

# Latch, High Voltage Hall-Effect Switch IC

## 1 Product Description

The MT838X 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 3.8V to 60V, 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 alternating north and south 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).

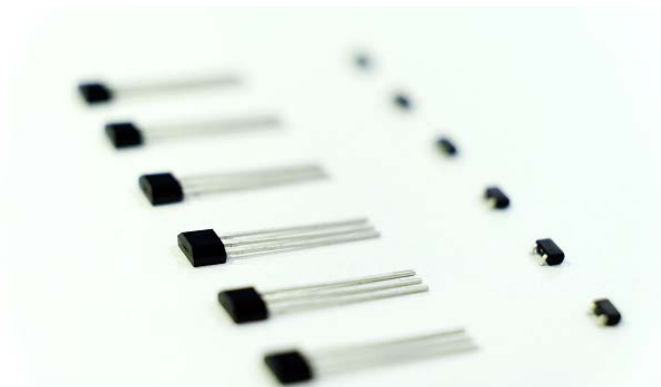
The MT838X family provides a variety of packages to customers: SOT-23/SOT-89B/SOT-23 (Thin Outline) for surface mount and flat TO-92 for through-hole mount. All packages are RoHS compliant.

## 2 Features

- AEC-Q100 Automotive Qualified MT838XAT & MT838XET
- BCD Technology
- Latch Switch
- 3.8~60V Operating Vcc Range
- 40℃~150℃ Operating Temperature
- Package Option:  
Flat TO-92  
SOT-23  
SOT-23 (Thin Outline)  
SOT-89B
- Magnetic Sensitivity Option:  
MT8381 (BOP=50Gs, BRP=-50Gs)  
MT8382 (BOP=20Gs, BRP=-20Gs)
- Internal 10K pull-up resistor
- 20V Reversed Power Supply Protection
- Output Limiting Current Protection
- RoHS Compliant: (EU)2015/863

## 3 Product Overview of MT838X

| Part No. | Description                                      |
|----------|--------------------------------------------------|
| MT838XA  | Flat TO-92, bulk packaging (1000pcs/bag)         |
| MT838XAT | SOT-23, tape & reel (3000pcs/bag)                |
| MT838XET | SOT-23 (Thin Outline), tape & reel (3000pcs/bag) |
| MT838XBT | SOT-89B, tape & reel (1000pcs/bag)               |



## 4 Applications

- Automotive, Home appliances,
- Industrial
- Speed Detection
- Magnetic Encoder
- Brushless DC Motor Communication

## 5. Pin Configuration and Functions

|                       | Vcc   | Out                       | GND    |
|-----------------------|-------|---------------------------|--------|
| SOT-23                | 1     | 2                         | 3      |
| SOT-23 (Thin Outline) | 1     | 2                         | 3      |
| SOT-89B               | 1     | 3                         | 2      |
| Flat TO-92            | 1     | 3                         | 2      |
| Description           | Power | Internal Pull-up Resistor | Ground |

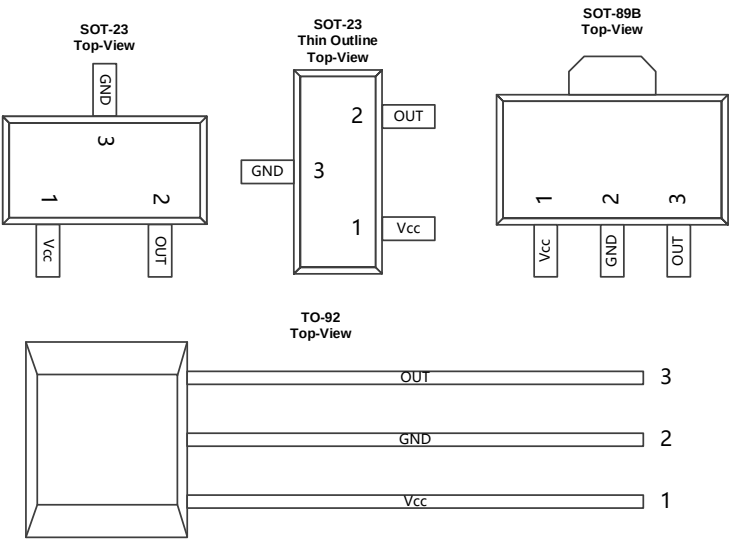


Figure.1 Pin Configuration & Functions

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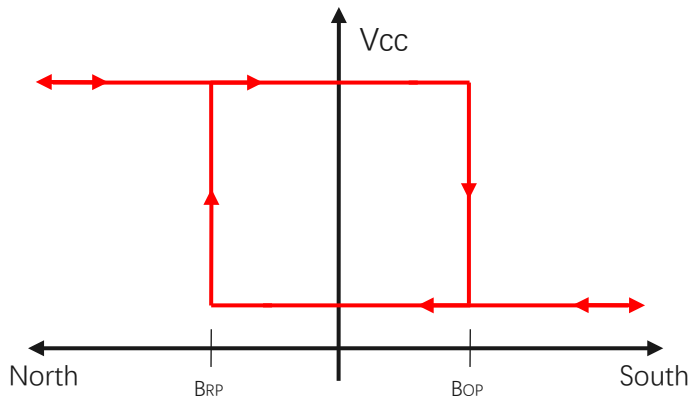
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## Reversion History

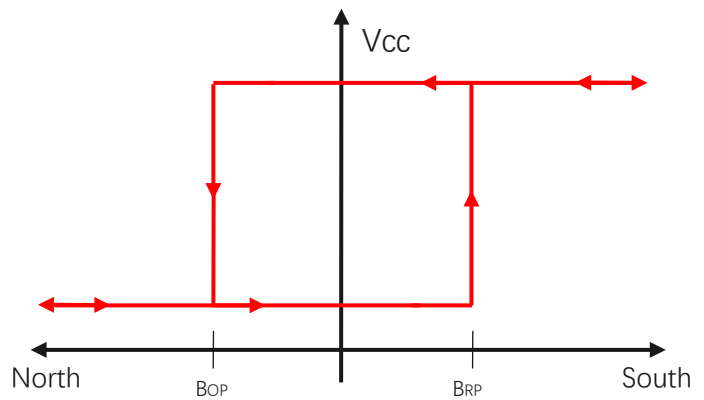
|   |                    |                                                           |
|---|--------------------|-----------------------------------------------------------|
| 1 | Originally Version |                                                           |
| 2 | 1.1 Version        | Update MT8382 Series                                      |
| 3 | 1.2 Version        | Remove Typical Application Circuit                        |
| 4 | 1.3 Version        | Update AEC-Q100 Automotive on MT838XAT                    |
|   |                    | Update RoHS compliant to (EU)2015/863                     |
| 5 | 1.4 Version        | Update AEC-Q100 Logo                                      |
|   |                    | Update Copy Rights and Disclaimer                         |
| 6 | 1.5 Version        | Update AEC-Q100 Automotive on MT838XET                    |
| 7 | 1.6 Version        | Update the marking spec of SOT-23 & SOT-23 (Thin Outline) |
| 8 | 1.7 Version        | Update the application circuit                            |
| 9 | 1.8 Version        | Update the Logo of MagnTek                                |

## 6 Definition of Switching Function

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



**Figure.2** Switching Function of Flat TO-92 & SOT-89B & SOT-23 (Thin Outline)



**Figure.3** Switching Function of SOT-23

## 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 ( $V_{OUT}=Low$ )

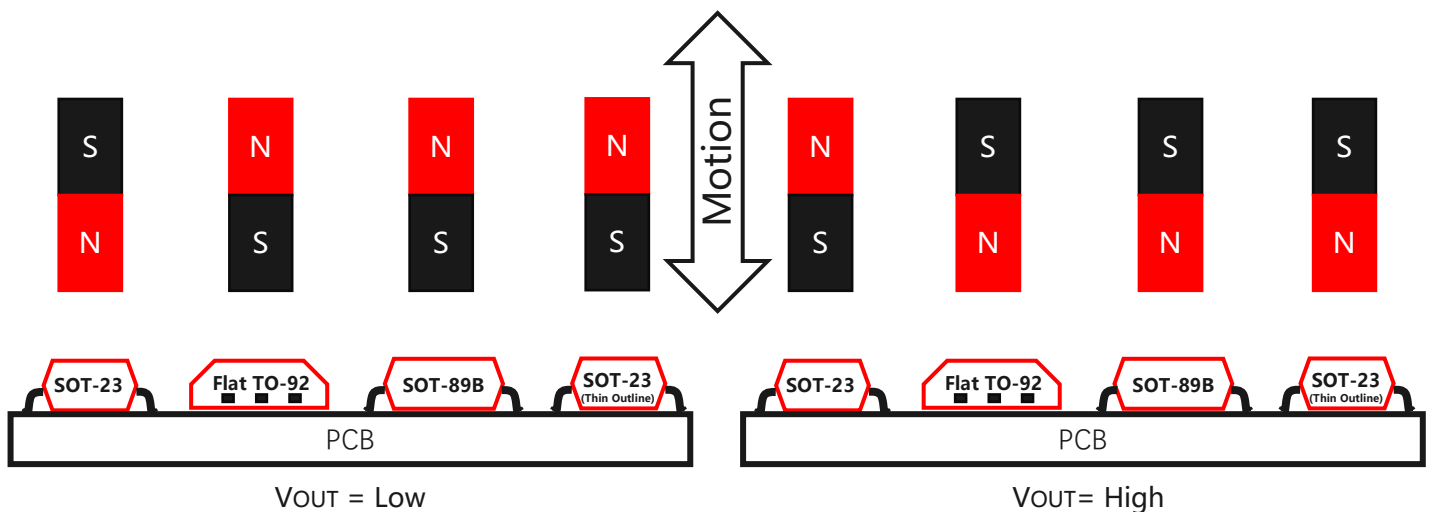
**B<sub>RP</sub>:** Releasing Point, Magnetic flux density applied on the branded side of the package which turns the output driver OFF ( $V_{OUT}=High$ )

**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 MT838X 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

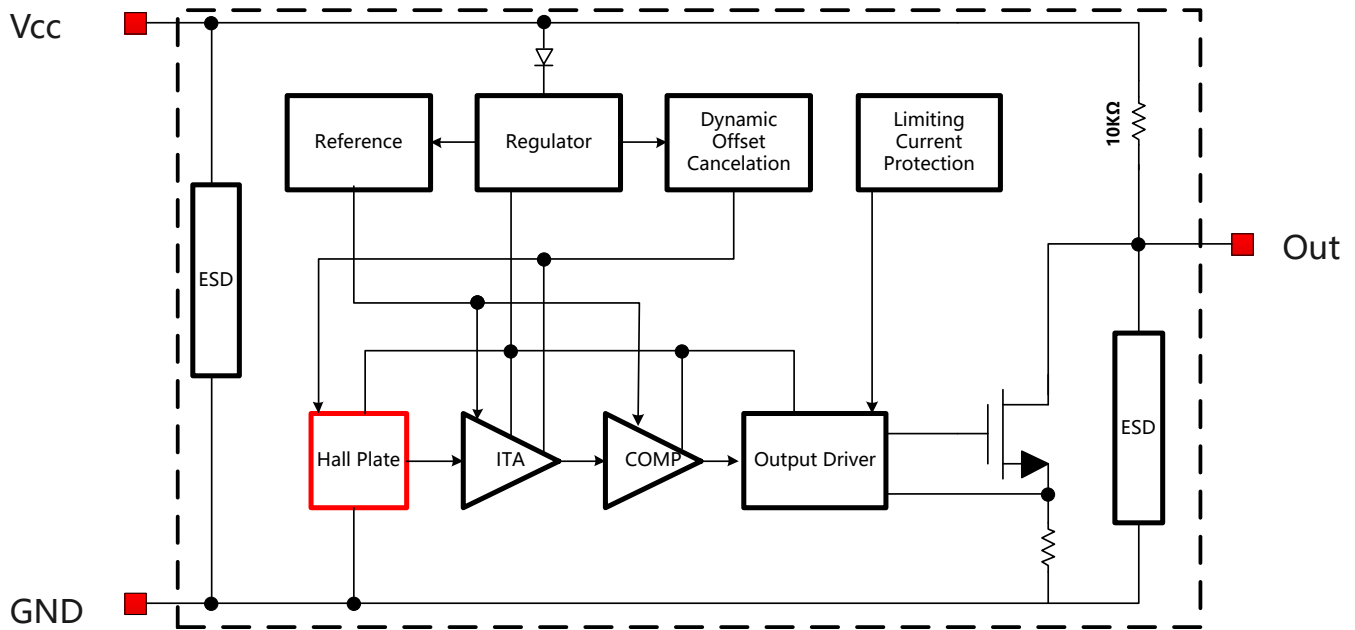


Figure.5 Functional Block Diagram

## 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 |
|--------|-------------------------------|----------|-----|-------|
| VCC    | Supply Voltage                | -        | 65  | V     |
| VRCC   | Reverse Battery Voltage       | -20      | -   | V     |
| VOUT   | Output Voltage                | -        | 65  | V     |
| IOUT   | Continuous Output Current     | -        | 40  | mA    |
| TA     | Operating Ambient Temperature | -40      | 150 | °C    |
| TS     | Storage Temperature           | -50      | 150 | °C    |
| TJ     | Junction Temperature          | -        | 165 | °C    |
| B      | Magnetic Flux Density         | No Limit |     | Gs    |

## 10.2 Electrical Specifications

At  $T_A = -40 \sim 150^\circ\text{C}$ ,  $V_{CC} = 3.8\text{V} \sim 60\text{V}$  (unless otherwise specified)

| Symbol       | Parameters                                  | Test Condition                                            | Min | Typ | Max | Unit                      |
|--------------|---------------------------------------------|-----------------------------------------------------------|-----|-----|-----|---------------------------|
| $V_{CC}$     | Supply Voltage                              | Operating                                                 | 3.8 | -   | 60  | V                         |
| $I_{CC}$     | Supply Current                              | $B < B_{RP}$                                              | -   | 4   | 6   | mA                        |
| $I_{OCP}$    | Short Circuit Protection Current            | $B > B_{OP}$ ,<br>$V_{OUT} = V_{CC}$                      | -   | 50  | -   | mA                        |
| $V_{DS(on)}$ | Output Saturation Voltage                   | $I_{OUT} = 15\text{mA}$ ,<br>$B > B_{OP}$                 | -   | -   | 0.4 | V                         |
| $I_{OFF}$    | Output Leakage Current                      | $V_{OUT} = 60\text{V}$                                    | -   | -   | 10  | $\mu\text{A}$             |
| $T_R$        | Output Rise Time                            | $R_L = 1\text{K}\Omega$ ,<br>$C_L = 20\text{pF}$          | -   | -   | 1.0 | $\mu\text{s}$             |
| $T_F$        | Output Fall Time                            | $R_L = 1\text{K}\Omega$ ,<br>$C_L = 20\text{pF}$          | -   | -   | 1.0 | $\mu\text{s}$             |
| $T_{PO}$     | Power on Time                               | $dV_{CC}/dt > 5\text{V}/\mu\text{s}$<br>$B > B_{OP(MAX)}$ | -   | -   | 10  | $\mu\text{s}$             |
| $F_C$        | Chopping Frequency                          |                                                           | -   | 800 | -   | KHz                       |
| $F_S$        | Sampling Frequency                          |                                                           | -   | 200 | -   | KHz                       |
| $R_{PU}$     | Internal pull-up Resistor                   |                                                           |     | 10  |     | $\text{K}\Omega$          |
| $R_{TH}$     | 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 Flat TO-92            |                                                           | -   | 230 | -   | $^\circ\text{C}/\text{W}$ |
|              | Thermal Resistance of SOT-89B               |                                                           | -   | 230 | -   | $^\circ\text{C}/\text{W}$ |

## 10.3 Magnetic Characteristics

At  $V_{CC} = 3.8\text{V} \sim 60\text{V}$  (unless otherwise specified)

| Part No.      | Symbol                                | Min | Typ | Max | Unit |
|---------------|---------------------------------------|-----|-----|-----|------|
| MT8381 Series | $B_{OP}$ , $T_A = 25^\circ\text{C}$   | 35  | 50  | 65  | Gs   |
|               | $B_{RP}$ , $T_A = 25^\circ\text{C}$   | -65 | -50 | -35 | Gs   |
|               | $B_{HYST}$ , $T_A = 25^\circ\text{C}$ | 70  | 100 | 130 | Gs   |
| MT8382 Series | $B_{OP}$ , $T_A = 25^\circ\text{C}$   | 10  | 20  | 30  | Gs   |
|               | $B_{RP}$ , $T_A = 25^\circ\text{C}$   | -30 | -20 | -10 | Gs   |
|               | $B_{HYST}$ , $T_A = 25^\circ\text{C}$ | 20  | 40  | 60  | Gs   |

## 10.4 ESD Ratings

| Symbol    |                            | Reference    | Values   | Unit  |
|-----------|----------------------------|--------------|----------|-------|
| $V_{ESD}$ | Human-body model (HBM)     | AEC-Q100-002 | Class II | Grade |
|           | Charged-device model (CDM) | AEC-Q100-011 | Class C6 | Grade |

## 10.5 Characteristic Performance

At  $V_{CC}=5V$

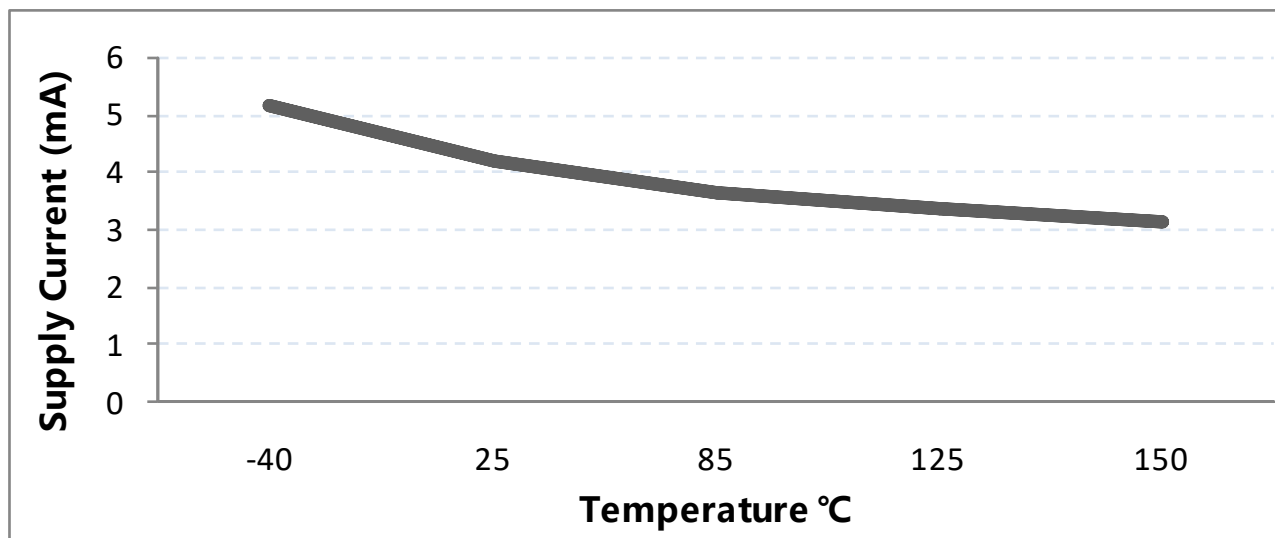
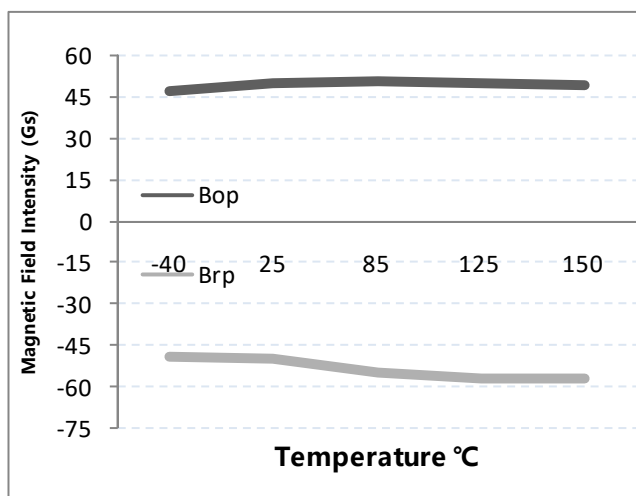


Figure.6 Supply Current vs. Temperature

### MT8381



### MT8382

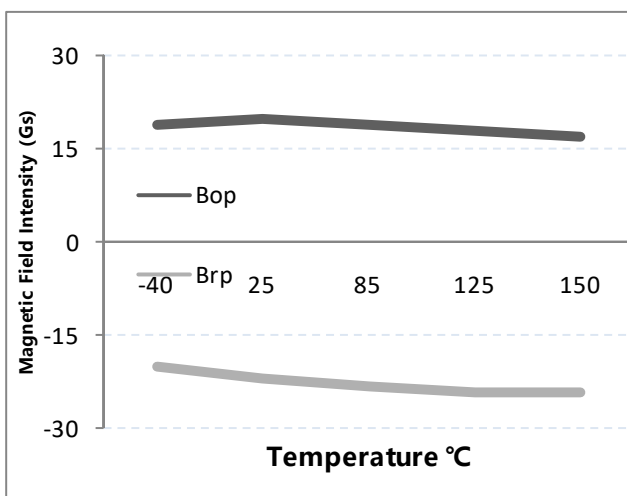
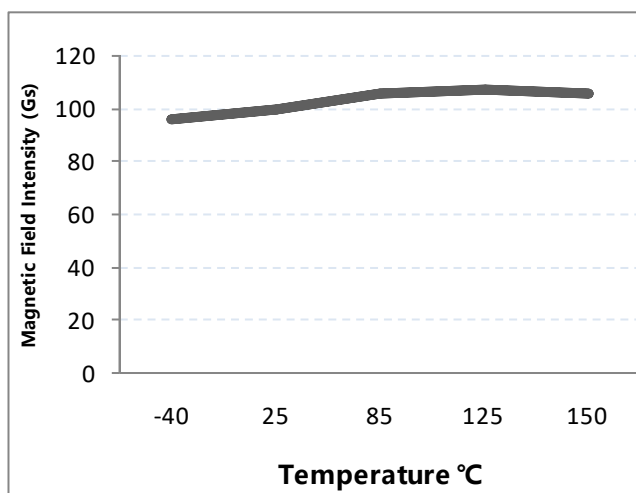


Figure.7 Magnetic Characteristics vs. Temperature (BOP & BRP)

### MT8381



### MT8382

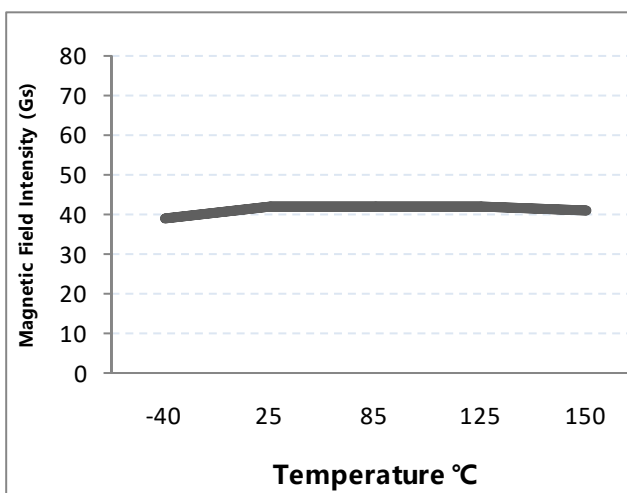


Figure.8 Magnetic Characteristics vs. Temperature (BHYS)

## 10.6 Typical Output Waveform

MT8381A as example

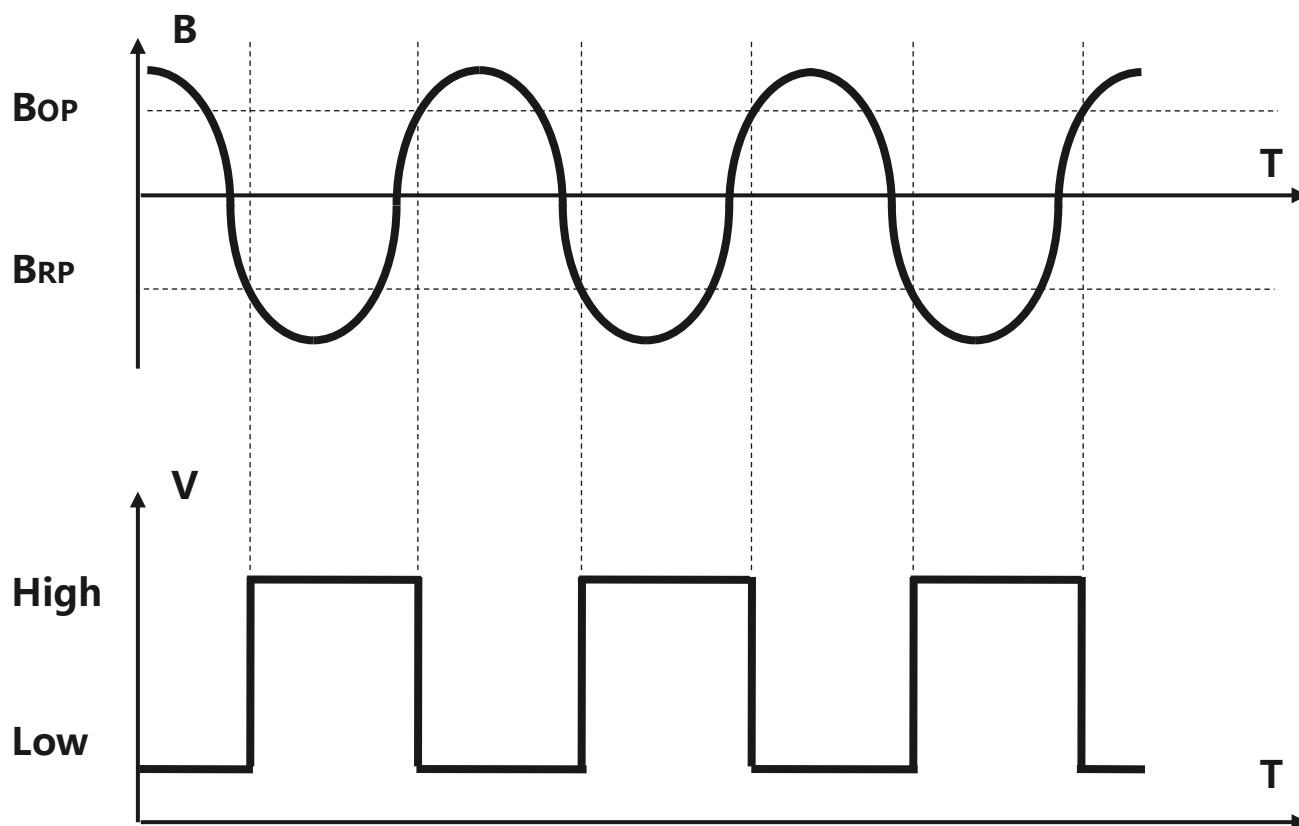


Figure.9 Digital Output vs. Magnetic Flux Density

## 11 Typical Application Circuit

MT8381AT as example

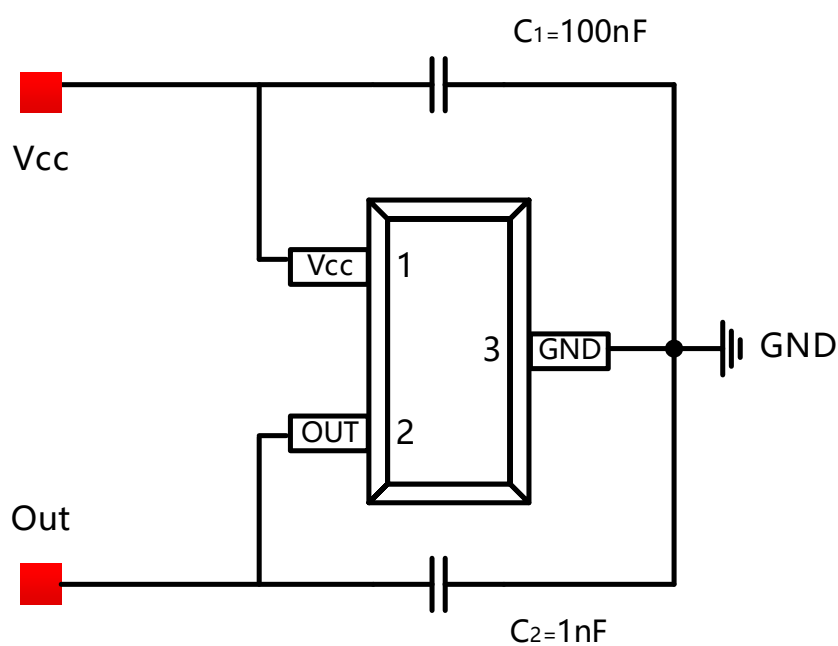


Figure.10 Typical Application Circuit

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

### 12.1 SOT-23 Package Information

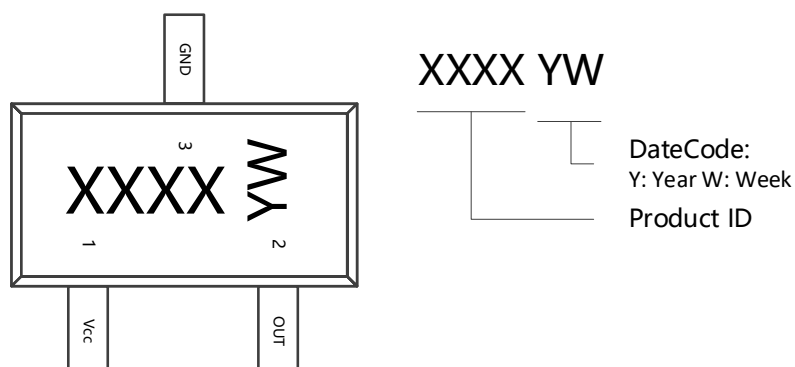


Figure.11 SOT-23 Chip Marking Spec

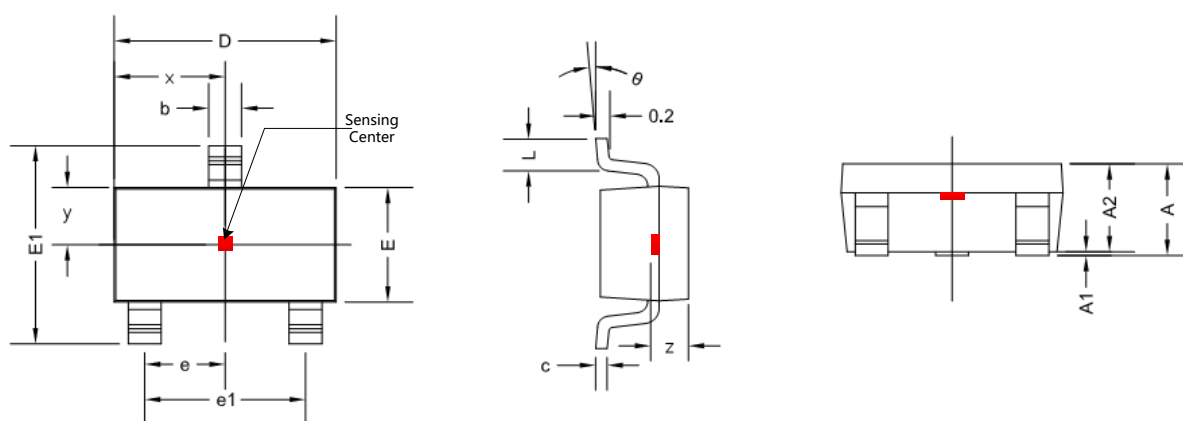


Figure.12 SOT-23 Package Drawing

| Symbol   | Dimensions in Millimeters |       | Dimensions in Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min                       | Max   | Min                  | Max   |
| A        | 1.050                     | 1.300 | 0.041                | 0.051 |
| A1       | 0.000                     | 0.150 | 0.000                | 0.006 |
| A2       | 1.000                     | 1.200 | 0.039                | 0.047 |
| b        | 0.300                     | 0.500 | 0.012                | 0.020 |
| c        | 0.080                     | 0.220 | 0.003                | 0.009 |
| D        | 2.800                     | 3.020 | 0.110                | 0.119 |
| E        | 1.500                     | 1.700 | 0.059                | 0.067 |
| E1       | 2.600                     | 3.000 | 0.102                | 0.118 |
| 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 |
| $\theta$ | 0 °                       | 8 °   | 0 °                  | 8 °   |
| x        | 1.460 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

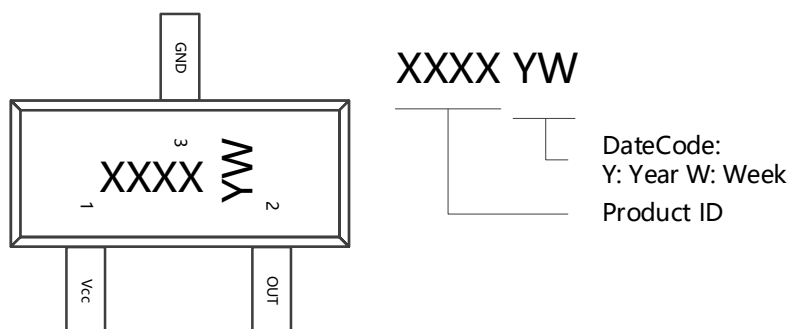


Figure.13 SOT-23 (Thin Outline) Chip Marking Spec

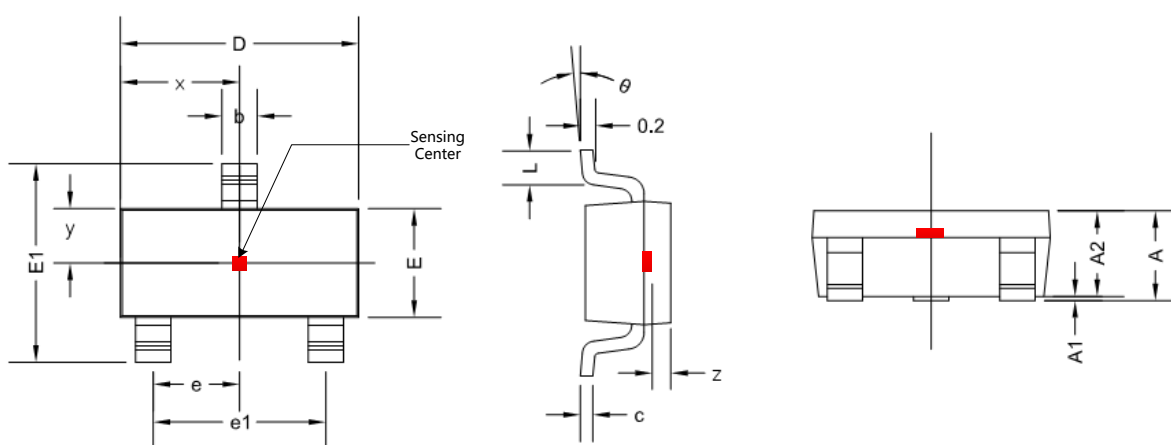


Figure.14 SOT-23 (Thin Outline) Package Drawing

| 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                     | 1.100 | 0.035                | 0.043 |
| b        | 0.300                     | 0.500 | 0.012                | 0.020 |
| c        | 0.132                     | 0.202 | 0.005                | 0.008 |
| 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 SOT-89B Package Information

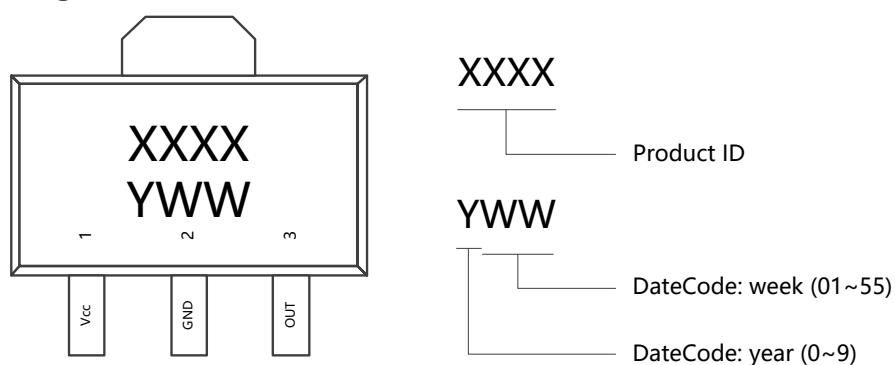


Figure.15 SOT-89B Chip Marking Spec

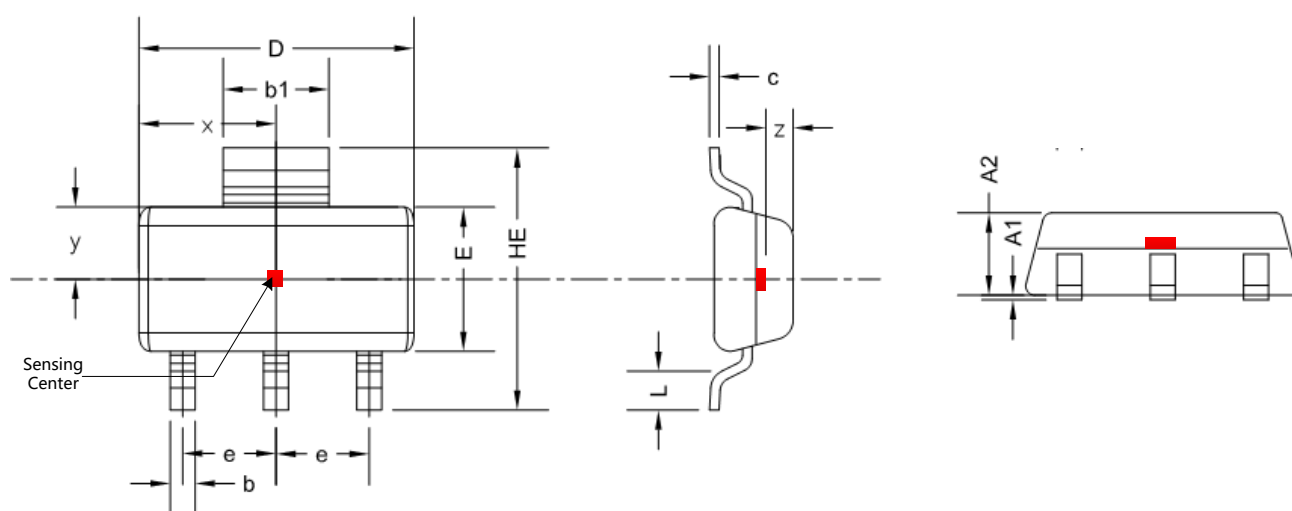
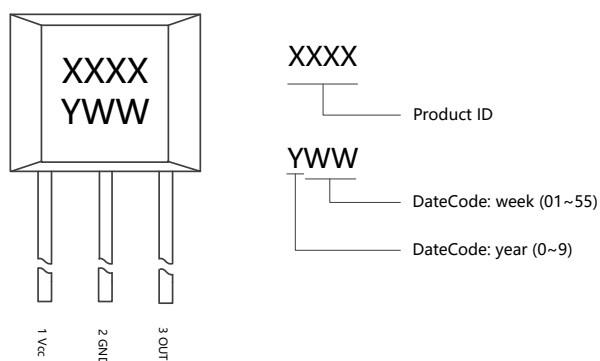


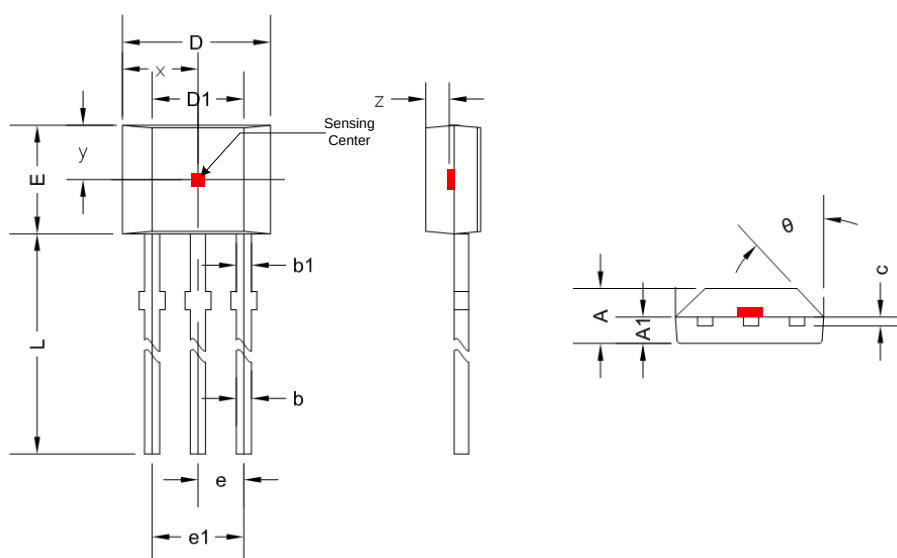
Figure.16 SOT-89B Package Drawing

| Symbol | Dimensions in Millimeters |       | Dimensions in Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A2     | 1.220                     | 1.420 | 0.048                | 0.056 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.052                     | 0.252 | 0.002                | 0.010 |
| D      | 4.400                     | 4.600 | 0.173                | 0.181 |
| b1     | 1.600                     | 1.800 | 0.063                | 0.071 |
| E      | 2.400                     | 2.600 | 0.094                | 0.102 |
| HE     | 4.000                     | 4.400 | 0.157                | 0.173 |
| e      | 1.400                     | 1.600 | 0.055                | 0.063 |
| L      | 0.350                     | 0.550 | 0.014                | 0.022 |
| x      | 2.250 TYP                 |       | 0.089 TYP            |       |
| y      | 1.250 TYP                 |       | 0.049 TYP            |       |
| z      | 0.300 TYP                 |       | 0.012 TYP            |       |

## 12.4 Flat TO-92 Package Information



**Figure.17** Flat TO-92 Chip Marking Spec



**Figure.18** 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                     | 0.910  | 0.026                | 0.036 |
| b      | 0.330                     | 0.560  | 0.013                | 0.022 |
| b1     | 0.400                     | 0.510  | 0.016                | 0.020 |
| c      | 0.330                     | 0.510  | 0.013                | 0.020 |
| D      | 3.900                     | 4.200  | 0.154                | 0.165 |
| D1     | 2.280                     | 2.680  | 0.090                | 0.106 |
| E      | 2.900                     | 3.280  | 0.114                | 0.128 |
| e      | 1.270 TYP                 |        | 0.050 TYP            |       |
| e1     | 2.440                     | 2.640  | 0.096                | 0.104 |
| L      | 13.500                    | 16.200 | 0.531                | 0.638 |
| 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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