MH481 a linear Hall-effect sensor, is composed of Hall sensor, linear amplifier and Totem-Pole output stage. It features low noise output, which makes it unnecessary to use external filtering. It also can provide increased temperature stability and accuracy. The linear Hall sensor has a wide operating temperature range of -40℃ to +105℃, appropriate for commercial, consumer, and industrial environments.

The high sensitivity of Hall-effect sensor accurately tracks extremely weak changes in magnetic flux density. The linear sourcing output voltage is set by the supply voltage and in proportion of vary of the magnetic flux density. Typical operation current is 2.5mA and operating voltage range is 3.0 volts to 6.5 volts.

MH481 is rated for operation between the ambient temperatures –40℃ and + 105℃ for the I temperature range. The four package styles available provide magnetically optimized solutions for most applications. Package types SQ is a DFN2020-3(0.5 mm nominal height), SD is a DFN2020-6(0.6mm nominal height), ST is a Tsot-23 (0.7 mm nominal height) miniature low-profile surface-mount package, while package UA is a three-lead ultra-mini SIP for through-hole mounting.
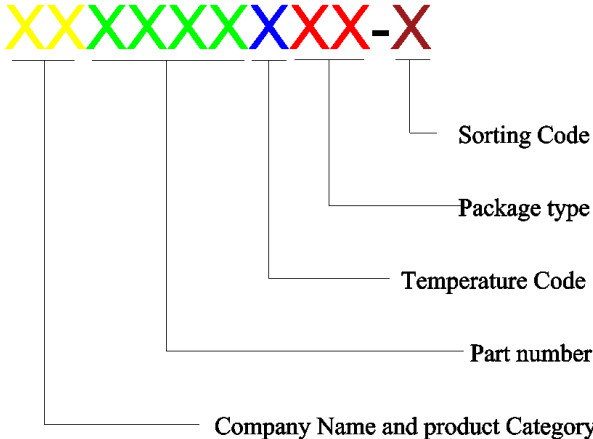
Features and Benefits
- Operating Voltage Range: 3.0V~6.5V
- Power consumption of 2.5 mA at 5 V_{DC} for energy efficiency
- Low-Noise Operation
- Linear output for circuit design flexibility
- Totem-Pole for a stable and accurate output
- Responds to either positive or negative gauss
- Small package for SMD
- Magnetically Optimized Package for SIP
- Cost competitive
- Robust ESD performance
- RoHS compliant 2011/65/EU and Halogen Free

Applications
- Current sensing
- Motor control
- Position sensing
- Magnetic code reading
- Rotary encoder
- Ferrous metal detector
- Vibration sensing
- Liquid level sensing
- Weight sensing

Ordering Information

XXXXXXXXX-X

Sorting Code

Package type

Temperature Code

Part number

Company Name and product Category

Company Name and Product Category

 MH:MST Hall Effect/MP:MST Power IC

Part number

 181,182,183,184,185,248,249,276,477,381,381F,381R,382.....

 If part # is just 3 digits, the forth digit will be omitted.

Temperature range

 E: 85 ℃, I: 105 ℃, K: 125 ℃, L: 150 ℃

Package type

 UA:TO-92S, VK:TO-92S(4pin), VF:TO-92S(5pin),

 SO:SOT-23,SQ:QFN-3,ST:TSOT-23,SN:SOT-553,

 SF:SOT-89(5pin),SS:TSOT-26,SD:DFN-6

Sorting

 α,β,Blank.....

Part No.	Temperature Suffix	Package Type
MH481IUA	I (-40°C to + 105°C)	UA (TO-92S)
MH481IST	I (-40℃ to + 105℃)	ST(TSOT-23)
MH481ISQ	I (-40°C to + 105°C)	SQ (QFN2020-3)
MH481ISD	I (-40°C to + 105°C)	SD (QFN2020-6)

Functional Diagram
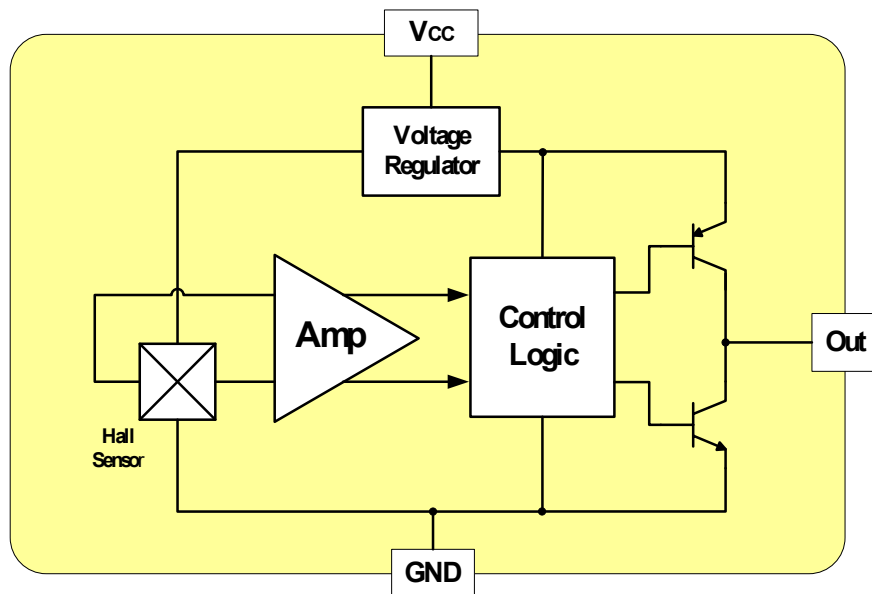
Absolute Maximum Ratings *At (Ta=25℃)*

Characteristics		Values	Unit
Supply Voltage, (*Vcc*)		8	V
Reverse Voltage, (*Vcc*)		-0.5	V
Magnetic Flux Density		Unlimited	Gauss
Output Current, (*Iout*)		10	mA
Operating Temperature Range, (*Ta*)	"I" version	-40 to +105	℃
Storage temperature range, (*Ts*)		-65 to +150	℃
Maximum Junction Temp, (*Tj*)		150	℃
Thermal Resistance	(*θja*) UA / SQ / ST/ SD	206 / 543 / 310 / 160	℃/W
	(*θjc*) UA / SQ / ST/ SD	148 / 410 / 223 / 35	℃/W
Package Power Dissipation, (*PD*)UA / SQ / ST / SD		606 / 230 / 400 / 780	mW

Note: Do not apply reverse voltage to V_{CC} *and* V_{OUT} *Pin, It may be caused for Miss function or damaged device.*

MH 481IUA-α Electrical Specifications
DC Operating Parameters： *T_A=+25℃, V_{CC}=5.0V*

Parameters	Test Conditions	Min	Typ	Max	Units
Supply Voltage, (*V_{CC}*)	Operating	3.0		6.5	V
Supply Current, (*I_{CC}*)	B=0 Gauss		2.5	5.0	mA
Output Current, (*Io*)	Vcc>3V	1.0	1.5		mA
Null Output Voltage, (*V_{Null}*)	B=0 Gauss	2.3	2.5	2.7	V
Output Bandwidth, (*Bw*)			20		kHz
Output Voltage Span, (*Vos*)		2.95	3.2		V
Magnetic Range Gauss		±500	±800		Gauss
Linearity	% of Span		0.7		
Response Time			3		uS
Sensitivity		1.9		2.1	mV/G
Electro-Static Discharge	HBM	3			kV

MH 481IUA-βElectrical Specifications
DC Operating Parameters： *T_A=+25℃, V_{CC}=5.0V*

Parameters	Test Conditions	Min	Typ	Max	Units
Supply Voltage, (*V_{CC}*)	Operating	3.0		6.5	V
Supply Current, (*I_{CC}*)	B=0 Gauss		2.5	5.0	mA
Output Current, (*Io*)	Vcc>3V	1.0	1.5		mA
Null Output Voltage, (*V_{Null}*)	B=0 Gauss	2.3	2.5	2.7	V
Output Bandwidth, (*Bw*)			20		kHz
Output Voltage Span, (*Vos*)		2.95	3.2		V
Magnetic Range Gauss		±500	±800		Gauss
Linearity	% of Span		0.7		
Response Time			3		uS
Sensitivity		1.8		1.9	mV/G
Electro-Static Discharge	HBM	3			kV

MH 481IUA/SQ / ST/SD Electrical Specifications

DC Operating Parameters： T_A=+25℃, V_{CC}=5.0V

Parameters	Test Conditions	Min	Typ	Max	Units
Supply Voltage, (V_{CC})	Operating	3.0		6.5	V
Supply Current, (I_{CC})	B=0 Gauss		2.5	5.0	mA
Output Current, (I_O)	Vcc>3V	1.0	1.5		mA
Null Output Voltage, (V_{Null})	B=0 Gauss	2.3	2.5	2.7	V
Output Bandwidth, (Bw)			20		kHz
Output Voltage Span, (Vos)		2.95	3.2		V
Magnetic Range Gauss		±500	±800		Gauss
Linearity	% of Span		0.7		
Response Time			3		uS
Sensitivity		1.8		2.1	mV/G
Electro-Static Discharge	HBM	3			kV

Typical application circuit

C1：1000PF

C2：10PF
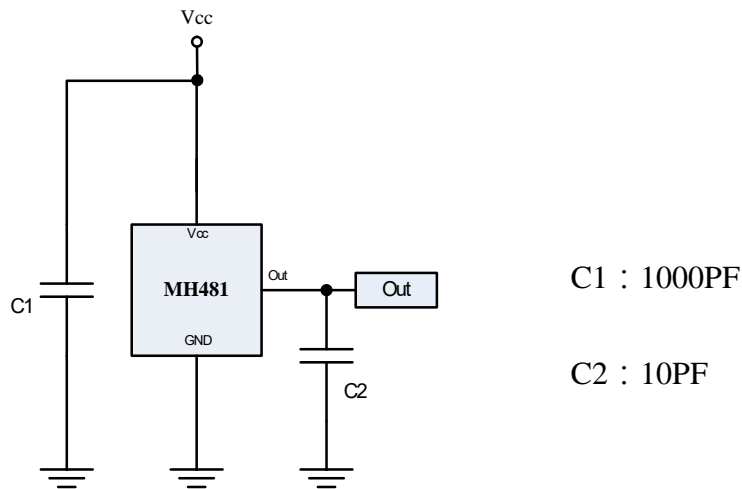
Output Behavior versus Magnetic Pole

DC Operating Parameters： T_a = 25℃, V_{CC}= 5V

South Pole

SD Package

South Pole

SQ Package

South Pole

UA Package

North Pole

ST Package

OUT

Output Voltage in Volts

4.1

2.5

0.9

N

S

-800   0   +800

Magnetic Flux Density in Gauss
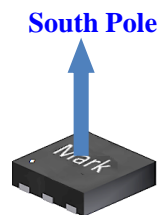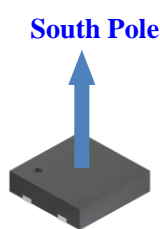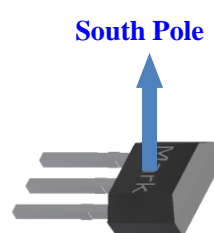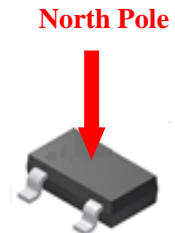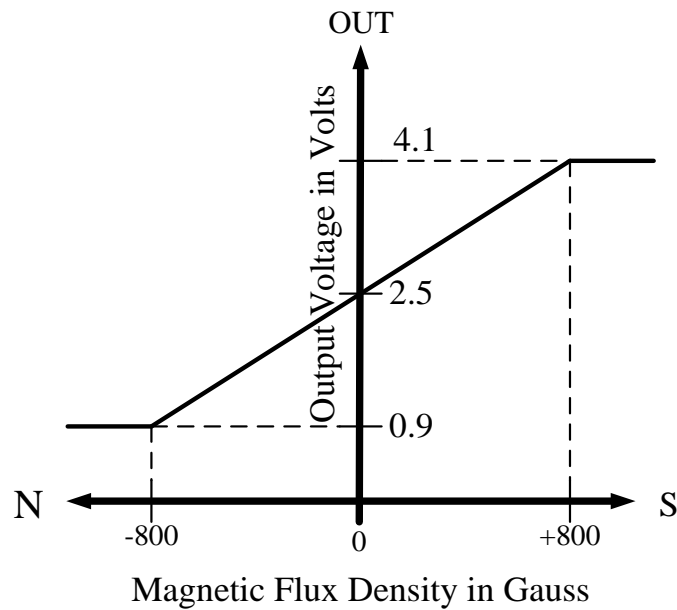
Performance Graph

Typical Flux Density Versus Output Voltage

5V, 25°C

Output Voltage(V)

Flux Density(Gauss)
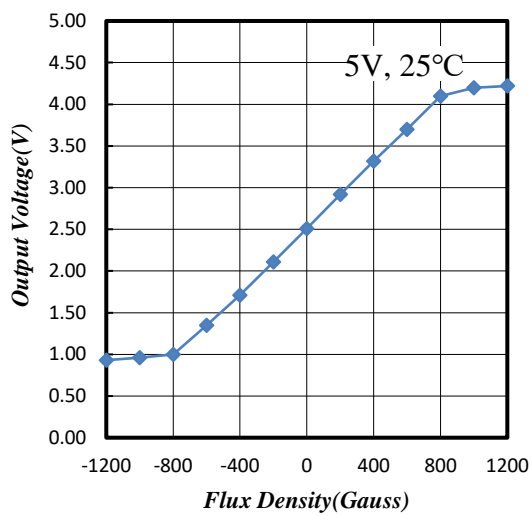
Typical Temperature (T_A) Versus Output Voltage Offset

5V

V_{Null} offset (%)
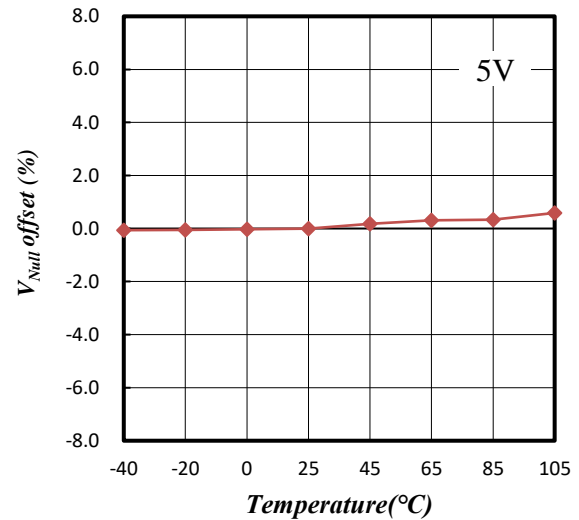
Temperature(°C)

Typical Supply Voltage (V_CC) Versus Ratio of V_out to V_CC

25°C

V_{Null} / V_{CC} (%)
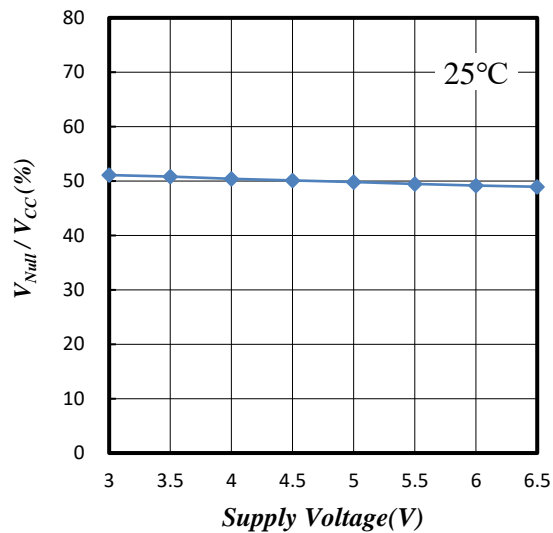
Supply Voltage(V)

Typical Supply Voltage (V_CC) Versus Linearity
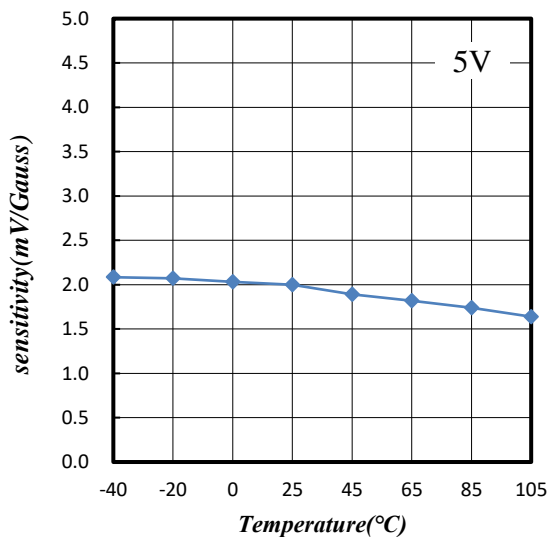
25°C

Linearity
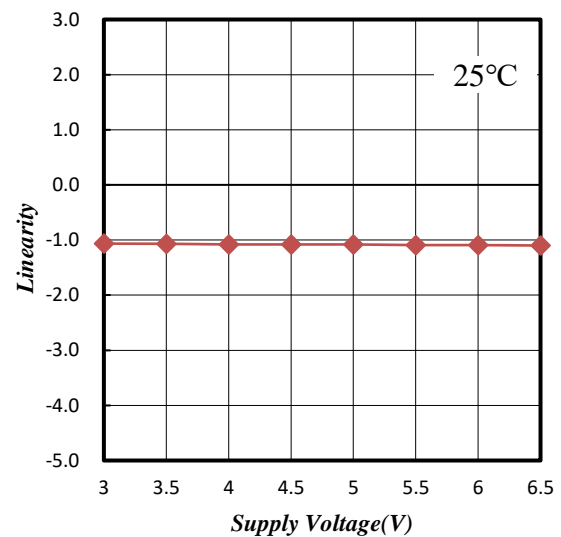
Supply Voltage(V)

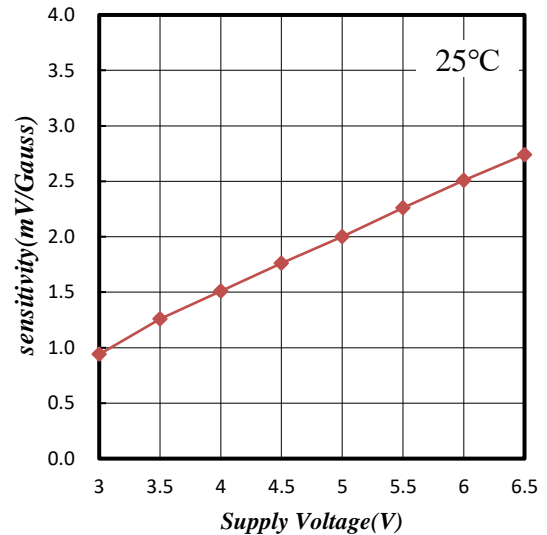*Typical Temperature (T$_A$) Versus Supply Current (I$_{CC}$)*
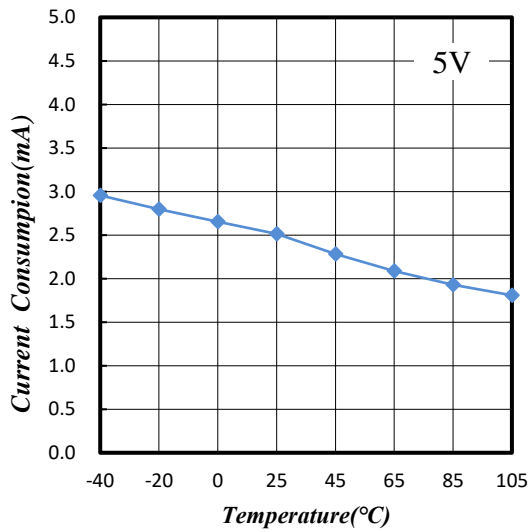
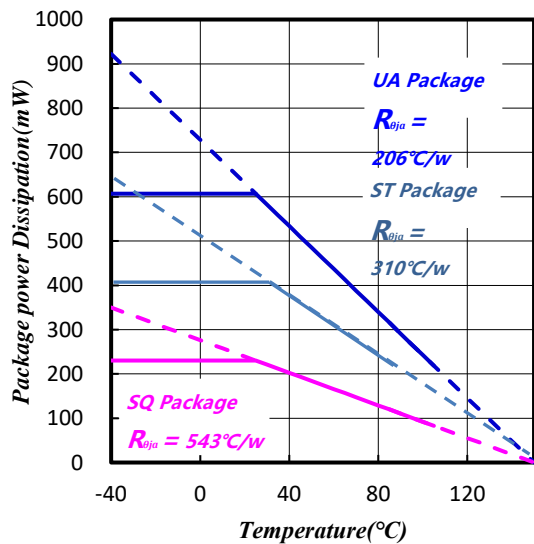*Typical Supply Voltage (V$_{CC}$) Versus Supply Current (I$_{CC}$)*
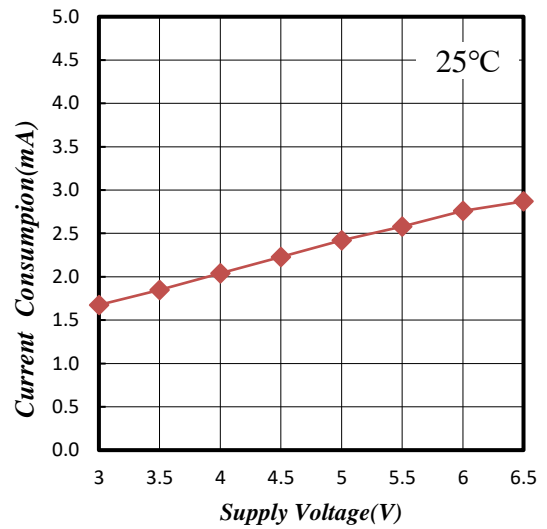
Typical Temperature (T$_A$) Versus Sensitivity

Typical Supply Voltage (V$_{CC}$) Versus Sensitivity

Power Dissipation Versus Temperature (T$_A$)

UA Package
$R_{\theta ja} = 206°C/w$
ST Package
$R_{\theta ja} = 310°C/w$
SQ Package
$R_{\theta ja} = 543°C/w$

Output Voltage

The output voltage of linear Hall Effect Sensor is an analog signal and which is proportional to the magnetic flux density. The basis of its output voltage will be changed by the supply voltage. Therefore, under the different supply voltage, the output voltage is proportional to magnetic flux density. V_{OUT} can be calculated as follows:

$$V_{OUT} = \frac{1}{2} \times V_{CC} + B_M \times \text{Sensitivity}$$

While $\text{Sensitivity} = \left[\frac{1}{2} \times (V_{CC} - 1) - \left(\frac{T_a - 25}{20} \times 0.09 \right) \right] \times \frac{1}{1000}$

V_{OUT} is output voltage of IC (V)

V_{CC} is supply voltage of IC (V)

B_M is magnetic flux density on IC (Gauss)

Sensitivity can be calculated via the supply voltage (V_{CC}) and ambient temperature (T_a)

T_a is ambient temperature of IC (℃)

The range of parameters that can meet the above formula: the supply voltage is from 3V to 6.5V; T_a is between 25℃ to 105℃, the magnetic flux density is between -800Gauss ~ +800Gauss. If T_a is lower than 25 ° C, the temperature operand $\left(\frac{T_a - 25}{20} \times 0.09 \right)$ on Sensitivity is negligible.

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 25℃, one can calculate the power dissipation of the device which in this case is 606 milliwatts.

$$P_D (UA) = \frac{150℃ - 25℃}{206℃/_w} = 606mW$$

The 206℃/W for the UA package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 606 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.
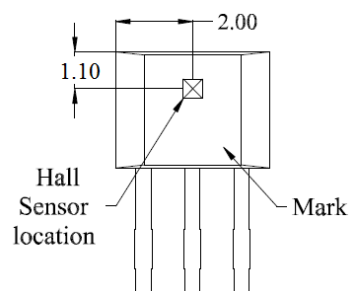
Sensor Location, package dimension and marking

UA Package

Hall Chip location
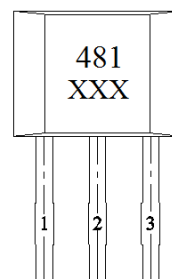

Hall Sensor location

Mark
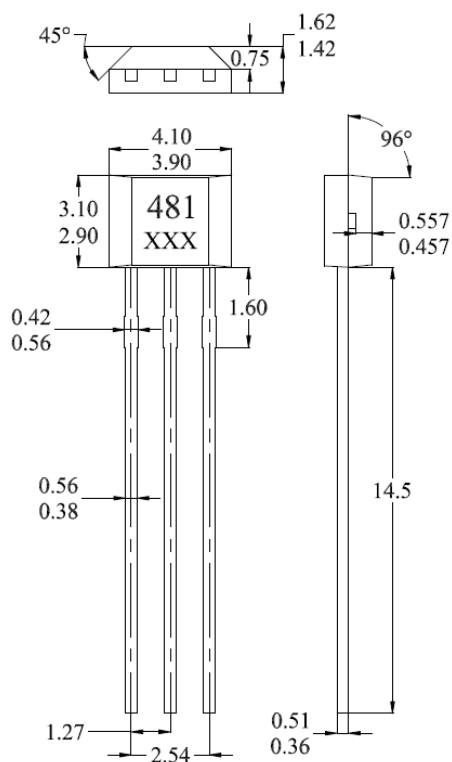
NOTES:

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   VCC
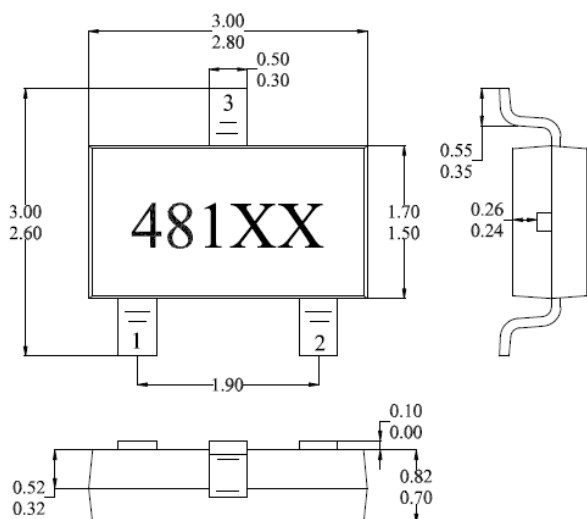   Pin 2   GND
   Pin 3   Output

Output Pin Assignment

(Top view)

481
XXX

1   2   3

ST Package (TSOT-23)

(Top view)

481XX

NOTES:
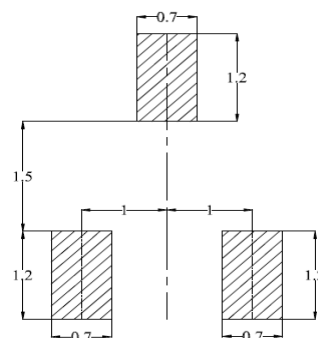
1. PINOUT (See Top View at left:)

   Pin 1   VDD
   Pin 2   Output
   Pin 3   GND
2. Controlling dimension: mm;

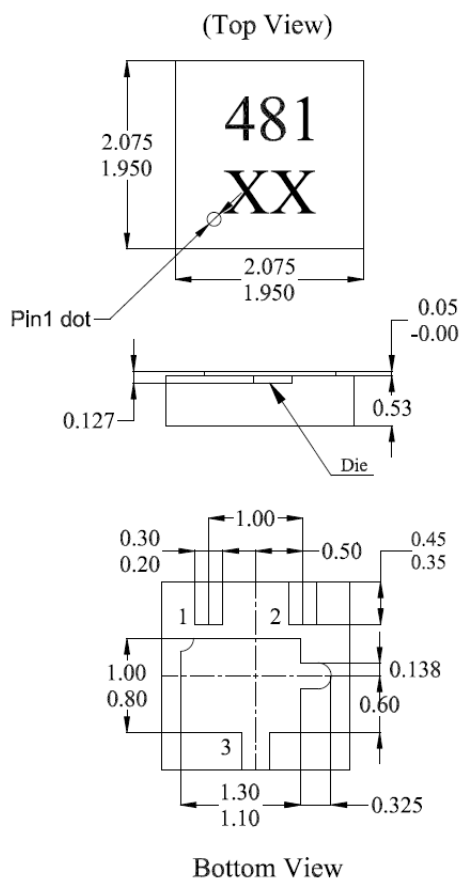### Hall Plate Chip Location

(Bottom view)
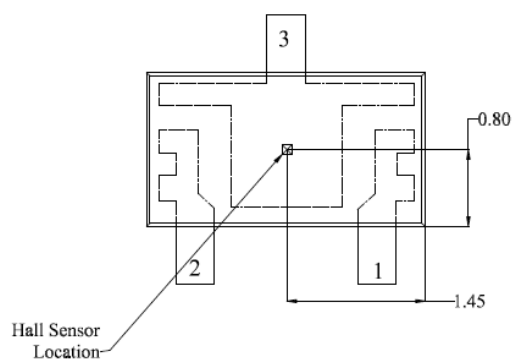
Hall Sensor Location

(For reference only) Land Pattern

MH481
Ratio-metric Linear Hall Effect Sensor

SQ Package（QFN2020-3）

(Top View)

Pin1 dot

Die

Bottom View

Hall Plate Chip Location
(Top view)

Hall Sensor Location

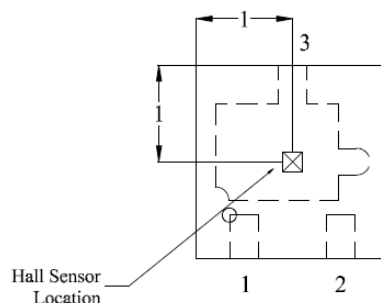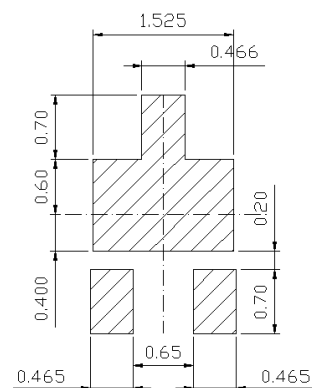## (For reference only) Land Pattern

NOTES:
1. PINOUT (See Top View at left)
   Pin 1 VCC
   Pin 2 Output
   Pin 3 GND
2. Controlling dimension: mm;
3. Chip rubbing will be 10 mil maximum;
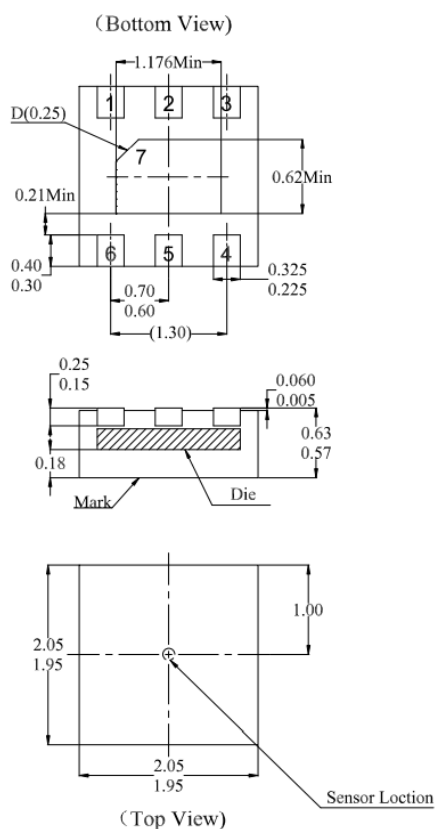4. Chip must be in PKG. center.

SD package (DFN2020-6)

（Bottom View）

Mark   Die
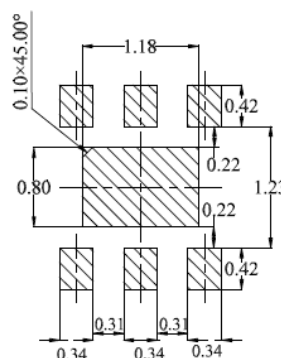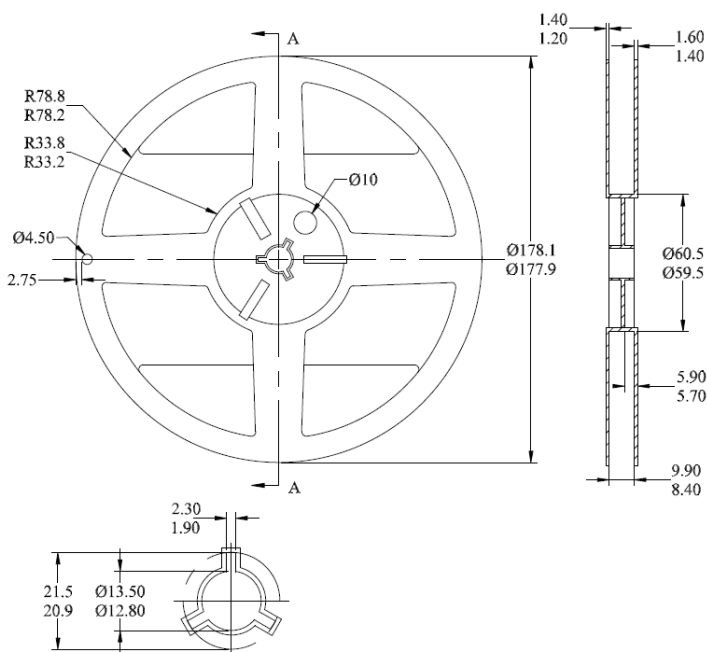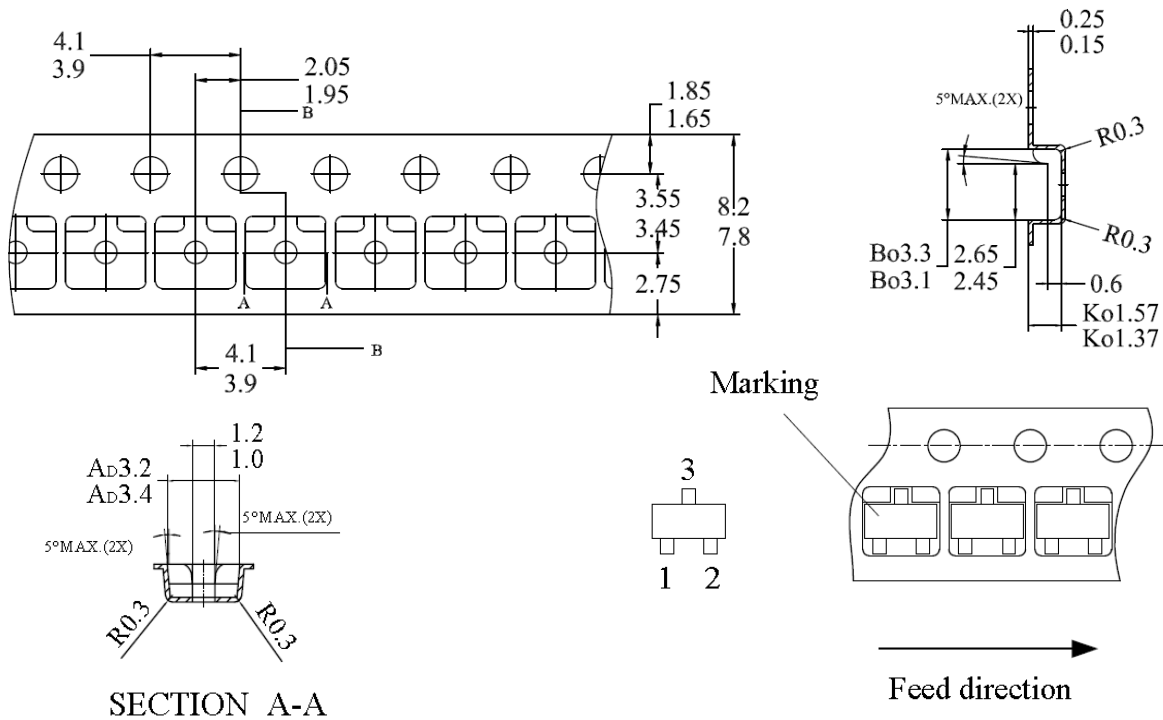
（Top View）

Sensor Loction

NOTES:
1. Controlling dimension: mm
2. Leads must be free of flash and plating voids
3. Lead thickness after solder plating will be 0.254mm maximum
4. PINOUT:

Pin No.	Pin Name	Function
1	V_{DD}	Power Supply
2	N.C	N.C
3	V_{OUT}	Output
4	N.C	N.C
5	V_{SS}	Ground
6	N.C	N.C
7	V_{SS}	Ground

5. （For reference only）Land pattern

TSOT-23 package Tape On Reel Dimension

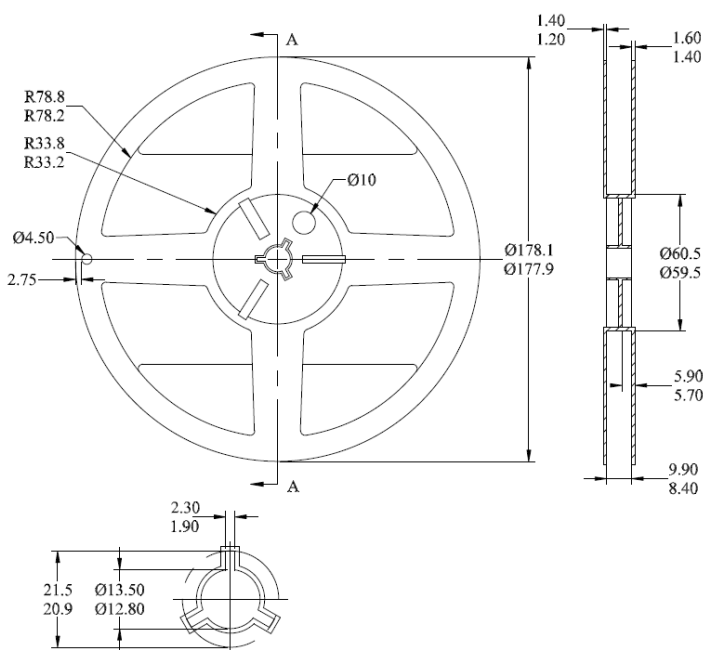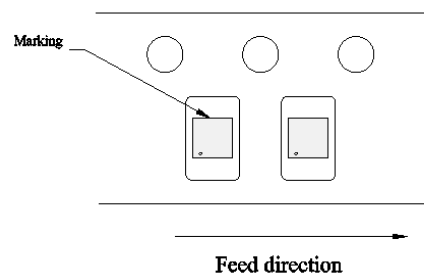SECTION A-A

Marking

Feed direction

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.

QFN2020-3 Tape On Reel Dimension

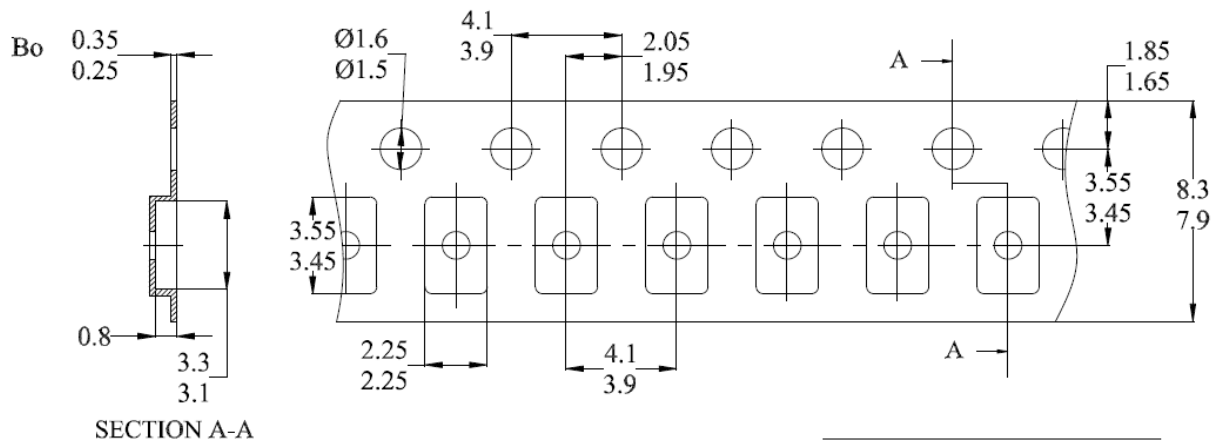SECTION A-A

Marking

Feed direction

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;
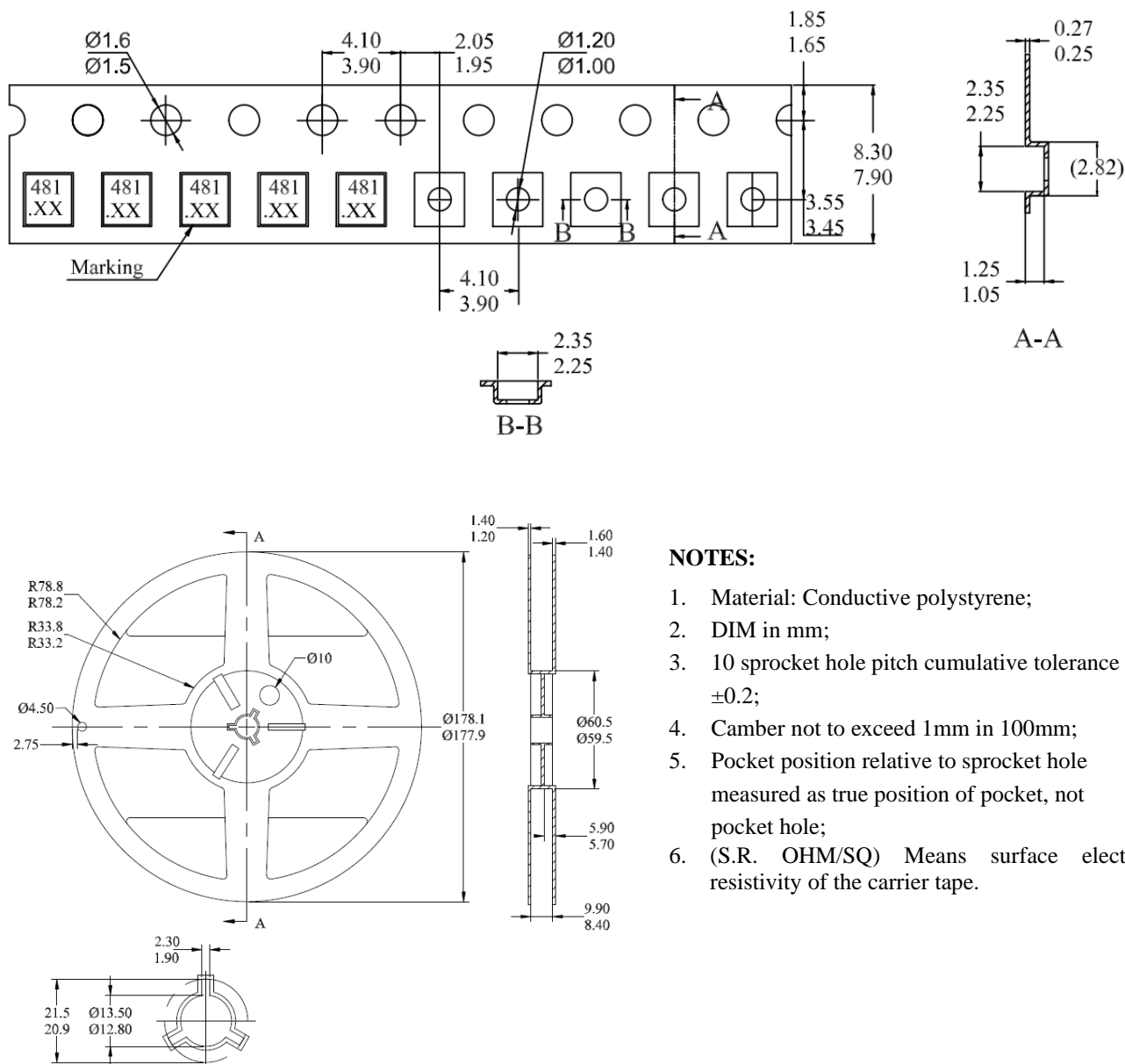6. (S.R.OHM/SQ) Means surface electric resistivity of the carrier tape.

SD package Tape On Reel Dimension

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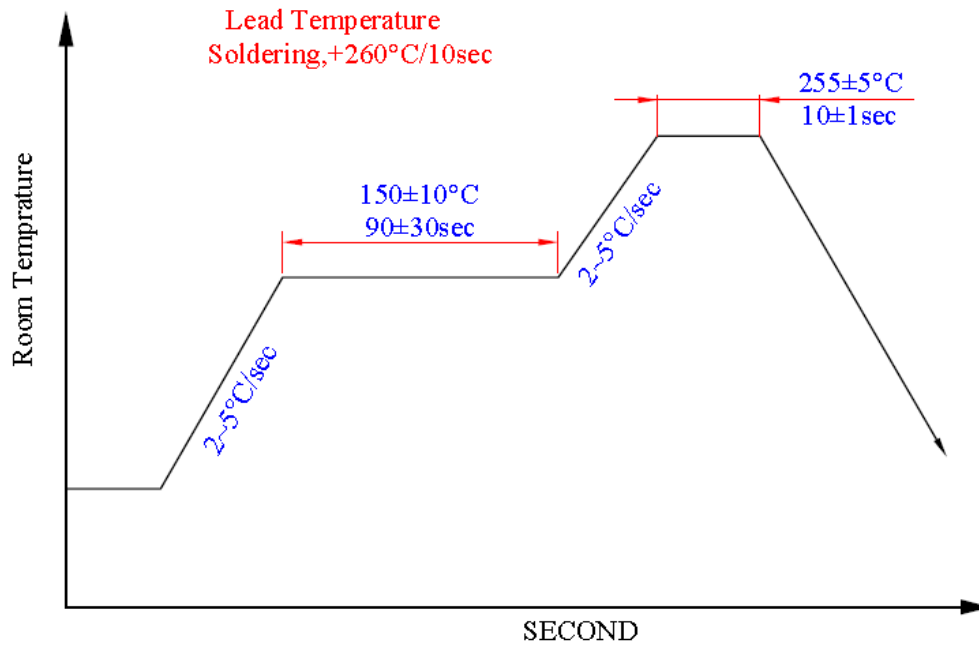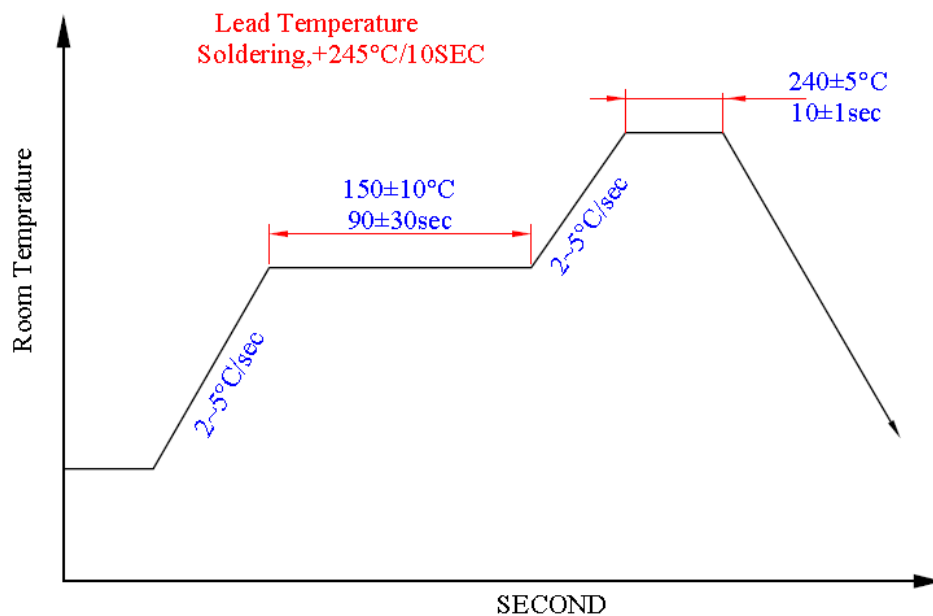
1. Material: Conductive polystyrene;
2. DIM in mm;
3. 10 sprocket hole pitch cumulative tolerance ±0.2;
4. Camber not to exceed 1mm in 100mm;
5. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole;
6. (S.R. OHM/SQ) Means surface electric resistivity of the carrier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

IR reflow curve

SQ/ST/SD Soldering Condition

UA Soldering Condition

Packing specification:

Package	Bag	Box	Carton	Carton	Carton
TO-92S-3L(UA)	1,000pcs/bag	10bags/box	10 boxes/carton	5 boxes/carton	4 boxes/carton
TSOT-23-3L(ST)	3,000pcs/reel	5reels/box	6boxes/carton	6boxes/carton	6 boxes/carton
QFN2020-3(SQ)	3,000pcs/reel	5reels/box	6boxes/carton	6boxes/carton	6 boxes/carton
QFN2020-6(SD)	4,000pcs/reel	5reel/box	12 box/carton	4,000pcs/reel	4,000pcs/reel

TO-92S-3L	Weight	TSOT-23-3L	Weight
1000pcs/bag	0.11kg	3000pcs/reel	0.12kg
10bags/box	1.26kg	5reels/box	0.72kg
10 boxes/carton	13.38kg	6boxes/carton	4.79kg
5 boxes/carton	6.82kg	6boxes/carton	4.79kg
4 boxes/carton	5.54kg	6boxes/carton	4.79kg

QFN2020-3(SQ)	Weight	QFN2020-6(SD)	Weight
3000pcs/reel	0.10kg	4000pcs/reel	0.11kg
5reels/box	0.64kg	5 reels/box	0.66kg
6boxes/carton	4.34kg	12 boxes/carton	8.72kg

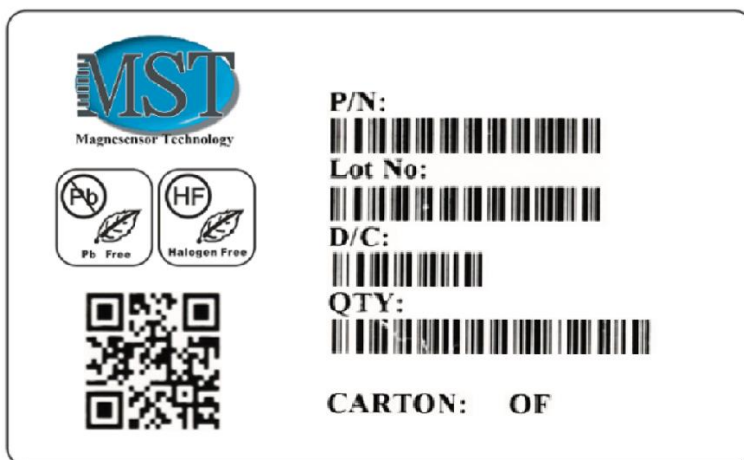### ST/SQ/SD Package Inner box label：Size:5cm*8cm

ST/SQ/SD Carton label：Size:6cm* 9cm

UA Package Inner box label：Size:5cm*8cm

UA Carton label：Size:6cm* 9cm

Combine:

When combine lot, one reel could have two D/C and no more than two DC. One carton could have two devices, no more than two;