

KTH462N Series

High-Performance, Low Power, Ultra-Sensitivity
2D Hall Switch

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1 Features

- Low power consumption
 - 30Hz version: average current is $32.3\mu\text{A}@2.5\text{V}$
 - Continuous mode (1.7KHz): average current is $1.9\text{mA}@2.5\text{V}$
- Wide supply voltage range: $2.5\text{V} \sim 5.5\text{V}$
- Magnetic threshold: typical $B_{OP} = 25\text{Gs}$
- Latch-type operation
- NMOS open-drain output
- Package: SOT-23-6L
- Operating temperature: $-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$
- Excellent ESD protection: HBM $\pm 4\text{kV}$
- RoHS compliant

2 Typical Applications

- 2D magnetic field switching detection
- Rotary knob control
- Smart door/window sensors
- Electric garage door detection

3 Application Circuit

In order to filter power supply noise, a $1\mu\text{F}$ capacitor should be connected between VDD and GND, and placed as close as possible to the VDD pin.

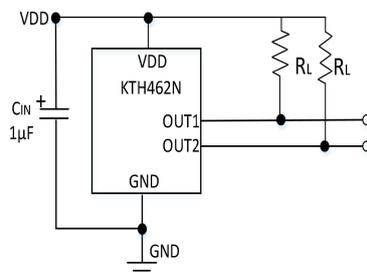


Figure 1: Typical application circuit

4 Overview

The KTH462N series is a low-power, latch-type Hall-effect sensor capable of detecting two-dimensional magnetic fields.

It provides two independent digital outputs:

- KTH4622 series: for speed and direction calculation
- KTH4621 series: for direct latch-type switch outputs on each axis

Multiple switching frequencies and package options are available for various applications.

When the applied magnetic flux density exceeds the operating point B_{OP} , the chip outputs logic LOW and maintains it. When the field drops below the release point B_{RP} , the output returns to HIGH.

Internally, the chip integrates:

- Ultra-sensitive, low-offset Hall plates (XY, XZ, YZ)
- Multiplexing switches
- Differential amplifiers
- Schmitt triggers
- NMOS open-drain outputs

Advanced SPIN and digital filtering techniques, alongside optimized clock control, ensure stability in switching points and operating frequency.

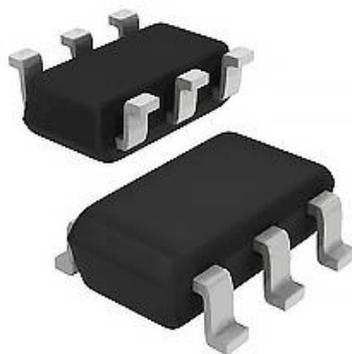


Figure 2: Package: SOT-23-6L

5 Part Number Information

Table 1: Model Matrix

Model	B_{OP} (typ.)	Detection Plane	OUT1	OUT2
KTH4621AXX	25 Gs	XY	X	Y
KTH4621BXX	25 Gs	XZ	Z	X
KTH4621CXX	25 Gs	YZ	Z	Y
KTH4622AXX	25 Gs	XY	Speed	Direction
KTH4622BXX	25 Gs	XZ	Speed	Direction
KTH4622CXX	25 Gs	YZ	Speed	Direction

6 Pin Definition and Descriptions

The KTH462N series adopts the SOT-23-6L package. The pin configuration and markings are shown below.

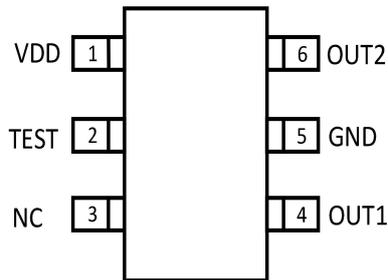


Figure 3: SOT-23-6L pin configuration

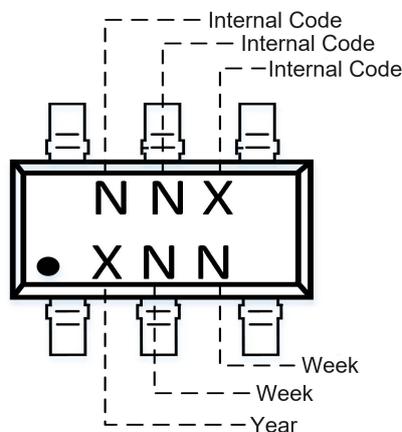


Figure 4: SOT-23-6L marking view

Table 2: Pin Descriptions (KTH462NXXX-ST6)

Pin	Symbol	Description
1	VDD	Power supply
2	TEST	Ground
3	NC	Ground
4	OUT1	KTH4621A: X-axis output KTH4621B: Z-axis output KTH4621C: Z-axis output KTH4622: Speed output
5	GND	Ground
6	OUT2	KTH4621A: Y-axis output KTH4621B: X-axis output KTH4621C: Y-axis output KTH4622: Direction output

7 Functional Block Diagram

Different models integrate combinations of orthogonal Hall plates (XY, XZ, YZ).

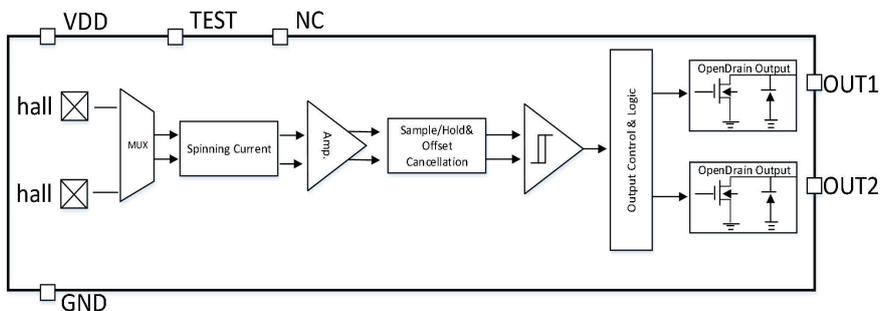


Figure 5: Block diagram of KTH462N series

8 Functional Description

Common 2D latch-type Hall sensors are typically constructed from either dual-plane latching Hall elements or two single-plane latching sensors. These devices are widely applied in rotary encoders or sensing applications that require speed and directional indication.

The basic principle is to spatially separate the two Hall sensors by a certain angle so that both can perceive the same rotating magnetic field while maintaining a fixed phase difference. The frequency of the output signals reflects speed or displacement, while the phase difference between them reveals the direction of rotation.

1

To achieve this, the two latching elements must be placed with a magnetic spacing of half a pole plus an integer multiple of full poles ($\frac{1}{2}$ pole + n poles), thereby creating signals with a 90° phase difference.

The KTH462N series integrates two orthogonal latching-type Hall sensor units internally. There are three main variants, each capable of detecting magnetic field components along different orthogonal planes (XY, XZ, and YZ). In other words, each device measures the same magnetic field projected onto different orthogonal planes.

For the three variants—A, B, and C—the detection directions are respectively XY, XZ, and YZ. Since the two sensing axes within each chip are arranged orthogonally, the corresponding output signals will naturally be separated by 90° .

Thus, regardless of the sensor's placement in a system, the two output signals will always remain orthogonal to each other.

¹In quadrature signal processing, orthogonal waveforms with a 90° phase difference are preferred to accurately extract direction.

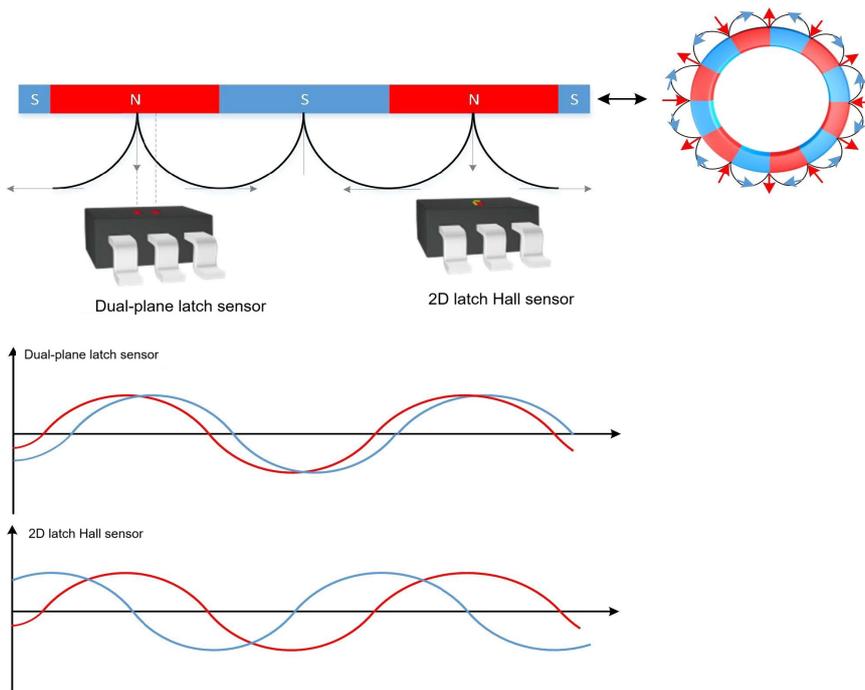


Figure 6: Comparison between dual-plane latch sensor and 2D latch Hall sensor

9 Output Characteristics

The KTH462N series provides two independent digital outputs. For the KTH4622 series, these outputs are internally processed to represent rotational speed and direction. For the KTH4621 series, each output directly reflects the latch-type switching state of an individual sensing axis.

Figure 7 and Figure 8 illustrates the response waveforms of the KTH4621 and KTH4622 series when exposed to a sinusoidal magnetic field. For the KTH4621 series, each channel behaves as a standard latch-type Hall switch:

When the applied magnetic flux density on a given axis exceeds the operating threshold B_{OP} , the corresponding output is pulled LOW and latched in that state. Only when the field drops below the release point B_{RP} does the output return HIGH.

The KTH4622 series, in contrast, includes an internal logic block that converts these raw switching signals into quadrature signals used to determine speed and direction of magnetic field rotation.

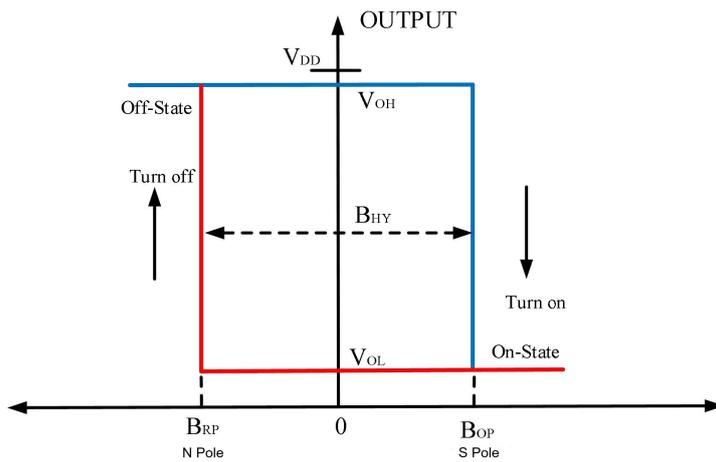


Figure 7

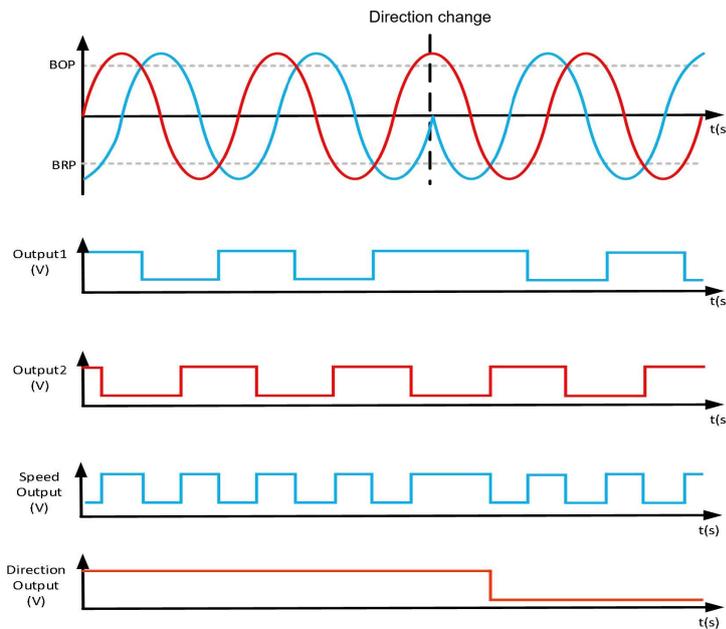


Figure 8: Output modes of KTH462N

Note: For the KTH4622 series, when powered on in the presence of a magnetic field, the initial output states of the speed and direction pins are undefined. These states depend on the magnetic environment surrounding the chip at the moment of power-up.

In a magnetic field-free environment, the speed output pin defaults to a logic LOW level, while the direction output pin defaults to a logic HIGH level.

10 Model Configuration

This section outlines the naming structure for KTH462N series models. Each model code defines the detection plane, operating frequency, and packaging type.

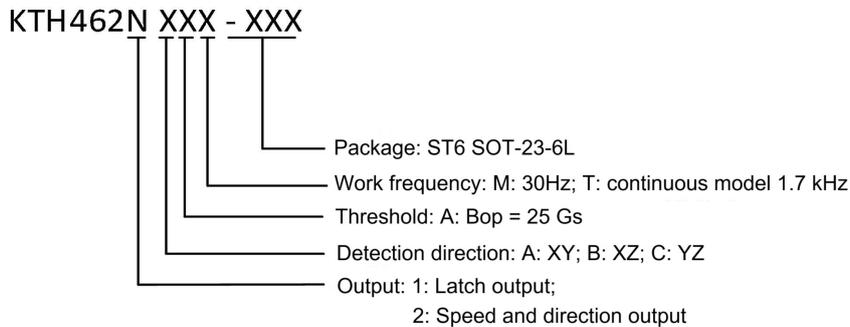


Figure 9: Model Configuration

11 Absolute Maximum Ratings

Unless otherwise specified, all parameters are tested at $T_A = 25^\circ\text{C}$ and voltages are referenced to GND.

Table 3: Absolute Maximum Ratings

Parameter	Symbol	Min	Max
Supply Voltage	V_{DD}	-0.3 V	6 V
Output Current	I_{OUTPUT}	—	30 mA
Magnetic Field	B	—	No limit
Storage Temperature	T_{STG}	-50 °C	150 °C
Junction Temperature	T_J	—	$\leq 150^\circ\text{C}$
ESD Rating (HBM)	—	-6000 V	6000 V

12 Recommended Operating Conditions

Table 4: Recommended Operating Conditions

Parameter	Description	Conditions	Value
V_{DD}	Supply voltage range	Chip operation	2.5 V ~ 5.5 V
T_A	Ambient operating temperature	Chip operation	-40 °C ~ 125 °C

13 Electrical Characteristics

Unless otherwise specified, test conditions are: $T_A = 25\text{ °C}$,
 $V_{DD} = 3.3\text{ V}$

KTH462N XAM Series (Low Power, 30Hz)

Table 5: Electrical Characteristics —KTH462N XAM

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply voltage	V_{DD}	—	2.5	3.3	5.5	V
Low-level output voltage	V_{OL}	$I_{OUT} = 1\text{ mA}$	—	0.01	0.05	V
High-level output voltage	V_{OH}	$I_{OUT} = 1\text{ mA}$	$V_{DD} - 0.15$	$V_{DD} - 0.1$	—	V
Average supply current	$I_{DD(avg)}$	$V_{DD} = 2.5\text{ V}$ $T_A = 25\text{ °C}$	—	32.3	—	μA
Wake-up time	T_{AWAKE}	—	—	945	—	μs
Sampling frequency	f_S	—	—	30	—	Hz

KTH462N XAT Series (Continuous Mode, 1.7kHz)

Table 6: Electrical Characteristics —KTH462N XAT

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply voltage	V_{DD}	—	2.5	3.3	5.5	V
Low-level output voltage	V_{OL}	$I_{OUT} = 1 \text{ mA}$	—	0.01	0.05	V
High-level output voltage	V_{OH}	$I_{OUT} = 1 \text{ mA}$	$V_{DD} - 0.15$	$V_{DD} - 0.1$	—	V
Average supply current	$I_{DD(avg)}$	$V_{DD} = 2.5 \text{ V}$ $T_A = 25 \text{ }^\circ\text{C}$	—	1.9	—	mA
Sampling frequency	f_S	—	—	1.7	—	kHz

14 Magnetic Characteristics

Unless otherwise specified, test conditions are: $T_A = 25 \text{ }^\circ\text{C}$, $V_{DD} = 3.3 \text{ V}$

Table 7: Magnetic Parameters

Symbol	Description	Test Conditions	Min	Typ	Max	Unit
$B_{OP(out1)}$ $B_{OP(out2)}$	Magnetic operate point	South pole to the left, facing the bottom or marked side (see Fig. 10)	—	25	40	GS
$B_{RP(out1)}$ $B_{RP(out2)}$	Magnetic release point	South pole to the left, facing the bottom or marked side (see Fig. 10)	-40	-25	—	GS
$B_{HY(out1)}$ $B_{HY(out2)}$	Magnetic hysteresis	$B_{HY} = B_{OP(out1)} - B_{RP(out1)} $ $B_{HY} = B_{OP(out2)} - B_{RP(out2)} $	—	50	—	GS

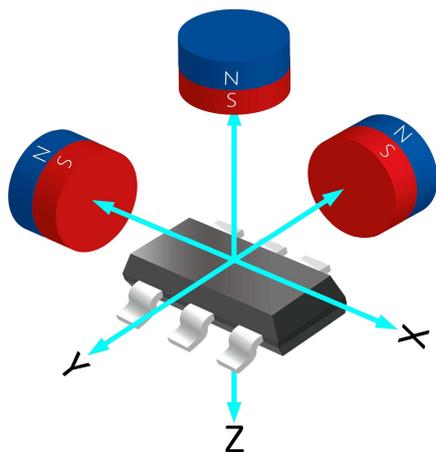


Figure 10: 3D Orientation of Magnetic Axis

15 Performance Curves

The following plots illustrate the magnetic and electrical performance of the KTH462N series under varying supply voltages and temperatures.

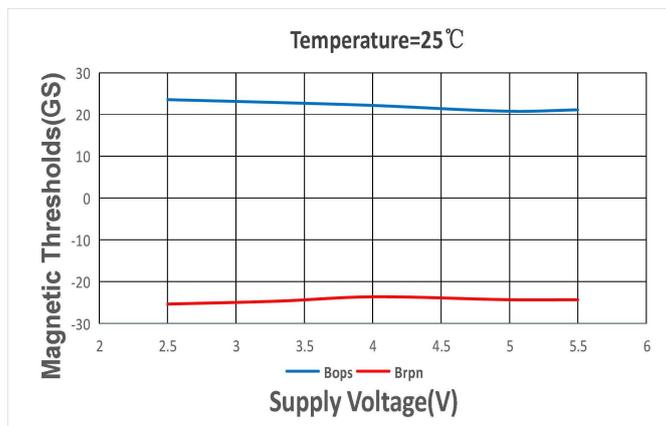


Figure 11: X-axis Magnetic Threshold vs V_{DD} at $T_A = 25^\circ\text{C}$

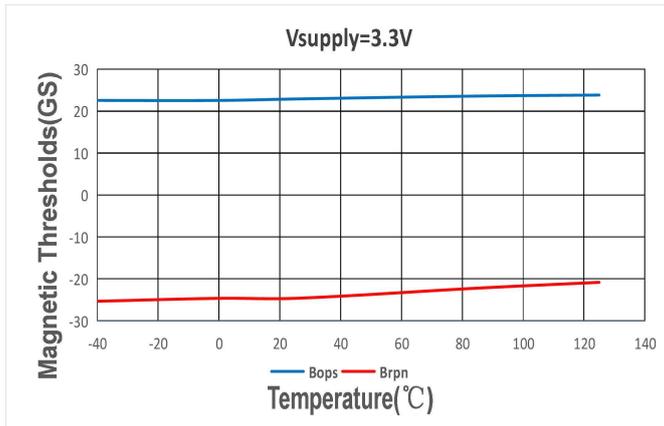


Figure 12: X-axis Magnetic Threshold vs Temperature at $V_{DD} = 3.3V$

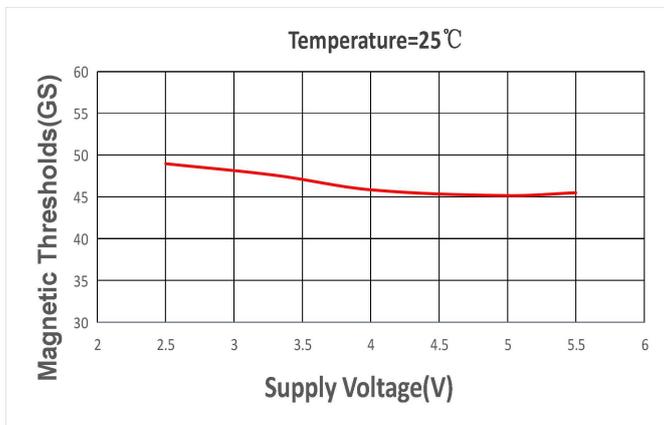


Figure 13: X-axis Hysteresis vs V_{DD} at $T_A = 25^\circ C$

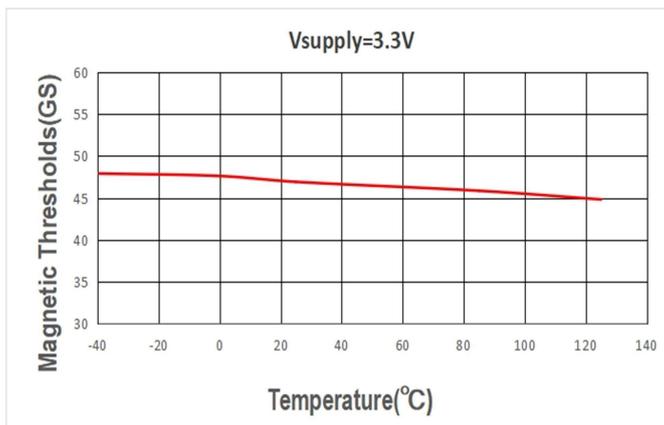


Figure 14: X-axis Hysteresis vs Temperature at $V_{DD} = 3.3V$

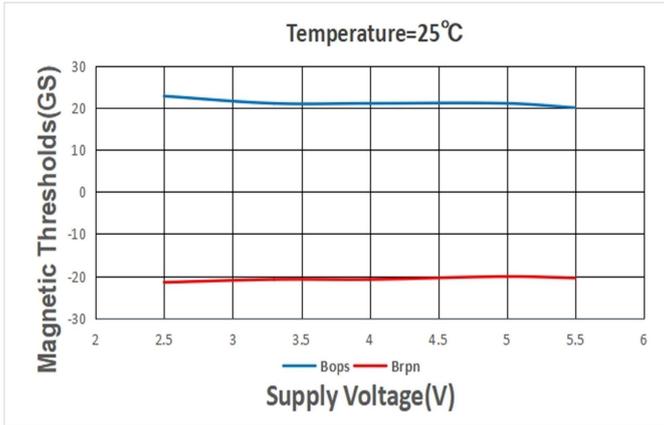


Figure 15: Y-axis Magnetic Threshold vs V_{DD} at $T_A = 25^\circ\text{C}$

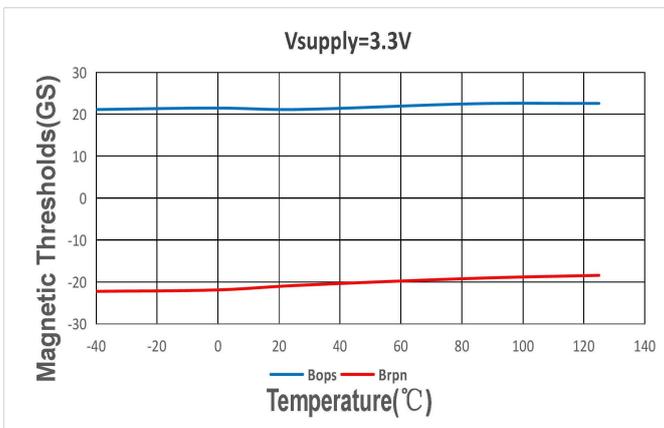


Figure 16: Y-axis Magnetic Threshold vs Temperature at $V_{DD} = 3.3\text{V}$

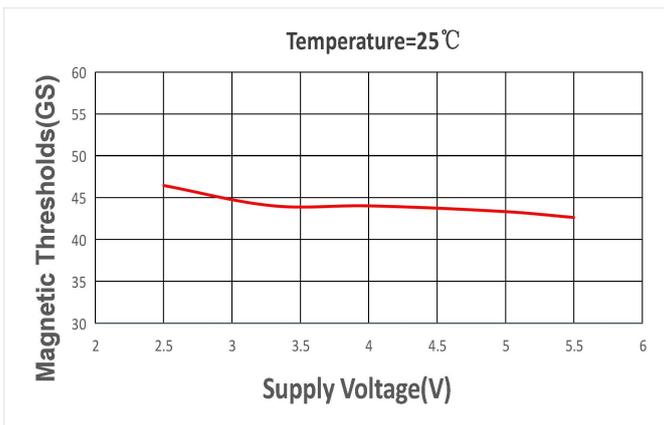


Figure 17: Y-axis Hysteresis vs V_{DD} at $T_A = 25^\circ\text{C}$

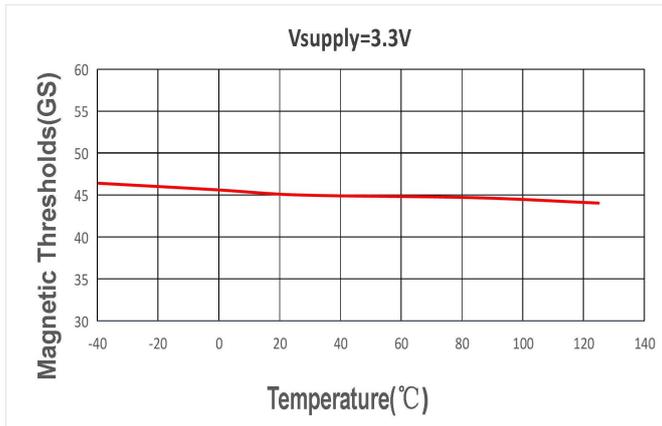


Figure 18: Y-axis Hysteresis vs Temperature at $V_{DD} = 3.3V$

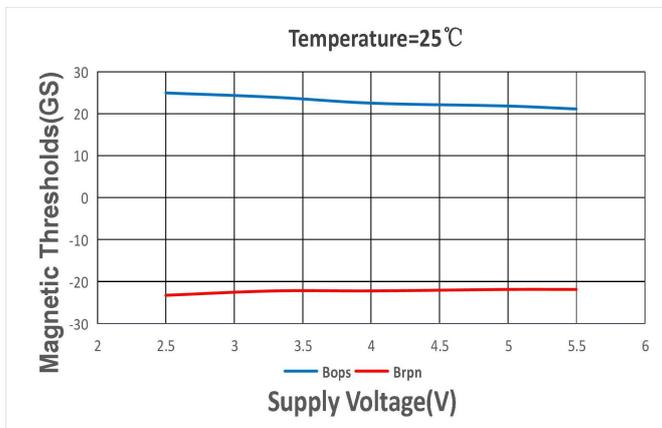


Figure 19: Z-axis Magnetic Threshold vs V_{DD} at $T_A = 25^\circ C$

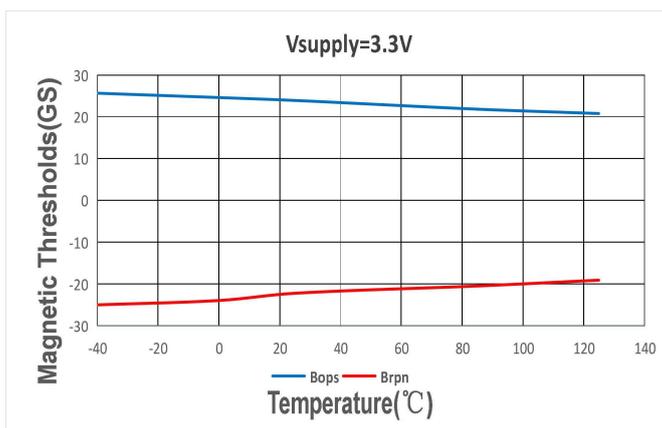


Figure 20: Z-axis Magnetic Threshold vs Temperature at $V_{DD} = 3.3V$

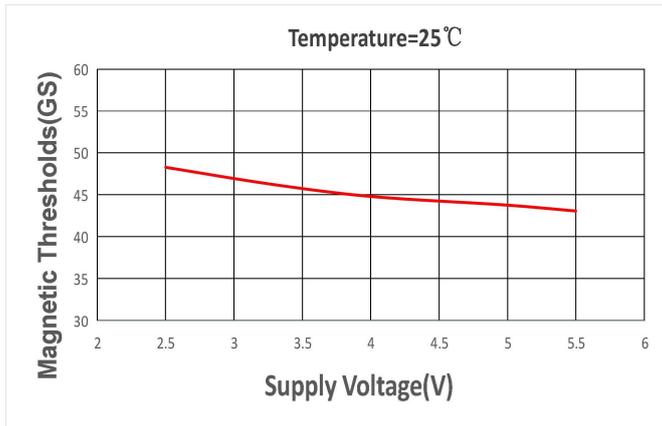


Figure 21: Z-axis Hysteresis vs V_{DD} at $T_A = 25^\circ\text{C}$

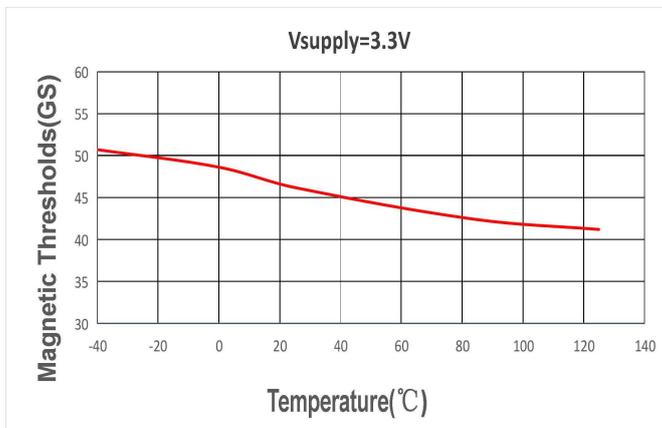


Figure 22: Z-axis Hysteresis vs Temperature at $V_{DD} = 3.3\text{V}$

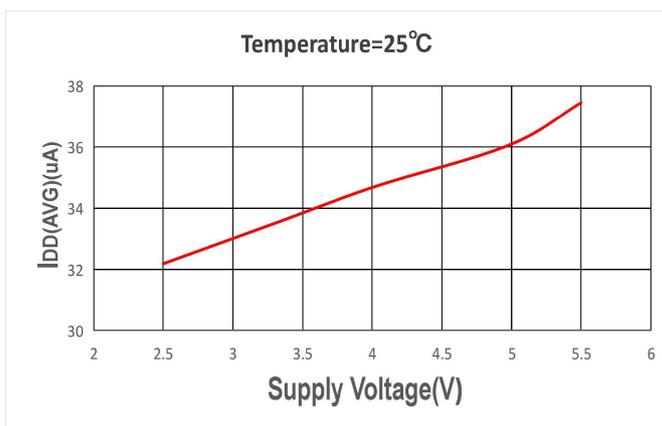


Figure 23: Average Current vs V_{DD} for KTH462NXXM series at $T_A = 25^\circ\text{C}$

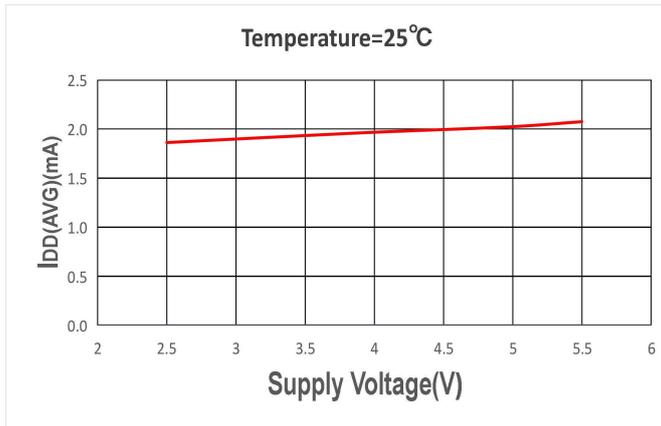


Figure 24: Average Current vs V_{DD} for KTH462NXXT series at $T_A = 25^\circ\text{C}$

16 Ordering Information

The following table lists available part numbers for the KTH462N series, including their configurations, package types, and recommended operating conditions.

Table 8: Ordering Information for KTH462N Series

Model	Package	Pins	Magnetic Threshold	Switching Frequency	Temperature Range
KTH4621AAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4621BAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4621CAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4621AAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4621BAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4621CAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622AAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622BAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622CAM-ST6	SOT-23-6L	6	25 Gs	30 Hz	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622AAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622BAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$
KTH4622CAT-ST6	SOT-23-6L	6	25 Gs	Continuous	$-40^\circ\text{C} \sim 125^\circ\text{C}$

17 Magnet Placement Guidelines

The outer edge of a ring magnet typically exhibits the strongest magnetic field. Placing the sensor near this edge maximizes flexibility in determining sensing distance.

Figures 25 demonstrate placement options for the KTH462NAXX, which senses in the XY plane. The sensor may be positioned on the same plane as the ring magnet, either directly facing it or mounted laterally. Rotation around the Z-axis by 180° is permitted.

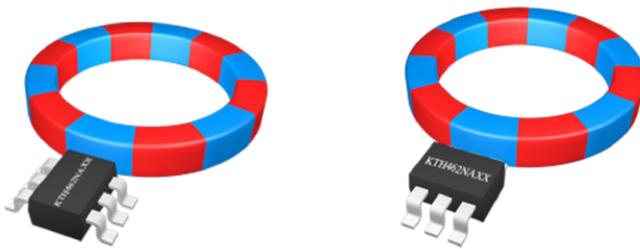


Figure 25: KTH462NAXX in XY plane: same-plane front or side mounting

Figures 26 show the KTH462NBXX configuration, which detects magnetic fields in the XZ plane. The sensor may be located beneath the magnet or aligned vertically with it. Z-axis rotation is supported.

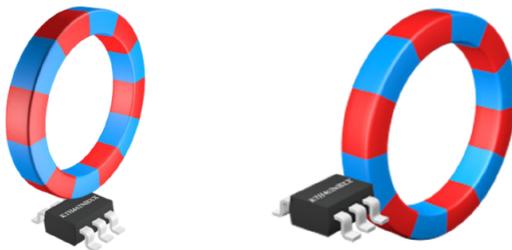


Figure 26: KTH462NBXX in XZ plane: bottom-mounted or front-facing

Figures 27 illustrate the YZ detection layout using KTH462NCXX. The sensor is located under the magnet or with its lateral surface facing the magnet's ring. Z-axis rotation remains valid.

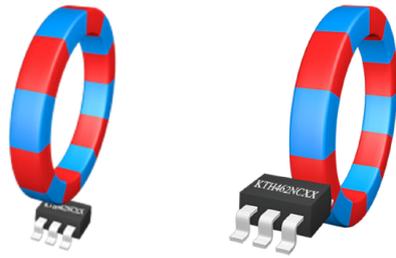


Figure 27: KTH462NCXX in YZ plane: under or lateral placement

The magnetic field at the side edge of a ring magnet is significantly weaker than at its outer edge. When the sensor is placed near this side edge, sensing distance flexibility is reduced. In such cases, a stronger magnet may be necessary.

Figures 28 further show how KTH462NAXX may be placed in the XY plane with its sensing surface or lateral edge facing the magnet's side. Z-axis rotation is supported.

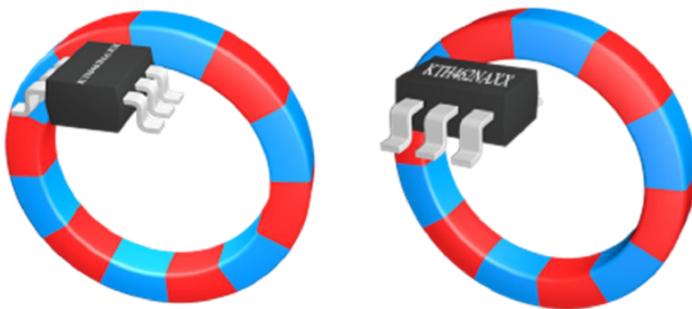


Figure 28: KTH462NAXX in XY plane: facing side edge of the magnet

Figures 29 show KTH462NBXX in the XZ plane, with either the sensor's front or top surface facing the magnet side.

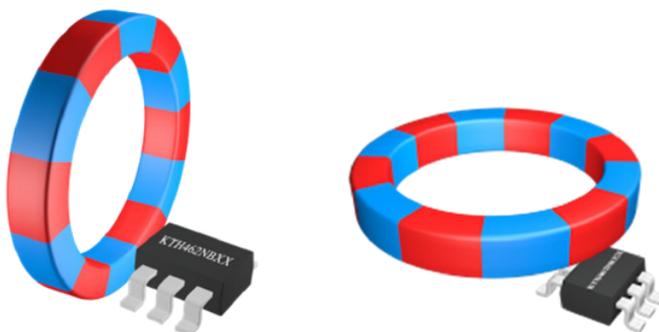


Figure 29: KTH462NBXX in XZ plane: front-facing or top-facing side edge

Figures 30 illustrate KTH462NCXX placements in the YZ

plane, either side-facing or top-facing relative to the magnet's side edge.

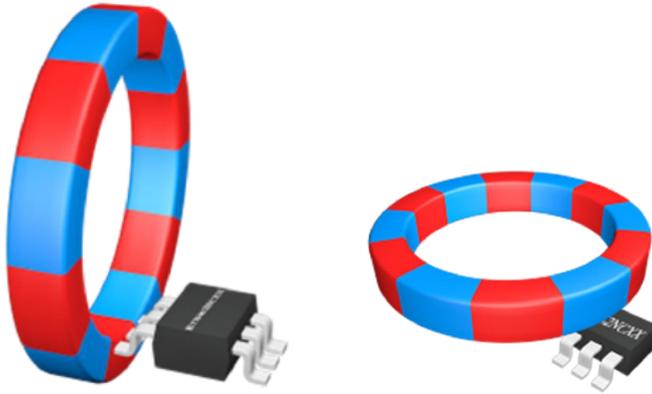


Figure 30: KTH462NCXX in YZ plane: lateral or top orientation toward magnet side

18 Package Information

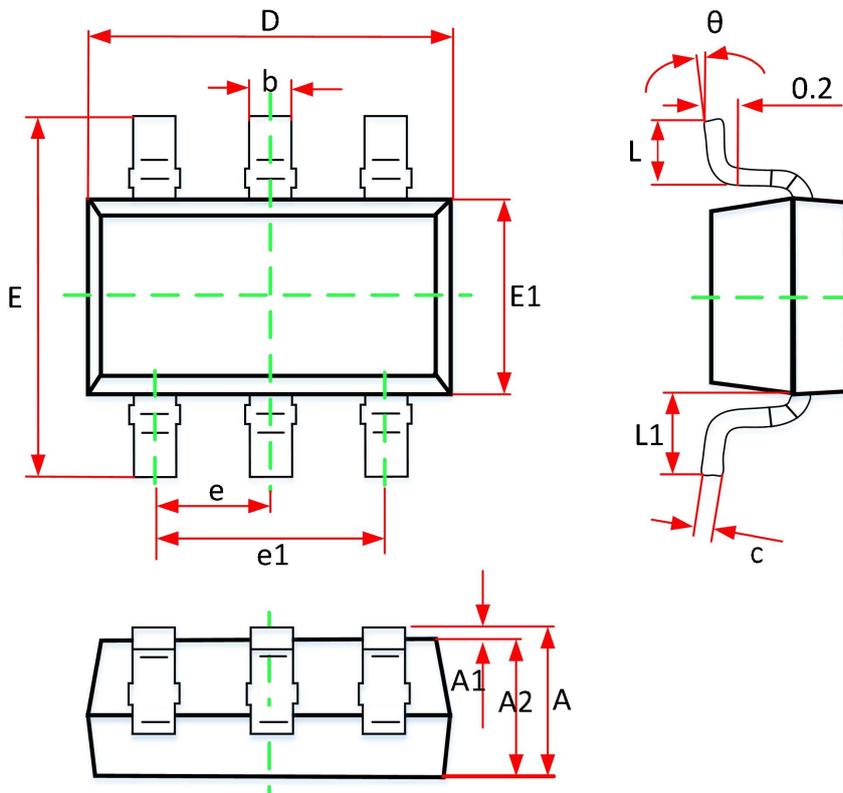


Figure 31: SOT-23-6L Outline Drawing

Table 9: SOT-23-6L Package Dimensions

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.050	1.280	0.041	0.050
A1	0.000	0.130	0.000	0.005
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.720	0.059	0.068
E	2.650	3.000	0.104	0.118
e	0.950 (BSC)		0.037 (BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600 (REF)		0.024 (REF)	
θ	0°	8°	0°	8°