Shur-Shot® X-Proof
Hydrogen Fluoride Alarm
Operations Manual

P/N 1000006053 Rev E

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Chapter 1
Getting Started

General Description

The SHUR-SHOT is a reliable, cost effective, specific detector of high concentrations of hydrogen fluoride (HF). It is suited for leak monitoring of flanges, pumps, seals, and other components at risk of releasing HF. Even pinhole sized leaks in an HF process stream, can produce localized concentrations in the 1000s of ppm range before being dispersed in the air. SHUR-SHOT rapidly detects localized leaks that may not be detected by other HF detectors located several feet away. Because the SHUR-SHOT is a high concentration detector, these leaks are easily differentiated from low ppm ambient levels of HF. The sensor assembly is a one-shot disposable item that must be replaced after exposure.

Because low ppm ambient levels of HF affect SHUR-SHOT signal output over long periods of time, periodic replacement of the sensor assembly is required.

The electrical components are housed in an explosion proof enclosure, with NEMA 4 rating, with the following approvals: UL, CSA, and FM for Class 1, Groups, B, C, and D, Class II, Groups E, F, and G, Class III hazardous locations.

Principle of Operation

Detection is based on the very specific reaction of HF with a glass-like coating on a sensor chip in the sensor assembly. This coating, in the form of a blue surface on a shiny substrate, is etched away during the reaction with HF. The surface of the chip is continuously illuminated by light from a red LED through an optical fiber. The reflected light is collected by another optical fiber and transmitted back to a photosensor, where it is converted to an analog 4-20 mA signal.

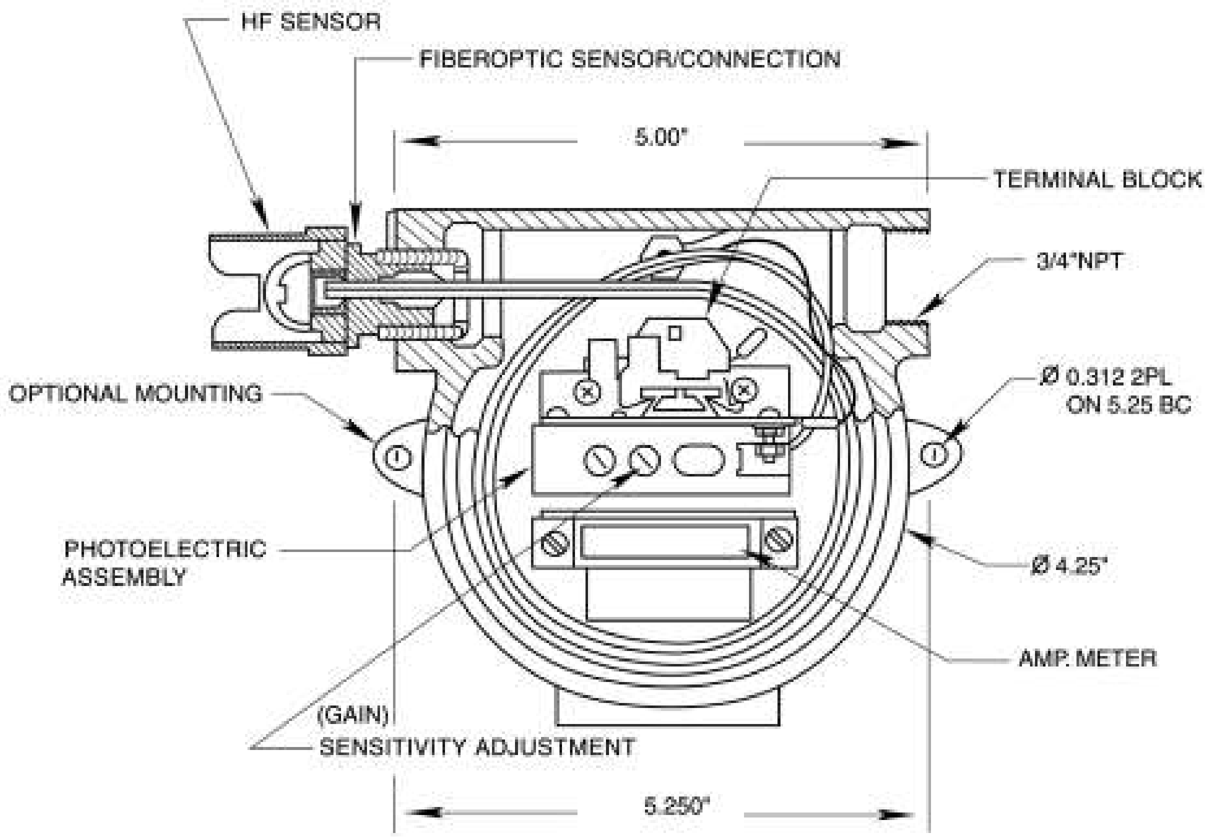
As the HF reacts with and removes the coating, the amount of reflected light increases until all of the coating is gone, causing the signal to reach a maximum value. This increase of light intensity, monitored in the form of a current level change, provides a positive indication of detection.

If the sensor assembly is removed or damaged, or if the optical path is interrupted for any reason, the output signal will decrease to a minimum value, indicating a failure or fault condition.

A porous Teflon® membrane protects the sensor from environmental effects such as rain, dust, and sunlight.

Figure 1-1: Explosion Proof (X-Proof) SHUR-SHOT

System Components



Major Assemblies

Sensor Assembly

This is a disposable item consisting of the following parts:
- chemical sensor chip
- chip holder and environmental shield

Fiber Optic Sensor/Connector Assembly

This assembly consists of the following parts:
- fiber optic sensor/connector
- 1/2 or 3/4-inch NPT adapter

Photoelectric Sensor Assembly

This assembly consists of the following parts:

- photoelectric Sensor/4-20 mA transmitter
- 0-25 mA DC ammeter. **Not intended for use as a precision readout**.
- terminal block. Allows user electrical connections.
- 2-piece holder and mounting hardware
- calibration resistor (10 ohm, 1%, metal film)

Photoelectric Sensor Features

LED Indicators Not used.
Adjustments and Controls:
• sensitivity adjustment. A 4-turn adjuster, located beneath the red LED indicator.
• logic operating point adjustment below the sensitivity adjustment. **Not used.**
4-20 mA converter output. (See Appendix B for line length vs. resistance calculation).
Shur-Shot X-Proof Manual Page 2-1

Chapter 2
Installation

Safety Requirements of the Installation Area

SHUR-SHOT's active electrical components are housed in an explosion-proof enclosure, with NEMA 4 rating, and the following approvals: UL, CSA, and FM for Class 1, Groups, B, C, and D Class II, Groups E, F, and G Class III hazardous locations.

Installation Using Conduit and the 3/4-inch NPT Port

Seal the conduit within 18 inches (46 cm) of the instrument enclosure. For European applications, an ATEX-approved cable entry must be used.

Installation Using Mounting Feet

The enclosure may be installed using the mounting feet. See Figure 1-2, "System Components," on page 1-3.
The mounting feet have two .312-inch diameter holes located on a 5.25-inch bolt circle. The structure to which SHUR-SHOT is mounted must be strong and rigid enough to support the enclosure as well as the enclosed device and wiring.

Before installation, determine the safety requirements for the area where SHUR-SHOT will be installed and select an appropriate hub and compound.

Installing Wiring

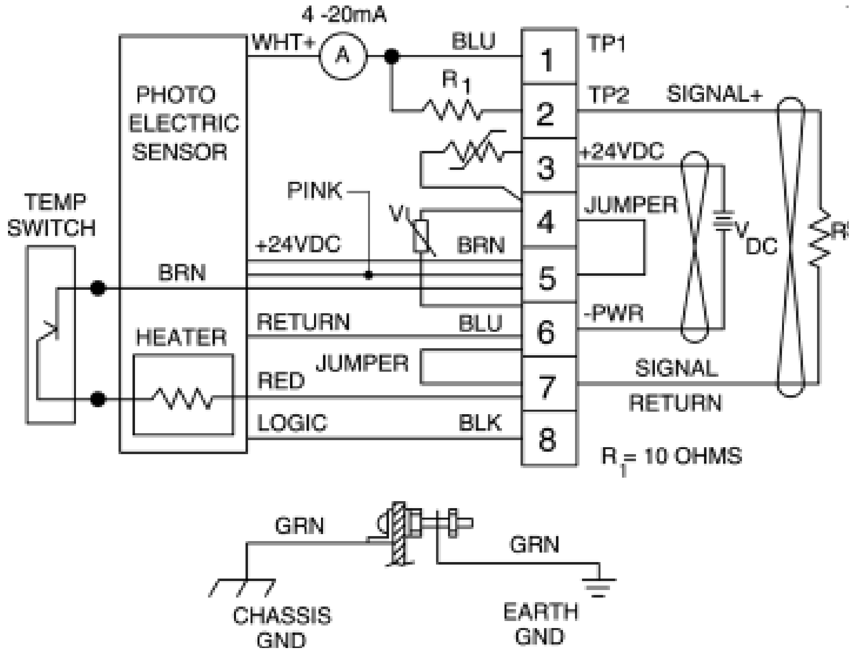


Figure 2-1: Wiring Diagram

To install 4-20 mA and power wiring

1. See Appendix B, "Signal Line Length vs. Resistance Calculations" and calculate the wire gauge that must be used.
2. Remove the SHUR-SHOT chassis cover by unscrewing it counterclockwise until it can be removed.
3. Locate the screw that holds the terminal block retainer on the rail.
4. Loosen the screw and remove the terminal block retainer.
5. Carefully pull the terminal block toward the end of the rail until terminal 7 can be accessed.
6. Feed the 4-20 mA wires through the NPT port and pull them through until the ends can be connected to the terminal block.
7. Connect wires to the terminals 7 and 2 as show in Figure 2-2, “Connecting Wire to the Terminal Strip,” on page 2-5.

8 Feed the power wires through the NPT port and pull them through until the ends can be connected to the terminal block at terminals 3 and 6.
9 Connect the power wires to the terminal block.
10 Replace the terminal block and the terminal block retainer.
11 Tighten the terminal block retainer screw.
12 Screw the chassis cover onto the chassis. **Hand tighten only**!

Installing the HF Sensor Assembly

The sensor assembly must be installed to make the SHUR-SHOT functional
.
NOTE: Install the HF Sensor Assembly only after the SHUR-SHOT chassis has been installed in the location it will be monitoring.

To install the Sensor Assembly:

1 Locate the Sensor Assembly.
2 Remove the shipping cap from the exposed end.
3 Install the sensor assembly on the stainless steel fiber optic sensor/connector assembly so that its plastic base is in contact with the stainless steel surface as shown in Figure 1-2, “System Components,” on page 1-3.

• To ensure safe performance, the user shall install, operate, and maintain SHUR-SHOT per National Electrical Code (NEC) Articles 500-504
.
• The user must comply with national regulations and may use EN60079-14 as an installation guide.

CAUTION:

Hand-tighten only. Stop tightening when the plastic base touches the stainless steel surface.

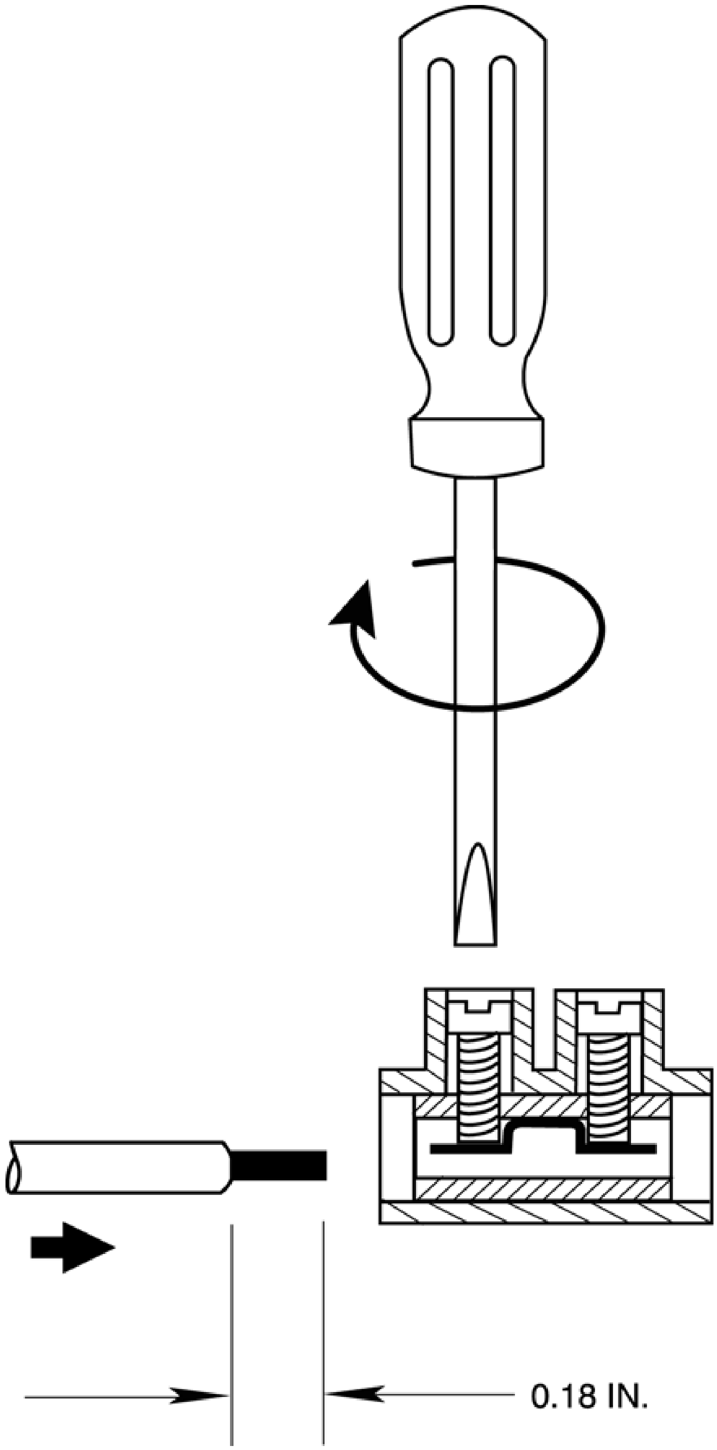


Figure 2-2: Connecting Wire to the Terminal Strip

Chapter 3
Set-up and Operation

Setting the Operating Point (New Sensors)

Required instrument: Precision voltmeter (0–200 mV scale 0.5% accuracy or better).

WARNING:

Ensure that the area is certified as non-hazardous or that adequate protective devices exist before turning power ON or removing the instrument cover. Verify that all electrical connections have been made and that the installation complies with all local, State, and Federal laws, regulations, and codes. Verify that the sensor assembly has been installed.

Required instrument: Precision voltmeter (0–200 mV scale 0.5% accuracy or better).

To set the operating point:

1. Turn on power.
2. Allow a one hour minimum warm-up time.
3. Verify that the 4-20 mA loop is closed.
4. Use the table below to verify that the ambient temperature is within the required range for instrument calibration.
5. Remove the instrument cover by turning it counter-clockwise.
6. Connect the voltmeter across the 10 Ohm calibration resistor on the terminal block. resistor R1 Figure 2-1 on page 2-2.

7 Adjust the gain (sensitivity) potentiometer located on the front of the photoelectric sensor, underneath the red and green LEDs, until the 4-20 mA output reading on the voltmeter is 8 mA ±0.2 mA (80 mV ±2 mV.

Check-out

Use the following steps to verify instrument output when the sensor has been removed or the optical link is interrupted.

Required tool: Precision voltmeter (0–200 mV scale ±0.5% accuracy or better) and orange/red Alarm Test Sensor Assembly (provided with ShurShot).

To verify the instrument's output:

1 Connect the precision voltmeter across the 10 ohm resistor and verify that output is 8 mA ±0.2 mA (80 mV ±2 mV).
2 Remove the sensor assembly from the SHUR-SHOT chassis by unscrewing it counterclockwise.
3 Observe the precision voltmeter's reading. It should be less than 4.5 mA, but >2.5 mA. This is the FAULT range reading expected when the sensor has been removed or if the fiber optic link is interrupted.
4 Install the Alarm Test Sensor Assembly and observe the precision voltmeter's reading. It must be greater than 14 mA.
5 Confirm that the AMP meter permanently connected to the far end of the sensor wiring produces the same reading.

NOTE: The Alarm Test Sensor Assembly is reusable. **Do Not Discard the Alarm Test Sensor Assembly** (orange/red color). Save it for future use.

6 Remove the Alarm Test Sensor Assembly.
7 Replace the sensor assembly.
8 Current output should return to the calibration reading, 8 mA ±0.2 mA (80 mV ±2 mV).

NOTE: Output of the unit may stabilize at less than 20 mA After exposure to HF/Alarm

Operation

The recommended alarm threshold point is 12 mA.
During normal operation, with no HF present, the SHUR-SHOT will continue to read 8 mA when set-up as described above. Slight fluctuations may be noted due to changes in temperature and humidity. In locations where there is high humidity and sudden temperature changes, the signal output may drift up to 9 mA.

The presence of HF is indicated by an increase in the 4-20 mA loop signal. A slow increase over several hours or days is an indication of relatively low concentrations of HF. A rapid signal increase is an indication of a high concentration of HF.

SHUR-SHOT output is expected to level off above 13 mA after a large HF exposure; further exposure to HF has no effect on the output.

After a large HF exposure, the sensor assembly must be replaced. The sensor assembly should also be replaced when low level HF concentrations produce a slow rise to above 10 mA. This will assure that a false alarm is not triggered by low level releases.

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Chapter 4
Maintenance and Spare Parts

Warning:

Keep the sensor assembly free of ice, oil, bird droppings, and other material that may impair normal diffusion of HF vapors into the sensor assembly.

Check-out

Use the following steps to verify instrument output when the sensor has been removed or the optical link is interrupted.

Required tool: Precision voltmeter (0–200 mV scale ±0.5% accuracy or better).

To verify the instrument's output:

1. Connect the precision voltmeter across the 10 ∧ resistor and verify that output is 8 mA ±0.2 mA (80 mV ±2 mV).
2. Remove the sensor assembly from the SHUR-SHOT chassis by unscrewing it counterclockwise.
3. Observe the precision voltmeter's reading. It should be less than 4.5 mA, but >2.5 mA. This is the *FAULT* range reading expected when the sensor has been removed or if the fiber optic link is interrupted.
4. Install the Alarm Test Sensor and observe the precision voltmeter's reading. It must be greater than 14 mA.

NOTE: The Alarm Test Sensor is reusable. **Do Not Discard the Alarm Test Sensor** (orange color). Save it for future use.

5. Remove the Alarm Test Sensor.
6. Replace the sensor assembly.
7. Current output should return to the calibration reading, 8 mA ±0.2 mA (80 mV ±2 mV).

NOTE: Output of the unit may stabilize at less than 20 mA.

Sensor Replacement

No special tools are needed.

To replace the sensor assembly:

1. Ensure that a replacement sensor assembly and O-ring are available.
2. Ensure that the area is safe to work in.
   See Figure 1-1, "Explosion Proof (X-Proof) SHUR-SHOT," on page 1-2 and Figure 1-2, "System Components," on page 1-3
3. Unscrew the sensor assembly.
4. Visually inspect the O-ring seal. Replace it if is cracked or deformed.
5. Screw the sensor assembly onto the fiber optic sensor/connector assembly so that its plastic base is in contact with the fiber optic sensor/connector assembly's stainless steel surface. **Hand Tighten Only**. **Do Not Over-tighten**.

Spare Parts

Part or Assembly Part Number

X PROOF 82425400-40 (heated, 24 V)
Sensor Assembly (6 pack) 1000007263
Photoelectric sensor assembly
Photoelectric sensor/4-20 mA transmitter 1000012202
0–25 mA current meter 1000006077
Calibration Resistor, 10 ohm, 1%, metal film 1000007484
Fuse 1000006413

Test Sensor Assembly (with etched chip) 1000007473

NOTE: The Test Sensor Assembly is painted bright orange/red to differentiate it from the regular sensor assembly, which is white.

Adaptor (1/2-3/4-inch NPT) 1000005438
O-ring 1000006258
Thermostat 1000006708
Heater 24 VDC 1000005937

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Chapter 5
Diagnostics and Troubleshooting

Current Output	System Condition	Recommended Action
0–2.45 mA	System Failure	• Check power to the photoelectric sensor. • Check the photoelectric sensor and the 4-20 mA • loop connections
2.5–6.0 mA	Sensor Fault	• Check sensor assembly, unit out of adjustment • Check the fiber optic link. • Inspect the fiber optic cable for bends. • Verify that the photo sensor is operating within the • specified temperature range. • Inspect the sensor assembly, replace if damaged.
7.5–10 mA	Normal operation 10 mA should be set as a maintenance alarm	• **Replace sensor if above 10 mA.** • A slow rise above 8 mA indicates that the sensor has been exposed to a relatively low concentration of HF **Warning!** **Do not readjust the 4-20 mA after initial installation and setting**
10–12 mA	**WARNING**: Sensor assembly may have been exposed to high concentrations of HF. Lethal concentrations of HF may be present.	• A slow rise from 10-12 mA indicates that maintenance has not been done, and sensor has been exposed to a low concentration of HF • A rapid rise to above 12 mA indicates that the sensor has been exposed to a high concentration of HF
>12 mA	**High Alarm**	• **See Exposure warning above** • Replace sensor

Follow applicable Safety and Emergency procedures

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Appendix A
Technical Specifications

Performance Specifications
Interface

Environmental

Chemicals Detected: Hydrogen Fluoride
Concentration: Catastrophic releases.
Alarm Time: 30 or less seconds to a catastrophic leak. See Figure A-1, "HF Concentration vs. Alarm Time," on page A-2

Interface

Ammeter 0–25 mA DC +/- mA
Note: For reference only. The readout may not agree with exact 4–20 mA output. For precision readings, read voltage across the 10 ^ calibration resistor (40 mV to 200 mV output) provided, or any other calibrated load.

Indicator Lights Not used.

Adjustments One (1) adjustment potentiometer under the red and green LEDs to set gain. Set current can be read through the calibration 10 ^ resistor

Communications Analog: 4–20 mA current loop. (See Appendix B for maximum loop length).

Environmental

82425400-40 Heated 24 VDC -40° C to +50° C (-40 to 122° F)
Humidity: 0% to 100% RH

Mechanical Configuration

The active electrical components are housed in an explosion-proof enclosure, with NEMA 4· rating.
Enclosure approvals: UL, CSA, and FM for Class I, Groups B, C, and D, Class II, Groups E, F, and G Class III hazardous locations.

Electrical

18-25 VDC, 0.20 mA

Logistics

Sensor Assembly Life: One shot. Discard and replace the sensor assembly if the 4-20 mA signal output is greater than 10 mA.

Appendix B
Signal Line Length vs. Resistance Calculations

Wiring Configuration — Signal Cabling Requirements

The following diagram shows a SHUR-SHOT connected in a four wire configuration.

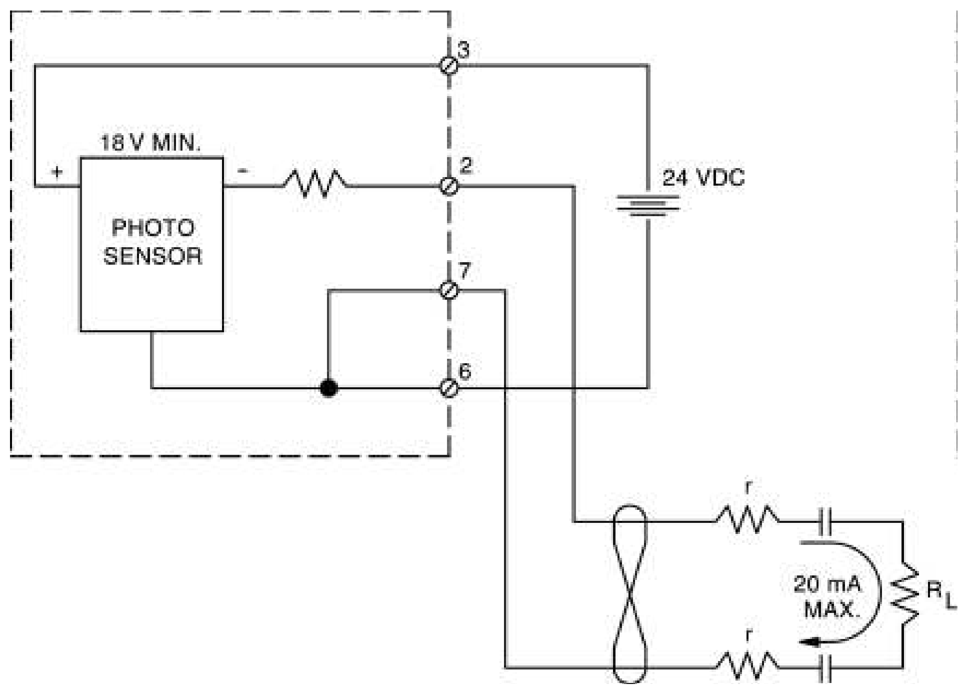

Figure B-1: Wiring Schematic — Local Power Supply

If the signal loop's total resistance (Rt) is defined as the loop's line resistance (R1) plus load resistor (RL), then:
Rt = R1 + RL, or
Rt = 2r + RL,
where r is defined as line resistance for half of the signal loop's total length.

The maximum allowable Rt is 240 ∧. ™he cabling length and gage must be sized accordingly. Refer to Table B-3 for the resistance of stranded copper wire.

Maximum Signal Loop Length for 24 V Local Power Supply and 4-wire Configuration

In this configuration the power supply is local to the photoelectric sensor.

Table B-1: Maximum Signal Loop Resistance for 24 VDC Supply

Termination Resistance	Maximum Signal Loop Resistance
25 ohms	215 ohms
50 ohms	190 ohms
100 ohms	140 ohms
200 ohms	40 ohms

Table B-2: Line Resistance per 1000 feet of copper wire

AWG Size	At 0°C (32° F)	At 20°C (68° F)	At 40°C (104° F)
14	2.33 ohms	2.52 ohms	2.73 ohms
16	3.7 ohms	4.01 ohms	4.35 ohms
18	5.88 ohms	6.39 ohms	6.97 ohms
20	9.36 ohms	10.15 ohms	11.01 ohms
22	14.87 ohms	16.14 ohms	17.52 ohms
24	23.65 ohms	25.67 ohms	27.86 ohms

Wiring Configuration —Power Cabling Requirements

For installations that are a long distance from the power source, the resistance of the cable needs to be calculated to ensure that the voltage at the sensor is >18V.
To calculate the longest cable that can be used, find the resistance that drops the voltage by 6 V.
Rcable = 6 V/ 160 mA = 37.5 ohms
For 20 AWG @ 40° C this limits cable length to 3406 feet (1703 feet each way).

4-wire Configuration and Remote Power Supply

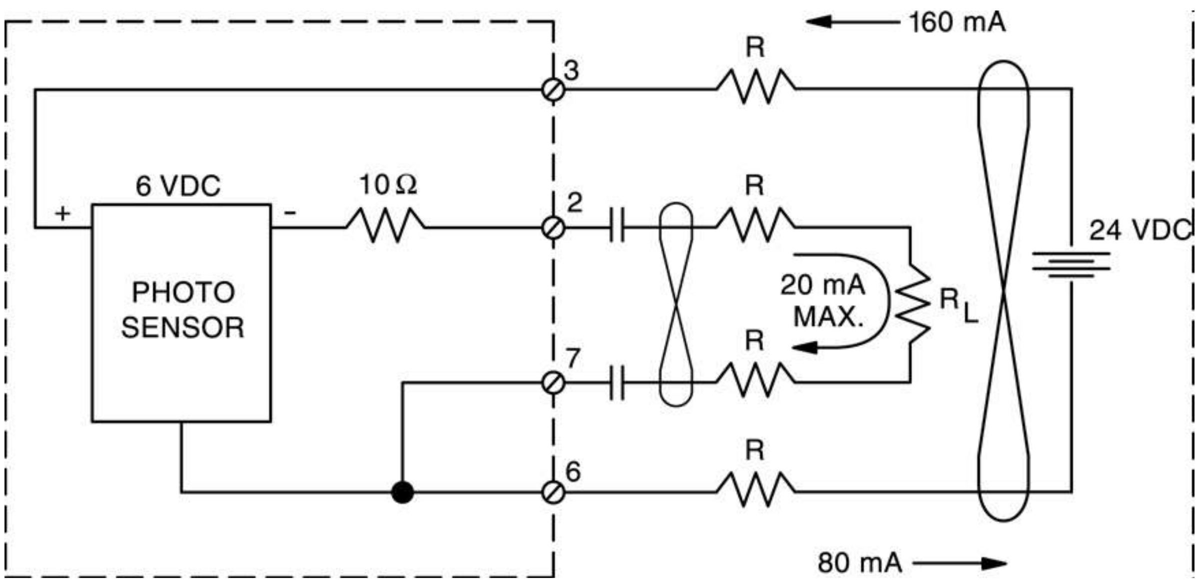

Figure B-2: Wiring Schematic — Remote Power Supply

Wiring Check

Check the power supply voltage at the ShurShot is in the range of 18 - 24 V
Measure total resistance of signal cabling and termination resistor:

- Disconnect power from unit
- Disconnect signal cable from pins 2 and 7 of unit
- Using an ohmmeter, measure the resistance around the signal cable. The resistance should be less that 240 ohms