

CPS123

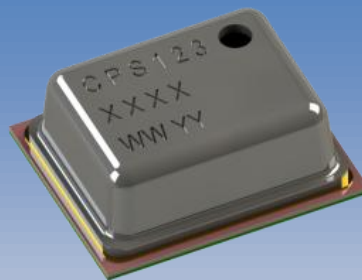


Consensic

Data Sheet

Digital Barometer

Rev1.1
March 2021
DAT-0016



CPS123

Digital Barometer



Overview

The CPS123 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 CPS123 solution simple to use. The ADC comprise of an internal calibration logic that provides accurate pressure and temperature measurements to the application via the 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
- Current Consumption: <5uA
- Sleep State Current: <200nA (25°C)
- Operating Temperature Range: -40°C to +85°C
- Pressure Accuracy: <±0.2kPa (<±2.0mbar) @ 25°C
- Temperature Accuracy: ±1.0°C
- Altitude Resolution Better Than 1.0 meter (50cm) in Active Mode

Interfaces

- I²C™* Compatible (≤400kHz)

Physical Characteristics

- Small Form Factor, 2.5 x 2 x 1mm (w x l x h)
- LGA Package, 8 Lead
- Top Side Sensing Port

*I²C™ is a registered trademark of NXP



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CPS123 BLOCK DIAGRAM

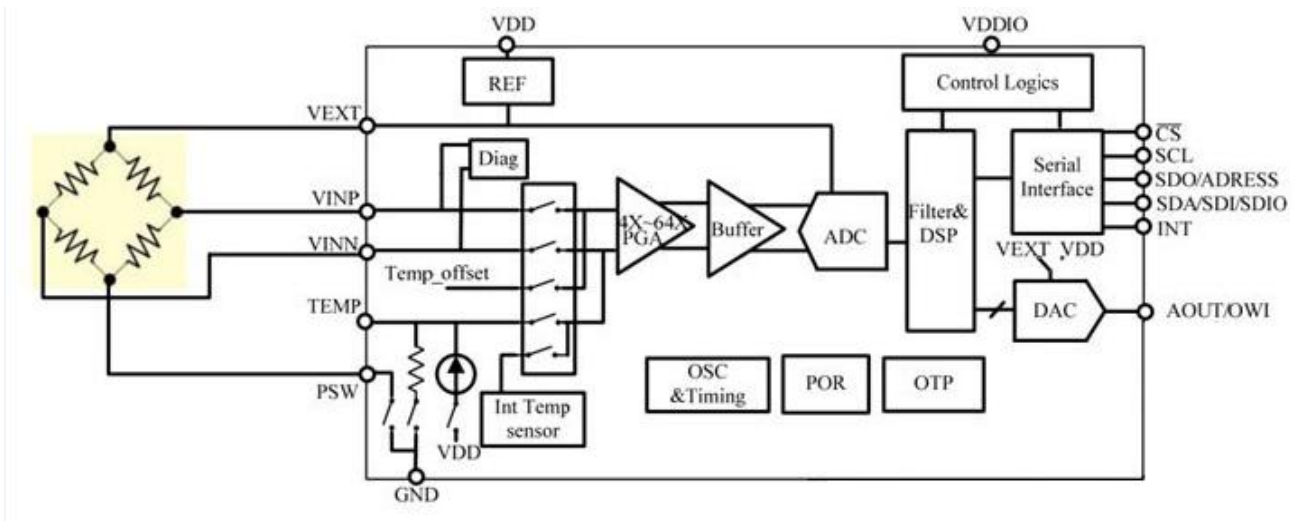


TABLE 1: ORDERING INFORMATION

| PART NUMBER | OUTPUT MODE | OPERATION MODE | PACKAGE |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------|
| CPS123 | I ² C | Sleep | 8-Lead LGA |
| SALES and CONTACT INFORMATION sales@consensic.com | | | |
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CPS123

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 | 8 |
| 3 | OUTPUT MODES..... | 8 |
| 3.1 | I ² C | 8 |
| 3.1.1 | I ² C COMMANDS | 8 |
| 4 | CALCULATING OUTPUT | 13 |
| 4.1 | PRESSURE OUTPUT | 13 |
| 4.2 | TEMPERATURE OUTPUT | 13 |
| 5 | PACKAGE AND ASSEMBLY | 14 |
| 5.1 | PIN ASSEMBLY AND MECHANICAL DRAWING | 14 |
| 5.2 | SOLDERING CONDITIONS | 14 |
| 6 | DOCUMENT HISTORY | 15 |
| 7 | DISCLAIMER..... | 15 |

CPS123

Digital Barometer



LIST OF TABLES

| | |
|------------------------------------------|---|
| TABLE 1: ORDERING INFORMATION | 3 |
| TABLE 2: I ² C COMMANDS | 8 |

LIST OF FIGURES

| | |
|------------------------------------------------------------------------------------------|----|
| FIGURE 1: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES | 10 |
| FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES | 10 |
| FIGURE 3: I ² C MEASUREMENT REQUEST COMMAND (0xA) | 12 |

CPS123

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 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------|-----------------|-----------------|-----------------|---------------|
| PRESSURE SENSOR | | | | | | |
| Range | | | 30 (300) | | 130 (1300) | kPa (mbar) |
| Resolution | | | | 0.001 (0.01) | | kPa (mbar) |
| Accuracy | | 70 to 115kPa @25°C | -0.2 (-2.0) | | +0.2 (+2.0) | kPa (mbar) |
| | | 70 to 115kPa (0°C to 50°C Verified) | -0.25 (-2.5) | | +0.25 (+2.5) | kPa (mbar) |
| 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 GND ¹ | V_{SUPPLY} | | 2 | 3.0 | 5.5 | V |
| Operating Temperature Range | | | -40 | | 85 | °C |
| I ² C Pull-Up Resistors | R_{PU} | | 1 | 2.2 | | kΩ |
| ¹ 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. | | | | | | |

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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_{avg} I_{sc} I_{ss} | VDD=3V | | 3.95 1.5 | 0.2 | μA mA uA |
| ANALOG TO DIGITAL CONVERTER | | | | | | |
| Resolution | r_{ADC} | | | | 24 | Bit |
| I ² C Clock Frequency | $F_{C,I2C}$ | | | | 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.

2 OPERATION MODES

The CPS123 is factory programmed in Sleep Mode. In Sleep Mode, the CPS123 waits for commands from the master before taking measurements. After it receives a MR command, it runs a full measurement, and then turns into sleep mode again.

3 OUTPUT MODES

3.1 I²C

Two-wire I²C are available for reading data from the CPS123. The interface is selectable by the voltage level on the CSB pin:

- CSB = 1 or float → I²C Mode

When CSB = 1 or not connected (IC internal pull-up at CSB pin).

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

3.1.1 I²C COMMANDS

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

TABLE 2: I²C COMMANDS

| TYPE | DESCRIPTION | SUPPORT |
|--------------------------|--------------------------------------------------------------------------------|------------------|
| Get Data (GD) | Used to Get Data in Active Mode, and Automatically Turns into Sleep Mode Again | I ² C |
| Measurement Request (MR) | Used to Enter Active Mode from Sleep Mode, and Take a Measurement | I ² C |

The Get Data (GD) command is used to get data in Active mode. With the start of communication (for I²C after reading the slave address; for SPI at the falling-edge of CSB) the entire 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.

CPS123

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

3.1.1.1 I²C GET DATA

An I²C Get Data command starts with the 7-bit slave address and the 8th bit = 1 (READ). The device as the slave sends and acknowledges (ACK) indicating success. The number of data bytes returned by the device is determined by when the master sends the NACK and stop condition.

Figure 1 shows examples of receiving a total of 8 bytes. The first byte contains the I²C address followed by internal register address(0x06), and then restart again, with I²C address, three pressure bytes and two temperature bytes then output.

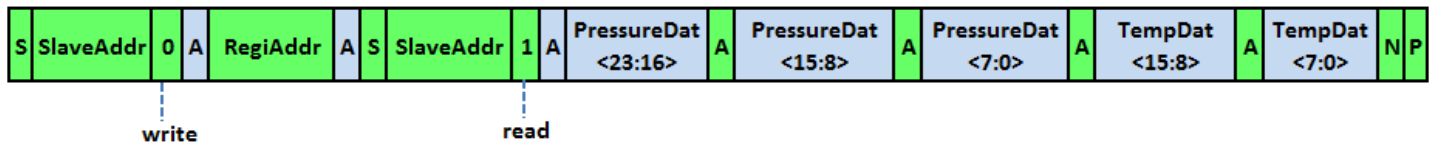
In Figure 1, the last five bytes returns 3 bytes of pressure data followed by 2 bytes of temperature data.

After executing the MR command, use the GD command to retrieve the Pressure and Temperature raw output counts.

2 bytes temperature counts are in 2’s complement code.

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

I2C Get Data



- from master to slave
- from slave to master
- S START condition
- P STOP condition
- A Acknowledge
- N Not Acknowledge

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

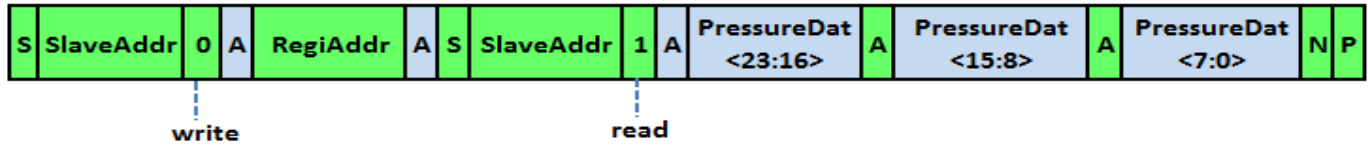
FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES

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Digital Barometer



I2C Get Data

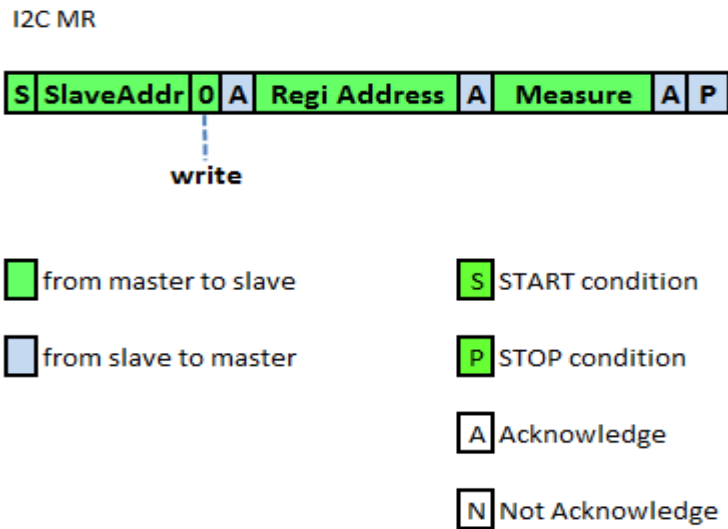


- from master to slave
- from slave to master
- S START condition
- P STOP condition
- A Acknowledge
- N Not Acknowledge

3.1.1.2 I²C MEASUREMENT REQUEST

The I²C MR is used to wake up the device in Sleep Mode and start a complete cycle starting with the Pressure measurement, followed by the Temperature measurements; after the DSP calculations. The results are then written to the digital output register. As shown in Figure 6, the communication contains firstly the slave address and the WRITE bit (0), and then the Register Address of 0x30, finally 0xA for measurement, sent by the master. After the IC responds with the slave ACK, the master creates a stop condition.

FIGURE 3: I²C MEASUREMENT REQUEST COMMAND (0xA)



4 CALCULATING OUTPUT

After retrieving the data, the compensated output can be calculated by following the equations below.

4.1 PRESSURE OUTPUT

An example of the 24-bit compensated pressure with a full scale range of 30 to 130kPa can be calculated as follows:

$$\text{Pressure [kPa]} = (\text{Pressure 3rd Byte [23:16]} \times 65536 + \text{Pressure 2nd Byte [15:8]} \times 256 + \text{Pressure 1st Byte [7:0]}) / 2^6 / 1000$$

4.2 TEMPERATURE OUTPUT

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

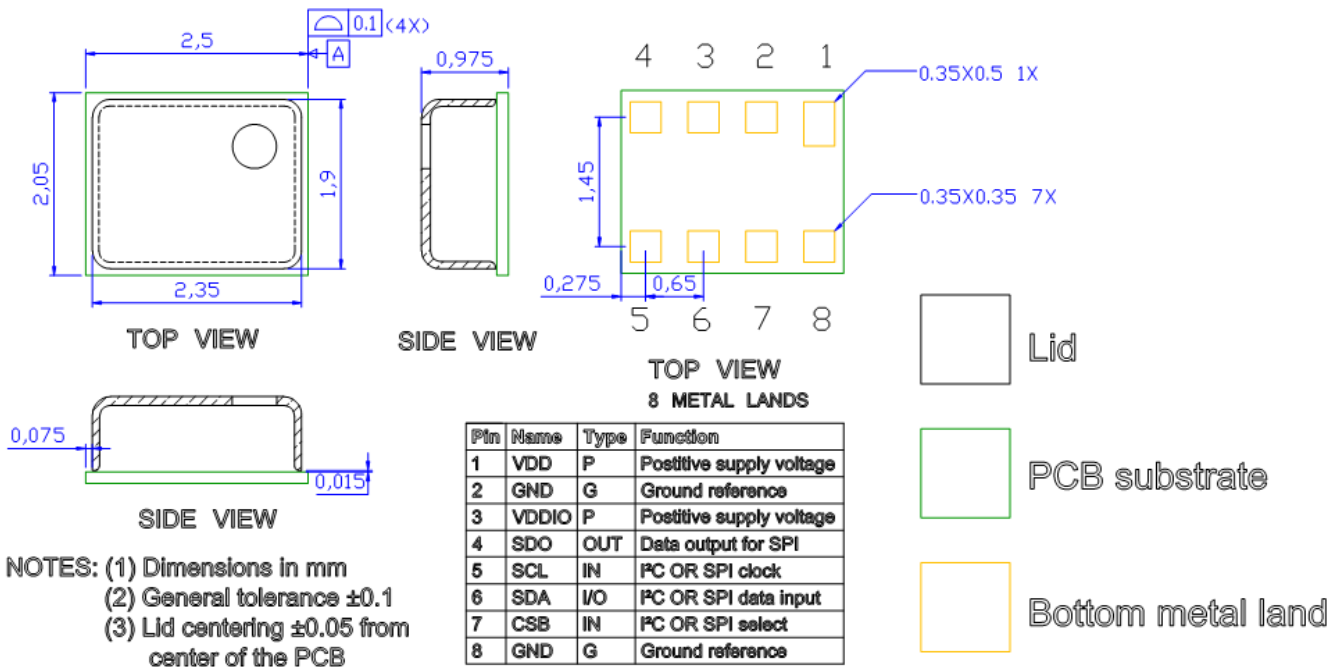
$$\text{Positive Temperature [}^\circ\text{C]} = (\text{Temperature High Byte [15:8]} \times 256 + \text{Temperature Low Byte [7:0]}) / 2^8$$

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

5 PACKAGE AND ASSEMBLY

The CPS123 is available in a LGA package.

5.1 PIN ASSEMBLY AND MECHANICAL DRAWING



5.2 SOLDERING CONDITIONS

TABLE 4: PACKAGE REFLOW TEMPERATURE

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

6 DOCUMENT HISTORY

| REVISION | DATE | DESCRIPTION |
|----------|-------------|------------------------|
| 0.0 | 24-Nov-2014 | Initial Release |
| 1.0 | 26-Mar-2020 | Remove SPI mode |
| 1.1 | 01-Mar-2021 | Modify company address |

7 DISCLAIMER

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