

# CPS135B



Consensic

## Data Sheet

Digital Barometer

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# CPS135B

## Digital Barometer



### Overview

The CPS135B SIP (System-in-a-Package) solution comprises of a resistive bridge type pressure sensor and a 24-bit ADC for high resolution and accurate pressure measurements. The fully calibrated pressure and temperature compensated digital output makes the CPS135B solution simple to use. The CPS135B comprises of an internal calibration logic that provides accurate pressure and temperature measurements to the application via I<sup>2</sup>C interface. There is no need to separately download internal calibration coefficients and have the host micro-controller conduct complicated compensation calculations.

### Applications

- Altimeters
- Portable and Stationary Barometers
- Weather Stations
- GPS Applications
- Hard Disk Drives(HDD)
- Industrial Equipment
- Air Control Systems
- Vacuum Systems

### Benefits

- Low Power Consumption. Excellent for Battery and Other Low-Power Applications
- External Clock not Required
- High Resistance to Sensing Media

### Features

- Factory Calibrated Pressure and Temperature Sensor
- Supply Voltage: 2V to 5.5V(3V @typical)
- Current Consumption: <5uA(One Measurement)
- Sleep State Current: <200nA (25°C)
- Operating Temperature Range: -40°C to +85°C
- Pressure Accuracy:  $\pm 0.3\text{kPa}$  ( $\pm 3.0\text{mbar}$ ) @ 25°C
- Temperature Accuracy:  $\pm 1.0^\circ\text{C}$

### Interfaces

- I<sup>2</sup>C<sup>TM</sup>\* Compatible ( $\leq 400\text{kHz}$ )

### Physical Characteristics

- Small Form Factor, 4.5 x 4.5 x 3.5mm (w x l x h)
- SMD, 6 Lead
- Ceramic Substrate

\*I<sup>2</sup>C<sup>TM</sup> is a registered trademark of NXP



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## CPS135B BLOCK DIAGRAM

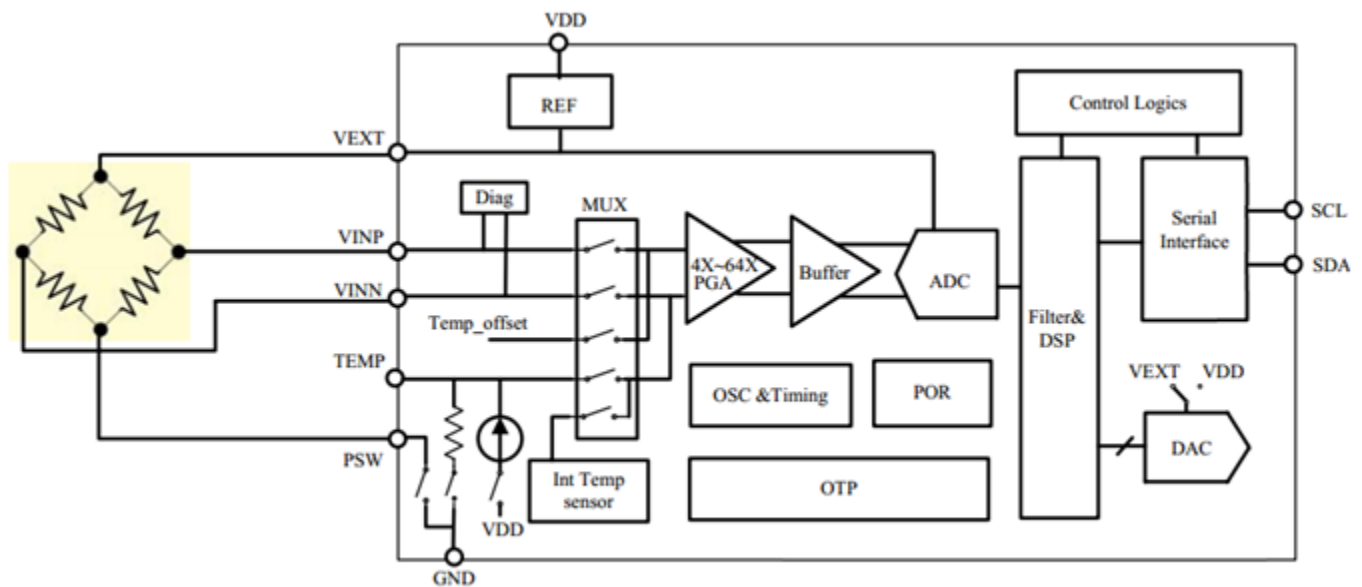


TABLE1: ORDERING INFORMATION

PART NUMBER	OUTPUT MODE	OPERATION MODE	PACKAGE
CPS135B	I <sup>2</sup> C	Sleep	6-Lead SMD
SALES and CONTACT INFORMATION <a href="mailto:sales@consensic.com">sales@consensic.com</a>			<a href="http://www.consensic.com">www.consensic.com</a>

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## 1 OPERATING CHARACTERISTICS

### 1.1 ABSOLUTE RATINGS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Over Pressure					2X FS	kPa (bar)
Supply Voltage (with respect to GND)	$V_{DD}$		-0.3		6.5	V
Voltages at Analog and Digital I/O Pins	$V_{A\_IO}$		-0.3		$V_{DD} + 0.3$	V

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	$V_{D IO}$					
Storage Temperature	$T_{STOR}$		-60		150	°C

## 1.2 OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>PRESSURE SENSOR</b>						
Range			50 (500)		160 (1600)	kPa (mbar)
Resolution <sup>1</sup>				0.01 (0.1)		kPa (mbar)
Accuracy		50 to 160kPa @25°C	-0.3 (-3.0)	±0.15 (±1.5)	+0.3 (+3.0)	kPa (mbar)
		50 to 160kPa (0°C to 50°C Verified)	-0.5 (-5.0)	±0.3 (±3.0)	+0.5 (+5.0)	kPa (mbar)
Solder Drifts			-0.2		+0.2	kPa
<b>TEMPERATURE SENSOR</b>						
Range			-40		85	°C
Resolution				0.003		°C
Accuracy		-40°C to 85°C	-1	±0.75	+1	°C
<b>OPERATION</b>						
Supply Voltage to GND <sup>2</sup>	$V_{SUPPLY}$		2	3.0	5.5	V
Operating Temperature Range			-40		85	°C
I <sup>2</sup> C Pull-Up Resistors	$R_{PU}$		1	2.2		kΩ
<sup>1</sup> Guaranteed by design of 24bits ADC, and calculated according to the range in application. <sup>2</sup> Factory calibrated for Pressure and Temperature at 3.0V±10%. Output accuracy will be affected if used outside this range. Other ranges available upon request.						

## 1.3 ELECTRICAL PARAMETERS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>SUPPLY CURRENT</b>						

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Supply Current, average(1) during conversion(2) standby(no conversion)	I <sub>avg</sub> I <sub>SC</sub> I <sub>SS</sub>	VDD=3V		3.95 1.5	0.2	μA mA uA
ANALOG TO DIGITAL CONVERTER						
Resolution	R <sub>ADC</sub>				24	Bit
I <sup>2</sup> C Clock Frequency	F <sub>C,I2C</sub>				400	kHz

## Notes

- 1) Under the assumption of one conversion every second. Conversion means either a pressure or a temperature measurement
- 2) During conversion, the sensor will be switched on to VDD, and after conversion ended, the sensor will automatically be switched off from VDD.

## 2 OPERATION MODES

The CPS135B is factory programmed to Sleep Mode. In this mode, the CPS135B remains asleep until the master/host sends a measurement request (MR) before taking sensor measurements. After the CPS135B receives an MR command, it wakes up, runs a full measurement cycle, stores the measurement data in internal registers and then returns to sleep mode again.

## 3 OUTPUT MODES

### 3.1 I<sup>2</sup>C Slave

Two-wire I<sup>2</sup>C is available for reading sensor measurement data from the CPS135B.

The factory setting for the I<sup>2</sup>C slave address is 0x6D and the communication is restricted to this address only.

- I<sup>2</sup>C Address = 0x6D

### 3.2 I<sup>2</sup>C COMMANDS

Table 2 details the commands to interface with the device in the I<sup>2</sup>C mode.



TABLE 2: I<sup>2</sup>C COMMANDS

TYPE	DESCRIPTION
Get Data (GD)	Retrieves the sensor measurement data from the internal CPS135B registers*.
Measurement Request (MR)	Wakes up the CPS135B, performs a sensor measurement, stores the sensor measurement data in internal registers and returns to sleep

*\*Note: GD does not initiate a new measurement. Repeated GD commands will return the same (or stale) sensor measurement data. An MR is required to perform a full sensor measurement cycle to refresh the sensor register data.*

The Get Data (GD) command is used to read out data from the CPS135B. With the start of communication (for I<sup>2</sup>C after reading the slave address) the entire sensor measurement output packet will be loaded in a serial output register. The register will be updated after the communication is finished. The output is always scaled to 24-bits.

The ordering of the bits is “big-endian”.

### 3.2.1 I<sup>2</sup>C GET DATA

An I<sup>2</sup>C Get Data command starts with the 7-bit slave address and the 8<sup>th</sup> bit = 1 (READ). The device then sends acknowledge (ACK), indicating I<sup>2</sup>C communication success. The number of data bytes returned by the device is determined by the master, which controls NACK and stop conditions.

Figure 1 displays an example for sending three bytes followed by reading five bytes. The first byte contains the I<sup>2</sup>C address followed by internal register address(0x06). Then the I<sup>2</sup>C address is repeated, followed by the slave sending out three pressure bytes and two temperature bytes.

**The GD command is used to retrieve the pressure and temperature sensor data after an MR command has been executed.**

#### FIGURE 1: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES

Note that the two temperature byte codes are formatted in 2's complement.

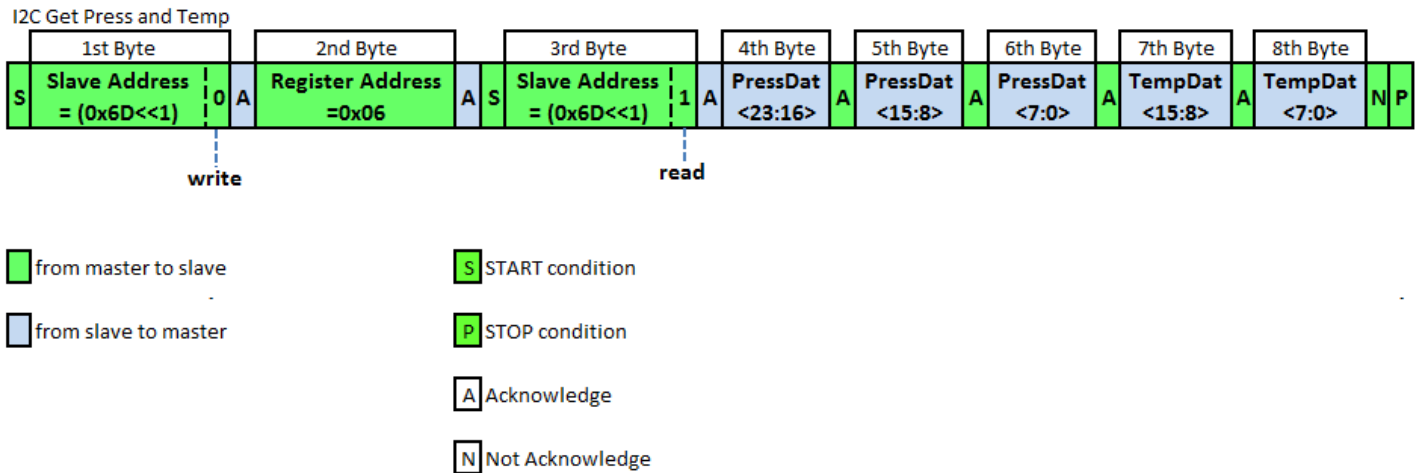
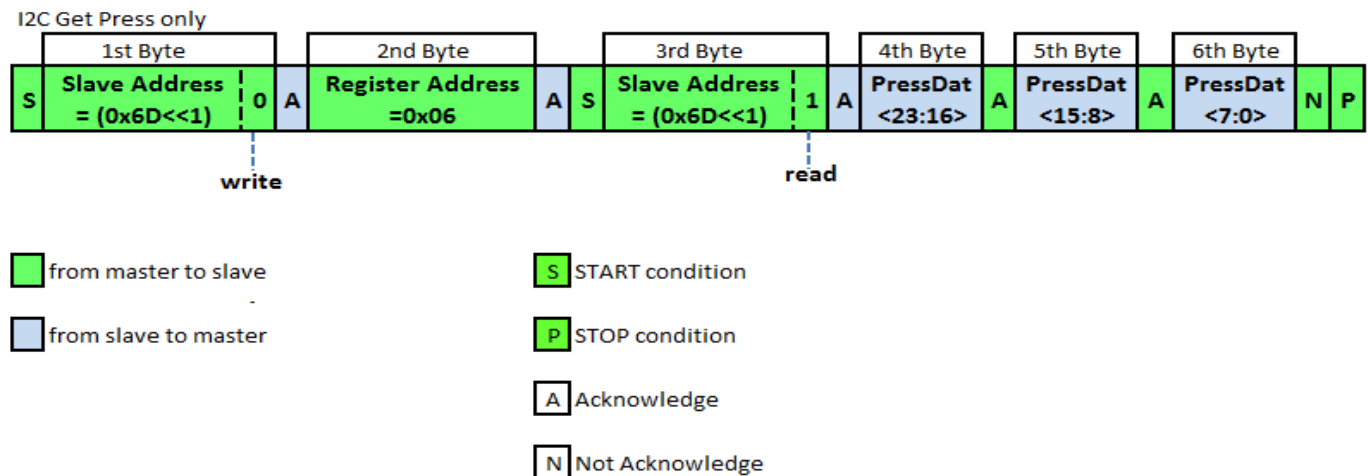


FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES

For Pressure data only, the data stream can be terminated after the sixth pressure byte. See Figure 2 below.



### 3.2.2 I<sup>2</sup>C MEASUREMENT REQUEST

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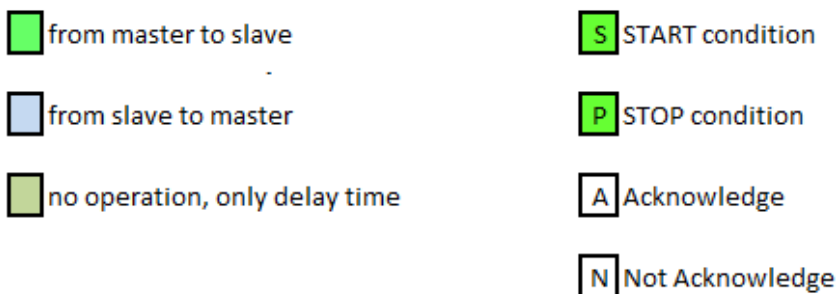
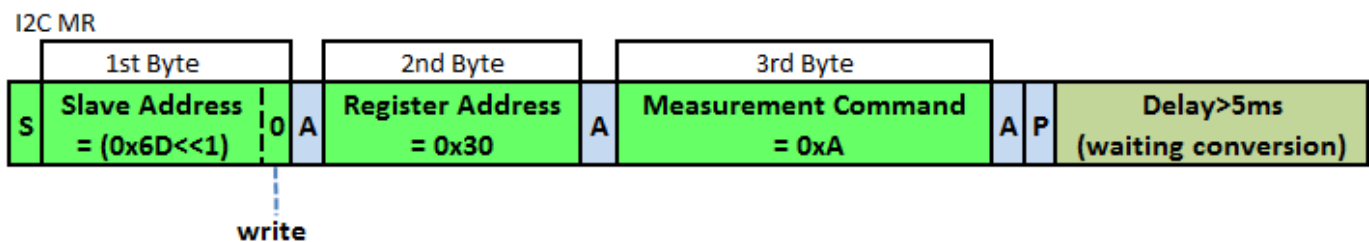
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The I<sup>2</sup>C MR is used to wake up the device from Sleep Mode and start a complete sensor measurement cycle, before the device returns to Sleep Mode again. The measurement cycles starts with a pressure measurement followed by a temperature measurement. The sensor measurements are digitized and run through an onboard compensation algorithm before the final measurement values are written to the digital output register. As shown in Figure 3, the communication requires the slave address (0x6D) and a WRITE bit (0) to initiate the MR. This is followed by two bytes; register address (0x30) and measurement (0xA). After the CPS135B responds with the slave ACK, the master terminates the communication with a stop condition.

Sensor measurement conversion time takes approximately 5ms, so MRs should not be sent faster than every 5ms.

**FIGURE 3: I<sup>2</sup>C MEASUREMENT REQUEST COMMAND (0xA)**



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## 4 CALCULATING OUTPUT

After retrieving the data, the compensated output can be scaled to real world values by following the equations below.

### 4.1 PRESSURE OUTPUT

An example of the 24-bit compensated pressure with a full scale range of 50 to 160kPa can be calculated as follows:

$$\text{Pressure [kPa]} = (\text{Pressure 3rd Byte [23:16]} \times 65536 + \text{Pressure 2nd Byte [15:8]} \times 256 + \text{Pressure 1st Byte [7:0]}) / 2^{15}/1000$$

### 4.2 TEMPERATURE OUTPUT

The 16-bit compensated temperature can be calculated as follows:

$$\text{Positive Temperature [}^{\circ}\text{C]} = (\text{Temperature High Byte [15:8]} \times 256 + \text{Temperature Low Byte [7:0]}) / 2^8$$

$$\text{Negative Temperature [}^{\circ}\text{C]} = (\text{Temperature High Byte [15:8]} \times 256 + \text{Temperature Low Byte [7:0]} - 65536) / 2^8$$

## 5 PACKAGE AND ASSEMBLY

The CPS135B is available in a 6-pin SMD package.

### 5.1 PIN ASSEMBLY AND MECHANICAL DRAWING

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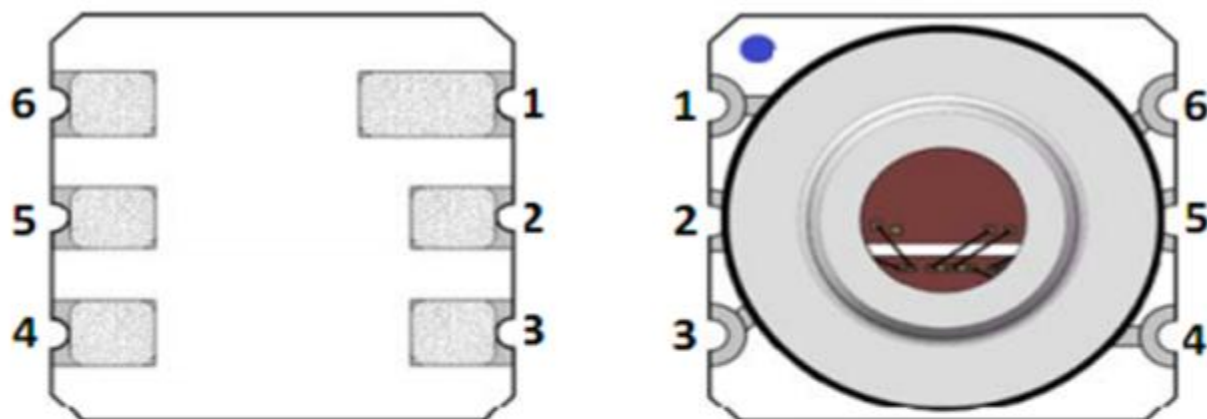


Figure 1. Pin Configuration

PIN	Name	Type	Function
1	VDD	P	Positive Supply Voltage
2	NC	---	---
3	SCL	I	Serial Data Clock
4	SDA	I/O	I <sup>2</sup> C Data IO
5	NC	---	---
6	GND	P	Ground

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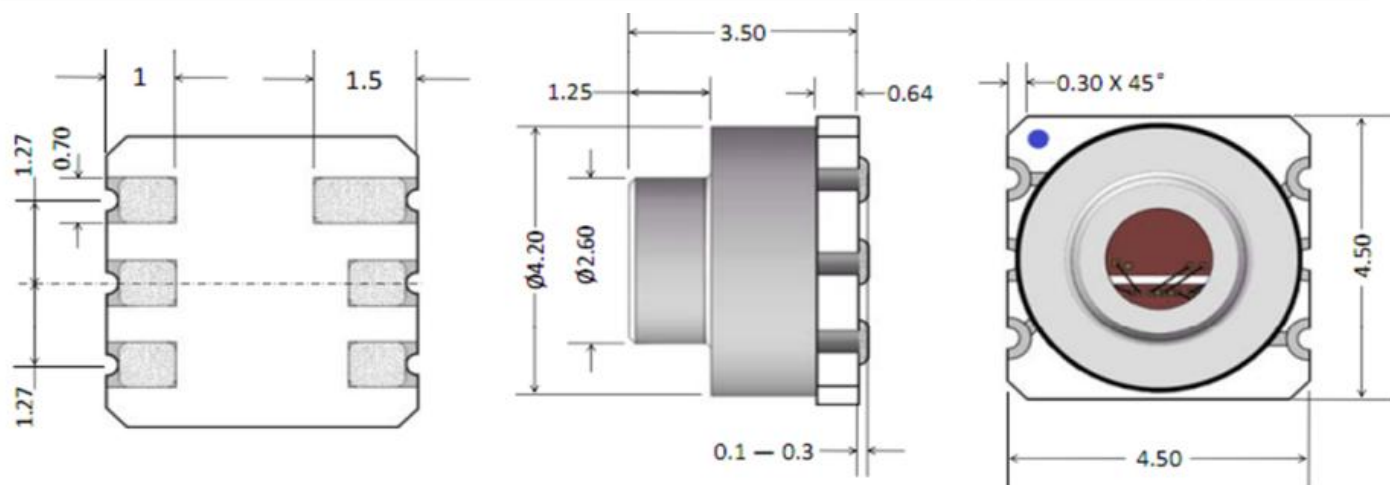


Figure 2. CPS135B Package Outline

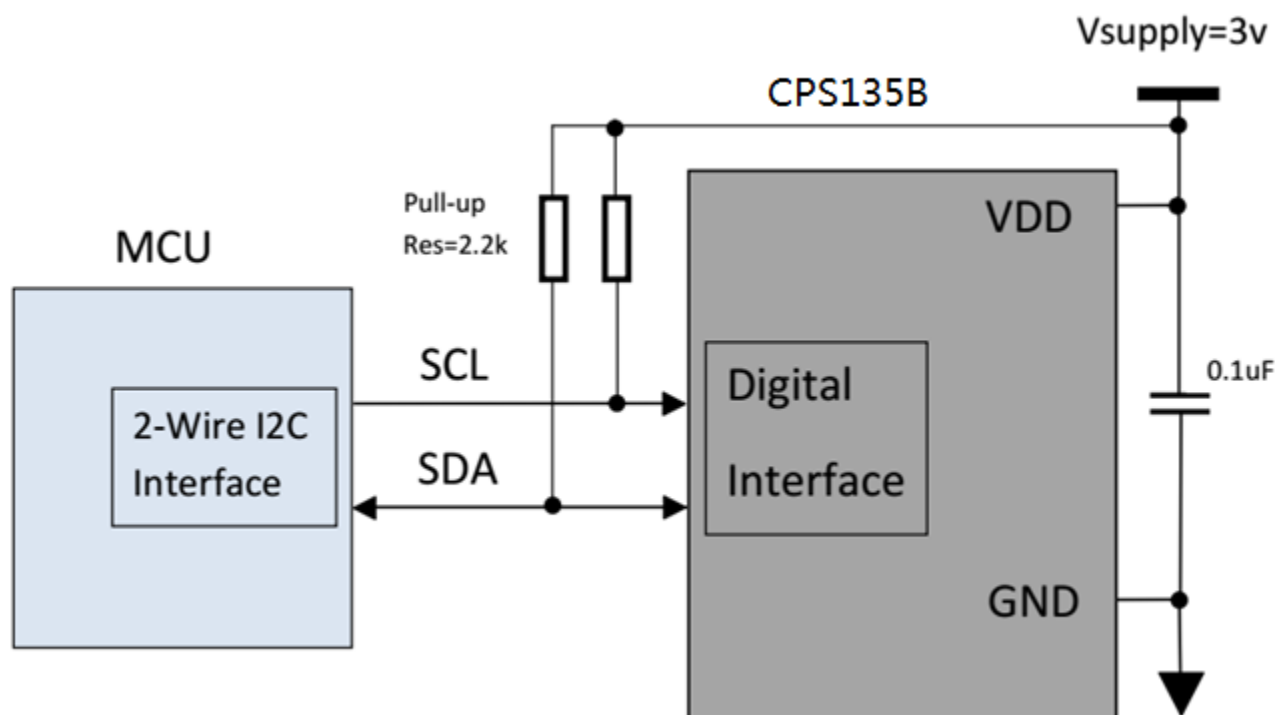
- Note:
1. Dimensions in mm
  2. Interpret Dim and tolerance per ASME Y14.5M-1994
  3. Angular Dimensions  $\pm 0.3^\circ$
  4. Hole Locations  $\pm 0.1$
  5. Linear Dimension  $\pm 0.04$
  6. Cap centering  $\pm 0.15$  from center of ceramic

## 5.2 SOLDERING CONDITIONS

TABLE4: PACKAGE REFLOW TEMPERATURE

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Soldering Peak Temperature	Less than 30 seconds (JEDEC-STD-020 Standard)			260	°C

## 6 APPLICATION DIAGRAM



## 7 DOCUMENT HISTORY

REVISION	DATE	DESCRIPTION
0.0	Sep-2016	Preliminary
1.0	OCT-2016	Range change to 50kpa ~160kpa

## 8 DISCLAIMER

Information in this datasheet is provided solely to enable implementation and use of Consensic products. The specifications and characteristics are subject to change without notice. Consensic reserves the right to make changes without further notice to any products herein.

“Typical” parameters provided in this datasheet can and do vary in different applications and actual performance may vary over time. Customers must validate all operating parameters for their application.

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