

**Rent an all-in-one  
digital toxic gas detection solution  
to enhance health, safety, and  
environmental performance**

**Digital Gas  
Monitoring  
Ecosystem**

**#GoDigitalSafety**



**SHEPHERD**  
SAFETY SYSTEMS

# The Shepherd Digital Gas Monitoring Ecosystem™ is an all-in-one digital toxic gas detection solution that enhances health, safety, and environmental performance.

## Digital Gas Monitoring Ecosystem

#GoDigitalSafety

### StaySafer Toxic Gas Sensors

The system integrates multigas sensors, wearable personal monitors, and a field communications and command platform that allows onsite and offsite personnel to monitor crew safety and emissions from any location. As an original equipment manufacturer (OEM), services, and rental equipment provider, Shepherd is uniquely positioned to help asset owners establish an asset-to-enterprise, 24x7 toxic gas detection, monitoring, and response system.

Oil and gas drilling, completion, production, and midstream operations are renting Digital Gas Monitoring Ecosystem equipment to reduce significant injuries and fatalities and to cut greenhouse gas emissions. The Shepherd team supports customer operations with system design and implementation, 24x7 oversight, rapid response, and preventive maintenance and calibration services.

### BeSafer Wearable Personal Monitors

Shepherd maintains an inventory of rental equipment that can be quickly mobilized to detect CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S, LEL, CO, SO<sub>2</sub>, and O<sub>2</sub>. On request, sensor packages for ClO<sub>2</sub>, HCl, HCN, NO, NO<sub>2</sub>, O<sub>3</sub>, and PH may be integrated into the Shepherd Digital Gas Monitoring Ecosystem.

### DigitalSafety Hubs

Asset owners who partner with Shepherd to improve safety and reduce greenhouse gas emissions have documented less downtime from false alarms, faster response to incidents, and better ESG scores.

*Shepherd's sensors and communications equipment are made in America and are so affordable that named point sensors can be reliably deployed to minimize risk and pinpoint leaks at upstream, midstream, and downstream locations.*

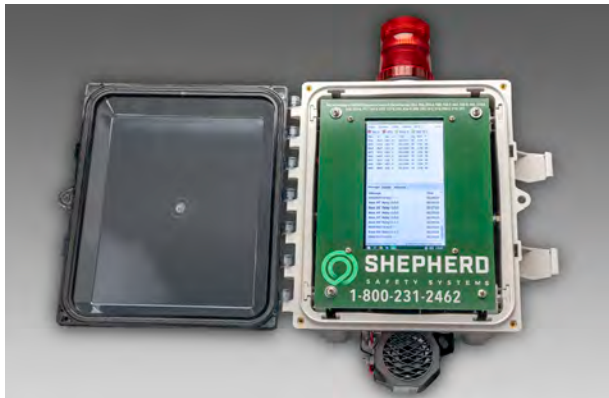


# Unique asset-to-enterprise technology links remote field and office locations to keep workers safe and minimize greenhouse gas emissions.



StaySafer™ Toxic Gas Sensors combine nondispersive infrared and electrochemical technologies to detect up to five gases. Each sensor can be named with a specific location—compressor, doghouse, H<sub>2</sub>S scavenger, separator, shale shaker, VRU, wellhead, etc.—to ensure personnel immediately understand where emissions occur.

The BeSafer™ Wearable Personal Monitor empowers field crews to quickly respond to prevent toxic gas incidents, injuries, and fatalities while ensuring regulatory compliance. These hassle-free monitors feature two-way connectivity, multigas detection, GPS location, employee-down alerts, and check-in/out-of-location logging.



DigitalSafety™ Hubs receive and send data and commands via satellite, cellular LTE, Wi-Fi, or Ethernet between monitored field locations and Shepherd or client remote operations centers. Wireless alarms, powered by solar panels, are controlled by the hubs, and the alarms can be positioned anywhere on location. Alerts are sent via text, email, mobile app, and client portal. Incident notifications include named sensor identification, contact numbers, and GPS coordinates.



BeSafer  
  
StaySafer

## Products

- Fixed gas controllers
- Fixed multigas sensors
- Multigas personal monitors
- Alarm stands
- Signs, flags, SCBAs, laptops
- Cascade trailers (air trailers)

## Services

- 24x7 overwatch
- Rig up/rig down
- Code red rapid response
- Proactive threshold alerts and alarms
- Maintenance and calibration
- Training

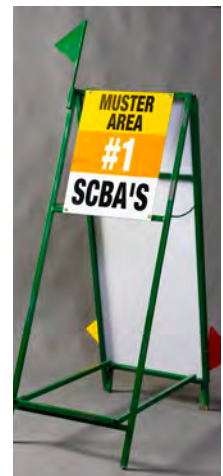


## Digital Gas Monitoring Ecosystem

### Typical Equipment Scenarios

	Sensors	Hubs	Alarm stands	SCBAs
Drilling	5-8	1	1-2	4
Completion	8-12	1	2	2-4
Production	◆	1	◆◆	◆◆
Midstream	◆	1	◆◆	◆◆
Downstream EC	◆	1	◆◆	◆◆

- ◆ Perimeter sensors are recommended with named point sensors for pneumatic controllers, tanks, separators, compressors, pumps, VRUs, scrubbers, etc.
- ◆◆ The number of alarm stands and respiratory equipment varies with size of installation.



The Digital Gas Monitoring Ecosystem solution is being used by 35 operators and asset owners across the oil and gas value chain. This scalable, asset-to-enterprise solution, establishes a single chain of accountability for HSE performance improvement.

Know Gas  No Gas

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# BeSafer™ Wearable Personal Monitor



The BeSafer™ Wearable Personal Monitor empowers field crews to quickly respond to prevent toxic gas incidents, injuries, and fatalities while ensuring regulatory compliance. Incorporating a high-technology personal monitor into the Shepherd Digital Gas Monitoring Ecosystem™ solution reduces risk and lowers the total cost of operations.



## Advanced features

- Individual identification with GPS coordinate tracking
- Check employees in and out of location
- Employee down notification
- Single- or multigas detection
- Full integration with Shepherd communications hub, controller, and alarm stands

## Standard safety features

- Emergency/panic alarm with push-button
- Low battery with configurable threshold
- Configurable timer for worker check-in, 5–180 min, or off
- Home-base geofence
- Gas alarm features
  - Time-weighted average (TWA)
  - Short-term exposure limit (STEL)
  - High and low gas alerts
  - Bump test and calibration notification and failure alert

## Power/battery

- Rechargeable Li-ion battery, 2,000 mAh
- Battery life 8 days, 192 hr @ 70°F under normal usage
- Charge time 8 hr, max 10 hr
- Charging status monitoring

## Hardware features

- ARM Cortex-M3 microcontroller with up to 512-kb flash, 80-kb RAM
- Logging data written to flash memory chip in a circular fashion; new data replaces oldest
- Entries time stamped with UTC time at the time they are written
- Logs may be read by the host over the radio link
- 60 days of data in typical use
- Events of interest written as they occur
  - Status messages for start/end of warning, start/end of alarm, bump test
  - Calibration
- Adequate storage for 6 months assuming 1 alarm/day, 1 bump test/day, 1 calibration/week
- Communicates to servers through base station and Shepherd DigitalSafety™ Hub controller
- Wireless radio
  - Zigbee radio, 2.5 GHz
  - TX power +18 dBm
  - RX sensitivity -101 dBm
  - Mesh capable
  - Internal antenna
  - Radio link range 598.4 yd [547.1 m] line of sight if not using mesh capability

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# BeSafer™ Wearable Personal Monitor

## Location technology

GPS radio	72-channel high sensitivity
GPS accuracy	16 ft [-5 m] outdoors
Location update frequency	Configurable
Default	60 sec

## User notification

Personal alarm indicators	Speaker, LEDs, and vibration motor
Sound pressure level	~90 dB @ 3.94 in. [-90 dB @ 10 cm]

## User interface

Display	Dot matrix liquid crystal with front lighting, menu system
Operation	2-button keypad for power on/off, check-in, emergency/panic

## Wireless updates

Device config. changes	Yes
Device firmware upgrade	Over-the-air (FOTA)

## Shepherd portal application

Safety monitoring application, highly customizable for specific customer requirements

Includes live map, alert management, device configurations, alert setups, and reporting

## Environmental

Storage temperature	-22°F to 140°F [-30°C to 60°C]
Operating temperature	-4°F to 122°F [-20°C to 50°C]
Charging temperature	32°F to 113°F [0°C to 45°C]
Ingress protection	IP67

## Gas sensor options

### H<sub>2</sub>S (hydrogen sulfide)

Sensor type	Electrochemical
Range	0-100 ppm
Resolution	1 ppm

### LEL combustible

Sensor type	NDIR
Range	0-100% LEL
Resolution	1% LEL

### COSH (hydrogen sulfide, carbon monoxide)

Sensor type	Electrochemical
Range H <sub>2</sub> S	0-100 ppm
Resolution H <sub>2</sub> S	0.2 ppm
Range CO	0-400 ppm
Resolution CO	1 ppm

### SO<sub>2</sub> (sulfur dioxide)

Sensor type	Electrochemical
Range	0-100 ppm
Resolution	0.1 ppm

### O<sub>2</sub> (oxygen, lead free)

Sensor type	Long-life pump, electrochemical
Range	0-25% vol
Resolution	0.1% vol

## Certifications

IEC 60079-0 60079-11  
Class I, Division 1



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# StaySafer™ Toxic Gas Sensors



StaySafer™ Toxic Gas Sensors detect multiple gases and vapors, including CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S, LEL, CO, SO<sub>2</sub>, and O<sub>2</sub>. These rugged, all-in-one sensors are easy to deploy, set up, and name to indicate specific locations in the field (compressor, doghouse, separator, shale shaker, tank, VRU, etc.). Each multifunction sensor sends calibration status, battery levels, and gas concentrations to the Shepherd communications hub and receives firmware updates and alarm signals. The corrosion-resistant housing and sensors are rated Class I, Division 1. The unit features an intuitive LCD screen for field crew status updates. As key components of the Shepherd Digital Gas Monitoring Ecosystem, StaySafer sensors reduce risk, lower the total cost of operations, and help cut greenhouse gas emissions.

## Detection

Electrochemical and microchip-based nondispersive infrared (NDIR) optical gas sensors are incorporated in StaySafer sensors for single- or multigas sensing. For some toxic gases with low concentrations, electrochemical detection measures the concentration of a target gas by oxidizing or reducing the target gas at an electrode and measuring the resulting current. For other gases, proprietary Shepherd NDIR technology uses an infrared light emitter and an infrared sensor to accurately detect gas type and concentration with uniquely low power consumption, under 3 mW. StaySafer sensors are proven to deliver high reliability, accuracy,

and fast reaction to growing gas concentrations.

Standard sensor units detect CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S, LEL, CO, SO<sub>2</sub>, and O<sub>2</sub>. On request, sensor packages for ClO<sub>2</sub>, HCl, HCN, NO, NO<sub>2</sub>, O<sub>3</sub>, and PH may be integrated into the Shepherd Digital Gas Monitoring EcoSystem™ sensors.



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## Specifications

### Sensors

Gas	Detector*	Range	Resolution	Power dissipation
CH <sub>4</sub>	NDIR	50–50,000 ppm	50 ppm	10 mW
H <sub>2</sub> S	EC	0–100 ppm	0.2–1 ppm	5 mW
LEL	NDIR	0–100%	1% LEL	10 mW
CO	EC	0–400 ppm	1 ppm	10 mW
SO <sub>2</sub>	EC	0–100 ppm	0.1 ppm	10 mW
O <sub>2</sub>	EC	0–25% volume	0.1% volume	10 mW

\*NDIR = nondispersive infrared; EC = electrochemical

### Radio

- 2.4 to 2.5 GHz ISM
- Network protocol: Zigbee
- Radio transmit power: 63 mW
- Antenna: 4.3-dbi J-pole with approximate omnidirectional pattern
- Wireless range: Urban 300 ft, line of sight 2 miles
- Intrinsically safe FCC Part 15 IP66

### Battery

- Type: Lithium-ion rechargeable
- Capacity: 4,000 mAh at room temperature
- Maximum current: 200-mA fused

### Environmental

- Operating temperature: -4°F to 122°F [-20°C to 50°C]
- Operating relative humidity: 0 to 90% continuous, 95% intermittent
- Altitude restrictions: Sea level to 6,750 ft (2,060 m)







The DigitalSafety™ Hub is the communications and command platform for the Shepherd Digital Gas Monitoring Ecosystem™ solution. The hub receives and sends data and commands via satellite, cellular LTE, Wi-Fi, or Ethernet between the field location network of StaySafe™ and BeSafer™ sensors and remote operations centers. Wireless alarms, powered by a solar panel, are controlled by the hub and can be positioned anywhere on location. Onsite and offsite personnel can monitor field crew safety and emissions from any location.

## Specifications

- 24x7 connected monitoring and overwatch
- 12 in. x 10 in. x 6 in. Class I, Division 1 explosion-proof, fiberclass casing
- Satellite, cellular LTE, Wi-Fi, or Ethernet connectivity
- Iridium Q9603 modem
- Automated calibration
- Stand-alone alarms set to activate at different levels
- Touch screen operations
- Password-protected lock screen
- Active status message display
- Active sensor list with rotating gas and reading status
- Supports eight, 4-20 ma sensor reading outputs
- Customizable sensor allowed/block list
- GPIO General-Purpose Input-Output support
- 16-bit Modbus slave support
  - RTU, TCP, UDP, and ASCII protocols
  - RS-485, RS-232 protocols
  - IP Direct protocols
- Operating voltage: 12V DC, 110V AC
- Current consumption: 750 mA at 12V DC

- Wireless radio band: 2.4-GHz direct sequence spread spectrum ISM Band
  - Network protocol: Zigbee
  - Transmit power: 63 mW
  - Antenna: 9 dBi omnidirectional
  - Range: Urban 300 ft, line of sight 2 miles

## Configurable settings

- Duration
- Gas
- Message delay
- Relay type
- Siren delay
- Threshold
- Updated interval





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