

CPS135B

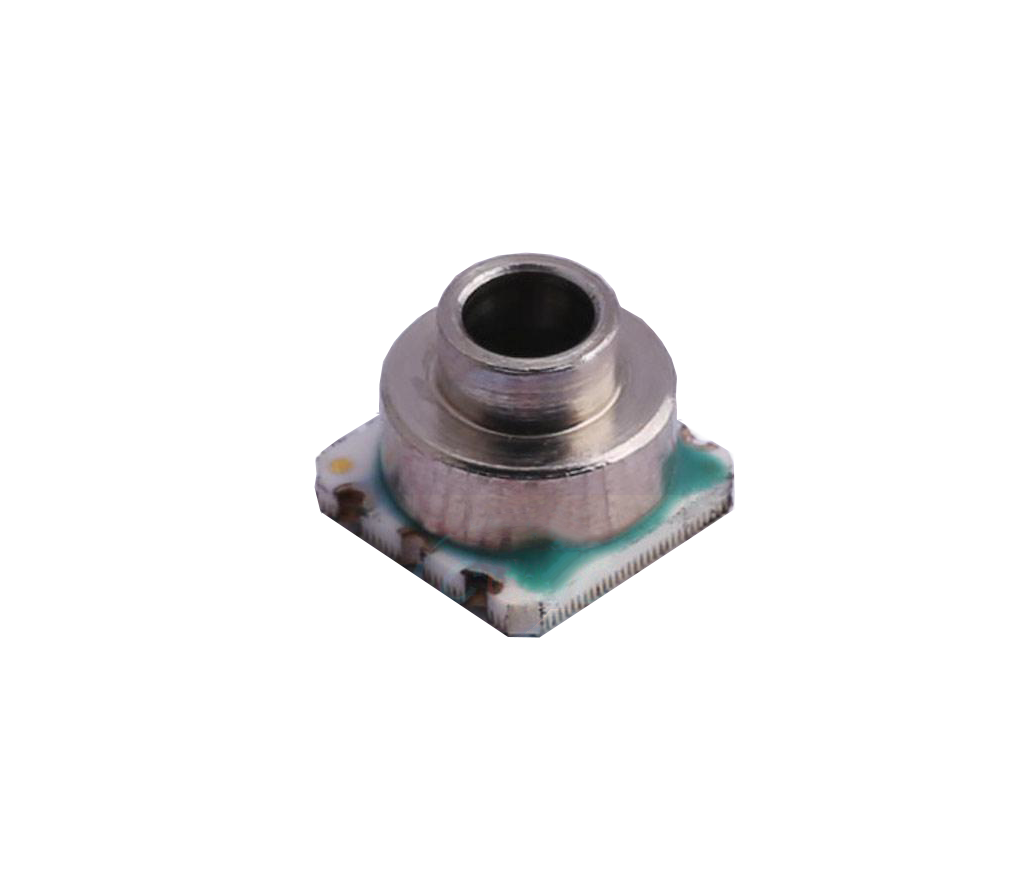
Consensic

Rev1.1

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DAT-0030

Data Sheet



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 I²C 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: ±0.3kPa (±3.0mbar) @ 25°C * Temperature Accuracy: ±1.0°C   **Interfaces**   * I²CTM\* 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 |

\*I²C TM is a registered trademark of NXP

**CPS135B BLOCK DIAGRAM**

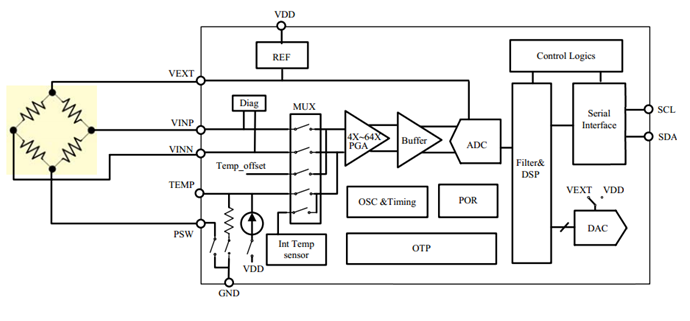


TABLE1: ORDERING INFORMATION

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PART NUMBER** | **OUTPUT MODE** | **OPERATION MODE** | | **PACKAGE** |
| CPS135B | I2C | Sleep | | 6-Lead SMD |
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CONTENTS

[1 OPERATING CHARACTERISTICS 6](#_Toc445125247)

[1.1 ABSOLUTE RATINGS 6](#_Toc445125248)

[1.2 OPERATING CONDITIONS 6](#_Toc445125249)

[1.3 ELECTRICAL PARAMETERS 7](#_Toc445125250)

[2 OPERATION MODES 7](#_Toc445125251)

[3 OUTPUT MODES 7](#_Toc445125252)

[3.1 I2C Slave 7](#_Toc445125253)

[3.2 I2C COMMANDS 8](#_Toc445125254)

[4 CALCULATING OUTPUT 11](#_Toc445125255)

[4.1 PRESSURE OUTPUT 11](#_Toc445125256)

[4.2 TEMPERATURE OUTPUT 11](#_Toc445125257)

[5 PACKAGE AND ASSEMBLY 12](#_Toc445125258)

[5.1 PIN ASSEMBLY AND MECHANICAL DRAWING 12](#_Toc445125259)

[5.2 SOLDERING CONDITIONS 13](#_Toc445125260)

[6 APPLICATION DIAGRAM 14](#_Toc445125261)

[7 DOCUMENT HISTORY 14](#_Toc445125262)

[8 DISCLAIMER 15](#_Toc445125263)

LIST OF TABLES

[TABLE 1: ORDERING INFORMATION 3](#_Toc430247244)

[Table 2: I2C COMMANDS 8](#_Toc430247245)

LIST OF FIGURES

[Figure 1: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES 9](file:///C:\Users\Administrator\Desktop\DAT-0022,%20rev%200.0%20CPS137%20Data%20Sheet.docx#_Toc430247238)

[FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES 10](file:///C:\Users\Administrator\Desktop\DAT-0022,%20rev%200.0%20CPS137%20Data%20Sheet.docx#_Toc430247239)

[Figure 3: I2C MEASUREMENT REQUEST COMMAND (0xA) 11](file:///C:\Users\Administrator\Desktop\DAT-0022,%20rev%200.0%20CPS137%20Data%20Sheet.docx#_Toc430247240)

# OPERATING CHARACTERISTICS

## ABSOLUTE RATINGS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER** | **SYMBOL** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| Over Pressure |  |  |  |  | 2X FS | kPa  (bar) |
| Supply Voltage (with respect to GND) | VDD |  | -0.3 |  | 6.5 | V |
| Voltages at Analog and Digital I/O Pins | VA\_IO  VD\_IO |  | -0.3 |  | VDD +0.3 | V |
| Storage Temperature | TSTOR |  | -60 |  | 150 | °C |

## OPERATING CONDITIONS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER** | **SYMBOL** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| **PRESSURE SENSOR** | | | | | | |
| Range |  |  | 50  (500) |  | 160  (1600) | kPa  (mbar) |
| Resolution1 |  |  |  | 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 |
| **TEMPERATURE SENSOR** | | | | | | |
| Range |  |  | -40 |  | 85 | °C |
| Resolution |  |  |  | 0.003 |  | °C |
| Accuracy |  | -40°C to 85°C | -1 | ±0.75 | +1 | °C |
| **OPERATION** | | | | | | |
| Supply Voltage to GND2 | VSUPPLY |  | 2 | 3.0 | 5.5 | V |
| Operating Temperature Range |  |  | -40 |  | 85 | °C |
| I2C Pull-Up Resistors | RPU |  | 1 | 2.2 |  | kΩ |
| 1Guaranteed by design of 24bits ADC, and calculated according to the range in application.  2 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. | | | | | | |

## ELECTRICAL PARAMETERS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER** | **SYMBOL** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| **SUPPLY CURRENT** | | | | | | |
| Supply Current,  average(1)  during conversion(2)  standby(no conversion) | Iavg  Isc  Iss | VDD=3V |  | 3.95  1.5 | 0.2 | µA  mA  uA |
| **ANALOG TO DIGITAL CONVERTER** | | | | | | |
| Resolution | rADC |  |  |  | 24 | Bit |
| I2C Clock Frequency | FC,I2C |  |  |  | 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.

# 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.

# OUTPUT MODES

## I2C Slave

Two-wire I2C is available for reading sensor measurement data from the CPS135B.

The factory setting for the I2C slave address is 0x6D and the communication is restricted to this address only.

* I2C Address = 0x6D

### 3.2 I2C COMMANDS

Table 2 details the commands to interface with the device in the I2C mode.

Table 2: I2C 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 I2C 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 I2C GET DATA

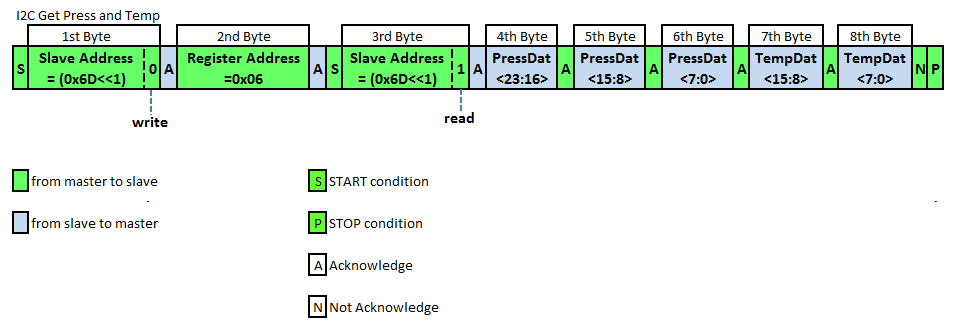
An I2C Get Data command starts with the 7-bit slave address and the 8th bit = 1 (READ). The device then sends acknowledge (ACK), indicating I2C communication success. The number of data bytes returned by the device is determined by the master, which controls NACK and stop conditions.

Figure 1 displays and example for sending three bytes followed by reading five bytes. The first byte contains the I2C address followed by internal register address(0x06). Then theI2C 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.**

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

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



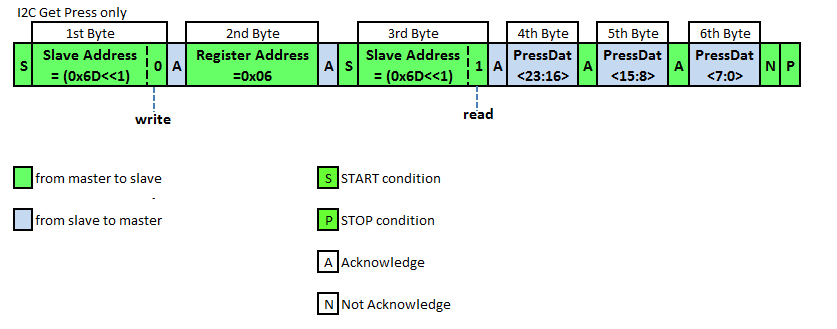
For Pressure data only, the data stream can be terminated after the sixth pressure byte. See Figure 2 below.

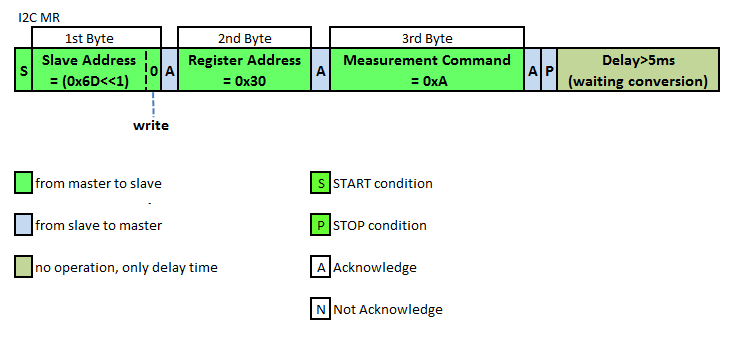
FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES

#### 3.2.2 I2C MEASUREMENT REQUEST

The I2C 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: I2C MEASUREMENT REQUEST COMMAND (0xA)



# CALCULATING OUTPUT

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

## PRESSURE OUTPUT

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

Pressure [kPa] = (Pressure 3rd Byte [23:16] x 65536+Pressure 2nd Byte [15:8] x 256 + Pressure1st Byte [7:0]) / 2^5/1000

## TEMPERATURE OUTPUT

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

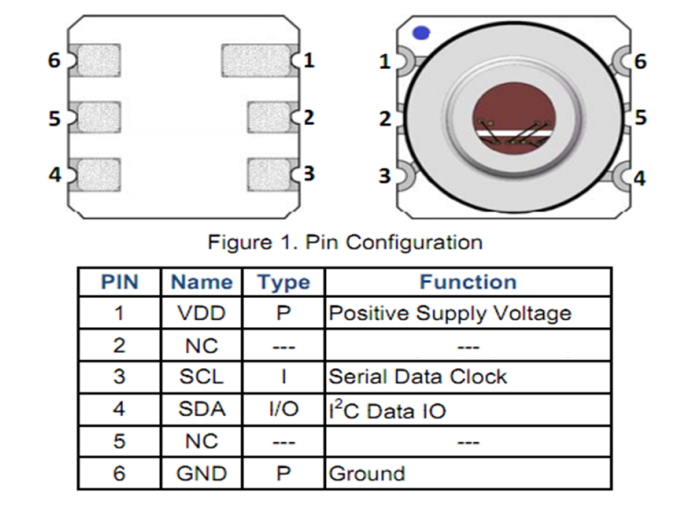
Positive Temperature [°C] = (Temperature High Byte [15:8] x 256 + Temperature Low Byte [7:0]) / 2^8

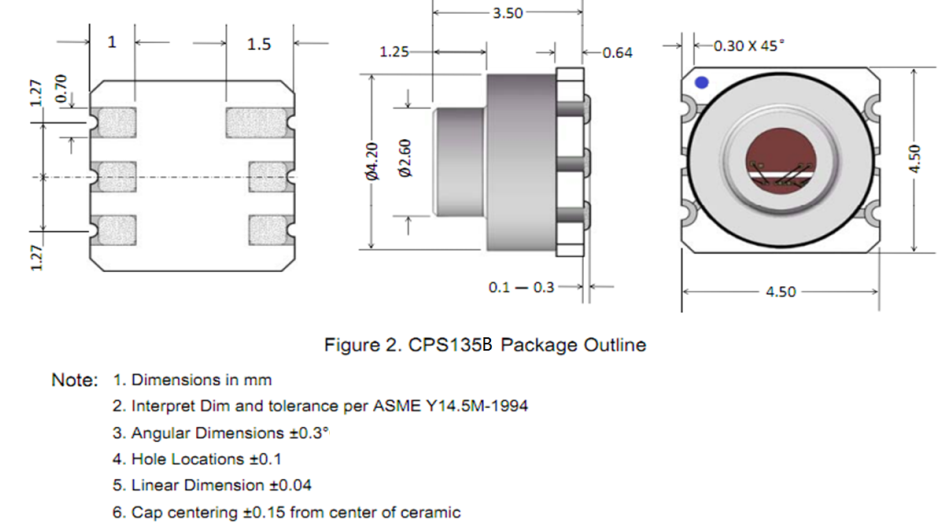
Negative Temperature [°C] = (Temperature High Byte [15:8] x 256 + Temperature Low Byte [7:0]-65536) / 2^8

# PACKAGE AND ASSEMBLY

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

## PIN ASSEMBLY AND MECHANICAL DRAWING



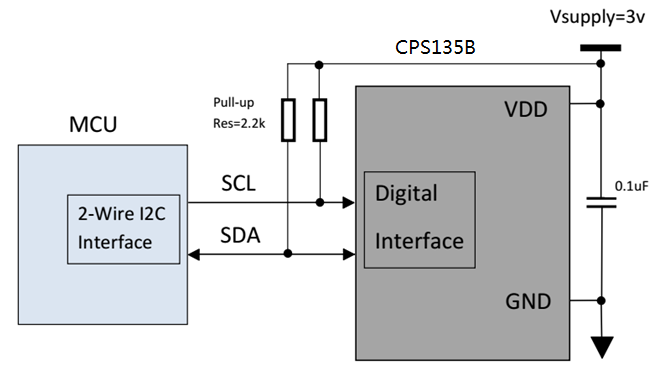


## SOLDERING CONDITIONS

TABLE4: PACKAGE REFLOW TEMPERATURE

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

# APPLICATION DIAGRAM



# DOCUMENT HISTORY

|  |  |  |
| --- | --- | --- |
| **REVISION** | **DATE** | **DESCRIPTION** |
| 0.0 | 01-Sep-2016 | Preliminary |
| 1.0 | 10-Oct-2016 | Range change to 50kpa ~160kpa |
| 1.1 | 01-Mar-2021 | Modify company address |

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