DOCUMENT CONTROL NUMBER /

DETECTORS, MF300 RANGE

PRODUCT APPLICATION AND DESIGN INFORMATION

1. INTRODUCTION

The MF300 Range of Ion-Chamber Smoke Detectors form part of the M300 series of plug in detectors for ceiling mounting. The range is intended for two-wire operation with the majority of control equipment currently manufactured by the company. Detectors having different sensitivities and response characteristics are offered, as is an intrinsically safe type for use in hazardous atmospheres.

WARNING:

THESE DETECTORS CONTAIN A SMALL AMOUNT OF RADIOACTIVE MATERIAL - [Americium 241]. DETECTORS ARE SAFE UNDER THE PRESCRIBED CONDITIONS OF USE BUT MUST NOT BE DISMANTLED BY UNAUTHORISED PERSONS. STORAGE AND TRANSPORT OF DETECTORS MUST BE ARRANGED IN ACCORDANCE WITH COMPANY PUBLICATION TSG 10.4. THORN SECURITY LIMITED PROVIDE A DISPOSAL SERVICE FOR THESE DETECTORS.

2. OPERATING PRINCIPLE CHAMBER

Detectors in the MF300 range use an ionisation chamber to detect the presence of both visible and invisible particles [aerosols] produced in fires. All detectors in the range use the same chamber which is represented diagrammatically in Fig. 1.

The small radioactive source [<33.3kBq of Americium 241] ionises the air within the volume enclosed by the slotted outer cover. The ionisation causes a small current to flow between the source and the cover which have a fixed voltage applied between them.

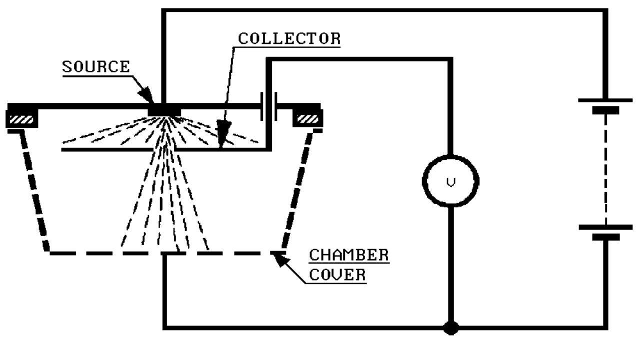

Fig. 1 Representational Diagram Ion-Chamber

Within the chamber is a perforated electrode known as the collector. This electrode will, under clean air conditions, assume a certain potential relative to the outer cover. This potential is largely unaffected by the strength of the source or by temperature, pressure and humidity.

If smoke/aerosols are introduced into the chamber, however, the potential of the collector will increase. The magnitude of this potential can be used to indicate the smoke density. The current that flows across the chamber is very small and the device used to sense the potential of the collector must therefore be of very high impedance, see Fig. 2.

To ensure high stability and resistance to corrosion all metal parts of the chamber are of stainless steel and the critical insulators are of PTFE.

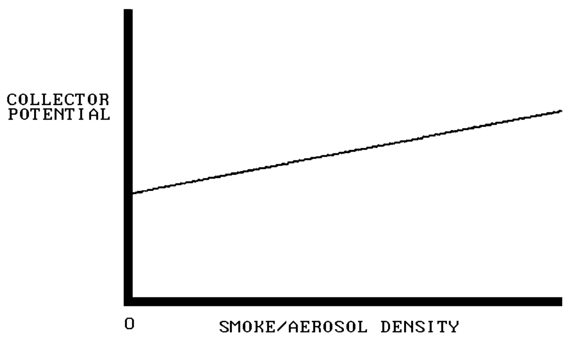

Fig. 2 Graph Showing Collector Potential Relative to Smoke/Aerosol Density

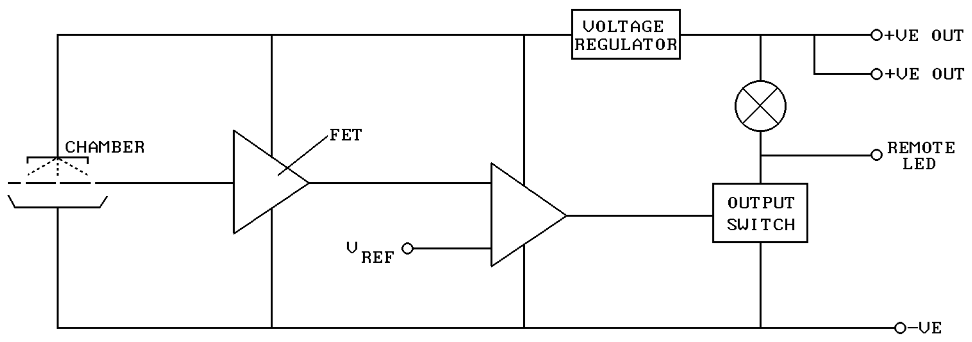

Fig. 3 Simplified Block Schematic Diagram of Detector

2.1 CIRCUIT

2.1.1 STANDARD VERSION DETECTORS

A simplified block schematic is given in Fig. 3.

The voltage of the collector electrode of the chamber is buffered by the high impedance amplifier stage and compared with a factory-set reference voltage. When the collector voltage exceeds the preset reference level, which determines the sensitivity of the detector, the comparator output changes state.

This change of state causes the output switch to draw extra current from the supply to signal an ‘Alarm’ condition and to light the integral alarm indicator.

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

Drive is supplied from the detector circuit for a remote LED indicator and two +ve terminals are provided to allow monitoring of the zone circuit through the detector.

2.1.2 DELAYED RESPONSE VERSIONS

The delayed response versions of the detector operate in a similar manner to the standard versions but have a time delay element between the comparator and the output switch. In this way it is necessary for the smoke level to be above the preset alarm level for typically 20 seconds before an alarm is released.

2.1.3 INTRINSICALLY-SAFE VERSIONS OF THE DETECTOR

The operation of the intrinsically-safe versions is identical to the conventional [safe-area] types. Circuits are modified, however, to ensure that intrinsic safety is maintained under normal conditions and with any two zone circuit faults.

3. MECHANICAL CONSTRUCTION

The major components of the detectors are:

- Body Assembly
- Printed Circuit/ Chamber Assembly
- Baffle and Insect Screen
- Outer Cover

An exploded view of the detector is given in Fig. 4.

3.1 BODY ASSEMBLY

The body assembly consists of a plastic moulding to which are secured the four detector contacts which align with contacts in the M300 Base. The moulding incorporates securing and polarising features to retain the detector in the base.

The inside surface of the moulding is metallised to provide shielding against EMI [Electro Magnetic Interference]; the connections between the contacts and the PCB are made using feed-through capacitors.

3.2 PRINTED CIRCUIT/CHAMBER ASSEMBLY

All electronic components, including the alarm LED indicator and FET buffer are mounted on a single printed circuit board. The complete chamber assembly is also mounted on the PCB although its cover is removable to facilitate routine factory cleaning.

The printed circuit/chamber assembly is fitted inside the body assembly and secured to the feed-through capacitors. All external connections to the circuit are therefore provided with EMI filtering.

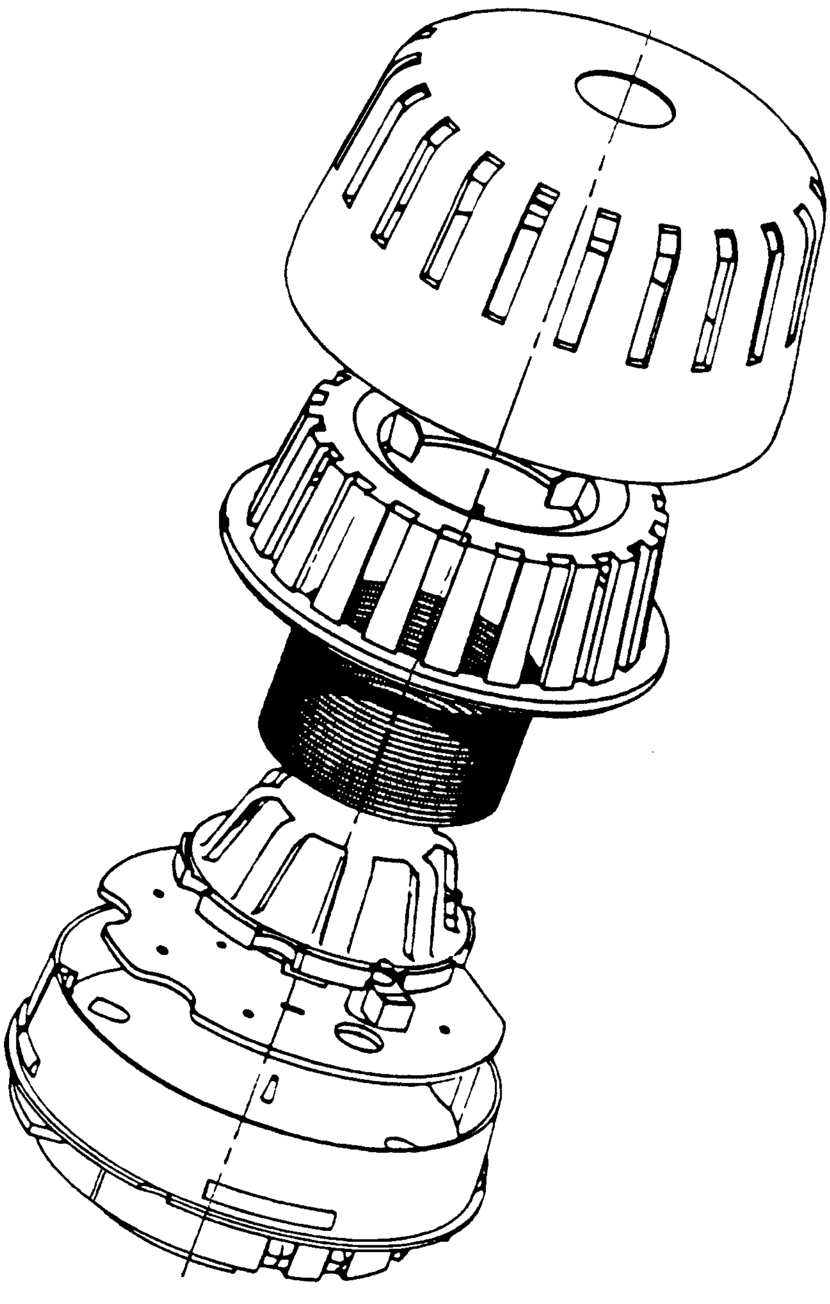

Fig. 4 Exploded View of Type MF300 Detector

The body assembly is then filled with epoxy resin so that all critical components and conductors are encapsulated as a protection against corrosion and mechanical shock.

3.3 FINAL ASSEMBLY

The assembly described in para 3.2 is, in effect, a complete detector but the remaining components provide further protection against external influences.

The insect screen is fitted over the outer cover of the chamber to prevent the entry of insects which would cause false alarms. The baffle, in conjunction with the outer cover, is carefully designed to allow easy entry to smoke and, at the same time, to minimise the effects of wind on the chamber. Both the baffle and the insect screen are retained by the outer cover which is snap fitted onto the body assembly.

4. TECHNICAL SPECIFICATION

4.1 GENERAL

Several detector variations are offered within the MF300 Range. The technical specifications of these are very similar and the details given are applicable to all unless otherwise stated.

4.2 MECHANICAL

Dimensions

The dimensions of the MF300 detector are shown in Fig. 5.

Materials

Body and Cover:	“BAYBLEND” ABS /polycarbonate alloy Thermoplastic, self-colour white.
Chamber Components:	Bright stainless Steel to BS 1449: Pt 2 Grade 316 S16, PTFE, and polycarbonate.

Weight

Detector:	0.2kg
Detector plus base:	0.3kg

Environmental

Operating Temperature:	-20^{o}C to +70^{o}C but see note.

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

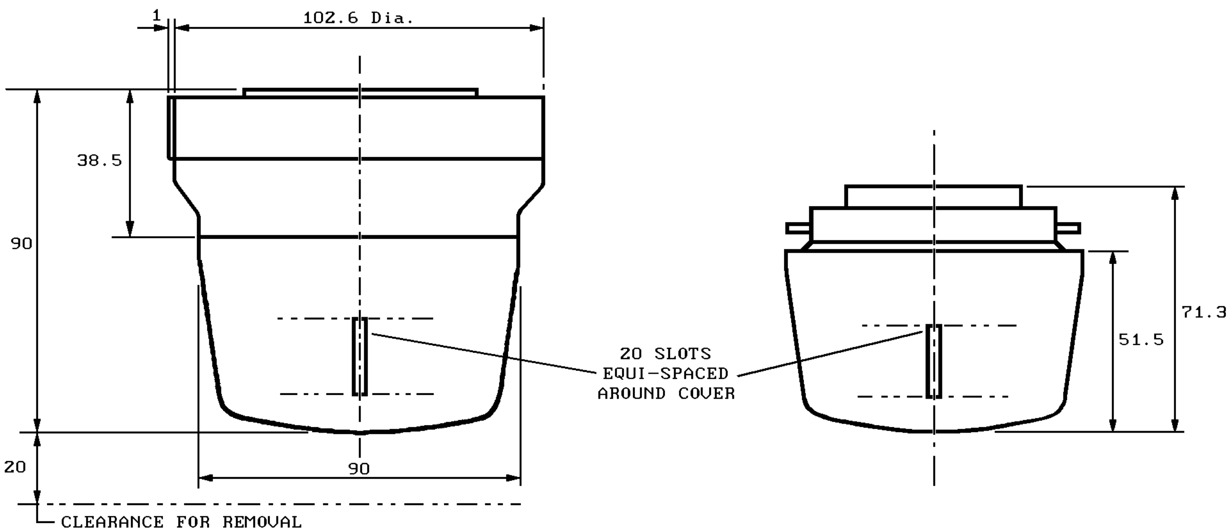

Fig. 5 Overall Dimensions of MF300 Range Detector

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

Relative Humidity: 95% non-condensing

Shock:
Vibration:
Impact:
Corrosion:
} To BS 5445: Pt 7 [EN54 -7]

EMI: Equals or exceeds the requirements of BS EN 50081-1 and BS EN 50082-1

4.3 ELECTRICAL

Characteristics	Min.	Typ.	Max.	Unit
Operating Voltage [d.c.]	15	20	24	V
Operating Voltage [Ex's]	16	20	24	V
Quiescent Current			100	µA
Switch-on-Surge			0	A
Stabilisation Time			20	sec
Alarm Current	5	25	60	mA
Alarm Current [Ex types]	5	20	50	mA
Holding Current	60		200	µA
Holding Voltage	0.6		4	V
Reset Time			2	sec
Remote LED drive	Alarm Current less 10 mA			

Table. 1 Electrical Characteristics

Characteristics

The characteristics shown in Table 1 are taken at 25^{o}C with an operating voltage of 20V unless otherwise specified. The alarm load presented to the controller by the detector is shown in Fig. 6.

4.4 INTRINSIC SAFETY

The MF301Ex is designed to comply with BS 5501: Pt 7 [EN 50 020] for intrinsically safe apparatus. It is designed to be certified:

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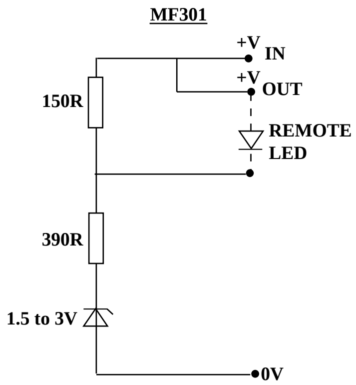
and used in conjunction with a suitable zener safety barrier in a certified intrinsically-safe system.

Electrical and performance details are generally the same as for the MF301 detector. The following additional information is applicable to the MF301Ex detector:

Maximum Voltage [for safety]: 28V
Maximum Power Input: 1W
Equivalent Inductance: 0
Equivalent Capacitance: 1.5nF



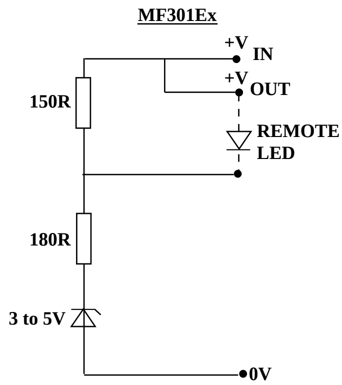


Fig. 6 The Alarm Load Presented to the Controller

DESIGNATION	RESPONSE THRESHOLD VALUE Y	RESPONSE DELAY SEC.	IDENTIFICATION COLOUR
MF301H	0.4	8	RED
MF301DH	0.4	20	RED & YELLOW
MF301	0.75	8	WHITE
MF301D	0.75	20	WHITE & YELLOW
MF301Ex	0.75	8	WHITE
MF301L	1.3	8	BLUE

Table. 2 Typical Response Threshold Values and Response Delays

4.5 PERFORMANCE CHARACTERISTICS

The fundamental parameter in defining the performance of a 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 in which the smoke density is monitored by a standard ionisation chamber. Smoke density is expressed as a `y' value which is proportional to the aerosol concentration.

Also of importance is the built-in time delay which ensures that no alarm will be given until the smoke density has exceeded the response threshold value for a certain length of time. Such a delay is useful for the elimination of transient effects although the sensitivity of the detector to real fires is also affected.

Each detector type is identified by a coloured spot fitted in the centre of the outer cover. Typical response threshold values and response delays are given in Table 2.

The MF301 is suitable for the majority of applications: the high and low sensitivity types should only be used for very clean and very dirty [smoky] environments respectively.

The effect of wind, atmospheric pressure and temperature on the detectors is discussed in paras 4.5.1 to 4.5.4.

4.5.1 THE EFFECT OF AIRFLOW ON DETECTOR SENSITIVITY

The MF300 range of detectors have been specifically designed not to give false alarms when subjected to draughts or gusts of wind which may be experienced due to an open window, etc.

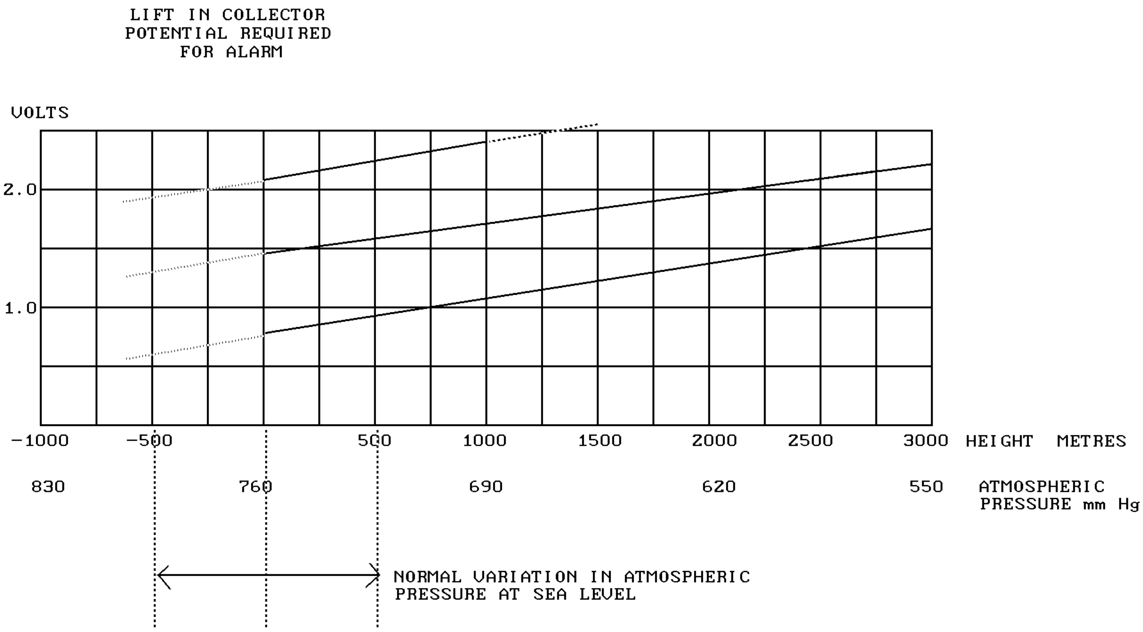


Fig. 7 Graph to Show Change in Detector Sensitivity with Atmospheric Pressure

In general, in areas where continuous forced ventilation exists, it is recommended that:

a) Only high sensitivity [H] detectors may be fitted where the airflow exceeds 4m/s,

b) standard sensitivity detectors may be fitted where the airflow is less than 4m/s and,

c) low sensitivity detectors may only be fitted where the air flow is less than 2m/s.

The MF300 series of detectors meets the airflow requirements of EN54 Pt 7.

4.5.2 THE EFFECT OF TEMPERATURE ON DETECTOR SENSITIVITY

The detector includes electronic temperature compensation. The detector sensitivity is substantially constant over its specified operating range.

4.5.3 THE EFFECT OF ATMOSPHERIC PRESSURE ON SENSITIVITY

Atmospheric pressure reduces with altitude. The effect of this is to reduce the sensitivity of the detector as the altitude increases, [see Fig. 7]. For installations sited above 1500m, it is recommended that high sensitivity [H] detectors be installed instead of standard sensitivity detectors. Low sensitivity [L] detectors should not be installed in areas sited above 1000m.

4.6 RESPONSE TO FIRE TESTS

The response of a detector to real or large-scale test fires will be partly dependent upon its Response Threshold Value and its Response Delay. Other factors, however, such as the smoke entry characteristic of the detector and the rate of development of the fire, the thermal lift of the fire and the type of smoke it produces, are also important. For this reason, smoke detectors are subjected to test fires covering a range of fire types.

The tests are defined in BS 5445: Pt 9 which also defines the way in which detector sensitivity is classified. Three classes are used: A, B and C, where A is the highest sensitivity. If the detector does not respond, or responds inadequately, to a test fire it is not classified, i.e. [N].

Typical test results for the MF301 detector are given in Table 3.

DESIGNATION	TYPE	CLASSIFICATION
TF1	open cellulosic [wood - flaming]	A
TF2	smouldering pyrolysis [wood]	C
TF3	glowing smouldering cotton]	B
TF4	open plastics polyurethane foam	A
TF5	liquid [n-heptane]	B
TF6	liquid [methylated spirit]	N

Table. 3 Test Results for MF301 Detector

5. ORDERING INFORMATION

MF301H	High Sensitivity:	516-020-005
MF301DH	High Sensitivity Delayed Response:	516-020-006
MF301	Normal Sensitivity:	516-020-002
MF301D	Normal Sensitivity Delayed Response:	516-020-004
MF301Ex	Normal Sensitivity Intrinsically-Safe:	516-020-003
MF301L	Low Sensitivity:	516-020-001

6. RELATED PUBLICATIONS

01A-02-D2	DESIGN INFORMATION, M300 SERIES DETECTOR BASE AND ACCESSORIES
01A-02-I1	INSTALLATION, M300 SERIES DETECTOR BASE AND ACCESSORIES
01A-02-C1	COMMISSIONING, M300 SERIES DETECTOR BASE AND ACCESSORIES
01A-02-S1	MAINTENANCE & SERVICE, M300 SERIES DETECTORS AND BASE

JM/jm

20th February 1996