# MT836X

AEC Qualified

MagnTek | Now Part of NOVOSENSE

## Latch, High Voltage Hall-Effect Switch IC

## 1 Product Description

The MT836X 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 ($B_{OP}$), 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).

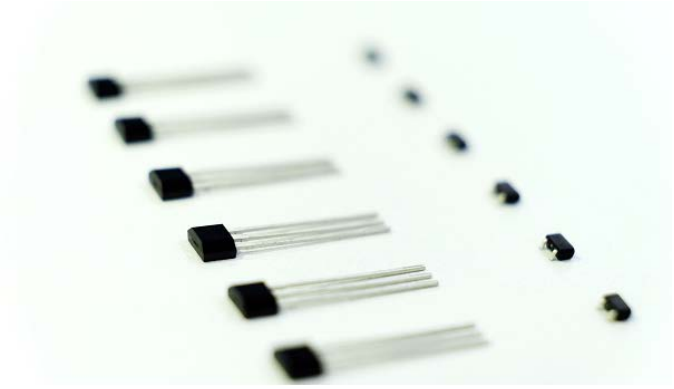
The MT836X family provides a variety of packages to customers: SOT-23/SOT-89-3L/SOT-23 (Thin Outline) for surface mount and flat TO-92 for through-hole mount. All packages are RoHS compliant.

## 2 Features

- AEC-Q100 Automotive Qualified
  MT836XAT & MT836XET & MT836XA
- BCD Technology
- Latch Switch
- 3.8~60V Operating Vcc Range
- -40℃~150℃ Operating Temperature
- Package Option:
  Flat TO-92 / Flat TO-92 (Radial Lead) / SOT-23 / SOT-23 (Thin Outline) / SOT-89-3L
- Magnetic Sensitivity Option:
  MT8361 ($B_{OP}$=50Gs, $B_{RP}$=-50Gs)
  MT8362 ($B_{OP}$=20Gs, $B_{RP}$=-20Gs)
- Open-Drain Output
- -20V Reversed Power Supply Protection
- Output Limiting Current Protection
- RoHS Compliant: (EU)2015/863

## 3 Product Overview of MT836X

| Part No. | Description |
|---|---|
| MT836XA | Flat TO-92, bulk packaging (1000pcs/bag) |
| MT836XA-T | Flat TO-92, radial lead, bulk packaging (1000pcs/bag) |
| MT836XAT | SOT-23, tape & reel (3000pcs/bag) |
| MT836XET | SOT-23 (Thin Outline), tape & reel (3000pcs/bag) |

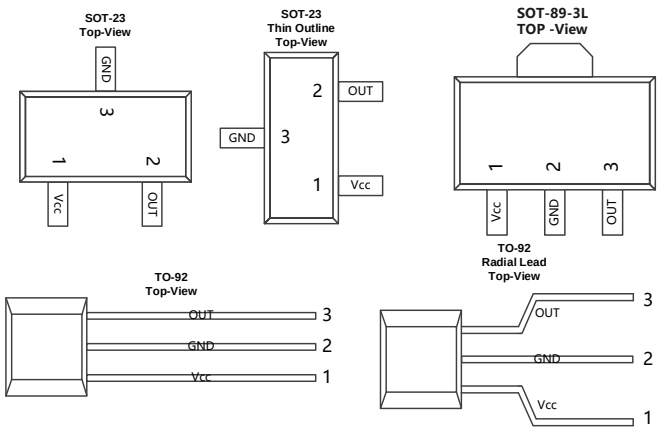


## 4 Applications

- 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 |
| Flat TO-92 (Radial Lead) | 1 | 3 | 2 |
| Flat TO-92 | 1 | 3 | 2 |
| SOT-89-3L | 1 | 3 | 2 |
| Description | Power | Output Open-Drain | Ground |




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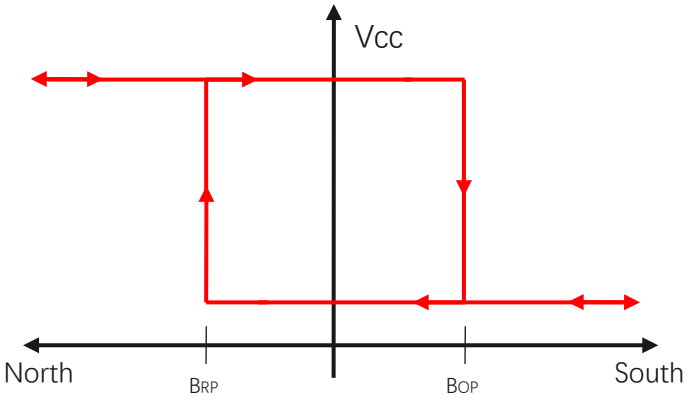
## Reversion History

| | | |
|---|---|---|
| 1 | Originally Version | |
| 2 | 1.1 Version | Update SOT-23 (Thin Outline) Package |
| 3 | 1.2 Version | Update MT8362 Series |
| 4 | 1.3 Version | Update Flat TO-92 (Radial Lead) Package |
| 5 | 1.4 Version | Update AEC-Q100 Automotive on MT836XAT<br>Update RoHS compliant to (EU)2015/863 |
| 6 | 1.5 Version | Update AEC-Q100 Logo<br>Update Copy Rights and Disclaimer |
| 7 | 1.6 Version | Update AEC-Q100 Automotive on MT836XET |
| 8 | 1.7 Version | Update the marking spec of SOT-23 & SOT- 23 (Thin Outline) |
| 9 | 1.8 Version | Update the Logo of MagnTek |
| 10 | 1.9 Version | Update SOT-89-3L Package Outline |
| 11 | 2.0 Version | Update AEC-Q100 Automotive on MT836XA |
| 12 | 2.1 Version | Update SOT-23 (Thin Outline) & SOT-23-3L Package Outline |
| 13 | 2.2 Version | Update TO-92S Package Outline |

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## 6 Definition of Switching Function

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



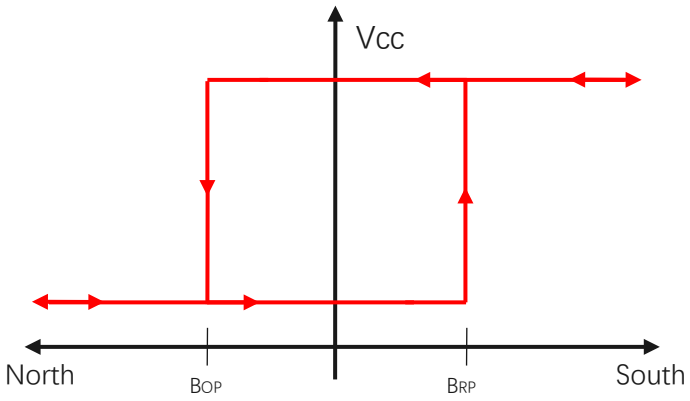




Figure.2 Switching Function of Flat TO-92 & SOT-89-3L & SOT-23 (Thin Outline)

Figure.3 Switching Function of SOT-23

## 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 MT836X device is sensitive to the magnetic field component that is perpendicular to the top of the package

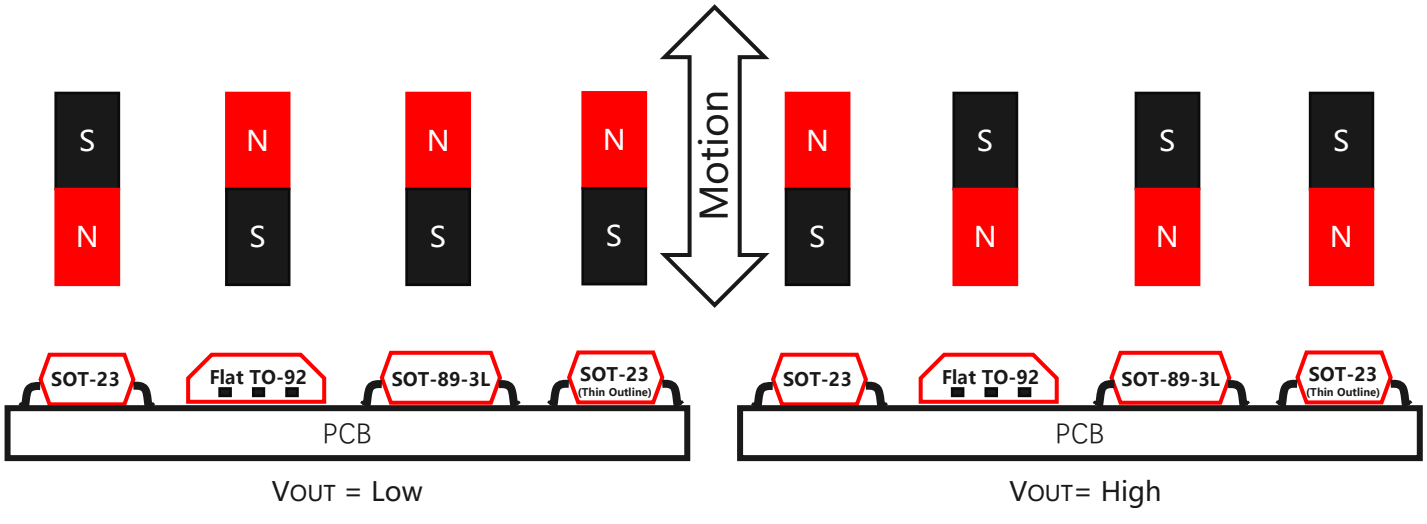



Figure.4 Flux Direction Polarity

## 9 Functional Block Diagram

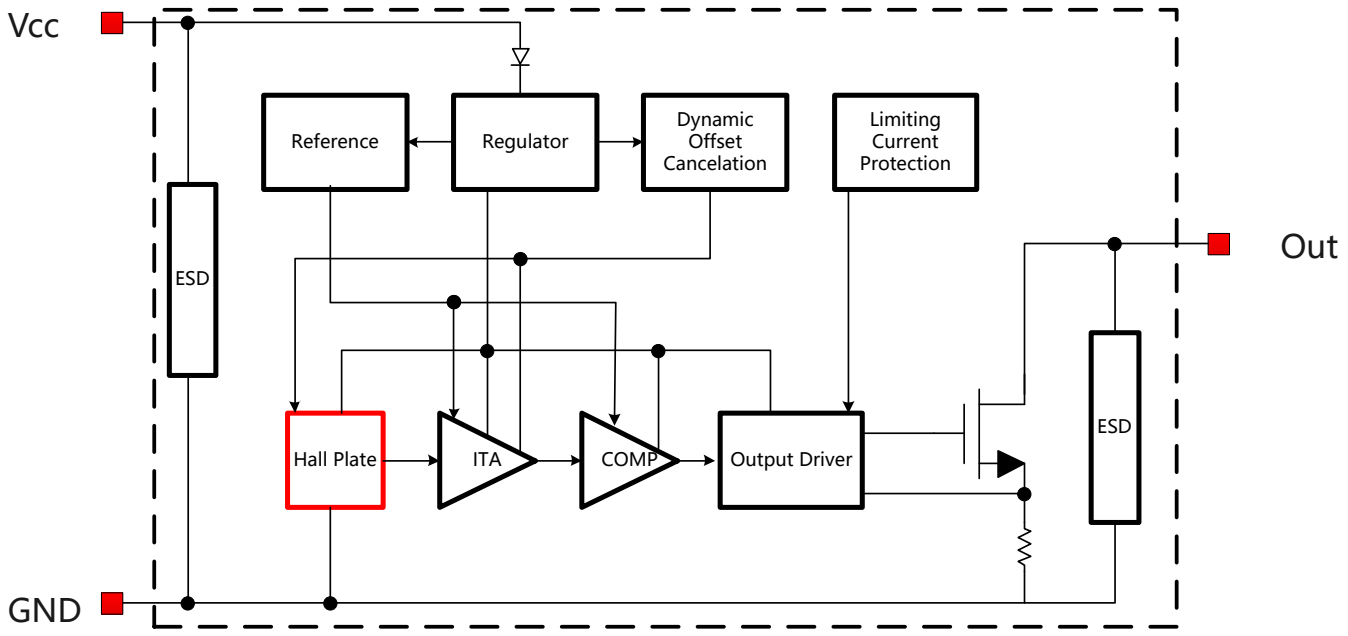



Figure.5 Functional Block Diagram

## 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 | - | 65 | V |
| $V_{RCC}$ | Reverse Battery Voltage | -20 | - | V |
| $V_{OUT}$ | Output Voltage | - | 65 | V |
| $I_{OUT}$ | Continuous Output Current | - | 40 | 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 ℃, $V_{CC}$=3.8V~60V (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>$B_{OP}$, $V_{OUT}$=Vcc | - | 50 | - | mA |
| $V_{DSON}$ | Output Saturation Voltage | $I_{OUT}$=15mA, B>$B_{OP}$ | - | - | 0.4 | V |
| $I_{OFF}$ | Output Leakage Current | $V_{OUT}$=60V | - | - | 10 | uA |
| $T_R$ | Output Rise Time | $R_L$=1KOhm, $C_L$=20pF | - | - | 1.0 | us |
| $T_F$ | Output Fall Time | $R_L$=1KOhm, $C_L$=20pF | - | - | 1.0 | us |
| $T_{PO}$ | Power on Time | $dV_{CC}/dt$>5V/uS B>$B_{OP(MAX)}$ | - | - | 10 | us |
| $F_C$ | Chopping Frequency | | - | 800 | - | KHz |
| $F_S$ | Sampling Frequency | | - | 200 | - | KHz |
| $R_{TH}$ | Thermal Resistance of SOT-23 | | - | 301 | - | ℃/W |
| | Thermal Resistance of SOT-23 (Thin Outline) | | - | 301 | - | ℃/W |
| | Thermal Resistance of Flat TO-92 | | - | 230 | - | ℃/W |
| | Thermal Resistance of SOT-89-3L | | - | 250 | - | ℃/W |

## 10.3 Magnetic Characteristics

At $V_{CC}$=3.8V~60V (unless otherwise specified)

| Part No. | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| MT8361 Series | $B_{OP}$, $T_A$ =25℃ | 35 | 50 | 65 | Gs |
| | $B_{RP}$, $T_A$ =25℃ | -65 | -50 | -35 | Gs |
| | $B_{HYST}$, $T_A$ =25℃ | 70 | 100 | 130 | Gs |
| MT8362 Series | $B_{OP}$, $T_A$ =25℃ | 10 | 20 | 30 | Gs |
| | $B_{RP}$, $T_A$ =25℃ | -30 | -20 | -10 | Gs |
| | $B_{HYST}$, $T_A$ =25℃ | 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 |

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## 10.5 Characteristic Performance

At Vcc=5V

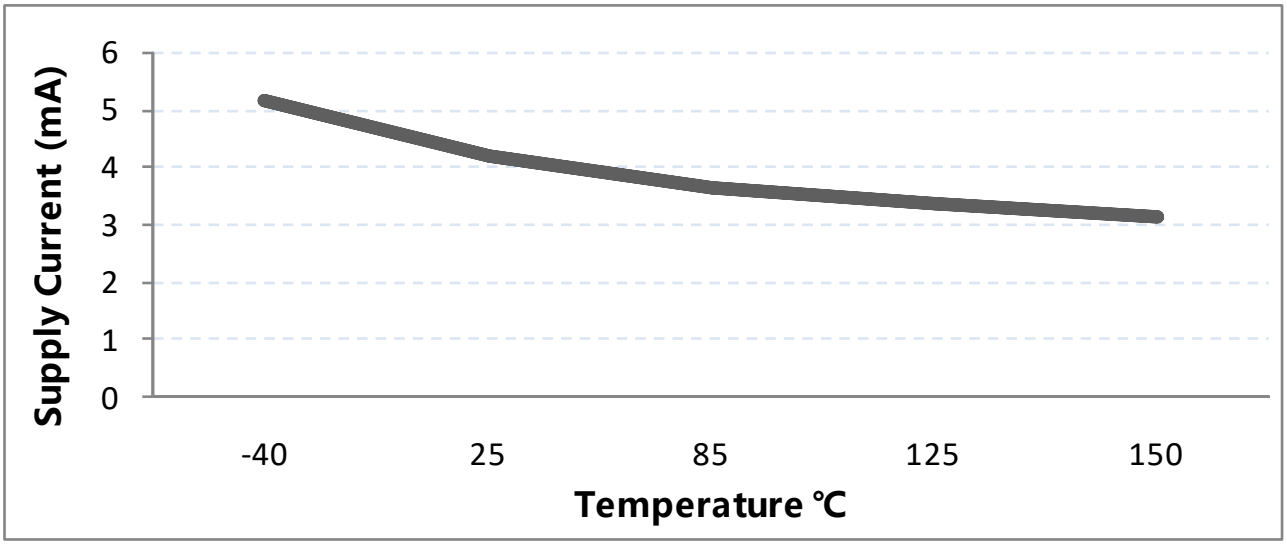



Figure.6 Supply Current vs. Temperature

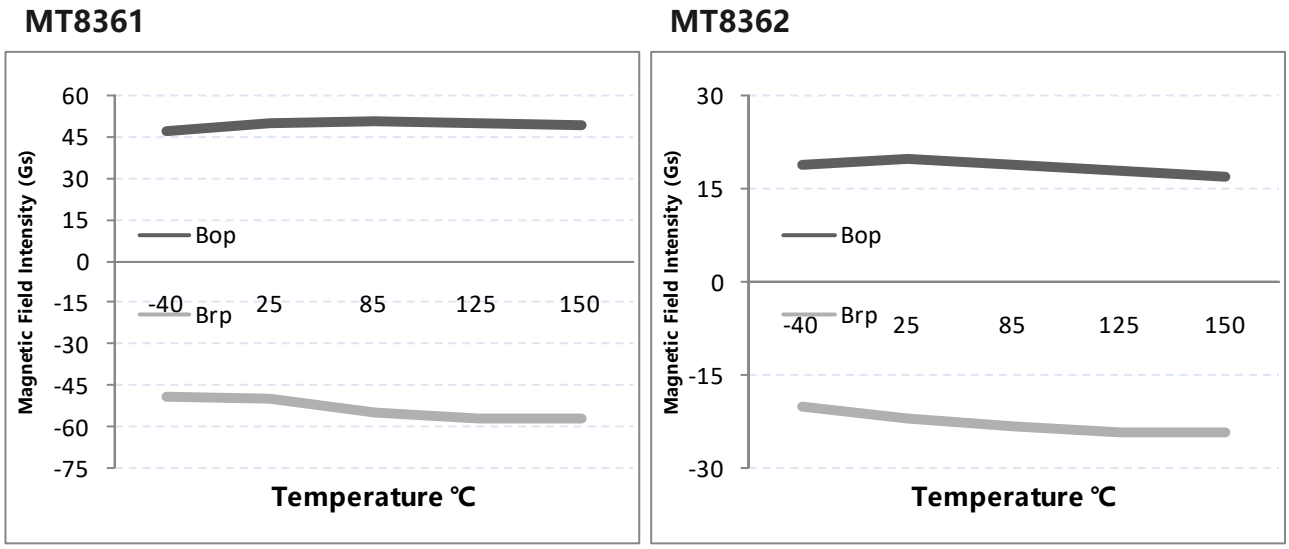



Figure.7 Magnetic Characteristics vs. Temperature (BOP & BRP)

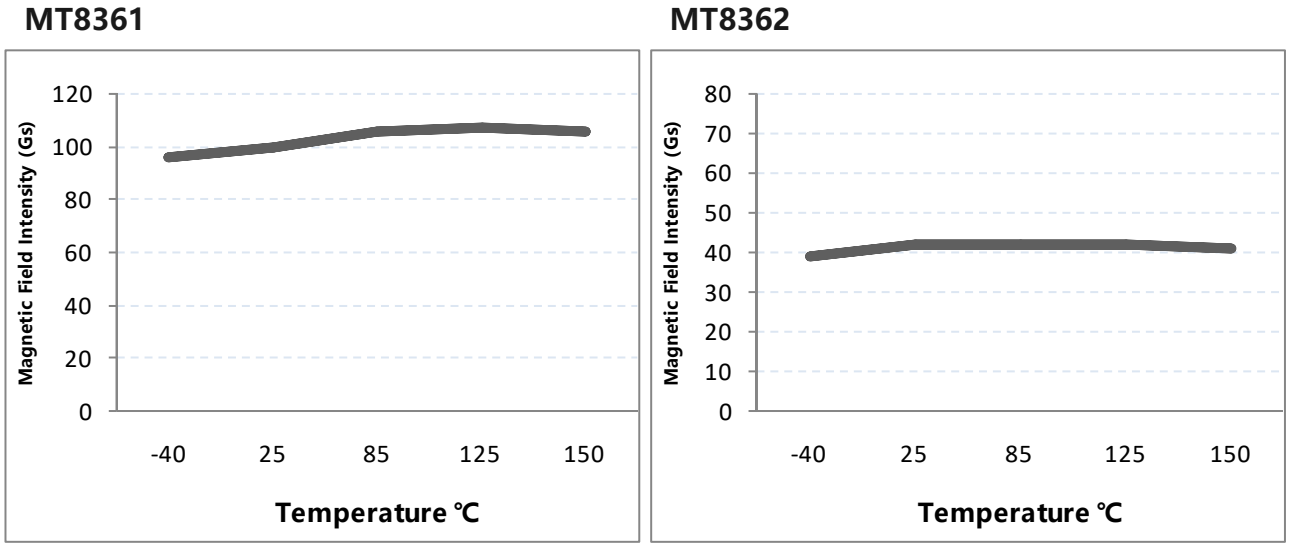



Figure.8 Magnetic Characteristics vs. Temperature (BHYST)

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## 10.6 Typical Output Waveform

MT8361A as example

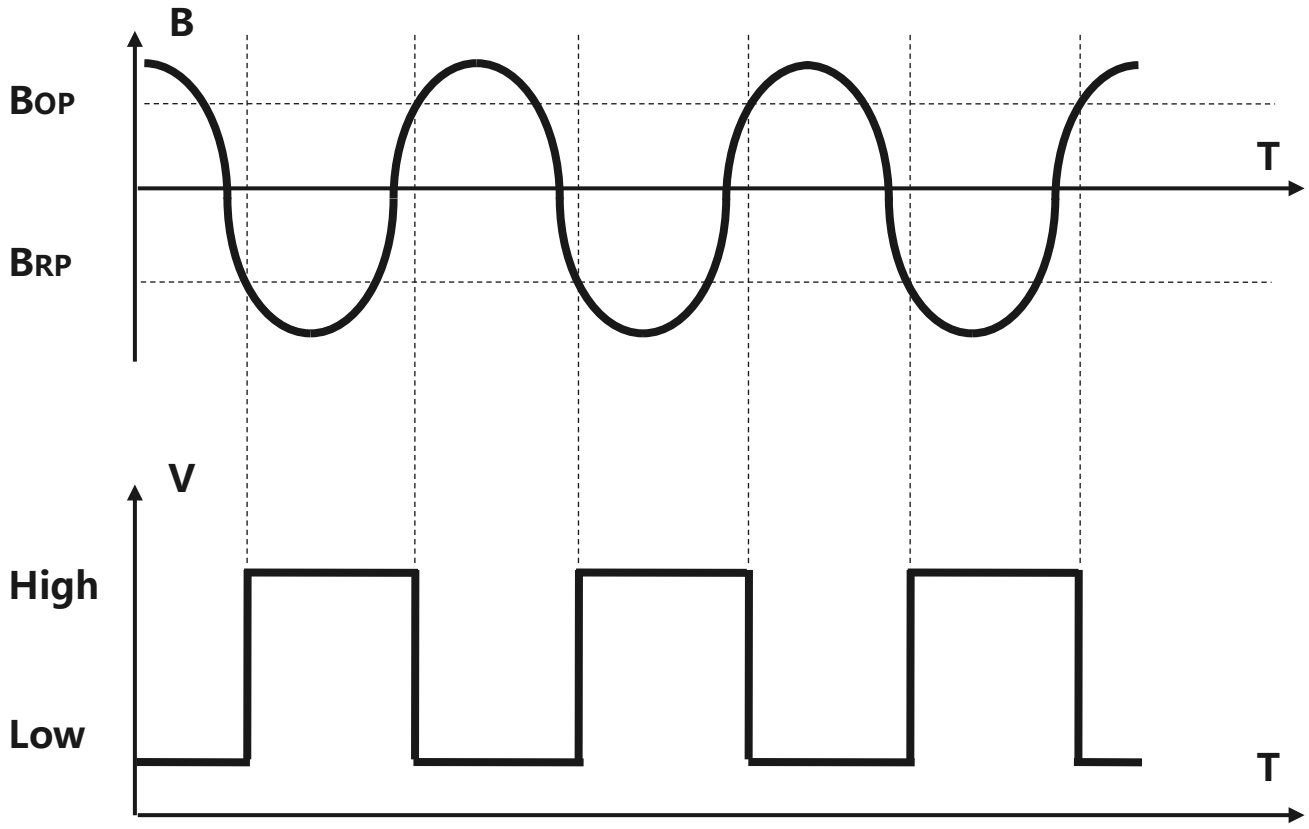



Figure.9 Digital Output vs. Magnetic Flux Density

## 11 Typical Application Circuit

MT8361AT as example
Note: Recommended value for $R_L$ is 1KOhms to 10KOhms

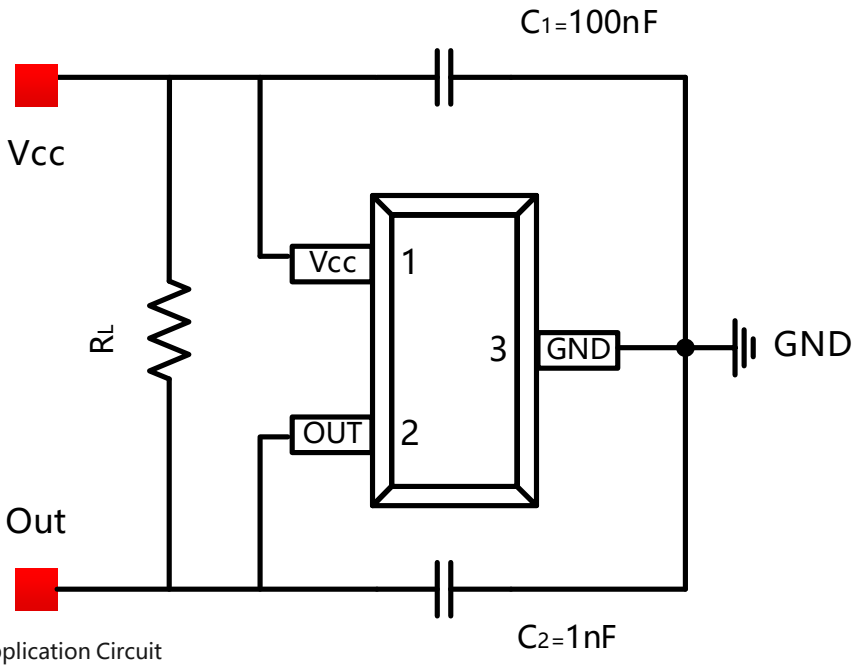



Figure.10 Typical Application Circuit

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

### 12.1 SOT-23 Package Information

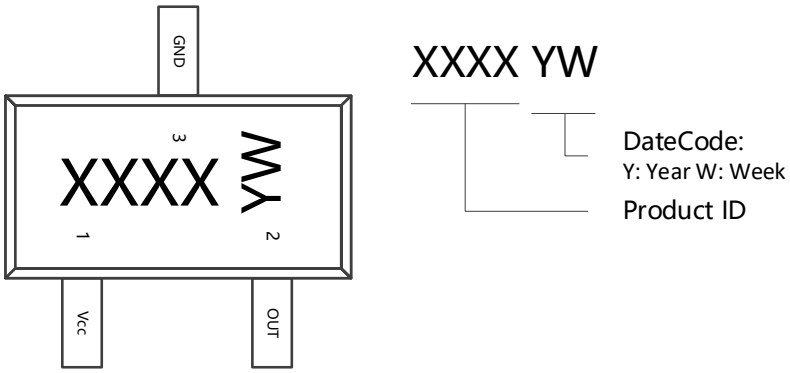



Figure.11 SOT-23 Chip Marking Spec

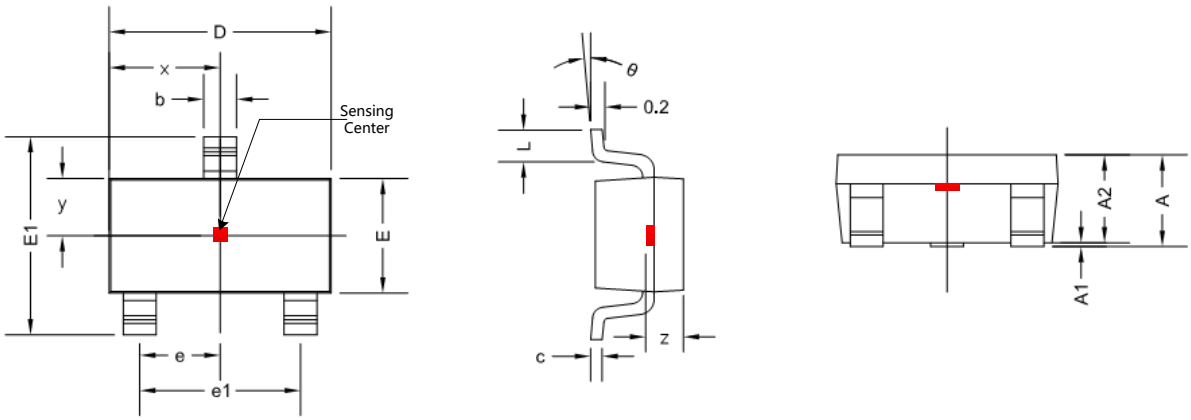



Figure.12 SOT-23 Package Drawing

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 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 |
| θ | 0 ° | 8 ° | 0 ° | 8 ° |
| x | 1.460 TYP | | 0.057 TYP | |
| y | 0.800 TYP | | 0.032 TYP | |
| z | 0.700 TYP | | 0.027 TYP | |

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

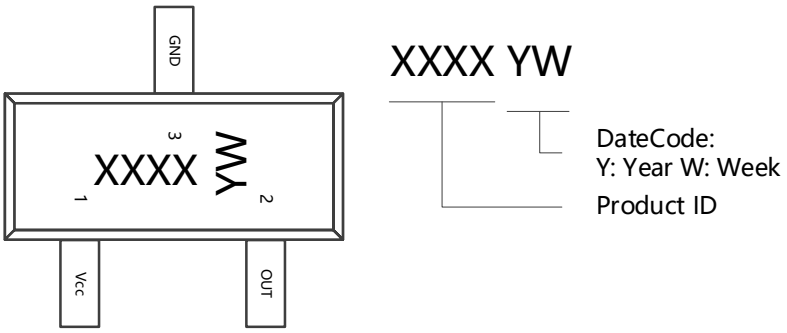



Figure.13 SOT-23 (Thin Outline) Chip Marking Spec

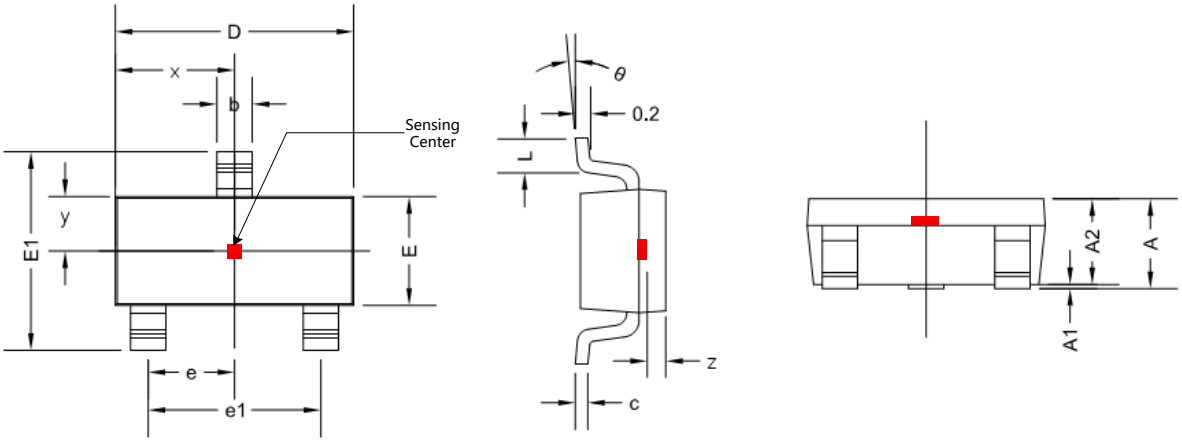



Figure.14 SOT-23 (Thin Outline) Package Drawing

| 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 |
| θ | 0 ° | 8 ° | 0 ° | 8 ° |
| x | | 1.460 TYP | | 0.057 TYP |
| y | | 0.650 TYP | | 0.026 TYP |
| z | | 0.190 TYP | | 0.007 TYP |

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## 12.3 SOT-89-3L Package Information

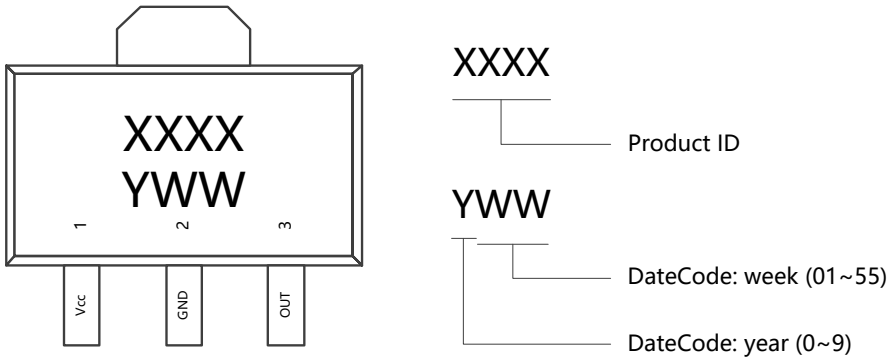



Figure.15 SOT-89-3L Chip Marking Spec

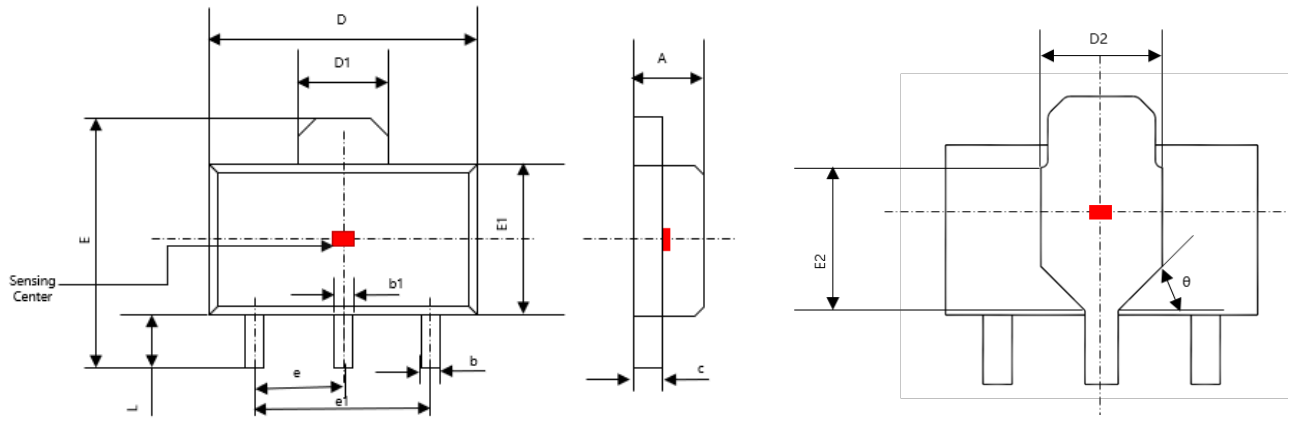



Figure.16 SOT-89-3L Package Drawing

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.020 |
| b1 | 0.380 | 0.580 | 0.015 | 0.023 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.550 REF | | 0.061 REF | |
| D2 | 1.750 REF | | 0.069 REF | |
| E | 3.940 | 4.250 | 0.155 | 0.167 |
| E1 | 2.300 | 2.600 | 0.091 | 0.102 |
| E2 | 1.900 REF | | 0.060 REF | |
| e | 1.500 TYP | | 0.060 TYP | |
| e1 | 3.000 TYP | | 0.118 TYP | |
| L | 0.900 | 1.200 | 0.035 | 0.047 |
| θ | 45° | | 45° | |

## 12.4 Flat TO-92 Package Information

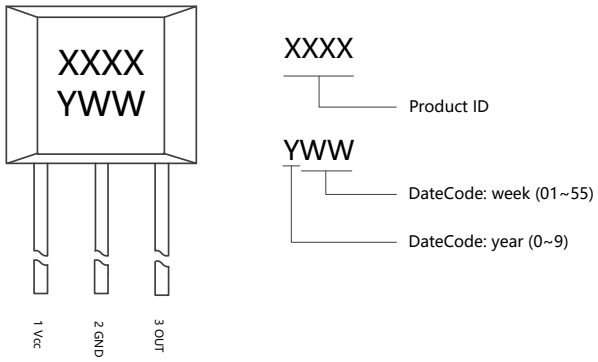



Figure.17 Flat TO-92 Chip Marking Spec

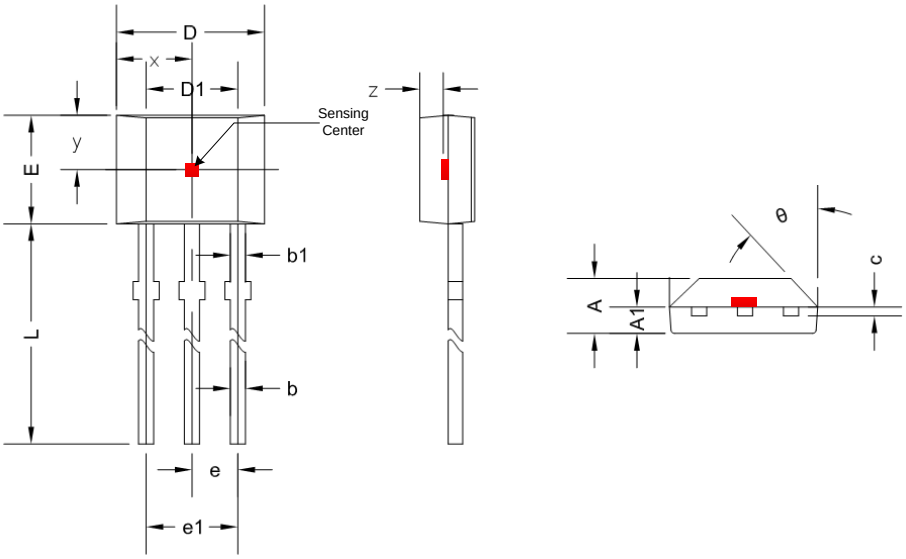



Figure.18 Flat TO-92 Package Drawing

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.450 | 1.590 | 0.057 | 0.063 |
| A1 | 0.660 | 0.860 | 0.026 | 0.034 |
| b | 0.330 | 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 | 4.000 | 4.100 | 0.157 | 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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## 12.4 Flat TO-92 Package Information (Radial Lead)

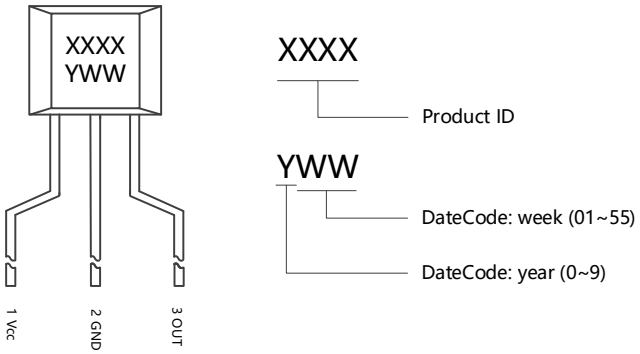



Figure.19 Flat TO-92 (Radial Lead) Chip Marking Spec

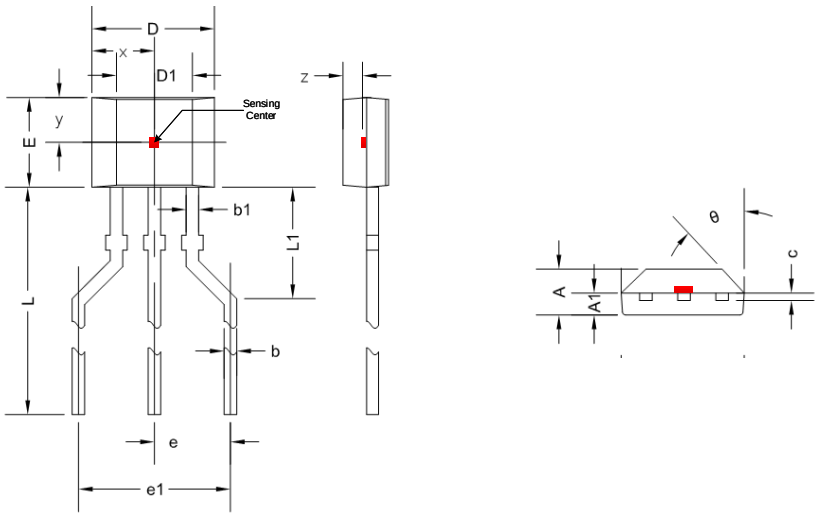



Figure.20 Flat TO-92 (Radial Lead) Package Drawing

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.450 | 1.590 | 0.057 | 0.063 |
| A1 | 0.660 | 0.860 | 0.026 | 0.034 |
| b | 0.330 | 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 | 4.000 | 4.100 | 0.157 | 0.161 |
| D1 | 2.280 | 2.680 | 0.090 | 0.106 |
| E | 3.050 | 3.250 | 0.120 | 0.128 |
| e | 2.540 TYP | | 0.100 TYP | |
| e1 | 5.000 TYP | | 0.197 TYP | |
| L1 | 2.000 TYP | | 0.079 TYP | |
| L | 13.88 TYP | | 0.546 TYP | |
| 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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