

Solid State Pressure Sensor

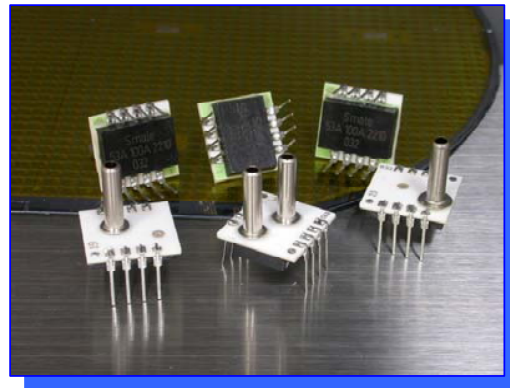
DIGITAL
OUTPUT



CCD Series – Model 53D

FEATURES

- DIL/SMD Ceramic Package
- Calibrated Span and Offset
- Multi-order Temperature Compensation
- OWI, I²C or SPI Interface
- 3V or 5V
- Customized Configuration Available



DESCRIPTION

The Series CCD 53D is a smart pressure sensor with calibrated and digital output. The ceramic hybrid package performs excellent isolation to external stress during operation. Digital compensation of sensor offset, sensitivity, temperature drift and nonlinearity is accomplished in factory via an internal DSP running a correction algorithm with calibration coefficients stored in on-chip EEPROM.

A variety of output configuration, including resolution, sampling rate, output interface are available to provide simple and ready-to-use solution for a wide range of application.

The Series CCD 53D is available for pressure range from 0.15 psi to 150 psi. . Special configuration as low as 2.5 mbar is also applicable. Please contact factory for detail.

Ordering Information

Series CCD 53 Digital

53D L - XXX G - X 0 X X

Series

Supply Voltage

Blank = 4.75 to 5.25 V
L = 2.75 to 3.33 V

Pressure range

Medium Pressure

003 = 0 ~ 3 psi

005 = 0 ~ 5 psi

007 = 0 ~ 7 psi

015 = 0 ~ 15 psi

030 = 0 ~ 30 psi

050 = 0 ~ 50 psi

100 = 0 ~ 100 psi

150 = 0 ~ 150 psi

Low Pressure

L15 = 0 ~ 0.15 psi

L30 = 0 ~ 0.3 psi

L50 = 0 ~ 0.5 psi

L70 = 0 ~ 0.7 psi

Ultra-low Pressure

Notes:

Custom ranges and units are available upon request. Please contact factory.

Type of Pressure

G: Gage (Port B only)

H: Gage (Dual Port)

A: Absolute (Port A only)

D: Differential (Dual Port)

Option

0: No special request

Sampling Rate

0 = 1 kHz

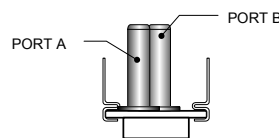
1 = 200 Hz

2 = 40 Hz

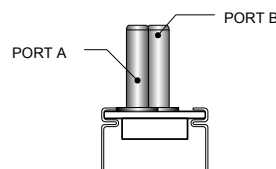
3 = 8 Hz

Leading Direction

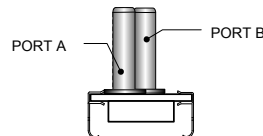
1= Leads same side as Port Metal



2= Leads opposite side as Port Metal



3= Leads for surface mount



1. Port B is used for positive differential
2. Port A is used for absolute
3. Port B is used for gage

Type of Output

0 = 1-wire P

1 = 1-wire P+T

2 = 0.5 to 4.5 V

3 = 0.2 to 4.8 V

4 = N/A

5 = 0 to 1 V

6 = 0.2 to 4.7 V

7 = N/A

8 = I²C

9 = SPI

S = Special

NOTES:

1. Custom output, pressure range and temperature compensated range are available.
2. Negative gage normally has offset (0.5V) at 0 psi and full scale output (4.5V). Reverse is also applicable.
3. Accuracy may vary on pressure range
4. Minimum absolute pressure that can be specified is 100 psia
5. Medium is available for clean air. For other medium please contact factory.

Characteristics

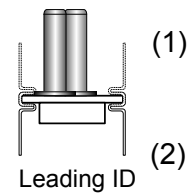
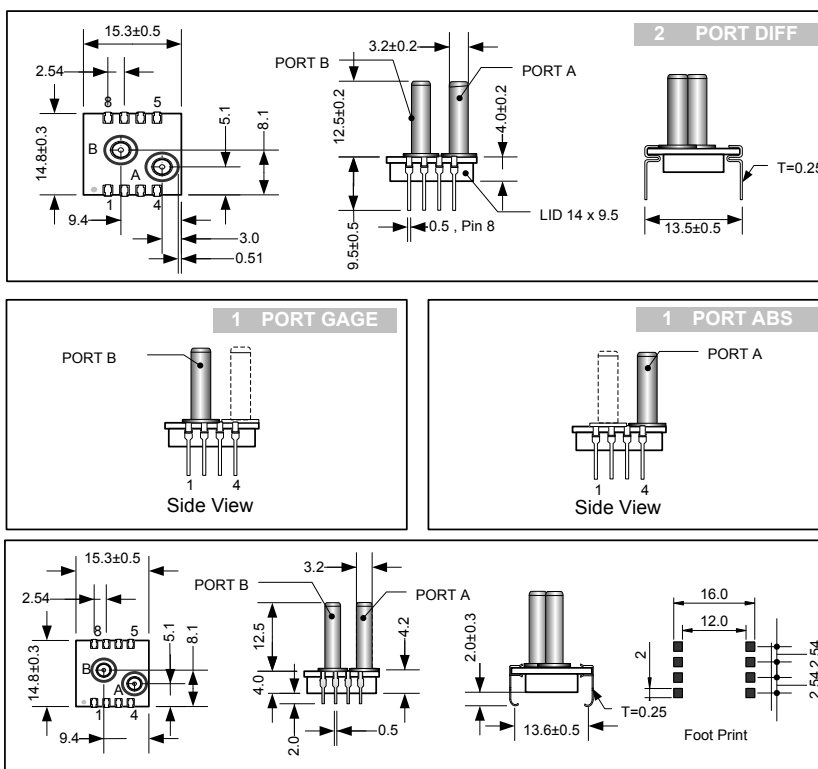
Unless otherwise specified, all parameters are measured at 3/5V, 25 °C and 60% RH

| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|----------------|
| Excitation ¹ | 2.75 | | 5.25 | V |
| Pressure range ² | 3 | | 150 | PSI |
| Resolution ³ | | 14 | | Bit |
| Accuracy ³ | | ±1.8 | | %FS, +1LSB |
| Zero Output ⁴ | | 0666 | | Hex |
| Full Scale Output ⁴ | | 3999 | | Hex |
| Warm-up Time | | 1 | 2 | ms |
| Start-up Time | | | 10 | ms |
| Sampling Rate | 8 | | 1000 | Hz |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁵ | | | 3X | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Smaller range and other units are also available for ordering
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- Output is ratiometric to supply voltage
- Output load resistance to Vss or Vdd: 2.5KΩ (min), 10KΩ (typ)

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{SS} |
| 3 | OUT |
| 4 | V _{DD} |
| 5~8 | N.C. |

NOTES:

- N.C. pins must be left floating
- A 0.1µf capacitor must be connected between V_{DD} and V_{SS}
- Package : 12 pcs/tube

Characteristics

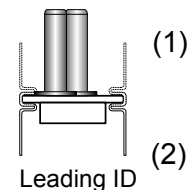
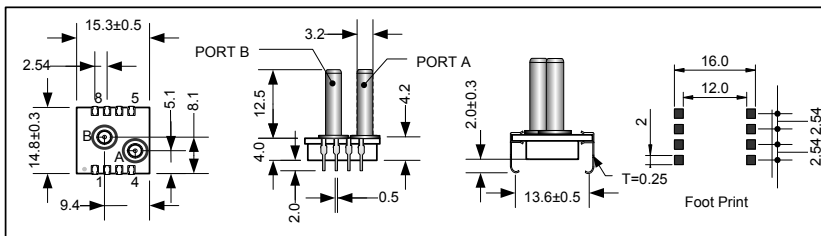
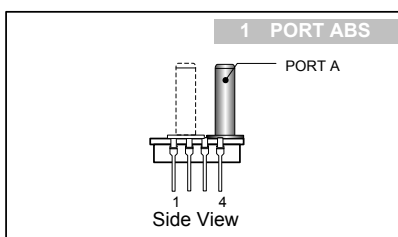
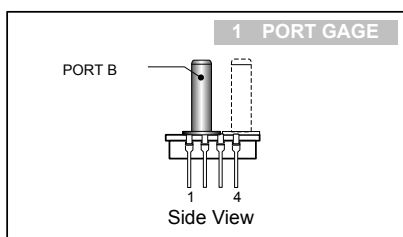
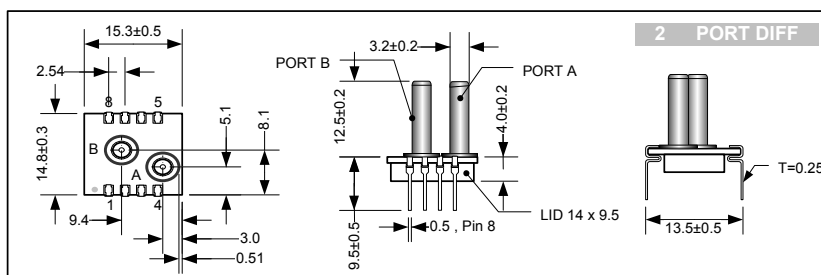
Unless otherwise specified, all parameters are measured at 3/5V, 25 °C and 60% RH

| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|----------------|
| Excitation ¹ | 2.75 | | 5.25 | V |
| Pressure range ² | 0.15 | | 3 | PSI |
| Resolution ³ | 12 | | | Bit |
| Accuracy ³ | | ±2.2 | | %FS, +1LSB |
| Zero Output ⁴ | | 0666 | | Hex |
| Full Scale Output ⁴ | | 3999 | | Hex |
| Warm-up Time | | 1 | 2 | ms |
| Start-up Time | | | 10 | ms |
| Sampling Rate | 8 | | 1000 | Hz |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁵ | | | 3X | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Smaller range and other units are also available for ordering
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Over-pressure will vary on different range
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- Output load resistance to Vss or Vdd: 2.5KΩ (min), 10KΩ (typ)
- Zeroing at installation is required

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{SS} |
| 3 | OUT |
| 4 | V _{DD} |
| 5~8 | N.C. |

NOTES:

- N.C. pins must be left floating
A 0.1uf capacitor must be connected between V_{DD} and V_{SS}
 Package : 12 pcs/tube

Characteristics

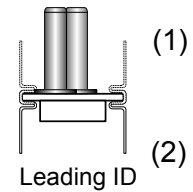
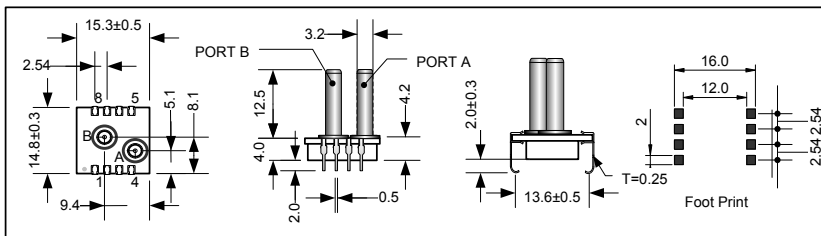
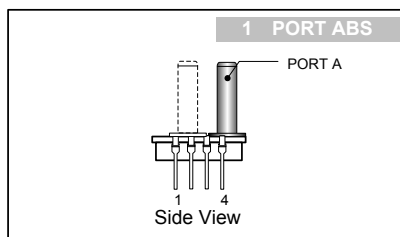
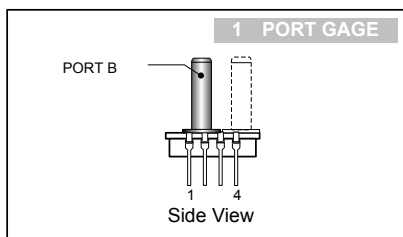
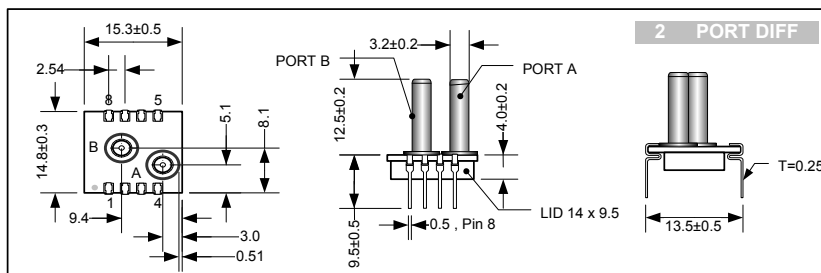
Unless otherwise specified, all parameters are measured at 3/5V, 25 °C and 60% RH

| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|----------------|
| Excitation ¹ | 2.75 | | 5.25 | V |
| Pressure range ² | 2.5 | | 10 | mbar |
| Resolution ³ | 12 | | 14 | Bit |
| Accuracy ⁴ | | | ±4.5 | %FS, +1LSB |
| Zero Output ⁵ | | 0666 | | Hex |
| Full Scale Output ⁵ | | 3999 | | Hex |
| Warm-up Time | | 1 | 2 | ms |
| Start-up Time ⁶ | | | 10 | ms |
| Sampling Rate | 8 | | 1000 | Hz |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁷ | 5X | | | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Smaller range and other units are also available for ordering
- Vary with sensor configuration. Refer to individual data sheet.
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Power up to output
- Over-pressure will vary on different range
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- Output load resistance to Vss or Vdd: 2.5KΩ (min), 10KΩ (typ)
- Zeroing at installation is required

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{SS} |
| 3 | OUT |
| 4 | V _{DD} |
| 5~8 | N.C. |

NOTES:

- N.C. pins must be left floating
A 0.1µf capacitor must be connected between V_{DD} and V_{SS}
 Package : 12 pcs/tube

Characteristics

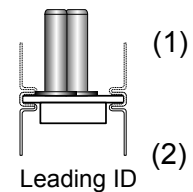
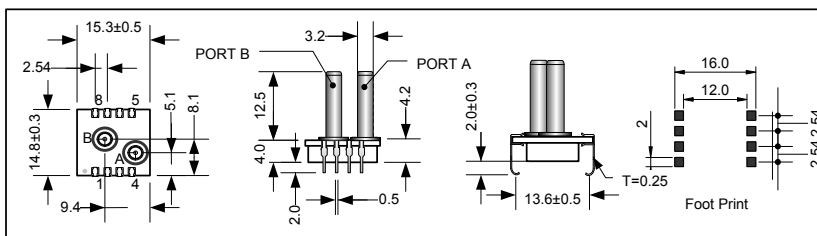
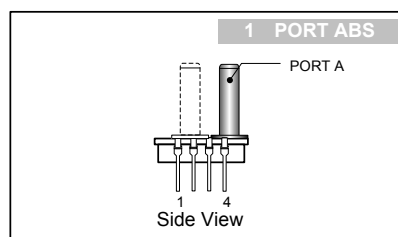
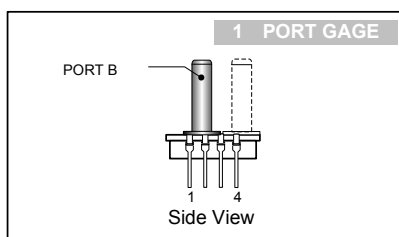
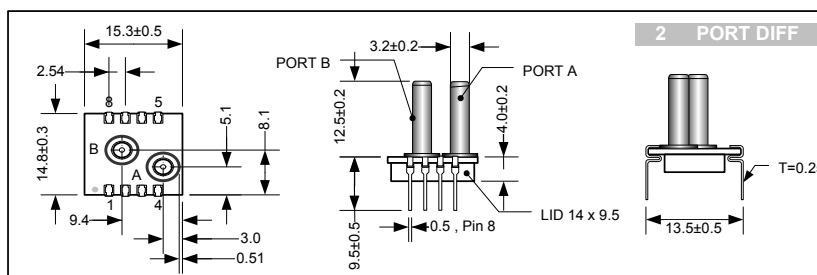
Unless otherwise specified, all parameters are measured at 3/5V, 25 °C and 60% RH

| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|------------------|
| Excitation ¹ | 2.75 | | 5.25 | |
| Pressure range ² | 3 | | 150 | PSI |
| Resolution ³ | | 14 | | Bit |
| Accuracy ³ | | 1.8 | | %FS, +1LSB |
| Zero Output ⁴ | | 0666 | | Hex |
| Full Scale Output ⁴ | | 3999 | | Hex |
| Voltage Low Level | | 0 | 0.2 | V _{DD} |
| Voltage High Level | 0.8 | 1 | | V _{DD} |
| Output Lo-Level | | | 0.1 | V _{DDA} |
| SCL clocking | 100 | | 400 | KHz |
| System Freq | | 1 | | MHZ |
| Update Rate | 1 | | 125 | ms |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁶ | | | 3X | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Smaller range and other units are also available for ordering
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Minimum pull-up on SDA and SCL is 1KΩ
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- The factory setting for I2C slave address is 0x28

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{DD} |
| 3 | INT |
| 4 | SDA |
| 5 | SCL |
| 6 | N.C. |
| 7 | N.C. |
| 8 | V _{SS} |

NOTES:

- N.C. pins must be left floating
A 0.1µf capacitor must be connected between V_{DD} and V_{SS}
 Package : 12 pcs/tube

Characteristics

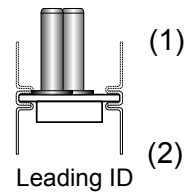
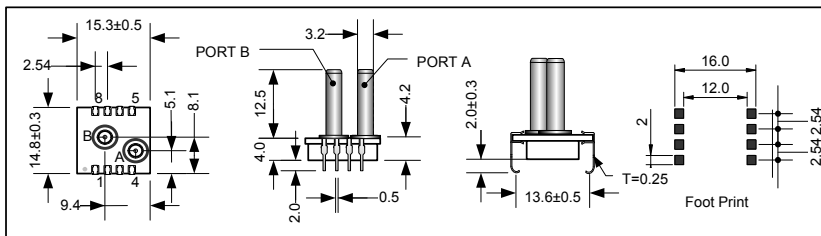
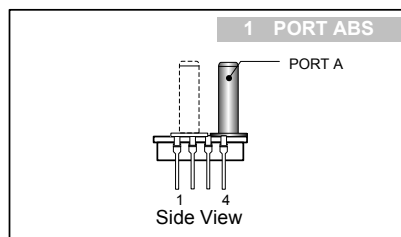
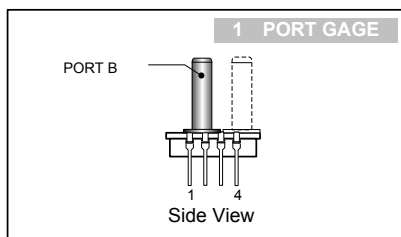
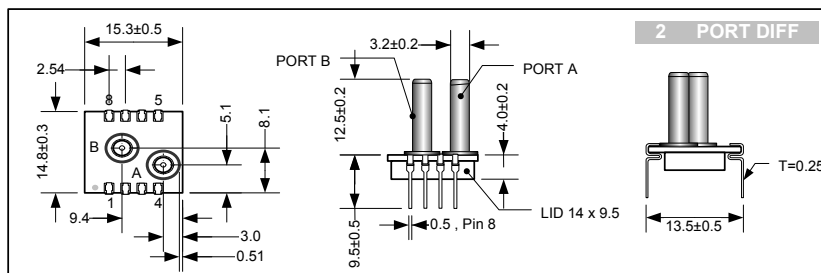
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| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|------------------|
| Excitation ¹ | 2.75 | | 5.25 | |
| Pressure range ² | 0.15 | | 3 | PSI |
| Resolution ³ | | 14 | | Bit |
| Accuracy ³ | | 2.2 | | %FS, +1LSB |
| Zero Output ⁴ | | 0666 | | Hex |
| Full Scale Output ⁴ | | 3999 | | Hex |
| Voltage Low Level | | 0 | 0.2 | V _{DD} |
| Voltage High Level | 0.8 | 1 | | V _{DD} |
| Output Lo-Level | | | 0.1 | V _{DDA} |
| SCL clocking | 100 | | 400 | KHz |
| System Freq | | 1 | | MHZ |
| Update Rate | 1 | | 125 | ms |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁶ | | | 3X | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Smaller range and other units are also available for ordering
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Minimum pull-up on SDA and SCL is 1KΩ
- Over-pressure will vary on different range
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- The factory setting for I2C slave address is 0x28
- Zeroing at installation is required

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{DD} |
| 3 | INT |
| 4 | SDA |
| 5 | SCL |
| 6 | N.C. |
| 7 | N.C. |
| 8 | V _{SS} |

NOTES:

- N.C. pins must be left floating
- A 0.1µf capacitor must be connected between V_{DD} and V_{SS}
- Package : 12 pcs/tube

Characteristics

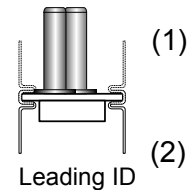
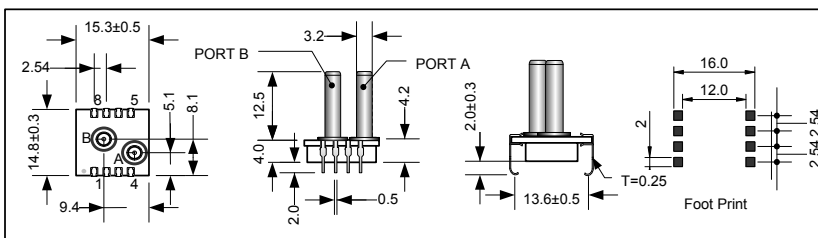
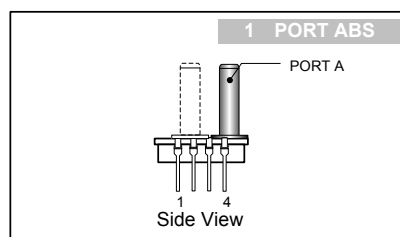
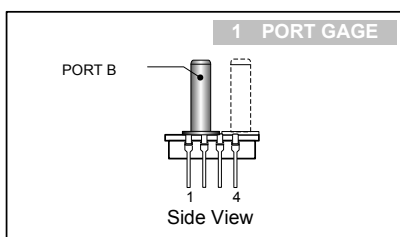
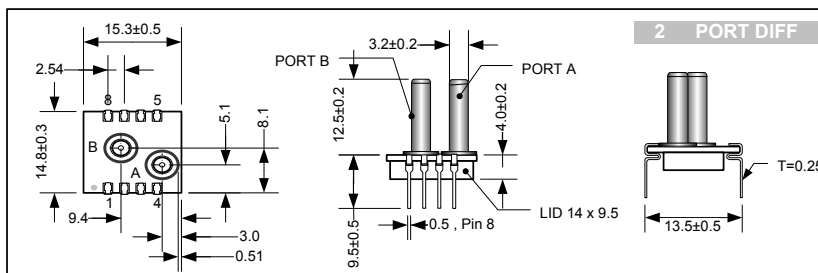
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| Parameters | Min | Typ | Max | Unit |
|--------------------------------|------|------|------|------------------|
| Excitation ¹ | 2.75 | | 5.25 | |
| Pressure range ² | 2.5 | | 10 | mbar |
| Resolution ³ | 12 | | | Bit |
| Accuracy ³ | | | ±4.5 | %FS, +1LSB |
| Zero Output ⁴ | | 0666 | | Hex |
| Full Scale Output ⁴ | | 3999 | | Hex |
| Voltage Low Level | | 0 | 0.2 | V _{DD} |
| Voltage High Level | 0.8 | 1 | | V _{DD} |
| Output Lo-Level | | | 0.1 | V _{DDA} |
| SCL clocking | 100 | | 400 | KHz |
| System Freq | | 1 | | MHZ |
| Update Rate | 1 | | 125 | ms |
| Temp - Compensating | 0 | | 50 | °C |
| Temp - Operating | -20 | | +85 | °C |
| Temp - Storage | -40 | | +125 | °C |
| Over Pressure ⁶ | 5X | | | Rated Pressure |

NOTES:

- Supply 3V or 5V must be ordered separately.
- Custom range and other units are available for ordering
- May vary with sensor configuration
- Accuracy includes NOL, hysteresis, TCS and TCO over 0/50°C, BFSL definition
- For differential pressure, offset = 2000 hex, FS = 666/3999
- Minimum pull-up on SDA and SCL is 1KΩ
- Over-pressure may vary from pressure ranges
- Wetted material: PA, RTV, Epoxy, ceramic, Au, nickel and silicon
- The factory setting for I2C slave address is 0x28
- Zeroing at installation is required

Dimension



NOTE:

- Port B is used for positive differential
- Port A is used for absolute
- Port B is used for gage
- All dimensions are mm
- Recommended tubing 3.2 (OD) 1.8 (ID) Turning tube

| Pin # | Description |
|-------|-----------------|
| 1 | N.C. |
| 2 | V _{DD} |
| 3 | INT |
| 4 | SDA |
| 5 | SCL |
| 6 | N.C. |
| 7 | N.C. |
| 8 | V _{SS} |

NOTES:

- N.C. pins must be left floating
- A 0.1µf capacitor must be connected between V_{DD} and V_{SS}
- Package : 12 pcs/tube

Communication Interface

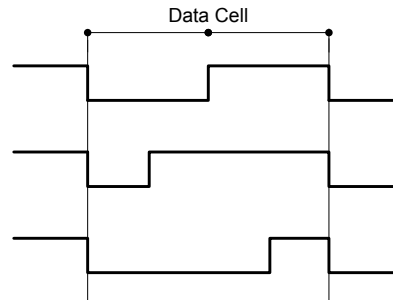
Manchester codes by a transition at the cell boundary are used to represent the binary values of pressure and temperature.

Bit Encoding

Start Bit \Rightarrow 50% duty cycle used to set up strobe time

Logic 1 \Rightarrow 75% duty cycle

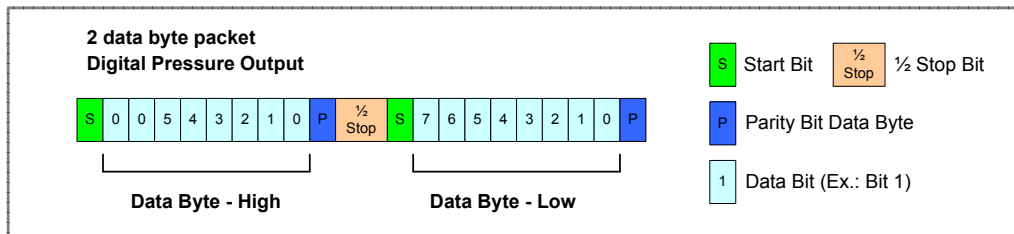
Logic 0 \Rightarrow 25% duty cycle



Read Operation

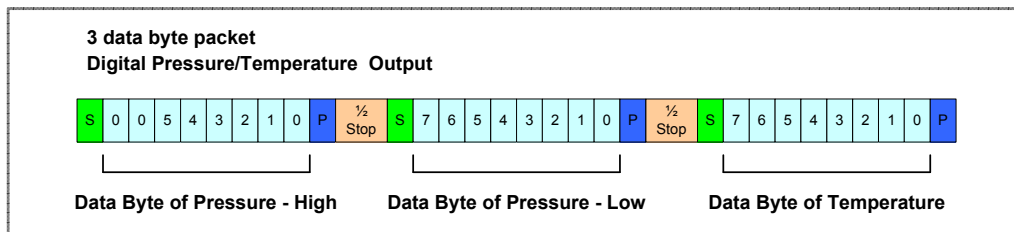
There are two modes (DPT digital pressure output with temperature, and DTO digital pressure out only) available for the output of transducer.

For DPO mode, the transducer first transmits the high byte of pressure data followed by the low byte. The pressure data is 14-bits in resolution, so the upper two bits of the high byte are always zero padded. There is a half stop bit interval between bytes in a packet. That means for the time of half a bit width, the signal level is in high level.



DPO - Digital Pressure Output

For DPT mode, the pressure and temperature will be transmitted as 3 data packets.



DPT - Digital Pressure/Temperature Output

Timing

The baud rate (transmission frequency) of the Manchester coded bit stream is determined during factory calibration and depends on the update rate and thus response time that the customer specifies for the transducer. If no response time is specified by the customer the default response time of 5ms (200Hz) will be selected.

There are a total of 4 different update rates listed below. Using the two faster update rates will result in the baud rate being 32kHz and the two slower update rates will result in the baud rate being set to 8kHz.

| Update Rate | Response Time | Baud Rate | Idle Time Between Data |
|-------------|---------------|-----------|------------------------|
| 1000 Hz | 1 ms | 32kHz | 1ms |
| 200 Hz | 5 ms | 32kHz | 4.85ms |
| 40 Hz | 25 ms | 8kHz | 22.5ms |
| 8 Hz | 125 ms | 8kHz | 118ms |

Hints for Writing Firmware:

The Baud rates (8kHz and 32kHz respectively) will vary +/- 10% with the supply voltage and across temperature. It is strongly recommended that any firmware used to read the digital pressure and temperature readings first use the **start bit** which is 50% high and 50% low to determine the exact frequency before decoding the digital output.

The idle time is the time in between data packets where no transmission occurs (the output is always high when idle).

Suggested Algorithm:

Connect the output of the sensor to a pin of a microcontroller capable of causing an interrupt on a falling edge. When the falling edge is detected this causes a branch into an ISR which is a counting loop incrementing until a rising edge is detected in the output. Now based on the number of counts the frequency can be determined.

Now that the frequency is known the ISR can simply wait for the appropriate time before sampling the other bits.

How to Interpret the Pressure Value

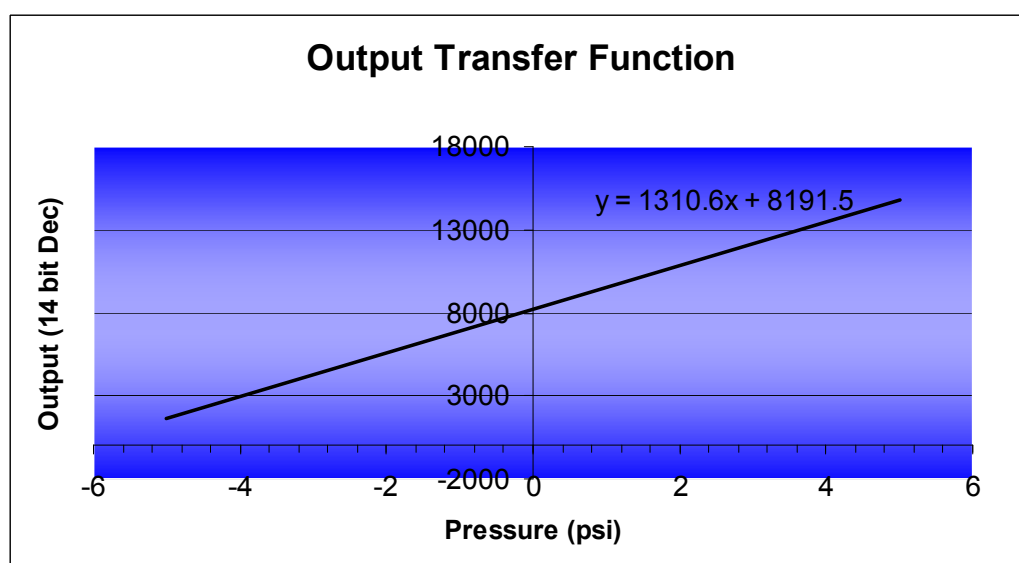
The CCD series pressure sensors have been calibrated to a straight line transfer function. The pressure value can be easily obtained by inserting the output into the transfer function. The process is explained below.

The pressure value is read out as a 14 bit word. The word corresponds to 0x0000 to 0x3FFF in Hex or 0 to 16383 in Decimal.

The first step is to convert the Hex value to Decimal. The calculator supplied with Microsoft Windows will easily do this.

The next step is to port the decimal value into the straight line function shown in the chart below.

The following example is for a -5 to +5 psi transfer function:



The output word is 0x1ABC.

The output word is translated into decimal which is 6844

The decimal word is then inserted into the equation which gives:

$6844 = 1310.6x + 8191.5$ where x is the pressure in psi

We then compute $x = -1.028$ psi

*Note: The transfer function varies for each pressure range. Make sure you use the correct function. If in doubt please consult the factory.

Obtaining the transfer function:

The transfer function is a straight line equation in the standard form $y=mx+c$, where y and x are x,y coordinates, m is the gradient and c is the y -axis intercept.

To compute your straight line transfer function you will simply need the 2 sets of x,y coordinates. These will be supplied to you with outputs of 10%FS and 90% FS by default (custom outputs are available on request).

Example:

Pressure = 0 psi, Output 10% FS

Pressure = 100 psi, Output 90% FS

First we note that the output is 14 bits ie. 0x0000 to 0x3FFF.
In decimal this becomes 0 to 16383.

10% FS is 1638
90% FS is 14745

First we find the gradient m , of our straight line.

$$\begin{aligned} m &= (y_2 - y_1) / (x_2 - x_1) \\ &= (14745 - 1638) / (100\text{psi} - 0\text{psi}) \\ &= 131.07 \end{aligned}$$

Now we substitute this in and we get:

$$y = 131.07x + c$$

We substitute $y=1638$ when $x=0$ and we get

$$c = 1638$$

Which leaves us with our transfer function:

$$y = 131.07x + 1638 \text{ where } y \text{ is the output in Hex and } x \text{ is the corresponding pressure}$$

Note that the pressure x , can be specified in any units bar, psi...etc in which case the transfer function will only be valid for that particular pressure unit.

AN05 (Preliminary)

Digital Output Description for I²C Pressure Sensors (I Series)

This Application Note applies to the following pressure sensors:

CCD Series 53I and 54I

MAP Series 36I

SLP Series 33I and 35I

SPD Series 34I

Abstract:

This application note describes in detail the digital output format of the I Series digital pressure sensors with I²C output.

Design considerations as well as hints for writing interface firmware with an MCU are given

After reading this application note the user should be able to:

- Be able to issue commands to initiate a pressure measurement and read out the result
- Calculate the transfer function for his/her respective sensor

Foreword

The I Series pressure sensors represent the next generation in digital pressure sensing. Designed to be Microcontroller friendly and optimized for battery powered operation. Among the key features:

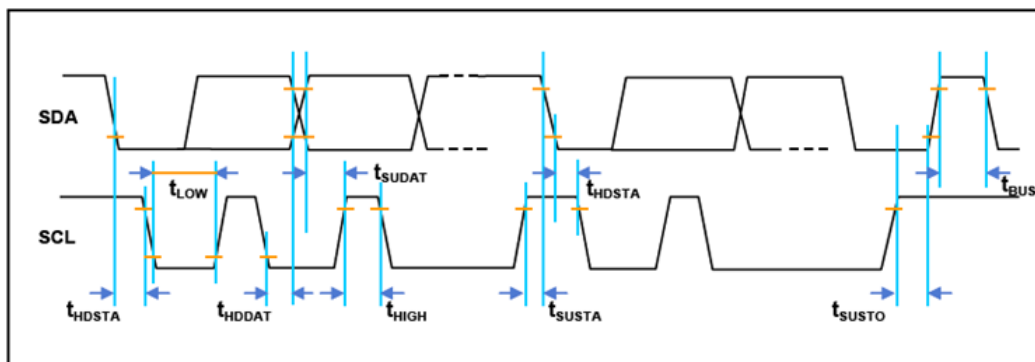
- I²C interface with different address options
- Sleep mode with **2μA** standby current
- Peak operating current of **2mA**
- Low voltage operation from **2.7V** to 5.5V and as low as **2.4V** with de-rated accuracy.

I²C Communication Parameters

| Parameters | Min | Typ | Max | Unit | Remarks |
|--|-----|-----|-----|------------|-------------|
| Voltage Low Level | | 0 | 0.2 | Vdd | |
| Voltage High Level | 0.8 | 1 | | Vdd | |
| SCL Clock Frequency | | 100 | | kHz | f_{SCL} |
| Start Condition Hold Time | 0.1 | | | μ s | t_{HDSTA} |
| Minimum SCL clock Low width | 0.6 | | | μ s | t_{LOW} |
| Minimum SCL clock High width | 0.6 | | | μ s | t_{HIGH} |
| Start Condition Setup Time | 0.1 | | | μ s | t_{SUSTA} |
| Data Hold Time on SDA | 0 | | | μ s | t_{HDDAT} |
| Data Setup Time on SDA | 0.1 | | | μ s | t_{SUDAT} |
| Stop Condition Setup Time on SCL | 0.1 | | | μ s | t_{SUSTO} |
| Bus free time between Start and Stop Condition | 1.0 | | | μ s | t_{BUS} |
| Pull Up resistor on SDA & SCL | 1.5 | | | k Ω | |

Notes

- 1) Relative to SCL Edge
- 2) Combined low and high widths must equal or exceed minimum SCL period
- 3) All Timing is subject to a $\pm 10\%$ variation



I²C Timing Diagram

Sensor Operation

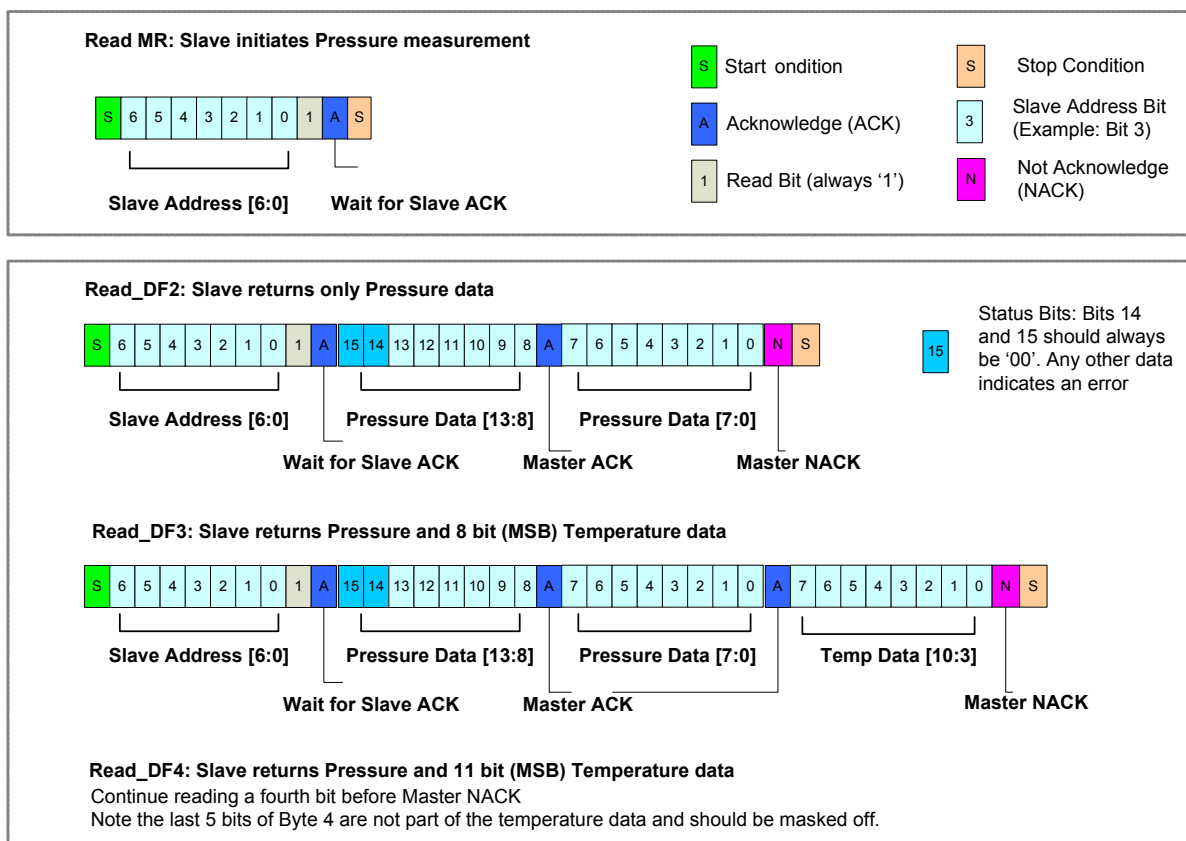
The operation of the I Series pressure sensors are detailed by the ASM chart on the following page.

Upon power on the sensor performs various reset and initialization functions. This will take 6 ms before entering into 'Sleep Mode'. The sensor remains in this mode whenever not in use to conserve power.

To initiate a pressure measurement, the I²C master issues a Read_MR command. This prompts the sensor to initiate a pressure measurement. The process takes 25 ms to complete the measurement after which it re-enters Sleep Mode.

After the result is ready it can be read out using Read_DF2 or Read_DF3 commands depending on what data is required to be read.

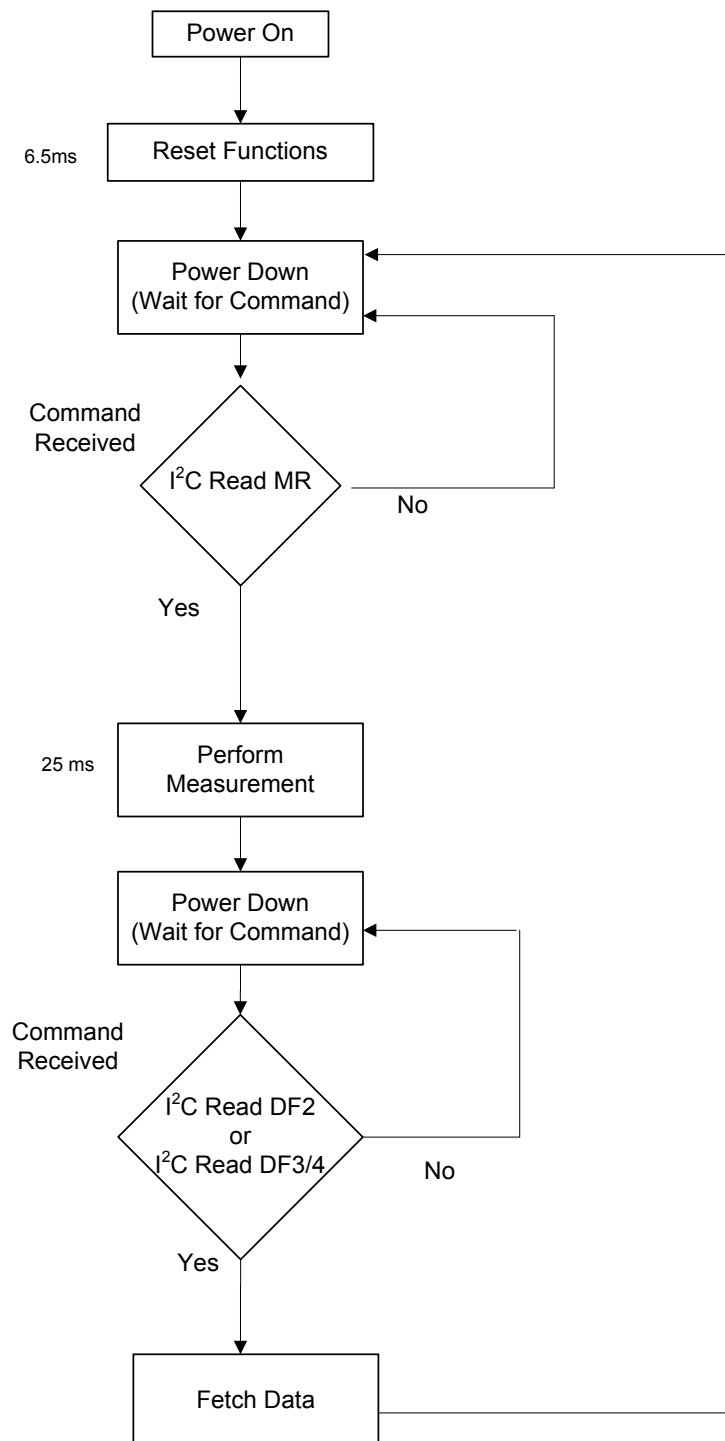
After the read command, the sensor returns to the Sleep Mode and waits for the next command to initiate pressure measurement.



I²C Packet Reading

Note: We do not guarantee the accuracy of the Temperature output but instead provide it as an added feature at no extra cost.

Working Mode Description



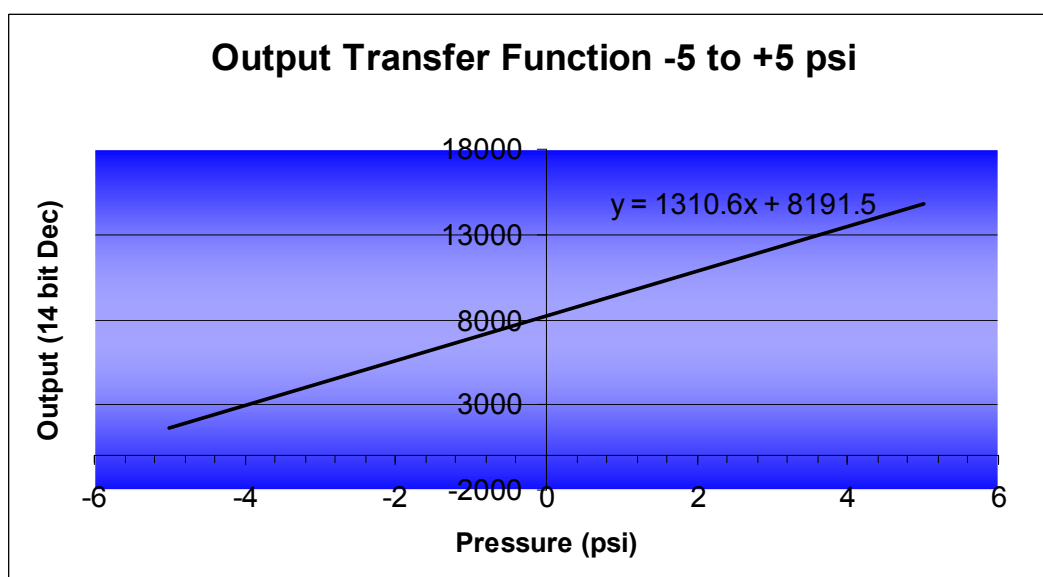
How to Interpret the Pressure/Temperature Value

All digital pressure sensors have been calibrated to a straight line transfer function. Temperature and non-linearity compensation are already included and are transparent to the user. The pressure value can be easily obtained by inserting the output into the transfer function. The process is explained below.

The pressure value is read out as a 14 bit word. The word corresponds to 0x0000 to 0x3FFF in Hex or 0 to 16383 in Decimal.

The first step is to convert the Hex value to Decimal. The calculator supplied with Microsoft Windows will easily do this.

The next step is to port the decimal value into the straight line function shown in the chart below.



The following example is for a -5 to +5 psi transfer function:

The output word is 0x1ABC.

The output word is translated into decimal which is 6844

The decimal word is then inserted into the equation which gives:

$6844 = 1310.6x + 8191.5$ where x is the pressure in psi

We then compute $x = -1.028$ psi

*Note: The transfer function varies for each pressure range. Make sure you use the correct function. The transfer functions for standard ranges are found on the next page

Transfer Function

To obtain the transfer function we start with the two parameters found in the sensor datasheet shown again below for convenience.

| Parameters | Min | Typ | Max | Unit |
|-------------------|-----|------|-----|------|
| Zero Output | | 0666 | | Hex |
| Full Scale Output | | 3996 | | Hex |

Zero output = 0x0666 and Full Scale output = 0x3996.

The total output resolution is 14 bits or 0x3FFF.

We convert these into decimal for convenience:

Zero output = 1638, Full Scale output = 14742 and Total output resolution = 16383

Note that 1638 is 10% of total resolution and 14742 is 90% of total resolution so only 80% of the total 14 bit resolution is used to represent the required FS.

Now we correlate the outputs to the pressure range (see ordering guide in datasheet on how to specify pressure range). The example below refers to the output function on the previous page.

| Parameter | Corresponding Pressure | Hex | Decimal |
|-------------------|------------------------|--------|---------|
| Zero Output | -5 psi | 0x0666 | 1638 |
| Full Scale Output | + 5 psi | 0x3996 | 14742 |

So taking the coordinates (-5 psi , 1638 counts) and (+5 psi, 14742 counts) we can calculate the corresponding straight line transfer function by calculating the gradient and Y-axis intercept.

In this case it is $Y = 1310.6X + 8191.5$ where Y=Digital output in Decimal and X= pressure in psi

Temperature Transfer Function:

| Temperature Range | Transfer Function |
|-------------------|--|
| -50 to 150 °C | $y = 1.275x + 63.75$ (8 bit (MSB) version) |
| -50 to 150 °C | $y = 10.24x + 512$ (11 bit version) |

Note: The temperature transfer function is the same regardless of the pressure range chosen. The temperature output is not intended for high accuracy measurements but is instead an additional function provided at no extra cost.

Effective Resolution

While the resolution is stated as 14 bits in the datasheet it is impossible to attain this resolution in practice.

14 bits is merely the resolution of the internal Analog to Digital converter (ADC) of the ASIC used to achieve the digital compensation and output.

In practice its resolution will be lower than 14 bits with quantization noise and amplification errors that result in a non-perfect match of the input range of the ADC to the sensor being compensated.

Therefore the guaranteed resolution of the sensors is 0.05% FS or 11 bits.

In most cases the software designed to read the pressure word should (where possible) allow for an averaging of 2-8 readings. The exact resolution versus sampling speed should be determined by the customer as it is very much dependent on the application.

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