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GE Reuter-Stokes

8499 Darrow Road
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FLAME TRACKER™
SiC TWO WIRE FLAME SENSOR (4-20 mA)
OPERATION & MAINTENANCE MANUAL
MODEL RS-FS-9001
REVISION M

MANUFACTURER: REUTER – STOKES
TWINSBURG, OH, USA

www.ge-mcs.com

GENERAL ELECTRIC COMPANY

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Certification Information

ATTENTION! The RS-FS-9001 **Flame Tracker** sensor complies with the following standards:

ETL

Intertek Control Number 9900287

Class 1, Div. 2, Grp A,B,C,D T3
Class 1, Zone 2 AEx nA IIC T3 Gc

ATEX / IECEx

CE 0359 Ex II 3 G
Ex nA IIC T3 Gc

Temperature Range
-40ºC ≤ T_a ≤ 150ºC; T3
-40ºC ≤ T_a ≤ 235ºC; T2 ; with cooling coil

These certifications are based on the use of approved interconnecting cables only. Currently available approved interconnecting cables are GE Reuter Stokes RS-E2-0285PXXX and GE 362A1053PXXX. See Section 1.1.2 for details.

WARNING

Certifications are based on the use of approved cables only. Currently available approved cables are GE Reuter-Stokes RS-E2-0285 and GE 362A1053.

Do not attempt to disassemble the sensor. Sensor is not repairable. Breaching the seal of the sensor will cause lose of the inert fill gas and render the sensor unusable.

Do not remove the sensor by wrenching on the body. Always use the 1 3/8 inch mounting nut. Wrenching on the body may breach the seal. Breaching the seal of the sensor will cause lose of the inert fill gas and render the sensor unusable. Once the seal has been broken it cannot be resealed by reassembly.

Do not install a sensor that has a cracked window, damaged threads or one that has been disassembled.

CAUTION

The operating temperature range of the Flame Sensor is **-40°C to 150°C**. Do not attempt to work on the Flame Sensor until it has reached a safe handling temperature.

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TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 SPECIFICATIONS 1
1.1.1 Flame Tracker™ -RS-FS-9001 1
1.1.2 INTERCONNECTING CABLE RS-E2-0285PXXX OR 362A1053PXXX 2
1.2 REFERENCE 3
1.3 GENERAL DESCRIPTION 4
2 SENSOR 4
3 INSTALLATION 6
3.1 MECHANICAL 6
3.2 ELECTRICAL 8
3.3 CONNECTOR PINOUT 9
3.4 SENSOR CHECKOUT 9
3.5 CONTROLLER SETUP 9
4 MAINTENANCE 10
4.1 WARNING 10
4.2 CAUTION 10
5 TROUBLESHOOTING 10
5.1 WARNING 10
5.2 CAUTION 10

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1 INTRODUCTION

1.1 SPECIFICATIONS

1.1.1 Flame Tracker™ -RS-FS-9001

Mechanical

Body Mount:	AISI316 Stainless Steel
Housing:	AISI304 Stainless Steel (sealed and Argon filled)
Connector	
Process:	3/4” NPT female
Electrical:	MIL-C-38999 Series III size 15 (5 pin)
Sensor:	Silicon Carbide photodiode
Window:	Sapphire

Operating

Sensitivity:	
RS-FS-9001	>5 mA @ $1x10^{10}$ photons/in^2/sec. @ 310 nm
Output:	4 - 20 mA dc, Max < 21 mA
Response time	<25 milliseconds
Power Requirements:	12 - 30 vdc @ > 100 mA
Temperature Range (ambient):	-40°F to 302°F (-40°C to 150°C) 455°F (235°C) with specified water cooling
Relative Humidity	100% Non-Condensing
Process Pressure	400 psig (2.8 Mpa)
Vibration	0.1 inches DA 10 – 40 Hz 8 G continuous 40 – 2000 Hz 14 G Peak

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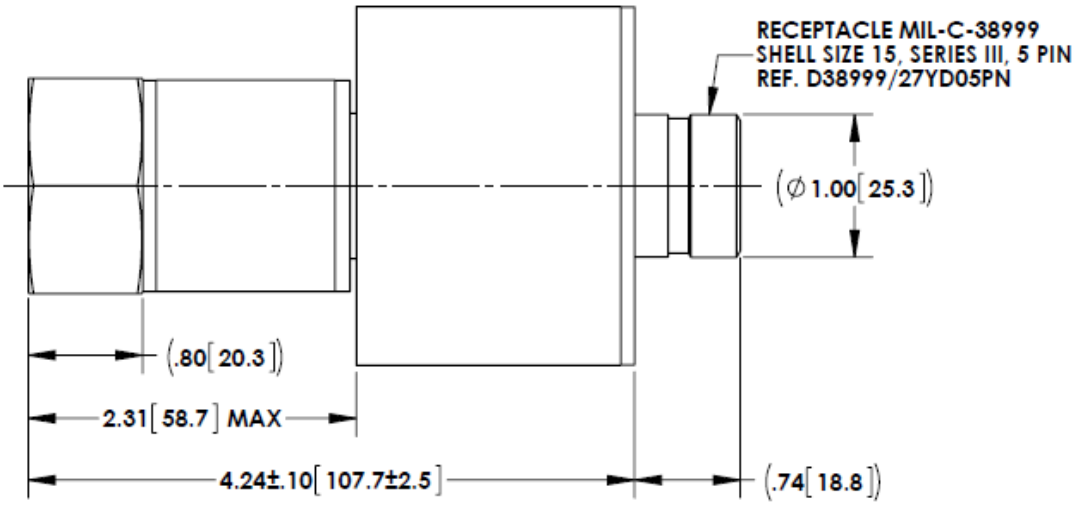
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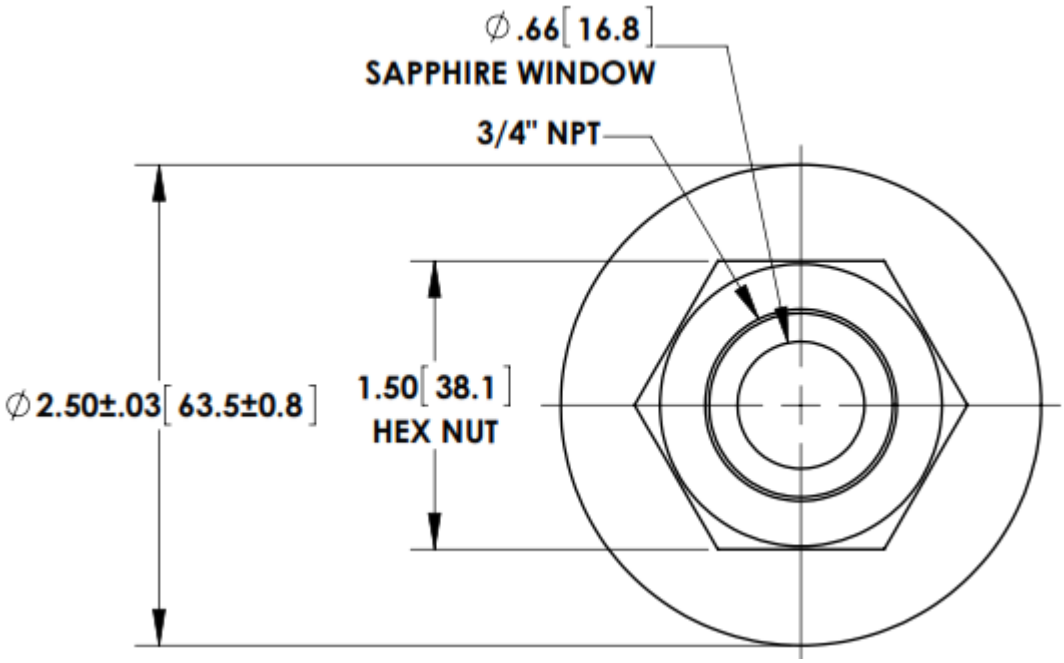
1.1.2 INTERCONNECTING CABLE RS-E2-0285PXXX OR 362A1053PXXX

Mechanical	
Wire	18 gauge (1.02 mm), 19 strand nickel plated copper
Insulation	Teflon PTFE
Shield	36 gauge (0.127 mm) nickel plated copper braid
Jacket	Extruded PFA
Armor	Stainless steel braid
Connector	MIL-C-38999 series III, shell size 15, 5 #16 pins (only 3 pins are used)
Operating	
Voltage (max)	300 vrms
Temperature (max)	482°F (250°C)

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1.2 REFERENCE





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1.3 GENERAL DESCRIPTION

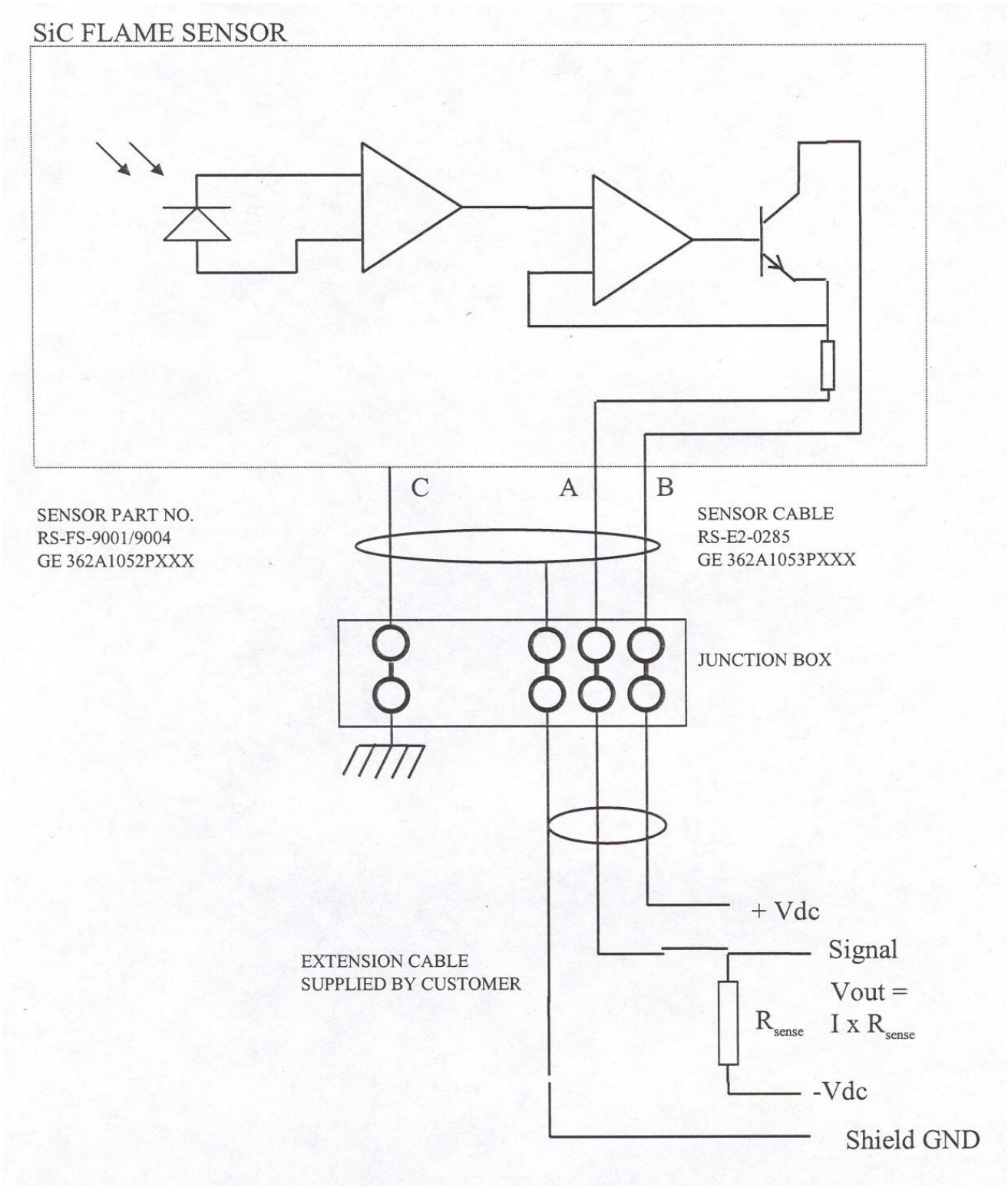
On Liquid Dry Low Nox Applications, as well as those applications with significant levels of water and steam injection, the ultra-violet light sensed by the Geiger Mueller tube based flame detectors is absorbed by the fog of fuel, steam or water. GE's research center invented a silicon carbide (SiC) photodiode that is significantly more sensitive to the longer wavelength components of the UV light generated by the flame. This longer wavelength light does penetrate the fog of oil quite well and therefore the SiC based sensor is significantly more sensitive to the presence of flame. A flame sensor utilizing the SiC photodiode is being produced by GE Reuter Stokes, and has been successfully operated on a number of GE gas turbine installations.

2 SENSOR

Figure 1 is a block diagram of the SiC Flame Sensor. The sensor has a sapphire window that is transparent to UV light and can withstand the compressor discharge temperature and pressure. It has a lens inside that focuses the light on a silicon carbide photodiode in a hermetic package. The photodiode is wired to a MOSFET input amplifier. The amplifier has a high initial gain, which automatically shifts to a lower gain in order to accommodate a wide range of input light level without saturating. The sensor regulates the supply current in proportion to the amount of UV light present. Both power and signal are transmitted on the same two wires. The sensor can be powered from a dc voltage between 12 and 30 volts. The whole transducer is sealed and filled with dry argon.

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FIGURE 1 - SiC FLAME SENSOR WIRING DIAGRAM



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3 INSTALLATION

3.1 MECHANICAL

The maximum operating temperature for the flame sensor is 302° F (150° C). If the peak ambient temperature at the location of the sensor exceeds this then cooling will be required. There are three methods available for cooling: Water-cooling, air-cooling with ambient air, and air-cooling with pressurized air.

Water cooling requires the use of a water cooling coil Part Number sp-566, GE Part Number 353B3490G001. The water-cooling coil requires water at a temperature of 50° F to 135° F (10° C to 57° C) at a flow rate of 1.0 gpm (3.8 lpm) per sensor. When using water-cooling the flame sensor can be operated to an ambient temperature of (455°F) 235°C.

Air-cooling with ambient air can be used in installations where the enclosure is cooled with forced air. This would be typical of LM2500 and LM6000 aircraft engine applications. The air velocity at the sensor must be 5 ft/sec (1.5 m/sec), or greater, at a temperature of 50° F (10° C), or less, above outside ambient. Under these conditions the sensors will operate at outside ambient temperatures up to 140° F (60° C).

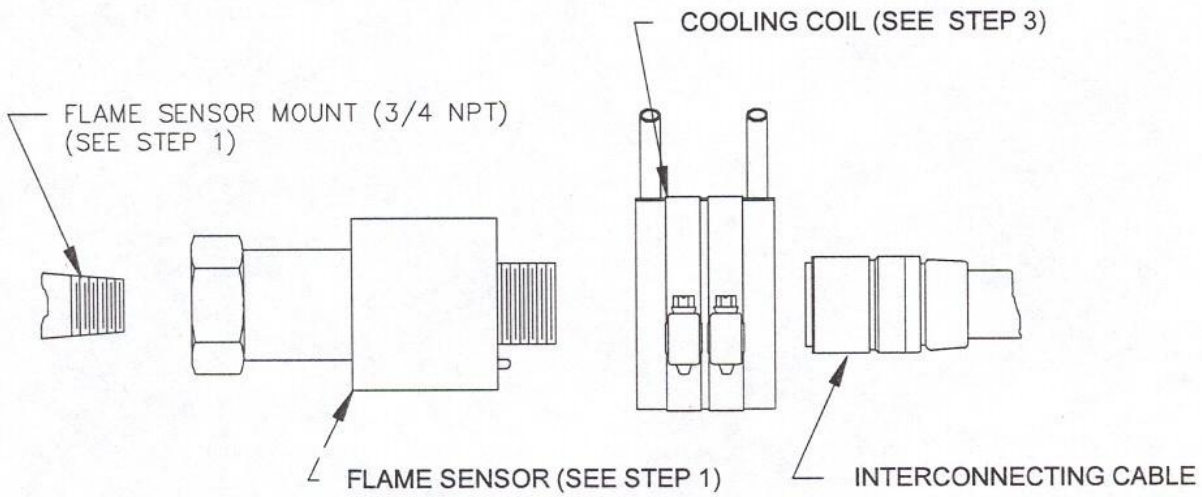
Air-cooling with pressurized air requires the use of Air-Cooling Can. GE Reuter-Stokes Part Number RS-E2-0259 (GE Part Number 07482SOCNL44821P01). The Air-Cooing Can is installed in the same manner as the water-cooling coil. The Air-Cooling Can requires 25-psi (170 kPa) minimum at 120° F (49° C) maximum.

Do not complete step 2 in the “FLAME SENSOR AND WATER COOLING JACKET INSTALLATION INSTRUCTIONS” on the next page. Leave the sensors installed hand tight until after the sensor checkout described in Section 3.3.

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FLAME SENSOR AND WATER COOLING JACKET INSTALLATION INSTRUCTIONS



1. Apply a small amount of Never-Seez PN NG-165 (GE PN 248A9779P001) to threads, prior to reinstalling the Flame Sensor

2. Inspect the window and clean with Isopropanol soaked swab. If required install hand tight (3-4 Full turns) tighten with a wrench approximately 2.5 turns. Tighten further as required to align keys on cable connector with slots in sensor connector

3. Slide cooling coil over Flame Sensor major diameter and orient tubes on the coil as required for assembly. Tighten clamps 50-60 in. lbs. Install Swagelok fittings re-torque clamps to 50-60 in. lbs. after first shut down

Note: 50 - 60 in. lbs = 5.6 - 6.8 Nm. When installing the Water Cooling Coil, ensure that the edge of the Sheet Metal Band is not in contact with the cooling tubes. This will ensure that no rubbing or fretting of the cooling tubes by the band's edge will occur during turbine operation.

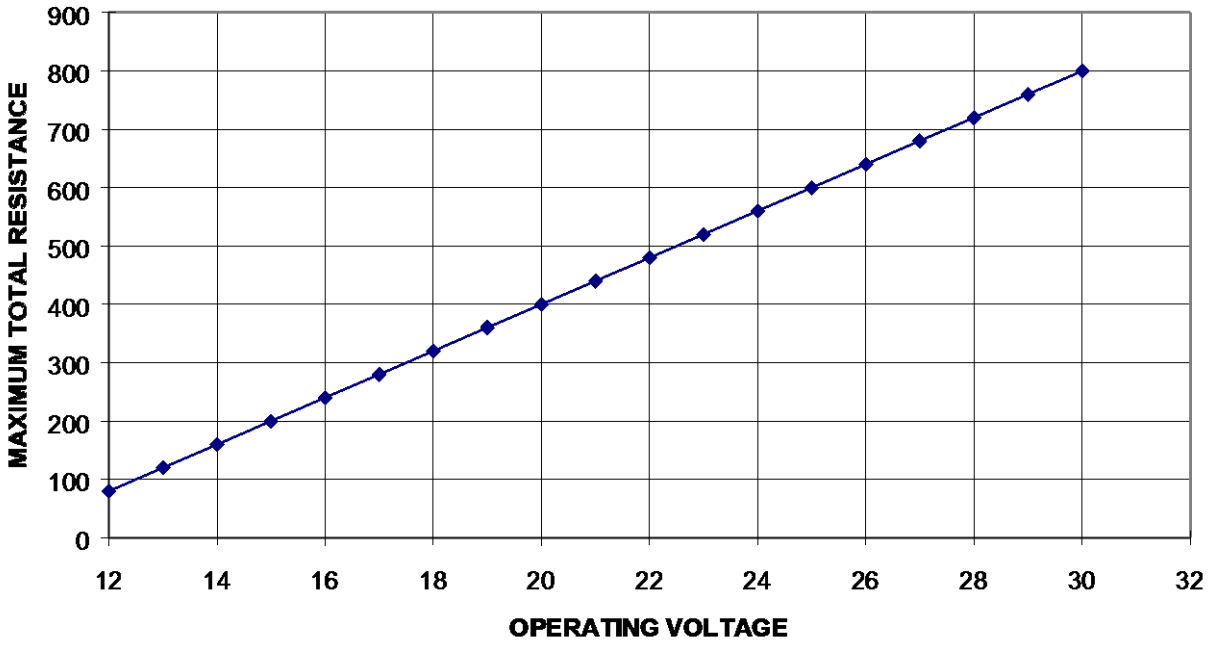
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3.2 ELECTRICAL

The sensors are connected to the turbine junction box with connector cable RS-E2-0285 or equivalent. The RS-E2-0285 consists of black, white and green wires twisted and shielded. All wiring must be in grounded conduit. The green wire must be connected to earth ground at the junction box. Do not connect the shields to each other or to earth ground at any location. The shields should be individually jumped through all junction boxes and connected to the proper ground terminal at the Controller. The polarity of the cable is as follows; white is positive and black is negative/signal return. Reverse polarity will not damage the sensor. Signal cable from the junction box to the Controller should be 18 gauge (1.02 mm) twisted shielded pair. The extension cable from the junction box to the Controller is the customer's responsibility.

FIGURE 2 - MAXIMUM RESISTANCE VS. OPERATING VOLTAGE



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The Flame Tracker™ is connected to the controller as a typical two wire current transmitter. It can be operated from any well-filtered dc supply from 12 volts to 30 volts. The supply should be capable of supplying 100 milliamps.

The power supply must be protected to prevent the supply voltage from exceeding 30 volts in normal use and more than 42 volts under transient conditions. The sensor is protected against reverse polarity. The maximum value for the sense resistor plus the wire resistance is dependent on the supply voltage. At 24 volts this value is 560 ohms. Resistance values for other voltages can be determined from the chart in Figure 2.

Figure 1 shows the preferred wiring for the sensor with the R_{sense} of the controller in the return line of the sensor. This configuration can be used with controllers that have single ended inputs (one side of the input grounded) or differential inputs (neither side of the input grounded). For pin outs and cable color code see Figure 1.

3.3 CONNECTOR PINOUT

The pinout for the power connector is as follows:

CONNECTOR LEGEND	
PIN	**CIRCUIT DESIGNATION**
A	-
B	+
C	Ground
D	Not Used
E	Not Used

3.4 SENSOR CHECKOUT

Disconnect the sensors and unscrew them from the turbine. Plug the sensor cables back in to each of the sensors. Apply power to the sensors. Check the current values at the controller for each of the sensors. The sensors are sensitive to light, and may have some reading, depending on the ambient light level. Test each sensor by covering the port to see the zero flame intensity signals, and with a flashlight to see a positive reading. With no light the reading should be 3.7 to 4.1 milliamps, while with most flashlights the reading should be above 8 milliamps. An LED flashlight may not work for this application. Variations in flashlight type, strength, or battery voltage may cause variation in signal output. The flashlight test is intended as a field test for general functionality only and is not a controlled or quantitative test. If a sensor is outside these rough check limits see Section 5.0.

Disconnect the sensor cables, and reinstall the sensors according to the instruction in Section 3.1. At this time step 2 of Section 3.1 should be completed and the sensor cables reconnected. Make sure that the sapphire window is clean; if it needs cleaning, do this according to the maintenance instructions in Section 4.0. Check that all sensors are reading between 3.7 to 4.1 milliamps.

3.5 CONTROLLER SETUP

The Flame Sensor provides a minimum output of 5 milliamps when exposed to the minimum flame intensity specified in GE specification number 362A1052. The set point for flame off should be set to 6.25%, which equals 5 milliamps. The set point for flame on should be 10%, which equals 5.6 milliamps. If the intensity levels are to low for these settings their may be other problems. Low intensity levels may be a sign of other problems. Refer to Section 5.0 - Troubleshooting.

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4 MAINTENANCE

4.1 WARNING

Do not disconnect connector while circuit is energized (or live), unless area is known to be non-hazardous.

4.2 CAUTION

The operating temperature range of the Flame Sensor is **-40°C to 150°C**. **Do not** attempt to work on the Flame Sensor or the cable until they have reached a safe handling temperature.

The Flame Sensor output will deteriorate as the lens becomes dirty. It is recommended, when initially installed, that the signal level be recorded during normal operation. During subsequent running, the signal level should be compared with the initial values. If a significant reduction in the signal level is noticed, then it is recommended that the lens be cleaned at the next opportunity (with the turbine shut down and cold). Clean the lens with isopropyl alcohol or other residue free solvent compatible with Sapphire. In order to reduce the risk of galling, an anti seize compound should be applied to the mounting thread prior to reinstallation of the sensor.

5 TROUBLESHOOTING

5.1 WARNING

Do not disconnect connector while circuit is energized (or live), unless area is known to be non-hazardous.

5.2 CAUTION

The operating temperature range of the Flame Sensor is **-40°C to 150°C**. **Do not** attempt to work on the Flame Sensor or the cable until they have cooled to a safe handling temperature.

PROBLEM	CAUSE	SOLUTION
No current flows	Reversed polarity Open wire	Change polarity Check connections
Low sensitivity during checkout or operation	Dirty lens Grounded cable	Clean lens (Section 4.0) Check cable for grounds
Low flame intensity signal during operation	Misalignment of the sensor mount	Check the squareness of all flanges and pipes of the sensor mount. Verify that the sensors have a clear view of the flame.
Periodic low reading on secondaries of DLN1 turbines	Condensation on the lens that can occur under high humidity situations.	A shorter mount tube (PN# E1-0058P002), is available from GE Reuter Stokes and may improve this condition. Please contact GE Reuter Stokes for further information.

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