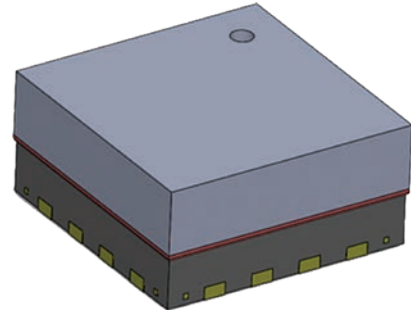


NPB 102

Digital Output Absolute Pressure Sensor



Applications

- Automobile Applications - Thermal Runaway Detection, Infotainment, and Enhanced GPS Navigation
- Mobile Devices - Smart Phones, Smart Watches, and Tablets
- Indoor and Outdoor Navigation
- Altimeter and Barometer for Portable Devices
- Weather Station Equipment
- Leisure and Sports
- Hard Disk Drive (HDD)
- Weather Forecast
- Consumer Drones



Features

- Absolute Pressure Range: 260 mBar to 1260 mBar and 50kPa to 200kPa (Other pressure ranges available upon request)
- Pressure Resolution: 18-bit, Temperature Resolution: 16-bit
- Operating Temperature: -40°C to +125°C
- Pressure Accuracy (Total Error Band):
± 2%FSO (0 to +85°C)
± 3%FSO (-40 to +125°C)
- Interface: I²C (SPI available upon request)
- Operating Range: 1.7V ~ 3.6V
- Small size package
- Package: 4x4mm QFN
- Fully-calibrated and compensated
- Digital compensation via 26-bit internal digital signal processor (DSP) running a correction



Overview

- The NPB 102 is an absolute pressure sensor with digital output for low cost applications.
- With a standard 4x4 mm QFN package, it is ideally suited for automobile, portable electronics and space-constrained applications.
- A wide operating temperature range from -40°C to +125°C fits well with demanding environmental requirements.
- NPB-102 employs a MEMS pressure sensor with a signal-conditioning IC to provide accurate pressure measurement from 26kPa to 200kPa.
- The NPB 102 not only compensates and calibrates the pressure element, but also provides a corrected temperature output using an internal sensor.
- The measured and corrected bridge values are provided at the digital output pins through an I²C interface.
- Digital compensation of the signal offset, sensitivity, temperature and non-linearity is accomplished via 26-bit internal digital signal processor (DSP) running a correction algorithm.
- Calibration coefficients are stored on-chip in highly reliable, nonvolatile, multiple-time programmable (MTP) memory.

Specifications

Absolute Maximum Ratings

Symbol	Parameter	Limits			Unit
		Min.	Typical	Max.	
V _{DD}	Analog Supply Voltage	-0.4	-	3.63	V
I _{IN}	Input Current except RES &SS	-100	-	100	mA
P _{OVR}	Overpressure (Pressure element only, non-hermetic package)	-	-	400	kPa
V _{HBM1}	ESD-HBM	4000	-	-	V
T _{STOR}	Storage Temperature	-50	-	130	°C

Operating Conditions

Symbol	Parameter		Limits			Unit
			Min.	Typical	Max.	
V _{DD}	Supply Voltage		1.68	-	3.63	V
t _{VDD}	VDD Rise Time		-	-	200	us
t _{STA1}	Start up Time	V _{DD} ramp up to communication	-	-	1	ms
t _{STA2}		V _{DD} ramp up to operation	-	-	2.5	ms
t _{WUP1}	Wake up Time	Sleep to Active communication	-	-	0.5	ms
t _{WUP2}		Sleep to Active operation	-	-	2	ms
I _{VDD}	Current Consumption	Active State	-	1050	1500	uA
		Sleep Mode ≤125°C	-	50	750	nA
P _{OPR}	Operating Pressure Range	NPB-102X-0126A	26	-	126	kPa
		NPB-102X-0200A	50	-	200	kPa
T _{OPR}	Operating Temperature Range		-40	-	125	°C
	Media Compatibility:	Compatible with exposed materials-thermoset plastic, epoxy and silicone				

Specifications (cont.)

Performance Specifications

Unless otherwise specified: 3.3VDC Supply Voltage, Room Temperature

Symbol	Parameter	Limits				Notes
		Min	Typical	Max	Unit	
t_{RES}	Response Time	-	3.7	-	ms	270Hz update rate
P_{TEB}	Pressure Accuracy (Total Error Band)	-2.0	-	+2.0	%FSO	0~85°C
		-3.0	-	+3.0	%FSO	-40~0°C & 85~125°C
T_{EB}	Temperature Accuracy	-	±4	-	°C	-40~125°C
$f_{C,I2C}$	I ² C Clock Frequency	-	-	3.4	MHz	
$f_{C,SPI}$	SPI Clock Frequency	-	1	10	MHz	
$f_{C,I2C}$	I ² C Slave Address	-	0x27	-	Hex	
P_{BIT}/T_{BIT}	Output Data Bits	-	-	24	bit	

I²C Commands

The I²C read command supported by the NPB-102 are listed in the table below. The command to read an address in the user memory is the same as its address.

Command (Byte)	Return	Description
AA _{HEX}	24-bit formatted fully corrected sensor measurement data + 24-bit corrected temperature data	Measure Triggers full measurement cycle and calculation and storage of data in interface (configurations from MTP)

General Status Byte

Bit	7	6	5	4	3	2	1	0
Meaning	0	Powered	Busy	Mode	Mode	Memory Error	Config Setup	ALU Saturation

Mode Status Byte

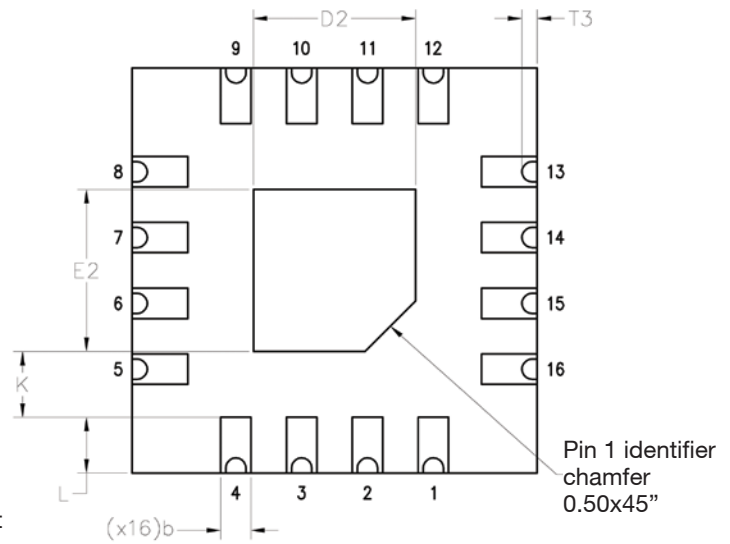
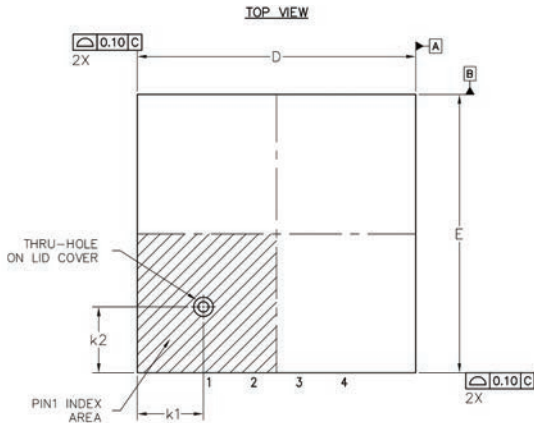
Status [4:3]	00	01	10	11
Mode	Normal Mode	Command Mode	Reserved	Command Mode and Reserved

Calculating Pressure & Temperature Output

$$Pressure [kPa] = 1.25 \times (P_{max} - P_{min}) \times (P_{count} \div 16777216 - 0.1) + P_{min}$$

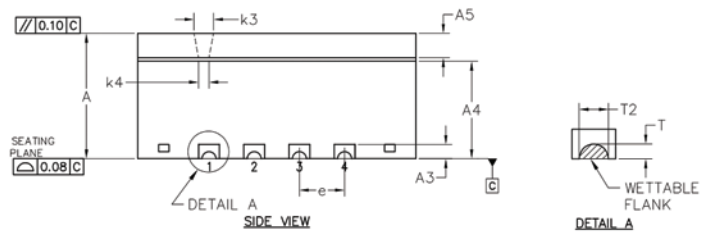
$$Temperature [C] = 169 \times (T_{count} \div 16777216) - 41$$

Package Information

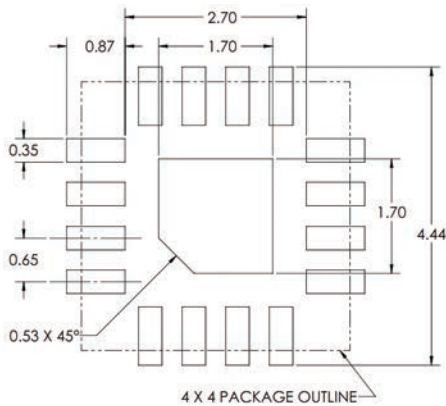


Bottom View

1. Dimensions in mm.
2. Footprint is only a recommendation, subject to test by the customer.
3. Stencil design and volume of solder used is the responsibility of the user.



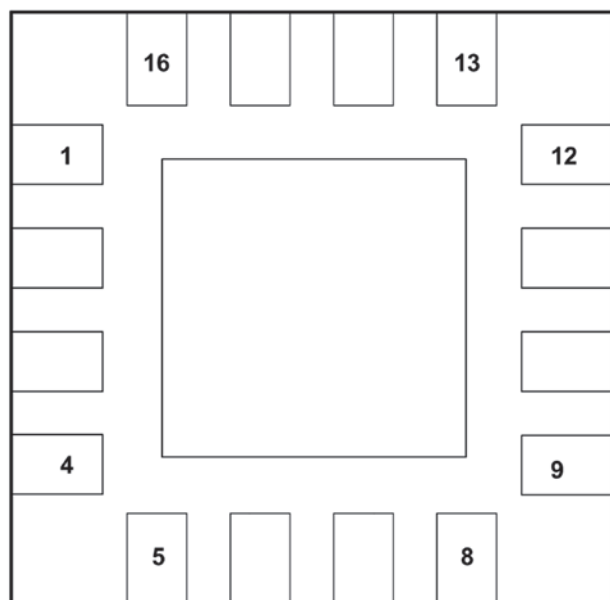
DETAIL A



PCB Layout Footprint

Symbol	Common					
	Dimensions mm			Dimensions in.		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A		1.80			0.071	
A3		0.203 Ref			0.008 Ref	
A4		1.40 Ref			0.055 Ref	
A5		0.35 Ref			1.014 Ref	
b	0.25	0.30	0.35	0.010	0.012	0.014
D	3.90	4.00	4.10	0.154	0.157	0.161
D2	1.50	1.60	1.70	0.059	0.063	0.067
E	3.90	4.00	4.10	0.154	0.157	0.161
E2	1.50	1.60	1.70	0.059	0.063	0.067
e	0.65 BSC			0.026 BSC		
L	0.45	0.55	0.65	0.018	0.022	0.026
K	0.60	0.650	0.07	0.024	0.026	0.003
k1	0.85	0.95	1.05	0.033	0.037	0.041
k2	0.85	0.95	1.05	0.033	0.037	0.041
k3	0.18	-	0.28	0.007	-	0.011
k4	0.10	-	0.15	0.004	-	0.006
T	0.05	0.10	0.15	0.002	0.004	0.006
T2	0.15	0.20	0.25	0.006	0.008	0.010
T3	0.05	0.15	0.25	0.002	0.006	0.010

Pin Description



Pin No.	Name	Description
1	VDD	Ground
2	RES	Reset
3	EOC	End of conversion
4	MISO	Data output for SPI
5 ~ 8	-	Not connected
9	SCL/SCLK	Clock for I ² C/SPI
10	SDA/MISO	Data for I ² C/SPI
11	SS	Slave select for SPI
12 ~ 15	-	Not connected
16	VDD	Supply voltage

I²C Communications Interface

I²C

In I²C Mode, each command is started as shown in Figure 1. Only the number of bytes that is needed for the command has to be sent. After the execution of a command (busy = 0) the expected data can be read as illustrated in Figure 3, or if no data are returned by the command the next command can be sent. The status can be read at any time as described in Figure 2.

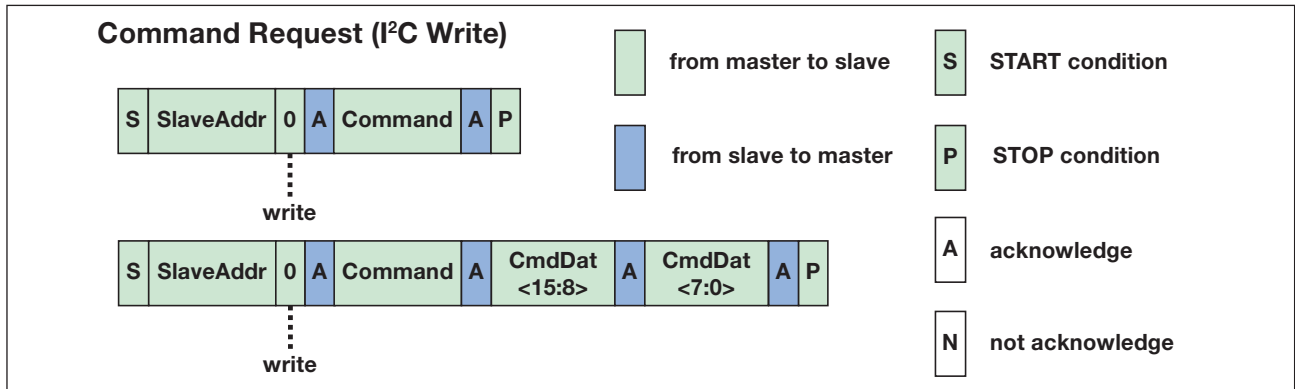


Figure 1 - I²C Command Request

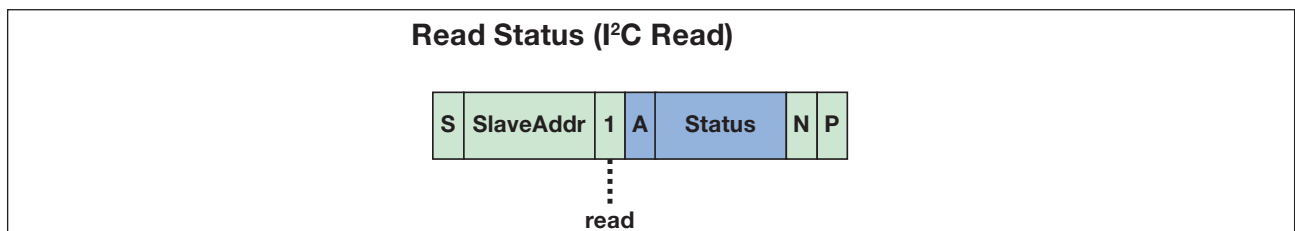
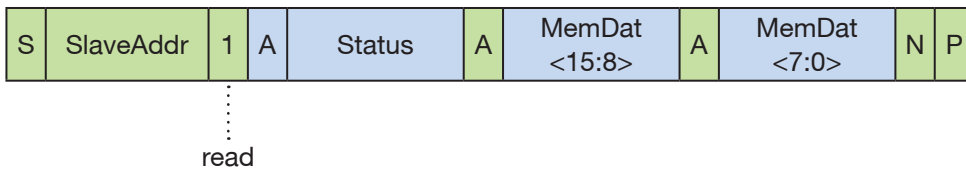


Figure 2 - I²C Read Status

Read Data (I²C Read)

(a) Example: after the completion of a Memory Read command



(b) Example: after the completion of a Measure command (AA_{HEX})

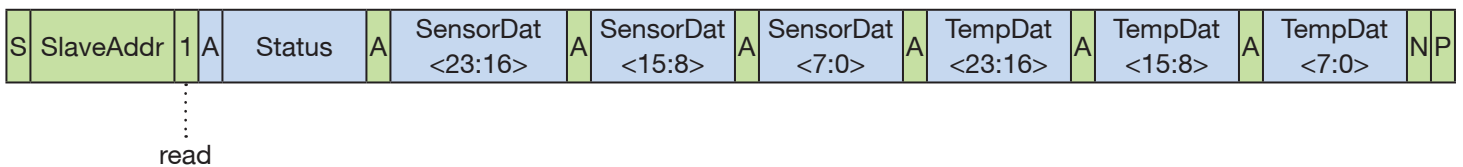


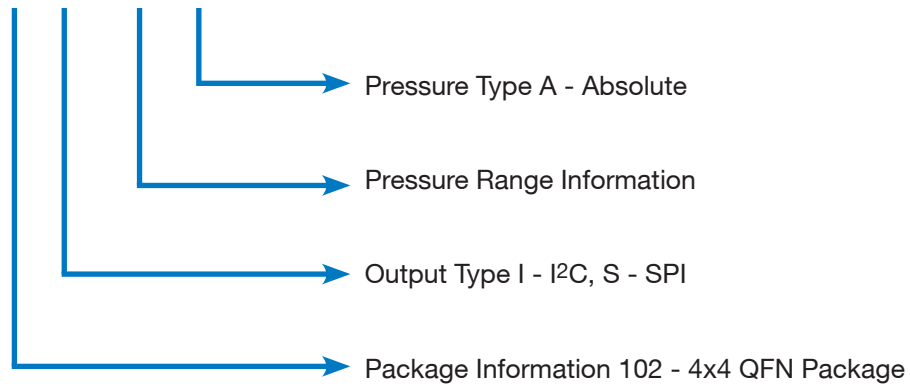
Figure 3 - I²C Read Data

All mandatory I²C-bus protocol features are implemented. Optional features like clock stretching, 10-bit slave address, etc., are not supported by the sensor's interface.

In I²C-High Speed Mode, a command consists of a fixed length of three bytes.

Ordering Information

NPB-102X-XXXX



Part Number	Description
NPB-102I-0126A	26-126kPa, I ² C output
NPB- 102I - 0200A	50-200kPa, I ² C output

