MT4401-EN

AEC Qualified

Latch, High Voltage Hall-Effect Switch IC

MagnTek

1 Product Description

The MT4401-EN 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).

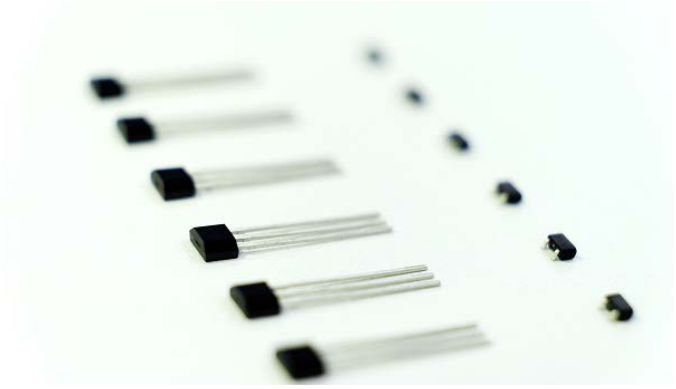
The MT4401-EN family provides a variety of packages to customers: SOT-23/SOT-89-3L for surface mount and flat TO-92 for through-hole mount. All packages are RoHS compliant.

2 Features

- 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-89-3L
- Magnetic Sensitivity Option:
  BOP=50Gs, BRP=-50Gs
- Open-Drain Output
- -20V Reversed Power Supply Protection
- Output Limiting Current Protection
- RoHS Compliant: (EU)2015/863

3 Product Overview of MT4401-EN

Part No.	Description
MT4401A-EN	Flat TO-92, bulk packaging (1000pcs/bag)
MT4401A-T-EN	Flat TO-92 (Radial Lead), bulk packaging (1000pcs/bag)
MT4401AT-EN	SOT-23, tape & reel (3000pcs/bag)
MT4401BT-EN	SOT-89-3L, 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
Flat TO-92	1	3	2
SOT-89-3L	1	3	2
Description	Power	Output Open-Drain	Ground

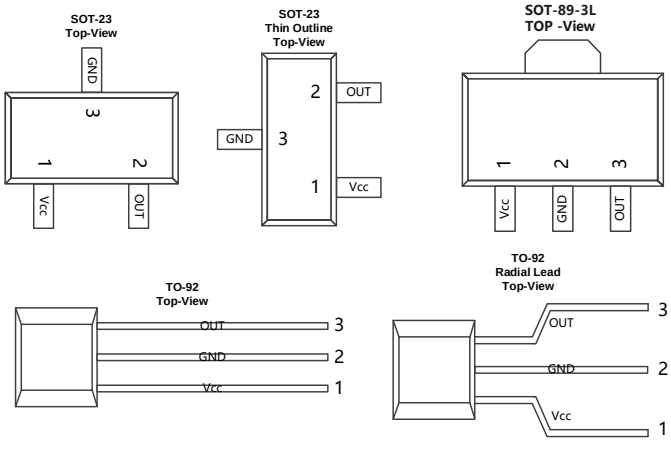


Figure.1 Pin Configuration & Functions

Table of Contents

Reversion History

1	Originally Version	
2	1.1 Version	Tighten Bop & Brp spec
3	1.2 Version	Update RoHS compliant to (EU)2015/863
4	1.3 Version	Update Copy Rights and Disclaimer Update the marking spec of SOT-23
5	1.4 Version	Update the MT4401A-T-EN
6	1.5 Version	Update the Logo of MagnTek
7	1.6 Version	Update SOT-89-3L Package Outline

6 Definition of Switching Function

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

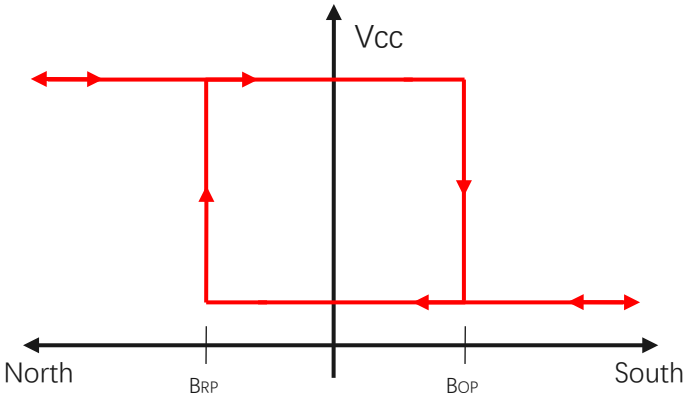


Figure.2 Switching Function of Flat TO-92 & SOT-89-3L

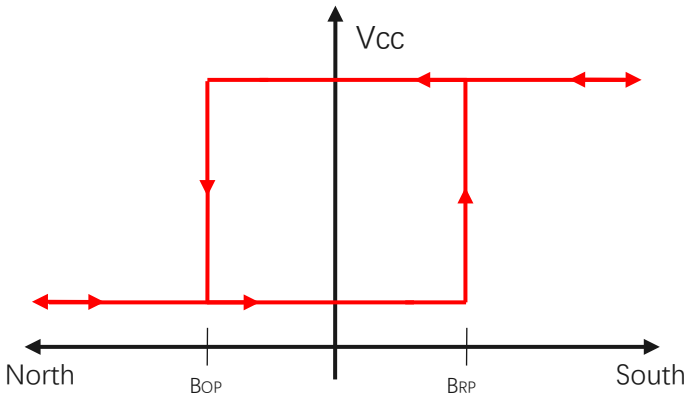


Figure.3 Switching Function of SOT-23

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 MT4401-EN device is sensitive to the magnetic field component that is perpendicular to the top of the package

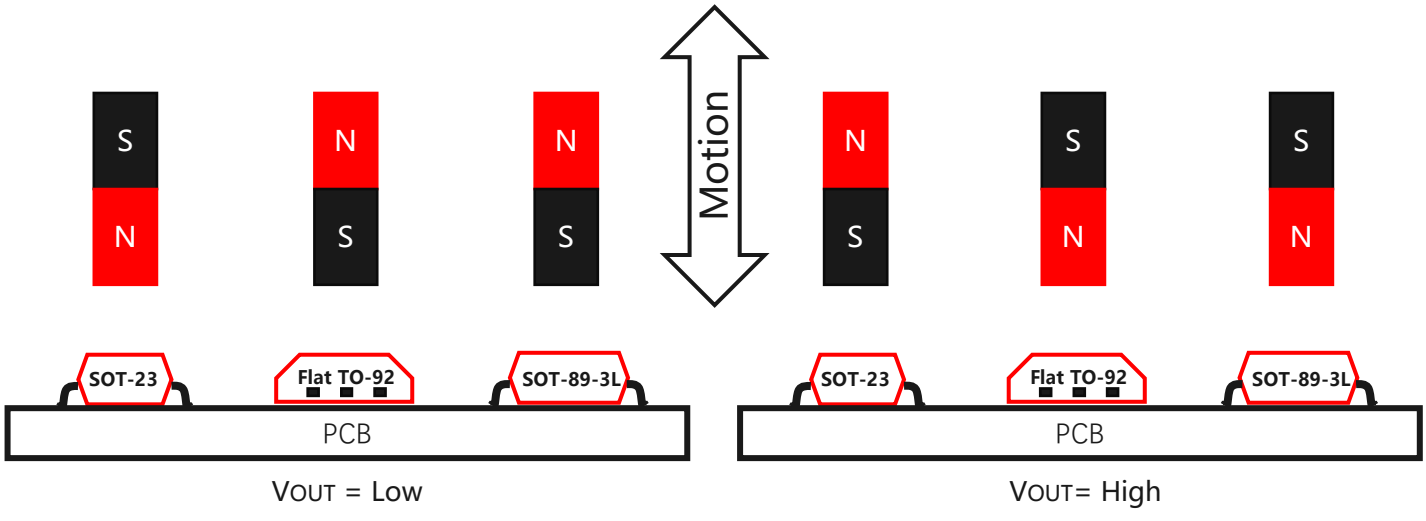


Figure.4 Flux Direction Polarity

9 Functional Block Diagram

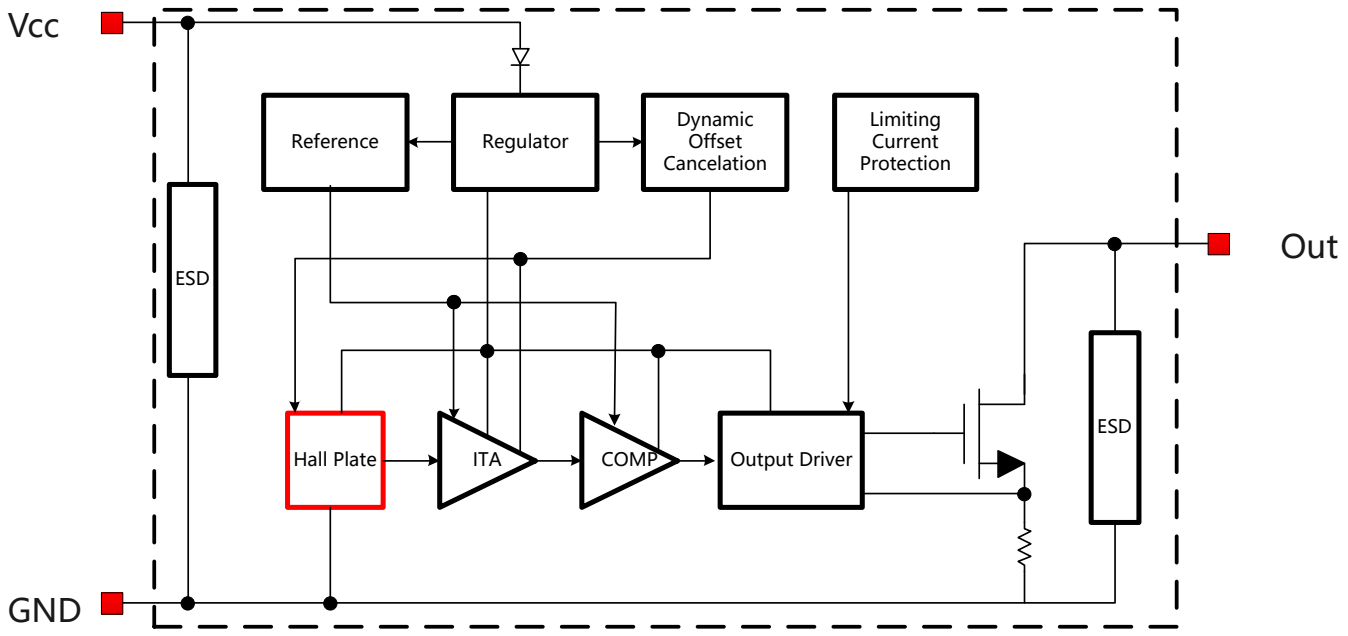


Figure.5 Functional Block Diagram

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 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
MT4401-EN 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

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

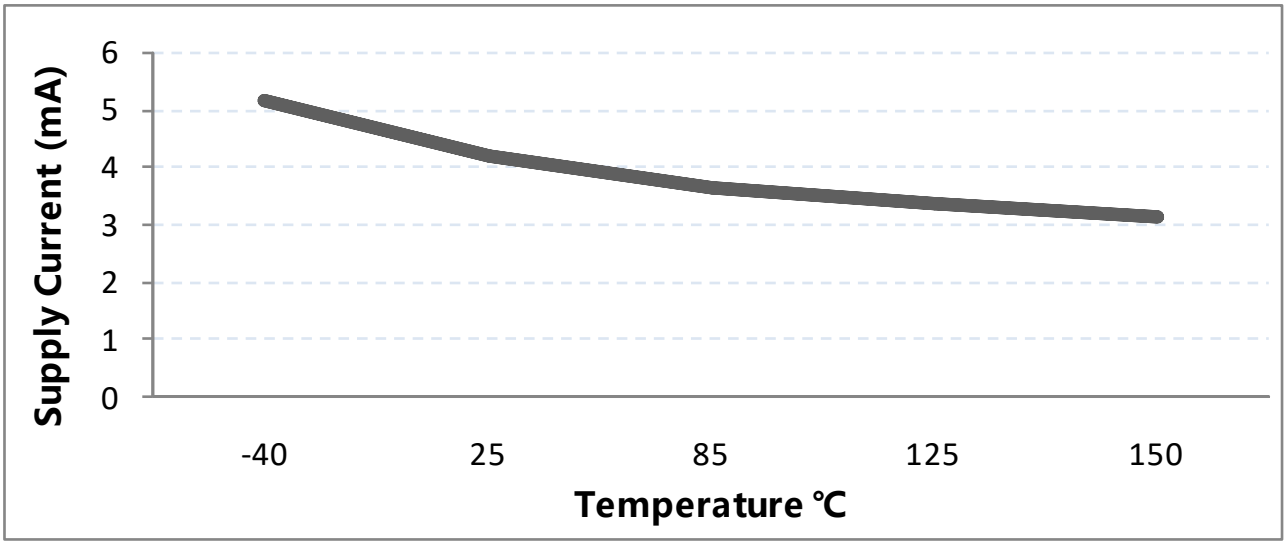


Figure.6 Supply Current vs. Temperature

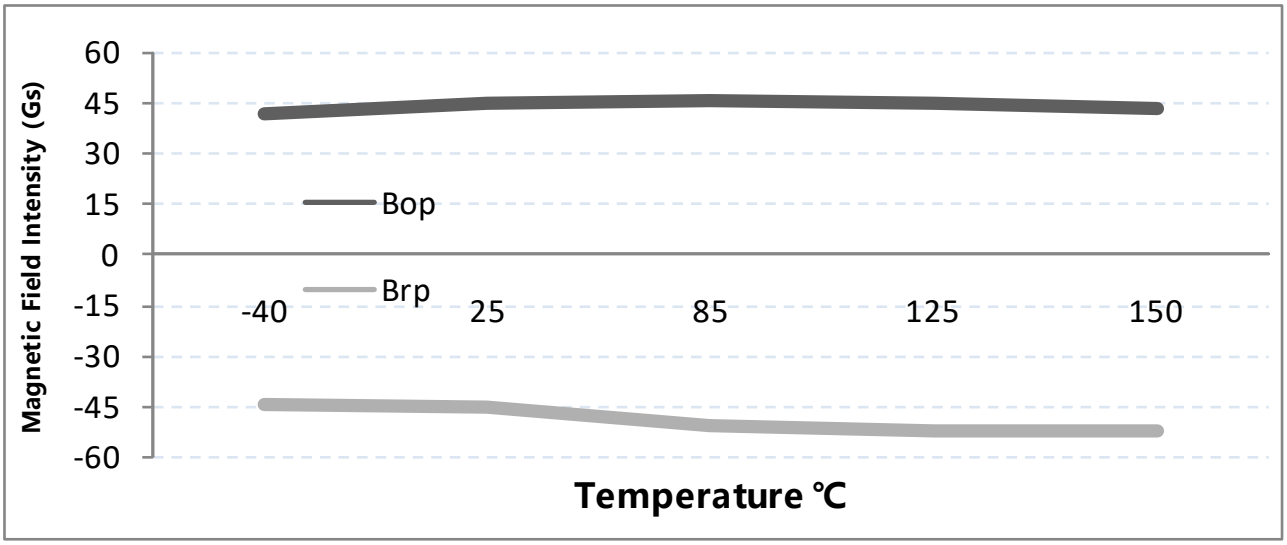


Figure.7 Magnetic Characteristics vs. Temperature (B_{OP} & B_{RP})

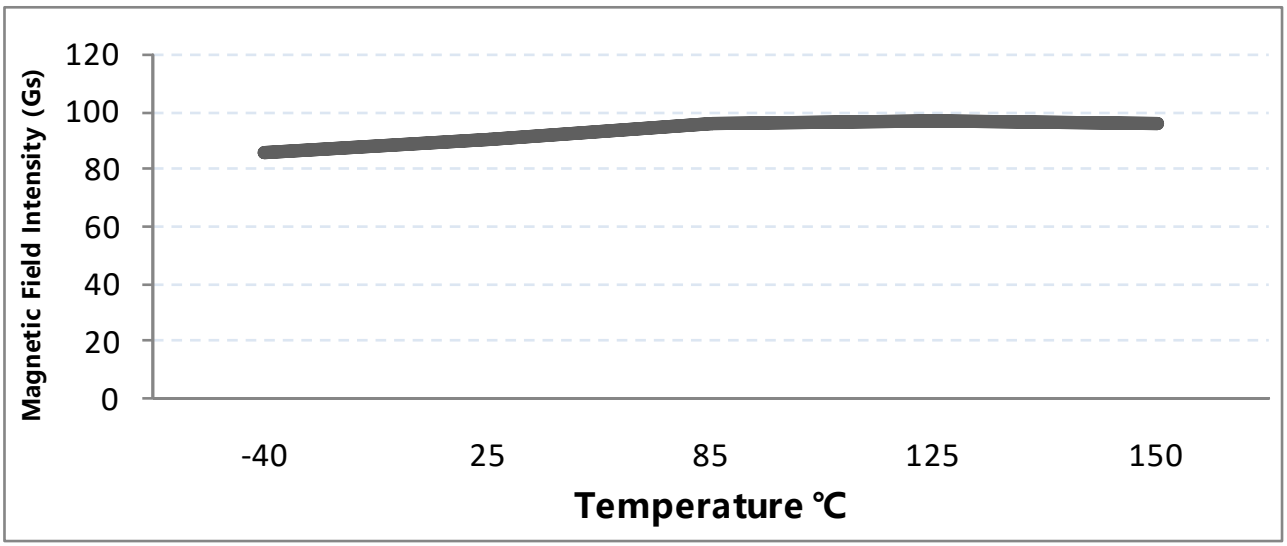


Figure.8 Magnetic Characteristics vs. Temperature (B_{HYST})

10.6 Typical Output Waveform

MT4401A-EN as example

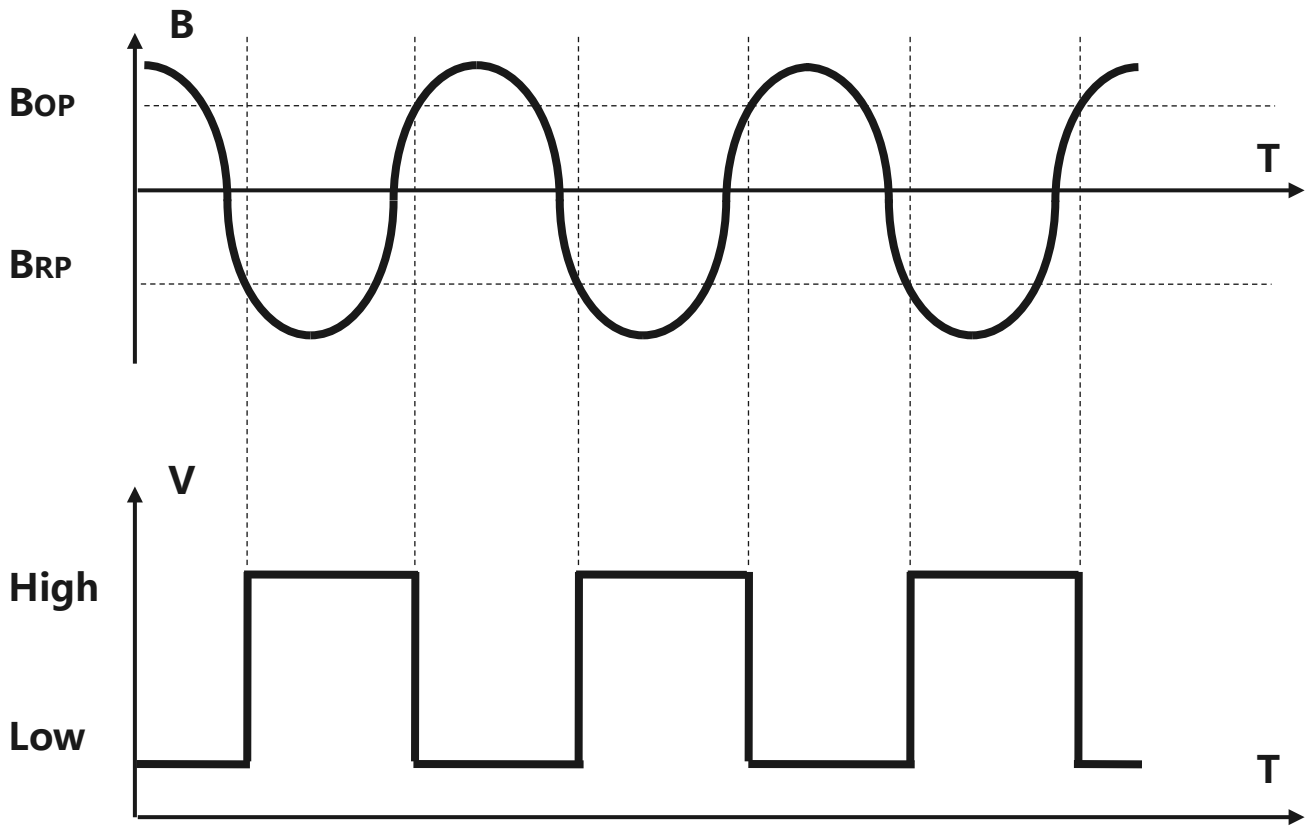


Figure.9 Digital Output vs. Magnetic Flux Density

11 Typical Application Circuit

MT4401AT-EN as example
Note: Recommended value for R_L is 1KOhms to 10KOhms

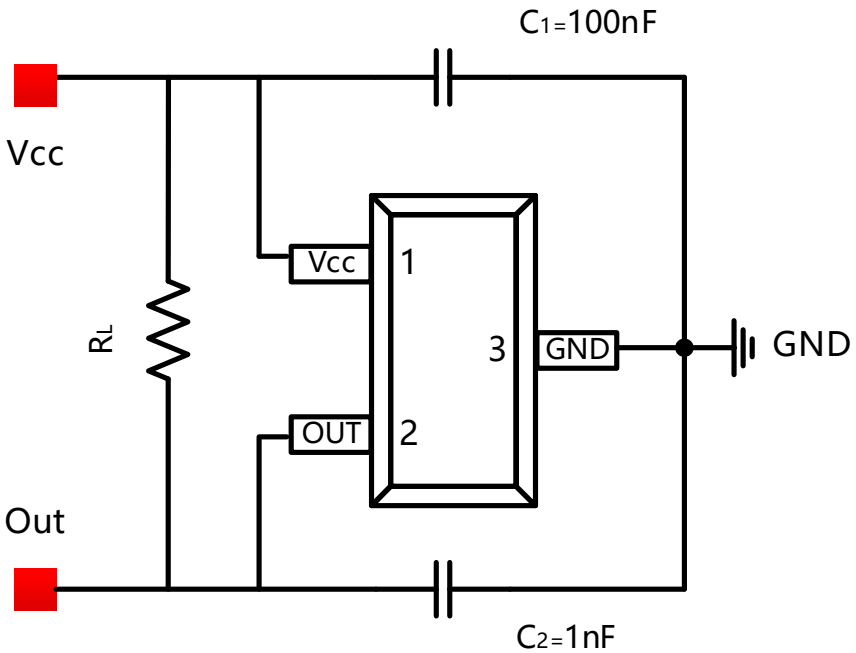


Figure.10 Typical Application Circuit

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

12.1 SOT-23 Package Information

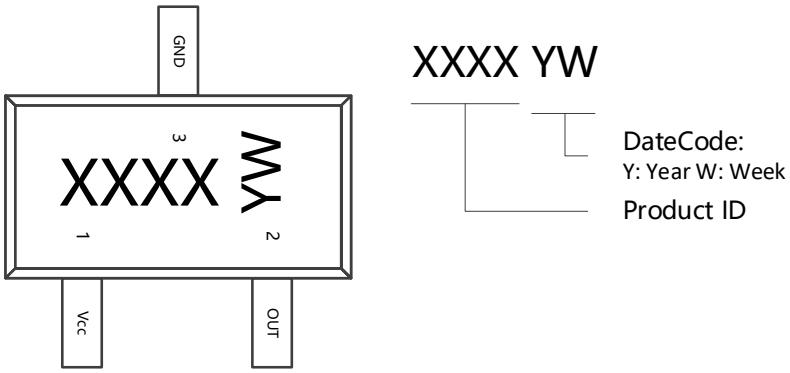


Figure.11 SOT-23 Chip Marking Spec

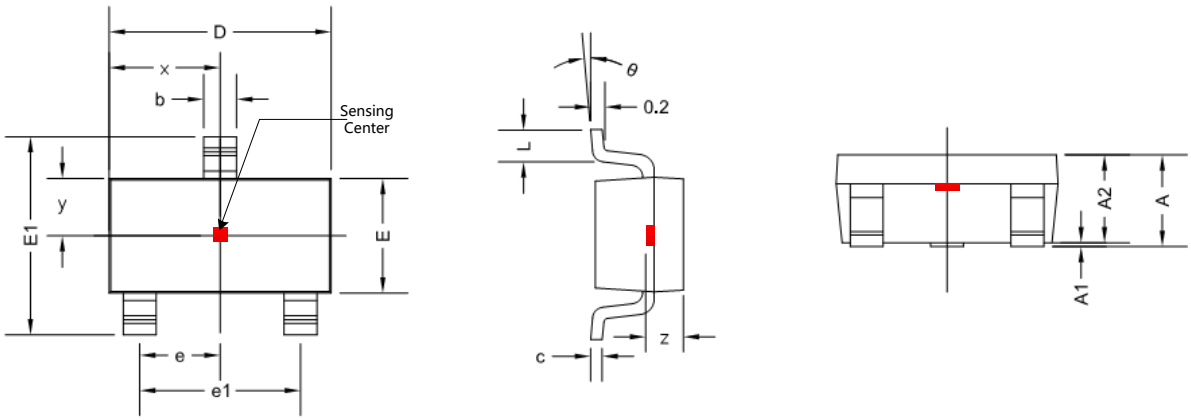


Figure.12 SOT-23 Package Drawing

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	0.600 TYP		0.024 TYP	

12.2 SOT-89-3L Package Information

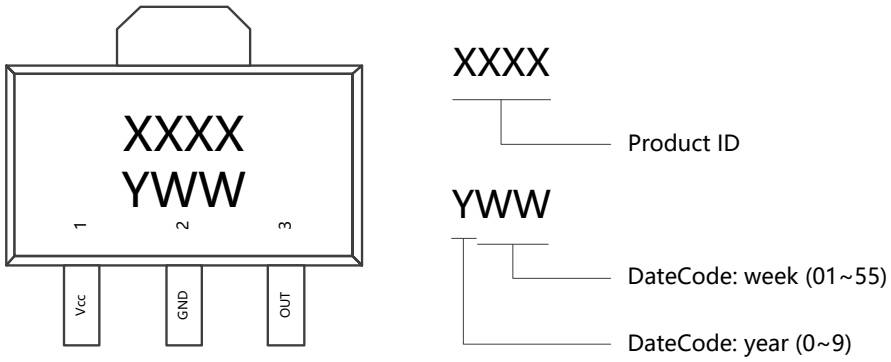


Figure.13 SOT-89-3L Chip Marking Spec

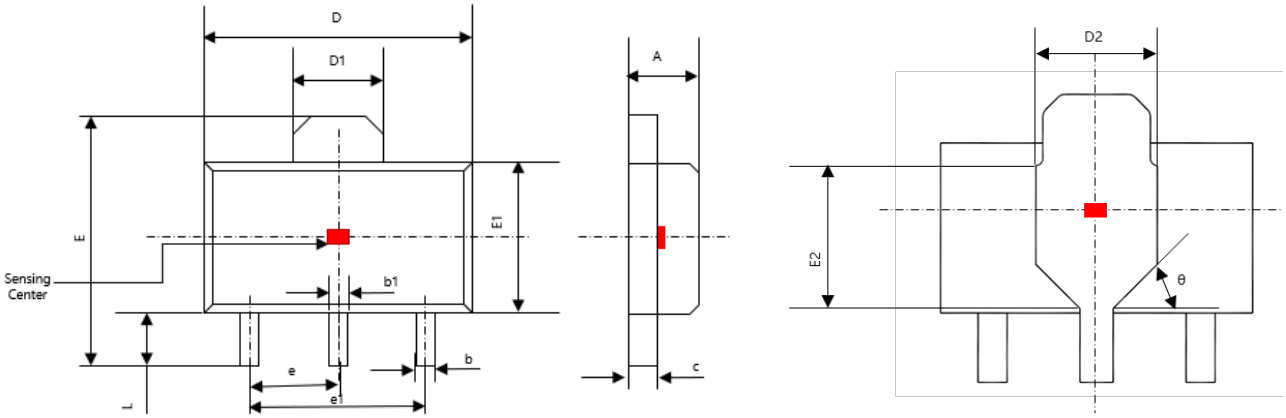


Figure.14 SOT-89-3L Package Drawing

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°	

12.3 Flat TO-92 Package Information

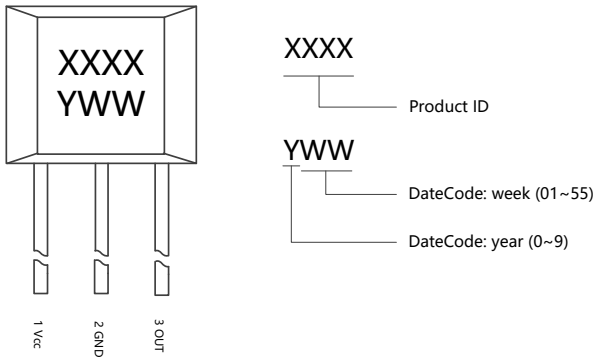


Figure.15 Flat TO-92 Chip Marking Spec

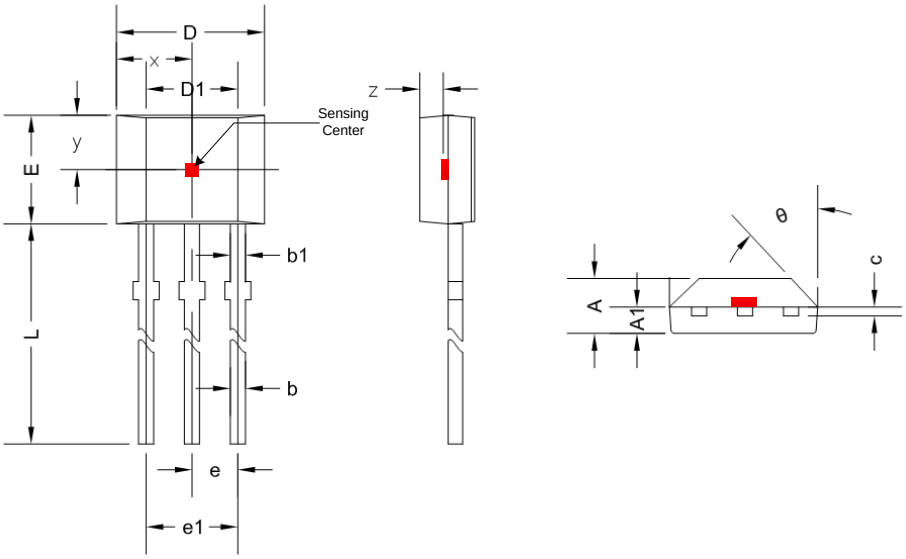


Figure.16 Flat TO-92 Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.420	1.620	0.056	0.064
A1	0.660	0.910	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	

12.4 Flat TO-92 Package Information (Radial Lead)

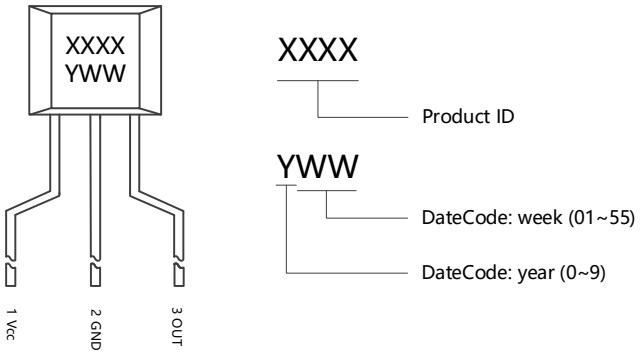


Figure.17 Flat TO-92 (Radial Lead) Chip Marking Spec

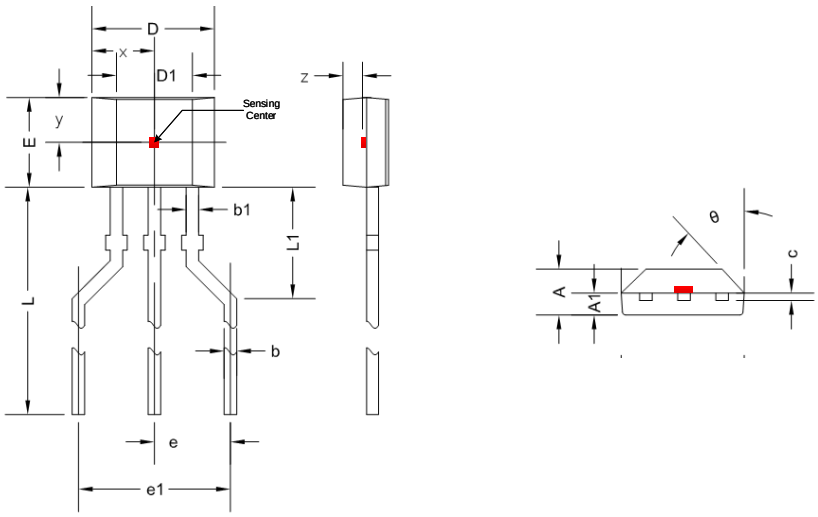


Figure.18 Flat TO-92 (Radial Lead) Package Drawing

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	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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