

Instructions

Line-of-Sight Infrared Hydrocarbon Gas Detector Model LS2000



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INSTRUCTIONS



Line-of-Sight Infrared Hydrocarbon Gas Detector Model LS2000





IMPORTANT

Be sure to read and understand the entire instruction manual before installing or operating the gas detection system. This product is intended to provide early warning of the presence of a flammable or explosive gas mixture. Proper device installation, operation, and maintenance is required to ensure safe and effective operation.

APPLICATION

The Model LS2000 is a line-of-sight infrared gas detection system that provides continuous monitoring of combustible hydrocarbon gas concentrations in the range of 0 to 5 LFL-meters, over a distance of 5 to 120 meters. Standard system outputs include an electrically isolated/ non-isolated 4-20 mA dc current output with the ability to go below 4 mA to indicate fault conditions, and also HART and RS-485 Modbus communication. Alarm and fault relays are available as an option.

The system consists of two stainless steel modules - a transmitter and a receiver, along with mounting and alignment bracket. The receiver provides the measurement signal outputs, and is furnished with onboard "status indication" LEDs and an internal magnetic calibration switch. The transmitter houses a high quality xenon flash lamp and "status indication" LEDs. Both modules are powered from an external 24 volt DC supply and are equipped with microprocessor controlled heated optics to increase resistance to moisture and ice. Both modules must be installed at approximately the same elevation and must be aligned to point directly at one another. No direct electrical interconnection between the two modules is required.

The LS2000 is certified explosion-proof for use in Class I, Division 1 and Division 2 hazardous areas, and has third party performance certification for methane, butane, and propane gas detection. It can be used as a stand-alone detector, or as part of a larger facility protection system using other Det-Tronics equipment.

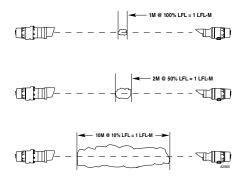
OPERATION OVERVIEW

THEORY OF OPERATION

The LS2000 transmitter module uses a Xenon flash lamp to produce a collimated IR light source. This light source illuminates the path between transmitter and receiver. The transmitter uses a filter to block visible light emissions and is eye safe.

As flammable hydrocarbon gases intersect the light beam between the two modules, certain IR wavelengths are absorbed by the gas, while other IR wavelengths are not. The amount of IR absorption is determined by the concentration of the hydrocarbon gas. A pair of optical detectors and associated electronics located in the receiver module measure the absorption. The change in intensity of the absorbed light (active signal) is measured relative to the intensity of light at a non-absorbed wavelength (reference signal). The microprocessor computes the gas concentration and converts the value into a 4-20 mA current output signal, which is then communicated to external control and annunciation systems.

The gas concentration is indicated by a 4-20 mA signal, which corresponds to 0-5 LFL-meters. To better understand the concept of LFL-meters, refer to Figure 1, which shows how three gas clouds of different size and concentration would produce the same output of 1 LFL-meter by the line-of-sight gas detection system. To convert a given LFL-m value to ppm-m for methane, propane or butane gas, refer to Table 1.



LS2000 OUTPUT EQUALS 1 LFL-M IN ALL THREE SCENARIOS

Figure 1—Detector Response to Three Gas Clouds of Different Size and Concentration

DETECTABLE GASES

The LS2000 is capable of detecting most hydrocarbon gases and vapors including methane, propane, and butane. Gas type and other operational parameters are selected via HART or Modbus communication. The LS2000 is factory calibrated to methane, propane, and butane, and comes from the factory set for methane. For detection of gases other than the three selection settings (methane, propane, and butane), performance characteristics / transfer curves are available. Please contact the factory for details.

DETECTION RANGES

The LS2000 is offered in two detection ranges in order to meet customer needs, as listed below:

Short Range	5-60 meters		
Long Range	30-120 meters		

For installations with short separation distances (5-15 meters for the short range model and 30-40 meters for the long range model), the range reduction aperture kit (supplied) is required. Refer to "Aperture Kit for Short Range Applications" section in this manual for details.

The correct range for the LS2000 must be chosen to meet specific application needs. The detection range of the LS2000 pair is determined by the Receiver. Receiver units can be converted from long to short or short to long range in the field by replacing the front electronics module. A single transmitter model is used for both detection range options.

STANDARD OUTPUT

The LS2000 receiver module provides an analog 4-20 mA signal output. HART and RS-485 Modbus serial communication are available at either module. The 4-20 mA current loop corresponding to 0–5 LFL-meters is provided for connection to analog input devices such as gas controllers, logic controllers, or distributed control systems (DCS). To convert the mA reading to LFL-meters, use the following formula:

$$\frac{\text{mA Reading } -4}{16} \qquad X \quad 5 = \text{LFL-Meters}$$

Table	1-LFL-m to	PPM-m	Conversion

Gas Path Length Cond		Cloud Concentration (LFL)	Cloud Concentration (v/v, by volume)	Cloud Concentration (ppm)	LFL-m	ppm-m
Methane	1	100%	5.0%	50000	1	50000
Methane	2	100%	5.0%	50000	2	100000
Methane	3	100%	5.0%	50000	3	150000
Methane	4	100%	5.0%	50000	4	200000
Methane	5	100%	5.0%	50000	5	250000
		a		· · · ·		
Propane	1	100%	2.2%	22000	1	22000
Propane	2	100%	2.2%	22000	2	44000
Propane	3	100%	2.2%	22000	3	66000
Propane	4	100%	2.2%	22000	4	88000
Propane	5	100%	2.2%	22000	5	110000
		A		·		
Butane	1	100%	1.9%	19000	1	19000
Butane	2	100%	1.9%	19000	2	38000
Butane	3	100%	1.9%	19000	3	57000
Butane	4	100%	1.9%	19000	4	76000
Butane	5	100%	1.9%	19000	5	95000

OPTIONAL RELAYS

The LS2000 can be furnished with factory installed relays - two programmable alarm relay outputs and one fault relay output. All relays are sealed and provide form C (NO/ NC) contacts. The high and low alarm relays are programmable, and can be set for latching / non-latching operation, and a normally energized / de-energized coil (see Table 3). The low alarm cannot be set above the high alarm threshold. Alarm configuration can be done with the HART or Modbus interface. The onboard multi-color LEDs indicate a LOW alarm condition via a flashing red color, and a HIGH alarm condition via a steady red color. Latched alarms can be reset using the internal magnetic switch, an external switch connected to the calibration line terminal, a HART Field Communicator, or Modbus communication. A short-duration magnetic switch activation of 1 second will reset latched alarms. Holding the magnetic switch closed for a three second duration will start the calibration sequence.

When the optional relays are ordered, the LS2000 receiver is certified for Ex d operation.

OPTIONAL COMMUNICATION LINK

By connecting the transmitter and receiver via a three-wire shielded cable, an optional "communication link" can be created between the two devices.

The communication link offers the following advantages:

- Single point system diagnostics The link offers the ability to view device variables of the receiver while connected to the transmitter, or vice versa (using a HART handheld or Modbus device). These variables include signal strength, status, and configuration parameters such as alarm set points, heater settings, gas type, etc.
- 2. Dynamic lamp power The link enables the system to optimize lamp power per the application. This optimization only happens during the zero calibration process.

- Synchronized LEDs on each device can signal a common system status condition. Without the link, the transmitter is unable to signal alarm status.
- Transmitter variables can be configured via connection to the receiver. Configurable transmitter variables include lamp power and heater settings.

NOTE

Alarm setpoints in the receiver cannot be changed from the transmitter.

5. The communication link provides the ability to initiate Calibration from either the transmitter or receiver.

For retrofit applications where an interconnecting wire is not available or possible, the system can operate without the link. If the link is not connected, the system will not indicate a "link fault."

A "link fault" feature can be enabled (using a HART handheld or Modbus device), which will indicate a fault if the link is broken. The "link fault" can only be detected and annunciated by the receiver.

NOTE

The default setting for the "link fault" feature is Disabled.

NOTE

All third-party performance and hazardous location approvals apply with and without the communication link connected.

HISTORY LOGS

Non-volatile memory is provided in the receiver to save a record of the 100 most recent calibrations and 1000 most recent alarm/fault events. Operating temperature and voltage of the receiver are also recorded with each event log. A real time clock is provided for time stamping events. This information is accessible using HART or Modbus communication.

OPERATION

INTERNAL MAGNETIC SWITCH / CALIBRATION LINE TERMINAL

An internal magnetic switch is provided for resetting latched alarms and initiating field zero calibration. See Figure 2 for switch location. The same functions can be accomplished remotely by installing a switch (momentary closure) between the CAL and 0V COM terminals on the LS2000 receiver. Momentary switch activation will reset alarms, while holding the switch closed for 3 seconds or longer (not to exceed 30 seconds) will start the calibration sequence. The LEDs will begin flashing green (5 Hz) when the reset criteria have been met and will change to flashing vellow (5 Hz) when the calibration period has been met (>3 seconds, <30 seconds). The device will reset if the switch is released during a flashing green LED and will enter calibration if the switch is released during a flashing yellow LED.

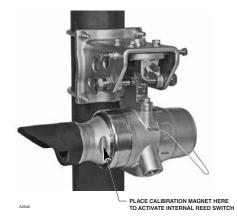


Figure 2—Location of Internal Magnetic Switch on Receiver Module

MODULE IDENTIFICATION

See Figure 3 for identification of the transmitter and receiver modules. The functional and electrical characteristic differences of the two devices are described in Table 2.

FACTORY RESET COMMAND

The LS2000 provides a factory reset command that sets all user configurable parameters back to their default settings. This command can be accessed via HART or Modbus communication.

Characteristic	Transmitter	Receiver
Functional Description	Contains a xenon flash lamp, and generates optical energy to enable hydrocarbon detection.	Contains opto-electronics, signal processing, output drivers, and diagnostic electronics.
Electrical Connections	Connections for power, HART, RS-485, Communication Link.	Connections for power, 4-20 mA, HART, RS-485, relay contacts (optional), Communication Link, and calibration/reset.
Onboard LED Indicators	Indicates device status. Green indicates normal operation. Yellow indicates fault condition. When the Communication Link is used, the transmitter LED operation matches receiver LED operation, including alarm status.	Indicates normal, alarm, fault, and calibration status. Green indicates normal operation. Blinking red indicates low gas alarm condition. Steady red indicates high gas alarm condition. Yellow indicates system fault. See Tables 4 and 5 for details. LED operation for fault status is non-latching. LED operation for gas alarms is configurable for latching/non-latching.
Magnetic Calibration Switch (See Figure 2 for switch location.)	NA	Momentary activation provides reset function for latched alarm outputs. Activation for longer than 3 seconds will initiate zero calibration.
Adjustable Settings	Programmable IR signal intensity and heater operation. HART or Modbus communication is required to change the factory default settings.	Factory calibrated for methane, propane, and butane, 0-5 LFL-meters full scale. Default gas depends on model. See Table 3 for receiver factory default settings. HART or Modbus communication is required to change the factory default settings.

Table 2-Functional and Electrical Comparison of Transmitter and Receiver

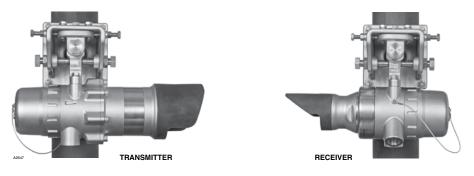


Figure 3— Identification of Transmitter and Receiver Modules

OPERATING MODES

The LS2000 has three operating modes: warmup, normal (measuring / monitoring), and calibrate.

Warm-up

Warm-up mode is entered upon application of 24 Vdc operating power. During warm-up, the 0-20 mA current loop output will indicate warm-up, the indicating LED is yellow, and the alarm outputs are disabled. The warm-up time typically lasts from 15 to 150 seconds, depending upon alignment accuracy.

Table 3—Factory	Default	Settings
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	Default	Configurable Options
Gas Type	Methane	Methane, Propane, Butane
Low Alarm Threshold (LFL-M)	1	0.5 to 4.5 (10% to 90%)
High Alarm Threshold (LFL-M)	3	0.5 to 4.5 (10% to 90%)
High & Low Alarm Relays (Optional)	Non-Latching, De-Energized	Latching/Non-Latching, Energized/ De-Energized
Beam Block Delay	60 Seconds	60–3600 Seconds
Fault Mode	LS2000	LS2000, Advanced, User Defined
Heater Mode*	Smart Mode	Smart Mode, Always On, Always Off

*See "Heater Control" section for details.

Normal

After warm-up mode is completed, the device automatically enters the Normal mode, and all analog and alarm outputs are enabled. The LS2000 modules must be properly aligned before normal operation is attained. See the "Installation" section of this manual for details.

Calibrate

After alignment is completed, zero calibration is required. Span calibration of the LS2000 is performed at the factory; however, the user has the option to verify proper calibration if necessary. It is recommended that the zero calibration procedure be performed annually. Refer to the "Calibration" section in this manual for details.

4-20 MA CURRENT LOOP OUTPUT

The LS2000 provides a linear current loop output that is proportional to the detected gas level. Fault and calibration status are also indicated by this output.

The full-scale output corresponding to 5 LFLmeters is 20 mA. HART and Modbus interfaces also have the ability to calibrate (trim) the 4 mA and 20 mA levels.

The LS2000 is equipped with output monitoring circuitry for the current loop and will indicate a fault when the output mA level does not match the output set point of the device. This monitoring (disabled by default) will indicate a fault if the current loop is not terminated correctly. The loop monitoring feature can be enabled via HART or Modbus communication.

NOTE: The system must be configured for less than 60% of the full scale measuring range, with consideration to the accepted gas cloud size and concentration.

HEATER CONTROL

The LS2000 optics in both transmitter and receiver are heated to provide moisture and ice resistance. These heaters are microprocessor controlled and can be configured to operate in the following modes:

- Always On
- Always Off
- Smart Mode (default)
- Heaters maintain a user programmable temperature set point (default = 50°C).
- Heaters increase to full power when signal strength is degraded due to moisture or condensation on the window, or any obscuration faults are active.
- Heaters shut off when the input voltage drops below a user defined level (default = 18.5 Vdc).
- Heater power usage can be limited from 0-100% (default uses up to 100% power if needed). See the "Specifications" section for power consumption details.

Table 6 indicates the typical window glass temperature rise for various heater setting and ambient temperature combinations.

NOTE

Higher heater settings reduce or eliminate moisture buildup on the window, thereby providing optimum detector performance.

	4-20mA Output		put	Rela	ays		
Status	LS2000 Default	Advanced	User Defined	Fault Relay	Alarm Relay	LED	
Warm up	1.0	1.0	Detection Disabled	De-energized	Disabled	Yellow - Solid	
Normal	4.0 to 20.5	4.0 to 20.5	4.0 to 20.5	Energized	Enabled	Green - Solid = Normal Red - Flashing = Low Alarm Red - Solid = High Alarm	
Zero Calibration	1.0	2.2	Configuration	Energized	Disabled	Yellow - Flashing @ 5 Hz	

Table 4—LS2000 Receiver Status Conditions

Note: When the Communication Link is used, the transmitter LED operation matches receiver LED operation, including alarm status.

Table 6—Typical LS2000 Window Temperature Rise (Degrees C)
for Various Heater Settings and Ambient Temperatures

LS200	0 Window	AMBIENT TEMPERATURE			
Tempera	ture Rise (C)	-55°C	-40°C	0°C	25°C
30%	Receiver	5.1	5.3	4.5	3.0
Heater Setting	Transmitter	4.2	4.1	4.2	3.0
50%	Receiver	7.2	6.8	7.0	5.0
Heater Setting	Transmitter	5.3	5.2	5.3	3.6
70%	Receiver	9.8	9.1	7.5	7.1
Heater Setting	Transmitter	7.8	6.6	5.1	3.8
100%	Receiver	15.8	14.9	8.6	7.3
Heater Setting	Transmitter	13.3	10.6	5.9	4.5

	4-20mA Output			Relays		
Status	Default	Advanced	User Defined	Fault Relay	Alarm Relay	LED
4-20 Fault (Open Loop)	0.0	0.0	0.0	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 1 Pulse
RAM Fault	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Data Flash Fault	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Flash CRC Fault	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
AFE Fault	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Internal Voltage Fault	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Active Signal Saturated	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Ref. Signal Saturated	1.0	1.2	Detection Disabled	De-energized	Disabled	Yellow - Solid
Low Voltage	1.0	1.4	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 2 Pulses
High Voltage	1.0	2.0	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 8 Pulses
Heater Fault	1.0	1.6	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 3 Pulses
Broken Link	1.0	1.8	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 4 Pulses
Failed Zero Calibration	1.0	2.4	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 5 Pulses
Calibrate Active at Startup	1.0	2.6	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 6 Pulses
Beam Block	2.0	2.8	Detection Disabled	De-energized	Disabled	Yellow - Solid for 10 seconds, followed by 7 Pulses
Low Signal	3.0	3.2	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 9 Pulses
Negative Drift -9% of Scale	1.0	3.6	Advisory	De-energized	Enabled	Yellow - Solid for 10 seconds, followed by 10 Pulses
Over Range	20.5	20.5	20.5	Energized	Enabled	Red - Solid

4-20 Fault (Open Loop) The 4-20 mA output loop is not functioning properly; the output mA level does not match the output set point of the device. Check field wiring, termination points, and resista of the 4-20 mA loop. Ensure that the 4-20 mA loop. Internial of the LS2000 Receiver is connected to ground through an appropriate sized load (see instruction manual for details). RAM Fault System RAM test failed. Cycle power to the unit. (If problem does not clea return to factory.) Data Flash Fault Data can no longer be read/written to flash Fault Cycle power to the unit. (If problem does not clea return to factory.) AFE Fault Receiver gain circuit failed. Cycle power to the unit. (If problem does not clea return to factory.) AFE Fault Receiver gain circuit failed. Cycle power to the unit. (If problem does not clea return to factory.) Active Signal Saturated Active sensor is receiving too much light intensity from transmitter. 1. For installation with module separation distance between 5 and 40 meters, the range reduction aperture kit (supplied) is required. Ref. Signal Saturated Reference sensor is receiving too much light intensity from transmitter. 1. For installation with module separation distance between 5 and 40 meters, the range reduction aperture kit (supplied) is required. Low Voltage Supply voltage to LS2000 is less than 16V. Supply voltage should be lowered to reduce signal to receiver. High Voltage Supply voltage needs to drop below 33V. Check supply volt
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this status condition is configurable and is problem persists.
disabled by default.)
Failed Zero This fault will persist through power cycle If the calibration process is allowed to time out, th Calibration until a successful calibration is completed; fault is set and can only be reset with a successful
calibration will time out at 10 minutes calibration.
Calibrate Zero calibration line is pulled low during 1. Check receiver wiring to verify any wired
Active power up, resulting in a Zero Calibration connection to terminal 6 (Reset/Cal) is not connect
at Startup active during power-up. to ground.
Upon power-up of the unit, make sure a magne is not positioned very close to the receiver bulkhe
area where magnetic switch resides.
Beam Block The receiver doesn't see the light signal 1. Clear beam obstruction.
from the transmitter continuously for 1 2. Check alignment and re-align if necessary.
minute or the time set by user (Min 1 minute, Max 6 hours, default 1 minute)
Low Signal Indicated when the received light intensity 1. Clean windows of receiver and transmitter.
is below 30% of full scale at gain 100 2. Check alignment and re-align if necessary.
Negative Drift A constant under range condition where 1. Zero calibration in clean air environment.
-9% of Scale the gas reading is at or below -10% of full 2. Dense fog may be in beam path.
scale reading for a period of one minute or
more. (Gas detection is still enabled, but output reading will be lower than actual
gas concentration applied.)
Over Range Overange condition is indicated by Gas is likely present in high concentration; react
a steady 20.5 mA output, as this is accordingly.
a steady 20.5 mA output, as this is accordingly. maximum gas concentration that will be displayed.

STATUS AND FAULT INDICATION

Status and fault conditions are indicated using the 4-20 mA analog signal output. Signaling modes include two predefined modes, and a user defined mode for third party compatibility. The user defined mode allows users to define a mA output level (range 1.0 - 3.6 mA) for each of the three status / fault categories: configuration, advisory, and detection disabled. Refer to Table 4 for status indications and Table 5 for fault conditions. Status and fault indication configuration options can be changed via HART or Modbus communication. (Refer to the "Troubleshooting" section for additional information regarding fault identification.)

NOTE

Transmitter warmup and fault conditions are indicated by a solid yellow LED, and diagnostics can be performed using HART or Modbus communication. The receiver will continue to perform its safety function, and will indicate a fault status if normal operation has been compromised.

If a transmitter fault occurs, perform normal maintenance and ensure correct input voltage at the device. If normal operation cannot be restored, return the device to the factory.

SPECIFICATIONS

OPERATING VOLTAGE (Both Modules)— 24 Vdc nominal. Operating range is 18 to 30 Vdc. Ripple cannot exceed 0.5 volts P-P.

POWER CONSUMPTION-

Power Consumption (Watts)			
		Transmitter Maximum	Receiver Maximum
	Total Unit, No Heaters or Relays	6.5	2.6
	30% Heater Only	1.4	1.1
@ 24	50% Heater Only	2.5	2.0
VDC	70% Heater Only	3.5	2.7
	100% Heater Only	4.2	3.3
	Relay Only	N/A	1.2
	Total Unit, Max	10.7	7.2
	Total Unit, No Heaters or Relays	6.5	2.9
	30% Heater Only	2.3	1.8
@ 30	50% Heater Only	4.2	3.1
VDC	70% Heater Only	5.9	4.2
	100% Heater Only	7.2	5.1
	Relay Only	N/A	1.2
	Total Unit, Max	13.7	9.3
@ 33 VDC*	Total Unit, Max	16.0	10.0

* Per regulatory approval requirements, the unit power consumption was measured at 33 VDC input voltage (10% above claimed range) and results listed on the product label.

TRANSMITTER LAMP-

Xenon flashlamp, field-replaceable module (10 yr warranty).

WARMUP TIME-

15 seconds minimum, 150 seconds maximum from power-up, depending upon alignment accuracy.

CURRENT OUTPUT-

Linear 4-20 mA (isolated/non-isolated) rated at 600 ohms maximum loop resistance @ 24 Vdc operating voltage, with the ability to go below 4 mA to indicate a fault condition.

RELAY OUTPUTS (Optional)—

Available on Ex d approved models only.

ALARM RELAYS-

Low and High

Form C Type (NO/NC). De-Energized during Normal mode, Energized on Alarm.

Contact Rating: 3 amperes at 30 VDC.

Programmable for Latching or Non-Latching Operation.

Low Alarm: 0.5 to 4.5 LFL-meters

(default = 1 LFL-meters, Non-latching). High Alarm: 0.5 to 4.5 LFL-meters

(default = 3 LFL-meters, Non-latching). Alarm relays are programmable using HART or Modbus communication.

When the LS2000 Gas Detector is used in conjunction with an appropriate certified Control Unit and configured for a nonlatching high alarm, the control unit must **always** latch and require a deliberate manual action to clear a high gas alarm. When used as a stand alone device, the high alarm must always be programmed for latching operation.

FAULT RELAY—

Form C Type (NO/NC). Energized during Normal mode, De-Energized on Fault or loss of power. Contact Rating: 3 amperes at 30 VDC. Non-Latching Operation only — not programmable.

VISUAL STATUS INDICATOR-

LEDs - Transmitter:

Red = Low alarm, high alarm*

Green = Power on / OK

Yellow = Fault / warmup / calibration* *Communication link required for low / high

alarm and calibration indication.

LEDs – Receiver:

Red = Low alarm, high alarm Green = Power on / OK Yellow = Fault / warmup / calibration

See Tables 4 and 5 for details.

AVAILABLE GAS SETTINGS-

Third party performance approved to methane, butane, and propane.

DETECTION RANGE—

Short Range 5-60 meters Long Range 30-120 meters.

Note: It may be necessary to add the aperture (supplied) to the transmitter when operating at the lower 10-15 meters of each range.

MISALIGNMENT TOLERANCE-

 ± 0.8 degree minimum (~ ± 56 cm @ 40m; ~ ± 168 cm @ 120m). The LS2000 is third party verified to maintain specified accuracy within the entire 0.8 degree field of view for both Receiver and Transmitter.

Note: The receiver has a circular field of view. The transmitter has an oval shaped field of view with a minimum 0.8 degree tolerance along the horizontal axis and a minimum 1.5 degree tolerance along the vertical axis (Det-Tronics verified).

CALIBRATION-

LS2000 systems are span calibrated for methane, propane, and butane at the factory. Span calibration in the field is not required.

Zero calibration is accomplished in the field by one of the following methods:

- On-board magnetic reed switch
- Modbus communication
- HART communication
- External calibration switch

RESPONSE TIME

Refer to the appropriate Approval/Certification Appendix for details.

ACCURACY-

Refer to the appropriate Approval/Certification appendix for details. Accuracy specification applies to full operating temperature, humidity, and pressure ranges listed, unless noted otherwise.

NOTE

Misalignment will cause the manufacturer stated Accuracy limits to increase, but remain within the limits of EN 60079-29-4 and IEC 60079-29-4.

TEMPERATURE RANGE—

Operating: -55°C to +75°C (-67°F to +167°F) Relay version: -55°C to +65°C (-67°F to +149°F)

Storage: -55° C to $+85^{\circ}$ C (-67° F to $+185^{\circ}$ F)

Hazardous Locations: Refer to the appropriate Approval/ Certification Appendix for correct ambient temperature range.

HUMIDITY-

5 to 99% relative humidity; designed for outdoor applications.

OPERATING PRESSURE—

91.5 - 105.5 kPA non-compensated.

MEASUREMENT RANGE—

0-5 LFL-meters.

Note: A Negative Zero Drift fault is indicated at -9% of full scale.

INTERFERENCE RESISTANCE—

Immune to sun and flare radiation, tested to 800 \pm 50 W/m² at \geq 3° to optical axis and common contaminants.

SELF-DIAGNOSTIC TEST-

Fail-Safe operation ensured by performing all critical tests once per second.

MODULE HOUSING MATERIAL

316 stainless steel (CF8M).

CONDUIT ENTRY OPTIONS—

3/4 inch NPT or M25, with two entries for transmitter and four entries for receiver.

OPTICS PROTECTION-

Microprocessor controlled heated optics mitigate against ice and dew formation. Brow provides a degree of protection against windblown dirt and rain. See "Mounting Instructions" for brow installation procedure.

INGRESS PROTECTION—

NEMA Type 4X certified, IP66/67 (Det-Tronics verified).

WIRING-

Field wiring screw terminals are UL/CSA rated for up to 14 AWG shielded wire, and are DIN/VDE rated for 2.5 mm² wire. Screw terminal required torque range is 3.5-4.4 lb.-in. (0.4-0.5 N•m).

The receiver can be wired using 3 or 4 wires. The transmitter requires two wires (power only). The use of shielded wiring is recommended.

Field wiring for supply connection must be rated to $95^{\circ}C$ (203°F).

CERTIFICATION-



For complete approval details, refer to the appropriate Appendix:

Appendix A - FM Appendix B - CSA Appendix C - ATEX Appendix D - IECEx Appendix E - SIL

DIMENSIONS-

See Figure 4 for dimensions of the transmitter and Figure 5 for dimensions of the receiver.

MOUNTING & ALIGNMENT BRACKET ADJUSTMENT RANGE—

±12 degrees from center, both vertical and horizontal.

WARRANTY-

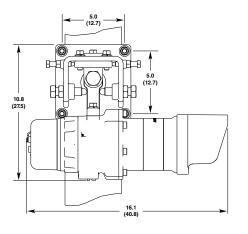
5 year limited warranty. 10 year warranty on IR source.

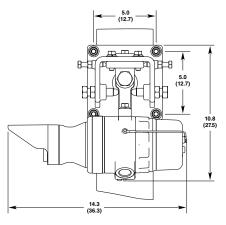
SHIPPING WEIGHT-

Transmitter and receiver with mounting hardware: 85 pounds (38 kg)

Replacement Transmitter:	23 lbs (10.4 kg)
Replacement Receiver:	20 lbs (9 kg)

Transmitter Electronics Module: 10.4 lbs (4.7 kg) Receiver Electronics Module: 7.8 lbs (3.6 kg)





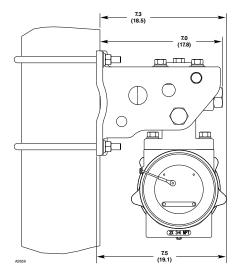


Figure 4—Mounted Dimensions of LS2000 Transmitter in Inches (cm)

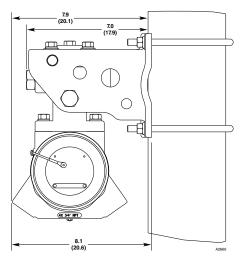


Figure 5—Mounted Dimensions of LS2000 Receiver in Inches (cm)

IMPORTANT SAFETY NOTES

The wiring procedures in this manual are intended to ensure proper functioning of the system under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with the NEC as well as all local ordinances. If in doubt, consult the authority having jurisdiction before wiring the system. Installation must be done by a properly trained person.

ACAUTION

This product has been tested and approved for use in hazardous areas. However, it must be properly installed and used only under the conditions specified within this manual and the specific approval certificates. Any device modification, improper installation, or use in a faulty or incomplete configuration will render warranty and product certifications invalid.

The system contains no user serviceable internal components. Service or repair should never be attempted by the user. Device repair should be performed only by the manufacturer or trained service personnel.

LIABILITIES

The manufacturer's warranty for this product is void, and all liability for proper function of the system is irrevocably transferred to the owner or operator in the event that printed circuit boards are removed or the device is serviced or repaired by personnel not employed or authorized by Detector Electronics Corporation, or if the system is used in a manner not conforming to its intended use.

ACAUTION

Observe precautions for handling electrostatic sensitive devices.

NOTE

The LS2000 is intended for detection of hydrocarbon vapors only. The device will not detect hydrogen gas.

NOTE

The terminal compartment for LS2000 without relays is designed for either an increased safety "e" termination or a flameproof "d" termination of the supply cable. If a flameproof connection is chosen, then an ATEX certified cable entry device must be used. The LS2000 with relays requires Ex d cable entry devices only.

INSTALLATION

IDENTIFICATION OF VAPOR(S) TO BE DETECTED

It is necessary to identify the flammable vapor(s) of interest at the job site in order to determine the proper calibration gas setting for the LS2000. In addition, the physical and fire hazard properties of the vapor, such as vapor density and flashpoint, should be identified and used to assist in selecting the optimum detector mounting locations within the area. The detector must be installed by qualified personnel only, following local electrical equipment installation practices.

SYSTEM LOCATION CONSIDERATIONS

The LS2000 system is designed for installation in hazardous industrial areas. Each module is normally installed using a solid vertical steel post or flat surface mounting adapter to support the weight of the module. The modules must be strategically located so that the hydrocarbon vapor(s) to be detected will intersect the light beam generated by the transmitter module. Dispersion characteristics and behavior of the vapor cloud resulting from a gas leak can be difficult to estimate due to the significant number of variables that exist at different applications. Identification of expected gas leakage source(s), leak scenario identification, determination of prevailing wind direction, and onsite leak simulation are the steps generally recommended to provide the most accurate means of identifying optimum system installation locations

In all cases, the beam path and surrounding area should be kept free of obstructions that could block the infrared beam or hinder the free movement of air within the area. A clear beam path of 20 CM diameter or greater is required. The system is immune to the effects of exposure to both direct and reflected sunlight.

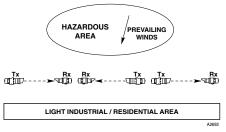


Figure 6—Proper Order of Modules for a Multiple System Installation

Avoid installation in areas with obstructions such as steam vents and plumes, smoke stacks and chimneys, walkways and personnel areas, splash and sprayed water, parking, loading, cranes, vehicle-related areas such as bus stops, road junctions, and vegetation such as trees, shrubs, grass etc.

Det-Tronics Field Service Engineering group routinely provides jobsite application surveys and analysis for customers, and their services are highly recommended if guidance on optimum installation locations is required. Additional guidance on the positioning of gas detectors for optimum coverage is contained in BS6959 and other national codes. Consult these codes of practice when determining where detectors are to be located.

Consideration of the following system location guidelines is also recommended. Routine maintenance is recommended after abnormal events.

Module Separation Distance

The transmitter and receiver modules must be installed directly facing each other across the area to be protected. Physical obstructions in the direct line of sight between the modules are not permitted. The overall line of sight distance between the modules must not fall outside the specified operating distance range (refer to "Specifications" for details).

Multiple System Installations

If multiple LS2000 systems are to be installed, ensure that each receiver can view only the intended transmitter. For fence line applications, the recommended order is Tx-Rx, Rx-Tx, Tx-Rx, etc. as shown in Figure 6.

For redundant systems, spacing between units should be a minimum of 3 ft (1 meter) and the receiver should be set back from the transmitter a minimum of 12 inches (30 cm) as shown in Figure 7.

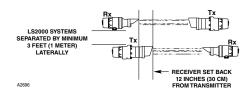


Figure 7—LS2000 Systems in Redundant Configuration

System Mounting Elevation

In all cases, the modules should be installed at the same elevation above grade to ensure that alignment capability and foul weather performance are not compromised. For detection of lighter than air vapors such as methane, installation of modules at approximately 2 meters above grade minimizes typical beam block conditions due to human activities, while enabling satisfactory detection capability. For detection of heavier than air vapors, installation of detectors below the expected leakage source is generally recommended unless nuisance beam blocks will occur at an unacceptable rate. In this case, identification and analysis of application specific conditions should be completed to determine the optimum installation elevation.

Sources of Heavy Contamination

Avoid locations where high levels of contaminants will persistently be blown onto the detector windows. Potential sources of heavy contamination include generator / turbine exhausts, flare stacks, drilling equipment, process vents / chimneys, etc. If sources of heavy contamination cannot be avoided, consider fitting extra shielding and/or providing good access for routine cleaning.

LED Visibility

Whenever possible, select a mounting orientation where the status indication LED is visible to personnel within the area.

The LS2000 provides the option to turn off the Green LED in the Normal mode when no alarms or faults are occurring. When configured for OFF mode, the green LED will turn OFF after a specified period of time. The default is 60 seconds, with a selectable range from 30 to 600 seconds.

Do NOT expect the LED to turn off immediately after changing the setting. Also note that momentary closure of the magnetic switch, fault clear, and alarm clear will reset the OFF mode timer, and the green LED will remain lit for the selected time delay period.

This option is selected from the "Gen Configuration" screen using HART communication.

Snow and Ice in Ambients Below –20°C

The heated optics on both modules will melt snow or ice on the windows in ambient temperatures down to approximately -20°C. Below this temperature, snow or ice blown onto the window will not be melted until the ambient temperature rises. If long term outdoor operation in very cold climates is intended, extra shielding / covers are recommended to prevent accumulation of snow and ice on the windows.

Deluge and Flooding

The modules are rated IP66/IP67 and will not be damaged by occasional deluge or flooding. However, during such an event, the unit will completely lose it's IR signal and will enter the "Beam-Block / Fault" state. In addition, when the deluge / flooding subsides, there is the possibility that contaminants will be left on the windows. Install the modules away from areas prone to deluge or flooding.

Areas Prone to Subsidence and Settling

Avoid installation of the modules in areas where problems with subsidence, settling or thawing of permafrost can occur or cause significant movement. If such locations cannot be avoided, the foundations of the mounting structure should be engineered to minimize any angular movements between the receiver and transmitter."

Areas Prone to Earthquakes

In the event of an earthquake, there is a chance that the modules will become misaligned with respect to each other. As long as the modules do not suffer from direct mechanical impact damage during an earthquake, they should remain undamaged by such events. After an earthquake, it is recommended that the system alignment be checked. Anti-vibration mounts are unlikely to be of any benefit and are not recommended.

Misalignment by Accidental Impact

Locations where there is a significant likelihood of equipment, personnel or moving objects accidentally knocking the modules out of alignment should be avoided where possible. If such locations cannot be avoided, measures including improved mechanical protection and warning notices should be considered.

MODULE MOUNTING RECOMMENDATIONS

LS2000 modules **must** be affixed to a solid, non-vibrating structure capable of supporting a minimum of 100 lbs (46 kg), located within the system's rated separation distance.

A building wall, a heavy steel I-beam, or nearly any type of masonry typically provides the most rigid mounting surface available. However, avoid the use of wood structures or supports if the possibility of warping exists. When using a vertical post, the post **must** be absolutely stable and without vibration. Square stock pole is recommended. Mounting height should not exceed 3 meters.

The post can be set into the ground or attached to a secure surface. If a post is set into the ground, the portion below grade should be set in concrete at least 1 meter deep.

IMPORTANT

In all cases, consider whether additional bracing or support is needed to ensure the structural integrity of the module installation. See Figure 8. Remember that accurate module alignment is essential for proper performance of a line-of-sight gas detection system. Movement may have a detrimental effect on alignment. This is especially true for installations with significant module separation distances.

Module mounting options include:

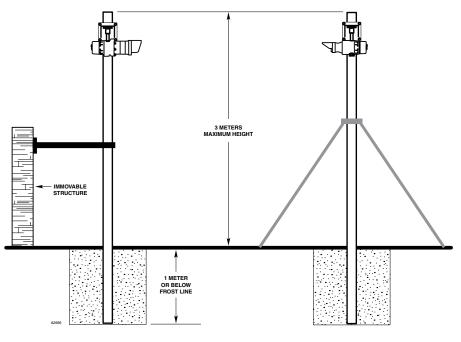
- A vertical or horizontal post with a nominal outside diameter of 4.5" (11.43 cm). Acceptable outside diameter range is 4" to 4 5/8" (10.16 to 11.75 cm). See Figure 9.
- For flat surface mounting, refer to Figure 10.

NOTE

Anti-seize material (provided) must be applied to the U-bolt threads at the time of installation to prevent galling.

NOTE

To ease installation and future removal, all threaded covers, stopping plugs, and thread adapters must be installed using thread lubricant. See the "Ordering Information" section for part number avoid the use of silicone grease. For devices with NPT threads, Teffon tape or thread seal lubricant must be used for enhanced sealing capability. A minimum torque of 20 foot-pounds is required to maintain ingress protection. To maintain the IP or NEMA ratings when using NPT stopping plugs, one to three wraps of Teflon tape is required.



NOTE: INSTALLATIONS NEAR MAXIMUM HEIGHT TYPICALLY REQUIRE BRACING TO ENSURE NO MOVEMENT OF THE LS2000 DETECTOR.

Figure 8-Example of Bracing Added to Vertical Mounting Poles for Increased Robustness of LS2000 Installation



Figure 9-LS2000 Gas Detector Mounted to Vertical Post



Figure 10—LS2000 Gas Detector Mounted to Flat Surface (Refer to "Dimensions" in the "Specifications" section for mounting plate hole spacing dimensions.)

REPLACING AN EXISTING MODEL OPECL WITH AN LS2000

Flat Surface Mount

An optional adapter plate (part number 012718-003) is available for converting an existing OPECL flat surface mount to an LS2000 flat surface mount without drilling new holes. See Figure 11 for dimensions. The mounted LS2000 will have the following offsets compared to the OPECL detector (when looking straight at the wall/beam).

Left/right = 0"

Up/down = 1 inch lower

 $\mbox{In/out}$ = 0.3" closer to the wall/beam for the LS2000.

Pole Mount

The LS2000 can be mounted to the same pole as the Model OPECL using U-bolts. The LS2000 will have the following offsets compared to the OPECL detector.

Left/right = 0"

0.5

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2X 0.5

2X 5.0 (12.7)

Up/down = 0" if the top U-bolt for the LS2000 is mounted 1" lower than the top U-bolt of the OPECL detector.

6.0 (15.24)

2X 3/8-16 LINC THRU

4X 0.41 THRU

4X 0.5 (1.27)

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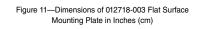
2X 13.0 (33.02)

5.0 (12.7)

In/out = 0.8" closer to the pole for the LS2000.

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24 VDC POWER SUPPLY REQUIREMENTS

Calculate the total gas detection system power consumption rate in watts from cold start-up. Select a power supply with adequate capability for the calculated load. Ensure that the selected power supply provides regulated and filtered 24 Vdc power for the entire system. If a back-up power system is required, a float-type battery charging system is recommended. If an existing source of 24 Vdc power is being utilized, verify that system requirements are met.

NOTE

If disconnection of power is required, separate disconnect capability must be provided.

WIRING CABLE REQUIREMENTS

Always use proper cabling type and diameter for input power as well as output signal wiring. 14 to 18 AWG (2.5 to 1.0 mm²) shielded stranded copper wire is recommended.

Always install a properly sized master power fuse or breaker on the system power circuit.

NOTE

The use of shielded cable in conduit or shielded armored cable is required for ATEX conformance. In applications where the wiring is installed in conduit, dedicated conduit is recommended. Avoid low frequency, high voltage, and non-signaling conductors to prevent nuisance EMI problems.

The use of proper conduit installation techniques, breathers, glands, and seals is required to prevent water ingress and/or maintain the explosion-proof rating.

AWARNING

It is required that each conduit plug or fitting be wrench tightened to an appropriate installation torque and meet the minimum thread engagement requirements per the applicable local standards, codes and practices in order to retain the defined ingress protection rating. All unused entries must contain appropriately rated conduit plugs or fittings. PTFE sealant (or equivalent) should be used on NPT threads.

14.0 (35.6

2X 0.5 (1.27)

POWER WIRING SIZE AND MAXIMUM LENGTH

- To ensure proper operation, LS2000 power terminals and 4-20 mA terminals must receive 18 Vdc minimum. 24 Vdc is recommended.
- 2. Always determine voltage drops that will occur to ensure that 24 Vdc is delivered to the LS2000.
- Normally, nothing smaller than 18 AWG (1.0 mm²) is recommended by Det-Tronics for LS2000 power cabling.

Wire size requirements are dependent upon power supply voltage and wire length.

The maximum distance between the LS2000 detector and its power supply is determined by the maximum allowable voltage drop for the power wiring loop. If the voltage drop is exceeded, the device will not operate. To determine the maximum power loop voltage drop, subtract the minimum operating voltage for the device (18 Vdc) from the minimum output voltage of the power supply.

To determine the actual maximum wire length:

- 1. Divide the maximum allowable voltage drop by the maximum current draw of the LS2000 (0.771 A),
- Divide by the resistance of the wire (ohms/ foot value available in wire manufacturer's specification data sheet),
- 3. Divide by 2.

For example: Consider an installation using 18 AWG wiring with a power supply providing 24 Vdc.

Power supply voltage = 24 Vdc, LS2000 minimum operating voltage = 18 Vdc

24 - 18 = 6 Vdc

Maximum Voltage Drop = 6 Maximum Current = 0.771 A Wire Resistance in Ohms/Foot = 0.006523

 $6 \div 0.771 \div 0.006523 \div 2 = 596$ feet

OPTIONAL RELAYS

Optional relay contacts are "dry", meaning that the installer must provide the voltage to the common terminal of the relay output. AC voltage should not be switched directly using the LS2000 relays. The use of an external relay is required if AC voltage must be switched by the LS2000 relays. Note: External relay is not covered by any Certifications.

In order to change alarm relay settings from the factory default settings, it is recommended to use a HART Field Communicator. Contact the factory for further assistance.

NOTE

Refer to "Alarm Relays" in the "Specifications" section of this manual for important information regarding alarm relays.

WIRING PROCEDURE

For systems using conduit, modules must be wired using a short piece of suitable flexible conduit to allow optical alignment of the modules. Conductor insulation should be stripped off with a bare conductor length of 0.2 inch (5 mm) minimum and 0.35 inch (9 mm) maximum. Screw terminal torque range is 3.5– 4.4 lb.-in. (0.4–0.5 N•m).

Cable shield, if used, should be properly terminated. If not terminated, clip the shield wire off short and insulate it within the detector housing to prevent the shield wire from accidentally contacting the detector housing or any other wire.

Figure 12 shows the wiring terminal strip located inside the detector's integral junction box.

NOTE

The LS2000 housing must be electrically connected to earth ground. A dedicated earth ground lug is provided for this purpose.

Figure 13 shows the wiring terminal configuration for the LS2000 transmitter.

Figure 14 shows the wiring terminal configuration for the LS2000 receiver without relays.

Figure 15 shows the wiring terminal configuration for the LS2000 receiver with relays.

Figures 16 through 19 show the 4-20 mA output of the LS2000 receiver in various wiring schemes.

See Figure 20 for benchtop test wiring.

NOTE

For proper HART communication, it is required that an analog signal loop resistance of 250 to 500 ohms be present at the receiver analog output terminals. For LS2000 systems using HART communication, the maximum wiring distance is 2,000 feet. No external resistance needs to be added to the **transmitter** wiring for proper HART operation.

A pair of HART connector pins is provided for ease in connecting a HART handheld device. See Figure 21 for location.

NOTE

To establish the optional "communication link" between the transmitter and receiver, connect a three-wire shielded cable to the INTR A, INTR B, and INTR GND terminals of the two devices. See Figure 22. Take care not to connect any of these lines to 0V COM. Doing so will damage the 4-20 mA circuit and make the device susceptible to surge.

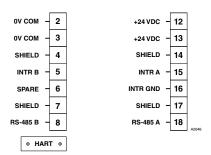


Figure 13—Transmitter Wiring Terminal Identification

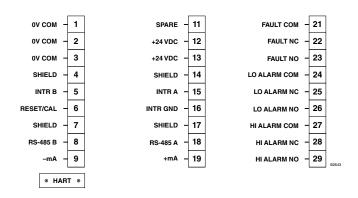


Figure 15—Wiring Terminal Identification for LS2000 Receiver with Relays

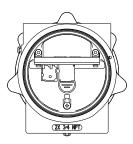


Figure 12-Terminal Strip Located Inside Wiring Compartment

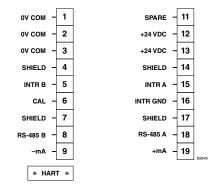
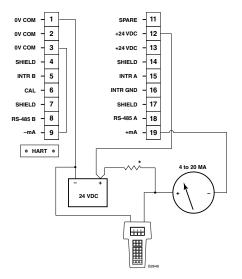
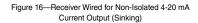
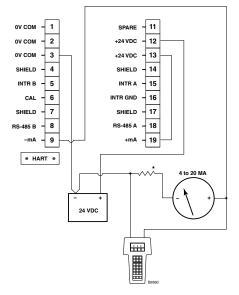


Figure 14—Wiring Terminal Identification for LS2000 Receiver without Relays

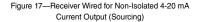


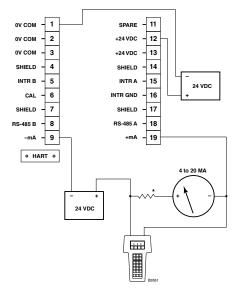
*TOTAL LOOP RESISTANCE = 250 OHMS MINIMUM, 600 OHMS MAXIMUM. NOTE: SHIELDED CABLE RECOMMENDED (REQUIRED FOR ATEX).





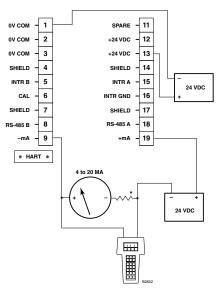
*TOTAL LOOP RESISTANCE = 250 OHMS MINIMUM, 600 OHMS MAXIMUM. NOTE: SHIELDED CABLE RECOMMENDED (REQUIRED FOR ATEX).





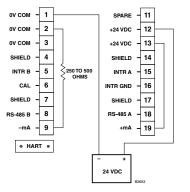
*TOTAL LOOP RESISTANCE = 250 OHMS MINIMUM, 600 OHMS MAXIMUM. NOTE: SHIELDED CABLE RECOMMENDED (REQUIRED FOR ATEX).

Figure 18—Receiver Wired for Isolated 4-20 mA Current Output (Sinking)



*TOTAL LOOP RESISTANCE = 250 OHMS MINIMUM, 600 OHMS MAXIMUM. NOTE: SHIELDED CABLE RECOMMENDED (REQUIRED FOR ATEX).

Figure 19—Receiver Wired for Isolated 4-20 mA Current Output (Sourcing)



NOTE: THE HART HANDHELD DEVICE CAN BE CONNECTED EITHER TO THE HART TERMINALS OR ACROSS THE LOAD RESISTOR.

Figure 20—Wiring the LS2000 Receiver for Benchtop Testing/Programming Using HART Protocol

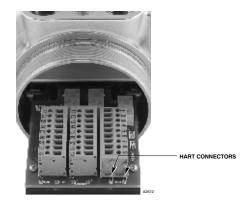
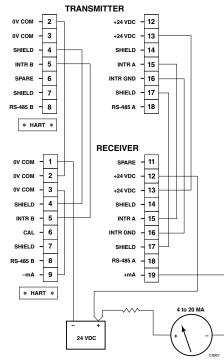


Figure 21—Location of HART Connector Pins (Receiver Module Shown)



NOTE 1: TOTAL LOOP RESISTANCE OF 4-20 MA CIRCUIT = 250 OHMS MINIMUM, 600 OHMS MAXIMUM.

NOTE : NOTE: SHIELDE CABLE RECOMMENDED (REQUIRED FOR ATEX). CAUTION: DO NOT CONNECT THE COMMUNICATION LINK "INTR GND" TERMINAL TO POWER SUPPLY COMMON OR ANY OTHER GROUND CONNECTION.

Figure 22— Typical System Wiring

Including Optional Communication Link — Receiver Wired for Non-Isolated 4-20 mA Current Output (Sinking)

STARTUP

When the LS2000 is installed and wired as described in the "Installation" section, it is ready for commissioning. If the application requires that specific changes be made to the factory settings, HART communication will be required.

NOTE

Ensure that alarm devices are bypassed during commissioning.

NOTE

The safety function (gas input-toactuation/notification) must always be verified upon completion of installation and/or modification.

ALIGNMENT

OVERVIEW

The LS2000 modules must be properly aligned before normal operation will be attained.

NOTE

Refer to the FM, ATEX, or IECEx Appendix for information regarding the effect of misalignment on system accuracy.

IMPORTANT

Upon completion of system alignment, ensure that **ALL** bolts on the LS2000 mounting and alignment bracket are properly tightened.

EQUIPMENT REQUIRED

- 1. Properly installed and powered LS2000 system (transmitter and receiver). Easy access to both modules is highly recommended.
- LS2000 Alignment Tool. The alignment tool is recommended for use in commissioning all LS2000 systems. The following instructions cover the use of the Alignment Tool.
- 3. 9/16 inch wrench.
- 4. 15/16 inch wrench.
- 5. For installations with short separation distances (5-15 meters for the short range model and 30-40 meters for the long range model), the short range aperture kit (supplied) is typically needed. Refer to "Aperture Kit for Short Range Applications" section in this manual for details.

ALIGNMENT PROCEDURE

- Ensure that the system modules are located within the specified separation range and securely fixed to the support structures. Bypass all external gas alarm devices that are connected to the receiver outputs.
- Ensure that the system modules are installed with their windows at approximately the same height above grade. Each module should be roughly aligned to face in the direction of the other module.
- 3. Loosen the Horizontal and Vertical Adjustment Bolts on the mounting and alignment bracket using the 9/16" wrench for the Horizontal Adjustment Bolts and the 15/16" wrench for the Vertical Adjustment Bolts. See Figure 23.
- 4. Loosen the four Horizontal Locking Bolts on top of the mounting and alignment bracket using a 9/16" wrench, then retighten until just snug against the top plate of the Detector Mounting Assembly. The Detector Mounting Assembly should still be able to rotate on its axis when adjusting the Horizontal Adjustment Bolts. If not, slightly loosen the four Horizontal Locking bolts.
- 5. Remove the brow by gently working side to side while pulling forward.

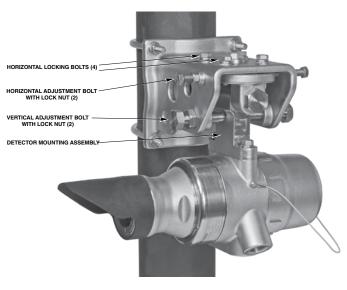


Figure 23-LS2000 Mounting and Alignment Bracket (Receiver Module Shown)

- 6. Install the Alignment Tool onto the receiver module by inserting the captive thumbscrews into the threaded holes on the faceplate. See Figure 24. Ensure that the alignment tool is properly attached, that the eyepiece is accessible, and that the thumbscrews are completely tightened.
- 7. Using the Horizontal and Vertical Adjustment Bolts, adjust the receiver module as required until the cross hairs are centered as close as possible to dead center on the window of the transmitter module. Do not tighten the adjustment bolts at this time, just snug down all adjustment bolts finger tight.
- Slightly loosen the Vertical Adjustment Bolts so that tightening the 4 Horizontal Locking Bolts does not cause the Detector Mounting Assembly to bind as it is being pulled up.
- 9. Tighten the 4 Horizontal Locking Bolts in an opposing-alternating pattern. Torque each bolt to 200 in-lbs (22.6 N•m) maximum.
- 10.Tighten the Horizontal Adjustment Bolts to 200 in-lbs (22.6 N•m) maximum, being careful to tighten each bolt evenly against each other to prevent torquing of the Detector Mounting Assembly. Tighten the Locking nuts to 200 in-lbs (22.6 N•m) maximum. The mounting and alignment bracket is now secured horizontally.
- 11. Verify alignment using the Alignment Tool. The Vertical alignment may have shifted slightly due to tightening of the 4 Horizontal locking bolts pulling the Detector Mounting Assembly up. Adjust the vertical alignment if needed using the Vertical Adjustment Bolts.
- 12. When proper alignment has been achieved, tighten the Vertical Adjustment Bolts and Locking Nuts to 90 ft-lbs (122 N•m) maximum, being careful to tighten each bolt evenly against each other to prevent torquing of the Detector Mounting Assembly. The Receiver is now secured vertically and aligned with the Transmitter.
- 13.Rotate the telescope alignment tool by 180° and verify that the cross hairs are in the same position. If the cross hairs are not in the same position, the telescope alignment screws must be adjusted as follows:
 - A. Adjust the telescope alignment screws until the cross hairs are midway between the original position (center of transmitter window) and the current position (after the scope was rotated 180°). See Figure 25.



Figure 24— LS2000 with Alignment Tool Installed

B. Return the scope to its original position (rotate 180°) and repeat steps 7 through 13 until correct alignment is achieved.

NOTE

No further adjustments are required when the cross hairs are centered on the window with the scope in both 180° positions.

- 14.Repeat the alignment procedure for the transmitter module (steps 3 to 13).
- 15.Re-check the alignment one final time using the alignment tool and adjust as needed.
- 16.Remove the Alignment Tool and re-install the brow.
- 17. Bypass all external gas alarm devices that are connected to the receiver outputs, and then apply 24 Vdc power to the modules.
- 18.Upon completion of warm-up mode (approximately 2 minutes or less), the receiver should produce a 4 mA output signal and a green LED indication. If not, the required zero calibration step below may resolve this issue.
- 19.For installations with module separation distances between 5 and 40 meters, install the aperture as described in the "Aperture Kit for Short Range Applications" section.

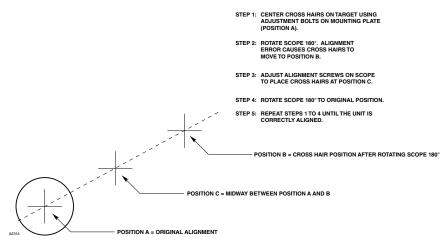


Figure 25—LS2000 Alignment Using the Telescope Alignment Tool

20.Perform a zero calibration. (Refer to "Zero Calibration" in the "Calibration" section of this manual.) Any faults that may be present as a result of the alignment process should be cleared.

NOTE

The LS2000 transmitter lamp output intensity is automatically optimized during the zero calibration process if the communication link wires are attached between transmitter and receiver. If no communication link is installed, the transmitter lamp output can be adjusted via Modbus or HART connection to the transmitter. This adjustment is rarely needed. (See "Transmitter Lamp Voltage" section for more information.)

- 21. Proper operation should be confirmed by bypassing all system alarms, then placing an optical test film (sold separately) into the light beam and checking for the appropriate 4-20 mA output level or relay actuation. The LS2000 test film packet consists of five separate test films. Table 7 shows the response of the different LS2000 gas settings to each of the five test films. Alarm conditions, if present, should clear when the test film is removed from the beam.
- 22.Confirm proper operation by completely blocking the light beam with a solid object such as a piece of cardboard until a beam block fault is signaled by the appropriate 4-20 mA output level or relay action (default delay is 60 seconds). The fault should clear

when the blocking device is removed from the beam.

23. When Basic Alignment and Zero Calibration have been successfully completed, a green LED should be displayed on the receiver module and the analog signal output level should be 4.0 milliamperes.

APERTURE KIT FOR SHORT RANGE APPLICATIONS

The Short Range Aperture Kit enables successful application of the LS2000 gas detector at short separation distances (5-15 meters for the short range model and 30-40 meters for the long range model). The aperture is made of aluminum and is included with the LS2000 transmitter.

	oonig aa		
Test Film	Methane	Butane	Propane
1	0.6	1.1	1.3
	(12%)	(22%)	(26%)
2	1.5	2.3	2.6
	(29%)	(46%)	(52%)
3	2.5	3.6	3.9
	(50%)	(72%)	(78%)
4	3.7	4.9	5.4
	(74%)	(98%)	(108%)
5**	5.0	6.0	6.0
	(100%)	(120%)	(120%)

Table 7—Typical System Response* in LFL-M (% Full Scale) Using Gas Test Films

*Accuracy = ± 0.2 LFL-M or $\pm 15\%$ LFL-M from typical system response, whichever is greater.

**A HART handheld device is needed to read over-range values.

Procedure for System Commissioning Using the Aperture

- Align the LS2000 system using the Basic Alignment procedure. At the completion of this alignment, the output signal at the receiver may indicate a fault condition as a result of signal saturation. (See the "Gain Level Check" section for additional information on signal strength checks.)
- Attach the aperture to the front of the LS2000 transmitter module using the captive screws provided. For best weather protection, the aperture hole should be located at the top of the unit.
- Perform a zero calibration. After performing the zero calibration, the receiver module should display a normal condition (green LED) and a steady 4 mA output.

NOTE

If the receiver continues to indicate a fault condition as a result of signal saturation, rotate the aperture 90 degrees and repeat step 3 above.

RECOMMENDATIONS FOR USING THE HART FIELD COMMUNICATOR

WARNING

The LS2000 does not use Intrinsically Safe circuitry for connection to the HART 475 Communicator. Connecting a HART 475 Communicator to the LS2000 may invalidate the Intrinsic Safety circuits of the HART 475 Communicator.

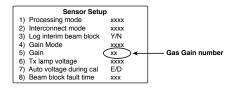
- The HART communication device must include the LS2000 device descriptor (DD) software menu. The use of HART communication devices without the proper DDs may establish generic mode HART communication, but will not enable proper operation with LS2000. Refer to the HART Appendix for additional information.
- A minimum level of understanding with regard to the operation and navigation of the HART communicator is required. Please refer to the appropriate HART communicator instruction manual for basic operating instructions if required. Additional information on the use of the HART communicator is provided within the HART Appendix in this document.
- For proper HART communication to occur, it is required that a 250-500 ohm resistive load be present in the LS2000 analog 4-20 mA signal loop output. See "Wiring Procedure" in the "Installation" section.

GAIN LEVEL CHECK (Optional)

It is necessary to complete the alignment procedure before checking the gain level. HART or Modbus communication is required to check the gain.

Procedure

- 1. Connect the handheld HART communicator to the receiver module's 4-20 mA circuit.
- 2. Turn on the HART communicator and check for LS2000 device recognition. When HART communication is established, the LS2000 Online menu will be displayed on the communicator display.
- 3. From the Online menu, Navigate to the Detector Setup menu, then select the Sensor Setup menu.
- 4. The following screen will be displayed. Observe the level indicated for "Gain."



5. Table 8 can be used as a guideline for new installations to assess the detector gain level with proper alignment.

Table 8-Expected das dain Settings for ES2000			
Distance (meters)	Transmitter Type		
	Short Range	Long Range	
5	1 (Aperture)		
20	5 (Aperture)		
30	1	2 (Aperture)	
40	2-5	5 (Aperture)	
60	5-10	1-2	
80		2-5	
100		2-5	

Table 8—Expected Gas Gain Settings for LS2000

5-10

120

6. Verify the gain setting. The gas gain setting options are 1, 2, 5, 10, 20, 50, and 100; ideal gain settings are 2, 5, and 10.

A gain of 1 indicates that the system may be near saturation (signal strength is too high). If the gas gain number = 1 and the Active avg or Ref avg numbers are greater than 1500, use the aperture kit to reduce signal. See the "Transmitter Lamp Voltage" section for additional signal strength reduction options as needed. If using the Long range receiver, it may be necessary to switch to the Short range version.

A gain of 20 or greater indicates that the system signal strength is less than expected. Ensure that the system has a clear beam path, clean windows, and was properly aligned and calibrated in clear weather. See the "Transmitter Lamp Voltage" section for additional signal strength increase options as needed. If using the Short range receiver, it may be necessary to switch to the Long range version.

Contact the factory for further information or assistance.

In all cases, a green LED and 4 mA output indicate that the unit will properly perform its safety function. Gain adjustments and checks are simply a way to optimize the system so that it will perform in the widest variety of application scenarios (e.g., shifting mounts, inclement weather, mechanical impact, lens obscuration, etc.).

TRANSMITTER LAMP VOLTAGE

The LS2000 has a feature that automatically adjusts transmitter lamp voltage during zero calibration if the communication link is connected. (This feature is disabled by default.) Alternatively, lamp voltage can be adjusted via HART or Modbus communication directly to the transmitter. The transmitter lamp voltage should be lowered to reduce signal at the receiver. Transmitter lamp voltage should be raised to increase signal at the Receiver. The adjustment range for the transmitter lamp is 400-950 V (default = 750 V). Contact the factory for further information or assistance.

CALIBRATION

CALIBRATION OVERVIEW

Span calibration is not required. The LS2000 supports non-intrusive field zero calibration, although routine calibration is normally not required.

ZERO CALIBRATION

Zero Calibration is a one-step process consisting of clean air (zero) condition adjustment only, which is performed automatically by the device. This procedure adjusts the "clean air" signal output only, and is normally used if the gas output signal level has drifted. The cause of drift is typically due to the presence of background gas during calibration. Additionally, the zero calibration procedure will optimize the transmitter lamp output intensity if the optional communication link is installed. This is useful for situations where the signal strength at the receiver is too large (saturation) or too small. Ensure that the optical path is clear of hydrocarbons prior to calibration initiation to ensure an accurate zero (clean air) condition.

IMPORTANT CALIBRATION NOTES

NOTE

Ensure that the detector has been operating for at least two hours before calibrating.

NOTE

Always ensure that the LS2000 optics are totally free of all hydrocarbons before initiating calibration.

NOTE

Zero calibration cannot be performed if the detector is improperly aligned. When correct alignment is achieved, the sensor ratio (active vs. reference signals) should be between 0.8 and 1.3. To check the ratio, connect a HART handheld and navigate to:

Main > Detector Status > Sensor Info > Ratio

An out-of-tolerance ratio value typically indicates incorrect alignment or presence of background gas.

CALIBRATION INITIATION

Calibration may be initiated by any of the following means:

- · The onboard magnetic calibration switch
- Digital communication via HART (see HART appendix) or Modbus communication (consult factory for details)
- Remote calibration line

Upon initiation, the LS2000 automatically performs the zero calibration adjustment, and then signals with a green LED when this operation is complete.

Calibration Using Magnetic Switch

The LS2000 receiver provides an onboard magnetic calibration/reset switch for nonintrusive calibration capability. The magnetic switch is actuated by holding a calibration magnet at the specified location on the device bulkhead. See Figure 2 for switch location. An onboard multi-color LED provides status indication during calibration.

To initiate calibration, hold the calibration magnet against the side of the receiver at the location shown in Figure 2. Apply the magnet for 3 to 30 seconds and release while the LEDs are flashing yellow at 5 Hz.

Calibration Using Calibration Line Terminal

The calibration / reset function can be accomplished remotely by installing a switch between the CAL and 0V COM terminals of the LS2000 receiver.

To initiate calibration, short the CAL and OV COM terminals for 3 to 30 seconds and release while LEDs are flashing yellow at 5 Hz.

CALIBRATION SEQUENCE

- 1. Initiate calibration using one of the methods listed above:
 - A. The LEDs continue to flash yellow at 5 Hz.
 - B. The current output decreases to 1 mA, 2.2 mA, or as configured by the user.
- 2. When zero calibration is complete:
 - A. The onboard LEDs change from flashing yellow to steady green.
 - B. Calibration is complete and the current output returns to 4 mA.

NOTE

Calibration will time out if unsuccessful after 10 minutes.

NOTE

To abort an in-process calibration, repeat the calibration initiation sequence (e.g., hold the magnet for 3 seconds or more and release). The device will revert to its previous calibration setting.

MAINTENANCE

WARNING

Do not open cover when an explosive gas atmosphere may be present.

NOTE

Refer to the LS2000 Safety Manual, number 95-8727, for specific requirements and recommendations applicable to the proper installation, operation, and maintenance of all SIL-Certified LS2000 IR gas detectors.

ROUTINE INSPECTION

The LS2000 detector should be inspected periodically to ensure that external obstructions such as plastic bags, mud, snow, or other materials do not block the path and thereby impair the performance of the device.

OPTICS CLEANING

Cleaning of the LS2000 optical surfaces is normally required only if an optical fault is indicated.

Thoroughly douse both window surfaces using a liberal amount of isopropyl alcohol to clear away contaminant particles. Repeat the alcohol flush to remove any remaining contaminants.

WARNING

Bypass/Inhibit: Volatile organic compounds in cleaning solutions could cause false alarms.

FUNCTIONAL CHECKING

Functional checks should be performed as required by site conditions and local regulations. For specific approval requirements regarding functional checks, see appendices and the LS2000 safety manual.

Det-Tronics provides two functional check options for the LS2000. The **test film** method provides a basic functional check as described in step 20 of the basic alignment procedure.

Alternatively, the **gas test cell** method can be used for a more precise output verification. The gas cell is typically used to verify the factory calibration of the LS2000. The gas cell has a known optical length and has infrared transparent windows on both ends. When filled with 100% v/v gas, it contains a specific LFL-M amount of gas. When the gas cell is placed in the beam of the detector, the output will rise to a specific value.

The gas cell is not intended for routine use. It does, however, demonstrate in a very direct way the response of the detector to hydrocarbons along with the resulting control action. This is particularly useful when required by regulatory authorities. See the gas cell instruction manual, number 95-8591, for further details and use instructions.

PROTECTIVE CAPS AND COVERS

Ensure that the wiring compartment cover is installed and fully engaged.

TROUBLESHOOTING

A Fault status is indicated by a yellow LED and also by the 4-20 mA output. Refer to Table 9 for assistance in correcting malfunctions with the LS2000 Detector.

Fault Condition	Corrective Action
Low 24 volts	24 vdc operating voltage is out of range. Verify proper wiring to the detector and correct voltage output from the power source. Power supply faults are self-clearing when the condition is corrected. If the fault does not clear, consult the factory.
Dirty Optics	Perform cleaning procedure, then recalibrate as required. (Refer to "Maintenance" for details.)
Calibration Fault	If the calibration process is allowed to time-out, the fault is set and can only be reset with a successful calibration.
Negative Signal Output	This fault is indicated when the signal output drops below -0.5 LFL-M. Normally detection capability is not compromised in this condition. The device was probably zero calibrated with background gas present. If the condition persists, purge with clean air and repeat the zero calibration. Ensure that the heaters are on and the windows are not fogged.
Calibration line active at start-up	The only way to clear this fault is to correct the wiring and reapply power. Be sure that the calibration line is not shorted and that the calibration switch is open. If the fault does not clear, consult the factory.
Signal Saturation	Add aperture to the transmitter module or adjust lamp voltage if needed.
EE Error	Return unit to the factory.
Other Faults	Consult the factory.

Table 9—Troubleshooting Guide

REPLACING LS2000 TRANSMITTER/RECEIVER ELECTRONICS MODULE

MWARNING

Do not open when an explosive gas atmosphere may be present.

ACAUTION

Only Det-Tronics authorized personnel are allowed to perform this repair.

Replacement of the LS2000 transmitter or receiver module requires disassembly of the device housing. Remove power to the device before disassembly.

The LS2000 detector contains semiconductor devices that are sensitive to electrostatic discharge (ESD). Use normal precautions for handling ESD sensitive devices. Handle the device by the housing, taking care not to touch electronic components or terminals.

MODULE REPLACEMENT PROCEDURE

Tools Required:

- 6 mm hex wrench (transmitter)
- 5/16 inch hex wrench (receiver)
- Torque wrench capable of accurately measuring 40 inch-pounds
- 1. Bypass system alarms as needed, then remove 24 Vdc power from the LS2000 detector.

2. Transmitter

Remove the seven stainless steel flange bolts using a 6 mm hex wrench. See Figure 26. Take care to properly support the module as the last flange bolt is removed.

Receiver

Using a 5/16 inch hex wrench, loosen the locking set screw. Turn the retainer ring by hand to loosen the module. See Figure 27.

- 3. Carefully remove the old module by extracting it straight out from the bulkhead.
- Ensure that the o-ring is present, undamaged, and correctly seated in the groove. This o-ring is required to maintain the watertight integrity of the LS2000 housing.
- 5. Line up the pin on the replacement module with the hole in the bulkhead and insert the module straight into the bulkhead. See Figure 28 for the transmitter and Figure 29 for the receiver.

6. Transmitter

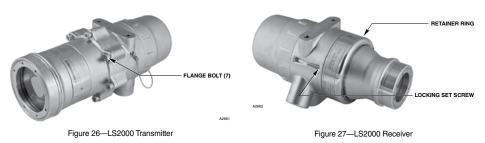
Insert and tighten the seven flange bolts in an opposing consecutive order in two stages — first partially tighten all seven bolts equally, and then fully tighten each bolt in an opposing order to 90 in-lbs (10.2 N•m) maximum of torque. Bolts are M8-1.25x 16M.

ACAUTION

Flange bolts are critical to maintaining the flameproof properties of the LS2000. If replacement flange bolts are needed, DEC spare part number 012713-001 must be used in order to maintain the integrity of the enclosure. The use of any other bolts will void the Ex d certification of the LS2000.

Receiver

Fully tighten the retainer ring on the receiver module, then tighten the set screw to prevent the ring from being turned.



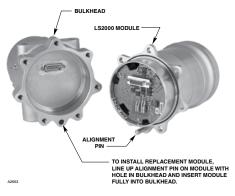


Figure 28-Transmitter Module Removed from Bulkhead

- When all equipment has been properly installed, ensure that system alarms are appropriately bypassed and apply power to the system.
- 8. Perform the alignment procedure as previously described in this manual.

IMPORTANT

If the LS2000 module had an aperture installed, install the aperture after performing the alignment procedure (install aperture on the transmitter, not on the receiver). If the separation distance is between 5–40 meters and signal saturation is indicated after completion of the Basic Alignment procedure, an aperture will be required (even if no aperture was originally installed). Refer to the "Aperture Kit for Short Range Applications" section of this manual for complete information regarding apertures.

- 9. Perform a zero calibration of the detector.
- 10. Upon completion of zero calibration, verify proper operation by performing an "optical test film test" and also a "beam block test" (see steps 20 and 21 in the "Basic Alignment Procedure" section in this manual).

NOTE

Replacement receiver modules are furnished from the factory with default configuration settings. If the LS2000 system has had any configuration changes in the field, the new receiver will require changes to configuration parameters using a HART communicator, a FlexVu UD10 display unit, or Modbus communication.



Figure 29—Receiver Module Removed from Bulkhead

11. Restore system alarms (remove bypass).

DEVICE REPAIR AND RETURN

The LS2000 IR Hydrocarbon Gas Detector is not designed to be repaired in the field. If a problem should develop, first carefully check for proper wiring, programming and calibration. If it is determined that the problem is caused by an electronic failure, the device must be returned to the factory for repair.

Prior to returning devices, contact the nearest local Detector Electronics office so that a Return Material Identification (RMI) number can be assigned. A written statement describing the malfunction must accompany the returned device or component to assist and expedite finding the root cause of the failure.

Pack the unit properly. Always use sufficient packing material. Where applicable, use an antistatic bag as protection from electrostatic discharge.

NOTE

Inadequate packaging that ultimately causes damage to the returned device during shipment will result in a service charge to repair the damage incurred during shipment.

Return all equipment transportation prepaid to the factory in Minneapolis.

ORDERING INFORMATION

When ordering, please refer to the LS2000 Model Matrix:

ALIGNMENT EQUIPMENT

Part Number Description

012287-002 LS2000 Alignment Tool Consists of a 32mm sighting device with 3-9x zoom magnifier that is factory assembled with precision holder and reflective mirror.

ACCESSORIES

Part Number	Description
011773-001	Short Range Aperture Kit
012673-001	System Test Films (set of 5 films)
103922-001	Model 475 HART handheld communicator
009246-003	High Range Gas Test Cell
012354-001	3/4" NPT Stopping plugs
012351-001	M25 Stopping plugs
012353-001	M25/M20 Reducer
012312-001	Transmitter Brow
012300-001	Receiver Brow
012718-003	Flat Surface Mounting Plate
012790-001	Thermal Shield, Right
012791-001	Thermal Shield, Left

SPARE PARTS

Part Number	Description
102740-002	Calibration Magnet
104346-154	O-Ring, 3.75" i.d., for wiring compartment cover
104346-046	O-Ring, 4.25", for front flange, Transmitter
400525-023	M8 Flange Bolt
012660-001	Spare Mounting and Alignment Bracket (for one LS2000 module only)
006680-001	Silicone Grease Kit

MODEL	DESCF	RIPTION										
LS2000	Line-of-	-Sight In	Sight Infrared Gas Detector									
	TYPE	MATEF	IAL									
	S	Stainles	ss Steel	Steel								
		TYPE	COND	UIT ENTRY THREAD TYPE								
		N	3/4" NF	PT, 4 Port Receiver, 2 Port Transmitter								
		м	Metric	M25, 4 Port Receiver, 2 Port Transmitter								
			TYPE	OUTPUT								
			00	None (Transmitter only)								
			18	4-20 mA, RS485, HART (Receiver or Kit)								
			25	4-20 mA, RS485, HART w/Optional Relays (Receiver or Kit) – Ex d only								
				TYPE	PE RANGE							
				N	None (Fransmi	tter only					
				S Short Range, 5-60 Meter				ters (R	eceiver or Kit)			
				L Long Range, 30-120 Meters (Receiver or Kit)					(Receiver or Kit)			
					TYPE FACTORY SET TARGET GAS*							
					Ν	N None (Transmitter only)			nly)			
					M Methane (Receiver or Kit)							
					P Propane (Receiver or Kit)							
					B Butane (Receiver or Kit)							
						TYPE	TYPE APPROVALS [†]					
						S						
						A FM/CSA						
						E	E ATEX/IECEx					
						В	INMETRO (Brazil)					
							TYPE CLASSIFICATION					
							1 Division and/or Ex d e					
							2 Division and/or Ex d					
							TYPE CONFIGURATION					
					S	Transmitter/Receiver/Mounting Hardware						
								Т	Transmitter Only			
								R	Receiver Only			
						ТМ	Spare Transmitter Electronics Module					

*The LS2000 is factory calibrated to Methane, Propane, and Butane gas types. This selection indicates which gas type the device was configured to detect when it left the factory. This selection can be changed in the field via HART or Modbus.

RM

Spare Receiver Electronics Module

[†]Type Approvals can use one or more letters to designate the approvals of the product.

NOTE: "Kit" is a complete system, consisting of a transmitter, receiver, aperture, and mounting hardware.

APPENDIX A

FM APPROVAL DESCRIPTION

The following items, functions, and options describe the FM approval.

APPROVAL

Line-of-Sight Infrared Hydrocarbon Gas Detector, Model LS2000.

Receiver with or without Relays

Class I, Div. 1, Groups B, C & D (T4). Class I, Div. 2, Groups A, B, C & D (T4). Class II/III, Div. 1 & 2, Groups E, F & G (T4). Tamb = -50° C to $+65^{\circ}$ C. Class I, Zone 1, AEx db IIC T4 IP66/67. Tamb = -50° C to $+65^{\circ}$ C. Type 4X, IP66/67.

Receiver without Relays

Class I, Div. 1, Groups B, C & D (T4). Class I, Div. 2, Groups A, B, C & D (T3C). Class II/III, Div. 1, Groups E, F & G (T4). Class II/III, Div. 2, Groups E, F & G (T3C). Tamb = -50° C to $+75^{\circ}$ C. Class I, Zone 1, AEx db eb IIC T4 IP66/67. Tamb = -50° C to $+75^{\circ}$ C. Type 4X, IP66/67.

Transmitter

Class I, Div. 1, Groups B, C & D (T4). Class I, Div. 2, Groups A, B, C & D (T3C). Class II/III, Div. 1, Groups E, F & G (T4). Class II/III, Div. 2, Groups E, F & G (T3C). Tamb = -50° C to $+75^{\circ}$ C. Class I, Zone 1, AEx db IIC T4 IP66/67. Class I, Zone 1, AEx db eb IIC T4 IP66/67. Tamb = -50° C to $+75^{\circ}$ C. Type 4X, IP66/67.

Conduit seal required within 18 inches (450mm) of the enclosure.

Performance verified in accordance with FM 6325, ANSI/ISA 12.13.04 for Methane, Propane & Butane.

LS2000 hazardous location and performance testing was successfully completed down to -55° C. However, the FM approved rating is limited to -50° C as there are no conduit fittings, cables, or cable glands that are presently listed for use below -50° C in the US. FM approvals policy does not allow product temperature ratings to exceed required installation components (such as conduit seals). The user must ensure that conduit fittings, cables, cable glands, etc. are rated for the expected minimum ambient temperature of the installation.

ACCURACY

±5% of full scale gas concentration or ±10% of applied gas concentration, whichever is greater.

NOTE

In order to remain within $\pm 5\%$ of full scale gas concentration or $\pm 10\%$ of applied gas concentration, the maximum misalignment is ± 0.8 degrees.

T90: 2 seconds (5.0 LFL-meters applied).

NOTES

Approval of the LS2000 does not include or imply approval of the apparatus to which the detector may be connected and which processes the electronic signal for eventual end use. In order to maintain an approved system, the apparatus to which the detector is connected must also be approved.

This Approval does not include or imply Approval of the communications protocol or functions provided by the software of this instrument or the communications apparatus or software connected to this instrument.

The LS2000 may be used with FM Approved PointWatch Termination Box Model PIRTB Series.

Accessories with the following part numbers are approved for use with the LS2000:

011773-001	Short Range Aperture Kit
012287-XXX	LS2000 Alignment Tool
009246-003	High Range Gas Test Cell
012673-001	System Test Film
012312-001	Transmitter Brow
012300-001	Receiver Brow
012660-001	Mounting Bracket
103922-001	HART Handheld Communicator
011824-001	Modbus Program
102740-002	Calibration Magnet

FM Standards:

Class 3600	2011
Class 3611	2004
Class 3615	2006
Class 3616	2011
Class 3810	2005
Class 6325	2005
ANSI/ISA 12.13.04	2007
ANSI/NEMA 250	2008
ANSI/IEC 60529	2004

APPENDIX B

CSA CERTIFICATION DESCRIPTION

The following items, functions, and options describe the CSA certification.

APPROVAL

Line-of-Sight Infrared Hydrocarbon Gas Detector, Model LS2000.

Receiver with Relays

Class I, Div. 1, Groups B, C & D (T4). Tamb = -55° C to $+75^{\circ}$ C. Class I, Div. 2, Groups A, B, C & D (T4). Class II/III, Div. 1 & 2, Groups E, F & G (T4). Tamb = -55° C to $+65^{\circ}$ C. Class I, Zone 1, Ex db IIC T4 IEC 60079-29-4 IP66/67. Tamb = -55° C to $+75^{\circ}$ C. Type 4X, IP66/67.

Receiver without Relays

Class I, Div. 1, Groups B, C & D (T4). Class I, Div. 2, Groups A, B, C & D (T3C). Class II/III, Div. 1, Groups E, F & G (T4). Class II/III, Div. 2, Groups E, F & G (T3C). Tamb = -55° C to $+75^{\circ}$ C. Class I, Zone 1, Ex db B IIC T4 IEC 60079-29-4 IP66/67. Tamb = -55° C to $+75^{\circ}$ C. Class I, Zone 1, Ex db IIC T4 IEC 60079-29-4 IP66/67. Tamb = -55° C to $+75^{\circ}$ C. Type 4X, IP66/67.

Transmitter

Class I, Div. 1, Groups B, C & D (T4). Class I, Div. 2, Groups A, B, C & D (T3C). Class II/III, Div. 1, Groups E, F & G (T4). Class II/III, Div. 2, Groups E, F & G (T3C). Tamb = -55° C to $+75^{\circ}$ C. Class I, Zone 1, Ex db IIC T4 IEC 60079-29-4 IP66/67. Tamb = -55° C to $+75^{\circ}$ C. Class I, Zone 1, Ex db eb IIC T4 IEC 60079-29-4 IP66/67. Tamb = -50° C to $+75^{\circ}$ C. Type 4X, IP66/67.

Conduit seal required within 18 inches (450mm) of the enclosure.

ACCURACY

±5% of full scale gas concentration or ±10% of applied gas concentration, whichever is greater.

NOTE

In order to remain within $\pm 5\%$ of full scale gas concentration or $\pm 10\%$ of applied gas concentration, the maximum misalignment is ± 0.8 degrees.

RESPONSE TIME

T90: 2 seconds (5.0 LFL-meters applied).

NOTES

Approval of the LS2000 does not include or imply approval of the apparatus to which the detector may be connected and which processes the electronic signal for eventual end use. In order to maintain an approved system, the apparatus to which the detector is connected must also be approved.

This Approval does not include or imply Approval of the communications protocol or functions provided by the software of this instrument or the communications apparatus or software connected to this instrument.

The LS2000 may be used with CSA Certified PointWatch Termination Box Model PIRTB Series.

Accessories with the following part numbers are approved for use with the LS2000:

011773-001 Short Range Aperture Kit 012287-XXX LS2000 Alignment Tool 009246-003 High Range Gas Test Cell 012673-001 System Test Film 012312-001 Transmitter Brow 012300-001 Receiver Brow 012660-001 Mounting Bracket 103922-001 HART Handheld Communicator Modbus Program 011824-001 102740-002 Calibration Magnet

CSA Standards:

C22.2 No. 0-10 (R2015) C22.2 No. 25-1966 (R2014) C22.2 No. 30M1986 (R2012) C22.2 No. 94-M91 (R2011) C22.2 No. 142-M1987 (R2014) C22.2 No. 213-M1987 (R2013) C22.2 No. E60079-0: 2007 C22.2 No. E60079-1: 2011 C22.2 No. E60079-7: 2012 C22.2 No. 60529 (R2015)

APPENDIX C

ATEX APPROVAL DESCRIPTION

The following items, functions, and options describe the ATEX approval.

APPROVAL

Line-of-Sight Infrared Hydrocarbon Gas Detector, Model LS2000.

Receiver

Transmitter

€ € 0539 ⓑ II 2 G DEMKO 15 ATEX 1386X Ex db eb IIC T4 EN 60079-29-4 IP66/67 T4 (Tamb −50°C to +75°C) --OR--Ex db IIC T4 EN 60079-29-4 IP66/67 T4 (Tamb −55°C to +75°C)

Performance verified with Methane, Butane and Propane in accordance with EN 60079-29-4.

ATEX Special Conditions for Safe Use (general):

- The Model LS2000 shall be installed in places where there is low risk of mechanical damage.
- The field wiring terminal connections are certified for a single wire in size from 0.2–2.5 mm², (or two conductors with same cross section 0.2 to 0.75 mm²). The screws must be tightened down with a torque of 0.4–0.5 Nm.
- The metal housings of the Model LS2000 Gas Detector must be electrically connected to earth ground.
- The Model LS2000 has an ambient temperature rating of -55°C to +75°C.
- Only suitable certified Ex d or Ex e (as applicable) cable entries, adapters, and blanking elements are to be used, including 1/2 inch NPT, 3/4 inch NPT, M20 and M25 sizes, with IP66/67 rating.
- Flameproof joints are not user serviceable; contact Det-Tronics Service.
- Seven special fasteners are provided for the Transmitter electronics module, M8 bolts per ISO 965 with M6 head, SST with a yield strength of 483 N/mm² (70,000 PSI). The tightening torque in an opposing order is 19 Nm (169 inch-pounds) per flange bolt.

WARNING

Always ensure that the detector/junction box hazardous (classified) location ratings are applicable for the intended use.

MARNING

Potential electrostatic charging hazard on brow. Use caution when servicing in an explosive environment.

Additional Safety Notes:

 For ambient temperatures below –10°C, use field wiring suitable for the expected conditions, and for ambient temperatures above +60°C, use field wiring and cable glands suitable for 15°C above the maximum expected conditions.

ATEX Standards:

EN 60079-29-4: 2010 Performance Approved for Methane, Butane, and Propane. EN 60079-0: 2012 +A11:2013 EN 60079-1: 2014 EN 60079-7 2007 EN 60079-28:2007 EN 60529 1991+A1 2000 EN 50270: 2006 EN 50271: 2010

CE: Conforms to: Low Voltage Directive: 2006/95/EC, EMC Directive: 2004/108/EC. ATEX Directive: 94/9/EC. WEEE 2002/96/EC.

ACCURACY (PER EN 60079-29-4)

 $\pm 5\%$ of full scale gas concentration or $\pm 10\%$ of applied gas concentration, whichever is greater.

RESPONSE TIME

2 seconds (2.5 LFL-meters applied). T90

ALIGNMENT

011773-001

Misalignment will cause the manufacturer stated accuracy limits to increase, but remain within the limits of FN 60079-29-4

Accessories with the following part numbers are approved for use with the LS2000:

Short Range Aperture Kit 012287-XXX LS2000 Alignment Tool 009246-002 Gas Test Cell 012673-001 System Test Film 012312-001 Transmitter Brow Receiver Brow 012300-001 012660-001 Mounting Bracket HART Handheld Communicator 103922-001 011824-001 Modbus Program 102740-002 Calibration Magnet

NOTES

Approval of the LS2000 does not include or imply approval of the apparatus to which the detector may be connected and which processes the electronic signal for eventual end use. In order to maintain an approved system, the apparatus to which the detector is connected must also be approved.

This Approval does not include or imply Approval of the communications protocol or functions provided by the software of this instrument or the communications apparatus or software connected to this instrument.

APPENDIX D

IECEX APPROVAL DESCRIPTION

The following items, functions, and options describe the IECEx approval.

APPROVAL

Line-of-Sight Infrared Hydrocarbon Gas Detector, Model LS2000.

Receiver

IECEx ULD 05.0001X Ex db eb IIC T4 IEC 60079-29-4 IP66/67 T4 (Tamb –50°C to +75°C) (Receiver without relays) --OR--Ex db IIC T4 IEC 60079-29-4 IP66/67 T4 (Tamb –55°C to +75°C) (Receiver with or without relays)

Transmitter

IECEx ULD 05.0001X Ex db eb IIC T4 IEC 60079-29-4 IP66/67 T4 (Tamb -50°C to +75°C) --OR--Ex db IIC T4 IEC 60079-29-4 IP66/67 T4 (Tamb -55°C to +75°C)

Performance verified with Methane, Butane, and Propane in accordance with IEC 60079-29-4.

IEC Standards:

IEC 60079-0: 2011 IEC 60079-1: 2014 IEC 60079-7: 2007 IEC 60079-28:2006 IEC 60529, 2.1 ed.+Corr.1:2003+2:2007 IEC 61000-4-1:2006 IEC 61000-4-3:2010 IEC 61000-4-4:2012 IEC 60079-29-4:2010 Performance Approved for Methane, Butane, and Propane

IEC Conditions of Certification (general):

- Only suitable certified Ex d or Ex e (as applicable) cable entries, adapters, and blanking elements are to be used, including 1/2 inch NPT, 3/4 inch NPT, M20 and M25 sizes, with IP66/67 rating.
- The Model LS2000 assemblies are to be installed in places where there is a low risk of mechanical damage.
- The field wiring terminal connections are certified for a single wire in size from 0.2 to 2.5 mm2, (or two conductors with same cross section 0.2 to 0.75 mm2). The screws must be tightened down with a torque 0.4 to 0.5 Nm.
- The metal housings of the Model LS2000 Gas Detector must be electrically connected to earth ground.
- Flameproof joints are not user serviceable; contact Det-Tronics Service.
- Seven special fasteners are provided for the Transmitter electronics module, M8 bolts per ISO 965 with M6 head, SST with a yield strength of 483 N/mm2 (70,000 PSI). The tightening torque in an opposing order is 19 Nm (169 inch-pounds) per flange bolt.
- The following additional previous editions of Standards noted under the "Standards" section of the Certificate where applied to integral Components as itemized below. There are no significant safety related changes between these previous editions and the editions noted under the "Standards" section.

Phoenix Contact Terminal Block Model Front 2.5

IEC 60079-7:2001, IEC 60079-0:2004

WARNING

Always ensure that the detector/junction box hazardous (classified) location ratings are applicable for the intended use.

WARNING

Potential electrostatic charging hazard on brow. Use caution when servicing in an explosive environment.

Additional Safety Notes:

• For ambient temperatures below -10°C, use field wiring suitable for the expected conditions, and for ambient temperatures above +60°C, use field wiring and cable glands suitable for 15°C above the maximum expected conditions.

ACCURACY (per IEC 60079-29-4)

±5% of full scale gas concentration or ±10% of applied gas concentration, whichever is greater.

RESPONSE TIME

T90: 2 seconds (2.5 LFL-meters applied).

ALIGNMENT

Misalignment will cause the manufacturer stated accuracy limits to increase, but remain within the limits of IEC 60079-29-4.

Accessories with the following part numbers are approved for use with the LS2000:

- 011773-001 Short Range Aperture Kit 012287-XXX LS2000 Alignment Tool 009246-002 Gas Test Cell 012673-001 System Test Film 012312-001 Transmitter Brow 012300-001 Receiver Brow 012660-001 Mounting Bracket 103922-001 HART Handheld Communicator 011824-001 Modbus Program
- 102740-002 Calibration Magnet

NOTES

Approval of the LS2000 does not include or imply approval of the apparatus to which the detector may be connected and which processes the electronic signal for eventual end use. In order to maintain an approved system, the apparatus to which the detector is connected must also be approved.

This Approval does not include or imply Approval of the communications protocol or functions provided by the software of this instrument or the communications apparatus or software connected to this instrument.

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APPENDIX E

OTHER APPROVALS

The following items, functions, and options describe various other approvals applicable to the LS2000.

SIL APPROVAL



IEC 61508: 2010 Parts 1-7 Certified SIL 2 Capable.

Refer to the Safety Reference Manual (form number 95-8727) for details.

INMETRO

UL-BR 15.0742X Ex db eb IIC T4 Ex db IIC T4 IP66/67 $-50^{\circ}C \le Tamb \le +75^{\circ}C$ (for Ex db eb version) $-55^{\circ}C \le Tamb \le +75^{\circ}C$ (for Ex db version)

APPENDIX F

HART COMMUNICATION

Digital communication with the LS2000 is necessary to monitor internal status and to modify the factory settings. This appendix provides guidance on establishing HART communication, and describes the communication menu structure when using the LS2000 with the HART Handheld Communicator.

INTERCONNECTING THE HART COMMUNICATOR WITH THE LS2000

Connect the HART Communicator to the LS2000. Press the "on" key to switch on the HART Communicator. The Online menu is the first menu to appear when the Communicator is properly connected to the LS2000. This menu is structured to provide important information about the connected device immediately on powering up the Communicator. This menu displays up-to-date device information including primary variable, analog output, lower range value, and upper range value.

NOTE

The HART protocol incorporates a concept called the "Device Description Language" that enables all suppliers of HART instruments to define and document their products in a single consistent format. This format is readable by handheld communicators, PC's and other process interface devices that support DDL. DDL enables full interoperability of devices, regardless of manufacturer, allowing full functionality from any HART device.

In the event that your Communicator does not establish communications with the LS2000, you may need to ensure that the appropriate DDL's for the LS2000 are included within your Communicator. To review the device descriptions programmed into your HART Communicator:

- 1. From the Main menu, press to access Offline menu.
- 2. From the Offline menu, press New Configurations to access the list of device descriptions programmed into your HART Communicator. The Manufacturer menu displays a list of each manufacturer with device descriptions currently installed in your Communicator's Memory Module. The standard 12 MB Memory Module is recommended, as it allows for more device descriptions.
- 3. Select a manufacturer, and the Model menu displays, containing a list of currently installed device models provided by the selected manufacturer.
- 4. Review the different manufacturers and models to determine the installed HART-compatible devices in your Communicator.

If you cannot find the LS2000 device on your Communicator, the device revision you are looking for is not programmed into the Memory Module. In this instance, you are limited to what is available using the generic interface built into your HART Communicator.

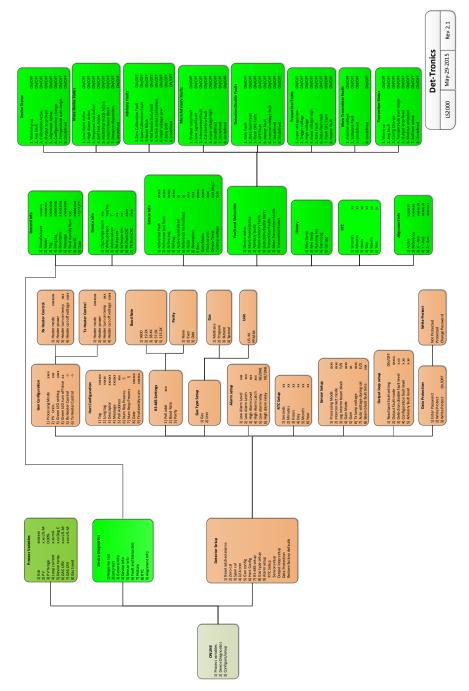
The HART Communication Foundation (www.ccsi.com/hart) manages a library of Manufacturer Device Descriptions, which are distributed to programming sites for inclusion in master devices. A complete listing of the HCF DD Library is available for download in manufacturer and device type sequence.

NOTE

If a device is found, the HART Communicator displays the Online menu. If no device is found, the Communicator displays the Main menu. If no device is found, check the connections, verify the presence of a minimum of 250 ohms load resistance in series in the loop, and retry by selecting 'Online'. To poll multiple devices in the loop, refer to the HART Communicator manual.

LS2000 HART MENU STRUCTURE

This section displays the menu trees for the LS2000. The Menu tree shows the primary commands and options available when using menu selections.







FlexSonic[®] Acoustic Leak Detector



X3301 Multispectrum IR Flame Detector

PointWatch Eclipse[®] IR Combustible Gas Detector



FlexVu[®] Universal Display with GT3000 Toxic Gas Detector



Eagle Quantum Premier® Safety System

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Det-Tronics manufacturing system is certified to ISO 9001 the world's most recognized quality management standard.



CONNECTIONS AND HARDWARE

The HART Communicator can interface with the LS2000 from the control room or from any wiring termination point in the analog output signal loop. To communicate, connect the HART communicator in parallel with the LS2000 analog signal or load resistor. The connections are non-polarized. Refer to the "Wiring Procedure" section for installation instructions.

NOTE

The HART Communicator needs a minimum of 250 ohms resistance in the loop to function properly. The HART Communicator does not measure loop current directly.

ONLINE MENU

When HART communication is established with the receiver, the first menu displayed is the LS2000 Online menu:

Online

- 1) Process Variables
- 2) Device Diagnostics
- 3) Configure/Setup

To select any of the menu options shown, highlight the desired option using the up/down arrow key, and then press the "right arrow" key.

COMMONLY USED HART COMMANDS

The most commonly used HART commands for the LS2000 are:

- 1. Setting the real time clock
- 2. Setting alarm thresholds & latch/nonlatch functions
- 3. Setting the analog fault code menu
- 4. Performing full system alignment
- 5. Performing zero calibration
- 6. Assigning a nonvolatile tag name to the receiver
- 7. Defining a nonvolatile descriptor for future reference
- 8. Interrogating the history menu for information including total running hours, max/min temperature, calibration and event logs.