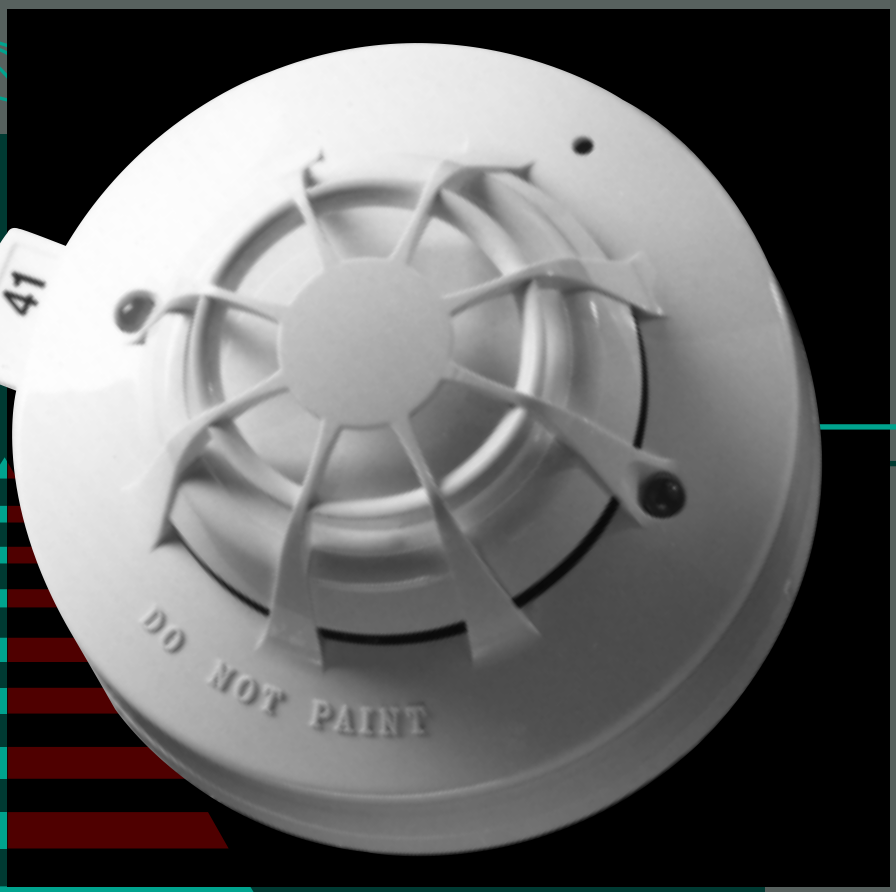
DISCOVERY ENGINEERING PRODUCT GUIDE

DISCOVERY



Ionisation Smoke Detector
Optical Smoke Detector
Temperature Detector
Multisensor Detector
Manual Call Point

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next

Discovery® is a range of high-specification, analogue addressable fire detectors developed and manufactured by Apollo Fire Detectors Limited.

Designed to meet specifications for detectors incorporated in sophisticated systems, Discovery provides engineers with an additional dimension in fire protection capability.

In view of some of the advanced features of Discovery, we recommend that engineers familiarise themselves thoroughly with the range by reading this product guide carefully.

In addition to the familiar smoke (ionisation and optical) and heat detectors, the Discovery range features a multisensor detector. This incorporates an optical smoke sensor and a heat sensor which can operate independently or together, with the analogue value being derived by means of sophisticated algorithms. The multisensor detector matches the strengths of both ionisation and optical detectors, and can, in most installations be used instead of an ionisation detector.

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Key features

- Rejection of transient signals
- Flashing LED option
- Five response modes for ease of optimisation to changing environments
- Drift compensation to ensure constant sensitivity
- Four bytes of non-volatile memory for user data
- Alarm flag for fast alarm reporting
- Conventional alarm facility during CIE processor fault
- 360° visibility in alarm
- Compatible with XP95 systems

The Discovery range

- Ionisation smoke detector
- Optical smoke detector
- Heat detector
- Multisensor detector
- CO detector
- Manual call point

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COMMUNICATIONS

Discovery uses a digital communications protocol which has been developed from the XP95 protocol but which differs in that it allows communication in three different modes: Normal, Read and Write. The reason for developing the protocol is that the Discovery range requires a more extensive exchange of information than previous analogue addressable ranges. In addition, Discovery can store data in non-volatile memory.

The Normal mode is identical to the XP95 protocol with the exception that the five additional analogue value bits in the XP95 protocol extension have been re-defined for use as a mode selection indicator (four bits) and a drift warning flag. This enables the control and indicating equipment (CIE) to distinguish between Discovery and XP95 devices.

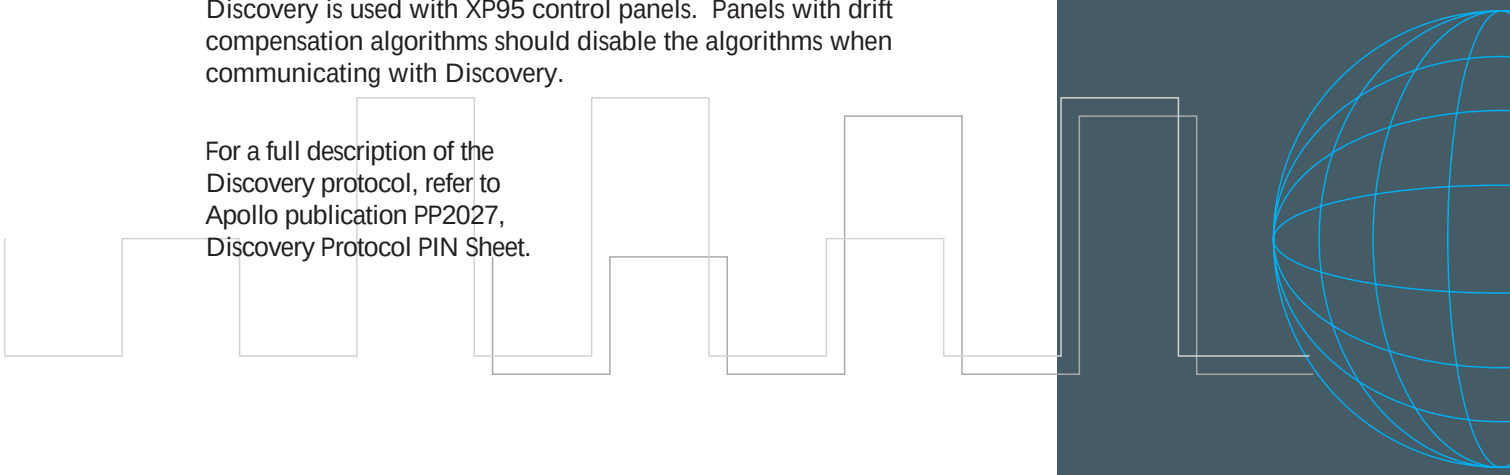
The Read mode is used to check information stored in the non-volatile memory of each detector. It is accessed by using a simple extension to the Normal mode communication method from the control and indicating equipment (CIE) to the detector.

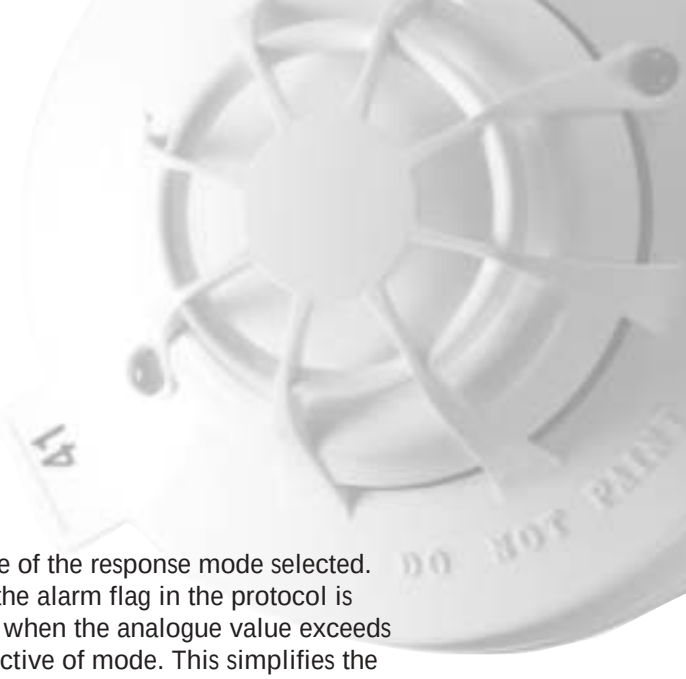
In Write mode the CIE is able to write information to the detector by extending the communication method in the same way as in Read mode.

The detector does not return its analogue value during Read or Write modes, but, in the event of the detector calculating an alarm value during this time, it can use the alarm flag and alarm address mechanism to alert the CIE to its status.

Discovery detectors are compatible with XP95. It should be noted, however, that Discovery features will not be available when Discovery is used with XP95 control panels. Panels with drift compensation algorithms should disable the algorithms when communicating with Discovery.

For a full description of the Discovery protocol, refer to Apollo publication PP2027, Discovery Protocol PIN Sheet.





DISCOVERY FEATURES – SMOKE AND HEAT DETECTORS

Response setting

Each detector in the Discovery range can operate in one of five response modes, any of which can be selected from the control panel. Each mode corresponds to a unique response behaviour, which can be broadly related to sensitivity to fire. Whatever the type of detector, Mode 1 will give a higher sensitivity to fire than Mode 5. The selection of the most suitable mode depends on the application. Guidance on detector and mode selection is given on pages 21-23.

For ionisation and optical smoke detectors, the modes relate to different combinations of smoke response threshold and response time. For the heat detector, the mode relates to the fixed temperature setting and the sensitivity to rate-of-rise of temperature. For the multisensor, the mode relates to the levels of smoke and heat sensitivity and to the way in which the responses of the two sensors are combined.

The response characteristics of the detectors have been carefully set so that detectors will comply with the requirements of the relevant part of EN54 in all response modes. The mathematical algorithms embedded in the detectors are used to carry out changes in characteristics between modes. Since the response characteristics are defined within the detectors, Apollo takes responsibility for compliance with standards in different response modes.

The internal signal processing of the detectors is designed so that the analogue value reported is always close to 25 for a normal condition. The alarm threshold is 55, irrespective of the response mode selected. Similarly, the alarm flag in the protocol is always set when the analogue value exceeds 55, irrespective of mode. This simplifies the switching between response modes since the alarm threshold in the control panel can remain fixed at 55 and the alarm flag is valid in all modes.

The response mode, which is selected through the protocol, is stored in non-volatile memory and will therefore be retained when the detector is powered down. All Discovery detectors are factory set to mode 3 before shipping.

Response modes are defined more fully in the individual detector descriptions.

User bytes and other stored data

All Discovery devices contain non-volatile memory, in the form of Electrically Erasable Programmable Read Only Memory (EEPROM), which is included primarily to store data needed for the correct operation of the device. However, four bytes of this EEPROM are available to the user and can be accessed by the control panel through the protocol. This block of non-volatile memory can be used, for example, to store the installation date, the site code or date of last service. The only restriction on use is that the maximum number of write cycles should not exceed 20,000 over the life of the device.

The way in which this memory can be accessed is described in the Discovery Protocol PIN Sheet PP2027.

Conventional alarm facility
Discovery devices should be polled at regular intervals to maintain communication with the control panel and therefore enable correct monitoring of the protected premises. However, if the polling mechanism fails, for example because of a processor failure in the panel, the internal operation of the Discovery device will be unaffected as long as a DC supply is maintained. After 108± 4 seconds without protocol, the device will automatically switch to its conventional alarm mode. In this mode it will operate as if it were a conventional detector (or manual call point) and will impose an alarm signal on the loop if an alarm condition is detected by the internal processing.

The alarm signal takes the form of periodic current pulses, which can be detected by simple hardware in the control panel. A full description of the signal can be found in the Discovery Protocol PIN Sheet PP2027.

Flashing LED
All Discovery detectors have two integral LED indicators, which can be illuminated at any time by the control panel to indicate devices in alarm. When activated, the LEDs will draw an extra 3mA from the loop. In addition to this mode of operation it is possible to enable a flashing LED mode by writing to one of the memory locations. In this mode the LEDs will flash each time the device is polled. The device does not draw extra current in this mode since the LED current is part of the normal current pulse reply from the device.

This facility is available on all Discovery detectors and the manual call point. Discovery detectors and call points are factory set to non-flashing mode.

Remote test feature
This feature, available on all Discovery detectors and the call point, is enabled from the CIE by changing the state of a forward command bit. On receipt of the command the detector is forced by electrical means into an alarm condition. After a delay of approximately 10 seconds due to signal processing, an analogue value of between 54 and 120 – nominally 85 – is returned, provided that the detector is functioning correctly. This value is sustained until the forward command bit is changed back to its original state, after which a period of 40 seconds is required for the detector to return to its normal analogue value.

The manual call point is different in that the receipt of the command bit will cause the call point to generate the interrupt sequence, followed by a sustained value of 64. The call point resets when the forward command bit is changed back to its original state. For further details of this function, see Discovery Protocol PIN Sheet, PP2027.

Rejection of transient signals
All Discovery detector algorithms are designed to give low sensitivity to very rapid changes in the sensor output, since these are unlikely to be caused by real fire conditions. This is achieved by digital low-pass filtering of the sensor values which optimises the rejection of false alarm sources while maintaining the response to fire.

The filter parameters depend on the mode selected and for some modes the filtering is minimal. The filtering has no significant effect on the response to fires but does affect the way in which detectors respond to transients and to step changes of smoke or heat. This is seen in the “minimum time to alarm” given in individual detector specifications. These times represent the time taken by the detector to reach the alarm condition when responding to a large step change in input.

Servicing Note
The “minimum time to alarm” referred to above is important when detectors are tested in situ, for example using aerosol test gas. A delay in response may be apparent.

DISCOVERY

DISCOVERY FEATURES – SMOKE DETECTORS

Drift compensation

All Discovery smoke detectors include compensation for sensor drift as part of the internal signal-processing algorithm. The algorithm will compensate for changes in sensor output caused, for example, by dust in the chamber, and will therefore hold the sensitivity at a constant level even with severe chamber contamination. This increased stability is achieved without significantly affecting the detector's sensitivity to fire.

The compensation level is stored in the detector's memory as a single value between 0 and 31. The normal level, that is, with no compensation applied, is 16. Values above or below this indicate drift towards alarm or away from alarm respectively.

For compensation values in the range 4 to 30 the detector is working within its allowable range. A value which is less than 4 or greater than 30 results in a warning flag. A value of zero results in a fault signal.

The maximum compensation that can be applied is 31. If further drift occurs, the analogue values will simply track the drift and the detector will become more sensitive.

Compensation values are stored in non-volatile memory and will be retained even if detectors are disconnected. It is possible to use the control panel to ascertain the level of compensation applied at any time.

For the Discovery smoke detectors, the compensation algorithms are designed such that the detectors meet the requirements of the European draft standard EN54–7:2000 in all response modes.

It is possible, through the protocol, to carry out a normalisation procedure which rapidly "updates" the drift compensation. This facility may be useful during commissioning when detectors can be quickly acclimatised to the prevailing ambient conditions, or after a compensated detector has been cleaned.

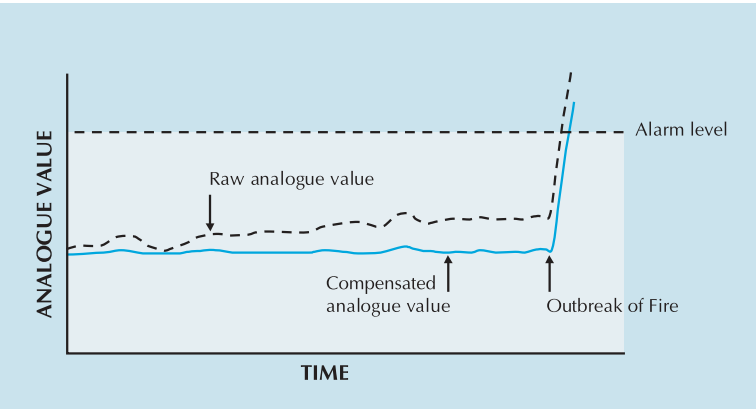


Fig.1 Drift Compensation Graph

Discovery Ionisation Smoke Detector ▲ **Part Number 58000-500**

Mode	Alarm threshold y value	Minimum time to alarm (sec)
1	0.45	5
2	0.45	30
3	0.70	5
4	0.70	30
5	1.0	5

Compensation rate complies with EN54–7:2000

Table 1 Ionisation detector operating modes

page ***6***

OPERATING PRINCIPLES

The Discovery ionisation smoke detector has a moulded white polycarbonate case with wind-resistant smoke inlets. Inside the case is a printed circuit board which has the ionisation chamber mounted on one side and the signal processing and communications electronics on the other.

The ionisation chamber consists of a reference chamber contained inside a smoke chamber (Figure 2).

The outer smoke chamber has inlet apertures fitted with insect resistant mesh. The radioactive source holder and the smoke chamber form positive and negative electrodes respectively. An Americium 241 radioactive source mounted within the reference chamber irradiates the air in both chambers, producing positive and negative ions. A voltage across the electrodes produces an electric field.
Ions are attracted to the electrode of the opposite sign to their own charge; many recombine but a small electric current flows between the electrodes. At the junction between reference and smoke chambers, the sensing electrode converts variations in chamber current into voltage changes.

When smoke particles enter the ionisation chamber, ions become attached to them with the result that the current flowing through the chamber decreases.
This effect is greater in the smoke chamber than in the reference chamber, and the imbalance causes the sensing electrode to become more positive.

The analogue voltage at the sensor electrode is converted to a digital format which is processed to provide an analogue value for transmission to the control panel when the device is polled.

Ionisation smoke detectors are supplied in individual packing with a red lid serving as a dust cover which can be left in place after fitting to prevent ingress of foreign material until commissioning of the system takes place. *At this point the covers must be removed.*

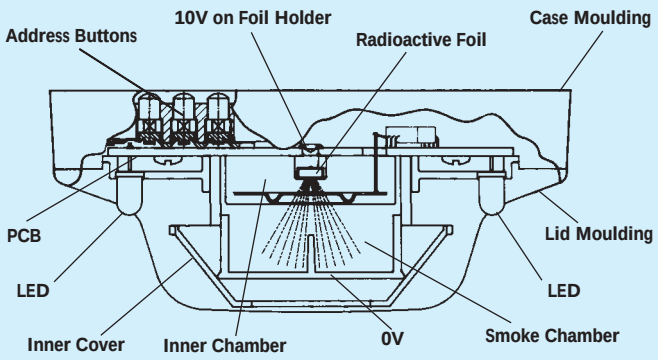


Fig.2 Sectional view - Discovery Ionisation Smoke Detector

TECHNICAL DATA

Discovery Ionisation Smoke Detector
Part No 58000-500

Specifications are typical at 24V, 23°C and 50% relative humidity unless otherwise stated.

Detection principle:
Ionisation chamber

Chamber configuration:
Twin compensating chambers using one single sided ionising radiation source

Radioactive isotope:
Americium 241

Activity:
33.3 kBq, 0.9µCi

Type code:
Bits 2 1 0 4 3 7 6 5
0 1 1 0 0 0 0 0

Supply wiring:
Two-wire supply, polarity insensitive

Terminal functions:

L1 & L2	supply in and out connections
+R	remote indicator positive connection (internal 2.2kΩ resistance to positive)
–R	remote indicator negative connection (internal 2.2kΩ resistance to negative)

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–9V peak to peak

Quiescent current:
500µA average 750µA peak

Power-up surge current:
1mA

Maximum power-up time:
10s

Alarm current, LED illuminated:
3.5mA

Remote output characteristics:
Connects to positive line through 4.5kΩ (5mA maximum)

Clean-air analogue value:
23 +4/–0

Alarm level analogue value:
55

Alarm indicator:
2 red Light Emitting Diodes (LEDs). Optional remote LED

Electro-magnetic compatibility:
CE marked
A copy of the relevant declaration is available on request

Temperature range:

Max. continuous operating	+60°C
Min. continuous operating	0° C
Min. operating (no condensation/icing)	–20°C
Storage	–30°C to +80°C

Humidity:
0 to 95% relative humidity (no condensation)

Effect of temperature:
Less than 10% change in sensitivity over rated range

Effect of atmospheric pressure:
Less than 15% change in sensitivity up to 2000m

Effect of wind:
Less than 20% change in sensitivity at speeds up to 10m/s.

Note: slow changes in ambient conditions will automatically be compensated and will not affect sensitivity

Vibration, Impact and Shock:
To EN54–7:2000

IP rating:
43

Dimensions:
100mm diameter;
42mm height
50mm (height in base)

Weight:

Detector	105g
Detector in base	160g

Materials:
Housing: White polycarbonate V–0 rated to UL94
Terminals: Nickel plated stainless steel

technical data

SAFETY NOTE

In the United Kingdom, ionisation smoke detectors are subject to the requirements of the Radioactive Substances Act 1960 and to the Ionising Radiations Regulations 1985 made under the provisions of the Health and Safety at Work Act 1974.

The detectors, independently tested by the National Radiological Protection Board (NRPB), conform to all the requirements specified in the 'Recommendations for ionisation smoke detectors in implementation of radiation standards' published by the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD) 1977.

There is no limit to the number of ionisation smoke detectors which may be installed in any fire protection system.

Storage regulations depend on local standards and legislation, but, in the UK, up to 500 detectors may be stored in any premises, although there are stipulations on storage facilities if more than 100 ionisation detectors are stored in one building.

At the end of their recommended working life of ten years, ionisation smoke detectors should be returned to Apollo for safe disposal or disposed of in an otherwise locally approved and environmentally safe manner. Please see "A guide to the care, maintenance and servicing of Apollo products", PP2055.

Guidance on storage and handling can be given by Apollo Fire Detectors and full details can be requested from:

Radioactive Substances Regulation Function
Environment Agency
Rio House, Waterside Drive
Aztec West, Almondsbury
Bristol BS32 4UD.

Outside the UK, please contact the relevant national agency.

Discovery Optical Smoke Detector ▲ **Part Number 58000-600**

Mode	Alarm threshold %/m	Minimum time to alarm (sec)
1	1.4	5
2	1.4	30
3	2.1	5
4	2.1	30
5	2.8	5

Compensation rate complies with EN54–7:2000

Table 2 Optical detector operating modes

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OPERATING PRINCIPLES

The Discovery optical detector uses the same outer case as the ionisation smoke detector and is distinguished by the indicator LEDs which are clear when the detector is in quiescent state and red in alarm. Within the case is a printed circuit board which, on one side, has the light-proof chamber with integral gauze surrounding the optical measuring system and, on the other, the signal processing and communications electronics.

An infra-red light emitting diode within its collimator is arranged at an obtuse angle to the photo-diode. The photo-diode has an integral daylight-blocking filter (Fig.3).

The IR LED emits a burst of collimated light every second. In clear air the photo-diode receives no light directly from the IR LED, because of the angular arrangement and the chamber baffles. When smoke enters the chamber it scatters light from the emitter IR LED onto the photo-diode in an amount related to the smoke characteristics and density. The photo-diode signal is processed to provide an analogue value for transmission when the detector is interrogated.

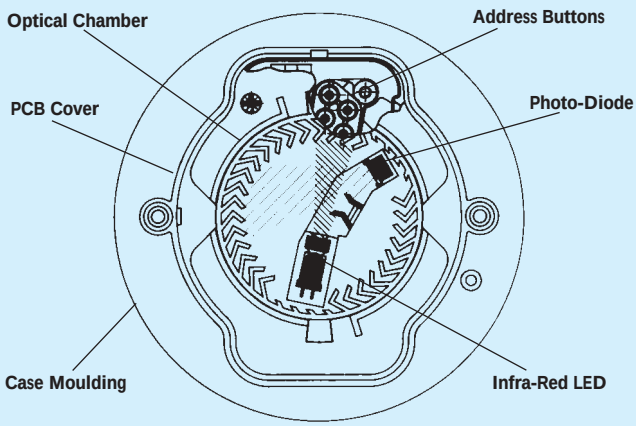

Fig.3 Top section - Discovery Optical Smoke Detector

TECHNICAL DATA

Discovery Optical Smoke Detector
Part No: 58000-600

Specifications are typical at 24V, 23°C and 50% relative humidity unless otherwise stated.

Detection principle:
Photo-electric detection of light scattered in a forward direction by smoke particles

Chamber configuration:
Horizontal optical bench housing infra-red emitter and sensor, arranged radially to detect forward scattered light

Sensor:
Silicon PIN photo-diode

Emitter:
GaAlAs infra-red light emitting diode

Sampling frequency:
1 per second

Type code:
Bits 2 1 0 4 3 7 6 5
1 0 1 0 0 0 0 0

Supply wiring:
Two-wire supply, polarity insensitive

Terminal functions:

L1 & L2	supply in and out connections
+R	remote indicator positive connection (internal 2.2kΩ resistance to positive)
–R	remote indicator negative connection (internal 2.2kΩ resistance to negative)

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–9V peak to peak

Quiescent current:
400µA average 650µA peak

Power-up surge current:
1mA

Maximum power-up time:
10s

Alarm current, LED illuminated:
3.4mA

Remote output characteristics:
Connects to positive line through 4.5Ω (5mA maximum)

Clean-air analogue value:
23 +4/–0

Alarm level analogue value:
55

Alarm indicator:
2 colourless Light Emitting Diodes (LEDs); illuminating red in alarm. Optional remote LED

Electro-magnetic compatibility:
CE marked
A copy of the relevant declaration is available on request

Temperature range:

Max. continuous operating	+60°C
Min. continuous operating	0°C
Min. operating (no condensation/icing)	–20°C
Storage	–30°C to +80°C

Humidity:
0 to 95% relative humidity (no condensation)

Effect of temperature:
Less than 15% change in sensitivity over rated range. Note: slow changes in ambient conditions will automatically be compensated and will not affect sensitivity

Effect of atmospheric pressure:
None

Effect of wind:
None

Vibration, Impact and Shock:
To EN54–5:2000

IP rating:
43

Dimensions:
100mm diameter;
42mm height
50mm (height in base)

Weight:

Detector	105g
Detector in base	160g

Materials:
Housing: White polycarbonate V–0 rated to UL94
Terminals: Nickel plated stainless steel

technical data

Discovery Heat Detector ▲ **Part Number 58000-400**

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OPERATING PRINCIPLES

Discovery heat detectors have a common profile with ionisation and optical smoke detectors but have a low air flow resistance case made of self-extinguishing white polycarbonate.

The Discovery heat detector uses a single thermistor to sense the air temperature at the detector position. The thermistor is connected in a resistor network, which produces a voltage output dependent on temperature. The design of the resistor network, together with the processing algorithm in the microcontroller, gives an approximately linear characteristic from 10°C to 80°C. This linearised signal is further processed, depending on the response mode selected, and converted to an analogue output.

For the European standard version of the detector, the five modes correspond to five "classes" as defined in the draft standard EN54–5:2000. The classes in this draft standard correspond with different response behaviour, each of which is designed to be suitable for a range of application temperatures. All modes incorporate "fixed temperature" response, which is defined in the draft standard by the "static response temperature". The application temperatures and static response temperatures for all response modes are given in Table 3.

In addition to the basic classification, a detector may be given an "R" or "S" suffix. The "R" suffix indicates that the detector has been shown to have a rate-of-rise characteristic. Such a detector will still give a rapid response even when starting from an ambient temperature well below its typical application temperature. This type of detector is therefore suitable for areas such as unheated warehouses in which the ambient temperature may be very low for long periods.

The "S" suffix on the other hand indicates that the detector will not respond below its minimum static response temperature even when exposed to high rates of rise of air temperature. This type is therefore suitable for areas such as kitchens and boiler rooms where large, rapid temperature changes are considered normal.

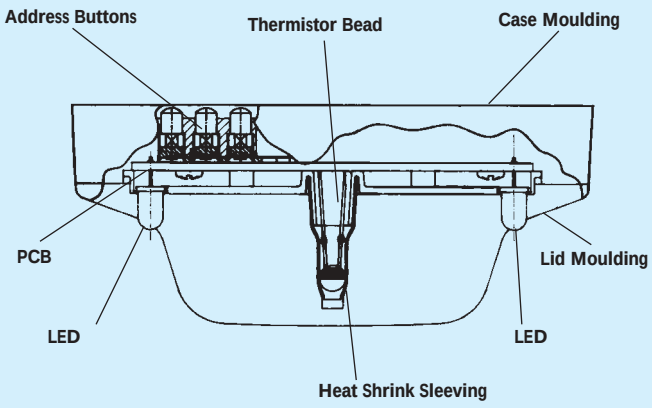


Fig.4 Discovery Heat Detector

TECHNICAL DATA

Discovery Heat Detector
Part No: 58000-400

Specifications are typical at 24V, 23°C and 50% relative humidity unless otherwise stated.

Detection principle:
Temperature sensitive resistance.

Type code:
2 1 0 4 3 7 6 5
1 1 0 0 0 0 0 0

Supply wiring:
Two-wire supply, polarity insensitive

Terminal functions:

L1 & L2	supply in and out connections
+R	remote indicator positive connection (internal 2.2kΩ resistance to positive)
–R	remote indicator negative connection (internal 2.2kΩ resistance to negative)

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–9V peak to peak

Quiescent current:
500µA average 750µA peak

Power-up surge current:
1mA

Maximum power-up time:
10s

Alarm current, LED illuminated:
3.4mA

Remote output characteristics:
Connects to positive line through 4.5kΩ (5mA maximum)

Alarm level analogue value:
55

Alarm indicator:
2 red Light Emitting Diodes (LEDs).
Optional remote LED

Electro-magnetic compatibility:
CE marked
A copy of the relevant declaration is available on request

Temperature range:

Max. continuous operating	see Table 3
Min. continuous operating	0°C
Min. operating (no condensation/icing)	–20°C
Storage	–30°C to +80°C

Humidity:
0 to 95% relative humidity (no condensation)

Vibration, Impact and Shock:
To EN54–5:2000

IP rating:
53

Dimensions:
100mm diameter; 42mm height

Weight:

Detector	105g
Detector in base	160g

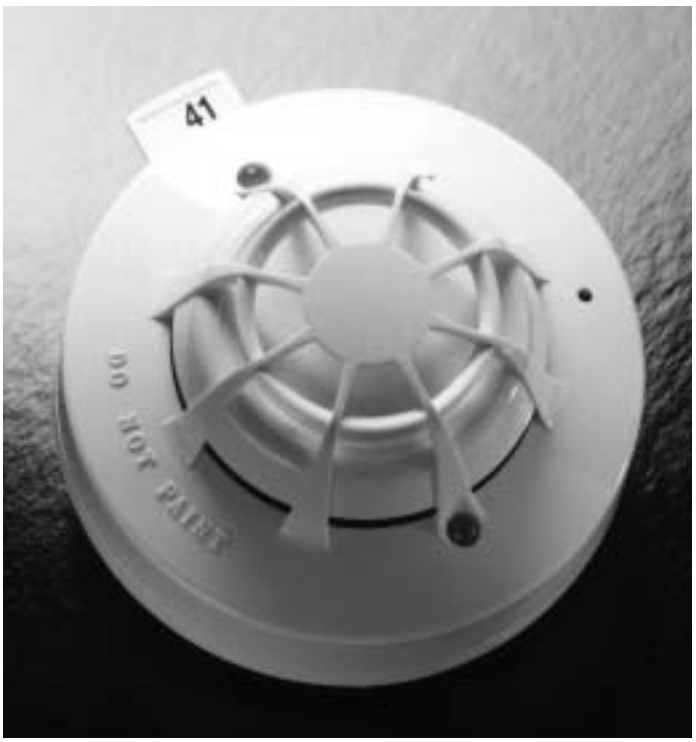
Materials:
Housing: White polycarbonate V–0 rated to UL94
Terminals: Nickel plated stainless steel

technical data

Mode	Class (EN54–5:2000)	Application Temperature °C		Static Response Temperature °C		
		Typ	Max	Min	Typ	Max
1	A1R	25	50	54	57	65
2	A2	25	50	54	61	70
3	A2S	25	50	54	61	70
4	CR	55	80	84	90	100
5	CS	55	80	84	90	100

For air temperatures in the range 15°C to 55°C, the analogue value for a detector in mode 1 will correspond approximately to the air temperature.

Table 3 Heat Detector response modes



Discovery Multisensor Detector ▲ **Part Number 58000-700**

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OPERATING PRINCIPLES

The Discovery multisensor detector contains an optical smoke sensor and a thermistor temperature sensor whose outputs are combined to give the final analogue value. The way in which the signals from the two sensors are combined depends on the response mode selected. The five modes provide response behaviour which incorporates pure heat detection, pure smoke detection and a combination of both. The multisensor is therefore useful over the widest range of applications.

The multisensor construction is similar to that of the optical detector but uses a different lid and optical mouldings to accommodate the thermistor temperature sensor. The sectional view (Fig 5) shows the arrangement of the optical chamber and the thermistor.

The signals from the optical smoke sensing element and the temperature sensor are independent, and represent the smoke level and the air temperature respectively in the vicinity of the detector. The detector's micro-controller processes the two signals according to the mode selected. When the detector is operating as a multisensor (i.e. modes 1, 3 and 4) the temperature signal processing extracts only rate-of-rise information for combination with the optical signal. In these modes the detector will not respond to a slow temperature increase – even if the temperature reaches a high level. A large sudden change in temperature can, however, cause an alarm without the presence of smoke, if sustained for 20 seconds.

The processing algorithms in modes 1 to 4 incorporate drift compensation.

The characteristics of the five response modes are summarised below.

Mode 1 has very high smoke sensitivity combined with high temperature sensitivity. This gives a high overall sensitivity to both smouldering and flaming fires.

Mode 2 has a smoke sensitivity similar to that of a normal optical smoke detector but has no response to temperature. This mode is therefore equivalent to a standard optical detector. It is suitable for applications in which wide temperature changes occur under normal conditions.

Mode 3 has moderate smoke sensitivity combined with a moderate sensitivity to heat. This combination is considered the optimum for most general applications since it offers good response to both smouldering and flaming fires.

Mode 4 has lower than normal smoke sensitivity combined with high heat sensitivity. This makes it suitable for applications in which a certain amount of fumes or smoke is considered normal.

Mode 5 has no smoke sensitivity at all, but gives a pure heat detector response meeting the response time requirements for a Class A1 detector in the draft European standard EN54–5:2000. In this mode the detector will respond to slowly changing temperatures and has a "fixed temperature" alarm threshold at 58°C. The analogue value in this mode will give the approximate air temperature over the range 15°C to 55°C.

In mode 5, the smoke sensor is still active though it does not contribute to the analogue signal. As a consequence, if the detector is used in a dirty or smoky environment the optical sensor drift flag may be activated in the heat-only mode.

Note: in situ testing of the multisensor detector should be carried out as for smoke detectors in response modes 1-4 and for heat detectors in response modes 5.

Design Note: if the multisensor is to be used in mode 5, heat detector spacing/coverage should be applied.

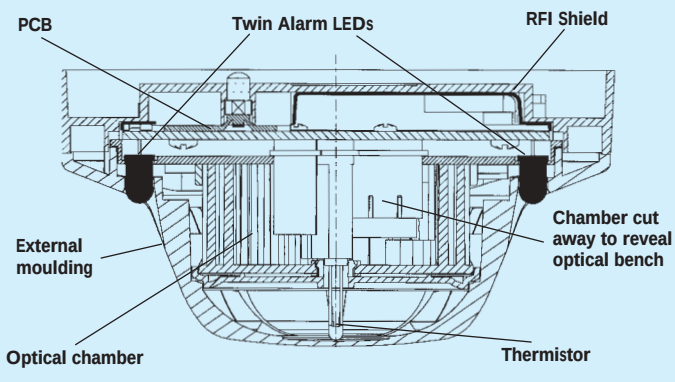

Fig.5 Sectional view - Discovery Multisensor Detector

TECHNICAL DATA

Discovery Multisensor Detector, Part No 58000-700

Specifications are typical and apply at temperature 23°C and relative humidity 50% unless otherwise stated.

Detector principle:
Smoke: Photoelectric detection of light scattered by smoke particles

Heat: Temperature-sensitive resistance

Type code:
Bits 2 1 0 4 3 7 6 5
1 0 1 1 1 0 0 0

Supply wiring:
Two-wire supply, polarity insensitive

Terminal functions:

L1 & L2	supply in and out connections
+R	remote indicator positive connection (internal 2.2kΩ resistance to positive)
–R	remote indicator negative connection (internal 2.2kΩ resistance to negative)

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–9V peak to peak

Quiescent current:
500µA average 750µA peak

Power-up surge current:
1mA

Maximum power-up time:
10s

Alarm current, LED illuminated:
3.5mA

Remote output characteristics:
Connects to positive line through 4.5kΩ (5mA maximum)

Clean-air analogue value:
23 +4/–0

Alarm level analogue value:
55

Alarm indicator:
2 colourless Light Emitting Diodes (LEDs); illuminated red in alarm
Optional remote LED

Electro-magnetic compatibility:
CE marked

A copy of the relevant declaration is available on request

Temperature range:

Max. continuous operating	+60°C
Min. continuous operating	0°C
Min. operating (no condensation/icing)	–20°C
Storage	–30°C to +80°C

Humidity:
0 to 95% relative humidity (no condensation)

Effect of temperature on optical sensor:
Less than 15% change in sensitivity over rated range. Slow changes in ambient conditions will automatically be compensated and will not affect sensitivity

Effect of atmospheric pressure on optical sensor:
None

Effect of wind on optical sensor:
None

Vibration, Impact and Shock:
To EN54–7:2000

IP rating:
43

Dimensions:
100mm diameter;
50mm height
58mm (height in base)

Weight:

Detector	105g
Detector in base	160g

Materials:
Housing: White polycarbonate V–0 rated to UL94
Terminals: Nickel plated stainless steel

Smoke element only:

Chamber configuration:
Horizontal optical bench housing infra-red emitter and sensor, arranged radially to detect forward scattered light

Sensor:
Silicon PIN photo-diode

Emitter:
GaAlAs infra-red light emitting diode

Sampling frequency:
1 per second

technical data

Mode	Smoke Sensitivity (grey smoke) % per m	% per ft	Temperature Sensitivity (relative)	Response Type	Minimum Time to Alarm (seconds)
1	1.1	0.35	High	Multisensor	20
2	2.1	0.7	No response to heat	Optical	30
3	2.8	0.9	Low	Multisensor	20
4	4.2	1.4	High	Multisensor	20
5	No response to smoke		See text	Heat A1	30

Table 4 Multisensor Detector operating modes

DISCOVERY CARBON MONOXIDE DETECTOR

Discovery Carbon Monoxide Detector ▲ **Part Number 58000-300**

page ***14***

OPERATING PRINCIPLES

Discovery CO fire detectors contain a long-life electro-chemical carbon monoxide sensor which is tolerant of low levels of common vapours and household products. The sensing technology is fast, accurate and needs only very low power. These factors make the CO sensor suitable for fire detection applications.

The detection capabilities are enhanced by a rate-sensitive response. Fast rises in the carbon monoxide level are often associated with hot fires and the detector will respond earlier under these conditions. The analogue reply from the detector is rate limited to remove nuisance alarms resulting from short-term high levels caused by sources such as pipe smokers or gas flame ignition.

APPLICATION

CO detectors do not detect smoke particles or heat and are not universal replacements for smoke detectors.
Apollo does not endorse the use of CO detectors as the main method of fire detection if:

- the protected area is an escape route
- there is a requirement to detect overheating of electrical equipment or cables
- the protected area is exposed to sources of CO such as vehicle exhausts, or to hydrogen or to high levels of alcohol vapour as emitted by some cleaning agents
- there is a requirement to detect fires involving flammable liquids

CO fire detectors are particularly suitable for **supplementing** smoke detection when there is:

- a deep seated smouldering fire risk
- a risk of fire starting in an enclosed space
- a likelihood of stratification taking place

Carbon monoxide detectors may be used as the **primary** fire detector in areas where the following conditions exist:

- the main risk is smouldering fires
- optical smoke detectors are deemed unsuitable (see '**FALSE ALARMS**' below)
- the fire compartment is not greater than 50m^2

Typical applications include hotel bedrooms, halls of residence, sheltered accommodation and hospital wards.

DETECTOR SITING

CO fire detectors should be sited using the recommendations for smoke detectors from BS5839: Part 1 (or other applicable code).

In the development of a fire, smoke and CO in the smoke plume is spread by convection to a fire detector. As CO is a gas, it further spreads—like smells—by diffusion. For this reason CO may reach a detector faster than smoke would.

This potential advantage can be exploited when designing a fire protection system and CO detectors may be used for supplementary detection. Equally, the opposite effect might occur, with CO moving away from a detector.

The behaviour of CO is therefore unpredictable and diffusion should not be relied on when designing a fire protection system.

FALSE ALARMS

Carbon monoxide detectors are less susceptible than smoke detectors to false alarms from sources such as toast, steam, cooking, plumbing work and hair spray. They may therefore be used in **some** applications in which smoke detectors would be susceptible to unwanted alarms.

Conversely, they may be more susceptible than smoke detectors to false alarms from fumes containing CO, such as vehicle exhausts, open fires and gas appliances.

LIMITATIONS

Carbon monoxide detectors also have important limitations. They are set to a higher sensitivity than the maximum allowed by the domestic CO alarm standard and will respond to CO from faulty gas appliances or vehicle exhausts. *These detectors **should not** be used in place of carbon monoxide alarms complying with BS7860 or UL2034.*

OPERATING MODES

The Discovery CO detector has five operating modes, each having a set combination of sensitivity and response delay, which the user can select for any given application. See table on page 16.

DRIFT COMPENSATION

In view of the inherent stability of CO cells, there is no need for Discovery CO detectors to compensate for drift. Discovery CO detectors are set to report a drift value of 16.

CELL TEST

The Discovery carbon monoxide fire detector has a remote test feature, which is used to verify that the electro-chemical cell is fitted and that it is active. A test must be carried out at least once a year but preferably more frequently to ensure that the cell has not dried out. (Note that the cell will not be affected by the test, even if the remote test is carried out once a day.)

If the test indicates a sensor failure, ie, the detector returns a pre-set analogue value of 25, the detector should be sent to Apollo's Service Department for cell replacement and detector recalibration.

PRECAUTIONS WHEN INVESTIGATING ALARMS

It is important to remember that CO is a colourless, odourless gas, which is not directly detectable by human senses. If a CO fire detector is in an alarm condition, it is possible that a dangerous level of CO exists around the detector. Extreme care must be taken when investigating alarms from CO fire detectors even if no combustion products can be seen or smelled.

Because of this danger, it is imperative that CO fire detectors are correctly identified at the control panel so that personnel investigating alarms may take the relevant precautions.

MAINTENANCE AND SERVICE

The electrochemical cell used in the Discovery CO fire detector has a more limited life than would normally be expected from a smoke detector. In a typical environment, the life of the cell is seven years.

High temperature or low relative humidity can, however, reduce the life significantly. The limits given in the section '**technical data**' overleaf should be carefully observed.

It is essential that systems using CO fire detectors be correctly maintained and that the maintenance schedule include functional testing of the CO fire detectors.

CO fire detectors will not respond to the aerosol testers commonly used for the in-situ testing of smoke detectors. Apollo recommends that CO fire detectors be tested using a "hand warmer", burning compressed charcoal fuel rods. These hand warmers are available in camping and outdoor shops. The charcoal rod should be ignited at one end according to the instructions. To achieve a reliable test, the complete hand warmer should be placed inside a hood which fits over the detector, allowing CO to build up around the detector. The Apollo (No Climb) detector tester can be used for this purpose.

If there is any doubt over the sensitivity of a Discovery CO fire detector it should be returned to Apollo for servicing and calibration.

HEALTH AND SAFETY GUIDELINES

This product contains a sealed electro-chemical cell and in normal usage represents no chemical hazard in the sense of COSHH and the Health and Safety at Work Act 1974. Chemical hazard can, however, arise if the following notes on storage, handling and disposal are not observed.

For maximum life, the product should be stored before installation in clean dry conditions between 0°C and 20°C. It should not be exposed to temperatures outside the range –40°C to +60°C or to organic vapours.

The electrochemical cell contained in this product is fitted into sockets on the printed circuit board; to avoid damage to the cell do not remove it.

The electrochemical cell contains sulphuric acid in a relatively concentrated state. In the event of leakage (which may be caused by mechanical damage or use outside the operating specification for the cell) the cell should be removed from the detector using protective gloves. Avoid contact with any liquid. If skin or eye contact with the electrolyte occurs, wash immediately with plenty of water and

TECHNICAL DATA

Discovery Carbon Monoxide Fire Detector

Specifications are typical and apply at 24V, 23˚C and 50% relative humidity unless otherwise stated.

Detector Part no:
58000-300

Base Part no:
45681-210

Detector principle:
Ambient carbon monoxide level

Type code:
Bits 2 1 0 4 3 7 6 5
0 1 1 0 1 0 0 1

Supply wiring:
Two-wire supply, polarity sensitive

Terminal functions:

L2	positive supply in and out connections
L1	negative supply in and out connections
+R	remote indicator positive connection (internal 2.2kΩ resistance to positive)
–R	remote indicator negative connection (internal 2.2kΩ resistance to negative)

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–V peak to peak

Quiescent current:
500µA average, 750µA peak

Power-up surge current:
1mA

Maximum power-up time:
10s

Alarm current, LED illuminated:
3.5mA

Remote output characteristics:
Connects to positive line through 4.5kΩ (5mA maximum)

Sampling frequency:
1 per second

Clean air analogue value:
25±2

Alarm level analogue value:
55

Alarm indicator:
2 red Light Emitting Diodes (LEDs);
Optional remote LED

Electro-magnetic compatibility:
CE marked

Storage Temperature:
Continuous: +10˚C to +30˚C
Transient: –40˚C to +55˚C

Storage Pressure:
If air freighted this product should be placed in a pressurised hold

Operating Pressure:
Atmospheric ±10%

Operating Temperature:
Continuous: 0˚C to +50˚C
Transient: –20˚C to +50˚C
(no condensation/icing)

Operating Humidity:
Continuous: 15% to 90% RH
Transient: 0% to 99% RH

Cell Life:
maximum 7 Years
(assumes regular checks are satisfactory)

Effect of temperature on detector:
Less than 15% change in sensitivity over rated range

Effect of wind:
None

Vibration, Impact and Shock:
To EN54–7:2000

IP rating:
43

Dimensions:
100mm diameter
42mm height
50mm (height in base)

Weight:
Detector 105g
Detector in base 160g

Materials:
Housing: White polycarbonate, V–0 rated to UL94
Terminals: Nickel plated stainless steel

obtain medical advice. All traces of electrolyte should be washed away with copious amounts of clean water. The cell should be disposed of according to local waste management requirements and environmental legislation. It should not be burnt since it may release toxic fumes.

Mode	Alarm Threshold (ppm)	Minimum time to alarm (seconds)	Typical application
1	30	60	Sleeping with no ambient CO
2	45	30	General use fast response such as supplementary protection in atria
3	45	60	General use and sleeping risk with some low-level CO (such as from light smoking or an unventilated gas fire)
4	60	30	General smoking area and supplementary detection of deep seated fires such as laundry rooms
5	75	30	Supplementary use in kitchen or boiler room

Table 6 Relative performance of detectors in test fires

Discovery/XP95 Mounting Base ▲ **Part Number 45681-210** with XPERT card

TECHNICAL DESCRIPTION

All detectors in the Discovery range fit into XP95 mounting bases. Full details of bases and mounting accessories are given in PP1089 and PIN sheets PP2040 and 2043.

An earth connection is not required for either safety or correct operation of detectors. The ground (earth) terminal is isolated and is provided for tidy termination of grounded conductors or cable screens and to maintain earth continuity where necessary.

All terminals are marked according to their function.

Bases have a wide interior diameter for ease of access to cables and terminals and there are two slots for fixing screws. The slots enable two fixing screws to be located at a spacing of 51 to 69mm.

The bases are of 100mm diameter and have five terminals:

L1	line in and line out	double terminal
L2	line in and line out	double terminal
–R	remote LED negative supply	double terminal
+R	remote LED positive supply	double terminal
E	earth	single terminal

Detectors fit into bases one way only, without snagging, and require clockwise rotation without push force to be plugged in.

Universal patented address cards, known as XPERT cards, are supplied with all bases. Consult the coding guide in the installation instructions to determine which pips are to be removed from the card to give the correct address. Lay the card on a flat surface, pips down, insert a screwdriver into the slot on the reverse of the pip to be removed and give a firm twist.

When the card is coded insert it into the slot in the side of the appropriate base, making sure that the card locks itself into place. As a detector is inserted into the base, the remaining pips operate the address buttons on the detector and the detector electronics reads the address.

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Discovery Manual Call Point (MCP) ▲ **For Part Numbers see Table 5**

page ***18***

OPERATING PRINCIPLES

The Discovery call point is based on the KAC World Series.

The address of each call point is set at the commissioning stage by means of a seven-segment DIL switch.

If an MCP is activated it interrupts the normal protocol to give a fast response. For full details of the patented interrupt feature, see publication PP2027.

The Discovery call point has 4 bytes of non-volatile memory available for the user in the same way as Discovery detectors. The call point has the conventional alarm facility. The Discovery manual call point has only one response mode. This is factory preset to 16.

A single alarm LED is provided on the call point. This LED is controlled, independently of the call point, by the CIE and may be set to flash each time the call point is polled.

Call points can be remotely tested from the control and indicating equipment by transmission of a single bit in the communications protocol. Call points respond by providing an analogue value of 64 which corresponds to the alarm value. The CIE should recognise this response as a test signal and should not raise a general alarm.

NON-STANDARD MANUAL CALL POINTS

Manual call points approved for use in countries applying DIN standards are available, as are XP95 manual call points for outdoor use or for special purposes, such as initiating an 'Evacuate' alarm. It should be remembered, however, that XP95 manual call points have no user bytes available and do not have the Discovery conventional alarm facility.

The Discovery Manual Call Point is available in two versions:

Part no. 58000-910
For surface mounting, incorporating the call point assembly and a back-box.

Part no. 58000-920
For flush mounting, incorporating the call point assembly and a terminal tray.

For flush mounting an outlet (pattress) box with a minimum depth of 25mm is also needed.

Table 5 Manual Call Point Part Numbers

TECHNICAL DATA

Manual Call Point

Specifications are typical and apply at temperature 23°C and relative humidity 50% unless otherwise stated.

Call point type:
Break glass

Part No 58000-910
surface mount assembly
Weight 190g
Part No 58000-920
flush mount assembly
Weight 180g

Part No 26729-107
back-box
Part No 26729-110
terminal tray

Call point principle:
Operation of a switch

Alarm indicator:
Red Light Emitting Diode (LED)

Type code:
Bits 2 1 0 4 3 7 6 5
1 1 1 1 1 0 0 0

Supply wiring:
Two-wire supply, polarity insensitive

Loop connections L1/L2:
Flying leads with spade terminals

Operating voltage:
17–28V DC

Communication protocol:
Apollo Discovery 5–9V peak to peak

Quiescent current:
350µA average 600µA peak

Power-up surge current:
1mA

Maximum power-up time:
4s

Alarm current, LED illuminated:
3.35mA

Normal analogue value:
16

Alarm state value:
64

Electro-magnetic compatibility:
CE marked
A copy of the relevant declaration is available on request

Temperature range:

Max. continuous operating	+60°C
Min. continuous operating	0°C
Min. operating (no condensation/icing)	–20°C
Storage	–30°C to +80°C

Humidity:
0 to 95% relative humidity (no condensation)

Vibration, Impact and Shock:
To BS5839: Part 2

IP rating:
53

Dimensions:
87mm x 87mm x 52mm (surface mount version)

Materials:
Housing: Red self-coloured PC/ABS

technical data

MECHANICAL CONSTRUCTION

All detectors in the Discovery range have the same external dimensions, except the multisensor detector, which is deeper. The housing of the ionisation and optical smoke detectors is identical.

The material used to mould the housings is a UL 94 V–0 grade of polycarbonate in a pure white finish.

Two light-emitting diodes (LEDs) are mounted on the printed circuit board within the housing. They protrude through the lid to be easily visible and provide external alarm indication.

The LEDs of the ionisation smoke detector and the heat detector are red, and the optical and multisensor detectors have colourless LEDs which emit red light in the alarm state.

All detectors in the Discovery range have four nickel-plated stainless steel wipers at the back of the housing which make contact with the double terminals when the detector is fitted to a base.

INTER-CHANGEABILITY

Any Discovery detector may be replaced by any other type in the range. For example, if a smoke detector proved unsuitable in a particular application, it could be simply replaced with a heat detector set to the appropriate grade or range, provided that the maximum floor area coverage does not exceed that specified by BS5839: Part1 or other local code.

Discovery detectors can also be used to replace XP95 detectors and again, it is possible to change types, e.g. smoke for heat or vice versa when mixing types. Factory-new Discovery detectors are set to mid range, equivalent to XP95, and the flashing LED feature is disabled.

Note: *the control and indicating equipment must not have a drift compensation algorithm activated when interrogating Discovery detectors.*
Some XP95 panels may not recognise the multisensor or CO detector type codes. Contact the panel manufacturer for advice.

ISOLATORS

All XP95 isolators and isolating bases are patented and are suitable for use with Discovery detectors and manual call points.

These are:

Product	Part no	Literature
Isolating base 20D	45681–321	PIN sheet PP2039
Isolator	55000–700	Product guide PP1039
Base for isolator	45681–211	Product guide PP1039

INTERFACES

All XP95 interfaces are fully compatible with Discovery detectors and call points. Please see the Interfaces Brochure, PP2025, for further information.

SOUNDERS

Loop sounders developed for use with XP95 systems may be used in exactly the same way with Discovery. See publication PP2031.

MAINTENANCE OF DETECTORS

Apollo Fire Detectors has published a guide to the care, maintenance and servicing of Apollo products, PP2055, which is available on request. This guide outlines the maintenance routines recommended for optimum detector performance and the services available from Apollo's factory-based Service Department.

CONTROL PANEL COMPATIBILITY

Discovery detectors are designed to be operated with purpose-designed control and indicating equipment that makes full use of their features. Discovery can, however, be connected to any control panel which can operate existing ranges of Apollo analogue addressable detectors with the previously noted rule, *that the control and indicating equipment must not have a drift algorithm operating on Discovery devices. Contact the panel manufacturer for guidance. For a list of compatible panel manufacturers, see Apollo publication PP1010.*

APPLICATION OF DISCOVERY DETECTORS

The process of designing a fire detection system using Discovery detectors is the same as that used for any other detector range, except that Discovery offers more choices to the system designer. The principles set out in relevant codes of practice such as BS5839: Part 1 should be followed in any system design. The notes below are intended to supplement the codes of practice and to give some specific guidance on the choices available with the Discovery range.

Choice of Detector Type

The choice of detector from the Discovery range follows the well-established principles of system design. That is, the optimum detector type will depend on the type of fire risk and fire load, and the type of environment in which the detector is sited.

For general use, smoke detectors are recommended since these give the highest level of protection. Smoke detectors from the Discovery range may be ionisation, optical or multisensor types. It is generally accepted that ionisation types have a high sensitivity to flaming fires whereas optical detectors have high sensitivity to smouldering fires. As a result of this, ionisation types are widely used for property protection, and optical types for life protection. These general principles still apply to the Discovery detectors, although the availability of a multisensor in the Discovery range offers more choice to the system designer.

The multisensor is basically an optical smoke detector and will therefore respond well to the smoke from smouldering fires. In response modes 1, 3 and 4, however, (ie, in the multisensor modes) the detector also senses air temperature. This temperature sensitivity allows the multisensor to give a response to fast burning (flaming) fires which is similar to that of an ionisation detector. The multisensor can therefore be used as an alternative to an ionisation detector while still retaining the benefits of an optical smoke detector.

Where the environment is smoky or dirty under normal conditions, a heat detector may be more appropriate. It must be recognised, however, that any heat detector will respond only when the fire is well established and generating a high heat output. The Discovery heat detector can be used in a wide range of

	Ionisation	Optical	Multisensor	Heat	CO
Overheating/thermal decomposition	Poor	Very good	Very good	Very poor	Very poor
Smouldering/glowing combustion	Moderate/Good	Good	Good	Very poor	Excellent
Flaming combustion	Very good	Good	Good	Poor	Poor
Flaming with high heat output	Very good	Good	Very good	Moderate/good	Moderate
Flaming – clean burning	Poor	Very poor	Moderate/good	Moderate/good	Very poor

Table 6 Relative performance of detectors in test fires

conditions by selecting the correct mode (see Table 7).

The relative performance of the four detector types for different fire types is given in Table 6.

Choice of Response Mode
A major objective in designing a detection system is to achieve the best detection performance while keeping the number of unwanted alarms at a low level. Unwanted alarms are normally caused by environmental influences. For any given environment, unwanted alarms will, as a rule, be more frequent for detectors of higher sensitivity.

It has already been pointed out that the response modes for Discovery detectors correspond to different sensitivity to fire, with response mode 1 being more sensitive than mode 5. It follows, then, that Discovery detectors set to mode 1 will be most suitable for environments in which sources of unwanted alarms are rare. Such environments include cleanrooms and computer suites. At the other extreme, response mode 5 will be suited to more dusty or smoky environments such as loading areas where diesel forklift trucks are operating. Response mode 3 is a general-purpose setting for which the response is similar to that of the corresponding XP95 detector.

It will be seen, then, that it is often more useful to think of particular response modes being suited to different environments rather than simply having different sensitivity to fire. Table 7 shows response modes for Discovery detectors that are considered suitable for different environment types. Any of those identified as suitable should give acceptable performance. The recommended detector/mode combinations will give the best available performance from Discovery.

Time-related systems
Discovery detectors are particularly useful for installations in which it is desirable to set different detector response characteristics at different times of the day because of changes in the environment. For example, if an industrial process generates smoke or fumes during working hours and the area is clean at other times the optimum response mode will be different at different times of the day. Outside working hours the sensitivity can be switched to a higher level to maintain maximum protection.

The Discovery multisensor is especially suitable for time-related systems. Because its response can be switched from a pure heat response to a sensitive multisensor smoke response, it can be optimised for very clean or dirty (smoky) environments. However, if mode switching between heat and smoke (or multisensor) modes is used, it is important to remember that the area coverage in the heat-only mode is half that of the smoke or multisensor modes.

The detector spacing must therefore be based on the heat detector spacing of the relevant standard.

APPROVALS

Discovery detectors comply with EN54-5:2000 and EN54-7:2000. Detectors also comply with EMC Directive 89/336/EEC and are CE marked.

Discovery detectors have been approved by several approval and regulatory bodies woldwide, including LPCB in the UK, VdS in Germany, DBI in Denmark and SSL in Australia.

PATENTS HELD

Protocol interrupt system
Addressable isolators
Addressable XPERT card

	Cleanroom EDP suite					Hotel room; Studio apartment; small flat (<50m2)					Office; Long Corridor; Hospital wards; Light industrial factory					Warehouse; Bar					Loading bay; Car park (enclosed & ventilated)					Kitchen; Laundry					Boiler room				
Mode	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
MULTI	■							■	▒				▒	▒			▒	■	▒	▒		▒	▒	■	▒			▒	▒			▒				
OPTICAL	▒							▒	▒	▒			▒	▒	▒				▒					▒							▒	▒				
ION	▒							▒	▒	▒			▒	▒	▒			▒	▒					▒	▒											
CO						▒		▒				S						S	S										▒	▒					▒	
HEAT																▒	▒				▒	▒						■	▒	▒			▒		■

KEY

■ Recommended

▒ Suitable

S Suitable as supplement

Table 7 Discovery Response Mode Selection Grid

APOLLO FIRE DETECTORS LIMITED

Apollo Fire Detectors Limited is part of the Halma plc group of companies and one of the world's leading manufacturers of conventional and analogue addressables smoke and heat detectors for commercial and industrial applications. Our products are sold in over 75 countries and we have won 3 Queen's Awards for Export Achievement.

Quality Systems Certificate No 010
Assessed to ISO 9001

Our detectors hold product approvals worldwide and the company is quality certificated to ISO 9001 by the LPCB.

The company's premises are located in Havant on the south coast of England.

Information in this guide is given in good faith, but Apollo Fire Detectors Limited cannot be held responsible for any omissions or errors. The company reserves the right to change specifications of products at any time and without prior notice.

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FIRE DETECTORS LIMITED

INVESTOR IN PEOPLE

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Quality Systems Certificate No 010
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