Revised August 2006

SEN-S65
Magneto-Inductive Sensor

General Description

PNI Corporation's Magneto-Inductive (MI) sensors are 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 11096 Sensor Driver ASIC is the recommended implementation of this patented circuit, and can be used with the SEN-S65 to construct a magnetometer with up to 3-axes.

Advantages of the SEN-S65 include low voltage and power, small size surface mount package, large signal noise immunity under all conditions, and a large dynamic range. When used with the 11096 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

- Low power: draws < 100 µA at 3 VDC
- Small size: 6.3 x 2.3 x 2.2 mm
- Large field measurement range: ±1100 µT (±11 Gauss)
- High resolution field measurement: 0.015µT (0.00015 Gauss)
- Wide temperature range: -55° to140°C (operational)
- Few external components: PNI 11096 ASIC with two resistors per sensor
- Surface mount package supplied on tape & reel
- RoHS Compliant

Applications

- Handheld 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 Number	MOQ	Package
11244P	<5000	Cut Tape
11244	5000	Tape & Reel

PNI Corporation • 133 Aviation Blvd., Ste. 101, Santa Rosa CA 95403 USA • 707-566-2260 • fax 707-566-2261 • www.pnicorp.com

For the most current specifications, please visit our website at www.pnicorp.com

Absolute Maximum Ratings

Symbol	Parameter	Maximum
V_{coil}	Voltage across coil	2.0 VDC
V_B	Coil to case breakdown voltage	200 VDC
I_{IN}	Input Pin Current	50 mA at 25 °C
T_{STRG}	Storage Temperature	-65 °C to 155 °C

Stresses beyond those listed under "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.

Sensor Characteristics

Parameter	Min	Typ	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	-55		140	°C
Storage Temperature	-65		155	°C

(a) Determined with a DC source.

(b) No DC bias, 100kHz at 1 Vp-p, orthogonal to Earth's magnetic field.

Sensor Characteristics with PNI 11096 ASIC

Parameter	Condition	Min	Typ	Max	Units
Current[(a)]	3 VDC, Rb = 33Ω 5 VDC, Rb = 56Ω (measured at ASIC V_{cc})		0.4 0.42	0.5 0.5	mA RMS
Field measurement range [(b)]	3 VDC, Rb = 33Ω 5 VDC, Rb = 56Ω	-1100 -1100		1100 1100	µT
Gain [(c)]	3 VDC, Rb = 33Ω 5 VDC, Rb = 56Ω		27 –38 18 – 26		counts/µT
Linearity	(best fit straight line at ±300 µT)		0.6	1	% of 300 µT
Resolution [(d)]	PS=2048 PS=4096		0.030 0.015		µT
Frequency	3 VDC, Rb = 33Ω (within free Earth's magnetic field)		175		kHz
Operating Temperature (when used with PNI 11096)		-20		70	°C

(a) Current includes the ASIC and two SEN-S65 in continuous sequential sampling.

(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 1/gain. Maximum resolution obtained by setting the ASIC period select to 4096

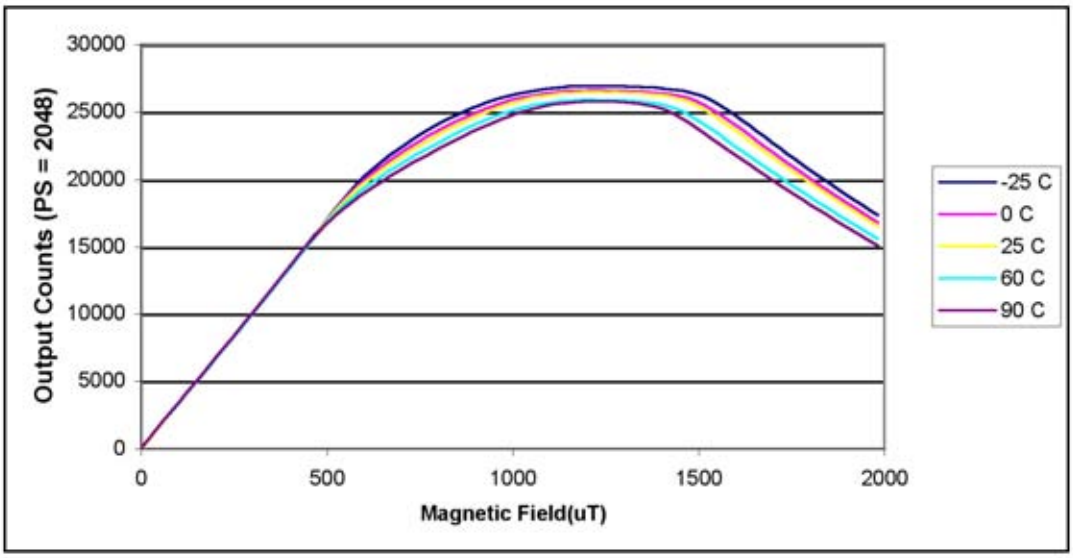
For more information, see "PNI-11096 ASIC data sheet"

SEN-S65 Continous Sampling 3V at 8Hz

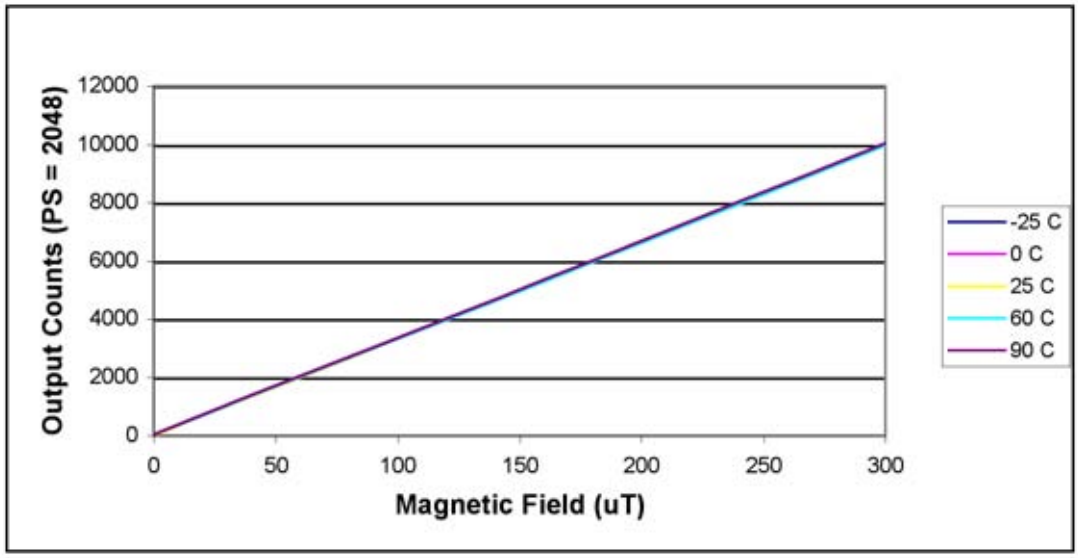
Period Select	Ratio	Gain (Counts/µT)	Resolution (µT)	Typical Operating Current (mA RMS)
0	/32	0.523	1.912	0.022
1	/64	1.047	0.956	0.035
2	/128	2.094	0.478	0.06
3	/256	4.188	0.239	0.11
4	/512	8.375	0.120	0.21
5	/1024	16.75	0.060	0.41
6	/2048	33.5	0.030	0.786
7	/4096	67	0.015	1.126

Typical Operating Characteristics: SEN-S65 (3VDC; Rb = 43 Ω)

Temperature Characteristics

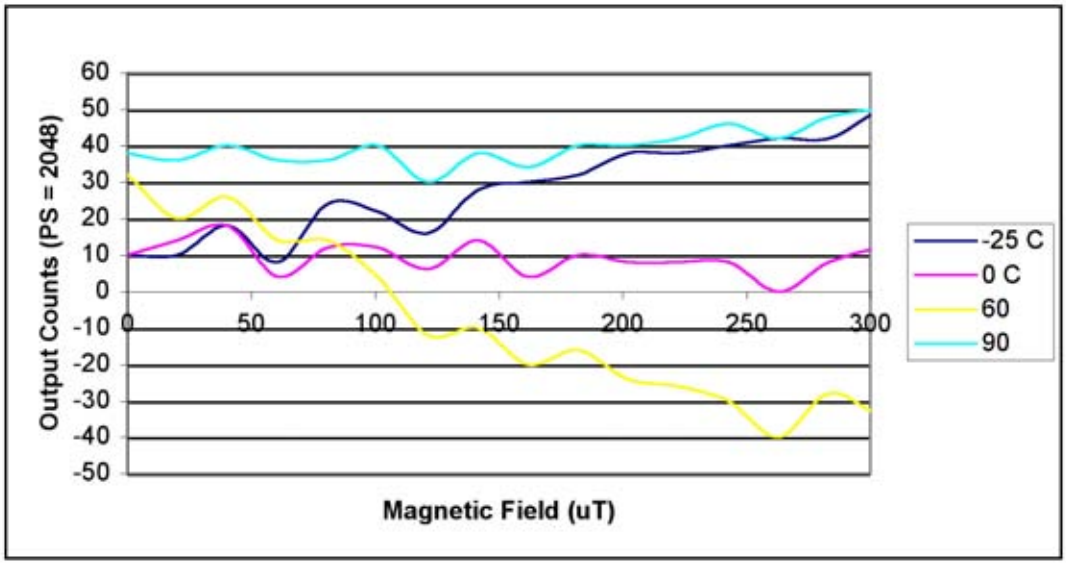


Linearity vs. Temperature



Typical Operating Characteristics: SEN-S65 (3VDC; Rb = 43 Ω)

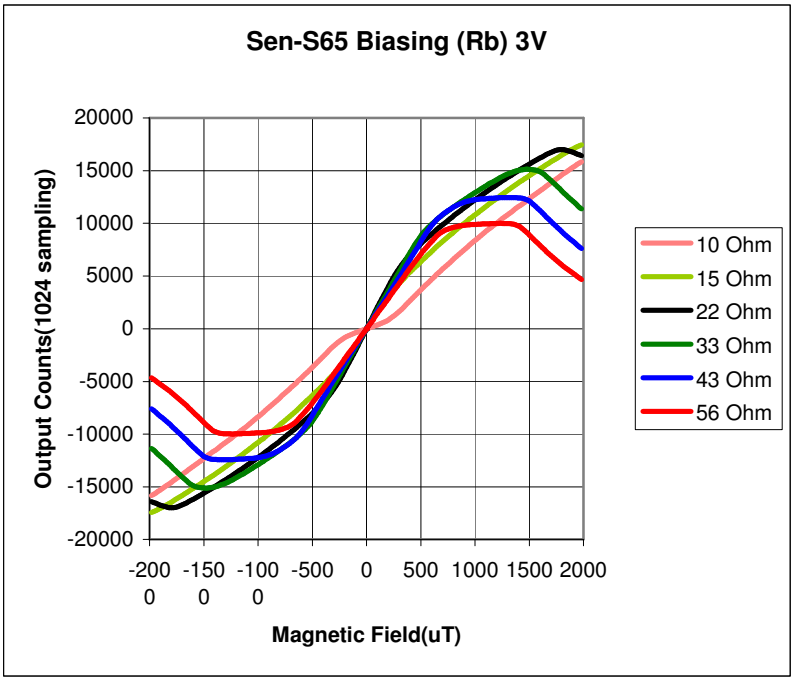
Linearity vs. Temperature, Normalized to Room Temperature (RMT)



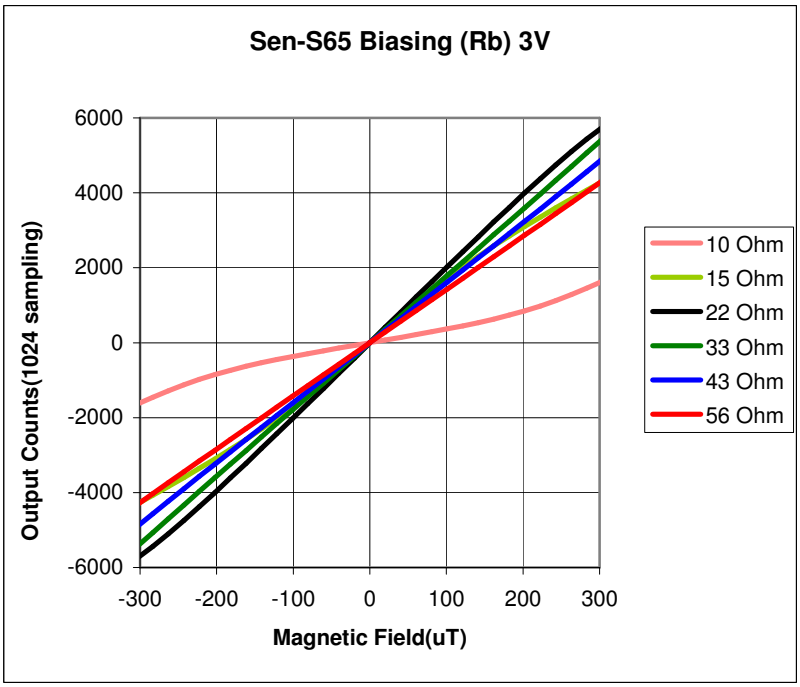
Output Counts is defined as the Period Select (PS) setting for the 11096 ASIC. See *"PNI-11096 ASIC* data sheet" for more information.

Typical Operating Characteristics: SEN-S65

Linearity Over Field Range ±2000 μT at 3V

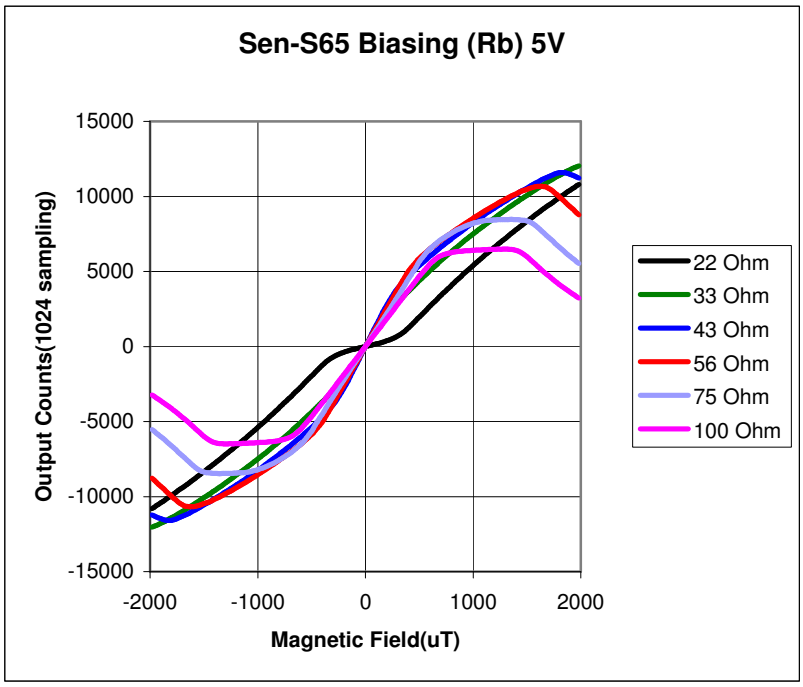


Linearity Over Typical Operating Range at 3V

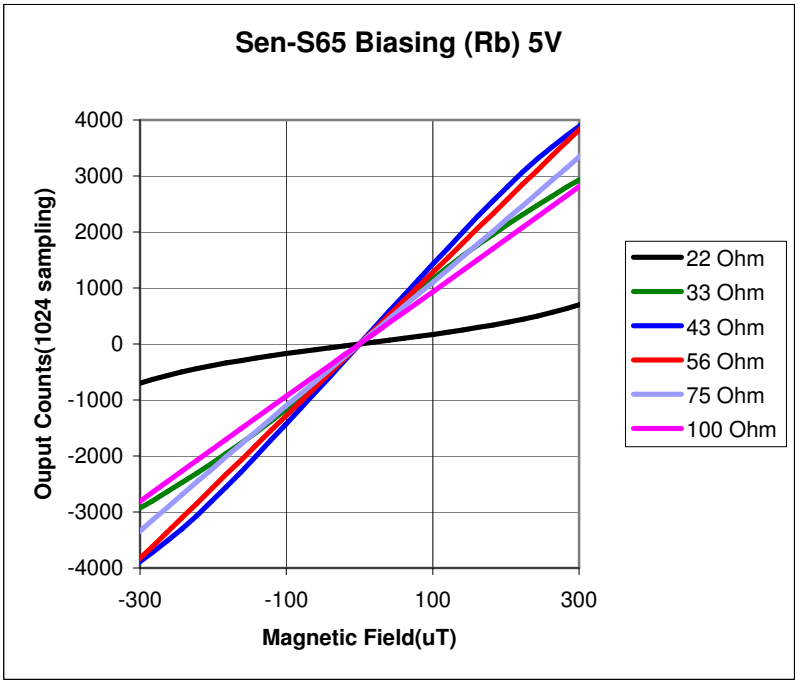


Typical Operating Characteristics: SEN-S65

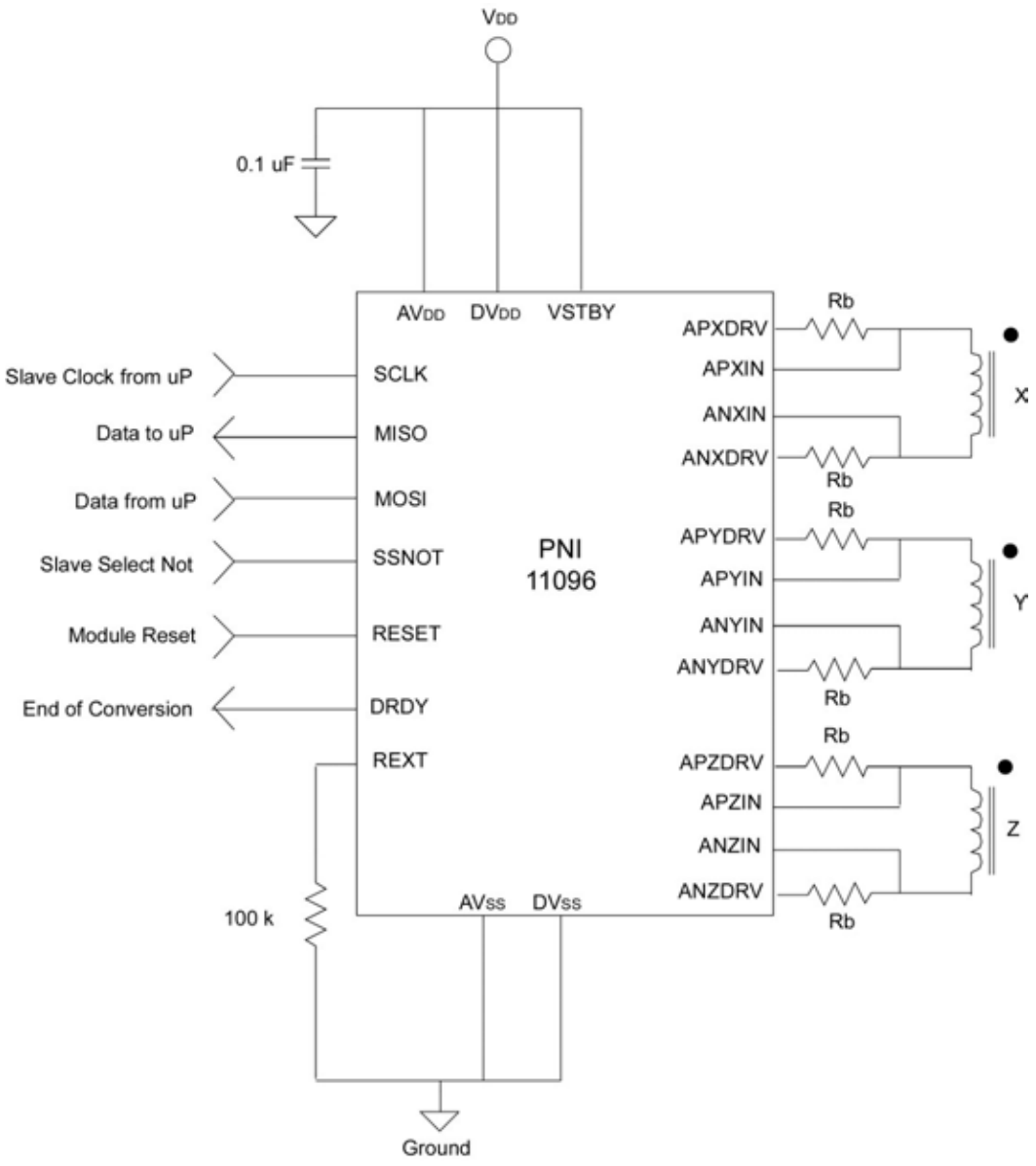
Linearity Over Field Range ±2000 μT at 5V



Linearity Over Typical Operating Range at 5V



Recommended Circuit Block Diagram



Rb is dependent on the supply voltage.

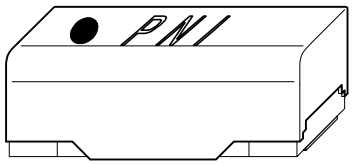
5 VDC: Rb = 75 Ω

3 VDC: Rb = 43 Ω

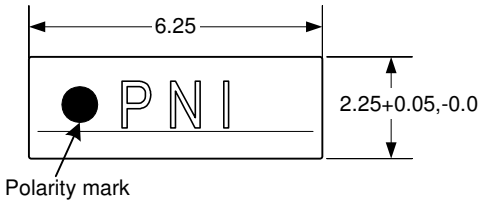
Package Information

SEN-S Outline dimensions

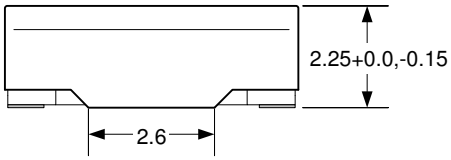
(Unit : mm)



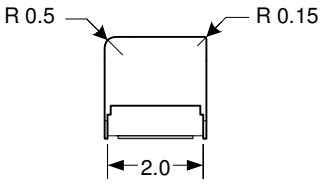
3D VIEW



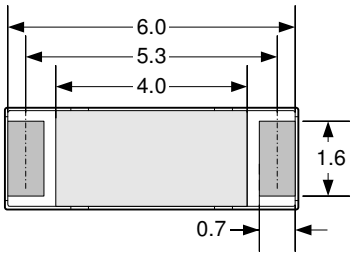
Top view



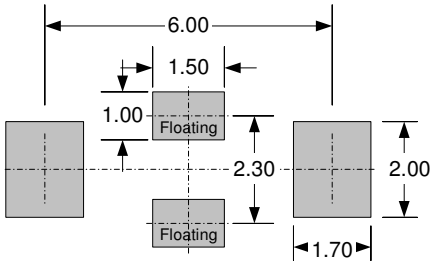
Front view



Side view



Bottom view

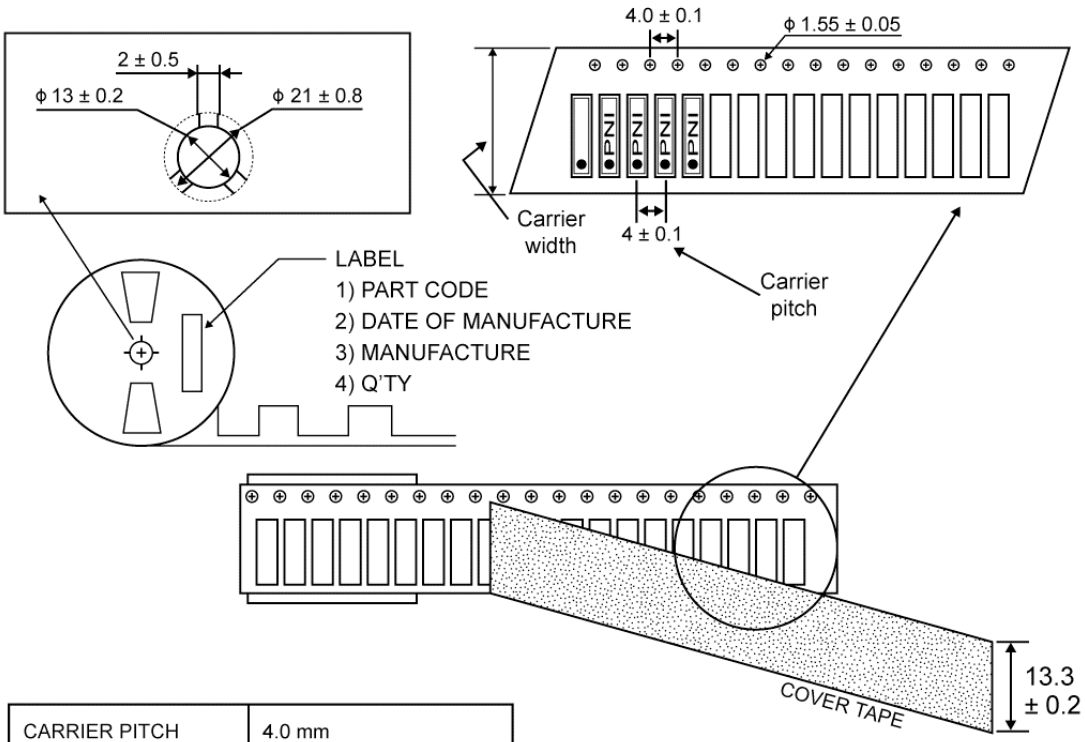


Foot Print

Note :

- Polarity mark indicates start winding of the Sensor (Black ink imprinted mark)
- The letters " PNI " are engraved on metal shield can
- Tolerances are +/-0.05 mm unless otherwise specified

Tape & Reel Information



CARRIER PITCH	4.0 mm
CARRIER WIDTH	16.0 mm
RELL WIDTH	ϕ 330 ± 2 mm
COVER TAPE WIDTH	13.3 mm
Q'TY	5000 PCS
REEL TAPE MARGIN	START: 200 mm (over)
	FINISH: 200 mm (over)
PACKING METHOD	PICTURE COMOARISON
COVER TAPE STRIP STRENGTH	20 - 60g
COVER TAPE STRIP AN ANGLE	10° - 20°

Recommended Processing Parameters

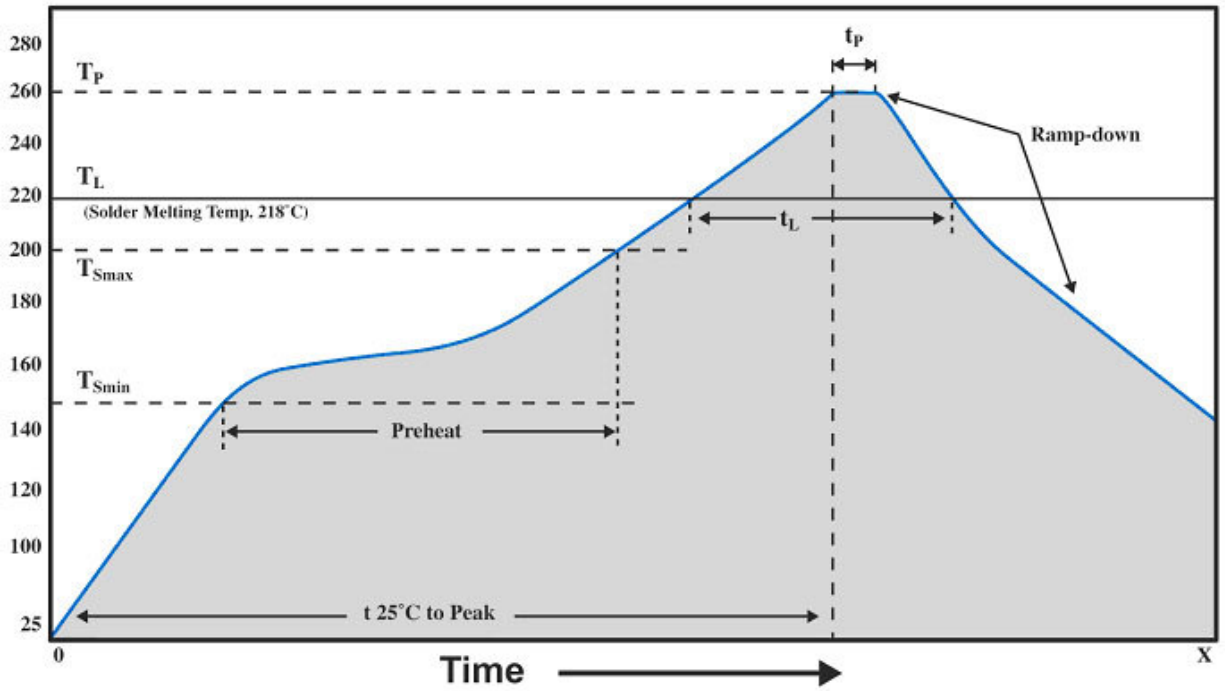


Table 1: Recommended Processing Parameters[a]

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 lead free profile recommendation (IPC/JEDEC J-STD-020)