Magnetic Sensor ICs

Bipolar Latch Detection High Performance Hall-Effect Sensor IC

AS1690

General Description

Using low power CMOS process, the AS1690 is designed for low power, high performance latch detection hall-effect application, such as automotive, industrial, electric tools, home appliances, brushless DC motor etc, contactless switch, solid state switch and lid close sensor etc battery operation. The hall IC integrated an on-chip hall voltage generator for magnetic sensing, a comparator that amplifiers the hall voltage, a Chopper amplifier, a Schmitt trigger to provide switching hysteresis for noise rejection, and a complementary output.

The total power consumption of AS1690 is typically less than 2.0mA at 3.6V power supply. AS1690 is designed to respond to alternating North and South poles. When the magnetic flux density (B) is larger than operate point (B_{OP}), the output will be turned on (low), the output is held until the magnetic flux density (B) is lower than release point (B_{RP}), then turn off (high).

The device is available in DFN1014-4L, DFN0808-4L and SOT23-3L Package and is rated over the -40°C to 125°C. The all packages are RoHS and Green compliant.

Features

- Input Voltage Range : 2.2V to 5.5V
- Bipolar Latch Operation, easy to use as output
- Chopper stabilization amplifier stage
- Magnetic Sensitivity (typical)
  B_{OP}= ±18Gauss, B_{RP}=±18Gauss
- Good RF noise immunity
- Integrated 10Kohms pull-up resistor
- Small Solution Size
- RoHS Compliant
- DFN1014-4L, DFN0808-4L and SOT23-3L Packages
- -40℃ to +125 ℃ Temperature Range

Applications

- Cover switch in Notebook, PC/PAD
- Contact-less switch in consumer products
- Solid State Switch
- Handheld Wireless Handset Awake Switch
- Lid close sensor for battery-powered devise
- Magnet proximity sensor for reed switch replacement in low duty cycle applications
- DV, DSC, and White Goods

Ordering Information

AS1690XXX

Package：
ST: SOT23-3L
D: DFN1014-4L
D08: DFN0808-4L

Packing：
R:Tape&Reel

Temperature Grade：
N: -40°C~85°C
Y: -40°C~125°C

Part Number	B_{OP}(Gauss)	B_{RP} Gauss)	Package Type	Package Qty	Temperature	Eco Plan
AS1690DRN	-18Gauss	+18Gauss	DFN1014-4L	7-in reel 3000pcs/reel	-40～85℃	Green
AS1690STRN	+18Gauss	-18Gauss	SOT23-3L	7-in reel 3000pcs/reel	-40～85℃	Green
AS1690D08RN	-18Gauss	+18Gauss	DFN0808-4L	7-in reel 10000pcs/reel	-40～85℃	Green
AS1690DRY	-18Gauss	+18Gauss	DFN1014-4L	7-in reel 3000pcs/reel	-40～125℃	Green
AS1690STRY	+18Gauss	-18Gauss	SOT23-3L	7-in reel 3000pcs/reel	-40～125℃	Green
AS1690D08RY	-18Gauss	+18Gauss	DFN0808-4L	7-in reel 10000pcs/reel	-40～125℃	Green

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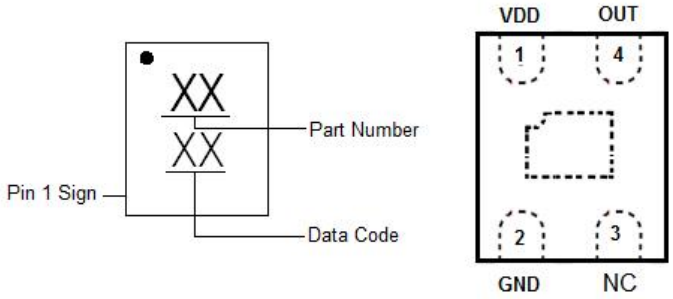
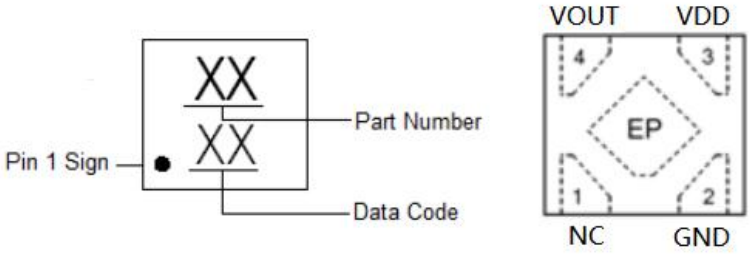
■ Marking Information

DFN1014-4L：



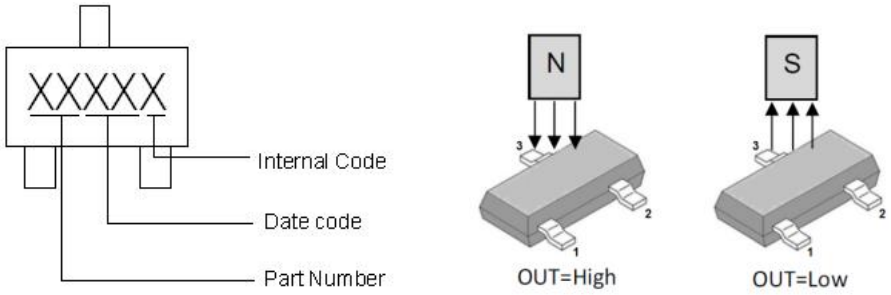
Pin Name	Pin No. DFN1014-4L	I/O	Pin Function
VDD	1	P	Input Power Supply.
GND	2	P	Ground.
NC	3	-	Not Connected.
OUT	4	O	Output Pin.

DFN0808-4L：



Pin Name	Pin No. DFN0808-4L	I/O	Pin Function
VDD	3	P	Input Power Supply.
GND	2	P	Ground.
NC	1	-	Not Connected.
VOUT	4	O	Output Pin.

SOT23-3L：



Pin Name	Pin No. SOT23-3L	I/O	Pin Function
VDD	1	P	Input Power Supply.
GND	3	P	Ground.
OUT	2	O	Output Pin.

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■ Typical Application Circuit

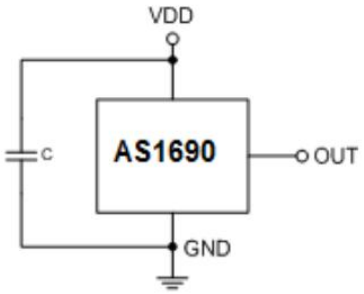

Figure 1, Typical Application Circuit of AS1690

■ Block Diagram

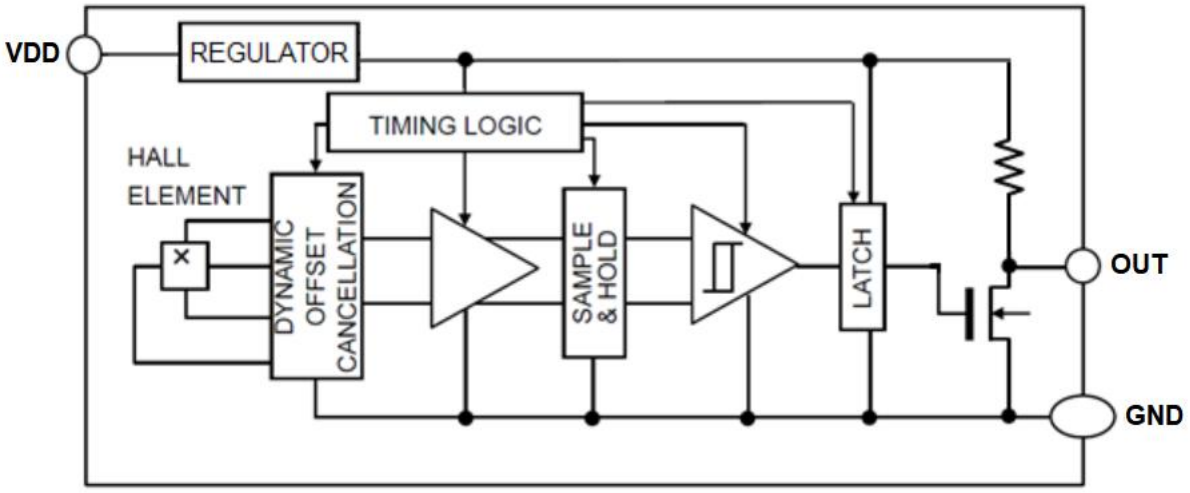

Figure 3, Block Diagram of AS1690

■ Absolute Maximum Ratings[1] (T_A=25°C, unless otherwise noted)

Parameter		Symbol	Rating	Unit
V_{DD} Pin to GND		V_{DD}	-0.3 to 6.0	V
Out Pin to GND		V_{OUT}	-0.3 to V_{DD} +0.3	V
Max. Continuous Output Current		I_{OUTMAX}	1.0	mA
Magnetic Flux Density		B	Unlimited	Gauss
Package Power Dissipation	DFN1014-4L/DFN0808-4L	P_D	250	mW
	SOT23-3L		310	mW
ESD (HBM)		ESD	6000	V
Storage Temperature Range		T_S	-55 to +150	℃
Operating Junction Temperature Range		T_{OP}	-40 to +150	℃
Maximum Soldering Temperature (at leads, 10 sec)		T_{LEAD}	300	℃

■ Recommended Operating Conditions[2]

Parameter	Symbol	Rating	Unit
V_{DD} Pin to GND	V_{DD}	2.2 to 5.5	V
Continuous Output Current	I_{OUT}	1.0	mA
Operating Temperature Range	T_{OP}	-40 to +125	℃

Note: 1: Stresses above those listed in absolute maximum ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one absolute maximum rating should be applied at any one time.

2: The device is not guaranteed to function outside of its operating conditions.

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■ Electrical Characteristics

(T_A = -40 to +85℃ unless otherwise noted. Typical values are at T_A= +25℃, V_{DD} = 3.6V)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Input Voltage		2.2	-	5.5	V
I_{DD}(AVG)	Supply Current	Average supply current, T_A=25℃	-	2.0	4.0	mA
t_{ON}	Power On Time		-	28	50	uS
V_{SON}	Output Saturation Voltage	V_{CC} = 5V, I_{OUT}=10mA	-	0.20	-	V
T_R	Output Rise Time	R_L=1K, C_L=50pF	-	0.45	-	uS
T_F	Output Fall Time	R_L=1K, C_L=50pF	-	0.09	0.2	uS
T_D	Output Delay Time	B=B_{RP}-100Gs to B_{OP}+100Gs	-	15	25	uS
f_{BW}	Operation Bandwidth		20	-	-	KHz
R	Pull-Up Resistance	Integrated Pull-Up Resistor	-	10	-	KΩ
Magnetic Para.						
B_{OPN}	Magnetic Operating Point	DFN1014/DFN0808 Package	-40	-18	-	Gauss
B_{OPS}		SOT23-3L Package	-	18	40	
B_{RPS}	Magnetic Release Point	DFN1014/DFN0808 Package	-	18	40	Gauss
B_{RPN}		SOT23-3L Package	-40	-18	-	
B_{HYS}	Hysteresis Window		-	36	-	Gauss

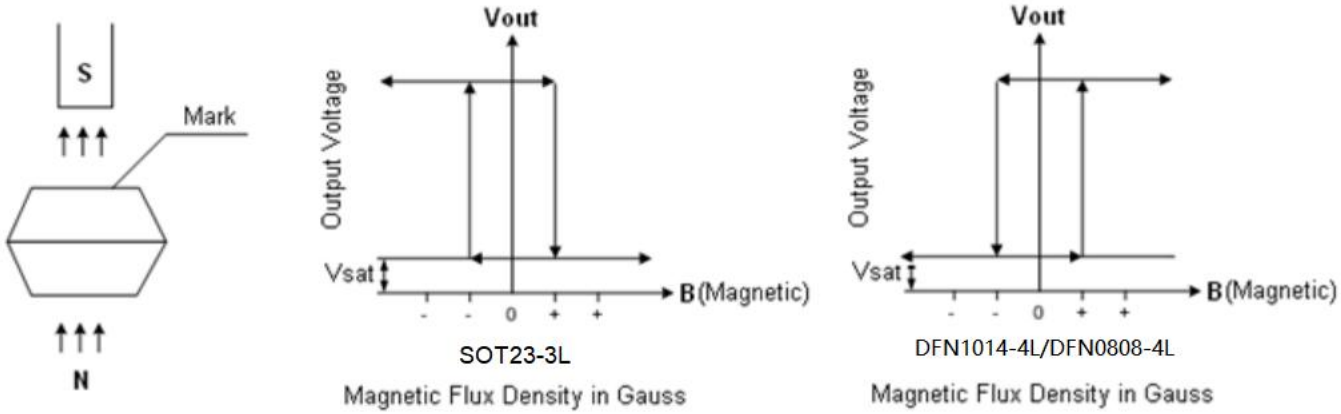

Fig 4, Magnetic Operation Characteristic of AS1690

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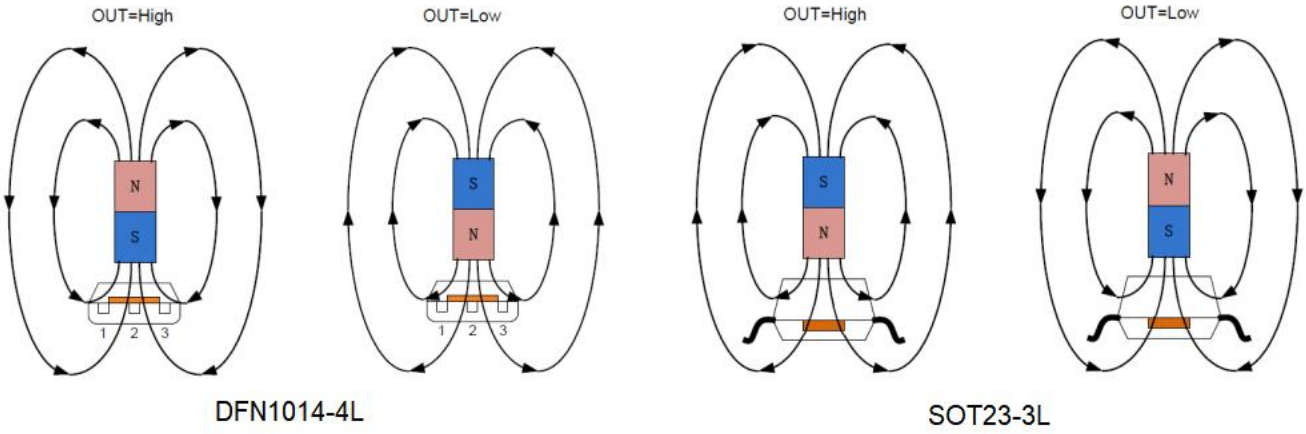
■ Hall Sensor Location

A positive magnetic field is defined as a south pole near the marked side of the package (SOT23-3L package) .



If the device is powered on with a magnetic field strength between B_{RP} and B_{OP}, then the device output is determinate High. For SOT23-3L package, if the field strength is greater than B_{OPS}, then the output is pulled low. If the field strength is less than B_{RPN}, the output is released. For DFN1014-4L/DFN0808-4L package, if the field strength is less than B_{OPN}, then the output is pulled low. If the field strength is greater than B_{RPS}, the output is released.

■ Typical Output Waveform:

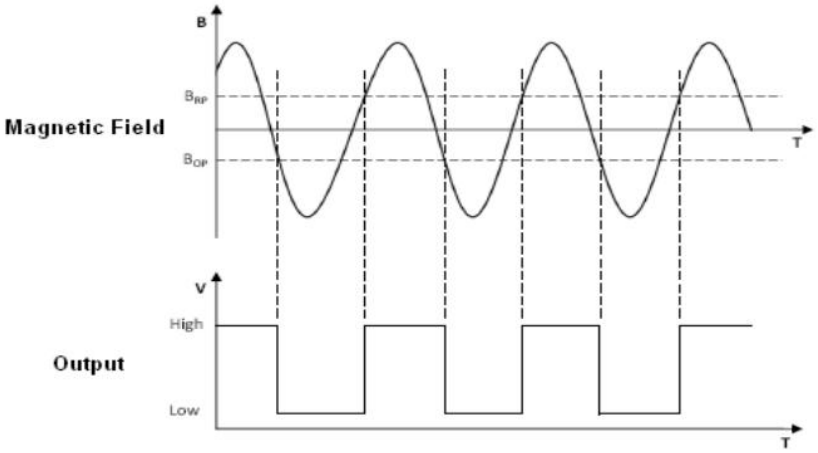


Fig 6, Typical Output Waveform of AS1690

■ Function Description

Chopper-Stabilized Technique

The Hall element can be considered as a resistor array similar to a Wheatstone bridge. A large portion of the offset is a result of the mismatching of these resistors. These devices use a proprietary dynamic offset cancellation technique, with an internal high-frequency clock to reduce the residual offset voltage of the Hall element that is normally caused by device over-molding, temperature dependencies, and thermal stress. The chopper-stabilizing technique cancels the mismatching of the resistor circuit by changing the direction of the current flowing through the Hall plate using CMOS switches and Hall voltage measurement taps, while maintains the Hall voltage signal that is induced by the external magnetic flux. The signal is then captured by a sample-and-hold circuit and further processed using low-offset bipolar circuitry. This technique produces devices that have an extremely stable quiescent Hall output voltage, are immune to thermal stress, and have precise recoverability after temperature cycling. A relatively high sampling frequency is used for faster signal processing capability can be processed.

Magnetic Field Detection Mechanism

The Hall IC cannot detect magnetic fields that run horizontal to the package top layer. Be certain to configure the Hall IC so that the magnetic field is perpendicular to the top layer.

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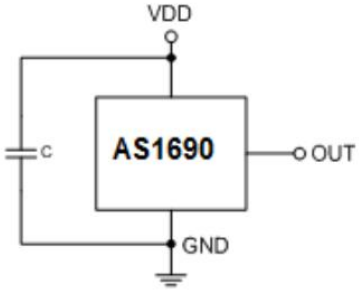
Operation

The output of this device switches low (turns on) when a magnetic field perpendicular to the Hall sensor exceeds the operate point B_{OPS} (or is less than B_{OPN}). After turn-on, the output is capable of sinking up to 1mA and the output voltage is V_{OUT}(ON). When the magnetic field is reduced below the release point B_{RPN} (or increased above B_{RPS}), the device output switches high (turns off). The difference between the magnetic operates and release points are the hysteresis (Bhys) of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

Applications:



AS1690's pole-independent sensing technique allows for operation with either a north or south poles magnet orientation, enhancing the manufacturability of the device. The state-of-the-art technology provides the same output polarity for either pole face.

C1 serves two purposes: minimizing ripples on the input voltage and enhancing immunity from RF transmission noises within close proximity. Recommended values are between 10nF and 100nF. The larger the capacitance, the better the noise immunity is for the AS1690.

It is strongly recommended that an external bypass capacitor be connected (in close proximity to the Hall sensor) between the supply and ground of the device to reduce both external noise and noise generated by the chopper-stabilization technique. This is especially true due to the relatively high impedance of battery supplies. The simplest form of magnet that will operate these devices is a bar magnet with either pole near the branded surface of the device.

Thermal Considerations

The maximum IC junction temperature should be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation of the AS1690. Calculate the maximum allowable dissipation, $P_{D(max)}$, and keep the actual dissipation less than or equal to $P_{D(max)}$. The maximum-power-dissipation limit is determined using following equation:

$$P_{D(MAX)} = \frac{125℃ - T_A}{R_{\theta JA}}$$

Where, T_A is the maximum ambient temperature for the application. $R_{\theta JA}$ is the thermal resistance junction-to-ambient given in Power Dissipation Table.

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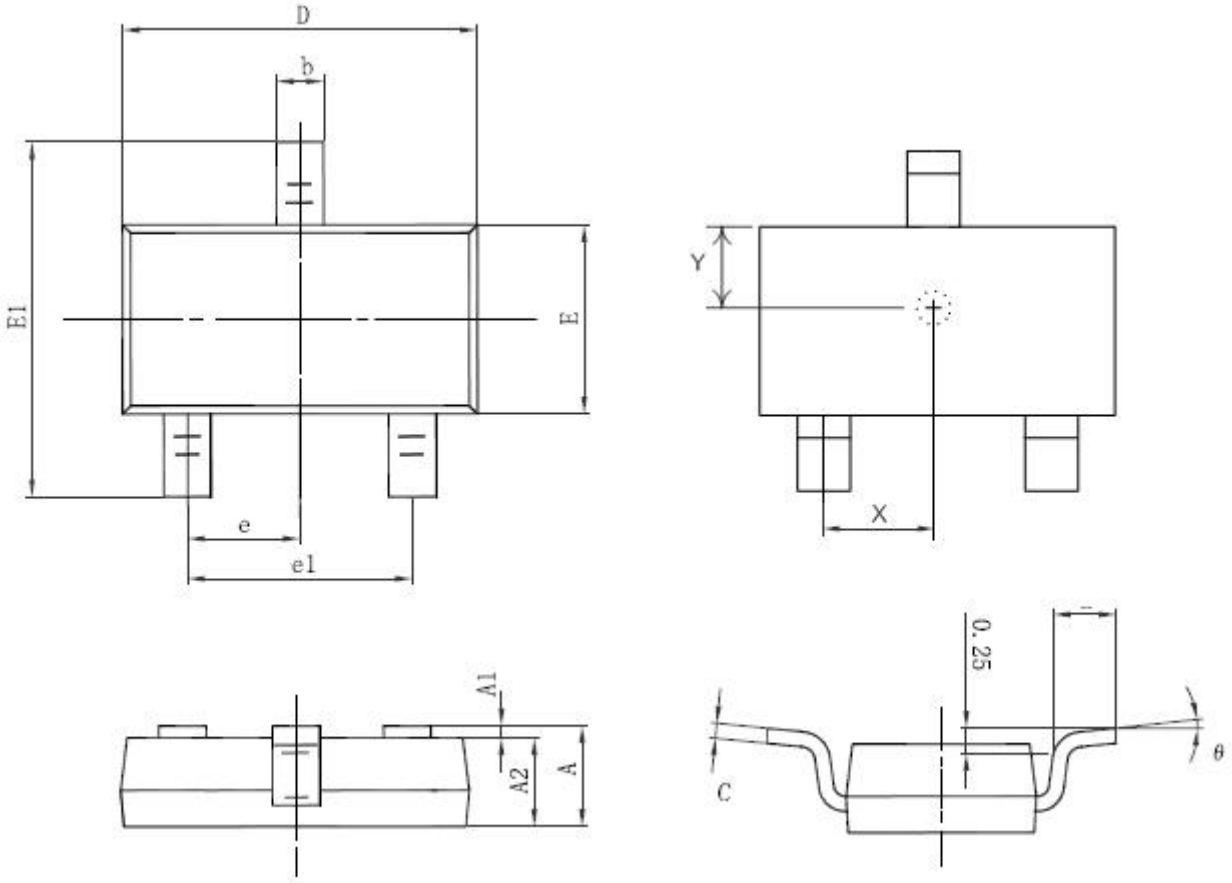
■ Package Information

SOT23-3L:



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
B	0.300	0.500	0.012	0.020
C	0.100	0.200	0.004	0.008
D	2.82	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.95	0.104	0.116
e	0.950(BSC)		0.037（BSC）	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°
X	0.950(BSC)		0.037(BSC)	
Y	0.750	0.850	0.030	0.033

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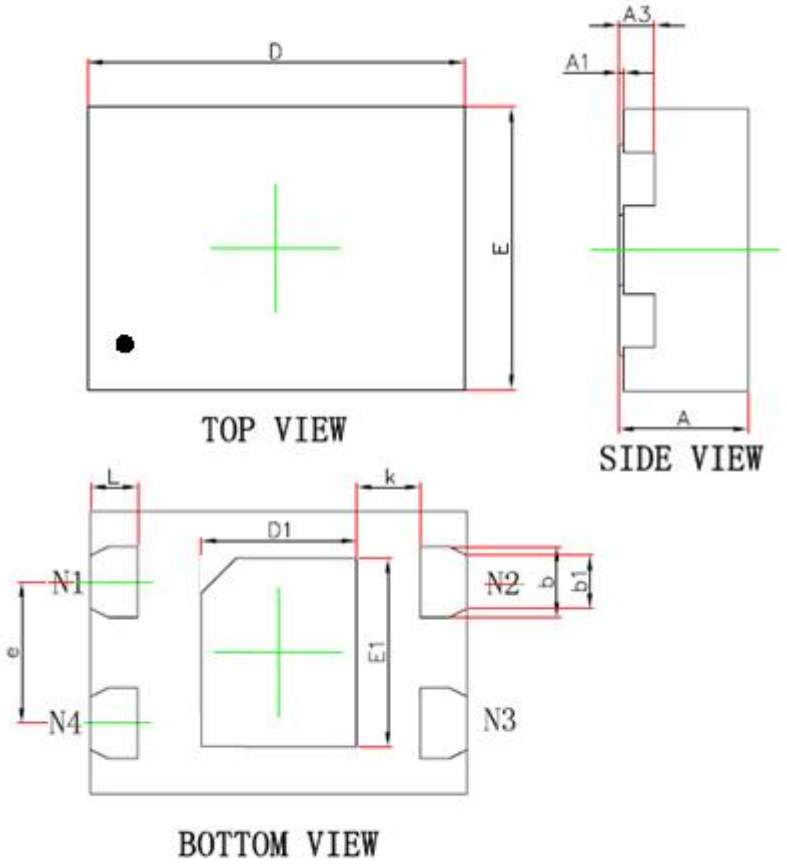
DFN1014-4L:



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0. 320	0.370	0.400	0.013	0.014	0.016
A1	0.000	-	0.050	0.000	-	0.002
A3	0.102 (BSC)			0.004 (BSC)		
D	1.400 (BSC)			0.055 (BSC)		
E	1.000 (BSC)			0.039 (BSC)		
D1	0.500	0.600	0.700	0.020	0.024	0.028
E1	0.700	0.800	0.900	0.028	0.031	0.035
L	0.150	0.200	0.250	0.006	0.008	0.010
b	0.170	0.220	0.270	0.007	0.009	0.011
b1	0.170	0.220	0.270	0.007	0.009	0.011
e	0.500 (BSC)			0.020 (BSC)		
k	0.200 (BSC)			0.008 (BSC)		

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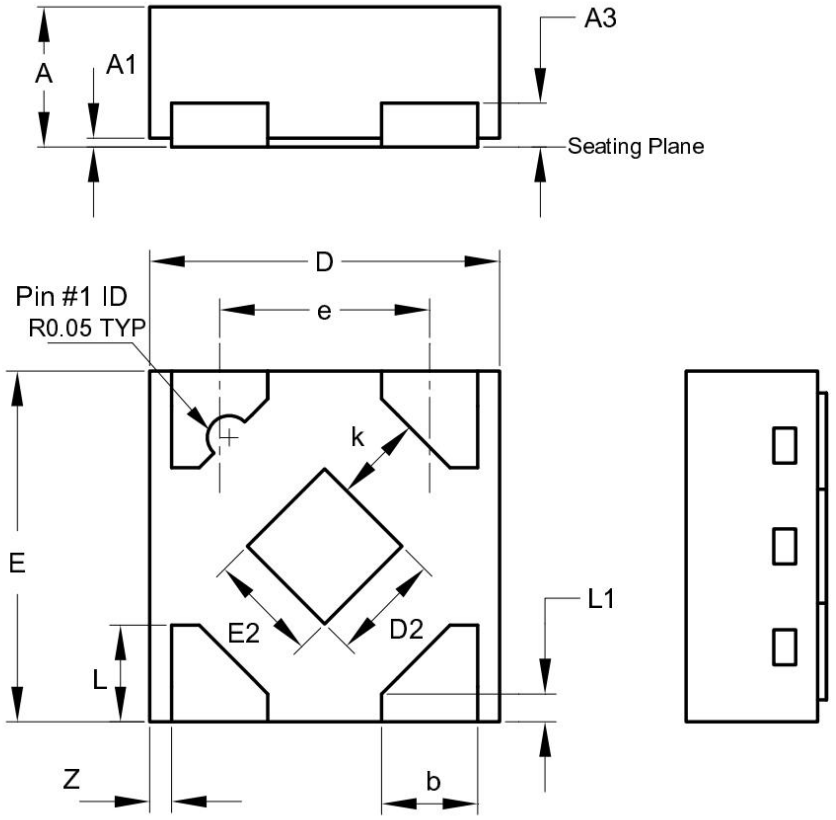
DFN0808-4L:



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.340	0.400	0.014	0.016
A1	0.000	0.050	0.000	0.002
A3	0.130 BSC		0.005 BSC	
b	0.170	0.270	0.007	0.011
D	0.750	0.850	0.030	0.033
D2	0.150	0.350	0.006	0.014
E	0.750	0.850	0.030	0.033
E2	0.150	0.350	0.006	0.014
k	0.200	-	0.008	-
e	0.480 BSC		0.019 BSC	
L	0.170	0.270	0.007	0.011
L1	0.020	0.120	0.001	0.005
z	0.50 BSC		0.002 BSC	

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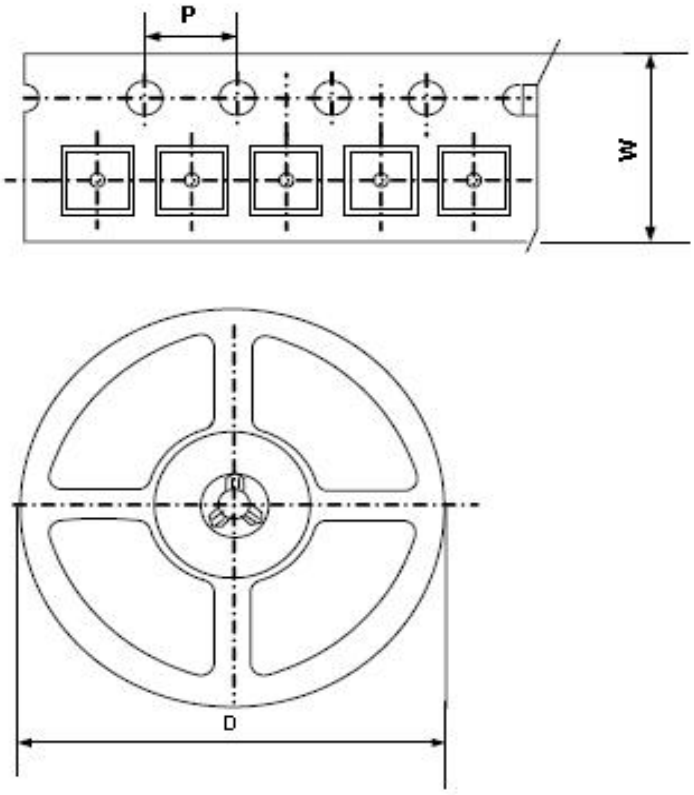
■ Packing Information



Package Type	Carrier Width(W)	Pitch(P)	Reel Size(D)	Packing Minimum
SOT23-3L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs
DFN1014-4L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs
DFN0808-4L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	10000pcs

Note: Carrier Tape Dimension, Reel Size and Packing Minimum

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