



# INTRODUCTION

TTK Digital Detection and Locating Systems design and application guide is mainly addressed to engineering consultants, contractors and end users. This guide, illustrated with a great quantity of drawings, shows the TTK digital locating systems: FG-NET and FG-SYS typical layouts and applications.

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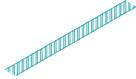
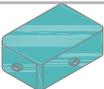
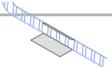
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# PRODUCTS LIST

Belowing table lists all products you will find in this guide. For each item, a real product photo, its symbol in drawings as well as a brief introduction are presented in order to ease your reading.

Product Photo & Symbol	Reference	Description
<b>Alarm Units</b>		
 	FG-NET	Touch screen digital unit, it serves as a control alarm panel, it activates audible alarm, display location of the initial point of the leak, active the relays associated.
 	FG-SYS	Digital Unit, it serves as a control alarm panel, it activates a luminous and audible alarm, display location of the initial point of the leak precise to 1 meter, once liquid touches sense cable.
<b>Sense Cables</b>		
 	FG-EC	Preterminated digital water and bases sense cable, with location in metric mode; it exists in 3, 7 and 15 meters.
 	FG-AC	Preterminated digital acid sense cable, with location in metric mode; it exists in 3, 7 and 15 meters.
 	FG-OD	Preterminated digital hydrocarbon/oil sense cable, with digital location in metric or sector mode; it exists in 3, 7 and 12 meters. For oil sense cable applications, ref to «TTK Fuel Leak Detection Design Guides».
 	FG-ECS	Preterminated digital water sense cable, with location in sector mode; it exists in 3, 7 and 15 meters.
<b>Diversion Boxes</b>		
 	FG-DTC	Diversion Box for 'TTK Bus 8723'.
 	FG-DTCS	Addressable Box for one Water or Acids Cable, on 'TTK Bus 8723' (Sector Mode).
 	FG-DOD	Bus Interface, for Integration of FG-OD Cables (max 10 cables, on 'OD Bus 8771'), on a Water & Acids 'TTK Bus 8723'.
<b>Accessories</b>		
 	FG-CLC	Leader Cable 3.5m, on 'TTK Bus 8723', for connecting two digital sensing cables in a none risk area or between FG-SYS Digital Unit and sense cable.
 	CFC-100	Hold down clips with adhesive (cold glue) to fix sensing cable lengths. Recommended at corner or every 1.5 meter.
 	ES-EC, ES-OD	Tags, for caution use, recommended every 3 meters or where needed.
 	FG-TMC, FG-TMOD	Modular end termination plug is used to terminate each circuit of sense cables.

## 1.1 System Description

This part offers some layout examples of FG-SYS / FG-NET locating systems in building environment. Both systems have the same technical limit as precising below:

- FG-SYS and FG-NET digital units both have 3 outputs (figure 1.1).
- Each output can manage up to 40 cables (figure 1.1.1).
- Every cable is fully independant and is considered as one zone.
- 3 outputs are independant from each other, the user can use one, two or all the outputs.

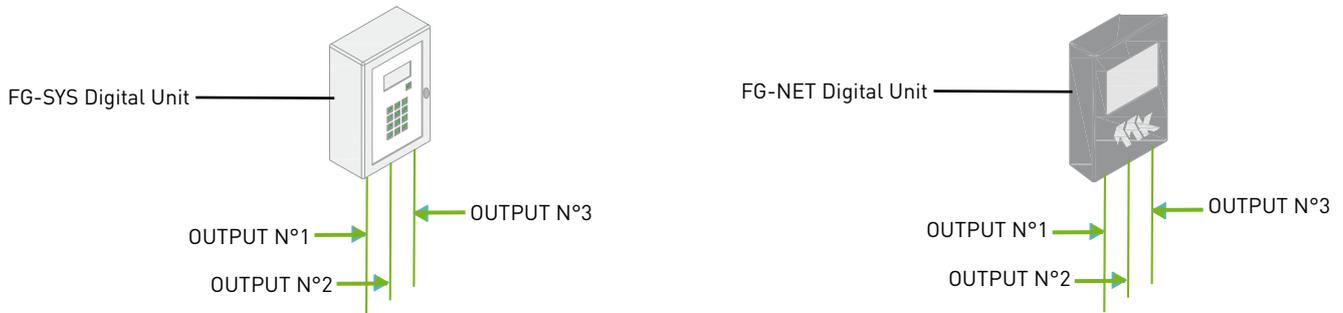


Figure 1.1

**Note:**

FG-SYS / FG-NET Digital Unit can manage up to 120 digital sense cables, or 1800 meters with its 3 outputs.

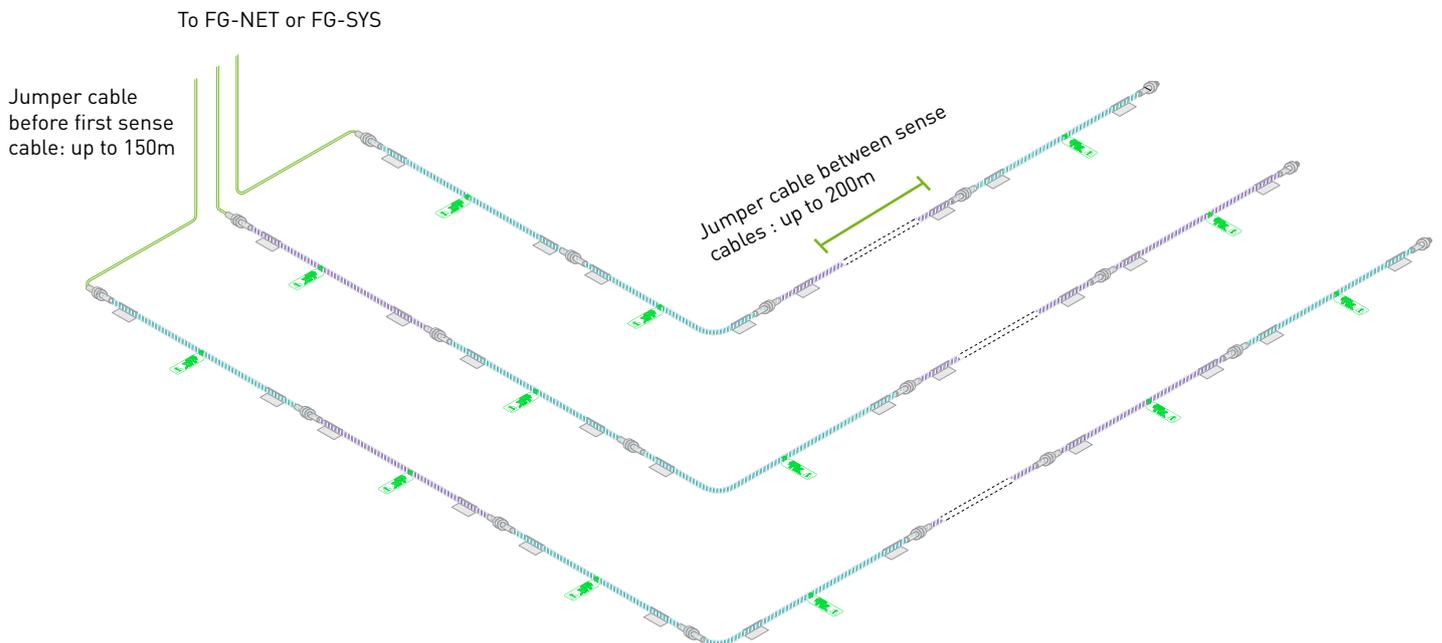


Figure 1.1.1

- Each output can connect  $\leq 40$  cables
- Each output can connect  $\leq 600$  meters

**Note:**

Different types of sense cables (eg: for water and acid) can be connected mixed.

## 1.2 Basic Installation

FG-SYS / FG-NET locating system includes basically: (figure 1.2)

- FG-SYS / FG-NET Digital Unit.
- TTK bus 8723 Jumper Cable (for connecting between panel and sense cables in this layout).
- Digital Sense cable (FG-EC in this layout, standard lengths are 3, 7 and 15 meters).
- End termination (used at end of last sense cables, mark the termination of one circuit).
- Accessories:
  - Hold-down clips (fix sense cable, stick on the floor);
  - Tags (caution use).

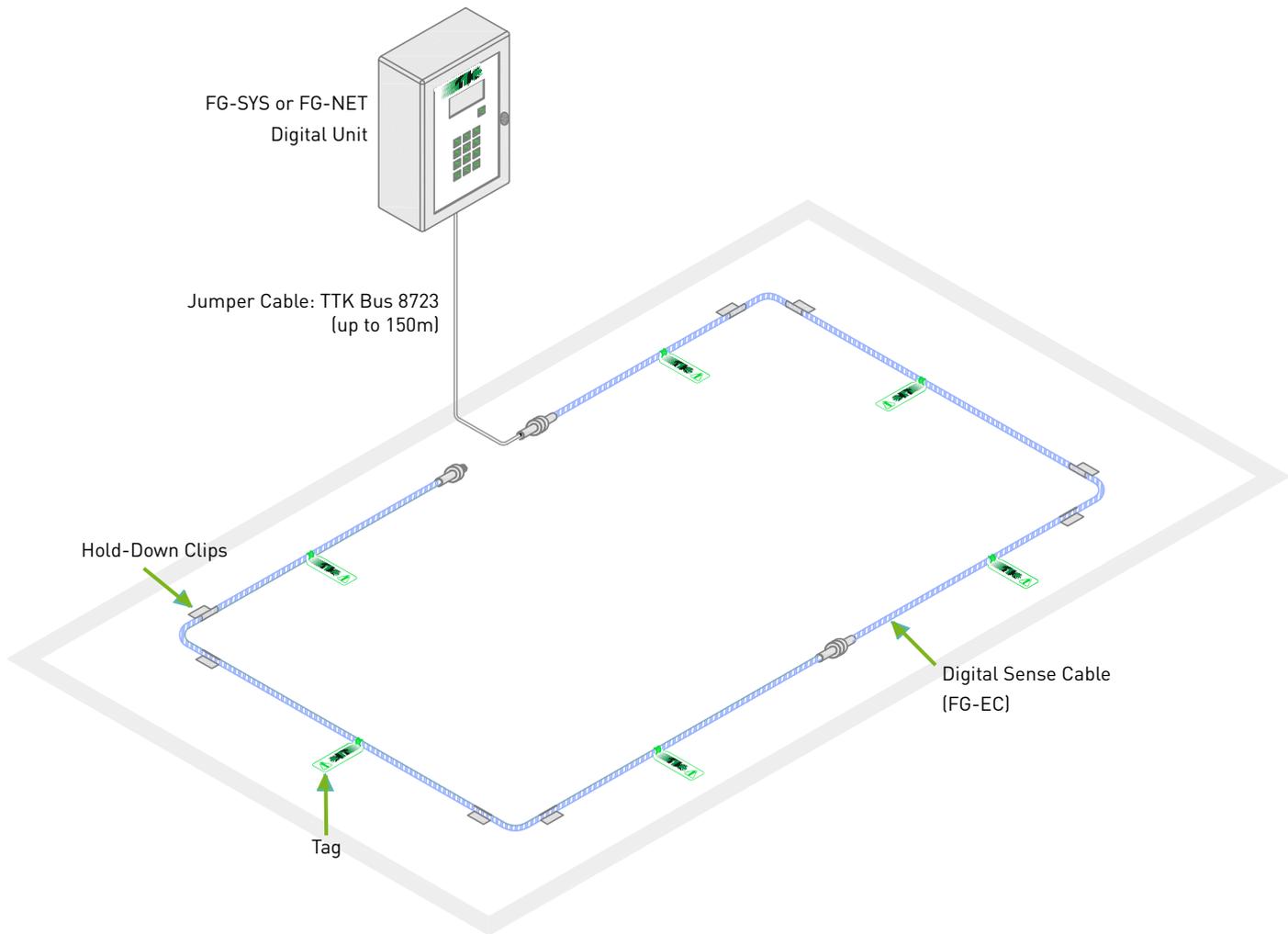


Figure 1.2

## 1.3 One Output Layout with Diversion Boxes

In order to fit the complex installation, TTK offers three kinds of boxes: FG-DTC, FG-DTCS and FG-DOD. They have their own characteristics but all of them facilitate the extension of the system in different situation. Layouts in session 1.3 explain different situation.

### 1.3.1 Diversion Box: FG-DTC

- The digital diversion box FG-DTC makes it possible to split a detection circuit into two parts, so as to allow the system to cover more horizontal space (figure 1.3.1).

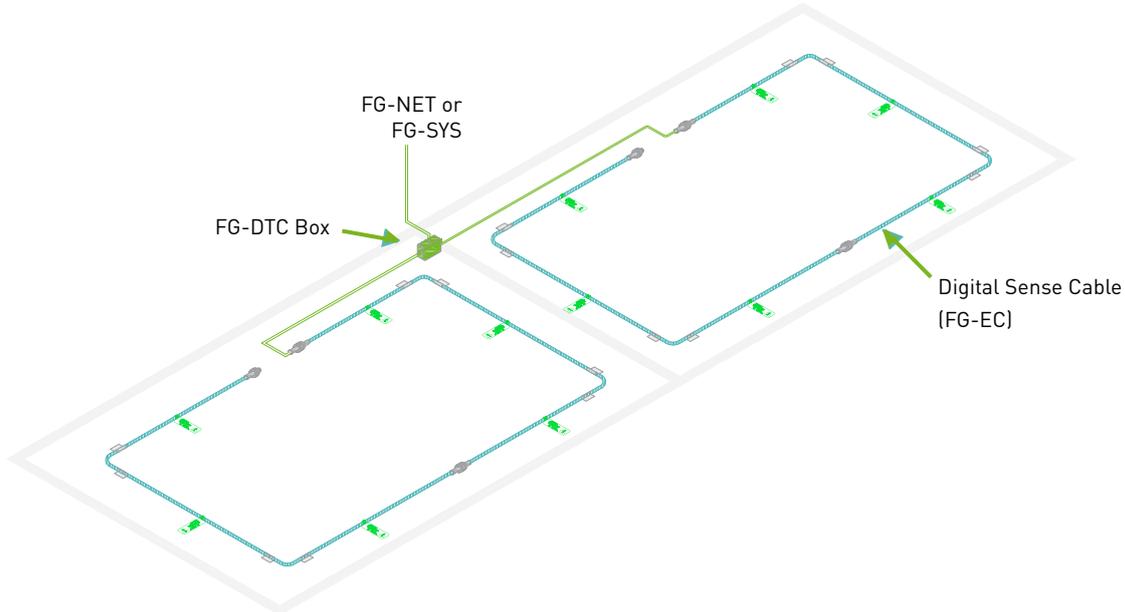


Figure 1.3.1: Layout with FG-DTC

### 1.3.2 Addressable Box: FG-DTCS

- The addressable sector box FG-DTCS allows connecting digital unit FG-SYS or FG-NET with analog sense cables and makes these cables addressable, in the meantime it has a unique advantage to cover vertical space (as illustrated in figure 1.3.2).

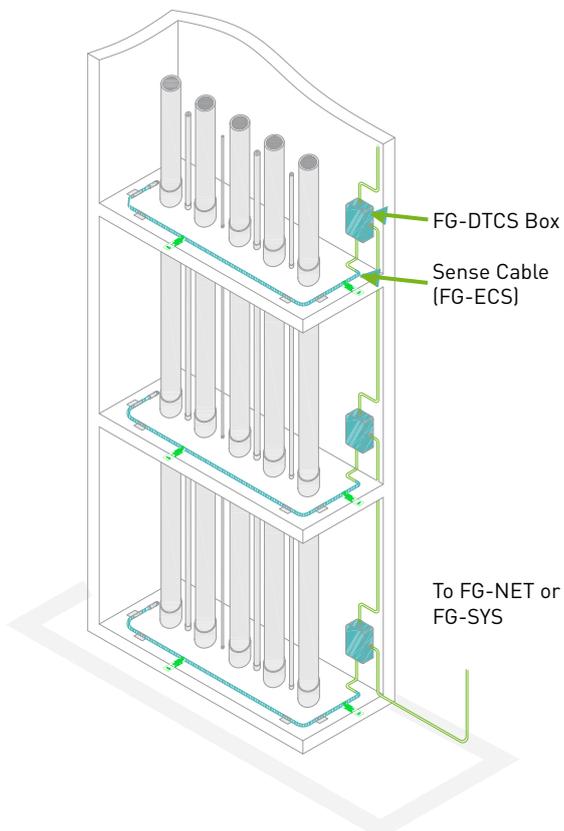


Figure 1.3.2: Layout with FG-DTCS

#### FG-ECS Sense Cable:

- FG-ECS cable is an analog water sense cable (without micro-chip).
- Each cable includes a jumper cable and an end termination at two tips.
- The standard lengths are 3, 7 and 15m.

#### Design Tips:

- FG-DTCS box is designed to use with FG-ECS and FG-ACS analog sense cables (above two figures use FG-ECS cable as example).
- FG-DTCS box has advantages when used for similar small to medium size space on different levels (vertical areas) as sector layout.

### 1.3.3 Mixed Installation with FG-DTC & FG-DTCS boxes

- In real installation, FG-SYS / FG-NET system layout could be quite complex. A mixed installation of FG-DTC and FG-DTCS boxes could ease installation, it allows extension of the system.

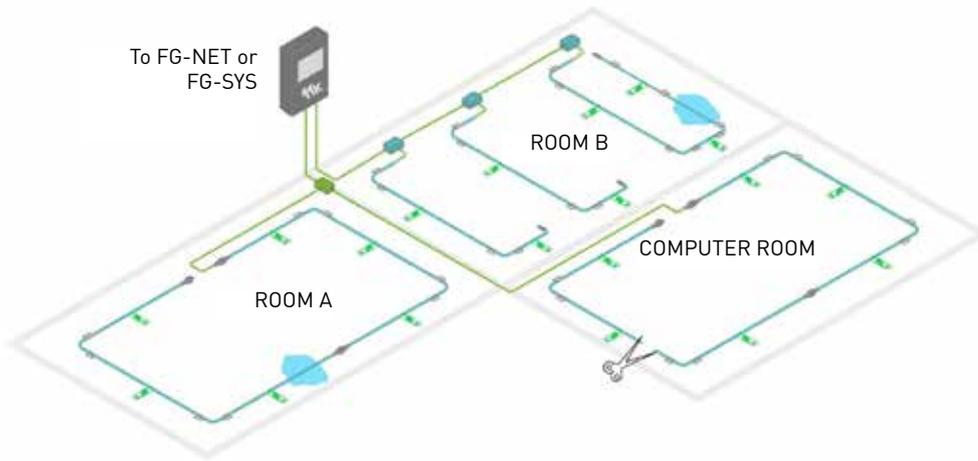


Figure 1.3.3 : Layout with FG-DTC et FG-DTCS

#### Design Tips:

- Use jumper cable for wall or corridor passage between two sense cables. Maximum jumper cable length for each FG-SYS / FG-NET output is 150 meter.
- FG-EC cables can be daisy-chained, this is used for horizontal extension (on wide areas on the same floor).
- FG-ECS cables (without connector) has a termination at end tip of the cable, it is recommended to use for vertical extension (on different floors).

#### Layout Explanation (Figure 1.3.3) :

- The system uses one FG-DTC box and three FG-DTCS boxes.
- Both ROOM A and COMPUTER ROOM are protected by four FG-EC sense cables. These cables are connected to the first circuit of the panel via a FG-DTC box.
- ROOM B is protected by three sector sense cables FG-ECS via 3 FG-DTCS boxes.
- In this installation, the panel will trigger 3 alarms:
  - leak alarm in ROOM A with +/-1m leak precision;
  - leak alarm in ROOM B indicating the alarming cable;
  - cablebreak alarm in COMPUTER ROOM +/-1m leak precision (all upstream cables in COMPUTER ROOM still functioning).

### 1.3.4 Interface Box: FG-DOD

- FG-DOD is an OD Bus Interface Box.
- It is used for FG-OD sense cables installed in combination with a water/acid installation on FG-NET/FG-SYS digital unit.
- It will split a standard bus into two outputs, the first one being dedicated to water/acid sense cables, the second one being ATEX approved and dedicated to FG-OD sense cables.
- Up to ten FG-OD sense cables can be connected to one FG-DOD box.

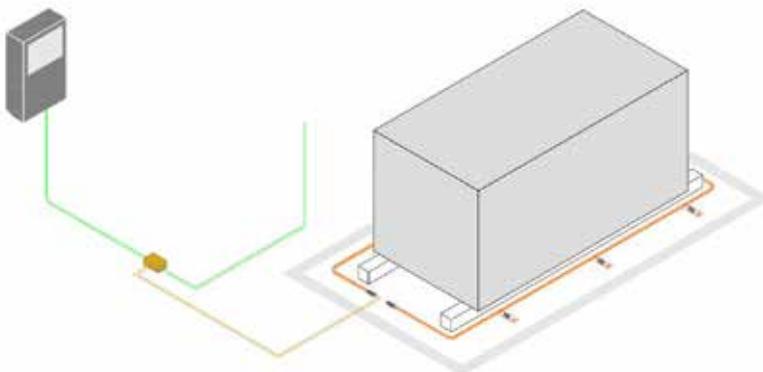


Figure 1.3.4 : Layout with FG-DOD

#### Layout Explanation (Figure 1.3.4) :

- FG-OD oil leak sense cables are installed in the perimeter of the generator.
- These cables are connected on the digital unit (FG-NET or FG-SYS) through FG-DOD, the interface box.
- The first output (in orange color in the figure) of the box is to connect hydrocarbon sense cables; the second output (in green color) allows to connect with water/acid sense cables.

## 1.4 Three Outputs Horizontal Layout

FG-SYS / FG-NET Digital Unit has 3 outputs. They can be used for both horizontal and vertical installation for a larger extension. The layout presented below (figure 1.4) is a horizontal layout.

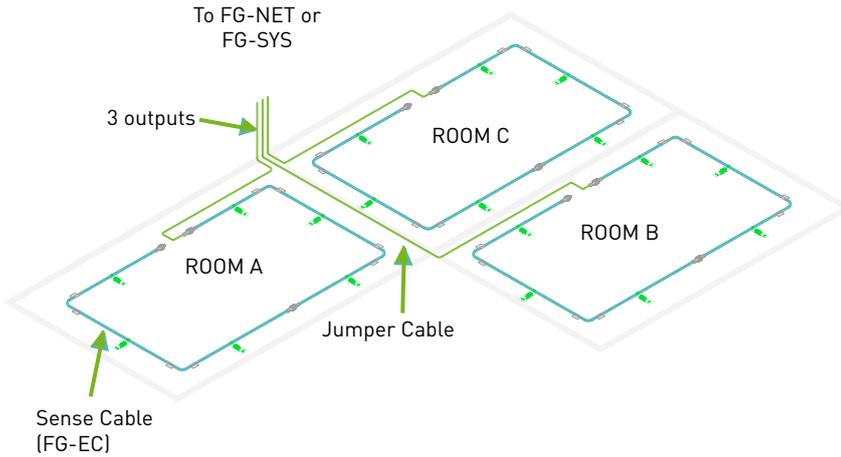


Figure 1.4 Horizontal layout

### Layout Explanation (Figure 1.4) :

- The system uses all the three outputs of a FG-SYS / FG-NET unit.
- Each output starts from FG-SYS / FG-NET with jumper cable for wall passage till the zone of protection.
- Output 1 goes to room A;
- Output 2 goes to room B;
- Output 3 goes to room C.
- Each output is independent. Room A, B and C are totally independent.

### Installation Tips (Figure 1.4) :

- Hold-down clips with adhesive are recommended every 1.5 meters or where required.
- An end termination is indispensable for the last sensing cable of one circuit.

## 1.5 Three Outputs Vertical Layout

For a vertical installation in building environment, FG-SYS / FG-NET three outputs are designed for providing extensions to several floors.

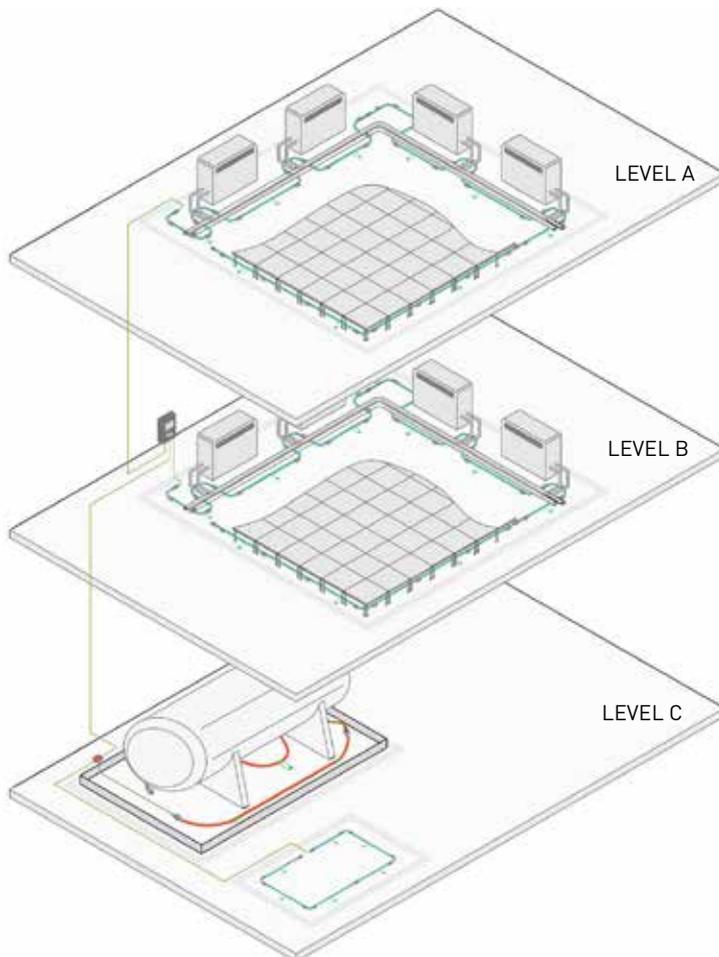


Figure 1.5 Vertical layout

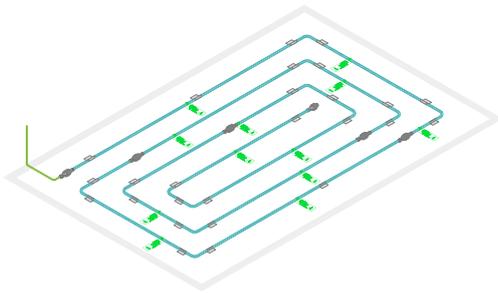
### Layout Explanation (Figure 1.5) :

- A single digital panel is enough to manage sense cables installed on these three levels.
- Each output starts from FG-SYS / FG-NET with jumper cable for wall passage till the zone of protection.
- On level C, FG-DOD is used for the connection with FG-OD sense cable.
- Each output is independent. Thus floor A, B and C are totally independently under control, to ensure a best security.

## 1.6 Three Typical Digital Sense Cable Layouts

In order to fit different installation situation and client's requirements, TTK suggests three typical layouts to protect an area.

### Extensive Density Protection

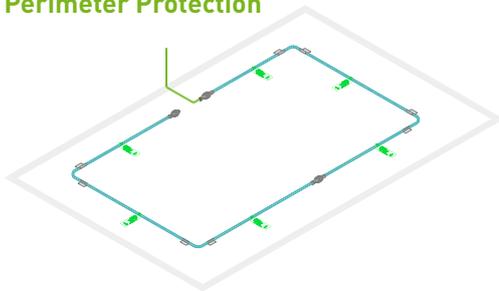


Typical 'very important place' extensive density protection, allowing perimeter and total floor coverage of the room.

#### Typical application:

Mission critical facilities, data center, hospital, emergency call center, airport control centre, expensive equipments/machines, UPS room, etc.

### Perimeter Protection



Typical and the most common design for prevent external liquid leak come inside the protected zone.

Sensing cable typically installed about 1 meter from the walls.

#### Typical application:

Offices, archives room, kitchen, toilets, technical room, tank room, lift pit, etc.

### Perimeter ACU Protection



Typical design for air-conditionners and leak possible objects, prevent leaks extend without acknowledge.

Sensing cable typically installed about 75cm in front of and near the air-outlet of machines.

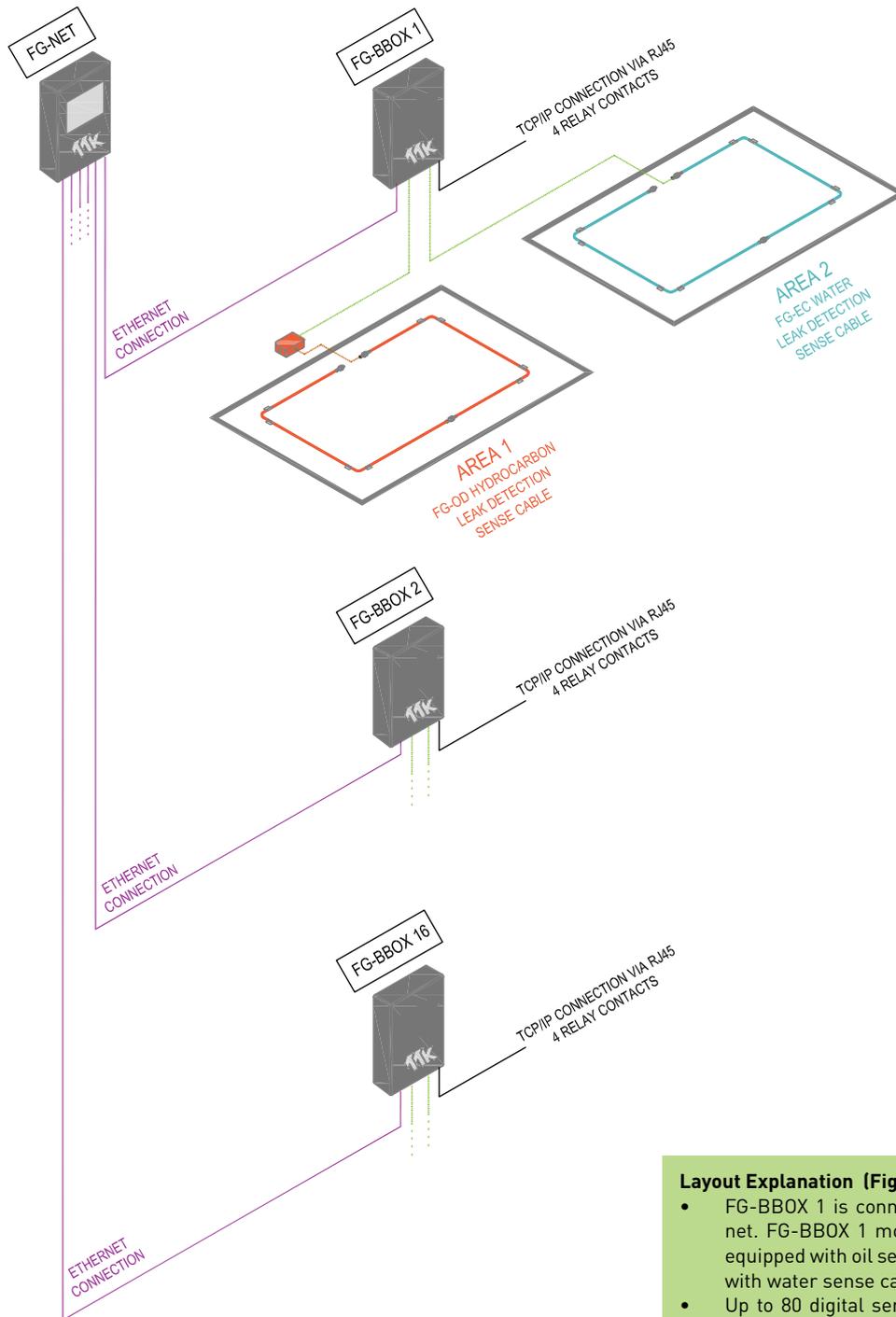
#### Typical application:

ACU room, comms room, vending areas, etc.

Figures 1.6 Three typical layouts

## 1.7 FG-BBOX: Satellite Device of FG-NET

The FG-BBOX is a satellite device of the TTK FG-NET Digital Unit. It is monitored by FG-NET via a standard Ethernet network.



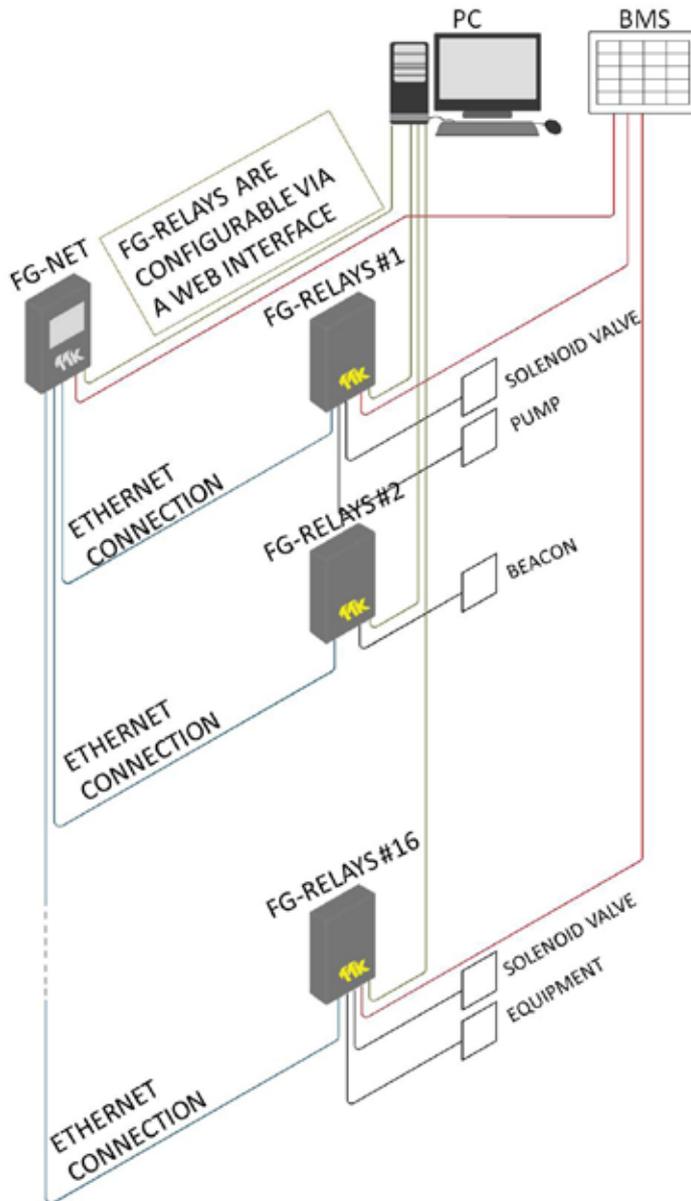
Figures 1.7 FG-BBOX connection with FG-NET

### Layout Explanation (Figure 1.7) :

- FG-BBOX 1 is connected to FG-NET via Ethernet. FG-BBOX 1 monitors two areas: AREA 1 : equipped with oil sense cable; AREA 2: equipped with water sense cable.
- Up to 80 digital sense cables can be managed independently on each FG-BBOX, providing maximum protected length of 1200m for both circuits.
- Up to 16 FG-BBOX can be connected to one FG-NET unit without exceeding a total number of 500 digital sense cables per FG-NET.
- In the event of a fault on the sense cables connected to the FG-BBOX, the relevant relay contact is activated and the LED on the relevant circuit switched to red.
- Each FG-BBOX proceeds TCP/IP connection via RJ45. Each FG-BBOX has four relay contacts: 2 leak relays (1 for each circuit), 1 cable break relay and 1 power failure relay.

## 1.8 FG-RELAYS: External Relays Box of FG-NET

The FG-RELAYS is a Digital External Relays Box. It works as a satellite device of the FG-NET Digital Unit. It adds a set of 24 configurable external relays to the FG-NET. It allows FG-NET to drive external devices such as solenoid valves, BMS signals, beacons and others, to react in case of leak or system alarms.



Figures 1.8 FG-RELAYS connection with FG-NET and BMS

### Layout Explanation (Figure 1.8) :

- FG-RELAYS #1, #2,... #16 are connected to FG-NET via Ethernet. They are presented as FG-RELAYS #1, FG-RELAYS #2 and so on displayed on the FG-NET Digital Unit.
- FG-RELAYS box status can be viewed on the FG-NET Digital Unit. In case of box disconnected, FG-NET displays an alarm and the general relay is activated.
- The FG-RELAYS is accessible via a web interface for configuration.
- Up to 16 FG-RELAYS boxes can be managed by one FG-NET allowing for a maximum of 384 (24x16) additional relays.

# PART 2 APPLICATIONS

## 2.1 Data Center, Air-Conditioner Room Applications

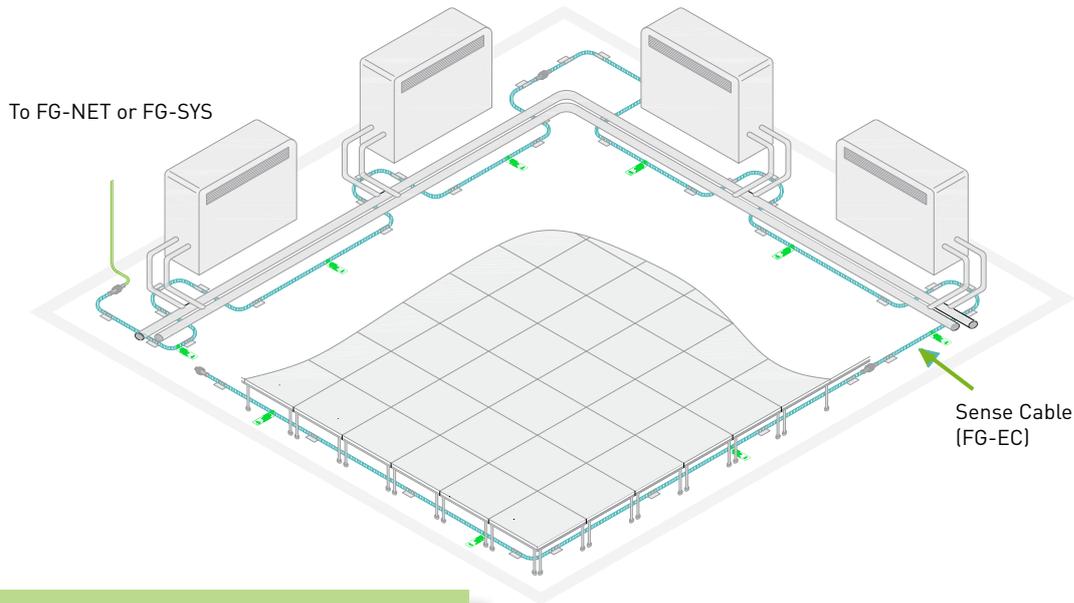


Figure 2.1

**Layout Explanation (Figure 2.1) :**

- Four Air Conditioner Units (ACUs) are installed in the perimeter of the room.
- In this case, sense cables (FG-EC) are installed in the perimeter of the room and in front of the (ACUs).
- This installation is to prevent leaks from ACUs and prevent external leaks from entering the room.

**Note:**

- Suggest to place Sensing Cables 75cm in front of the air outlet of air-conditioning unit.

## 2.2 Technical Equipments

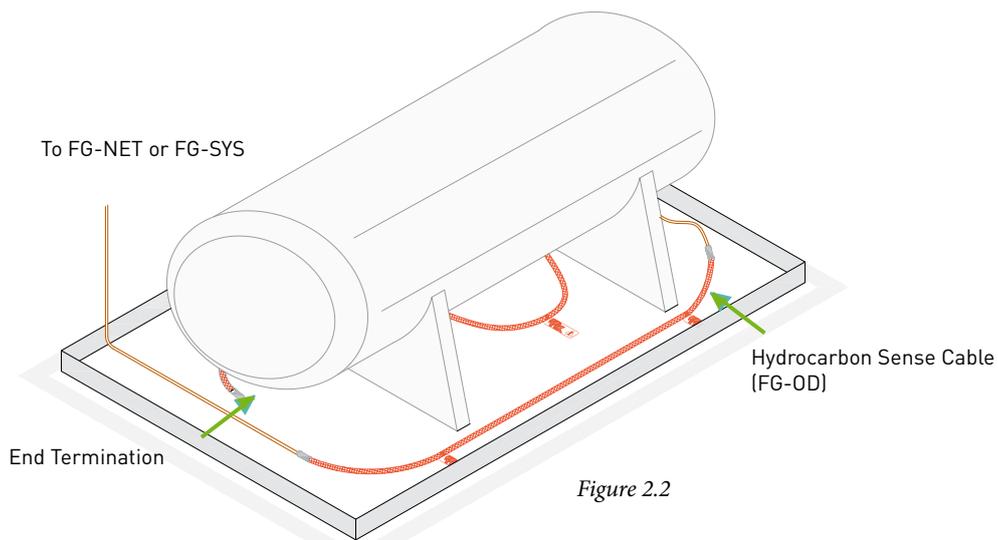


Figure 2.2

**Layout Explanation (Figure 2.2) :**

- This figure is a typical installation for fuel tank and generator.
- FG-OD sense cables are installed in the perimeter of the equipment.
- This installation is to prevent leaks from the technical equipment.
- For more information about the application examples of FG-OD, refer to hydrocarbon system Design Guides.

**FG-OD Digital Oil Sense Cable:**

- FG-OD detects the presence of liquids hydrocarbon and solvents.
- Fast response and re-usable after leak detection.
- Suitable for dangerous zones of explosive atmosphere – Zener Barrier: Ex ia IIB T4 Ga (ATEX "Zone 0").

## 2.3 Pipe Application

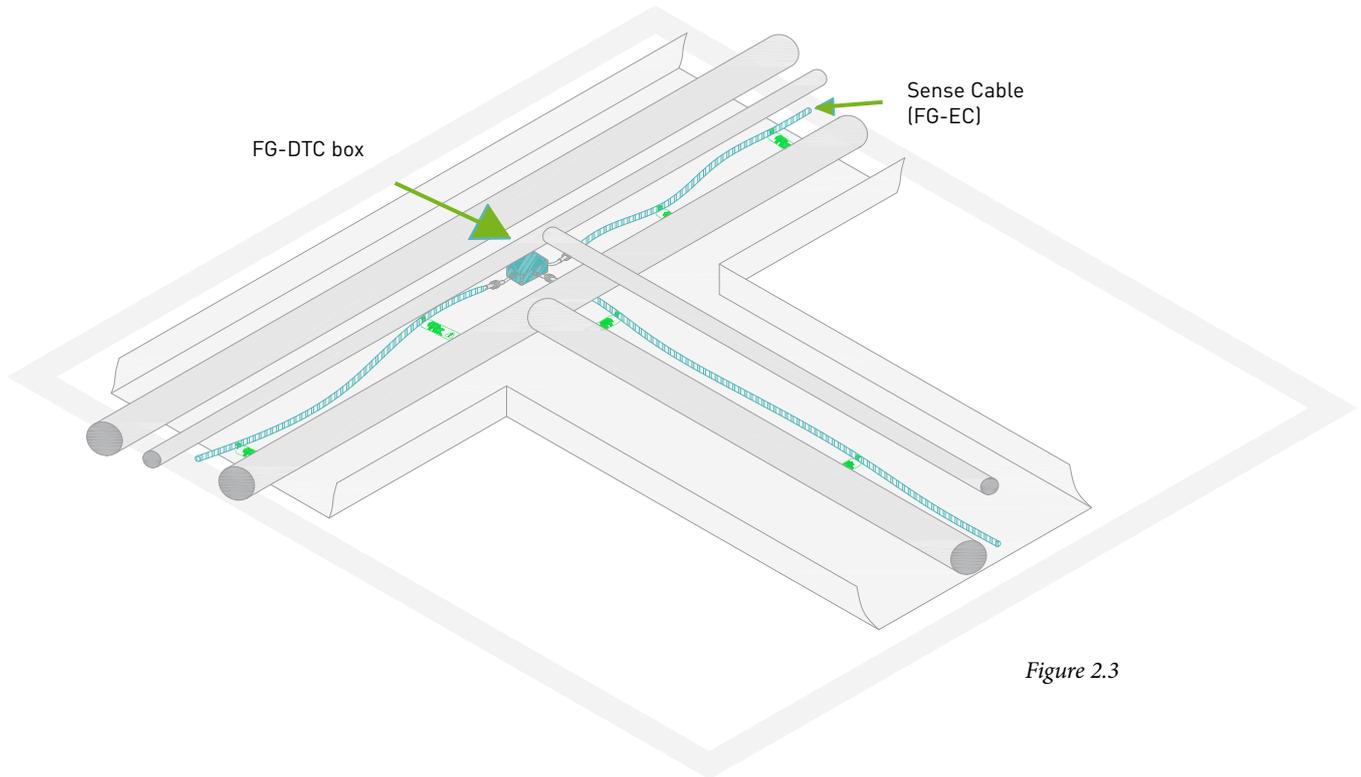


Figure 2.3

### Layout Explanation (Figure 2.3) :

- Sense cables (FG-EC) are installed in the drip trays under pipes.
- This installation makes sure an immediate detection for any leak from the pipe.
- Diversion box allows the circuit extends to two parts so as to cover more pipes.

For pipe with insulation (without drip tray), figure 2.3.1 et figure 2.3.2 present two kinds of water sensing cable installation.

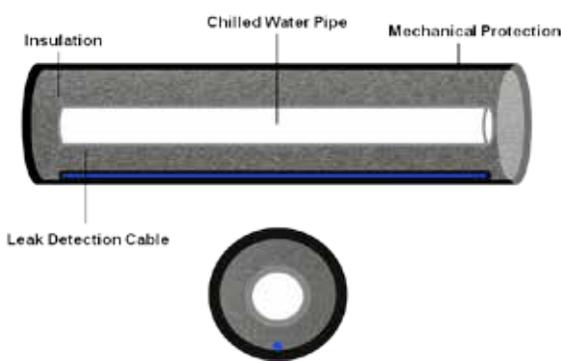


Figure 2.3.1

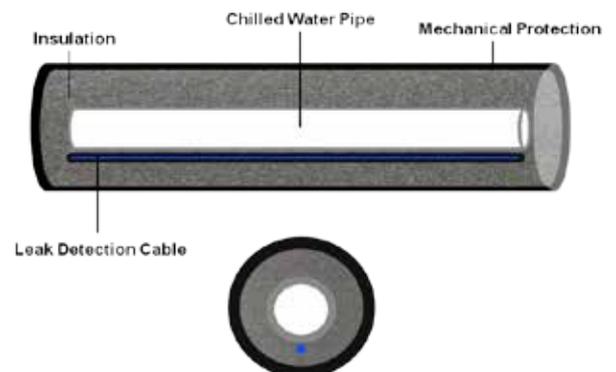


Figure 2.3.2

### Layout Explanation (Figure 2.3.1 & Figure 2.3.2) :

- The sense cable is installed in the insulation level, near the mechanical protection (Figure 2.3.1);
- The sense cable is installed in the insulation level, under the water pipe (Figure 2.3.2).
- Both installations assure an immediate detection for any leak from the pipe, the typical application when the pipes are not equipped with the drip tray.

## 2.4 Application for Several Levels in One Building

FG-SYS / FG-NET locating systems are flexible, from a small area to several big areas, they fit the situation. Both systems have unique advantages in multiple level buildings.

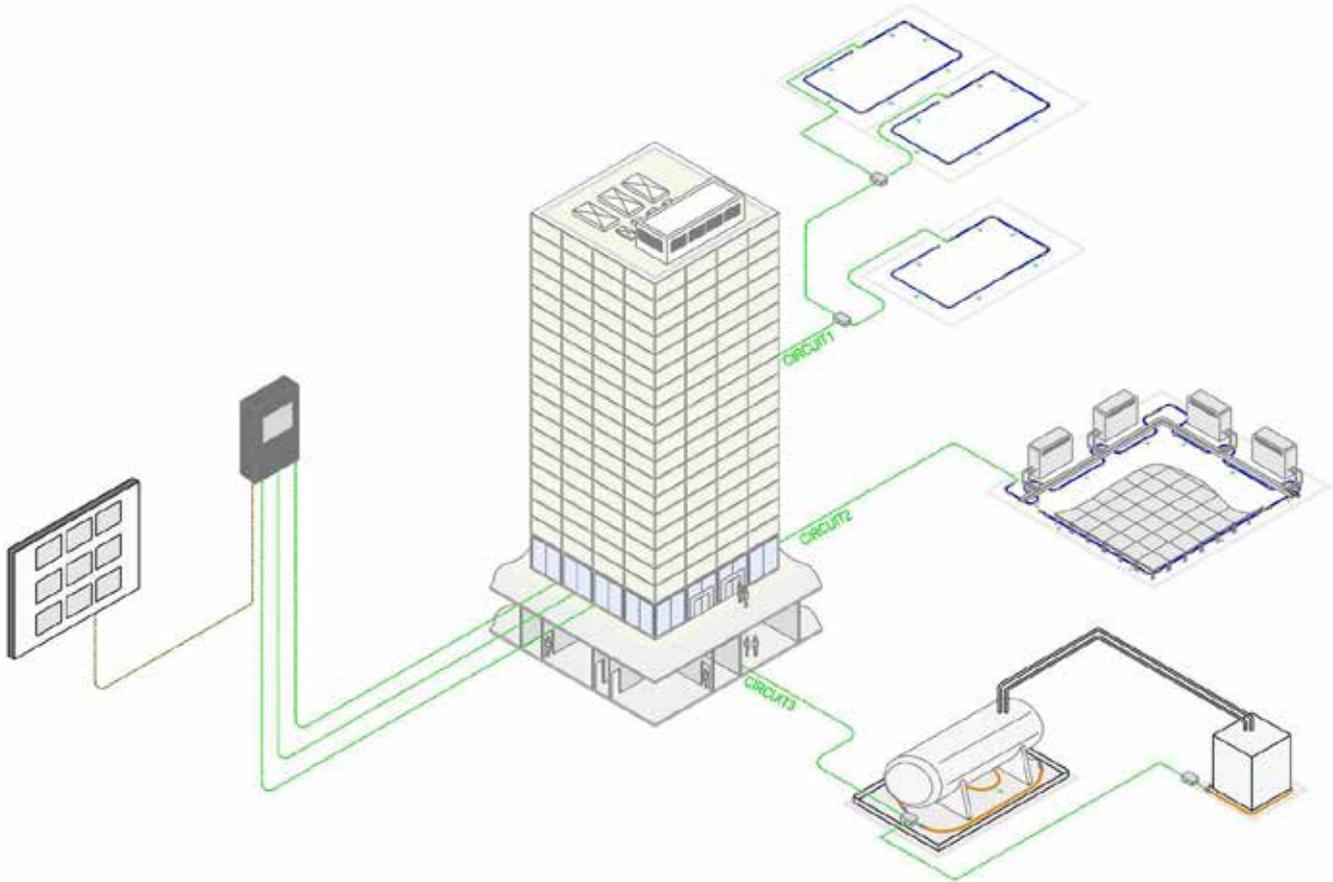


Figure 2.4

### Layout explanations (Figure 2.4) :

- The digital unit uses 3 outputs to go to different levels, thus to cover all places that need protection in the whole building.
- Each output has capacity till 600m cables, thus in total 1800m cables can be connected to only 1 digital unit. FG-NET can connect with satellite devices FG-BBOX (up to 1200m of sense cables per device, ref to chapter 1.7)
- Three possibilities to exploit the information on the digital unit:
  - RJ45 port for connecting network-Protocol TCP / IP;
  - RS232 or RS422/485series links - Jbus / Modbus protocol;
  - 9 relays: 8 fully configurable relays and one specific relay for power failure.
- The alarm panel is installed in ground floor security office for supervising the whole building.