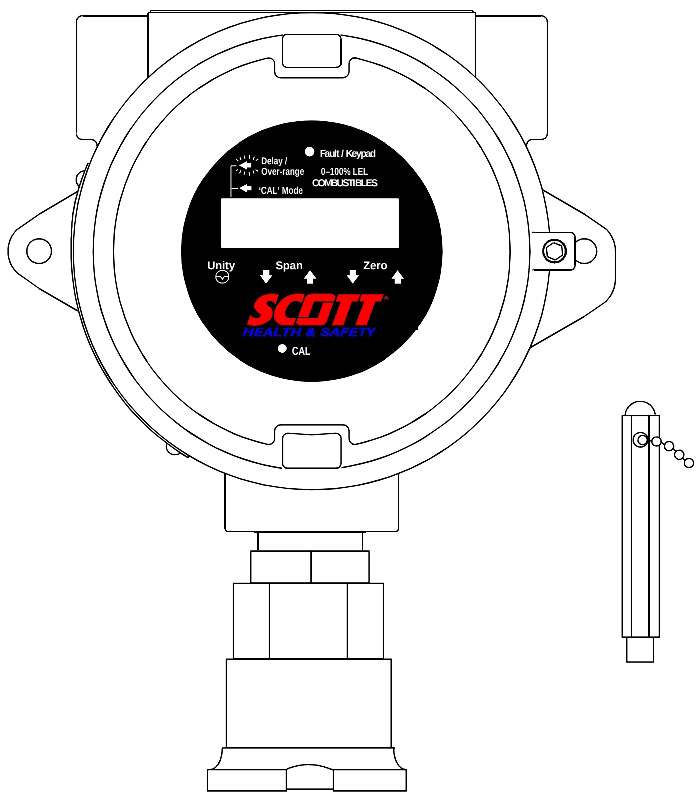
INSTRUCTION 9550-9142

4888A-NIC II LEL

COMBUSTIBLE GAS DETECTION TRANSMITTER (Non-Intrusive Calibration)

Installation/Operation/Maintenance
Rev.5 – April 2008
ECN #129031



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WARNING!

Because this instrument is used to detect and monitor materials and conditions which are listed by OSHA or others as potentially hazardous to personnel and property, the information in this manual must be fully understood and utilized to ensure that the instrument is operating properly and is both used and maintained in the proper manner by qualified personnel. An instrument that is not properly calibrated, operated and maintained by qualified personnel is likely to provide erroneous information, which could prevent user awareness of a potentially hazardous situation for the instrument user, other personnel and property.

If, after reading the information in this manual, the user has questions regarding the operation, application or maintenance of the instrument, supervisory or training assistance should be obtained before use. Factory assistance is available by calling (704) 291-8300.

Declaration of Conformity

Manufacturer's name:	Scott Health & Safety
Manufacturer's address:	4320 Goldmine Road Monroe, NC 28110
Product name:	4888A-NIC II Combustible Gas Transmitter conforms to the following specifications: European Directive 89/336/EEC
EMC:	EN 50081-1 (Emissions) EN 50082-2 (Immunity)

Contents

1 Introduction

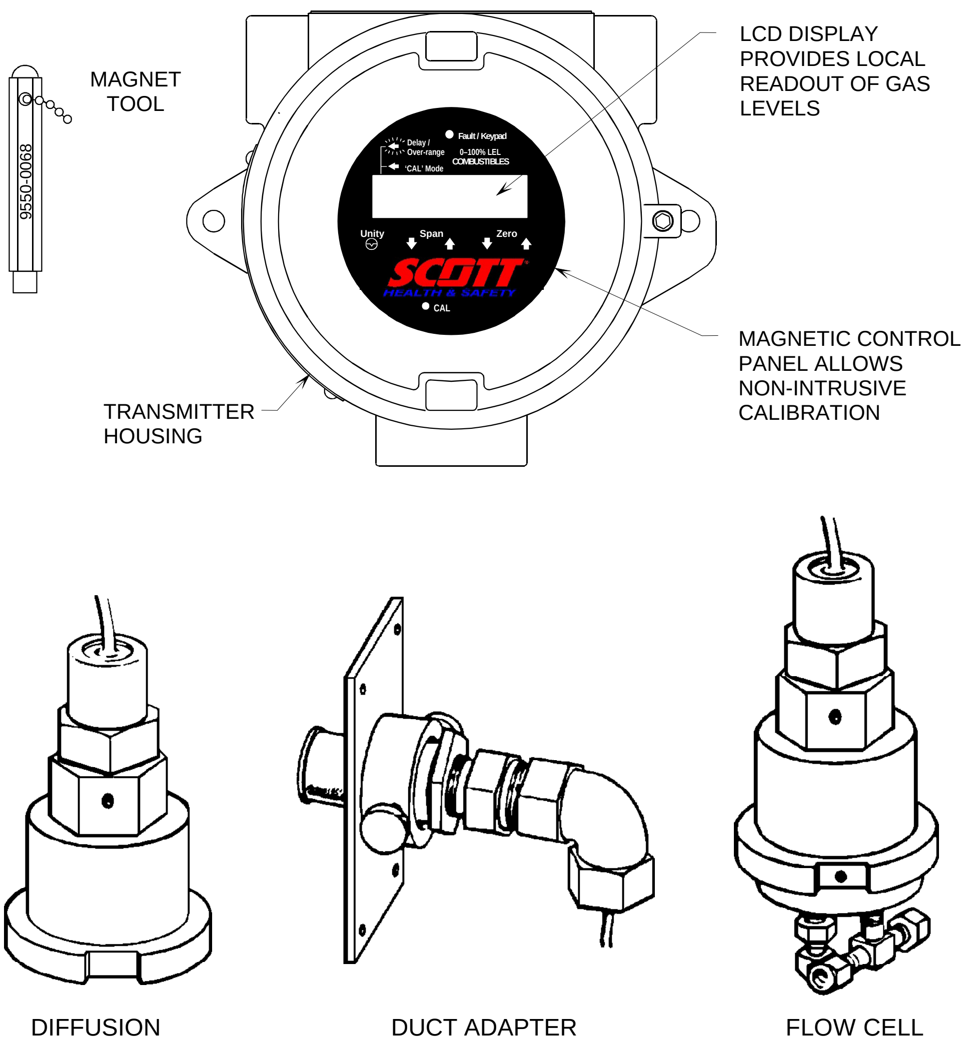
1.1 Transmitter Assembly Description

This manual describes how to install, operate, and maintain the Scott Health & Safety 4888A-NIC II LEL Transmitter (Non-Intrusive Calibration), and associated detector head (Figure 1-1).

The transmitter consists of a Front Panel/CPU assembly, one option board (if installed), and an Input/Output board all housed in an explosion-proof aluminum housing with viewing window. The transmitter operates from either 12 or 24 VDC, and can drive virtually any configurable 4–20 mA receiving unit (DCS, PLC, loop powered alarm, data logger, etc.) over three or four wires plus a conforming ground.

There are three basic detector heads: diffusion, duct adapter, and flow cell. Variations of these heads include diffusion with calibration port, and flow cells with and without an aspirator. Each of these detector heads contain a catalytic-bead, combustible-gas sensor.

Figure 1-1. 4800-NIC LEL Transmitter, with Magnet Tool and Associated Detector Heads



1.2 Transmitter Identification

A transmitter is identified by its model number, which in turn is determined by what type of sensor, detector head, and output/option board are installed at the time of manufacture. The transmitter’s model number is located on a label that is attached to the side of the enclosure.

The diagram below shows how the transmitter’s model number is used to specify its configuration.

For example: The model number 4888-1-1-1-2 denotes a transmitter with a combustibles sensor, an intergal diffusion detector head, and a 4–20 mA output with an optional relay board.

4 8 8 8 - X X X X

Sensor Type
1 - Combustibles - 6V "Gold Bell" sensor
2 - 5.5V Scott bead (Stainless Steel Diffusion Head)
3 - 5.5V Scott Poison Resistant Bead (Stainless Steel Diffusion Head)
4 - 5.5V Scott bead (Stainless Steel Positive Flow Head)
5 - 5.5V Scott Poison Resistant Bead (Stainless Steel Positive Flow Head)

Detector Head
1 - Diffusion attached to housing
2 - Duct Adaptor
3 - Flow Cell w/ aspirator
4 - Remote Diffusion
w/calibration port
5 - Flow Cell w/o aspirator
6 - Remote Diffusion
7 - Round Duct Adaptor (4" or greater)
8 - No Option

Power Options
1 - 24VDC (Standard)
2 - 12VDC

Transmitter Output
1 - 4–20 mA Non-Isolated
2 - 4–20 mA Non-Isolated and Relays
3 - RS-485 Modbus
4 - 4–20 mA Isolated

All transmitter configurations are designed to be installed using explosion-proof (XP) installation methods.

1.3 Features

- Continuous, local LCD readout of combustible gas levels in the range of 0–100% LEL.

- Non-intrusive calibration (NIC) using a magnet tool, allowing the transmitter to be calibrated in hazardous areas without area declassification.

- Three or four wire transmission, providing a standard 4 to 20 mA output signal.

- One-man calibration.

- The ability of being operated as a stand alone unit, or reporting to a host computer through commercial input/output processors.

- Indicators that show when the transmitter is warming up, in calibration, or in a fault condition.

- Diagnostic output signals which distinguish between the transmitter's calibration (1.5 mA), fault (0 mA) and overrange (20.5 mA) modes.

- An approved explosion proof aluminum transmitter enclosure with watertight O-ring. The enclosure is coated with a hybrid epoxy powder/polyester paint for superior chemical resistance. The 4888A-NIC II LEL Transmitter and its detector assembly are suitable for installation in Class I, Division 1, Group B, C, and D hazardous locations.

- Space is provided behind the Front Panel/CPU assembly to add a *single* circuit board for adding one of the following optional functions:

  - *Relay Board* provides local activation of WARN, ALARM, and FAIL annunciators for the purpose of alerting personnel of rising combustible gas levels or system electrical failures.

  - *Modbus RS-485 Serial Interface Board* allows up to 128 transmitters to communicate to a Modbus master device over a single 2- or 4-conductor cable.

  - *Isolated 4–20 mA Output Board* isolates the transmitter's output from its power supply and sensor circuits.

1.4 Operational Overview

In operation, when a mixture of air and combustible vapors or gases surrounds the detector head, the combustibles around the surface of the sensor's active element are rapidly oxidized (by catalytic oxidation), thus raising the temperature of that element. This rise in temperature causes an increase in the resistance of the active element in relation to the sensor's inactive (reference) element.

The transmitter's electronics measure the sensor's change of resistance and generates an output current of between 4 and 20 mA that is proportional to the detected combustible gas level, where 4 mA represents 0% LEL, and 20 mA represents 100% LEL. In addition to the transmitter's output signal, the LCD on the unit's faceplate, viewable through the explosion-proof enclosure's transparent cover, provides local display of the detected gas level in %LEL.

Calibration is performed at the transmitter without removing its explosion proof viewing cover, making area declassification unnecessary. The only tool required for this "non-intrusive" calibration is a small magnet, which is provided with the transmitter.

ZERO and SPAN operations are performed by placing the transmitter into its calibration mode by briefly holding the magnet tool over the CAL dot on the faceplate. The transmitter responds by causing the 'CAL' Mode arrow to light steadily. The magnet serves as a "pass-key" which makes it difficult for unauthorized personnel to tamper with the calibration settings. Calibration of the system is then performed by applying calibration gas and holding the magnet over the ↑↓ Zero and ↑↓ Span symbols as required to obtain the correct readings. Once calibration is complete, an E^2 PROM provides backup to retain calibration settings during power interruptions.

2 Technical Data

Readout .... 3-½ digit LCD (% LEL)

Power Requirements .... 18.0 to 30.0 VDC; 4.2 watts maximum steady state @ 24 VDC nominal input (with relay option board installed, relays energized)

Signal Output .... 4–20 mA into 800 ohms with 24 VDC power standard. Range of operation is 0 to 20.5 mA.

Magnetic Calibration Adjustment Range .... **ZERO**: ±15% of full scale.
SPAN: Turn up to gain of 2, down to gain of 0.5 (The sensor can lose up to 50% of its signal strength, and the magnetic SPAN adjustment can still be used to properly calibrate the transmitter without having to open the enclosure.)

Calibration Resolution .... 0.1% of full scale

Diagnostics .... **CAL mode:** Lighted 'CAL' Mode arrow with the output held at 1.5 mA.
FAULT mode: Lighted Fault/Keypad LED with the output held at 0 mA. A fault condition is detected if the sensor develops an open or short circuit, or its output drifts far enough negative to cause the 4–20 mA output signal to drop to 2.4 mA (–10% of full scale).
Over-range mode: Over range arrow flashes 3–4 times a second with the output held at 20.5 mA, until the over-range condition clears.
ESL: ESL will flash on display every 10 seconds when trip point is exceeded during calibration.

Memory Backup .... E^2 PROM device retains calibration settings during power interruptions.

Housing .... Transmitter electronics is housed in an HKB-style explosion-proof aluminum enclosure with watertight O-ring. Hazardous area rating: Class I, Div. 1, Groups B, C and D.

Accuracy (electronics) .... ±0.1% of full scale, ±1 count

Ambient Temperature:

Transmitter electronics .... – 40 to 158 °F (– 40 to 70 °C)
Note that the transmitter's low-end temperature performance is based on self-heating of the electronics by having the cover in place and power applied for at least 1 hour prior to evaluating performance .

Combustibles Sensor .... – 40 to 200°F (– 40 to 93°C) 6 Volt Detector
– 40 to 400°F (– 40 to 200°C) 5.5 Volt Detector

Temperature Drift .... Less than 0.1% per °C over ambient temperature range

Response Time .... <10 seconds to 50% full scale
<30 seconds to 90% full scale

Dimensions .... See Figure 3-4

Weight ....

Transmitter Assembly	–	3 lb 8 oz (1.6 kg)
Diffusion Detector	–	8 oz (0.2 kg)
Flow Cell Detector	–	14 oz (0.4 kg)
Duct Adapter Detector	–	1 lb 9 oz (0.7 kg)

Sensor:

Type .... Catalytic (platinum bead), 6 volt operation

Life Expectancy .... 1 year normal service when intermittently exposed to combustible gas-in-air mixtures

Catalyst "Poisoning" .... Do not expose catalytic sensor to silicone vapor or silicone compounds that outgas before fully curing. Consult factory for further details.

Hazardous Area Rating .... CSA — Explosion proof installation, Class I, Division 1, Groups B, C and D Hazardous Location C22.2 No. 152

CSA/US — CSA has accreditation in U.S. from Occupational Safety and Health Administration (OSHA) as a nationally recognized testing laboratory.

Relay Board Option:

Contact Rating .... Relay contacts are SPDT, Form C, rated for:
5A @ 250 VAC / 30 VDC (resistive)

Typical Alarm Settings .... 20% LEL WARN level (Alarm 1)
40% LEL ALARM level (Alarm 2)

Controls .... DIP switch determines setting of eight board functions;
Two rotary switches set the WARN and ALARM trip points

4–20 mA Output Board Option .... 1500 V isolation between the 4–20 mA output signal and the transmitter's power supply

RS-458 Serial Board Option .... Modbus protocol

3 Installation

3.1 Transmitter Location

Mount the transmitter with its detector head facing downward, where it can be calibrated and maintained safely and easily. Leave enough clearance for service personnel to make adjustments or repairs. When planning the installation, remember that 3/4" conduit will need to run from the transmitter to its receiving equipment, and, if the optional relay board is installed, from the transmitter to the WARN, ALARM and FAIL annunciators and their power source. See Figure 3-1.

When in doubt about where to mount the transmitter, we recommend that you consult a professional safety engineering firm.

Generally, for accurate combustible gas detection, install the 4888A-NIC II LEL Transmitter and its attached detector head:

- Where air currents contain high concentrations combustible gas. Mount near the floor for heavier-than-air gases, or near the ceiling or roofs for lighter-than-air gases.
- In areas within the operating temperature range of the transmitter — refer to Section *2 Technical Data*. If the area is subject to temperature extremes, protect the transmitter by choosing a “friendly” mounting location where natural protection is available to shade, reduce, or nullify the adverse temperature condition.
- Away from the direct destructive effects of corrosive agents, moisture, dust and dirt, if possible. Take precautions to prevent any blockage or freeze-over of the gas-diffusion path.
- In an area where the transmitter can be calibrated and maintained in a safe and easy manner. Leave enough clearance for service personnel to make adjustments or repairs.

Figure 3-1. Typical Transmitter, showing a Diffusion Detector Head

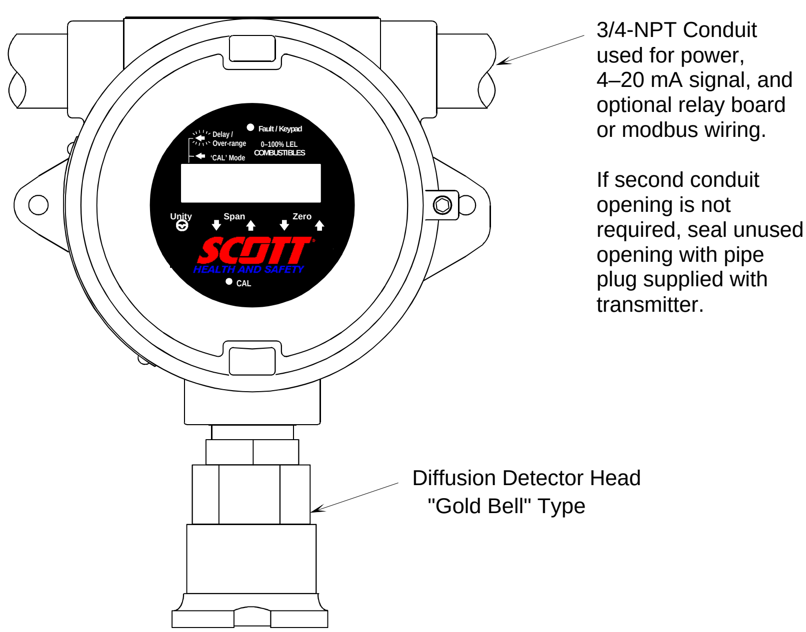
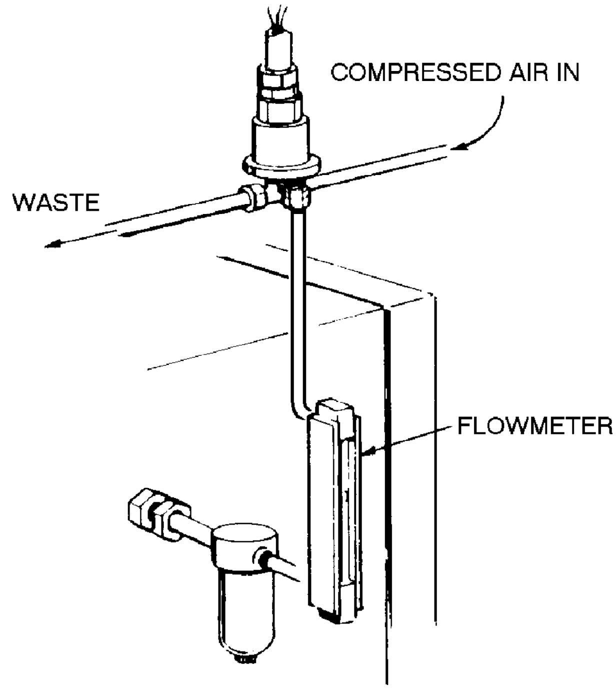
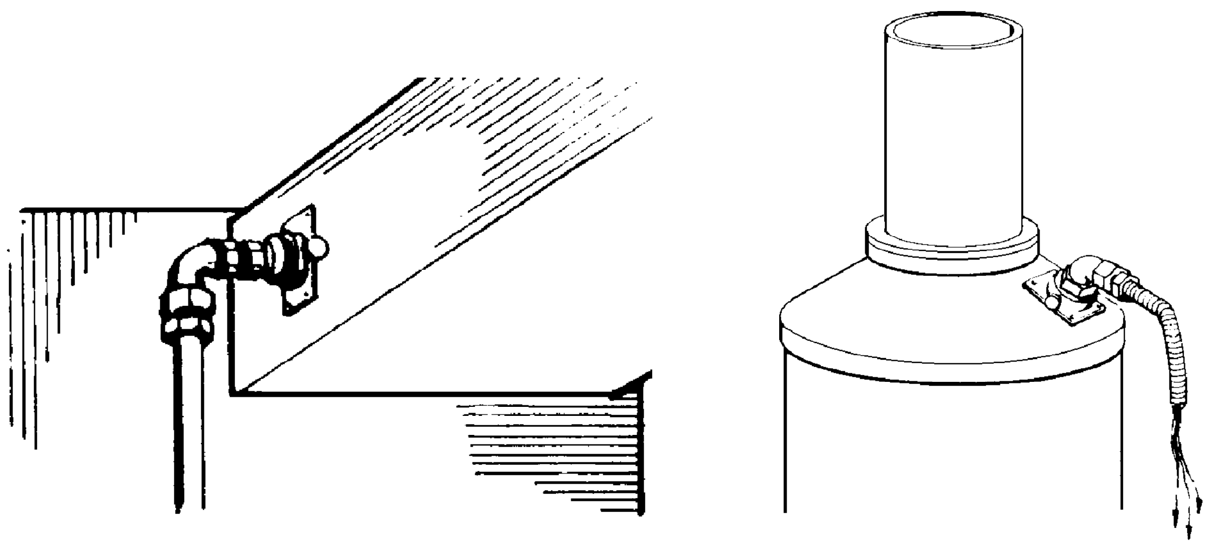


Figure 3-2 shows typical mounting of the flow cell and duct adapter detector heads (detailed mounting instructions of the flow cell detector are supplied in Instruction 51-9098).

Figure 3-2.
Typical Flow Cell and Duct Adapter Detector Head Locations



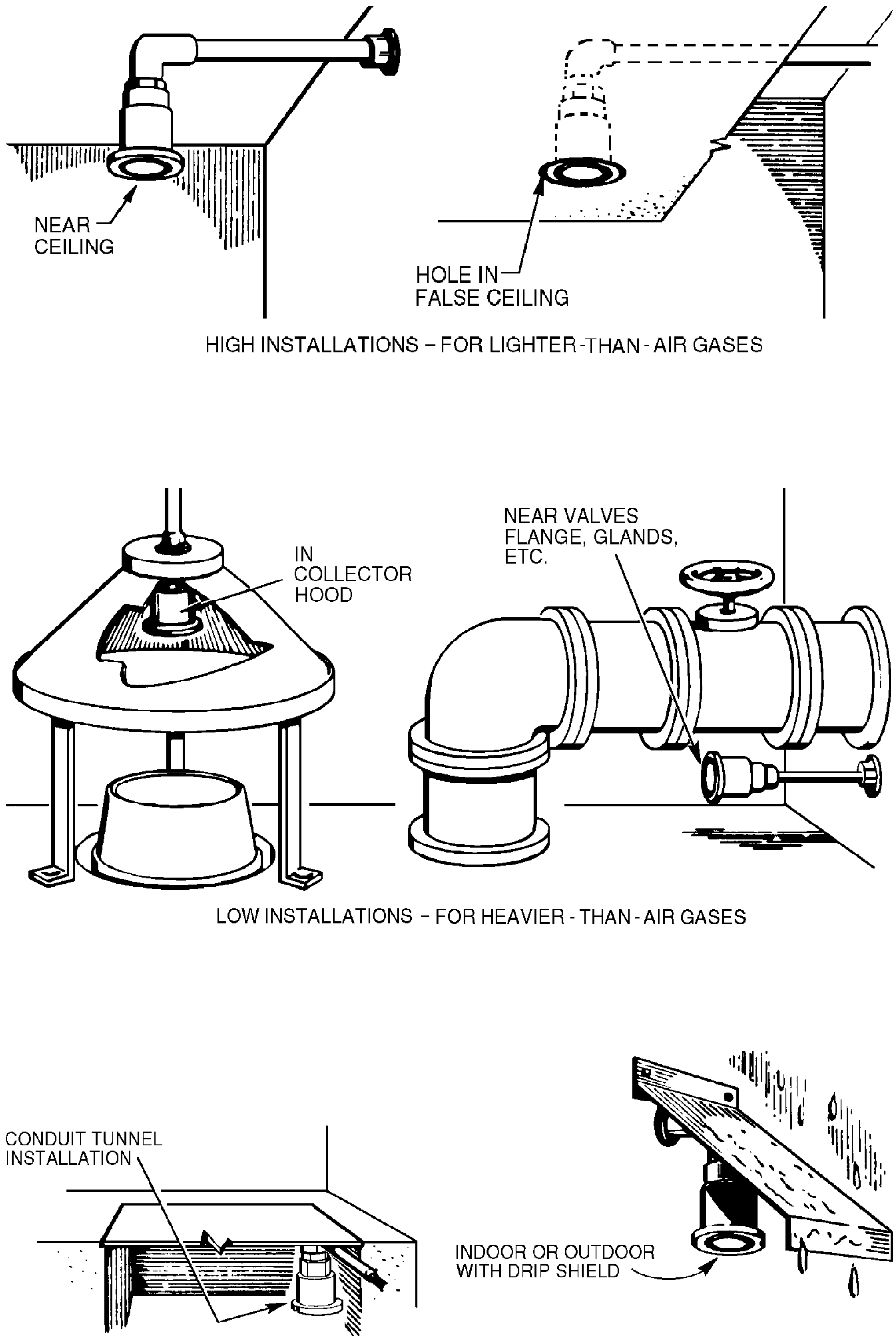
FLOW CELL w/ASPIRATOR



DUCT ADAPTER

Figure 3-3 shows installation of a diffusion detector head mounted separate from the transmitter (106 foot maximum separation) in areas where it is not convenient to have both units together.

Figure 3-3.
Typical Diffusion Head Mounting Locations when Separated from the Transmitter Housing



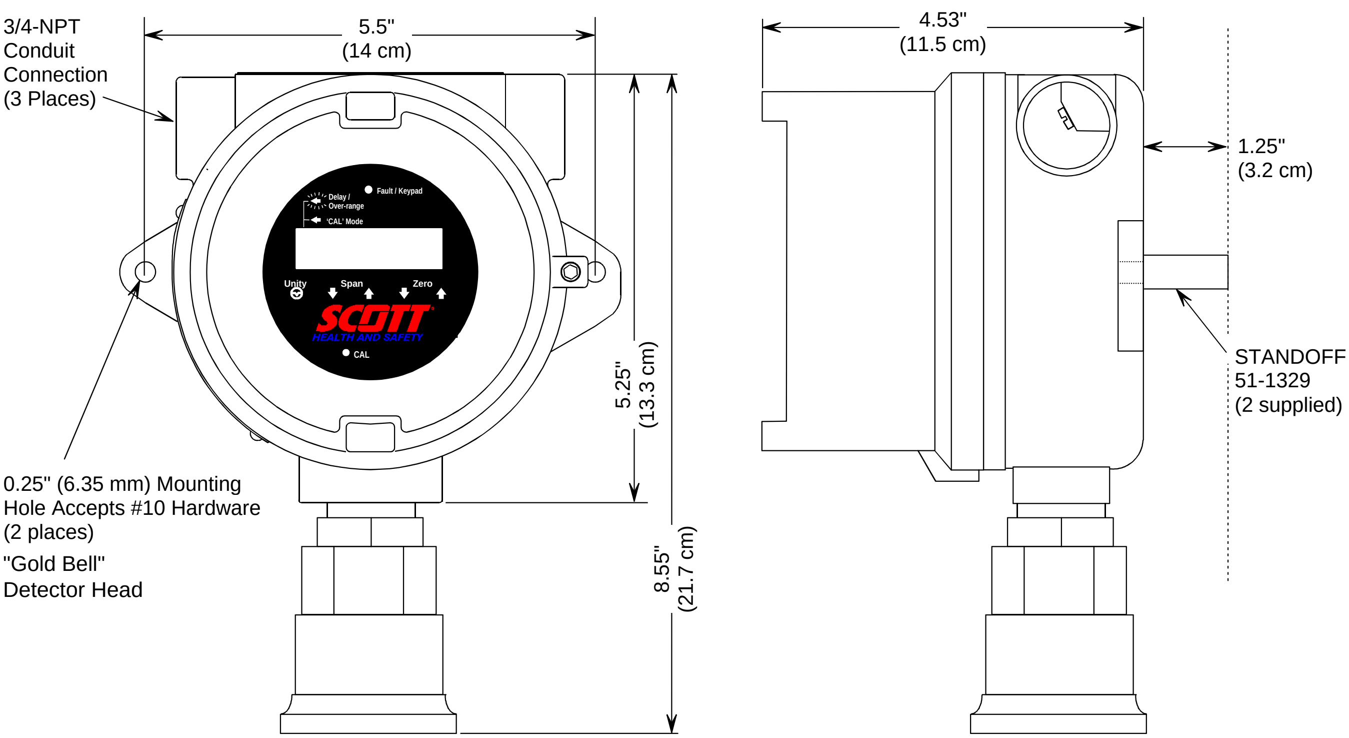
3.2 Mounting the Transmitter

Mount the transmitter on a vertical surface, in the area determined from Section *3.1 Transmitter Location*.

Choose appropriate #10 hardware that will safely secure the transmitter and its two 1-¼" standoffs (P/N 51-1329) on the mounting surface. Note that if the detector head is being located separate from the housing, then the standoffs are not required. Refer to Section *2 Technical Data* to determine the combined weight of the transmitter and detector head. Mounting dimensions are shown in Figure 3-4.

The general mounting procedure is to place the transmitter where it will be mounted; mark the positions of its two mounting holes; predrill the mounting holes; then use #10 hardware to secure the transmitter and its standoffs (if used) to the supporting structure.

Figure 3-4. Transmitter and Detector Head Outline and Mounting Dimensions



4 Wiring

4.1 Wiring Overview

WARNING!

Be sure to declassify the area to non-hazardous before opening the transmitter or any other electrical enclosures. Then check the area for the presence of combustibles with a portable gas detector.

Wire the 4888A-NIC II LEL Transmitter to:

- Its detector head.
- A power source that will supply between 18–30 VDC at the input of the transmitter. The power source must be well filtered and regulated, and of sufficient quality to provide a reasonable degree of protection. (10–18 VDC operation is also possible. Refer to Section *4.6.1*.)
- Equipment capable of receiving the transmitter's standard 4–20 mA output signal (e.g., PLC, DCS, loop powered alarm, data logger, etc.).
- *Optional* WARN, ALARM and FAIL annunciators (e.g., bells, buzzers, strobe lights, etc.) which function to alert personnel of rising gas levels and transmitter electrical malfunctions.
- *Optional* Modbus RS-485 master which functions to retrieve information from up to 128 transmitters using either 4 wire full duplex, or 2 wire half duplex connections.

4.2 Meeting Electrical Codes

WARNING!

To avoid an explosion or electrical fire, encase the cable connection to the transmitter in conduit. The conduit must meet prevailing electrical codes for hazardous-area installations which specify conduit sealing, explosion-proof fittings, and special wiring methods.

To meet prevailing electrical codes, use conduit and all other materials required for electrical wiring in hazardous areas. Install wiring according to National Electrical Code (NEC) Articles 501-517.

As supplied, the detector head's wiring is already sealed and requires no additional sealing to conform to NEC requirements for explosion-proof installations, as long as the detector is mounted no further than 18" (457 mm) from the transmitter [NEC Article 501-5(a)(1)].

4.3 Selecting Wire Size

4.3.1 4–20 Signal Loop Resistance

The maximum signal-loop resistance that can be connected to the transmitter's output is 800 ohms @ 24 VDC (400 ohms @ 12 VDC). In almost all cases, the wire size chosen for the power supply leads will be more than adequate for the 4–20 mA signal lead. Note that 18 AWG wire provides a 4–20 mA signal lead wiring distance of approximately 34,000 feet!

> **Note:** *Maximum signal-loop resistance is defined as the sum of the 4–20 mA signal-wire resistance, the receiver's input resistance (normally 250 ohms), and the resistance of the common ground wire between the transmitter and power supply.*

4.3.2 Power Supply Wire Length

The transmitter requires an operating voltage of between either 10–18 or 18–30 VDC, as determined by the installation of a jumper at J04 on the Input/Output board. Use a power supply that provides a voltage within the appropriate range at the transmitter after taking into consideration the "IR" drop of the power supply leads as described below. The transmitter's terminal block can accept wire sizes of up to 14 AWG; however, 16 or 18 AWG should be sufficient for most installations.

The minimum AWG wire size that can be used to connect the power supply to the transmitter is determined by the output voltage of the power supply, the maximum current drawn by the transmitter, and the voltage drop that occurs across the wiring.

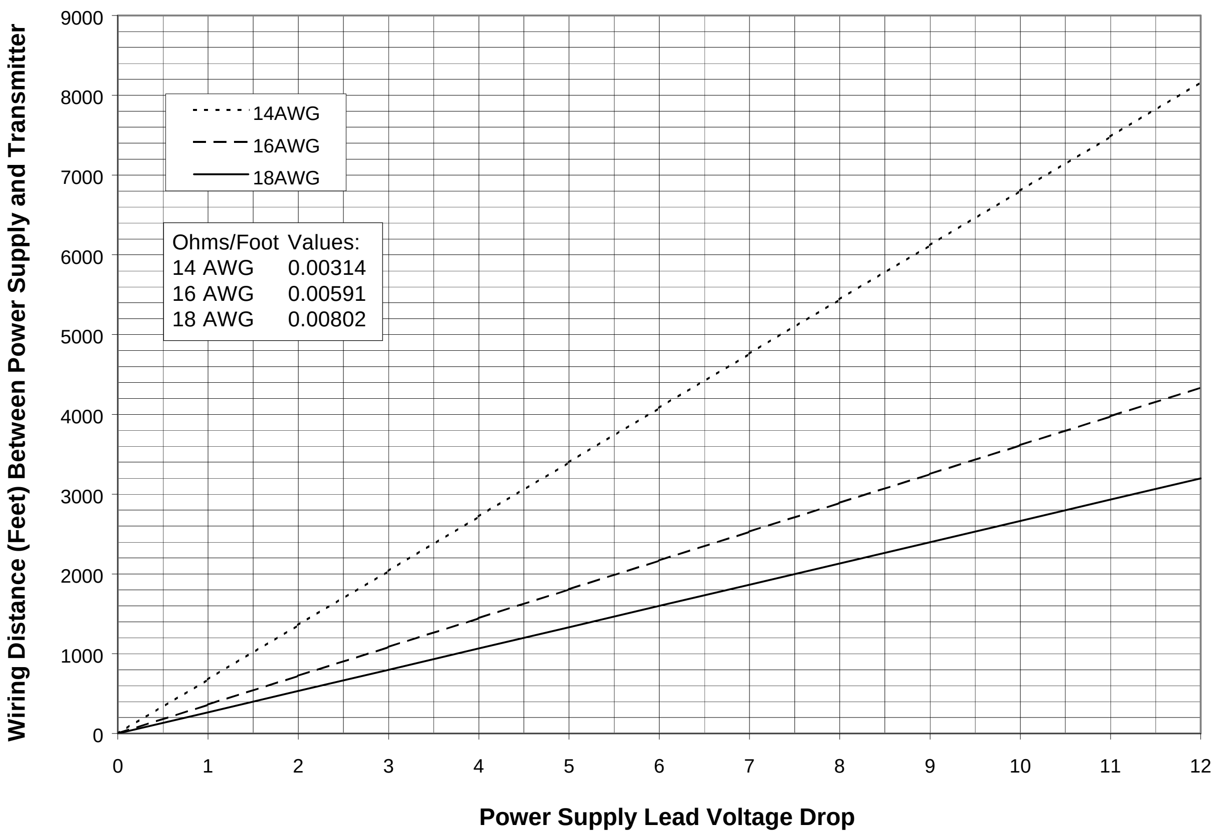
When choosing the location of the transmitter and its power supply, the *size* and *length* of the power supply wires become an issue if the wiring's voltage drop would cause the transmitter's input voltage to drop below its minimum operating voltage.

The following graphs are provided as an aid in determining maximum wiring distances for various power supply voltages and wire sizes. To determine the maximum wiring distance, first calculate the wiring's maximum allowable voltage drop by subtracting the transmitter minimum operating voltage (either 10 or 18 VDC) from the power supply's output voltage. Then use the appropriate graph to determine the maximum wiring distance for 18, 16 and 14 AWG wire.

Note that Graph 1 is based on a worse case transmitter current of 234 mA at 18 VDC, while Graph 2 is based on a current of 420 mA at 10 VDC. Both graphs are based on a temperature of 85 °C, and take into consideration that the wiring distance consists of two wires (both hot and return). The graphs are invalid, however, if the wire being used has a different ohms/foot value from that listed.

If your wiring requirements fall outside the boundaries of the graph, then use Equation 4-1 to calculate the maximum wire length.

Graph 1. Voltage Drop vs. Wiring Distance, 234 mA @ 18 VDC

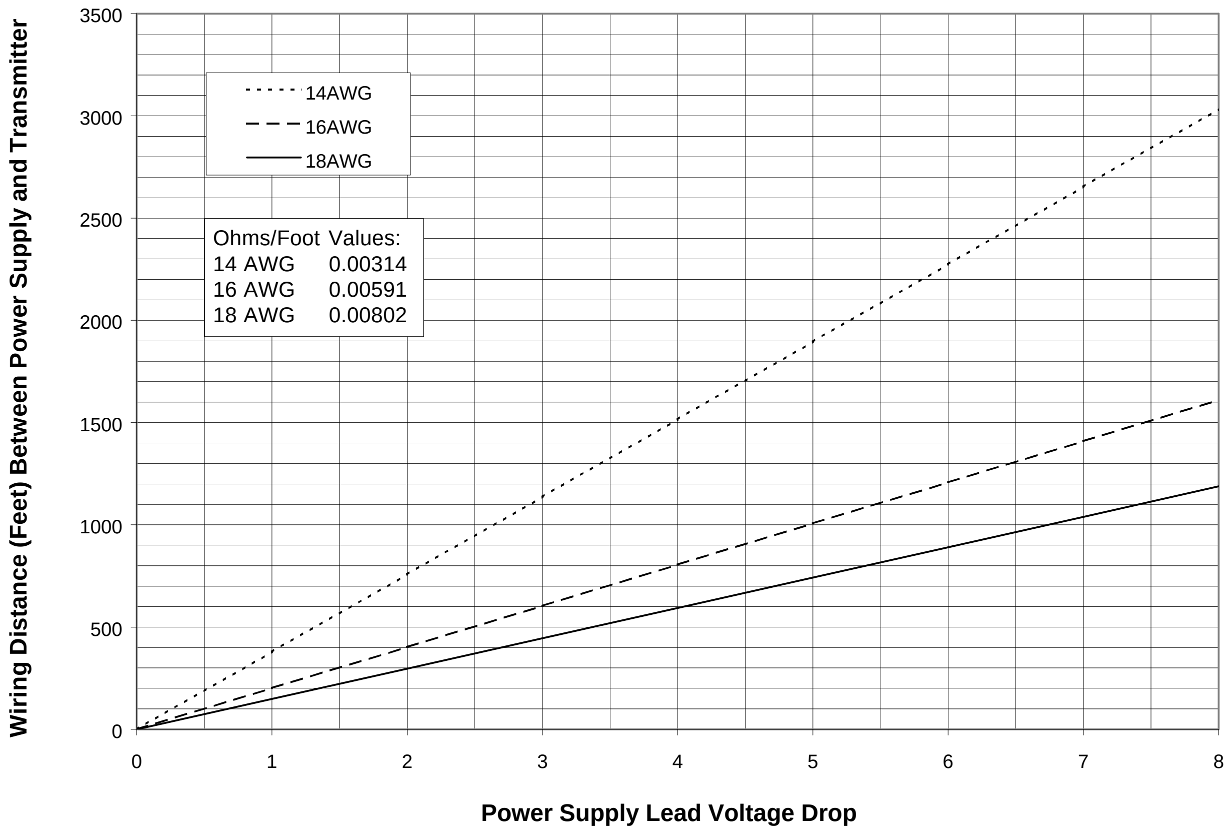


Example 1: When wiring the 4888A-NIC II LEL Transmitter to a 24 VDC power supply (transmitter setup for 18–30 VDC operation per Section 4.6.1), the power supply leads cannot drop more than 6 VDC in order to provide at least 18 VDC at the transmitter. Using Graph 1, note that a power supply lead voltage drop of 6 volts crosses the wire size lines at approximately the following wiring distances:

14 AWG – 4050 ft
16 AWG – 2150 ft
18 AWG – 1600 ft

The power supply wiring distance should not *exceed* the value determined for its associated wire size. In this example, 18 AWG wire can be used for wiring distances of up to 1600 ft.

Graph 2. Voltage Drop vs. Wiring Distance, 420 mA @ 10 VDC



Example 2: When wiring the 4888A-NIC II LEL Transmitter to a 12 VDC power supply (transmitter setup for 10–18 VDC operation per Section 4.6.1), the power supply leads cannot drop more than 2 VDC in order to provide at least 10 VDC at the transmitter. Using Graph, note that a power supply lead voltage drop of 2 volts crosses the wire size lines at approximately the following wiring distances:

14 AWG – 760 ft
16 AWG – 400 ft
18 AWG – 300 ft

The power supply wiring distance should not *exceed* the value determined for its associated wire size. In this example, 18 AWG wire can be used for wiring distances of up to 300 ft.

Equation 4-1. Wiring Distance

$$D_{ir} = \frac{V_{Power\ Supply} - V_{Min}}{I_{Max} \times R_{Wire} \times 2}$$

Where: D_{ir} = Maximum wire length in feet based on the wire's loop voltage (IR) drop

$V_{Power\ Supply}$ = Power Supply output voltage

V_{Min} = Minimum operating voltage of transmitter

I_{Max} = Maximum current in amperes

R_{Wire} = Resistance of wire in ohms/foot

Example 3: When wiring the 4888A-NIC II LEL Transmitter that is configured for 10-18 VDC operation to a 16 VDC power supply, the power supply leads cannot drop more than 6 VDC in order to provide at least 10 VDC at the transmitter. Using Equation 4-1, the maximum wiring distance for 18 AWG wire is:

$$D_{ir} = \frac{16 - 10}{0.42 \times 0.00802 \times 2} = \underline{\underline{890\ \text{ft.}}}$$

4.4 Removing Housing Cover and Front Panel

To access the wiring terminal blocks inside the transmitter housing, remove the housing cover and front panel as follows:

1. Loosen locking screw on housing cover using a 7/64" hex wrench; then unscrew and remove cover.

2. Loosen the two captive thumb screws on the front panel assembly; then lift out the front panel with its circuit boards attached as far as allowed by the ribbon cable.

3. After wiring is complete, replace the front panel assembly by aligning its two thumb screws with their mating standoffs and firmly hand tighten.

4. Replace the housing cover and tighten its locking screw.

4.5 Detector Head Wiring

Each 6 Volt detector head assembly is supplied with 18" of wire, allowing it to be mounted on the transmitter housing either directly, or by a short section of ¾" conduit per Figure 4-1 (Example 1). 5.5 Volt detectors are supplied with 6" of wire for direct mounting to the transmitter housing. Note that the wiring attached to the detector head is already sealed and requires no additional sealing to conform to NEC requirements for explosion-proof installations, as long as the detector head is mounted no further than 18" from the transmitter [NEC Article 501-5(a)(1)]. For exceptions to this distance, read the label on the transmitter housing.

If the detector head is being mounted *more* than 18" from the transmitter (**106 ft max.**) as shown in Figure 4-1 (Example 2), splice a three-conductor cable (preferably with black, red, and white wires) onto the detector head's existing wiring as described below. The maximum distances between the detector head and transmitter for various wire sizes are listed in Table 4-1. The detector head's safety-ground wire must the same size as the other transmitter wires as determined from Section *4.3 Selecting Wire Size.*

The added detector-head wiring must meet prevailing electrical codes for hazardous-area installations that specify conduit sealing, explosion-proof fittings, and special wiring methods.

Note: *Table 4-1 only applies to the "Gold Bell" 6.0V bead design. The 5.5V Scott stainless steel head design can be seperated up to 1,600 feet using 18 AWG wire.*

TABLE 4-1. MAXIMUM DISTANCE BETWEEN DETECTOR AND TRANSMITTER

AWG	Ohms/Foot at 85°C (185°F)	Maximum Distance
12	0.0023	106' (38 m)
14	0.0031	80' (24 m)
16	0.0059	42' (13 m)
18	0.0080	31' (9 m)

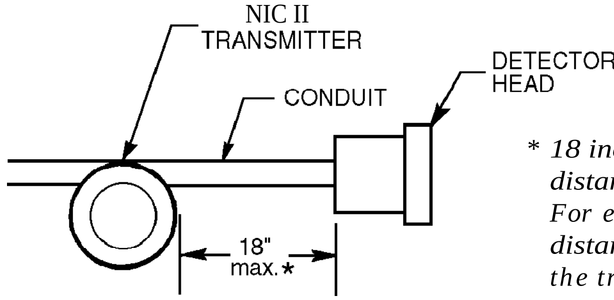
Note: *Consult the factory if longer distances are required when the temperature between the transmitter and the detector head is relatively constant.*

When installing conduit and wiring from the detector head to the transmitter housing, see Figure 4-1 and follow the procedures listed below.

- If the detector head is mounted more than 18" from the transmitter, encase all wire splices in a junction box. Also place conduit seals, Crouse-Hinds EYS 216 (or equivalent), between the transmitter housing and the junction box.
- Use AMP (or equivalent) parallel or butt type splices for all wire connections.
- Ground the junction box.

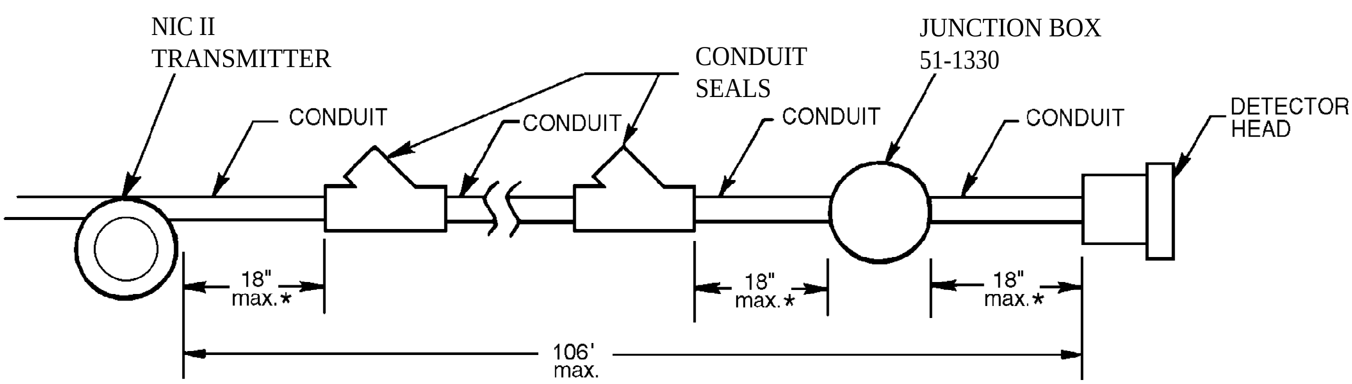
After mounting the detector head either on the transmitter housing or at its remote location, trim off any excess wire and connect the detector head's black, white, and red wires to terminal block TB1 terminals R, C, and A on the Input/Output board per Figure 4-2, 4-3, 4-4, or 4-5. The green wire serves as an earth ground that is connected to the ground screw inside the transmitter enclosure.

*Figure 4-1.
Typical Explosion Proof Conduit Configurations from Transmitter Housing to Detector Head for Installation in Group B, C and D Hazardous Areas*



* *18 inches is the standard distance per NEC Articles. For exceptions to this distance, read the label on the transmitter housing.*

EXAMPLE 1: Transmitter and Detector threaded together as a unit, or mounted within 18 inches of each other



EXAMPLE 2: Connecting the Detector to the Transmitter Housing at a distance greater than 18 inches

4.6 Power Supply and Receiver Wiring

The transmitter can be connected to its power supply and receiver using individual wires, but the recommended method is to use a multi-conductor overall shielded cable. It is strongly recommended that the transmitter wiring not be run in common conduit or raceways with AC power conductors or conductors servicing raceway equipment that may generate RFI.

4.6.1 Setting the Transmitter’s Operating Voltage

The transmitter is normally configured for an operating voltage of 18–30 VDC; however, 10–18 VDC operation is also possible by soldering a jumper at J04 on the Input/Output board. The lower voltage setting is used when the transmitter is used as a stand-alone unit with a 12 VDC power supply. The location of jumper J04 is shown in Figures 4-4 and 4-5.

4.6.2 Power Supply Wiring

Following all wiring methods previously described for hazardous-area installations, run wires of an appropriate AWG size (as determined from Section *4.3 Selecting Wire Size*) from the remote power supply to the transmitter housing. Connect the “+” and “–” power supply leads to TB2 terminals PWR and GND on the Input/Output board per Figure 4-2, 4-3, 4-4, or 4-5. Or refer to Appendix “B” if the transmitter is being connected to an Sentinel VI, Sentinel 16 or Series 6800 Gas Receiver.

4.6.3 Isolated and Non-Isolated 4–20 mA Output

When the optional Isolated 4–20 mA Output board is installed, the output signal is isolated from the transmitter’s power supply and sensor leads. Without this board installed, the transmitter’s circuit boards, sensor, and output signal all share a common power supply wire. Use the Isolated 4–20 mA Output board option if your receiving equipment requires an isolated input.

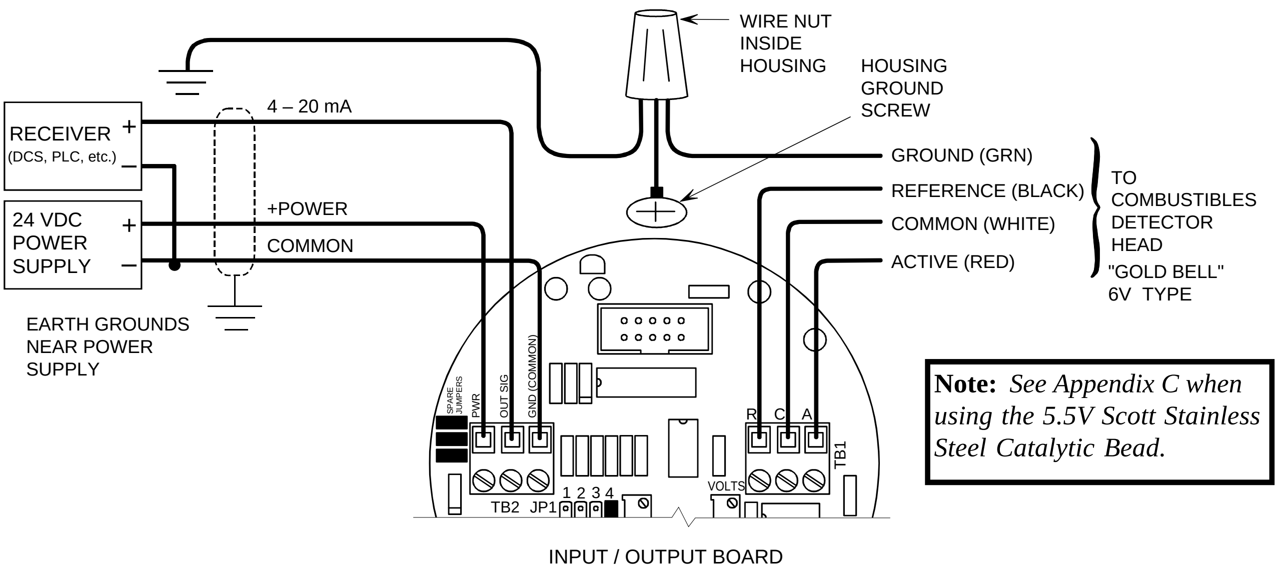
Note that a transmitter with a *non-isolated* output requires 3 wires, while a transmitter with an *isolated* output requires 4 wires. In both cases, a conforming safety-ground wire is also required (shielding the ground wire is optional).

4.6.4 Receiver Wiring

If the transmitter will be reporting to a remote receiving device (e.g., PLC, DCS, loop powered alarm, data logger, etc.), then connect the transmitter’s 4–20 mA output to the receiving device as follows:

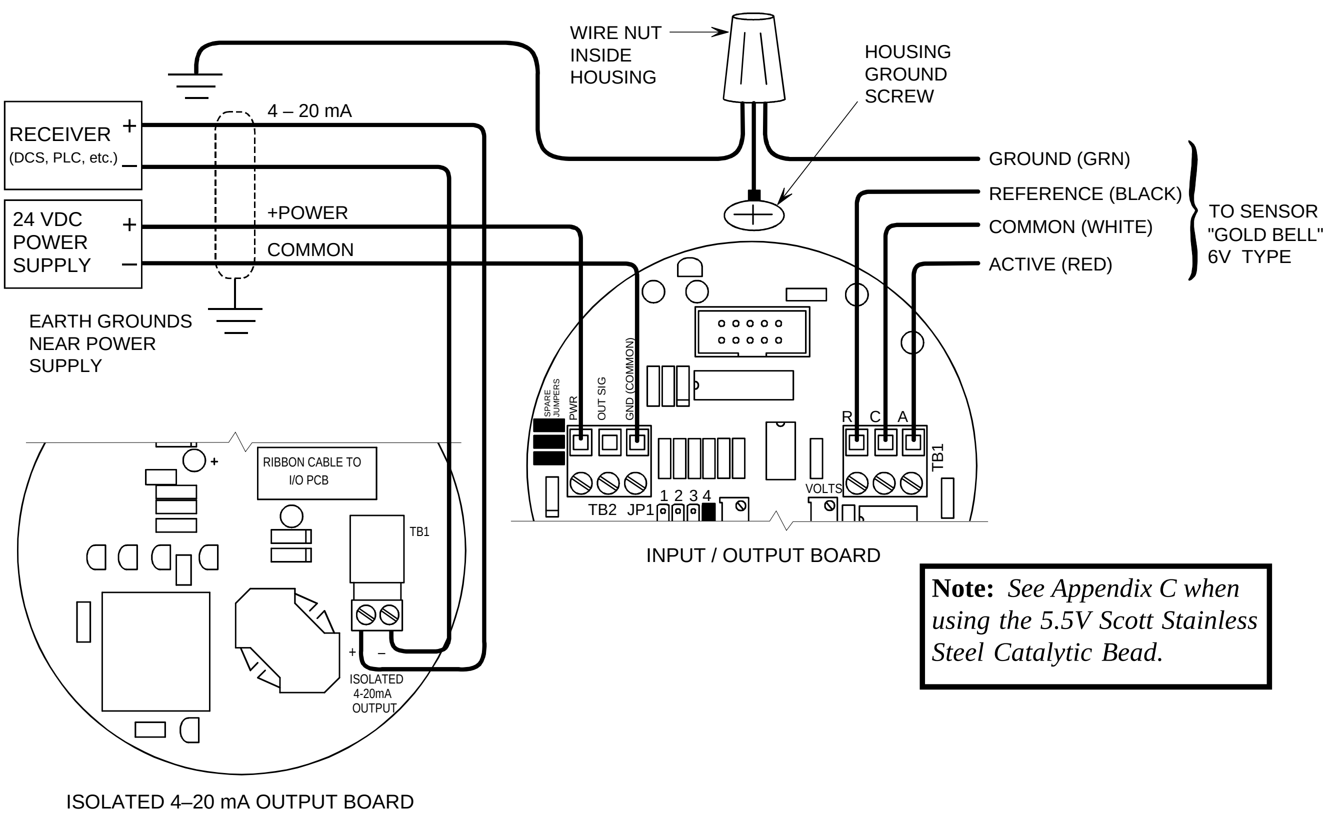
- For transmitter’s requiring a *non-isolated* output, connect the receiver’s 4–20 mA input to TB2 terminal OUT SIG on the Input/Output board per Figure 4-2.
- For transmitters requiring an *isolated* output, connect the receiver’s 4–20 mA input to TB1 terminals “+” and “–” on the optional Isolated 4–20 mA Output board per Figure 4-3.

Figure 4-2.
Transmitter Wiring Diagram, Non-Isolated 4–20 mA Output



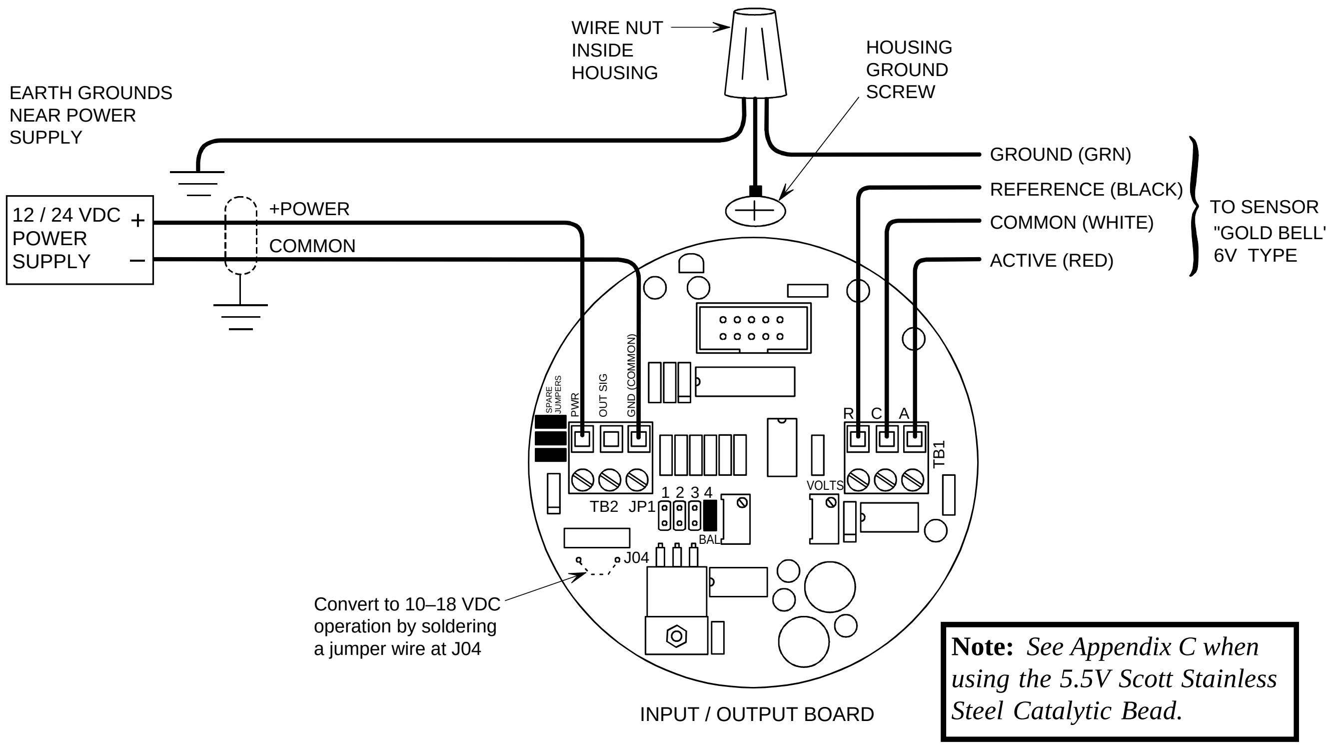
Note: *See Appendix C when using the 5.5V Scott Stainless Steel Catalytic Bead.*

Figure 4-3.
Transmitter Wiring Diagram, Isolated 4–20 mA Output



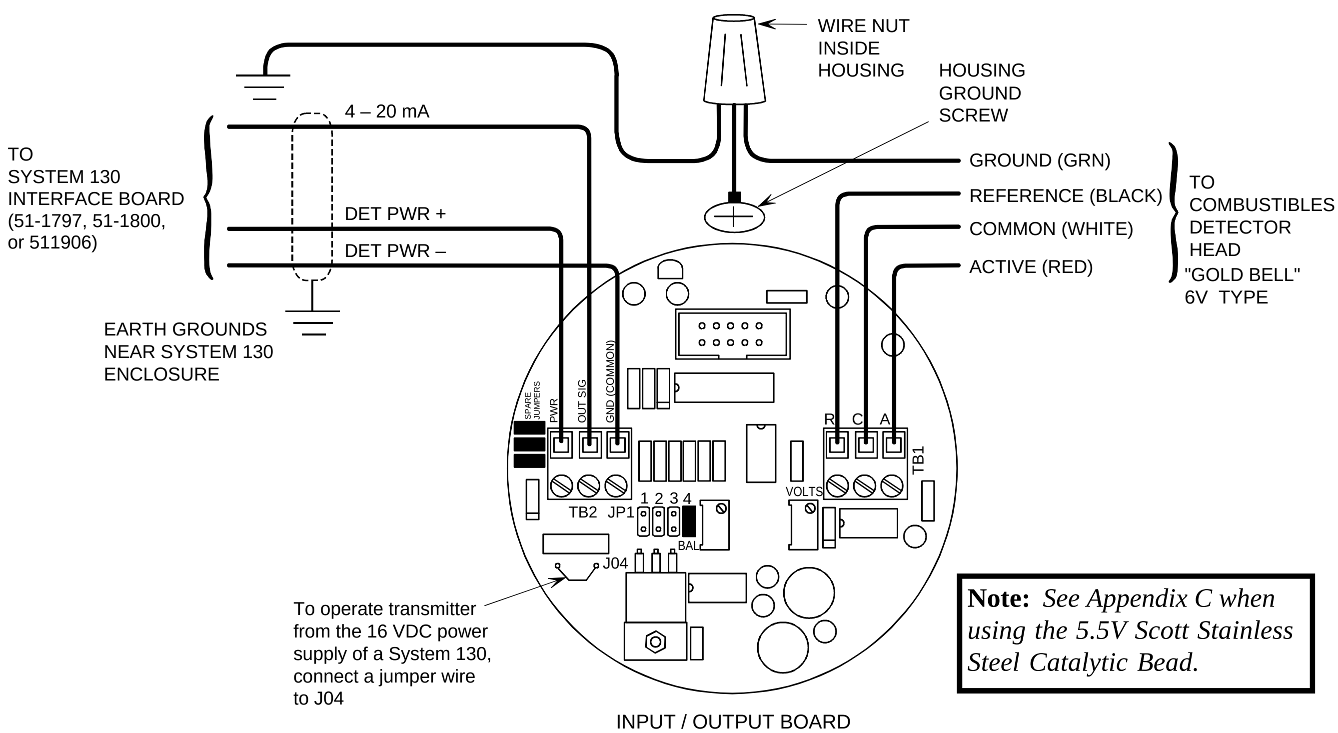
Note: *See Appendix C when using the 5.5V Scott Stainless Steel Catalytic Bead.*

Figure 4-4.
Transmitter Wiring Diagram, Stand-Alone Operation, Local Readout Only



Note: *See Appendix C when using the 5.5V Scott Stainless Steel Catalytic Bead.*

Figure 4-5.
Integrated Transmitter Wiring Diagram, Bacharach System 130



Note: *See Appendix C when using the 5.5V Scott Stainless Steel Catalytic Bead.*

- For transmitters being connected to an Scott Health & Safety Series 6004 Quad Scan, Series 6104 Panel Mount Quad Scan, or Series 6800 Gas Receiver, refer to Appendix "B".

4.6.5 Grounding and Shielding

Following all wiring methods previously described for hazardous-area installations, connect a conforming safety-ground wire per local code from the transmitter's ground screw to an earth ground near the power supply / receiving equipment. The ground wire must be no smaller than the largest current carrying transmitter wire. Shielding the ground wire is optional.

Connect the shield of the transmitter wires to an earth ground near the power supply / receiving equipment. *Do not* ground both ends of the shield!

4.7 Relay Board Wiring and Setup

The optional relay board provides contact closures for the activation of *local* annunciators (e.g., horns, bells, buzzers or lights) for the purpose of alerting personnel of ALARM 1, ALARM 2, and ALARM 3 (WARN, ALARM, FAIL) conditions.

ALARM 3 is typically a *fail safe* FAIL relay, and is tripped by a defective sensor, or if the 4–20 mA output has drifted below –10% of full scale. Since a FAIL relay is normally energized (relay de-energizes under a fault condition), this alarm also indicates loss of power to the transmitter. If the FAIL relay is not required, it is possible to configure the ALARM 3 relay to trip with ALARM 2. This configuration is useful if ALARM 2 is to drive an audible device, which needs to be *acknowledgeable*, but another ALARM 2 relay is needed for driving another *non-acknowledgeable* device such as a fan.

The ALARM 1 and ALARM 2 relays activate their associated annunciators when the gas level rises above predetermined trip-points. These trip-points are set by each relay's associated 16-position rotary switch. The ALARM 1 and ALARM 2 relays can be made to function in the following manner as determined by the FUNCTION DIP switch:

- **Increasing Trip:** Action occurs when the gas level *rises above* the trip-point.
- **Decreasing Trip:** Action occurs when the gas level *falls below* the trip-point.
- **Non-Latch:** Annunciator automatically turns off then the gas level falls below the trip-point.
- **Latch:** Annunciator remains on even if the gas level falls below the trip-point. Once activated, the annunciator must be manually reset by either closing a remote switch connected to TB4 on the relay board as shown in Figure 4-6, or by holding a magnet near the transmitter' enclosure per Figure 4-7.

- **De-energized:** The relay is *de-energized* under normal operating conditions, and becomes energized when the gas level exceeds the trip-point.
- **Energized:** The relay is *energized* under normal operating conditions, and becomes de-energized when the gas level exceeds the trip-point. The normally energized operating mode may also be referred to as “fail-safe.”
- **Acknowledge:** The ALARM 2 (ALARM level) annunciator can be turned off by activating the local magnetic or remote RESET switch (Alarm 2 condition acknowledged; horn silenced) when the gas level is still *above* its trip-point.
- **No Acknowledge:** The ALARM 2 annunciator cannot be reset until the gas level drops *below* its trip-point.
- **A3 FAIL:** Operate the ALARM 3 relay in its FAIL mode (normally energized). For gas detection applications, A3 should always be operated as a FAIL relay.
- **Trips with A2:** Operate the ALARM 3 relay in conjunction with ALARM 2.

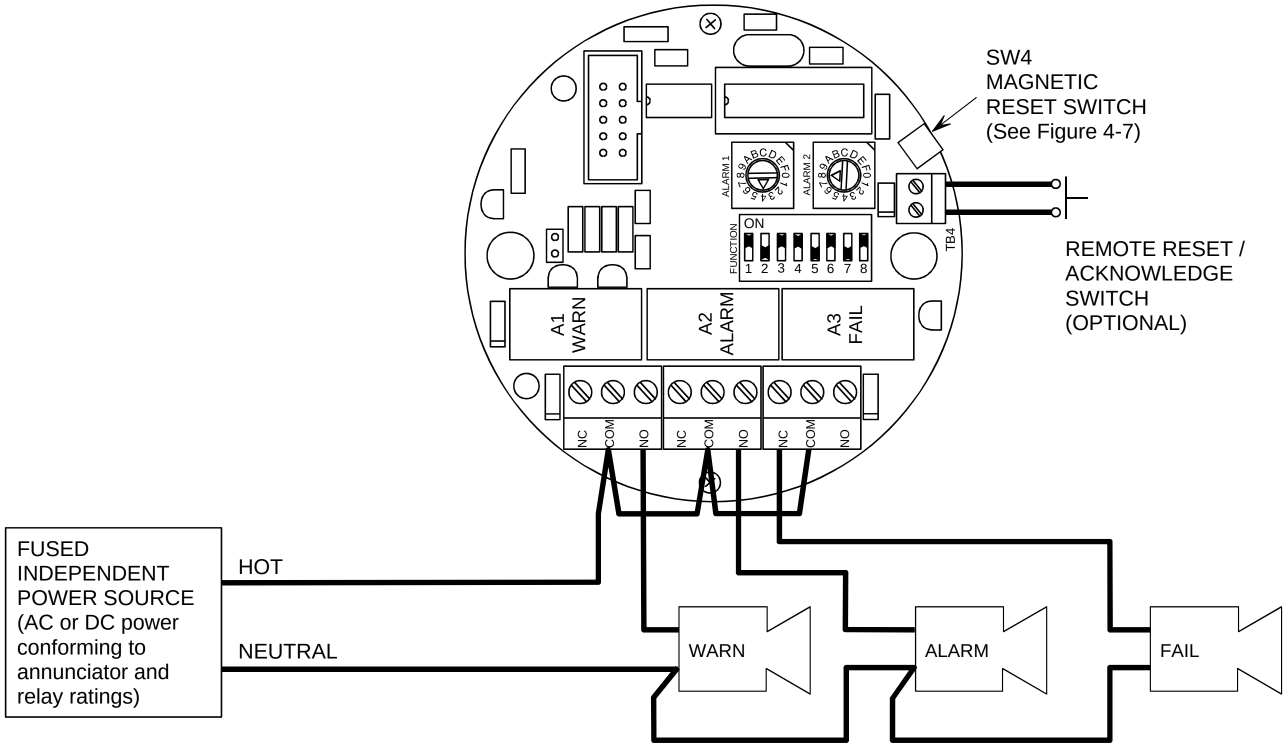
Connect the annunciators to their own power source — DO NOT use the transmitter’s power supply to power the annunciators. Also make certain that the annunciator’s power source is properly fused.

Run wires of a suitable AWG size, according to NEC and any appropriate local electrical codes, from each annunciator to Terminal Blocks A1, A2 and A3. Use the annunciator’s power consumption rating to determine wire size and fuse rating. The relays are capable of switching loads of up to 5 A resistive at 250 VAC / 30 VDC.

> **Important!** *The relay contacts are rated for* ***resistive*** *loads. Appropriate surge suppressors should be installed across loads to prevent arcing on the contacts. Arcing generates high levels of RFI, which may interfere with the measurement signals.*

Figure 4-6 shows a typical wiring scheme that has the ALARM 1 and ALARM 2 relays wired for normally de-energized operation, and the ALARM 3 relay wired for FAIL operation.

Figure 4-6.
Relay Board Wiring and Switch Settings



FUNCTION DIP SWITCHES

POSITION	ON	OFF
ALARM 1		
1	INCREASING TRIP	DECREASING TRIP
2	NON-LATCH	LATCH
3	DE-ENERGIZED	ENERGIZED
ALARM 2		
4	INCREASING TRIP	DECREASING TRIP
5	NON-LATCH	LATCH
6	DE-ENERGIZED	ENERGIZED
7	NO ACKNOWLEDGE	ACKNOWLEDGE
ALARM 3		
8	A3 FAIL	TRIPS WITH A2

ALARM 1 & 2 ROTARY SWITCH TRIP-POINTS % OF FULL SCALE

POSITION = TRIP-POINT	POSITION = TRIP-POINT
0 = INACTIVE	8 = 40%
1 = 5%	9 = 45%
2 = 10%	A = 50%
3 = 15%	B = 55%
4 = 20%	C = 60%
5 = 25%	D = 65%
6 = 30%	E = 70%
7 = 35%	F = 78%

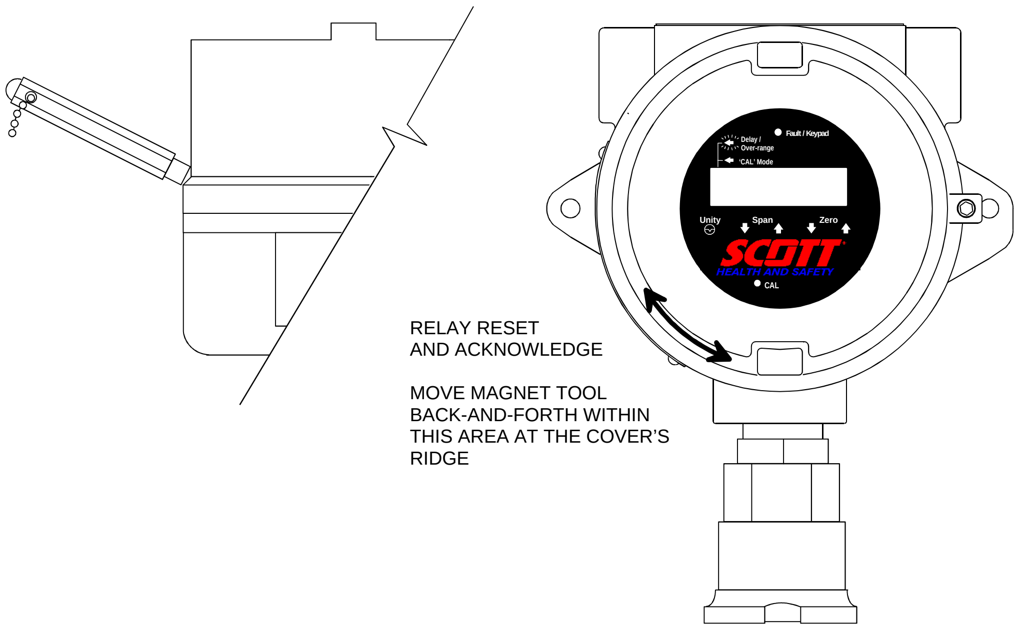
4.7.1 Latching Alarms

When the FUNCTION DIP switches are set up for *latching* operation, the WARN and ALARM annunciators must be manually reset/acknowledged as follows:

Remote RESET/ACKNOWLEDGE is accomplished by a momentary-action pushbutton that is wired to Terminal Block TB4 per Figure 4-6.

Local RESET/ACKNOWLEDGE is accomplished, without opening the enclosure, by moving the magnet tool back-and-forth along the cover's ridge as shown in Figure 4-7.

Figure 4-7.
Non-Intrusive Relay Reset / Acknowledge



4.7.2 Normally Energized Alarms

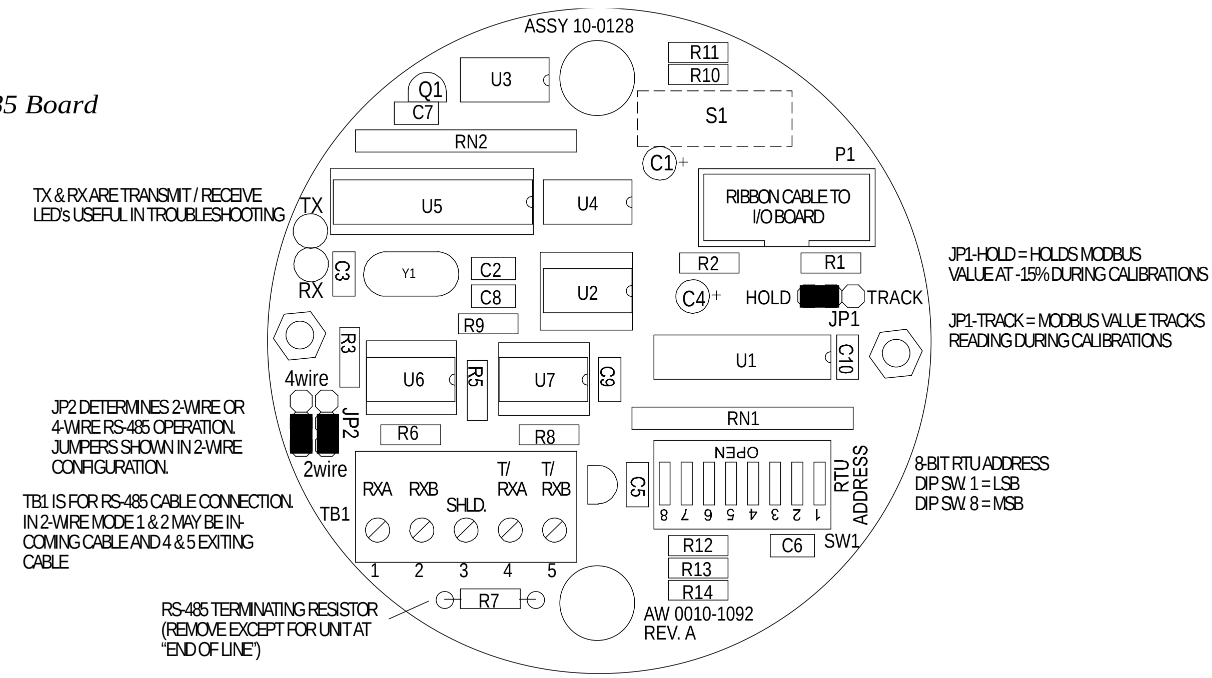
The FUNCTION DIP switches allow the WARN and ALARM relays to operate normally energized when the transmitter is powered, but when no alarm condition exists. When an alarm condition occurs, the relays then de-energize. The advantage of this configuration is that a loss-of-power condition creates the same relay outputs as an alarm condition. Note, however, that the annunciators must be powered by a backup power source if they are to activate during a power outage. Also note that the FAIL relay should always be operated normally energized.

4.7.3 Relay Trip Points

Alarm 1 and Alarm 2 trip points are controlled by two 16-position rotary switches. See Figure 4-6 for a definition of the switch positions. Note that both alarm setpoints incorporate approximately 1.5% hysteresis. In other words, 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.

4.8 Modbus RS-485 Board Wiring and Setup

Figure 4-8.
Modbus RS-485 Board



The optional Modbus RS-485 Serial Interface board (Figure 4-8) allows up to 128 transmitters to communicate to a Modbus master device on a single cable. Modbus is the *protocol*, or language used by the transmitter to communicate with other devices. The transmitter is a Modbus *slave* that requires a Modbus *master* to interrogate it and retrieve information made available in specific register locations. Modbus master devices are typically PLCs or PCs running HMI or GUI software equipped with a Modbus driver.

4.8.1 RTU Address

The 8 position switch, SW1, allows a different RTU address to be assigned to each transmitter. The 8 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 to each transmitter communicating on the same RS-485 port.

4.8.2 Modbus Data Registers and Function Codes

Table 4-2 identifies the transmitter's Modbus register locations and function codes that are available.

TABLE 4-2. MODBUS REGISTER SUMMARY

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Fail Bit	**12000**	**2**	**NA**

0 = OK

1 = Fault

Alarms	**12008**	**2**	**NA**

Returned as 8 discrete bits packed in the low byte of the response data.

12008:bit 0 = Fault (tracks 12000)

12008:bit 1 = Alarm1

12008:bit 2 = Alarm2

12008:bit 3 = Not Used

12008:bit 4 = Not Used

12008:bit 5 = Not Used

12008:bit 6 = Alarm2 Acknowledgeable

12008:bit 7 = Not Used

A2D Raw	**33000**	**3&4**	**NA**

10 bit value representing the A2D value of 0 to 1023 for -20 to 103 %FS (197=0% & 1003=100%).

A2D ASCII	**31010 (6 bytes)**	**3&4**	**NA**

6 bytes of data representing the scaled span value including the decimal point. The first 5 bytes contain the value with the last byte being a space. They are arranged with the first byte as the MSD with leading zero spacing. For example, with a span value of 1234 with 1 decimal point, the correct value of 123.4 is returned for 100% of full scale as follows:

Byte	0	1	2	3	4	5	6	7	8	9	10
Response	[address]	[04]	[06]	[31]	[32]	[33]	[2E]	[34]	[20]	[Crcl]	[Crch]
ASCII Char	[address]	[♦]	[♠]	[1]	[2]	[3]	[.]	[4]	[sp]	[Crcl]	[Crch]

With the same settings a 50% of full scale reading of 617 would be:

Byte	0	1	2	3	4	5	6	7	8	9	10
Response	[address]	[04]	[06]	[20]	[36]	[31]	[2E]	[37]	[20]	[Crcl]	[Crch]
ASCII Char	[address]	[♦]	[♠]	[sp]	[6]	[1]	[.]	[7]	[sp]	[Crcl]	[Crch]

TABLE 4-2. MODBUS REGISTER SUMMARY (Cont.)

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
EUNITS	40319-40324	3	6

6 ASCII characters assigned to the engineering units read as bytes.

Measurement Name	**40325-40340**	**3**	**6**

16 ASCII characters assigned to the unit identifier read as bytes.

Span	**40343**	**3**	**6**

An integer from 1 to 9999 used to scale the A2D ASCII value.

Alm1Setpoint	**40345**	**3**	**6**
Alm2Setpoint	**40347**	**3**	**6**

Integer compared to the A2D Raw value to determine alarm 1 or 2 status. The 0 to 100% set point must be scaled from 197 to 1003. This is done by using (Alarm% * 806) + Offset .

Example: A 40% set point would be computed as (0.4 * 806) + 197

D.P.Position	**40349**	**3**	**6**

Determines how many decimal positions return with the A2D ASCII value. Valid range is 0 to 3.

Alm1Trip	**40351**	**3**	**6**
Alm2Trip	**40359**	**3**	**6**

Set to 255 alarms on high, set to 0 alarm on low.

Alm1Latch	**40353**	**3**	**6**
Alm2Latch	**40355**	**3**	**6**

Set to 0 causes alarm 1 or 2 to auto reset, set to 255 causes alarms 1 or 2 to latch.

AlmZoneWord	**40357**	**3**	**6**

16 bit value which may be used as a zone alarm mask for the master.

AlarmReset	**2000**	**NA**	**5**

Setting to 255 causes any latched or acknowledgeable alarms to reset.

InitRtu	**2010**	**NA**	**5**

Setting to 255 causes a re-start which applies updated configuration variables.

4.8.3 MODBUS Configuration Software

All of the register values described in Section 4.8.2 must be configured via the serial port. This is a *one time only* requirement unless changes within the application necessitate adjustments after the initial installation. This function is usually built into the Modbus master.

4.8.4 RS-485 Wiring

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. Place a jumper on JP2 to correspond to the number of wires being used. See Figure 4-9.

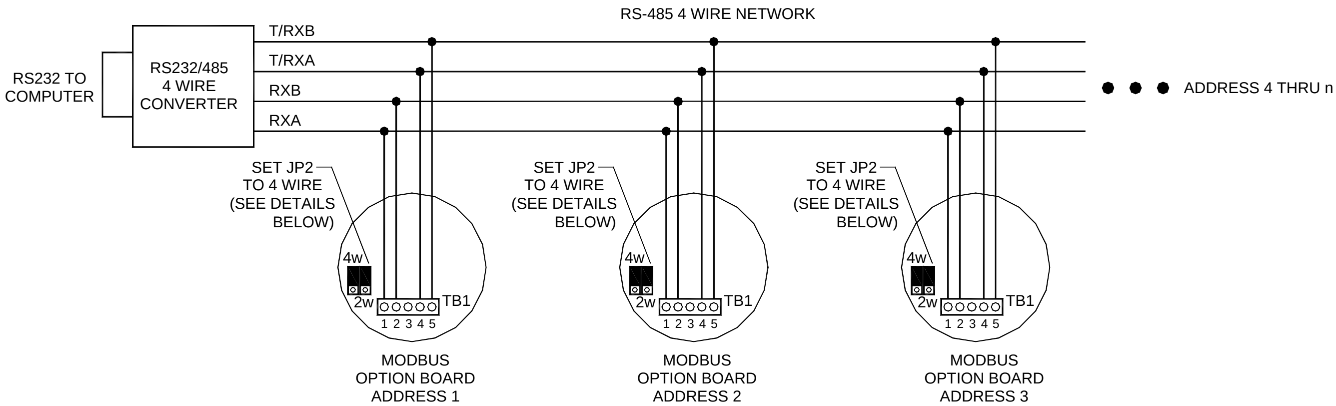
4.8.5 R4/R7 End-of-Line Terminating Resistor

Note:
Current boards (Rev. A or later) only have R7 resistor, see Figures 4-8 and 4-9.
Older boards (Rev. 0) have R4 and R7 resistors, see Figure 4-9.

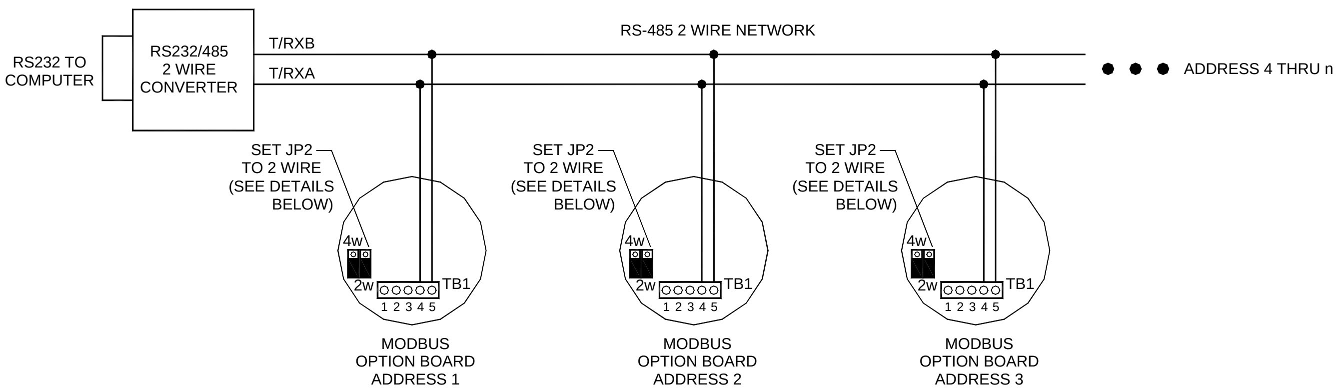
R4/R7 are socketed, plug-in resistor positions for a 120 ohm End-of-Line terminating resistor. All units are supplied with one 120 ohm resistor installed. Remove the resistor from all transmitters, except for the transmitter at the end of the serial communications Data Highway. The unit furthest from the Host Computer or other master communications device such as a PLC or system controller MUST have one 120 ohm resistor installed. Position R4 is used with a 2-wire, half-duples data communications highway, while Position R7 is used with a 4-wire, full-duples highway. See applicable Figures 4-8 and 4-9.

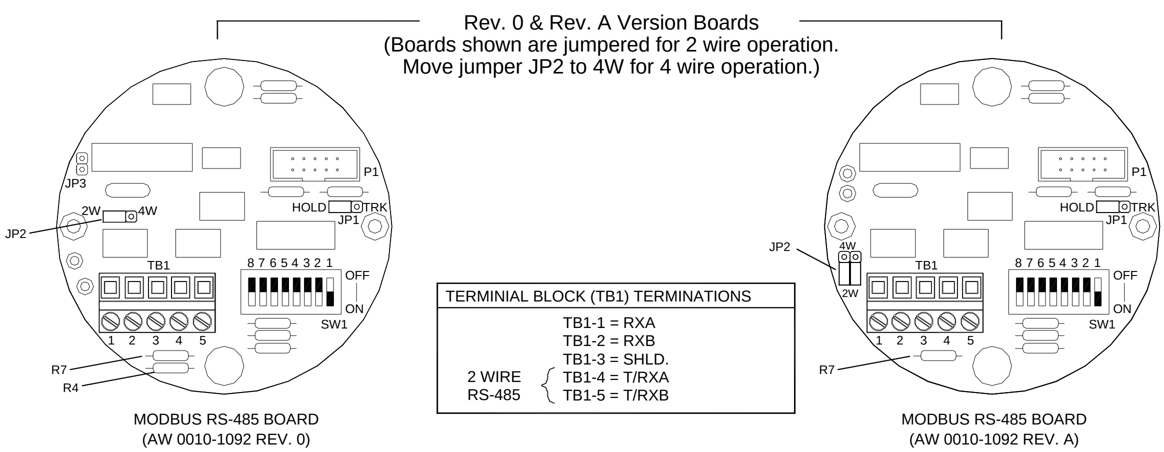
Note: On very short runs, (e.g. less than 20 feet) no resistor is typically required.

Figure 4-9.
Typical RS-485 Wiring



IMPORTANT!
These drawings reference the National Semiconductor standard specification in regard to the polarity of terminals A & B. Some converter manufacturers, e.g. B&B, have chosen to reverse this polarity. Please note that reversing this polarity will cause the transmitter to not send the digital stream in a correct fashion and therefore the unit will not communicate properly. Note that A is the positive or high side and B is the negative or low side of the input.





Notes

5 Calibration

WARNING!

Before performing any calibration procedures that require the removal of the transmitter cover, be sure to declassify the area to non-hazardous before opening the transmitter or any other electrical enclosures.

5.1 Calibration Intervals

- Calibrate after initial installation
- Calibrate after replacing the transmitter, the sensor, detector or any circuit assemblies
- Calibration frequency is to be determined by the user however as a general rule check calibration once a week for the first month of operation; then monthly or as experience dictates thereafter.

5.2 Preparing for Calibration

Calibrate the transmitter and detector preferably on the gas that it will be monitoring. If more than one gas or vapor will be monitored, calibrate the instrument on the gas /solvent vapor that requires the highest gain setting on the transmitter. Contact Scott Health & Safety for additional information if necessary. Refer to Appendix "A" for additional calibration details and a chart with recommended calibration gas to be used for most common combustible vapors.

Equipment required for calibration:

- Digital Volt Meter (DVM) with a minimum accuracy of 0.5% and a 2.00 Vdc range
- Small flat blade screwdriver
- Calibration Kit – See Appendix “A” and Section 8.5 Accessories
- Calibration Cup:
  - 23-4098 for Diffusion 6 Volt detector ("Gold Bell" configuration)
  - 3470-9500 for Diffusion 6 Volt detector with Duct Adapter

  Note: 5.5 Volt detectors do not require a calibration cup (Scott stainless steel configuration)
- Sensor Adapter Board 23-4027: Only required for a 6 Volt detector mounted more than 18" away from the transmitter.
- Zero Gas Cylinder: See Section 8.5 Accessories
- Combustible gas cylinder(s): See Appendix “A” and Section 8.5 Accessories

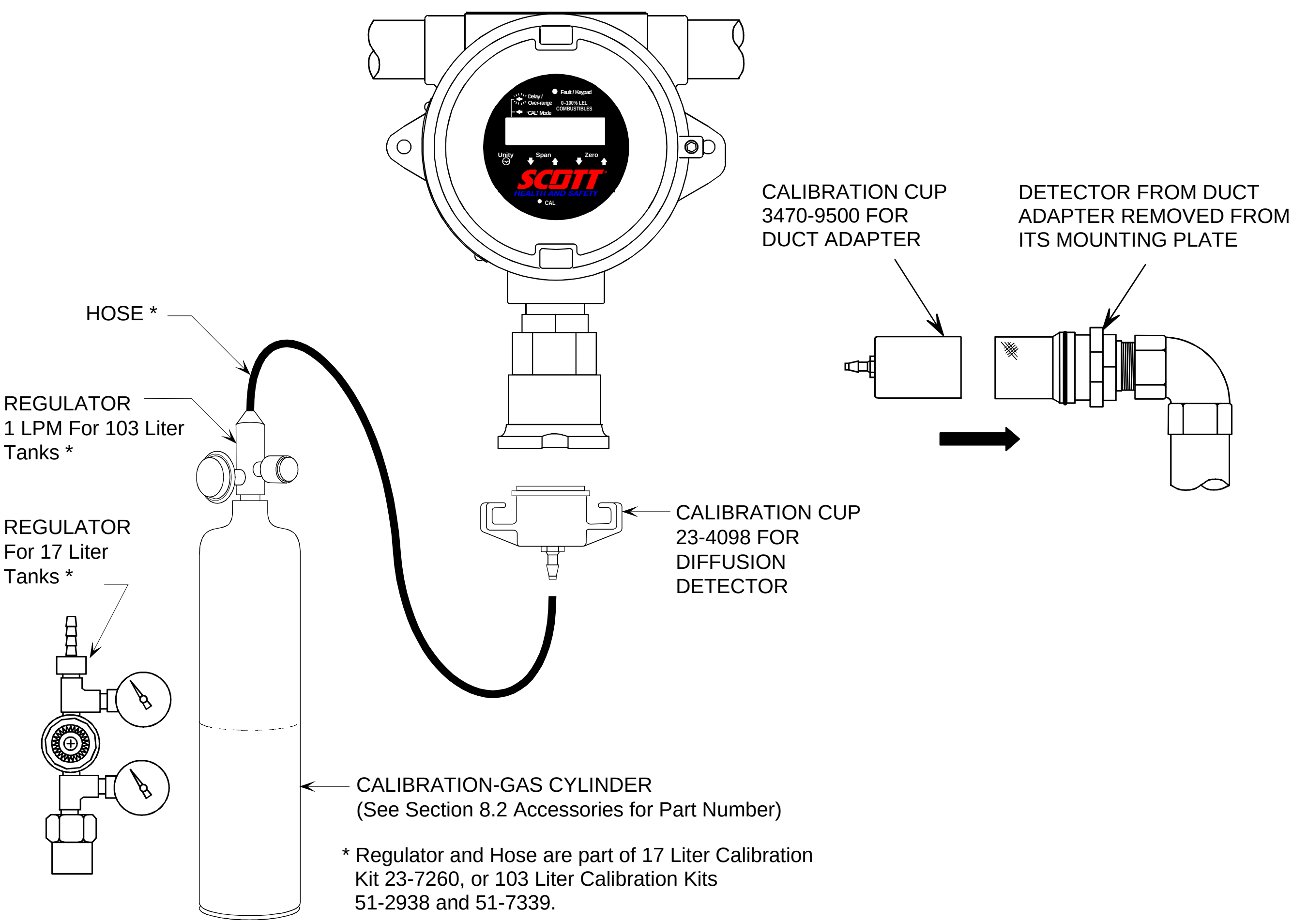
5.3 Assembling the Calibration Equipment

Assemble the calibration fixture as shown in Figure 5-1, using the appropriate calibration kits that is listed in Section *8.5 Accessories*.

> **Note:** *6 Volt detectors require a nominal gas flow of 1 liter per minute. The 5.5 Volt detectors require a nominal gas flow of 2 liters per minute. Be sure that the proper gas bottle regulator is used.*

FOR CALIBRATING THE SCOTT 5.5V CATALYTIC BEAD SENSOR, REFER TO APPENDIX C, FIGURE C-5

Figure 5-1. Calibration Fixture - Showing 6V "Gold Bell" Catalytic Bead



5.4 Initial Start-Up

Perform these procedures after installing a new transmitter, or after replacing the transmitter's Input/Output printed circuit board or whenever a sensor / detector is replaced. For routine calibration, skip to Section *5.6 Routine Calibration.*

WARNING!

Declassify the area to non-hazardous before opening the transmitter housing or any other electrical enclosures.

Remove the cover from the transmitter enclosure. To access the adjustment potentiometers and terminals on the Input / Output board, remove the front panel by loosening the two (2) thumbscrews located on the panel. Pull the front LCD panel away from the enclosure. The LCD panel is connected to the Input / Output board with a ribbon cable that has sufficient length so that the panel can be placed to the side for access. Do not disconnect the cable at either end.

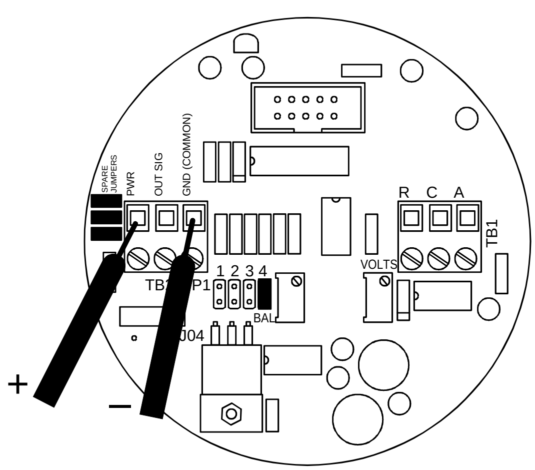
After all power and signal connections have been made and checked, apply power to the transmitter. The current loop output will be held for approximately one (1) minute at 4 mA as indicated by the flashing delay arrow on the LCD. This delay time upon initial power up is to allow the sensor time to stabilize, thus reducing the possibility of an erroneous alarm condition. Allow a new sensor to stabilize for one (1) hour before proceeding.

5.4.1 Input Voltage Check

Measure the inout voltage with a DVM as shown in Figure 5-2 across TB2 terminals PWR and GND and verify that it is between 18 and 30 Vdc (or 10 to 18 Vdc if a jumper has been installed in J04 on the Inout / Output board).

If the measured voltage is not correct, check the power supply. Also check that the powerwiring wire length and wire size is adequate as described in Section 3.

Figure 5-2. Input Voltage Measurement Points



INPUT / OUTPUT BOARD

5.4.2 Sensor Voltage Adjustment

The sensor voltage will need to be adjusted to either 6.0 Vdc or 5.50 Vdc depending on which sensor / detector is installed. The voltage must be adjusted as measured at the detector location. To check and adjust this voltage, use one of the following procedures:

Detectors - 6.0 Vdc ("Gold Bell" configuration)

- Refer to Figure 5-3
- If the detector head is attached to the transmitter or located no more than 18 inches away, connect a DVM to TB1-R and TB1-A and adjust the Volts potentiometer for a DVM indication of 6.00 +/- 0.05 Vdc.
- If the detector head is located more than 18 inches from the transmitter, disassemble the detector head and install a Sensor Adapter Board 23-4027 between the sensor and the detector socket.
- Attach the DVM to the adapter board terminals “A” and “R” and adjust the Volts potentiometer for a DVM indication of 6.00 +/- 0.05 Vdc.
- Remove the Adapter Board and reassemble the detector head

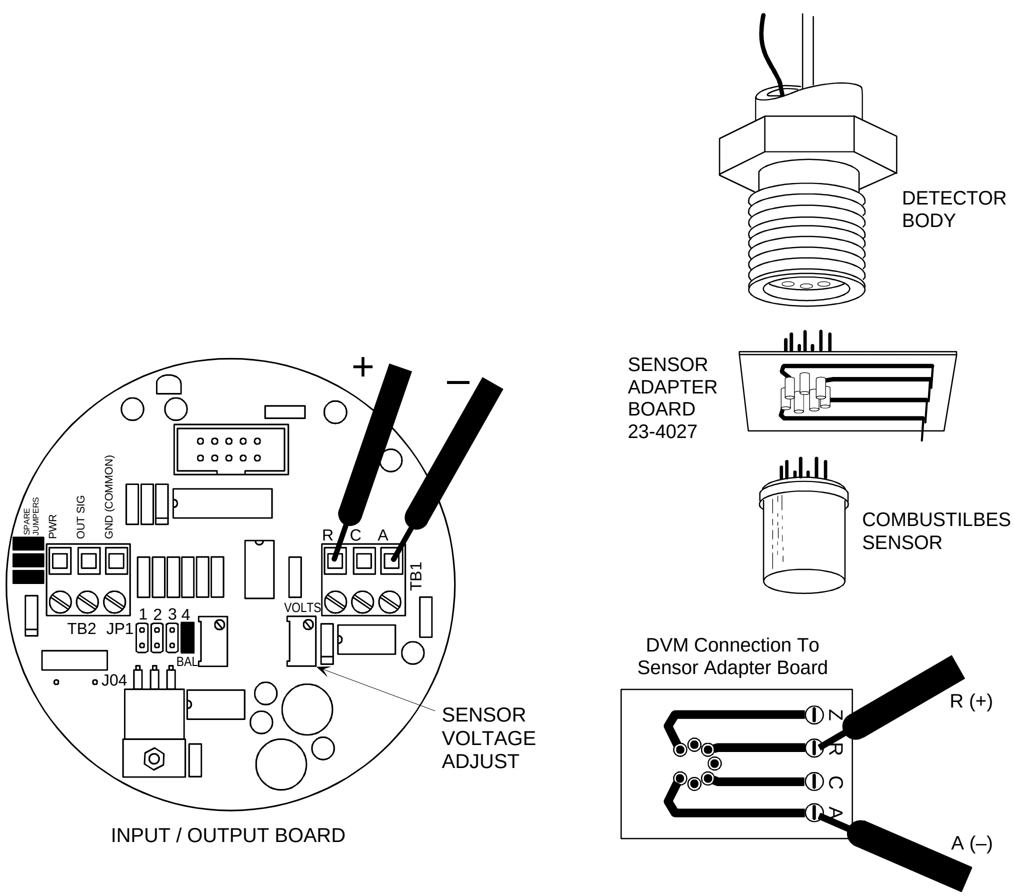
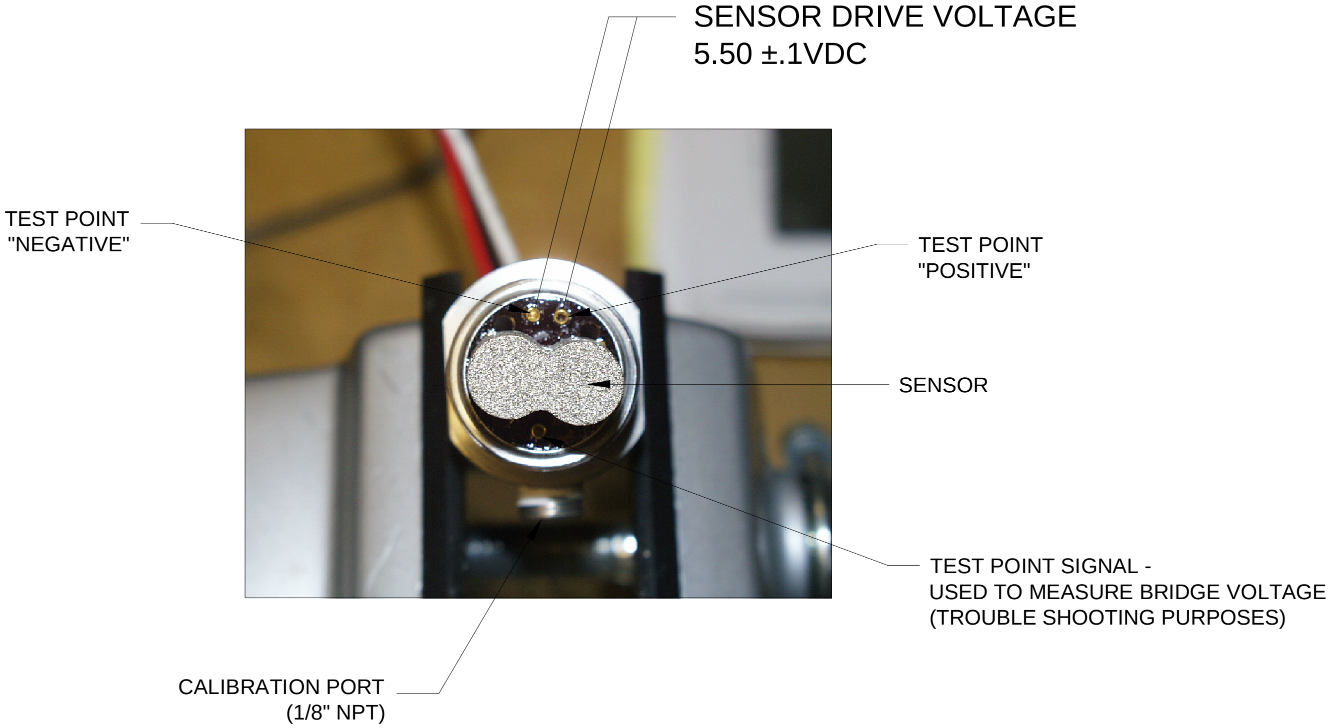


Figure 5-3. Sensor Voltage Measurement and Adjustment

Detectors - 5.50 Vdc (Scott stainless steel configuration)

- Refer to Figure 5-4.
- Remove the detector outer guard. Measure the voltage across the test points as indicated and adjust the Volts potentiometer for a DVM indication of 5.50 Vdc.
- Replace the detector outer guard.

Figure 5-4.
SCOTT 5.5V Detector Test Points



5.4.3 Monitoring the VOUT Test Point

The V OUT test point on the Input / Output board may be monitored during the remainder of this section to verify correct initial setup. Connect the DVM to TB2 GND and V OUT as shown in Figure 5-5.

V OUT has a total voltage swing of 1.6 volts, with an active range of 0.4 to 2.0 volts corresponding to 0 to 100 % LEL. The Input / Output board may be considered properly configured when V OUT is at or slightly above the desired value. A V OUT voltage that is below the expected value may result in a shortened sensor life.

5.4.4 Balance Adjustment

The balance adjustment matches the resistance of a sensor to the transmitters input bridge circuit. This adjustment is required whenever a new sensor is installed. Adjust the BAL potentiometer as follows but only after the new sensor has stabilized for (1) hour minimum:

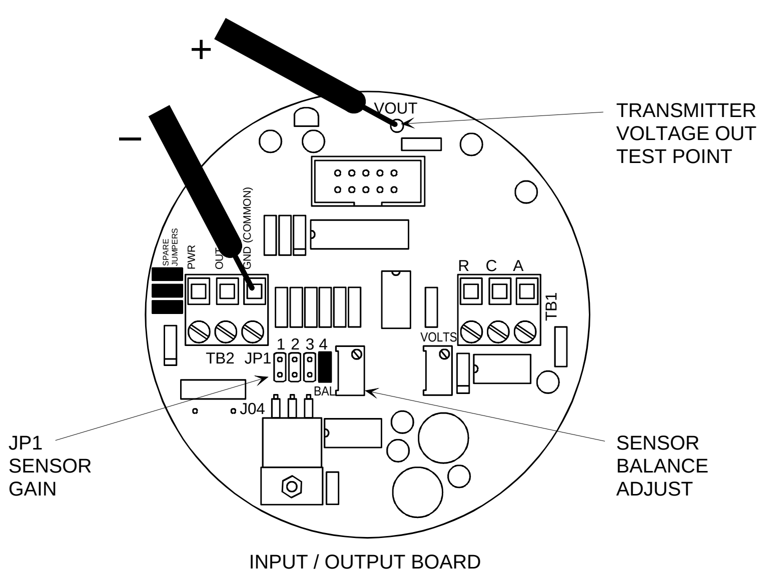
1. Connect a DMM to the I/O board as shown in Figure 5-5.

2. With the detector exposed to combustible gas-free air, adjust the BAL potentiometer until the VOUT test point measures 0.4 Vdc.

This is an approximate adjustment. Precision zero adjustment is made using the magnetic zero controls. The Zero Up and Down arrow keys have an adjustment range of +/- 15% of full scale that the sensor would have to drift beyond before the BAL potentiometer would require further adjustment.

Use of combustible gas free air is required for installation areas that may contain combustible or flammable vapors.

Figure 5-5.
Test Point VOUT, Balance Adjustment, and JP1 Gain Setting



5.4.5 Initial Fixed Gain (JP1) Setting

The transmitter has four fixed gain settings that select the range of sensitivity of the sensor. The gain settings are selectable via the location of jumper(s) on JP1 located on the I/O board (Figure 5-5). Each jumper position provides a different amount of sensor amplification. Different gain settings are required for various combustible gas and solvent vapors to be detected. The gain values for JP1 are as follows:

Jumper in Position 1 = Gain of 51
Jumper in Position 2 = Gain of 26
Jumper in Position 3 = Gain of 12.5
Jumper in Position 4 = Gain 7
No Jumper = Gain of 1

Note: Multiple jumpers are additive in relation to gain. For example, jumpers can be placed in positions 3 and 4 to provide a gain of 19.5.

To determine the proper gain jumper position, either the gas to be detected must be applied to the sensor or the surrogate gas to be used for calibration must be applied. The jumper location is determined while measuring the voltage on the VOUT test point or by observing the LCD display when the UNITY mode is selected.

Important: *JP1 must be configured only with a new sensor. Configuring JP1 using a sensor that has been is use for any period of time may cause inaccurate gas readings.*

Note: *JP1 is located to set the course span value by setting the gain of the sensor's bridge circuit. JP1 is only a coarse setting.The Span Up and Down arrow keys have an adjustment range equal to a minimum gain of 0.5 to a maximum gain of 2 (For example, when the gain jumper JP1 is located in position 4, a course gain of 7 is set. The arrow keys can reduce the gain to 3.5 or raise it to 14.)*

VOUT Test Point Method:

The VOUT test point has a total voltage swing of 1.6 volts between 0.4 and 2.0 Vdc. This voltage swing is equivalent to 0 - 100% LEL. Therefore, a voltage of 1.2 Vdc will correspond to 50 % LEL. Use Equation 5-1, Table 5-1 and Appendix "A" to determine the span voltage that is to be indicated on the VOUT test point for a given calibration. The following examples show how to properly use the information contained in these sections.

Example 1: If Methane in air is the gas to be monitored, apply an appropriate calibration gas to the detector (preferably use 2.5% Methane which is 50% LEL). The JP1 jumper is to be configured so that the voltage measured at VOUT corresponds to the gas concentration applied. If 2.5% Methane in air is used (50% LEL), position JP1 so that the voltage at VOUT is approximately 1.2 Vdc or slightly higher.

When finished, remove gas from sensor and go to Section 5.4.6

Note: *Example 2 assumes 6V "Gold Bell" catalytic bead sensor*

Example 2: If Acetylene in air is the gas to be monitored, Propane in air will be used as a surrogate gas as detailed in Appendix "A". The voltage to be measured at VOUT is based on the K-Factor of Acetylene. Using the procedure detailed in Appendix "A", it is determined that 42.9% Propane in air is equivalent to 60% LEL Acetylene. The VOUT that corresponds to 60% LEL is 1.36 Vdc (see Table 5-1). Therefore, by applying 42.9% LEL Propane in air (0.94 % Propane), position JP1 so that the voltage at VOUT is approximately 1.36 Vdc or slightly higher.

When finished, remove gas from sensor and go to Section 5.4.6

Equation 5-1

VOUT = [1.6 x (LEL of calibration gas / 100)] + 0.40

Example: VOUT for a 25% LEL calibration gas cylinder is:

VOUT = [1.6 x (25 / 100)] + 0.40 = 0.80 Vdc

TABLE 5-1.
CALIBRATION GAS vs. VOUT

Calibration Gas (%LEL)	VOUT (VDC)
10	0.56
20	0.72
30	0.80
40	1.04
50	1.20
60	1.36
70	1.52
80	1.68
90	1.84

LCD Display Method using Unity Mode:

This method of configuring JP1 for the proper gain setting uses the LCD to display the sensor output. The transmitter must first be placed into its Unity Gain Mode as follows:

1. With power off to the transmitter, hold a magnet over the UNITY symbol on the LCD module.
2. Turn on the power to the transmitter. The LCD will display "cb" a few seconds after the power is turned on. Remove the magnet from the display.
3. The LCD will show a value with both the flashing arrow and steady arrow on for (1) minute.
4. This will set the gain to unity (no gain), the meter span to 100 and the End of Service Life value to 1.9.

The Unity feature has now been activated so that the LCD display can be used to position JP1.

> **Important:** *Whenever the Unity feature is activated, the transmitter must be recalibrated. All previous calibration information will be erased when the Unity feature is accessed.*

Use Equation 5-1, Table 5-1 and Appendix "A" to determine the level that is to be displayed on the LCD for a given calibration. The following examples show how to properly use the information contained in these sections.

Example 1: If Methane in air is the gas to be monitored, apply an appropriate calibration gas to the detector (preferably use 2.5% Methane which is 50% LEL). The JP1 jumper is to be configured so that the LCD display corresponds to the gas concentration applied. If 2.5% Methane in air is used (50% LEL), position JP1 so that the display on the LCD is approximately 50 or slightly higher.

When finished, remove gas from sensor and go to Section 5.4.6

> **Note:** *Example 2 assumes 6V "Gold Bell" catalytic bead sensor*

Example 2: If Acetylene in air is the gas to be monitored, Propane in air will be used as a surrogate gas as detailed in Appendix "A". The LCD display is based on the K-Factor of Acetylene. Using the procedure detailed in Appendix "A", it is determined that 42.9% Propane in air is equivalent to 60% LEL Acetylene. Therefore, by applying 42.9% LEL Propane in air (0.94 % Propane) position JP1 so that the display on the LCD shows approximately 60 or slightly higher.

When finished, remove gas from sensor and go to Section 5.4.6

5.4.6 Completing Initial Start-Up

After completing the initial start-up procedures, reinstall the front panel assembly by aligning the (2) thumbscrews with their mating standoffs and tightening firmly by hand. Replace the housing cover and tighten its locking screw.

5.5 End of Service Life

The model 4888A NIC II Transmitter has a standard feature whereby the sensor gain level can be displayed after calibration and compared to a user adjusted level for the purpose of determining the remaining service life of the sensor.

Catalytic combustible sensors inherently lose output signal strength as they age. Knowing the signal strength of a new sensor as defined by the gain applied during calibration when it is first installed allows a user to track its signal deterioration over time.

A high gain level alert can be activated by the 4888A as a means of automatic notification following a successful calibration that a particular sensor is nearing its end of service life. This enables a user to plan sensor replacement during scheduled maintenance time while the sensor is still operational rather than after a sensor is found to be beyond its service life which is typically not known until a calibration is attempted unsuccessfully.

The gain value will display from 0.50 to 2.00. (0.50 representing a low gain and 2.00 representing a high gain value). This value represents the amount of gain applied to the sensor output signal to calibrate it. The initial gain applied to a new sensor during the initial calibration will be dependent on the gas / solvent vapor that the detector is being calibrated for as well as the position of JP1. It is normal for new sensors calibrated on the same cal gas to have initial gain settings vary by as much as 20 percent. Sensors will also lose output signal strength at varying levels due to many factors regarding the application and operating environment. Calibration frequency and how often / how much gas is detected will also affect the loss of sensitivity of a given detector.

5.5.1 Display Gain Setting

In normal operation, hold a magnet over the SPAN DOWN arrow key. The gain will display as a number between 0.50 and 2.00 with the delay arrow flashing. The gain will display so long as the magnet remains over the SPAN DOWN arrow key. Remove the magnet and the display will go back to normal operation.

This value represents the gain applied to the sensor output at the time it was last calibrated. Each time the sensor is calibrated the gain setting may change to a higher value as additional gain is applied to the sensor output to compensate for the loss of sensitivity that is inherent in catalytic bead sensors.

5.5.2 Set End of Service Life Indicator

The 4888A NIC II will display "ESL" every ten seconds after a calibration results in the gain applied to the sensor output exceeding the trip point that has been set. The gain range is 0.50 to 2.00 as described in section 5.4.5. The factory trip point is adjusted at 1.90 and is adjustable by the user as follows:

1 In normal operation, hold a magnet over the UNITY key for approximately 5 seconds until a value is displayed with the delay arrow flashing.
2 The value displayed will be the Compared Gain Value and is adjustable from 0.50 to 2.01.
3 Use the SPAN UP/DOWN arrow keys to adjust this value. **Setting the value to 2.01 will disable the ESL feature.**
4 After the desired value is displayed, hold the magnet over the UNITY key momentarily to return to normal operation.

5.6 Routine Calibration (Non-Intrusive)

Routine calibration *does not* require the area to be declassified as non-hazardous since all adjustments are done with the transmitter's cover intact. Adjustments are made through the housing's transparent window using a magnet tool that is supplied with the transmitter.

Routine calibration consists of first applying a zero gas to the sensor and adjusting the magnetic Zero controls for a zero indication on the transmitter's LCD display. An appropriate span gas is then applied and the magnetic Span controls are adjusted for the correct span value.

> **Note:** *While in the calibration mode, the transmitter's output is held at 1.5 mA to prevent alarms from being tripped by the span gas that will be applied later in the calibration procedure. However, transmitters integrated into CE130 Systems will cause the system's FAIL relay to drop out.*

Zero Adjustment

1. Attach a zero-gas cylinder to the regulator of the calibration fixture.

2. Place transmitter into its calibration mode by briefly holding the magnet tool over the "CAL" dot on the front-cover plate. The transmitter responds by displaying a left-hand arrow on the LCD display. See Figure 5-6.

   The calibration mode is indicated by a steady arrow. It is important that this arrow is not flashing during calibration, since a fast flash rate of 3–4 times per second indicates a saturated A-D converter. If the arrow is flashing, ensure that jumper JP1 on the Input/Output board is correctly installed per Section 5.4.5.

3. Open regulator on calibration fixture and allow zero gas to flow over sensor until LCD readout stabilizes.

4. Zero readout by holding magnet tool over the appropriate Zero ↑↓ symbol until the LCD display shows zero.

5. Shut off regulator, and remove zero-gas cylinder.

SPAN Adjustment

6. Attach an appropriate span-gas cylinder to the calibration fixture's regulator.

7. Open regulator and allow span gas to flow over sensor until the LCD readout stabilizes.

8. Hold magnet tool over the appropriate Span ↑↓ symbol until the correct span indication is observed on the LCD display.

If a flashing left hand arrow appears on the LCD during calibration, the calibration procedure should be halted since the analog voltage being applied to the A-D converter is too high. Either the span gas concentration is incorrect, or the fixed gain jumper on the Input/Output board is set incorrectly (refer to Section 5.4.5).

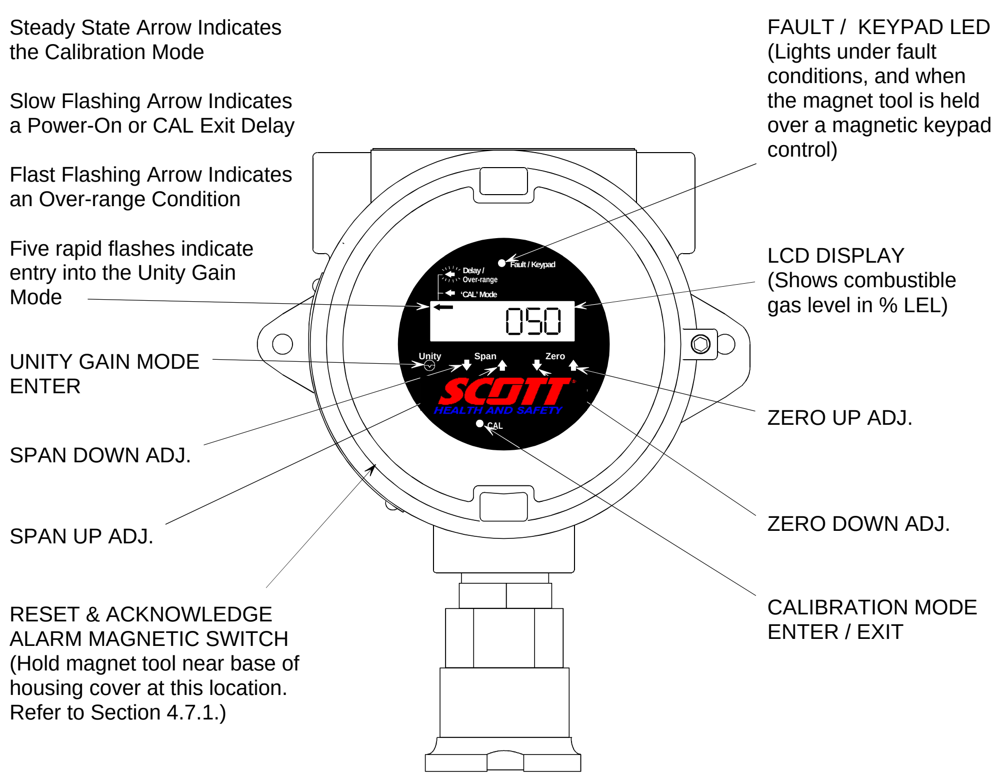
9. Shut off regulator and remove calibration cup. Then before proceeding with Step 10, wait until the transmitter's LCD readout drops below the system's alarm trip-points; otherwise, alarms may sound when the transmitter is placed back into its normal-mode of operation.

10. Exit the calibration mode by again briefly holding the magnet tool over the front panel's "CAL" dot. The left-hand arrow should now start slow flashing and then turn off after a 1 minute delay.

    If the calibration mode is not exited manually, it will automatically exit after 5 minutes of keypad inactivity.

11. Disassemble the calibration fixture.

Figure 5-6.
Front Panel Indicators and Magnetic Adjustments (as seen through the Front Cover Window)



5.7 4-20mA Simulate Mode:

During NORMAL MODE operation, holding the magnet over the DOWN ZERO key for at least 10 seconds places the unit into a 4-20mA SOURCE MODE. The LCD indicates directly in milliamps the actual value of the 4-20mA output and is irregardless of gas on the sensor. The UP/DOWN SPAN keys are used to set this value between 4mA and 20mA. This feature is provided to make it easier to test display and alarm devices connected to the 4800A's 4-20mA output without exposing the sensor to test gas. 4-20mA SOURCE MODE exits back to NORMAL MODE by touching the UNITY key or automatically after 5 minutes without operator input.

6 Operation

6.1 ‘Normal Mode’ Operation

The 4888A-NIC II LEL Transmitter is in its ‘Normal Mode’ any time the LCD’s left-hand arrow is not visible and the Fault/Keypad LED is not illuminated. At this time the transmitter sends a standard 4–20 mA signal to the attached receiving unit, where 4 mA corresponds to 0% LEL, and 20 mA corresponds to 100% LEL full scale. If connected to a Scott Health & Safety Controller, the controller’s readout begins to indicate the level of combustible gas surrounding the transmitter’s detector head.

In addition to the transmitter’s output signal, an LCD display, which is visible through the housing window, shows the detected level of combustible gas in %LEL.

6.2 Fault Supervision

- With the transmitter operating in its ‘Normal Mode’ as described in Section 6.1, a fault condition is signaled if the transmitter’s output drifts far enough negative to cause the output signal to drop to 2.4 mA (–10% of full scale).

> **Note:** *During ‘Normal Mode’ operation, both the transmitter’s 4–20 mA output and LCD readout do not track input values below 0% of full scale. This prevents erroneous and momentary negative noise signals from being transmitted and displayed, but a –10% of full scale drift will still cause a fault indication to occur.*

- The transmitter is also equipped with fault-detection circuitry that detects when the sensor’s catalytic beads open or short circuit. This fault condition will exist until the sensor is replaced.

The transmitter signals either of the above fault conditions by lighting the front panel Fault/Keypad LED, dropping out the ALARM 3 (FAIL) relay on the optional relay board, and clamping the transmitter’s output signal at 0 mA.

> **Note:** *The ALARM 3 relay on the optional relay board should always be configured as a FAIL alarm, causing this relay to de-energize in the event of a fault condition.*

If the transmitter is connected to a Scott Health & Safety Controller, the transmitter’s 0 mA output signal will cause the controller’s FAIL indicator to light and actuate its FAIL alarm circuit.

6.3 Overrange

The A-D converter saturates at readings above 103% of full scale. At this point an overrange condition is indicated by a fast flashing (3–4 times per minute) left-hand arrow on the transmitter’s LCD display.

Note that if an overrange condition occurs during calibration, check if either the span gas concentration is incorrect, or the fixed gain jumper on the Input/Output board is set incorrectly (refer to Section 5.4.5).

The transmitter identifies an overrange condition to the receiving equipment by locking its output signal at 20.5 mA until the overrange condition clears.

6.4 Sensor Flooding

WARNING!

Explosion hazard. The sensor could become damaged if the detector becomes flooded or samples high combustible-gas concentrations (over 100% LEL) for long periods of time. Always recalibrate the transmitter as per Section “5.6 Routine Calibration (Non-Intrusive)” after sampling a high-gas concentration. If the sensor cannot be calibrated, replace it per Section “7.2 Replacing the Sensor”, and then recalibrate the transmitter.

If the atmosphere around the transmitter’s sensor becomes “flooded” with a high concentration of combustible gas or vapor:

- The gas indication at the receiving unit and on the transmitter’s faceplate will quickly jump above 60% LEL, and then rapidly fall to 0% LEL. This indicates that a high, possibly explosive, concentration of combustible gas is surrounding the detector. Even a concentration too rich to be explosive should be considered dangerous.

  The rapid increase of the gas reading was caused by the high concentration of combustible gas combining with the air already inside the detector and being oxidized by the sensor. The now “flooded” sensor can no longer oxidize the gas due to a lack of Oxygen, in turn, causing the gas reading to return to zero even though combustible gas is still present at the detector.

- The WARN and ALARM annunciators, either activated by the optional relay board or a Scott Health & Safety Controller, turn on and remain activated or immediately turn off. Don’t attempt to reset alarms until the combustible gas or vapor is cleared. Let qualified personnel reset alarms only after the area is known to be free of combustibles.

  If the relays in the alarm circuit are set up for non-latching operation, then in the case of sensor flooding as previously described, the annunciators will turn on and then quickly turn off even though combustible gas is still present at the detector.

- The transmitter won’t respond to new combustible gas concentrations at the sensor until the atmosphere clears, and adequate Oxygen levels return.

For safety reasons, check calibration per Section *5.6 Routine Calibration (Non-Intrusive)* after the combustible gas or vapor flooding has cleared.

6.5 Delay Modes

6.5.1 Power Up Delay

The 4–20 mA output is held at 4 mA for 1 minute after power is first applied to the transmitter. This delay is to allow the combustibles sensor time to stabilize and reduce the possibility of causing an erroneous alarm condition within the gas-detection system.

6.5.2 ‘CAL’ Mode Exit Delay

Span gas is 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 gas value and trip alarms. For this reason, the transmitter’s 4–20 mA output is held at 4 mA for 1 minute after exiting the CAL mode.

6.5.3 Automatic ‘CAL’ Mode Exit Timer

The transmitter’s 4–20 mA output is held at 1.5 mA during calibration. This alerts any loop-monitoring devices that a special condition is present. Since it is possible for an operator to forget to return the transmitter to its normal operating mode, the transmitter’s microprocessor monitors the magnetic keypad while in the CAL mode, and if no key stroke is made during a 5 minute interval the CAL mode is automatically exited.

6.5.4 Aborting the Delay Modes

Troubleshooting or other testing procedures may be easier to perform without the power-up and CAL-mode-exit delays active. These delays can therefore be temporarily turned off by first removing power; holding the magnet tool over the Zero ↑ control; and then reapplying power. Note that the transmitter must not be in a fault condition when power is reapplied.

Any subsequent power-up without holding the magnet tool over the Zero ↑ control reactivates both delay periods.

6.6 Calibration Values Back-Up Power

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

7 Maintenance

WARNING!

Before performing any maintenance procedures that require the transmitter housing, detector head, or any other electrical enclosure to be opened, be sure to declassify the area to non-hazardous.

It is advisable that spare transmitter circuit boards and sensors be on hand to facilitate maintenance. The following sections describe how to:

- Perform routine maintenance
- Replace the sensor
- Replace a transmitter circuit board
- Readjust the LCD’s electrical SPAN (R19) and ZERO (R20) readings

7.1 Routine Maintenance

Routine maintenance consists of simply calibrating the transmitter as described in Section *5.6 Routine Calibration (Non-Intrusive)* on a periodic basis.

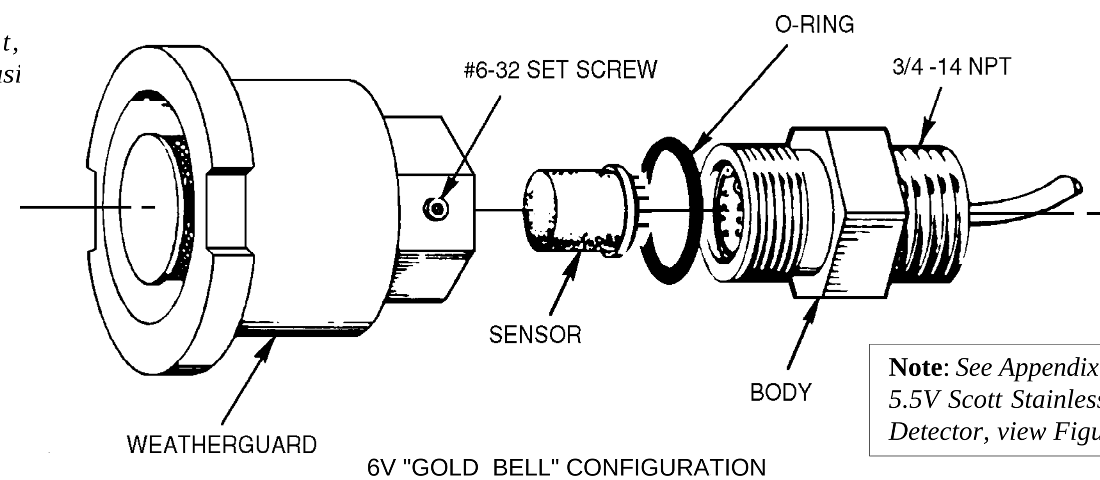
Check calibration of the transmitter once a week for the first month of operation; monthly, or as experience dictates thereafter.

7.2 Replacing the Combustibles Sensor

Remove power from the transmitter. Then disassemble the detector head and replace the sensor as shown in either Figure 7-1, 7-2, or 7-3.

After replacing the sensor, perform the procedures in Sections *5.4.2 Sensor Voltage Check, 5.4.4 Balance Adjustment, 5.5 Checking Sensor Output Signal Strength, and 5.6 Routine Calibration.*

Figure 7-1.
Sensor Replacement, 6V "Gold Bell" Diffusi Head Assembly



Note: *See Appendix C for 5.5V Scott Stainless Steel Detector, view Figure C-6*

Figure 7-2.
Sensor Replacement,
6V "Gold Bell"
Flow Cell Assembly

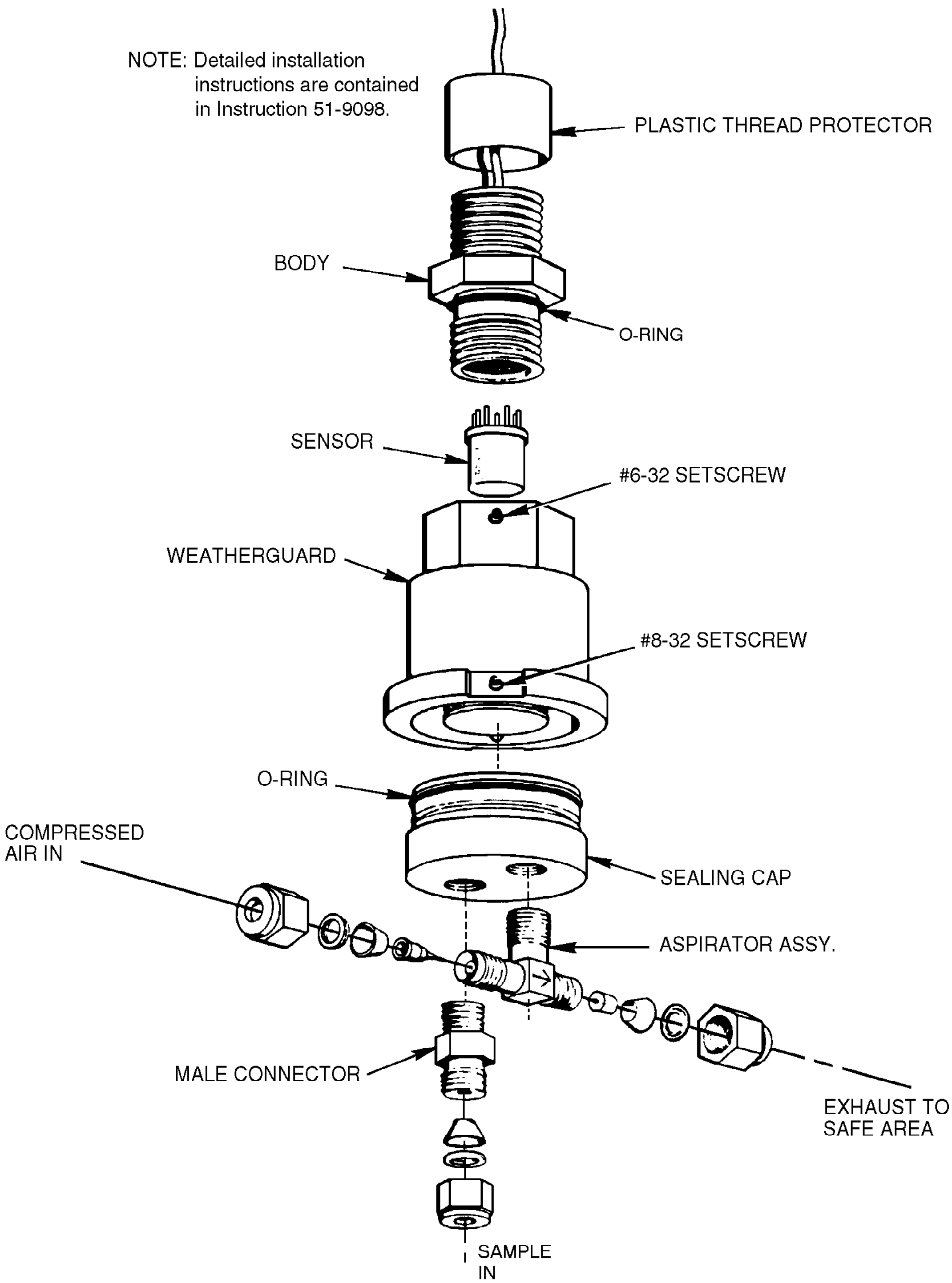
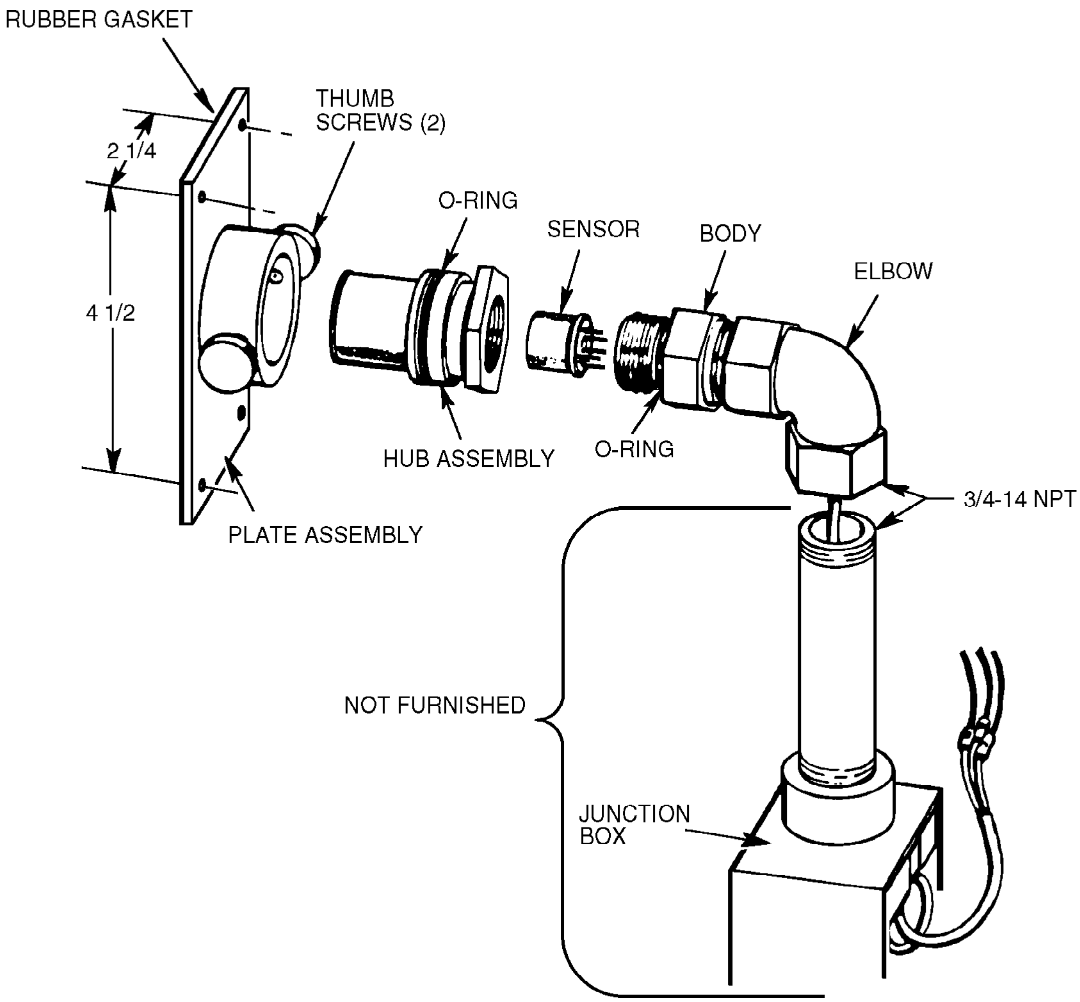


Figure 7-3.
Sensor Replacement,
6V "Gold Bell" Duct
Adapter Assembly



7.3 Transmitter Circuit Board Replacement

Material Required:

- No. 1 Phillips-head screwdriver
- Small flat blade screwdriver
- 7/64" socket-head wrench
- Method of tagging wires
- Replacement boards as needed:
  - Front Panel/CPU Board Assembly
  - Input/Output Board
  - Relay Board, Modbus RS-485 Board, or Isolated 4–20 mA Board

Procedure:

1. Disarm any annunciators; then switch off power to the transmitter.

2. Loosen socket-head screw on housing cover; then unscrew and remove cover.

3. Referring to Figure 8-1, disassemble the transmitter as necessary to remove the circuit board being replaced. If the board has external wires connected to its terminal block(s), be sure to first tag the wires before removing them.

4. Install the new circuit board. Then, if necessary, reconnect any wires that were removed in Step 3.

   If the Input/Output board was replaced, also be sure jumpers J04 and JP1 are placed correctly. Refer to Sections 4.6.1 and 5.4.5 for information on jumper placement. In addition, the board's VOLTS and BAL potentiometers will need to be adjusted per Sections 5.4.2 and 5.4.4.

   If the Relay board was replaced, also be sure the ALARM 1 and ALARM 2 rotary switches and the FUNCTION DIP switch are set correctly. Refer to Section 4.7 for information on switch positions.

   If the Modbus RS-485 board was replaced, also be sure the DIP switches and jumpers are set correctly. Refer to Section 4.8 for information on switch and jumper positions.

5. Replace housing cover and tighten its socket-head screw.

6. Calibrate transmitter per Section 5.

7.4 LCD Full Scale Display Adjustment

This procedure is performed at the factory, and need not be repeated unless the LCD indications for 4 and 20 mA need to be changed or verified. The LCD indication for 4 mA is factory set to 0% LEL, while the indication for 20 mA is set to 100% LEL.

> **Note:** *When calibration of the LCD display is necessary, it is important to understand that the only requirement is that the display must read '0' with a 4 mA output and '100' with a 20 mA output. This adjustment has no affect on the transmitter's analog output.*
>
> *4800A Version:*
> *Set meter span: Hold the cal key until the word "CAL" disappears (approx. 5 seconds) and a value appears with the arrow flashing. The Span up and down adjusts the reading from 20 to 1999. The Unity key sets the decimal point. Touching the Cal key returns the unit to the cal mode.*

Material Required - 4800 Version: (Older Version - Front Display does not say 4800A)

- Digital milliampere meter (DMM)
- Cylinders of zero and span calibration gas normally used when calibrating the transmitter
- Several feet of 22 AWG hook-up wire
- No. 1 Phillips-head screwdriver
- $^{7}/_{64}$" socket-head wrench
- Potentiometer adjustment tool

Procedure:

1. Disarm any annunciators; then switch off power to the transmitter.
2. Loosen socket-head screw on housing cover; then unscrew and remove cover.
3. Loosen the two captive thumb screws on the front panel assembly; then lift out

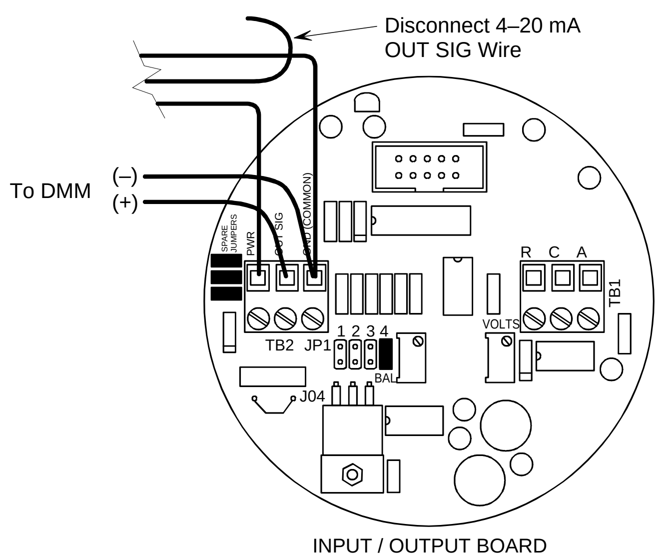


Figure 7-4.
DMM Connection to TB2 for Measuring Transmitter Output

the front panel with its circuit board(s) attached as far as allowed by the ribbon cable. This step exposes the wiring connected to TB2 on the Input/Output board.

4. Remove the 4–20 mA signal lead from TB2 terminal OUT SIG. Then connect a DMM to TB2 terminals OUT SIG and GND (– COMMON) using 22 AWG hook-up wire (Figure 7-4). *The DMM is used to display the transmitter's milliampere output signal.*

5. Reapply power to transmitter.

6. Force transmitter to produce a 4 mA output as shown on the DMM when zero air is applied to the detector.

   This can be accomplished by placing the transmitter into its CAL mode, and then adjusting the magnetic ↑↓ Zero controls to produce a 4 mA output when the transmitter is placed back into its normal-operation mode. (Remember that the transmitter's output is held at 1.5 mA while in the CAL mode; therefore, no DMM movement will be seen while adjusting the magnetic ↑↓□Zero controls while in this mode.)

7. Adjust LCD ZERO control R20 (Figure 7-5) until the LCD shows 0% LEL at 4 mA.

8. Force transmitter to produce a 20 mA output as shown on the DMM.

   This can be accomplished by exposing the sensor to an appropriate level of calibration gas, and then adjusting the magnetic ↑↓ Span controls while in the CAL mode to produce a 20 mA output when the transmitter is placed back into its normal-operation mode.

9. Adjust LCD SPAN control R19 until the LCD reads 100% LEL at 20 mA.

10. Remove transmitter power, remove test equipment and 22 AWG test leads, reconnect 4–20 mA signal lead to TB2 terminal OUT SIG, and then reassemble transmitter.

WARNING!

If any alarm circuits were disabled during this procedure, reactivate them now; otherwise, hazardous combustible gas levels may go undetected.

11. Calibrate the transmitter per Section 5.

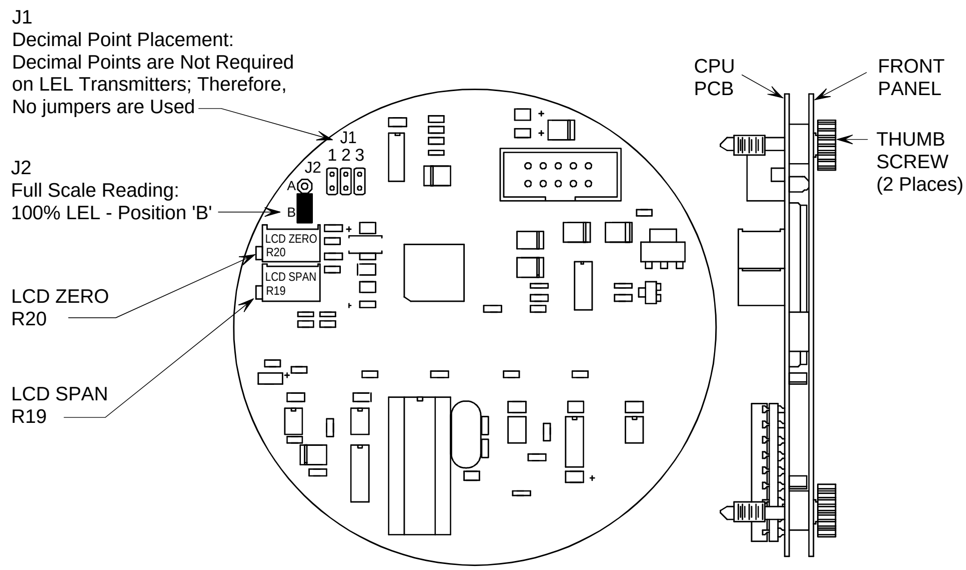


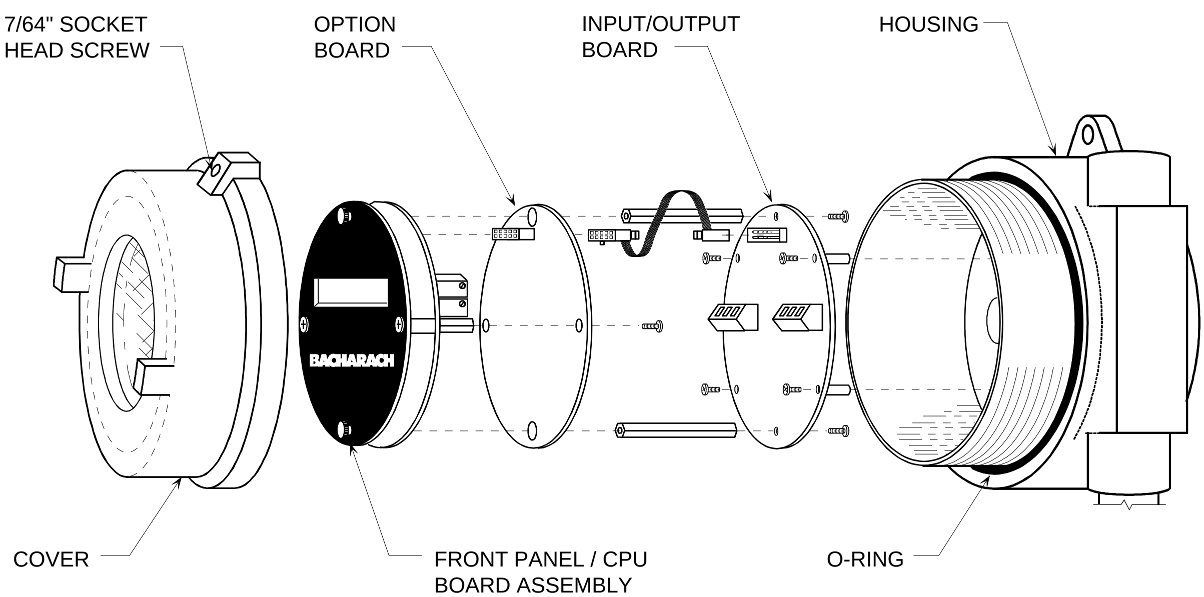
Figure 7-5.
Jumper Placement and Potentiometer Adjustments on CPU Board (4800 Version only, not 4800A)

8 Replacement Parts

8.1 4888A-NIC II LEL Transmitter

Description	Part No.
Complete Transmitter Assembly with Detector Head and Option Board — Refer to Section *1.2 Ordering Information*	
Housing, Aluminum, Explosion Proof	9505-0038
Cover w/Window, Housing	51-2745
O-Ring, Housing	05-5042
Front Panel / CPU Board Ass'y	9550-2083
* Input / Output Board	9550-2086
Relay Board (Option)	9550-2079
Modbus RS-485 Board (Option)	9550-2084
Isolated 4–20 mA Board (Option)	9550-2085
Magnet Tool	9550-0068
* Input / Output Board (When using 5.5V Detectors only, as referenced in Section 8.2b & 8.2c)	096-2805

Figure 8-1. Exploded View of the 4888A-NIC II LEL Transmitter



8.2a Diffusion Detector Head - 6V "Gold Bell" Type

(See Figure 7-1)

Description	Part No.
Complete Assembly:	
Standard Rain Guard	23-4012
w/ Calibration Port	9550-1002
#6-32 Setscrew	02-0789
O-Ring	05-5007
Body	23-4019
Weatherguard	23-4692
Sensor, Combustibles	8000-8050

8.2b 5.5V SCOTT Diffusion Detector Assembly -

(See Appendix "C", Figure C-2)

Description	Part No.
Complete Assembly (Standard)	40011600
Complete Assembly (w/ Poison Resistant Sensor)	096-2678
Detector Body Assembly	40009065
Stainless Steel Pipe Plug	40002800
Combustible Sensor (Standard) Replacement Kit	40011528
Poison Resistant Combustible Sensor	40012111
Outer Guard Assy. (Standard Sensor)	40009066
Outer Guard (Poison Resistant Sensor)	096-2648
Set Screw	33351-017

8.2c 5.5V SCOTT Positive Flow Detector Assembly -

(See Appendix "C", Figure C-3)

Description	Part No.
Complete Assembly (Standard)	40009263
Complete Assembly (w/ Poison Resistant Sensor)	096-2679
Detector Body Assembly	40009065
Stainless Steel Pipe Plug	40002800
Combustible Sensor (Standard) Replacement Kit	40011528
Poison Resistant Combustible Sensor	40012125
Positive Flow Cap Assy. (Std. Sensor)	40009329
Positive Flow Cap Assy.(Poison Resistant Sensor)	096-2649)
O-Ring	40009264

8.3 Flow Cell Detector Head - 6V "Gold Bell" Type

(See Figure 7-2)

Description	Part No.
Complete Assembly	23-4017
#8-32 Setscrew	02-0788
#6-32 Setscrew	02-0789
Male Connector	03-1822
Plastic Thread Protector	05-3243
O-Ring, Body	05-5007
O-Ring, Sealing Cap	05-5012
Body	23-4019
Aspirator Assembly	23-4092
Sealing Cap	23-4099
Weatherguard	23-4693
Sensor, Combustibles	8000-8050

8.4 Duct Adapter Diffusion Head - 6V "Gold Bell" Type

(See Figure 7-3)

Description	Part No.
Complete Assembly	23-4014
O-Ring, Body	05-5007
O-Ring, Hub Assembly	05-5038
Body	23-4019
Plate Assembly	23-4020
Hub Assembly	23-4021
Rubber Gasket	23-4067
Elbow	3301-0900
Sensor, Combustibles	8000-8050

8.5 Accessories -

Item	Part No.	Description
Calibration Cup	23-4098	For use with 6V "Gold Bell" type Diffusion Detector
Calibration Cup	3470-9500	For use with 6V Duct Adapter Detector

8.6 Scott Health & Safety Sales/Service

Scott Health & Safety
4320 Goldmine Road
Monroe, NC 28110

Phone: 800-247-7257
FAX: (704) 291-8340

APPENDIX "A"
Multiplying "K" Factors

From time to time Scott Health & Safety is requested to supply multiplying K-factors that can be used to simulate response to a combustible in terms of a readily available compressed calibration gas such as propane-in-air. It should be understood that such *conversion factors are calculated estimates only.* They are intended to serve as a guide to show approximate typical response of an instrument to the particular gas needed for calibration.

The K-factors shown in Table A-1 are based on test studies of related gases and a calculated comparison to standard theoretical values of pertinent gas parameters available to Bacharach, Inc. at the time of estimating.

For measurements *critical* to determining a health or explosive/flammable hazard, *a particular instrument should always be calibrated using the specific gas or vapor to be measured.* There is no other way to ensure reliable readings. Too many parameters are involved to make any single, simple conversion factor accurate.

WARNING!

For maximum safety in determining existence of an explosive, flammable, or health hazard, your particular instrument should be calibrated using the specific gas/vapor to be measured. If your instrument has an agency approved certification (e.g. Factory Mutual, CSA, etc.), failure to calibrate on the specific gas hazard to be monitored may void the certification. When in doubt as to proper calibration gas or procedure, contact your Bacharach, Inc. Sales Representative or factory applications engineer.

The multiplying K-factors in Table A-1 may be used to calibrate a 4800-NIC II LEL Transmitter fitted with the 6.0 volt, "Gold Bell" housing P/N 8000-8050, with propane when gases other than propane are to be detected.

For example, to use Scott Health & Safety' standard Propane gas cylinder 077-0241 (42.9% LEL) to calibrate a transmitter for Hexane: Multiply 42.9% LEL Propane by the Hexane multiplying K-factor of 1.7, as given in Table A-1, to obtain 73% LEL Hexane. Adjust the transmitter's span control to indicate 73% LEL with 42.9% LEL Propane being applied to the detector.

The results obtained when using the K-factors are approximate and must not be construed as representing highly accurate LEL percentages. They are usually considered to be adequate for general detection of combustible gases, but are not adequate for accurate gas analysis.

The calibration factors for Scott stainless steel head P/N 40011528 and 40012111 are found in Table A-2.

Table A-1. Multiplying (K) Factors for Various Combustible Gases and Vapors for 6V "Gold Bell" Detector

Combustibles Gas/Vapor	K-Factor* (Based on Propane)
Acetone (C_3H_6O)	1.3
Acetylene (C_2H_2)	1.4
Acrylonitrile (C_3H_3N)	0.97
Ammonia	0.7
Benzene (C_6H_6)	1.5
Butadiene (C_4H_6)	1.5
Butane (C_4H_{10})	1.1
Cyclohexane (C_6H_{12})	1.5
Dichloromethane (CH_2Cl_2)	1.5
1,2 Dichloropropane ($C_3H_6Cl_2$)	1.5
Difluoromethane	0.9
Ethane (C_2H_6)	0.8
Ethyl Alcohol (C_2H_6O)	1.1
Ethylene (C_2H_4)	0.9
Ethylene Oxide (C_2H_4O)	1.1
Heptane (C_7H_{16}), JP-4, gasoline	1.9
Hexane (C_6H_{14})	1.7
Hydrogen (H_2)	0.8
Isopropyl Alcohol (C_3H_8O)	1.5
Methane (CH_4)	0.6
Methyl Alcohol (CH_4O)	1.1
Methyl Chloride (CH_3Cl)	0.7
Methylene Chloride (CH_2Cl)	1.5
Methyl Ethyl Ketone (C_4H_8O)	1.8
Methyl Fluoride	1.1
Pentane (C_3H_{12})	1.3
Propane (C_3H_8)	1.0
Propylene (C_3H_6)	1.2
Propylene Dichloride ($C_3H_6Cl_2$)	1.5
Propylene Oxide (C_3H_6O)	1.4
Styrene (C_8H_8)	3.95
Toluene (C_7H_8)	1.7
Vinyl Chloride (C_2H_3Cl)	1.2
O-Xylene (C_8H_{10})	3.0

* K-Factors applicable to Combustibles Sensor (6 VDC) 8000-8050

Table A-2 Diffusion Detector Calibration Check Gas Readings Valid Only in Ambient Air with Oxygen Content Aproximately 21% - For use with 5.5V Scott Stainless Steel Head

	FOR SENSOR 4888-2 P/N 40011528 OPTION				FOR SENSOR 4888-3 P/N 40012111 OPTION			
	1% PROPANE (45% LFL) P/N 40009173		1/2% PROPANE (22% LFL) P/N 40009614		1% PROPANE (45% LFL) P/N 40009173		1/2% PROPANE (22% LFL) P/N 40009614	
GAS/ SOLVENT	XMIT VOLTS	% GAS METER	XMIT VOLTS	% GAS METER	XMIT VOLTS	% GAS METER	XMIT VOLTS	% GAS METER
ACETALDEHYDE	1.12	45						
ACETONE			0.93	33			0.93	33
ACRYLONITRILE	1.07	42						
ACETYLENE	1.17	48						
AMMONIA	1.12	45						
BENZENE			0.93	33			1.2	50
1,3 - BUTADIENE	1.18	49					0.88	30
N - BUTANE	1.33	58						
ISO - BUTANE	1.38	61						
ISO-BUTYLENE	1.36	60						
BUTYL ACETATE			1.3	56				
N - BUTYL ALCOHOL			1.04	40				
CHLOROBENZENE			0.93	33			0.93	33
CYCLOHEXANE			0.96	35				
CYCLOHEXANONE			1.12	45				
DIMETHYL FORMAMIDE			0.93	33				
DIETHYL ETHER			0.96	35				
N - DECANE			1.3	56				
ETHANE	1.12	45						
ETHYL ACETATE			0.94	34				
ETHYL ACRYLATE			1.04	40				
ETHYL ALCOHOL	1.31	57					1.09	43
ETHYL BENZENE			1.04	40				
ETHYLENE	1.51	47						
ETHYLENE OXIDE	1.26	54			1.3	56		
HEPTANE			0.98	36				
N - HEXANE			0.98	36			1.3	56
HEXANE	1.38	61						
ISOPROPYL ALCOHOL	1.44	65						
METHYL ETHYL KETONE			0.93	33			1.09	43
METHYL ISO BUTYL KETONE			0.98	36				
N - METHYL 2-PYRROLIDONE			1.01	38		NO SPAN		NO SPAN
METHANOL	1.22	51			1.22	51		
METHYL STYRENE	1.25	53						
MINERAL SPIRITS			1.39	62				
MONOCHLOROBENZENE			0.93	33				
NAPTHA V.M. & P.			1.14	46				
NITRO PROPANE			0.94	34				
ISO - OCTANE			1.04	40			1.38	61
N-OCTENE			1.3	56				
OCTENE			1.15	47				
PENTANE			0.93	33				
ISO - PENTANE			0.93	33				
ISOPRENE	1.23	52						
PROPANE	1.18	49						
PROPYLENE	1.31	57						
STYRENE			1.09	43			1.41	63
TETRAHYDROFURAN	1.31	57					1.2	50
TOLUENE			0.98	36			1.36	60
VINYL ACETATE	1.41	63						
VINYL CHLORIDE			1.06	41				
O - XYLENE			1.14	46			1.49	68

FOR 40011528 SENSOR
HYDROGEN - USE 1% HYDROGEN (25% LFL) P/N 40009171
METHANE - USE 2 1/2% METHANE (50% LFL) P/N 40009061

Notes:
1. Check gas readings include 10% positive correction for calibration port calibration at 2000 cc per minute.
2. Actual calibration field checks require use of factor shown on calibration gas cylinder to correct for actual concentration variations in calibration gas lots.
3. Calibration check gas readings using conventional diffusion techniques (plastic bag filled with calibration gas and placed over detector) should be reduced by 10% (multiply table % gas reading by 0.91).
4. % gas meter readings are the flammable gas concentration expressed as % lower flammable limits in air.
5. Instrument must be above flash point of the vapor to be detected.

APPENDIX “B”
Scott Instrumennts Series 6004, 6104 and 6800 Transmitter Wiring

Refer to Figure B-1, B-2, or B-3 when wiring a 4800-NIC II LEL Transmitter to an Scott Health & Safety 6004 Quad Scan, 6104 Panel Mount Quad Scan, or Series 6800 Gas Receiver.

Figure B-1.
Transmitter Wiring Diagram, Scott Health & Safety Series 6004 Quad Scan

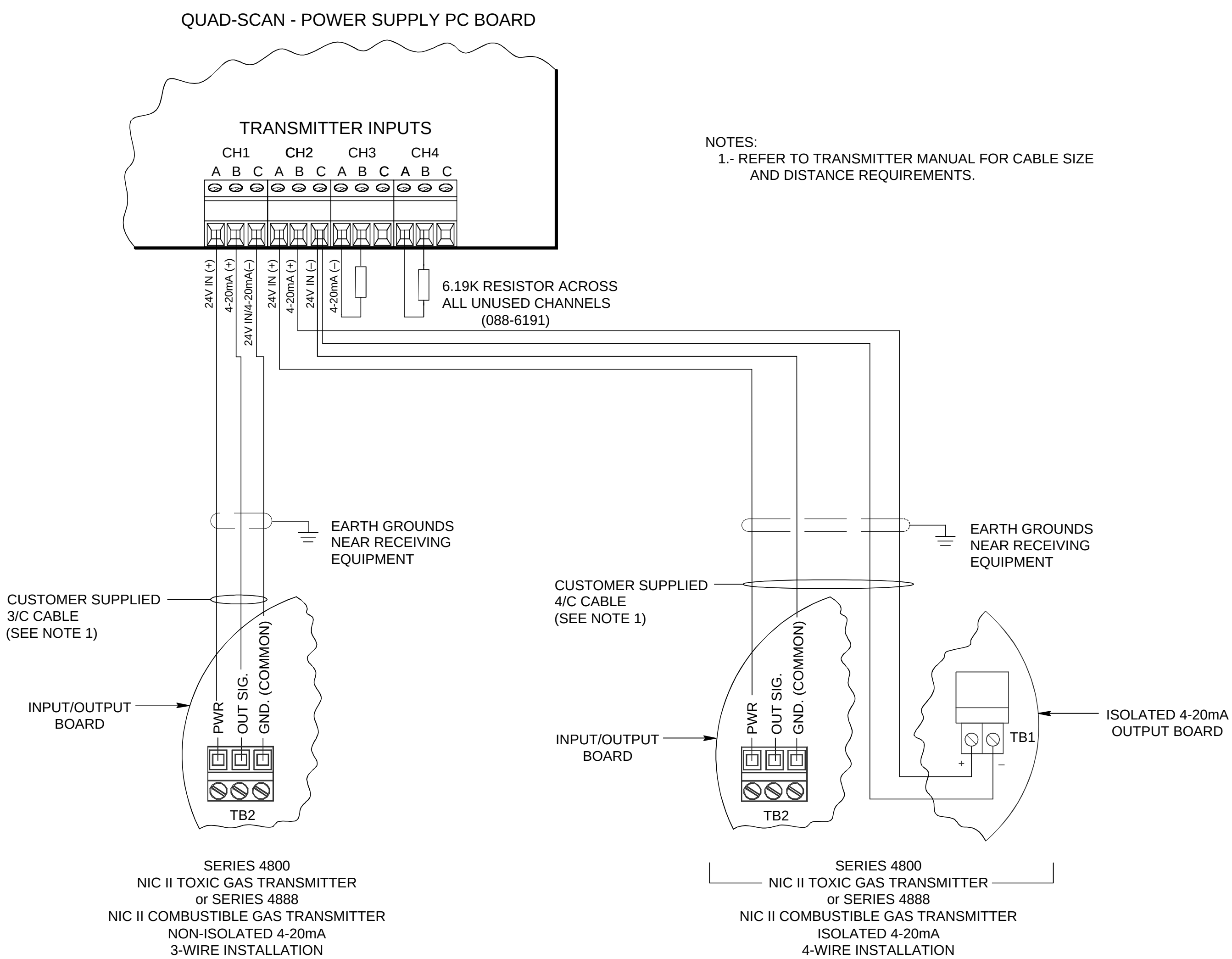


Figure B-2.
Transmitter Wiring Diagram, Scott Health & Safety Series 6104 Panel Mount Quad Scan

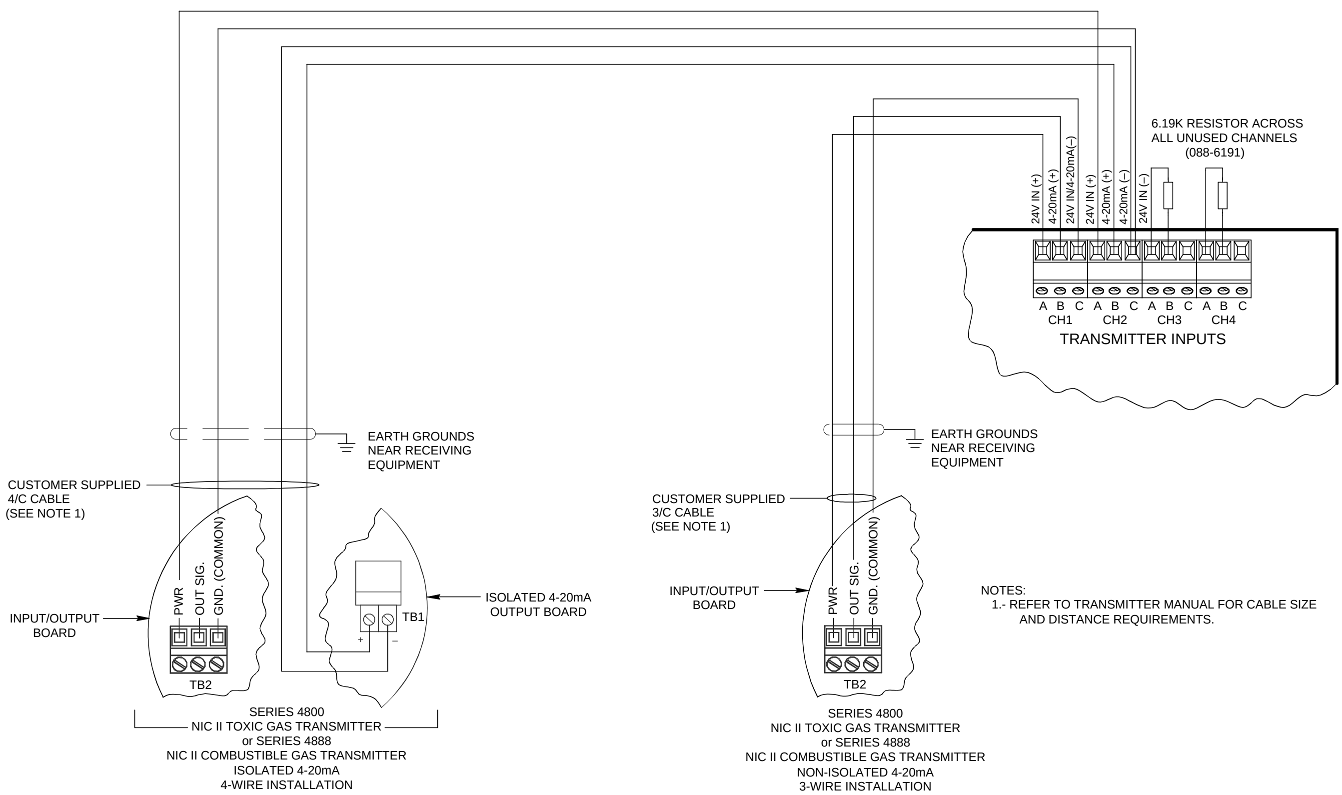
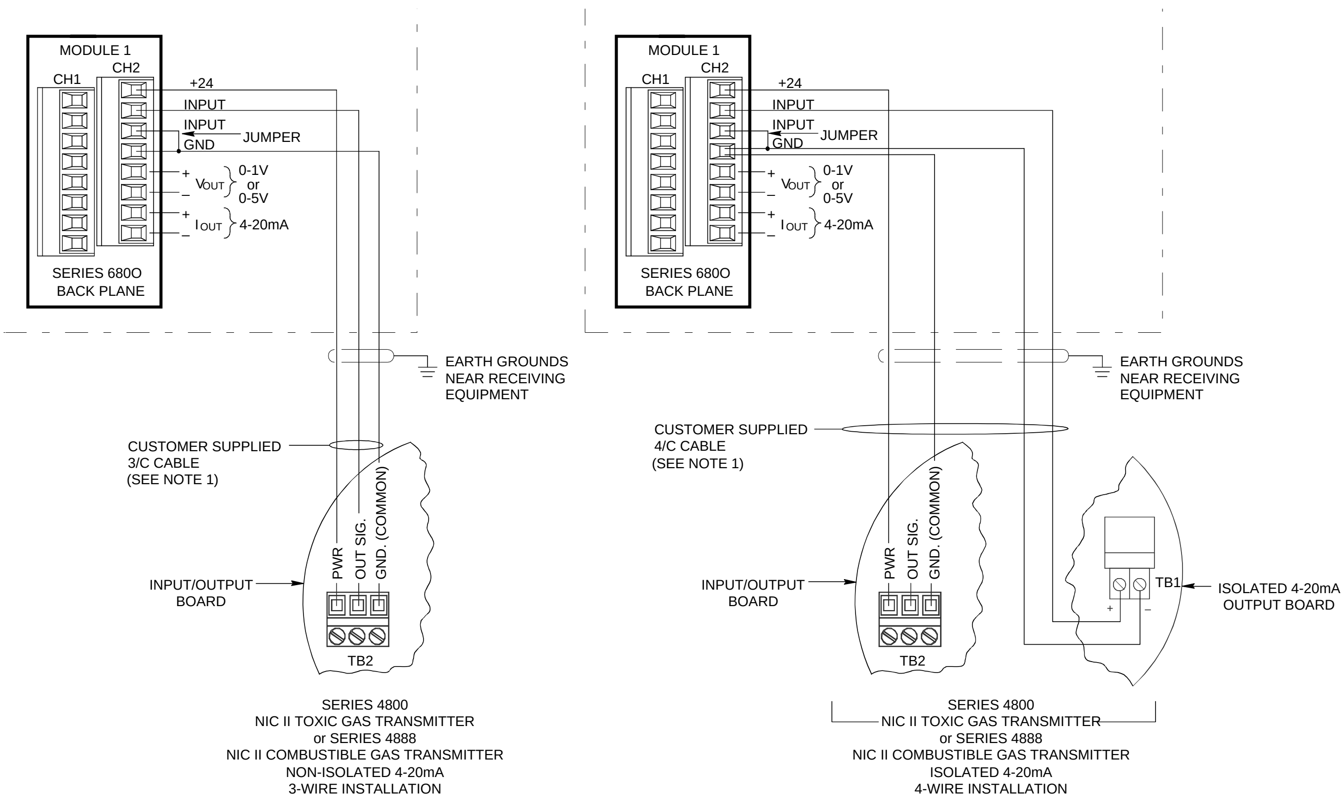


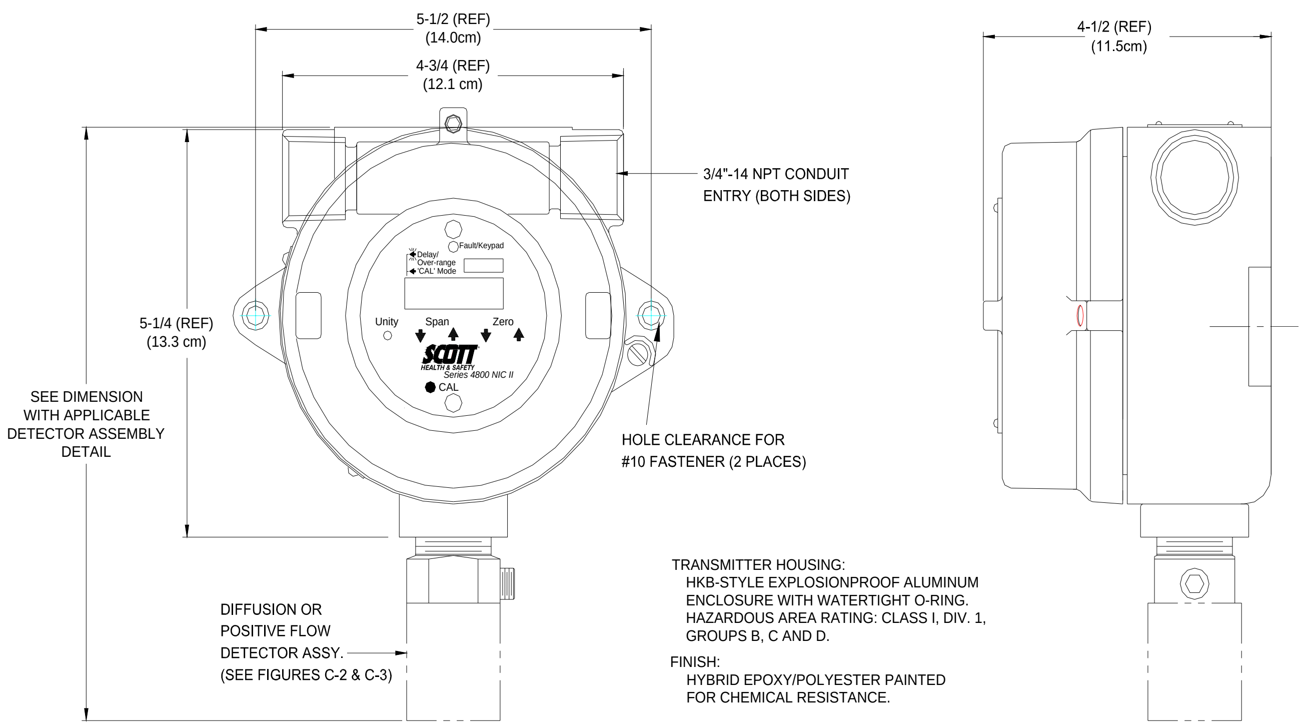
Figure B-3.
Transmitter Wiring Diagram, Scott Health & Safety Series 6800 Gas Receiver



NOTES:
1.- REFER TO TRANSMITTER MANUAL FOR CABLE SIZE AND DISTANCE REQUIREMENTS.

APPENDIX “C”
4888A NIC II LEL Transmitter with P/N 40011600, 40009263, 096-2678 or 096-2679 Detectors

Figure C-1
Series 4888A NIC II Catalytic Bead Combustible Gas Transmitter / Detector



SERIES 4888 NIC II CATALYTIC BEAD COMBUSTIBLE GAS TRANSMITTER / DETECTOR

NOTES:

1. TRANSMITTER / DETECTOR ASSEMBLY MUST BE INSTALLED XP. OPERATES ON NOM. 24 VDC INPUT (18 - 30 VDC).
2. TRANSMITTER HOUSING IS CERTIFIED XP FOR CLASS I, DIV. 1, GROUP B, C & D. DETECTOR HOUSING IS SUITABLE FOR CLASS I,DIVISION 1, GROUPS A, B, C & D AND MAY BE REMOTED FROM TRANSMITTER HOUSING IF REQUIRED BY APPLICATION OR AREA CLASSIFICATION.

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Figure C-2
Diffusion Detection Assembly

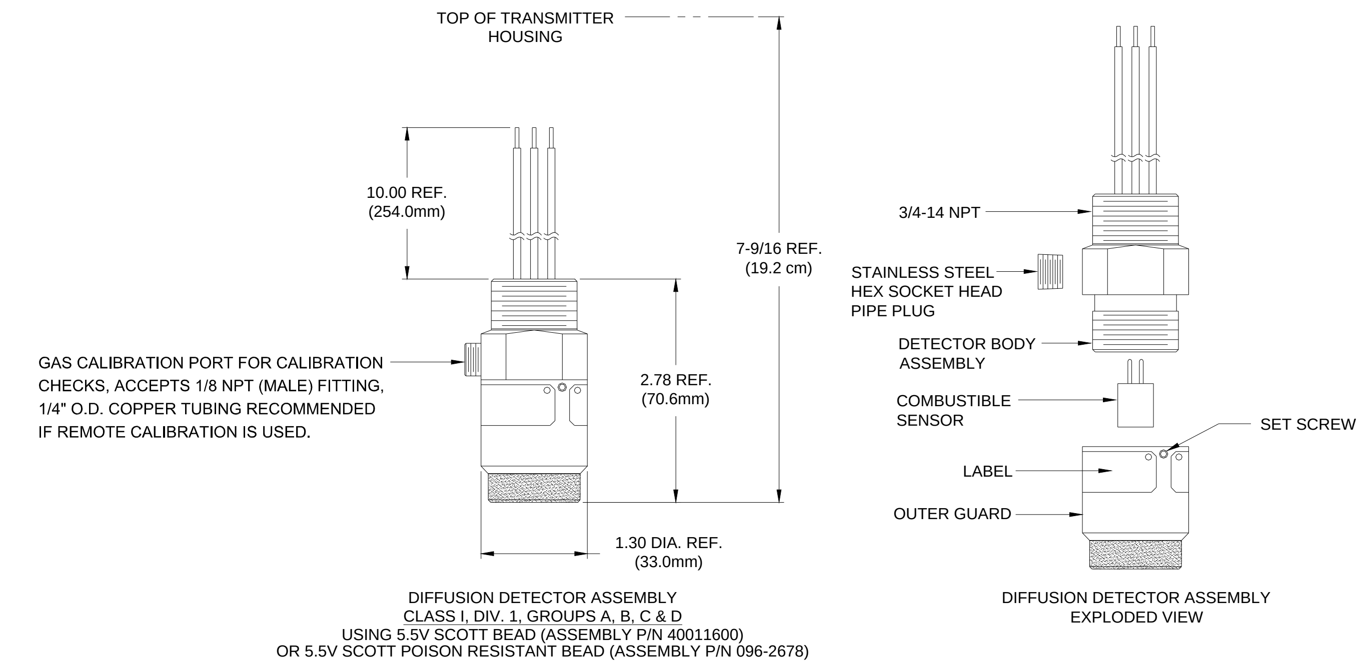


Figure C-3
Positive Flow Detector Assembly

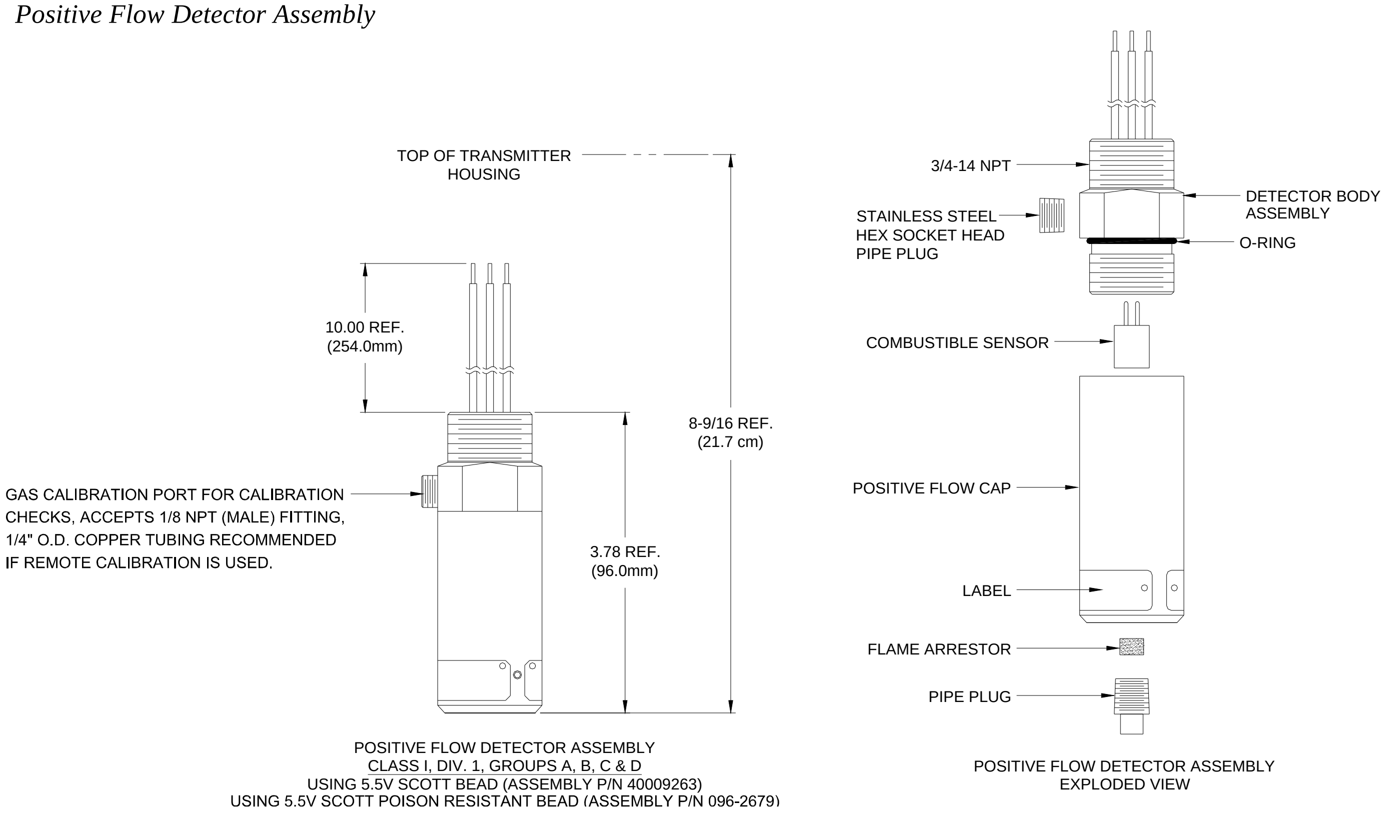
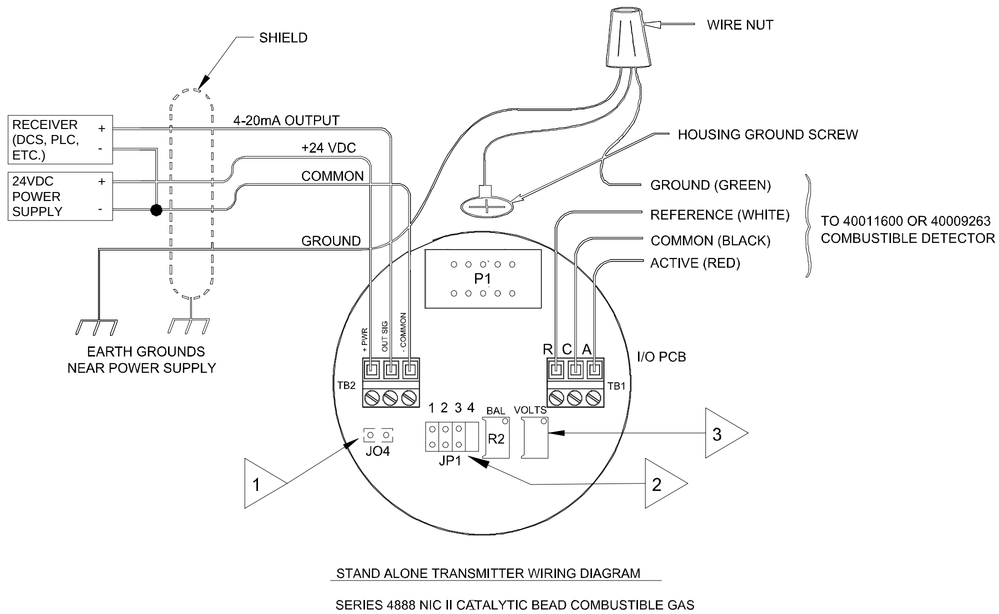


Figure C-4
4888A NIC II LEL Transmitter Customer Wiring Connections



NOTES:

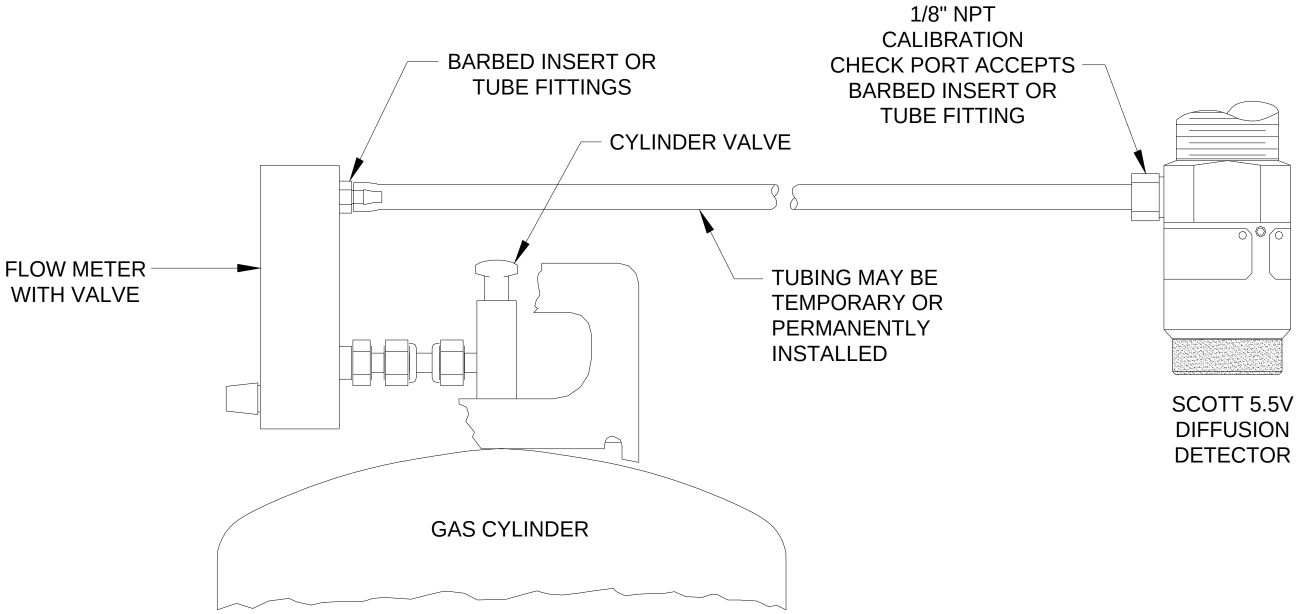
1. TO CONVERT TO 12VDC (10-18) OPERATION, INSTALL SOLDER-IN JUMPER J04.

2. SENSOR GAIN JUMPER JP1 MAY REQUIRE TO BE POSITIONED OTHER THAN SHOWN DEPENDING ON GAS TO BE MONITORED. REFER TO MANUAL 9550-9142 FOR ADDITIONAL INFORMATION.

3. VOLTS POTENTIOMETER IS TO BE ADJUSTED TO INDICATE 5.50 ±0.05VDC AT DETECTOR. IF DETECTOR IS ATTACHED TO TRANSMITTER ATTACH DVM TO TB1-R AND TB1-A TO MAKE ADJUSTMENT. IF DETECTOR IS MORE THAN 18" (457mm) AWAY FROM TRANSMITTER, REMOVE OUTER GUARD AND CONNECT DVM TO (2) TWO TEST POINTS LOCATED ADJACENT TO SENSOR AND ADJUST VOLTS POTENTIOMETER.

4 REFER TO MANUAL 9550-9142 FOR OTHER INSTALLATION, OPERATION, AND CALIBRATION INSTRUCTIONS.

Figure C-5
4888A NIC II LEL Transmitter Calibration Test Set-Up for SCOTT 5.5V Detector



MUST USE ONE OF THE FOLLOWING CALIBRATION TEST KITS:

- 2-1/2% METHANE IN AIR (P/N 40009061)
- 1% HYDROGEN IN AIR (P/N 40009171)
- 1% PROPANE IN AIR (P/N 40009173)
- 1/2% PROPANE IN AIR (P/N 40009614)