

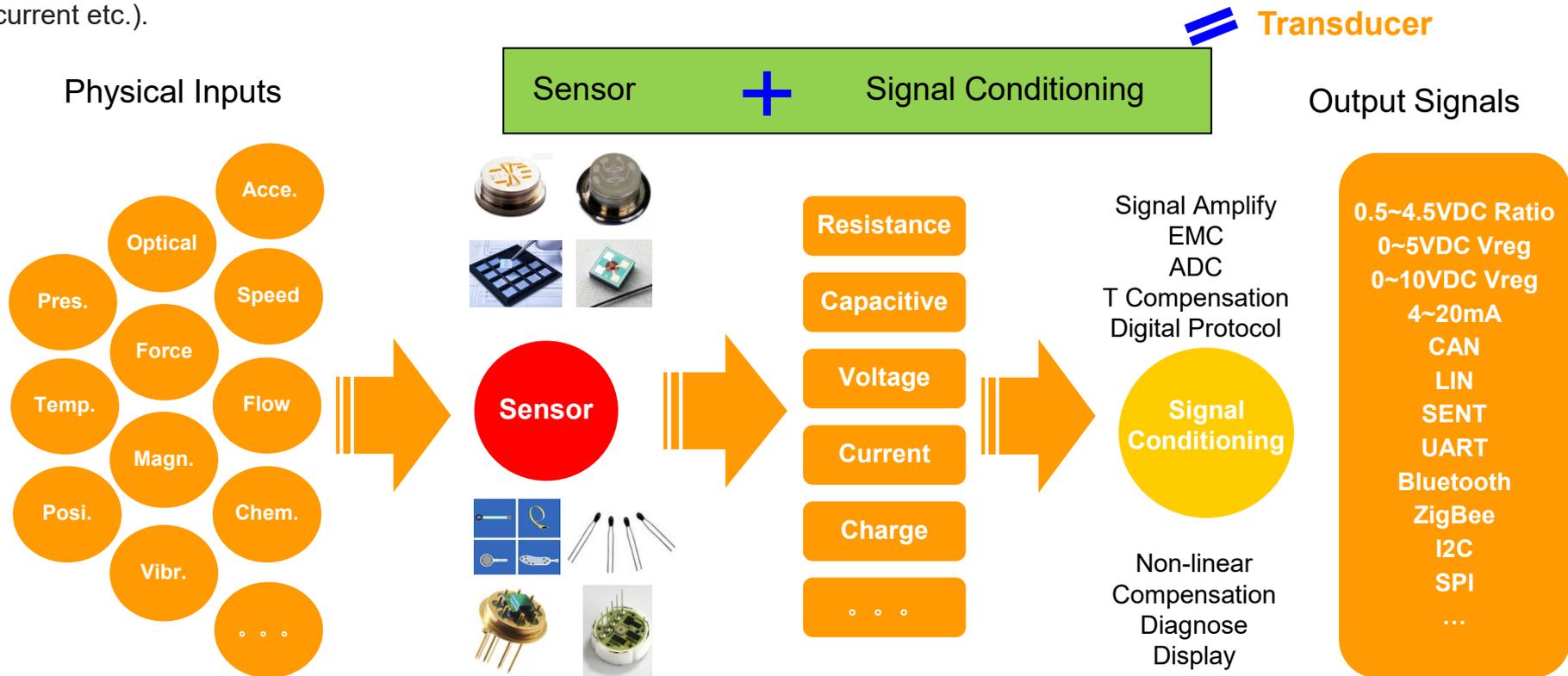


VRF Sensor Introduction

Oct. 10, 2022

What Is a Sensor or a Transducer?

- The **sensor** is a device that measures the physical quantity (i.e. Heat, light, sound, etc.) into an easily readable signal (voltage, current etc.).

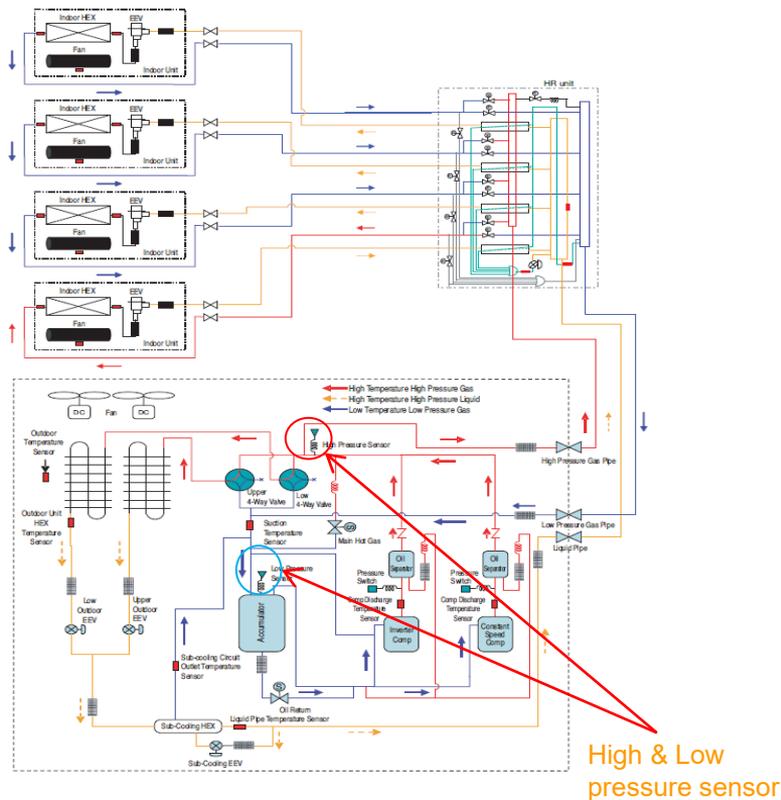


Where Are the Sensor Used?



Sensors are everywhere.

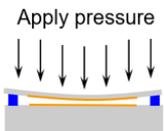
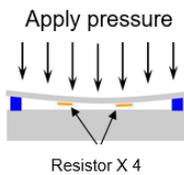
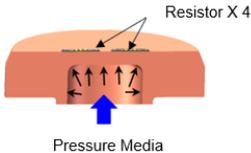
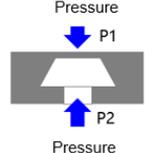
Sensor Requirement for VRF System



- Variable refrigerant flow (VRF) can effectively reduce energy consumption.
 - Usually there is one or more variable speed compressors
 - Multiple indoor evaporators
 - Achieve heating and cooling at the same time
- Pressure sensors need to be installed separately on the high and low pressure sides to achieve complex system control.
 - Sensor installation outdoor and need to meet lightning and high/low temperature requirement
 - Easy installation
 - Stable performance, Long life, High reliability
 - No Refrigerant leakage (R22→R410a→R32→...)
 - . . .

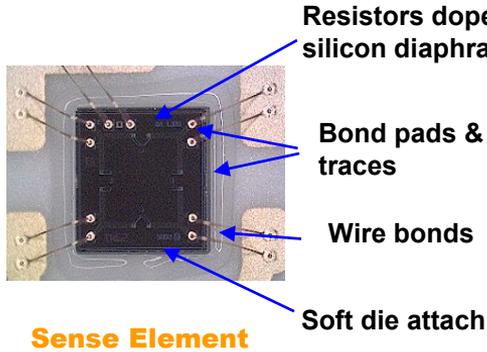
Pressure Sensor Solution Comparison

➤ Various solutions for pressure sensing technology

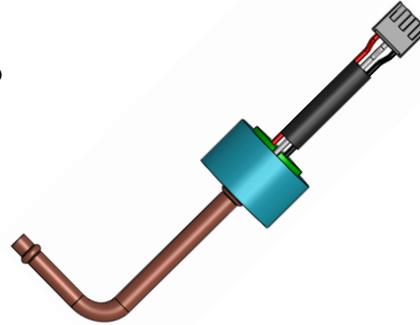
Sensor type	Ceramic capacitor	Ceramic resistor	Glass micro-melting	MEMS	Oil-filled MEMS
Principle					
Hermetic design	N (O-ring)	N (O-ring)	Y	N (Gel / Brazing)	Y
Pressure range applicability	Y	Y	N	Y	Y

- **No Perfect O-ring to meet different refrigerant environment.** There will be sealing leakage issue, especially due to Refrigerant pressure increase.
- Pressure range applicability for different sensor type is important to ensure the product accuracy.

Sensing Technology



Sense Element



- Pressure across diaphragm results in tensile stress in center, compressive stress at edge
- Strain-sensitive piezo resistors are implanted in silicon substrate and connected in a full bridge configuration
- Applied pressure results in a bridge imbalance that is amplified and compensated in signal conditioning electronics

FORCE / PRESSURE



MECHANICAL DEFLECTION/ STRESS



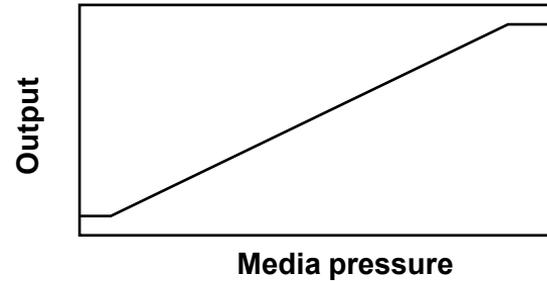
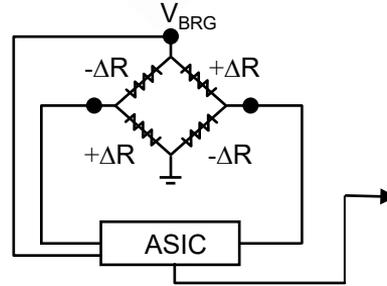
SILICONE PIEZORESISTIVE EFFECT



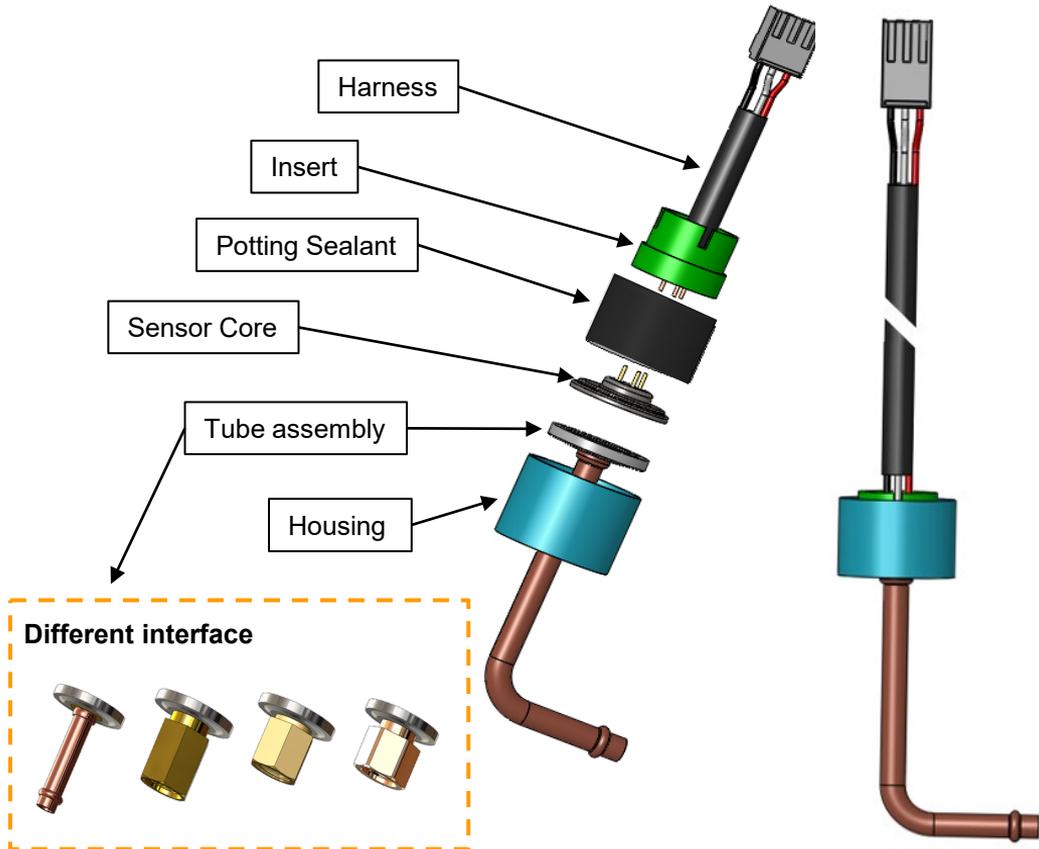
CONDITIONING ELECTRONICS



PWM/CAN/LIN/ Analog OUTPUT PROPORTIONAL TO MECH. INPUT



Product Design and Parameter



No.	Item	Parameter for low pressure	Parameter for high pressure
1	Operating Pressure	0 ~ 2MPa	0.448~4.5MPa
2	Input voltage	DC 4.5 ~ 5.5V	DC 4.5 ~ 5.5V
3	Output voltage	DC 0.5 ~ 4.5V	DC 0.5 ~ 4.5V
4	Reverse voltage	-14V	-14V
5	Accuracy	±1.5%FS	±1.5%FS
6	Operating Temp.	-40 ~ 120°C	-40 ~ 120°C
7	Media Temp.	-40 ~ 130°C	-40 ~ 130°C
8	Proof Pressure	4MPa	9MPa
9	Burst pressure	6MPa	13.5MPa
10	Max. Voltage	DC 20V	DC 20V
11	Current	<10mA	<10mA
12	Load Resistance	> 10kΩ	> 10kΩ
13	Insulation Resistance	100MΩ	100MΩ
14	Dielectric strength	AC 1500V, 1min AC 1800V, 1s	AC 1500V, 1min AC 1800V, 1s
15	IP level	IP66	IP66

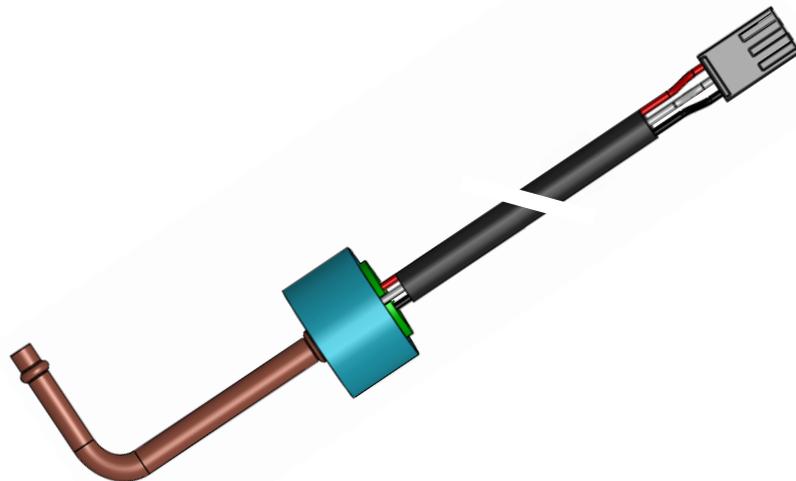
Product Characteristic

➤ Product Characteristic

- Oil-filled MEMS technology, **true hermetic design** and no rubber parts to **avoid leakage risk**
- Platform design, Compact structure, small size, flexible installation
- Digital temperature and pressure compensation: **high accuracy**
- Customized mechanical interface: Brazing, threaded connections, etc.
- Wide range of harness interface options
- Different output type: Voltage & Current etc.
- Excellent electronic performance
- Excellent cold media compatibility
- **Provide customized design**

➤ Application

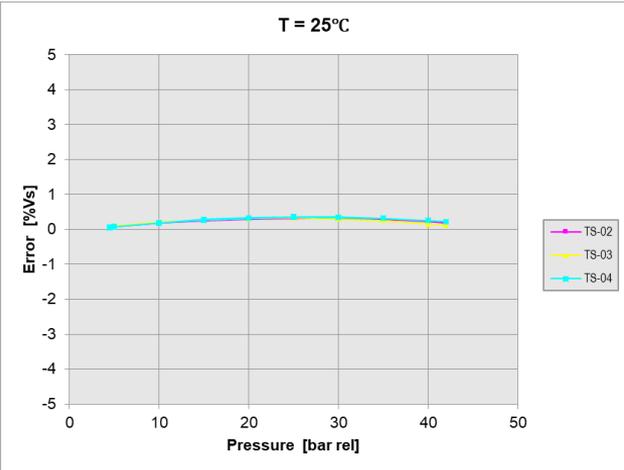
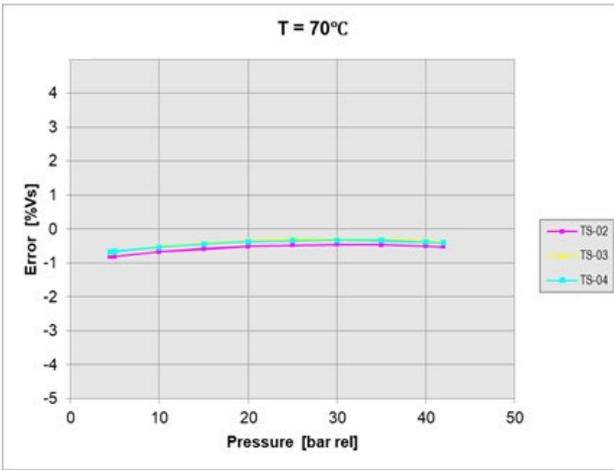
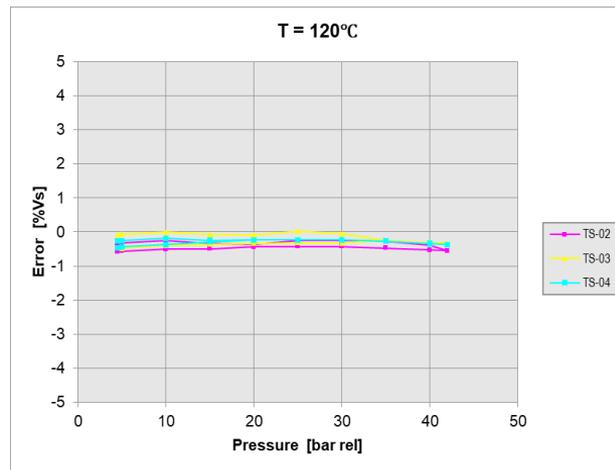
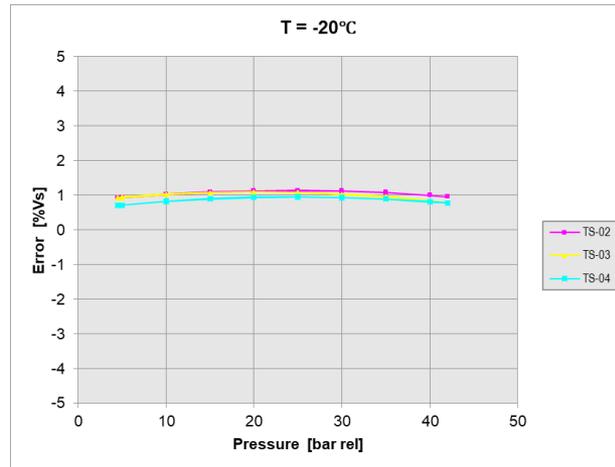
- Variable frequency air conditioning
- Variable frequency hydraulic control system
- Variable frequency air compressor
- Cold storage and refrigeration systems



Product Durability Accuracy

Product Thermal shock test: 2200 hrs: Achieve 1% Vcc at all temperatures.

1. -40~140°C,
2. Keep 30min for each temperature.



Thanks!