Biosystems
NXP
Fixed Gas Detector Head

Reference Manual

Sperian Instrumentation

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Version 1.01
10SEP2009
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⚠WARNING

THE BIOSYSTEMS NXP FIXED GAS DETECTOR HEAD HAS BEEN DESIGNED FOR THE DETECTION AND MEASUREMENT OF POTENTIALLY HAZARDOUS ATMOSPHERIC CONDITIONS.

IN ORDER TO ASSURE THAT THE USER IS PROPERLY WARNED OF POTENTIALLY DANGEROUS ATMOSPHERIC CONDITIONS, IT IS ESSENTIAL THAT THE INSTRUCTIONS IN THIS REFERENCE MANUAL BE READ, FULLY UNDERSTOOD, AND FOLLOWED.

Biosystems NXP
Reference Manual
Sperian Instrumentation Part Number 13-345
Version 1.01

Sperian Protection Instrumentation, LLC
Middletown, Connecticut 06457

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Signal Words

The following signal words, as defined by ANSI Z535.4-1998, are used in the NXP Reference Manual.

⚠DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION indicates a potentially hazardous situation, which if not avoided, may result in moderate or minor injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

⚠DANGER The NXP MUST be installed in a non-hazardous area.

Modification of Sperian Instrumentation Products

⚠WARNING Any unauthorized modification of any Sperian Instrumentation product may compromise the certification and the safety of the product, and may lead to serious personal injury or death. Modification of any part or component of a Sperian Instrumentation product requires the express written approval of both the appropriate certification agency and Sperian Instrumentation.

Operating Temperature and Humidity Limits

⚠WARNING The Biosystems NXP's operating temperature range is printed on the label on the inside of the instrument. The Biosystems XPR's operating temperature range is printed on the housing. Use of Sperian Gas Detection products outside of their specified operating temperature ranges may result in inaccurate and potentially dangerous readings.

Warnings and Cautions

1. **⚠WARNING The Biosystems NXP gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicates the presence of a potentially life-threatening hazard and should be taken very seriously.**
2. **⚠WARNING In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and to return only after further testing determines that the area is once again safe for entry. Failure to immediately leave the area may result in serious injury or death.**
3. **⚠WARNING The accuracy of the NXP should be checked periodically with known concentration calibration gas. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.**
4. **⚠WARNING Fresh air/zero calibrations may only be performed in an atmosphere that is known to contain 20.9% oxygen, 0% LEL and 0 PPM toxic gas. If fresh air is unavailable, a cylinder of "Zero Air" must be used during the fresh air/zero calibration procedure. Calibration of the NXP in a contaminated atmosphere may lead to inaccurate and potentially dangerous readings.**
5. **⚠WARNING The accuracy of the NXP should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.**
6. **⚠WARNING A sensor that cannot be calibrated or is found to be out of tolerance should be replaced immediately. An instrument that fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.**
7. **⚠WARNING Do not reset the calibration gas concentration unless you are using a calibration gas concentration that differs from the one that is normally supplied by Sperian for use in calibrating the NXP. Customers are strongly urged to use only Sperian calibration materials when calibrating the NXP. Use of non-standard calibration gas and/or calibration kit components when calibrating the NXP can lead to inaccurate and potentially dangerous readings and may void the standard Sperian warranty.**

   Sperian offers calibration kits and long-lasting cylinders of test gas specifically developed for easy NXP calibration. Customers are strongly urged to use only Sperian calibration materials when calibrating the NXP.
8. **⚠WARNING For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand this reference manual before operating or servicing the NXP.**
9. **⚠WARNING A rapid up-scale reading followed by a declining or erratic reading may indicate a hazardous combustible gas concentration that exceeds the XPR's zero to 100 percent LEL detection range.**

1. Overview

1.1 Capabilities

The NXP Gas Detector Head is a fixed gas detection system from Sperian Instrumentation. The NXP can function on its own as a stand-alone unit, and can also be used as part of a 4-20 mA current loop system with a PLC or other type of controller.

Standard features include user interface, built-in digital readout to allow for direct calibration at the head, and relays to allow for additional alarms and control.

Each NXP Gas Detector Head includes a sensor housing and gas-specific sensor. Sensor housings are available in non-explosion-proof and remote explosion-proof (XPR) versions. Sensors can be mounted directly to the NXP housing, or can be placed remotely (up to 50 feet away) using a special remote sensor cable.

Note: Conduit, wire and other components necessary to connect the NXP Gas Detector Head to a controller are not included and must be ordered separately.

⚠WARNING Installation of explosion-proof housings must be performed in accordance with local regulations.

1.2 Method of sampling

The atmosphere being measured reaches the sensor in the NXP/XPR by diffusing through a protective filter directly into the sensor. Normal air movements are usually enough to carry the sample to the sensor. The sensor reacts to changes in the concentration of the hazard being measured. Values are constantly updated and displayed on the NXP Gas Detector head's LCD readout. If the head is connected to a controller, the appropriate level 4-20 mA signal is simultaneously sent to the controller.

The NXP Gas Detector head may be installed at a substantial distance from the controller. The maximum distance between the head and the controller is 2000 feet when using the proper cable. Wiring requirements are discussed in detail in section 2.5.

1.3 Sensor options

NXP Gas Detector Heads can be configured to detect a number of different atmospheric hazards. Each NXP uses a single substance-specific sensor that determines the hazard that the system is configured to detect. The sensors that are currently available, along with their ranges and resolutions, are shown in table 1.3.

Note: Changing the sensor range will require calibration of the instrument.

Sensor	Range	Resolution
Oxygen (O_2)	0-25%/Vol. 0-30%/Vol.	0.1% Vol
Combustible (LEL sensor)	0-100% LEL 0-5.0% CH_4	1% LEL 0.05% CH_4
Carbon Monoxide (CO)	0-100 PPM 0-500 PPM 0-1000 PPM	1 PPM
Carbon Monoxide (CO-H)	0-100 PPM 0-500 PPM 0-1000 PPM	1 PPM
Hydrogen Sulfide (H_2S)	0-10 PPM	0.1 PPM
Hydrogen Sulfide (H_2S)	0-50 PPM 0-100 PPM 0-250 PPM	1 PPM
Sulfur Dioxide (SO_2)	0-25 PPM 0-50 PPM	0.1 PPM

Table 1.3 – Sensor Ranges

1.4 Verification of accuracy

NXP Gas Detector Heads have been designed for easy verification of accuracy.

⚠WARNING The accuracy of the NXP should be checked periodically with known concentration calibration gas. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.

Please see Sperian's calibration recommendations in Appendix C.

Verification of detector accuracy is a two-step procedure for toxic and LEL (XPR only) sensor-equipped detectors, and a one-step procedure for oxygen sensor-equipped detectors.

Verification normally begins by exposing the NXP's sensor to known "fresh air" and

checking the readings. If the readings differ from those expected in fresh air (20.9% oxygen, 0 PPM toxic gas, 0% LEL combustible gas), a "fresh air zero" adjustment must be made. For most fixed applications, where the freshness of the ambient air is in question, a cylinder of “Zero Air” must be used during the fresh air/zero calibration.

The second step, which only applies to toxic and LEL sensors, is to verify sensor accuracy by exposing it to known concentration test gas and noting the response. Toxic and LEL readings are considered accurate if the readings are between 90% and 120% of the expected value as given on the gas cylinder. If the reading is accurate, then the instrument requires no further adjustment. Toxic and LEL readings that fall outside of this range are considered inaccurate and indicate that the sensor must be calibrated before further use.

Calibration procedures are discussed in detail in Chapter 4.

1.5 Displays and controls

NXP Gas Detector Heads include a 3-digit LCD located on the face of the detector housing. The heads also include a MODE button that allows the user to initiate and control the calibration of the detector.

Figure 1.5 – Main NXP Components

1.6 Power requirements

Power to the NXP can be provided either from a controller or via a standard wall cube available from Sperian.

The NXP requires a power supply of 13-30 VDC. Power is applied to connector J1 (see Figure 2.5). Once powered up and running, the NXP is intended for continuous monitoring. If it is necessary to power down the NXP, power should be removed from the wall cube or controller that is supplying power to the NXP.

1.7 Alarms and Alarm Logic

⚠WARNING NXP Gas Detector Heads have been designed for the detection of dangerous atmospheric conditions. An alarm condition indicates the presence of a potentially life-threatening hazard and should be taken very seriously.

In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and return only after further testing together with other appropriate safety procedures determine that the area is once again safe for entry.

1.7.1 Atmospheric Hazard Alarms

NXP Fixed Gas Detectors with toxic or combustible gas sensors include two levels of alarms. One alarm serves as the warning alarm; the second alarm serves as the danger alarm. Detectors with oxygen sensors have four alarm levels, as described below.

Toxic and combustible gas sensors have “ascending” alarms, meaning that the alarms are activated when gas readings rise above a pre-set alarm threshold.

Oxygen sensors have both “ascending” and “descending” alarms, meaning that the alarms activate when gas readings rise above a pre-set alarm threshold or fall below a pre-set alarm threshold. There is a warning alarm and a danger alarm in each direction.

Table 1.7 lists the available alarm levels and span gas values for each sensor type. Custom alarm levels and calibration gas values may be set using BioTrak II

software. Please see the BioTrak II operation manual for instructions. The alarm levels apply to both warning and danger alarms, with the following restrictions:

- Alarms can not be set to a value above the full-scale range. If a range is selected that is below current alarm levels, the alarms will be adjusted to default values for that range.
- The warning alarm can not be set beyond the danger alarm setting.

Sensor Type	Available Alarm Levels	Available Span Gas Settings
Oxygen (O_2)	(Process) High: OFF, 1.0, 2.0, 2.5, 5% (Process) Low: OFF (Safety) High: 22.0, 22.5, 23.0, 23.5% (Safety) Low: 20.0, 19.5, 19.0, 18.5, 18.0%	N/A
Combustible (LEL display)	OFF, 5, 10, 15, 20, 25, 50% LEL	25, 30, 40, 50, 60% LEL
Combustible (CH_4 display)	OFF, 0.25, 0.5, 0.75, 1.0, 1.25, 2.5% CH_4	1.25, 1.5, 2.0, 2.5, 3.0% CH_4
Carbon monoxide (CO, CO-H)	OFF, 10, 25, 35, 50, 100, 150, 200 PPM	35, 50, 75, 100, 150, 200 PPM
Hydrogen sulfide (H_2S)	OFF, 2, 5, 10, 15, 20 PPM	10, 20, 25, 30 PPM
Sulfur Dioxide (SO_2)	OFF, 2, 5, 10, 15, 20 PPM	10, 20, 25, 30 PPM

Table 1.7 – Available alarm levels and calibration span gas settings

When an alarm set point is exceeded the LEDs on the front panel and in the strobe housing will flash (Yellow for Warning, Red for Danger), and the audible alarm will sound. Any external devices controlled by means of the NXP's alarm relay contacts will also be activated.

Latching Alarms

NXP alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, the instrument returns to normal operation, and the alarms and relay contacts are turned off.

It is possible to set NXP's alarms so that they "latch". During latched operation, once an alarm condition occurs, the visual and audible alarms and relays will remain active even after the atmospheric hazard has cleared. They must be manually reset using the MODE button. See section 5.6 for information on setting latching alarms.

Alarm Acknowledgement

During an alarm condition, the audible alarm and the strobe LEDs can be acknowledged (temporarily deactivated) by pressing the MODE button. The LEDs on the display board and the alarm relays will remain active. Once acknowledged, the audible alarm and strobe LEDs will be reactivated under the following conditions:

- Gas level remains above the alarm level for 5 minutes
- Gas level decreases below the alarm level, and then rises above it again
- Warning alarm was acknowledged, and the gas level then rises above the Danger alarm level

1.7.2 Sensor Over-range Alarms

If the concentration of the gas being detected goes above the selected sensor range, a sensor over-range occurs.

The instrument will act as if a danger alarm condition exists, even if the alarms have been disabled.

- **Oxygen and Toxic Gas Over-range**

When the gas concentration falls back within the sensor's range, the over-range alarm will be reset, unless latching alarms have been selected.

- **Combustible Gas Over-range**

In the case of an LEL over-range condition (LEL over 100%), power to the LEL sensor will be disconnected to protect the sensor from overheating and premature failure. The instrument will remain in alarm with the sensor powered down until the MODE button is pressed or the instrument's power is cycled.

If the MODE button is pressed during this time, power to the sensor will be turned on briefly. If the gas level is below 100% LEL, the sensor will remain on and the instrument will resume gas detection mode, along with any applicable alarms. If the gas level is still over 100% LEL, the sensor will be shut off again and the instrument will remain in over-range alarm.

1.7.3 Alarm Relays

The NXP incorporates relays that are activated during alarm conditions. There are separate relays for Warning and Danger alarms, as well as a Fault condition relay (see section 1.8).

The Warning and Danger relays are activated any time that the gas level exceeds the current alarm levels. Each relay has a normally-open and a normally-closed contact. Normally-open contacts close (make contact) during an alarm condition, while normally-closed contacts open (break contact).

These contacts can be used to operate external alarms or larger relays that drive other equipment, such as ventilation systems. See Figure 2.5 for relay connection locations.

The relay contacts in the NXP do not supply power to the external accessories. They act as switch contacts only. External alarms, relays and contactors require their own power supplies.

The maximum rating of the NXP's relay contacts is 30 VDC at 5 amps.

⚠WARNING Under no circumstances should AC line voltage be connected directly to the relay contacts.

1.8 Fault Conditions

The NXP is capable of detecting certain internal fault conditions. During one of these conditions the loop current will fall to 2 mA, the Fault relay will be activated, and the red LEDs will flash every 5 seconds to alert the user to the problem. Fault codes are listed below. See Appendix B for explanations of fault codes.

F1 - Sensor Fault

F2 – EEPROM Read Fault

F5 – EEPROM Write Fault

F11 – Power Low Fault

F12 – Power High Fault

Power Failure Fault

The Fault relay is normally energized. This is called Fail-Safe mode. In the case of a total loss of power to the instrument, the Fault relay will trip, and any external devices connected to it will be activated. Loop current will fall to 0 mA.

Note: The Fault relay does not supply power to the device(s) connected to it. It acts as a switch contact only. External power must be supplied to any devices connected to this relay.

⚠WARNING Under no circumstances should AC line voltage be connected directly to the relay contacts.

1.9 Remote Sensors

The NXP normally comes with the sensor housing attached to the instrument. When necessary, the sensor can be installed remotely, up to 50 feet from the instrument.

The standard sensor can be used for non-hazardous (non-explosive) environments.

For use in hazardous locations, the XPR explosion-proof sensor housing must be used. The XPR is built into a heavy-duty stainless steel explosion-proof housing. See section 2.8 for remote sensor installation.

⚠WARNING The XPR remote sensor housing must not be opened in a hazardous location unless power to the NXP has been disconnected. Power must not be restored to the NXP until the XPR housing has been completely closed.

⚠WARNING Installation of explosion-proof housings must be performed in accordance with local regulations.

1.10 4-20 mA Current Loop

The NXP incorporates a connection for an industry-standard 4-20 mA current loop. This circuit generates a current based on the gas level detected. The NXP is normally set to “Source” mode, meaning that it generates a current output. It can also be set to “Sink” mode if needed, meaning that it sinks (inputs) the current from an external source.

A 4 mA signal indicates a reading of zero, and a 20 mA signal indicates a full-scale reading. Full-scale is determined by the Loop Range setting in the Setup menu. See Table 1.3 for available ranges and section 5.4 for instructions on setting the Loop Range. See Figure 2.5 for wiring of the loop signal.

1.11 Event Logger

The event logger in the NXP stores data associated with alarm conditions. Each event (alarm) includes the following data:

- Event Start time
- Event End time
- Duration of the event.
- Minimum reading during event
- Maximum reading during event
- Average reading during event
- Temperature at end of event
- Sensor type
- Flags for ‘In calibration’, warning alarm, danger alarm and temperature alarm during event
- Time event was acknowledged

The NXP stores the data from the 128 most recent alarm events. Once 128 events have been stored, the NXP will begin to overwrite the data from the oldest event in memory with data from new events. One event may be a combination of different alarms occurring simultaneously or in immediate succession.

The event logger may be downloaded using BioTrak II software. The PC must be equipped with an IrDA port to provide a connection.

⚠WARNING While the NXP is communicating through its IrDA connection, it IS NOT sensing the gas level of the atmosphere, and WILL NOT activate any alarms. The area must be made safe or another form of atmospheric monitoring must be used during IrDA communication.

1.12 Firmware Upgrades

As improvements are made and features are added to the NXP’s firmware, new versions of the firmware will be made available to customers. Normally, this firmware can be downloaded and installed by the customer using a computer with IrDA communication capability and the FX2 Flash Upgrade utility software.

Instrument firmware and upgrade utility software can be downloaded from http://www.biodownloads.com in the Download Section.

2. Installation

2.1 Installation overview

Sperian Instrumentation's gas detection systems are fully tested and calibrated before they leave the factory. Following installation, Sperian strongly recommends that full testing and verification of proper operation be carried out before the system is placed in service.

Repair of system components damaged as a result of improper installation can be expensive. NXP Gas Detector Head installation, initial setup, and/or system modification should only be undertaken by individuals who are qualified and authorized to do so. Call Sperian's Instrument Service Department at (860) 344-1079 or 800-711-6776 if you need help or have any questions.

Case and Mounting Dimensions (inches [mm])

Oxygen detector assemblies are available in both standard (non-explosion-proof) and remote explosion-proof (XPR) housings.

Toxic gas sensors are available in standard (non-explosion-proof) housings, and certain toxic sensors are also available in remote explosion-proof (XPR) housings.

Remote detector assemblies for combustible gas are only available in explosion-proof (XPR) housings.

NXP Gas Detector Heads are equipped to provide a 4-20 mA output that is used to communicate with a remotely located controller or PLC system. Each detector head also has a built-in LCD readout for local display of gas type and concentration. When used in this type of configuration, power is supplied to the detector by the controller.

When used as a stand-alone detector, power can be supplied to the detector from a standard wall cube that is included with the detector, or from an external power supply with an output of 13-30

VDC. In this configuration, the NXP must be set to Source mode (see Figure 2.5).

2.2 Cautions

⚠DANGER The NXP MUST be installed in a non-hazardous area. Only the XPR explosion-proof sensor housing, if used, may be installed in a hazardous location.

Disconnect the NXP Gas Detector Head from any external power source and from any battery backup power supply before installing, replacing, or handling system components.

Both the Gas Detector head and any connected controller unit should be calibrated and alarm levels tested at the time of initial installation before the system is first put into service.

2.3 NXP Detector Head Environmental Ratings

The NXP housing has an environmental rating of NEMA 4X and an ingress protection rating of IP66. These ratings apply to the NXP only, and do not extend to the wall cube power supply. If the NXP is to be installed in an area where it could be exposed to pressurized jets of water, wind-blown sand or dust, or other adverse environmental conditions, it is recommended that power be connected through weather-proof cabling or conduit. See section 2.7 for instructions on removing the wall cube and connecting external wiring.

2.4 Siting of detector heads

The specific placement of gas detector heads should be determined by the type of area being monitored, the type and source of the atmospheric hazard being measured, prevailing wind patterns, and other information.

Call Biosystems Technical Service Department at (860) 344-1079 or 800-711-6776 for additional advice.

In general, for gases lighter than air the detector heads should be placed at a level slightly above the area where leaks are likely to occur. For gases that are heavier than air the detectors should be located close to floor level or in inspection pits or ducts in which gases that are heavier than air may collect.

There are many circumstances that may modify this general advice. It is beyond the scope of this manual to attempt to describe all of the potential situations that could cause this advice to be modified, but a single example follows:

The molecular weight of nitrogen (MW ≅ 28) is very close to that of air (MW ≅ 29). When nitrogen is at the same temperature as the air into which it is introduced, it mixes readily, and tends to spread evenly throughout the affected atmosphere. On the other hand, if the nitrogen is under pressure, and then suddenly released into the atmosphere, as the gas expands (going from higher pressure to a lower pressure) it cools. The cooler gas is denser than the air into which it is being introduced, so it no longer mixes as readily. Instead, the nitrogen tends to sink to floor level and spread laterally. In this case remote detectors being used to monitor for oxygen deficiency should be located near floor level in order to detect the deficiency as quickly as possible.

The nearer in density to air a gas is, the more easily it will flow with air due to drafts, ventilation etc. A compromise approach for placement of detectors used to measure gases which are only slighter lighter (such as carbon monoxide) or heavier (such as hydrogen sulfide) than air is to mount the detectors at a height as close as possible to the breathing area of personnel being protected.

When installing detector heads it is important to ensure that the sensor is not exposed to liquid or dust contamination that would interfere with the passage of gas through the protective filter into the sensor. Detector assemblies should be placed so that the sensor points straight downward. A splash deflector should be used when water or other liquids are chronically present in the area where the detector is located.

2.5 Wiring requirements

Recommendations for wire used to connect NXP detector assemblies to a standard controller unit with a 24 VDC power supply are listed in Table 2.5.

Lower power supply voltages may require larger size wire.

Conductor Size (AWG)	Number of Conductors	Maximum length (ft)
22	3	500
20	3	800
18	3	1200
16	3	2000

Table 2.5 NXP system wiring recommendations

"Maximum length" indicates the maximum distance a detector head may be located from the controller when using the indicated gauge of conductor. For all types of detector assemblies, use 3-conductor shielded cable with drain.

Due to the relatively low signal levels carried by wiring between gas detectors and the control unit, it is essential not to run wire near high power electrical equipment. When NXP heads are installed in environments that contain high power electrical equipment it is usually best to install the wire in conduit.

The NXP wiring diagram is given below in figure 2.5.

Remote Sensor Cable

The sensor can be placed remotely up to 50 feet away from the NXP (See section 2.8). Cable for connecting a remote sensor to the NXP must be specified when placing the order.

2.5.1 Grounding

Cable used to connect NXP gas detector heads to a controller should always have a shield and drain lead. In order to reduce electromagnetic interference (EMI), the screen (drain) of the cable should be connected to the ground connection of the detector head. Ground loops must be avoided. Grounding is done through the normal safety earth of the system.

2.6 Output Specifications

When the NXP is used with a controller, the controller should be configured to respond to an industry-standard 4-20 mA current loop signal, with 4 mA indicating a reading of zero (0% LEL, 0% O_2 or 0 PPM toxic gas), and 20 mA indicating a full-scale reading (100% LEL or a full-scale oxygen or toxic gas reading).

The NXP is shipped in Source Mode, meaning it acts as the source of the loop current. It can be switched to Sink Mode if necessary by moving the jumper from J10 to J9 on the communication board, and connecting the signal wire to pin 2 instead of pin 3 on J1 (see Figure 2.5).

When used as a stand-alone instrument, whether powered by a wall cube or external power supply, the NXP must be in Source mode.

2.7 External Wiring

The NXP is shipped with a wall cube attached for ease of installation. In some cases it may be desirable to use external wiring instead, such as when connecting the NXP to a controller or other power supply, or when it is to be mounted in an area where it could be exposed to water, dust, or other harsh environments. To install external wiring, follow the instructions below.

1. Make sure that there is no power applied to the NXP. Unscrew the four screws on the cover. Pull the cover straight out, and then swing it to the left.

2. Grasp the electronics assembly and carefully pull it straight out from the housing, being careful not to pull on the attached wiring.

3. Unplug the 4-pin connector that is plugged into J1 on the rear PCB. Using a small screwdriver, loosen the wire contact screws on the connector and remove the wires.

4. Pull the wall cube wires out through the back of the unit. From inside the housing, screw the supplied #8 self-tapping screw (with washer) into the hole where the wall cube wires were removed.

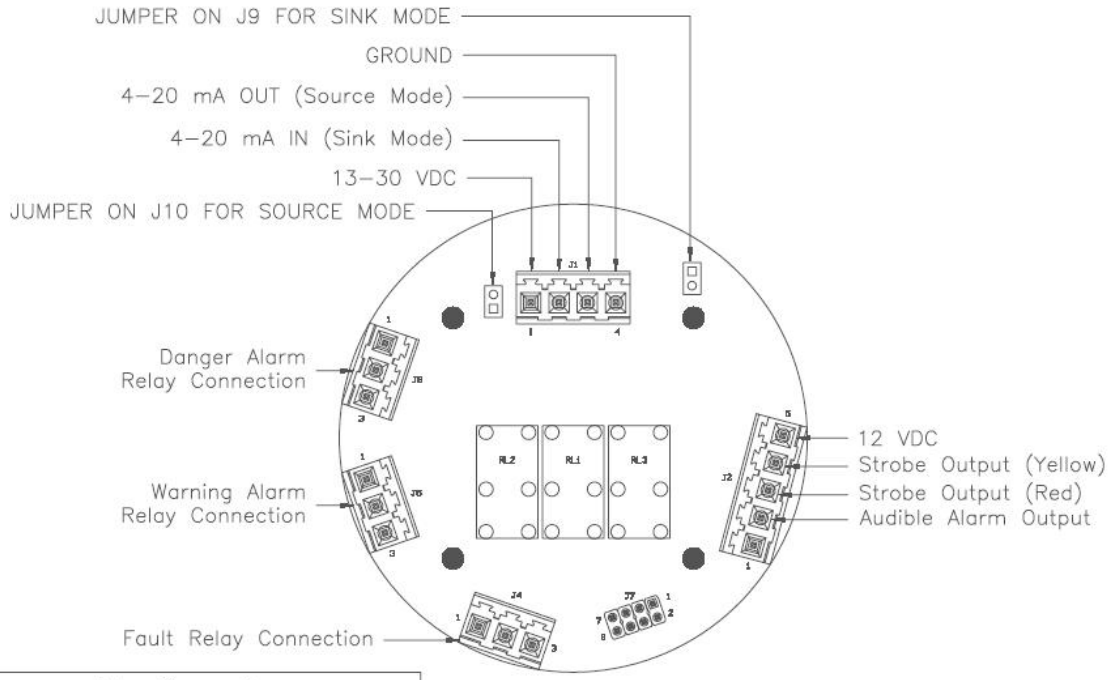
5. Remove one of the plastic plugs from either side of the housing. Depending on the desired wiring, install either a 1/2" NPT cable strain relief or a 1/2" NPT conduit fitting, using Teflon tape on the threads. Tighten firmly but do not overtighten.

6. Route the wiring through the strain relief or fitting and connect the wires to the

connector. Refer to Figure 2.5 for the correct connections.

7. Plug the connector into J1 on the PCB. Reinstall the electronics assembly and push until it is fully seated against the standoffs to which it mounts.

8. Apply power to the NXP and ensure correct operation. Make sure the cover gasket is seated, close the cover and tighten the cover screws securely.



Relay Connections			
	Pin 1	Pin 2	Pin 3
Danger	Normally Closed	Common	Normally Open
Warning	Normally Closed	Common	Normally Open
Fault	Normally Open	Common	Normally Closed

Figure 2.5 NXP detector wiring diagram

2.8 Remote Sensor Installation

The NXP normally comes with the sensor housing attached to the instrument. When necessary, the sensor can be installed remotely, up to 50 feet from the instrument. Follow the procedure below to connect the sensor using a separately supplied remote connector cable. Cables are available in lengths of 5, 10 and 50 feet.

2.8.1 Disconnecting the sensor

⚠CAUTION Be sure that power is removed from the NXP.

Unscrew the four cover screws on the front of the NXP housing, then pull the cover slightly away from the housing and swing it open.

Grip the circular electronics assembly and gently pull the assembly from its mounting points. Disconnect the sensor cable from the PCB connector.

Using a 1-1/8” wrench on the flat surfaces just below the threads, unscrew the entire sensor housing from the instrument housing. There is no need to remove the sensor housing cover.

2.8.2 Connecting the sensor cable

Apply Teflon sealing tape to the threads of the metal thread adapter and install it in the hole where the sensor housing was removed. Tighten snugly, but do not overtighten.

Apply Teflon sealing tape to the threads of the strain relief, which can now be installed into the metal thread adapter or into one of the other ports near the top of the unit. Close off any unused ports (including the thread adapter, if not used) with the plugs provided in order to maintain the environmental integrity of the enclosure.

Insert the female end of the sensor cable into the strain relief outer nut, making sure that the internal rubber grommet is in place. Push several inches of the cable into the instrument housing. Do not tighten the nut yet.

Connect the cable to the PCB connector where the sensor cable was removed. Be sure to observe the correct polarity when connecting the cable. When it is connected, replace the electronics assembly in the housing, pushing firmly so that it seats on its mounting points.

Make sure that there are a few inches of slack in the cable inside the housing, and then tighten the strain relief nut until the cable is grasped firmly.

2.8.3 Mounting the remote sensor

Thread the sensor housing into the sensor connection box supplied with the remote cable kit and tighten securely.

Mount the box in the chosen location with the sensor housing facing downward. Mounting the sensor in any other orientation could allow water or debris to collect on the sensor face, impairing operation.

⚠WARNING For explosion-proof sensors in hazardous locations, conduit is required from the sensor connection box to the safe area. Check local electrical requirements for proper conduit and conduit seals.

2.8.4 Connecting the cable (non-explosion-proof sensor)

Route the cable through any necessary wire trays, conduit, etc., to the location of the remote sensor. If using conduit, remove the strain relief from the connection box and connect the conduit to the box. Otherwise, run the male end of the cable through the strain relief and into the box, using the procedure outlined in section 2.8.2. See figure 2.8 for an exploded view of the assembly.

Connect the cable to the sensor connector, observing the polarity of the connectors. Provide some slack inside the box, and then tighten the strain relief nut until the cable is grasped firmly.

Install the connection box cover, apply power to the instrument and check for proper operation.

2.8.5 Connecting the cable (explosion-proof sensor)

⚠WARNING For explosion-proof sensors in hazardous locations,

explosion-proof conduit is required from the sensor connection box to the safe area. Check local electrical requirements for proper conduit and conduit seals.

Route the cable through the conduit to the location of the remote sensor.

Inside the sensor connection box, connect the cable to the sensor connector, observing the polarity of the connectors.

Close the connection box and tighten the cover securely. Make sure any required conduit seals are in place.

Apply power to the instrument and check for proper operation.

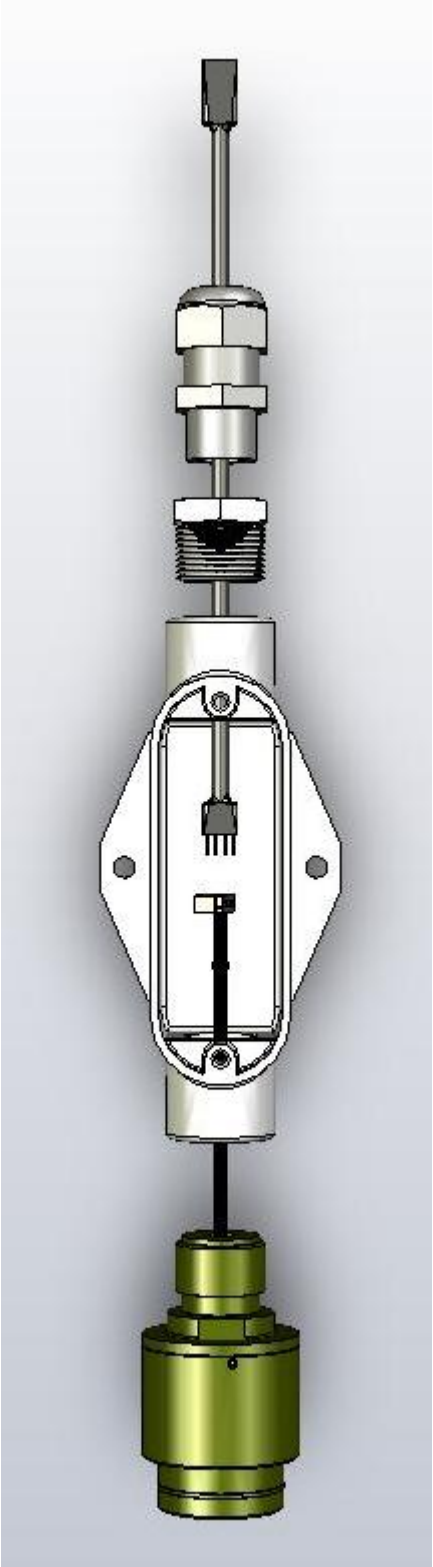


Figure 2.8 Non-explosion-proof remote sensor assembly

3. Field Usage

Once the NXP has been installed and connected to a power source, it will run through a boot-up process, and then be in continuous operation. During the boot-up process, the following information will be shown on the display:

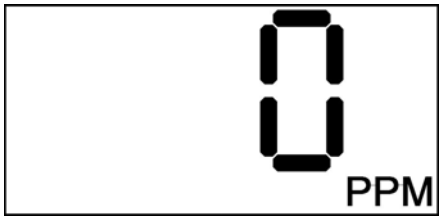
- Power supply voltage
- LCD Test (All Segments On)
- Firmware Version
- "NEP" (Indicates Non-Explosion-Proof Instrument)
- Sensor Type
- Loop Range (See Section 5.4)
- Instrument Serial Number
- Warning and Danger Alarm Levels
- Calibration reminder (if set)
- Bump Test reminder (if set)
- 10-second countdown

Gas readings are shown on the display on the front of the detector. Toxic gas readings are normally displayed in parts-per-million (PPM), oxygen readings are given in terms of percent volume (%Vol), and combustible gas readings are given in either percent LEL (LEL), or percent volume methane (CH_4).

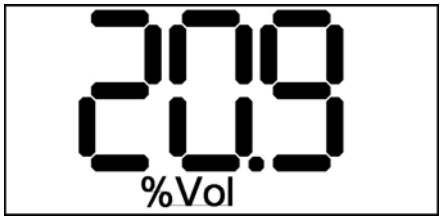
3.1 Modes of operation

Press the MODE button to scroll through the screens. The current gas reading screen is shown during normal operation.

Detector heads equipped with toxic gas sensors will display gas readings in parts-per-million (PPM). Some sensors will resolve readings to tenths of a part per million.

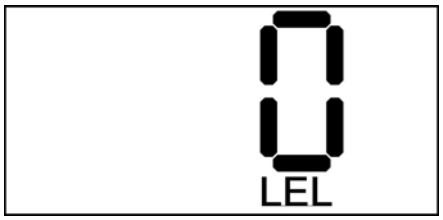


Detector heads equipped with oxygen sensors display readings in percent-by-volume. Fresh air contains 20.9% oxygen by volume.

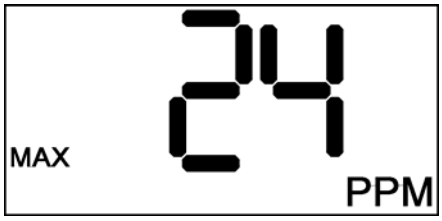


Detector heads equipped with combustible gas sensors can display readings in terms of either percentage of the Lower Explosive Limit (%LEL) or percent methane by volume (%CH4).

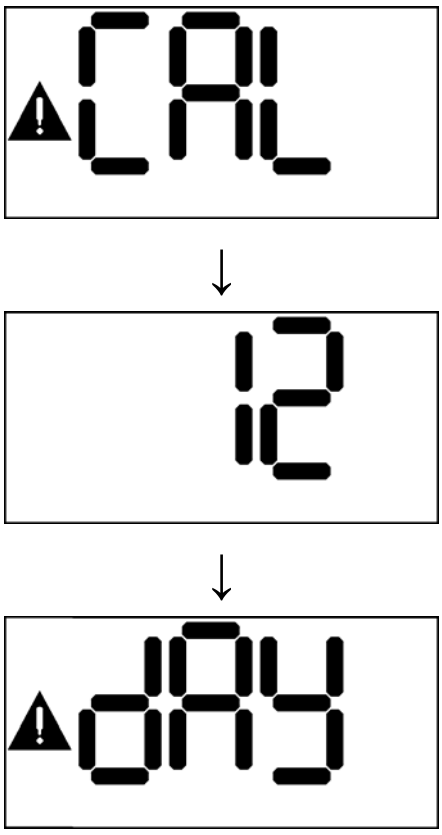
⚠WARNING A reading of 100% LEL or 5% CH4 indicates a potentially explosive environment.



From the current gas readings screen, press the MODE button once to view the MAX reading screen. The MAX readings screen displays the highest reading that has been recorded by the instrument in the past 24 hours.



If the Calibration Interval has been set, pressing the MODE button again within 8 seconds will display the number of days until calibration is due.

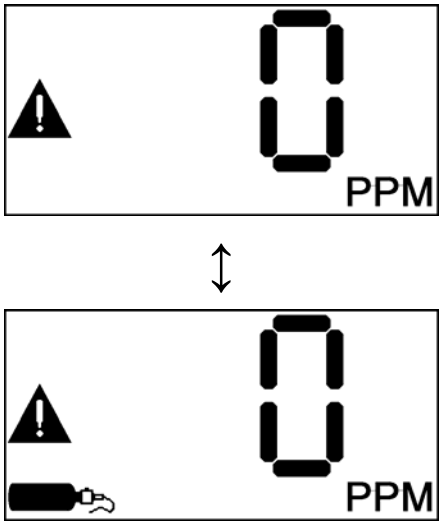


Similarly, if the Bump Interval has been set, pressing the MODE button again within 8 seconds will display the number of days until a bump test is due.

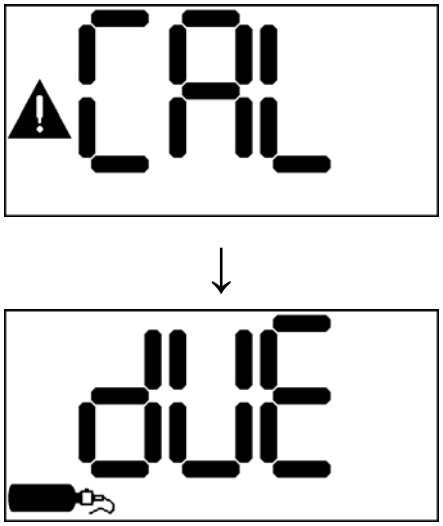
See chapter 4 for instructions on verifying sensor accuracy.

3.1.1 Calibration Due Warnings

When the NXP is due for calibration, the triangular warning symbol is shown in the current gas readings screen and the calibration icon and green LED will blink.

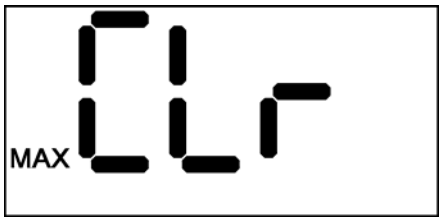


In addition, every 30 seconds the “CAL dUE” reminder will appear on the display and the red LEDs will flash.



3.2 Clearing the MAX reading

If it becomes necessary to clear the MAX reading, press and hold the MODE button for 4 seconds. The “MAX CLr” screen will appear. Release the button within 4 seconds and a countdown will start. Press the MODE button during the countdown to reset the MAX reading to zero.



3.3 Effect of contaminants on NXP sensors

The atmosphere in which the NXP gas detector head is located can have a lasting effect on sensor accuracy. Sensors may be poisoned or suffer degraded performance if exposed to certain substances.

There are three basic types of sensors that may be installed in NXP detector assemblies; galvanic oxygen, catalytic hot-bead combustible gas (LEL), and electrochemical toxic. Each type of sensor uses a slightly different detection principle, so the conditions that affect the accuracy of the sensors vary from one type of sensor to the next.

⚠WARNING The accuracy of the NXP should be checked immediately following any known exposure to contaminants by testing sensor response with known concentration test gas before further use. Failure to check accuracy after a known sensor exposure can lead to inaccurate and potentially dangerous readings.

3.3.1 Effects of contaminants on oxygen sensors

Oxygen sensors may be affected by prolonged exposure to "acid" gases such as carbon dioxide. The oxygen sensors used in Sperian instruments are not recommended for use in atmospheres which continuously contain more than 25% CO_2.

3.3.2 Effects of contaminants on combustible sensors

Combustible sensors may be affected by exposure to substances containing silicone. For a complete list of known LEL sensor contaminants, see the sensor section of the Sperian Standard Warranty in Appendix D.

Note: If sensitivity of the combustible sensor is lost due to poisoning, it tends to be lost first with regards to methane.

A partially poisoned LEL sensor might still respond accurately to propane while showing a dangerously reduced response to methane.

Sperian's "Propane Equivalent" calibration gas mixtures have been developed to eliminate this potentially dangerous source of calibration error. Sperian's "Propane Equivalent" mixtures are based on methane so any loss of sensitivity to methane is detected (and can be corrected) immediately.

⚠WARNING The combustible sensor used in the NXP/XPR requires a minimum of 10% oxygen by volume in order to generate accurate combustible gas readings. Combustible sensor accuracy may be diminished if the instrument is used in oxygen-deficient atmospheres.

⚠WARNING A rapid up-scale reading may indicate a hazardous combustible gas concentration that exceeds the NXP's detection range.

3.3.3 Effects of contaminants on toxic gas sensors

Sperian uses "substance-specific" electrochemical sensors that have been carefully designed to minimize the effects of common interfering gases. "Substance-specific" sensors are designed to respond only to the gases that they are intended to measure. The higher the specificity of the sensor the less likely the sensor will be affected by exposure to other gases which may also be present. For instance, a "substance-specific" carbon monoxide sensor is deliberately designed not to respond to other gases that may be present at the same time, such as hydrogen sulfide and methane.

Even though care has been taken to reduce cross-sensitivity, some interfering gases may still have an effect on toxic sensor readings. In some cases the interfering effect may be "positive" and result in readings that are higher than actual. In other cases the interference may be negative and result in readings that are lower than actual.

Cross sensitivity figures for toxic sensors and common interfering gases are listed in Appendix A.

3.4 Sensor Replacement

The sensor in the NXP is located inside the sensor housing located on the bottom of the instrument (see figure 1.5), or at the remote sensor location.

⚠WARNING If a remote XPR (explosion-proof) sensor housing is being used with the NXP, do not open any part of the XPR's housing in a hazardous location unless power to the NXP has been disconnected. Power must not be restored to the NXP until the XPR housing has been completely closed.

To replace a sensor:

1. Remove power to the NXP.

2. Loosen the setscrew on the cover of the sensor housing. Unscrew and remove the cover.

3. Remove the metal collar around the sensor by pulling it straight out of the housing (do not twist). If the sensor did not come out with the collar, remove it separately.

4. Notice the small hole on the end surface of the collar. Re-insert the collar, lining up the hole with the pin on the sensor adapter board. Make sure the collar is fully inserted.

5. Line up the key on the new sensor with the slot in the collar and push the sensor into the collar until it mates with the connector on the adapter board.

6. Install the sensor cover and screw it on until it is fully seated against the sensor housing base. Re-tighten the setscrew.

7. Apply power to the NXP. New sensors must be allowed to stabilize prior to use, according to the following schedule.

Sensor	Stabilization Period
Oxygen (O_2)	1 hour
LEL	5 minutes
Toxic Sensors	15 minutes

Once the stabilization period has passed, perform the Fresh Air Zero and the Gas Calibration procedures as discussed in sections 4.3 and 4.4.

4. Verification of Accuracy (Calibration)

4.1 Warnings and cautions concerning verification of accuracy

⚠WARNING The accuracy of the NXP should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use. Failure to check accuracy after a known sensor exposure can lead to inaccurate and potentially dangerous readings.

⚠WARNING A sensor that cannot be calibrated or is found to be out of tolerance should be replaced immediately. An instrument that fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.

⚠WARNING Use of non-standard calibration materials may lead to dangerous error and may void Biosystems standard warranty for gas detection products. Customers are strongly urged to use only Biosystems calibration materials when calibrating the NXP detector.

⚠WARNING The accuracy of the NXP should be checked periodically with known concentration calibration gas. Failure to check accuracy can lead to inaccurate and potentially dangerous readings. See Appendix C for Sperian's position on calibration frequency.

4.2 Overview of verification of accuracy

NXP Gas Detector Heads have been designed for easy single-person calibration. The MODE button is located on the display board and is used to enter the Calibration and Test modes. The LCD readout provides ongoing readings and messages at the detector head during calibrations and bump tests.

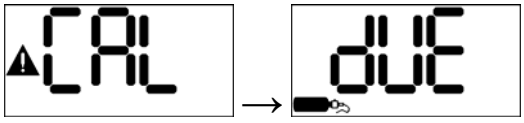
For detector heads that are used as part of a detection system with a controller, it is necessary to calibrate both the controller and the gas detector head when the system is first put into use. Once the system has been properly calibrated, the accuracy of the gas detector head should be regularly verified by exposure of the sensor to known concentration test gas.

4.2.1 Calibration Interval

A regular schedule for ongoing verification of gas detector head accuracy should be set up. **See Appendix C for Sperian's position on calibration frequency.**

The NXP has the ability to alert the user when calibration is required. See section 5 for instructions regarding setting the Calibration Interval.

When the calibration interval is reached, the instrument will alert the user by flashing "CAL dUE" and the gas bottle icon on the display once every 30 seconds. The red alarm LEDs will also flash.



4.2.2 Special Instructions for Fixed Gas Detectors

Fixed detectors are commonly located in environments in which the purity of the ambient air is unknown. In this case, a cylinder of "Zero Air", which contains 20.9% oxygen and no contaminants, must be used to verify that the detector is displaying the correct readings for a fresh air atmosphere, and to perform a fresh air calibration when necessary. "Zero Air" is available from Sperian.

A second cylinder of gas is also required for instruments equipped with toxic and combustible gas sensors, so it is not unusual to use two cylinders of calibration gas to calibrate a fixed gas detector.

4.2.3 Accuracy of Oxygen Sensors

Oxygen detectors should read 20.9% in a fresh air environment.

If the oxygen detector is reading anything except 20.9% when exposed to fresh air, it should be fresh air calibrated as discussed in section 4.3.

As discussed in section 4.2.2, a cylinder of “Zero Air” must be used during the fresh air calibration if there is any reason to question the purity or composition of the ambient atmosphere.

4.2.4 Accuracy of Toxic and LEL Sensors

In a fresh air environment, toxic gas detectors should read 0 PPM and LEL detectors should read 0% LEL.

If the toxic or LEL detector reads anything other than zero when exposed to a known source of fresh air, it should be fresh air calibrated as discussed in section 4.3.

As discussed in section 4.2.2, a cylinder of “Zero Air” must be used during the fresh air calibration if there is any reason to question the purity or composition of the ambient atmosphere.

The second step (for toxic and LEL sensors only) is to expose the sensor to known concentration test gas and note the sensor response. To test sensor response in the NXP, place the detector in Test Mode as discussed in section 4.5 and apply calibration gas.

During the sensor response test, toxic and LEL readings are considered accurate if the readings are between 90% and 120% of the expected value as given on the gas cylinder. If readings are accurate, then the instrument requires no further adjustment. Toxic and LEL readings that do not fall between 90% and 120% of the value on the cylinder are considered inaccurate and indicate that the sensor must be calibrated before further use as discussed in sections 4.3 and 4.4.

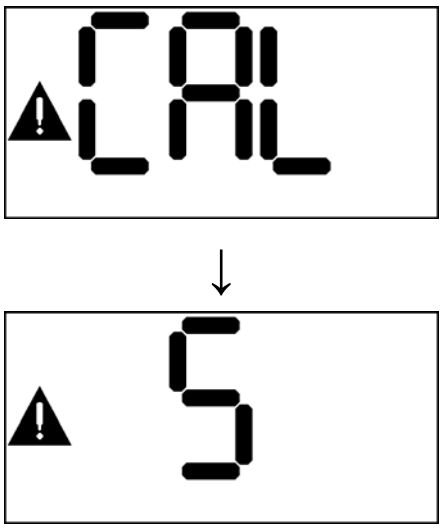
4.3 Fresh air calibration

As discussed in section 4.2.2, fixed systems are often used in locations where the ambient air may not be fresh. In these situations it is necessary to use a cylinder of “Zero Air” to provide a known source of contaminant-free air with 20.9% oxygen for the fresh air calibration.

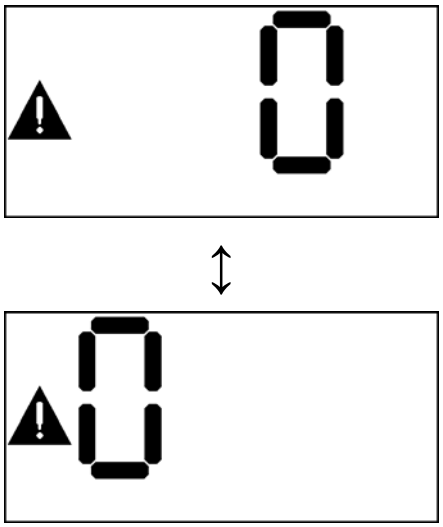
If a cylinder of “Zero Air” is to be used to provide the fresh air source during the fresh air calibration, connect the cylinder to the detector and flow gas to the sensor for 30 seconds before beginning this procedure.

To initiate the fresh air calibration, press the MODE button three times quickly in succession.

The detector head will show “CAL” with the triangular warning symbol and proceed to a 5-second countdown. The triangular warning symbol is lit in this case to let the user know that the gas alarms will be disabled for the duration of the fresh air calibration procedure.



Press the MODE button prior to the end of the countdown to initiate the fresh air calibration. The screen will show alternating left and right zeroes during the process with the warning icon lit to show that the alarms are disabled.

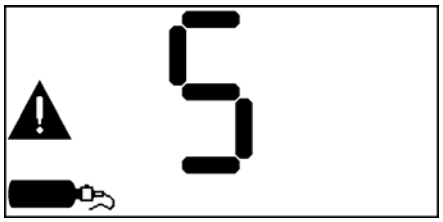


Following successful zero calibration, NXP detectors with toxic or combustible gas sensors will proceed to the span calibration routine and will begin another 5-second countdown with the calibration bottle icon lit.

To conclude the fresh air calibration without performing a span calibration, allow the countdown to reach zero without pressing the MODE button. The NXP will then return to the current gas reading screen.

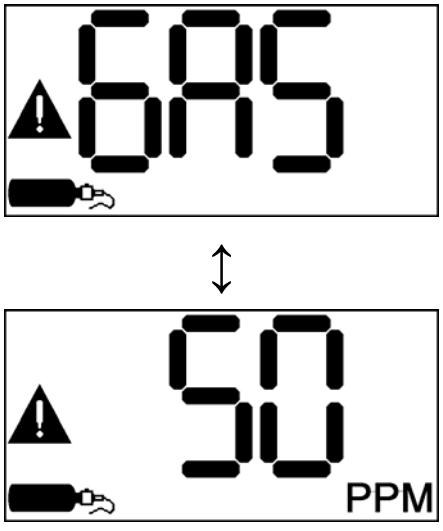
4.4 Span calibration of Toxic and LEL sensors

To initiate the span calibration routine for toxic and LEL sensors, first complete the fresh air calibration as detailed in section 4.3. A second 5-second countdown will begin. The calibration cylinder icon will be lit to let the user know that this countdown is for the span calibration routine.



Press the MODE button before the countdown concludes to initiate the span calibration. If a cylinder of “Zero Air” was used to provide fresh air during the fresh air calibration, the cylinder should be disconnected from the detector now.

The screen will alternate between GAS and the expected calibration gas level.



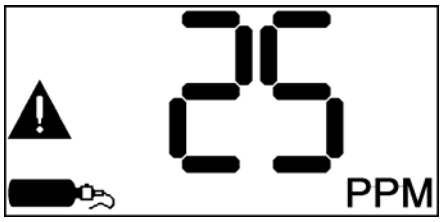
Connect the cylinder with the span calibration gas to the detector and flow gas to the sensor.

⚠WARNING Customers are strongly urged to use only Sperian calibration materials when calibrating the NXP. Use of non-standard calibration gas and/or calibration kit components when calibrating the NXP can lead to inaccurate and potentially dangerous readings and may void the standard Sperian warranty.

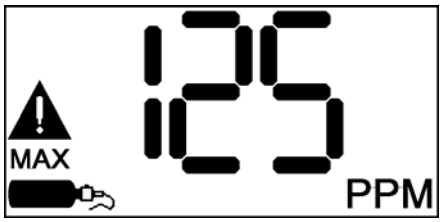
⚠WARNING The expected calibration gas values should match the applied gas values from the calibration tank. Failure to ensure that these numbers match can lead to inaccurate and potentially dangerous readings which could result in serious injury or death.

Sperian Instrumentation offers calibration kits and long-lasting cylinders of test gas specifically developed for easy NXP calibration.

Once gas is detected, the current reading is shown with the bottle icon to show that the detector is in calibration mode.

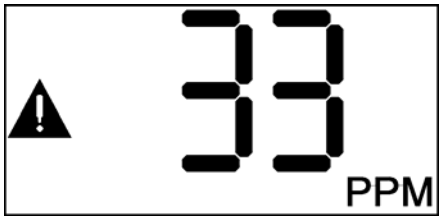


Once the instrument successfully completes the span calibration, it will display the maximum span calibration adjustment value for two seconds. The calibration gas should be removed at this time.



Following the Max Span screen the instrument will continue to show the current gas reading without the alarms in order to allow the readings to drop back below alarm levels. The triangular

warning symbol will remain on to remind the user that alarms are currently disabled.



Once the readings drop below the alarm level threshold the detector will return to normal operation. However, alarms will be enabled again in 60 seconds regardless of the gas level.

The span calibration mode can be canceled at any time by pressing the MODE button. If the sensor has not detected the presence of calibration gas, the detector returns immediately to normal operation. If calibration gas was detected, the “alarms off” settling time described above will occur.

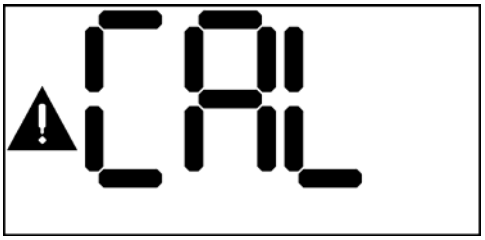
4.5 Test Mode

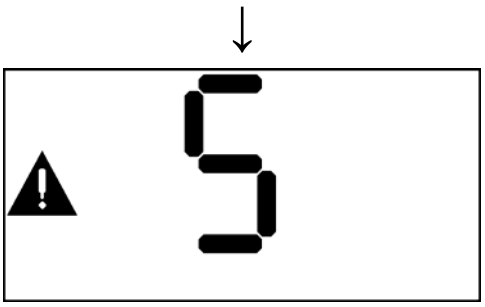
The Test Mode is used to verify accuracy without performing a full calibration. This type of test is commonly referred to as a bump test. While the instrument is in Test Mode, it will not go into alarm despite the fact that the instrument may detect levels of gas that exceed the alarm threshold.

For detectors that are used with a controller, during Test Mode the detector will send a signal to the controller that mimics a fresh air reading to keep the controller from registering an alarm condition.

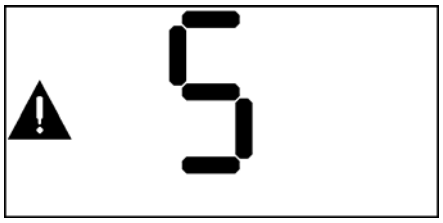
While in test mode, the green and yellow LEDs will blink once every 10 seconds to remind the user that alarms have been disabled.

To enter the Test Mode, press the MODE button three times quickly in succession as if to enter the Fresh Air Calibration routine. The screen will show CAL and begin a 5-second countdown.

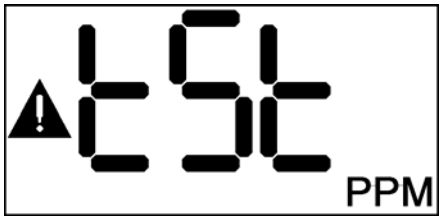




Allow the countdown to reach zero. The test countdown will then be shown.



Press MODE before the end of the countdown to enter Test Mode. The screen will alternate between “tSt” and the gas reading for the duration of the test.

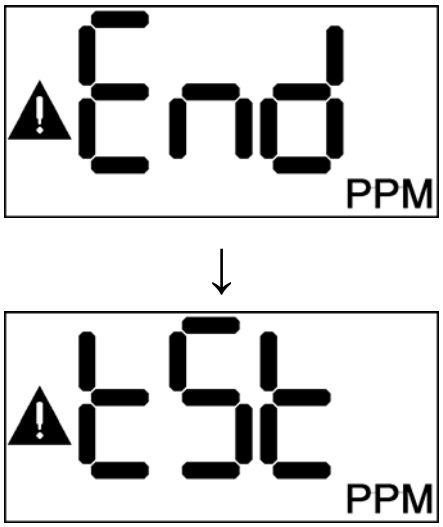


Apply a known concentration calibration gas to the sensor. Toxic and LEL readings are considered accurate if the readings are between 90% and 120% of the expected value as given on the gas cylinder. If readings are accurate, then the instrument requires no further adjustment. Toxic and LEL readings that do not fall between 90% and 120% of the value on the cylinder are considered inaccurate and indicate that the sensor must be calibrated before further use as discussed in sections 4.3 and 4.4.

⚠WARNING Customers are strongly urged to use only Sperian calibration materials when calibrating the NXP. Use of non-standard calibration gas and/or calibration kit components when calibrating the NXP can lead to inaccurate and potentially dangerous readings and may void the standard Sperian warranty.

Sperian Instrumentation offers calibration kits and long-lasting cylinders of test gas specifically developed for easy NXP calibration.

Press MODE to end the test and resume normal gas reading mode.



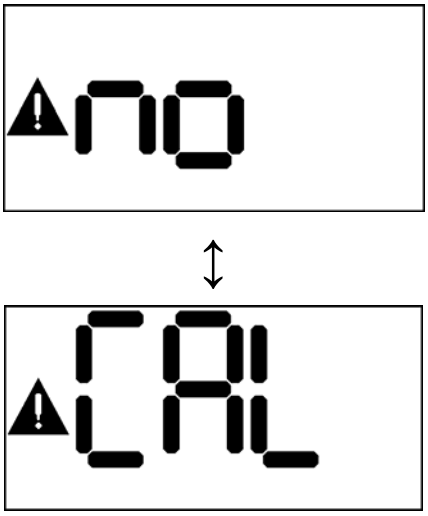
The detector will then return to the current gas reading screen. The warning icon will be lit to show that the alarms are off until the readings fall below the alarm levels.

The instrument will automatically exit Test Mode if the MODE button is not pressed within 5 minutes.

4.6 Calibration Failures

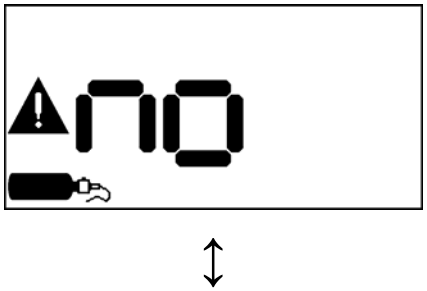
4.6.1 Fresh Air Calibration Failure

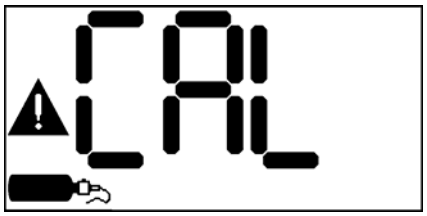
If the NXP is unable to complete the fresh air calibration, the instrument will show “no CAL” and then the countdown for Test Mode before returning to the current gas reading screen.



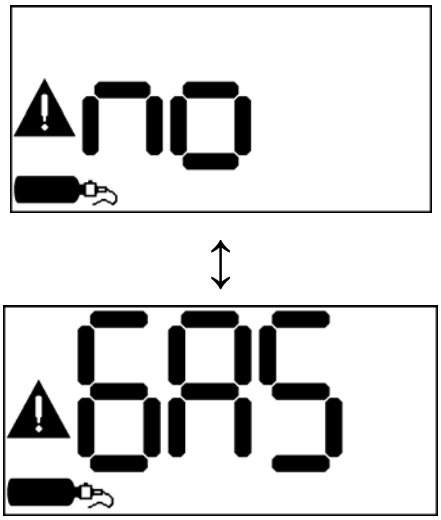
4.6.2 Span Calibration Failure

If the NXP is unable to complete the span calibration, the instrument will show “no CAL” with the calibration cylinder icon before returning to the current gas reading screen.





If the NXP is unable to complete the span calibration because it completely fails to detect gas, it will show “no GAS” before returning to the current gas reading screen.



Possible causes of span calibration failure and remedies:

1. Empty calibration gas cylinder. Verify that there is calibration gas in the cylinder.

2. Expired calibration gas cylinder. Verify that the expiration date on the cylinder has not passed.

3. Calibration equipment not connected correctly. Check all connections between cylinder, regulator, tubing, calibration adapter and sensor.

4. Calibration gas setting does not correspond to calibration gas concentration. The default calibration gas concentration is stored in the instrument’s memory. If the value on the calibration cylinder is different from the instrument’s calibration gas setting, the calibration gas setting must be changed to match the new value, or the correct value calibration gas must be obtained. Calibration gas value can be changed by accessing the setup menu with the MODE button as discussed in section 5.

5. LEL only: Wrong type of combustible calibration gas. LEL calibration gas may be based on several different response standards; methane, propane and pentane are the most common. If using a new cylinder of calibration gas, make sure that the type and concentration of combustible gas is identical to that of the previous bottle. Sperian Instrumentation offers calibration gases in Methane, Propane Equivalent and Pentane Equivalent.

6. Inoperative sensor. Contact Sperian Instrumentation for a replacement sensor.

7. Instrument problem. Contact Sperian Instrumentation’s Instrument Service department at the phone number on the front of this manual.

5. Configuration

The following section explains how to set up the NXP using the setup menu and MODE button. All of the features in the setup menu are also available through IrDA communication using Sperian's BioTrak II software. Please see the BioTrak II manual for instructions.

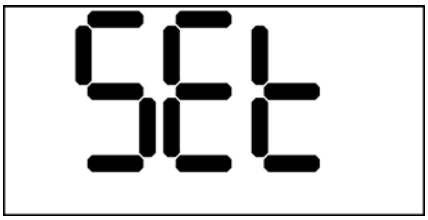
The NXP includes a setup menu that allows the user to set up various parameters and functions. The menu is accessed though the MODE button.

The Setup menu and all of the submenus are on a 5-second clock. To enter one of the submenus, press the MODE button while the submenu item is shown. To skip over a submenu, do nothing. Once 5 seconds have passed the NXP will automatically move to the next submenu. This will continue until the final submenu is reached. At the end of the 5-second countdown for the final submenu, if the MODE button is not pressed, the NXP will return to the current gas reading screen.

The operating logic in the submenus is the same as the operating logic in the main menu. In each of the submenus, press the MODE button to go deeper into the submenu, or to make changes. Do nothing to move on to the next submenu item without making changes. Once the final item in a submenu is reached, the NXP will return to the next higher submenu.

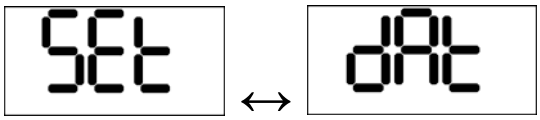
5.1 Accessing the Setup menu and Submenus

To access the Setup Menu, press and hold the MODE button. The current gas reading screen will be replaced with the MAX Clr screen after about 3 seconds. Continue to hold the button. In a few more seconds, "SEt" will be shown.



Release the MODE button. "UP" will be shown, then a 5-second countdown will start. To enter the setup menu, press the MODE button before the countdown reaches zero. To return to the gas reading screen, do nothing. Once 5 seconds have passed, the NXP will display the current gas reading.

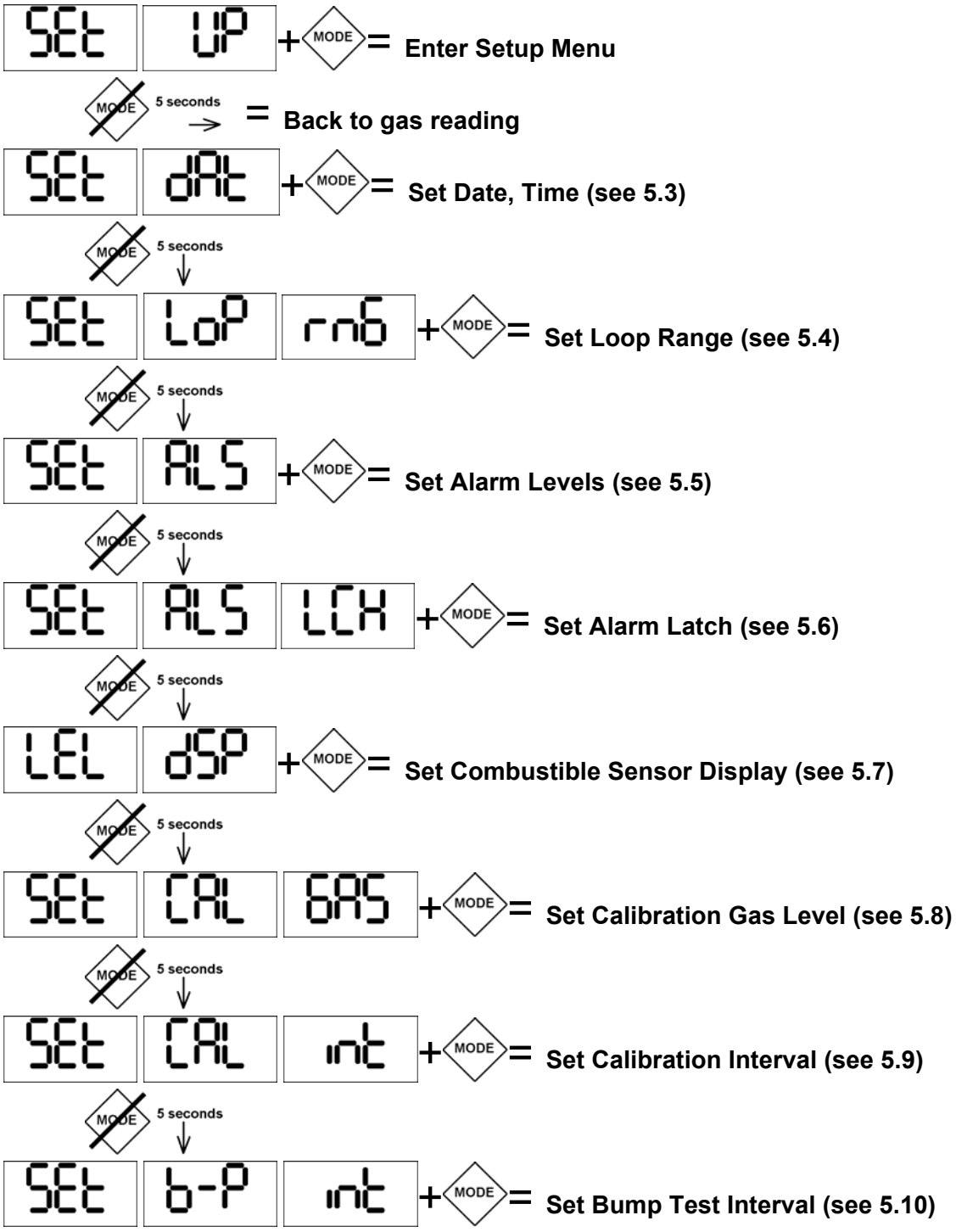
Once in the setup menu, the NXP will display "Set dAt".



The instrument will automatically scroll through all of the menu choices. See the flow chart in section 5.2 for details.

5.2 Setup Submenu Flow Chart

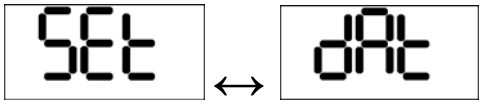
Depending on the installed sensor, some of the following menu choices may be unavailable. See individual sections for more information.



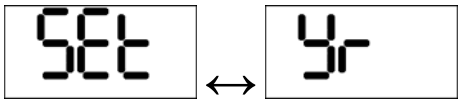
After the Bump Interval menu, the display will return to the current gas reading.

5.3 Set Date and Time

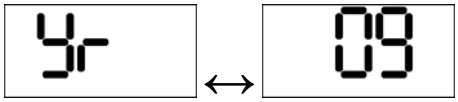
The first submenu controls date and time functions. “SEt” “dAt” will be shown.



Press MODE again within 5 seconds to set date and time. “Set” Yr” will be shown.



Press MODE again within 5 seconds to view and/or change the year setting.



Hold the MODE button to change the year. Once the year is set, release the MODE button and wait 5 seconds. The display will cycle through month (Mo), day (dAY), hour (Hr), and minute (Mn). For each of these, press the MODE button to view the curent value. Hold the MODE button to change as necessary, or wait 5 seconds to keep the current value.

5.4 Set Loop Range

Press the MODE button within 5 seconds to view the loop range setting. This setting determines the value that corresponds to a full-range 20 mA loop current. Hold the MODE button to change the setting. The loop ranges available in the menu depend on the type of sensor installed.

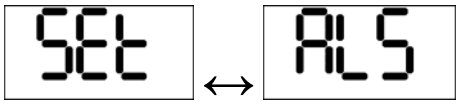
Changing to a lower range will set default alarms for the range if the current alarm settings are outside of the new range. The decimal point will also be turned on or off depending on the range selected.

This menu item only appears when a toxic gas or oxygen sensor is installed.

Note: Changing the loop range will require a recalibration of the instrument.

⚠WARNING Changing the loop range will affect the operation of any attached 4-20 mA controller. Range adjustment or recalibration of the controller may be necessary.

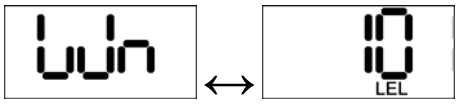
5.5 Set Alarm Levels



5.5.1 Setting alarms for Toxic and Combustible gas sensors

Toxic and combustible gas sensors have both Warning (Wn) and Danger (dnG) alarm levels. They can be set equal to each other, but the Warning alarm can not be set higher than the Danger alarm.

Press the MODE button within 5 seconds to view the Warning (Wn) alarm setting.



Press the MODE button within 5 seconds to change the warning alarm level. Release the MODE button and wait 5 seconds for the display to show the Danger (dnG) alarm level.

The alarm levels available in the menu depend on the type of sensor installed.

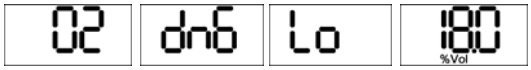
⚠WARNING Adjusting the alarm levels at the head will ONLY affect the attached Audible and Visual alarms and relays. If connected to a 4-20 mA controller, the controller’s alarm levels will need to be adjusted.

5.5.2 Setting alarms for Oxygen sensors

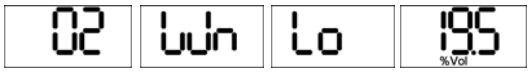
Oxygen sensors have four different alarm settings. There are both Warning and Danger alarms in each direction – falling (oxygen deficiency) and rising (oxygen enrichment). The falling and rising alarms are referred to as Low (Lo) and High (Hi), respectively.

The High Warning alarm can not be set higher than the High Danger alarm. The Low Warning alarm can not be set lower than the Low Danger alarm.

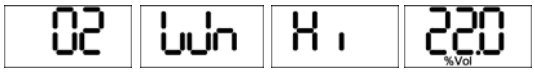
Press the MODE button within 5 seconds to enter the alarm setting submenu. The Low Danger alarm setting will be shown.



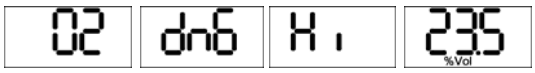
Press the MODE button within 5 seconds to change the alarm level. Release the MODE button and wait 5 seconds for the display to show the Low Warning alarm level.



Press the MODE button within 5 seconds to change the alarm level. Release the MODE button and wait 5 seconds for the display to show the High Warning alarm level.



Press the MODE button within 5 seconds to change the alarm level. Release the MODE button and wait 5 seconds for the display to show the High Danger alarm level.

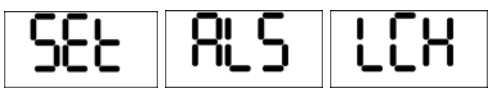


Press the MODE button within 5 seconds to change the alarm level. Release the MODE button and wait 5 seconds.

Because some values can not be changed without changing other values first, the menu will continue to cycle through the alarm levels until it completes one full cycle with no changes. It will then return to the main menu.

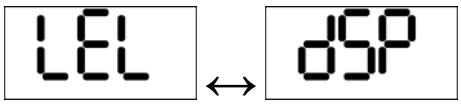
Note: For process measurements (measuring very low levels of oxygen), the Low Danger and Warning alarms must be set to “OFF” before the High Danger and Warning alarms can be set to the low values.

5.6 Set Alarm Latch



Press the MODE button within 5 seconds to view the current alarm latch setting. Use the MODE switch to toggle the latch between on and off.

5.7 Set Combustible Gas Sensor Display



The NXP can display combustible gas level in either %LEL or %CH_4 by volume. Press the MODE button within 5 seconds to view the current display mode for the combustible gas sensor.

Press the MODE button again to change the setting. This menu item only appears when a combustible gas sensor in an XPR housing is installed.

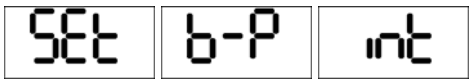
5.8 Set Cal Gas Concentration

Press the MODE button within 5 seconds to view the current calibration gas concentration. Use the MODE switch to adjust it if necessary. This menu item only appears when a combustible or toxic gas sensor is installed.

5.9 Set Cal Interval

Press the MODE button within 5 seconds to view the current calibration interval. Use the MODE switch to adjust it if necessary.

5.10 Set Bump Test Interval



Press the MODE button within 5 seconds to view the current bump test interval. Use the MODE switch to adjust it if necessary.

6. Diagnostics

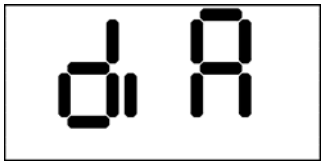
The NXP includes a diagnostics menu that allows the user to view certain internal parameters and exercise the NXP's output functions. This menu is accessed though the MODE button.

The menu options in the diagnostic menu are on a countdown timer. The timer is shown by the red LED's being illuminated and turning off one at a time, followed by the yellow LEDs. To activate one of the options, press the MODE button while the option is shown, before the last yellow LED is extinguished. To exit the option, press the MODE button again.

To skip over a menu option, do nothing. Once 6 seconds have passed the NXP will automatically move to the next menu option. This will continue until the final menu option is reached. At the end of the 5-second countdown for the final menu option, if the MODE button is not pressed, the NXP will return to the current gas reading screen.

6.1 Accessing the Diagnostics menu and Options

To access the Diagnostics Menu, press and hold the MODE button. The current gas reading screen will be replaced with the MAX Clr screen after about 3 seconds. Continue to hold the button. In a few more seconds, "Set" will be shown. Continue to hold the button. After a few more seconds, "diA" will be shown.

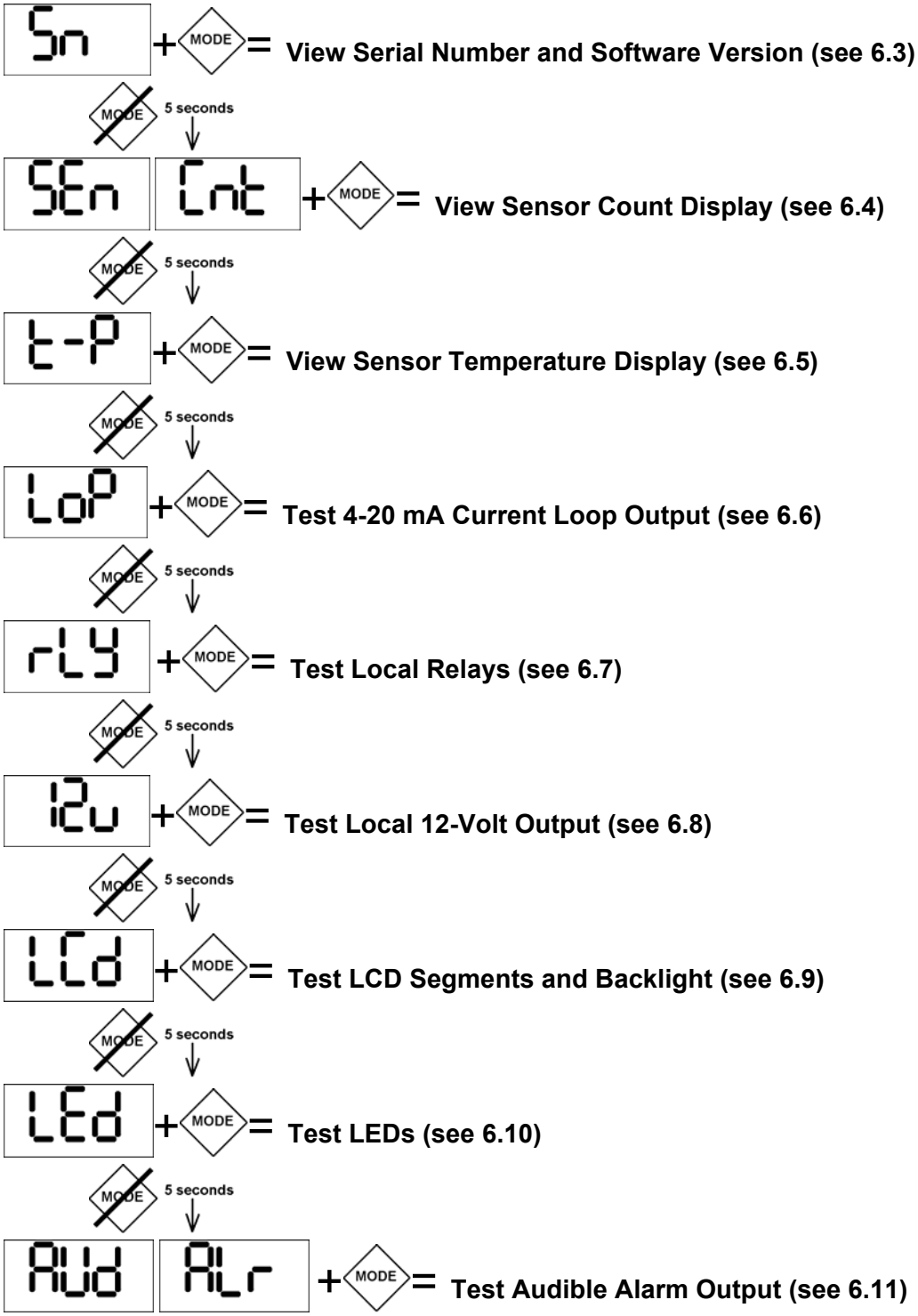


Release the MODE button. A 5-second countdown will start. To enter the diagnostics menu, press the MODE button before the countdown reaches zero. To return to the gas reading screen, do nothing. Once 5 seconds have passed, the NXP will display the current gas reading.

Once in the diagnostics menu, the NXP will display the first menu option, "Sn" (Serial Number and Software Version).

The instrument will automatically scroll through all of the menu choices. See the flow chart in section 6.2 for details.

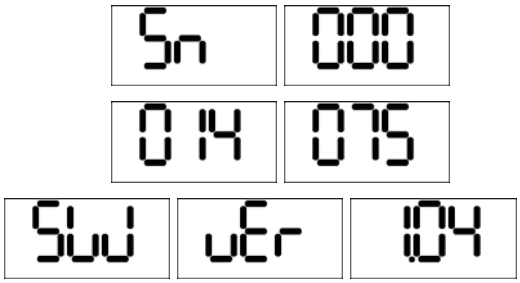
6.2 Diagnostic Menu Flow Chart



After the Audible Alarm option, the display will return to the current gas reading.

6.3 Serial Number / Software Version

Pressing the MODE button while “Sn” is shown will enter the serial number and software display. In this mode the display will cycle between the 9-digit instrument serial number and the currently installed software version, as shown below.

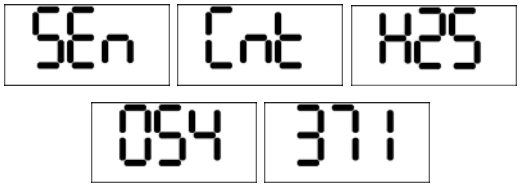


Press the MODE button to continue.

6.4 Sensor Count Display

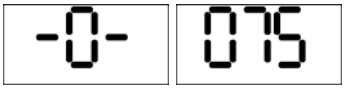
The next option is the sensor count mode. This mode displays several parameters related to the sensor function, and also the external power supply level.

The first value shown is the sensor type and count. This value is used by Sperian service personnel to determine the correct functioning of the sensor.



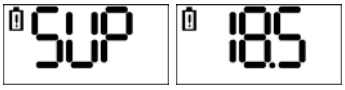
The display will cycle through these values until MODE is pressed again.

The next value shown is the zero counts.



Pressing the MODE button again will show the span counts.

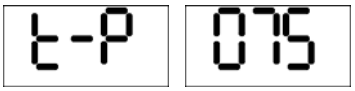
Finally, the next MODE press will show the power supply voltage.



Press the MODE button to exit.

6.5 Sensor Temperature Display

The next menu option is the sensor temperature reading. The display will show the temperature at the sensor.



6.6 Current Loop Output Test

The next menu option is the Current Loop Output Test.

This test applies a set of output currents to the 4-20 mA loop so that the connection between the NXP and a controller or other loop device can be tested, and the controller can be calibrated. The following currents are output in sequence:

3.5 mA	3.75 mA	4.0 mA
8.0 mA	12.0 mA	16.0 mA
20.0 mA	22.0 mA	24.0 mA

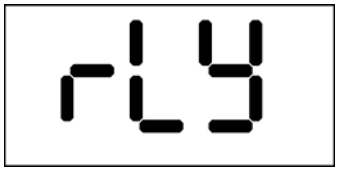
Press the MODE button to advance to the next output level. The loop current is displayed on the LCD. When the last level is reached, the next MODE button press will wrap around to the lowest level and begin the cycle again.

NOTE: Any alarms attached to the controller will be activated during this test.

Press and hold the MODE button to exit this test and return to the Diagnostics menu.

6.7 Relay Test

The next option is the Relay Test.



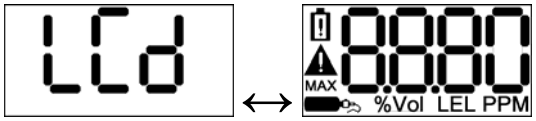
During this test, the relays in the NXP head will be alternately activated and deactivated in order to test any devices that are connected to them.

6.8 12-Volt Output Test

The next option is the 12-volt output test. This test will alternately pulse the yellow and red strobe LEDs.

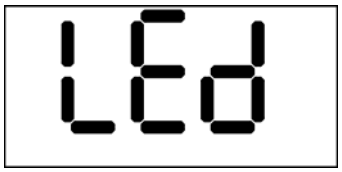
6.9 LCD and Backlight Test

The next option is the LCD test. This test will alternately show “LCd” and all segments of the LCD, while also turning the LCD backlight on and off.



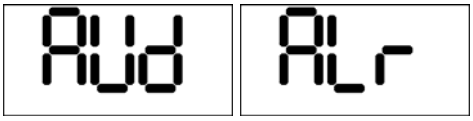
6.10 LED Test

The next option is the LED test. This test will show “LEd” on the display and alternately flash the yellow LEDs and the red LEDs.



6.11 Audible Alarm Test

The next option is the Audible Alarm test. “AUd” and “ALr” will alternate on the display, and the audible alarm will be pulsed quickly to verify correct operation.



Press the MODE button to exit.

7. Service

Returning your NXP to Sperian Instrumentation for service or repair

Please contact the Sperian Instrumentation Service Department at (860) 344-1079 or 800-711-6776 to obtain a “Return Authorization” number prior to shipment. A Sperian service representative will record all relevant information or special instructions at that time.

To insure safe transport please use the original NXP packing materials, or other packing materials that similarly protect the instrument and accessories.

Please contact the Sperian Instrumentation Service Department at (860) 344-1079 or 800-711-6776 if you require any additional information.

Note: The return authorization number must be clearly marked on the outside of the box.

Prominently showing the return authorization number on the outside of the box ensures that it is immediately identified and logged into our system at the time it is received. Proper tracking helps avoid unnecessary delays in completion of service procedures.

Appendices

Appendix A: NXP Toxic Sensor Cross Sensitivity Data

The table below lists the cross sensitivity of electrochemical toxic sensors used in Biosystems NXP gas detectors to gases other than their target gas. Depending on the nature of the reaction each gas has with the sensor, the effect can either decrease the signal (negative cross sensitivity) or increase the signal (positive cross sensitivity). Each figure represents the reaction of the sensor to 100 ppm of gas, thus providing a percentage sensitivity to that gas relative to its target gas.

Type of Sensor	Interfering Gas										
	CO	H_2S	SO_2	NO	NO_2	Cl_2	H_2	HCN	HCl	NH_3	C_2H_4
Carbon Monoxide (CO)	100	<10	5	<20	-15	< 10	50	<15	< 3	0	50
Hydrogen Sulfide (H_2S)	2	100	15	<5	-20	<-20	1	0	0	0	0
Sulfur Dioxide (SO_2)	1	1	100	1	-100	-50	0	< 50	0	0	0

Appendix B: Fault Conditions

Fault conditions are indicated on the display by the letter ‘F’ followed by one or two decimal digits. The fault conditions displayed by the NXP are:

F1 – Sensor Fault

A sensor fault can occur at power-up or at any time during normal operation. F1 indicates that the NXP’s processor has lost communication with the installed sensor. This could be due to the sensor being removed during operation, a faulty connection, or a failure of the sensor electronics. The NXP must be rebooted after the problem is resolved.

F2 – EEPROM Read Fault

This fault occurs when the instrument encounters an error while trying to read from the EEPROM that stores the instrument configuration data. The instrument must be rebooted if this fault occurs. If the fault persists, the instrument should be initialized (see Section 7).

F5 – EEPROM Write Fault

This fault occurs when the instrument encounters an error while trying to write to the EEPROM that stores the instrument configuration data. The instrument must be rebooted if this fault occurs. If the fault persists, the instrument should be initialized (see Section 7).

F11 – Power Low Fault

F11 indicates that the power supply voltage being applied to the NXP is too low, which could cause alarm outputs and relays not to function correctly. The minimum voltage for correct operation of the NXP is 13 VDC. Correct the problem and reboot the NXP.

F12 – Power High Fault

F12 indicates that the power supply voltage being applied to the NXP is too high, which could cause component failures in the NXP electronics. The maximum voltage for correct operation of the NXP is 30 VDC. Correct the problem and reboot the NXP.

Appendix C: Calibration Frequency Recommendation

One of the most common questions that we are asked at Sperian Instrumentation is: ***"How often should I calibrate my gas detector?"***

Sensor Reliability and Accuracy

Today's sensors are designed to provide years of reliable service. In fact, many sensors are designed so that with normal use they will only lose 5% of their sensitivity per year or 10% over a two-year period. Given this, it should be possible to use a sensor for up to two full years without significant loss of sensitivity.

Verification of Accuracy

With so many reasons why a sensor can lose sensitivity and given the fact that dependable sensors can be key to survival in a hazardous environment, frequent verification of sensor performance is paramount.

There is only one sure way to verify that a sensor can respond to the gas for which it is designed. That is to expose it to a known concentration of target gas and compare the reading with the concentration of the gas. This is referred to as a "bump" test. This test is very simple and takes only a few seconds to accomplish. **The safest course of action is to do a "bump" test prior to each day's use**. It is not necessary to make a calibration adjustment if the readings fall between 90%* and 120% of the expected value. As an example, if a CO sensor is checked using a gas concentration of 50 PPM it is not necessary to perform a calibration unless the readings are either below 45 PPM or above 60 PPM.

***The Canadian Standards Association (CSA) requires an instrument with a combustible gas sensor to undergo calibration when the displayed LEL value during a bump test fails to fall between 100% and 120% of the expected value for the gas.**

Lengthening the Intervals between Verification of Accuracy

We are often asked whether there are any circumstances in which the period between accuracy checks may be lengthened.

Sperian Instrumentation is not the only manufacturer to be asked this question. One of the professional organizations to which Sperian Instrumentation belongs is the Industrial Safety Equipment Association (ISEA). The "Instrument Products" group of this organization has been very active in developing a protocol to clarify the minimum conditions under which the interval between accuracy checks may be lengthened.

A number of leading gas detection equipment manufacturers have participated in the development of the ISEA guidelines concerning calibration frequency. Sperian Instrumentation's procedures closely follow these guidelines.

If your operating procedures do not permit daily checking of the sensors, Sperian Instrumentation recommends the following procedure to establish a safe and prudent accuracy check schedule for your Sperian instruments:

1. During a period of initial use of at least 10 days in the intended atmosphere, check the sensor response daily to be sure there is nothing in the atmosphere that is poisoning the sensor(s). The period of initial use must be of sufficient duration to ensure that the sensors are exposed to all conditions that might have an adverse effect on the sensors.
2. If these tests demonstrate that it is not necessary to make adjustments, the time between checks may be lengthened. The interval between accuracy checking should not exceed 30 days.
3. When the interval has been extended the toxic and combustible gas sensors should be replaced immediately upon warranty expiration. This will minimize the risk of failure during the interval between sensor checks.
4. The history of the instrument response between verifications should be kept. Any conditions, incidents, experiences, or exposure to contaminants that might have an adverse effect on the calibration state of the sensors should trigger immediate re-verification of accuracy before further use.
5. Any changes in the environment in which the instrument is being used, or changes in the work that is being performed, should trigger a resumption of daily checking.
6. If there is any doubt at any time as to the accuracy of the sensors, verify the accuracy of the sensors by exposing them to known concentration test gas before further use.

Gas detectors used for the detection of oxygen deficiencies, flammable gases and vapors, or toxic contaminants must be maintained and operated properly to do the job they were designed to do. Always follow the guidelines provided by the manufacturer for any gas detection equipment you use!

If there is any doubt regarding your gas detector's accuracy, do an accuracy check! All it takes is a few moments to verify whether or not your instruments are safe to use.

One Button Auto Calibration

While it is only necessary to do a "bump" test to ensure that the sensors are working properly, all current Sperian gas detectors offer a one-button auto calibration feature. This feature allows you to calibrate a Sperian gas detector in about the same time as it takes to complete a "bump" test. The use of automatic bump test and calibration stations can further simplify the tasks, while automatically maintaining records.

Don't take a chance with your life. Verify accuracy frequently!

Please read also Sperian Instrumentation's application note: *AN20010808 "Use of 'equivalent' calibration gas mixtures"*. This application note provides procedures to ensure safe calibration of LEL sensors that are subject to silicone poisoning.

Sperian Instrumentation's website is located at

http://www.biosystems.com

Appendix D: Sperian Instrumentation Warranty Gas Detection Products

General

Sperian Protection Instrumentation, LLC (hereafter Sperian) warrants gas detectors, sensors and accessories manufactured and sold by Sperian, to be free from defects in materials and workmanship for the periods listed in the tables below.

Damages to any Sperian products that result from abuse, alteration, power fluctuations including surges and lightning strikes, incorrect voltage settings, incorrect batteries, or repair procedures not made in accordance with the Instrument's Reference Manual are not covered by the Sperian warranty.

The obligation of Sperian under this warranty is limited to the repair or replacement of components deemed by the Sperian Instrument Service Department to have been defective under the scope of this standard warranty. To receive consideration for warranty repair or replacement procedures, products must be returned with transportation and shipping charges prepaid to Sperian at its manufacturing location in Middletown, Connecticut, or to a Sperian Authorized Warranty Service Center. It is necessary to obtain a return authorization number from Sperian prior to shipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. SPERIAN WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

Instrument & Accessory Warranty Periods

Product(s)	Warranty Period
Biosystems EXP, NXP Gas Detection Heads	18 months from date of purchase

Sensor Warranty Periods

Instrument(s)	Sensor Type(s)	Warranty Period
Biosystems EXP, NXP Gas Detection Heads	O_2, CO, H_2S	2 Years
	CO-H, SO_2, LEL**	1 Year
	All Other Sensors	1 Year

**** Damage to combustible gas sensors by acute or chronic exposure to known sensor poisons such as volatile lead (aviation gasoline additive), hydride gases such as phosphine, and volatile silicone gases emitted from silicone caulks/sealants, silicone rubber molded products, laboratory glassware greases, spray lubricants, heat transfer fluids, waxes & polishing compounds (neat or spray aerosols), mold release agents for plastics injection molding operations, waterproofing formulations, vinyl & leather preservatives, and hand lotions which may contain ingredients listed as cyclomethicone, dimethicone and polymethicone (at the discretion of Sperian's Instrument Service department) void Sperian Instrumentation's Standard Warranty as it applies to the replacement of combustible gas sensors.**