PMJ9100S1: Media Tracking Chip

Product Datasheet

General Description

The PMJ9100S1 is PixArt Imaging's high performance Media Tracking Chip (MTC), using low power CMOS chip designed specifically to track print media in printer applications. The MTC offers high repeated accuracy with error rate of +/- 15 um over one inch of media movement with speeds up to 15 inches per second (ips). The MTC integrates IR LED light source and optical chip with built in picture element recognition engine and DSP that provides the host system real-time feedback.

Key Features

- Single axis tracking chip
- Integrated 12 pin module
- High accuracy with error rate of +/- 15 um over 1 inch travel distance
- High resolution of 17904 cpi
- Supports Four-Wire Serial Port Interface (SPI)
- External interrupt output for motion detection
- Internal Oscillator – no clock input needed

Applications

- Print media applications

Key Parameters

Parameter	Value
Supply Voltage (V)	V_{DD}: 3.0 – 3.6 V_{DDIO}: 3.0 – 3.6
LED Supply Voltage (V)	V_{LED}: 3.0 – 3.6
Raw Data Array	128 Col x 16 Row
Interface	4-Wire SPI @ 2 MHz
Repeated Accuracy Error (um)	+/- 15
Media Lift Height (um)	+/- 50
Speed (ips)	15
Acceleration (m/s^2)	4
Resolution (cpi)	17904
Z Height (mm) (Distance from Lens Reference Plane to Tracking Surface)	9
Package Type	12 pin module

Ordering Information

Part Number	Package Type
PMJ9100S1	12-pin Module

RoHS compliant

For any additional inquiries, please contact us at http://www.pixart.com/contact.asp

1.0 Signal Description

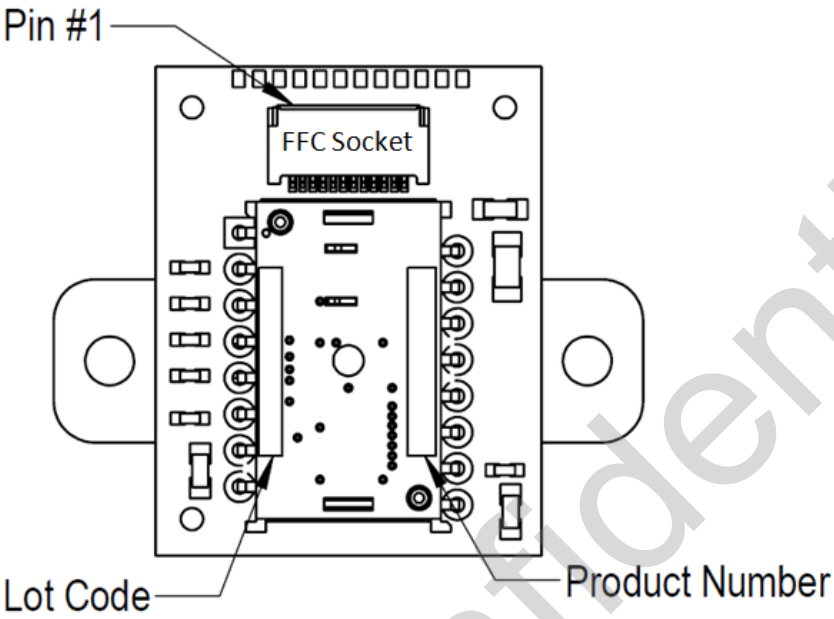


Figure 1. Pin Configuration

Table 1. PMJ9100S1 FFC Socket Signal Pins Description

Pin No.	Signal Name	Type	Description
Functional Group:		Power Supplies	
2	VDDIO	Power	I/O reference voltage
9	VDD	Power	Input power supply
12	VLED	Power	Supply to LED anode
1	DGND	Ground	Digital ground
8	AGND	Ground	Analog ground
11	LED_GND	Ground	LED Ground
Functional Group:		Control Interface	
3	SCLK	Input	Serial data clock
4	MISO	Output	Serial data output
5	MOSI	Input	Serial data input
6	NCS	Input	Chip select
Functional Group:		Functional I/O	
7	NRST	Input	Hardware reset
10	MOTION	Output	Motion interrupt

2.0 Operating Specifications

2.1 Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	T_S	-40	85	℃	
Supply Voltage	V_{DD}	-0.5	3.7	V	
	V_{DDIO}	-0.5	3.7	V	
	V_{LED}	-0.5	3.7	V	
Input Voltage	V_{IN}	-0.5	V_{DDIO} + 0.5	V	All I/O pins
ESD	ESD_{HBM}		2	kV	All pins (Human Body Model)

Notes:

1. Maximum Ratings are those values beyond which damage to the device may occur.
2. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum-rated conditions is not implied.
3. Functional operation should be restricted to the Recommended Operating Conditions.

2.2 Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Description	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Temperature	T_A	0		40	°C	
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Including supply noise
	V_{DDIO}	3.0	3.3	3.6	V	Including supply noise
	V_{LED}	3.0	3.3	3.6	V	Including supply noise
Power Supply Noise				100	mV_{p-p}	At the supply point to the chip
Serial Port Clock Frequency	f_{SCLK}			2	MHz	50% duty cycle
Distance from Lens Reference Plane to Tracking Surface	Z	8.85	9.00	9.15	mm	Required module mounting / assembly accuracy
Media Lift Range	Z_V	-0.05		0.05	mm	Distance change from Lens Reference Plane to non-printing side of Media Surface.
Repeated Accuracy Error	A	-15		+15	um	Over 1 inch distance, tracking on non-printing side of media. Repeatability tested over the same 1 inch location, at stable temperature.
Speed	V			15	ips	Max constant velocity, along long axis of chip's array.
Acceleration	G			4	m/s^2	Acceleration from stationary, along long axis of chip's array.
Resolution of motion report				17904	cpi	
Rotational Angle Misalignment	R_A			0.5	°	
Module Y Axis Height Misalignment	Y_H			0.05	mm	
Module X Axis Height Misalignment	X_H			0.05	mm	

Note: PixArt does not guarantee the performance of the system beyond the recommended operating condition limits.

2.3 DC Characteristics

Table 4. DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply Current	I_{DD_RUN}		18		mA	Average current consumption, including LED current with 1ms polling.
Power Down Current	I_{PD}		30		uA	
Input Low Voltage	V_{IL}			0.3* V_{DDIO}	V	SCLK, MOSI, NCS
Input High Voltage	V_{IH}	0.7* V_{DDIO}			V	SCLK, MOSI, NCS
Input Hysteresis	V_{I_HYS}		100		mV	SCLK, MOSI, NCS
Input Leakage Current	I_{LEAK}		± 1	± 10	uA	V_{in} = V_{DDIO} or 0V, SCLK, MOSI, NCS
Output Low Voltage	V_{OL}			0.45	V	I_{OUT} = 1mA, MISO, MOTION
Output High Voltage	V_{OH}	V_{DDIO} - 0.45			V	I_{OUT} = -1mA, MISO, MOTION

Notes:

1. All the parameters are tested under operating conditions: V_{DD} = 3.3V, V_{DDIO} = 3.3V, V_{LED} = 3.0V, Internal Clock = 80 MHz, Internal Slow Clock = 1 kHz, T_A = 25°C.
2. Typical pulse current drawn by V_{LED} is 120 mA.

2.4 AC Characteristics

Table 5. AC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Motion Delay After Navigation Start	$t_{MOT-NAV}$	35			ms	From navigation engine start to valid motion, assuming motion is present
Shutdown	t_{STDWN}			1.5	ms	From Shutdown mode active to low current
Wake from Shutdown	t_{WAKEUP}	5			ms	From Shutdown mode inactive to ready to accept IO command. Notes: A RESET must be asserted after a shutdown. Refer notes in section "**Error! Reference source not found.** Power-Down Sequence", also note $t_{MOT-NAV.}$
MISO Rise Time	t_{r-MISO}		50		ns	C_L = 100pF
MISO Fall Time	t_{f-MISO}		50		ns	C_L = 100pF
MISO Delay After SCLK	$t_{DLY-MISO}$			170	ns	From SCLK falling edge to MISO data valid, with 100pF load
MISO Hold Time	$t_{hold-MISO}$	200			ns	Data held until next falling SCLK edge
MOSI Hold Time	$t_{hold-MOSI}$	200			ns	Amount of time data is valid after SCLK rising edge
MOSI Setup Time	$t_{setup-MOSI}$	120			ns	From data valid to SCLK rising edge
SPI Time Between Write Commands	t_{SWW}	180			µs	From rising SCLK for last bit of the first data byte, to rising SCLK for last bit of the second data byte.
SPI Time Between Write And Read Commands	t_{SWR}	180			µs	From rising SCLK for last bit of the first data byte, to rising SCLK for last bit of the second address byte.
SPI Time Between Read And Subsequent Commands	t_{SRW} t_{SRR}	20			µs	From rising SCLK for last bit of the first data byte, to falling SCLK for the first bit of the address byte of the next command.

SPI Read Address-Data Delay	t_{SRAD}	160			µs	From rising SCLK for last bit of the address byte, to falling SCLK for first bit of data being read.
SPI Read Address-Data Delay for Burst Mode Motion Read	t_{SRAD_MOTBR}	35			µs	From rising SCLK for last bit of the address byte, to falling SCLK for first bit of data being read. Applicable for Burst Mode Motion Read only.
NCS Inactive After Motion Burst	t_{BEXIT}	500			ns	Minimum NCS inactive time after motion burst before next SPI usage
NCS To SCLK Active	$t_{NCS-SCLK}$	120			ns	From last NCS falling edge to first SCLK rising edge
SCLK To NCS Inactive (For Read Operation)	$t_{SCLK-NCS}$	120			ns	From last SCLK rising edge to NCS rising edge, for valid MISO data transfer
SCLK To NCS Inactive (For Write Operation)	$t_{SCLK-NCS}$	35			µs	From last SCLK rising edge to NCS rising edge, for valid MOSI data transfer
NCS To MISO High-Z	$t_{NCS-MISO}$			500	ns	From NCS rising edge to MISO high-Z state
MOTION Rise Time	$t_{r-MOTION}$		50		ns	C_L = 100pF
MOTION Fall Time	$t_{f-MOTION}$		50		ns	C_L = 100pF
Input Capacitance	C_{in}		50		pF	SCLK, MOSI, NCS
Load Capacitance	C_L			100	pF	MISO, MOTION
Transient Supply Current	I_{DDT}			33	mA	Max supply current during the supply ramp from 0V to VDD with min 150 us and max 20 ms rise time. (Does not include charging currents for bypass capacitors)
	I_{DDTIO}			50	mA	Max supply current during the supply ramp from 0V to VDDIO with min 150 us and max 20 ms rise time. (Does not include charging currents for bypass capacitors)

Note: All the parameters are tested under operating conditions: V_{DD} = 3.3V, V_{DDIO} = 3.3V, T_A = 25°C.

3.0 Mechanical Specifications

3.1 Package Marking

Refer to Figure 1. Pin Configuration for the code marking location on the device package.

Table 6. Code Identification

Code	Marking	Description
Product Number	PMT9100DM-T2QU	Chip part number label
Lot Code	AYWWXXXXXX	A: Assembly House Y: Year WW: Week XXXXXX: Reserved as PixArt reference

3.2 Module Outline Drawing

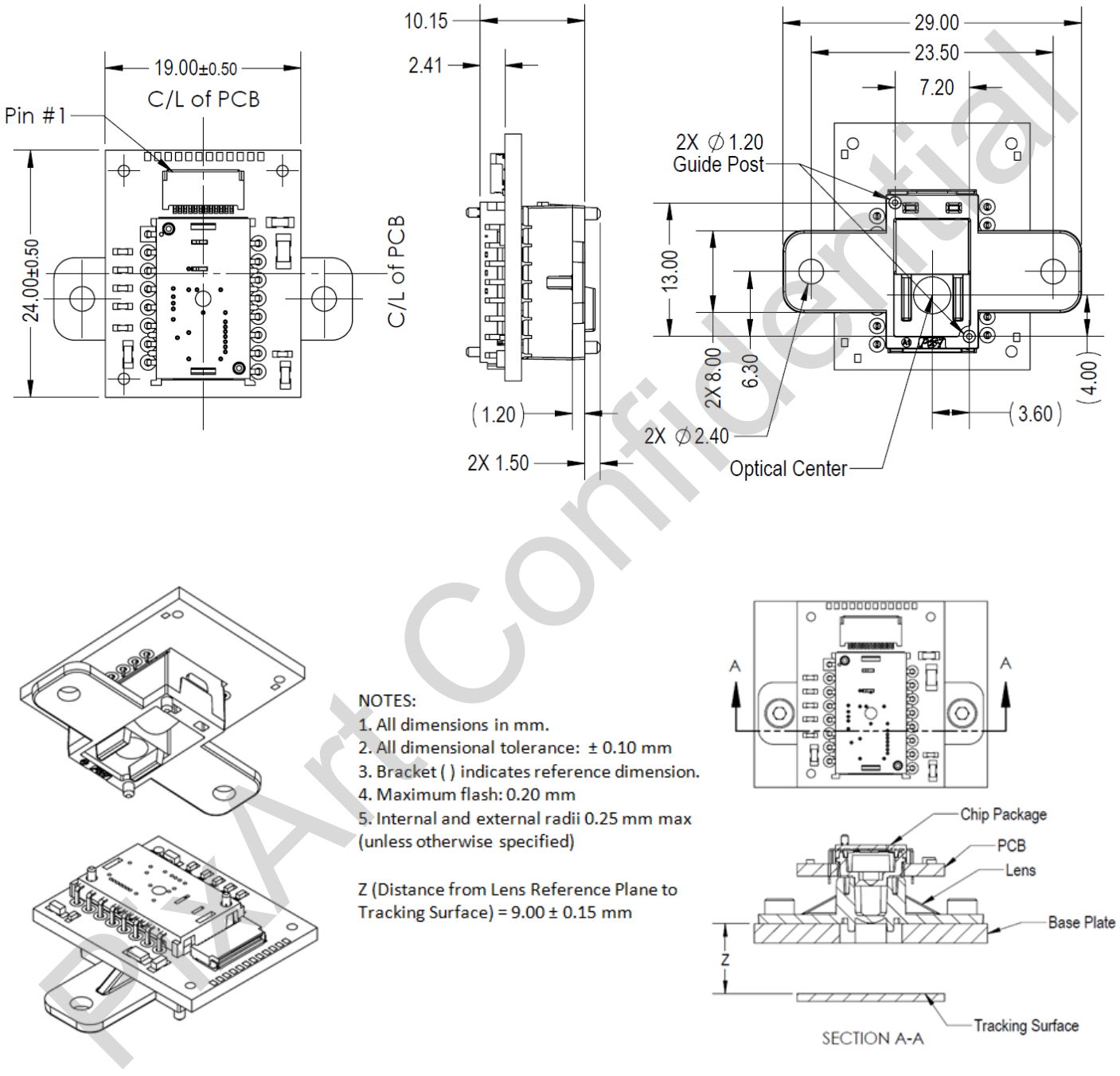
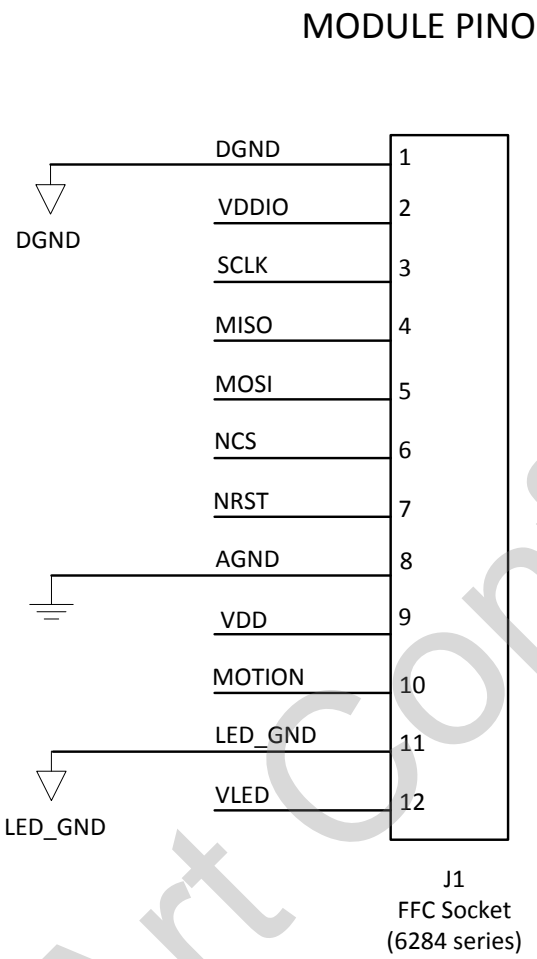


Figure 2. Module Outline Drawing

4.0 System Level Description

4.1 Reference Schematic



Note:
1. FFC Socket P/N: Kyocera 046284012002846 (Au Plating).
2. Recommended maximum length of FFC = 6"

Figure 3. PMJ9100S1 Reference Schematics

4.2 Assembly Recommendation

- PMJ9100S1 should be mounted flat and parallel to the media to be tracked, spaced with the gap Z shown in Figure 2. Module Outline Drawing. The Z height is the assembly height measured (with reference to the optical center) from the lens flange (termed as Lens Reference Plane) to the tracking surface.
- PMJ9100S1 should be mounted such that the longer axis of the module is aligned to the direction of media movement to be tracked, at either at 0° or 180°, with deviations of less than 0.5°. Refer example shown in Figure 4. Mounting Direction.
- It is recommended that the two guide posts on the bottom of PMJ9100S1 be utilized to aid the positioning of the module via corresponding guide holes on the baseplate.
- In addition, PMJ9100S1 should be secured to the baseplate with M2 screws through the two holes on the flange of the lens.
- Take note to ensure module misalignments during assembly do not exceed the specifications stated in Table 3. Recommended Operating Conditions.
- Parameter H1 to H4 in Figure 5. Type of Assembly Misalignments refer to the distance from the edges of the lens to the tracking surface.

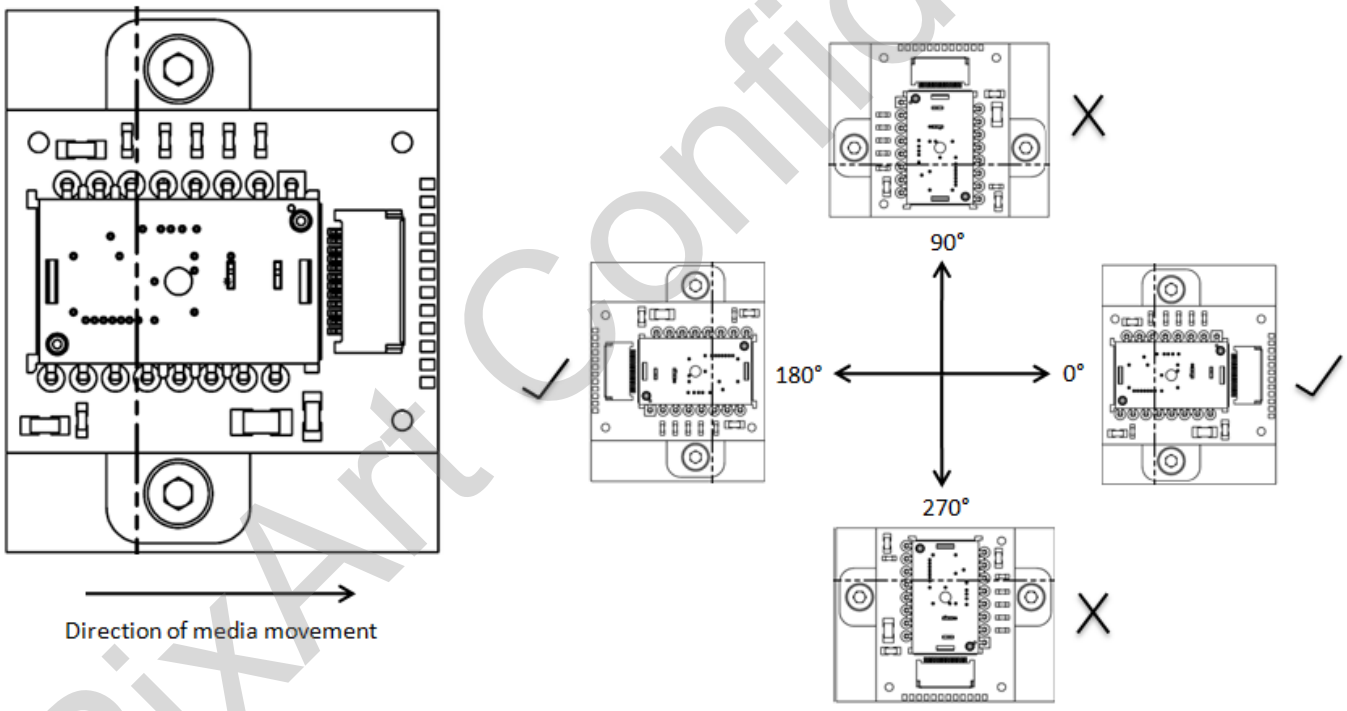
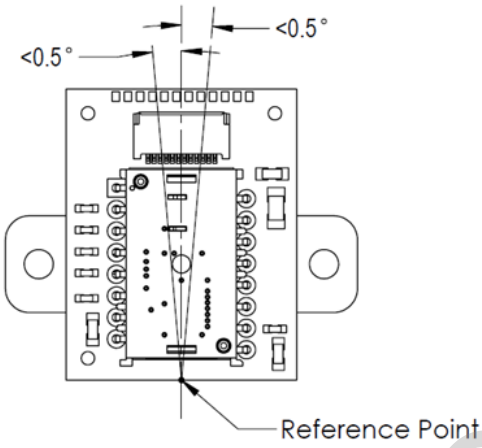
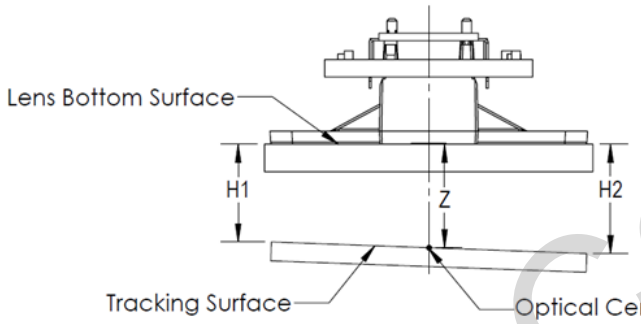


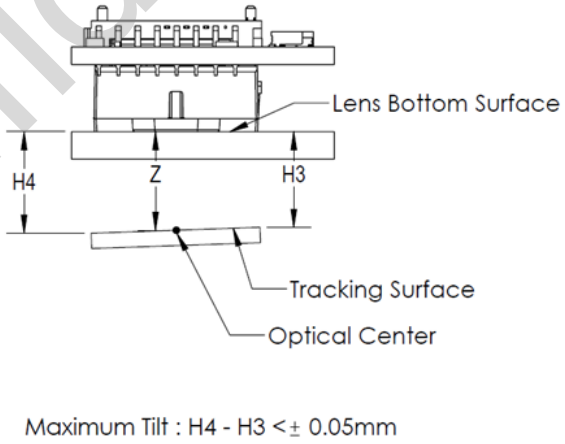
Figure 4. Mounting Direction



Rotational Angle Misalignment



Y Axis Height Misalignment



X Axis Height Misalignment

Figure 5. Type of Assembly Misalignments

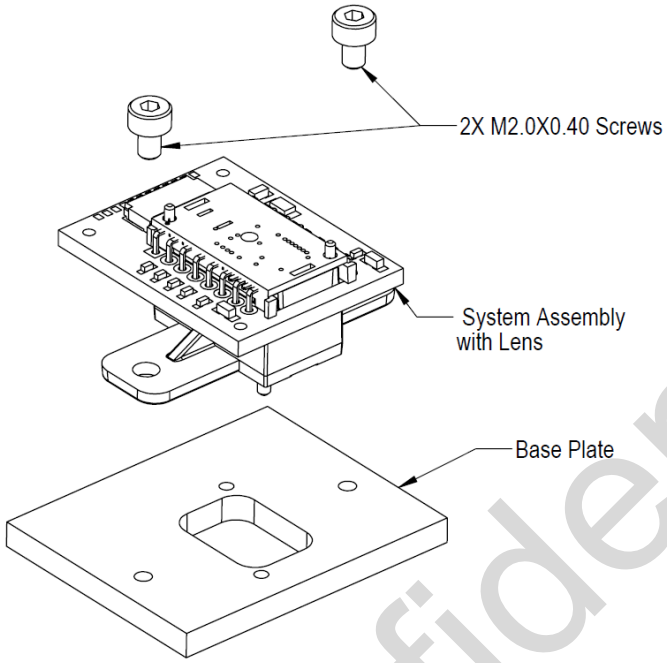
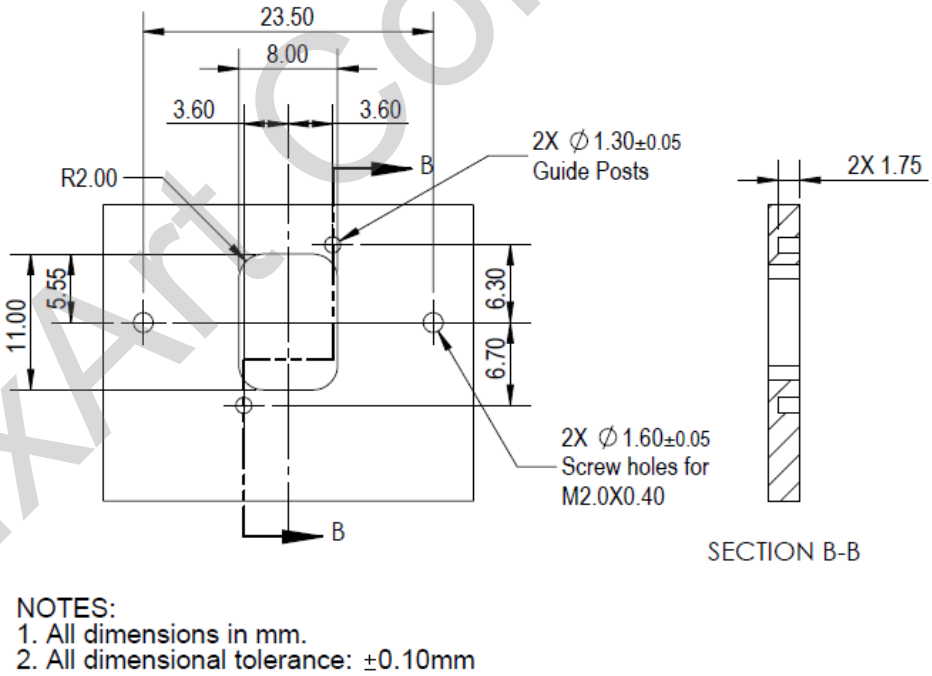
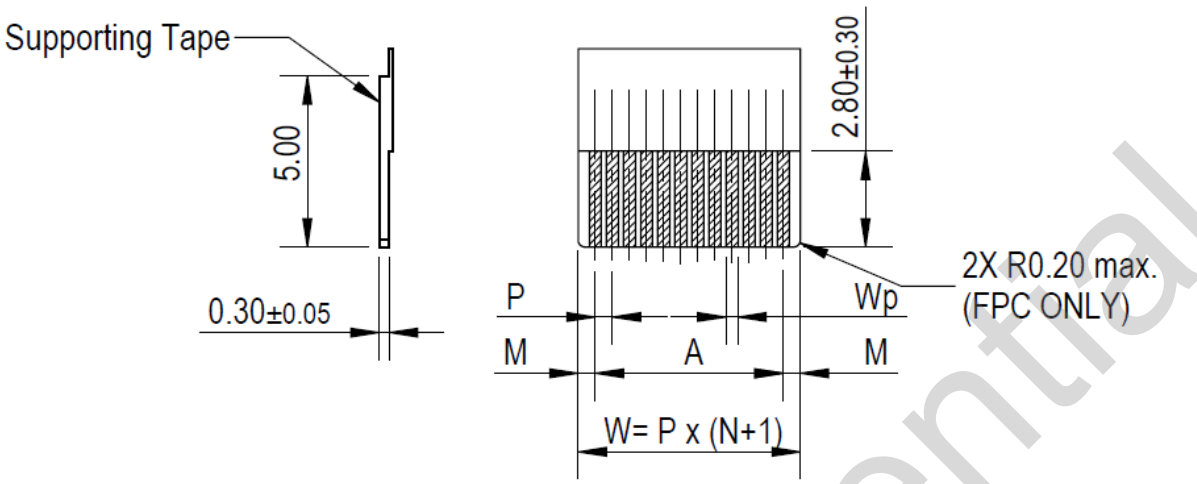


Figure 6. Exploded View of System Assembly



NOTES:
1. All dimensions in mm.
2. All dimensional tolerance: ±0.10mm

Figure 7. Recommended Base Plate Design



Notes: A = 5.50mm, N = 12

Applicable for FPC & FFC

	FPC		FFC	
	1	2	1	2
M	0.5±0.12	0.5±0.10	0.5±0.10	0.5±0.08
P	0.5±0.02	0.5±0.05	0.5±0.03	0.5±0.05
A	A±0.03	A±0.05	A±0.03	A±0.05
W	W±0.07	W±0.07	W±0.07	W±0.07
Wp	$0.35^{+0.04}_{-0.03}$	0.35±0.05	$0.3^{+0.05}_{-0.02}$	$0.3^{+0.05}_{-0.02}$

Figure 8: Recommended FPC / FFC Design

5.0 Registers

5.1 Registers List

PMJ9100S1 registers are accessible via the serial port. The registers are used to read motion data and status as well as to set the device configuration.

Table 7. Register List

Address	Register Name	Access	Reset	Address	Register Name	Access	Reset
0x00	Product_ID	RO	0xA0	0x23	Config3	R/W	0x81
0x01	Revision_ID	RO	0x02	0x25	Config5	R/W	0x04
0x02	Motion	RO	0x00	0x26	Observation	R/W	0x00
0x03	Delta_X_L	RO	0x00	0x29	SROM_ID	RO	0x00
0x04	Delta_X_H	RO	0x00	0x2E	Data_Out_Upper	RO	N/A
0x05	Delta_Y_L	RO	0x00	0x2F	Data_Out_Lower	RO	N/A
0x06	Delta_Y_H	RO	0x00	0x3A	Power_Up_Reset	WO	N/A
0x07	Squal_Upper	RO	0x00	0x3B	Shutdown	WO	N/A
0x08	Squal_Lower	RO	0x00	0x3D	Temp_Stabilizer	R/W	0x02
0x09	RawData_Sum_Upper	RO	0x00	0x3F	Inverse_Product_ID	RO	0x5F
0x0A	RawData_Sum_Lower	RO	0x00	0x50	Motion_Burst	R/W	0x00
0x0B	Maximum_RawData	RO	0x00	0x62	SROM_Load_Burst	WO	N/A
0x0C	Minimum_RawData	RO	0xFF	0x64	RawData_Burst	R/W	0x00
0x0D	Shutter_Upper	RO	0x90	0x70	Temp_Comp_Ctrl	R/W	0x00
0x0E	Shutter_Lower	RO	0x01	0x71	TCount_Upper	RO	N/A
0x12	Frame_Capture	R/W	0x00	0x72	TCount_Lower	RO	N/A
0x13	SROM_Enable	R/W	0x00	0x73	Temp_Update_Rate	R/W	0x00
0x14	Config2	R/W	0x08				