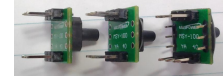
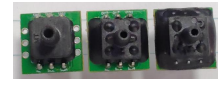


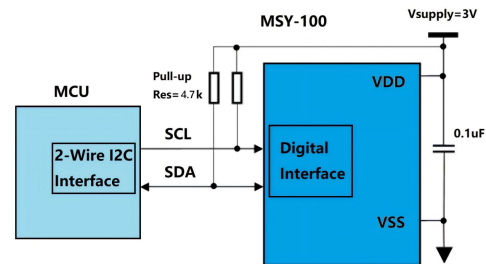
Features 特色

- Factory Calibrated Pressure and Temperature Sensor
出厂全部参数校准
- Supply Voltage: 2.5V to 5.5V
工作电压 2.5V-5.5V
- Average Current Consumption: <5uA (One Measurement)
平均工作电流小于 5uA(一次测试)
- Sleep State Current Consumption: <100nA (25°C)
休眠模式电流小于 100nA
- Operating Temperature Range: -30°C to +105°C
工作温度范围: -30°C to +105°C
- Air Pressure Measuring Range: 0kPa~700KPa.....1400KPa
气压测量范围: 0KPa~700KPa.....1400KPa



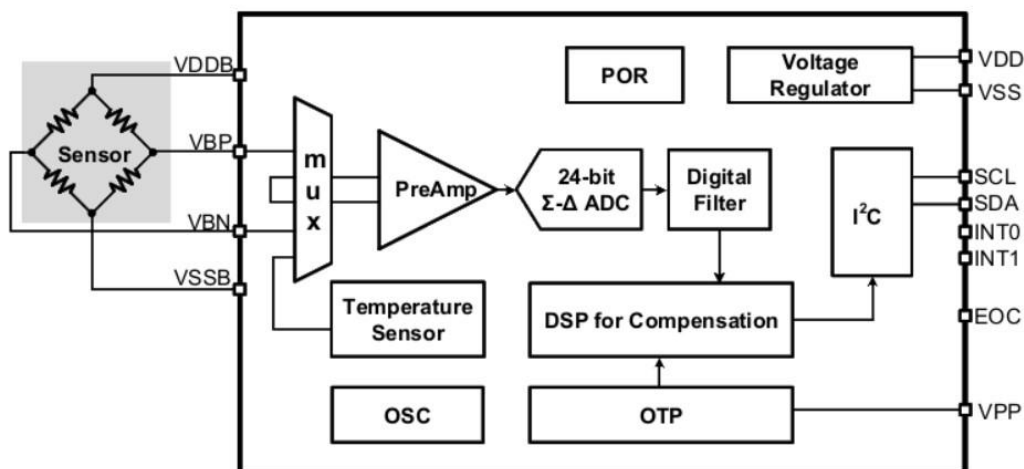
Applications 应用

- Industrial Equipment 工业设备
- Air Control Systems 气动控制系统
- Vacuum Systems 真空控制系统



Interfaces 接口

- I²C (up to 400kHz)



Description 描述

The MSY-100 adopts DIP6 surface-mount packaging, featuring a built-in pressure sensor and signal conditioning chip. It digitally compensates for the sensor's offset, sensitivity, temperature drift, and non-linearity. It uses a 24-bit ADC and the conditioning chip incorporates a temperature sensor, capable of outputting high-precision pressure and temperature values. It also provides an IIC communication protocol interface, with strong anti-interference capabilities. All measurement data has undergone thorough calibration and temperature compensation.

The MSY-100 pressure sensor is highly integrated, compact in size, easy to install, and convenient for system integration. It is widely used in altimeters, unmanned aircraft, air pumps, sports and fitness equipment, and other fields.

MSY-100 采用 DIP6 直插封装，内有封装的压力传感器与信号调理芯片，对传感器的偏移、灵敏度、温漂和非线性进行数字补偿。采用 24 位 ADC，并且调理芯片内置温度传感器，可以输出高精度的压力值和温度值。同时提供 IIC 通讯协议接口，抗干扰能力强。所有测量数据都经过充分校准和温度补偿。

MSY-100 型压力传感器集成度高、体积小，易安装，便于系统集成，广泛用于高度计、无人机、充气泵、运动健身器材等领域。

This product is manufactured based on advanced micro-electromechanical principles. Its core technologies include a MEMS pressure sensor chip based on the silicon piezoresistive effect and a high-performance signal conditioning ASIC chip. The silicon micro-piezoresistive MEMS pressure sensor chip forms a Wheatstone bridge using four strain-sensitive resistors, and the output signal is amplified, temperature compensated and linearized by the ASIC chip. The linearization and temperature compensation of the transfer function are achieved by the digital processing circuit in the ASIC. High-precision pressure measurement within the full operating temperature range is realized through polynomial compensation algorithms and multi-point pressure calibration techniques at multiple temperatures.

本产品用先进的微机电原理制作，核心技术为基于硅压阻效应的 MEMS 压力传感器芯片和高性能的信号调理 ASIC 芯片，硅微压阻式 MEMS 压力传感器芯片通过四个应变敏感电阻构成的惠斯通电桥，输出信号被 ASIC 芯片放大、温度补偿和线性化，传递函数的线性化和温度补偿由 ASIC 中的数字处理电路实现，通过多项式补偿算法和多个温度下的多点压力标定技术，实现了全工作温度范围内的高精度压力测量。

Absolute Ratings 极限指标

All the indicators below were measured under the power supply voltage of 3.3 V DC and a temperature of 25°C.

以下所有指标均是在电源电压为 3.3 伏直流、温度为 25 摄氏度的条件下测量得出的。

Parameter 参数	Symbol	Min.	Typ.	Max.	Units
Supply Voltage 供电电压	V_{DD}	-0.3		6.5	V
Voltages at Analog and Digital I/O Pins	V_{A-IO} V_{D-IO}	-0.3		$V_{DD}+0.3$	

I/O 口电压范围					
Storage Temperature 储存温度	T _{STOR}	-40		125	°C
ESD protection ESD 防护	HBM		±2		KV

Sensor Performance Indicators 传感器性能指标

Parameter 参数	Symbol	Min.	Typ.	Max.	Units
Operating temperature range 工作温度范围	T _A	-30		105	°C
Operating pressure range 工作压力范围	P	0		700..... 1400	KPa
Accuracy 测试精度		-1.5		1.5	%Span
Response time 响应时间(OSR_P=1024X)		-	2.5	-	ms
SDA/SCL Pull-Up Resistors SDA/SCL 上拉电阻		-	4.7	-	kΩ
Zero-point temperature drift 零点温度漂移		-0.03		+0.03	%FS/°C
Full-scale temperature drift 满量程温度漂移		-0.03		+0.03	%FS/°C
Overload pressure 过载压力		-	1.5x	-	Rated
Destructive pressure 破坏压力		-	2.0x	-	
Compensation temperature 补偿温度		0		60	°C

Sensor Electrical Parameters 传感器电气参数

Parameter 参数	Symbol 符号	Conditions 条件	Min. 最小值	Typ. 典型值	Max. 最大值	Units 单位
Supply Voltage 供电电压	VDD		2.5		5.5	V
Standby Current (no conversion)待机电流	I _s		-	100	-	nA
LDO Output Voltage LDO 输出	V _{LDO}			3.0		V
PSRR	PSRR			60		dB

Resolution 分辨率	R_{ADC}				24	Bit
Output Common-mode Signal Rejection Ratio 输出共模信号抑制比			80	110		
Output data resolution 输出数据解析度		$LSB=(1/256)^{\circ}C$		16		bit
Built-in Temperature Sensor Accuracy 内置温度传感器准确度		0~60 $^{\circ}C$			± 0.5	$^{\circ}C$
		非校准温区			± 1	$^{\circ}C$
I2C Clock Frequency I2C 通信速率	$F_{C,I2C}$				400	kHz

1 Under the assumption of one conversion every second. Conversion means either a pressure or a temperature measurement

平均值基于每秒采集 1 次数据获得

2 During conversion, the sensor will be switched on to VDD, and after conversion ended, the sensor will automatically be switched off from VDD

ADC 转换时通过 VDD 给 ADC 供电，转换结束后 ADC 断开 VDD 供电，从而获得超低功耗。

Operation Modes 操作模式

The MSY-100 is factory programmed to Sleep Mode. In this mode, the MSY-100 remains asleep until the master/host sends a measurement request (MR) before taking sensor measurements. After the MSY-100 receives an MR command, it wakes up, runs a full measurement cycle, stores the measurement data in internal registers and then returns to sleep mode again.

MSY-100 在出厂时编程为睡眠模式。在此模式下，MSY-100 保持睡眠状态，直到主/主机发送测量请求（MR）后再进行传感器测量。MSY-100 收到 MR 命令后，将唤醒，运行一个完整的测量周期，将测量数据存储在内部寄存器中，然后再次返回休眠模式。

I²C communication protocol I²C 通信协议

The I²C bus uses SCL and SDA as signal lines. Both of these lines are connected to VDD through an upper pull-up resistor (typical value 4.7K), and remain at a high level when there is no communication.

I²C 总线使用 SCL 和 SDA 作为信号线，这两根线都通过上拉电阻（典型值 4.7K）连接到 VDD，不通信时都保持为高电平。

The factory setting for the I2C slave address is 0x6D and the communication is restricted to this address only.

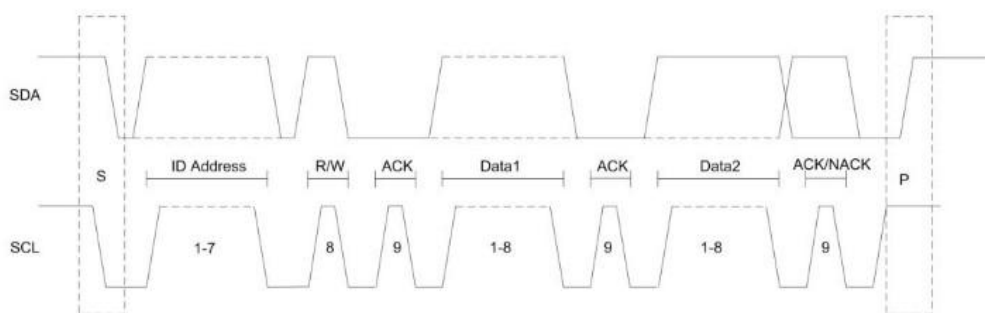
I²C 地址的出厂设置为 0x6D,且通信仅限于此地址。

■ I²C 时序图

The I2C communication protocol has specific start (S) and stop (P) conditions. When SCL is at a high level, the falling edge of SDA indicates the start of data transmission. The I2C master device sequentially sends the address (7 bits) of the slave device and the read/write control bit. When the slave device recognizes this address, it generates a response signal and pulls SDA low in the ninth cycle. After receiving the response from the slave device, the master device continues to send the 8-bit register address and continues to send or read data after receiving the response. When SCL is at a high level, an ascending edge action of SDA indicates the end of I2C communication. Besides the start and stop conditions, the data transmitted by SDA must remain stable when SCL is at a high level. When SCL is at a low level, the value transmitted by SDA can change. All data transmission in I2C communication is based on 8 bits as the basic unit, and an answer signal is required after each 8-bit data transmission to maintain the continuation of transmission.

I2C 通讯协议有着特殊的开始(S)和终止(P)条件。当 SCL 处于高电平同时, SDA 的下降沿标志数据传输开始。I2C 主设备依次发送从设备的地址(7 位)和读/写控制位。当从设备识别到这个地址后,产生一个应答信号并在第九个周期将 SDA 拉低。得到从设备应答后,主设备继续发送 8 位寄存器地址,得到应答后继续发送或读取数据。SCL 处于高电平,SDA 发生一个上升沿动作标志 I2C 通信结束。除了开始和结束标志之外,当 SCL 为高时 SDA 传输的数据必须保持稳定。当 SCL 为低时 SDA 传输的值可以改变。I2C 通信中的所有数据传输以 8 位为基本单位,每 8 位数据传输之后需要一位应答信号以保持继续传输。

■ I²C 协议



I²C 命令

The commands to interface with the device in the I²C.

I²C 与器件接口的命令。

Type 类型	Description 描述	Support 支持
Measurement Request (MR) 测量请求	唤醒 MSY-100, 执行传感器测量, 将传感器测量数据存储在内部寄存器中并返回睡眠状态	I ² C
Get Data (GD) 获取数据	从 MSY-100 内部寄存器获取数据*.	I ² C

*: GD does not initiate a new measurement. Repeated GD commands will return the same (or stale) sensor measurement data. An MR is required to perform a full sensor measurement cycle to refresh the sensor register data.

GD 不会启动新的测量。重复的 GD 命令将返回相同（或过时）的传感器测量数据。需要 MR 来执行完整的传感器测量周期，以刷新传感器寄存器数据。

The Get Data (GD) command is used to read out data from the MSY-100. With the start of communication the entire sensor measurement output packet will be loaded in a serial output register. The register will be updated after the communication is finished. The output is always scaled to 24-bits. The ordering of the bits is “big-endian”.

获取数据（GD）命令从 MSY-100 读出数据。通信开始，传感器测量输出数据包以串行输出。通信完成后，寄存器将更新。输出 24 位高位编址数据。位的顺序是“二进位资料次序”。

I²C GET DATA (GD) I²C 获取数据(GD)

An I²C Get Data command starts with the 7-bit slave address and the 8th bit = 1 (READ). The device then sends acknowledge (ACK), indicating I²C communication success. The number of data bytes returned by the device is determined by the master, which controls NACK and stop conditions.

一个 I²C 获取数据命令以 7 字节从地址开始，第 8 个字节地址设置为 1(READ)。之后设备发送确认指令，表示 I²C 通信成功。设备返回的数据字节数由主控决定，主控控制着 NACK 和停止条件。

Figure 1 displays an example for sending three bytes followed by reading five bytes. The first byte contains the I²C address followed by internal register address (0x06). Then the I²C address is repeated, followed by the slave sending out three pressure bytes and two temperature bytes.

图 1 显示了发送三个字节然后读取五个字节的示例。第一个字节包含 I²C 地址，后面跟着内部寄存器地址(0x06)。然后是 I²C 地址重复，随后从机发送三个压力字节和两个温度字节。

The GD command is used to retrieve the pressure and temperature sensor data after an MR command has been executed.

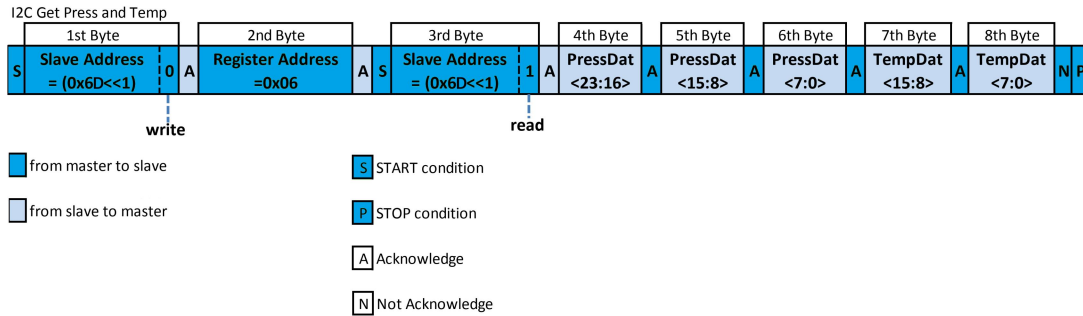
GD 指令是用于在执行 MR 命令后检索压力和温度传感器数据。

Note that the two temperature byte codes are formatted in 2's complement.

注意，这两个温度字节码的格式是 2 的补码。

Figure 1: Slave Address Followed By Three Pressure and Two Temperature Bytes

图 1:从地址后面跟着三个压力和两个温度字节

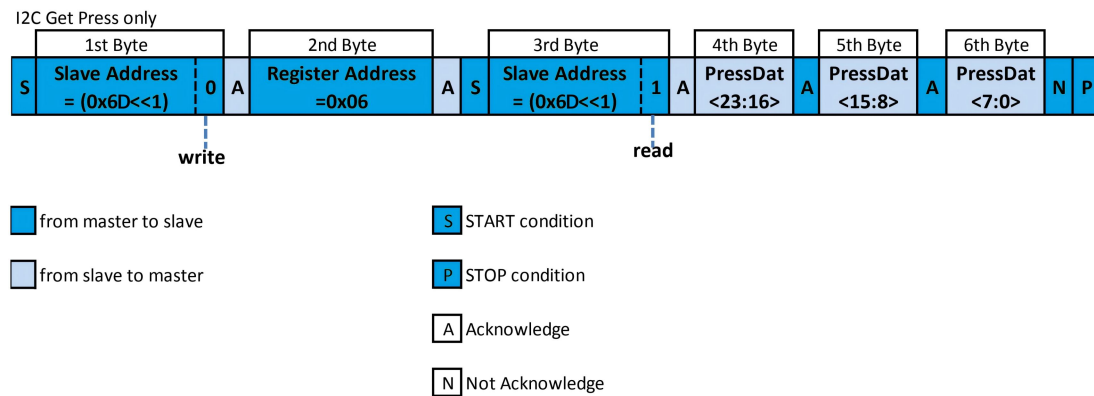


For Pressure data only, the data stream can be terminated after the sixth pressure byte. See Figure 2 below.

仅对于压力数据，数据流可以在第六个压力字节后终止。参考下面的图 2。

Figure 2: 7-Bit Slave Address Followed By Three Pressure Bytes

图 2:7 位从地址后面跟着三个压力字节



I²C Measurement Request (MR) I²C 测量请求(MR)

The I2C MR is used to wake up the device from Sleep Mode and start a complete sensor measurement cycle, before the device returns to Sleep Mode again. The measurement cycles starts with a pressure measurement followed by a temperature measurement. The sensor measurements are digitized and run through an onboard compensation algorithm before the final measurement values are written to the digital output register. As shown in Figure 3, the communication requires the slave address (0x6D) and a WRITE bit (0) to initiate the MR. This is followed by two bytes; register address (0x30) and measurement (0xA). After the MSY-100 responds with the slave ACK, the master terminates the communication with a stop condition.

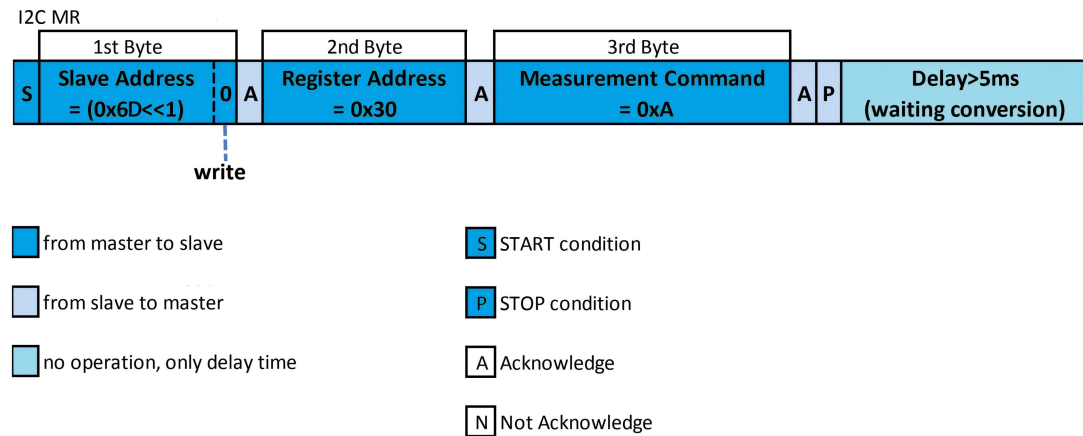
I²C MR 用于将设备从睡眠模式唤醒，并在设备再次返回睡眠模式之前启动完整的传感器测量周期。测量周期从压力测量开始，然后是温度测量。在将最终测量值写入数字输出寄存器之前，传感器测量值被数字化并通过板载补偿算法运行。如图 3 所示，通信需要从地址(0x6D)和 WRITE 位(0)来初始化 MR，接下来的两个字节是寄存器地址(0x30)和测量(0xA)。在 MSY-100 响应从机的 ACK 后，主机以停止条件终止通信。

Sensor measurement conversion time takes approximately 5ms, so MRs should not be sent faster than every 5ms

传感器测量转换时间约为 5ms，因此发送 MRs 的速度不应超过每 5ms 一次

Figure3: I2C Measurement Request Command

图 3:I2C 测量请求命令



Calculating Output 预测输出

After retrieving the data, the compensated output can be scaled to real world values by following the equations below.

检索数据后，可以按照下面的公式将补偿后的输出值缩放到真实世界的值。

Pressure Output 压力输出

An example of the 24-bit compensated pressure with a full scale range of 0 to 131kPa can be calculated as follows: $\text{Pressure [kPa]} = (\text{Pressure 3rd Byte [23:16]} \times 65536 + \text{Pressure 2nd Byte [15:8]} \times 256 + \text{Pressure 1st Byte [7:0]}) / K / 1000$.

例如，满量程为 0 到 131kPa 的 24 位补偿压力可以计算如下: $\text{压力[kPa]} = (\text{压力第三字节[23:16]} \times 65536 + \text{压力第二字节[15:8]} \times 256 + \text{压力第一字节[7:0]}) / K / 1000$ 。

Temperature Output 温度输出

1. The 16-bit compensated temperature can be calculated as follows:

Positive Temperature $[\text{°C}] = (\text{Temperature High Byte [15:8]} \times 256 + \text{Temperature Low Byte [7:0]}) / K$

Negative Temperature $[\text{°C}] = (\text{Temperature High Byte [15:8]} \times 256 + \text{Temperature Low Byte [7:0]} - 65536) / K$

16 位补偿温度的计算方法如下:

正温度 $[\text{°C}] = (\text{温度高字节[15:8]} \times 256 + \text{温度低字节[7:0]}) / K$

负温度 $[\text{°C}] = (\text{温度高字节[15:8]} \times 256 + \text{温度低字节[7:0]} - 65536) / K$

Pressure Measure Range and K Value Comparison Table 压力量程与 K 值对照表

Measure Rang(Kpa) 量程	K Value K 值
$1000 \leq P$	4
$524 < P < 1000$	8

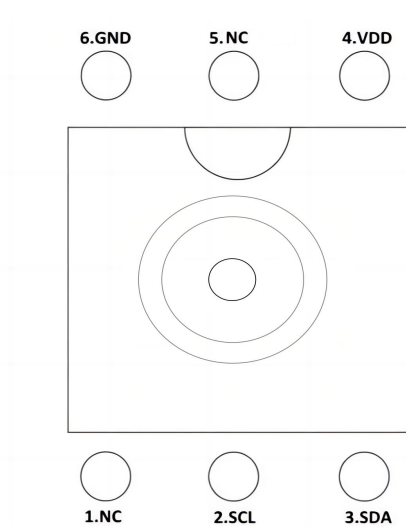
$262 < P \leq 524$	16
$131 < P \leq 262$	32
$P \leq 131$	64

Package and Assembly 包装

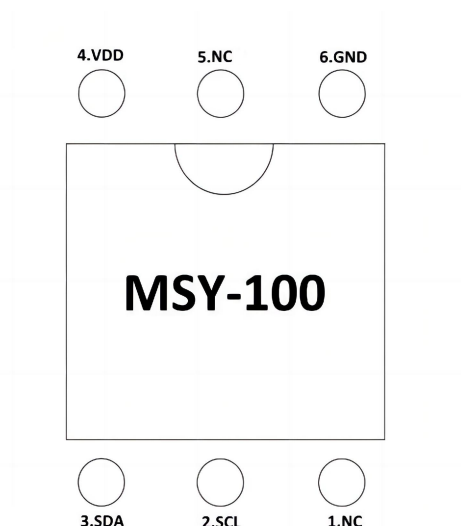
Pin Assembly and Mechanical Drawing Pin 组成和机械图

Pin	Name	Function
1	NC	Not Connect
2	SCL/SCLK	I2C
3	SDA/SDIO	I2C DATA In/Out
4	VDD	Power Supply, Connect 0.1uF CAP to GND
5	NC	Not Connect
6	GND	Ground

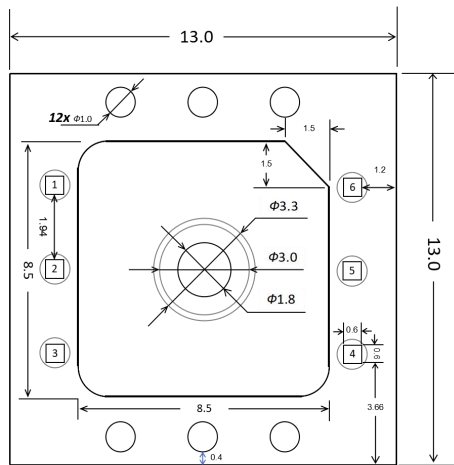
俯视图-脚位图



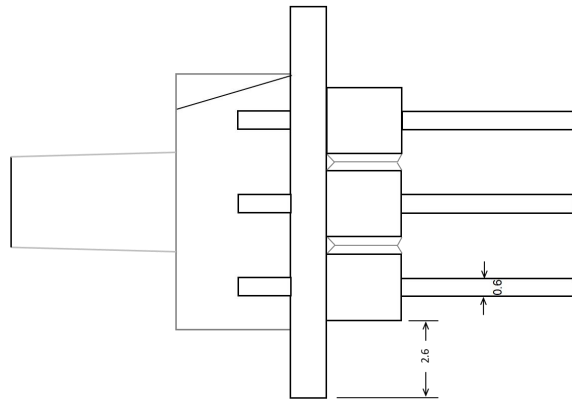
底视图-脚位图



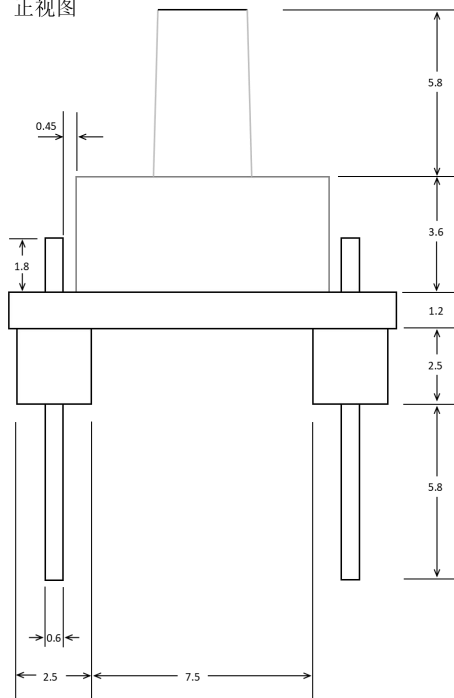
俯视图



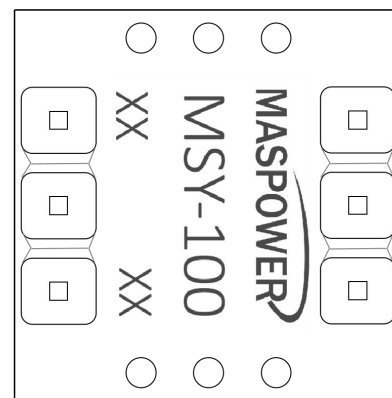
侧视图



正视图



底视图

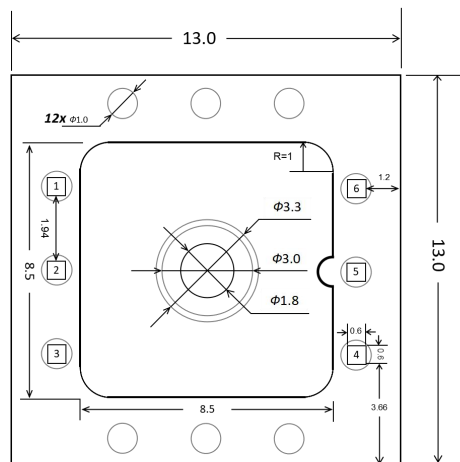


unit:mm

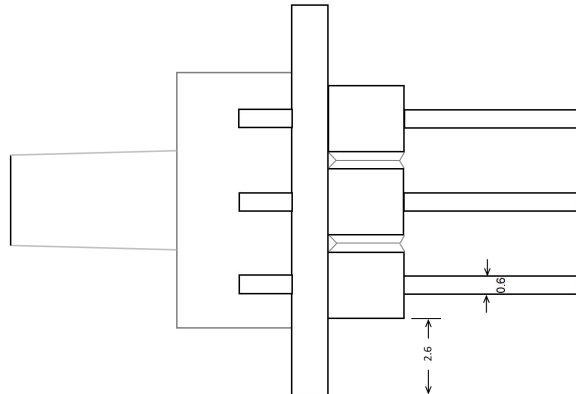
standard tolerance: $\pm 0.3\text{mm}$

code:07

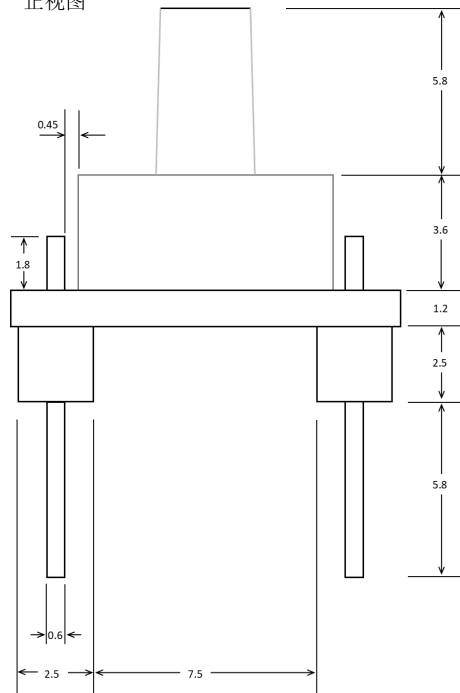
俯视图



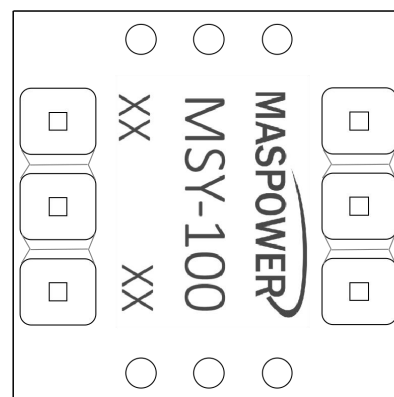
侧视图



正视图



底视图

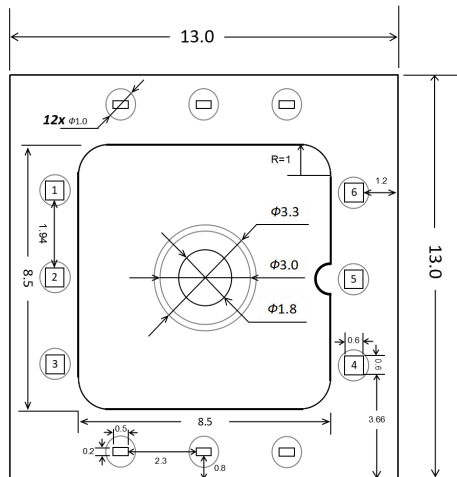


unit:mm

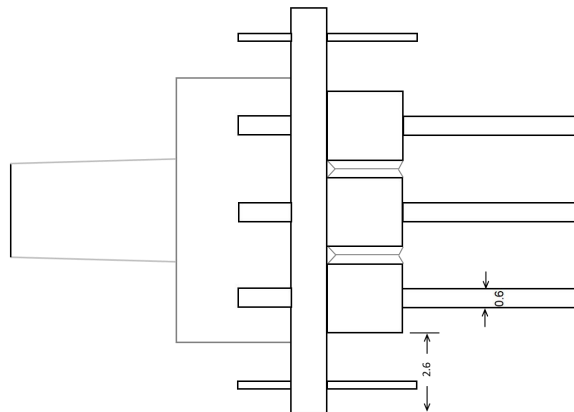
standard tolerance: $\pm 0.3\text{mm}$

code:06

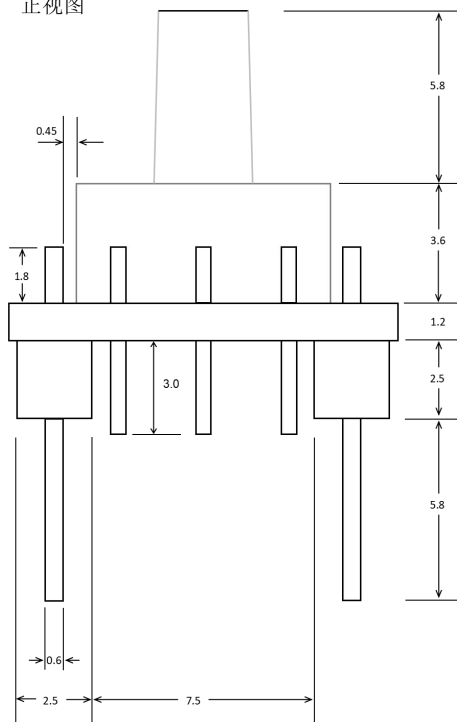
俯视图



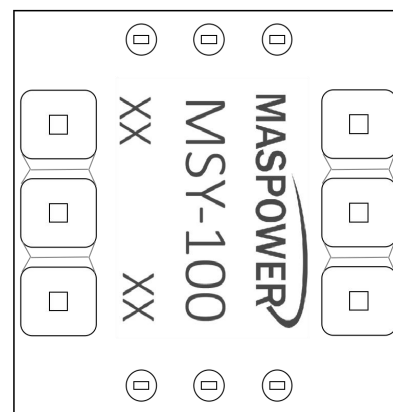
侧视图



正视图



底视图



unit:mm

standard tolerance: $\pm 0.3\text{mm}$

code:05

Caution 使用注意事项

1. Cleaning Requirements 清洗要求

1) Since the product is of an open type, please be careful not to allow the cleaning solution to enter the interior.

由于产品为开放型,因此请注意不要使清洗液侵入内部。

2) When using ultrasonic waves for cleaning, it may cause the product to malfunction. Therefore, please avoid using ultrasonic waves for cleaning

使用超声波进行清洗时,可能会使产品发生故障,因此请避免使用超声波进行清洗。

2. Storage and Transportation 存储与运输

1) This product is not designed to be water-resistant. Therefore, please do not use it in places where water or other liquids may splash.

本产品为非防滴构造,因此请勿在可能溅到水等的场所中使用。

2) Do not use in an environment where condensation may form. Additionally, if moisture adheres to the sensor chip and freezes, it may cause fluctuations in the sensor's output or even damage the sensor.

请勿在产生凝露的环境中使用。另外,附着在传感器芯片上的水分冻结后,可能会造成传感器输出的变动或者破坏。

3) Once the chip of the pressure sensor comes into contact with light, its output will change. Especially when pressure is applied through transparent covers or other means, please avoid allowing light to reach the sensor's chip.

压力传感器的芯片在构造上接触到光后,输出会发生变动。尤其是通过透明套等施加压力时,请避免使光接触到传感器的芯片。

4) The pressure sensor in normal packaging can be transported using ordinary conveying tools. Please note: During transportation, the product must be protected from moisture, impact, sun exposure and pressure.

正常包装的压力传感器可通过普通输送工具运输。请注意:产品在运输过程中防止潮湿、冲击、晒伤和压力。

3. Other Usage Notes 其他使用注意事项

1) If the installation method is incorrect, it may cause an accident. Therefore, please be careful. 安装方法错误时,会造成事故,因此请注意。

2) Please avoid using methods that apply high-frequency vibrations, such as ultrasonic waves. 请避免采用超声波等施加高频振动的使用方法。

3) The only pressure medium that can be directly used is dry and non-corrosive gas. Any other medium, especially corrosive ones and those containing moisture or foreign substances, will cause malfunctions and damage. Therefore, please avoid using it in the aforementioned environments.

能够直接使用的压力媒介仅为干燥无腐蚀性气体,除此以外的媒介,尤其是在腐蚀性介质和含有水分、异物的媒介中使用,会造成故障和破损,因此请避免在上述环境中使用。

4) Inside the pressure inlet, there is a pressure sensor chip. If any foreign object such as

a needle is inserted into the pressure inlet, it will cause damage to the chip and blockage of the inlet. Therefore, please absolutely avoid performing such an operation.

压力导入口的内部配置有压力传感器芯片。从压力导入口插入针等异物后,会造成芯片破损和导入口堵塞,因此请绝对避免上述操作。

5) Regarding the use of pressure, please operate within the rated pressure range. Using it outside this range will cause damage.

关于使用压力,请在额定压力的范围内使用。在范围外使用时,会造成破损。

6) Due to the possibility of damage caused by static electricity, please pay attention to the following points when using it.

由于可能因静电而造成破坏,因此使用时请注意以下事项。

Please ground the electrified objects on the table and the workers themselves to ensure that the static electricity around is safely discharged.

请将桌子上的带电物,作业人员接地,以使周围的静电安全放电。

If you have any questions, please feel free to contact us.

如有疑问,敬请垂询

Safety Precautions 安全注意事项

This product is manufactured using semiconductor components commonly found in electronic devices (communication equipment, measuring devices, work machinery, etc.). Products using these semiconductor components may malfunction or fail due to external interference and surges. Therefore, please confirm the performance and quality under actual usage conditions. To ensure safety, please perform safety design on the device (installation of fuse, circuit breaker, protection circuits, device multiplexing, etc.), so that even if there is a malfunction, it will not cause injury, damage to the body, or loss of property. To prevent injuries and accidents, please strictly follow the following instructions: 本产品是使用一般电子设备用(通信设备,测量设备,工作机械等)的半导体部品而制成的。使用这些半导体部品的产品,可能会因外来干扰和浪涌而发生误动作和故障,因此请在实际使用状态下确认性能及品质。为以防万一,请在装置上进行安全设计(保险丝,断路器等保护电路的设置,装置多重化等),一旦发生误动作也不会侵害生命,身体,财产等。为防止受伤及事故的发生,请务必遵守以下事项:

1. The driving current and voltage should be used below the rated values.驱动电流和电压应在额定值以下使用。

2. Please connect the wires according to the electrical specifications. Especially after reversing the connection of the power supply, there is a risk of circuit damage such as overheating, smoke emission, and fire, which may lead to accidents. Therefore, please pay attention to this.请按照电气定义进行接线。特别是对电源进行逆连接后,会因发热,冒烟,着火等电路损伤引发事故,因此敬请注意。

3. When fixing the product and connecting the pressure inlet, please be very careful.

对产品进行固定和对压力导入口进行连接时请慎重。