

## Free Pitch Latch with Speed & Direction Output

### 1 Product Description

The MT73XX-OXX family is a Hall-effect dual latch produced by BCD technology with both high performance and high reliability. The Hall IC internally includes an on-chip Hall voltage generator, a voltage regulator for operation with supply voltage of 3.0V to 24V, temperature compensation circuitry, small-signal amplifier, Hall IC with dynamic offset cancellation system, schmitt trigger and two open drain output, all in a single package.

The MT73XX-OXX family have been designed with free pitch dual latch sensor IC. The MT73XX-OXX has integrated two Hall plate which sense magnetic filed from two different axis, which allows each sensor to detect a quadrature component of the same magnetic field. One of the Hall plate provide the speed signal output. The combination of both the Hall plate signals is then internally processed to directly deliver a direction signal output.

The MT73XX-OXX family provides SOT-23-6L for surface mount to customers & flat TO-94 for through-hole mount. All packages are RoHS compliant.



### 2 Features

- AEC-Q100 Automotive Qualified (MT730X-OXX)
- Two Integrated Hall Plates for Direction Detection
- 3.0~24V Operating  $V_{CC}$  Range
- -40°C~150°C Operating Temperature
- Package Option:  
SOT-23-6L / Flat TO-94
- Magnetic Sensitivity Option:  
MT73X1-OXX (BOP=25Gs, BRP=-25Gs)  
MT73X2-OXX (BOP=50Gs, BRP=-50Gs)
- Speed & Direction Open-Drain Output  
Dual Speed Open-Drain Output
- -30V Reversed Power Supply Protection
- Output Over Current Protection
- RoHS Compliant: (EU)2015/863

### 3 Product Overview of MT73XX-OXX

Part No.	Description
MT73XXAT-OXX	SOT-23-6L, tape & reel (3000pcs/bag)
MT73XXA-OXX	Flat TO-94, bulk packaging (500pcs/bag)

### 4 Applications

- Windows Lifter with Anti-Pinch Feature
- Rotation Speed & Direction Detection
- Linear Speed & Direction Detection

### 5 Pin Configuration and Functions

SOT-23-6L	No.	Description
V <sub>CC</sub>	1	Power Supply
GND	2	Ground
NC	3	Unconnected
OUT1	4	Speed Signal Out1
NC	5	Unconnected
OUT2	6	Speed Signal Out2 or Direction Signal Out

Flat TO-94	No.	Description
V <sub>CC</sub>	1	Power Supply
OUT2	2	Speed Signal Out2 or Direction Signal Out
OUT1	3	Speed Signal Out1
GND	4	Ground

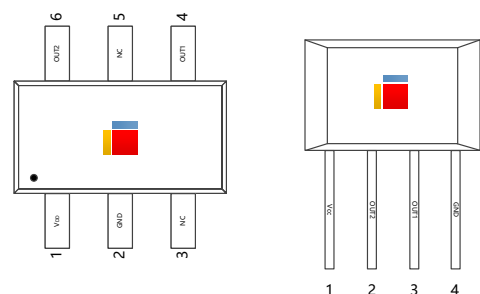


Figure.1 Pin Configuration & Functions  
SOT-23-6L & Flat TO-94 Top-View

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**History**

- 1.0 Initial version
- 1.1 Update the power consumption range of ZY version and remove the XY version

### 6 Definition of Product Name

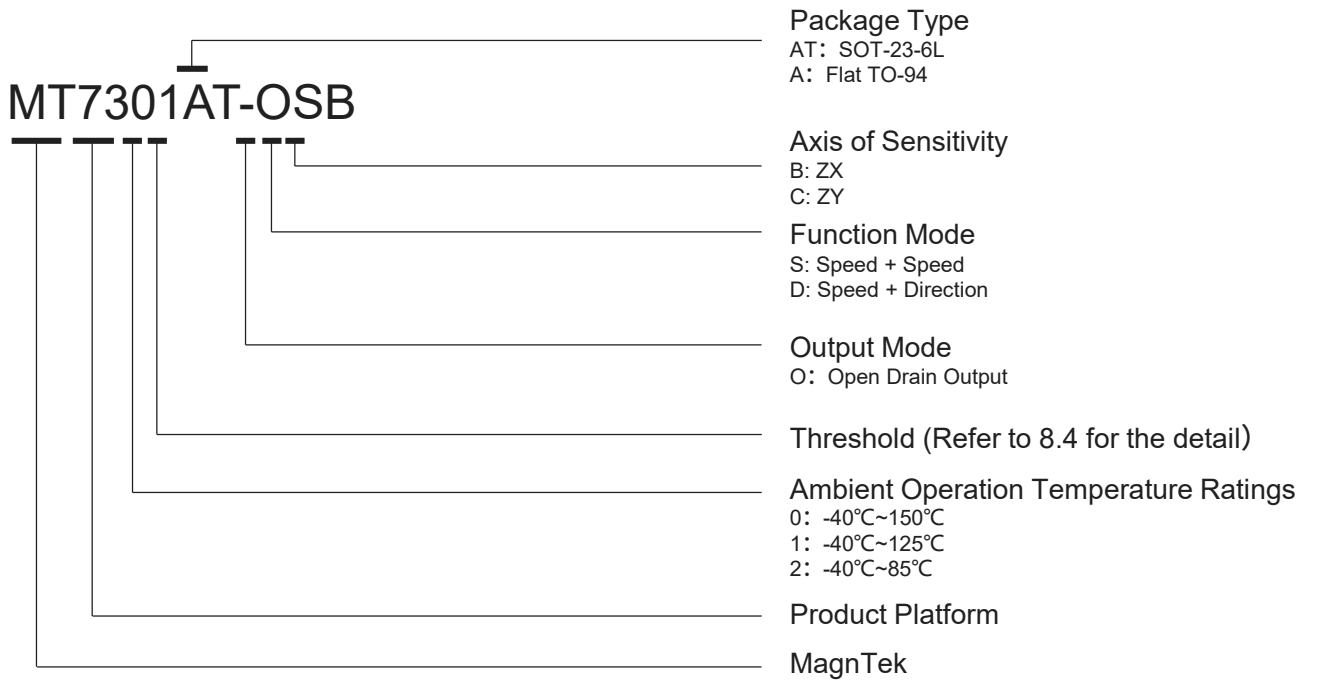


Figure.2 Definition of Product Name

### 7 Functional Block Diagram

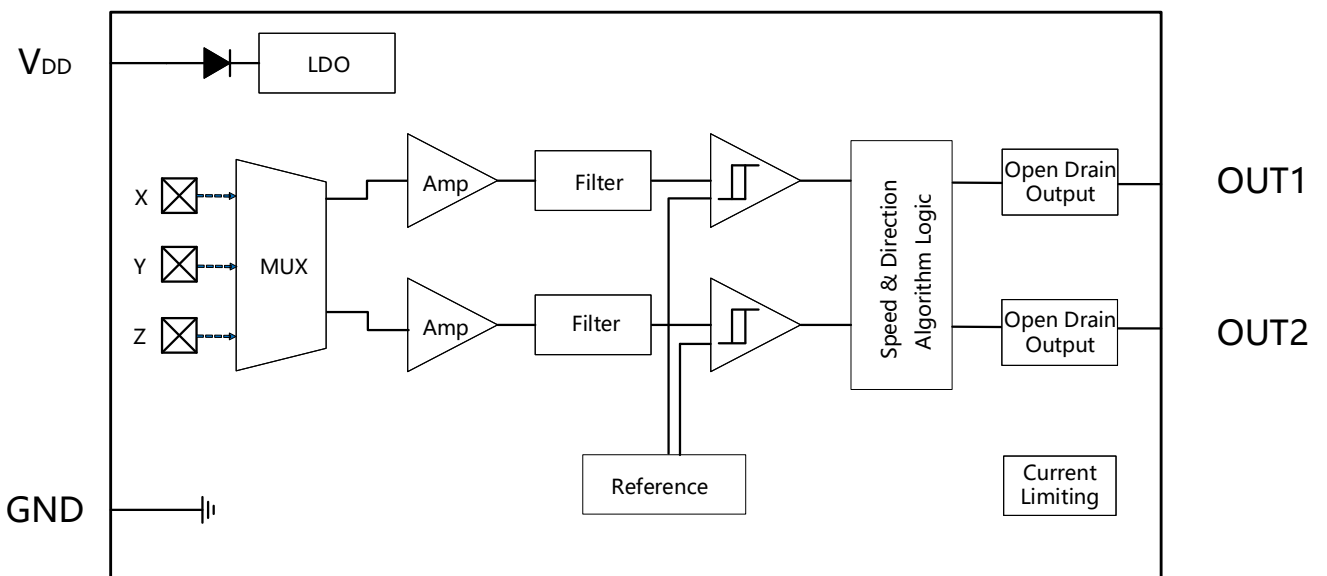


Figure.3 Functional Block Diagram

## 8 Electrical and Magnetic Characteristics

### 8.1 Absolute Maximum Ratings

Absolute maximum ratings are limited values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

Symbol	Parameters	Min	Max	Units
V <sub>CC</sub>	Supply Voltage	-	30	V
V <sub>RCC</sub>	Reverse Battery Voltage	-30	-	V
V <sub>OUT</sub>	Output Voltage	-0.7	30	V
I <sub>OUT</sub>	Continuous Output Current	-	40	mA
T <sub>A</sub>	Operating Ambient Temperature	-40	150	°C
T <sub>S</sub>	Storage Temperature	-50	160	°C
T <sub>J</sub>	Junction Temperature	-	165	°C
B	Magnetic Flux Density	No Limit		Gs

### 8.2 Electrical Specifications

At T<sub>A</sub>=-40~150 °C, V<sub>CC</sub>=3.0V~24V (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
V <sub>CC</sub>	Supply Voltage	Operating	3.0 <sup>(1)</sup>	-	24	V
I <sub>CC</sub>	Supply Current	ZX Version F <sub>S</sub> =100kHz	-	7	10	mA
		ZY Version F <sub>S</sub> =100kHz	-	5	8	mA
I <sub>OCP</sub>	Short Circuit Protection Current	B>B <sub>OP</sub> , V <sub>OUT</sub> =V <sub>CC</sub>	-	30	-	mA
V <sub>DSON</sub>	Output Saturation Voltage	I <sub>OUT</sub> =10mA, B>B <sub>OP</sub>	-	-	0.4	V
V <sub>UDRESET</sub>	Under Voltage Lockout Threshold		-	2.6	-	V
V <sub>UDRLS</sub>	Under Voltage Release Threshold		-	3.0	-	V
I <sub>OFF</sub>	Output Leakage Current	V <sub>OUT</sub> =24V,  B < BRP	-	-	10	uA
T <sub>R</sub> & T <sub>F</sub>	Output Rise & Fall Time	R <sub>L</sub> =1KOhm, C <sub>L</sub> =20pF	-	-	1.0	us
T <sub>PO</sub> <sup>(1)</sup>	Power on Time	dV <sub>CC</sub> /dt>5V/uS B>B <sub>OP</sub> (MAX)	-	40	-	us
Pos	Power on State	MT730X-OSX	V <sub>pull-up</sub>		-	-
Pos	Power on State	MT730X-ODX	V <sub>pull-down</sub>		-	-
F <sub>S</sub>	Sampling Frequency		-	100	-	KHz
T <sub>D</sub>	Delay Time		-	1.2	2.5	us
R <sub>TH</sub>	Thermal Resistance of SOT-23-6L		-	301	-	°C/W
	Thermal Resistance of Flat TO-94		-	230	-	°C/W

Note 1: After power on with the power supply over than 3V, then drop down, the minimum number is 2.7V

### 8.3 ESD Ratings

Symbol		Reference	Values	Unit
V <sub>ESD</sub>	Human-body model (HBM)	AEC-Q100-002	5500	V
	Charged-device model (CDM)	AEC-Q100-011	1500	V

### 8.4 Magnetic Characteristics

At V<sub>CC</sub>=3.0V~24V (unless otherwise specified)

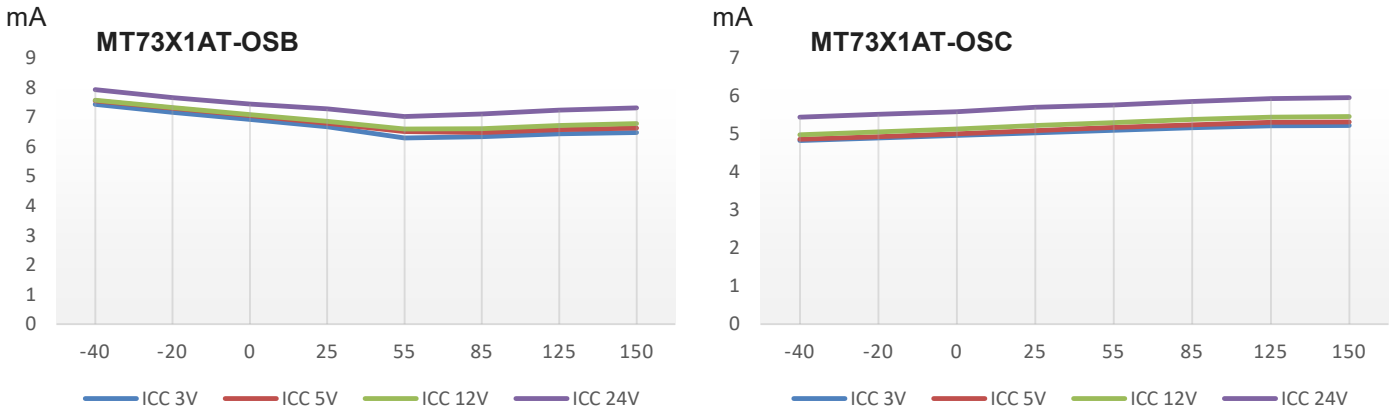
#### 8.4.1 MT73X1 Series

Parameter	Symbol	Min	Typ	Max	Unit
Operating Point	BOP, T <sub>A</sub> =25°C	10	25	40	Gs
Release Point	BRP, T <sub>A</sub> =25°C	-40	-25	-10	Gs
Hysteresis Window	BHYST, T <sub>A</sub> =25°C	20	50	80	Gs
Magnetic Matching	BOP1-BOP2 or BRP1-BRP2, T <sub>A</sub> =25°C	-20	-	20	Gs
Magnetic Offset	BOP1+BRP1 or BOP2+BRP2, T <sub>A</sub> =25°C	-25	-	25	Gs

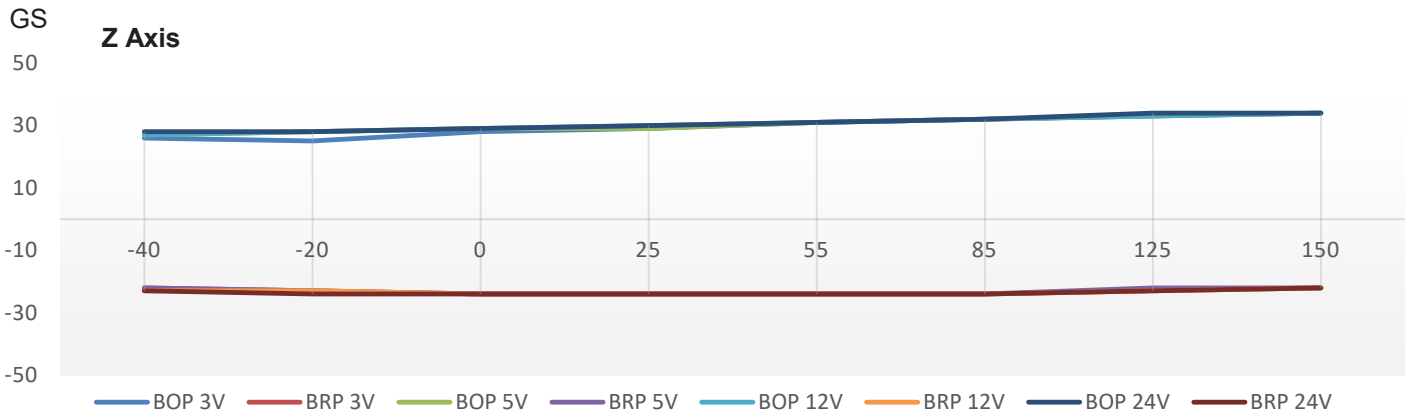
#### 8.4.2 MT73X2 Series

Parameter	Symbol	Min	Typ	Max	Unit
Operating Point	BOP, T <sub>A</sub> =25°C	25	50	75	Gs
Release Point	BRP, T <sub>A</sub> =25°C	-75	-50	-25	Gs
Hysteresis Window	BHYST, T <sub>A</sub> =25°C	50	100	150	Gs
Magnetic Matching	BOP1-BOP2 or BRP1-BRP2, T <sub>A</sub> =25°C	-20	-	20	Gs
Magnetic Offset	BOP1+BRP1 or BOP2+BRP2, T <sub>A</sub> =25°C	-25	-	25	Gs

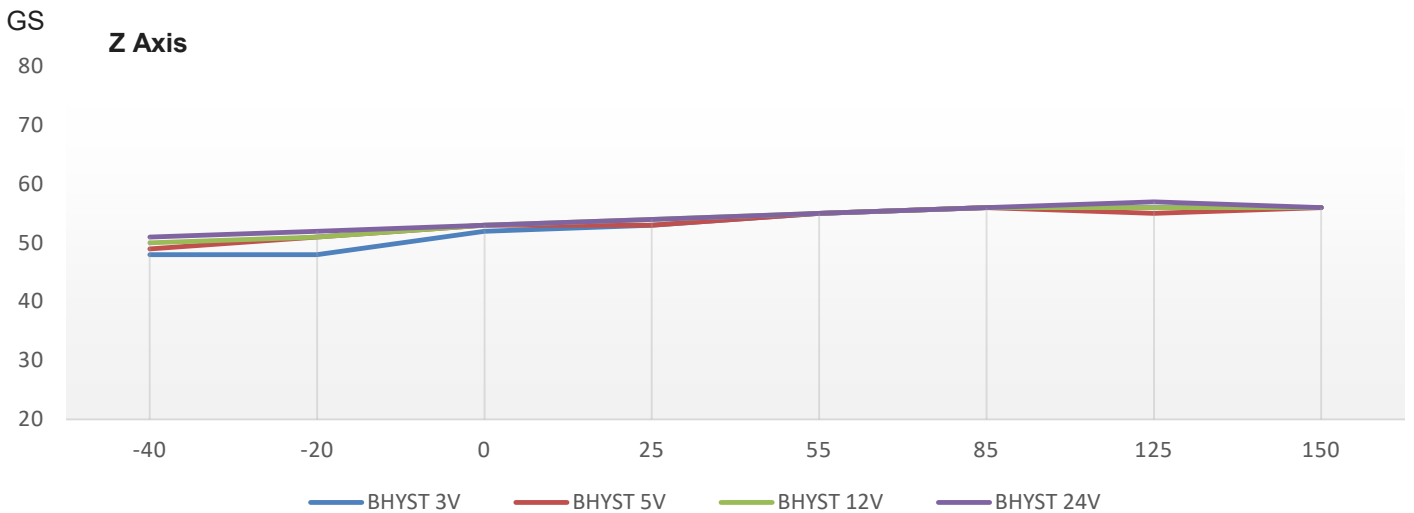
### 8.5 Characteristic Performance



**Figure.4** Supply Current vs. Temperature & Vcc (MT73X1AT-OSB & MT73X1AT-OSC as example)



**Figure.5** Magnetic Characteristics (Bop & BRP) vs. Temperature & Vcc (Z Axis as example)



**Figure.6** Magnetic Characteristics (Bhyst) vs. Temperature & Vcc (Z Axis as example)

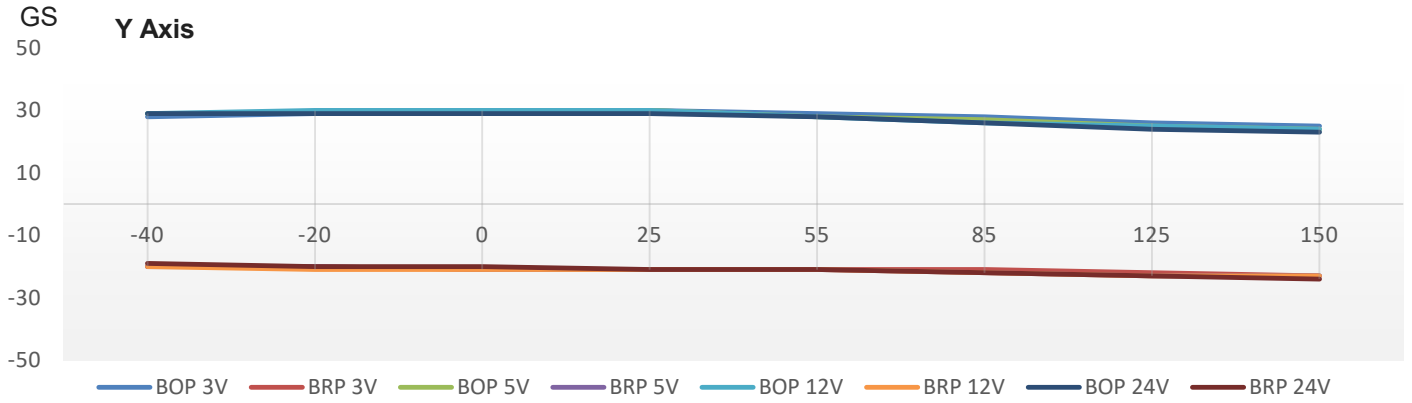


Figure.7 Magnetic Characteristics (Bop & BRP) vs. Temperature & Vcc (Y Axis as example)

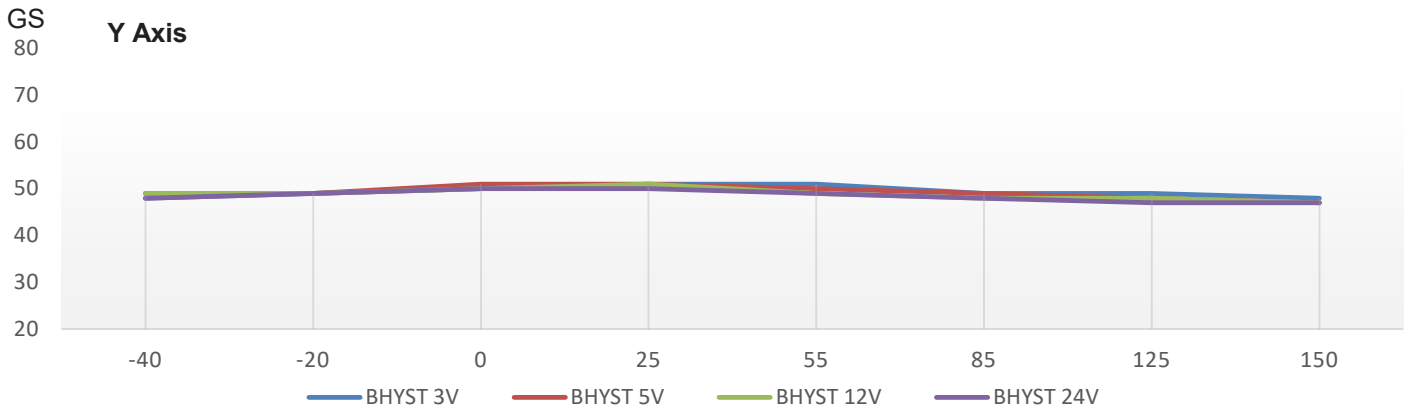


Figure.8 Magnetic Characteristics (Bhyst) vs. Temperature & Vcc (Y Axis as example)

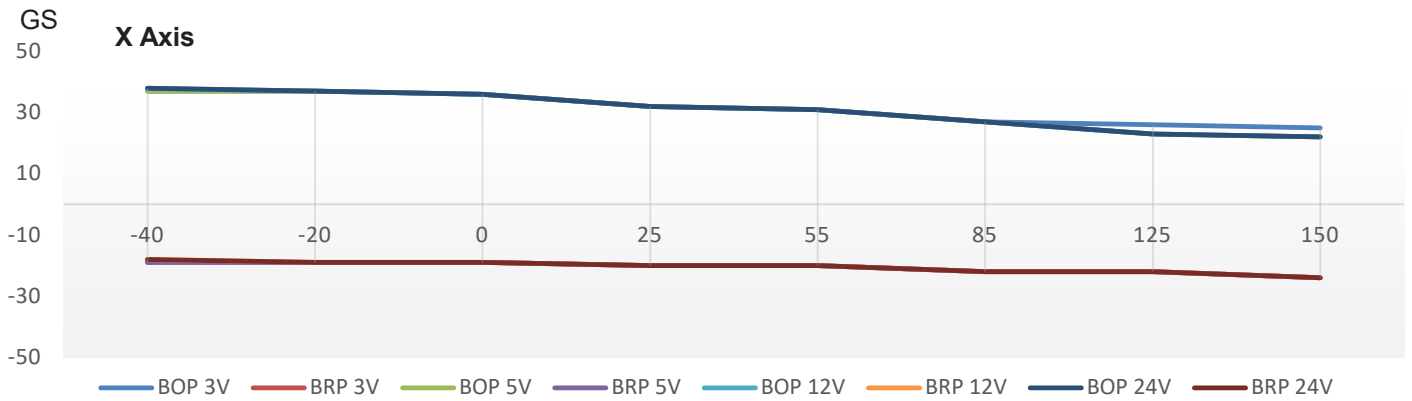


Figure.9 Magnetic Characteristics (Bop & BRP) vs. Temperature & Vcc (X Axis as example)

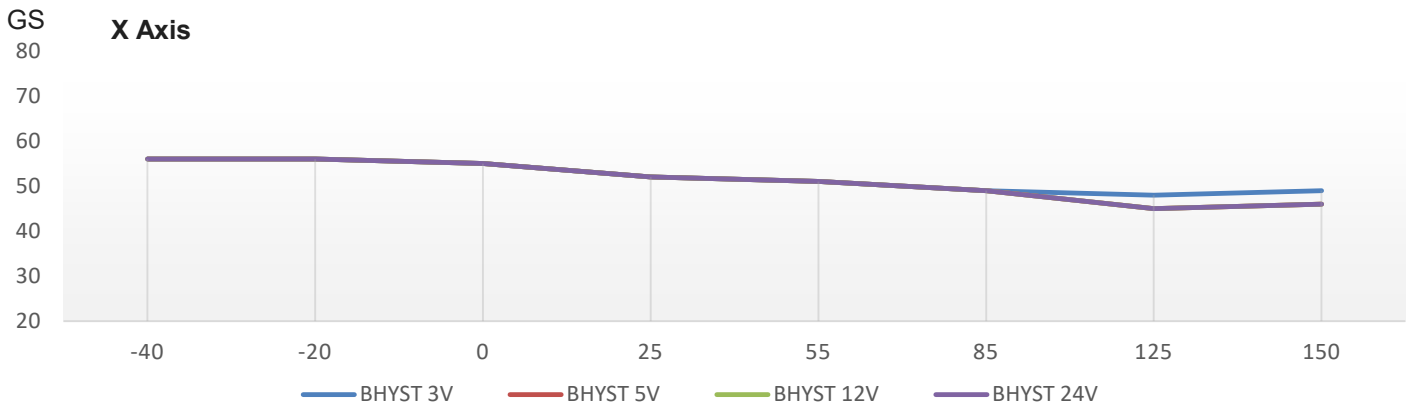


Figure.10 Magnetic Characteristics (Bhyst) vs. Temperature & Vcc (X Axis as example)

9 Output Behavior Comparison (MT890XAT-SS vs. MT73XXAT-OSB)

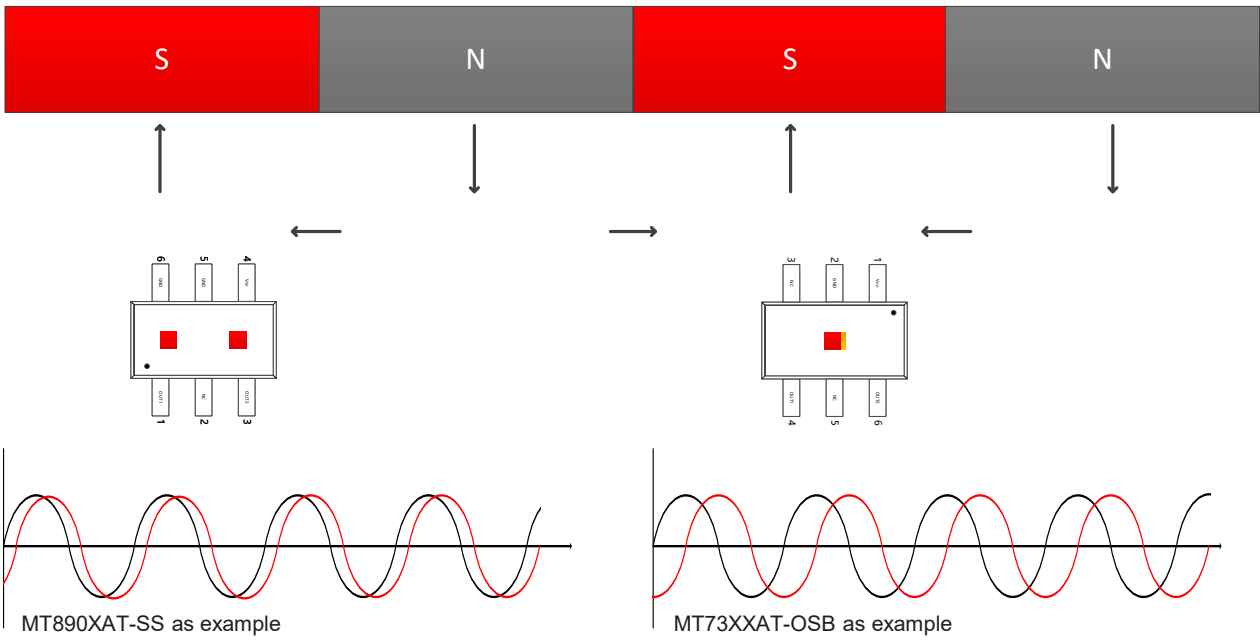


Figure.11 Output Behavior Comparison (The magnet should run directly above the chip)

10 Typical Output Waveform

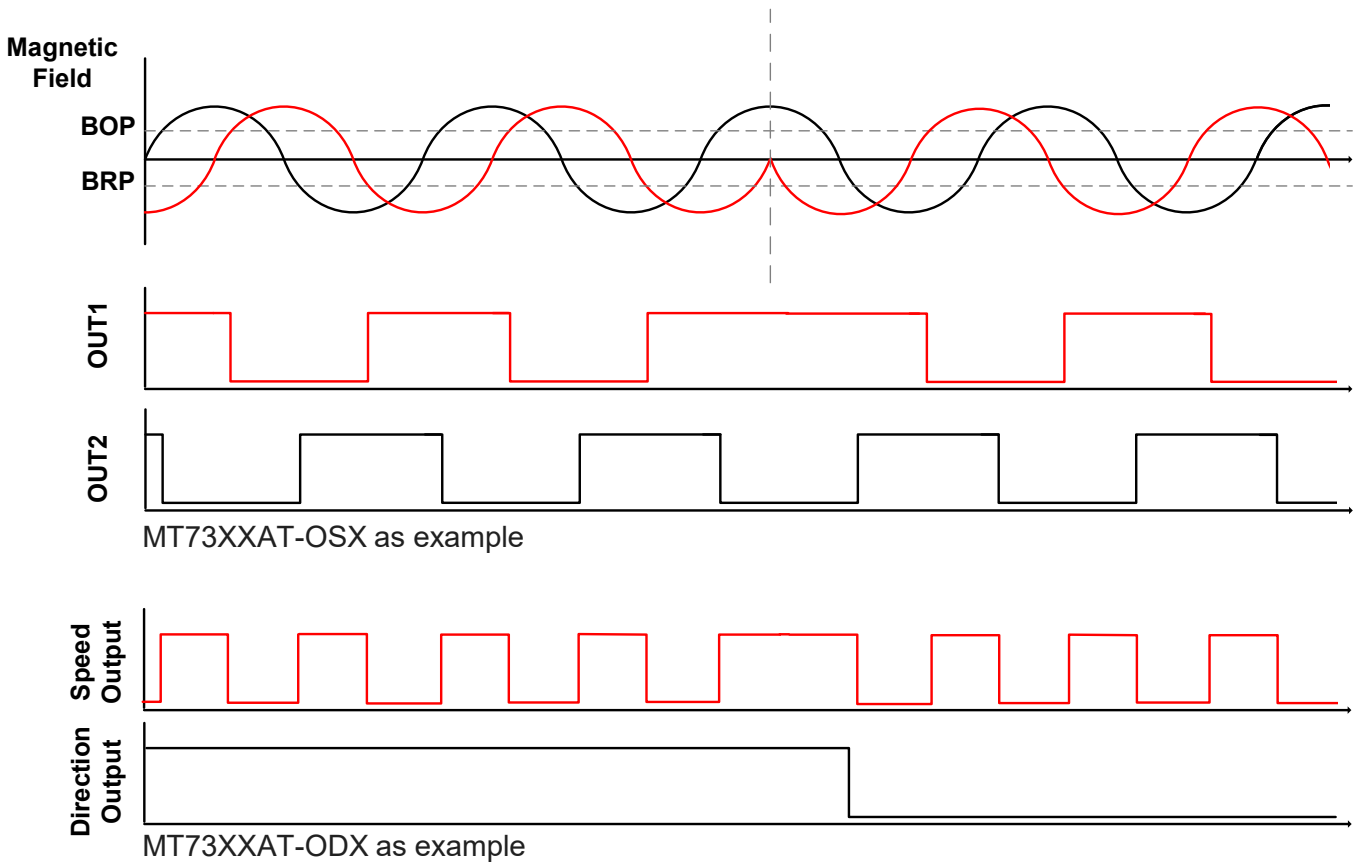


Figure.12 Typical Output Waveform

### 11 Power on Status

During power-on, the output voltage of MT73XX-OSX keeps high when the Vcc reach to the Vcc (Min), which is the pull-up voltage, until the device is ready to respond appropriately to the input magnetic field, the power on status keeps longer than TPO. Refer to the figure.13.

During power-on, the output voltage of MT73XX-ODX keeps high when the Vcc reach to the Vcc (Min), which is the pull-down voltage, until the device is ready to respond appropriately to the input magnetic field, the power on status keeps longer than TPO. Refer to the figure.14.

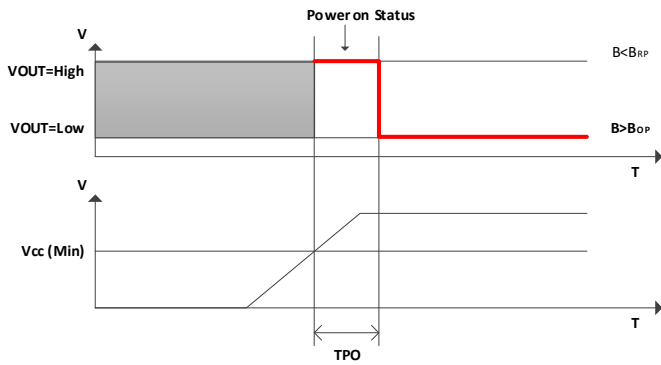


Figure.13 Power on Status (MT73XX-OSX)

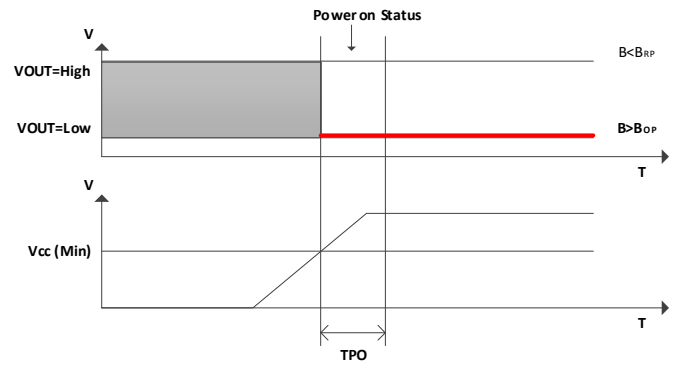


Figure.14 Power on Status (MT73XX-ODX)

### 12 Under Voltage Protection

After power on, when the Vcc lower than the VUDRESET which caused by the unstable power supply, the device will jump into the status of under voltage protection, the device will lock the output & do not reactive to the input magnetic field. Until Vcc back to VUDRLS

If the Vcc lower than 2.0V after power on, the device will re-start

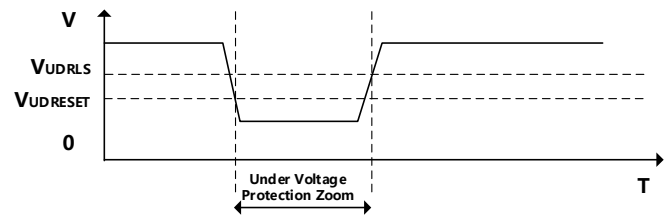


Figure.15 Under Voltage Protection

### 13 Typical Application Circuit

MT73XXAT-OXX as example

Note: Recommended value for RL1 & RL2 is 5KOhms to 20KOhms

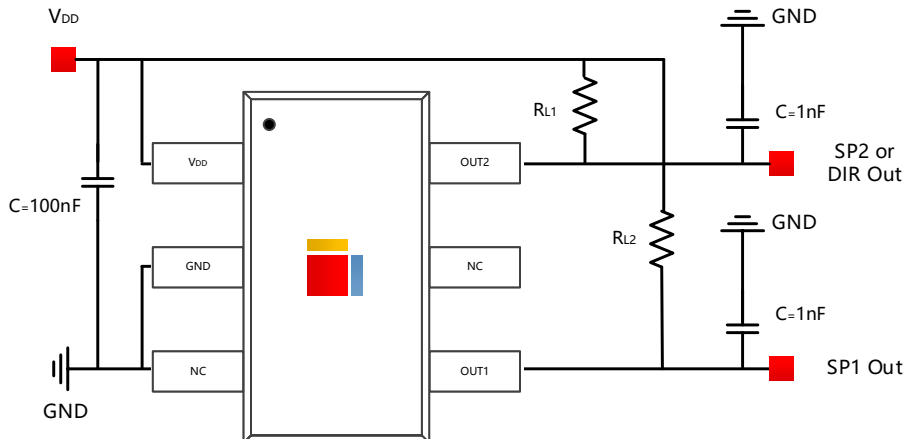


Figure.16 Typical Application Circuit

### 14 Device Options Compared with Magnet

Device Name	Axis of Sensitivity	Out 1	Out 2
MT73XX-OSB	ZX	Z	X
MT73XX-OSC	ZY	Z	Y
MT73XX-ODB	ZX	Speed	Direction
MT73XX-ODC	ZY		



Figure.17 MT73XXAT-OXB (ZX Output)

MT73XXAT-OXB sense the magnetic field from Z & X axis, figure.17 shows two relative positions as example



Figure.18 MT73XXAT-OXC (ZY Output)

MT73XXAT-OXC sense the magnetic field from Z & Y axis, figure.18 shows two relative positions as example

15 Package Material Information (For Reference Only – Not for Tooling Use)

15.1 SOT-23-6L Package Information

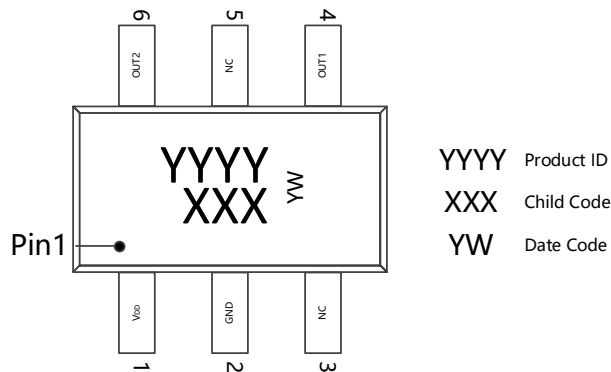


Figure.19 SOT-23-6L Chip Marking Spec

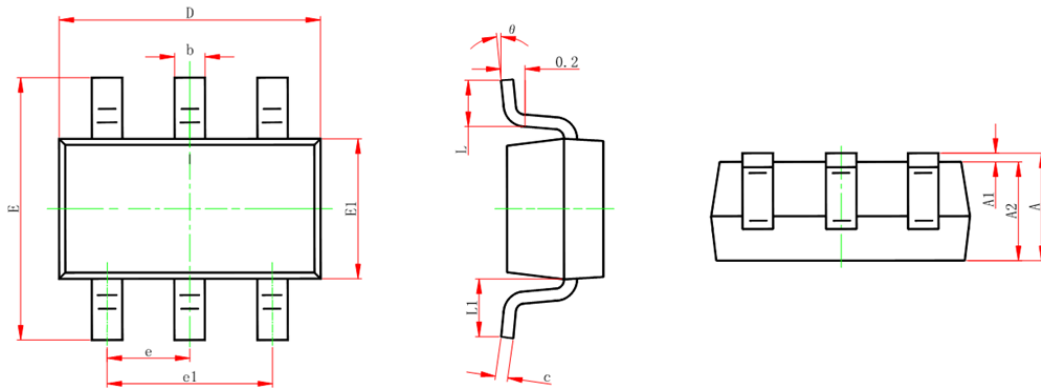


Figure.20 SOT-23-6L Package Drawing

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
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600 TYP		0.024 TYP	
θ	0 °	8 °	0 °	8 °

15 Package Material Information (For Reference Only – Not for Tooling Use)

15.2 Flat TO-94 Package Information

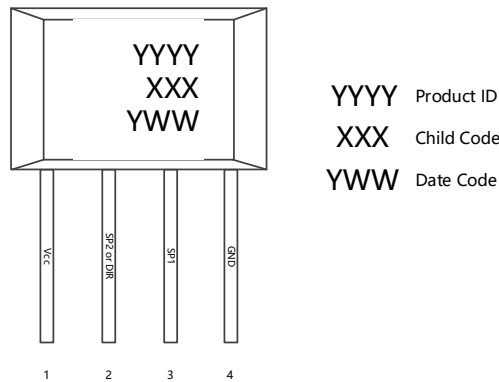


Figure.21 Flat TO-94 Chip Marking Spec

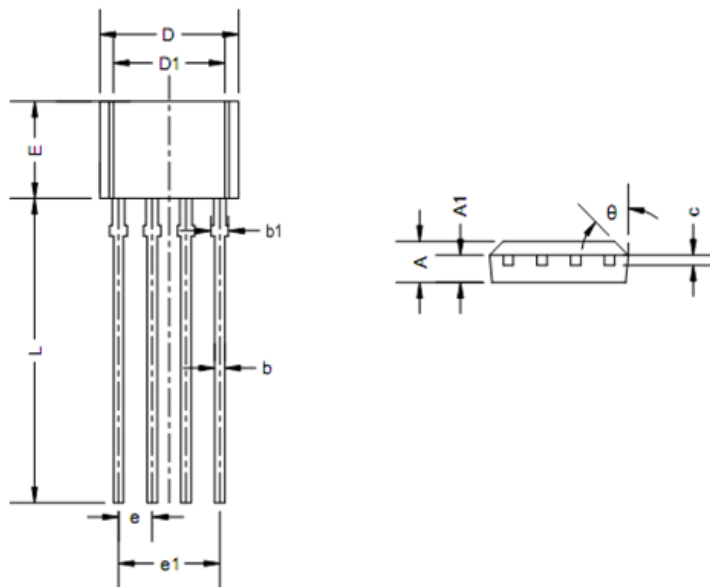


Figure.22 Flat TO-94 Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.400	1.800	0.055	0.071
A1	0.700	0.900	0.028	0.035
b	0.360	0.500	0.014	0.020
b1	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.980	5.280	0.196	0.208
D1	3.780	4.080	0.149	0.161
E	3.450	3.750	0.136	0.148
e	1.270 TYP		0.050 TYP	
e1	3.710	3.910	0.146	0.154
L	14.900	15.300	0.587	0.602
θ	45 °		45 °	

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