KTM1301 Series

High sensitivity, Low Power Omni-Polar TMR Switch

Technical Support
sales.global@conntek.com.cn

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1 Product Features

- Ultra-low power consumption
  - 50Hz version: $160\,\text{nA@}3.0\,\text{V}$
  - 1.6kHz version: $600\,\text{nA@}3.0\,\text{V}$
  - Continuous operation version: $1.9\,\mu\text{A@}3.0\,\text{V}$
- Wide operating voltage range: $1.8\,\text{V} \sim 5.5\,\text{V}$
- Selectable magnetic field threshold (B_{OP})
  - $B_{OP} = \pm 45\,\text{Gs},\ B_{RP} = \pm 36\,\text{Gs}$
  - $B_{OP} = \pm 30\,\text{Gs},\ B_{RP} = \pm 21\,\text{Gs}$
  - $B_{OP} = \pm 18\,\text{Gs},\ B_{RP} = \pm 12\,\text{Gs}$
  - $B_{OP} = \pm 9\,\text{Gs},\ B_{RP} = \pm 6\,\text{Gs}$
  - $B_{OP} = \pm 7\,\text{Gs},\ B_{RP} = \pm 4\,\text{Gs}$
- Omni-polar magnetic field detection
- CMOS push-pull output
- Package: SOT-23-3L (MSL1), TO-92S
- Operating temperature range: $-40°C \sim 125°C$
- Excellent ESD performance: HBM $8\,\text{kV}$
- RoHS compliant

2 Typical Applications

- Water meters, gas meters, flow meters
- Non-contact detection
- Electronic locks, valve position detection
- Switch detection for laptops and tablets
- TWS earphones, mobile phones

3 Application Circuit Diagram

Note: To filter the noise from the chip's power supply, a 100nF capacitor should be connected between the power supply and ground, and the capacitor should be as close to the VDD pin as possible.

4 Overview

The KTM1301 is a magnetic switch sensor integrating Tunnel Magneto-Resistance (TMR) technology and CMOS technology. It features high precision, high speed, low power consumption, and high sensitivity, making it suitable for magnetic switch detection in industrial and consumer electronics. The chip's internal circuitry includes a voltage generator, comparator, digital logic control module, threshold adjustment module, and CMOS output circuit.

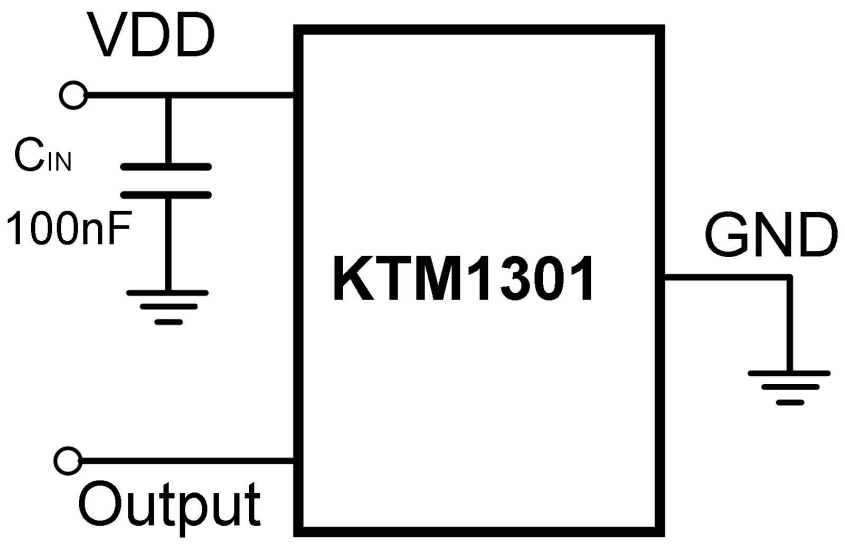


Figure 1: Application Circuit Diagram

The KTM1301 operates over a wide voltage range and a wide temperature range. This series offers various magnetic field thresholds, switch operating frequencies, and package options to fit different applications.

As an all-polarity magnetic field detection switch, the KTM1301 provides a full-polarity magnetic response with very low current consumption. It detects magnetic fields parallel to the chip package surface. When the magnetic field strength exceeds the operating point (B_{OP}), the switch outputs a low level; when the magnetic field strength is below the release point (B_{RP}), the switch outputs a high level. The chip operates within a supply voltage range of $1.8\,\text{V} \sim 5.5\,\text{V}$ and is available in standard SOT-23-3L and TO-92S packages.

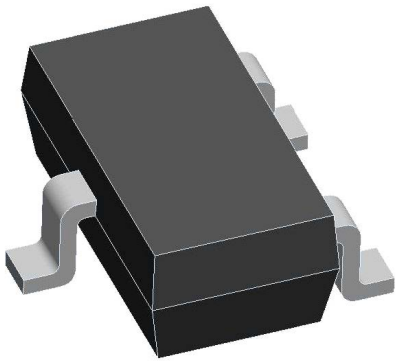


Figure 2: SOT-23-3L

Figure 3: TO-92S)

5 Pin Definition and Marking Information

5.1 SOT-23-3L

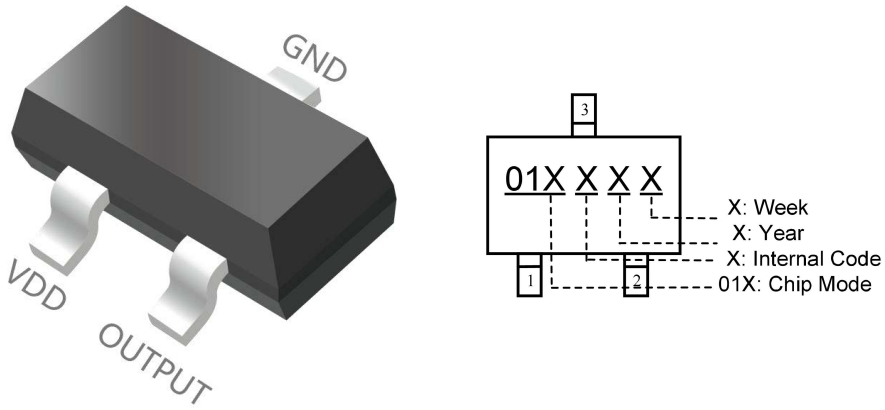


Figure 4: SOT-23-3L Pin Structure (Top View)

Pin Name	Pin Number	Description
VDD	1	Power supply input
OUTPUT	2	Output
GND	3	Ground

Table 1: SOT-23-3L Pin Definition

5.2 TO-92S

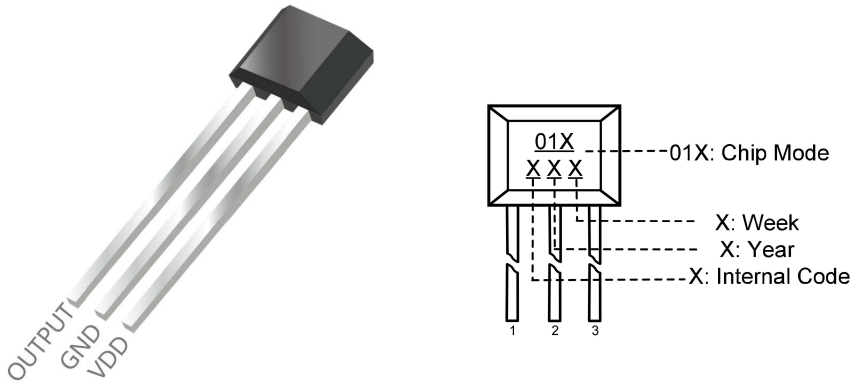


Figure 5: TO-92S Pin Structure (Top View)

Pin Name	Pin Number	Description
VDD	3	Power supply input
GND	2	Ground
OUTPUT	1	Output

Table 2: TO-92S Pin Definition

6 Functional Block Diagram

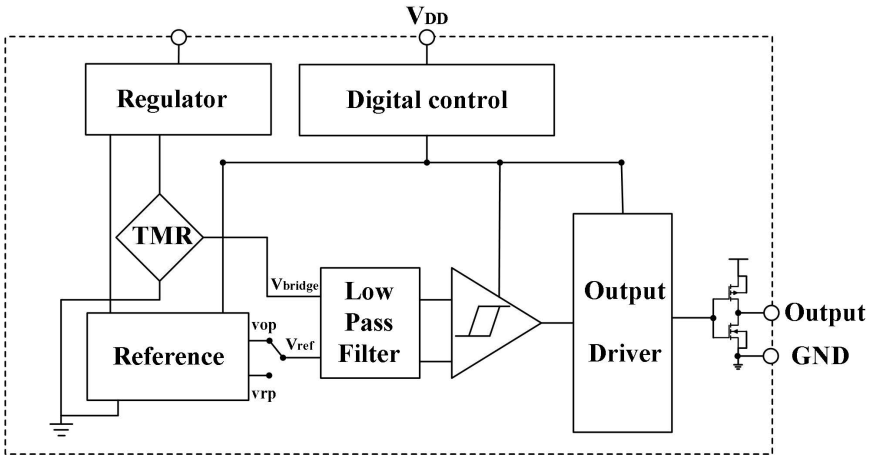
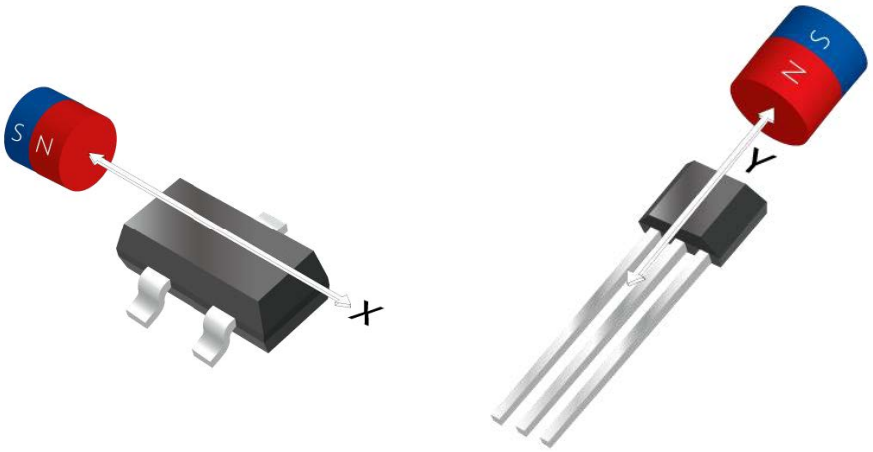


Figure 6: Functional Block Diagram

7 Switch Output Characteristics

7.1 Magnetic Field Detection Direction

The chip detects magnetic fields parallel to the chip surface. The following figures illustrate the correct usage of the magnet with the chip.



As shown in the Figure 7 below, the KTM1301 can detect magnetic fields parallel to the chip package surface.

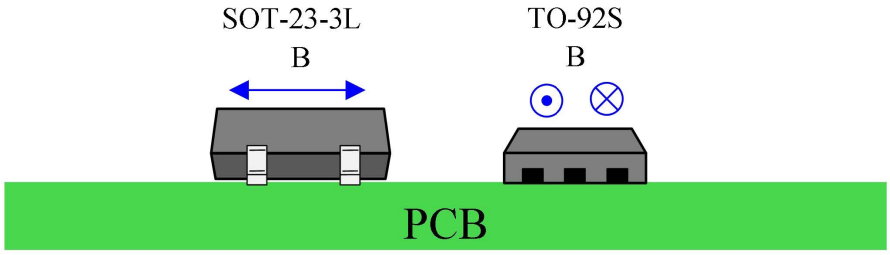
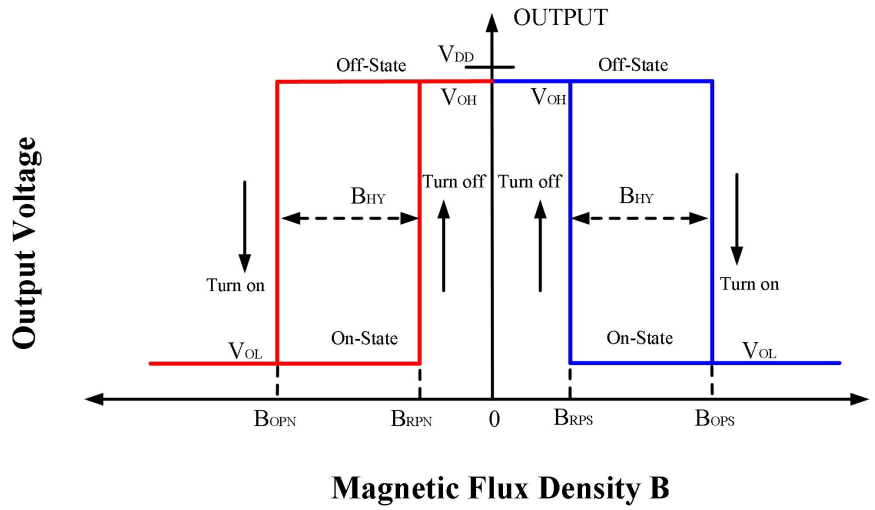
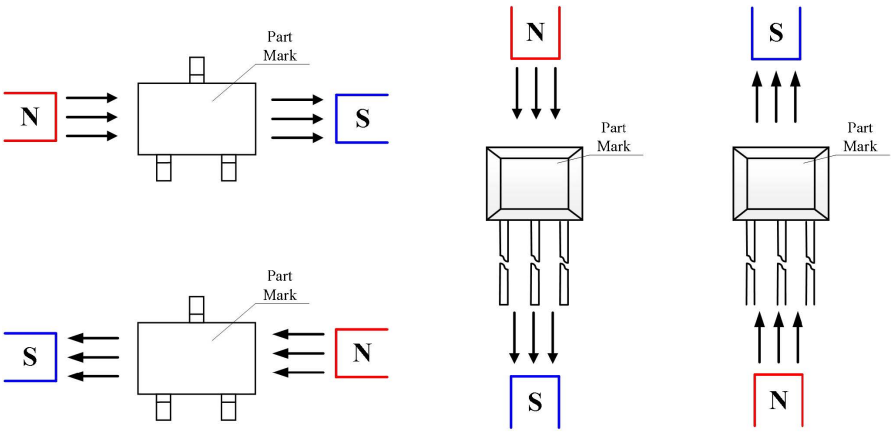


Figure 7: Magnet and Chip Configuration on PCB

7.2 Output Characteristics





8 Part Name Composition

KTM1301 X X-XXX

Package abbreviation: ST3：SOT-23-3L
TO3：TO-92S

Magnetic sensitivity：A: B_{OP}=45 Gauss B: B_{OP}=30 Gauss
C: B_{OP}=18 Gauss D: B_{OP}= 9 Gauss
E: B_{OP}=7 Gauss

Operating cycle： T：Continuous Version M：f = 1.6KHz
S： f = 50Hz

9 Absolute Maximum Ratings

@T_A=+25°C, unless otherwise noted

Parameter	Description	Value	Unit
V_{DD}	Supply voltage	6	V
V_{DD_REV}	Reverse supply voltage	-0.3	V
I_{OUTPUT}	Output drive current	5	mA
B	Maximum magnetic field	3000@<5min	Gauss
T_{STG}	Storage temperature range	-50 ~ +150	°C
T_J	Maximum junction temperature	+150	°C
$T_{soldering}$	Maximum soldering temperature	260	°C
ESD HBM	ESD capability	8000	V

Table 3: Absolute Maximum Ratings

Note: Exceeding absolute maximum ratings may cause permanent damage. Prolonged operation at absolute maximum conditions can affect the reliability of the chip.

10 Reference Operating Conditions

@T_A=+25°C, unless otherwise noted

Parameter	Description	Operating condition	Value	Unit
V_{DD}	Supply voltage range	Chip operating	1.8 ~ 5.5	V
T_A	Operating temperature range	Chip operating	-40 ~ 125	°C

Table 4: Reference Operating Conditions

11 Electrical Parameters

@T_A=+25°C, unless otherwise noted

11.1 KTM1301SX Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage	Operating	1.8	-	5.5	V
V_{OL}	Output low voltage	I_{OUT} = 1mA	-	0.008	0.05	V
V_{OH}	Output high voltage	I_{OUT} = 1mA	$V_{DD}-0.05$	$V_{DD}-0.015$	-	V
$I_{DD(AVG)}$	Average current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	160	-	nA
$I_{DD(Awake)}$	Awake state current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	1.9	-	μA
$I_{DD(Sleep)}$	Sleep state current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	148	-	nA
T_{AWAKE}	Wake-up time	Operating	-	40	-	μs
T_{PERIOD}	Period	Operating	-	20	-	ms

Table 5: KTM1301SX Series Electrical Parameters

11.2 KTM1301MX Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage	Operating	1.8	-	5.5	V
V_{OL}	Output low voltage	I_{OUT} = 1mA	-	0.008	0.05	V
V_{OH}	Output high voltage	I_{OUT} = 1mA	$V_{DD} - 0.05$	$V_{DD} - 0.015$	-	V
$I_{DD(AVG)}$	Average current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	600	-	nA
$I_{DD(Awake)}$	Awake state current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	1.9	-	μA
$I_{DD(Sleep)}$	Sleep state current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	148	-	nA
T_{PERIOD}	Period	Operating	-	625	-	μs
f_s	Sampling frequency	Operating	-	1600	-	Hz

Table 6: KTM1301MX Series Electrical Parameters

11.3 KTM1301TX Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage	Operating	1.8	-	5.5	V
V_{OL}	Output low voltage	I_{OUT} = 1mA	-	0.008	0.05	V
V_{OH}	Output high voltage	I_{OUT} = 1mA	$V_{DD} - 0.05$	$V_{DD} - 0.015$	-	V
$I_{DD(AVG)}$	Average current	$T_A = +25°C$, $V_{DD} = 3.0V$	-	1.9	-	μA
FS	Switching frequency	Operating	-	5000	-	Hz

Table 7: KTM1301TX Series Electrical Parameters

12 Magnetic Parameters

@T_A=+25°C, unless otherwise noted

12.1 KTM1301XA Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
B_{OPS}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	40	45	50	Gauss
B_{RPS}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	31	36	41	Gauss
B_{OPN}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	-50	-45	-40	Gauss
B_{RPN}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	-41	-36	-31	Gauss
B_{HY} ($\lvert B_{OPX}\rvert - \lvert B_{RPX}\rvert$)	Hysteresis		-	9	-	Gauss

Table 8: KTM1301XA Series Magnetic Parameters

12.2 KTM1301XB Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
B_{OPS}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	26	30	36	Gauss
B_{RPS}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	16	21	26	Gauss
B_{OPN}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	-36	-30	-26	Gauss
B_{RPN}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	-26	-21	-16	Gauss
B_{HY} $(\|B_{OPX}\| - \|B_{RPX}\|)$	Hysteresis		-	9	-	Gauss

Table 9: KTM1301XB Series Magnetic Parameters

12.3 KTM1301XC Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
B_{OPS}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	15	18	24	Gauss
B_{RPS}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	9	12	15	Gauss
B_{OPN}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	-24	-18	-15	Gauss
B_{RPN}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	-15	-12	-9	Gauss
B_{HY} $(\|B_{OPX}\| - \|B_{RPX}\|)$	Hysteresis		-	6	-	Gauss

Table 10: KTM1301XC Series Magnetic Parameters

12.4 KTM1301XD Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
B_{OPS}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	6	9	12	Gauss
B_{RPS}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	3	6	9	Gauss
B_{OPN}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	-12	-9	-6	Gauss
B_{RPN}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	-9	-6	-3	Gauss
B_{HY} $(\|B_{OPX}\| - \|B_{RPX}\|)$	Hysteresis		-	3	-	Gauss

Table 11: KTM1301XD Series Magnetic Parameters

12.5 KTM1301XE Series

Parameter	Description	Conditions	Min	Typ	Max	Unit
B_{OPS}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	4	7	10	Gauss
B_{RPS}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	1	4	7	Gauss
B_{OPN}	Magnetic operating point	$T_A = +25°C$, $V_{DD} = 3.0V$	-10	-7	-4	Gauss
B_{RPN}	Magnetic release point	$T_A = +25°C$, $V_{DD} = 3.0V$	-7	-4	-1	Gauss
B_{HY} $(\|B_{OPX}\| - \|B_{RPX}\|)$	Hysteresis		-	3	-	Gauss

Table 12: KTM1301XE Series Magnetic Parameters

13 Performance Curves

13.1 KTM1301XA Series

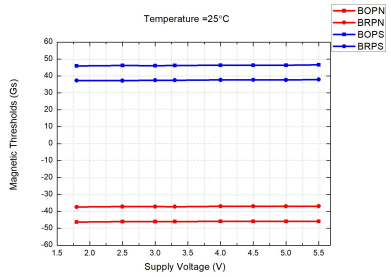


Figure 8: Mag. Thresholds vs. Voltage @ $T_A = 25°C$

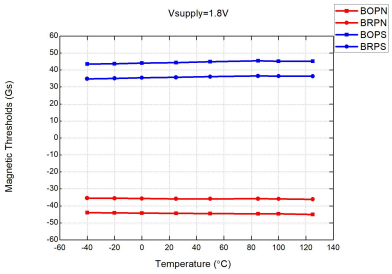


Figure 9: Mag. Thresholds vs. T_A @$V_{DD} = 1.8V$

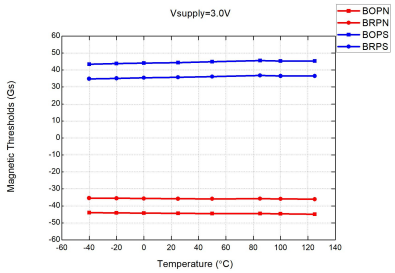


Figure 10: Mag. Thresholds vs. T_A @$V_{DD} = 3.0V$

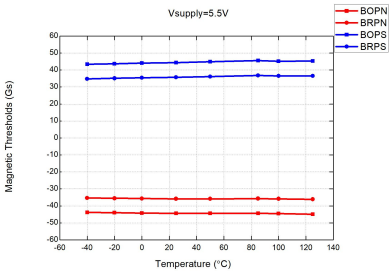


Figure 11: Mag. Thresholds vs. T_A @$V_{DD} = 5.5V$

13.2 KTM1301XB Series

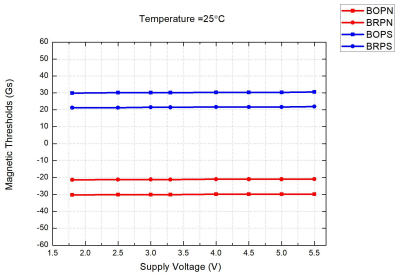


Figure 12: Mag. Thresholds vs. Voltage @$T_A = 25°C$

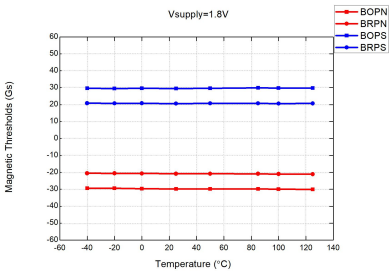


Figure 13: Mag. Thresholds vs. T_A @$V_{DD} = 1.8V$

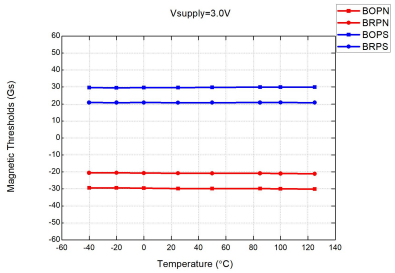


Figure 14: Mag. Thresholds vs. T_A @$V_{DD} = 3.0V$

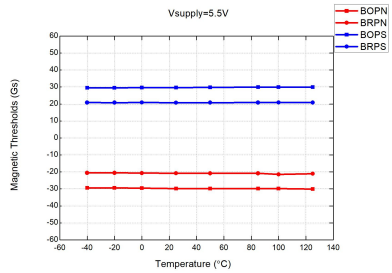


Figure 15: Mag. Thresholds vs. T_A @$V_{DD} = 5.5V$

13.3 KTM1301XC Series

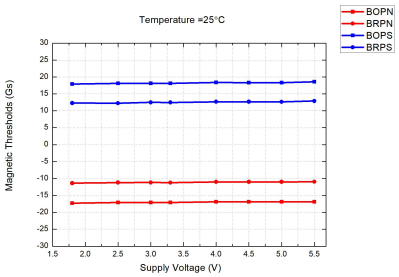


Figure 16: Mag. Thresholds vs. Voltage @$T_A = 25°C$

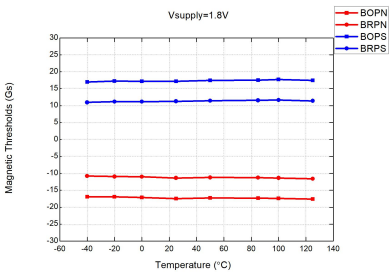


Figure 17: Mag. Thresholds vs. T_A @$V_{DD} = 1.8V$

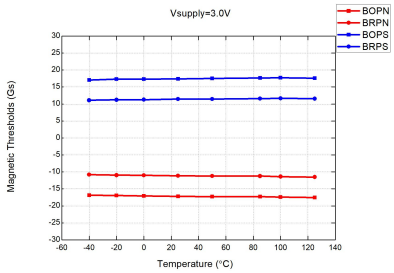


Figure 18: Mag. Thresholds vs. T_A @$V_{DD} = 3.0V$

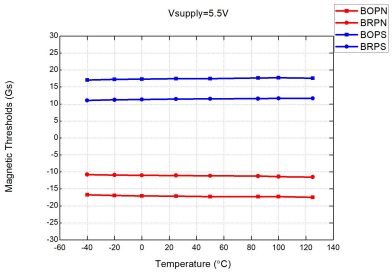


Figure 19: Mag. Thresholds vs. T_A @$V_{DD} = 5.5V$

13.4 KTM1301XD Series

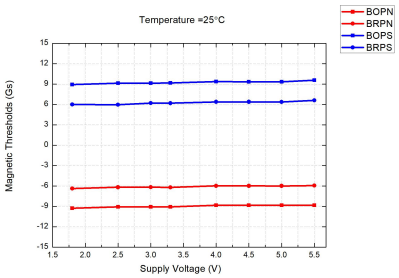


Figure 20: Mag. Thresholds vs. Voltage @$T_A = 25°C$

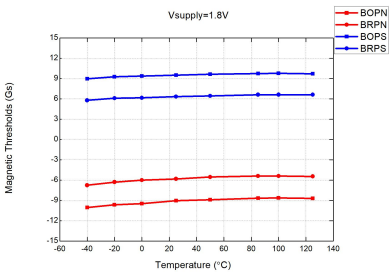


Figure 21: Mag. Thresholds vs. T_A @$V_{DD} = 1.8V$

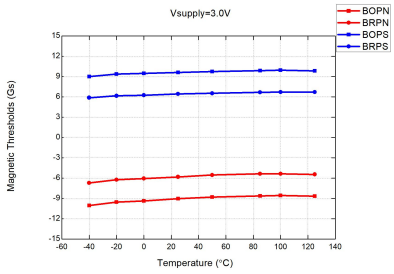


Figure 22: Mag. Thresholds vs. T_A @$V_{DD} = 3.0V$

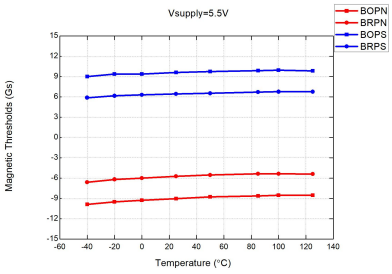


Figure 23: Mag. Thresholds vs. T_A @$V_{DD} = 5.5V$

13.5 KTM1301XE Series

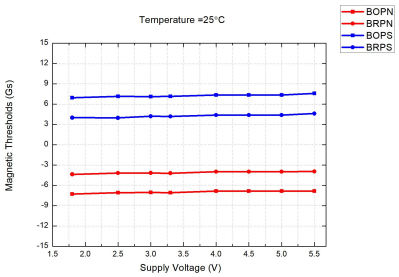


Figure 24: Mag. Thresholds vs. Voltage @$T_A = 25°C$

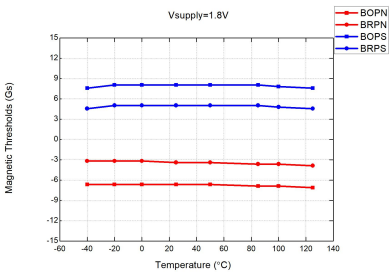


Figure 25: Mag. Thresholds vs. T_A @$V_{DD} = 1.8V$

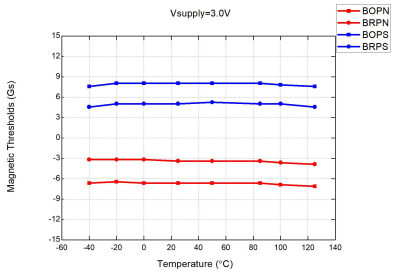


Figure 26: Mag. Thresholds vs. T_A @$V_{DD} = 3.0V$

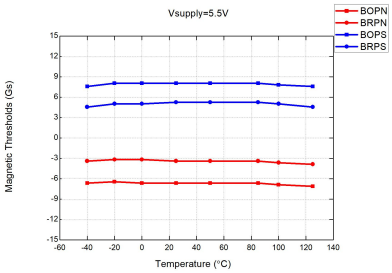


Figure 27: Mag. Thresholds vs. T_A @$V_{DD} = 5.5V$

13.6 Chip consumption in different working frequencies

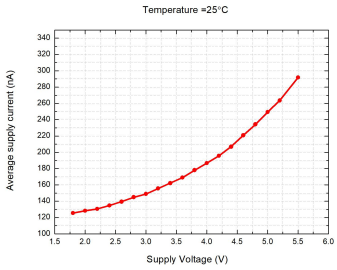


Figure 28: KTM1301SX (50Hz) consu. @$T_A = 25°C$

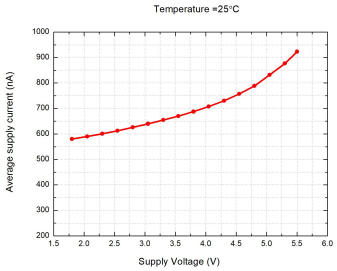


Figure 29: KTM1301MX (1.6kHz) consu. @$T_A = 25°C$

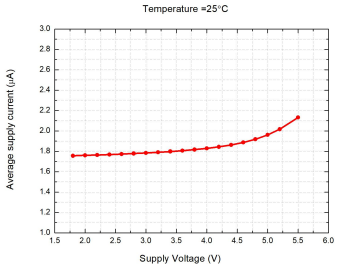


Figure 30: KTM1301TX (continuous operation) consu. @ $T_A = 25°C$

14 Ordering Information

Part Numbers	Package Type	Number of Pins	Magnetic Threshold B_{op}	Operating Frequency	Temperature
KTM1301TA-ST3	SOT-23-3L	3	45 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TB-ST3	SOT-23-3L	3	30 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TC-ST3	SOT-23-3L	3	18 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TD-ST3	SOT-23-3L	3	9 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TE-ST3	SOT-23-3L	3	7 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301MA-ST3	SOT-23-3L	3	45 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MB-ST3	SOT-23-3L	3	30 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MC-ST3	SOT-23-3L	3	18 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MD-ST3	SOT-23-3L	3	9 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301ME-ST3	SOT-23-3L	3	7 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301SA-ST3	SOT-23-3L	3	45 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SB-ST3	SOT-23-3L	3	30 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SC-ST3	SOT-23-3L	3	18 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SD-ST3	SOT-23-3L	3	9 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SE-ST3	SOT-23-3L	3	7 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301TA-TO3	TO-92S	3	45 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TB-TO3	TO-92S	3	30 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TC-TO3	TO-92S	3	18 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TD-TO3	TO-92S	3	9 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301TE-TO3	TO-92S	3	7 Gauss	Continuous operation	$-40°C \sim 125°C$
KTM1301MA-TO3	TO-92S	3	45 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MB-TO3	TO-92S	3	30 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MC-TO3	TO-92S	3	18 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301MD-TO3	TO-92S	3	9 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301ME-TO3	TO-92S	3	7 Gauss	1.6 kHz	$-40°C \sim 125°C$
KTM1301SA-TO3	TO-92S	3	45 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SB-TO3	TO-92S	3	30 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SC-TO3	TO-92S	3	18 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SD-TO3	TO-92S	3	9 Gauss	50 Hz	$-40°C \sim 125°C$
KTM1301SE-TO3	TO-92S	3	7 Gauss	50 Hz	$-40°C \sim 125°C$

Table 13: Ordering Information

15 Package Outline Dimensions

15.1 SOT-23-3L

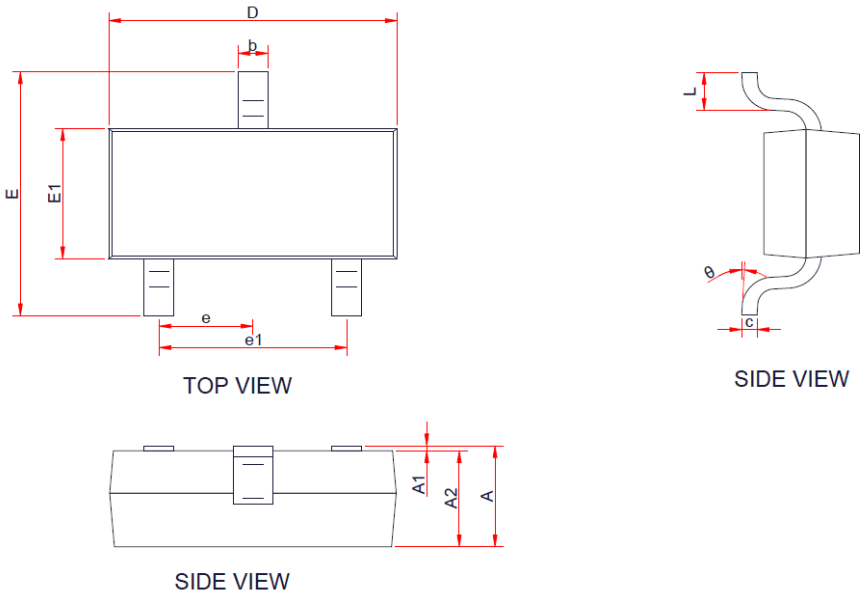


Figure 31: SOT-23-3L Package Dimensions

Symbol	Min (mm)	Typ (mm)	Max (mm)
A	1.0	-	1.25
A1	0.00	-	0.15
A2	1.00	1.10	1.20
b	0.30	-	0.50
c	0.10	-	0.20
D	2.82	2.95	3.02
E	2.65	2.80	2.95
E1	1.50	1.65	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
θ	0°	-	8°

Table 14: SOT-23-3L Package Dimensions

15.2 TO-92S

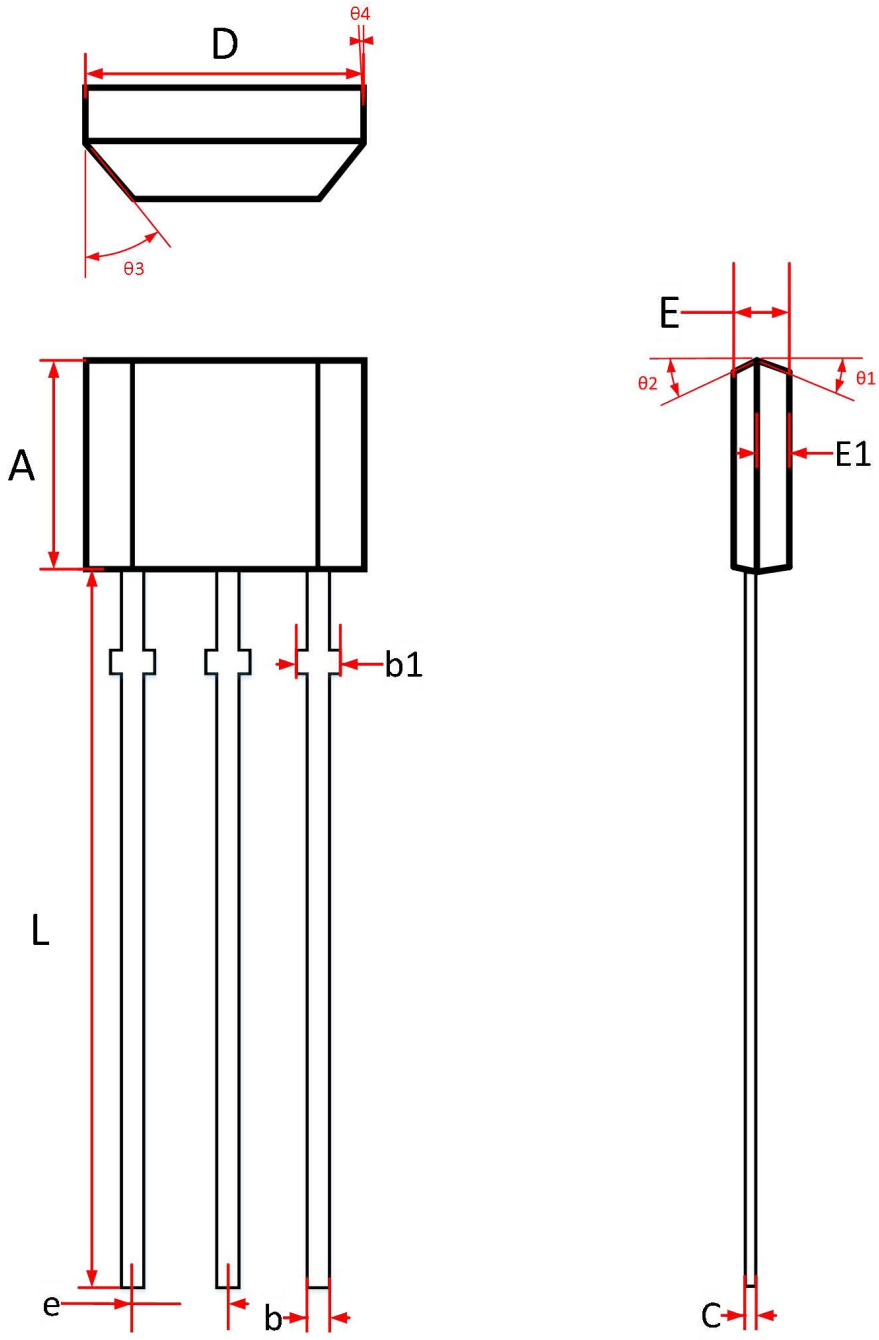


Figure 32: TO-92S Package Dimensions

Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	2.90	3.05	3.25
b	0.33	0.415	0.50
b1	0.40	0.44	0.55
C	0.36	0.38	0.45
D	3.90	4.00	4.10
E	1.42	1.52	1.62
E1	-	0.75	-
e		1.27 (TYP)	
L	13.50	14.50	15.50
θ_1	-	6°	-
θ_2	-	3°	-
θ_3	-	45°	-
θ_4	-	3°	-

Table 15: TO-92S Package Dimensions