Electro-Sentry 1
Installation & Operation Manual

Part Number: 990-005500
Revision D

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Introduction To This Manual

What is in this manual?

This installation and operation manual provides detailed technical information about the Electro-Sentry 1. It should serve as your technical resource to install, set up, operate, and test the Electro-Sentry 1.

Who should use this manual *(audience)*

Keep in mind that the function of the Electro-Sentry 1 installed in a mechanical process is to monitor speed and temperature; therefore, it must be installed by qualified personnel only. This manual is designed for persons who have the primary responsibility to install, set up, operate, and test the Electro-Sentry 1.

The secondary audience would be those persons seeking technical information about the electrical concepts and operation of the Electro-Sentry 1.

Knowledge level

Persons installing, setting up, and operating the Electro-Sentry 1 should have good knowledge and understanding of electrical and mechanical concepts and principles pertaining to speed and temperature monitoring and associated alarms.

Again, the Electro-Sentry 1 should be installed by qualified personnel only.

Notices

- Installing Electro-Sensors, Inc., products is the responsibility of the purchaser, and is in no way guaranteed by Electro-Sensors, Inc.
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Electro-Sentry 1 Quick Start Guide

Here are the basic questions/steps the user needs to perform to get the Electro-Sentry 1 (a.k.a. ES1) up and running:

1) What is the application's voltage? 115 or 230 Vac?

VAC	SW1 Position	Fuse F12	Notes:
115	Towards Right	115Vac/0.4Amp Slo-Blo	Factory Setting
230	Towards Left	230Vac/0.2Amp Slo-Blo	User Selectable

(The ES1 is shipped with one 230Vac/0.2 Amp Slo-Blo fuse, and one extra 115Vac/0.4 Amp Slo-Blo fuse).

2) Do you need to display speed, or need Speed Alarm Monitoring?

A) NO, Speed Display/Alarm Monitoring is not needed:

- Skip User Variables **Var01** through **Var08**.
- Skip the setting of the **SW9** 3-DIP Switch.
- Set **Var09** Speed_Display_Select to either a '0002' or a '0003' to disable Speed Monitoring, as needed.
- Skip **Var10** MAX_ANALOG_RPM.
- Skip **Var34** Hour_and_Speed_Command_Select for now. [If you plan to use the Hour Meter feature, we will return to **Var34** later in section (5) below].

B) YES, Speed Alarm Monitoring and/or Speed Display is needed:

- What type of Speed encoder are you using? A 4-20 mA Analog encoder or a Pulse-Train encoder?
- Set **Var01** Encoder_Type_Select, as needed:

'0000' = 4-20 mA Analog Speed Encoder Type (speed signal is received at **TB16**).

'0001' = Pulse-Train Speed Encoder Type (speed signal is received at **TB30**). When Var01 = 0001, then you need to set the **SW9** 3-DIP Switch for NPN or PNP/ 5V logic-level Encoder Type, as needed per your pulse-train encoder. The SW9 DIP switch is on the back side of the Front Panel, to the left of the J7 ribbon cable. **The Factory default setting of SW9 is for an NPN Pulse-Train Encoder (which is SW9's switch #1 = ON, switch #2 = OFF, switch #3 = OFF).** Note: Electro-Sensors Pulse-Train Encoders are NPN encoders.

Variable	Default Value	User's Value
Var01 Encoder_Type_Select. 0000 = 4-20mA Analog Encoder. 0001 = Pulse-Train Encoder.	0000	

For applications using a **4-20 mA Analog Speed Encoder** (i.e., **Var01** = 0000):
Set the following variables as needed:

Variable	Default Value	User's Value
Var02 Pulse_Per_Rev Value.	N.A.[1]	N.A.[1]
Var03 RPM_at_20mA. This is the analog encoder's rated RPM corresponding to 20mA. (See Note[2]).	0200 RPM	
Var10 MAX_ANALOG_RPM. This is the peak RPM seen by the analog encoder in the application, and the 100% RPM on which the speed setpts are based.	0200 RPM	
Var04 Speed_Slowdown_Alarm_ SetPt %. (See Note[3]). This is the 'Yellow_Alarm' speed expressed as a % of **Var10** MAX_ANALOG_RPM.	0090 %	
Var06 Speed_Shutdown_Alarm_ Setpt %. (See Note[3]). This is the 'Red_Alarm' speed expressed as a % of **Var10** MAX_ANALOG_RPM.	0080 %	

Note[1]: "N.A." means not applicable to this portion of Electro-Sentry 1 set-up.

Note[2]: The definition of **Var03** is slightly different when **Var01** is programmed for an analog speed encoder versus a pulse-train speed encoder.

Note[3]: If you only need to display the speed, without Speed Alarm Monitoring, then you can skip setting **Var04** and **Var06**. But you then need to set **Var09** to either a '0002' or '0003' as needed per your speed viewing needs. (More about **Var09** on next page).

For applications using a **Pulse-Train Speed Encoder** (i.e., **Var01** = 0001): Set the following variables as needed:

Variable	Default Value	User's Value
Var02 Pulse_Per_Rev Value. Most Electro-Sensors pulser targets give 8 PPR.	0008 PPR	
Var03 PULSE_MAX_RPM. This is the peak RPM of the rotating pulser target seen in the application, and the 100% RPM on which the speed setpts are based. (See Note[2]).	0200 RPM	
Var10 MAX_ANALOG_RPM	N.A.	N.A.
Var04 Speed_Slowdown_Alarm_ SetPt %. (See Note[3]) This is the 'Yellow_Alarm' speed expressed as a % of **Var03** PULSE_MAX_RPM.	0090 %	
Var06 Speed_Shutdown_Alarm_ Setpt %. (See Note[3]) This is the 'Red_Alarm' speed expressed as a % of **Var03** PULSE_MAX_RPM.	0080 %	

For **either type of Speed Encoder** (i.e., **Var01** = 0000 or 0001): Set the following variables as needed:

Variable	Default Value	User's Value
Var05 Speed_Slowdown_Alarm_ Delay	0001 sec	
Var07 Speed_Shutdown_Alarm_ Delay	0001 sec	
Var08 Underspeed_Start_Delay	0005 sec	
Var09 Speed_Display_Select. 0000 = % and Enable. 0001 = RPM and Enable. 0002 = % and Disable 0003 = RPM and Disable (See Note[3])	0000	
Var34 Hour_and_Speed_ Command_Select. 0000 = Maintained Disable/Enable. 0001 = One-Shot Disable/Enable with Disable = Closed. 0002 = One-Shot Disable/Enable with Disable = Open.	0000	

Factory default for Var34 is 0000 for a 'Maintained' Disable/Enable command needed at input TB34.

Note: See the "**UserVar Variables**" section in the Reference portion of the User Manual for details on any of the above mentioned **VarXX's**, if so needed.

What Speed alarms do you need?

Is a Speed Slowdown Warning Alarm or a Speed Shutdown Alarm needed?

If so, connect the application's 'alarm' circuitry to the ES1's terminal blocks as shown in the following table:

Function	Relay Output#	Terminal Blocks
Speed (or temperature) Shutdown Alarm	4	TB24 TB23
Speed (or temperature) Warning Alarm	3	TB22 TB21
Speed Only Shutdown Alarm	2	TB20 TB19
Speed Only Warning Alarm	1	TB18 TB17

(These four ES1 relay outputs are 'Dual Form C SPDT'). See Reference portion of the User Manual, pages 16, 18, and 19, for details on any of the above mentioned terminal blocks, if so needed.

3) How to set-up your Electro-Sentry 1 for Temperature Monitoring:

A) The application's Temperature sensors are typically connected to the Electro-Sentry 1's 4-20 mA Analog Inputs as follows:

Terminal Block	Analog Input #	Description
TB1	1	Head Bearing Left
TB2	2	Head Bearing Right
TB3	3	Head Rub Block Left
TB4	4	Head Rub Block Right
TB5	5	Knee Bearing Left
TB6	6	Knee Bearing Right
TB7	7	Knee Rub Block Left
TB8	8	Knee Rub Block Right
TB9	9	Tail Bearing Left
TB10	10	Tail Bearing Right
TB11	11	Tail Rub Block Left
TB12	12	Tail Rub Block Right

For the TB1 through TB12 terminal blocks:
Pin1 = +24Vout_A, Pin 2 = 4-20 mA Signal Input, Pin 3 = Gnd_A.

B) All 12 Analog Inputs can be setup for sensors having a Temperature proportional 4-20mA output. Six Analog Inputs can also be setup for sensors having a Contact Closure output, as shown in the following table.

Terminal Block	Analog Input #	Temp Sensor[4]	Contact Closure	Var11
TB1	1	Yes	No	N.A.
TB2	2	Yes	No	N.A.
TB3	3	Yes	Yes	See Var11
TB4	4	Yes	Yes	See Var11
TB5	5	Yes	No	N.A.
TB6	6	Yes	No	N.A.
TB7	7	Yes	Yes	See Var11
TB8	8	Yes	Yes	See Var11
TB9	9	Yes	No	N.A.
TB10	10	Yes	No	N.A.
TB11	11	Yes	Yes	See Var11
TB12	12	Yes	Yes	See Var11

If your application uses Contact-Closure sensors for Rub Blocks, etc, then see page 3 of the Reference portion of the User Manual for details on how to setup **Var11.**

Note[4]: Factory default for Var11 is 0000, for all Analog Inputs are set for 4-20 mA Temperature sensors.

C) For those Analog Inputs that you are not using (i.e., those Analog Inputs having no Temperature sensors or no Contact-Closure sensors connected to them): You must turn 'OFF' the effect of any unused Analog Inputs by setting their BIAS Temperature Setpts to '**0999**'. The BIAS Setpts are in **Var14 through Var25**, and correspond to the 4-20 mA Analog Inputs as follows:

Var#	Description	Default Value	User's Value
14	Input #1 BIAS Temperature SetPt.	0000	
15	Input #2 BIAS Temperature SetPt.	0000	
16	Input #3 BIAS Temperature SetPt.	0000	
17	Input #4 BIAS Temperature SetPt.	0000	
18	Input #5 BIAS Temperature SetPt.	0000	
19	Input #6 BIAS Temperature SetPt.	0000	
20	Input #7 BIAS Temperature SetPt.	0000	
21	Input #8 BIAS Temperature SetPt.	0000	
22	Input #9 BIAS Temperature SetPt.	0000	
23	Input #10 BIAS Temperature SetPt.	0000	
24	Input #11 BIAS Temperature SetPt.	0000	
25	Input #12 BIAS Temperature SetPt.	0000	

The factory default settings for all the BIAS Temperature Setpts Var14 through Var25 is 0000, which enables all Analog Inputs, but which disables their BIAS alarm feature. (More details about the BIAS alarm feature later).

D) What temperature scale do you want to use, F° Fahrenheit or C° Celsius?
Set **Var30** Temperature_Display_Select as needed.

Variable	Default Value	User's Value
Var30 Temperature_Display_ Select. 0000 = Fahrenheit, F°. 0001 = Celsius, C°.	0000 (F°)	

E) What temperature levels do you want for the 'Yellow_Alarm' Warning Setpt, and the 'Red_ Alarm' Shutdown Setpt?
Set the following variables as needed:

Variable	Default Value	User's Value
Var12 Warning_Setpt_ Temperature ('Yellow_Alarm')	0160 degrees	
Var13 Shutdown_Setpt_ Temperature ('Red_Alarm')	0175 degrees	

F) Do you want to use the **BIAS Temperature Setpt** alarm feature?
This is where the temperature difference (or deviation) of a left-side temperature sensor triggers a BIAS Setpt 'Yellow_Alarm' if it exceeds its right-side companion sensor by the left-side BIAS Setpt amount (and likewise vice-versa). The BIAS Setpts are in **Var14 through Var25 (as shown in the table to the left).**
The factory default settings for all the BIAS Temperature Setpts Var14 through Var25 is 0000, which enables all Analog Inputs, but which disables their BIAS alarm feature.
See the table on page 5 of the Reference portion of the User Manual for more details about left-side/right-side temperature sensor BIAS companion pairs.

- If you want to use the **BIAS Temperature Setpt** alarm feature, then set the desired Analog Input's **VarXX** BIAS Temperature Setpt to the deviation desired, in degrees.
  – For example, set left-side Input #1 temperature sensor's BIAS setpt **Var14** to 0020 degrees if you want a BIAS Setpt 'Yellow_Alarm' to happen when Input #1's temperature rises 20 degrees higher than its right-side companion's temperature at Input #2.

- If you do NOT want to use the **BIAS Temperature Setpt** alarm feature, then set (or leave) the desired Analog Input's **VarXX** BIAS Temperature Setpt to 0000 (to disable the BIAS Setpt feature).

See section (**3, A**) above for which Analog Input is a left-side input and which Analog Input is a right-side input (as set by the position of the Analog Input's corresponding 3-digit LED display on the ES1's Front-Panel).
See section (**3, C**) above for the correlation between **VarXX** BIAS Temperature Setpts and the Analog Input #'s.
See the "**UserVar Variables**" section in the Reference portion of the User Manual for details on any of the above mentioned **VarXX's**, if so needed.

G) What Temperature or Contact Closure alarms do you need?
Is a Temperature or Contact Closure Warning Alarm or a Temperature Shutdown Alarm needed?
If so, connect the application's 'alarm' circuitry to the ES1's terminal blocks as shown in the following table:

Function	Relay Output#	Terminal Blocks
(Speed or) Temperature Shutdown alarm (N/A to Contact Closure)	4	TB24 TB23
(Speed or) Temperature/ Contact Closure Warning alarm	3	TB22 TB21

(These two ES1 relay outputs are 'Dual Form C SPDT').

4) Do you need a Horn, a Red Light, a Yellow Light, or a Green Light for audio/visual alarm indication, whenever a Speed alarm, a Temperature alarm or a Contact Closure alarm occurs?

A) If you need a Horn, then set **Var33** Horn_Operation_ Select, as needed:

Variable	Default Value	User's Value
Var33 Horn_Operation_Select. See details in Reference Section. Note: A setting of 0999 is for a solid blast until a manual 'Silence_Horn/Alarm_RESET' command is given.	0999	

See Reference portion page 6 for details on **Var33**.
Then connect the application's 'Horn' circuitry to the ES1 as shown in the table below.

B) If you need a Red Light, a Yellow Light, or a Green Light then connect the application's 'Light(stack)' circuitry to the ES1's terminal blocks as shown in the following table:

Horn or Light(stack)	Relay Output #	Terminal Block
Horn	8	TB28
Red Light(stack)	7	TB27
Yellow Light(stack)	6	TB26
Green Light(stack)	5	TB25

(These four ES1 relay outputs are 'Single Form A SPST').

5) Do you need to use the Hour Meter?

A) NO, the Hour Meter is not needed:

- Skip User Variables **Var31** and **Var32**.
- Skip **Var34** Hour_and_Speed_Command_Select [unless you already set-up **Var34** for Speed Monitoring - then leave **Var34** 'as-is'].

B) YES, the Hour Meter is needed:
Set the following variables as needed:

Variable	Default Value	User's Value
Var31 Hour_Meter_Warning_ Time	9000 Hours	
Var32 Hour_Meter_ Maintenance_Time	9500 Hours	
Var34 Hour_and_Speed_ Command_Select. 0000 = Maintained Disable/Enable. 0001 = One-Shot Disable/Enable with Disable = Closed 0002 = One-Shot Disable/Enable with Disable = Open.	0000	

Note: The Hour Meter increments and its discrete Green/ Yellow/Red LEDs light-up only if all of the following are true:

- If **Var31** is non-zero. (i.e., **Var31** = 0000 disables the Hour Meter).
- AND If in Normal Mode, not in Program Mode. (i.e., Being in Program Mode disables the Hour Meter).
- AND If the Hour_and_Speed_Enable command is present. (i.e., The Hour_and_Speed_Disable command disables the Hour Meter).

If any one of these three prerequisites are NOT met, then the Hour Meter does NOT increment hours, NOR do the Hour Meter's discrete Green/Yellow/Red LEDs light-up as per the number of hours reached.

6) Leave **Var35** Test Mode Select at the default value of '0000', to operate the ES1 in the 'real-live-data-mode'.

7) Please see the Reference Section of the User Manual for details of any of the UserVars.

8) Please see the Reference Section of the User Manual for details of the TBx terminal blocks (found on pages 18 and 19 of the Reference Section), or use the handy diagram silkscreened into the back side of the Front-Panel.

9) For easy reference, log your user variable values in the chart on the inside of the Electro-Sentry 1's front cover.

Electro-Sentry 1 Reference Manual

Description

The Electro-Sentry 1 (a.k.a. ES1) is a Complete Single-Leg Hazard Monitoring System. The ES1 contains the following:

- At-a-glance Temp/Speed monitoring with alarm identification, for up to twelve 4-20 mA analog Temperature sensors, and for one 4-20 mA analog or pulse-train Speed sensor.
- 8 relay outputs, for Temperature/Speed alarms, for a Green/Yellow/Red Lightstack operation, and for a Horn.
- Built-in Hour Meter to aid in maintenance schedules.
- Minimal end-user calibration and setup, with calibration stored in non-volatile EEPROM memory.
- Easy one-button tests of systems and alarms, for simulating temperature increases and speed decreases.
- Rugged, industrial-duty systems and sensors.

Front-Panel Displays

- Twelve Temperature 3-digit LED displays, each with its own discrete Green/Yellow/Red status LED.
- One Speed 4-digit LED display, with its own discrete Green/Yellow/Red status LED.
- One Hour Meter 4-digit LED display, with its own discrete Green/Yellow/Red status LED.
- One Four-digit LCD display to aid in programming UserVars (located in lower-left-corner of Front-Panel).

Front-Panel User Interface

- Four Push-buttons for programming UserVars. The buttons are ENTER, SHIFT-LEFT, INCRement, and DECPT.
- One Push-button for Hour_Meter_RESET.
- One Push-button for Test_Left_Side_Temperature_Rise.
- One Push-button for Test_Right_Side_Temperature_Rise.
- One Push-button for Test_Speed_Drop.

Enclosure

The enclosure is rated: NEMA 3R, NEMA 4, NEMA 4X, and NEMA 12. Customer to cut their own conduit holes, preferably in the bottom wall of the enclosure.

Modes of Operation:

The Electro-Sentry 1 has two modes of operation, **Normal Mode** and **Program Mode**.

When in either mode the Front-Panel temperature and speed displays, and their alarms are active. The presence of either mode can be seen by looking at the small four-digit LCD display located in the lower-left-corner of the Front-Panel, as follows.

Normal Mode

This mode is the normal operation mode, and it is to be used when the user is NOT changing any of the UserVars.

The Normal Mode is indicated by the absence of the "VAR" icon in the lower-left-corner of the LCD display.

Program Mode

This mode allows the user to change the UserVar variables. The LCD display will display the name of the present active variable (as 'PrXX') or its value (as 'XXXX').

The Program Mode is indicated by the presence of the "VAR" icon in the lower-left-corner of the LCD display.

Entering and Using Program Mode:

Programming is accomplished by using the four pushbuttons located in the lower left corner of the Front-Panel.

The four UserVar programming buttons are ENTer, Shift-left, INCRement, and DECPT.

a) Press the ENTer button. The "Var" icon will display on the LCD and the 4 digits will show "PR01".

b) Press the INCRement button repeatedly until you get to the variable you want to change.

c) Press the ENTer button to access that variable.

d) While in that variable you must press the INCRement button to change the active digit (flashing digit), then press the Shift-left button to work your way through all accessible digits. (Not all digits are accessible in all UserVars).

e) When you are done with that variable press the ENTer button to save that new UserVar value, and return to the 'PrXX' list.

f) To step to the next variable in the 'PrXX' list press the INCRement button.

g) To exit the Program Mode and get back to Normal Mode, repeatedly press the INCRement button while in the 'PrXX' list until the "VAR" icon disappears, or simply press the DECPT button while in the 'PrXX' list to make a 'quick-exit' out of Program Mode.

Note: If the user does NOT manually exit the Program Mode, and if there is no further activity in Program Mode for one minute, then the ES1 **automatically exits** the Program Mode.

- When this **'auto-exit'** is performed, any UserVar that was changed and accepted by pressing the ENTER button during the present Program Mode session will have their new value properly retained.
- If the LCD screen was displaying a UserVar's value (and not displaying the name 'PrXX') at the instant the **'auto-exit'** was performed, then that particular UserVar value is restored to its previous value (and its new unsaved value is lost). This since the user had NOT pressed the ENTER button during the present Program Mode session to accept the present 'flashing' new value of that UserVar.

Note: Electro-Sentry 1's UserVars all have the decimal point locked in the far right position.

How to reset the Electro-Sentry 1's UserVars back to factory-defaults

Use this procedure to reset the Electro-Sentry 1's UserVars back to factory-default values:

1) Remove the Vac power.
2) Simultaneously press and hold the INCRement and ENTER buttons (located just below the small four-digit LCD display in the lower-left-corner of the Front-Panel).
3) Re-apply the Vac power.
4) When the small LCD display shows "rESE", release the buttons. (The UserVars have now been automatically reset to their factory-default values).

The UserVar Variables:

Speed variables (Var01 through Var10)

The Electro-Sentry 1 has two speed signal inputs (only one at a time can be programmed for use, as per **Var01**):

- the first input accepts a 4-20 mA signal (**TB16**),
- the second input accepts pulse train signals (**TB30**).

Var01. Encoder_Type_Select.

The **Var01** range is limited to these below listed choices:

Var01 Value	Encoder Type Selection	Speed Signal Input	Speed vs. mA or RPM Reference Points
0000	4-20mA Analog	TB16	0% speed = 4mA = 0 RPM. 20mA = **Var03**_RPM_at_20mA (but this 20mA point is NOT necessarily the 100% speed point. See **Var10** MAX_ANALOG_RPM for related information).
0001	Pulse-Train	TB30	0% speed = 0 RPM. 100% speed = **Var03**_PULSE_MAX_RPM

Factory default for Var01 is 0000 for 4-20 mA Encoder Type.

If **Var01**=0001 for Pulse-Train Encoder Type, then the NPN vs PNP or 5V logic-level Encoder Type is further selected by SW9 (the 3-pin DIP switch located on the back side of the Front Panel, to the left of the J7 ribbon cable) as follows:

SW9 Switch			
Switch Pin #	1 Pullup	2 Pulldown	3 Cap filter
NPN	ON	OFF	OFF
PNP, 5V Logic	OFF	ON	OFF

Note: Switch 'ON' is towards your right when facing SW9.

Var02. Pulse_Per_Rev Value.

This is the number of pulses generated by the rotating magnetic target.

Var02 range is 0000 to 9999 PPR.

Factory default for Var02 is 0008 PPR,

Note: If **Var01**=0000 for the 4-20 mA Analog Encoder Type, then **Var02** is irrelevant and its value is ignored, and a value of 60 PPR is assumed for internal frequency calculations.

Var03. PULSE_MAX_RPM or RPM_at_20mA.

If **Var01**=0000 for 4-20mA encoder type, then **Var03** is the encoder's rated RPM that corresponds to a 20mA output.

If **Var01**=0001 for Pulse-Train encoder type, then **Var03** is the maximum RPM of the rotating magnetic target seen in the application.

Var03 range is 0000 to 9999 RPM.

Factory default for Var03 is 0200 RPM.

Var04. Speed_Slowdown_Alarm_Setpt_%

Var04 is the speed at which a slowdown warning alarm occurs, as expressed in % of **Var03** PULSE_MAX_RPM for pulse-train encoders, and % of **Var10** MAX_ANALOG_RPM for 4-20mA encoders.

(Alarms as: Speed display's discrete Yellow-LED / Yellow-Lightstack-Relay / Speed-Only-Warning-Relay / Speed-Temperature-Warning-Relay / Horn-Relay).

Var04 range is 0000 to 2000 %.

Factory default for Var04 is 0090 %.

Var05. Speed_Slowdown_Alarm_Delay.

This is the number of seconds to wait after the speed has dropped below the slowdown Setpt, before actually triggering the alarm.

Var05 range is 0000 to 0030 seconds.

Factory default for Var05 is 0001 second.

Var06. Speed_Shutdown_Alarm_Setpt_%.

Var06 is the speed at which a shutdown alarm occurs as expressed in % of **Var03** PULSE_MAX_RPM for pulse-train encoders, and % of **Var10** MAX_ANALOG_RPM for 4-20mA encoders.

(Alarms as: Speed display's discrete Red-LED / Red-Lightstack-Relay / Speed-Only-Shutdown-Relay / Speed-Temperature-Shutdown-Relay / Horn-Relay).

Var06 range is 0000 to 2000 %.

Factory default for Var06 is 0080 %.

Var07. Speed_Shutdown_Alarm_Delay.

This is the number of seconds to wait after the speed has dropped below the shutdown Setpt, before actually triggering the alarm.

Var07 range is 0000 to 0030 seconds.

Factory default for Var07 is 0001 second.

Var08. Underspeed_Start_Delay_Time.
This is the number of seconds to wait after an Hour_and_Speed_Enable command has been given, before enabling speed monitoring.
Var08 range is 0000 to 0030 seconds.
Factory default for Var08 is 0005 seconds.

Var09. Speed_Display_Select.
Show speed in % or RPM on the 4-digit LED Speed Display, and Enable/Disable Speed Alarm Monitoring.
The **Var09** range is limited to the display selections listed below:

Var09 Value	Display Selection	Speed Alarm Monitoring
0000	Speed in %	Enabled
0001	Speed in RPM	Enabled
0002	Speed in %	Disabled
0003	Speed in RPM	Disabled

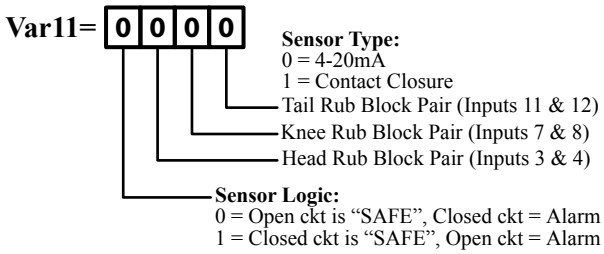
Factory default for Var09 is 0000 for speed in '%' and Speed Alarm Monitoring enabled.

Var10. MAX_ANALOG_RPM.
When **Var01**=0000 for 4-20mA analog encoder type, then **Var10** MAX_ANALOG_RPM is the maximum RPM seen by the 4-20mA encoder in the application.
Note: **Var10** is meant to be used when the application's maximum speed is less than the analog speed encoder's rated 20mA RPM (i.e. a **Var10** less than **Var03**).
Var10 range is 0000 to 9999 RPM.
Factory default for Var10 is 0200 RPM.
Note: If **Var01** is set for Pulse-Train encoder type, then **Var10** is irrelevent and it's value is ignored.

Sensor Type Select Variable (Var11)

Var11. Belt_Alignment_Sensor_Type_Select.
Var11 allows the Analog Inputs #'s 3, 4, 7, 8, 11, and 12, to be programmed for either 4-20mA Temperature type sensors or for Contact-Closure type sensors. Rub Block sensors are always expected to be operated in pairs and are horizontally across from each other on the ES1's Front-Panel.

Var11 range is 0000 to 1111, with only **0**'s and **1**'s allowed.
The left-most-digit programs the Contact-Closure's Sensor Logic.
The three-right-most-digits program the Analog Input pair's Sensor Type.



- Left-most-digit = '0': programs the normally 'Open-circuit' case as the 'non-alarm' Green zone state, and the Contact-Closure's 'Closed -circuit' case as the 'Yellow_Alarm' state.
- Left-most-digit = '1': programs the normally 'Closed-circuit' case as the 'non-alarm' Green zone state, and the Contact-Closure's 'Open-circuit' case as the 'Yellow_Alarm' state.

Factory default for Var11 is 0000, for all Analog Inputs are set for 4-20 mA temperature sensors.

Notes for **Var11**:
- When a Contact-Closure sensor gives an alarm it is a 'Yellow_Alarm' only (i.e., no 'Red_Alarm' for a Contact-Closure).
- When a Contact-Closure sensor 'alarms', it alarms with the corresponding 3-digit display's discrete Yellow-LED / Yellow-Lightstack-Relay / Speed-Temperature-Warning-Relay / Horn-Relay, and the 3-digit LED display shows 'ALr'. If the Contact-Closure sensor were to return to the Green zone 'non-alarm' state, then the 'Yellow_Alarm' remains 'latched', with the 3-digit LED display remaining at 'ALr'. Once the Contact-Closure sensor has returned to the Green zone 'non-alarm' state, then to 'clear' the latched 'Yellow_Alarm' the user must give a 'Silence_Horn/Alarm_RESET' command to the ES1. (See Operating Note section "How to Clear Alarms" for details.)

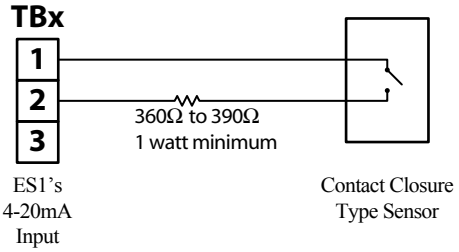
(Var11 continued on next page).

- When the message '**bAd**' is shown on the Contact Closure's corresponding 3-digit LED display, the associated relays go into a 'Yellow_Alarm' to indicate that something is NOT normal. Most likely the user has programmed for a Contact-Closure sensor, while they are still using a 4-20 mA type temperature sensor. ('**bAd**' means verify sensor type).

Contact Closure's Input Current Range	Defined State	Message on 3-digit LED display
20.83mA or more	Closed-Circuit (Valid)	SAF or ALr, as per Var11 (Valid)
1.1mA to 20.8mA	Bad Sensor (Invalid)	bAd (Verify sensor type)
1mA or less	Open-Circuit (Valid)	SAF or ALr, as per Var11 (Valid)

- Changes to the "**Var11**_Belt_Alignment_Sensor_Selection" automatically clear any corresponding 'orphaned' alarms when changing sensor pairs from Temperature sensors to Contact-Closure sensors, and vice versa.
- A Contact-Closure input can be turned 'OFF' completely by setting the input's BIAS setpt to '0999'. See discussion on **Var14** through **Var25** setpts below. (However note, the BIAS feature itself is not applicable to Contact-Closure sensors).

IMPORTANT NOTE: If an analog input is programmed for use with a Contact-Closure type sensor, then an external **resistor between 360Ω to 390Ω (1 watt minimum)** must be used 'in-line' with the corresponding Analog Input's Signal terminal **(TBx pin2)**, as shown in the figure below.
The Electro-Sentry 1 is supplied with (8) eight 360Ω, 1 watt resistors.



The Warning and Shutdown SetPt Temperature Variables (Var12 and Var13)

Var12. Warning_Setpt_Temperature degrees (for all temperature sensors).
If a Temperature Sensor exceeds this SetPt, then the ES1 gives an alarm by the corresponding temperature display's discrete Yellow-LED / Yellow-Lightstack-Relay / Temperature-Warning-Relay / Horn-Relay, and the 3-digit LED display 'Latches' the highest value reached.
Var12 range is 0000 to 0250 degrees.
Factory default for Var12 is 0160 degrees.

Var13. Shutdown_Setpt_Temperature degrees (for all temperature sensors).
If a Temperature Sensor exceeds this SetPt, then the ES1 gives an alarm by the corresponding temperature display's discrete Red-LED / Red-Lightstack-Relay / Temperature-Shutdown-Relay / Horn-Relay, and the 3-digit LED display 'Latches' the highest value reached.
Var13 range is 0000 to 0250 degrees.
Factory default for Var13 is 0175 degrees.

Notes: For Var12 and Var13: To 'clear' the latched Yellow or Red_Alarm the user must give a 'Silence_Horn/Alarm_RESET' command to the ES1 once the temperature has dropped below the associated setpt. (See Operations Notes Section "How to Clear Alarms" for details).

The BIAS Setpt Temperature Variables (Var14 through Var25)

The below listed BIAS Setpts set the temperature difference (or deviation) at which a left-side temperature sensor triggers a BIAS Setpt 'Yellow_Alarm' if it exceeds its right-side companion sensor by the left-side BIAS Setpt amount.
And likewise vice-versa if a right-side sensor exceeds its left-side companion sensor by the right-side BIAS Setpt amount.
Each sensor input has its own BIAS Setpt, with range 0000 to 9999.

- A BIAS Setpt = 0000 enables the Analog Input, but disables its BIAS Alarm "Left-side sensor vs. Right-side sensor" comparison feature.
- A BIAS Setpt between 0001 and 0998 enables the Analog Input, and enables its BIAS Alarm feature by giving it the desired temperature deviation SetPt value.
- A BIAS Setpt = 0999 disables an Analog Input completely by turning 'OFF' that particular temperature sensor's input and its effects on the temperature alarms. The sensor's 3-digit LED display then shows 'OFF".

Note: Even though the BIAS setpts accept up to 0998 degrees, typical ESI sensors only run up to 248 degrees.

The BIAS Setpts are in **Var14** through **Var25**, and all have **a factory default of 0000, which enables all analog inputs, but which disables their BIAS alarm feature.**
The left-side/right-side BIAS 'companion' pairs are listed below with their associated analog input, UserVar variable, and nomanclature.

Input #	Variable	Nomanclature
1	Var14	Head Bearing Left BIAS SetPt
2	Var15	Head Bearing Right BIAS SetPt
3	Var16	Head Rub Block Left BIAS SetPt
4	Var17	Head Rub Block Right BIAS SetPt
5	Var18	Knee Bearing Left BIAS SetPt
6	Var19	Knee Bearing Right BIAS SetPt
7	Var20	Knee Rub Block Left BIAS SetPt
8	Var21	KneeRub Block Right BIAS SetPt
9	Var22	Tail Bearing Left BIAS SetPt
10	Var23	Tail Bearing Right BIAS SetPt
11	Var24	Tail Rub Block Left BIAS SetPt
12	Var25	Tail Rub Block Right BIAS SetPt
13	Var26	Unused / Reserved
14	Var27	Unused / Reserved
15	Var28	Unused / Reserved
16	Var29	Unused / Reserved

When a BIAS Setpt's deviation value is exceeded, it gives an alarm by turning ON the corresponding temperature display's discrete Yellow-LED, plus putting the Yellow-Lightstack-Relay / Speed-Temperature-Warning-Relay / Horn-Relay, all into their alarm states.
Also, once a sensor goes into a BIAS Setpt 'Yellow_Alarm', its 3-digit LED display 'Latches' the highest value reached. To 'clear' the latched BIAS Setpt 'Yellow_Alarm' the user must give a 'Silence_Horn/Alarm_RESET' command to the ES1 once the temperature has dropped below the BIAS setpt. (See Operations Notes Section "How to Clear Alarms" for details).

Var30. Temperature_Display_Select. (Temperature in Fº Fahrenheit or Cº Celsius).
The **Var30** range is limited to these below listed choices:

- '0000' = display temperatures in Fº Fahrenheit.
- '0001' = display temperatures in Cº Celsius.

Note: If you setup your ES1 to display temperatures in Fahrenheit Fº and have your temperature setpts in Fº, and then later change **Var30** to Celsius Cº, the ES1 does NOT automatically convert the setpts over to equivilent Cº values, (or vice versa Cº to Fº)

Factory default for Var30 is 0000 for degrees Fahrenheit.

System Variables (Var31 through Var36)

Var31. Hour_Meter_Warning_Time in Hours.
(Alarms as: Hour Meter display's discrete Yellow LED only, with no relays involved).

The Hour Meter keeps track of how long the system has been in operation, assuming a few prerequisites are first met.
The Hour Meter increments and its discrete Green/Yellow/Red LEDs light-up only if all three of the following cases are true:

- If **Var31** is non-zero.
  (i.e., **Var31** = 0000 disables the Hour Meter).
- AND If in Normal Mode, not in Program Mode.
  (i.e., Being in Program Mode disables the Hour Meter).
- AND If the Hour_and_Speed_Enable command is present at **TB34**. (i.e., The Hour_and_Speed_Disable command disables the Hour Meter).

If any one of these three prerequisites are NOT met, then the Hour Meter does NOT increment hours, NOR do the Hour Meter's discrete Green/Yellow/Red LEDs light-up as per the number of hours reached.

The Hour Meter value is automatically saved once every 10 minutes, because of this at most only 10 minutes of operating time is ignored if the ES1's Vac power is lost.
For normal Hour Meter operation once the **Var31** Hour value is exceeded, then the Hour Meter's discrete Green LED turns 'OFF' and its discrete Yellow LED turns 'ON'.
When operation exceeds the **Var32** Hour value, then the Hour Meter's discrete Yellow LED turns 'OFF' and its discrete Red LED turns 'ON'.
The Hour_Meter feature does NOT trigger the Horn-Relay alarm, nor the Yellow-Lightstack-Relay alarm, nor the Red-Lightstack-Relay alarm, nor the Unit_Alarm_LEDs.
If not manually cleared after 9999 hours, the Hour Meter holds at 9999 hours with its discrete Yellow or Red LEDs 'ON'.

There is an Hour_Meter_RESET button on the Front-Panel, and an AUX_Hour_Meter_RESET at input **TB31:1,2**, that can be used to 'clear' the Hour Meter. When an Hour_Meter_RESET command is given for longer than 3 seconds it returns the meter to 0000 and turns OFF the Hour Meter's discrete Yellow/Red LEDs, and turns ON the Hour Meter's discrete Green LED.

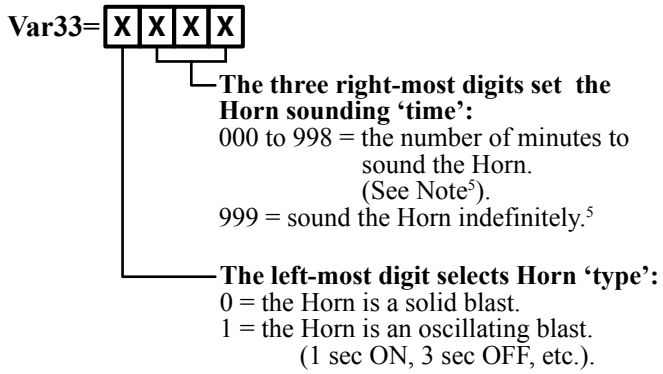
Note: A **Var31** = '0000' disables the Hour Meter (i.e., keeps it from growing), and also turns 'OFF' the Hour Meter's discrete Green/Yellow/Red LEDs. This **Var31** = 0000 feature does NOT clear the Hour Meter, but rather keeps it from growing any further when an Hour_and_Speed_Enable command is present.

Note: If the UserVar programming LCD screen is in Program Mode, then the Hour Meter feature is disabled and the Hour Meter cannot increase (even if an Hour_and_Speed_Enable command is present). Also when in Program Mode the Hour_Meter_RESET command is disabled.

Var31 range is 0000 to 9999 Hours.
Factory default for Var31 is 9000 Hours.

Var32. Hour_Meter_Maintenance_Time in Hours.
(Alarms as: Hour Meter display's discrete Red LED only, with no relays involved).
Var32 range is 0000 to 9999 Hours.
Factory default for Var32 is 9500 Hours.

Var33. Horn_Operation_Select.
Var33 selects how the user wants the Horn-Relay to sound.
Var33 range is 0000 to 1999.
The **Var33** value is limited to these below listed choices.



Note[5]: The user can always give a manual 'Silence_Horn/Alarm_RESET' command at any time to turn OFF the Horn, and keep it OFF, until the Horn sounds again for the next alarm event.

The usable values of **Var33** are 0000 to 1999. Some examples are shown in the table below:

Var33 Value	Horn Type	Horn Time	Notes
0000	Solid Blast	Indefinite	This has the same effect as **Var33**=0999
0001	Solid Blast	1 Min.	---
0030	Solid Blast	30 Min.	---
0999[6]	Solid Blast	Indefinite	Solid Horn until a 'Silence_Horn/Alarm_RESET' given
1000	Oscillating	0	This is an oscillating blast for '0' minutes, consisting of only one 'beep' lasting 1 second ON and then a continuous OFF
1001	Oscillating	1 Min.	---
1030	Oscillating	30 Min.	---
1999	Oscillating	Indefinite	Oscillate Horn until a 'Silence_Horn/Alarm_RESET' given.

Note[6]: Factory default for Var33 is 0999 for solid blast until a 'Silence_Horn/Alarm_RESET' command is given.

Note: The **Var33** Horn_Operation_Select can be changed at any time, whether or not an alarm event is present. Also, while the Horn Relay #8 is sounding, **Var33** can be changed 'on-the-fly' from solid blast to oscillating blast, or from oscillating blast to solid blast, and its effects are immediately heard (as long as the Horn 'time' has not expired following an alarm event.)

Note: The Horn-Relay is also used to tell the user that a 'Silence_Horn/Alarm_RESET' command has existed for 60 or more seconds. This happens independently of how **Var33** is programmed. See Troubleshooting Section "LCD Display and 4-digit LED Display Error Messages, Err6" for details.

Var34. Hour_and_Speed_Command_Select.

Var34 selects how the Disable/Enable commands are given to the ES1 for operating the Hour_Meter and for Speed_Monitoring.
The **Var34** range is limited to these below listed choices:

'0000' = Disable (i.e., Stop) the Hour_Meter and Speed_ Monitoring by a 'maintained' open input at **TB34** (i.e., **TB34** pin 1 disconnected from pin 2).
Enable (i.e., Run) the Hour_Meter and Speed_ Monitoring by a 'maintained' closed input at **TB34** (i.e., **TB34** pin 1 connected to pin 2).

'0001' = Disable (i.e., Stop) the Hour_Meter and Speed_ Monitoring by a 'maintained' closed or a 'one-shot' closed input at **TB32** pins 1 and 2.
Enable (i.e., Run) the Hour_Meter and Speed_ Monitoring by a 'one-shot' closed input at **TB34** pins 1 and 2, (but if-and-only-if the 'Disable' input at **TB32** pins 1 and 2 is open).

'0002' = Disable (i.e., Stop) the Hour_Meter and Speed_ Monitoring by a 'maintained' open or a 'one-shot' open input at **TB32** pins 1 and 2.
Enable (i.e., Run) the Hour_Meter and Speed_ Monitoring by a 'one-shot' closed input at **TB34** pins 1 and 2, (but if-and-only-if the 'Disable' input at **TB32** pins 1 and 2 is closed).

Note: When **Var34** = 0001 or 0002, then the Disable command takes precedence over the Enable command. Because of this, the Enable (Run) command at **TB34** is only effective if the Disable (Stop) command at **TB32** is not present.

Note: If not using Speed Monitoring, then see **Var09** for how to disable Speed Monitoring completely, which then leaves the **Var34** settings to apply to just the Hour_Meter.

Factory default for Var34 is 0000 for a 'maintained' closed input is needed at TB34 for an Enable command.

Note: See the "Troubleshooting Section" for related discussion of 'Concerning the Var34 Disable/Enable Commands' vs. the Speed Display's discrete LED's and speed alarms.

Var35. Test_Mode_Select.

This variable selects whether to operate the ES1 in the 'real-live-data-mode' or in a 'test-data-mode'.
The **Var35** range is limited to these below listed choices:

Var35 Value	LED Display Operation Mode	Method of Relay Output Testing
0000	Live Data	N.A.
0001	Test Data	In simulated alarm events (as described below)
0002	Test Data	All relays held 'energized'
0003	Test Data	All relays held 'de-energized'
0004	Test Data	Test each of the 8 digital inputs with each of the 8 relay outputs. (See next table for details on Var35 = 0004).

When **Var35** is set to a '0001', a '0002', a '0003', or a '0004', then the LCD and LED displays cycle through and display all '0000', all '1111', all '2222', etc, all the way up to all '9999', then wrap back around to all '0000', repeating the cycle indefinitely.
Also when **Var35** is set to 'non-zero' the following happens:

- When the LCD/LED displays all show '0000', then the small discrete LED warning lights are all OFF, and all four of the LCD's decimal points are ON as '0.0.0.0.'.
  - And with **Var35** = '0001' the 8 output Relays are all de-energized.
- When the LCD/LED displays all show '1111', '2222', or '3333', then the small discrete LED warning lights are all Green.
  - And with **Var35** = '0001' the 8 output Relays simulate a 'Green zone' event (i.e., all is okay – no alarms present).
- When the LCD/LED displays all show '4444', '5555', or '6666', then the small discrete LED warning lights are all Yellow.
  - And with **Var35** = '0001' the 8 output Relays simulate a 'Yellow_Alarm' event (i.e., a warning event).
- When the LCD/LED displays all show '7777', '8888', or '9999', then the small discrete LED warning lights are all Red.
  - And with **Var35** = '0001' the 8 output Relays simulate a 'Red_Alarm' event (i.e., a shutdown event).

(Var35 continued on next page).

When **Var35** is set to a '0004', then the 'test-data-mode' correspondence between the 8 digital switch/button inputs and the 8 Relay outputs is shown in the table below. (Momentarily closing the following Remote Switch Digital Inputs or pressing the associated Front Panel button will momentarily de-energize the following relay, otherwise the relay is energized):

Input	Nomanclature	Relay
TB32	Hour_and_Speed_Disable command	8
TB33	Silence_Horn/Alarm_Reset	7
TB34	Hour_and_Speed_Enable command	6
TB31: 1-2	Aux_Hour_Meter_Reset or HOUR_METER_RESET button on Front Panel	5
TB31: 3-4	Aux_Test_Left_Side or TEST_LEFT_SIDE button on Front Panel	4
TB31: 5-6	Aux_Test_Right_Side or TEST_RIGHT_SIDE button on Front Panel	3
TB31: 7-8	Aux_Test_Speed or TEST_SPEED button on Front Panel	2
TB31: 9-10	Aux_Silence_Horn/Alarm_Reset	1

CAUTION: Doing this Var35 test may cause actual system alarms.

Factory default for Var35 is 0000 for operate in 'real-live-data-mode'.

Var36. Software Identification. (Read Only)
This variable shows which version of software is loaded into the Electro-Sentry 1. **Var36**'s value is viewable only, with NO changes allowed.

- Note: The Software Identification is also shown for 2 seconds on the LCD display during power-up.

Electro-Sentry 1 Operation Notes Section:

Alarms

1) The Unit_Alarm_LEDs blink when there is an alarm on the unit, so operator can identify which unit has the alarm.

2) Speed alarms are active only when the Hour_and_Speed_ Enable command is present at **TB34 AND** if **Var09** has Speed Monitoring Enabled.

3) Temperature and Contact Closure alarms are always active, independent of the Hour_and_Speed_Disable/Enable commands.

Latching and holding of Alarms

4) Concerning the Temperature displays and 'setpt violation latching':
During any Temperature 'Yellow_Alarm' or 'Red_Alarm' (i.e., a BIAS Setpt Alarm, a Warning Alarm, or a Shutdown Alarm), the corresponding 3-digit LED temperature display is only allowed to increase in value as the violation escalates. This means that if the temperature input cools down on its own accord, the maximum temperature reached will be 'latched' on the display, the discrete Yellow/Red LEDs will 'latch', and the associated relays will 'latch'. To return the 3-digit LED temperature display to show 'live' temperatures, the user must manually acknowledge the alarm by giving a 'Silence_Horn/Alarm_RESET' command.

5) Concerning the Contact-Closure displays and 'alarm latching':
When a Contact-Closure sensor 'alarms', it alarms with the corresponding 3-digit display's discrete Yellow-LED / Yellow-Lightstack-Relay / Speed-Temperature-Warning-Relay / Horn-Relay, and the 3-digit LED display shows 'ALr' (for "Alarm"). If the Contact-Closure sensor were to return to the Green zone 'non-alarm' state, then the 'Yellow_Alarm' remains 'latched', with the 3-digit LED display remaining at 'ALr'. Once the Contact-Closure sensor has returned to the Green zone 'non-alarm' state, then to 'clear' the latched 'Yellow_Alarm' the user must give a 'Silence_Horn/Alarm_ RESET' command to the ES1. After that, the 3-digit LED display then shows "SAF" (for "Safe").

6) Concerning the Speed display and 'setpt violation latching':
The ES1's 'setpt violation latching' feature is slightly different for the 4-digit Speed display than it is for the Temperature displays. For the 4-digit Speed display during a 'Yellow_Alarm' or 'Red_Alarm', the Speed's discrete Yellow/Red LEDs and Speed Alarm relays do 'Latch' once the speed drops below one of the Speed Setpts, but the actual 4-digit Speed display itself does NOT 'Latch'. This is because for safety reasons, we want to show 'live' speeds at all times, whether or not the speed sensor has previously dropped below one of the Speed Setpts and then since recovered on its own.

How to 'clear' Alarms

7) There are four ways to give a manual 'Silence_Horn/Alarm_ RESET' command to the ES1.
- By 'closing' the regular 'Silence_Horn/Alarm_RESET' input at TB33 pins 1 and 2.
- By 'closing' the AUXILARY 'Silence_Horn/Alarm_ RESET' input at TB31 pins 9 and 10.
- By simultaneously pressing the Front-Panel's TEST_ LEFT_SIDE and TEST_RIGHT_SIDE Temperature Rise test buttons.
- By simultaneously 'closing' the AUX_TEST_LEFT_ SIDE and AUX_TEST_RIGHT_SIDE inputs at TB31 pins 3-4 and 5-6.

A 'Silence_Horn/Alarm_RESET' command is used to first turn OFF the Horn-Relay unconditionally, and further used to 'clear' a Speed, Temperature, or Contact Closure alarm (provided the alarm event has dissipated).

Note: There are a few instances where an active existing Speed, Temperature, or Contact Closure Alarm, is 'automatically cleared' without the user having to give a manual 'Silence_Horn/Alarm_RESET' command to the ES1, and these are the following cases:
- A Speed Alarm is automatically 'cleared' when the 'Hour_and_Speed_Enable' command is removed, or when the **Var09** Speed Monitoring selection is changed from 'Enabled' to 'Disabled', or when the **Var01** Encoder Type Select is changed.
- A Temperature or Contact Closure Alarm is automatically 'cleared' when a sensor with an active alarm (either a Temperature Setpt 'Red_Alarm' or 'Yellow_Alarm', or a BIAS Setpt 'Yellow_Alarm', or a Contact Closure Alarm) has its BIAS Setpt changed to '999' to turn 'OFF' that sensor.
- A Temperature or Contact Closure Alarm is automatically cleared if the sensor type is changed.
- A Contact Closure Alarm can be automatically cleared when **Var11's** Logic Selection is changed.
- If one of the TEST_Features have been used (i.e., the TEST_LEFT_SIDE or the TEST_RIGHT_SIDE Temperature Rise tests, or the TEST_SPEED features), and if a 'Red_Alarm' or 'Yellow_Alarm' was generated by one of those tests, then that alarm will automatically 'clear-out' 60 seconds after the last TEST_Feature was used.
  - Also, if a 'real' alarm event has dissipated during those 60 seconds following a TEST_Feature operation, then it too will be automatically 'cleared' 60 seconds after the last TEST_Feature was used.

Using multiple Electro-Sentry 1's in the same application

7) Multiple Electro-Sentry 1's can be connected together to the same external Green/Yellow/Red Lightstack status indicator to monitor a larger overall system, as follows:
   - Connect all of the individual ES1's Green-Lightstack-Relays in series with each other and with the external Lightstack.
   - Connect all of the individual ES1's Yellow-Lightstack-Relays in parallel with each other and with the external Lightstack.
   - Connect all of the individual ES1's Red-Lightstack-Relays in parallel with each other and with the external Lightstack.

   With multiple Electro-Sentry 1's connected together as described, the following alarm behavior is seen:
   - The external Green Lightstack is lit if-and-only-if all ES1's have no alarms present.
   - The external Green Lightstack is unlit if any ES1 has any alarm present.
   - The external Yellow Lightstack is lit if any ES1 has a 'Yellow_Alarm' present.
   - The external Yellow Lightstack is unlit if-and-only-if all ES1's have no 'Yellow_Alarms' present.
   - The external Red Lightstack is lit if any ES1 has a 'Red_Alarm' present.
   - The external Red Lightstack is unlit if-and-only-if all ES1's have no 'Red_Alarms' present.

Built-in Test Features Section:

Temperature Rise and Speed Drop Alarm Test Features

1) Press and hold the 'TEST_LEFT_SIDE' button on the Front-Panel to artificially increase the temperature readings in the left side column of temperature displays. Keep the button pressed-in to increase the temperatures to levels above the **Var12**_Warning_Setpt_Temperature, the **Var13**_Shutdown_Setpt_Temperature, and/or the individual BIAS_Temperature_Setpts. (This test can also be accessed by TB31 pins 3-4). This test can be used to test the effectiveness of how the temperature alarm output relays will work with the overall application. Give a manual 'Silence_Horn/Alarm_RESET' command to the ES1 to 'clear' any alarms generated by this test. (See Operations Notes Section "How to Clear Alarms" for details).
   CAUTION: This test will cause actual system alarms.

2) Press and hold the 'TEST_RIGHT_SIDE' button on the Front-Panel to artificially increase the temperature readings in the right side column of temperature displays. Keep the button pressed-in to increase the temperatures to levels above the **Var12**_Warning_Setpt_Temperature, the **Var13**_Shutdown_Setpt_Temperature, and/or the individual BIAS_Temperature_Setpts. (This test can also be accessed by TB31 pins 5-6). This test can be used to test the effectiveness of how the temperature alarm output relays will work with the overall application. Give a manual 'Silence_Horn/Alarm_RESET' command to the ES1 to 'clear' any alarms generated by this test. (See Operations Notes Section "How to Clear Alarms" for details).
   CAUTION: This test will cause actual system alarms.
   Note: Concerning the TEST_LEFT_SIDE and TEST_RIGHT_SIDE temperature tests, only one of these tests can be performed at a time. If both of these temperature tests are attempted at the same time, then the test feature is disabled, and the dual activation is actually an "Alarm_RESET" command. (See the Operation Notes "How to Clear Alarms" for details).

3) Press and hold the 'TEST_SPEED' button on the Front-Panel to artificially decrease the Speed Display value. Keep the button pressed-in to decrease the speed to levels below the **Var04**_Slowdown_Setpt and the **Var06**_Shutdown_Setpt. (This test can also be accessed by TB31 pins 7-8). This test can be used to test the effectiveness of how the speed alarm output relays will work with the overall application. Give a manual 'Silence_Horn/Alarm_RESET' command to 'clear' any alarms generated by this test. (See Operations Notes Section "How to Clear Alarms" for details).
   Note: For the 'TEST_SPEED' button feature to work, the following requirements must first be met:
   - **Var09** must be set for Speed Monitoring Enabled.
   - An Hour_and_Speed_Enable command must be present at **TB34**.

   CAUTION: This test will cause actual system alarms.

Troubleshooting Section:

Standard Temperature vs. 4-20mA Temperature Sensors

As a quick troubleshooting guide for any of the 4-20 mA Temperature Sensors, the following voltages can be seen at the 4-20 mA Input terminals TB1 thru TB12 (voltages as measured between pin 2 Signal and pin 3 Analog Ground), corresponding to the following standard temperatures:

F°	C°	mA	TBx Vdc
248	120	20.000	9.60
212	100	18.000	8.64
175	79.44	15.944	7.64
160	71.11	15.111	7.25
100	37.78	11.778	5.65
80	26.67	10.667	5.11
70	21.11	10.111	4.85
60	15.56	9.555	4.58
32	0	8.000	3.85
0	-17.78	6.222	2.99
-40	-40	4.000	1.92

'Out-of-Range' Sensor Detection

1) A 4-20 mA out-of-normal-range Temperature Sensor Detection feature works as shown in the table below:

Temperature Sensor's Input Current Range	Message shown on 3-digit LED Display	Type of Alarm
3.9mA to 20.1mA	N.A. (Live Temperature)	N.A. (Green zone.)
20.83mA or higher	CLS (Closed Circuit)	Red_Alarm
20.1mA to 20.83mA	HI (High_mA)	Red_Alarm
1.0mA to 3.9mA	LO (Low_mA)	Yellow_Alarm[7]
1.0mA or lower	OPn (Open Circuit)	Yellow_Alarm[7]

Note[7]: Because the 'out-of-range' Temperature Sensor LO and OPn cases have 4-20mA signals less than 3.9mA, they are not **Var12** and **Var13** over-temperature setpoint violations, (but rather would be under-temperature cases). Because the ES1 monitors for over-temperature behavior and not under-temperature behavior, these cases are not outright temperature violations. However, the Temperature Sensor LO and OPn cases are treated as 'Yellow_Alarm' events because the effected sensor could be programmed for the BIAS setpt feature. And if a sensor goes 'out-of-range', then the user needs to know this.

A) If a Temperature sensor fails as 'LOW_mA' or 'Open_ckt', then its 3-digit display shows the "LO" or "OPn" message respectively, and it alarms with its discrete Yellow-LED / Yellow-Lightstack-Relay / Speed-Temperature-Warning-Relay /Horn-Relay.
   - Also in this situation the opposite side companion sensor does NOT go into a BIAS Setpt 'Yellow_Alarm' as a BIAS response, for code is in place to see that the first sensor failed. Because of this the second sensor does NOT compare to a 'out-of-range' sensor.

B) If a Temperature sensor fails as 'HI_mA' or 'Closed_ckt', then its 3-digit display shows the "HI" or "CLS" message respectively, and it alarms with its discrete Red-LED / Red-Lightstack-Relay / Speed-Temperature-Shutdown-Relay / Horn-Relay.
   Note: Since the 'HI' and 'CLS' cases have 4-20 mA signals exceeding 20.1 mA, these cases must be treated as over-temperature "Red_Alarms'.

C) **Concerning the Temperature displays and 'out-of-range' sensor latching:**
During any 'out-of-range' Temperature Sensor 'Yellow_Alarm' or 'Red_Alarm' (the OPn, LO, HI, or CLS cases), the corresponding 3-digit LED temperature display 'latches' the most recent message, and will not automatically return to showing 'live' temperature values (even if the sensor 'recovers'). This means that once an 'out-of-range' Temperature Sensor has been detected, the corresponding 3-digit LED display will show the most recent message. This allows the ES1 to show if a Temperature Sensor's condition goes from bad to worse, such as a LO case turning into an OPn case, or a HI case turning into a CLS case, and vice versa. To return the 3-digit LED temperature display to show 'live' temperatures, the user must manually acknowledge the alarm by giving a 'Silence_Horn/Alarm_RESET' command.

2) If an analog input is programmed as a 'Contact-Closure' input by **Var11**, then the 3-digit messages shown are SAF, ALr, or bAd.
For 'Contact-Closure' sensors the SAF and ALr are normal valid messages, and the bAd message is used for invalid sensor indication. See **Var11** Belt_Alignment_Sensor_Type_Select section for details.

(Section continued on next page).

3) A 4-20mA out-of-normal-range Analog Speed Encoder Detection feature works as shown in the table below (this is when **Var01** Encoder_Type_Select is set to 0000):

Speed Sensor's Input Current Range	Message shown on 4-digit LED Display	Type of Alarm
3.9mA to 20.7mA	N.A. (Live Speed)	N.A.[9] (Green zone.)
20.83mA or higher	CLS (Closed Circuit)	Yellow_Alarm [8]
20.7mA to 20.83mA	HI (High_mA)	N.A.[8,9] (Green zone.)
1.0mA to 3.9mA	LO (Low_mA)	Red_Alarm
1.0mA or lower	OPn (Open Circuit)	Red_Alarm

Note[8]: Because the 'out-of-range' Analog Speed Encoder HI and CLS cases have 4-20mA signals exceeding 20.7mA, these cases are not **Var04** and **Var06** under-speed setpoint violations (but rather are over-speed cases). Since the ES1 monitors for under-speed and not over-speed, the HI and CLS cases are not outright speed violations.
However, if an Analog Speed Encoder has its 4-20mA signal in the CLS range, then most likely the encoder has been physically damaged. To alert the user to this possibility the CLS range creates a 'Yellow_Alarm' if the CLS condition exists for more then the **Var05** time delay.
On the other hand, the LO and OPn cases have signals less than 3.9mA. That means they are under-speed setpoint violations, and create a 'Red-Alarm' if the LO or OPn conditions exist for more than the **Var07** time delay.

Note[9]: For Analog Speed Encoders, the acceptable signal range extends up to 20.7mA to allow for display of slight overspeeds such as 103%, 104%, etc. before 'HI' kicks-in. (This is in contrast to temperature sensor signals having a maximum acceptable signal of 20.1mA).

A) Concerning the Speed display and 'out-of-range' sensor latching:
The ES1's 'out-of-range' sensor latching feature is slightly different for the 4-digit Speed display than it is for the Temperature displays. For the 4-digit Speed display, IF the Speed Encoder is of the 4-20 mA Analog Encoder type, AND if it is detected as an 'out-of-range' sensor, THEN the Speed Display will show the appropriate OPn, LO, HI, or CLS out-of-range sensor message.
However, if the analog Speed Encoder 'recovers' on its own to normal 4-20 mA ranges, then the Speed Display will NOT 'Latch' that alpha message, but rather will automatically return to showing 'live' speed in % or in RPM. However, the Speed's discrete Yellow and Red LEDs and Speed Alarm relays do 'Latch' once an out-of-range sensor has been detected, but the actual Speed display itself does NOT 'Latch'. This is because for safety reasons, we want to show 'live' speeds at all times whenever the speed sensor is within the normal 4-20 mA range, whether or not the speed sensor has previously strayed above or below the normal 4-20 mA range, and then since recovered on its own.

LCD Display and 4-digit LED Speed Display Error Messages

1) There are hardware error, calibration error, operational error, and other messages, displayed on the LCD and the 4-digit LED speed display.
These messages are listed in the following five tables below, and are listed from highest rank to lowest rank. (Higher ranking messages can have lower ranking messages 'silently' stacked-up behind them, so clearing a higher ranking message may reveal the next highest ranking error message behind it - if the prerequisite conditions are met).

The hardware error messages are (these are the highest ranking):

LCD Display Message	LED Speed Display Message	Definition
Err6	Err6	'Silence_Horn/Alarm_RESET' command existing for a continuous 60 seconds or more

Note: If the 'Silence_Horn/Alarm_RESET' command exists for a continuous 60 seconds or more, then it is assumed that one of the following has occured:
- the 'Silence_Horn/Alarm_RESET' input at TB33 is 'shorted-out',
- or the 'AUX_Silence_Horn/Alarm_RESET' at TB31 Pins 9 and 10 are both 'shorted-out',
- or the Front-Panel's TEST_LEFT_SIDE and TEST_RIGHT_SIDE Temperature Rise test buttons are somehow both 'shorted-out'.
- or the AUX_TEST_LEFT_SIDE and AUX_ TEST_RIGHT_SIDE inputs at TB31 pins 3-4 and 5-6 are both 'shorted-out'.

If any one of these four events occurs, then a 'Yellow_Alarm' or 'Red_Alarm'' could happen, but the ES1 would not be able to latch those alarms and they would automatically 'clear' once their offending alarm event dissipated. This results in the user never knowing an 'Alarm' came and went, unacknowledged. This defeats one of the main reasons for using an ES1 in the first place (i.e., latch and hold alarms).
To warn the user of such a 'short-out', the Horn-Relay goes into a 0.25 second ON, 0.25 second OFF, repeating cycle, the LCD shows 'Err6' and the 4-digit LED Speed Display shows 'Err6'.

The speed calibration error messages are (with their ranking in this order):

LCD Display Message	LED Speed Display Message	Definition
Err2	Err2	**Var02**_PPR * **Var03**_PULSE_MAX_RPM combo is less than 0.5Hz (when **Var01** = 0001 for Pulse-Train Encoder Type).
Err2	Err2	**Var03**_RPM_at_20mA = 0000 (when **Var01** = 0000 4-20mA Encoder Type).
Err1	Err1	**Var02**_PPR * **Var03**_PULSE_MAX_RPM combo exceeds 9999Hz (when **Var01** = 0001 for Pulse-Train Encoder Type only).
Err5	Err5	A Speed Relay_Setpt exceeds 9999Hz (when **Var01** = 0001 for Pulse-Train Encoder Type).
Err5	Err5	Either a a speed relay setpt is grossly large, or **Var10**_MAX_ANALOG_RPM is grossly larger than **Var03**_RPM_at_20mA, either way causes the Speed Relay_Setpts to exceed an equivalent 9999Hz (when **Var01** = 0000 for 4-20mA Encoder Type).

The speed operational error messages are (with their ranking in this order):

LCD Display Message	LED Speed Display Message	Definition
Err3	Err3	Speed signal is above 9999Hz (when **Var01** = 0001 for Pulse-Train Encoder Type only).
Err4	Err4	Speed signal is greater than the maximum allowed for the present **Var02**_PPR value and **Var03**_PULSE_MAX_RPM value (when **Var01** = 0001 for Pulse-Train Encoder Type only).

Also, when the speed signal is from an Analog Encoder, these following 4-20 mA sensor 'out-of-range' operational error messages can be seen on the 4-digit LED speed display.

(Because only one of these four 4-20 mA sensor operational error messages can happen at a given time, they each have equal ranking against each other in the 'out-of-range' group of messages):

LCD Display Message	LED Speed Display Message	Definition
Live Speed	CLS	Analog Speed Encoder is 20.83mA or more.
Live Speed	HI	Analog Speed Encoder is between 20.7mA and 20.83mA.
Stop	LO	Analog Speed Encoder is between 1.0mA and 3.9mA.
Stop	OPn	Analog Speed Encoder is 1.0mA or less.

Other LCD/LED speed display messages are (these are lowest ranking):

LCD Display Message	LED Speed Display Message	Definition
Flashing 9999	FFFF	Speed signal exceeds the 4-digit capability of the displays.
Stop	0000	Speed signal is 0 Hz, 0 RPM, 0%, or 4mA.

To summarize, the hardware error message of "Err6" is highest priority of all messages.
The speed calibration errors of 'Err2', 'Err1', 'Err5' are next highest priority, followed by the speed operational errors of 'Err3' and 'Err4'.
Next in priority are all of the 4-20 mA sensor out-of-range operational errors of CLS, HI, LO, and OPn.

Finally, at the bottom of the priority list is 'FFFF' and '0000'. The 'HI' and 'CLS' analog 4-20 mA input sensor operational errors, take precedence over the 'FFFF' 4-digit LED overflow output error. This because you can't have valid output results unless of course you first have proper input data. Because of this the 'HI' and 'CLS' analog input errors outrank the 'FFFF' display output error.

The 'LO' and 'OPn' analog 4-20 mA input sensor operational errors, take precedence over the '0000' 4-digit zero speed value. Again, this since you can't have valid output results unless of course you first have proper input data. Because of this the 'LO' and 'OPn' analog input errors outrank the '0000' display zero speed value.

Note: These 'out-of-range' error messages involved with the 4-20 mA speed sensor, can also be seen in the 3-digit

temperature displays. See Troubleshooting Section, "Out-of-range Sensor Detection" for details.

2) Electro-Sentry 1's 4-digit LED speed display can show in '%' or in 'RPM', as per the **Var09** selection (as already discussed). However to aid in troubleshooting , the small LCD display (mainly used for UserVar programming) can toggle between % and RPM just by pressing the INCREMENT button when in Normal Mode. This LCD feature is independent of **Var09**.
When displaying '%' values the LCD shows the 'OUT%' icon in the upper-right-corner.
When displaying 'RPM' values the LCD does not show the 'OUT%' icon in the upper-right-corner.

Concerning the Var34 Disable/Enable Commands:

- If an Hour_and_Speed_Enable command is NOT present at **TB34**, then none of the Speed display's discrete Green/Yellow/Red LEDs are enabled, nor are the speed alarms enabled. However even without an Hour_and_Speed_Enable command present, the Speed display continues to show speed in % or RPM - this is so speed can be displayed on a ramp-down to 'STOP' after an Hour_and_Speed_Disable command has been given.
- If an Hour_and_Speed_Enable command is present at **TB34 AND** if **Var09** has Speed Monitoring Enabled, then the Speed display's discrete Green/Yellow/Red LEDs and speed alarms are all enabled and will activate as needed.
  Note: **Var09** can be used to disable Speed Alarm Monitoring, thereby allowing the Hour_and_Speed_ Enable command to be used for starting/stopping just the Hour_Meter in those applications that do not use Speed Alarm Monitoring. See **Var09** for details.
  Note: If an Hour_and_Speed_Enable command is already present when changing **Var09** 'on-the-fly', then the effects of enabling Speed Alarm Monitoring are not seen until after the **Var08** Underspeed Start Delay time plus the time of **Var05** delay or **Var07** delay has passed, after the instant **Var09** has been changed to Enable Speed Alarm Monitoring.
- Temperature sensors and their discrete LEDs, displays, and alarms are always active, independent of the **Var34** based Hour_and_Speed_Disable/Enable commands.

The Green Indicator LEDs, the Replaceable Fuse F12, and the Resettable Fuses F1 through F11:

1) The Electro-Sentry 1 has two **Green indicator LEDs** for the on-board power circuits.
   - The **Green indicator LED D34** is for the digital power circuit.
   - The **Green indicator LED D28** is for the analog power circuit.
   - If one or both of the Green LEDs D34 and D28 are 'OFF', then perform the following troubleshooting steps:
     a) Is the SW1 Vac Selection Switch set FIRMLY to the proper 115Vac or 230Vac position (and NOT inadvertently sitting part-way between the selections)?
     b) Is there proper Vac power applied to the ES1 unit at terminal block TB29?
     c) Is the main **replaceable Fuse F12** still GOOD? Note: F12 is a replaceable fuse (it is not the resettable type).
     d) If one or both of the Green LEDs D34 and D28 are still 'OFF' after successfully performing the first three steps, then the Electro-Sentry 1's main power circuitry has been damaged.

2) The Electro-Sentry 1 uses on-board **resettable fuses** in the output circuits of the digital power supply (**Fuse F11**), and the analog power supply (**Fuse F10**).
   - If a higher than normal current occurs in the ES1's digital circuit section, then Fuse F11 heats-up and effectively removes the +24Vout_D voltage and the **Green indicator LED D32** turns 'OFF'.
   - If a higher than normal current occurs in the ES1's analog circuit section, then Fuse F10 heats-up and effectively removes the +24Vout_A voltage and the **Green indicator LED D30** turns 'OFF'.
   - If either the Green LEDs D32 or D30 are 'OFF', then perform the following troubleshooting steps:
     a) First, verify that the Green LEDs D34 and D28 are both 'ON'. If not, then see section (1) above.
     b) Next, remove the Vac power from the ES1 unit for about 2 minutes (to allow Fuse F11, or Fuse F10, to cool-down).
     c) Then, re-apply the Vac power to the ES1 unit.
     d) If the **Green LED D32** or **D30** is still 'OFF', then the on-board digital power supply or the analog power supply (whatever the case may be), has been damaged.

3) The Electro-Sentry 1 uses on-board **resettable fuses** in the power supply paths going to the 4-20 mA Temperature/ Contact Closure sensors, the 4-20 mA Analog Speed encoder, and the Frequency Pulse Train Speed encoder.

   For the Temperature or Contact Closure sensors the resettable fuses are in series with pins #1 of TB1 thru TB14. There is one on-board **resettable fuse** for each pair of Inputs, as follows:

Input Fuse	Input Terminal Blocks	Analog Input Pairs
F1	TB1 & TB2	#1 & #2
F2	TB3 & TB4	#3 & #4
F3	TB5 & TB6	#5 & #6
F4	TB7 & TB8	#7 & #8
F5	TB9 & TB10	#9 & #10
F6	TB11 & TB12	#11 & #12
F7	TB13 & TB14	#13 & #14 (Unused)

For the 4-20 mA Analog Speed encoder the **resettable fuse** is in series with pins #1 of TB15 and TB16, as follows:

Input Fuse	Input Terminal Blocks	Analog Input Pairs
F8	TB15 & TB16	#15 & #16 (#15 is unused)

For the Frequency Pulse Train Speed encoder the **resettable Fuse F9** is in series with pin #1 of TB30.

If a higher than normal current occurs in any of the Temperature or Contact Closure sensors, the Analog Speed encoder, or the Frequency Pulse Train Speed encoder, then the corresponding resettable fuse heats-up and effectively removes the +24 Vdc output power from the sensor's TBx terminal block pin #1. If it appears any one of these sensors have no +24 Vdc power at their TBx terminal block, then perform the following troubleshooting steps to try to restore the +24 Vdc power:

a) First, verify that all four Green indicator LEDs D28, D30, D32, and D34 are 'ON'. If not, see sections (1) and (2) above.

b) Next, remove the corresponding TBx terminal block for about 2 minutes and let the effected resettable fuse cool-down. (This means for the 4-20 mA Temperature sensors you must unplug **BOTH** of the TBx terminal blocks of an Input pair to remove all electrical current flowing through the effected resettable fuse in order for it to cool-down).

c) Finally, plug-in the corresponding TBx terminal block, and see if the resettable fuse holds or then trips again. If the fuse trips again, then check for a BAD sensor or BAD wiring going out to that sensor.

Specifications Table	
Power	**Parameters**
Voltage	115 Vac or 230 Vac
Frequency	50 - 60 Hz
Electrical Connection	3-Pos Pluggable Terminal Block
Fuse (F12) 115 Vac	0.4 Amp Slo-Blo
Fuse (F12) 230 Vac	0.2 Amp Slo-Blo

Input Signal	**Parameters**
TB1 through TB12	12 - Analog Temperature (4-20mA) or up to 6 - Contact Closure/6 - Analog (See Var11)
Temperature Sensor Calibration	4mA @ -40ºC (-40ºF) 20mA @ +120ºC (+248ºF)
TB16	Analog Speed (4-20mA)
Sensor Type	2 - Wire 4-20mA (ESI Model ST420) 3 - Wire 4-20mA (ESI Model FB420)
TB13, 14, 15	Unused
TB30	Digital Pulse Train Speed (NPN, PNP, 5V Logic Level) See Section about **Var01** and **SW9**
Frequency Range	0.1 Hz to 9999 Hz Pulse Train Signal

Set Point Data	**Parameters**
Speed	Two (Warning and Shutdown)
Temperature	Two (Warning and Shutdown)
Temperature Bias	Twelve (Warning Only)
Hour Meter	Two (Warning and Maintenance)

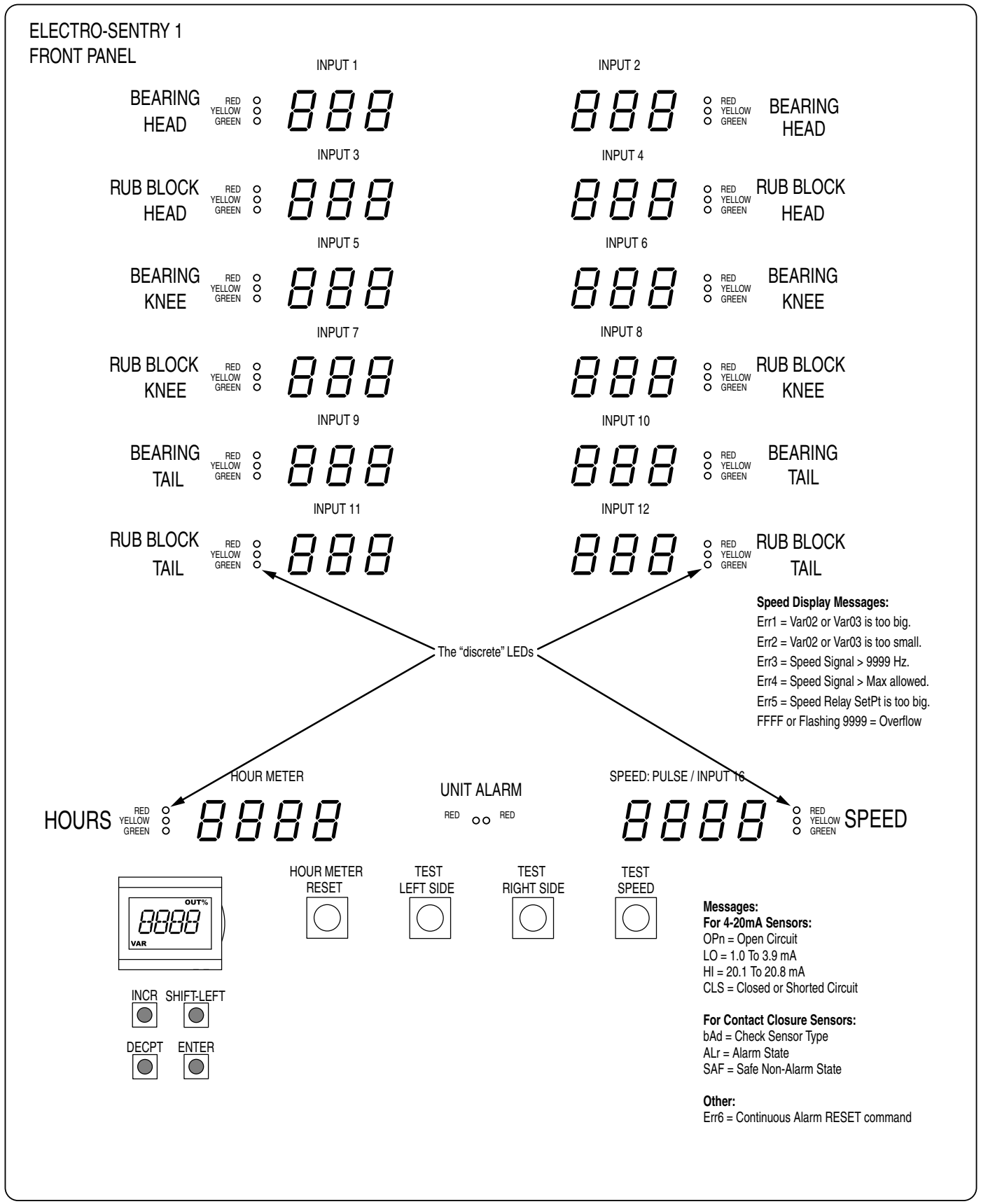
Relay Output Data	**Parameters**
Relays 1, 2, 3, 4	5 Amp Dual Form C SPDT
Relays 5, 6, 7, 8	5 Amp Single Form A SPST
Relay Contact Rating	5 Amp @ 30 Vdc, or 250 Vac resistive

Physical/Environment	**Parameters**
Enclosure Material	Polycarbonate
Recommended Minimum Installation Area	15.4” x 14.7”
Operating Temperature	-30ºC to +70ºC (-22ºF to +158ºF)
Storage Temperature	-40ºC to +80ºC (-40ºF to +176ºF)
Shipping Weight	12 pounds

Setpoint Accuracy	**Parameters**
Temperature setpts	±1º Fahrenheit
Speed setpts w/analog encoder	±0.5% of full scale error.
Speed setpts w/pulse-train encoder	±0.1% of full scale error.

Specifications are subject to change without notice.

Front Panel Drawing



Terminal Block Connections			
Analog Inputs (4-20mA)			
Analog Inputs 1 - 16 (TB13, 14, 15 Unused)	TB1 Through TB16	1	+24 Vout Analog (Resettable fused at 50mA per pair max, at 70ºC/158ºF) See* note below
		2	4-20mA Signal
		3	Analog Ground
Relay Outputs (Dual Form C SPDT)			
Relay #1 Speed Only Warning	TB17	1	Normally Open
		2	Common
		3	Normally Closed
	TB18	1	Normally Open
		2	Common
		3	Normally Closed
Relay #2 Speed Only Shutdown	TB19	1	Normally Open
		2	Common
		3	Normally Closed
	TB20	1	Normally Open
		2	Common
		3	Normally Closed
Relay #3 Speed/Temp Warning	TB21	1	Normally Open
		2	Common
		3	Normally Closed
	TB22	1	Normally Open
		2	Common
		3	Normally Closed
Relay #4 Speed/Temp Shutdown	TB23	1	Normally Open
		2	Common
		3	Normally Closed
	TB24	1	Normally Open
		2	Common
		3	Normally Closed
Relay Outputs (Single Form A SPST)			
Relay #5 Green Light (Stack)	TB25	1	Normally Open
		2	Common
Relay #6 Yellow Light (Stack)	TB26	1	Normally Open
		2	Common
Relay #7 Red Light (Stack)	TB27	1	Normally Open
		2	Common
Relay #8 Horn	TB28	1	Normally Open
		2	Common

AC Power Inputs			
115Vac/ 230Vac	TB29	1	Hot (115Vac)
		2	Earth Ground
		3	Neutral (Hot 230Vac)
Frequency Pulse Train Speed Input			
Pulse-Train Input	TB30	1	+24 Vout Digital (Resettable fused at 27mA max, at 70ºC/158ºF)
		2	Signal
		3	Digital Ground
Remote Switch Digital Inputs (Contact Closure)			
Aux Hour Meter Reset	TB31	1	Input
		2	Digital Ground
Aux Test Left Side Temp Rise		3	Input
		4	Digital Ground
Aux Test Right Side Temp Rise		5	Input
		6	Digital Ground
Aux Test Speed Drop		7	Input
		8	Digital Ground
Aux Silence Horn /Alarm Reset		9	Input
		10	Digital Ground
Hour_and_Speed_ Disable command	TB32	1	Input
		2	Digital Ground
Silence Horn/Alarm Reset	TB33	1	Input
		2	Digital Ground
Hour_and_Speed_ Enable command	TB34	1	Input
		2	Digital Ground

*Note: Analog input "pairs" and their corresponding terminal blocks are described on Page 15.
Example: Two sensors per pair with each drawing 25mA each is permissable. One sensor drawing 50mA is permissable as long as no sensor is used in its corresponding "paired" input.

SW1 Vac Selection Switch

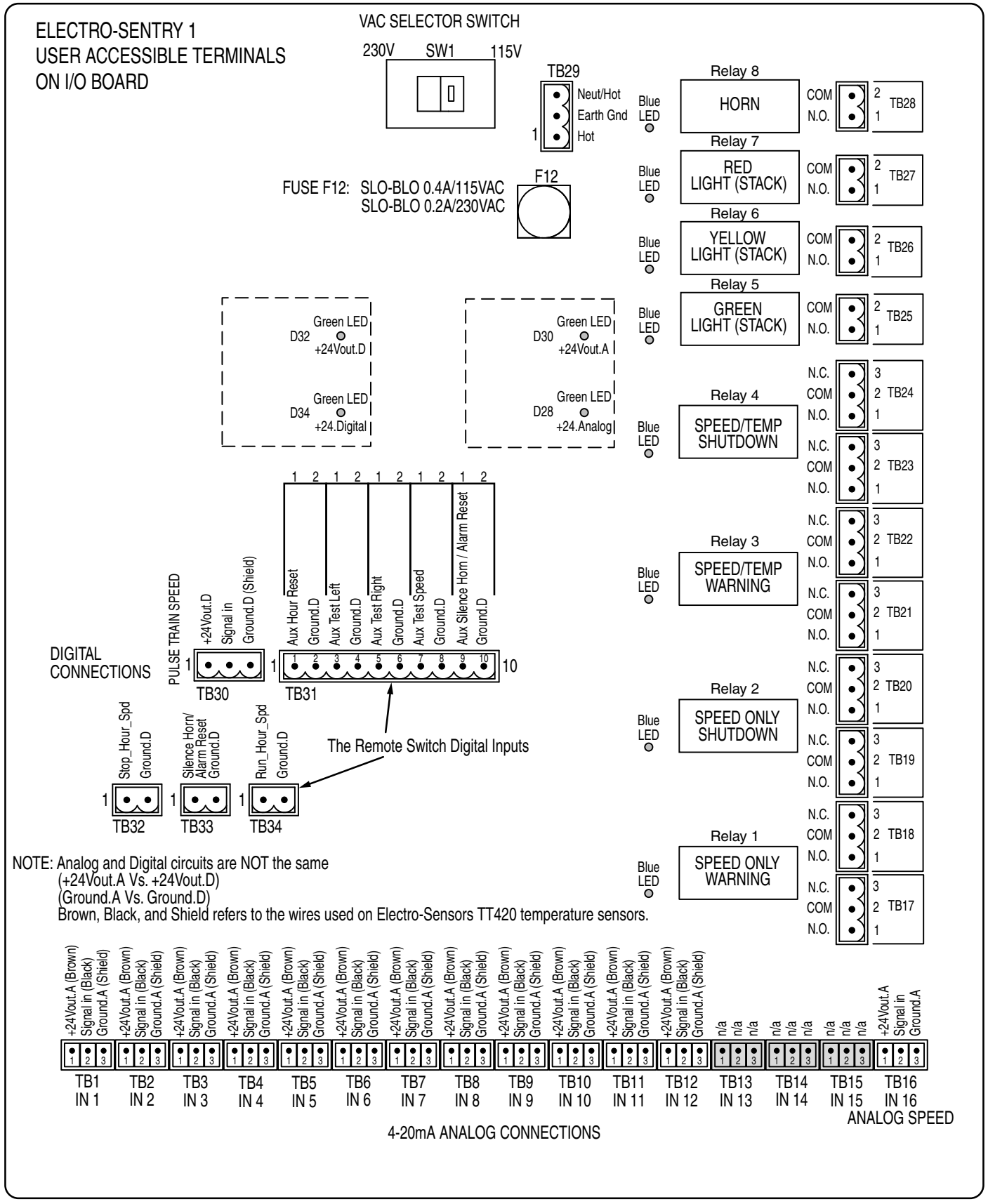
The Vac power is selectable via selector switch SW1 located next to the Vac TB29 terminal block on the I/O terminal board. Slide the switch to the right for 115 Vac or to the left for 230 Vac.

The ES1 is shipped with SW1 set for 115Vac, and with the replaceable fuse, F12, as a 115Vac/0.4Amp Slo-Blo fuse.

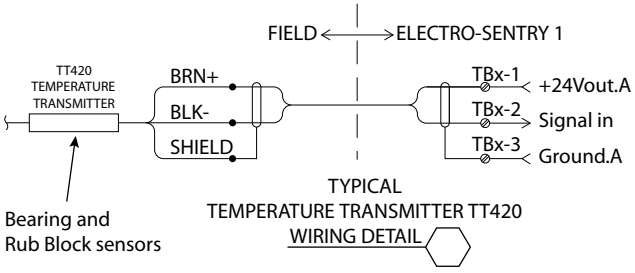
If your application needs SW1 switched to 230Vac, then also install a 230Vac/0.2Amp Slo-Blo fuse into F12

The ES1 is shipped with one extra 115Vac/0.4Amp Slo-Blo fuse and one 230Vac/0.2Amp Slo-Blo fuse.

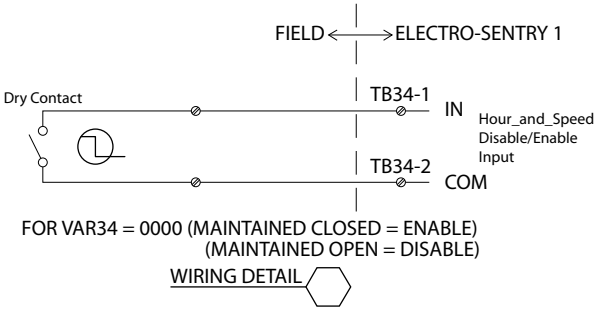
I/O Board - Terminal Drawing



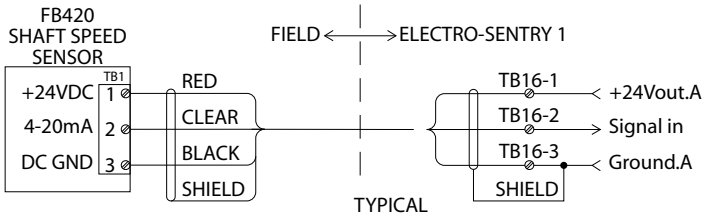
Typical Wiring Connection Examples



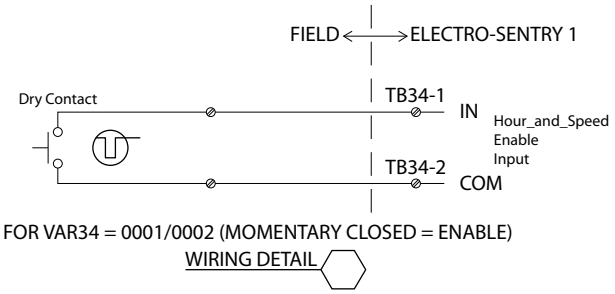
TYPICAL
TEMPERATURE TRANSMITTER TT420
WIRING DETAIL



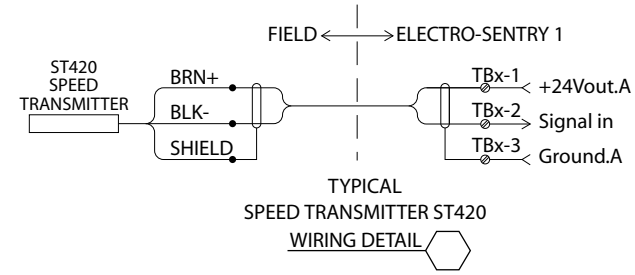
FOR VAR34 = 0000 (MAINTAINED CLOSED = ENABLE)
(MAINTAINED OPEN = DISABLE)
WIRING DETAIL



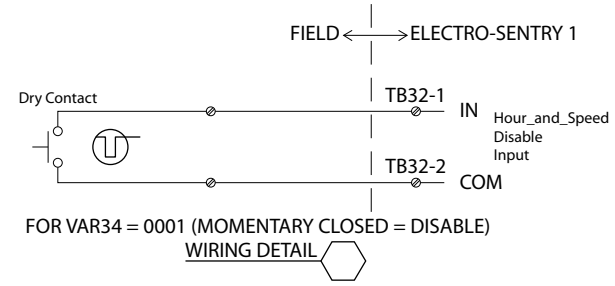
TYPICAL
SPEED TRANSMITTER FB420
WIRING DETAIL



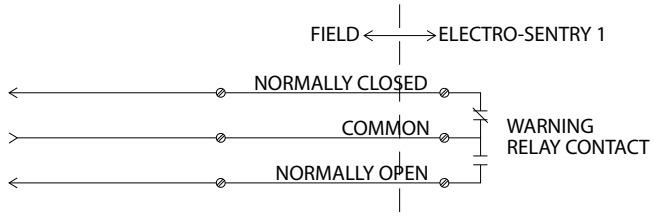
FOR VAR34 = 0001/0002 (MOMENTARY CLOSED = ENABLE)
WIRING DETAIL



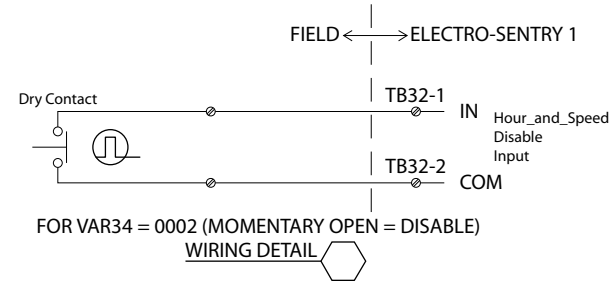
TYPICAL
SPEED TRANSMITTER ST420
WIRING DETAIL



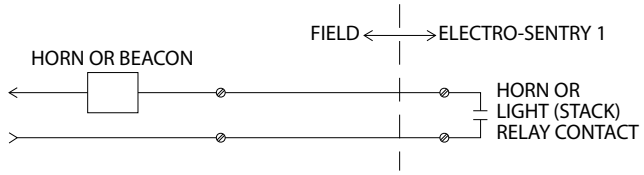
FOR VAR34 = 0001 (MOMENTARY CLOSED = DISABLE)
WIRING DETAIL



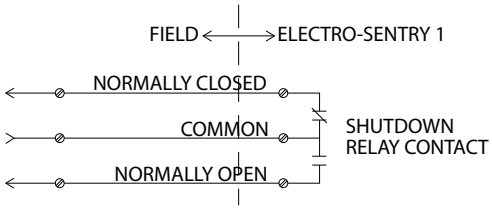
TYPICAL SPEED OR TEMPERATURE
WARNING ALARM
TB17, TB18, TB21, TB22
WIRING DETAIL



FOR VAR34 = 0002 (MOMENTARY OPEN = DISABLE)
WIRING DETAIL



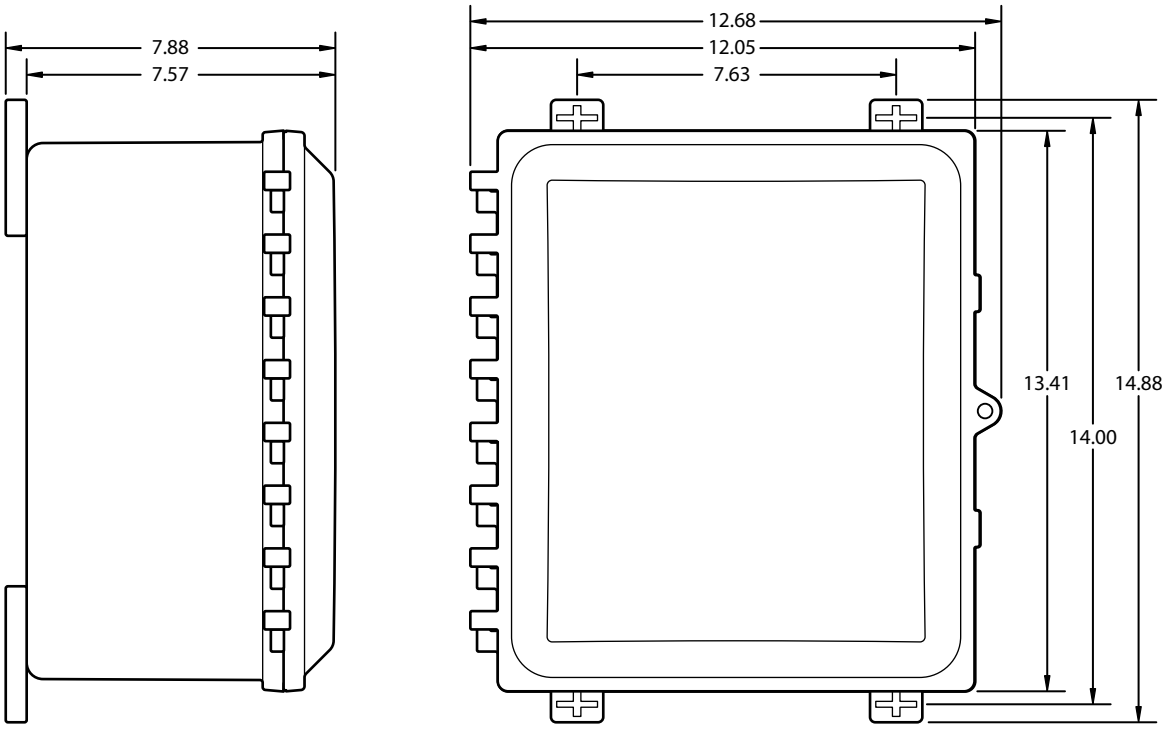
TYPICAL HORN OR LIGHT (STACK) ALARM
TB28, TB27, TB26, TB25
WIRING DETAIL



TYPICAL SPEED OR TEMPERATURE
SHUTDOWN ALARM
TB19, TB20, TB23, TB24
WIRING DETAIL

User Variable List				
Var #	**Description**	**Pg #**	**Default Value**	**User's Value**
Var01	Encoder Type Select 0000 = 4-20mA Analog 0001 = Pulse Train	2	0000	
Var02	PPR Value	2	0008	
Var03	Pulse Max RPM or RPM @ 20mA	2	0200	
Var04	Speed Slowdown Alarm SetPoint %	2	0090	
Var05	Speed Slowdown Alarm Delay	2	0001	
Var06	Speed Shutdown Alarm SetPoint %	2	0080	
Var07	Speed Shutdown Alarm Delay	2	0001	
Var08	Underspeed Start Delay Time	2	0005	
Var09	Speed Display Select 0000 = % w/Alarms 0001 = RPM w/Alarms 0002 = % w/o Alarms 0003 = RPM w/o Alarms	3	0000	
Var10	Max Analog RPM	3	0200	
Var11	Belt Alignment Sensor Type Select (4-20mA or Contact Closure) 0 = 4-20mA Sensor 1 = Contact Closure Sensor xxx**?** = TRB (Inputs 11,12) xx**?**x = KRB (Inputs 7,8) x**?**xx = HRB (Inputs 3,4) 0xxx = Open Ckt = Good 1xxx = Closed Ckt = Good	3	0000	
Var12	Temp Warning SetPoint	4	0160	
Var13	Temp Shutdown SetPoint	4	0175	
Var14	Input #1 Bias Temp Set-Point	4	0000	
Var15	Input #2 Bias Temp Set-Point	4	0000	
Var16	Input #3 Bias Temp Set-Point	4	0000	
Var17	Input #4 Bias Temp Set-Point	4	0000	
Var18	Input #5 Bias Temp Set-Point	4	0000	
Var19	Input #6 Bias Temp Set-Point	4	0000	
Var20	Input #7 Bias Temp Set-Point	4	0000	
Var21	Input #8 Bias Temp Set-Point	4	0000	
Var22	Input #9 Bias Temp Set-Point	4	0000	
Var23	Input #10 Bias Temp Set-Point	4	0000	
Var24	Input #11 Bias Temp Set-Point	4	0000	
Var25	Input #12 Bias Temp Set-Point	4	0000	
Var26	Unused		N/A	
Var27	Unused		N/A	
Var28	Unused		N/A	
Var29	Unused		N/A	
Var30	Temp Display Select 0000 = ºF 0001 = ºC	4	0000	
Var31	Hour Meter Warning Time (In hours)	4	9000	
Var32	Hour Meter Maint. Time (In hours)	5	9500	
Var33	Horn Operation Select 0xxx = Solid Horn 1xxx = Oscillating Horn x000 - x999 = Horn 'time' in Minutes.	5	0999	
Var34	Hour and Speed Command Select. 0000 = Maintained Disable/Enable. 0001 = One-Shot Disable/Enable w/Disable = Closed. 0002 = One-Shot Disable/Enable w/Disable = Open.	6	0000	
Var35	Test Mode Select 0000 = Operate 0001 = Test w/Relays 0002 = Test w/o Relays 0003 = Test w/o Relays 0004 = Test w/Manual Relay control	6	0000	
Var36	Software Identification (Read Only)	7	N/A	

Electro-Sentry Enclosure Dimensions



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