Hall Element Preliminary Datasheet

1. General Introduction

M1201 is a high-sensitivity InSb Hall Element. It is performing the Hall Effect, which a proportional to magnetic field and outputs an analog signal. The output voltage is proportional to the magnetic field vertically applied to it, and positive and negative voltage according to the direction of the magnetic field. The output near zero when there is not applied magnetic field.

It is simple connected to operational device, which can be applicated on both digital and analog circuit. The output voltage can be applied several hundred milli-voltage. It also has a wide operating temperature range of -40℃to +125℃, appropriate for commercial, consumer, and industrial environments.

The output voltage can be classificated at rank E , rank F and rank G.
The S4/L4 package are mini SMD in SMT process.
The Y4 package is thin-type SIP package.

2. Features

- Operating Voltage Range: 1.0V~2.0V
- Power consumption of 3mA at 1 VDC
- Measurement range ±1,000 Gauss
- Proportional output for Magnet
- Bridge type Resistance for output
- Responds to either positive or negative gauss
- Small package for SMD
- Magnetically Optimized Package
- RoHS Compliant 2011/65/EU

3. Applications

- Motor control
- Rotary encoder
- Position sensing
- Current sensor

4. Maximum Rating

DC Operating Parameters : At (Ta=25 degree C)

Characteristics		Values	Unit
Supply Voltage,(***V**C*)		2.2	V
Input Current,(***I**C*)		20	mA
Operating Temperature Range, (T_A)	"K" Class	-40 ~ +125	℃
Storage temperature Range, (T_S)		-40 ~ +150	℃
Maximum Junction Temp,(T_J)		150	℃
Thermal Resistance	(θ_{JA})	666	℃/W
	(θ_{JC})	467	℃/W
Package Power Dissipation, (P_D)		150	mW

Note*:For constant-voltage drive without protective resistance,please stay within the input voltage derating curve.*

5. Specifications

DC Operating Parameters: At (Ta=25℃)

Parameters	Test Conditions	Min	Typ	Max	Units
Supply Voltage,(V_C)	Operating	1.0		2.0	V
Supply Current,(I_C)	B= 0 Gauss			20.0	mA
Output Hall Voltage, (*VH*) (*E Rank*)	B=500G,VC=1V	228		274	mV
Output Hall Voltage, (*VH*) (*F Rank*)	B=500G,VC=1V	266		320	mV
Output Hall Voltage, (*VH*) (*G Rank*)	B=500G,VC=1V	310		370	mV
Input Resistance,(*Rin*)	B=0G,IC=1mA	240		550	Ω
Output Resistance,(*Rout*)	B=0G,IC=1mA	240		550	Ω
Offset Voltage, (*VOS*)	B=0G, VC=1V	-7		+7	mV
Temp. quotiety of VH, (*αVH*)	Average by 0~40℃B=500G, IC=5mA		-1.8		% / ℃
Temp. quotiety of Rin, (*αRin*)	Average by 0~40℃B=0G, IC=1mA		-1.8		% / ℃
Electro-Static Discharge	HBM	1800			V
Electro-Static Discharge	MM	200			V
Dielectric Resistance, (*DR*)	100V DC	1.0			MΩ
Sensitivity(*E Rank*)	VC=1V	0.46	0.50	0.55	mV/G
Sensitivity(*F Rank*)	VC=1V	0.53	0.59	0.64	mV/G
Sensitivity(*G Rank*)	VC=1V	0.62	0.68	0.74	mV/G

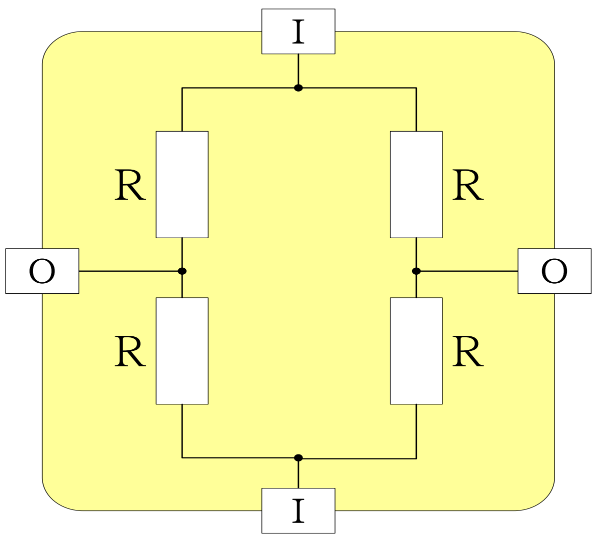
Notes：1. $V_H = (V_{H+} - V_{H-}) - (V_u)\ (V_{H+} = V_{PIN2}、V_{H-} = V_{PIN4})$

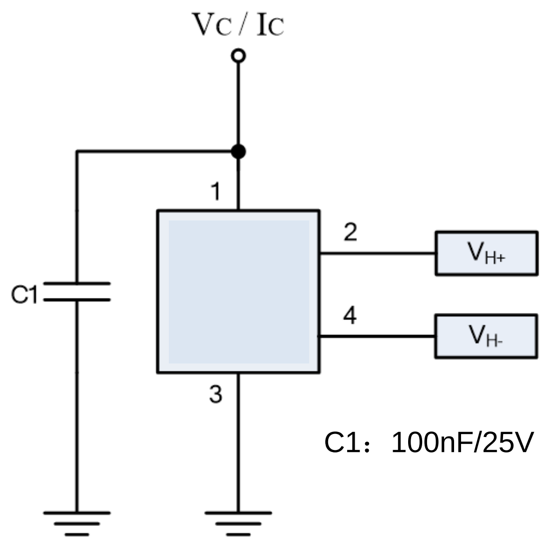
2. $\alpha V_H = \frac{1}{V_H(T_1)} \times \frac{V_H(T_3)-V_H(T_2)}{(T_3-T_2)} \times 100$

3. $\alpha R_{in} = \frac{1}{R_{in}(T_1)} \times \frac{R_{in}(T_3)-R_{in}(T_2)}{(T_3-T_2)} \times 100$

$T_1 = 20℃，T_2 = 0℃，T_3 = 40℃$

6 · Schematic Diagram



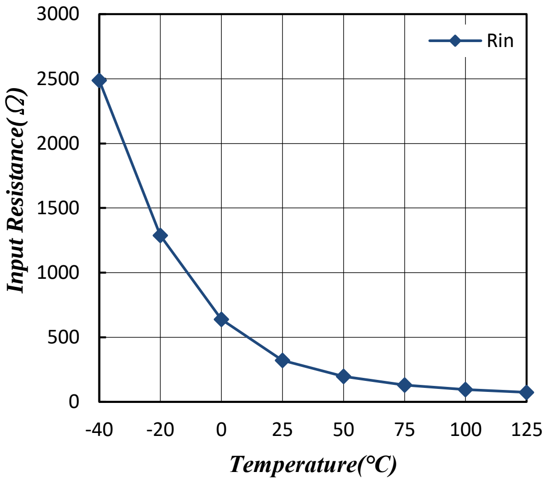


7. Ordering Information

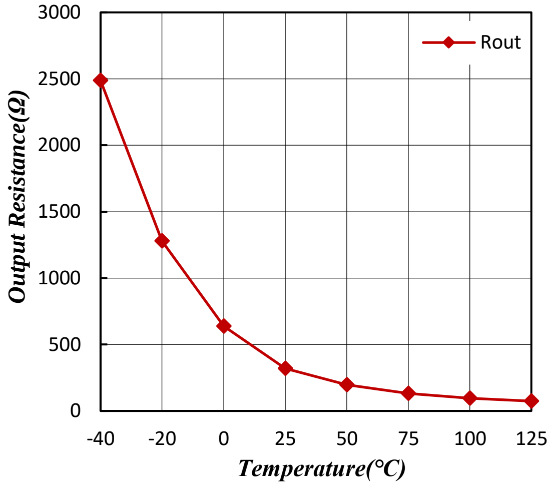
Part No.	Temperature Suffix	Package Type
M1201KS4-E	K(-40℃~125℃)	S4(SOT-143-4)
M1201KS4-F	K(-40℃~125℃)	S4(SOT-143-4)
M1201KS4-G	K(-40℃~125℃)	S4(SOT-143-4)
M1201KL4-E	K(-40℃~125℃)	L4(SOT-143-4L)
M1201KL4-F	K(-40℃~125℃)	L4(SOT-143-4L)
M1201KL4-G	K(-40℃~125℃)	L4(SOT-143-4L)
M1201KY4-E	K(-40℃~125℃)	Y4(SIP-4Y)
M1201KY4-F	K(-40℃~125℃)	Y4(SIP-4Y)
M1201KY4-G	K(-40℃~125℃)	Y4(SIP-4Y)

8. Performance Graph

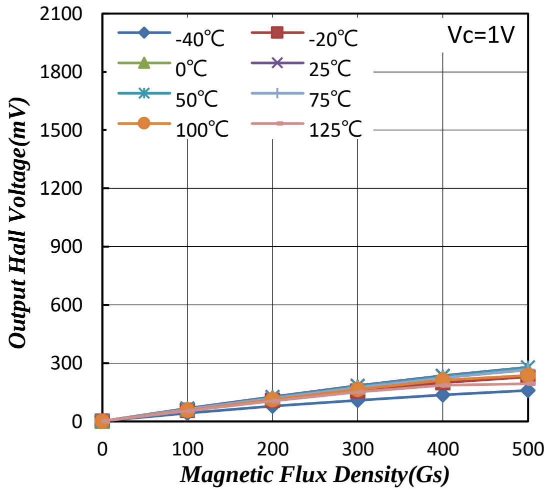
Typical Temperature (T_A) Versus Input Resistance (R_{in})



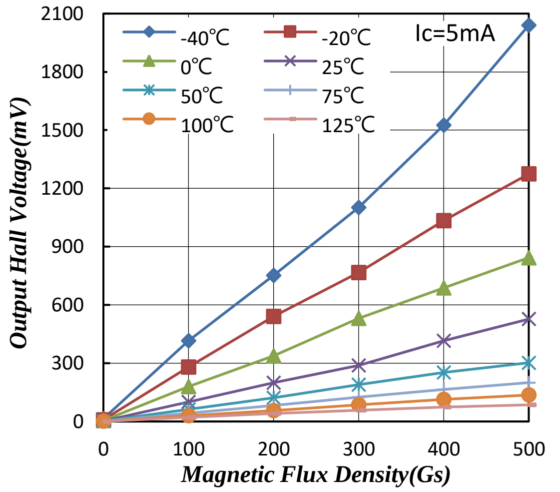
Typical Temperature (T_A) Versus Output Resistance (R_{out})



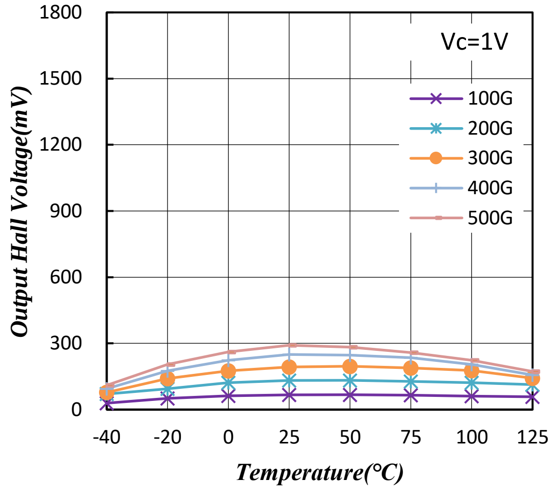
Typical Flux Density Versus Output Hall Voltage (V_H)



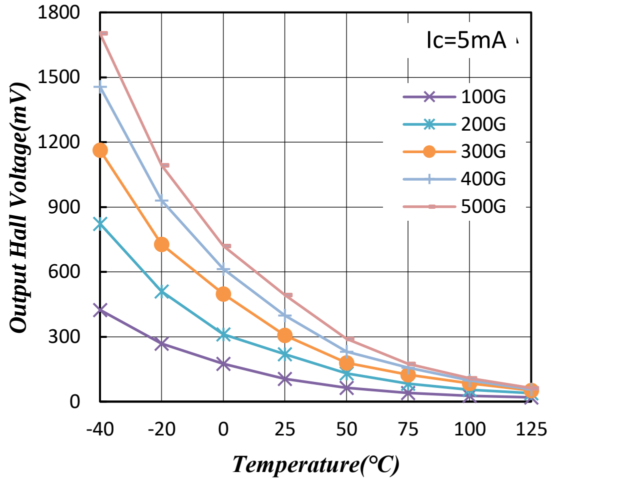
Typical Flux Density Versus Output Hall Voltage (V_H)



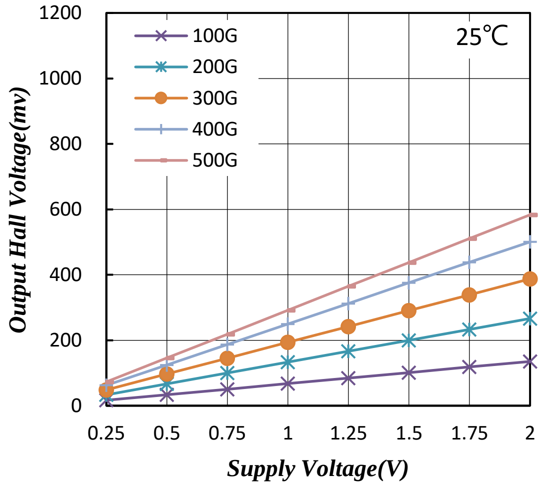
Typical Temperature (T_A) Versus Output Hall Voltage (V_H)



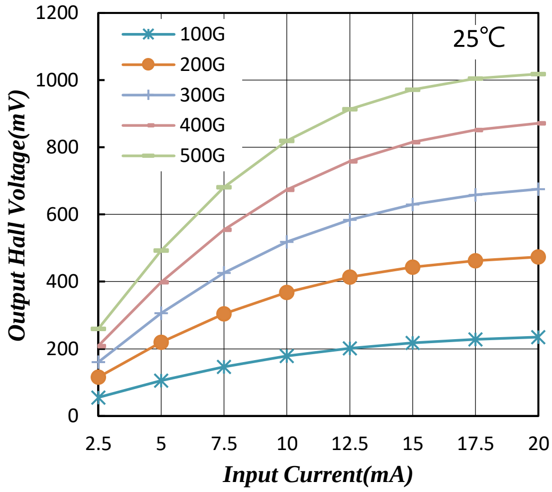
Typical Temperature (T_A) Versus Output Hall Voltage (V_H)



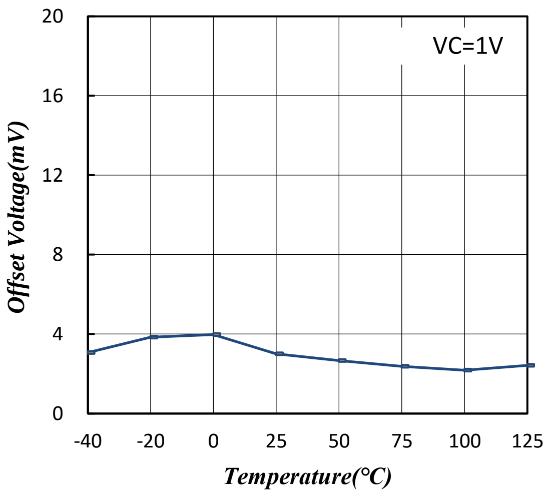
Typical Supply Voltage (V_C) Versus Output Hall Voltage (V_H)



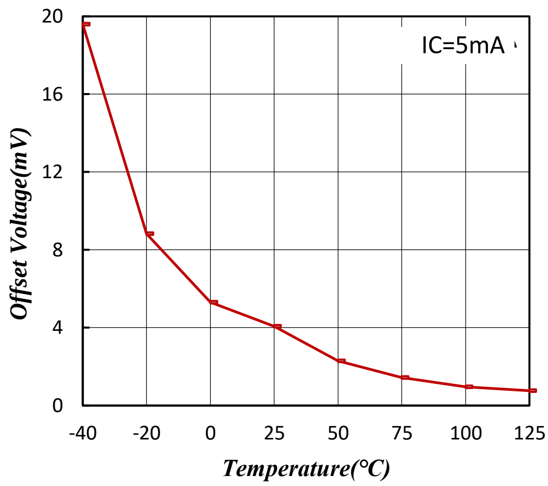
Typical Supply Current (I_C)Versus Output Hall Voltage (V_H)



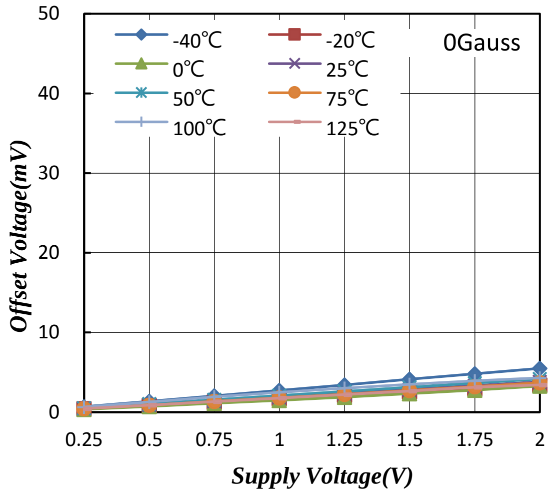
Typical Temperature (T_A) Versus Offset Voltage (V_{OS})



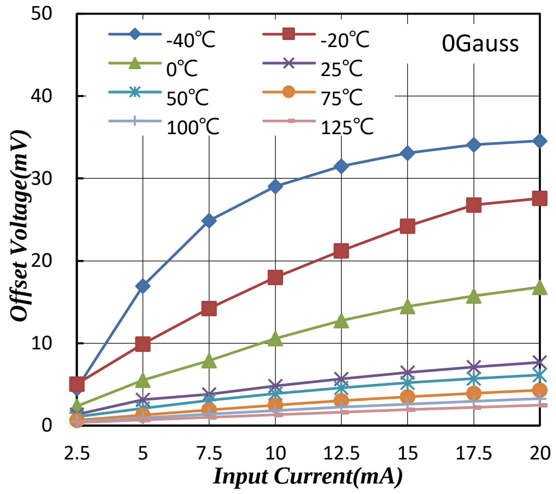
Typical Temperature (T_A) Versus Offset Voltage (V_{OS})



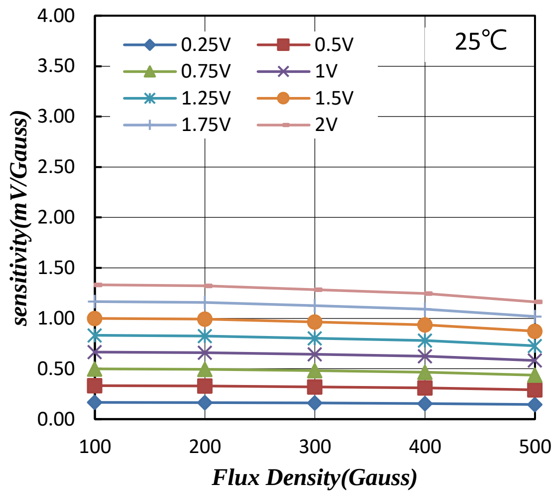
Typical Supply Voltage (V_C) Versus Offset Voltage (V_{OS})



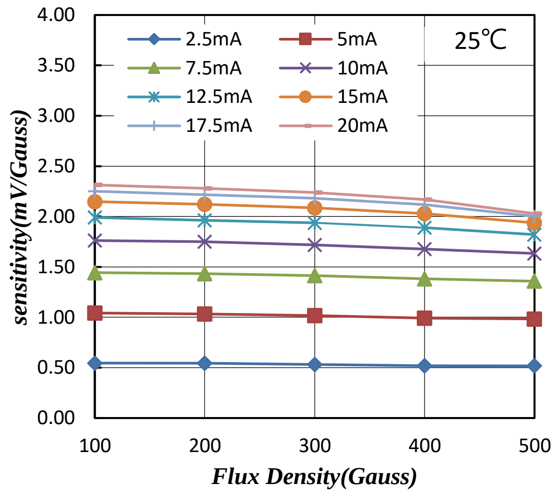
Typical Supply Current (I_C) Versus Offset Voltage (V_{OS})



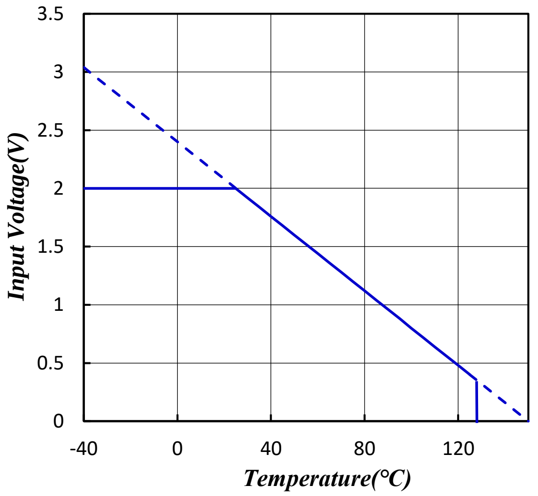
Typical Flux Density Versus sensitivity by Input Voltage (V_C)



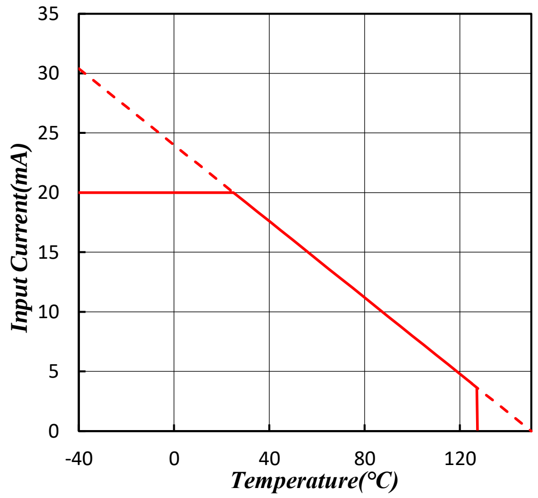
Typical Flux Density Versus sensitivity by Input Current (I_C)

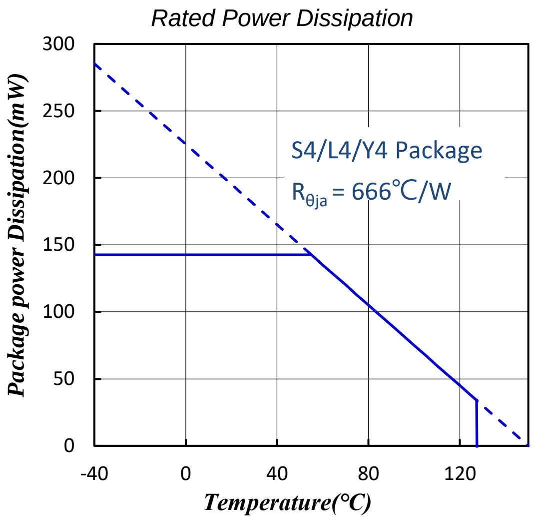


Rated Input Voltage (V_C)



Rated Input Current (I_C)

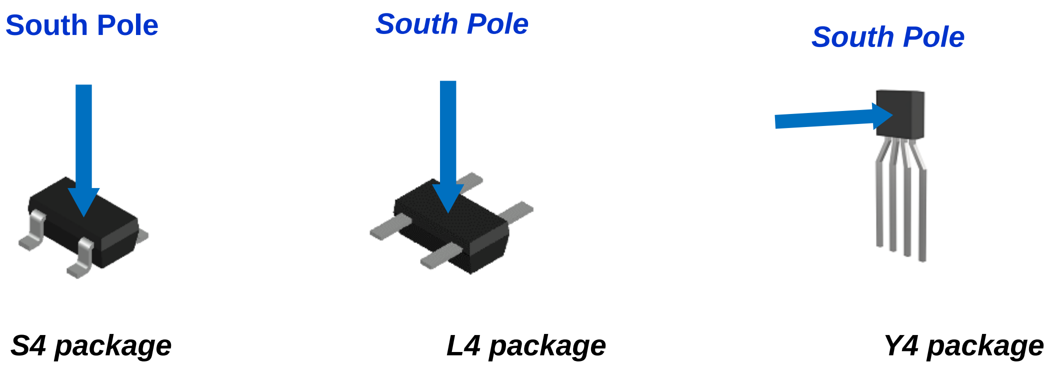


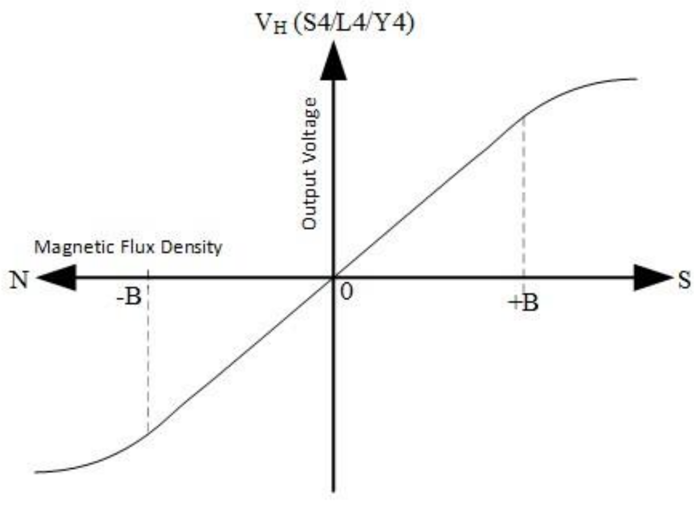


9. Output Behavior versus Magnetic Polar

DC Operating Parameters TA = -40 to 125℃, V_C =1.0 to 2.0 V(PIN 1)

Parameter	Test condition	V_H (L4/S4/Y4)
South pole	B>0 Gauss	> 0
North pole	B<0 Gauss	< 0





10. Function Description

(1) Offest Voltage output

In the zero magnetic field state, the two output voltage deviation of V_{H+} and V_{H-} .

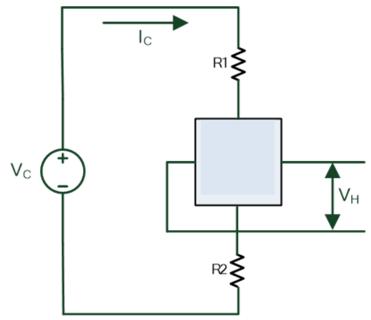
(2) Sensitivity

The amount of the output voltage is proportional to the magnetic fields changes. This proportionality is specified as the below

$$Sens = \frac{V_{H(B+)} - V_{H(B-)}}{(B+) - (B-)}$$

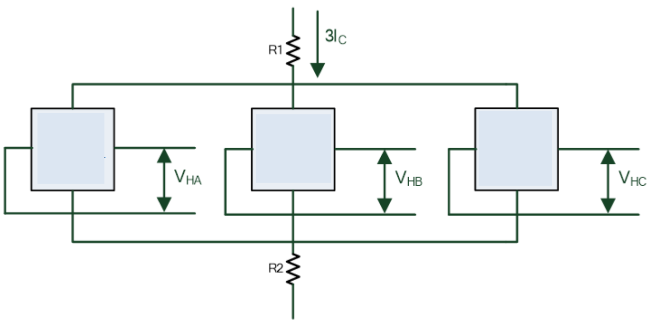
(3) Drive circuit

The input equivalent resistance will decrease as ambient temperature increases. So to avoid damage hall element which restriction resistance is inserted in series.

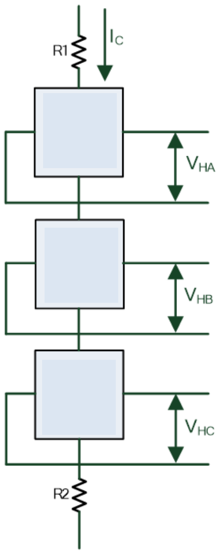


(4) Used on three phase BLDC motor

There two type of Hall element connection: parallel and series.



parallel



series

11. Package Power Dissipation

The power dissipation of the Package is a function of the pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating temperature, Ta. Using the values provided on the data sheet for the package, PD can be calculated as follows:

$$P_D = \frac{T_{J(max)} - Ta}{R_{\theta ja}}$$

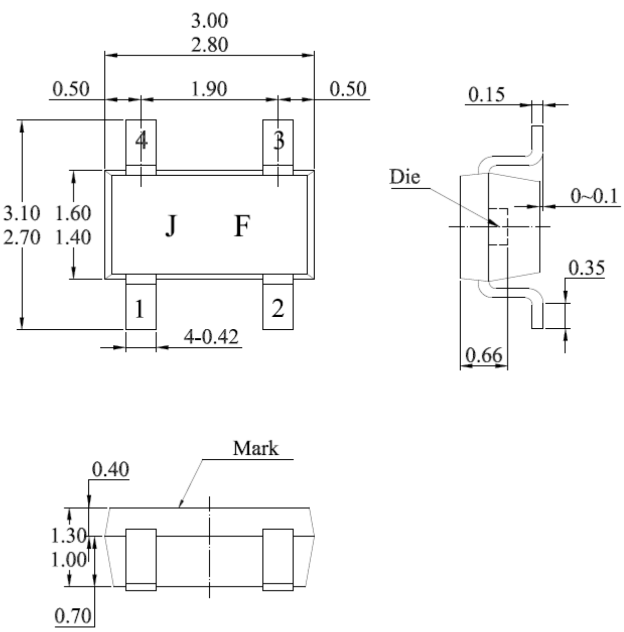
The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature Ta of 50°C, one can calculate the power dissipation of the device which in this case is 150 milliwatts.

$$P_D(S4) = \frac{150℃ - 50℃}{666\,℃/W} = 150mW$$

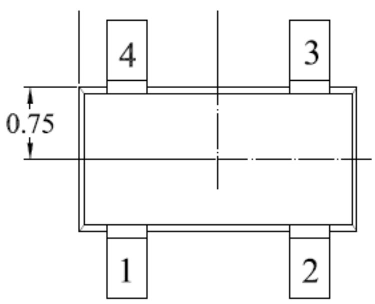
The 666℃/W for the S4 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 150 milliwatts. There are other alternatives to achieving higher power dissipation from the Package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

12. Packing Instructions

SOT-143 Package
（Top View）



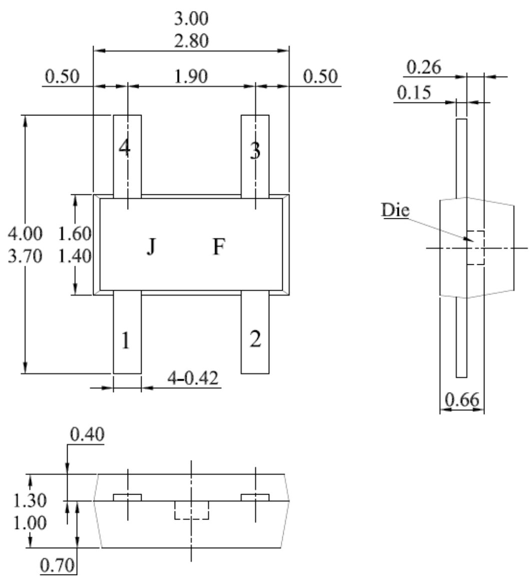
Hall Plate Chip Location
(Top view)



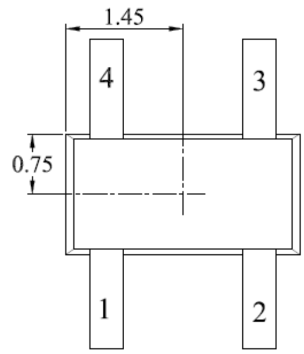
NOTES:

1. PINOUT (See Top View at left)
   Pin 1 Input (±) Pin 2 Output (±)
   Pin 3 Input(∓) Pin 4 Output(∓)
2. Controlling dimension: mm;
   3. J:Date Code; F:Rank;
   EX：2019 Year_10 Month/Rank : F → J F

SOT-143-Flat Package
（Top View）



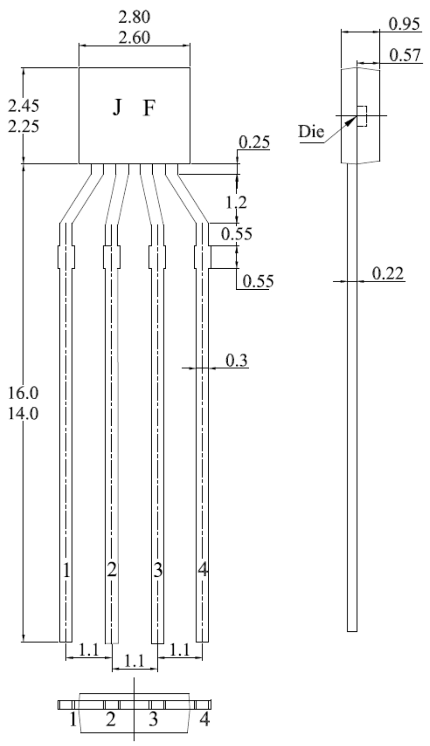
Hall Plate Chip Location
(Top view)



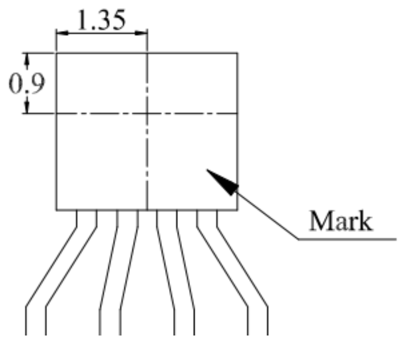
NOTES:

1. PINOUT (See Top View at left)
   Pin 1 Input (±); Pin 2 Output (±)
   Pin 3 Input(∓) ; Pin 4 Output(∓)
2. Controlling dimension: mm
3. J: Date Code; F: Rank;
   EX：2019 Year_10 Month/Rank : F → J F

SIP 4Y Package
(TOP View)



Sensor location
(Top View)



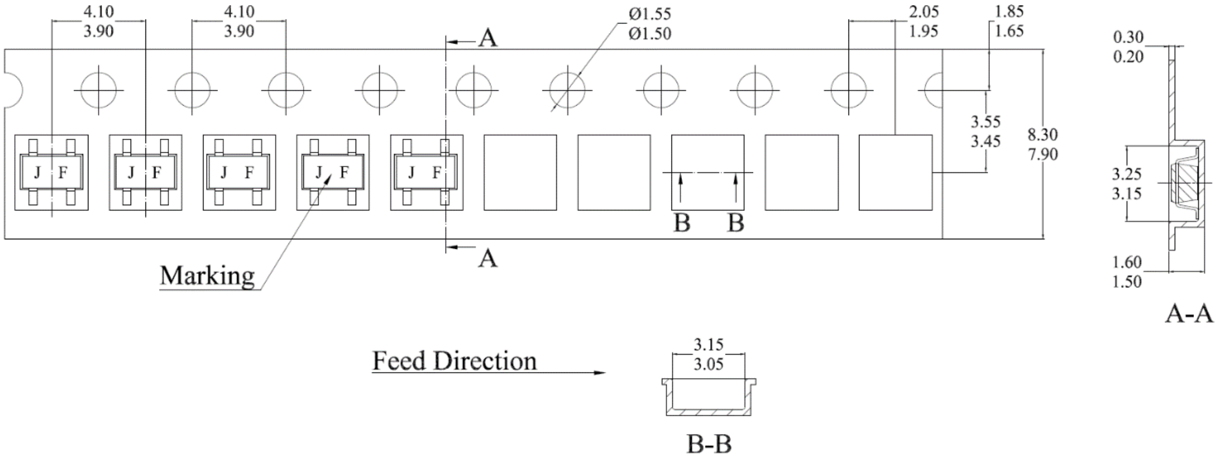
NOTES:

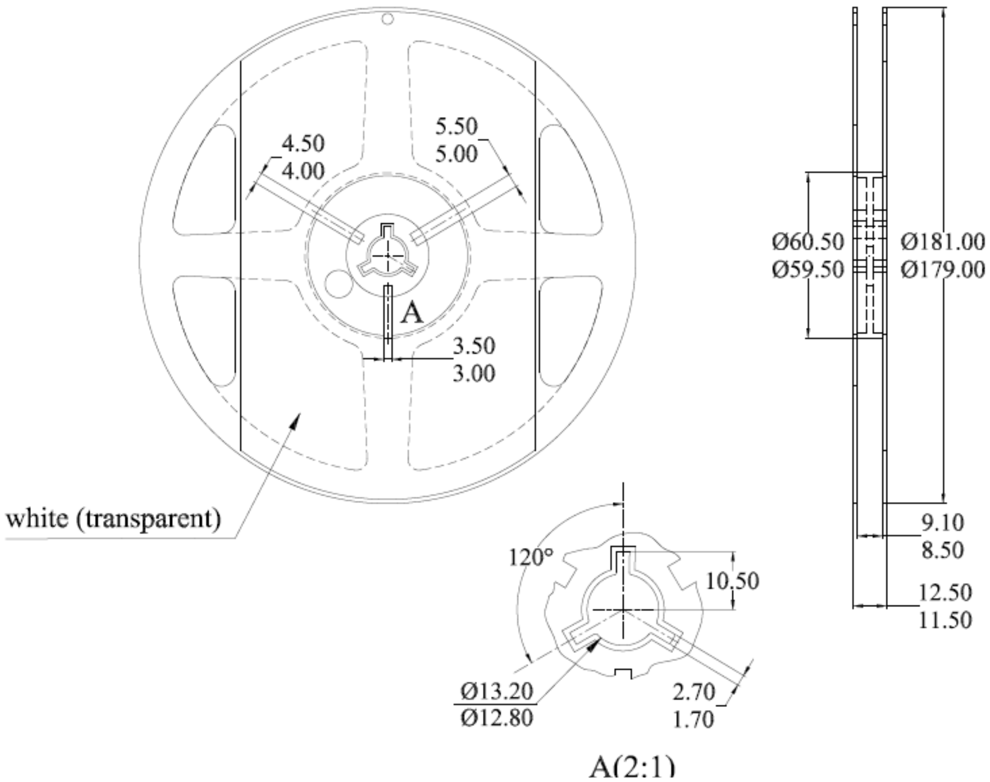
1. Controlling dimension: mm
2. Leads must be free of flash and plating voids
3. Do not bend leads within 1 mm of lead to package interface.
4. PINOUT:
   Pin 1 Input (±); Pin 2 Output(±)
   Pin 3 Input (∓); Pin 4 Output(∓)
5. J: Date Code; F: Rank;
   EX：2019 Year_10 Month/Rank : F → J F

Date Code Schedule

Month of Odd Year	1	2	3	4	5	6	7	8	9	10	11	12
code	A	B	C	D	E	F	G	H	I	J	K	L
Month of Even Year	1	2	3	4	5	6	7	8	9	10	11	12
code	M	N	O	P	Q	R	S	T	U	V	W	X

S4（SOT-143）package Tape On Reel Dimension

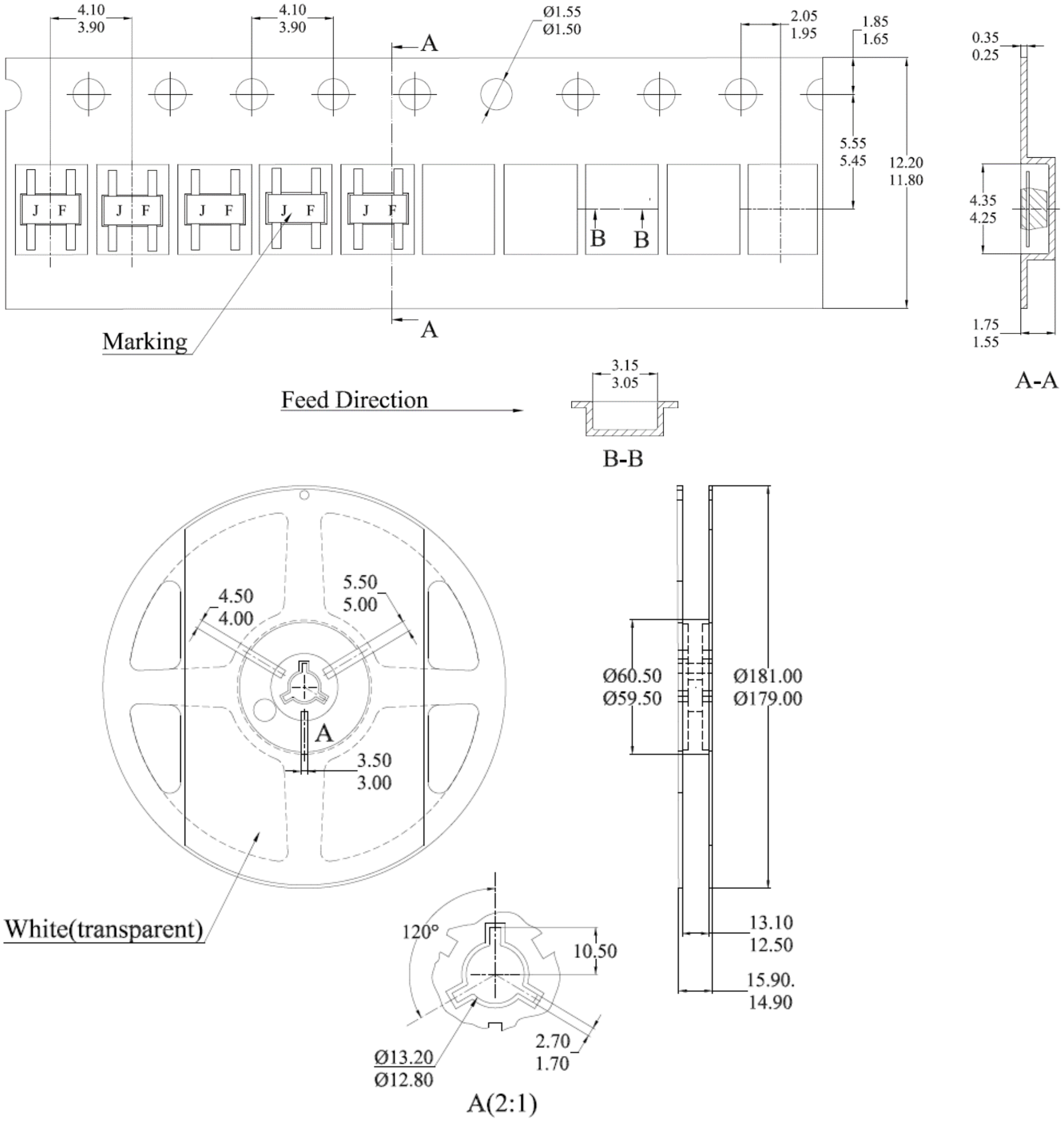




NOTES:

1. Material: Conductive polystyrene;
2. DIM in mm;
3. 10 sprocket hole pitch cumulative tolerance ±0.2;
4. Camber not to exceed 1mm in 100mm;
5. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole;
6. (S.R. OHM/SQ) Means surface electric resistivity of the carrier tape.

L4（SOT-143-Flat）package Tape On Reel Dimension



NOTES:

1. Material: Conductive polystyrene;
2. DIM in mm;
3. 10 sprocket hole pitch cumulative tolerance ±0.2;
4. Camber not to exceed 1mm in 100mm;
5. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole;
6. (S.R. OHM/SQ) Means surface electric resistivity of the carrier tape.

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