High Sensitivity Hall Latch

KH181

Spring 2011

KH181

High Sensitivity Hall Latch

Features

- Wide operation voltage range
  Single supply voltage 3.5V to 24V
- Specified Operating Temperature Range:
  –40℃ to 125℃
- High Magnetic Sensitivity
- Chopper-Stabilized Amplifier Stage
- Open Drain Type Output
- 3-lead SOT23 and 3-lead SIP3 packages
- High ESD Capability:
  4KV HBM

Product Description

The KH181 is a Hall-effect latch designed in mixed-signal CMOS technology. The device integrates a voltage regulator, Hall sensor with dynamic offset cancellation system, Schmitt trigger and an open-drain output driver, all in a single package.

Thanks to its wide operating voltage range and extended choice of temperature range, it is quite suitable for use in automotive, industrial and consumer applications.

The device is delivered in a Small Outline Transistor (SOT23) for surface mount process and in a Plastic Single In Line (SIP3) for through hole mount. Both 3-lead packages are RoHS compliant.

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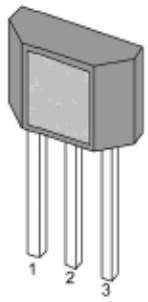
Pin Configuration

Table 1: Pin description for SIP3

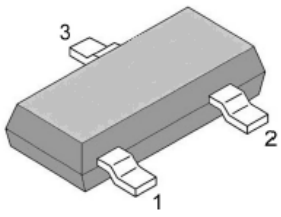
Pin No.	Pin Name	Functions
1	VDD	Power supply
2	GND	Ground
3	OUT	Output



SIP3 package

Table 2: Pin description for SOT23

Pin No.	Pin Name	Functions
1	VDD	Power supply
2	OUT	Output
3	GND	Ground



SOT23 package

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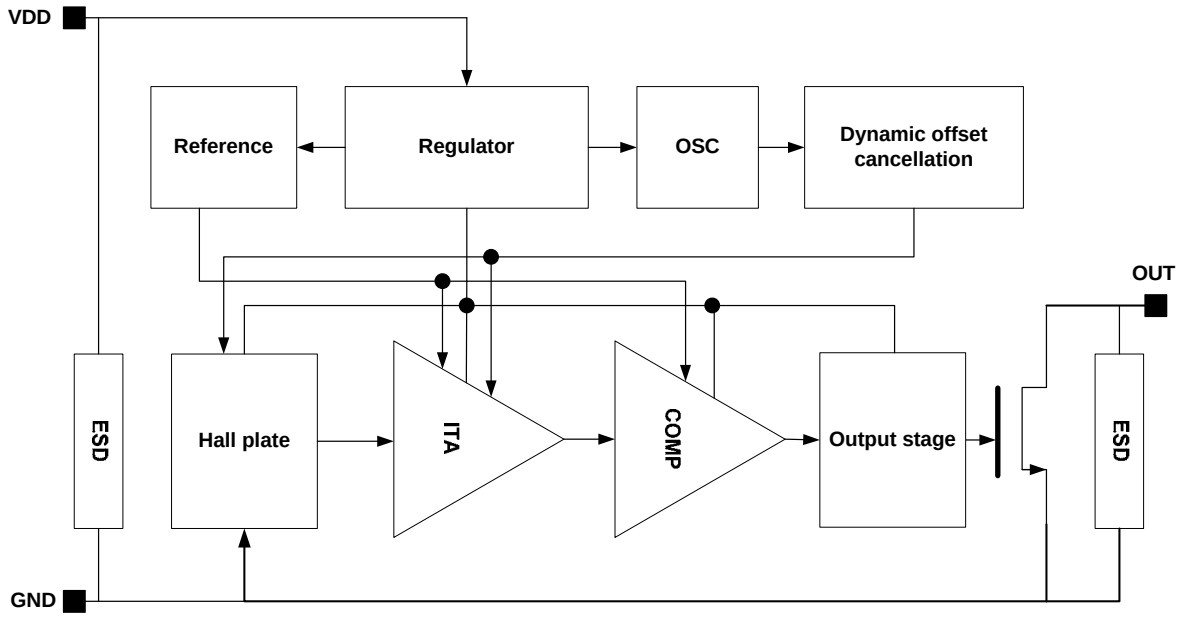
Block Diagram



Brief Theory of Operation

- Magnetic flux is transferred to a small voltage signal by the Hall device.
- Instrument amplifier amplifies the Hall voltage into a large swing signal.
- Dynamic offset cancelation system reduces the offset of Hall plate and amplifier
- Hysteresis comparator converts the amplified signal into switch signal as to the setting
- Output stage latches the output of comparator, and drives an open-drain type output pin

Definition of Magnetic Parameters

B_{OP}: Operating Point

Magnetic flux density applied on the branded side of the package which turns the output driver ON (V_{OUT} = V_{DSon})

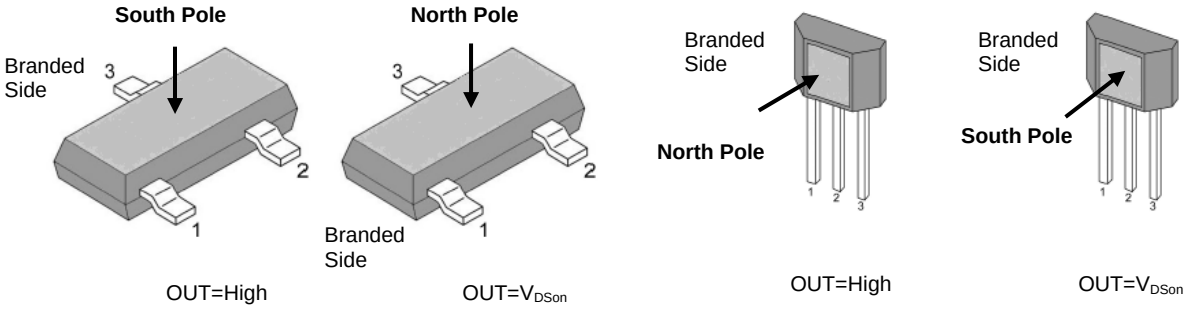
B_{RP}: Release Point

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}

Definition of Switching Function



Switching Point of SOT23

Switching Point of SIP3

DC Operating Parameters Ta = -40℃ to 125℃ V_{DD} = 3.5V to 24V (unless otherwise specified)

Table 3: Switching Function

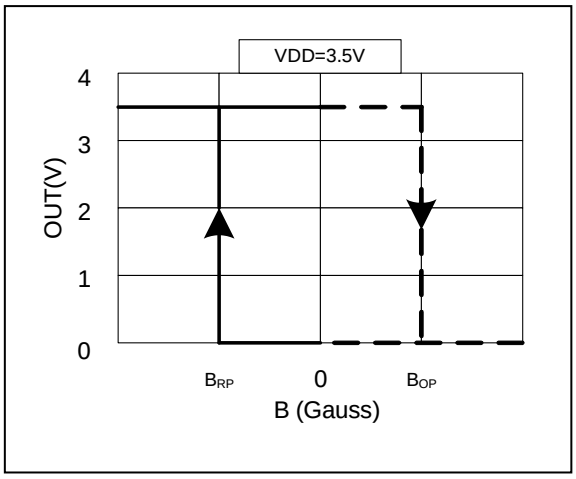
Parameter	Pole（SIP3）	OUT（SIP3）	Pole(SOT23)	OUT(SOT23)
South Pole	B>B_{OP}	V_{DSon}	B<B_{RP}	High
North Pole	B<B_{RP}	High	B>B_{OP}	V_{DSon}

Latch Characteristic

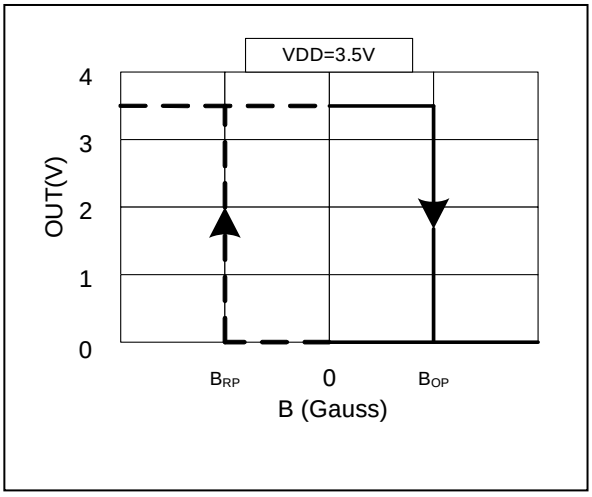
The KH181 device exhibits latch magnetic switching characteristics. Therefore, it requires both south and north poles to operate properly.

The device behaves as a latch with symmetric operating and release switching points (B_{OP}=|B_{RP}|). This means magnetic fields with equivalent strength and opposite direction drive the output high and low. Removing the magnetic field (B→0) keeps the output in its previous state. This latching property defines the device as a magnetic memory.

A magnetic hysteresis B_{HYST} keeps B_{OP} and B_{RP} separated by a minimal value. This hysteresis prevents output oscillation near the switching point.



Latch Characteristic SOT23 Package



Latch Characteristic SIP3 Package

Note:

South Pole
North Pole

Absolute Maximum Ratings

Absolute maximum ratings are limiting 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.

Table 4: Absolute maximum ratings: all voltages listed are referenced to GND

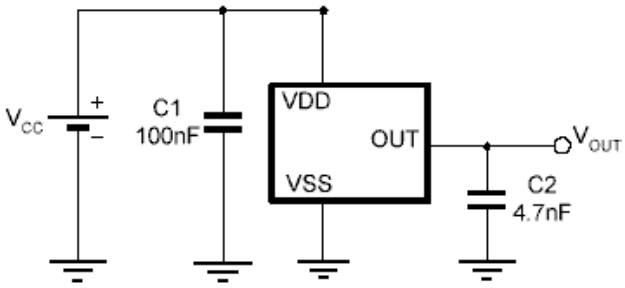
Symbol	Parameters	Min	Max	Unit	Notes
T_S	Storage temperature	-50	150	℃	
T_J	Junction temperature	-50	150	℃	
V_{DD}	Supply voltage		28	V	
I_{DD}	Supply current		50	mA	
V_{OUT}	Output voltage		28	V	
I_{OUT}	Continuous output current		50	mA	

Electrical Characteristic

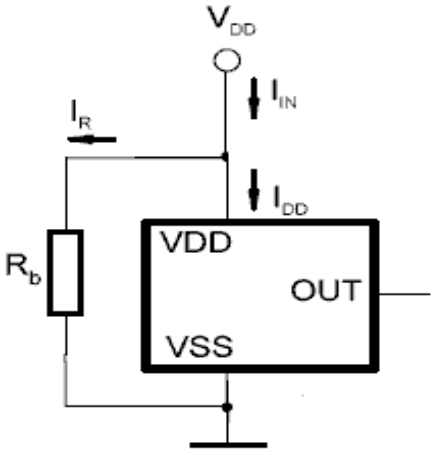
Table 5: Characteristics: at T_A=-40℃ to +125℃, V_{DD}=3.5 to 24V, if not otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	Operating	3.5		24	V
Supply Current	I_{DD}	B< B_{RP}			5	mA
Output Saturation Voltage	V_{DSON}	I_{OUT} = 20mA, B > B_{OP}			0.5	V
Output Leakage Current	I_{OFF}	B< B_{RP}, V_{OUT}=24V			10	uA
Output Rise Time	T_R	R_L=1KΩ, C_L=20pF			0.45	uS
Output Fall Time	T_F	R_L=1KΩ, C_L=20pF			0.45	uS
Max Switching Frequency	F_{SW}			10		KHz
Package Thermal Resistance	R_{TH}	Single layer (1S) JEDEC board		301		° C/W
Magnetic Operating Point	B_{OP}		0.5		7.5	mT
Magnetic Release Point	B_{RP}		-7.5		-0.5	mT
Hysteresis Window	B_{HYST}		5.6	8	10.4	mT
Electro-Static Discharge	ESD	HBM		4		KV

Application Circuit



3-Wire Application Circuit



2-Wire Application Circuit

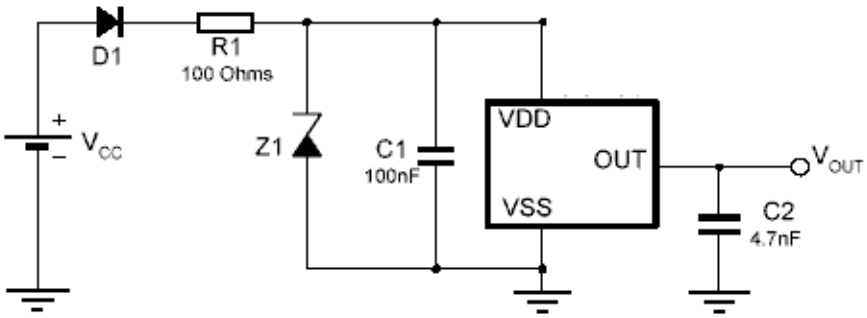
Note:

With this circuit, precise ON and OFF currents can be detected using only two connecting wires.

The resistors R_{pull} and R_b can be used to bias the input current. Refer to the part specifications for limiting values.

B_{RP}: $I_{OFF} = I_R + I_{DDOFF} = V_{DD}/R_b + I_{DDOFF}$

B_{OP}: $I_{ON} = I_R + I_{DDON} = I_{OFF} + V_{DD}/10K$



3-Wire Application Circuit For Harsh and Noisy Environment

Application Comments

For proper operation, a 100nF bypass capacitor should be placed as close as possible to the device between the VDD and ground pin.

For reverse voltage protection, it is recommended to connect a resistor or a diode in series with the VDD pin. When using a resistor, three points are important:

- The resistor has to limit the reverse current to 50mA maximum (VCC / R1 ≤ 50mA)
- The resulting device supply voltage VDD has to be higher than VDD min (VDD = VCC – R1×IDD)
- The resistor has to withstand the power dissipated in reverse voltage condition (PD = VCC^2 / R1)

When using a diode, a reverse current cannot flow and the voltage drop is almost constant(≈0.7V). Therefore, a 100W/0.25W resistor for 5V application and a diode for higher supply voltage are recommended. Both solutions provide the required reverse voltage protection.

When a weak power supply is used or when the device is intended to be used in noisy environment, it is recommended that 3-Wire Application Circuit For Harsh and Noisy Environment is used. The low-pass filter formed by R1 and C1 and the Zener diode Z1 bypass the disturbances or voltage spikes occurring on the device supply voltage VDD. The diode D1 provides additional reverse voltage protection.

KH181

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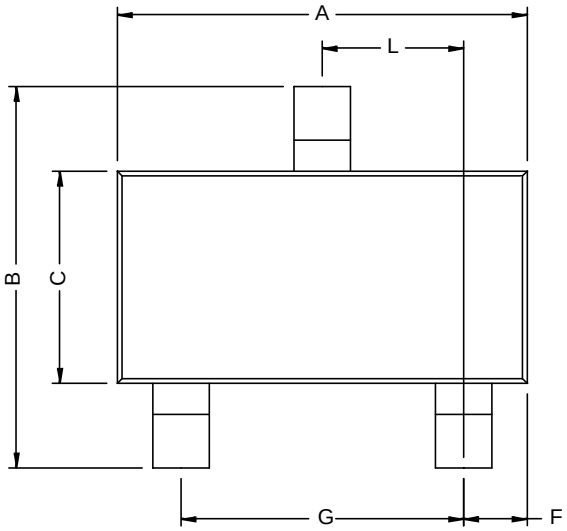
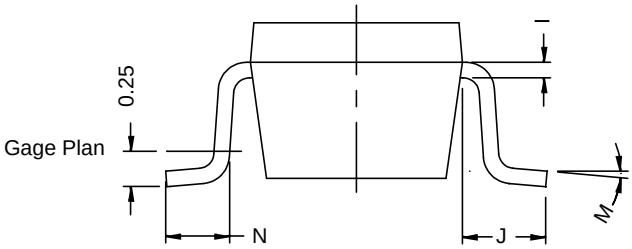
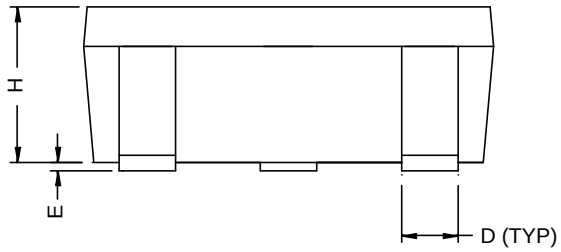
■ 3-lead SOT23 package diagram



Top View



End View

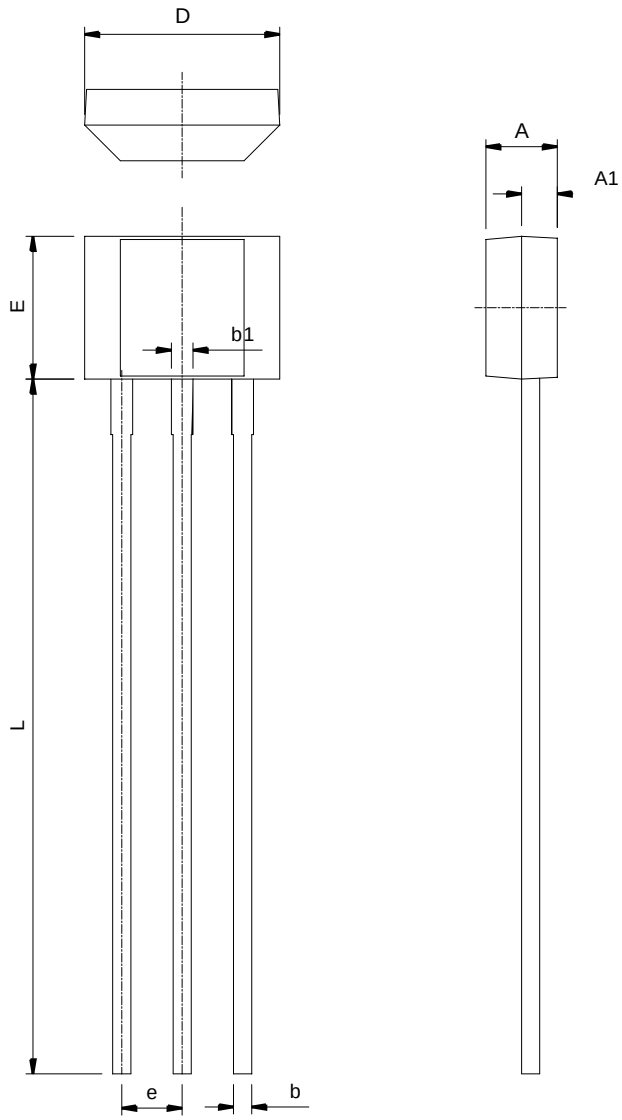


Side View

Dimentions

REF	Milimeter	
	Min	Max
A	2.70	3.10
B	2.40	2.80
C	1.40	1.60
D	0.35	0.50
E	0	0.10
F	0.45	0.55
G	2.10 REF	
H	1.00	1.30
I	0.10	0.20
J	0.40	-
L	0.95	1.15
M	0°	10°
N	0.30	0.60

3-lead SIP3 package diagram



Dimentions

REF	Milimeter	
	Min	Max
A	1.245	1.753
A1	0.750 REF	
b	0.330	0.432
b1	0.406	0.508
D	3.962	4.216
E	2.870	3.164
L	13.60	15.60
e	1.270 REF	

KH181

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■ Ordering Information

Code Number

Part Number	K	H	-	X	X	X	-	X	X	X	X
	1	2		3	4	5	-	6	7	8	9

1. Prefix

2. Series Name
Hall Sensor

3. Function
1=Latch
2=Switch
4=Liner

4. Application area
4=LV application
8=HV application

5. Design Option

6. Package Type
O=SOT23
P=SIP3

7. Temperature Range
I=Industry (-40℃ to 125℃)

8. Pack Type
B=Bulk (ESD bag)
A=Ammopack
R=Reel (Tape)

9. Plating Technology
G=RoHS compliant
X=Green

■ Product Datasheet Change Notice

Datasheet Revision History		
Version	**Content**	**Date**
1.0	Initial version	Dec., 2010
1.1	Package information added	Apr., 2011

KH181

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Data Sheet, Revision 1.1