activated until either the Gas Level drops below the Alarm threshold, or the user “Silences” the alarm. Once “silenced” it will not reactivate until the gas level has fallen below the Alarm threshold and again rises above the Alarm threshold.

For SEC 3100 versions < 2.1.0095, the screen appears as shown on the following page:



Shown above is the "Relay Latch Settings" screen for SEC 3100 device versions under 2.1.0095 (less than feature level 6). As shown, the values can only by either "Yes" or "No", changing the behavior of the relay latches to either "Latching On" or "Latching Off"- normal mode. Whereas the previous screen shown is for SEC 3100 device version 2.1.0095+ (feature level 6+) having the Audible Alarm Latching feature support.

To commit the changes and write them to the SEC 3100, simply press the "Commit Changes To 3100" button. A popup status box then appears, indicating the progress of updating the Relay Latch Mode settings in the 3100, as shown on the following page:

Once the update process is complete, the screen will return back to normal as it was prior to the changes, except it will contain the changed values on the display.

6.2.5 Changing Relay Delay Settings

Pressing the "Change Relay Delay Settings" button from the Navigation panel on any of the Sensor configuration screens, as shown below:

Will display the "Relay Delay Settings" Screen as shown on the following page:

By choosing one of the “Relay Delay” “On” or “Off” text boxes (low, mid, high or fault) touching the associated current value, the new value can be entered in seconds using the popup keypad. You may continue to change the other relay delay values as long as you remain on this screen. If you wish to cancel the changes, simply press the “Alarm Levels” button to navigate back to the “Alarm Levels” Screen.

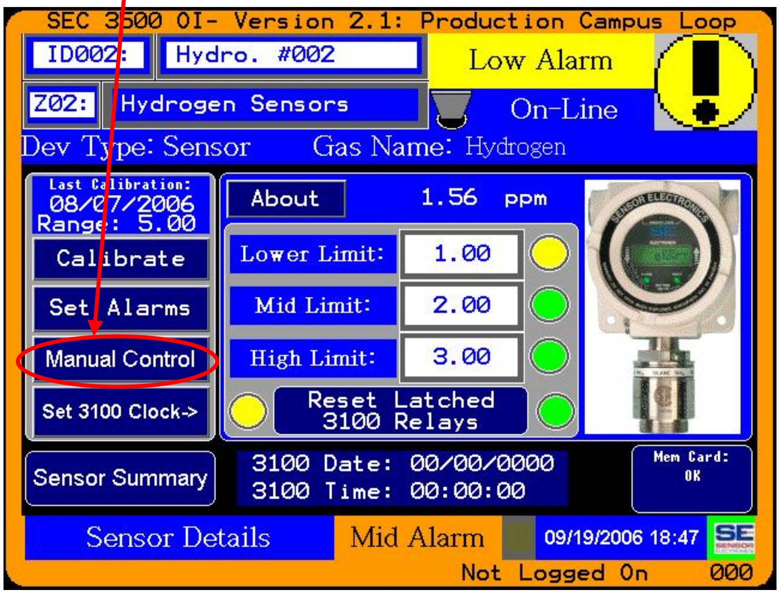
This setting changes the behavior of the SEC 3100 relays, such that when they are energized on or off the prescribed delay in seconds will occur ***before*** changing states. For example; a low alarm/relay “On” delay of 4 seconds will be applied when the low alarm transitions from an off condition to an on condition- therefore it will not actually turn on until 4 seconds after the actual “on” event occurs. If the on event goes away during the 4 seconds delay, then it will never turn on. The same can be applied to the “Off” timing. A relay will delay transitioning from “On” to “Off” by the “Off” time in seconds. If the “Off” event goes away during the “Off” time delay period, then the relay will not transition from “On” to “Off”. A value of zero indicates no delay timing.

To commit the changes and write them to the SEC 3100, simply press the “Commit Changes To 3100” button. A popup status box then appears, indicating the progress of updating the Relay Delay Settings in the 3100, as shown on the following page. Once the update process is complete, the screen will return back to normal as it was prior to the changes, except it will contain the changed values on the display.

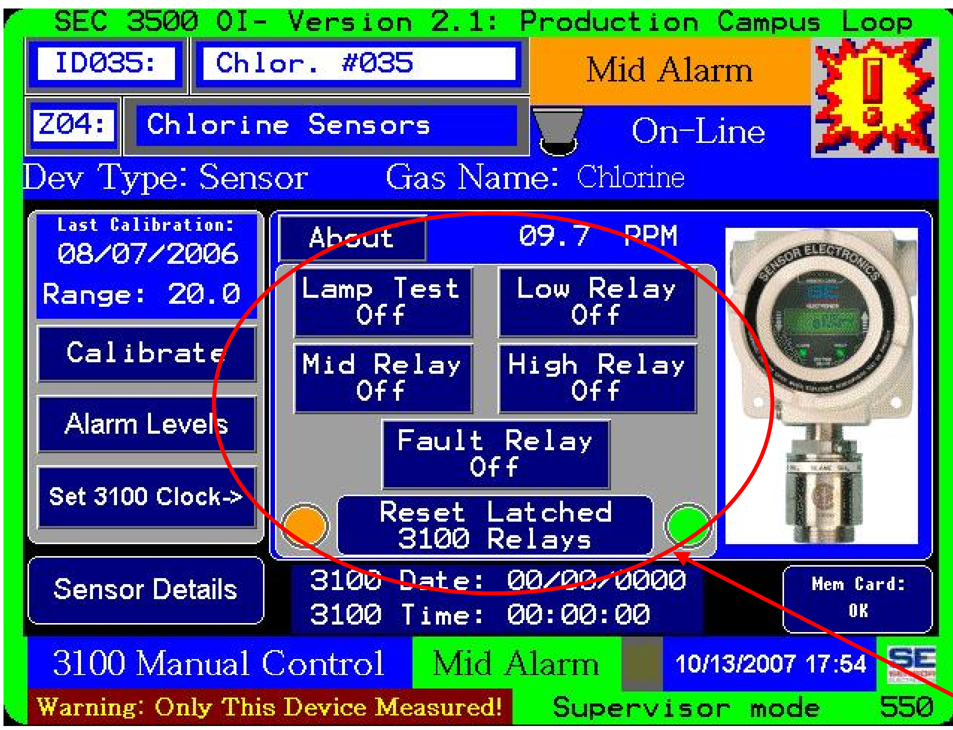
Popup status box displayed when committing the Relay Delay Settings to the SEC 3100 device.

6.3 3100 Manual Control

The SEC 3100 can be manually controlled for various diagnostic tests of its relay coils and LEDs. As shown below, the 3100 Manual Control screen is launched by pressing the “Manual Control” button from the Sensor Details Screen:

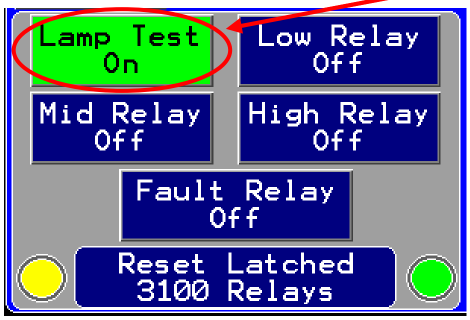


Which launches the SEC 3100 Manual Control Screen:



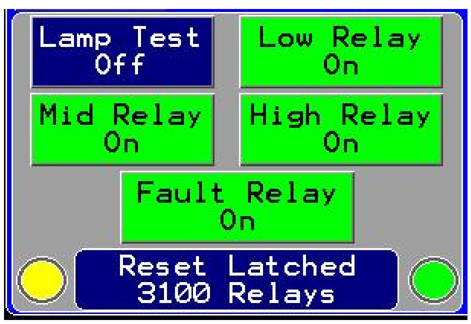
All SEC 3100 Manual Control functions are handled in the Manual Control Panel shown above. As the buttons above are pressed, the function occurs at the 3100.

To perform a lamp test to either determine the location of a remotely installed 3100 or insure that the LEDs on a given 3100 are working, press the “Lamp Test” button from the Manual Control Panel- There will be a slight delay of up to 5 seconds before it may begin:

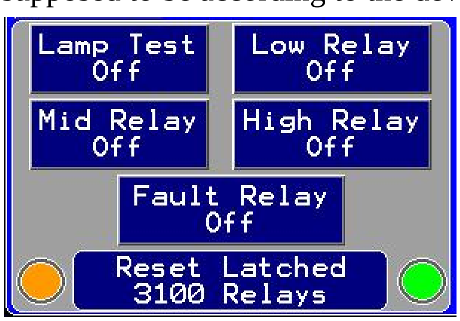


The button changes from blue to green and the text changes from “Off” to “On”. It will remain this way until it is turned off. While this screen is displayed, all LED and 3100 relay states for the given device are controlled as seen in this panel- this panel represents the actual states of these relays and LEDs.

As shown above, all relay coils are off. They can individually be turned on and off, including all functions on or all functions off, or in groups, such as all relays on as shown below:

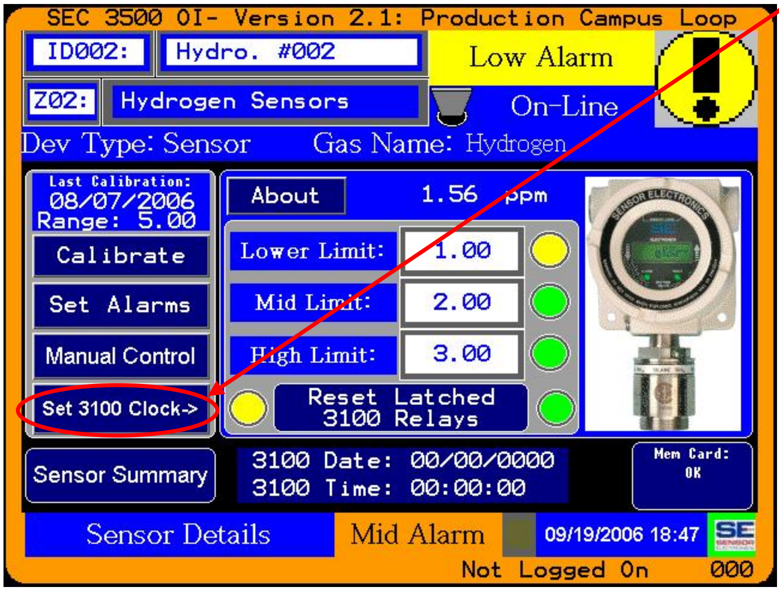


Once you leave the Manual Control Screen, all states are returned back where they are supposed to be according to the device. Ideally it is best to turn all functions off:

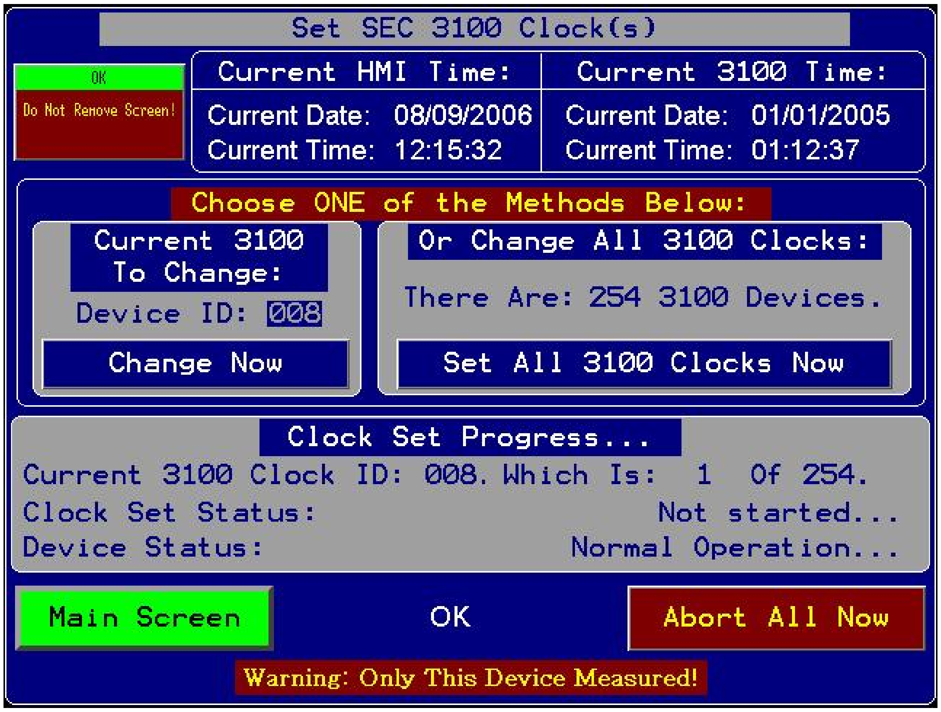


6.4 Changing the SEC 3100 Clock

Changing the SEC 3100 device clock is accomplished by pressing the "Set 3100 Clock" button on the Sensor Device Summary screen or the Sensor Device Details Screen as shown below:



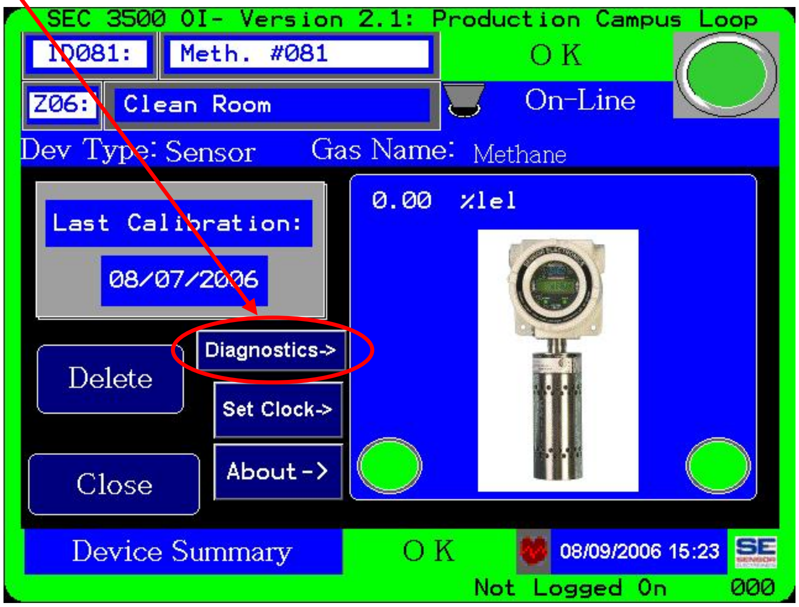
This causes the system to transition through the primary detection stop control screen and ultimately display the "Set SEC 3100 Clock(s)" Screen as shown below:



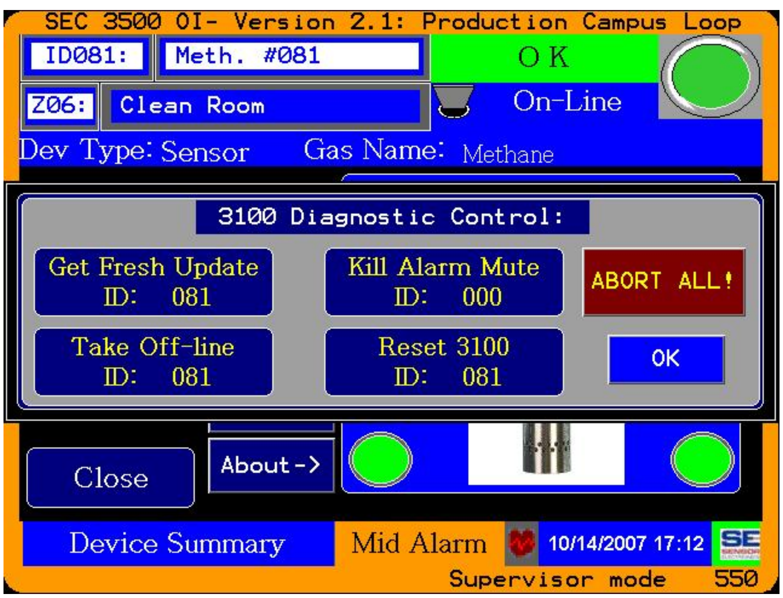
See section 5.5.2 of the Basic Operator's guide for more details setting the clock.

6.5 SEC 3100 Diagnostic Controls

Special functions for controlling SEC 3100 Diagnostics can be performed by pressing the "Diagnostics" button as shown below (which shows the SEC 3100 Diagnostics Screen):



Pressing the "Diagnostics" button brings up the 3100 Diagnostics popup control panel:



At this time, all that is allowed are two functions of the four shown above; (1) Getting a fresh update of all SEC 3100 device parameters, and (2) Reset 3100 device. Normally, these functions should never be used. However, their may be unusual situations were it may be warranted or requested by Sensor Electronics for you to perform.

Refreshing SEC 3100 device parameters; Press the “Get Fresh Update” button:

The button changes to “Retrieving…” in yellow, while it is processing the request:

The “Abort ALL!” button may be pressed at anytime to cancel an operation so long as it is still pending or processing. Even if you return to this screen at a later time with a different device, if this last request is still pending “Retrieving” it will show this and allow an abort. Once the process completes, all new parameters are pulled from the SEC 3100 device, fresh from the Sensor head all the way up through to the HMI panel data base.

If necessary, you may also reset a given SEC 3100 device, by pressing the “Reset 3100” button shown above:

This commands the SEC 3100 device to reset- thus causing it to voluntarily go through a warm-reboot cycle. It may take a few minutes before it returns back on-line.

7.0 Changing Relay Module Settings

The SEC 3500 OI supports the SEC Relay Modules for controlling important external devices such as emergency control valves, indicators, audible alarms, etc. based on Gas levels reported by individual SEC 3100 devices, entire zones, or all zones (global) on the entire Modbus controlled by the particular SEC 3500 OI. Alarms can be mapped to individual Relay Module coils using Boolean logic. For instance; a single device alarm level can be mapped to a single Relay Module coil, or multiple alarm levels from a single device can be logically combined together to control a single coil. Essentially the combinations are almost limitless.

Relay Module Coil Mapping Considerations:

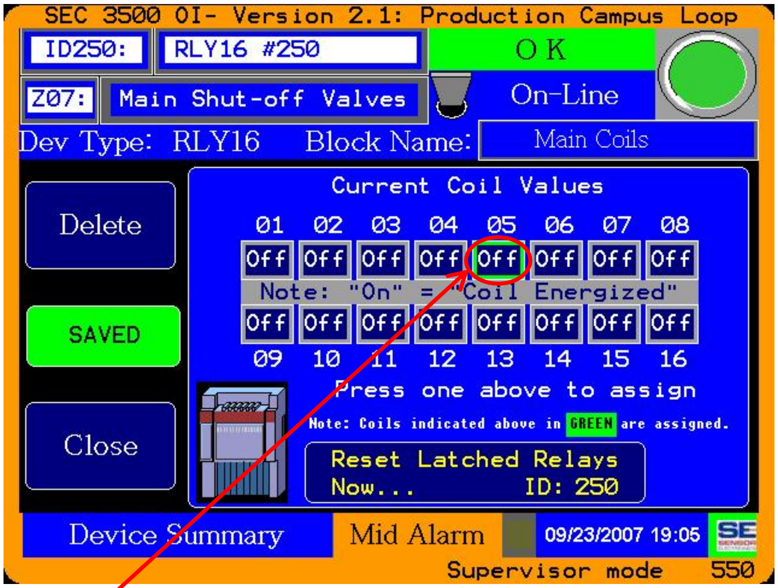
- A single device can be mapped to multiple Relay Module coils.
- Multiple alarm levels can be logically combined together to control a Relay Module coil.
- Multiple devices combined in a single zone can be mapped to multiple coils.
- Multiple zones (global) can be mapped to multiple coils.

Coil Configurations/Considerations:

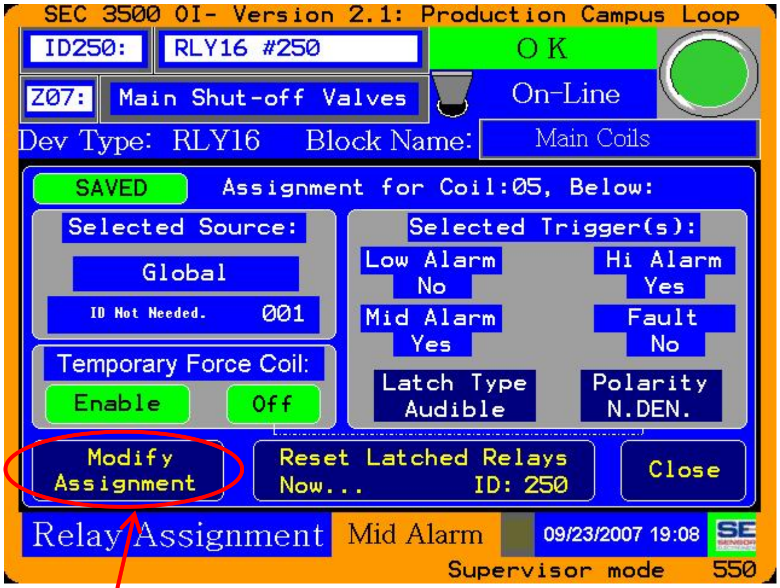
- Normally Open or closed (constantly energized or de-energized).
- Latching Modes; Normal (off), Latching (on), or Audible (in HMI version 2.1.0080+).
- They can individually be manually forced on or off whether or not they have been configured for control by a device, zone or a global (all devices/zones) alarm set.

7.1 Mapping and Assigning Relay Coils

To configure or manually control the Relay Module coils, you must launch the Relay Module Assignment Screen from the Relay Module Device Summary screen shown below (only when logged on as Supervisor):

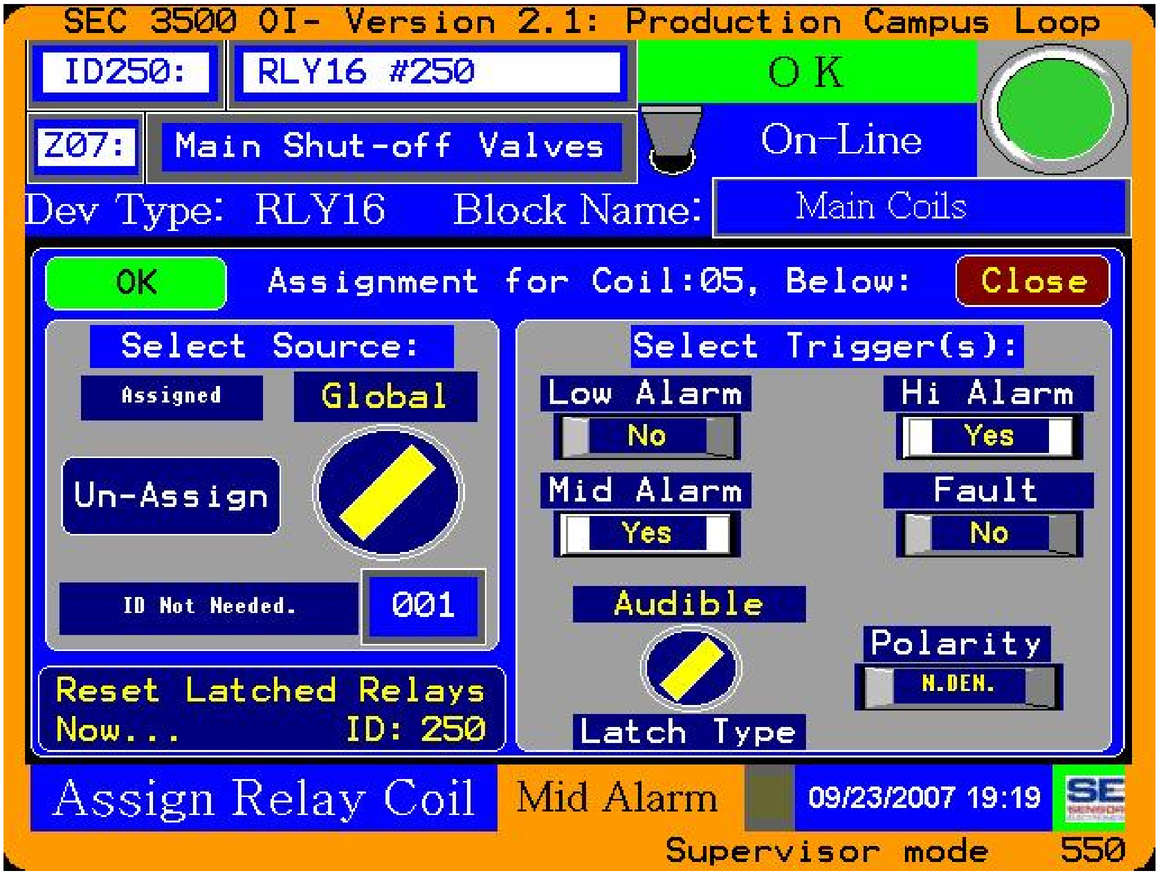


By selecting a coil that you wish to assign or modify, the Relay Module Assignment Screen appears as shown below (in the following example, coil #5 is pressed):



By pressing the “Modify Assignment” button, the Coil Assignment Screen will be shown, allowing configuration and mapping of the coil as shown on the following page:

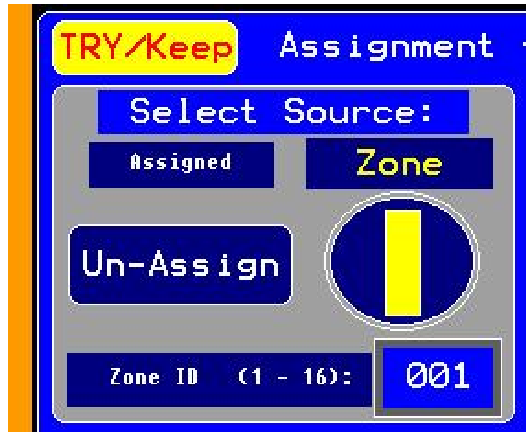
Coil Assignment Screen:



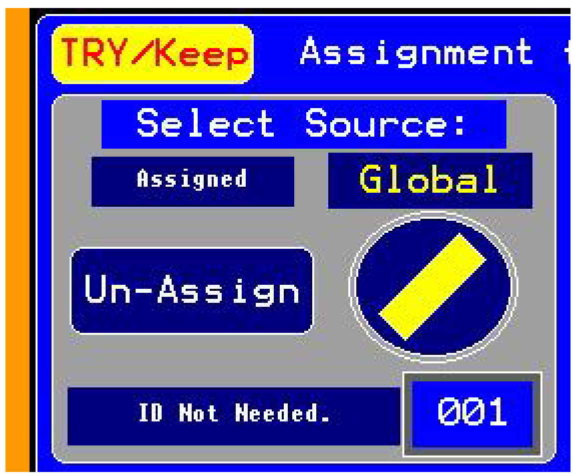
In the above screen shot, the coil is assigned by mapping an alarm source, to the selected coil on the chosen relay module, and the alarm triggers to activate the coil are mapped in along with determination of coil latching type and coil energizing polarity.

7.2 Choosing the Coil Map Source

To map the coil, you must first choose the device, zone or global (all) source from the left side of the screen:



Device 25 is selected (shown above). Zone 1 is selected (shown above).

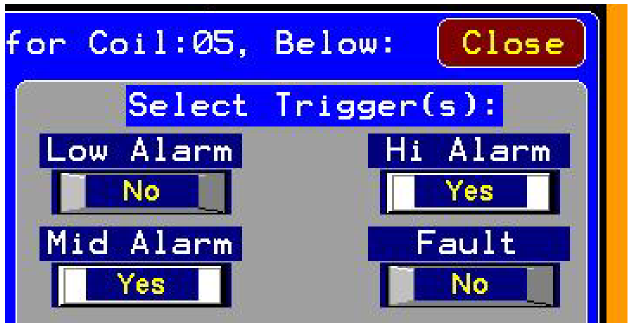


Global (All Zones) is selected.

Once a source is chosen, it is considered temporarily assigned. If this coil had previously been assigned, it can also be un-assigned by pressing the “Un-Assign” button.

7.3 Choosing the Alarm Triggers

Next, the Alarm trigger combination must be made from the right side of the screen:



Any combination may be made. When selected, it appears lit up. Above, both the high and mid alarm triggers are selected, meaning that either the high OR mid alarm if triggered, will activate the coil.

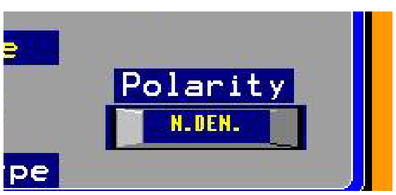
7.4 Choosing the Latch Type

Normal Latching (off)

Latching (on)

Audible Alarm Type

Then finally, the coil polarity must be chosen from the right under the Trigger(s) Pane:



Normally de-energized

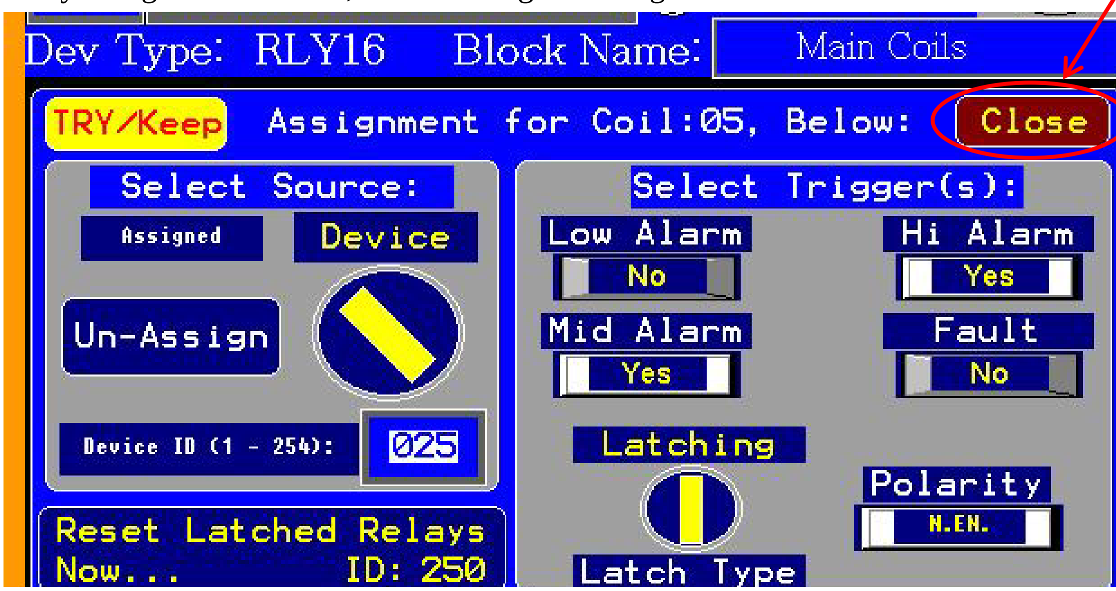
Normally Energized

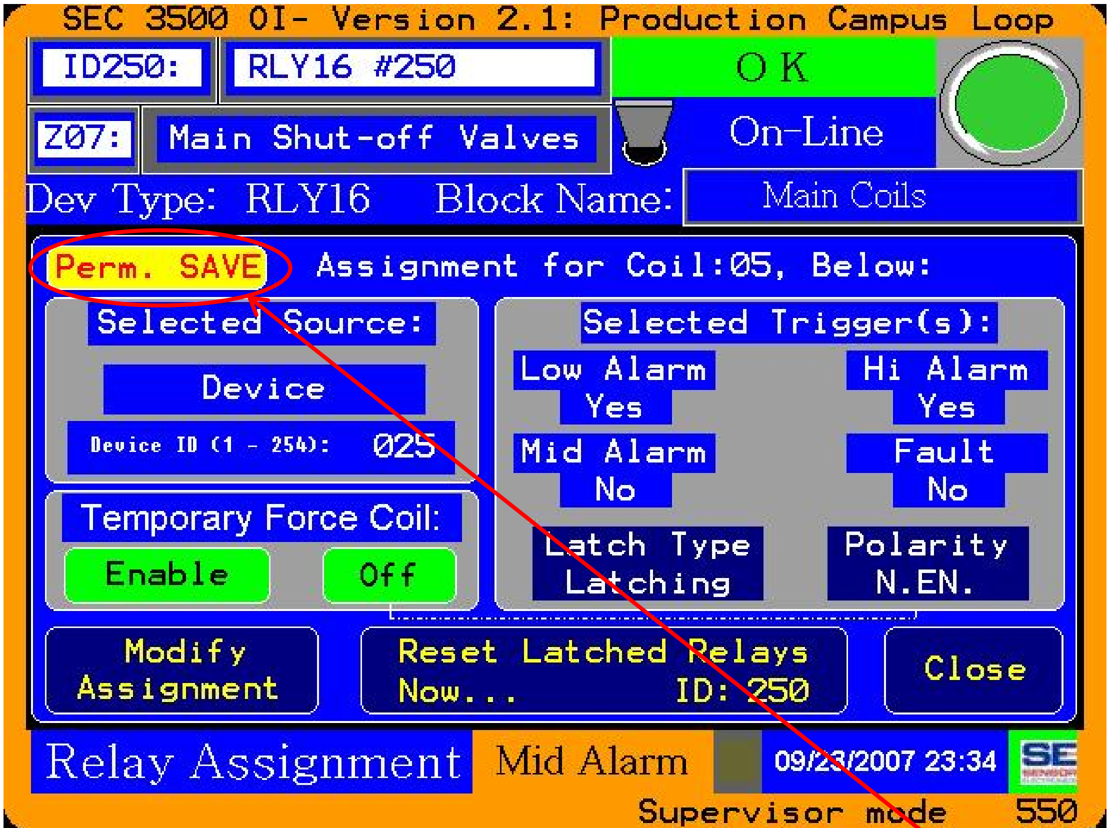
7.5 Testing and Saving Settings

Then, the selections can be tested by pressing the “Try/Keep” button (previously labeled “OK”), enabling them to be saved:

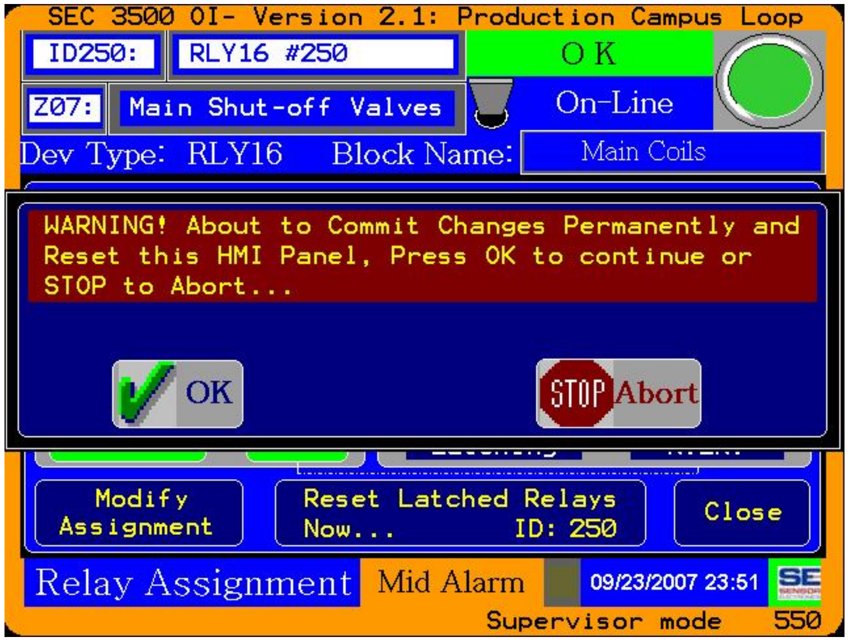
“OK” becomes “Try/Keep”

If all is OK then the “Close” button can be pressed, navigating the screen back to the “Relay Assignment” Screen, now showing the changes.

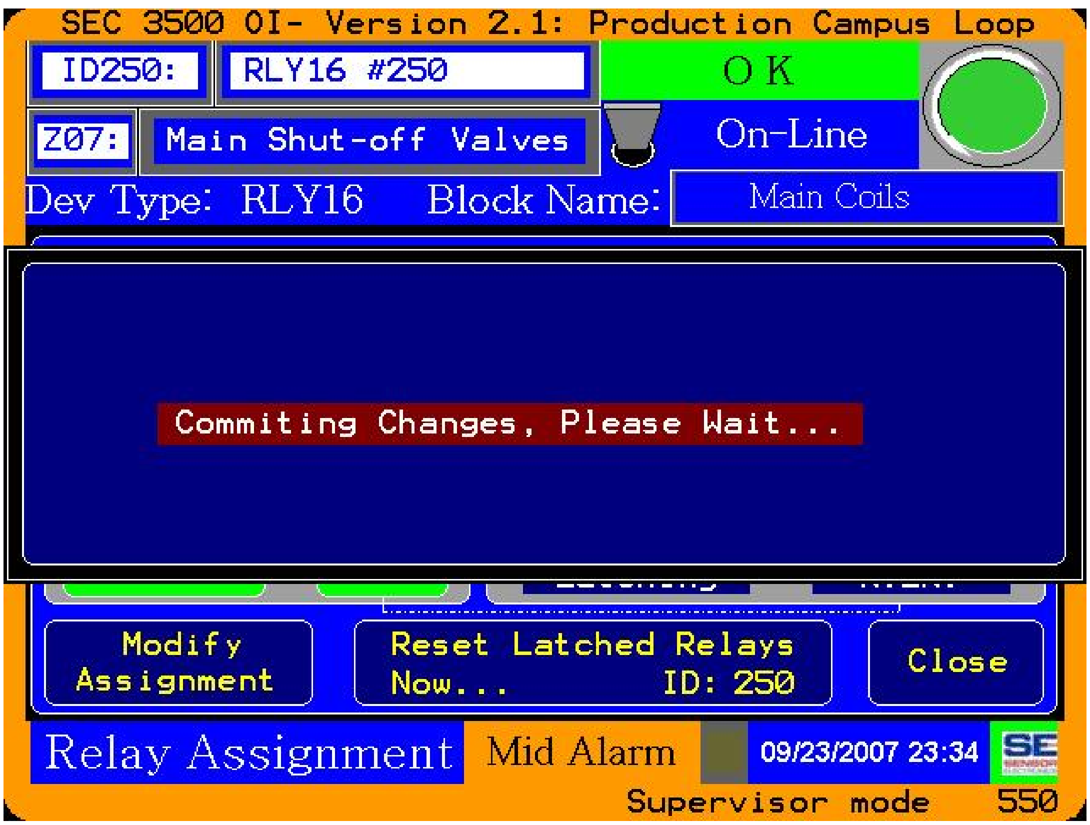




Returning from the Coil Assignment Screen, the changes made are now updated on the Relay Assignment Screen. The button labeled “Saved” is now labeled “Perm. SAVE”, indicating that the changes made still need to be permanently changed and the SEC 3500 OI rebooted. If pressed, changes will be permanently saved and the SEC 3500 OI rebooted. If not, eventually the panel will perform the save and reboot automatically, especially if the Device Summary Screen (which also contains a “Save” button just like this one) is exited. Saving pops up a warning box, allowing the user to abort the procedure (shown on the following page):

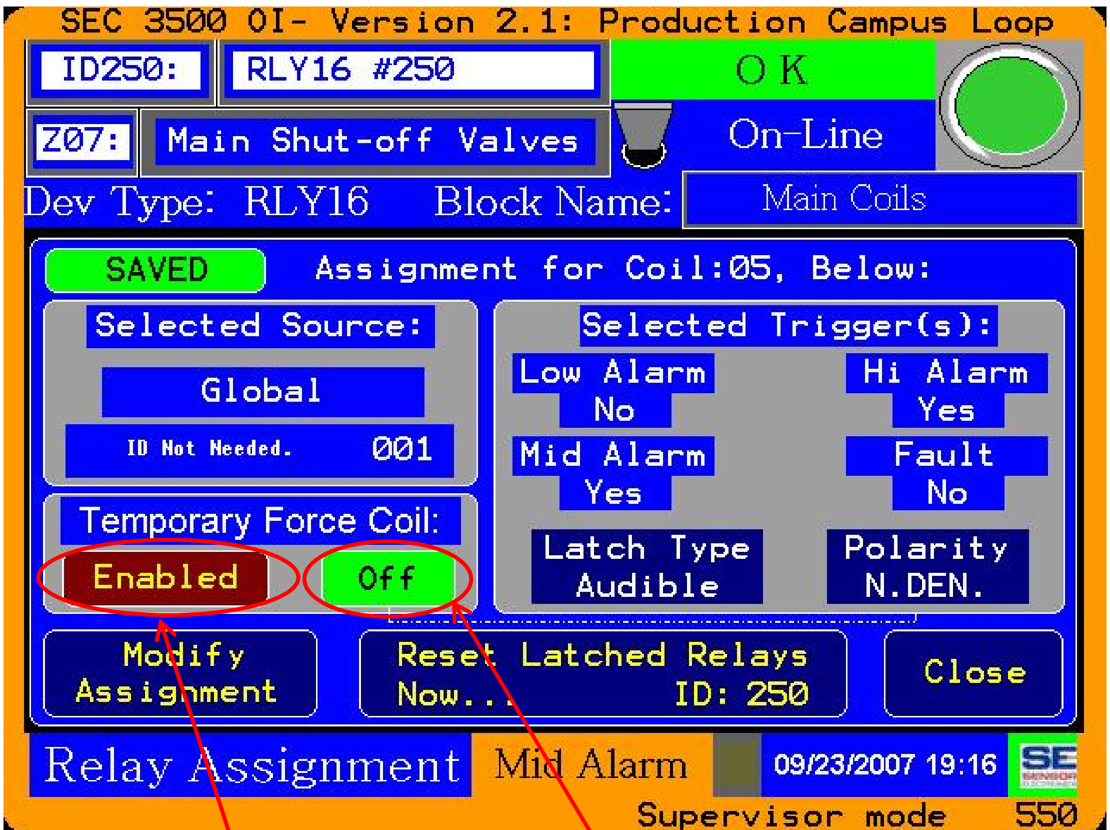


Once the user presses the "OK" button, the permanent save process begins and the SEC 3500 OI panel reboots, returning back to normal operation:



7.6 Manually Forcing Relay Coil States

From the Relay Assignment Screen, you can force individual coils on and off to test connections, behavior, etc. First you must press the “Enable” button below to cause the state to change as indicated (“On” means energized, “Off” means de-energized):

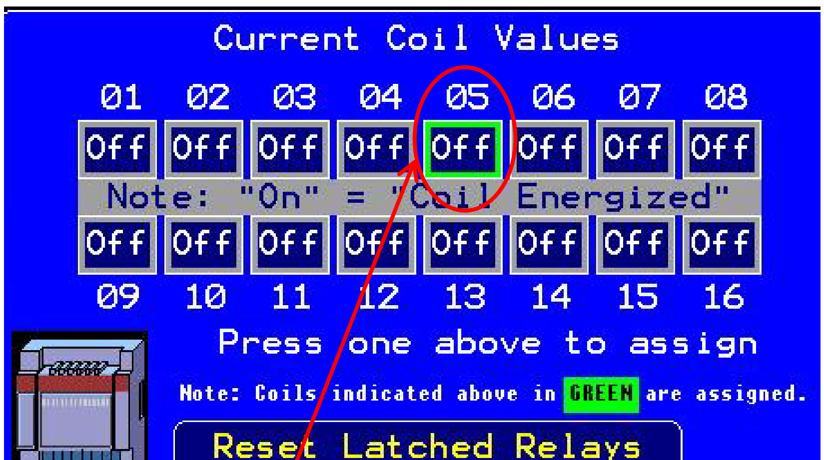


When the “Enable” button is green as shown here: Enable forcing the coil state is not enabled. Press it and it will turn red Enabled (and the text will change to “Enabled” indicating that whatever state the “On”/”Off” button is showing, is now the state that the SEC 3500 OI panel is now forcing for this coil on this Relay Module. Coils can be forced regardless of whether or not they have been assigned. You can also choose to change the state of the coil to “On” or “Off” before enabling the force. Insure that before you leave this screen, you disable the coil forcing, or your Relay Module obviously will not behave as you expect! When the coil is set to be forced to “Off” it appears in green Off and in On red when it is set to be forced on with the text “On”.

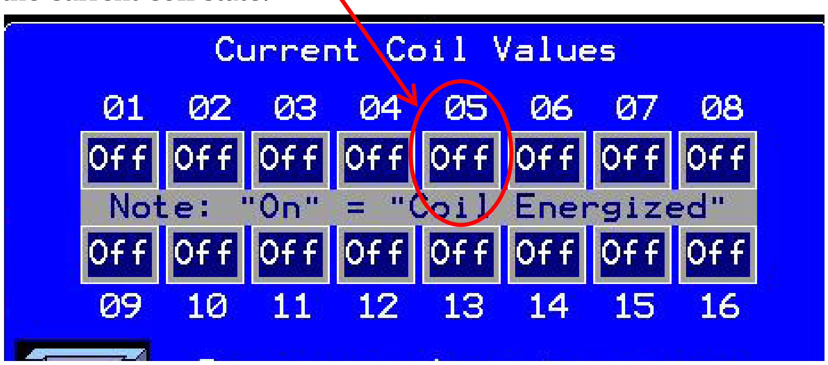
The “On” and “Off” states are determined by the state of the polarity, shown by the relationship dotted lines between the On/Off button to the Polarity Button:

Hence when the relay polarity is set to Normally De-energized, “On” then energizes the coil, otherwise it would de-energize the coil (as shown above) in the “On” state. The “Off” state in the Normally De-energized polarity then de-energizes the coil, whereas it energizes the coil in Normally Energized polarity (as shown above) when in the “Off” state.

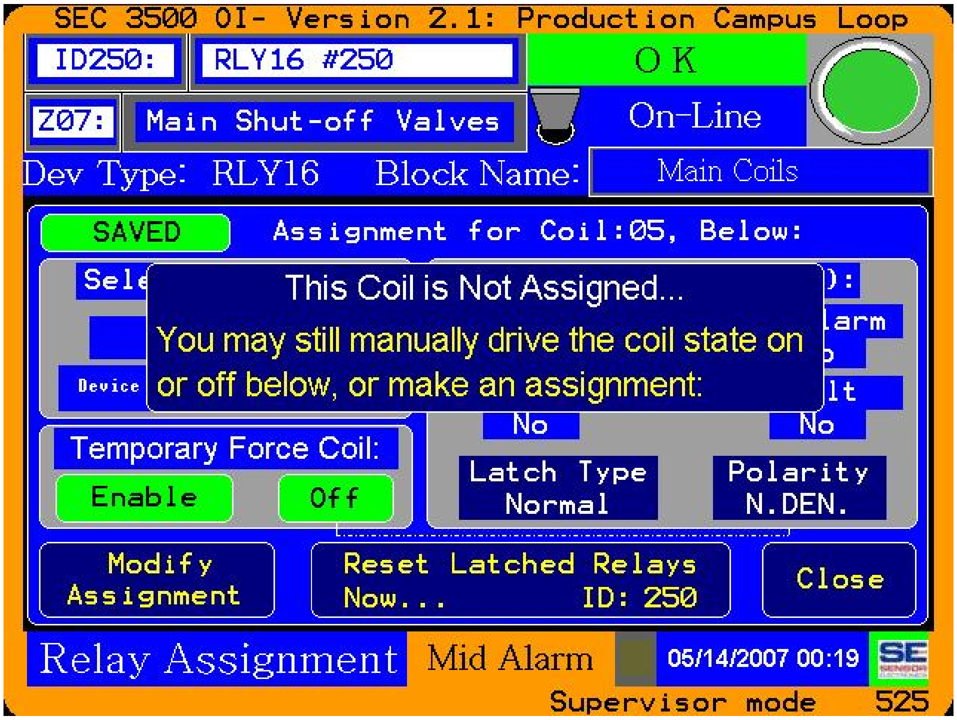
When forcing a coil that has not been assigned, it works exactly the same except the Device Summary screen will not show a green box around the coil you select:



Pictured above is coil #5 assigned, shown with a green box surrounding its current state. Below is depicted coil #5 un-assigned, and therefore not having the green box surrounding the current coil state:

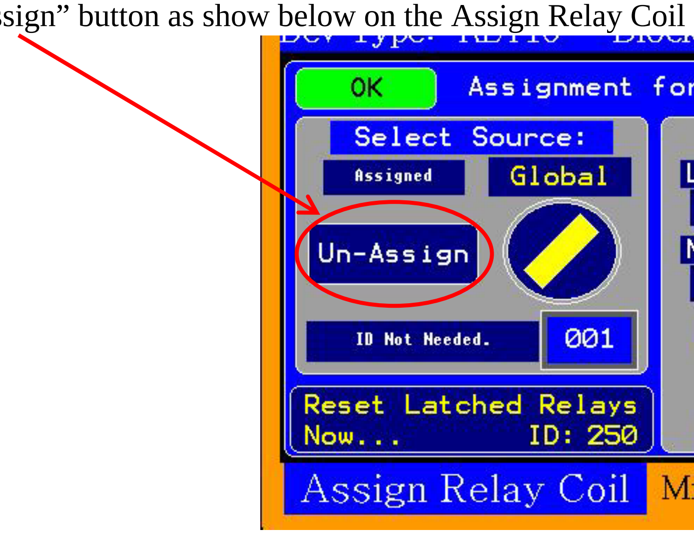


Pressing coil #5 when it is not assigned will result in the following Coil Assignment screen as depicted on the following page:



As shown above, a popup appears in the middle of the display indicating that the coil has not yet been assigned. You can assign this coil by pressing the “Modify Assignment” button, as previously discussed. But more specifically regarding coil forcing, even though it is not assigned, you can still force the coil on or off as indicating in the popup box. The behavior is identical to that previously described for forcing coils.

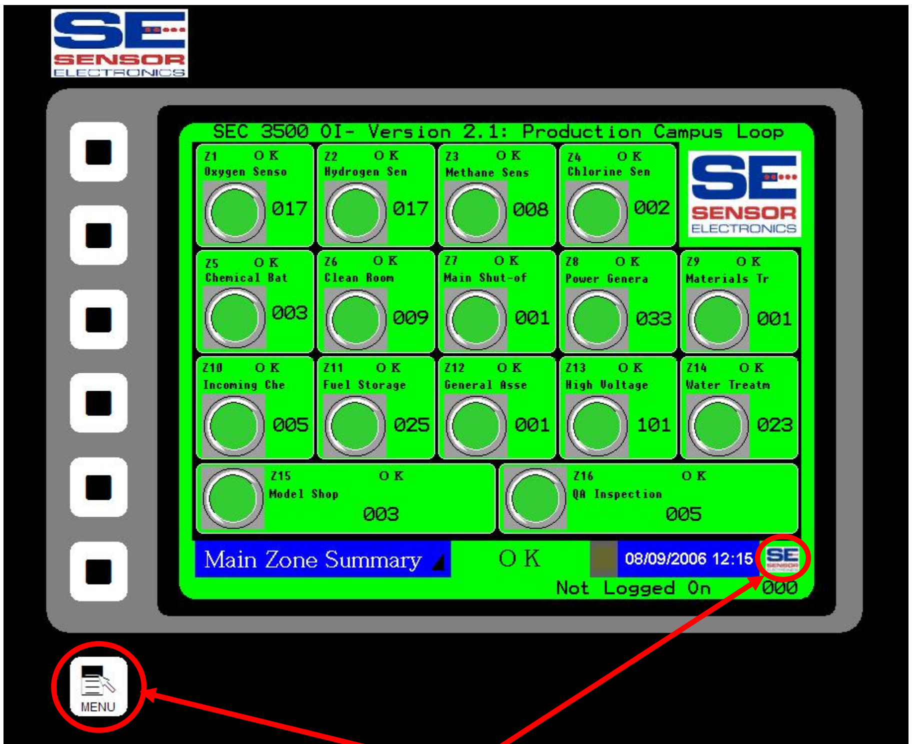
If in the process of assigning a coil or at any other time, you decide you do not want a particular coil assigned anymore, you may un-assign it by navigating from the Device Summary screen for the associated Relay Module, choose the coil, select the “Modify Assignment” button on the Relay Assignment screen as shown above, and then press the “Un-Assign” button as show below on the Assign Relay Coil Screen shown below:



8.0 Configuration Menus

The configuration menus associated within the Supervisor context will be discussed in this section. Up to this point, all focus has been on configuration of attached devices, and first time startup procedures as outlined in the Basic Startup User's Guide. This section is dedicated for functions that are only unique to the SEC 3500 OI Panel. To access them, you must be logged in as the Supervisor.

8.1 Supervisor Login

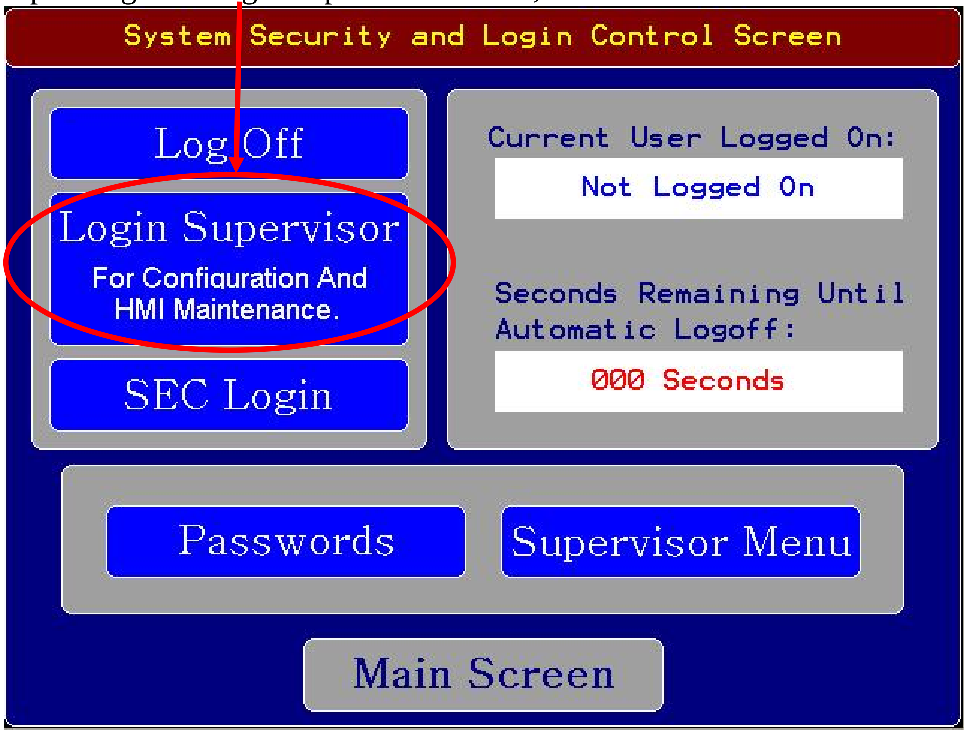


(Menu Button Areas)

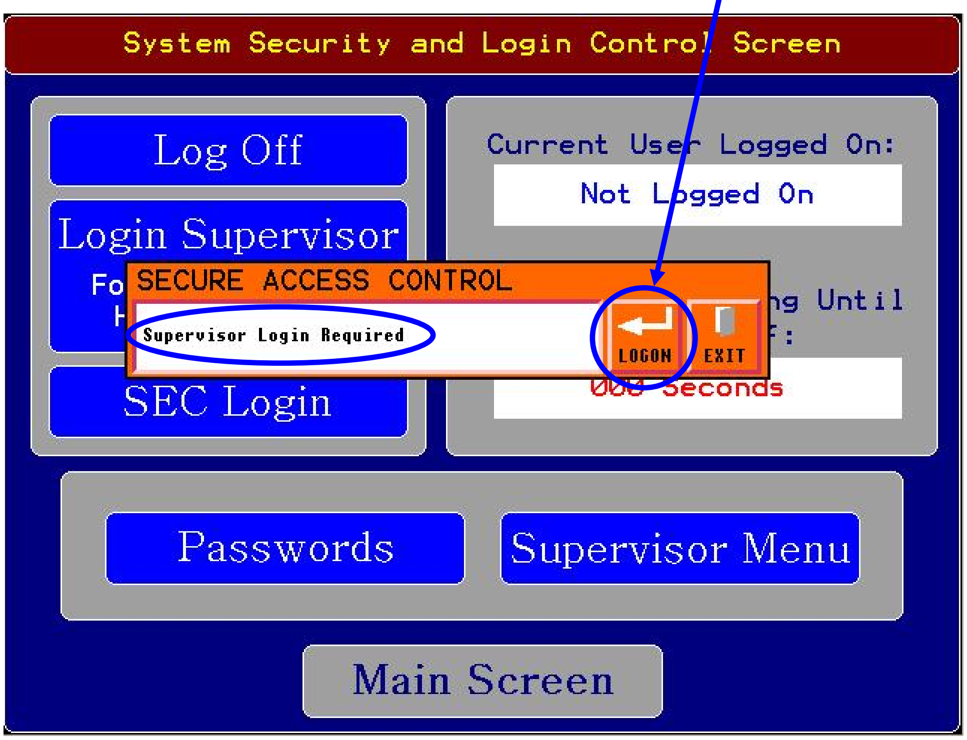
Press one of the above Menu Button Areas to launch the Main Menu:

Then press the "Login/Logout" button to launch the Login Screen:

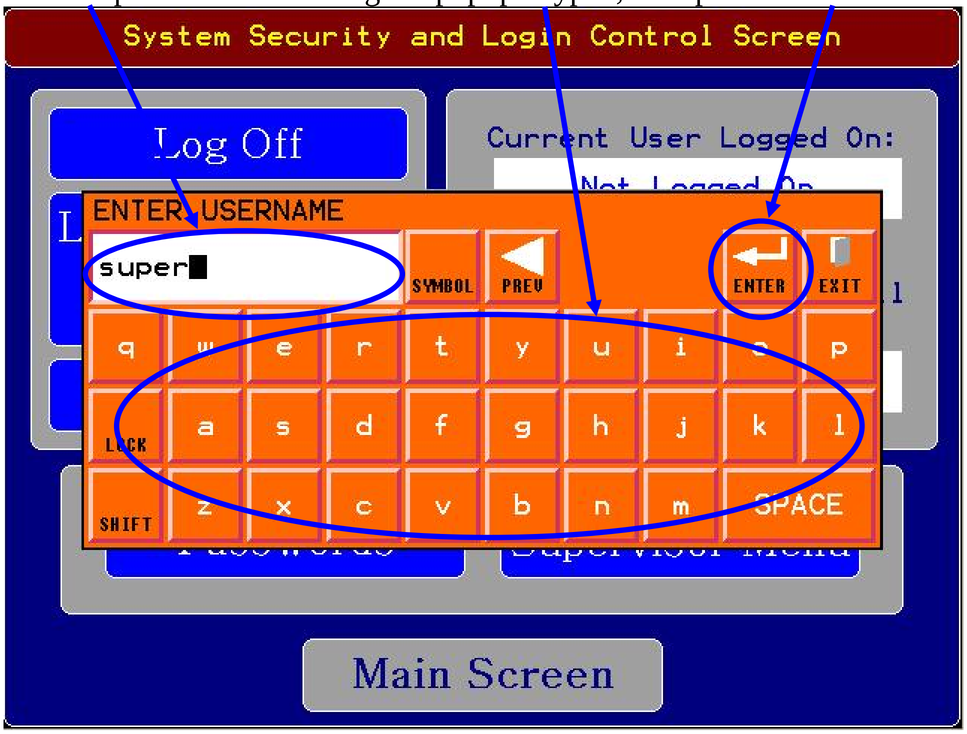
Then pressing the “Login Supervisor” button, as shown below:



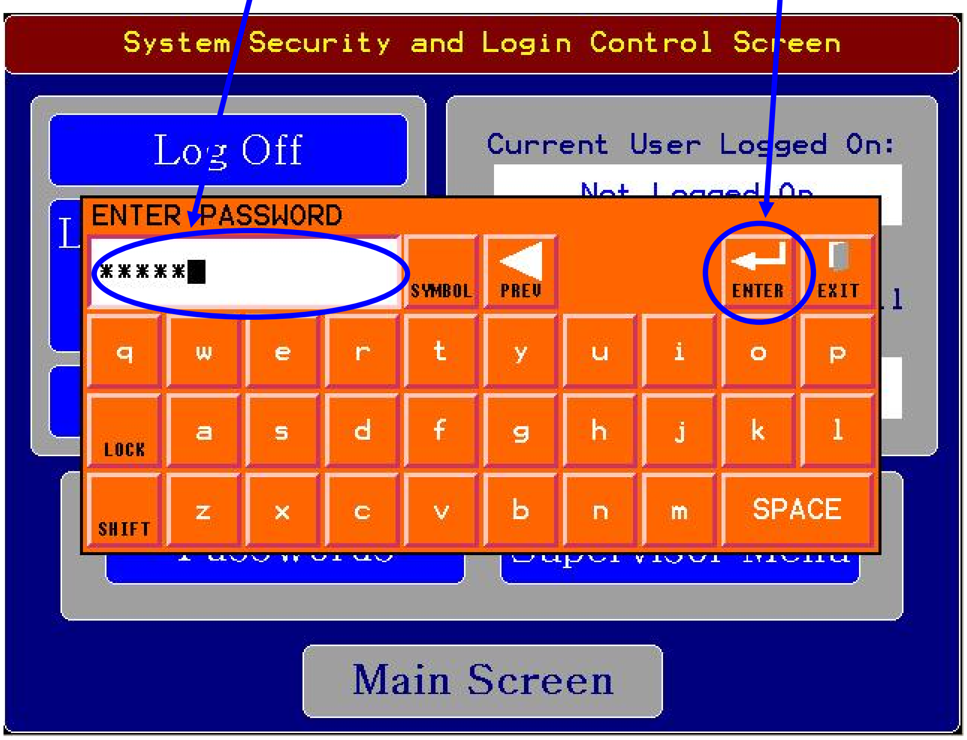
Then entering the Supervisor Name (after pressing LOGON):



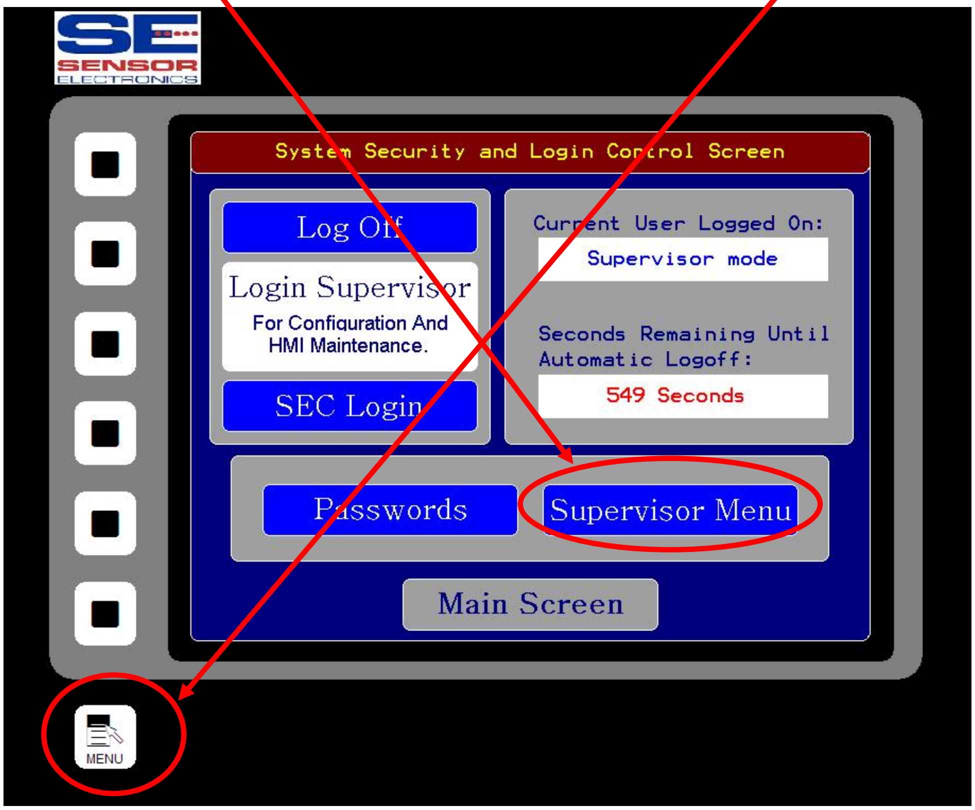
Enter the Supervisor Name using the popup keypad, then press “ENTER”:



Then enter the password on the popup keypad, and press “ENTER”:



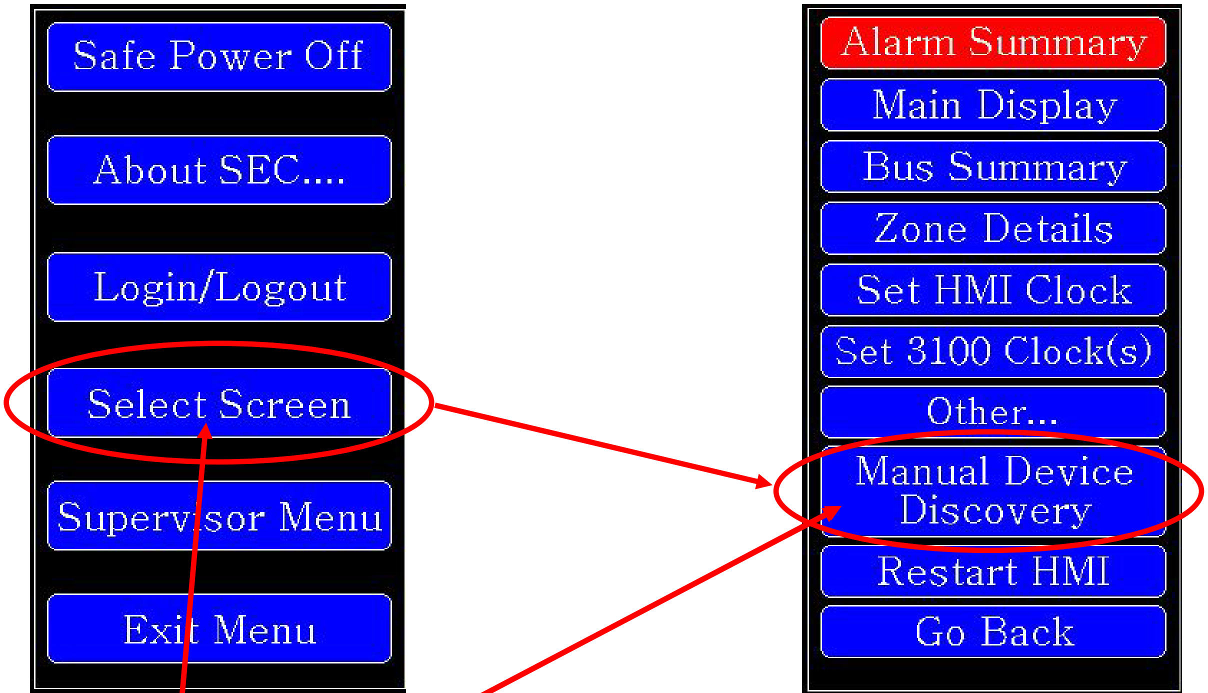
Press the “Supervisor Menu” then “Main Menu” buttons or the Main Menu Key to launch the Main Menu.



8.2 Manually Discovering Devices

There are various reasons for manually discovering devices on the RS485 Modbus. It may be a new setup, or a newly added device, or even a replaced device. If you have not configured the HMI for Auto-Discovery (factory default state), this would then be required, or if you simply want to bring the device up immediately before waiting for Auto-Discovery, then performing this operation manually make sense.

Once logged in as the Supervisor, launch the Main Menu by pressing either the menu key on the bottom-left-hand corner of the HMI, or by pressing the SEC Logo icon on the bottom-right corner of the screen. Choose the “Screen Selection” option from the Main Menu (as depicted on the following page):



"Select Screen" from the Main Menu Launches the Screen Selection Menu- Then choose "Manual Device Discovery" from the Screen Selection Menu, which will transition through the Modbus stop process screen and ultimately show the Manual Device Discovery Screen:

For more information on manual device discovery, see section 3.0 paragraph 3 onward in the Startup Basics Guide.

8.3 Supervisor Menu

The supervisor menu encapsulates configuration of the SEC 3500 OI HMI Panel-specific configuration of 3500 features not specific to other attached SEC devices. We will follow a top-down the menu order.

Main Menu

See Section 8.3.1

See Section 8.3.2

See Section 8.3.3

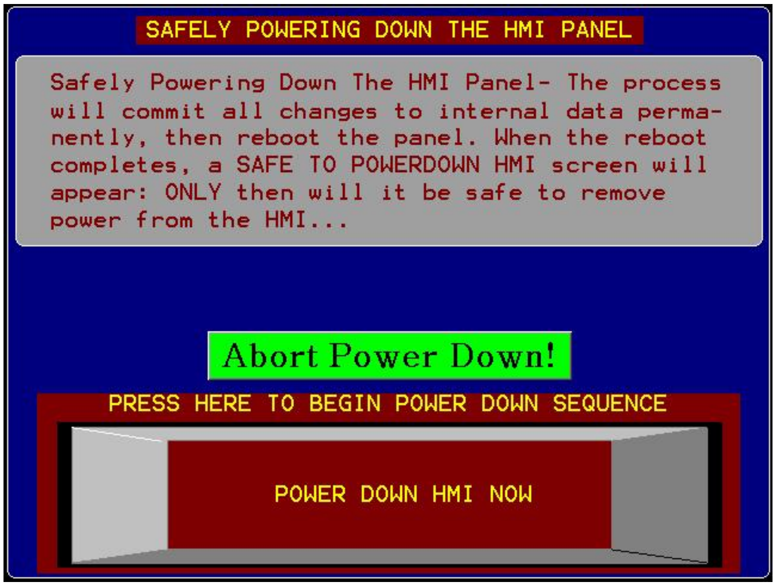
See Section 8.3.4

See Section 8.3.5

Return to previous screen (remove menu)

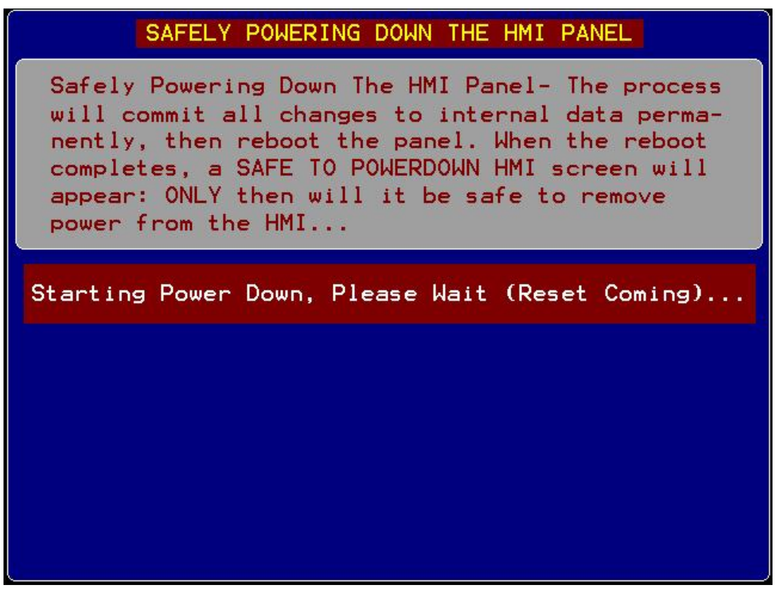
This is the Main Menu, which appears also for the default operator. What is different though, is that in Supervisor mode, the Supervisor Menu button appears active as shown above.

8.3.1 Safe Power Off- Main Menu Item



Perform this operation ***before*** removing power to the HMI to save configuration data permanently. When you make sensor, relay module, or other HMI configuration changes, they are not immediately committed to internal permanent storage. If you cannot afford to lose the changes, then intentionally performing this operation before removing power from the HMI is best practice.

Once you press the big "POWER DOWN HMI NOW" button, the process begins:

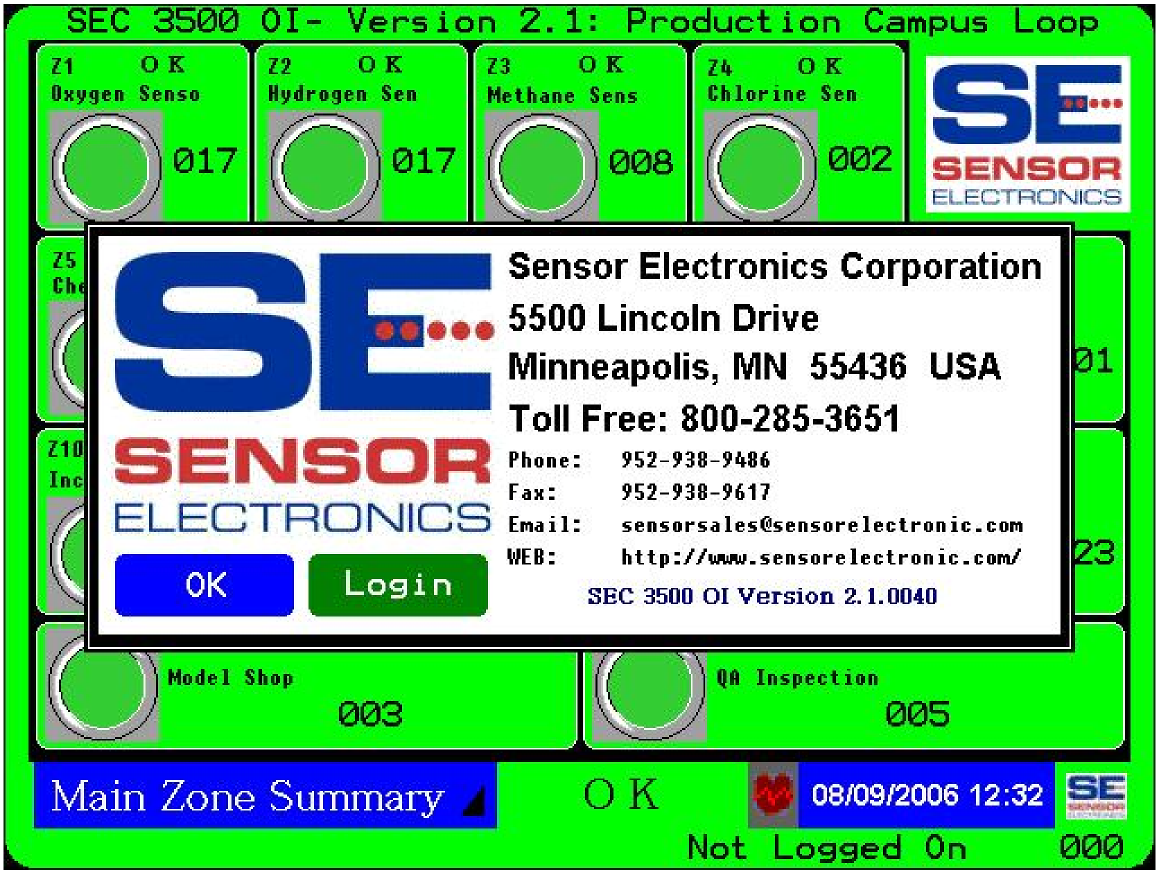


Data is saved to permanent storage and then the HMI will automatically begin to reboot into "Power Down" mode.

Once the panel reboots this screen will appear, indicating that it is now safe to remove power from the HMI and all data has been permanently saved to internal storage. Even when power is restored to the HMI, this screen will continue to return. When you desire to bring the panel back up into operation, press the "Restart" button shown above:

While the HMI is rebooting, this screen is shown, then when finally complete the splash screen is shown and the Main Zone summary screen appears and normal operation has then resumed.

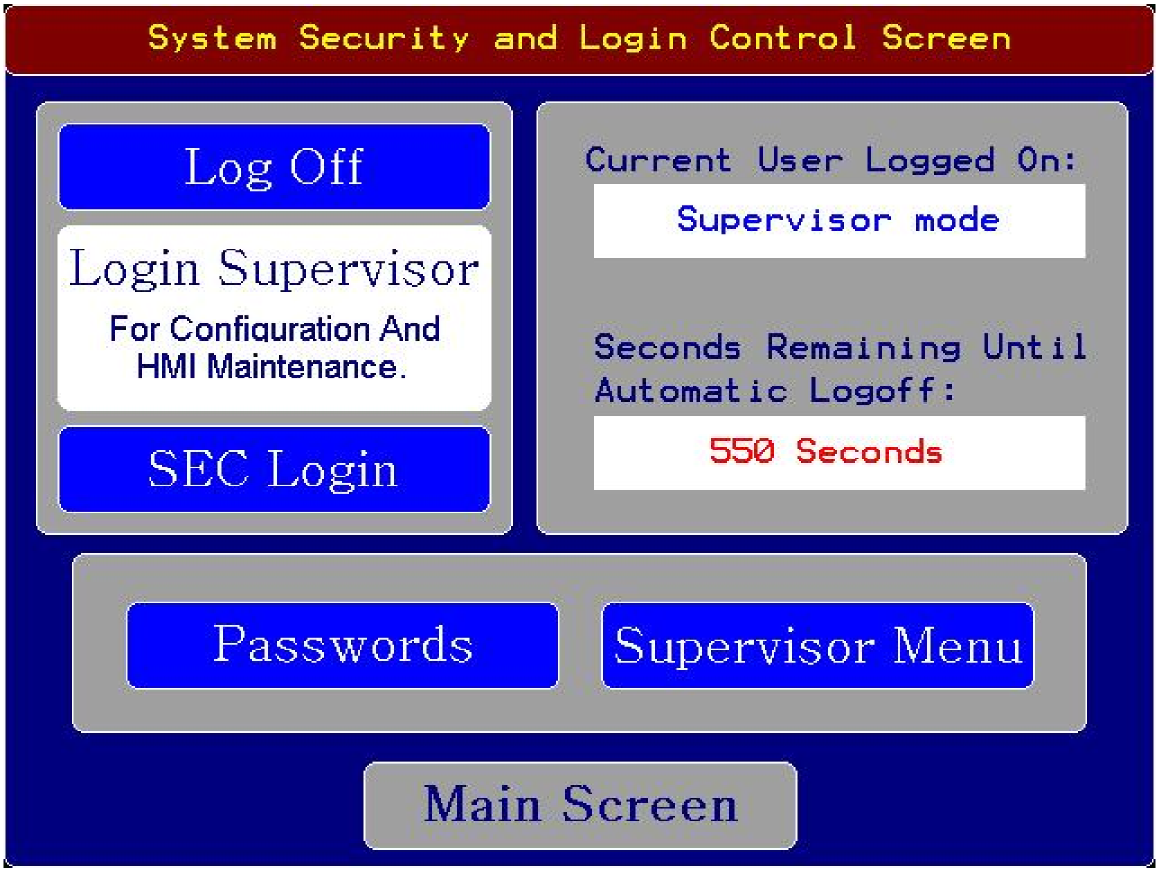
8.3.2 About Screen- Main Menu Item



Shown above is the about screen displayed over (popup) any other screen, after pressing the “About SEC…” main menu button. It will be removed automatically in about 30 seconds, or you may press “OK” at anytime. SEC may ask you for your HMI version- this is how you obtain it.

You may also go directly to the login screen by pressing the “Login” button on the about screen popup (See the next section 8.3.3 for more information).

8.3.3 Login/Logout- Main Menu Option

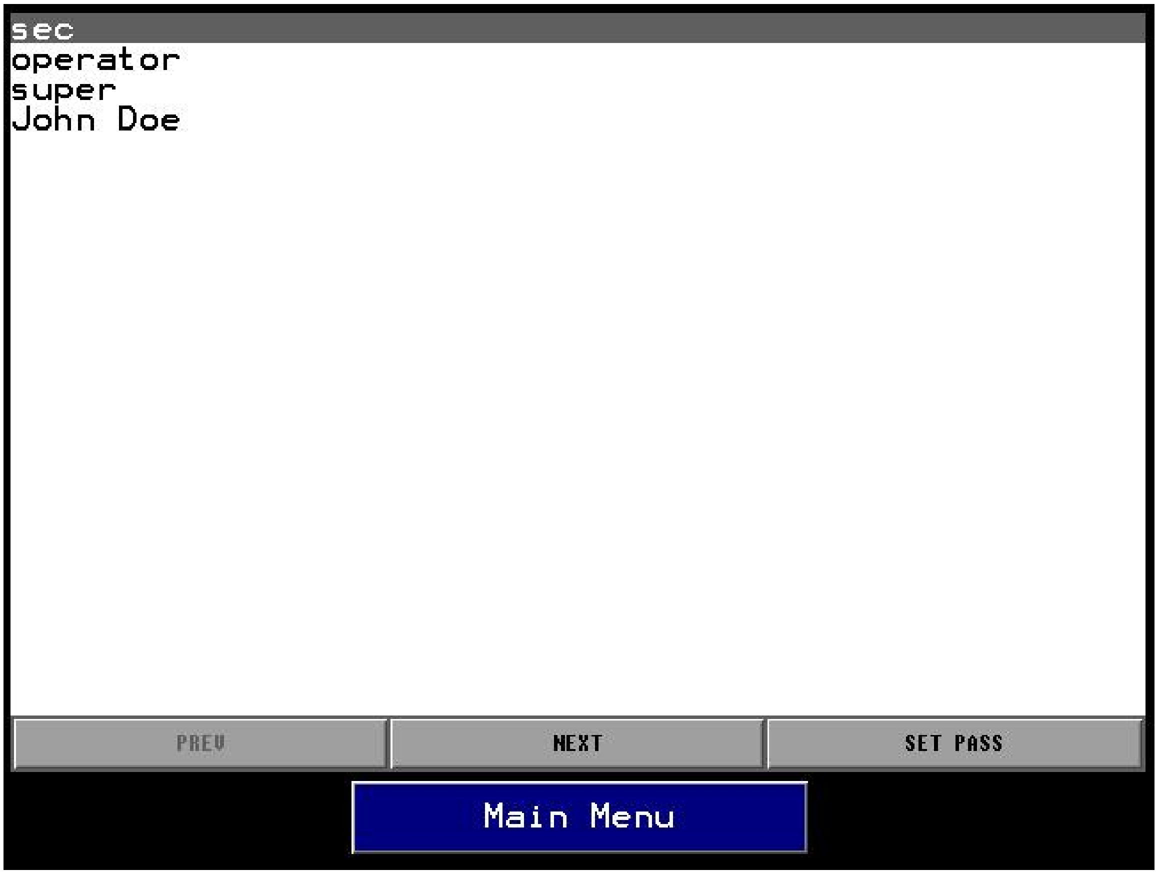


When the Login/Logout button is pressed on the Main Menu, this screen appears. Shown above, the operator category currently logged in is shown as dark blue text on a white background. To the right, the operator name is shown and how much time remains before automatic logoff happens. You have approximately 600 seconds to complete your configuration operations when logged in as the supervisor, regardless of key/touch presses; otherwise you will be automatically logged off. The default operator does not have to be logged in- this is default behavior and therefore can never be automatically logged off.

From here you can choose to Log off (by pressing the “Log Off” button- returning to default operator mode. Do this when you are done configuring to keep configuration secured from tampering. You can Log on as Supervisor by pressing the “Login Supervisor” button, entering the name “super” and the password (default password from manufacturing is “super”), which can be changed on the “Password Change” security screen- shown on the following page. You may also launch the Supervisor Menu directly by pressing the “Supervisor Menu” button.

8.3.3.1 Changing the Supervisor Password

Once you press the “Passwords” button on the Login/Logout Security screen, the security passwords screen is shown below:

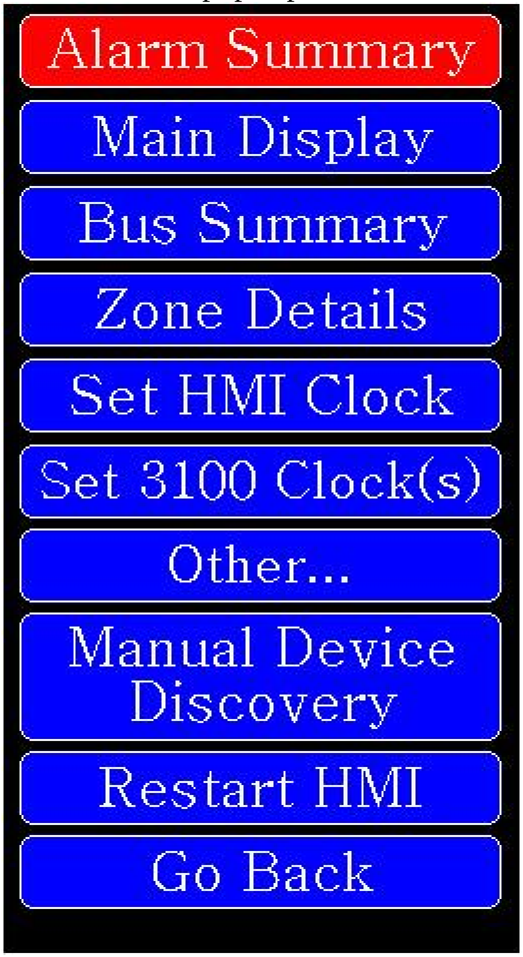


Highlight the name “super” (and not any other name shown above: WARNING: do not change the password for any other name shown above other than “super” or access to the panel could be locked out). Then press the “SET PASS” button at the bottom-right. A popup requests you to change the password to a new value and validate it. Do not forget this password!

Press the “Main Menu” button to leave the password change screen.

8.3.4 Screen Selection Menu- Main Menu Option

Once you have selection the “Select Screen” option from the main menu, the screen selection menu pops up as shown below:



See the Basic Operator’s Guide

See the Basic Operator’s Guide

See the Basic Operator’s Guide

See the Basic Operator’s Guide

See the Basic Operator’s Guide

See Section 6.4

Does nothing at this time

See Section 8.2

Restarts the HMI

Returns to the main menu

8.3.5 Supervisor Menu- Main Menu Option

See Section 8.3.5.1

See Section 8.3.5.2

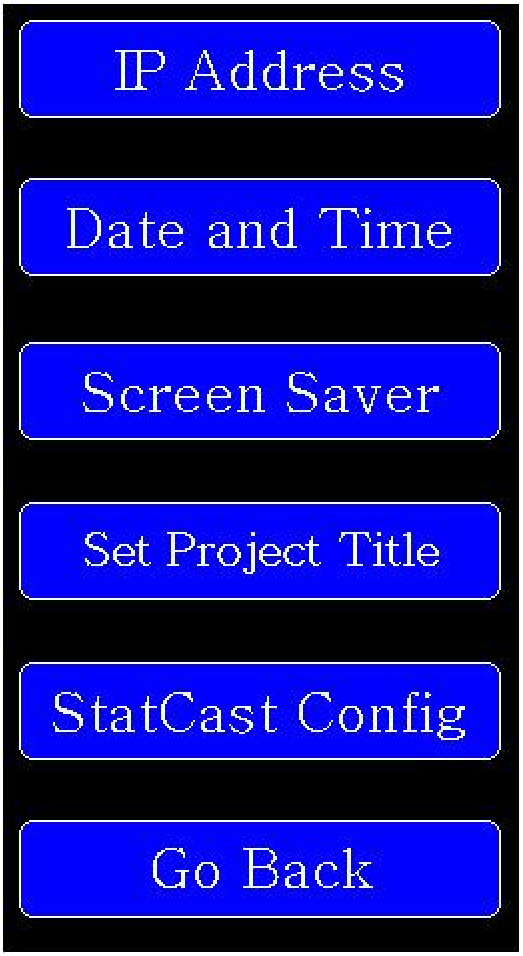
See Section 8.3.5.3

See Section 8.3.5.4

Not allowed- SEC only.

Return to the Main Menu

8.3.5.1 Configuration Menu- Supervisor Menu Item



See Section 8.3.5.1.1

See Section 8.3.5.1.2

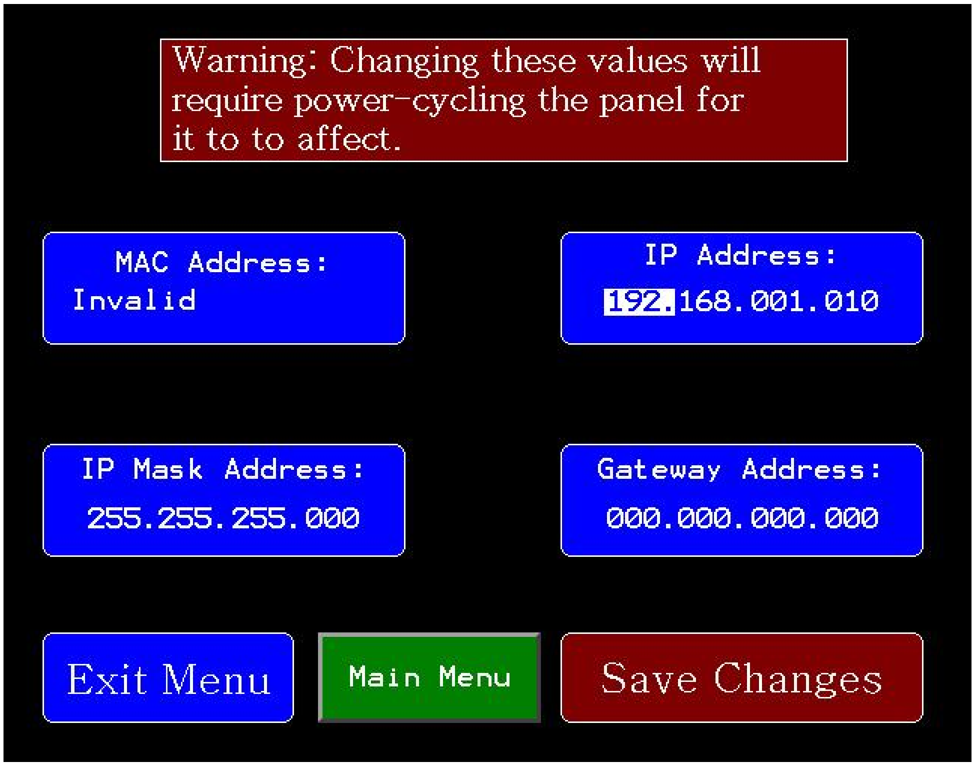
See Section 8.3.5.1.3

See Section 8.3.5.1.4

See the StatCast Configuration Guide

Go back to the Supervisor Menu

8.3.5.1.1 Change IP Address Screen

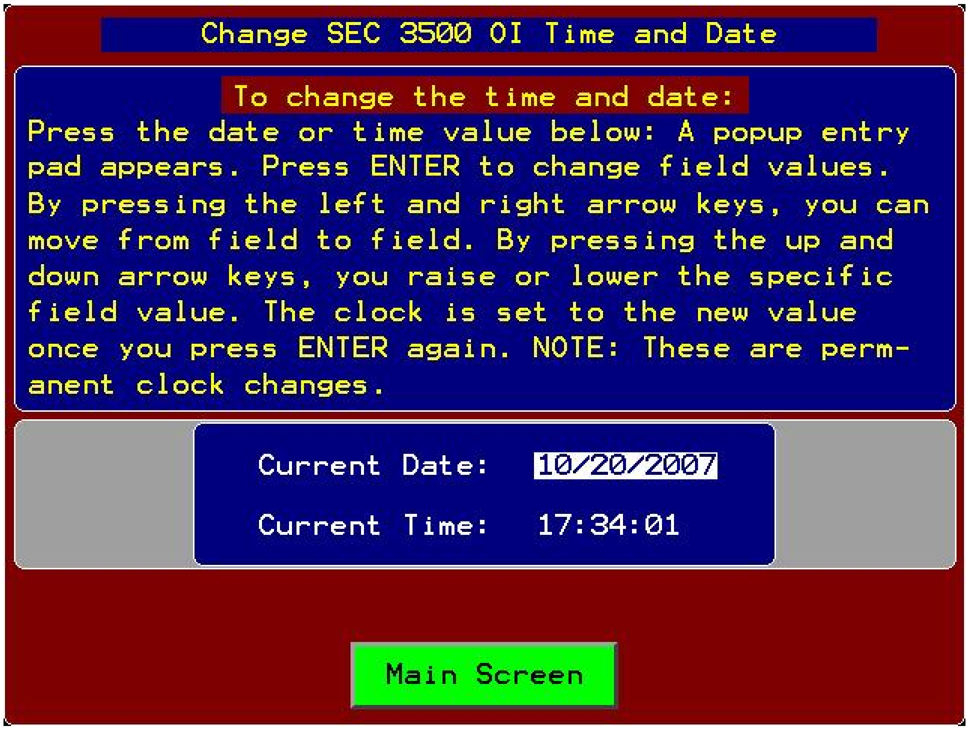


The Ethernet IP address and other related network parameters can be set as shown above, for your specific factory or management network if you intend to have network access to your SEC 3500 OI HMI panels. If you do, you can take advantage of the built in WEB server that allows viewing of real-time summary statistics, data trending (when it is added), other future WEB pages, as well as remote access and control of the HMI through a WEB browser. Additionally, there are future possible connectivity options over the Ethernet port such as OPC, Modbus Ethernet/IP, and many others.

The HMI's MAC address is displayed in the top-left panel- this cannot be changed but can be used for adding this panel as a trusted device in a secured domain- this address uniquely identifies each individual panel on the network. The top-right panel allows entry of the assigned static IP address, obtained from your network administrator. The lower-left panel allows entry of your subnet mask, and the bottom-right panel allows you to enter your gateway IP address- both obtained from your network administrator.

Once you are done making your changes, you MUST press "Save Changes" for them to take effect- the panel will be rebooted automatically once you press "Save Changes" and the IP settings will not go into effect until the panel is rebooted and up and running. It is important to power-cycle the unit after it is rebooted to be certain that the IP settings are truly set and functioning as intended.

8.3.5.1.2 Change Date and Time Screen

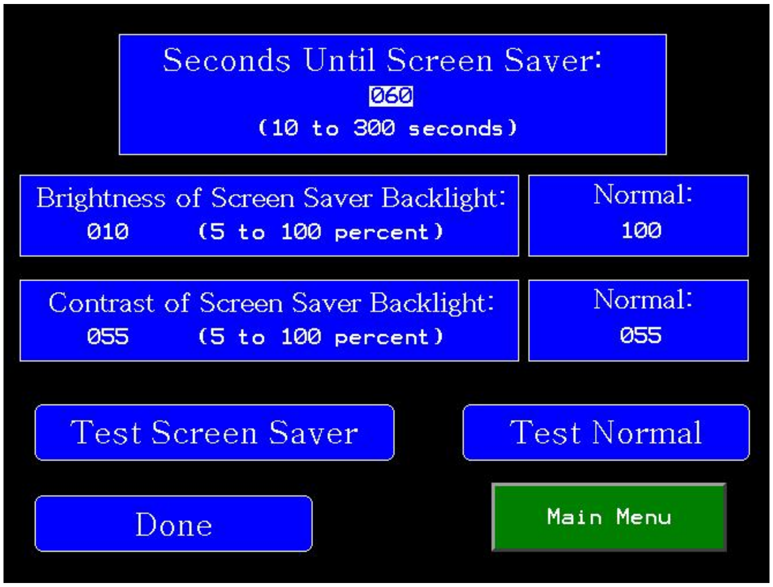


The screen shown above, for setting the SEC 3500 OI HMI Panel Clock is accessed from both the Main Menu and the Supervisor Configuration Menu. Simply enter the date in the date field and enter the time in the time field when you touch the values above respectively; a popup keyboard appears for you to enter the current time or date.

This date and time is used to synchronize the SEC 3100 devices attached to the SEC Modbus loop, when you choose to set their clocks. It is especially useful when setting ALL SEC 3100 devices on the Modbus loop at once since the process grabs the real-time HMI clock at the instant a device is ready to receive the clock update- moreover, as the HMI continues the sync process it re-adjusts the 3100 clock(s) until it is within 5 seconds of the HMI clock.

In the future, an option may be added to have the HMI clock automatically synchronized to a network time server over the Ethernet port, to keep all HMIs in time-sync and all their associated Modbus networks and devices in time-sync.

8.3.5.1.3 Set Screen Saver Options Screen



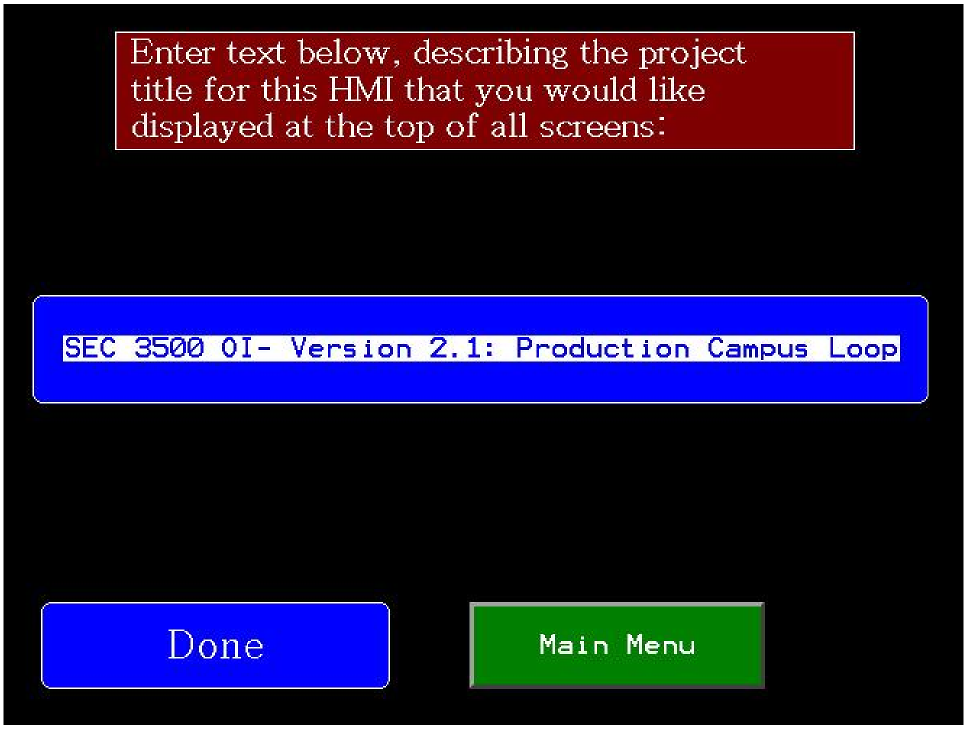
Setting the screen saver settings is accomplished after selecting this option from the Supervisor Configuration Menu. Here you can make changes and test them- especially the normal brightness and contrast of the LCD display without leaving the screen, whereas testing the screen saver takes you away and returns to the home screen, where you will have to come back to the Screen Saver Settings Screen to make any further changes if needed.

Seconds Until Screen Saver: Changing this setting allows you to vary the time delay from when a screen enters until it is automatically brought to the screen saver with no user key/touch activity. When returning from the screen saver, the system will revert back to the home screen regardless of where the screen saver started from. Valid values are from 10 seconds to 300 seconds.

Normal Brightness and Normal Contrast: These values define how the normal screens appear- how bright, and how much contrast. These values do not apply to the screen saver. Valid values are between 5 and 100 percent. Depending on the LCD angle, contrast values should not generally exceed 55 or the screen will wash out. Brightness however, may need to be near 100 depending on the operating environment, and assuming a brightly lit area. If the area is low light, then the brightness can bee reduced.

Screen Saver Brightness and Contract (Backlight): These values define how the screen saver appears. The goal of the screen saver is to greatly extend the life of the LCD backlight, which can be rather short if left on and on high contrast and brightness for long periods of time. The contrast value can remain the same as normal if desired, however the main value to change is the brightness, since this directly controls the backlight level. This value should be set to 5 or 10 percent- just enough to barely see that something is there.

8.3.5.1.4 Set Project Title Screen



This screen is entered by selecting this option from the Supervisor Configuration Menu. This text will be displayed at the top of all screens, prominently on the Splash Screen, and scrolling in the screen saver.

Simply touch the title area in the middle of the screen, and enter the title you wish to use on the popup keyboard and press done. You should use a name that describes the function of this particular Modbus sensor loop, panel role, or something unique to distinguish this panel or configuration from others in the same area.

8.3.5.2 Global Reset Feature- Configuration Menu Item

As shown above, the “Global Reset” feature can be enabled or disabled. By pressing the button, it will toggle between “On” and “Off”. This feature when enabled, allows the operator to reset Relay and Sensor global alarm latches when any that have been configured become latched- As described in the Basic Operator’s Guide and the Startup User’s Guide. When a global alarm latch occurs and this feature us enabled, an Icon appears in the top-right corner of the display allowing a reset of the latch conditions (it is first hidden by the “Silence Audible Alarms” icon.

8.3.5.3 Delete Devices- Supervisor Configuration Menu Item

See section 5.1 for more details.

8.3.5.4 Auto Device Discovery- Supervisor Configuration Item

As shown above, the Auto Discovery feature can be enable or disabled. By pressing the button, it will toggle between “On” and “Off”. This feature when enabled, allows the HMI to automatically (in the background) periodically check for newly added devices to the SEC Modbus. If it finds a new device it recognizes, it will popup a “loading parameters” box and load all parameters from the device and add it to the HMI database and screens. By disabling the feature, devices are not automatically discovered- therefore a new device added must be discovered manually using the Manual Device detection screen as described in section 8.2.

SEC 3500 OI
Startup Basics
Manual

May, 2007

Sensor Electronics Corporation
5500 Lincoln Drive
Minneapolis, Minnesota 55436 USA
(952) 938-9486

Table Of Contents:

1.0 Purpose

This document describes how to get started with the SEC 3500 Operator Interface (OI) Panel. It describes the basics of discovering SEC Modbus 485 devices, and the basic startup configuration. This document is NOT a detailed all-encompassing Startup, Basic Operator, Supervisor or Technical User’s Manual. This manual is part of a documentation pack that contains all necessary information for using, starting up, configuring and enabling higher-end functionality, and is the first manual in the pack necessary for getting started.

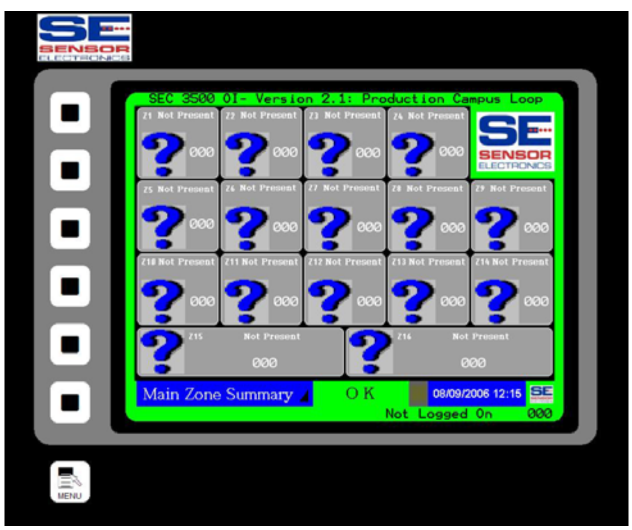
2.0 Overview

The SEC 3500 OI Panel drives and masters the SEC 3500 Modbus 485 Digital Gas Monitoring Loop, based on the loop-attached SEC 3100 Digital Gas Transmitter slaves. It draws information from all SEC 3100 Digital Gas Transmitters on the loop into a single location, where all information is accessible and configurable. In addition, it adds features for controlling separate SEC Modbus 485 Relay modules, allowing a central coordinated command and control center for a given loop.

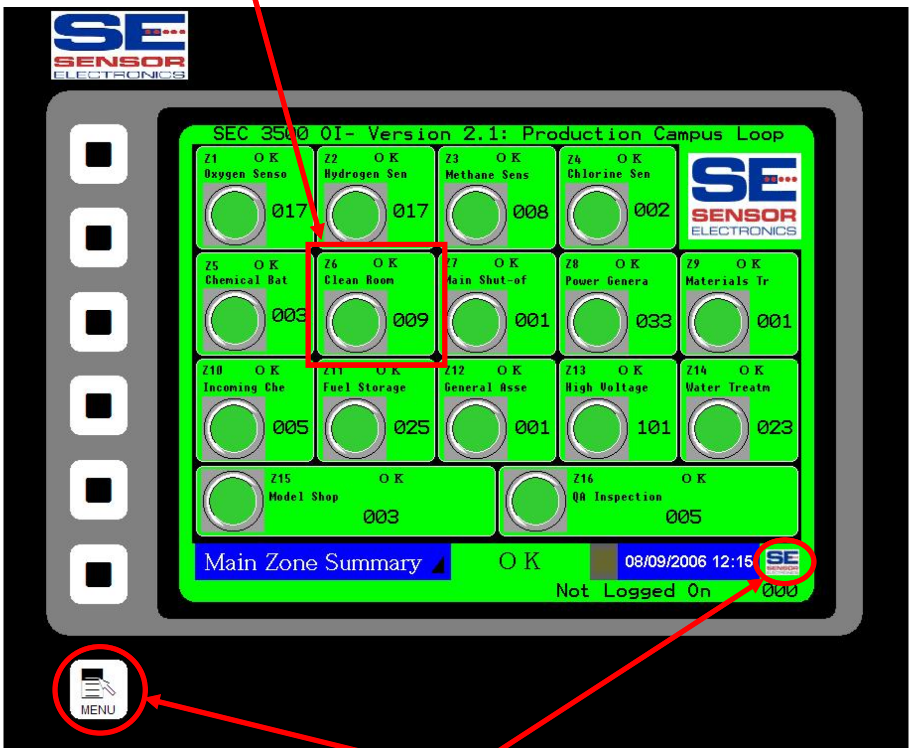
The SEC 3500 OI is a self-contained standalone intelligent touch-screen Human Machine Interface (Operator Interface Panel). It contains various communication ports for RS485 communications, RS232 Gas Status Text Dumps, and 10/100mb Ethernet for Web-based services. It also contains a compact flash card socket for software updates and data logging. It operates on 24vdc, and permanently stores its program and non-volatile data in internal flash memory- There are NO disk drives.

3.0 First Time Setup/Updating Setup

The very first time you turn on the SEC 3500 with a SEC 3500 Modbus 485 Digital Gas Monitoring loop connected with SEC 3100 Digital Gas Transmitter slave(s) attached, you may have a blank main screen once it is powered up, such as this:



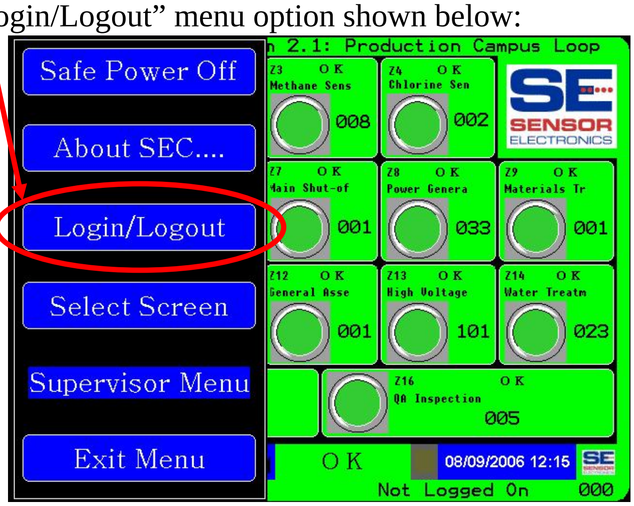
If so, then this is either the first time the 3500 has been powered on, or you do not have the Gas Monitoring loop setup/configured properly, or you have not detected any SEC 3500 compatible devices yet. Otherwise, if at least one compatible device is connected, online and had been setup previously, then at least one of the sixteen zone summary boxes would be green- see below:



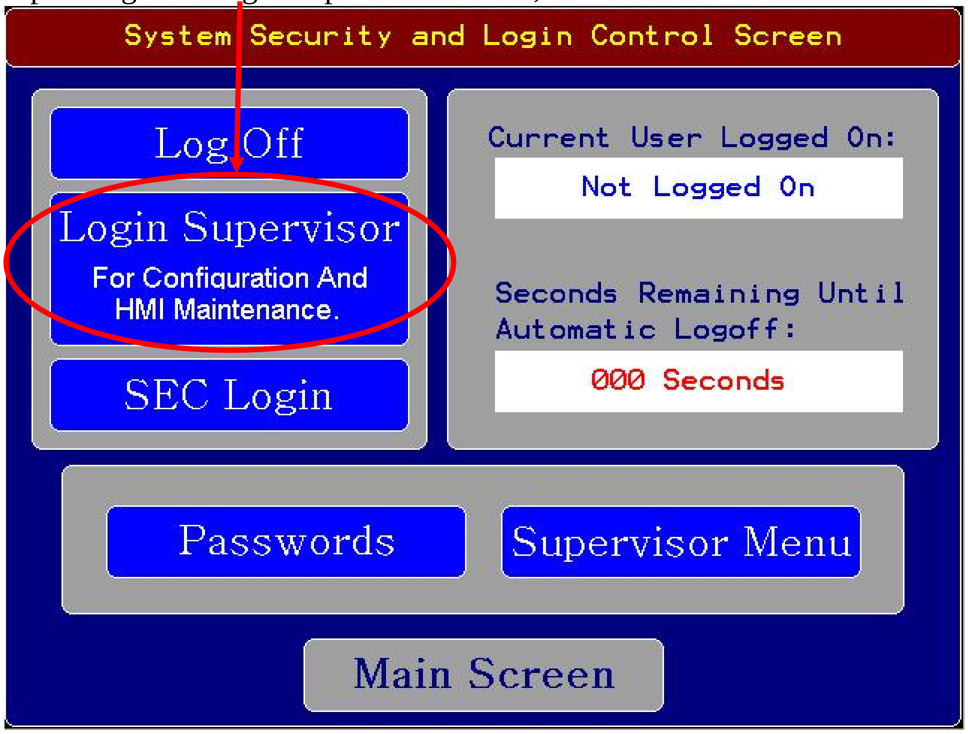
(Menu Button Areas)

If this is the first time startup, or scanning the loop for new devices, the following must be performed (***do not follow this for loops that will contain SEC Relay Modules-*** See Section 4.0 and in depth look at configuration in the Supervisor's Manual):

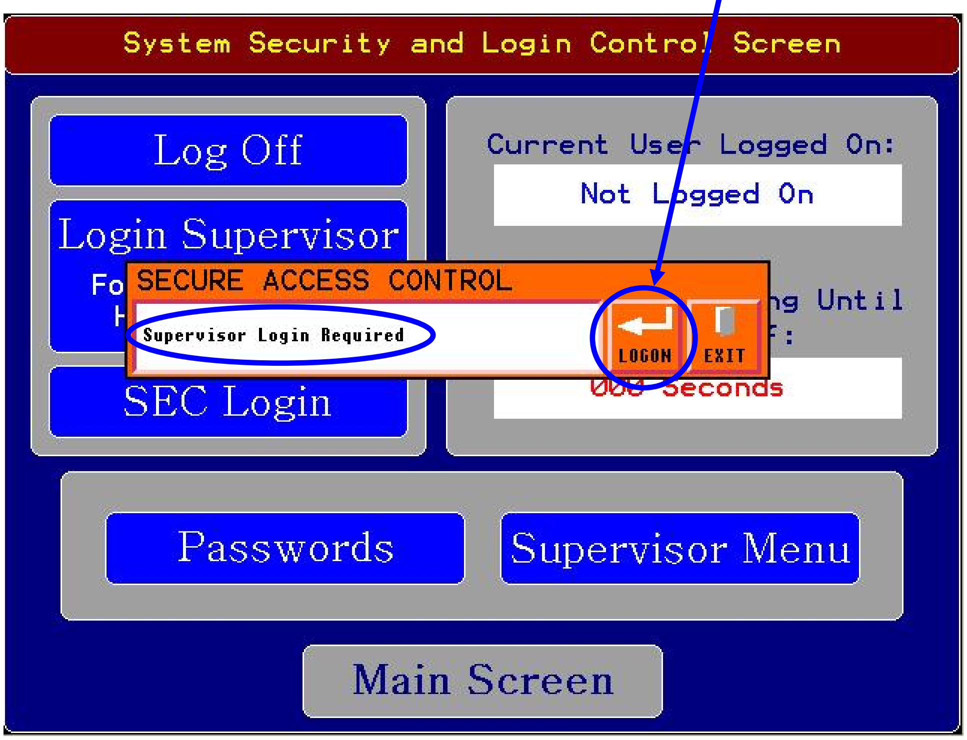
1) The supervisor must login to the 3500, by either pressing the Menu button or touching the SEC logo at the bottom-right of the screen, as circled in red above, selecting the "Login/Logout" menu option shown below:



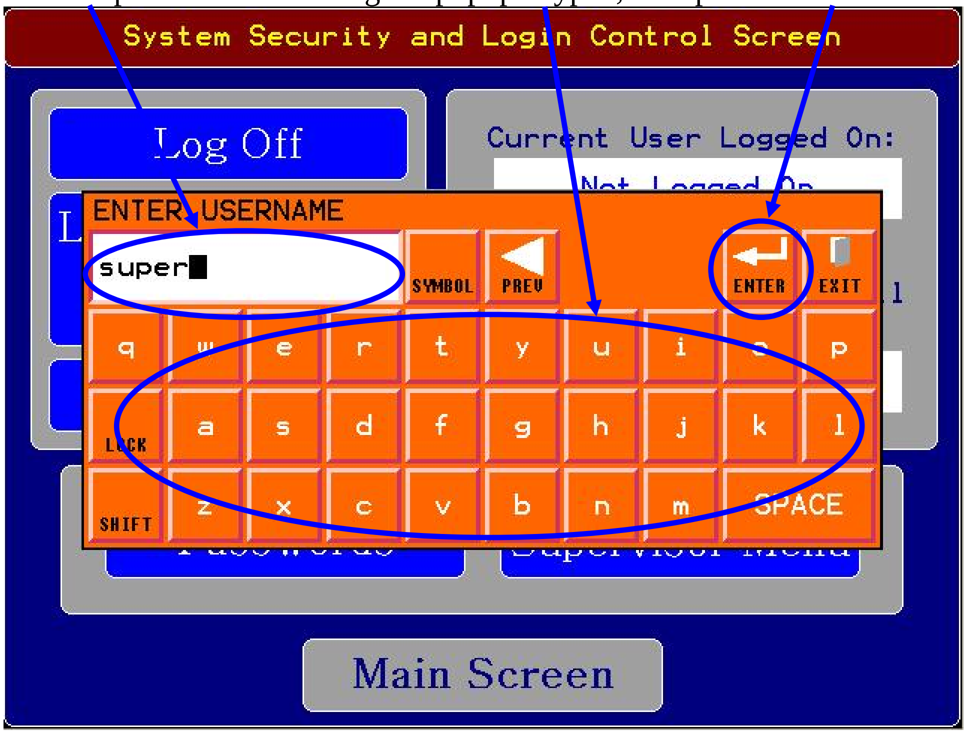
Then pressing the “Login Supervisor” button, as shown below:



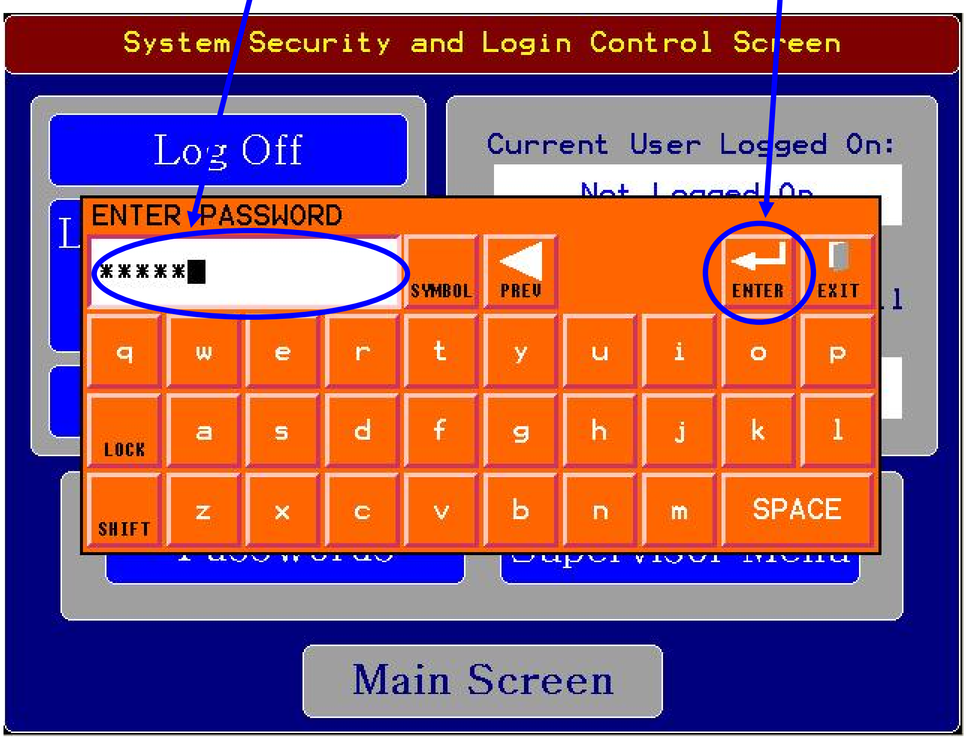
Then entering the Supervisor Name (after pressing LOGON):



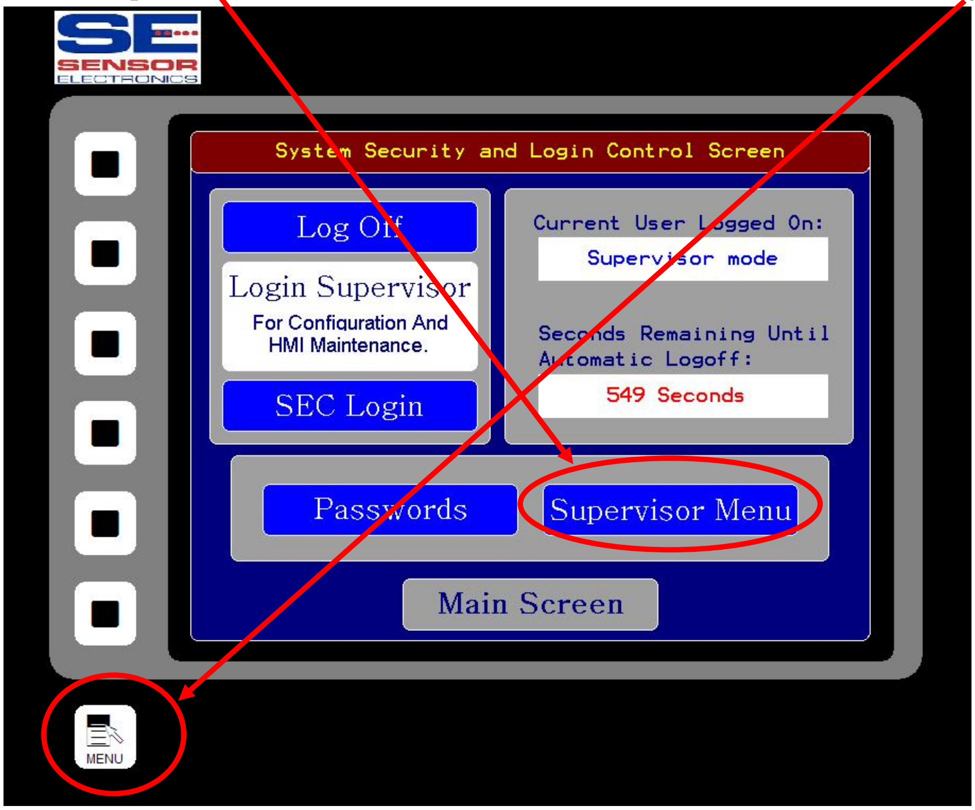
Enter the Supervisor Name using the popup keypad, then press “ENTER”:



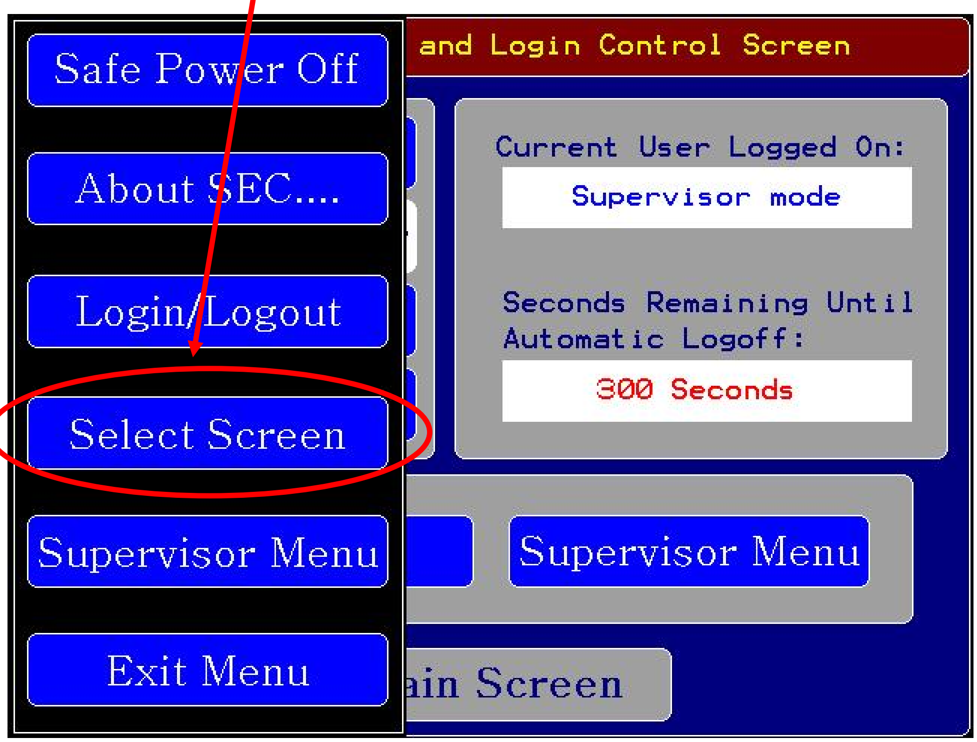
Then enter the password on the popup keypad, and press “ENTER”:



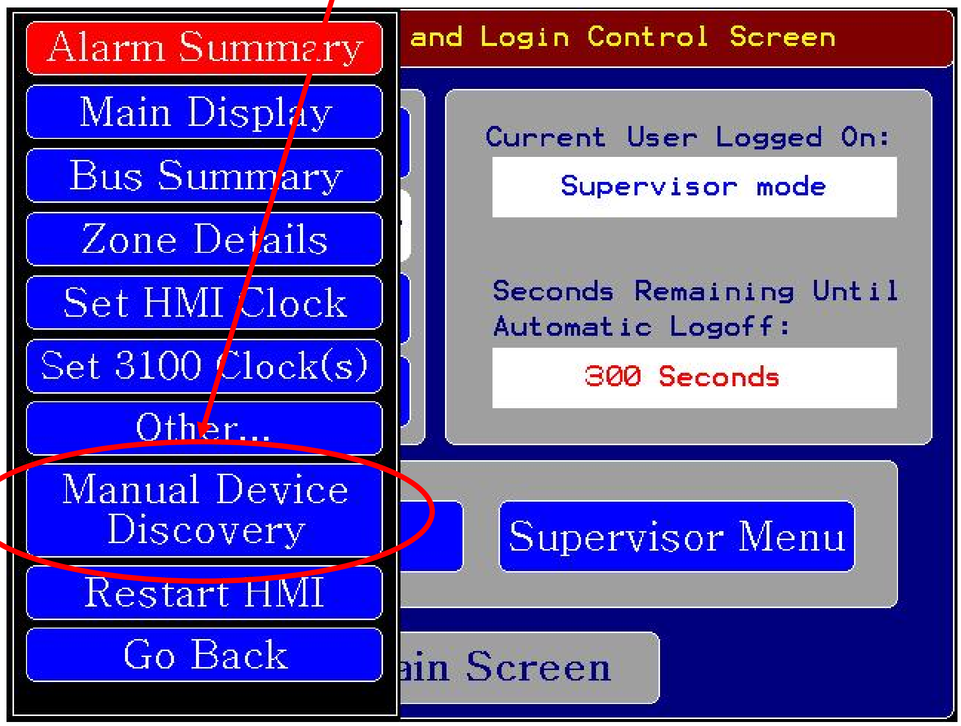
2) Press the "Supervisor Menu" then "Main Menu" buttons or the Main Menu Key:



Then press the "Select Screen" button:

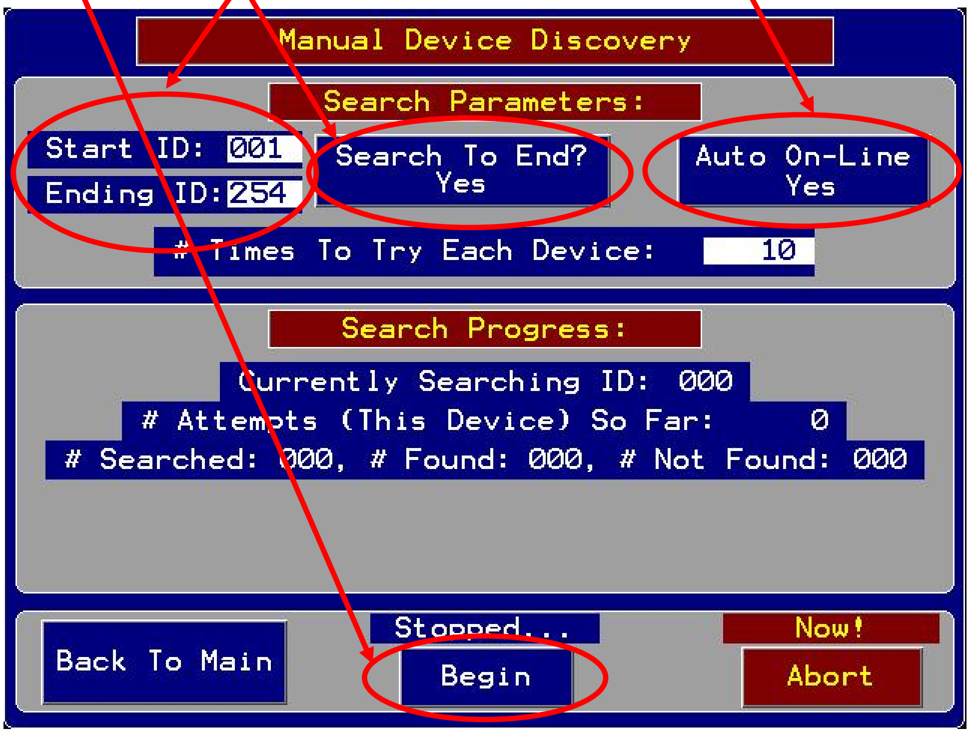


Then press the "Manual Device Discovery" button:



Which then transitions through the Primary Detection Loop Stop Screen:

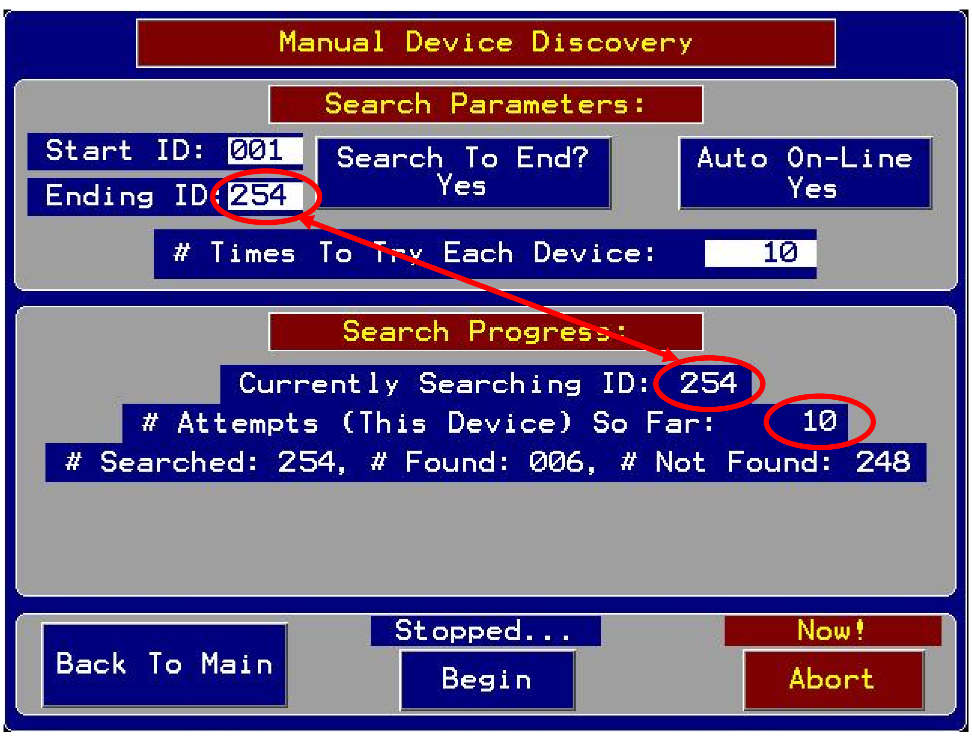
3) Then enter the start and ending device ID (search range) to search, insure that "Search To End" is set to "Yes", and "Auto On-Line" is set to "Yes", as shown below, and press "Begin":



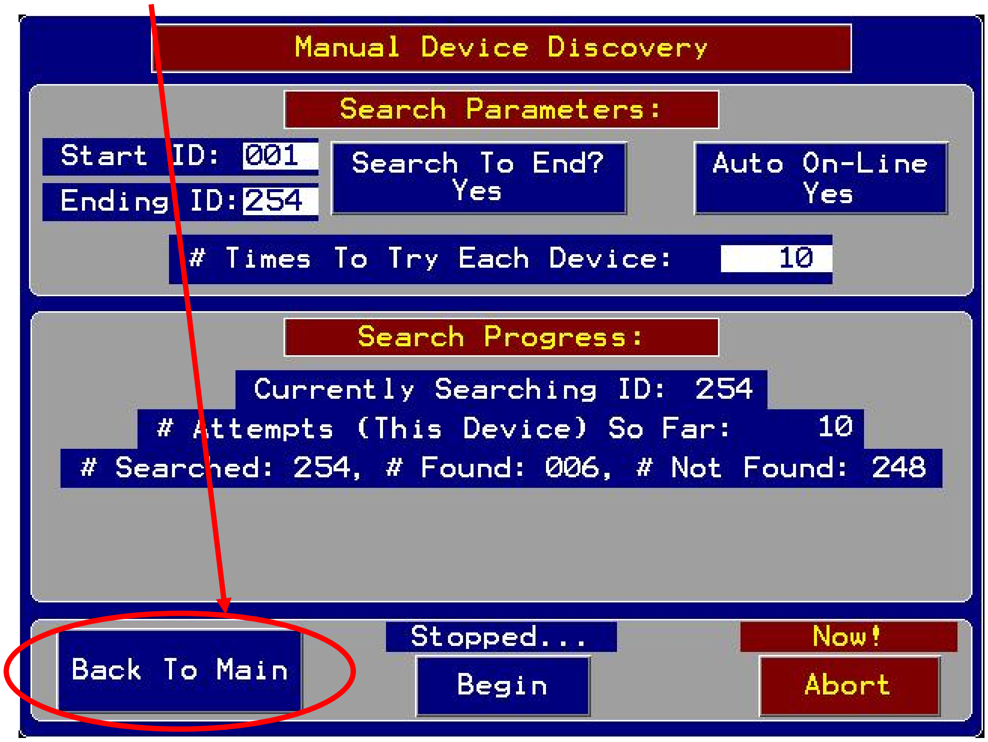
As the device discovery is in progress, the status is updated as below (circled):

Found devices automatically are identified and brought on-line:

4) When discovery is complete, the "Currently Searching ID" will show the "Ending ID", the "# Attempts…" will have stopped counting, and the popup "Reading…" box will have disappeared, as shown below:

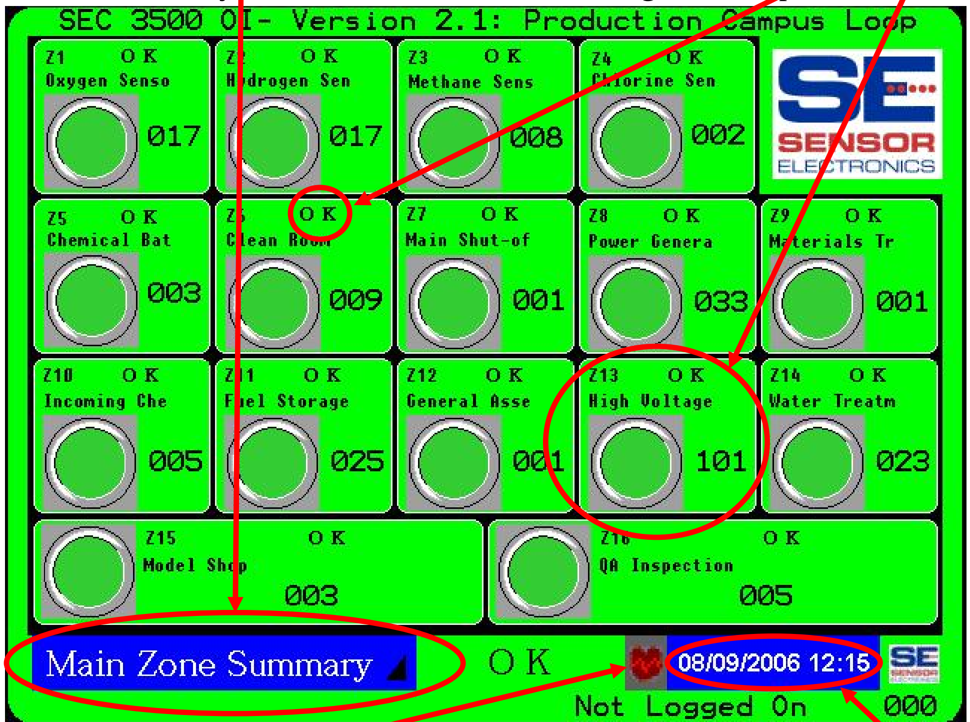


Press “Back To Main” next:



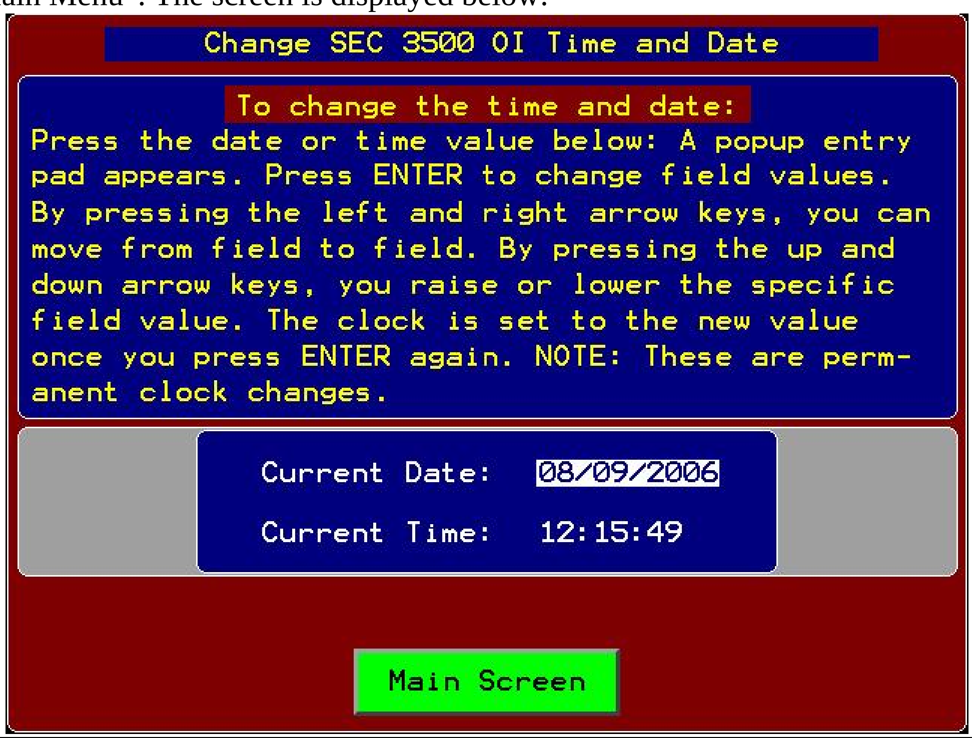
5) Then the “Start Primary Loop” screen transitions to the Main Screen:

6) The "Main Zone Summary" screen is displayed, with the correct zone squares populated with newly discovered devices and showing normal operation:

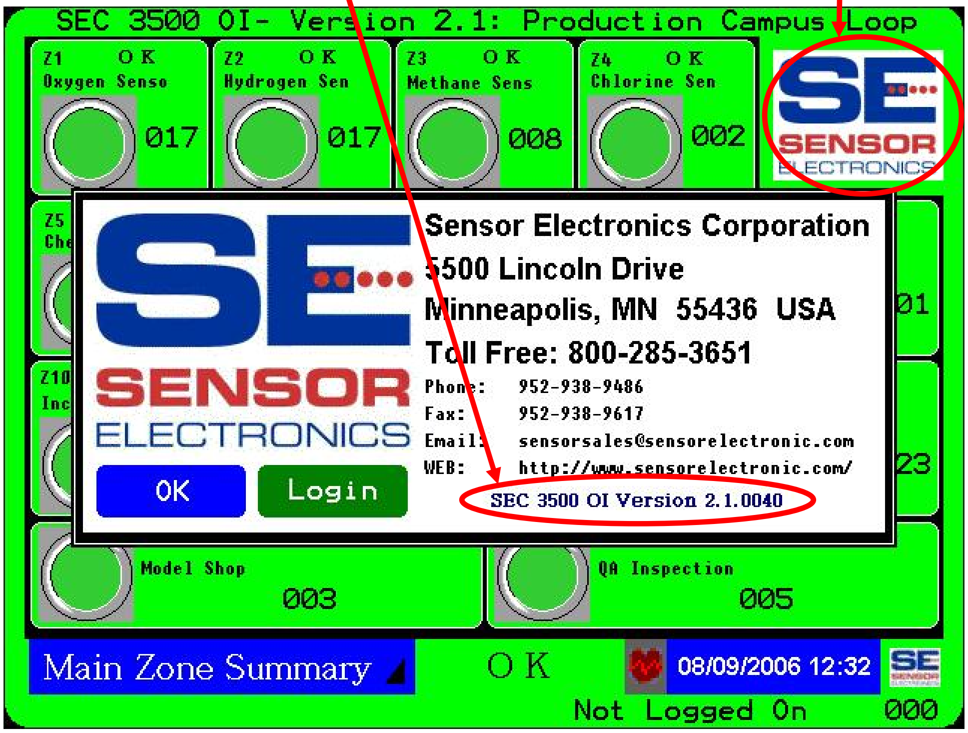


Periodic Flashing (Communication Functioning Properly)

7) Set the time and date- press either the clock display at the bottom/right corner of the screen or select "Set HMI Clock" from the "Select Screen" menu item from the "Main Menu". The screen is displayed below:



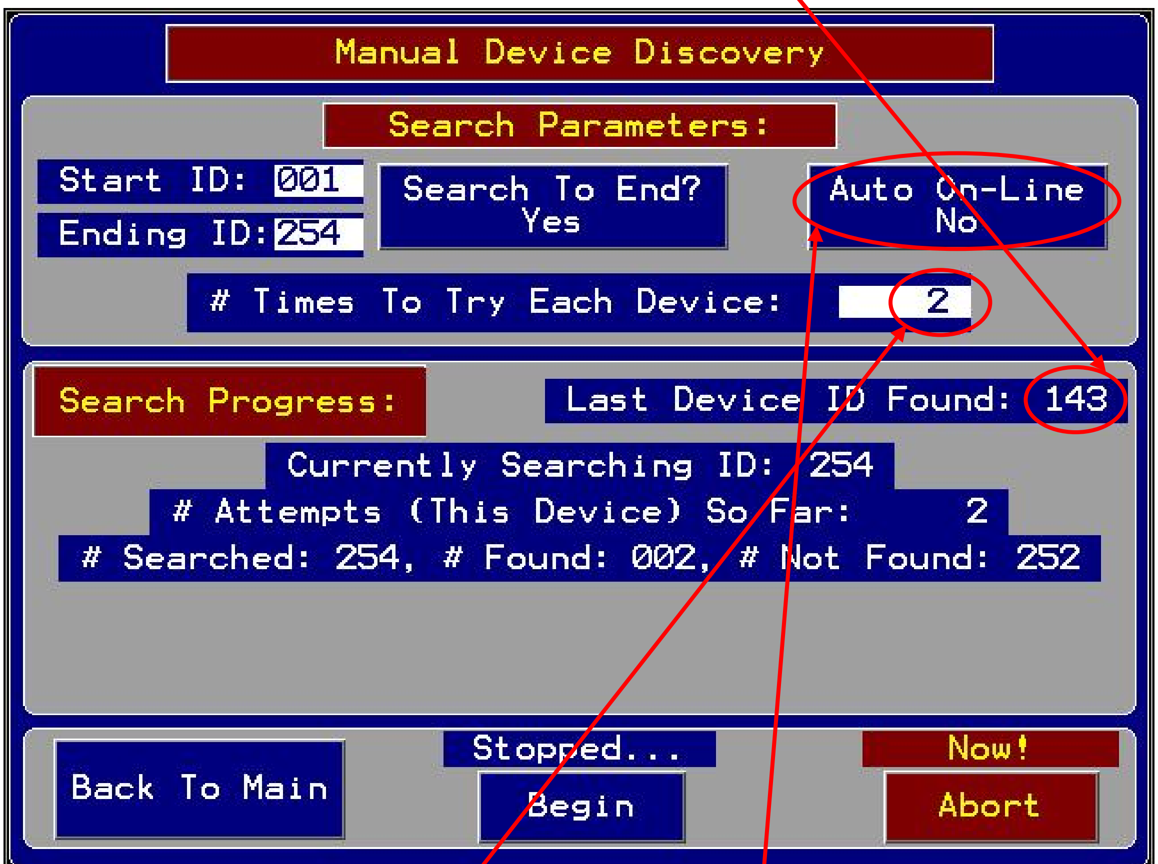
8) To verify the 3500 Firmware Version, press the SEC Logo at the top/right corner of the “Main Zone Summary” screen, or select the “About SEC…” option from the “Main Menu”: a popup appears displays such as this:



4.0 Basic SEC Relay Module Setup

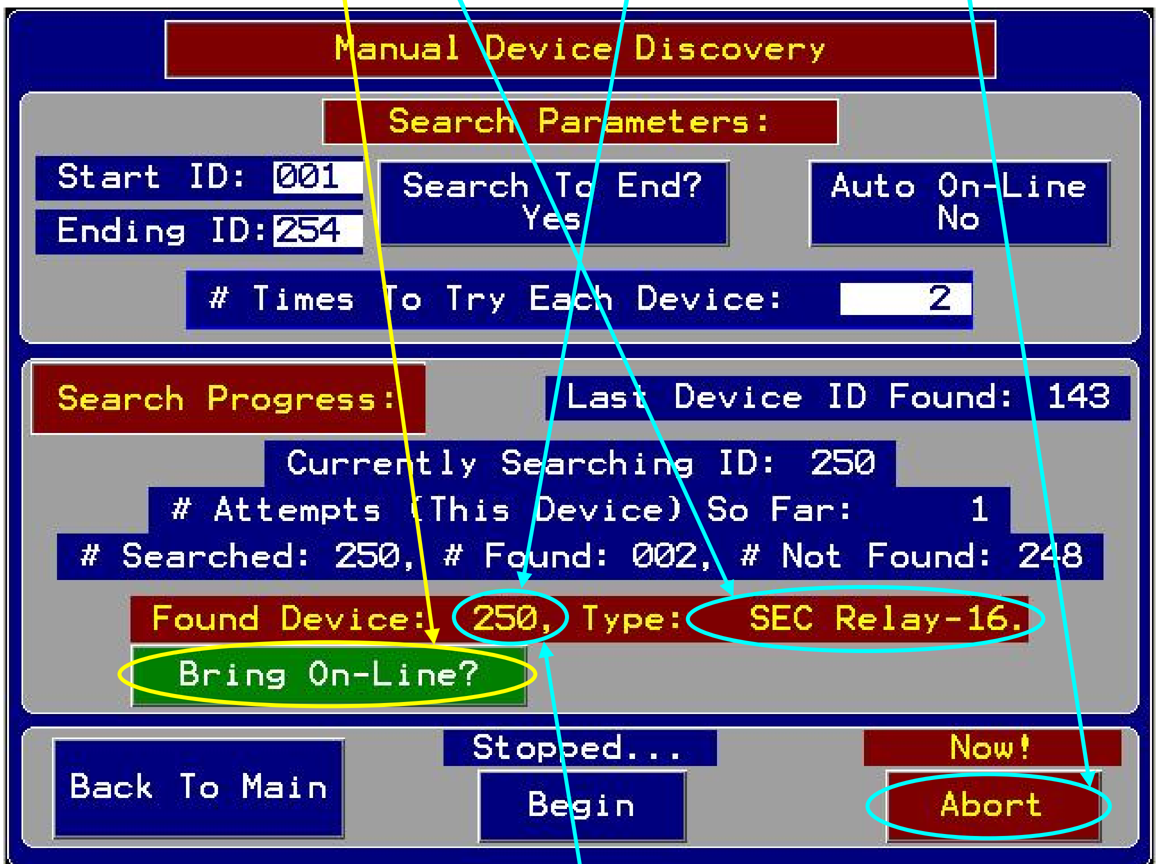
As mentioned in quick setup section 3.0, establishing an SEC 3500 Modbus 485 Loop bus network for the first time including the Relay Modules is a bit different. The very first thing that needs to be accomplished in a mixed SEC 3100 & SEC Relay module network is to first isolate each Relay module to be added, without the interference (and potential collision with) other SEC devices. As follows;

1) Disconnect ALL SEC Relay Module devices from the bus.
2) Perform all the steps in section 3.0, and note the number of devices found and the highest device ID (this is the "Last Device ID Found" displayed when the scan is complete), but do NOT leave the "Manual Device Discovery" screen.



3) If possible, disconnect all SEC 3100 devices now.
4) For each Relay module desired to be added to the bus, do the following, one at a time:
   a) Add one SEC Relay module to the bus.
   b) Scan the entire network from ID 1 to 254, with "Auto On-Line" turned off, and "# Times To Try Each Device" set to 2.

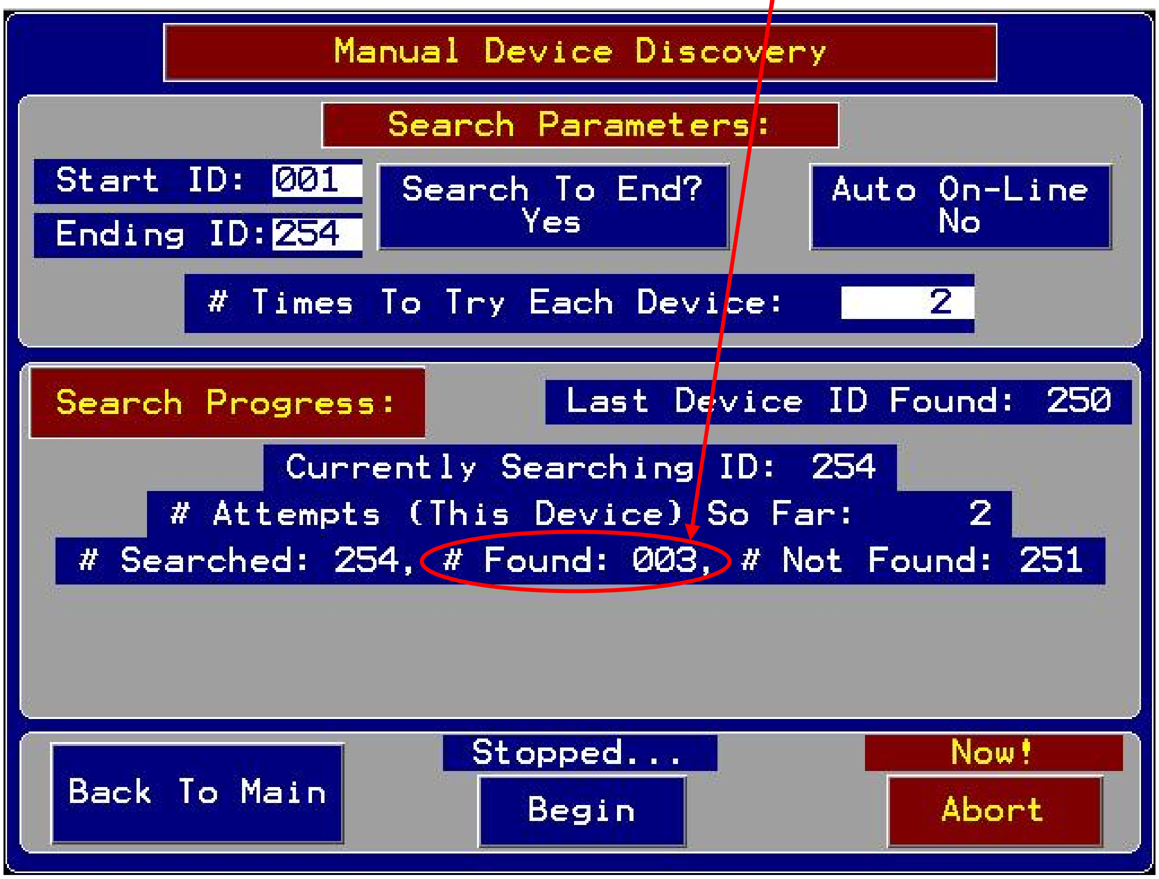
It should pause when it finds a new device, which should show either "SEC Relay-8" or "SEC Relay-16". Note the device ID at this time. If this is the proper device, press "Bring On-Line" when it appears, if not, press "Abort" to terminate the search. If this process completes and it never pauses indicating a new device, then either the device is not connected properly, or it is conflicting with another device online.



i) If it conflicts with another device on the bus (such as an SEC 3100 that you left attached to the bus during this time), notice that the "# Found" counter is identical to what it was in step 2. Identifying this device can only be done by disconnecting all devices from the bus, and deleting all devices from the database, and changing the device ID. This is beyond the scope of this document, if you are a "supervisor operator", refer to the Supervisor's Manual for more advanced diagnostics and setup detail for this condition. At this point then you must stop in this manual, and continue in the Supervisor's Manual.

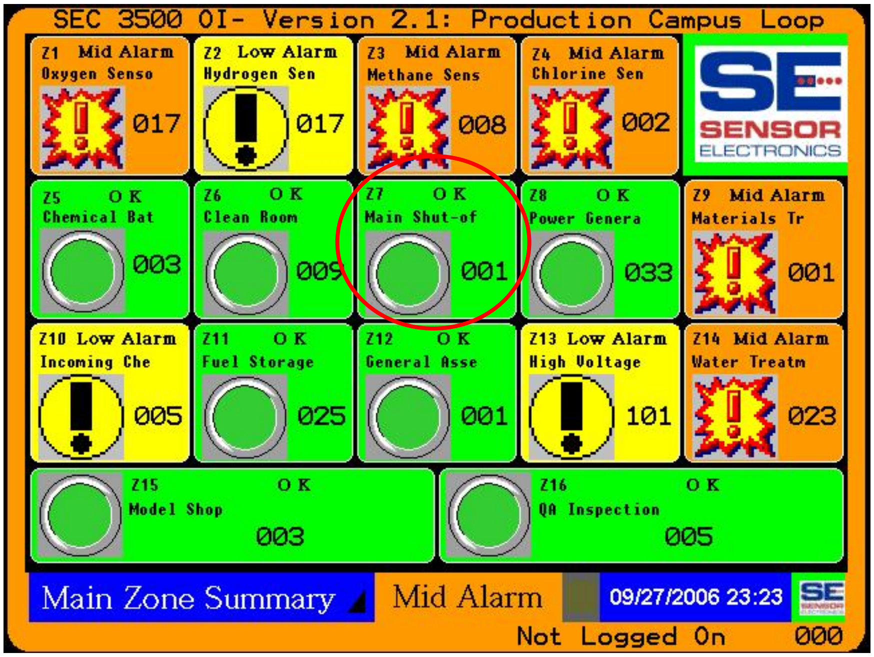
c) If it was brought on-line, recall the device ID when it paused to be brought on-line (in step 4b above). Make sure this ID is NOT at all in the range of the SEC 3100 devices noted in step 2 above (above the highest device ID). If it is conflicting, or in that range, follow the Supervisor's Manual to change the device ID. Either way, the Device ID should be changed since only the SEC 3500 can assign its network ID. This should be done before proceeding to the next Relay Module device, since the next one could conflict with this one. The device ID should be set to a value well above the SEC 3100 device range- such as 200 – 254. Since some Relay Modules could arrive from the factory with values set to 254, it is a good idea to start setting them at 200 and incrementing each newly added Relay Module.

d) Once the Device ID is changed, take it off-line. Record the device ID, and type.
e) If you brought this device online, then the total "# Found" will increment by one in step 4b when you repeat it again for the next Relay Module to add (which refers to the number in step 2 above). Repeat step 4 until complete.

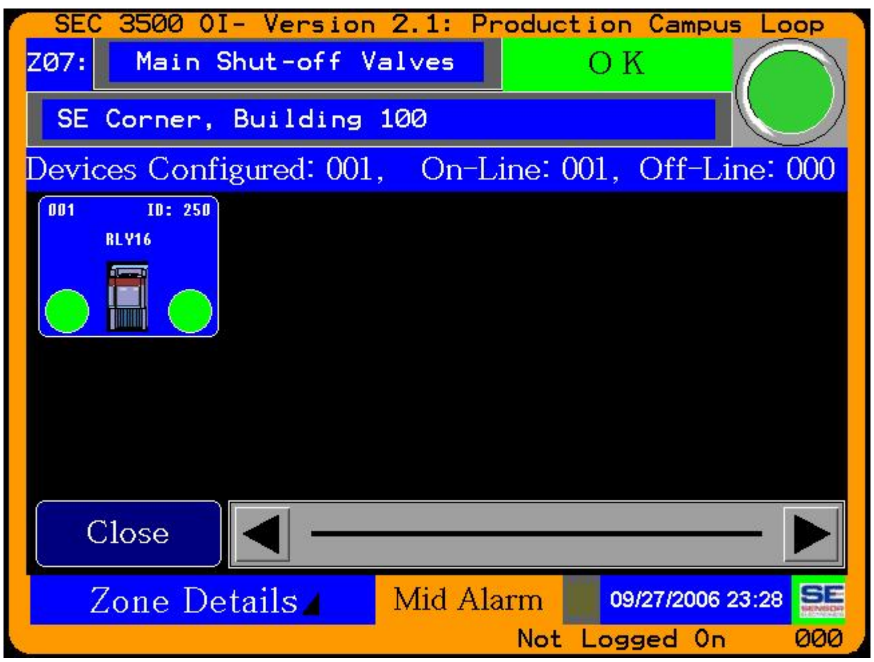


5) When all is done; attach all devices to the bus and restart the search as shown above. It should show exactly the expected "# Found" devices when you add the # found from step 2 to the accumulation in step 4 (in this example, only one was performed). The last Device ID Found should be equal to the last Relay Module device found. If all looks proper, then it is OK to return to normal operation. Press the "Back To Main" button, transitioning through the Primary Loop Start screen, returning to the Main Zone Summary screen. All expected devices should now show up in the zone tallies, including the SEC Relay Modules added.

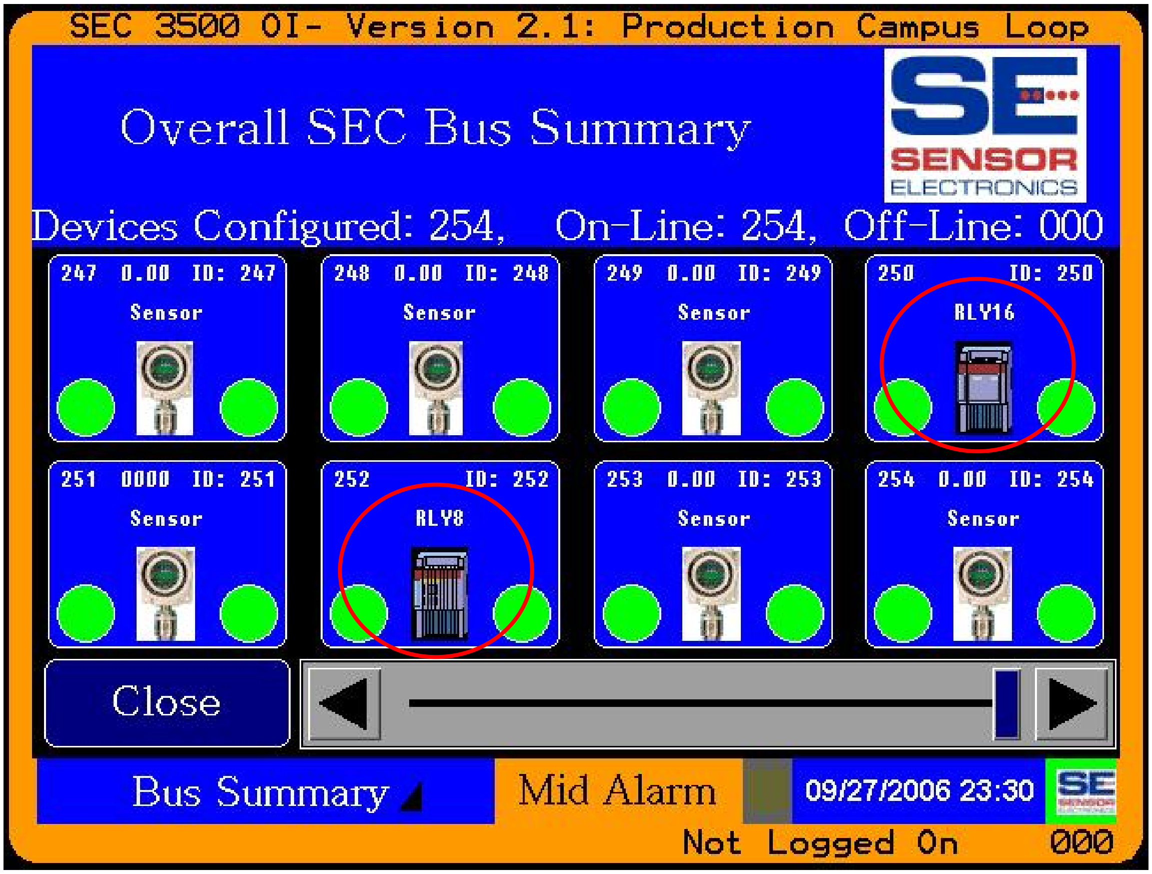
SEC Relay Modules within a Zone:



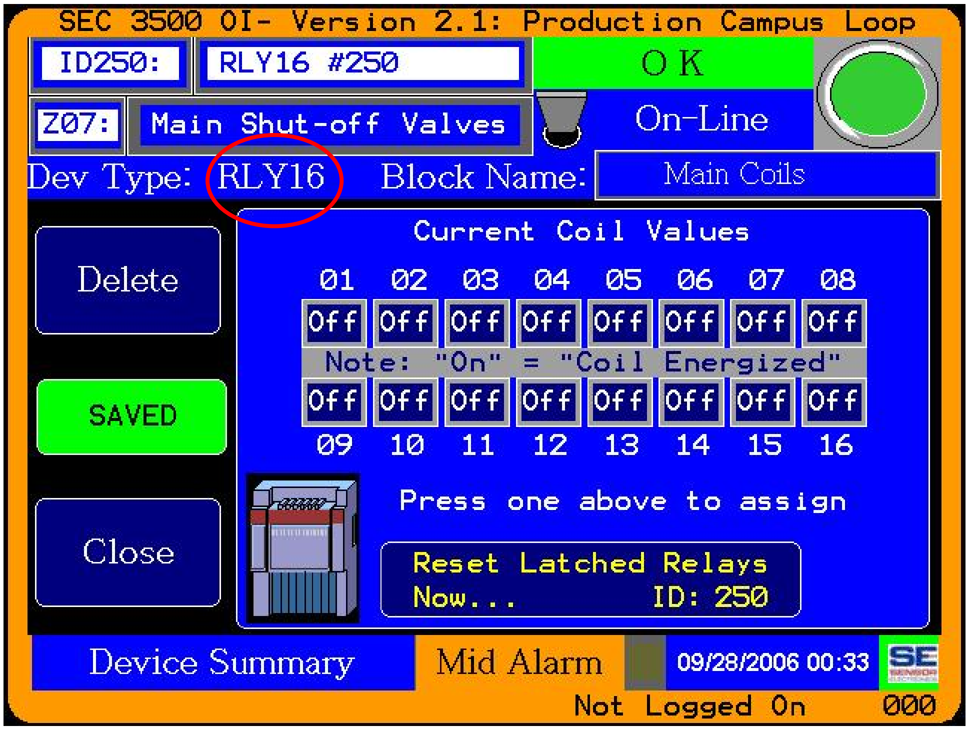
Zone Details Screen Showing Relay Module:

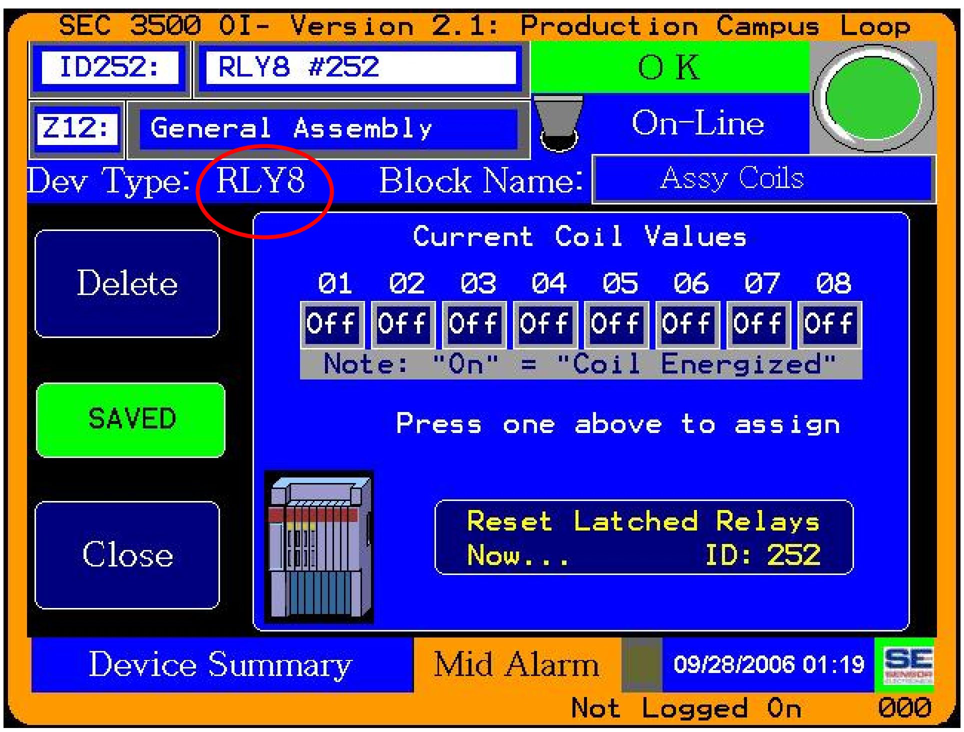


Bus Summary Screen Showing Relay Modules:



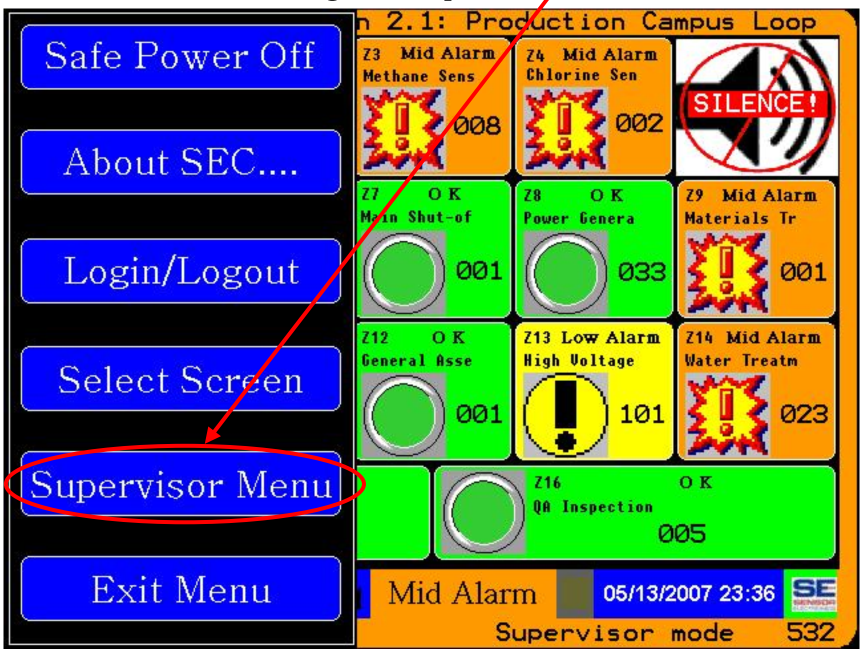
Device Summary for Relay Modules:



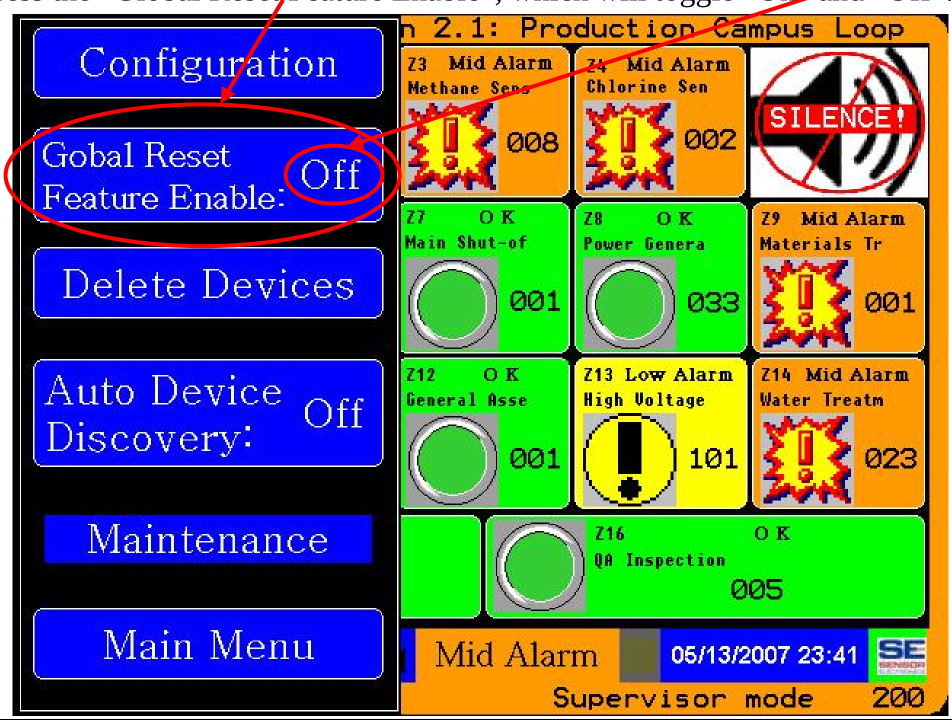


5.0 Enabling the Global Latch Reset Feature

The “Global Latch Reset” features (see the Basic User’s Guide for a complete description) may be enabled or disabled by a Supervisor-level operator logged in to the SEC 3500 OI Panel (See Section 3.0, item 1 for details on logging in), by pressing the one of the menu buttons and selecting the “Supervisor Menu”:



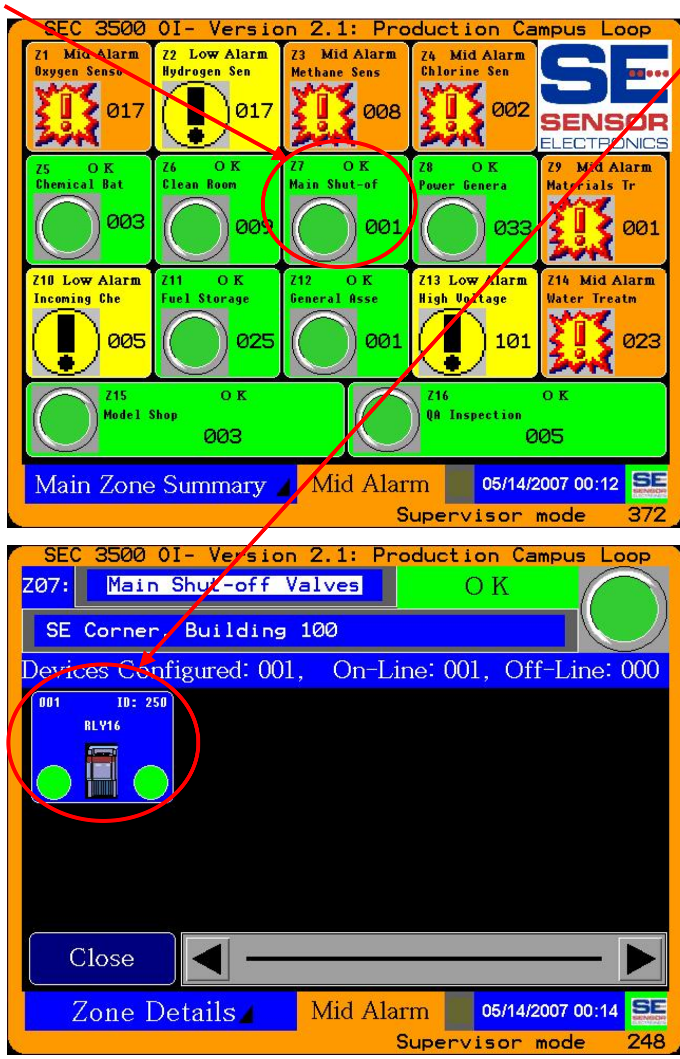
Then press the “Global Reset Feature Enable”, which will toggle “On” and “Off”:



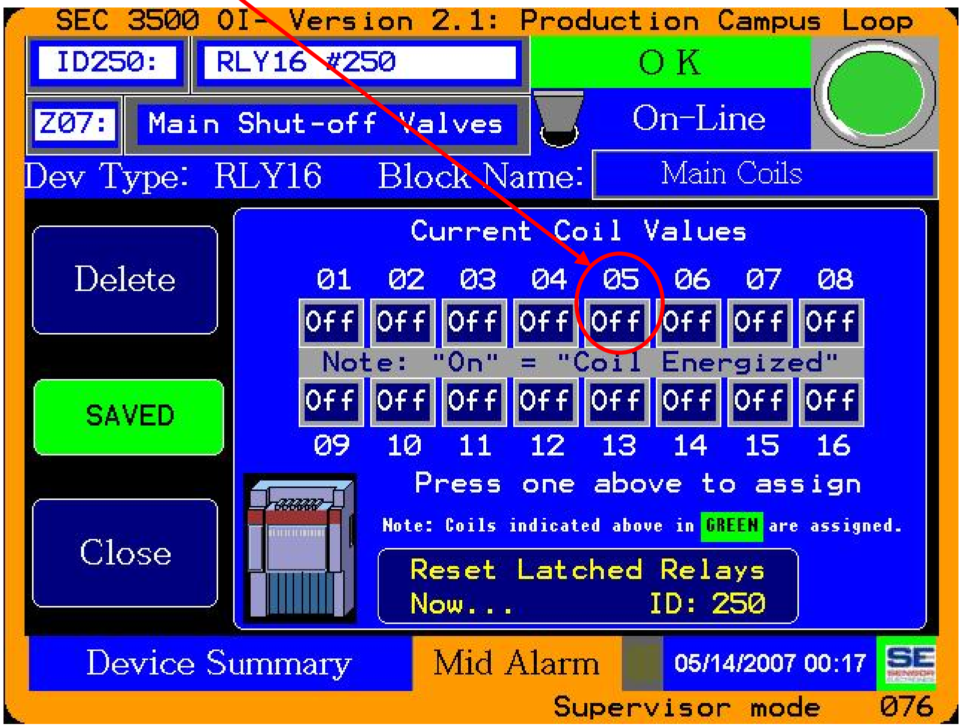
When the “Global Latch Reset” feature is enabled, then when Relay Module Latches are activated, a new Global Latch Reset icon appears, as described in the Basic Operator’s Guide, so that any operator may reset them by simply pressing the icon that will appear at the top, right-hand corner of the “Home Zone” screen.

6.0 Configuring Global Latches

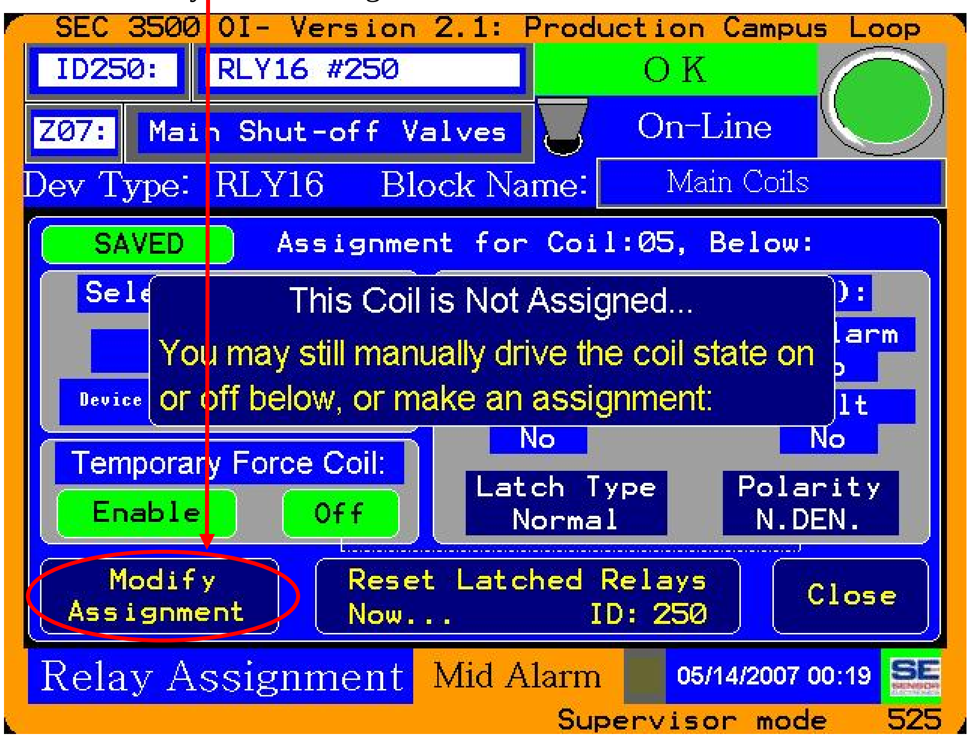
Once the “Global Latch Reset” feature is enabled, as previously described in section 5.0, established Relay Module Latches will now be able to be reset by the “Reset” icon described in section 5.0. There are many reasons for configuring latching global relay coils. Related to the SEC 3500 OI compatible Relay Modules, it is quite simple to setup. Once the hardware has been connected to a compatible SEC Relay Module, and the polarity and latching desires have been determined, then log into the panel as the “Supervisor” as previously described in this document. Select the Relay Module from the appropriate Zone:



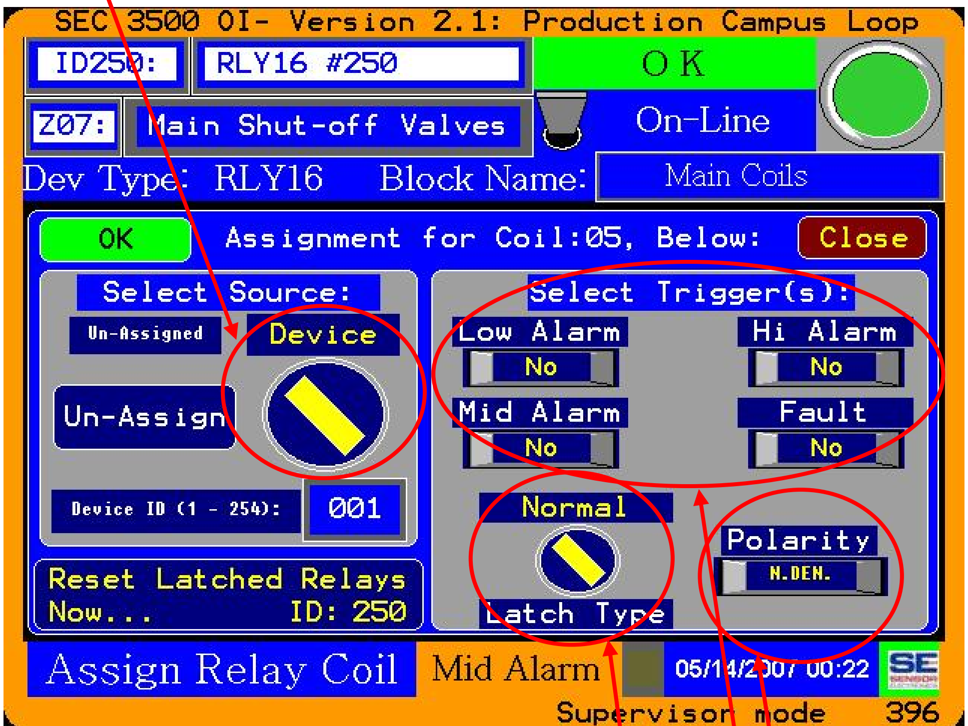
Then select the relay coil wired to the device:



Then choose to modify the coil assignment:

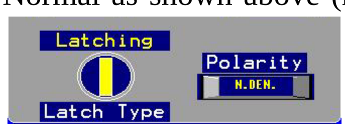


Select a source for this relay module coil to monitor:



By rotating the source selection dial, you may choose from a specific SEC 3100 Device (then choose the Device ID in the box below it) as shown above, a Zone (then choose the Zone ID in the box below it), 

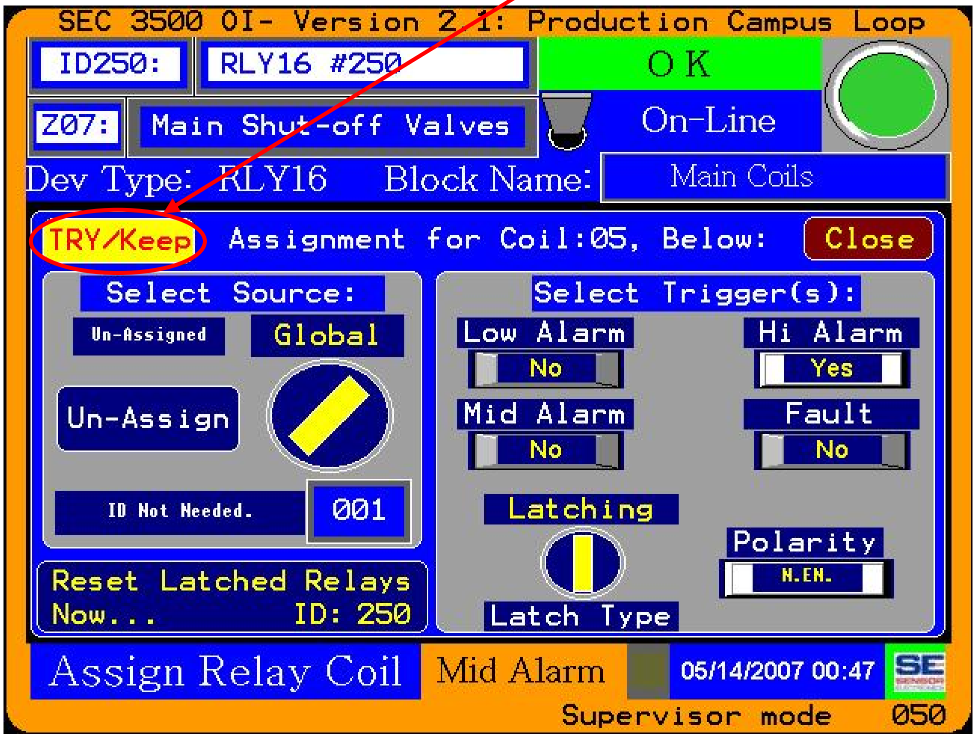
or a Global 

(a rollup of all devices and zones). Once a source is chosen, then it is time to select a Trigger Set, which may be any combination of the above. Following that is the selection of coil polarity to match how it is wired to its activating device (such as a valve), and finally choosing the Latch Type, which may be set to Normal as shown above (no latching- coil goes of when condition(s) go away, Latched 

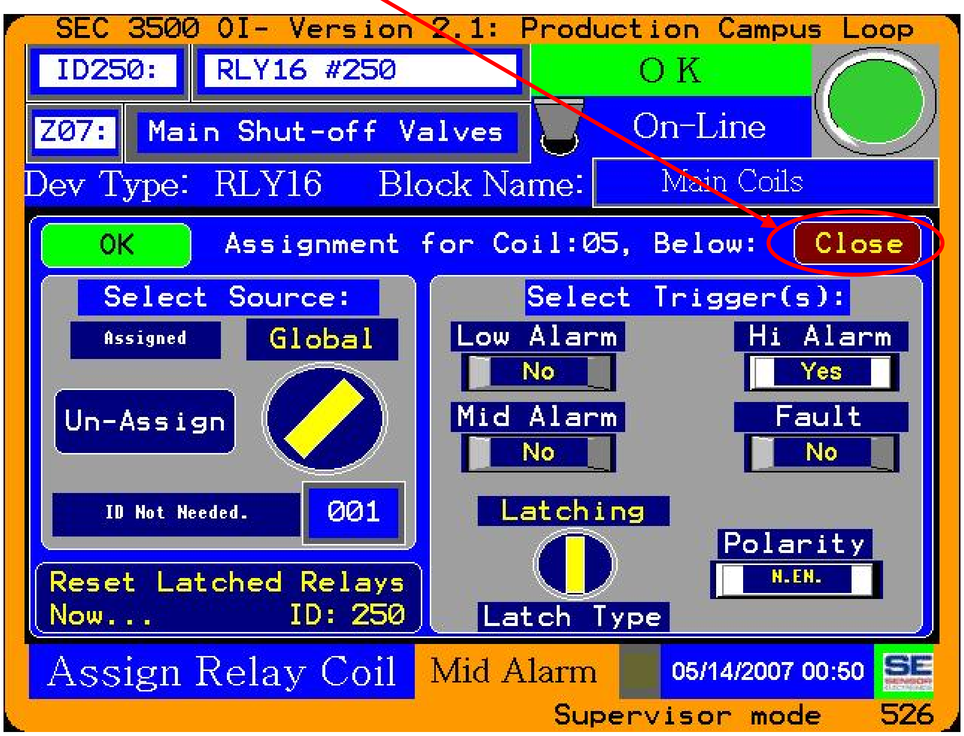
(stays activated after condition(s) go away until reset manually, or audible 

(intended for audible notification devices, activation goes away when condition(s) go away OR when alarms are manually silenced (See section 7.0 for more configuration details).

Once all selections/mapping is complete, it is time to "Try" the settings and choose NOT to discard them by pressing the "Try" button:

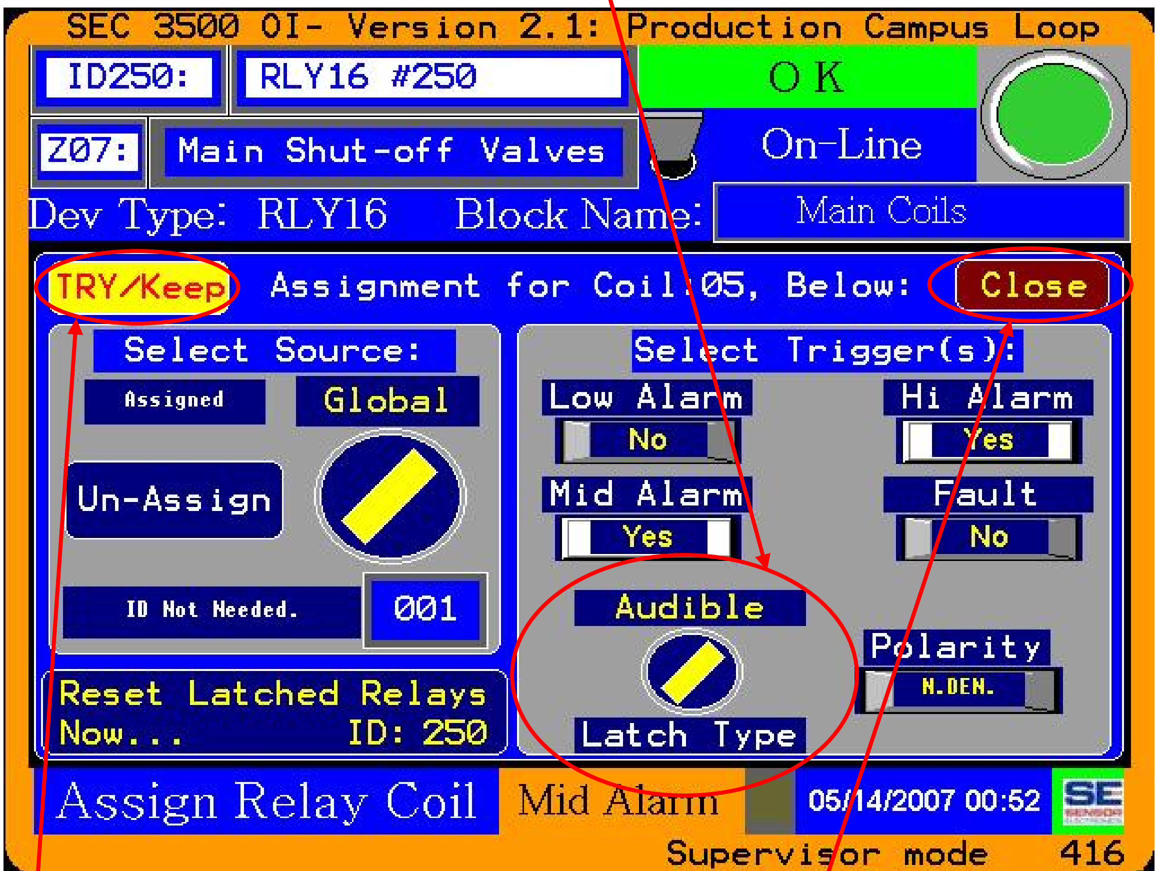


And if all is well, then press Close:

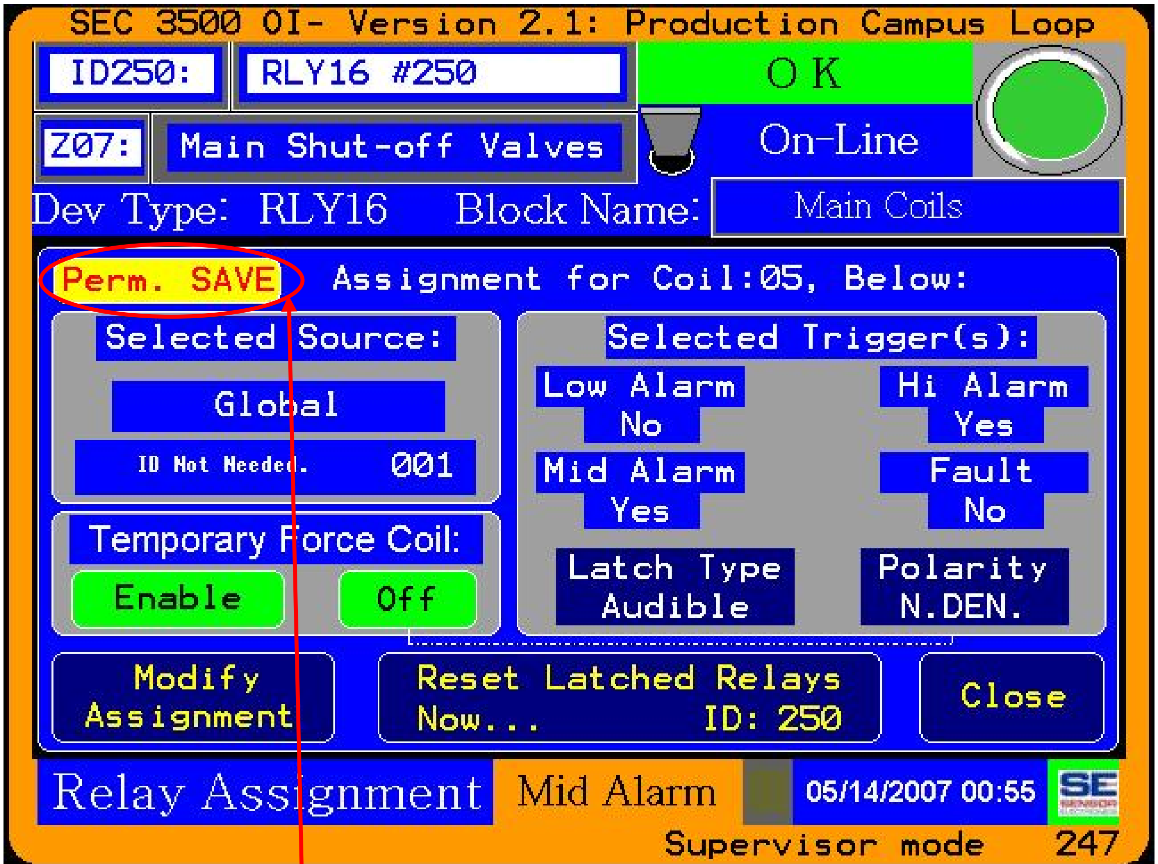


7.0 Setting a Global Alarm Latch Type

Setting a Global Alarm Latch type is identical in function and form to setting any other type of SEC 3500 OI Relay Module coil configuration. First follow the directions shown in section 6.0 previously for establishing the source, establish the triggers and coil polarity, then change the coil latch type to “Audible”:



This of course is done while logged in as the “Supervisor”, and then the “Try” button is pressed to save the settings, then the “Close” button, resulting in the coil review/coil assignments screen depicting the settings and warning that the changes have not yet been permanently committed to firmware (shown on the next page).



("Permanent Save Warning", and the temporarily saved/tested audible configuration)

Once changes are permanently saved (the 3500 OI panel saves to flash and resets), they become active at restart. Anytime the selected source meets the trigger conditions, in addition to the SEC 3500 OI built-in speaker and screen flasher for Global alert, the configured Audible coil(s) are also engaged. When alarms are silenced by the operator (by pressing the silence alarm icon  located at the top right-hander corner of the screen), so are the Audible coil(s). If the conditions fully go away and then return, the Audible coil(s) will again be re-activated automatically by the SEC 3500 OI.

SEC 3500 OI
Basic Operator's Manual

July, 2007

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(952) 938-9486

Table Of Contents:

1.0 Purpose

This document describes how to use the SEC 3500 Operator Interface (OI) Panel, from a basic operator user perspective (not for setup configuration or maintenance; see the separate manual's for each operator user class and the startup basics manual). It describes the basic operation, basic screens and basic screen/menu navigation. This document is NOT a detailed all-encompassing Supervisor or Technical User's Manual. This manual is part of a documentation pack that contains all necessary information for using, starting up, configuring and enabling higher-end functionality, and is the second manual in the pack necessary for getting started.

2.0 Overview

The SEC 3500 OI Panel drives and masters the SEC 3500 Modbus 485 Digital Gas Monitoring Loop, based on the loop-attached SEC 3100 Digital Gas Transmitter slaves. It draws information from all SEC 3100 Digital Gas Transmitters on the loop into a single location, where all information is accessible and configurable. In addition, it adds features for controlling separate SEC Modbus 485 Relay modules, allowing a central coordinated command and control center for a given loop.

The SEC 3500 OI is a self-contained standalone intelligent touch-screen Human Machine Interface (Operator Interface Panel). It contains various communication ports for RS485 communications, RS232 Gas Status Text Dumps, and 10/100mb Ethernet for Web-based services. It also contains a compact flash card socket for software updates and data logging. It operates on 24vdc, and permanently stores its program and non-volatile data in internal flash memory- There are NO disk drives.

2.1 Immediate Audible Alarm Silence

The SEC 3500 OI is equipped with an audible alarm, built right into the panel. It begins to sound and flash the screen whenever any SEC 3100 device enters one of the alarm conditions defined by it or by any Global Alarm set point triggered for any one of the so configured Relay Modules at the SEC 3500 panel. If a Global Alarm relay is set to trigger, that specific Relay Module coil will also be engaged as it is configured, and one of the allowed relay types is the "Audible Alarm": this type of alarm is intended to augment the 3500 OI panel's internal speaker and screen flash mechanism by allowing user's to so equip their environments with user defined Audible speakers, horns, or such other attention-grabbing devices. The 3100 also contains audible alarm types and behave identically. These 3100 audible relays are also silenced by the Global Alarm Silence icon on the 3500.

Once an alarm triggers the 3500 OI Global Alarm, it will not stop sounding until ***all*** alarm conditions are cleared, or the Alarm is silenced. A graphical large icon of a speaker with a red "x" across it will appear in

the top-right corner of all screens, when an alarm condition exists. If the icon is pressed, the Global Alarm will be silenced and all “Audible” type Relays and 3100 audible relays will be silenced as well (then the alarm silence icon is removed and the previous contents restored). However, if an alarm condition returns, the Global Alarm will again sound, as well as all defined “Audible” alarms.

If the “Global Latch Reset” feature

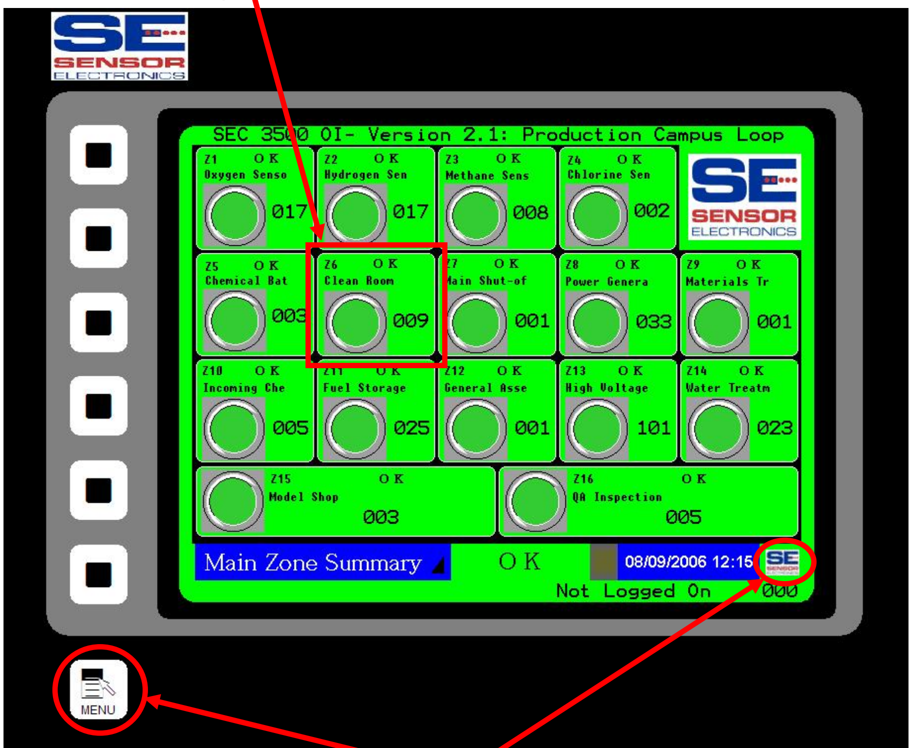
is enabled, its icon may remain on the very same upper-right hand corner of the Main Zone Summary Screen if a Relay Module coil has been defined to latch and has entered a latched state, even if the “Audible” silence icon has been pressed (this “Global Latch Reset” button remains in the same location until it is pressed, and once pressed, provides a status

as the latches are being reset showing the current device ID number being reset- once the reset is complete, the icon will return to the main SEC logo if no further Global Alarm silencing is required).

3.0 First Time Setup/Updating Setup

The very first time you turn on the SEC 3500 with an SEC 3500 Modbus 485 Digital Gas Monitoring loop connected with SEC 3100 Digital Gas Transmitter slave(s) attached, you may have a blank main screen once it is powered up, such as this:

If so, then this is either the first time the 3500 has been powered on, or you do not have the Gas Monitoring loop setup/configured properly, or you have not detected any SEC 3500 compatible devices yet. Otherwise, if at least one compatible device is connected, online and had been setup previously, then at least one of the sixteen zone summary boxes would be green- see below:



(Menu Button Areas)

If this is the first time startup, or scanning the loop for new devices, refer to the "Startup Basics Guide" and "Supervisor's Manual" to establish the panel.

4.0 Basic Screen Navigation

The goal of this section is to describe the basic screens and their touch-screen navigation methods that provide the normal operational information at all the different information levels:

- **Level 1- Device**. Information is captured at the lowest level; every SEC 3100 Digital Gas Transmitter device connected to the SEC 3500 Primary Modbus Gas Transmitter Loop. Under normal operation, only Gas level and Transmitter status is captured for each SEC 3100 device on the loop, once per scan, repeated infinitely.
- **Level 2- Zone**. Per scan, Gas levels and alarm states are collected, sorted and summarized into the sixteen different zones shone on the "Main Zone Summary" screen. Each device can only be assigned to one of these sixteen zones. The highest alarm level (highest possible level is a Fault) of all devices in each zone determine each zone alarm rollup level.

- **Level 3- Global**. Then, all zones are rolled up together to create a single global status for the particular SEC 3500 Loop, which again will be the highest alarm level of all the sixteen zones. If there are SEC Modbus 485 Relay Modules connected to the Loop, with coils assigned to either individual SEC 3100 devices, individual zones, or to the Loop global status levels, the assigned Boolean logic formulas are applied to each assigned coil and the coil energize/de-energize results are applied. Following this, if the RS232 Gas Status Text Dump (StatCast) feature is enabled, then its next window of data is output. Then the loop is repeated infinitely.

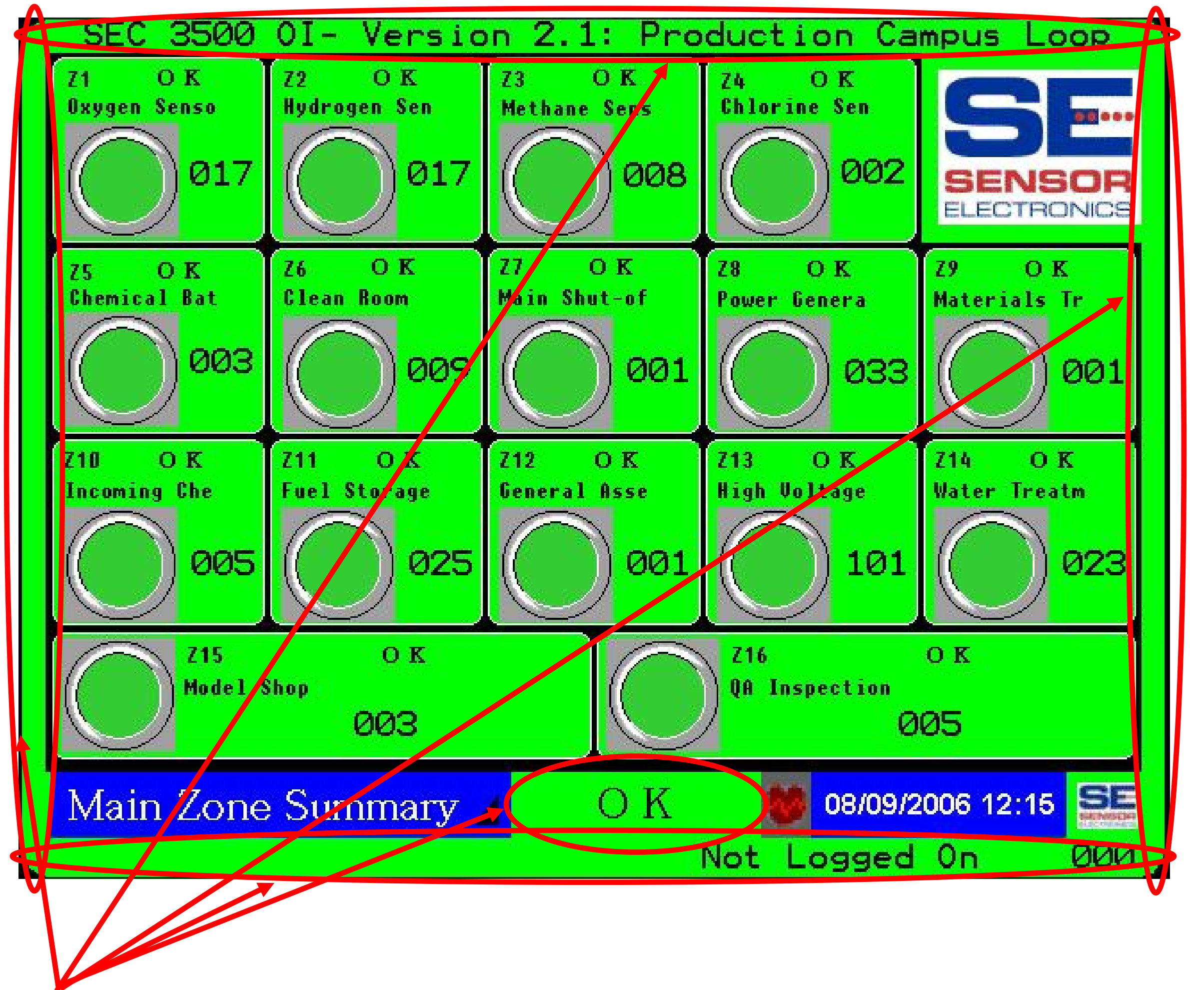
This now forms the basis for how the information is displayed, as follows:

- **Main Zone Summary.** This shows both the Level 3 Global Alarm status in the borders of the screen, and the individual Zone Alarm status (Level 2) for each of the sixteen zones in sixteen individual boxes within the inside of the global borders. These global borders will contain the global status (encoded in colors and flash rates) in this same way for all of these basic operations screens at all three levels.
- **Bus Summary.** This shows all devices (Level 1) that are on the 3500 loop. Each device, regardless of zone, is shown in a simple small box, and all devices can be viewed by scrolling back and forth 8 devices at a time. The borders depict the Global Alarm status (Level 3).
- **Zone Details.** This shows all devices (Level 1) that are in a specific zone. Each device within the zone is shown in a simple small box just like the bus summary screen, and all devices can be viewed by scrolling back and forth 8 devices at a time. The borders depict the Global Alarm status (Level 3).
- **Device Summary.** This shows the Gas and Alarm status for a specific SEC 3100 device (Level 1). The borders depict the Global Alarm status (Level 3), yet a summary icon at the top-right indicates the device alarm status.
- **Sensor Details.** This shows all basic parameters as well as Gas and Alarm status information for a specific SEC 3100 device (Level 1). The borders depict the Global Alarm status (Level 3), yet a summary icon at the top-right indicates the device alarm status.

4.1 Main Zone Summary Screen

The Main Zone Summary screen, as previously generalized, depicts the highest alarm levels for all devices within each zone, and the highest alarm level of all of the zones in the Loop global status. Zones are depicted as sixteen different boxes within the borders, and the borders indicate the Loop global status. This screen is the primary default and normal operation screen. All other screens eventually time out and will ultimately fall back here. When this screen times out, then the screen saver is shown; and when the screen saver is touched, it returns to this Main Zone Summary screen. Now let's examine the parts and information contained, see the screen-shot on the following page.

Main Zone Summary Screen- Global Status Borders:



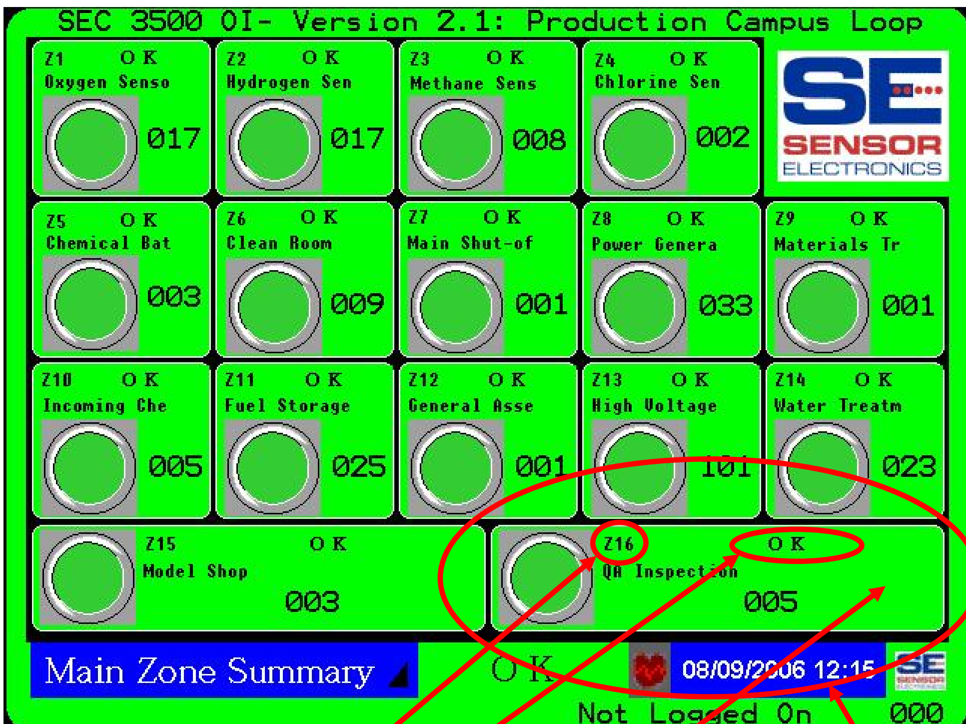
4.1.1 Main Zone Summary Global Status Borders

These borders, present not just on the Main Zone Summary screen, yet also on all of the major operations screens, show the color of the global alarm status:

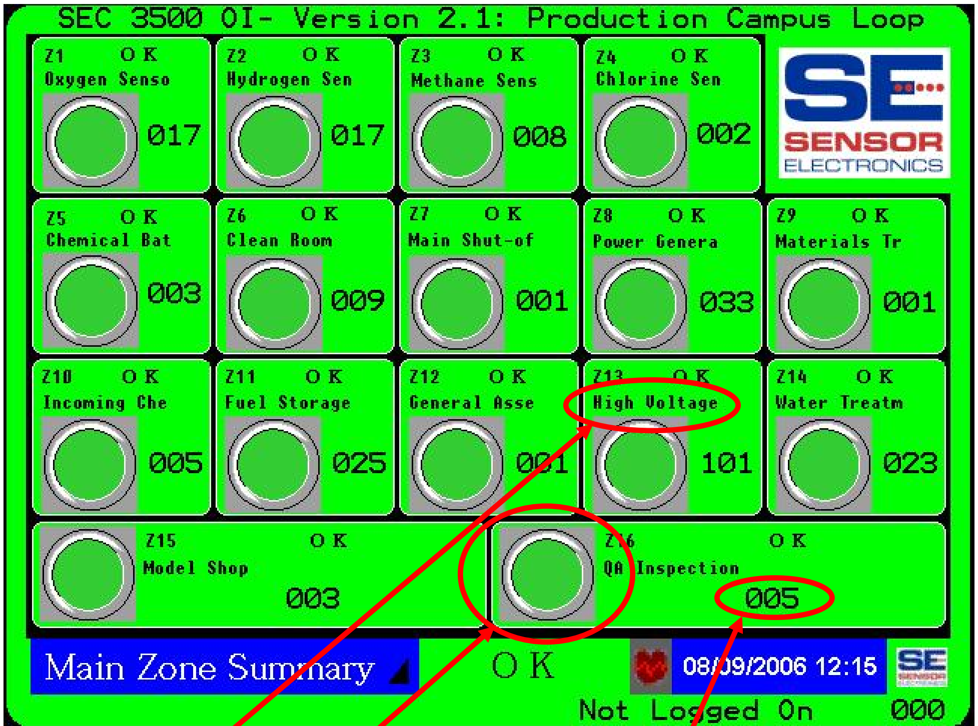
1) Green Green for “OK” or normal operations (not flashing- steady), no alarm or fault conditions in the global status, any zone, or any device that is on-line.
2) Yellow Yellow for “Low Alarm” conditions, flashing to gain attention (and no fault conditions); for the global status, or for one or more zone(s) and for one or more device(s) that is/are on-line.
3) Orange Orange for “Mid Alarm” conditions, flashing to gain attention (and no fault conditions); for the global status, or for one or more zone(s) and for one or more device(s) that is/are on-line.
4) Red for Red “High Alarm” conditions, flashing more erratically to gain attention (and no fault conditions); for the global status, or for one or more zone(s) and for one or more device(s) that is/are on-line.

5) Red for Red "Fault" conditions, flashing to gain attention (not erratically); for the global status, or for one or more zone(s) and for one or more device(s) that is/are on-line, or for a device that has been deemed off-line.
6) The alarm status text (bottom-middle box, just above the bottom global status border) also shows the same coloring with the words as follows; Normal condition (not flashing- steady): OK Low-Alarm condition (flashing): Low Alarm Mid-Alarm condition (flashing): Mid Alarm High-Alarm condition (erratic flashing): High Alarm And Fault condition (flashing): Fault

4.1.2 Main Zone Summary Screen- Zone Status Info

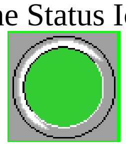


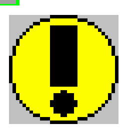
1) There are sixteen zones, and therefore sixteen individual zone status boxes on the screen. They indicate;
   a) The Zone Number,
   b) The Zone Status Text and Status Color (never flashes) as described in section 4.1.1 previously for the global alarm status box,

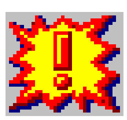


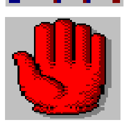
c) The Zone Name,

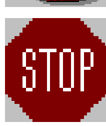
d) The Zone Status Icon;

i) OK, 

ii) Low Alarm, 

iii) Mid Alarm, 

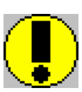
iv) High Alarm, 

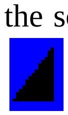
v) Fault, 

e) The Zone On-Line Device Count.

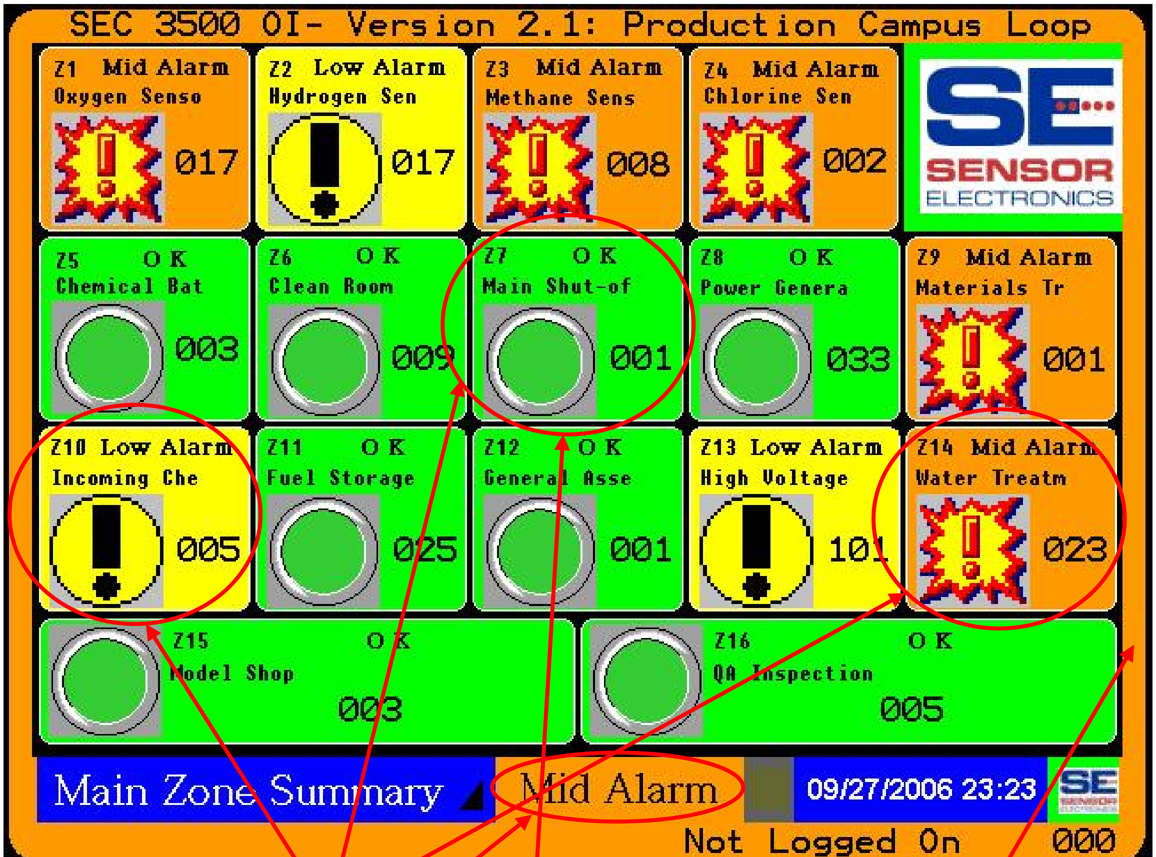
4.1.3 Main Zone Summary Screen- Status Bar

1) Screen Label & Navigation.
   a) Press to toggle between Main Zone Screen and Bus Summary Screen.
2) Global Alarm Status Text- (As previously described in 4.1.1). Press this to display Alarm Summary.
3) Communications Currently Reading Bus.
4) SEC 3500 Clock Date and Time Display (Press to enter the Clock change screen.
5) SEC Logo- Press to bring up the SEC Main Menu.
6) Current Operator Logged On to the SEC 3500 Panel (Operator is default without a logon), and Time Remaining before Auto-Logoff.



Important Note: It is important to realize that the bottom status bar region remains constant for all of the main operations screens, along with the global status bars and status text. The only difference will be the screen name in the lower left corner. If the screen name is followed by a navigation  indicator icon (as it is in the above screen), then it allows rapid navigation between it and the Bus Summary screen.

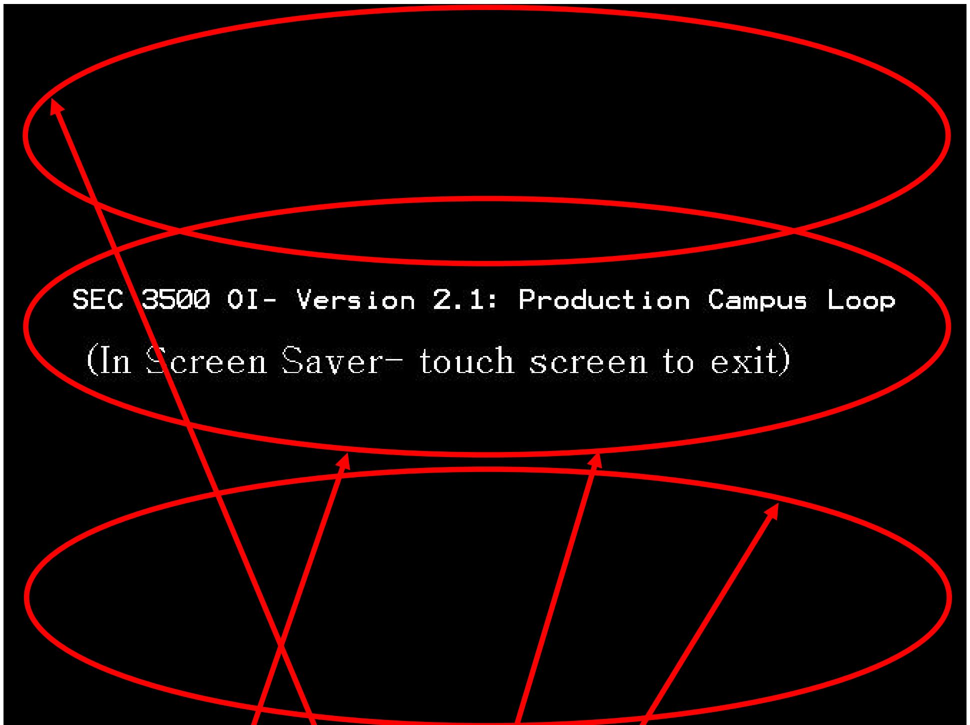
4.1.4 Main Zone Summary Screen with Alarms



1) Note that the each zone maintains its own rollup status of all of its assigned devices, which is separate from the global rollup loop status shown in the borders and in the global rollup status text in the bottom bar.
2) This zone contains an SEC Relay Module.

4.2 Screen Saver

The screen saver only appears when the Main Zone Summary screen has not been touched or a key activated by an operator for the screen saver timeout period, initially set from the factory at sixty seconds. When this occurs, the Main Zone Summary screen disappears and the screen saver appears:



1) The Screen Saver Text rolls down from the top of the screen to the bottom of the screen in three distinct moves (top, middle, bottom) and repeats itself forever, or until the operator touches any portion of the screen, transitioning back to the Main Zone Summary screen. As each roll is made from top to middle, middle to bottom, bottom back to top; the text and graphics in the position that is moving from will become invisible, and the text and graphics for the next position will become visible. In the example above, the top became invisible, the middle become visible, and the bottom remained invisible.
2) During the screen saver, the contrast and brightness of the screen are reduced to save the life of the panel LCD elements.
3) If an alarm or fault condition occurs, the global icon associated with certain alarm level will also be displayed with the text, so that attention is drawn to the SEC 3500 panel, and the alarm speaker will also be beeping and the screen will be flickering.

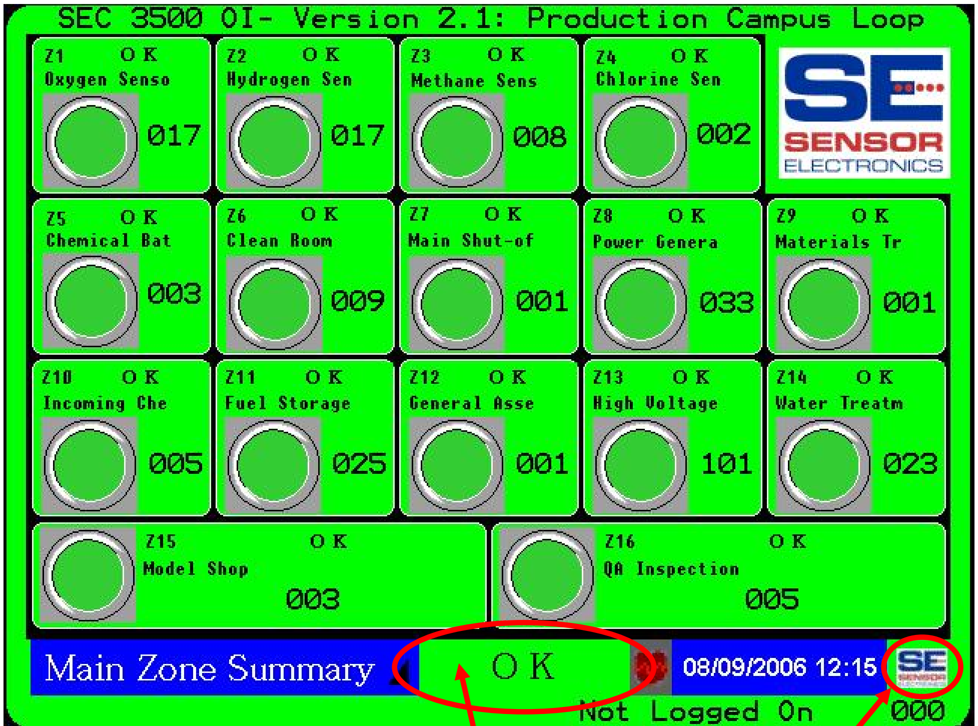
4.3 Transitioning from Main Zone to Bus Summary

(Launch Main Menu)

1) By pressing on the bottom status bar button "Main Zone Summary", the screen will change to the "Bus Summary" screen. This can also be accomplished by bringing up the Main Menu, choosing "Select Screen" and selecting "Bus Summary".

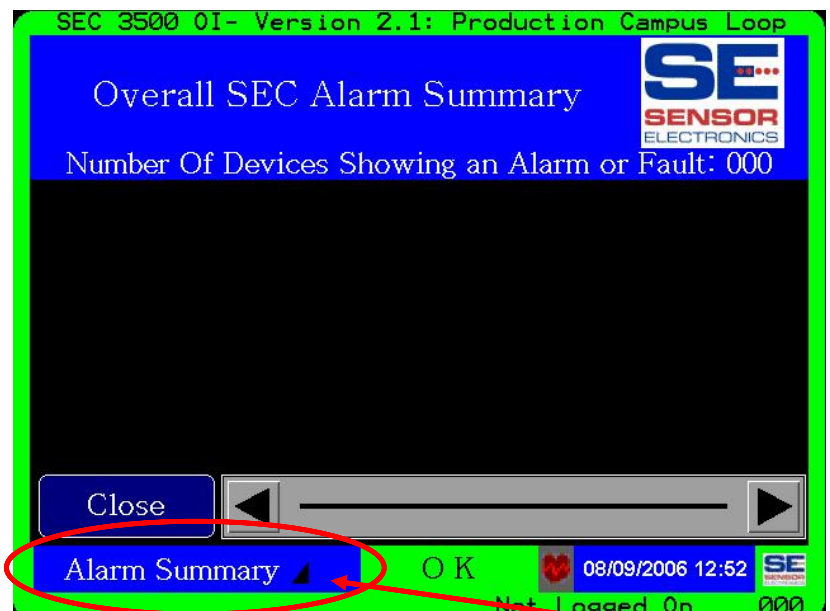
To transition Back to Main Zone Summary Screen, Press this button. More on this screen later.

4.3.1 Transitioning From Main Zone to Alarm Summary



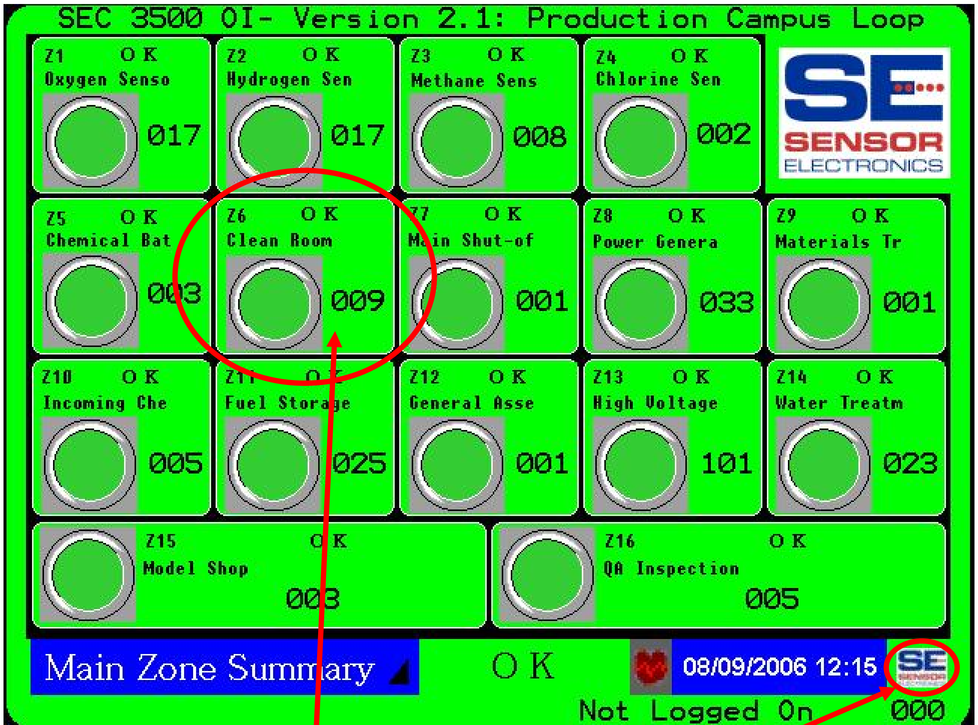
(Launch Main Menu)

1) By pressing on the global status text button, the screen will change to the "Alarm Summary" screen. This can also be accomplished by bringing up the Main Menu, choosing "Select Screen" and selecting "Alarm Summary".

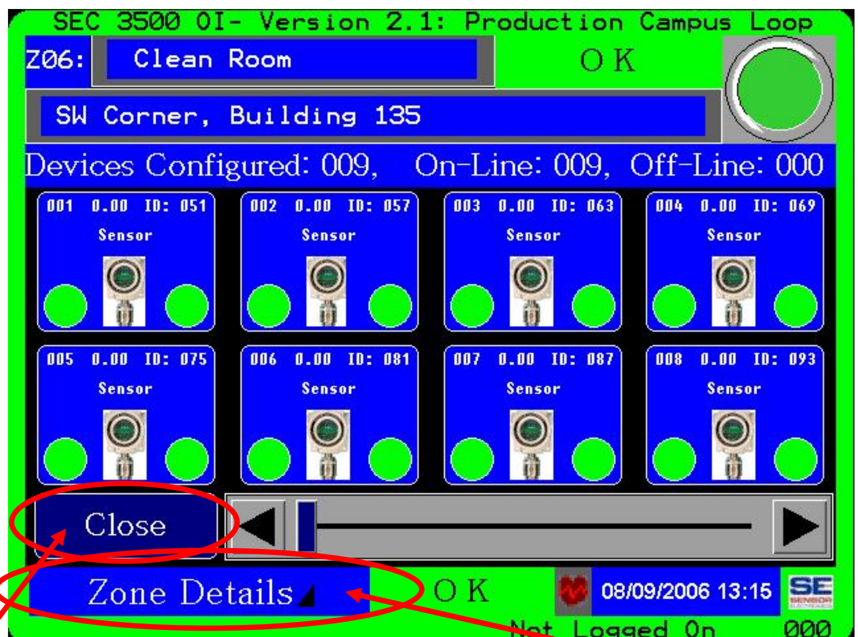


To transition Back to Main Zone Summary Screen, Press this button. More on this screen later.

4.3.2 Transitioning from Main Zone to Zone Details Screen

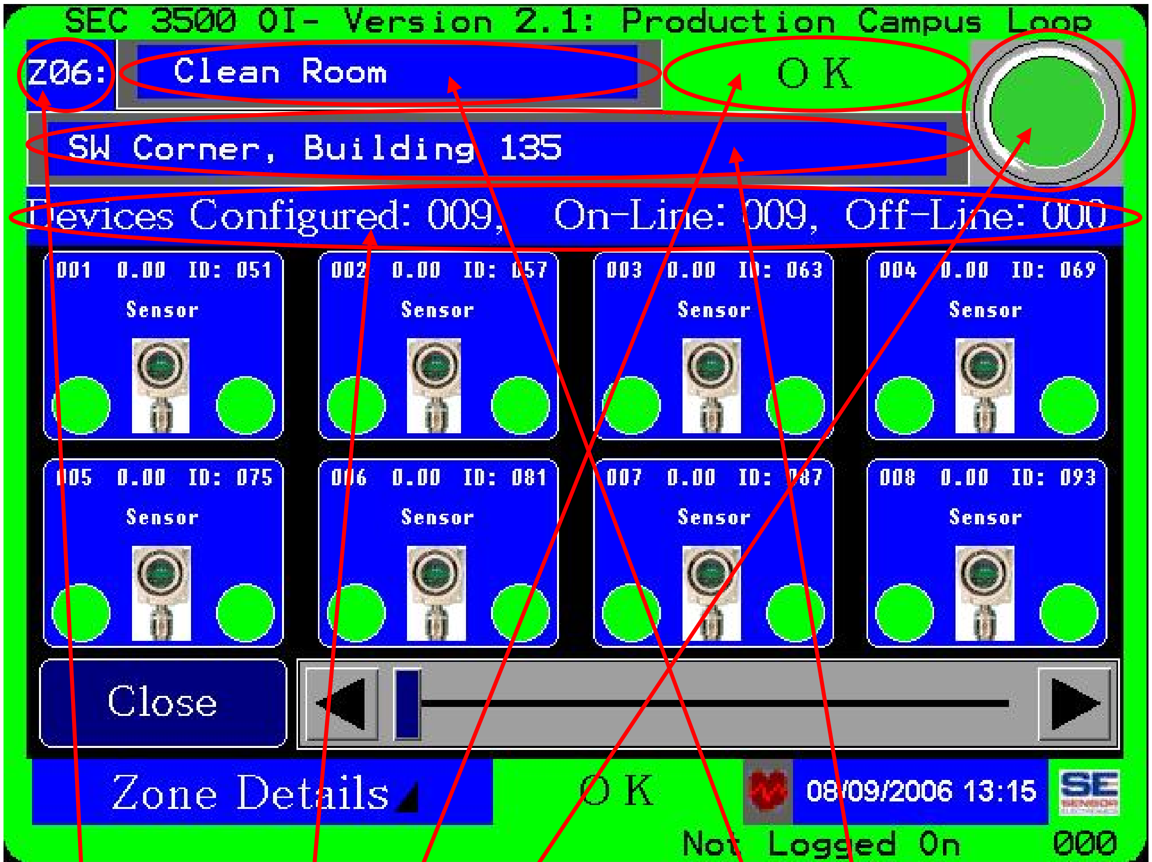


Simply press on the desired zone box, or bring up the Main Menu and select "Select Screen", then "Zone Details", then the desired zone number/name then press "Select".



To transition Back to Main Zone Summary Screen, Press this button or "Close". More on this screen later.

4.4 The Zone Details Screen



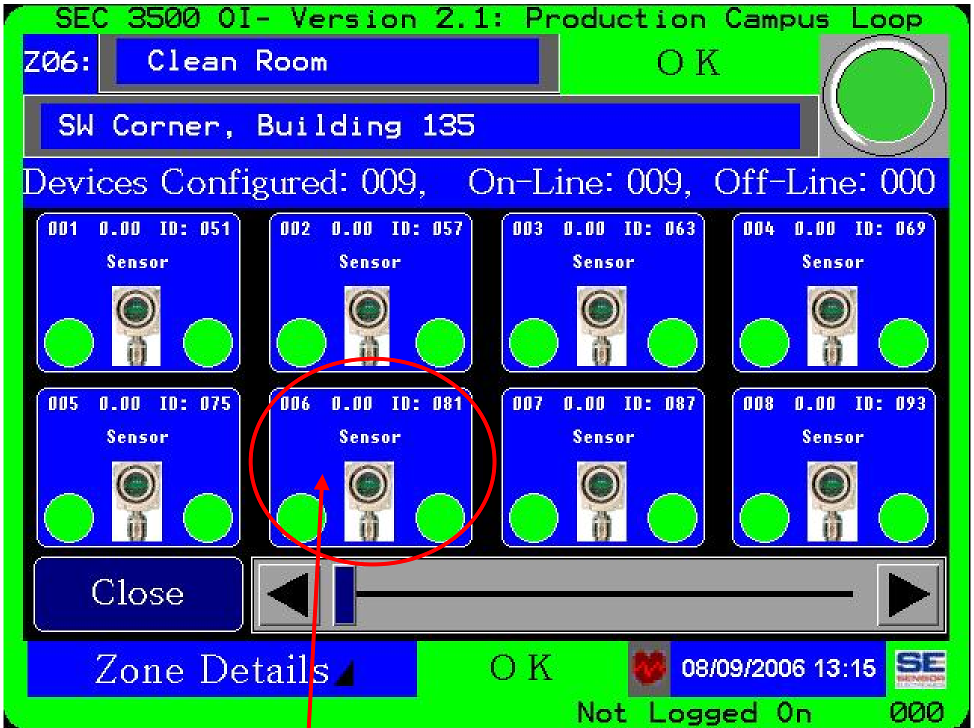
4.4.1 Zone Details Top Level Information

1) Zone Number.
2) Zone Name (can be modified- press the name, use the keypad).
3) Zone Location (can be modified- press the location, use the keypad).
4) Zone Alarm Status Text (As described in section 4.1.1), however it is NOT the global status alarm text, which is in the bottom status bar.
5) Zone Alarm Status Icon (As described in section 4.1.2, Item 1d), however it is NOT the global status alarm icon.
6) Zone Device Configuration, On-Line, Off-Line status list.

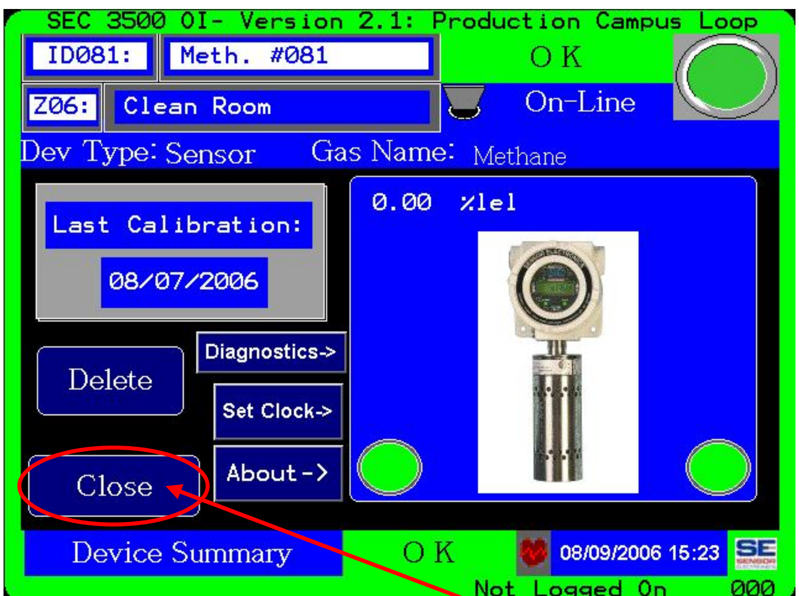
4.4.2 Zone Details Device Icons

1) The zone device list of status boxes- eight at a time, and scrollable.
2) Each device Icon contains summary information about the device;
   a) Device Network ID,
   b) Current Gas Level (if a sensor),
   c) Device Type Short Name,
   d) Icon of basic device type (sensor as shown, relay module, etc.),
   e) Alarm Status (represented by green, yellow, orange or red color) from device LED.
   f) Fault Status (green or red color) from device LED.

4.4.3 Navigating to Device/Sensor Summary

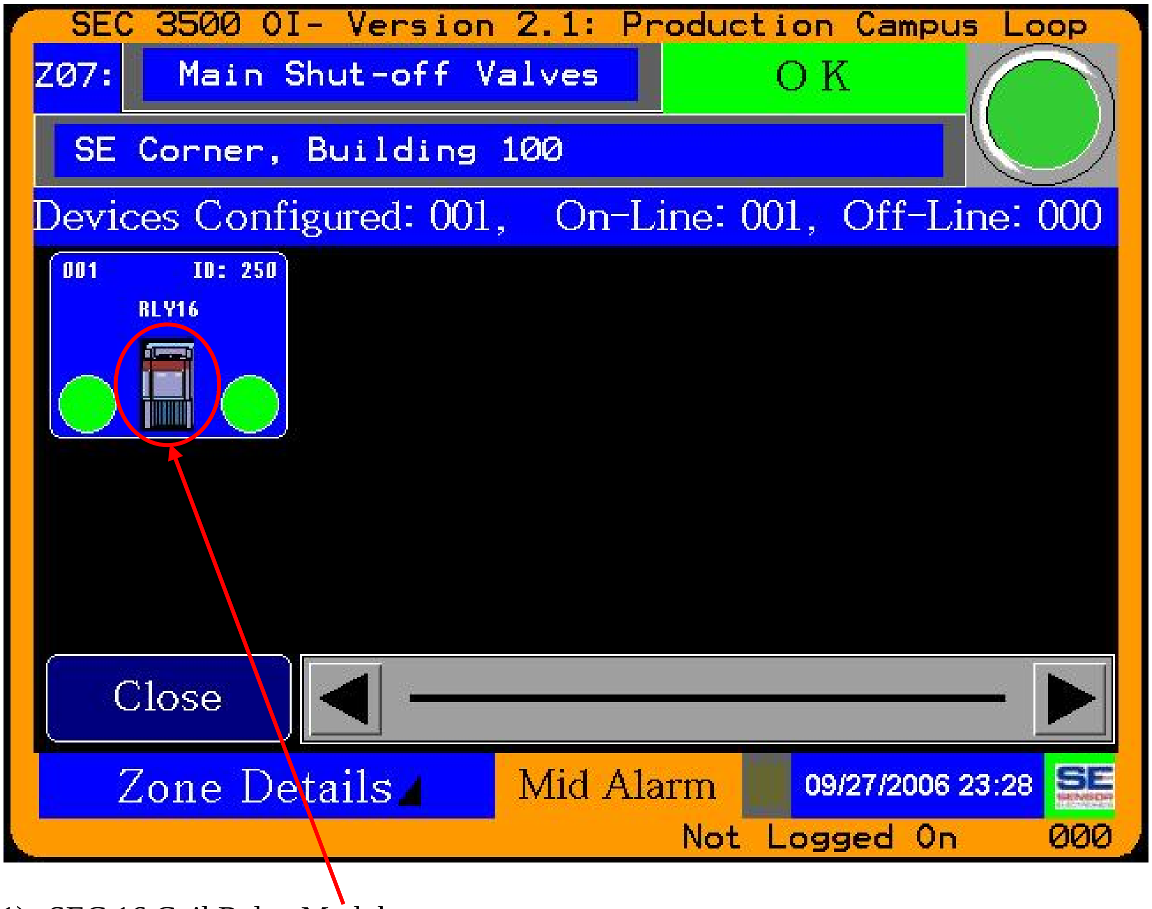


Simply press on the desired device box from the "Zone Details" screen as shown.



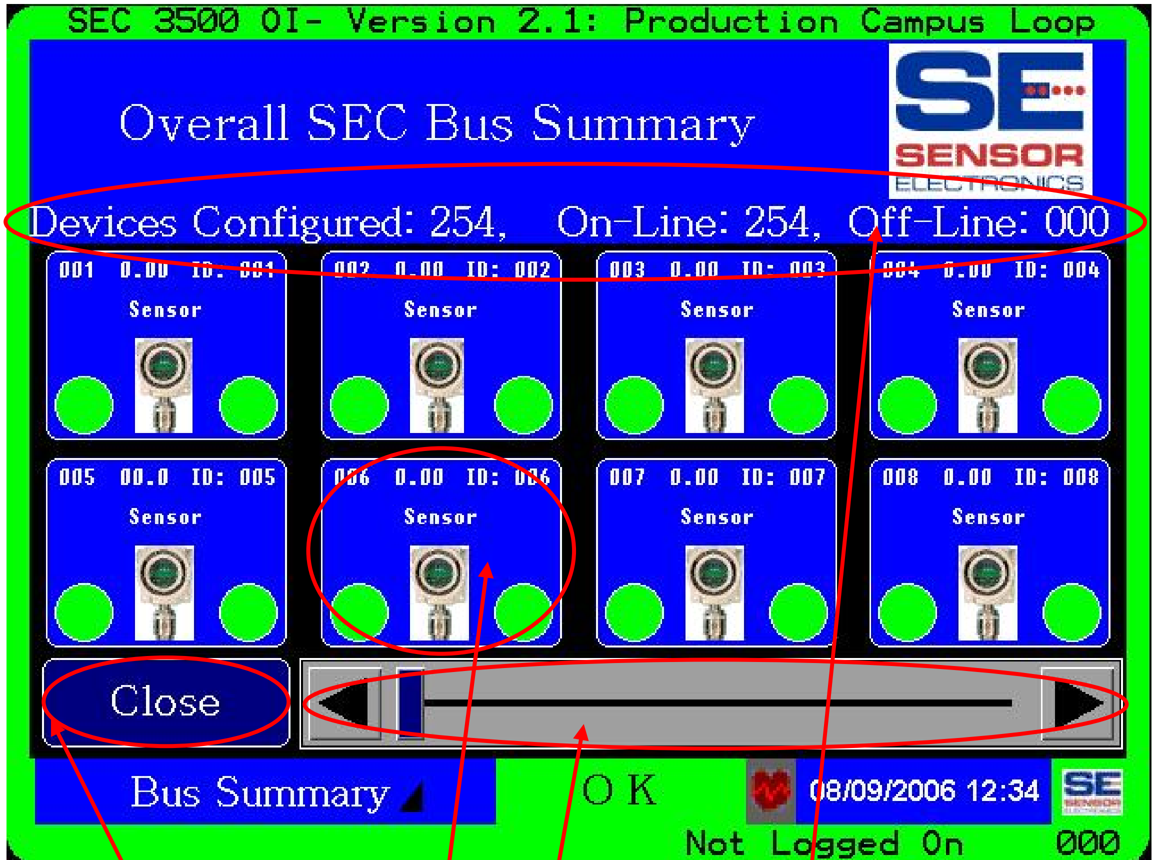
To transition back to the Zone Details Screen, Press the "Close" button. More on this screen later.

4.4.4 Zone Details Screen Showing SEC Relay Modules



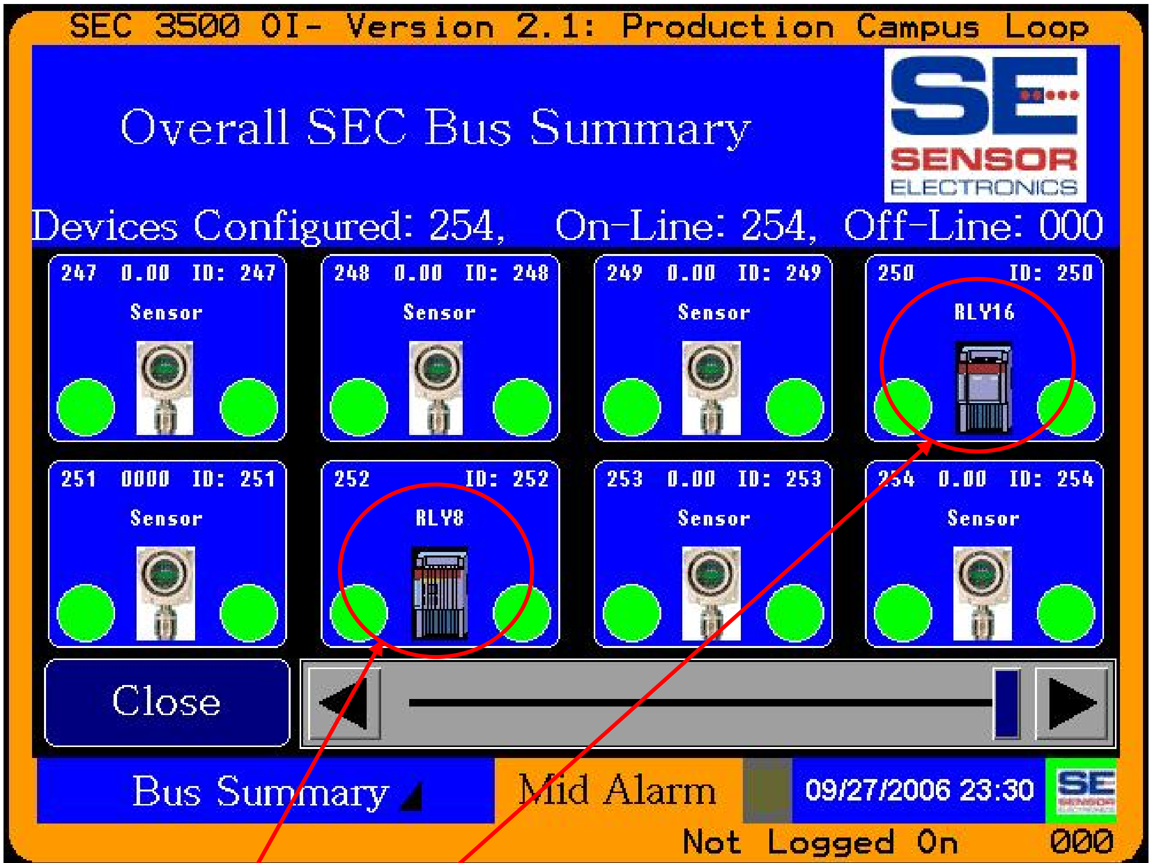
1) SEC 16 Coil Relay Module.

4.5 Bus Summary Screen



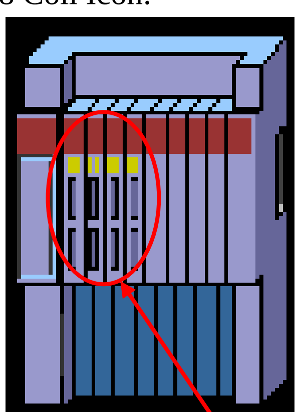
1) The Bus Summary Screen displays all Level 1 status information for all devices connected to the SEC 3500 Modbus Loop for this panel, regardless of zone assignments.
2) The borders of the screen act identically to all other normal operational screens such as the Main Zone Summary screen- they indicate the global loop alarm status.
3) Likewise, the bottom status bar acts just as the Main Zone Summary screen, in that it indicates the Login status, clock, communication activity, Global Loop alarm status text, screen title, main menu SEC logo and navigation toggling between this screen and Main Zone Summary by pressing the screen title button above.
4) By pressing the “Close” button, as previously described in section 4.3.2. The Main Zone Summary screen will be returned to as well.
5) Just as in the Zone Details screen, up to eight icons depict the device status of each device, eight at a time and scrollable from beginning to end, eight at a time.
6) Navigation to the Device Summary screen is also identical to the Zone Details screen, just select the desired device box and press it- the Device Summary Screen will appear. Likewise, the same information is also displayed in the device status boxes.
7) The top information box indicates the TOTAL devices configured on this panel’s Modbus 485 loop, as well as those on-line and off-line.

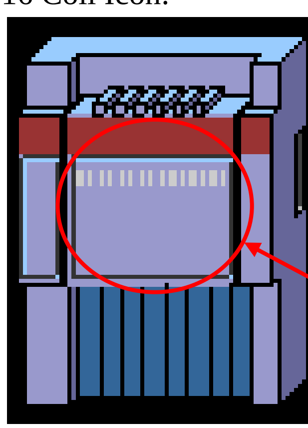
4.5.1 Bus Summary Screen Showing SEC Relay Modules



1) SEC 8 Coil Relay Module.
2) SEC 16 Coil Relay Module.
3) Note the difference between the icons, so they can be visually identifiable:

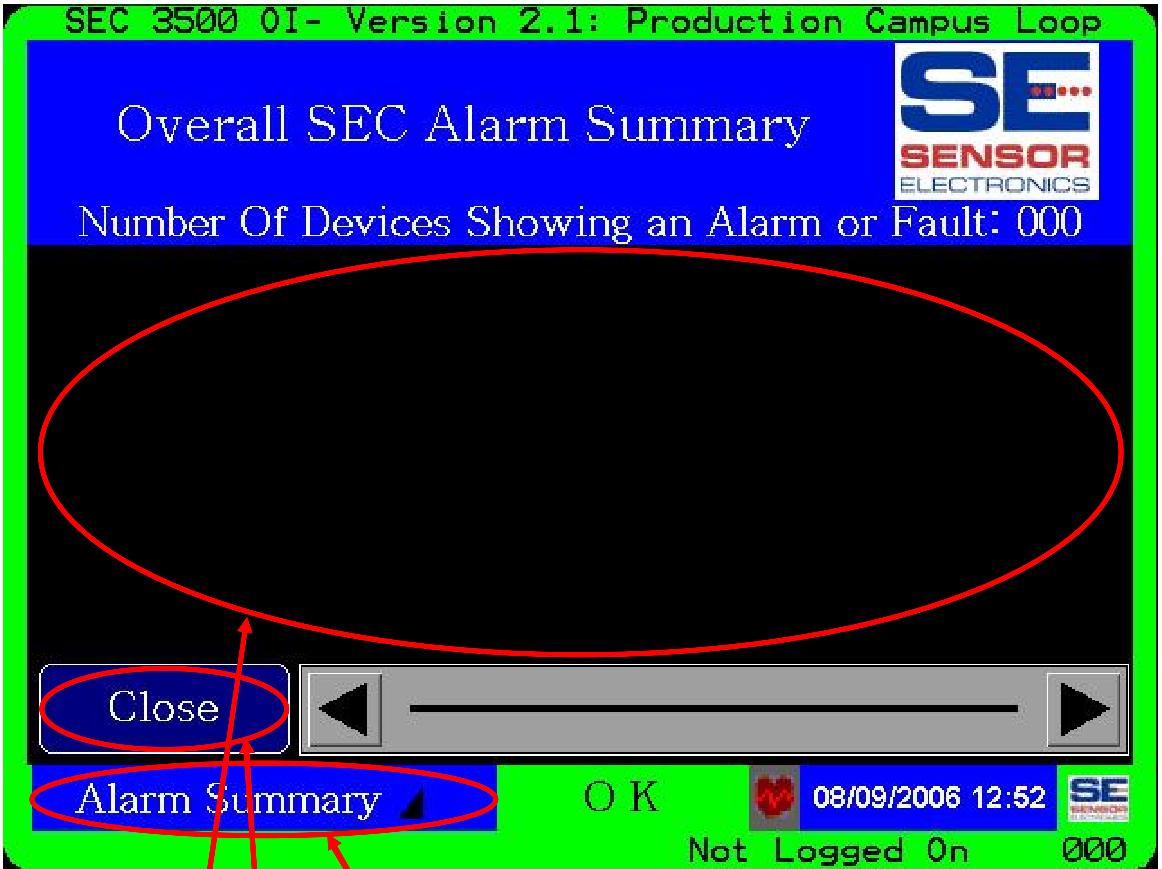
8 Coil Icon: 16 Coil Icon:





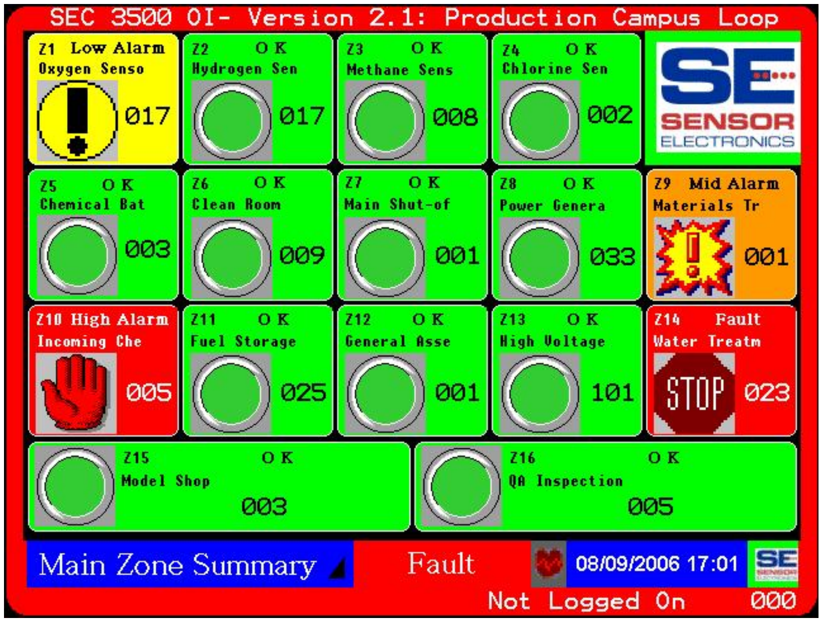
The left side of the 8 Coil Icon is filled, with the remainder open, whereas the 16 Coil Icon is completely filled.

4.6 Alarm Summary Screen

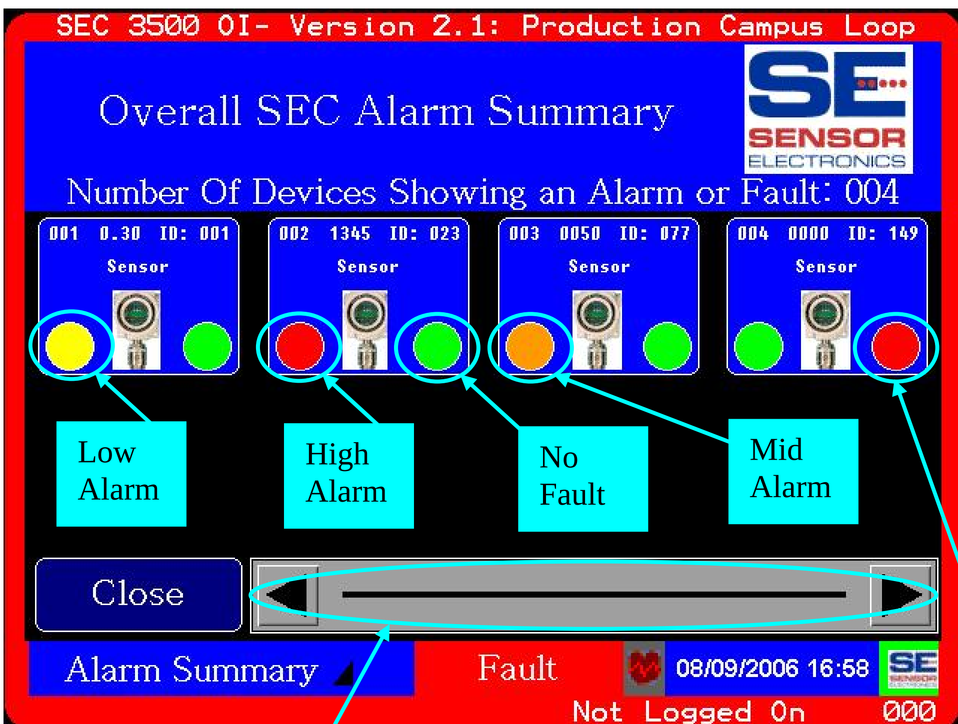


1) The Alarm Summary Screen displays device status icons for all devices in an alarm or fault state (does not include devices deemed off-line by an SEC 3500 generated fault). Hence it is possible (as shown above) to show a blank device information area if there are no devices in an alarm or fault condition. This would be the case if a device(s) deemed as off-line could cause the General Loop alarm status and particular zone status (on the Main Zone Summary screen) to show a fault without any device status boxes in the alarm summary above. Of course an empty display such as this is possible simply by navigating to it when there are no devices in an alarm or fault state.
2) All navigation and control in the bottom status bar is identical to the Main Zone Summary and other operations screens.
3) Pressing the "Close" button or the screen title in the bottom status bar returns the screen back to the Main Zone Summary screen. See the example on the following page.

4.6.1 Alarm Summary Returning to Home Zone Summary

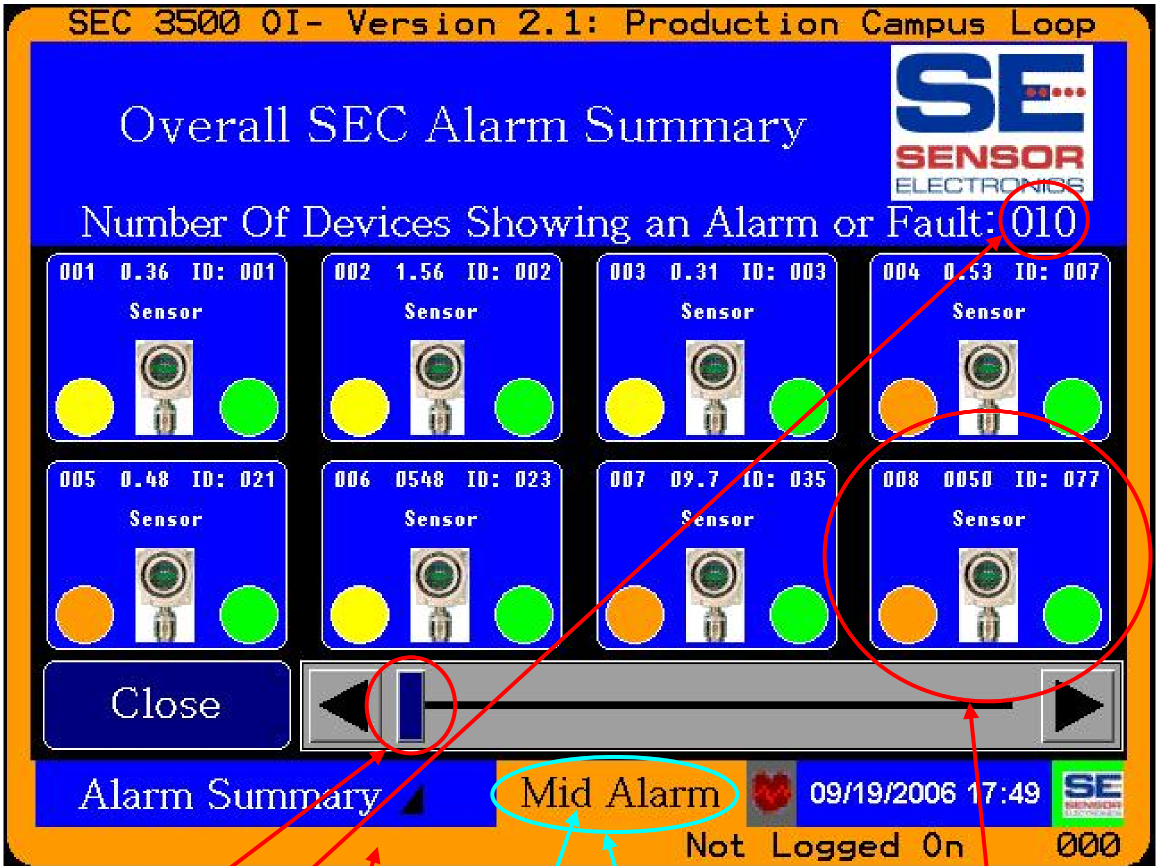


4.6.2 Alarm Summary with Partial Set of Devices



1) As shown above, only four devices are in an alarm or fault state. The one in the Fault state dominates as the highest global loop status shown in the borders and the bottom status bar.
2) Notice there is no navigation possible since there are less than nine devices.

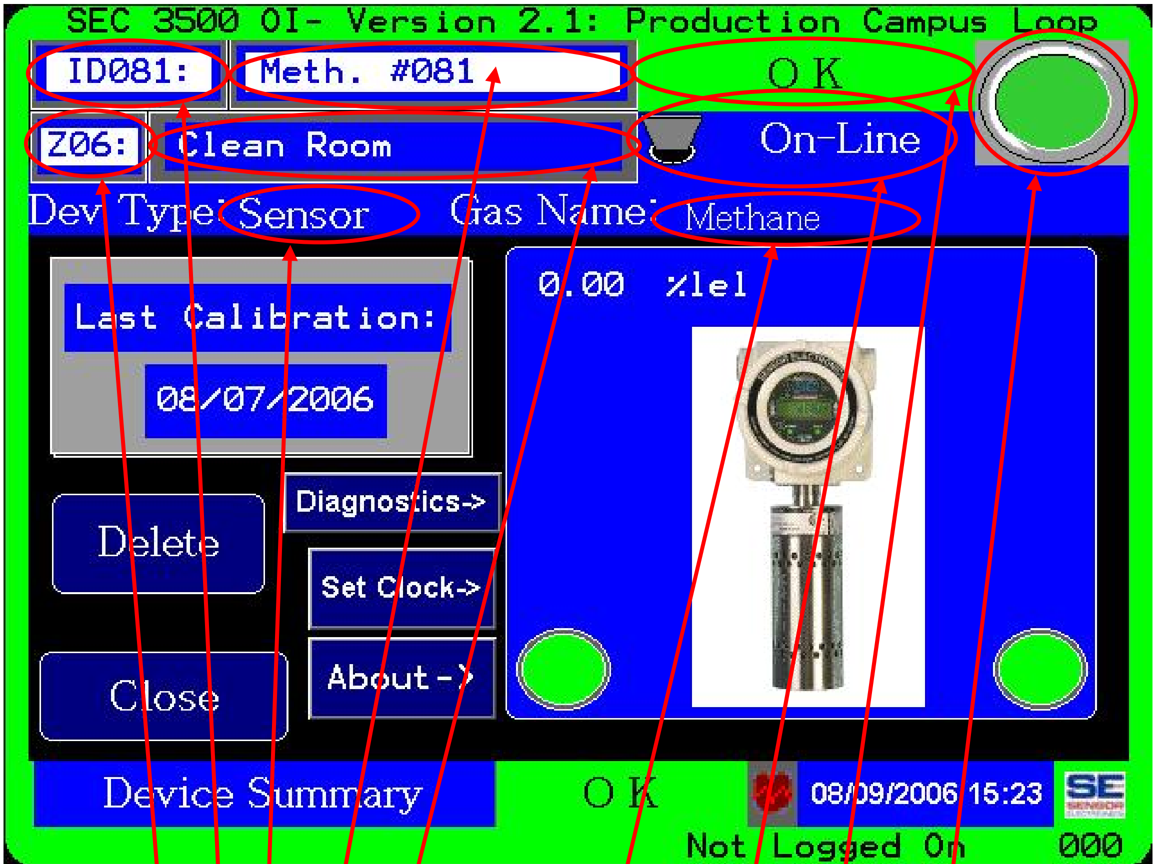
4.6.3 Alarm Summary with more than eight devices



1) Here we have ten devices (eight shown at a time) in alarm conditions, with the ability to scroll eight at a time back and forth, start to end.
2) In this example, the highest alarm level of all devices and zones is a Mid Alarm, hence the Global Loop status shows the Orange Mid Alarm status in the borders and in the bottom status bar Global Loop Alarm Status Text.
3) In all operational screens, pressing on the bottom status bar Global Loop Alarm Status Text will send the display to the Alarm Summary screen, mute the alarm speaker (until a higher alarm level occurs), and refreshes the Alarm Summary screen.

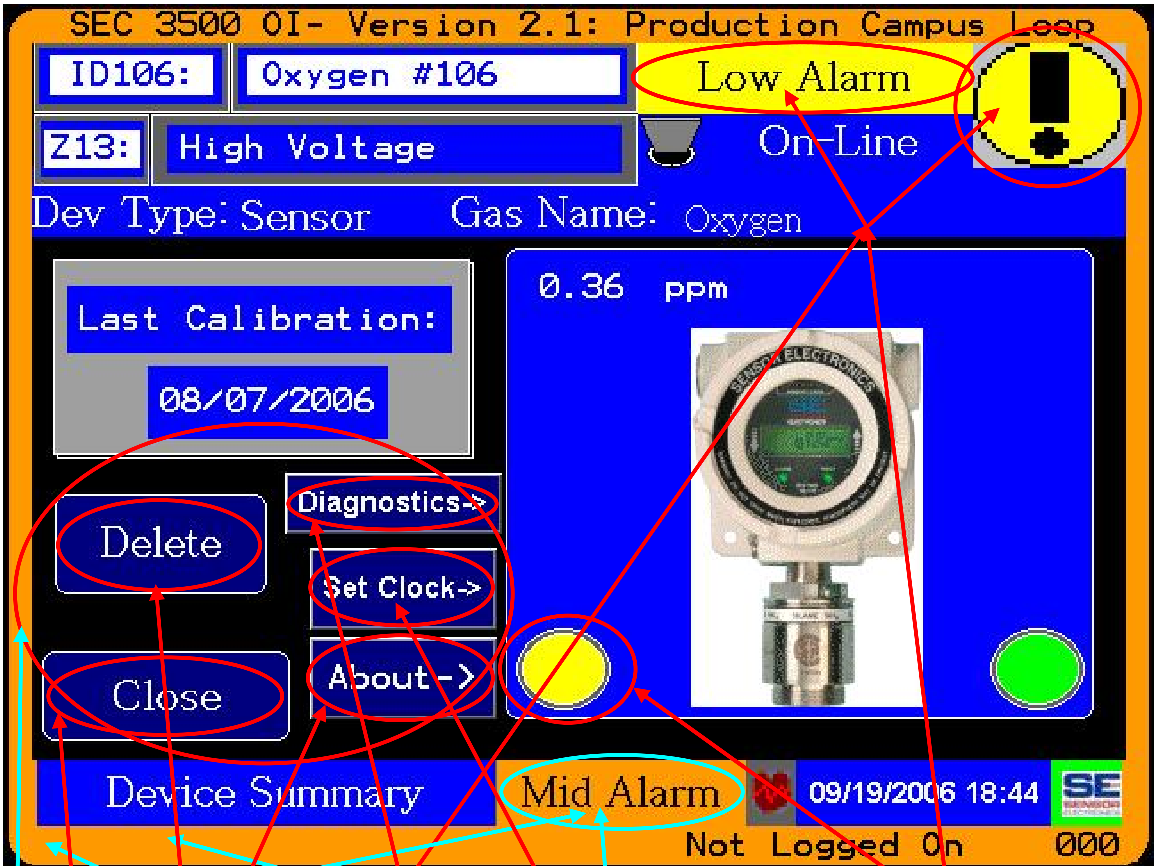
Important Note: It is important to realize that common to the Zone Details, Bus Summary and Alarm Summary screens; by simple pressing on the device status box will launch the Device Summary screen.

4.7 Device Summary Screen



4.7.1 Top Level Device Information

1) Network ID- This is the SEC 3500 Modbus 485 Loop network ID for this device.
2) Zone ID- This is the SEC 3500 Zone this device is assigned to.
3) Device Description- This is a short name given to describe the device.
4) Zone Name- This is same name that appears on Zone Details and Zone Summary, and can be modified be selecting it here and entering a new name with the popup keypad.
5) Device Alarm Status Text- This is the specific device alarm status- NOT the zone or global alarm status text!
6) Device Alarm Status Icon- This is the specific device alarm status- NOT the zone or global alarm status text! Note: Pressing this icon will mute the alarm speaker.
7) Device On-Line Status- Indicates if the device is actively communicating with the panel, or is deemed off-line by the panel. This Icon is Up when on-line, down when off-line.
8) Device Type Text- Short name indicating type (Sensor or one of the Relay Modules).
9) Gas Short Name (for sensors) - Short name indicating the type of gas measured by the sensor.

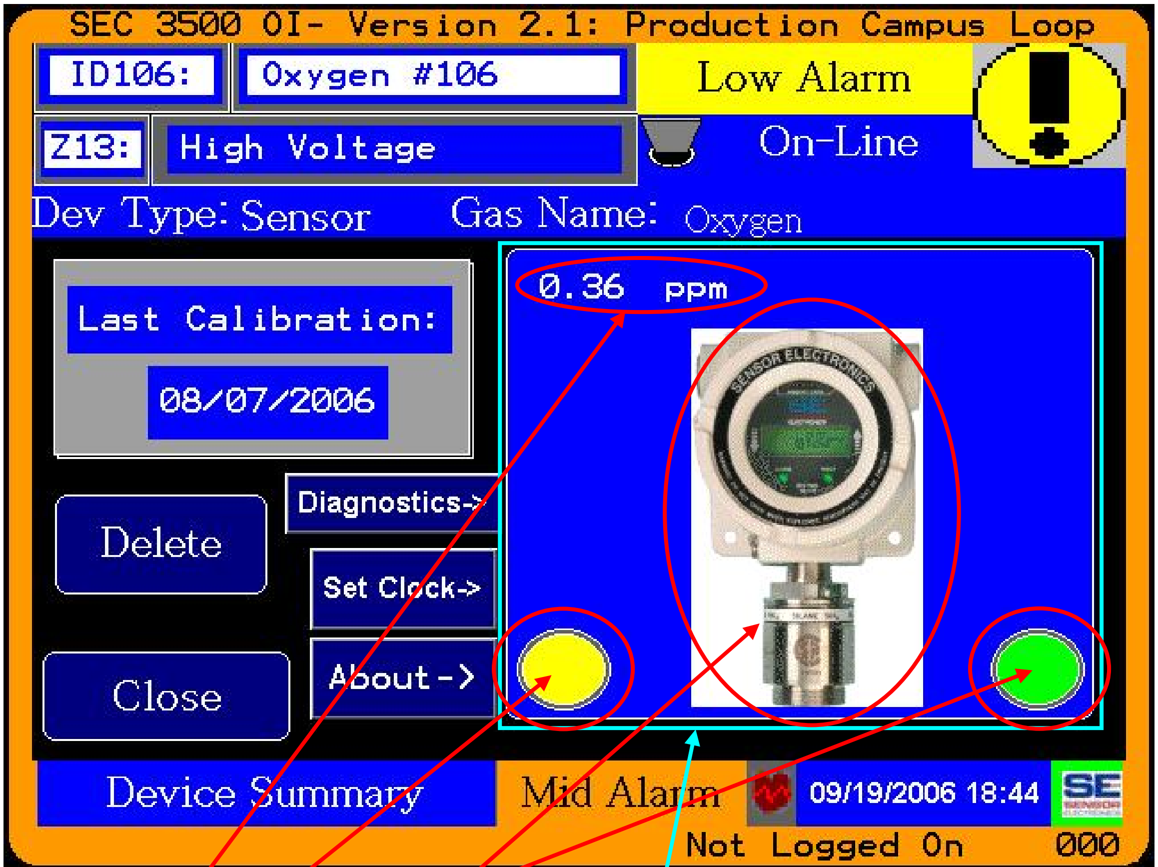


10) Notice how the Device Status Text and Icon can be different than the Global Status Text and borders. Hence what is depicted here is a device in a Low Alarm state, yet the Global Loop Status is depicted in a Mid Alarm state by another device(s).

4.7.2 Left Action Buttons

1) **Close**- Pressing on this button will return the display to the Zone Summary, Bus Summary or Alarm summary screen from where it came from.
2) **About**- Pressing this button will display information about the version info for the SEC 3100 and attached sensor.
3) **Set Clock**- Pressing this button will allow you to set this 3100 device clock or all 3100 device clocks.
4) **Diagnostics**- Perform special diagnostics on the SEC 3100 device.
5) **Delete**- Delete the SEC 3100 from the SEC 3500 Panel memory.

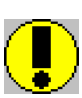
4.7.3 Summary Box Details



1) Current Sensor Gas Level and Gas Units.
2) Device Alarm Level Indicator (can be green-ok, yellow-low, orange-mid, red-high.
3) Device Fault Indicator (can be green-ok or red-fault).
4) Sensor Type Icon:
   a) Toxic sensor as shown, and,
   b) Infrared sensor as shown in section 4.7.1 and here

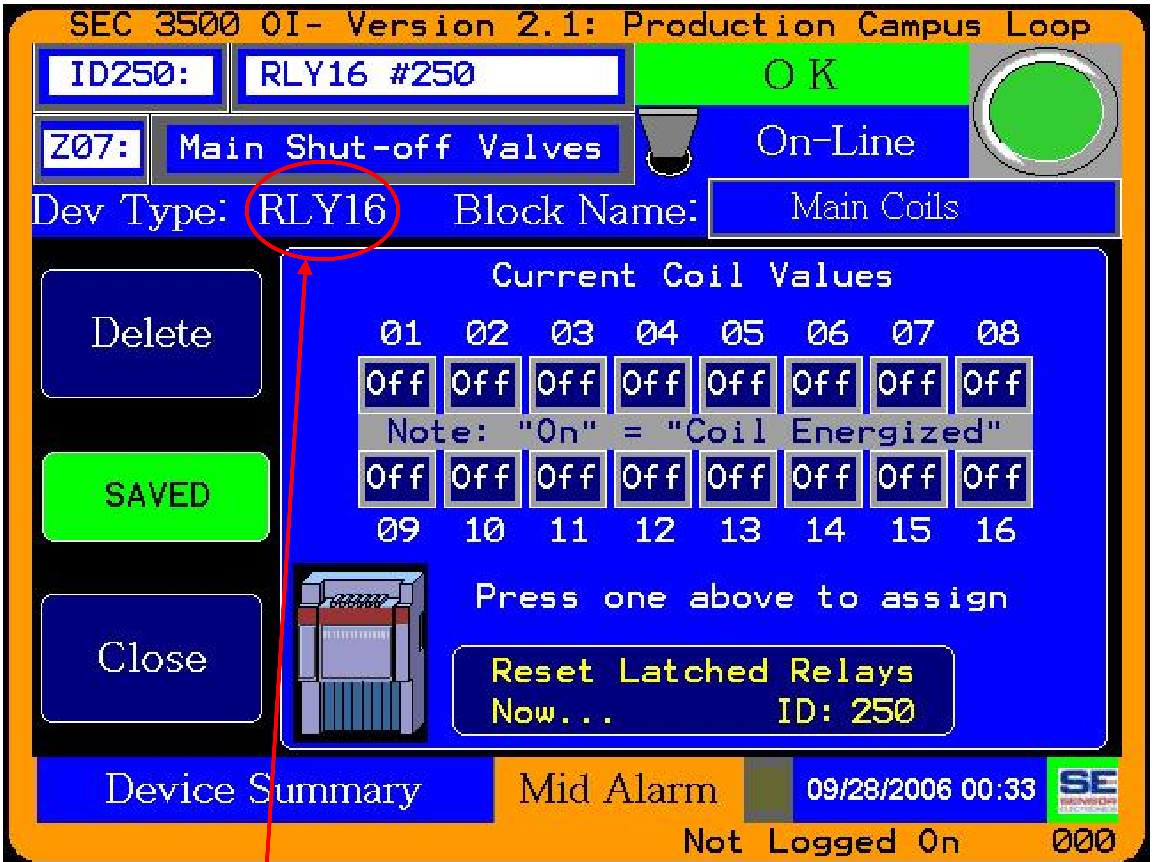
4.7.4 Navigation to Sensor Details Screen

By pressing any where in the Summary Details Box, the Sensor Device Details screen will be displayed.



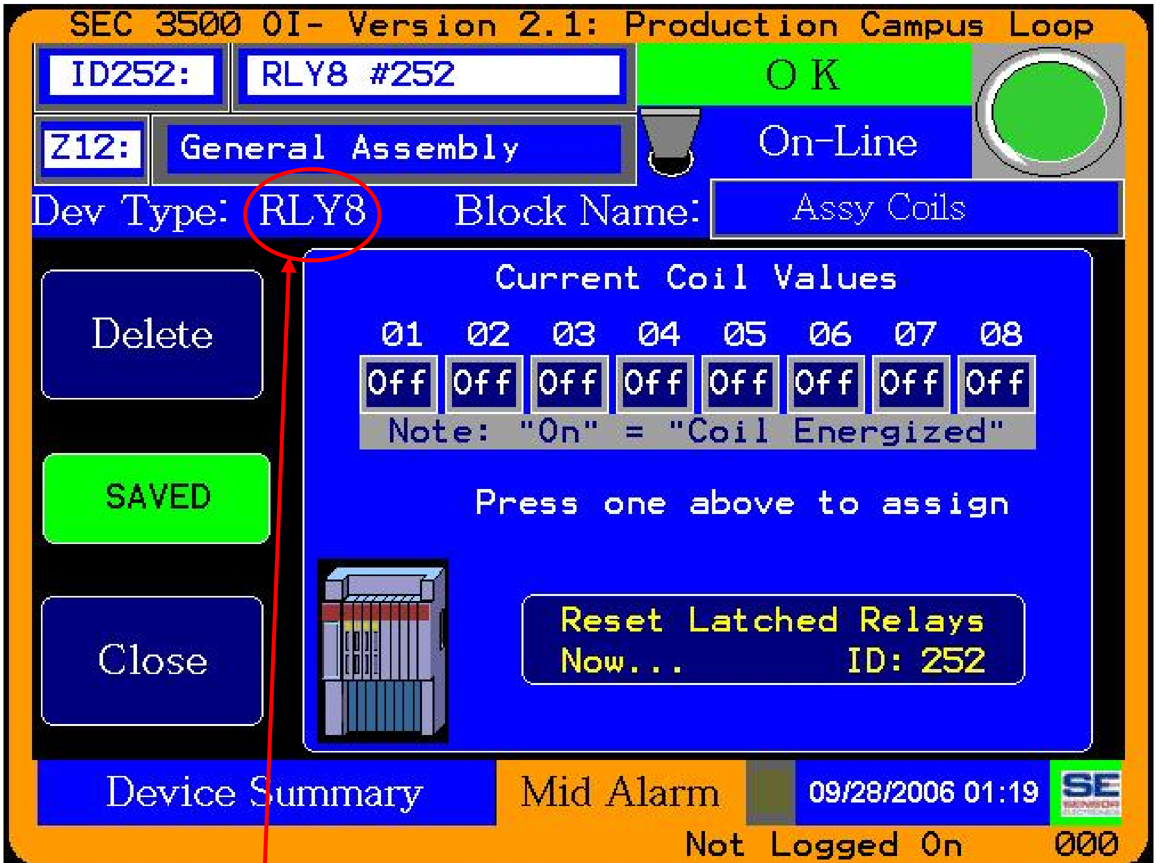
Important Note: The Global Status Borders and Text are identical in appearance and behavior to all of the other operation screens, such as the Main Zone Summary Screen, as is the bottom status bar collection.

4.7.5 Device Summary Screen for SEC Relay16 Modules



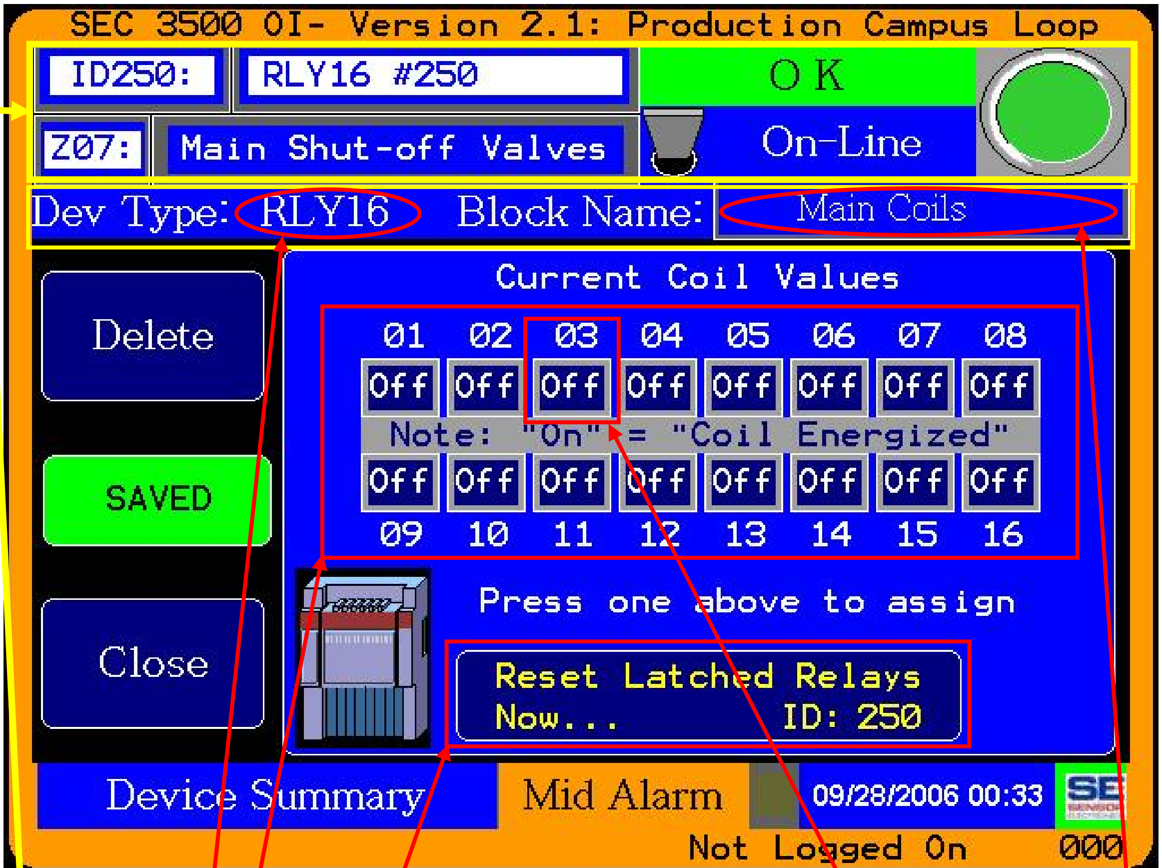
Note: This is a 16 Coil Relay Module above.

4.7.6 Device Summary Screen for SEC Relay8 Modules



Note: This is an 8 Coil Relay Module above.

4.7.7 SEC Relay Module Device Summary Screen Specifics



1) The top information panel is identical in information and function as the Sensor Device Summary, described in section 4.7.1.
2) The device type in the bottom bar of the top information panel shows the device type of either “RLY8” or “RLY16” for Relay Modules with eight coils or sixteen coils, respectively.
3) The Block Name in the bottom bar of the top information panel shows the user given name to describe the use of this bank of coils. It can be changed by simple touching the box or current name and pressing again to bring up the popup keypad and entering a new name.
4) The Main area of interest on this screen is in the center, under the heading “Current Coil Values”. It shows the current “On” or “Off” state of each coil. Where “On” is defined as “Coil Energized”. Any one of these coil state boxes may be pressed to bring up Coil Assignment Screen.
5) “Reset Latched Relays” issues a command to cause all coils to reset to “off” states.
6) The “Delete” button removes the Relay Module and resets the 3500.
7) The “Close” button returns to the Zone Details or Bus Summary screen where it had come from.
8) The “Saved” notice/button is used to permanently save changes made in assignments.

4.8 Sensor Details Screen

4.8.1 Top Level Information Box

1) All of this information is identical to the information shown in the Device Summary Screen for this device. See section 4.7.1 for details.

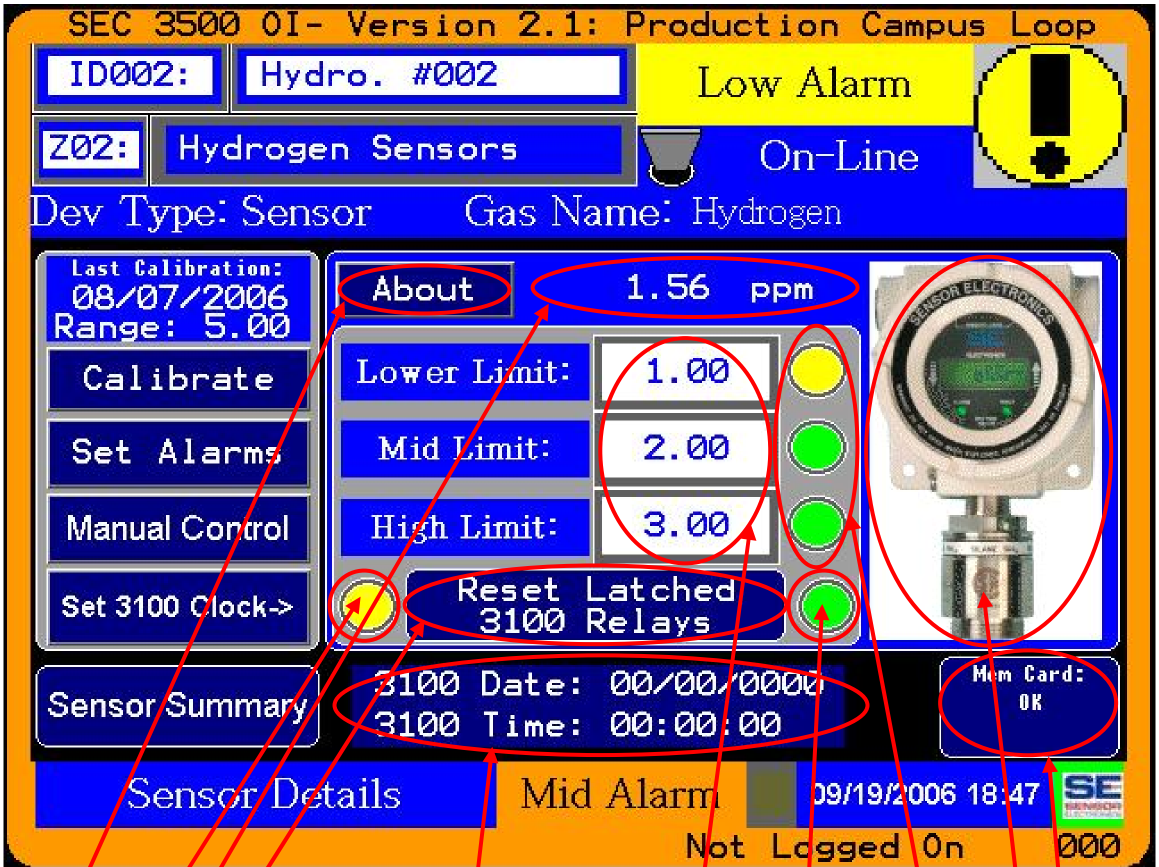
2) Navigating back to the Sensor Summary screen is accomplished simply by pressing the Sensor Summary button above.

3) The Global Alarm Status borders and Global Alarm Status text in the bottom status bar behave identically with the Device Summary Screen as mentioned in section 4.7.4.

4) Likewise, the Device Status Text and Icon behave identically with the Device Summary Screen as described in section 4.7.1.

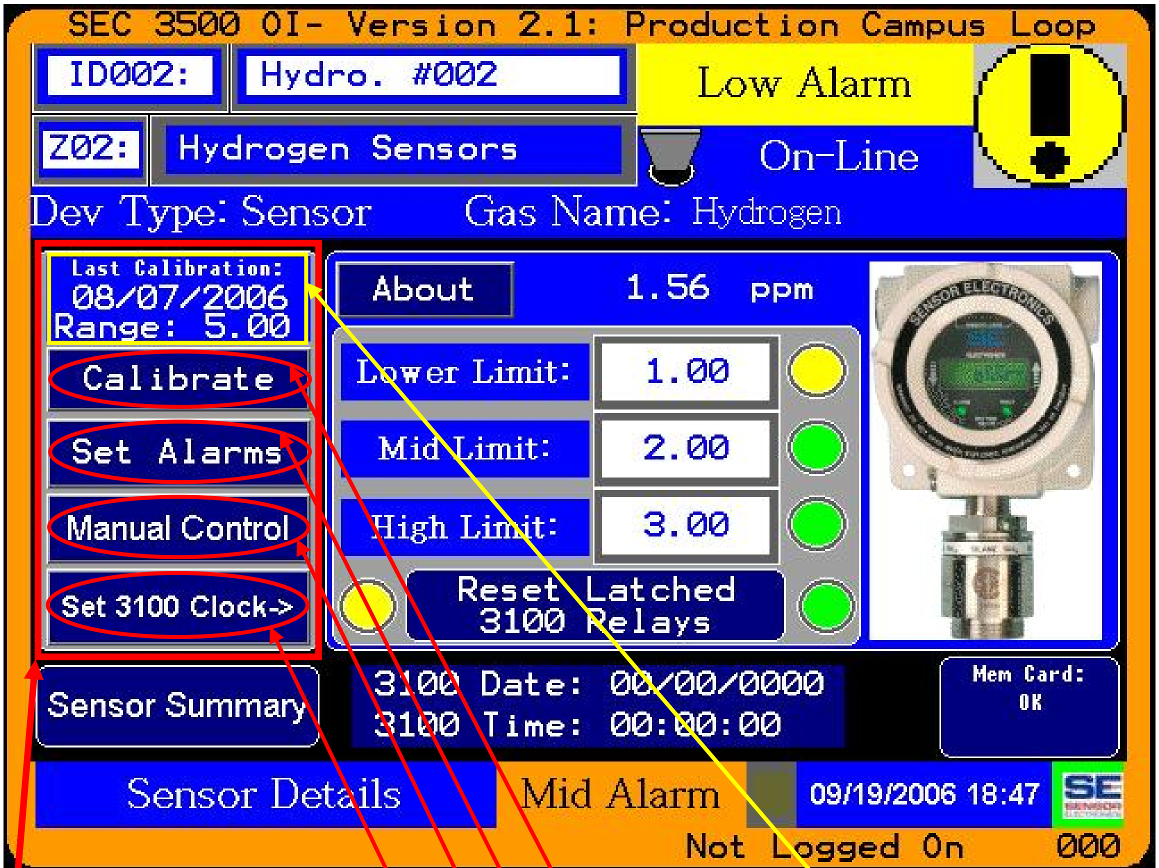
5) And finally, the bottom bar status collection behaves identically with the Device Summary Screen as described in section 4.7.1, just as it does with the Main Zone Summary Screen and all other primary operation screens.

4.8.2 Details Box



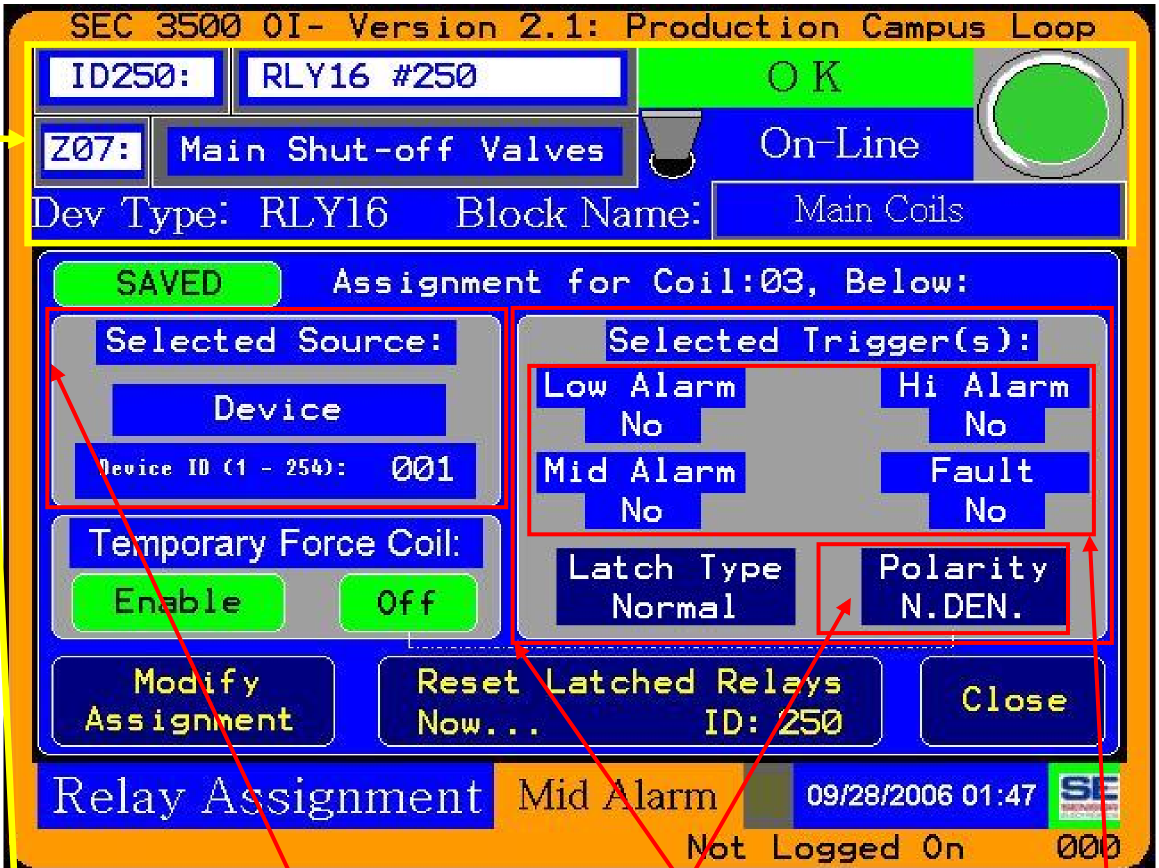
1) **About**- Pressing this button provides version information for the specific SEC 3100 device and the attached sensor.
2) **Current Gas Level and Units**- Displays the current Gas Level in the displayed measurement units.
3) **Device Alarm Level Indicator**- Displays the alarm level of the device, color-coded as previously described (green, yellow, red).
4) **Reset Latched 3100 Relays**- By pressing this button; request is made for the device to reset any 3100 relays that may have been previously latched.
5) **Alarm Set Points**- The alarm threshold set point values.
6) **Device Fault Indicator**- Displays the SEC 3100 device fault status (green or red).
7) **Independent Alarm Level Indicators**- Displays alarm indication for each individual alarm status conditions; Low is either green or yellow, Mid is either green or orange, High is either green or red. Only one can be any color other than green.
8) **Sensor Type Icon**- Displays the proper sensor type image, toxic or infrared as above.
9) **Current 3100 Date & Time**- Displays the current 3100 time and date retrieved from the 3100. It is updated with a yellow highlighted box in the seconds to indicate at that moment the time has been read and should be in agreement with the clock display for the panel.
10) **Status of the 3100 Flash Card**- OK or not. More details to come in a future version.

4.8.3 Control Panel

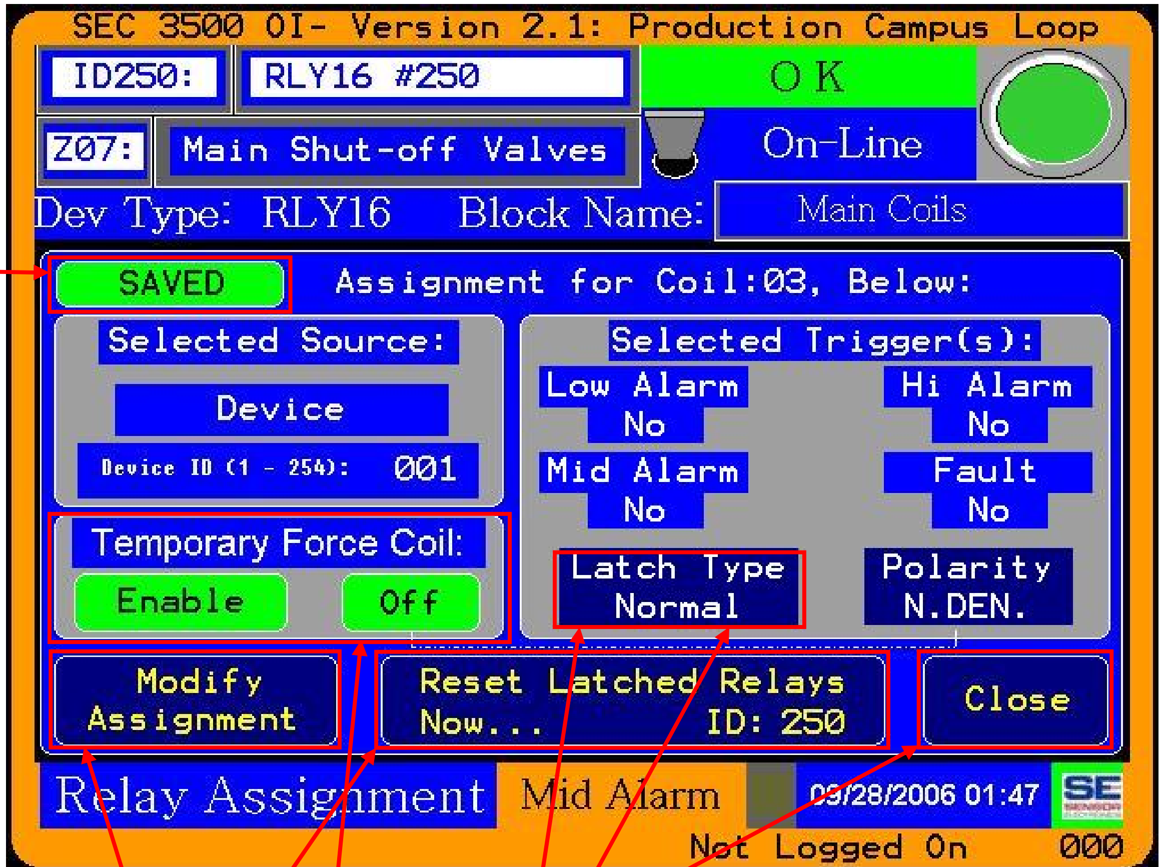


1) **Control Panel**- This display panel will remain in this location throughout all configuration screens that each of these control buttons will change to. Configuration is not handled in this manual.
2) **Info Box**- Displays the last calibration date and the range of the sensor.
3) **Calibrate**- Enters the calibration process screens. Not handled by this manual.
4) **Set Alarms**- Enters the alarm threshold set point screen. Not handled by this manual.
5) **Manual Control**- Allows manual drive and control of 3100 relays and lamp test. Not handled by this manual.
6) **Set 3100 Clock**- Allows setting this 3100 clock or all 3100 clocks on the bus.

4.8.4 Relay Module Device Coil Assignments Screen

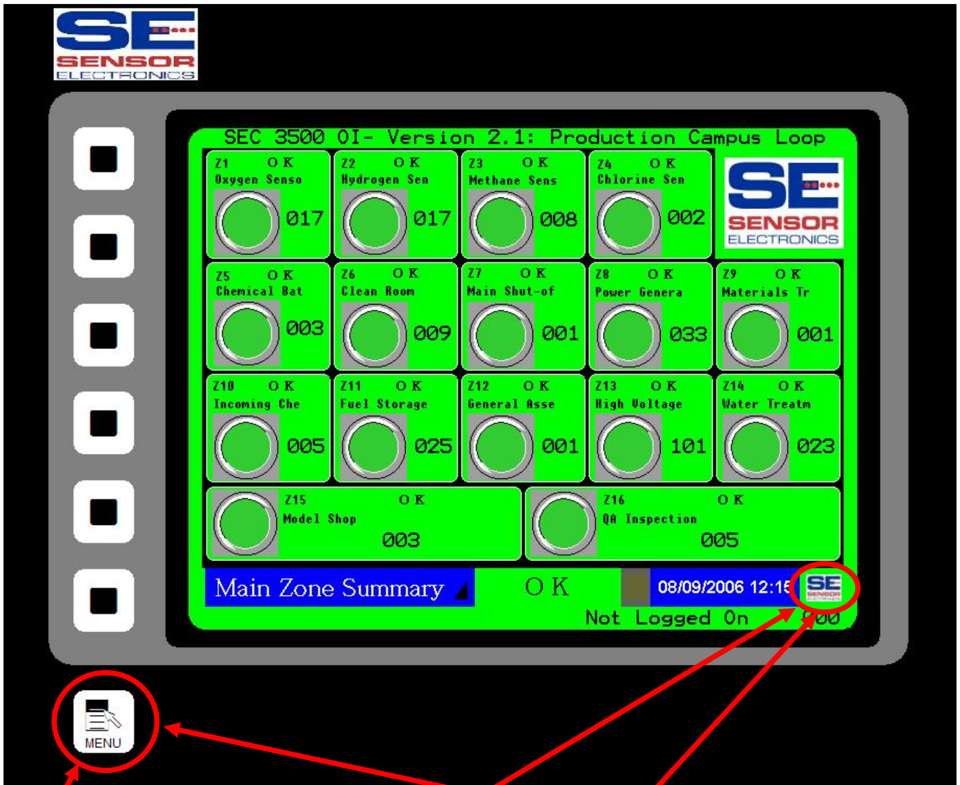


1) The Top Information Panel is identical to the description previously, for the Relay Module Device Summary Screen.
2) The middle section of the screen displays the coil assignments for the coil number titled (for this example, it is coil #3).
3) It shows the source assigned (on the left) for the trigger action (on the right). The source may be a specific SEC 3100 device, a specific zone, or the global loop status.
4) The source assigned is used by the Boolean logic function established by the trigger panel to the right. It can be any combination of the four alarm conditions. A trigger remains active until a higher trigger becomes active (i.e. {example not shown above} If “Low Alarm” is only selected above, then when the Gas Level rises above the Low Alarm and causes the trigger to activate; and as the gas rises above the low alarm, the trigger will stay active until it reaches the mid alarm level- and since the mid alarm is NOT selected as a trigger in this example, the trigger becomes in-active until the gas level falls into its range.).
5) The trigger Boolean function result is then applied to the settings for how to engage the coil itself. If the “Polarity” above is set to normally de-energized (N.DEN.), then an active trigger will cause the coil to become energized, otherwise it will be de-energized.



6) If the Coil has been set to remain latched once a trigger has activated, then no matter what conditions exist, the coil energy cannot be changed by any successive triggers until it is reset.
7) Pressing the "Close" button returns the screen to the Relay Module Device Summary screen.
8) The Temporary Force coil box is not accessible to the basic operator, but allowable when the supervisor operator is logged in. See the Supervisor's Manual for more information.
9) The "Modify Assignment" button is also not accessible to the basic operator. See the Supervisor's Manual for more information.
10) The "Saved" status/button is used to indicate whether an assignment has been permanently saved or if it needs to be saved. This is not accessible to the basic operator; please see the Supervisor's Manual for more information.
11) There are three "Latch Type" modes (shown above is "Normal"): "Normal"- no latching, "Latching"- which remains latched as described above in item 6), and "Audible"- which is intended for audible sounding equipment and remains on so long as a trigger condition exists, and off when all conditions clear. This is a special latch type since it can be silenced (unlike "Normal" or "Latching") while a trigger exists. This is silenced as described in section 2.1 previously, for "Immediate Alarm Silence".

5.0 Basic Menu Navigation



(Menu Button Areas)

Everything begins with the Main Menu. Therefore, there are two primary ways of gaining access to the Menu System;

1) Through the menu push button on the bottom-left corner of the panel (not the touch-screen).
2) Through touching the small SEC Logo at the bottom-right corner of the touch-screen area.

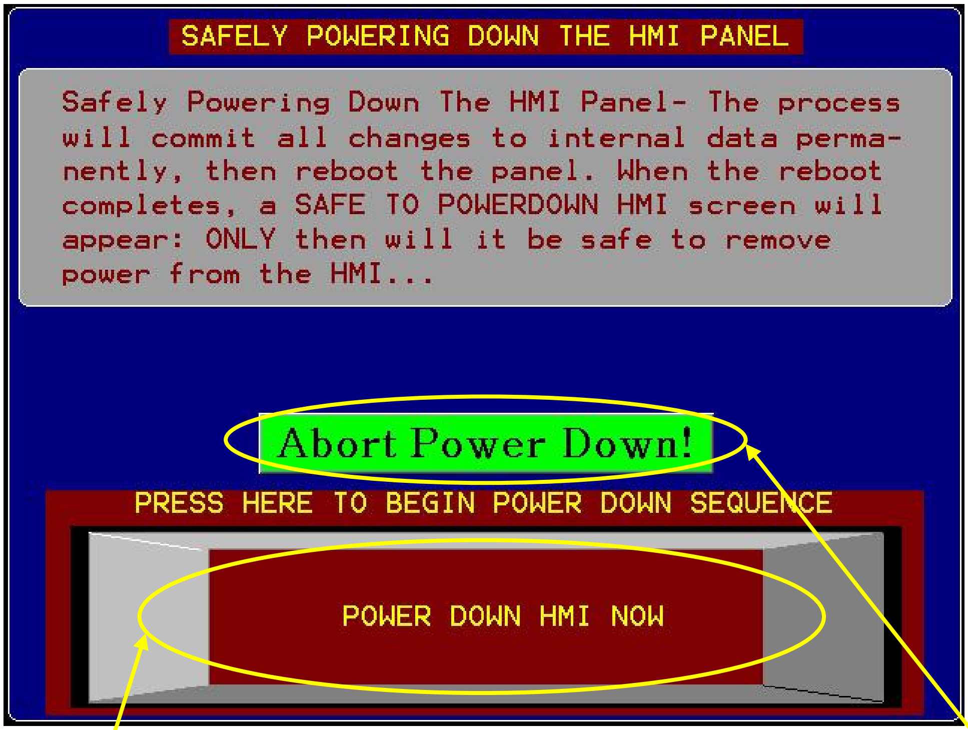
Either method is equally valid, and always present and active, regardless of the operational screen. There are some utility screens that do not have the SEC Logo, and usually provide an on-screen button to access the menu; however, you can always access the main menu from the panel button as described in consideration 1 above.

Menu items exist for most major functions that can also be accessed faster directly on screen, however, all of this is under a security system, organized for different types of users. This manual was designed for the basic operator; hence we will not go into the other levels other than to mention them. It is noteworthy that the main menu appears slightly different depending on what user is logged in- in the sense of what items are inactive, and sub-menus are definitely different depending on the operator logged in.

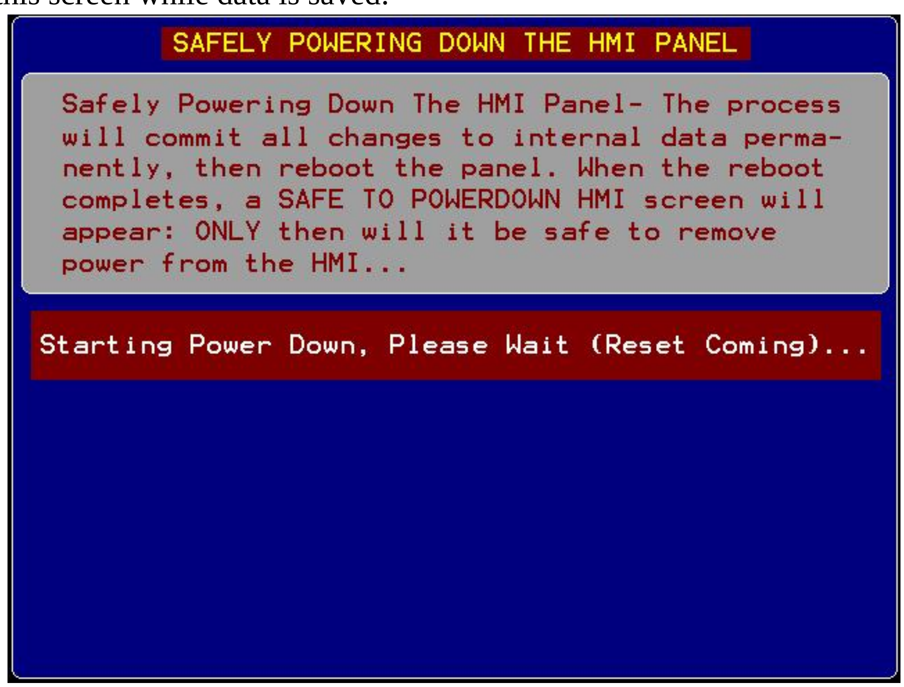
5.1 Main Menu

1) **<u>Safe Power Off</u>-** Selecting this item is crucial for insuring that data collected, settings made, etc. are permanently stored. Data is stored in internal volatile RAM, and occasionally stored into permanent storage after varying periods of time. To insure that there is no data loss due to this uncertainty, selecting this option causes this data to be permanently saved, the panel is prepared for a valid power-of condition, and will not display the main page until the operator is ready for normal operation, thus insuring the communication busses are essential down. See section 5.2.
2) **<u>About SEC…</u>-** Pressing this touch item pops up the information box, describing the contact information for Sensor Electronics Corporation, as well as the firmware version of the SEC 3500, and provides a shortcut to logging into the panel. See section 5.3.
3) **<u>Login/Logout</u>-** Pressing this allows the user to Login to another account, or logout of the current account. For higher level users, this allows passwords to be changed as well. See section 5.4.
4) **<u>Screen Selection</u>-** This is the primary selection used by operators for screen navigation; it allows the operator to select a specific screen or function screen to go to. See section 5.5.
5) **<u>Supervisor Menu</u>-** Notice that it is missing the surrounding box with white borders. This indicates that it is inactive. When the operator is logged in as the supervisor or higher user, this item will be fully active as the others and allow the supervisor user to access other sub-menus for configuration.
6) **<u>Exit Menu</u>-** Pressing this should cause the menu to be removed from the screen behind it.

5.2 Safe Power-Down Screen



At this point, if the operator intended to safely shut the panel down, then press the "POWER DOWN HMI NOW" button, otherwise if it was unintentional, press the "Abort Power Down!" button. "Abort…" will return back to the Main Zone Summary screen. Pressing "POWER DOWN HMI NOW" will begin the power down process, first showing this screen while data is saved:

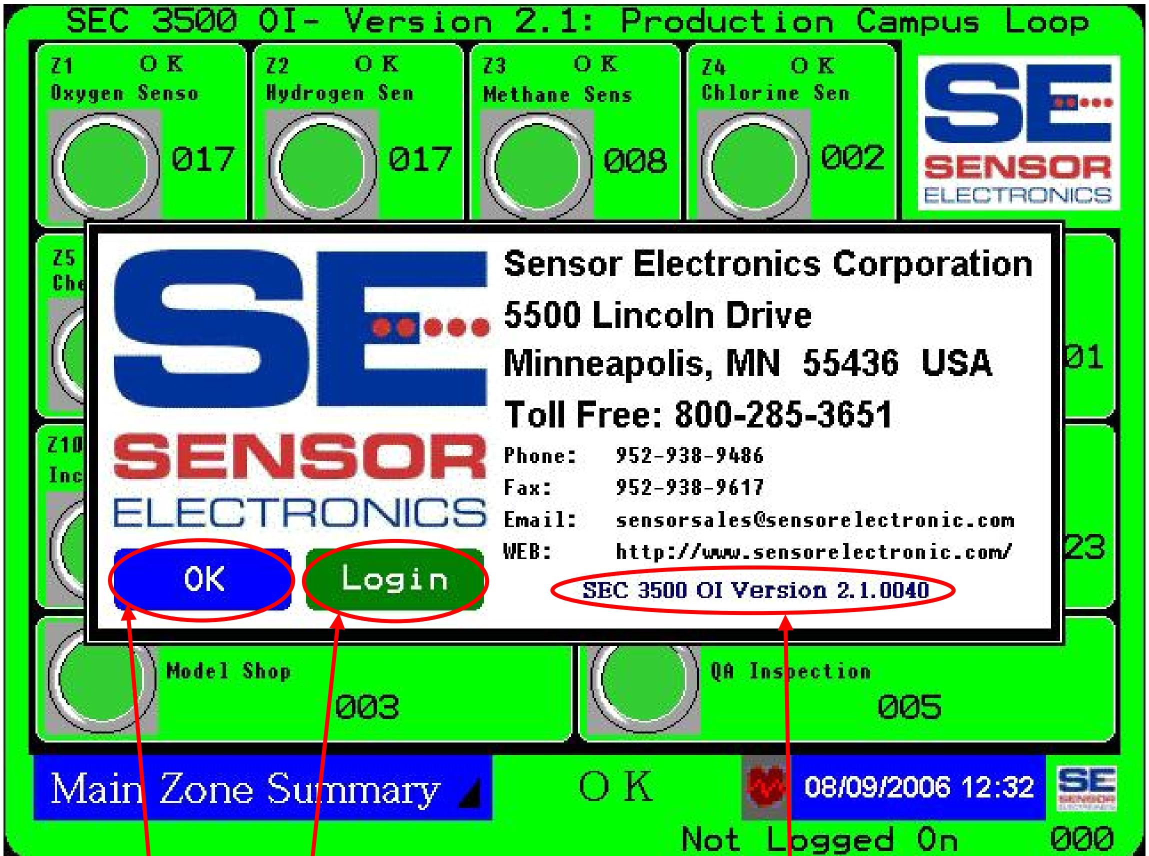


Then the 3500 panel resets, displays the splash page and displays the following page:

This screen will continue to display every time the panel is powered down until "Restart" above is pressed. So for now, if the intention is to safely shut down; now is the proper time to remove power from the panel. When the panel is power back on, the screen will return. And if you are ready to return to normal operation, then press the "Restart" button, and the following screen will be displayed:

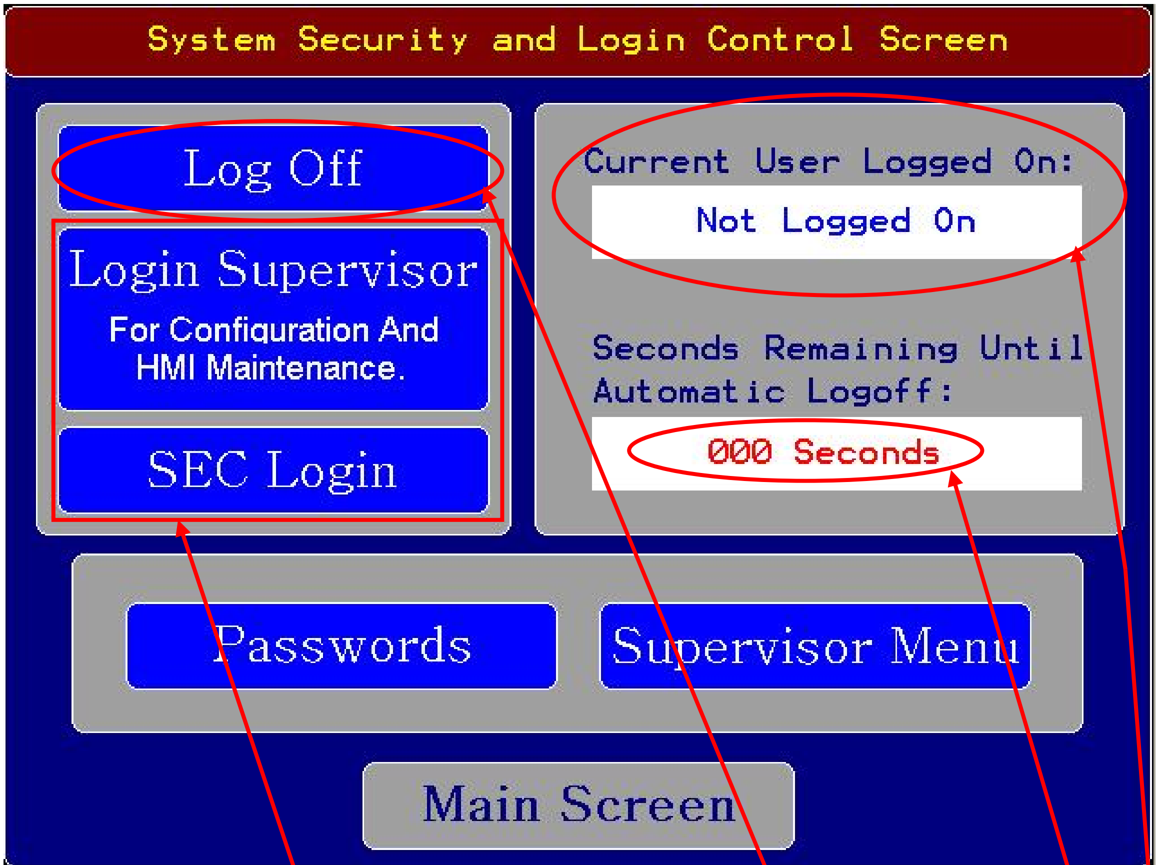
Followed by the 3500 panel restarting, the splash screen displayed and the Main Zone Summary screen display- Normal Operation has now been resumed.

5.3 “About SEC…” Popup Display



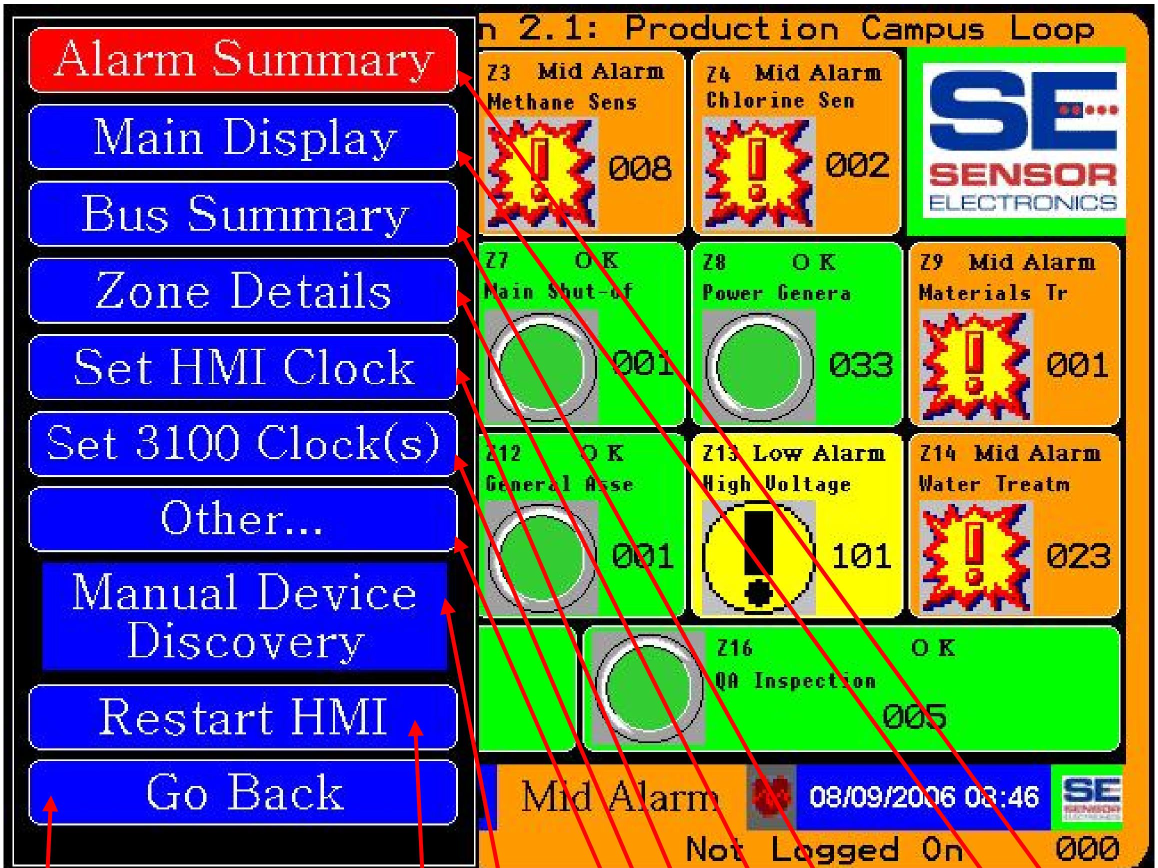
1) The SEC “About”… box is shown either by selecting it off the Main Menu, or by pressing the SEC logo on ANY screen. The small logo at the bottom-right of any screen will launch the Main Menu; however the larger icon show at the top-right of any screen will launch this “About box” directly.
2) The “OK” button may be pressed at anytime before the popup is automatically removed after thirty seconds, and it will be immediately removed.
3) The “Login” button may be pressed at anytime before the popup is automatically removed after thirty seconds, and the “Security” screen will be launched- See section 5.4.
4) The primary content of this information box is to provide the contact information for Sensor Electronics Corporation. In addition, the version number information of the SEC 3500 panel is also displayed, necessary for SEC Customer Support to help diagnose any customer issue that may arise.

5.4 The Security Screen- Login/Logout



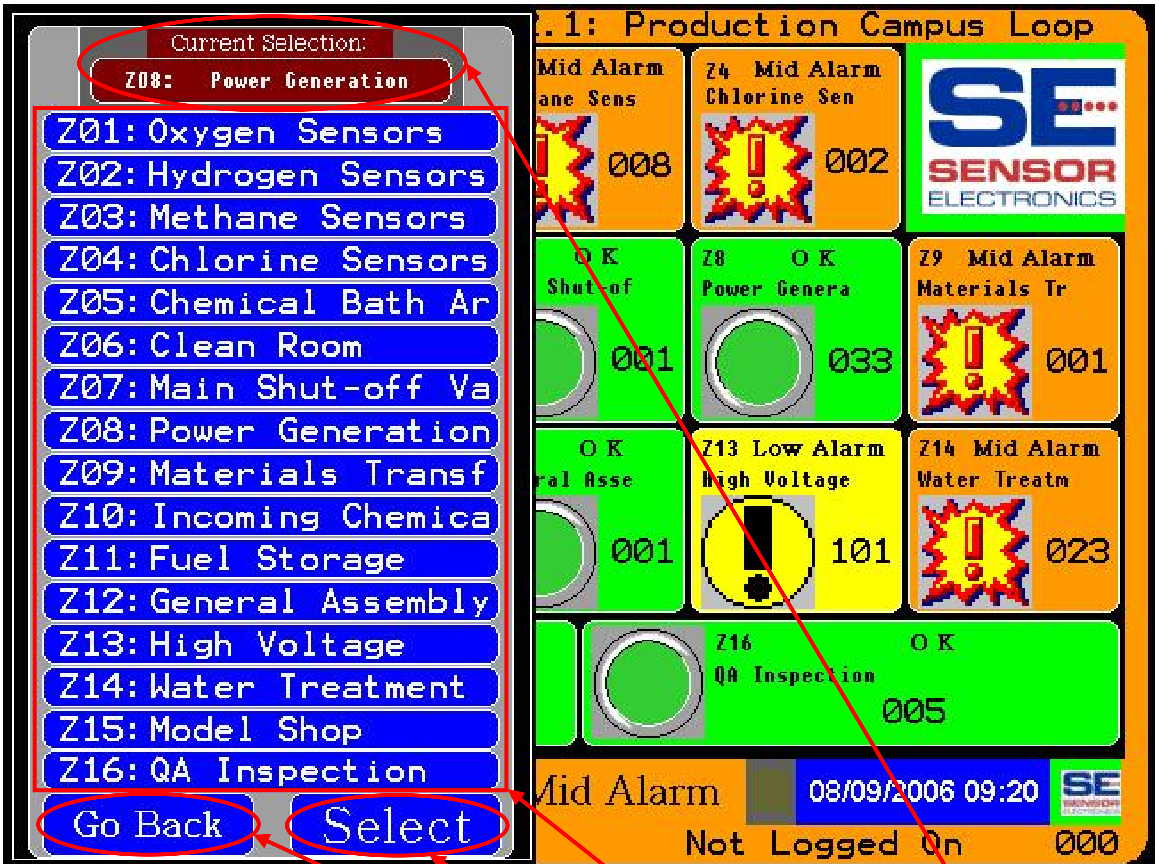
1) The security system of the SEC 3500 OI Panel is established to maintain three levels of increasing capability, configuration and information. It is managed by what user is logged on. Which user category is logged in at any given time is displayed above on this screen, and as well on the bottom of the primary operation screens, along with the amount of time remaining until that user is automatically logged off. It is set for ten minutes (600 seconds), and cannot be modified, or restarted by touch screen activity (as contrasted by the screen saver and screen timeouts).
2) The basic operator category, which audience this manual is written for, does not have to login to the panel. If a higher category user is logged in and is ready to leave the panel, that user should go to this security screen and choose to “Log Off” to return the SEC 3500 operational behavior and security settings to the basic operator category.
3) The two remaining operator categories, shown above, can be logged in by pressing on their respective button, entering the user name and password as the popup keypad entry displays appear. If all is entered properly, the user will show that it is logged on above as well as a count down of the time remaining. See “Startup Basics Guide” section 3.0 (1) and (2) previously for an example.

5.5 Screen Selection Menu



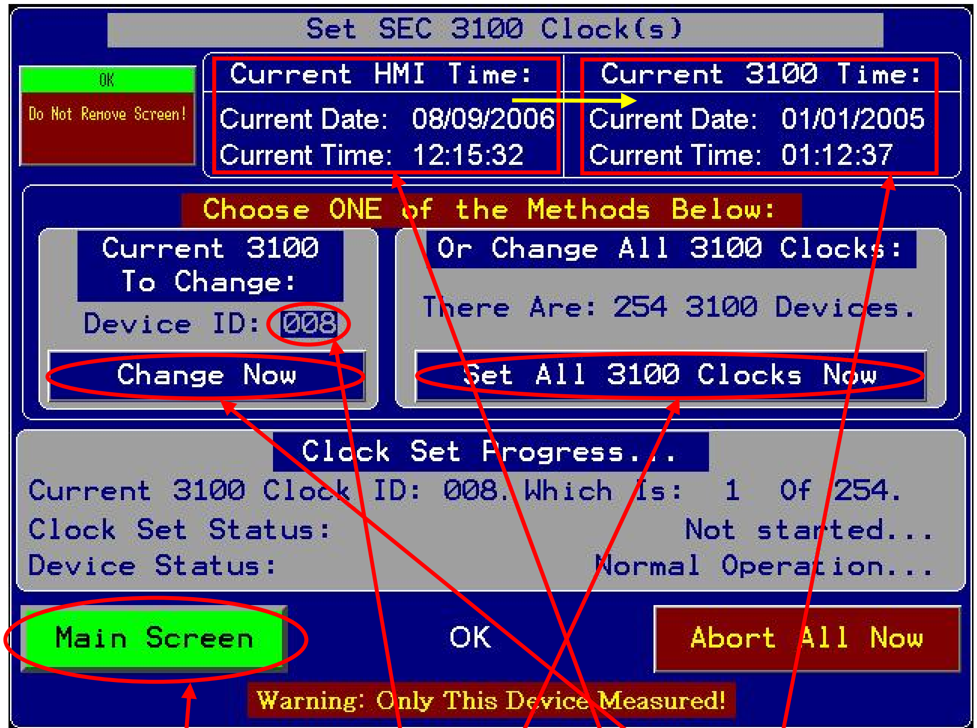
1) **Alarm Summary**- Transitions to the Alarm Summary screen when pressed. See section 4.6.
2) **Main Display**- Transitions to the Main Zone Summary screen when pressed. See section 4.1.
3) **Bus Summary**- Transitions to the Bus Summary screen when pressed. See sec. 4.5.
4) **Zone Details**- Shows a zone selection menu screen when pressed. See section 5.5.1.
5) **Set HMI Clock**- Transitions to the Change SEC 3500 clock screen when pressed. See "Startup Basics Guide" section 3.0 (7).
6) **Set 3100 Clock(s)** - Transitions to the set 3100 Clock screen. See section 5.5.2.
7) **Other…** - This is a placeholder for a future main menu item. No action occurs if pressed.
8) **Manual Device Discovery**- See "Startup Basics Guide" section 3.0 (3).
9) **Restart HMI**- Saves all permanent data not saved and reboots the SEC 3500 Panel. See section 5.5.3.
10) **Go Back**- This will transition back to the Main Menu.

5.5.1 Zone Details Selection Menu



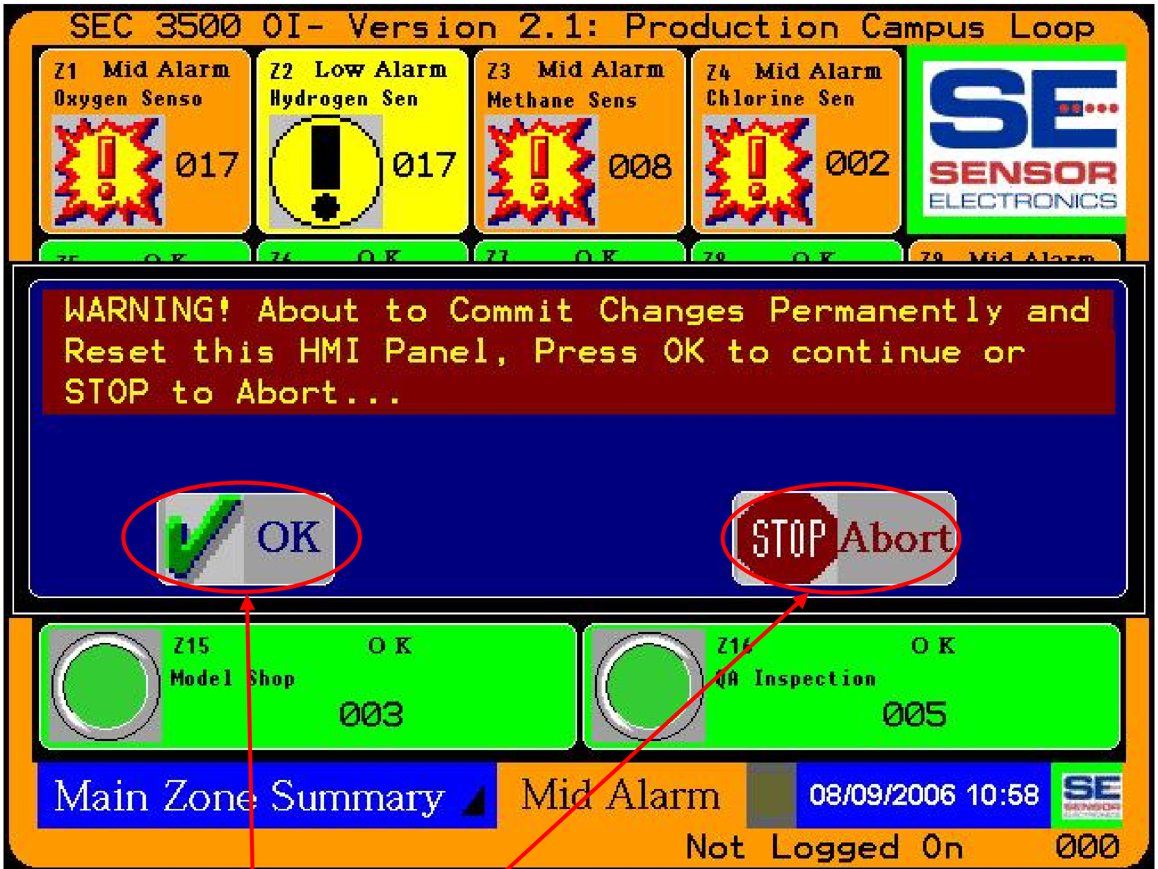
1) This menu allows the operator to select a specific zone to show zone details for. By pressing one of the above zone number/name buttons, the current selection is updated above.
2) If this is not the desired menu, then press “Go Back” to return to the screen selection menu.
3) If this is the desired menu (zone screen selection menu), press the “Select” button above and the screen will transition to the Zone Details screen with the information for the selection zone. See section 4.4.

5.5.2 Set 3100 Clock Screen

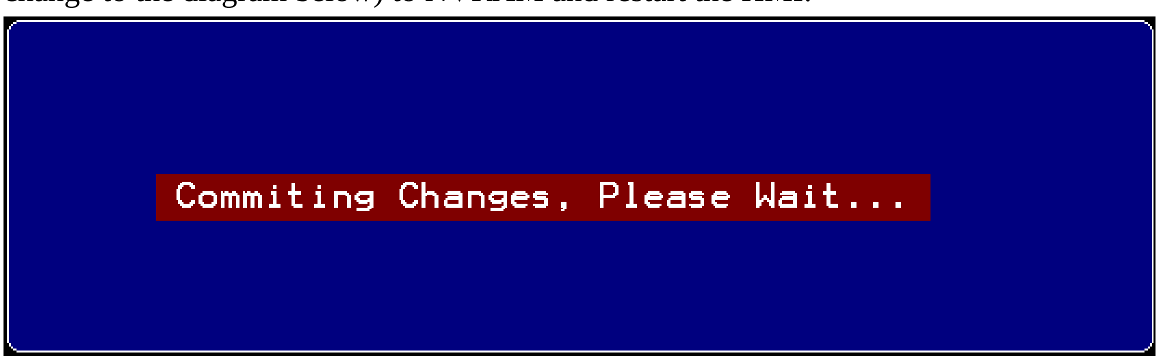


1) Setting an individual 3100 clock or all 3100 clocks on the specific SEC 3500 Loop 485 Modbus; is accomplished by either pressing the "Change Now" button to the left, or pressing the "Set All 3100 Clocks Now" to the right in the middle of the screen.
2) When Changing only one 3100 clock, the desired SEC 3100 unit to change can be changed by pressing the Device ID field and changing the number in the popup keypad that will show.
3) When a 3100 clock is being set, the current HMI date and time as displayed above, are copied into the 3100 device shown above to the right. It will advance the 3100 clock a few seconds if necessary so that the net result is close to the HMI time, however during the process, it continuously retrieves the latest HMI time. If the minute, hour or date is within thirty to fifteen seconds of rolling over, then it will wait until the rollover occurs, and then applies the set-ahead principle just mentioned. When a clock is done, it can be as much as five seconds behind the HMI due to the number of polls of the 3100 clock needed to validate; and this does cause some latency.
4) When all clocks are being set, the process marches through all 3100 devices on the bus that are in a proper state to accept clock changes; hence it is possible that all 3100 clocks on the bus are not changed. This is a very efficient way to set 100's of clocks.
5) Press "Main Screen" when clock setting is complete.
6) Transitioning to or from this screen results in transitioning through the primary loop stop and start screens, as previously described in "Startup Basics Guide" section 3.0 (2) and (5).

5.5.3 Restarting the SEC 3500 HMI



When Reset HMI is selected from the Screen Selection Menu or from another action on a configuration screen, this display box will popup, and in this case, will allow the operator to choose to Abort/Stop before starting, or if truly desiring to restart the HMI, then by pressing "OK", it will then permanently save all data (the popup display will change to the diagram below) to NVRAM and restart the HMI:



The SEC 3500 panel will then reboot, the splash screen will appear, and the Main Zone Summary screen will be displayed and normal operation resumed.

6.0 Basic Trouble-Shooting

1) **Q -** ***I cannot find any of my SEC 3100 devices on the 3500.***
   A - (a) If all of the zones are grey on the Main Zone summary screen, and the Bus Summary screen is empty, or if you cannot find your devices on either of these screens, then you should (b) Follow the setup instructions in section 3.0. If after following the instructions in manually discovering devices in section 3.0 and it does not discover any devices ***before*** you leave manual Discovery, then the problem most likely is that the devices are not properly configured, or there is a wiring problem- Review your wiring, configuration settings, etc. (c) Otherwise, if Manual Discovery finds your devices then this is normal operation if (i) you do not have Automatic Discovery enabled (default) or (ii) you did not wait long enough for Automatic Discovery to find them (which could take tens of minutes, depending on bus-load.

2) **Q –** ***Every time I power-cycle my SEC 3500, it displays an "OK to shutdown the panel" screen, and I cannot see the Main screens.***
   A – It is necessary to press the "Restart" button at the center of the screen, to return it to normal operation after a safe power shutdown. Once it is pressed, the screen should indicate that it is rebooting the HMI. The SEC 3500 should reboot, flash the splash screen and eventually show the Main Zone Summary screen. If this does not work, call SEC Customer Service.

3) **Q –** ***When I upgrade the SEC 3500 firmware via Compact Flash card and cycle the power, it stops with a black screen on power up with a GMC code and an error message. What should I do?***
   A – Contact SEC Customer Service- it may be an acceptable code for a panel repair currently under repair but not yet released. Customer Service will guide you through the next steps.

4) **Q –** ***When I need to power down the SEC 3500 Panel, do I always have to use the "Power Down Safely" menu option?***
   A – Generally speaking- ***yes.*** Data is accumulated by the SEC 3500 when there are devices attached to its Modbus and configured to consider them online. Also, any configuration settings made, devices added, devices deleted, modified, etc. are saved in temporary RAM, and are saved to permanent NVRAM based on a roughly six minute last-updated-rule to extend the life of the internal flash memory storage. This does not mean that the SEC 3500 could become corrupt and non-functional like a personal computer, just that some data might not be saved if powering down safely is not performed before a power cycle.

5) **Q –** ***When I press certain areas of the screen, it displays "Insufficient User Rights!!"- Why?***

A – Because certain areas can launch configuration of such items however the user logged in (or not if an operator) does not have the proper rights to perform that function. Log in as the proper user and try it again.

6) **Q –** ***When a sensor drifts into an error, and I am viewing the Sensor Details screen, it falls back to the Device Summary screen, even when I push on the summary icon, it just keeps falling back. Why can't I view these details?***

A – When a sensor has an error, which could be any number of things including the transmitter (3100) communicating erratically or off-line, or even the sensor head removed or calibrating, etc; The SEC 3500 does not trust that the details are sound or correct, so it falls back and displays the specific and general error conditions for that device. When that device returns to normal operation, it will allow the sensor details to again be viewed.

7) **Q –** ***When the screen saver appears, does it continue to measure Gas and Status on the Modbus Loop of all configured SEC 3100 Devices?***

A – ***Yes.*** And if any device enters an alarm or fault condition, the global alarm/fault status will be set accordingly and the screen saver will display both the global alarm text and the global alarm icon for that alarm level and if alarms have not been muted, the speaker will be sounding out the alarm.

7.0 How Does the SEC 3500 Modbus 485 Loop Work?

The SEC 3500 collects gas level and status information from all SEC 3100 Advanced Digital Gas Transmitters in a continuous loop, one device at a time, over an RS485 Modbus RTU loop. It is the master; meaning the 3500 is the only device on the bus allowed to initiate communication. It does this by issuing a Gas&Status Request to a given 3100 device (the Modbus slave), then wait's for it to respond with its Gas&Status data, or timeout. Then it moves on to the next device in the loop. Once all 3100 devices are polled, it rolls up the alarm status for each zone, and then rolls up alarm status of all zones (global alarm status). Then it sets mapped SEC Relay Module coils accordingly, changes the alarm display borders and the zone and global alarm status.

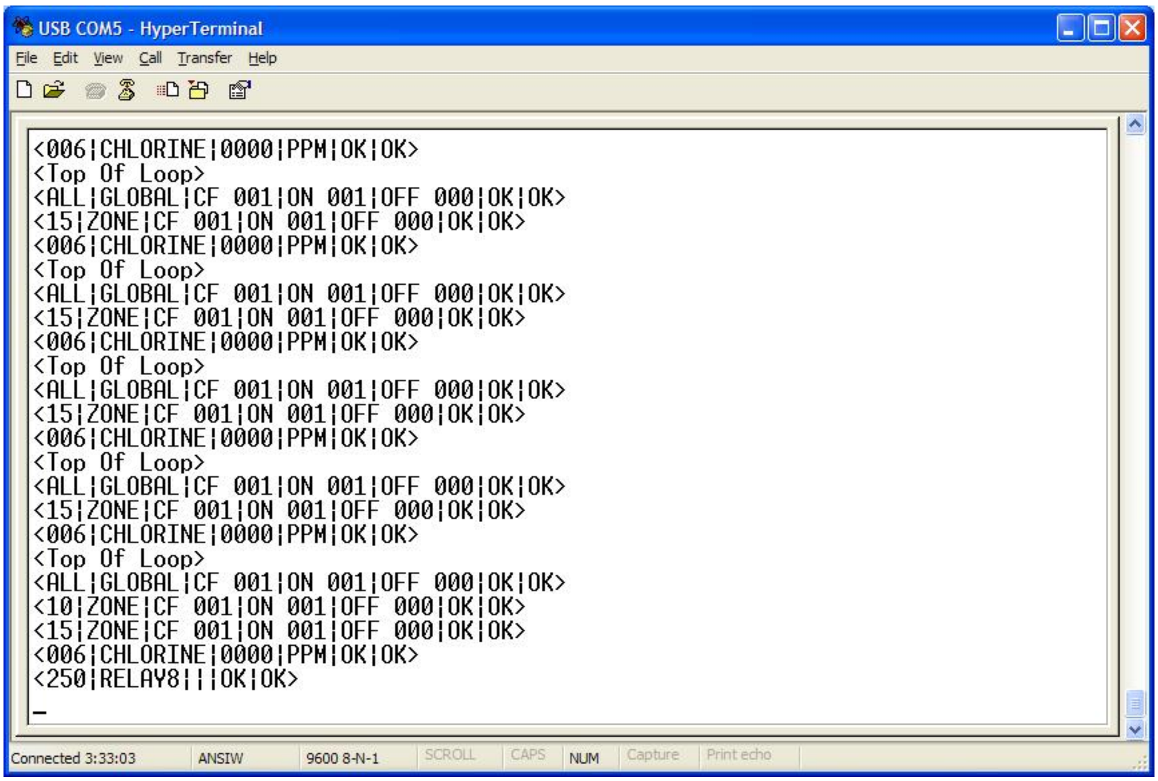
The SEC 3500 maintains an internal database of all device values, parameters and alarm conditions. The database is updated when device information is read from the device. Zone and global alarm information is stored in the database when the zone and global alarm status rollups occur. The user interface is updated after that, depending on which screen is displayed; which pulls its information from the database.

Since the SEC 3500 provides external interface broadcasts, just before the next gas detection data collection scan occurs, the StatCast Gas Status Text Broadcast feature operates, pulling data from the internal database, translating it into text and sending the status and gas data text out the RS232 port for external consumption. It also rolls up the status into a status update Web page, for external WEB browser support.

Timeout Handling-

1) During a scan, when a device fails to respond within the required timeout windows (start bit window, byte-to-byte window, total packet response window), it will attempt a second transmission after the full packet window has expired, and will attempt to receive the response within the given timeout windows. If this again fails, the SEC 3500 will move on to the next device and apply the same rule. This rule applies for devices that are on-line, and during gas and status requests.
2) When detailed information is attempted, such as following off-line to on-line transitions, configuration updates at the SEC 3100, calibration, or an error condition; The number of attempts per data item increases to the configurable "maximum bring on-line" value, typically twenty attempts. These block transfers are considered critical, and must get through, hence waiting for detailed data is worth the price in time, since this should be a rare but intentional action to fulfill a user display request.
3) In both (1) and (2) above, once the maximum allowed (and configurable) "offline warning" (incremented each time one of these declares a timeout) counts are reached, the device is treated is untrustworthy, and a warning is displayed on the screen.
4) If the maximum allowed (and configurable) "offline count" is reached, the device is declared off-line, and the user cannot interact with it effectively until it returns to normal operation. This will cause the SEC 3500 to generate a zone fault for it.

SEC 3500 OI- StatCast
RS232 Gas Status Text Broadcast
Configuration Manual



August, 2006

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Table Of Contents:

Intended Audience

This document is written for plant maintenance personnel or those personnel who will configure and/or collect continuous gas level and status text streams from the SEC 3500 OI, using the StatCast Feature.

Purpose

This document describes the StatCast RS232 Text Output Feature of the SEC 3500 OI, beginning with version 2.1. It will describe how to configure it, establish the best balance of performance vs. reasonable data update rate, and what the format of the text data broadcast stream is. This feature is very similar to the output that can be obtained from the SEC Supervision Plus monitoring system, yet enhanced, more configurable and more efficient for Modbus-based SEC Gas Monitor networks.

Overview

StatCast is not a new feature to the SEC product line, however it is a new addition to the SEC 3500 Operator Interface (OI) Panel, when used with SEC 3100 Gas Transmitters and Relay Modules.

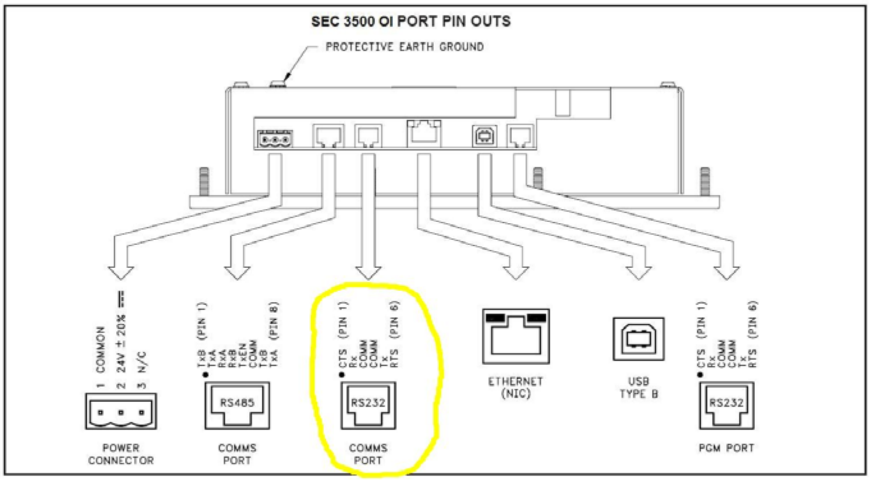
StatCast is a broadcast server built into the SEC 3500 OI Panel Software starting in version 2.1. It broadcasts Sensor, Zone and Global gas level and status records continuously as formatted text over a standard RS232 Serial Port. Virtually any terminal can capture this text, or application such as Microsoft HyperTerminal. Database applications may desire to capture the broadcast to monitor ambient gas levels and provide trending, as well as track alarm events.

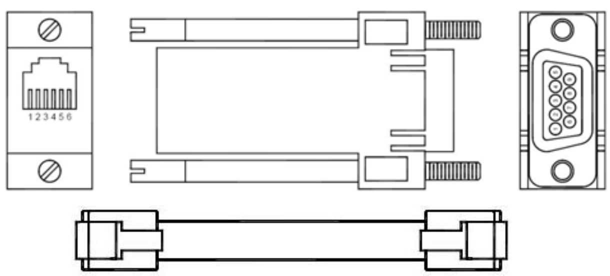
StatCast provides Plant Floor Maintenance with the ability to configure which data to broadcast, how fast, how many records per scan, and at what baud rate. Plant Maintenance can decide to enable or disable the feature, and determine the appropriate balance of data update rate vs. performance impact on the Gas monitoring loop of the SEC 3500 with real time on-screen parameters, so that when it is finally established, there are no hidden performance hits or unexpected or unplanned excessive data latency.

In short, the customer is in control, and in the driver's seat. So let's dive in and examine more about this feature and how to use it!

Physical Link- RS232

The physical link for the RS232 Text Output Broadcast is a single RS232 Serial connection, using a full 6-wire 6pin modular RJ12 jack, off the back off the SEC 3500 OI Unit, labeled "RS232". RTS/CTS hardware flow control is provided, as well as baud rates programmable from 1200 to 19200. The frame can be programmed to either 7 or 8 data bits, 1 or 2 stop bits, and parity set to none, odd or even. These parameters are configurable from the StatCast Configuration screen in the 3500 OI v2.1 or higher. Input is not accepted, broadcast output only provided. **See the following diagrams:**





3500 OI RS232 to a PC

Connections			
OI: RJ12	Name	PC: DB9	Name
4	COMM	1	DCD
5	Tx	2	Rx
2	Rx	3	Tx
	N/C	4	DTR
3	COM	5	GND
	N/C	6	DSR
1	CTS	7	RTS
6	RTS	8	CTS
	N/C	9	RI

Normal Functional Operation

When the StatCast Feature is properly configured [1] and enabled, it will continuously broadcast all enabled record categories and gas levels, at the top of every gas detector scan loop of the 3500 OI. Ideally, this would be a burst of all gas levels and rollup status collected during the foregoing cycle; however this depends on how StatCast is configured. StatCast broadcasts the latest data it contains in the panel (3500 OI) database. There is a delay between the detector's measurements and when it reaches the broadcast stream, which will vary depending on configuration of the StatCast feature, the number of detectors on the loop, etc., however it will at the very least, be a delay of 2 seconds or more.

The StatCast broadcast is present at the RS232 output whenever the primary 3500 OI Operator gas detection summary screens [2] are displayed, with some exceptions. [3] During those exceptions, broadcasts are paused or stopped. Broadcasts resume when a primary 3500 OI Operator gas detection summary screen is displayed, or the screen saver is displayed.

Therefore, as a rule of thumb, if the 3500 OI is not being manually (or remotely) manipulated, is sitting on the main screen or the screen saver, and the StatCast feature is properly configured and enabled, then the StatCast broadcast is present at the RS232 port.

The output can be configured as a burst of all status and gas levels measured in the foregoing gas detection scan loop, or broken up into a sliding-window of a fixed number of records per scan-loop to maintain gas detection scan loop responsiveness and performance, absent of increasing StatCast RS232 baud-rate to a suitably high speed. The sliding window can be configured from as few as one record output per scan, to ALL records (271) per scan. Regardless of the configuration method, whatever record is output, that record ***will contain the most currently known, or up to date value*** in the 3500 database. See the diagram on the following page to illustrate the two primary methods.

StatCast ONLY broadcasts known devices: it does not broadcast records for devices that have not been discovered and brought online. Once a device has been brought online and is in the panel database, it will have a record broadcast whether online or not until the device is deleted from the database. Therefore, even if ALL records are chosen for broadcast, ONLY the records related to valid and known devices are broadcast.

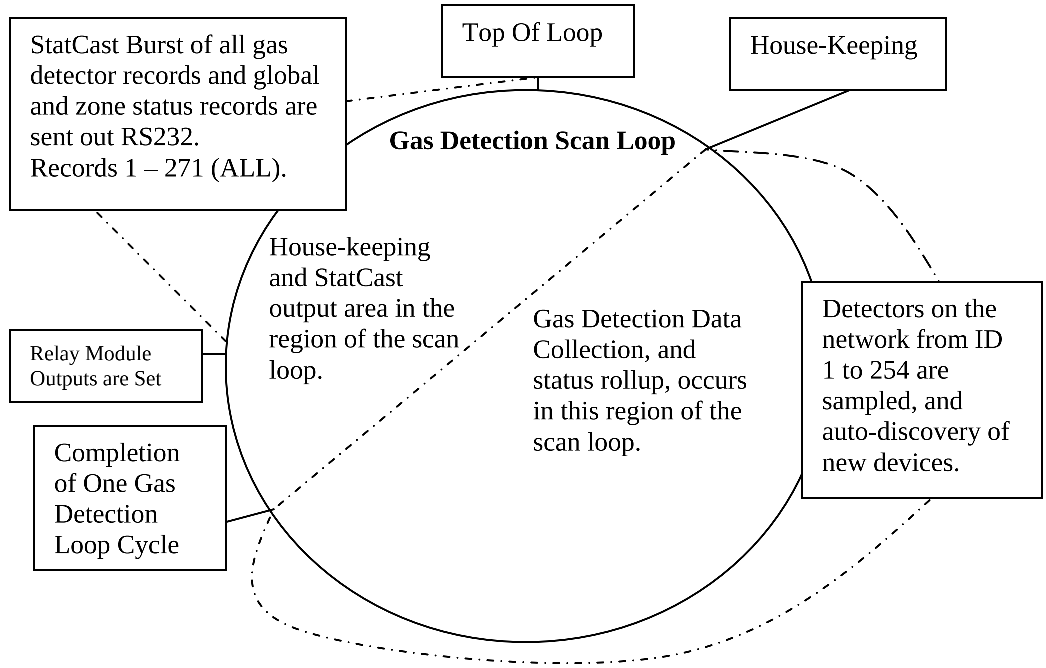
---

[1] Port parameters (baud rate, stop bits, data bits, parity) MUST be saved before they become active-including first time configuration. In fact, before the timing impact can be properly measured, these parameters must be saved first, if never previously saved.

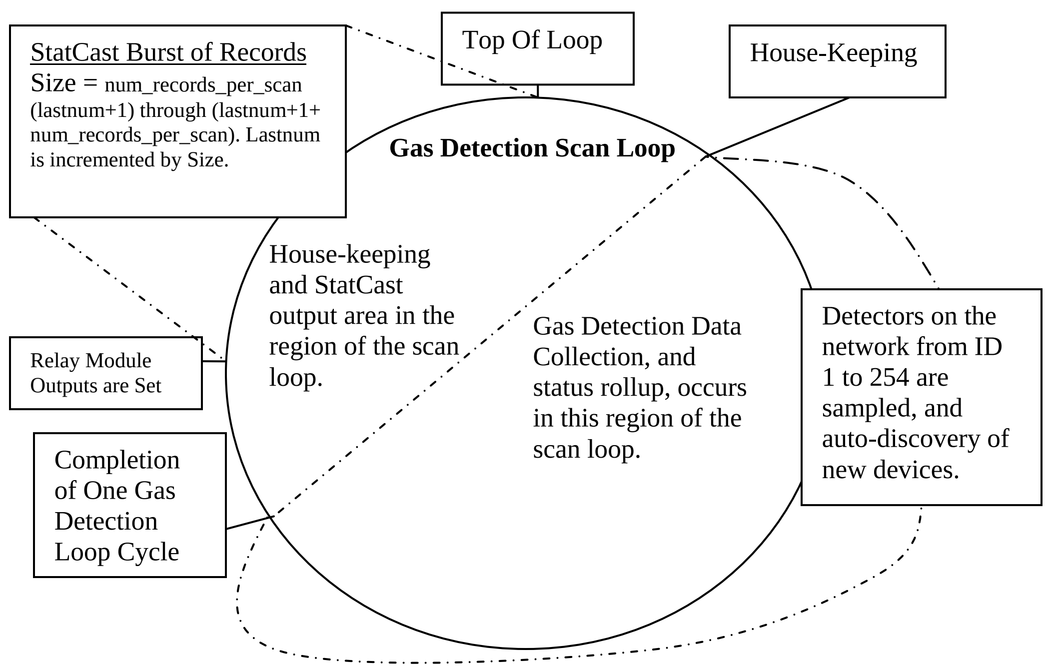
[2] Those screens are; Home Zone or main screen, Zone, Bus or Alarm summary screens, Device Selection screens, Sensor Summary screen, and all Relay Module Screens.

[3] Exceptions are; Sensor Configuration Screens (alarm threshold, alarm parameters, relay parameters), Calibration, Network ID and name change screens, diagnostics, manual override screens, manual device discovery, 3100 clock set screen, maintenance screens, other 3500 configuration screens, menu screens, etc.

Full burst of everything per gas detection scan loop:



Sliding-Window Burst per gas detection scan loop:



Therefore, if the number of records (size) to be sent per gas detection scan loop is 50 for example, and there are 100 detectors on the bus, it would require two full gas detector scans to output all gas level and status records.

Reasonable broadcast times should be held to no longer than 2 seconds, that way only one sensor gas detection interval is missed per scan loop (essentially, every other sample, since the SEC 3000 sensor outputs a gas value every 1.65 seconds), worse case. This is accomplished primarily by adjusting the number of records broadcast per gas detection scan loop.

Example Scan Loop (100 gas detectors) with a Sliding Window (25 Records):

Gas Detector Loop	Elapsed Time:	Sliding Window
7 seconds **Gas Detector Loop 1:** ID 1 – 100 scanned again		1 second **Sliding Window (1 of 4):** ID 1 – 25 Records output
	7+1 = 8 secs	
7 seconds **Gas Detector Loop 2:** ID 1 - 100 scanned again		1 second **Sliding Window (2 of 4):** ID 26 – 50 Records output
	8+7+1 = 16 secs	
7 seconds **Gas Detector Loop 3:** ID 1 - 100 scanned again		1 second **Sliding Window (3 of 4):** ID 51 – 75 Records output
	16+7+1 = 24 secs	
7 seconds **Gas Detector Loop 4:** ID 1 - 100 scanned again		1 second **Sliding Window (4 of 4):** ID 76 – 100 Records output
	24+7+1 = 32 secs	

Example Scan Loop (100 gas Detectors) *without* a Sliding Window (100 records):

Gas Detector Loop	Elapsed Time:	StatCast Output
7 seconds **Gas Detector Loop 1:** ID 1 – 100 scanned again		4 seconds **StatCast Output:** ID 1 – 100 Records output
	7+4 = 11 secs	
7 seconds **Gas Detector Loop 2:** ID 1 - 100 scanned again		4 seconds **StatCast Output:** ID 1 – 100 Records output
	7+4 = 11 secs	

Of course there is another way to avoid either the excessive data latency (24 seconds) shown in the sliding window example previously, or the missed gas detection period (4 seconds) in the full burst shown in the immediate previous example; and that is to increase the baud rate, and add line repeaters as needed. This can be accomplished using the configuration utility to change rates, adjust record count and try and measure before committing a final configuration. In the above example, a baud rate of 19,200 would decrease the time in the full burst example from 4 seconds to 2 seconds, and a baud rate of 38,400 with multiple line repeaters (if the distance is long) would reduce that to an acceptable delay of only 1 second.

Of course a compromise could be made, by increasing the baud rate from 9600 to 19200 (1 second per window burst of 50 records), and setting a sliding window of 50 records, producing a latency of only 2 scans or 7 seconds for the entire set. In this manner, the gas detection loop is hardly impacted (1 seconds, quite acceptable), and the added latency to acquire a full StatCast set is only 7 seconds.

The formatted output of StatCast is discussed in the next section, and configuration of StatCast in the section following that.

Data Record Format

Data is output to the RS232 port in formatted text, in a record format. There is one record per status item. A status item may be;

(1) **Global Status**- i.e. status of highest alarm/fault level of all zones, including a tally of all devices configured on the bus, a tally of all devices on line, and a tally of all the devices that are off-line.
(2) **Zone Status-** i.e. status of highest alarm/fault level of all devices within the given zone, including a tally of all devices configured in the given zone, a tally of all zone devices on line, and a tally of all zone devices that are off-line.
(3) **Device Status-** i.e. Current gas level and alarm status of the current device.

There is one record for each status item; hence there will be one record for global status, and sixteen (16) records for each of the sixteen zones. There is also one record for each device, therefore up to 254 records for 254 configured devices (actual number will depend on the number of actual configured devices for the bus). This gives a possibility of up to 1 Global + 16 Zones + 254 Device records = 271 total possible records (if all three categories are selected for output). There is also one (not counted) Top of Loop indicator record to indicate the beginning of a new scan.

All records are delimited by angle brackets < >, and terminated with carriage return/line feed characters, so that one record appears per line on a standard RS232 terminal or applications such as Windows HyperTerminal. There are six (device) or seven (global or zone) fields within a record, each separated by a pipe character (vertical bar) |:

<A|B|C|D|E|F|G>

A = ID: Is either "ALL" for global status, 1-16 for zone status, or 1-254 for Device ID.

B = NAME: "GLOBAL" for global status, "ZONE" for zone status, "RELAY8" for an 8 coil relay module, "RELAY16" for a 16 coil relay module, "AIM" for analog interface module, or a gas name abbreviation for gas sensor (such as "Chlorine" or "Methane" [4]).

C = VALUE: For global or zone status, this will be the number of devices configured for the entire bus (global) or zone (format: "CF 000"), for Relay modules this will be empty ||, for AIM and gas detectors this will contain the value (gas detectors, this will be the formatted gas level, precision set to scale of sensor range; AIM this will be the analog voltage level).

D = UNITS: For global or zone status, this will be the number of devices online either for the entire bus (global) or the zone (format "ON 000"), for Relay

[4] Note: during sensor power-up, it may be empty, appearing as two || symbols with no space.

modules this will be empty ||, for Gas detectors this will be the Gas Units (i.e. “ppm” [5]).

E = DEVICE STATUS: For global or zone status, this will be the number of devices offline either for the entire bus (global) or the zone (format “OFF 000”), for relay modules, this will be “OK”, “OFFLINE”, or “OFFWARN” (for not responding properly and suspect). For Gas Detectors this can additionally be “LOWALRM”, “MIDALRM”, “HIALRM”, “FAULT”, “MISSING” (for missing sensor), “INIT” (for sensor or device initialization), “CALIB” (sensor is being calibrated or user is in the calibration menu), or “SELF TEST” (sensor is in self test mode [6]).

F = LINE STATUS: For global and zone records, this will actually be field E above, STATUS: with the following contents: “OK”, “LOWALRM”, “MIDALRM”, “HIALRM”, or “FAULT”. For Devices, this will be the Mod-Bus Line/Loop status: “OK” or “LB” for line break detected.

G = LINE STATUS: For global and zone records only (“OK” or “LB”, as in field F above). For devices, this field and pipe symbol will NOT be present.

Examples:

<u>Top Of Loop/Scan Indicator Message:</u>

<Top Of Loop>

<u>Global Status Message:</u>

OK Message (123 devices configured, 120 online, 3 offline, rollup status OK, line status OK):

<ALL|GLOBAL|CF 0123|ON 0120|OFF 0003|OK|OK>

MID Alarm rollup:

<ALL|GLOBAL|CF 0123|ON 0120|OFF 0003|MIDALRM|OK>

Fault Alarm rollup (higher than HI alarm):

<ALL|GLOBAL|CF 0123|ON 0120|OFF 0003|FAULT|OK>

<u>Zone Status Message:</u>

OK Message (zone ID #5, 11 devices configured, 7 online, 4 offline, rollup status OK, line status OK):

<05|ZONE|CF 0011|ON 0007|OFF 0004|OK|OK>

High Alarm rollup:

<05|ZONE|CF 0011|ON 0007|OFF 0004|HIALRM|OK>

---

[5] See Note [4] previously.

[6] The “SELF TEST” indicator will be ***inserted before*** the alarm status: **both** will be included!

Relay Module Status Message:

OK Message (Device ID #250, 8 coil relay module, rollup status OK, line status OK):
<250|RELAY8|||OK|OK>

Offline Message:
<250|RELAY8|||OFFLINE|OK>

Offline Warning Message: (Occurs when it is not responding, but net yet declared offline):
<250|RELAY8|||OFFWARN|OK>

Gas Detector (through 3100) Module Status Message:

OK Message (Device ID #6, chlorine sensor, range >= 100, 284 PPM level, rollup status OK, line status OK):
<006|CHLORINE|0284|PPM|OK|OK>

MID alarm Message:
<006|CHLORINE|0845|PPM|MIDALRM|OK>

Power-up Init Message:
<006||0000||INIT|OK>

Sensor Init Message:
<006|CHLORINE|0000|PPM|INIT|OK>

Sensor Span Calibration Message:
<006|CHLORINE|0983|PPM|CALIB|OK>

Sensor Zero Calibration Message:
<006|CHLORINE|0000|PPM|CALIB|OK>

Sensor Removal or Missing Message:
<006|CHLORINE|0000|PPM|MISSING|OK>

Sensor Self Test Message:
<006|CHLORINE|1734|PPM|SELF TEST|HIALRM|OK>

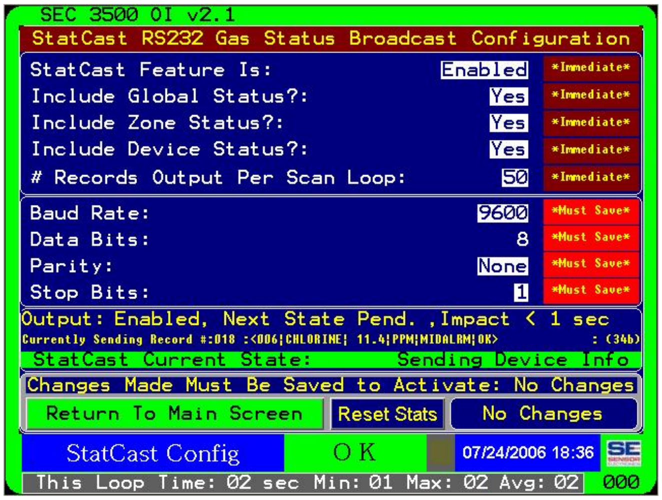
OK Message (Device ID #10, chlorine sensor, range < 10, 0.84 PPM level, rollup status OK, line status OK):
<010|Chlorine|0.84|ppm|OK|OK>

OK Message (Device ID #15, chlorine sensor, range < 100, 10.3 PPM level, rollup status OK, line status OK):
<015|Chlorine|10.3|ppm|OK|OK>

Offline Warning Message (Occurs when it is not responding, but net yet declared offline):
<015|Chlorine|10.3|ppm|OFFWARN|OK>

Offline Message (Occurs when it is declared offline and failing to respond to pings):
<015|Chlorine|10.3|ppm|OFFLINE|OK>

SEC 3500 OI StatCast Configuration Utility



The SEC 3500 OI StatCast Configuration Utility, shown above, allows plant floor maintenance personnel to configure the StatCast Feature. To access this utility, simply logon as user "maint", select the |supervisor menu|Configuration|StatCast Config| sub-menu. This utility allows configuration and measurement of impact on the gas detection scan loop, so that the proper balance of data latency and responsiveness can be achieved according to the user's criteria.

In the above screen-capture, there are colored indicators to the right of each user-selectable feature. Where the indicator shows dark red text "*Immediate*"; values changed with this notation take effect immediately as the parameter is changed. It does NOT indicate that the value is saved permanently if the panel were powered down incorrectly though.[7] These parameters, will take effect at the very next StatCast cycle (which may be a sliding window partial output). Changes made to these are immediately noticed at the "Impact" measurement status label.[8]

Right-side indicators shown in lighter red text "*Must Save*" indicate that they MUST be saved [9] in order to take effect, and for the "Impact" status label to accurately show measurements based on the new RS2332 line parameters.

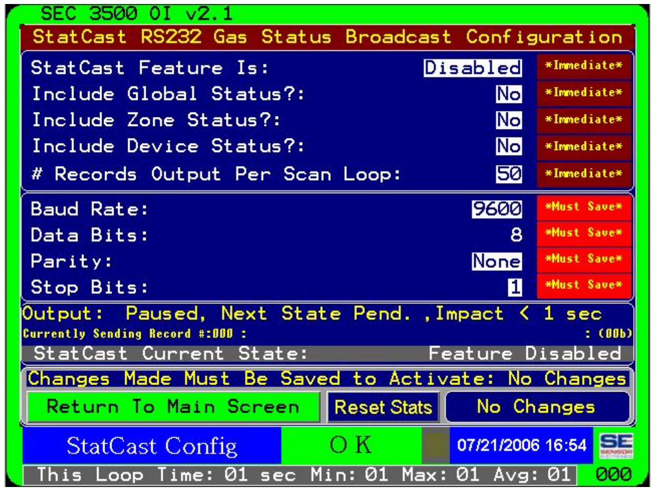
---

[7] Any time an operator or panel (SEC 3500 OI) user desires to remove power from the panel, the **"Safely Power Down HMI"** menu item should be performed and follow all instructions before doing so, to insure all data is safely stored in non-volatile ROM. If this is not done, it is possible to lose changes made and data collected in the past six minutes.

[8] NOTE: It is crucial that baud rate values shown are saved to be active for impact measurements shown to be accurate.

[9] The "No Changes"/"Save Now" button must be pressed for any RS232 line parameters to take effect. This will cause the panel to reboot.

When SEC 3500 OI version 2.1 is first installed, the feature is disabled, and the screen appears as follows:



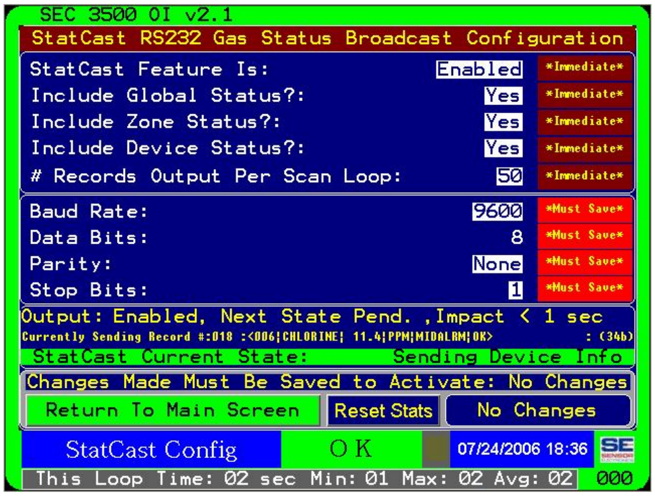
The very first thing that MUST be done, is to set the Baud Rate, Data Bits, Parity and Stop Bit settings, and save them by pressing the “No Changes”/”Save Now” button, even if what is shown is the desired parameters, since they have NOT been set and activated for the RS232 port. Once the panel resets and the maintenance operator returns to this utility, the feature settings in the topmost group of “Immediate” values may be changed. The first decision to consider before enabling the StatCast feature is whether or not the global and zone status records should be sent. These can be individually set. Also, the device status should be set to “Yes” so that gas levels will be included in the stream.

Take note of the current gas detection loop statistics shown at the bottom of the screen; this is what any analysis should be based on, regarding additional tolerable delay once the StatCast feature is enabled. Only the maintenance operator can determine what is proper for such implementation. The loop statistics can be reset and restarted by pressing the “Reset Stats” button, located above the alarm status indicator (shown above as “OK”.

At this point, it is proper to enable the StatCast Feature, by changing the value at the top of the first set of parameters to “Enabled”. Immediately, StatCast will begin text output to the RS232 port. The impact measurement will display how many additional seconds [10] are impacting the gas detection loop as well as the loop statistics at the bottom of the screen will increase from the baseline noted in the above paragraph, by the amount shown by the impact measurement analysis. The states, current record output, and the actual contents of the last record buffer are displayed below the impact measurement analysis, as shown on the next page:

---

[10] This value is granular to seconds, therefore if the value is just slightly less than 1 second, it will show “< 1 sec”, or if the value is between two whole numbers, then it will display the number followed by a plus sign such as “1+ secs”.



Using a baud rate of 9600 as a basis in the above example, we can see that by including the global status, zone status set, and device status set (gas levels and alarm status) in a sliding window of 50 records per StatCast output, the impact is less than one second. By examining the loop statistics at the bottom of the screen, we can see that the actual round trip time on average for gas detection with this configuration has added about one full second. The discrepancy indicates that the gas detection loop stats used for a baseline were probably showing a time between 1 and 2 seconds, so the addition of a fraction of a second causes the total loop statistics to crossover the next whole number to 2 seconds.

The sliding window size can be adjusted by selecting the item “# Records Output Per Scan Loop” and selected a value between 1 and ALL. A selection of “ALL” will burst all values per gas detection scan loop, and will typically have the highest impact measurement. If the impact is unacceptable either because the sliding window causes too much latency in data split across multiple gas detection scans, or because the impact time is too large AND all records are desired to be sent per gas detection loop, then baud rate should be increased. Remember when adjusting RS232 line parameters such as baud rate, they do not take immediate effect until they are saved.

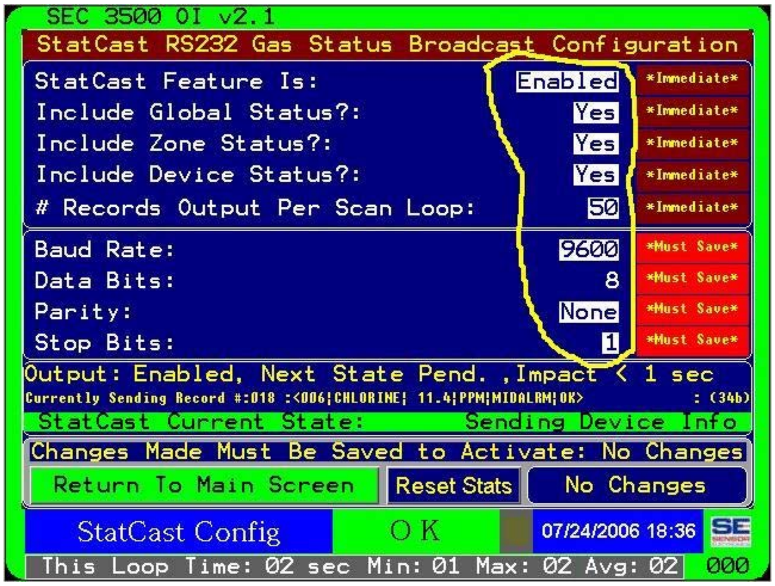
Once the desired balance of impact and latency are achieved, [11] all settings should be saved permanently to non-volatile ROM by pressing the “No Changes”/”Save Now” button and allowing the panel to reset.

---

[11] ***Impact*** is the amount of time that immediately delays the start of the next gas detection data collection scan loop. ***Latency*** is the amount of additional accumulative time (not shown) required to gather an entire StatCast output of all desired records, measured in #scans required to capture all records multiplied by the total scan loop time - 1.

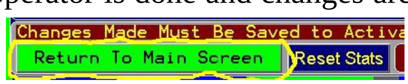
Other Interaction Description of StatCast Config Utility

A great deal of the functional aspects of the StatCast Configuration screen have already been discussed in previous sections, however there are some interactions the reader should be aware of:



When any of the above parameters are changed, the "Changes Made Must Be Saved to Activate:" label value and the "No Changes" button above will change from "No Changes" to "Save Now", and the color will change to yellow on dark red; thus indicating that these values must be permanently saved to survive a loss of power to the panel.

When the maintenance operator is done and changes are saved, the green "Return To Main Screen" button may be pressed to return to the main zone home screen. If the maintenance operator is done using the panel, he/she should log out so that permissions fall back to the bottom operator level.



Keep in mind, that normal gas detection, relay module action and status rollup activity operates; therefore detectors may enter into alarm conditions, and the surrounding alarm status borders [12] of the screen as well as the alarm status indicator [13] will change correspondingly. The Alarm Summary Screen can be immediately transported to be pressing the Alarm Status indicator.

[12] In the above example it will appear in green.
[13] In the above example it will appear as "OK".

16-bit Standard Modbus Technical Use Sheet

For Version 1.2+ SEC 3120 Digital Transmitters

P/N 1580282, Rev 1, 20121228

Sensor Electronics Corporation

December, 2012

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General Description

About The SEC 3120 Digital Gas Transmitter

The SEC 3120 Digital Gas Transmitter is the latest generation Gas Transmitter from Sensor Electronics Corporation, and is fully compatible with its predecessor, the SEC 3100. The SEC 3120 Digital Gas Transmitter allows multiple single and multi-channel SEC sensors to be connected to it and acts as a central communication, control, status and data logging hub for them. While the SEC 3100 did not provide full 16-bit standard Modbus (PI-MBUS-300 Rev. J. compliance) support, the special SEC 3100MB16 does and is compatible with the SEC 3120 which provides full (relevant) compliance and major feature and sensor consolidation capabilities, as well as optional sensor redundancy.

SEC 3120 Modbus Standard Supported

The SEC 3120 Digital Gas Transmitter supports master mode communication as a Modbus RTU slave. While it supports other Modbus interfaces, this document addresses the specific 16-bit standard Modbus protocol as described in the Modicon Modbus Specification PI-MBUS-300 Rev. J. The reader should familiarize themselves with this document to fully understand and utilized this Modbus interface.

16-bit Modbus Supported Features and Functions Overview

Functions Codes -

03 - Read Multiple Holding Registers (supported fully)
06 - Preset Single Holding Register (supported fully)
16 - Preset/Write Multiple Holding Registers (supported fully)
01 - Read Coils **(not supported)**
05 - Force Single Coil **(not supported)**
15 - Force/Write Multiple Coils **(not supported)**
07 - Read Exception Register **(not supported)**

Broadcast (Network ID 0) for all other function codes is ***not supported,*** *except for Preset (code 06) Holding Register 42920 (Listen Only Modbus Mode) and 42921 (Resume from Listen Only Modbus Mode).*

All other function codes are not supported for broadcast mode in this interface.

Overall SEC 3120 Modbus Register Map

Internal Register	Modbus Holding Register	Region Description
00000 - 01999	40001 - 42000	Reserved for coil registers- future
02000 - 02099	42001 - 42100	16-bit Sensor ALL apply region (region 0)
02100 - 02199	42101 - 42200	16-bit Sensor 1 region
02200 - 02299	42201 - 42300	16-bit Sensor 2 region
02300 - 02399	42301 - 42400	16-bit Sensor 3 region
02400 - 02499	42401 - 42500	16-bit Sensor 4 region
02500 - 02599	42501 - 42600	16-bit Sensor 5 region
02600 - 02699	42601 - 42700	16-bit Sensor 6 region
02700 - 02799	42701 - 42800	16-bit Sensor 7 region
02800 - 02899	42801 - 42900	16-bit Sensor 8 region
02900 - 02999	42901 - 43000	16-bit 3120 unit region (region 9)
03000 - 03999	43001 - 44000	Reserved for SEC HMI Legacy
04000 - 04999	44001 - 45000	Reserved for SEC HMI Legacy
05000 - 05499	45001 - 45500	Reserved for SEC 32-bit future
05500 - 05999	45501 - 46000	Reserved for SEC 32-bit future
06000 - 06999	46001 - 47000	Reserved for future use
07000 - 07499	47001 - 47500	Reserved for SEC 32-bit future
07500 - 07999	47501 - 48000	Reserved for SEC 32-bit future
08000 - 08999	48001 - 49000	Reserved for SEC HMI Advanced SID
09000 - 09998	49001 - 49999	Reserved for SEC HMI Legacy

Memory Map – 16-bit Interface Holding Registers Overview

The SEC 3120 implements the 16-bit Modbus interface by breaking the address region into ten classes (unit and sensors) and eight plus one sensor sub-regions (each sensor region repeats the same command set with the same relative offsets) as shown previously.

Region 0 applies a sub-set of written values to ALL logical sensors, while regions 1 – 8 apply to each individual logical sensor, and region 9 contains 3120 unit specific (non-sensor) information. The entire 16-bit region is shown previously in green.

Within the sensor regions, the same information/register address offsets are repeated, containing gas concentration, alarm set points, sensor status, etc. (relative offsets 42x01 – 42x99, where x = sensor number 1 – 8).

Within the unit specific region (9), the holding register addresses are absolute (42901 = operating status, 42902 = fault relay reason code, etc.).

Communication Parameters

- Protocol: Modbus RTU slave.
- Baud rates: 1200, 2400, 4800, 9600, 19200 bps field selectable, Word length 8.
- Parity: Odd, Even, None, field selectable.
- Stop Bits: 1 or 2, field selectable.
- Electrical Interface:
    - RS 485, multi-drop 2-wire positive/negative (using A/B nomenclature).
    - Transmit and Receive: Half Duplex.
    - Useable speed will depend on cable length.
- Modbus addressable: 1-247 (up to 254 if ONLY SEC 3120 units on a single bus).

Modbus Sensor Read Only Registers

- Gas concentration (expressed as an integer scaled up by factor) representing the units of measurement for that specific sensor's current gas type (PPM, % LEL, %V/V, etc.)
- Operating Status (normal, calibrating, self test, start up, in an alarm (low, mid high) or fault
- Gas category Type (toxic, hydrocarbons, oxygen, etc.)
- Sensor firmware version
- Sensor serial number
- Alarm relay mode (trip above or below threshold, audible or normal action)
- Modbus address (Network ID)
- Sensor Range and Gas Factor
- Sensor Status and Error code, as well as Cell Test Warn code
- ASCII Gas name and Gas Units Name

Modbus Sensor Read/Write Registers

- Alarm thresholds (low, mid and high set points)
- Zone ID (Network Zone ID)
- Execute Self Test

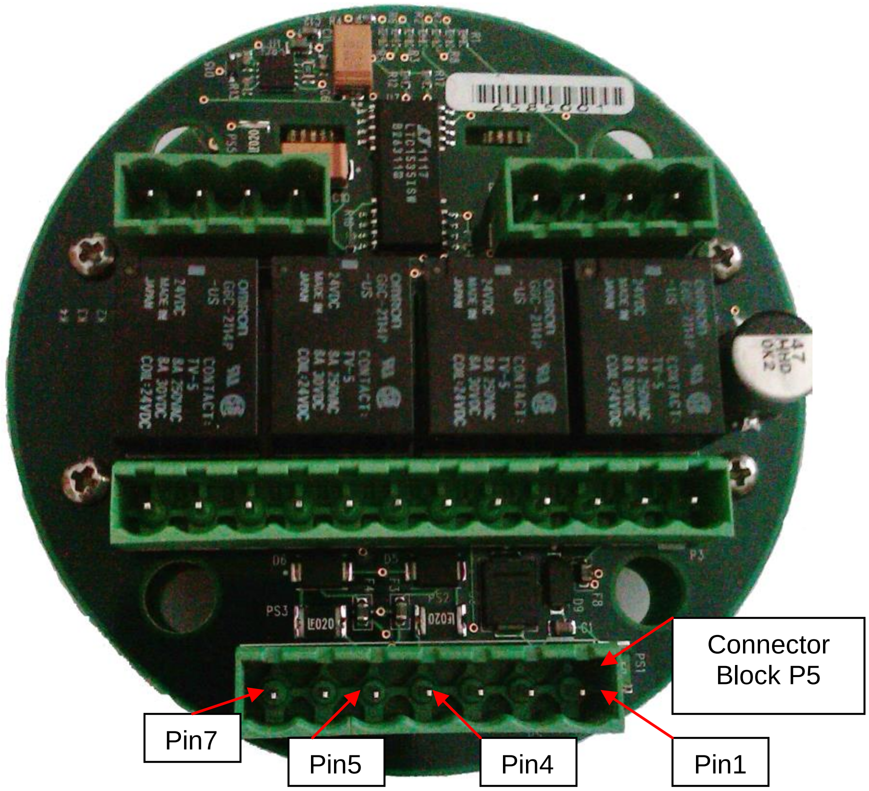
Modbus 3120 Unit Read Only Registers

- Unit Operation Status
- Unit Fault Relay Reason Code
- Unit Serial Number
- Maximum Number of Sensors That Can Be Attached
- Unit Clock- Read Current Time
- Unit Type
- Unit Firmware Version Info

Modbus 3120 Unit Read/Write Registers

- Unit Clock- Write New Time Registers
- Unit Clock- Set New Time Now
- Unit Diagnostics Control (force relays on/off, toggle LEDs to flash)
- Unit- Place into Modbus listen only mode
- Unit- Restore out of Modbus listen only mode

SEC 3120 Setup and Configuration

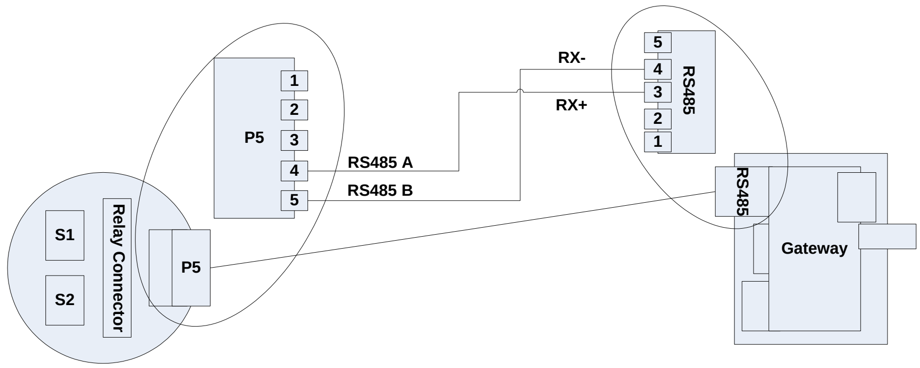


(Bottom View of SEC 3120- Relay Board Connectors)

SEC 3120 Modbus RS-485 Network Connections

- Pin 5 (RS485 B) of the SEC 3120 power and communication connection block P5 is typically connected to a Modbus Master device (RX-) terminal in two-wire connections. For the EGX-100 Gateway, this would be Pin 4 of the RS485 connection block.
- Pin 4 (RS485 A) of the SEC 3120 power and communication connection block P5 is typically connected to a Modbus Master device (RX+) terminal in two-wire connections. For the EGX-100 Gateway, this would be Pin 3 of the RS485 connection block.
- The EGX-100 Gateway is connected to the Ethernet using its Ethernet port and 10/100 base T/TX cable to an Ethernet switch.

Figure 1: Modbus RS485 Connections



First Time Configuration

When SEC 3120 units are first removed from the shipping container, unless otherwise instructed upon ordering, units may arrive configured in the following modes:

1. **Sensor Role:** ***Unique***- Multiple sensors can be connected having different gas types, units of measure and ranges. This can be changed to **"Identical"** mode if all attached sensors have identical gas types, ranges and units of measure, thus allowing redundancy of measurement. It can also be changed to **"Single"** mode, where only one sensor is attached to the unit in the sensor 1 connector. In "Single" mode, the unit will ignore anything connected to the sensor 2 connector.
2. **Relay Mode:** ***OR***- Sensors control the alarm relay coils in a logical "OR" fashion. Fault relay is always controlled in a logical "OR" fashion (Any sensor fault drives fault relay coil). The alarm relay logic mode can be changed to **"AND"**- forcing both sensor's alarm status to be in agreement before the alarm relay coils are driven (except for fault relay coil). This mode is typically used with the **"Identical"** Sensor Role to provide measurement redundancy.
3. **Modbus Network ID Mode:** ***Unique-*** One Network ID is assigned to each sensor, typically sensor 2 ID is greater than sensor 1 ID. These ID's can be independently adjusted and are available on the bus and the unit will respond to either ID for all sensors attached (Ex: Sensor 2 ID: 12, Sensor 1 ID 11). This can be changed to "Single" mode, where all sensors are accessed through a single ID and the IDs are identical to all sensors (Sensors 1 and 2 IDs are 5).
4. **RS485 Bus Settings:** ***SEC Default-*** Baud rate is 9600, stop bits are 2, parity is set to none. This can be changed to **"Alternate:"-** Baud rate 9600, stop bits 1, parity none. The bus settings may also be set to custom values, where the baud rate, stop bits and parity are independently changed (i.e. Baud rate 19200, stop bits 1, parity odd).

To change these settings, you must adjust them using the user interface controls on the SEC 3120 unit. When making changes out of the box, the following order of changes should be made (remove the unit from the communication bus until everything is set the way you desire):

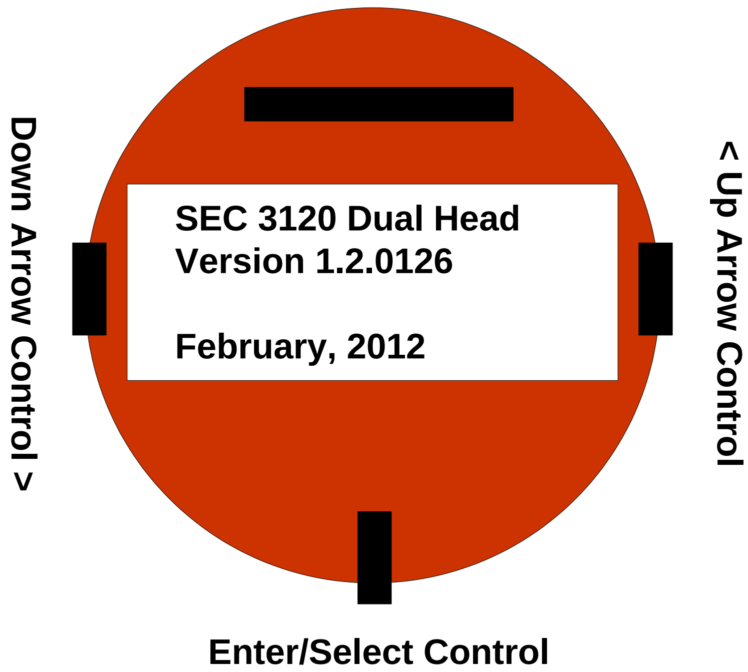
1. **Sensor Role-** Change the sensor role in the Network Modbus Settings menu. Save the changes first and exit the menus before returning to make further changes.
2. **Sensor Relay Mode**- Change the sensor relay mode in the Relay Settings menu. Save the changes first and exit the menus before returning to make further changes.
3. **Modbus Network Mode**- Change the Modbus Network mode in the Network Modbus Settings menu. Save the changes first and exit the menus before returning to make further changes. Do NOT try to change the network IDs or RS485 bus settings without exiting the menus first!
4. **Modbus Network IDs**- Set the Modbus Network ID(s) (Addresses based on the network mode chosen above, using the Network Modbus ID menu. Save the changes first and exit the menus before returning to make further changes.
5. **RS485 Bus Settings**- Set the RS485 Communication Settings to your desired line settings in the Network RS485 Bus Settings Menu. Changes are applied immediately after you choose to save them, therefore make sure these settings are correct before connecting the unit to the bus. Make sure you have no conflicting network IDs with any other Modbus devices on the bus.

Relevant Screens you may see in order of operation, to change the unit to the following settings (example):

- **Sensor Role - Unique**
- **Relay Logic Mode- OR**
- **Modbus Network Mode- Single**
- **Modbus Network IDs**
- **RS485 Bus Settings- SEC Alternate** (9600 baud, 1 stop bits, no parity)

First, we must examine how the user interface works on the 3120, is described on the following pages:

Figure 2: SEC 3120 User Interface



The SEC 3120 User Interface, as depicted above, contains the following key elements:

- The 4-Line LCD Display in the center. This will contain the main status screen (showing gas concentration, gas type, gas units, range, ID, etc.) for one or more sensors by automatically rotating and displaying the values for each sensor, one at a time for a few seconds dwell. The next sensor can be advance by activating either the down (left) or up (right) wand magnet/switches.
- The Down Arrow Control is positioned to the left. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units), the next menu item down the list is moved to, a lower value is chosen, etc.
- The Up Arrow Control is positioned to the right. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units), the previous menu item up the list is moved to, a higher value is chosen, etc.
- The Enter/Select Control is position below the center of the LCD display. When activated (using a magnet on explosion-proof versions, or through a push button on DIN-rail mount units) from the main status screen, the menu system is entered and displayed. If on a menu item, that item will be chosen. If a value is selected to be changed, it will either enter/exit changing a value.

The first menu displayed after it is brought up by activating the enter key from the main status display, is referred to as the "Top Menu". The top menu requires two full screens to present all of the possible items. The up/down controls allow navigation through the list, where selecting down below the bottom of the first page brings up the second page of the Top Menu. When selecting down below the bottom of the second page (end of the list), the top item of the list and the first page of the Top Menu is displayed. Likewise, if selecting above the top item in the first page of the Top Menu, the last item in the list on the second page will be highlighted and displayed, or if selecting above the top item of the second page then the bottom item of the first page of the Top Menu is displayed.

This is indicated by ↑up and ↓down arrows next to the top and bottom menu items respectively, if this kind of multi-page menu scrolling is available. Not all menus are longer than one page, and therefore do not contain these arrow indicators.

The Top Menu is the first menu that is encountered and the last menu before returning to the status display. Every menu item selected from the Top Menu drives another nested menu or item that must be exited to bring the Top Menu back. Let's examine the Top Menu:

Figure 3: SEC 3120 Top Menu

Top Menu Page 1

*↑EJECT MEMORY CARD
  ABORT WARMUP
  INFO MENU
 ↓MAIN MENU

Top Menu Page 2

 ↑SEC DIAGNOSTICS
  RESET RELAYS
  FORMAT FLASH CARD
 ↓EXIT

The asterisk to the left of the menu item row indicates where the cursor is. As you advance the cursor down the list by activating the down (left) arrow control, the asterisk moves to indicate the newly highlighted menu item row, just as the asterisk moves up as you activate the up (right) arrow control. When you activate the Enter/Select control, that menu item is selected and the menu listed on that menu item row is display. This Top Menu will be returned to the display once the newly selected menu is exited.

The purpose of the Top Menu is to place the most important, quick access items up front to the user first. For example, if you want to eject the flash card immediately without incurring data loss or corruption, you would select this. If you want to display information about the SEC 3120 unit or attached sensors, you would select the Information Menu.

To leave the Top Menu and return to the main status screen, simply scroll down to the Exit Menu Item and select it. Menu timer time's key activations, and once it expires (typically 30 seconds), the menus are automatically exited and the main status screen is re-displayed.

Figure 4: SEC 3120 Nested Menu Navigation

Shown below, is the menu navigation list. Each new menu is shown indented, indicating that you must back out (or exit) that current menu level to return to the next menu up:

- TOP MENU PAGE 1:
  - EJECT FLASH CARD
  - ABORT SENSOR WARMUP
  - INFO MENU:
    - ABOUT 3120 UNIT
    - ABOUT SENSORS
    - EXIT MENU ABOUT MENU
  - MAIN MENU:
    - MAIN MENU PAGE 1:
      - CONFIGURATION MENU (CALIBRATION):
        - CONFIGURATION TOP MENU PAGE 1:
          - SELECT SENSOR NUMBER-
          - ZERO CALIBRATION SENSOR
          - SPAN CALIBRATE SENSOR
          - CHANGE CALIBRATION VALUE-
        - CONFIGURATION TOP MENU PAGE 2:
          - EXIT CONFIGURATION MENU
      - ALARM CONFIGURATION TOP MENU:
        - ALARM PAGE 1:
          - SELECT SENSOR NUMBER-
            - LOW ALARM SETTINGS MENU:
              - CHANGE LOW SET POINT VALUE-
              - CHANGE LOW ACTIVE MODE-
              - EXIT LOW ALARM SETTINGS MENU
            - MID ALARM SETTINGS MENU:
              - CHANGE MID SET POINT VALUE-
              - CHANGE MID ACTIVE MODE-
              - EXIT MID ALARM SETTINGS MENU
            - HIGH ALARM SETTINGS MENU:
              - CHANGE HIGH SET POINT VALUE-
              - CHANGE HIGH ACTIVE MODE-
              - EXIT HIGH ALARM SETTINGS MENU
        - ALARM PAGE 2:
          - EXIT TOP ALARM CONFIGURATION MENU
      - RELAY CONFIGURATION TOP MENU:
        - RELAY PAGE 1:
          - LOW RELAY SETTINGS MENU:
            - LOW RELAY SETTINGS MENU PAGE 1:
              - CHANGE LOW LATCHING MODE-
              - CHANGE LOW ON DELAY TIME-
              - CHANGE LOW OFF DELAY TIME-
              - CHANGE LOW COIL ENERGIZE MODE-
            - LOW RELAY SETTINGS MENU PAGE 2:
              - EXIT LOW RELAY SETTINGS MENU
          - MID RELAY SETTINGS MENU:
            - MID RELAY SETTINGS MENU PAGE 1:
              - CHANGE MID LATCHING MODE-
              - CHANGE MID ON DELAY TIME-
              - CHANGE MID OFF DELAY TIME-
              - CHANGE MID COIL ENERGIZE MODE-
            - MID RELAY SETTINGS MENU PAGE 2:
              - EXIT MID RELAY SETTINGS MENU
          - HIGH RELAY SETTINGS MENU:
            - HIGH RELAY SETTINGS MENU PAGE 1:
              - CHANGE HIGH LATCHING MODE-
              - CHANGE HIGH ON DELAY TIME-
              - CHANGE HIGH OFF DELAY TIME-
              - CHANGE HIGH COIL ENERGIZE MODE-
            - HIGH RELAY SETTINGS MENU PAGE 2:
              - EXIT HIGH RELAY SETTINGS MENU
          - FAULT RELAY SETTINGS MENU:

```
                        FAULT RELAY SETTINGS MENU PAGE 1:
                            CHANGE FAULT LATCHING MODE-
                            CHANGE FAULT ON DELAY TIME-
                            CHANGE FAULT OFF DELAY TIME-
                            CHANGE FAULT COIL ENERGIZE MODE-
                        FAULT RELAY SETTINGS MENU PAGE 2:
                            EXIT FAULT RELAY SETTINGS MENU
                RELAY PAGE 2:
                    RELAY LOGIC MODE MENU:
                            CHANGE RELAY LOGIC MODE-,
                            EXIT RELAY LOGIC MODE MENU
                    EXIT TOP RELAY CONFIGURATION MENU
            NETWORK TOP MENU:
                NETWORK ID MENU:
                    SELECT SENSOR-
                    CHANGE SENSOR NETWORK ID-
                    CHANGE SENSOR NETWORK ZONE ID-
                    EXIT NETWORK ID MENU
                MODBUS NETWORK MENU:
                  MODBUS NETWORK MENU PAGE 1:
                    CHANGE DEVICE ONLINE-
                    CHANGE SENSOR ROLE-
                    CHANGE NETWORK ID MODE-
                    485 BUS SETTINGS MENU:
                            SELECT SEC DEFAULT SETTINGS
                            SELECT ALTERNATE SETTINGS
                            CUSTOM 485 LINE SETTINGS MENU:
                              CUSTOM 485 LINE SETTINGS PAGE 1:
                                  CHANGE DATA BITS-
                                  CHANGE STOP_BITS-
                                  CHANGE PARITY MODE-
                                  CHANGE BAUD RATE-
                              CUSTOM 485 LINE SETTINGS PAGE 2:
                                  EXIT CUSTOM 485 SETTINGS MENU
                            EXIT 485 BUS SETTINGS MENU
                  MODBUS NETWORK MENU PAGE 2:
                    EXIT MODBUS NETWORK MENU
                EXIT NETWORK TOP MENU
        MAIN MENU PAGE 2:
            HIDE LOW GAS MENU:
                TOGGLE HIDE MODE ON/OFF-
                EXIT GAS HIDE MENU
            SELF TEST MENU:
                SELECT SENSOR-
                CANCEL SELF TEST MENU
                ABORT OPERATING SENSOR SELF TEST
                START SENSOR SELFT TEST
            DATE AND TIME MENU:
                CHANGE DATE:
                    CHANGE MONTH-
                    CHANGE DAY-
                    CHANGE YEAR-
                    EXIT CHANGE DATE
                CHANGE TIME:
                    CHANGE HOURS-
                    CHANGE MINUTES-
                    CHANGE SECONDS-
                    EXIT CHANGE TIME
                EXIT DATE AND TIME MENU
            EXIT MAIN MENU
TOP MENU PAGE 2:
    SEC DIAGNOSTICS MENU
            REBOOT SYSTEM
            TOGGLE AND FLASH LEDS
            TOGGLE RELAYS ON/OFF MENU:
              MENU_DIAGNOSTICS_RLY_TOGGLE_t,
                MENU_TOGGLE_LOW,
                MENU_TOGGLE_MID,
                MENU_TOGGLE_HI,
                MENU_TOGGLE_FAULT,
```

MENU_DIAGNOSTICS_RLY_TOGGLE_2,
MENU_TOGGLE_EXIT,
EXIT SEC DIAGNOSTICS MENU
RESET LATCHED RELAYS
FORMAT FLASH CARD
EXIT TOP MENU

Note: When changes are made to values, a **"Save or Abort Changes"** message is displayed forcing you to choose to save the changes or discard them before the previous menu is displayed. If you want to make the changes permanent, choose "Save", if you are not sure, then choose "Abort":

Save or Abort Changes Popup

* SAVE CHANGES
ABORT CHANGES

Figure 5: Changing the 3120 Sensor Role

After entering the menu system, choose the Main Menu:

Top Menu 1

↑EJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*↓MAIN MENU

Top Menu 2

↑SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓EXIT

Then choose the Network Menu:

Main Menu 1

↑CALIBRATION
ALARM
RELAY
*↓NETWORK

Main Menu 2

↑HIDE LOW GAS
SELF TEST
SET DATE TIME
↓PREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

NETWORK ID MENU
* MODBUS SETTINGS
PREVIOUS MENU

Then highlight the Sensors Item and activate enter:

Modbus Settings Menu 1

↑ONLINE	YES
* SENSORS	UNIQUE *
NET ID	SINGLE
↓485 BUS MENU	

Modbus Settings Menu 2

↓PREVIOUS MENU

Activate the left/right up/down controls until "Unique" (for our example) is shown. Notice the asterisk to the right of the mode- this indicates the value that is changing and that the up/down controls now effect choosing a value up/down. When the correct choice shows, active enter again and the asterisk to the right will disappear. Scroll down the menu and choose "Previous Menu" to back out of the Modus Settings menu, then choose "Previous Menu" to exit the Network Menu (which will bring up the Save or Abort confirmation), then scroll down to and choose the "Previous Menu" item and exit the Main Menu, then scroll down to "Exit" and press enter to return to the Main Status Display.

Figure 6: Changing the 3120 Relay Logic Mode

After entering the menu system, choose the Main Menu:

Top Menu 1

↑EJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*↓MAIN MENU

Top Menu 2

↑SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓EXIT

Then choose the Relay Settings Menu:

Main Menu 1

↑CALIBRATION
ALARM
* RELAY
↓NETWORK

Main Menu 2

↑HIDE LOW GAS
SELF TEST
SET DATE TIME
↓PREVIOUS MENU

Then scroll down to and choose the Relay Logic Mode Menu:

Relay Top Menu 1

↑LOW
MID
HIGH
↓FAULT

Relay Top Menu 2

*↑LOGIC MODE
↓PREVIOUS MENU

Then use the up/down keys to select the desired mode:

Relay Logic Mode Menu

* MODE AND *
PREVIOUS MENU

Change the item to "OR" (for our example). Notice the asterisk to the right disappears. Now scroll down and choose the "Previous Menu" item to return to the Relay Settings menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to return to the Main Menu. Then scroll down to and choose the "Previous Menu" item to return to the Top Menu. Then scroll down to and choose the "Exit" item to return back to the Main Status screen.

Figure 7: Changing the 3120 Network ID Mode

After entering the menu system, choose the Main Menu:

Top Menu 1

↑EJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*↓MAIN MENU

Top Menu 2

↑SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓EXIT

Then choose the Network Menu:

Main Menu 1

↑CALIBRATION
ALARM
RELAY
*↓NETWORK

Main Menu 2

↑HIDE LOW GAS
SELF TEST
SET DATE TIME
↓PREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

NETWORK ID MENU
* MODBUS SETTINGS
PREVIOUS MENU

Then highlight the Net ID item and activate enter:

Modbus Settings Menu 1

↑ONLINE	YES
SENSORS	UNIQUE
* NET ID	SINGLE *
↓485 BUS MENU	

Modbus Settings Menu 2

↓PREVIOUS MENU

Using the up/down arrows, change the value to "Single" (for our example). Press enter, and note that the asterisk to the right of the value now disappears. Scroll down to and choose the "Previous Menu" item to exit to the Network Top Menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to exit to the Main Menu. Scroll down to and choose the "Previous Menu" item to exit to the Top Menu. Scroll down to and choose the "Exit" menu item to exit the menu system and return back to the Main Status Screen.

Figure 8: Changing the 3120 Network ID

After entering the menu system, choose the Main Menu:

Top Menu 1

↑EJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*↓MAIN MENU

Top Menu 2

↑SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓EXIT

Then choose the Network Menu:

Main Menu 1

↑CALIBRATION
ALARM
RELAY
*↓NETWORK

Main Menu 2

↑HIDE LOW GAS
SELF TEST
SET DATE TIME
↓PREVIOUS MENU

Then choose the Network ID Menu:

Network Top Menu

* NETWORK ID MENU
MODBUS SETTINGS
PREVIOUS MENU

Then highlight the Network ID item and activate enter (in single sensor role, you cannot change the sensor number so this item cannot be highlighted and the ID should be selected automatically first):

Network ID Menu

FOR SENSOR:	ONE
* ID	12 *
ZONE	4
PREVIOUS MENU	

Using the up/down controls, change the ID value to the desired value. Activate enter. You may also change the Zone value as well. If you are not in Single Sensor Role, you may also scroll up and change the sensor number to TWO and repeat the process if you are choosing to set different network IDs.

Once you are done, scroll down and choose the "Previous Menu" item to exit to the Network Top Menu. Scroll down and choose the "Previous Menu" item to exit to the Main Menu (which will bring up the Save or Abort confirmation). Scroll down to and choose the "Previous Menu" item to exit to the Top Menu. Scroll down to and choose the "Exit" menu item to exit and return back to the Main Status Screen.

Figure 9: Changing 3120 485 Bus Settings

After entering the menu system, choose the Main Menu:

Top Menu 1

↑EJECT MEMORY CARD
ABORT WARMUP
INFO MENU
*↓MAIN MENU

Top Menu 2

↑SEC DIAGNOSTICS
RESET RELAYS
FORMAT FLASH CARD
↓EXIT

Then choose the Network Menu:

Main Menu 1

↑CALIBRATION
ALARM
RELAY
*↓NETWORK

Main Menu 2

↑HIDE LOW GAS
SELF TEST
SET DATE TIME
↓PREVIOUS MENU

Then choose the Modbus Settings Menu:

Network Top Menu

NETWORK ID MENU
* MODBUS SETTINGS
PREVIOUS MENU

Then highlight the 485 Bus menu and activate enter:

Modbus Settings Menu 1

↑ONLINE YES
SENSORS UNIQUE
NET ID SINGLE
*↓485 BUS MENU

Modbus Settings Menu 2

↓PREVIOUS MENU

Scroll down to and choose "Comm-Alternate" to change from stop bits of 2 to 1 while preserving all other SEC default settings. Press enter, and all of the bus values will be displayed.

485 Bus Settings Menu

COMM-DEFAULT
* COMM-ALTERNATE
COMM-CUSTOM
PREVIOUS MENU

The values will be displayed for all parameters, and when you are done viewing them, press enter to return to the 485 Bus Settings menu. Scroll down to and choose the "Previous Menu" item (which will bring up the Save or Abort confirmation) to exit and return to the Modbus Settings menu. Scroll down to and choose the "Previous Menu" item to exit and return to the Network Top Menu. Scroll down to and choose the "Previous Menu" item (which will bring up the Save or Abort confirmation) to exit and return to the Main Menu. Scroll down to and choose the "Previous Menu" item to exit and return to the Top Menu. Scroll down to and choose the "Exit" menu item to exit and return to the Main Status Screen.

Place the unit on your bus when you are properly configured and ready to test. Navigate through the menus to the Network Menu, Modbus Settings Menu and make sure that the device is set to be "Online".

You may use a Modbus Master device on the bus (such as the WEB interface of a Schneider EGX gateway) or a PC running ModSCan32 to read the network ID by choosing the network ID of the 3120 device, choosing holding register 42110, 1 item. The value read back should be the same value as the network ID.

Modbus 16-bit Holding Register Map

Table 1: Overall 16-bit Holding Register Region Map

Region	Address Range	Description
0	42001 – 42100	Apply parameter subset to all Sensors
1	42101 – 42200	Sensor 1 Parameters
2	42201 – 42300	Sensor 2 Parameters
3	42301 – 42400	Sensor 3 Parameters
4	42401 – 42500	Sensor 4 Parameters
5	42501 – 42600	Sensor 5 Parameters
6	42601 – 42700	Sensor 6 Parameters
7	42701 – 42800	Sensor 7 Parameters
8	42801 – 42900	Sensor 8 Parameters
9	42901 – 43000	3120 Unit Parameters

Table 2: Region 0: All Sensors- Write only

Holding Register Address Range	ALL Sensor Register Description (Write Only) (See Parameter Tables for specifics)
42004 - 07	Alarm Set Points (Scaled)
42011	Network Zone ID (with password)
42019 - 27	Alarm Set Points (IEE 754 32-bit floating point)
42028 - 39	Calibration Value (IEE 754 32-bit floating point)
42040	Start Self Test

Table 3: Regions 1 - 8: Sensors (x = region/sensor #)

Holding Register Address	Read or Write	Sensor Register Description (See Parameter Table for specifics)
42x01	**Read**	Gas Concentration (Scaled)
42x02	**Read**	Operating Status (bit map)
42x03	**Read**	Sensor Firmware Version
42x04 - x06	**Read/Write**	Alarm Set Points (Scaled)
42x07	**Read/Write**	Calibration Value (Scaled)
42x08	**Read**	Range Value (Scaled)
42x09	**Read**	Gas Factor (Scale value)
42x10	**Read**	Network Address ID
42x11	**Read/Write**	Network Zone ID
42x12	**Read**	Sensor Device Type Code
42x13	**Read**	Sensor Status Code
42x14	**Read**	Sensor Error Code
42x15	**Read**	Sensor Cell Test Warning Code
42x16	**Read**	Sensor Serial Number
42x17 - x18	**Read**	Current Gas (IEEE 754 32-bit float)
42x19 - x27	**Read/Write**	Alarm Set Points (IEEE 754 32-bit float)

Holding Register Address	Read or Write	Sensor Register Description (See Parameter Table for specifics)
42x28 -x 30	**Read/Write**	Calibration Value (IEEE 754 32-bit float)
42x31 -x32	**Read**	Sensor Range (IEEE 754 32-bit float)
42x33	**Read**	Alarm Configuration (bit map)
42x34 - x37	**Read**	Gas Name (ASCII characters eight, 1st left to right)
42x38 - x39	**Read**	Gas Units Name (ASCII characters four, 1st left to right)
42x40	**Write Only**	Start Self Test (with password)

Table 4: Region 9: 3120 Unit Registers

Holding Register Address	Read or Write	3120 Unit Register Description (See Parameter Table for specifics)
42901	**Read**	Unit Operating Status (bit map)
42902 - 03	**Read**	Fault Relay Reason Code (32-bit bit map)
42904 - 05	**Read**	Unit Serial Number (32-bit integer)
42906 - 11	**Read**	Clock Read Registers (real-time)
42912 - 17	**Write Only**	Clock Write Registers (New write hold registers)
42918	**Write Only**	Set Clock from New Clock write hold registers
42919	**Write Only**	Diagnostics (force alarm/fault relays, force LED blinking)
42920	**Write Only**	Set Unit into Listen Only Modbus Mode
42921	**Write Only**	Restore Unit back from Listen Only Modbus Mode
42922	**Read**	Maximum number of sensors that can be attached
42923	**Read**	Unit Type Code
42924 - 25	**Read**	Unit Firmware Version (2- words for major.minor.build)

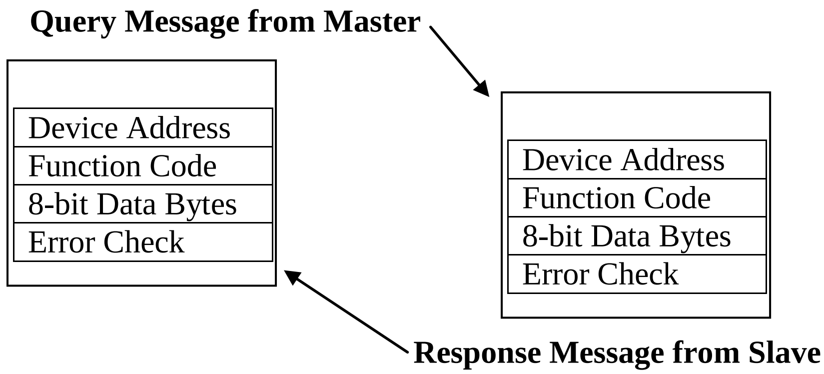
Modbus Protocol

Introducing Modbus Protocol

Modbus communication is based on a master–slave technique, in which only one device (the master) can initiate transactions (queries). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. The master can address individual slaves or can initiate a broadcast message to all slaves. Slaves return a message (a response) to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus protocol establishes the format for the master’s query by placing the device (or broadcast) address, a function code defining the requested action, any data to be sent and an error-checking field into the message. The slave’s response message is also constructed using Modbus protocol. The response contains fields confirming the action taken, any data to be returned and an error-checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as the response.

The Query–Response Cycle



The Query: The function code in the query tells the addressed slave device which kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function. For example, function code 03 will query the slave to read holding registers and respond with their contents. The data field must contain the information telling the slave which register to start at and how many registers to read. The error check field provides a method for the slave to validate the integrity of the message contents.

The Response: If the slave makes a normal response, the function code in the response is an echo of the function code in the query. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response, and the data bytes contain a code that describes the error. The error check field allows the master to confirm that the message contents are valid.

RTU Modbus Message Framing

In RTU serial transmission mode, a Modbus message is placed by the transmitting device into a frame that has a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion, determine which device is addressed (or all devices, if the message is broadcast) and know when the message is completed. Partial messages can be detected and errors can be set as a result.

In RTU mode, messages start with a silent interval of at least 3.5 character times. This is most easily implemented as a multiple of character times at the baud rate that is being used on a network (shown as T1-T2-T3-T4 in Table 5). The first field then transmitted is the device address.

The allowable characters transmitted for all fields are hexadecimal 0-9, A-F. Networked devices monitor the network bus continuously, including during the “silent” intervals. When the first field (the address field) is received, each device decodes it to determine if it is the addressed device.

Following the last transmitted character, a silent interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message is shown below:

Table 5: RTU Message Frame

Start	Address	Function	Data	CRC Check	End
T1-T2-T3-T4	8 Bits	8 Bits	n x Bits (high byte to low byte)	16 Bits (low byte then high byte)	T1-T2-T3-T4

The address field of a message frame contains eight bits (RTU). Valid slave devices are assigned addresses in the range of 1–247 (if only SEC 3120 devices are on this bus slave addressed may go up to 254). A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in the address field of the response to let the master know which slave is responding.

Address 0 is used for the broadcast address, which all slave devices recognize.

The function code field of a message frame contains eight bits (RTU). For the SEC 3120, valid codes are 1, 3, 5, 6, 15 and 16 (although holding register ranges are currently only established for codes 3, 6, and 16).

When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform. When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to logic 1.

In addition to its modification of the function code for an exception response, the slave places a unique code into the data field of the response message. This tells the master what kind of error occurred or the reason for the exception.

The master device's application program has the responsibility of handling exception responses. Typical responses are to post subsequent retries of the message, to try diagnostic messages to the slave and to notify operators.

The data field of messages sent from a master to slave devices contains additional information that the slave must use to take the action defined by the function code. This can include items such as discrete and register addresses, the quantity of items to be handled and the count of actual data bytes in the field.

For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

The data field can be nonexistent (of zero length) in certain kinds of messages.

CRC Error Checking

In RTU mode, messages include an error-checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message.

The CRC field is 2 bytes, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results. The CRC algorithm uses a polynomial of Hexadecimal A001:

1. Load a 16–bit register with FFFF hex (all 1's). Call this the CRC register.
2. Exclusive OR the first 8–bit byte of the message with the low–order byte of the 16–bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zero–filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift).
   (If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).
5. Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8–bit byte will have been processed.
6. The CRC register now contains the check value to be appended to (or compared to the received message check value) the end of the message, low 8-bit CRC byte followed by the high 8-bit CRC byte.

Implemented Functions and Registers Defined

The function code identifies the command being issued to the device. It is one byte in length and has a value of 1, 3, 5, 6, 15 or 16.

Table 6: Function Codes Supported By SEC 3120

Function Code	Description
1	Read Coil Status Registers (not supported)
3	Read Holding Registers
5	Force Single Coil Register (not supported)
6	Preset Single Holding Register
15	Force Multiple Coil Registers (not supported)
16	Preset Multiple Holding Registers

For the current 16-bit version, registers are only mapped for function codes 3, 6, and 16. Otherwise an exception response will be generated.

In most cases, there is no response for a query that contains an invalid slave address, invalid CRC data or a non-supported broadcast mode, etc. In some cases, the unit might issue an Exception 2 as an error response if an invalid register address is requested for a valid function code. However, if invalid function code is issued, such as function 07 were transmitted, then an Exception 1 message would be generated to indicate that the function code is not supported.

Query Coil Status Message

Field Name	**Example (Hex)**
Slave Address	01
Function Code	03
Address High	01
Address Low	5B
Num Points High	00
Num Points Low	03
CRC Low Byte	75
CRC High Byte	E4

Response Exception 2

Field Name	**Example (Hex)**
Slave Address	01
Function Code	83
Exception Code	02
CRC Low Byte	C0
CRC High Byte	F1

Query Exception Status Message

Field Name	Example (Hex)
Slave Address	11
Function Code	07
CRC Low Byte	4C
CRC High Byte	22

Response Exception 1

Field Name	Example (Hex)
Slave Address	11
Function Code	87
Exception Code	01
CRC Low Byte	83
CRC High Byte	F5

Function Code 03 - Read Holding Registers

The following holding registers (4X references) are supported by the SEC 3120 for one or multiple sequential function code 03 read 16-bit binary operations (multiple read operations must be sequential starting at the specified valid holding register address in the read list). Broadcast mode is not supported for this function.

Table 7: Function Code 03 Read Holding Registers

Internal Register Address x = sensor number (1 - 8)	Holding Register Address	Function Code 03- Read Sensor Register Description (Data bits and Parameter Specifics)
2x00	**42x01**	*Scaled Sensor Gas Concentration
2x01	**42x02**	Bit-mapped Sensor Operating Status: Bit 0,1: alarm status (0,0 = no alarm, 0,1 = low alarm, 1,0 = mid alarm, 1,1 = high alarm. Bit 2: fault alarm status (1 = fault, 0 = no) Bit 3: self test (1 = testing, 0 = not) Bit 4: cell test warning (1 = have warning, 0 = no) Bit 5: init/warm (1 = init/startup, 0 = idle/run) Bit 6: sensor missing (1 = missing, 0 = ok) Bit 7: calibration (1 = calibrating, 0 = not) Bit 8 - 15: **Sensor Status Code (8 bit integer)
2x02	**42x03**	Sensor Firmware Version (1 – 255)
2x03	**42x04**	*Scaled Low Sensor Alarm Set Point
2x04	**42x05**	*Scaled Mid Sensor Alarm Set Point
2x05	**42x06**	*Scaled High Sensor Alarm Set Point
2x06	**42x07**	*Scaled Sensor Calibration Value
2x07	**42x08**	*Scaled Sensor Range Value
2x08	**42x09**	Sensor Gas Factor
*These registers are scaled by Sensor Gas Factor (2x08). To obtain the real floating point		

Internal Register Address	Holding Register Address	Function Code 03- Read Sensor Register Description (Data bits and Parameter Specifics)
x = sensor number (1 - 8)		
value in its specific gas units (2x37,38), divide these *register values by the gas factor.		
2x09	**42x10**	Network Address ID (1 – 254)
2x10	**42x11**	Network Zone ID (1 – 254)
2x11	**42x12**	Sensor Device Type Code (1/11= toxic, 2/12 = oxygen, 32/33 = infrared combustible, others t.b.d.)
2x12	**42x13**	**Sensor Status Code
2x13	**42x14**	***Sensor Error Code
2x14	**42x15**	Sensor Cell Test Warning Code (128 - to 255 t.b.d)
2x15	**42x16**	Sensor Serial Number
2x16	**42x17**	**** Sensor Current Gas Concentration high word
2x17	**42x18**	**** Sensor Current Gas Concentration low word
2x18	**42x19**	Sensor Low Alarm Set Point Password Register
2x19	**42x20**	****Sensor Low Alarm Set Point high word
2x20	**42x21**	****Sensor Low Alarm Set Point low word
2x21	**42x22**	Sensor Mid Alarm Set Point Password Register
2x22	**42x23**	****Sensor Mid Alarm Set Point high word
2x23	**42x24**	****Sensor Mid Alarm Set Point low word
2x24	**42x25**	Sensor High Alarm Set Point Password Register
2x25	**42x26**	****Sensor High Alarm Set Point high word
2x26	**42x27**	****Sensor High Alarm Set Point low word
2x27	**42x28**	Sensor Calibration Value Password Register
2x28	**42x29**	****Sensor Calibration Value high word
2x29	**42x30**	****Sensor Calibration Value low word
2x30	**42x31**	****Sensor Range Value high word
2x31	**42x32**	****Sensor Range Value low word
2x32	**42x33**	*****Sensor Alarm Configuration
2x33	**42x34**	Sensor Gas Name (ASCII first and second characters)
2x34	**42x35**	Sensor Gas Name (ASCII third and fourth characters)
2x35	**42x36**	Sensor Gas Name (ASCII fifth and sixth characters)
2x36	**42x37**	Sensor Gas Name (ASCII seventh and eighth characters)
2x37	**42x38**	Sensor Gas Units (ASCII first and second characters)
2x38	**42x39**	Sensor Gas Units (ASCII third and fourth characters)
**See Sensor Status Parameter Table 8 ***See Sensor Error Code Parameter Table 9 ****Value is an IEEE 754 32-bit Floating Point number represented in its associated gas units (2X37, 38). Values are split into two 16-bit register words, high word followed by low word. *****See Alarm Configuration Parameter Table 10 Sensor Gas Name Example: ASCII text such as "Chlorine", "Oxygen ", etc.. Sensor Gas Units Example: ASCII text such as "PPM ", "%LEL", "%V/V", etc.		

Internal Register Address	Holding Register Address	Function Code 03- Read Unit Register Description (Data bits and Parameter Specifics)
2900	**42901**	Bit-mapped Unit Operating Status: Bit 0: In calibration mode. Bit 1: In start-up init mode. Bit 2: Relays and lights under master control. Bit 3: User operating 3120 display menus. Bit 4: Reading sensors. Bit 5: Accessing media. Bit 6: Saving parameters to NVROM. Bit 7: B.I.T. operation in progress. Bit 8: Formatting media. Bit 9: Setting real time clock. Bit 10: Low relay engaged. Bit 11: Mid relay engaged. Bit 12: High relay engaged. Bit 13: Fault relay engaged. Bit 14: One or more relays latched on. Bit 15: 3120 busy/write protected from changes.
2901	**42902**	Bit-mapped Fault Relay On Reason Code, Word 1: Bit 0: Have a fault from sensor 1. Bit 1: Have a fault from sensor 2. Bit 2: Have a fault from sensor 3. Bit 3: Have a fault from sensor 4. Bit 4: Have a fault from sensor 5. Bit 5: Have a fault from sensor 6. Bit 6: Have a fault from sensor 7. Bit 7: Have a fault from sensor 8. Bits 8 - 15: Reserved for future sensor channels.
2902	**42903**	Bit-mapped Fault Relay On Reason Code, Word 2: Bits 7 - 0: Sensor error code of highest faulting sensor. Bits 15 -0: Have a 3120 unit fault (0xFFFF). Bit 15: Alone, sensor is missing. Bits 12,8: Under master control- on (1,0). Bits 12,8: Under master control- off (1,1). Bits 13,14,11,10,9: 0 not defined, t.b.d.
2903	**42904**	Unit Serial Number (32-bit) high 16-bit word
2904	**42905**	Unit Serial Number (32-bit) low 16-bit word
2905	**42906**	Unit Clock Month- Read register (1 - 12)
2906	**42907**	Unit Clock Day- Read register (1 - 31)
2907	**42908**	Unit Clock Year- Read register (2000 - 2150)
2908	**42909**	Unit Clock Hours- Read register (0 - 23)
2909	**42910**	Unit Clock Minutes- Read register (0 - 59)
2910	**42911**	Unit Clock Seconds- Read register (0 - 59)
2917	**42918**	Unit Clock Set Status- Set pending (1), not (0)

Internal Register Address	Holding Register Address	Function Code 03- Read Unit Register Description (Data bits and Parameter Specifics)
2921	**42922**	Maximum number of sensors that can be attached (Allows master to determine if device is a SEC 3100MB16, which only supports one sensor, or an advanced transmitter such as the SEC 3120 which supports at least two sensors)
2922	**42923**	Unit Type Code (0x0100 or 256 decimal)- SEC 3100MB16, (0x0101 or 257 decimal)- SEC 3120 Dual Sensor, (0x0111 or 273 decimal)- SEC 3120 supporting multiple logical sub-channels, other values TBD...
2923	**42924**	Unit Firmware Version Word 1 (Major version- MSB {0 - 255}, Minor version- LSB {0 - 255})
2924	**42925**	Unit Firmware Version Word 2 (Revision/Build number- 16-bit build number increment, 0 - 65535)

Table 8: Sensor Status Code Parameter Table

Value (Hex)	Description
0000	**Sensor is running, normal mode. All is well, OK.**
0001	Not used.
0002	**Sensor Zero Calibrating.**
0003	**Sensor Span Calibrating.**
0004	Sensor 4-20ma Calibrating.
0005	**Sensor in Warm-up.**
0006	Sensor in Power Up Fault.
0007	Sensor in Calibration Fault.
0008	Sensor in Span Fault.
0009	Sensor in Unit Fault.
000A	Sensor in Optics Fault.
000B	**Sensor in Zero Drift Fault.**
000C	Sensor in Configuration Fault.
000D	Sensor in Hot Zero Calibration.
000E	Sensor in Cool Zero Calibration.
000F	Sensor in Self Test Operation.
0010	Sensor in Reference Channel Fault.
0011	Sensor in Active Channel Fault.
0012	Sensor in Power Fault.
0013 - 00FF	Other values t.b.d.

Table 9: Sensor Error Code Parameter Table

Error Code (Hex)	Description
0000	No error, all is well and OK.
0001	EEPROM Header Error.
0002	EEPROM Checksum Error.
0003	Sensor Never Zero Calibrated.
0004	Sensor Never Span Calibrated.
0005	Zero values out of spec.
0006	4-20ma Calibration 1 error.
0007	4-20ma Calibration 2 error.
0008	Signal High Error.
0009	4VDC Reference Low.
000A	4VDC Reference High.
000B	Balance Pot Max.
000C	Balance Pot Min.
000D	AGC Pot Max.
000E	AGC Pot Min.
000F	Span Pot Max.
0010	Span Pot Min.
0011	Sensor Never Hot Zero Calibrated.
0012	Sensor Never Cool Zero Calibrated.
0013	Unit Temperature > +85 degrees Celsius.
0014	Unit Temperature < -35 degrees Celsius.
0015	Insufficient Analytical Range.
0016	No table downloaded.
0017	Span calibration invalidated by new range or calibration value.
0018	Span Pot overflow (not enough span pot range for temperature adjustment or insufficient analog signal).
0019	24VDC Supply Low.
001A	24VDC Supply High.
001B - 00FF	t.b.d.

Table 10: Alarm Configuration Parameter Table

Bit Field	Description
Bit 0	Low alarm relay normally energized (1) or not (0).
Bit 1	Low alarm relay latching mode enabled (1) or not (0).
Bit 2	Low alarm relay audible alarm mode enabled (2) or not (0).
Bit 3	Low alarm on when gas is above low set point (1) or below (0).
Bit 4	Mid alarm relay normally energized (1) or not (0).
Bit 5	Mid alarm relay latching mode enabled (1) or not (0).
Bit 6	Mid alarm relay audible alarm mode enabled (2) or not (0).
Bit 7	Mid alarm on when gas is above mid set point (1) or below (0).
Bit 8	High alarm relay normally energized (1) or not (0).
Bit 9	High alarm relay latching mode enabled (1) or not (0).
Bit 10	High alarm relay audible alarm mode enabled (2) or not (0).
Bit 11	High alarm on w/gas above high set point (1) or below (0).
Bit 12	Fault alarm relay normally energized (1) or not (0).
Bit 13	Fault alarm relay latching mode enabled (1) or not (0).
Bit 14	Fault alarm relay audible alarm mode enabled (2) or not (0).
Bit 15	Fault alarm on when fault code for sensor non-zero (always 0).

Read Holding Registers Query

The query message specifies the starting register and quantity of registers to be read. SEC 3120 internal registers are addressed starting at zero: Modbus holding registers 1–16 are addressed as 0–15.

Multiple sensors are allowed to be attached to a single 3120 unit; therefore the register map is split into regions as shown previously in Table 1. Each sensor has its own region (a repetition of the same parameter registers that address each specific sensor's parameters), and each region is a multiple of 100, as expressed by its sensor number (i.e. sensor 1 - region 1, or internal register 21xx, sensor 2 - region 2, or internal register 22xx).

Region 0 is reserved for write-only for applying changes to all sensors, therefore ***Region 0 (internal registers 20xx) cannot be read.***

Region 9 is reserved for SEC 3120 unit level information rather than sensor specific information. Region 9 (internal registers 29xx) can be read. The maximum number of sensors that may be attached to the transmitter can be queried from internal registers 2921. This will allow the master to determine if the other regions apply (region 0, 2-8) if it returns a one indicating that it is an SEC 3100MB16 device, or an advanced transmitter such as the SEC 3120 (returning two or more).

Note: An SEC 3120 configure as "Single Sensor" mode, will return a one indicating that only regions 1 and 9 are accessible- requests to read regions outside of this range (2 - 8 or 0) will generate exception 2 messages.

Here is an example of a request to read Modbus holding registers 42104–42106 from slave device 17, sensor 1 (region 1 = 21xx):

Read Holding Register Query

Field Name	Example (Hex)
Slave Address	11
Function Code	03
Starting Address High	08
Starting Address Low	37
Num Points High	00
Num Points Low	03
CRC Low Byte	B4
CRC High Byte	F5

Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits, and the second byte contains the low order bits.

Here is an example of a response to the query:

Read Holding Register Response

Field Name	Example (Hex)
Slave Address	11
Function Code	03
Byte Count	06
Data High Byte (Register 42104)	01
Data Low Byte (Register 42104)	2A
Data High Byte (Register 42105)	01
Data Low Byte (Register 42105)	8F
Data High Byte (Register 42106)	03
Data High Byte (Register 42106)	21
CRC Low Byte	04
CRC High Byte	5D

The contents of register 42104 are shown as the two byte values of 01 2A hex or 298 decimal. The contents of registers 42105 and 42106 are 01 8F and 03 21 hex, or 399 and 801 decimal, respectively.

SEC 3120 units support 40+ holding registers for each sensor attached, as well as an additional 12+ holding registers specific to the 3120 unit head itself as listed in Table 7.

If a starting address is not within the range shown in Table 7, the SEC 3120 unit will issue an Exception 2 as a response. If the number of points is too many, the SEC 3120 may issue an Exception 3 as a response.

Response Exception 2

Field Name	**Example (Hex)**
Slave Address	01
Function Code	83
Exception Code	02
CRC Low Byte	C0
CRC High Byte	F1

Response Exception 3

Field Name	**Example (Hex)**
Slave Address	01
Function Code	83
Exception Code	03
CRC Low Byte	01
CRC High Byte	31

Note: <u>SCAN MODE</u>: A crucial feature of the SEC 3120 16-bit Modbus implementation is that it **enables a Modbus Master to gain one or *more* holding register contents at a time.** This allows the master to start at any legal holding register address and retrieve in ***one scan block,*** an ***entire set*** of relevant parameters for a given sensor, such as Gas Concentration, Operating Status and Alarm Set Points or more in ***one read query operation.***

Function Code 06 - Preset Single Holding Register

Description

Presets a value into a single holding register (4x references). Modbus allows a broadcast mode with function presets to the same register reference in all attached slaves, however the SEC 3120 supports multiple sensors attached to a single unit, hence broadcast mode is not allowed, except for one preset register pair 42920 (listen only mode) and 42921 (restore from listen only mode).

To accomplish the same functionality as a broadcast to the same preset reference in the SEC 3120, so long as the sensors attached are truly identical, region 0 of the holding register map (holding register address range 42001 - 42099) may be used. If written to the same relative offsets as the sensor regions (i.e. 42004 for 42x04, 42005 for 42x05, where x = specific sensor number) then the values written to region 0 registers will apply as if written to all sensor relative region offset registers.

The advantage of using a preset function is that it does not have the overhead of an item count or a byte count. It is a very small packet targeted at changing one very specific 16-bit register with a full read-back of the contents to ensure proper communication.

Table 11: Function Code 06 Preset Holding Register

Internal Register Address x = sensor number, or 0 to apply to all sensors.	Holding Register Address	Function Code 06- Preset Sensor Register Description (Data bits and Parameter Specifics)
2x03	**42x04**	*Scaled Integer Sensor Alarm Low Set Point. 4000 Hex must be added as a password to write value.
2x04	**42x05**	*Scaled Integer Sensor Alarm Mid Set Point. 4000 Hex must be added as a password to write value.
2x05	**42x06**	*Scaled Integer Sensor Alarm High Set Point. 4000 Hex must be added as a password to write value.
2x06	**42x07**	*Scaled Integer Sensor Calibration Value. 4000 Hex must be added as a password to write value.
2x10	**42x11**	**Sensor Zone ID. 4000 Hex must be added as a password to write value.
2x39	**42x40**	**Start Sensor Self Test Operation (00FF Hex Start, 0 stop) 4000 Hex must be added as a password to write value.

*The real value must be multiplied by the Gas Factor (2x08).
i.e. 2.12 ppm to set low set point register: scaled low set point = 2.12 X 10 (from 2x08) = 212 (00D4 Hex). When the password is added (4000 Hex) the complete value needed to write the register and change the low set point then is 40D4 Hex.

** Zone ID (2010/42012) and Self Test (2039/42040) may be written to in region zero (apply to all sensors) for a 3120 with two or more sensors attached, when the sensor role is either "Unique" or "Identical" modes, but NOT when in "Single" sensor role- an exception message will be generated and sent back to the master in place of a message echo. If sensor role is "Identical", values must also be identical!

Internal Register Address	Holding Register Address	Function Code 06- Preset Unit Register Description (Data bits and Parameter Specifics)
2911	**42912**	New 3120 Unit Clock Month Value. 4000 Hex must be added as a password to write value.
2912	**42913**	New 3120 Unit Clock Day Value. 4000 Hex must be added as a password to write value.
2913	**42914**	New 3120 Unit Clock Year Value. 4000 Hex must be added as a password to write value.
2914	**42915**	New 3120 Unit Clock Hours Value. 4000 Hex must be added as a password to write value.
2915	**42916**	New 3120 Unit Clock Minutes Value. 4000 Hex must be added as a password to write value.
2916	**42917**	New 3120 Unit Clock Seconds Value. 4000 Hex must be added as a password to write value.
2917	**42918**	Set New 3120 Unit Clock NOW (00FF Hex set, 0 clear). 4000 Hex must be added as a password to write value.

Internal Register Address	Holding Register Address	Function Code 06- Preset Unit Register Description (Data bits and Parameter Specifics)
2918	**42919**	Bit-mapped Diagnostics Force Coils And Toggle LEDs. Bit 0: Force low relay coil (1 = on, 0 = off) Bit 1: Force mid relay coil (1 = on, 0 = off) Bit 2: Force high relay coil (1 = on, 0 = off) Bit 3: Force fault relay coil (1 = on, 0 = off) Bit 4: Toggle LEDs red/green (1 = on, 0 = off) Duration of force will be approximately 30 seconds unless re-written. 4000 Hex must be added as a password to write value.
2919	**42920**	Modbus Listen Only (00FF engages). No response will be given and unit will not respond to any commands addresses to it or broadcast, other than command to restore from listen only (2920). 4000 Hex must be added as a password to write value.
2920	**42921**	Modbus Restore From Listen Only (00FF engages). Response will be given and unit will resume responding to commands addresses to it or broadcast. 4000 Hex must be added as a password to write value.

The SEC 3120 supports sensor preset holding registers as shown in table 11 previously. To avoid accidentally writing to any of these registers, 4000 hex (16384 decimal) must be added to the register value as a password. Parameter registers low, mid, and high alarm set points and calibration value must be less than the full scale (range) of measurement. For example, if the range of measurement is 2000 ppm for Chlorine, then to set 1200 ppm as the high alarm set point, the value of register 42x06 should be 44B0 hex (17584 decimal).

The normal response is an echo of the query, returned after the register contents have been preset.

Query

The query message specifies the register reference to be preset. Registers are addressed starting at zero: register 1 is addressed as 0.

Here is an example of a request to preset register 42106 to set high alarm set point as 1200 in slave device 17, for sensor 1:

Preset One Sensor High Set Point Holding Register Query

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	08
Address Low	39
Data High	44
Data Low	B0
CRC Low Byte	6B
CRC High Byte	83

Preset ALL Sensor High Set Point Holding Registers Query

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	07
Address Low	D5
Data High	44
Data Low	B0
CRC Low Byte	A9
CRC High Byte	62

The normal response is an echo of the query, returned after the register contents have been preset.

Response

Here is an example of a response to the query shown above:

Preset One Sensor High Set Point Holding Register Response

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	08
Address Low	39
Data High	44
Data Low	B0
CRC Low Byte	6B
CRC High Byte	83

Preset ALL Sensor High Set Point Holding Registers Response

Field Name	Example (Hex)
Slave Address	11
Function Code	06
Address High	07
Address Low	D5
Data High	44
Data Low	B0
CRC Low Byte	A9
CRC High Byte	62

If the register address in the query shown previously is not valid for a preset register function, the SEC 3120 unit will issue an Exception 2 as a response. If the preset data in the query does not include the password, the SEC 3120 unit will issue an Exception 8 as a response. If the SEC 3120 unit is not operating in identical sensor role mode (for setting threshold values), it will generate an Exception 3 response.

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	02
CRC Low Byte	C3
CRC High Byte	A1

Response Exception 3

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	03
CRC Low Byte	02
CRC High Byte	61

Response Exception 8

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	08
CRC Low Byte	43
CRC High Byte	A6

Function Code 16 - Write Multiple Holding Registers

Description

Writes a set of values into one or more sequential holding registers (4x references). Modbus does NOT allow a broadcast mode with this function code.

Table 12: Function Code 16 Multiple Write Holding Registers

Internal Register Address x = sensor number, or 0 to apply to all sensors.	Holding Register Address	Function Code 16- Write Multiple Sensor Registers (Data bits and Parameter Specifics)
2x03	**42x04**	*Scaled Integer Sensor Alarm Low Set Point. 4000 Hex must be added as a password to write value.
2x04	**42x05**	*Scaled Integer Sensor Alarm Mid Set Point. 4000 Hex must be added as a password to write value.
2x05	**42x06**	*Scaled Integer Sensor Alarm High Set Point. 4000 Hex must be added as a password to write value.
2x06	**42x07**	*Scaled Integer Sensor Calibration Value. 4000 Hex must be added as a password to write value.
2x10	**42x11**	***Sensor Zone ID. 4000 Hex must be added as a password to write value.
2x18	**42x19**	Sensor Low Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x19	**42x20**	**Sensor Low Alarm Set Point Float high word.
2x20	**42x21**	**Sensor Low Alarm Set Point Float low word.
2x21	**42x22**	Sensor Low Alarm Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x22	**42x23**	**Sensor Alarm Mid Set Point Float high word.
2x23	**42x24**	**Sensor Alarm Mid Set Point Float low word.
2x24	**42x25**	Sensor Alarm High Set Point Enable Register. This register must be written to first with 4259 Hex as a password.
2x25	**42x26**	**Sensor Alarm High Set Point Float high word.
2x26	**42x27**	**Sensor Alarm High Set Point Float low word.
2x27	**42x28**	Sensor Calibration Value Enable Register. This register must be written to first with 4259 Hex as a password.
2x28	**42x29**	**Sensor Calibration Value Float high word.
2x29	**42x30**	**Sensor Calibration Value Float low word.
2x39	**42x40**	***Start Sensor Self Test Operation (00FF Hex Start, 0 stop) 4000 Hex must be added as a password to write value.

Internal Register Address	Holding Register Address	Function Code 16- Write Multiple Sensor Registers (Data bits and Parameter Specifics)
x = sensor number, or 0 to apply to all sensors.		

*The real value must be multiplied by the Gas Factor (2x08).
i.e. 2.12 ppm to set low set point register: scaled low set point = 2.12 X 10 (from 2x08) = 212 (00D4 Hex). When the password is added (4000 Hex) the complete value needed to write the register and change the low set point then is 40D4 Hex.
**Sensor Float parameters (low, mid and high set points and calibration values) must be written in sequence in at least one multiple item write operation, starting in order with the enable password register, high word then low word. These values are IEEE 754 encoded 32-bit values split into two 16-bit words. Upon a complete write of the triad, the value is saved internally.
***Zone ID (2010/42011) and Self Test (2039/42040) may be written in region 0 (apply to all sensors) when a SEC 3120 is in either "Identical" or "Unique" sensor roles (unlike set point or threshold registers where the sensor role must be "Identical"), however if in the "Single" sensor role, an exception message will be transmitted to the master. If sensor role is "Identical", values must also be identical!

Internal Register Address	Holding Register Address	Function Code 16- Write Multiple Unit Registers (Data bits and Parameter Specifics)
2911	**42912**	New 3120 Unit Clock Month Value. 4000 Hex must be added as a password to write value.
2912	**42913**	New 3120 Unit Clock Day Value. 4000 Hex must be added as a password to write value.
2913	**42914**	New 3120 Unit Clock Year Value. 4000 Hex must be added as a password to write value.
2914	**42915**	New 3120 Unit Clock Hours Value. 4000 Hex must be added as a password to write value.
2915	**42916**	New 3120 Unit Clock Minutes Value. 4000 Hex must be added as a password to write value.
2916	**42917**	New 3120 Unit Clock Seconds Value. 4000 Hex must be added as a password to write value.
2917	**42918**	Set New 3120 Unit Clock NOW (00FF Hex set, 0 clear). 4000 Hex must be added as a password to write value.
2918	**42919**	Bit-mapped Diagnostics Force Coils And Toggle LEDs. Bit 0: Force low relay coil (1 = on, 0 = off) Bit 1: Force mid relay coil (1 = on, 0 = off) Bit 2: Force high relay coil (1 = on, 0 = off) Bit 3: Force fault relay coil (1 = on, 0 = off) Bit 4: Toggle LEDs red/green (1 = on, 0 = off) Duration of force will be approximately 30 seconds unless re-written. 4000 Hex must be added as a password to write value.

The SEC 3120 supports multiple write holding sensor and unit registers as shown in table 12 above. To avoid accidentally writing to any of these registers, a password is required. For most registers (as designated in the table above) 4000 hex (16384 decimal) must be added to the register value as a password.

For floating point register sets, the first register in the trio is the password enable register. This register must have the Hex value 4259 written to it first, followed by the high word and then the low word of the 32-bit IEEE floating point encoded value, using at leas one multiple write operation.

Parameter registers low, mid, and high alarm set points and calibration value must be less than the full scale (range) of measurement.

When setting the new clock time, registers 42912-17 are written first, followed by 42918 to actually set the time (copy new values to clock and run).

The normal response is an echo of the query header (which contains the unit number, function code, starting address and number of registers).

Query

The query message specifies the register reference to be preset. Registers are addressed starting at zero: register 1 is addressed as 0.

Here is an example of a request to write holding registers 42119 - 42121 to set the low alarm set point floats 400.12 (43C8 0F5C Hex) in slave device 17, for sensor 1:

Write Multiple Holding Registers Query

Field Name	Example (Hex)
Slave Address	11
Function Code	10
Address High	08
Address Low	46
Item Count High	00
Item Count Low	03
Num Data Bytes	06
Data High (42119)	42
Data Low (42119)	59
Data High (42120)	43
Data Low (42120)	C8
Data High (42121)	0F
Data Low (42121)	5C
CRC Low Byte	92
CRC High Byte	27

The normal response is an echo of the query header, returned after the register contents have been written.

Response

Here is an example of a response to the query on the previous page:

Write Multiple Holding Registers Response

Field Name	Example (Hex)
Slave Address	11
Function Code	10
Address High	08
Address Low	46
Item Count High	00
Item Count Low	03
CRC Low Byte	61
CRC High Byte	2D

If the register address in the query is not valid for a multiple register write function, the SEC 3120 unit will issue an Exception 2 as a response. If the multiple register write enable password register in the query did not include the proper password, the SEC 3120 unit will issue an Exception 8 as a response. If the SEC 3120 unit is not operating in identical sensor role mode, and an attempt to write to ALL sensors (address range 42001 to 42100, except 42011- Zone ID & 42040- Self Test) it will generate an Exception 3 response.

Response Exception 2

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	02
CRC Low Byte	C3
CRC High Byte	A1

Response Exception 3

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	03
CRC Low Byte	02
CRC High Byte	61

Response Exception 8

Field Name	Example (Hex)
Slave Address	01
Function Code	86
Exception Code	08
CRC Low Byte	43
CRC High Byte	A6

Note: <u>**SCAN MODE**</u>**:** A crucial feature of the SEC 3120 16-bit Modbus implementation is that it **enables a Modbus Master to update one or *more* holding register contents at a time.** This allows the master to start at any legal holding register address and update in ***one scan block,*** an ***entire set*** of relevant parameters for a given sensor, such as all Alarm Set Points in ***one write operation.***

This is especially useful for updating a sequence of 16-bit registers that need to be written together to be valid and protect against unwanted or accidental write operations. In the case of the IEEE 754 32-bit Floating Point Alarm Set Points, a triad of registers is required to fully change a given set point, all in one action otherwise the operation will be rejected as a password failure. Since a 32-bit floating point value requires two 16-bit registers to hold the entire contents, a set of three registers is designated;

1. Password enable register- must contain the Hexadecimal value 4259.
2. High 16-bit word of IEEE 754 encoded floating point set point value.
3. Low 16-bit word of IEEE 754 encoded floating point set point value.

A state machine ensures that the sequence order is followed and that the password enable register occurs first in the multi-write operation and contains the correct value. If the sequence is not followed correctly or the password is incorrect, the set point will not be updated and an exception generated. This prevents un-intended write operations.

At the same time, it allows multiple-word values or blocks that make up a huge value to be written, without breaking the Modbus 16-bit specification or creating a burdensome long set of 16-bit operations.

In both multiple read and write operations, it allows a low-level Master driver to determine whether it uses a single or multiple register operation, thus enabling better efficiency in the Modbus Master.

Sensor Roles and Modbus

The SEC 3120 allows three major modes or roles of operation regarding attached sensors;

1. **Single Sensor Role-** In this role, the SEC 3120 works much more like the SEC 3100 and 3100MB16, monitoring and reporting on only one attached sensor to its sensor one connector while ignoring any other attached sensors. The effect is a single sensor, single network ID, and total exclusive control of the units relays, screen and LEDs.
    - **Modbus Effects-** since the 3120 (head) operates as if it only has a single sensor attached;
        - The address ALL sensor region (42001 - 42099) will be ignored and generate exception messages if addressed by a master. No reads or writes will be allowed.
        - Sensor region one will only be readable and writeable (42101 - 42199).
        - Sensor regions two through eight (42201 - 42899) will be ignored and if accessed will generate exception messages to the master.
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.
2. **Identical Sensor Role-** In this role, ALL sensors attached (more than one) must have identical gas types, detection types and gas ranges. The purpose of this role is to provide redundancy and reliability to sensitive detection operations where relays should not be activated unless at least two sensors are in agreement as to the actual gas concentration levels independently measured. The relays are controlled in a logical "AND" operation for alarm levels, while faults continue to operate the fault relay in a logical "OR" configuration- meaning ANY sensor with a fault will cause the fault relay to energize.
    - **Modbus Effects-** since the 3120 (head) operates as if it has identical sensors attached;
        - The address ALL sensor region (42001 - 42099) will be allowed to apply thresholds/set points and calibration values to ALL sensors to streamline setup and configuration.
        - All sensor regions in accordance with the number of reported maximum attached sensors (see unit register 42922) are independently readable and writeable (42101 - 42899).
        - A change written in threshold/set point registers in any given sensor region will result in that value being copied to the other corresponding sensor parameter.
        - Writes to Zone ID (42x11) must be identical in all sensors regions, and in fact, the final region written (typically 42211) will set the final value for all sensors.
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.

3. **Unique Sensor Role-** In this role, all sensors attached may have different gas types, ranges and detection types. The purpose of this role is consolidate space and act as a central hub to multiple sensors and logical sub-channels. Alarm relays may be programmed to operate in any fashion, but typically driven in a logical "OR" configuration, thus ANY sensor alarm level drives the respective relay. Sensor faults by any sensor operate the fault relay in a logical "OR" configuration as well.
    - **Modbus Effects-** since the 3120 (head) operates allowing multiple sensors having different gas detection types and ranges and sub-channels;
        - The address ALL sensor region (42001 - 42099) will be ignored and generate exception messages if addressed by a master. No reads or writes will be allowed.
        - All sensor regions in accordance with the number of reported maximum attached sensors (see unit register 42922) are independently readable and writeable (42101 - 42899).
        - Unit region nine (42901 - 42999) will function normally as described in this document, unaffected by sensor role.

Sensor Electronics Corporation
12730 Creek View Avenue
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Accessing SEC 3500 on a Network Using a PC

This document will outline a step-by-step process on how to bring a single SEC 3500 (or multiple) onto a network and access the information on a PC. In order for this to happen, the SEC 3500 needs to be connected to the same network as the PC being used to monitor the system. The default gateway address of the PC being used must also be known.

Connecting the SEC 3500 to the Network

1) Find Default Gateway IP address for the computer being used to view the 3500s. This can be done by contacting the network administrator and asking for the default gateway address.
2) Make sure there is an Ethernet cable available that has access to the network.
3) Plug in an Ethernet cable into the 3500. See figure 1 for correct placement. **Caution: If the Ethernet cord is too long, the computer may not be able to access the 3500 on the network or it may have a very slow connection. Make sure the cord is only as long as it needs to be.**

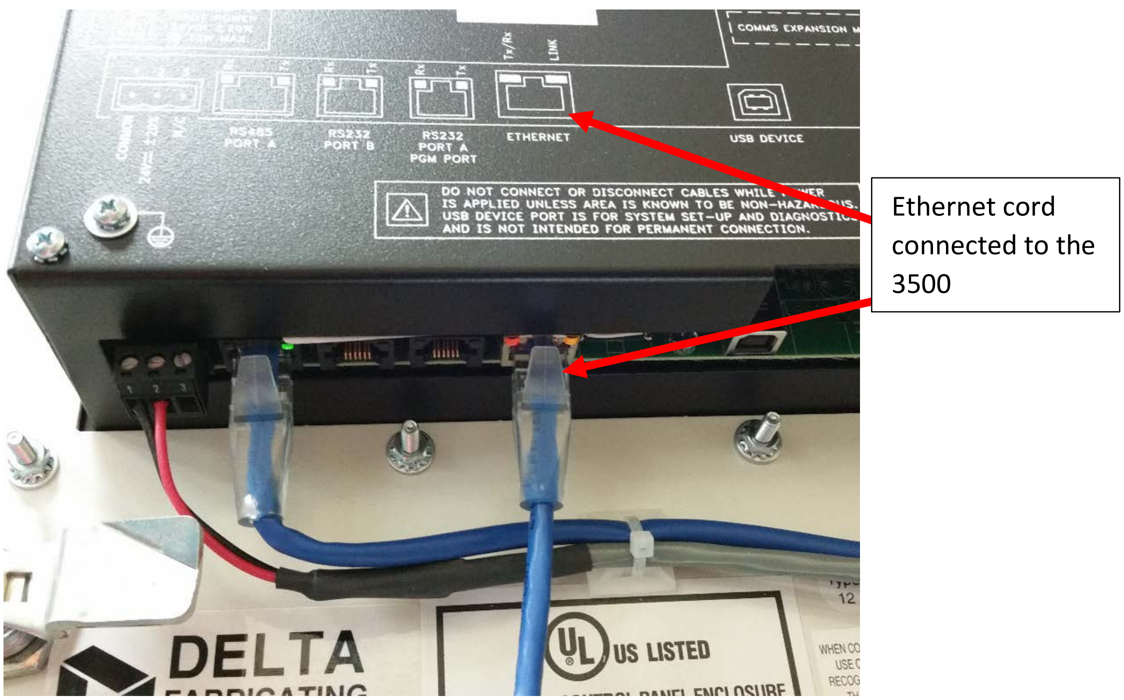

Figure 1 – Correct Placement of Ethernet Cable

4) Now access is needed to get into the supervisor menu.
5) Login to Supervisor Menu for access to the configuration menu.

- In order to do this follow the steps in section 8 of the "3500 OI Supervisor Manual" and make sure the date is September, 2007. This guarantees the latest version. The steps start on page 46 and end on 49. The default username is super and the default password is also super (this can be changed later, follow page 56 for this in the manual).

6) Once the supervisor has logged in, press the “Supervisor Menu” button.
7) This will bring up a list of buttons to press, press the “Configuration” button at the top.
8) Another list of buttons will show and click the “IP Address” button at the top.
9) Now a screen will appear with four boxes. The only two we will worry about currently are the two on the right, “IP Address:” and “Gateway Address:” See figure 2 for this screen.

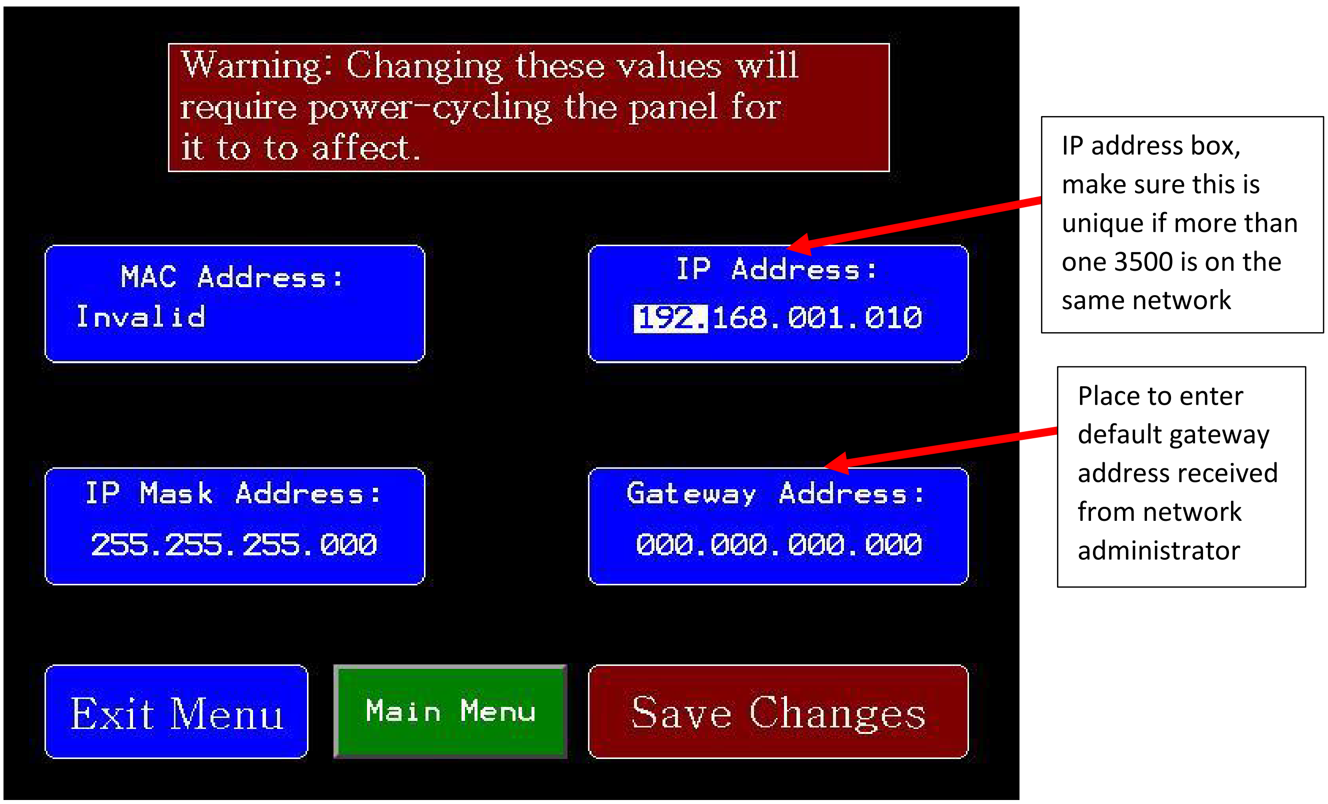

Figure 2 – IP Address Menu

10) Click on the “Gateway Address:” button and enter the gateway address you got from the network administrator. Note: You may need to click on the first three numbers in the “Gateway Address:” box to highlight the numbers. Then click on them again to bring up the menu to start entering the address.
11) Start by typing in the first three digits, the press the next button, do this until the address has been entered.
12) An example address would be 192.168.1.1. When entering this in, first enter in the 192 and click next, then enter 168 and click next, then enter one and click next, and finally enter 1 again and click enter. The ending address should like as follows: 192.168.001.001.

13) Now look at the IP Address of the 3500 and make sure to write it down. If there are multiple 3500s on the same network, each one will need to have a unique IP Address and this may need to be changed. If there are three 3500s connected to a network and the first IP Address is 192.168.001.010, the next one could be 192.168.001.020 and the last on could be 192.168.001.030. Make sure to take note of all IP addresses used.
14) Once this is done press “Save Changes.” The 3500 will then restart.

Access the SEC 3500 from a PC

1) Once the 3500 has been correctly placed on the network, open up a web browser (Internet Explorer, Google Chrome, and Mozilla Firefox all work) and type in the IP address of the 3500 to view.
2) A page will appear like the one in figure 3 titled “SEC 3500 Master HMI Web Server v3.5.28.”

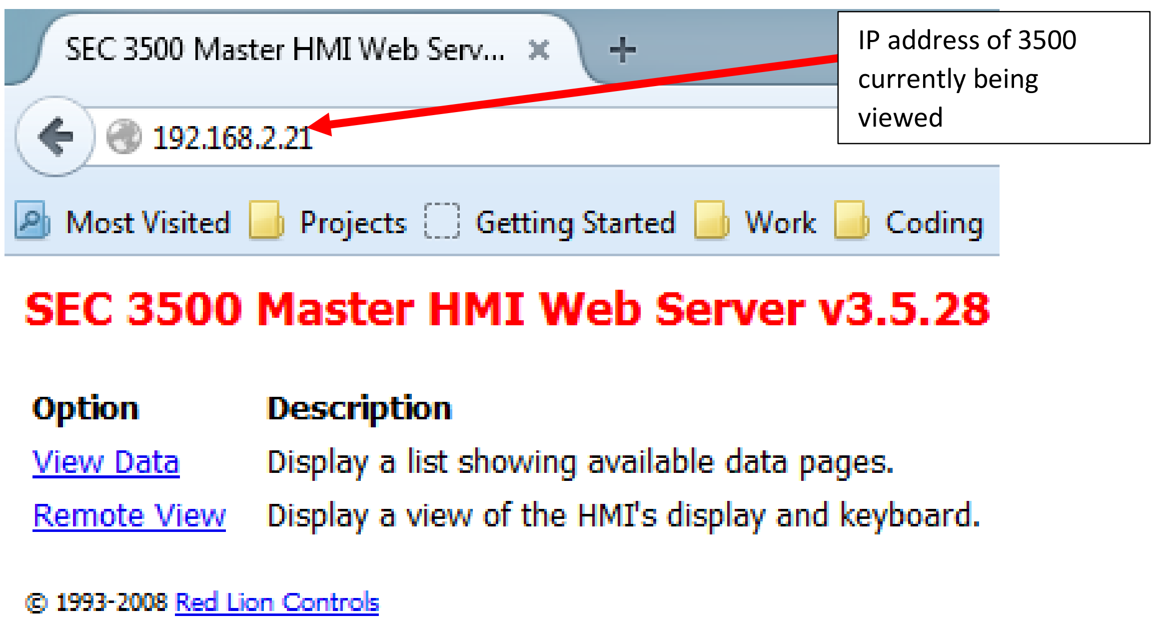

Figure 3 – Homepage of 3500

- There are now two options to choose from, “View Data” and “Remote View.” View Data will give a general overview of everything connected to the 3500 (zone faults, number of devices on the controller, number of devices in alarm, etc).
- The “Remove View” will give access to the 3500 as if the user was standing in front of it. This gives you remote access to the 3500’s specific sensors, zones, and information that can be read right from the computer.

Note: If the user has connected more than one 3500 to the same network with different IP address, just open a new tab in the web browser and type in the IP address of that specific 3500.

SEC 3500 HMI Operator Interface

Hardware Manual

Sensor Electronics Corporation
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Savage, Minnesota 55378 USA
(952) 938-9486 Fax (952) 938-9617
Email sales@sensorelectronic.com

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.

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.

Table of Contents

Contents

Revision History

Rev	Date	ECO	Description of Change	Page
032113	03/21/13	-	Initial Release	
1	9/20/2016	-	Update to Current P/N Scheme Update Specifications Add Installation Steps Add Testing Add Maintenance Add UL2017 Information	All
2	10/26/2016	-	Change model to SEC3500 HMI Add all Components Inside Enclosure to Specs Add Recommended Power Supply Add Earth Ground Callout to Page 9 Add Note about ISO Comm on Repeaters Add Part about SEC3500 HMI Being the System	All
A		000209	UL2017 Approved	All

I. SPECIFICATIONS

Model: SEC3500 HMI

Interface
RS485 Port: Interactive “Modbus” (expandable to two)
RS232 Port: “Statcast” System parameter broadcast
Ethernet Port: Remote Screen Access
16 Programmable Relays (expandable to 40)

Construction: Powder Coated Steel

Dimensions: 16” X 16” X 10”

Weight: 45lbs

Operating Temperature Rating:
0° to +50°C at 0 to 99% RH (non-condensing)

Operating Voltage: 19 to 29 VDC ⎓

Power Consumption: 40 Watt Max. (Not including relay contact current or 24VDC power supplied to external devices)

Relay Contacts: 1 NO, 1 NC per Relay.
Contact Rating: 8A @ 30VDC, 8A @ 250VAC

Type AM System

System Components:
SEC 3500 Operator Interface (Red Lion HMI)
SEC 3100 Gas Transmitter (Not UL 2017 Approved)
SEC 3500 - XX Relay Controller
SEC 3100 AIM Interface Module (Not UL 2017 Approved)
SEC 3100 LIM Interface Module (Not UL 2017 Approved)
SEC 3100 ISO Repeater
SEC 3500 Enclosure
Circuit Breaker
DC to DC Converter 12-24V to 24V 1A

Approvals: CSA: C22.2 No 0, No 0.4-04, No 14-05, No 142
UL 508
ETL: 5002065 UL 2017 (SEC3500 HMI, whole system)

Installation Category: Cat. I, Pollution Degree 2

RS485 Max Line Impedance: ~100-140Ω

Recommended Power Supply: IDEC PS5R-SD24
Input: 100 to 240VAC Output: 24V 2.5A Power Supply
Other supplies may be used as long as they are class 2 power supplies

II. GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement

⎓ VDC (DC Voltage)

SEC 3500 HMI

The SEC3500 HMI Operator Interface, an Attendant-Monitored system, continuously interrogates up to 254 system devices over the 9600 baud RS485 Modbus Interface. The OI, operating as the Modbus Master, can communicate with any SEC3XXX Device and any 4-20 transmitter via the SEC3100AIM.
There is a power indicator LED located on the front panel of the 3500.
Network devices can be interrogated, configured, and calibrated using the password protected touchscreen user interface.
16 embedded programmable relays provide external device control/interface based on network events. Additional relays can be located anywhere on the network (groups of 8).
The Statcast RS232 interface continuously scrolls through system operating status. (Read only for the user)
An Ethernet port allows remote access to system screens.
The SEC3500 HMI refers to the system as a whole, not just the SEC3500 (what is inside the metal enclosure).

⚠ WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR SAFETY

III. OPERATION

The SEC3500 HMI Operator Interface is an intuitive operator interface. For the individual page operations please refer to the following individual instruction manuals on the SEC website:

3500 OI Basic Operators Guide.pdf

3500 OI Startup Basics Guide.pdf

StatCast.pdf

IV. INSTALLATION

1. Mounting Instructions:
    a. Find an accessible spot for the SEC 3500 to be mounted. This spot should have enough room for incoming/outgoing wires to be easily routed around. The SEC 3500 should be accessible at a regular height so the monitor can be easily accessed at all time alarms. Make sure the monitor is in a safe location in case of alarm.
    b. The SEC 3500 needs to be mounted on a solid wall
    c. Recommended Hardware:
        i. Use all 4 mounting brackets when mounting the SEC 3500
        ii. Bolts: minimum of ¼” – 20 thread, 1 ½” long
        iii. Nuts: ¼” – 20 Thread ½” Wide
        iv. Washers: Minimum 0.260” ID, 0.750” OD for washers between the bolt head and the SEC 3500. Maximum 0.375” ID, Minimum 1.50” OD for washers between mounting wall and bolt

2. The SEC 3500 requires an 18-29V DC power supply. **This power supply must cover Class 2 requirements as well as be UL 1310 approved**. Then run the power through the bottom-left hole of the SEC 3500 unit. Then connect the power supply to the DC-to-DC converter.

3. Run the RS485 (Data Highway) through the bottom-left side hole of the SEC 3500. Then attach to the data highway to the proper terminals on the terminal block.

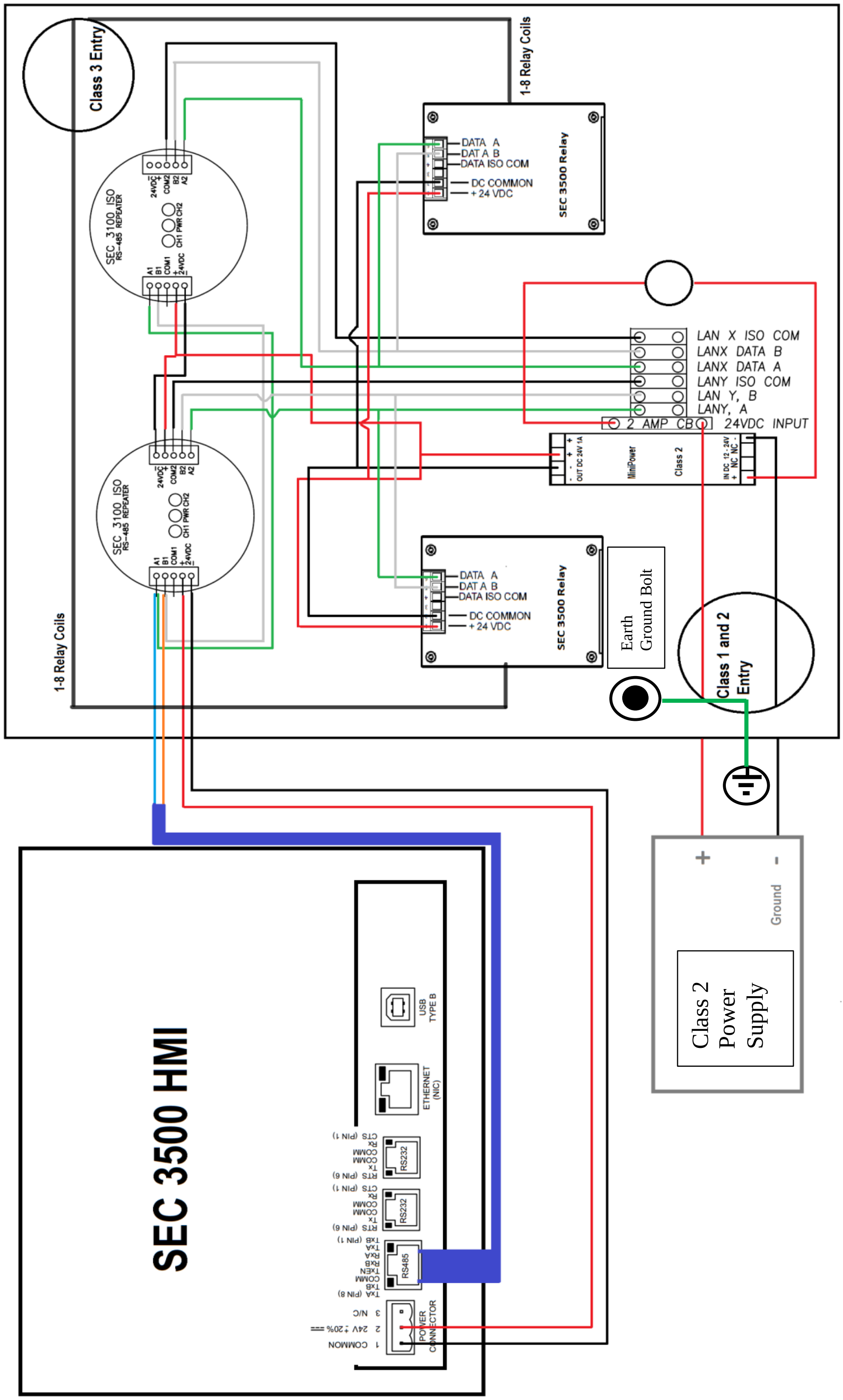
4. When connecting 120 VAC (Class 1) circuits to the SEC 3500, wires should be routed through the top-right opening. Then all class 2 and 3 power circuits going to the relay switches should go through the bottom-left opening. Class 1 wires must be kept at least 1/4”inches away from class 2/3 circuits.

5. Relay controller labeled 253 in the SEC3500 HMI housing has relay 1 designated for the alarm horn.
    a. The horn needs to be supplied with +24VDC.

6. Sensor Electronics recommends not connecting earth ground and DC common together. Instead connect earth ground to the bolt inside the enclosure. It is located inside the enclosure on the bottom left and is connected to the panel door.

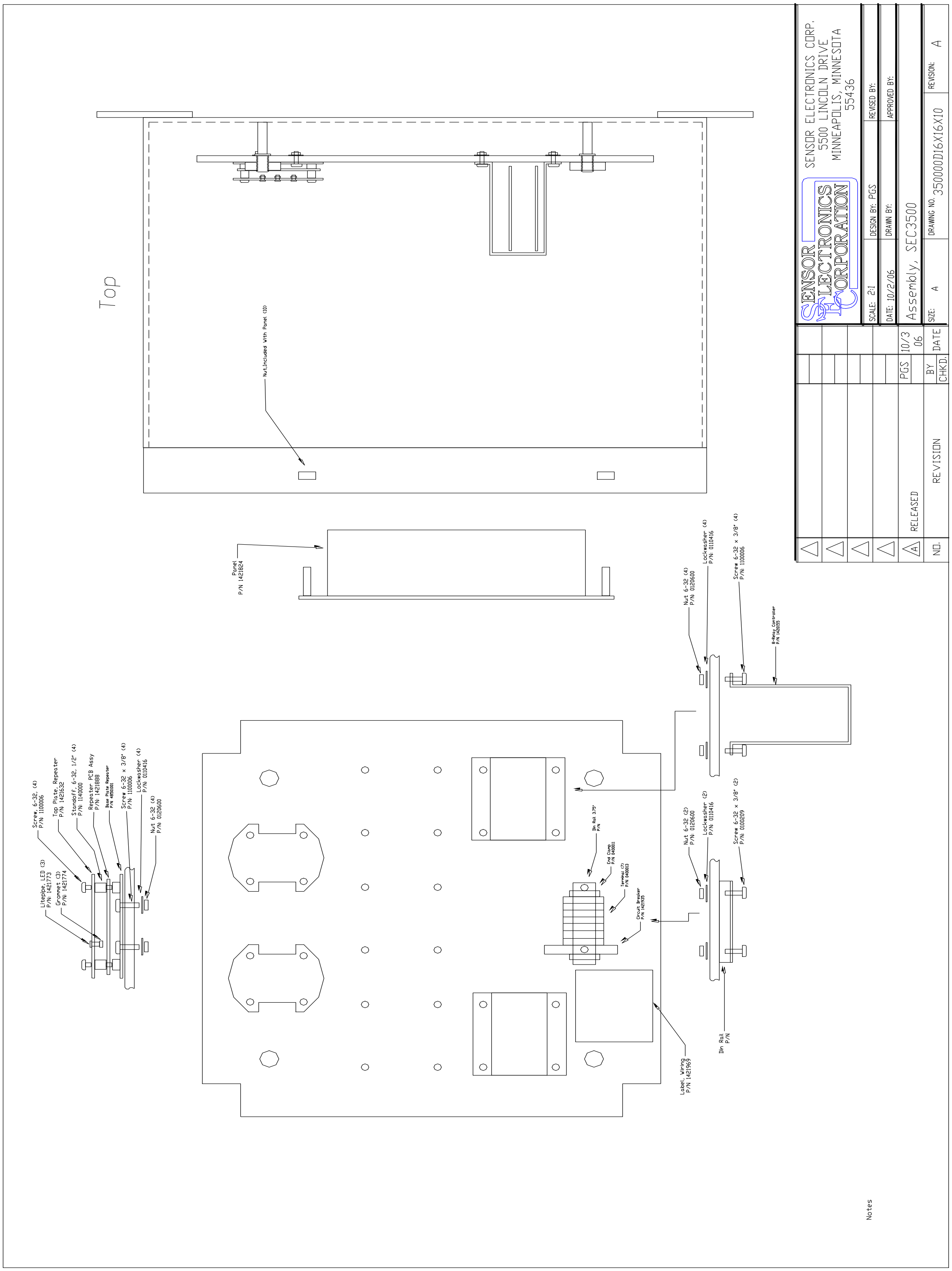
7. **For the UL2017 approval, all wiring that interconnects equipment must be located within the same room.**

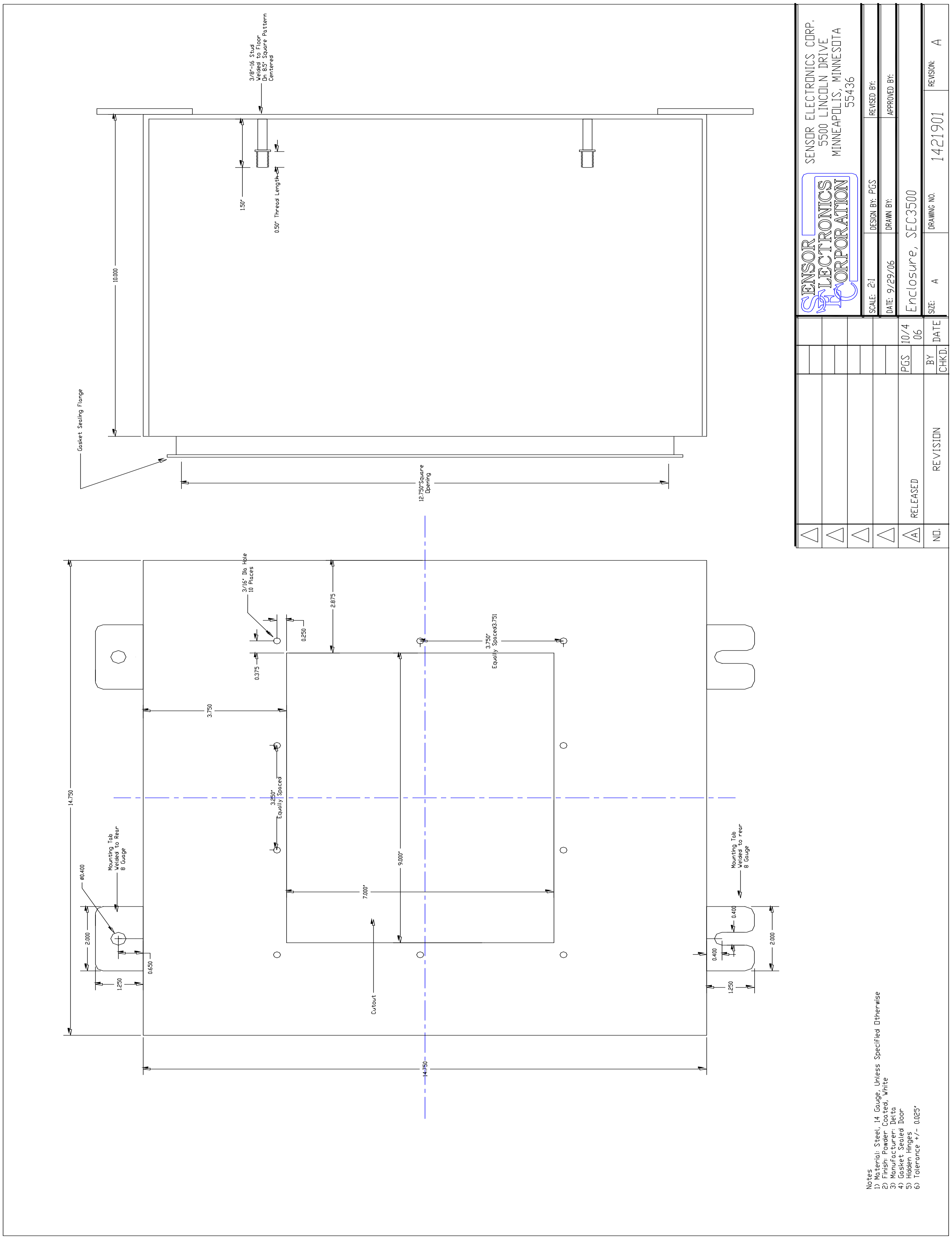
*NOTE: COM ON THE SEC 3100 ISO REFERS TO THE ISO COMMON, NOT DC COMMON



V. DRAWINGS

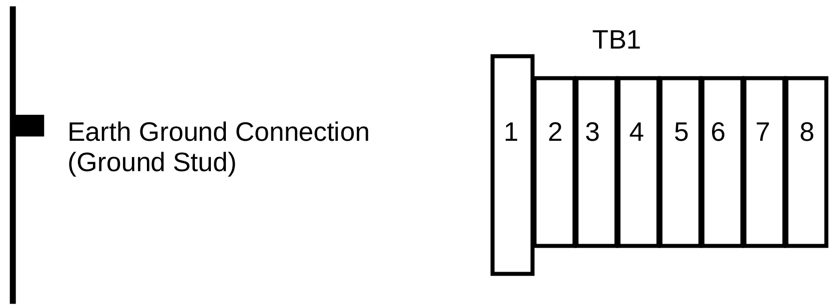
Part Number	Description
1421901	Mounting and Dimensional Drawing
350000016X16X10	Internal Component Layout
1460015 (separate document)	Overall Wiring Diagram
-	Wiring Examples


SENSOR ELECTRONICS CORP.
5500 LINCOLN DRIVE
MINNEAPOLIS, MINNESOTA
55436
SENSOR ELECTRONICS CORPORATION
SCALE: 2:1
DESIGN BY: PGS
REVISED BY:
DATE: 10/2/06
DRAWN BY:
APPROVED BY:
Assembly, SEC3500
SIZE: A
DRAWING NO. 3500000D16X16X10
REVISION: A
RELEASED
PGS
10/3 06
NO.
REVISION
BY CHKD.
DATE
Top
Panel P/N 1421824
Notes


SENSOR ELECTRONICS CORP.
5500 LINCOLN DRIVE
MINNEAPOLIS, MINNESOTA
55436
SCALE: 2:1
DESIGN BY: PGS
DATE: 9/29/06
Enclosure, SEC3500
SIZE: A
DRAWING NO. 1421901
REVISION: A
RELEASED
PGS
10/4 06
NO.
REVISION
BY CHKD.
DATE
Gasket Sealing Flange
12.750"Square Opening
3/8"-16 Stud Welded to Floor On 8.5" Square Pattern Centered
0.50" Thread Length
3/16" Dia Hole 10 Places
Mounting Tab Welded to Rear 8 Gauge
Cutout
Notes
1) Material: Steel, 14 Gauge, Unless Specified Otherwise
2) Finish: Powder Coated, White
3) Manufacturer: Delta
4) Gasket Sealed Door
5) Hidden Hinges
6) Tolerance +/- 0.025"

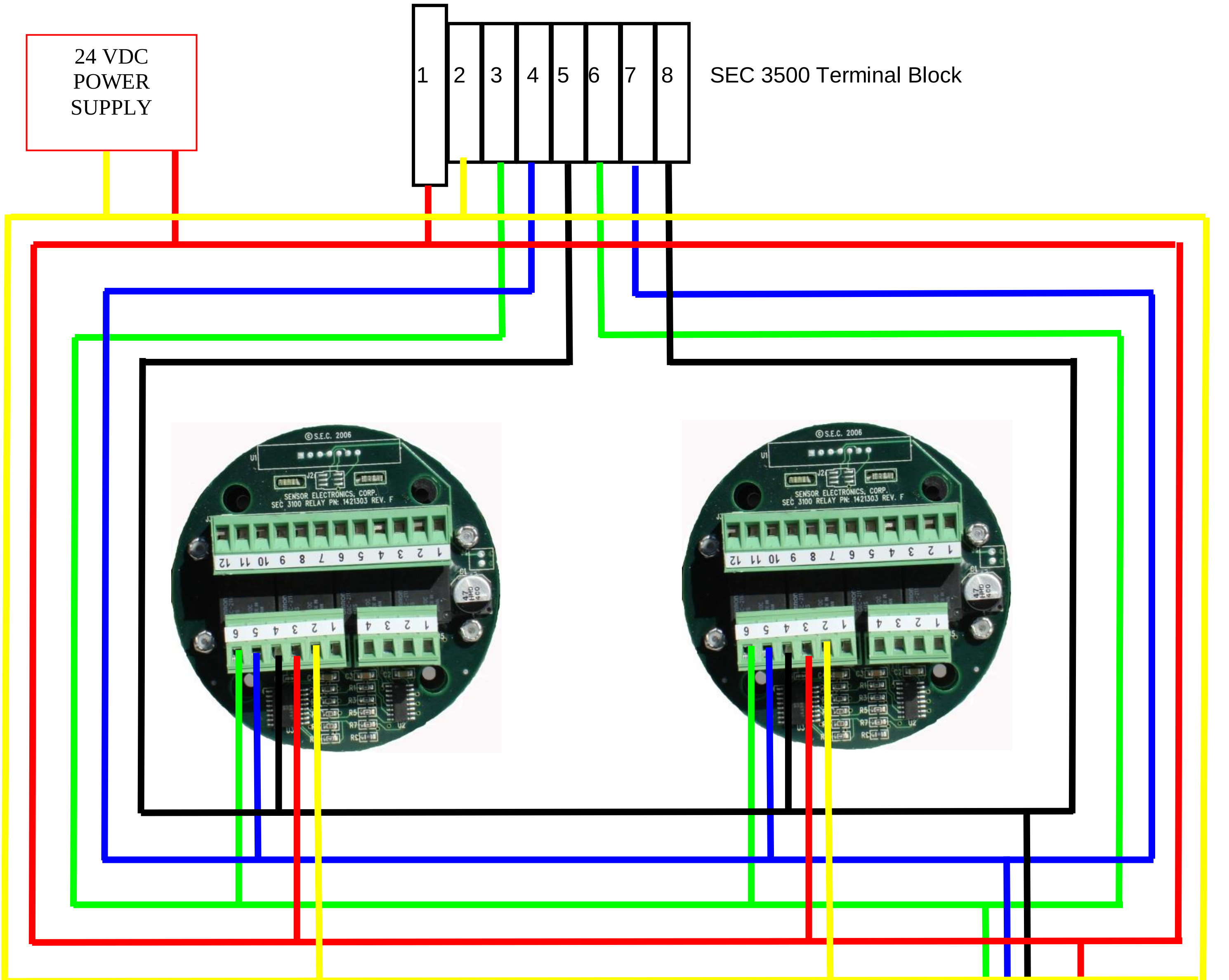
WIRING TERMINATION

The wiring diagram is for the input power to the SEC 3500 and RS485 Data Highway Connection.

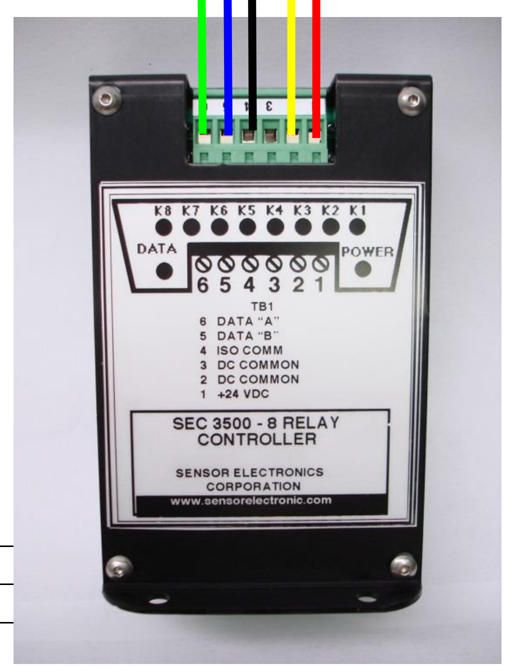


Enclosure Wall

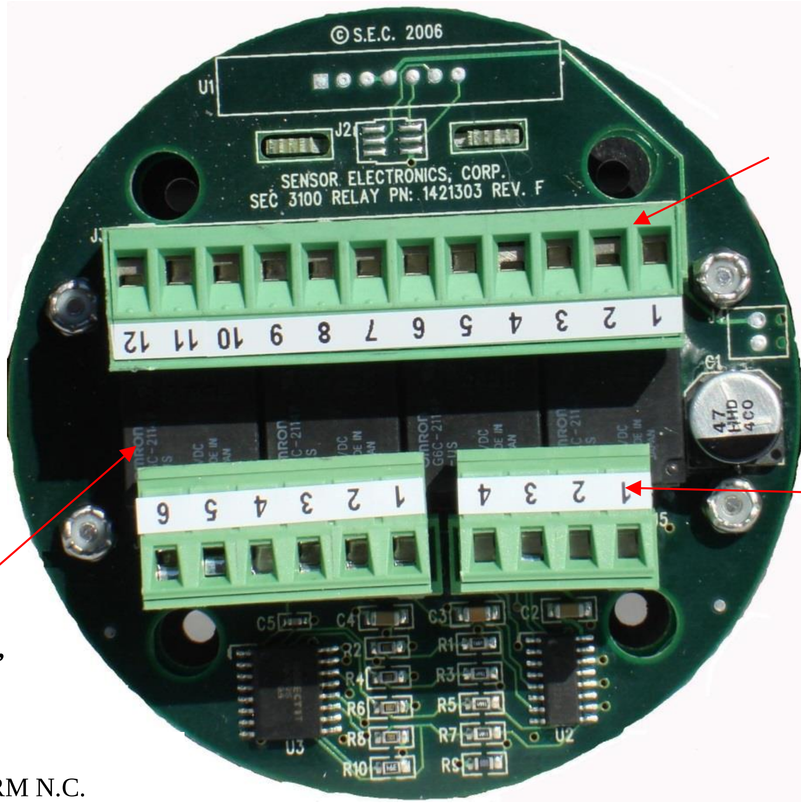
Terminal	Description:
1	2 AMP Circuit Breaker Power for SEC 3500 only
2	DC Common
3	LAN Y DATA A
4	LAN Y DATA B
5	LAN Y ISOLATED DC COMMON
6	LAN X DATA A
7	LAN X DATA B
8	LAN X ISOLATED DC COMMON



WIRING EXAMPLE:
SEC 3500 TO SEC 3100
TRANSMITTERS AND SEC 3500 – 8
RELAY CONTROLLER



SEC P/N: 1460014	
Rev / ECO: A / 000209	



TB 1 RELAY WIRING

TB 3 SENSOR WIRING

TB 2 POWER, DATA HWY, ANALOG OUTPUT

TB 1
(12) LOW ALARM N.C.
(11) LOW ALARM COMMON
(10) LOW ALARM N.O.
(9) MID ALARM N.C.
(8) MID ALARM COMMON
(7) MID ALARM N.O.
(6) HIGH ALARM N.C.
(5) HIGH ALARM COMMON
(4) HIGH ALARM N.O.
(3) FAULT (N.E.) N.C.
(2) FAULT (N.E.) COMMON
(1) FAULT (N.E.) N.O.

TB 2
(1) 4-20 mA ANALOG OUTPUT
(2) DC COMMON
(3) +24 VDC
(4) DATA ISO COMMON
(5) RS485 DATA B
(6) RS485 DATA A

TB 3
(1) WHITE
(DATA/CAL)
(2) BLUE OR GREEN
(4-20 mA)
(3) RED
(+24 VDC)
(4) BLACK
(DC COMMON)

SENSOR ELECTRONICS CORPORATION 12730 CREEK VIEW AVE SAVAGE, MINNESOTA 55378 USA (T) 952.938.9486 (F) 952.938.9617 sales@sensorelectronic.com	BACK VIEW OF SEC 3100 **SEC 3100 WIRING**

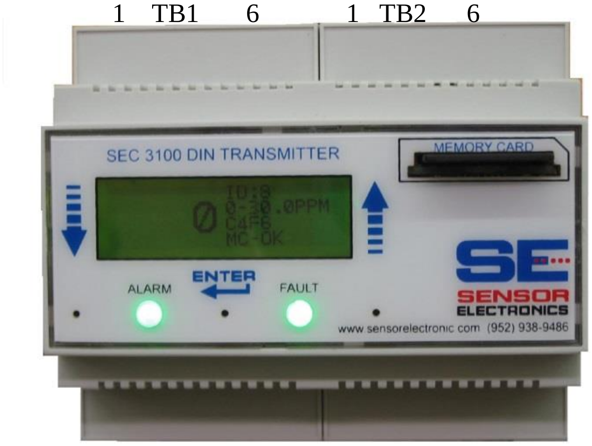
TB 1 Relay Wiring

1 High Alarm N.C.
2 High Alarm Common
3 High Alarm N.O.
4 Fault N.O.
5 Fault Common
6 Fault N.C.

TB 2 Relay Wiring

1 Low Alarm N.C.
2 Low Alarm Common
3 Low Alarm N.O.
4 Mid Alarm N.C.
5 Mid Alarm Common
6 Mid Alarm N.O.

1 TB1 6 1 TB2 6



1 TB5 4 1 TB6 6

TB 5 Sensor Wiring

1 DC Common (Black)
2 + 24 VDC (Red)
3 4-20 mA (Blue or Green)
4 Communication (White)

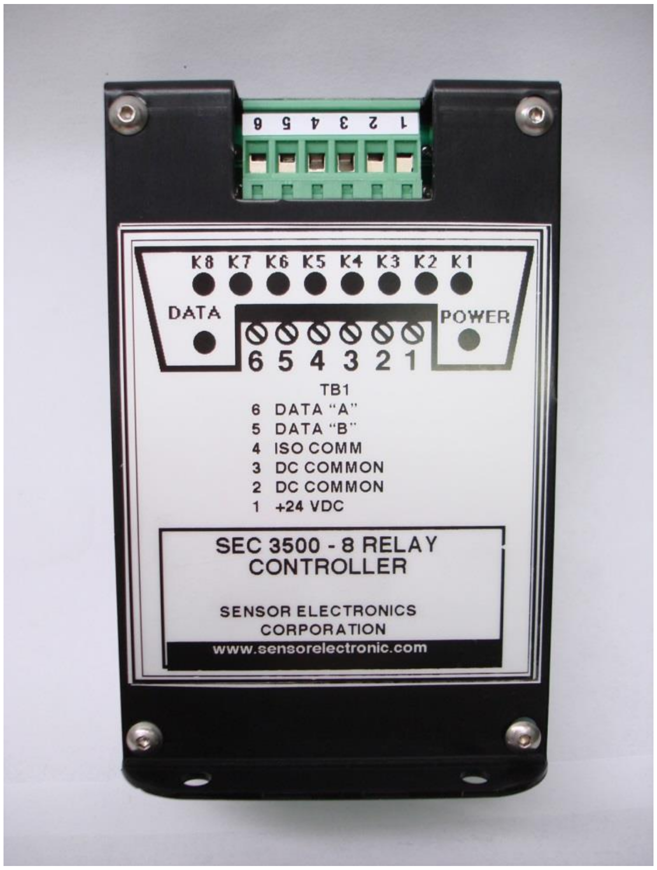
TB 6 Power / Data Wiring

1 Data A
2 Data B
3 Iso-Common
4 + 24 VDC Input Power
5 DC Common
6 4-20 mA Output

Housing Dimensions

3.54 (W) x 4.17 (L) x 2.28 (H) inches
{90 (W) x 106 (L) x 58 (H) mm}

SEC 3500-8 RELAY CONTROLLER



TB 1 (WIRING CONNECTION FOR POWER AND RS485)

TB 2 AND TB 3 (RELAY CONTACT WIRING)

SPECIFICATIONS

INPUT POWER: 10-30 VDC

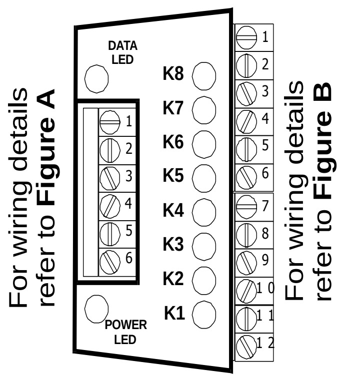
RELAY CONTACT RATING: 8 AMPS @ 250 VAC OR 8 AMPS @ 30 VDC

COMMUNICATION: ISOLATED RS485 (MODBUS)

WEIGHT: SEC 3500 – 8 RELAY CONTROLLER (PN 1421999) 2 LBS
SEC 3500 – 16 RELAY CONTROLLER (PN 1422182) 3 LBS

POWER: SEC 3500 – 8 RELAY CONTROLLER 4 WATTS @ 24 VDC
SEC 3500 – 16 RELAY CONTROLLER 6 WATTS @ 24 VDC

TOP VIEW OF SEC 3500 - 8 RELAY CONTROLLER



TOP VIEW OF SEC 3500 -16 RELAY CONTROLLER

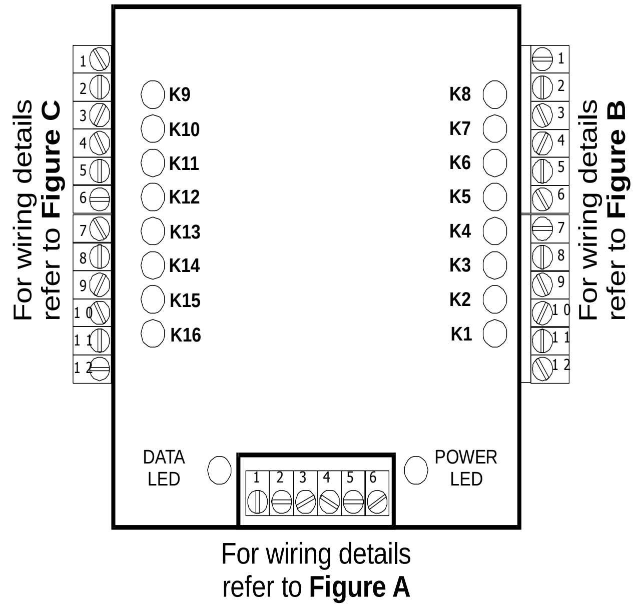


Figure A
(TB 1)

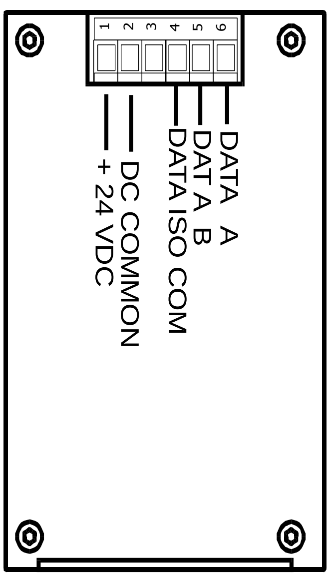


Figure B
TB 2 (K1-K4)
TB 3 (K5-K8)

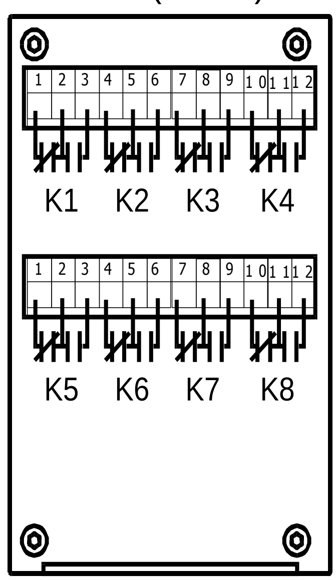
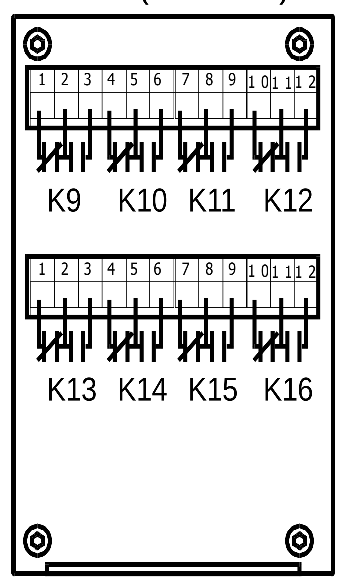
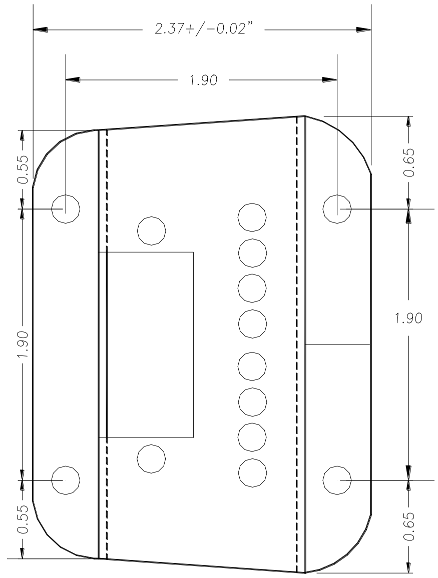


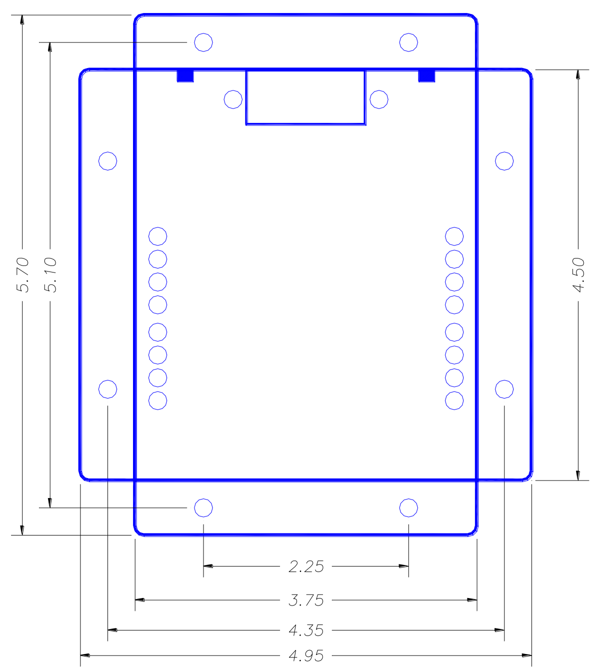
Figure C
TB 4 (K9-K12)
TB 5 (K13-K16)



SEC 3500-8 RELAY CONTROLLER DIMENSIONS



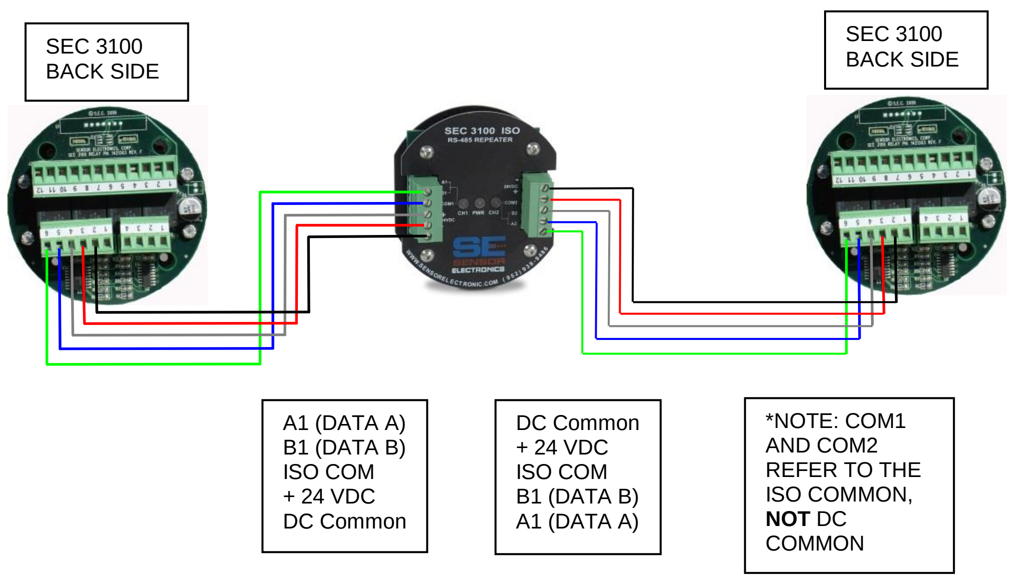
SEC 3500 – 16 RELAY CONTROLLER DIMENSIONS



SEC 3100 ISO
RS-485 Repeater Module

Operation

The SEC 3100 ISO RS-485 Repeater Module is used in conjunction with the SEC 3100 transmitters and the SEC 3500 HMI Operator Interface or other MODBUS RS-485 data highway systems. The SEC 3100 ISO RS-485 Repeater Module is used to extend the distance of the RS-485 network and increase the number of devices on the RS-485 network. The SEC 3100 ISO RS-485 Repeater Module provides 1500 volt isolation bidirectional data flow and transient suppression on the RS-485 data lines. An SEC 3100 ISO RS-485 Repeater Module should be installed for every 1000 feet of data highway cable or 32 network devices. The SEC 3100 ISO RS-485 Repeater Module is powered by 24 VDC and wired in line with the SEC RS-485 network devices. A typical wiring diagram is shown below:



SPECIFICATIONS

Operating Voltage 18-32 VDC	**Temperature Rating** -40° to + 70°C	**Humidity** 0-99% RH (non-condensing)
Operating Current 50mA @ 24VDC	**Input / Output (digital)** MODBUS RTU	**Part Number** 3100-000-REPEAT

SEC 3100 AIM
Analog Input Module

Operation

The SEC 3100 AIM is used in conjunction with the SEC 3100 explosion proof transmitter or SEC 3100 DIN transmitter. A non-SEC device with a conventional analog 4 - 20 mA output is wired to the SEC 3100 AIM. The SEC 3100 AIM receives a sourced 4 - 20 mA signal from the device, converts the analog signal into a digital signal compatible with the SEC 3100 transmitter. The SEC 3100 AIM is factory programmed with the following customer supplied variables:

Device Name
Range
Unit of Measure
Calibration Value

The SEC 3100 visually displays the variables on the LCD the same as if the SEC 3100 had an SEC gas detector connected. The SEC 3100 transmitter reports the foreign device status bidirectional to the SEC 3500 HMI Operator Interface via the MODBUS RS485 communication network. The SEC 3100 AIM can be installed in the SEC 3100 explosion proof transmitter housing using a taller window dome.

The SEC 3100 AIM accepts one device input. Examples of 4 - 20 mA devices that can be used with the SEC 3100 AIM are:

Open Path Gas Detectors
Fire Detectors
Temperature Transmitter
Pressure Transmitter
Pyrolyzers

SPECIFICATIONS

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
50mA @ 24VDC

Output (digital)
SEC SSP (Smart Sensor Protocol)

Temperature Rating
-40° to + 70°C

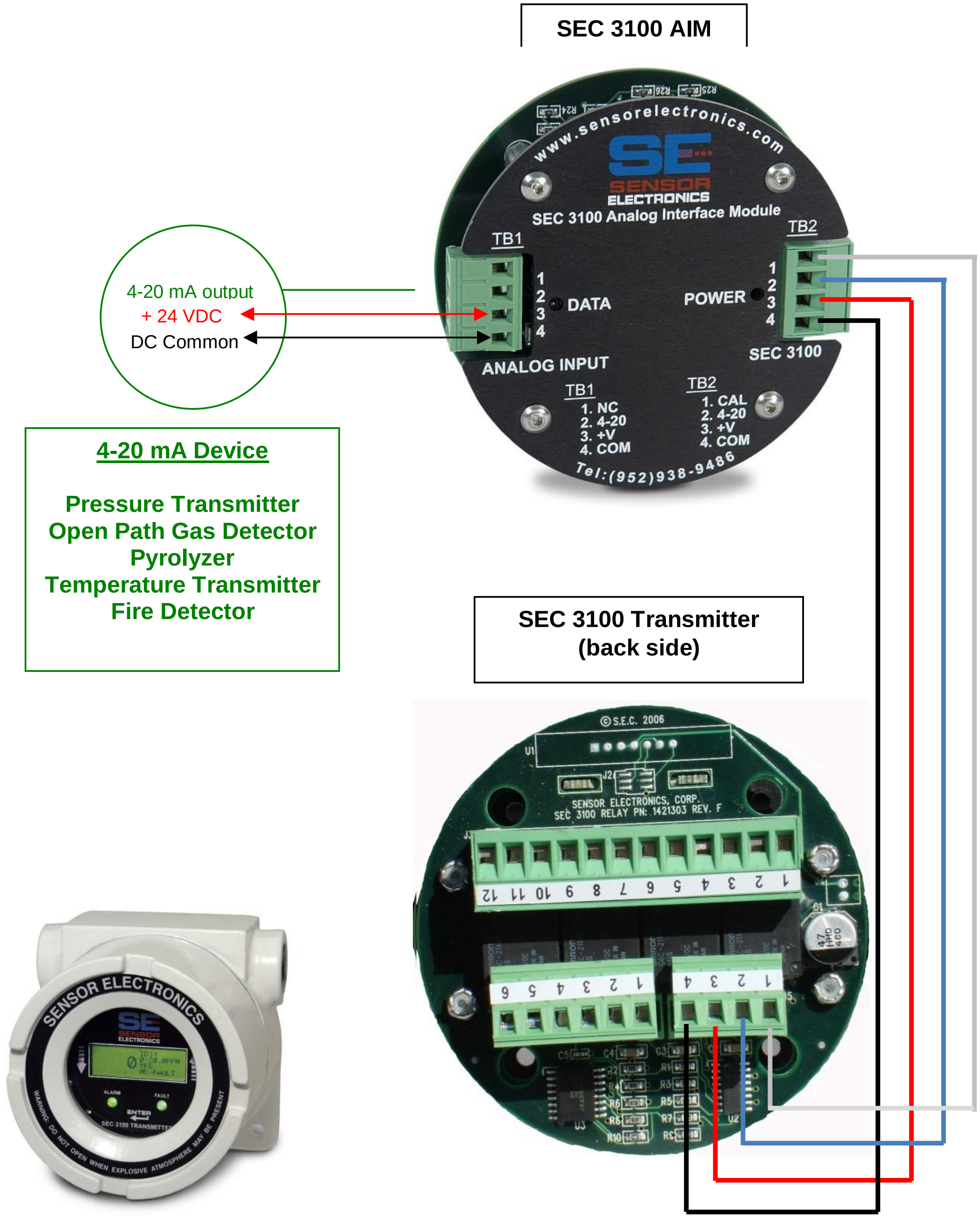
Humidity
0-99% RH (non-condensing)

Input
Low Alarm
High Alarm

Device Variable Characters
Device Name: 8
Range: 4
Unit of Measure: 4
Calibration Value: 4

(Standard ASCII Characters)

Part Number
3100-000-000-LIM



SEC 3100 Explosion Proof Transmitter

NOTE: Refer to the SEC 3100 Transmitter Instruction Manual for additional wiring connections.

SEC 3100 LIM
Logic Input Module

Operation

The SEC 3100 LIM is used in conjunction with the SEC 3100 explosion proof transmitter or SEC 3100 DIN transmitter. A non-SEC device with normally open contacts is wired to the SEC 3100 LIM. The SEC 3100 LIM receives a Low and High contact closure from the device, converts the input signal into a digital signal compatible with the SEC 3100 transmitter. The SEC 3100 LIM is factory programmed with the following customer supplied variables:

Device Name
Range
Unit of Measure
Calibration Value

The SEC 3100 visually displays the variables on the LCD the same as if the SEC 3100 had an SEC gas detector connected. The SEC 3100 transmitter reports the foreign device status bidirectional to the SEC 3500 HMI Operator Interface via the MODBUS RS485 communication network. The SEC 3100 LIM can be installed in the SEC 3100 explosion proof transmitter housing using a taller window dome.

The SEC 3100 LIM accepts one device input for Low Alarm and High Alarm. Examples of switch contact devices that can be used with the SEC 3100 LIM are:

Open Path Gas Detectors
Fire Detectors
Temperature Switch
Pressure Switch

Specifications

Operating Voltage
18-32 VDC

Operating Current (No Sensor)
50mA @ 24VDC

Output (digital)
SEC SSP (Smart Sensor Protocol)

Temperature Rating
-40° to + 70°C

Humidity
0-99% RH (non-condensing)

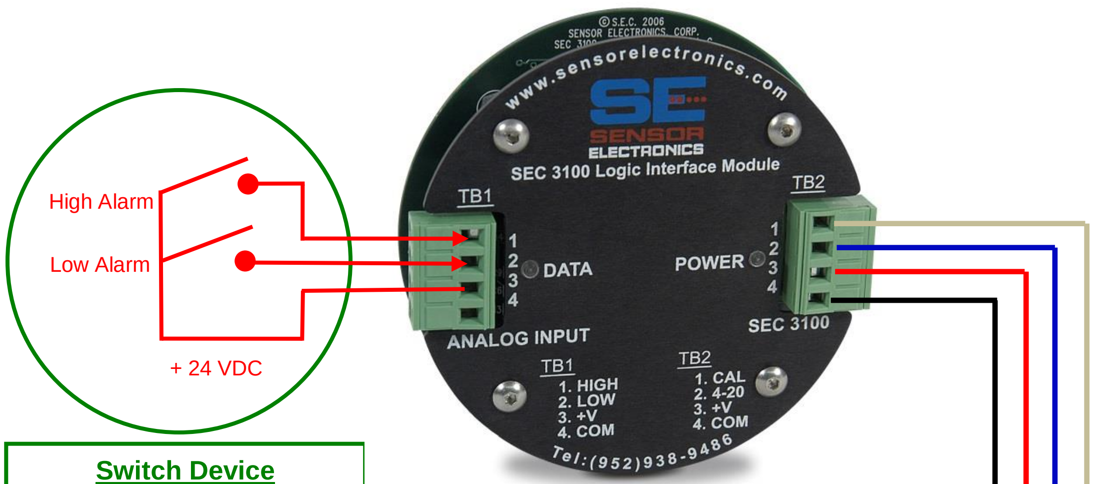
Input (analog)
Impedance: 200 Ω
Max applied voltage: 32 VDC

Device Variable Characters
Device Name: 8
Range: 4
Unit of Measure: 4
Calibration Value: 4

(Standard ASCII Characters)

Part Number
3100-000-000-AIM

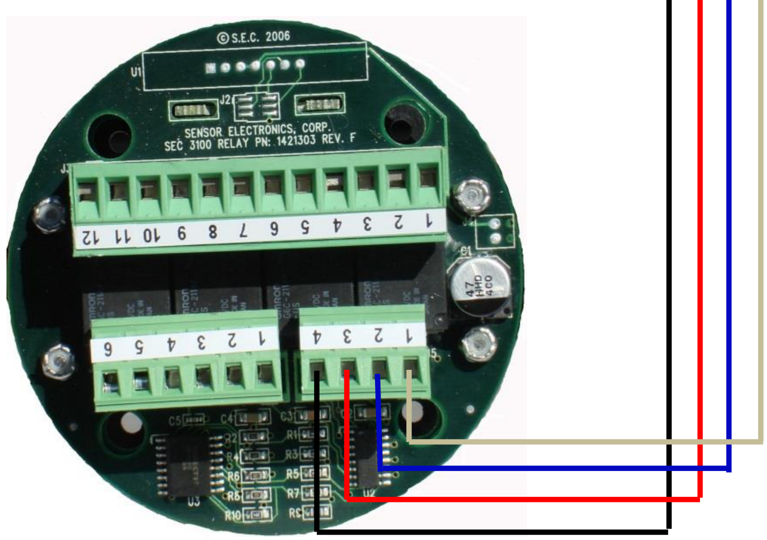
SEC 3100 LIM



Switch Device

Pressure Switch
Open Path Gas Detector
Air Flow Switch
Temperature Switch
Fire Detector

SEC 3100 Transmitter (back side)



SEC 3100 Explosion Proof Transmitter

NOTE: Refer to the SEC 3100 Transmitter Instruction Manual for additional wiring connections.

VI. TESTING

In order to test the system and its functions, Navigate to the 3100 Manual Control page and begin a device Self-Test. This will simulate the sensor going into Low, Mid then High alarm. As the sensor goes through these alarms the 3500 screen should show the sensor going into alarm and respond accordingly (turn fan on/siren/lights/etc.…) depending on the user's system settings and what the response to those alarms.

To keep an alarm on longer than the Self-Test runs or to leave an alarm on indefinitely, this can be done through the SEC 3500 OI. Navigate to the Relay Assignment page and set the desired relay to On. This will keep the alarm active until this is changed back.

VII. MAINTENANCE

Maintenance will need to be done by SEC personal. The maintenance needed is minimal. If issues arise and maintenance is needed, please contact Sensor Electronics at 952-938-9486.

SENSOR ELECTRONICS

SEC IREvolution™

Infrared
Ammonia Gas Detector

HART® COMMUNICATION PROTOCOL

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over ten years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Fast response time*
- *Smart calibration*
- *Self-compensating optics, pressure and temperature (U.S. Patents 6,414,310 and 7,132,657)*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant Ammonia background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output, HART® enabled*
- *Digital Display option available*

Applications

The **SEC IREvolution™** ammonia detectors are designed to be used as an upgrade in the same applications where electrochemical sensors have been applied.

- Refrigeration
- Power generation
- Compressors
- Cold storage
- Ice arena refrigeration room
- Anhydrous ammonia

Operation / Description

SEC IREvolution™ is a complete self contained optical ammonia gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC IREvolution™

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC 5000 IREvolution™ Infrared
Ammonia Gas Detector

Part Numbers and Ranges:

Range	Part Number
0-10% VOL	5100-013
0-1000 PPM	5100-012
0-2500 PPM	5100-011
0-10,000 PPM	5100-001

***Please note** that this list is not all-inclusive. The SEC IREvolution™ can be calibrated for most hydrocarbons, CO_2, NH_3, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Detection Method: Diffusion. Compatible with Optional Sample-Draw Accessories. (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 10 seconds
T90 < 20 seconds

Construction:
Anodized aluminum, 316 stainless steel

Accuracy:
+/- 5% of value or 0.5% of full scale

Repeatability:
+/- 2% of value

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

U.S. Patent: 6,414,310
7,132,657

Installation Category: Cat. I, Pollution Degree 2

Dimensions: Length 11” Diameter 2.75” Weight 3 lbs.
Length 5” Diameter 2.75” Weight 1.8 lbs.

Certification
CSA/NRTL Class 1, Div. 1, Groups A, B,C,D T5
IECEx Class 1, Zone 1, Group IIC - *Pending*

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.6 mA	Unit Fault
0.8 mA	Reference channel fault
0.9 mA	Analytical channel fault
0.7 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

Sensor Electronics Corporation
12730 Creek View Avenue, Savage, MN 55378 U.S.A. • (800) 285-3651 • (952) 938-9486 • FAX: (952) 938-9617
Email: sales@sensorelectronics.com • website: www.sensorelectronics.com

SE SENSOR ELECTRONICS

SEC IREvolution™

Infrared
Hydrocarbon Gas Detector

HART COMMUNICATION PROTOCOL

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over ten years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Anodized aluminum or stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Self-compensating optics, pressure and temperature (U.S. Patents 6,414,310 and 7,132,657)*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output, HART® enabled*
- *0 to 100% LFL detection range - %LEL, % Vol, PPM, Density*
- *Digital Display option available*

Applications

The **SEC IREvolution™** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries, process applications
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC IREvolution™ is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC IREvolution™

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC 5000 IREvolution™ Infrared
Gas Detector

Available Gases:

Propane	Propylene	Diflouromethane
Methane	n-Butane	Diesel
Gasoline	Ethanol	Isopropyl Alcohol
Ethylene	Methanol	DF 2000
Pentane	Ammonia	Green Earth
Cyclopentane	Jet A	Isobutane
Sulfur Hexafluoride (SF6)		PFC Gases

***Please note** that this list is not all-inclusive. The SEC IREvolution™ can be calibrated for most hydrocarbons, CO_2, NH_3, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Detection Method: Diffusion. Compatible with Optional Sample-Draw Accessories. (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 10 seconds
T90 < 20 seconds

Construction:
316 stainless steel or anodized aluminum

Accuracy:
+/- 5% of value or 0.5% of full scale

Repeatability:
+/- 2% of value

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

U.S. Patent: 6,414,310
7,132,657

Installation Category: Cat. I, Pollution Degree 2

Weight: 3.25 lbs. (1.5 kg.)

Dimensions: Length 4.75" Diameter 2.5"

Certification
CSA/NRTL Class 1, Div. 1, Groups A, B,C,D T5
IECEx Exdb IIC T5 Gb

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.6 mA	Unit Fault
0.8 mA	Reference channel fault
0.9 mA	Analytical channel fault
0.7 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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SEC 5000 *IR*Evolution Gas Detector

Instruction and Operation Manual

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Email: sales@sensorelectronics.com
Web site: www.sensorelectronics.com

Part Number 1460005
Revision C

Sensor Electronics Corporation

Sensor Electronics Corporation (SEC) designs and manufactures innovative fixed system gas detection equipment, for combustible gases, oxygen, carbon dioxide and toxic gases.

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.
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.

CONVENTIONS

The following conventions are used in this manual.

⚠	Warning Statement
⎓	VDC (DC Voltage)

Part Number 1460005
Revision C

Revision History

Rev	Date	Description of Change	Page
A	6/13/2016	Initial Release	All
B	9/29/2016	Update IEC marking to ETL, Change description to “Manual,SEC5000 Users Manual”	5
C	2/28/2017	Update Approved Models Add Drawing for 5200/5300 Series Add Drawing for 5210/5211 Series	5 15 16

Table of Contents

I. SPECIFICATIONS

Model:
Sensor Electronics Corporation SEC 5000 *IR*Evolution Infrared Gas Detector

Available gases:
Methane
Hexafluoro Butadiene
Difluoromethane
Methyl Fluoride
Ammonia

Please note *that this list is not all-inclusive. The SEC 5000 IR*Evolution *can be calibrated for many other gases, provided a calibration gas is available. For more please contact Sensor Electronics Corporation.*

Detection Method:
Diffusion

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

Response Time (Methane Version):
T50 < 15 seconds
T90 < 30 seconds

Construction:
316 stainless steel (SEC 5000)
6061 Aluminum (SEC 5100)

Dimensions: Length x Diameter
Stainless 5.5in x 2.5in
Aluminum 5.75in x 2.75in

Unit Weight:
Stainless Steel 3.7 lb
Aluminum 1.9 lb

Accuracy (Methane Version):
+/- 3% of Full Scale for applied gas concentrations up to 50% of full scale
+/- 5% of Full Scale for applied gas concentrations above 50% of full scale

Operating Temperature Rating:
-40° to +70°C at 0 to 99% RH (non-condensing)

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

Power Consumption: 5.1 Watts Max.

Max. Current Draw: (at 24 VDC)
Average: 210 mA (Peak: 400 mA)

Approvals: APPROVED MODELS ONLY: 5000/5100
CSA, For -40°C to +50°C operation, Performance Tested C22.2 No. 152
CSA: Cl I, Div 1, Grps B,C,D, T5
IECEx ETL 16.0034X: Ex d_b IIC T5 G_b

Installation Category: Cat. I, Pollution Degree 2

II GENERAL DESCRIPTION

The SEC 5000 *IR*Evolution Infrared gas detector is a rugged reliable microprocessor based intelligent gas detector. The SEC 5000 can be used to monitor for explosive Hydrocarbons, Alcohols, PFCs, Ammonia and many others.
The SEC 5000 *IR*Evolution is ideally suited for use in harsh environments and where the costs of required maintenance for conventional catalytic or electrochemical detectors are prohibitive. The SEC 5000 *IR*Evolution Infrared gas detector will perform reliably in the presence of silicone and other catalytic poisoning agents and can also operate in oxygen free environments or where high background gas levels are present. There are no known poisons that affect this technology.

The SEC 5000 *IR*Evolution is a stand-alone device providing a linear continuous 4 to 20 mA output representing 0 to Full Scale.

~~The SEC5000 also provides a one-wire interactive digital interface and an optional HART interface.~~

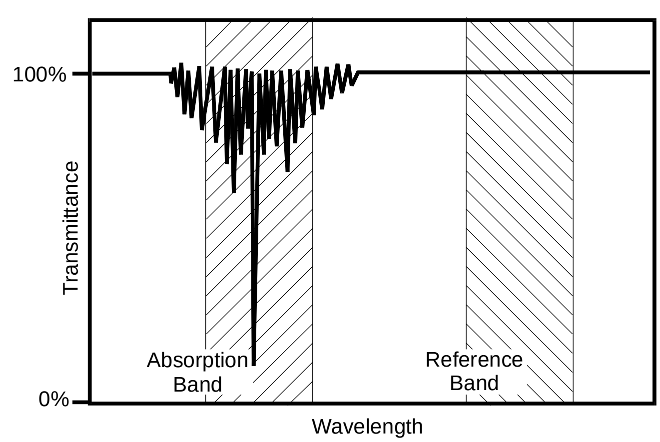
Features

- Requires no routine calibration to ensure proper operation.
- Continuous self-test automatically indicates a fault, with fail to safe operation.
- A multi-layered filtering system protects optics from dirt and water ingress.
- Straight optical path eliminates the need for reflective surfaces, such as mirrors or beam splitters.
- Performs well in the presence of high concentrations or constant background levels of hydrocarbons and in oxygen depleted atmospheres.
- Highly resistant to poisoning and etching.
- Standard 4 to 20 mA output (current source)
- Explosion proof housing designed for harsh environments.
- Smart Calibration AutoAC™ circuit.

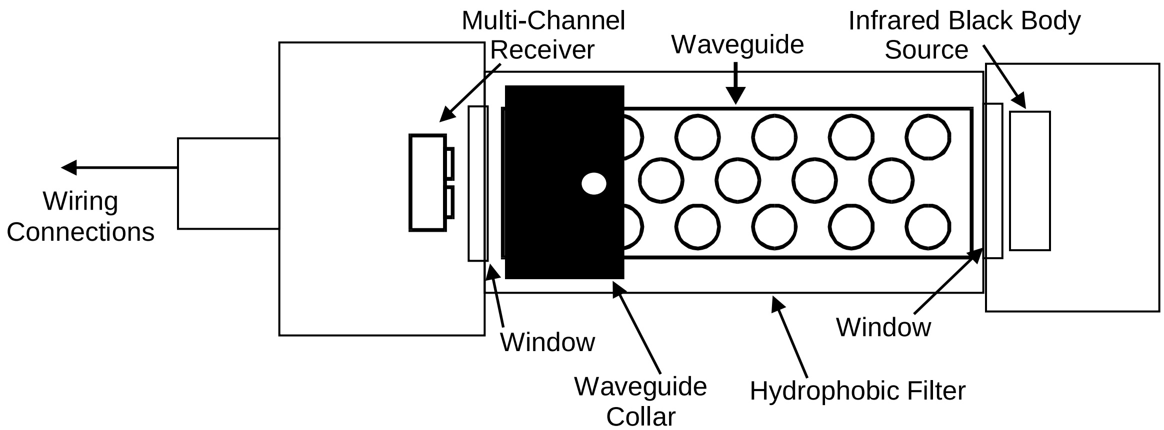
Infrared Detection Technology

The SEC 5000 *IR*Evolution Infrared gas detector uses infrared absorption technology for detecting combustible hydrocarbon gases. Gases absorb infrared light only at certain wavelengths. The concentration of a gas can be quantified by measuring and comparing intensities in light bands where there is significant absorption by the target gas and in bands where there is little absorption by the target gas. The SEC 5000 *IR*Evolution uses an infrared light source that passes collimated light through a waveguide containing the gas sample. At the other end of the waveguide is a multiple channel receiver. The measuring channel intensities and the reference channel intensities are then analyzed to quantify the gas concentration. The gas concentration is then represented at the output as a gas density measurement or a %Vol measurement/PPM measurement (selectable).

Infrared Absorption Spectrum Example



The multiple-channel receiver consists of several filtered light sensors monitoring light bands critical to the target gas. The multi-channel design affords high sensitivity, high selectivity, excellent drift control and superior thermal stability over the entire temperature range.



The straight line optical system eliminates the need for any special lenses or beam splitters.

The SEC 5000 *IR*Evolution utilizes a unique patent pending feature, the AutoAC™ circuit. The AutoAC™ circuit is an automatic analog control circuit, which allows the SEC 5000 *IR*Evolution to be calibrated for any combustible hydrocarbon, provided that a calibration quality level of the gas is available. This eliminates setting dipswitches or changing out sensors for different types of hydrocarbons; simply calibrate the unit with a calibration gas of the specific gas to be detected.

The optics can be easily disassembled for cleaning. This does not require powering the unit down and does not compromise the units' explosion proof rating. The device will self-compensate for dirty optics until a point at which the optical surfaces are completely obscured.

There are no consumable components contained in this product.

III. OPERATION

Installation and Startup

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC 5000 *IR*Evolution. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC 5000 *IR*Evolution be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air or for vapors resulting from flammable liquid spills. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.

- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.

- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.

- The sensor should be accessible for maintenance.

- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices.

The SEC 5000 *IR*Evolution has a ¾" NPT threaded connector for mounting the detector to a certified explosion proof junction box. The thread engagement shall be at least 5 full threads. Corrosion inhibiting grease may be used if it is non-setting and as long as earthing/grounding between the certified metallic junction box and detector is maintained.

The bonding connection on the cap of the detector must provide an effective connection for earthing/grounding. This is done by using a conductor of at least 4 mm^2. It is acceptable to use suitable wiring lugs for installation if necessary.

SEC can provide a junction box with terminals for this purpose. A conduit seal must be installed within 18" of the detector for use of approved units..

A user-supplied junction box can be used providing it has the appropriate sized NPT conduit entries. The junction box and terminal blocks must be suitable for use in the application and location in which it is being installed. After the device has been installed, a calibration is required. Refer to the Calibration section of this manual.

Wiring connections

Red wire: 18 to 32 VDC ⎓
Black wire: DC Common
Blue wire: 4 to 20 mA output
White wire: Smart Calibration Wire (data wire)
Earth Ground: 10-32 Green Ground Screw on *IR*Evolution cap, see figure 1.

Wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG (rated at least 8°C above max. ambient)
501 to 1000 feet, recommended wire gauge size 14 AWG (rated at least 8°C above max. ambient)

Shielded cable is recommended. Wiring should be installed in metal conduit with no other cabling in the same conduit.

Warm-up

When power is applied to the detector, it enters a one (1) minute warm-up mode. The output current will be 4.0 mA during the warm up time period. At the end of the warm-up period with no faults present, the detector automatically enters the normal operating mode (4-20mA). If a fault is present after warm-up, the detector current output will indicate a fault. See the following chart for fault code status.

Normal Operation

In the normal operating mode, the 4 to 20 mA signal levels correspond to the detected gas concentration. The detector continuously checks for system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC 5000 *IR*Evolution is a non-isolated current source.

Current Output and Corresponding Status

Current Output	Status.
0.6 mA	Unit Fault
4.0 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
2.4 mA	Reference Channel Fault
2.6 mA	Analytical Channel Fault
4.0 mA	Zero gas level (0% F.S.)
5.6 mA	(10% Full Scale)
8.0 mA	(25% Full Scale)
12 mA	(50% Full Scale)
16 mA	(75% Full Scale)
20 mA	Full scale (100% F.S.)
>20 mA	Over-range (> 100% F.S.)

CAUTION: HIGH OFF-SCALE READINGS
(READINGS GREATER THAN 20mA) MAY
INDICATE AN EXPLOSIVE CONCENTRATION

Once the fault is cleared the SEC 5000 *IR*Evolution will automatically resume normal operation.

IV. CALIBRATION

The SEC 5000 *IR*Evolution is factory calibrated zeroed and spanned. *Unlike catalytic sensors it does not require routine span gas calibration to ensure proper operation.*

A typical field calibration only requires the use of zero air (or 99.99% nitrogen). *If the sensor is located in an area that is known to be free of the target gases then ambient air can be used as a zero reference.*

If zero air is used for the calibration, there is a fitting at the side of the sensor for a 1/8" ID tubing connection.

Zero Calibration

Before beginning calibration use the SEC 5000 *IR*Evolution Insulation Tube to cover outer cylinder holes and connect a clean air source to the sensor's calibration port for a minimum of 3 minutes. To enter into the calibration mode, the calibration (white) wire must be connected to the DC Common (black) wire for ten (10) seconds, upon release the sensor will automatically enter the zero calibration routine. The electronics will automatically adjust the sensor's signal to the new zero reference level. During the zero calibration routine, the current output of the SEC *IR*Evolution will go to 2.2 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the zeroing procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from common, the SEC 5000 *IR*Evolution will ignore the signal and continue operation as normal. If the SEC5000 is connected to an SEC transmitter, the Zero operation can also be initiated by the transmitter from the Calibration menu. The calibration wire initiation is only used if no transmitter in connected

Span Calibration

The SEC *IR*Evolution can also be spanned in the field. Initiating the Spanning operation is similar to initiating the Zeroing operation other than the calibration wire is connected to the +24V (red) wire for 10 seconds and released. The Span initiation command is also available at the transmitter from the calibration menu. The output current will go to 2.0mA while the unit is spanning.
It is highly recommended that a Zero be performed prior to a Span.
The spanning concentration for the SEC5000 is always ½ of the full scale concentration.
Please contact the factory for further details.

V. MAINTENANCE

The SEC 5000 *IR*Evolution does not normally require cleaning of the optics. However if the unit is operating in a very dirty or dusty environment the optical path might become obscured. If the obscuration is severe enough to affect the unit's accuracy, the unit will indicate an "Optics Fault". To clear an Optics Fault, first try a calibration. If the calibration does not correct the fault condition, clean the optics.

The outer barrel can be removed by loosening the two screws at the top of the barrel and rotating barrel slightly clockwise until barrel can be pulled free. You will then see the hydrophobic filter. The hydrophobic filter is a Teflon coated stainless steel mesh that keeps moisture and particulates out of the optical path. The top of the filter snaps into a groove in the housing and is located by a pin in the housing. Pulling the filter free of the groove allows the filter to be removed. Once the hydrophobic filter is removed, the internal waveguide tube should be inspected for cleanliness. The waveguide and waveguide collar can be removed by inserting rigid instruments such as Allen wrenches into one hole of the waveguide and one hole of the collar. Turning the collar counterclockwise with respect to the tube will loosen the waveguide allowing the collar to be screwed down on to the waveguide until it can be removed from the SEC 5000 *IR*Evolution housing. This will allow access to the windows of the SEC 5000 *IR*Evolution for cleaning.

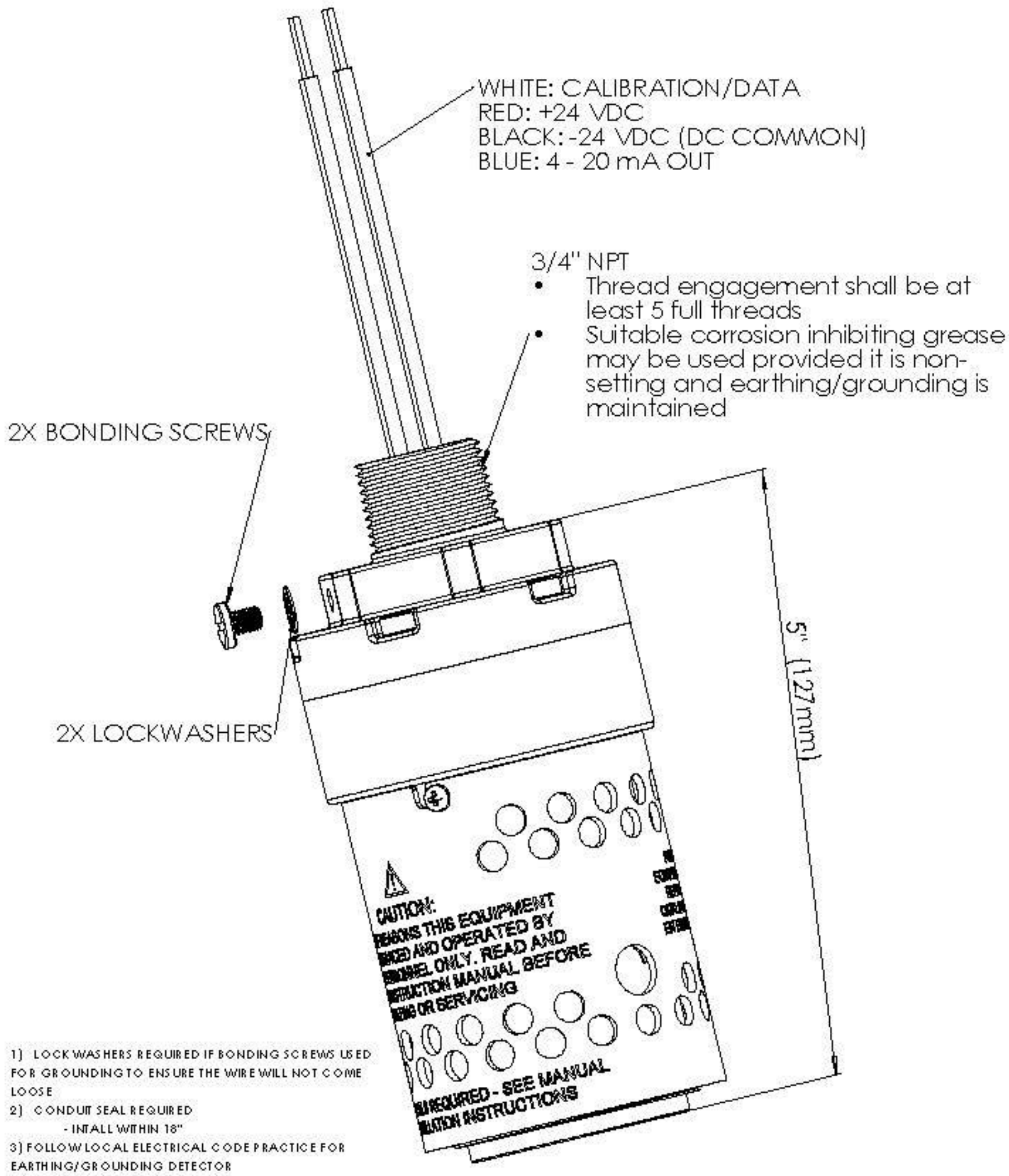
Dust can be removed using compressed air. Hard or oily deposits can be removed using Isopropyl alcohol and cotton tipped swabs. Wipe any film or residue left by the alcohol on the windows with a clean dry cotton swab. The internal electro-polished wave-guide tube can be cleaned the same way. Be careful not to leave any particles of the cleaning swab in the waveguide. The waveguide holes can collect pieces of the cleaning swab.

After reassembling the unit (the waveguide and collar should be very tight to both ends of the SEC 5000 *IR*Evolution housing. Once the unit is completely reassembled and power is reapplied, the SEC 5000 *IR*Evolution must then be Zero calibrated. Refer to the calibration section of this manual.
If the fault doesn't clear, contact the factory.

⚠**Warning: The SEC 5000 IR Evolution detector's flameproof joints are not intended to be repaired.**

VI. Parts List

Part Number	**Description**
142-2188	Replacement Hydrophobic Filter
142-2409	Wave Guide Tube
142-2408	Wave Guide Tube Collar



1) LOCK WASHERS REQUIRED IF BONDING SCREWS USED FOR GROUNDING TO ENSURE THE WIRE WILL NOT COME LOOSE
2) CONDUIT SEAL REQUIRED
- INTALL WITHIN 18"
3) FOLLOW LOCAL ELECTRICAL CODE PRACTICE FOR EARTHING/GROUNDING DETECTOR

APPROVALS:		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL± ANGULAR: MACH ±1° BEND ± TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005		NAME	DATE
SCHEMATIC	N/A		DRAWN	C. PETERS	02/2013
PWB RAW	N/A		CHECKED		
CERT DWG	5100-000EX		MFG APPR.		
CERT DWG REV	B	MATERIAL	PROPRIETARY AND CONFIDENTIAL		
NEXT ASSY	N/A	FINISH	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SENSOR ELECTRONICS CORP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SENSOR ELECTRONICS CORP. IS PROHIBITED.		
USED ON	SEC5100				
APPLICATION		DO NOT SCALE DRAWING			

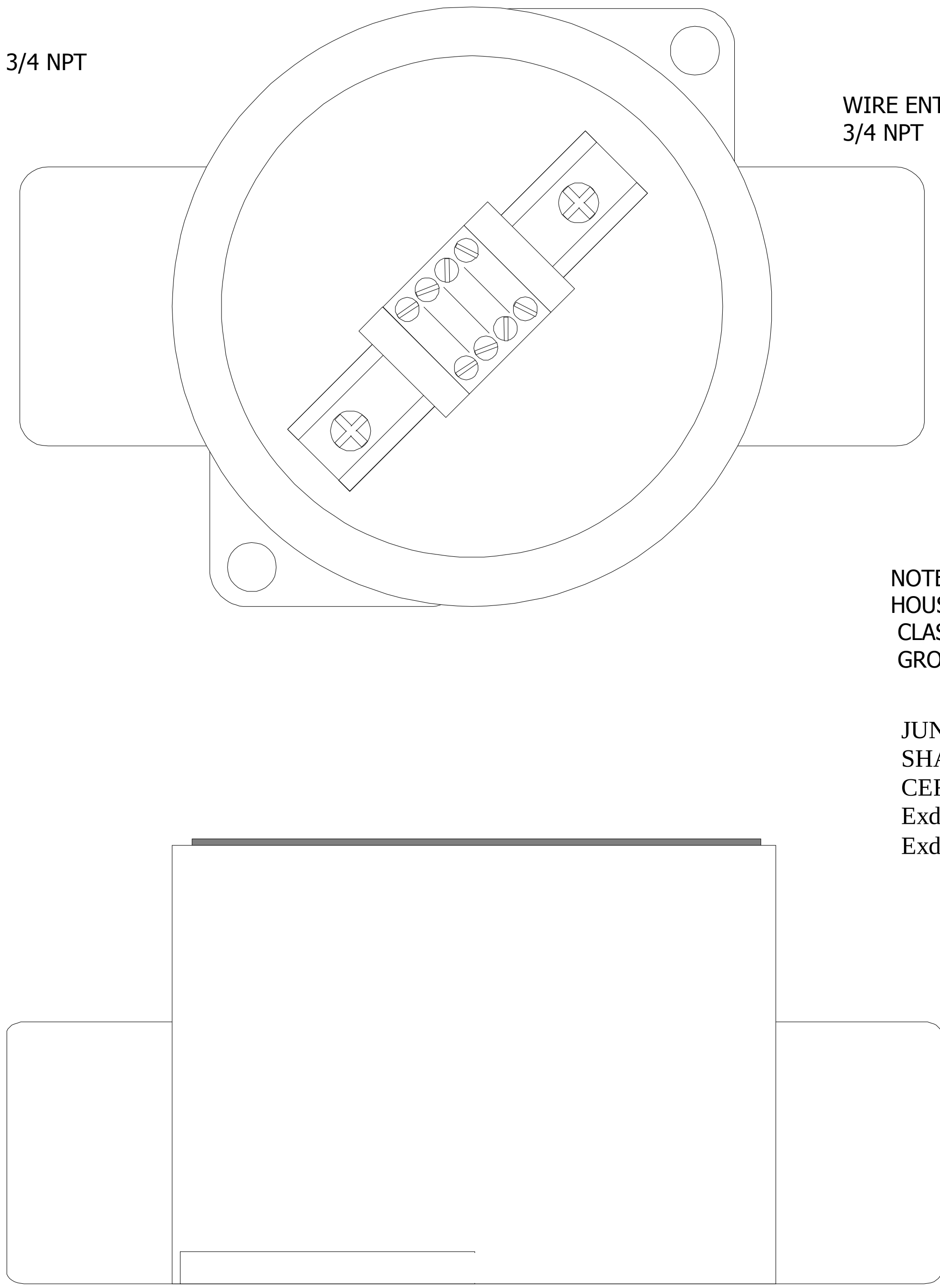
SENSOR ELECTRONICS

Sensor Electronics Corp.
12730 Creek View Ave
Savage, Minnesota 55378

SEC5000 WIRING DIAGRAM

SIZE A | DWG. NO. FIGURE 1 | REV. -

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1



NOTE:
HOUSING RATED FOR
CLASS 1, DIV 1,
GROUPS B, C AND D

JUNCTION BOX
SHALL BE IEC
CERTIFIED
Exd IIC
Exd_b IIC

SENSOR ELECTRONICS CORPORATION

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12730 Creek View Ave
Savage, MN 55378
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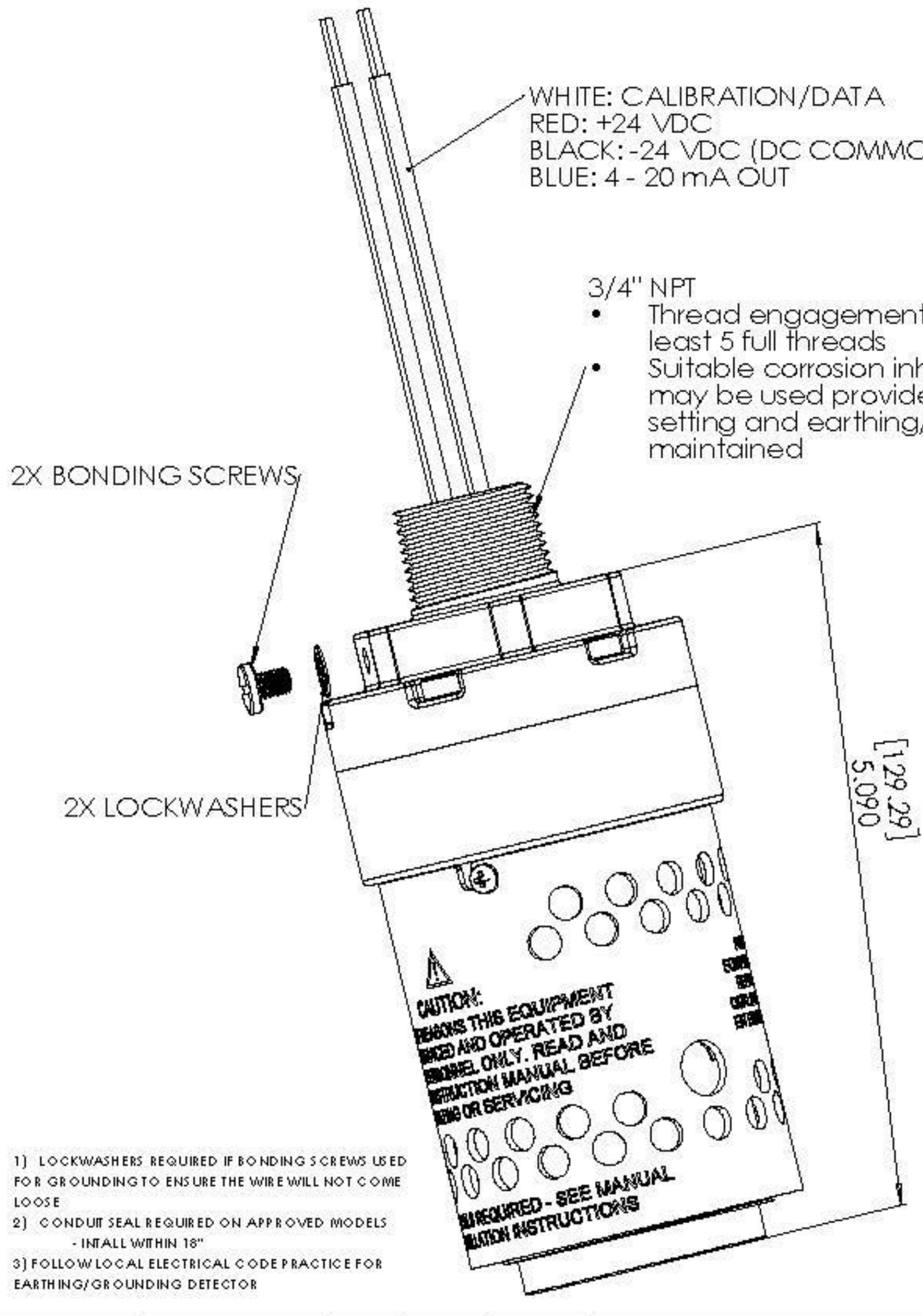
Fax: (952) 938-9617
sales@sensorelectronics.com

SEC SENSOR
SEPARATION KIT

FIGURE 2



1) LOCKWASHERS REQUIRED IF BONDING SCREWS USED FOR GROUNDING TO ENSURE THE WIRE WILL NOT COME LOOSE
2) CONDUIT SEAL REQUIRED ON APPROVED MODELS
- INTALL WITHIN 18"
3) FOLLOW LOCAL ELECTRICAL CODE PRACTICE FOR EARTHING/GROUNDING DETECTOR

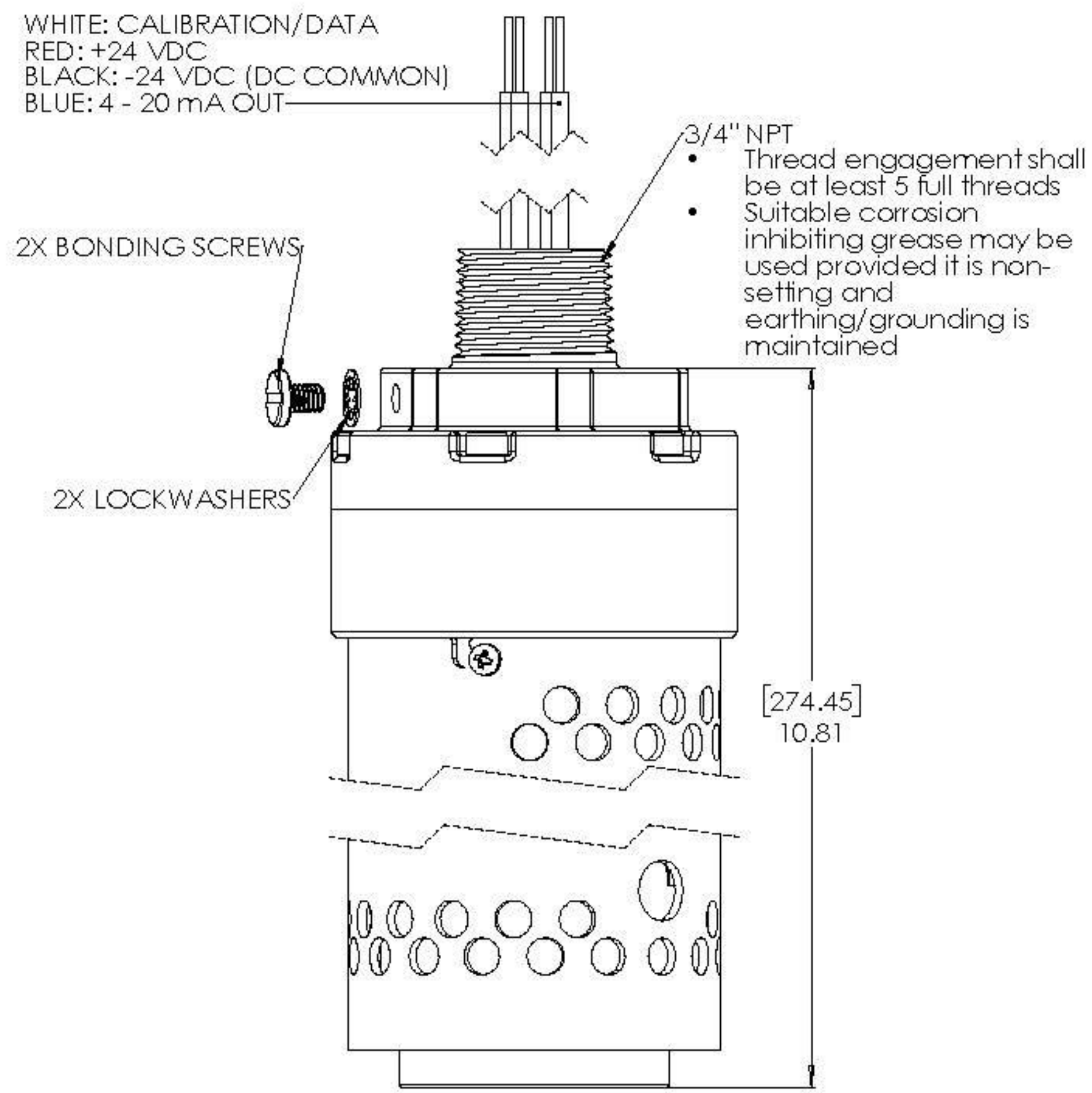
APPROVALS:		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL± ANGULAR: MACH ±1° BEND ± TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005		NAME	DATE
			DRAWN	J.ECKLEIN	02/2017
SCHEMATIC	N/A		CHECKED		
PWB RAW	N/A		MFG APPR.		
CERT DWG			PROPRIETARY AND CONFIDENTIAL		
CERT DWG REV		MATERIAL	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SENSOR ELECTRONICS CORP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SENSOR ELECTRONICS CORP. IS PROHIBITED.		
NEXT ASSY		FINISH			
USED ON	SEC5200/5300				
APPLICATION		DO NOT SCALE DRAWING			

SENSOR ELECTRONICS

Sensor Electronics Corp.
12730 Creek View Ave
Savage, Minnesota 55378

SEC5200/5300 WIRING DIAGRAM

SIZE	DWG. NO.	REV.
A	FIGURE 3	-
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1



1. LOCKWASHERS REQUIRED IF BONDING SCREWS USED FOR GROUNDING TO ENSURE THE WIRE WILL NOT COME LOOSE
2. CONDUIT SEAL REQUIRED ON APPROVED MODELS
   - INSTALL WITHIN 18"
3. FOLLOW LOCAT ELECTRICAL CODE PRACTICE FOR EARTHING/GROUNDING DETECTOR

APPROVALS:		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL± ANGULAR: MACH ±1° BEND ± TWO PLACE DECIMAL ±0.10 THREE PLACE DECIMAL ±0.005		NAME	DATE
			DRAWN	J.ECKLEIN	02/2017
SCHEMATIC	N/A		CHECKED		
PWB RAW	N/A		MFG APPR.		
CERT DWG			PROPRIETARY AND CONFIDENTIAL		
CERT DWG REV		MATERIAL	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SENSOR ELECTRONICS CORP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SENSOR ELECTRONICS CORP. IS PROHIBITED.		
NEXT ASSY					
USED ON	SEC5200/5300	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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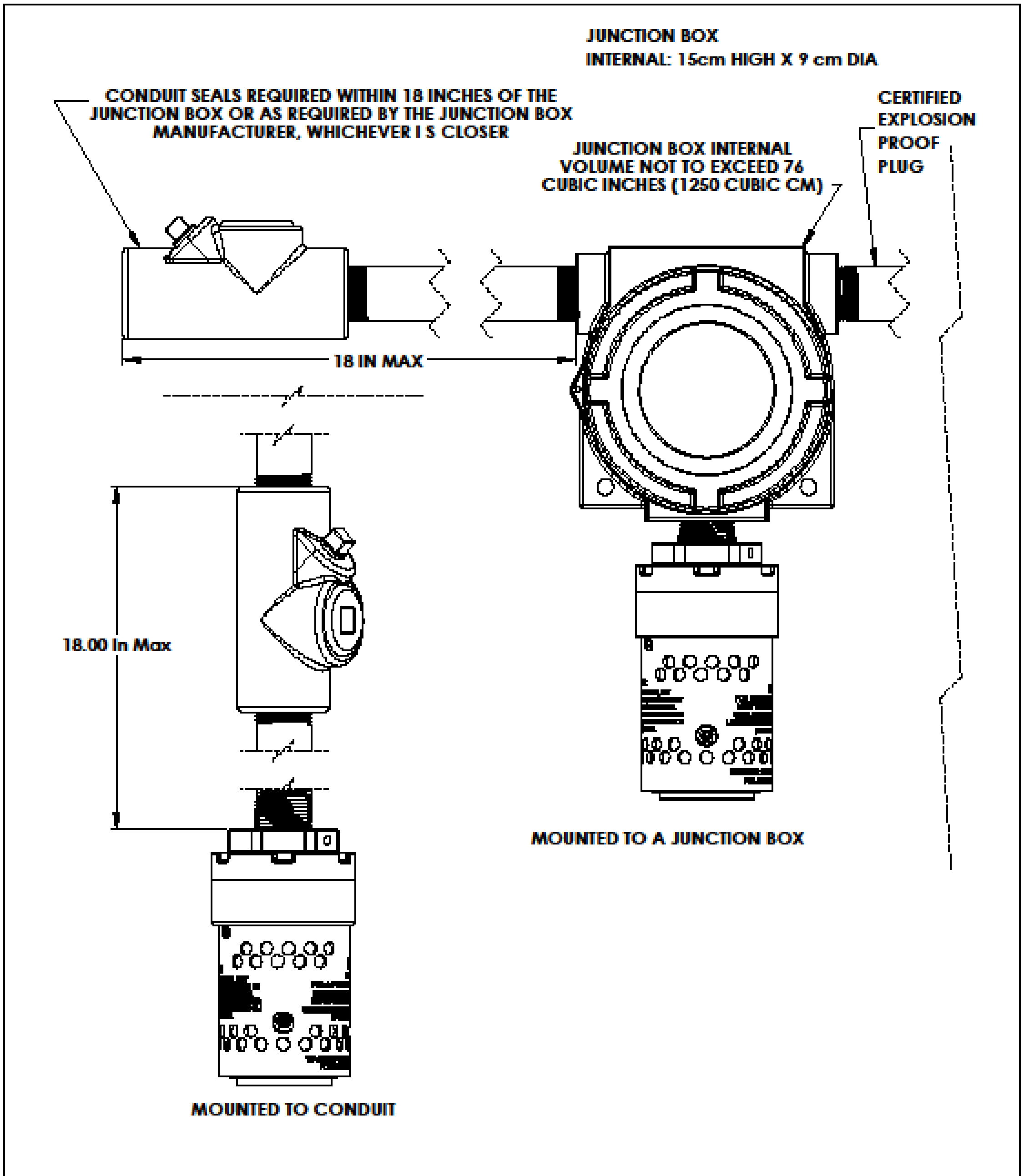
SEC5210 WIRING DIAGRAM

SIZE	DWG. NO.	REV.
A	FIGURE 4	-

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1



APPROVALS:
SCHEMATIC
PWB RAW
CERT DWG
NEXT ASSY
USED ON
APPLICATION

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL±
ANGULAR: MACH± BEND ±
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
MFG APPR.		

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SENSOR ELECTRONICS CORP. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SENSOR ELECTRONICS CORP. IS PROHIBITED.

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SAMPLE INSTALLATION ILLUSTRATION

SIZE A DWG. NO. NOT ASSIGNED REV. NA
SCALE:1:3.5 WEIGHT: SHEET 1 OF 1

SEC Millenium

Carbon Dioxide Gas Detector

Features

- *Infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Compact & lightweight*
- *Fast response time*
- *Smart calibration*
- *Self-compensating optical bench*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *Many ranges available*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** detectors are designed to be used where a rugged, explosion proof, ultra reliable device is required.

- Gas Storage
- Injection Oil Recovery
- Industrial Process Control
- Food Processing/Packaging
- Greenhouses
- Bottling Plants
- Water Industry
- Environmental Chambers
- Laboratories
- Breweries/Wineries
- HVAC (DCV, Energy Management)
- Engine Test Cells

Operation / Description

SEC infrared carbon dioxide detector is a single source dual wavelength instrument. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium

CO_2 Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM Infrared Carbon Dioxide Gas Detector

Range: 0-0.5% Volume 4900135000M12 (5,000 ppm)
0-1% Volume 49001300001V12 (10,000 ppm)
0-2% Volume 49001300002V12 (20,000 ppm)
0-5% Volume 49001300005V12 (50,000 ppm)
Alternate ranges are available.

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% 0 to 50% Full Scale
+/- 5% 51 to 100% Full Scale

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: **(at 24VDC)**
Average: 210 mA Peak: 400 mA

Approvals: Class 1, Division 1, Groups B,C,D

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% Full Scale
8.0 mA	25% Full Scale
12 mA	50% Full Scale
16 mA	75% Full Scale
20 mA	100% Full Scale
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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SEC Millenium Carbon Dioxide Gas Detector

Instruction and Operation Manual

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Part Number 71-5000 Version 040109

Sensor Electronics Corporation

Sensor Electronics Corporation (SEC) designs and manufactures innovative fixed system gas detection equipment, for combustible gases, oxygen, carbon dioxide and toxic gases.

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.
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 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.

Table of Contents

I. SPECIFICATIONS

Model:
Sensor Electronics Corporation SEC MILLENIUM Infrared Carbon Dioxide (CO_2) Gas Detector

Part Number: 142-0617
Specify range when ordering

Detection Method:
Diffusion
Optional sample draw (requires a minimum of 1 liter per minute flow rate)

Available Ranges:
0-1% Volume
0-2% Volume
0-5% Volume
(1 % volume = 10,000 PPM)
High level CO_2 (and hydrocarbon gases) monitors available in SEC Signature product line

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 5% measured value or +/- 3% full scale (whichever greater)

Operating Temperature Rating:
-40° to +70°C at 0 to 99% RH (non-condensing)

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

Power Consumption: 5 Watts Max.

Current Draw: (at 24 VDC)
Average: 250 mA
Peak: 400 mA

Approvals: CSA , For -40C to +50C operation

Installation Category: Cat. I, Pollution Degree 2

II GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement

⎓ VDC (DC Voltage)

SEC MILLENIUM

The SEC MILLENIUM Infrared gas detector is a microprocessor based intelligent gas detector that continuously monitors carbon dioxide gas vapors within the specified range.

The SEC MILLENIUM is ideally suited for use in harsh environments. The SEC MILLENIUM Infrared gas detector will perform reliably in the presence of poisoning agents and can also operate in oxygen free environments or where high background gas levels are present. There are no known poisons that affect this technology.

The SEC MILLENIUM is a stand-alone device providing a continuos 4 to 20 mA output.

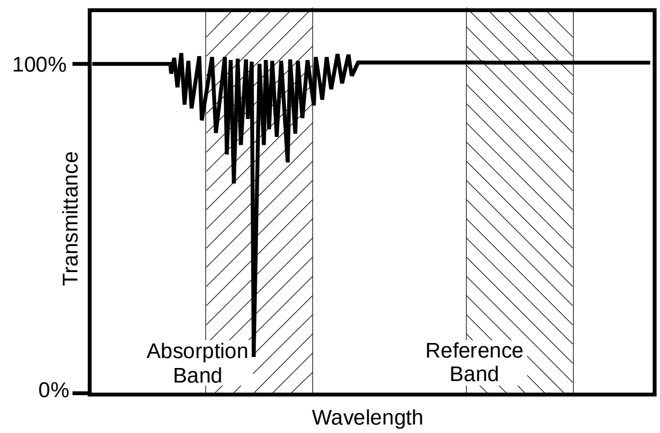
Features

- Requires no routine calibration to ensure proper operation.
- Continuous self-test automatically indicates a fault, with fail to safe operation.
- A multi-layered filtering system protects optics from dirt and water ingress.
- Straight optical path eliminates the need for mirrors or reflective surfaces or beam splitters.
- Performs well in the presence of high concentrations or constant background levels of carbon dioxide and in oxygen depleted atmospheres.
- Highly resistant to poisoning and etching.
- Standard 4 to 20 mA output (current source)
- Explosion proof housing designed for harsh environments.
- Smart Calibration AutoAC™ circuit.

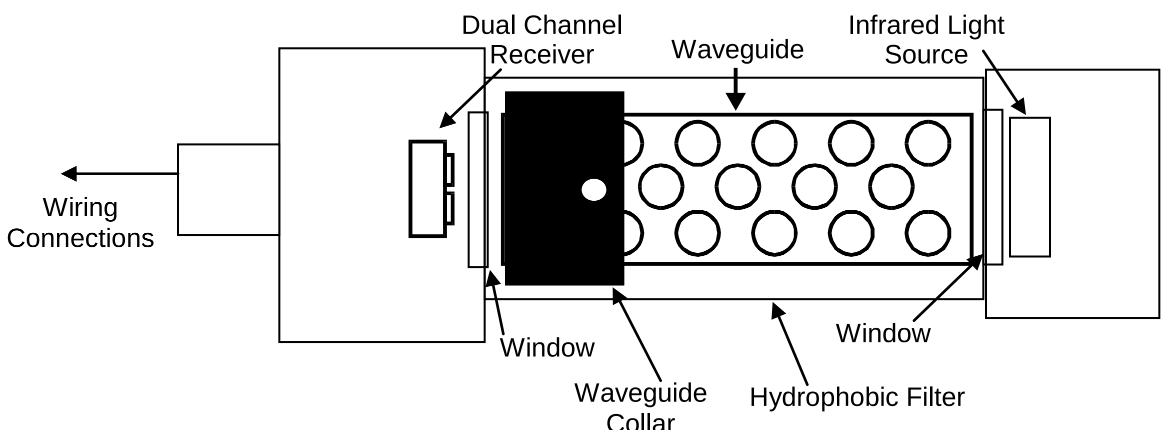
Infrared Detection Technology

The SEC MILLENIUM Infrared gas detector uses infrared absorption technology for detecting carbon dioxide gas (CO2). CO2 absorbs infrared light only at certain wavelengths. The concentration of a gas can be measured by the difference of two channels (wavelengths), a reference and a measurement channel. The SEC MILLENIUM uses a collimated infrared light source that passes through a waveguide, at the end of the waveguide is a dual channel receiver. The dual channel receiver measures the intensity of two specific wavelengths, one at an absorption wavelength and another outside of the absorption wavelength. The gas concentration is determined by a comparison of these two values.

Infrared Absorption Spectrum for Carbon Dioxide



The dual channel receiver is a single wafer, double filtered, dual receiver with an internal optical barrier. The elements are perfectly matched resulting in overall stability and superior performance throughout the entire temperature range.



Using a dual channel receiver there is no need to use any special lenses or beam splitters to achieve the different measurement bands.

The SEC MILLENIUM utilizes a unique patent pending feature, the AutoAC™ circuit. The AutoAC™ circuit is an automatic analog control circuit, which allows the SEC MILLENIUM to be calibrated for CO2, provided that a calibration quality level of the gas is available.

The optics can be easily disassembled for cleaning. This does not require powering the unit down and does not compromise the units' explosion proof rating. The device will self compensate for dirty optics until a point in which the optical surfaces are completely obscured.

There are no consumable components contained in this product.

III. OPERATION

Installation and Startup

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC MILLENIUM. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC MILLENIUM be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.

- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.

- The sensor should be accessible for maintenance.

- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices**.**

- RgasD = 1.53 (Relative density of gas (CO_2) referenced to air =1. Indicates how many times a gas is heavier than air at the same temperature).

- Normal constitute of air is about 300 PPM of CO_2.

The SEC MILLENIUM has a ¾" NPT threaded connector for mounting the detector to a junction box. SEC can provide a junction box with terminals for this purpose.

A user-supplied junction box can be used providing it has the appropriate sized NPT conduit entries. The junction box must be suitable for use in the application and location in which it is being installed. After the device has been installed, a calibration is required. Refer to the Calibration section of this manual.

Wiring connections
Red wire: 18 to 32 VDC ⎓
Black wire: DC Common
Blue wire: 4 to 20 mA output
White wire: Smart Calibration Wire (data wire)
Earth Ground: Male 10-32 Stud on SEC Millenium cap, see figure 1.

Wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG
501 to 1000 feet, recommended wire gauge size 14 AWG

Shielded cable is recommended. Wiring should be installed in medal conduit with no other cabling in the same conduit.

Warm-up

When power is applied to the detector, it enters a one (1) minute warm-up mode. The output current will be 0.8 mA during the warm up time period. At the end of the warm-up period with no faults present, the detector automatically enters the normal operating mode (4 mA). If a fault is present after warm-up, the detector current output will indicate a fault. See the following chart for fault code status.

Normal

In the normal operating mode, the 4 to 20 mA signal levels correspond to the detected gas concentration. The detector continuously checks for system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC MILLENIUM is a non-isolated current source.

Current Output and Corresponding Status

Current Output	Status.
0-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4.0 mA	Zero gas level
20.0 mA	Full scale
20.1- 23 mA	Over-range (> 100% full scale)

Once the fault is cleared the SEC MILLENIUM will atomatically resume normal operation.

IV. CALIBRATION

SEC MILLENIUM

The SEC MILLENIUM is factory calibrated zeroed and spanned. *Unlike other types of sensors it does not require routine span gas calibration to ensure proper operation.*

The SEC MILLENIUM is required to be spanned with gas only one time with CO2. Typically this is done at the factory, but it is possible to field span the device by connecting the SEC MILLENIUM to a computer and using a software package provided by SEC. Please contact the factory for further details.

A typical field calibration only requires the use of 99.99% nitrogen.

There is a fitting on the bottom of the sensor for a 1/8" ID tubing connection.

Before beginning calibration use the SEC MILLENIUM Insulation Tube to cover outer cylinder holes and connect a 99.99% nitrogen source to the sensor's calibration port for a minimum of 3 minutes. To enter into the calibration mode the calibration wire must be connected to negative (common of the power supply) for ten (10) seconds, upon release the sensor will automatically enter the zero calibration routine. The electronics will automatically adjust the sensor's signal to the new zero reference level. (Applying span gas is not necessary because of the SEC MILLENIUM's unique software algorithms). During the zero calibration routine, the current output of the SEC MILLENIUM will go to 2.2 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the zeroing procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from common, the SEC MILLENIUM will ignore the signal and continue operation as normal.

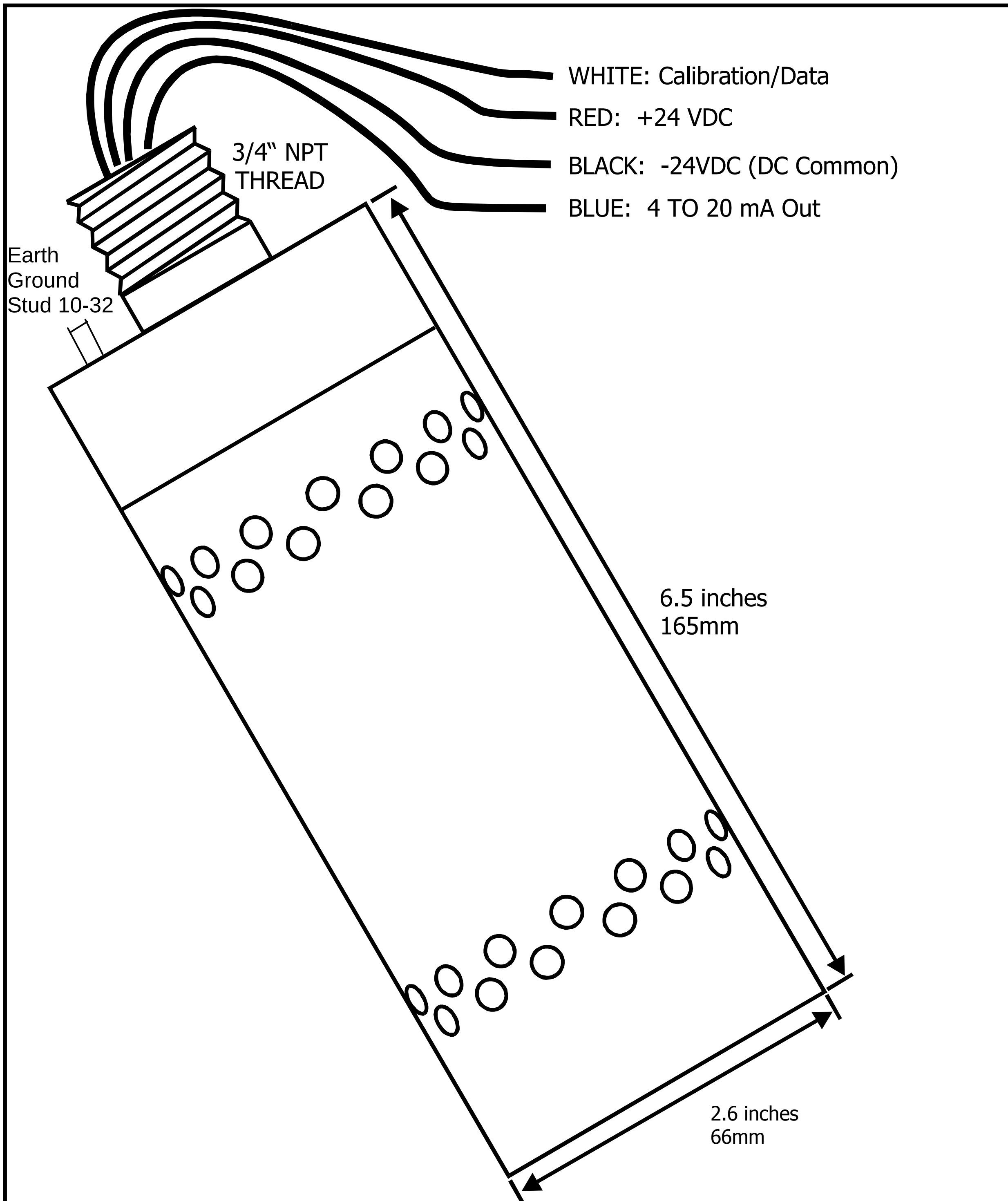
V. MAINTENANCE

The SEC MILLENIUM does not normally require cleaning of the optics. However if the unit is operating in a very dirty or dusty environment the optical path might become obscured. If the obscuration is severe enough to affect the unit's accuracy, the unit will activate an "Optics Fault" will. To clear an Optics Fault, first try a calibration. If the calibration does not correct the fault condition, try to clean the optics. The outer barrel (tube with two sets of holes) can be removed (unscrewed) to inspect the cleanliness of the hydrophobic filter. The hydrophobic filter is a Teflon coated stainless steel mesh that keeps moisture and particulates out of the optical path. A setscrew holds the filter to the MILLENIUM's housing. Once the hydrophobic filter is removed, the internal waveguide tube should be inspected for cleanliness. The waveguide and waveguide collar can be removed by inserting rigid instruments such as Allen wrenches into one hole of the waveguide and one hole of the collar. Turning the two instruments in opposite directions will loosen the waveguide allowing the collar to be screwed down on to the waveguide until it can be removed from the SEC MILLENIUM housing. This will allow the windows of the SEC MILLENIUM to be cleaned. Dust can be removed using compressed air. Hard or oily deposits can be removed using Isopropyl alcohol and cotton tipped swabs. Wipe any film or residue or film left by the alcohol on the windows with a clean dry cotton swab. The internal electro polished wave-guide tube can be cleaned the same way. Be careful not to leave any particles of the cleaning swab in the waveguide. The waveguide holes can collect pieces of the cleaning swab. After reassembling the unit (the waveguide and collar should be very tight to both ends of the SEC MILLLENIUM housing after installation. Once the unit is completely reassembled and power is reapplied, the SEC MILLENIUM must be calibrated. Refer to the calibration section of this manual.

VI. Parts List

Part Number	Description
142-0617	Replacement Sensor SEC MILLENIUM (Specify range when ordering)
190-1001	SEC 2001 Sensor Separation Kit
142-0877	SEC Insulation Tube
142-0497	SEC MILLENIUM Replacement Hydrophobic Filter
142-0297	SEC MILLENIUM Wave Guide Tube
142-0570	SEC MILLENIUM Wave Guide Tube Collar
142-0636	SEC IR PC Link Kit
142-0962	SEC MILLENIUM Sample Draw Adaptor

VII. Drawing Section



SENSOR ELECTRONICS CORPORATION

Sensor Electronics Corporation
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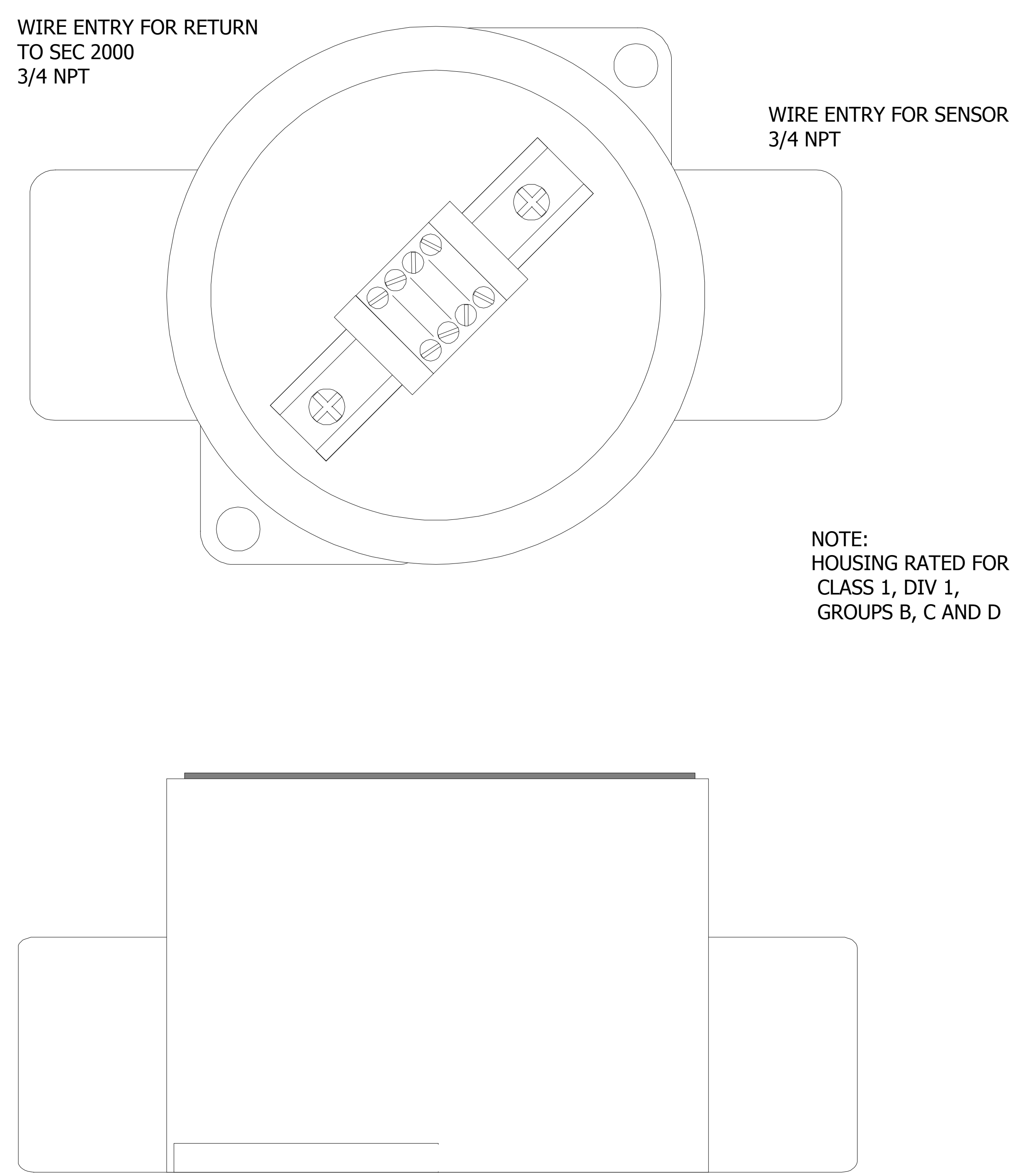
Fax: (952) 938-9617
sales@sensorelectronic.com

WIRING DIAGRAM
MILLENIUM SENSOR

FIGURE 1



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SEC SENSOR
SEPARATION KIT

FIGURE 2

CSA Performance Approved

SENSOR ELECTRONICS

SEC Millenium

Infrared Hydrocarbon Gas Detector

Document #1460001 Revision B

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, greater than 10 year life expectancy*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Rugged stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Patented self-compensating optics*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *0 to 100% LFL detection range*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC Millenium is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium

Infrared Gas Detector

Document #1460001 Revision A

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM Infrared Hydrocarbon Gas Detector

Available gases:	Propane	Propylene
Methane	n-Butane	Ethane
Gasoline	Ethanol	Isopropyl Alcohol
Ethylene	Methanol	Aeromatic 150
Pentane	Hexane	Cyclopentane
Isobutane	Toluene	Methyl Amyl Ketone
P-Xylene	MEK	Tert-Butyl Acetate

***Please note** that this list is not all-inclusive. The SEC MILLENIUM can be calibrated for most hydrocarbons, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Part Numbers:

Methane PN: 49000000100L12	(0-100% LEL)
Methane PN: 49000000050L12	(0-50% LEL)
Methane PN: 49000000100V12	(0-100% VOL)
Propane PN: 49000100100L12	(0-100% LEL)
Propane PN: 49000100100V12	(0-100% VOL)
Propane PN: 49000100100U12	(0-100% UEL)
Aeromatic 150 PN: 49000200100L12	(0-100% LEL)
Ethane PN: 49000300100L12	(0-100% LEL)
Ethanol PN: 49000400100L12	(0-100% LEL)
Ethylene PN: 49000500100L12	(0-100% LEL)
Gasoline PN: 49000600100L12	(0-100% LEL)
Hexane PN: 49000700100L12	(0-100% LEL)
Isobutane PN: 49000800100L12	(0-100% LEL)
Isopropyl Alcohol (IPA) PN: 49000900010L12	(1-100% LEL)
Methanol PN: 49001000100L12	(0-100% LEL)
N-Butane PN: 49001100100L12	(0-100% LEL)
Pentane PN: 49001200100L12	(0-100% LEL)
Methyl Amyl Ketone PN: 49001400100L12	(0-100% LEL)
Cyclopentane PN: 49002500100L12	(0-100% LEL)
Propylene PN: 49002900100L12	(0-100% LEL)
Toluene PN: 49003700100-L12	(0-100% LEL)
P-Xylene PN: 4900400100-L12	(0-100% LEL)
Tert-Butyl Acetate PN: 49003400100-L12	(0-100% LEL)

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals:
C22.2 No. 152-M1984 (R1997)
Performance Tested
Class 1, Division 1, Groups B, C and D
Conforms to UL2075, Methane 0-100% LEL

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

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CSA Performance Approved

SEC Millenium WS

Infrared Hydrocarbon Gas Detector

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Rugged stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Patented self-compensating optics*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *0 to 100% LFL detection range*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC Millenium is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium WS

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM WS Infrared Hydrocarbon Gas Detector

Available gases:
Acetone PN: 49002300100L012 (0-100% LEL)
DF 2000 PN: 490020001000L012 (0-100% LEL)
Green Earth PN: 49002100100L012 (0-100% LEL)

***Please note** that this list is not all-inclusive. The SEC MILLENIUM can be calibrated for most hydrocarbons, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals: C22.2 No. 152-M1984 (R1997)
Performance Tested

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

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SENSOR ELECTRONICS

SEC Millenium

Carbon Dioxide Gas Detector

Features

- *Infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Compact & lightweight*
- *Fast response time*
- *Smart calibration*
- *Self-compensating optical bench*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *Many ranges available*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** detectors are designed to be used where a rugged, explosion proof, ultra reliable device is required.

- Gas Storage
- Injection Oil Recovery
- Industrial Process Control
- Food Processing/Packaging
- Greenhouses
- Bottling Plants
- Water Industry
- Environmental Chambers
- Laboratories
- Breweries/Wineries
- HVAC (DCV, Energy Management)
- Engine Test Cells

Operation / Description

SEC infrared carbon dioxide detector is a single source dual wavelength instrument. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium

CO_2 Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM Infrared Carbon Dioxide Gas Detector

Range: 0-0.5% Volume 4900135000M12 (5,000 ppm)
0-1% Volume 49001300001V12 (10,000 ppm)
0-2% Volume 49001300002V12 (20,000 ppm)
0-5% Volume 49001300005V12 (50,000 ppm)
Alternate ranges are available.

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% 0 to 50% Full Scale
+/- 5% 51 to 100% Full Scale

Operating Temperature Rating:
-40° to +70°C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals: Class 1, Division 1, Groups B,C,D

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% Full Scale
8.0 mA	25% Full Scale
12 mA	50% Full Scale
16 mA	75% Full Scale
20 mA	100% Full Scale
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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CSA Performance Approved

SEC Millenium

Infrared Hydrocarbon ETOAMB Gas Detector

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Rugged stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Patented self-compensating optics*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *0 to 100% LFL detection range*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC Millenium is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM Infrared Hydrocarbon ETOAMB Gas Detector

Available gases: Ethylene Oxide

Please note *that this list is not all-inclusive. The SEC MILLENIUM can be calibrated for most hydrocarbons, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Part Number: 49002200050L012 (0-50% LEL)
49002200100L012 (0-100% LEL)

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals: C22.2 No. 152-M1984 (R1997)
Performance Tested

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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SENSOR ELECTRONICS

SEC Millenium

Infrared Hydrocarbon HT Gas Detector

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Rugged stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Patented self-compensating optics*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *0 to 100% LFL detection range*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium HT** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC Millenium is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium HT

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC MILLENIUM HT Infrared Hydrocarbon Gas Detector

Available gases: Methane

Please note *that this list is not all-inclusive. The SEC MILLENIUM can be calibrated for most hydrocarbons, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Part Number: 49000000100HL12

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40˚ to +90˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals: C22.2 No. 152-M1984 (R1997)
Performance Tested
-40˚ + 0 + 70˚C at 0-99% RM (non-condensing)

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Detector accessories, weather shields
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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CSA Performance Approved

SEC Millenium

Infrared LC
Hydrocarbon Gas Detector

Features

- *Reliable infrared sensing technology*
- *Virtually maintenance free*
- *Low cost of ownership, over five years operating life*
- *Immune to poisoning and etching*
- *Designed for harsh environments*
- *Explosion proof*
- *Rugged stainless steel construction*
- *Fast response time*
- *Smart calibration*
- *Patented self-compensating optics*
- *No moving parts*
- *Heated optical chamber*
- *Low power consumption*
- *Operates in constant hydrocarbon background*
- *Operates in anaerobic atmospheres*
- *Fault indications for all failure states*
- *Routine calibrations are not required*
- *4 to 20 mA output*
- *0 to 100% LFL detection range*
- *Can be coupled with SEC 3100 transmitter for network applications*
- *RS-485 communication link available*
- *Digital Display option available*

Applications

The **SEC Millenium** hydrocarbon detectors are designed to be used as an upgrade in the same applications where catalytic bead sensors have been applied.

- Refineries
- Drilling and production platforms
- Fuel loading facilities
- Oil well logging
- LNG/LPG processing and storage facilities
- Gas turbines
- Chemical plants
- Compressor stations
- Wastewater treatment facilities
- Transportation facilities

Operation / Description

SEC Millenium is a complete self contained optical hydrocarbon gas detector. The sensing and reference elements are self-compensating for optical integrity and other signal inhibitors. The industry standard 4 - 20 mA analog output provides remote alarm, fault and calibration signals.

SEC Millenium

Infrared Gas Detector

Specifications

Model: Sensor Electronics Corporation
SEC Millenium Infrared LC
Hydrocarbon Gas Detector

Available gases:
Diesel PN: 49001600100L012 (0-100% LEL)
Jet A PN: 49001700100L012 (0-100% LEL)
Kerosene PN: 49001500100L012 (0-100% LEL)
JP5 PN: 49002600100L012 (0-100% LEL)
JP8 PN: 49002700100L012 (0-100% LEL)
Dimethyl Ether PN: 49002800100L012 (0-100% LEL)
Propane with rejection to Methane PN: 49001805000M012 (0-5000 ppm)

***Please note** that this list is not all-inclusive. The SEC Millenium can be calibrated for most hydrocarbons, provided a calibration gas is available. For more information please contact Sensor Electronics Corporation.*

Detection Method: Diffusion - Optional sample draw (requires a minimum of 1 liter per minute flow rate.)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40˚ to +70˚C at 0 to 99% RH (non-condensing)

Operating Range:
18 to 32 VDC measured at the detector head

Power Consumption:
5 Watts Max

Max Current Draw: (at 24VDC)
Average: 210 mA Peak: 400 mA

Approvals: C22.2 No. 152-M1984 (R1997)
Performance Tested

Installation Category: Cat. I, Pollution Degree 2

Weight: 5 lbs. (2.3 kg.)

Unit Status Chart

Current Output	Status
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit Zeroing
4.0 mA	Zero gas level
5.6 mA	10% LEL
8.0 mA	25% LEL
12 mA	50% LEL
16 mA	75% LEL
20 mA	100% LEL
20.1 – 23 mA	Over range (>100%)

Other Products Available

Gas Detectors – Explosion proof
Gas Detectors – Non-explosion proof
Infrared Gas Detectors
Process Gas Analyzers
Dual Gas Analyzers
Portable Fire Suppression Systems:
Dry Chemical
Halotron
Twin Agent
Stationary Fire Suppression Systems

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SEC Millenium Carbon Dioxide Gas Detector

Instruction and Operation Manual

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Part Number 71-5000 Version 040109

Sensor Electronics Corporation

Sensor Electronics Corporation (SEC) designs and manufactures innovative fixed system gas detection equipment, for combustible gases, oxygen, carbon dioxide and toxic gases.

Commitment

Our quality and service are uncompromising. We back each of our products with a two-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.

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 would 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.

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 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.

Table of Contents

I. SPECIFICATIONS

Model:
Sensor Electronics Corporation SEC MILLENIUM Infrared Carbon Dioxide (CO2) Gas Detector

Part Number: 142-0617
Specify range when ordering

Detection Method:
Diffusion
Optional sample draw (requires a minimum of 1 liter per minute flow rate)

Available Ranges:
0-1% Volume
0-2% Volume
0-5% Volume
(1 % volume = 10,000 PPM)
High level CO2 (and hydrocarbon gases) monitors available in SEC Signature product line

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.
Class 1, Division 1, Groups B, C and D

Accuracy:
+/- 5% measured value or +/- 3% full scale (whichever greater)

Operating Temperature Rating:
-40° to +70°C at 0 to 99% RH (non-condensing)

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

Power Consumption: 5 Watts Max.

Current Draw: (at 24 VDC)
Average: 250 mA
Peak: 400 mA

Approvals: CSA , For -40C to +50C operation

Installation Category: Cat. I, Pollution Degree 2

II GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning Statement

⎓ VDC (DC Voltage)

SEC MILLENIUM

The SEC MILLENIUM Infrared gas detector is a microprocessor based intelligent gas detector that continuously monitors carbon dioxide gas vapors within the specified range.

The SEC MILLENIUM is ideally suited for use in harsh environments. The SEC MILLENIUM Infrared gas detector will perform reliably in the presence of poisoning agents and can also operate in oxygen free environments or where high background gas levels are present. There are no known poisons that affect this technology.

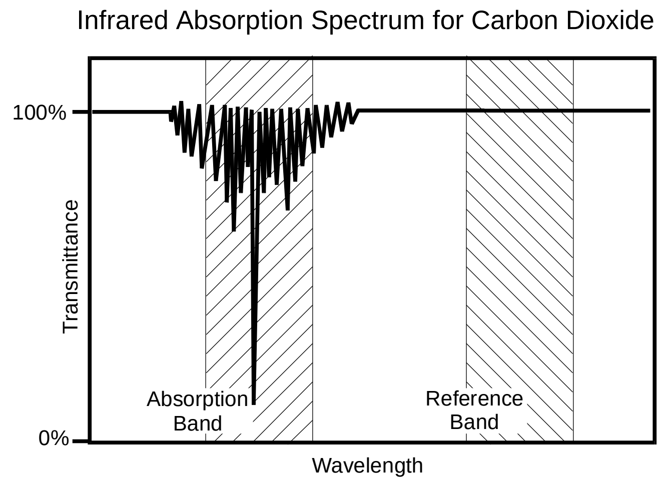
The SEC MILLENIUM is a stand-alone device providing a continuos 4 to 20 mA output.

Features

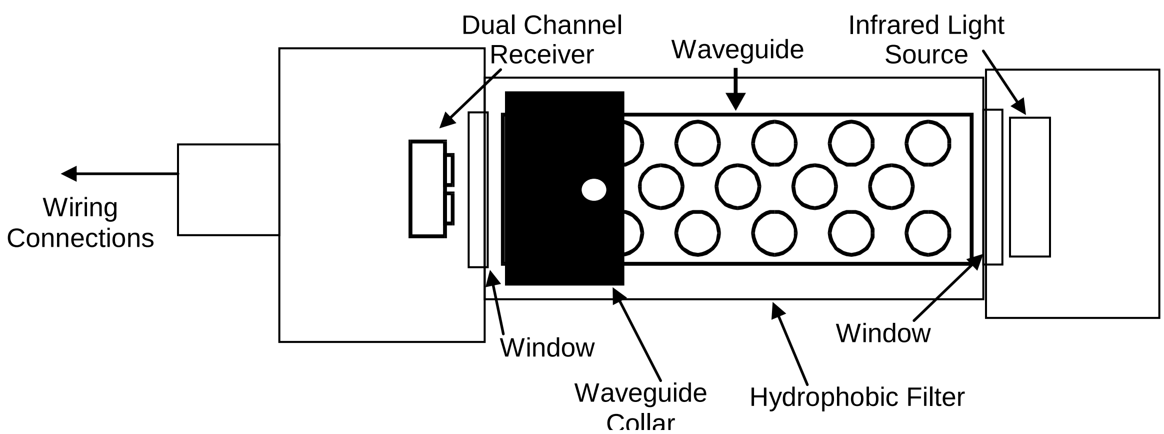
- Requires no routine calibration to ensure proper operation.
- Continuous self-test automatically indicates a fault, with fail to safe operation.
- A multi-layered filtering system protects optics from dirt and water ingress.
- Straight optical path eliminates the need for mirrors or reflective surfaces or beam splitters.
- Performs well in the presence of high concentrations or constant background levels of carbon dioxide and in oxygen depleted atmospheres.
- Highly resistant to poisoning and etching.
- Standard 4 to 20 mA output (current source)
- Explosion proof housing designed for harsh environments.
- Smart Calibration AutoAC™ circuit.

Infrared Detection Technology

The SEC MILLENIUM Infrared gas detector uses infrared absorption technology for detecting carbon dioxide gas (CO2). CO2 absorbs infrared light only at certain wavelengths. The concentration of a gas can be measured by the difference of two channels (wavelengths), a reference and a measurement channel. The SEC MILLENIUM uses a collimated infrared light source that passes through a waveguide, at the end of the waveguide is a dual channel receiver. The dual channel receiver measures the intensity of two specific wavelengths, one at an absorption wavelength and another outside of the absorption wavelength. The gas concentration is determined by a comparison of these two values.



The dual channel receiver is a single wafer, double filtered, dual receiver with an internal optical barrier. The elements are perfectly matched resulting in overall stability and superior performance throughout the entire temperature range.



Using a dual channel receiver there is no need to use any special lenses or beam splitters to achieve the different measurement bands.

The SEC MILLENIUM utilizes a unique patent pending feature, the AutoAC™ circuit. The AutoAC™ circuit is an automatic analog control circuit, which allows the SEC MILLENIUM to be calibrated for CO2, provided that a calibration quality level of the gas is available.

The optics can be easily disassembled for cleaning. This does not require powering the unit down and does not compromise the units' explosion proof rating. The device will self compensate for dirty optics until a point in which the optical surfaces are completely obscured.

There are no consumable components contained in this product.

III. OPERATION

Installation and Startup

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC MILLENIUM. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC MILLENIUM be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.

- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the down wind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.

- The sensor should be accessible for maintenance.

- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.

- Follow all national and local installation codes and practices.

- RgasD = 1.53 (Relative density of gas (CO_2) referenced to air =1. Indicates how many times a gas is heavier than air at the same temperature).

- Normal constitute of air is about 300 PPM of CO_2.

The SEC MILLENIUM has a ¾" NPT threaded connector for mounting the detector to a junction box. SEC can provide a junction box with terminals for this purpose.

A user-supplied junction box can be used providing it has the appropriate sized NPT conduit entries. The junction box must be suitable for use in the application and location in which it is being installed. After the device has been installed, a calibration is required. Refer to the Calibration section of this manual.

Wiring connections
Red wire: 18 to 32 VDC ⎓
Black wire: DC Common
Blue wire: 4 to 20 mA output
White wire: Smart Calibration Wire (data wire)
Earth Ground: Male 10-32 Stud on SEC Millenium cap, see figure 1.

Wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG
501 to 1000 feet, recommended wire gauge size 14 AWG

Shielded cable is recommended. Wiring should be installed in medal conduit with no other cabling in the same conduit.

Warm-up

When power is applied to the detector, it enters a one (1) minute warm-up mode. The output current will be 0.8 mA during the warm up time period. At the end of the warm-up period with no faults present, the detector automatically enters the normal operating mode (4 mA). If a fault is present after warm-up, the detector current output will indicate a fault. See the following chart for fault code status.

Normal

In the normal operating mode, the 4 to 20 mA signal levels correspond to the detected gas concentration. The detector continuously checks for system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC MILLENIUM is a non-isolated current source.

Current Output and Corresponding Status

Current Output	Status.
0-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
0.8 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4.0 mA	Zero gas level
20.0 mA	Full scale
20.1- 23 mA	Over-range (> 100% full scale)

Once the fault is cleared the SEC MILLENIUM will atomatically resume normal operation.

IV. CALIBRATION

SEC MILLENIUM

The SEC MILLENIUM is factory calibrated zeroed and spanned. *Unlike other types of sensors it does not require routine span gas calibration to ensure proper operation.*

The SEC MILLENIUM is required to be spanned with gas only one time with CO2. Typically this is done at the factory, but it is possible to field span the device by connecting the SEC MILLENIUM to a computer and using a software package provided by SEC. Please contact the factory for further details.

A typical field calibration only requires the use of 99.99% nitrogen.

There is a fitting on the bottom of the sensor for a 1/8" ID tubing connection.

Before beginning calibration use the SEC MILLENIUM Insulation Tube to cover outer cylinder holes and connect a 99.99% nitrogen source to the sensor's calibration port for a minimum of 3 minutes. To enter into the calibration mode the calibration wire must be connected to negative (common of the power supply) for ten (10) seconds, upon release the sensor will automatically enter the zero calibration routine. The electronics will automatically adjust the sensor's signal to the new zero reference level. (Applying span gas is not necessary because of the SEC MILLENIUM's unique software algorithms). During the zero calibration routine, the current output of the SEC MILLENIUM will go to 2.2 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the zeroing procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from common, the SEC MILLENIUM will ignore the signal and continue operation as normal.

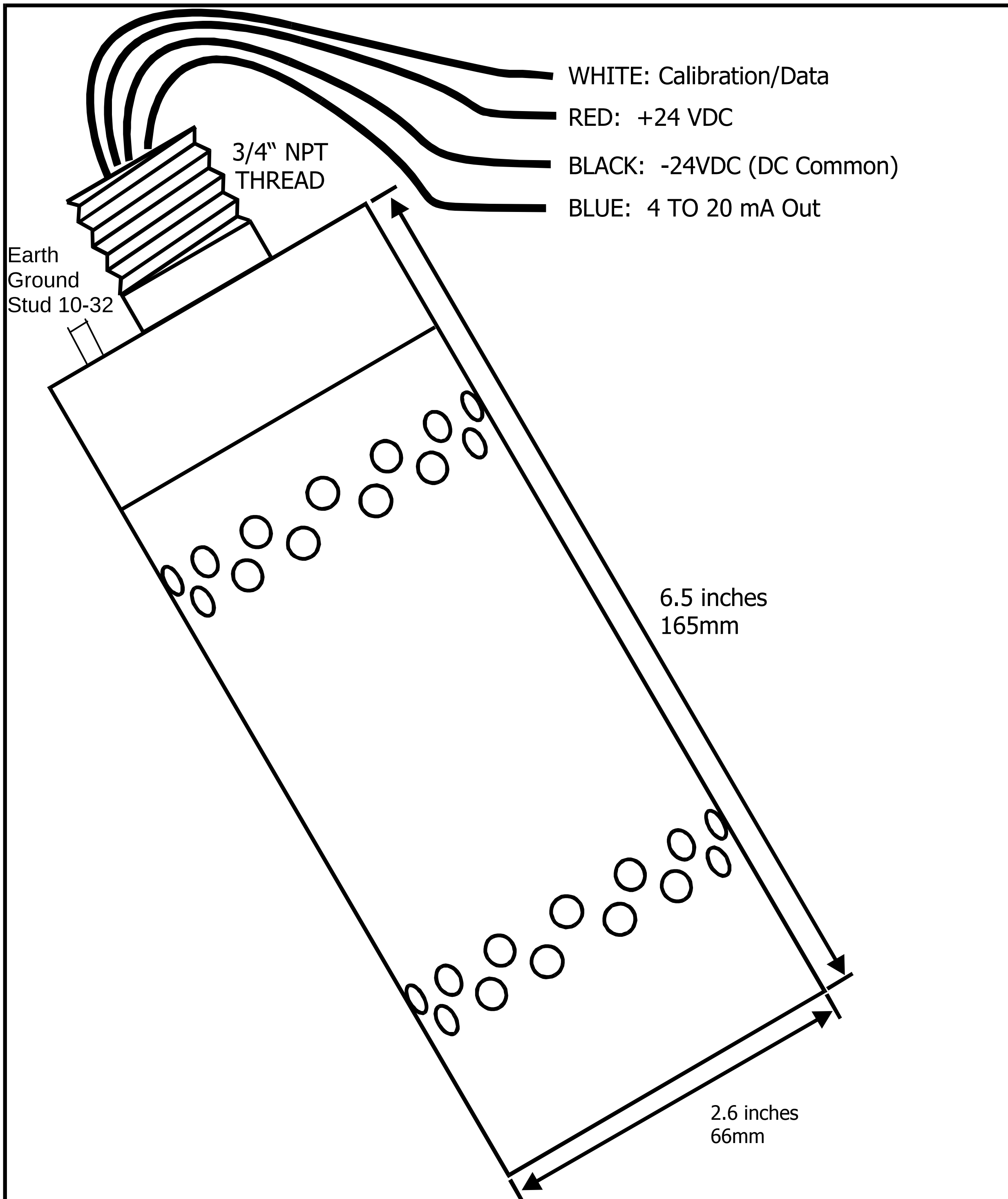
V. MAINTENANCE

The SEC MILLENIUM does not normally require cleaning of the optics. However if the unit is operating in a very dirty or dusty environment the optical path might become obscured. If the obscuration is severe enough to affect the unit's accuracy, the unit will activate an "Optics Fault" will. To clear an Optics Fault, first try a calibration. If the calibration does not correct the fault condition, try to clean the optics. The outer barrel (tube with two sets of holes) can be removed (unscrewed) to inspect the cleanliness of the hydrophobic filter. The hydrophobic filter is a Teflon coated stainless steel mesh that keeps moisture and particulates out of the optical path. A setscrew holds the filter to the MILLENIUM's housing. Once the hydrophobic filter is removed, the internal waveguide tube should be inspected for cleanliness. The waveguide and waveguide collar can be removed by inserting rigid instruments such as Allen wrenches into one hole of the waveguide and one hole of the collar. Turning the two instruments in opposite directions will loosen the waveguide allowing the collar to be screwed down on to the waveguide until it can be removed from the SEC MILLENIUM housing. This will allow the windows of the SEC MILLENIUM to be cleaned. Dust can be removed using compressed air. Hard or oily deposits can be removed using Isopropyl alcohol and cotton tipped swabs. Wipe any film or residue or film left by the alcohol on the windows with a clean dry cotton swab. The internal electro polished wave-guide tube can be cleaned the same way. Be careful not to leave any particles of the cleaning swab in the waveguide. The waveguide holes can collect pieces of the cleaning swab. After reassembling the unit (the waveguide and collar should be very tight to both ends of the SEC MILLLENIUM housing after installation. Once the unit is completely reassembled and power is reapplied, the SEC MILLENIUM must be calibrated. Refer to the calibration section of this manual.

VI. Parts List

Part Number	Description
142-0617	Replacement Sensor SEC MILLENIUM (Specify range when ordering)
190-1001	SEC 2001 Sensor Separation Kit
142-0877	SEC Insulation Tube
142-0497	SEC MILLENIUM Replacement Hydrophobic Filter
142-0297	SEC MILLENIUM Wave Guide Tube
142-0570	SEC MILLENIUM Wave Guide Tube Collar
142-0636	SEC IR PC Link Kit
142-0962	SEC MILLENIUM Sample Draw Adaptor

VII. Drawing Section



SENSOR ELECTRONICS CORPORATION

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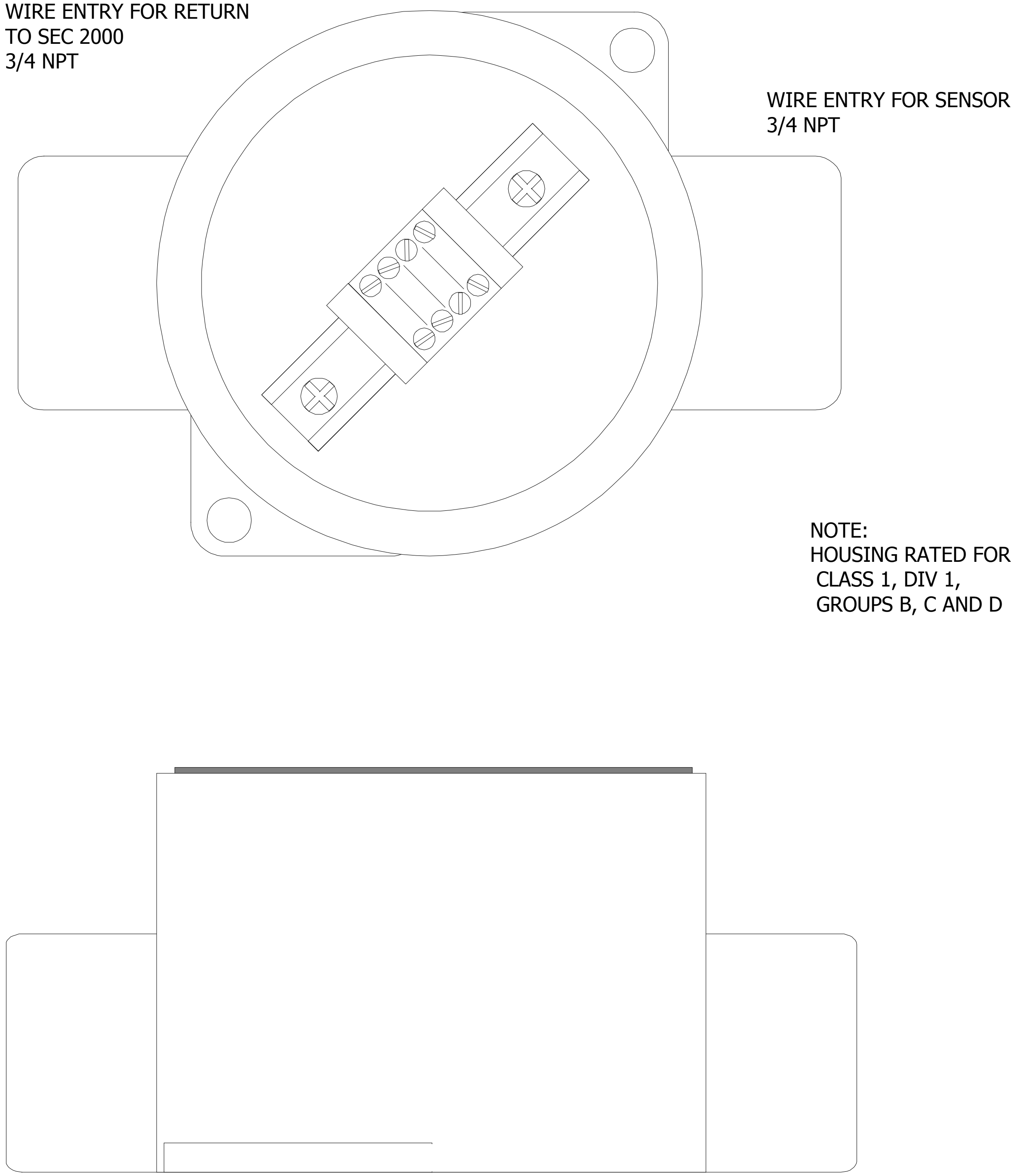
WIRING DIAGRAM
MILLENIUM SENSOR

FIGURE 1



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SEC SENSOR SEPARATION KIT

FIGURE 2

SEC *Millenium* Hydrocarbon Gas Detector

Instruction and Operation Manual

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Document Number 1460002, Revision C

Sensor Electronics Corporation

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Chemical Sensor Elements
Fuses and Batteries.
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.**

WARNING: READ AND UNDERSTAND THE USER'S MANUAL BEFORE OPERATING OR SERVICING

WARNING: KEEP COVER TIGHT WHILE CIRCUITS ARE LIVE

CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONEL ONLY

Revision History

Rev	Date	Description of Change	Page
C	May 2016	Update Warm-up current to 4.00mA	9
B	Oct 2015	Clarify UL 2075 requirement that the Methane Millenium be used with SEC3120,	5
		Add the following part numbers to the 'Available Gases' list; - Toluene - P-Xylene - Tert-Butyl Acetate - MEK	5
A	Aug 2015	Assign new part number, place under ECO control	All (footer)
		Update Company Address	Cover Figure 1 Figure 2
		Remove Y2K Disclaimer (obsolete)	1
		Add Certification Data for UL 2075	5
040109	Apr 2009	Change history unknown	

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I. SPECIFICATIONS

Model:

Sensor Electronics Corporation SEC MILLENIUM Infrared Hydrocarbon Gas Detector

Available gases:

Methane	Hexane	Jet A	Toluene
Ethane	Diesel	Ethanol	P-Xylene
Ethylene	Gasoline	Methanol	Tert-Butyl Acetate
Ethylene Oxide	Green Earth	Butane	MEK
Propane	DF 2000	Hexane	

Please note *that this list is not all-inclusive. The SEC MILLENIUM can be calibrated for most hydrocarbons, provided a calibration gas is available. For more please contact Sensor Electronics Corporation.*

Part Number: 1420280

Detection Method:
Diffusion
Optional sample draw (requires a minimum of 1 liter per minute flow rate)

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

Response Time:
T50 < 5 seconds
T90 < 10 seconds

Construction:
316 stainless steel.

Accuracy:
+/- 3% LFL, 0 to 50% LFL (Lower Flammable Limit)
+/- 5% LFL, 51 to 100% LFL

Operating Temperature Rating:
-40° to +70°C at 0 to 99% RH (non-condensing)

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

Power Consumption: 5 Watts Max.

Max. Current Draw: (at 24 VDC)
Average: 210 mA
Peak: 400 mA

Approvals:

Explosion Proofness:	Class I, Division 1, Groups B,C and D, Temp T5; (CSA for -40C to +50C)
Combustible Gas Performance:	C22.2 No 152, ANSI/ISA 12.13.01 – 2000; (CSA)
	UL 2075, Methane 0-100%LEL Only; (Conforms to UL2075, Intertek Listed) (UL2075 Listing requires the use of the SEC3120 Transmitter.)

Installation Category: Cat. I, Pollution Degree 2

II GENERAL DESCRIPTION

CONVENTIONS

The following conventions are used in this manual.

⚠ Warning or Caution Statement

⎓ VDC (DC Voltage)

SEC MILLENIUM

The SEC MILLENIUM Infrared gas detector is a microprocessor based intelligent gas detector that continuously monitors combustible hydrocarbon gases and vapors within the Lower Flammable Limit (LFL).

The SEC MILLENIUM is ideally suited for use in harsh environments and where the cost of required maintenance for conventional catalytic detectors is prohibitive. The SEC MILLENIUM Infrared gas detector will perform reliably in the presence of silicone and other catalytic poisoning agents and can also operate in oxygen free environments or where high background gas levels are present. There are no known poisons that affect this technology.

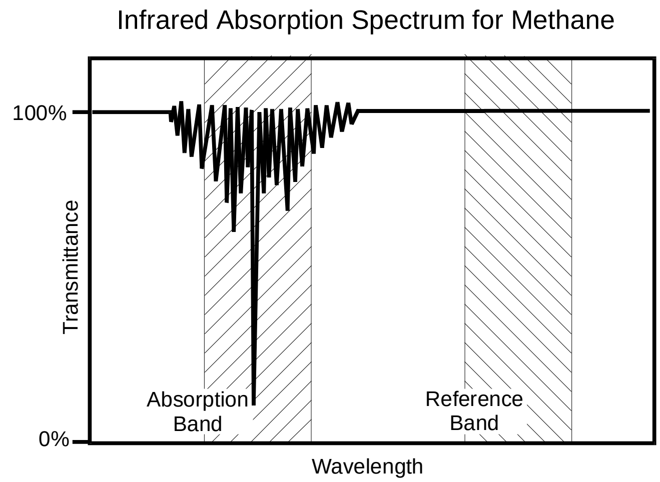
The SEC MILLENIUM is a stand-alone device providing a continuous 4 to 20 mA output.

Features

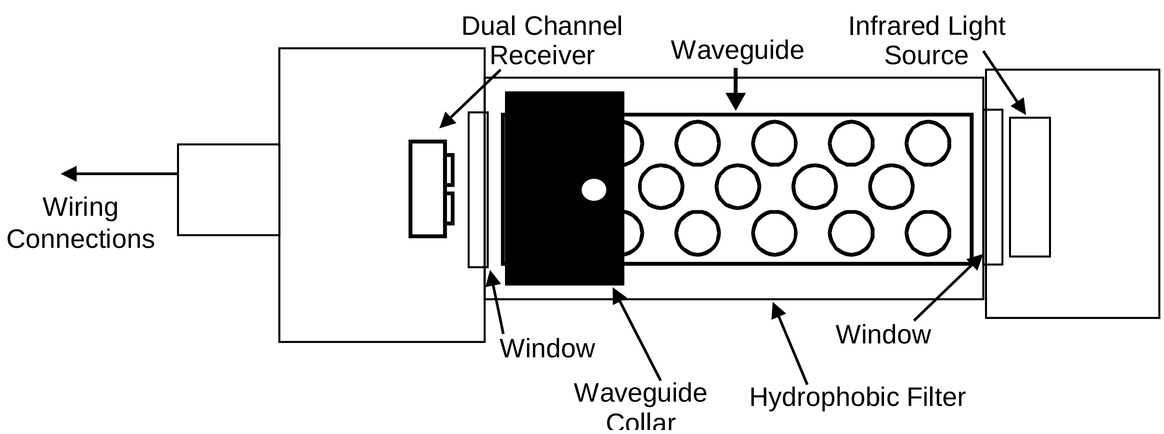
- Requires no routine calibration to ensure proper operation.
- Continuous self-test automatically indicates a fault, with fail to safe operation.
- A multi-layered filtering system protects optics from dirt and water ingress.
- Straight optical path eliminates the need for mirrors or reflective surfaces, such as mirrors or beam splitters.
- Performs well in the presence of high concentrations or constant background levels of hydrocarbons and in oxygen depleted atmospheres.
- Highly resistant to poisoning and etching.
- Standard 4 to 20 mA output (current source)
- Explosion proof housing designed for harsh environments.
- Smart Calibration AutoAC™ circuit.

Infrared Detection Technology

The SEC MILLENIUM Infrared gas detector uses infrared absorption technology for detecting combustible hydrocarbon gases. Gases absorb infrared light only at certain wavelengths. The concentration of a gas can be measured by the difference of two channels (wavelengths), a reference and a measurement channel. The SEC MILLENIUM uses a collimated infrared light source that passes through a waveguide, at the end of the waveguide is a dual channel receiver. The dual channel receiver measures the intensity of two specific wavelengths, one at an absorption wavelength and another outside of the absorption wavelength. The gas concentration is determined by a comparison of these two values.



The dual channel receiver is a single wafer, double filtered, dual receiver with an internal optical barrier. The elements are perfectly matched resulting in overall stability and superior performance throughout the entire temperature range.



Using a dual channel receiver there is no need to use any special lenses or beam splitters to achieve the different measurement bands.

The SEC MILLENIUM utilizes a unique, patented feature; the AutoAC™ circuit. The AutoAC™ circuit is an automatic analog control circuit, which allows the SEC MILLENIUM to be calibrated for any combustible hydrocarbon, provided that a calibration quality level of the gas is available. This eliminates setting dipswitches or changing out sensors for different types of hydrocarbons, simply calibrate the unit with a calibration gas of the specific gas to be detected.

The optics can be easily disassembled for cleaning. This does not require powering the unit down and does not compromise the units' explosion proof rating. The device will self-compensate for dirty optics until a point in which the optical surfaces are completely obscured.

There are no consumable components contained in this product.

III. OPERATION

Installation and Startup

⚠ Warning: If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The first step in the installation process is to establish a mounting location for the SEC MILLENIUM. Select a location that is typical of the atmosphere to be monitored or close to the anticipated source of a dangerous gas.

It is very important that the SEC MILLENIUM be properly located to enable it to provide maximum protection. The most effective number and placement of sensors vary depending on the conditions of the application. When determining where to locate sensors the following factors should be considered.

- What are the characteristics of the gas that is to be detected? Is it lighter or heavier than air? If it is lighter than air the sensor should be placed above the potential gas leak. Place the sensor close to the floor for gases that are heavier than air or for vapors resulting from flammable liquid spills. Note that air currents can cause a gas that is heavier than air to rise. In addition, if the temperature of the gas is hotter than ambient air or mixed with gases that are lighter than air, it could also rise.
- How rapidly will the gas diffuse into the ambient air? Select a location for the sensor that is close to the anticipated source of a gas leak.
- Wind or ventilation characteristics of the immediate area must also be considered. Movement of air may cause gas to accumulate more heavily in one area than in another. The detector should be placed in the areas where the most concentrated accumulation of gas is anticipated. For outdoor applications with strong wind conditions, it may require the sensors to be mounted closer together and on the downwind side, to the anticipated area of a gas leak. Also take into consideration for indoor applications, the fact that many ventilation systems do not operate continuously.
- The sensor should be accessible for maintenance.
- Excessive heat or vibration can cause premature failure of any electronic device and should be avoided if possible.
- Follow all national and local installation codes and practices.

The SEC MILLENIUM has a ¾" NPT threaded connector for mounting the detector to a junction box. SEC can provide a junction box with terminals for this purpose.

A user-supplied junction box can be used providing it has the appropriate sized NPT conduit entries. The junction box must be suitable for use in the application and location in which it is being installed.

After the device has been installed, a calibration is required. Refer to the Calibration section of this manual.

Wiring connections
Red wire: 18 to 32 VDC ⎓
Black wire: DC Common
Blue wire: 4 to 20 mA output
White wire: Smart Calibration Wire (data wire)
Earth Ground: Male 10-32 Stud on SEC Millenium cap, see figure 1.

Wire sizing:
0 to 500 feet, recommended wire gauge size 16 AWG
501 to 1000 feet, recommended wire gauge size 14 AWG

Shielded cable is recommended. Wiring should be installed in metal conduit with no other cabling in the same conduit.

Warm-up

When power is applied to the detector, it enters a one (1) minute warm-up mode. The output current will be 4.0 mA during the warm up time period. At the end of the warm-up period with no faults present, the detector automatically enters the normal operating mode and continues to show 4 mA. If a fault is present after warm-up, the detector current output will indicate a fault. See the following chart for fault code status.

Normal

In the normal operating mode, the 4-to-20 mA signal levels correspond to the detected gas concentration. The detector continuously checks for system faults or initiation of calibration and automatically changes to the appropriate mode.

The 4 to 20 mA output of the SEC MILLENIUM is a non-isolated current source.

Current Output and Corresponding Status

Current Output	Status.
4-20 mA	Normal measuring mode
0.0 mA	Unit Fault
0.2 mA	Reference channel fault
0.4 mA	Analytical channel fault
4.0 mA	Unit warm up
1.0 mA	Optics fault
1.2 mA	Zero drift fault
1.6 mA	Calibration fault
2.0 mA	Unit spanning
2.2 mA	Unit zeroing
4.0 mA	Zero gas level (0%LEL)
5.6 mA	(10%LEL)
8.0 mA	(25%LEL)
12 mA	(50%LEL)
16 mA	(75%LEL)
20 mA	Full scale (100% LEL)
20.1- 23 mA	Over-range (> 100% LEL)

Once the fault is cleared the SEC MILLENIUM will atomatically resume normal operation.

IV. CALIBRATION

SEC MILLENIUM

The SEC MILLENIUM is factory calibrated; zeroed and spanned. *Unlike catalytic sensors it does not require routine span gas calibration to ensure proper operation.*

The SEC MILLENIUM can be calibrated for almost any hydrocarbon using a calibration gas of the hydrocarbon that is to be detected (target gas). The SEC MILLENIUM is required to be spanned with gas only one time with the target gas. Typically this is done at the factory, but it is possible to field span the device by connecting the SEC MILLENIUM to a computer and using a software package provided by SEC. Please contact the factory for further details.

A typical field calibration only requires the use of zero air (or 99.99% nitrogen). *If the sensor is located in an area that is known to be free of the hydrocarbon gases then ambient air can be used as a zero reference.*

If zero air is used for the calibration, there is a fitting on the bottom of the sensor for a 1/8" ID tubing connection.

Before beginning calibration use the SEC MILLENIUM Insulation Tube to cover outer cylinder holes and connect a clean air source to the sensor's calibration port for a minimum of 3 minutes. To enter into the calibration mode the calibration wire must be connected to negative (common of the power supply) for ten (10) seconds, upon release the sensor will automatically enter the zero calibration routine. The electronics will automatically adjust the sensor's signal to the new zero reference level. (Applying span gas is not necessary because of the SEC MILLENIUM's unique software algorithms). During the zero calibration routine, the current output of the SEC MILLENIUM will go to 2.2 mA. Although this can be accomplished manually, installation of a switch (contact closure) can accomplish the zeroing procedure. It is recommended that this switch be a momentary type switch to prevent it from inadvertently being left in the calibrate position. If after 20 seconds the calibration lead has not been removed from common, the SEC MILLENIUM will ignore the signal and continue operation as normal.

The SEC MILLENIUM can be spanned in the field if the customer wishes to change the target hydrocarbon gas. Please contact factory for additional equipment information and pricing for SEC PC IR Link Package)

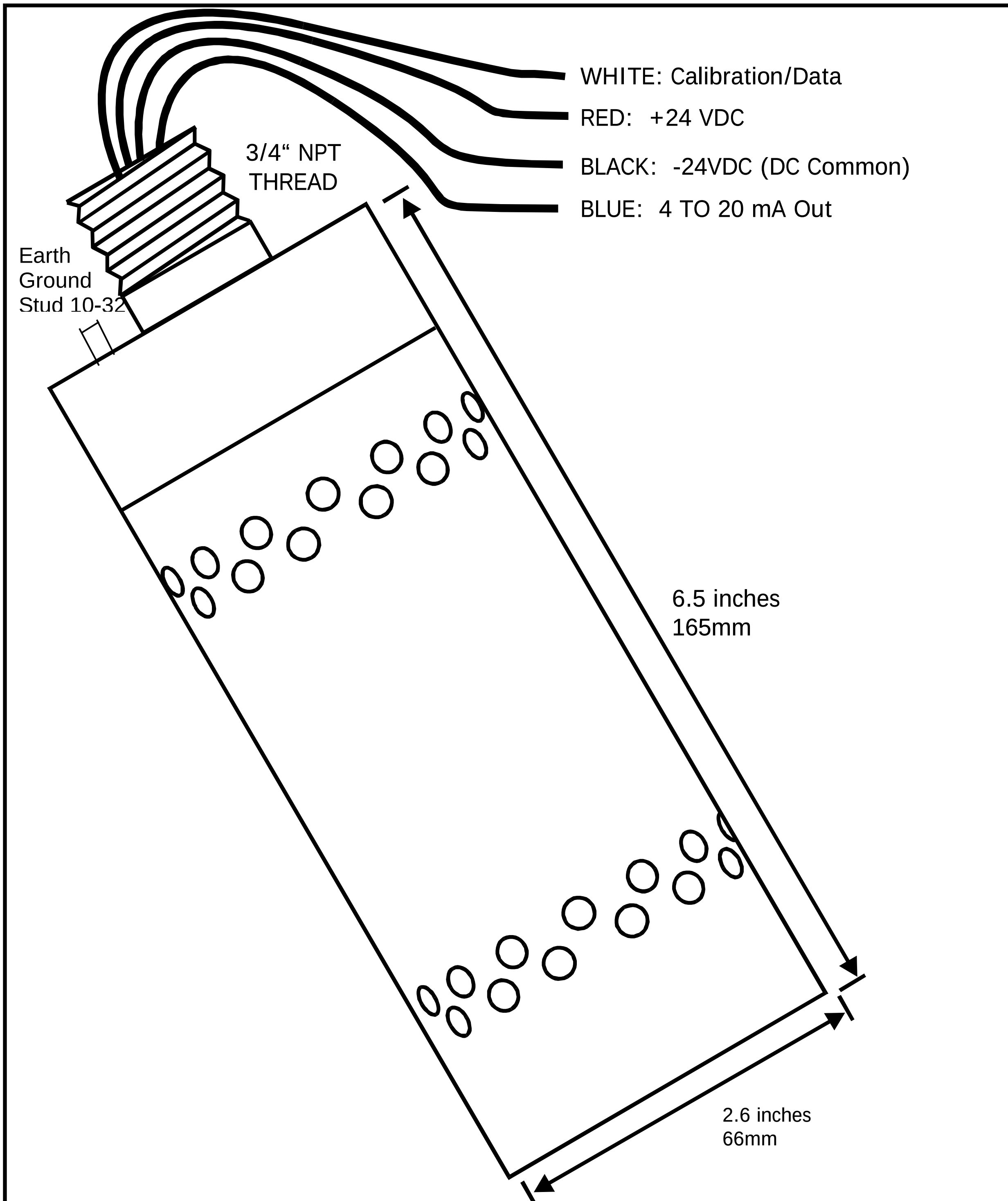
V. MAINTENANCE

The SEC MILLENIUM does not normally require cleaning of the optics. However if the unit is operating in a very dirty or dusty environment the optical path might become obscured. If the obscuration is severe enough to affect the unit's accuracy, the unit will activate an "Optics Fault". To clear an Optics Fault, first try a calibration. If the calibration does not correct the fault condition, try to clean the optics. The outer barrel (tube with two sets of holes) can be removed (unscrewed) to inspect the cleanliness of the hydrophobic filter. The hydrophobic filter is a Teflon coated stainless steel mesh that keeps moisture and particulates out of the optical path. A setscrew holds the filter to the MILLENIUM's housing. Once the hydrophobic filter is removed, the internal waveguide tube should be inspected for cleanliness. The waveguide and waveguide collar can be removed by inserting rigid instruments such as Allen wrenches into one hole of the waveguide and one hole of the collar. Turning the two instruments in opposite directions will loosen the waveguide allowing the collar to be screwed down on to the waveguide until it can be removed from the SEC MILLENIUM housing. This will allow the windows of the SEC MILLENIUM to be cleaned. Dust can be removed using compressed air. Hard or oily deposits can be removed using Isopropyl alcohol and cotton tipped swabs. Wipe any film or residue or film left by the alcohol on the windows with a clean dry cotton swab. The internal surface of the electro-polished wave-guide tube can be cleaned the same way. Be careful not to leave any particles of the cleaning swab in the waveguide. The waveguide holes can collect pieces of the cleaning swab. After reassembling the unit (the waveguide and collar should be very tight to both ends of the SEC MILLLENIUM housing after installation. Once the unit is completely reassembled and power is reapplied, the SEC MILLENIUM must be calibrated. Refer to the calibration section of this manual.

VI. Parts List

Part Number	Description
142-0280	Replacement Sensor SEC MILLENIUM
190-1001	SEC 2001 Sensor Separation Kit
142-0877	SEC Insulation Tube
142-0497	SEC MILLENIUM Replacement Hydrophobic Filter
142-0297	SEC MILLENIUM Wave Guide Tube
142-0570	SEC MILLENIUM Wave Guide Tube Collar
142-0636	SEC PC IR Link Kit

VII. Drawing Section



SENSOR ELECTRONICS

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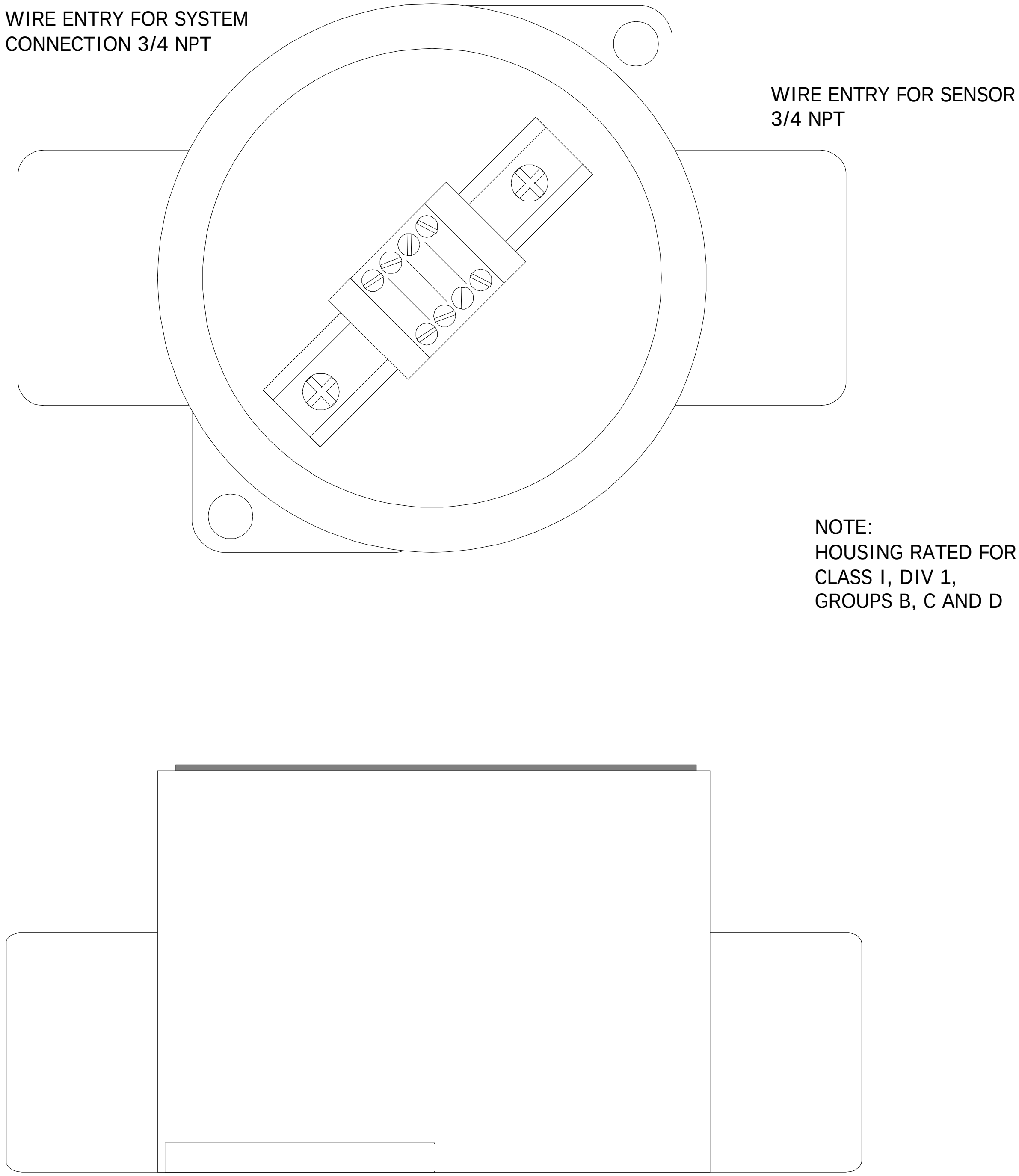
WIRING DIAGRAM
MILLENIUM SENSOR

FIGURE 1



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SEC SENSOR
SEPARATION KIT

FIGURE 2