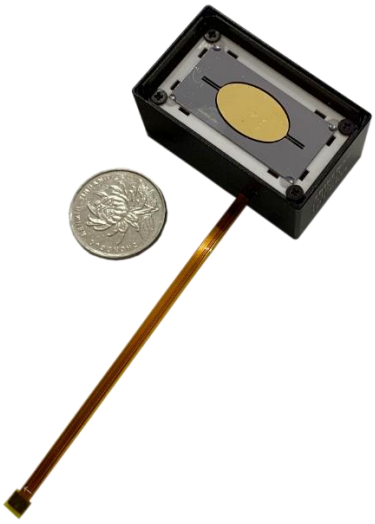
Xi'an ZhiSENSOR Technologies Co., Ltd.



P1220 MEMS Mirror Module

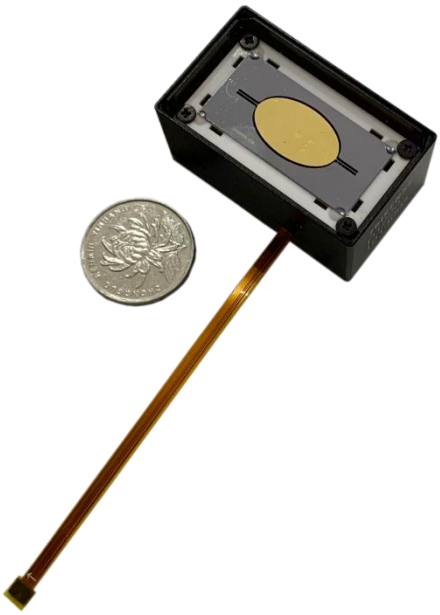
Data Sheet

V1.0

P1220 Data Sheet

The P1220 is a one-axis MEMS mirror module. This module consist of a MEMS mirror chip and closed-loop control circuit.

This module can provide real-time scanning position of MEMS mirror. The module outputs a marking signal when the MEMS mirror scanning a marking angle. Furthermore, the marking angle is configurable by users. Incremental pulse signals are indicated as the position of MEMS mirror with a maximum resolution of 0.05°.



Applications:

- **Solid-state LiDAR**
- **Industrial Inspection**

Features:

- **The maximum scan angle is 60°**
- **The highest angular resolution is 0.05°**
- **The resonant frequency is 200±10%Hz**
- **Mirror dimension 20mm×12mm**
- **Data interface UART**
- **High reliability and stability**
- **Low power consumption, small size**

Attention

The following conditions must be strictly observed for proper application.

1. Interface

   This module uses df37b-10dp-04v as the connector, and the number of plugs is 20.

2. Scan angle

   Since this module is based on MEMS technology, due to the principle limitation, the maximum optical scan angle is 60°, and the mirror cannot stop at a certain angle. And this module provide real-time scanning position signal, which the smallest marking angle is 0.05°.

3. Hot plugging

   This module does not support hot plugging.

4. About this manual

   The latest version of the data sheet will be supplied on our official website, please check it periodically.

5. Protection

   P1220 is susceptible to permanent loss of function due to impact or falling, etc. Please pay attention to protection.

Contents

1. Introduction

The P12200 can perform stable scanning according to a setting angle. During the scanning process, there will be a zero marking pulse signal output (from TRIG0) when the mirror pass through the zero position (the balance position of the MEMS mirror). In addition, there will be an angle marking pulse signal output (output from TRIG1) when the MEMS mirror scanning a marking angle. Therefore, the real-time scanning position can be calculated according to the zero marking pulse signal and the angle marking pulse signals.

After the P1220 started, the module will give the operator 5s for setting the scan angle and the marking angle. If the parameters of the module are successfully set, the angle marking pulse signal will be output according to the setting. Otherwise, the system will automatically set by default parameters: the scan angle is 60°, the angle of marking signal is 60°, the marking angle is 1°. Moreover, the module can also be reconfigured during its working.

2. Features

2.1 Features of the MEMS mirror

The P1220 is designed based on one-dimensional MEMS mirror. The MEMS mirror is made of monocrystalline silicon and has the characteristics of high reliability, small size, and lightweight. Aiming to increase reflectivity, the mirror is coated with a metal film. In addition, the mirror is supported by the torsion beam and working in the resonant state which has high stability and robustness.

The dimension of the MEMS mirror is 20mm × 12mm and the resonant frequency is 200±10% Hz.

2.2 Electrical features

2.2.1 Electrical requirements

Please abide by the requirements shown as below:

Table1. Absolute Maximum Ratings

Symbol	Min	TYP	Max	Unit
VCC	-0.2	5.0	6.0	V
	-	-	300	mA
RX	-0.3	3.3	5.0	V
	-	-	25	mA
TX	-0.3	3.3	5.0	V
	-	-	25	mA
TRIG0	-0.5	3.3	3.75	V
	-	-	10	mA
TRIG1	-0.5	3.3	3.75	V
	-	-	10	mA

2.2.2 Electrical connection

The power supply and various input and output signals of the P1220 are connected through the flexible cable connector. The schematic diagram is shown in figure 1. The terminal connector is df37b-10dp-04v.

Figure 1-1 shows the front side of the connector, and figure 1-2 shows the back side. Pin number of connector is marked in the figure. Furthermore, the length of the cable is approximately 176mm.

1-1 Front side 1-2 Back side

Figure 1 Schematic diagram of the connect

The function of the pins as list in table 2.

Table 2. The function of the pins

Pin	Symbol	Input/Output	Function	Condition
1	Reserved	-	Reserved pin	LVTTL3.3
2	Reserved	-	Reserved pin	LVTTL3.3
3	Reserved	-	Reserved pin	LVTTL3.3
4	RX	Input	UART_RX	LVTTL3.3
5	TX	Output	UART_TX	LVTTL3.3
6	VCC	-	Power supply	5V
7	GND	-	GND	GND
8	TRIG0	Output	Zero marking pulse signal	LVTTL3.3
9	TRIG1	Output	Angle marking pulse signal	LVTTL3.3
10	NC	-	-	-

Figure 2 shows the connection between the P1220 and the external device.

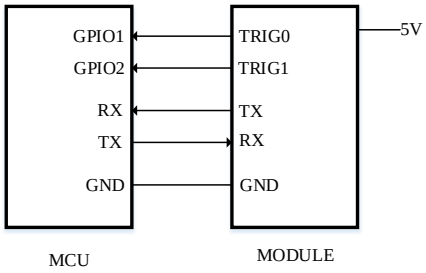


Figure 2. The connection between the P1220 and external device

2.3 Material properties

The material components of the P1220 are the aluminum shell, ceramic PCB.

2.4 Precision

(1) Error of scan angle <0.05°;

(2) The smallest marking angle is 0.05°

(3) Error of marking angle is ±0.025°

3. Application specification

3.1 Parameter configuration

3.1.1 Configurable parameters

Users can configure parameters of P1220 according to actual needs. Configurable parameters include: scan angle, marking angle, angle of marking signal. The

configurable scan angle of P1220 is 50°~ 60°. When the scan angle is set below the minimum scan angle 50°, the scan angle is not changed, which will be the minimum angle. The minimum marking angle is 0.05°. The configurable angle of marking signal is 0°~ 60°.

P1220 communicates with external devices through UART to configure parameters and query status.

3.1.2 UART protocol

P1220 communicate with extern device through UART. The protocol are list as table 3.

Table 3 Protocol of UART

Items	Value	Note
Baud rate	115200	-
Data bits	8	-
Check digit	non	-
Stop bit	1	-

3.1.3 Configure scan angle and marking angle

Users can configure the P1220 according to a certain format. The parameters are sent in ASCII code. The format is list in table 4.

Parameters	Operate code	Value
Scan angle	A	xx.xx
Marking angle	I	xx.xx

What is noteworthy is that the value of scan angle send to P1220 through UART is half of the scan angle. For example, the users send 0x4132382E3030 (A28.00 in ASCII), the scan angle of P1220 is 56°.

The value of marking angle must be a multiple of 0.05°. For example, the users send 0x44930302E3430(I00.40 in ASCII), the marking angle is 0.4°.

3.1.4 Query current parameters

The current parameters of P1220 can be acquired by sending the operate code: '**a**' or '**i**'. Users send 0x61(a in ASCII) to P1220 will get the current scan angle. Similarly, users send 0x69 (i in ASCII) to P1220 will get the current marking angle. For example,

Users send 0x61 to P1220 and then receives 0x3392E3030 (29.00 in ASCII), which means the current scan angle is 58°. Users send 0x69 to P1220 then receives 0x30302E3230 (00.20 in ASCII), which means the current marking angle is 0.2°.

3.2 Real-time position calculation

According to the zero marking pulse signal: TRIG0 and the angle marking pulse signal: TRIG1, the real-time scanning position of the MEMS mirror can be obtained. Figure 3 shows the relationship of the marking pulse signal and time. This result is got by assuming the scan angle is 60° (±30°) and the marking angle is 3°. In this diagram, the green line is the zero marking pulse signal, which outputs only when the mirror pass through the zero position. In addition, this signal only outputs once each period. As for the yellow line, it is the angle marking pulse signal, which outputs when the MEMS mirror scanning a marking angle.

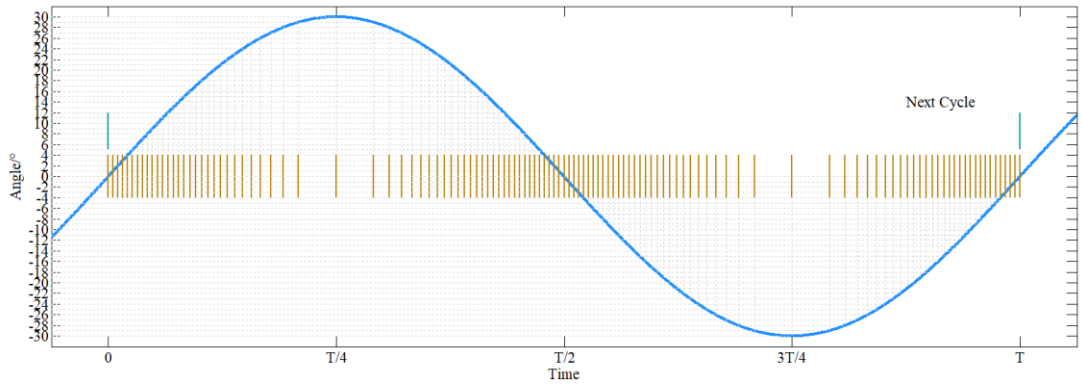


Figure 3 The relationship of the marking pulse signal and time,

Generally, the scan angle is 2Φ (±Φ) and the marking angle is δ. In order to simplify the process of calculating the real-time scanning position of the MEMS mirror, equally divided a period (T) into four parts as shown in Figure 4.

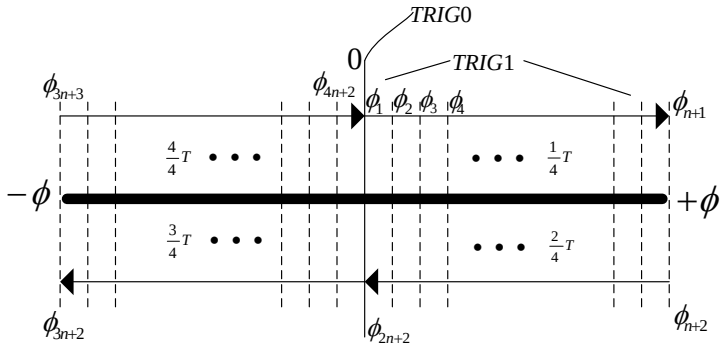


Figure 4 A period is divided into four parts

(1)In first 1/4 T

At the beginning of the period, a zero marking pulse signal and an angle marking pulse signal will be output. After that, there will be an angle marking pulse signal when the MEMS mirror scanning a marking angle each time, until this 1/4 T is over. The number of angle marking pulse signal output by the P1220 in this 1/4 cycle is N+1. Where:

$$N=\Phi/\delta \qquad \text{Formula (1)}$$

The example that shown in figure 4 has 11 angle marking pulses signal (from TRIG1).

(2)In second 1/4T

During this 1/4 cycle, the MEMS mirror will return to the zero position at the end. However, only the angle marking pulse signal will be output at this period, there will be no zero marking pulse signal output. In this second 1/4T, there are also N+1 angle marking pulses signal. In figure 4, the number of angle marking pulse signal (TRIG1) is 11.

(3) In third 1/4T

This 1/4 period is similarly to the first 1/4T. The angle marking pulse signal will be output when the MEMS mirror scanning a marking angle, and the total number of the pulse during this 1/4 cycle is N. In figure 4, the number of angle marker pulse (TRIG1) is 10.

(4) In fourth 1/4T

At the end of this 1/4 cycle, the MEMS mirror will return to the zero position again. It also means that a new period will start. During this time, the angle marking pulse signals will keep outputting and the total number of the pulse is N. In figure 4, the number of angle marker pulse (TRIG1) is 10.

Consequently, in one resonance period, there will be totally 4*N+2 angle marking pulse signals output from P1220, and only one zero marking pulse signal output. The zero marking pulse signal is regarded as the beginning of a cycle. Setting the first 2*N+2 angle marker pulses are the positive scan angle, and the second 2*N angle mark pulses are the negative scan angle.

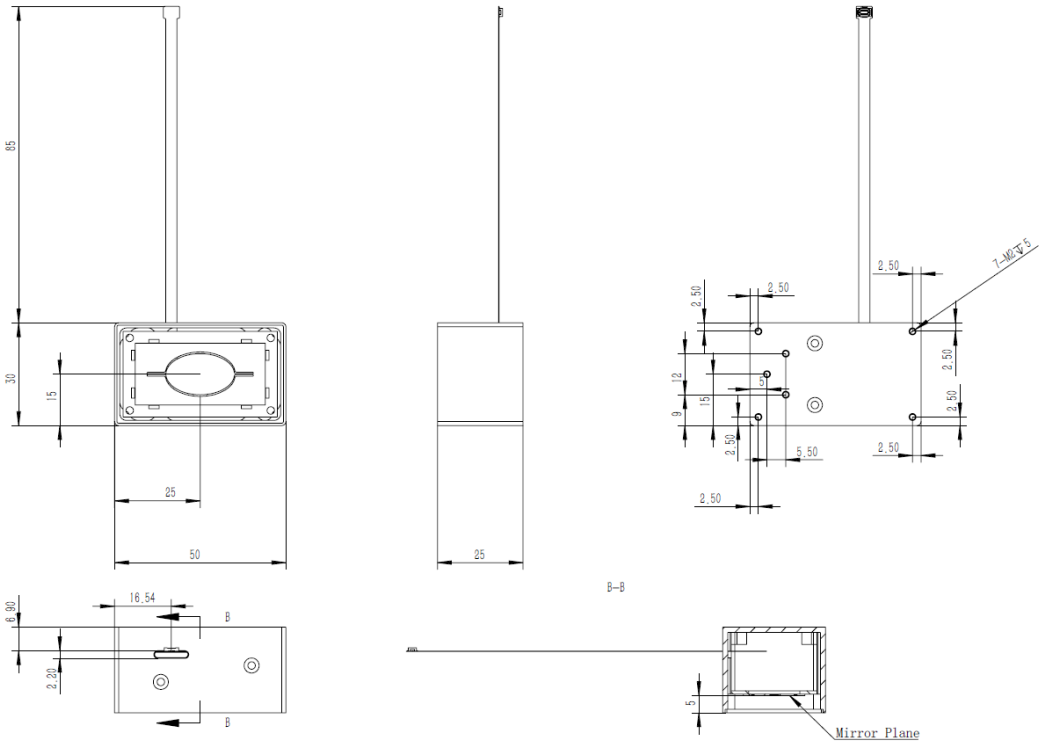
In a resonance period, the calculation formula of the real-time scanning position is:

$$\Phi_i = \begin{cases} (i-1)*\delta & 1 < i \le N+1 \\ (2*N-i+2)*\delta & N+1 < i \le 2N+1 \\ 0 & i = 1, 2N+2 \\ -(i-2*N-2)*\delta & (2N+2) < i \le (3N+2) \\ -(4*N+3-i)*\delta & (3N+2) < i \le (4N+2) \end{cases} \quad \text{Formula (2)}$$

where N is calculated according to formula (1).

In particular, decide the positive and negative directions is a prerequisite for correctly measuring the real time scan angle. The positive and negative directions of the scan angle are marked on the shell of the P1220.

3.3 Dimension



unit:mm

Figure 5 Dimension of P1220

4. Evaluation

Our company has developed an official test board for testing the P1220, which is available for users to quickly evaluate P1220, and users can order it from our company. For instructions on how to use test board, please refer to *Test board for MEMS mirror module P1220.*

Order information

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Revision History

Date	VER	Description
2018-12-01	V1.0	The first edition