



## X2200 UV, X9800 IR, X5200 UVIR SIL 2 Certified Flame Detectors

### SAFETY-CERTIFIED FLAME DETECTORS

This manual addresses the specific requirements and recommendations applicable to the proper installation, operation, and maintenance of all Safety-Certified (SIL-Certified) X2200 UV, X9800 IR, and X5200 UVIR Flame Detectors. The safety function of the X2200/X9800/X5200 is to detect a variety of fires and to provide present alarm status to its relay and analog outputs. For complete information regarding performance, installation, operation, maintenance and specifications, refer to appropriate instruction manual:

X2200 UV Flame Detector	95-8549
X9800 IR Flame Detector	95-8554
X5200 UVIR Flame Detector	95-8546



### QUALITY POLICY STATEMENT

All quality assurance control measures necessary for safety management as specified in IEC 61508 Part 1 have been implemented. The quality management system of Det-Tronics is based on the requirements of EN ISO 9001 and ANSI/ASQC Q9001 through the application of the United Technologies Company Achieving Competitive Excellence (ACE) program. In addition, the Quality Management System complies with the European ATEX Directive requirements per EN 13980, the International Electrotechnical Commission requirements per OD005/V2, and the supervised testing requirements per ISO 17025.

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of personnel performing the operations. Information that raises potential safety issues is indicated by the word "Warning". Always read and understand these safety messages.

#### **WARNING**

*The X2200, X9800 and X5200 are intended for use in hazardous environments that may include explosive levels of flammable gases and vapors. These products must be properly installed, operated and maintained. Improper installation or use could result in an explosion or fire resulting in death or serious injury.*

- *Do not remove the detector cover in explosive environments when device power is on and circuits are live.*
- *Detector must be properly installed, and wiring compartment cover must be fully engaged to meet hazardous area explosion-proof/non-incendive requirements.*

## DESIGN

The X2200/X9800/X5200 flame detector is classified as a Type B smart device according to IEC61508. The standard model provides an isolated 4-wire, 0-20 mA output, together with on-board Alarm and Fault relay contacts. These outputs serve to indicate normal operating condition of the detector, fault, or the presence of a flame alarm. The X2200/X9800/X5200 contains extensive self-diagnostics and is programmed to send the current output to a specified state (0 mA, 1 mA, or 2 mA) upon internal detection of a failure or fault condition.

HART communication is available as an option. The HART option allows the operator to monitor the status of the detector, determine factory settings, adjust field settings, and initiate field tests. For specific information regarding HART communication, refer to the appropriate HART Addendum:

X2200 UV Flame Detector	95-8638
X9800 IR Flame Detector	95-8637
X5200 UVIR Flame Detector	95-8636

### NOTE

*All configuration changes to the X2200/X9800/X5200 must be verified by the user via a proof test, power cycle and re-check of settings, or other appropriate method.*

The X2200/X9800/X5200 is designed for operation with a supply voltage from 18-30 volts DC. Proper operation outside this range cannot be assumed.

Safety-Certification of the X2200/X9800/X5200 includes:

- Analog Output
- Relay Output
- HART Output as non-interfering.

Safety-Certification of the X2200/X9800/X5200 does **not** include:

- Pulse Output
- EQP LON Output version
- RS-485 Modbus signal.

## VALID INPUT RANGE

Fault annunciation is provided on the 0-20 mA signal output loop by signaling to a 1 mA, 2 mA, or 3 mA current output level. The receiving device must be programmed to indicate a fault condition when current levels reach over-current (> 21 mA) or undercurrent (< 2.25 mA).

## NOTE

*The X2200/X9800/X5200 analog signal and relay outputs are not safety-rated during detector warm-up or signal output loop testing (including proof testing). Alternative means should be used at the job site to ensure facility safety during these activities.*

## DIAGNOSTIC RESPONSE TIME

The X2200/X9800/X5200 will perform all critical diagnostic functions within 58 minutes, worst case diagnostic detection time. The user must not configure the automatic **oi** test interval and failure annunciation count combination to be greater than 58 minutes (default setting is one minute intervals, with failure annunciation after three failed **oi** tests).

## OPTICAL INTEGRITY TEST

The **oi** test is designed to generate a fault when the unit's detection range has been reduced by 50% or more. This factor should be carefully considered during detector placement with regard to the required safety function.

## CERTIFICATION

The X2200/X9800/X5200 Safety-Certified version is certified to IEC61508:2010 for single input use in low demand SIL 2 Safety Instrumented Systems.

## SAFETY-CERTIFIED PRODUCT IDENTIFICATION

Safety Certification of all X2200/X9800/X5200 models meeting SIL 2 safety standards is clearly identified on the product label.

## INSTALLATION

### NOTE

*For complete information regarding performance, installation, operation, maintenance and specifications, refer to the appropriate instruction manual:*

<i>X2200 UV Flame Detector</i>	<i>95-8549</i>
<i>X9800 IR Flame Detector</i>	<i>95-8554</i>
<i>X5200 UVIR Flame Detector</i>	<i>95-8546</i>

Tools Required:

- 14 mm hexagonal wrench

No special installation requirements exist above and beyond the standard installation practices documented in the instruction manual. Environmental specification limits are also as published in the general specifications section in the instruction manual.

The operating power distribution system must be designed and installed so the terminal voltage does not drop below 18 Vdc when measured at any specific location. The maximum current limit must be less than 2 amperes. The external system providing power to the X2200/X9800/X5200 must have overvoltage protection that ensures supply voltage does not exceed 33 Vdc.

### Common Misuse Scenarios

Refer to the General Application Information section of the appropriate instruction manual for detailed information on common misuse scenarios. Application environments to avoid include the following:

**UV Detectors** Intense UV sources including electric arc welding, high voltage corona, x-rays and gamma radiation should not be present in the detection area.

**IR Detectors** Intense IR sources should not be present in detection area.

#### NOTE

*The above common misuse scenarios will cause the X2200/X9800/X5200 relay or 4-20 mA outputs to annunciate a high background and/or false alarm depending on the intensity of the radiation and the relay configuration.*

**UV & IR Detectors** Glass and Plexiglas windows attenuate radiation and should not be located between the detector and detection area.

The detector must have a direct line-of-sight to any potential flame source in the detection area; care must be taken to keep physical obstructions out of the line of view of the detector.

#### NOTE

*The black plastic shipping cap must be removed prior to placing the detector into service.*

### START-UP AND COMMISSIONING

All safety functions of the X2200/X9800/X5200 are active within 30 seconds of power-up without any user action required.

### Commissioning Personnel

The Safety Certified X2200/X9800/X5200 flame detector can be commissioned by any qualified person with knowledge of flame detection instruments and the configuration device being used. Refer to the Start-Up section provided in the instruction manual.

### Relay Configuration Requirements

The end user must provide transient and current limiting on the output contacts of the relays. The maximum relay contact output must be limited to 2 amperes at 30 Vdc. The load must be a resistive load. The user must protect against transients by using standard protection methods such as proper grounding of shielded wire and separation of relay load wires from other lines carrying rapidly switched high current (e.g. large motor power supply lines).

If the 0-20 mA analog output is not being monitored for fault conditions, the status of the Fault relay must be monitored and appropriate action taken.

The fault relay is configured for normally energized operation. The alarm relay must be configured for normally de-energized operation (i.e. the alarm relay must energize during alarm conditions).

### Configuration

Digital communication with the X2200/X9800/X5200 is necessary to monitor internal status and to modify the factory settings. For specific information regarding HART communication, refer to the appropriate HART Addendum:

X2200 UV Flame Detector 95-8638

X9800 IR Flame Detector 95-8637

X5200 UVIR Flame Detector 95-8636

#### NOTE

*Prior to device configuration (setting alarm thresholds, latch/non-latch function, etc.) all alarm outputs must be bypassed. The device is not safety certified during configuration change activities.*

#### NOTE

*All configuration changes to the X2200/X9800/X5200 must be verified by the user via a proof test, power cycle and re-check of settings, or other appropriate method. The LED flash rate during power-up should be checked to verify proper setting.*

### Configuration Protection

When using the 0-20 mA output with HART as a safety output, it is required that Write Protect be set to "on" to ensure that the HART is non-interfering. If HART write protect is temporarily disabled, the user must take specific action to re-enable Write Protect to ensure that HART communication remains non-interfering.

Table 1—Frequency of Proof Tests

Proof Test Name	Commissioning	Frequency
Visual Field Inspection Proof Test	Yes	As needed, depending on level and type of contaminants present
Detector Response Mag <b>o</b> <sub>i</sub> Proof Test	Yes	Yearly

**OPERATION, MAINTENANCE, INSPECTION AND PROOF TESTING**

Tools Required:

- Magnetic **o**<sub>i</sub> test tool (p/n 102740-002)
- Window cleaner (p/n 001680-001 or isopropanol)
- Lens tissue and cotton swabs
- 4 mm flat blade screwdriver

After normal installation and start-up have been completed as recommended within the instruction manual, Proof Tests must be performed for every Safety-Certified X2200/X9800/X5200 detector installed.

Personnel performing Proof Test procedures shall be competent to perform the task. All Proof Test results must be recorded and analyzed. Any corrective actions taken must be documented in the event that an error is found in the safety functionality. The Proof Tests must be performed at a frequency as shown in Table 1.

**WARNING**

*Failure to perform the specified testing and inspection may lower or void the SIL rating for the product or system.*

**VISUAL FIELD INSPECTION PROOF TEST**

Visual inspection of all Safety-Certified X2200/X9800/X5200 flame detectors shall be conducted as needed to confirm that there are no obstructions in the optical field of view. Corrective action will include removal of such impediments should they exist.

Completion of Visual Field Inspection Proof test will be recorded and documented in the SIS logbook.

**DETECTOR RESPONSE MAG **o**<sub>i</sub> PROOF TEST**

**WARNING**

*Any external alarm equipment, systems or signaling devices that could be automatically initiated by performing this test must be disabled or bypassed before performing this test!*

Tools Required:

- Magnetic **o**<sub>i</sub> test tool (part number 102740-002)

All flame detectors must be performance tested using the Mag **o**<sub>i</sub> Procedure as described in the Magnetic **o**<sub>i</sub> / Manual **o**<sub>i</sub> section of the instruction manual and inspected to ensure that they are capable of providing expected performance and protection. Note that the Mag **o**<sub>i</sub> Procedure and Manual **o**<sub>i</sub> Tests are not interference free. During these tests the unit is not performing normal flame detection functions. Model X2200/X9800/X5200 provides an onboard status LED, which indicates Green color when internal operational parameters are normal.

To indicate a successful proof test, the LED changes to a Red color, the Alarm and Auxiliary relays change state to indicate an alarm condition, and the current output indicates 20 mA. These results should be verified on the control device.

To indicate an unsuccessful proof test, the LED changes to Yellow, the Fault relay becomes de-energized, and the current output indicates 2 mA. The fault indication can be reset by momentarily applying the magnet or manual **o**<sub>i</sub> switch.

## FAULT/FAILURE ACTION PLAN

In the event of a non-alarm condition result with the Mag **oi** test, the standard Maintenance and Troubleshooting procedures listed in the instruction manual must be followed. In the event that the condition cannot be resolved, the standard Device Repair and Return procedures listed in the instruction manual must be followed.

Any and all failures to successfully complete the alarm test must be recorded and documented in the SIS logbook.

### **WARNING**

*Any external alarm equipment, systems or signaling devices that were disabled must be re-activated at the conclusion of proof testing activities.*

## PRODUCT REPAIR

The X2200/X9800/X5200 is not field-repairable and any internal device repairs must be conducted at the factory. No firmware changes are permitted or authorized. All failures indicated by internal diagnostics or Proof Tests that cannot be resolved through the troubleshooting and maintenance procedures described in the manual must be reported to the manufacturer.

## OPERATING, ENVIRONMENTAL AND PERFORMANCE SPECIFICATIONS

The operating temperature range for the Safety Certified X2200/X9800/X5200 is -40C to +75C. The Safety-Certified X2200/X9800/X5200 product versions fully comply with, and must be operated in accordance with the functional and performance specifications provided in the corresponding instruction manual. A 24 hour mean time to repair should be assumed for safety availability calculations.

## SPARE PARTS

Refer to the spare parts section of the instruction manual. Safety certification is based on a sufficient number of spares to achieve a 24 hour mean time to repair.

## CERTIFICATION AND FAILURE RATE DATA

All Safety-Certified X2200/X9800/X5200 models are certified compliant to:

IEC61508: 2010

Type B Device

Systematic Capability: SIL 2 certified

HFT: 0

Low Demand Mode

PFDavg should be calculated for any safety instrumented function using the X2200/X9800/X5200. (Refer to FMEDA report for necessary information, including DU rate).

Safety Accuracy: Not applicable.

Safety Response Time: See appendix A of the corresponding instruction manual for response time details.

Product Life X2200: 25-53 years, based on manufacturer data.

Product Life X9800: 21-43 years, based on manufacturer data.

Product Life X5200: 10-78 years, based on manufacturer data.

All failure rate data for SIL verification is in the FMEDA report, which is available upon request.

## PRODUCT CERTIFICATIONS



FM, CSA, ATEX, CE, IECEx, and *exida*.  
Refer to the Instruction Manual for details.

FMEDA Report available.

For complete information regarding performance, installation, operation, maintenance and specifications of the X2200/X9800/X5200, refer to the appropriate instruction manual:

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## TERMS AND DEFINITIONS

EQP	Eagle Quantum Premier System
EQPSL/SLC	Eagle Quantum Premier Safety Loop / Signaling Line Circuit
FMEDA	Failure Mode Effects and Diagnostics Analysis
HART	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
LFL	Lower Flammable Limit
PFD	Probability of Failure on Demand (Probability of Dangerous Failure)
PFDavg	Average Probability of Failure on Demand
SFF	Safe Failure Fraction
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
X2200	Ultraviolet Flame Detector
X9800	Infrared Flame Detector
X5200	Ultraviolet and Infrared Flame Detector

## IEC 61508 Failure Rates in FIT<sup>1</sup>

Failure Category	$\lambda_{sd}$	$\lambda_{su}^2$	$\lambda_{dd}$	$\lambda_{du}$	SFF <sup>3</sup>
X2200 Analog Output	0	75	704	61	92.7%
X2200 Analog Output w HART	0	67	877	73	92.8%
X2200 Relay	208	78	501	72	91.6%
X9800 Analog Output	0	93	628	68	91.4%
X9800 Analog Output w HART	0	84	800	80	91.7%
X9800 Relay	220	95	412	79	90.2%
X5200 Analog Output	0	98	834	74	92.6%
X5200 Analog Output w HART	0	90	1007	86	92.7%
X5200 Relay	248	102	591	85	91.7%

<sup>1</sup> FIT = 1 Failure / 10<sup>9</sup> Hours

<sup>2</sup> It is important to realize that the No Effect failures are no longer included in the Safe Undetected failure category according to IEC 61508, ed2, 2010.

<sup>3</sup> Safe Failure Fraction needs to be calculated on (sub)system level.

Specifications subject to change without notice.

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