

## Uni-polar, Hall-Effect Switch IC

### 1 Product Description

The MT851X family is 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 an open collector output. It also includes an clamp diode at output and reversed power supply protection enhances the robustness of Hall IC.

The Hall IC designed to respond to a single poles. While the magnetic flux density(B) is larger than operating point (BOP), the output will be turned on (Low), the output is held until the magnetic flux density(B) is lower than releasing point (BRP), then turn off (High).

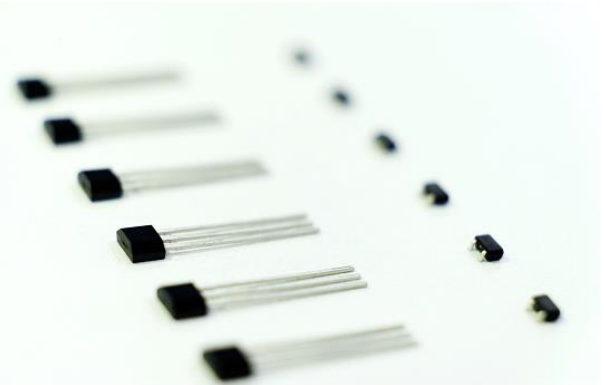
The MT851X family provides a variety of packages to customers: SOT-23/SOT-23 (Thin Outline) for surface mount and flat TO-92 for through-hole mount. All packages are RoHS compliant.

### 2 Features

- BCD Technology
- Uni-polar Switch
- 3.0~24V Operating Vcc Range
- -40°C~150°C Operating Temperature
- Package Option:
  - Flat TO-92
  - SOT-23
  - SOT-23 (Thin Outline)
- Magnetic Sensitivity Option:
  - MT8511 (BOP=28Gs, BRP=18Gs)
  - MT8512 (BOP=120Gs, BRP=90Gs)
- Open-Drain Output
- -16V Reversed Power Supply Protection
- Output Limiting Current Protection
- RoHS Compliant: (EU)2015/863

### 3 Product Overview of MT851X

Part No.	Description
MT851XA	Flat TO-92, bulk packaging (1000pcs/bag)
MT851XAT	SOT-23, tape & reel (3000pcs/bag)
MT851XET	SOT-23 (Thin Outline), tape & reel (3000pcs/bag)



### 4 Applications

- Automotive, Home appliances, Industrial
- Speed Detection
- Position Detection
- Magnetic Encoder
- Solid-State Switch
- Proximity Switch

### 5. Pin Configuration and Functions

	Vcc	Out	GND
SOT-23	1	2	3
SOT-23 (Thin Outline)	1	2	3
Flat TO-92	1	3	2
Description	Power	Output Open-Drain	Ground

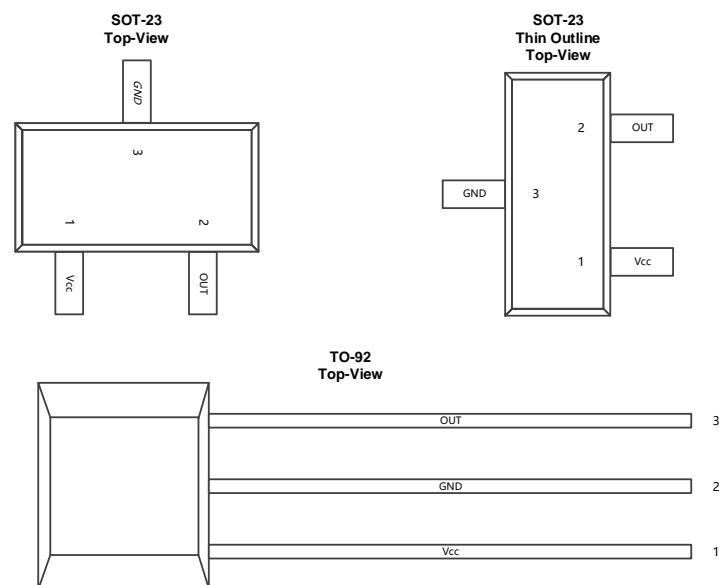


Figure.1 Pin Configuration & Functions

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## Reversion History

1	Originally Version	
2	1.1 Version	Add MT8512 Series
3	1.2 Version	Update the marking spec of SOT-23 & SOT-23 (Thin Outline)

## 6 Definition of Switching Function

Figure.2 & Figure.3 shows the device functionality and hysteresis

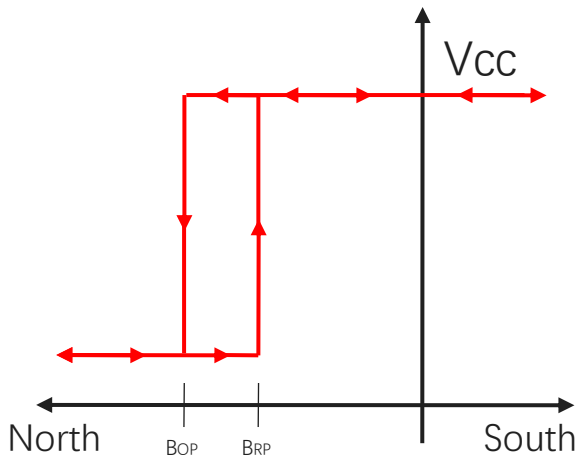


Figure.2 Switching Function Uni-polar (North)  
SOT-23

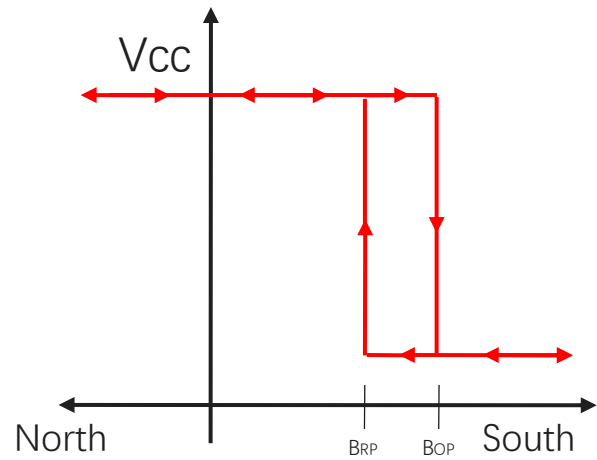


Figure.3 Switching Function Uni-polar (South)  
SOT-23 (Thin Outline) / Flat TO-92

## 7 Function Description

**B<sub>OP</sub>:** Operating Point, Magnetic flux density applied on the branded side of the package which turns the output driver ON ( $V_{OUT}=Low$ )

**B<sub>RP</sub>:** Releasing Point, Magnetic flux density applied on the branded side of the package which turns the output driver OFF ( $V_{OUT}=High$ )

**B<sub>HYST</sub>:** Hysteresis Window,  $|B_{OP} - B_{RP}|$

Devices that have a lower magnetic threshold ( $V_{OUT}=High$ ) detect magnets at a farther distance. Higher thresholds ( $V_{OUT}=Low$ ) generally require a closer distance or larger magnet.

## 8 Feature Description

The MT851X device is sensitive to the magnetic field component that is perpendicular to the top of the package

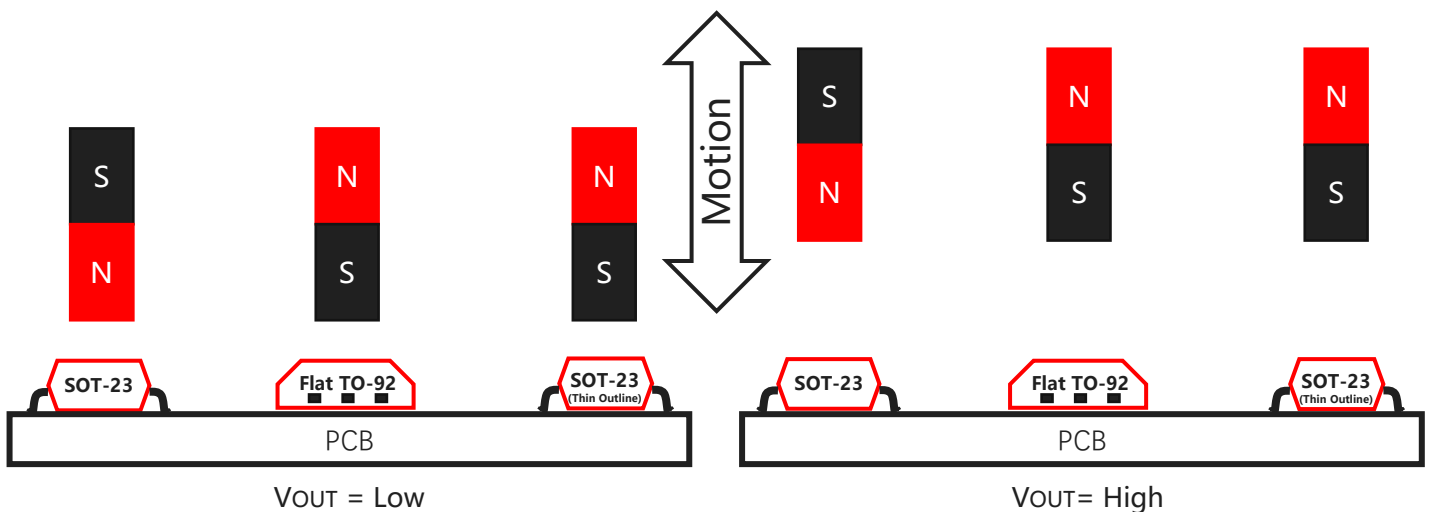


Figure.4 Flux Direction Polarity

## 9 Functional Block Diagram

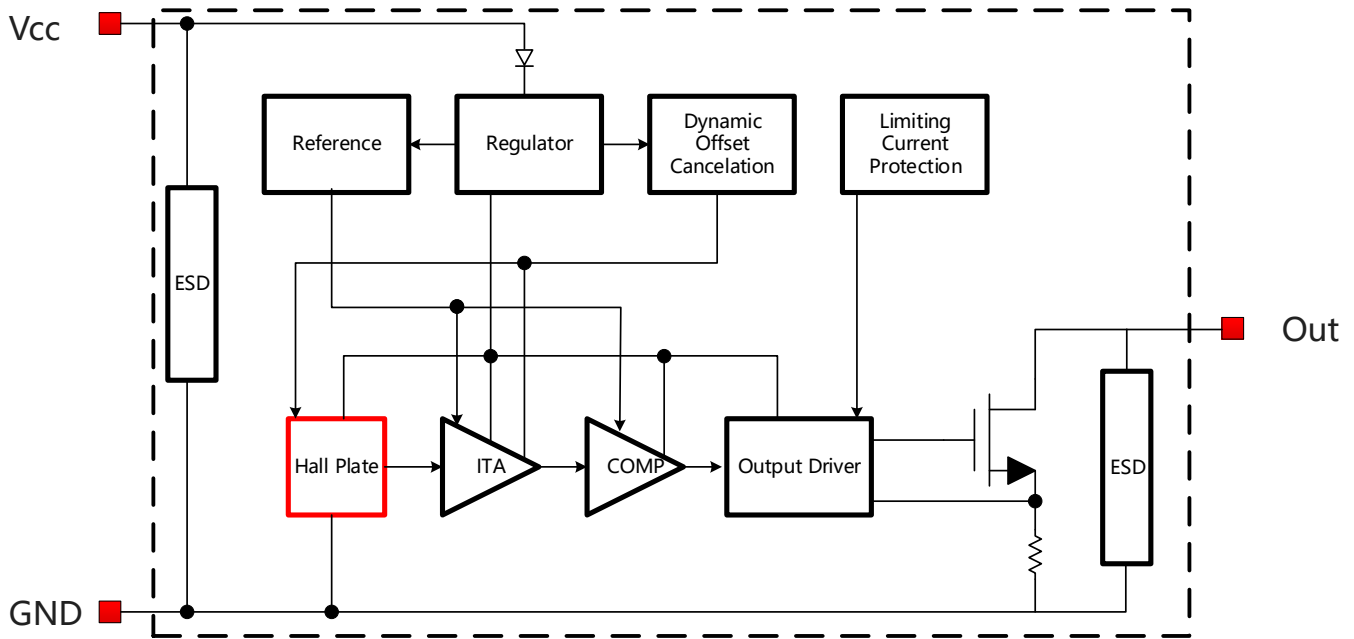


Figure.5 Functional Block Diagram

## 10 Electrical and Magnetic Characteristics

### 10.1 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	-16	-	V
V <sub>OUT</sub>	Output Voltage	-	30	V
I <sub>OUT</sub>	Continuous Output Current	-	55	mA
T <sub>A</sub>	Operating Ambient Temperature	-40	150	°C
T <sub>S</sub>	Storage Temperature	-50	150	°C
T <sub>J</sub>	Junction Temperature	-	165	°C
B	Magnetic Flux Density	No Limit		Gs

## 10.2 Electrical Specifications

At  $T_A = -40 \sim 150 \text{ }^\circ\text{C}$ ,  $V_{CC} = 3.0\text{V} \sim 24\text{V}$  (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
$V_{CC}$	Supply Voltage	Operating	3.0	-	24	V
$I_{CC}$	Supply Current	$B < B_{RP}$	-	1	1.5	mA
$I_{OCP}$	Short Circuit Protection Current	$B > B_{OP}$ , $V_{OUT} = V_{CC}$	-	50	-	mA
$V_{DSON}$	Output Saturation Voltage	$I_{OUT} = 20\text{mA}$ , $B > B_{OP}$	-	-	0.4	V
$I_{OFF}$	Output Leakage Current	$V_{OUT} = 24\text{V}$ , $B < B_{RP}$	-	-	10	$\mu\text{A}$
$T_R$	Output Rise Time	$C_L = 20\text{pF}$	-	-	1.0	$\mu\text{s}$
$T_F$	Output Fall Time	$C_L = 20\text{pF}$	-	-	1.0	$\mu\text{s}$
$T_{PO}$	Power on Time	$dV_{CC}/dt > 5\text{V}/\mu\text{s}$ $B > B_{OP} (\text{MAX})$	-	-	15	$\mu\text{s}$
$F_C$	Chopping Frequency		-	400	-	KHz
$F_S$	Sampling Frequency		-	25	-	KHz
$R_{TH}$	Thermal Resistance of SOT-23		-	301	-	$^\circ\text{C}/\text{W}$
	Thermal Resistance of SOT-23 (Thin Outline)		-	301	-	$^\circ\text{C}/\text{W}$
	Thermal Resistance of TO-92		-	230	-	$^\circ\text{C}/\text{W}$

## 10.3 Magnetic Characteristics

At  $V_{CC} = 3.0\text{V} \sim 24\text{V}$  (unless otherwise specified)

Part No.	Symbol	Min	Typ	Max	Unit
MT8511 Series	$B_{OP}$ , $T_A = 25^\circ\text{C}$	18	28	38	Gs
	$B_{RP}$ , $T_A = 25^\circ\text{C}$	8	18	28	Gs
	$B_{HYST}$ , $T_A = 25^\circ\text{C}$	3	10	17	Gs
MT8512 Series	$B_{OP}$ , $T_A = 25^\circ\text{C}$	90	120	150	Gs
	$B_{RP}$ , $T_A = 25^\circ\text{C}$	60	90	120	Gs
	$B_{HYST}$ , $T_A = 25^\circ\text{C}$	15	30	45	Gs

## 10.4 ESD Ratings

Symbol	Reference	Level	Unit
$V_{ESD}$	Human-body model (HBM)	AEC-Q100-002	Class H2 Grade
	Charged-device model (CDM)	AEC-Q100-011	Class C3 Grade

### 10.5 Characteristic Performance

At  $V_{CC}=5V$

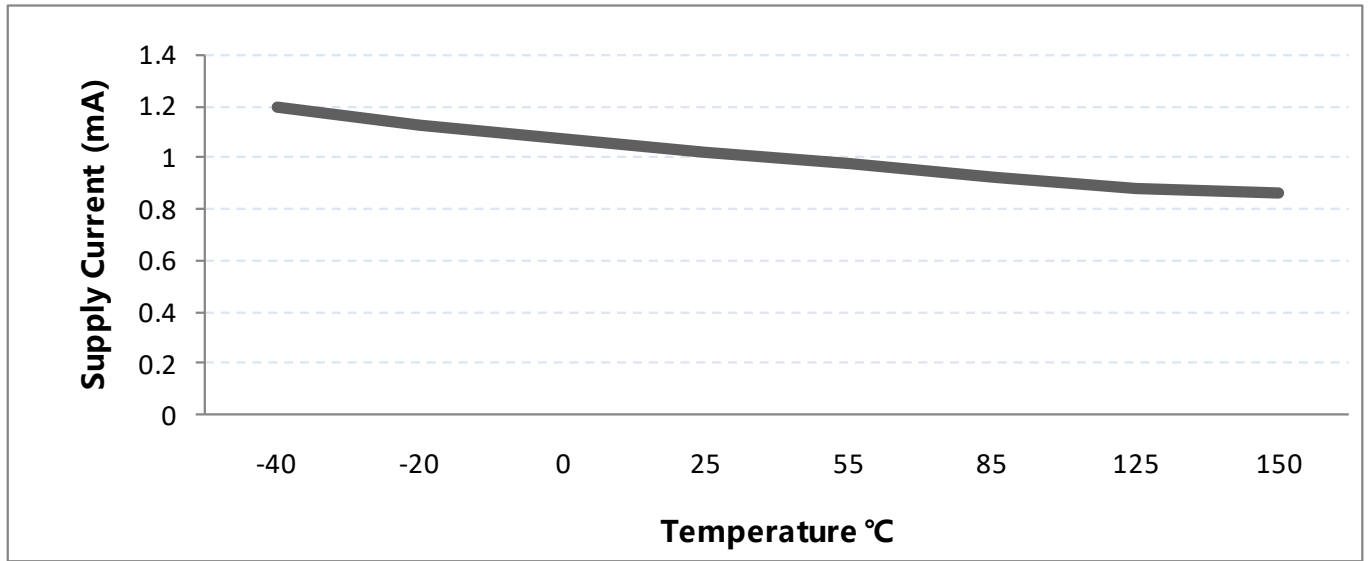


Figure.6 Supply Current vs. Temperature

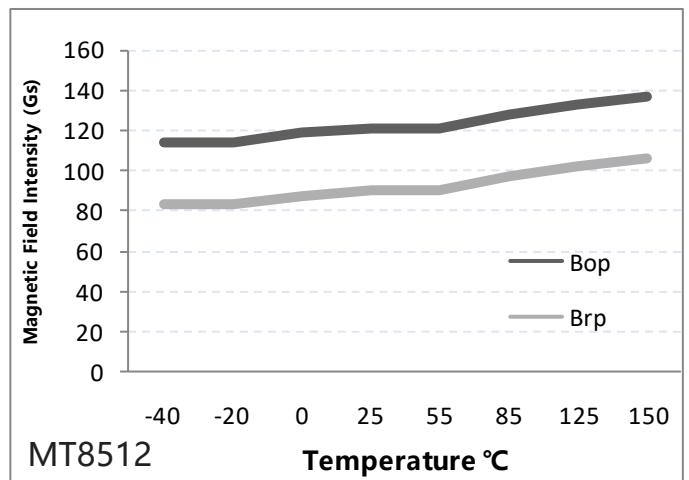
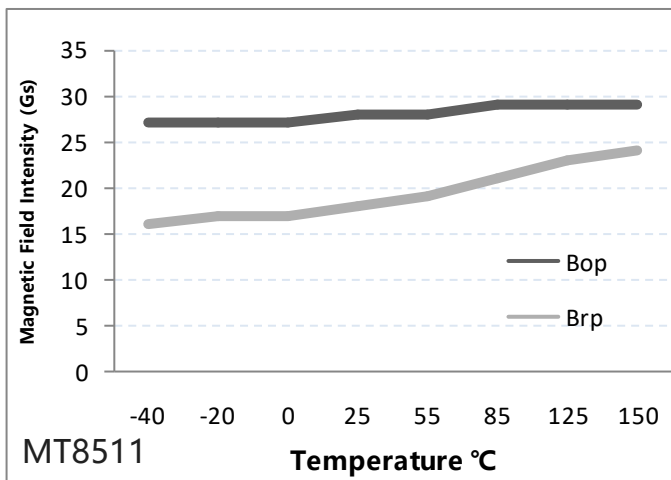


Figure.7 Magnetic Characteristics vs. Temperature (BOP & BRP)

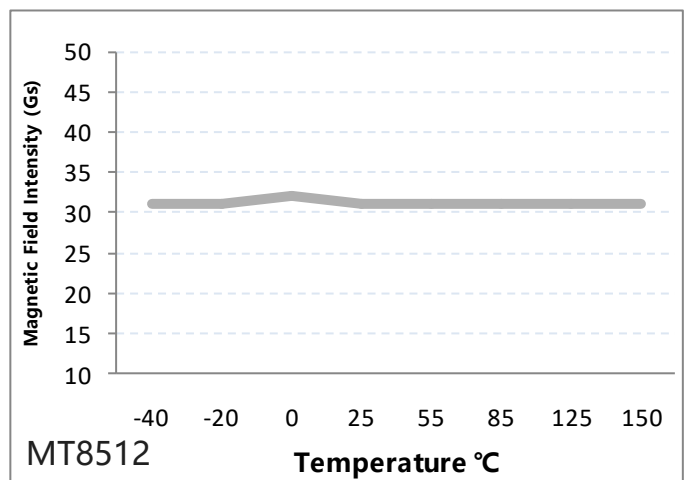
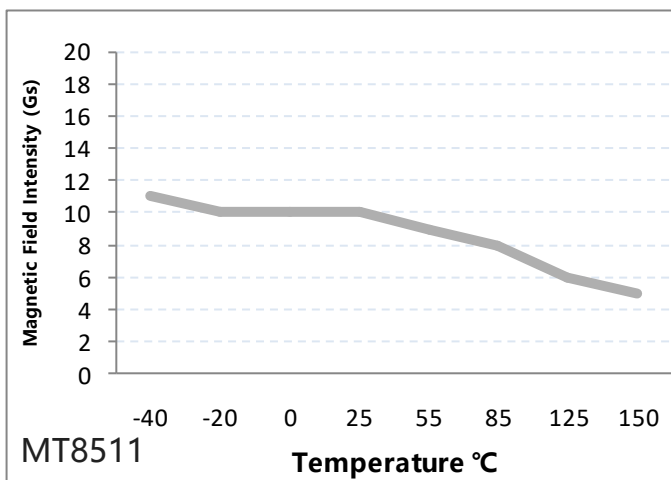


Figure.8 Magnetic Characteristics vs. Temperature (BHYST)

### 10.6 Typical Output Waveform

MT8511A as example

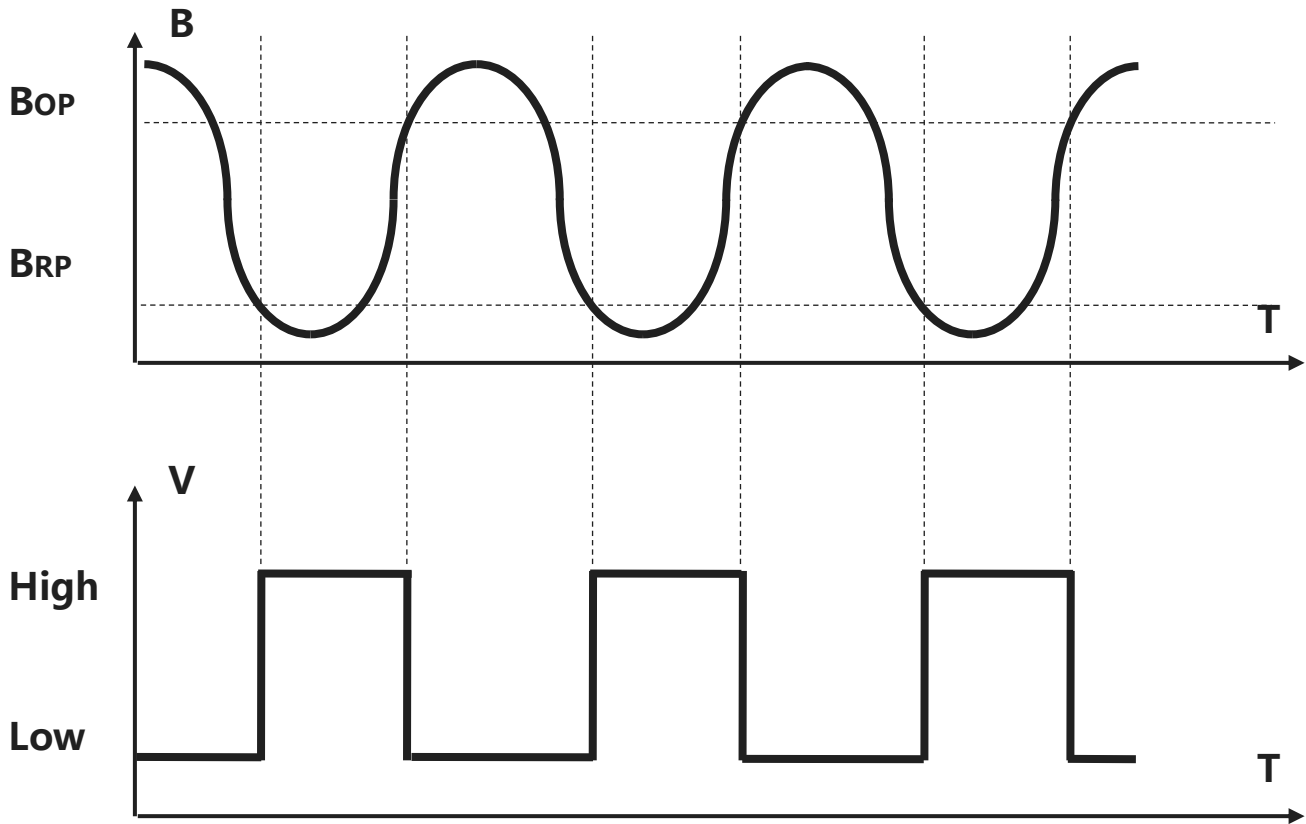


Figure.9 Digital Output vs. Magnetic Flux Density

### 11 Typical Application Circuit

MT8511AT as example

Note: Recommended value for  $R_L$  is 1KOhms to 10KOhms

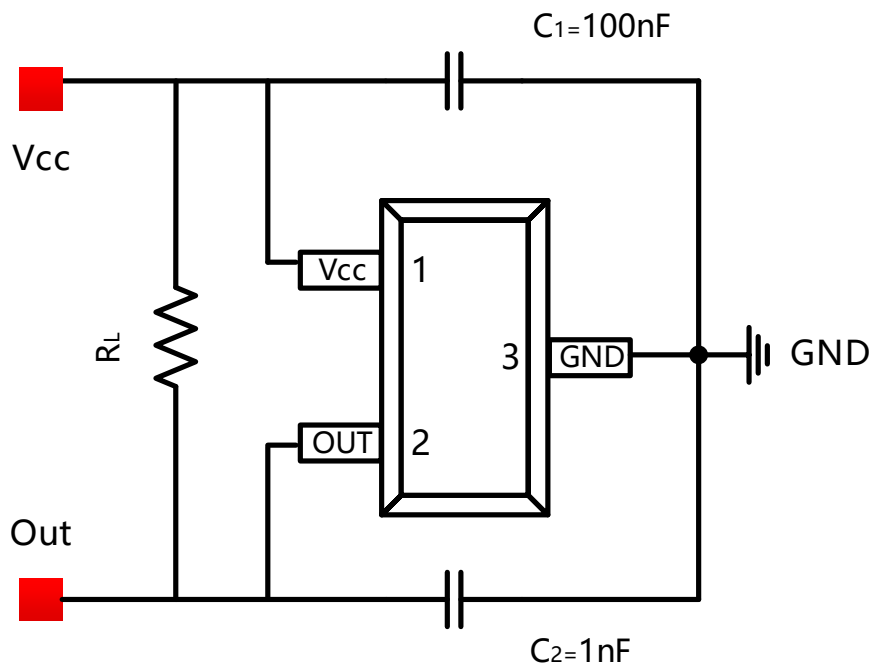


Figure.10 Typical Application Circuit

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

### 12.1 SOT-23 Package Information

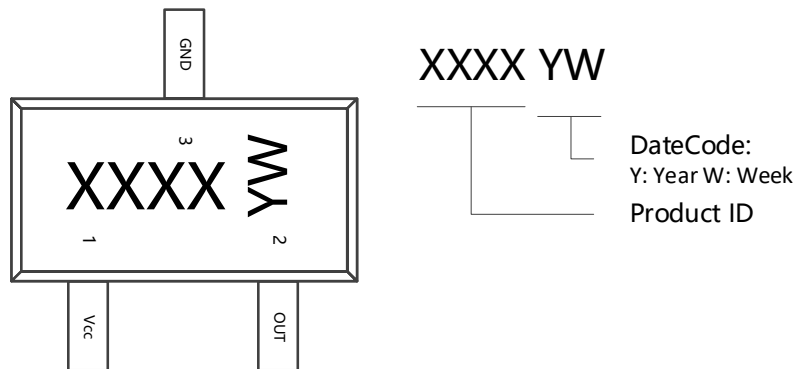


Figure.11 SOT-23 Chip Marking Spec

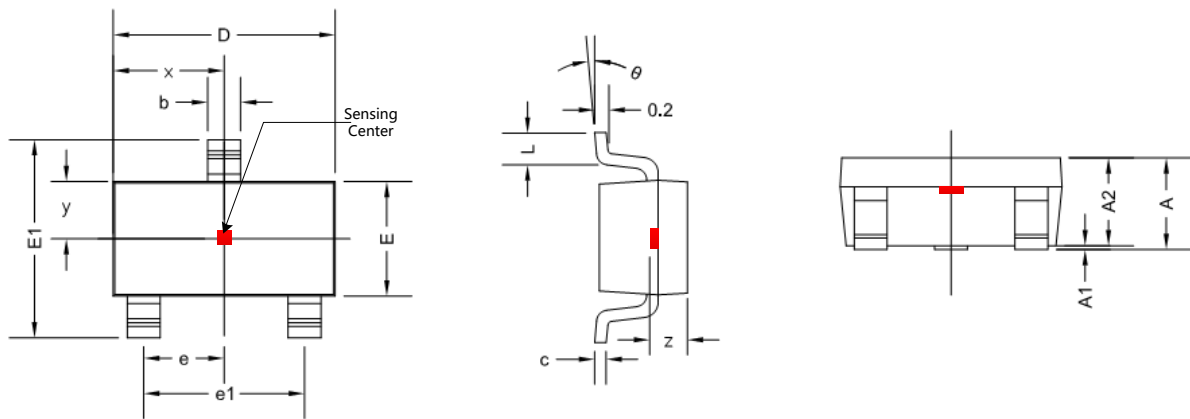


Figure.12 SOT-23 Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	-	1.300	-	0.0512
A1	0.000	0.150	0.0000	0.0059
A2	1.000	1.200	0.0394	0.0472
b	0.300	0.500	0.0118	0.0197
c	0.080	0.220	0.0031	0.0087
D	2.800	3.000	0.1102	0.1181
E	1.500	1.700	0.0591	0.0669
E1	2.600	3.000	0.1024	0.1181
e	0.870	1.030	0.0343	0.0406
e1	1.820	1.980	0.0717	0.0780
L	0.300	0.600	0.0118	0.0236
$\theta$	0 °	8 °	0 °	8 °
x	1.450 TYP		0.057 TYP	
y	0.800 TYP		0.032 TYP	
z	0.600 TYP		0.024 TYP	



## 12.2 SOT-23 (Thin Outline) Package Information

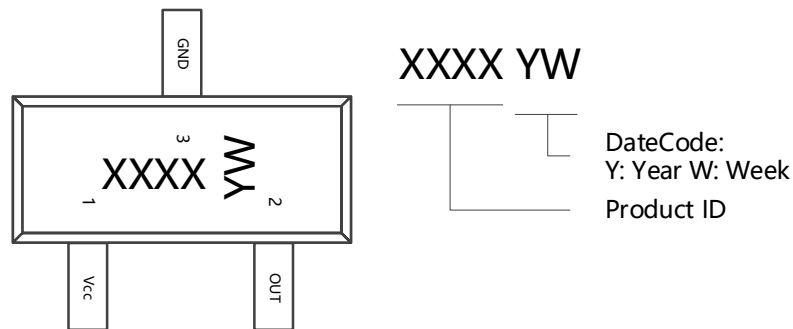


Figure.13 SOT-23 (Thin Outline) Chip Marking Spec

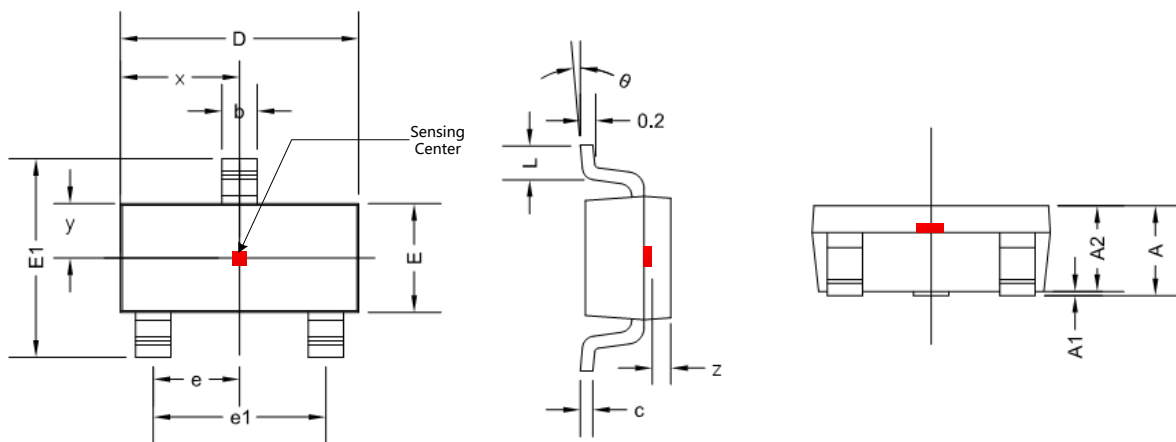


Figure.14 SOT-23 (Thin Outline) Package Drawing

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 TYP		0.037 TYP	
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
$\theta$	0 °	8 °	0 °	8 °
x	1.460 TYP		0.057 TYP	
y	0.650 TYP		0.026 TYP	
z	0.500 TYP		0.020 TYP	

### 12.3 Flat TO-92 Package Information

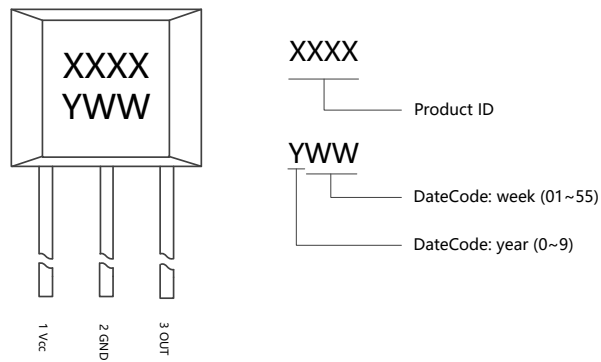


Figure.15 Flat TO-92 Chip Marking Spec

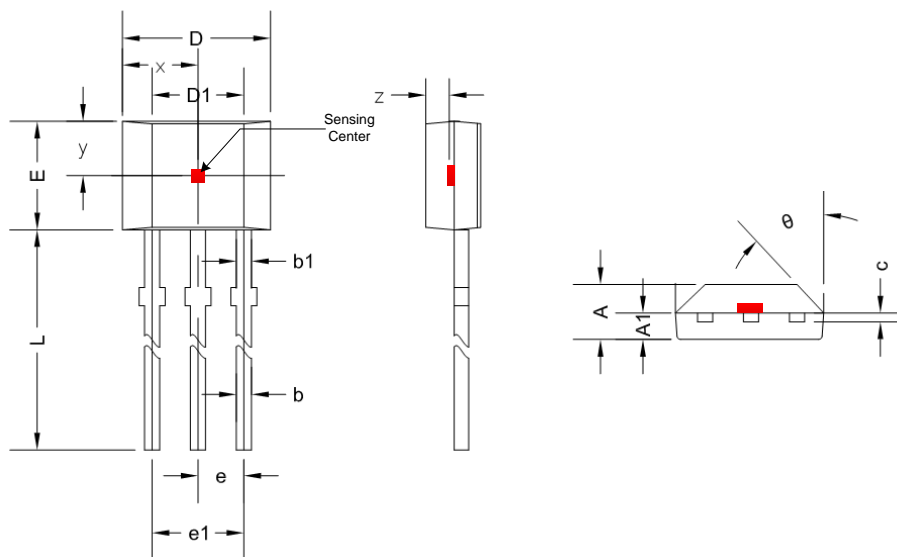


Figure.16 Flat TO-92 Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.420	1.620	0.056	0.064
A1	0.660	0.860	0.026	0.034
b	0.350	0.480	0.013	0.019
b1	0.400	0.510	0.016	0.020
c	0.330	0.510	0.013	0.020
D	3.900	4.100	0.154	0.161
D1	2.280	2.680	0.090	0.106
E	3.050	3.250	0.120	0.128
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.350	14.750	0.565	0.581
$\theta$	45 ° TYP		45 ° TYP	
x	2.025 TYP		0.080 TYP	
y	1.545 TYP		0.061 TYP	
z	0.500 TYP		0.020 TYP	

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