TOX-NO2/ANA SERIES

MODELS:
TOX-NO2/1 AND TOX-NO2/2
TOX-NO2/4 AND TOX-NO2/5
NITROGEN DIOXIDE GAS TRANSDUCER
4 To 20 ma
or
0 to 5 VDC

Toxalert model TOX-NO2/ANA sensor/transducers have a range of 0 to 10 PPM and outputs a linear 4 to 20 ma signal or 0 to 5 VDC over its range.

Model	Description
Tox-NO2/1	4 to 20 ma output
Tox-NO2/2	0 to 5 VDC output
Tox-NO2/4	4 to 20 ma output & relays
Tox-NO2/5	0 to 5 VDC output & relays

This manual is intended for the installer and user to produce a well installed system and insure the owner/user of a well operating system for years to come.

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BACKGROUND:

The Toxalert Nitrogen Dioxide (NO_2) Transmitter combines safety and energy savings. A common producer of NO_2 is diesel engine exhaust. Diesel exhaust is a known cancer causing agent as reported in the U.S. Department of Health and Human Services' *Current Intelligence Bulletin 50* dated August 1988. An electro-chemical cell is required to measure such small amounts of NO_2. The device's sensor is capable of measuring NO_2 in increments of 0.1 PPM.

PRODUCT FEATURES

Features of the Toxalert Nitrogen Dioxide sensor that make it stand out above competitive equipment.

1.) Sensing element life: 2 years in normal service.
2.) Explosion proof housing.
3.) 1 year warranty on sensor element and electronics.
4.) Response time: 30 seconds to 90% of change.
5.) Linear 4 to 20 ma output signal over range, or
6.) 0 to 5 VDC output signal over range.
7.) Light emitting diode (LED) indicators:
- **a.) Power to sensor**
- **b.) Sensor failure LED**
- **c.) Loop current indicator: lights with varying intensity when 4 to 20 ma sensor output current is flowing.**

Other features:

1.) Low voltage circuits.
2.) Interfaces directly to DDC control systems.
3.) Low power consumption-less than one and a half watts.
4.) Field replaceable sensing element.
5.) Easy calibration and calibration check.

1. PRODUCT DESCRIPTION

1.1 Introduction

The Model Tox-NO2/1 and Tox-NO2/2 Nitrogen Dioxide Gas Sensor/Transducers are designed for use in conjunction with Toxalert and other industry standard 4-20 ma or 0 to 5 VDC loop controllers. The module requires a three wire connection. Two wire 24 VDC power (16 to 35 VDC Maximum) and one wire signal. (Note: Voltage requirement for sensors with the relay option is 20 to 35 VDC Maximum.)

DO NOT APPLY OVER 35 VDC POWER.

The model Tox-NO2/1 output current is a linear 4 to 20 ma signal over its 0 to 10 ppm NO_2 range. The model Tox-NO2/2/A output is a linear 0 to 5 VDC signal over its 0 to 10 ppm NO_2 range.

1.2 Application

The Model Tox-N02/ANA Nitrogen Dioxide Gas sensor is intended for use in ambient monitoring applications. It is designed for fixed installation and for continuous operation. Sensor(s) should usually be mounted within 5 to 6 feet from the finished floor.

1.3 Configuration

The gas transducer is comprised of a NEMA-7 enclosure which contains the transmitter electronics and a gas sensor which is installed in one of the two 3/4" conduit hubs.

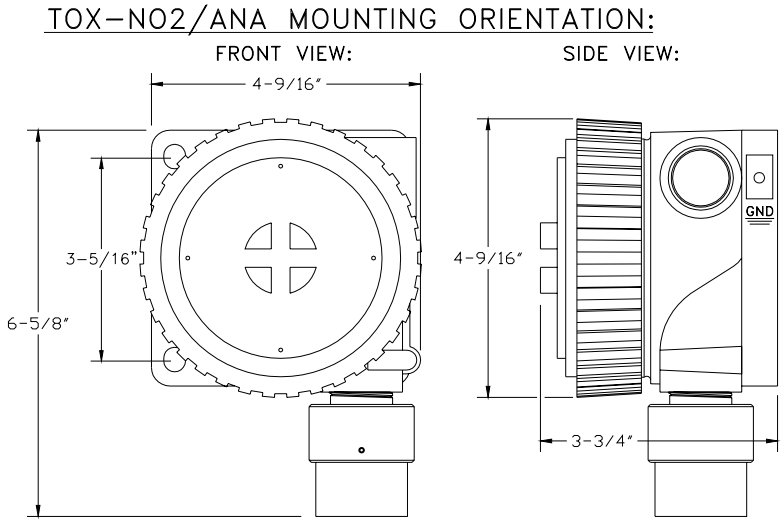

FIGURE 1.1

1.4 Electronics

When installed, the transmitter electronics will be connected to a power supply and control device via three wire cable.

The electronics provide a linear 4-20 ma current or 0 to 5V signal which is proportional to the full scale sensitivity of the sensor. Integral features include:

--Volt meter readout terminals proportional to concentration,
--Visual indicators for fault condition and sensor power,
--4 to 20 ma loop current indicator to indicate when output loop current is flowing.

1.5 Sensor

The gas sensor is an electrochemical cell. The sensor element uses a capillary diffusion barrier. The rate at which atmosphere gases can get to the electrode through diffusion barrier is dependent on the concentration of gases (NO2 in this case) in the ambient atmosphere.

Previous electrochemical sensors use a very thin plastic membrane. This results in handling and stability problems at high temperature and pressure coefficients which limit the usefulness of the device. The Toxalert sensor uses a proven technology, allowing gas to diffuse into the sensor making it extremely robust and stable.

2. CAUTIONS; WARNINGS & RECOMMENDATIONS

2.1 Introduction

Although the sensor module is designed and constructed for installation and operation in industrial applications including "hostile" environments, caution should be taken to insure that the installation is in compliance with this instruction manual and that certain procedures and conditions are avoided.

READ AND UNDERSTAND THIS INSTRUCTION MANUAL BEFORE OPERATING OR SERVICING THIS EQUIPMENT.

2.2 Wiring

Electro magnetic and radio frequency interference to the analog communication between the sensor and the controller can occur. The manufacturer recommends that extra caution be taken where the installation is near any sources of these interferences.

Avoid running sensor cable close to high power cables, radio transmission lines, or cables subject to pulses of high current. Avoid running cables near large electric motors or generators.

If the facility has variable frequency drives (VFD's) to operate fan or pump motors, make sure that these are wired per the manufacturers instructions. Most VFD manufacturers recommend that the power to the VFD and the VFD output be in separate, grounded, metallic conduits. The input and output conduits should have NO other wire running in these conduits because of the high RFI generated by the VFD if other wiring is run in these conduits, it can transmit RFI signals throughout the entire complex possibly causing many problems.

Use shielded cable in any location which may be expected to be electrically noisy or where cable is expected to be in close contact with AC wiring. The shield should be connected to the controller common, one end only.

The wiring should be run in either a cable tray or conduit as required by applicable code and area classification. Control wiring should not be installed in a cable tray or conduit with higher voltage and AC circuits. See Table 2 for recommended wire gauge.

NOTE: Because of the inherent low impedance of 4 to 20 mA circuits, nominally about 250 ohms, the 4 to 20 ma circuits tend to pick up less stray noise (RFI) than do higher impedance voltage input circuits.

Wiring connections at the gas sensor module are as follows:

Table #1

Function	Terminal J2
Power	#1
Signal	#2
Common (GND)	#3

2.21 Power:

Power the sensor with 16 to 35 VDC, nominal of 24 VDC. (20 to 35 VDC for models with relay option) DO NOT POWER WITH HIGHER THAN 35 VDC. Sensor requires less than one and a half watt of power at 24 VDC.

Table #2
Recommended Wire/Cable Gauge

Wire Gauge	Maximum Length
22 AWG	1000 FT.
20 AWG	1500 FT.
18 AWG	2500 FT.
16 AWG	3500 FT.

(w/max drop of 4 volts in run.)

All splices must be via either a lug and terminal system or soldered. Improperly spliced cable can result in corrosion, resistance changes and system errors.

NOTE: Temperature rating of cable wire insulation must be above 75 degrees C (85 degrees C or greater rated wiring is recommended.) If cable runs through higher temperature environments, it should be specified for that environment.

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NOTE: The smaller the wire gauge used for the sensor installation the easier it will be to wire and replace the electronics back in its housing.

2.3 Sensor Modules-General

Avoid installing sensor modules where they will be unnecessarily exposed to wind, dust, water (esp. direct hose down), shock, or vibration. Observe temperature range limitations.

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity, or corrosion, may be gradual if such materials include: High concentrations of solvent vapors, acid vapors, caustic liquids or vapors.

Sensor modules must <u>not</u> be painted. Paint may contain compounds which will contaminate the sensor. Paint will also cause clogging of the metal filter that covers the sensing element and will cause difficulties during attachment of the calibration head. The module should be tagged "DO NOT PAINT".

When sensor element is replaced the thread on the sensor housing **must be teflon taped** to avoid metal to metal binding which will damage the housing threads.

2.4 Preventative Maintenance

DUST AND DIRT CONTROL: When calibration is performed the controller and sensors should be checked visually to determine if dust or dirt build up needs to be removed. This cleaning should be done with dry instruments such as compressed air, cloth wipes or whisk broom.

WIRING OR CABLE CONDITIONS: Any wiring or cables which are not in conduit should be checked once a year for damage to insulation or corrosion of splice or terminal points.

3. INSTALLATION

3.1 Sensor Mounting

Mount the sensor on a wall in the vertical position with the sensor element pointing down See figure 1.1 in this manual.

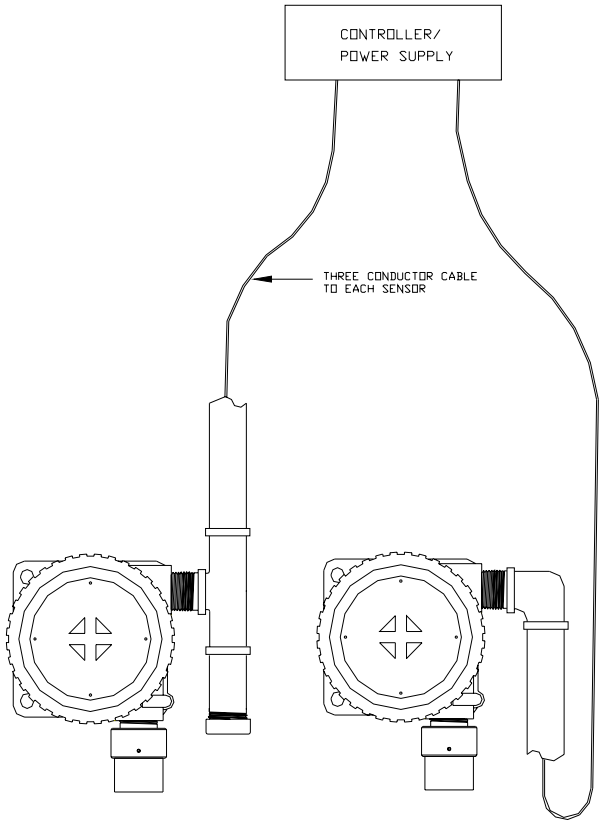

FIGURE 3.1

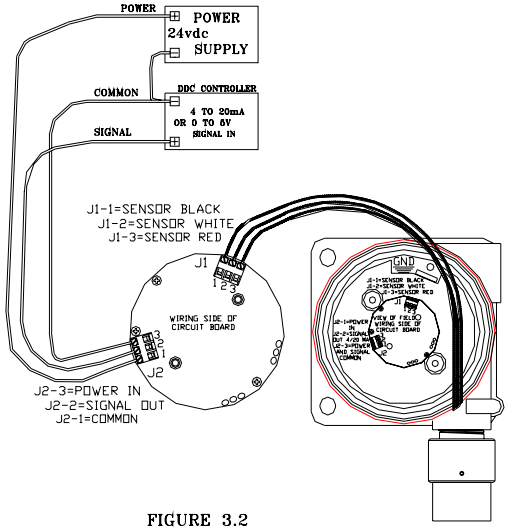

FIGURE 3.2

3.2 Sensor Locations

Select locations for each of the sensors based on the following:

Normally, the unit mounts 5 feet above the floor in a central area where air movement is generally good. This location will sense the concentration of the target gas at approximately breathing height.

Avoid mounting locations that would not be representative of the average gas value in that area. Locations near doorways, fans, ventilation inlets and outlets and areas with a high volume of air flow should be avoided.

Avoid locations that are directly in the outlet air vents of heaters or air conditioners.

Do not allow exhaust from engines to flow directly on the transmitters.

Sensors should be pointed down and the conduit should include an inverse trap to reduce moisture (condensation) from accumulating in the electronics enclosure.(See fig. 3.1)

3.3 Sensor Module Installation

1. Remove the sensor electronics (figure 3.2) from the module enclosure by:

a. Unscrew the two captive panel screws in the top plate.
b. Lift the electronics out of the enclosure.
c. Disconnect the black, white and red sensing element leads from J1 terminal strip and remove the green ground lug.

(Note terminal block identification J1, J2, J3 J4 in the bottom of sensor housing. This label also gives terminal numbers 1,2,3 for each block.) The Tox-N02/1, /2 does not include terminal blocks J3 and J4.

2. Install the module housing onto the end of the supply conduit and bolt into position as required.

NOTE: If enclosure grounding is required for the installation a threaded lug is located outside the housing near the conduit inlet. A screw is provided with a crimp connector attached to it.

3. Connect the three (3) wires which run from the controller to the three position terminal strip, J2, on the bottom of the electronics assembly. See figure 3.2. A label glued in the bottom of the sensor housing also indicates which terminal strip is J1 and J2. The label also indicates terminal numbering and identifies which wire goes where. Also reference figure 3.2 in this manual.

4. Reconnect the sensing element leads to the sensor connector on the top of the electronic assembly terminal strip, J1, and connect the green ground wire to the lug located at the back of the inside enclosure. Figure 3.2.

Twist the assembly 180 degrees to take up the service loop on both the incoming wire and the sensor harness. Carefully fit the electronics over the two posts in the enclosure and tighten the captive panel screws.

3.4 "Loop Up" LED

The loop-up light emitting diode (LED) is in series with the 4 to 20 ma output signal. The LED is intended to indicate communications with its controller. When signal is normal and in communications with the controller, the LED will be lighted green. If LED is out (not lighted) it indicates an open circuit. The loop-up LED will not operate on 0 to 5 VDC models.

4. CALIBRATION

4.1 Frequency of Calibration

The manufacturer recommends that the gas sensor module be calibrated every ninety days.

4.2 Calibration Process

The output signal of the gas sensor is calibrated using a span mixture containing a known concentration of the gas of interest, NO_2. The concentration of the span gas must be within the full scale of the sensor module, 10 ppm NO_2, and either 50% of full scale or approximately equal to the lowest alarm level.

Calibration requires application of the span gas to the sensor and adjustment of the "SPAN" potentiometer to make the signal output equivalent to the concentration of sample gas.

4.3 Equipment Required

- small scredriver
- calibration gas, usually Air Zero and 10 ppm NO_2 balance air
- calibration adapter
- digital volt meter (DVM)

4.4 Calibration Procedure

Use Figure 4.1 to identify the test points and adjustments referenced in this procedure.

Before beginning the calibration procedure the sensor must have been powered for at least 30 minutes.

To begin calibration, remove the cover from the transmitter. Connect the DVM to the plus (+) and minus (-) CAL SIGNAL test jacks on the face plate of the transmitter electronics (see figure 4.1).

Confirm that the sensor is presently exposed to clean air (or apply a source of clean air at a flow rate of 300 mL/min and, if necessary, adjust the ZERO potentiometer so that the meter reading is **0.040 VDC**, +/- 0.001 VDC.

Apply the calibration span gas, usually 10 ppm NO_2 balance air, at a flow rate of 300 mL/min. Allow the gas to flow for 3 to 5 minutes before making any adjustments. If necessary, adjust the SPAN potentiometer so that the CAL SIGNAL voltage is **0.200 VDC**, +/- 0.001 VDC. This sets the transmitters output at 20 mA with 10 ppm NO_2 span gas applied. If a different span gas is used see the correlation table below for the correct CAL SIGNAL voltage to use.

Remove the span gas and verify that the meter reading returns to **0.040 VDC** in clean air within five minutes. If the reading does not return to 0.040 VDC adjust the zero potentiometer until the meter reads **0.040 VDC** +/- 0.001 VDC.

Remove the voltmeter and close the module enclosure.

NO2 Correlation
PPM / CAL SIG

0	0.040 volts
1	0.056 volts
2	0.072 volts
3	0.088 volts
4	0.104 volts
5	0.120 volts
6	0.136 volts
7	0.152 volts
8	0.168 volts
9	0.184 volts
10	0.200 volts

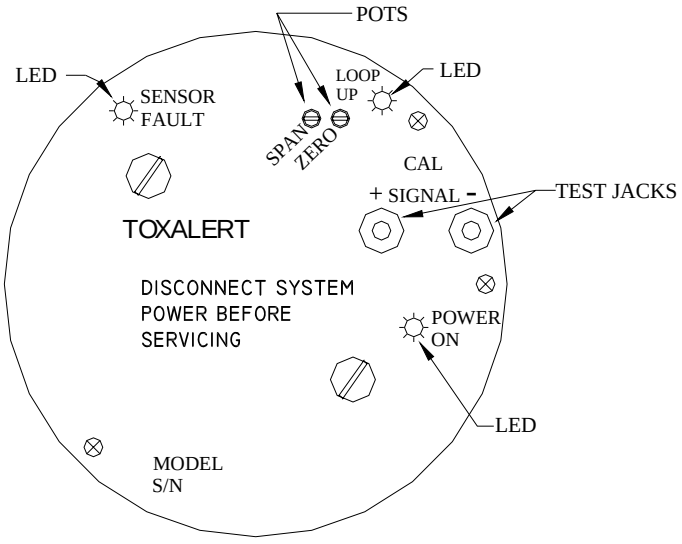

FIGURE 4.1

5. OPERATION

5.1 Signal Value

The Model Tox-NO2/1 is a linear 4 to 20 ma signal over the sensors range. The Model Tox-NO2/2 is a linear 0-5 vdc signal over the sensors range. At 0 ppm NO_2 the sensor will output 4 ma or 0 vdc; at 10 ppm NO_2 the sensor will output 20 ma or 5 vdc. To make field calibration and systems checkout easier we have provide a voltage signal across the (+) and (-) "Cal Signal" terminals on the face of the sensor under the screw on/off cover.

=====NO_2 ppm vs Sensor output Signal=====

Nitrogen Dioxide	CAL Signal	Tox-NO2/1 mA output	Tox-NO2/2 voltage output
0.0 PPM	0.040 V	4.00 mA	0.00 V
0.5 PPM	0.048 V	4.80 mA	0.25 V
1.0 PPM	0.056 V	5.60 mA	0.50 V
1.5 PPM	0.064 V	6.40 mA	0.75 V
2.0 PPM	0.072 V	7.20 mA	1.00 V
2.5 PPM	0.080 V	8.00 mA	1.25 V
3.0 PPM	0.088 V	8.80 mA	1.50 V
3.5 PPM	0.096 V	9.60 mA	1.75 V
4.0 PPM	0.104 V	10.40 mA	2.00 V
4.5 PPM	0.112 V	11.20 mA	2.25 V
5.0 PPM	0.120 V	12.00 mA	2.50 V
5.5 PPM	0.128 V	12.80 mA	2.75 V
6.0 PPM	0.136 V	13.60 mA	3.00 V
6.5 PPM	0.144 V	14.40 mA	3.25 V
7.0 PPM	0.152 V	15.20 mA	3.50 V
7.5 PPM	0.160 V	16.00 mA	3.75 V
8.0 PPM	0.168 V	16.80 mA	4.00 V
8.5 PPM	0.176 V	17.60 mA	4.25 V
9.0 PPM	0.184 V	18.40 mA	4.50 V
9.5 PPM	0.192 V	19.20 mA	4.75 V
10.0 PPM	0.200 V	20.00 mA	5.00 V

6. SERVICE

6.1 General: No maintenance is required except for periodic cleaning and calibration of sensor. See paragraph 4.1 (in this manual).

6.2 Sensor Element Replacement.

The sensing element has an expected life of two (2) years in normal service.

To replace the sensing element, first disconnect the 24 VDC power to the sensor. Then unscrew the sensor cover and remove the electronics. (Reference paragraph 3.3 in this manual). Disconnect the three sensor element lead wires (black, white and red) from terminal block J1. Black wire is connected to terminal 1 of J1, white wire is connected to terminal 2 of J1 and red wire is connected to terminal 3 of J1.

Unscrew the sensor element housing from the transmitter housing.

Screw new sensor housing into transmitter housing using teflon tape on threads. Connect sensor leads to J1. Black lead to terminal 1, white lead to terminal 2 and red lead to terminal 3. Allow element to be mounted--pointing down- for 30 minutes before attempting to calibrate sensor with its new element. After 30 minutes, calibrate sensor using "Calibration Procedure", Paragraph 4.2 in this manual.

7. SPECIFICATIONS

Type: Electrochemical cell
Range: 0 to 10 ppm NO_2
Response time: 30 seconds to 90% of change
Sensing Element Life: 2 years in normal service
Accuracy: $\pm$ 5% of Full Scale
Warranty: 1 year
Electrical Data:
- Input voltage: 24 VDC nominal, 16 to 35 VDC (20 to 35 VDC with relay option)
- Input power: Less than one and a half watt
- Output signal: Linear 4 to 20 mA or 0 to 5 vdc
- Sensor failure signal: 2mA or less
- Loop Resistance: 850 ohms maximum
- Input current: 30mA (46mA with relay option)
- Wiring: 3 wire non-isolated

Operating Temperature: 4 degree F to 122 degree F (-20 degree C to 50 degree C)
Storage Temperature: -4 degree F to 140 degree F (-20 degree C to 60 degree C)
Relative Humidity: 15 to 90% non-condensing

Unit Construction:

Housing: Division 1, Class 1, Group B,C,& D
Physical: 6 5/8" H x 4 1/2' w X 3 3/4" D
Mounting style: Surface
Weight: 2 pounds

8. ACCESSORIES AND SPARE PARTS

1.) Calibration adapter part number NO2/ANA/Caladapter
2.) Cal Kit part number TOXNO2CalKit

O2/ANA Transmitter Outputs	Complete Sensor Part #	Transmitter Electronics Part #	Sensor Element Part #
4 to 20 mA	Tox-NO2/1	Tox-NO2/1-TP	Tox-NO2-SP
0 to 5V	Tox-NO2/2	Tox-NO2/2-TP	Tox-NO2-SP
4 to 20 mA w/ relay	Tox-NO2/4	Tox-NO2/4-TP	Tox-NO2-SP
0 to 5V w/ relay	Tox-NO2/5	Tox-NO2/5-TP	Tox-NO2-SP

9. WARRANTY

Toxalert International, Inc. hereinafter referred to as the "Company", warrants that it will provide, at the Company's option, either free replacement parts or free repair of components in the event any product manufactured by the Company and used in the United States proves defective in material or workmanship within twelve (12) months from invoice date.

To obtain assistance under parts warranty, simply contact the selling agency. To obtain further information or to gain factory help, contact Toxalert International, Inc. Warranty Claims Department, 2361 Wilshire Blvd., Mound, MN. 55364. Telephone (952) 472-4541. All returned parts must have an RMA (return material authorization) number from the factory before being returned.

10. RELAY ADJUSTMENT PROCEDURE

Field procedure for setting relay trip points for models Tox-NO2/4 and Tox-NO2/5.

— FIELD PROCEDURE —
SETTING RELAY TRIP POINTS FOR TOX-NO2/4, /5

There are two (2) relays in the relay control output option. Each of these relays has an associated adjustment that allows setting a trip activation point.

Each relay is of a form "C" type, and all three (3) field wiring connections are provided at the field wiring terminal strips. Contacts are rated 1 Amp @ 24 VDC.

The relays, associated adjustments, associated activated state LED indicators, and adjustment voltage monitoring test points are referred to as K1 or K2 (for relay K1 and relay K2).

The adjustment process and operation and use is the same for each relay, and the relays are independent of each other in operation.

ADJUSTMENT PROCESS FOR MODELS FEATURING 4/20 mA OUTPUT AND RELAY OPTION

The adjustment process will require a voltmeter such as a digital portable meter capable of reading from 0 to 5 volts.

It is not necessary to wire the relay contacts to any loads prior to this adjustment. The LED indicators will show when the relays have been activated, and test points (referred to below) will indicate the relative setting of the trip points for the relays. Likewise, it is not necessary to have the 4/20 mA signal output attached to any load. It is necessary to power the unit, and it is necessary that the unit read standard clean air with 4 mA at the output.

If there is uncertainty about the NO_2 level being read, either connect a milliamp meter to the output terminals J2-2 (4/20mA SIG) and J2-3 (COM), or short these terminals together and connect a voltmeter to the test points on the front panel labeled CAL SIGNAL + and -. The milliamp reading would be 4 milliamps and the panel test point reading would be 0.040 volts for standard clean air – no NO_2 present.

Next use the following equation to determine the adjustment voltage for the relay trip point.

TRIP POINT VOLTAGE = ppm NO_2 desired TIMES 0.1127

If the desired trip point is 3 ppm NO_2 the volage would be:

TRIP POINT VOLTAGE = ppm NO_2 desired TIMES 0.1127
= 3 ppm NO_2 X 0.1127
= 0.3381 volts

The factory default trip points are 3 ppm for K1 and 5 ppm for K2 with a deadband of 0.5 ppm for both.

Next, connect the voltmeter positive lead to test point K1 and the negative lead to KCOM.

Then adjust K1ADJ to the voltage calculated from the equation above. This sets the trip point to the desired ppm NO_2.

This completes adjustment of relay K1 trip point. The process for K2 is identical expect that the meter positive lead should be moved to test point K2, calculate the new value, and adjust K2ADJ to this value.

Model TOX-NO2/4, & /5

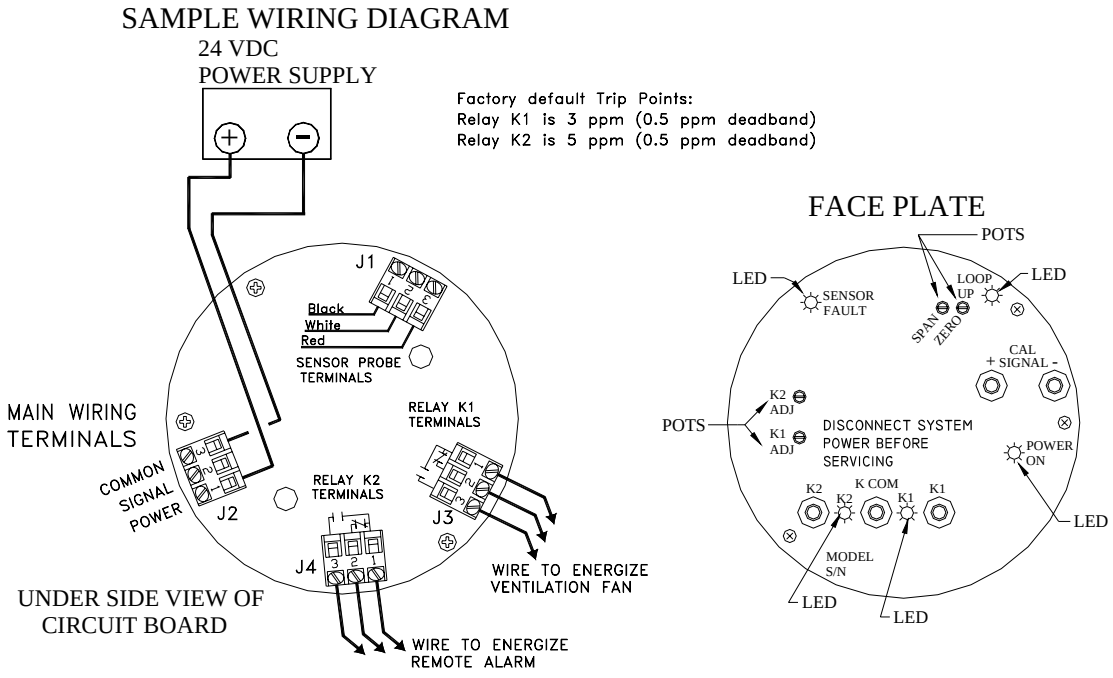

FIGURE 10.1