ST200 ST300 SERIES

INSTRUCTIONS

AMC-ST200 Electrochemical
AMC-ST350 Solid State
AMC-ST360 Catalytic

INSTALLATION AND OPERATING INSTRUCTIONS FOR THE AMC-ST200, ST350, ST360 TRANSMITTERS

IMPORTANT:

Please read these installation and operating instructions completely and carefully before starting.

The Armstrong Monitoring Corporation (AMC)
(613) 225-9531 - ☎
(613) 225-6965 - (Fax)
1 (800) 465-5777 - ☎ (U.S. Toll Free)

WARRANTY:

The AMC-ST Series Super Transmitter is warranted against defects in material and workmanship for a period of two years from date of delivery (For sensor, see 1.2 sensor Specifications). During the warranty period, we will repair or replace components that prove to be defective in the opinion of *The Armstrong Monitoring Corporation (AMC)*. We are not liable for auxiliary interfaced equipment, nor consequential damage. This warranty shall not apply to any product, which has been modified in any way, which has been repaired by any other party other than qualified technician or authorized *AMC* representative, or when such failure is due to misuse or conditions of use.

LIABILITY:

All *AMC* products must be installed and maintained according to instructions. Only qualified technicians should install and maintain the equipment.

AMC shall have no liability arising from auxiliary interfaced equipment for consequential damage, or the installation and operation of this equipment. *AMC* shall have no liability for labour or freight costs, or any other costs or charges in excess of the amount of the invoice for the products.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SPECIFICALLY THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES, WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE THEREOF.

MODIFICATIONS AND SUBSTITUTIONS:

Due to an ongoing development program, *AMC* reserves the right to substitute components and change specifications at any time without incurring and obligations.

PRODUCT RETURN:

All products returned for warranty service will be prepaid freight and they will only be accepted with an R.M.A. number issued by *AMC*. All products returned to the client will be freight collect.

PRODUCT INFORMATION:

Transmitter/Sensor unit Order Number …….. __________________________

Transmitter Part Number ……………………. __________________________

Transmitter Serial Number ………………….. __________________________

Sensor Part Number …………………………. __________________________

Power Supply Requirement 18-30 VDC; less than 4 Watts

Signal Output Load 4-2OmA into 800 ohms max.

FACTORY CALIBRATION:

Gas Type ……………………………………… __________________________

Zero Gas, at 4mA Signal ……………………… __________________________

Gas Concentration at 20 mA Signal ………….. __________________________

SECTION I

GENERAL DESCRIPTION

1.1 DESCRIPTION:

This manual describes the *AMC* microprocessor based ST Series Non-Intrusive Transmitters. Three models of the ST Series are described within this manual.

The ST360 Series accepts catalytic bead combustible sensors. The ST350 Series is a non-intrusive transmitter used with solid state sensors. The ST200 Series accepts electrochemical toxic and oxygen sensors.

Several options are available to enhance ST Series Non-Intrusive Transmitters capabilities. These include an isolated 4-20 mA output, an RS-485 Modbus® serial interface, or an alarm providing 5 A form C relays for fault, warn and high alarm conditions.

The *AMC* ST Series Non-Intrusive Transmitters accept a wide range of gas detection sensors. These sensors are directly connected to the ST Series without need of other transmitters or electronics. Supplied transmitters are factory calibrated. A 4-20 mA output and 3 1/2 digit LCD readout provide analog and visual indications of gas concentration. Magnetic sensors allow complete "end to end" calibrations to be performed to the transmitter section without opening the explosion-proof enclosure. This is especially useful when the area is classified as potentially hazardous and declassification is required to open enclosures.

FAULT conditions, such as LEL sensor opens and shorts, missing EC sensor, or negative drift below 1.6 mA (-15% of full scale), are detected and flagged by the ST Series. During these FAULT conditions the 4-20 mA output is held at 0 mA and the KEYPAD/FAULT LED indicator is illuminated.

The only tool required to perform calibrations is a small magnet, which is provided on a key chain. The integral 3 1/2 digit LCD readout may be calibrated for direct reading in engineering units such as percent of LEL (lower explosive limit) or PPM (parts per million).

Before calibration is possible, the ST Series must be properly activated by entering the CAL MODE. This is done by briefly holding the magnet to a location on the panel marked by a small dot. The ST Series will respond by illuminating a left hand arrow on the LCD readout. This serves as a "pass-key" and makes it difficult for unauthorized personnel to tamper with settings. During CAL MODE, the 4-20 mA output is held at 1.5 mA to prevent alarms or other instrumentation from being affected by calibration levels.

Calibration of the system may now be performed by appropriately exciting the sensor and holding the magnet close to the UP/DOWN ZERO or UP/DOWN SPAN controls, as required to obtain correct readings on the front panel LCD readout. ZERO and SPAN controls do not interact when the zero adjustment is performed first. The RESET control is provided to place the ST Series in a UNITY GAIN mode of operation. This returns the ZERO and SPAN controls to the center of their adjustment range thereby returning offset and gain values to the same starting point each time UNITY GAIN mode is entered. This is useful for tracking the sensor's sensitivity, which may deteriorate with age. If a RESET is applied before calibration, the SPAN gas may be applied and signal shift observed. When signal shift falls to half the original value of when the sensor was new, it is approaching time to replace that particular sensor.

A non-volatile memory device provides indefinite battery back-up of calibration values during power interruptions.

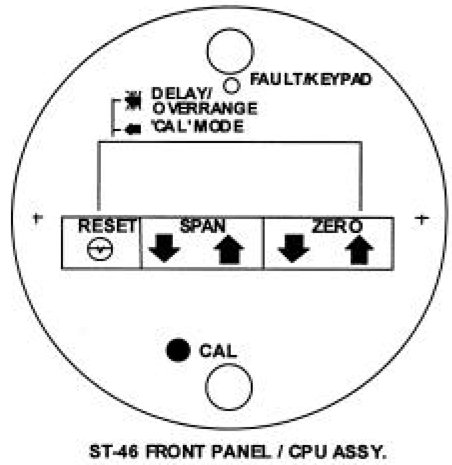


FIGURE 1.1

1.2 SPECIFICATIONS:

1.2.1 SENSOR VOLTAGE (ST350/360 SERIES):

Adjustable Voltage; 2 W Max.

1.2.2 SIGNAL OUTPUT:

4-20 mA into 800 Ohms Max. with 24VDC Power Standard

1.2.3 POWER SUPPLY:

18-30 VDC; 4 W Max.

1.2.4 CALIBRATION RANGE:

ZERO - $\pm$ 15 % of Full Scale

SPAN – Turn UP to GAIN of 2, DOWN to GAIN of 0.5

1.2.5 CALIBRATION RESOLUTION:

0.1% of Full Scale

1.2.6 ACCURACY:

± 0.1% of Full Scale ± 1 Count

1.2.7 AMBIENT TEMPERATURE RANGE:

-40 to +60 °C

1.2.8 TEMPERATURE DRIFT:

Less than 0.1% /°C over Ambient Temperature range.

1.2.9 HOUSING:

Explosion Proof Class 1, Groups B, C, D & Class 2, Groups E, F, G with CSA and FM approval.

SECTION II

INSTALLATION

2.1 MOUNTING:

The ST Series is packaged in an explosion-proof housing with two 3/4 inch N.P.T. conduit hubs located in line and across the housing from each other (see figure 8.1). This housing has symmetrical mounting holes for the electronics, which are drilled so the conduit hubs may be oriented across the bottom, top, left side or right side. Simply mount the housing as desired then remove the four screws which hold the ST Series I/O printed circuit board in place. Orient the I/O PCB so the LCD readout will align properly and replace the mounting screws.

Note: To gain access to the I/O PCB for wiring or mounting purposes, loosen the two captive thumb screws in the ST Series front panel and remove the PANEL/CPU PCB assembly as far as is allowed by the ribbon cable. The front panel and attached PCB may then be removed from the ST Series housing leaving the I/O PCB fully exposed. To replace the front panel assembly, align the two thumb-screws with their mating stand-offs and firmly hand tighten. Be sure the front panel is centered in the ST Series housing opening.

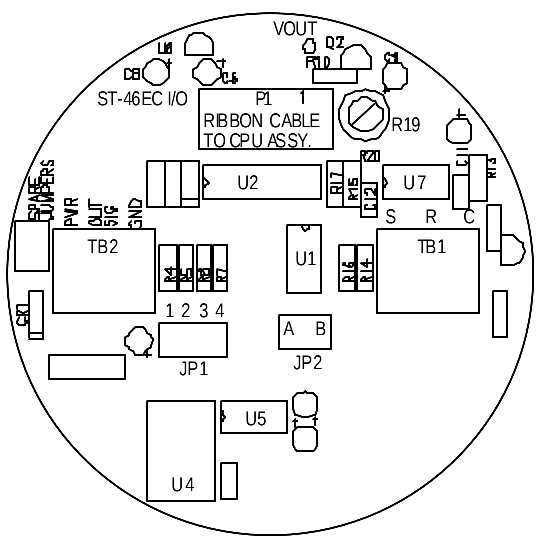
2.2 ELECTRICAL CONNECTIONS:

Please see the above note for instructions how to access the ST Series I/O terminals for field wiring.

The ST Series is a three-wire device. There is a positive 24VDC power wire (other power supplies are available by special order), and a positive output signal wire which is typically 4-20 mA. The third wire is the system common and serves as power supply and signal returns. These three wires connect to the three point terminal block labeled TB2. An earth ground lug inside the explosion-proof enclosure is provided for earth grounding of shield wires if the three-wire cable is shielded.

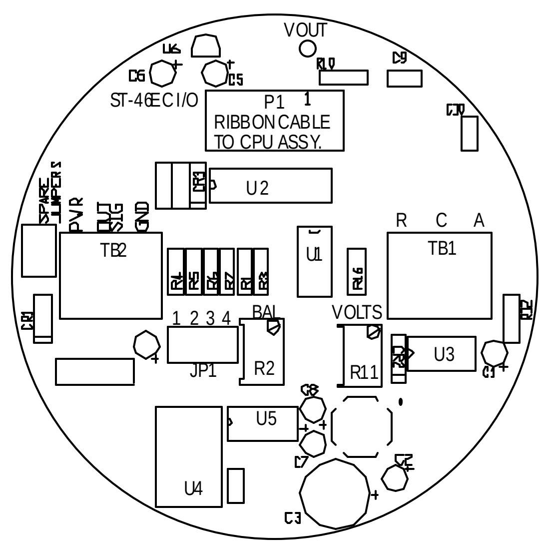
Since the ST Series is designed to function with ambient gas sensors, there is another three point terminal block labeled TB1 and provided for sensor wires. ST360 Series TB1 terminals are labeled R, C, and A. R is for the reference element, C is for the junction of the reference and active elements, and A is for the active element. A is the same as system common. The sensor voltage level may be measured across A and R. For AMC-ST200 Series units, TB1 terminals are labeled S, R, and C. S is for the SENSE electrode, R for the REFERENCE electrode and C for the COUNTER electrode.

TB1 and TB2 may accept wire sizes up to 14 AWG. It is suggested the wires be stripped 1/4 inch and the bare copper wire be tinned with solder to prevent loose strands from shorting.



ST-46EC I/O PCB FOR
ELECTROCHEMICAL SENSORS

FIGURE 2.1



ST-46LEL I/O PCB FOR
CATALYTIC BEAD SENSORS

FIGURE 2.2

SECTION III

OPERATING PROCEDURES

3.1 NORMAL MODE OPERATION:

The NORMAL MODE is present any time the LCD's left hand arrow or the FAULT / KEYPAD LED is not illuminated. During this time the ST Series functions as a 4-20 mA transmitter with a digital LCD readout. LCD readouts are typically factory calibrated to display engineering units being monitored by the sensor.

During NORMAL MODE the 4-20 mA output and the LCD readout do not track input values below 0% of full scale. This prevents erroneous and momentary negative noise from being transmitted and displayed. This feature does require the NORMAL MODE be exited and the CAL MODE entered prior to exposing the sensor to ZERO gas for checking ZERO drift. Negative ZERO drift will only be displayed during the CAL MODE.

3.2 OVERRANGE:

The analog input to the ST Series is converted to a 0.4 - 2 volt signal on the I/O PCB and then applied to a 10 bit analog to digital (A-D) converter on the CPU PCB. If gain settings are too high on the I/O PCB, or if gas values are too high, it is possible for upscale inputs to exceed 2 volts. The A-D converter saturates at readings above 103% of full scale, or, about 2.06 V. At this point an OVERRANGE condition is indicated by a fast (3-4 times per second) flashing of the left hand arrow. If OVERRANGE occurs during a SPAN calibration the calibration should be halted since the analog voltage being applied to the A-D converter is too high. Either the SPAN gas is incorrect, or, the FIXED GAIN jumper setting on the I/O PCB is too.

3.3 ROUTINE CALIBRATIONS USING CAL MODE:

Routine calibrations of gas readings are easily performed using the magnet tool provided with each ST Series Non-Intrusive Calibrating Transmitter. To enter CAL MODE, briefly hold the magnet close to the small dot located on the lower left of the front panel. The left hand arrow on the upper left side of the LCD will illuminate and the 4-20 mA output is locked at 1.5 mA, indicating the ST Series is ready for calibration. CAL MODE is indicated by a steady arrow. *Note: It is important the arrow NOT be flashing during calibrations since a fast flash rate (3-4 times per second) indicates a saturated A-D converter and may require a lower gain setting be selected on the I/O PCB.* Expose the sensor to a ZERO gas and observe the LCD readout. If it does not return to the correct ZERO reading a ZERO adjustment is needed. Hold the magnet close to the UP ZERO or DOWN ZERO sensor and adjust the reading to the correct ZERO value.

Then expose the sensor to an appropriate SPAN gas, such as 50% of the gas being monitored. If the LCD does not display the correct SPAN value a SPAN adjustment is needed. With the arrow still on, hold the magnet close to the UP SPAN or DOWN SPAN sensors and adjust the reading to the correct SPAN value.

The monitor is now calibrated.

REMEMBER TO DEACTIVATE THE CAL MODE BY HOLDING THE MAGNET CLOSE TO THE SMALL DOT AGAIN. THE 4- 20 mA OUTPUT IS HELD AT 1.5 mA WHILE ACTIVATED FOR CALIBRATION TO PREVENT ALARMS FROM BEING TRIPPED BY CALIBRATION LEVELS.

3.4 UNITY GAIN MODE:

A RESET magnetic control is available during CAL MODE to allow the ZERO and SPAN adjustments to be centered within their range. This is similar to setting a potentiometer so the wiper terminal is exactly halfway between the clockwise and counterclockwise terminals. This is identified as the UNITY GAIN mode. In UNITY GAIN the ZERO controls have a $\pm$15% of full scale adjustment range. For example, in UNITY GAIN, if the sensor's ZERO output has drifted so high that it reads 15% with ZERO gas applied, the DOWN ZERO magnetic control could still bring the ST Series reading to ZERO. However, it will be at the end of its adjustment range. If the ZERO adjustment required is greater than ±10% of full scale, a BALANCE adjustment should be performed as described in section 4.2.2.

In UNITY GAIN the SPAN controls have a 0.5 to 2 adjustment range. For example, in UNITY GAIN, if a sensor's output sensitivity has been reduced to the point where a 50% SPAN gas provides only a 25% reading, the UP SPAN magnetic control could still calibrate the reading to the proper value of 50%. However, it will be at the end of its adjustment range.

The RESET control is also useful because it may be used to begin each calibration from the same starting point. That point being UNITY GAIN. If each calibration begins at the same point, it is possible to observe the cumulative affect of sensor drift over time. It is known that gas detection sensors lose output signal strength as they age. Knowing the signal strength of a sensor from its initial installation, and being able to track its deterioration over time, may be useful in determining when to replace it **before** failure occurs.

3.5 DELAY MODES:

The POWER UP DELAY and the CAL MODE EXIT DELAY described in this section are both indicated by the slow flashing of the LCD’s left hand arrow. During these delays the LCD readout is active, but the 4-20 mA output is held at 4 mA.

3.5.1 POWER UP DELAY:

The 4-20 mA output is held a 4 mA for 1 minute after power is applied. This is to allow the sensor to stabilize briefly and reduce the possibility of causing an erroneous alarm condition within the gas detection system.

3.5.2 CAL MODE EXIT DELAY:

SPAN values are typically the last gas applied during a routine calibration. If the CAL MODE is exited too quickly after removing SPAN gas from the sensor, the reading may still correspond to the SPAN value and trip alarms. For this reason the ST Series 4-20 mA output is also held at 4 mA for 1 minute after exiting the CAL MODE.

3.5.3 AUTOMATIC CAL MODE EXIT TIMER:

The ST Series 4-20 mA output is held at 1.5 mA during the CAL MODE. This alerts any loop monitoring devices that a special condition is present. Since it is possible for an operator to forget to return the ST Series to the NORMAL MODE, a 5 minute timer monitors the magnetic keypad during the CAL MODE. If no keystroke is made during a 5 minute interval, the CAL MODE is exited and the 4-20 mA output becomes active again.

3.5.4 ABORTING THE DELAY MODES:

Trouble shooting or other testing procedures may be easier without the delay periods described above. These may be aborted by removing power, holding the magnet to the UP ZERO control and then reapplying power. This procedure only works if the sensor is not in a FAULT condition when power is applied. Any subsequent power up without holding the magnet to the UP ZERO control returns the delay periods.

3.6 FAULT CONDITIONS:

The FAULT / KEYPAD LED is a dual-purpose indicator. If it is illuminated without a magnet near the keypad it is signaling a FAULT condition. A FAULT also causes the 4-20mA output to be held at 0 mA. Negative sensor drift below -15% of full scale will automatically cause the FAULT indication. Sensor failures, described in sections 4 & 5, will also cause the FAULT indication.

3.7 BACK-UP OF CALIBRATION VALUES DURING POWER LOSS:

An E^2 non-volatile memory device provides unlimited periods of continuous storage of calibration values during power interruptions.

3.8 LCD READOUT CALIBRATION PROCEDURE:

Note: This procedure is typically performed at the factory and normally need not be repeated unless engineering units displayed by the LCD are to be changed. When calibration of the LCD readout is necessary it is important to understand that the only requirement is the display must read '0' engineering units with 4 mA outputs and 'full scale' engineering units with 20 mA outputs.

A. Remove the two thumbscrews attaching the front panel assembly to the enclosure. This assembly is connected to the I/O PCB via a ribbon cable long enough to remove it from the enclosure without disconnection. Removal exposes ZERO (R20) & SPAN (R19) potentiometers and J1 & J2 jumpers on the back of the display PCB assembly as shown in figure 3.1. J1 allows decimal point placement and J2 determines full scale engineering unit values.

B. Determine the desired full scale readout, including decimal point position, and place jumpers in J1 and J2 accordingly. No jumper in J2 allows LCD readings between 700 & 1999 counts. A jumper in position 'B' is for readings between 60 & 600 counts and 'A' is for readings between 20 & 50 counts. NOTE: These 'count' values do not consider decimal points. It is important to understand that a reading of 0-50 ppm may be obtained by reading 500 counts with a decimal point between the 0's (50.0), or by reading only 50 counts with no decimal point. The choice depends upon the resolution desired in the readout. J1-1 illuminates the right hand least significant decimal point (XX**.**X). J1-2 illuminates the middle (X**.**XX) and J1-3 illuminates the left hand decimal point (**.**XXX).

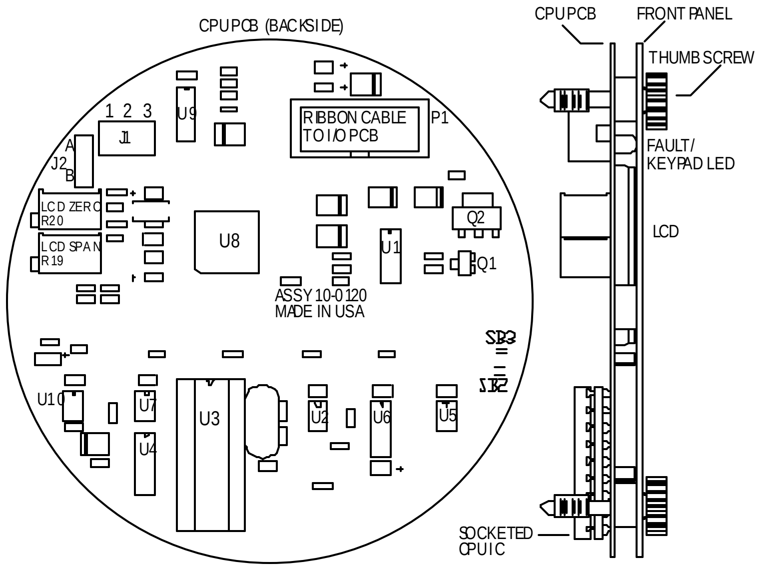
C. Force the ST Series to provide a 4 mA output. This may be done by a number of methods such as activating CAL MODE and utilizing the UP/DOWN ZERO or UP/DOWN SPAN controls to provide a 4mA output when it is deactivated (the 4-20 mA output is held at 1.5mA while activated).

D. Adjust the LCD ZERO control (R20) until the display reads the desired value for 4 mA outputs.

E. Force the ST Series to provide 20 mA output by exposing the sensor to the appropriate level of gas or by simulating this value.

F. Adjust the LCD SPAN control (R19) until the display reads the desired value for 20 mA outputs.

IT IS IMPORTANT TO UNDERSTAND THAT R19 AND R20 HAVE NO AFFECT UPON THE ST Series ANALOG OUTPUT. THEY ARE AVAILABLE ONLY TO CALIBRATE THE LCD READOUT TO DISPLAY THE DESIRED ENGINEERING UNITS.



ST-46 FRONT PANEL/CPU ASSY.

FIGURE 3.1

SECTION IV

MODEL ST350 & 360 SERIES

4.1 GENERAL DESCRIPTION:

Catalytic bead sensors interfaced to the ST360 Series are powered by a high efficiency switching power supply with an adjustable output to accommodate many sensor voltage requirements. An input bridge circuit with a balance adjustment allows matching of various types of combustible sensors to the ST360 Series input.

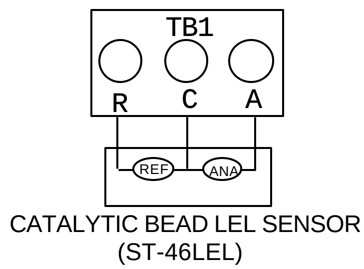


FIGURE 4.1

Solid State sensors interfaced to the ST350 Series are powered by a switching power supply with an adjustable output to accommodate many sensor voltage requirements. An input circuit with a precision adjustment allows matching of various types of solid state sensors to the ST350 Series input.

4.2 INITIAL START-UP AND CALIBRATION PROCEDURE:

*<u>Note:</u> After all power and signal connections have been checked, apply power and wait one hour for the system to stabilize. For the **initial** start-up procedure only, the front panel assembly must be removed as described in section 2.1 to perform the following adjustments.*

IMPORTANT: Be sure to reclassify the area non-hazardous before opening the ST Series or any other electronic enclosures.

4.2.1 SENSOR VOLTAGE ADJUSTMENT:

The ST360 Series has been factory set to 2.0V, the ST350 is set to 2.7V. The sensor operating voltage is applied to the R and A terminals of TB1 (see FIGURE 4.1). The ST350/ST360 Series switching regulator power supply on the I/O PCB has an adjustable output. To prevent sensor damage this voltage must be set to the correct value by adjusting the SENSOR VOLTAGE ADJUST potentiometer, R11. Operating at sensor voltages too low may cause incorrect readings and too high may damage the sensor. Again, these have been set at the factory

4.2.1 MONITORING THE VOUT TEST POINT:

The VOUT test point on the I/O PCB may be monitored during the remainder of this section to verify correct initial set-up. An alternative to this is to attach the LCD assembly ribbon cable and monitor VOUT using the ST Series LCD. The LCD assembly must be placed in UNITY GAIN by entering the CAL MODE and applying a RESET to the magnetic keypad.

To use a voltmeter, the minus lead is attached to the power supply return, or 0 volt terminal, and the plus lead to the VOUT test point. The active range of VOUT is 0.4 - 2 volts corresponding to 0-100% of full scale. Therefore, 0% = 0.4 volts, 25% = 0.8 volts, 50% = 1.2 volts, 75% = 1.6 volts and 100% = 2.0 volts. The I/O board may be considered properly configured when VOUT is within 20% of the desired reading without exceeding the desired value. For example, if 50% of LEL SPAN gas reads between 1.0 and 1.2 volts, this is an acceptable value if 100% of LEL is full scale.

4.2.2 BALANCE ADJUSTMENT:

Differences in element resistance from sensor to sensor necessitate a BALANCE adjustment, which simply matches a particular sensor to the ST Series input bridge circuit. This adjustment should only be made when a sensor is ***initially*** wired to the ST Series I/O PCB. With the new sensor exposed to a ZERO gas (usually ambient air) adjust the BALANCE potentiometer, R2, until the VOUT test point equals 0.4 volts. THIS IS AN APPROXIMATE ADJUSTMENT. THE FINAL PRECISION ADJUSTMENT IS MADE VIA THE MAGNETIC ZERO CONTROLS. The UP/DOWN ZERO magnetic controls have a ±15% of full scale adjustment range which the sensor's ZERO drift would have to exceed before any BALANCE potentiometer adjustment becomes necessary again.

4.2.3 ST350/ST360 SERIES INITIAL FIXED GAIN ADJUSTMENT:

The ST Series I/O PCB has 4 fixed ranges of sensitivity, which are selectable via JP1. The JP1 positions are labeled 1, 2, 3 & 4. The VOUT test point on the I/O PCB has a range of 0.4 - 2 volts for 0 - 100% of the measurement range. The BALANCE potentiometer sets the 0.4 volt value as described in section 4.2.2 above. JP1 jumpers set the coarse upscale SPAN values by affecting the gain of the bridge circuit. JP1 is set correctly if a 50% of full scale gas reads between 1.0 & 1.2 volts on VOUT. Fine tuning of these settings is done later by adjusting the ST Series magnetic controls. JP1 jumpers are factory set and normally only require configuring if a new sensor is installed or if the monitoring range is changed.

JP1 gain values are as follows:

JP1 with jumper in position 1 = GAIN = 51

JP1 with jumper in position 2 = GAIN = 26

JP1 with jumper in position 3= GAIN = 12.5

JP1 with jumper in position 4 = GAIN = 7

JP1 with no jumper = GAIN = 1

More than one jumper may be installed to allow additional gain values. Multiple jumpers are additive in relation to the gain value. For example, if a gain of 20 is needed, jumpers should be placed in positions 3 and 4 to provide a gain of 19.5.

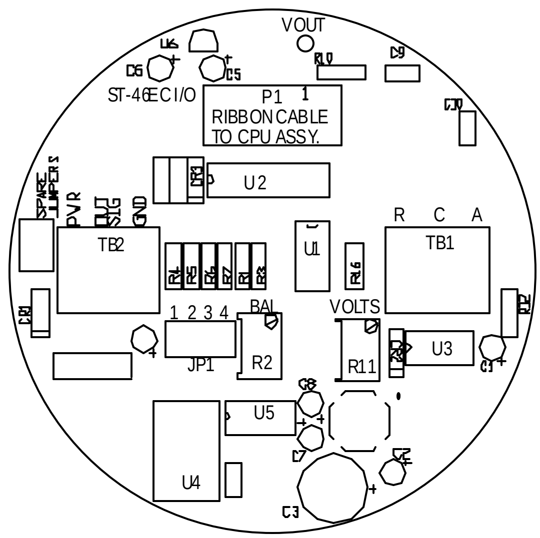
Determining what gain value is required for the application may be determined either by applying a known value of gas and configuring JP1 for the correct voltage on the VOUT test point, or, by reviewing the sensor's mV output specification and predicting the correct gain. When using the front panel LCD to read the output and configure JP1, it is important to place the ST Series in UNITY GAIN MODE (see section 3.4) to insure additional gain is not being applied by the magnetic controls. The following equation describes the relationship between sensor millivolts and gain requirements:

JP1 GAIN = 1600 / sensor millivolts full scale

For example, if the application is to monitor 0-100% LEL of methane, and if the sensor provides .5 mV per % LEL, then the full scale millivolt range is 50 millivolts. The gain required by JP1 is equal to 1600 / 50 = 32. To avoid saturating the analog to digital converter by upscale gas values, it is best not to exceed the calculated gain value. Therefore, for this example with a calculated gain of 32, the most desirable JP1 setting would be position 2 for a gain of 26. Remember, this is only a coarse setting! The precision adjustment is made at the final magnetic control stage which has a minimum gain of .5 and maximum of 2. The JP1 gain of 26 can be reduced to 13 or increased to 52 by the magnetic controls!

4.3 SENSOR FAULT SUPERVISION:

The typical failure mode of sensors is for the elements to open circuit. In rare cases a short circuit may develop. The ST350/ST360 Series is equipped with fault detection circuitry, which detects either condition. A FAULT is also signaled if the sensor output drifts far enough negative to cause the 4-20 mA output to reach 2.4 mA (-10% of full scale). The ST Series signals that a FAULT condition exists by illuminating the red LED on the front panel and by clamping the 4-20 mA output at 0 mA. These conditions exist until the FAULT is corrected.



ST-46LEL I/O PCB FOR
CATALYTIC BEAD SENSORS

FIGURE 4.2

SECTION V

MODEL ST200 & SERIES

5.1 GENERAL DESCRIPTION:

The Model ST200 & Series accepts electrochemical sensors directly, without the need of other transmitters or electronics. The micro-amp output from the sensor is converted to a 0.4-2 volt level by an ultra-stable pre-amplifier on the EC I/O PCB.

Since the ST-200 is designed to accept electrochemical gas sensors, there is a three point terminal block labeled TB1 provided for sensor wiring. TB1 has SENSE, REFERENCE, and COUNTER terminals, which connect directly to sensor terminals with the same names.

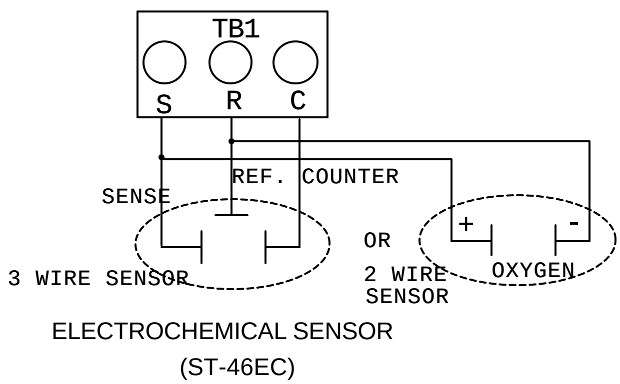


FIGURE 5.1

5.2 INITIAL START-UP AND CALIBRATION PROCEDURE:

<u>Note:</u> *After all power and signal connections have been checked, apply power and wait one hour for the system to stabilize. For the* ***initial*** *start-up procedure only, the front panel assembly must be removed as described in section 2.1 to perform the following adjustments.*

IMPORTANT: Be sure to reclassify the area non-hazardous before opening the ST Series or any other electronic enclosures.

5.2.1 SENSOR RESPONSE COEFFICIENT:

Jumper header JP2, located on the I/O PCB, allows the ST200 Series to be configured to accept either positive or negative coefficient sensors. JP2's dual jumpers must both be placed in either the 'A' or 'B' positions. 'A' corresponds to a positive coefficient output sensor and 'B' to a negative. These have been factory set.

5.2.2 SELECTING PRE-AMP GAIN RESISTOR R13:

Note: R13 is preset at the factory and only needs to be changed if the measurement gas or range are to be modified dramatically after shipment.

Depending upon the gas being monitored, electrochemical sensors have a very wide range of micro-amps per PPM (parts per million) output signal. Socketed resistor R13 is the gain resistor for the pre-amplifier, which converts these micro-amps to a more suitable voltage range. The formula for selecting the value of R13 is as follows:

R13 (ohms) = 1,000,000 / µamps full scale input

For example, if the sensor output is 1 µamp per PPM, and the measurement range is 0-100 PPM, then 100 µamps is the full scale input. Therefore, R13 should = 1,000,000 / 100, or 10K ohms. This should be considered a coarse setting since there are 2 additional gain adjustments available after the preamp signal. A high quality 1% metal film grade of resistor should be used.

5.2.3 INITIAL FIXED GAIN ADJUSTMENT:

The ST Series I/O PCB has 4 fixed ranges of sensitivity, which are selectable via JP1. The JP1 positions are labeled 1, 2, 3 & 4. The VOUT test point on the I/O PCB has a range of .4 - 2 volts for 0 - 100% of the measurement range. JP1 jumpers set the coarse upscale SPAN values by affecting the gain of the analog circuit. JP1 is set correctly if a 50% of full scale gas reads between 1.0 & 1.2 volts on VOUT. Fine tuning of these settings is done later by adjusting the ST Series magnetic controls. JP1 jumpers normally only require configuring if a new sensor is installed or if the monitoring range is changed.

JP1 gain values are as follows:

JP1 with jumper in position 1 = GAIN = 5.5

JP1 with jumper in position 2 = GAIN = 4

JP1 with jumper in position 3= GAIN = 2.3

JP1 with jumper in position 4 = GAIN = 1.5

JP1 with no jumper = GAIN = 1

More than one jumper may be installed to allow additional gain values. Multiple jumpers are additive in relation to the gain value. For example, if a gain of 6.5 is needed, jumpers should be placed in positions 2 and 3 to provide a gain of 6.3.

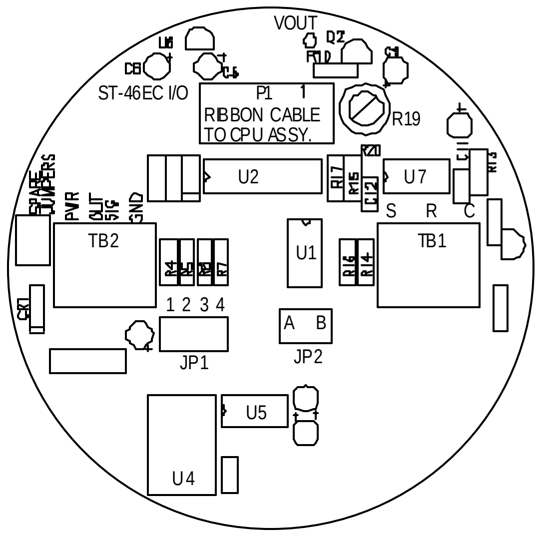
Determining what gain value is required for the application may be determined either by applying a known value of gas and configuring JP1 for the correct voltage on the VOUT test point, or by reviewing the sensor's µamp per PPM specification and predicting the correct gain. When using the front panel LCD to read the output and configure JP1, it is important to place the ST Series in UNITY GAIN MODE (see section 3.4) to insure additional gain is not being applied by the magnetic controls. The following equation describes the relationship between sensor µamps, R13 and gain requirements:

JP1 GAIN = 1,600,000 / (sensor µamps)(R13)

For example, if the application is to monitor 0-10 PPM of carbon monoxide and the sensor provides 0.8 µamp per PPM, then the full scale µamp range is 8 µamps. The calculated value for R13 from the equation in section 5.2.2 is 125K ohms so we may assume a common value of 100K ohms for the actual R13 value. The gain required by JP1 is equal to 1,600,000 / (8)(100,000) = 2. To avoid saturating the analog to digital converter by upscale gas values, it is best not to exceed the calculated gain value. Therefore, for this example of a calculated gain of 2, the most desirable JP1 setting would be position 4 for a gain of 1.5. Remember that this is only a coarse setting. The precision adjustment is made at the final magnetic control stage, which has a minimum gain of 0.5 and maximum of 2. The JP1 gain of 1.5 may be reduced to 0.75 or increased to 3 by the magnetic controls.

5.3 ELECTROCHEMICAL SENSOR FAULT SUPERVISION:

The ST200 Series is equipped with fault detection circuitry, which detects a missing sensor. Within several minutes of removing an EC sensor, the ST200 Series transmitters will signal a FAULT condition. A FAULT is also detected if the sensor output drifts far enough negative to cause the 4-20 mA output to reach 2.4mA (-10% of full scale). The ST Series demonstrates that a FAULT condition exists by illuminating the red LED on the front panel and by clamping the 4-20 mA output at 0 mA. These conditions exist until the FAULT is corrected.



ST-46EC I/O PCB FOR
ELECTROCHEMICAL SENSORS

FIGURE 5.1

SECTION VI

OPTIONAL FEATURES

6.1 GENERAL DESCRIPTION:

Space is provided behind the front panel/CPU assembly to add a single circuit board adding features not provided on the standard ST Series. Field wiring should be an important consideration when determining if an option is required. Each option board contains terminals for wiring which are located behind the front panel / CPU assembly. Space for field wiring inside the ST Series enclosure is limited and extra care must be taken to cut wires to only the length needed to complete the connections.

6.2 ISOLATED 4-20 MILLIAMPERE OUTPUT OPTION:

One available option is the isolated 4-20 mA output board shown in Figure 6.1. A 2 point terminal strip located on this board provides the 1500 V isolated signal. This option should be used when it is necessary that the 4-20 mA output be isolated from the ST Series power supply and sensor inputs.

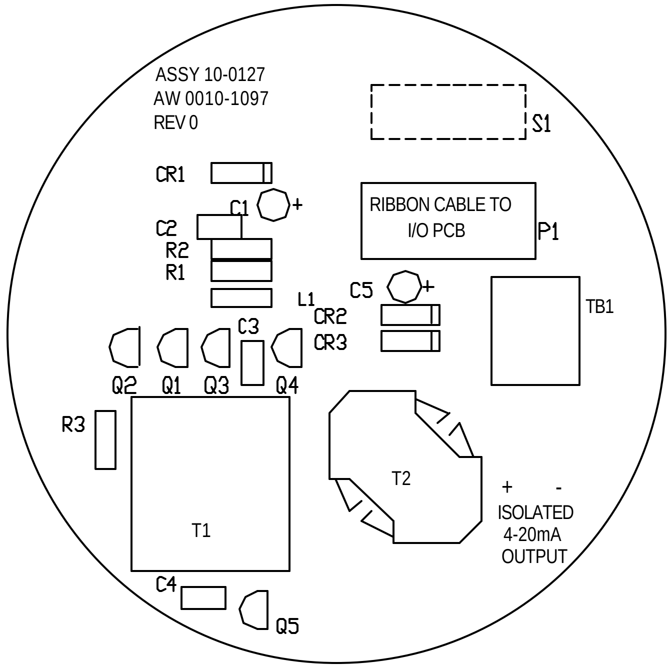


FIGURE 6.1: OPTIONAL ISOLATED 4-20mA OUTPUT

6.3 MODBUS® RS-485 SERIAL INTERFACE OPTION:

The Modbus RS-485 serial interface board allows up to 128 ST Series Transmitters to communicate to a Modbus master device on a single cable. Modbus is the *protocol*, or language used by the ST Series to communicate with other devices. The ST Series is a Modbus *slave.* It requires a Modbus *master* to interrogate it and retrieve information made available in specific register locations. Modbus master devices are typically PLC's or PC's running MMI or GUI software equipped with a Modbus driver. The RS-485 electrical standard allows cable lengths up to 4000 feet between Modbus master and slave. Both 4 wire full duplex and 2 wire half duplex connections are supported by the ST Series serial interface option.

6.3.1 RTU ADDRESS:

The eight DIP switches allows a different RTU address be assigned to each ST Series. The 8 DIP switches represent an 8 bit binary number with 1 = LSB and 8 = MSB. For example, OFF, ON, ON, OFF, ON, OFF, OFF, OFF = 0110 1000 = RTU address 104. A unique RTU address must be assigned each ST Series communicating on the same RS-485 port.

6.3.2 DATA REGISTERS AND FUNCTION CODES:

The following table identifies the ST Series Modbus register locations and function codes available.

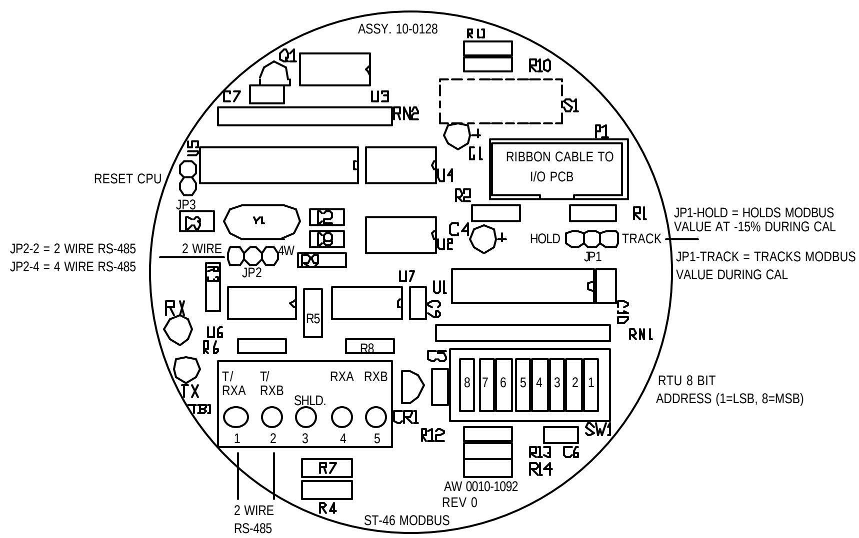
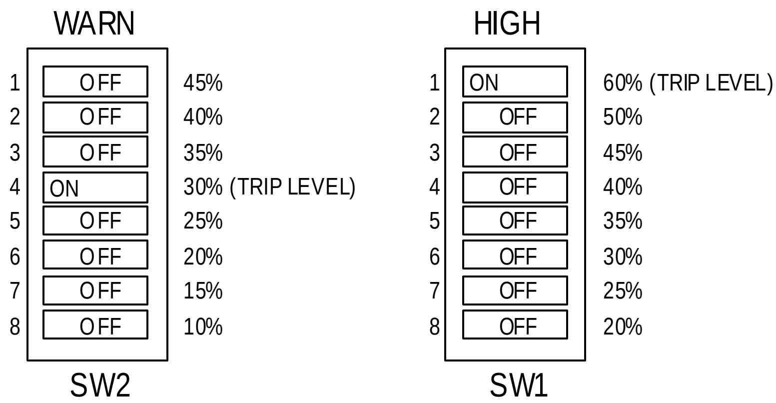


FIGURE 6.2: OPTIONAL MODBUS RS-485

6.4 ALARM RELAYS OPTION:

The alarm option provides 5 A resistive form C relays for FAULT, ALARM 1 and ALARM 2 conditions. The fault relay is *fail safe* and is activated by the defective sensor conditions described in sections 4.3 and 5.3 of this manual. Since it is fail safe it also indicates loss of power conditions at the ST Series. Alarm 1 and Alarm 2 trip points are controlled by two banks of eight DIP switches. Alarm 1 has the lower WARN levels while ALARM 2 has the upper HIGH levels. Each may be set at the 8 percents of full scale shown below:



SELECT ONLY 1 TRIP LEVEL PER SWITCH

Only one of SW1 and SW2's 8 DIP switches may be ON for correct operation. In the example shown above, since SW2 #4 is ON, the WARN alarm will trip at 30% of full scale. Since SW1 #1 is ON, the HIGH alarm will trip at 60%. Both alarm set-points incorporate approximately 1.5% hysteresis. Therefore, the signal must drop about 1.5% below the trip level to reset the alarm. This prevents alarm "chatter" when the input signal equals the trip level.

IMPORTANT! The contacts are rated for 5 amp *resistive* loads. Appropriate surge suppressers should be installed across loads to prevent arcing on the contacts. Arcing generates high levels of RFI which likely will interfere with measurement signals.

6.4.1 LATCHING ALARMS:

JP3 and TB4 are provided to enable latching the WARN and/or HIGH alarm relays. Placing JP3 jumpers in the latching position requires manual reset of alarm conditions. Reset is done by shorting the 2 terminals of TB4. This is accomplished either by wiring to a remote switch.

6.4.2 FAIL SAFE ALARMS:

JP1 and JP2 are provided to make the HIGH and WARN alarms operate in a "fail safe" condition. This means the relays are energized in the safe, or no alarm condition. When an alarm condition exists the relay de-energizes. The advantage of this configurations is "loss of power" conditions create the same relay outputs as alarm conditions. The FAULT relay is always fail safe.

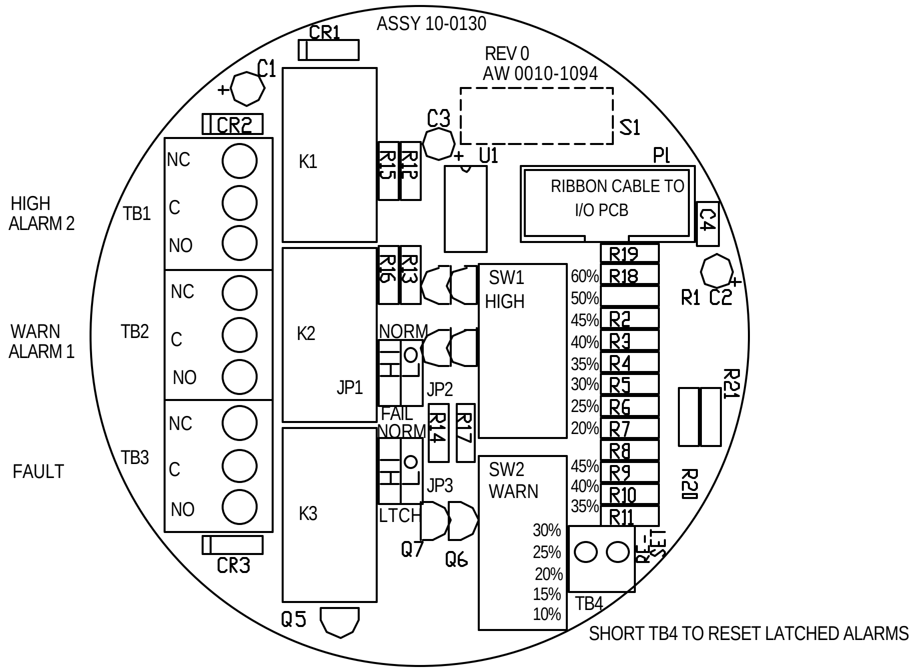


FIGURE 6.3: OPTIONAL ALARMS

SECTION VII

CUSTOMER SUPPORT

7.1 TECHNICAL SERVICE:

Technical service can be obtained by contacting Armstrong Monitoring Corporation at

(613) 225-9531

(800) 465-5777 (U.S. Toll Free)

Fax (613) 225-6965

7.2 HEAD OFFICE:

The Head Office of **Armstrong Monitoring Corporation** is located at

215 Colonnade Road. Nepean, Ontario, Canada. K2E 7K3.

SECTION VIII

PHYSICAL DIMENSIONS

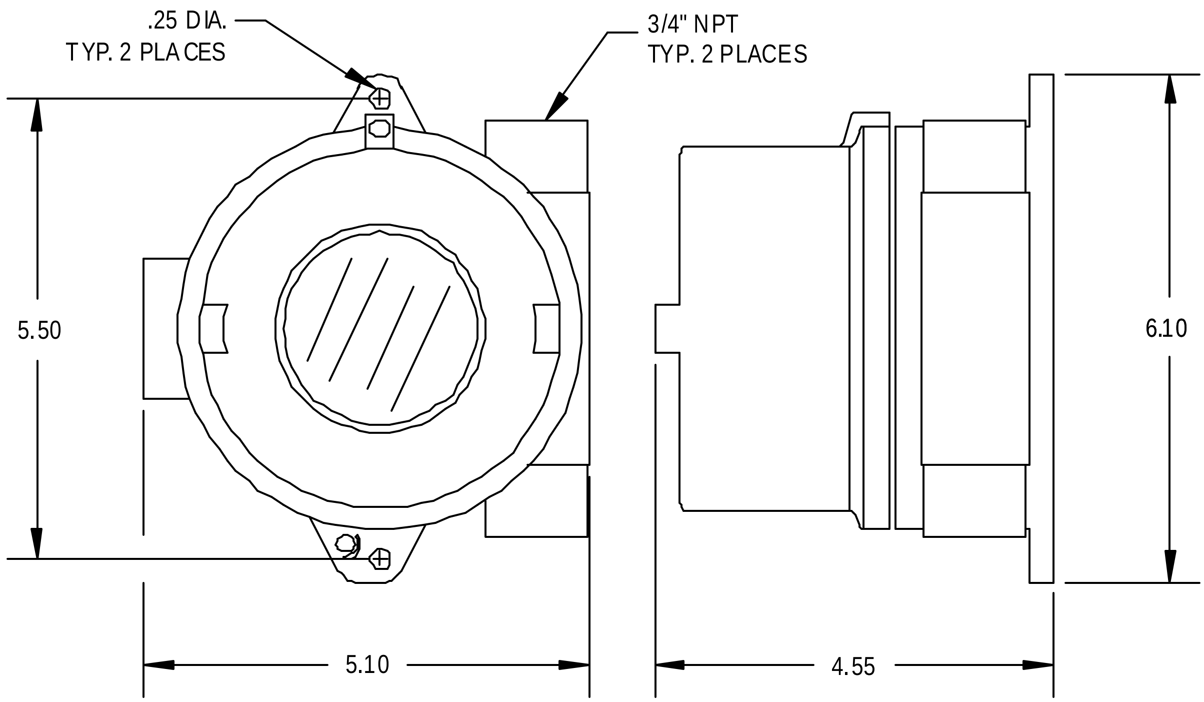


FIGURE 8.1

ST-420 ADDENDUM

This instruction manual addendum describes a special version of the ST series modified to accept 4-20mA transmitter inputs in lieu of sensors. Portions of the manual not specifically addressing sensors still apply to the ST-420. This allows the ST-420 to be mounted in series with the transmitting device in need of its non-intrusive calibration and readout features.

Jumper positions must be located vertically in position 4 for JP1 and horizontally in position A for JP2. The modified I/O board, reflecting the terminal assignments for TB1 and TB2, is shown in figure below. Also shown below, TB1 connects to the transmitters and TB2 connects back to the main panel supply as usual.

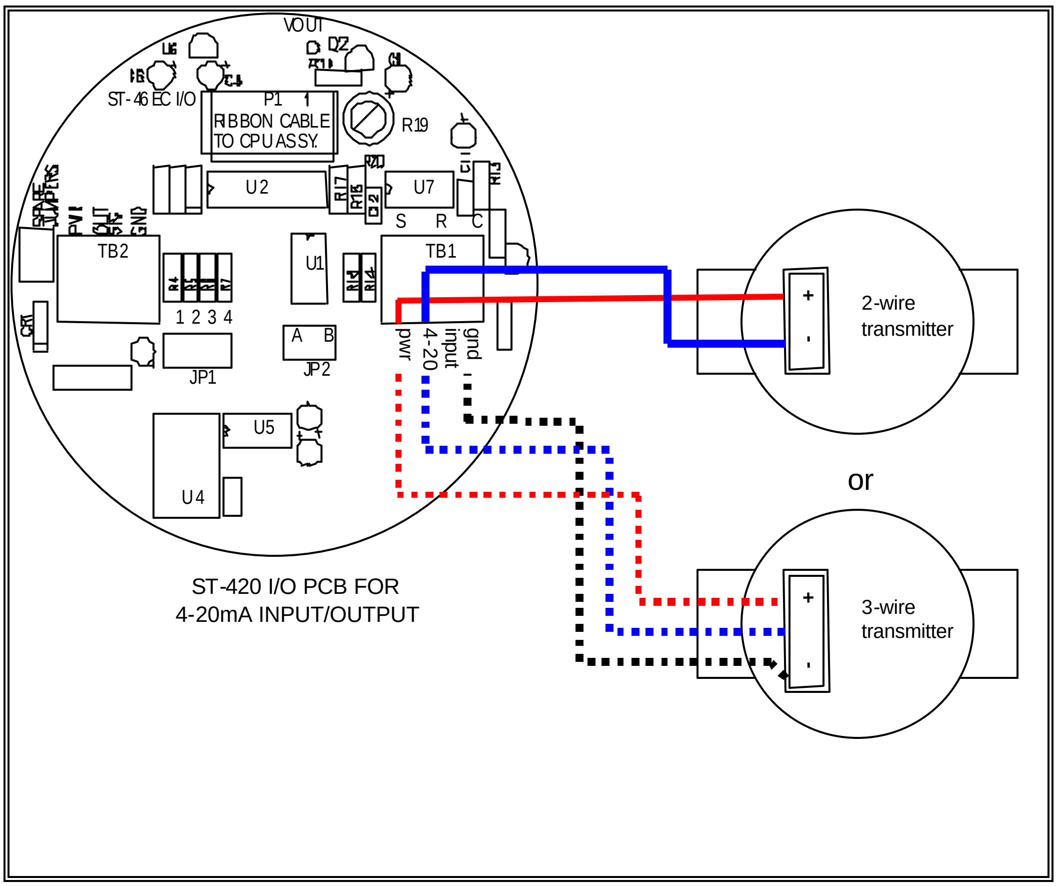


Figure – The AMC ST-420 connected to 2 and 3 wire transmitters