

**FIRE DETECTION AND ALARM SYSTEM**

Scope

Furnish a complete 24V DC analogue addressable, electrically supervised, zone annunciated, fire detection and alarm system as specified herein and indicated on the drawings. The system shall include but not be limited to, a control panel or panels with integral power supply to provide the 24V DC, signal initiating devices, audible and visual alarm devices, and all accessories required to provide a complete and operating system.

The fire alarm system shall be wired as 2 core signal loops. 24V DC power wiring shall be installed to alarm sounders via addressable sounder modules or via conventional monitored sounder outputs within the control panel. Loop powered sounders shall be connected directly to the signal loops..

Codes and Standards

The following codes and standards shall apply to work of this section.

- EN54-2 and EN54-4 - Fire Alarm CIE and PSE
- ISO9001 - Quality control
- BS 5839:part 1 - Fire Detection and Alarm Systems for Buildings

Qualifications of Manufacturers

Manufacturers of the products supplied for the fire alarm system shall have been in the business of manufacturing Fire Alarm products for at least five years. They shall confirm compliance to the above codes and standards.

Fire Alarm Control Panel (FACP)

Functional Description

The fire alarm control panel (FACP) shall be the central processing unit of the system, receiving and analysing signals from fire sensors, providing audible and visual information to the user, initiating automatic alarm response sequences and providing the means by which the user interacts with the system.

The FACP shall be certified as meeting the requirements of EN54-2 and EN54-4 by a suitable, notified body. A certificate and test report shall be made available for inspection as evidence of certification.

The FACP shall be easily configurable to meet the exact detection zone and output mapping requirements of the building.

The FACP shall be microprocessor based and operate under a multitasking software program. Operating programs and configuration data shall be contained in re-configurable non-volatile memory. Retention of the memory shall not rely on any form of battery or capacitor back-up device. The FACP shall incorporate separate processors for loop processing and central processing.

Provision shall be made for each addressable loop to be sub-divided into geographical zones. The section of wiring corresponding to each zone circuit shall be protected from faults in other sections by line isolator modules.

In order to facilitate re-configuration and system extension, the allocation of addresses to devices shall be independent of their physical arrangement on the loops.

Up to 240 individually addressed standard devices shall be configured on each addressable loop. Loop powered sounders and beacons incorporated as sensor bases shall be available.

The FACP shall have the capability to support sub-addressing of addressable modules.

It shall be possible to fit a 40-column printer to the FACP which will print system events automatically and logged data upon request.

The FACP shall incorporate a real time clock to enable events to be referenced against time and date.

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Additional Components

It shall be possible to fit the FACP with a network board to allow up to sixty-four control panels to communicate with each other. The network shall be fully fault tolerant and shall continue to function normally under any single fault condition.

It shall be possible to fit the FACP with a modem board to allow remote interrogation and monitoring of a network of control panels.

It shall be possible to fit up to thirty-two, sixteen way input/output modules, eight way relay modules, six way sounder modules or four way conventional zone modules or any combination thereof to each control panel. Modules shall connect to a separate serial bus but shall be programmable in the same manner as devices connected to the addressable loops.

Configuration

It shall be possible to perform configuration updates on site using a portable personal computer and a Windows ® based configuration utility. This facility shall allow the following parameters to be set: -

System

- a) Produce a configuration file which contains data for up to 64 control panels connected together as a network.
- b) Set cause and effect tables for any device to operate devices or functions on any panel or panels connected to the network.
- c) Upload and view graphically the configuration from a single panel or entire network of panels.

Control panel

- a) Panel name (network identity, fifteen characters minimum)
- b) Panel text (comfort message or service company forty characters minimum)
- c) Change code numbers for access levels two and three.
- d) Select sounder ringing mode as common, zonal or two stage
- e) Select first and second stage delay times for each sounder output to between zero and five minutes.
- f) Set number of loops on panel as one, two or four
- g) Set number of zones on panel as 0,16, 48 or 96
- h) Set loop sounder volume globally
- i) Set start and end times for day night mode for each day of the week

Detectors

- a) Allocate a zone
- b) Set a delay before the panel responds to a fire signal
- c) Indicate pre-alarm
- d) Set day sensitivity and night sensitivity separately
- e) Address loop powered base sounders
- f) Allocate a forty character location text message

Call points

- a) Allocate a zone
- b) Allocate a forty character location text message

Switch units (input)

- a) Allocate a zone for each input and the device itself
- b) Define input action as fire, fault, pre-alarm, technical alarm, evacuate, alert, security alarm, silence alarm, reset, transparent, disablement or test mode.
- c) Change the input action message from the default to any one of the above or to any one of a user defined library of 10 additional action messages.
- d) Set a delay before the panel responds to a fire signal
- e) Select whether the input requires the control panel to be reset or is self clearing upon removal of the input
- f) Allocate a forty character location text message

Relay or sounder units (output)

- a) Allocate a zone for each input and the device itself
- b) Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable, needs to be reset or produces a single pulsed operation of between one and five seconds (programmable)
- c) Has a delay before operating (zero to five minutes)
- d) Allocate a forty character location text message

Loop powered sounders and beacons

- a) Allocate a zone
- b) Define whether the device responds to evacuate inputs, as a sounder (default ringing), is silenceable or needs to be reset.
- c) Has a delay before operating (zero to five minutes)
- d) Allocate a forty character location text message

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Panel Construction

The housing containing the FACP shall be of metal construction and shall be capable of being surface or semi-flush mounted. It shall be complete with cable knocks-outs in sufficient quantity to accommodate all likely cabling requirements.

The housing shall afford a minimum ingress protection to IP30 and it shall not be possible to open the FACP without the use of a special tool or key.

Panel Indications

The FACP shall monitor the status of all devices on the addressable loops for fire, short-circuit fault, open-circuit fault, incorrect addressing, unauthorised device removal or exchange, pre-alarm condition and contaminated detector condition.

The FACP shall also monitor the status of internal connections and interfaces including charger and batteries.

The FACP shall provide the following discrete visual indications:

a) POWER ON	green LED indicator
b) FIRE ALARM	red LED indicator
c) PRE-ALARM	yellow LED indicator
d) ON TEST	yellow LED indicator
e) BUZZER SILENCED	yellow LED indicator
f) DELAY ACTIVE	yellow LED indicator
g) MORE EVENTS	yellow LED indicator
h) GENERAL DISABLEMENT	yellow LED indicator
i) GENERAL FAULT	yellow LED indicator
j) POWER FAULT	yellow LED indicator
k) SYSTEM FAULT	yellow LED indicator
l) SOUNDER FAULT/DISABLED	yellow LED indicator

Display

In addition to the indications above, the FACP shall have an integral 240 x 64-pixel graphic LCD display.

The display shall incorporate a backlight which will illuminate upon any event (excluding mains failure) or button press.

The display shall be capable of simultaneously indicating the number of outstanding events and their types as well as the current event.

Panel Controls

The panel shall be provided with at least the following manual controls: -

- a) SILENCE BUZZER
- b) ACKNOWLEDGE ALARM
- c) RE-SOUND ALARM
- d) RESET
- e) LAMP TEST
- f) FUNCTION 1
- g) MORE FIRES
- h) MORE EVENTS
- i) HELP
- j) MENU NAVIGATION PAD (UP,DOWN,LEFT,RIGHT,ENTER,EXIT)

Remote Monitoring Signals

The FACP shall contain at least three programmable inputs to allow interconnection to other systems.

The FACP shall contain at least two programmable outputs to allow interconnection to other systems.

The FACP shall be capable of monitoring and controlling remote site devices, such as relays for the control of plant and dampers directly from the addressable loops.

The FACP shall be capable of monitoring fire doors such that, in the event of a fire alarm condition, an event is generated to warn of the failure of a fire door to close.

Software

The FACP shall have, as a standard software enhancement, the ability to annunciate a pre-alarm condition designed to give the earliest possible warning of potential fire condition without raising the full alarm condition.

The FACP shall have as a standard software enhancement the ability to automatically adjust the alarm threshold levels to compensate for changes in detector sensitivity due to contamination over a period of time.

The FACP shall have, as a standard software enhancement, the ability to provide an indication that a detector is nearing a level of contamination, which requires that it be replaced or serviced.

The FACP shall have, as a standard software enhancement, the ability to provide automatic warning that a detector has reached a level of contamination, which requires that it be replaced or serviced.

The FACP shall have, as a standard software enhancement, the ability to synchronise loop data transmission to eliminate the possibility of data corruption due to cross-talk or similar effects.

The FACP shall have, as a standard software enhancement, extensive, context sensitive help screens to offer additional information on system status at all times.

Sounders

The FACP shall provide the necessary outputs to separately operate a minimum of two monitored circuits of common system sounders. Each output shall be capable of driving a sounder load of up to 1A.

The FACP shall also be able to monitor the integrity of and control standard sounder circuits, via a suitable addressable module.

The FACP shall be capable of providing a two-stage alarm sounder facility that can be programmed, either on a zonal basis or common system basis, to meet the requirements of the fire authority. Sounder outputs shall be available as follows:

- Alert, intermittent pulsed tone
- Evacuate, continuous tone

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The FACP shall have the facility to change, on a per sounder zone basis, the sound output dependent upon whether the source of alarm is:

- an automatic detector, e.g. smoke, heat,
- a manual call point.

The FACP shall have the facility to generate a slow pulsed output to all sounder circuits in response to a security alert input.

### Fault Reporting

The FACP shall monitor all critical system components and interconnections, internal and external, such that a failure, which would prevent the correct operation of the alarm functions, causes the FAULT indicator to light and a message to be given on the alphanumeric display within 60 seconds of occurrence.

The following faults shall be reported in the manner described above: -

- a. Loop Short Circuit
- b. Loop Open Circuit
- c. Unconfigured Device
- d. Device missing
- e. Addressable Device Failure
- f. Incorrectly Configured Device
- g. System fault (processor)
- h. Low battery
- i. Charger failure
- j. Earth fault monitoring
- k. Battery Fault
- l. Mains Failure
- m. Sounder Wiring Open Circuit (per circuit)
- n. Sounder Wiring Short Circuit (per circuit)

To help fault finding and repair, the FACP shall provide text messages to indicate the location of where a fault has occurred in the system.



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System Management

The FACP shall incorporate the following system management facilities:

- a. Isolate/re-connect individual outputs or inputs of addressable points
- b. Isolate/re-connect individual zones
- c. Isolate/re-connect individual loops
- d. Isolate/re-connect all or individual sounder circuits
- e. Isolate/re-connect all volt-free contacts individually
- f. Isolate/re-connect panel inputs
- g. Walk-test of a selected zone to verify detectors and sounders
- h. View system status
- i. Print event log
- j. Print point status.
- k. Set time
- l. View contamination status

Access to the facilities describe above shall be restricted to user Engineer level or above.

The FACP shall have an event log capable of storing the last 500 events that have occurred. It shall be possible to view the content of the log via the alphanumeric display. Events shall be displayed in chronological order with the newest events first. It shall be possible to scroll through the events.

The FACP shall be designed so that, for each type of analogue addressable detector, the overall response time including the sensor, the signal transmission system and the fire decision algorithm, meets the requirement of European Standards.

The FACP shall be capable of isolating a group of selected detectors in areas of the building where maintenance work is carried out.

Automatic Fire Detectors (General)

General

The manufacturer shall have available the following types of analogue addressable automatic sensors, for direct connection to the system addressable loops:

- Ionisation smoke sensors
- Photoelectric smoke sensors
- Heat sensors
- Multi-sensors

Addressable Units

The manufacturer shall be capable of offering two-state addressable versions of the following units, taking only one address from the loop:

- Ionisation smoke detectors
- Photoelectric smoke detectors
- Heat detectors
- Photoelectric beam smoke detectors
- Ultra-violet flame detectors
- Conventional detector interface module
- Addressable sounder modules
- Addressable relay interface modules
- Addressable switch monitoring modules
- Short circuit isolator modules (no address required)
- Loop powered sounders
- Manual call points for indoor use
- Manual call points for outdoor use
- Multiple inputs/outputs
- Radio interfaces to detectors and call points

Conventional Units

The manufacturer shall have available the following types of conventional automatic detectors, manual call points and ancillary units for connection to the system via suitable interfaces:

- Ionisation smoke detectors
- Photoelectric smoke detectors
- Photoelectric beam smoke detectors
- Ultra-violet flame detectors
- Heat detectors
- Manual call points for indoor use
- Manual call points for outdoor use
- Remote indicator units
- Sounders

Analogue Addressable and addressable detectors and modules must be able to transmit to the FACP an address to be used in the system configuration.

It must be possible to connect and mix automatic detectors, addressable manual call points and addressable modules within the same zone sub-division of an

addressable loop.

All equipment connected to the system addressable loop, either directly or via interfaces, shall be proofed against electrical noise, high frequency pulses and electromagnetic influences from other equipment.

The manufacturer shall have available suitable equipment to test and remove or exchange all three main types of automatic point-type detectors when installed.

#### Ionisation Smoke Detectors

The ionisation smoke detectors shall be capable of detecting visible and invisible combustion gases emanating from fires, using a dual ionisation chamber in which the air is ionised by a single radioactive source.

The radioactive source used shall be AM 241 of one microcurie or less.

The ionisation smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.

The ionisation smoke detectors shall be suitable for operation in air speeds of up to 10m/s and shall incorporate screens to minimise the effects of small insects.

The manufacturer shall have available the following versions of the ionisation smoke detector to meet different applications:

- Analogue addressable
- Conventional

The ionisation smoke detector shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

#### Photoelectric Smoke Detectors

The photoelectric smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall employ the forward light-scatter principle.

The point-type photoelectric smoke detectors shall be equally sensitive to a wide range of combustible materials.

The design of the point-type photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.

The point-type photoelectric smoke detectors shall incorporate screens designed to prevent all but the very smallest of insects from entering the sensing chamber, (50 holes per square centimetre or more).

The photoelectric smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.

The manufacturer shall have available the following versions of the point type photoelectric smoke detector to meet different applications:

- Analogue addressable
- Conventional - normal sensitivity
- Conventional – normal sensitivity – delayed response
- Conventional – normal sensitivity – Intrinsically Safe

The photoelectric smoke detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

#### Multi-Sensors – Analogue Addressable

The multi-sensor should be capable of monitoring two different sensing elements:

- 1) Photoelectric
- 2) Thermal

The design of the point-type multi-sensor photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.

The point-type multi-sensors shall incorporate screens designed to prevent all but the very smallest of insects from entering the sensing chamber, (50 holes per square centimetre or more).

The multi-sensors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated

and conducted electrical interference.

The sensor should be able to operate in the following modes:

Combination Mode

The sensor should be able to operate as a photoelectric sensor but when the ambient temperature reaches 40° C or above, the thermal elements should be capable of sensing the 'Rate of Rise' and adjust the sensitivity of the photoelectric element automatically. The sensitivity of the photoelectric should be increased via an internal algorithm.

Photoelectric mode

The sensor should be able to return the analogue value for the photoelectric element during a normal polling sequence.

The sensor should also be able to signal to the FACP if the thermal sensing element exceeds a fixed temperature threshold.

Thermal mode

The sensor should be able to return the analogue value for the thermal element during a normal polling sequence. The sensor should also be able to signal to the FACP if the photoelectric sensing element exceeds a pre-defined threshold.

The multi-sensor shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation. The LED's should be controlled from the FACP if the LED's flash during the normal polling sequence.

The modes of the multi-sensor should be controlled by the FACP, when the FACP changes from one mode to another the FACP should re-calibrate the multi-sensor.

In locations where the detector is not readily visible, remote indicator units shall be provided.

The multi-sensor should have the capability of monitoring both sensing elements, if either or both of the elements fail it should be reported and displayed at the FACP.

Duct smoke detectors

The manufacturer shall produce standard equipment for the installation of smoke detectors in air ducts. This equipment shall be designed to accommodate the manufacturer's standard smoke detectors and bases: Analogue addressable, Addressable and conventional.

Heat detectors

The heat detectors shall be capable of detecting rapid rise in temperature and/or fixed absolute temperatures.

The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.

The heat detectors shall include RFI screening to minimise the effect of radiated and conducted electrical interference.

The manufacturer shall have available the following versions of heat detectors to meet different applications:

- Analogue addressable – grade 1, 2 or 3.
- Two state addressable – grade 1
- Two state addressable – grade 2
- Conventional – grade 1
- Conventional – grade 2
- Conventional – range 1
- Conventional – static 60°C
- Conventional – static 90°C

The heat detectors shall incorporate LED's, clearly visible from the outside, to provide an indication of alarm actuation.

In locations where the detector is not readily visible, remote indicator units shall be provided.

Detector Base

The automatic point-type fire detectors shall be fixed to the installation by means of plug-in bases. Analogue addressable bases, sounder bases and conventional detector bases shall be available.

The three types of bases specified above shall incorporate the optional feature of being able to lock the detectors in place once plugged in. Termination facilities shall be available for earthing.

Standard conventional and Analogue Addressable bases shall not contain any electronic circuitry. This shall enable insulation and continuity checks to be completed on the wiring with the detector heads removed.

Other devices

Addressable Manual Call points

The addressable manual call points shall monitor and signal to the FACP the status of a switch operated by a “break glass” assembly. They shall be red in colour and suitable for surface or flush mounting. The addressable call points shall be provided with an integral red LED to indicate activation.

One version of the addressable call point shall be available mounted in a weatherproof housing, affording protection to IP 66.

The addressable call points shall be capable of operating by means of thumb pressure and not require a hammer. They shall be capable of being tested using a special ‘key’ without the need for shattering the glass.

The addressable call points shall incorporate a mechanism to interrupt the normal addressable loop scan to provide an alarm response within 3 seconds and shall be field programmable to trigger either an alert or an evacuate response from the FACP.

Addressable Sounder Module

The addressable sounder module shall be capable of monitoring and controlling two independent circuits of alarm sounders using a single loop address.

24 V DC power to drive the sounders shall be derived independently from the FACP.

The addressable sounder module shall be capable of operating both sets of

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sounders in a pulsing or continuous mode as determined on the module. Each circuit shall be individually programmable. Sounder circuits shall be capable of synchronisation.

The addressable sounder module shall provide the facility to monitor the wiring to the sounders for open or short-circuit and transmit the necessary fault signal to the FACP. Each sounder circuit shall be separately fused.

The addressable sounder module shall provide the facility to monitor for failure of the power supply for the sounders and transmit the necessary fault signal to FACP.

The addressable sounder module shall provide a green LED indication when the FACP is polling it.

#### Conventional detector interface module

The conventional detector interface module shall be capable of monitoring two independent zones, each of up to 30 conventional detectors using a single loop address.

24 V DC power to power the conventional detectors shall be derived independently from the FACP.

The conventional detector interface module shall provide the facility to monitor the detector zones for open or short-circuit and transmit the necessary fault signal to the FACP.

The conventional detector interface module shall provide a remote LED facility to indicate detectors in alarm and shall provide a red LED indication when the FACP is polling it.

#### Addressable relay interface module

The addressable relay interface module shall be capable of switching two independent relays; either normally open or normally closed, each rated at 30V, 1Amp.

A single input shall provide open and short circuit monitoring facilities, set locally at the unit.

The addressable relay interface module shall use a single loop address.

The unit shall be powered directly from the addressable loop.



The addressable relay interface module shall provide an LED indication when the FACP is polling it.

Addressable switch monitoring module

The addressable switch monitoring module shall be capable of monitoring two independent voltage free contacts, each either normally open or normally closed, using a single loop address.

The unit shall be powered directly from the addressable loop.

The addressable switch-monitoring module shall provide a red LED indication when the FACP is polling it. The LED shall be continuously lit when either input is active.

Short Circuit Isolator Module

The short circuit isolator module shall provide protection on the addressable loop by automatically disconnecting the section of wiring between two modules where a short circuit has occurred.

The short circuit isolator module shall derive power directly from the addressable loop and shall provide an LED indication that the module has tripped. A base mounted version is available.

Loop powered sounders

Addressable electronic sounders shall be connected directly to the detection loops where required. These shall be incorporated in a suitable mounting base so that an analogue smoke or heat sensor may also be connected to the base, if required. Loop powered sounders shall be ceiling or wall mountable. A cover plate shall be fitted when a sensor is not to be fitted on the sounder.

Photoelectric beam smoke detectors

The photoelectric beam smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall utilise the light obscuration principle. The emitter shall project a near infra red beam to the receiver.

Two types are acceptable:

1. The photoelectric beam smoke detectors shall consist of an emitter and a receiver pair. The detectors shall operate over a 5 – 100 metre range.

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2. A Photoelectric reflective beam smoke detector consisting of a combined control unit and a separate reflector. The detector shall operate over a 5-30 metre range.

The photoelectric beam smoke detectors shall have automatic recalibration in order to adjust for contamination.

The photoelectric beam smoke detectors shall be designed to have high resistance to corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.

The photoelectric beam smoke detectors shall incorporate two LED's, clearly visible from the outside and below, to provide indication of alarm actuation and fault.

#### Ultra-violet flame detectors

The flame detector shall be of a point-type. It shall be mounted on its base using a simple twist action for ease of installation and removal.

The flame detector shall be able to detect weak ultra-violet rays in a 120° cone of vision, in a direct line of sight.

#### Remote Indicator Unit

The remote indicator unit shall provide a remote indication for any detector that may be located in an enclosed or locked compartment.

The remote indicator unit shall be driven directly from its associated local detector. It shall be either flush or surface mountable.

#### Sounders

Two types of Electronic sounders shall be acceptable: loop-powered addressable sounders (see above) and stand-alone versions. Stand-alone versions shall be powered by 24 Volts DC from the FACP.

Non loop-powered versions shall be flush or surface mountable, red in colour. They shall have a minimum sound output of 95 dB (A) at 1 meter distance and shall have a maximum current consumption at 24V DC of 100 mA.

Alarm Bells

Fire alarm bells shall be under dome type with a high resonance pressed alloy-steel gong to ensure a loud clear-tone ring. They shall be fully suppressed and polarised.

The operating mechanism shall be fully enclosed and the gong shall be red stove enamelled for long life.

Alarm bells shall have a minimum sound output of 95 dB (A) at 1 metre distance, and shall have a maximum current consumption at 24V DC of 30 mA.

END OF SPECIFICATION