The **LP2 Series** is a go-to solution for ultra-low-pressure sensing. This innovative sensor combines high stability with affordability, making it a standout product in the market.

The LP2 sensor is designed with full compensation for temperature and pressure nonlinearity, ensuring highly accurate pressure readings across various environmental conditions. This advanced feature means it self-corrects for temperature shifts, providing you with reliable data in all situations. Equipped with multiple communication interfaces and voltage ranges in a single package, it facilitates seamless integration and simplifies design upgrades

COMPANY: Merit Sensor is a leader in piezoresistive pressure sensing and partners with clients to create high performing solutions for a variety of applications and industries.

SENTIUM: Merit Sensor products incorporate a proprietary Sentium® technology developed to provide a best-in-class operating temperature range and superior stability.

TECHNOLOGY: Merit Sensor utilizes a piezoresistive Wheatstone bridge in a design that anodically bonds glass to a chemically etched silicon diaphragm. All products are RoHS compliant.

CAPABILITIES: Merit Sensor designs, engineers, fabricates, dices, assembles, tests, sells and services die and packaged products from a state-of-the-art facility near Salt Lake City, Utah

FEATURES

- Wide pressure range options: from 150 to 7000Pa
- Total Error band better than 1.5%FS (before reflow and without autozero)
- Pressure Type: Differential or gage
- Electrical Connection: SMD solder pads, 1.27mm standard spacing
- Output: Digital I2C and SPI, Analog ratiometric 10% to 90% Vs
- Burst pressure: 10 to 100 times maximum operating pressure (depending on pressure range)
- Low power mode
- Wide Supply Voltage: 2.7V to 5.5V
- Compensated temperature range: -10C to 60C
- Operating temperature range: -40 to 85C
- Autozero and output signal averaging*

APPLICATIONS

- **Industrial:** Air Flow / HVAC / VAV
- **Medical:** Equipment for diagnosis and analysis / Ventilators
- **Consumer:** Sleep Apnea / CPAP Machines
- **Other:** Dry non-corrosive gas pressure applications

* For more information about Autozero and output averaging function please contact Merit Sensor.

LP2 Part Number Configurator

1440-XXXX-XXXX-XXX*

Full Scale Pressure
0150 = 150Pa (0.6 inH2O)
0500 = 500Pa (2 inH2O)
2500 = 2500Pa (10 inH2O)
7000 = 7000Pa Gage (1PSI)

Pressure Type
G = Gage
D = Differential

Comm. Address[1]
0 = 0x28

Output Modes
S = I2C and Analog
F = I2C / SPI / Analog /EOC / Sensor Reset

Calibrated Supply Voltage
1 = 5V
2 = 3.3V
3 = 2.7V

Operational Mode
0 = Cyclic (continuous operation)
1 = Sleep (ultra-low power)

Notes:
[1]Other I2C addresses available upon request
*The final "XX" in the part number configurator is reserved for future use

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LP2seriesDS.001

SPECIFICATIONS

| Parameter	Minimum	Typical	Maximum	Units	Notes
Electrical					
Supply Voltage (Vs)	2.7		5.5	V	
Supply Current	0.006	3	3.3	mA	Minimum current rated at sleep mode
ESD Protection			4000	V	According to the Human Body Model. As per ASIC`s datasheet.
EOC Pin	0		Vs	V	End of conversion. This pin is active for each new pressure calculation is performed.
Performance					
Output Range (Vout)	10		90	% of counts	2^24 counts
Resolution	16 (TBD)	18	22 (TBD)	bits	
Startup Time			2.5	ms	Power on to full operation time
Wake Up Time			2	ms	Sleep mode to full operation time
Update Time (digital mode)		5		ms	
Accuracy					
Digital mode	-1.5%	±0.5%	+1.5%	FSO	Accuracy includes all error for pressure and thermal hysteresis and linearity over the entire compensated temperature range. It does not include lifetime drift.
Analog output	-2.0%		2.0%		
Lifetime Drift	-1		1	%FS	1000 hours @85C
Static Proof Pressure	2.5x			FS	
Burst Pressure	10			PSI	Up to 1000Pa parts
Burst Pressure	50			PSI	Above 2500Pa parts
Environmental					
Operating Temperature	-40		85	°C	
Storage Temperature	-40		85	°C	
Weight				g	
Media Type	Dry non-corrosive gases				
Analog Interface					
Output Range (minimum to maximum pressure)	10		90	% Vsupply	
Clipping	5		95	% Vsupply	
Resolution		14		bits	
Output Current			12	mA	For optimal accuracy, the output current must be maintained below 1mA
Output update rate	1.33		1.58	kHz	
Digital Interface (for reference only)					
I²C™ voltage level HIGH	0.7x		1.0x	Vs	
I²C™ voltage level LOW	0		0.3x	Vs	
SCL clock frequency			400	kHz	
SPI Interface Clock	0.05	1	3	MHz	fSCL
SPI voltage level High	0.7x		1.0X	Vs	
SPI voltage level LOW	0.0		0.3	Vs	
Delay time [a] between SS-activation					
edge and first edge of SLCK, MOSI or MISO	1	50		nS	
Delay time [a] between SS- deacti-vation edge and last edge of SLCK, MOSI or MISO	1	50		nS	
Delay between SS-deactivation edge of last command and of SS-activation edge for next command	10			µS	

PRELIMINARY

MERIT SENSOR LP2 I2CTM COMMUNICATION

- **Sleep Mode**
  - If the part is in sleep/low current mode (see part configurator), the first command regardless of the command type will take part out of sleep and the command will be executed. Once the command has been completed, the part returns to sleep mode.

- **Cyclic Mode**
  - Used in applications where power isn't as big of a concern. When power is applied to the sensor, the sensor will constantly be reading the pressure from the sensing bridge. The bridge is always powered up. During this mode only a read request is required to fetch the data from the part.

Command Request (Sensor Write):

Command Request (IC Write)
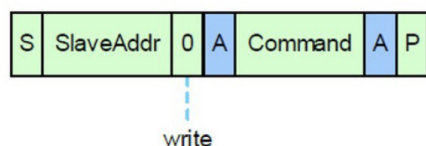
| S | SlaveAddr | 0 | A | Command | A | P |

write

	From master to slave		S	START condition
	From slave to master		P	STOP condition
			A	Acknowledge
			N	Not acknowledge

The following commands are available for the device:

Command	Description	Sleep Mode	Command Mode	Cyclic Mode
0xA8	Start Sleep Mode	NO	YES	YES
0xA9	Start Command Mode	YES	NO	YES
0xAA	Single Measurement	YES*	YES	NO
0xAB	Enter CYCLIC Mode φ	YES	YES	NO
0xAC	Returns Mean of 2 measurements	YES*	YES	NO
0xAD	Returns Mean of 4 measurements.	YES*	YES	NO
0xAE	Returns Mean of 8 measurements.	YES*	YES	NO

* The device will power on (2-10 μS depending on configuration), take measurements and return to sleep mode.

φ Reading a 4 bytes (Status and Pressure only) or 7 bytes (Status, Pressure and Temperature) at any time will return the most current measurement. Note: Status can show as "BUSY" during cyclic mode.

- Please note: writing to any other registers can disable the part or degrade the accuracy
- *For more information about Autozero and output averaging function please contact Merit Sensor*
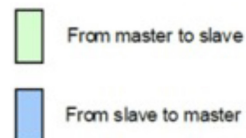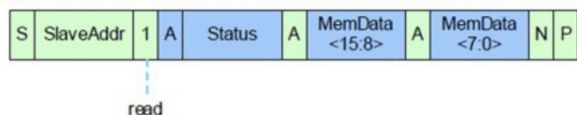
Example:

- **Reading Pressure Data:**

Reading data from the sensor. Data will come back in the following format:
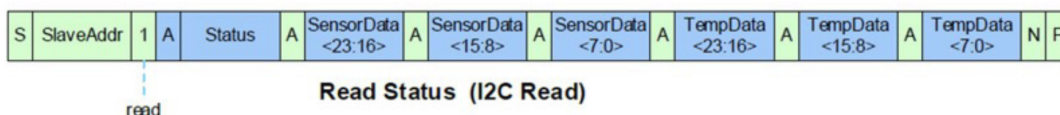
- **Reading pressure only: Example (a) at cyclic mode operation**
- **Reading pressure and temperature*: Example (B) at cyclic mode operation**

Read Data (I2C Read)

(a) Example: after the completion of a Memory Read command

| S | SlaveAddr | 1 | A | Status | A | MemData <15:8> | A | MemData <7:0> | N | P |

read

(b) Example: After the completion of a read command (0xAA, 0xAC, 0xAD, 0xAE, 0xAF). A 7 byte read will result in the following:

| S | SlaveAddr | 1 | A | Status | A | SensorData <23:16> | A | SensorData <15:8> | A | SensorData <7:0> | A | TempData <23:16> | A | TempData <15:8> | A | TempData <7:0> | N | P |

read

Read Status (I2C Read)

| S | SlaveAddr | 1 | A | Status | N | P |

read

|	
(green)	From master to slave
(blue)	From slave to master
S	START condition
P	STOP condition
A	Acknowledge
N	Not acknowledge

Figure 12. I2C Read Status

Note: The TempData refers to the internal not calibrated temperature sensor and should not be used as a temperature reference. A 4 byte read will result in only status and sensor data.

- The first Byte (8 bits) returned is the "Status" of the part. It can be decoded in the following manner:

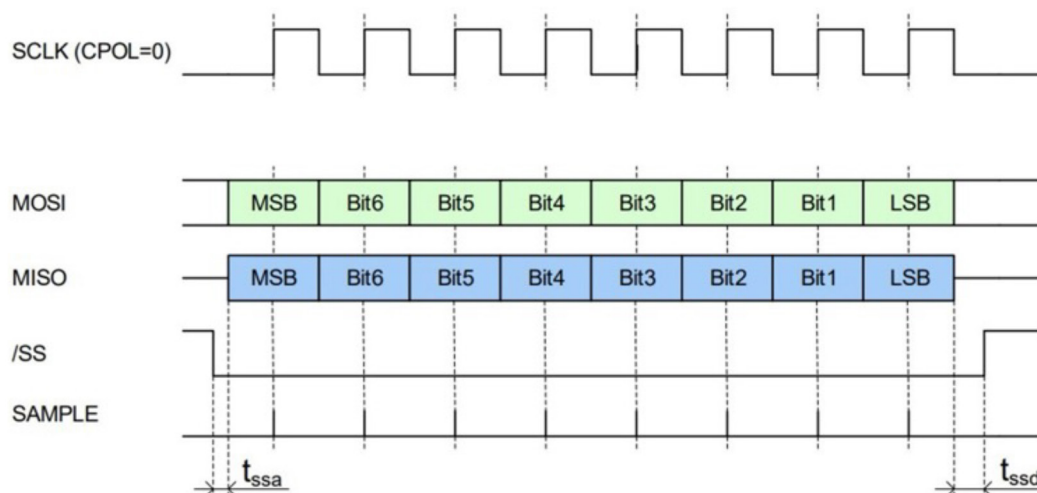| Bit Number	7	6	5	4	3	2	1	0
Meaning	0	Powered	Busy	MODE	MODE	Memory Error	Connection fault	Math Saturation

° MODE meaning (bits 3 & 4):
  – MODE = 00 is Command Mode
  – MODE = 01 is CYCLIC Mode (Bit 5 is also set)
  – MODE = 10 is SLEEP Mode
  All others reserved

MERIT SENSOR LP2F1440 I²C TIMING DIAGRAM (FOR REFERENCE ONLY)
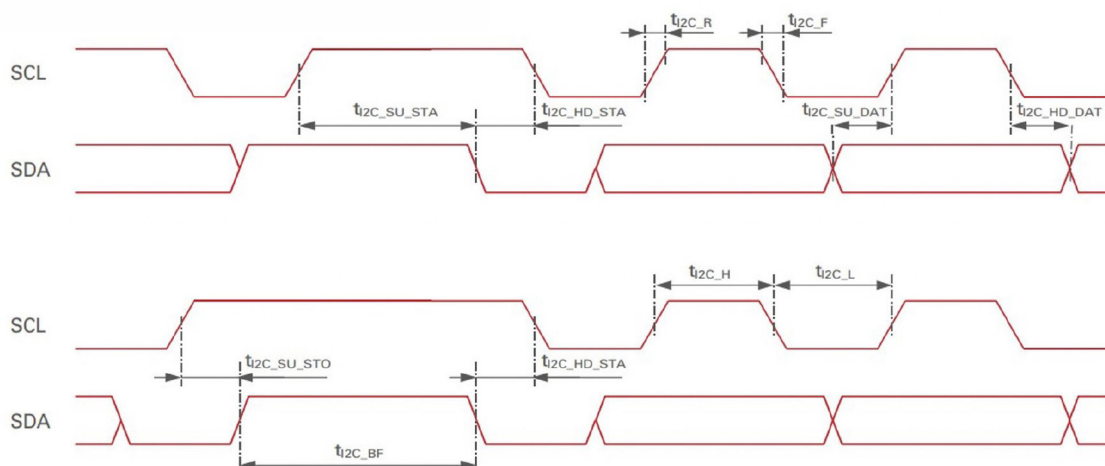
MERIT SENSOR LP2 SPI COMMUNICATION

SPI Timing Diagram

- To start a communication via SPI, the /SS (pin 01) must be at zero, the CMS SPI comm is configured by default for clock polarity and phase = 0 and Slave select = 0
- Upon power up, part will be in sleep/low current mode. Sending the SS pin to zero will take I Mode, each command except NOP is started as shown in below. Note: A command request always the part out of sleep mode into command mode.
- In SPI Mode, each command except NOP is started as shown in below. Note: A command request always consists of 3 bytes. If the command is shorter, then it must be completed with 0 s. The data on MISO depend on the preceding command.

Command Request

MOSI	Command other than NOP	CmdDat <15:8>	CmdDat <7:0>
MISO	Status	Data	Data

- After the execution of a command (busy = 0), the expected data can be read as illustrated below
° Reading data after a Memory Read command:

MOSI	Command = NOP	00HEX	00HEX
MISO	Status	MemData <15:8>	MemData <7:0>

° Reading data after a Measure command (AAHEX)

MOSI	Command = NOP	00HEX	00HEX	00HEX	00HEX	00HEX	00HEX
MISO	Status	SensorData <23:16>	SensorData <15:8>	SensorData <7:0>	TempData <23:16>	TempData <15:8>	TempData <7:0>

Note: The TempData refers to the internal not calibrated temperature sensor and should not be used as a temperature reference

- If no data are returned by the command, the next command can be sent. The status can be read at any time with the NOP command

Read Status

MOSI	Command = NOP
MISO	Status

TRANSFER FUNCTION EXAMPLE (Digital)

TRANSFER FUNCTION FORMULA

$$P = (P_{max} - P_{min}) \times \left(\left(P_{counts} - (0.1 \times Max) \right) \div (0.8 \times Max) \right) + P_{min}$$

Where:
P = Measured pressure
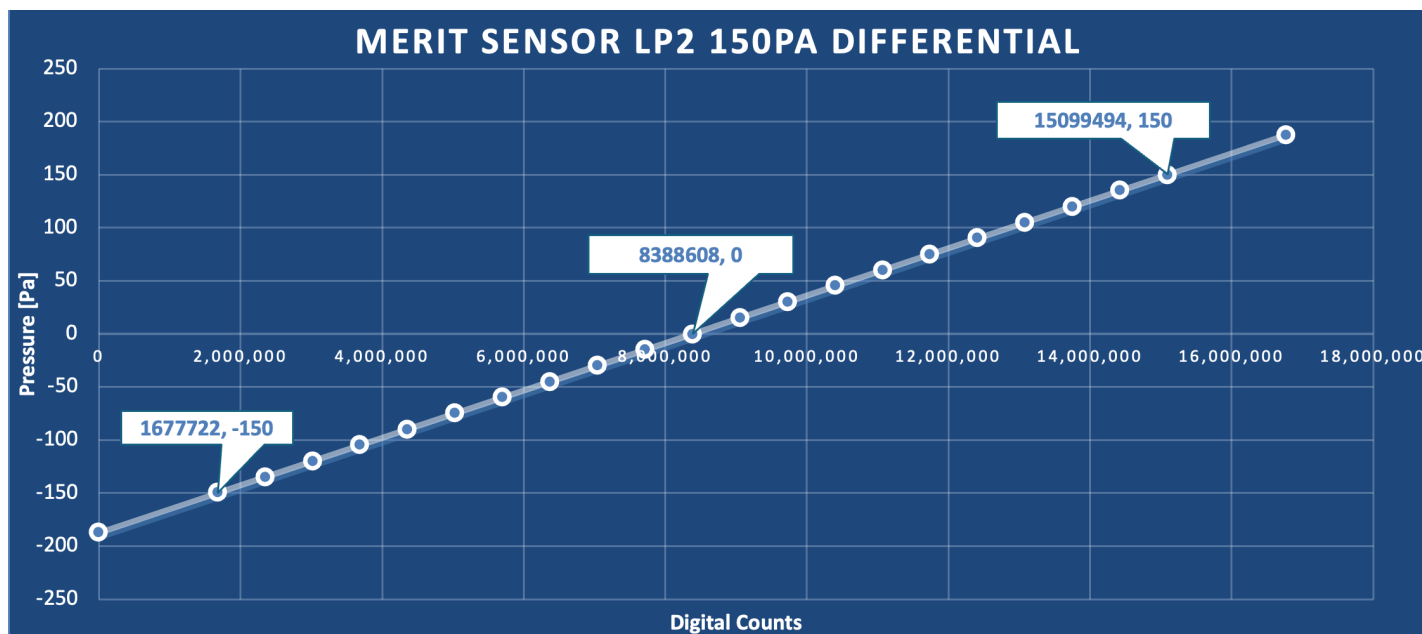*Pcounts = Pressure counts from Merit Sensor part*
Pmin = Minimum working pressure
Pmax = Maximum working pressure
Max = Maximum output counts@24bits = 16777216

Digital Pressure Reading Example (150Pa Differential part):

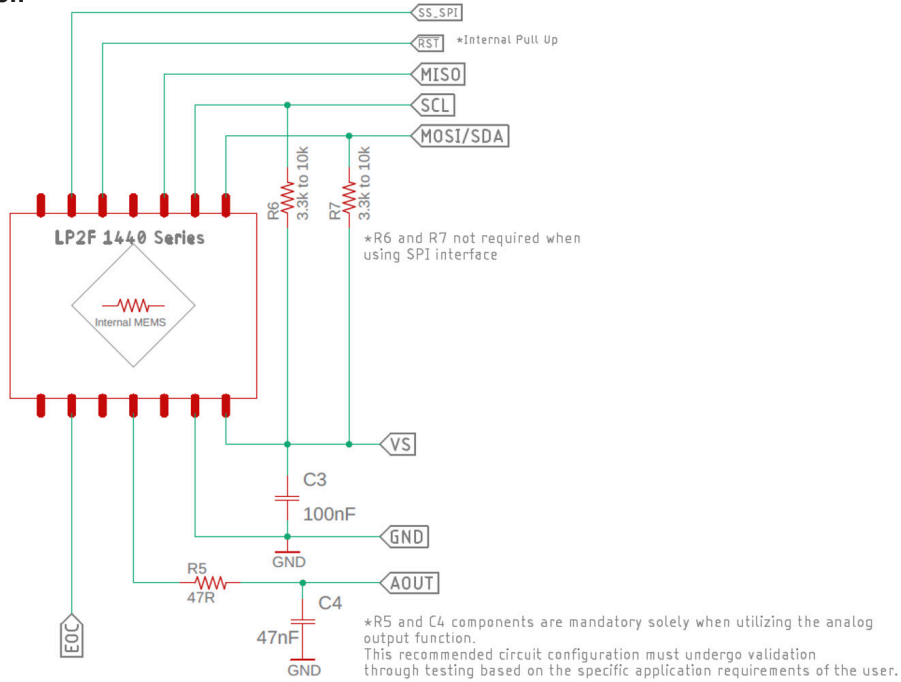Ideal Out at -150Pa = 10% of 2^24 = 1,677,722 Counts
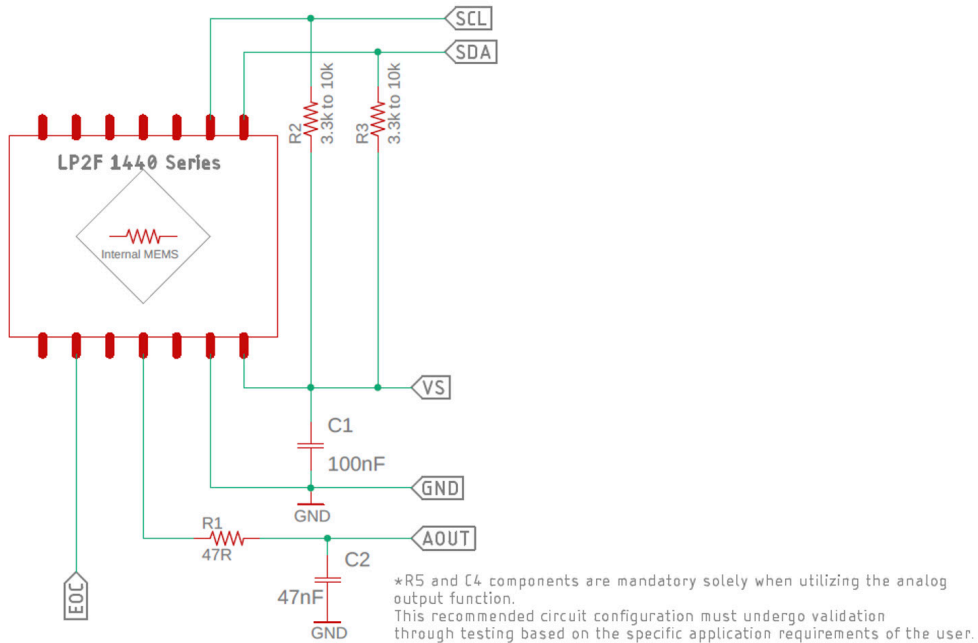Ideal Out at +150Pa = 90% of 2^24 = 15,099,494 Counts

MERIT SENSOR LP2 150PA DIFFERENTIAL

15099494, 150

8388608, 0

1677722, -150

Pressure [Pa]

Digital Counts

PRELIMINARY

ELECTRICAL

Full Configuration

SS_SPI
RST *Internal Pull Up
MISO
SCL
MOSI/SDA

LP2F 1440 Series

Internal MEMS

R6 3.3k to 10k
R7 3.3k to 10k

*R6 and R7 not required when using SPI interface

VS

C3
100nF

GND
GND

R5
47R

AOUT

C4
47nF
GND

EOC

*R5 and C4 components are mandatory solely when utilizing the analog output function.
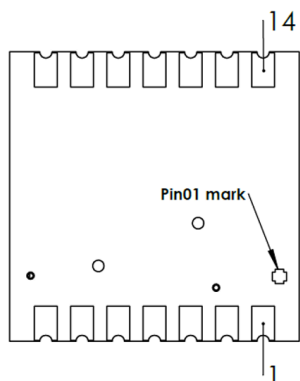This recommended circuit configuration must undergo validation through testing based on the specific application requirements of the user.

Standard Configuration

SCL
SDA

LP2F 1440 Series

Internal MEMS

R2 3.3k to 10k
R3 3.3k to 10k

VS

C1
100nF

GND
GND

R1
47R

AOUT

C2
47nF
GND

EOC

*R5 and C4 components are mandatory solely when utilizing the analog output function.
This recommended circuit configuration must undergo validation through testing based on the specific application requirements of the user.

MERIT SENSOR™

PIN ASSIGNMENT

Pin01 mark

14

1

Pin	Function	Description	Version
1	NC		
2	EOC	End of conversion, flags when a new measurement cycle is ready to be read	Full only
3	NC		
4	Aout	Analog output	Full / Standard
5	NC		
6	GND	Ground from supply	Full / Standard
7	Vsupply	2.7V to 5.5V	Full / Standard
8	MOSI/SDA	SPI data input or I2C data	Full / Standard
9	SCL	I2C clock	Full / Standard
10	MISO	SPI data out (referenced to Vs level)	Full Only
11	NC		
12	/RST	Sensor Reset, 0V active (internal pull-up)	Full Only
13	/SS	SPI slave select, 0V selects part	Full Only
14	NC		

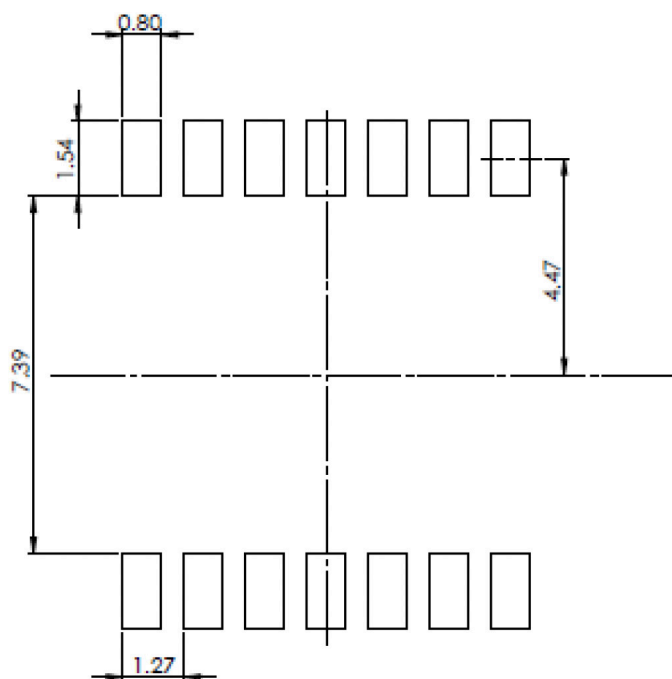*NC stands for Not Connected

DIMENSIONS [MM]:
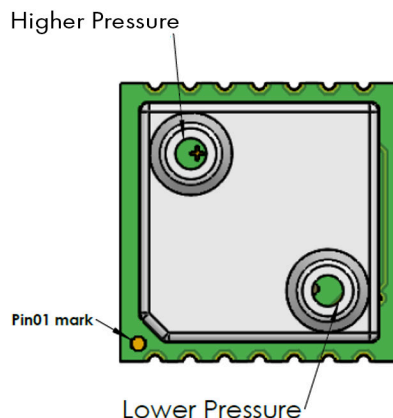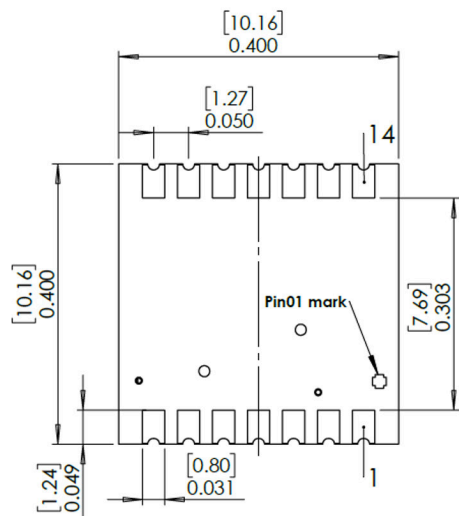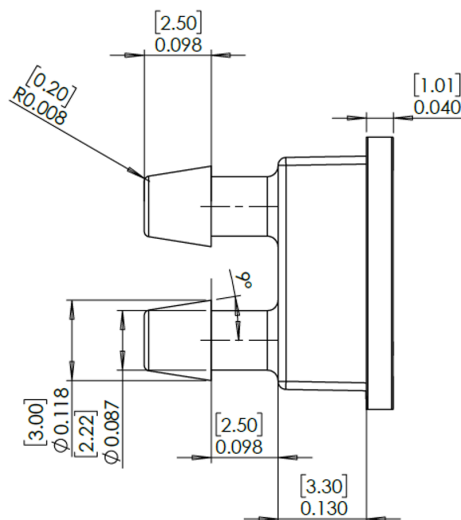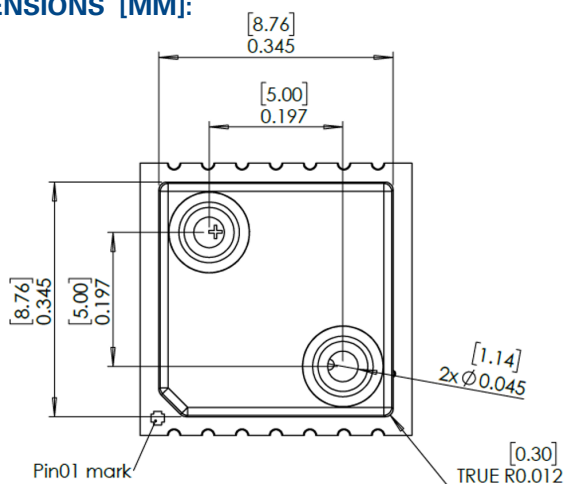
*Dimensions for reference only. Engineering drawings (with tolerances) available upon order

PRELIMINARY

PACKAGING AND SHIPPING (TAPE AND REEL)

SUGGESTED LAND PATTERN (*FOR REFERENCE ONLY)
Dimensions in mm

*Note: The land pattern shall be tested on customers application and equipment before used in production

Merit Sensor is based in Salt Lake City, Utah

MERIT SENSOR™