

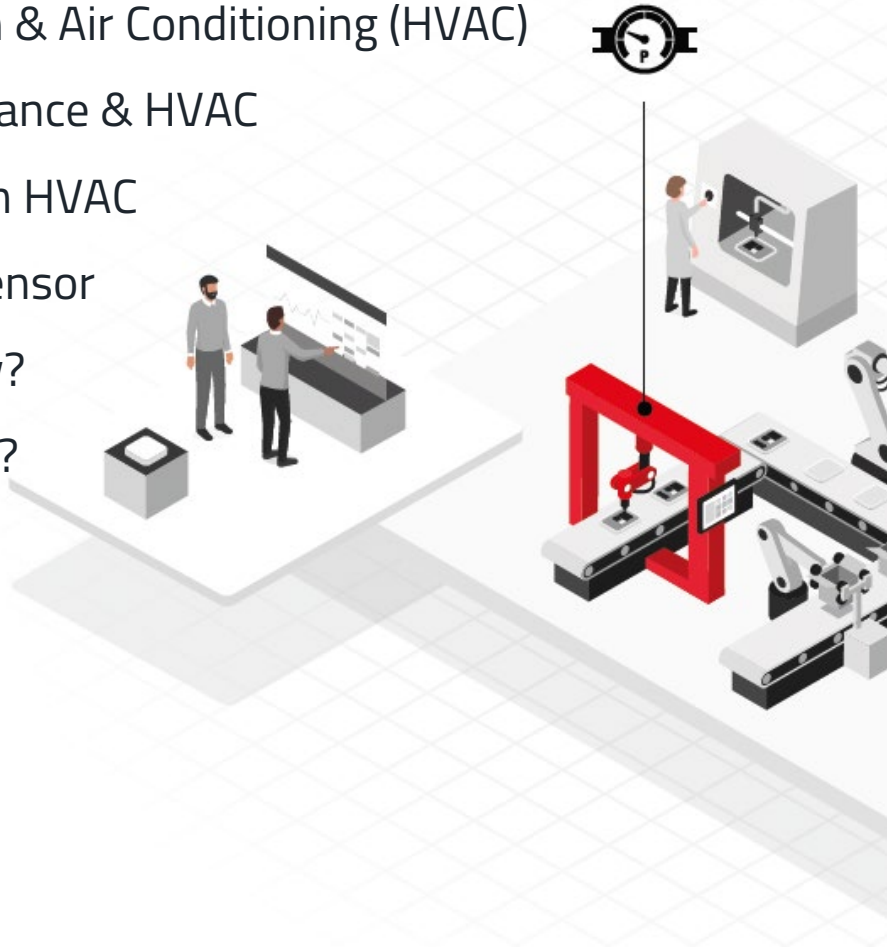
PREDICTIVE MAINTENANCE IN HVAC

Role of differential pressure sensors

Ninad Mehta, Product Manager | Sensor Components

AGENDA

- Heating Ventilation & Air Conditioning (HVAC)
- Predictive maintenance & HVAC
- Pressure sensors in HVAC
- Choose the right sensor
 - Pressure or flow?
 - Analog or digital?
- WSEN-PDUS
 - Customization



HVAC - HEATING VENTILATION & AIR CONDITIONING

What is HVAC ?



Heating

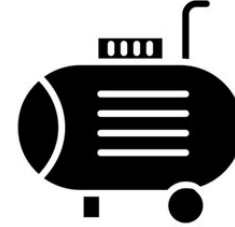
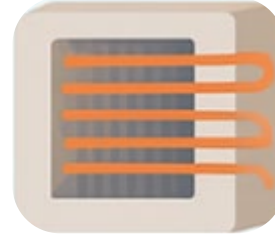


Ventilation



Air conditioning

Major Components

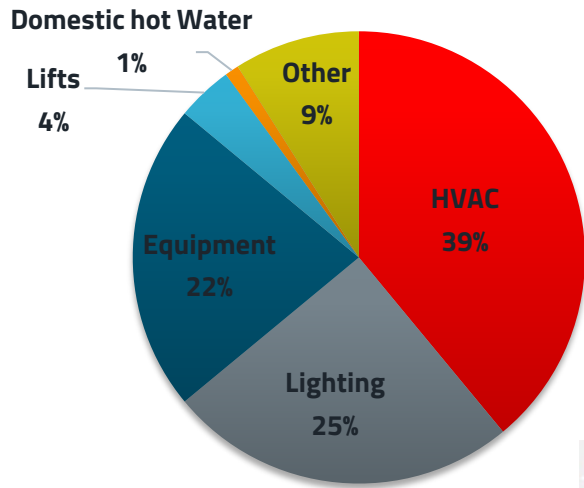


- Maintain
- Repair
- Upgrade

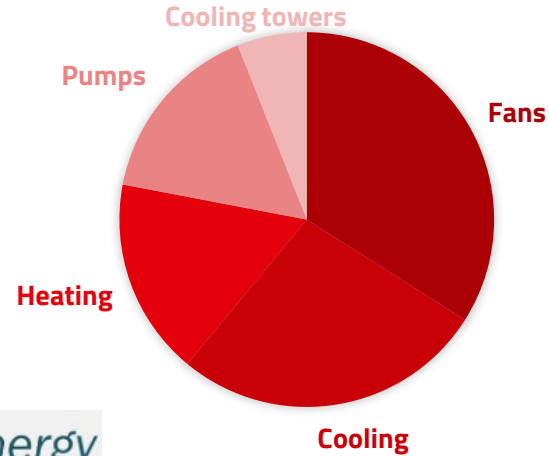
HVAC - HEATING VENTILATION & AIR CONDITIONING

Status quo & requirements

Energy consumption in an Office building



HVAC END USAGE BREAKDOWN

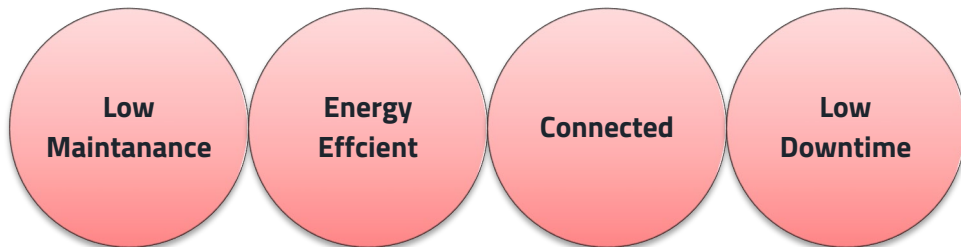


Continuous Monitoring



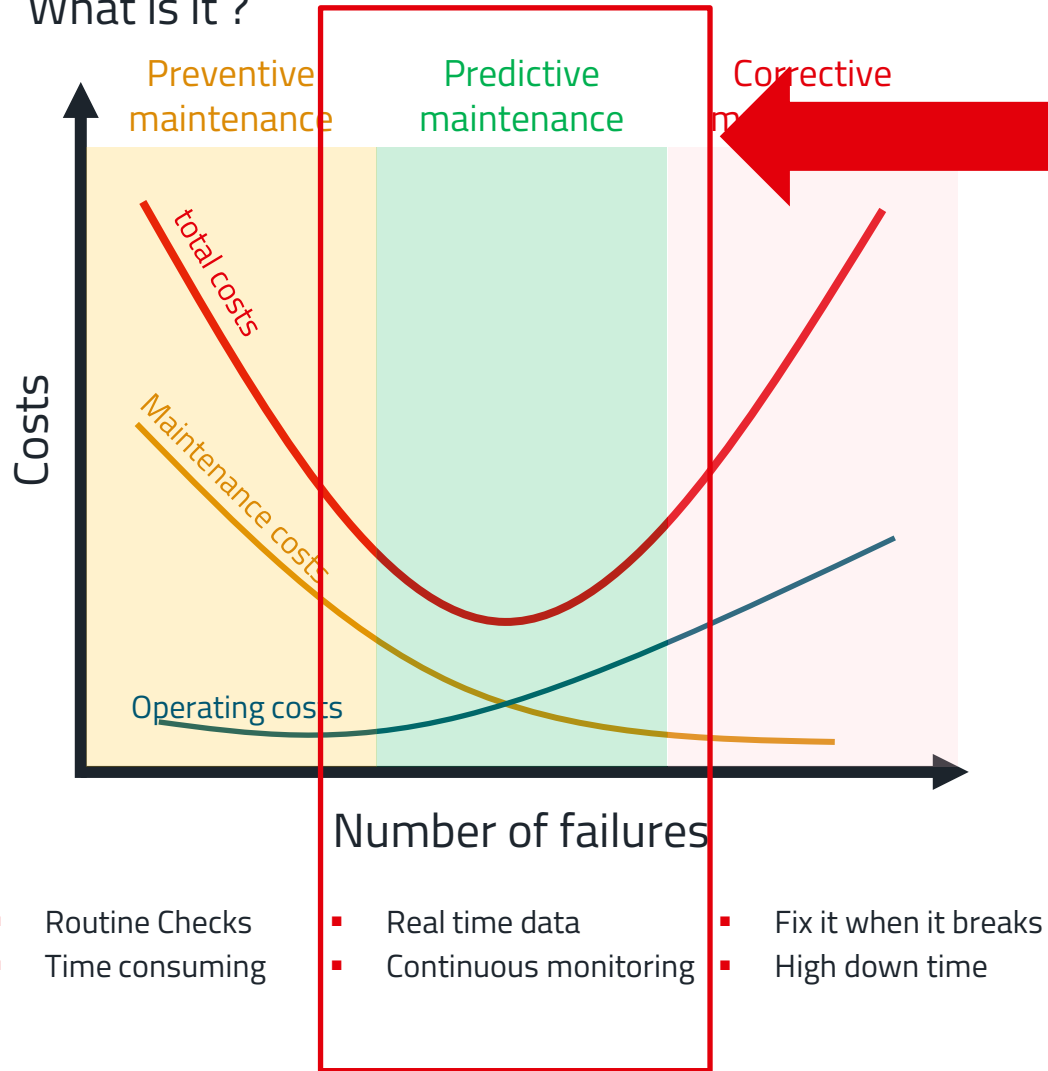
SENSORS

Eyes and ears of the HVAC system



PREDICTIVE MAINTANANCE

What is it ?



- | | | |
|--|---|---|
| <ul style="list-style-type: none"> ▪ Routine Checks ▪ Time consuming | <ul style="list-style-type: none"> ▪ Real time data ▪ Continuous monitoring | <ul style="list-style-type: none"> ▪ Fix it when it breaks ▪ High down time |
|--|---|---|



- Is the data normal?
- Within expected range
- Detect any abnormal behavior?



Use data



Evaluate data



Display data



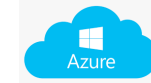
Collect data



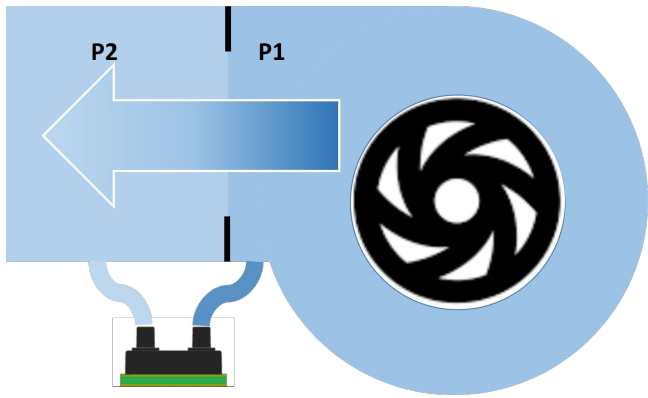
Transfer data



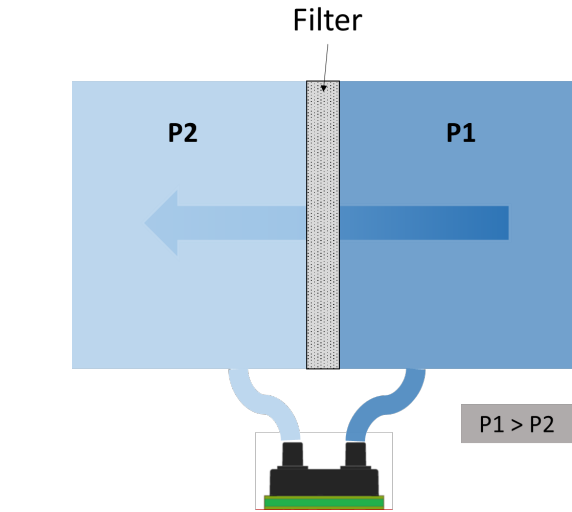
Capture data



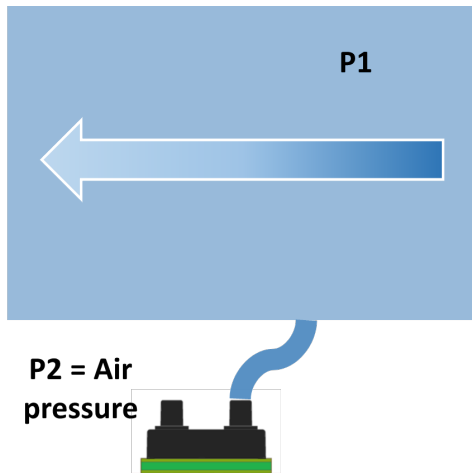
DIFFERENTIAL PRESSURE SENSORS IN HVAC



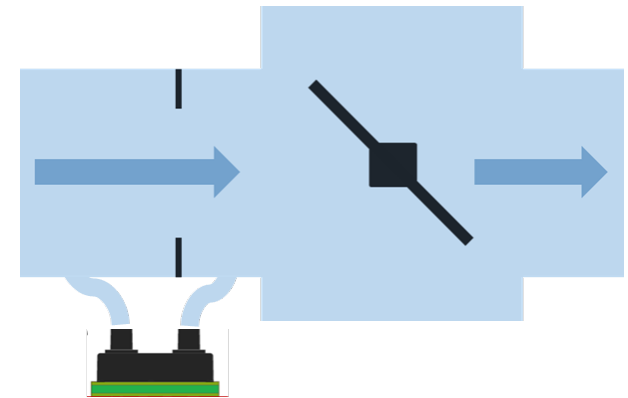
Ventilator & Fan Control



Filter Monitoring



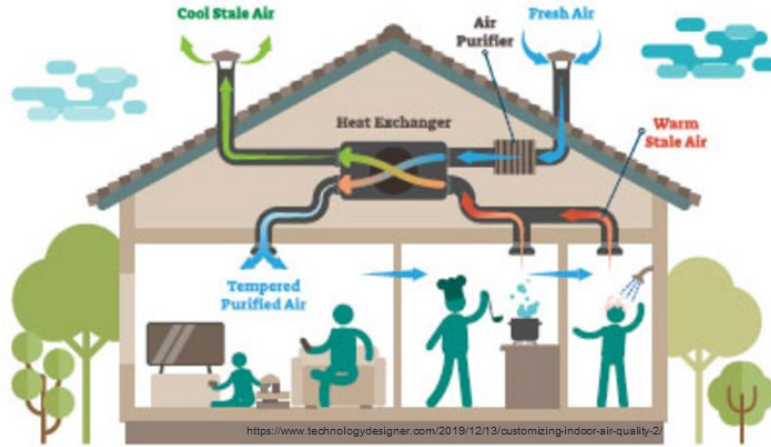
Static Air Pressure Control



Variable Air Volume (VAV)

FILTER MONTORING

When is the right time to change filter ?



Indoor Air Quality: more important than ever...

~70% lives spent Indoors

~3x more pollutants indoors

Average adult breathes 3000 gallons of air per day

Indoor air pollution is among top environmental dangers

Source: <https://www.epa.gov/>



Dirty – changed too late

- Reduced air flow – cooling efficiency
- Increased energy consumption - costs
- Poor indoor air quality

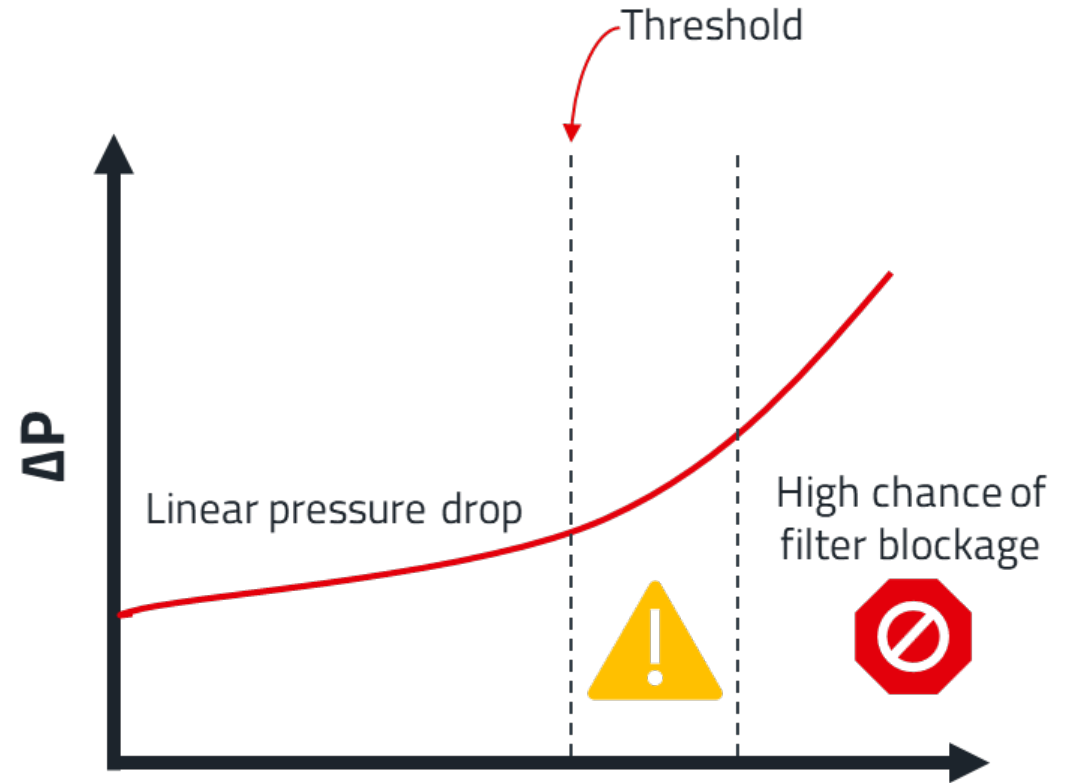
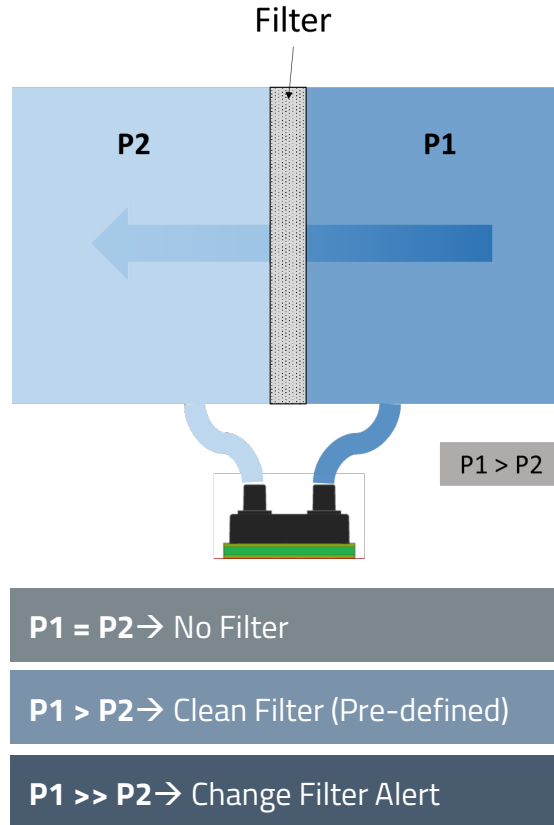
Clean – changed too early

- Increased material costs
- Not environment friendly

Important to change/clean the filter at right time...

FILTER MONTORING

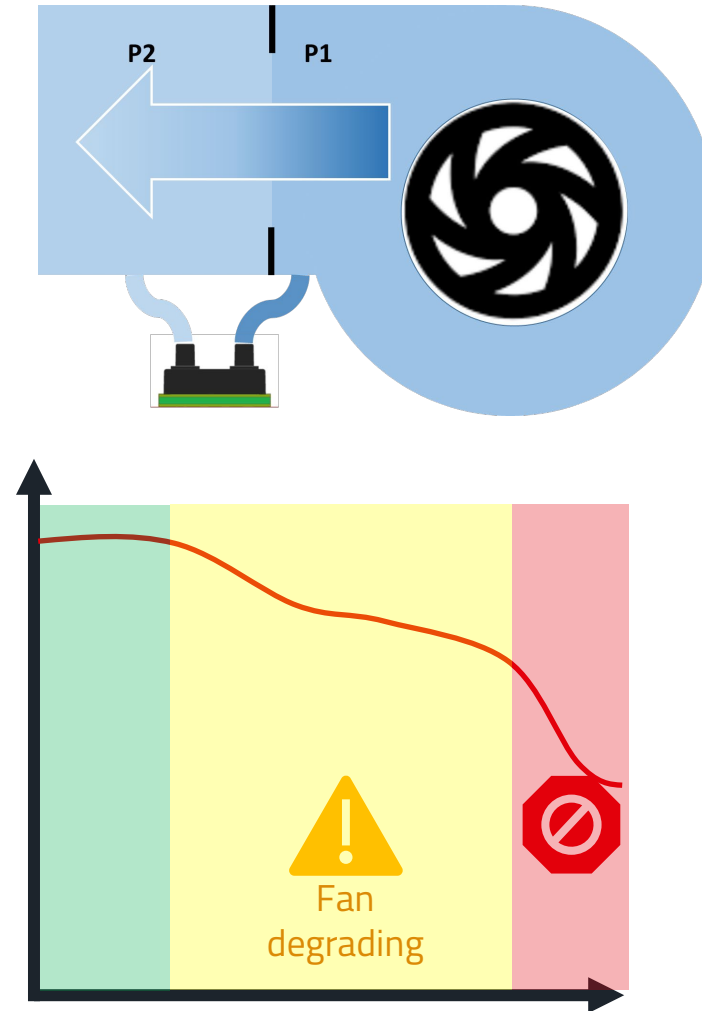
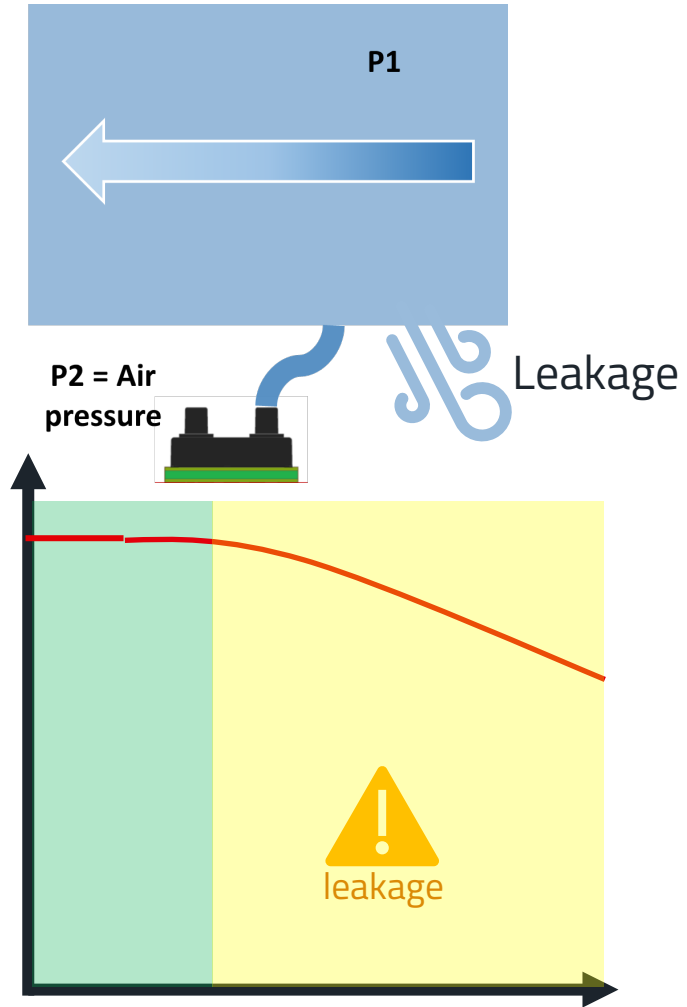
When is the right time to change filter ?



A smart air filter monitoring system...!

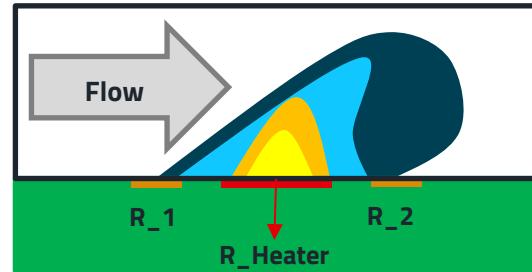
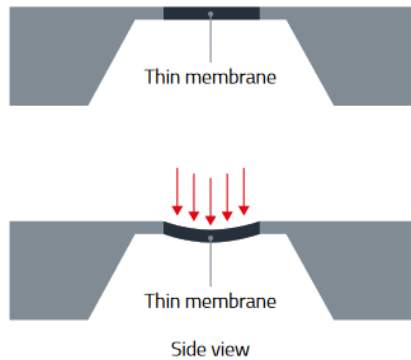
FAN FAILURE OR LEAKAGE DETECTION

Is my system running as intended ?



WHICH SENSOR TO USE ?

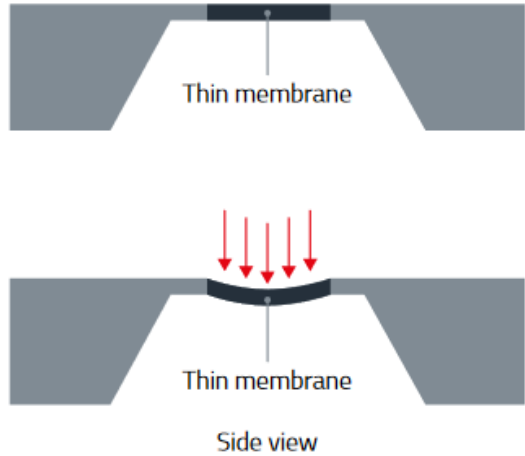
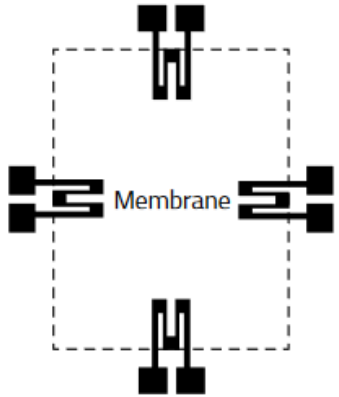
Pressure sensor or Flow sensor...



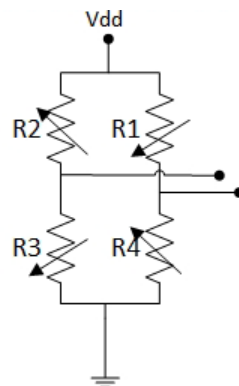
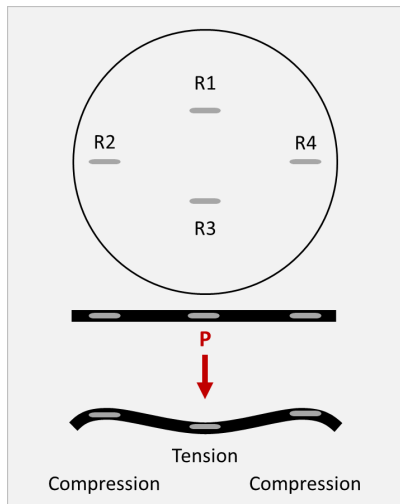
	Thermal Flow	MEMS Pressure
Calibrated for all Gases?		✓
Low power application		✓
Faster response time		✓
Ultra-low pressure/flow application	✓	
Better Stability	✓	
Re-calibration of drifts		✓
Resistance to contamination		✓
Linear output characteristics		✓

MEMS BASED PRESSURE SENSORS


Piezo-resistive technology



<https://www.radiolocman.com/review/article.html?di=148185>



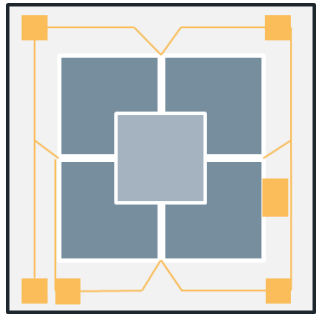
- Analog
- Uncompensated
- Non-calibrated

 - High linearity
- Easy to produce, no complex structures
- Low cost

 - Sensitive to temperature changes

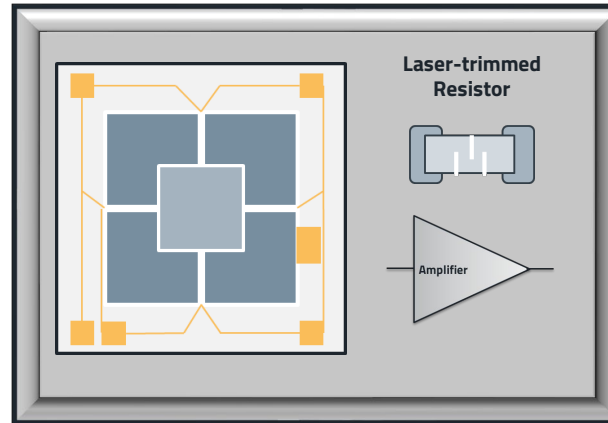
SCALE OF INTEGRATION

MEMS Cell



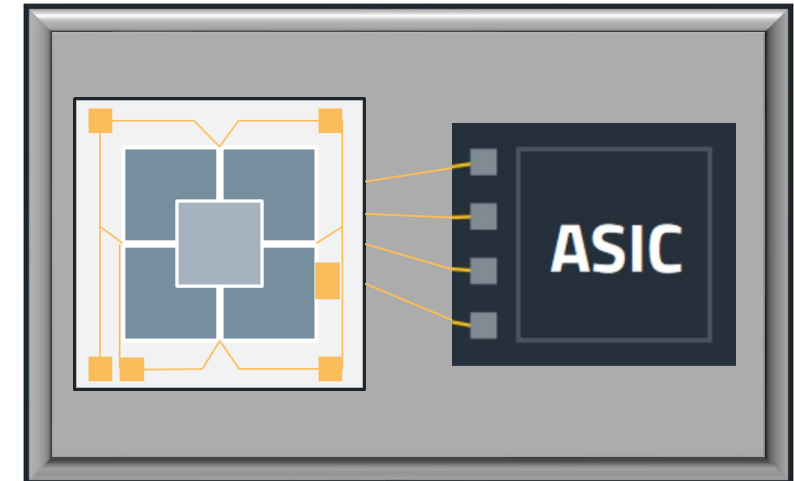
- Uncompensated
- Non-calibrated
- Analog (mV) output
- Bare-die or Packaged

Amplified Sensor



- Passively compensated
- Partly calibrated
- Analog output
- Packaged

Integrated Sensor



- Compensated over temperature
- Fully calibrated
- Integrated DSP & Memory
- Digital and Analog
- Packaged

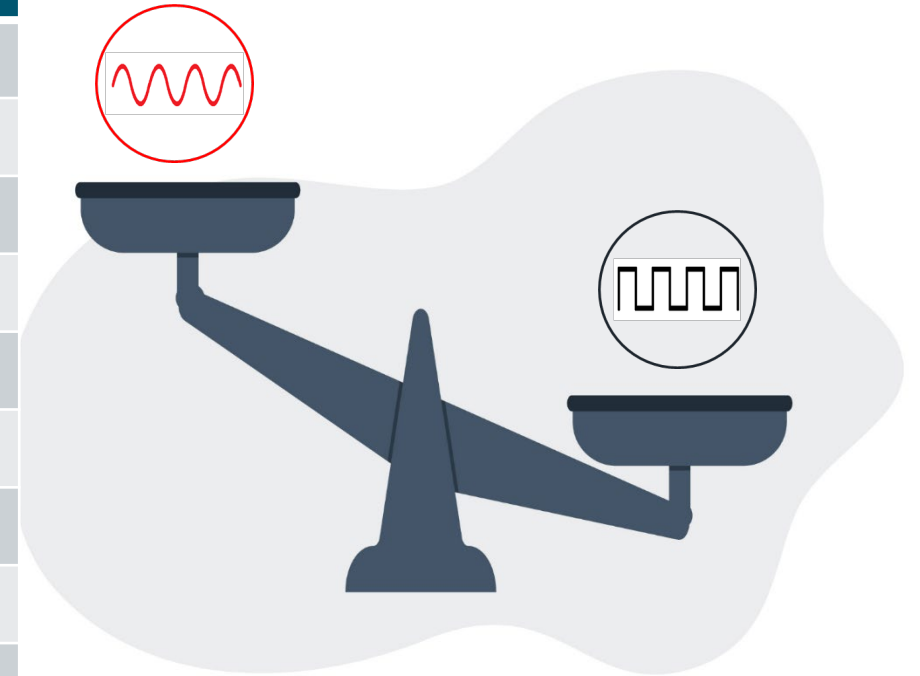


From sensing cell. . . to integrated sensor system

WHICH PRESSURE SENSOR IS RIGHT FOR YOUR APPLICATION?

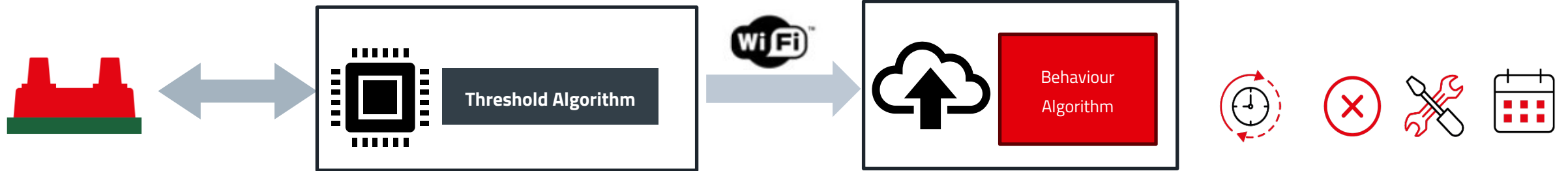
Analog v/s Digital Sensor

	Requirements/Features	Analog	Digital
Sensor Parameters	High Accuracy	✓	
	High Resolution		✓
	Low current consumption		✓
	Additional Temperature information		✓
Output	Variable current	✓	
	Variable voltage	✓	
	Digital I2C/SPI		✓
Interfaces	Wireless connection		✓
	IIoT or IoT applications		✓
	PLC interfacing	✓	



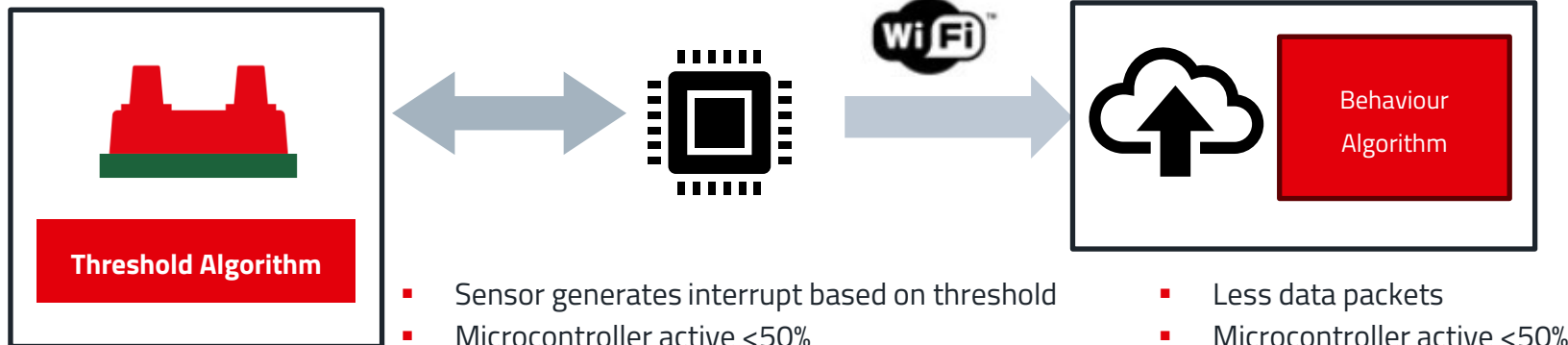
Choose as per the end application requirements...!

A SMART SENSOR MATTERS...



- Continuous communication
- Microcontroller active 100%
- High current consumption

- More data packets sent
- Higher processing power required




- Sensor generates interrupt based on threshold
- Microcontroller active <50%
- Lower current consumption

- Less data packets
- Microcontroller active <50%
- Lower current consumption

PRESSURE SENSORS PORTFOLIO

Which is the one suitable to your application?



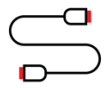
STANDARD
Differential
Pressure
Sensor



Standard Pressure Ranges:

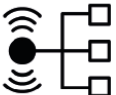


Low	Medium	High
± 0.1 kPa ± 1 kPa	± 10 kPa 0 to 100 kPa	-100 to 1000 kPa 0 to 1500 kPa

Standard Features

 5 V	 15-bits	 I ² C and Analog
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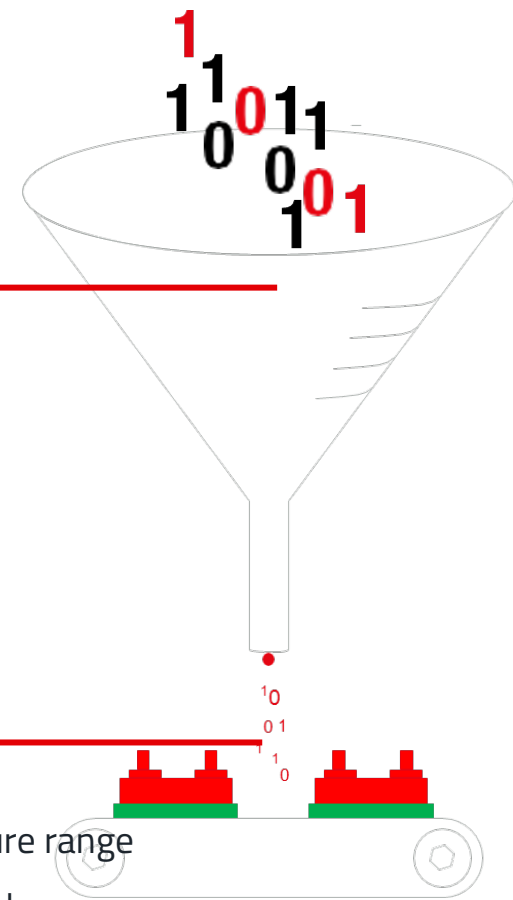
- 6 Pressure ranges
- Fixed configuration
- Available ex-stock
- EV Board with adapter

Suitable for...

 Sensor Networks	 Battery driven devices	 Real time monitoring	 Wireless Data transmission
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... STANDARD PRODUCT IS NOT FOR YOU?

WE can find a suitable sensor through Individualization



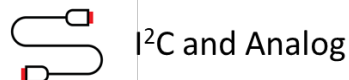
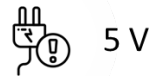
STANDARD
Differential
Pressure
Sensor



Standard Pressure Ranges:


Low	Medium	High
± 0.1 kPa ± 1 kPa	± 10 kPa 0 to 100 kPa	-100 to 1000 kPa 0 to 1500 kPa

Standard Features

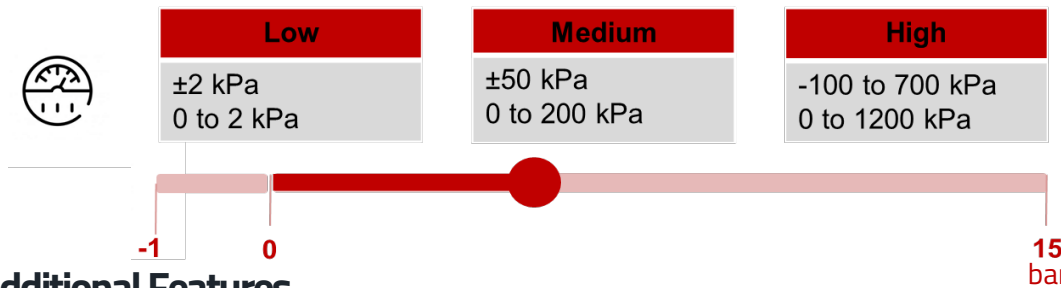


- 6 Pressure ranges
- fixed configuration
- Available ex-stock
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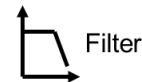
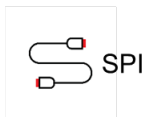
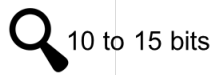
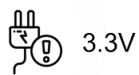
INDIVIDUALIZED
Differential
Pressure
Sensor



Exemplary Pressure Ranges:



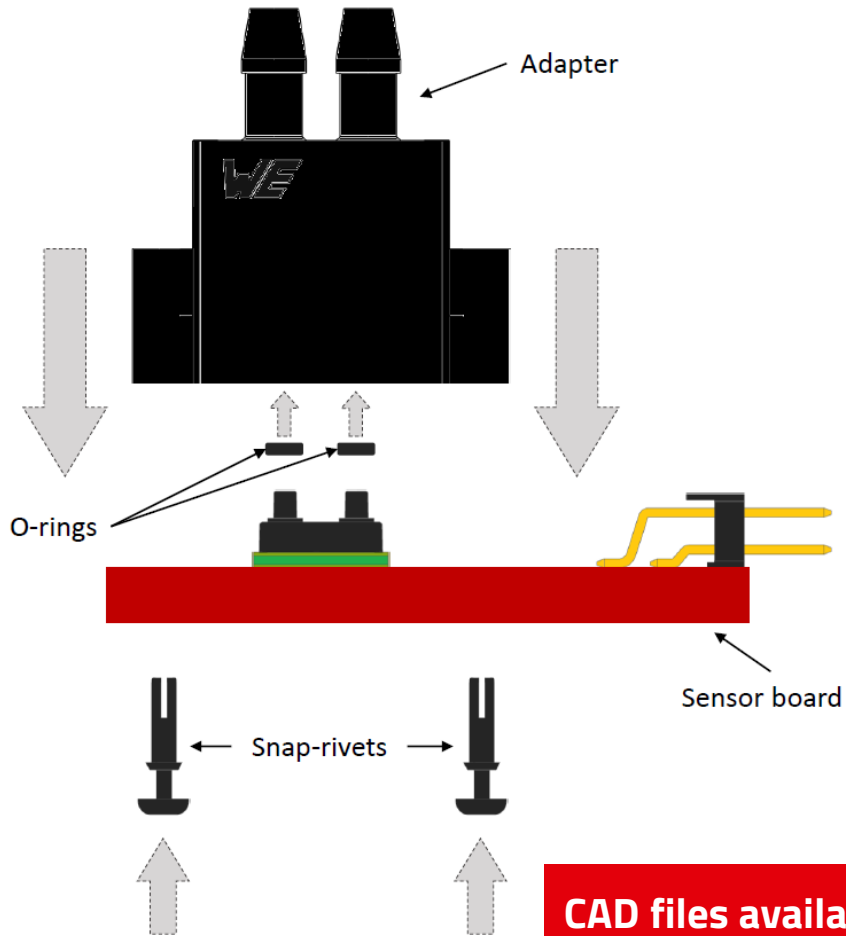
Additional Features



- Custom defined pressure range
- Horizontal barbed nozzles
- Fully Calibrated & tested
- Additional individualization possibilities
 - Resolution: Sensitivity vs response time
 - Filter: Noise reduction
 - Additional communication interface
 - Interrupt functionality

EVALUATION BOARD

All inclusive EVAL board



Direct tube connection → $\varnothing = 2 \text{ mm}$



Adapter with barbed nozzles → Standard 6 mm ($\varnothing = 4 \text{ mm}$) pneumatic tube connection

- ✓ Better mechanical stability
- ✓ Less stress on the solder joints
- ✓ Increased safety
- ✓ Quick prototyping

CAD files available → Accelerate your Development!

\varnothing = inner diameter

Questions

& Answers



We are here for you now!
Ask us directly via our chat or via E-Mail.

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Ninad.Mehta@we-online.de