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CENTRAL POLYTECHNIC COLLEGE

THARAMANI, CHENNAI

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1122 Diploma in Fire Technology and Safety

Fire Alarm Systems -Student Manual

Prepared by
P M Subramanian, GL,FTS

DETAILED STUDENT TECHNICAL MANUAL: FIRE ALARM SYSTEMS

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CHAPTER 1: PRESENTATION

1.1 Presentation of the Equipment

Fire alarm systems are engineered active fire protection installations designed to discover fires early in their development when time is still available for the safe evacuation of building occupants.

An active fire protection system controls all fire alarm modules across a facility. It is composed of:

- **Alarm Initiating Devices:** Smoke detectors, heat sensors, and manual call points.
- **Alarm Notification Appliances:** Sirens, horns, bells, and flashing visual strobes.
- **Fire Control Units / Suppression Systems:** Automatic sprinkler system interlocks or gaseous fire extinguisher activation relays.
- **Power Supplies:** Primary mains AC transformers and secondary DC battery backups.
- **Wiring Infrastructure:** Supervised signaling line circuits (SLCs) and notification appliance circuits (NACs).





The teaching objective of this training equipment is to provide diploma students with practical competency in studying, installing, programming, and maintaining Fire Alarm Systems (FAS).

Teaching Aim:

The teaching aim of this equipment is to study and implement the Fire Alarm System.

The following subjects can be dealt with:

- Study of the System Architecture
- Installation of the Fire Alarm Equipment
- Programming the Fire Alarm System Tool to control the Different Fire Sensors
- Manual Call Points
- Associated Output Devices installed in a Building
- Generate Reports

CHAPTER 2: FIRE ALARM SYSTEM FUNDAMENTALS

What is a Fire Alarm System?

A fire alarm system functions as an active fire protection mechanism designed to oversee and control all fire alarm modules present within a building. These systems serve the critical purpose of discovering fires early in their development phase, ensuring that sufficient time remains available for the safe evacuation of occupants. Furthermore, early detection plays a significant role in safeguarding the physical safety of emergency response personnel.

By initiating control efforts while a fire is still small, property loss can be significantly reduced and operational downtime minimized. Most alarm systems also provide vital information to emergency responders regarding the exact location of the fire, thereby speeding up the overall process of fire control.A fire alarm system is an automated active safety network designed to detect combustion signatures early. Early detection plays a vital role in protecting emergency response personnel, reducing property loss, and minimizing operational downtime.

Sensors are calibrated to detect specific thresholds of heat, smoke, or invisible combustion gases. Once tripped, they signal the Fire Alarm Control Unit (FACU), which initiates audible and visual warnings (such as bells, sirens, and strobe lights for hearing-impaired occupants).

Core Components

The architecture of a fire alarm system is composed of several critical elements:

- Alarm initiating devices, which include smoke detectors and heat sensors.
- Alarm notification appliances, consisting of sirens or devices that produce loud noises.
- Fire control units, such as sprinkler systems or fire extinguisher systems.
- Essential infrastructural elements, including power supplies and wirings.

Operation and Functionality

A fire alarm system can be triggered automatically through smoke detectors and heat detectors, or it can be activated manually. These sensors are specifically calibrated to detect particular thresholds of heat or smoke that signify the presence of a fire. To alert building occupants, a loud bell or a siren is utilized, which is sometimes accompanied by blinking or flashing lights to accommodate individuals who have hearing difficulties. Gaining a thorough understanding of how these mechanisms operate requires examining the specific components in detail, beginning with the foundational presence of smoke detectors to identify smoke or fire.

Different Types of Fire Alarm Signaling Systems

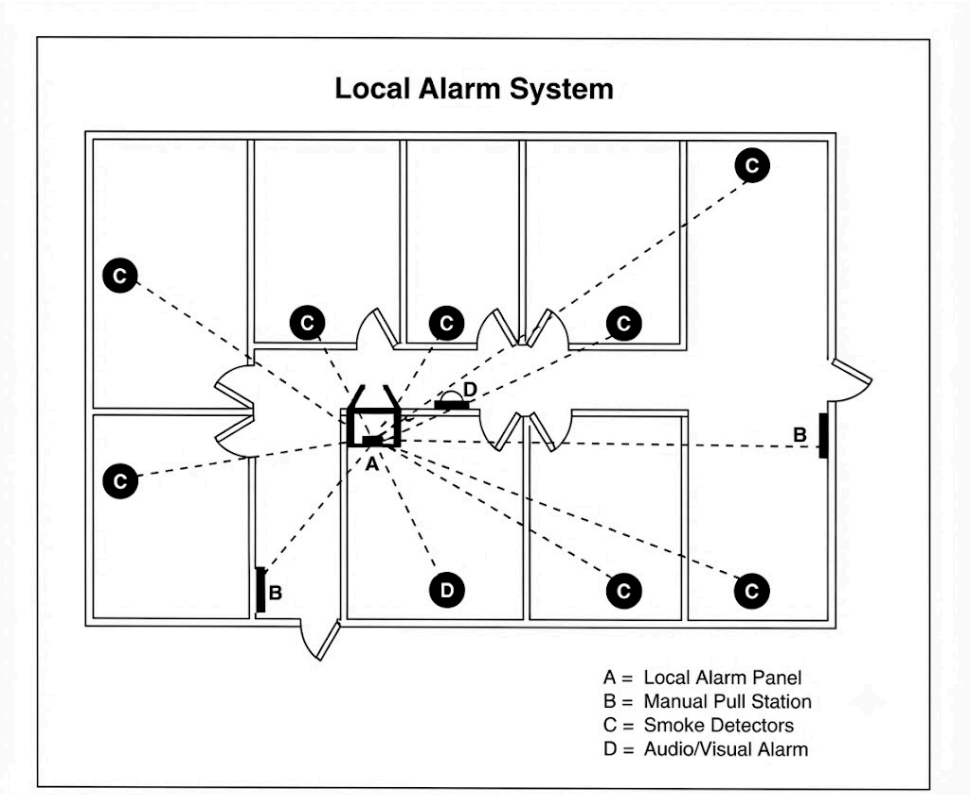
A simple fire alarm system may only sound a local evacuation alarm. A more complex system may sound a local alarm, activate building services, and notify fire and security agencies to respond. The type of system required depends upon the type of occupancy of the building and is affected by the following factors:

- Level of life safety hazard
- Structural features of the building
- Hazard level presented by the contents of the building
- Availability of fire suppression resources, such as water supply, hydrants, and automatic sprinkler systems
- State and local code requirements

The type of system deployed in a building depends on occupancy type, life safety hazard levels, structural features, and local building codes. Technicians must recognize two primary categories of signaling systems:

A. Protected Premises (Local) Systems

A protected premises system is designed to provide notification to building occupants only on the immediate premises (as shown in fig). Where these systems are allowed, there are no provisions for automatic off-site reporting. The protected premises system can be activated by manual means, such as a manual call point, or by automatic devices, such as smoke detectors. A protected premises system may also be capable of annunciating a supervisory or trouble condition to ensure that service interruptions do not go unnoticed.Designed to notify occupants within the immediate building premises without automatic off-site reporting.



Localized Control TypesThe localized control can be of following types:

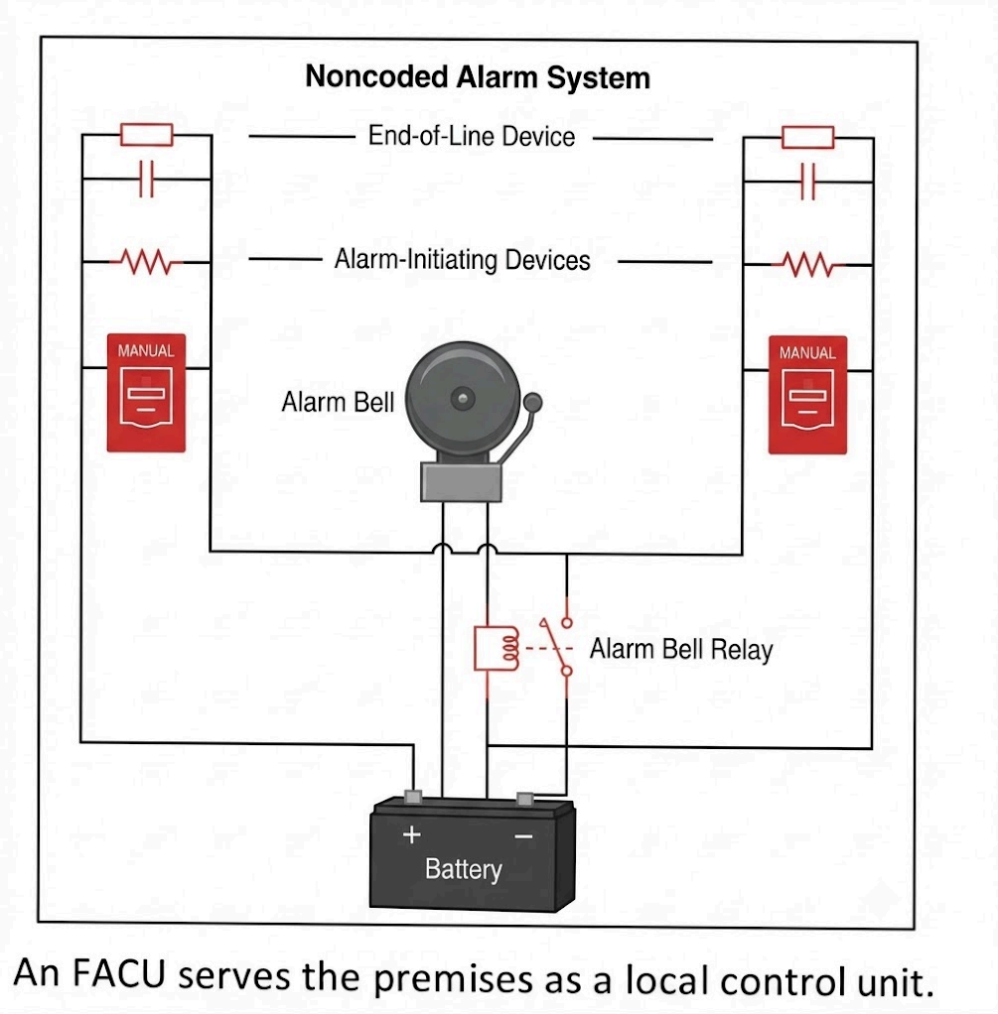
Conventional Alarm Systems

A conventional system is the simplest type of protected premises alarm system. When an alarm-initiating device, such as a smoke detector, sends a signal to the FACU, all of the alarm-signaling devices operate simultaneously. The signaling devices usually operate continuously until the FACU is reset. The FACU is incapable of identifying which initiating device triggered the alarm; therefore, building and fire department personnel must walk around the entire facility and visually check to see which device was activated. These systems are only practical in small occupancies with a limited number of rooms and initiating devices.

Zoned Conventional Alarm Systems

Fire-alarm system annunciation enables emergency responders to identify the general location, or zone, of alarm device activation. In this type of system, an annunciator panel, FACU, or a repeater panel visibly indicates the building, floor, fire zone, or other area that coincides with the location of an operating alarm-initiating device.

Alarm-initiating devices in common areas are arranged in circuits or zones. Each zone has its own indicator light or display on the FACU. When an initiating device in a particular zone is triggered, the notification devices are activated, and the corresponding indicator is illuminated on the FACU. This signal gives responders a better idea of where the problem is located.



An FACU serves the premises as a local control unit.

Addressable Alarm Systems

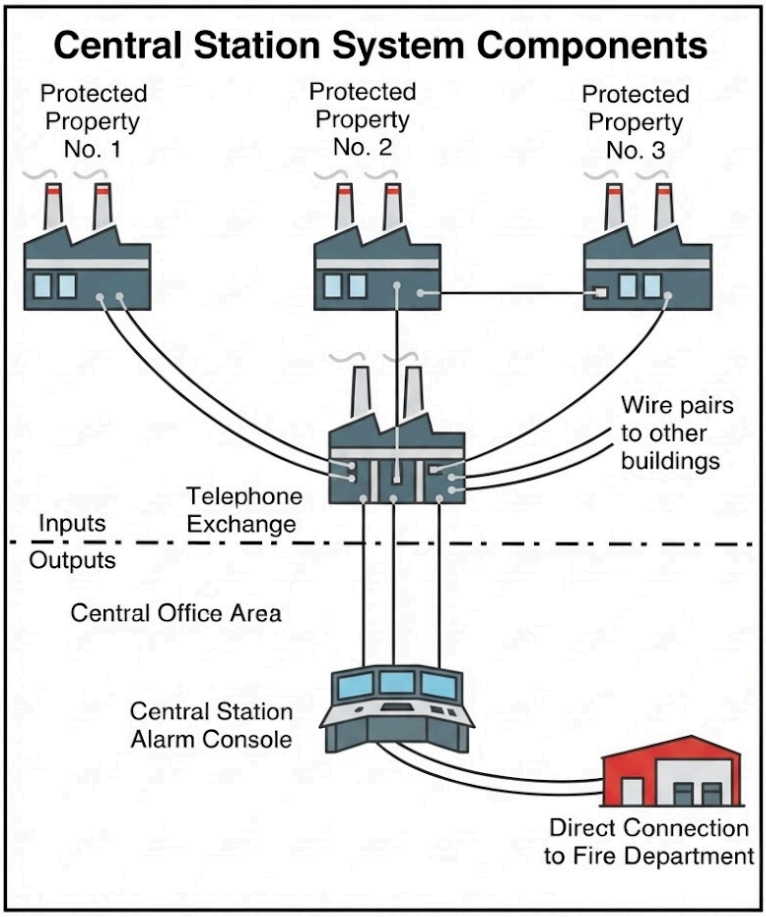
Addressable alarm systems display the location of each initiating device on the FACU and the repeater panel if provided. This connection enables emergency responders to pinpoint the specific device that has been activated. Addressable systems reduce the amount of time that it takes to respond to emergency situations. These systems also allow repair personnel to quickly locate and correct malfunctions in the system.

Supervising Station Systems

For buildings that are not constantly attended by qualified personnel, initiating device signals are required to be transmitted to a supervising station. A supervising station is a facility that receives signals from a protected premises fire alarm system and where the signal is processed by personnel.

Central Station System

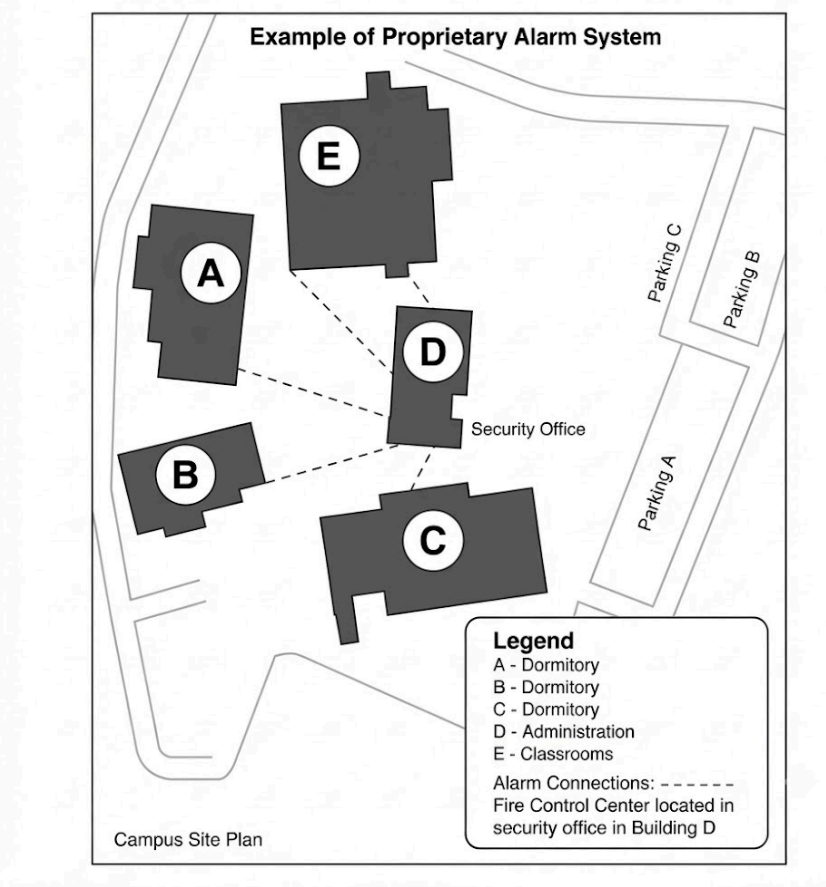
A central station system is a listed supervising station that monitors the status of protected premises alarm systems and provides inspection, testing, and maintenance services.



The primary difference between a central station system and a proprietary system is that the receiving point for alarms in a central station system is located outside the protected premises and is monitored by a contracted service. The external receiving point is called the central station.

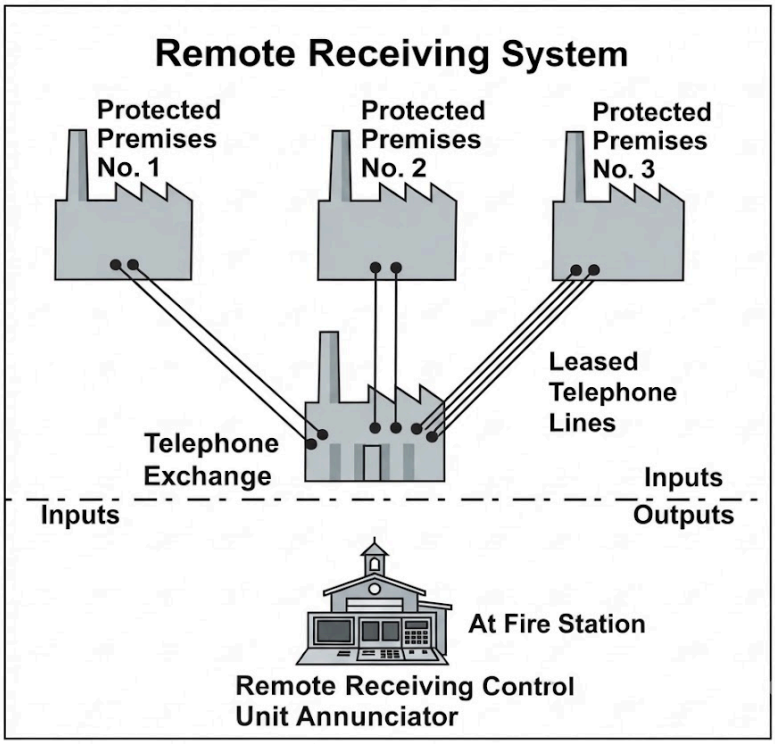
Proprietary System

A proprietary system is used to protect large commercial and industrial buildings, high-rise structures, and groups of commonly owned facilities, such as a college campus or industrial complex in single or multiple locations. Each building or area has its own system that is wired into a common receiving point that the facility owner owns and operates. The receiving point must be in a separate structure or a part of a structure that is remote from any hazardous operations.



Remote Receiving System

A listed supervising station that monitors the status of protected premise alarm systems through contracted services is called a remote receiving station. Remote receiving stations do not provide inspection, testing, or maintenance services. Depending on local requirements, the fire department may approve other organizations to monitor the remote system.



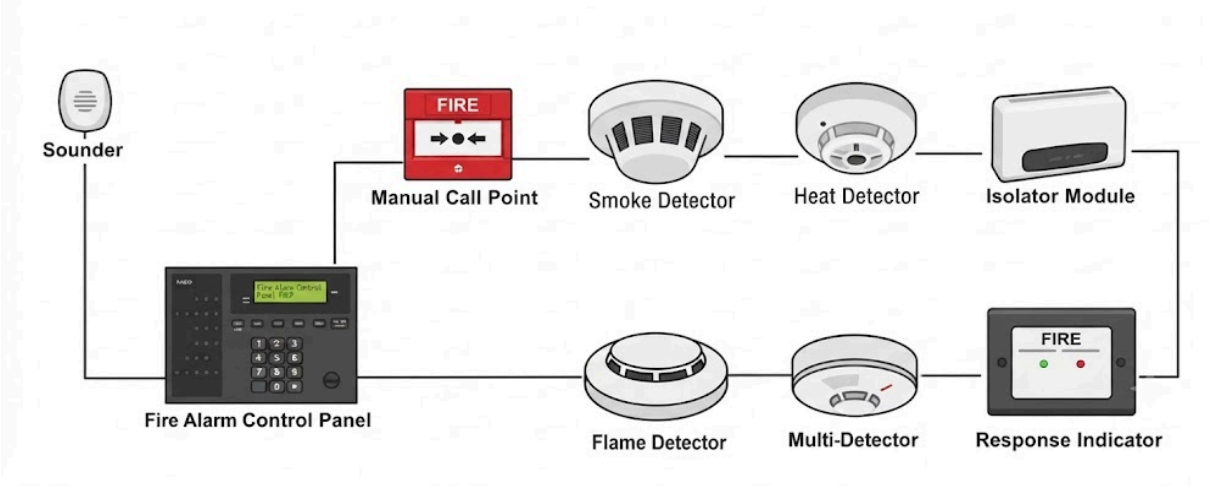
Public Emergency Alarm Reporting Systems

In some communities, fire alarm signals from a protected premise are transmitted directly to the fire department. Instead of being connected to the fire department telecommunications center through a municipal fire alarm box system, the public emergency alarm reporting system is connected by another means, usually a leased telephone line. Where permitted, a radio signal over a dedicated fire department radio frequency may also be used.

Emergency Communications Systems

The purpose of emergency communications systems is to provide a reliable communication system for occupants and firefighters. This system may either be a stand-alone system, or it may be integrated directly into the overall fire detection and alarm-signaling system. System types include voice notification, two-way communication, and mass notification.

Fire Alarm System Architecture



Advantages and Disadvantages of Fire Alarm System

Advantages:

Avoid Smoke Inhalation

Smoke inhalation represents the primary cause of fire-related fatalities, surpassing heat and flames. Comprising a complex mixture of particles, chemicals, and gases, smoke causes widespread harm ranging from skin and mucous membrane irritation to severe respiratory distress and airway collapse. Without immediate medical intervention, exposure can result in suffocation and death. Installing a fire alarm offers essential protection against hazardous substances typically present in smoke, such as carbon monoxide, ammonia, and hydrogen cyanide.

Early Fire Detection

Audible or visual alerts provide immediate notification, allowing occupants to pursue safety promptly after a fire originates. Triggering the system during early smoke or fire conditions enables individuals to utilize nearby fire extinguishers or safely evacuate family members. Early detection prevents catastrophic destruction, safeguarding key living areas such as kitchens, bathrooms, bedrooms, and family rooms while immediately alerting firefighters to curtail overall damage.

Decreased Risk of Fire Damage

Repairing property damage often demands substantial financial investments and extensive time. Implementing a residential fire alarm protects adjacent properties by empowering emergency responders to suppress fires before escalation occurs. Minimizing structural harm facilitates faster recovery and restoration of affected rooms.

Placement Flexibility

Fire alarms offer versatile installation options across various locations. System effectiveness peaks when detectors are positioned close to kitchens or other areas prone to fire hazards. Proximity to bedrooms and family rooms remains crucial to guarantee quick audibility during emergencies.

24/7 Monitoring

Fire alarms provide constant protection, whether you're at home, asleep for the night, or away in which case you can receive remote [alerts]. These advantages exemplify the many uses of a fire alarm system. Also, many systems include 24/7 monitoring services for constant protection no matter where you are.

Easy & Affordable

Once installed, fire and smoke detectors are easy to use. They automatically sense hazardous conditions without you doing anything. It's not expensive to have a professional installer to install the system.

Low Maintenance

Despite their importance, fire alarms require little maintenance, except for occasionally changing batteries or having them professionally inspected. There's little obligation and cost-overhead associated with having a fire alarm system.

Disadvantages:

Particles of combustion or "smoke" from a developing fire may not reach the sensing chambers of the smoke detector because:

- Barriers such as closed or partially closed doors, walls, or chimneys may inhibit flow.
- Smoke particles may become "cold" and stratify and may not reach the ceiling or upper walls where detectors are located.
- Smoke particles may be blown away from detectors by air outlets.
- Smoke particles may be drawn into air returns before reaching the detector.

The amount of "smoke" present may be insufficient to alarm smoke detectors. Smoke detectors are designed to alarm at various levels of smoke density. If such density levels are not created by a developing fire at the location of detectors, the detectors will not go into alarm.

Smoke detectors, even when working properly, have sensing limitations. Detectors that have photoelectronic sensing chambers tend to detect smoldering fires better than flaming fires, which have little visible smoke. Detectors that have ionizing-type sensing chambers tend to detect fast flaming fires better than smoldering fires. Because fires develop in different ways and are often unpredictable in their growth, neither type of detector is necessarily best nor a given type of

detector may not provide adequate warning of a fire.

Smoke detectors are subject to false alarms and nuisance alarms. For example, a smoke detector located in or near a kitchen may go into nuisance alarm during normal operation of kitchen appliances. In addition, dusty or steamy environments may cause a smoke detector to falsely alarm. If the location of a smoke detector causes an abundance of false alarms or nuisance alarms, do not disconnect the smoke detector; call a professional to analyze the situation and recommend a solution.

Smoke detectors cannot be expected to provide adequate warning of fires caused by arson, children playing with matches (especially within bedrooms), smoking in bed, violent explosions (caused by escaping gas, improper storage of flammable materials, etc.).

Heat detectors do not sense particles of combustion and are designed to alarm only when heat on their sensors increase at a predetermined rate or reaches a predetermined level. Heat detectors are designed to protect property, not life.

Warning devices (including horns, sirens, and bells) may not alert people or wake up sleepers who are located on the other side of closed or partially open doors.

Telephone lines needed to transmit alarm signals from a premise to a central station may be out of service or temporarily out of service. For added protection against telephone line failure, backup radio transmission systems are recommended.

System components, though designed to last many years, can fail at any time. As a precautionary measure, it is recommended that smoke detectors be checked, maintained, and replaced per manufacturer's recommendations.

System components will not work without electrical power. If system batteries are not serviced or replaced regularly, they may not provide battery backup when AC power fails.

Environments with high air velocity or that are dusty or dirty require more frequent maintenance.

CHAPTER 3:ELEMENTS SUPPLIED & SYSTEM REQUIREMENTS

Equipment Supplied

The complete "Fire Alarm System" consists of:

Description	References
Fire Alarm Control Panel	GSFGST200N1
Multi Detector	GSFDI9101E
Photoelectric Smoke Detector	GSFDI9102E
Heat Detector	GSFDI9103E
Manual Call Point	GSFDI9204E
Sounder and Strobe	GSFI9403
Loop Isolator	GSFC9503E
Response Indicator	SSFRI007H
Input Output Module	GSFI9301

Portable Programming Tool	GSFP9910B
Graphical Software	GSFGSTGMCV30

Documentation Supplied

- A technical manual and an exercises book.
- A CD-ROM containing in particular the technical and didactic manual in ".pdf" format as well as the programs used by teachers and the reference program.

Equipment not supplied

- The microcomputer.
- The measurement devices.
- All other items not mentioned in the section Equipment supplied.

Chapter 4: CONDITION OF USE

Warnings

Schneider Electric is not responsible in case of hardware or software modification without its express prior consent. Study the entire equipment documentation and store it in a safe place.

- Strictly comply with the warnings and instructions given in the documentation and on the actual equipment.
- All operations must be performed in strict accordance with safety instructions, relating to operation of an electrotechnical system.
- This teaching facility is certified. It is designed and produced according to standards and principles for the safety of persons and equipment.
- However, as it is supplied by a 230Vac mono-phase network, its operation calls for a minimum number of precautions to guard against the risk of accidents relating to use of live equipment.
- Use of the equipment for purposes other than those intended by the Institute Schneider Formation is strictly forbidden.
- All operations must be carried out under the supervision and the responsibility of a teacher or other accredited person, trained in handing live equipment.
- No more than two students should work on the equipment at the same time.
- Although this equipment simulates an industrial system, it is not necessarily considered as a machine but rather as a laboratory apparatus.
- It conforms to standard EN-61010 (safety rules for electrical measurement, regulation

and laboratory apparatus). In this case it is not compulsory to mark cabling wires, as the exercises do not relate to the wiring diagram.

Symbols Used

Symbol	Reference	Description
	CEI 60417 - 5031	AC current
	CEI 60417 - 5032	DC current
	CEI 60417 - 5033	AC and DC current
		3Ph AC current
	CEI 60417 - 5017	Earth terminal
	CEI 60417 - 5019	Protection earth terminal
	CEI 60417 - 5020	Frame earth terminal
	CEI 60417 - 5021	Equipotentiality

	CEI 60417 - 5007	ON (power supply)
	CEI 60417 - 5008	OFF (power supply)
	CEI 60417 - 5172	Device fully protected by double insulation and enhanced insulation
		Warning, risk of electric shock
	CEI 60417 - 5041	Warning, hot surface
	ISO 7000 - 0434	Warning, risk of danger (see note)
		Warning, risk of jamming
		Warning, risk of pinching

If you see one of these symbols on the equipment, consult the technical manual for more details.

Environment

Storage and the conditions of use of the equipment must comply with the following rules:

Temperature

In operation:

$1^{\circ}C(30^{\circ}F) < t <+ 45^{\circ}C(113^{\circ}F)$

Storage:

$25^{\circ}C(- 13^{\circ}F) < t <+ 55^{\circ}C(131^{\circ}F)$

Hygrometry

Relative humidity of air: \$0\%\$ to \$93\%\$ (without condensation nor runoff).

Altitude

Lower than $2000m$ ($6560feet$)

Ventilation

These openings must therefore never be obstructed or covered.

Do not insert objects (particularly metal) into these openings as there is a risk of touching voltage points or of creating short-circuits that are hazardous for people and equipment.

Pollution

The bench is designed for use in conditions where pollution is only of the non-conductive dry type. The bench must be protected against dust, corrosive gases, liquid projections, etc.

Noise: less than $70dBA$

European directive (no. 86-188) recommends reducing the equivalent noise level to less than $90dB(A)$.French labour code R 232-8 and hereafter indicate the measures to be taken according to the thresholds reached:

as from $85dB(A)$ (danger presumption threshold) hearing protection devices are provided;

equal or higher than $90dB(A)$ (actual risk of hearing impairment): wear of personal ear protectors is required and a technical project to reduce the noise near the machines should be

provided when it is technically possible.

Brightness

Decrees 83-721 and 83-723 of the labour code concerning lighting on the work place.

Premises allocated to work and their dependencies	Minimum illumination values
Internal circulation routes	40 lux
Stairways and warehouses	60 lux
Working premises, cloakrooms, toilets	120 lux
Blind premises allocated to permanent wor	200 lux

External areas	Minimum illumination values
External circulation routes	10 lux
Exernal areas where permanent works are performed	40 lux

Circular of 11 April 1984 on the types of activity

Types of activity	**Minimum illumination values**
Medium mechanics, typing, office work	200 lux
Work on small parts, drafting department, mechanical data processing	300 lux
Fine mechanics, etching, colour comparison, difficult drawings, clothing industry	400 lux
Precision mechanics, fine electronics, various inspection	600 lux
Very difficult tasks in industry or laboratories	800 lux

Power supply

Electrical

The supply source to which the equipment is connected must exhibit the following characteristics:

Voltage: 230 V 1Ph +/- 10 %

Frequency: 50 Hz +/- 5 %

Current: $10/16A$ Note :

The electrical network must comprise, upstream from the equipment, a residual current device (RCD) with a sensitivity $30mA$ of AC class.

Technical data

Earthing: The $2P + E16A$ plug must only be plugged into a socket equipped with a protective conductor

Chapter-5:PUTTING IN OPERATION

Installation and Connection of Test bench

For Panels:

- On reception of the Panel or the loose pack, check the quantity and references of the equipment using the grouping list giving the packing detail.
- Before installing the didactic equipment, check the mechanical strength of the support (Floor or table).
- For increased safety, we recommend that you install the bench on a stable table whose surface is far larger than the bench.
- Connect to the 230V, AC 50Hz Supply

For Loose Pack:

- Install the cubicle as specified
- Install the artwork
- Mount the components and wire as per the wiring diagram
- Connect to the 230V, AC 50Hz Supply

Chapter-6:USE

Equipment Description

Fire Alarm Control Unit

The fire alarm control unit (FACU), formerly called the fire alarm control panel (FACP), contains the electronics that supervise and monitor the integrity of the wiring and components of the fire alarm system.

It receives signals from alarm-initiating devices, processes the signals, and produces output signals that activate audible and visual appliances.

The FACU can also provide command to public address systems and mass notifications alerts through prerecorded evacuation messages or independent voice communications.

The FACU also transmits signals to an off-site monitoring station when provided. Power and fire alarm circuits are connected directly into this panel.



Initiating Devices

A fire detection system consists of manual and automatic alarm-initiating devices that are activated by the presence of fire, smoke, flame, or heat. The devices then send a signal to the

FACU using one of two methods: a hard-wire system or a generated signal conveyed by radio wave over a special frequency to a radio receiver in the panel. The possible initiating devices are:

- Manual pull stations
- Smoke detectors
- Flame detectors
- Heat detectors
- Combination detectors
- Waterflow devices



Notification Appliances

Audible notification signaling appliances are the most common types of alarm-signaling systems used for signaling a fire alarm in a structure. Once an alarm-initiating device is activated, it sends a signal to the FACU, which then processes the signal and initiates actions. The primary action initiated is usually local notification, which can take the form of:

- Bells
- Buzzers
- Horns
- Speakers
- Strobe lights
- Other warning appliances

Depending on the system's design, the local alarm may either activate a single notification appliance, notification appliances within a specific zone, designated floor(s), or the entire facility. Notification appliances fall under the following categories:

- Audible — Approved sounding devices, such as horns, bells, or speakers, that indicate a fire or emergency condition.
- Visual — Approved lighting devices, such as strobes or flashing lights, that indicate a fire or emergency condition.
- Textual — Visual text or symbols indicating a fire or emergency condition.
- Tactile — Indication of a fire or emergency condition through sense of touch or vibration.



Additional Information

<u>Automatic Alarm-Initiating Devices</u>

Automatic alarm-initiating devices, commonly called detectors, continuously monitor the atmosphere of a building, compartment, or area. When certain changes in the atmosphere are detected, such as a rapid rise in heat, the presence of smoke, or a flame signature, a signal is sent to the FACU. These signals originate a change-of-state condition like sprinkler water flow, the presence of smoke in a room or area, operation of a manual fire alarm box, or the loss of power to a fire pump.

The basic types of automatic initiating devices are those that detect heat, smoke, flame, and

water flow. The two categories of heat detectors are fixed temperature and rate of rise. Devices that are a combination of these basic types are also available. The sections that follow describe the use of these devices:

Fixed-temperature heat detectors

Fire detection systems using heat detection devices are among the oldest still in service. They are the least prone to nuisance alarms. They are, however, typically slower to activate under fire conditions than other types of detectors. To be effective, heat detectors must be properly placed where heat is expected to accumulate. Heat detectors must also be selected at a temperature rating that will give at least a small margin of safety above the normal ceiling temperatures expected in a particular area.



According to NFPA® 72, heat-sensing fire detectors must be color-coded and marked with their listed operating temperatures. The list of colors and temperatures for these detectors. Because heat is a product of combustion, devices that use one of the following three primary principles of physics can detect the presence of heat:

1. Heat causes expansion of various materials.
2. Heat causes melting of certain materials.
3. Heated materials have thermoelectric properties that are detectable.

Heat-Sensing Fire Detector Color Coding, Temperature Classification, and Temperature Rating

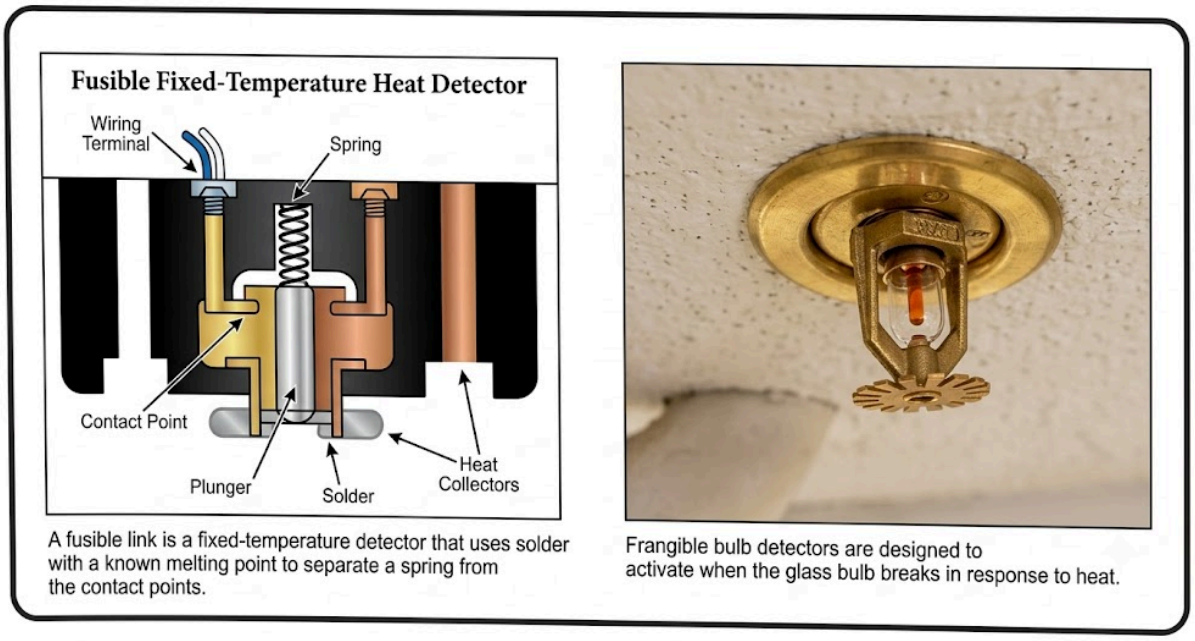
Color Coding	Temperature Classification	Temperature Rating (°F)	Temperature Rating (°C)
Uncolored	Low	100–134	38–57
Uncolored	Ordinary	135–174	57–79
White	Intermediate	175–249	79–121
Blue	High	250–324	121–162
Red	Extra High	325–399	163–204
Green	Very Extra High	400–499	204–259
Orange	Ultra High	500–575	260–302

All heat-detection devices operate on one or more of these principles. The various styles of fixed-temperature devices or detectors used in fire detection systems are addressed in the sections that follow.

Fusible Links/Frangible Bulbs

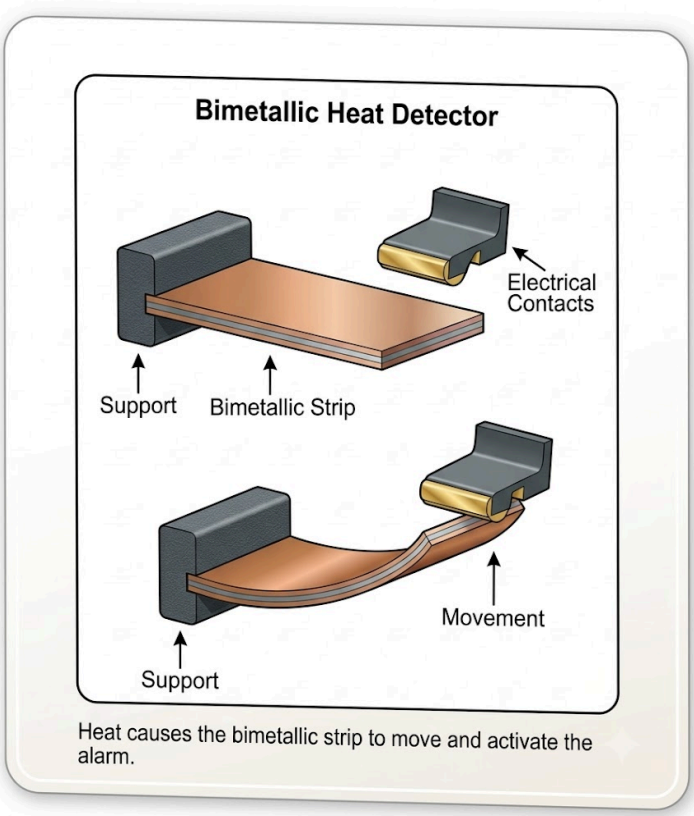
Fusible links hold a spring device in the detector in the open position. When the melting point of the fusible link is reached, it melts and drops away. This action causes the spring to release and touch an electrical contact that completes a circuit and sends an alarm signal. In order to restore

the detector, the fusible link must be replaced. A fragile bulb is also inserted into a detection device to hold two electrical contacts apart. As the temperature increases, the liquid in the bulb expands. The expanded liquid compresses the air bubble in the glass, and the bulb fractures and falls away. The contacts close to complete the circuit and send the alarm.



Bimetallic Heat Detector

A bimetallic heat detector uses two types of metal with different heat-expansion ratios that are bonded. When subjected to heat, one metal expands faster than the other and causes the combined strip to arch. The amount the strip arches depends on the characteristics of the metals, amount of heat they are exposed to, and degree of arch present when in normal positions. All of these factors are calculated into the design of the detector. A bimetallic strip may be positioned with one or both ends secured in the device. When positioned with both ends secured, a slight bow is placed in the strip. When heated, the expansion causes the bow to snap in the opposite direction. Depending on the design of the device, this action either opens or closes a set of electrical contacts that in turn sends a signal to the FACU. Most bimetallic detectors are the automatic-resetting type.



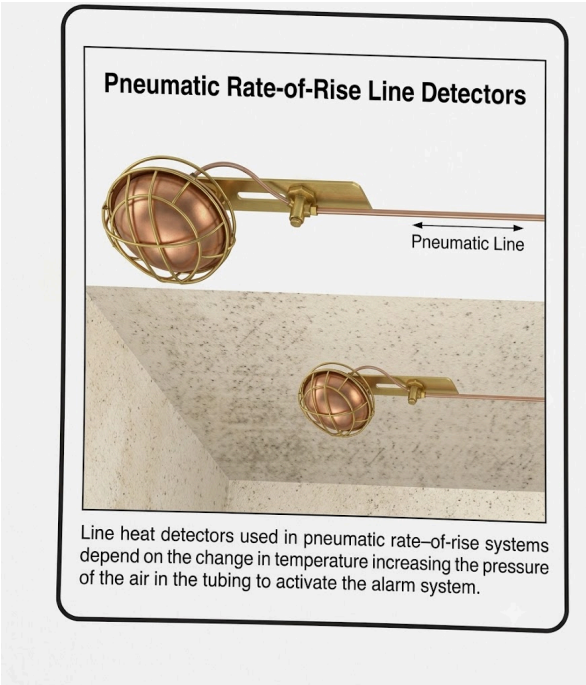
Rate-of-rise heat detectors

A rate-of-rise heat detector operates on the principle that fires rapidly increase the temperature in a given area. These detectors respond at substantially lower temperatures than fixed-temperature detectors. Typically, rate-of-rise heat detectors are designed to send a signal when the rise in temperature exceeds 7 deg C to 8 deg C degrees per minute because temperature changes of this magnitude are not expected under normal or non-fire circumstances.

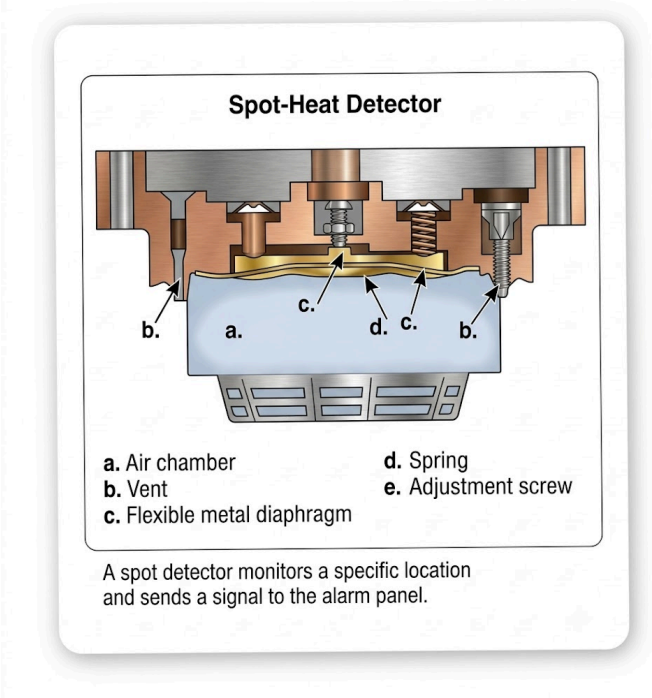
All rate-of-rise heat detectors automatically reset. The following different styles of rate-of-rise heat detectors are currently in use:

Pneumatic Rate-of-Rise Line Heat Detector

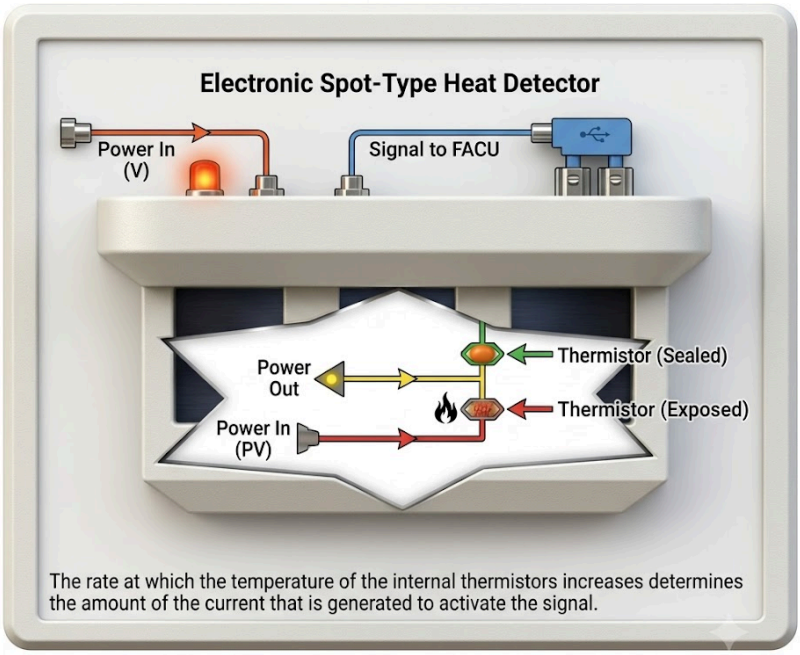
A pneumatic rate-of-rise line heat detector can monitor large areas of a building. Line heat detectors consist of a system of metal pneumatic tubing arranged over a wide area of coverage. The space inside the tubing acts as a pressurized air chamber that allows the contained air to expand as it heats. These heat detectors contain a flexible diaphragm that responds to the increase in pressure from the tubing. When an area being served by the tubing experiences a temperature increase, the air pressure increases, and the heat-detection device operates.



Pneumatic Rate-of-Rise Spot Heat Detector: Operating on the same core concept as line-style pneumatic heat detectors, this variant functions as a single, self-contained unit tailored to monitor an individual target area. It features direct alarm wiring linking the local detector back to the main Fire Alarm Control Unit (FACU).



Electronic Spot-Type Heat Detector: This model uses one or more thermistors whose electrical resistance shifts noticeably when subjected to rising temperatures. The speed of the temperature increase dictates how much electrical current flows through the system; faster and higher thermal gains produce greater current, ultimately activating the main fire alarm system.



Smoke detectors

Smoke detectors serve the purpose of early detection, notification, and reaction. Some detectors are also used to activate mechanical or electrical systems, such as dampers, doors, and electronic shutdown. Smoke detectors have evolved into two principal types of devices:

- A detector that provides early detection and reports back to an alarm panel to initiate evacuation alarms
- A detector that provides some type of signal to initiate one of the actions discussed above

Smoke detection is the preferred automatic alarm device in such occupancy types as residences and health and institutional care facilities because smoke detectors sense the presence of a fire much more quickly than heat-detection devices.

Because of the dangers of toxic fire gases, an early warning can mean the difference between a safe escape and no escape at all. Many factors affect the performance of smoke detectors, including:

- Type and amount of combustibles
- Rate of fire growth
- Proximity of the detector to the fire
- Ventilation within the area involved

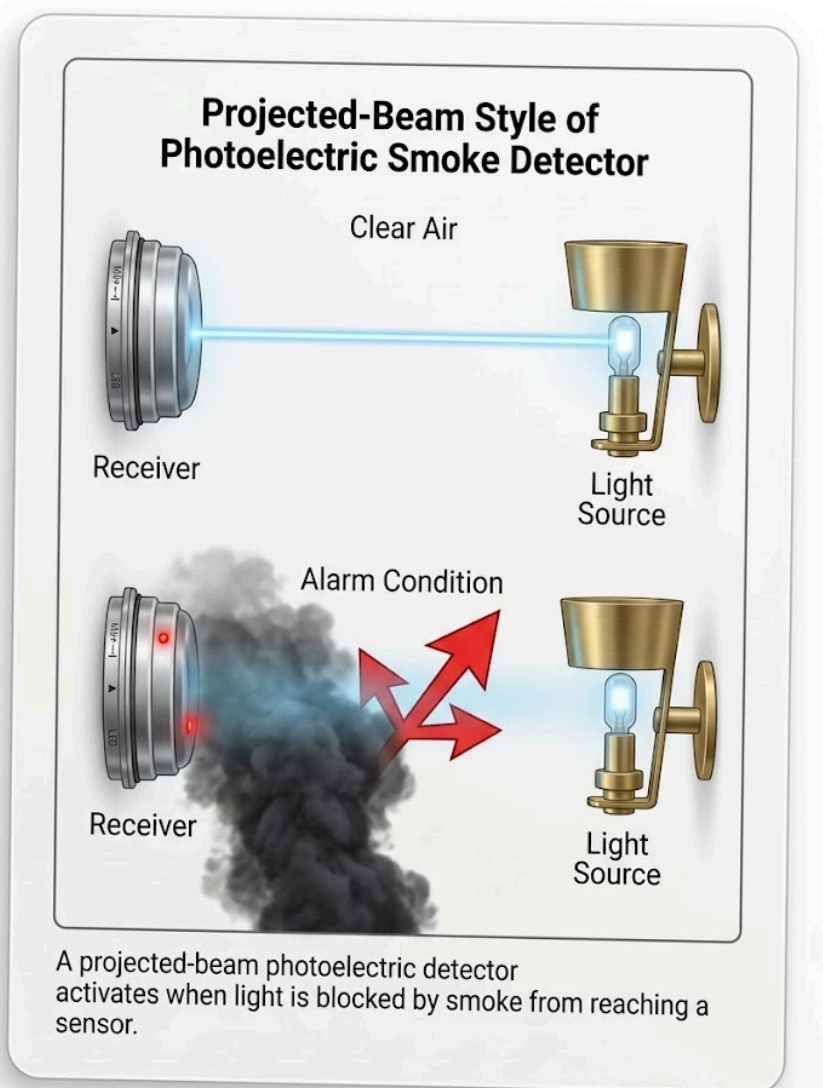
Two basic methods of smoke detection are in use: photoelectric and ionization.

Photoelectric Smoke Detectors

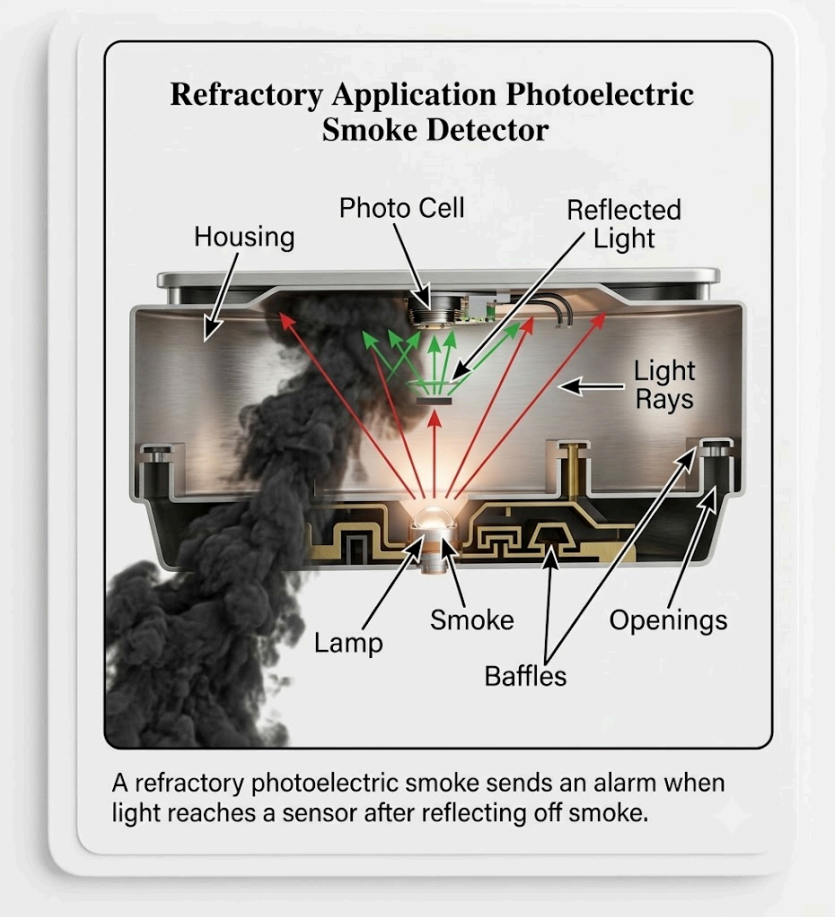
Photoelectric smoke detection works on all types of fires and usually responds more quickly to smoldering fires than ionization smoke detection. Photoelectric smoke detection is best suited for areas containing overstuffed furniture and other areas where smoldering fires can occur.

A photoelectric device consists of a photoelectric cell coupled with a specific light source. The photoelectric cell functions in one of two ways to detect smoke: projected-beam application (obscuration) or refractory application (scattered).

The projected-beam application style of photoelectric detector uses a beam of light focused across the area being monitored onto a photoelectric-receiving device such as a photodiode. The cell constantly converts the beam into current, which keeps a switch open. When smoke interferes with or obscures the light beam, the amount of current produced is lessened. The detector's circuitry senses the change in current and initiates an alarm when a current change threshold is crossed. Projected-beam application smoke detectors are particularly useful in buildings where a large area of coverage is desired, such as in churches, atriums, or warehouses.

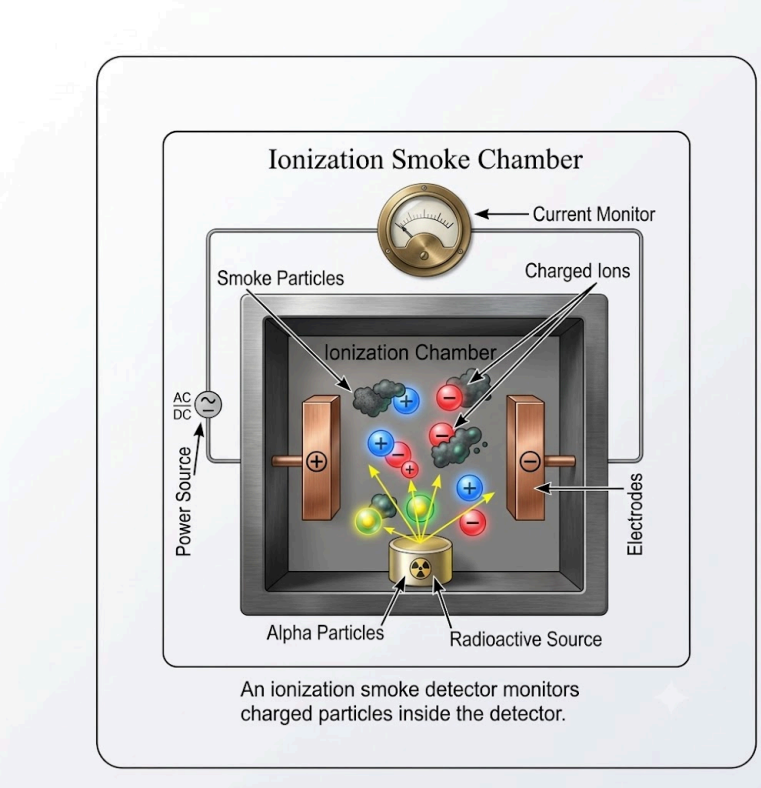


A refractory application photoelectric smoke detector uses a beam of light from a light-emitting diode (LED) that passes through a small chamber at a point distant from the light source. Normally, the light does not strike the photocell or photodiode. When smoke particles enter the light beam, light strikes the particles and reflects in random directions onto the photosensitive device, causing the detector to generate an alarm signal.



Ionization Smoke Detectors

An ionization smoke detector contains a sensing chamber consisting of two electrically charged plates (one positive and one negative) and a radioactive source for ionizing the air between the plates. A small amount of Americium 241 that is adjacent to the opening of the chamber ionizes the air particles as they enter. The ionized particles free electrons from the negative electron plate and the electrons travel to the positive plate. Thus, a small ionization current measurable by electronic circuitry flows between the two plates. Products of combustion, which are much larger than the ionized air molecules, enter the chamber and collide with the ionized air molecules. As the two interact, they combine, and the total number of ionized particles is reduced. This action results in a decrease in the chamber current between the plates. When a predetermined threshold current is crossed, an alarm is initiated.



An ionization smoke detector monitors charged particles inside the detector.

Flame detectors

A flame detector is sometimes called a light detector. There are three basic types: Those that detect light in the ultraviolet wave spectrum (UV detectors) Those that detect light in the infrared wave spectrum (IR detectors) Those that detect light in both UV and IR waves.

An infrared detector is effective in monitoring large areas, such as an aircraft hangar or computer room. While these types of detectors are among the fastest to respond to fires, they are also easily activated by such nonfire conditions as welding, sunlight, and other bright light sources. They must only be placed in areas where these triggers can be avoided or limited. They must also be positioned so that they have an unobstructed view of the protected area. If they are blocked, they cannot activate.



Manually Actuated Alarm-Initiating Devices

Manually actuated fire alarm boxes, commonly called manual call points, allow occupants to manually initiate the fire alarm signaling system. Manual pull stations may be connected to systems that sound local alarms, off-premise alarm signals, or both. Although manual call points come in a variety of shapes and sizes, they are usually red in color with white lettering that specifies what they are and how they are to be used. The manual call point should only be used for fire-signaling purposes unless it is designed for other uses or to activate a fixed fire suppression system.

Manual pull stations can be single-action or double-action, which are described as follows:

Single-action — Operates after a single motion is made by the user. When the station lever is pulled, a lever or other movable part is moved into the alarm position and a corresponding signal is sent to the FACU.

Double-action — Requires the operator to perform two steps to initiate an alarm. First, the operator must lift a cover or open a door to access the alarm control. Then the operator must manipulate an alarm lever, switch, or button to send the signal to the fire alarm control panel. Double-action manual pull stations may be confusing to certain occupant/ operators due to the

need to perform two separate steps before an alarm is initiated.



Manually operated alarm-initiating devices may look slightly different, but all are important tools for signaling emergencies.



Single-action pull station stations require only a single motion to trigger an alarm



A double-action pull station station has a panel that must be lifted so the operator can access and operate the pull station.

Chapter-7 :MAINTENANCE

Servicing

➢ To clean the equipment, you must First disconnect it from the electrical network.

➢ Avoid splashes of water and other liquids. Do not use sponges impregnated with water: use a slightly damp cloth (no chemically corrosive products).

➢ Concerning inside the boxes, if necessary, use compressed air (blower) to remove any dust from the devices.

Troubleshooting

➢ When changing components, whether Schneider or otherwise, refer to the equipment parts list included in this manual.

➢ Prior to maintenance work on components, it is essential to disconnect from the electrical network.

➢ Re-energise only once all new parts, connections and protective housing fasteners have been put back.

➢ Secure the plate with the original HSHC screws. The slotted head screws are strictly forbidden for this type of fixation

⚠ This operation must only be carried out only by competent and accredited personal following UTE C 18-510 standards.

Chapter-8 :HAND ON EXERCISE

Exercise – 1: Adding and configuring the FACU.

Purpose:

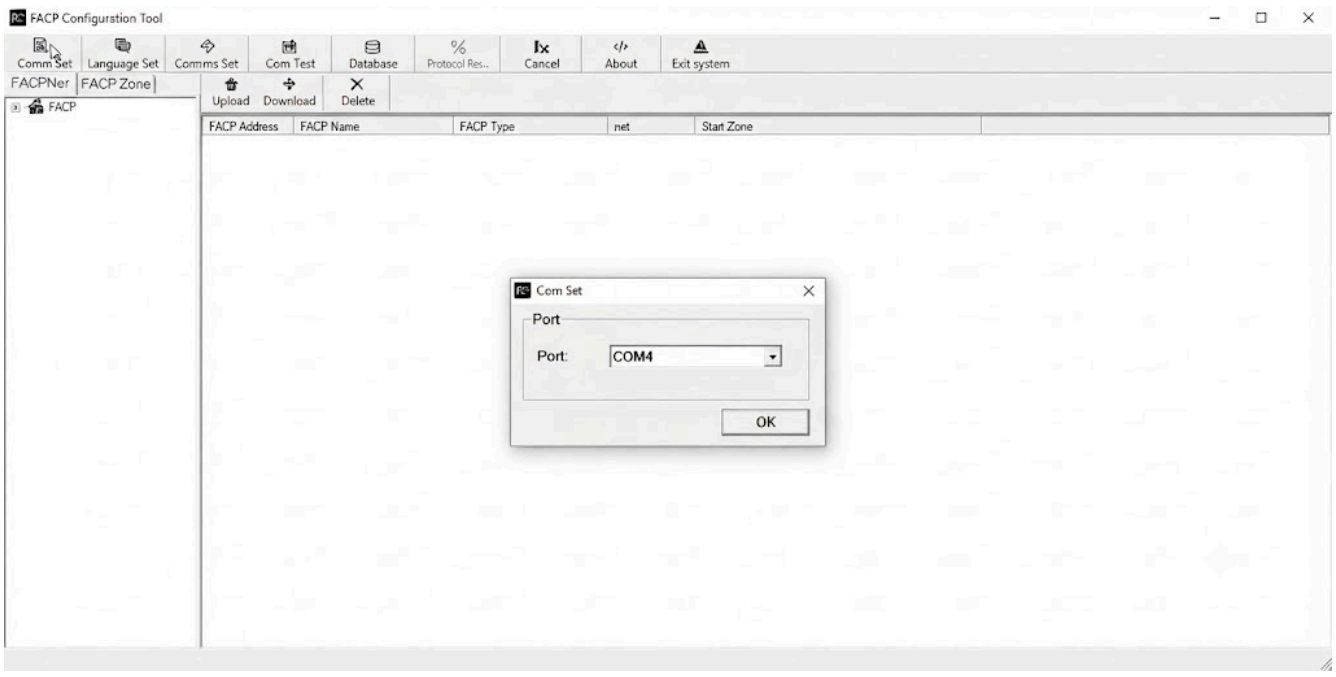
To add the available FACU for the configuration knowing the FACU model number using GSTDef 3.0 configuration tool.

Before you start:

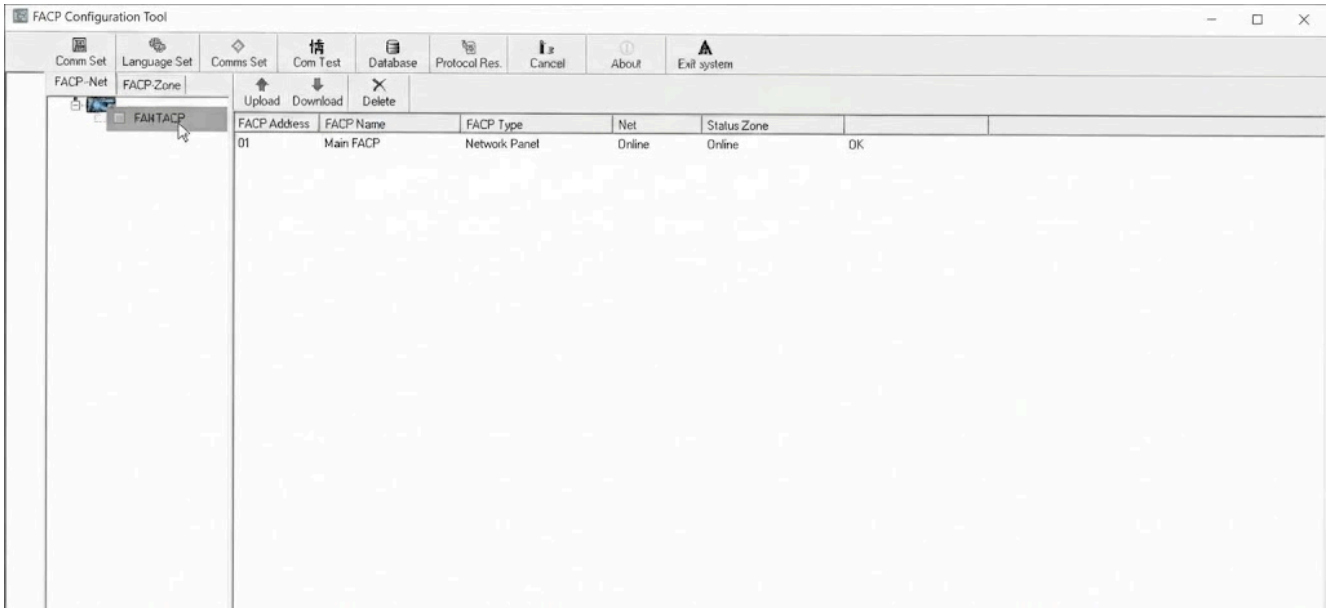
Ensure the power connection is valid and correct. Also, all the devices are connected and end resistors if required are connected to create the close loop.

Steps:

4. Open the FACU configuration tool GstDef3.0.
5. Connect the FACU with the computer using the serial interface cable.
6. In the configuration tool, set up the communication port by clicking “com set” as shown below.



7. Confirm the communication setup by selecting the “OK”.
8. The next step is to add the FACU, to perform this click on “FACP Net” icon.
9. Right-click “FACP” and select “Add FACP”.

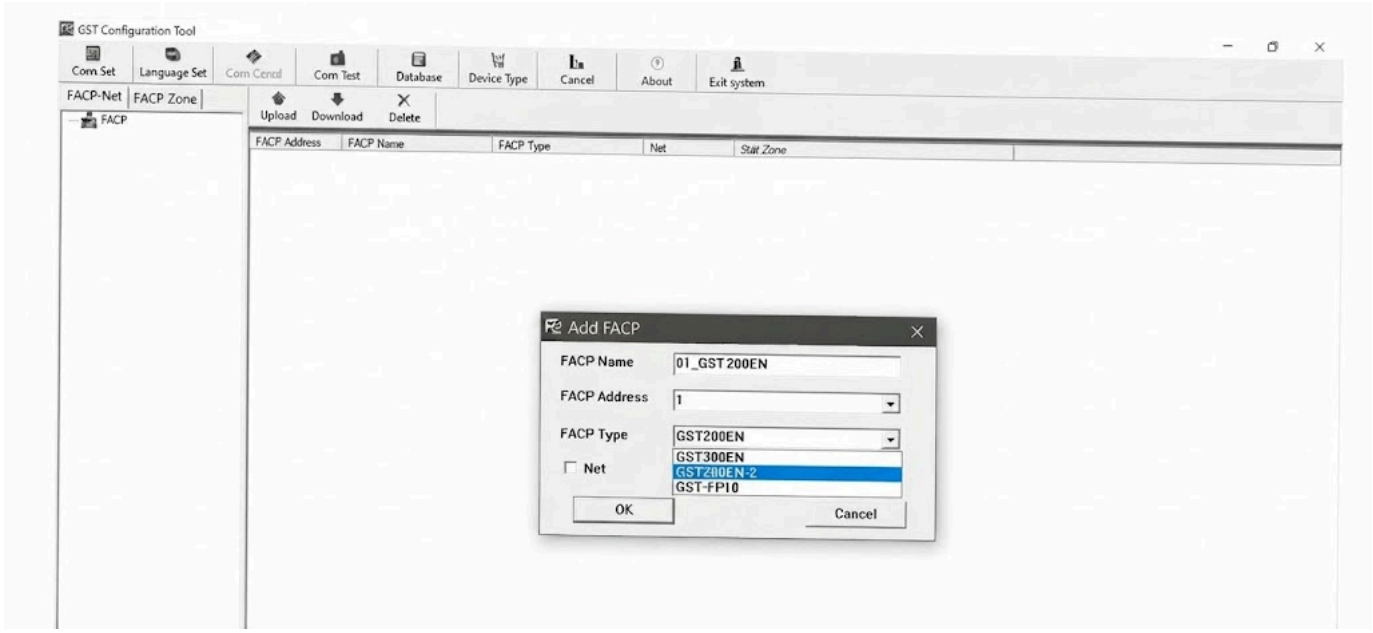


10. In the FACP pop up, select the following parameters:

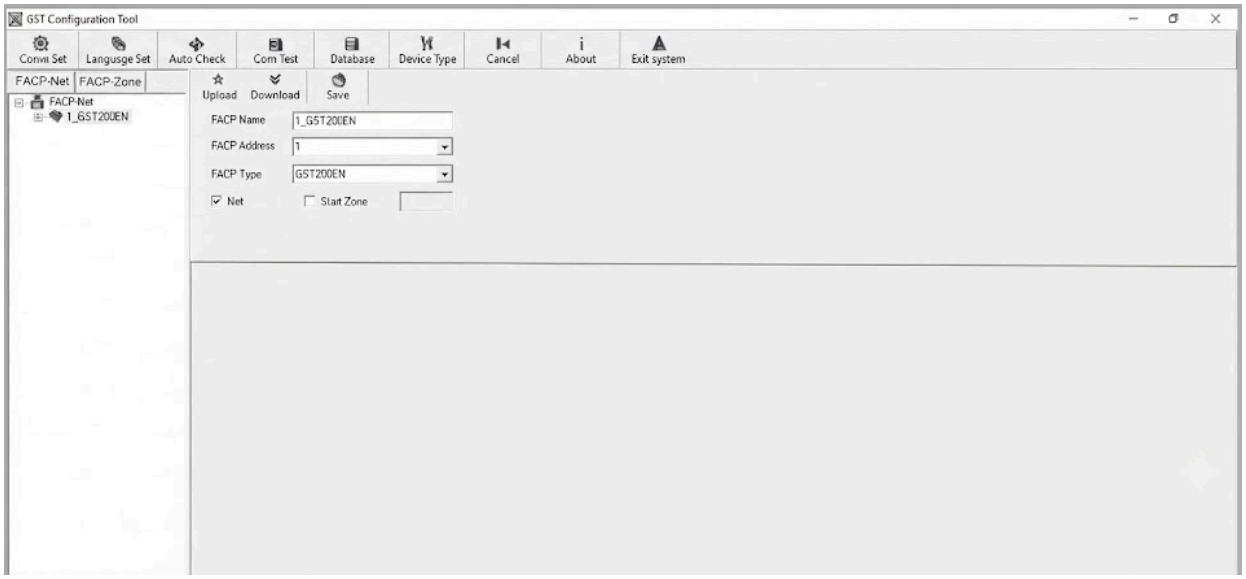
    FACP Type: Select the panel part number

    FACP Address: Address of the panel

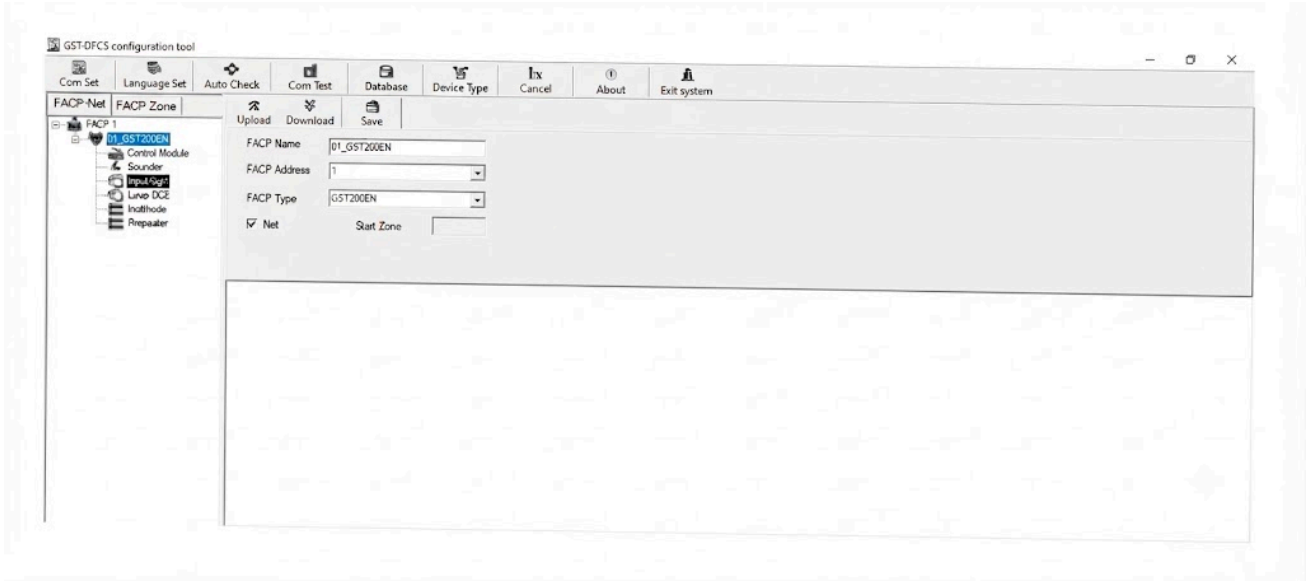
    FACP Name: File name reference



11. After details submitted, the defined FACU will be opened on the left panel as shown below.



12. Click on the "+" symbol on the left of the currently added FACU panel. And select on the number of loops of initiating devices



Exercise – 2: Configure the initiating devices as described below:

Address	Loop	Device Type	Location
1	1	Damper	Lift Room
2	1	Multi Detector	Lift Passage
3	1	Heat Detector	Lift Passage 1

Purpose:

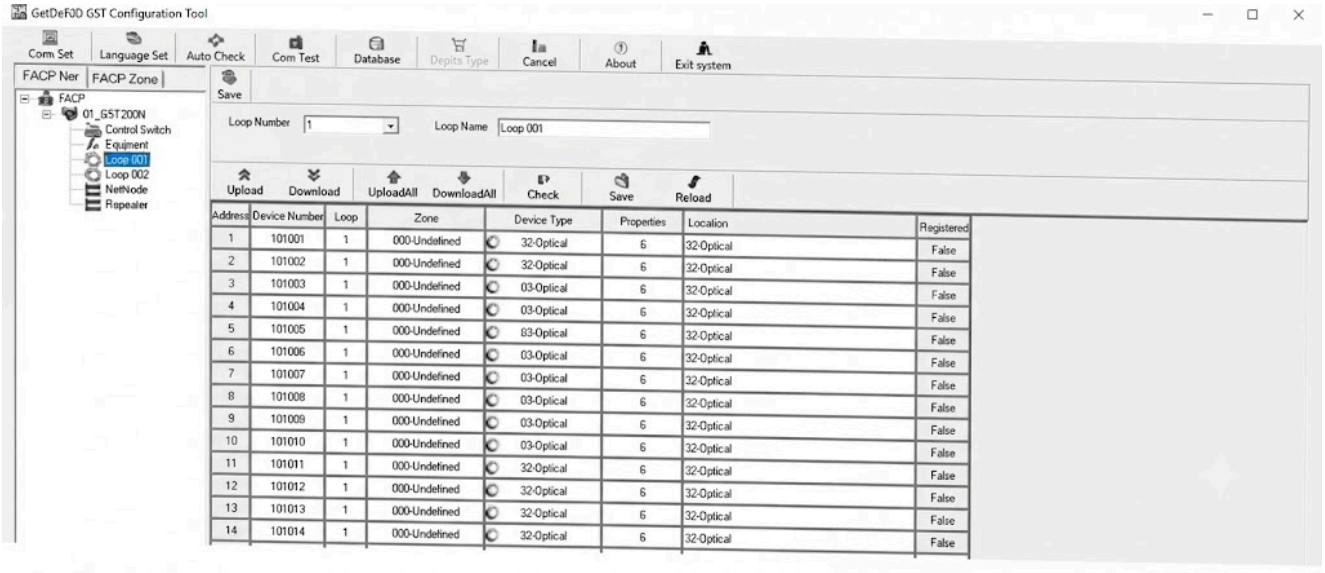
To add the inhibited devices of the loop in the FACU and configure each of them according to the type of the device.

Steps:

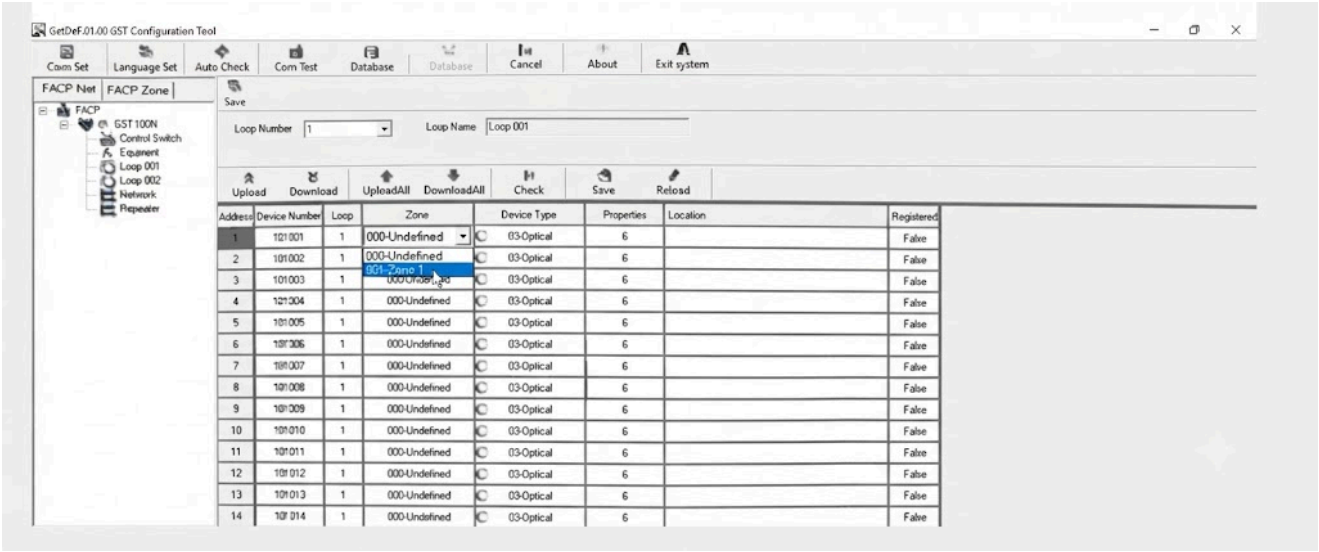
13. After adding the FACU panel, select the loop designation, this depends on the number of loops planned for the installation.

Note: In this case we have the 2 Loop panel and installation is executed for 1 Loop only, similar process to be followed for any number of loops.

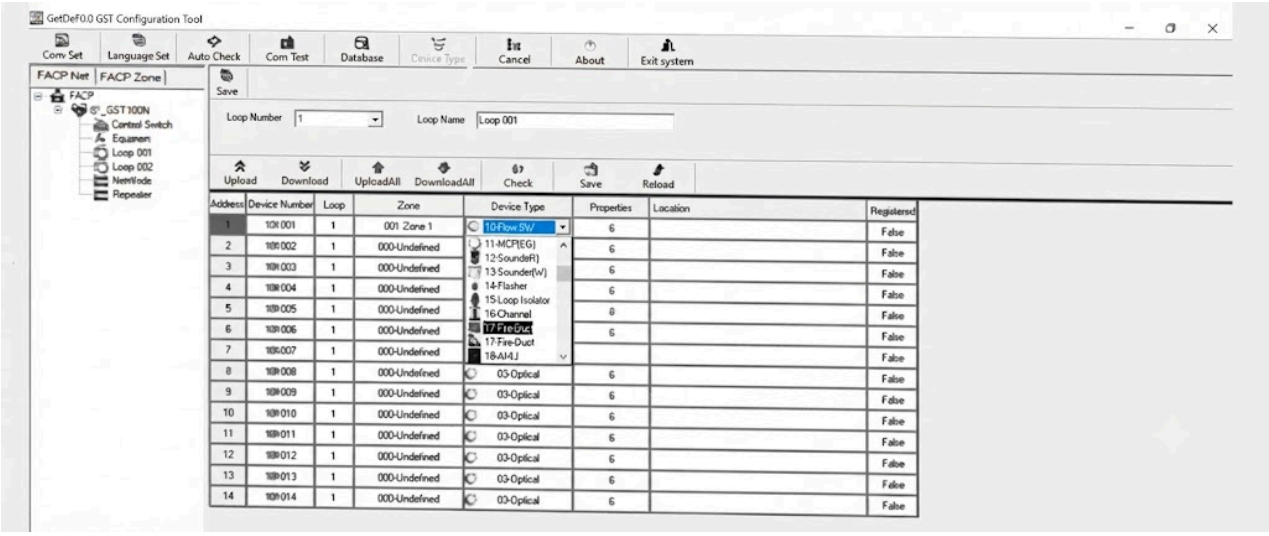
Select Loop 1 to add the devices as proposed.



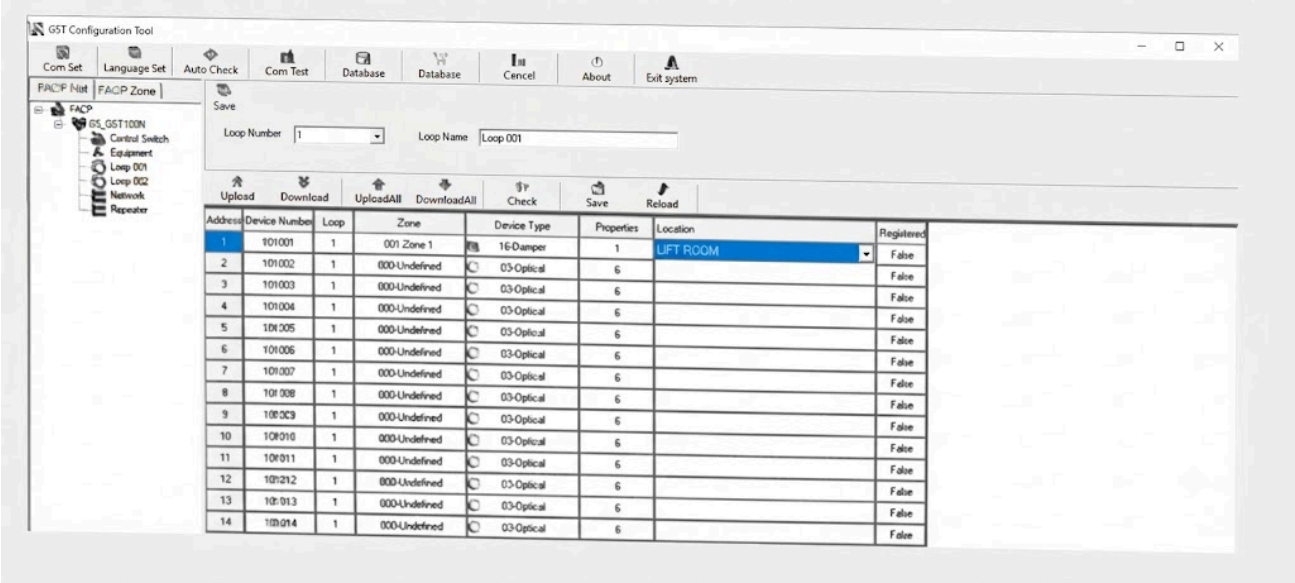
14. Click on the Address 1, as shown in the image below and select Zone to define of the sensor.



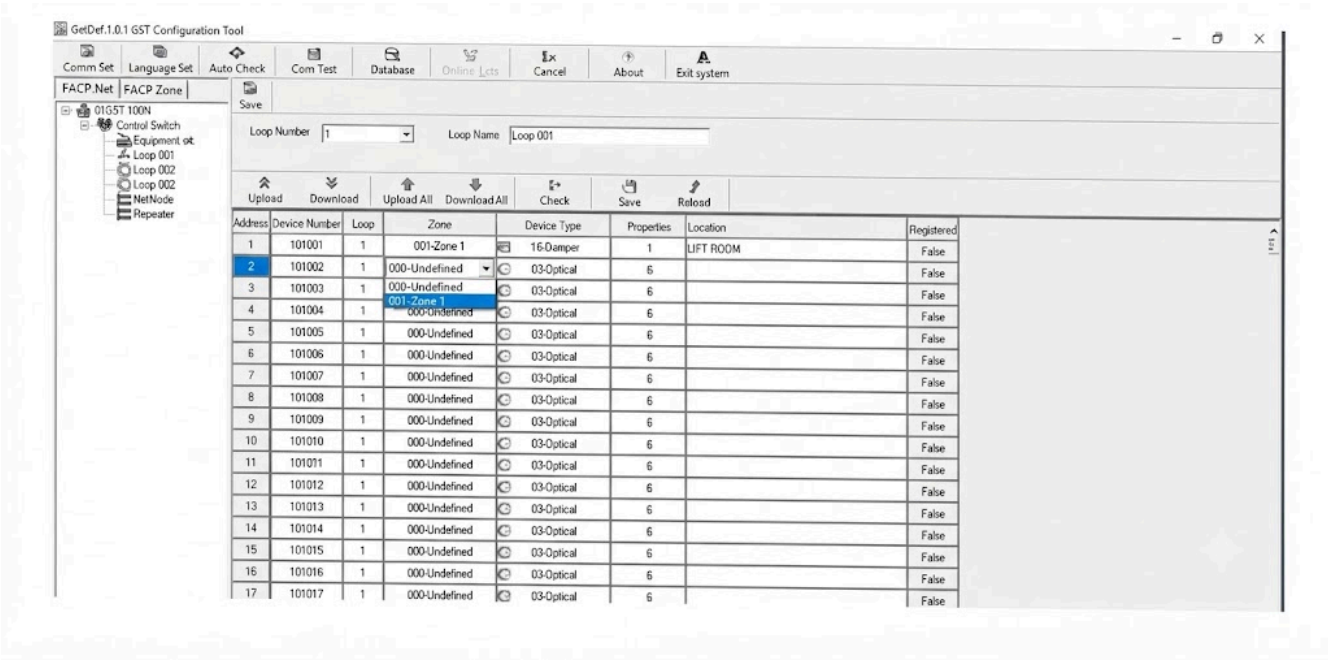
15. And now its turn to select the device type, as proposed in the table above it is scheduled to allocate “Address 1” to “Damper”, From the device type column select the drop down to the select the device as “Damper”.



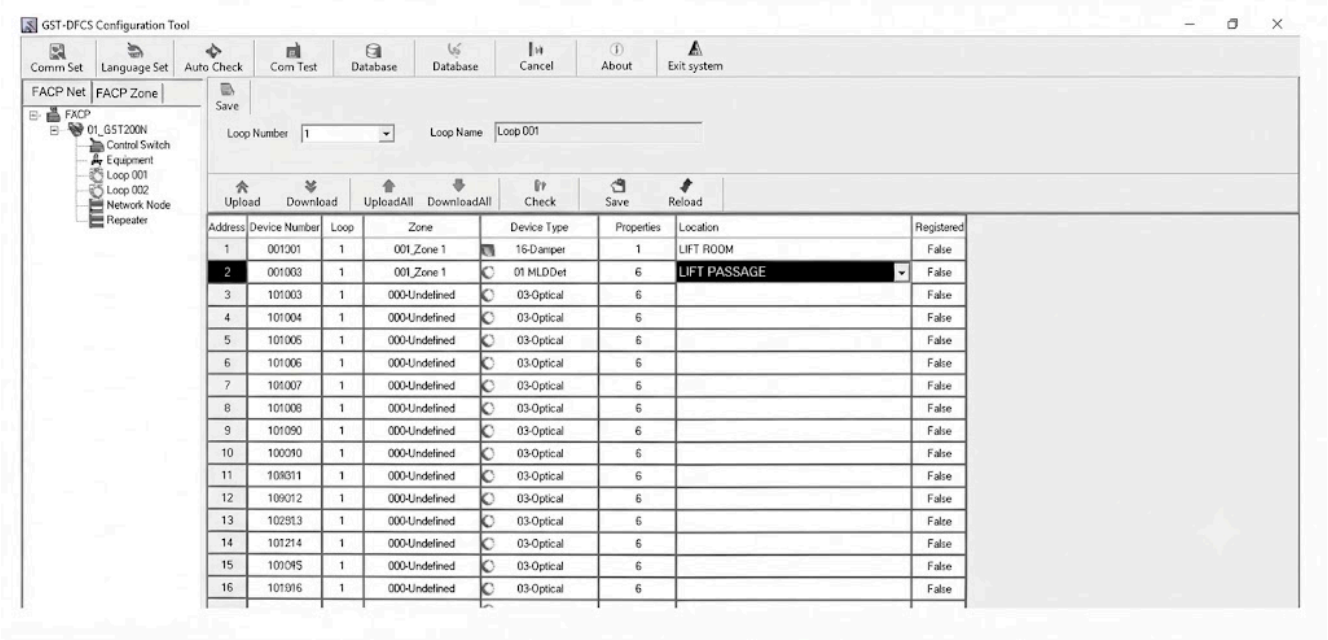
16. In the properties column allocate the Zone 1 by selecting 1 and add location of the device in the Location column as “Lift Room”.



17. Repeat the same process for the “Multi Detector” installed in the Lift passage.

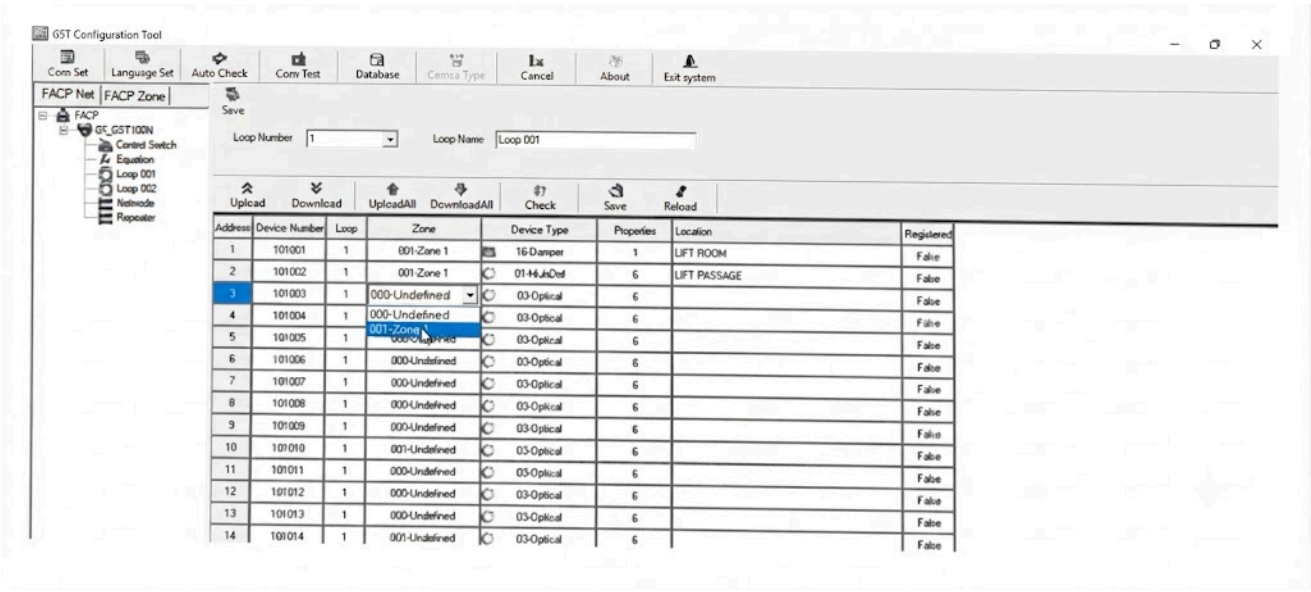


18. Click on Address 2, select the Zone as Zone 1 and the device type as scheduled as “Multi Detector”. Also add the properties as 1 and change the location to “Lift Passage”.

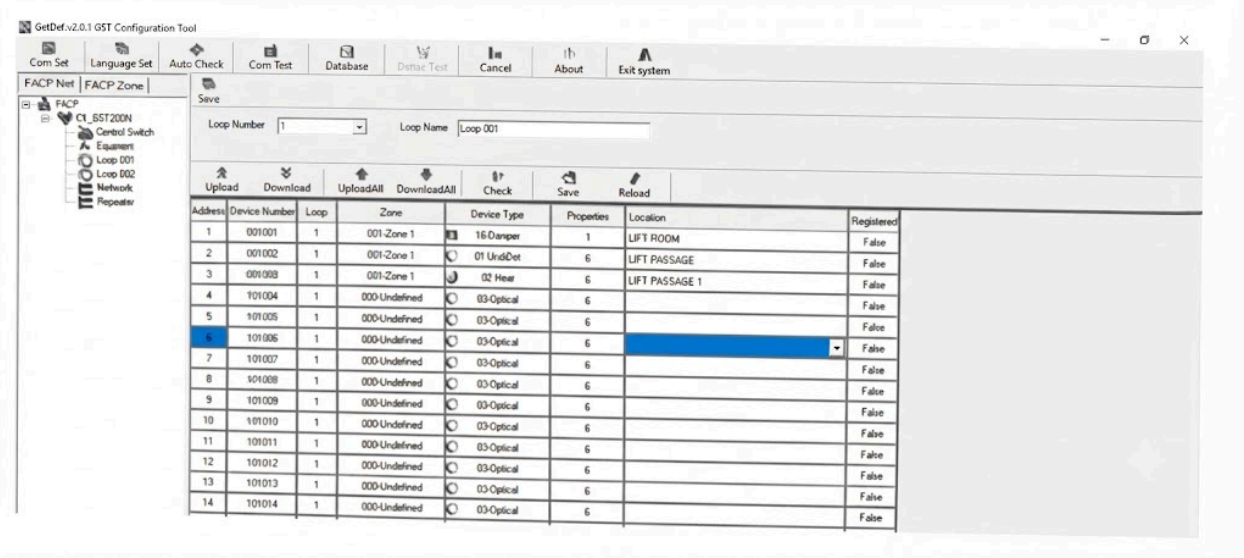


19. Again repeat the same process to add the third device, i.e the heat detector. Allocate address 3 for this optical sensor installed in the Lift Passage 1.

Assign the zone as Zone-1 since all these devices are connected in the same loop.



20. As done above, in the device type select the device type as “Heat Detector” and the properties to 1 and change the location to “Lift Passage 1”.



Note: After all the devices click on the “Download button to transfer the data to the FACU.

Exercise – 3: Configure the initiating devices as described below:

Address	Loop	Device Type	Location
1	1	Damper	Lift Room
2	1	Multi Detector	Lift Passage
3	1	Heat Detector	Lift Passage 1
4	1	Sounder	Entrance

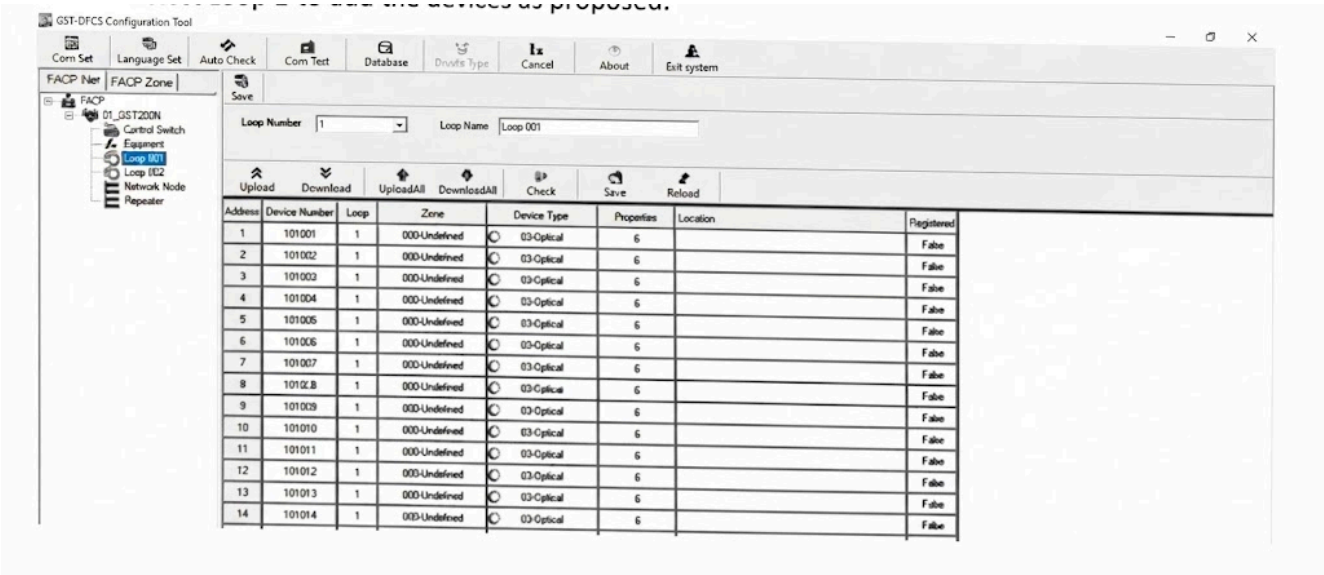
Purpose: To add the inhibited devices of the loop in the FACU and configure each of them according to the type of the device.

Steps:

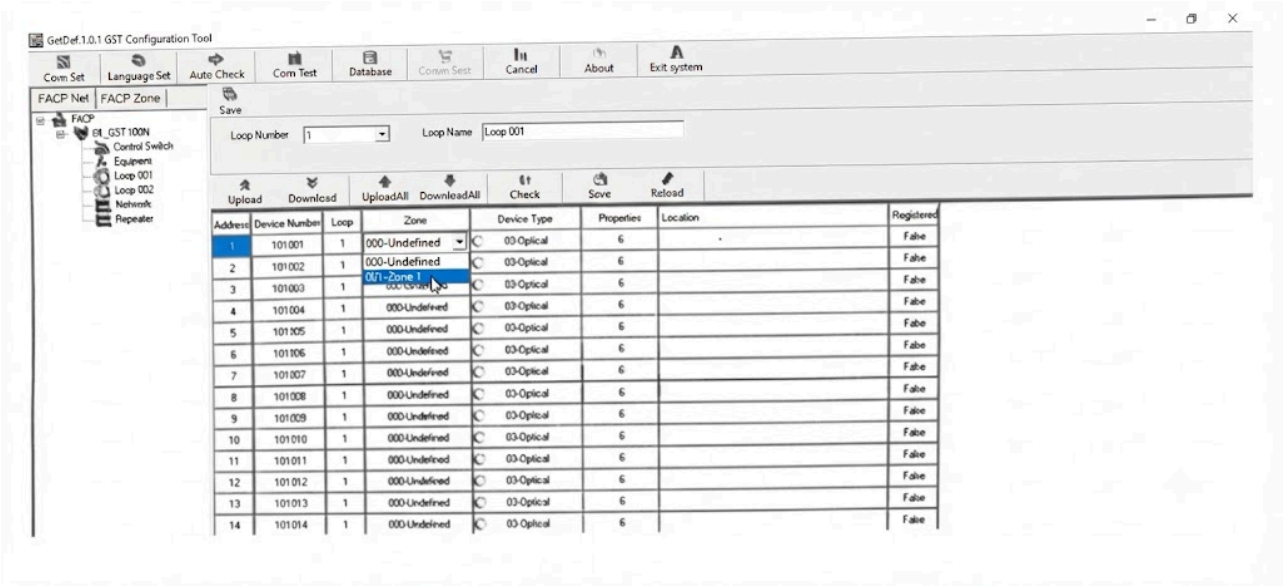
1. After adding the FACU panel, select the loop designation, this depends on the number of loops planned for the installation.

Note: In this case we have the 2 Loop panel and installation is executed for 1 Loop only, similar process to be followed for any number of loops.

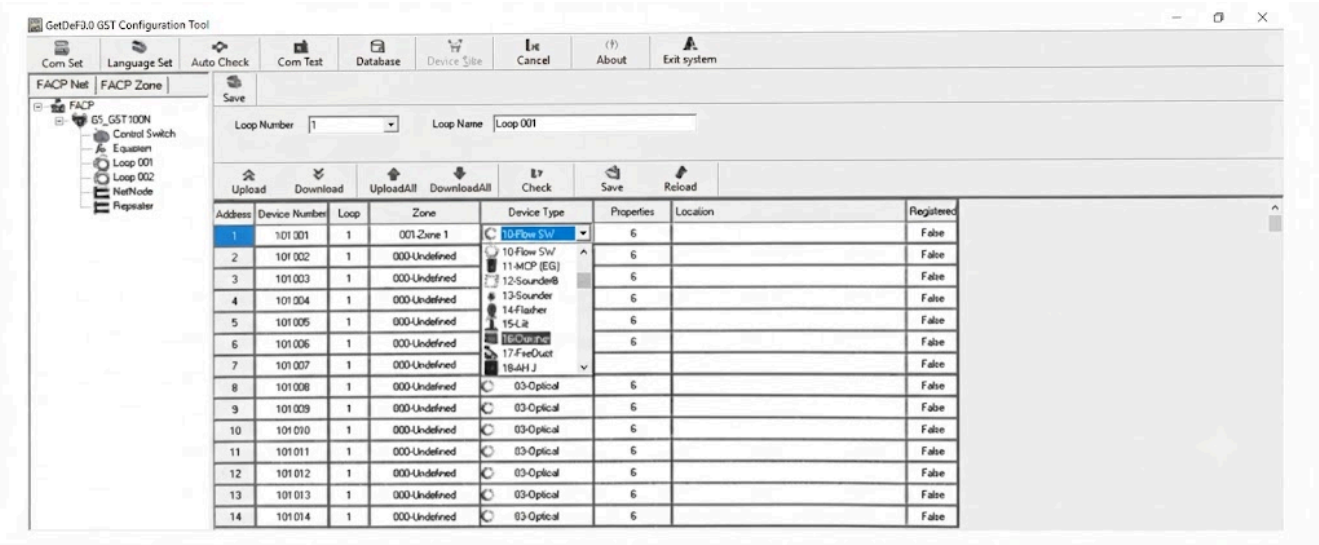
Select Loop 1 to add the devices as proposed.



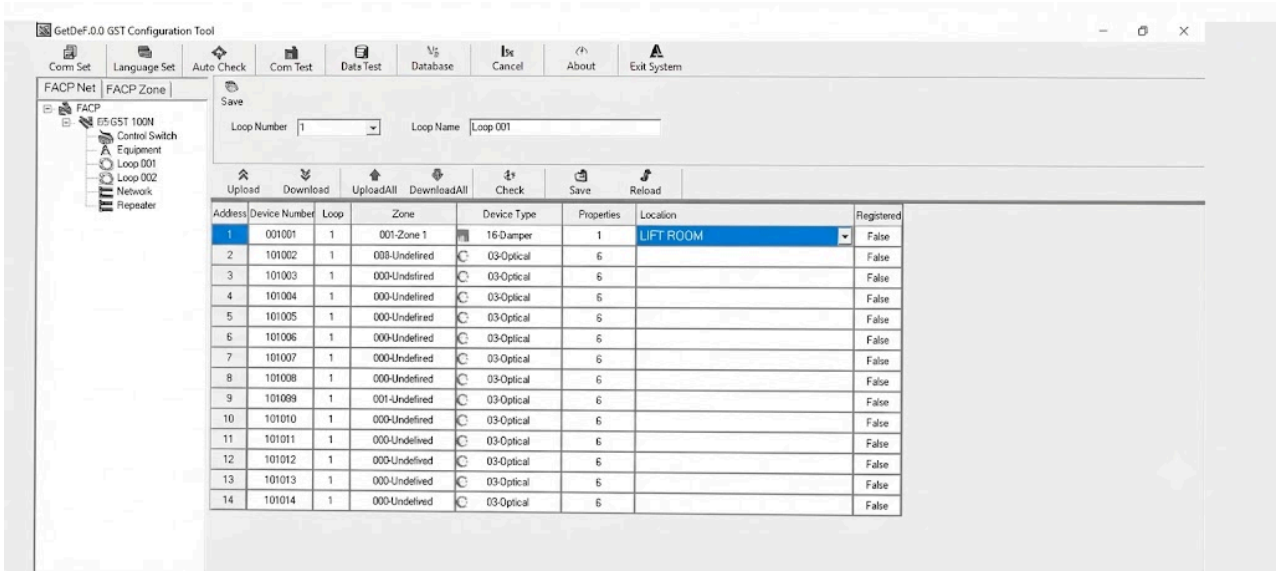
2. Click on the Address 1, as shown in the image below and select Zone to define of the sensor.



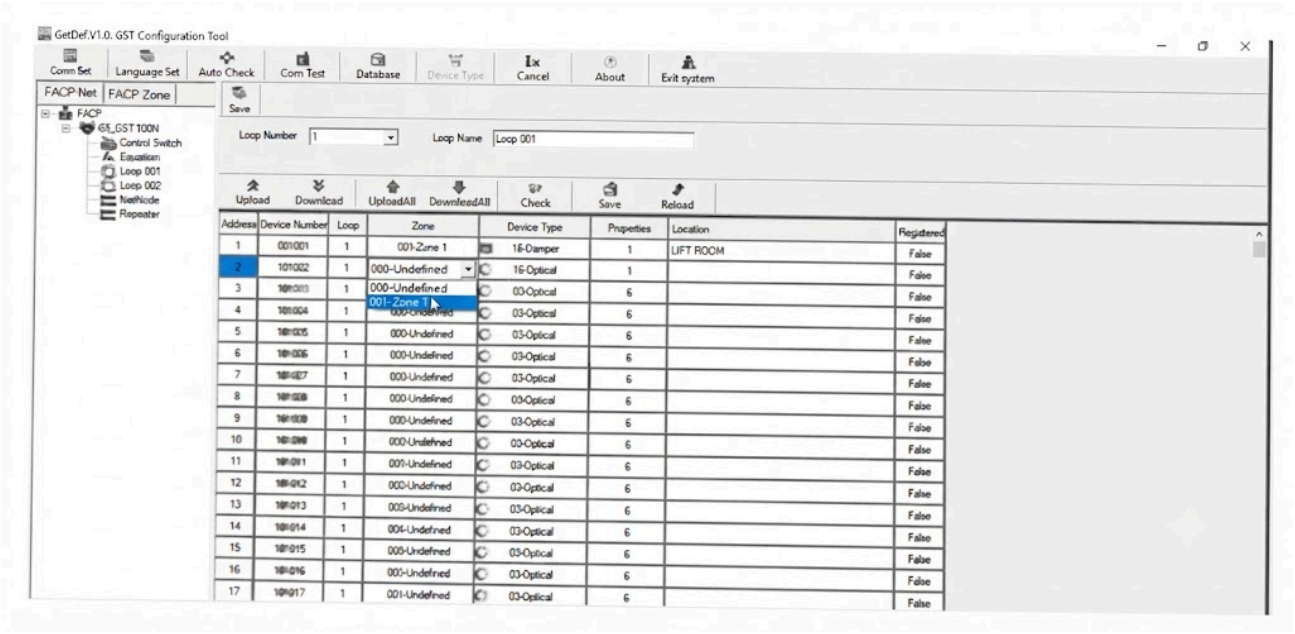
3. And now its turn to select the device type, as proposed in the table above it is scheduled to allocate “Address 1” to “Damper”. From the device type column select the drop down to select the device as “Damper”.



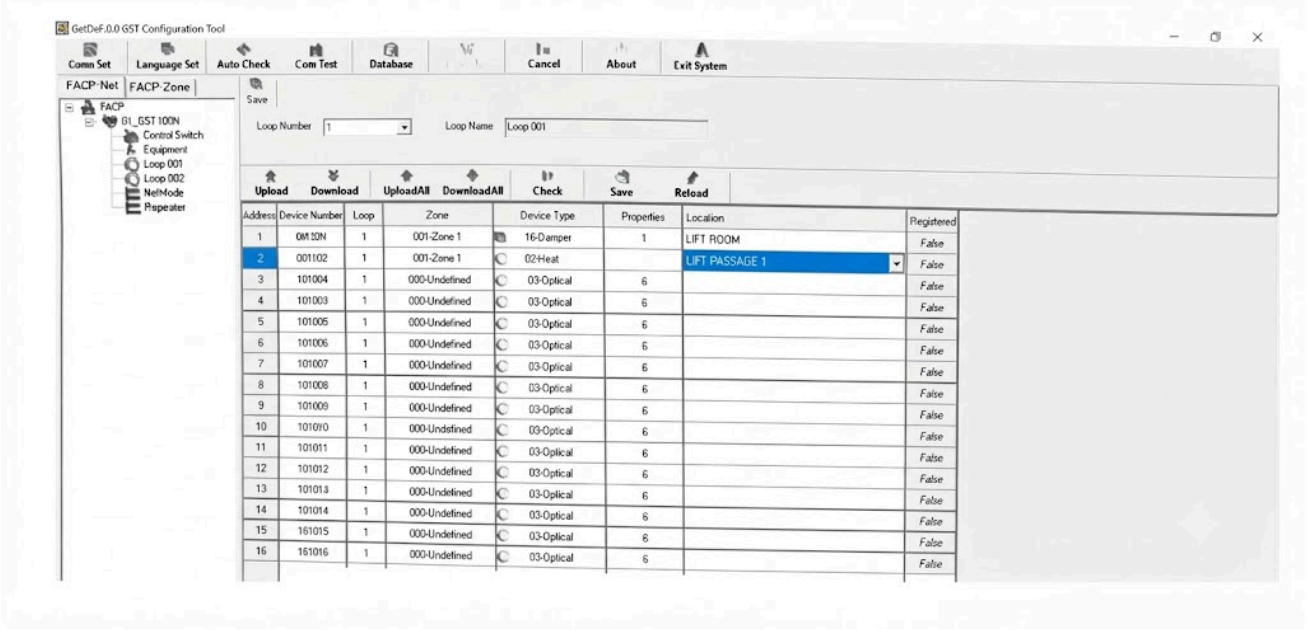
4. In the properties column allocate the Zone 1 by selecting 1 and add location of the device in the Location column as “Lift Room”.



5. Repeat the same process for the “Multi Detector” installed in the Lift passage.

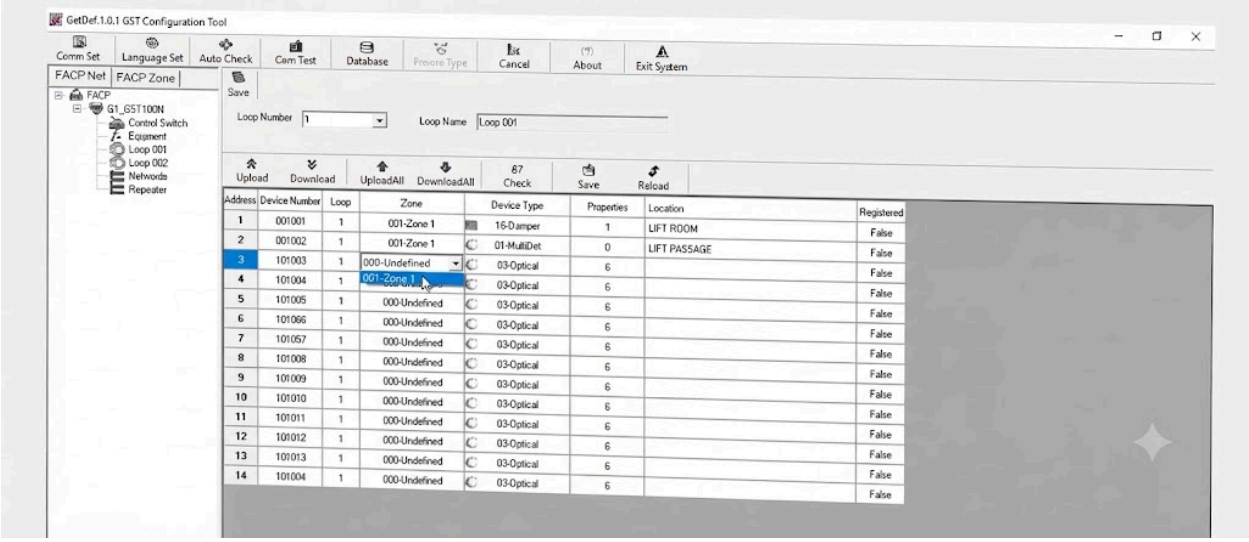


6. Click on Address 2, select the Zone as Zone 1 and the device type as scheduled as "Multi Detector". Also add the properties as 1 and change the location to "Lift Passage".

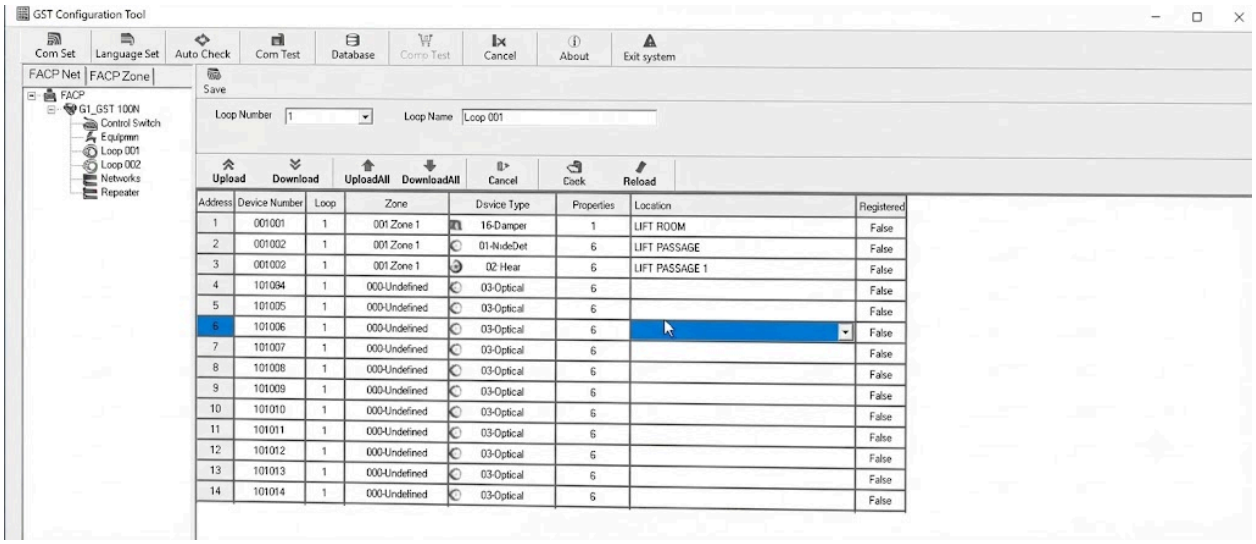


7. Again repeat the same process to add the third device, i.e the heat detector. Allocate address 3 for this optical sensor installed in the Lift Passage 1.

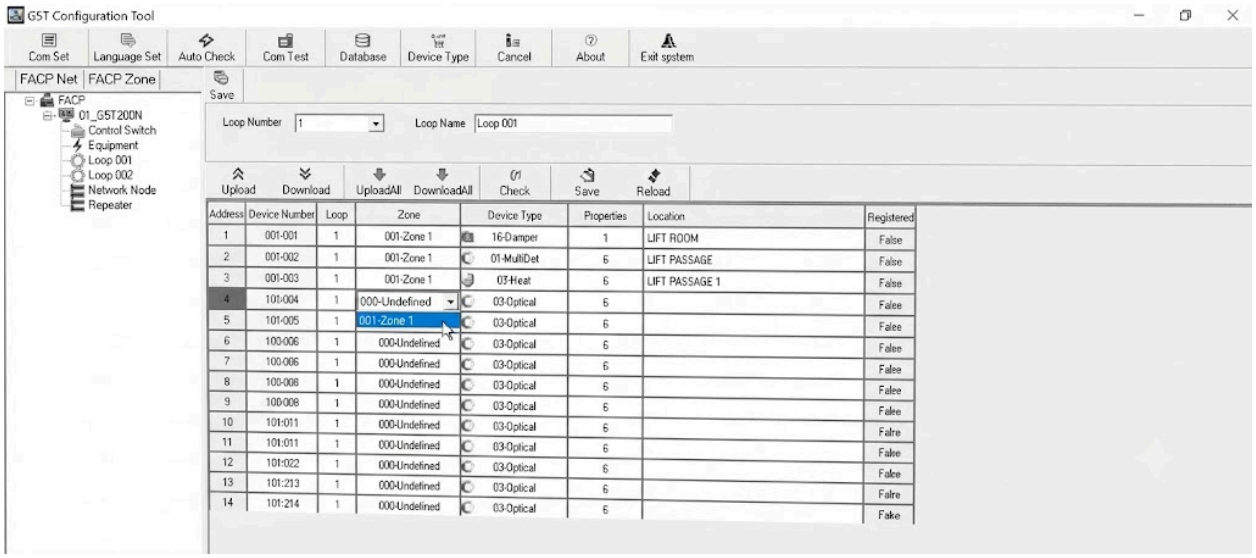
Assign the zone as Zone-1 since all these devices are connected in the same loop.



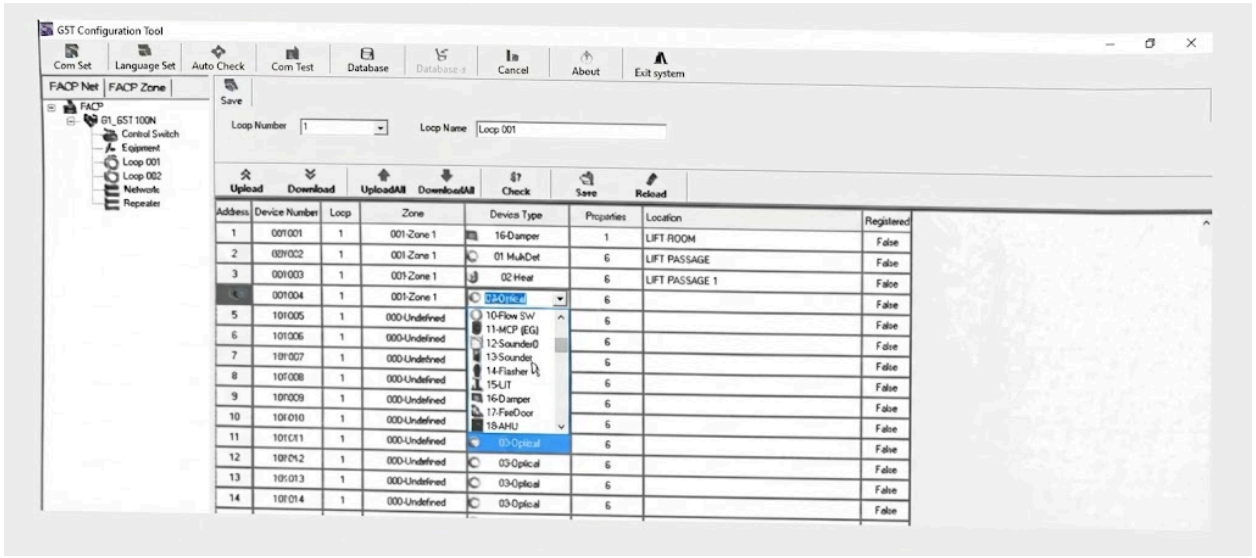
8. As done above, in the device type select the device type as “Heat Detector” and the properties to 1 and change the location to “Lift Passage 1”.



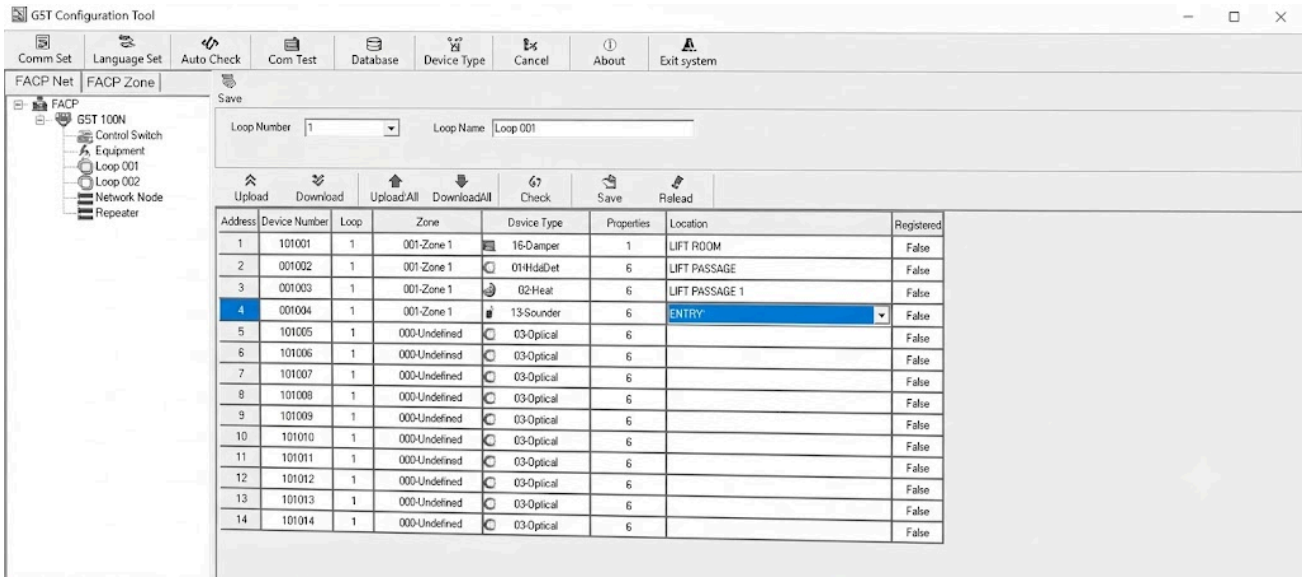
9. Now to add the output device i.e the sounder to the loop, select the address and the address as shown below:



10. Its now to select the device type, i.e “Sounder” and allocate the location of the device.



And the location.



Note: After all the devices click on the “Download button to transfer the data to the FACU

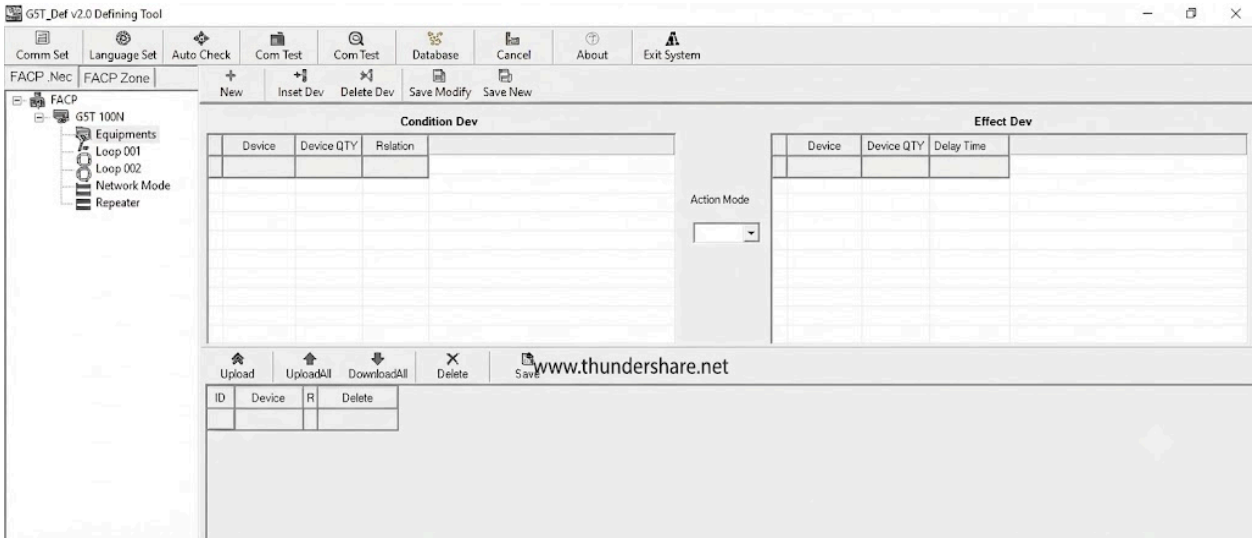
Exercise – 4: CONDITIONING OF THE INITIATING AND THE OUTPUT DEVICES BASED ON APPLICATION.

Purpose: To apply equation, this is required to allocate the situation when the system devices are detecting and providing a response to the detection.

Steps:

1. After adding the FACU panel and the initiating devices and the output devices. These devices are to be put into an equation so as to operate of the conditions related.

On the left-hand pane, select equation and see if this window opens:

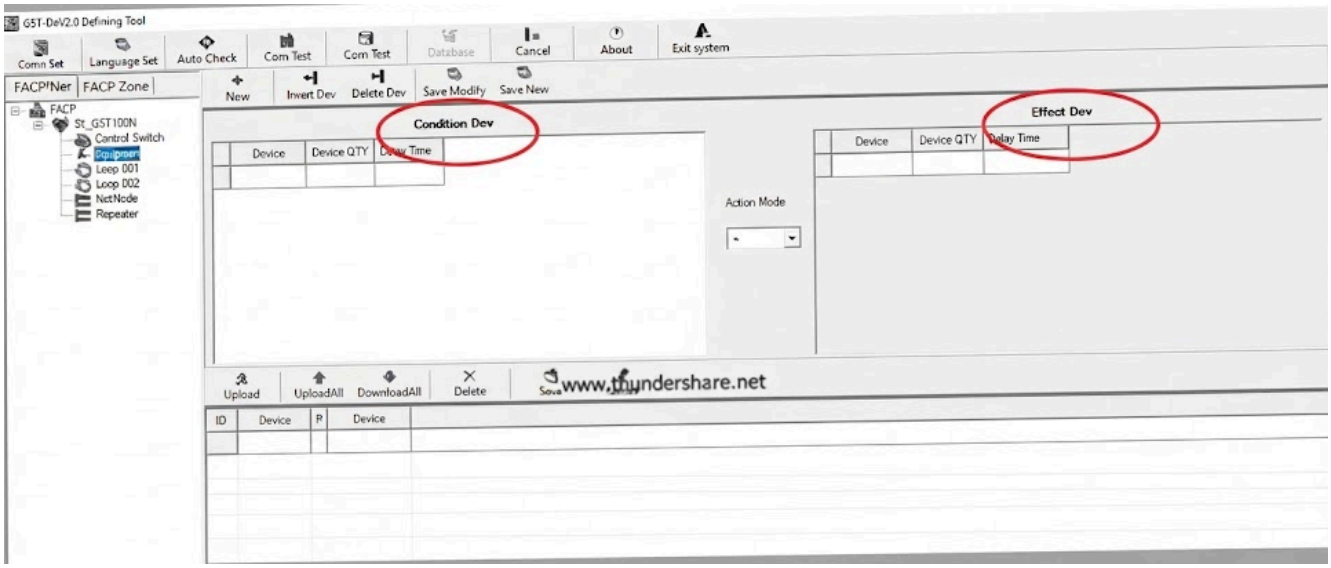


2. From the list of the devices defined in the loop/Zone, we would recall these devices to conditionalize the operation.

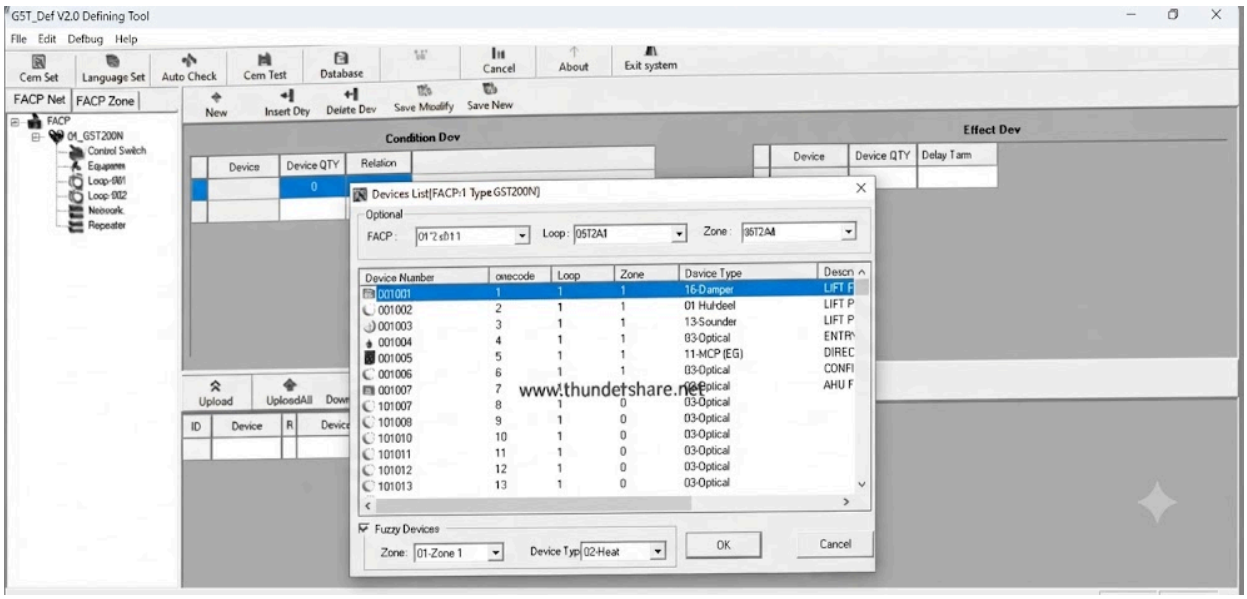
Here in the window seen above, we have:

Condition Dev (highlighted in red – left hand side): This column is used to add all the input devices, such as smoke detector, heat detector, multidetector and the manual call point.

Effect Dev (highlighted in red – right hand side): This column is used to add all the output devices those should respond to the action of the input devices. The devices such as sounder/strobe, actuators are the output devices.



3. To add the input device on the "condition Dev" click on the "Device as shown and select the input device to add to this equation.



4. It is defined as the device "001002" is defined as Multi detector and is required to call for the initiation, click on this device to add to this equation and allocate the kind of conditional operation required from the device.

Note: Conditional operation designated to the "AND (*)" and "OR (+)" logic.

AND Logic

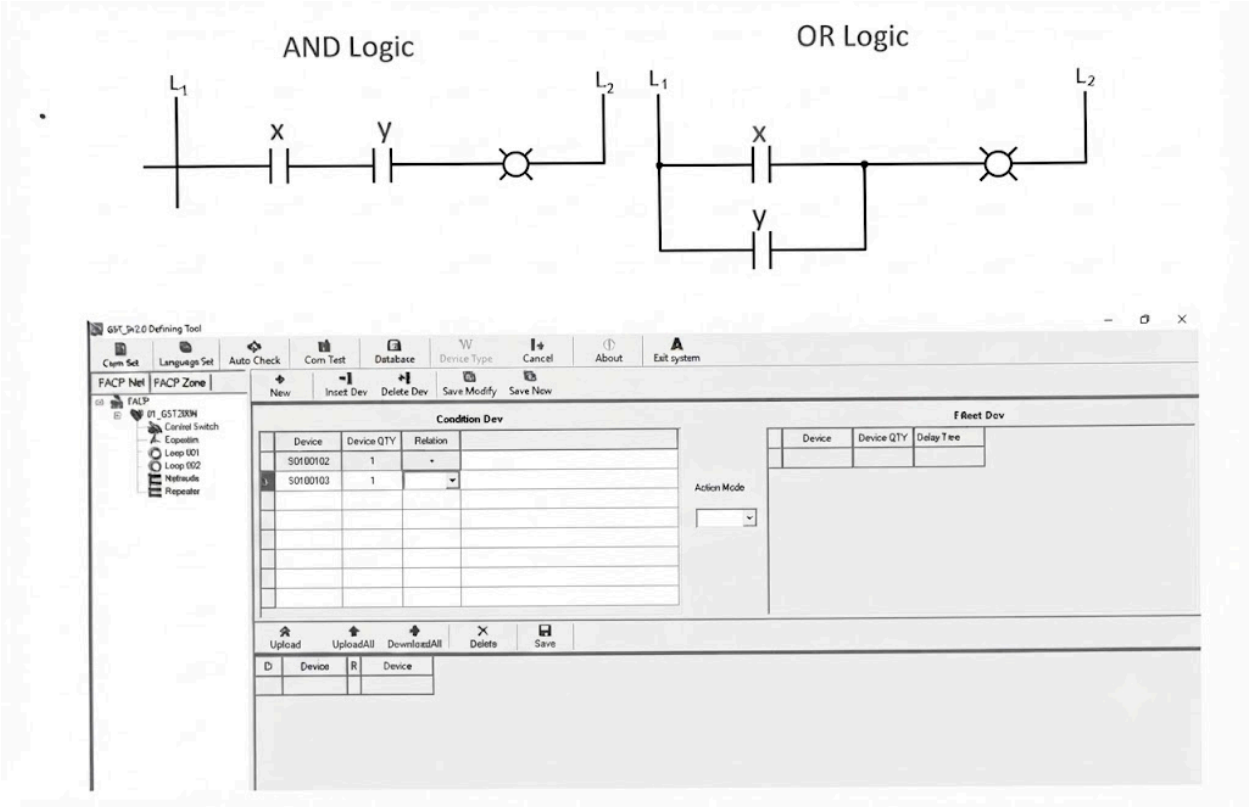
x	y	x*y
0	0	0
0	1	0
1	0	0
1	1	1

OR Logic

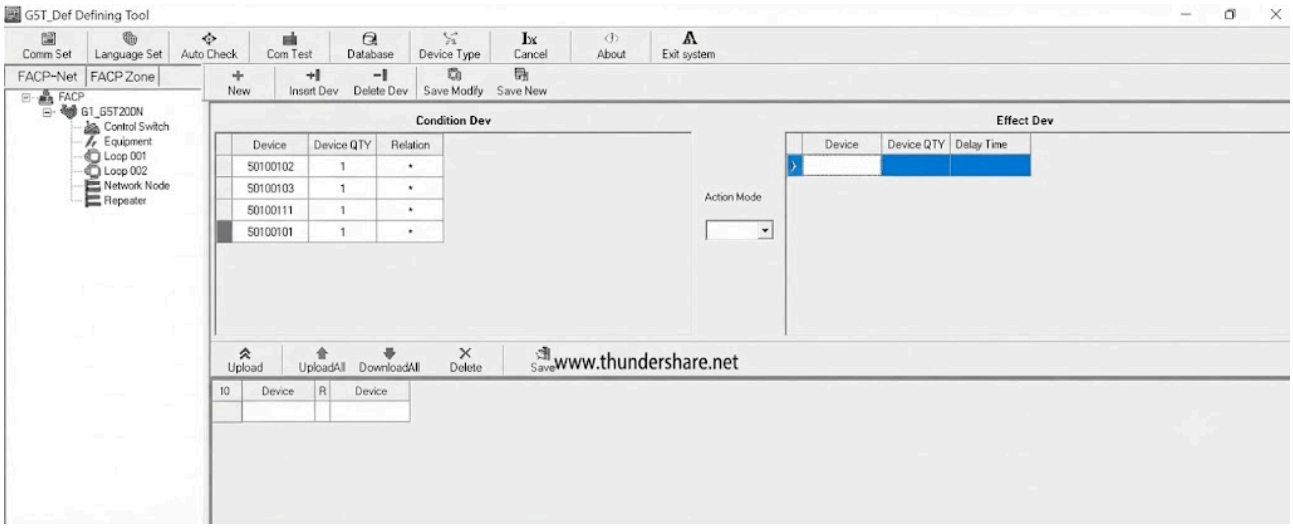
x	x	x+y
0	0	0
1	0	1
0	1	1
1	1	1

From the table above it is evident, in case of AND logic the output will be high only when both/all the inputs are high.

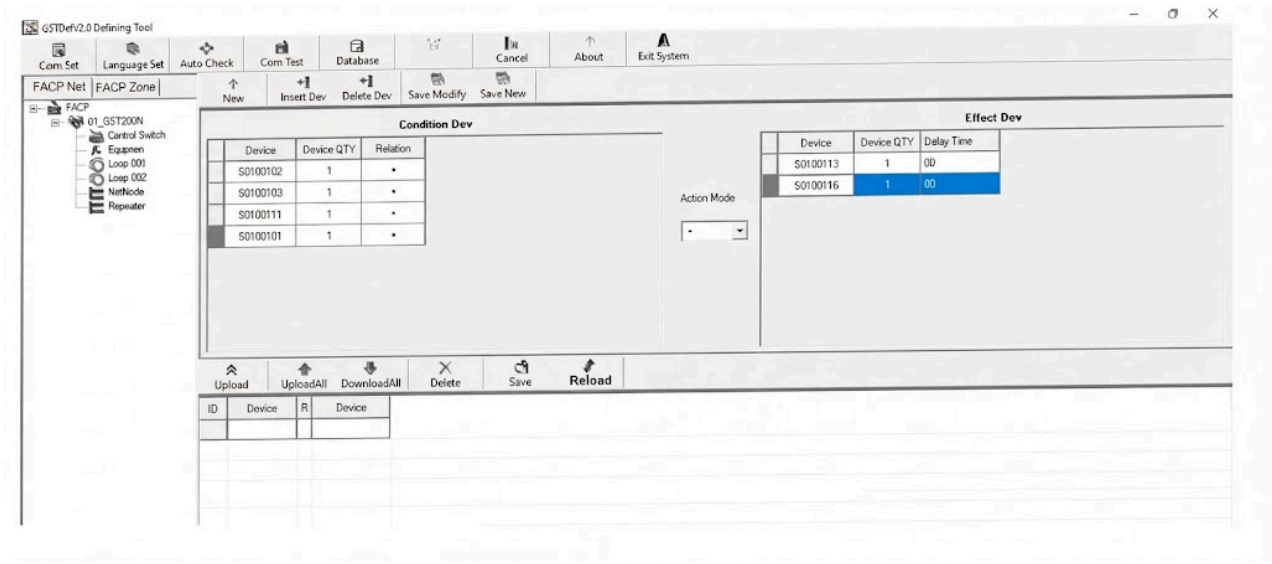
And in case of OR logic output will be high even any one of the inputs are high. This can also be represented using the swicth diagrm shown below.



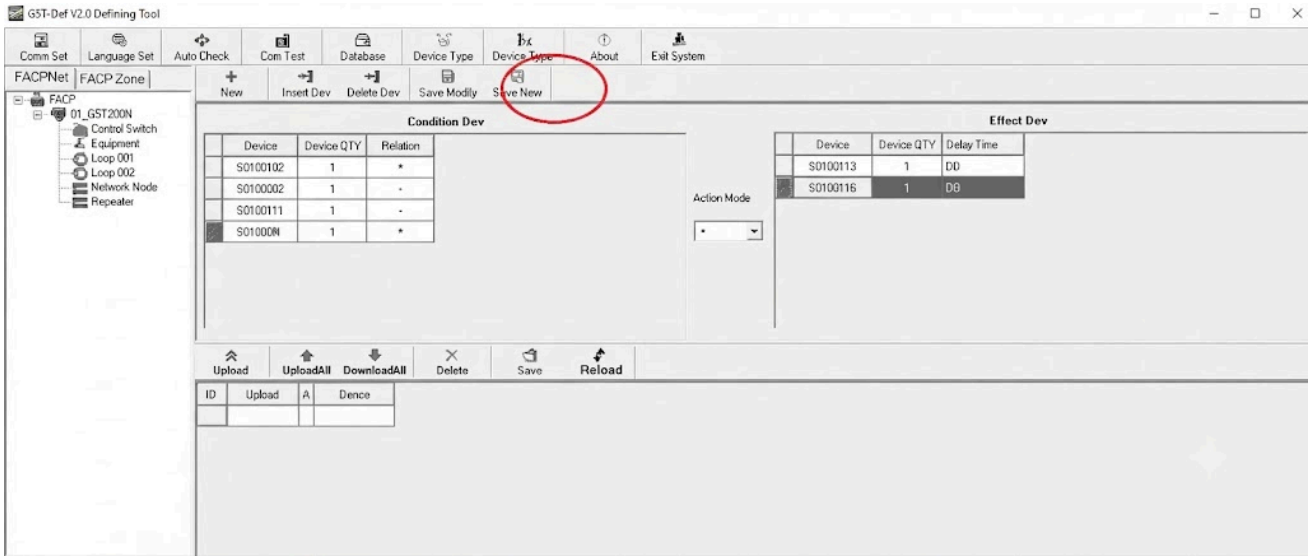
5. Add all the input devices connected in the loop and consider the OR logic, which defines in situation of emergency the output will go high if any of the sensors connected in the loop activates.



6. Similarly add all the output devices, which will provide an alarm in case of exigencies.

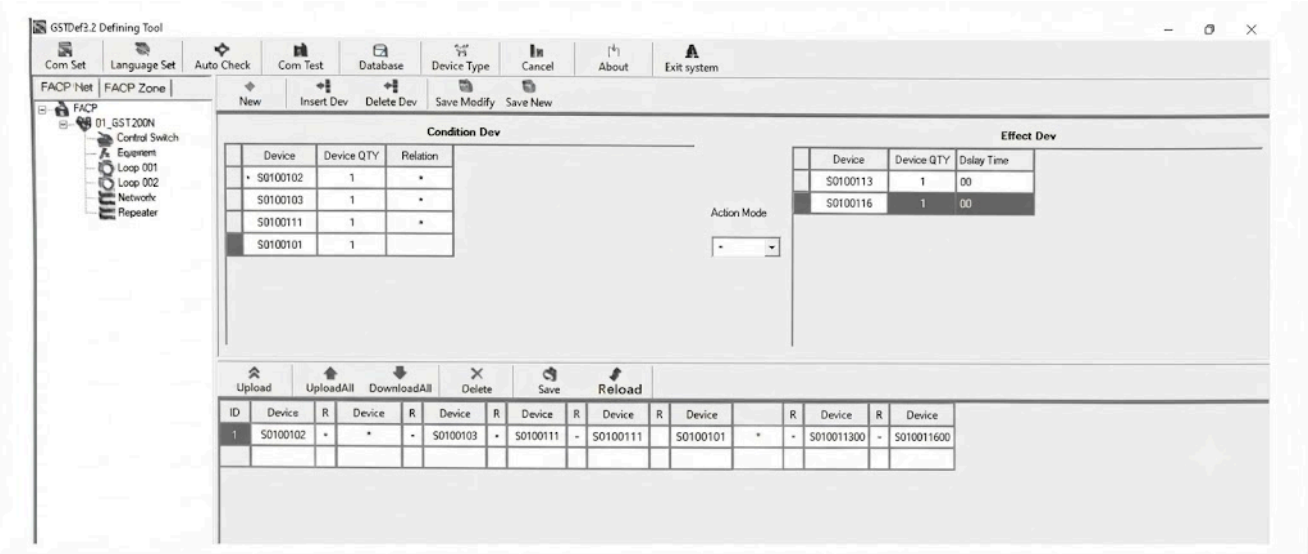


7. After adding all the input and output devices, click on "Save New" on the top command tool to execute this equation, please refer the image as shown below.

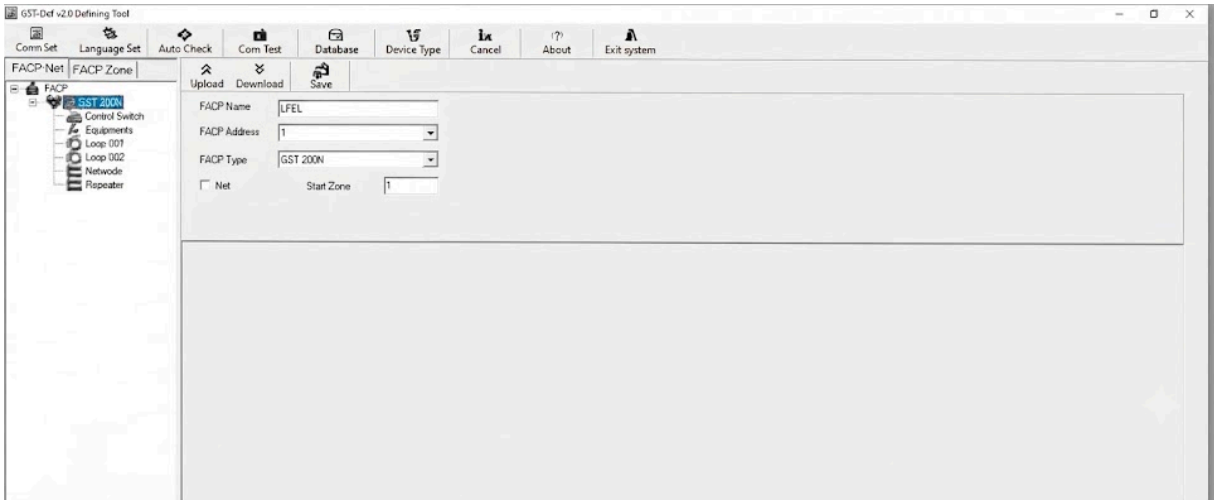


8. After saving this new equation we have the final output in the form shown below.

This suggests that the sounder/strobe will go high in case any one the devices detect smoke/heat in the sensor surroundings.



9. After we have this condition of operation, click on the "GST200N" and click "Save" to our selection and finally click on the "download" button to transfer program to the fire alarm panel, refer image as shown below



Note: The icon Upload is used to copy the data from the FACU to the computer and the icon Download is used to transfer program from the computer to the FACU.

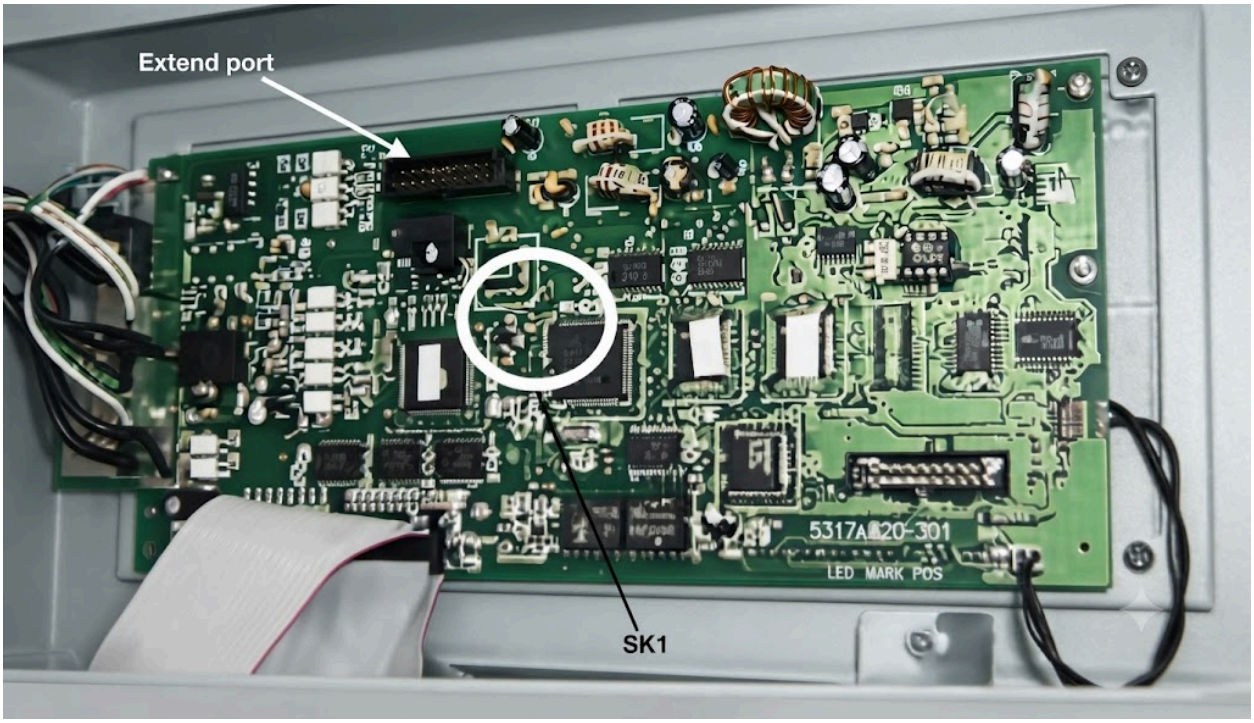
Note: To transfer program from computer to the FACU follow the procedure as mentioned.

1. Press "System", on the FACU and Enter the password "24220011" (Commissioning password) them Press "Enter". (Note: "-" sign means the panel is set to commissioning mode)



2. Press "SK1 button" behind the door. (Note: procedure should be done within 25

seconds otherwise the control panel will initialize the normal panel reset)



Exercise - 5: ANNOUNCING THROUGH PUBLIC ADDRESSING SYSTEM.

Purpose: To alert all the occupants of the premises in the eventuality of fire, we can combine FAS and PAS.

Steps:

1. Follow the steps as discussed, all above to program the FACU and transfer the program to FACU.
2. To allow the PA system to auto announce, connect the isolator contacts "NO-COM" of the FAS panel to the PAS terminals as shown below.
3. This connection triggers the PAS to start playing announcements when the fire alarm is activated.

FAS	PAS
NO	GND
COM	ALARM IN

