

Merit Sensor Systems

Company presentation
Products overview



MERIT SENSOR™

Merit Sensor (History)

- 1991 : Founded as Sentir Semiconductor, Santa Clara, California

- 1999 : Acquired by Merit Medical

 - Employees: >3'800 worldwide. Sales: > \$650 Million in 2016

 - Publicly traded – NASDAQ: MMSI

- 2003 : Broke ground on new Fab in South Jordan, Utah

- 2007 : Completed the transfer of the manufacturing facility to Merit Medical campus

- 2017 : Employees: 59 / Products: Piezoresistive Pressure Sensor / MEMS Sensor based solutions

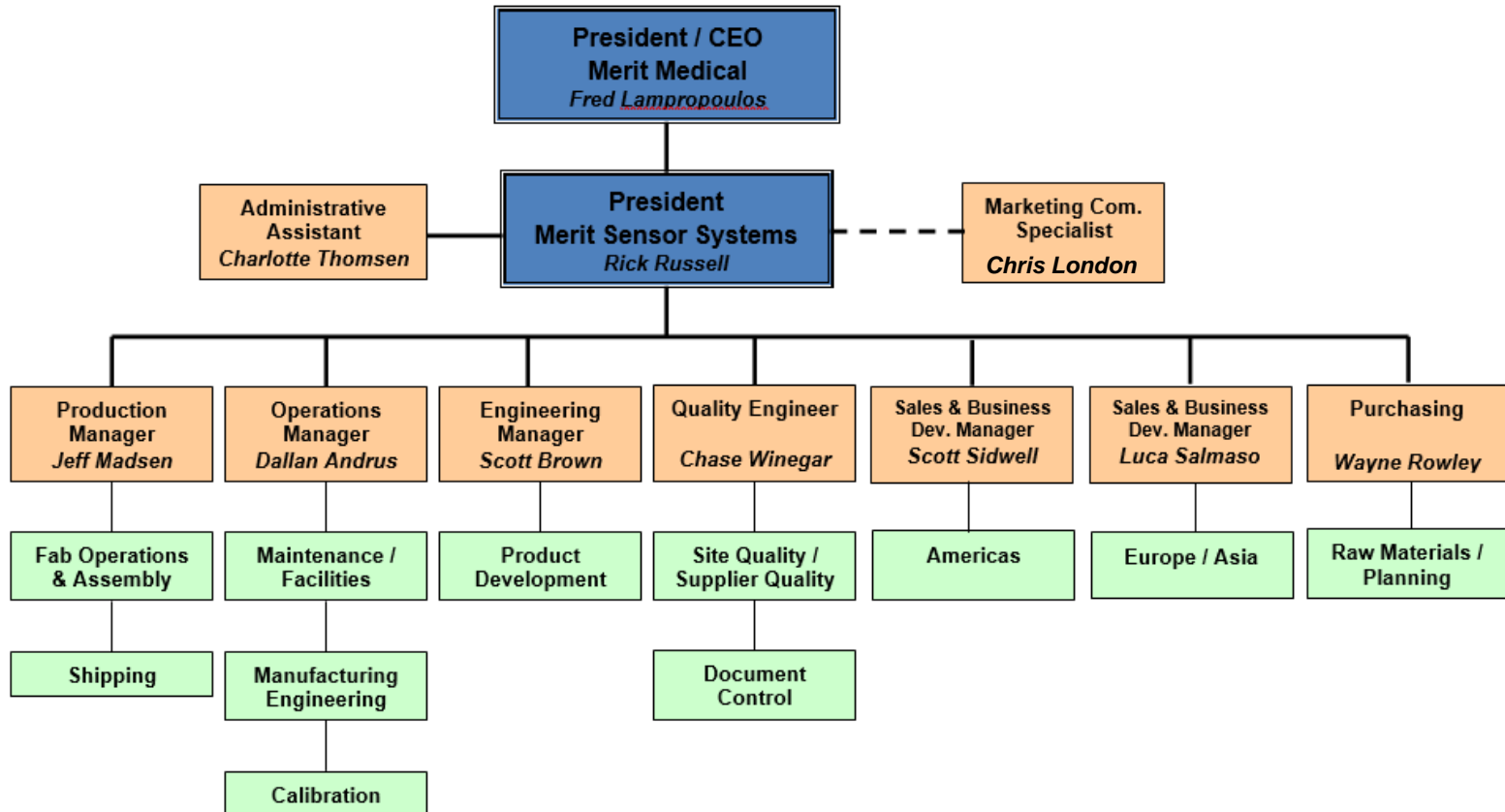


Confidential



MERIT SENSOR™

Organizational Chart



Confidential



MERIT SENSOR™

Vision

- Superior silicon piezoresistive pressure sensor supplier.

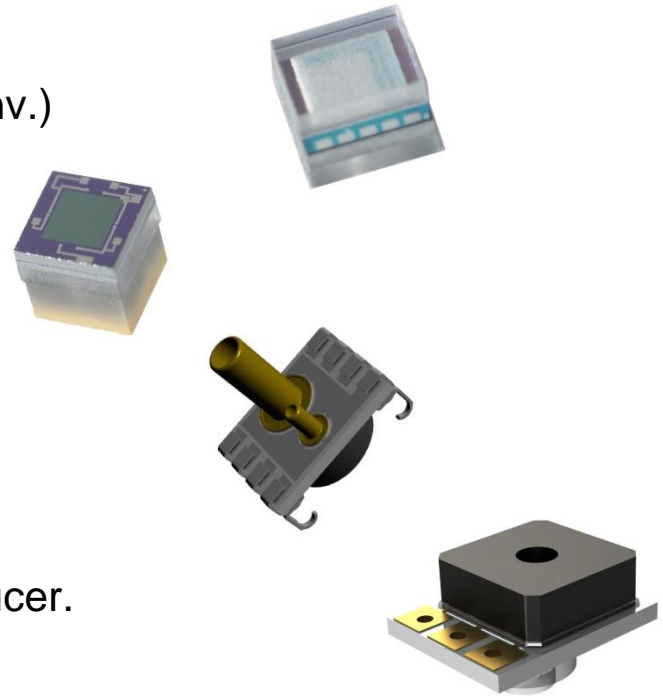
- Backside pressure (bottom side pressure / harsh env.)

- Standard architecture (top-side pressure)

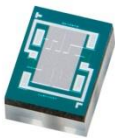
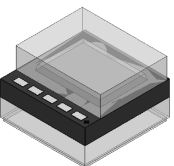
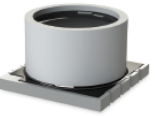


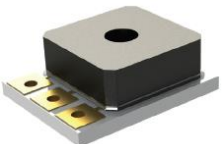

- Silicon pressure sensor based semifinished module.

- Silicon pressure sensor based full compensated transducer.

- Process know-how at Merit Sensor / Key-vendors (FAB, Poly, Gold,..)



Merit Sensor capabilities

| Merit Sensor Series | Type | Sentium® Technology Silicon Sensor | Uncompensated Packages | Passive compensated packages | Full Compensated packages |
|--|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| 3000,5000,7000, L, AP301,HM, K 10mbar..1000 bar |   | <input checked="" type="checkbox"/> | — | — | — |
| Lpup, SMD, MS, PMD 10mbar..30 bar |   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | — | — |
| BP, AP |  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | — |
| TR 1. .35 bar |   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | — | <input checked="" type="checkbox"/> |

Confidential



MERIT SENSOR™

PRESSURE RANGE

| | | | | | | | | | |
|----------|-------|--------|---------|---------|---------|-----------|-----------|------------|-------------|
| 0.15 psi | 5 psi | 15 psi | 100 psi | 300 psi | 500 psi | 1,000 psi | 5,000 psi | 10,000 psi | 15,000 psi |
| 10 mbar | 1 psi | | | | | | | | 1,034 bar |
| 1 KPa | | | | | | | | | 103,421 KPa |

L Series **G**
0.15 - 1 psi
 10 - 689 mbar; 1 - 6.89 KPa
 Size (mm): 3.3 x 3.3
 Glass Thickness (mm): 0.9/1.4

J Series **AG**
1 to 300 psi
 68.9 mbar to 21 bar; 6.89 to 2100 KPa
 Size (mm): 1.9 x 1.9
 Glass Thickness (mm): 1.5 / 0.5 / 0.9 / 2.2

K Series **AG**
1,000 - 15,000 psi
 68.9 - 1,034 bar; 6,895 - 103,421 KPa
 Size (mm): 1.4 x 1.4
 Glass Thickness (mm): 0.5 / 0.9

D Series **AG**
15 - 300 psi
 1 - 20.7 bar; 103 - 2,068 KPa
 Size (mm): 1.42 x 1.42
 Glass Thickness (mm): 0.5 / 0.9

Optional
1,000 psi
Upon Request

Optional
1,000 psi
Upon Request

3000 Series **AG**
5 - 100 psi
 0.34 - 6.9 bar; 34.5 - 689 KPa
 Size (mm): 2.5 x 3.3mm
 Glass Thickness (mm): 0.5 / 0.9 / 1.5

AP301 Series **AG**
100 - 1,000 psi
 6.9 - 68.9 bar; 689 - 6,895 KPa
 Size (mm): 2.2 x 2.8mm
 Glass Thickness (mm): 0.5 / 0.9 / 1.5

5000 Series **A**
1,000 - 10,000 psi
 69 - 689 bar; 6,895 - 68,948 KPa
 Size (mm): 1.6 x 1.9mm
 Glass Thickness (mm): 0.5 / 0.9

7000 Series **AG**
15 - 500 psi
 1 - 34.5 bar; 103 - 3,447 KPa
 Size (mm): 1.6 x 2.2
 Glass Thickness (mm): 0.5 / 0.9 / 1.5

Optional
2,000 psi
Upon Request

HM Series **AG**
15 - 500 psi
 1 - 34.5 bar; 103 - 3,447 KPa
 Size (mm): 2.1 x 2.1 Glass Thickness (mm): 0.5
 Backside pressure, harsh environment

G Gage **AG** Absolute Gage **A** Absolute
 Poly-FS (standard with L,J,K)
 available for all other series
 Custom sensitivities available
 Custom layout available

Facilities

- Facility:
 - Full Size: 40,000SqFt
 - Utilized Space = 15,000 SqFt
- Class 100/1000 Clean Room:
 - Size: 3,000 SqFt
- Assembly / Maintenance:
 - Size: 5,500 SqFt
- General Office / Facilities:
 - Size: 6,500 SqFt
- Production Schedule
 - 3 shifts 5 days per week
 - Average Lead time =
 - 8..12 weeks (fab)
 - 4...6 weeks (assembly)



Target Industries / Applications



Automotive

- Oil Pressure
- Fuel Vapor
- Smart Suspension
- Fuel Level
- Fuel Pressure
- Brake Pressure
- Transmission Pressure



Industrial

- Hydraulics
- Compression
- Agriculture
- Refrigeration
- Tank Level
- P-to-I Converters
- Pressure Indicator
- Heating, Ventilation, & Air Conditioning (HVAC)



Medical

- Disposable Blood Pressure Sensor
- Catheter Tip Pressure Sensor
- Kidney Dialysis Equipment
- Angioplasty Inflation Pump
- Infusion Pumps



Consumer

- Digital Tire Pressure Gage
- Altimeters/Barometers
- Scuba Diving Gauges



Aviation

- Altitude
- Tire Pressure
- Hydraulic Pressure
- Brake Pressure



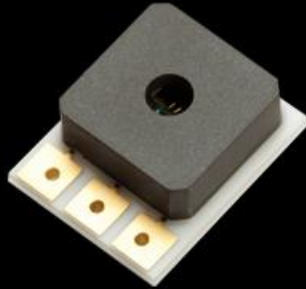
Defense

- Hydraulic Pressure
- Tire Pressure
- Brake Pressure



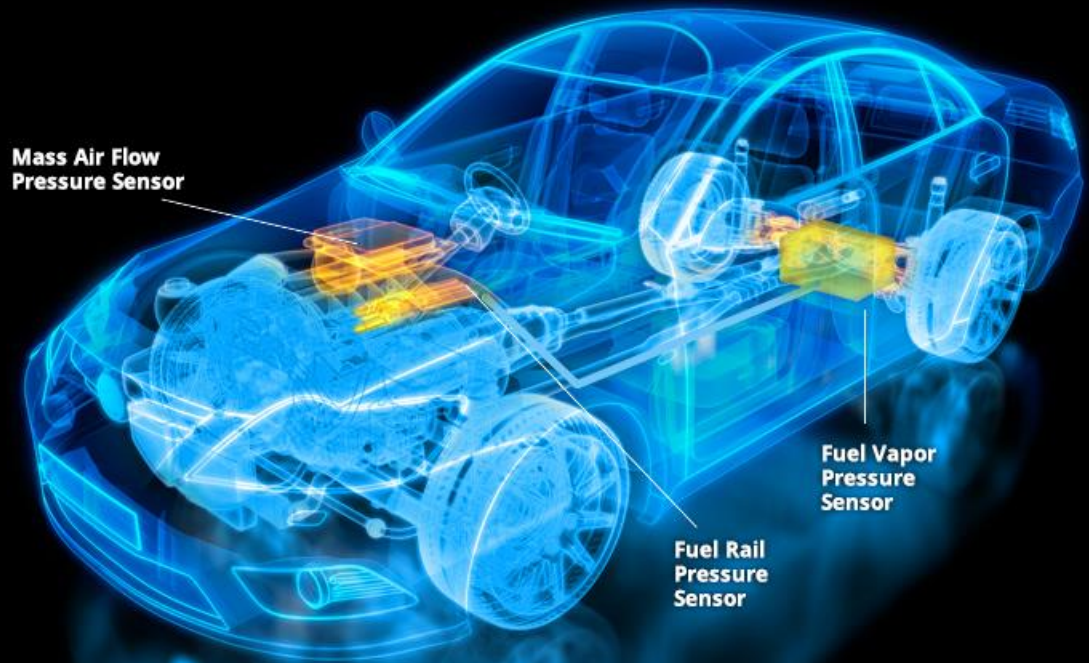
Target Industries / Applications

Fuel Pressure



TR Series Pressure Sensor The ideal pressure sensor for automotive applications, designed for air, liquid and gas harsh media compatibility over a broad temperature range (-40°C to 150°C)

[LEARN MORE](#)



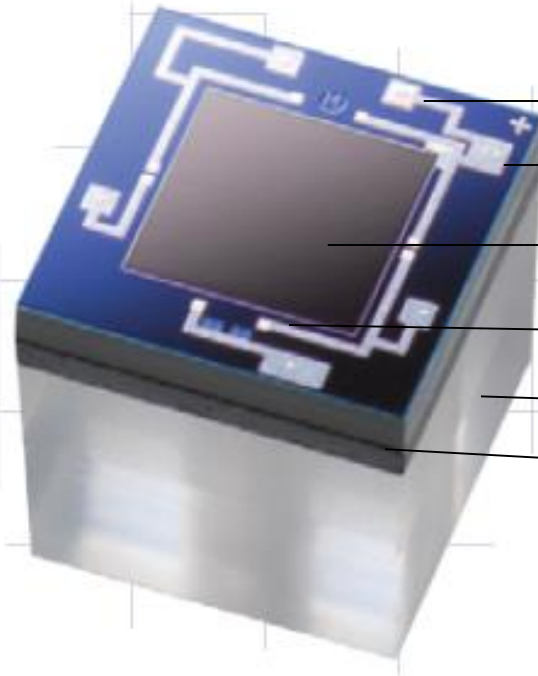
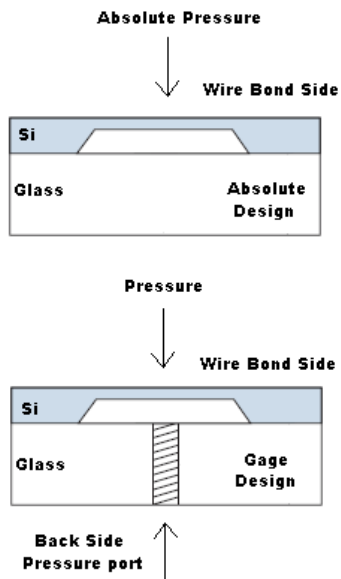
Confidential



MERIT SENSOR™

Basic Architecture

Piezoresistive Die



- Aluminum Conductor
- Bond Pad
- Diaphragm
- Piezoresistor
- Pyrex Glass
- Silicon



HM Series Die

with optional Temp Diode & Au Metal

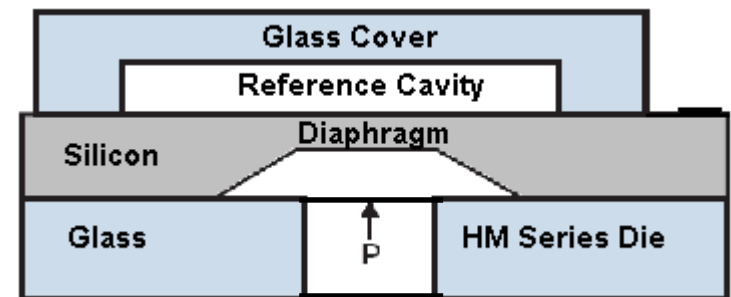
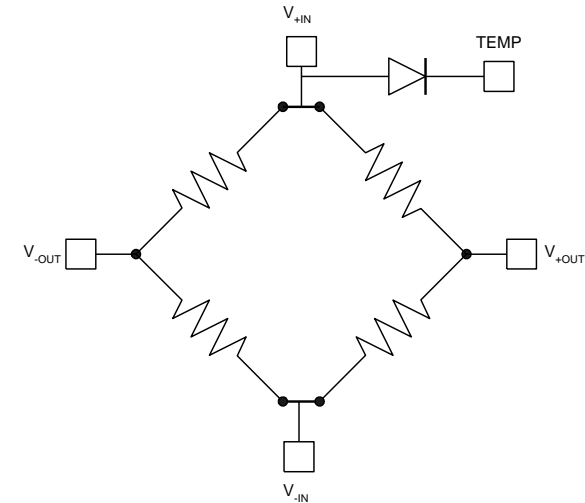
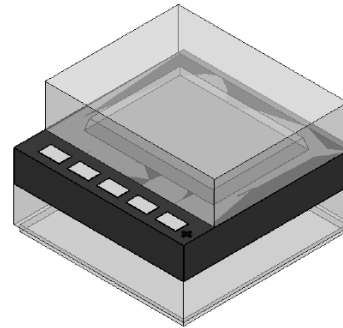
- HM Series suitable back side absolute pressure (wet or dry)

- Temperature Sensing Diode

- Advantages:

- Very accurate compensation due to location of sensor
- Cost : in cases when it replaces a thermistor on the PCB

- Apply a small current and measure the voltage drop between +IN and TEMP pads



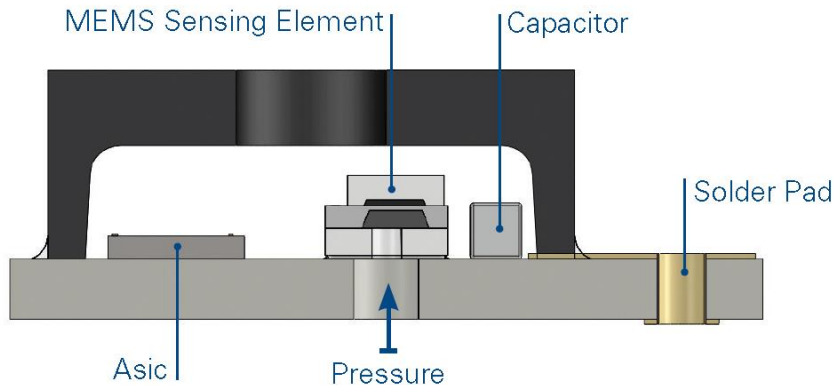
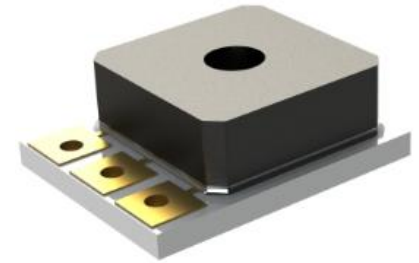
Confidential



MERIT SENSOR™

TR Series – Digitally Compensated

- Temperature compensated from -40°C to 150°C
- Absolute or gage
- Pressure ranges up to 500psi
- Pressure die “eutectic soldered” for aggressive media compatibility
- Automotive compatible media : fuel, diesel, oil, water
- Available with ferrule for radial sealing.
- Easy to be integrated (plastic/metal-housing)
- Media compatible
- Analog ratiometric output (future options: SENT)



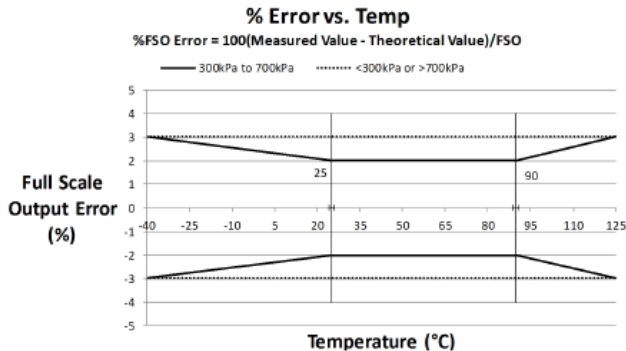
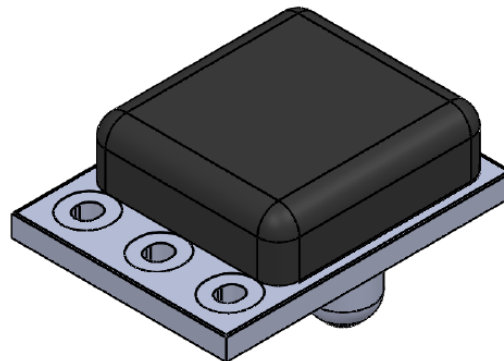
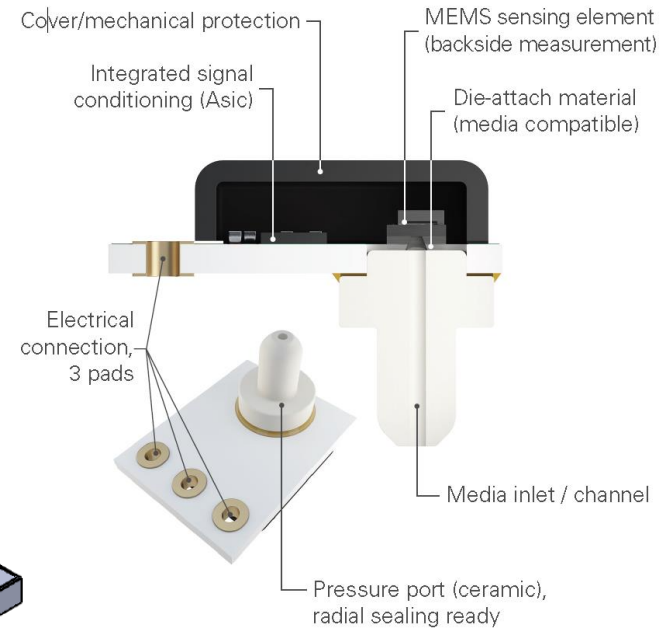
Confidential



MERIT SENSOR™

Sensor transducer – Fuel vapour

- Temperature compensated from -40°C to 150°C
- Absolute or gage
- Pressure ranges 1 to 500psi (1..35 bar)
 - Fuel Vapour : P = 300..700kPa (output : 10..90%Vdd)
- Pressure die attached on pressure plug
- Media compatibility (automotive : fuel)
- Radial sealing (single point pressure connection)
- Easy to be integrated (plastic/metal-housing)
- Analog ratiometric output (future options: SENT)

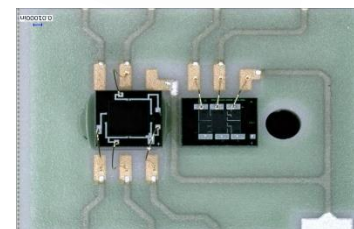
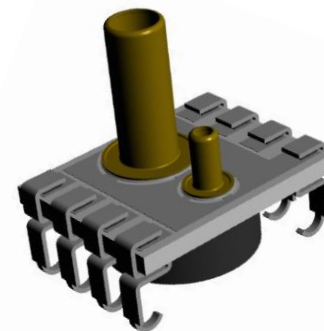


Confidential



Dual Die Differential – Air Mass-flow

- Typical Truck application : Air mass-flow measurement
- Double die on ceramic
- Backside ΔP pressure (Venturi)
- Topside absolute pressure
- Extremely low thermal hysteresis
- Custom design with ferrule/barb
- Uncompensated or with signal conditioning (option)
 - Analog ratiometric
 - Digital (SPI, SENT, I2C, ..)
- Temperature measurement with integrated diode on die (option)
- Temp.range : -40..+125°C (up to 150°C optional)
- 8 pin SMD package



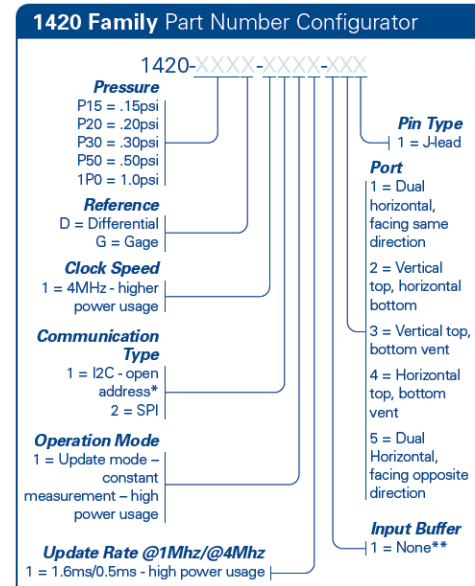
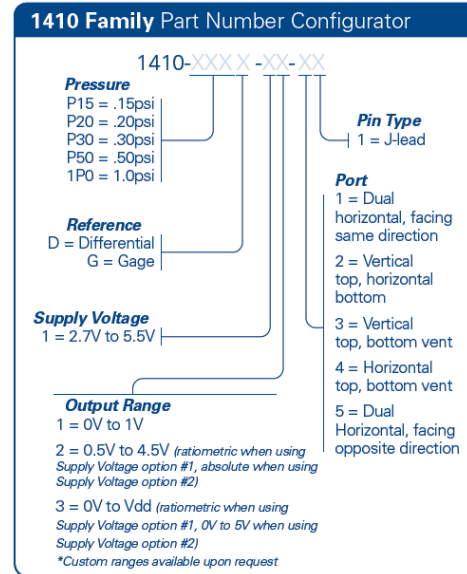
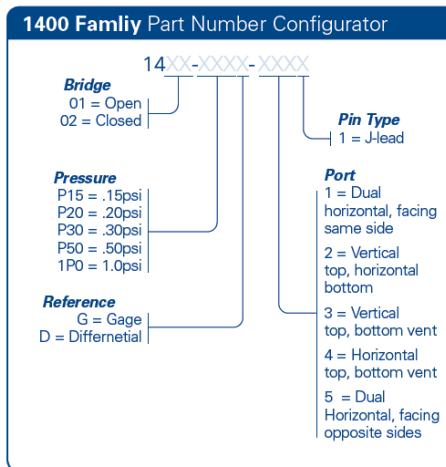
LP Series - Uncompensated

- Pressure Range : 0.15 to 1 psi (10 to 70 mbar)
- Excellent linearity and hysteresis
- Wide operating temperature range : - 40..+85°C
- Pressure type : Gage and differential
- Dual cap configuration Horizontal / Vertical
- SMT / 8-pin design



Dual horizontal port

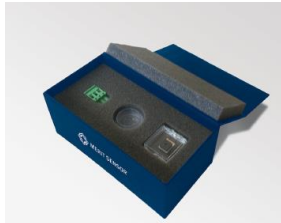
vertical port



Evaluation KIT

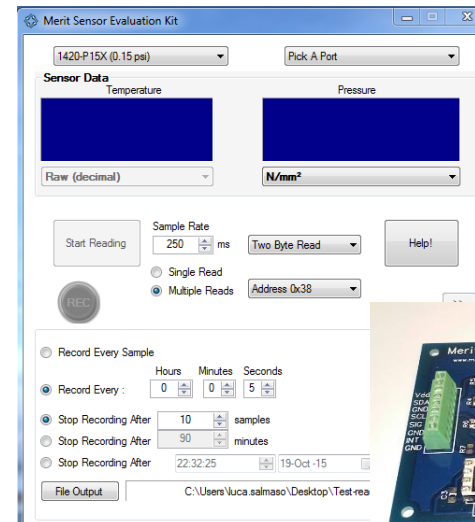
TR-Series MeriTREK®

- Starter-Kit housing ready for the TR-Series
- Axial-sealing through O-ring NBR
- 1/4" NPT Thread for easy coupling
- 1 x TR1-0100A-001 included



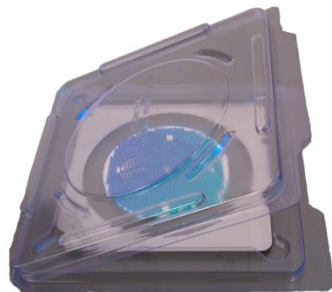
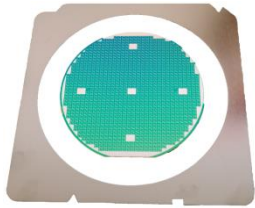
LP-Series Ev.Kit MULPEK

- Starter-Kit PCB-Board ready for the LP-Series (1410/1420)
- Direct USB Interface
- Software for sampling/monitoring/testing

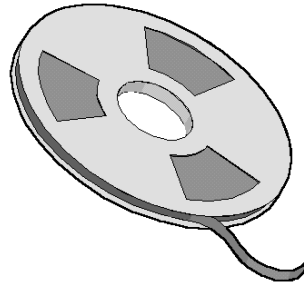


Packaging

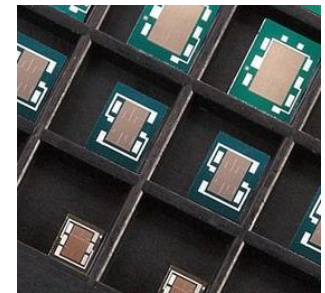
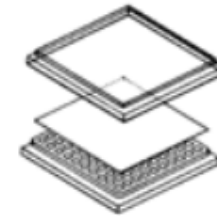
Tape Frame (die)



T&R or Tubes (Assemblies)



Waffle Pack (die)



Merit Quality

Supplier Sensitivity

■ Quality

- ISO9001 certified
- Statistical Process Control
- 8D Reporting
- Gage R&R
- Project / Process FMEA
- Automotive Qualified (AEC Q100)
- RoHS/REACH compliant



Confidential



MERIT SENSOR™

Thank you !

Confidential



MERIT SENSOR™