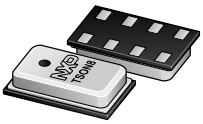

FXPQ3115BV

I²C precision pressure sensor with altimetry

Rev. 4 — 12 April 2018 Short data sheet: technical data

1 General description

The FXPQ3115BV is a compact, piezoresistive, absolute pressure sensor with an I²C digital interface. FXPQ3115BV has a wide operating range of 20 kPa to 110 kPa. This sensor is ideal for inhalers, continuous positive airway pressure (CPAP) masks or other medical devices coming in contact with a patient's airway. The MEMS and ASIC die are coated with a biomedically-approved gel. The gel is a nontoxic, nonallergenic elastomer which meets all United States Pharmacopeia (USP) biological testing class VI requirements. The gel properties allow uniform pressure transmission to the MEMS diaphragm.

A high resolution ADC provides fully compensated and digitized outputs for pressure in Pascals and temperature in °C. The compensated output is available as either barometric pressure in Pascals or as an altitude in meters. The internal processing in FXPQ3115BV removes compensation and unit conversion load from the system MCU, simplifying system design.

FXPQ3115BV's advanced ASIC has multiple user programmable modes such as power saving, interrupt and autonomous data acquisition modes, including programmed acquisition cycle timing, and poll-only modes. Typical active supply current is 40 µA per measurement-second.

2 Features and benefits

- Operating range: 20 kPa to 110 kPa absolute pressure
- Calibrated range: 50 kPa to 110 kPa absolute pressure
- Calibrated temperature output: −40 °C to 85 °C
- I²C digital output interface
- Fully compensated internally
- Precision ADC resulting in 1.5 Pa of effective resolution
- Direct reading
  - Pressure: 20-bit measurement (Pascals)
    - 20 to 110 kPa
  - Temperature: 12-bit measurement (°C)
    - –40 °C to 85 °C
- Programmable interrupts
- Autonomous data acquisition
  - Embedded 32-sample FIFO
  - Data logging up to 12 days using the FIFO
  - One-second to nine-hour data acquisition rate
- 1.95 V to 3.6 V supply voltage, internally regulated
- 1.6 V to 3.6 V digital interface supply voltage
- Operating temperature from −40 °C to +85 °C

3 Applications

- Inhalers/nebulizers
- Medical tablets
- Health activity monitors
- Oxygen concentrators
- CPAP machine and mask
- Spyrometry

4 Ordering information

Table 1. Ordering information

Device number	Shipping	Package	Number of ports			Pressure Type			Digital interface
			None	Single	Dual	Gauge	Differential	Absolute	
FXPQ3115BV	Tray	98ASA002260D	•	—	—	—	—	•	•
FXPQ3115BVT1	Tape and reel	98ASA002260D	•	—	—	—	—	•	•

5 Block diagram

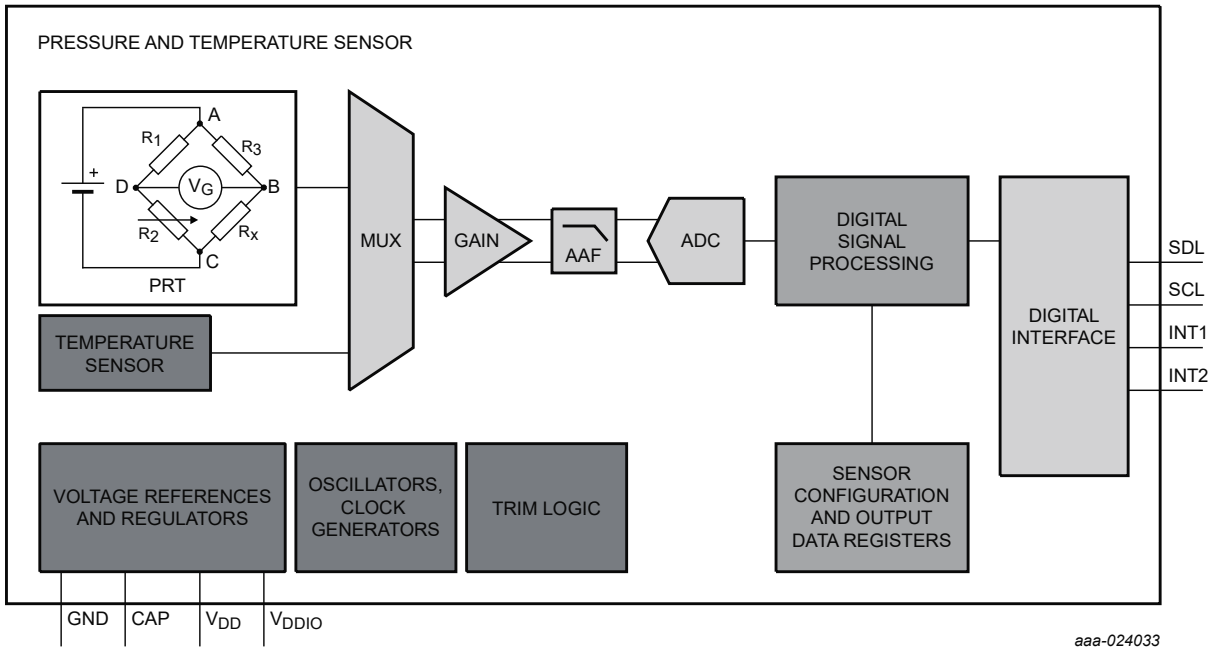

Figure 1. Block diagram

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6 Pinning information

6.1 Pinning

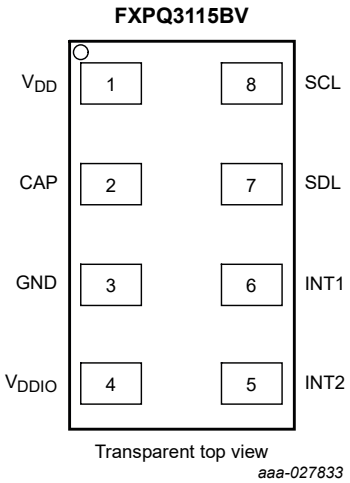

Figure 2. 8-pin LGA pinout

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
V_{DD}	1	V_{DD} power supply connection (1.95 to 3.6 V)
CAP	2	External capacitor
GND	3	Ground
V_{DDIO}	4	Digital interface power supply (1.62 to 3.6 V)
INT2	5	Pressure interrupt 2
INT1	6	Pressure interrupt 1
SDL	7	I^2C serial data
SCL	8	I^2C serial clock

7 Handling and board mount recommendations

The sensor die is sensitive to light exposure. Direct light exposure through the port hole can lead to varied accuracy of pressure measurement. Avoid such exposure to the port during normal operation.

7.1 Methods of handling

Components can be picked from the carrier tape using either the vacuum assist or the mechanical type pickup heads. A vacuum assist nozzle type is most common due to its lower cost of maintenance and ease of operation. The recommended vacuum nozzle

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configuration should be designed to make contact with the device directly on the metal cover and avoid vacuum port location directly over the vent hole in the metal cover of the device. Multiple vacuum ports within the nozzle may be required to effectively handle the device and prevent shifting during movement to placement position.

Vacuum pressure required to adequately support the component should be approximately 25 in Hg (85kPa). This level is typical of in-house vacuum supply. Pickup nozzles are available in various sizes and configurations to suit a variety of component geometries. To select the nozzle best suited for the specific application, it is recommended that the customer consult their pick and place equipment supplier to determine the correct nozzle. In some cases it may be necessary to fabricate a special nozzle depending on the equipment and speed of operation.

Tweezers or other mechanical forms of handling that have a sharp point are not recommended since they can inadvertently be inserted into the vent hole of the device. This can lead to a puncture of the MEMS element that will render the device inoperable.

7.2 Board mount recommendations

Components can be mounted using solder paste stencil, screen printed or dispensed onto the PCB pads prior to placement of the component. The volume of solder paste applied to the PCB is normally sufficient to secure the component during transport to the subsequent reflow soldering process. Use of adhesives to secure the component is not recommended, but where necessary can be applied to the underside of the device.

Solder pastes are available in variety of metal compositions, particle size and flux types. The solder paste consists of metals and flux required for a reliable connection between the component lead and the PCB pad. Flux aids the removal of oxides that may be present on PCB pads and prevents further oxidation from occurring during the solder process.

The use of a No-Clean (NC) flux is recommended for exposed cavity components. Using pressure spray, wire brush, or other methods of cleaning is not recommended since it can puncture the MEMS device and render it unusable. If cleaning of the pcb is performed Water Soluble (WS) flux can be used. However, it is recommended the component cavity is protected by adhesive Kapton tape, vinyl cap or other means prior to the cleaning process. This covering will prevent damage to the MEMS device, contamination, and foreign materials from being introduced into device cavity as result of cleaning processes.

Ultrasonic cleaning is not recommended as the frequencies can damage wire bond interconnections and the MEMS device.

8 Mechanical and electrical specifications

8.1 Absolute maximum ratings

Absolute maximum ratings are the limits the device can be exposed to without permanently damaging it. Absolute maximum ratings are stress ratings only, functional operation at these ratings is not guaranteed. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

This device contains circuitry to protect against damage due to high static voltage or electrical fields. It is advised, however, that normal precautions be taken to avoid

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application of any voltages higher than maximum-rated voltages to this high-impedance circuit.

Table 3. Maximum ratings

Symbol	Characteristic	Value	Unit
P_{max}	Maximum applied pressure	500	kPa
V_{DD}	Supply voltage	−0.3 to 3.6	V
V_{DDIO}	Interface supply voltage	−0.3 to 3.6	V
V_{IN}	Input voltage on any control pin (SCL, SDA)	−0.3 to V_{DDIO} + 0.3	V
T_{OP}	Operating temperature range	−40 to +85	°C
T_{STG}	Storage temperature range	−40 to +125	°C

Table 4. ESD and latchup protection characteristics

Symbol	Rating	Value	Unit
HBM	Human body model	±2000	V
CDM	Charge device model	±500	V
—	Latchup current at T = 85 °C	±100	mA

Caution
This device is sensitive to mechanical shock. Improper handling can cause permanent damage to the part or cause the part to otherwise fail.

Caution
This is an ESD sensitive device. Improper handling can cause permanent damage to the part.

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8.2 Mechanical characteristics

Table 5. Mechanical characteristics

V_{DD} = 2.5 V, T = 25 °C, over 50 kPa to 110 kPa, unless otherwise noted.

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Pressure sensor						
P_{FS}	Measurement range	Calibrated range	50	—	110	kPa
		Operational range	20	—	110	kPa
	Pressure reading noise [1]	1x oversample	—	19	—	Pa RMS
		128x oversample	—	1.5	—	Pa RMS
	Pressure absolute accuracy	50 to 110 kPa over 0 °C to 50 °C	–0.75	—	0.75	kPa
		50 to 110 kPa over −10 °C to 70 °C	—	±0.75	—	kPa
	Pressure relative accuracy	Relative accuracy during pressure change between 70 to 110 kPa at any constant temperature between −10 °C to 50 °C	—	±0.05	—	kPa
		Relative accuracy during changing temperature between −10 °C to 50 °C at any constant pressure between 50 kPa to 110 kPa	—	±0.1	—	kPa
	Pressure/altitude resolution [2][3][4]	Barometer mode	0.25	1.5	—	Pa
		Altimeter mode	0.0625	0.3	—	m
	Output data rate	One-shot mode	—	100	—	Hz
		FIFO mode	—	—	1	Hz
	Board mount drift	After solder reflow	–0.45	±0.15	0.45	kPa
	Long term drift	After a period of 1 year	–0.3	±0.1	0.3	kPa
Temperature sensor						
T_{FS}	Measurement range	—	–40	—	+85	°C
	Temperature accuracy	@25 °C	—	±1	—	°C
		Over temperature range	—	±3	—	°C
T_{OP}	Operating temperature range	—	–40	—	+85	°C

[1] Oversample (OSR) modes internally combine and average samples to reduce noise.
[2] Smallest bit change in register represents minimum value change in Pascals or meters. Typical resolution to signify change in altitude is 0.3 m.
[3] Reference pressure = 101.325 kPa (sea level).
[4] At 128x oversample ratio.

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8.3 Electrical characteristics

Table 6. Electrical characteristics

@ V_{DD} = 2.5 V, T = 25 °C unless otherwise noted.

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{DDIO}	I/O supply voltage	—	1.62	1.8	3.6	V
V_{DD}	Operating supply voltage	—	1.95	2.5	3.6	V
I_{DD}	Integrated current 1 update per second	Highest speed mode oversample = 1	—	8.5	—	µA
		Standard mode oversample = 16	—	40	—	µA
		High resolution mode oversample = 128	—	265	—	µA
I_{DDMAX}	Max current during acquisition and conversion	During acquisition/ conversion	—	2	—	mA
I_{DDSTBY}	Supply current drain in STANDBY mode	STANDBY mode selected SBYB = 0	—	2	—	µA
VIH	Digital high level input voltage SCL, SDA	—	0.75	—	—	V_{DDIO}
VIL	Digital low level input voltage SCL, SDA	—	—	—	0.3	V_{DDIO}
VOH	High level output voltage INT1, INT2	I_O = 500 µA	0.9	—	—	V_{DDIO}
VOL	Low level output voltage INT1, INT2	I_O = 500 µA	—	—	0.1	V_{DDIO}
VOLS	Low level output voltage SDA	I_O = 500 µA	—	—	0.1	V_{DDIO}
T_{ON}	Turn-on time [1][2][3]	High speed mode	—	—	60	ms
		High resolution mode	—	—	1000	ms
T_{OP}	Operating temperature range	—	−40	25	+85	°C
I²C addressing						
I²C Address	—	—	0x60			Hex
The device uses 7-bit addressing and does not acknowledge general call address 000 0000. Slave address has been set to 60h or 110 0000. 8-bit read is C1h, 8-bit write is C0h.						

[1] Time to obtain valid data from STANDBY mode to ACTIVE mode
[2] High speed mode is achieved by setting the oversample rate of 1x.
[3] High resolution mode is achieved by setting the oversample to 128x.

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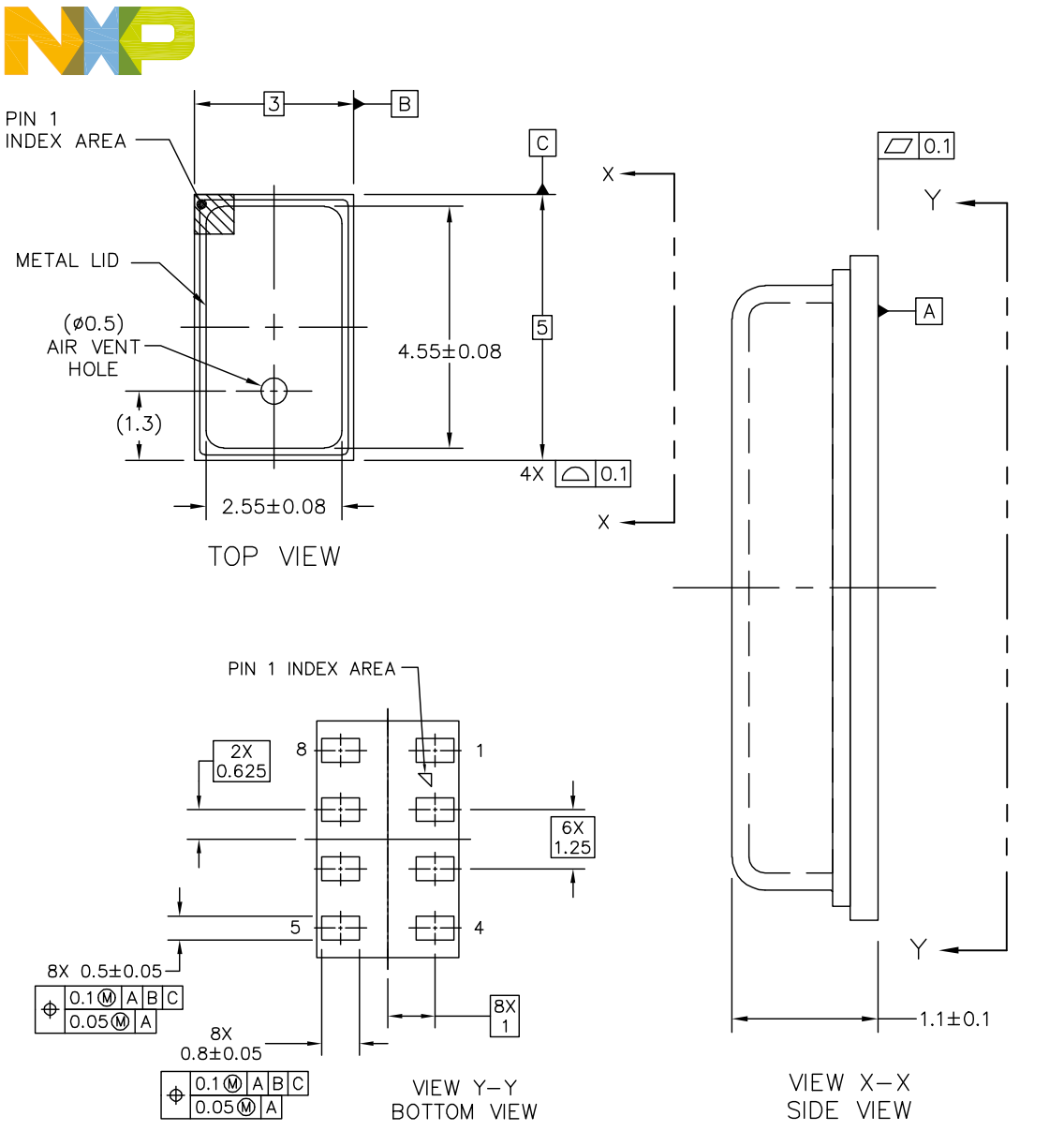
9 Package information

9.1 Package dimensions

This drawing is located at http://nxp.com/files/shared/doc/package_info/98ASA00260D.pdf.



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TITLE: LGA 8 I/O, 3 X 5 X 1.25 PITCH, SENSOR 1.2MAX MM PKG	DOCUMENT NO: 98ASA00260D	REV: A
	STANDARD: NON–JEDEC	
	SOT1768–1	07 JAN 2016

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NOTES:

1. ALL DIMENSIONS IN MILLIMETERS.

2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994

3. STYLE:
   PIN 1: VDD PIN 5: INT2
   PIN 2: CAP PIN 6: INT1
   PIN 3: GND PIN 7: SDA
   PIN 4: VDDIO PIN 8: SCL

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	STANDARD: NON–JEDEC	
	SOT1768–1	07 JAN 2016

Figure 3. Case 98ASA00260D, LGA package

10 Soldering/landing pad information

The LGA package is compliant with the RoHS standard.

Note: *Pin 1 index area marker does not have any internal electrical connections. Handling and soldering recommendations for pressure sensors are available in application notes AN1984 and AN3150.*

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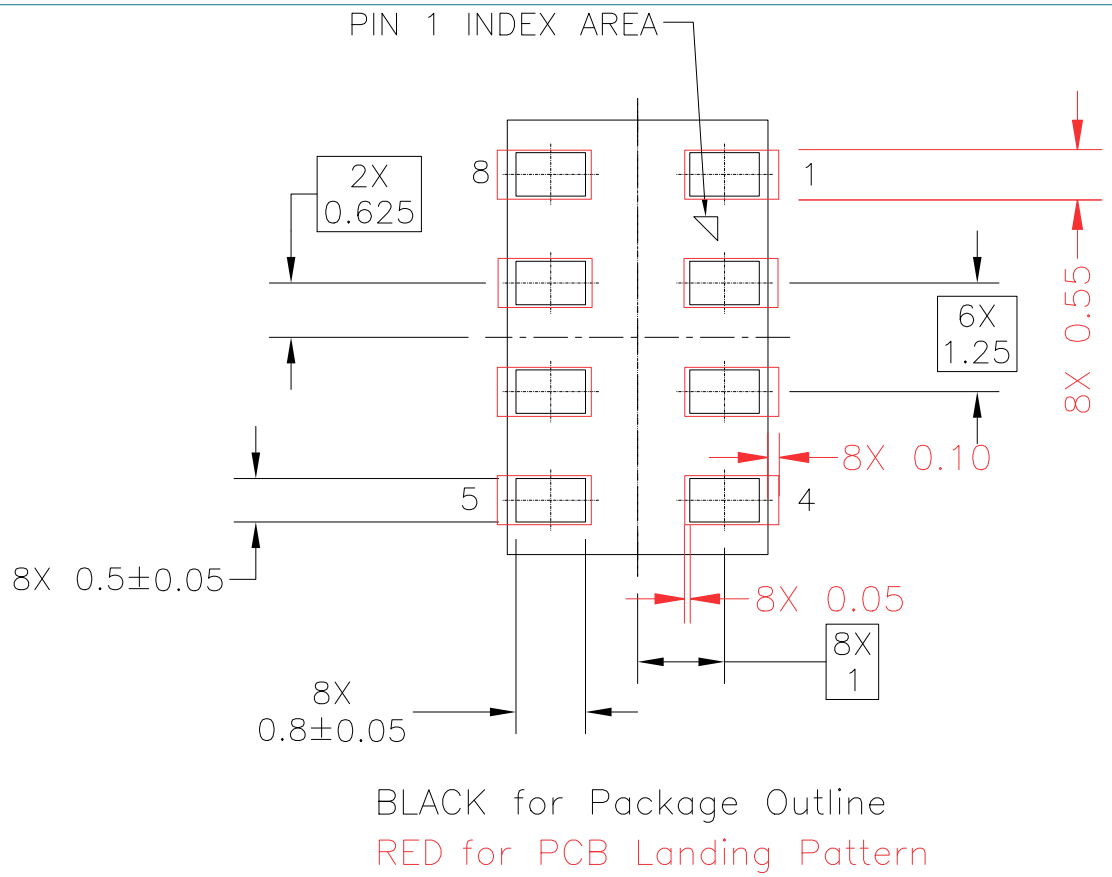

Figure 4. Recommended PCB landing pattern

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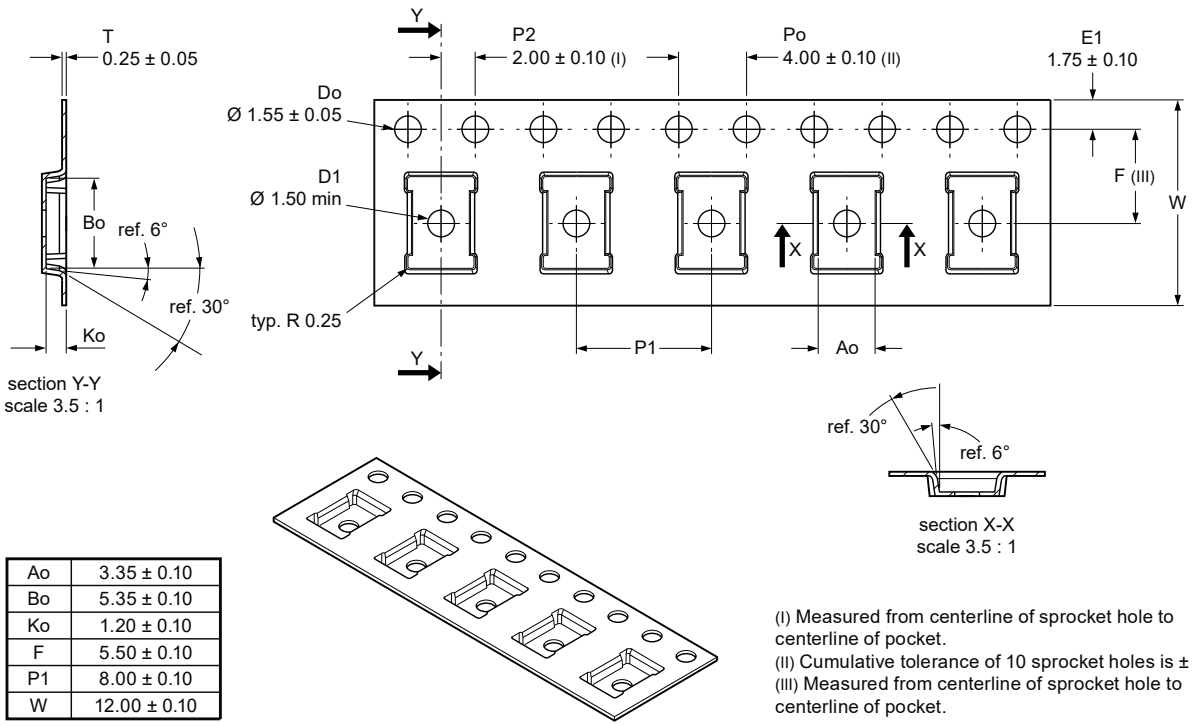
11 Tape and reel specifications



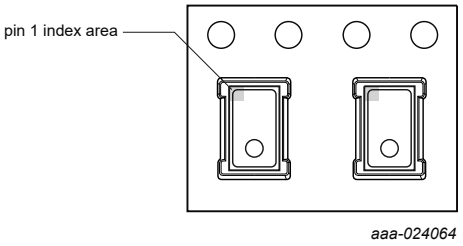
Ao	3.35 ± 0.10
Bo	5.35 ± 0.10
Ko	1.20 ± 0.10
F	5.50 ± 0.10
P1	8.00 ± 0.10
W	12.00 ± 0.10

(I) Measured from centerline of sprocket hole to centerline of pocket.
(II) Cumulative tolerance of 10 sprocket holes is ± 0.20.
(III) Measured from centerline of sprocket hole to centerline of pocket.

Dimensions are in millimeters.

aaa-024062

Figure 5. LGA 3 mm × 5 mm embossed carrier tape dimensions



aaa-024064

Figure 6. Device orientation in chip carrier

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12 Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supercedes
FXPQ3115BVSDS v.4	20180412	Technical data	n.a.	FXPQ3115BVSDS v.1
Modifications	• Changed the revision of this short data sheet from v.1 to v.4 to synchronize the revision with the full datasheet. All applicable changes are included in this revision history. • Updated the package image on the first page. • Revised Section 2 as follows: – Removed "Repeatability of ±20 Pa" from list – Updated "I²C digital output interface (up to 400 kHz)" to "I²C digital output interface". • Updated the image in Figure 1 of Section 5. • Updated the image in Figure 2 of Section 6. • Added Section 7 "Handling and board mount recommendations". • Removed "Pressure Repeatability" row in Table 5 of Section 8.2. • Updated the images in Figure 5 and Figure 6 in Section 11.			
FXPQ3115BVSDS v.1	20171009	Technical data	n.a.	n.a.

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[short] Data sheet: technical data	Production	This document contains the product specification. NXP Semiconductors reserves the right to change the detail specifications as may be required to permit improvements in the design of its products.

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[2] The term 'short data sheet' is explained in section "Definitions".
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