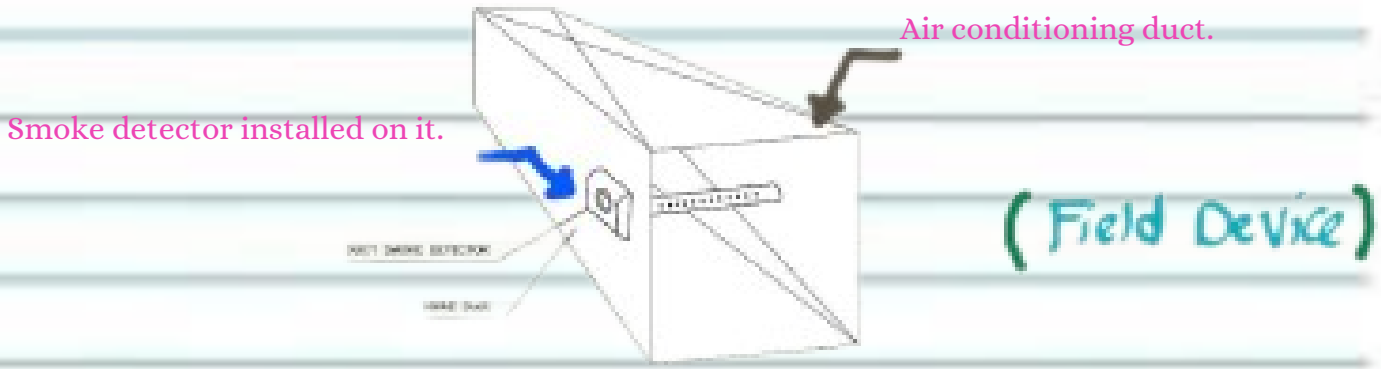
FIELD DEVICES

- In the previous lectures, we learned basic information about the three levels of BMS (Building Management System) and we also learned the contents of each level and their exact placement.

- In this lecture, we will discuss some details about the first level in the system and learn about its most important components.

Firstly: Where is it located?

- On the equipment you want to monitor or control.



What are their types?

- Let's simplify things, and say that the site's devices consist of only two sections, which are:

[1] Devices to read values and monitor status.

[2] Devices to operate and disconnect equipment.

- The devices I will use to read the status, and these can be referred to as:

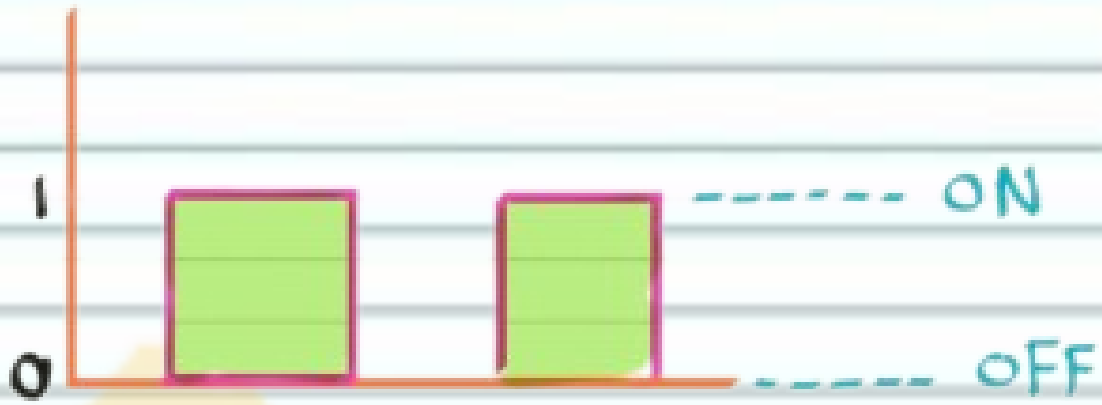
  - Sensors
  - Switches

What's the difference?

- To understand the difference, let's first explain two important terms,,, But before explaining, you should keep in mind that these terms can be helpful with:

Digital Signals

- they each have two states only, no more 0 , 1
- Something is either working or not working, open all the way or completely closed, and so on.



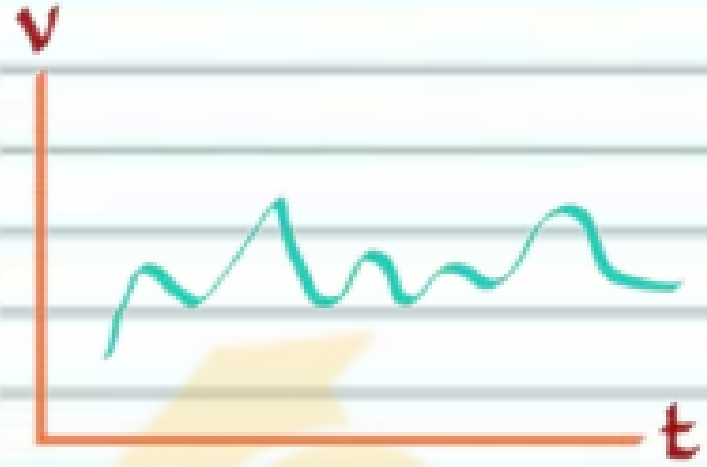
- This type is typically found in switches, so when you see a device labeled "Switch", you immediately know that it deals with digital signals.

Ex: DPS "Differnetial Pressure Switch"

- This is a pressure switch. It is set to a specific pressure difference between two points, and when it reads that pressure value, it triggers a change in the control points. This is how the controller understands that this switch has the desired pressure difference.

Analog Signals

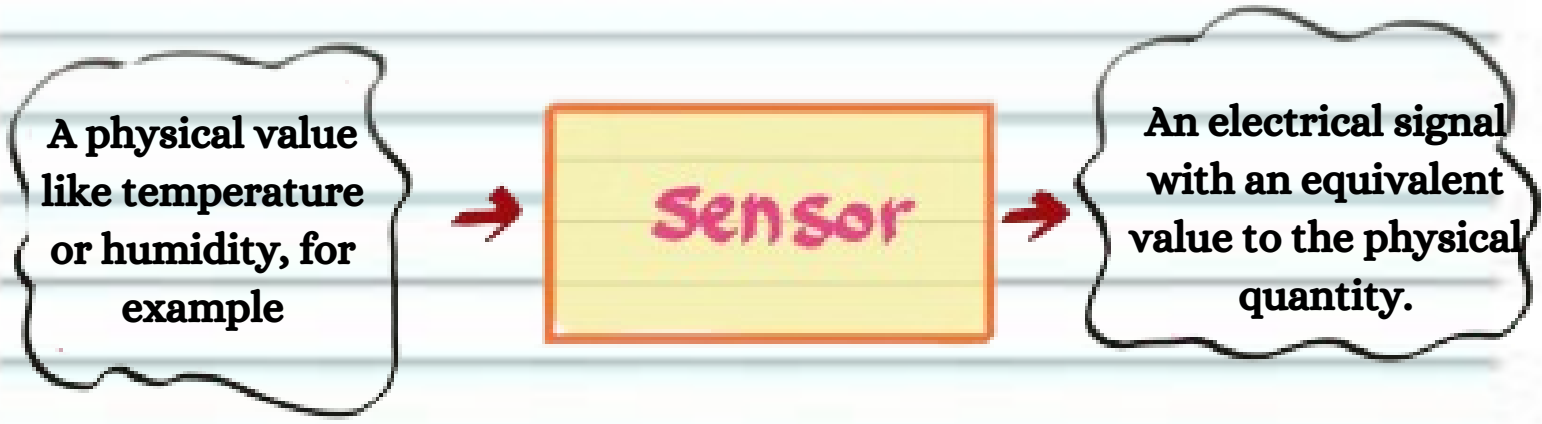
- So, we're talking about signals that don't have a specific value, but their output is related to the relationship between voltage and time.



- This type is typically found in sensors, so when you come across a device described as a sensor, you immediately know that its signal is analog.

Ex: Temperature Sensor

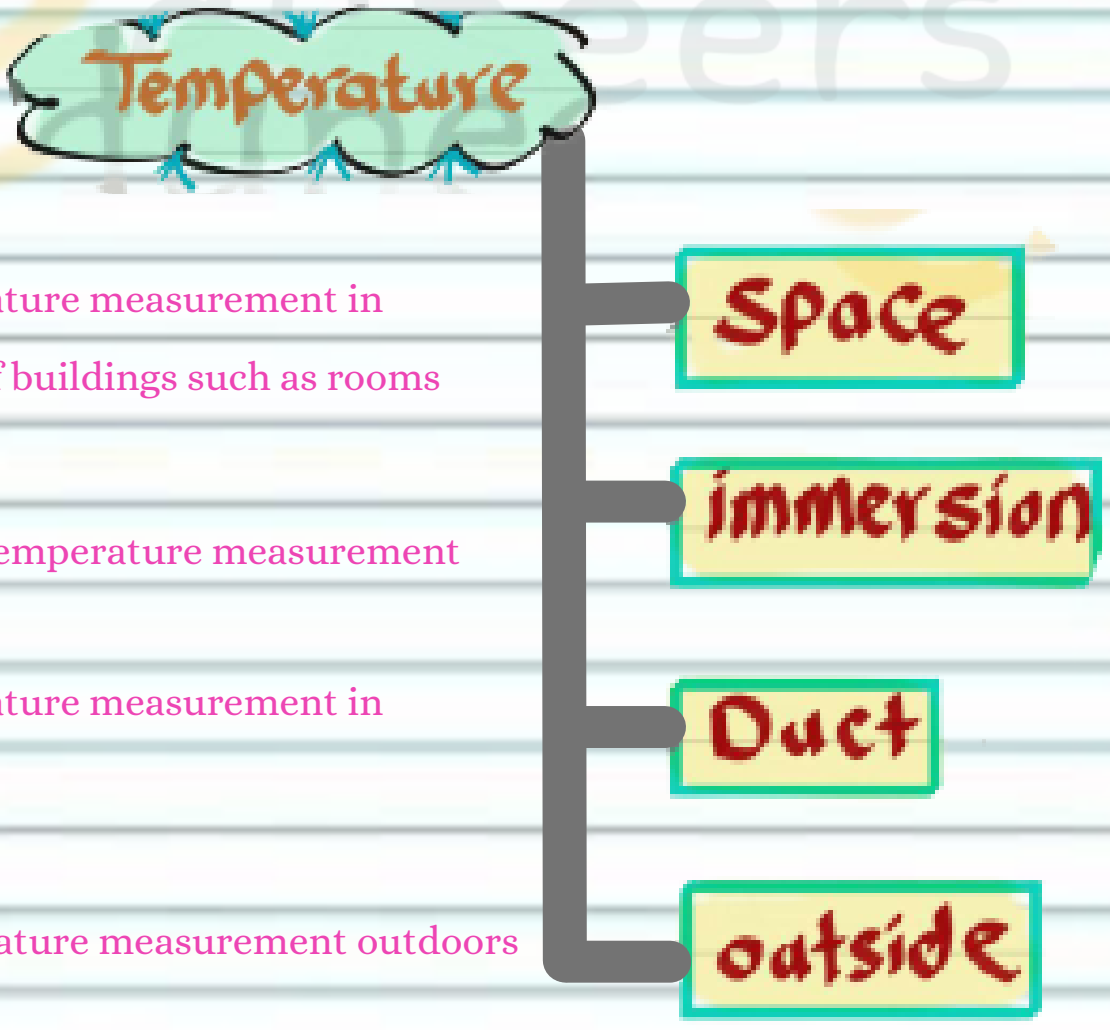
A sensor's purpose is to monitor the temperature in a specific location, and for each temperature value, it sends an electrical signal with an equivalent value.



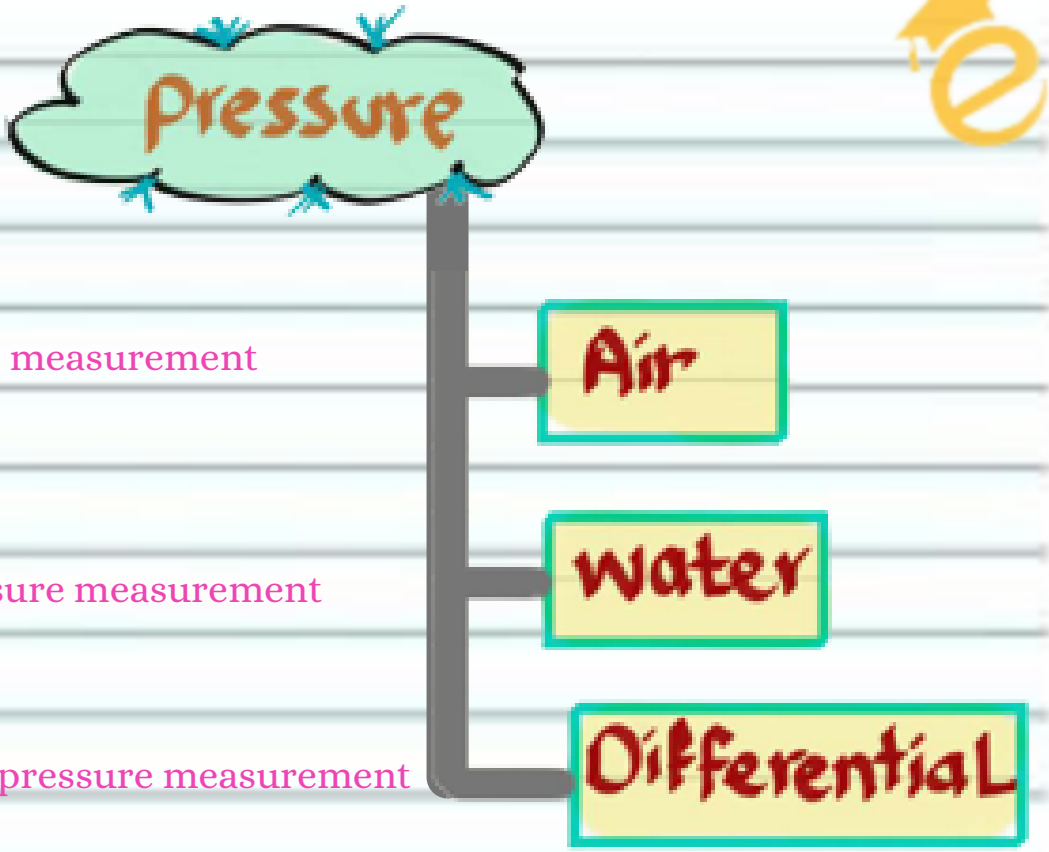
- So, we understand that my input is confined between two terms:
  - Digital input (DI)
  - Analog input (AI)

EXAMPLES

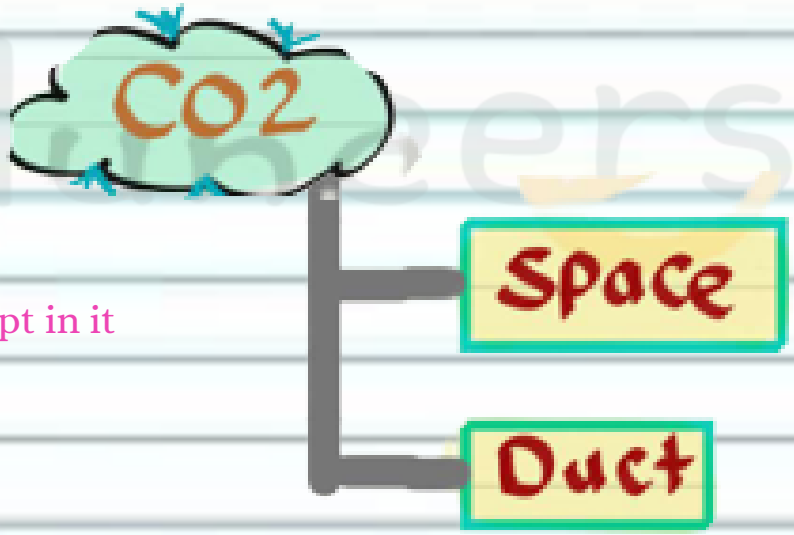
- before we explore examples, let me categorize sensors and switches commonly used for categories like:



- Types of temperature measurement in interior spaces of buildings such as rooms
- Types of liquid temperature measurement
- Types of temperature measurement in HVAC ducts
- Types of temperature measurement outdoors



- Types of air pressure measurement
- Types of water pressure measurement
- Types of differential pressure measurement

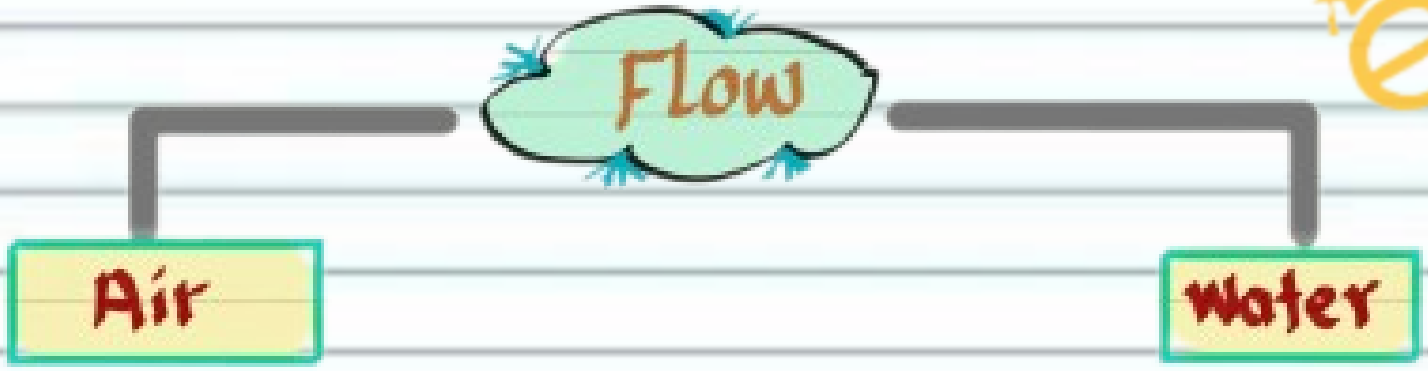


- We'll find the same concept in it

In indoor spaces.

Outside buildings

Inside ducts



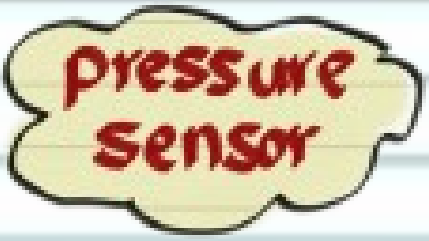
- There are other types , for example:

-Motion sensor: It provides a signal when there is motion inside the area it covers, like when someone passes in front of it.

-Occupancy Sensor: It's one of the crucial sensors for energy conservation, and its concept is that it detects the presence or absence of people in the area it is installed in.

- Most of the types we mentioned can come in either sensor or switches, and the key difference between them is illustrated in this example...

A switch, on the other hand, only changes its state when the pressure reaches a specific value.



A sensor continuously reads the pressure, and for each pressure value, it generates an electrical signal equivalent to it.

- We've identified the types, and everything seems clear now. Let's move on and take a look at real-world examples to see how we can benefit from the data provided in their datasheets.

Ex(1):

- What we're discussing now is an increase in your knowledge, and it's essential to always be certain that there is no information without purpose.

- The example: A sensor from Siemens with the code QAE21.

The cable control (gland) entry point.

(Customized sizes)

The part that is installed in the item to measure its temperature (probe).

This part is the (sensor head), and it contains the electrical connections.

Water temperature sensor.

Immersion

Temperature

Sensors

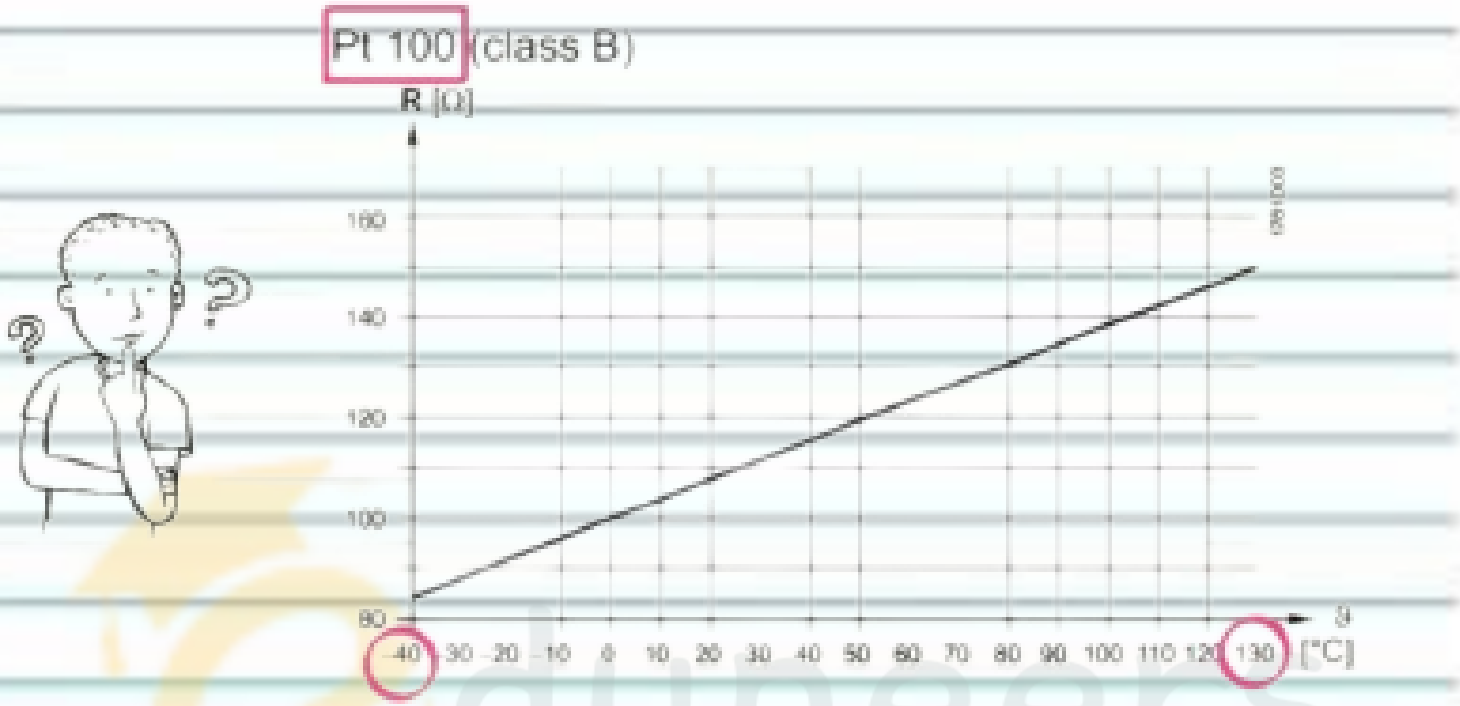
The signal is analog

AI

Or, to be more precise, it will be an Analog Input AI.

Passive sensors for acquiring the water temperature in pipes and tanks.

- I wrote to you in the description that the sensor is sold exactly as we explained.



- To understand this, let's first agree on a fundamental concept: Temperature sensors work by establishing a relationship between the temperature they measure and an equivalent resistance in ohms. This relationship can be either linear or inverse and depends on the materials used in the sensor.

NTC : negative temperature Coffient.

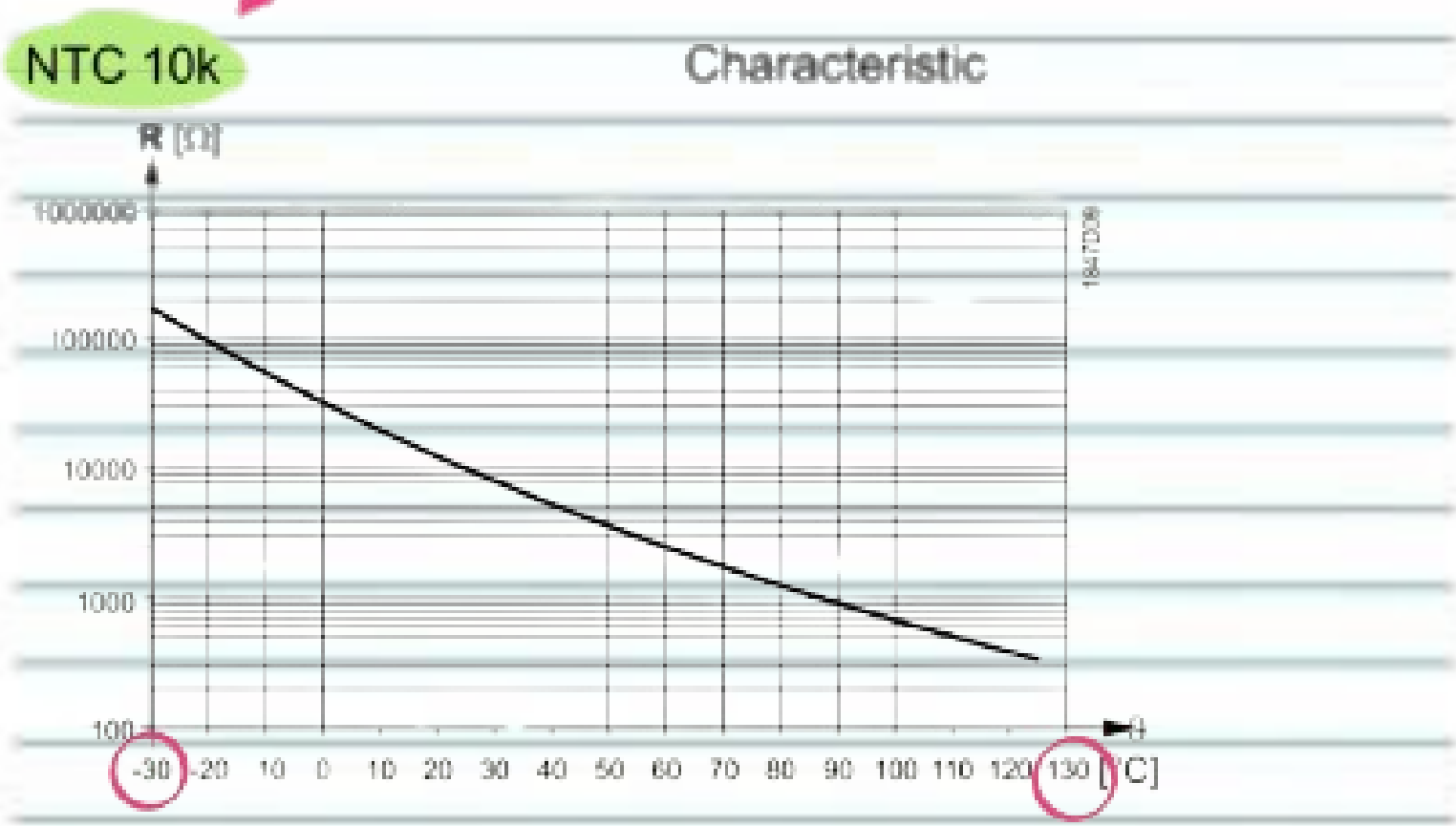
- The types made of materials whose resistance decreases as the temperature rises are referred to as having an (inverse relationship)

PTC :Positive temperature Coffient

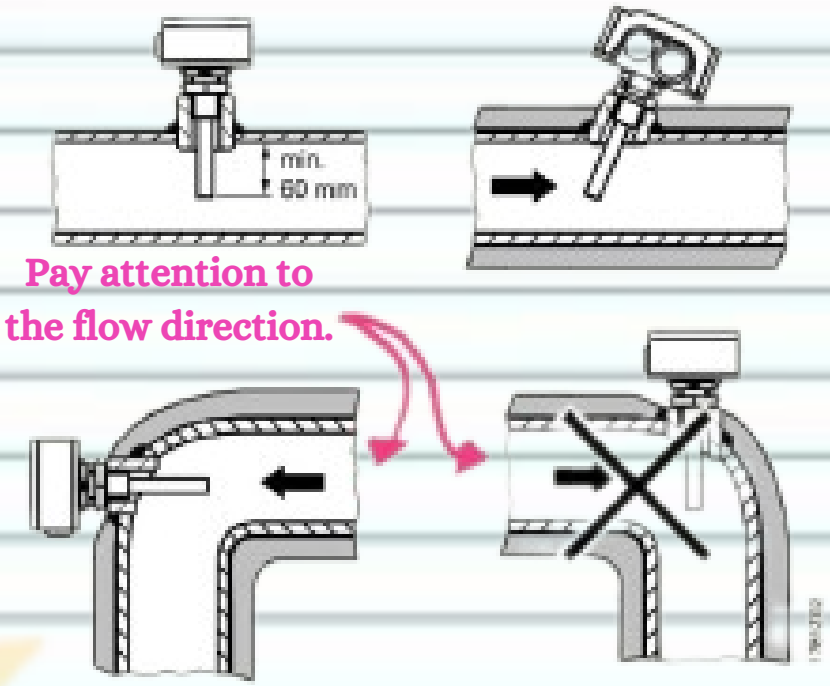
- The types made of materials whose resistance increases as the temperature rises are referred to as having a linear relationship. This includes sensors like PTC (Positive Temperature Coefficient) sensors, which can measure cold water up to 400°C and hot water up to 130°C.

- For each temperature value within this range, there will be a resistance in the elements that make up the sensor, and this resistance will be the reason for generating an equivalent electrical signal from the sensor.

This is the second type



- You'll also find installation guidelines in the datasheet



Pay attention to the flow direction.

- You'll also find a description of the control cable that you'll connect to the sensor's terminal and later use to connect it to the control unit, which is usually located nearby in most cases 1.5 * 2
- Finally, you'll find information about the wiring, whether there will be any issues if the connections on the sensor terminal are reversed or not.

The internal diagram is identical for all types of immersion temperature sensors covered by this Data Sheet.

The connecting wires are interchangeable.

Adaptable for point swapping.

- Let's look at another example, but this time...

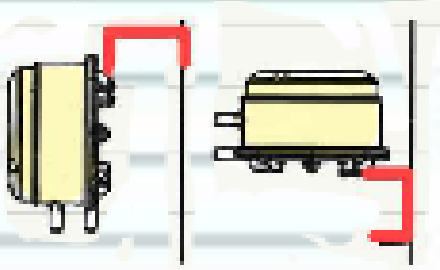
DPS

Differential pressure switch

EX (2) :

Entering the control cable.

support
For mounting on equipment bodies.



An adjuster to set the pressure differential value.

The location for installing the pipes through which the pressure difference is to be measured at the two points

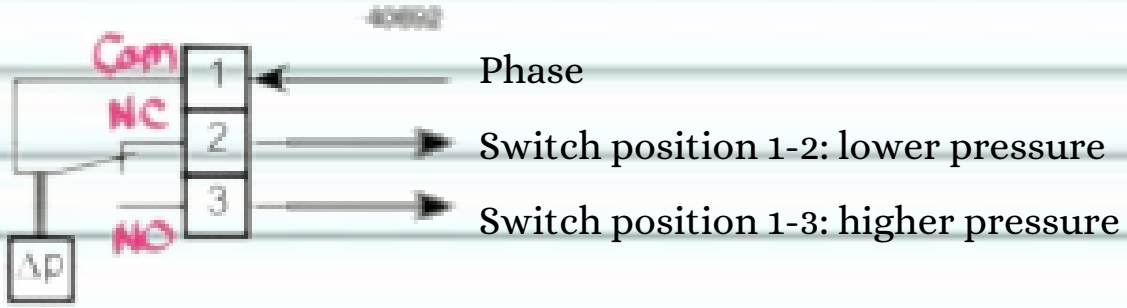
Differential Pressure Switch QBM81-...

for air and nonaggressive gases

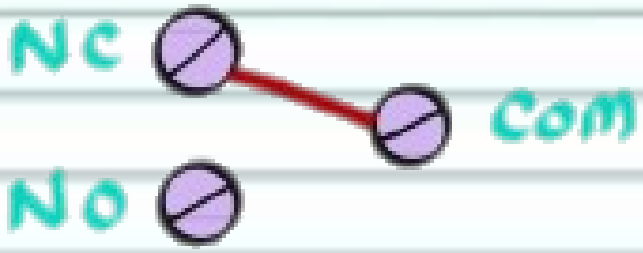
For use in gases

It will provide a digital signal (1,0), which occurs when the pressure difference reaches the value we've set on the indicator, causing the internal points of the switch to change

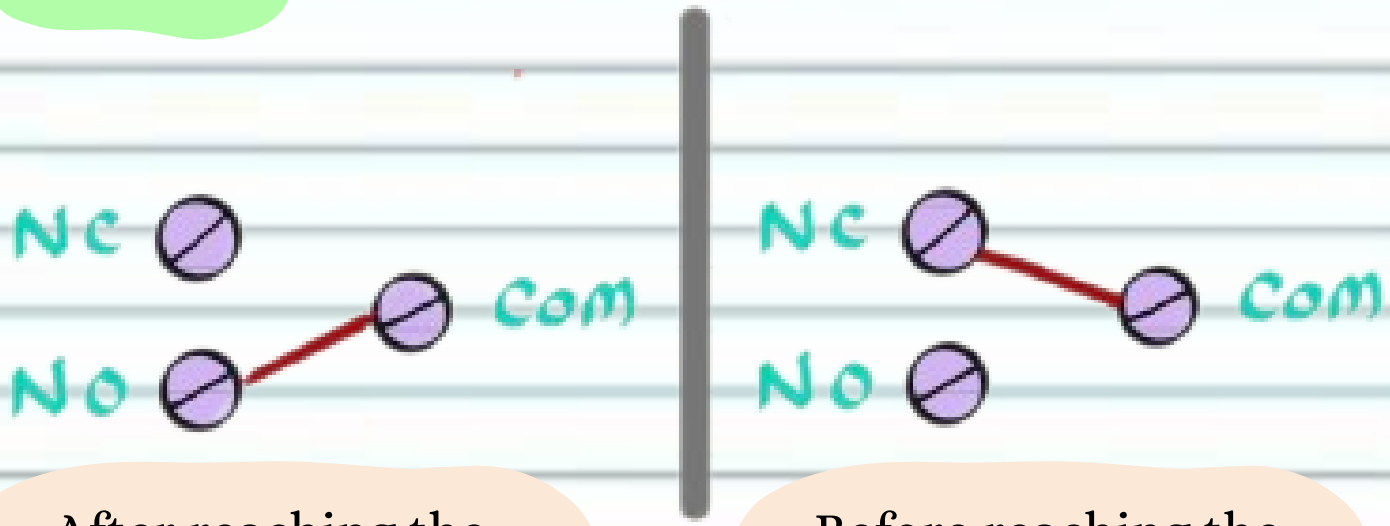
DI



- Don't worry, the topic is very simple.
- Look, sir, the switch has a point we call a "pivot point."



- One of them is a common point shared with the other two points, labeled as "com"
- The second point is normally closed (NC), meaning it's connected when the switch reads pressure difference.
- The third point is normally open (NO), meaning it's disconnected when the switch reads pressure difference.



After reaching the pressure difference.

Before reaching the pressure difference.

- The control cable can be 2x1.5 if you only want to use the NO point and receive a signal when it closes. However, for certain applications that require the NC as well, you may need a 3x1.5 control cable in that case.

Other examples „

outside humidity temperature Sensor

space humidity+ Co2 + temperature sensor

Water Flow Switch

Differential Pressure Switch For Liquids

Ceiling mounted Occupancy Sensor

outputs

- Devices used to turn equipment on and off, and the most commonly used ones include:

- Linear actuators
- Rotary actuators
- Contactors
- Relays
- Motorized CBs

- Let's explain what this means:

Actuators

- The muscles of the BMS (Building Management System), through which it can control the activation and deactivation of equipment, especially in a central HVAC (Heating, Ventilation, and Air Conditioning) system.

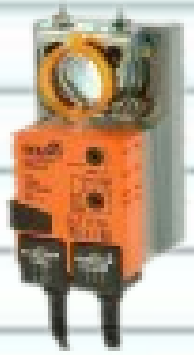
Its types include...

- The division is based on the type of movement you'll need to provide

This means that „

we have two types based on the type of movement:

Rotary actuators



- A type that, when given a signal, produces rotational movement. It is commonly used in applications like „

Rotary actuators

Rectangular Damper

A damper is a mechanism used to control the airflow within HVAC ducts, (AHUs), and (VAV) boxes.

Let me explain them further

single blade butterfly

- There are also types that can be installed on valves where the opening and closing are achieved by rotating them.

3-way Valve

2-way Valve

butterfly Valve

The valve's shape before installation

Well... is the choice random?

- of course not. The choice is made based on a few factors like...

1. The operating voltage
   - 24 VDC
   - 24 VAC
   - 230 VAC

2. Is it
   - **Spring Type:** The actuator returns to its default position automatically when the power is disconnected.
   - **Non-Spring Type:** When the power is disconnected, the actuator remains in its last set position.

3. The control signal
   - **Position Control-2:** A signal that instructs it to stay in the current position or move to the other position.
   - **Multi-position control:** It allows you to set the opening to specific positions, such as fully open, halfway open, or a quarter open, providing more precise control over the valve or damper's position.

- The second type based on the type of movement will be...

Linear actuator

- The movement here is up and down, and this type is commonly used with valves, (controlling the opening and closing of the valve.)

This part is called "Stroke", and it can be either short, like 4mm, or long.

The installation method is called a

Flange Connection

The installation method is called a

Threaded Connection

- We've defined actuators based on their types of movement, but there are other methods used for controlling operations like..

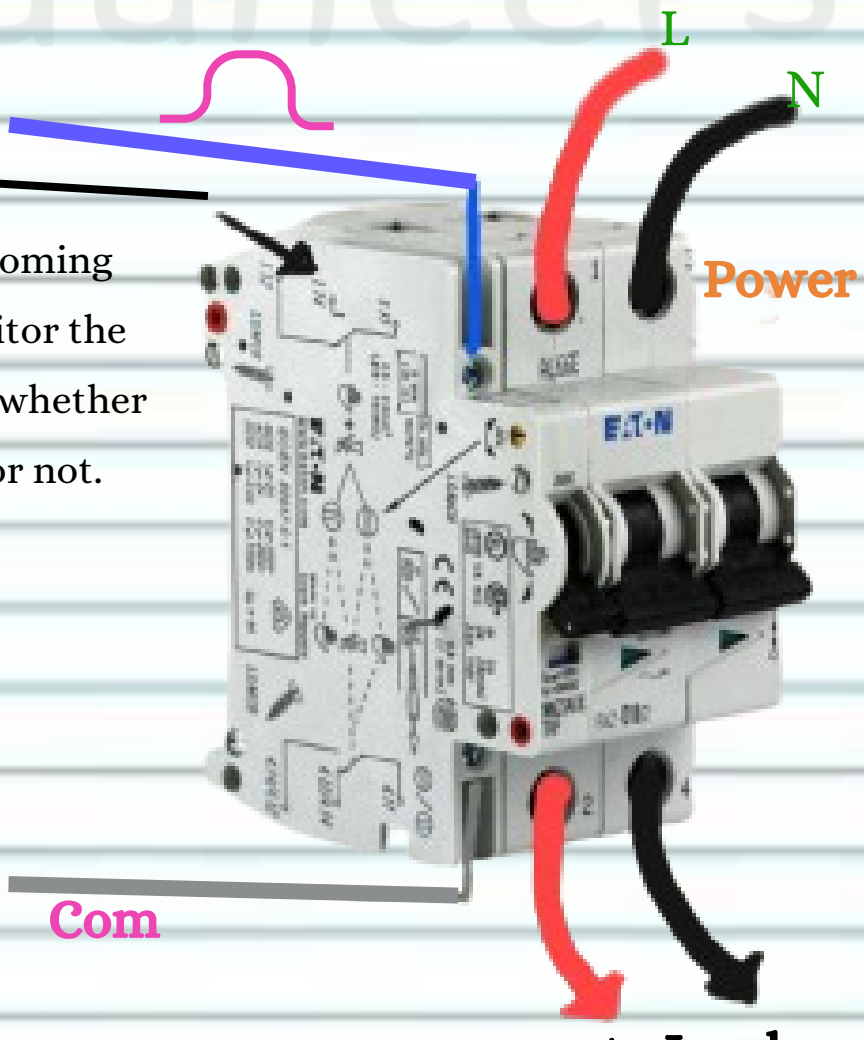
Circuit breakers

- When you request the panel from the panel builders, you must clearly specify that the following circuit breakers will be monitored using the BMS. This will ensure that the circuit breakers come with additional points used for monitoring. These points are called :

1. Auxillary Contacts
2. Free Contacts

aux Contact

A link with a control wire coming from the BMS panel to monitor the status of the circuit breaker, whether it is functioning properly or not.



- But... If you want to control the circuit breaker, not just monitor it, you can request a unit called "Shunt Trip" to be installed with it. Here's an example of what it looks like:

To control remote disconnection.

Shunt Trip (SNT)

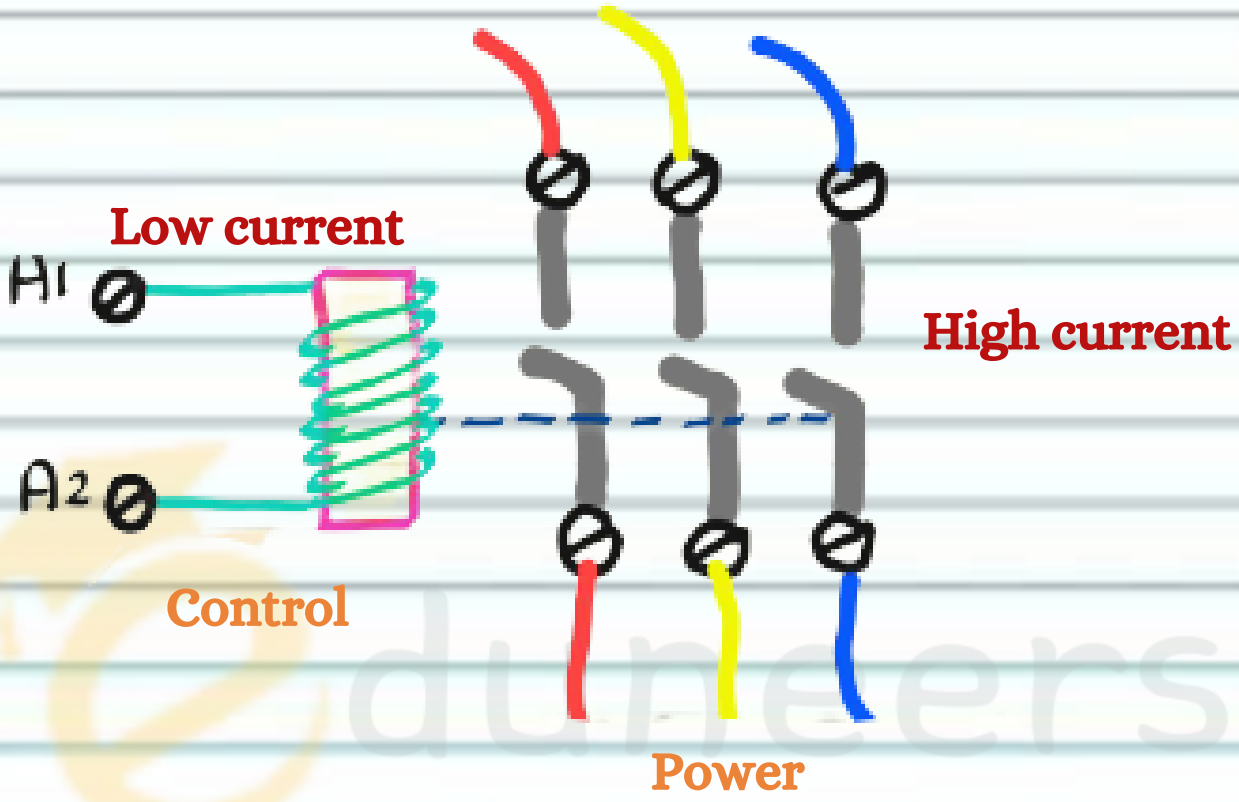
- Allows remote tripping of the MCCB by applying control voltage to the shunt trip coil
- ~~Frames G, H, I, J, K, and M are supplied with 1 meter (39 in) pigtail wiring (each terminal wire is marked)~~
- ~~Frames M and N are wired internally to the breaker and terminated for connection using a 3-pin quick~~

Description	Diagram[1]	Frame Size
12V DC		
24…30V AC/DC		
48…60V AC/DC		
110…127V AC/110…125V DC		G, H, I, J
220…240V AC/220…250V DC		
380…440V AC		
480…525V AC		

There are high-voltage versions, as you can see, so choose the one that suits your needs

Contactors

- A solenoid-operated circuit breaker can be controlled for both opening and closing through its coil



Now you have the ability to control the operation and disconnection of the load by using a small control current to control a larger current

Help points...

- The contactor typically comes with auxiliary contacts used for monitoring rather than control. These auxiliary contacts have two types: normally open (NO) and normally closed (NC).

NC : Normally Close

After turning on the contactor

Before turning on the contactor

NO: Normally open

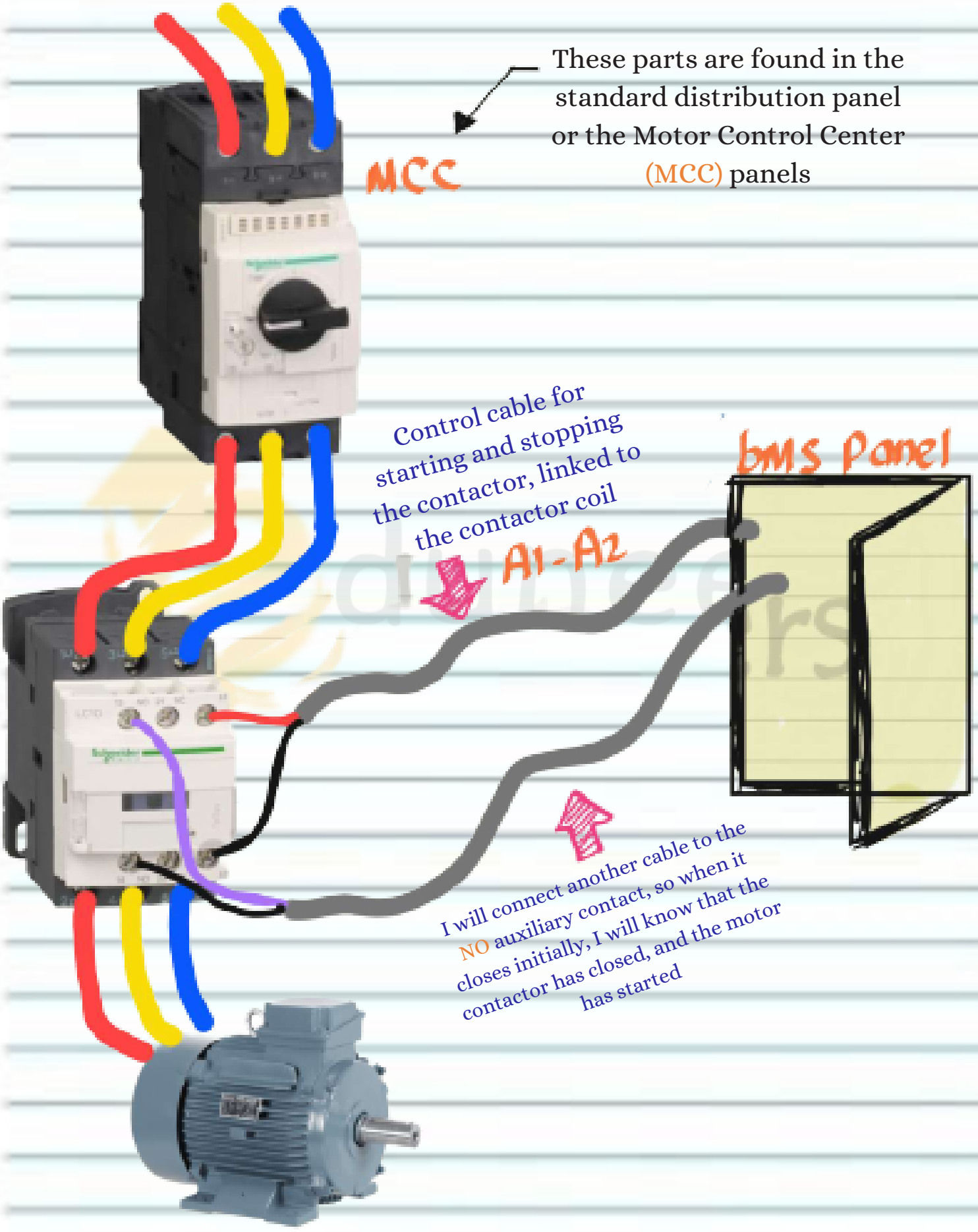
After turning on the contactor

Before turning on the contactor

- The auxiliary contacts can come as a part of the contactor itself, or they can be a separate component that is installed next to it or on its front panel.

Help points

- Look with me at this example:

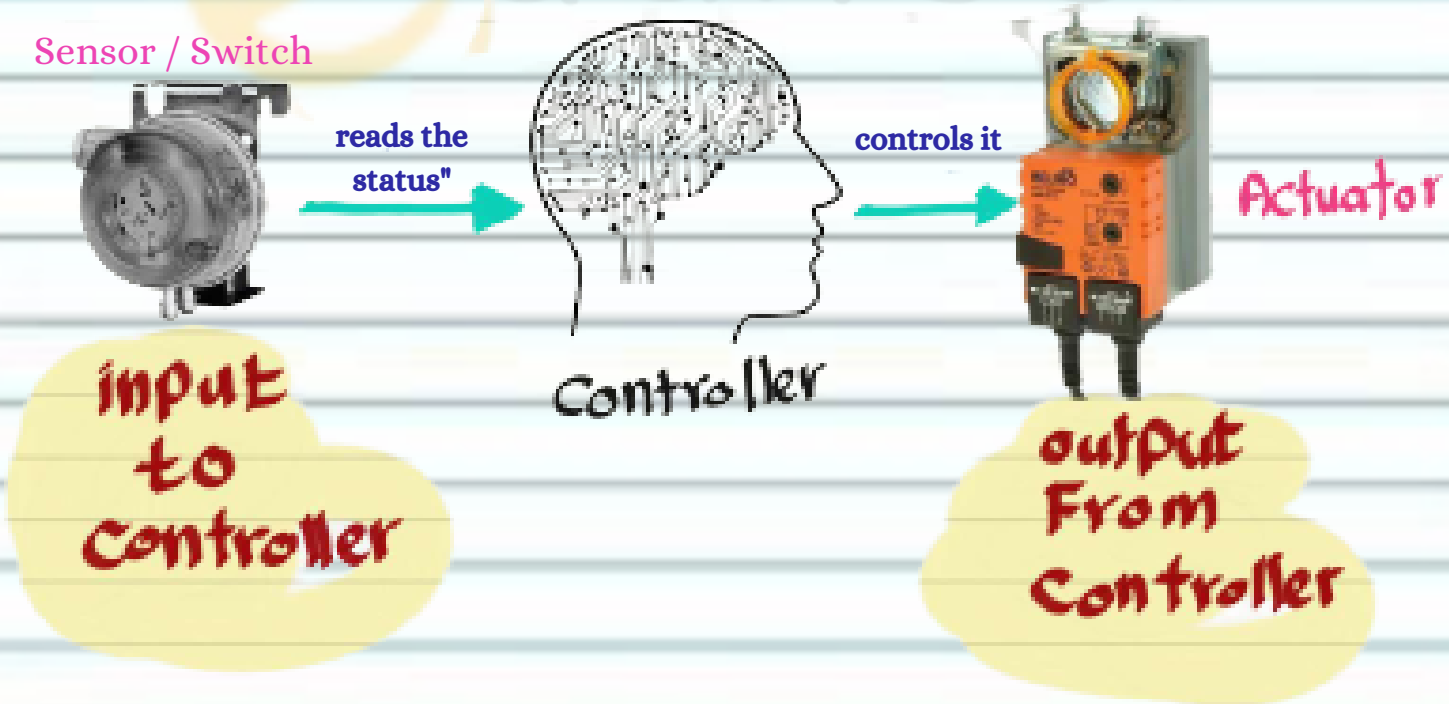


In summary, what we've discussed is..

- The first level in BMS is called Field Devices, and it includes devices responsible for two things :

1. Monitoring the equipment status.
2. Controlling the equipment's on and off.

- The devices that are monitored using input signals are the ones from which the controller receives data, and the devices controlled by it are substituted by the controller's output signals



- The inputs and outputs have another division based on the type of signal present, and the types are as follows:

inputs

Digital input

DI

A signal coming in the form of 0 , 1

OFF ON

Ex)

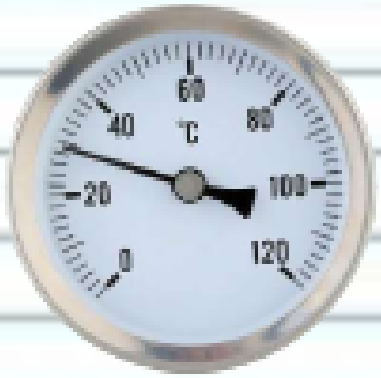
0 OFF 1 ON

Analog input

AI

A signal that has no specific meaningful value and where the value depends on what the sensor is reading

Ex)



This has no specific meaningful value, and the indicator can provide you with various values from the many available on the indicator

Outputs

Digital outputs

DO

We're not saying anything different from what was explained earlier, except that this will be a command from the controller to either turn something on (1) or off (0)

Analog outputs

AO

The controller with this type can send a command to such-and-such sensor and tell it to open to half or to a quarter, for example. (You can control the amount he wants)

- If things still aren't making sense in this part, understand it to the best of your ability, and with more examples, it should become clear

تم بحمد الله

محمد السيد

<< Translated by me >>

Rama Alshaer