SEN-Z65

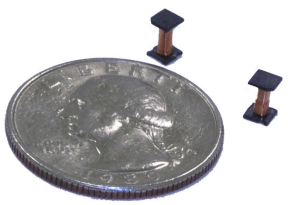
Magneto-Inductive Sensor

General Description

The SEN-Z is the newest version of PNI Corporation's Magneto-Inductive (MI) sensors. It is a replacement for a vertically mounted SEN-S. It is based on patented technology that delivers breakthrough, cost-effective magnetic field sensing performance. These sensors change inductance by 100% over their field measurement range. This variable inductance property is used in a patented temperature and noise stabilized oscillator/counter circuit to detect field variations. The PNI Sensor Driver ASIC is the recommended implementation of this patented circuit, and can be used with the SEN-Z to construct a magnetometer with up to 3-axes.

Advantages of the SEN-Z include no additional hardware needed to vertically mount the sensor low voltage and power, small size surface mount package, large signal noise immunity under all conditions, and a large dynamic range. All three sensors can now be mounted on one PCB with no need for a daughter board. When used with the PNI ASIC, resolution and field measurement range are software configurable for a variety of applications. The measurement is very stable over temperature and inherently free from offset drift.

These advantages make PNI Corporation's MI sensors the choice for a wide variety of applications.



Features

- Z-Axis mounted on same PCB as X and Y axes
- Low power: draws < 100 µA at 3 VDC
- Small size: 3.0 x 3.0 x 5.05 mm
- Large field measurement range: ±1100 µT (±11 Gauss)
- High resolution field measurement: 0.015µT (0.00015 Gauss)
- Wide operational temperature range:
  - -40º to 85ºC
- Few external components: PNI ASIC with two resistors per sensor
- Surface mount package supplied on tape & reel
- RoHS Compliant

Applications

- Handheld & compact battery-powered devices with built-in compass feature
- High-performance magnetic field sensing
- High-performance solid-state navigation equipment for automotive, marine and aeronautic applications
- Magnetic object proximity sensing

Ordering Information

Part #	MOQ	Package	RoHS Compliant
12690P	<1,200	Cut-Tape	Yes
12690	1,200	Tape & Reel	Yes

Table 1

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SPECIFICATIONS

CAUTION:

Stresses beyond those listed under **Table 2: Absolute Maximum Ratings** may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2: Absolute Maximum Ratings

Symbol	Parameter	Maximum
V_{coil}	Voltage across coil	2.0 VDC
I_{IN}	Input Pin Current	50 mA at 25 °C
T_{STRG}	Storage Temperature	-40 °C to 85 °C

Table 3: Sensor Characteristics

Parameter	Min	Typical	Max	Units
DC resistance at 25 °C ±15 °C[a]	30		45	Ω
DC resistance versus temperature		0.4		% / °C
Inductance[b]		400-600		µH
Operating Temperature	-40		85	ºC
Storage Temperature	-40		85	°C

a. Determined with a DC source.
b. No DC bias, 100 kHz at 1 Vp-p, orthogonal to Earth's magnetic field

Table 4: Sensor Characteristics

Parameter	Condition	Min	Typical	Max	Units
Current[a]	3 VDC, Rb = 43Ω 5 VDC, Rb = 68Ω (measured at ASIC V_{cc})			0.5 0.5	mA RMS
Peak Current	3 VDC 5 VDC		2.5 3.8		mA
Field measurement range[b]	3 VDC, Rb = 43Ω 5 VDC, Rb = 68Ω	-1100 -1100		1100 1100	μT
Gain[c]	3 VDC, Rb = 43Ω 5 VDC, Rb = 68Ω		27 –38 18 – 26		counts/μT
Linearity	(best fit straight line at ±200 μT)		0.6	2	% of 200 μT
Resolution[d]	3V, PS=2048 5V, PS=2048		0.031 0.042		μT
Frequency	3 VDC, Rb = 43Ω (within free Earth's magnetic field)		175		KHz

a. Current includes the ASIC and SEN-Z in continuous sequential sampling @ 8 Hz and PS of /1024
b. Field measurement range is defined as the monotonic region of the output characteristic curve.
c. Gain is defined as the change in number of counts from the ASIC, when the period select is set to 2048, per change in the magnetic field of μT. For situations requiring higher gain and less field measurement range, the gain and resolution can be increased by a factor of 2 by setting the ASIC period to 4096. When setting higher period selects, be aware that the ASIC counter can overflow if the field is strong enough to drive the count beyond a signed 16-bit integer. Period select set to 2048 is the highest setting where it is impossible to overflow the counter.
d. Resolution is defined as the reciprocal of gain. Maximum resolution obtained by setting the ASIC period select to 4096

For more information, see "PNI ASIC Datasheet"

Table 5: SEN-Z Continuous Sampling 3V at 8Hz with PNI ASIC

Period Select	Ratio	Gain (Counts/μT)	Resolution (μT)	Single Axis Typical Operating Current (mA RMS)	Typical Sample Time
0	/32	0.523	1.912	0.009	0.366
1	/64	1.047	0.956	0.015	0.731
2	/128	2.094	0.478	0.027	1.46
3	/256	4.188	0.239	0.051	2.85
4	/512	8.375	0.120	0.100	5.65
5	/1024	16.75	0.060	0.198	11.7
6	/2048	33.5	0.030	0.394	23.4
7	/4096	67	0.015	0.785	46.8

Typical Operating Characteristics (3VDC; Rb = 43 Ω) -

Figure 1: Temperature Characteristics

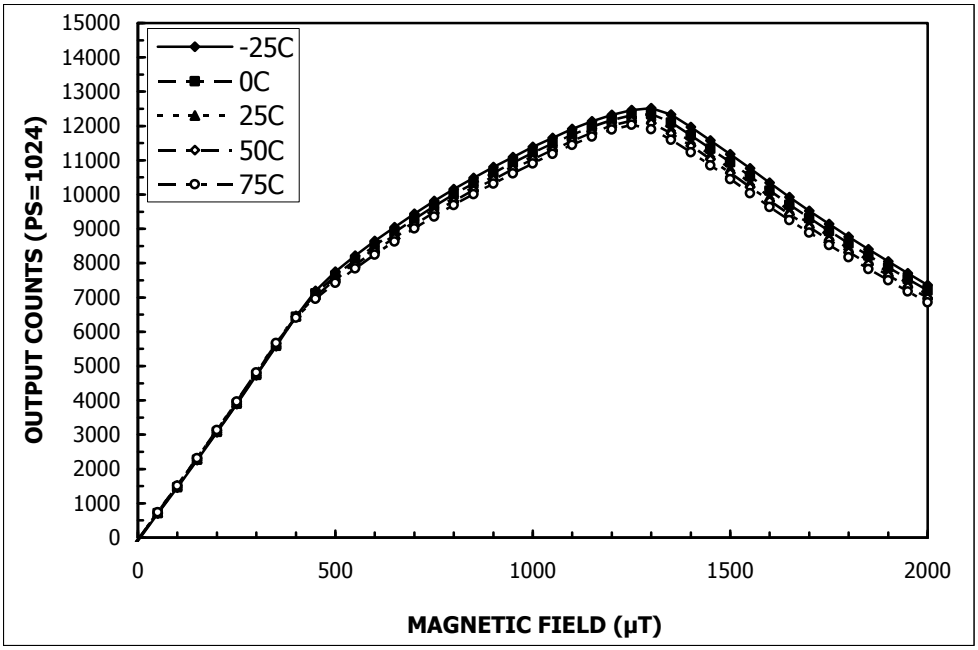

Figure 2: Linearity vs. Temperature

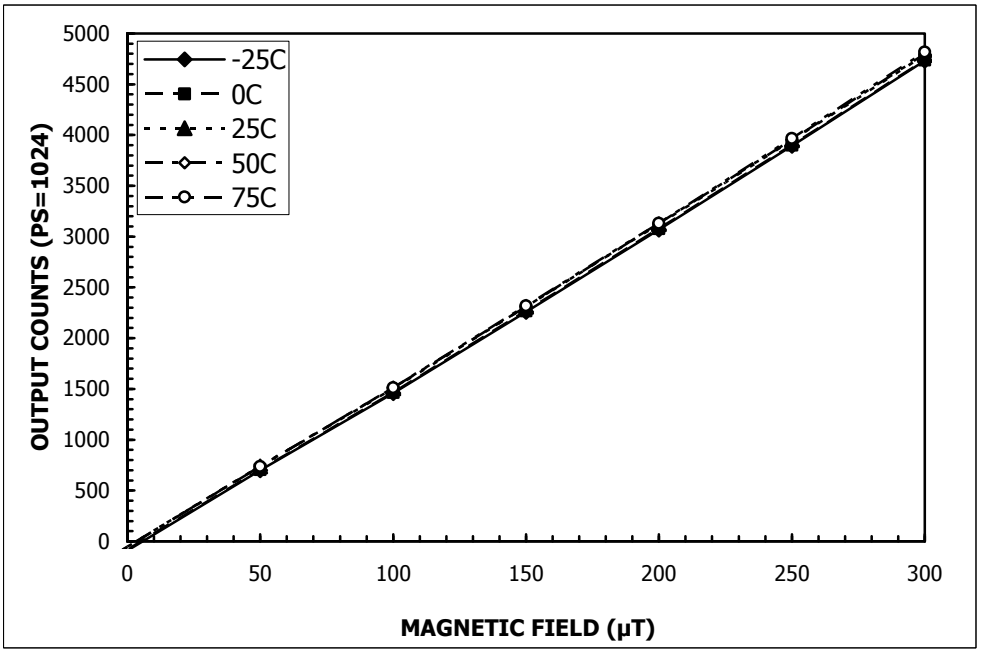

Figure 3: Recommended Bias Resistance vs. Supply Voltage

Rb ≈ 14*V_S when using PNI ASIC

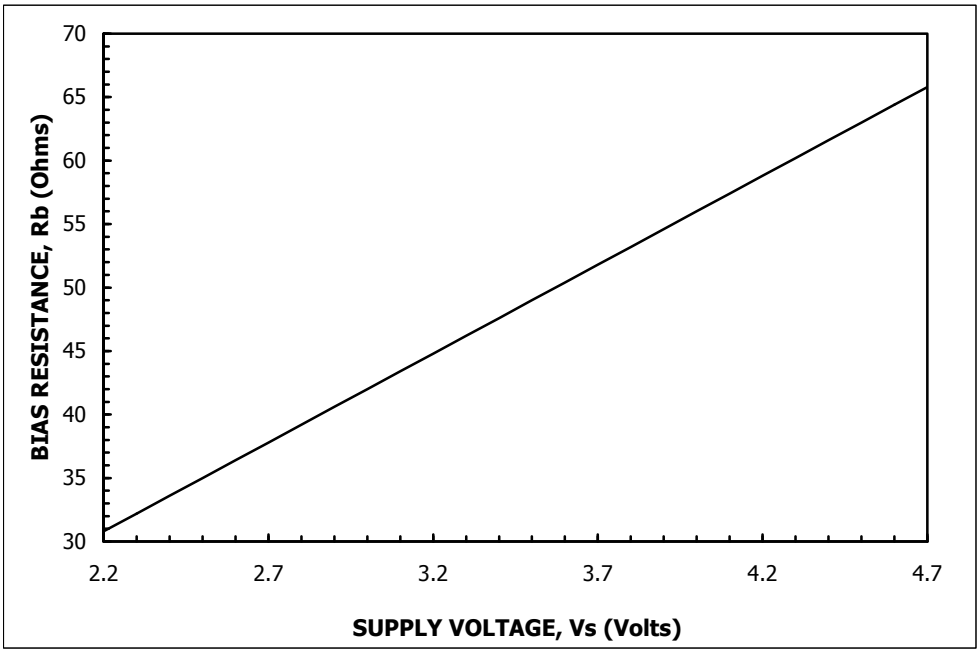

Figure 4: Hysterisis and Repeatability

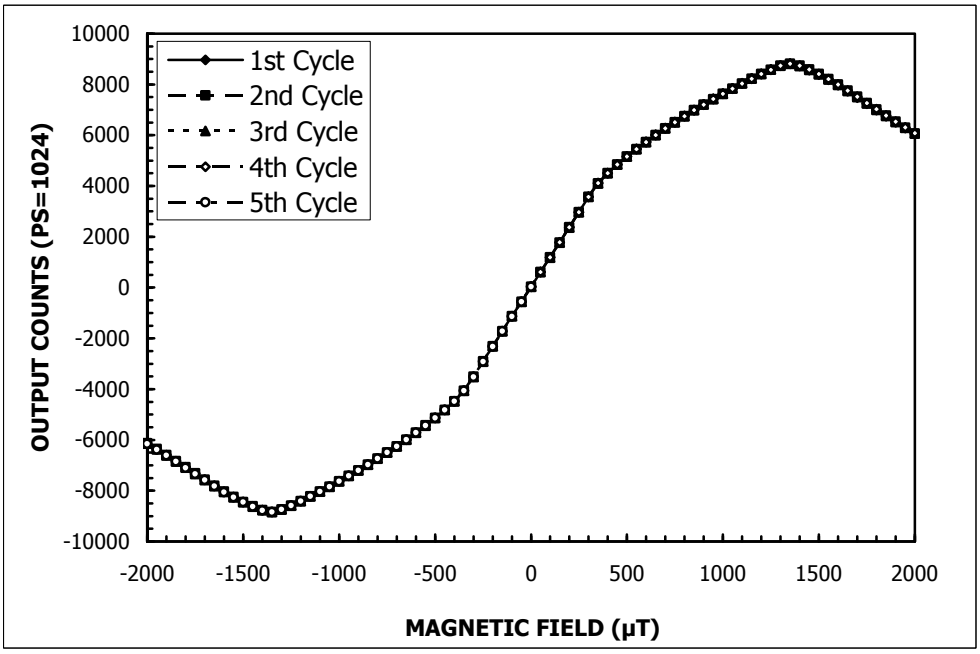

Figure 5: Dynamic Range, ±2000 µT at 3V

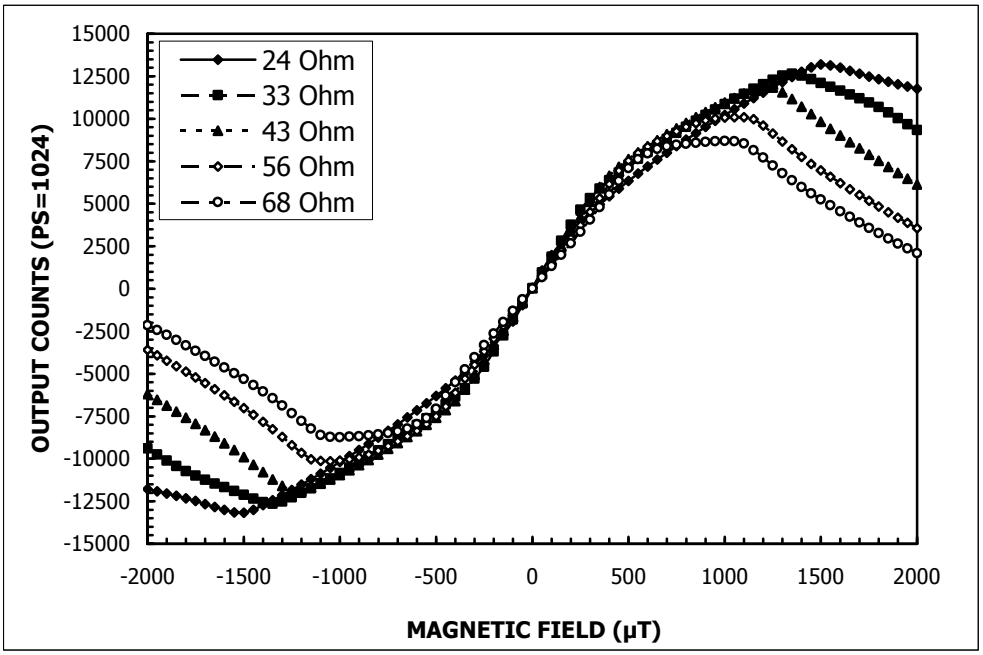

Figure 6: Linearity over Typical Operating Range, ±300µT at 3V

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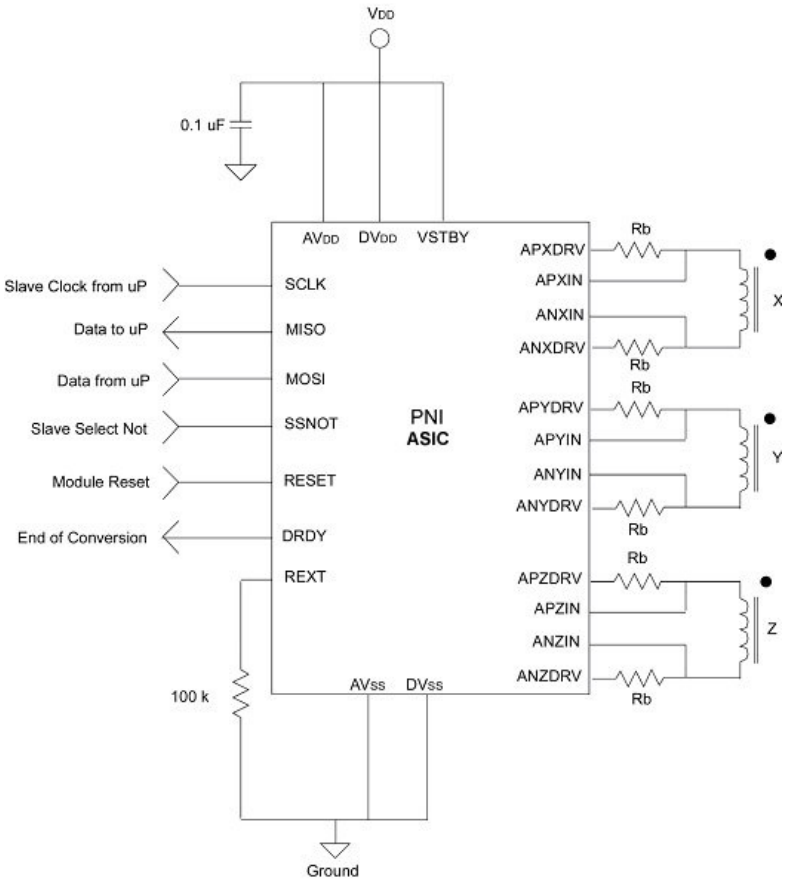
Recommended Circuit Block Diagram

Figure 7: ASIC Connections Relative to Sensor Axis



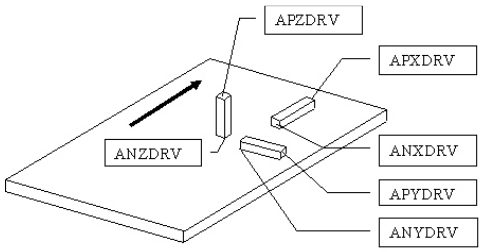
Rb is dependent on the supply voltage:

5VDC: Rb = 68Ω

3 VDC: Rb = 43Ω

For more information, see PNI ASIC datasheet

Figure 8: ASIC Connections Relative to Sensor Axis



Package Information

Sensor Information/Dimensions

Unless otherwise specified:

- Bracketed numbers **[x.xx]** are mm, non-bracketed numbers are inches
- Polarity mark indicates start winding of the sensor
- Tolerance are ±0.05mm

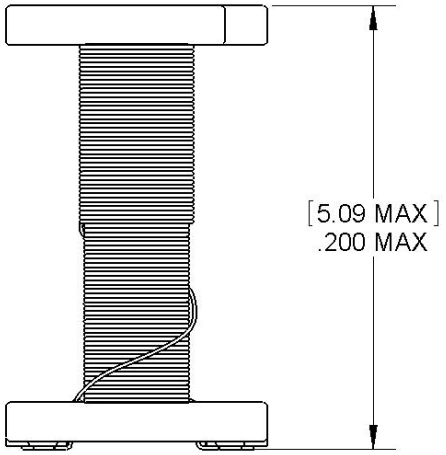


Figure 9: Side View

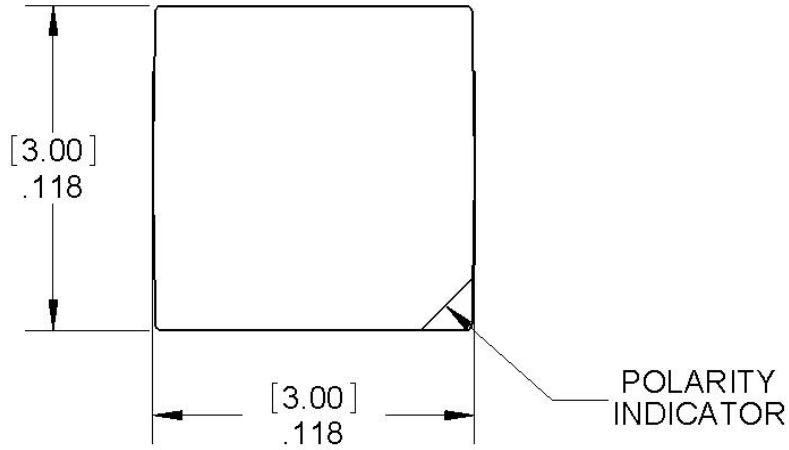


Figure 10: Top View

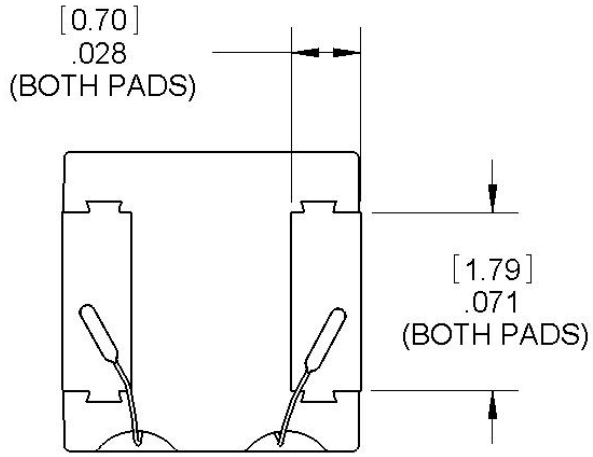


Figure 11: Bottom View

Pad Layout

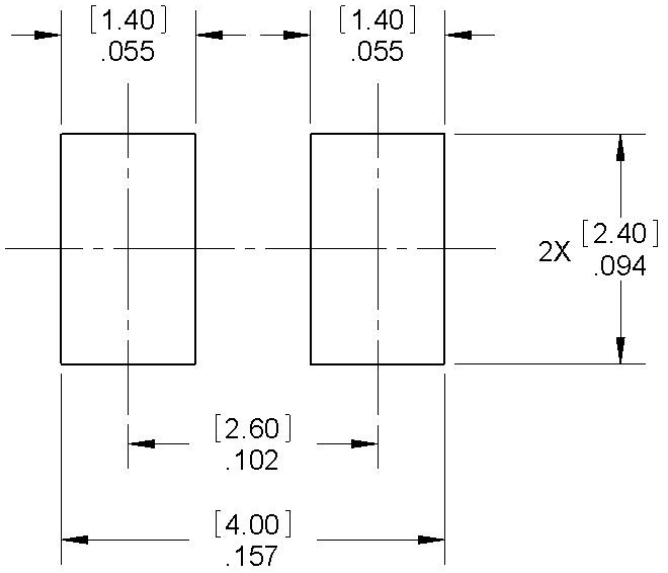


Figure 12: SEN-Z Land Pattern

Tape & Reel Information

Unless otherwise specified:

- All measurements are in millimeters
- Tolerances are ± 0.1 mm

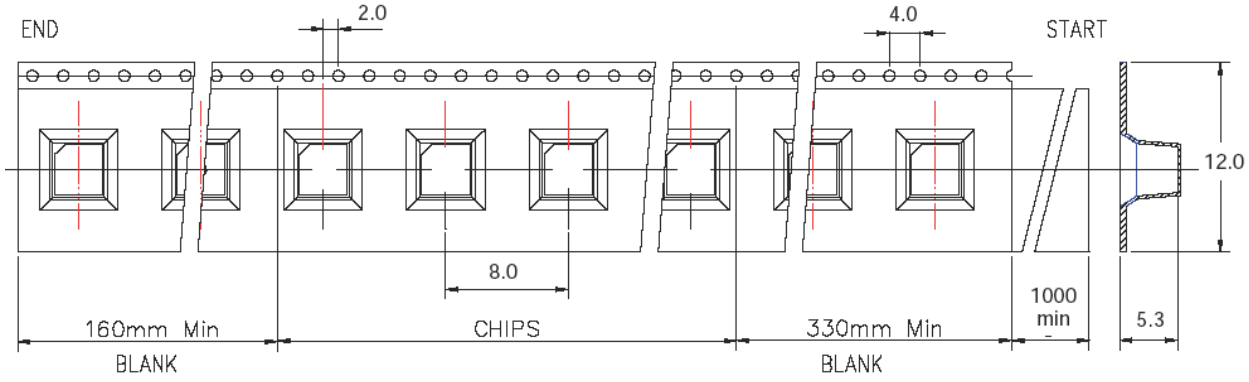


Figure 13: SEN-Z Tape Diagram

Full reel is 1,200 pcs. Smaller quantities on cut-tape.

Recommended Processing Parameters

Figure 14: Reflow Profile

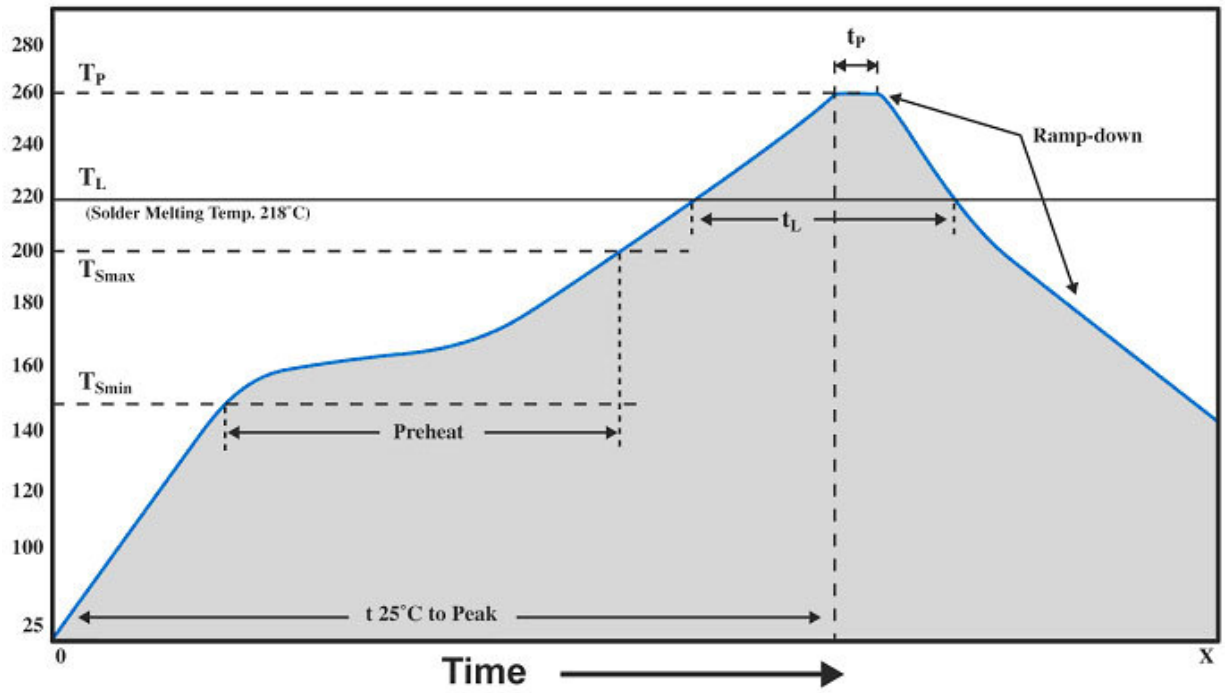


Table 6: Recommended Processing Parameters[a]

REFLOW PARAMETER	TEMPERATURE (°C)	TIME (SEC)
Preheat Temperature (T_{smin} To T_{smax})	150°C – 200°C	60-180
Temperature T_l (Typical Solder Melting Point)	>218°C	
T_{smax} To T_l Ramp-Up Rate	3°C/Second Max	
Peak Temperature T_p	<260°C	
Time 25°C To Peak T_p	6 Minute Max	
Time Maintained Above Temperature T_l (T_l)	218°C	60-120
Soak (Time Within 5° Of Actual Peak T_p)		10-20
Rampdown Rate	4°C/Second Max	

a. Meets IPC/JEDEC J-STD-020 profile recommendations