Series D12

IR Gas Transmitter

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PRODUCT WARRANTY

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's products prove to be defective in materials or workmanship within the earlier of 18 months after the date of shipment or 12 months after the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors, except oxygen sensors, are covered by this warranty, but are subject to inspection for evidence of extended exposure to excessive gas concentrations. Should inspection indicate that sensors have been expended rather than failed prematurely, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse, or has not been operated or stored in accordance with instructions or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

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INTRODUCTION

The D12-IR transmitter is used to continuously monitor for gas leaks in ambient air near process tanks, piping, or in enclosed spaces where gases may accumulate. The transmitter is explosion proof, and is designed for use in hazardous locations (see specifications). It features an NDIR (non-dispersive, infrared) sensor, referred to hereafter as an IR sensor, backlighted graphics display, four button (magnetic switch) panel, three level alarm system with three (optional) alarm relays, high-resolution 4-20mA current loop output, real-time clock, data-logger, and optional HART™ or Modbus™ network interface.

IR Sensors

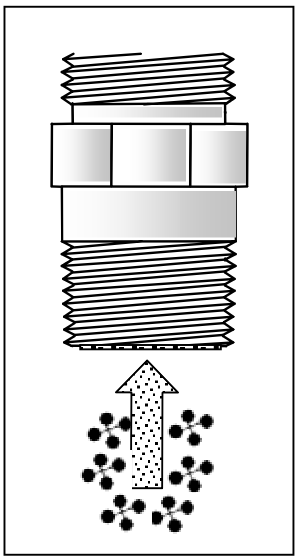


Figure 1. D12 IR Sensor

The IR sensor is constructed in an explosion proof, stainless steel housing that is threaded into the base of the transmitter (or remote housing, if ordered). A porous, stainless steel frit is welded into the opposite end to permit gas entry, and to prevent possible ignition of a combustible atmosphere. Threads are cut into the sensor housing to accommodate various accessories, such as rain shields, and calibration adapters.

The working parts of the sensor consist of an infrared light source, detector, thermistor, and memory device. The light source is a thin wall, tungsten filament lamp, with an MTBF of 100,000 hours. It is pulsed at 2hz to provide excitation to the detector, and as a side benefit, warms the components of the sensor a few degrees above ambient. This warming effect helps prevent water vapor from condensing on interior surfaces of the sensor, which could lead to excessive drift, or even false alarms.

The detector is a dual element, pyroelectric design. The elements, labeled “active” and “reference”, are piezo crystals that distort when heated, and generate a small charge in response to radiation pulses emitted by the lamp. Specially designed, optical filters cover each element. The active element is covered by an optical filter that passes radiation in a band that will be absorbed by a target gas, such as Methane. Its output will decrease in amplitude when the gas is in the path of the lamp’s radiation. The “reference” element has an optical filter whose pass-band is outside of the active element’s filter, and is unaffected by the presence of the target gas. It is used primarily to compensate for slight variations of lamp intensity, humidity, and other environmental factors.

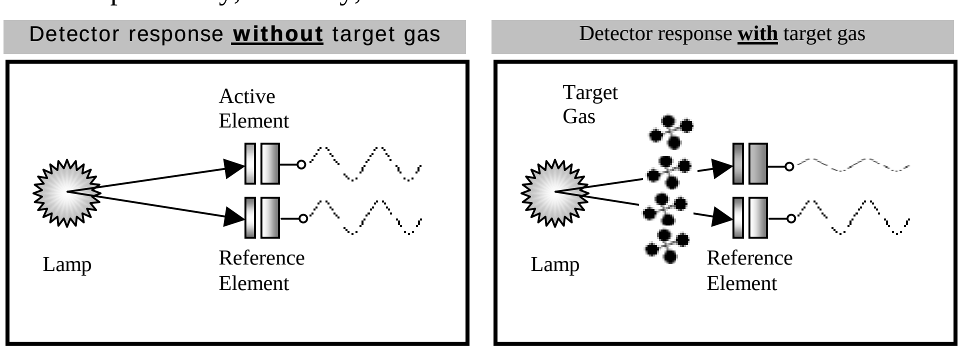


Figure 2. Signal outputs before and after gas exposure.

The signal output of an element is proportional to the amount of filtered radiation reaching it. When an IR absorbing gas enters the optical path, it reduces the radiation reaching the active element by an amount that is a function of the gas type, and concentration. The figure below illustrates the absorption spectra of both Methane and Propane at identical concentrations, overlaid with the filter pass-bands of the Standard LEL Hydrocarbon sensor (P/N 00-1375). To the right of each spectrum is a graph of the sensor's relative, fractional absorption (FA) plotted over the same concentration range.

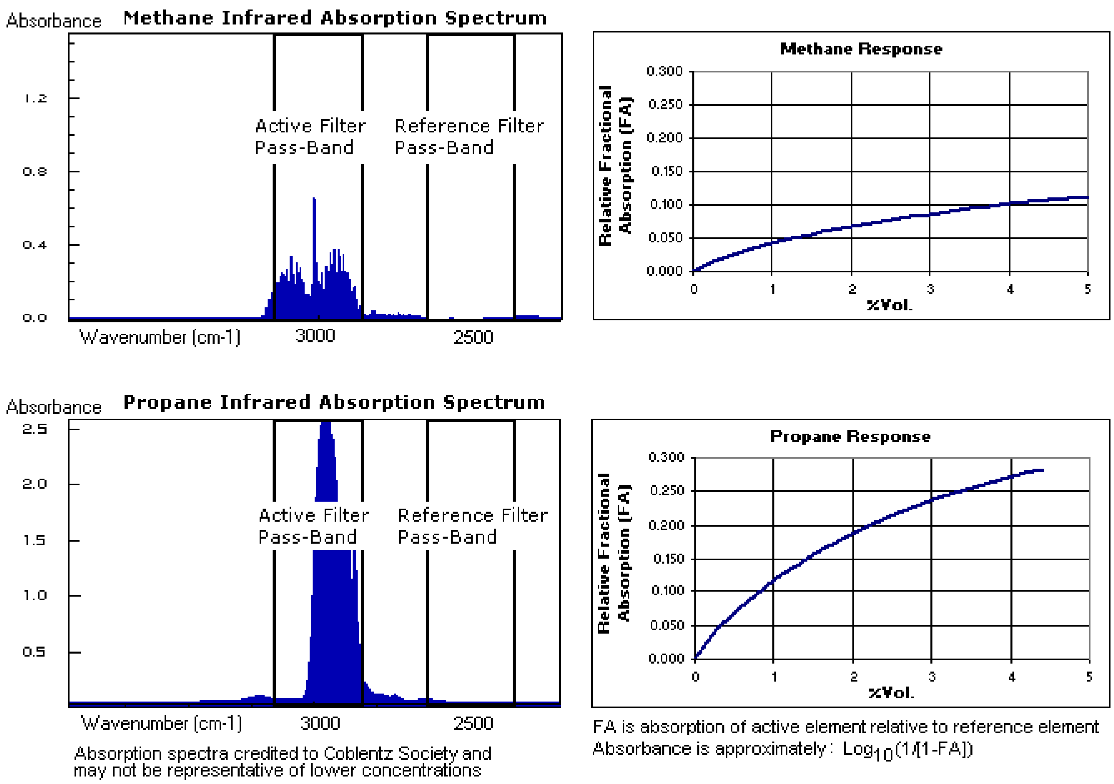


Figure 3. Absorption spectrum and corresponding sensor response.

The transmitter's CPU monitors the output from each element, computes a fractional absorption value and linearizes it into a gas concentration reading in units of %LEL, or %V/V. The linearization function is derived from Beer's Law, The CPU also monitors the sensor's thermistor output and, if required, corrects the concentration readings over its specified temperature range.

The memory of the sensor stores a table of information about one or more target gasses, including names, ranges, alarm settings, linearity, sensitivity, and calibration status information. Once the factory has calibrated the sensor with one or more gasses listed in the table, any one of those gases may be selected for monitoring at the customer site. In addition to the gas table, the sensor memory stores a calibration history. The history includes room for 63 zero, and 63 span calibration records, before rolling over.

IR Sensor Versions

The current list of sensor versions available for the D12 transmitter are shown below (contact factory for a complete list). Except for the optical filters, the construction and operation of the each version is identical.

Part No.	Abbreviation	Description
00-1375	HC	Standard LEL (low range) hydrocarbon sensor for Methane, Propane, Butane, Pentane, etc.
00-1376	HHC	High range hydrocarbon sensor for high concentrations (normally above the UEL) of Propane, Butane, LPG.
00-1377	CO2	Standard range Carbon dioxide sensor
00-1378	HCO2	High range Carbon dioxide sensor
00-1431	N2O	Standard range Nitrous oxide sensor

Sensors are not approved for monitoring Acetylene.

Table 1. D12 IR Sensor Versions

Standard LEL Hydrocarbon (HC) IR Sensor, P/N 00-1375

This sensor is designed to detect combustible, hydrocarbon gas in locations where high concentrations of gas are not likely to exist normally, but could occur as the result of a leak. Gases listed in this sensor's table include Methane, Ethane, Propane, n-Butane, and more.

Target Gas Setting	LEL %V/Air	UEL * %V/Air	Default FS Range %LEL	Default Caution %LEL	Default Warning %LEL	Default Alarm %LEL	FA% @LEL
Methane	5.0	15.0	100	-10	20	50	*11*
Ethane	3.0	12.4	100	-10	20	50	---
Propane	2.2	10.0	100	-10	20	50	*20*
n-Butane	1.8	9.0	100	-10	20	50	*19*
Pentane	1.5	7.8	100	-10	20	50	*16*
Hexane	1.2	7.4	100	-10	20	50	*13*
Cyclohexane	1.3	8.4	100	-10	20	50	*4*
Ethyl acetate	2.2	11.0	100	-10	20	50	*11*
Dimethyl - formamide (DMF)	2.2	15.2	100	-10	20	50	---
Acetone	2.6	13.0	100	-10	20	50	---
High-Methane **	5.0	15.0		Off	Off	Off	---

Contact factory for complete list.
* Information only, HC sensor not approved for monitoring above LEL concentrations (exception: High-Methane)
** Do not use High-Methane setting for leak detection.
--- Not applicable, or not available at time of publication, contact factory.

Table 2. Target gas settings for the Standard LEL Hydrocarbon IR Sensor

With so many potentially explosive, hydrocarbon gasses in use today, this sensor has the largest table of target gases. Each gas must be span calibrated at the factory to permit its selection in the field.

Unlike a catalytic bead sensor, compounds of Silicon do not poison the sensor, nor does it rely on atmospheric Oxygen. Although not entirely accurate above the target gas LEL, readings will not decrease when exposed to a 100%Vol. concentration of the target gas. In addition, the sensor can operate in a 100%Vol. Methane environment (only on the High-Methane setting, see below).

LEL, UEL

Various hydrocarbon gases become explosive when mixed with air at, or above, a concentration limit referred to as the LEL (Lower Explosive Limit). For Methane, the LEL concentration is 5% by volume, in air, labeled as 5%V/Air. As more gas is mixed with air, the concentration rises and remains explosive, until it reaches the UEL (Upper Explosive Limit). Above the UEL, the concentration is considered non-explosive. For Methane, the UEL concentration is 15%V/Air.

%LEL

Various gas selections cause the transmitter to report combustible gas concentrations as a percentage of the LEL, or %LEL. For example, 2.5%V/Air of Methane would be reported as 50%LEL, and so on. A reading at or above 100%LEL indicates a dangerous, explosive environment exists at the transmitter, and every effort to evacuate personnel and prevent ignition should be taken.

By default, gasses listed in this sensor's table report concentration in units of %LEL, have alarms set at: C=-10, W=20 and A=50 %LEL, and are not permitted to have alarms set above 60%LEL (exception: High-Methane).

Target and Interferent Gases

Any gas or vapor that absorbs IR in the pass-band of the active detector element will cause a positive response of the sensor. This principle permits a sensor to be used for monitoring more than one gas – but not at the same time. The IR sensor cannot distinguish one gas type from another, however; it can be calibrated for any gas that causes a positive response. Once calibrated (by the factory), that gas may be selected for monitoring at the customer site, and is referred to as a "target" gas. Once a target gas has been selected, any other gas that causes the sensor to respond (especially other target gases) is considered to be an "interferent" gas. Since the Standard LEL Hydrocarbon sensor has highest number of possible interferent gasses, a discussion of how to manage them appears below.

Managing Interferent Gas Environments

As mentioned above, the Standard LEL Hydrocarbon sensor has the largest number of possible target gases, and since it may only monitor one at a time, it also has the largest number of possible interferent gases. In the best case, an interferent gas may cause nuisance alarms. In the worst case, it may pose an undetected, explosive, or deadly toxic atmosphere.

In locations where one or more IR absorbing gases may be present, select the target gas with the lowest FA (fractional absorption) at the LEL of the gas. This value is shown for most target gases in the table above as **FA%@LEL**. For example, consider the case where both Methane and Propane are piped through a confined space that must be monitored for potential leaks. The fractional absorption levels are found in table 2 above:

Methane	5.0	15.0	100	-10	20	50	11
Ethane	3.0	12.4	100	-10	20	50	---
Propane	2.2	10.0	100	-10	20	50	20

In this case, Methane's 11 is less than the 20 for Propane, so we would select Methane as the target gas. If, by mistake, we were to make Propane the target gas, and subsequently experience a leak of Methane, the fractional absorption level would need to rise to 12.5 (the 50%LEL level of Propane) before triggering the alarm. A Methane leak would form an explosive mixture below that level, and therefore go undetected. Although a Propane leak might result in a false Methane alarm, the space would not be explosive.

Methane and High-Methane Target Gas Settings

The sensor provides the "Methane", and "High-Methane" settings to improve the accuracy of readings for low and high concentrations of Methane. As can be seen below, the "shape" of the sensor's response at lower concentrations differs from that at higher concentrations, and the accuracy of readings can be improved by using a linearization function that more closely fits the response of the sensor.

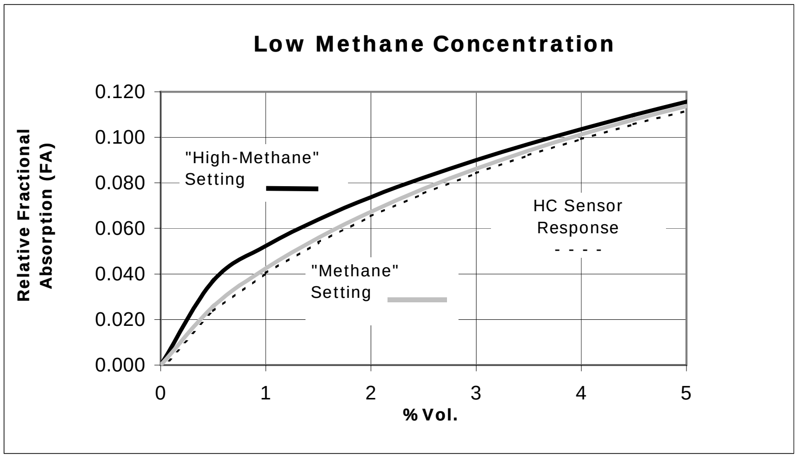


Figure 4. Comparison of "Methane" to "High-Methane" linearization for low concentrations of Methane (Sensor response is dashed line).

Choose the "Methane" setting when monitoring Methane concentrations below the LEL. This setting is typically used for detecting leaks in piping, and around storage tanks. This setting is not recommended for monitoring above the UEL (15%Vol).

Choose the "High-Methane" setting when monitoring Methane concentrations above the UEL (15%Vol.). This setting is typically used for process gas monitoring, or applications other than leak detection.

This setting is not recommended for monitoring below the LEL (5%Vol).

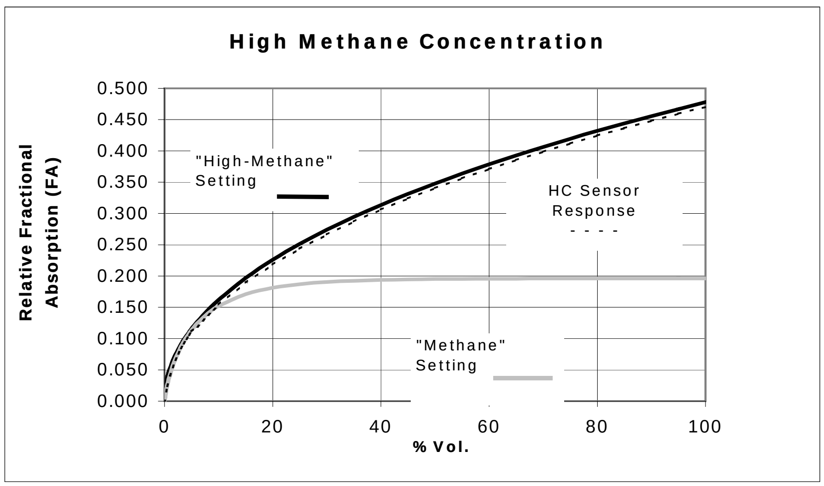


Figure 5. Comparison of "Methane" to "High-Methane" linearization for high concentrations of Methane. (Sensor response is dashed line).

High-range Hydrocarbon (HHC) IR Sensor, P/N 00-1376

This sensor is designed to monitor high concentrations of hydrocarbon gas in locations where high concentrations are likely to exist normally, and usually above the UEL of the respective gas. Gases listed in this sensor's table include Propane, n-Butane, and LPG. Each gas must be span calibrated at the factory to permit its selection in the field. This sensor is not recommended for Methane (for Methane applications, please use P/N 00-1375, Standard LEL IR Sensor).

Target Gas Setting	FS Range (Min,Max)	Default Caution	Default Warning	Default Alarm
Propane	100 %V/V (10,100)	Off	Off	Off
n-Butane	100 %V/V (10,100)	Off	Off	Off
LPG	100 %V/V (10,100)	Off	Off	Off

Contact factory for complete list.
HHC sensor not approved for monitoring below LEL concentrations.

Table 3. Target gas settings for the High-range Hydrocarbon IR Sensor

By default, gasses listed in this sensor's table report concentration in units of %V/V (equivalent to %V/Air, or %Vol), and have their alarms disabled. Alarms may be enabled, and programmed to activate on either rising or falling concentration levels.

Standard range Carbon Dioxide (CO2) IR Sensor, 0-5%Vol, P/N 00-1377

Target Gas Setting	FS Range (Min,Max)	Default Caution	Default Warning	Default Alarm
CO2	1.0 %V/V (1.0,5.0)	-0.1 %V/V	0.2 %V/V	0.5 %V/V
Low-CO2	200 PPM (200,5000)	-20 PPM	40 PPM	100 PPM

Contact factory for complete list.

Table 4. Target gas settings for the Standard-range Carbon Dioxide IR Sensor

The sensor provides the "CO2", and "Low-CO2" settings to improve the accuracy of readings for high and low concentrations of Carbon dioxide. The "shape" of the sensor's response at lower concentrations differs from that at higher concentrations, and the accuracy of readings are improved by using a linearization function that more closely fits the response of the sensor.

High-range Carbon Dioxide (HCO2) IR Sensor, 0-50%Vol,P/N 00-1378

Target Gas Setting	FS Range (Min,Max)	Default Caution	Default Warning	Default Alarm
CO2	10.0 %V/V (5.0,50.0)	-1.0 %V/V	2.0 %V/V	5.0 %V/V

Contact factory for complete list.

Table 5. Target gas settings for the High-range CO2 IR Sensor

Standard range Nitrous oxide (N2O) IR Sensor, 0-1%Vol , P/N 00-1431

Target Gas Setting	FS Range (Min,Max)	Default Caution	Default Warning	Default Alarm
N2O	0.5 %V/V (0.2,0.5)	-0.05 %V/V	0.1 %V/V	0.25 %V/V

Contact factory for complete list.

Table 6. Target gas settings for the Standard-range N2O IR Sensor

SPECIFICATIONS

Standard IR Sensor	Standard LEL Hydrocarbon (HC) IR Sensor, P/N 00-1375 For LEL Methane, Ethane, Propane, n-Butane, and more (contact factory)
Optional IR Sensors	High-range Hydrocarbon (HHC) IR Sensor, P/N 00-1376 For 100%Vol. Propane, n-Butane, and LPG
	Standard-range Carbon Dioxide (CO2) IR Sensor, P/N 00-1377 Minimum range: 0 to 200PPM, Maximum range: 0 to 5%V/V
	High-range Carbon Dioxide (HCO2) IR Sensor, P/N 00-1378 Minimum range: 0 to
	Standard range Nitrous oxide (N2O) IR Sensor, 0-1%Vol, P/N 00-1431
Response Time	T90 < 30 seconds
Accuracy	Standard IR sensor: ±2%LEL (0.1%V/V) Methane Optional sensors: +/- 2% of minimum range of target gas
Repeatability	Standard IR sensor: ±2%LEL (0.1%V/V) Methane Optional sensors: ±2% of minimum range of target gas
Zero Drift	Standard IR sensor: ±1%LEL (0.05%V/V) Methane, per month Optional sensors: +/-1% of minimum range of target gas, per month
Span Drift	Standard IR sensor: ±1%LEL (0.05%V/V) Methane, per month Optional sensors: ±1% of minimum range of target gas, per month
Humidity Range	0 to 95 %RH non-condensing
Analog Output	4-20mA, 675 ohms max. at 24 VDC, current sourcing
AO Range	Standard IR sensor: 4mA is 0%LEL, 20mA is 100%LEL (programmable down to 50%LEL) Optional sensors: 4mA is 0, 20mA is 100% of target gas range.
Serial Interface	HART® 1200 baud modem interface, registered DDL file Modbus ® 1200-9600,14.4k,28.8k ,RS232/RS485
Data Logger	ASCII output to terminal or printer (XON/XOFF)
Power	12 to 30 VDC (250 mA @ 24VDC maximum, 3-wire mode)
Alarm Relays	(3) SPST, contacts are rated at 5A@250 VAC, resistive load
Relay Coils	Normally energized or de-energized, programmable
Enclosure	Explosion-proof, Class 1, Div. 1, Groups B, C, & D.
Controls	Non-intrusive (4 magnetic switches on front of transmitter)
Operating Temp	-40° to +75° C
Weight	4 Lbs. (1.8 Kg.)

INSTALLATION

SENSOR LOCATION

The sensor is housed in a corrosion resistant stainless steel shell with a sintered metal flame arrestor, isolating the sensing element from ambient air. A ¾" NPT thread at the back of the sensor mates with the threaded entry on the explosion-proof transmitter enclosure. D12-IR transmitters are designed for use in Class 1, Division 1, Group B, C, or D locations. These transmitters should not be used in Group A environments (atmospheres containing Acetylene).

IR sensors are used to detect a variety of gases or vapors. For gases that are heavier than air, such as Butane, sensors should be mounted near the floor. If the gas vapor has a density near that of air, locate the sensor about 5 feet above the floor in enclosed areas. Gas sensors mounted outdoors should be located near anticipated leak sources (valves, flanges, compressors) and the location will depend on normal wind patterns and anticipated employee activity areas.

The following table lists common gases, along with their relative density (air = 1.00). Densities less than one indicate gases that are lighter that air while those with densities greater than one are heavier than air. Combustible vapors from most solvents, such as Benzene, n-Hexane, Methanol, Ethanol, and MEK, are heavier than air and will tend to accumulate near the floor in enclosed spaces with little air movement.

Gas Name	Density Relative to Air
Methane	0.55
Ethane	1.05
Propane	1.55
Butane	2.11
Carbon dioxide	1.53
Nitrous oxide	1.53

Table 7. Relative densities of target gases.

MECHANICAL MOUNTING

Figure 6 shows the dimensions of the transmitter enclosure, and location and size of the electrical conduit opening. When used in a classified area, an explosion-proof seal should be installed as required by the local electrical code. If conduit is used, it must also be sealed internally at the housing entry to prevent condensation inside the conduit draining into the enclosure.

Failure to seal the conduit entry or cable gland will result in water entering the enclosure causing damage to, or failure of, the transmitter electronics.

The transmitter should be mounted with the sensor facing down. Transmitters are shipped with a protective plastic cap over the sensor that should be left in place during installation, and removed before placing the transmitter in service (leave the cap installed whenever painting around the transmitter).

	Remove protective cap from sensor prior to operation.	

Supporting the Transmitter

The transmitter should be secured to a wall or flat surface through two mounting holes in the enclosure, as shown in figure 6. If proper conduit fasteners are used, the transmitter enclosure may be supported by conduit alone.

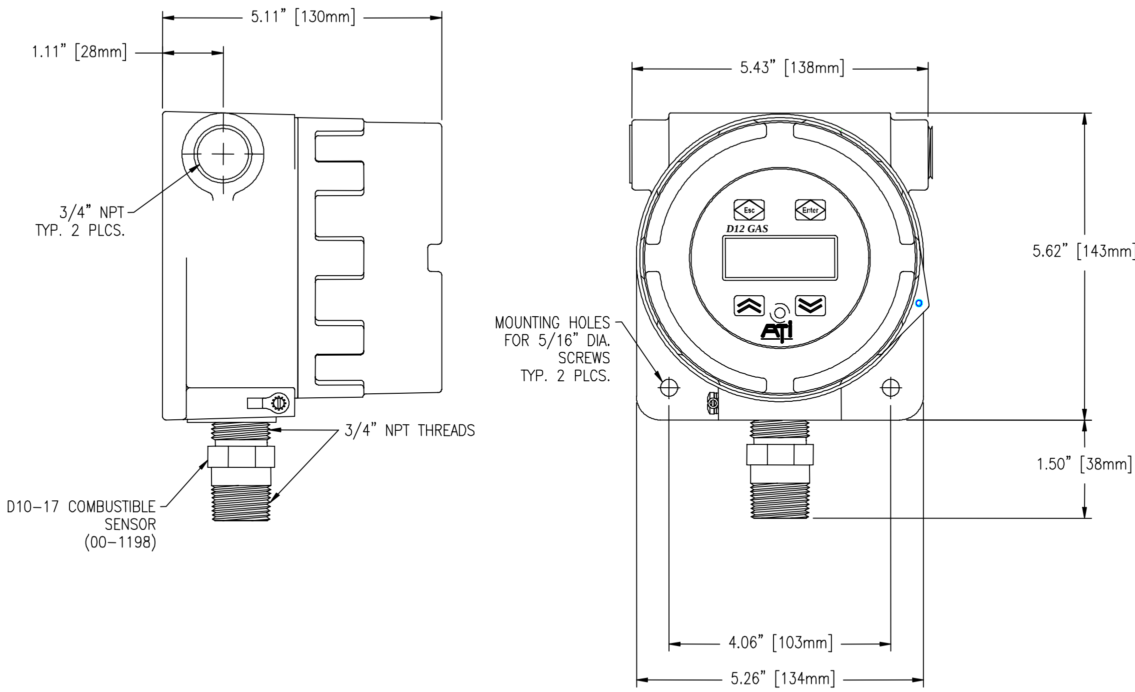


Figure 6. Overall dimensions.

ELECTRICAL CONNECTIONS

External Power Supply

The transmitter requires a regulated DC supply, operating between 12 and 30 VDC. Transmitters ordered with relays will require a maximum current of 250mA, worst case (all relays energized). Power supplies for operating multiple units should be sized for twice the calculated load to allow for start-up (inrush) current.

The Stack

The transmitter consists of three circuit boards, known collectively as the "stack". From top to bottom, they are the, Display, CPU, and Power Supply. The top two boards, Display and CPU, are fastened together with metal standoffs, and plug into the Power Supply board, which is fastened to the lower housing with similar metal standoffs. Since most external wiring connections are made to terminals on the Power Supply board, it will be necessary to remove the top two boards.

	Please be aware of the hidden ribbon cable that connects the top two boards to the sensor. This cable is just long enough to permit the boards to come free from the housing, but no further.	

Grasp the outer edge of the metal faceplate covering the Display board and gently rock it side to side, while pulling it up and away from the housing. Once the top two boards come free, lift them out and disconnect the sensor ribbon cable (note: this connector is keyed for ease of reconnecting later).

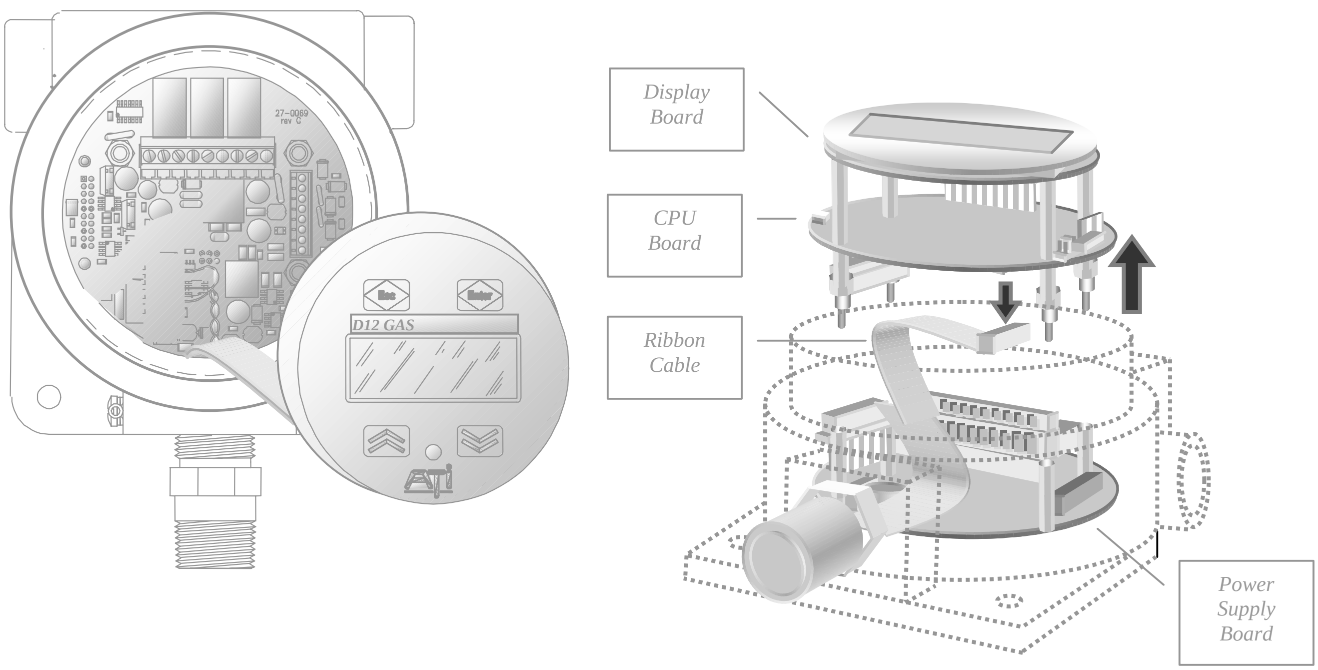


Figure 7 – Removing Top Boards to Access Transmitter Terminals.

Power Supply Board Connections

Electrical connections are made to terminal blocks, TB1 and TB2, on the Power Supply board. Power, current loop, (optional) digital communications, and remote alarm reset, are connected at TB1, while connections to the three (optional) relays are made at TB2.

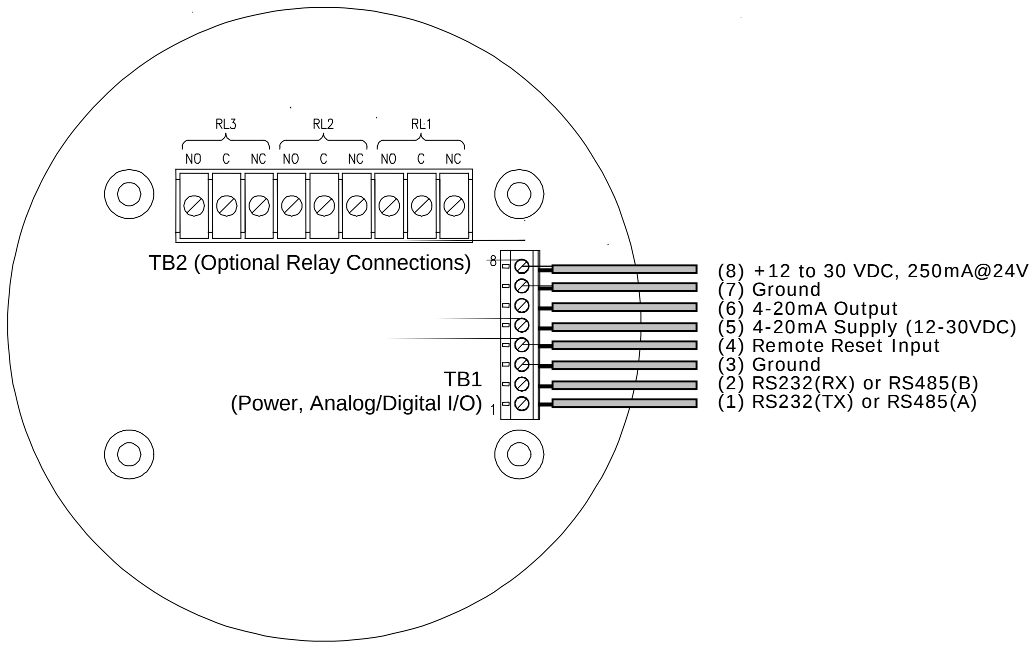


Figure 8 – Power Supply PCB Layout

Note: the D12-IR transmitter cannot operate on loop power alone (known as 2-wire mode), due to the power requirement of the sensor. Primary power, between 12 and 30 VDC, must always be applied to pins 7(-) and 8(+) of TB1. All other connections are optional, and detailed below.

Always follow wiring practices governed by local, state, and national electrical codes.

1 Connections to ATI A17/B14 Monitor(s)

A single ATI A17 may be used to for up to two D12-IR transmitters in 3-wire mode, and two ATI B14 receivers (see B14 Monitor O&M Manual).

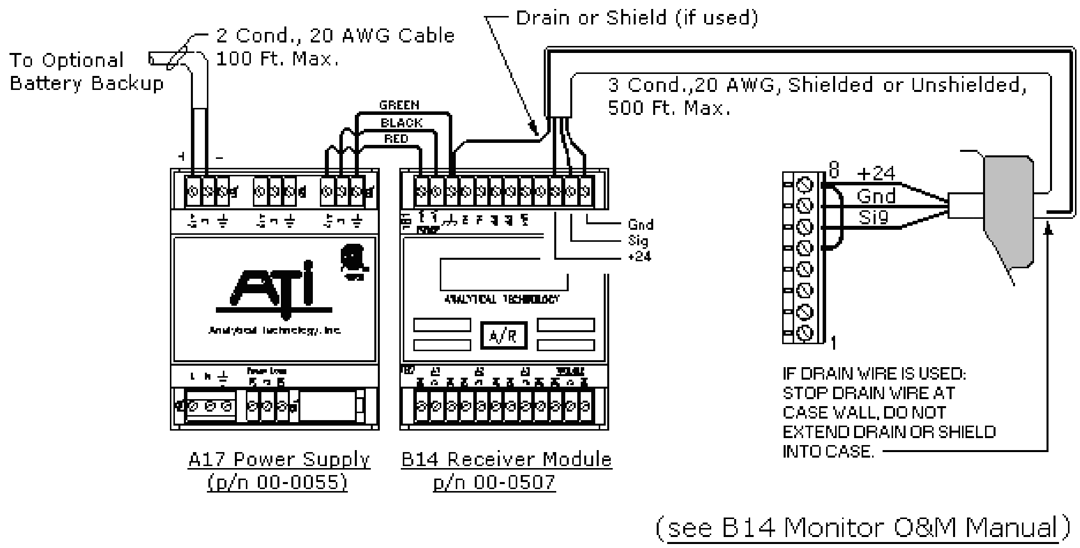


Figure 9 – Connections to ATI A17/B14 Monitor

2 Connections to Power Only, No Output Options

If there are no output options, transmitters may be powered from a single, primary supply as shown. Size each power supply according to the number of transmitters, the current demand of each (see specifications), and the wire resistance. The wire resistance must not be allowed to drop the primary supply voltage below 10V at the primary supply terminals of any transmitter. Hint: If possible, use 12-14 AWG wire on primary supply connections (shown in bold), keep the number of transmitters low, and verify the voltage on the on the transmitter furthest from the supply.

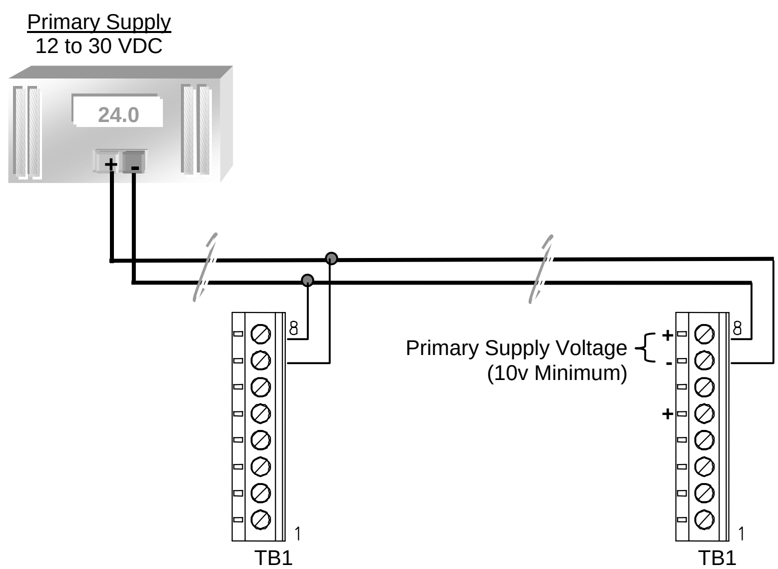


Figure 10 –Connections to Power Only, No Output Options

Connections to Current Loop Receiver, Single Supply (3-Wire Mode)

The transmitter will source current to a loop receiver as shown. A single power supply provides both primary and loop power to the transmitter. Size each power supply according to the number of transmitters, the current demand of each (see specifications), and the wire resistance. The wire resistance must not be allowed to drop the Primary Supply Voltage below 10V at the terminals of any transmitter. Hint: if possible, use 12-14 AWG wire on supply connections (shown in bold).

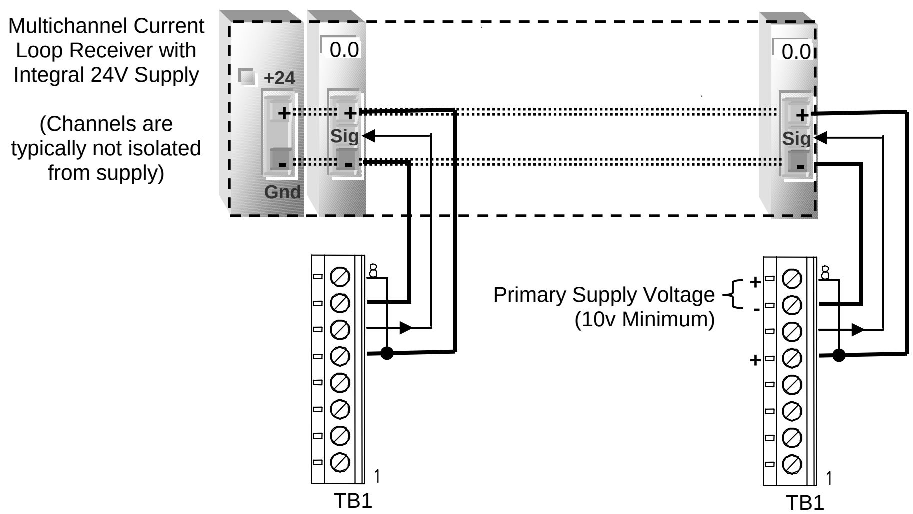


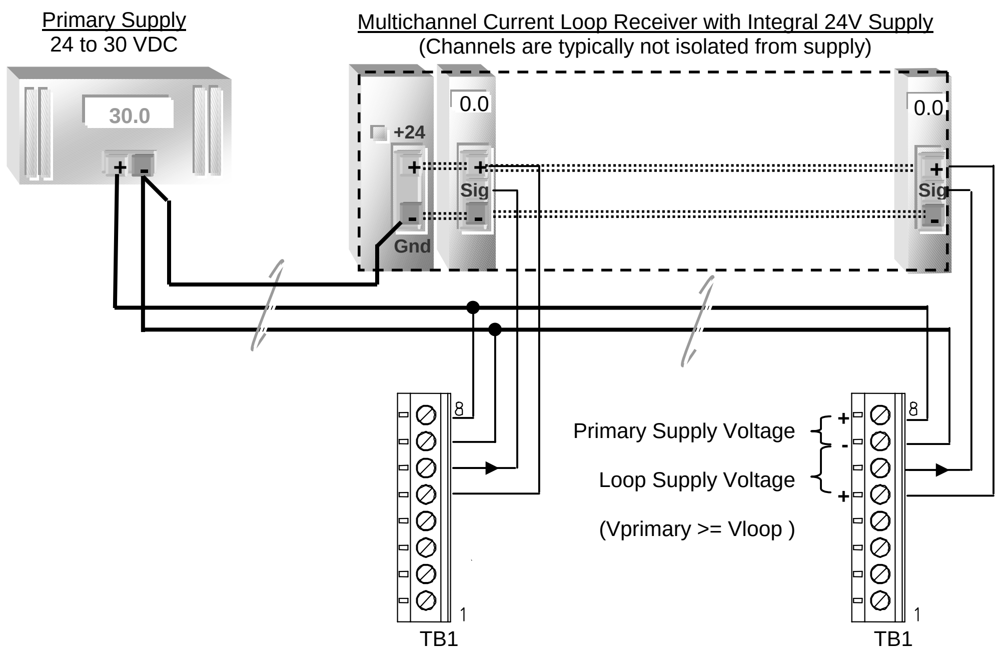
Figure 11 – Connections to Current Loop Receiver, Single Supply (3-Wire Mode)

Connections to Current Loop Receiver, Dual Power Supplies (4-Wire Mode)

To reduce the power requirement of a single current loop supply, the transmitter may be powered from both a primary and loop supply, providing the following conditions are met.

1. Supply grounds are directly connected to minimize ground loops, and,
2. The Primary Supply Voltage must not drop below the Loop Supply Voltage, as measured at instrument terminals.

Size each power supply according to the number of transmitters, the current demand of each (see specifications), and the wire resistance. The wire resistance must not be allowed to drop the Primary Supply Voltage below the Loop Supply Voltage, as measured at the terminals of any transmitter. Hint: select a Primary Supply with a higher voltage output than the Loop Supply, and use 12-14 AWG wire, if possible. Keep the number of transmitters supplied by the Primary Supply low, and verify the voltages at the terminals of the transmitter furthest from the Primary Supply.



IMPORTANT
Primary Supply Voltage must not drop below Loop Supply Voltage at terminals of any transmitter.

Hint: Use 12 AWG wire on Primary supply connections to minimize voltage drops.

1. Select a Primary Supply with a higher voltage output, and,
2. Connect supply commons to minimize ground loops and voltage drops that might reduce the Primary Supply Voltage below the Loop Supply Voltage, at transmitter.

Connections for HART Transmitter, Point-to-Point, Active Source (3-Wire)

The HART "Point-to-Point" connection permits the transmitter to communicate digitally, while retaining the functionality of its 4-20mA current loop. Setting the transmitter's polling address to 0 permits the current loop to function normally. According to HART specifications, the current loop must be terminated with a load resistor between 230 and 1100 ohms; however, transmitter specifications restrict the maximum analog output resistance to a lower value (see Specifications). The term, "active source", refers to a transmitter that is not loop powered, and sources current from power applied to it on separate terminals. Size the power supply according to the number of transmitters, the current demand of each transmitter (see specifications), and wire resistance. Wire resistance must not be allowed to drop the Primary Supply Voltage below 10V at the terminals of any transmitter. Hint: use at least 14 AWG wire on supply connections (shown in bold).

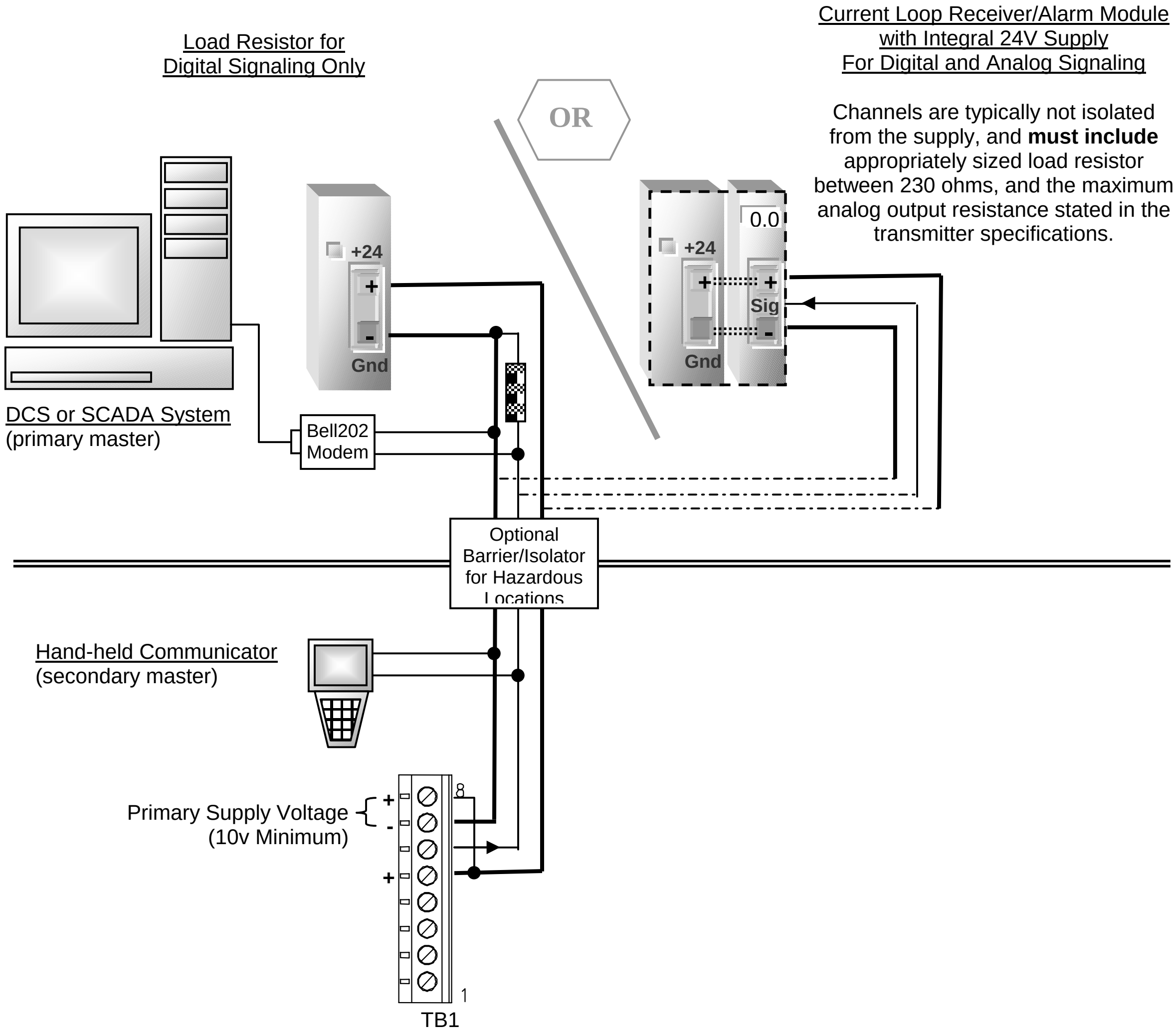


Figure 13 – Connections for HART Transmitter Operation, Point-to-Point

Connections for HART Transmitter, Multi-drop, Active Source (3-Wire)

The HART "Multi-drop" connection permits up to 15 transmitters to communicate digitally on the same bus, but at the cost of analog current signaling. Setting the transmitter's polling address from 1 to 15 fixes the current loop output at 4mA. According to HART specifications, the current loop must be terminated with a load resistor between 230 and 1100 ohms; however, transmitter specifications restrict the maximum analog output resistance to a lower value (see Specifications). The term, "active source", refers to a transmitter that is not loop powered, and sources current from power applied to it on separate terminals. Size the power supply according to the number of transmitters, the current demand of each transmitter (see specifications), and wire resistance. Wire resistance must not be allowed to drop the Primary Supply Voltage below 10V at the terminals of any transmitter. Hint: use at least 14 AWG wire on supply connections (shown in bold).

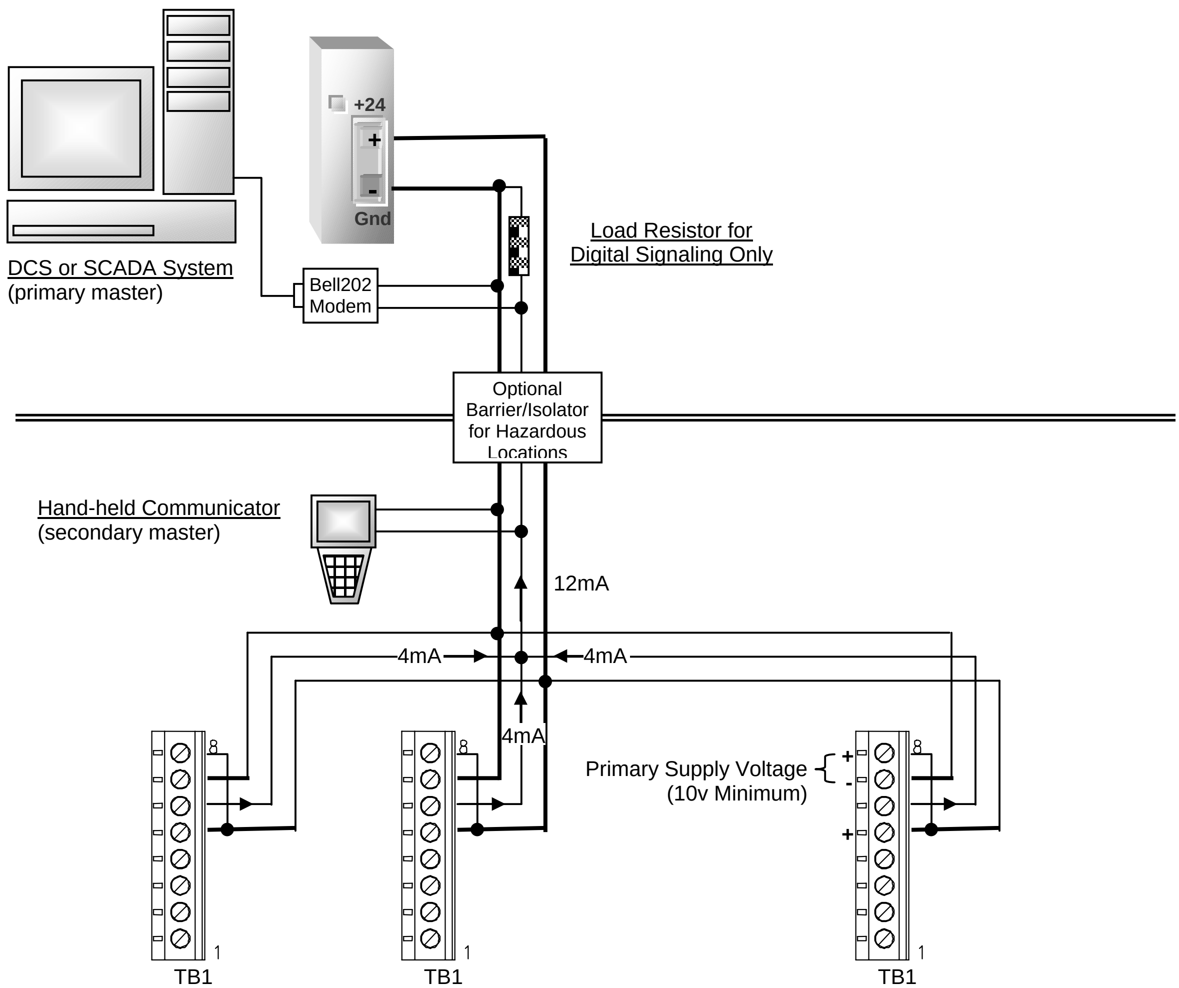
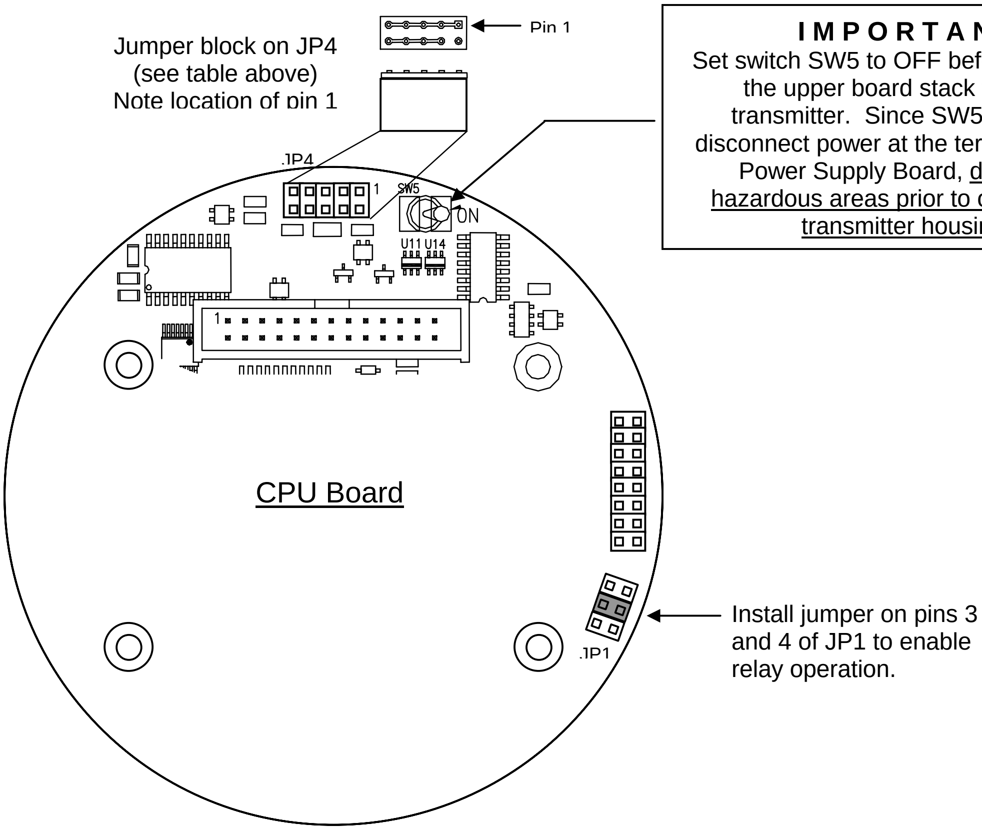


Figure 14 – Connections for HART Transmitter Operation, Multi-drop

CPU Board Configuration

Install one jumper plug on JP4 based on communication protocol and interface options. If equipped with relays, install the relay option jumper on JP1.

Protocol	***Interface***	***Jumper Plug Label***	***Comments***
HART	Bell 202	None Required	Okay to install any.
Modbus	RS232	"RS232"	Use to connect one transmitter to a master device in a "point-to-point" configuration. See "D12 Modbus Manual" for details.
Modbus	RS485	"RS485"	Use to connect up to 4 transmitters to a master device in a "multi-drop" configuration. Each transmitter connection biases and terminates the transmission line, as shown below. See "D12 Modbus Manual" for details.
Modbus	RS485	"RS485 Unterminated"	Use to connect more than 4 transmitters to a master device in a "multi-drop" configuration. Transmitters are connected without adding bias or termination. Install one (terminating) "RS485" jumper plug on transmitter at furthest end of transmission line. See "D12 Modbus Manual" for details.
ASCII	RS232	"RS232"	Use to connect one transmitter to a printer, or system terminal (see Datalogging section).



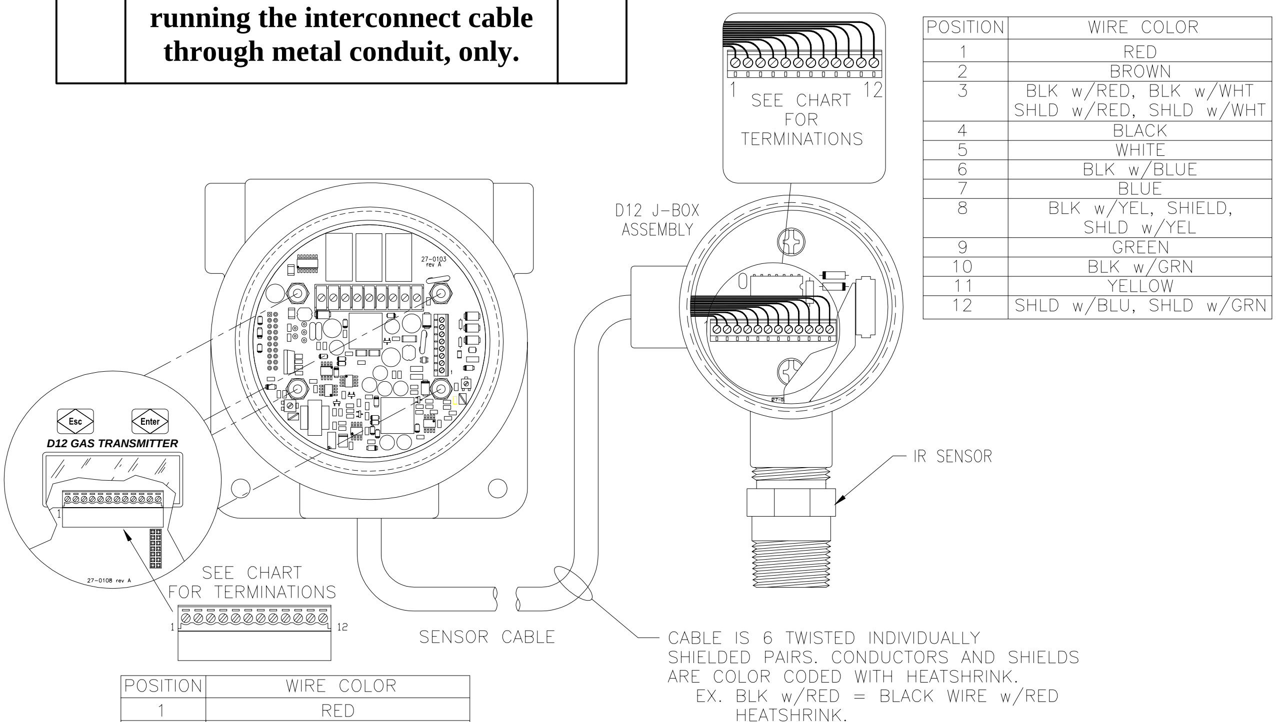
IMPORTANT
Set switch SW5 to OFF before removing the upper board stack from the transmitter. Since SW5 does not disconnect power at the terminals of the Power Supply Board, <u>declassify hazardous areas prior to opening the transmitter housing.</u>

Figure 15 – CPU Board Configuration Jumpers

REMOTE SENSOR WIRING

The remote sensor option allows separation of the sensor and transmitter by up to 25 feet. The sensor is threaded into a junction box, and connected to the transmitter using a supplied cable, which may be shortened, if necessary. Figure 16 shows the wiring connections at each end.

Manufacturer recommends running the interconnect cable through metal conduit, only.



POSITION	WIRE COLOR
1	RED
2	BROWN
3	BLK w/RED, BLK w/WHT SHLD w/RED, SHLD w/WHT
4	BLACK
5	WHITE
6	BLK w/BLUE
7	BLUE
8	BLK w/YEL, SHIELD, SHLD w/YEL
9	GREEN
10	BLK w/GRN
11	YELLOW
12	SHLD w/BLU, SHLD w/GRN

POSITION	WIRE COLOR
1	RED
2	BROWN
3	BLK w/RED, BLK w/WHT SHLD w/RED, SHLD w/WHT
4	BLACK
5	WHITE
6	BLK w/BLUE
7	BLUE
8	BLK w/YEL, SHIELD, SHLD w/YEL
9	GREEN
10	BLK w/GRN
11	YELLOW
12	SHLD w/BLU, SHLD w/GRN

Figure 16 – Remote Sensor Wiring

OPERATION

OPERATOR INTERFACE

The operator interface displays the main concentration reading, and provides four "keys" to access various displays to configure the transmitter, and calibrate the sensor. The interface is non-intrusive, meaning that you do not have to remove the housing cover to use it. The keys are actually graphic icons, below which reside magnetic switches that are activated when a magnet is held in close proximity. Throughout this manual, the method of activating keys in this manner is referred to as, "touching" the keys, even though it is not necessary to make physical contact. The transmitter is provided with a powerful, magnetic-screwdriver, designed specially for "touching" the keys through the housing's thick, glass window.

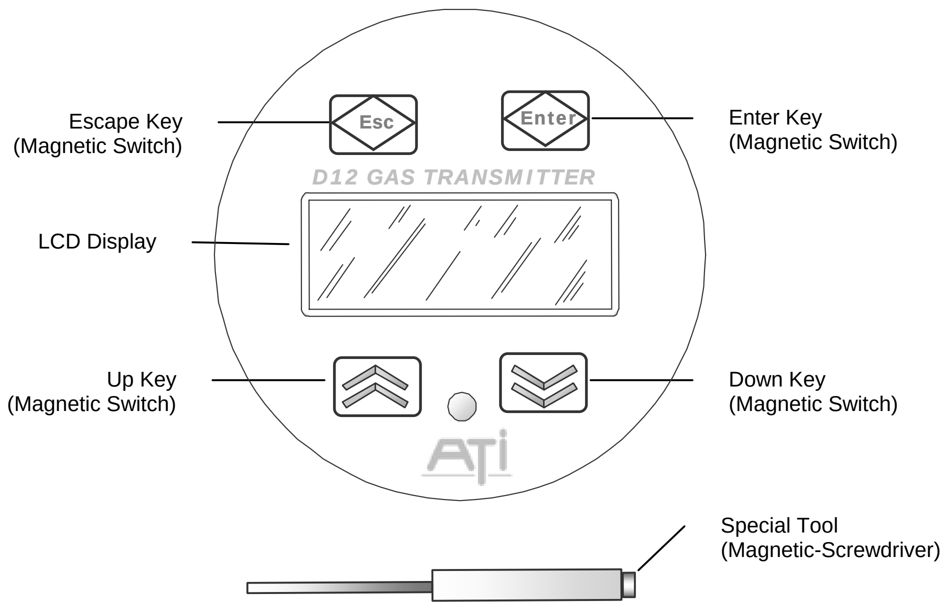


Figure 16 – Remote Sensor Wiring

Information is organized on screen "pages", and consists of readings and indicators, as well as text objects representing parameters, functions, and other pages. An arrow cursor appearing on the page may be moved from one object to the next by "touching" the magnet to the Up or Down key. Touching the magnet to the Enter key selects the object. The action performed when an object is selected depends on the type of object. Touching the magnet to the Esc key returns the display to the previous page (or cancels edit mode during parameter edit).

STARTUP

The transmitter will display the following review sequence when started. The examples that follow depict a transmitter equipped with a Standard LEL Hydrocarbon IR Sensor, 00-1375. (note: if the transmitter does not start, check that SW5 on the CPU board is in the ON position)

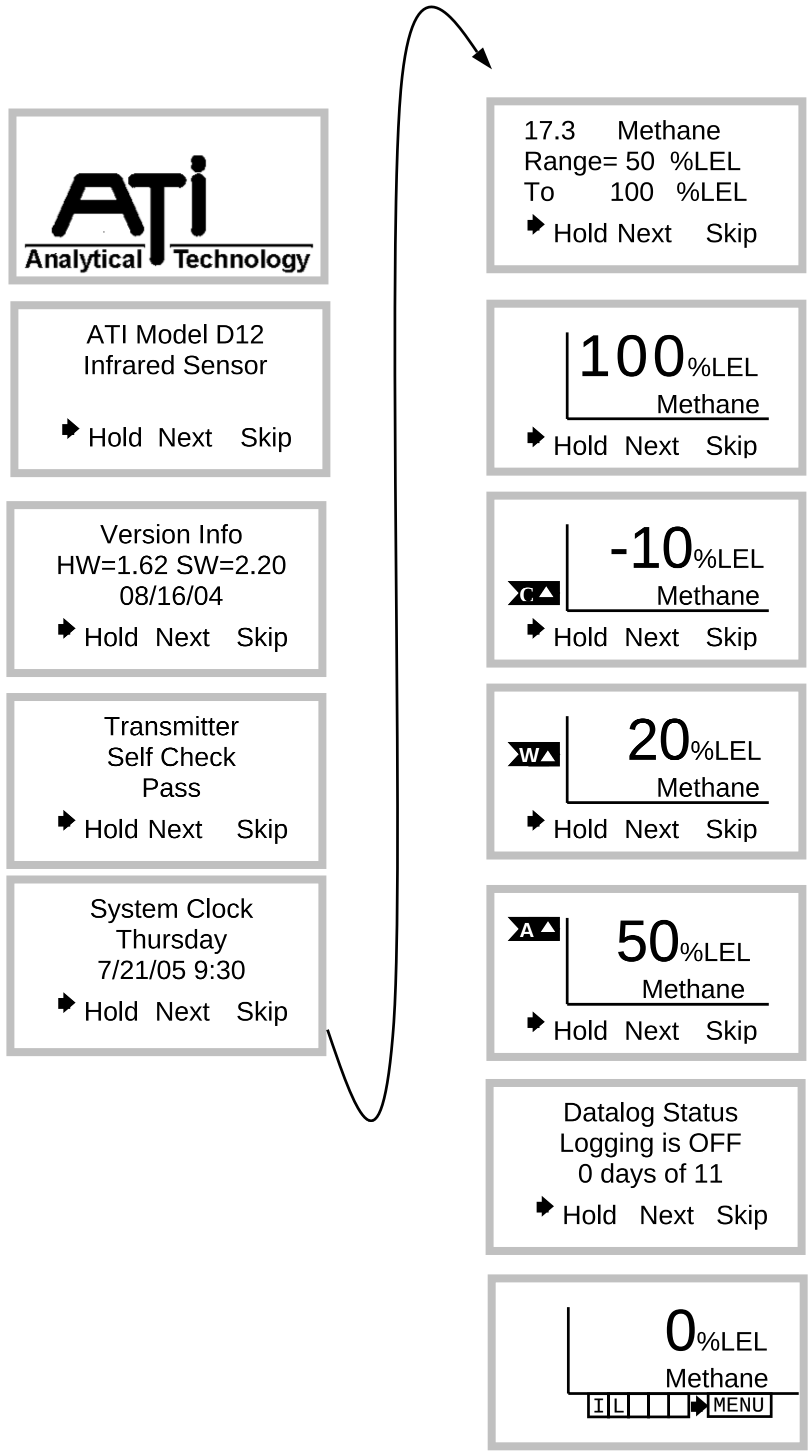


Figure 17 – Startup Review Sequence

MAIN DISPLAY AND INDICATORS

The transmitter's main display provides gas concentration information, unit of measurement (%LEL), and the combustible sensor name. In addition, a number of indicators are provided to show the status of internal alarms and to indicate various operational status parameters. Below is an explanation of each indicator shown on the display.

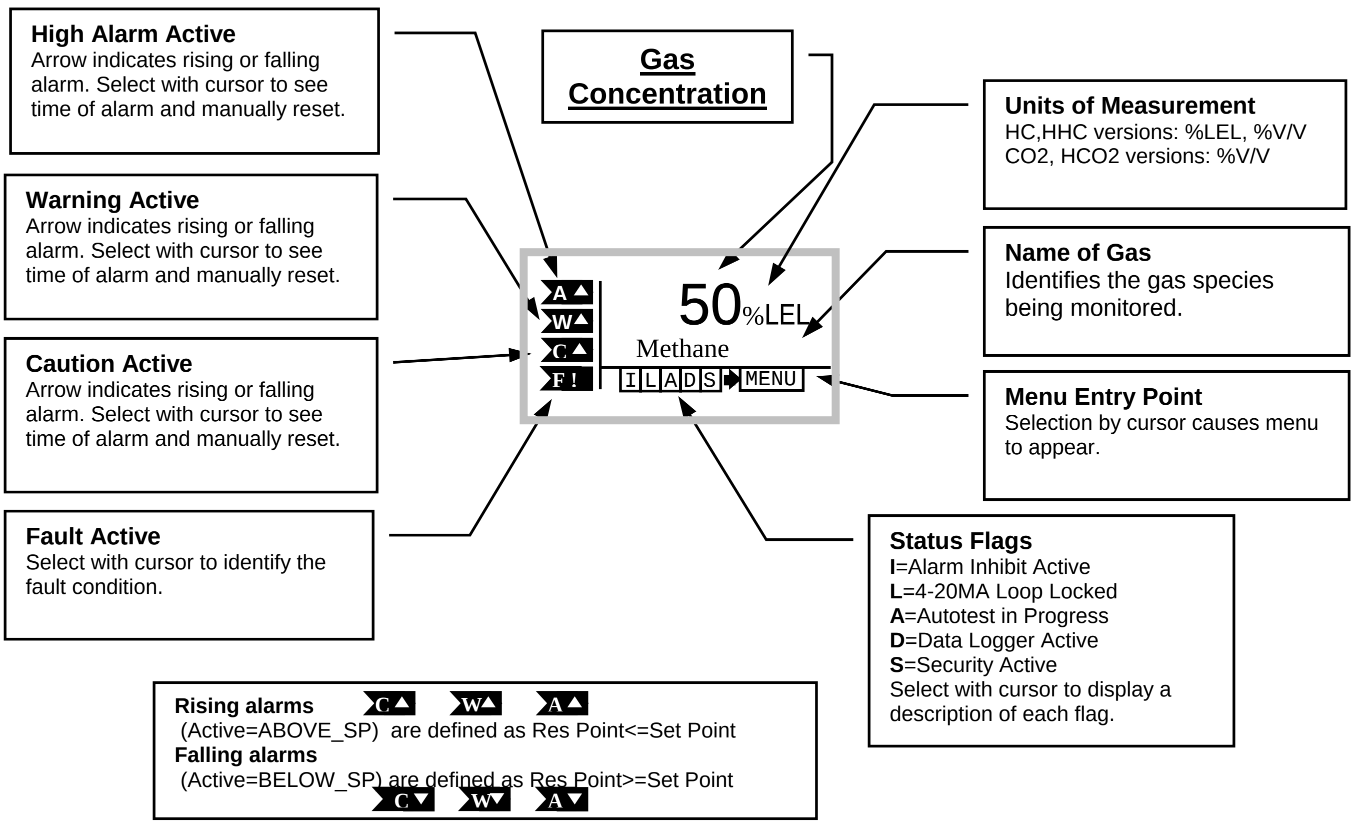


Figure 18 – Display Indicators

Esc Key Function

Holding the magnet over the ESC key for 2 seconds, then releasing, toggles the alarm inhibit state. If alarm inhibit was on, it will be turned off. If it was off, it will be turned on for 15 minutes (default value).

MENU NAVIGATION

Moving through the various menu pages, using the magnetic tool, is referred to as "menu navigation" With the cursor pointing to MENU on the Main page, touching the magnet to the Enter key will change the display to the Menu page as shown.

Navigation Shorthand
Throughout this manual, menu navigation is expressed in a type of path notation. For example, navigating onto the Sensor page in the sequence above would appear as:

Menu\Setup\Sensor

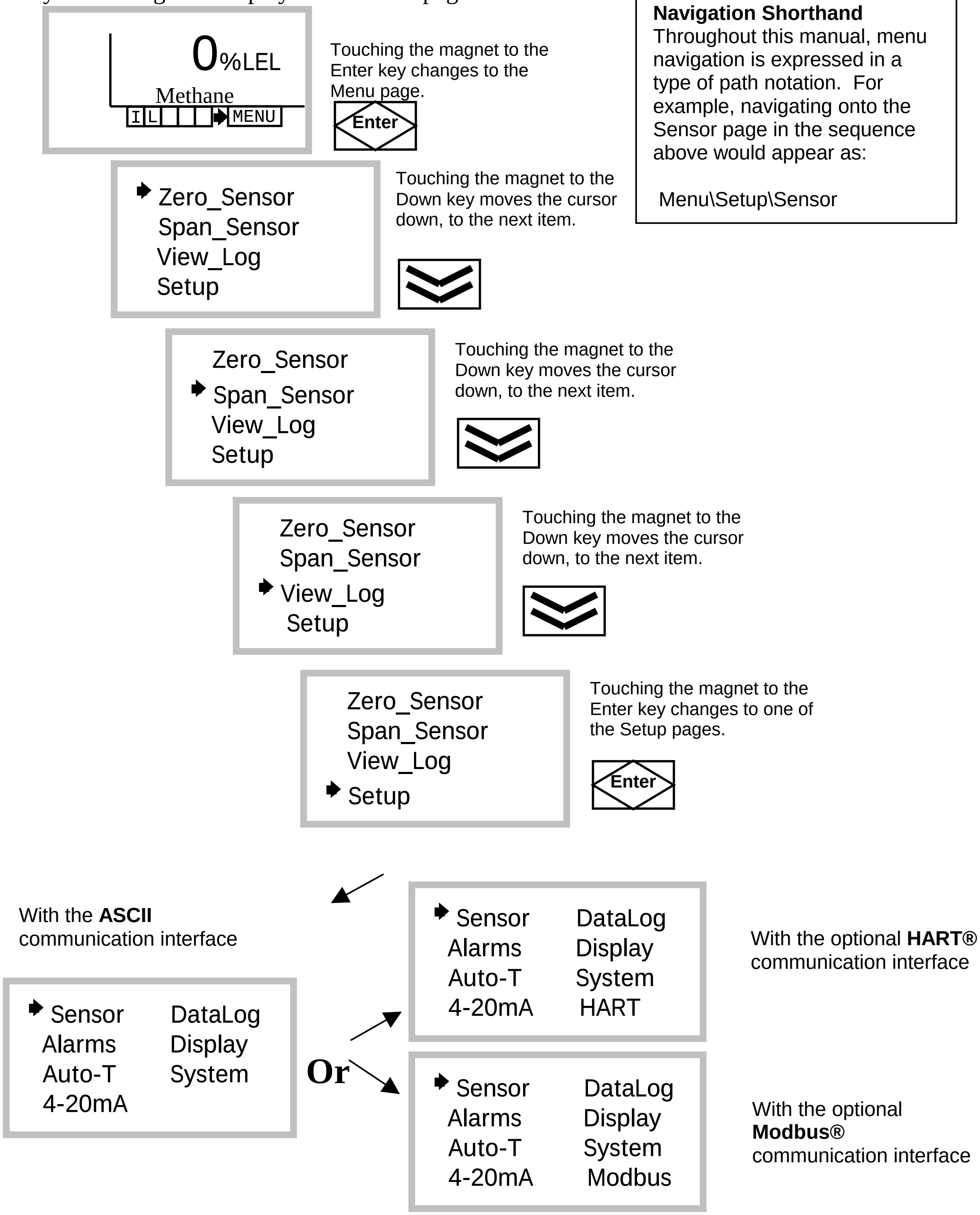
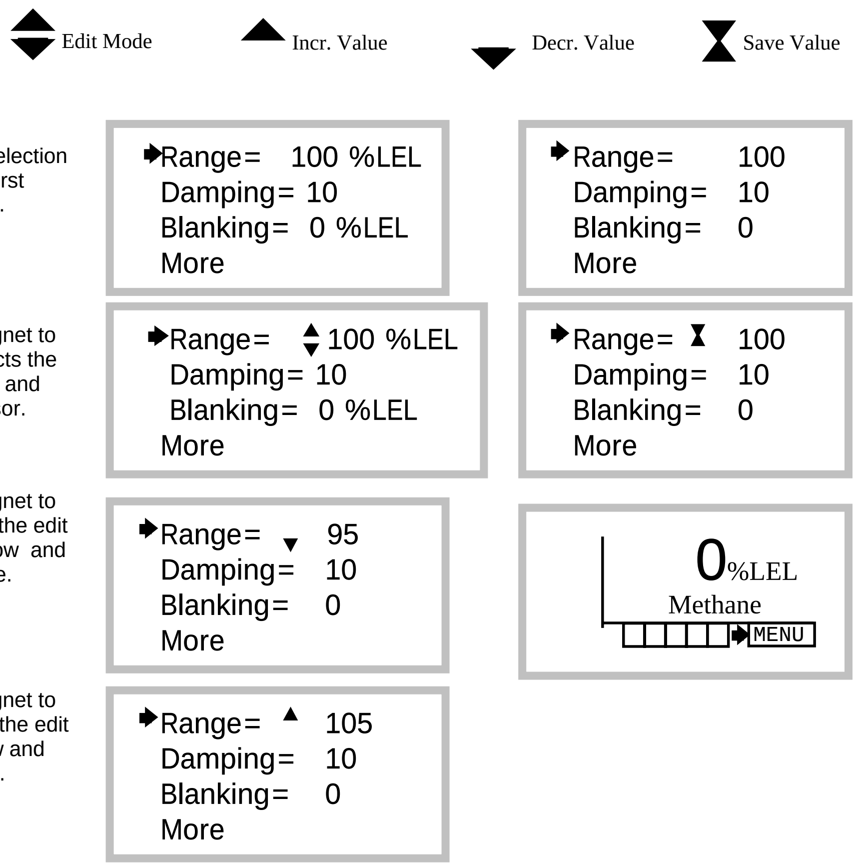


Figure 19 – Menu Navigation

PARAMETER EDITING

When a parameter is selected, the edit cursor appears. The shape of the cursor symbolizes the up-down scroll nature of the value being edited. When a key is activated, the cursor changes to a solid up-arrow when the magnet is touching the UP key, and to a solid down-arrow when the magnet is touching the DOWN key. When the parameter has been adjusted to the desired value, touching the magnet to the ENTER key changes the cursor to an hour glass shape while the program is saving the new value (recalculating associated parameters and updating non-volatile memories). Touching the magnet to the ESC key discards the edited value and restores the original value.



1. Upon entry, the selection cursor points to the first parameter for editing.
2. Touching the magnet to the ENTER key selects the parameter for editing and displays the edit cursor.
3. Touching the magnet to the DOWN changes the edit cursor to a down arrow and decrements the value.
4. Touching the magnet to the UP key changes the edit cursor to an up arrow and increments the value.
5. Touching the magnet to the ESCAPE key removes the edit cursor and restores the previous value.
6. Touching the magnet to the ENTER key changes the cursor to the hour glass until the new value is saved.
7. If left unattended for 5 minutes, operation reverts to normal.

Figure 20 – Parameter Editing

SETUP

As received, the transmitter should be ready for operation; however, it may become necessary to verify the instrument operation, or change the setup to suit a specific purpose.

IMPORTANT:
Adjustments in the setup menu can affect the proper operation of the gas detection safety system and should be undertaken only by authorized personnel.

Gas Selection and Full Scale Range

As received, the transmitter is set to monitor

Alarms and Relays

The D12 transmitter features three concentration alarms and one fault alarm. The concentration alarms, Caution, Warning, and Alarm (or High Alarm) have set point, reset point, set delay, and reset delay parameters. There are no parameters associated with the fault alarm, and the program logic that activates it is fixed. Even though a transmitter might not have relays, it will always have the four alarms, which may be read over the serial interface. The parameters for configuring the three concentration alarms are described below.

Set_Point

The Set Point parameter defines the concentration level at which the alarm becomes active. The alarm becomes active immediately if the set delay parameter is 0, otherwise, the alarm becomes active at the expiration of the set delay period. Note that when the set point is reprogrammed, the reset point value is also reprogrammed to the same value.

Reset_Point

The reset point parameter defines the concentration level that the alarm becomes inactive. Once the alarm is active, it will remain active until the concentration level reaches the reset point. The alarm then becomes inactive immediately if the set delay parameter is 0, otherwise, the alarm becomes inactive at the expiration of the reset delay period (and only if the reset parameter is programmed as AUTO – see below). The limits for the reset point are defined below.

Active=ABOVE_SP
    Upper limit = current set point value
    Lower limit = lowest set point value
Active=BELOW_SP
    Upper limit = highest set point value
    Lower limit = current set point value

Note that when the set point is reprogrammed, the reset point value is also reprogrammed to the same value.

Active

The Active parameter is used to specify the region of concentration where the alarm is active. When set to ABOVE_SP, the alarm becomes active *at* and *above* the set point (also referred to as a rising alarm or high alarm). When set to BELOW_SP, the alarm becomes active *at* and *below* the set point (also referred to a falling alarm or low alarm). An alarm may be permanently deactivated, by setting the value to DISABLED.

Reset

The reset parameter defines how the alarm is permitted to transition from active to inactive. When the parameter is set to AUTO, the alarm will transition automatically, without operator intervention as soon as conditions permit (concentration reaches the reset point, and the reset delay period expires). When the parameter is set to MANU, the reset conditions just described must be present and the alarm must be acknowledged manually, either by an operator through the operator interface, or through the remote reset contact closure (see Electrical Connections, page 12). Resetting the alarm through the operator interface is described below.

Fault_Goto

Fault goto overrides all other concentration alarm settings. When the concentration alarm becomes active, it will remain active until all of the necessary conditions are present for resetting it (see reset point description above). However, if the fault alarm should also become active, you may program the concentration alarm to behave in one of three ways.

When the Fault_Goto parameter is set to HOLD, the transmitter will attempt to hold the alarm in its current state. That is, if the alarm is active, it will remain active. If the alarm is inactive, it will be inhibited from becoming active until after the fault is cleared. When the parameter is programmed to SET, the alarm will become active immediately. When the parameter is programmed to RESET, the alarm will be forced immediately to inactive. The set delay and reset delay periods are ignored. This feature permits the alarm to signal either a concentration or fault condition.

Set_Delay

The set delay parameter is used to configure the amount of time in seconds that the concentration must be in the alarm active region before becoming active. It may be used to avoid triggering alarms on relatively short gas exposures. Also, it may be used to help prevent alarm relay chattering when the concentration level is varying between the set point and reset point. The parameter may be programmed between 0 (its default) and 10 seconds.

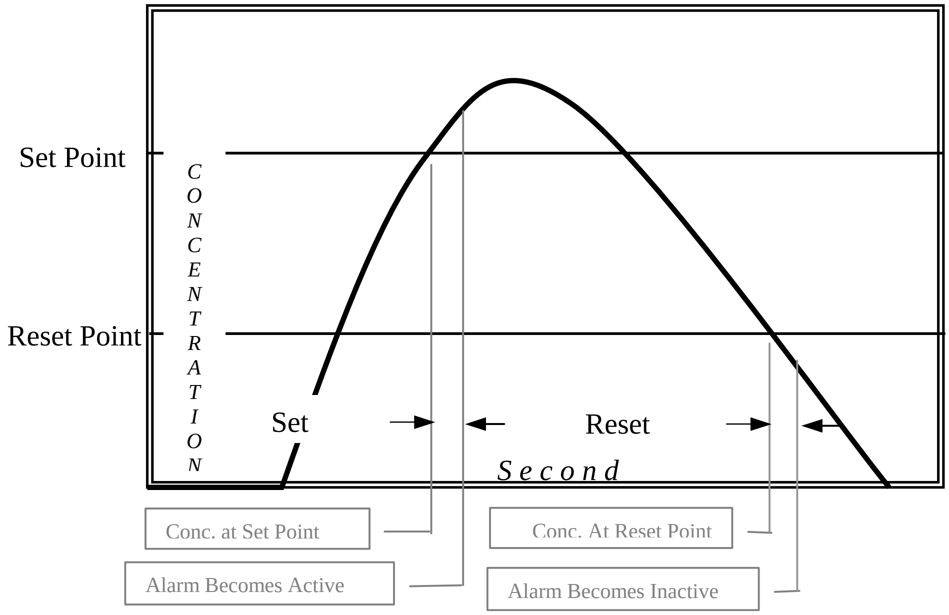
Reset Delay

The reset delay parameter is only displayed when reset is set to AUTO. It is used to configure the amount of time in seconds that the concentration must be in the alarm inactive region before becoming inactive. Like the set delay parameter, it may be used to help prevent alarm relay chattering and is preferred over using set delay. The parameter may be programmed between 0 (its default) and two hours (7200 seconds).

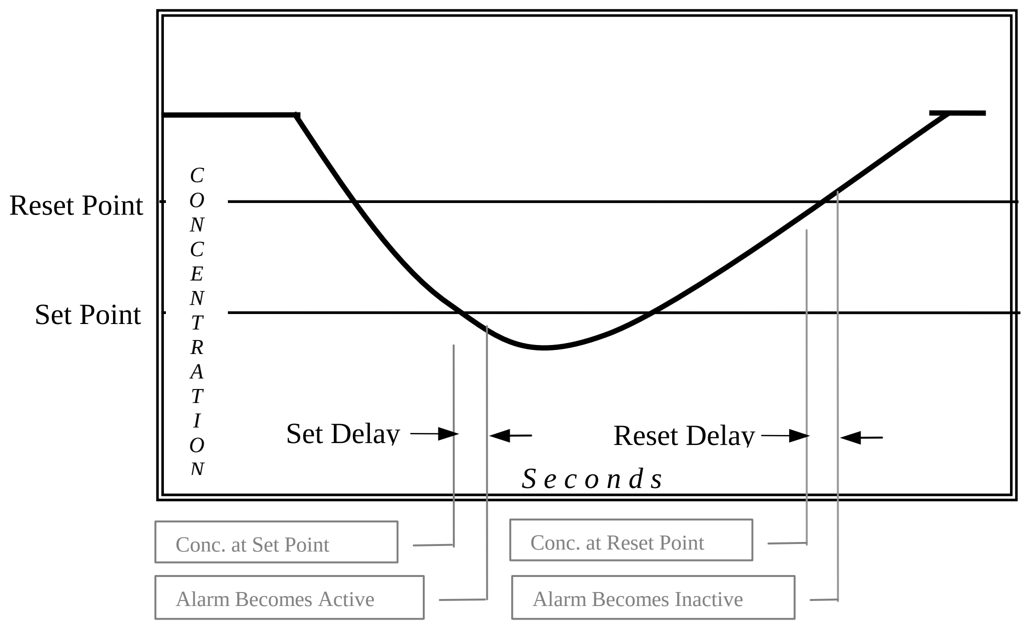
Relays

The transmitter has three alarm relays. In order to activate a relay, it must be assigned to one of the alarms. Any of the four alarms may be assigned to any relay. In addition, each relay may be normally de-energized, or normally energized (failsafe). A normally de-energized relay will have electrical continuity between its C and NC contacts, and will be open between its C and NO contacts. Conversely, a normally energized relay will have continuity between its C and NO contacts (while transmitter power is applied), and will be open between its C and NC contacts. Relay assignment and configuration is done in the Relays Setup menu (Menu/Setup/Alarms/Relays Setup), and the relay contacts are accessible on the power supply board at TB2 (see Electrical Connections).

Example: Alarm programmed as Rising Alarm (Active=ABOVE_SP, Reset=AUTO)



Example: Alarm programmed as Falling Alarm (Active=BELOW_SP, Reset=AUTO)



Sensor Calibration

In general, the D12-IR sensor will require little or no calibration or maintenance. However, over time, the transmitter reading may be observed to 'drift' slightly from zero without being exposed to gas. The Zero calibration will normalize this error and restore the instrument reading to zero.

Since infrared absorption differs among the various toxic and combustible gases, transmitters must be Span calibrated to a known concentration of gas in order to report concentration accurately. If an IR sensor were calibrated to Methane, and subsequently exposed to Propane, the transmitter reading would not be accurate and represent a potentially dangerous condition. D12-IR transmitters are shipped Span calibrated to one or more gasses. Once calibrated, only then are those gasses selectable for monitoring.

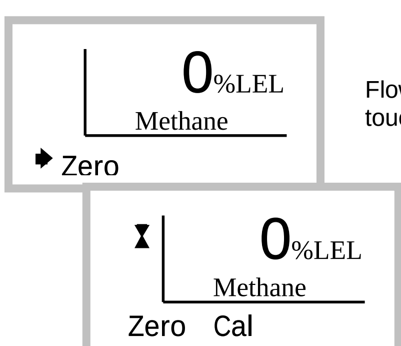
In general, dual element IR sensors are sensitive to abrupt changes in temperature. Therefore, gas required for Zero or Span calibration should be stored at, or allowed to equilibrate to, the same temperature as the transmitter's sensor, prior to calibration (within 2°C). Avoid calibrating the sensor in the presence of strong wind, which may displace gas applied to the sensor. Water vapor contains a strong IR absorption band, so it is advisable to avoid rainy days as well.

Zero Calibration

Zero calibration requires gas free of infrared absorbing compounds. A standard cylinder of zero air works well for combustible gas IR sensors (labeled HC or HHC), while 100%V/V nitrogen is recommended for all CO2 versions (labeled CO2 or HCO2). In addition to the gas, a 500 cc/min regulator, the sensor's calibration adapter, and a short length of ¼" tubing (2-6 ft) are required.

Screw the calibration adapter onto the bottom of the sensor, and connect one end of the tubing to it. Connect the other end of the tubing to the regulator attached to the zero gas cylinder. Using the magnet, navigate to the Menu\Zero_Sensor page and touch enter. At this point, the transmitter will enter inhibit mode (or cal mode) and will clear existing alarms, inhibit new alarms, and output the inhibit level (default=4.0mA) on the current loop output. Open the regulator and allow gas to flow to the sensor for four minutes at 500cc/min. The Zero_Sensor page will not timeout until a calibration has been performed.

After four minutes, move the cursor to the Zero selection and touch enter. The "Cal" message will appear briefly at the bottom of the page and the reading will be forced to 0 (or –0) %LEL. The procedure may be cancelled by selecting Undo. The Undo function is only possible while remaining on the Zero_Sensor page. Leaving the page will disable the possibility of canceling the calibration.
Touch the Escape key twice to leave the Zero_Sensor page and return to the Main page.



Flow zero gas to sensor for 4 minutes, then touch the Enter key

Span Calibration

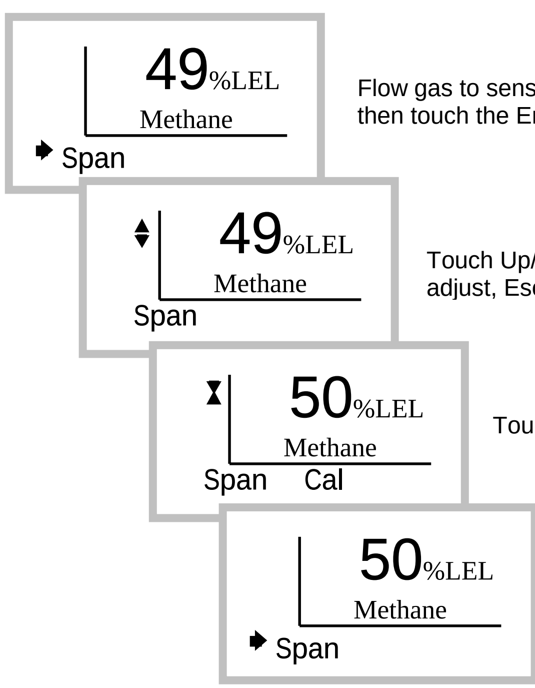
Important: Perform zero calibration prior to the span calibration. The transmitter must read +/-0,+/-0.0, or +/-0.00, before proceeding.

Span calibration requires a cylinder of gas at a known concentration. This must be the same gas as that monitored by the transmitter, and at a concentration within the calibration range of the transmitter. Note the date on the cylinder and verify it has not expired. Typically, cylinders should not be used if more than one year old. In addition to the gas, a 500 cc/min regulator, calibration adapter and a length of ¼” tubing, are required.

Screw the calibration adapter onto the bottom of the sensor and connect one end of the tubing to it. Connect to other end of the tubing to the regulator attached to the span gas cylinder. Using the magnet, navigate to the Menu/Span_Sensor page and touch enter. At this point, the transmitter will enter inhibit mode (or cal mode) which will clear existing alarms, inhibit new alarms, and output the inhibit level (default=4.0mA) on the current loop output. Open the regulator and allow gas to flow to the sensor for four minutes at 500cc/min. Observe that the displayed reading begins to increment. The Span_Sensor page will not timeout until a calibration has been performed.

At the end of four minutes, the reading should be stable. Move the cursor to the Span selection and touch enter. The concentration reading will become fixed, and the blinking Up/Dn edit cursor will appear just to the left of the reading. Touch the magnet to the Up or Down key to scroll to the correct reading, then touch Enter. The ‘Cal’ message will appear briefly at the bottom of the page and the reading will return to %LEL. The procedure may be cancelled by selecting Undo. The Undo function is only possible while remaining on the Span_Sensor page. Leaving the page will disable the possibility of canceling the span calibration.

Touch the Escape key twice to leave the Span_Sensor page and return to the Main page. Disconnect the calibration adapter from the sensor and permit the readings to return to zero. By default, alarms will become uninhibited and the current loop will return to normal after 15 minutes (unless the period has been reprogrammed).



Flow gas to sensor for 4 minutes, then touch the Enter key

Touch Up/Down key to adjust, Esc to abort.

Touch Enter to save.

Verify calibration is successful.

Calibration Records

The calibration records may be viewed in the Cal_History page. A calibration record is written into the sensor memory each time a zero or span calibration is performed. Memory is reserved for 63 zero calibrations and 63 span calibrations.

Zero calibration records are composed of an index number, date, and the concentration reading just prior to performing the calibration. The concentration reading can be thought of as the sensor drift relative to the previous record.

Example - Zero Calibration Record

Zero Record = 1
05/19/05
0 %LEL
Methane

Infrared sensors differ from electrochemical sensors, in that there is generally no degradation of sensitivity over time. In contrast to other versions of the transmitter, the D12-IR does not compute or report sensitivity. Instead, Span calibration records are similar to Zero calibration records and report an index number, date, and the name of the gas being monitored at the time of the calibration. Unlike zero records, the gas concentration reported is that of the bottled gas source used during the calibration.

Example - Span Calibration Record

Span Record = 1
05/19/05
50 %LEL
Methane

MENUS (Reference)

	IMPORTANT: **Adjustments to transmitter parameters can affect the proper operation of the gas detection safety system and should be undertaken only by authorized personnel.**	

```
>Zero_Sensor
 Span_Sensor
 View_Log
 Setup
```

MENU PAGE
Zero_Sensor – Zero Cal Page
Span_Sensor – Span Cal Page
View_Log - View Log Page
Setup – Setup Page

```
>Sensor    DataLog
 Alarms    Display
 4-20mA    System
           HART
           /Modbus
```

SETUP PAGE
Sensor – Sensor Setup Page
Alarms – Alarm Setup Page
4-20mA – Loop Setup Page
DataLog – Datalog Setup Page
System – System Setup Page
Modbus – Modbus Setup Page (Option)

SENSOR SETUP

>Sensor Datalog Alarms Display 4-20mA System HART Modbus	Select **Sensor** to access the sensor information
Range = 100 %LEL Damping = 10 Blank = 0 %LEL More	**Range**…Sets the full scale value of the transmitter **Damping**…Time in seconds to reach 63% (1TC) of final value **Blanking**…Concentrations below this value are reported as 0 Normal setting is 2% of full scale span. **More** … Access 2[ND] page
>Cal_History	**Cal_History**… Select to access the sensor calibration history. The transmitter stores calibration data for each zero and span.
Zero ➧ 1 07/09/01 0% LEL Span 1 07/09/01 50%LEL	**<Line 1>** - Total zero calibrations (63 max). **<Line 2>** - Date and reading at time of zero calibration. **<Line 3>** - Total span calibrations (63 max). **<Line 4>** - Date and gas concentration used for span calibration.

ALARM SETUP

D12 transmitters provide 3 levels of alarm setpoints, Caution, Warning, and Alarm. Relays associated with these alarm setpoints are optional. If a transmitter is not equipped with relays, the alarm setpoints and alarm indicators will still be displayed.

Rising alarms C▲ W▲ A▲
(Active=ABOVE_SP) are defined as Res Point<=Set Point
* * * Res Point cannot be programmed ABOVE the Set Point

Falling alarms C▼ W▼ A▼
(Active=BELOW_SP) are defined as Res Point>=Set Point
* * * Res Point cannot be programmed BELOW the Set Point

```
 Sensor    DataLog
➧Alarm     Display
 Auto-T    System
 4-20mA
```

```
➧Alarm      RELAYS
 Warning     Setup
 Caution     Test
 Inhibit
```

Select **Alarm** to setup the highest alarm. The relay setup box below appears only when the relay option jumper is installed.

```
 Active=ABOVE_SP
 Set_Point = 50
 Res_Point = 50
➧More
```

Active
ABOVE_SP…Alarm is active when concentration rises above set point
BELOW_SP…Alarm is active when concentration falls below set point
Set_Point…Level at which alarm becomes active (range determined by sensor).
Res_Point…Level at which alarm becomes inactive. This determines the alarm deadband.

```
➧Reset=MANU
 Fault_Goto= HOLD
 Set_Delay= 0
 Res_Delay
```

Reset
AUTO…alarm deactivates automatically when alarm condition subsides.
MANU…alarm must be manually reset after alarm conditions subside.
Fault_Goto…State which the alarm will assume when a fault condition is detected –
HOLD…Alarm is held at state prior to the fault until manually reset
SET…Alarm is held active until fault is cleared
RES…Alarm is held inactive until fault is cleared
Set_Delay…Number of seconds that an alarm condition must exist before the alarm is activated.

```
 Alarm      RELAYS
➧Warning     Setup
 Caution     Test
 Inhibit
```

Select **Warning** to setup the warning alarm. The relay setup box below appears only when the relay option jumper is installed.

```
 Active=ABOVE_SP
 Set_Point = 20.0
 Res_Point = 20.0
➧More
```

Active
ABOVE_SP…Alarm is active when concentration rises above set point
BELOW_SP…Alarm is active when concentration falls below set point
Set_Point…Level at which alarm becomes active (range determined by sensor).
Res_Point…Level at which alarm becomes inactive. This determines the alarm

```
➧Reset = AUTO
 Fault_Goto = HOLD
 Set_Delay  = 0
 Res_Delay = 0
```

Reset
AUTO…alarm deactivates automatically when alarm condition subsides.
MANU…alarm must be manually reset after alarm conditions subside.
Fault_Goto…State which the alarm will assume when a fault condition is detected –
HOLD…Alarm is held at state prior to the fault until manually reset
SET…Alarm is held active until fault is cleared
RES…Alarm is held inactive until fault is cleared
Set_Delay…Number of seconds that an alarm condition must exist before the alarm is activated.
Res_Delay…Number of seconds that the alarm is held active after alarm conditions subside (visible for auto-reset alarms only).

	RELAYS
Alarm	Setup
Warning	Test
➧ Caution	
Inhibit	

Select **Caution** to setup the caution alarm.

Active= BELOW_SP
Set_Point= -10.0
Res_Point= -10.0
➧ More

Active
ABOVE_SP…Alarm is active when concentration rises above set point
BELOW_SP…Alarm is active when concentration falls below set point
Set_Point…Level at which alarm becomes active (range determined by sensor).
Res_Point…Level at which alarm becomes inactive. This determines the alarm deadband.

➧ Reset= AUTO
Fault_Goto= HOLD
Set_Delay= 0
Res_Delay= 0

Reset
AUTO…alarm deactivates automatically when alarm condition subsides.
MANU…alarm must be manually reset after alarm conditions subside.
Fault_Goto…State which the alarm will assume when a fault condition is detected –
HOLD…Alarm is held at state prior to the fault until manually reset
SET…Alarm is held active until fault is cleared
RES…Alarm is held inactive until fault is cleared
Set_Delay…Number of seconds that an alarm condition must exist before the alarm is activated.
Res_Delay…Number of seconds that the alarm is held active after alarm conditions subside (visible for auto-reset alarms only).

	RELAYS
Alarm	Setup
Warning	Test
Caution	
➧ Inhibit	

Select **INHIBIT** to setup the alarm inhibit parameters and start or stop the alarm inhibit

Inhibit_mA = 3.6
Inhibit_Time = 15:00(mm:ss)
➧ Start

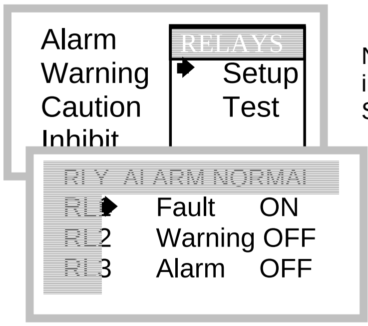
Inhibit_MA- this is the 4-20MA loop output during alarm inhibit, range 3.5 to 22.0 (note: this is also settable in the 4-20MA setup menu)
Inhibit_Time – shows the amount of time that alarms will be inhibited once started. The inhibit time is adjustable from 00:00 to 99:59 (mm:ss).
Start-activates the alarm inhibit period (see below).

Inhibit_mA = 3.6
Inhibit_Time =
14:59 (mm:ss)
➧ Stop

Once started, the Inhibit_Time period ticks down showing the amount of time remaining. Selecting Stop ends the alarm inhibit and restores the Inhibit_Time to its programmed value.

RELAY SETUP

The D12 relay option provides three SPDT mechanical relays rated for 5 amp non-inductive loads at 250 VAC. These relays are suitable for switching light loads such as horns or warning lamps, but should not be used to switch motors or other high current or highly inductive loads. Each relay may be assigned to any alarm setpoint. One relay is always factory set for "FAULT", but may be reprogrammed.

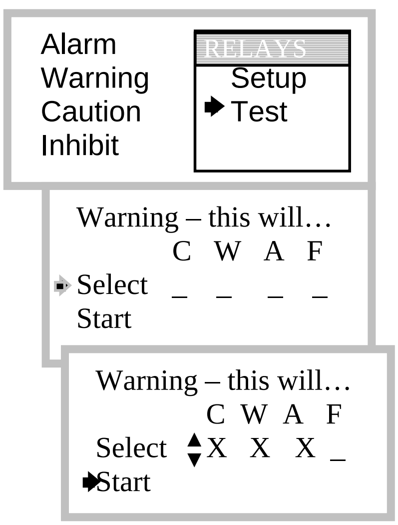


NOTE: The relay setup and test page labels appear only if the relay option jumper is installed on the CPU board.
Select **Setup** to associate each relay with one of the four alarms.

Relays are designated as RL1, RL2, and RL3. The first parameter to the right of the relay designator (under the ALARM heading) specifies which alarm the relay responds to – CAUTION, WARNING, ALARM, or FAULT.

The second parameter (under the NORMAL heading) specifies the normal (no alarm) state of the relay. When set to OFF, the relay remains de-energized until the alarm becomes active which then energizes the relay. When set to ON, the relay remains energized until the alarm becomes active which then de-energizes the relay.

Relays can be tested manually using the routines outlined below. Any warning and alarm devices wired to the relays will activate if the relay test is performed. Be sure to inform the proper personnel before performing the relay test.



Select **Test** to test alarm(s) and their associated relays.

Select – used to scroll the combinations of alarms to test. As you scroll the select value, an X appearing directly below the letter of each alarm means that alarm's relay will be activated when start is selected, otherwise it will be deactivated. This means that if any relay with an X is programmed as NORMAL OFF, it will be energized, and any NORMAL ON relays will be de-energized. A warning message scrolls across the top of the page to remind you about false alarms.

Start - activates the selected alarms (and associated relays).

4 – 20 mA SETUP AND VERIFICATION

This page allows programming of various analog output functions. The value of the output desired during Fault or Inhibit conditions may also be adjusted. The 4 mA and 20 mA points can be adjusted exactly or offset slightly if needed to match receiving equipment. The output can also be forced to any desired value in order to test devices connected to the output.

```
Sensor     DataLog
Alarms     Display
Auto-T     System
➧ 4-20mA
```

Select **4-20mA** to setup or test the current loop output.

```
Autotest_mA= 4.0
Inhibit_mA= 4.0
Fault_mA = 3.6
➧ More
```

Fault_MA – this is the 4-20MA output during a fault condition, range 3.5 to 22.0
Inhibit_MA- this is the 4-20MA output during alarm inhibit, range 3.5 to 22.0
(note: this is also settable in the alarm inhibit setup menu)

```
➧ Adjust_4mA
  Adjust_20mA
  Force = 4.0mA
```

Adjust 4mA – permits precise adjustment of the output at 4.00mA.
Adjust 20mA – permits precise adjustment of the output at 20.0mA.
Force X.X mA – displays the mA output until selected. Once selected, drives the output to a programmable mA level.

IMPORTANT: always inhibit alarms in the control room before changing these parameters. The 4-20mA output returns to normal after deselecting the parameter or upon page timeout if left unattended for two minutes.

```
 4.00mA_Output
 Monitor the 4-20mA
➧DAC_Value= 23
```

DAC_Value – scroll up or down to adjust the 4.0 mA level.

```
 20.0mA_Output
 Monitor the 4-20mA
➧DAC_Value= 759
```

DAC_Value – scroll up or down to adjust the 20.0 mA level.

DATA LOGGER SETUP/REVIEW

D12 transmitters contain an internal data-logging feature that allows operators to review gas concentration data. Data can be logged as often as once a minute or as infrequently as once every 60 minutes, providing data for 11 days to 464 days. Data can be displayed graphically or in a tabular log.

```
Sensor    ➧ DataLog
Alarms      Display
Auto-T      System
4-20mA
```

Select **DataLog** to setup the transmitter's data logger or to review logged data in either a tabular (text) format or a graphic format.

```
➧ Setup
Review_Tablular
Review_Graphic
 Status    Print
```

Select **Setup** to choose the sampling rate and enable the data logger.

```
➧ Sample = 1 mins
  Sample/Day = 1440
  Max_Days = 8
  Sampling =    ON
```

The sampling rate may be set by adjusting either Sample, Sample/Day, or Max Days. All fields are automatically updated while scrolling any parameter.
Sample – allows choice of number of minutes between samples.
Sample/Day – allows choice of number of samples collected each day.
Max Days – allows chioce of maximum number of days stored. Note that data logging doesn't stop, but continues by overwriting the oldest day's samples.
Sampling-ON (enables data logging),OFF(disables data logging), or CLR(clears log). WARNING: all data in the log is lost when the sample rate is changed.

```
  Setup
➧ Review_Tabular
  Review_Graphic
 Status    Print
```

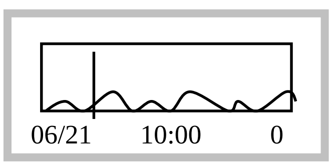
Select **Review_Tabular** to review the data log by selecting the date and time in a text format. You may then jump immediately to show the data in a graphic format.

```
➧ Date= 07/30/2002
  Time  =00:00
  Conc  =0
  Show_Graphic
```

Date – allows selection of specific day to review.
Time – allows selection of specific hour and minute for a sample.
Conc – displays the concentration at the specified date and time (0.5%FS resolution)
Show Graphic-permits jumps directly to the graphic review page with the cursor positioned at the specified date and time of the sample.

```
  Setup
  Review_Tabular
➧ Review_Graphic
  Status    Print
```

Select **Review_Graphic** to review the data log by scrolling the cursor to a specific sample. Touching the ENTER key jumps to the tabular review page.



Use the UP and DOWN keys to move the vertical cursor left and right. Moving the cursor to the left displays older samples, while moving it to the right displays younger samples. As the cursor is moved, the date, sample number, and gas concentration are updated along the bottom of the page. Touching the ENTER key jumps to the selected sample in the tabular review page.

The gas concentration appearing in the lower right corner may be replaced by one of the following:
"----"
"FFFF"
"TTTT" autotest in progress (if Log_Data=NO)

```
Setup
Review_Tabular
Review_Graphic
Status ➧ Print

➧ First=06/19/02
  Days=2 of 2
  Page_Setup
  Start_Printing
```

Select **Print** to select printer format.

First – Selects beginning day to be printed (note: printing begins at 00:00 on day 1 of the selection
Days – Selects the number of days to print beginning with the first day.
Page_Setup – Formats the output data for a particular printer.
Start_Printing – Begins sending data to the serial port. Touching Esc aborts printing.

DISPLAY SETUP

This menu page allows the operator to adjust the display contrast. The display on the D12 includes a backlight which will illuminate whenever a magnetic key is activated, or in the event of an alarm condition. The backlight will go off automatically after a few minutes to extend life.

```
Sensor    DataLog
Alarms   ➧Display
Auto-T     System
4-20MA

➧ Contrast      68%
  Light=ENABLED
```

Select **Display** to setup display characteristics.

Contrast – allows adjustment of the LCD contrast between 0 and 100%.
Light -
AUTO…allows EL backlight to turn on when a key is activated or
MANUAL …manually activates backlight when a key is touched
NEVER_ON…keeps backlight turned off
ALWAYS_ON …keeps backlight turned on

SYSTEM SETUP

The system setup menu page allows programming of basic functions such as setting the internal clock, setting security access, configuring communication protocols, and resetting various operating functions.

```
Sensor     DataLog
Alarms     Display
Auto-T   ➧ System
4-20mA

➧ Clock
  Security
  Reset
  Communication
```

Select **System** to view the system menu page.

Select **Clock** to set the time-of-day clock/calendar

➧Day= Monday
Date=07/09/2002
Form=MM/DD/YYYY
Time=10:00

Day – Monday through Sunday
Date – scrolls the date forward and backward (displays Sadie Hawkins day as required).
Form – use this to change the date display format – MM/DD/YYYY or DD MMM YY (example: 07/09/2001 or 09 JUL 01)
Time – scrolls the time forward and backward.

Sensor DataLog
Alarms Display
Auto-T ➧ System
4-20mA

Select **System** to view the system menu page.

Clock Commun
➧Secure Version
Reset

Select **Security** to access the transmitter security features.

SECURITY
➧ Change_Pswd
Status=OFF

Select **Change_Pswd** to change the security code required to lock and unlock the transmitter.

Old_Pswd= ▲▼ 0

New_Pswd=▲▼ 555

Repeat_New▲▼ 555
Accepted

To change the password, first enter the old password, followed by the password you wish to change to, and repeat it. When "Accepted" appears, the new password will be saved.

Default code is 0.
Master code 680.

SECURITY
Change Code
➧ Status=OFF

Security is OFF
Enter code to turn on.
➧ Enter Code 0

Security is OFF
Enter code to turn on.
Enter Code 0
(PASS)

SECURITY
Change Code
➧ Status=ON

Security is ON
Enter code to turn on.
➧ Enter Code 0

Security is OFF
Would you like to auto relock?
Autorelock? No

Sensor DataLog
Alarms Display
Auto-T ➧System
4-20mA

Select **System** to view the system menu page.

Clock ➧Commun
Security Version
Reset

Select **Commun** to view the communication setup page.

➧Protocol= HART
Interface= MODEM
Baud_Rate= 1200
Parameters= 0,8,1

Protocol – HART (HART version of transmitter required)
Interface – MODEM
Baud Rate – 1200
Parameters --
Changing the protocol to HART sets the interface, baud rate, and parameters as shown to the left. These are the required settings for operating the HART® protocol with interoperable equipment and are not selectable for adjustment. Causes HART® to appear in the setup menu.

➧Protocol= MODBUS
Interface= RS232
Baud_Rate= 9600
Parameters= N,8,1

Protocol – MODBUS or NONE (Modbus version of transmitter required)
Interface – RS232,RS485,Modem
Baud Rate – 1200,4800, 9600, 14.4k, 28.8k
Parameters --
Changing the protocol to MODBUS sets the interface, baud rate, and parameters as shown to the left. These settings are adjustable and must be set to communicate with the Modbus® master device. Causes MODBUS® to appear in the setup menu.

```
➧Protocol= ASCII
 Interface= RS232
 Baud_Rate= 9600
 Parameters= N,8,1
```

Protocol – ASCII or None
Interface – RS232,RS485,Modem
Baud Rate – 1200,4800,9600,14.4k,28.8k
Parameters --

Changing the protocol to **ASCII** sets the interface, Baudrate, and parameters shown to the left. The ASCII interface permits downloading of data from the data logger to a computer or a printer.

```
➧Protocol=
      NONE
```

Changing the protocol to **NONE** clears the interface, baud rate, and parity entries as shown to the left. Removes HART® and Modbus® from the setup menu

```
 Sensor     DataLog
 Alarms     Display
 Auto-T    ➧System
 4-20mA
```

Select **System** to view the system menu page.

```
 Clock      Commun
 Security   Version
➧Reset
```

Select **Reset** to view the Reset Functions page.

```
 Reset Functions
➧Sensor     DataLog
 Alarms     All
 4-20mA     Restart
```

Sensor – Zero, Span, will be reset, sensor must be recalibrated. On LEL transmitters, cal and autotest history are cleared.
Alarms - All alarm set/reset points, alarm options, delays, and inhibit mA output will be reset to factory defaults.
4-20mA – 4-20mA output cal will be reset, loop must be recalibrated.
DataLog – Data log history will be cleared.
All – Entire transmitter will be reset to factory defaults and require full setup and 4-20mA calibration.
Restart –Transmitter will restart which will temporarily affect HART and Modbus communications.

```
 Sensor     DataLog
 Alarms     Display
 Auto-T    ➧System
 4-20mA
```

Select **System** to view the system menu page.

```
 Clock      Commun
 Security  ➧Version
 Reset
```

Select **Version** to view the Reset Functions page.

```
 ATI/D12/LEL Gas
 [protocol option]
 HW=x.xx SW=x.xx
    MM/DD/YY
```

Line 1 – Model Description
Line 2 – Communication Option
Line 3 – Hardware and Software Revision Levels
Line 4 – Software Build Date

COMMUNICATION SETUP

```
Sensor     DataLog
Alarms     Display
Auto-T     System
4-20mA    ➧HART
```

Select **HART®** to setup the HART® communication interface.

```
HART Setup
 Tag=ATI_D12
➧Identification
 Operation
```

Select **Identification** to set and view address information.

```
➧ Poll_Addr =    0
  Mfg_Id =       253
  Dev_Type=      1
  Dev_Id=0
```

Poll_Addr – assigns a polling address (1-15) for multidrop operation.
(Note: 4-20mA output remains fixed when polling address > 0)
Mfg_Id – used in long frame address mode (read only).
Dev_Type – used in long frame address mode (read only).
Dev_Id – used in long frame address mode.

```
HART Setup
 Tag=ATI_D12
 Identification
➧Operation
```

Select **Operation** to setup transmitter operation on the HART® network.

```
➧ Fixed_mA=    4.0
  Resp_Preamb=5
```

Fixed mA – allows specification of the 4-20mA output hold level when connected on the HART® network. A value of 0.0 disables the fixed output mode and allows the output to follow the gas concentration. Note that the 4-20mA output will remain fixed when the transmitter is operating in multidrop configuration (polling address is set to a value greater than 0).
Resp_Preamb – Number of preambles (3-20) transmitted in normal messages.

```
Sensor     DataLog
Alarms     Display
Auto-T     System
4-20mA    ➧Modbus
```

Select **Modbus®** to setup the Modbus® communication interface.

```
Modbus Setup
➧ Slave_Addr= 1
  Time_Out=   3
```

Slave_Addr – allows assignment of the Modbus® slave address (1-247)
Time_Out – number of 500 microsecond periods permitted between characters in the Modbus® query. For example, the default of 3 is 1.5 milliseconds which is 1.5 character times at 9600 baud.

SPARE PARTS LIST

Part No.	Description
00-1375 (HC)	Standard LEL (low range) hydrocarbon sensor for Methane, Propane, Butane, Pentane, etc.
00-1376 (HHC)	High range hydrocarbon sensor for high concentrations (normally above the UEL) of Propane, Butane, LPG.
00-1377 (CO2)	Standard range Carbon dioxide sensor
00-1378 (HCO2)	High range Carbon dioxide sensor
00-1431 (N2O)	Standard range Nitrous oxide sensor
03-0303	D12-IR (3) Board Stack Assembly, Without Relays
03-0304	D12-IR (3) Board Stack Assembly, With Relays
00-0258	Calibration adapter
45-0086	Splash Guard
00-0261	Remote Calibration Adapter / Rain Shield
29-0007	Battery
55-0004	Magnetic Screwdriver