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 +/- 0.015 mm over 25 mm 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 +/- 0.015 mm over 25 mm 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 | +/- 0.015 |
| (mm) | |
| Media Lift Height (mm) | +/- 0.050 |
| Speed (ips) | 15 |
| Acceleration (m/s ²) | 4 |
| Resolution (cpi) | 17904 |
| Z Height (mm) | 9 |
| (Distance from Lens | |
| Reference Plane to | |
| Tracking Surface) | |
| Package Type | 12 pin module |

Ordering Information

| Part Number | | Package Type |
|-------------------|---|---------------|
| PMJ9100S1 | | 12-pin Module |
| RoHS compliant | 6 | } |

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

1.0 Signal Description





Table 1. PMJ9100S1 FFC Socket Signal Pins Description

| Pin No. | Signal Name | Туре | Description |
|----------|-------------|---------------|-----------------------|
| Function | al Group: | Power Suppl | ies |
| 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 |
| Function | al Group: | Control Inter | face |
| 3 | SCLK | Input | Serial data clock |
| 4 | MISO | Output | Serial data output |
| 5 | MOSI | Input | Serial data input |
| 6 | NCS | Input | Chip select |
| Function | al Group: | Functional I/ | 0 |
| 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 | Ts | -40 | 85 | °C | |
| | V _{DD} | -0.5 | 3.7 | V | |
| Supply Voltage | 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 _{нвм} | | 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. | Тур. | Max. | Unit | Notes | |
|--|-------------------|--------|------|---|------------------|---|--|
| Operating Temperature | T _A | 0 | | 40 | °C | | |
| | V _{DD} | 3.0 | 3.3 | 3.6 | V | Including supply noise | |
| Power Supply Voltage | V _{DDIO} | 3.0 | 3.3 | 3.6 | V | Including supply noise | |
| | V _{LED} | 3.0 | 3.3 | Max.UnitNotes40°C3.6V100Including supply noise3.6V100mV _{P-P} At the supply point to the chip2MHz50% duty cycle9.15mmRequired module mounting / assembly accuracy0.050mm40.015mm40.015mm15ips15ips17904cpi0.050mm2At coloration from stationary, along long axis of chip's array.17904cpi0.055mm | | | |
| 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 | Zv | -0.050 | | 0.050 | mm | Distance change from Lens Reference Plane to non-printing side of Media Surface. | |
| Repeated Accuracy Error | A | -0.015 | | +0.015 | mm | Over 25 mm distance, tracking on non-printing side of media Repeatability tested over the same 25 mm 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 | срі | | |
| Rotational Angle Misalignment | R _A | | | 0.5 | o | | |
| 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. | Тур. | 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 | VIL | | | 0.3* V _{DDIO} | V | SCLK, MOSI, NCS |
| Input High Voltage | VIH | 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. | Тур. | 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. |

PixArt Imaging Inc.

Media Tracking Chip (MTC)

| 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 | Cin | | 50 | | рF | SCLK, MOSI, NCS |
| Load Capacitance | CL | | | 100 | рF | MISO, MOTION |
| Transient Cumply Cumpent | I _{DDT} | | | 33 | mA | Max supply current during the supply ramp from OV to VDD with min 150 us and max 20 ms rise time. (Does not include charging currents for bypass capacitors) |
| Transient Supply Current | Ι _{σστιο} | | | 50 | mA | Max supply current during the supply ramp from OV 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 |

Version 1.20 | 29 Aug 2018

PixArt Imaging Inc.

3.2 Module Outline Drawing









Figure 2. Module Outline Drawing

Version 1.20 | 29 Aug 2018

4.0 System Level Description

4.1 Reference Schematic

MODULE PINOUT



Note:

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

Figure 3. PMJ9100S1 Reference Schematics

Version 1.20 | 29 Aug 2018

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







Maximum Tilt : H2 - H1 <± 0.05mm

Y Axis Height Misalignment

H4 Tracking Surface Optical Center

Maximum Tilt : H4 - H3 <± 0.05mm

X Axis Height Misalignment

Figure 5. Type of Assembly Misalignments



Figure 6. Exploded View of System Assembly



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



Version 1.20 | 29 Aug 2018



Notes: A = 5.50mm, N = 12

Applicable for FPC & FFC

| | FF | С | FFC | | | |
|----|--------------------------------|--------------------|-------------------------------|-----------------------|--|--|
| | 1 2 | | 1 | 2 | | |
| M | 0.5±0.12 | 0.5±0.10 | 0.5 <u>+</u> 0.10 | 0.5 ± 0.08 | | |
| Р | 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 <u>+</u> 0.07 | W <u>+</u> 0.07 | W <u>+</u> 0.07 | W <u>+</u> 0.07 | | |
| Wp | +0.04 0.35 _{-0.03} | 0.35 <u>+</u> 0.05 | +0.05 0.3 _{-0.02} | +0.05 0.3 -0.02 | | |

Figure 8: Recommended FPC / FFC Design

PixArt Imaging Inc.

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 Lis |
|-----------------------|
|-----------------------|

| 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 | OxFF | 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 | | | | |