801F/811F Infra-red Flame Detector

Introduction

The 801F Infra-red flame detector forms part of the 800 Series Addressable Fire detectors. The 811F is the Marine version of the 801F.

The detector is intended to plug into the following:

- 5B 5" Base
- 5B 5" Isolator Base

The detector is designed to transmit, to a remote MX/MX2/T2000/MZX fire controller, digital signals which represent status of the flame sensing element. The flame detector also has a self-test facility.

Operating Principle

Optical Characteristics

The 801F is designed to detect the infra-red radiation produced by flaming fires involving carbonaceous materials.

- Fig. 1(a) shows the spectrum of a typical fire of this type
- Fig. 1(b) the spectrum of the radiation of the sun and
- Fig. 1(c) that of a tungsten filament lamp.

It can be seen that there is a large peak in the flame output at wavelengths in the region of 4.45 µm. This peak is a characteristic of carbonaceous flames and results from the formation of carbon dioxide in the flame. It will be seen also that the radiation from the sun and from the filament lamp is relatively low in this region.

In order to exploit these spectral characteristics, the 801F uses an optical filter, which transmits infra-red between 4.38 µm and 4.56 µm (shown shaded in Fig. 1(a)). This bandwidth allows high sensitivity to flames with low sensitivity to other interfering sources.

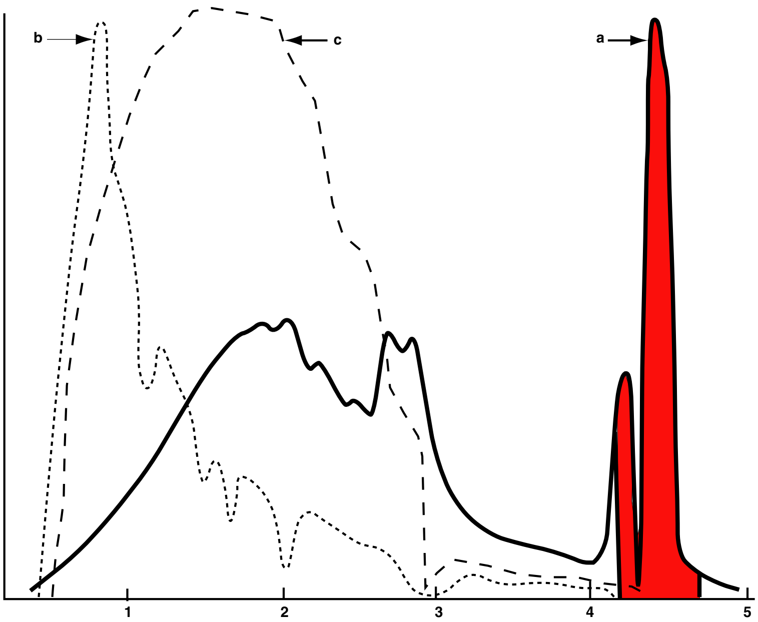

Fig. 1: Spectrums of:
a) Typical Carbonaceous Fire
b) Solar Radiation at Ground Level
c) Tungsten Filament Lamp

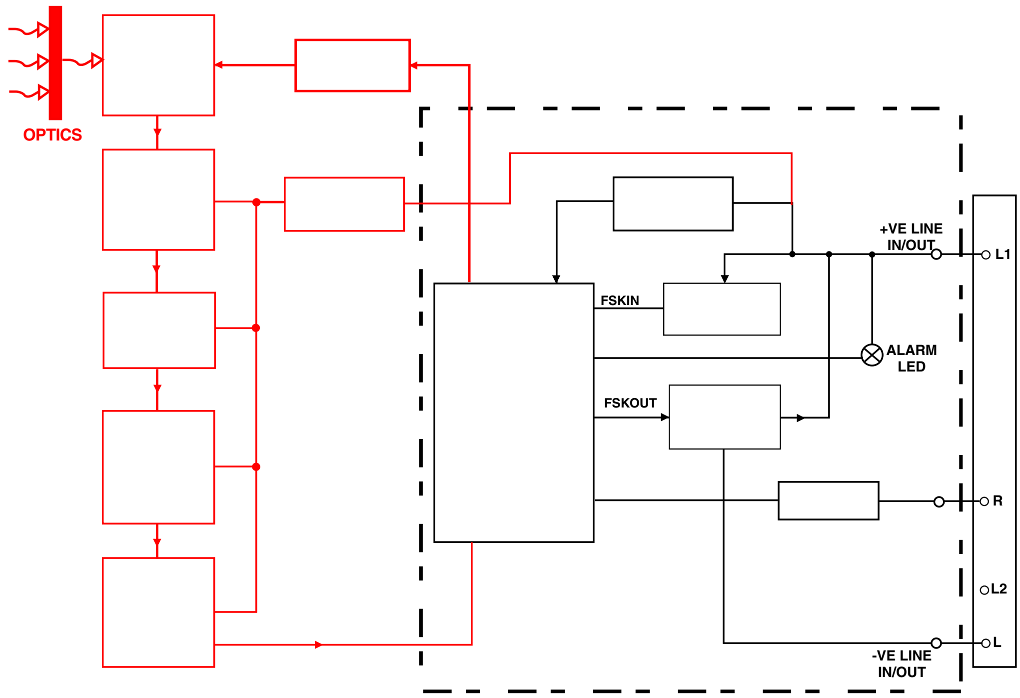

Fig. 2: Simplified Block Schematic Diagram of Detector

Flicker Characteristics

Radiation from a flame is not constant but varies with time. This flicker is present in all flames to a greater or lesser degree (including those resulting from high pressure gas jets) and can be used to give improved discrimination between flames and other sources of infra-red.

The 801F responds to flicker frequencies in the range of 1 - 10 Hz, which provides high sensitivity to almost all types of accidental fire.

Circuit Operation

Flame Sensor

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

The infra-red radiation passing through the narrow-band filter falls on a pyroelectric sensor, which responds to the flickering component of the radiation. The electrical signal produced is amplified and filtered, to remove frequencies outside the required flicker region.

The threshold detector and signal processor evaluate the amplitude and frequency characteristics of the flicker and pass the results to the signal processing logic in the common circuit.

All critical parts of the circuit are fed by an internal voltage regulator to make the sensitivity independent of supply over a wide range.

Common Circuit

Refer to Fig. 2.

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 flame sensor circuit 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.

The Common Circuit is also used to:

- Control the operation of the Remote LED via the 'Remote LED Circuit' from controller commands.

Wiring

Loop cabling is connected to the base terminals L (-ve) and L1 (+ve). A drive is provided for a remote indicator connected between loop positive and terminal R. Terminal L2 is for use with functional sounder and relay bases.

Mechanical Construction

The major components of the detector are:

- Body Assembly
- Printed Circuit
- Outer Cover
- Sapphire Lens

Body Assembly

The body assembly consists of a plastic moulding, secured with the four detector contacts, which aligns with contacts in the MUB/5B bases. The moulding incorporates securing features to retain the detector in the base.

The PCB is clipped to the body by four spring contacts. These contacts both hold the assembly together mechanically and provides electrical contact between the base contacts and the PCB.

Final Assembly

The assembly described in “Body Assembly” is, in effect, a complete detector. The outer cover is fitted with sapphire window, which is clipped onto the body assembly. The outer cover provides a further protection against external influences.

Approvals

The 801F/811F meet all the requirements of EN 54: Part 10 as a Class 2 flame detector.

Technical Specification

Mechanical

Parameter	Value
Materials: Body, Cover and Closure	FR3010 ‘BAYBLEND’ flame retardant.
Weight	74 g

Table 1: Technical Specification

The overall dimensions are shown in Fig. 3:

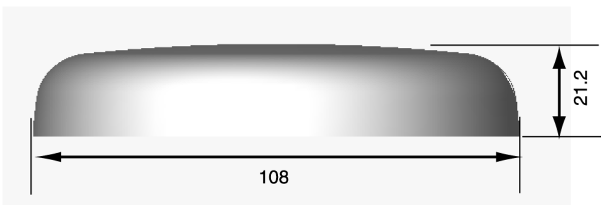

Fig. 3: Overall Dimension of 801F Detector

Environmental

Parameter	Value
Operating Temperature	-20 °C to +70 °C
Storage Temperature	-40 °C to +80 °C
Relative Humidity - Operational:	90% RH continuous (non-condensing) and up to 99% RH intermittent (non-condensing)
Relative Humidity - Storage:	>40% RH and <70% RH
Shock	To EN54 Part 10
Vibration	
Impact	
Corrosion	

Table 2: Environmental Conditions

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
- EN61000-6-3 for Emissions

Compatibility Standards
The EMC standards fulfil the requirements of the European Directive for EMC(89/336/EEC).

Electrical Characteristics

The following characteristics (Table 3) apply at 25 °C and detector nominal supply voltage of 37.5 V unless otherwise specified.

Characteristics	Min.	Typ.	Max.	Unit
Loop Voltage	20	-	40	V
Quiescent Current	-	300	350	µA
Alarm Current*		3	3.3	mA

Table 3: Electrical Characteristics
Note: ** No remote indicator fitted.*

Performance Characteristics

Mode of Operation

The "Operating Principle" of the detector has been described on page 1. This section is intended to illustrate how that electrical performance translates into practical fire detection operation.

It has been stated that the detector looks at radiation with a 'flame flicker' frequency, and will reach the alarm level approximately 5 seconds after receiving radiation that is above a threshold level. Below the threshold level no alarm will be raised, and if the level hovers around the threshold level the alarm may take slightly longer to be reached.

The level of the signal depends on the size of the flame and its distance from the detector. For liquid fuels the size of the flame is almost proportional to the surface area on fire, but for any fire, the signal level drops off with the square of the distance.

Fire tests are normally carried out using liquid fuels, burning in pans of known area. The sensitivity of a detector is usually then expressed as the on axis distance at which a 0.1 m^2 N-heptane (similar to petrol), pan fire can be detected.

As different fuels will take different lengths of time for a fire to establish, comparative figures for different types of fuel are always measured by exposing the detector to an already established fire. For example, diesel takes about 60 seconds to completely burn across the surface of a pan, whereas n-heptane takes about 6 seconds, although pre-heating the diesel to just below its flash point will generate similar behaviour to the n-heptane at 25 ^oC.

Fire Test Data

The fire test data presented is for fires which have reached equilibrium and with the detector axis horizontal with respect to the fire.

N-Heptane

This is chosen as the reference fuel because of availability and consistent burn. The graph in Fig. 4 shows how the detection range varies with pan size, and it can be seen that this approximates to a square law; that is to say that to obtain detection at twice the distance the pan area must be multiplied by 4.

The sensitivity of the detector also varies by how close to the axis the fire occurs. The polar diagram in Fig. 5 illustrates this. To read this diagram the curve which comes out from the detector represents the line of just detecting a fire. The curved gridlines give the fraction of range, so on axis the range is 1, dropping to about 80% at 40^o off axis, but by 50^o off axis it is already down to 50% and from then on it drops very rapidly.

The siting of detectors depends on how large a fire can be tolerated before an alarm has to be raised. The diagram in Fig. 6 uses the 50% range at 50^o angle of incidence to give an outline of the typical size of fire that can be seen at what distance to give an idea of both the ceiling mounting height and the area that can be covered when so mounted.

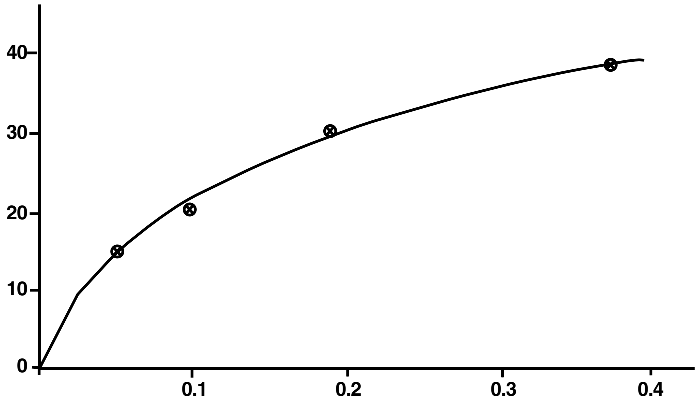

Fig. 4: Typical Detector Range vs. Pan Area - n-heptane

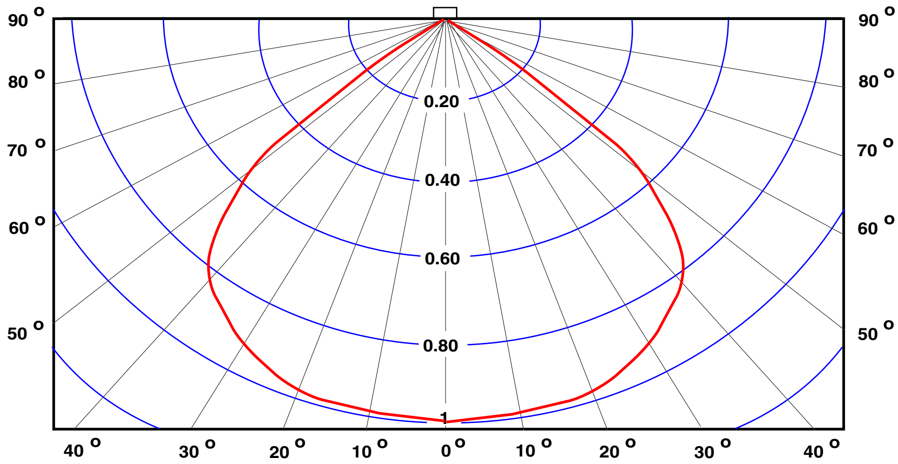

Fig. 5: Relative Range vs Angle of Incidence

Other Liquid Hydrocarbons

Ranges achieved with other fuels burning in 0.1 m^2 pans are as follows:

Fuel	Range
Kerosene	15.5 m
Alcohol (I.M.S.)	13 m
Diesel oil	13 m
Ethylene glycol	15.5 m

Table 4: Fuel Burning Ranges

The typical detection range for other pan areas may be calculated using the square law relationship given in the "Fire Test Data" on page 4.

Design of System

General

Using the information given in "Operating Principle" on page 1 to "Performance Characteristics" on page 4, it is possible to design a flame detection system having a predictable performance. Guidance on the application of the above data and on siting of detectors is given in the following section.

Use of Fire Test Data

It has been explained in "Performance Characteristics" on page 4 that the sensitivity of the detector is specified in terms of its response to well-defined test fires. Tests are carried out using a 0.1 m^2 pan. Sensitivity to other pan areas is calculated from the square law relationship. That is to obtain detection at twice the distance, the pan area must be multiplied by four.

Accidental fires are rarely of a well-defined size. It is still possible; however, to calculate the response to a 'real' fire using the fire test data.

For example, a spillage fire involving a highly volatile liquid, e.g., n-heptane: will spread quickly from the point of ignition to cover the complete surface of the pool. Such a spillage would normally cover approximately 2 m^2. Using the data for n-heptane fires and extrapolating to an area of 2 m^2, the 801F should respond at a distance of about 120 m.

If the spillage is of a less volatile material (e.g. diesel), the spread of the flame from the ignition point will be much slower, as will the detector response time.

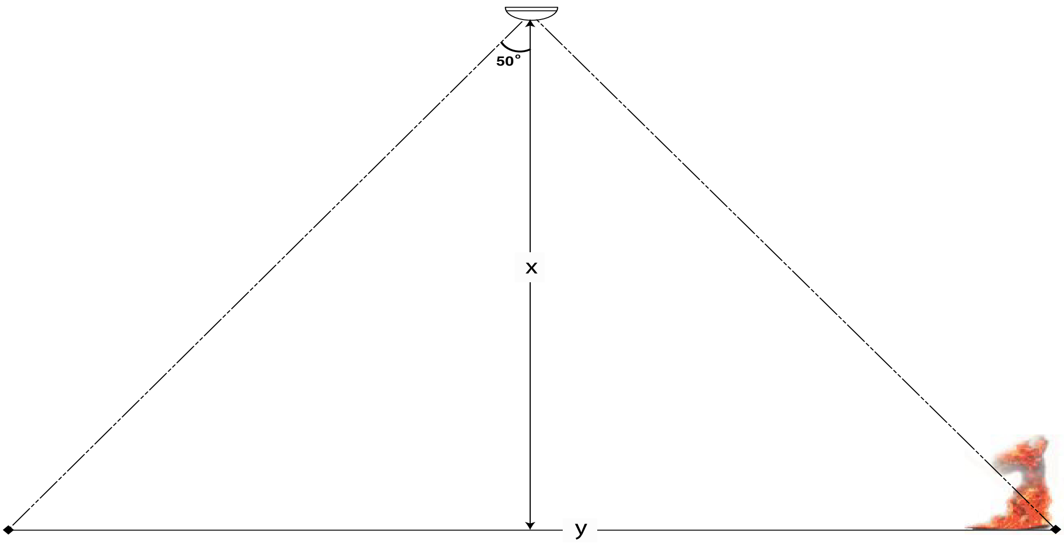

Fig. 6: Field of View

Determining the Number of Detectors

The number of detectors required for a particular risk will depend on the area involved and the fire size at which detection is required. Large areas or small fires require large numbers of detectors.

As there are no agreed 'rules' for the application of flame detectors, the overall system sensitivity must be agreed between the designer and the end user. When agreement has been reached the system designer can determine the area to be covered by each detector using the fire test data.

The detector is designed primarily for ceiling mounting with its axis vertically downwards. When used in this way it will cover a circular area at ground level, the diameters of the circle being proportional to the height. Under these conditions the effective sensitivity is that which is achieved at the edge of this circular area taking into account the slant range and the angle of incidence.

Fig. 5 shows the effective sensitivity for n-heptane fires when used in this configuration. Sensitivity to other fuels can be determined from the data given in "Other Liquid Hydrocarbons" on page 5.

NOTICE: Hot Vibrating Body

Engines (and other hot vibrating bodies) can cause false alarms. This happens when the rising column of hot air above the engine has a wave motion from the vibration. This is interpreted by the detector as the flickering of a flame, which could cause a false alarm.

To prevent this the detector should not be mounted above the engine. You should mount the detector so it points diagonally at the engine on a suitable bracket. Alternatively, mount the detector to a vertical wall pointing sideways at the engine.

NOTICE: Installation Guidance

Any object within the detector's field of view will cause a 'shadow' in the protected area. Small objects close to the detector can cause large shadows.

The detectors should not be installed directly below or in close proximity to watermist nozzles/sprinkler heads or where they will be directly effected by water when a release takes place.

Detector Address

The loop address of the detector is held in the internal E2PROM, which is programmed either from the controller, or by the 801AP MX Service Tool or the 850EMT Engineering Management Tool.

Configuration

The detector may be configured as Immediate (interrupt) or Verified (5 second delay).

Address Flag

Refer to Fig. 7. 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.

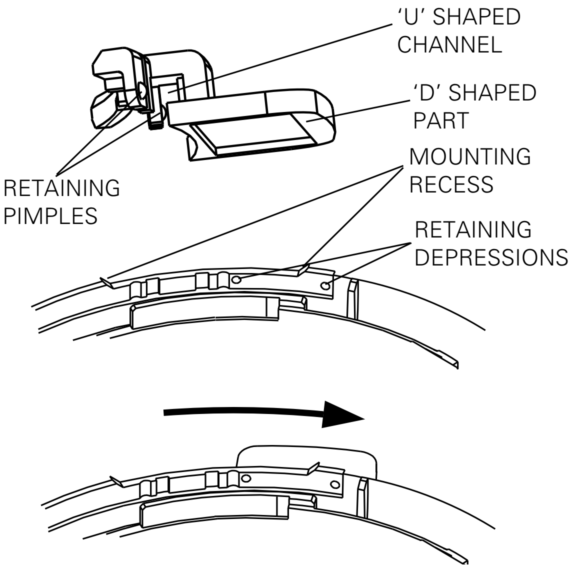

Fig. 7: Fitting Address Flag

CPR Information

0832

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8212 Neuhausen am Rheinfall,
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DoP-2015-4063

EN54-10: 2002 + A1: 2005

MX addressable Class 2 point type flame detector for use in fire detection and alarm systems in buildings.

801F

811F (Marine)

Essential Characteristics

EN54-10: 2002 + A1: 2005

Nominal activation conditions/Sensitivity, Response delay (response time) and Performance under fire conditions: Pass

Operational reliability: Pass

Tolerance to supply voltage: Pass

Durability of operational reliability and response delay; temperature resistance: Pass

Durability of operational reliability; vibration resistance: Pass

Durability of operational reliability; humidity resistance: Pass

Durability of operational reliability; corrosion resistance: Pass

Durability of operational reliability; electrical stability: Pass

Application & Design 17A-02-F

Installation Instructions 17A-03-5B

Service Instructions 17A-04-S

Ordering Information

Item	Order Code
801F Infra-red Flame Detector	516.800.006
811F Infra-red Flame Detector (Marine)	516.800.007
5B 5" Universal Base	517.050.017
5BI 5" Isolator Base	517.050.018
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

Table 5: Order Codes