High sensitivity, Low Power, Omni-polar Hall Switch

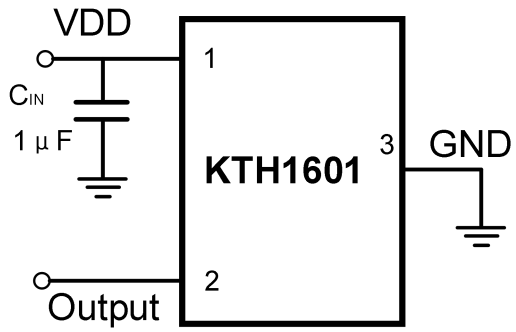
Features

- Low power Consumption
  - 5Hz Version：1.6uA@1.8V (typical)
  - 20Hz Version：3.3uA@1.8V (typical)
- Supply Voltage：1.6V~5.5V
- High Magnetic Sensitivity
  - B_{OP}=±22Gs B_{RP}=±16GS
  - B_{OP}=±33Gs B_{RP}=±23GS
  - B_{OP}=±46Gs B_{RP}=±34GS
- Magnetic Type: Omni-polar
- No External Pull-up Resistors Required
- Package：SOT-23-3L
  SOT-553
  TO-92S
- Operating Temperature：-40℃~85℃
- High ESD Rating：HBM 8KV
- RoHS Compliant

Application

- Cover switch in notebook PC/PAD
- TWS Earphones
- Door, Lids and Tray Position Switches
- Water, electric and gas utility meters
- Level, proximity and position switches

Typical Application Circuit

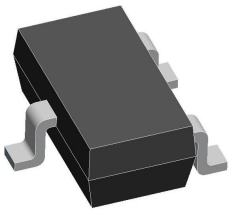


Note: C_{IN} is for stabilization and to strengthen the noise immunity, the recommended capacitance is 1 μ F typical and should be placed as close to the supply pin as possible.

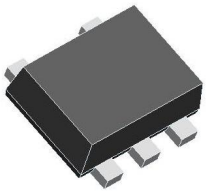
Descriptions

The KTH1601 is a miniature micropower magnetic Hall effect switch IC with single output. The temperature compensation circuitry improves stability of magnetic switch points over the whole operating range. If the magnetic flux density perpendicular to the part marking surface is larger than operating point (BOP), the output will be turned on; if it is less than releasing point (BRP), the output will be turned off. Designed for battery powered consumer equipment, home applications and industrial applications, the average supply current is only 1.6μA at 1.8V. To support portable equipment the KTH1601 can operate over the supply range of 1.6V to 5.5V.

The KTH1601 family provides a variety of package to customers: SOT-23-3L, SOT-553 for surface mount and TO-92S flat for through-hole mount. All package are RoHS compliant.



SOT-23-3L

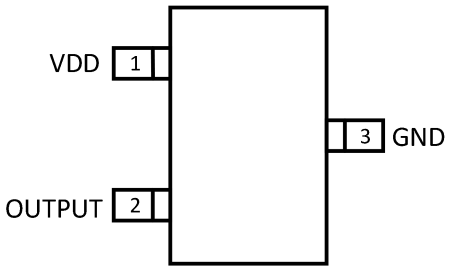


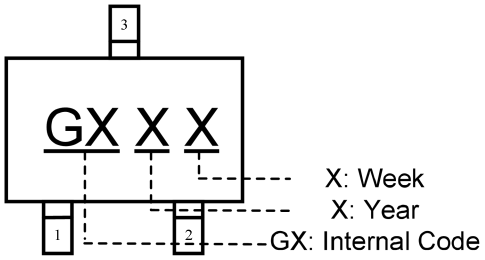
SOT-553

TO-92S

Pin Descriptions

SOT-23-3L

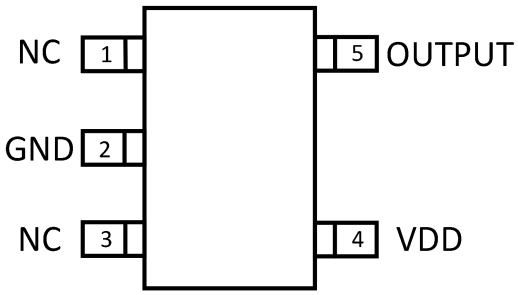


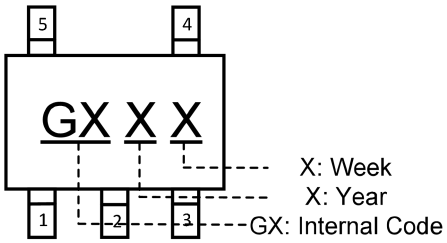


Top view

Pin Name	Pin Number	Function
VDD	1	Power Supply Input
OUTPUT	2	Output pin
GND	3	Ground Pin

SOT-553

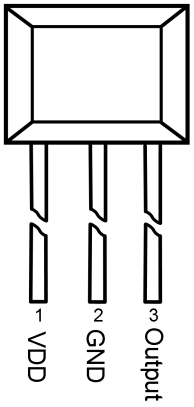


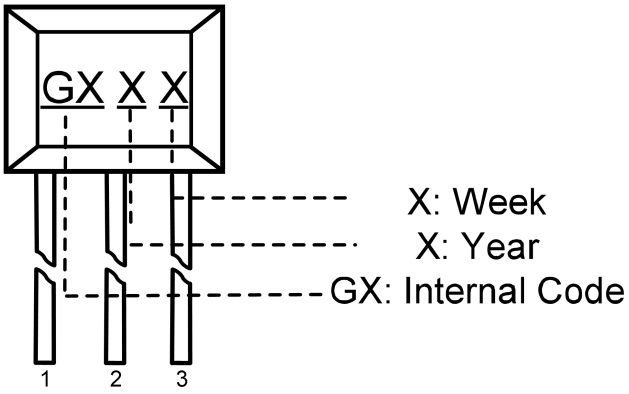


Top view

Pin Name	Pin Number	Function
VDD	4	Power Supply Input
OUTPUT	5	Output Pin
GND	2	Ground Pin
NC	1，3	NA

TO-92S

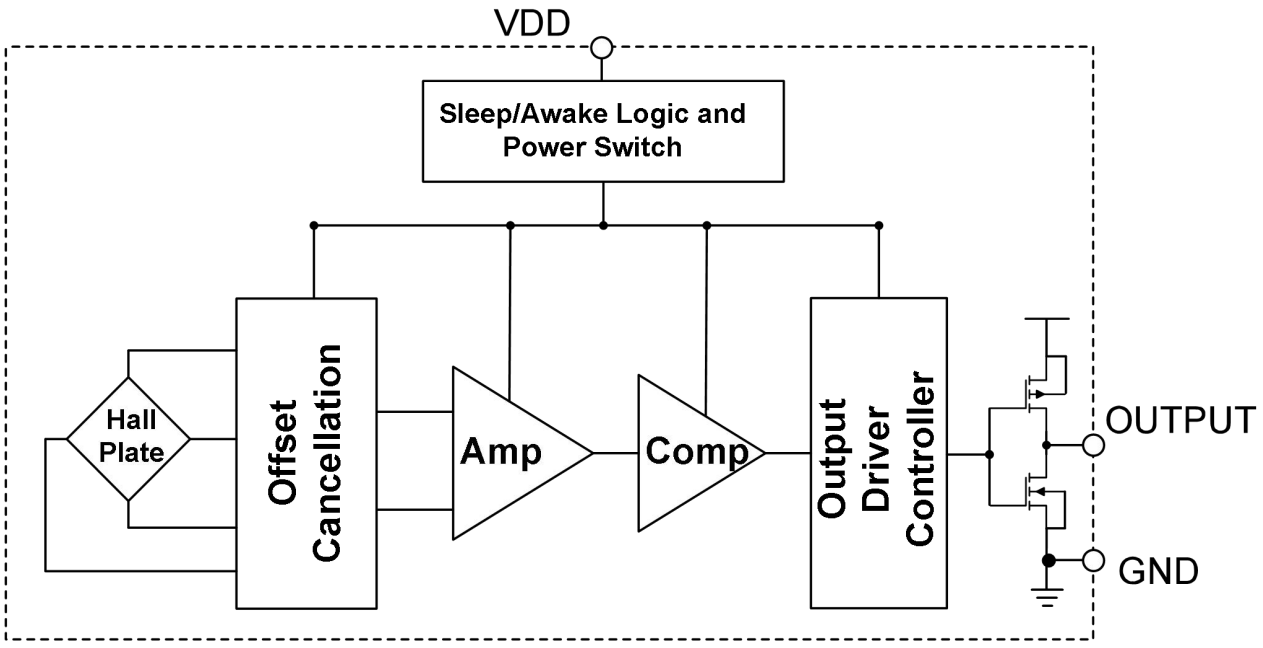




Top view

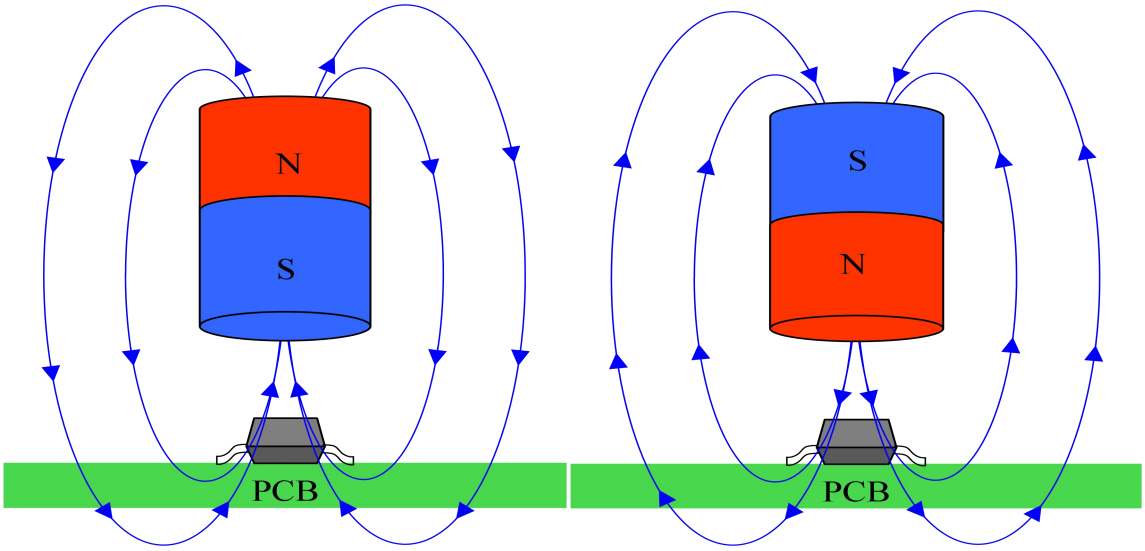
Pin Name	Pin Number	Function
VDD	1	Power Supply Input
GND	2	Ground Pin
OUTPUT	3	Output Pin

Block Diagram

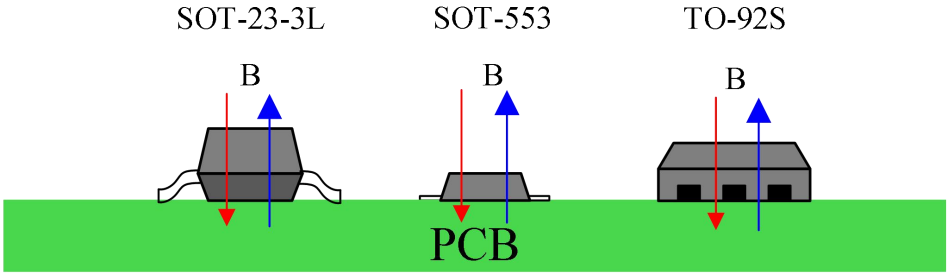


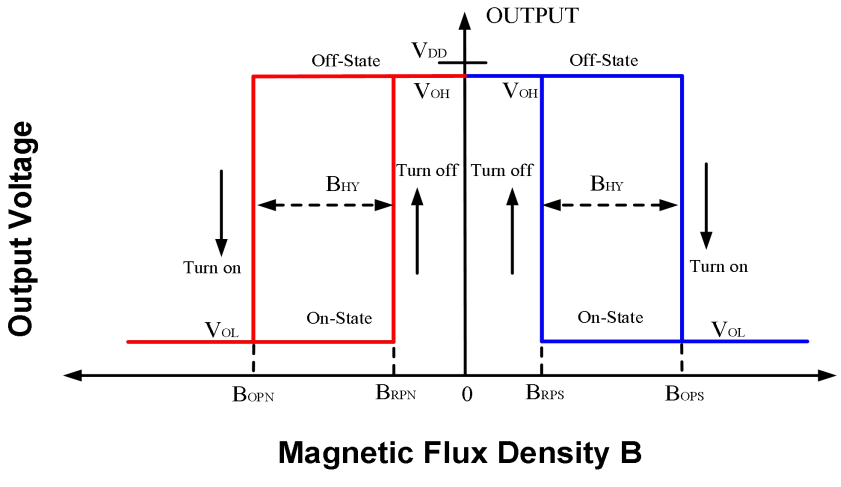
Output Switching Characteristics

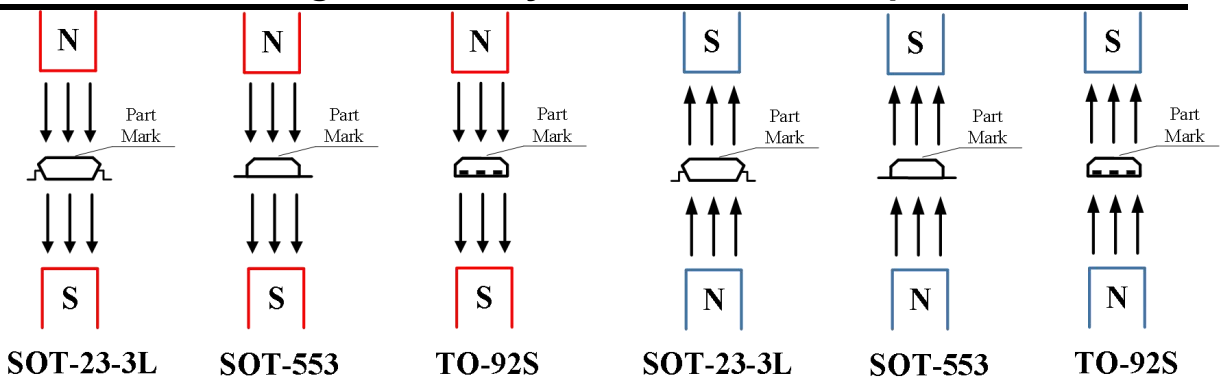
As shown in the figure below, when the South Pole of the magnet is near the top of the chip, the magnetic induction line passes from the bottom of the chip to the top. It is considered that the magnetic induction intensity B is positive at this time.When the North Pole of the magnet is near the top of the chip, the magnetic induction line passes from the top of the chip to the bottom, and the magnetic induction intensity B is considered to be negative.



As shown in the figure below, KTH1601 can detect the magnetic fields of the South Pole and the North Pole.







Magnetic Field Directions for Omnipolar Mode Operation

Product Name Structure

KTH1601 X X-XXX

- Package abbreviation：ST3：SOT-23-3L
  SF5：SOT-553
  TO3：TO-92S
- Magnetic sensitivity：H: B_{OP}=46 Gauss
  L： B_{OP}=33 Gauss
  U： B_{OP}=22 Gauss
- Operating cycle：T：f = 20Hz
  S：f = 5Hz

Absolute Maximum Ratings （@T_A=+25℃, unless otherwise specified）

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage Dissipation	6	V
V_{DD_REV}	V_{IN} Range	-0.3	V
I_{OUTPUT}	Output Current	5	mA
B	Magnetic Flux Density	Unlimited	Gauss
T_{STG}	Storage Temperature Range	-50～+150	℃
T_J	Maximum Junction Temperature	+150	℃
ESD HBM	Human Body Model ESD Capability	8000	V

Note: Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

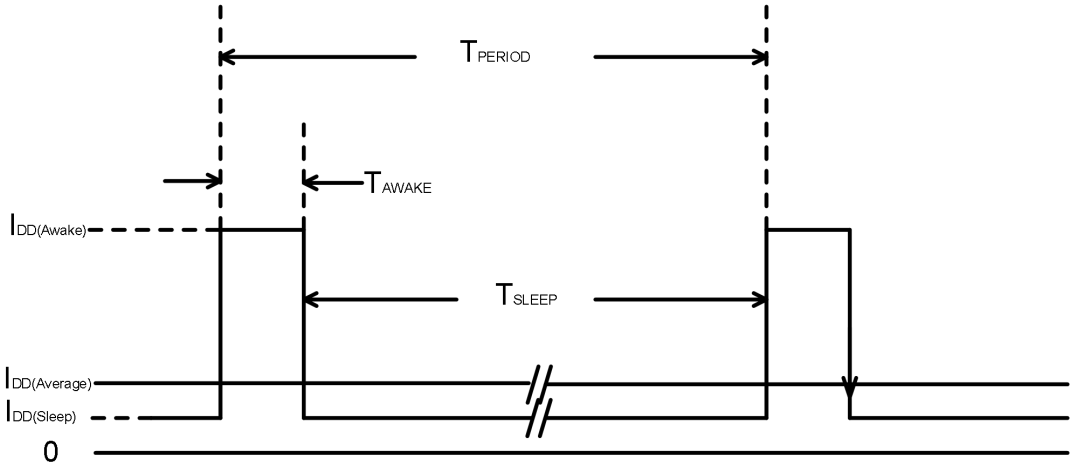
Recommended Operating Range （@T_A=+25℃, unless otherwise specified）

Symbol	Parameter	Conditions	Value	Unit
V_{DD}	Supply Voltage	Operating	1.6～5.5	V
T_A	Operating temperature Range	Operating	-40～85	ºC

Electronics Characteristics （@T_A=+25℃, V_{DD}=1.8V, unless otherwise specified）

KTH1601TX Series						
Symbol	**Parameter**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
VDD	Supply Voltage	Operating	1.6	—	5.5	V
VOL	Output Low Voltage (On)	I_{OUT}=1mA	—	0.05	0.15	V
VOH	Output High Voltage (Off)	I_{OUT}=1mA	V_{DD}-0.15	V_{DD}-0.05	—	V
$I_{DD(AVG)}$	Average Supply Current	TA=+25℃， VDD=1.8V	—	3.30	—	uA
$I_{DD(Awake)}$	Awake Supply Current	TA=+25℃， VDD=1.8V	—	2.0	—	mA
$I_{DD(Sleep)}$	Sleep Supply Current	TA=+25℃， VDD=1.8V	—	1.00		uA
T_{AWAKE}	Awake Time	Operating	—	50	—	μs
T_{PERIOD}	Period	Operating	—	50	—	ms
KTH1601SX Series						
Symbol	**Parameter**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
VDD	Supply Voltage	Operating	1.6	—	5.5	V
VOL	Output Low Voltage (On)	I_{OUT}=1mA	—	0.05	0.15	V
VOH	Output High Voltage (Off)	I_{OUT}=1mA	V_{DD}-0.15	V_{DD}-0.05	—	V
$I_{DD(AVG)}$	Average Supply Current	TA=+25℃， VDD=1.8V	—	1.6	—	uA
$I_{DD(Awake)}$	Awake Supply Current	TA=+25℃， VDD=1.8V	—	2.0	—	mA
$I_{DD(Sleep)}$	Sleep Supply Current	TA=+25℃， VDD=1.8V	—	1.0		uA
T_{AWAKE}	Awake Time	Operating	—	50	—	μs
T_{PERIOD}	Period	Operating	—	200	—	ms

Note: When the power is initially turned on, the operating VDD (1.6V to 5.5V) must be applied to guaranteed the output sampling. The output state is valid after the first operating cycle.。



Magnetic Characteristics （T_A=25℃, VDD=1.8V, unless otherwise noted）

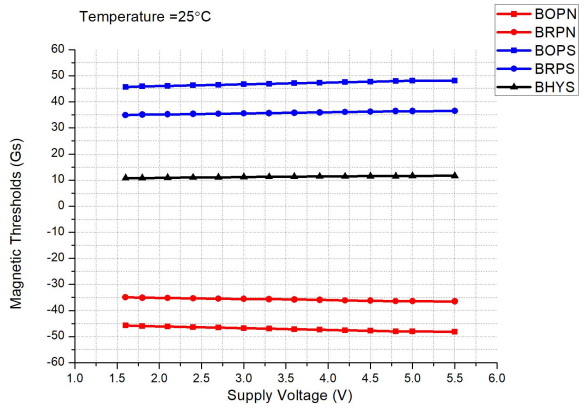
Symbol	Characteristics	Condition	Min.	Typ.	Max.	Unit
KTH1601X H Series						
B_{OPS}	Output Operation Point	TA=+25℃， VDD=1.8V	40	46	52	Gauss
B_{RPS}	Output Operation Point	TA=+25℃， VDD=1.8V	26	34	40	
B_{OPN}	Output Release Point	TA=+25℃， VDD=1.8V	-52	-46	-40	
B_{RPN}	Output Release Point	TA=+25℃， VDD=1.8V	-40	-34	-26	
B_{HY} ($\|B_{OPX}\|$-$\|B_{RPX}\|$)	Hysteresis		-	12	-	

Symbol	Characteristics	Condition	Min.	Typ.	Max.	Unit
KTH1601X L Series						
B_{OPS}	Output Operation Point	TA=+25℃， VDD=1.8V	26	33	38	Gauss
B_{RPS}	Output Operation Point	TA=+25℃， VDD=1.8V	16	23	28	
B_{OPN}	Output Release Point	TA=+25℃， VDD=1.8V	-38	-33	-26	
B_{RPN}	Output Release Point	TA=+25℃， VDD=1.8V	-28	-23	-16	
B_{HY} ($\|B_{OPX}\|$-$\|B_{RPX}\|$)	Hysteresis		-	10	-	

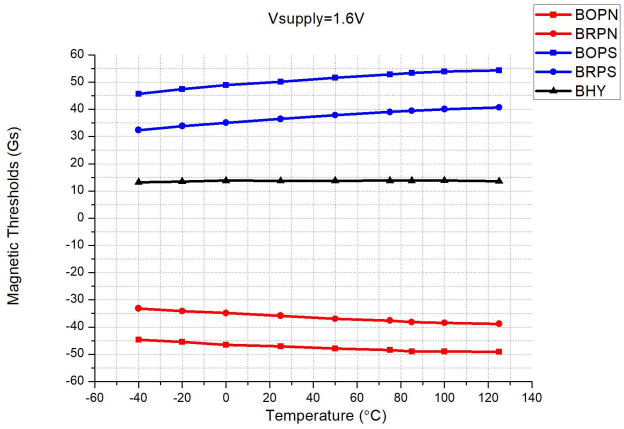
Symbol	Characteristics	Condition	Min.	Typ.	Max.	Unit
KTH1601X U Series						
B_{OPS}	Output Operation Point	TA=+25℃， VDD=1.8V	14	22	30	Gauss
B_{RPS}	Output Operation Point	TA=+25℃， VDD=1.8V	8	16	24	
B_{OPN}	Output Release Point	TA=+25℃， VDD=1.8V	-30	-22	-14	
B_{RPN}	Output Release Point	TA=+25℃， VDD=1.8V	-24	-16	-8	
B_{HY} ($\|B_{OPX}\|$-$\|B_{RPX}\|$)	Hysteresis		-	6	-	

Performance Graphs

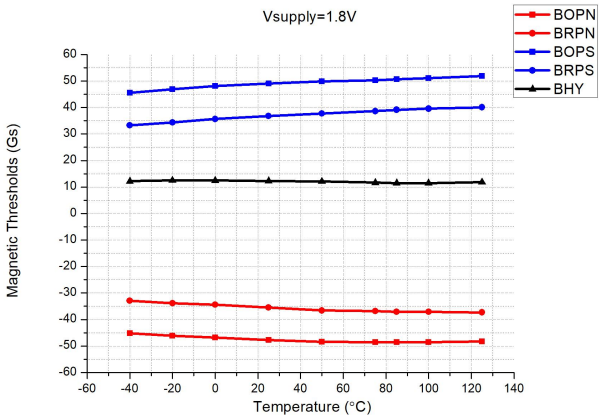
KTH1601XH Series（B_{OP}=46Gs）



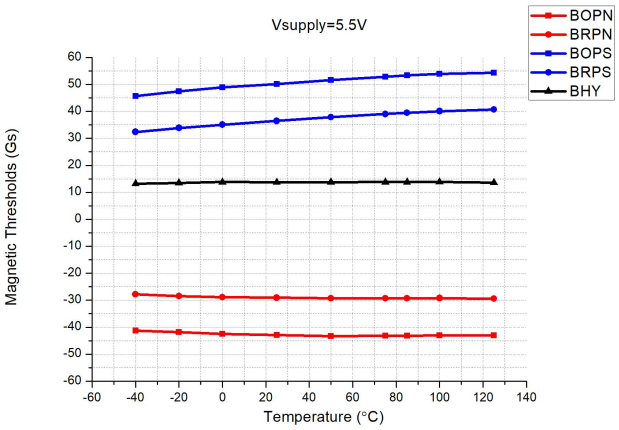
Magnetic Thresholds vs. Supply Voltage @T_A=25℃



Magnetic Thresholds vs T_A @VDD=1.6V

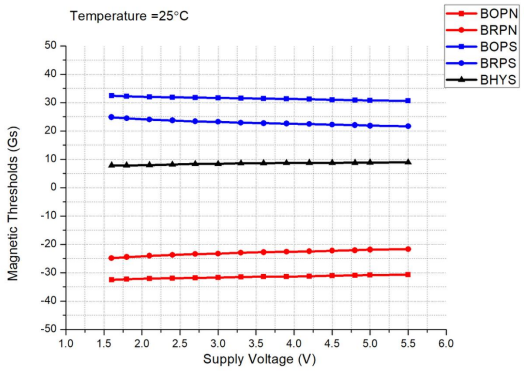


Magnetic Thresholds vs T_A @VDD=1.8V

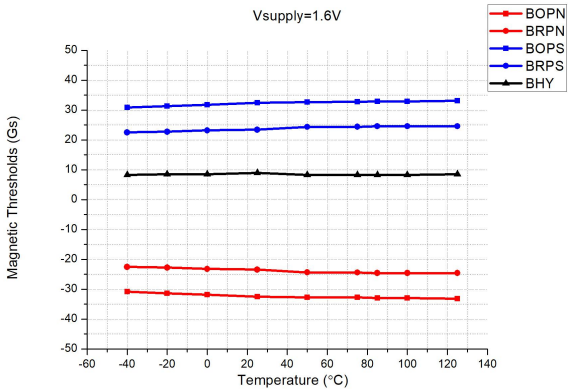


Magnetic Thresholds vs T_A @VDD=5.5V

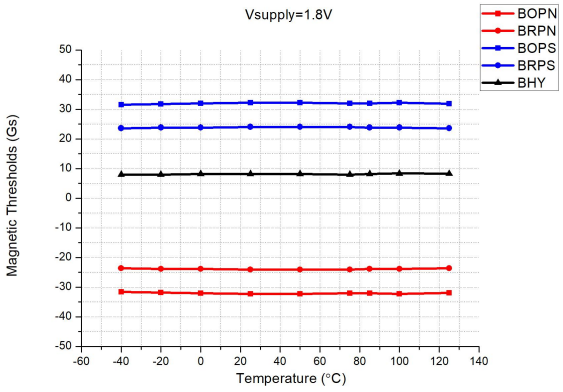
KTH1601XL Series（B_{OP}=33Gs）



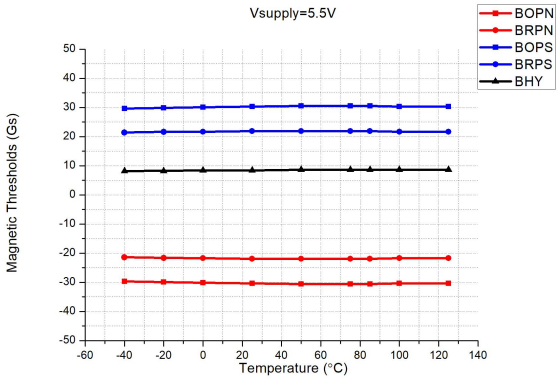
Magnetic Thresholds vs. Supply Voltage @T_A=25℃



Magnetic Thresholds vs T_A @VDD=1.6V

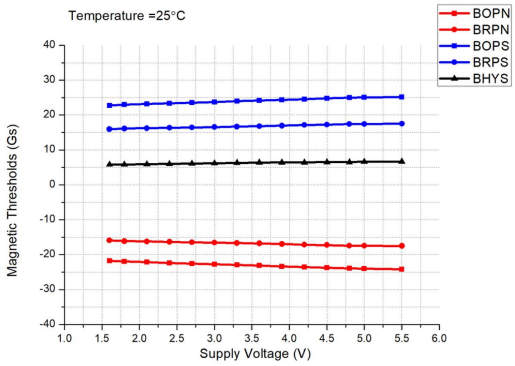


Magnetic Thresholds vs T_A @VDD=1.8V

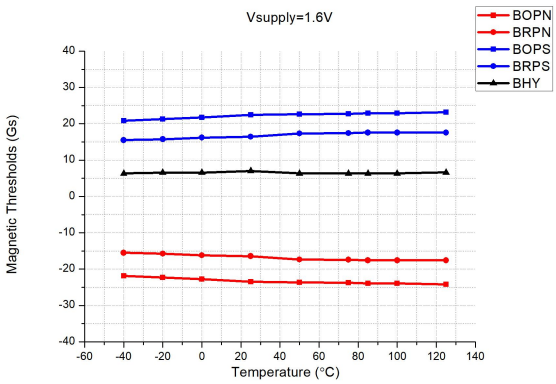


Magnetic Thresholds vs T_A @VDD=5.5V

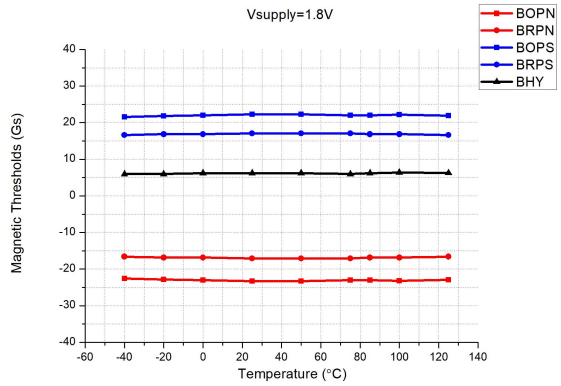
KTH1601XU Series（B_{OP}=22Gs）



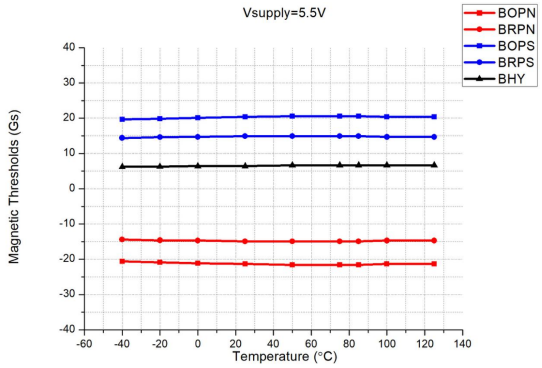
Magnetic Thresholds vs. Supply Voltage @T_A=25℃



Magnetic Thresholds vs T_A @VDD=1.6V

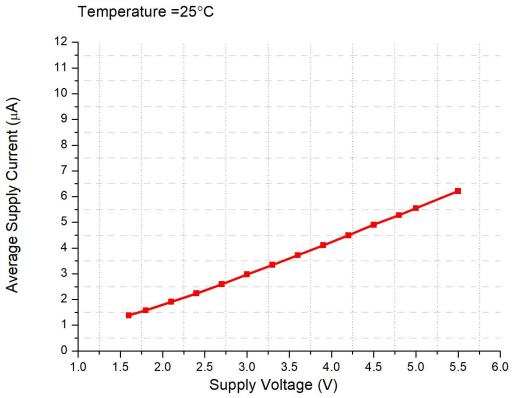


Magnetic Thresholds vs T_A @VDD=1.8V



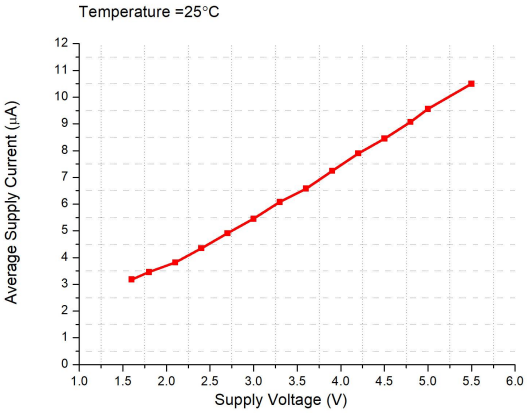
Magnetic Thresholds vs T_A @VDD=5.5V

KTH1601SX Series （t_{CYCLE}=200ms）



Current Consumption vs. Supply Voltage @T_A=25℃

KTH1601T X Series（t_{CYCLE}=50ms）



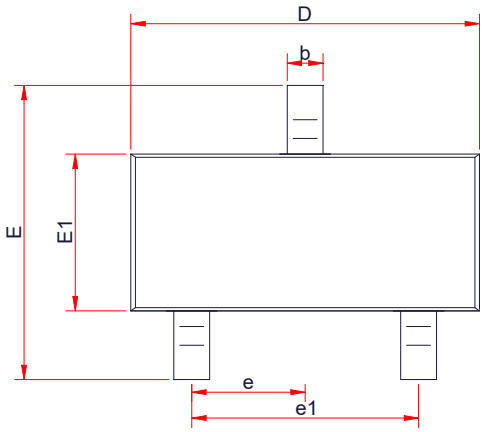
Current Consumption vs. Supply Voltage @T_A=25℃

Order Information

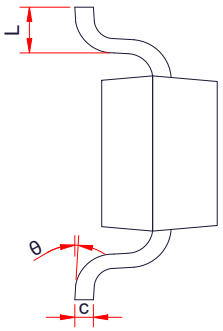
Part Numbers	Package	Number of Pins	Bop	Operating Frequency	Temperature
KTH1601TH-ST3	SOT-23-3L	3	46Gauss	20Hz	-40℃~85℃
KTH1601TL-ST3	SOT-23-3L	3	33Gauss	20Hz	-40℃~85℃
KTH1601TU-ST3	SOT-23-3L	3	22Gauss	20Hz	-40℃~85℃
KTH1601SH-ST3	SOT-23-3L	3	46Gauss	5Hz	-40℃~85℃
KTH1601SL-ST3	SOT-23-3L	3	33Gauss	5Hz	-40℃~85℃
KTH1601SU-ST3	SOT-23-3L	3	22Gauss	5Hz	-40℃~85℃
KTH1601TH-SF5	SOT-553	5	46Gauss	20Hz	-40℃~85℃
KTH1601TL-SF5	SOT-553	5	33Gauss	20Hz	-40℃~85℃
KTH1601TU-SF5	SOT-553	5	22Gauss	20Hz	-40℃~85℃
KTH1601SH-SF5	SOT-553	5	46Gauss	5Hz	-40℃~85℃
KTH1601SL-SF5	SOT-553	5	33Gauss	5Hz	-40℃~85℃
KTH1601SU-SF5	SOT-553	5	22Gauss	5Hz	-40℃~85℃
KTH1601TH-TO3	TO-92S	3	46Gauss	20Hz	-40℃~85℃
KTH1601TL-TO3	TO-92S	3	33Gauss	20Hz	-40℃~85℃
KTH1601TU-TO3	TO-92S	3	22Gauss	20Hz	-40℃~85℃
KTH1601SH-TO3	TO-92S	3	46Gauss	5Hz	-40℃~85℃
KTH1601SL-TO3	TO-92S	3	33Gauss	5Hz	-40℃~85℃
KTH1601SU-TO3	TO-92S	3	22Gauss	5Hz	-40℃~85℃

PACKAGE OUTLINE DIMENSIONS

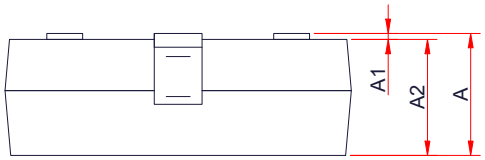
SOT-23-3L



TOP VIEW



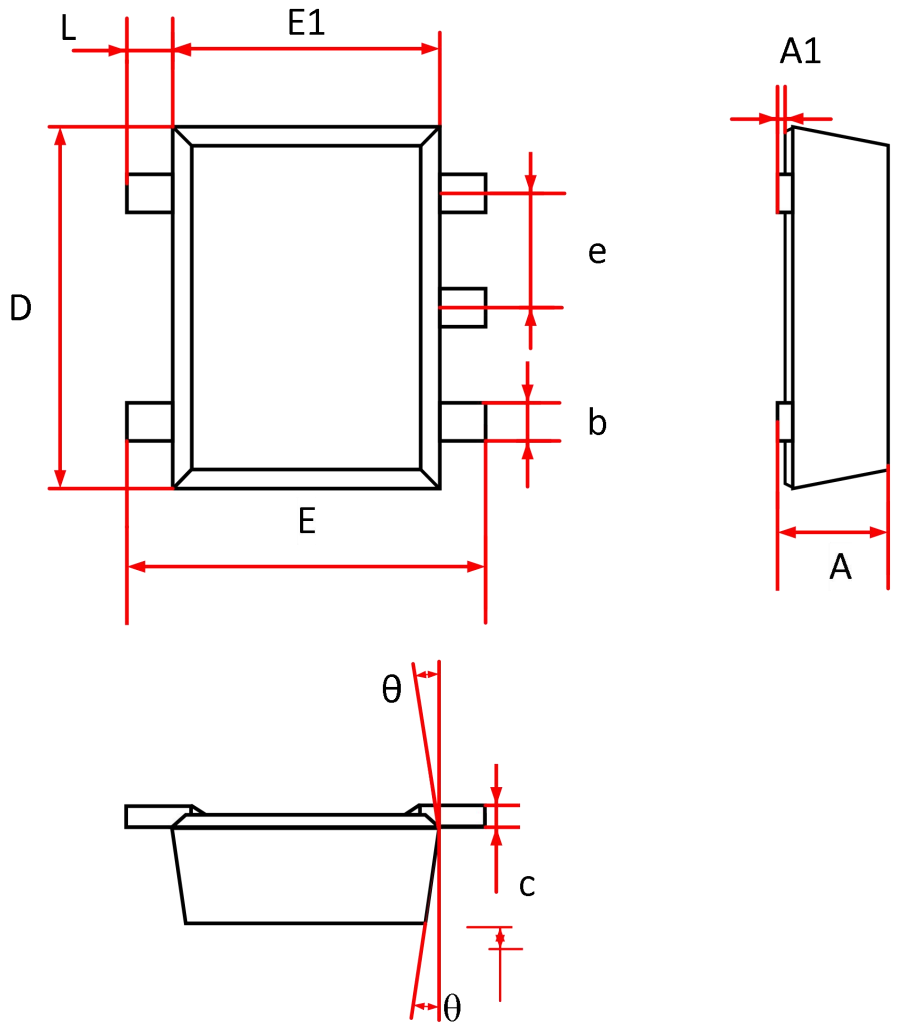
SIDE VIEW



SIDE VIEW

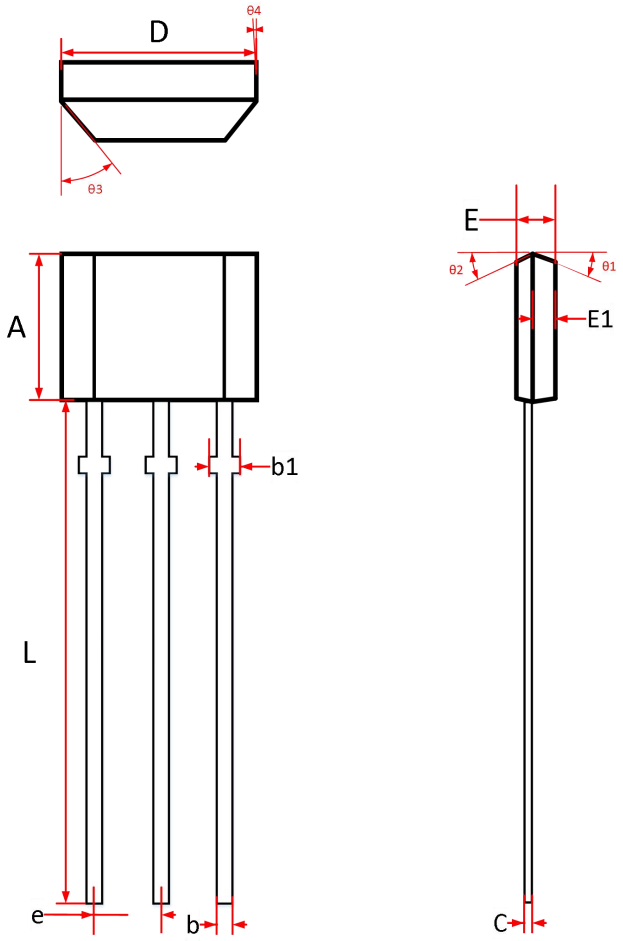
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.25
A1	0.00	-	0.1
A2	1.00	1.10	1.15
b	0.30	-	0.50
c	0.10	-	0.20
D	2.82	2.95	3.02
E	2.65	2.80	2.95
E1	1.50	1.65	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
θ	0 °	-	8 °

SOT-553



Symbol	Dimensions in Millimeters	
	Min.	Max.
A	0.45	0.60
A1	0.00	0.05
b	0.17	0.27
c	0.09	0.16
e	0.45	0.55
D	1.50	1.70
E	1.50	1.70
E1	1.10	1.30
L	0.10	0.30
θ	7° REF	

TO-92S



Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	2.90	3.00	3.10
b	0.35	0.39	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°	