

# NPI-19 I2C Digital Pressure Sensor

Application Guide



**Amphenol**  
Advanced Sensors

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## 1. General Description

The NPI I2C digital pressure sensors combines Amphenol Advanced Sensors' SenStable<sup>®</sup> silicon fusion bonded pressure die technology with packaged electronics to provide highly stable, amplified and calibrated pressure measurement.

## 2. Output Characteristics

### 2.1 Pressure Output Options

The NPI-19 I2C product is available in a range of pressure ratings, pressure configurations. The nominal output ranges for standard product ranges are detailed in Tables 1 and 2 below.

**Table 1: Available Pressure Output Ranges for Standard Products**

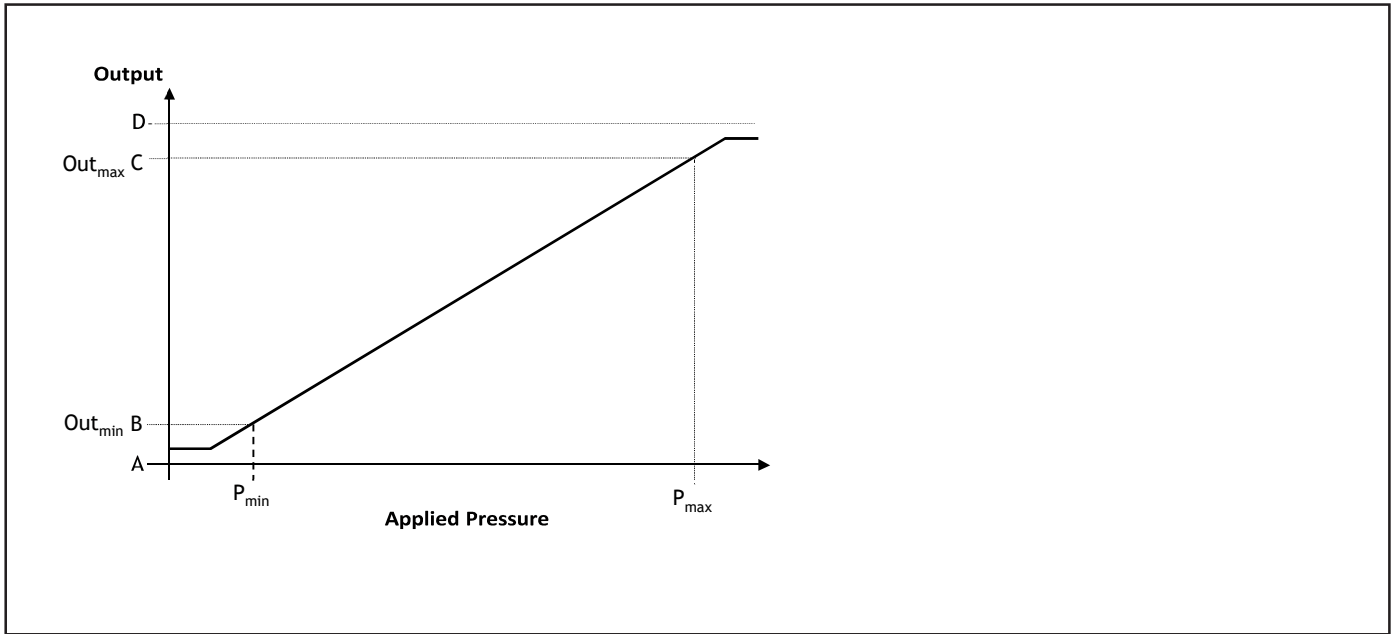
Device series	Units	Absolute/Gauge		Excitation
NPI-19 I2C	Counts	1638	14745	3.3 V

**Table 2: Output Transfer Function**

Pressure	% Output	Decimal Counts	Hexadecimal Counts
Pmin	10	1638	0x0666
Pmid	50	8192	0x2000
Pmax	90	14746	0x399A

## 2.2 Pressure Output Characteristics

All NPI-19 digital pressure sensors are factory calibrated to give a defined linear change in output over a specified range of pressures. Outside this range, the output varies with pressure but with unspecified accuracy.



**Figure 1: Output Characteristic of Calibrated Types**

Pressure can be calculated from the sensor output using the following formula:

$$P = P_{min} + \left( \frac{Out - Out_{min}}{Out_{max} - Out_{min}} \right) \cdot (P_{max} - P_{min})$$

where  $P$  = calculated pressure

$Out$  = measured sensor output

### 2.3 Pressure Accuracy

The measurement accuracy of calibrated NPI-19 Digital pressure sensor is defined in terms of percentage of full scale (FS) over a specified compensated temperature range. Standard parts are specified to be  $\pm 1.0\%$ . This accuracy figure is a total error band and includes all errors due to offset, span, linearity and temperature, as illustrated in Figure 2 below.

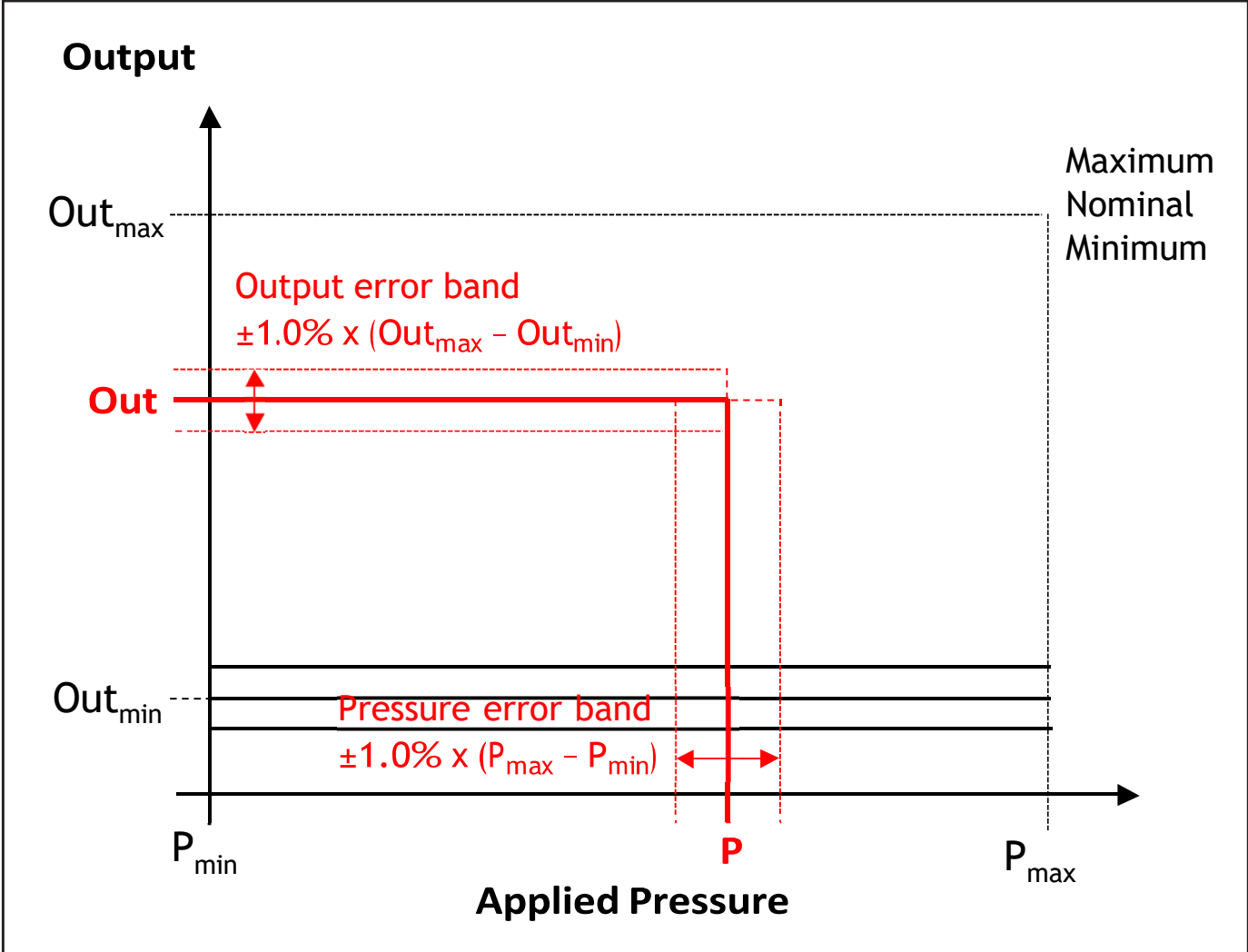


Figure 2: Accuracy of Calibrated NPI-19 Digital Pressure Sensor

### 3. Digital Output (I<sup>2</sup>C)

#### 3.1 General

NPI pressure sensor provides digital output data using the industry standard I<sup>2</sup>C protocol. Bit rates up to 400 kHz are supported, compatible with the Standard-mode (Sm) and Fast-mode (Fm) standards. Devices are supplied with a slave address of 0x28 as standard.

#### 3.2 Block Diagram

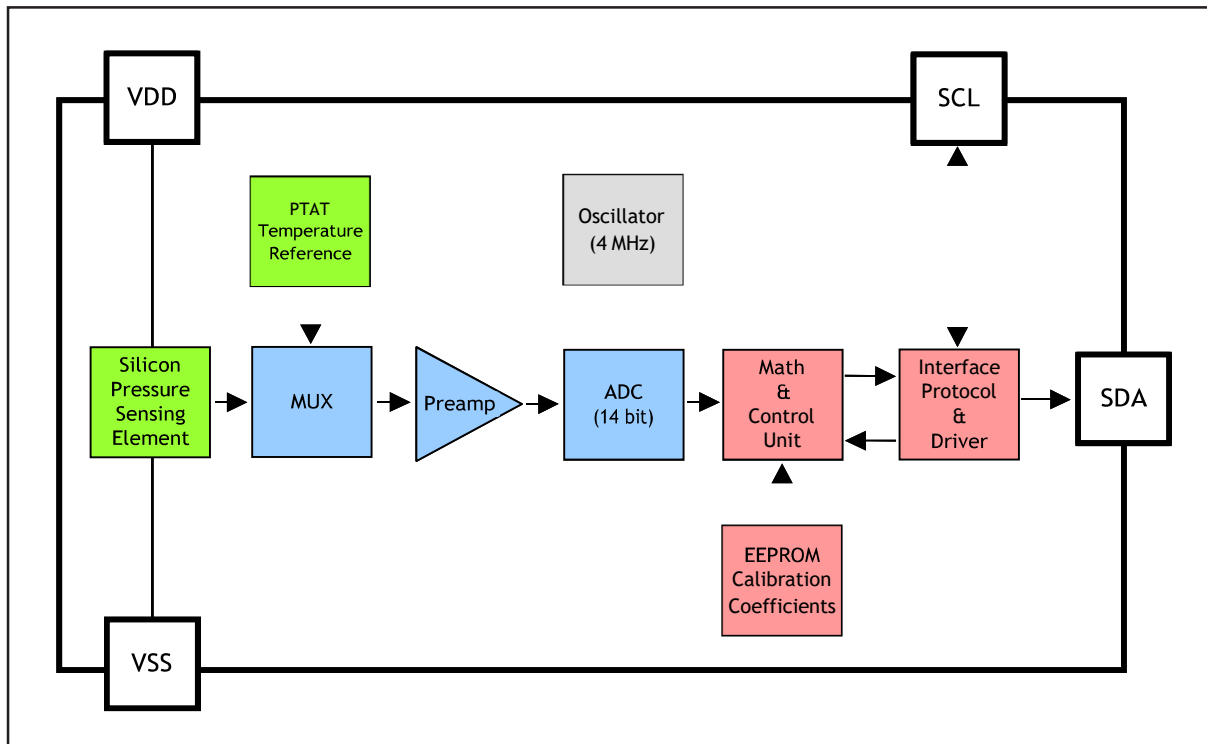


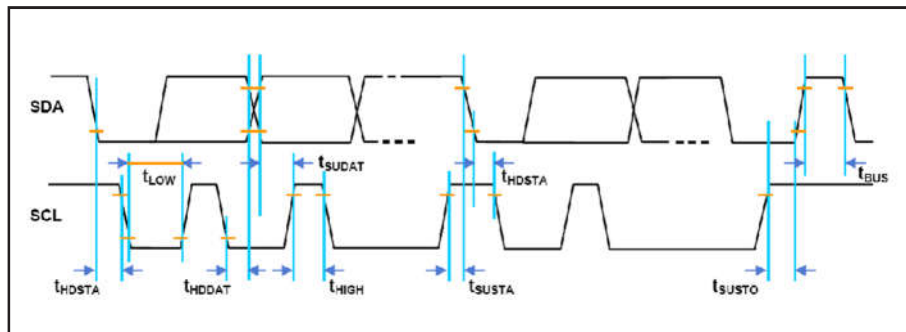
Figure 3: Block Diagram of NPI pressure sensor

### 3.3 I<sup>2</sup>C Timing

**Table 3: I<sup>2</sup>C Timing Parameters**

Parameter	Symbol	Min	Max	Units
SCL clock frequency	$f_{SCL}$	100	400	kHz
Start condition hold time relative to SCL edge	$t_{HDSTA}$	0.1		$\mu$ s
Minimum SCL clock low width*	$t_{LOW}$	0.6		$\mu$ s
Minimum SCL clock high width*	$t_{HIGH}$	0.6		$\mu$ s
Start condition setup time relative to SCL edge	$t_{SUSTA}$	0.1		$\mu$ s
Data hold time on SDA relative to SCL edge	$t_{HDDAT}$	0		$\mu$ s
Data setup time on SDA relative to SCL edge	$t_{SUDAT}$	0.1		$\mu$ s
Stop condition setup time on SCL	$t_{SUSTO}$	0.1		$\mu$ s
Bus free time between stop and start condition	$t_{BUS}$	2		$\mu$ s

\* Combined low and high widths must equal or exceed minimum SCL period.



**Figure 4: I<sup>2</sup>C Timing Diagram**

Two conditions can cause communication errors:

- Sending a start-stop condition without any transitions on the SCL line (no clock pulses in between) creates a communication error for the following communication, even if the next start condition is correct and the clock pulse is applied.
- Restart condition – a falling SDA edge during data transmission when the SCL line is still high will cause the next communication to fail.

In both situations, an additional start condition should be sent to restore communication.

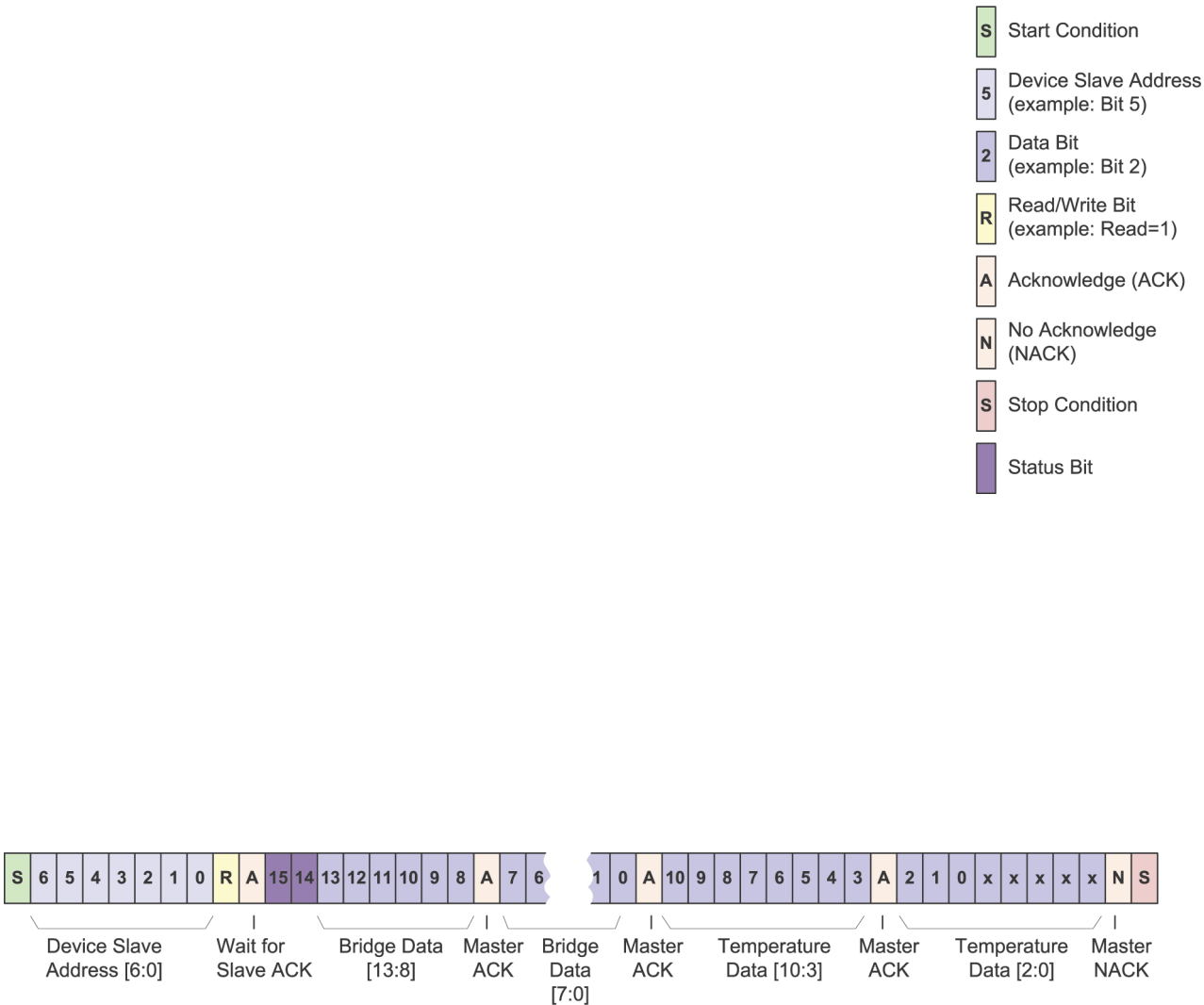
### 3.4 Data Read Operations

To read data from the NPI-19 digital sensor, the I<sup>2</sup>C master device sends 8 bits — the 7 bit slave address (0x28 for standard devices) and the 8th bit = 1 to designate a read request. The NPI-19 digital sensor then sends acknowledge (ACK) to indicate success.

The NPI-19 digital sensor has three I<sup>2</sup>C read commands:

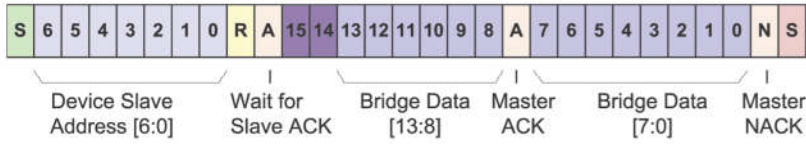
- Read\_DF2: Pressure (2 bytes)
- Read\_DF3: Pressure (2 bytes) + Temperature (1 byte)
- Read\_DF4: Pressure (2 bytes) + Temperature (2 bytes)

The number of data bytes returned by the NPI-19 digital sensor is determined by when the I<sup>2</sup>C master device sends the NACK and stop conditions as shown in Figure 5 below.

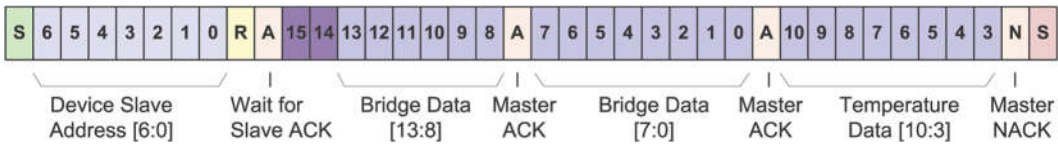




**Read\_DF2: Data Fetch 2 Bytes**



**Read\_DF3: Data Fetch 3 Bytes**



**Read\_DF4: Data Fetch 4 Bytes**

**Figure 5: I<sup>2</sup>C Data Packet Read**