

801PHEX INTRINSICALLY SAFE ADDRESSABLE OPTICAL SMOKE & HEAT DETECTOR

PRODUCT APPLICATION & DESIGN INFORMATION

1. INTRODUCTION

The 801PHEX Intrinsically Safe Optical Smoke & Heat Detector forms part of the 800Ex Intrinsically Safe Series of MX Addressable Fire Detectors. The detector plugs into an MUBEx 4" Universal Base or 5B 5" Universal Base.

The detector is designed to transmit, to a remote Minerva MX/T2000 fire controller, digital signals which represent status of the optical smoke and heat elements of the detector.

Software within the controller is used to interpret the returned optical and heat values to raise alarm or other appropriate response according to the type of detector configured in 'MX CONSYS'.

The mode of detector may be:

- Mode 1 - Optical smoke only detector (sensitivity High, Normal or Low)
- Mode 2 - HPO smoke detector (sensitivity High, Normal or Low)
- Mode 3 - Optical (sensitivity High, Normal or Low) plus heat fixed temperature 60°C (A2S)
- Mode 4 - Heat only normal ambient R-o-R (A1R) detector (no sensitivity selection)
- Mode 5 - Heat fixed temperature 60°C (A2S) (no sensitivity selection)
- Mode 6 - HPO (sensitivity High, Normal or Low) and heat fixed temperature 60°C (A2S)

Note:

- 1) The heat detection grades are to EN54-5.
- 2) Normal and High sensitivity settings meet the requirements of EN54: Part 7 using both normal and Fastlogic modes (see paras 1.1.1 and 1.1.2).

1.1 DETECTION LOGIC

The optical smoke detector can be selected in one of two logic modes as follows:

1.1.1 NORMAL MODE

In the normal detection mode, an alarm is generated when an alarm threshold is reached.

1.1.2 FASTLOGIC MODE

In the FASTLOGIC mode, the logic operates using a system that looks at both the output level and the pattern of the signals. Using information gathered from many different fire and false alarm situations, a fuzzylogic expert system has been created. This determines the likelihood of fire based on a combination of change in output level with time and the absolute output values.

1.2 SPLIT DEVICE

The detector may be used as two separate detectors using two loop addresses.

If the detector is selected as a split device in Consys, then Address 1 can only be Mode 1 or 2.

Address 2 can only be Mode 4 or 5.

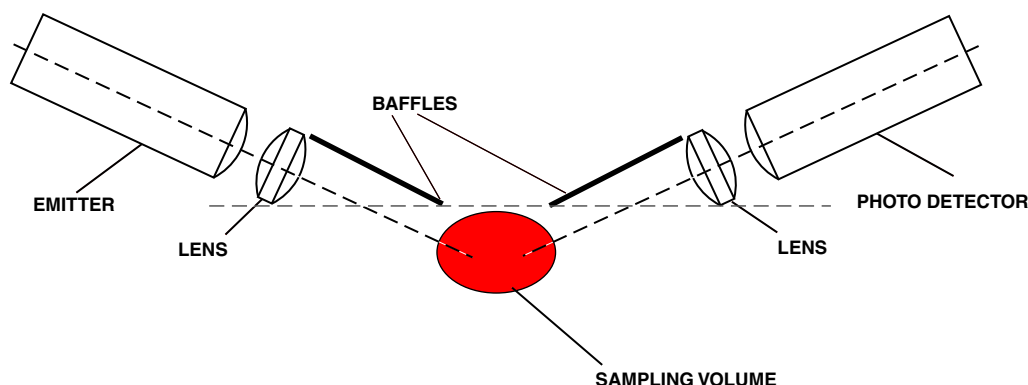


Fig. 1 Optical Chamber Schematic

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1.3 DAY/NIGHT SWITCHING

Two modes of detector operation are selectable from the list of possible modes as follows:

- ‘Normal’ mode, ie, night time operation in which the detector will be evaluated most of the time.
- ‘Day’ mode in which the detector can be switched under certain circumstances, eg, during daytime when the building is occupied with people being able to detect a fire manually. Switching to the ‘daytime’ mode can be done either by user action (pressing the DAY/NIGHT switch on the controller), event or time driven.

1.4 SENSITIVITY SWITCHING

In addition to mode switching, the sensitivity can be changed within the actual mode. This can be done either by user action or be event or time driven (eg, day/night switching). Changing the sensitivity is done by shifting the sensitivity by one level up or down.

2. INTRINSIC SAFETY

The detectors are for use in potentially explosive gas and dust atmospheres (zone 0 gas, zone 20 dust).

The detectors are designed to comply with EN/IEC 60079-0:2006, EN/IEC 60079-11:2007 and EN/IEC61241-11:2006 for Intrinsically Safe apparatus. They are certified:

ATEX code:	 II 1 GD
Certificate:	BAS01ATEX1394X
Gas/Dust code:	Ex ia IIC T5 Ex iaD 20 T100°C
IECEx Certificate:	IECEx BAS 07.0063X

These detectors are designed and manufactured to protect against other hazards as defined in paragraph 1.2.7 of Annex II of the ATEX Directive 94/9/EC.

2.1 DETECTOR USE

The detectors may only be used in conjunction with an IF800Ex Interface Module and a Pepperl+Fuchs KFD0-CS-Ex1.54 galvanic isolator.

2.2 SPECIAL CONDITIONS OF SAFE USE

The apparatus has a plastic enclosure which constitutes a potential electrostatic hazard. The enclosure must be cleaned only with a damp cloth.

3. OPERATING PRINCIPLE

The 801PHEx operates by sensing the optical scatter from smoke particles generated in a fire. While the optical scatter detector can give good detection performance for the majority of fires, some fast burning fires produce little visible smoke and some produce very black smoke, neither of which are easily detected by the optical scatter detector. (Such fires are represented in EN54-7 by Polyurethane and Heptane type fires respectively). These fires do, however, produce high heat outputs with an associated rise in air temperature.

The detector has been designed to offer improved detection of such fires, by detecting the rapid rate-of-rise of air temperature and under these conditions, increasing the smoke detection sensitivity. This gives an earlier detection of such fires and a broader detection capability than a standard detector.

The 801PHEx detector has two sensing systems as follows:

- An optical chamber with associated electronics to measure the presence of smoke by light scatter.
- A thermistor with its associated electronics to detect the presence of hot air draughts or high temperatures.

3.1 OPTICAL SYSTEM

The 801PHEx detects visible particles produced in fires by using the light scattering properties of the particles. The detector uses the optical arrangement shown diagrammatically in Fig. 1.

The optical system consists of an infra-red emitter and receiver, with a lens in front of each, so arranged that their optical axes cross in the sampling volume. The emitter, with its lens, produces a narrow beam of light which is prevented from reaching the receiver by the baffles. When smoke is present in the sampling volume a proportion of the light is scattered, some of which reaches the receiver. For a given type of smoke, the light reaching the photodetector is proportional to the smoke density.

3.2 SELF-TEST

The ‘Self-Test’ facility induces a signal into the receiver to produce an output above the alarm threshold, to signal an alarm condition when requested by the controller.

3.3 FEATURES OF MEASURING CHAMBER

The 801PHEx uses vertical chevrons to exclude ambient light.

Smoke incident on the detector is channelled into the detector by the outer cover fins (see Fig. 2) and passes through the vertical chevrons. The smoke is deflected into the optical chamber and through the sampling volume before passing out the other side of the detector.

The emitter (see Fig. 1) is a GaAlAs solid state type operating in the near infra-red (880nm peak), while the detector is a matched silicon photodiode. These devices, together with their associated lenses, are held in place by the chamber mouldings. The design of the optical system is such that the presence of small insects such as thrips, should not cause false alarms.

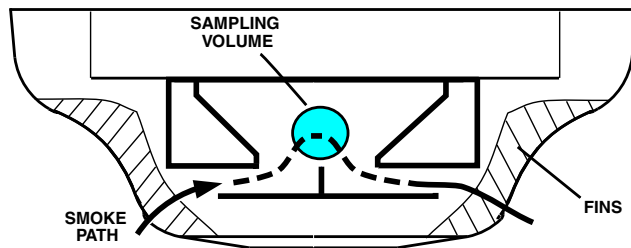


Fig. 2 Measuring Chamber Showing Smoke Flow Path

3.4 THERMAL MEASURING SYSTEM

The heat element of the detector uses a single thermistor to produce a linear output dependent on absolute temperature. Rate of change of temperature is determined by the controller by using differences between consecutive temperature values returned to the controller.

3.5 CIRCUIT DESCRIPTIONS

3.5.1 OPTICAL

Refer to Fig. 3. The emitter is only pulsed every time the detector is polled from the controller, to reduce quiescent current. The optical pulse signal as received by the photodetector (a signal proportional to the scatter within the optical chamber), is fed to the 'Optical ASIC'. The optical ASIC amplifies the analogue signal which is fed to an analogue input on the common circuit.

3.5.2 HEAT

Refer to Fig. 3.

The negative temperature coefficient thermistor produces a linear analogue output which is fed to an analogue input on the common circuit.

3.5.3 COMMON CIRCUIT

Refer to Fig. 3.

Communications between the controller and detector uses the Frequency Shift Keying (FSK) method.

The 'Discrimination Circuit' filters the FSK signal from the +ve line voltage and converts it to a digital square wave input for the 'Communications ASIC'.

The 'Communications ASIC' decodes the signal and when its own address is decoded, the analogue inputs received from the optical and heat sensing elements are converted to corresponding digital values. These digital values are then passed to the 'Tx Driver Circuit/Current Sink' which applies them to the +ve line for transmission to the controller.

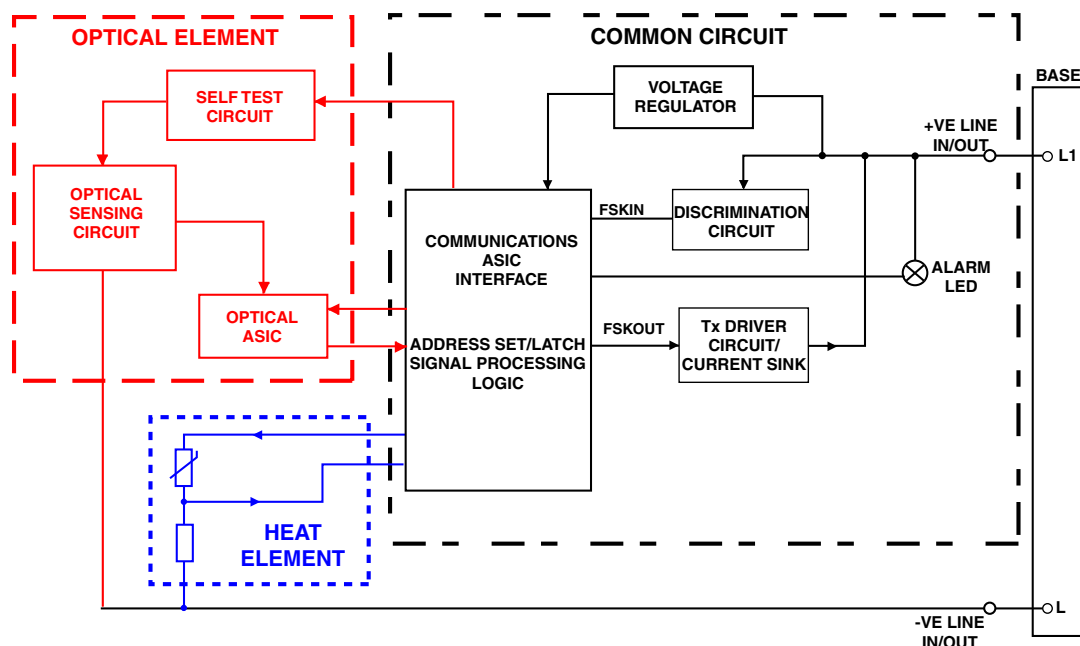


Fig. 3 Simplified Block Schematic Diagram of Detector

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3.6 WIRING

Loop cabling is connected to base terminals L (-ve) and L1 (+ve).

4. MECHANICAL CONSTRUCTION

The major components of the detector are:

- Body Assembly
- Printed Circuit
- Optical Chamber
- Optical Chamber Cover
- Thermistor
- Light Pipe
- Outer Cover

4.1 ASSEMBLY

The body assembly consists of a plastic moulding which has four embedded detector contacts which align with contacts in the MUBEx base. The moulding incorporates securing features to retain the detector in the base.

The PCB is soldered to the body contacts. These contacts act as a mechanical fixture during assembly and provide electrical contact between the contacts and the PCB. The PCB is then potted.

The chamber cover is clipped to the body over the optical chamber ensuring the thermistor protrudes through the cover. The light pipe is slotted into the chamber cover. Finally, the outer cover is clipped to the body.



Fig. 4 801PHEx Optical Smoke and Heat Detector with 5BEx 5" Base

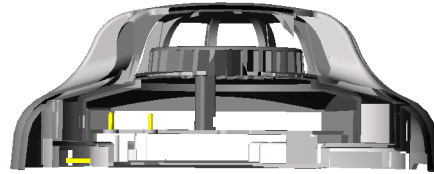


Fig. 5 Sectioned View of the Detector

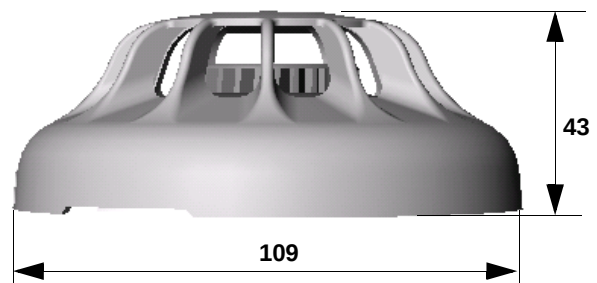


Fig. 6 Overall Dimensions of 801PHEx detector

5. TECHNICAL SPECIFICATION

5.1 MECHANICAL

Dimensions

The overall dimensions are shown in Fig. 5 (less base).

Materials

Body, cover, and closure: FR110 'BAYBLEND' flame retardant.

Weight

Detector: 0.126 kg
Detector + Base: 0.192kg

5.2 ENVIRONMENTAL

Temperature

Operating: -25°C to +70°C
Storage: -40°C to +70°C

Note: The operating temperatures quoted exceed the ATEX Certification limits.

Relative Humidity: 95% (non-condensing)

Shock:

Vibration: EN54 Pts. 5 and 7

Impact:

Corrosion: EN54 Pts. 5 and 7

The detectors comply with Lloyd's Register Test Specification Number 1 (1996). Environmental Category ENV5.

5.3 ELECTROMAGNETIC COMPATIBILITY

The detector complies with the following:

Product family standard EN50130-4 in respect of Conducted Disturbances, Radiated Immunity, Electrostatic Discharge, Fast Transients and Slow High Energy.

EN 61000-6-3 for Emissions.

5.4 ELECTRICAL CHARACTERISTICS

The following characteristics (Table 1) apply at 25°C and nominal supply voltage of 22V unless otherwise specified.

Characteristic	Min.	Typ.	Max.	Unit
Loop Voltage	18		24	V
Quiescent Current		350	400	µA
Alarm Current		3	3.5	mA

Table 1: Electrical Characteristics

Intrinsic Safety Rating:

Maximum Voltage for safety (U_i):	28V
Maximum Current for Safety (I_i):	93mA
Maximum Power Input (P_i):	650mW
Equivalent Inductance (L_i):	0
Equivalent Capacitance (C_i):	0

5.5 PERFORMANCE CHARACTERISTICS

The 801PHEX detector, with its base, forms an addressable detector which transmits signals representing the detector digital current levels to a remote control unit. The control unit evaluates these signals against pre-determined criteria and decides when an alarm condition has occurred. The information given below, therefore, relates to the performance of the 801PHEX as a transducer only, since the system alarm response is determined by the control unit.

5.5.1 RESPONSE TO SMOKE

The response of an optical smoke detector is normally measured with reference to the obscuration produced by smoke. Obscuration is measured in percent per metre, or in dB per metre. The latter unit is used in EN54-7 and is designated 'm'.

Unfortunately, there is no fixed relationship between optical scattering and obscuration, the ratio between them being dependent on the type of smoke. For convenience, 'grey' smoke is normally used but white and black smokes give more or less scattered light respectively, for a given obscuration level.

The working of the 801PHEX is a linear function of obscuration for a given type of smoke, as shown graphically in Fig. 7.

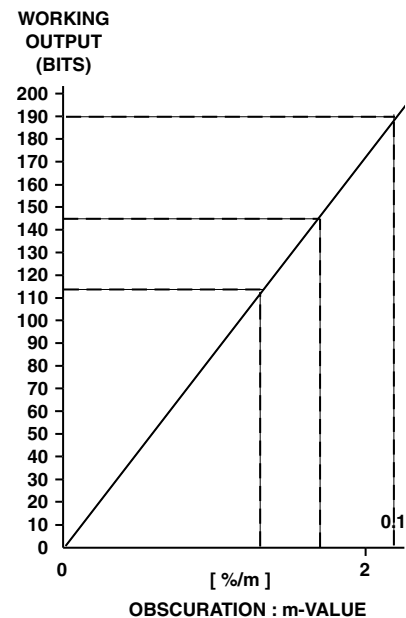


Fig. 7

5.5.2 RESPONSE TO RATE OF CHANGE OF TEMPERATURE

The detector will not be enhanced by slow rates of change of temperature or negative rates of change of temperature. The detector is designed to detect sudden horizontal draughts of hot air produced by fast burning fires. The enhancement switching point has been set to allow the detection of TF1 type fires.

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6. DETECTOR IDENTIFICATION

The detector is identified by the logo label colouring as shown in Fig. 8.

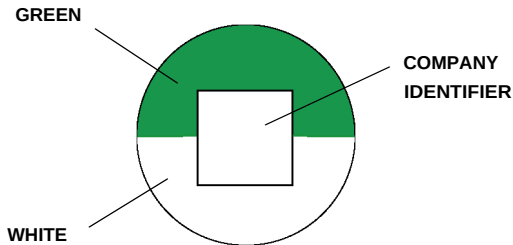


Fig. 8 Detector Identification

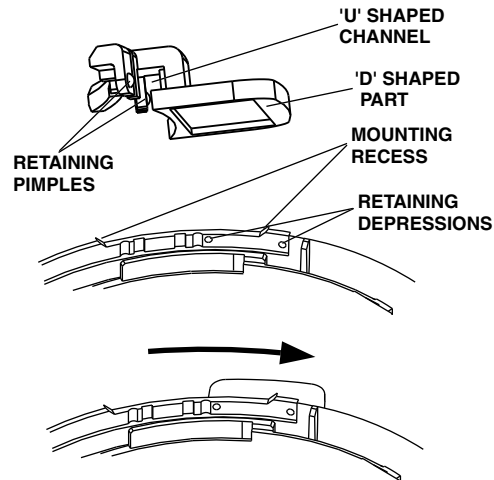


Fig. 9 Fitting Address Flag

7. DETECTOR ADDRESS

The loop address of the detector is held in internal E²PROM which is programmed either from the controller, or by a 801AP MX Service Tool.

A Service Tool Dongle (supplied with the EXI800) is required to be fitted to the 'AUX' port to program 800Ex detectors.

Note: The detector must be programmed in the Safe Area when using the MX Service Tool.

8. ADDRESS FLAG

Refer to Fig. 9. The address flag is used to identify the address and zone of the detector. The address flags are supplied in one of two packs (address 1 - 127 or 128 - 255, with a different colour for each loop) and are ordered separately from the detector. The address flag is fitted to the bottom of the detector. When the detector is fitted to the base and turned until fully located, the address flag is then transferred to the base. If the detector is removed from the base, the address flag remains with the base.

9. ORDERING INFORMATION

801PHEX Intrinsically Safe Optical Smoke + Heat detector:	516.800.530
MUBEx Base for use with Ex Detectors:	517.050.610
5BEx 5" Universal Base:	517.050.023
Address Flag Labels - Loop A (White):	516.800.931
Address Flag Labels - Loop B (Yellow):	516.800.932
Address Flag Labels - Loop C (Purple):	516.800.933
Address Flag Labels - Loop D (Green):	516.800.934
Address Flag Labels - Loop E (Grey)	516.800.935
Address Flag Labels - Loop F (Blue)	516.800.936
Address Flag Labels - Loop G (Orange)	516.800.937
Address Flag Labels - Loop H (Red)	516.800.938