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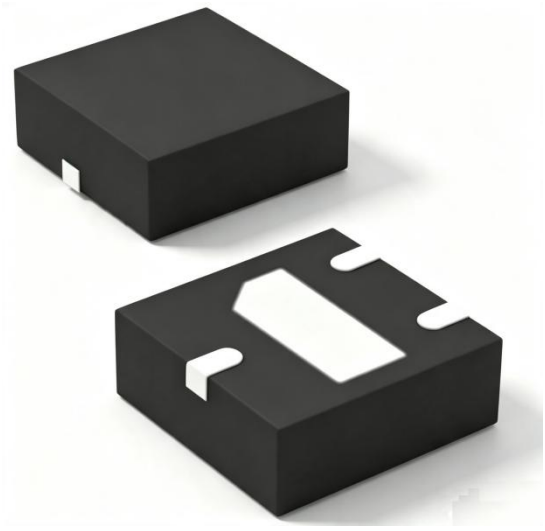
# Product Data Sheet

## TMR magnetic sensor chip

Product Series: FFE-002F16LV5JR

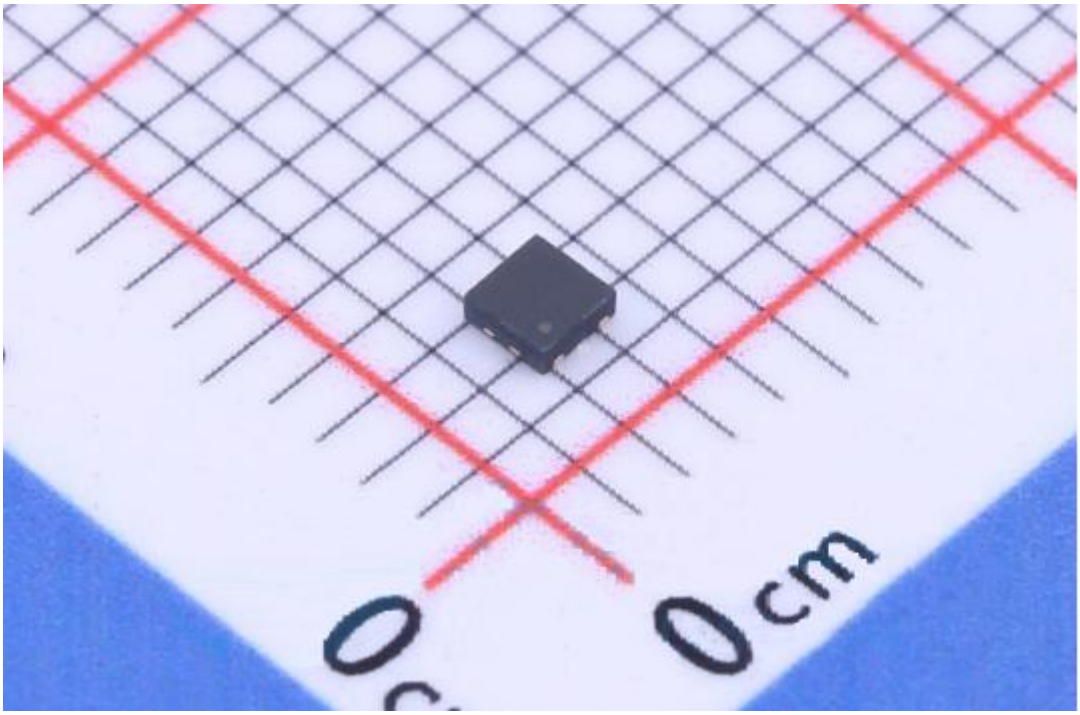
Part Number: FFE-002F16LV5JR

Version: Ver 1.0



# CONTENTS





# 1. Key Features

- TMR (Tunnel Magnetoresistance Effect) technology
- DFN1.6x1.6-3L package form exists half Wheatstone bridge
- Built-in high precision, low power operational amplifier
- The output signal is analog output
- Low power, low hysteresis, high frequency response
- Low output noise ensures excellent sensor resolution

# 2. Application

- Joystick
- Keyboard
- Magnetic field sensor
- Magnet position detection
- Motion detection

# 3. Description

FFE-002F16LV5JR series is a small-size linear reluctance sensor chip based on the TMR principle, with built-in high-precision ultra-low power operational amplifier. When the applied magnetic field changes parallel to the sensor's sensitive direction, the sensor provides a single terminal voltage output, and the output has good temperature stability.

Any source that can generate a magnetic field can drive this sensor. The matching magnetic circuit design enables the sensor to have the best performance in detecting current, magnetic field, Angle, position, etc.

The sensor is DFN1.6x1.6-3L package with dimensions of (L) 1.6mm × (W) 1.6mm × (H) 0.50mm.

# 4. Operating Characteristics

Vcc = 3.3 V, TA = 25 deg.C, Otherwise Specified

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 1.8 | 3.3 | 5.5 | V |
| Supply Current | $I_{DD}$ | Vcc=1.8 V | | 125 | | μA |
| | | Vcc=2.5 V | | 160 | | μA |
| | | Vcc=3.3 V | | 195 | | μA |
| | | Vcc=5.0 V | | 260 | | μA |
| Offset | $V_{OFF}$ | H = 0 Gs | -20 | 0 | 20 | mV/V |
| Offset Temperature Coefficient | TCO | H = 0 Gs | | 0.015 | | mV/V/°C |
| Range of working Field | $H_{WORK}$ | | -1000 | | 1000 | Gs |
| Linearity Error | £L | Fit ±50%*$H_{WORK}$ | | 5 | | % |
| Sensitivity with x2 Gain | SEN | Hex: ±25 Gs | | 0.5 | | mV/V/Gs |
| Sensitivity Temperature Coefficient | TCS | | | 1500 | | PPM/°C |

Note: working field range is defined as when the sensitivity dropped to the 20% of SEN (@±100 Gs).

## 5. Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Power Supply | $V_{CC}$ | —— | 6 | V |
| ESD (HBM) | $V_{ESD}$ | —— | 4 | KV |
| Storage Temperature | Tstg | -40 | 85 | °C |
| Operation Temperature | TA | -40 | 85 | °C |
| Range of working Field | $H_{WORK}$ | -160 | 160 | Gs |

Note: When the operating conditions of the product exceed the limit parameters, it may cause irreparable damage to the product. Working at the limit parameters for a long time may lead to a decline in product performance and product reliability.

## 6. Transfer Curve

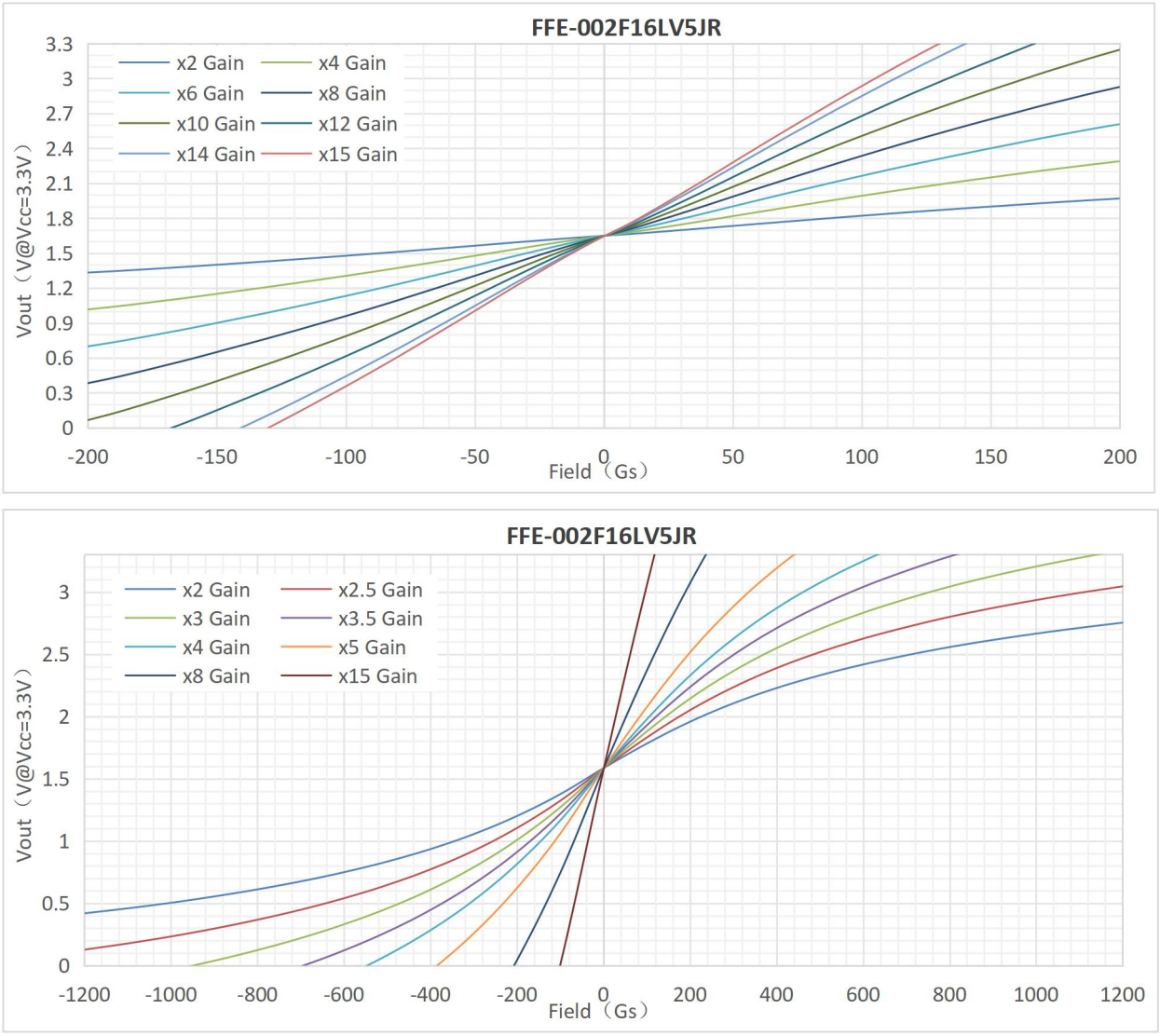



Fig.1 the output of FFE-002F16LV5JR series magnetic sensors with Vcc = 3.3 V.The gain can be adjusted. The adjustment range is from 2 to 15.

## 7. Power-on response time

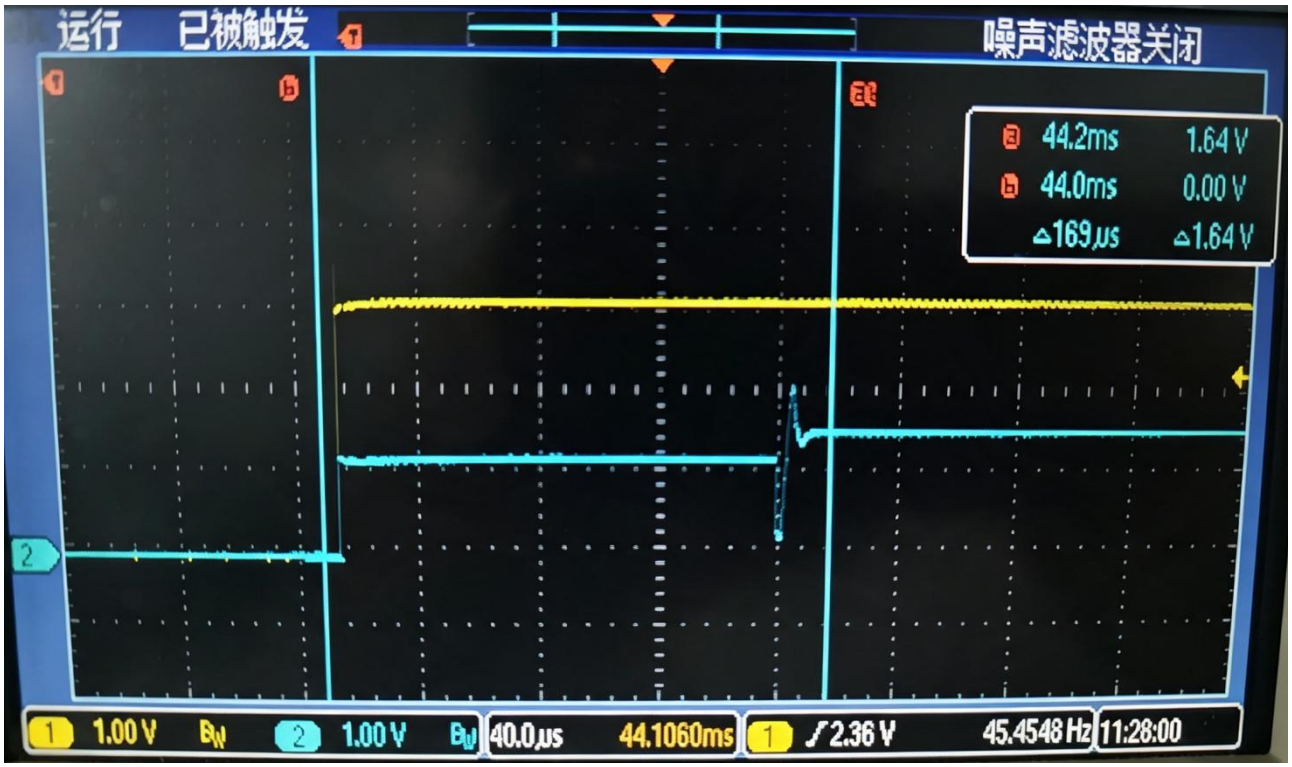



Fig.2 CH1 is Vcc voltage, and CH2 is output voltage; FFE-002F16LV5JR-020K series show Power-on response time of 170µs.

## 8. Typical output response time

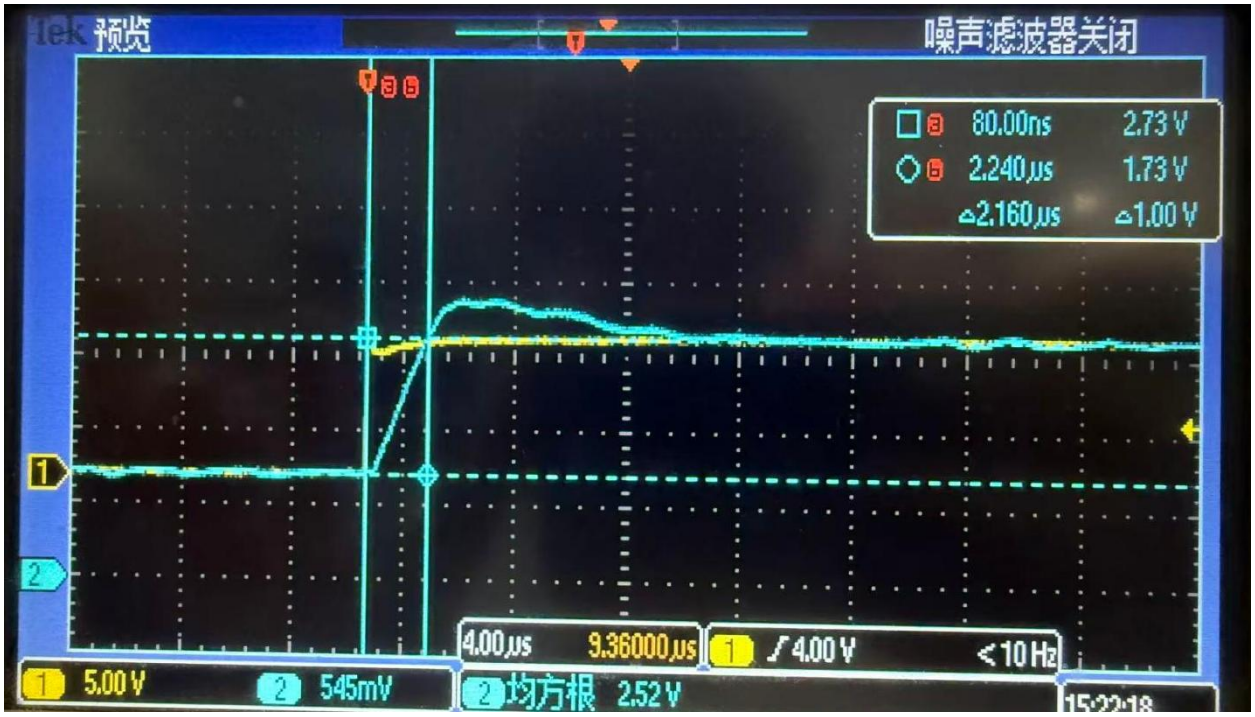
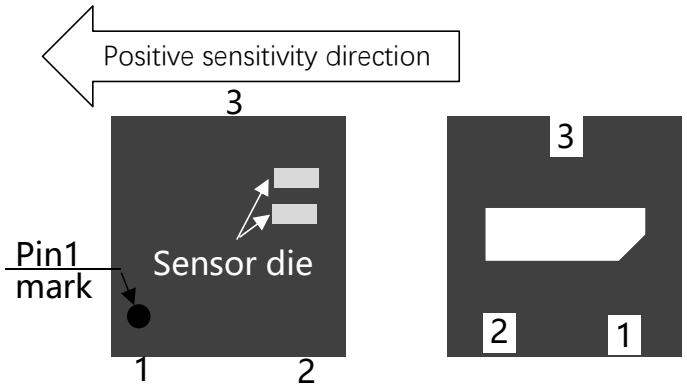



Fig.3 CH1 is primary magnetic field, and CH2 is output voltage; FFE-002F16LV5JR-020K series show output response time of 2.16 µs (~2 µs)

## 9. Functional Diagram and Sensing Direction




| PIN | Symbol | Description |
|---|---|---|
| 1 | Vout | Output |
| 2 | Gnd | GND of power supply |
| 3 | Vcc | Vcc of Power supply |

Fig.4 the functional diagram of the sensors, and the definition on the positive sensing direction, along this direction, the output voltage of the sensor increased with the increasing magnetic field.

## 10. Package Dimension & Sensing Area

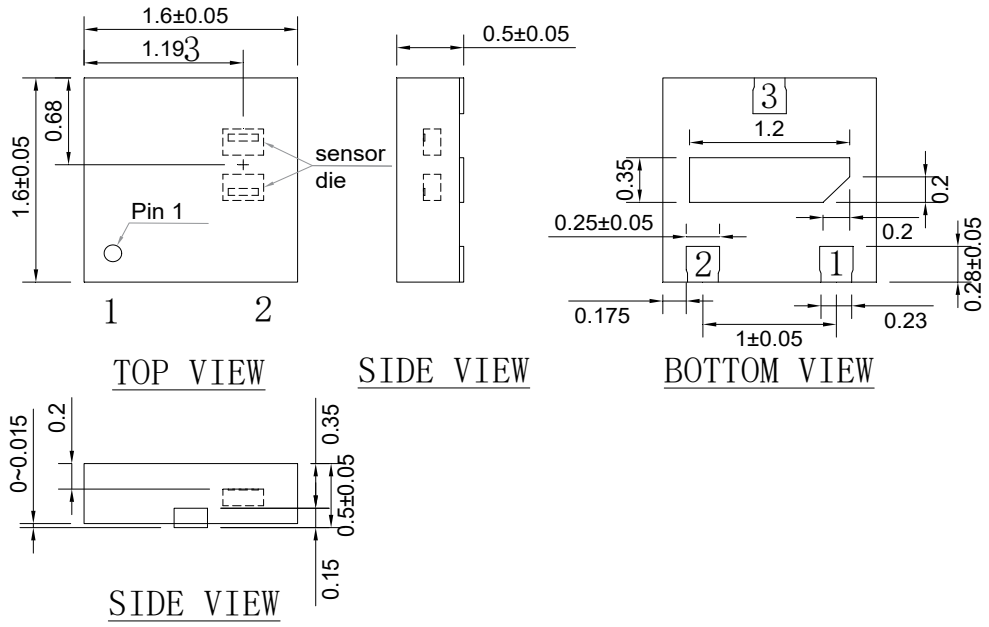



Fig.5 the dimensions of the packaged chips, and the position of sensing area(unit： mm).

## 11. Footprint on PCB

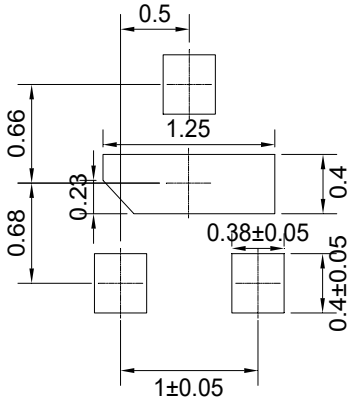



Fig.6 footprint of the sensor chips with DFN1616H055-4L package(unit： mm).

## 12. Keyboard Application Suggestions

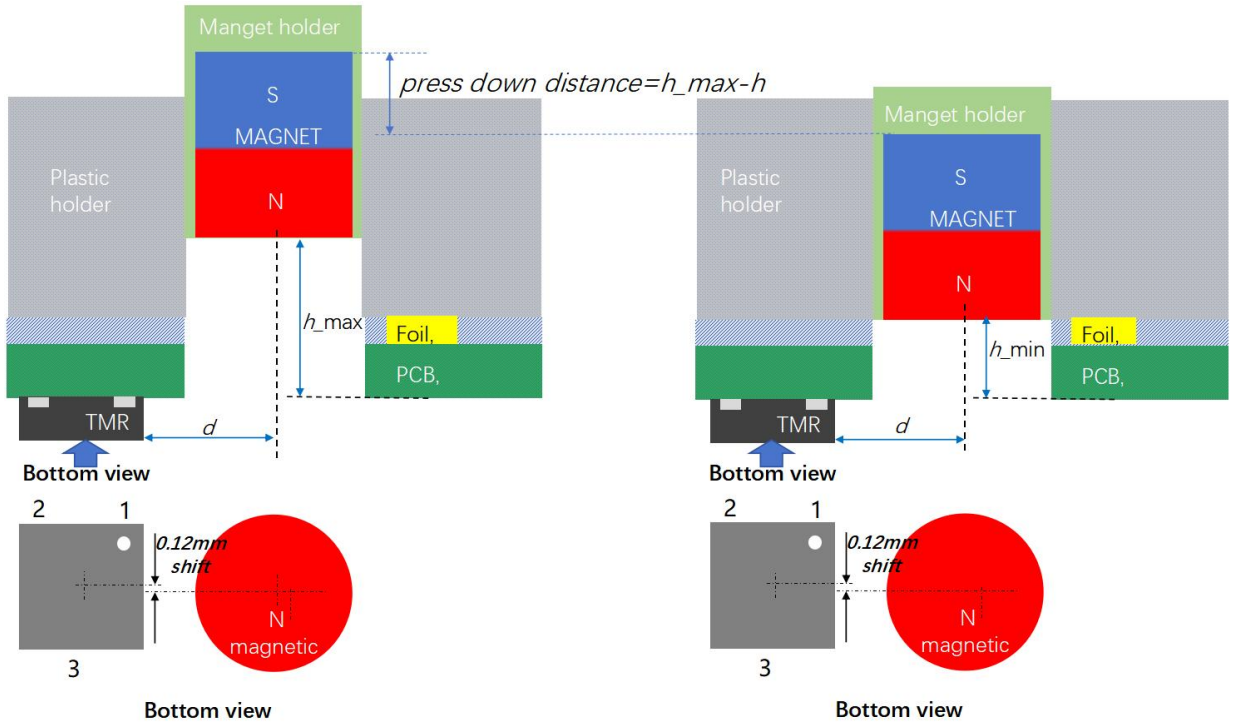
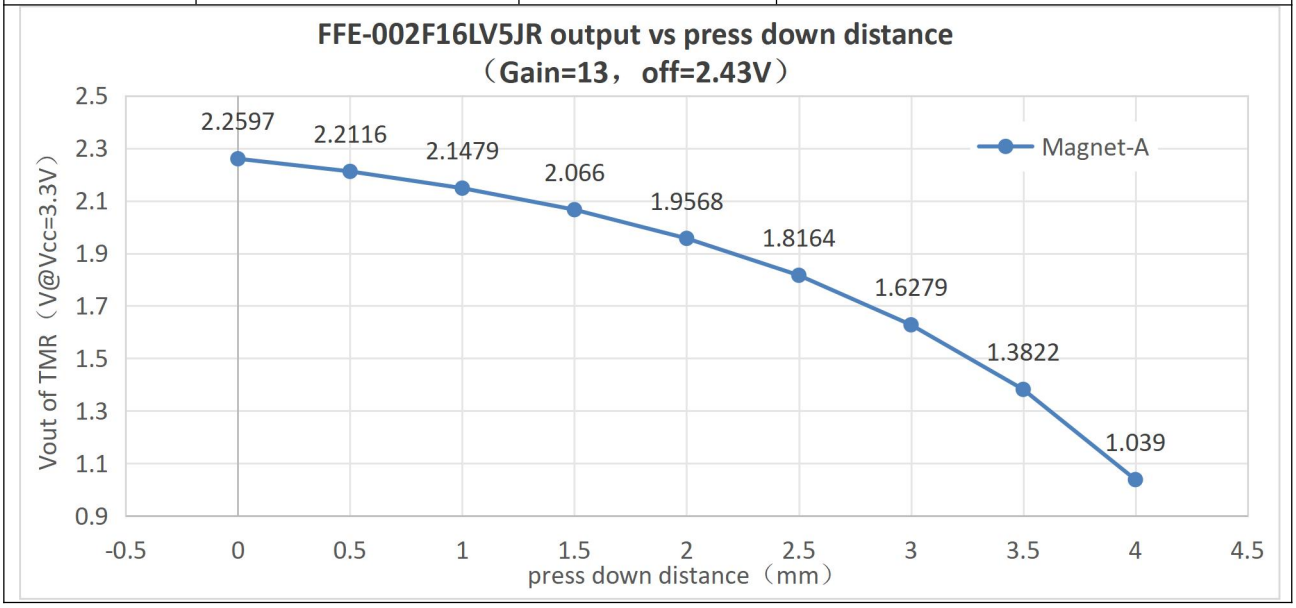



Fig 7. suggested configuration when detecting moving position of small magnet. When the magnet is pressed down, the value of *h* decreased. (*h*_max - *h*) is defined as "**Press down distance**".

The figure describes the relative position of the magnet and the sensor. The cylinder magnet is magnetized along axis direction. The distance from the axis of the magnet to the edge of the sensor chip is defined as "*d*". The distance from bottom of magnet to the bottom of the PCB is defined as "*h*".

☆For application magnets, the following is a typical N-type magnetic potential downward application example, if it is other magnetic pole direction application, please contact us, need to adjust the chip on the PCB board and magnet relative position.

| | | | | |
|---|---|---|---|---|
| Magnet-A | Diameter | Thickness | Magnetization | Material |
| | **2.8 mm** | **3.5 mm** | Axis direction | NdFeB N52 |
| TMR sensor | **FFE-002F16LV5JR** | Position | *d* = 1.81 mm, and *h*_min = 1.85 mm | |



## 13. Packing

| Item | Request | Remark |
|---|---|---|
| Reel | 7 inch | Fig.8 |
| Carrier width | 8 mm | Fig.9 |
| Leader empty length | 400 mm | REF：EIA-481 |
| Trailer empty length | 160 mm | REF：EIA-481 |
| Quantity of reel | 3000pcs/ 7” Reel; 10000pcs/ 13” Reel | Full of tape reel |
| MSL Level | L3 | J-STD-020E |

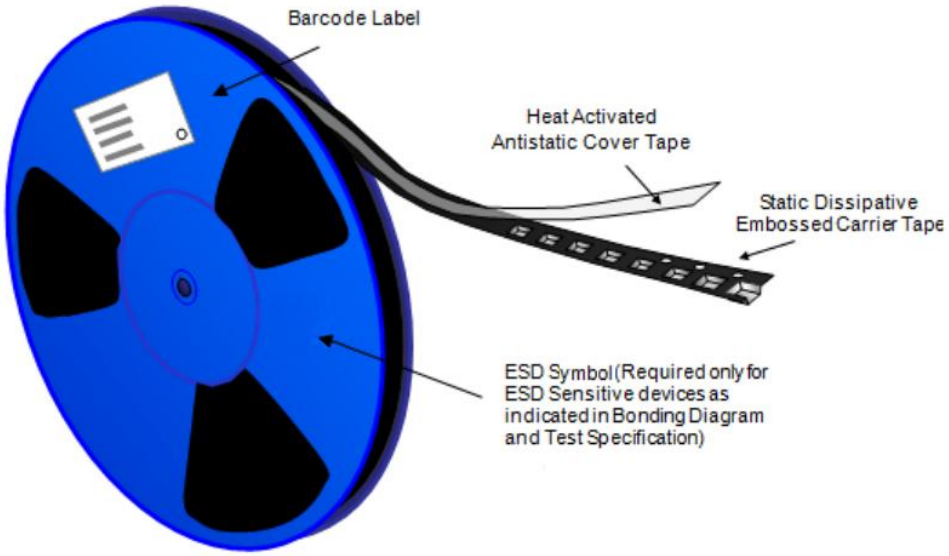



Fig.8 Tape diagram

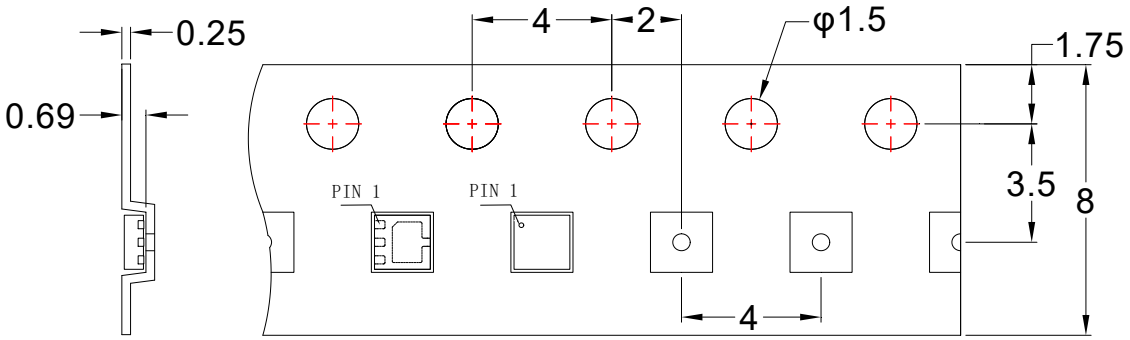



Fig.9 Carrier diagram

# 14. Reflow Profile (Reference)

Peak Temperature should not exceed 260 degC.

Below Profile is Reference. Please comfirm productivity in assembly process.