RS-FSM-1002 - INTERFACE MODULE

OPERATION AND MAINTENANCE

MANUAL

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FSM-1002 O&M
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RS-FSM-1002-001 AND RS-FSM-1002-002 INTERFACE MODULES FOR RS-FS-9001 TWO WIRE FLAME SENSORS

1 INTRODUCTION

1.1 General Description

The RS-FSM-1002-001 and RS-FSM-1002-002 interface modules are used to connect the RS-FS-9001 Flame Tracker™ to controllers that can not accept a 4 - 20 milliamp current input. This would include the GE MARK I, II, IV and V controllers. Instructions for installation of the RS-FS-9002 Flame Tracker™ are covered in FS-9001O&M. These Modules are powered from 24 volts dc and provide signal conditioning and power for four Flame Sensors. The sensor power is supplied by four separate supplies that are voltage regulated and current and voltage limited. The loss of one supply or sensor will not effect the other three sensors. The signal conditioning circuits consist of two separate circuits with separate power supplies. Each circuit handles two sensors. A failure of one circuit will not effect the other. An open circuit or short circuit on any input will cause the corresponding output to indicate "no flame." The modules provide isolation between input and output and can be operated from two isolated 24 volt supplies.

The two modules differ in signal processing and output. The RS-FSM-1002-001 incorporates an adjustable comparator and provides an open collector to ground logic output. The output is low for "flame on" and high for "flame off." This model interfaces directly with controllers requiring a logic level input such as the GE MARK I, II and IV controllers.

The RS-FSM-1002-002 incorporates a voltage to frequency converter and provides a frequency output. This module interfaces directly with the MARK V controller. The input circuits are typically powered from the isolated protective supply while the output circuits are powered from a grounded supply.

1.2 SPECIFICATIONS

1.2.1 Mechanical

Package: 9.92" x 5.75" x 2.16" (25.2 cm x 14.6 cm x 5.5 cm)

Connectors

Input:	Phoenix MSTBVA 2.5/3-G-5.08
Input mate:	Phoenix MVSTBR 2.5/3-ST-5.08
Output/power:	Phoenix MSTBVA 2.5/8-G-5.08
Output/power mate	Phoenix MVSTBR 2.5/8-G-5.08

1.2.2 Operating

Signal input:	4 to 20 millamps dc
Sensor power:	20 volts dc @ 100 milliamps
Output:	256 Hz/mA @ 5 mA input (FSM-1002-002)
Open collector to ground	30 vdc, 100 mA max. (FSM-1002-001)
Supply voltage:	20 to 30 vdc
Supply current:	150 milliamps

1.2.3 Certifications

1.2.3.1 CE Mark

European Standards:

EN 50082-2: 1995 Emissions Heavy Industrial

EN 50081-2: 1993 Immunity Heavy Industrial

2 FSM-1002-001 INTERFACE MODULE

2.1 Description

The FSM-1002-001 Interface Module provides an open collector to ground output for use with controllers accepting a logic input. This model will operate with all GE MARK I, II and IV controllers. Figure 1 is a block diagram of this interface module.

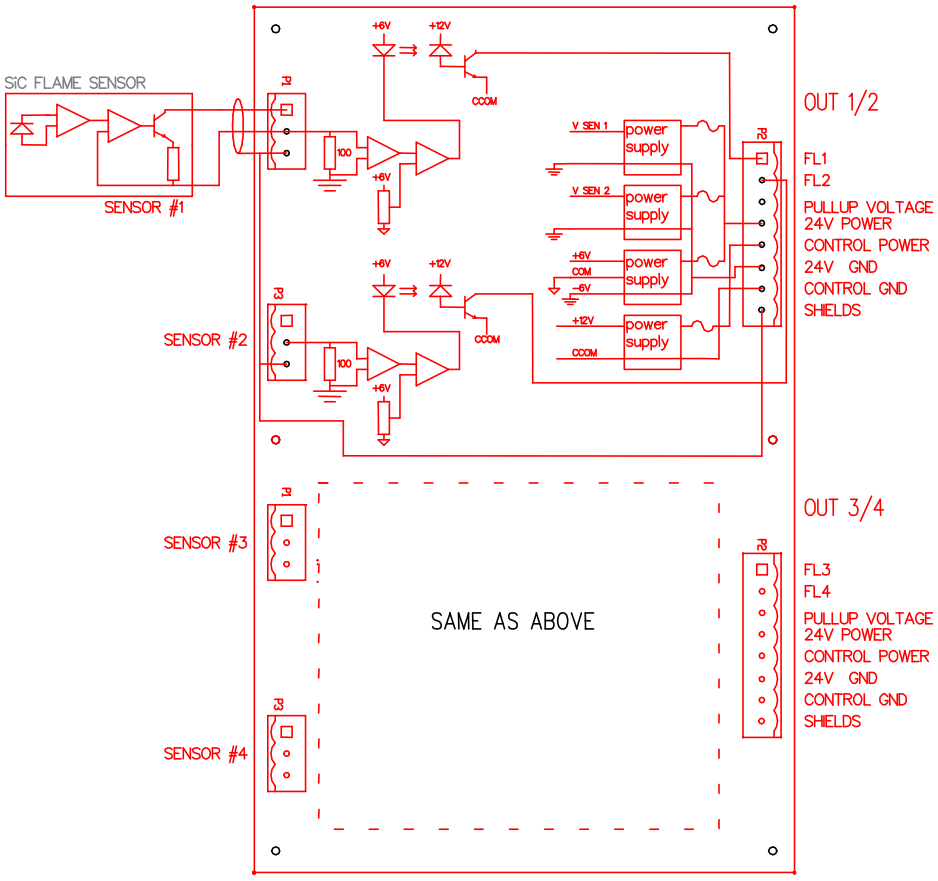

FIGURE 1 - FSM-1002-001 FLAME SENSOR I

2.1.1 This module is powered from any source of 24 volts dc capable of providing 150 milliamperes. The module has two separate circuits, each capable of handling two flame sensors. The failure of one circuit will disable a maximum of two sensors. In applications where only two sensors are used, one sensor should be connected to each circuit.

2.1.2 Each circuit has four independent power supplies. Two of the supplies provide regulated voltages for the sensors. These supplies are current limited at approximately 100 milliamperes and voltage limited at 30 volts. The use of separate supplies prevents a failure of one supply or sensor from effecting the other sensor input. One supply provides the ±6 volts to operate the signal conditioning circuitry. All three of the above supplies are powered from the 24 volt power input.

2.1.3 The fourth supply powers the output portion of the signal conditioning circuitry and is powered from the control power. An optocoupler provides isolation between the input and the output. This enables the input and output sections of the circuit to be operated from isolated power supplies. This feature is not normally used on GE MARK I, II and IV and other controllers that do not have isolated power supplies. In this case the "24 volt power" and "control power" inputs would be tied together.

2.1.4 The sensor input current is converted to a voltage by passing through a 100 ohm resistor. The signal is buffered by a differential amplifier and connected to an adjustable voltage comparator. The comparator output is connected to an optocoupler. The output section of the optocoupler provides the open collector to ground signal.

2.2 Installation

The interface module should be mounted in the control panel or other metal cabinet with a rating of pollution degree 2, IP20 or better. It should be mounted on a grounded metal surface.

2.2.1 Shielded cable preparation and installation..

2.2.1.1 Remove the outer insulation for a distance of approximately 5 inches.

2.2.1.2 Remove the shield for a distance of 4 inches. Leave 1 inch of shield exposed.

2.2.1.3 Insert the cable into the strain relief fitting until the shield is flush with the end of the fitting inside the box.

2.2.1.4 When all the cables have been inserted into the strain relief fitting, tighten the fitting to grip the cable. It is important that the metal fingers in the fitting contact the cable shield.

2.2.2 In most applications the FSM-1002-001 interface module will be replacing a Honeywell or a McGraw Edison flame detector module. Please refer to Figure 2 for the interface module terminal identification. The positive and negative connections from the 24 volt power to the existing system should be connected to terminals 4 and 6, respectively, of the "OUT 1/2" and "OUT 3/4" connectors. The connection should be made with 18 gauge (1.02 mm) shielded twisted pair cable. Install a jumper between terminals 4 ("24V POWER") and terminal 5 ("CONTROL POWER") on both connectors. Install another jumper between terminal 6 ("24V GND") and terminal 7 ("CONTROL GND") on both connectors. Separate power cables should be used for each circuit to provide redundancy. If redundancy is not required, then jumper the power supply terminals 4 and 6 of "OUT 1/2" to terminals 4 and 6 of "OUT 3/4." At the controller end of the power cable connect the +24 volt wire to the P28 terminal, or other +24 volts source, and the 24 volt common to the PCM terminal, or other power supply common terminal.. Connect the shield to the appropriate shield termination point on the controller panel. The 24 volt supply should be fused between 1 and 3 amps.

2.2.3 The input signal connections should be made with 18 gauge (1.02mm) shielded twisted pair wire. The shield is connected through the strain relief fitting. The signal wires are connected to pins 1 and 2 of the input connector. Pin 1 is the positive voltage to the sensor and pin 2 is the return current from the sensor. Pin 3 is not used.

For applications requiring full compliance with the CE EMI directive the signal input connections must be made with 18 gauge (1.02mm) double shielded twisted pair wire. The double shield should consist of a foil and a braided shield.

2.2.4 Use a 22 gauge (0.643 mm) shielded twisted pair cable for each output of the output terminals FL1 - FL4. Twist the two wires of each cable together before connecting to the terminal. Connect the shield to the appropriate shield termination point on the controller panel.

2.2.5 In applications using two sensors do not connect both sensors to the same circuit. Connect one sensor to each circuit. This provides a redundant system where a failure of one board will only affect one sensor. Connect the first sensor to SENSOR #1/FL1 or SENSOR #2/FL2 and the second sensor to SENSOR #3/FL3 or SENSOR #4/FL4. The outputs. FL1 through FL4, are connected to the same points as the original system wiring.

2.2.6 When replacing McGraw Edison Flame Detectors the FL1 through FL4 outputs of the interface module correspond to the FLM outputs of the McGraw Edison module. The fault output of the McGraw Edison module, FLT, is not provided by the Interface Module. This line must be tied to common to prevent a false fault signal.

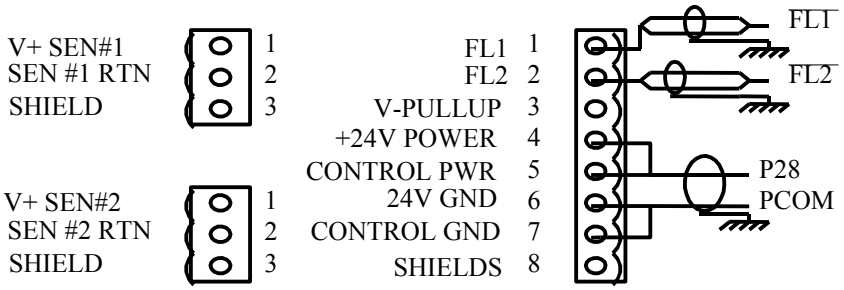

FIGURE 2 - TYPICAL WIRING DIAGRAM FOR FSM-1002-001

2.3 System Checkout

The FSM-1002-001 Interface Module used on the MARK I, II, and IV controllers provides an open collector to ground output. This is a "not" FLAME output. The output will be a logical "0" when flame is present and a logical "1" when flame is absent.

2.3.1 Remove the power to the module by disconnecting the output connector or removing the +24 volt power wire from the controller. Plug in the sensor cables to the appropriate input connector. Disconnect the sensor cable from the sensors and unscrew them from the turbine. Plug the sensor cables back in to each of the sensors. Restore the power to the interface module and the sensors. Check the appropriate output terminal for the output for each of the sensors. The outputs are referenced to "CONTROL COMMON", terminal 7 of the output connector (See figure 1.). 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 zero flame intensity signal, then use a flashlight or flame to see a positive reading. With no light the reading should be greater than 3 volts, while with a good flashlight the reading should be less than 0.5 volts. If a sensor is outside these rough check limits see Section 4.0.

2.3.2 Make sure that the sapphire window is clean; if it needs cleaning, do this according to the maintenance instructions in Section 2.4. Remove power from the module, disconnect the sensor cables, and reinstall the sensors. Refer to FS-9001 O&M for sensor installation instructions. Reconnect the sensor cables and apply power to the module.

2.3.3 The trip level is preset to the minimum flame intensity as defined in GE Specification 362A1052. This corresponds to a sensor output of 5 milliamperes. This value can be changed by adjusting the potentiometers on the module board. Turning the potentiometer clockwise will increase the trip level about 1 milliampere per turn.

2.4 Maintenance

The Flame Sensor output will deteriorate as the lens becomes dirty. Isopropyl alcohol is recommended for cleaning the lens. Other residue free solvents compatible with Sapphire can be used. 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.

3 FSM-1002-002 INTERFACE MODULE (FREQUENCY OUTPUT)

3.1 Description

The FSM-1002-002 Interface Module provides a frequency output proportional to ultraviolet intensity and is designed for use with the GE Mark V controller. Figure 3 is a block diagram of this interface module. The Module is powered from the protective <P> modules isolated 24volt supply. This supply consists of the output of three TCEA cards that have been diode selected on the TCTG card to provide the highest voltage of the three cards. The 24 volts from the TCTG card is connected to the flame sensor module. The module has two separate circuits, each capable of handling two flame sensors. The failure of one circuit will disable a maximum of two sensors. The control algorithms can allow the turbine to continue running, based on information from the remaining operating flame sensors. In applications requiring eight sensors, two modules would be required.

3.1.1 Each circuit has four independent power supplies. Two of the supplies provide regulated voltages for the sensors. These supplies are current limited at approximately 100 milliamperes and voltage limited at 30 volts. The use of separate supplies prevents a failure of one supply or sensor from effecting the other sensor input. One supply provides the ±6 volts to operate the signal conditioning circuitry. All three of the above supplies are powered from the 24 volt power input.

3.1.2 The fourth supply powers the output portion of the signal conditioning circuitry and is powered from the control power. An optocoupler provides isolation between the input and the output. This enables the input and output sections of the circuit to be operated from isolated power supplies. This is required when operating from the MARK V isolated supply.

3.1.3 The sensor input current is converted to a voltage by passing through a 100 ohm resistor. The signal is buffered by a differential amplifier and connected to a voltage to frequency converter circuit. The output of the voltage to frequency converter is connected to the optocoupler. Output of the optocoupler is sent to the controller for processing.

3.1.4 The controller circuits that ordinarily sense the pulses from the GM tube now receive the frequency generated by the interface module. When the SiC sensors detect flame, the Flame Sensor Interface Module generates pulses that are counted by the Mark V controller's TCEA cards exactly the same way the GM pulses were counted. Cables carrying the high voltage originally needed by the GM tubes should be disconnected.. The 300 volts will still be present on the TCEA cards, requiring appropriate safeguards while working with the controller connections.

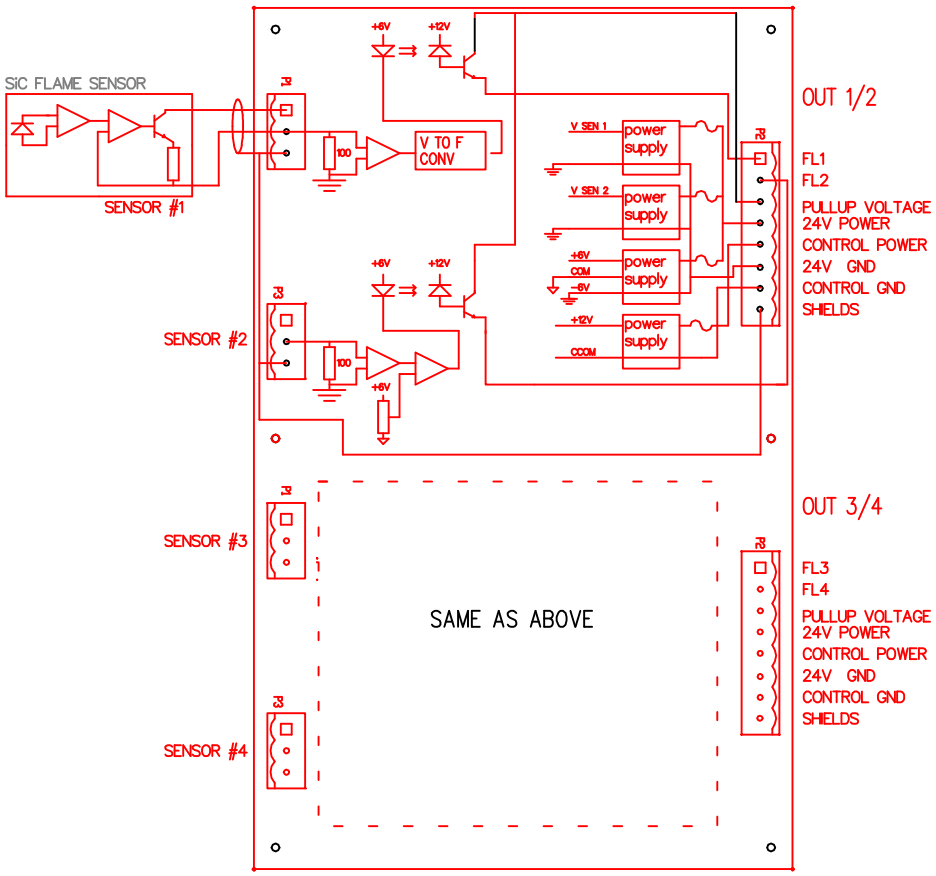

FIGURE 3 - FSM-1002-002 FLAME SENSOR INTERFACE MODULE

3.1.5 The frequency output of the Interface Module will range higher than the GM tube. The frequency conversion is nearly linear. The most significant requirement is that the output for the no flame condition does not drift up in voltage, which could cause a false flame on signal. The sensor specification requires that the minimum sensed light level must generate 5 milliamperes, and with no light less than 4.25 milliamperes. The module will generate approximately 256 Hz with a 5 milliampere input, (256 Hz/mA) and could range as high as several kilohertz with very bright UV light.

3.1.6 Because the frequencies generated by the SiC Flame Sensor and Interface Module range higher than the GM tube, it will be desirable to set the flame detection level constants higher. See Section 3.3 for a more detailed explanation of these constants.

3.2 Installation

The Interface Module should be mounted in the auxiliary compartment or other metal cabinet rated pollution degree 2, IP20 or better. It should be mounted on a grounded metal surface. Please refer to Figure 4 for terminal identification and typical wiring diagram.

3.2.1 Shielded cable preparation and installation..

3.2.1.1 Remove the outer insulation for a distance of approximately 5 inches

3.2.1.2 Remove the shield for a distance of 4 inches. Leave 1 inch of shield exposed

3.2.1.3 Insert the cable into the strain relief fitting until the shield is flush with the end of the fitting inside the box

3.2.1.4 When all the cables have been inserted into the strain relief fitting, tighten the fitting to grip the cable. It is important that the metal fingers in the fitting contact the cable shield.

3.2.2 In routing the wires from the flame sensor module to the Mark V, take particular care with the 24 volt power from the TCTG card to the module output connections because it is essential for turbine operation. It has been specified as a 18 gauge (1.02 mm) shielded twisted pair cable to help prevent noise from the switching mode power supplies on the TCEA cards from disturbing other electronic circuits and to give it a measure of protection against abuse. The shield should be terminated only once, in the Mark V next to the terminal board or on the shield bus depending on the style of Mark V on site. The 24 volts supply should be fused between 1 and 3 amps.

3.2.3 The input signal connections should be made with 18 gauge (1.02mm) shielded twisted pair wire. The shield is grounded through the strain relief fitting. The signal wires are connected to pins 1 and 2 of the input connector. Pin 1 is the positive voltage to the sensor and pin 2 is the return current from the sensor. Pin 3 is not used.

For applications requiring full compliance with the CE EMI directive the signal input connections must be made with 18 gauge (1.02mm) double shielded twisted pair wire. The double shield should consist of a foil and a braided shield.

3.2.4 Since the power supply from the TCTG card is isolated from all other power supplies, it can not be used to power the output section of the module. Power for the output section must be connected to terminals 5 and 7 of the output connectors, “CONTROL POWER” and “CONTROL GROUND”, respectively. The output section requires less than 10 milliamperes at 24 volts. This can be obtained from terminals 15 and 16 on the TBQB card. This connection should be made with 22 gauge (0.643 mm) shielded twisted pair cable. The shield should be terminated only once, in the Mark V next to the terminal board or on the shield bus depending on the style of Mark V on site.

3.2.5 The flame signals coming to the PTBA are shielded because they also might cause a disturbance to other sensitive circuits. These shields should be terminated only once, in the Mark V next to the terminal board or on the shield bus depending on the style of Mark V on site. Use two 22 gauge (0.643 mm) shielded twisted pair cables for each output connector used. Twist the two wires of each cable together before connecting to the terminal.

3.2.6 Please refer to Figure 5 for the terminal layout of the Mark V Interface Module and Table 1 for the Mark V connections.

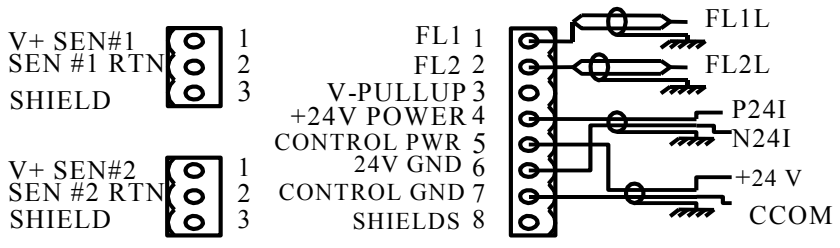

FIGURE 4 - TYPICAL WIRING DIAGRAM FSM-1002-002 FOR MARK V

TABLE 1 - MARK V CONNECTIONS

Flame Sensor Module		Mark V		<I>	
Connector	Pin	PTBA TB designation	PTBA Screw #	Flame Intensity	Flame Logic
MODULE #1					
OUT ½	1	FL1L	14	FD_INTENS_1	L28FDA
OUT ½	2	FL2L	16	FD_INTENS_2	L28FDB
		Shield	(PTBA)		
OUT ¾	1	FL3L	18	FD_INTENS_3	L28FDC
OUT ¾	2	FL4L	20	FD_INTENS_4	L28FDD
		Shield	(PTBA)		
MODULE #2					
OUT ½	1	FL5L	22	FD_INTENS_5	L28FDE
OUT ½	2	FL6L	24	FD_INTENS_6	L28FDF
		Shield	(PTBA)		
OUT ¾	1	FL7L	26	FD_INTENS_7	L28FDG
OUT ¾	2	FL8L	28	FD_INTENS_8	L28FDH
		Shield	(PTBA)		
		wire	board	connector	pin
OUT ½	4	P24I	TCTG	JT	1
OUT ½	6	N24I	TCTG	JT	2
		shield	PTBA		
OUT ¾	4	P24I	TCTG	JT	1
OUT ¾	6	N24I	TCTG	JT	2
		shield	PTBA		
OUT ½	5	control power	TBQB	15	
OUT1/2	7	control ground	TBQB	16	
		shield		DCOM	
OUT ¾	5	control power	TBQB	15	
OUT3/4	7	control ground	TBQB	16	
		shield		DCOM	

3.3 Software Constants

3.3.1 There are two constants for each flame sensor. Only the first set is used at the present time, but the other set should be set to the same value as a precaution against an inadvertent change of state in the selection logic.

3.3.2 For the first turbine start-up the constants should be set at 8 counts for each 1/16 of a second, or a frequency of 128 Hz required for flame on indication. The software has a hysteresis of 1 count for a flame out frequency of 112 Hz. Later, if the flame intensity levels for all conditions of operation remain high over time, these constants should be increased.

3.4 System Checkout

3.4.1 After careful inspection of the wiring, disconnect the sensor cable from the sensors and unscrew them from the turbine. Plug the sensor cables back in to each of the sensors. Apply power to the controller and the module. Check the <I> values of FD_INTENS_# 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 zero flame intensity signal, then use a flashlight or flame to see a positive reading. With no light the reading should be less than 50, while with a good flashlight the number should be above 500. If a sensor is outside these rough check limits see Section 4.0.

3.4.2 Make sure that the sapphire window is clean; if it needs cleaning, do this according to the maintenance instructions in Section 3.6. Remove power from the module, disconnect the sensor cables, and reinstall the sensors. Refer to FS-9001 O&M for sensor installation instructions. Reconnect the sensor cables. Apply power to the module and check that all the FD_INTENS_# reading for all sensors is less than 50.

3.5 Monitoring Performance

3.5.1 Before the initial start, be sure that the historian is properly recording the FD_INTENS_# signals and the flame logic signals, and that these data can be retrieved properly from the historian.

3.5.2 The flame detector frequency, as indicated by the FD_INTENS_# signals, is the most important indicator of the health of the system. Typically, a steady decline in these signals is an indication of contamination of the sapphire window or a buildup of carbon obstructing the view the sensor has of the flame. If the drop in these signals continues, it will lead to "flame flicker" where one sensor or another indicates flameout, causing an alarm but leaving the turbine running. When there is a coincidence of enough sensors indicating flame out, the unit will trip. A real flameout causes all the sensors to indicate zero, and the system will close the fuel valves to prevent an accumulation of potentially explosive gas in the machine.

3.6 Maintenance

The Flame Sensor output will deteriorate as the lens becomes dirty. It is recommended when initially installed , that the counts be recorded during L-L and Premix operation. During subsequent running, the flame intensity count should be compared with the initial values. If a significant reduction in the intensity reading is noticed, then it is recommended that the lens be cleaned at the next convenient opportunity (with the Turbine Shut Down and cold). Isopropyl alcohol is recommended for cleaning the lens. Other residue free solvents compatible with Sapphire can be used. 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.

4 TROUBLESHOOTING

NOTE: THE FLAME SENSOR MODULE IS PROTECTED WITH SELF RESETTING FUSES. IN THE EVENT OF AN OVERLOAD, THE FUSE WILL SWITCH TO A HIGH RESISTANCE STATE LIMITING THE VOLTAGE AND CURRENT TO THE LOAD. WHEN THE OVERLOAD IS REMOVED THE FUSE WILL RESET AND THE MODULE WILL RETURN TO NORMAL OPERATION.

4.1 If any sensor fails to operate properly check voltages at the input connector with the sensor connected. The voltages between terminal 1 of the input connector and terminal 6 of the output connector should be approximately 20 volts. If this voltage is less than 12 volts, disconnect the wire from terminal 1 and measure the voltage at the terminal. If the voltage returns to the proper value after the wire is removed the problem is a short circuit in the sensor or its wiring. If the voltage does not return to the proper value then the problem is in the module.

4.2 If the voltage at terminal 1 is within specifications then measure the voltage between terminal 2 of the input connector and terminal 6 of the output connector. This voltage should be between 0.35 and 2.5 volts depending upon the sensor signal level. With no light input into the sensor this voltage should be between 0.35 and 0.43 volt. If this voltage is zero then there is an open circuit in the sensor or its wiring.

4.3 If the sensor passes these tests then the problem is in the module. This can be verified by moving the sensor to a know good channel, if it operates properly then the module should be replaced.