DOCUMENT CONTROL NUMBER /

601P/601P-M OPTICAL SMOKE DETECTOR

PRODUCT APPLICATION AND DESIGN INFORMATION

1. INTRODUCTION

The 601P Optical Smoke Detector forms part of the Series 600 range of plug in detectors for ceiling mounting. The detector plugs into the Minerva MUB, 5B 5" Universal Base or 5BD 5" Conventional Continuity Base and is intended for two-wire operation with the majority of control equipment currently manufactured by the company.

The 601P-M is the Marine version of the 601P Optical Smoke Detector.

2. OPERATING PRINCIPLE

The 601P 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 EN 54 Part 7 by Wood Crib and Heptane type fires respectively).

2.1 OPTICAL SYSTEM

The 601P 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, so arranged, that their optical axes cross in the sampling volume. The emitter 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.

2.2 FEATURES OF MEASURING CHAMBER

The 601P uses a unique measuring system shown in Fig. 2. Unlike most other optical scatter detectors the 601P does not use vertical chevrons to exclude ambient light, but uses concentric baffles. This approach gives a better signal to noise ratio and allows the detector to be used in its high sensitivity enhanced mode. The chamber is the subject of a patent application.

The emitter (see Fig. 1) is a GaAlAs solid state type operating in the near infra-red at 880nm, while the sensor is a matched silicon photodiode. These devices are held in place by the labyrinth mouldings. The design of the labyrinth is such that the presence of small insects such as thrips should not cause false alarms.

The sampling volume is enclosed within a measuring chamber. The optical design of the chamber provides a very low background signal and is the subject of a patent application.

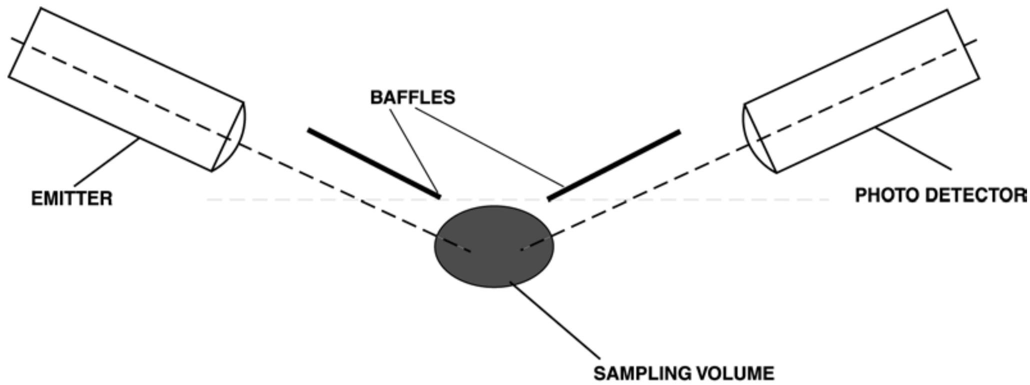

Fig. 1 Optical System Schematic

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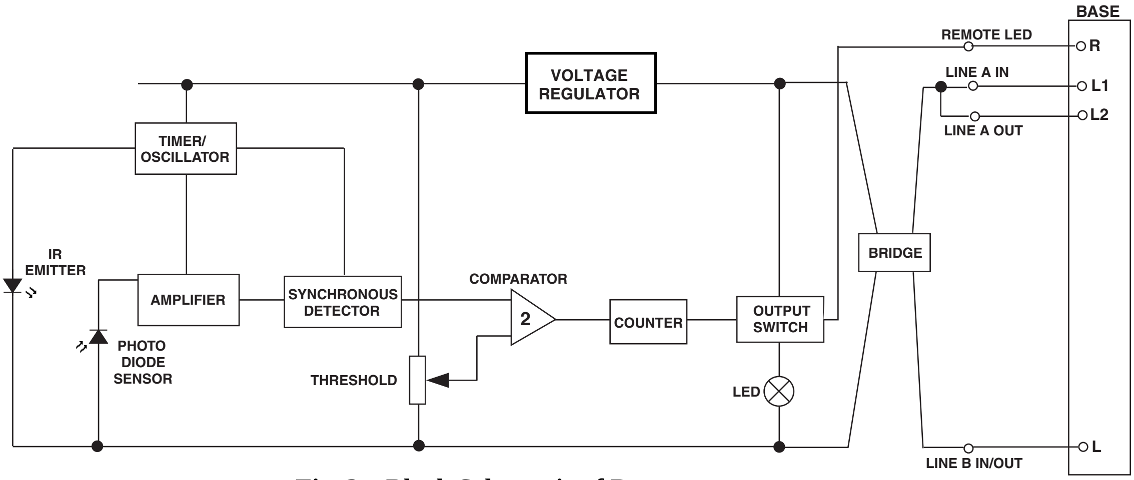

Fig. 2 Block Schematic of Detector

2.3 CIRCUIT OPERATION

A simplified block schematic of the detector is given in Fig. 2.

The emitter is subjected to a pulse stream only every 10s in order to reduce the quiescent current. The pulse signal received by the photodiode is fed to a high-gain amplifier. If smoke is present, the pulse signal received varies in proportion to the smoke density.

The amplifier output is fed via an integrator, the output of which is compared to a preset threshold level. Sophisticated synchronous detection techniques are used to reduce the effects of noise and spurious transients.

If the signal amplitude exceeds a threshold level, then the emitter samples the smoke every two seconds. The sample period remains at two seconds if the signal is above the threshold. When the counter has counted three consecutive pulses above the threshold, the output stage is latched into the alarm condition. If however, the amplitude of the second or third pulse is below the threshold, then the pulse period reverts to 10 seconds and the counter resets. The switching of the output stage lights the alarm LED and provides drive for an remote LED indicator.

The critical front end of the circuit is run off a 9.5V regulator to make it independent of supply voltage.

2.4 WIRING

The detector circuit requires a positive and negative supply and these are wired to terminals L1 and L on the base (see Fig. 4). The bridge circuit in the detector makes the detector polarity insensitive. Base terminal L1 is connected to base terminal L2 when the detector is fitted to provide continuity monitoring through the detector. Base terminals L2 and L provide outputs to the next detector or EOL device.

A drive is provided for a remote indicator connected between supply +ve and terminal R, therefore, at a detector where a remote indicator is connected, the polarity of the supply must be known.

3. MECHANICAL CONSTRUCTION

The major components of the detector are:

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

3.1 ASSEMBLY

The body assembly consists of a plastic moulding which has four embedded detector contacts aligning with contacts in the MUB, 5B or 5BD base. The moulding incorporates securing features to retain the detector in the base.

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

3.2 PRINTED CIRCUIT/OPTICAL ARRAY ASSEMBLY

All electronic components are fitted to the PCB including the Alarm LED, the IR emitter and the photo-diode.

3.3 TEST AND FINAL ASSEMBLY

The detectors are fully functionally tested and their sensitivities set in a smoke tunnel to ensure correct calibration. The sealing ring and labels are then fitted to complete detector assembly.

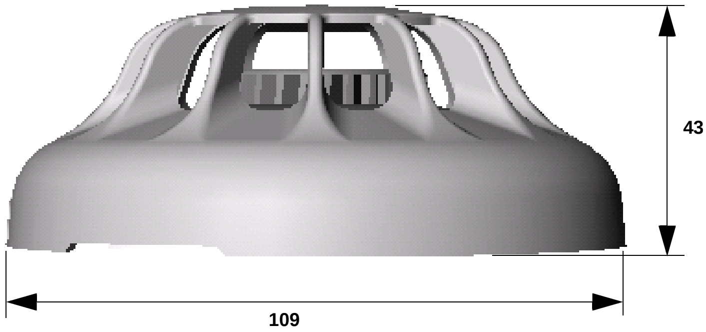

Fig. 3 Overall Dimensions of 601P

4. TECHNICAL SPECIFICATION

4.1 MECHANICAL

Dimensions

The dimensions of the 601P detector are shown in Fig. 3.

Materials

Body and cover: FR110 'BAYBLEND' Fire Resistant

Weight

Detector: 0.093kg

Detector + base: 0.143kg

4.2 ENVIRONMENTAL

Operating Temperature: -20^{o}C to +70^{o}C (please see note below).

Storage Temperature: -25^{o}C to +80^{o}C

Note:

1) *Operation below 0^{o}C is not recommended unless steps are taken to eliminate condensation and hence ice formation on the detector.*

Relative Humidity: 95% non-condensing

Shock:)
Vibration:)
Impact:) To EN54-7
Corrosion:)

4.3 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

4.4 ELECTRICAL CHARACTERISTICS

The alarm load presented to the controller is shown in Fig. 4.

The following characteristics shown in Table 1 are taken at 25^{o}C with a supply voltage of 24V unless otherwise specified.

Characteristics	Min.	Typ.	Max.	Unit
Operating Voltage (d.c.)	10.5	24	33	V
Average Quiescent Current	62	65	70	µA
Switch-on-Surge	110	130	150	µA
Stabilisation Time		30		sec
Alarm Current	See Fig. 4			mA
Holding Voltage			2	V
Holding Current			0.4	mA
Reset Time		2		sec
Remote LED drive	Remote LED via 1k			

Table. 1 Electrical Characteristics

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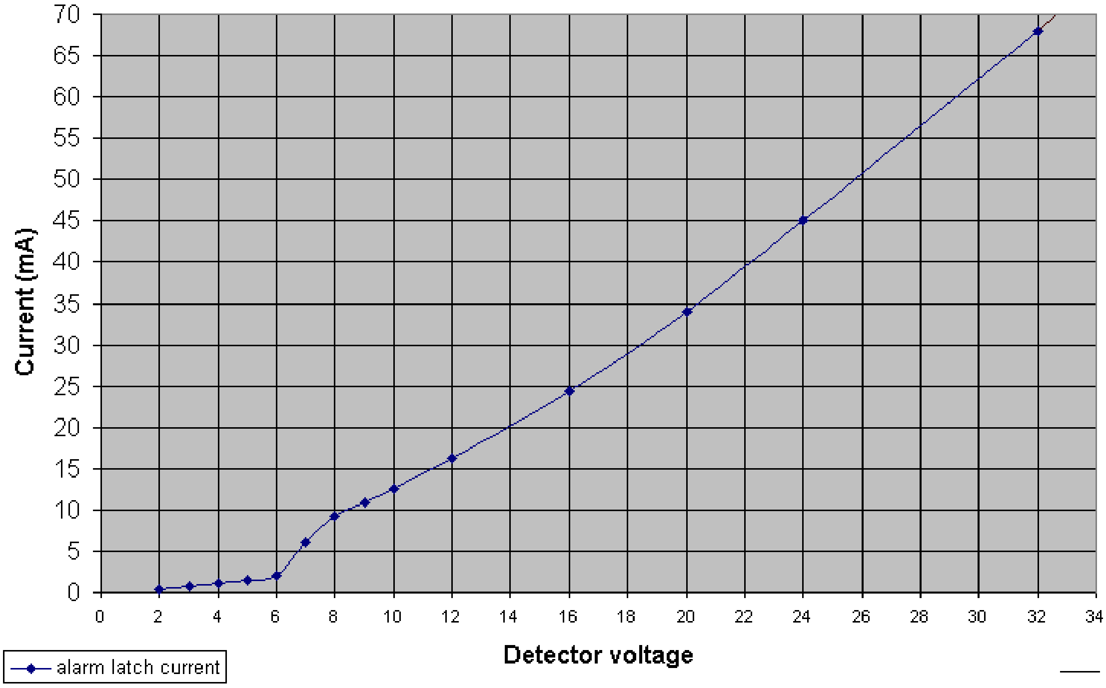


Fig. 4 Alarm Load Presented to the Controller

4.5 PERFORMANCE CHARACTERISTICS

The fundamental parameter used to define the sensitivity of an optical smoke detector is the level of smoke which will just produce an alarm under 'ideal' conditions. This parameter, known as the response threshold value, is normally measured in a smoke tunnel and is defined in terms of the obscuration produced by the smoke over a one metre path. The response threshold value is normally given in dB/m, (or % per m).

Interpretation of response threshold value is somewhat complicated by the fact that the measurement is given in terms of obscuration, whereas the detector works by scattering from the smoke particles. The response threshold (m) value will therefore, depend on the colour of the smoke. Black smokes give less scattering than light smokes for given values of obscuration as shown in Fig. 5.

Sensitivities are invariably specified for 'grey' smokes as produced by typical smouldering fires.

Normal response threshold = 0.12 dB/m, 2.7%/m typical.

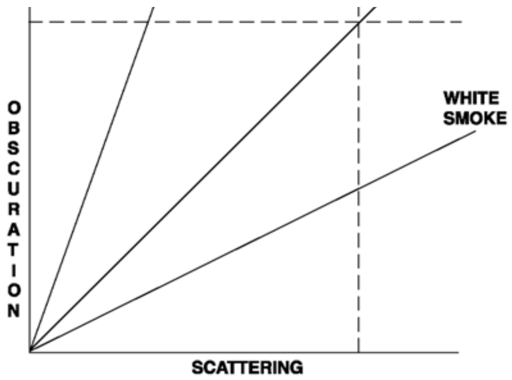


Fig. 5 Response Threshold vs Smoke Colour

4.6 RESPONSE TO FIRE TESTS

The response of an optical scatter detector to a particular 'real' fire will depend, to a large extent, on the colour of the smoke produced in the fire. However, the factors such as smoke entry characteristics, the rate of development of the fire and the thermal lift produced by the fire are also important. In order to evaluate the response under realistic conditions, detectors are subjected to test fires which cover a range of fire types. These tests are defined in EN54 Pt 7. The 601P passes the following Fire Tests:

TF1	open cellulosic (wood-flaming)
TF2	smouldering pyrolysis
TF3	glowing smouldering (cotton)
TF4	open plastics (polyurethane foam)
TF5	liquid (n-heptane)

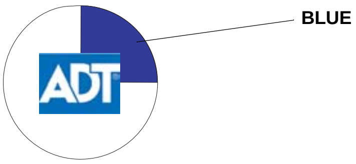
Table 2: Response to Fire Tests

Note: TF2 to TF5 are mandatory test fires required to meet EN54 Pt 7.

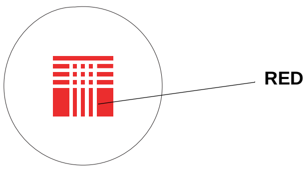
5. DETECTOR IDENTIFICATION

The detector is identified by the logo label, as shown in Fig. 6.

ADT Variant



Thorn Variant



Tyco Variant (Tyco Blue)

Tyco Marine Variant (Black)

Fig. 6 Detector identification

6. ORDERING INFORMATION

601P Optical Smoke Detector:	516.600.001.A/T/Y
601P-M Marine Optical Smoke Detector:	516.600.201
MUB Universal Base:	517.050.001
5B 5" Universal Base:	517.050.017
5BD 5" Conventional Continuity Base:	517.050.600

JM/pln

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