

General Description

The OCH1901 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 OCH1901 is available in small 3-pin SOT23 -3L and SIP-3L, 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 ± 850 Gauss 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 and SIP-3L , 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, SOT-23-3L and SIP-3L (Top View)

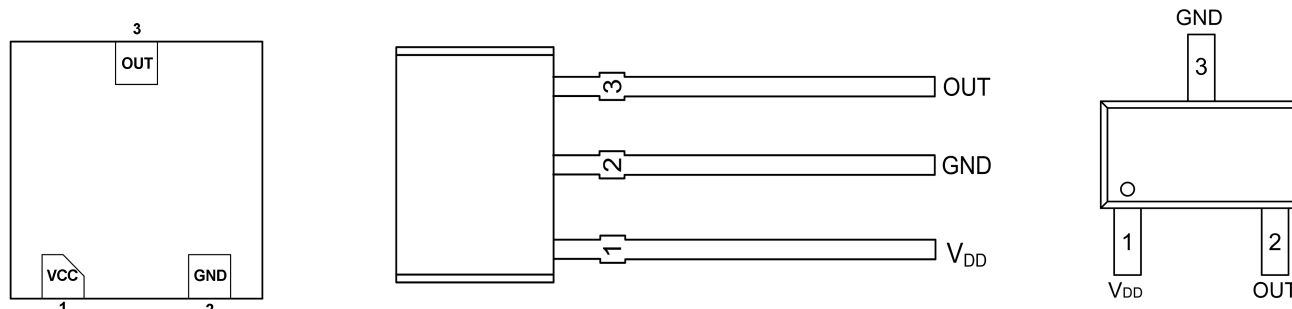


Figure 1, Pin Assignments of OCH1901

| 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



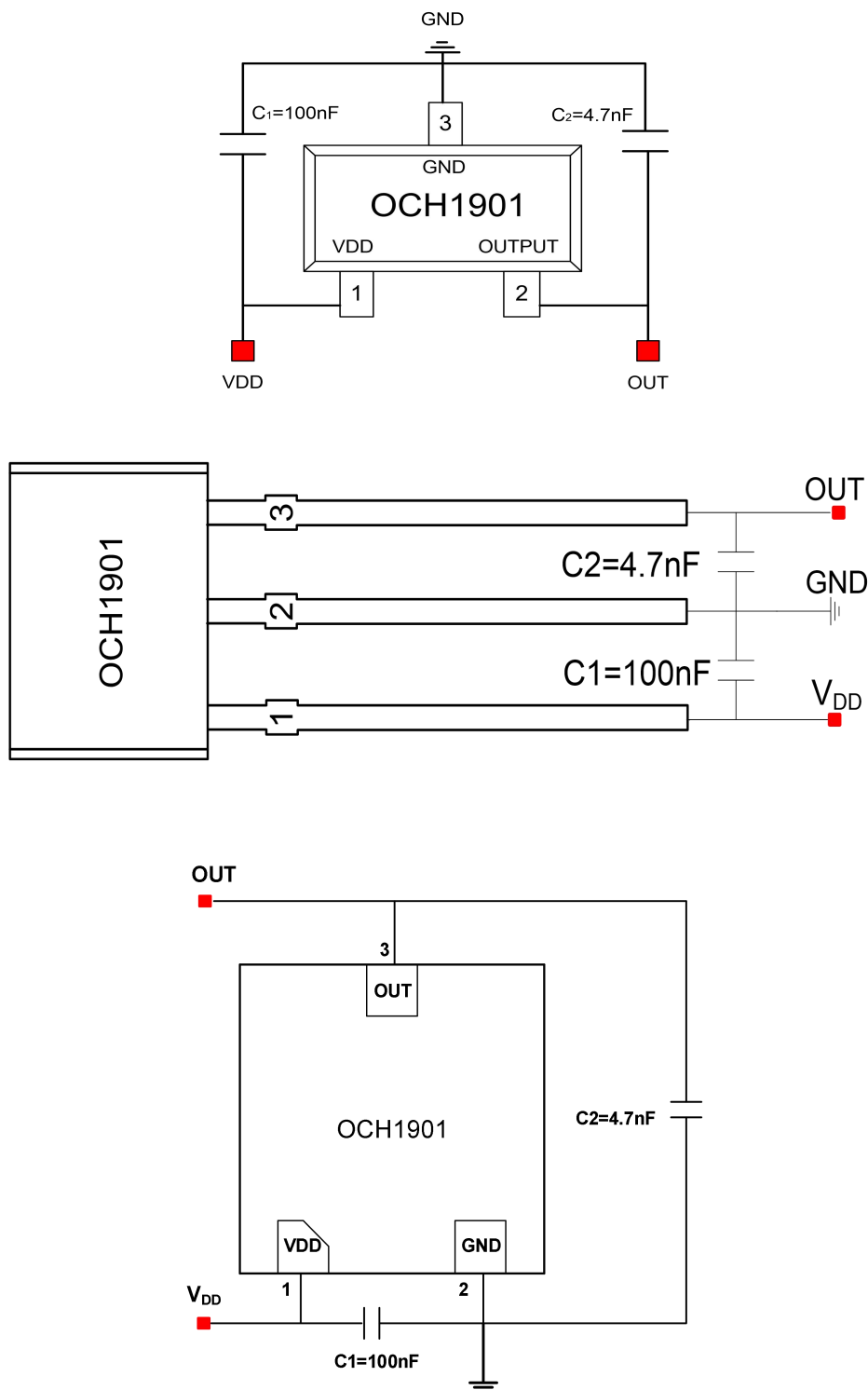
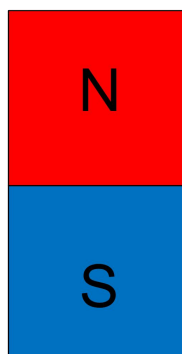


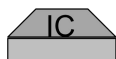
Figure 2, Typical Application Circuit

■ Transfer Characteristics (Vcc=5V)

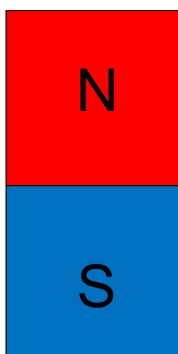




Mark Side



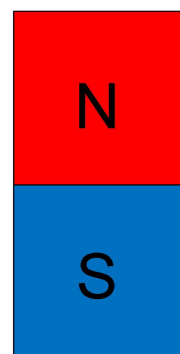
SIP-3L



Mark Side



SOT23-3L



Mark Side



DFN1616-3L

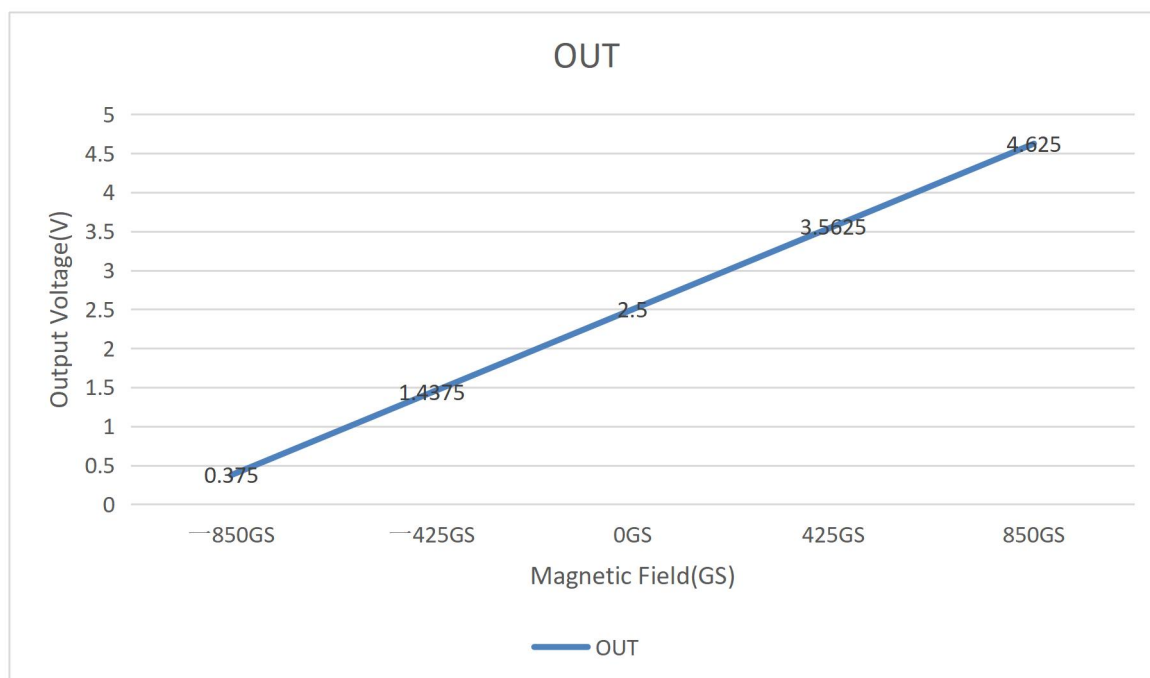


Figure 3, The Transfer Characteristics of OCH1901

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. The encapsulation chip of DFN1616-3L has the opposite polarity, The output rises in N field and decreases in S field

Ordering Information

| Part Number | Sensitivity (Typ.) | Package Type | Package Qty | Temperature | Eco Plan | Lead |
|-------------|--------------------|--------------|-------------|-------------|----------|------|
|-------------|--------------------|--------------|-------------|-------------|----------|------|



| | | | | | | |
|--------------|------------------------------------|------------|---------------------------|----------|-------|----|
| OCH1901EV6AD | 2.5mV/Gauss@5V 1.6mV/Gauss@3.3V | DFN1616-3L | 7-in reel 3000pcs/reel | -40~150℃ | Green | Cu |
| OCH1901WAE | 2.5mV/Gauss@5V 1.6mV/Gauss@3.3V | SOT23-3L | 7-in reel 3000pcs/reel | -40~150℃ | Green | Cu |
| OCH1901ME | 2.5mV/Gauss@5V 1.6mV/Gauss@3.3V | SIP-3L | Bulk 1000pcs/bag | -40~150℃ | Green | Cu |

■ Block Diagram

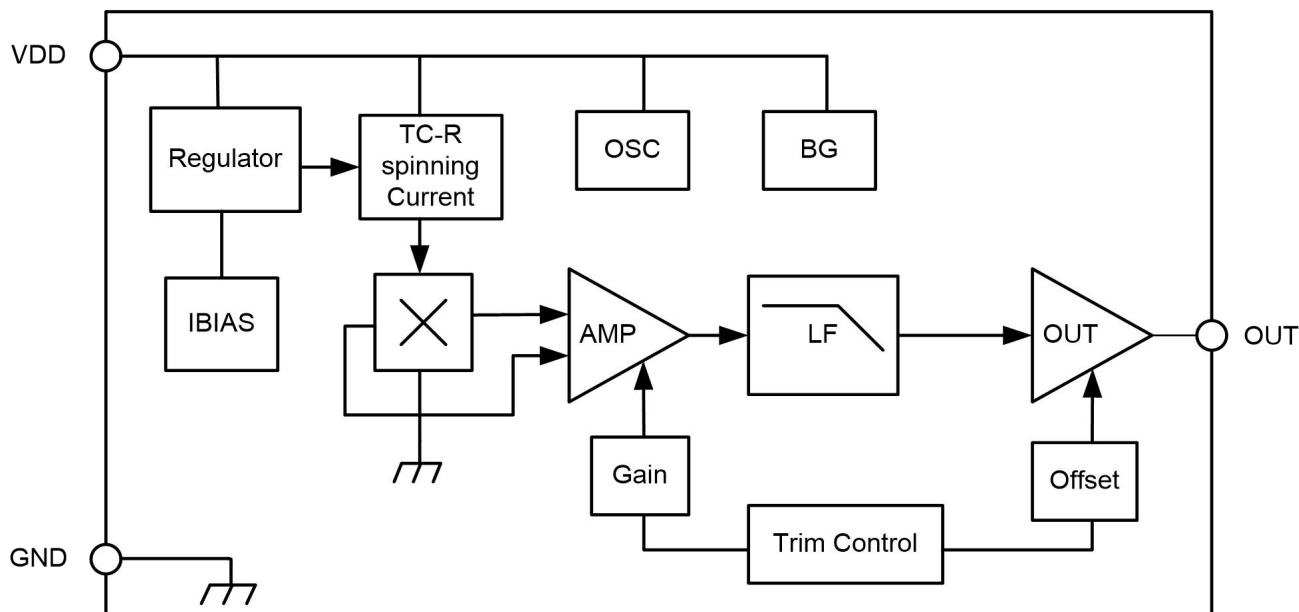


Figure 4, Block Diagram of OCH1901

■ 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 | μs |
| Gauss Sensitivity | | | | | | |
| A _{SEN} | Sensitivity@5V | | 2.35 | 2.50 | 2.65 | mV/Gauss |
| | Sensitivity@3.3V | | 1.48 | 1.6 | 1.72 | mV/Gauss |
| | Temperature Coefficient ¹ | | -10 | - | +10 | % |
| MGR | Measurable Gauss Range@5V | | - | ± 850 | ± 900 | Gauss |
| | Measurable Gauss Range@3.3V | | - | ± 800 | - | Gauss |
| BW | Bandwidth | | - | 50 | - | KHz |
| Chopping Frequency | fC | TA = 25°C | - | 400 | - | KHz |
| Ratiometry | | | | | | |
| ΔV _{OQ(ΔV)} | Output Voltage Error with Respect to ΔV _{DD} ¹ | 0 Gauss | -1.5 | | 1.5 | % |
| ΔS _{EN(ΔV)} | Magnetic Sensitivity Error with Respect to ΔV _{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 | %/°C |
| 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 | I _{out} ≤ ± 1.5mA, Output to GND | | | 10 | nF |
| V _{OUTN} | Wide Band Output Noise ¹ | | - | 1.8 | - | mVRms |
| I _{SOURCE} | Source Current | B=0, V _{out} =0 | - | - | 3 | mA |
| I _{SINK} | Sink Current | B=0, V _{out} = V _{cc} | 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:

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

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:

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

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 stage is designed to provide a linear output with a supply voltage of 5V. 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:

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

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

and output symmetry as:

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

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 air flow 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



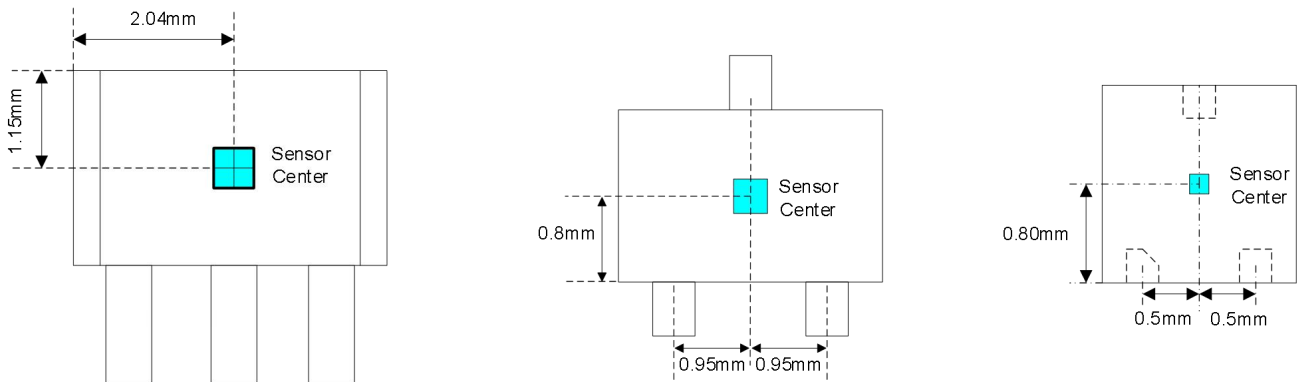
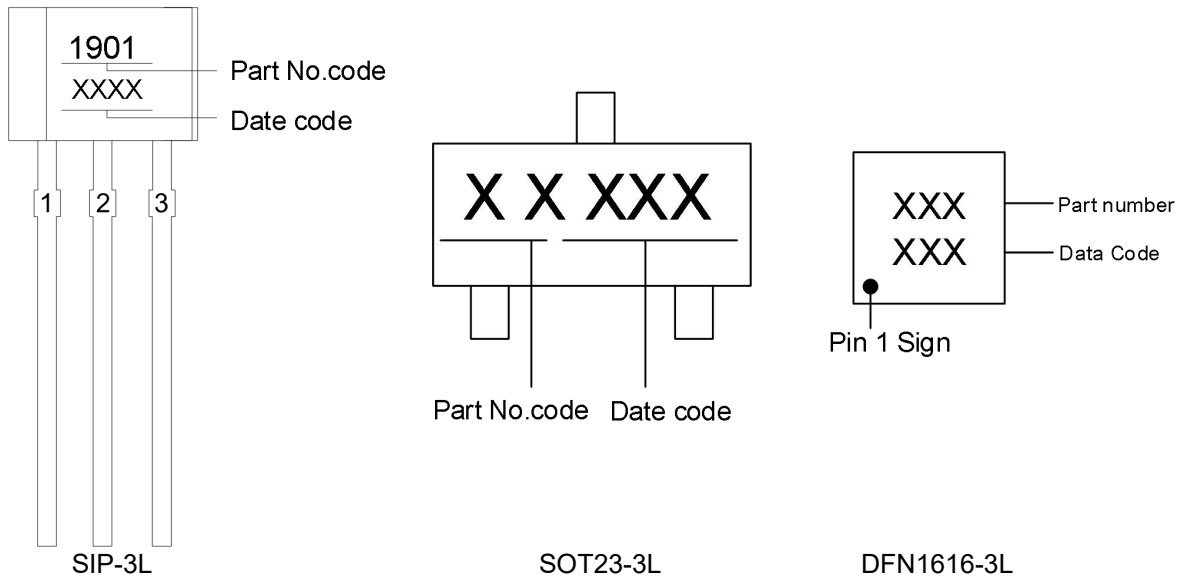


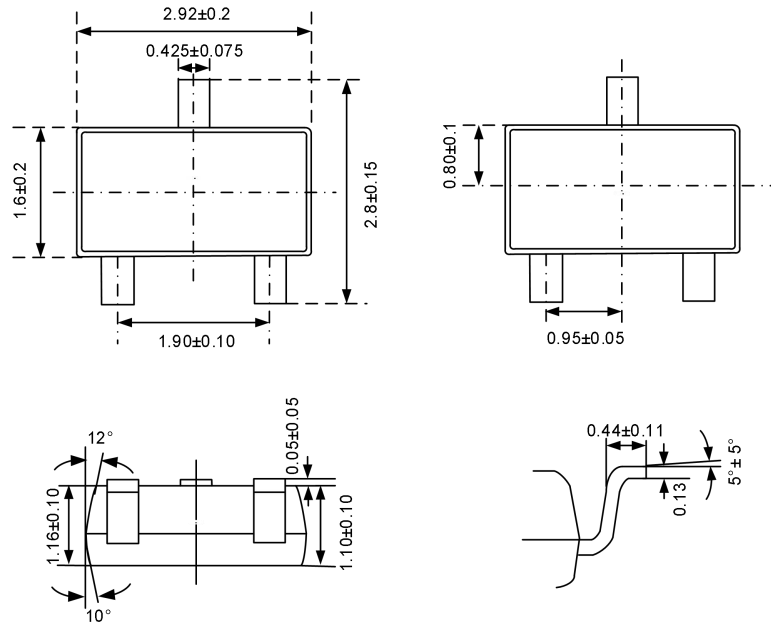
Fig5, OCH1901 Hall Sensor Location

■ Marking Information

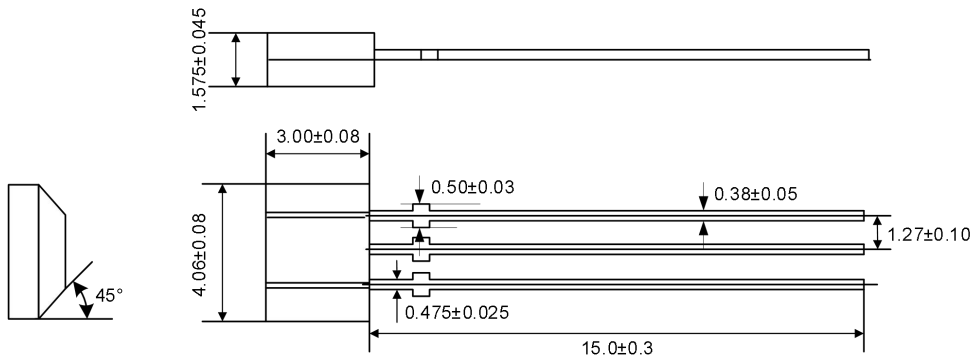


■ Package Information

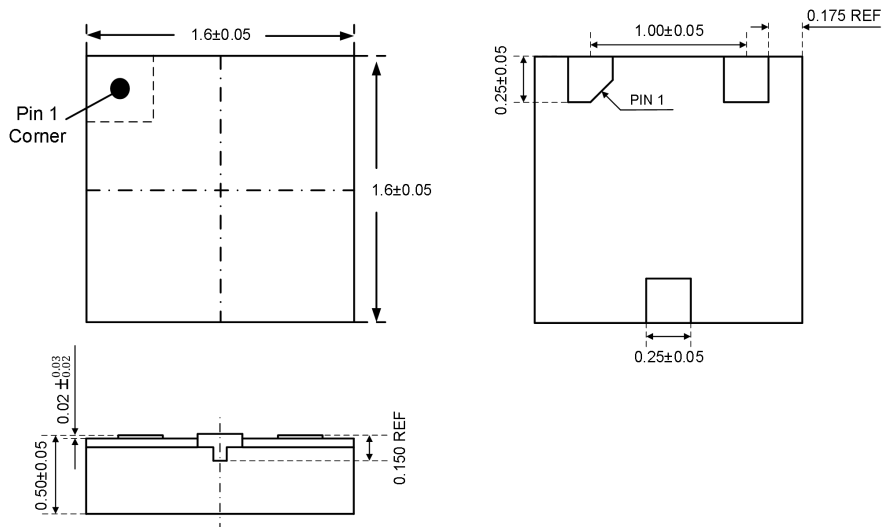
1) SOT23-3L



2) SIP-3L



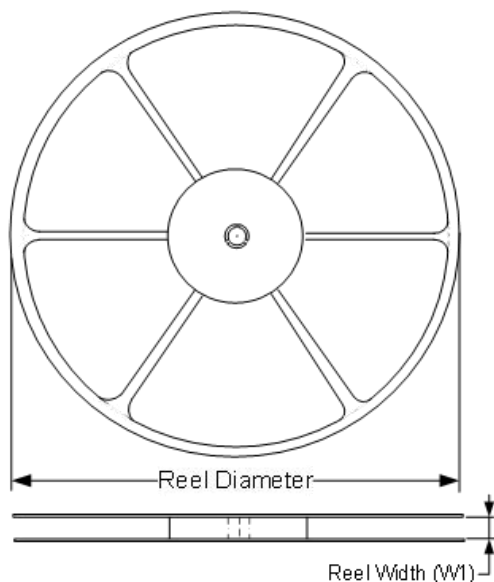
3) DFN1616-3L



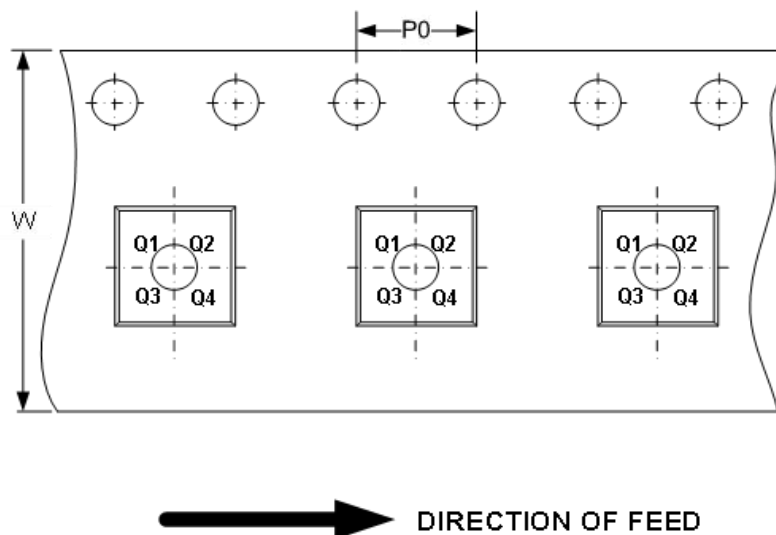
■ Packing Information

1) SOT23-3L/DFN1616-3L

REEL DIMENSIONS



TAPE DIMENSIONS



| 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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