CPS123

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Data Sheet

Digital Barometer

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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 ^{TM}* 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 ^{TM} is a registered trademark of NXP

RoHS Compliant
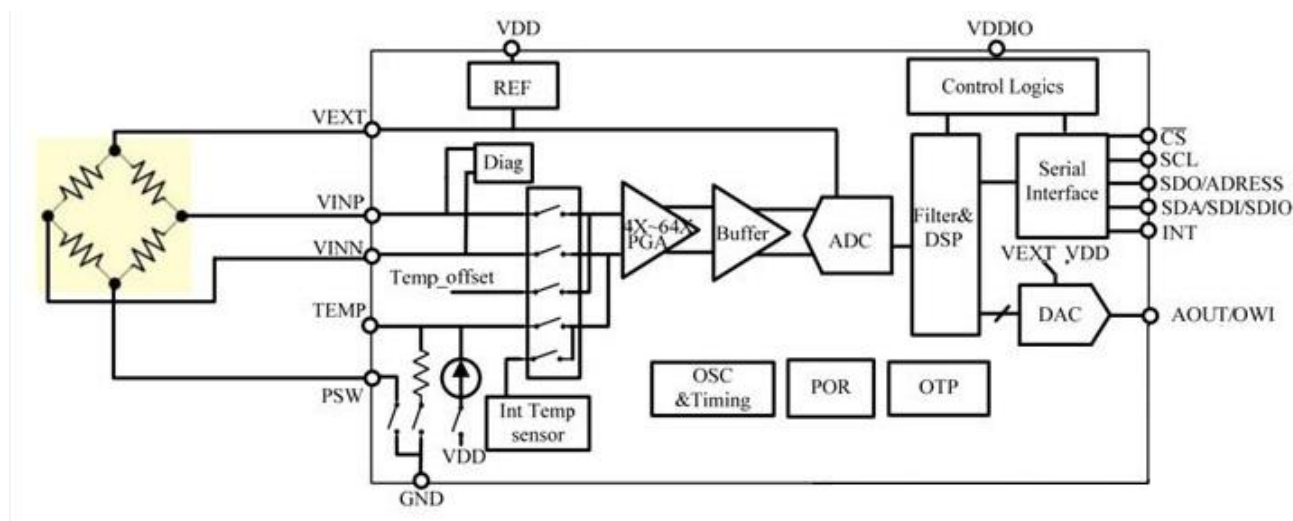
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CPS123 BLOCK DIAGRAM

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			
www.consensic.com			
United States Consensic, Inc. 1900 Powell Street,Suite 600 Emeryville California, 94608, USA Ph: +1 510.588.8735	**China** Wuxi Consensic Electronics Co., Ltd. 100 Dicui Road 530 Building B, Suite 704 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 100 号 530 大厦 B 栋 704 邮编 214072 電話：+86 510.85122279 传真：+86 510.85122259	

CPS123
Digital Barometer

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CONTENTS

DAT-0016, Rev1.0

CPS123
Digital Barometer

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LIST OF TABLES

LIST OF FIGURES

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^2C 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.

DAT-0016, Rev1.0

1.3   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	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   I^{2}C

Two-wire I^{2}C are available for reading data from the CPS123. The interface is selectable by the voltage level on the CSB pin:

- CSB = 1 or float→ I^{2}C Mode

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

The factory setting for the I^{2}C slave address is 0x6D and the communication is restricted to this address only.

3.1.1   I^{2}C COMMANDS

Table 2 details the commands to interface with the device in the I^{2}C modes.

TABLE 2:   I^{2}C 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 I^{2}C 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.

DAT-0016, Rev1.0

The ordering of the bits is "big-endian".

3.1.1.1   I^{2}C GET DATA

An I^{2}C 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 I^{2}C address followed by internal register address(0x06), and then restart again, with I^{2}C address, three pressure bytes and two temperature bytes then output.
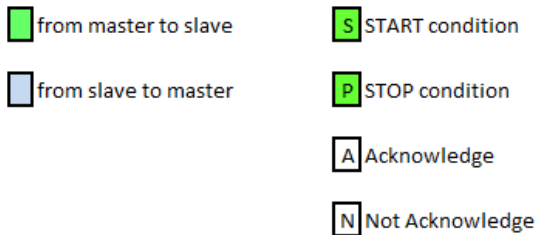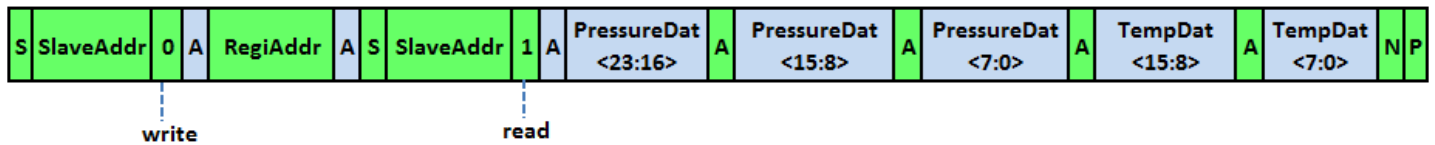
In Figure 1, the last five bytes returns 3 bytes of pressure data followed by 2 bytes of temperature data.

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.

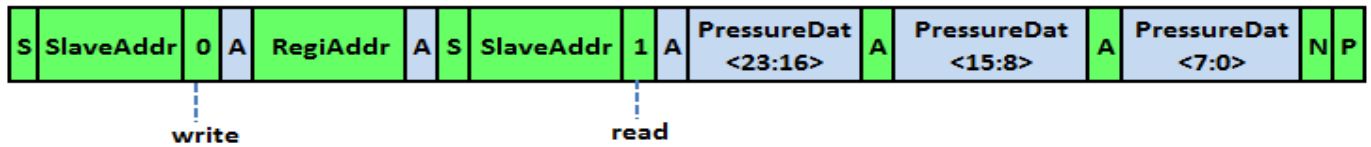**FIGURE 1: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES**

I2C Get Data

| S | SlaveAddr | 0 | A | RegiAddr | A | S | SlaveAddr | 1 | A | PressureDat <23:16> | A | PressureDat <15:8> | A | PressureDat <7:0> | A | TempDat <15:8> | A | TempDat <7:0> | N | P |

write   read

- 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

I2C Get Data

| S | SlaveAddr | 0 | A | RegiAddr | A | S | SlaveAddr | 1 | A | PressureDat <23:16> | A | PressureDat <15:8> | A | PressureDat <7:0> | N | P |

write   read

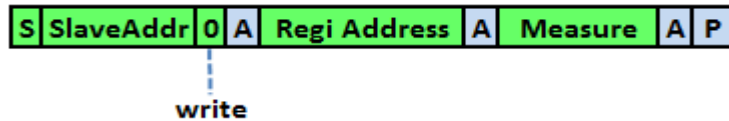| from master to slave   S | START condition |
from slave to master P	STOP condition
A	Acknowledge
N	Not Acknowledge

3.1.1.2   I^{2}C MEASUREMENT REQUEST

The I^{2}C 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: I^{2}C MEASUREMENT REQUEST COMMAND (0xA)

I2C MR

| S | SlaveAddr | 0 | A | Regi Address | A | Measure | A | P |

write

☐ (green) from master to slave

☐ (blue) from slave to master

| S | START condition
| P | STOP condition
| A | Acknowledge
| N | Not Acknowledge

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:

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

4.2 TEMPERATURE OUTPUT

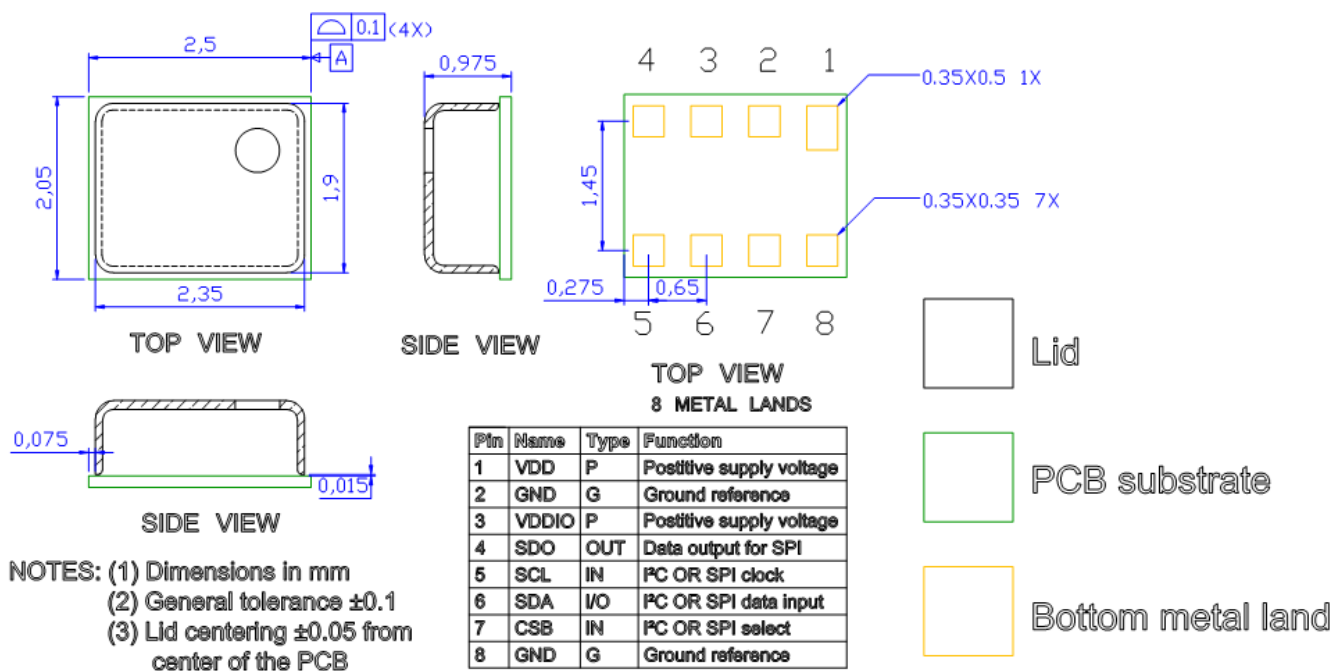The 16-bit compensated temperature can be calculated as follows:

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

5   PACKAGE AND ASSEMBLY

The CPS123 is available in a LGA package.

5.1   PIN ASSEMBLY AND MECHANICAL DRAWING

Pin	Name	Type	Function
1	VDD	P	Positive supply voltage
2	GND	G	Ground reference
3	VDDIO	P	Positive supply voltage
4	SDO	OUT	Data output for SPI
5	SCL	IN	I²C OR SPI clock
6	SDA	I/O	I²C OR SPI data input
7	CSB	IN	I²C OR SPI select
8	GND	G	Ground reference

NOTES: (1) Dimensions in mm
         (2) General tolerance ±0.1
         (3) Lid centering ±0.05 from
              center of the PCB

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-Mra-2020	Remove SPI mode

7   DISCLAIMER

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