DESIGN MANUAL

Model GT821
Oxygen NOVA-Sensor

70026

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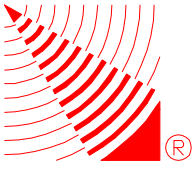

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Quick Finder - Model GT821 NOVA-Sensor

MODEL GT821 Oxygen NOVA-Sensor

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MODEL GT821 Oxygen NOVA-Sensor

QUICK START

Apply Power

Apply +24 volts DC to the labeled terminals (+24V, 24V RET).

Operation

Normal operation begins after a 30 second countdown is displayed.
The display will then show **20.9%,** the normal oxygen content of air. If 20.9% is not displayed, and the sensor is exposed to normal air, the sensor requires initial calibration.

Calibration

Calibration requires just 10 seconds of the sensor being exposed to known, clean air. Press the large MODE button on the outside of the sensor housing for 5 seconds, then release. Sensor flashes *20.9* while sampling the normal gas condition (10 seconds).

The sensor then begins normal operation. Operation can be confirmed by the operator lightly exhaling a small breath in the vicinity of the sensor. The %Oxygen will decrease and then return to 20.9%.

! Warning: Exhaling into sensor may cause Oxygen% to drop below alarm level. Do not test when NOVA-Sensor outputs may cause alarm or trigger other systems.

Alarm Points

Setting for Enrichment / Deficiency

Remove housing cover to access buttons labeled “UP” and “DOWN”.
Press the large externally mounted MODE button for 1 second.
The LOW alarm LED will light as the setpoint is displayed. Use the UP/DOWN button to alter the value. After 5 seconds, the HIGH alarm LED and setpoint are displayed, after 5 seconds of button inactivity, the sensor will return to normal operation.

Oxygen enrichment or deficiency may be sensed by setting the alarm trip points above or below 20.9%.

Confirming

To confirm or inspect the alarm setpoints without declassifying the area, simply press the large external MODE button for 1 second, then release. Each alarm setting will be displayed for 5 seconds.

DIP Switch: Latch / No Latch Alarms

DIP switch 4 (of the 4 position DIP) in the UP (Open) position selects LATCHING mode for the LOW alarm. Placing the switch DOWN (Closed) configures the alarms as NON-LATCHING. Power must be cycled to “read” the new DIP setting.

! DIP switch position 1 is not used. DIP switches 2 and 3 are factory set to UP position and must remain in this position for proper operation of the GT821.

DESCRIPTION

The SST Model GT821 Oxygen NOVA-Sensor is a completely self-contained device that measures and displays the concentration of gas accumulated in a protected area, performs local control functions, and optionally transmits this information to a central control point.

The SST sensors use the electrochemical fuel cell method of gas detection. Located inside a stainless steel housing, the sensing element is exposed to the detected gas through a diffusion barrier and gas permeable membrane. A reaction takes place at the working electrode (anode), releasing electrons which flow to the counter electrode (cathode), where a counter reaction occurs. These reactions may or may not consume the electrolyte; the SST cell is typical of cells which do not consume electrolyte.

This flow of electrons is measured as a concentration value by the SST NOVA-Sensor electronics.

Each SST NOVA-Sensor includes a high reliability microprocessor based transmitter/controller in the associated explosion proof junction box. A digital read-out is provided to continuously display operating status and the actual concentration of gas present in % volume. The transmitter converts this reading and generates a standard 4-20 mA signal. This signal may be connected to a suitable SST NOVA-5000 Gas Detection Module, or to any other device with a standard 4-20 mA input. Connections between the transmitter and control device are normally made with 3 conductor cable [+24 VDC, 24 V return, 4-20 mA signal]. Relays are provided for Low Gas Alarm (A1), High Gas Alarm (A2), and Fault. The low and high relays operate at user adjustable alarm trip points; the fault relay operates upon loss of power or internal failure of the unit. Relays are suitable for controlling local HVAC or equipment shutdown. An optional RS-485 interface is also available.

The Model GT821 is suitable for the most demanding applications. A large body mass insures excellent vibrational characteristics when used offshore. Corrosion resistant materials permit uses in extreme environments.

TECHNICAL SPECIFICATIONS

Power Supply	24 volts DC nominal, 110 mA standby, 125 mA when in alarm. Will operate within specifications at any supply voltage between 16 and 32 volts.
Response time	Maximum time required for measured concentration to reach 90% of the final concentration: 5 seconds.
Operating Temperature	-4 to +131^{o} F. -20 to +55^{o} C Sensors may be operated intermittently up to 150^{o} F.
Output Sensitivity	4 to 20mA output corresponds to 0% to 25% Oxygen Automatically adjusted during calibration
Accuracy	Linear response between 0 and 25%.
Display Resolution	0.1%
Relay Output Configuration	Three relays: Malfunction, High & Low Alarms each configurable as normally open or closed Alarms selectable: Latching / Non-Latching
Relay Contact Ratings	6 amps @ 28 VDC resistive 6 amps @ 300 VAC resistive 1/8 HP @ 120/240 VAC
Analog Output	Sensor will source 0 to 20 mA DC into a load of 600 ohms or less.
Optional Digital Output	Designed per RS-485 to permit bi-directional communication between detectors and data acquisition system over shielded twisted pairs.
Approval Code	E Ex d IIb IP66, Class I, Div 1, Groups A,B,C,D standards BS5501 Pt 1& 7
Approval Agency	BASEFA, CSA, UL, FM

INSTALLATION

Mounting the enclosure

The SST NOVA-Sensor consists of an explosion proof enclosure, a clear window to observe the operational status of the digital displays and LED's and an integral **MODE** push-button for use during the one-person calibration. The dimensional characteristics are shown in the figure below. It is preferable to attach the sensor to a wall or bracket,

using bolts through the two mounting holes. However, these mountings may be omitted if the electrical conduit is sufficiently rigid to support the weight of the detector.

The location of the sensor is important. Do not locate the sensors closer than 1 foot to a floor to prevent damage from water, dust, etc. Preferred orientation of the sensor is with the screen pointing down, as shown in the figure. If necessary, it may be installed at an angle or horizontally. The sensor must *never be installed pointing upwards.*

If the sensing point is not conveniently accessible to personnel, the sensor head may be removed from the junction box and mounted to an accessory junction box, SST part number 850-2. The two junction boxes are then connected together with conduit. Three wires are required between the sensor head and the NOVA-Sensor electronics as described in the following paragraph.

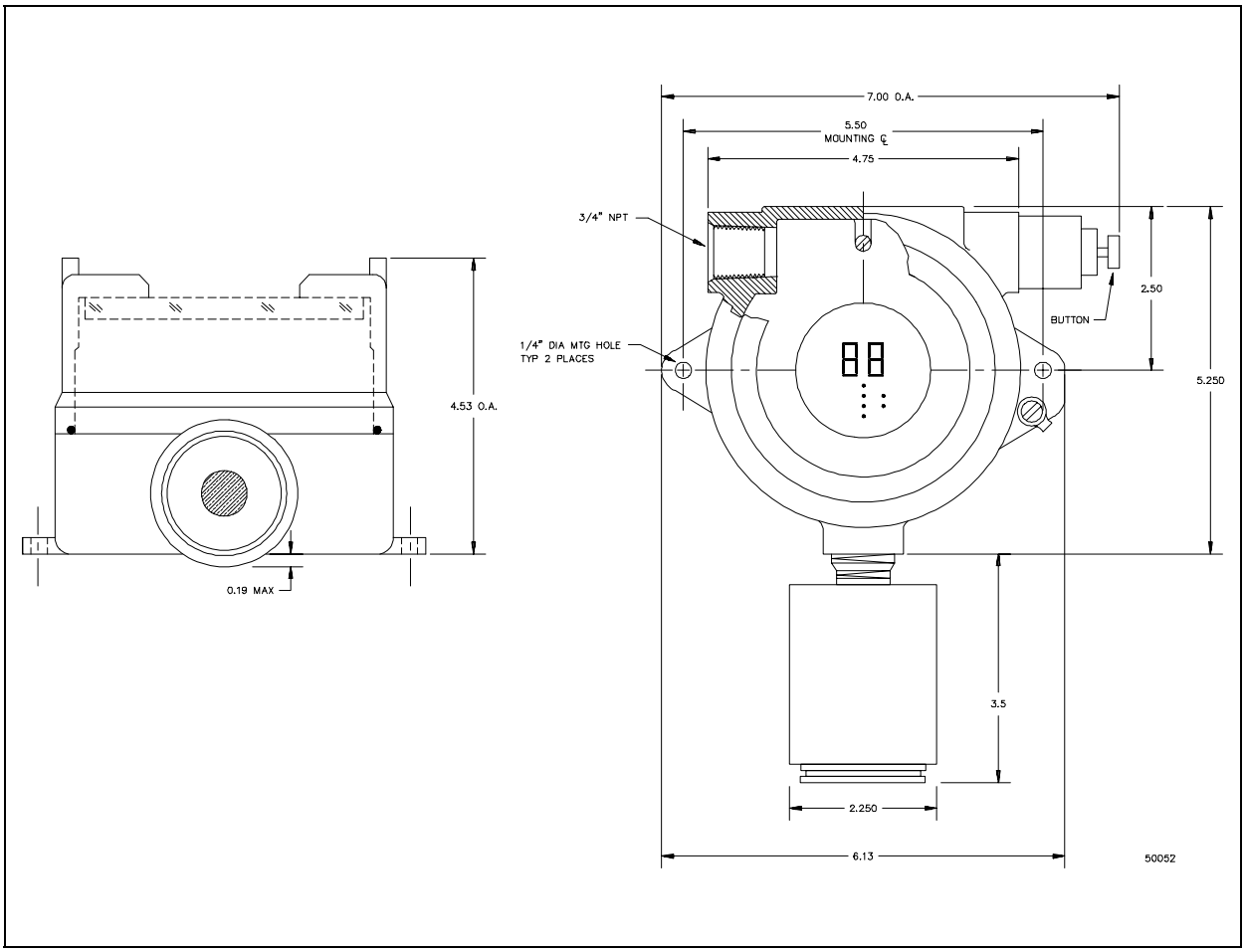

Figure 821-1 Mounting Dimensions

Wiring

Sensor Input

The sensor head is pre-wired to the NOVA-Sensor electronics by SST at the factory. In cases where the sensor is removed from the NOVA-Sensor housing and mounted remotely, you must provide wiring between the electronics and the housing. See figure 821-4. The color code of the sensor wires connected to the terminal block varies, depending on the type of sensor. Carefully note the color of wire connected to the terminals S, 01 and NS (if used). Install the remote sensor, and be sure that the colored wires connect to the proper terminals. These wires should be at least #16 AWG or 1.0 mm^2 and must be shielded or installed in shielded conduit.

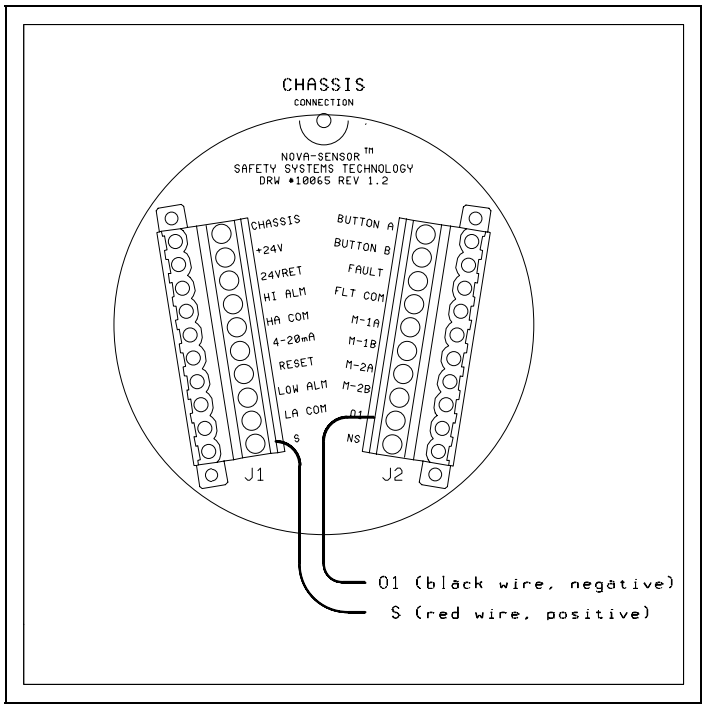

Figure 821-2 Sensor head color codes

Power input and Analog Signal Output

A typical installation is shown in figure. 821-3. This setup uses three wires between the NOVA-Sensor and the associated control modules. These wires carry the 24 VDC

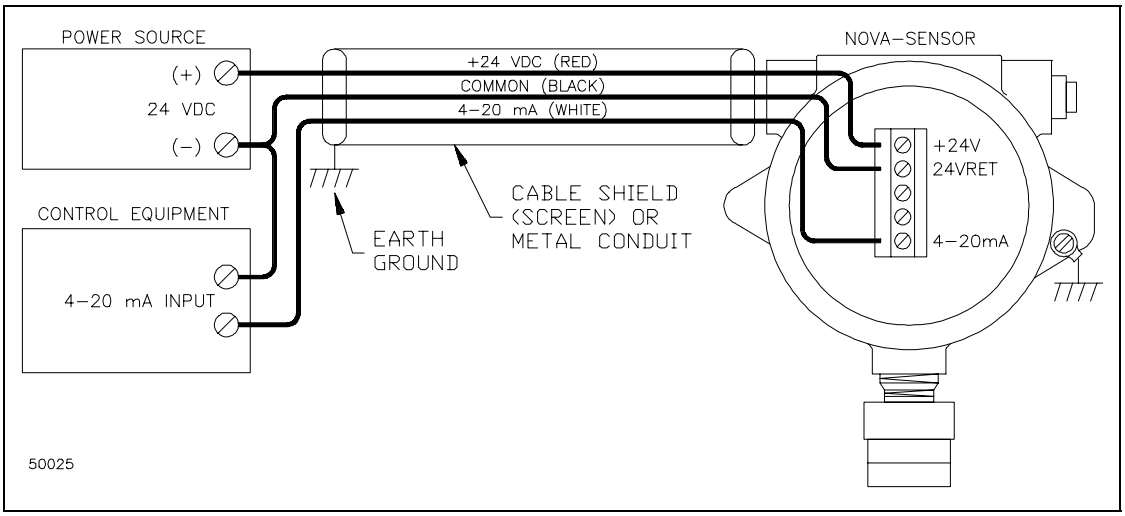

Figure 821-3 Sensor Output Wiring

operating power for the sensor, and transmit the 20 mA signal to the controls. The wires should be shielded or installed in metal conduit to prevent undesirable noise pickup. To wire the NOVA-Sensor, carefully remove the electronics module from the housing by pulling upward. Connect the three wires to the screw terminals in the housing. The terminals are marked as follows:

+24 V	+24 volts DC power input
24V RET	Common return for DC power and 4-20 mA signal
4-20 mA	Analog signal source to control equipment

Mode & Reset Pushbuttons

The integral, external MODE push-button on the NOVA-Sensor housing can be used to clear any relays or alarms in the NOVA-Sensor which have been latched when activated. Pressing the button for less than 3 seconds (.5 second minimum) will cause the latched relays to clear and the Alarm trip points to be momentarily displayed. An optional external, remotely located, push-button can be wired to the terminal marked RESET. This should be a normally open contact, and should connect the reset terminal to 24VRET to reset the sensor. The remote RESET button, when active for between .5 and 3 seconds will clear any latched relays.

Electronics Module

The electronics module consists of 4 circuit boards and a faceplate provided as a single replaceable unit. The DIP switch is visible from the side of the module, the suitcase jumpers can be found at the lower board edge. The electronics module contains no user serviceable parts.

Relay Contacts

If the internal alarm and fault relay contacts are being used, additional wiring is required. The terminals for these are marked as follows:

HIGH (A2) ALM	High Alarm (A2) relay contact
HA COM	Common contact for above
LOW (A1) ALM	Low Alarm (A1) relay contact
LA COM	Common contact for above
FAULT	Fault relay contact
FLT COM	Common contact for above

Suitcase jumpers on the lower most circuit board allow relay configuration as normally open or closed. Factory settings are:

Alarms:	Normally Open (N.O.)
Fault:	Open on Fault (O.F.)

! Two suitcase jumpers are factory installed at the positions marked “TOX”. Do not remove these jumpers nor move them to the “C” position.

DIP Switch Settings

The Dip switch(s) is visible from the side of the electronics module. Units configured with the RS-485 option will have two DIP switch banks, a four position and a five position switch. Separate instructions are provided to users of the RS-485 concerning the appropriate settings of the five position switch. When selecting a new DIP setting, power must be cycled to “read” the new DIP configuration.

The four position DIP configures the operation of the unit as follows.
DIP switch 4 configures the LOW and HIGH alarms as latching or non-latching. In the UP (Open) position selects LATCHING mode for the alarms. Placing the switch DOWN (Closed) configures the alarms as NON-LATCHING.
When latched, the relay will not return to normal until the Nova-Sensor is manually reset using the Mode button or remote Reset Button inputs.

DIP switch 1 is not assigned in models not equipped with the RS-485 option.

Remaining DIP switches are set at the factory - **DO NOT adjust these switches!**
The factory default settings for these DIP switches are:

Switch No.	**1**	**2**	**3**
Setting	DOWN	UP	UP

Digital Output

Connections to the optional RS-485 digital output are made to the four terminals marked M-1A through M-2B.

Operation

Power-Up

When power is first applied, the microprocessor executes a built in test (BIT), during which various internal components are checked. During the BIT, the indicator lights will be flashing. Upon successful completion of the BIT, the NOVA-Sensor begins a 30 second countdown period to allow time for proper temperature stabilization. The

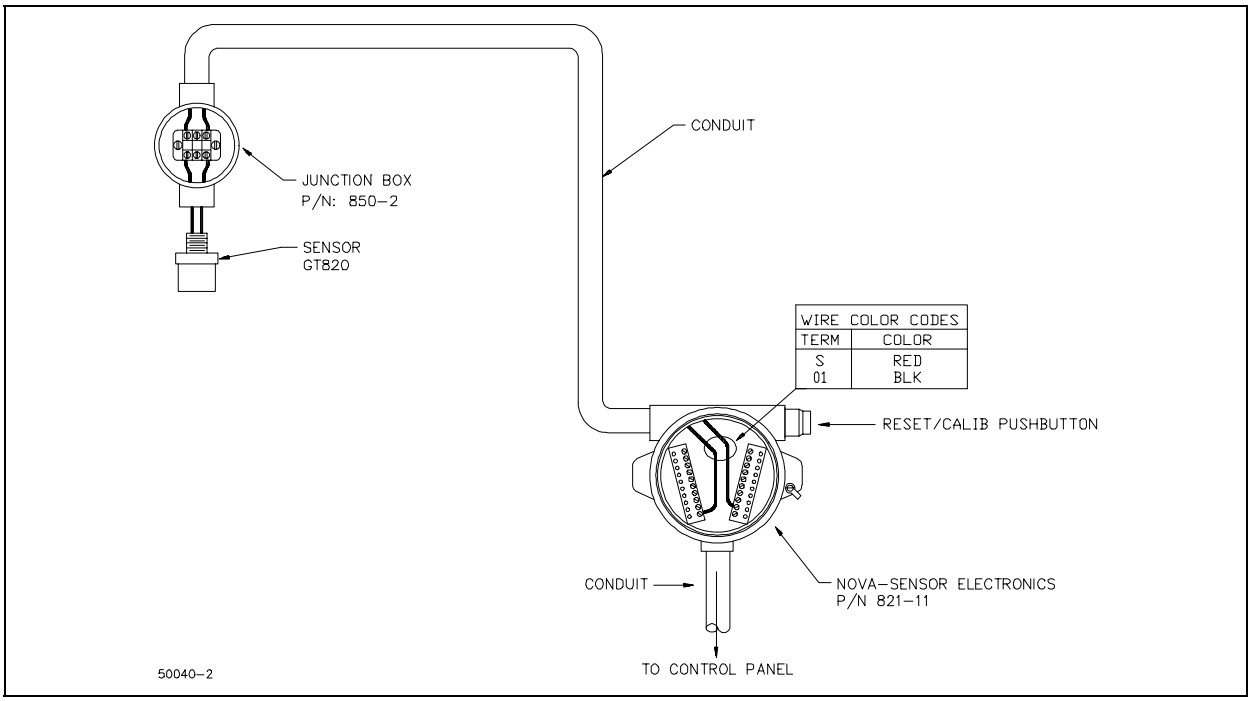

Figure 821-4 Installation with a remote sensor

countdown is displayed on the digital read-out. At the end of the countdown, the NOVA-Sensor begins normal **Protective Mode** operation. In protective mode, the digital read-out displays the current Oxygen concentration. The NOVA-Sensor is now operating at the factory default calibration and alarm setpoints. After calibration, the most recent field calibration and alarm set point information will be stored in the NOVA-Sensor's non-volatile memory. This insures optimum performance even after power supply to the sensor has been temporarily interrupted.

Non-Volatile Memory

Calibration data, and alarm trip points are maintained in non-volatile memory to insure proper operation should the +24 VDC supply be temporarily interrupted. No special care is required to maintain this memory.

Changing the Alarm Setpoints

Setpoints for high alarm and low alarm are available for user modification. Factory defaults for the Low and High alarms are 19.5% and 22%, respectively.

Note that setting setpoints above 20.9% will result in alarms being generated when the Oxygen level is above the setpoint, while setting setpoints below 20.9% will cause alarms being generated when the Oxygen level is below the setpoint.

The topmost board of the electronics module provides two clearly labeled setpoint buttons (UP and DOWN). To adjust the High or Low setpoints, press either button, using a small screwdriver or ballpoint pen. At this point, the low alarm LED will turn on, and the Low alarm setpoint will be displayed. The user has 5 seconds to begin to adjust the Low Alarm setpoint by pressing the UP or DOWN button. Once the microprocessor has detected 5 seconds of inactivity (no button press), the unit will light the High Alarm LED and display the previously stored setpoint value. The operator will again have 5 seconds to begin adjusting the high alarm setpoint. After an additional 5 seconds of inactivity, the NOVA-Sensor will store the new values in non-volatile memory and return to normal operation.

Calibration

The automatic calibration must not be started when any background gas is present at the sensor. In locations where free "clean" air cannot be assured, you may need to purge the sensor with clean air before beginning calibration. **DO NOT USE** nitrogen to purge the sensor, false calibration readings may result.

The one-person automatic calibration sequence is initiated by depressing the push-button MODE switch located on the side of the enclosure and holding it in for 6 to 10 seconds, then release. During the calibration, the NOVA-Sensor automatically executes the following sequence:

1. The NOVA-Sensor acknowledges that the mode button has been pressed by displaying a steady 3 decimal points on the digital read-out.

2. The read-out will then flash 20.9 for approximately 10 seconds. During this time, the sensor is setting a "normal", based on the condition present (clean air) at the sensor.

3. The sensor returns to normal operation.

The microprocessor stores the results of the calibration in its permanent (non-volatile) memory for use in subsequent measurements. There are no screwdriver or other manual adjustments required.

During the calibration process, the 4-20 mA is set to 2mA and the relay outputs from the sensor are normally suppressed. The sensor automatically returns to normal operation when the calibration is complete.

System Outputs

The characteristics of the various NOVA-Sensor outputs are explained in more detail in the following sections.

0 to 20 mA Current Loop

The current loop output is normally between 4 mA and 20 mA, and is a direct linear read-out of gas concentration. The output is 4 mA when 0% Oxygen is being detected and 20 mA with 25% Oxygen. Thus, the output loop will generate 17.37 mA at normal Oxygen levels of 20.9%. During normal operation, the loop current can be determined with the following formula:

$$I\ (mA) = 4 + 0.64 \times \%Oxygen$$

Should a malfunction occur in the sensor head, the output will be 4 mA (equivalent to 0% Oxygen). Faults of the electronics module or malfunction of the current loop wiring will result in 0 mA loop current (-6.25% Oxygen). During calibration, the output will be 2.0 mA.

Relay Outputs

The NOVA-Sensor includes three (3) relays for connection to external devices. The Low Alarm and High Alarm relays are operated when the concentration of gas measured reaches or surpasses the respective trip points. The fault relay transfers on detection of a fault in the NOVA-Sensor.

Each Relay can provide either a normally open or normally closed dry contact output. The **Low Alarm** and **High Alarm** relay can be set as either **latching** or **non-latching** - see section “Installation, DIP Switch Settings”. The **Fault Relay** is always **non-latching** (self clearing).

Setting for Normally Open or Normally Closed operation

Three small suitcase jumper plugs located on the lower board of the electronics module determine the sense of the relay contacts. The mating header pins are labeled LO ALM, HI ALM, and FAULT.

When the jumper plug on LO ALM or HI ALM is across the two contacts on the NO side of the header, the respective relay contacts are NORMALLY OPEN. The relay contacts close on alarm.

When the jumper plug on LO ALM or HI ALM is across the two contacts on the NC side of the header, the respective relay contacts are NORMALLY CLOSED. The relay contacts open on alarm.

When the jumper plug on FAULT is across the two contacts on the **OF** side of the header, the relay contacts will **O**PEN ON **F**AULT. The relay contacts will be closed during normal operation.

When the jumper plug on FAULT is across the two contacts on the **CF** side of the header, the relay contacts will **C**LOSE ON **F**AULT. The relay contacts will be open during normal operation.

Relay Protection Circuitry

Heavy duty relay contacts are provided in the NOVA-Sensor. These contacts are rated for resistive loads. If used for switching inductive loads, such as relay coils, lamps, beacons, etc., you must provide suitable suppression at the load. This will prevent burning the relay contacts, and also suppress harmful transients which can affect the operation of electronic equipment. The figures below show the recommended protection for DC and AC loads.

RS-485

The **RS-485** option allows reduced installation costs and increased communications and control between the NOVA-Sensor and the SST NOVA-5000 Detection and Control System. High speed digital communication and control is provided using the Safety Systems M-LAN bus protocol. The **RS-485** communications interface also provides increased diagnostics and control functions. Reduced installation costs are realized by simplified wiring. All NOVA-Sensors detectors communicate with the central controller via two sets (buses) of twisted pair bus wires. Bus redundancy further increases reliability.

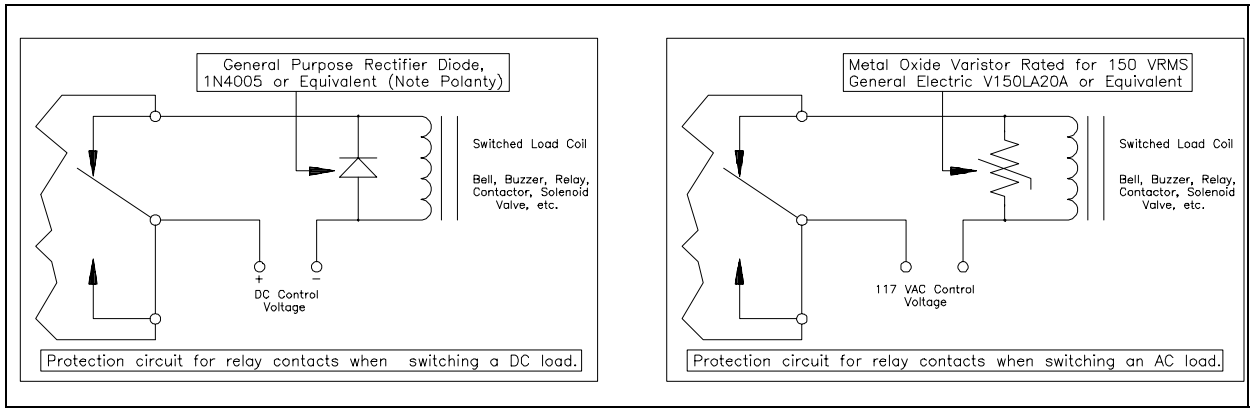

Figure 821-5 Relay Contact Protection Scheme

FINAL OPERATIONAL CHECK-OUT (CompTest™)

Once the NOVA-Sensor has entered normal operation, a final comprehensive output test (CompTest) of all detector inputs and outputs is available. The CompTest is a way to verify that the NOVA-Sensor relay outputs and 4-20 mA current loop are correctly operating. It can also be used to determine if the peripheral equipment is properly connected to the NOVA-Sensor.

The **CompTest** ramps the 4-20 mA current loop through each of its assigned values while changing the relay outputs as well. Each output state for the 4-20 mA loop and each of the three relays is held for about 2 seconds and repeated 3 times. The test lasts for approximately 1 minute. At the completion of the test, the built-in test (BIT) is executed and the unit is returned to normal **PROTECTIVE MODE** operation.

What keeps the CompTest from occurring during operation or by mistake?

Because the **CompTest** exercises all outputs, including **LOW ALARM** and **HIGH ALARM** states, there are several built-in safe guards against its inadvertent use. The button located on the side of the NOVA-Sensor (the Mode button) **will not** initiate a CompTest. The remote reset input on the NOVA-Sensor is used to initiate the test, based on a coded sequence of ON's and OFF's. Upon receiving the proper coded input (the CompTest Safety Code), the NOVA-Sensor begins the test. The NOVA-Sensor will only start the Output Tests if the proper Safety Code is entered. For additional security against inadvertent use, the Safety Code can only be entered **during the first 6 minutes** after the NOVA-Sensor has been returned to normal operation. Requiring a special **Safety Code** to be entered within 6 minutes of applying power, limits the **CompTest** to authorized personnel during system commissioning and periodic inspections.

How to Start the CompTest

WARNING:
Do not execute the CompTest until verifying that all systems connected to the NOVA-Sensor are properly configured to execute a test. Failure to do so may result in an unnecessary release of fire extinguishant or unnecessary dispatching of emergency personnel.

The CompTest must be started within 6 minutes of entering Protection Mode. The Safety-Code™ is entered into the NOVA-Sensor by using the remote RESET button, not the MODE switch which is on the NOVA-Sensor housing.

You begin the test in either of the two ways described below.

To begin the Test if Power has just been applied

To begin the test, wait at least 10 seconds after entering Protection Mode (but not more that 6 minutes). Then enter the **Safety-Code**™ as described below.

To begin the test in an already operational system

It is not necessary to remove and reapply system power to initiate entry to **Protection Mode**. If the NOVA-Sensor is already powered up and in **Protection Mode**, press the Remote **RESET** Button and hold it in (active) for 20 to 30 seconds, then release it. This causes the sensor to begin the normal power up sequence (as if power had been cycled).

Wait for 5 seconds after releasing **RESET**, then enter the **Safety-Code™** as described in the following section.

Entering the Safety-Code™

After following the previous instructions to insure that the NOVA-Sensor is ready to accept the Safety Code, press the Remote **RESET** Button for three (3) **ON** cycles (5 to 10 seconds each, separated by 5 to 10 second pauses). This will cause the sensor to execute the **CompTest**™. The sequence is summarized as follows:

Action	Position:	Hold For Duration of:
1	**ON**	5 Seconds
2	OFF	5 Seconds
3	**ON**	5 Seconds
4	OFF	5 Seconds
5	**ON**	5 Seconds
6	OFF	

Upon accepting the **Safety Code,** the NOVA-Sensor will pause for 10 seconds and begin the CompTest.

If an incorrect code is entered, the NOVA-Sensor will pause 15 seconds and initiate a normal reset sequence prior to returning to normal operation.

CompTest™ Operational Sequence

Upon receipt of the **Safety Code** within the first 6 minutes of entering Protection Mode, the following sequence is executed:

Fault Test

The following outputs are simultaneously toggled three (3) times, and are held in each state for approximately 2 seconds.

4-20 mA Loop	Alternates between 0 and 4 mA
Fault Relay	Toggles Open on Fault and Closed on Fault Outputs
LOW Alarm Relay	Inactive
HIGH Alarm Relay	Inactive

LOW Alarm Test

The following outputs are simultaneously toggled three (3) times, and are held in each state for approximately 2 seconds.

4-20 mA Loop	Alternates between 4 and 12 mA
Fault Relay	In Fault
LOW Alarm Relay	Toggles between active and inactive
HIGH Alarm Relay	Inactive

HIGH Alarm Test

The following outputs are simultaneously toggled three (3) times, and are held in each state for approximately 2 seconds.

4-20 mA Loop	Alternates between 4 and 20 mA
Fault Relay	In Fault
LOW Alarm Relay	Inactive
HIGH Alarm Relay	Toggles between active and inactive

Upon completion of the CompTest, the built-in self test (BIT) is executed and the system then returns to normal operation. If desired, the CompTest™ can be repeated by again entering the CompTest™ Security Code.

Maintenance

Calibration Schedule

Under normal operating conditions, SST gas detectors should be recalibrated every 90 days. However, the change in calibration over time is a function of how much "background" gas is present during normal operation, and how often the sensor is exposed to higher concentrations. Since the GT821 is calibrated without calibration gas, a deteriorating sensor head is not caught immediately during calibration. Thus, the function of the sensor head has to be verified after calibration, e.g. by applying a gas with a known Oxygen content.

Sensor Replacement

After extended use (1 to 2 years), the sensing element may age to the point where it will no longer be able to calibrate properly. This will be indicated by a FAULT after performing a calibration. At this time, it is only necessary to replace the sensor element, then recalibrate. Replacement sensors are available from Safety Systems Technology and include replacement instructions.

Spare Parts

Electronics Module . . . . . P/N 40821-02

Plug-in Fuel Cell for Oxygen Sensor Head . . . .P/N 20144-4
Type 1, for sensors shipped in 1996 or earlier. Sensor housing has white plastic screen in front of sensor.

Plug-in Fuel Cell for Oxygen Sensor Head . . . .P/N 10097-6
Type 2, for sensors shipped from 1997 to September 2000.
1.62 inch diameter cell for housing with porous metal filter in front of sensor.

Plug-in Fuel Cell for Oxygen Sensor Head . . . . P/N 20348-4
Type 3, for sensors shipped October 2000 or later.
1.25 inch diameter purple cell for housing with porous metal filter in front of sensor.

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