ANGSEMI

Datasheet

Magnetic Sensor IC

Unipolar Detection High Performance Low Power Hall-Effect Sensor IC

AD1912/N-K

General Description

Using low power CMOS process, the AD1912-K is designed for low power, high performance unipolar detection hall-effect application, such as cover switch, 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 AD1912-K is typically less than 3.0uA at 1.8V power supply. AD1912-K is designed to respond to alternating South pole. When the magnetic flux density (B) is larger than operate point (B_{OPS}), the output will be turned on (low), the output is held until the magnetic flux density (B) is lower than release point (B_{RPS}), then turn off (high). AD1912-KN is designed to respond to alternating North pole. When the magnetic flux density (B) is lower than operate point (B_{OPN}), the output will be turned on (low), the output is held until the magnetic flux density (B) is larger than release point (B_{RPN}), then turn off (high).

The device is available in DFN1010-4L, SOT23-3/SSOT23-3L and SOT553 Package and is rated over the -40°C to 125°C. The package is RoHS and Green compliant.

Features

- Input Voltage Range : 1.65V to 5.0V
- Micro-power consumption ideal for battery power applications
- Unipolar Operation, easy to use as output
- Very high sensitivity hall sensor
- Low Power CMOS process technology
- Chopper stabilization amplifier stage
- Magnetic Sensitivity (typical)
  - ✓ AD1912-K(S-pole):B_{OPS}=30Gauss, B_{RPS}=20Gauss
  - ✓ AD1912N-K(N-pole):B_{OPN}=-30Gauss, B_{RPN}=-20Gauss
- Good RF noise immunity
- No need pull-up resistor
- Small Solution Size
- RoHS & Green Compliant
- DFN1010-4L, SOT23-3L/SSOT23-3L and SOT553 Package
- -40℃ to +85 ℃ Temperature Range

Applications

- Cover switch in clam-shell cellular phones
- 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

AD1912/NXXX-K

Package：
D: DFN1010-4L
W: SOT553
ST: SOT23-3L
S2: SSOT23-3L

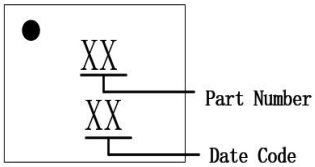
Packing：
R:Tape&Reel

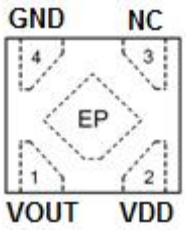
Temperature Grade：
N: -40°C~85°C

Part Number	B_{OP}(Gauss)	B_{RP} Gauss)	Package Type	Package Qty	Temperature	Eco Plan
AD1912DRN-K	+30	+20	DFN1010-4L	7-in reel 10000pcs/reel	-40～85℃	Green
AD1912WRN-K	+30	+20	SOT553	7-in reel 3000pcs/reel	-40～85℃	Green
AD1912STRN-K	+30	+20	SOT23-3L	7-in reel 3000pcs/reel	-40～85℃	Green
AD1912S2RN-K	+30	+20	SSOT23-3L	7-in reel 3000pcs/reel	-40～85℃	Green
AD1912NDRN-K	-30	-20	DFN1010-4L	7-in reel 10000pcs/reel	-40～85℃	Green
AD1912NWRN-K	-30	-20	SOT553	7-in reel 3000pcs/reel	-40～85℃	Green
AD1912NSTRN-K	-30	-20	SOT23-3L	7-in reel 3000pcs/reel	-40～85℃	Green
AD1912NS2RN-K	-30	-20	SSOT23-3L	7-in reel 3000pcs/reel	-40～85℃	Green

■ Marking & Pin Assignment

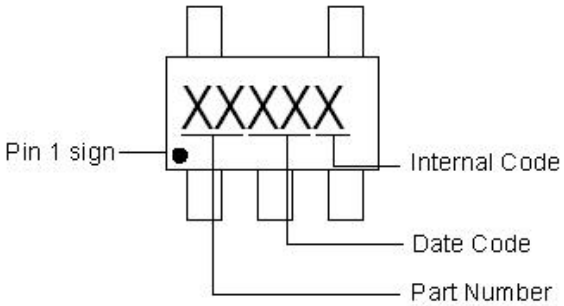
DFN1010-4L

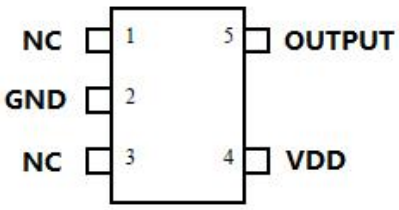




Pin Name	Pin No. DFN1010-4L	I/O	Pin Function
VDD	2	P	Input Power Supply
GND	4	P	Ground
NC	3	-	Not Connected
VOUT	1	O	Output Pin
-	EP	-	Not Connected

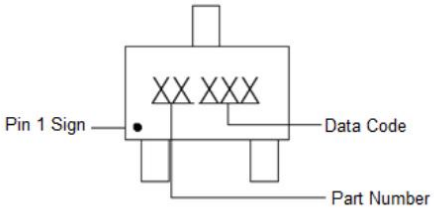
SOT553:

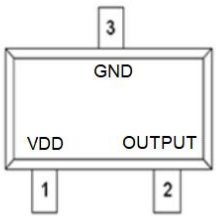




Pin Name	Pin No. SOT553	I/O	Pin Function
VDD	4	P	Input Power Supply
GND	2	P	Ground
NC	1, 3	-	Not Connected
OUTPUT	5	O	Output Pin

SOT23-3L/SSOT23-3L:





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

■ Typical Application Circuit

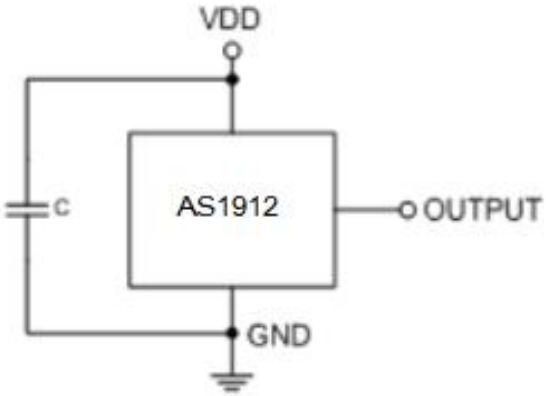


Figure 1, Typical Application Circuit of AD1912-K

■ Block Diagram

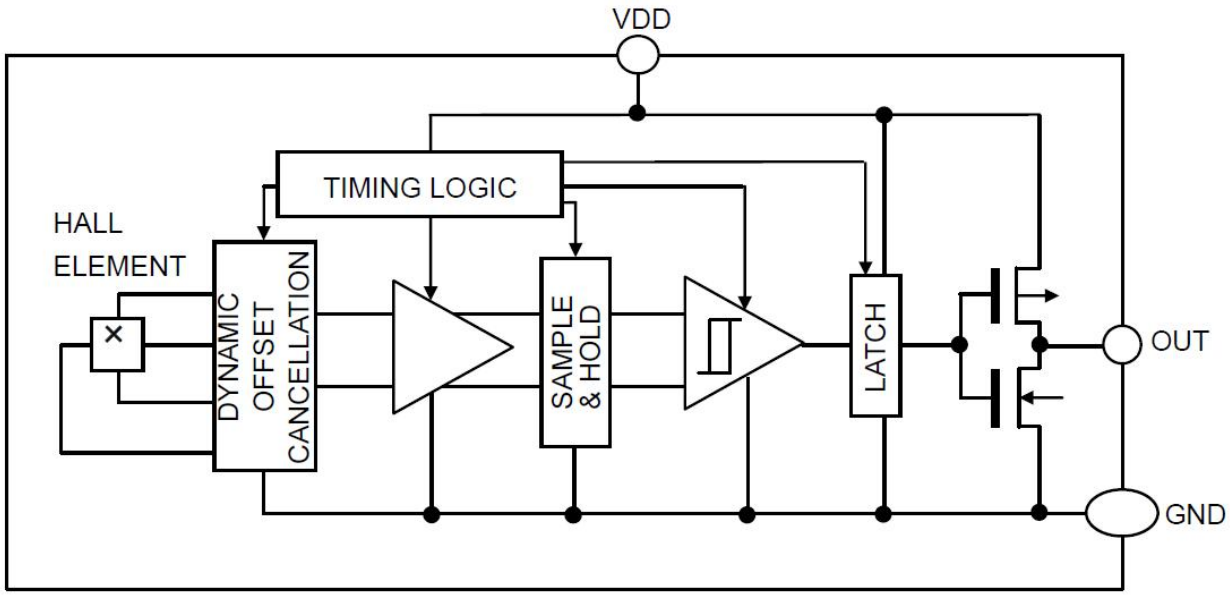


Figure 3, Block Diagram of AD1912-K

■ 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 5.5	V
Output Pin to GND		V_{OUTPUT}	-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	DFN1010-4L	P_D	250	mW
	SOT553		180	
	SOT23-3L		230	
ESD (HBM)		ESD	8000	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}	1.65 to 5.0	V
Continuous Output Current	I_{OUT}	1.0	mA
Operating Temperature Range	T_{OP}	-40 to +85	℃

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.

■ Electrical Characteristics

(T_A = -40 to +85℃ unless otherwise noted. Typical values are at T_A= +25℃, V_{DD} = 1.8V)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Input Voltage		1.65	-	5.0	V
I_{DD}(AVG)	Average supply current,	T_A=25℃, V_{DD}=1.8V	-	3.0	6.0	μA
		T_A= -40℃ to 125℃	-	3.0	8.0	
T_{awake}	Awake Time		-	50	100	μs
T_{period}	Period		-	50	100	ms
D.C.	Duty Cycle		-	0.05	-	%
V_{OH}	Output Off Voltage (High side)	I_{OUT}=+1mA	V_{DD}-0.3	V_{DD}-0.1	V_{DD}+0.3	V
V_{OL}	Output On Voltage (Low side)	I_{OUT}=-1mA	-0.3	0.1	+0.3	V
Magnetic Para. (AD1912-K)						
B_{OPS}	Magnetic Operating Point		-	30	40	Gauss
B_{RPS}	Magnetic Release Point		10	20	-	Gauss
B_{HYS}	Hysteresis Window		-	10	-	Gauss
Magnetic Para. (AD1912N-K)						
B_{OPN}	Magnetic Operating Point		-	-30	-40	Gauss
B_{RPN}	Magnetic Release Point		-10	-20	-	Gauss
B_{HYS}	Hysteresis Window		-	10	-	Gauss

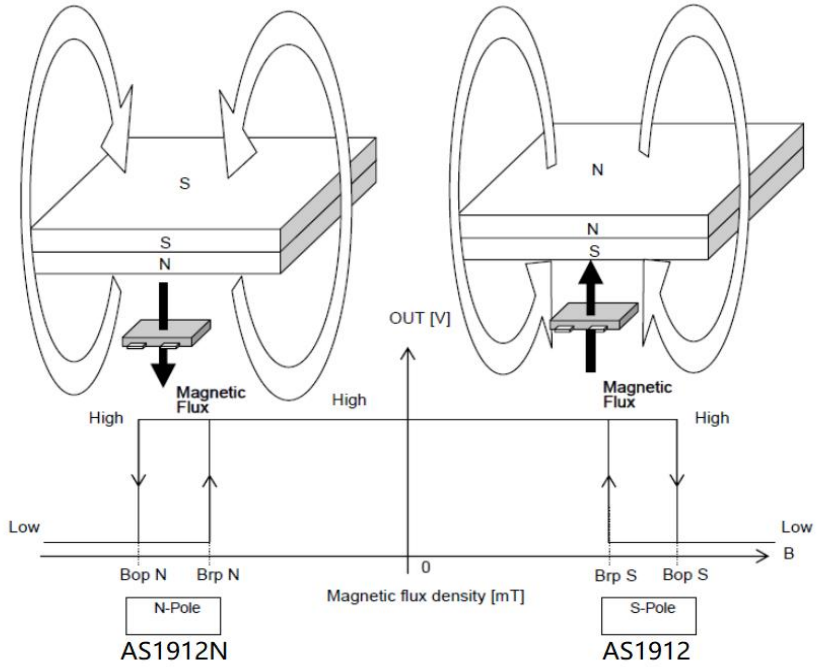
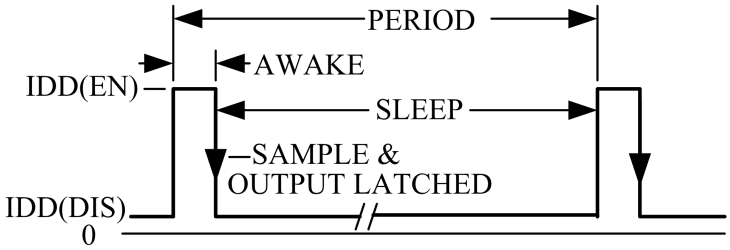


Fig 4, Magnetic Operation Characteristic of AD1912-K or AD1912N-K

■ Function Description



Micro-power Operation

Internal timing circuitry activates the sensor for 50μs and deactivates it for the remainder of the period (50ms). A short "awake" time allows for stabilization prior to the sensor sampling and data latching on the falling edge of the timing pulse. The output during the "sleep" time is latched in the last sampled state. The supply current is not affected by the output state.

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.

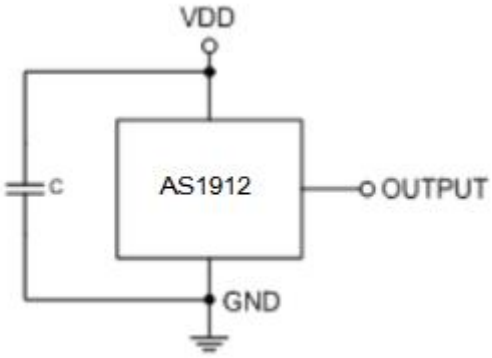
Magnetic Field Detection Mechanism

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.

Operation

AD1912-K is designed to respond to alternating South pole. When the magnetic flux density (B) is larger than operate point (B_{OPS}), the output will be turned on (low), the output is held until the magnetic flux density (B) is lower than release point (B_{RPS}), then turn off (high). AD1912N-K is designed to respond to alternating North pole. When the magnetic flux density (B) is lower than operate point (B_{OPN}), the output will be turned on (low), the output is held until the magnetic flux density (B) is larger than release point (B_{RPN}), then turn off (high).

Applications:



AD1912-K's pole-independent sensing technique allows for operation with south pole magnet orientation, enhancing the manufacturability of the device.

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 AD1912-K.

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 south pole near the branded surface of the device.

Thermal Considerations

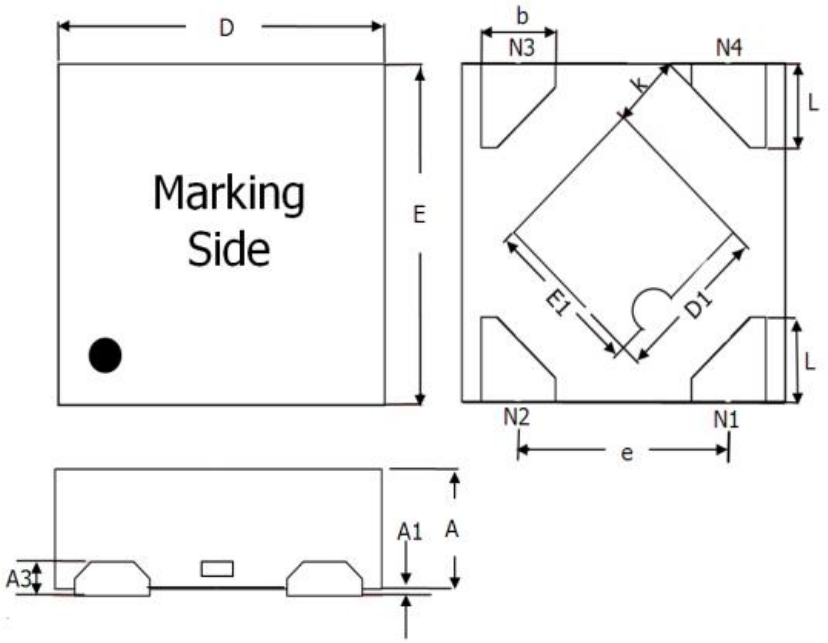
The maximum IC junction temperature should be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation of the AD1912-K. Calculate the maximum allowable dissipation, $P_{D(max)}$, and keep the actual dissipation less than or equal to $P_{D(max)}$. The maximum-power-dissipation 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.

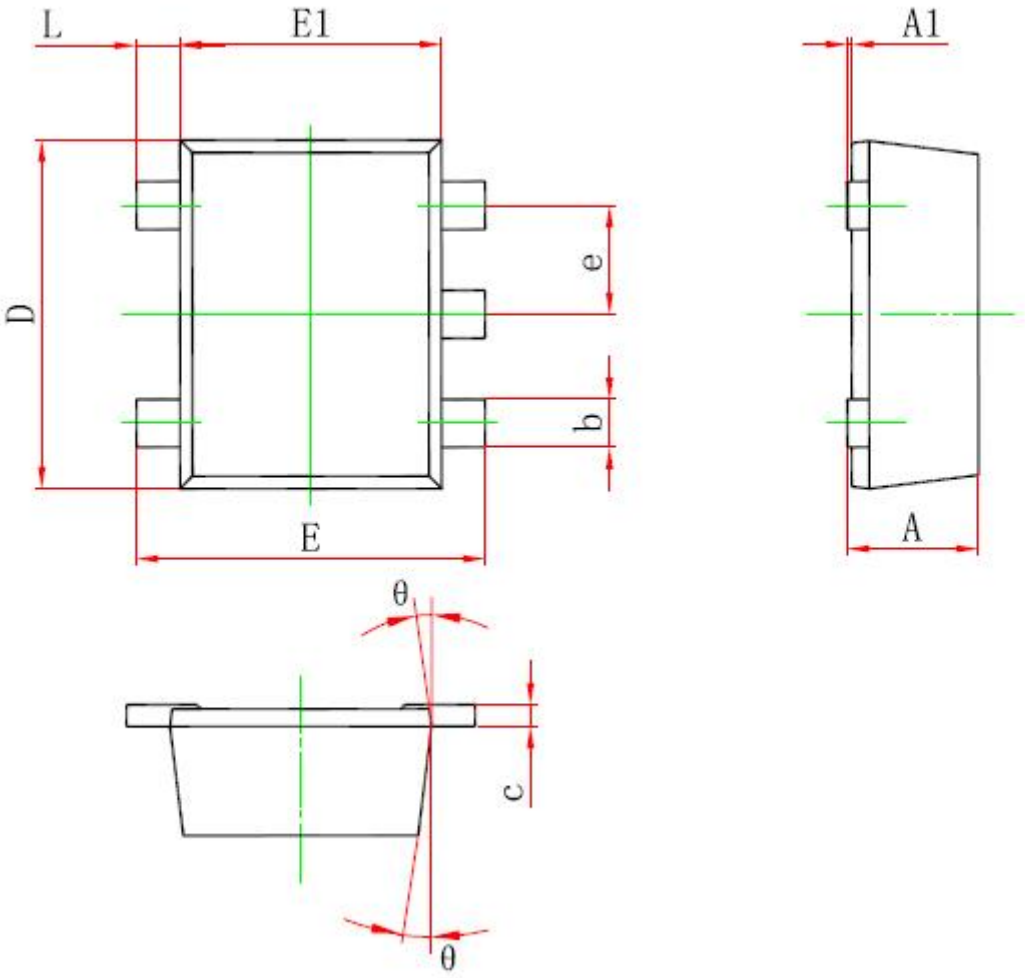
■ Package Information

DFN1010-4L:



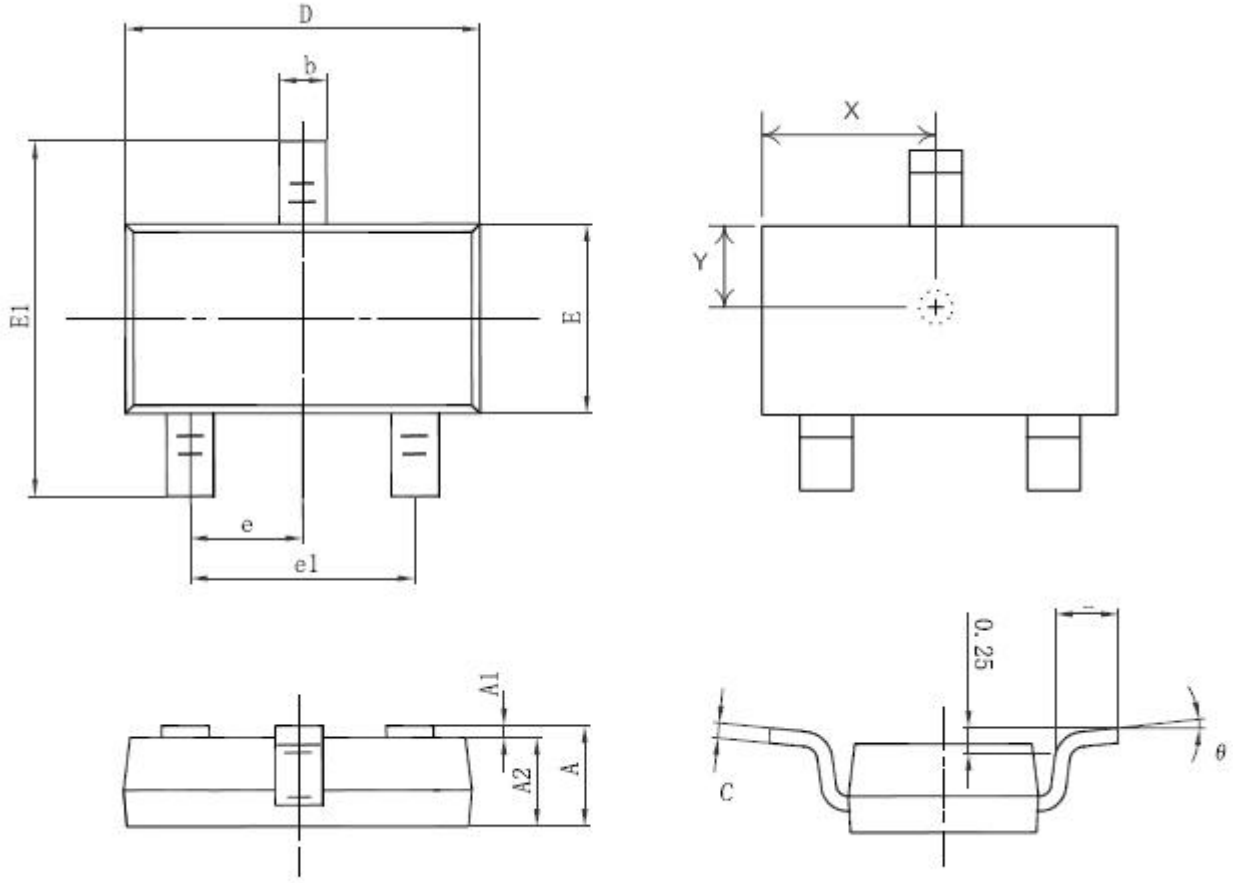
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.340	0.400	0.014	0.016
A1	0.000	0.050	0.000	0.002
A3	0.152 BSC		0.006 BSC	
D	0.950	1.050	0.038	0.042
E	0.950	1.050	0.038	0.042
D1	0.450	0.550	0.018	0.022
E1	0.450	0.550	0.018	0.022
k	0.211 BSC		0.008 BSC	
b	0.180	0.280	0.0072	0.0112
e	0.625 BSC		0.025 BSC	
L	0.200	0.300	0.008	0.012

SOT553:



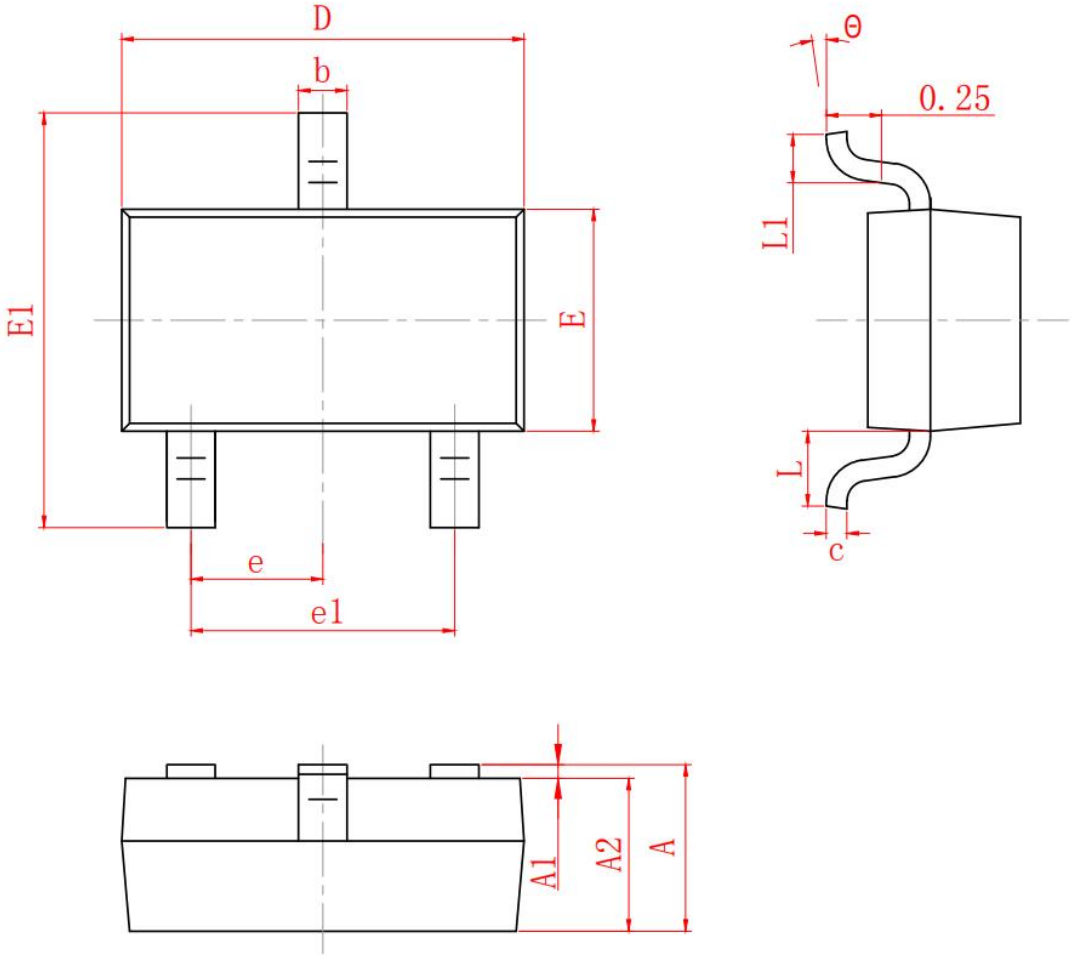
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
e	0.450	0.550	0.018	0.022
c	0.090	0.160	0.004	0.006
D	1.500	1.700	0.059	0.067
b	0.170	0.270	0.007	0.011
E1	1.100	1.300	0.043	0.051
E	1.500	1.700	0.059	0.067
θ	7° REF		7° REF	
L	0.100	0.300	0.004	0.012

SOT23-3L:



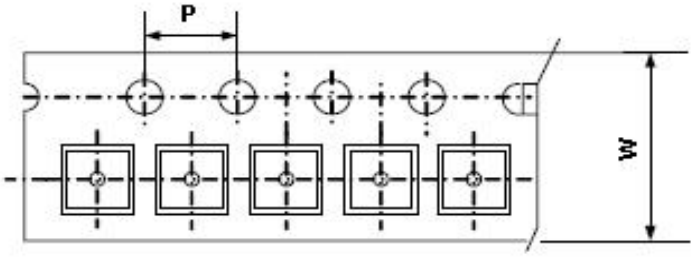
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.900(BSC)		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°
X	1.410	1.510	0.056	0.059
Y	0.800	0.850	0.031	0.033

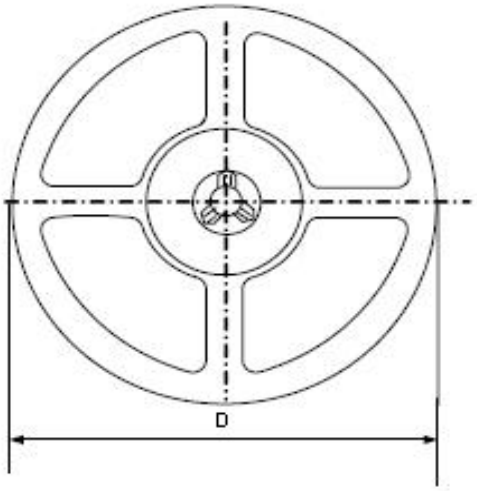
SSOT23-3L:

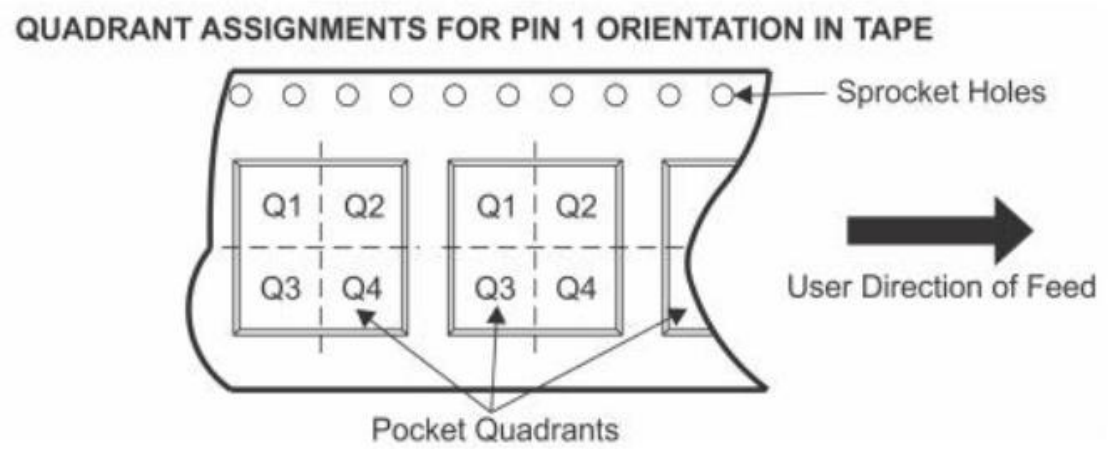


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950(TPY)		0.037（TPY）	
e1	1.800	2.000	0.071	0.079
L	0.550 REF		0.022 REF	
L1	0.300	0.500	0.012	0.020

■ Packing Information







Package Type	Carrier Width(W)	Pitch(P)	Reel Size(D)	Packing Minimum	Pin 1 Quadrant
DFN1010-4L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	10000pcs	Q1
SOT553	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs	Q3
SOT23-3L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs	Q3
SSOT23-3L	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs	Q3

Note: Carrier Tape Dimension, Reel Size and Packing Minimum