

NOVOSENSE **NSM2032-Q0** Core based High Bandwidth and Precision, Linear Hall-Effect Sensor Datasheet (EN)1.0

Product Overview

NSM2032-Q0 linear sensor IC enables precise current measurement for AC and DC current with concentrator core. It is designed for applications where it supports up to thousands of amps flow through a busbar or a cable. Current flowing through a busbar or cable generates a magnetic field that is sensed by the monolithic, low-offset, linear Hall IC. The NSM2032-Q0 is offered up to max 400kHz bandwidth with ultra-low noise, making it ideal for inverter phase current sensing, load detection and management, power supplies, and DC/ DC converters where fast switching is required. The fast response time enables overcurrent fault detection in safety critical applications. Monolithic Hall IC with over-voltage, under-voltage and broken ground detecting diagnostics provides more reliability and functional safety.

NSM2032-Q0 provides unique three different packages which support SMT reflow process and 1mm package thickness is suitable for space-constrained applications.

Key Features

- Up to 400kHz high bandwidth
- Programmable sensitivity from 0.5mV/G to 30mV/G
- $\pm 1.5\%$ sensitivity error over full temperature range
- $\pm 5\text{mV}$ offset error over full temperature range
- Under voltage/Over voltage detection
- Broken ground detection
- Operation temperature: $-40^{\circ}\text{C} \sim 150^{\circ}\text{C}$
- Support power supply ratiometric mode

- RoHS-compliant package
- AEC - Q100 Grade 0

Applications

- DCDC converters
- High voltage traction motor inverter
- 48 V / 12 V auxiliary inverter
- Battery monitoring
- Overcurrent detection
- Smart fuse
- Power distribution unit (PDU)

Device Information

Part Number	Package	Body Size
NSM2032-Q0	TO94	5.21mm*3.43mm
NSM2032-Q0	BV	5.21mm*3.43mm
NSM2032-Q0	BS	5.21mm*3.43mm
NSM2032-Q0	BZ	5.21mm*3.43mm

Functional Block Diagrams

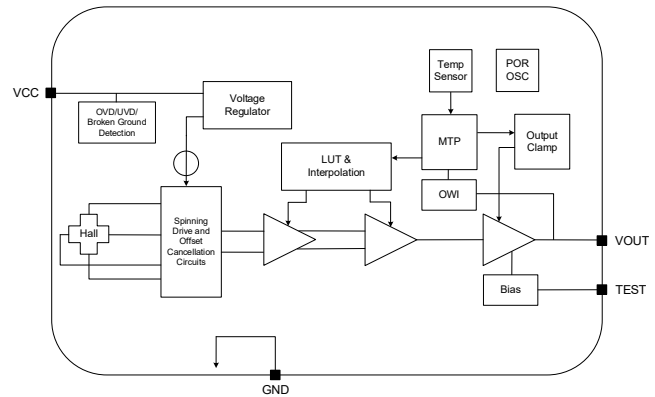


Figure 1. NSM2032-Q0 Block Diagram

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1. Pin Configuration and Functions

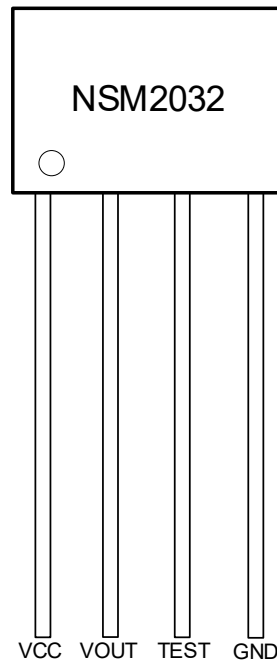


Figure 1.1 NSM2032-Q0 Package

Table 1.1 NSM2032-Q0 Pin Configuration and Description

<i>NSM2032-Q0 PIN NO.</i>	<i>SYMBOL</i>	<i>FUNCTION</i>
1	VCC	Power Supply
2	VOUT	Analog output / Program Pin
3	TEST	Internal circuits (this pin can be connected to GND in ratiometric-mode)
4	GND	Power GND

2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power Supply Voltage	V _{CC}	-0.3		6.5	V	
VOUT Voltage	V _{OUT}	-0.3		6.5	V	
Ambient Temperature	T _A	-40		150	°C	
Junction Temperature	T _J	-40		150	°C	
Storage Temperature	T _{STG}	-40		150	°C	

3. ESD Ratings

Parameters	Symbol	Value	Unit
V(ESD) Electrostatic Discharge	Human-Body Model (HBM), per AEC-Q100-002-RevE /ESDA-JEDEC JS-001	±8000	V
	Charged-Device Model (CDM), per AEC-Q100-011-RevD /ESDA-JEDEC JS-002	±2000	V

4. Thermal Information

Parameters	Symbol	TO94	Unit
Junction-to-ambient thermal resistance ^[1]	θ _{JA}	175	°C/W

[1] TO94 package tested on NSM2032-Q0 evaluation board

5. Specifications

5.1. Common Characteristics (V_{CC}=5V, T_A=-40°C to 150°C. Unless otherwise noted)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	V _{CC}	4.5	5	5.5	V	
Supply current	I _{CC}		10	15	mA	No load, V _{CC} =5V
Power on reset voltage	V _{PORH}	2.778	2.853	2.92	V	T _A = 25°C
	V _{PORL}	2.398	2.57	2.706	V	T _A = 25°C
Power on time	T _{PO}			1	ms	T _A = 25°C, C _L =1nF, C _{Bypass} =100nF
Output capacitance load ^{[1][2]}	C _L			10	nF	
Output resistance load ^{[1][2]}	R _L	10			kΩ	
DC output resistance	R _O			1	Ω	
Output short current	I _{short}		25		mA	Short to GND, T _A = 25°C
			45		mA	Short to V _{CC} , T _A = 25°C
Linear range	V _{Olin}	0.5		4.5	V	T _A = 25°C, C _L =1nF, V _{CC} =5V
Output voltage clamp	V _{CLPH}	4.65	4.7	4.75	V	T _A = 25°C, C _L =1nF, R _L =10kΩ to GND
	V _{CLPL}	0.25	0.3	0.36	V	T _A = 25°C, C _L =1nF, R _L =10kΩ to V _{CC}
Output voltage saturation	V _{SATH}		4.8		V	T _A = 25°C, C _L =1nF, R _L =10kΩ to GND. Clamp disables.
	V _{SATL}		0.2		V	T _A = 25°C, C _L =1nF, R _L =10kΩ to V _{CC} . Clamp disables.
Output voltage with broken GND	V _{BRK_UP}	4.8	4.9	5	V	T _A = 25°C, C _L =1nF, R _L =10kΩ to V _{CC}
	V _{BRK_DN}	0	0.1	0.2	V	T _A = 25°C, C _L =1nF, R _L =10kΩ to GND
Over-voltage detection	V _{OVD_H}	6.1	6.3	6.8	V	T _A = 25°C
	V _{OVD_L}	5.6	5.8	6.1	V	T _A = 25°C
Under-voltage detection	V _{UVD_L}	4	4.055	4.1	V	T _A = 25°C
	V _{UVD_H}	4.18	4.24	4.3	V	T _A = 25°C
Rise time ^{[1][2]}	T _r		1.2	3	μs	T _A = 25°C, C _L =1nF
Propagation delay ^{[1][2]}	T _{pd}		1.2	3	μs	T _A = 25°C, C _L =1nF
Response time ^{[1][2]}	T _{response}		1.5	3	μs	T _A = 25°C, C _L =1nF
Bandwidth ^{[1][2]}	BW		400		kHz	T _A = 25°C, C _L =1nF
RMS output noise ^{[1][2]}	N _{RMS}		3		mV _{RMS}	T _A = 25°C, C _L =1nF, Sens=5mV/G, BW=400kHz
Non-linearity	E _{NL}		±0.2		%	

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Ratiometric output sensitivity error	S _{ERR}		±0.5		%	Ratiometric version, V _{CC} = 4.5V~5.5V, T _A = 25°C
Ratiometric output offset error ^[3]	V _{OUT0R}	-0.2		0.2	%	Ratiometric version, V _{CC} = 4.5V~5.5V, T _A = 25°C
Zero current output voltage	QVO		V _{CC} /2			Ratiometric version
Operational magnetic field range	B _{op}	±150	±1300	±4500	G	
Programmable sensitivity range	SEN _{pr}	0.4		30	mV/G	
Fine offset programming bits			8		bit	
Coarse sensitivity programming bits			6		bit	
Fine sensitivity programming bits			10		bit	
Factory sensitivity error ^[3]	Esens	-1		1	%	T _A = 25°C Sensitivity=1mV/G
Sensitivity drift over temperature ^[3]	Δsens	-1		1	%	T _A = 25°C~150°C Sensitivity=1mV/G
		-1		1	%	T _A = -40°C~25°C Sensitivity=1mV/G
Factory offset error ^[3]	V _{OE}	-5		5	mV	T _A = 25°C
Offset drift over temperature ^[3]	Δoffset	-5		5	mV	T _A = 25°C~150°C
		-5		5	mV	T _A = -40°C~25°C
Offset lifetime drift ^{[4][5]}			±1.5		mV	T _A = 25°C
Sensitivity lifetime drift ^{[4][5]}			±0.8		%	T _A = 25°C, Sensitivity=1mV/G

[1]: Guaranteed by design.

[2]: Guaranteed by Bench Validation.

[3]: Min/Max value is the limit of Final test in production.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference. It is the worst case.

[5]: Lifetime drift parameter is average value from reliability testing.

5.2. Typical Performance Characteristics

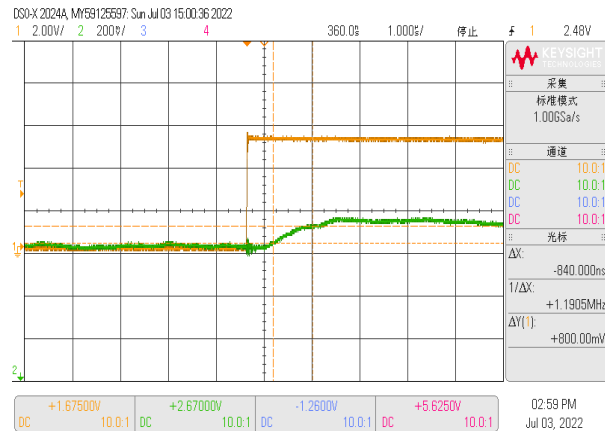


Figure 5.1 Rising time performance of step current

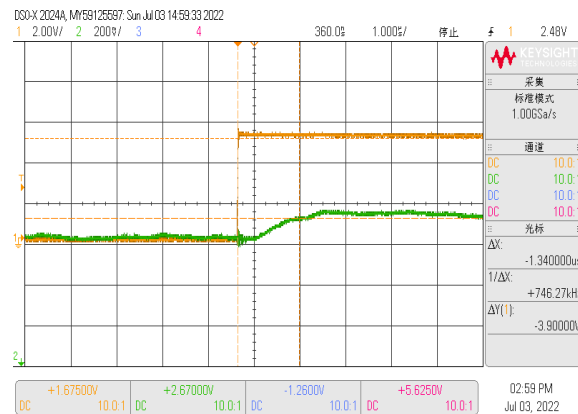


Figure 5.2 Response time performance of step

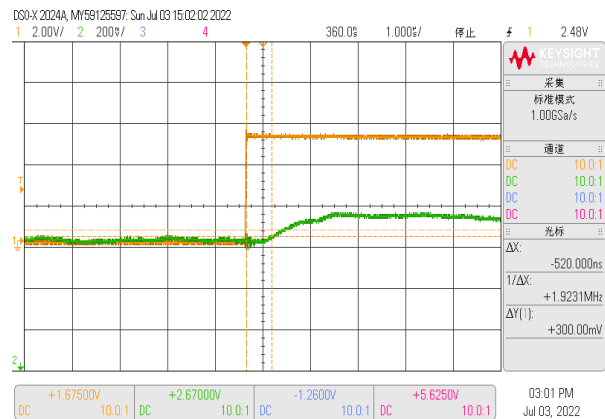


Figure 5.3 Propagation delay of step current

6. Function Description

6.1. Principal

NSM2032-Q0 can measure AC and DC current with ferromagnetic core. When current flows through a busbar or cable, it will generate magnetic field and is concentrated by core, NSM2032-Q0 senses this field and converts it to analog voltage. The device output will be proportional to the sensed magnetic field, which is proportional to the applied current. The relationship between applied current and generated field is described as:

$B = CF \cdot I$, CF is a coupling factor, which means how much magnetic field is generated by current, the unit is G/A.

6.2. Output Direction

Magnetic flux going through as shown in below figure, increases the output voltage from its QVO voltage (from 2.5V to 4.5V in 5V supply). The amount the output voltage increases is proportional to the magnitude of the flux. Conversely, magnetic flux going in the opposite direction decreases the output voltage from QVO voltage.

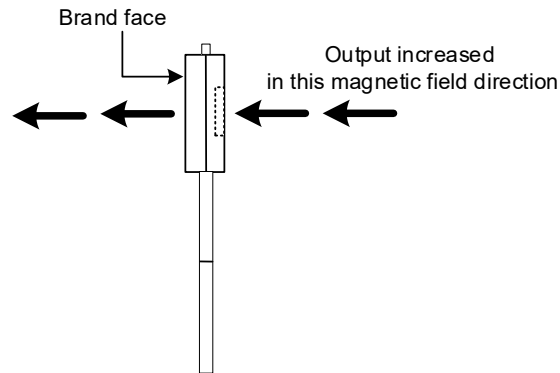


Figure 6.1 NSM2032-Q0 Output increases with magnetic flux direction (default setting)

6.3. Broken Wire Voltage

If the GND pin is disconnected (broken wire event), the output voltage will go to V_{BRK_UP} (if a load resistor is connected to V_{CC}) or to V_{BRK_DN} (if a load resistor is connected to GND).

6.4. Over-Voltage Detection

When V_{CC} is raised above the Over-voltage Detection enable voltage (V_{OVD_H}), the NSM2032-Q0 output stage enters high impedance. V_{OUT} will float to V_{CC} with a pull-up R_L , or to GND with a pull-down R_L , when V_{OVD_H} is reached. The NSM2032-Q0 output will resume normal operation after V_{CC} is below the over-voltage detection disable voltage V_{OVD_L} .

6.5. Under-Voltage Detection

When UVD function is enabled and the device is first powered on after POR, V_{OUT} will remain High-Z until V_{CC} rises above V_{UVD_H} , at which point V_{OUT} will begin to operate normally. If UVD is disabled, under the same conditions, after V_{CC} rises above V_{POR_H} , V_{OUT} will start running. If V_{CC} drops below V_{UVD_L} after normal operation, V_{OUT} will be pulled to GND. The V_{OUT} will remain at GND until V_{CC} rises above V_{UVD_H} . If V_{CC} rises above V_{UVD_H} after a UVD event, V_{OUT} will return to normal output. The device will enter POR and reset, V_{OUT} will switch to High-Z when V_{CC} drops below V_{POR_L} .

6.6. Power-On Time (T_{PO})

When the power supply climbs from 0 to the device's working range, NSM2032-Q0 needs some time to establish the internal working logic. T_{PO} time is defined as: the time from the power supply climbing to V_{CCmin} to the output reaching the steady state within $\pm 10\%$. as shown below:

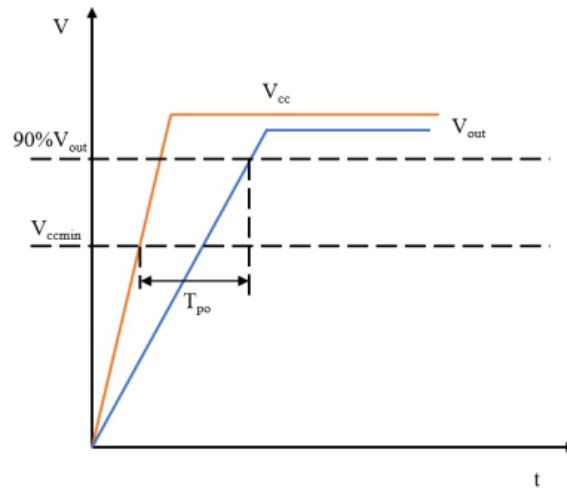


Figure 6.2 NSM2032-Q0 Power-on time

6.7. Rise Time (T_R)

The time from 10% to 90% of the output signal is defined as the output rise time. For step input signals, there is such an approximate relationship between the rise time and bandwidth of the output signal: $f(-3dB) = 0.35/T_r$.

6.8. Propagation Delay (T_{PD})

The time from 20% of the primary current to 20% of the output signal is defined as the output propagation delay time.

6.9. Response Time ($T_{response}$)

The time from 90% of the primary current to 90% of the output signal is defined as the output response time.

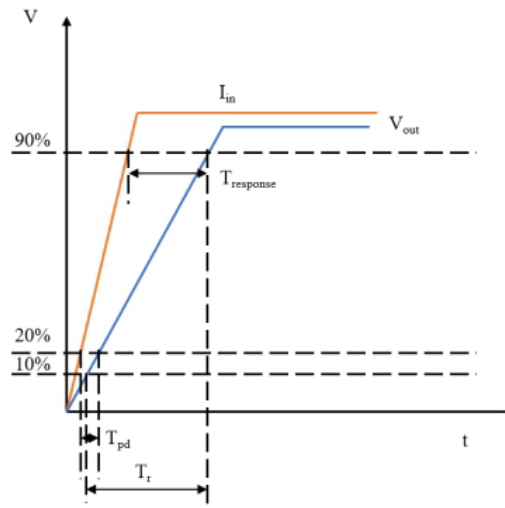


Figure 6.3 NSM2032-Q0 response time

6.10. Sensitivity and Sensitivity Error

Sensitivity is defined as the ratio of the output voltage proportional to the input magnetic field. Sensitivity is the slope of the curve in the figure below.

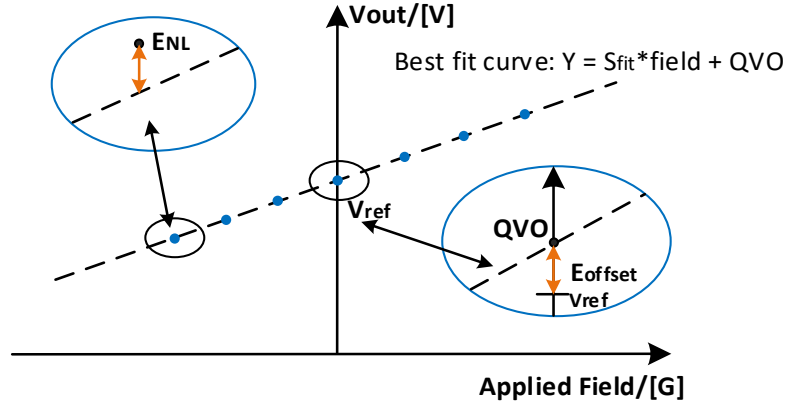


Figure 6.4 NSM2032-Q0 Sensitivity and error

The sensitivity error is defined as the deviation between the slope of the best-fit curve and the slope of the ideal curve. The slope of the best-fit curve comes from the measured value:

$$E_{sens} = \frac{(S_{fit} - S_{ideal})}{S_{ideal}} * 100\%$$

6.11. Offset Error

The zero magnetic field output error is defined as the difference between the output voltage and the reference voltage when the magnetic field is 0, reference voltage here is $V_{CC}/2$ (Ratiometric version):

$$E_{offset} = QVO - V_{ref}$$

6.12. Non-Linear Error

The linearity error is defined as the error from the maximum deviation point of the best-fit curve to the full scale. The mathematical expression is as follows:

$$V_{NL} = V_{outmax} - (S_{fit} * Field_{max} + QVO)$$

among them:

V_{outmax} is the output voltage furthest from the fitted curve;

$Field_{max}$ is the input magnetic field farthest from the fitted curve;

Therefore, the nonlinear error can be mathematically expressed as the following formula:

$$E_{NL} = \frac{V_{NL}}{FS} * 100\%$$

6.13. Ratiometric Output Sensitivity Error

The ratiometric output sensitivity error is defined as the error of the sensitivity change with the change of V_{CC} . In a perfectly ideal situation, when V_{CC} changes by 10%, the sensitivity should also change by 10%. The error is expressed by the following formula:

$$S_{ERR} = 100\% \times \left\{ \left(\frac{S(V_{CC})}{S(5V)} \right) - \left(\frac{V_{CC}}{5} \right) \right\}$$

6.14. Ratiometric Output Offset Error

The offset error of the ratiometric output is defined as the error condition of the zero-point change with the change of V_{CC} . In a perfectly ideal situation, the output zero point is $V_{CC}/2$, V_{CC} changes 10%, and the zero point should also change 10%. The error is expressed by the following formula:

$$V_{out0R} = 100\% \times \left\{ \left(\frac{V_{out0}(V_{CC})}{V_{out0}(5V)} \right) - \left(\frac{V_{CC}}{5} \right) \right\}$$

7. Application Note

7.1. Typical Application Circuit

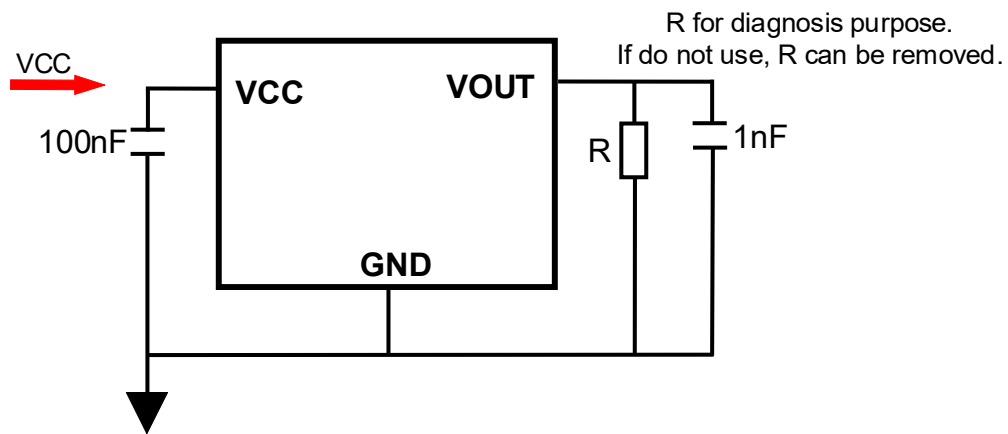
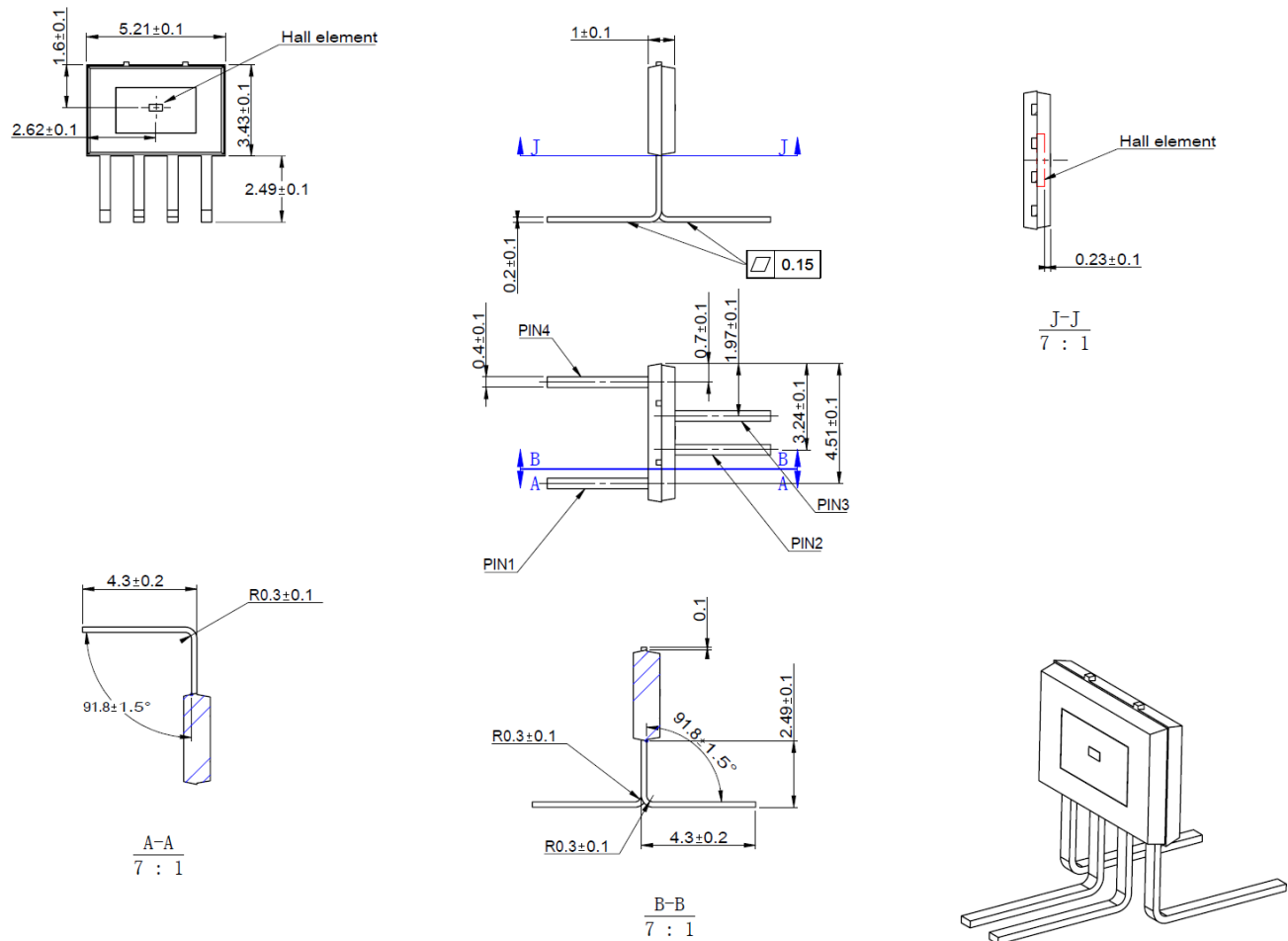


Figure 7.1 Typical application circuit of NSM2032-Q0

*In NSM2032-Q0 typical application circuit, R depends on diagnostic purpose.

8. Package Information

BS package



Technical drawing of the Hall element assembly. The drawing shows a rectangular component with a central square area labeled "Hall element". The dimensions are as follows:

- Overall width: 5.21 ± 0.1
- Overall height: 3.43 ± 0.1
- Distance from top edge to the top of the Hall element: 1.6 ± 0.1
- Distance from left edge to the left of the Hall element: 2.62 ± 0.1
- Distance from the bottom of the Hall element to the bottom of the component: 3.24 ± 0.1
- Distance from the left edge to the center of the first pin (PIN1): 0.4 ± 0.1
- Distance from the center of the first pin (PIN1) to the center of the second pin (PIN2): 0.7 ± 0.1
- Distance from the center of the second pin (PIN2) to the center of the third pin (PIN3): 1.97 ± 0.1
- Distance from the center of the third pin (PIN3) to the center of the fourth pin (PIN4): 0.7 ± 0.1
- Distance from the center of the fourth pin (PIN4) to the right edge: 0.4 ± 0.1
- Overall distance from the left edge to the center of the fourth pin (PIN4): 4.51 ± 0.1

Labels for the pins are PIN1, PIN2, PIN3, and PIN4. The label "Hall element" points to the central square area.

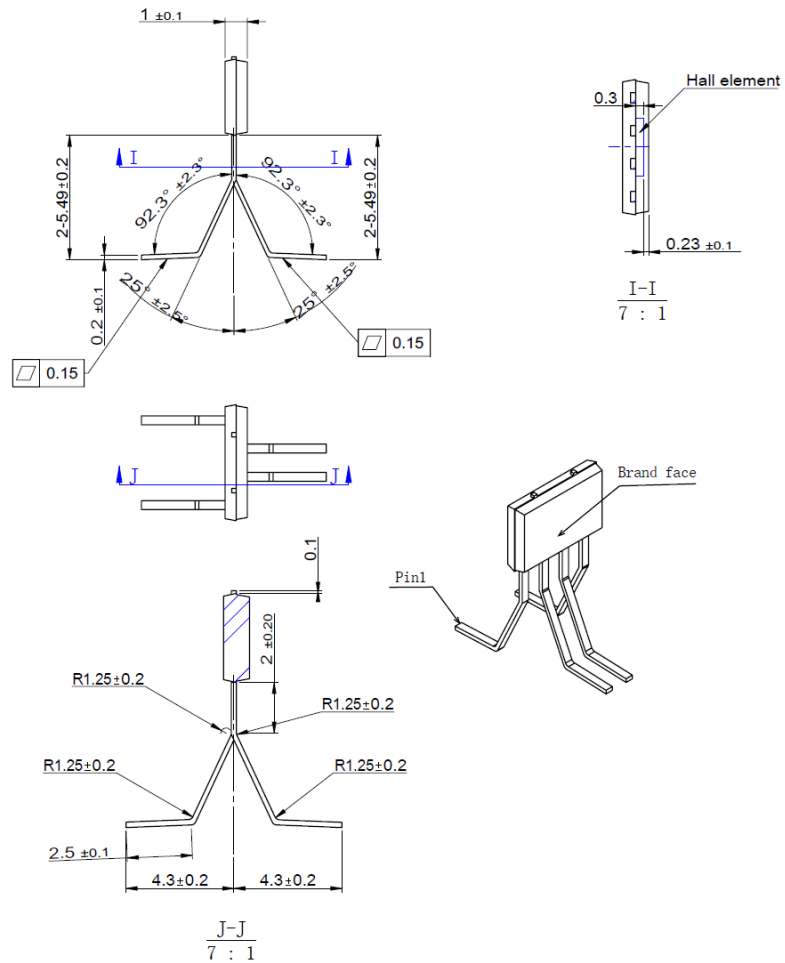
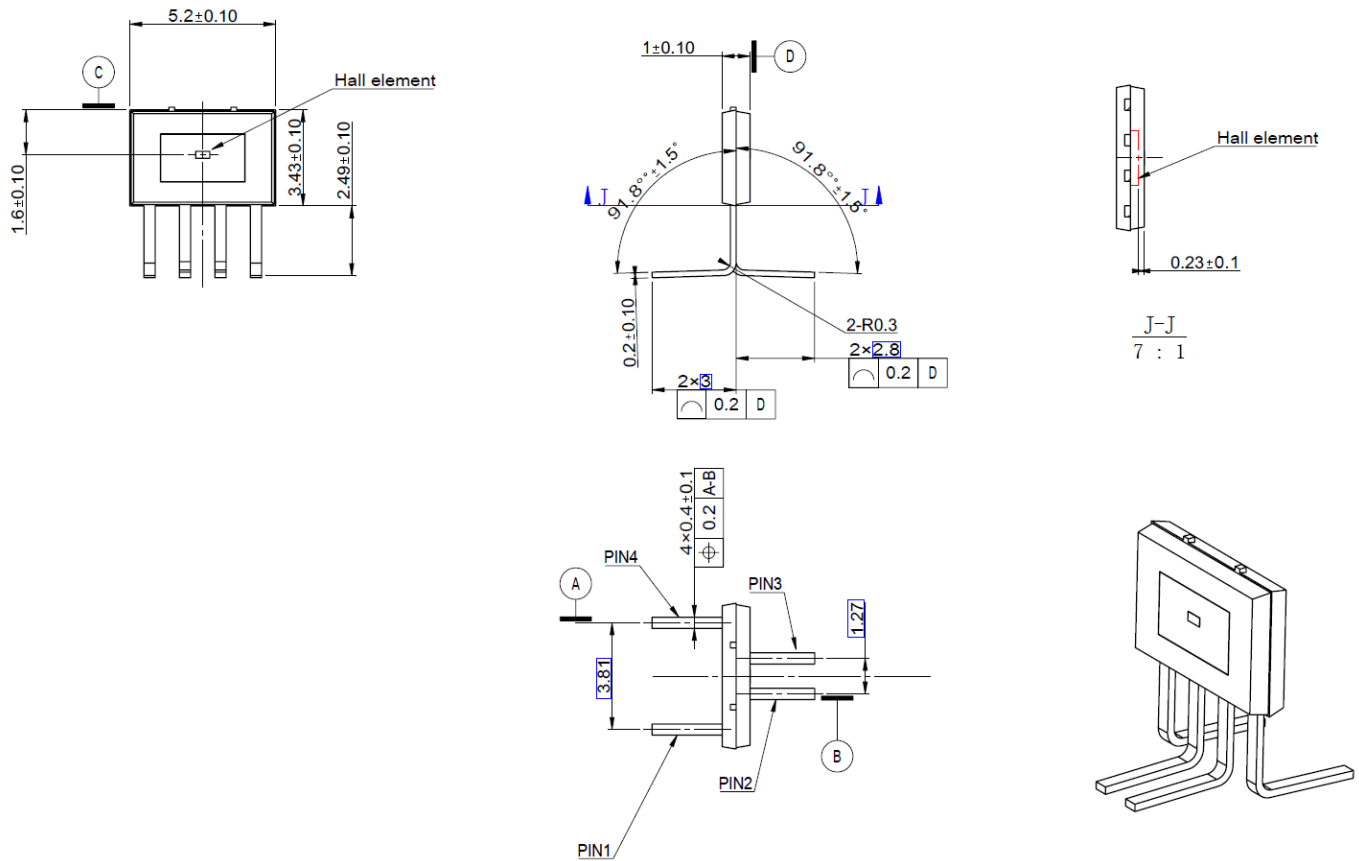
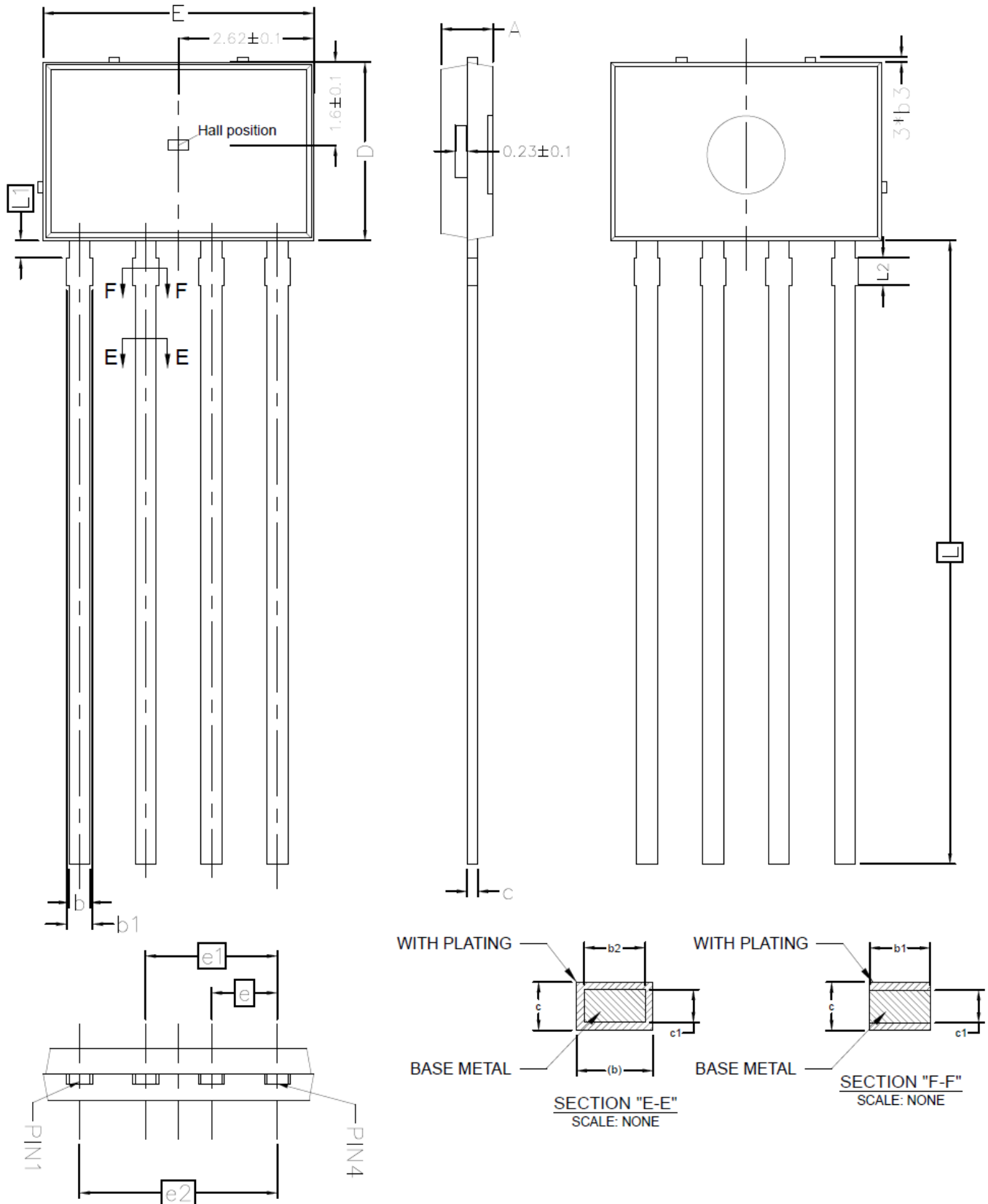


Figure 8.2 BV Package Shape and Dimension in millimeters

BZ package



TO94 package



NOTE ;

1. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. RADIUS ON TERMINAL IS OPTIONAL.
4. LEAD TRIM AND FORMING OPERATIONS PERFORMED ON ALLEGRO SUPPLIED MATERIAL.
- 5.TRUE POSITION AND PROFILE TOLERANCE APPLIES ALONG EACH LEAD IN A ZONE STARING FROM THE LEAD TIP AND ENDING NO MORE THAN 10mm IN FROM THE TIP.

METRIC TOLERANCES

X ±10%
X.X ±0.25
X.XX ±0.10
X.XXX ±0.025
ANGULAR ±0.5°

ALL SURFACES TO BE 32 μin (0.80 μm) OR BETTER
BREAK ALL SHARP EDGES 0.015"×0.015" (0.4mm x 0.4mm)
HOLD ALL DIMS AFTER PLATING

SYMBLE	MIN	MAX
A	0.90	1.10
b	0.30	0.50
b1	0.30	0.60
b2	0.30	0.45
b3	-	0.10
c	0.10	0.30
c1	0.10	0.25
D	3.33	3.53
E	5.11	5.31
e	1.27 BSC	
e1	2.54 BSC	
e2	3.81 BSC	
L	11.90	12.10
L1	0.25	0.45

Figure 8.4 TO94 Package Shape and Dimension in millimeters

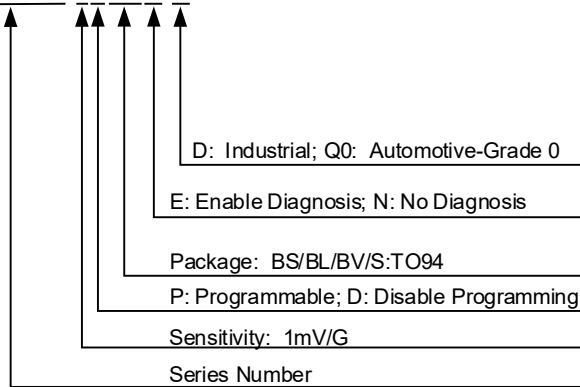
9. Ordering Information

Part Number	Power supply (V)	Factory Sensitivity (mV/G)	Programmable Sensitivity range (mV/G)	MSL	Operation Temperature (°C)	Package	SPQ /MPQ
NSM2032-0X5P	5	0.5	0.48~0.74	1	-40~150	TO94/BS/BV/BZ	TO94:4500; BS:800; BV:550; BZ:800;
NSM2032-1P	5	1	0.74~1.5	1	-40~150	TO94/BS/BV/BZ	
NSM2032-2X5P	5	2.5	1.5~3.5	1	-40~150	TO94/BS/BV/BZ	
NSM2032-5P	5	5	3.5~6	1	-40~150	TO94/BS/BV/BZ	
NSM2032-10P	5	10	6~15	1	-40~150	TO94/BS/BV/BZ	

*Any special requirements, please contact NOVOSENSE for support.

Part Number Rule:

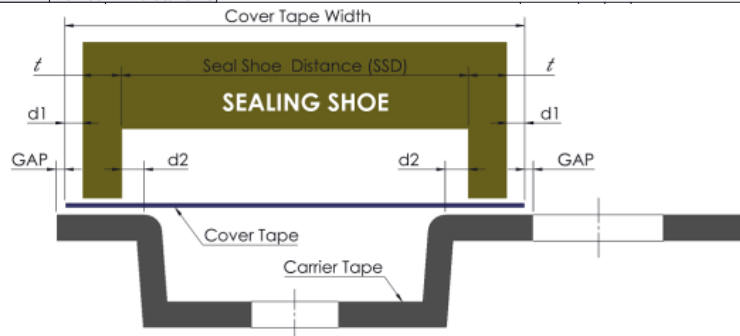
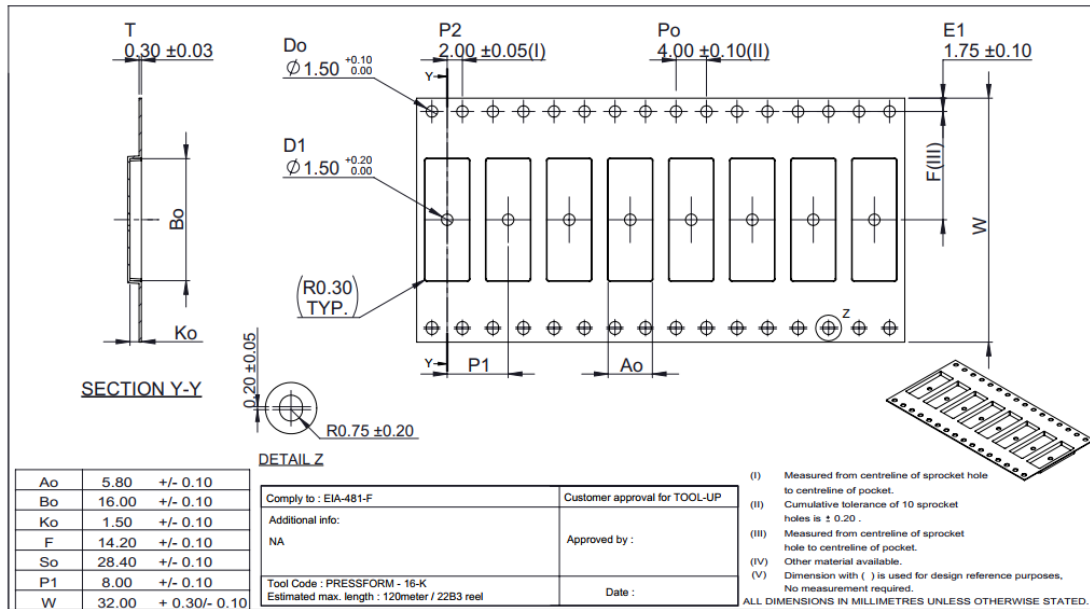
NSM2032-1PBSE-DTOR



* The diagnostic function includes OVD/UVD/Clamp.

10. Tape and Reel Information

TO94



Carrier Tape Width	Common Cover Tape Width	Normal Package					Thin Seal Package				
		t	d1	d2 (MIN)	GAP	SSD	t	d1	d2 (MIN)	GAP	SSD
8.00	5.30	0.40	0.50	0.50	0.10	3.50	0.40	0.20	0.20	0.10	4.10
12.00	9.20	0.45	0.50	0.50	0.10	7.30	0.45	0.20	0.20	0.10	7.90
16.00	13.30	0.45	0.50	0.50	0.10	11.40	0.45	0.20	0.20	0.10	12.00
24.00	21.30	0.45	0.50	0.50	0.10	19.40	0.45	0.20	0.20	0.10	20.00

t = Sealing Shoe Thickness

d1 = Distance between cover tape edge and sealing shoe (outer)

d2 = Distance between sealing shoe (inner) and pocket opening edge (at carrier tape sealing plane)

GAP = Distance between cover tape and carrier tape edges (for reference)

SSD = Sealing Shoe Distance (inner)

1. Sealing area is required at 1.50mm (MIN) per side for normal package. Package with sealing area fall in between 1.00 and 1.50mm (per side) will be classified as Thin Seal Package.

2. Peel Back Force spec will be 20 - 80 grams

3. Thin Seal Package will encounter high RISK of sealing issue such as cover tape tearing, wavy seal line, open seal & etc.

4. Sealing Shoe Size may differ from above recommendation upon the sealing test is conducted during FA evaluation.

5. User must share the evaluation report with sealing parameter, sealing shoe dimension and type of cover tape to C-Pak for documentation purposes (especially Thin Seal Package).

6. Recommendation for sealing shoe thickness (t) will be 0.45mm (18mils) as a standard. Other thickness is subjected to application condition.

7. Package with sealing area (per side) can't meet item (1) will not be recommended by C-PAK.

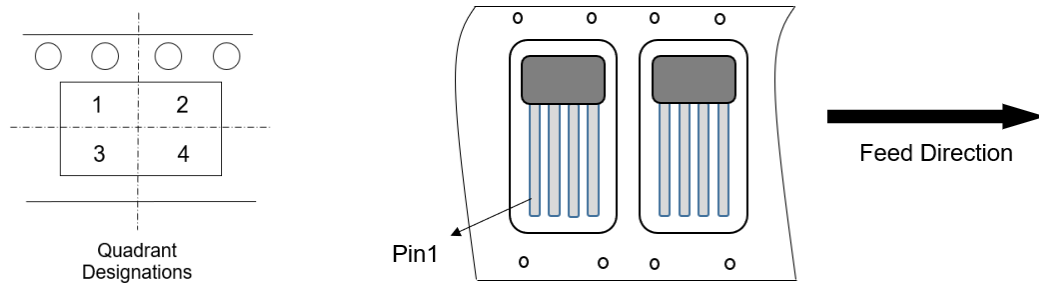
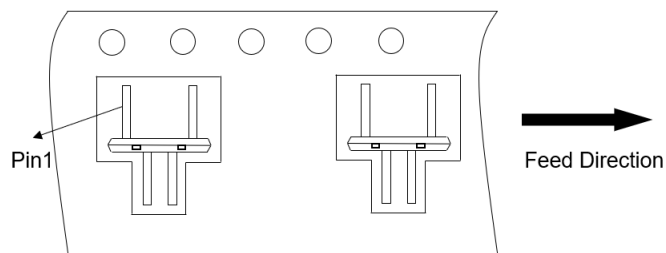


Figure 10.1 Tape and Reel Information of TO94

SECTION Y-Y

Ao	5.15	+/- 0.10	Comply to : EIA-481-F Additional info: NA Tool Code : FLATBED - 08 Estimated max. length : 30meter / 22R3 reel	Customer approval for TOOL-UP
Bo	1.20	+/- 0.10		Approved by :
Ko	6.35	+/- 0.10		
F	7.50	+/- 0.10		
P1	12.00	+/- 0.10		Date :
W	16.00	+0.30/-0.10		

- ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.



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BV

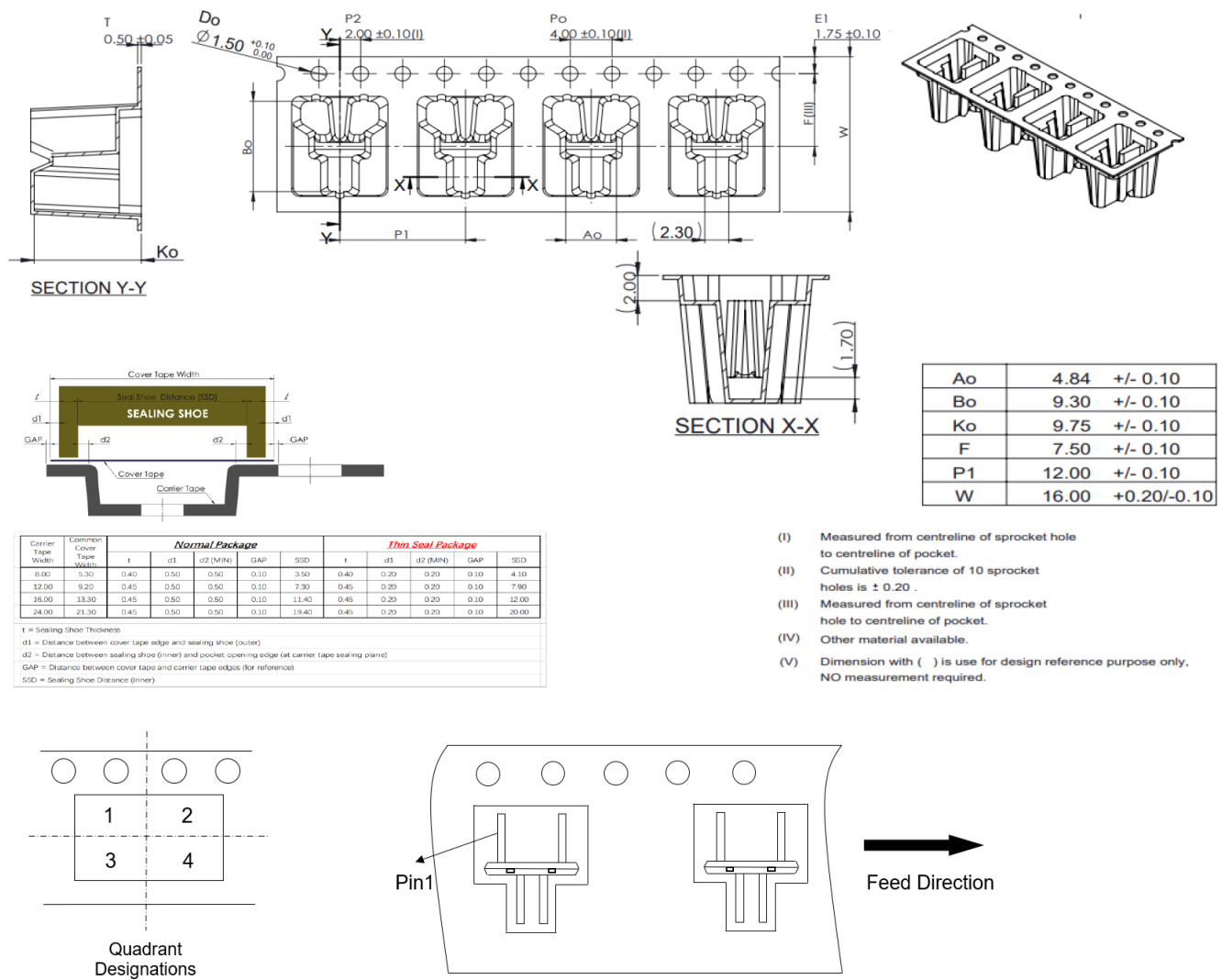


Figure 10.3 Tape and Reel Information of BV

11. Revision History

Revision	Description	Date
1.0	Released Version.	2026/07/03

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