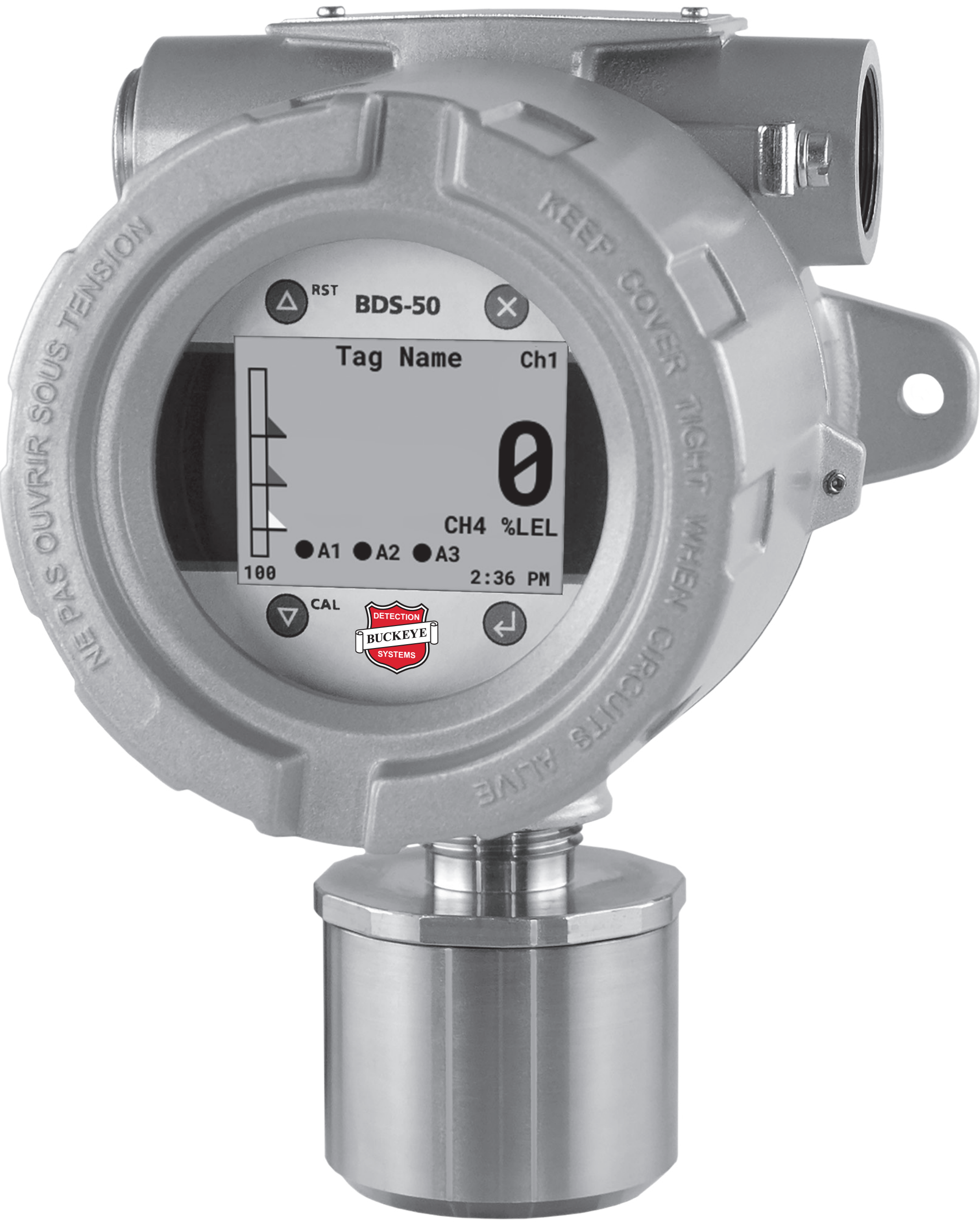
BUCKEYE DETECTION SYSTEMS

BDS-50
Gas Detection Transmitter

User Manual



www.buckeyedetects.com

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1.0 SAFETY

1.1 Safety Information

The following symbols are used in this manual to alert the user of important instrument operating issues

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.

This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

1.2 Warnings:

- SHOCKHAZARD - DISCONNECT OR TURN OFF POWER BEFORE SERVICING THIS INSTRUMENT.
- RISQUE DE CHOC - DÉBRANCHEZ OU COUPEZ L'ALIMENTATION AVANT L'ENTRETIEN CET INSTRUMENT.
- WARNING: KEEP EXPOSION PROOF COVER TIGHT WHILE CIRCUITS ARE ALIVE
- ATTENTION: LE COUVERCLE ANTIDÉFLAGRANT DOIT ÊTRE HERMÉTIQUEMENT FER-MÉ LORSQUE LES CIRCUITS SONT SOUS TENSION.
- EXPLOSION HAZARD- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- RISQUE D'EXPLOSION: NE PAS DÉBRANCHER L'ÉQUIPEMENT SAUF SI L'ALIMENTATION A ÉTÉ COUPÉE OU SI LA ZONE EST CONNUE COMME NON DANGEREUSE
- For safety reasons this equipment must be operated and serviced by qualified personnel only. Do not operate equipment until after the instruction manual is read and understood for proper installation and operation
- Pour des raisons de sécurité, cet équipement doit être utilisé et entretenu uniquement par du personnel qualifié. Ne pas utiliser l'équipement avant d'avoir lu et compris le manuel d'instructions pour une installation et un fonctionnement appropriés.
- Equipment not used as prescribed within this manual may impair overall safety of the product.
- Une utilisation de l'équipement non conforme aux prescriptions de ce manuel peut nuire à la sécurité gnérale du produit.
- Power down transmitter in hazardous locations before removing or installing a sensor or any activity requiring removal of the enclosure cover.
- Mettez l'émetteur hors tension dans des endroits dangereux avant de retirer ou d'installer un capteur ou toute activité nécessitant le retrait du couvercle du boîtier.

1.3 Recommended Reference Material

- IEC 60079-29-2: Explosive atmospheres- Selection, installation, use and maintenance of detectors for flammable gases and oxygen
- IEC 60079-20-1: Explosive Atmospheres Material Characteristics for Gas and Vapor Classification

1.4 Cleaning

Use a clean damp cloth to clean the BDS-50. Do not use harsh chemicals or solvents to clean the BDS-50.

2.0 GENERAL PRODUCT DESCRIPTION

2.1 Introduction

The BDS-50 is a state-of-the art gas detection transmitter approved for Class I, Division 1, Groups A, B, C, and D, T6 locations, (Canada & U.S.) for Toxic and Combustible gases. The BDS-50 is a universal transmitter that can be a single or dual channel gas monitor and accepts all Buckeye Detection Systems sensor types and ranges. The BDS-50 provides the user with an easy-to-read color display and user-friendly interface with a menu structure that is intuitive and feature rich. The BDS-50 is equipped with 4-20 mA and Modbus communication interface. The BDS-50 comes standard with four fully programmable relays.

2.2 Ratings Certifications

CSA Approvals (File # 2681264): BDS-50 with the 01-0001001 Sensor Housing is approved for Class I, Division 1, Groups A, B, C, and D T6 (Canada & U.S.)

Supply: Rated 10-30 VDC, 1 Amp max. input provided by a Class 2 / SELV source.

Ambient Temperature: Range -40C to +60C.

Relay Contacts: Rated 250 VAC, 30 VDC, 5.0 A max. Resistive, Form “C”

Warranty: See Standard Limited Warranty Section 14.0

2.3 System Design Specifications

Display: 2.4” Diagonal 240 x 320 Pixels LCD Color Display, LED Backlight

Analog Out: 3-wire 4-20mA current sourcing output at nominal 24V DC power supply

Power Supply: 10 – 30VDC @ 5 Watts

2.4 Buckeye Contact Information

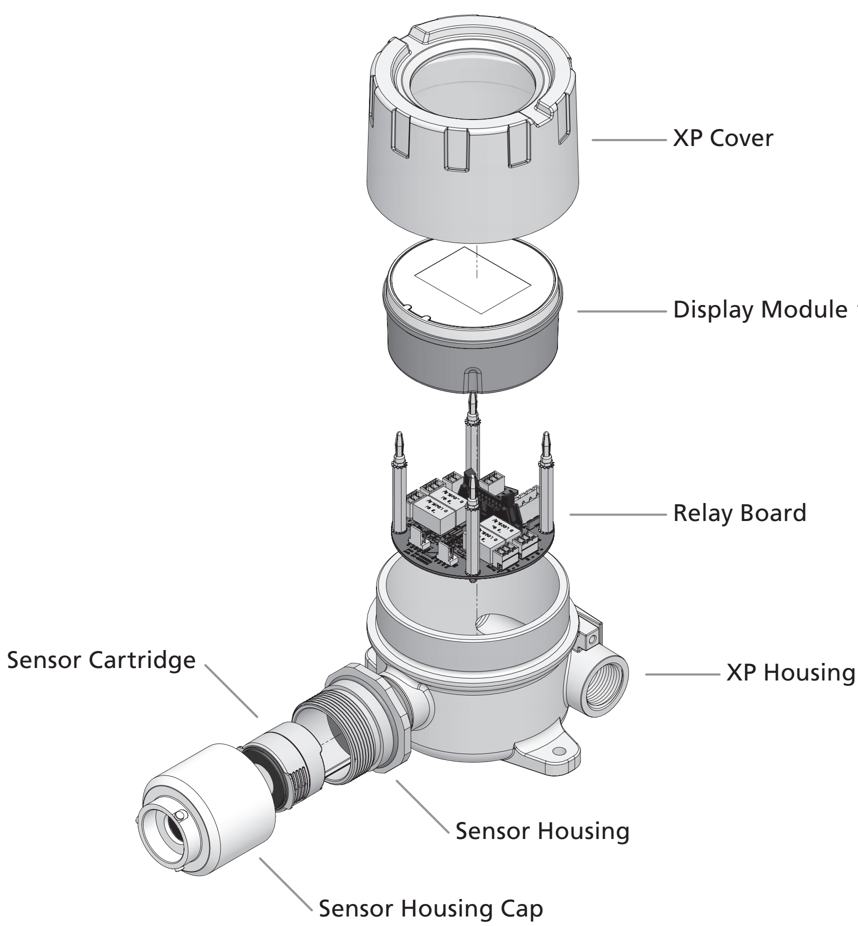
Address: Buckeye Fire Equipment, 110 Kings Road, Kings Mountain NC 28086
Main: 704.739.7415 **Direct:** 704.710.0322
Website: www.buckeyedetects.com

3.0 SYSTEM COMPONENTS

3.1 Overview

The BDS-50 gas detection transmitter assembly consists of the XP cast aluminum enclosure, display module “puck”, relay board, sensor housing, sensor cartridge and sensor housing accessories.

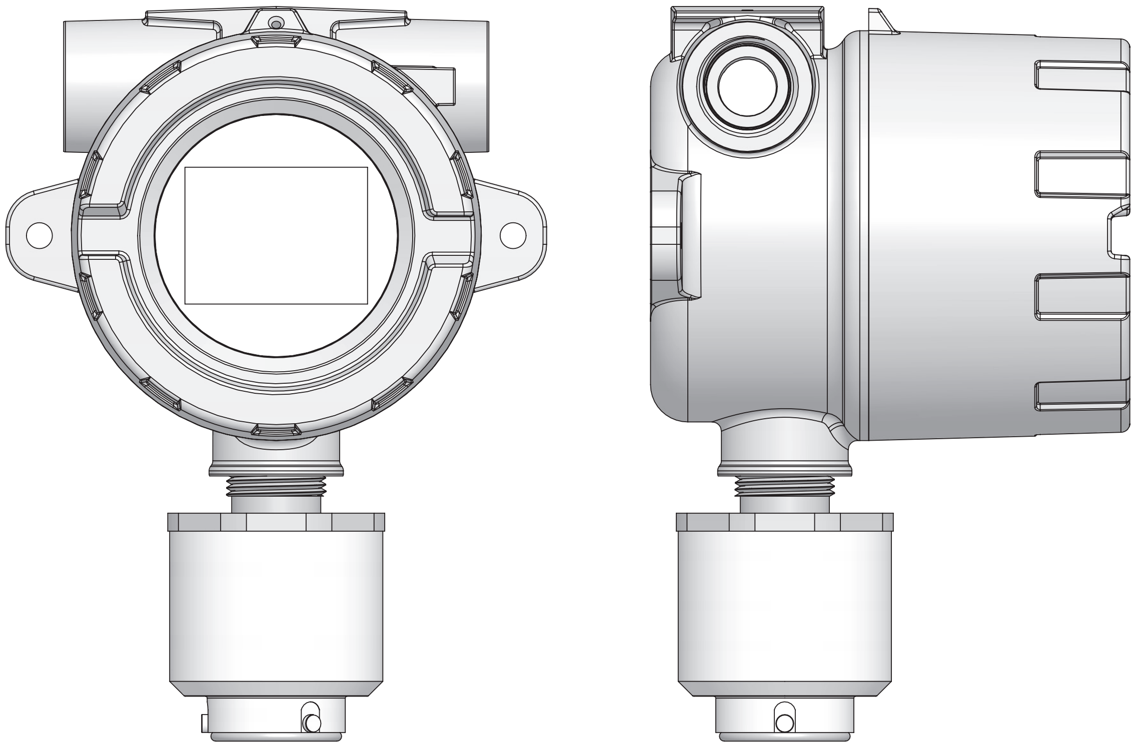
Fig 3.1a



3.2 XP Enclosure

The BDS-50 gas detection transmitter housing is an explosion proof aluminum cast enclosure with a viewing window. The enclosure has a mounting flange with two mounting holes with clearance for a ¼ inch bolt. The BDS-50 has two ¾ inch NPT ports for wiring entry into the enclosure.

Fig 3.2a



3.3 Sensor Housing

The sensor housing provides an XP approved enclosure for the sensor cartridge and electronics. The sensor housing is approved for hazardous locations Class I, Division 1, Groups A, B, C, and D T6 locations, (Canada & U.S.) for Toxic and Combustible gases. The sensor housing provides a unique keyed design for easy sensor insertion.

Fig 3.3a

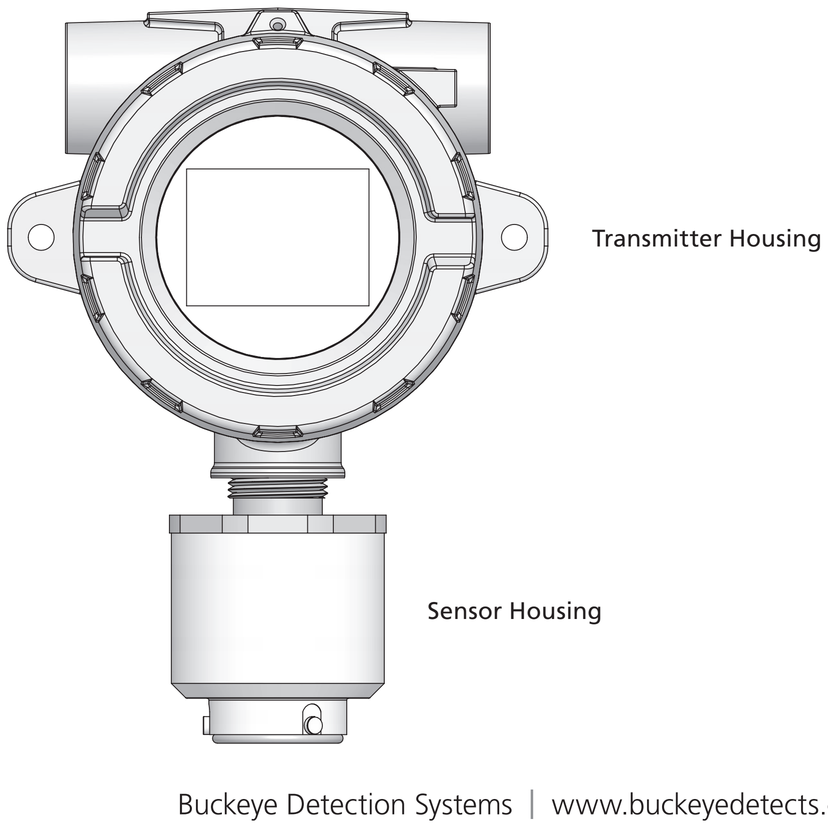
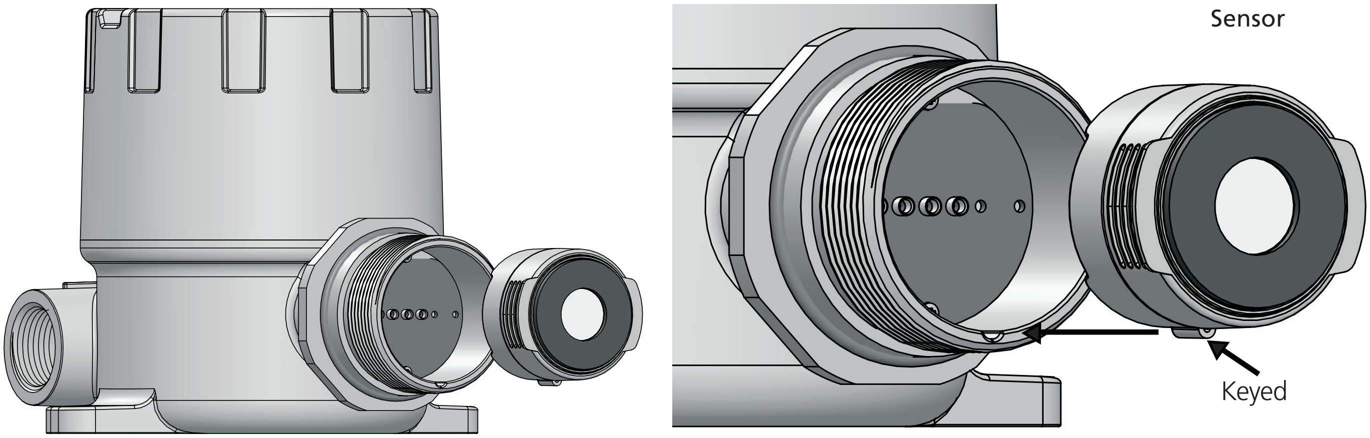


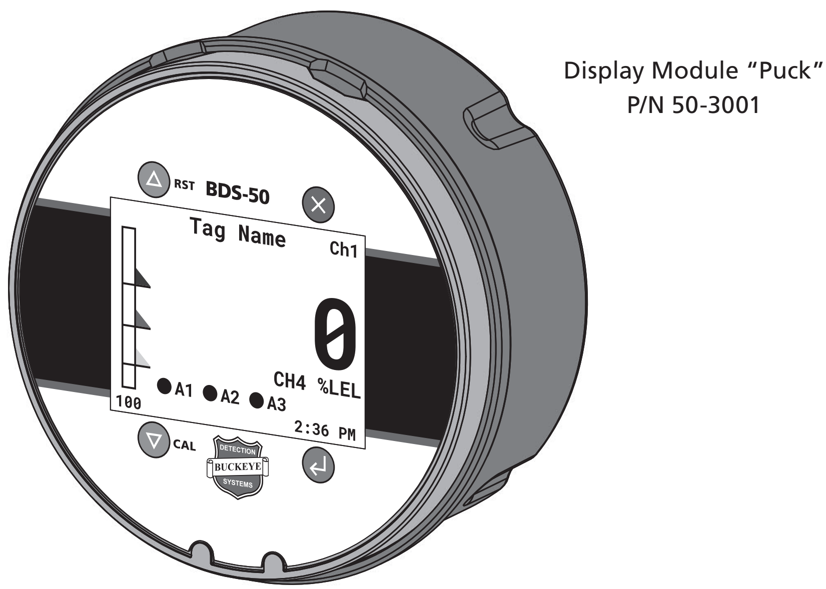
Fig 3.3b



3.4 Display Module

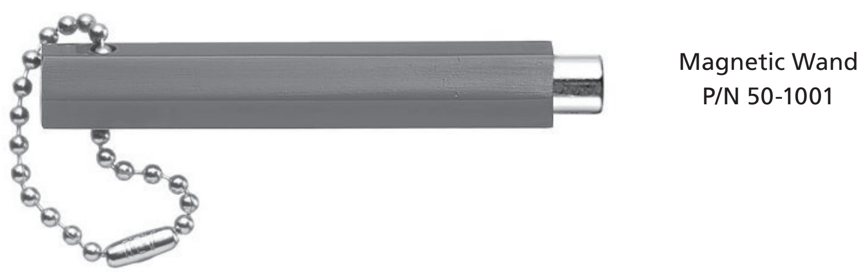
The BDS-50 display module "puck" has a bright color display that provides all information in an alpha-numerical format that is easy to view and understand.

Fig 3.4a



3.4.1 Display Module Non-Intrusive User Interaction

Fig 3.4.1a



The BDS-50 implements a non-intrusive method to allow the user to interact with the transmitter. Non-intrusive allows interaction with the transmitter without exposing the electrical components to the hazardous area. The transmitter has four hall-effect switches that detect a presence of a magnetic field. The hall-effect switch mimics a push-button switch but as a non-intrusive format. Buckeye Detection Systems provides a magnetic wand that is included with the transmitter and is required for transmitter user interaction.

The BDS-50 has four hall-effect switches that represent a specific user interaction / function. The BDS-50 display module overlay / label has four graphics that represent each hall-effect switch. The graphic area will be referenced as a "button" going forward.

The “Up / RST” button, Allows the user to scroll “Up” through screen menu items, configuration selections and alpha-numeric entries. This button also allows the user to acknowledge alarms.

The “Down / Cal” button, Allows the user to scroll “Down” through screen menu items, configuration selections and alpha-numeric entries   This button also allows the user to short-cut to the calibration function.

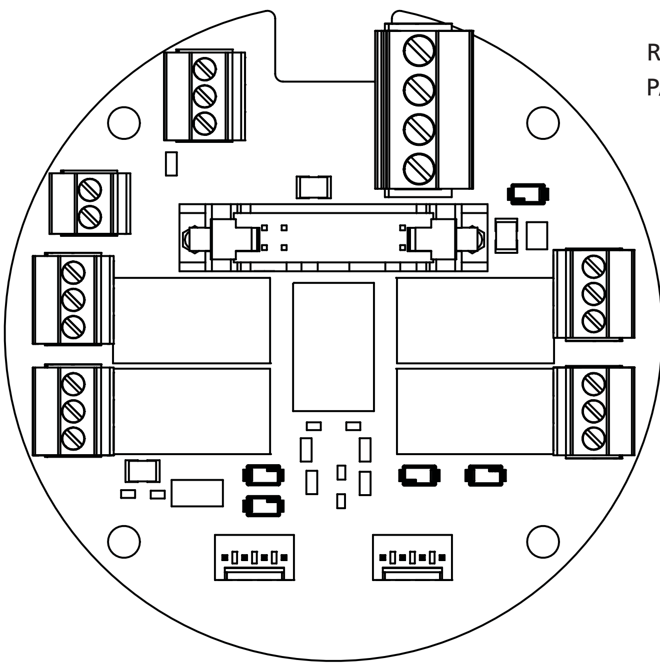
The “X” button, This button has multiple functions and will be discussed when applicable. However the “X” button allows the user to escape out of a menu selection, cancel a function or configuration, move between configuration selections, etc.

The “Enter” button, This button allows the user to enter into the transmitter configuration menu screens as well as accept a configuration selection or execute a function.

3.5 Relay Board

The BDS-50 Relay board provides all of the field wiring terminations for power, channel 1 and channel 2 analog 4-20 mA signals, relays, Modbus and alarm acknowledgement or discrete digital input. All wiring terminations have connectors that can be removed from the connector receptacle to assist with wiring.

Fig 3.5a



Relay Board
P/N 50-3002

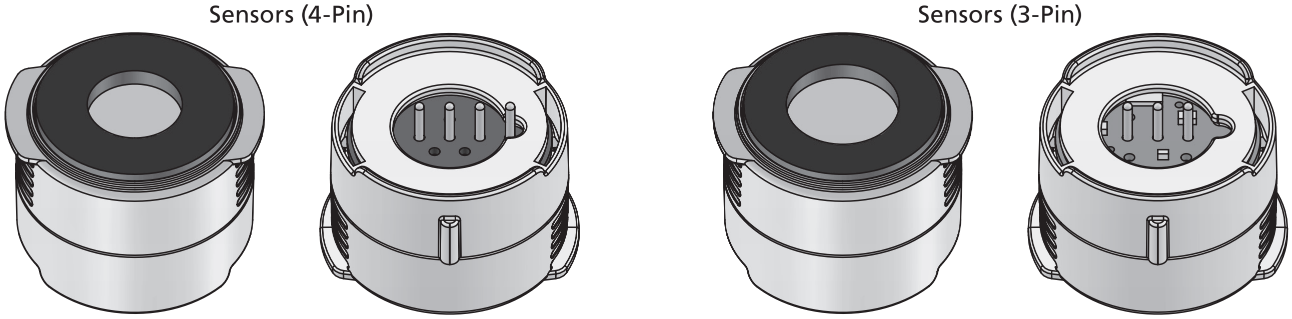
3.6 Sensor Cartridge

The BDS-50 has an unique sensor cartridge that is designed to allow all toxic and combustible sensors to be in one universal sensor cartridge. Once the sensor is installed into the sensor housing the sensor data is uploaded into the BDS-50 transmitter and is operational for any sensor installed without additional transmitter configuration.

Fig 3.6a

Combustible and CO2
Sensors (4-Pin)

Toxic and O2
Sensors (3-Pin)

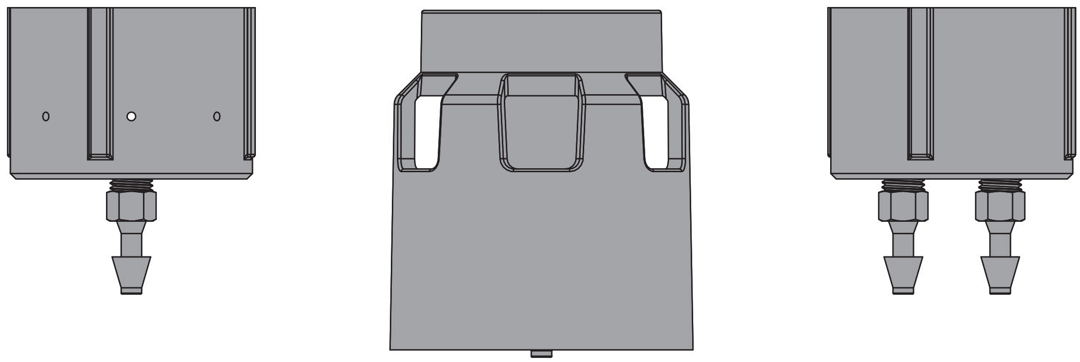


3.7 Sensor Housing Accessories

The BDS-50 sensor housing implements a quarter turn connection design to allow for easy attachment of the BDS-50 accessories such as the calibration adapter, weather guard and flow cell.

Fig 3.7

Calibration Adapter P/N 50-1009 | Weather Guard P/N 50-1008 | Flow Cell Adapter P/N 50-1010



3.7.1 Calibration Adapter

The calibration adapter allows the BDS-50 sensor housing / sensor to be connected to a Buckeye Detection Systems calibration kit.

3.7.2 Weather Guard Adapter

The weather guard adapter is recommended for applications in wash down areas, splash prone areas, outdoor weather elements, etc. The weather guard adapter has a ¼" tube barb that can be used as a bump test assembly for remote or elevated installations.

3.7.3 Flow Cell

The flow cell adapter allows the BDS-50 gas detector to be integrated into a sample draw system that allows the gas sample to flow in and out of the sensor housing.

4.0 INSTALLATION INSTRUCTIONS

4.1 Location

Consideration must be given to the following factors when choosing a location for mounting the BDS-50 transmitter.

Orientation – The BDS-50 should be mounted so that the transmitter sensor is pointed downward, failure to do so will restrict the sensor performance, allow for dust and contaminants and moisture to collect in the sensor housing preventing proper sensor diffusion detection.

Accessibility – When determining the BDS-50 mounting location, consider calibration procedures, future maintenance requirements and ease of location access.

Gas Density – For gases with densities greater than air, the BDS-50 should be installed approximately 18" from floor level. In these applications care should be taken to protect the sensors from physical damage. For gases with densities less than air, the Instrument should be installed at a high level or close to the potential leak source. For gases with densities equal to air, mount as close to potential leak source as practical. Ultimately transmitter placement is the responsibility of the end-user applicable to the application and safety concerns.

Air Flow – Factors such as air movement, gas density in relation to air, emission sources, gas interferences and environmental variables should be considered when determining the correct transmitter location. Air movement by fans, prevailing winds, exhaust duct, strong air-flow through a room, and convection should be carefully evaluated.

Gas Release Temperature – Evaluate the behavior of the gas when it is cooled or heated when released. Gases may rise or fall when first released but change as their temperature and properties change.

Avoid Pressure and Excessive Air Velocity – BDS-50 sensors are designed to detect gas concentrations under normal atmospheric conditions. Higher air velocities will result in inaccurate measurement.

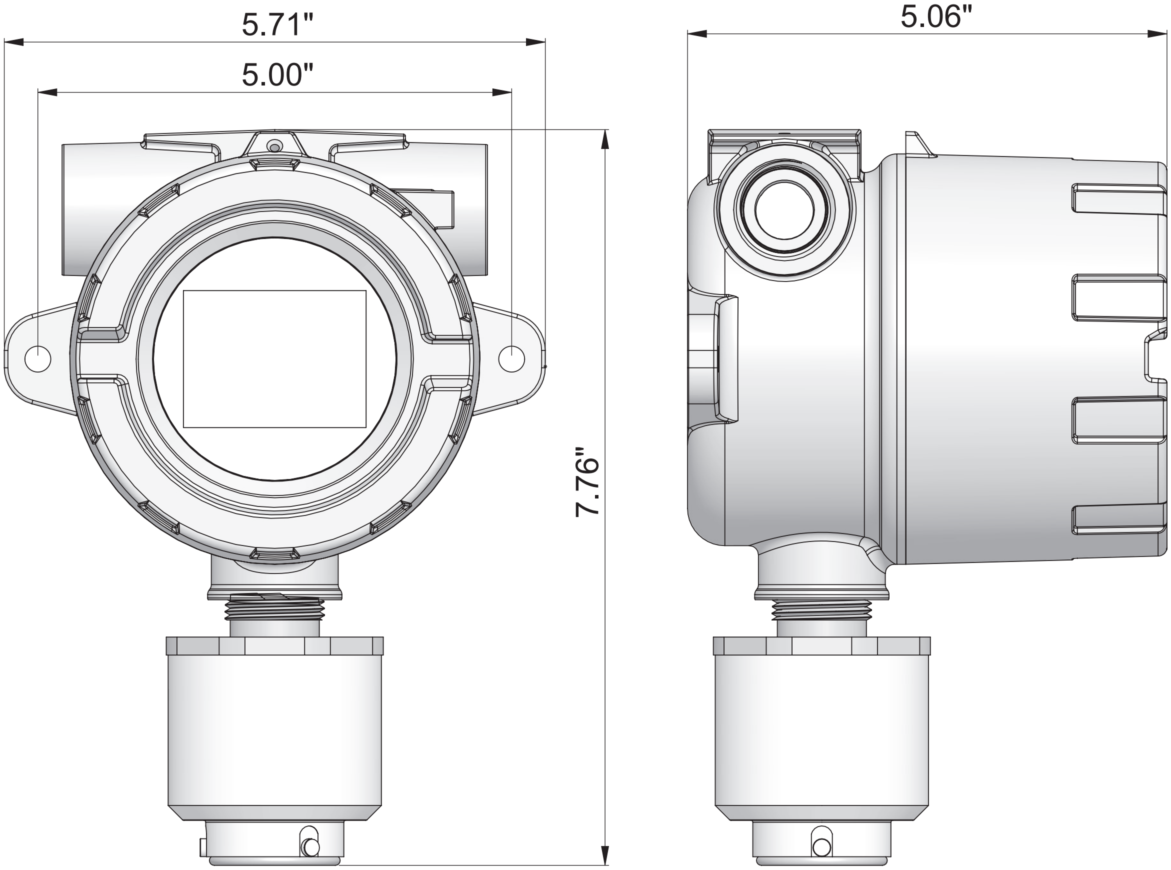
Ambient Temperature – Ensure that the device is located within an area that complies with the specified operating temperature range.

Environmental Damage – Effort should be made to protect the BDS-50 sensors from environmental damage caused by water, ice, shock, vibration, dirt, etc.

4.2 Mounting

The BDS-50 enclosure has a mounting flange with two mounting holes with a clearance for a ¼ inch bolt. The BDS-50 can be mounted on a flat surface or be pole mounted with the applicable hardware. The mounting infrastructure should be strong enough to maintain mounting and wiring / conduit integrity.

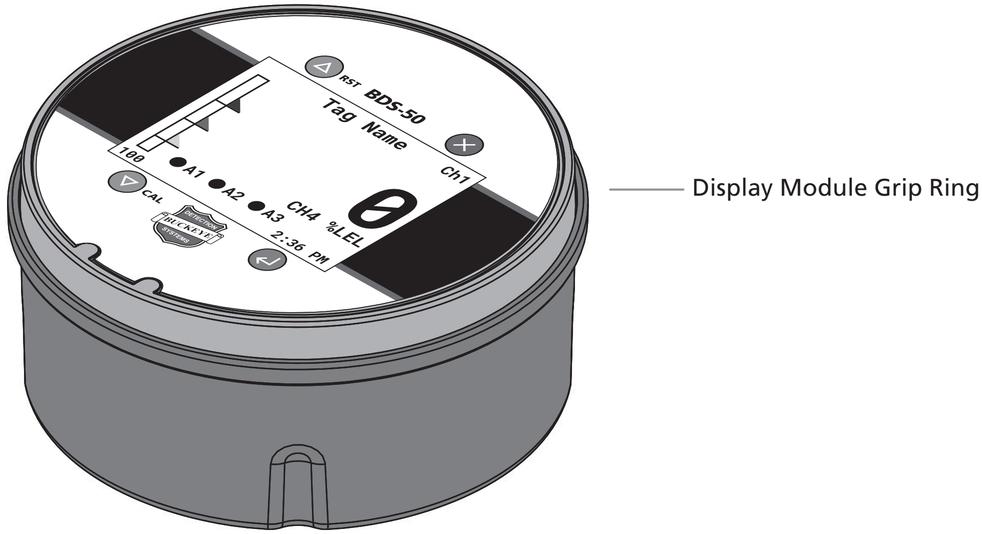
Fig 4.2a



4.3 Wiring

The BDS-50 relay board provides connectors for all field wiring terminations. Removing the display module "puck" allows access to the relay board connectors / terminations. To remove the display module firmly grip the display module grip ring and pull forward being careful as the display module is connected to the relay board via a ribbon cable.

Fig 4.3a

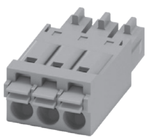


All field wiring terminations have removable connectors to allow easy wiring and wire routing management.

The BDS-50 has two types of removable terminals. A spring clamp terminal and a screw clamp terminal. The type of terminal shipped is determined by the BDS-50 transmitter part number.

The screw clamp terminal can be wired in place or removed from the terminal receptacle. The spring clamp terminal can remain in the terminal receptable and provides an alternative wiring implementation.

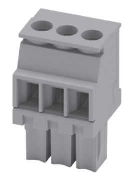
To wire the spring clamp terminal. Strip the wire insulation 10 mm (approx. 3/8”), with a small blade screwdriver press down the orange tab for the applicable termination point. Insert the wire fully into the terminal wire entry and release the orange tab. Test the connection with a slight pull-tug of the wire to ensure the mechanical connection of the termination.



Spring Clamp Terminal

2 and 3 position 24-16 Ga. range

4 position 24-16 Ga. range

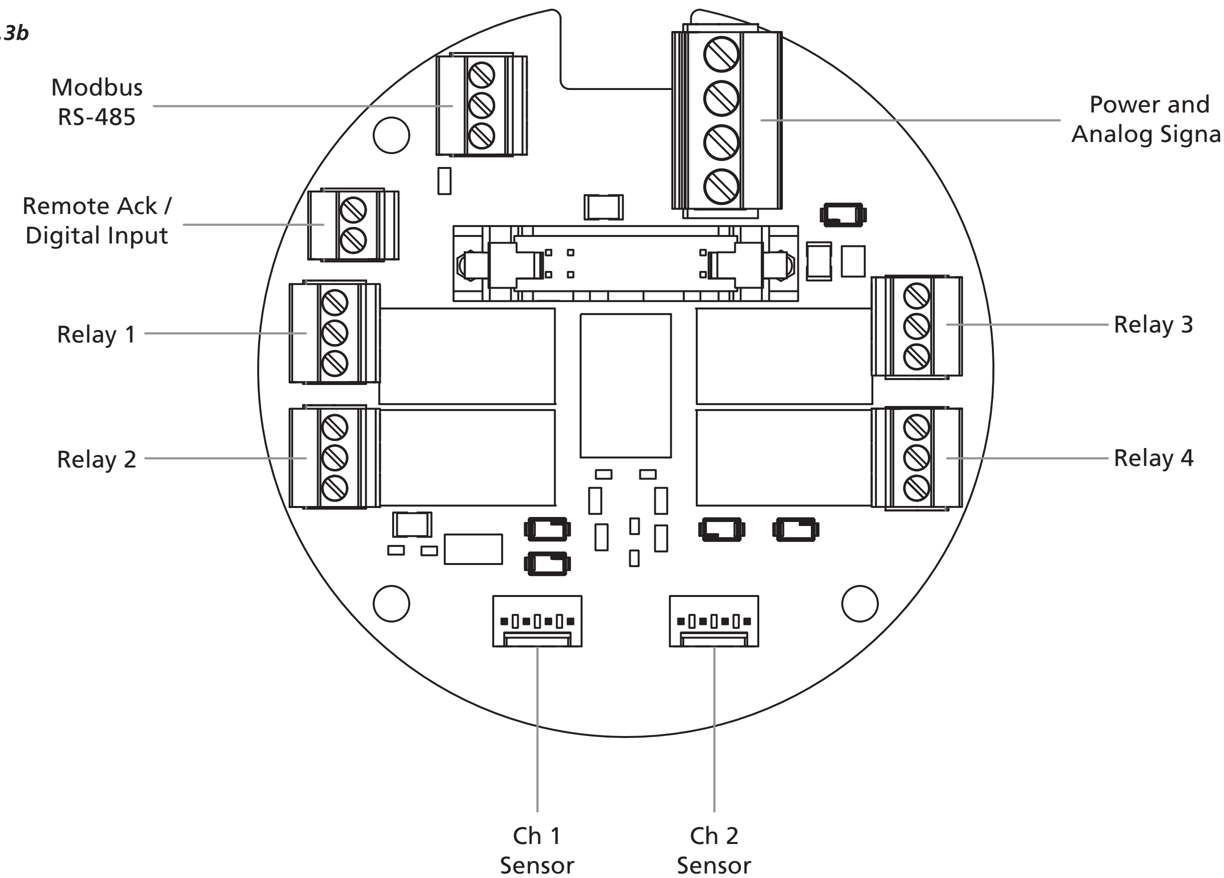


Screw Clamp Terminal

2 and 3 position 28-16 Ga. range

4 position 24-12 Ga. range

Fig 4.3b



4.3.1 Determining Wiring Parameters

Wire / Cable Recommendation – The BDS-50 is a sourcing transmitter that utilizes an analog 4-20 mA signal to communicate the transmitter concentration value to controllers, receivers, PLC, etc. The cable should be a 3 conductor (for single channel) or 4 conductor (for dual channel) shielded, (braided or foil wrapped) with a drain wire.

When the BDS-50 analog 4-20 mA signal is utilized the analog loop voltage drop is the determining factor for wire gauge and maximum length between the power supply / receiver input and the transmitter. The recommended wire gauge is 16 gauge and in most cases is sufficient for long distances within the 10-30 VDC range. The maximum distance between the transmitter and its power supply / controller is determined by the maximum allowable interconnecting loop-voltage drop. At the minimum 10 VDC supply power the max loop load is 300 ohms and at 30 VDC the max loop load is 1300 ohms, At a nominal 24 VDC the max loop load is 1000 ohms

For example: A BDS-50 powered by a nominal 24 VDC power supply is approximately 1000 feet from the power supply and PLC input. The "loop" consist of the PLC input resistor and the wiring. If the PLC input resistor is 250 ohms then the remaining loop resistance is 750 ohms. Since there is a loop wire and a +24 wire the wire resistance is doubled. 16 gauge wire would have an approximately resistance of 4 ohms per 1000 feet (times two = 8 ohms).

Conclusion: With the BDS-50 powered by a nominal 24 VDC at a 1000 feet distance from the power supply / PLC the "loop" resistance total is the PLC input resistance of 250 ohms plus the total wire (16 gauge) resistance of 8 ohms. The total "loop" resistance of 258 ohms is well below the allowed 1000 ohms available at a nominal 24 VDC supply.

4.3.2 Max Analog 4-20 mA Loop Resistance

The BDS-50 has the following nominal and max analog 4-20 mA loop resistance for the following common supply voltages.

Fig 4.3.2a

Supply Voltage	Rmax Nominal	Rmax
10 VDC	135	150
12 VDC	220	245
15 VDC	355	395
20 VDC	585	652
24 VDC	750	850
30 VDC	1030	1144

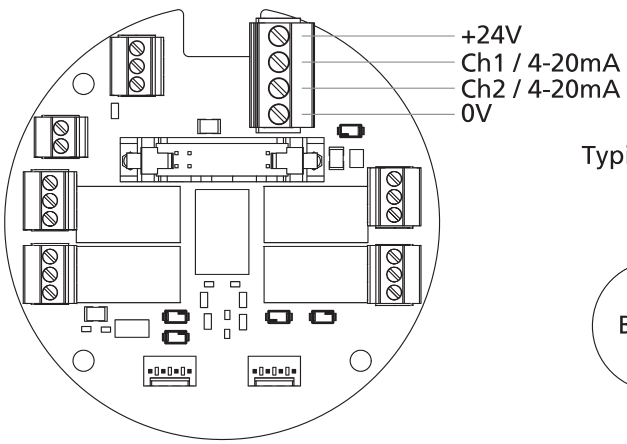
4.4 Wiring the BDS-50

4.4.1 Power and Analog Wiring

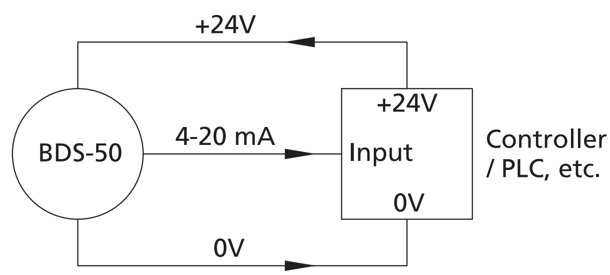
The BDS-50 power wiring and signal wiring are terminated on the relay board as shown in Fig 4.4.1a. The terminal block is equipped with a removable plug for ease of wiring and is marked "Power" on the relay board.

Fig 4.4.1a

Power and Analog Signal Terminations



Typical Analog Wiring (3 wire, Sourcing)

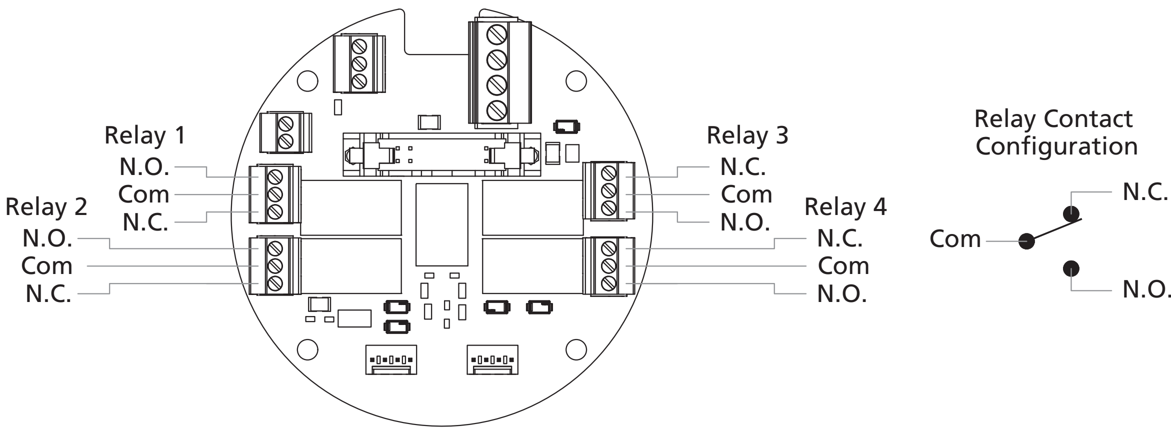


Note: The BDS-50 power terminations are reverse polarity protected to avoid power mis-wiring.

4.4.2 Relay Wiring

The BDS-50 is standard with four programmable relays and are wired on the relay board as shown in Fig 4.4.2a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Relay 1, Relay 2, Relay 3, and Relay 4. Each relay terminal is marked as N.O. (Normally Open), C, (Common) and N.C (Normally closed). These designators correspond to the quiescent (de-energized) state of the relay. When the relay is energized, the terminals reverse states. (see figure 4.4.2a below)

Fig 4.4.2a

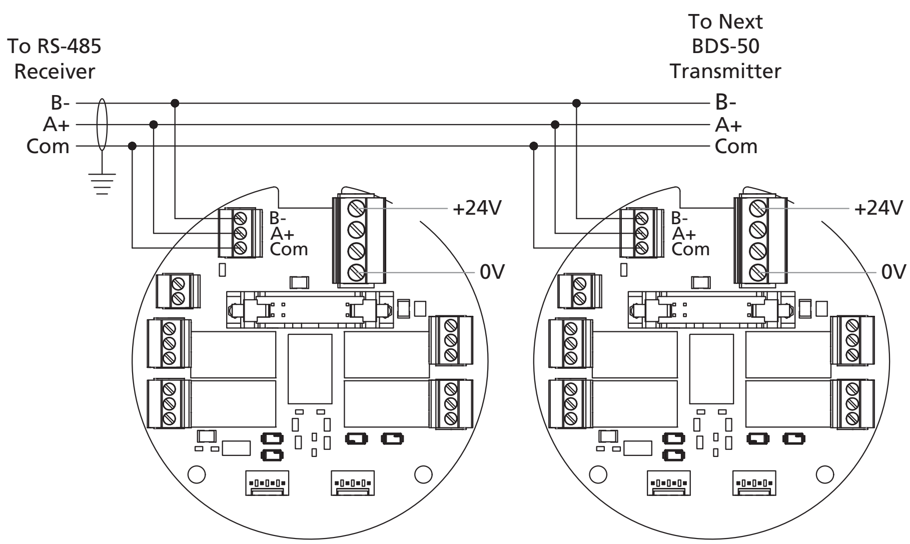


Relay Contacts are rated 250 VAC, 30 VDC, 5.0 A max. Resistive, Form "C".

4.4.3 Modbus Wiring

The BDS-50 is standard with RS-485 Modbus Communications and is wired on the relay board as shown in Fig 4.4.3a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Modbus. The terminal is marked B-, A+ and Com. A termination resistor is not required on the last transmitter.

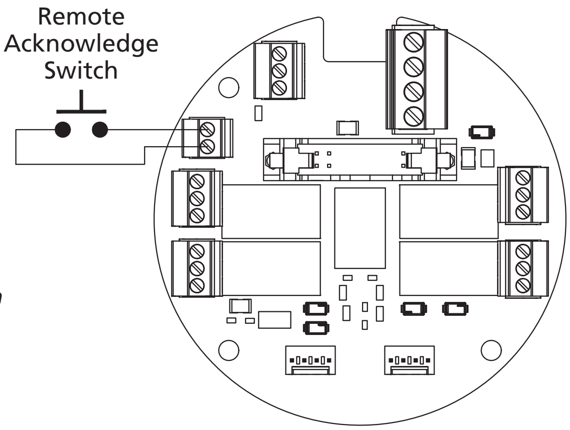
Fig 4.4.3a



4.4.4 Alarm Acknowledge and Digital Input

The BDS-50 is standard with an alarm acknowledge / reset and digital Input and is wired on the relay board as shown in Fig 4.4.4a. The terminal blocks are equipped with a removable plug for ease of wiring and the relay board is marked Alarm Ack, the terminal is marked Ack and Gnd. The termination allows for a remote switch to be implemented to remotely acknowledge an alarm or be used as a digital input to activate relays. Remote switch distance is max 75 feet at min 18 gauge.
(see figure 4.4.4a on the next page.)

Remote Acknowledge Switch Terminations



Digital Input Switch Terminations

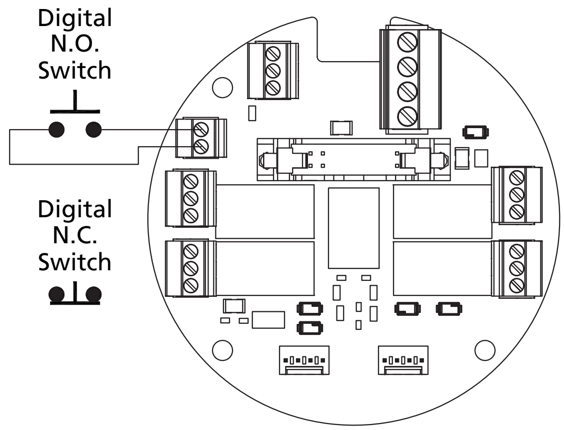


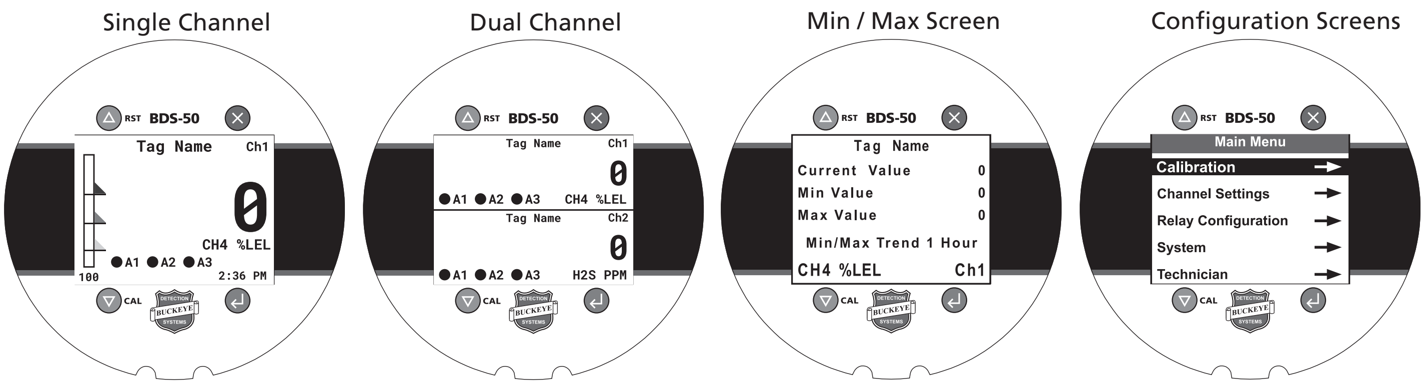
Fig 4.4.4a

5.0 BDS-50 DISPLAY SCREENS

The BDS-50 large color display provides the user with an enhanced transmitter interaction and configuration.

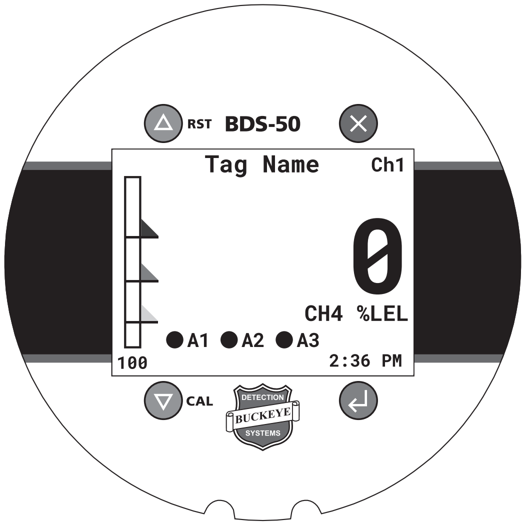
The BDS-50 has several main display screens that the user can select. In a single channel mode, tapping the "X" will cause the display to change from the enabled single channel screen to the same channel Min/Max screen. In a dual channel mode with both channels enabled, tapping the "X" will cause the display to change from the dual channel screen to the channel one min/max screen then the channel two min/max screen then the channel one main screen and then the channel 2 main screen.

Fig 5.0a



5.1 Single Channel Screen

Fig 5.1a

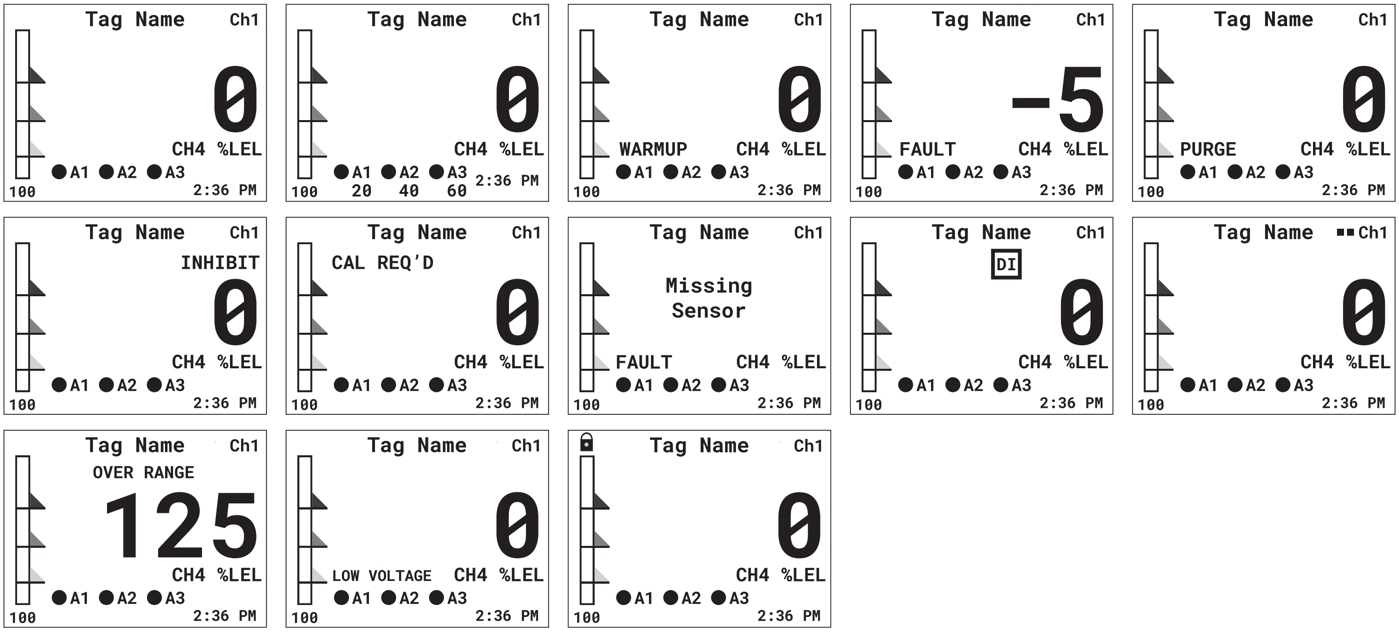


Single Channel

- Tag Name
- Channel No.
- Gas Concentration Value
- Engineering Units
- Bar Graph with Alarm Indicators
- Full Scale Value Indicator
- Alarm LED's with Alarm Setpoint
- Clock
- Warmup, Fault, Purge, Inhibit, Cal Req'd, Missing Sensor, and DI (Digital Input)

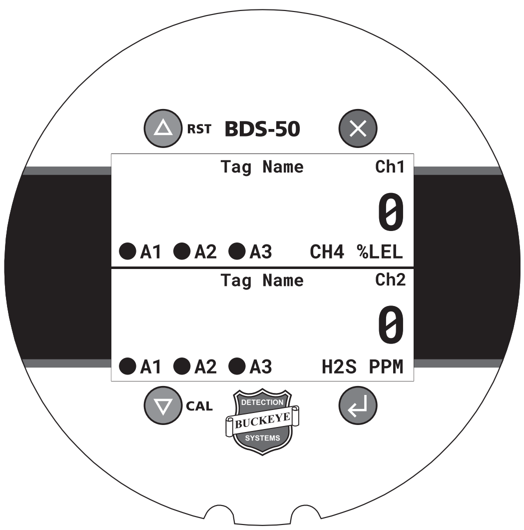
Single Channel Display Screens

Fig 5.1b



5.2 Dual Channel Screen

Fig 5.2a

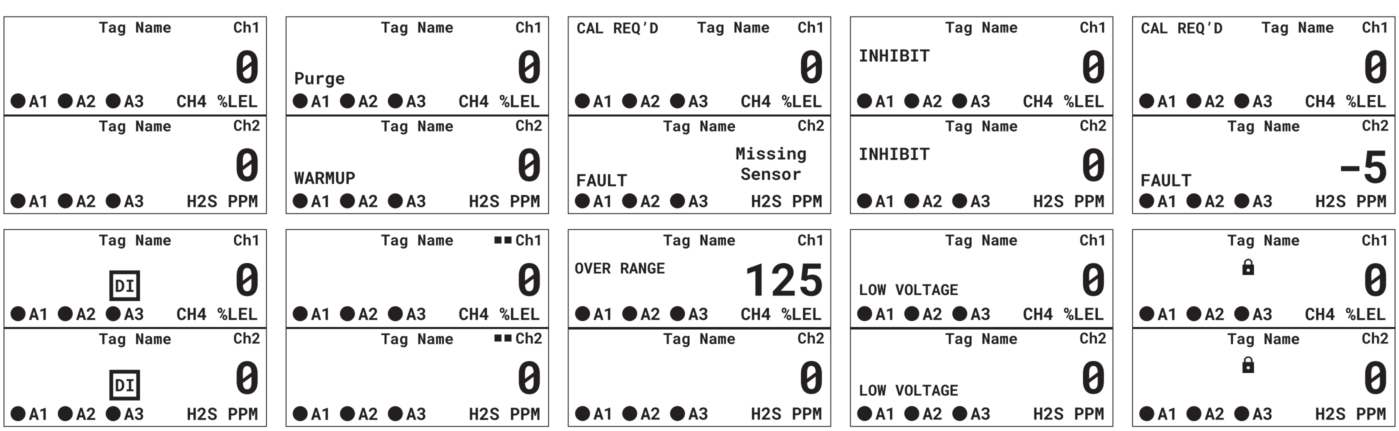


Dual Channel

- Dual Tag Name
- Dual Channel No.
- Dual Gas Concentration Value
- Dual Engineering Units
- Alarm LED's
- Warmup, Fault, Purge, Inhibit, Cal Req'd, Missing Sensor and DI (Digital Input)

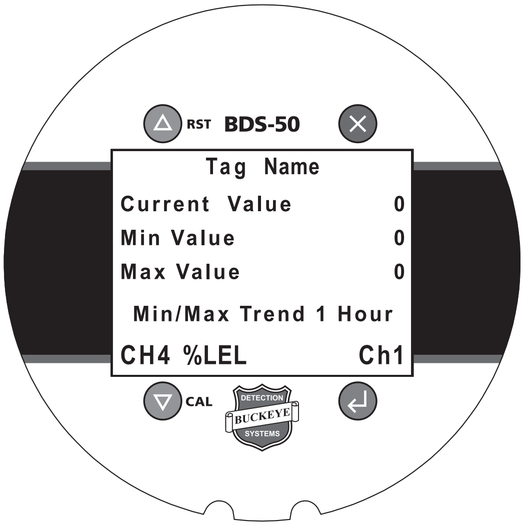
Dual Channel Display Screens

Fig 5.2b



5.3 Min/Max Screen

Fig 5.3a



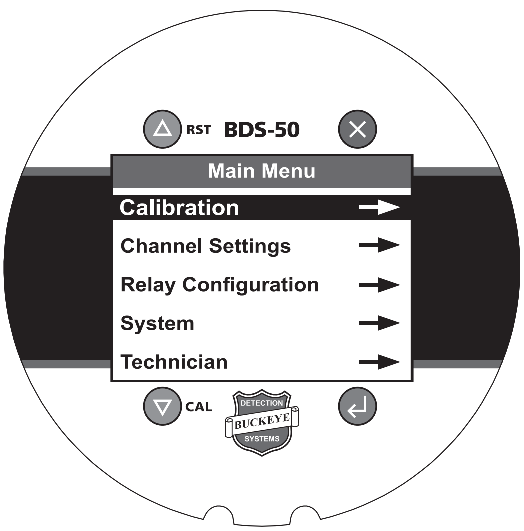
Min/Max Channel

- Tag Name
- Current Value
- Minimum Value
- Maximum Value
- Engineering units
- Channel No.

The BDS-50 gas detector tracks the gas concentration value for a duration of one hour and displays the minimum and maximum value on the Min/Max screen. The min/max displayed value is a continuous result of the past values for the past one hour from when the Min/Max screen is displayed. The min/max past one hour results can be reset at any given time by holding the magnet on the Up/RST button for two seconds. The reset feature is useful to track changes in a short period of time.

5.4 Configuration Screens

Fig 5.4a



Configuration Screen

- Calibration
- Channel Settings
- Relay Configuration
- System
- Technician

6.0 OPERATING THE BDS-50

Initially powering on the BDS-50 will display the Buckeye logo for about 5 seconds. The BDS-50 will perform a system check and display any sensor detected followed by a sensor data screen for each active channel then go to the single channel or dual channel main screen. If a sensor is missing in an active channel upon power-up then the display will show "missing sensor" once the main screen is displayed.

After the initial system check and the main screen is displayed the active channels will go into a warmup mode allowing the sensors to stabilize and inhibit all alarms and outputs. Once the warmup mode expires (default one minute) the BDS-50 will be operational "live" and display all transmitter current status conditions.

Note: Anytime a sensor is installed and initialized the BDS-50 will go into warmup mode and inhibit all alarms and outputs.

6.1 BDS-50 Main Menu Overview

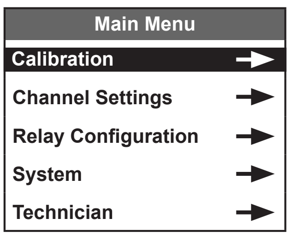
This section covers the various configuration parameters for the BDS-50. All configuration variables are selected via the menu screens and those variables are stored in the non-volatile memory. Many menu items contain default values from the factory and may require changes to better match the user application. Refer to section 7.0 for instruction and details for user interaction and navigating through the BDS-50 menus and configurations.

Quick Note: BDS-50 Magnetic Wand Interaction

- Tapping the wand on the "enter" button opens menu items, places the variable into edit mode and enters and saves new variables.
- Tapping the up or down arrow buttons moves the cursor "highlight" thru the active menu or variable choices.
- Tapping the "X" button can toggle the main screen through the single, dual, min/max screens, escape to the previous screen, move the cursor through variable selections, etc.
- The BDS-50 screens have a wand activation indicator in each corner to confirm to the user that the corresponding button was activated by a magnetic wand. This function assist the user when interacting with the BDS-50 with a magnetic wand.

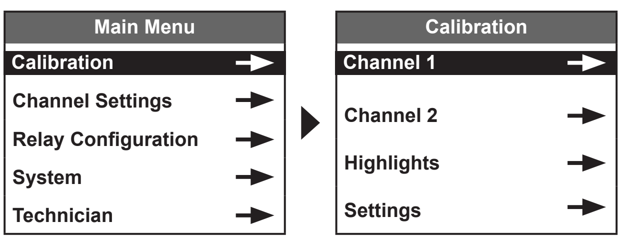
6.1.1 Main Menu

When the main operating screen is displayed, tapping the magnetic wand on the "Enter" button will access the BDS-50 Main menu. The main menu comprises of five categories with associated supporting screens.



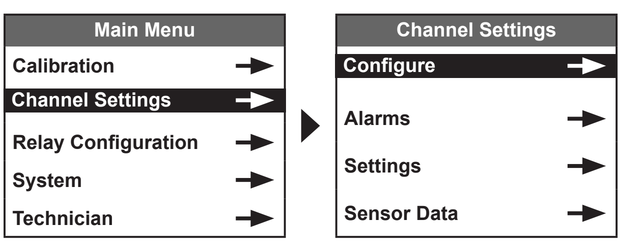
6.1.2 Calibration Menu

The Calibration menu allows the user to calibrate sensors, view calibration highlights and change the calibration time interval requirement.



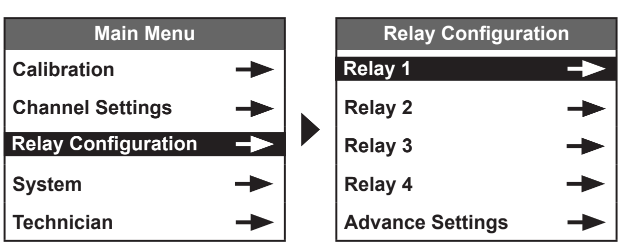
6.1.3 Channel Settings Menu

The Channel Settings menu allows the user to edit the channel configurations, information, alarms, settings and view sensor data.



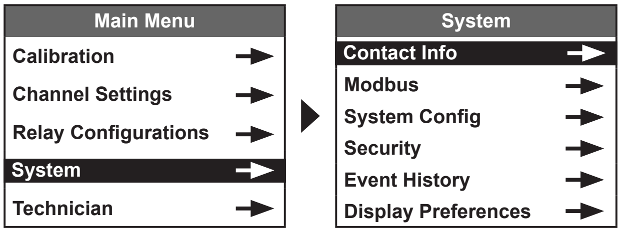
6.1.4 Relays Configuration Menu

The Relay Configuration menu allows the user to define the relay settings and assignments



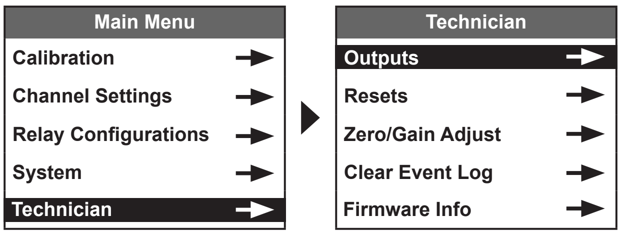
6.1.5 System Menu

The System Menu provides information and system parameter configurations for numerous functions of the BDS-50.



6.1.6 Technician Menu

The Technician Menu provides transmitter functions to test, simulate, clear event logs, etc.



6.2 Transmitter / Sensor Interaction

The BDS-50 gas detector is truly a universal transmitter that can be used with any Buckeye Detection Systems sensor type and sensor range. BDS-50 gas detectors are typically shipped with a sensor installed and the transmitter is ready for installation. However, BDS-50 gas detectors can be shipped without sensors or a sensor can be installed after installation or as a replacement.

When a sensor is inserted into a BDS-50 it runs a sensor profile check and the BDS-50 screen will prompt the user accordingly.

6.2.1 New Sensor / Same Type and Range

When a new sensor is inserted that is of the same type and range as the previous channel sensor data, the user will be prompted that a new sensor is detected and is of the same sensor type and range and the new sensor does not match the current channel data. The user will be prompted to upload the new sensor profile.

Note: If a sensor is removed and then re-inserted the BDS-50 will display sensor detected then the sensor data screen and then the user should choose not to upload sensor data. if the sensor data was altered, calibrated, etc prior to re-insertion then the new data should be uploaded.

6.2.2 Different Sensor Type

When a sensor is inserted that is a different type as the previous channel sensor data, the user will be prompted a new sensor is detected and the sensor type is different than the current channel data. The user has a choice to proceed and upload the sensor data or decline.

Decline: To decline the upload, highlight “No” by using the up/down arrow buttons and tap “Enter”. The display will prompt the user to Remove the Sensor and tap the “Enter” button after removal. This will allow the BDS-50 to resume the channel and sensor data as previous and the display will state “Missing Sensor” and “Fault”. Note: tapping the “X” button will change the display to the previous screen.

Accept: To accept the upload, highlight “Yes” by using the up/down arrow buttons and tap “Enter”. The BDS-50 will upload from the sensor all applicable sensor data and apply to the transmitter configurations. The BDS-50 will automatically go into a warmup mode.

Note: When a new sensor type is uploaded, the sensor type and range default alarm setpoints over-write previous setpoints.

6.2.3 Calibration

The BDS-50 gas detection monitor is recognized as a safety device when operated and maintained correctly. Verifying proper operation of the device in the form of zero calibration and span calibration is essential to ensure the device performs as intended. The frequency at which zero calibration and span calibration occur is best determined based on local regulatory standards, company policies, and industry best practices. Buckeye Detection Systems is not responsible for setting calibration interval policies or practices.

6.3 Calibration At a Glance

Zero Calibration is performed to establish baseline readings of atmospheres that are known to be free of toxic or combustible gases.

Span Calibration is performed to ensure the device detects target gases within specified operating parameters. Span Calibration is the adjustment of the gas detector sensor response to match a known concentration of gas. Sensors can lose sensitivity through normal degradation, humidity, temperature, exposure to high gas concentrations, age etc and should be calibrated periodically to ensure proper span adjustments are aligned with the sensor performance. Accurate calibration can be achieved only if specific concentrations of the correct gases are used.

Note: Although all BDS-50 sensors are calibrated at the factory. It is important to calibrate a sensor when its installed and powered to accommodate for atmospheric factors, (temperature, humidity, etc).

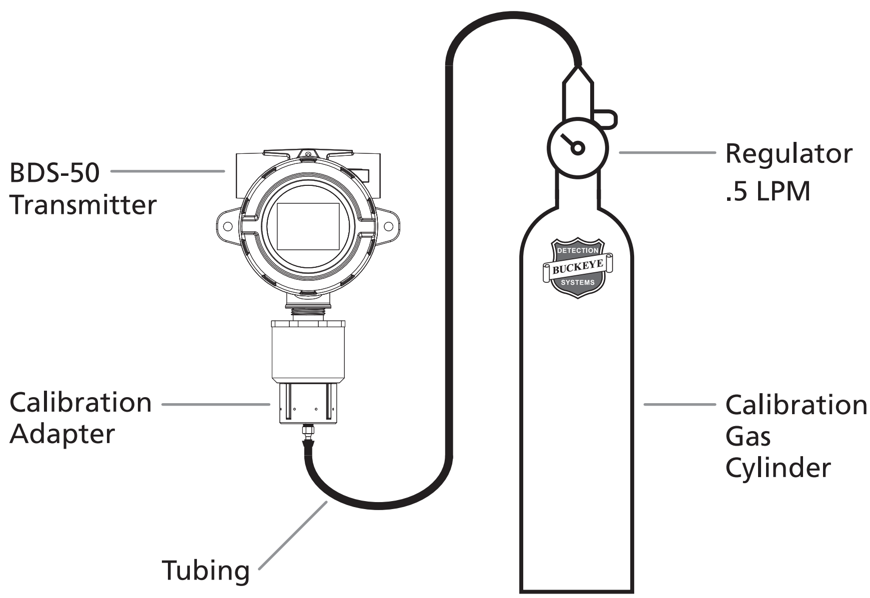
- Use the following guidelines for calibrating your BDS 50:
- Use calibration gases with National Institute of Standards and Technology (NISTS) trace ability.
- Only uses gases that have not exceeded their expiration date.
- Use proper Tygon or Teflon tubing that is applicable for the calibration gas
- Use a .5 LPM regulator for proper calibration gas flow
- Always calibrate a new sensor before it is commissioned for use.
- Create and maintain a regular calibration schedule as a part of preventive maintenance program.
- Ensure the calibration is performed in an environment free of background gases.

Note: Buckeye Detection Systems recommends, a calibration kit be ordered with the BDS-50 gas detector. All the components are included for a successful calibration, span calibration gas, zero calibration gas, regulator, calibration adapter and tubing are in the kit.

6.4 Typical Calibration Setup

The Buckeye Detections calibration kit would be assembled as shown below

Fig 6.4a



Note: Buckeye Detection Systems recommends using the appropriate tubing for a specific calibration gas. Tygon tubing is recommended for combustible gases and non-reactive gases. Teflon tubing is recommended for reactive "sticky" gases such as Ammonia, Chlorine, etc.

6.5 Calibration Procedure

The BDS-50 is designed so that calibration is an easy process. The following section provides step by step instructions to successfully calibrate a BDS-50 gas detection transmitter.

It's important that when a sensor is to be calibrated that the sensor has had ample time to stabilize with in its environment. Sensor types have various recommended burn-in times (powered) that are suggested prior to a calibration. Section 13.0 highlights recommended burn-in times for Buckeye Detection Systems sensors.

Once the sensor is ready for calibration and the user has the calibration kit assembled according to Fig 6.4a with the Zero Air calibration gas cylinder attached. The BDS-50 can then be placed into the calibration mode.

The BDS-50 can be placed into calibration mode by two different methods. Holding the magnetic wand on the Cal button (down arrow) for three seconds or by going into the main menu by tapping the enter button and navigating to the calibration procedure per the below sequence

Main Menu
Calibration →
Channel Settings →
Relay Configuration →
System →
Technician →

Calibration
Channel 1 →
Channel 2 →
Highlights →
Settings →

Once in the calibration procedure for the selected channel / sensor the following screen will be displayed for the applicable channel. Tap the enter button to proceed with the calibration or if required tap the "X" button to cancel the calibration and the BDS-50 will go back to the main operating screen.

Channel 1 Calibration
Channel 1
Enter Key to Proceed with Calibration
"X" Key to Cancel

6.5.1 Zero Calibration

Establishing a good "zeroing" is of the utmost importance for a successful calibration. It is recommended to use zero air to flush any background gases or impurities from the sensor to avoid zero offsets. Once in the Zero calibration screen as shown below, apply the zero air by turning on the .5 LPM regulator attached to the zero air calibration gas cylinder.

With the zero air flowing, the "live" reading in red will provide a real time zeroing response. It's a good practice to let the zero air flow long enough to allow the reading to reach "0" or stabilize close to "0" to establish a good zero baseline. When "0" is reached and or stabilized close to "0" tap the enter button to accept the zero calibration value and the screen will display "Cal Set" confirming the zero calibration was set. The BDS-50 will then display "Zero Calibration Successful"

Channel 1
Apply Zero Air to Sensor
0.0
Methane %LEL
Cal Time Expires: 3:24
Enter to Accept Zero Cal
"X" Key to Cancel

Channel 1
Apply Zero Air to Sensor
0.0
Methane %LEL
Cal Set
"X" Key to Cancel

Channel 1
Zero
Calibration Successful

The zero calibration screen has a five minute timer that provides the user an indication of how much time the Zero Air has been flowing as well as how much time is left before the zero calibration mode expires. If the user does not tap the enter button to set the zero calibration before the timer expires the BDS-50 will display "Calibration Time Exceeded". When the calibrated time exceeded screen is displayed the user has the option to tap the enter button to proceed back to the main operating screen or after a few seconds the BDS-50 will automatically go back to the main operating screen.

Note: An approximate time for the zero air to flow across the sensor would be 30 – 90 seconds or when the "live" reading has reached "0" or a reading close to "0" and has stabilized.

Note: An unsuccessful zero calibration can result if the "live" reading is too high of a percentage of the full scale. If this occurs the calibration procedure will not allow the user to proceed to the span calibration. Evaluate the calibration setup and resolve any issues that could prevent a successful zero calibration and enter the calibration procedure again.

Note: When zeroing an O2 (oxygen) sensor, Nitrogen gas must be used to provide a complete absence provide a complete absence of O2 to properly zero an O2 sensor.

Note: When a background gas is suspected, applying zero air to a sensor can be a good tool to see if the current value goes to zero or is reduced significantly.

Note: The calibration of a sensor / gas detector remains within the sensor memory.

6.5.2 Span Calibration

Calibration span gas that matches the "target" gas should be used whenever possible. It's important that the span gas concentration value matches the "Span Value" located in the channel configuration menu as this is the value the BDS-50 gas detector will span to. Default span values are uploaded from the sensor to the BDS-50 gas detector for all sensors. if a different span value other than the default is to be used then Buckeye Detection Systems recommends to use a span gas concentration that is within 25 – 75 % of the sensor range or approximate of the alarm setpoints to be used.

Note: For some applications a surrogate gas with a K-factor may be applied to simulate the target gas when the target gas is not readily available as a calibration gas standard. Surrogate calibration gases and K-factors will be discussed in a separate section.

A successful span calibration after a completed zero calibration aligns the BDS-50 to have an accurate response to a given gas concentration within the sensor type and range of the target gas. The BDS-50 span calibration can only be performed after a successful zero calibration. Once the zero calibration success screen is displayed the BDS-50 will automatically move to the span calibration screen as shown below.

Channel 1

Apply Span Gas to Sensor
0.0
Methane %LEL
Cal Time Expires: 2:45
Enter to Accept Span Cal
"X" Key to Cancel

With the span calibration screen as shown above. Apply the span calibration gas by turning on the .5 LPM regulator attached to the span gas calibration gas cylinder. With the span gas flowing, the "live" reading in red will provide a real time span gas response. It's a good practice to let the span gas flow long enough to allow the sensor to reach its fullest response as well as to reach a stabilized value.

When the span gas is first applied the "live" reading will rapidly climb to a value and then the value will increase slowly until it stabilizes. When the sensor has reached its maximum response and is stabilized tap the enter button to accept the span calibration and the screen will display "Cal Set" confirming the span calibration was set to the configured Span Value. The BDS-50 will then display "Span Calibration Successful" and to remove the span calibration gas.

Channel 1		Channel 1		Channel 1		Channel 1
Apply Span Gas to Sensor 0.0 Methane %LEL Cal Time Expires: 2:45 Enter to Accept Span Cal "X" Key to Cancel	▶	Apply Span Gas to Sensor 50.0 Methane %LEL Cal Set "X" Key to Cancel	▶	Span Calibration Successful 50.0 Methane %LEL	▶	Remove Span Calibration Gas

Following the span calibration successful screen and remove the span calibration gas screen the BDS-50 will display a "Sensor Life" screen (See next page) indicating an approximate life percentage that the sensor has remaining based on previous calibrations and gain applied during calibrations. Although the sensor life value is an approximation, it's a good indicator of sensor life to support maintenance schedules and sensor replacement.

Channel 1

Sensor Life	98%
Cal Date	11/10/2021

Once the Span Value was "Set" the BDS-50 will go into a purge mode that allows the outputs to be inhibited while the sensor recovers to zero to avoid false alarms, etc. During the purge mode the main screen will display "Purge" for the default time period of 60 seconds. The purge time period is adjustable in the system config menu.

Like the zero calibration screen the span calibration screen has a five minute timer that provides the user an indication of how much time the span gas has been flowing as well as how much time is left before the Span Calibration mode expires. If the user does not tap the enter button to set the Span Calibration before the timer expires the BDS-50 will display "Calibration Time Exceeded". When the calibrated time exceeded screen is displayed the user has the option to tap the enter button to proceed back to the main operating screen or after a few seconds the BDS-50 will automatically go back to the main operating screen.

Note: Both zero and span calibrations algorithms have parameters that must be met to provide a successful zero or span calibration. In the event that a zero or span calibration fails the BDS-50 will provide a calibration failed / out of range screen and the user can choose the "X" key to cancel or after five minutes the BDS-50 will return back to the main operating screen.

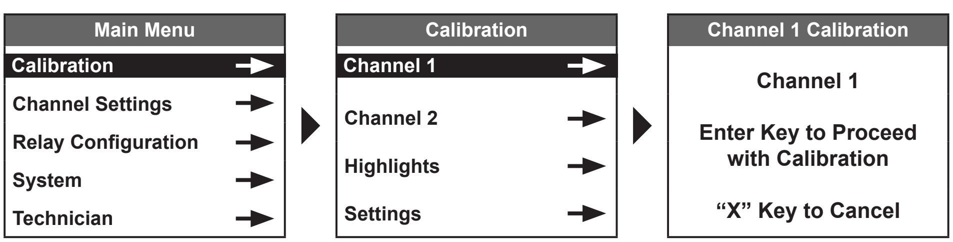
Note: During a calibration procedure, the BDS-50 is not detecting hazardous gases. Thus, gas monitoring and alarms are inhibited. During this time the 4-20 mA signal will be inhibited to the default of 4mA for all toxics and combustibles and a default of 17.38 mA for O2 (oxygen). The inhibit mA level is adjustable under the channel settings screen and will be discussed in another section.

7.0 NAVIGATING & UNDERSTANDING MENUS BDS-50 FUNCTIONS & CONFIGURATIONS

Quick Note: BDS-50 Magnetic Wand Interaction

- Tapping the wand on the "enter" button opens menu items, places the variable into edit mode and enters and saves new variables.
- Tapping the up or down arrow buttons moves the cursor "highlight" thru the active menu or variable choices.
- Tapping the "X" button can toggle the main screen through the single, dual, min/max screens, escape to the previous screen, move the cursor through variable selections, etc.
- The BDS-50 screens have a wand activation indicator in each corner to confirm to the user that the corresponding button was activated by a magnetic wand. This function assist the user when interacting with the BDS-50 with a magnetic wand.

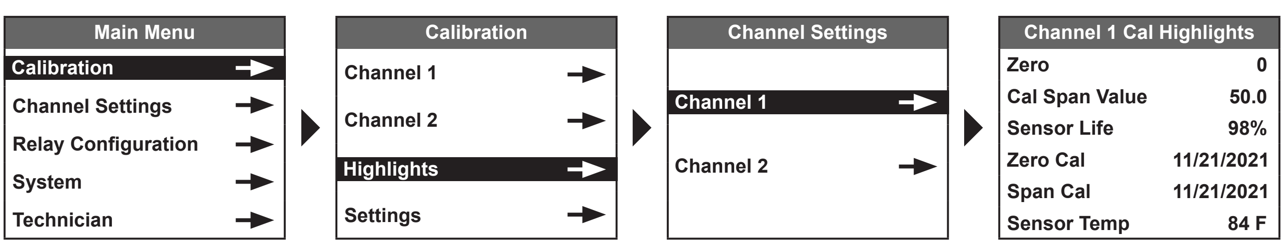
7.1 Calibration



7.1.1 Channel 1 / Channel 2

As highlighted in the calibration section, the calibration procedure is accessed via the calibration menu and the user is given the option to calibrate channel 1 or channel 2

7.1.2 Highlights



The calibration highlights screen provides a static overview of the calibration data and parameters for that particular channel.

Zero

This is the value that the sensor / gas detector will be zeroed to during a calibration procedure.

Cal Span Value

This is the value that the sensor / gas detector will be spanned to during a calibration procedure. This value can be changed.

Sensor Life

The sensor life value is an inverse representation of the sensors gain that is applied during a calibration procedure. The more gain required during a span calibration the less the sensor life is available. This function is a good tool to gauge the degradation of the sensor and assist with sensor replacement.

Last Zero Cal

The BDS-50 tracks the last date the sensor was zeroed during a calibration procedure

Last Span Cal

The BDS-50 tracks the last date the sensor was spanned during a calibration procedure

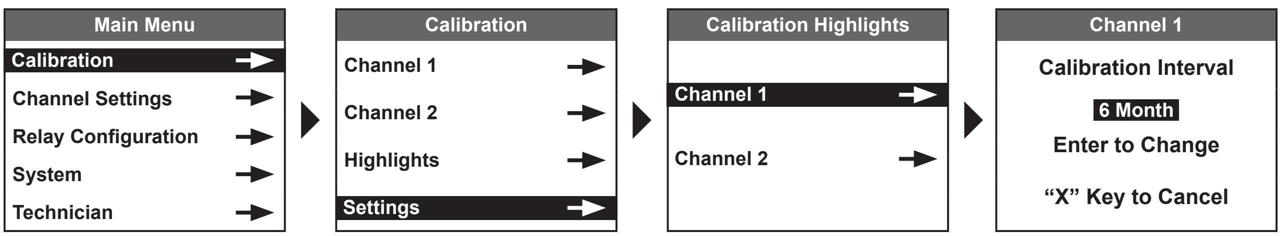
Sensor Temp

The BDS-50 sensors provide continuous temperature readings to facilitate gas response temperature compensation.

7.1.3 Settings

Calibration Interval

This function allows the user to setup a calibration interval that will monitor the last time the sensor / gas detector was calibrated and then display a “Cal REQ’D” on the main operating screen when the calibration interval has expired.

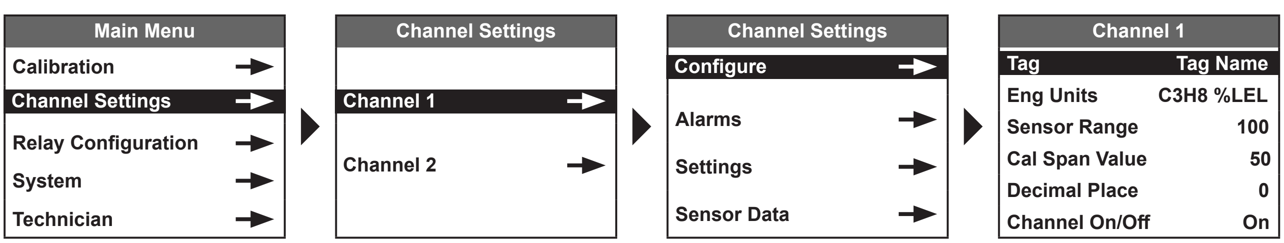


To edit, navigate through the calibration menu as shown above which will open the channel calibration interval screen. The user can view the current interval value and then scroll through calibration interval time period options by tapping the enter button and tap the up/down buttons. Once the new calibration interval has been selected the user can tap the enter button to save the selection or to exit tap the “X” button to cancel.

⚠ **Note:** If a calibration interval option is selected and the user taps the “X” button to cancel then the previous calibration interval will remain as the selected calibration interval time period. Default = “None” , Options = None, 1 week, 2 weeks, 1 month, 3 months, 6 months, 9 months, 12 months.

7.2 Channel Settings

7.2.1 Configure



Tag Name

The Tag Name is a user configurable field that can be used to identify the BDS-50 gas detector with a unique name, number, location, etc. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The tag name will appear on both a single or dual screen. Default = “Tag Name”

Eng Units

The Eng Units is a configurable field that can be used to identify the BDS-50 gas detector target gas with a unique engineering unit name. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The tag name will appear on both a single or dual screen. Default = The default engineering unit is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Sensor Range

The sensor range is a view only value that is uploaded from the sensor upon installation when a new type of sensor is installed and upload selected.

Cal Span Value

The Cal Span Value is the value that the BDS-50 will use to span to during a span calibration procedure. The cal span value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected. The cal span value can be edited by the user if a different calibration gas concentration is to be used for span calibration or if a surrogate gas with a K-factor is to be used. (K-factor will be discussed in a later section) Default = The cal span value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected

Decimal Place

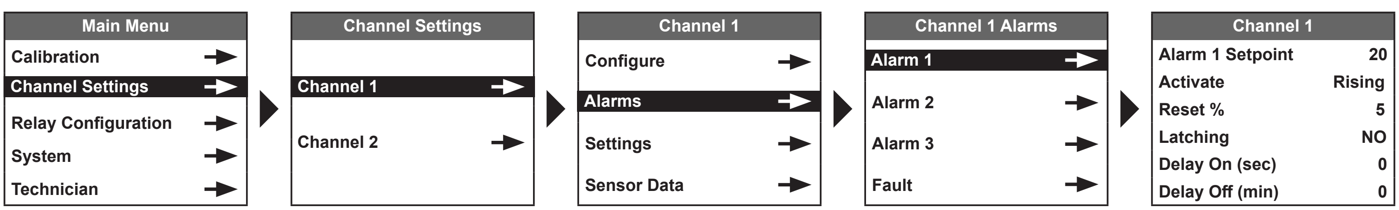
The decimal place value is a user configurable field and allows the user to define a lower or higher resolution of the displayed concentration value. The number of available decimal places to the right are defined by the full range of the sensor. Default = The Decimal Place value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Channel On/Off

The Channel On/Off function allows the gas detector selected channel to be enabled or dis-enabled. Note: The BDS-50 must have at least one channel on at all times. If a user attempts to turn both channels off the BDS-50 will display an error and will prevent the channel from being dis-enabled.

7.2.2 Alarms (A1, A2, A3)

The BDS-50 channel alarming structure is designed to provide many programming features to allow the user to define parameters for various alarms. The BDS-50 provides three alarm levels as well as a fault level per each channel. Alarm 1, Alarm 2 and Alarm 3 all have the same configuration screen, thus only "Alarm 1" configuration screen will be discussed.



Note: The main display as well as some configurations abbreviate Alarm 1 as "A1", Alarm 2 as "A2" and Alarm 3 as "A3"

Alarm Setpoint

The alarm setpoint is a value that sets the threshold for an alarm to activate. The user can edit the setpoint within the sensor full range. Default = The alarm setpoint value is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected. User defined setpoints are maintained in the gas detector unless a new sensor type or range is installed and uploaded.

Activate

Alarms can be defined to activate upon a rising or falling value. Most target gases and applications are triggered by a rising value that exceeds the alarm setpoint. However with an O2 (oxygen) sensor its typical for the alarms to be activated upon a falling value that exceeds the alarm setpoint. In some cases an application may require an alarm to be of a falling value and another to be a rising value thus each alarm can be independently configured to be rising or falling. Example: An O2 application where alarm 1 and alarm 2 are configured to be a falling to alarm for O2 deficiency and A3 would be configured for rising to alarm for O2 enrichment. Default = The rising or falling parameter is uploaded from the sensor upon installation when a new type of sensor is installed and upload is selected.

Reset %

The reset percentage is a value that defines the percentage of the full scale range that the alarm value needs to exceed before deactivating an activated alarm. Example: If a reset percentage value was five for a 0-100 full range sensor and an A1 setpoint was at 20, then the once the alarm activated at 20 the value would need to fall below 15 before the alarm deactivated (5% of 100 = 5). Default = 5.

Latching

The latching function allows the user to set the alarm to be latched or unlatched after an activated alarm is deactivated. Unlatched allows the alarm to reset automatically once the channel concentration value exceeds the Reset % value. Latched allows the alarm to remain in the alarm state even though the channel concentration value has exceeded the Reset % value. To reset a latched alarm, tap the Up or RST (reset) button to acknowledge (reset) the latched alarm. Note: To acknowledge the latched alarm the channel concentration value must exceed the reset % value. Default = No.

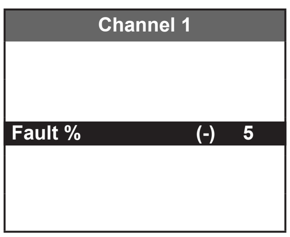
Delay On

The delay on value (maximum 10 seconds) delays the activation of an alarm when the channel concentration value exceeds the alarm setpoint. This function can reduce nuisance or false alarms within an application. Default = 0

Delay Off

The delay off value (maximum 120 minutes) delays the de-activation of an alarm when the channel concentration value exceeds the alarm reset % value. This function can hold an alarm active for a period of time after the alarm would typically reset. Default = 0

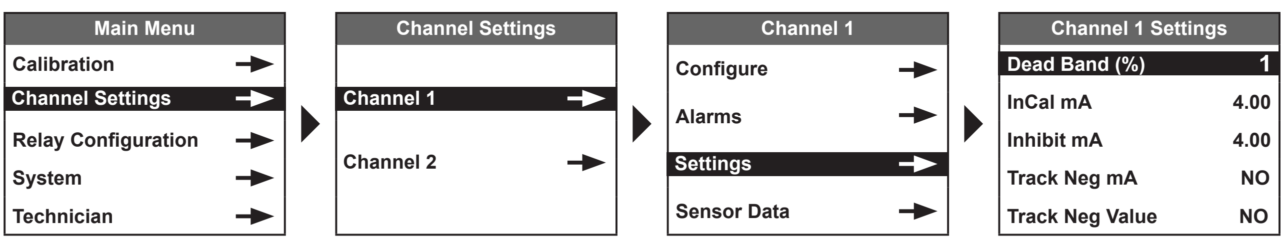
Alarms (Fault)



Fault

The negative drift fault alarm value is a percentage (maximum 10%) of the sensor full scale range. The value is the negative drift tolerance that the concentration value can fall below zero before the fault alarm is activated. Default = 10%

7.2.3 Settings



Deadband %

The deadband percentage value allows low concentration readings to continue to read zero. This is useful when there are small amounts of background gases that cause fluctuating concentration values above zero. The maximum amount of deadband allowed is 5%. Default = 1% Note: deadband affects the 4-20mA output signal and Modbus value register.

InCal mA

The InCal mA value allows the user to adjust the analog 4-20 mA output signal to lock in at a set value when the BDS-50 is in the calibration and purge mode. Default = 4.00 mA for all toxic and combustible sensors and 17.38 mA for O2 sensors.

Inhibit mA

The Inhibit mA value allows the user to adjust the analog 4-20 mA output signal to lock in at a set value when the BDS-50 is placed into the inhibit mode. The inhibit function allows the user to place the gas detector outputs and relays in a non-responsive mode. This function is useful when bump testing the BDS-50, sensor replacement or general maintenance. Default = 4.00 mA for all toxic and combustible sensors and 17.38 mA for O2 sensors.

To place the BDS-50 transmitter into an inhibit mode, hold the magnetic wand on the “Up” button for three (3) seconds. The Inhibit icon will appear on the display and will remain in inhibit for up to five (5) minutes. To manually exit the Inhibit mode hold the magnetic wand over the “Up” button for two (2) seconds.

Track Negative mA

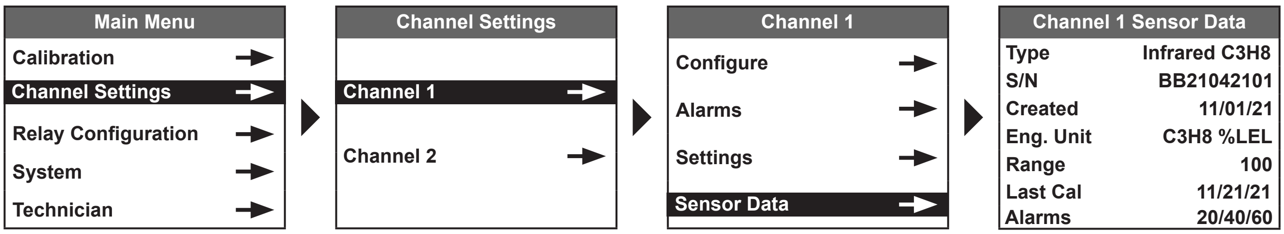
The track negative mA function allows the user to prevent the analog 4-20 mA output signal to follow the concentration value when it falls below zero. Default = No

Track Negative Value

The track negative value function allows the user to prevent the displayed readout value to follow the concentration value when it falls below zero. Default = No

7.2.4 Channel Sensor Data

The sensor data screen is a read only (non-edit) screen that provides an overview of default sensor parameters and user edited parameters.



Type

This is the type of sensor used (electrochemical “echem”, Infrared “IR”, pellister “cat-bead”, etc) and the target gas.

S/N

Each sensor cartridge has its own unique serial number that is programmed into the sensor when the sensor cartridge is assembled and configured. The serial number represents various information pertaining to the sensor programmed parameters.

- The sensor SN shall possess the following structure. TTYYMMDDXX
- TT = two-digit alpha defining the sensor gas.
- YY = two digit numeric defining the year
- MM = two digit numeric defining the month
- DD = two digit numeric defining the day of the month
- XX = two digit numeric with range 01- 99 defining the sensor production sequence

Created

When the sensor cartridge is assembled and programmed the sensor “created” date will be date-stamped accordingly.

Eng. Unit

The engineering unit is a unit of measure that defines the target gas. The engineering unit is uploaded from the sensor as a default per the sensor type but can be edited by the user per their preference or application specifics. Ex: LEL%, PPM, PPB, % , etc.

Range

The range value is the full scale range of the sensor. This value is uploaded from the sensor and is not an edited parameter.

Last Cal

The last cal date is a date-stamp which represents the last successful zero and span calibration.

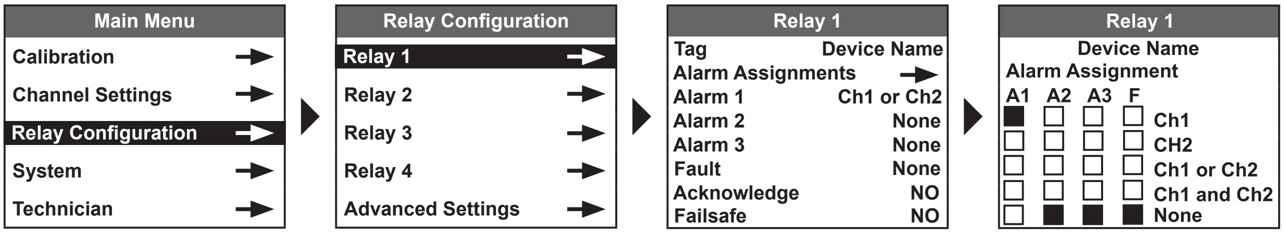
Alarms

The alarm values are the current alarm setpoints for A1, A2 and A3 alarm levels. Alarm setpoint values are uploaded from a sensor when a new sensor “type” is installed. The alarm setpoints can be edited will be displayed as the current alarm setpoints and will remain with the sensor cartridge.

7.3 Relay Configuration

The BDS-50 is standard with four relays that have an extensive programmable function that allows the user to assign channel 1 and / or channel 2 alarms with various relays and combinations. The relay configuration menu has a unique programming user interaction that provides easy and straight forward programming for the relay assignments and configurations. The relay configuration menu has four separate relay menus for Relay 1, 2, 3 and 4 that are identical in function, therefor only Relay 1 menu will be reviewed. Note: Relay 4 menu has the "failsafe" default as "YES"

The BDS-50 gas detector has an Advanced Settings menu that configures the Alarm Ack switch input termination to be used as a remote Alarm Acknowledgement switch input or as a Digital input switch to activate assigned relays.



7.3.1 Relays

The relay 1,2,3 and 4 menu is a multi-purpose screen that incorporates Device Name editing, relay assignment supporting menus, relay assignment overview, and relay configuration.

Tag

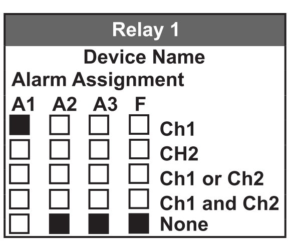
The BDS-50 implemented a function so that the user can assign a device name (ex. strobe, fan, horn, fire panel, etc) to each relay to assist with relay identification and programming. The device name is a user configurable field that can be used to identify the device that the relay is activating. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available. The device name will appear on the relay assignment screen and the relay test screen. Default = "Device Name"

Alarm Assignments

The BDS-50 gas detector relays can be assigned to various channel alarms as well as and/or combinations. The Device Name appears at the top of the screen to provide a relay to device identification and purpose. The assignment screen consist of boxes that when are selected have a solid box appearance and when not selected a box outline appearance.

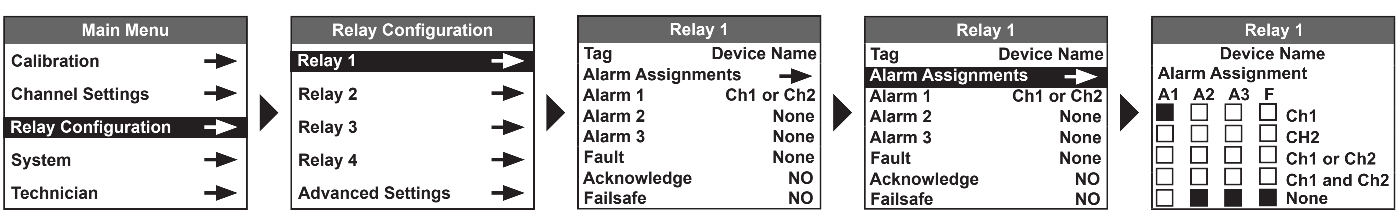
The relay assignment matrix is easily programmed by selected the alarm level and the channel or channel combination for the relay to activate. Each column under the alarms A1, A2, A3 and F (fault) can be selected per the channel or channel combination and/or condition or None.

Example, If the relay 1 was to activate only when channel 1 went into an alarm 1 (A1) condition then the following programming would be as follows



Relay Assignment Programming

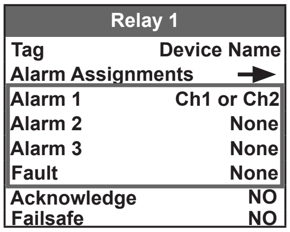
To program the relay for a specific alarm level and channel or channel combination. Enter the Alarm Assignment screen by using the Up/Down buttons to highlight the Relay Assignments menu and tap the Enter button.



When the alarm assignments programming screen is displayed a selection box will flash like a cursor in the A1 column, to select a new box within that column move the cursor with the Up/Down buttons to the desired box and tap the “X” button to accept the selection and the flashing box will become a solid black box as well as the cursor will move to the next column. The cursor can be moved to the desired column by tapping the “X” button and using the Up/Down buttons to make a relay assignment selection. If the relays assignments are complete tap the enter button to save selections and to exit the relay assignment screen.

Alarms and Fault Relay Assignment Overview

The BDS-50 provides a nice overview of what conditions the relay will activate. This feature allows the user to easily see what alarms and channel or channel combinations are assigned to the relay without entering the relay assignment programming screen and interpretating the alarming matrix. This feature also provides a confirmation of the programming results to the user. As shown below the relay assignments are displayed.



Default relay assignments are as follows:

Relay 1	**Relay 2**	**Relay 3**	**Relay 4**
A1 = Ch1 or Ch2	A1 = None	A1 = None	A1 = None
A2 = None	A2 = Ch1 or Ch2	A2 = None	A2 = None
A3 = None	A3 = None	A3 = Ch1 or Ch2	A3 = None
F = None	F = None	F = None	F = Ch1 or Ch2
Acknowledge = No	Acknowledge = No	Acknowledge = No	Acknowledge = No
Failsafe = No	Failsafe = No	Failsafe = No	Failsafe = Yes

Acknowledge

The BDS-50 gas detector alarms can be acknowledged by tapping the Up / RST button or via the remote input switch as well as a Modbus write to command. By selecting “YES” , an active alarm can be acknowledged and will change the state of an assigned relay. This feature is useful to silence a horn while an alarm is still active. When an alarm is acknowledged the associated display LED will change from blinking to a solid indication. Note: see advanced settings in this section for the acknowledge timeout setting. Default = “NO”

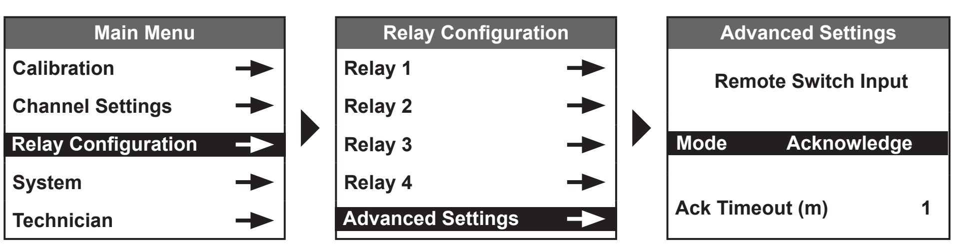
Failsafe

The failsafe function allows the relay to be set as non-failsafe or failsafe configuration during normal operating (no alarms) condition. Selecting “NO” represents a non-failsafe setting that configures the relay to be de-energized (shelf state) during normal operating conditions. Selecting “YES” allows the relay to be energized during normal operating conditions and is de-energized during an alarm or when power is lost. Default = “NO” (exception of relay 4 = YES)

7.3.2 Advanced Settings

The BDS-50 gas detector relay board has a remote input switch termination connector CN6 that can be wired to a switch to be configured as a remote acknowledge input or a digital input. The switch can be remotely mounted and wired to the connector with a wire length maximum of 75 feet.

The Remote Input Switch Mode can be selected as an Acknowledge input, N.O Digital input or a N.C. Digital input. Default = “Acknowledge”



Remote Input Switch Mode / Acknowledge

The BDS-50 remote input switch mode can be selected to be a remote acknowledge. By selecting “Acknowledge” an active alarm can be acknowledged via the remote switch and will change the state of an assigned relay. This feature is useful to silence a horn while an alarm is still active. When an alarm is acknowledged the associated display LED will change from blinking to a solid indication. The remote acknowledge switch will reset a latched alarm if the alarm is set to latched.

Ack Timeout

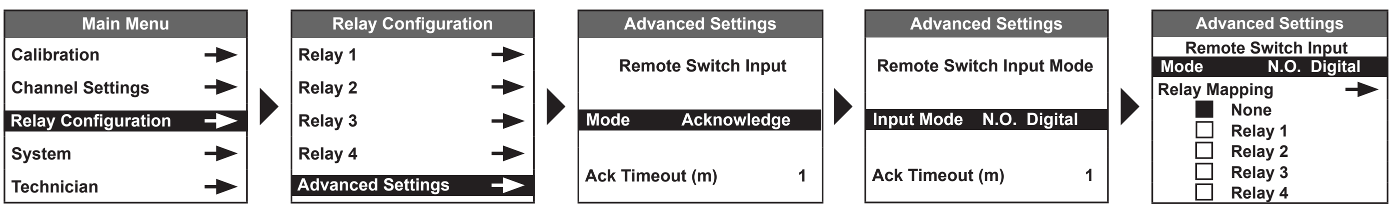
The ack timeout provides a time interval to re-activate the relay assigned to the current alarm. When a relay is acknowledged the BDS-50 acknowledgement timer will begin. Once the selected ack timeout interval is expired the current relay in an alarmed state will return to the alarmed condition. The user configurable ack timeout intervals are 1,5,10, 30 and 60 minutes. Default = “1”

Remote Input Switch Mode / Digital Input

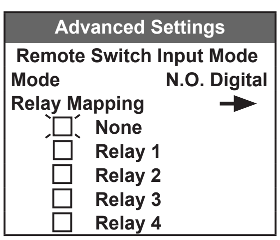
The BDS-50 gas detector relay board has a remote input switch termination connector CN6 that can be wired to a switch to be configured as a remote digital switch input that can be assigned to one of the four relays for remote relay activation. The switch can be remotely mounted and wired to the relay board connector with a wire length maximum of 75 feet.

The digital input can be selected as a N.O. (normally open) Digital switch or a N.C. (normally closed) Digital switch. A N.O. (normally open) switch when closed will activate the Digital N.O. input and the assigned relay. A N.C. (normally closed) switch when opened will activate the Digital N.C. input and the assigned relay.

To configure the remote input switch to be a digital input, highlight the Mode as shown below and tap the enter button to edit the field. Use the up/Down buttons to toggle through the input switch mode choices and tap enter to accept the normally open (N.O.) or normally closed (N.C.) digital switch input mode.

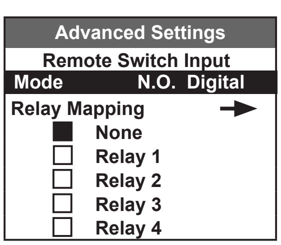


When selecting the remote input switch to be a digital input, a relay mapping screen is displayed as shown above. The relay assignment for the digital input will be identified by a solid box. To assign a relay or relays to the digital input switch, highlight “Relay Mapping” and tap the enter button to place the screen into edit mode.



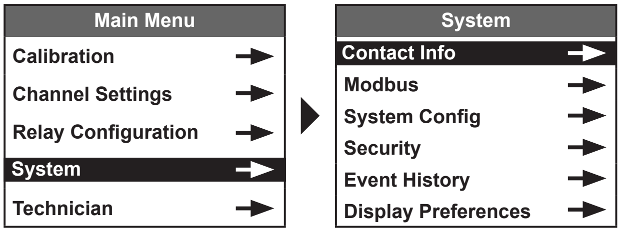
The box next to “None” will flash like a cursor. To assign a relay use the Up/Down buttons to move the flashing cursor box to the desired relay and tap the enter button to select that relay. To select and deselect the box use the enter button once selected the box becomes solid. Continue using the UP/Down buttons to move the flashing cursor box to assign additional relays or when the relay assignments are complete tap the “X” button to accept and exit edit mode. Default = “None”. Note: More than one relay can be assigned to the digital input switch.

To change the remote switch input mode from a Digital input to the Acknowledge input, highlight the Input Mode N.O. or N.C. Digital as shown below and tap the enter button to place the screen into edit mode and then use the Up/Down buttons to select “Acknowledge” and then tap the enter button.



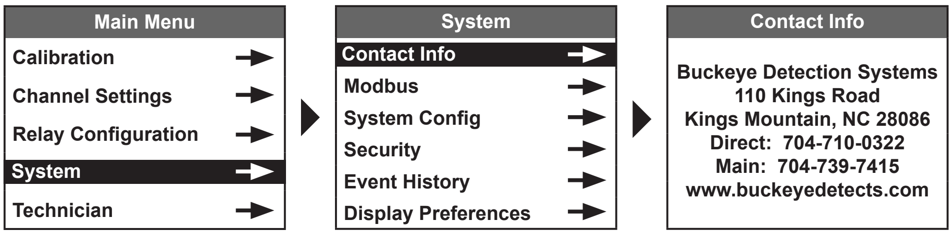
7.4 System

The system menu handles settings and configurations that support the transmitter operations, Modbus parameters, security, event history and display preferences.



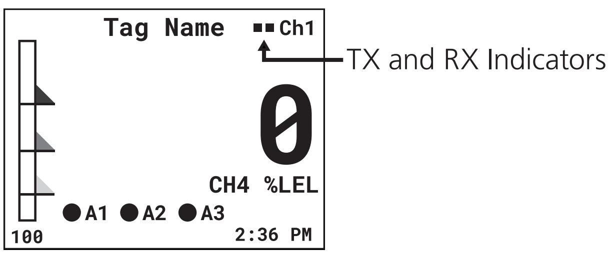
7.4.1 Contact Info

The contact info page provides company contact info, address, phone number, website, etc.

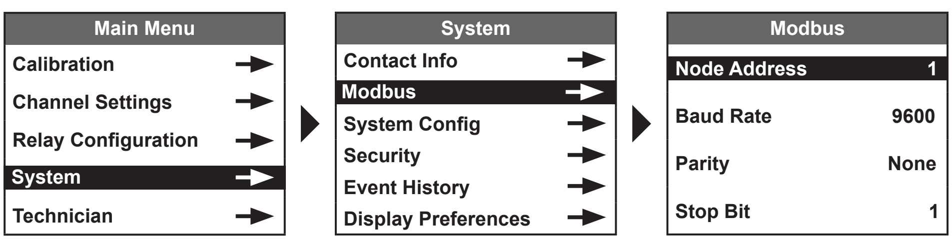


7.4.2 Modbus

The BDS-50 main display screen for the single and dual channel mode has TX and RX indicators next to the Ch1 or Ch2 that indicate the modbus communications. The TX and RX indicators are only visible when the TX or RX line is active.



Modbus parameters for the RS-485 Modbus port are handled in the Modbus menu, Node Address, Baud rate, Parity and Stop Bit. See section 4.4.3 for wiring protocol.



Node Address

Specifies the Modbus ID of the BDS-50 gas detector. Up to thirty-two (32) BDS-50 gas detector transmitters can be on a Modbus serial communication. Default = “1”

Baud Rate

Specifies the rate of bits transferred via the RS-485 digital communications protocol. The BDS-50 has multiple baud rate presets that can be selected. 9600, 19200, 38400, 57600 and 115200. Default = “9600”

Parity

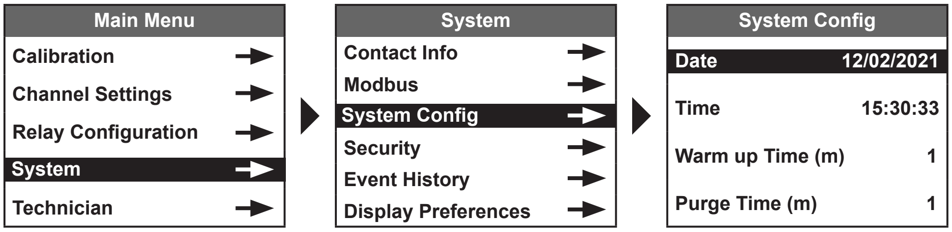
A parity bit is a bit that is added to ensure that the number of bits with the value “1” in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting within code. Default = “None”

Stop Bit

Serial communications stop bits, specifies 1 or 2 stop bit. Default = “1”

7.4.3 System Configuration

The system configuration screen provides access to the BDS-50 Date, Time, and time durations for the Warmup and Purge mode.



Date

The BDS-50 date is created at the factory upon the manufacturing initialization period, however the date can be edited via the edit procedure.

Time

The BDS-50 time is created at the factory upon the manufacturing initialization period, however the time can be edited via the edit procedure. The BDS-50 hour configuration parameter is based on a 24 hour setting. Note: The clock on the main display is a 12 hour am/pm.

Warm Up Time

Upon power up or a new sensor install the BDS-50 gas detector will initialize a warmup period to allow the sensor to stabilize or to prevent unwanted alarms. During the warmup mode the BDS-50 output signals and relays will be in an inhibit mode. The warm up time duration can be edited from 0 – 9 minutes. Default = “1 minute”).

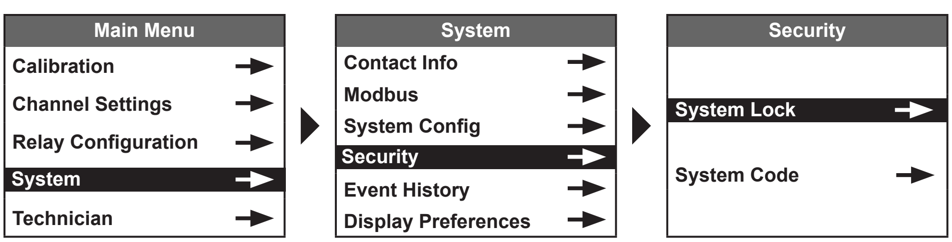
Purge Time

After a calibration procedure the purge time allows the BDS-50 gas detector to recover to a zero reading or (20.9 for O2). During the purge mode the BDS-50 output signals and relays will be in an inhibit mode. The Purge time duration can be edited from 0 – 9 minutes. Default = “1 minute”).

7.4.4 Security

The security screen allows the BDS-50 to enable or disable the system lock function. The security lock function prevents unauthorized transmitter access or parameters to be changed. Once the security lock is enabled the user will be alerted that the security lock is enabled and the parameter or task cannot be edited. The security screen has two main functions, the “System Code” and the “System Lock”. Default = “Disabled”.

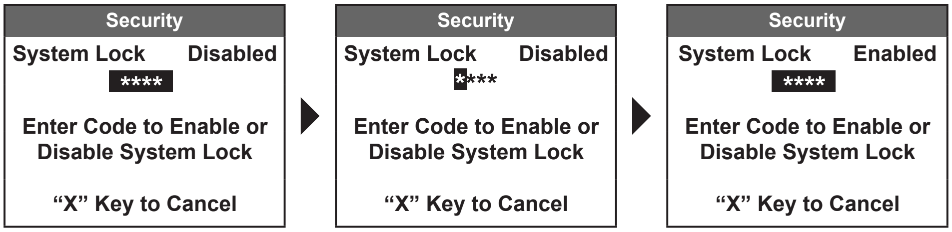
Note: A new BDS-50 will require a user unique four digit system code to be created prior to enabling the system lock. See the system code section below to create a user unique four digit system code.



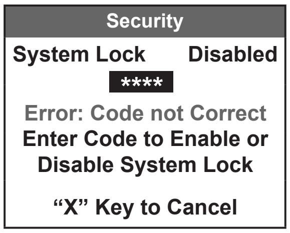
System Lock

The system lock option enables or disables the system lock function. Each time the four digit system code is entered the system lock option will toggle from the disabled to enabled or visa versa depending on what function is currently selected. Each time the system lock function enabled or disabled selection is changed the BDS-50 requires the system lock code to be entered.

To enable or disable the System Lock function, highlight the system lock and tap the enter button. Then tap the enter button again to allow access to enter the system lock code. Using the Up/Down buttons and the “X” button to move to the next digit, Enter the four digit system lock code and tap enter to toggle from Disabled or Enabled, etc as shown on the following page.



Note: If the entered system lock code is incorrect the Security screen will display "Error: Code not Correct"

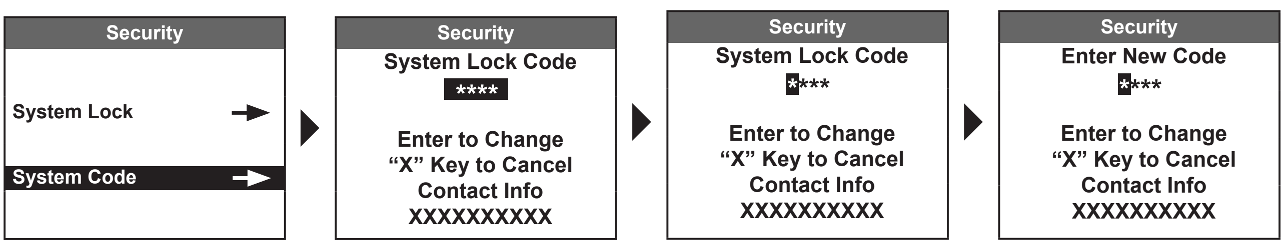


The System Code

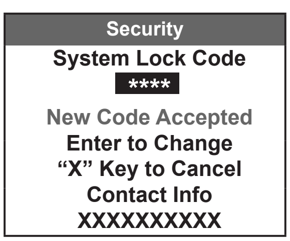
The system code provides the user the ability to select a unique four digit number from 0001 – 9999 to create a password to enable or disable the system lock.

To change the system code unique four digit number, highlight the system code option as shown below and tap the enter button, In order to enter a new unique four digit code the BDS-50 will require the previous four digit code to be entered to allow access to change to the new four digit user system lock code.

If the BDS-50 is a new transmitter the factory four digit code is "0000", With the four asterisks field highlighted tap the edit button and Using the Up/Down buttons and the "X" button to move to the next digit select a number, enter the "0000" or the previous code, then tap the edit button and if the code entered matches the existing system lock code then the display will display "Enter New Code" as shown below.



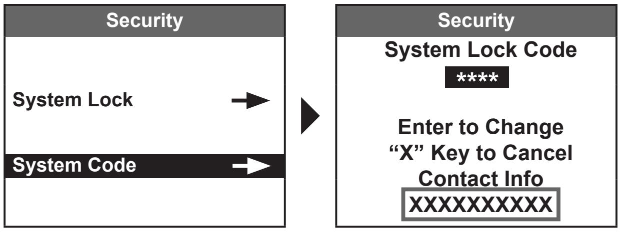
Using the Up/Down buttons and the "X" button to move to the next digit, Enter the new user unique four digit system lock code and tap enter to save. The screen will display "New Code Accepted". Tap the "X" button to exit and return to the Security screen.



Contact Info

The system code screen allows the user to edit the contact Info field to create a contact person, dept, phone number, etc in order to retrieve the unique system lock code.

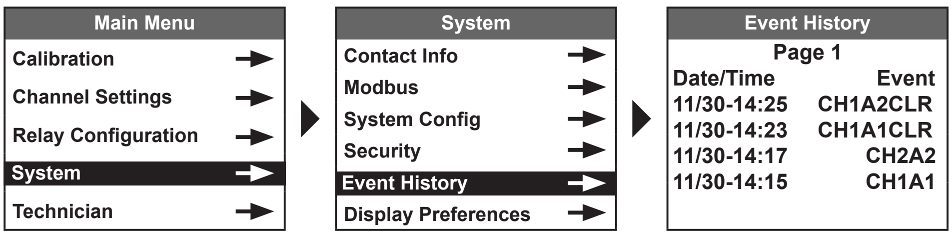
With the system lock screen displayed use the Up/Down arrow to highlight the contact field as shown on the next page and tap enter to edit. Using the "X" button to move to the next character and the Up/Down buttons to select the desired character, enter the contact information, etc then tap the enter button to accept the contact information. The field is limited to 12 characters, standard lower case and upper case letters, 0-9 numbers and special characters are available.



Note: If the transmitter is locked out and all efforts have been made to unlock or to retrieve the system lock code call the factory for assistance.

7.4.5 Event History

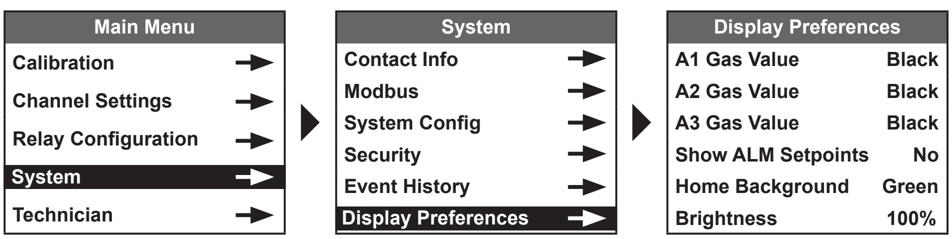
The event history screen highlights BDS-50 events with a time and date stamp. The event history screen will store up to 100 events and will populate the list in a first in / first out sequence. As events are posted the BDS-50 will create pages (max 20 pages) for the user to scroll through to view. Use the up/down arrows to scroll through the available pages.



Events per condition are listed in section 9.0

7.4.6 Display Preferences

The display preferences provides the BDS-50 main display screen to be configured to have various aesthetics, display information and alarm display preferences to customize the main screen per the user preferences.



A1, A2 and A3 Value Display Preference

The BDS-50 main operating display can be configured to highlight the concentration value in an alarm state to be red and flashing verses black and steady on.

A1 Alarm. During an A1 alarm event, the concentration value can be selected to be displayed as black steady on or can be displayed red (no-flash) while the concentration value is an alarm state. Default = "Black".

A2 Alarm. During an A2 alarm event, the concentration value can be selected to be displayed as black steady on or can be displayed red with a 1 Hz flash rate while the concentration value is an alarm state. Default = "Black"

A3 Gas Value, During an A3 alarm event, the concentration value can be selected to be displayed as black steady on or red with a 2 Hz flash rate while the concentration value is an alarm state. Default = "Black"

Show ALM Setpoints

The BDS-50 main operating display has alarm indicating icons A1, A2 and A3 that have the option to post the current alarm setpoints next to each alarm symbol. Default = "No".

Home Background

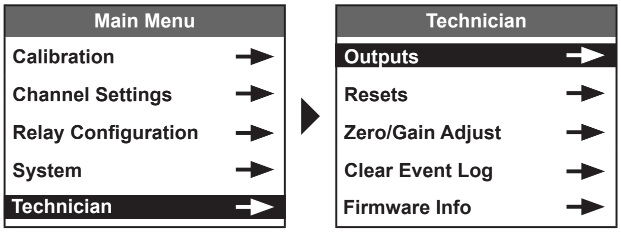
The BDS-50 main operating screen can be configured to have a green back-lit background or a white back-lit background. Default = "Green"

Display Preferences

The BDS-50 display brightness can be adjusted to four preset levels. This feature is useful for applications that require a brighter or dimmer display. The four preset levels are 25%, 50%, 75% and 100%. Default = "50%"

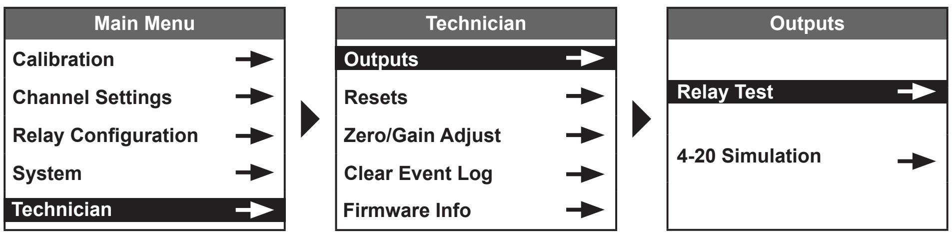
7.5 Technician Menu

The technician menu provides various technician level functions for testing outputs as well as system resets. Understanding the functions and their purpose is important when executing the technician menu.



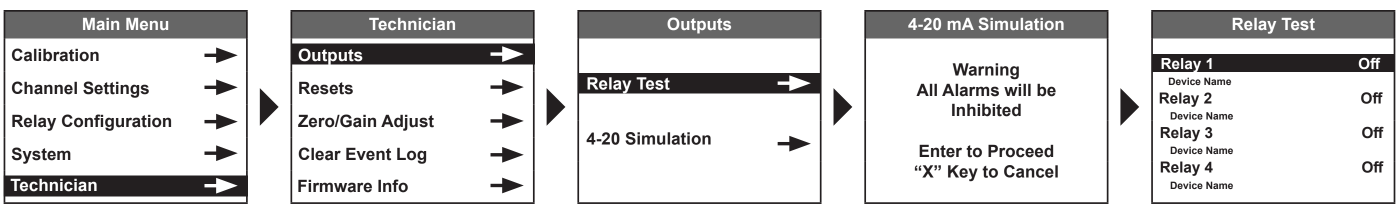
7.5.1 Outputs

The outputs screen consist of the relay test and 4-20 simulation function to assist with troubleshooting and system integration testing.



7.5.1.1 Relay Test

The relay test screen allows the user to activate or deactivate the onboard relays. This feature is convenient when testing relay interaction with connected components during system installation, system testing, etc.



Prior to entering the Relay Test screen, the user is prompted that all alarms will be inhibited when the relay test screen is displayed. When entering the relay test screen all relays will be shown in their energized or de-energized state depending on their current condition or their configured state.

To test the relay, highlight the relay to be tested and tap the enter button. The on / off variable field will be highlighted, use the up/down buttons to choose the relay state to be tested and tap the enter button to execute the relay test.

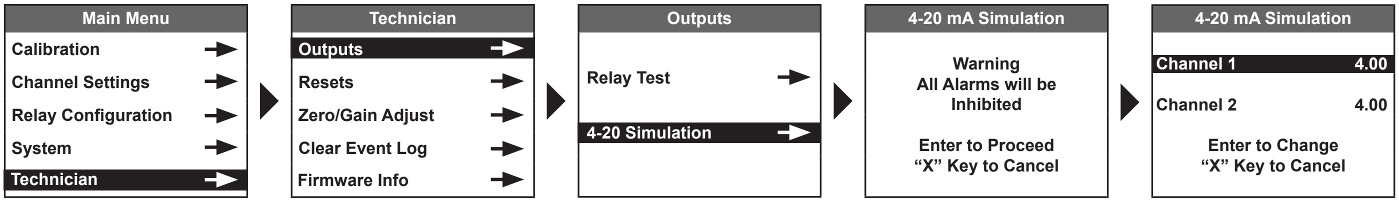
The relays are identified by their relay number as well as a device name that can be changed to a unique name such as strobe, horn, etc. in the Relay Configuration screen.

To exit the relay test screen, tap the "X" button and the relays will return to their current state or their configured state prior to opening the relay test screen.

⚠ **Note:** Once the relay test screen is displayed "activated" it will expire after five minutes regardless of interaction or if relays are in test mode.

7.5.1.2 4-20 Simulation

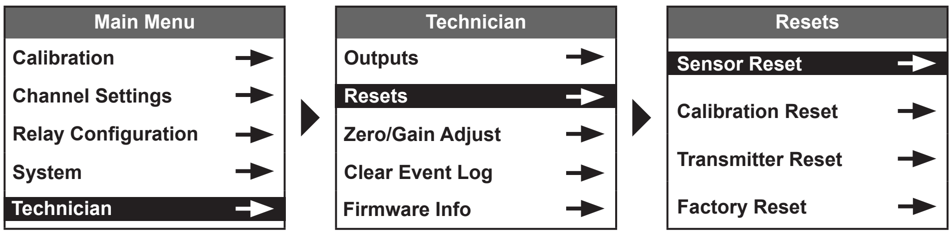
The BDS-50 gas detector has the capability to simulate an analog 4-20 mA signal for either the channel 1 or channel 2 output. This function is a great tool to test connected receivers, PLC's, controllers, etc, and their associated alarming executions. When the 4-20 mA simulation screen is displayed the analog 4-20 mA signal for both channels will be at 4 mA and can be incremented up or down by 1mA. If a channel is an "oxygen" O2 channel then then the simulation output will start at 17mA, with the intent that the simulation function outputs start at a safe or inhibit level preventing unwanted alarms or events.



To simulate a channels 4-20 mA output, enter the 4-20 mA simulation screen and highlight the channel to be simulated and tap the enter button. The mA value will be highlighted, use the up/down buttons to select a mA value and tap the enter button to simulate the selected value. To choose another mA value repeat the process. Upon exiting the 4-20 mA Simulation screen the mA values will return to their default values.

7.5.2 Resets

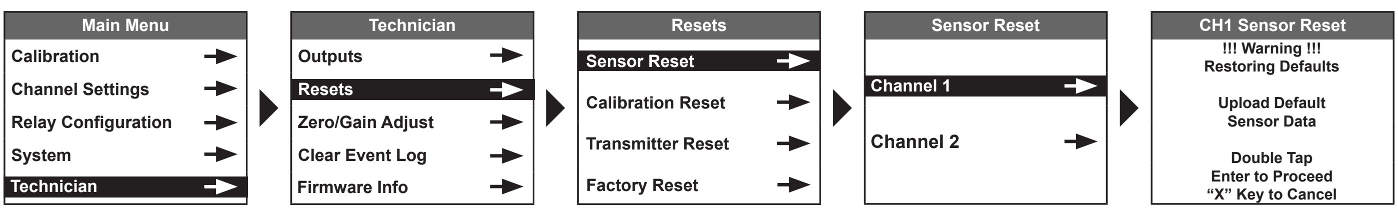
The resets screen consist of the sensor reset, calibration reset, transmitter reset and the factory reset. The reset functions assist with resetting various aspects of the sensor or transmitter back to factory defaults.



7.5.2.1 Sensor Reset

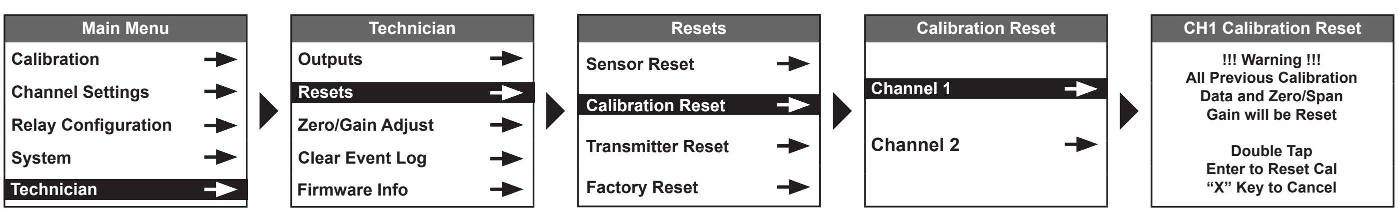
The sensor maintains a backup memory of the factory defaults that can be uploaded to the BDS-50 transmitter and overwrite user defined configurations. A sensor reset would include, alarm setpoints and types, number of decimals to be displayed and span calibration gas concentration, etc.

To reset the sensor (restore factory defaults), double tap the enter button such like a mouse double click. This technique prevents from unwanted sensor resets while navigating menus with the magnet.



7.5.2.2 Calibration Reset

The calibration reset should be reserved as a last effort to resolve a bad calibration or to set the sensor unity gain back to one. Performing a calibration reset will erase all previous calibration data which supports the sensor life percentage as well as reset the zero and span gains applied.



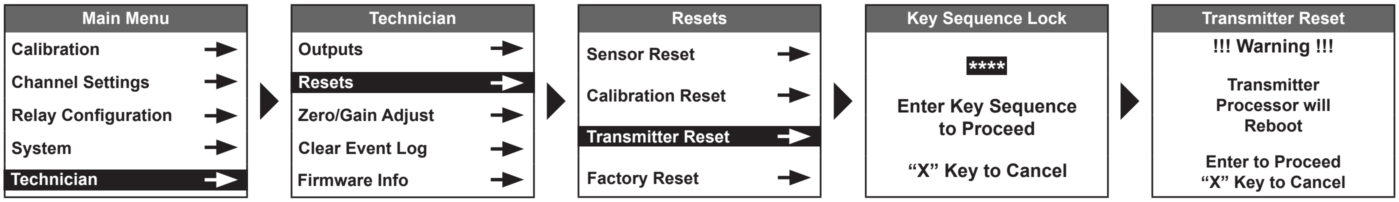
The calibration reset is an important function that should be used if only required. To reset the calibration, double tap the enter button such like a mouse double click. This technique prevents from unwanted calibration resets.

7.5.2.3 Transmitter Reset

The BDS-50 transmitter reset function provides a soft-reboot of the main processor. This function can be useful if for some unforeseen reason the display is non-responsive or the sensor is not recognized. The transmitter reset function should only be used if all other trouble shooting efforts have not been successful.

Important: The transmitter reset will reboot / restart the BDS-50 much like a power cycling. All previous transmitter and user configured parameters will remain intact.

To access the transmitter reset screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.

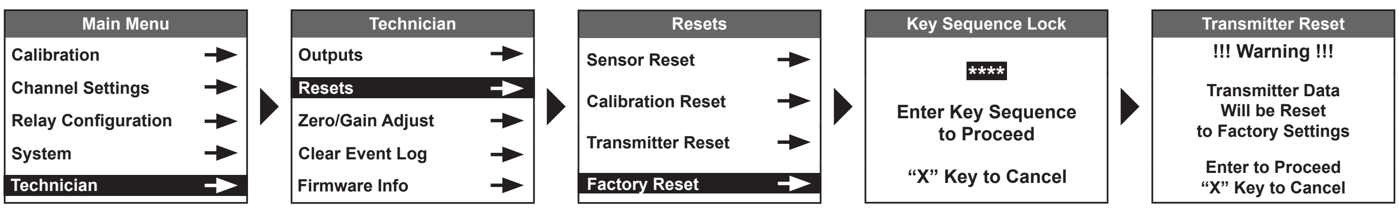


7.5.2.4 Factory Reset

The BDS-50 has a unique feature to allow the transmitter to be reset to factory defaults. This reset function should only be used if all other trouble shooting efforts have not been successful.

Important: The transmitter reset will reset the transmitter memory to the default state (same as a new transmitter). All user configured parameters will be reset to factory defaults. (Note: The event log will not be reset and will log a transmitter reset event)

To access the transmitter reset screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.



7.5.3 Zero/Gain Adjust

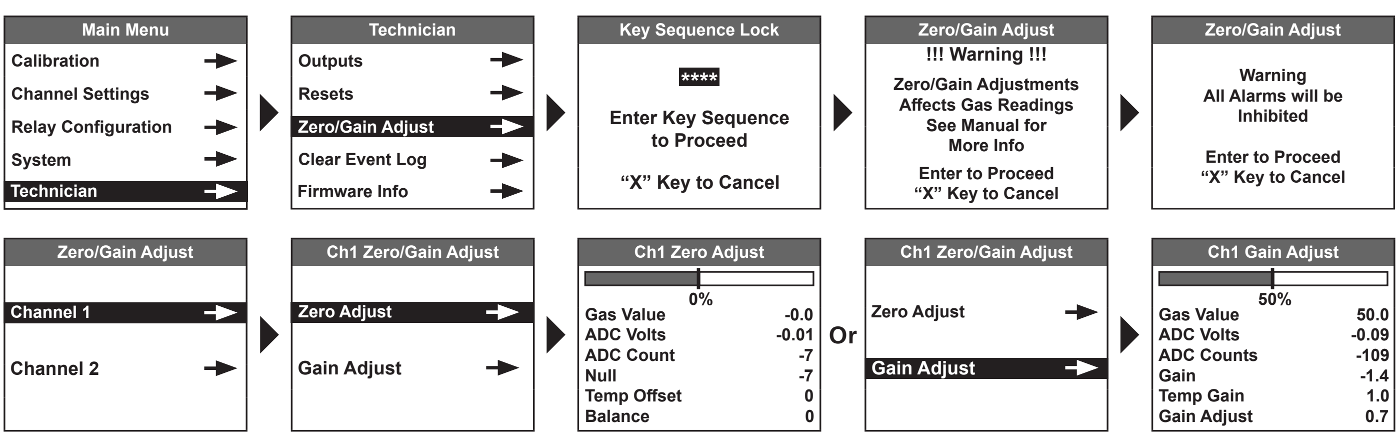
The zero/gain adjust screen consist of a zero adjust and a gain adjust function that provides a technician level capability to adjust sensor balance, zero and gain parameters.

It is recommended to perform a sensor calibration reset per section 7.5.2.2 prior to any zero/gain adjustments. A calibration reset will erase all previous calibration data and reset the zero and span gains applied

To access the transmitter zero/gain adjust screen the BDS-50 requires a specific key sequence. Using the magnetic wand tap the Up and Down buttons in the following sequence: Up / Down / Up /Down. The asterisks on the screen will advance with the correct sequence entered.

Note: It is recommended that the zero/gain adjust screen only be used as a last resort for calibration situations that require additional sensor output tuning. The zero/gain adjust screen should be used by a qualified technician that has a good understanding of gas detection instrumentation and has read the BDS-50 manual.

Note: The zero calibration is the key to a successful span calibration, therefor the zero adjust function should always be the first step to resolve a unique situation when using the zero/gain adjust function.



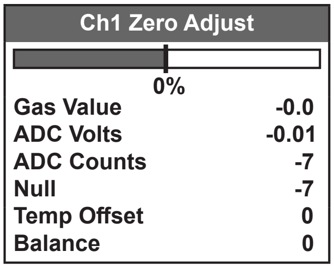
7.5.3.1 Zero Adjust

The zero adjust screen can be used to dial in the zero as a last resort when the zero calibration can not be successfully completed via the calibration procedure or has a zero gas reading outside of the 25% of the sensor range.

With zero gas applied to the sensor and the gas value reading has stabilized. Tap the up or down buttons so that the gas value is close to zero. The bar graph showing the current gas value will be in the range of -25% to +25% of the sensor range. The bar graph fill color will be green if the current gas value is within 5% of zero. Otherwise, the fill color will be red.

Once the zero gas value is within the 5% range or the desired gas value is obtained, tap the enter button to accept the new zero adjustment settings before exiting the zero adjust screen.

Note: The BDS-50 transmitter outputs and alarms will be inhibited during the zero/gain adjust function.\



· Gas value – live reading of gas value.
· ADC volts – conversion of sensor ADC reading to voltage
· ADC counts – ADC counts sent from sensor board
· Null – null value set during zero cal
· Temp Offset – temperature offset which is a function of the temperature
· Balance – value adjusted by the user in this screen

7.5.3.2 Gain Adjust

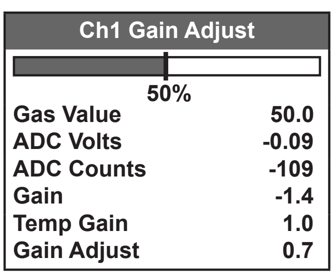
The gain adjust screen can be used to dial in the span as a last resort when the span calibration can not be successfully completed via the calibration procedure or has a span gas reading outside of the –25 to +25% of the sensor range.

With the applicable span gas applied to the sensor and the gas value reading has stabilized. Tap the up or down buttons so that the gas value is close to the cal span value. The bar graph showing the current gas value will be in the range of -25% to 25% of the sensor range. The bar graph fill color will be green if the current gas value is within 5% of the cal span value. Otherwise, the fill color will be red.

Once the gain gas value is within the 5% range or the desired gas value is obtained tap the enter button to accept the new span adjustment settings before exiting the gain adjust screen.

Note: Adjusting the gain will affect the sensor response and should be a last resort to resolve a failed calibration that was outside of the 25% range of the cal span value. If the gain requirement is too high it may result in the sensor being to sensitive and should be replaced.

Note: The BDS-50 transmitter outputs and alarms will be inhibited during the zero/gain adjust function.

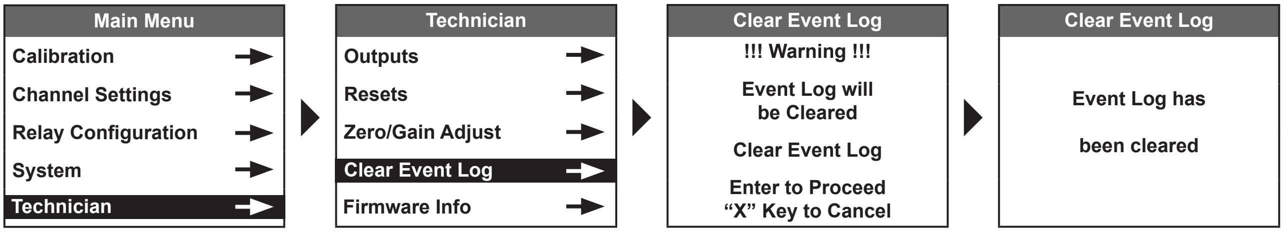


· Gas value – live reading of gas value.
· ADC volts – conversion of sensor ADC reading to voltage
· ADC counts – ADC counts sent from sensor board
· Gain – gain value set during span cal
· Temp Gain – temperature gain which is a function of the temperature
· Gain Adjust – value adjusted by the user in this screen

7.5.4 Clear Event Log

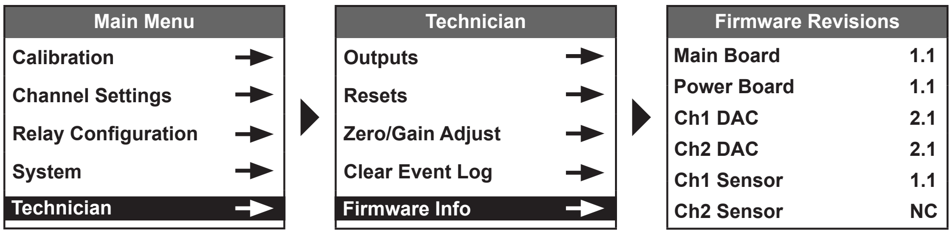
The BDS-50 transmitter stores various events as mentioned in section 7.4.5. The memory can hold 100 events and will continue to post new events and delete old events as required (FIFO). In the event that the user wants to clear the entire event history log then the “clear event log” function can be performed.

To clear the event log, enter the clear event log screen and tap the enter button to clear the event log. A new screen will appear confirming the event log was cleared and will automatically change the screen back to the main operating screen. (See next page)



7.5.5 Firmware Info

The firmware revision screen provides insight of the firmware revision for multiple processors. This level of information provides a better platform to identify upgrades, enhancements, etc.

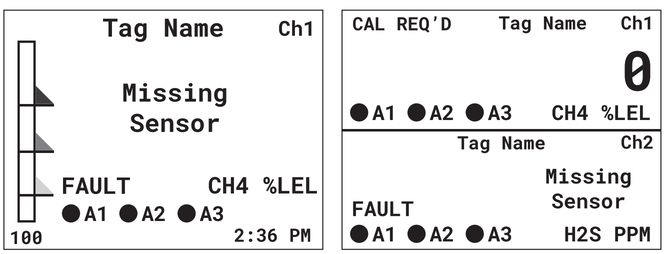


Note: if a channel is not "on" or a sensor is not installed then the corresponding channel DAC or channel sensor will have a "NC" as a firmware revision.

7.6 Faults, Over Range, and Low Voltage Indication

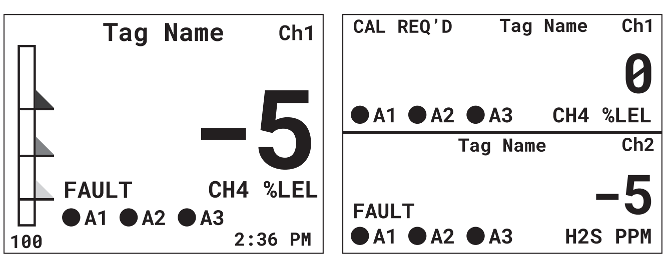
7.6.1 Missing Sensor Fault

If a channel is active and a sensor is not inserted into the sensor housing then the main display will indicate MISSING SENSOR and FAULT. The missing sensor fault event will cause the 4-20 analog signal to output a 1mA for the applicable channel.



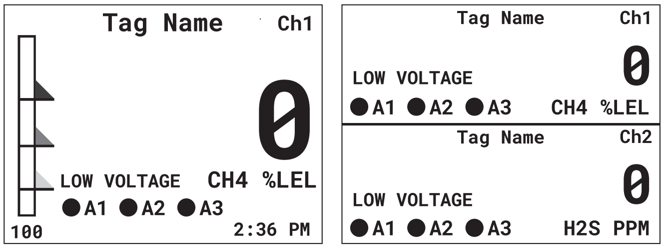
7.6.2 Negative Drift Fault

The negative drift fault alarm is a percentage (maximum-10%) of the sensor full scale range. The value is the negative drift tolerance that the concentration value can fall below zero before the fault alarm is activated. Upon a fault alarm the main display will indicate a FAULT condition and the 4-20 analog signal output will be 1mA for the applicable channel.



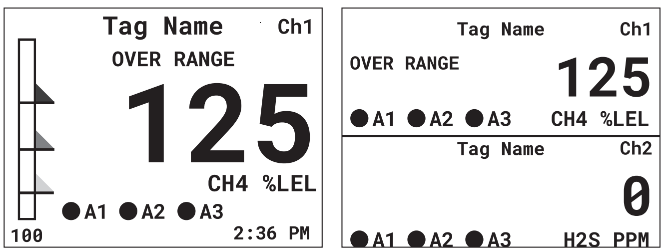
7.6.3 Low Voltage

The BDS-50 monitor has a supply voltage range of 10-30 VDC. When the BDS-50 is powered, it will monitor the supply voltage and if the supply voltage is below 10 VDC the main display will indicate LOW VOLTAGE. If the supply voltage is below 9 VDC the LOW VOLTAGE indication will continue, and the 4-20 analog signal output will be 1mA.



7.6.4 Over-Range

The BDS-50 monitor value will have a maximum displayed value of 125% of the full scale for that applicable channel. In the event of an over-range condition the BDS-50 will indicate OVER RANGE on the main display and the analog 4-20mA signal will be a maximum of 22mA.

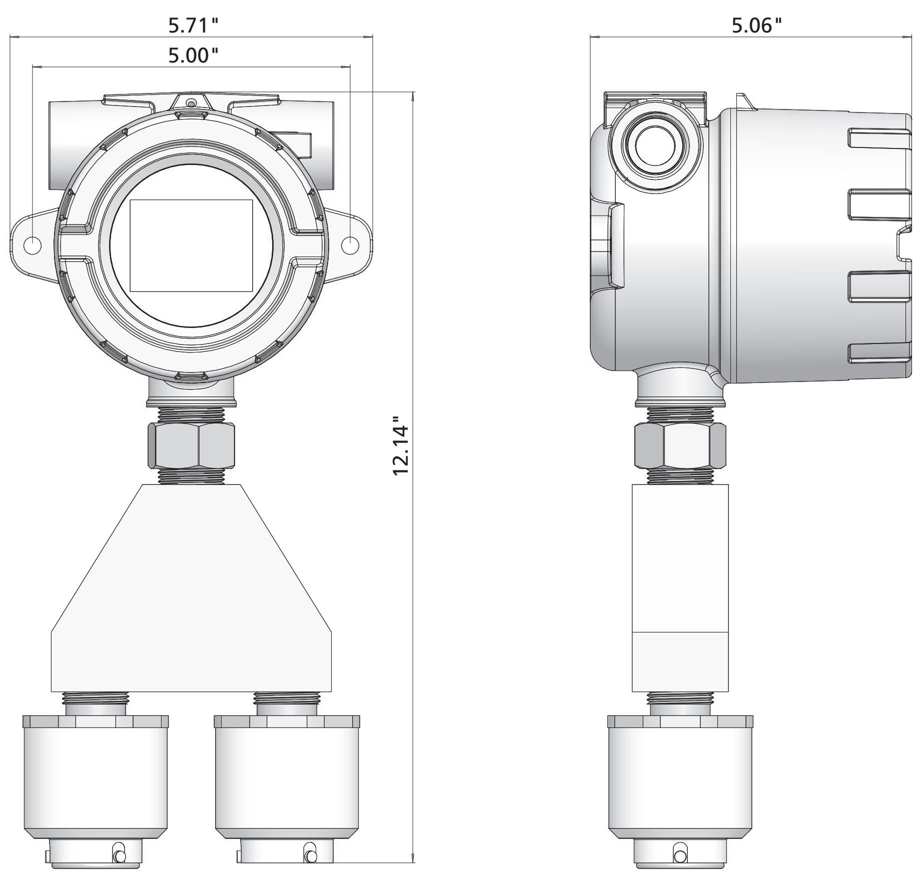


8.0 BDS-50 DUAL CHANNEL

The BDS-50 can be a single or dual channel transmitter. The BDS-50 can accept any combination of combustible or toxic sensors and can be installed into any channel.

8.1 BDS-50 Dual Channel Dimensions

Fig 8.1a



9.0 EVENT HISTORY

As discussed in section 7.4.5, the following events will be posted in the event history screen and have the corresponding applicable abbreviation.

9.1 Channel 1 Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Alarm 1	CH1ALM1	Alarm 1 activated
Alarm 2	CH1ALM2	Alarm 2 activated
Alarm 3	CH1ALM3	Alarm 3 activated
Alarm 1 Clear	CH1ALM1CLR	Alarm 1 cleared
Alarm 2 Clear	CH1ALM2CLR	Alarm 2 cleared
Alarm 3 Clear	CH1ALM3CLR	Alarm 3 cleared
Fault	CH1FAULT	Fault activated
Fault Clear	CH1FAULTCLR	Fault cleared
Cal Start	CH1CALSTART	Calibration started
Cal Exit	CH1CALEXIT	Calibration exited
Zero Cal	CH1ZEROCAL	Zero calibration successful
Span Cal	CH1SPANCAL	Span calibration successful
Cal Purge Timeout	CH1PURGETO	Calibration purge timed out
Cal Required	CH1CALREQD	Calibration is required flag activated
Cal Timeout	CHAN1CALTO	Calibration timer expired
Channel On	CH1ON	Channel is activated
Channel Off	CH1OFF	Channel is de-activated
Sensor Detected	CH1SENDET	Triggered when sensor first detected.
Sensor Missing	CH1SENMSSNG	Triggered when sensor is not detected
New Sensor Data	CH1NEWDATA	New / different sensor installed
Cal Reset	CH1CALRESET	Calibration reset
Sensor Reset	CH1SENRESET	Sensor reset
Min Max Reset	CH1HISTRST	Min / Max values reset
4-20 Connected	CH1420CONN	4-20 mA loop connected
4-20 Disconnected	CH1420DISN	4-20 mA loop disconnected
4-20 Error	CH1420ERR	4-20 mA internal error due to loop, etc
4-20 Error Cleared	CH1420ERRCLR	4-20 mA internal error cleared

9.2 Channel 2 Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Alarm 1	CH2ALM1	Alarm 1 activated
Alarm 2	CH2ALM2	Alarm 2 activated
Alarm 3	CH2ALM3	Alarm 3 activated
Alarm 1 Clear	CH2ALM1CLR	Alarm 1 cleared
Alarm 2 Clear	CH2ALM2CLR	Alarm 2 cleared
Alarm 3 Clear	CH2ALM3CLR	Alarm 3 cleared
Fault	CH2FAULT	Fault activated
Fault Clear	CH2FAULTCLR	Fault cleared
Cal Start	CH2CALSTART	Calibration started
Cal Exit	CH2CALEXIT	Calibration exited
Zero Cal	CH2ZEROCAL	Zero calibration successful
Span Cal	CH2SPANCAL	Span calibration successful
Cal Purge Timeout	CH2PURGETO	Calibration purge timed out
Cal Required	CH2CALREQD	Calibration is required flag activated
Cal Timeout	CHAN2CALTO	Calibration timer expired
Channel On	CH2ON	Channel is activated
Channel Off	CH2OFF	Channel is de-activated
Sensor Detected	CH2SENDET	Triggered when sensor first detected.
Sensor Missing	CH2SENMSSNG	Triggered when sensor is not detected
New Sensor Data	CH2NEWDATA	New / different sensor installed
Cal Reset	CH2CALRESET	Calibration reset
Sensor Reset	CH2SENRESET	Sensor reset
Min Max Reset	CH2HISTRST	Min / Max values reset
4-20 Connected	CH2420CONN	4-20 mA loop connected
4-20 Disconnected	CH2420DISN	4-20 mA loop disconnected
4-20 Error	CH2420ERR	4-20 mA internal error due to loop, etc
4-20 Error Cleared	CH2420ERRCLR	4-20 mA internal error cleared

BDS-50 System Events *continued*

9.3 BDS-50 System Events

EVENT	EVENT CODE	EVENT DESCRIPTION
Powerup	POWERUP	BDS-50 Transmitter
Relay 1	RLY1COILON	Relay 1 is energized
Relay 1	RLY1COILOFF	Relay 1 is de-energized
Relay 2	RLY2COILON	Relay 2 is energized
Relay 2	RLY2COILOFF	Relay 2 is de-energized
Relay 3	RLY3COILON	Relay 3 is energized
Relay 3	RLY3COILOFF	Relay 3 is de-energized
Relay 4	RLY4COILON	Relay 4 is energized
Relay 4	RLY4COILOFF	Relay 4 is de-energized
Alarm Ack	SYSACK	Alarm acknowledge was activated
Alarm Ack Clear by Modbus	SYSACKMBCLR	Alarm acknowledge was cleared via Modbus
Alarm Ack Timeout	SYSACKTO	Alarm acknowledge was cleared via timeout
Digital Input Change	DIGINPCHG	Digital input state was changed / activated
Password Entered	PSWDENT	Password entered was successful
Password Changed	PSWDCHNG	Password changed was successful
Event Log Cleared	EVENTLOGCLR	Event log was cleared
Relay Test Start	RLYTSTSTART	Relay test screen was activated
Relay Test End	RLYTSTEND	Relay test screen was exited
4-20 Simulation Start	420SIMSTART	4-20 mA simulation screen activated
4-20 Simulation End	420SIMEND	4-20 mA simulation screen exited
Inhibit Mode Start	INHBTSTART	Inhibit mode activated
Inhibit Mode End	INHBTEND	Inhibit mode de-activated
Date Change	DATECHG	System date was changed
Time Change	TIMECHG	System time was changed
Transmitter Reset	XMTRRESET	Transmitter reset was successful

10.0 MODBUS REGISTERS

All Modbus variables are accessible via Function 4 (read-only)

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 1 Gas Value	0	30001	2	Float	
Channel 1, 4-20 mA Value	2	30003	1	Integer	Integer value representative of 4-20 value. For example, 4000 = 4 mA; 20000 = 20 mA
Channel 1 Status Flags Ordering of bits from least significant to greatest are: Sensor 1 Enable Flag Sensor 1 Detected Flag Sensor 1 Warm Up Flag Sensor 1 Alarm 1 Flag Sensor 1 Alarm 2 Flag Sensor 1 Alarm 3 Flag Sensor 1 Fault Flag Sensor 1 Alarm 1 Latched Flag Sensor 1 Alarm 2 Latched Flag Sensor 1 Alarm 3 Latched Flag Sensor 1 Cal Required Flag Sensor 1 Cal in Progress Flag Sensor 1 Cal Purge Flag CH1 Sensor Reset Flag CH1 Cal Reset Flag Remaining bits are meaningless	3	30004	1	Packed Bits	Sensor 1 Cal in Progress Flag = Set when entering calibration, reset when out of calibration Sensor 1 Cal Purge Flag = Set when entering calibration, reset when purge is complete CH1 Sensor Reset Flag = Set for 10 seconds after Sensor Reset CH1 Cal Reset Flag = Set for 10 seconds after Cal Reset
CH1 Alarm 1 Flag	4	30005	1	Integer	
CH1 Alarm 2 Flag	5	30006	1	Integer	
CH1 Alarm 3 Flag	6	30007	1	Integer	
CH1 Fault Flag	7	30008	1	Integer	
CH1 Cal Required Flag	8	30009	1	Integer	
Channel 2 Gas Value	9	30010	2	Float	
Channel 2, 4-20 mA Value	11	30012	1	Integer	Integer value representative of 4-20 value. For example, 4000 = 4 mA; 20000 = 20 mA

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 2 Status Flags Ordering of bits from least significant to greatest are: Sensor 2 Enable Flag Sensor 2 Detected Flag Sensor 2 Warm Up Flag Sensor 2 Alarm 1 Flag Sensor 2 Alarm 2 Flag Sensor 2 Alarm 3 Flag Sensor 2 Fault Flag Sensor 2 Alarm 1 Latched Flag Sensor 2 Alarm 2 Latched Flag Sensor 2 Alarm 3 Latched Flag Sensor 2 Cal Required Flag Sensor 2 Cal in Progress Flag Sensor 2 Cal Purge Flag CH2 Sensor Reset Flag CH2 Cal Reset Flag Remaining bits are meaningless	12	30013	1	Packed Bits	Sensor 2 Cal in Progress Flag = Set when entering calibration, reset when out of calibration Sensor 2 Cal Purge Flag = Set when entering calibration, reset when purge is complete CH2 Sensor Reset Flag = Set for 10 seconds after Sensor Reset CH2 Cal Reset Flag = Set for 10 seconds after Cal Reset
CH2 Alarm 1 Flag	13	30014	1	Integer	
CH2 Alarm 2 Flag	14	30015	1	Integer	
CH2 Alarm 3 Flag	15	30016	1	Integer	
CH2 Fault Flag	16	30017	1	Integer	
CH2 Cal Required Flag	17	30018	1	Integer	
Global Status Flags Ordering of bits from least significant to greatest are: Relay 1 Triggered Flag Relay 2 Triggered Flag Relay 3 Triggered Flag Relay 4 Triggered Flag Acknowledge Flag Inhibit Mode Flag Technician Relay Test Control Flag Technician 4-20 Control Flag Event Log Clear Flag Zero Gain Adjust Flag Low Voltage Flag Remaining bits in register are meaningless	18	30019	1	Packed Bits	Technician Relay Test Control Flag = Set when technician relay test menu is entered Technician 4-20 Control Flag = Set when technician 4-20 mA simulation menu is entered Event Log Clear Flag = Set for 10 seconds after Event Log Clear event Technician Zero/Gain Adjust Control Flag = Set when technician zero/gain adjust menu screen is entered “LOW VOLTAGE” on the screen and 4-20 goes to 1 mA
Relay 1 Coil Energized Flag	19	30020	1	Integer	
Relay 2 Coil Energized Flag	20	30021	1	Integer	
Relay 3 Coil Energized Flag	21	30022	1	Integer	
Relay 4 Coil Energized Flag	22	30023	1	Integer	
Remote Switch Input Mode	23	30024	1	Integer	0 = Acknowledge mode. 1 = N.O. Digital, 2 = N.C. Digital
Remote Switch State	24	30025	1	Integer	0 = When input is not activated and 1 = when activated. Activation occurs when Ack input is shorted via push button or other means
Relay 1 Tag Name	25	30026	6	ASCII String	12 Characters (2 per register)
Relay 1 Acknowledgeable Enable	31	30032	1	Integer	
Relay 1 Failsafe Enable	32	30033	1	Integer	
Relay 2 Tag Name	33	30034	6	ASCII String	12 Characters (2 per register)
Relay 2 Acknowledgeable Enable	39	30040	1	Integer	
Relay 2 Failsafe Enable	40	30041	1	Integer	
Relay 3 Tag Name	41	30042	6	ASCII String	12 Characters (2 per register)
Relay 3 Acknowledgeable Enable	47	30048	1	Integer	
Relay 3 Failsafe Enable	48	30049	1	Integer	
Relay 4 Tag Name	49	30050	6	ASCII String	12 Characters (2 per register)
Relay 4 Acknowledgeable Enable	55	30056	1	Integer	
Relay 4 Failsafe Enable	56	30057	1	Integer	
Current Time Month	57	30058	1	Integer	
Current Time Day	58	30059	1	Integer	
Current Time Year	59	30060	1	Integer	
Current Time Hour	60	30061	1	Integer	
Current Time Minute	61	30062	1	Integer	
Current Time Second	62	30063	1	Integer	
Channel 1 Tag Name	63	30064	6	ASCII String	12 Characters (2 per register)
Channel 1 Engr Units	69	30070	6	ASCII String	12 Characters (2 per register)
Channel 1 Range	75	30076	2	Float	
Channel 1 Cal Span Value	77	30078	2	Float	
Channel 1 Decimal Places	79	30080	1	Integer	

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 1 Enable	80	30081	1	Integer	
Channel 1 Alarm 1 Setpoint	81	30082	2	Float	
Channel 1 Alarm 2 Setpoint	83	30084	2	Float	
Channel 1 Alarm 3 Setpoint	85	30086	2	Float	
Channel 1 Alarm 1 Type	87	30088	1	Integer	0 = falling, 1 = rising
Channel 1 Alarm 2 Type	88	30089	1	Integer	0 = falling, 1 = rising
Channel 1 Alarm 3 Type	89	30090	1	Integer	0 = falling, 1 = rising
Channel 1 Purge Flag	90	30091	1	Integer	Sensor 1 Cal Purge Flag = Set when entering calibration, reset when out of calibration and purge is complete
Channel 1 Warmup Flag	91	30092	1	Integer	
Channel 1 Cal in Progress Flag	92	30093	1	Integer	
Channel 1 Alarm 1 Reset %	93	30094	2	Float	
Channel 1 Alarm 2 Reset %	95	30096	2	Float	
Channel 1 Alarm 3 Reset %	97	30098	2	Float	
Channel 1 Alarm 1 Latching Enable	99	30100	1	Integer	
Channel 1 Alarm 2 Latching Enable	100	30101	1	Integer	
Channel 1 Alarm 3 Latching Enable	101	30102	1	Integer	
Channel 1 Alarm 1 On Delay (sec)	102	30103	2	Float	
Channel 1 Alarm 2 On Delay (sec)	104	30105	2	Float	
Channel 1 Alarm 3 On Delay (sec)	106	30107	2	Float	
Channel 1 Alarm 1 Off Delay (min)	108	30109	2	Float	
Channel 1 Alarm 2 Off Delay (min)	110	30111	2	Float	
Channel 1 Alarm 3 Off Delay (min)	112	30113	2	Float	
Channel 1 Fault Percentage	114	30115	2	Float	
Channel 1 Deadband	116	30117	2	Float	
Channel 1 InCal mA	118	30119	2	Float	
Channel 1 Inhibit mA	120	30121	2	Float	
Channel 1 Track Neg mA Enable	122	30123	1	Integer	
Channel 1 Track Neg Value Enable	123	30124	1	Integer	
Channel 1 Sensor Type	124	30125	6	ASCII String	12 Characters (2 per register)
Channel 1 Serial Number	130	30131	5	ASCII String	10 Characters (2 per register)
Channel 1 Born Month	135	30136	1	Integer	
Channel 1 Born Day	136	30137	1	Integer	
Channel 1 Born Year	137	30138	1	Integer	
Channel 1 Zero Cal Month	138	30139	1	Integer	
Channel 1 Zero Cal Day	139	30140	1	Integer	
Channel 1 Zero Cal Year	140	30141	1	Integer	
Channel 1 Span Cal Month	141	30142	1	Integer	
Channel 1 Span Cal Day	142	30143	1	Integer	
Channel 1 Span Cal Year	143	30144	1	Integer	
Channel 1 Cal Interval [days]	144	30145	1	Integer	
Channel 2 Tag Name	145	30146	6	ASCII String	12 Characters (2 per register)
Channel 2 Engr Units	151	30152	6	ASCII String	12 Characters (2 per register)
Channel 2 Range	157	30158	2	Float	
Channel 2 Cal Span Value	159	30160	2	Float	
Channel 2 Decimal Places	161	30162	1	Integer	
Channel 2 Enable	162	30163	1	Integer	
Channel 2 Alarm 1 Setpoint	163	30164	2	Float	
Channel 2 Alarm 2 Setpoint	165	30166	2	Float	
Channel 2 Alarm 3 Setpoint	167	30168	2	Float	
Channel 2 Alarm 1 Type	169	30170	1	Integer	0 = falling, 1 = rising
Channel 2 Alarm 2 Type	170	30171	1	Integer	0 = falling, 1 = rising
Channel 2 Alarm 3 Type	171	30172	1	Integer	0 = falling, 1 = rising
Channel 2 Purge Flag	172	30173	1	Integer	Sensor 2 Cal Purge Flag = Set when entering calibration, reset when out of calibration and purge is complete
Channel 2 Warmup Flag	173	30174	1	Integer	
Channel 2 Cal in Progress Flag	174	30175	1	Integer	
Channel 2 Alarm 1 Reset %	175	30176	2	Float	
Channel 2 Alarm 2 Reset %	177	30178	2	Float	
Channel 2 Alarm 3 Reset %	179	30180	2	Float	
Channel 2 Alarm 1 Latching Enable	181	30182	1	Integer	
Channel 2 Alarm 2 Latching Enable	182	30183	1	Integer	
Channel 2 Alarm 3 Latching Enable	183	30184	1	Integer	
Channel 2 Alarm 1 On Delay (sec)	184	30185	2	Float	
Channel 2 Alarm 2 On Delay (sec)	186	30187	2	Float	
Channel 2 Alarm 3 On Delay (sec)	188	30189	2	Float	
Channel 2 Alarm 1 Off Delay (min)	190	30191	2	Float	
Channel 2 Alarm 2 Off Delay (min)	192	30193	2	Float	
Channel 2 Alarm 3 Off Delay (min)	194	30195	2	Float	
Channel 2 Fault Percentage	196	30197	2	Float	
Channel 2 Deadband	198	30199	2	Float	
Channel 2 InCal mA	200	30201	2	Float	
Channel 2 Inhibit mA	202	30203	2	Float	
Channel 2 Track Neg mA Enable	204	30205	1	Integer	

Modbus Registers *continued*

VARIABLE NAME	MODBUS POLL ADDRESS	PROTOCOL ADDRESS	NUMBER OF REGISTERS	TYPE	NOTES
Channel 2 Track Neg Value Enable	205	30206	1	Integer	
Channel 2 Sensor Type	206	30207	6	ASCII String	12 Characters (2 per register)
Channel 2 Serial Number	212	30213	5	ASCII String	10 Characters (2 per register)
Channel 2 Born Month	217	30218	1	Integer	
Channel 2 Born Day	218	30219	1	Integer	
Channel 2 Born Year	219	30220	1	Integer	
Channel 2 Zero Cal Month	220	30221	1	Integer	
Channel 2 Zero Cal Day	221	30222	1	Integer	
Channel 2 Zero Cal Year	222	30223	1	Integer	
Channel 2 Span Cal Month	223	30224	1	Integer	
Channel 2 Span Cal Day	224	30225	1	Integer	
Channel 2 Span Cal Year	225	30226	1	Integer	
Channel 2 Cal Interval [days]	226	30227	1	Integer	
Global Inhibit Mode Flag	227	30228	1	Integer	
Modbus Address	228	30229	1	Integer	
Modbus Baud Rate	229	30230	1	Integer	
Modbus Parity	230	30231	1	Integer	0 = None, 1 = Even, 2 = Odd
Modbus Stop Bits	231	30232	1	Integer	
Sensor 1 Health	232	30233	2	Float	
Sensor 2 Health	234	30235	2	Float	
Sensor 1 Temp	236	30237	2	Float	Fahrenheit
Sensor 2 Temp	238	30239	2	Float	Fahrenheit
Warmup Time	240	30241	1	Integer	minutes
Cal Purge Time	241	30242	1	Integer	minutes
System Secure Flag	242	30243	1	Integer	0 = Unlocked, 1 = Locked
CH1 Sensor Reset Flag	243	30244	1	Integer	Set for 10 seconds after reset
CH2 Sensor Reset Flag	244	30245	1	Integer	Set for 10 seconds after reset
CH1 Cal Reset Flag	245	30246	1	Integer	Set for 10 seconds after reset
CH2 Cal Reset Flag	246	30247	1	Integer	Set for 10 seconds after reset
Event Log Clear Flag	247	30248	1	Integer	Set for 10 seconds after clearing log
CH1 Sensor Detected Flag	248	30249	1	Integer	
CH2 Sensor Detected Flag	249	30250	1	Integer	
Acknowledge Timeout [min]	250	30251	1	Integer	

10.1 Modbus Read / Write to Remote Acknowledge

The BDS-50 can be acknowledged remotely when in alarm via Modbus by writing a value of 1 (or 16 bit value other than 0) to Modbus address 40001 using Function 6 Modbus command.

Acknowledge mode can be cleared via Modbus by writing a 0 to this register. The current state of the acknowledge flag (0 when system not in acknowledge, 1 when system in acknowledge) can be read via Function 3 Modbus command.

11.0 CAT-BEAD (PELLISTOR) K-FACTOR CALIBRATIONS

11.1 Working with Cat-Bead Sensors and K-Factors

Foremost : It is always recommended to calibrate a Cat-Bead (Pellistor) combustible sensor with a calibration gas that is specific to the “target” gas.

However, a surrogate calibration gas along with K-factors can be used to calibrate a cat-bead sensor when acquiring or having the specific calibration gas is not available.

K-factors combined with a surrogate calibration gas can be used to simulate a response to a combustible target gas in terms of a readily available calibration gas such as methane. It should be understood that such conversion k-factors are calculated estimates only. They are intended to serve as a guide to show approximate typical responses of a monitor to the particular gas needed for calibration.

The BDS-50 gas monitor cat-bead sensor is supported with gas sensitivity response values for numerous combustible gases relative to methane calibration gas. Therefore all sensitivity methane surrogate K-factors are a multiplier that are applied to the surrogate calibration gas (methane) being used to offset the difference between how a cat-bead sensor would respond to a target gas verses a surrogate calibration gas such as methane.

When applying a k-factor to a surrogate gas, the objective is to have the gas monitor display a value that is the simulated reading of the combustible target gas being monitored. The displayed value is the sum of the response sensitivity to the calibration gas used and the applied k-factor, thus a span cal value is required to be configured.

The span cal value is the span number that the cat-bead sensor will be calibrated to when a known calibration concentration gas is applied during a calibration. Typically when using a specific calibration gas that represents the target gas, the span cal value is the actual concentration percentage of that gas.

However when a surrogate calibration gas and a k-factor is used to simulate the target gas the span cal value needs to reflect that sum (surrogate gas concentration percentage times the k-factor = cal span value).

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

11.2 Surrogate Gas and K-factor Considerations

The relative sensitivity response chart below provides target gases that have known response sensitivity data to support k-factor calculations. In general, when using a surrogate calibration gas with a k-factor, the sum or cal span value should be 25 to 75 % of full scale.

For example. If we were using 50 % methane as a surrogate gas to simulate for the target gas N-Heptane with a k-factor of 2.08 the cal span value would be 104% which is not in the 25 – 75 % range and would be over-range. Therefore we would use a 25% concentration calibration methane gas times the k-factor of 2.08 to set the cal span value to 52%.

To set the cal span value in the BDS-50 gas detector, please refer to the channel settings / configure / cal span value menu to set the cal span value.

Cal Span Value = The methane calibration gas "concentration percentage" multiplied by the target gas k-factor from the Relative Sensitivity Response chart

Conclusion: Cat-bead sensors should always be calibrated with a specific calibration gas for the target gas. However when needed a surrogate calibration gas combined with a k-factor can simulate a target gas response. By choosing the right methane surrogate gas concentration and the corresponding k-factor as well as setting the cal span value in the BDS-50. The cat-bead / gas monitor will be calibrated so that the gas detector monitor will provide a reading of the target gas percentage.

To calibrate, set the "Cal Span Value" as previously detailed and then follow the calibration procedure discussed in section 6.5.

11.3 Relative Sensitivity Response Chart

The relative sensitivity responses are based on methane 100% LEL

GAS	FORMULA	K-FACTOR	100 % LEL/ V (USA)	RELATIVE RESPONSE LEL %
Methane	CH4	1	5	100
Acetic acid	CH3COOH	14.29	5.4	7
Acetone	(CH3)2CO	3.85	2.6	26
Cyclo-hexane	C6H12	1.82	1.3	55
Cyclo-pentane	C5H10	1.69	1.5	59
Ethanol	C2H5OH	2.63	3.3	38
Ethyl acetate	C2H5COOCH3	3.23	2.2	31
Butyl acetate	C4H9COOCH3	5.56	1.4	18
Ethylene	C2H4	1.43	2.7	70
Hydrogen	H2	1.05	4	95
Iso-butane	C4H10	1.82	1.8	55
Iso-octane	C8H18	2.50	N/A	40
Iso-propanol	CH3CH(OH)CH3	3.03	2.2	33
Methanol	CH3OH	1.49	6.7	67
n-Butane	C4H10	2.22	1.8	45
n-Heptane	C7H16	2.08	1.05	48
n-Hexane	C6H14	2.04	1.2	49
n-Pentane	C5H12	1.79	1.4	56
Propane	C3H8	1.82	2.1	55
Styrene	C6H5CH=CH2	6.67	1.1	15
Toluene	C6H5CH3	5.00	1.2	20
Ammonia	NH3	1.43	15	70
Propylene	CH3-CH=CH2	1.67	2.4	60
Carbon Monoxide	CO	2.50	12.5	40
Methyl t-butyl ether	CH3OC(CH3)	1.69	N/A	59
Xylene	C6H4(CH3)2	5.00	1.1	20
n-Octane	CH3(CH2)6CH3	2.38	0.95	42
Iso-butanol	CH3CH(CH3)CH2OH	4.00	1.7	25
Iso-pentane	CH3CH(CH3)C2H5	2.17	N/A	46
n-propanol	C3H7OH	3.85	2.2	26

12.0 INFRARED SENSOR CALIBRATION ETHANOL OR BUTANE

It is always better to calibrate a sensor with the target gas, however when the target gas is not available a surrogate gas can be used with appropriate calibration factors applied.

Obtaining Ethanol in a calibration gas cylinder is not a readily available calibration gas, therefor propane calibration gas is used as a surrogate gas as it is readily available and the IR response curve data is based on propane response curves.

K-factors combined with a surrogate calibration gas can be used to simulate a response to a combustible target gas in terms of a readily available calibration gas such as propane. It should be understood that such conversion factors are calculated estimates only and are intended to serve as a guide to show approximate typical responses of a monitor to the particular surrogate gas for calibration.

The propane IR sensor response has a nice correlation between propane and ethanol. Although the Ethanol response is lower than propane, its close enough to calibrate using 50% LEL propane as a surrogate gas and use a calibration factor / multiplier “k-factor” to perform a successful calibration for an Ethanol target.

In order for a gas detector transmitter in an Ethanol application to respond to the correct % LEL concentration the gas detector needs to be calibrated using 50% LEL propane calibration gas and a cal span value of 45.5%. To set the cal span value in the BDS-50 gas detector, please refer to the channel settings / configure / cal span value menu to set the cal span value.

Once the BDS-50 with an IR propane sensor is calibrated to a 45.5% span, the BDS-50 gas monitor will be calibrated to respond accordingly for an ethanol target gas. With the calibration in place as previously mentioned the BDS-50 should display 50% LEL when 50% LEL ethanol is present in a vapor form. Again, It should be understood that such conversion factors are calculated estimates only and are intended to serve as a guide to show approximate typical responses of a monitor to the particular surrogate gas for calibration.

To calibrate, set the “Cal Span Value” to 45.5 and then follow the calibration procedure discussed in section 6.5.

Butane: The BDS-50 Propane IR sensor can be used to detect Butane, It is recommended to use 50% Butane to calibrate the BDS-50 Propane IR sensor for a Butane application.

13.0 SENSOR WARMUP TIME RECOMMENDATIONS

13.1 Toxic (Echem) Sensors

The majority of the BDS-50 gas detector toxic sensors generally require two hours to stabilize when they are new or have been offline for a considerable amount of time. Toxic sensors that are the exception of this recommended warmup time would be NO and HCL which require approximately 12 hours.

13.2 Cat-Bead (Pellistor) Sensors

The BDS-50 cat-bead sensor when powered-up for the first time following storage or a long period of inactivity can sometimes take a several hours to completely stabilize to their final zero offset point. Although the cat-bead sensor can stabilize after a couple of minutes its highly recommended to allow the sensor to “settle-in” for a couple of hours to burn off any impurities, stabilize, etc prior to a calibration.

13.3 IR (Infrared) Sensors

The BDS-50 IR sensor should have the opportunity to reach an equilibrium with the ambient air. Warmup time varies depending upon the ambient temperature. Although IR sensors have the least amount of warmup requirements its recommended for the IR sensor to have approximately 20 minutes to acclimate to ambient conditions.

13.4 Sensor Temperature and Humidity RH

The following list supports the BDS-50 sensor temperature and humidity RH ranges for the standard sensors and range. Please consult factory for any other sensor types and ranges.

Sensor	Sensor Type	BDS-50 Sandard Range	Temperature Range in Celsius	Humidity RH
Combustible	Cat-Bead	0-100 %	-20 +70	0-95%
Combustible	IR	0-100 %	-20 +50	0-95%
Carbon Dioxide	IR	0-2 %	-20 +50	0-95%
Ammonia	Echem	0-100 PPM	-40 +50	15-90 %
Carbon Monoxide	Echem	0-100 PPM	-20 +50	15-90 %
Chlorine	Echem	0-10 PPM	-20 +50	15-90 %
Chlorine Dioxide	Echem	0-10 PPM	-20 +50	15-90 %
Hydrogen	Echem	0-1000 PPM	-20 +50	15-90 %
Hydrogen Chloride	Echem	0-20 PPM	-20 +50	15-90 %
Hydrogen Cyanide	Echem	0-25 PPM	-20 +50	15-90 %
Hydrogen Fluoride	Echem	0-10 PPM	-20 +50	15-90 %
Hydrogen Sulfide	Echem	0-100 PPM	-40 +50	15-90 %
Nitrogen Dioxide	Echem	0-20 PPM	-20 +50	15-90 %
Nitric Oxide	Echem	0-50 PPM	-20 +50	15-90 %
Oxygen	Echem	0-25 %	-30 +55	0-90 %
Ozone	Echem	0-10 PPM	-40 +50	15-90 %
Phosphine	Echem	0-5 PPM	-20 +50	15-90 %
Sulfur Dioxide	Echem	0-10 PPM	-20 +50	15-90 %

14.0 BUCKEYE DETECTION SYSTEMS STANDARD LIMITED WARRANTY

Buckeye Detection Systems, Inc. warrants products manufactured and sold by Buckeye Detection Systems to be free from defects in materials and workmanship for the period listed in the tables on the following pages. This warranty is expressly limited to the original owner who purchases the equipment directly from Buckeye Detection Systems or from an authorized Buckeye Detection Systems Distributor.

To maintain this limited warranty, the product must be operated, calibrated, and maintained in accordance with the Operation and Maintenance Manual supplied with the product. Abuse, mechanical damage, alteration, or repairs not made in accordance with the Operation and Maintenance Manual void Buckeye Detection Systems Standard Limited Warranty.

The obligation of Buckeye Detection System under this limited warranty is limited to the repair or replacement of components deemed by the Buckeye Detection Systems Technical Support Center to have been defective under the scope of this Standard Limited Warranty. To receive consideration for warranty repair or replacement, the product must be returned to a Buckeye Detection Systems Authorized Service Partner or to Buckeye Detection in Kings Mountain, North Carolina, USA, with transportation and shipping charges prepaid. If the product is being returned to Buckeye Detection Systems it is necessary to obtain a return authorization number (RMA) from Buckeye Detection Systems prior to shipment.

This limited warranty is expressly in lieu of any and all representation, express or implied, including but not limited to the warranty of fitness for a particular purpose. Buckeye Detection Systems will not be liable for loss or damage of any kind connected to the use of this product or failure of its products to function or operate properly.

Warranty for Echem Sensors - 1 year
Warranty for Cat-Bead Sensors - 1 year
Warranty for IR Sensors - 2 years
Warranty for BDS-50 Transmitter - 2 years

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