

# CPS135B-1000D

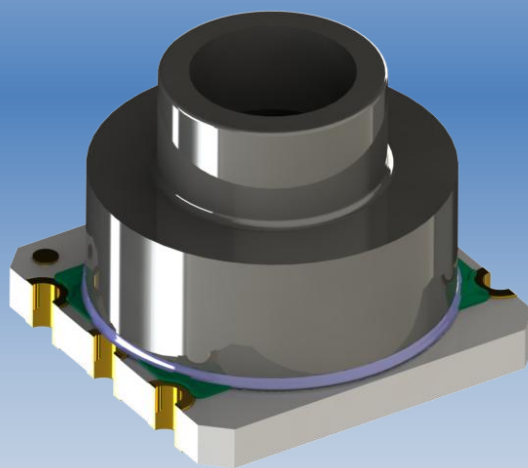


Consensic

## Data Sheet

Digital Barometer

Rev1.0  
July 2022  
DAT-0042



# CPS135B-1000D

Digital Barometer



## Overview

The CPS135B-1000D 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-1000D solution simple to use. The CPS135B-1000D 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: -20°C to +85°C
- Pressure Accuracy: ±2kPa (±20.0mbar) @ 25°C
- Temperature Accuracy: ±1.0°C

## Interfaces

- I<sup>2</sup>C™\* Compatible (≤400kHz)

## Physical Characteristics

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

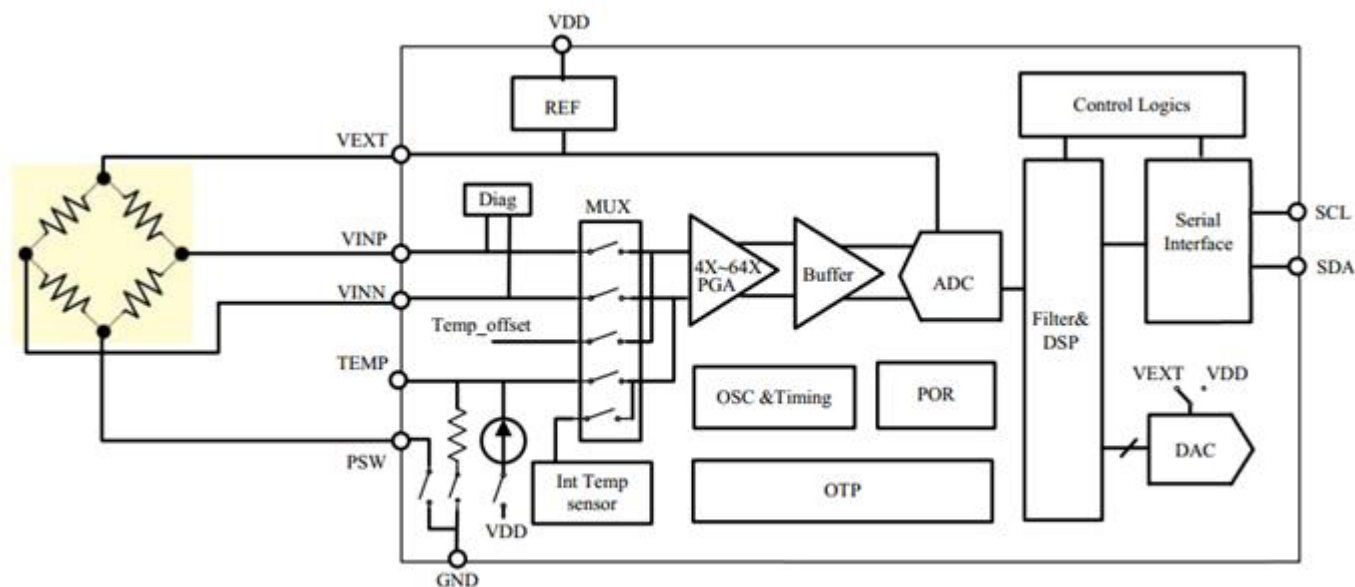
\*I<sup>2</sup>C™ is a registered trademark of NXP



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## CPS135B-1000D BLOCK DIAGRAM



### TABLE1: ORDERING INFORMATION

PART NUMBER	OUTPUT MODE	OPERATION MODE	PACKAGE
CPS135B-1000D	I <sup>2</sup> C	Sleep	6-Lead SMD
<b>SALES and CONTACT INFORMATION</b> <a href="mailto:sales@consensic.com">sales@consensic.com</a> <a href="http://www.consensic.com">www.consensic.com</a>			
<b>United States</b> Consensic, Inc. 1900 Powell Street,Suite 600 Emeryville California, 94608, USA Ph: +1 510.588.8735	<b>China</b> Wuxi Consensic Electronics Co., Ltd. No.86,Dicui Road,B5Building, Fourth Floor,Room 401, Wuxi, Jiangsu Province, 214072 Ph: +86 510.85122279 Fax: +86 510.85122259	无锡康森斯克电子科技有限公司 无锡市滨湖区滴翠路 86 号太湖智谷科技园 北门 B5 栋 4 楼 401 室 邮编:214072 电话: +86 510.85122279 传真: +86 510.85122259	

# CPS135B-1000D

Digital Barometer



## CONTENTS

1	OPERATING CHARACTERISTICS .....	6
1.1	ABSOLUTE RATINGS .....	6
1.2	OPERATING CONDITIONS .....	6
1.3	ELECTRICAL PARAMETERS .....	7
2	OPERATION MODES .....	7
3	OUTPUT MODES .....	7
3.1	I <sup>2</sup> C Slave .....	7
3.2	I <sup>2</sup> C COMMANDS .....	8
4	CALCULATING OUTPUT .....	11
4.1	PRESSURE OUTPUT .....	11
4.2	TEMPERATURE OUTPUT .....	11
5	PACKAGE AND ASSEMBLY .....	12
5.1	PIN ASSEMBLY AND MECHANICAL DRAWING .....	12
5.2	SOLDERING CONDITIONS .....	13
6	APPLICATION DIAGRAM .....	14
7	DOCUMENT HISTORY .....	14
8	DISCLAIMER .....	15

# CPS135B-1000D

Digital Barometer



## LIST OF TABLES

TABLE 1:	ORDERING INFORMATION .....	3
TABLE 2:	I <sup>2</sup> C COMMANDS .....	8

## LIST OF FIGURES

FIGURE 1:	7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES .....	9
FIGURE 2:	7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES .....	10
FIGURE 3:	I <sup>2</sup> C MEASUREMENT REQUEST COMMAND (0xA) .....	11

# CPS135B-1000D

Digital Barometer



## 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	$V_{A\_IO}$ $V_{D\_IO}$		-0.3		$V_{DD} + 0.3$	V
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)		1000 (10000)	kPa (mbar)
Resolution <sup>1</sup>				0.01 (0.1)		kPa (mbar)
Accuracy		50 to 1000kPa (-20°C to 0°C)	-3 (-30)	±2.5 (±25)	+3 (+30)	kPa (mbar)
		50 to 1000kPa (0°C to 65°C)	-2.5 (-25)	±2 (±20)	+2.5 (+25)	kPa (mbar)
Solder Drifts				±3		kPa
Long-term stability				±2		kPa/yr
<b>TEMPERATURE SENSOR</b>						
Range			-20		85	°C
Resolution				0.003		°C
Accuracy		-20°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			-20		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.

# CPS135B-1000D

Digital Barometer



## 1.3 ELECTRICAL PARAMETERS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENT						
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-1000D is factory programmed to Sleep Mode. In this mode, the CPS135B-1000D remains asleep until the master/host sends a measurement request (MR) before taking sensor measurements. After the CPS135B-1000D 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-1000D.

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

# CPS135B-1000D

Digital Barometer



## 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-1000D registers*.
Measurement Request (MR)	Wakes up the CPS135B-1000D, 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-1000D. 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.**

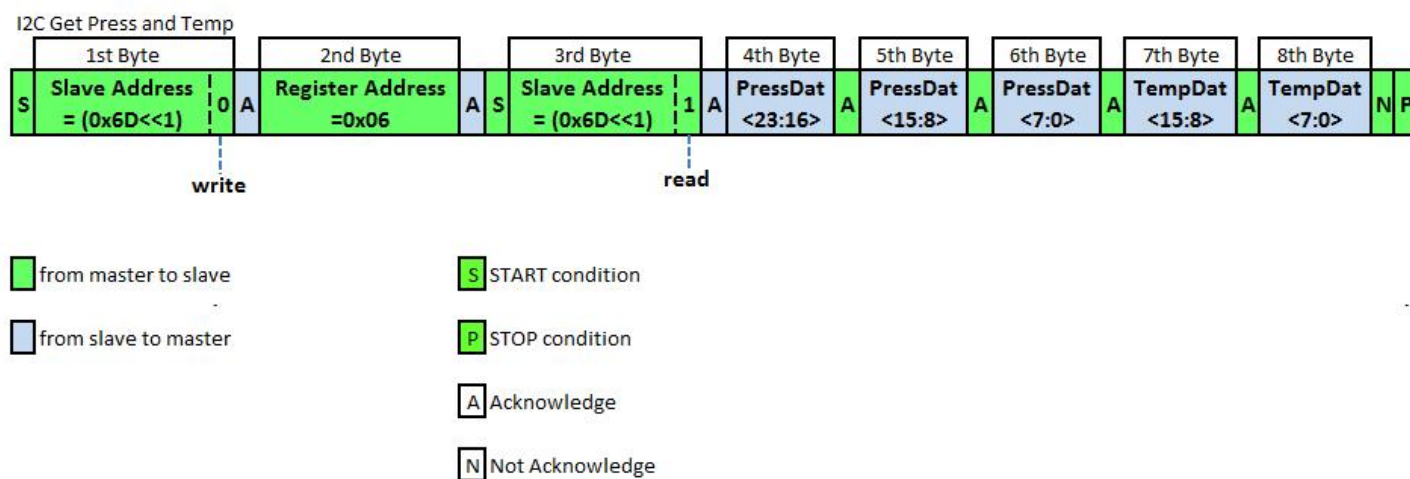
# CPS135B-1000D

Digital Barometer



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.



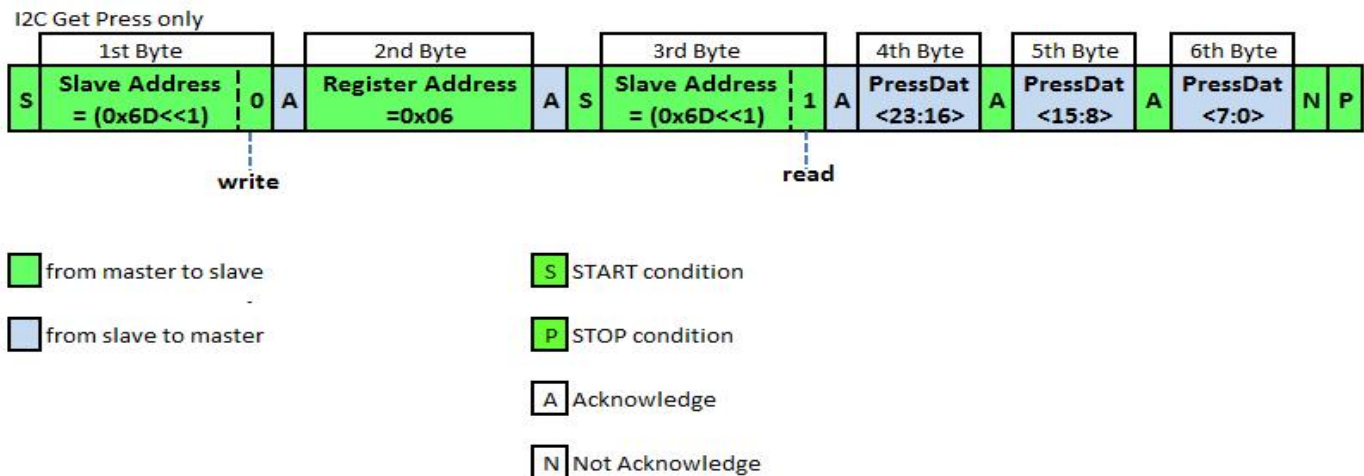
# CPS135B-1000D

Digital Barometer



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

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-1000D responds with the slave ACK, the master terminates the communication with a stop condition.

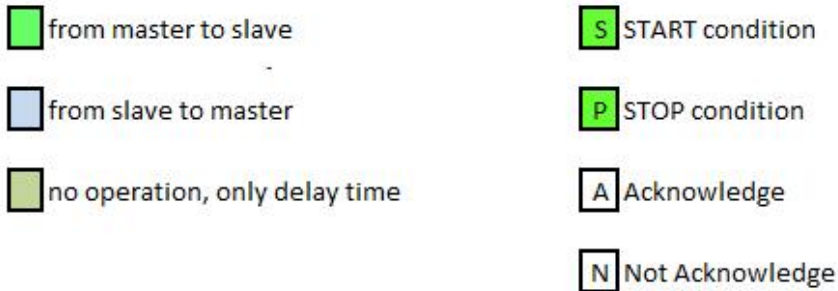
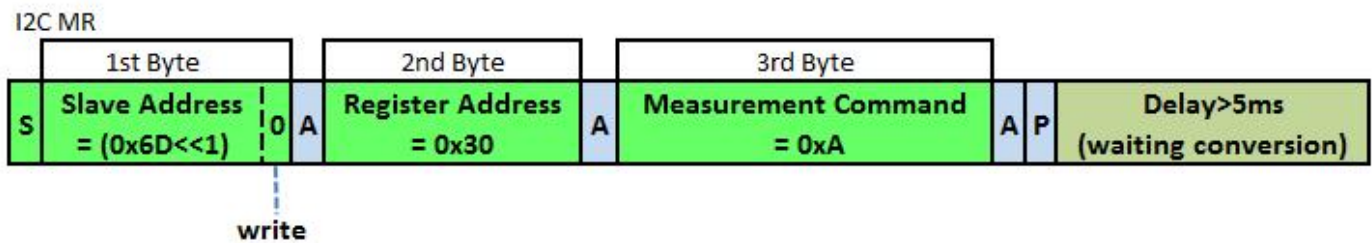
Sensor measurement conversion time takes approximately 5ms, so MRs should not be sent faster than every 5ms.

# CPS135B-1000D

Digital Barometer



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



## 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 1000kPa can be calculated as follows:

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

### 4.2 TEMPERATURE OUTPUT

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

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

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

# CPS135B-1000D

Digital Barometer



## 5 PACKAGE AND ASSEMBLY

The CPS135B-1000D is available in a 6-pin SMD package.

### 5.1 PIN ASSEMBLY AND MECHANICAL DRAWING

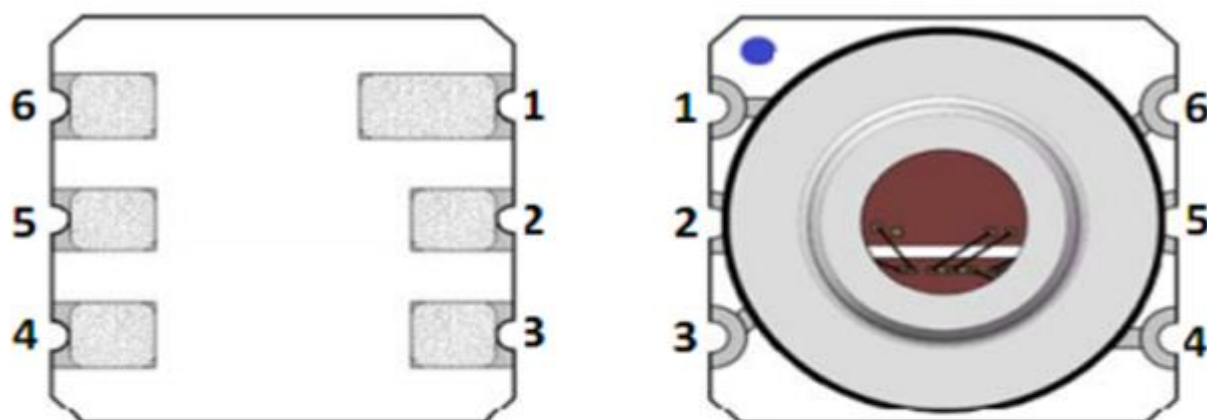


Figure 1. Pin Configuration

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

# CPS135B-1000D

Digital Barometer

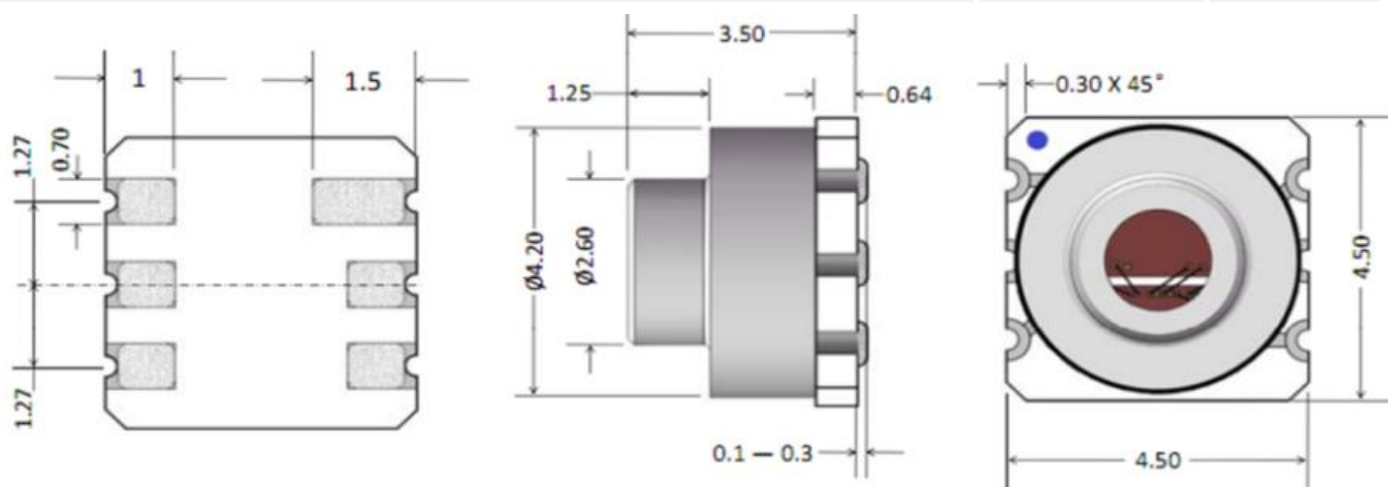


Figure2. Package Outline

- 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

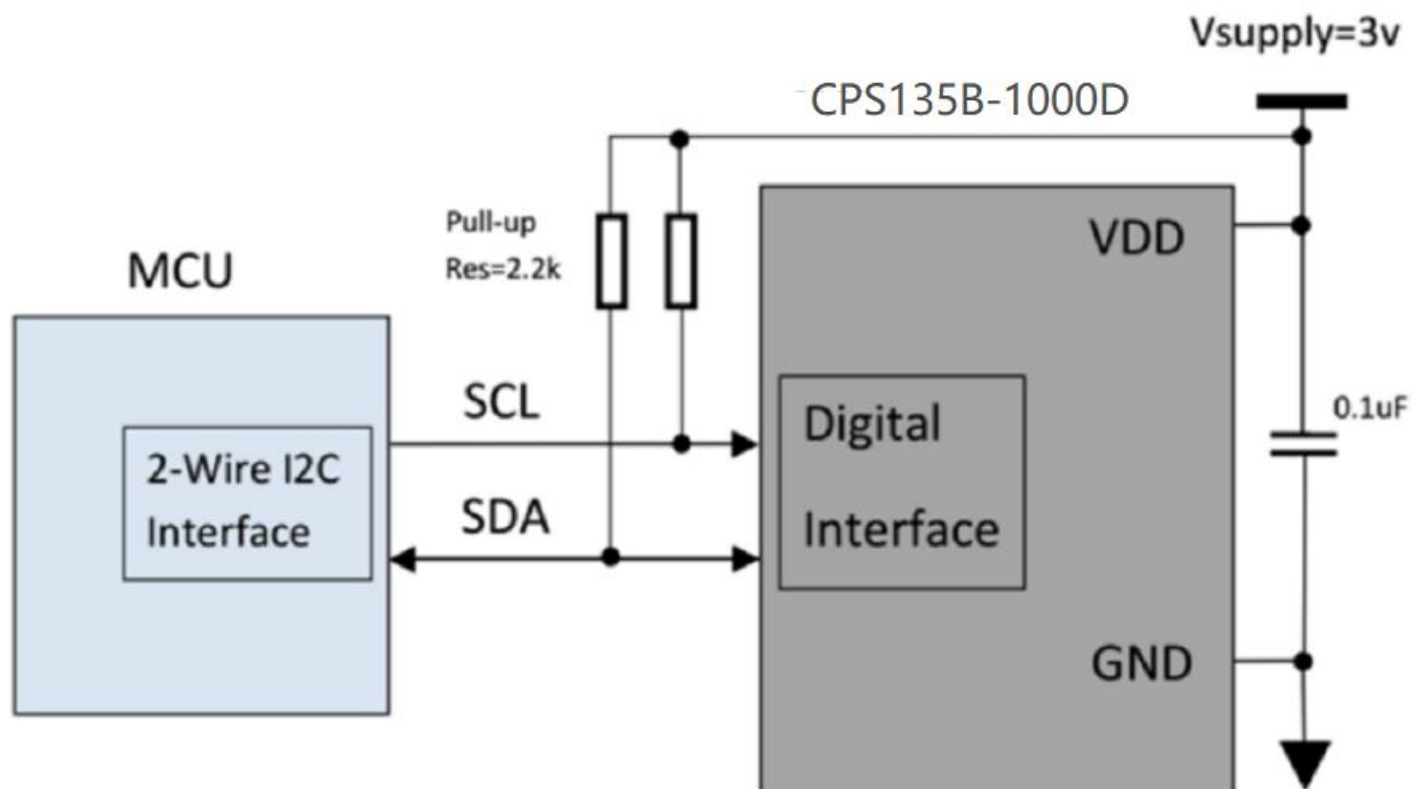
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Soldering Peak Temperature	Less than 30 seconds (JEDEC-STD-020 Standard)			260	°C

# CPS135B-1000D

Digital Barometer



## 6 APPLICATION DIAGRAM



## 7 DOCUMENT HISTORY

REVISION	DATE	DESCRIPTION
1.0	10-March-2022	Preliminary

# CPS135B-1000D

Digital Barometer



## 8 DISCLAIMER

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