# MT851X

## Uni-polar, Hall-Effect Switch IC

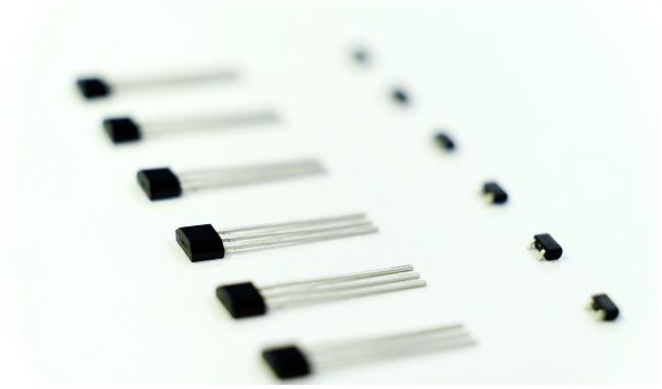
MagnTek

## 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 ($B_{OP}$), the output will be turned on (Low), the output is held until the magnetic flux density(B) is lower than releasing point ($B_{RP}$), 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℃~150℃ Operating Temperature
- Package Option:
  Flat TO-92
  SOT-23
  SOT-23 (Thin Outline)
- Magnetic Sensitivity Option:
  MT8511 ($B_{OP}$=28Gs, $B_{RP}$=18Gs)
  MT8512 ($B_{OP}$=120Gs, $B_{RP}$=90Gs)
- Open-Drain Output
- -16V Reversed Power Supply Protection
- Output Limiting Current Protection
- RoHS Compliant: (EU)2015/863

## 3 Product Overview of MT851X

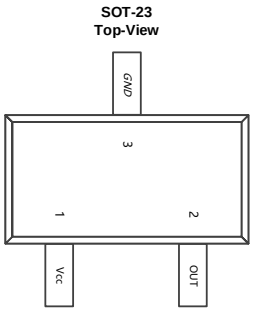
| Part No. | Description |
|---|---|
| MT851XA | Flat TO-92, bulk packaging (1000pcs/bag) |
| MT851XAT | SOT-23, tape & reel (3000pcs/bag) |
| MT851XET | SOT-23 (Thin Outline), tape & reel (3000pcs/bag) |

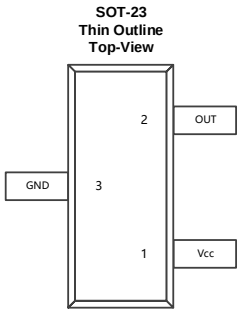
## 4 Applications

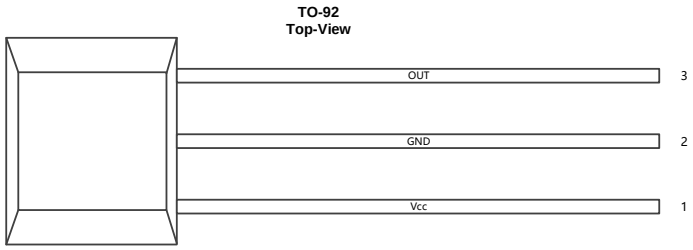
- Automotive, Home appliances, Industrial
- Speed Detection
- Position Detection
- Magnetic Encoder
- Solid-State Switch
- Proximity Switch

## 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 |



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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

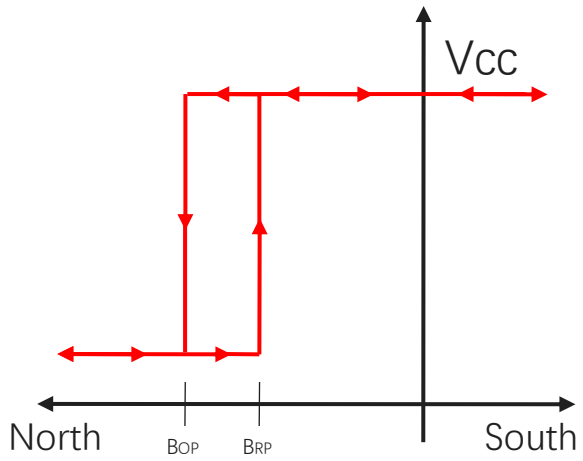



Figure.2 Switching Function Uni-polar (North)
SOT-23

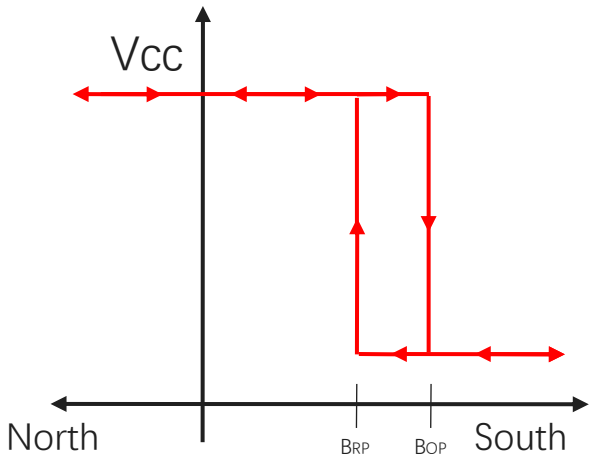



Figure.3 Switching Function Uni-polar (South)
SOT-23 (Thin Outline) / Flat TO-92

## 7 Function Description

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

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

$B_{HYST}$: 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

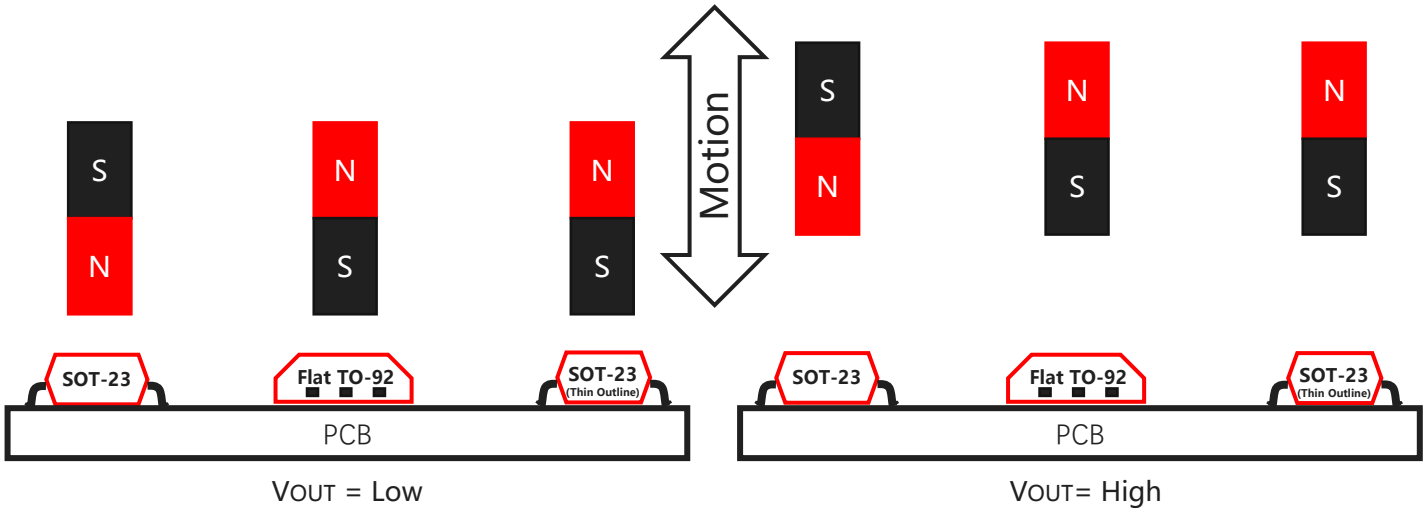



Figure.4 Flux Direction Polarity

## 9 Functional Block Diagram

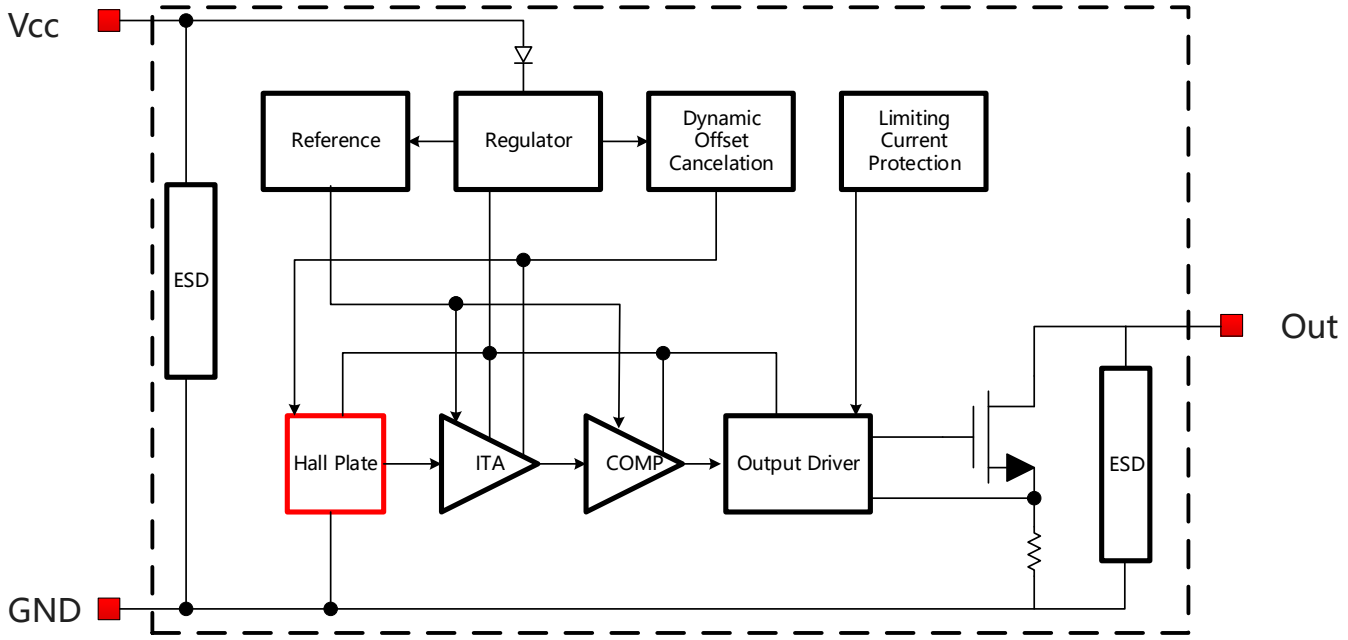



Figure.5 Functional Block Diagram

## 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 |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | - | 30 | V |
| $V_{RCC}$ | Reverse Battery Voltage | -16 | - | V |
| $V_{OUT}$ | Output Voltage | - | 30 | V |
| $I_{OUT}$ | Continuous Output Current | - | 55 | mA |
| $T_A$ | Operating Ambient Temperature | -40 | 150 | ℃ |
| $T_S$ | Storage Temperature | -50 | 150 | ℃ |
| $T_J$ | Junction Temperature | - | 165 | ℃ |
| B | Magnetic Flux Density | No Limit | | Gs |

## 10.2 Electrical Specifications

At $T_A$=-40~150 ℃, Vcc=3.0V~24V (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 | $I_{OUT}$=20mA, B>$B_{OP}$ | - | - | 0.4 | V |
| $I_{OFF}$ | Output Leakage Current | $V_{OUT}$=24V, B<$B_{RP}$ | - | - | 10 | uA |
| $T_R$ | Output Rise Time | $C_L$=20pF | - | - | 1.0 | us |
| $T_F$ | Output Fall Time | $C_L$=20pF | - | - | 1.0 | us |
| $T_{PO}$ | Power on Time | dVcc/dt>5V/uS B>$B_{OP}$ (MAX) | - | - | 15 | us |
| $F_C$ | Chopping Frequency | | - | 400 | - | KHz |
| $F_S$ | Sampling Frequency | | - | 25 | - | KHz |
| $R_{TH}$ | Thermal Resistance of SOT-23 | | - | 301 | - | ℃/W |
| | Thermal Resistance of SOT-23 (Thin Outline) | | - | 301 | - | ℃/W |
| | Thermal Resistance of TO-92 | | - | 230 | - | ℃/W |

## 10.3 Magnetic Characteristics

At $V_{CC}$=3.0V~24V (unless otherwise specified)

| Part No. | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| MT8511 Series | $B_{OP}$, $T_A$ =25℃ | 18 | 28 | 38 | Gs |
| | $B_{RP}$, $T_A$ =25℃ | 8 | 18 | 28 | Gs |
| | $B_{HYST}$, $T_A$ =25℃ | 3 | 10 | 17 | Gs |
| MT8512 Series | $B_{OP}$, $T_A$ =25℃ | 90 | 120 | 150 | Gs |
| | $B_{RP}$, $T_A$ =25℃ | 60 | 90 | 120 | Gs |
| | $B_{HYST}$, $T_A$ =25℃ | 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 Vcc=5V

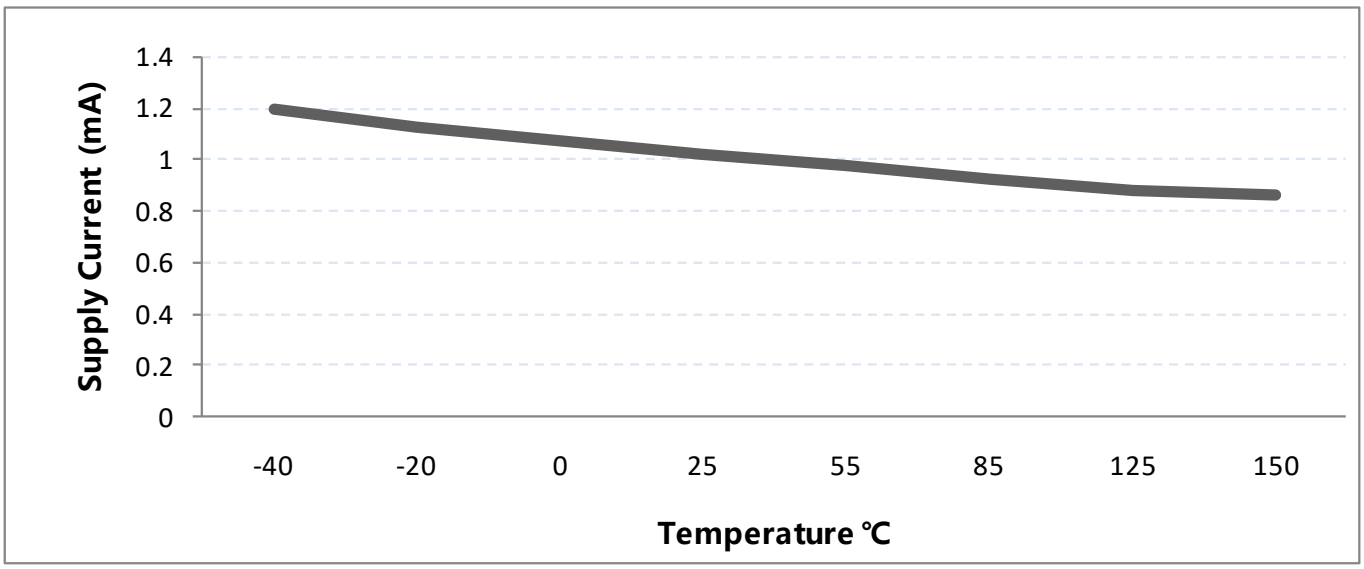
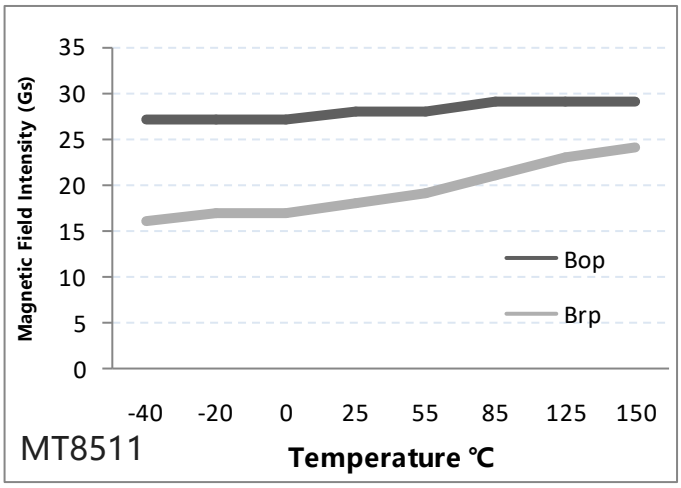



Figure.6 Supply Current vs. Temperature



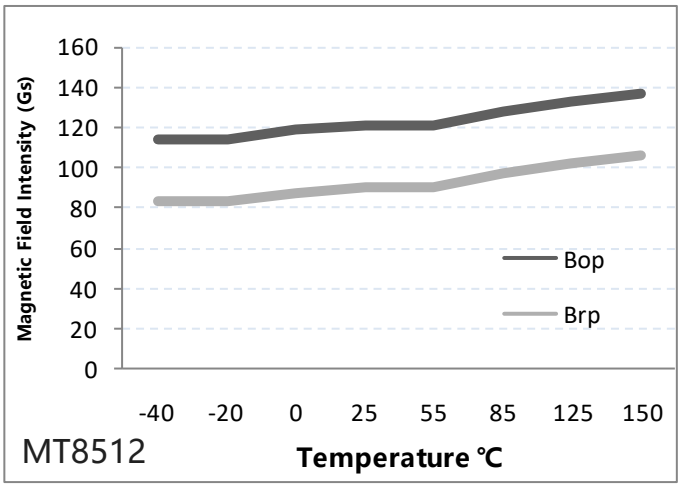
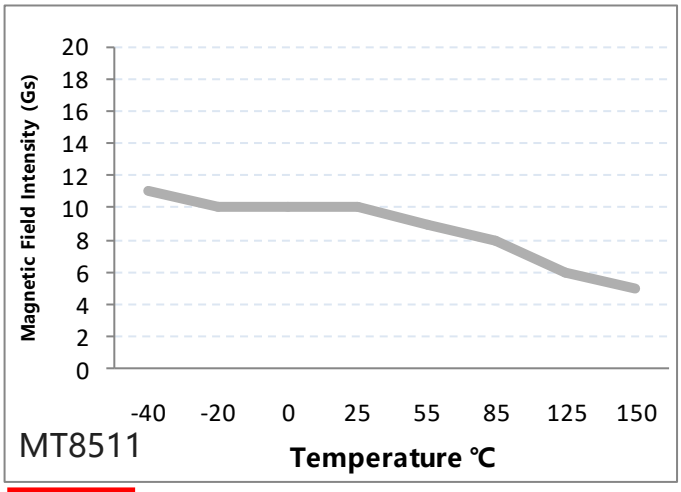




Figure.7 Magnetic Characteristics vs. Temperature (BOP & BRP)



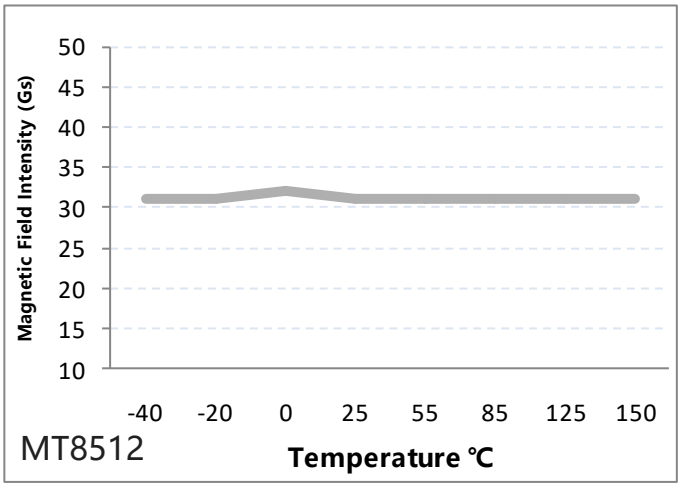




Figure.8 Magnetic Characteristics vs. Temperature (BHYST)

### 10.6 Typical Output Waveform

MT8511A as example

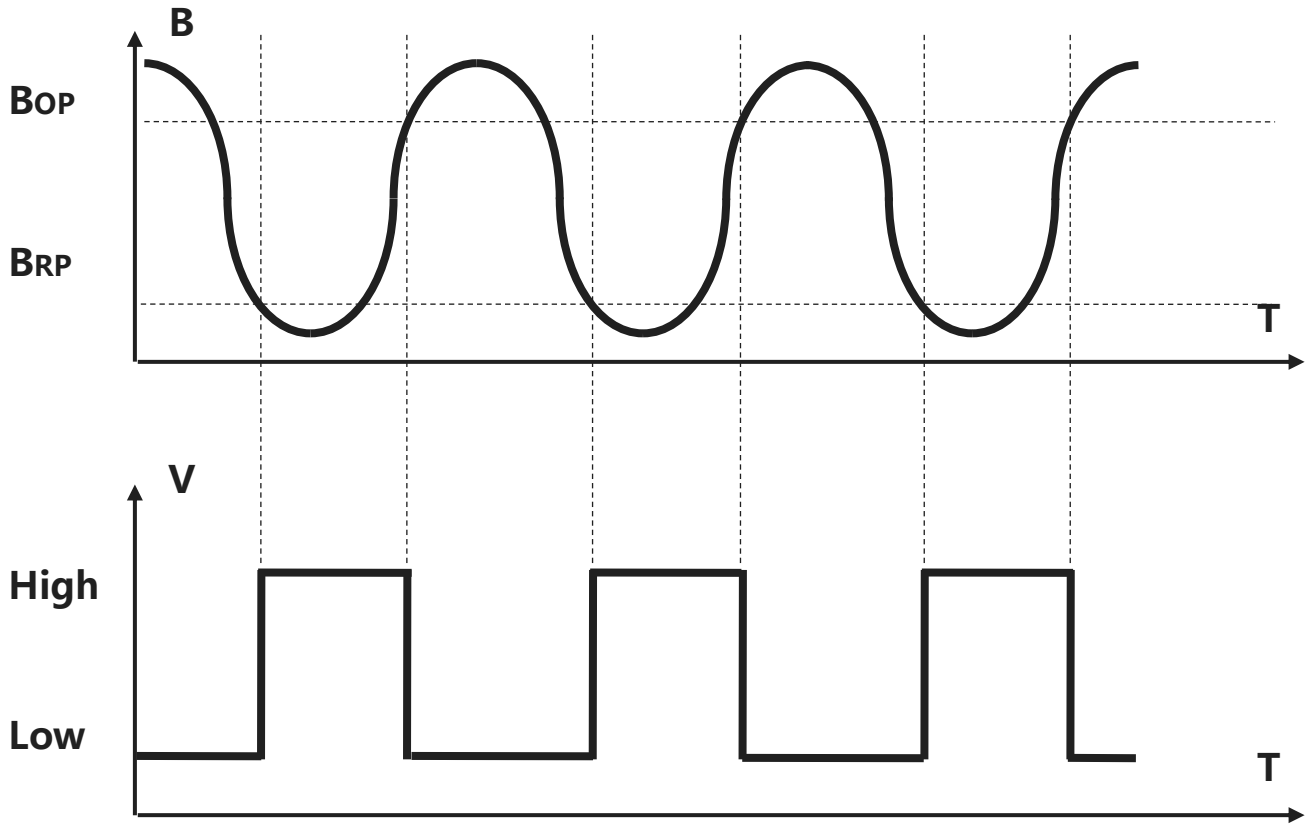



Figure.9 Digital Output vs. Magnetic Flux Density

### 11 Typical Application Circuit

MT8511AT as example
Note: Recommended value for $R_L$ is 1KOhms to 10KOhms

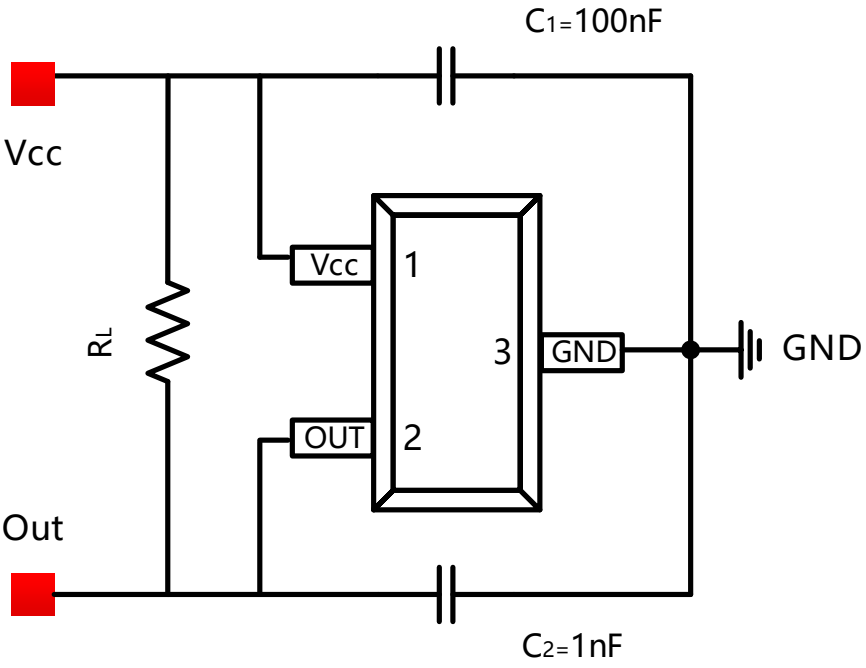



Figure.10 Typical Application Circuit

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

### 12.1 SOT-23 Package Information

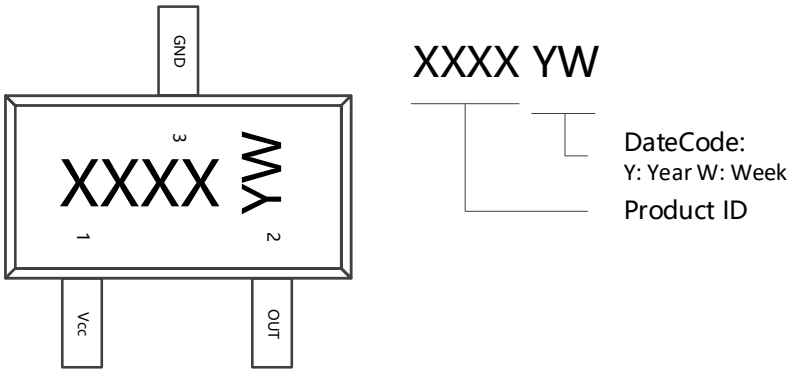



Figure.11 SOT-23 Chip Marking Spec

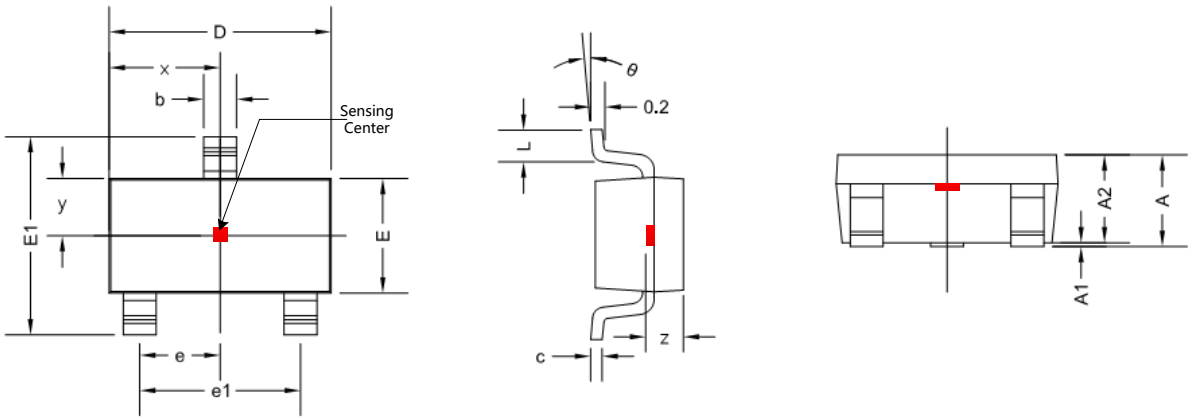



Figure.12 SOT-23 Package Drawing

| 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 |
| θ | 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

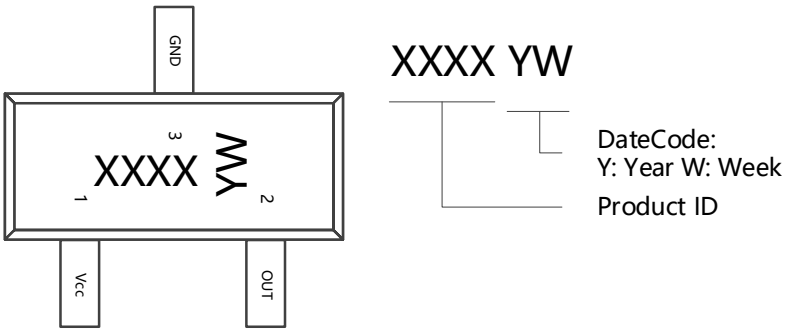



Figure.13 SOT-23 (Thin Outline) Chip Marking Spec

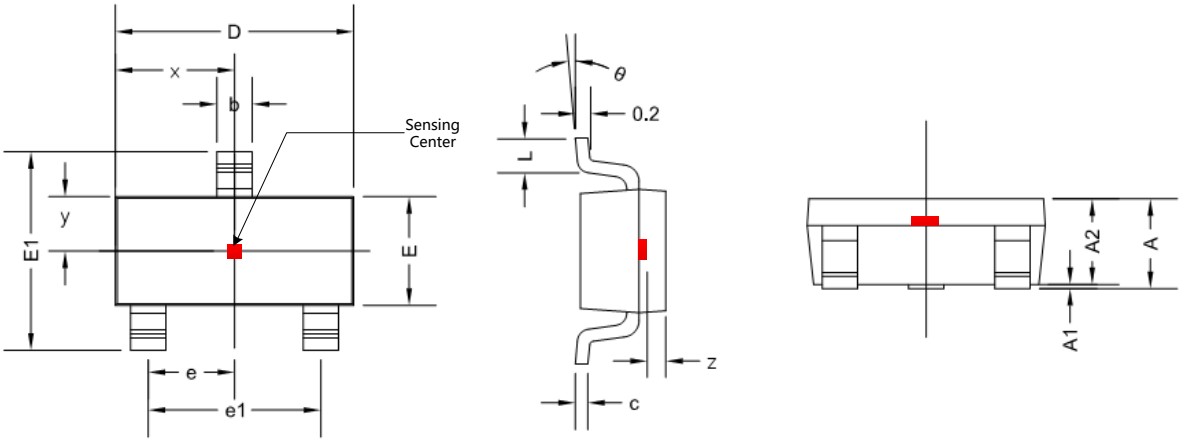



Figure.14 SOT-23 (Thin Outline) Package Drawing

| 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 |
| θ | 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 |

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## 12.3 Flat TO-92 Package Information

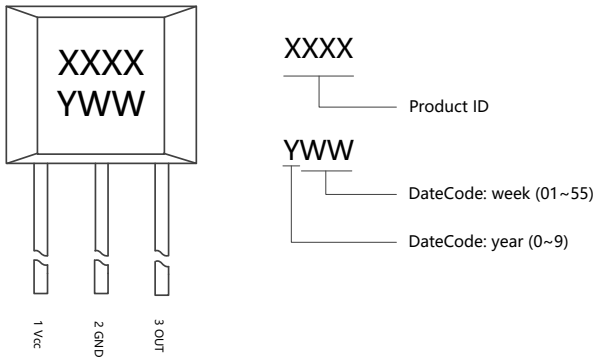



Figure.15 Flat TO-92 Chip Marking Spec

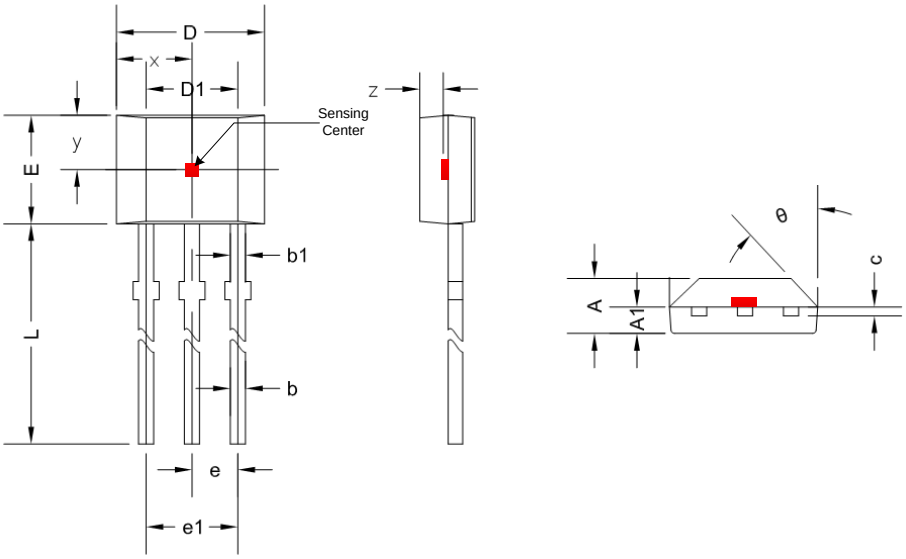



Figure.16 Flat TO-92 Package Drawing

| 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 |
| θ | 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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