Fire alarm control panel

A **fire alarm control panel** (FACP), also called a **fire alarm panel**. Technicians usually refer to the FACP as the **panel**. A **fire alarm control panel** is the central control device that receives information from input devices (smoke detectors, heat detectors, manual fire alarm stations, etc.) The **panel** then processes the information to trigger an output device (bells, horns, or strobes).

There are three types of panels: coded panels, conventional panels, and addressable panels.

Coded panels were the earliest type of central fire alarm control, and were made from the 1950s to the late 1970s. A coded panel is similar in many ways to a modern conventional panel (described below), except each zone was connected to its own code wheel (Ex: An alarm in zone 1 would sound code 1-2-4 [through the bells or horns in the building], while zone 2 would sound 1-2-5), which, depending on the way the panel was set up, would either do sets of four rounds of code until the initiating pull station was reset (similar to a coded pull station) or run continuosly until the panel itself was reset. Large panels could take up an entire wall in a mechanical room, with dozens of code wheels. Lists of codes had to be maintained, sometimes with copies being posted above certain pull stations (this setup is commonly seen in older wings of hospitals). Smaller panels could be set up in one of two ways. Most of the time, the panel would only have one zone, and therefore, only one code. Common one-zone codes were 4-4-0 and 17-0-0 (which is similar to the 120 bpm March Time setting found on modern panels). Alternatively, the panel could be made with no code wheels, using only what was called the gong relay. In large systems, this was primarily used to acommodate existing coded pull stations. However, it could also be used as its own zone, with the connected horns or bells sounding continuosly instead of in a particular code. These panels are not very common today, but can sometimes be found in older buildings such as those on college campuses or hospitals.

In a conventional panel, fire detection devices including, but not limited to smoke detectors, flame detectors, heat detectors and manual call points or manual pull stations are joined up with a number connected to each circuit. When a device on the circuit is activated, the panel recognizes an alarm on that circuit and could be set up to take a number of actions including directly calling the fire department via an alarm transportation system (ATS).

An addressable panel is a more modern type of panel, and has greater flexibility than a conventional panel. An addressable panel has a number of loops, where a number of devices are able to be connected, each with its own address. There is no standard protocol as such, and thus a number of proprietary solutions exist. Loop devices have traditionally been able to have 99 or 100 devices connected, but more recent protocols allow many more. This is usually overcome by having multiple loops on one system.

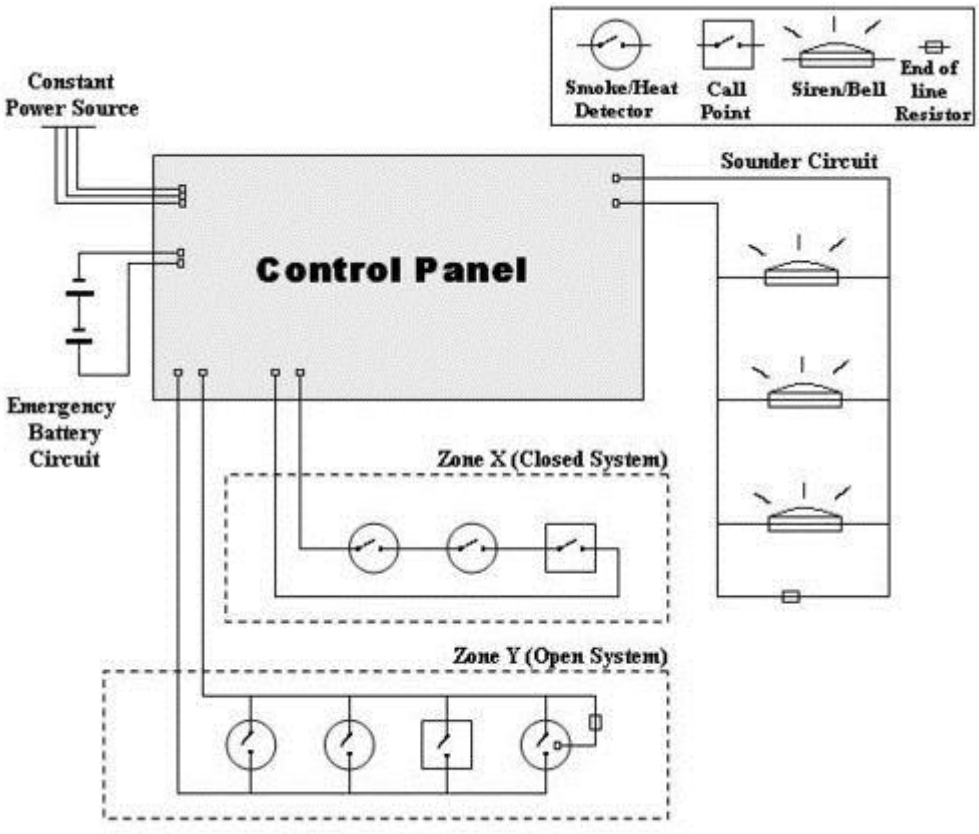
A fire alarm control panel is required under the building code for a majority of new commercial building construction in most countries.

Conventional panels

Conventional panels have been around ever since electronics became small enough to make them viable. They are no longer used frequently in large buildings, but are still used on smaller sites such as small schools or apartments.

Conventional panels usually have a small number of circuits, each circuit covering a zone within the building. A small map of the building is often placed near the main entrance with the defined zones drawn up, and LEDs indicating whether a particular circuit/zone has been activated. Another common method is to have the different zones listed in a column, with an LED to the left of each zone name.

The main drawback with conventional panels is that one cannot tell *which* device has been activated within a circuit. The fire may be in one small room, but as far as emergency responders can tell, a fire could exist anywhere within a zone. The same applies to coded panels, which nowadays are no longer made, but can be found in old systems. These, if the decision is made to keep them, are "grandfathered" in under NFPA regulations.



A wiring diagram for a simple fire alarm system consisting of two input loops (one closed, one open)

Addressable panels

Addressable panels are usually much more advanced than their conventional counterparts, with a higher degree of programming flexibility and single point detection. Notable examples include the EST 3, the Faraday MPC-2000 and the Simplex 4100U. Addressable fire alarm panels were introduced by many manufacturers during the microcontroller boom in the mid 1980s.

Loops

Panels usually have a number of loops within the range of two to 20 loops. At the present time, four or six loop panels are the most common.

Each loop can have a number of devices connected to it. Each device has its own address, and so the panel knows the state of each individual device connected to it. Common addressable input (initiating) devices include

- Smoke detectors
- Manual call points or Manual pull stations
- Responders
- Fire sprinkler inputs
- Switches
    - Flow control
    - Pressure
    - Isolate
    - Standard switches

Addressable output devices are known as relays and include

- (Warning System/Bell) Relays
- Door Holder Relays
- Auxiliary (Control Function) Relays

Relays are used to control a variety of functions such as

- Switching fans on or off
- Closing/opening doors
- Activating Fire suppression systems
- Activating notification appliances
- Shutting down industrial equipment

Since their inception, loops have generally been able to handle 99 devices. More recently however, new protocols have been designed that allow 256 devices on each loop.

Mapping

Also known as "Cause and Effect" or "Programming", mapping is the process of activating outputs depending on which inputs have been activated. Traditionally, when an input device is activated, a certain output device (or relay) is activated. As time has progressed,

more and more advanced techniques have become available, often with large variations in style between different companies.

Zones

Zones are usually made by dividing a building, or area into different sections, and placing each device in the building in a different zone.

Groups

Groups are used to group two or more relays. They are used to shorten programming time by allowing several detectors to link to any particular group which then maps to a group of relays.

Boolean logic

This is the part of a fire panel that has the largest variation between different panels. It allows a panel to be programmed to implement fairly complex inputs. For instance, a panel could be programmed to notify the fire department only if more than one device has activated. It can also be used for staged evacuation procedures in conjunction with timers.

Networking

The principle of networking involves connecting several panels together to form a system. Inputs on one panel may activate outputs on another, for example, or the network may allow monitoring of many systems. Networking is often used in situations where one panel is not large enough, or in multiple-building situations.

Although quasi-standards exist that allow panels from different manufacturers to be networked with each other, they are not in favour with a lot of companies (so they are not de-facto at all). One of the most common of these is named BACnet which is used for various type of industrial networks.

More recently, some panels are being networked with standard Ethernet, but this is not yet very common. Most organizations choose to create their own proprietary protocol, which has the added benefit of allowing them to do anything they like, allowing the technology to progress further. This has the serious downside, however, of hampering interoperability between manufacturers.

Networking may be used to allow a number of different panels to be monitored by one graphical monitoring system.

Monitoring

In nearly every state in the USA, the International Building Code requires fire alarm and sprinkler systems to be monitored by an approved supervising station.

A fire alarm system consists of a computer-based control connected to a central station. The majority of fire alarm systems installed in the USA are monitored by a UL listed or FM Global approved supervising station.

These systems will generally have a top level map of the entire site, with various building levels displayed. The user (most likely a security guard) can progress through the different stages. From top level site → building plan → floor plan → zone plan, or however else the building's security system is organised.

A lot of these systems have touch screens, but most users tend to prefer a mouse (and a normal monitor), as it is quite easy for a touch screen to become misaligned and for mistakes to be made. With the advent of the optical mouse, this is now a very viable option.

System functions

There are many functions on a fire alarm panel. Some of these are:

System reset

This resets the panel after an alarm condition. All initiating devices are reset, and the panel is cleared of any alarm conditions. If an initiating device is still in alarm after the system is reset, such as a smoke detector continuing to sense smoke, or a manual pull station still in an activated position, another alarm will be initiated. A system reset is often required to clear supervisory conditions. A system reset does not usually clear trouble conditions. Most trouble conditions will clear automatically when conditions are returned to normal.

Acknowledge

This function, also abbreviated to "ACK", is used to acknowledge an abnormal situation such as an alarm, trouble or supervisory. The acknowledge function tells the panel that building personnel or emergency responders are aware of the alarm, trouble, or supervisory condition. Acknowledging the alarm or trouble condition also normally silences the panel's own sounder, but does not silence any alarms.

Drill

Also known as "manual evacuation" or "evacuate". On panels that have this function, the drill function activates the system's notification appliances, often for purposes of conducting a fire drill. Using the drill function, an alarm is normally not transmitted to the fire department or monitoring center. However, building personnel often notify these agencies in advance in case an alarm is inadvertently transmitted.

Walk test

Will allow the functional testing of the systems initiation and notification devices without the assistance of additional people at the control panel itself.

Alarm silence

Also known as "audible silence". Depending on the configuration of the alarm system, this function will either silence the system's notification appliances completely, or will silence only the audible alarm, with strobe lights continuing to flash. Audible silence allows for easier communication amongst emergency responders while responding to an alarm. This can also be used during construction as a means of a preliminary test, before the final full test.

Lamp test

Also known as "flash test". This button is known to have become obsolete, but is still used on many panels. This function is used to check the condition of the LEDs themselves. A "Lamp Test" button is required by code on multi-zone panels installed in Canada.

Alarm circuit supervision

Various forms of alarm circuit supervision have been used to indicate trouble with an alarm circuit. Possible alarm circuit faults on a two wire circuit include one of the conductors being shorted to ground, open circuit (conductor continuity break), or a short circuit between the conductors. Also the circuits could be tampered with by having an external AC or DC voltage applied with various duty cycles or waveforms. There are a number of US patents that address this issue and some have been implemented in available system products. One of the first to address this issue was Patent No. 3,588,890 "Resistance Sensing Supervisory System" issued on June 28th 1971 and assigned to General Motors Corporation. General Motors used this supervision on all circuits installed in GM plants starting in 1970 [1]. An improvement to this basic "Resistance Sensing Supervisory System" can be obtained by providing a pulsed or time dependent variable voltage applied to the alarm circuit and is addressed in US patent numbers 4,030,095[1] and 4,716,401[2].

Panel alerting

Many panels today have the capability of alerting building personnel of a situation which can arise into a potentially serious problem. Fire alarm panels indicate an abnormal condition is via a solid or flashing LED. Some panels also contain a small sounder, used in conjunction with the visual alert. A number of indicators are shown below. Note that not all fire alarm panels have all of these indicators.

Alarm

Also known as "Fire". This indicator is lit when an alarm condition exists in the system, initiated by smoke detectors, heat detectors, sprinkler flow switches, manual pull stations, manual call points, or otherwise. Along with the indicator on the panel, notification appliances, such as horns and strobes, are also activated, signaling a need to evacuate to building occupants. In an alarm condition, the fire alarm panel indicates where the alarm originated. The alarm panel can be reset once the device which initiated the alarm is reset, such as returning the handle of a manual pull station to its normal position.

Audible silence

The Audible Silence indicator is used in conjunction with the "Alarm" indicator. It indicates that the fire alarm panel is still in an alarm condition, but that notification appliances have been silenced. While the alarm is silenced, other functions in an alarm condition continue to operate, such as emergency service for elevators, stairway pressurization, and ventilation functions. A new alarm initiation while the alarm is silenced will take the panel out of Audible Silence and reactivate the notification appliances.

Brigade called

This indicator is activated when emergency responders have been automatically notified by the fire alarm system. Requirements vary depending on jurisdiction regarding whether a direct connection to the fire department is required, optional, or prohibited. If a connection to the fire department is optional, or is prohibited, a fire alarm system is often connected to a monitoring center at the building owner's discretion.

Drill

On panels containing this function, the "Drill" indicator shows that the alarm condition was activated from the fire alarm panel, often in order to conduct a fire drill. When an alarm is initiated for a drill, the fire department or monitoring company is usually not notified automatically. However, building personnel preparing to conduct a fire drill often will provide advance notice of a drill to the fire department and monitoring center in case an alarm is unintentionally transmitted.

Trouble/fault

Also known as "Defect". When held steady or flashing, it means that a trouble condition exists on the panel. Trouble conditions are often activated by a contaminated smoke detector or an electrical problem within the system. Trouble conditions are also activated by a zone being disabled (disconnected from the system), a circuit being disabled, low power on the backup battery, the disabling of a notification appliance, the ground faults, or short or open circuits. Usually the alarm panel's sounder will activate if a trouble condition exists, though older systems would sometimes activate a bell or other audible signal connected to the panel. In a trouble condition, the panel displays the zone or devices causing the condition. The "Trouble" indicator goes out automatically when the situation causing the trouble condition is rectified and some panels have more specific indicators such as 'Trouble-PSU' which shows when the panel itself is compromised and 'Trouble-Bell' which shows that the sounders are not functioning correctly.

Supervisory

This signal indicates that a portion of the building's fire protection system has been disabled (such as a fire sprinkler control valve being closed and, consequentially, a sprinkler tamper switch being activated), or, less frequently, that a lower priority initiating device has been triggered (such as a duct smoke detector). The "Supervisory" indicator may go out automatically when the condition has cleared, but usually requires a "Reset" to clear.

AC power

Also known as "Normal". When this indicator is lit, power is being provided to the system from the building's electrical system, and not from the backup battery. When an AC power condition changes, the Trouble indicator comes on and the AC power indicator goes off and the screen alerts building personnel of a power failure. If the AC power indicator is lit without any other indicators also lit, then the system is in a normal condition. If no LEDs are lit, there is no power source feeding the panel.

DC power

This is used to tell the operator that DC power (batteries) are being charged or used. While using DC power, the system remains in a trouble condition.

Highrate

This LED is on when there are unusual power-line conditions.

Priority 2 alarm/security

This LED is common on top-of-the-line intelligent panels. This LED can only activate if there is a secondary device hooked into the "Priority 2 Alarm/Security" terminals. This secondary device could be a security system, building management system, or another fire alarm control panel. Depending on how the panel is programmed, the panel's alarms may or may not activate when a condition like this is present.