General Description

The OCH1902 is small, versatile linear Hall effect devices which are operated by the magnetic field from a permanent magnet or an electromagnet. They are optimized to accurately provide a voltage output that is proportional to an applied magnetic field. These devices have a quiescent output voltage that is 50% of the supply voltage.

The Hall-effect integrated circuit included in each device includes a Hall sensing element, a linear amplifier, and a CMOS Class AB output structure. Integrating the Hall sensing element and the amplifier on a single chip minimizes many of the problems normally associated with low voltage level analog signals.

High precision in output levels is obtained by internal gain and offset trim adjustments made at end-of-line during the manufacturing process.

The integrated circuitry provides increased temperature stability and sensitivity, for both linear target motion and rotational motion. These linear position sensors have an operating temperature range of -40°C to +150°C, appropriate for industrial environments. They respond to either positive or negative gauss, monitoring either or both magnetic poles. The quad Hall sensing element minimizes the effects of mechanical or thermal stress on the output. The positive temperature coefficient of the sensitivity helps compensate for the negative temperature coefficients of low cost magnets, providing a robust design over a wide temperature range.

The OCH1902 is available in small 3-pin SOT23 -3L、 SIP-3L and DFN1616-3L package, and is rated over the -40°C to +150°C. These packages are available in a lead (Pb) free version.

Features

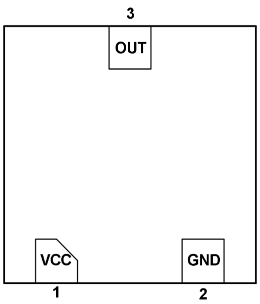
- Supply Voltage Range: 3.0V ~ 5.5V
- Fast Power-on Time
- Power Consumption of 8mA at 5V Supply Voltage
- Single Current Sinking or Current Sourcing Output
- Linear Output for Circuit Design Flexibility
- Ratio metric Output for A/D Interface
- Wide Sensible Magnetic Field Range on Different Supplied Voltage ±450Gauss on 5V Supplied Voltage
- Rail to Rail Operation Provides More Useable Signal For Higher Accuracy
- Temperature Stable Quiescent Output Voltage
- Quad Hall Sensing Element for Stable Output
- Low Noise Output
- Responds to Either Positive or Negative Gauss
- Robust EMC Protection
- Temperature Range of -40°C to +150°C
- Miniature Package SOT23-3L 、 SIP-3L and DFN1616-3L

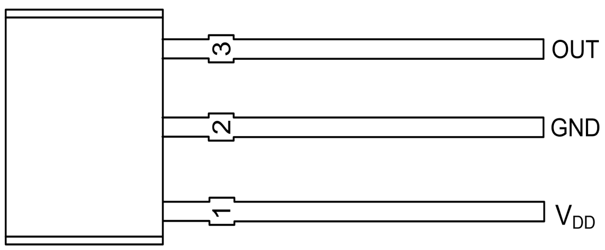
Applications

- Current Sensing
- Motor Control
- Linear Position Sensing
- Magnetic Code Reading
- Rotary Position Sensing
- Ferrous Metal Detector
- Vibration Sensing
- Liquid Level Sensing
- Weight Sensing

Pin Configuration

DFN1616-3L、SIP-3L and SOT-23-3L (Top View)





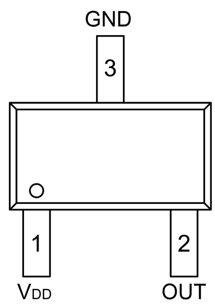


Figure 1, Pin Assignments of OCH1902

Pin Name	Pin No.			I/O	Pin Function
	SOT23-3L	SIP-3L	DFN1616-3L		
VDD	1	1	1	P	Power Supply Pin.
GND	3	2	2	P	Ground Pin.
OUTPUT	2	3	3	O	Linear Voltage Output Pin.

Typical Application Circuit

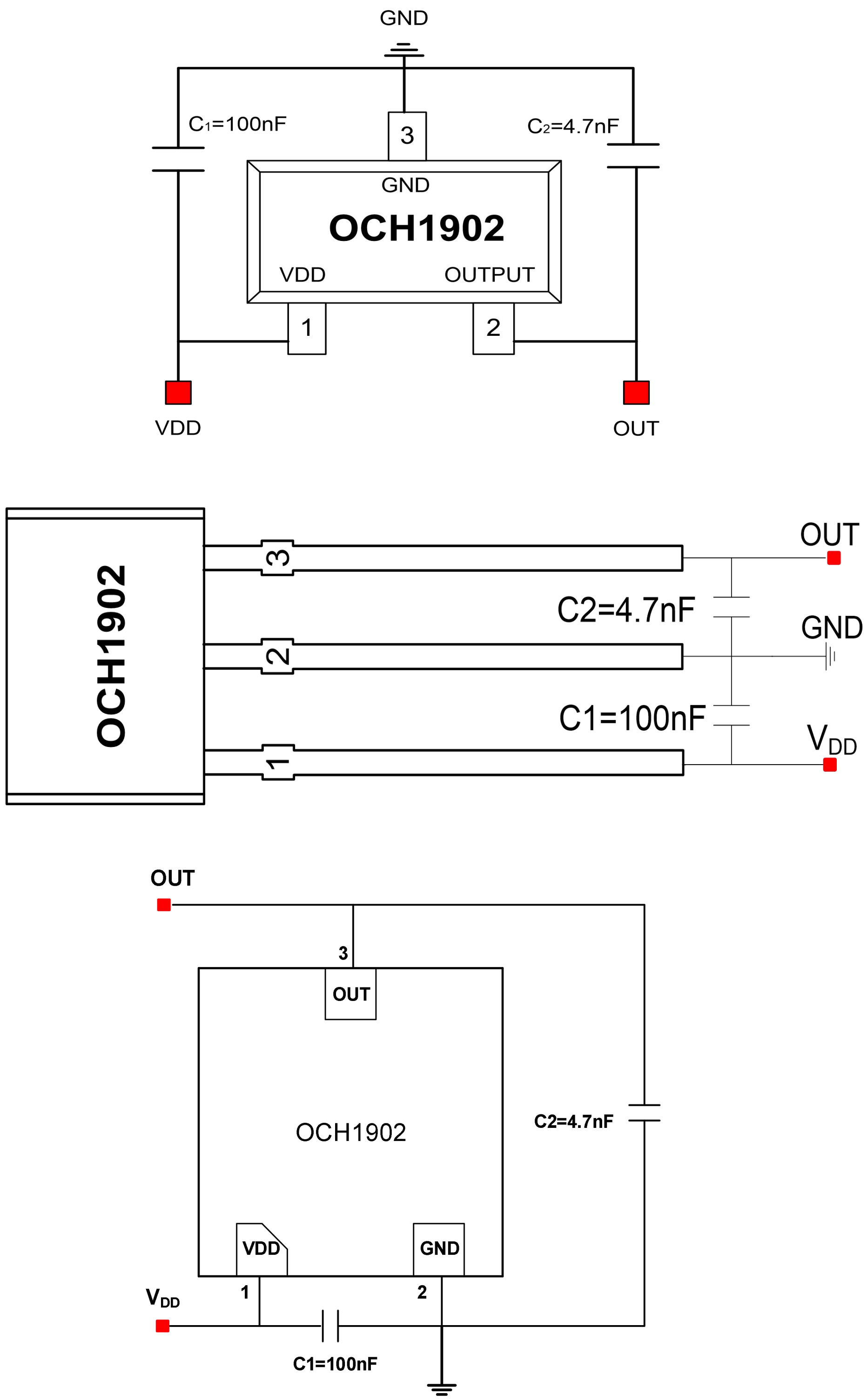
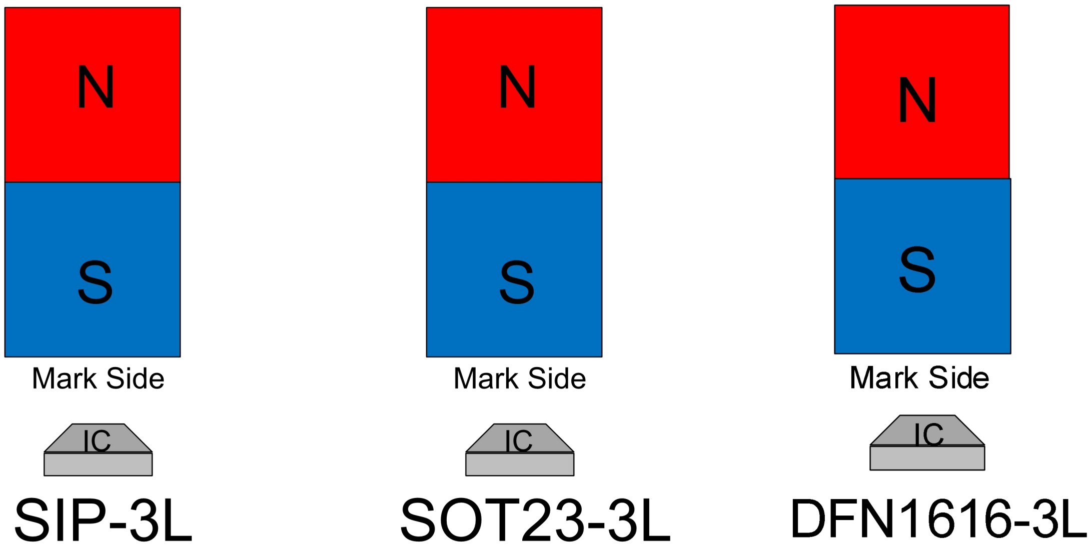


Figure 2, Typical Application Circuit

■ Transfer Characteristics (Vcc=5V)



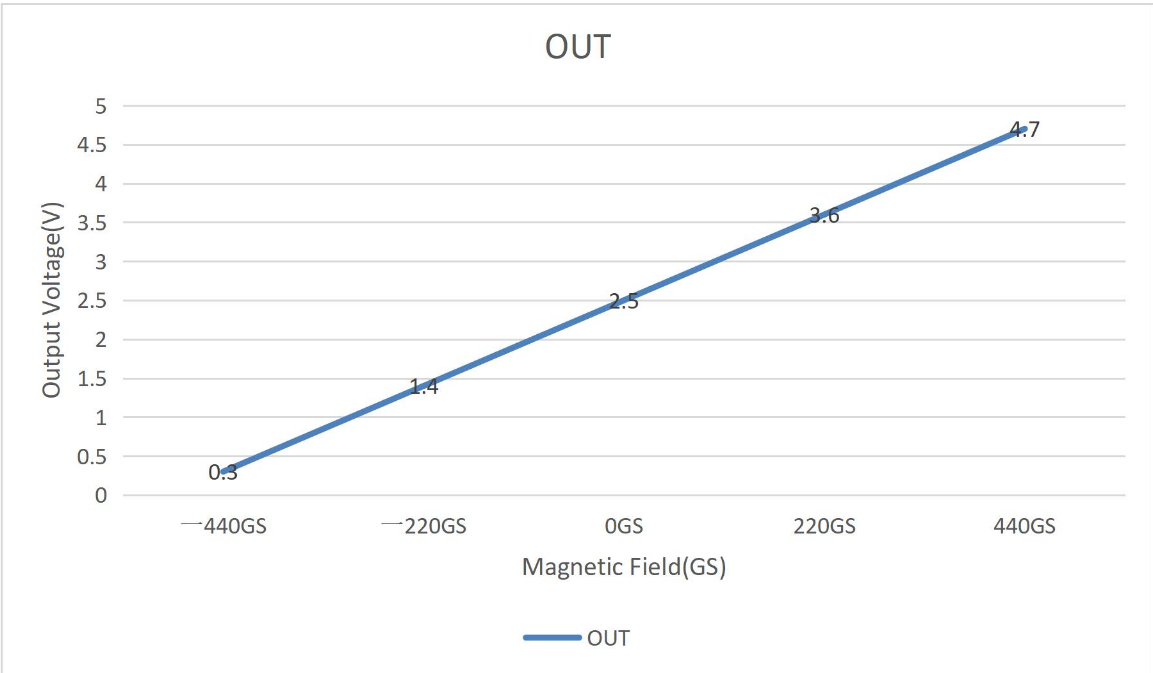


Figure 3, The Transfer Characteristics of OCH1902

Note: C1 is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 100nF. C2 is a stable output. In order to enhance anti-noise capability, it is recommended that the capacitor be set to 4.7NF.

■ Ordering Information

Part Number	Sensitivity (Typ.)	Package Type	Package Qty	Temperature	Eco Plan	Lead
OCH1902FV6AD	5mV/Gauss@5V 3.15mV/Gauss@ 3.3V	DFN1616-3L	7-in reel 3000pcs/reel	-40～150℃	Green	Cu
OCH1902WAE	5mV/Gauss@5V 3.15mV/Gauss@ 3.3V	SOT23-3L	7-in reel 3000pcs/reel	-40～150℃	Green	Cu
OCH1902ME	5mV/Gauss@5V 3.15mV/Gauss@ 3.3V	SIP-3L	Bulk 1000pcs/bag	-40～150℃	Green	Cu

■ Block Diagram

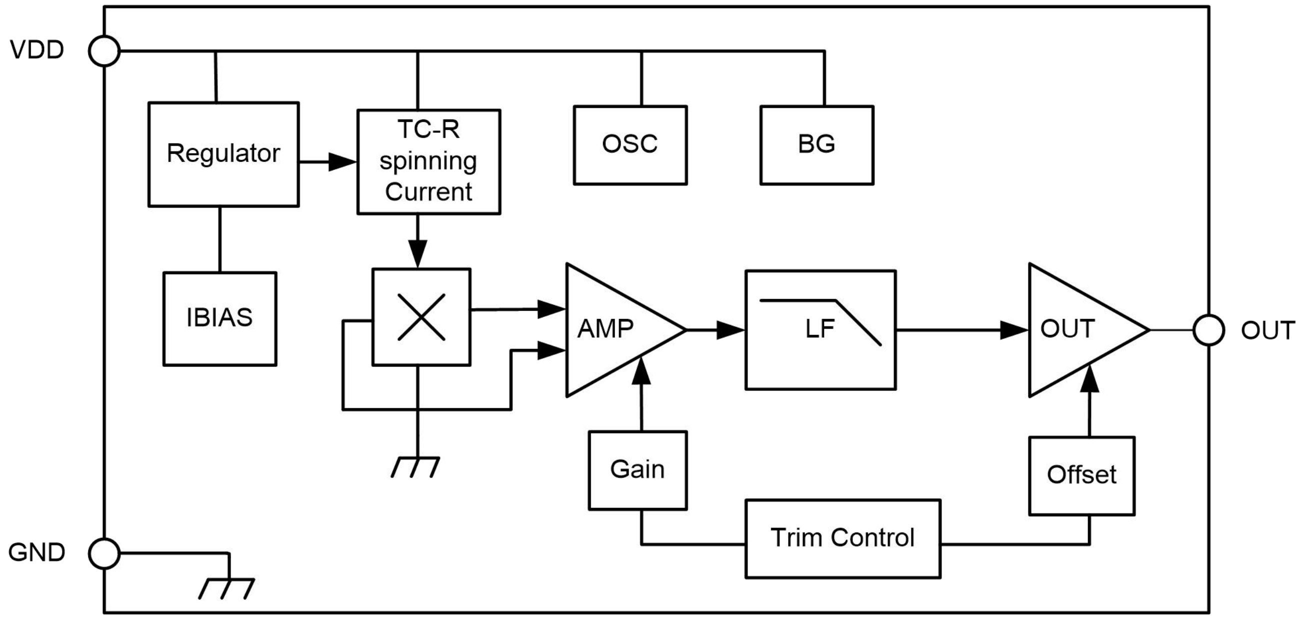


Figure 4, Block Diagram of OCH1902

■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
V_{DD} to GND	V_{DD}	-0.3 to 25	V
Output to GND	V_{OUTPUT}	-0.3 to V_{DD}	V
Output Current	I_{OUT}	10	mA
Power Dissipation (for SOT23-3L)	P_D	301	℃/W
Power Dissipation (for SIP-3L)	P_D	230	℃/W
Power Dissipation (for DFN1616-3L)	P_D	301	℃/W
Lead Temperature (Soldering, 10 Sec.)	T_{LT}	260	℃
Storage Temperature Range	T_S	-55 to +150	℃
Maximum Operating Junction Temperature Range	T_J	-40 to 165	℃
ESD (HBM)	ESD	8K	V

■ Recommended Operating Conditions

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{DD}	Operating	3.0 ~ 5.5	V
Output Voltage	V_{OUT}	Operating	0.3 ~ (V_{DD}-0.3)	V
Operating Temperature	T_{OP}	Operating	-40 ~ +150	℃

■ Electrical Characteristics

(Unless otherwise noted, typical values are at T_A=25℃, V_{DD}=5.0V)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
General Supply						
V_{DD}	Power supply		3.0	-	5.5	V
I_Q	Quiescent Current		-	8.0	10.0	mA
T_{PO}	Power On Time[1]		-	30	50	uS
Gauss Sensitivity						
A_{SEN}	Sensitivity@5V		4.65	5	5.35	mV/Gauss
	Sensitivity@3.3V		2.93	3.15	3.37	mV/Gauss
	Temperature Coefficient[1]		-10	-	+10	%
MGR	Measurable Gauss Range@5V		-	±440		Gauss
	Measurable Gauss Range@3.3V		-	±430	-	Gauss
BW	Bandwidth		-	50	-	KHz
Chopping Frequency	f_C	TA = 25°C	-	400	-	KHz
Ratiometry						
$\triangle V_{OQ(\triangle V)}$	Output Voltage Error with Respect to $\triangle V_{DD}$[1]	0 Gauss	-1.5		1.5	%
$\triangle S_{EN(\triangle V)}$	Magnetic Sensitivity Error with Respect to $\triangle V_{DD}$[1]		-1.5		1.5	%
Output Stage						
V_{OQ}	0 Gauss Output Voltage @5V		2.475	2.50	2.525	V
	0 Gauss Output Voltage @3.3V		1.62	1.65	1.68	V
	Temperature Coefficient[1]		-0.15	-	0.15	%/℃
Line	Output Voltage Linearity[1]		-1.5	-	1.5	%
Sym.	Symmetry[1]		-1.5	-	1.5	%
V_{OH}	Output Maximum Voltage	I_{OH}=1.5mA		V_{DD}-0.2	-	V
V_{OL}	Output Minimum Voltage	I_{OL}=-1.5mA	-	0.2		V
R_{OUT}	Output Resistance	I_{SINK}<1.0mA, I_{SOURCE}>1.0mA	-	2	4	Ω
C_L	Output Loading Resistance	Iout<=± 1.5mA,Output to GND			10	nF
V_{OUTN}	Wide Band Output Noise[1]		-	1.55	-	mVRms
I_{SOURCE}	Source Current	B=0, Vout=0	-	-	3	mA
I_{sink}	Sink Current	B=0, Vout= Vcc	3	-	-	mA

1) Guaranteed by design, not tested.

■ Application Information

Quiescent Voltage Output:

In the quiescent state (no magnetic field), the output equals about 2.5V over the operating voltage range and the operating temperature range. Due to internal component tolerances and thermal considerations, there is a tolerance on the quiescent voltage output both as a function of supply voltage and as a function of ambient temperature. For purposes of specification, the quiescent voltage output as a function of temperature is defined in terms of magnetic flux density, B, as:

$$\Delta V_{OQ(\Delta T)} = \frac{V_{OQ(TA)} - V_{OQ(25℃)}}{V_{OQ(25℃)}} * 100\%$$

This calculation yields the device’s equivalent accuracy, over the operating temperature range, in gauss (G).

Sensitivity:

The presence of a south-pole magnetic field perpendicular to the package face (the branded surface) increases the output voltage from its quiescent value toward the supply voltage rail by an amount proportional to the magnetic field applied. Conversely, the application of a north pole will decrease the output voltage from its quiescent value. This proportionality is specified as the sensitivity of the device and is defined as:

$$A_{SEN} = \frac{V_{OUT(-B)} - V_{OUT(+B)}}{2B}$$

The stability of sensitivity as a function of temperature is defined as:

$$\Delta A_{SEN(\Delta T)} = \frac{A_{SEN(TA)} - A_{SEN(25℃)}}{A_{SEN(25℃)}} * 100\%$$

Ratio-metric:

The OCH1901 family features a ratio-metric output. The quiescent voltage output and sensitivity are proportional to the supply voltage (ratio-metric).The percent ratio-metric change in the quiescent voltage output is defined as:

$$\Delta V_{OQ(\Delta V)} = \frac{V_{OQ(VDD)}/V_{OQ(5V)}}{V_{DD}/5V} * 100\%$$

and the percent ratio-metric change in sensitivity is defined as:

$$\Delta A_{SEN(\Delta V)} = \frac{A_{SEN(VDD)}/A_{SEN(5V)}}{V_{DD}/5V} * 100\%$$

Linearity and Symmetry:

The on-chip output stages designed to provide a linear output with a supply voltage of5V. Although application of very high magnetic fields will not damage these devices, it will force the output into a non-linear region. Linearity in percent is measured and defined as:

$$Linear += \frac{V_{OUT(+B)} - V_{OQ}}{2(V_{OUT(+B/2)} - V_{OQ})} * 100\%$$

$$Linear -= \frac{V_{OUT(-B)} - V_{OQ}}{2(V_{OUT(-B/2)} - V_{OQ})} * 100\%$$

and output symmetry as:

$$Sym = \frac{V_{OUT(+B)} - V_{OQ}}{V_{OQ} - V_{OUT(-B)}} * 100\%$$

Thermal Considerations:

For continuous operation, do not exceed the maximum operation junction temperature 165°C. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction temperatures to ambient temperature The maximum power dissipation can be calculated by following formula:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

The value of junction to case thermal resistance θ_{JC} is popular for users. This thermal parameter is convenient for users to estimate the internal junction operated temperature of packages while IC operating. It's independent of PCB layout, the surroundings airflow effects and temperature difference between junction to ambient. The operated junction temperature can be calculated by following formula:

$$T_J = T_C * P_D * \theta_{JC}$$

Where T_C is the package case (Pin 3 of package leads) temperature measured by thermal sensor, P_D is the power dissipation defined by user's function and the θ_{JC} is the junction to case thermal resistance provided by IC manufacturer. Therefore, it's easy to estimate the junction temperature by any condition.

■ Hall Sensor Location

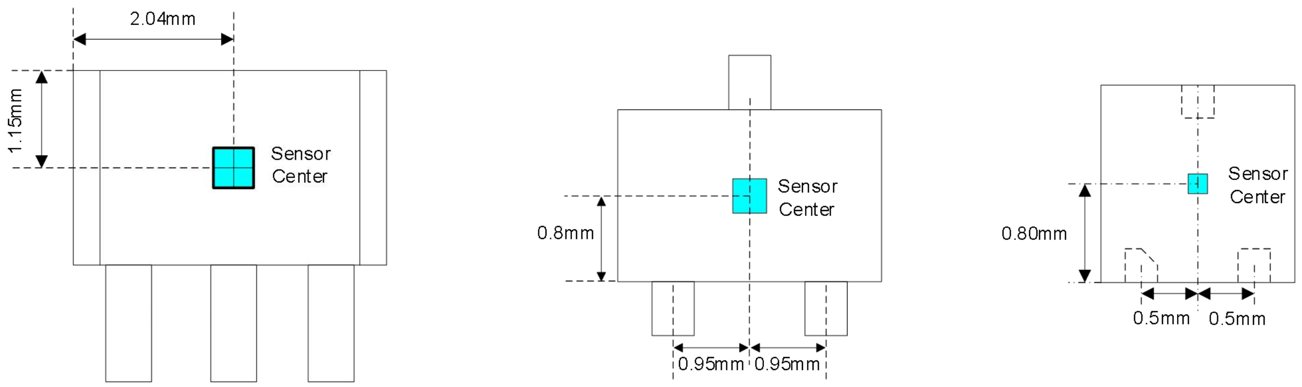
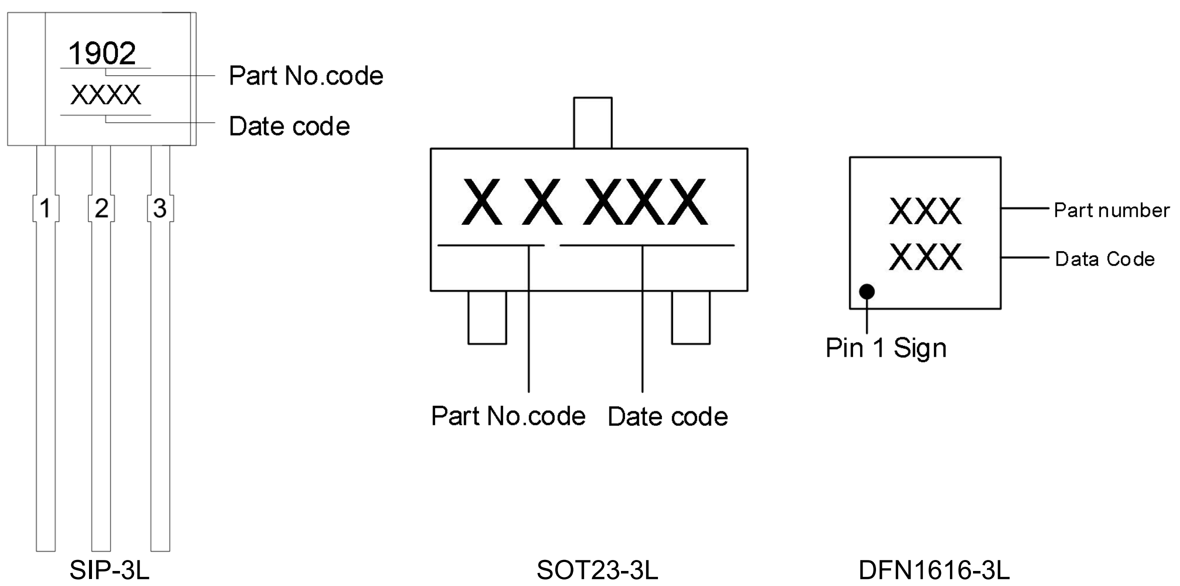


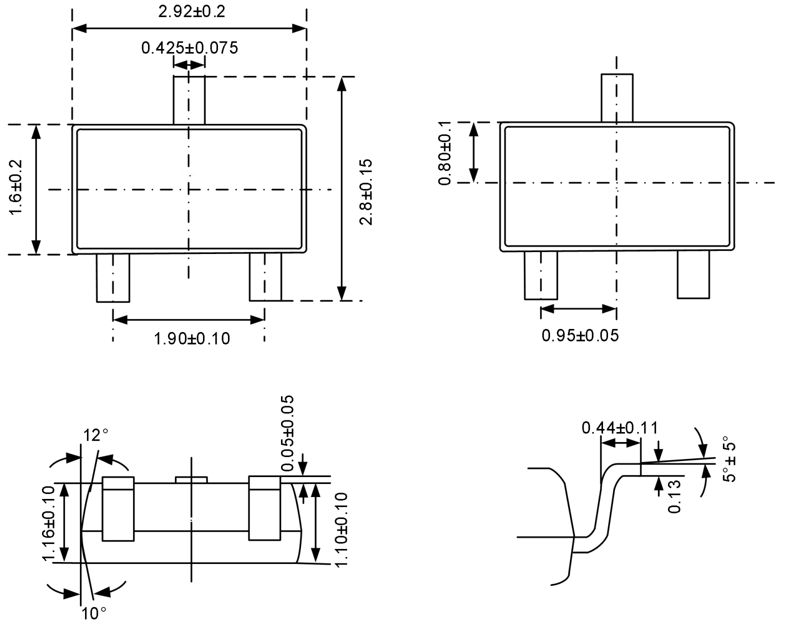
Fig5, OCH1901 Hall Sensor Location

■ Marking Information

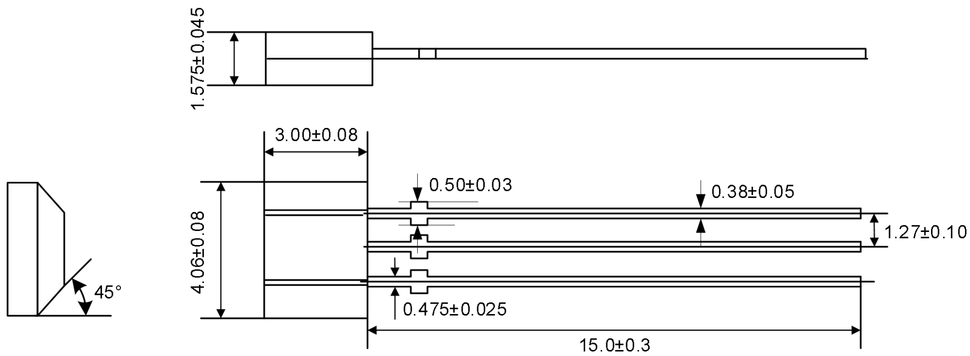


■ Package Information

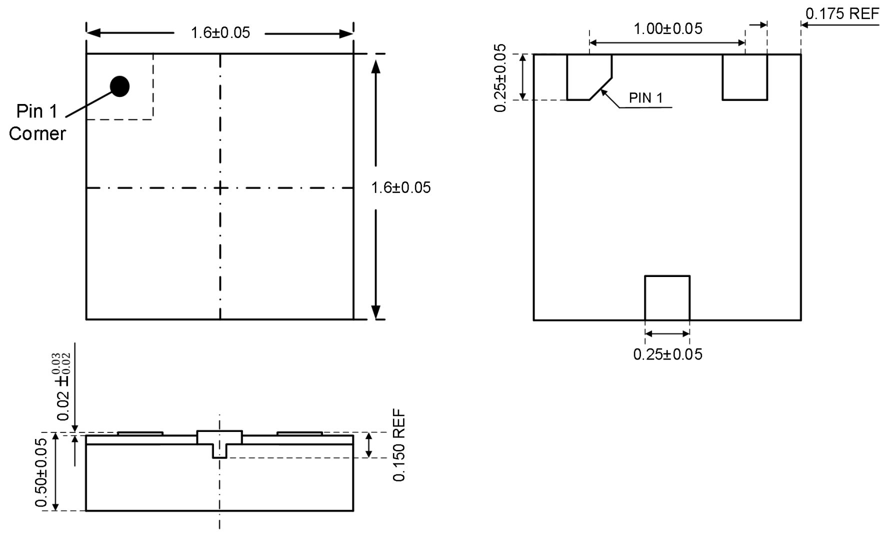
1) SOT23-3L



2) SIP-3L

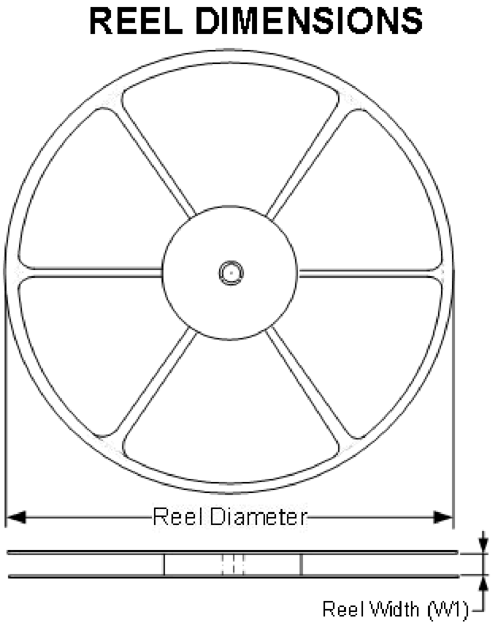


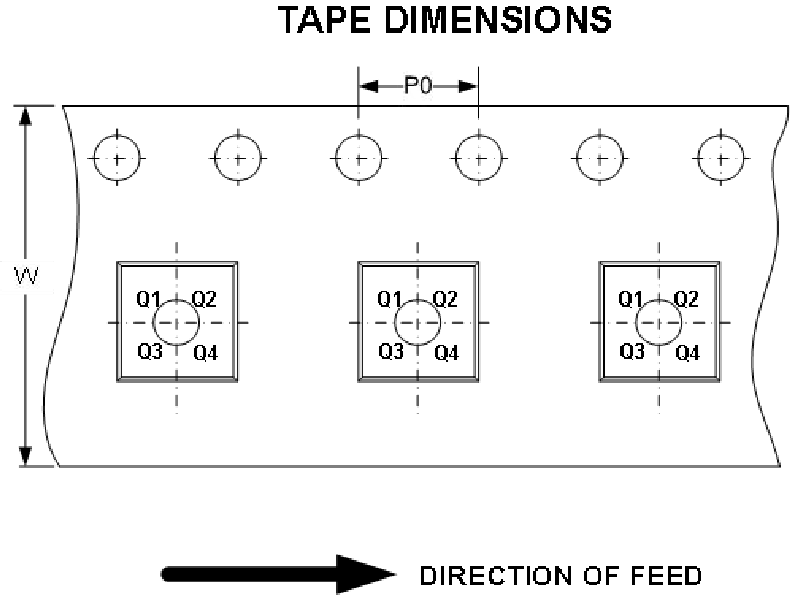
3) DFN1616-3L



■ Packing Information

1) SOT23-3L/DFN1616-3L





Package type	SPQ (PCS)	Reel Diameter (mm)	Reel Width W1(mm)	W (mm)	P0 (mm)	MSL	Pin 1 Quadrant
SOT23-3L	3000	180	8.6	8.0	4.0	Level-3	Q3
DFN1616-3L	3000	180	8.6	8.0	4.0	Level-1	Q1

Note: Carrier Tape Dimension, Reel Size and Packing Minimum

2) SIP-3L
1. Packing type: Bulk
2. Packing minimum: 1000pcs

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