IST8508

3D Micro Power Omnipolar AMR/Hall-effect Sensor Switch

Datasheet

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1 General Description

The iST8508 is a 3D omni-polar magnetic switch featuring low hysteresis, low power consumption, and adjustable magnetic operating points that can be as low as 15G. The iST8508 Hall effect sensor IC is fabricated with mixed signal CMOS technology. It comprises one AMR sensor, one Hall plate, and a CMOS output driver, mainly designed for battery-operation, hand-held equipment (such as Cellular and Cordless Phone, PAD). The total power consumption in normal operation is typically 18.81μW with a 3.3V power source.

A magnetic field of sufficient strength will turn the output on (low voltage). The output will be turned off (high voltage) when the magnetic field ceases to exist. More precisely, when the absolute value of the applied magnetic flux density (B) is larger than the absolute value of the operating point (BOP), the output will be turned low and kept low until the absolute value of B becomes lower than the absolute value of the release point (BRP), below which point the output returns to high voltage.

The iST8508 is available in SOT23-3L package. Operating temperature range of the iST8508 is from -40°C to 85°C.

To minimize the BOM cost, capacitors of the MLCC type are supported, and only one external component is needed to complete the application circuit.

Features

- Micro power consumption ideal for battery-powered applications
- Omni-polar (operation with magnetic field of either north or south pole), easy to use as output
- Input Voltage Range: 2.5V to 5.5V
- Very high sensitivity hall sensor
- Chopper stabilized amplifier stage
- Good RF noise immunity
- SOT23-3L package
- No need of a pull-high resistor

Applications

Cover switch in clam-shell cellular phones

Cover switch in Notebook PC/PAD

Contact-less switch in consumer products

Solid State Switch

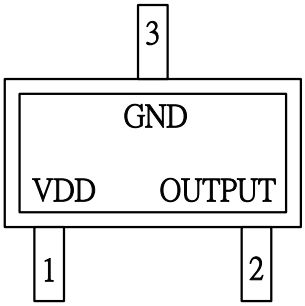
Handheld Wireless Handset Awake Switch

Lid close sensor for battery-powered devise

Magnet proximity sensor for reed switch replacement

2 Pin Configuration, Application Circuit, Block Diagram, and Package Dimension

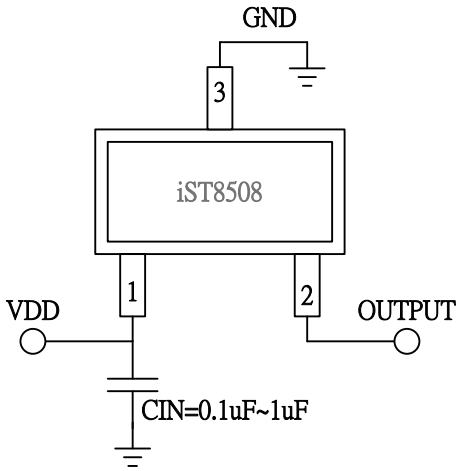
SOT23-3L(Top View)



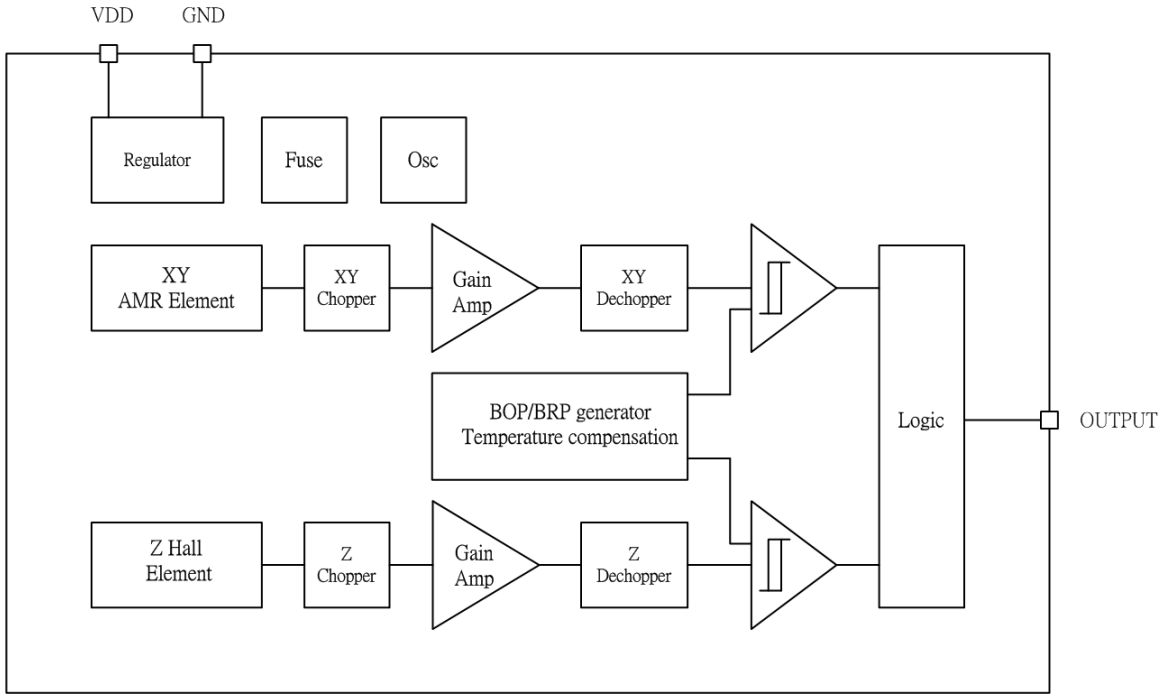
2.1 Pin Configuration

Pin Name	Pin No.	Pin Function
VDD	1	Power Supply Input
GND	3	Ground
OUTPUT	2	Output Pin

2.2 Application Circuit

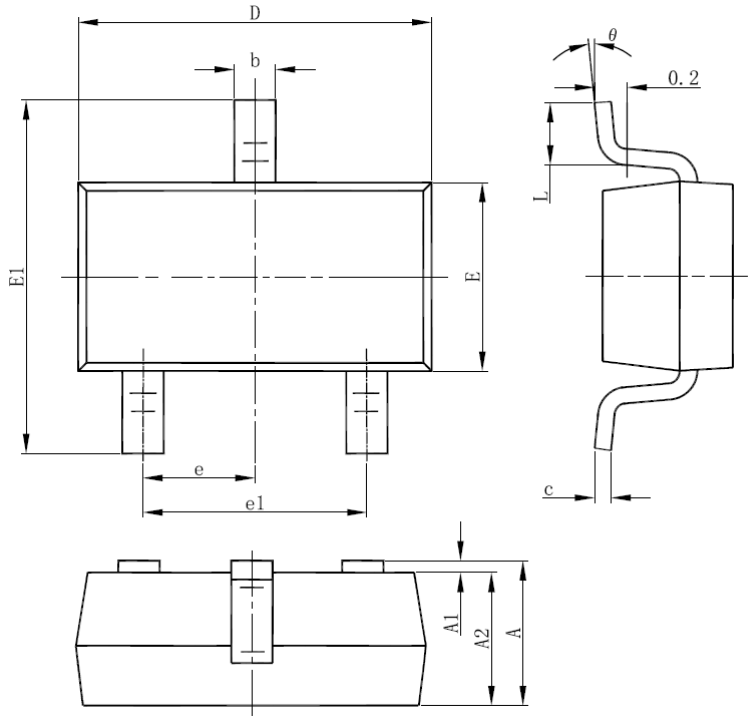


2.3 Block diagram



2.4 Package Dimensions and Pin Description

SOT23-3L

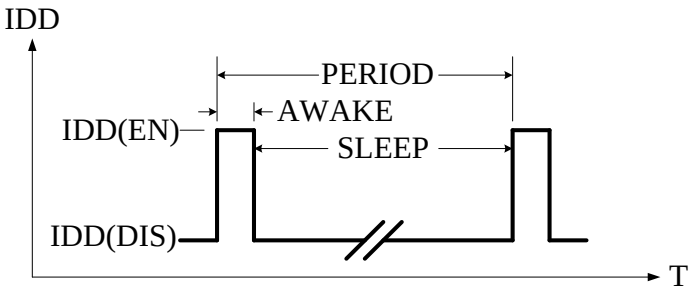


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.050	1.15	1.250	0.041	0.045	0.049
A1	0.000	0.050	0.100	0.000	0.002	0.004
A2	1.050	1.100	1.150	0.041	0.043	0.045
b	0.300	0.400	0.500	0.012	0.016	0.020
c	0.100	0.150	0.200	0.004	0.006	0.008
D	2.820	2.920	3.020	0.111	0.115	0.119
E	1.500	1.600	1.700	0.059	0.063	0.067
E1	2.650	2.800	2.950	0.104	0.110	0.116
e1	1.800	1.900	2.000	0.071	0.075	0.079
e	0.950 REF			0.037 REF		
L	0.300	0.450	0.600	0.012	0.018	0.024
θ	0°	4°	8°	0°	4°	8°

3 Functional Descriptions

3.1 Low Average Power

Internal timing circuitry activates the sensor for 140μs and deactivates it for the remainder of the period (100ms). 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.



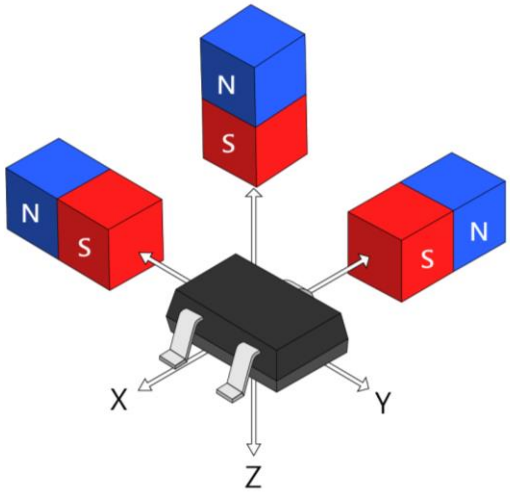
3.2 Chopper-Stabilized Technique

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, and simultaneously, extracts the Hall voltage signal induced by the external magnetic flux. The signal is then captured by a sample-and-hold circuit and further processed. This technique produces an extremely stable Hall output voltage that is immune to the thermal stress and has precise recoverability after temperature cycling. A relatively high sampling frequency is used for faster signal processing.

3.3 Magnetic Field Detection Mechanism

The Hall IC can detect magnetic fields along the perpendicular or parallel direction with respect to the package top layer. The AMR sensor detects the magnetic field along the X and Y axes, i.e, the perpendicular axes. The Hall sensor detects the magnetic field along the Z axis, i.e, the parallel axis.



3.4 Operation

The 3D switch can be programmed to respond to a B-field on combinations of axes – X only, Y only, Z only, X and Y, X and Z, Y and Z, and XYZ all-axes

The output of this device turns on (low voltage) when the absolute value of magnetic field on one of the X, Y, Z axis is greater than the absolute value of the operate point B_{OPS} or B_{OPN}.

The three axes work independently except that there is a correlation between X and Y axis if they are both enabled due to the nature of the AMR sensor design.

For example, in XYZ all-axis mode, if a 40G B-field is applied to the device along the Z axis, the switch turns on regardless of the field conditions of the X or Y axis. Similarly, in XYZ all-axis mode, if a 40G B-field is applied to the device along one of the X or Y axis, the device turns on regardless of the field condition on the Z axis.

However, in XYZ all-axis mode, if a 40G is incident on both the X and Y axes on the device, the output remains off unless there is a field on the Z, because the responses to the field on X and Y axes are correlated.

When the absolute value of the magnetic field is reduced below the absolute value of the release point B_{RPS} or B_{RPN}, the device output turns off (high voltage). The difference between a magnetic operate point value and its corresponding release point value is called a hysteresis (B_{hys}) of the device. Hystereses are implemented to allow clean switching of the output even in the presence of external mechanical vibration and electrical noise.

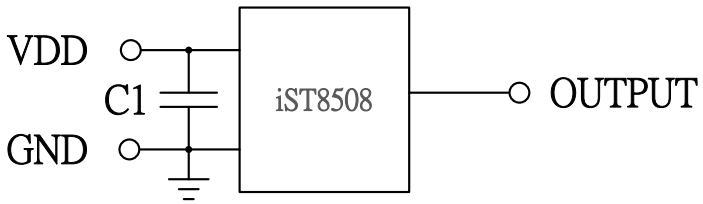
The state-of-the-art technology provides the same output polarity for either pole face.

The output is capable of sinking or pulling a current up to 5mA.

3.5 Programmability:

Besides the active axes combination, additional characteristics of the device can be permanently programmed such as the output data rate (ODR), the shared operate points for both the X and Y axis, the operate points for the Z axis, the hystereses (two status are provided: narrow and wide; narrow being default), the temperature compensation codes, and the output mode (push pull or open drain; push pull being default) characteristic.

3.6 Applications:



An MLCC capacitor C1 is recommended to be connected between VDD and GND。

C1 serves two purposes: minimizing ripples on the input voltage and enhancing immunity from RF transmission noises within close proximity. Recommended values are between 100nF and 1uF. The larger the capacitance, the better the noise immunity is for the iST8508.

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. The simplest form of magnet that can operate with the device is a bar magnet with either pole near the device along one of the X, Y, and Z axes.

4 Electrical Specifications

4.1 Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
VDD to GND		V_{DD}	-0.3 to 6	V
Magnetic Flux Density		B	Unlimited	
Storage Temperature Range		T_S	-55 to +150	°C
Operating Junction Temperature Range		T_J	-40 to 150	°C
Package Power Dissipation	SOT23-3L	PD	180	mW

4.2 Recommended Operating Conditions

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{DD}	Operating	2.5 ~ 5.5	V
Operating Temperature Range	T_A	Operating	-40 ~ +85	°C

4.3 Electrical Specifications

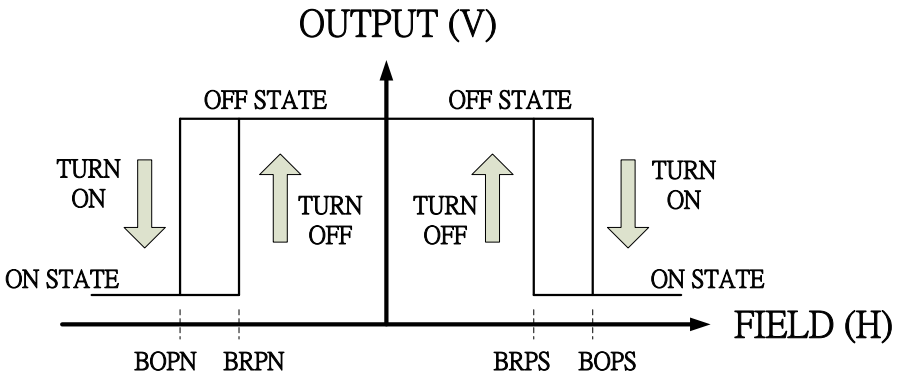
(Unless otherwise noted，typical values are at TA=25℃,VDD=3V)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
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 Off Voltage (Low side)	I_{OUT}=-1mA	-0.3	0.1	+0.3	V
I_{OFF}	Output Leakage Current	V_{OUT}=4.5V, Output off	-	<0.1	1.0	uA
I_{DD}(EN)	Supply Current (ODR=10Hz)	Chip enable, T_A=25℃, VDD= 3.3V	-	2.5	3	mA
I_{DD}(EN)		Chip enable, T_A=-40~85℃, V_{DD}= 2.5~5.5V	-	2.5	3	mA
I_{DD}(DIS)		Chip disable e, T_A=25℃, V_{DD}= 3.3V	-	2.0	2.5	uA
I_{DD}(DIS)		Chip disable, T_A=-40~85℃, V_{DD}=2.5V~5.5V	-	2.0	9.0	uA
I_{DD}(AVG)		Average supply current, T_A=25℃, V_{DD}=3.3V	-	5.7	7	uA
I_{DD}(AVG)		Average supply current, T_A=-40~85℃, V_{DD}= 2.5V~5.5V	-	5.7	12	uA
I_{DD}(NS)	Supply Current (No Sleep) (ODR=7kHz, BW=2kHz)	T_A=25℃, VDD= 3.3V	-	2.5	-	mA
T_{awake}	Awake Time	-	-	140	200	us
T_{period}	Period	-	-	100	150	ms
D.C.	Duty Cycle	-	-	0.14	-	%

4.4 Magnetic Specifications of XY axis

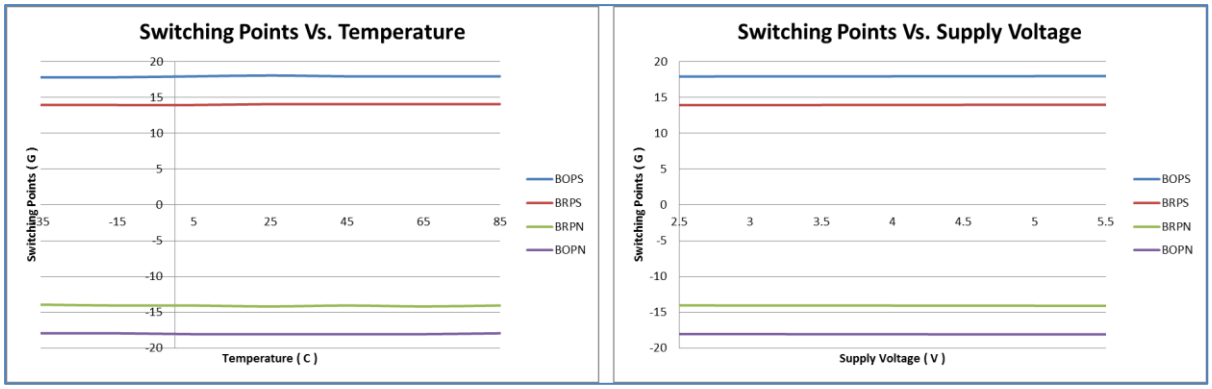
Symbol	Parameter	Min.	Typ.	Max.	Unit
BOPS	Operate Point	13	18	35	Gauss
BOPN		-35	-18	-13	
BRPS	Release Point	8	14	23	
BRPN		-23	-14	-8	
BHY	Hysteresis	-	4	-	



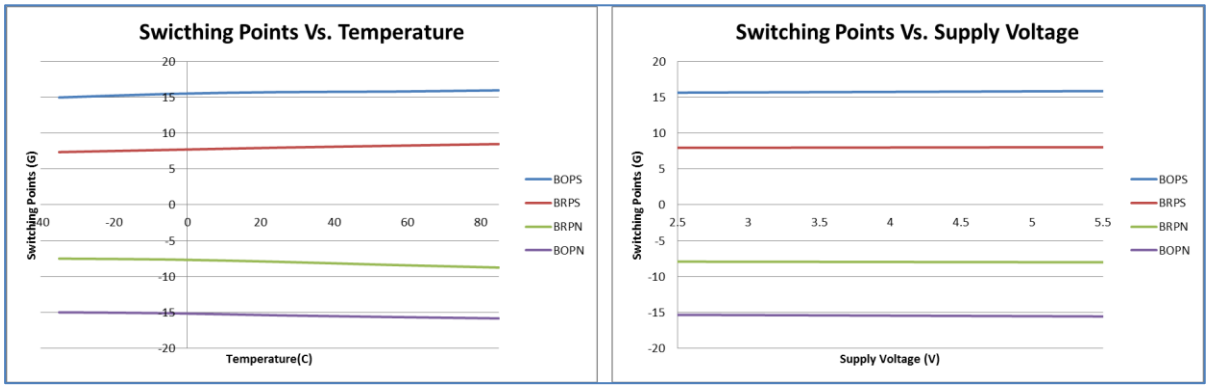
4.5Magnetic Specifications of Z axis

Symbol	Parameter	Min.	Typ.	Max.	Unit
BOPS (south pole to brand side)	Operate Point	13	16	28	Gauss
BOPN (north pole to brand side)		-28	-16	-13	
BRPS (south pole to brand side)	Release Point	8	12	18	
BRPN (north pole to brand side)		-18	-12	-8	
BHY (|BOPX-BRPX|)	Hysteresis	-	4	-	

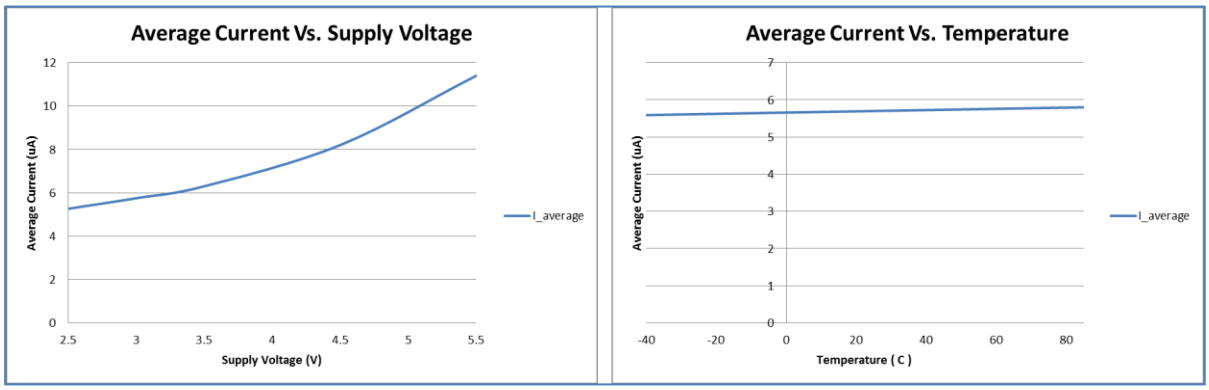
4.6 Typical Characteristics of XY Axes



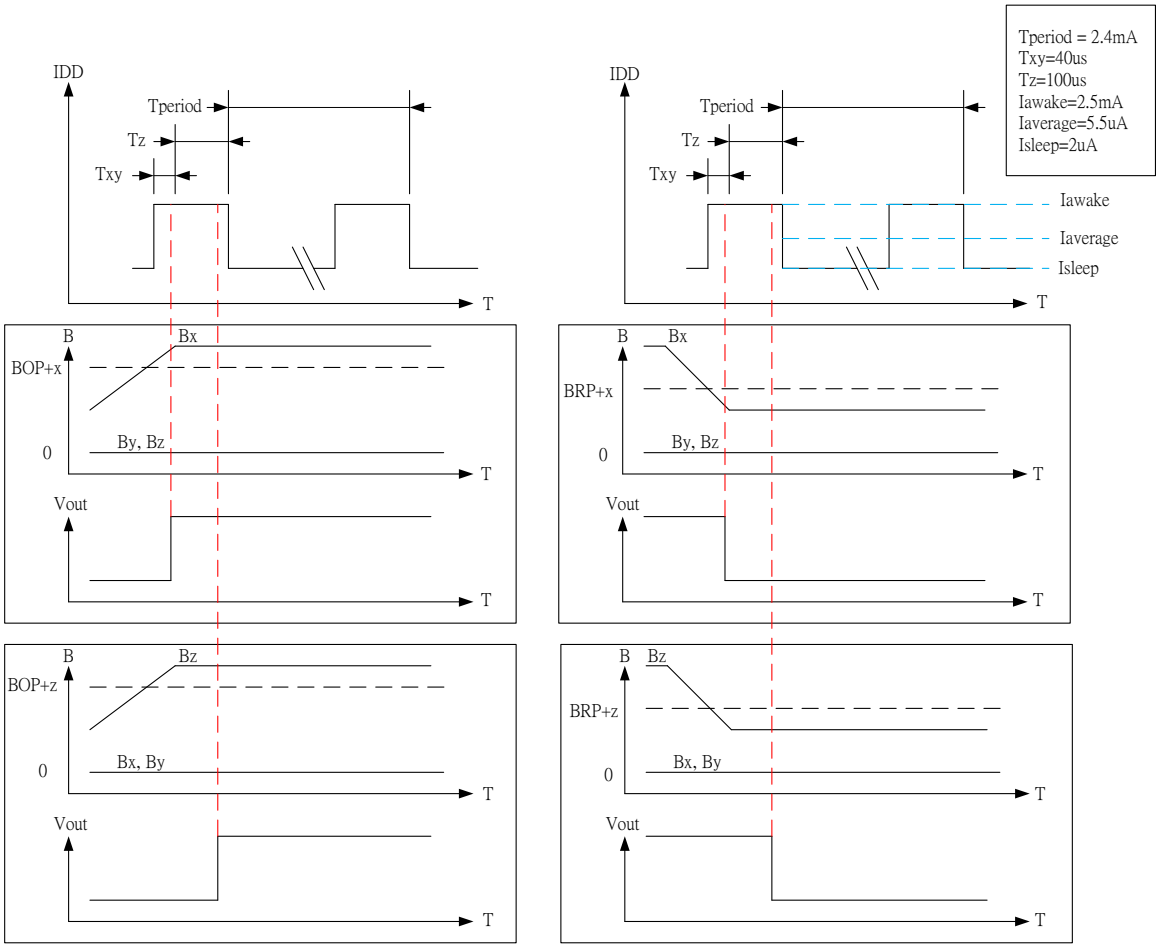
4.7 Typical Characteristics of Z Axis



4.8 Typical Characteristics of Average Current

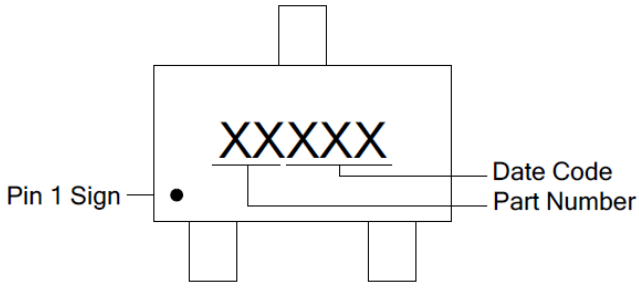


4.9 Timing Diagram

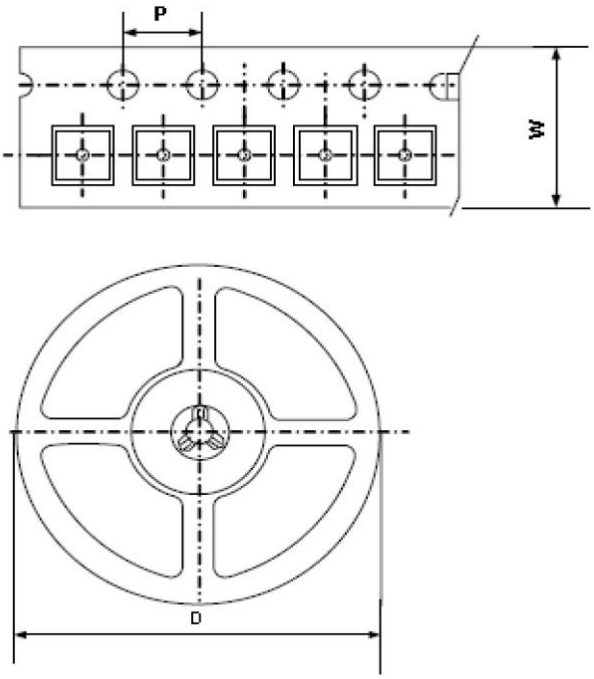


5 Marking Information

(1) SOT23-3L



6 Packing Information



Package Type	Carrier Width (W)	Pitch (P)	Reel Size (D)	Packaging Minimum
SOT23-3L	8.0±0.1mm	4.0±0.1mm	180±1mm	Tape and Reel: 3k pcs per reel

Note: Carrier Tape Dimension, Reel Size and Packing Minimum.

7 Ordering Information

Part Number	Package Type	Packing Quantity	B_{OPS} (Gauss)	B_{RPS} (Gauss)	Temp.	Eco Plan	Lead
IST8508	SOT23-3L	7-in reel 3000pcs/reel	±15~±28	±8~±18	-40~85°C	Green	Cu

For more information on iSentek's Magnetic Sensors, please contact us by phone at +86-156-22888- 337 (China) or +886-2-2698-3306 ext:111 (Taiwan); via e-mail: sales@isentek.com or visit us online at www.isentek.com.

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US Patent 9,297,863, Taiwanese Patents I437249, I420128 and I463160 apply to our magnetic sensor technology described.