PAW3021J1: Optical Finger Navigation Device

General Description

The PAW3021J1 is an Optical Finger Navigation (OFN) device. It is capable of finger motion speed detection – up to 24 IPS on small area of touch cover window. The XY navigation output comes with finger movement.

In addition, it has an on-chip oscillator and integrated LED to minimize external components. There are no moving parts, thus provide high reliability and less maintenance for the end users. Precision optical alignment is also not required, facilitating high volume assembly. The device is programmed via registers through either I^2C or SPI interface port. It is packaged into an 18-pin FPC device for ease of assembly via ZIF connector.

Key Features

- Automotive grade Chip
- Compliant to AEC-Q100 grade 3
- Precise optical motion estimation technology
- Motion detection up to 24 inch/sec @ PORON® surface
- Resolution: 200 to 2000 CPI (counts per inch)
- Operation mode
  - Free navigation mode
  - Directional modes - 2 / 4 / 8 directions
- Hardware reset for flexible system control
- Sunlight resistant

Applications

- In-Vehicle Infotainment System
- Finger navigation in HID

Key Parameters

Parameter	Value
Operating Temperature	-40 to 85°C
Supply Voltage	VDDM: 3.0 to 3.6V VDDIO: 1.62 to 3.6V VDDIO ≤ VDDM
Interface	4-wire SPI/I^2C
Tracking speed	Max 24 inch/sec @ PORON® surface
Acceleration	6g @ PORON® surface
CPI Resolution	200 to 2000 CPI (default 1000)
Operating Current **Note:** Including LED current	Typical: 4mA (with I/O toggle) Without finger touch: 13mA Sleep State: 2mA

Ordering Information

Part Number	Description	Package Type	Packing Type	MOQ
PAW3021J1	Optical Finger Navigation Device	18-pin FPC device with 0.5mm contact pitch	Tray	1800 PCS

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

RoHS compliant

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

Table of Contents

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

List of Figures

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

List of Tables

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

1.0 Introduction

1.1 Overview

The PAW3021J1 is an FPC device consists of OFN chip, optical lens and cover. The OFN chip is a high-performance CMOS-process optical chip with integrated DSP serving as a non-mechanical motion estimation engine for finger navigation. An infrared LED is integrated in the OFN device, serving as the light source. It is based on optical navigation technology which measures variation in position by optically acquiring sequential surface images (frames) and mathematically determining the direction and magnitude of movement. The movement of △X and △Y are available in the registers accessed via serial port.

Note: Throughout this document PAW3021J1is referred as the device.

Figure 1. Device Appearance

1.2 Block Diagram

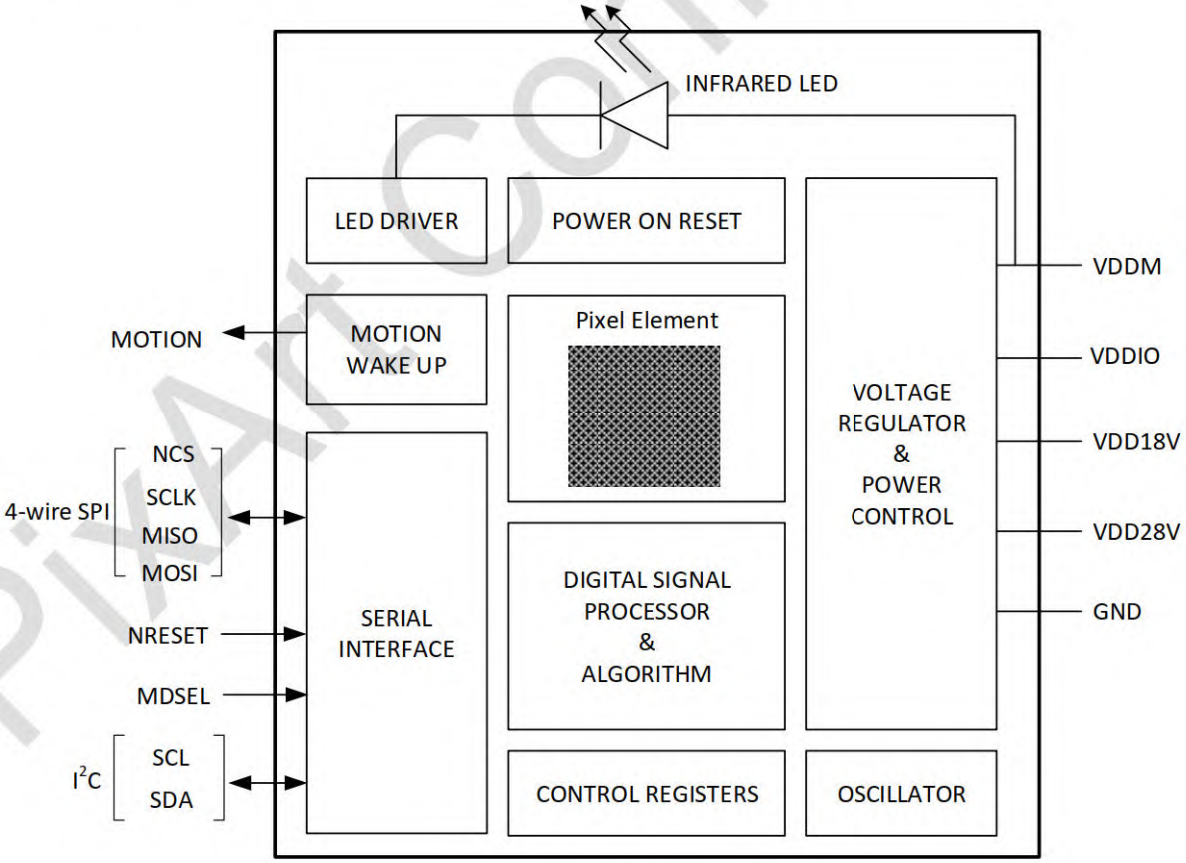


Figure 2. Block Diagram

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

1.3 Terminology

Term	Description
CMOS	Complementary Metal-oxide Semiconductor
CPI	Counts per inch
ESD	Electrostatic Discharge
FPS	Frame Per Second
FW	Firmware
GND	Ground signal
I^2C	Inter-integrated Circuit
IPS	inches per second
MSB	Most Significant Bit
LSB	Least Significant Bit
NA	Not Applicable
OFN	Optical Finger Navigation
R	Read
SPI	Serial Peripheral Interface
W	Write

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

1.4 Pin Assignment and Signal Description

Pin No.	Signal Name		Type	Description
	I^2C	4-wire SPI		
1	GND_ESD	GND_ESD	Ground	Ground for enhancing ESD protection.
2	NC	NC	NC	No connection
3	SDA	MISO	I/O	SDA pin for I^2C interface MISO pin for 4-wire SPI interface
4	ID1	NCS	Input	Slave ID selection for I^2C interface NCS pin for 4-wire SPI interface (low active)
5	ID0	MOSI	Input	Slave ID selection for I^2C interface MOSI pin for 4-wire SPI interface
6	MDSEL	MDSEL	Input	To select I^2C or 4-wire SPI interface Low : I^2C interface High : 4-wire SPI interface
7	SCL	SCLK	Input	Clock pin for I^2C / 4-wire SPI
8	VDDIO	VDDIO	Power	I/O power supply (1.62 to 3.6V) VDDIO ≤ VDDM
9	VDDM	VDDM	Power	Main power supply (3.0 to 3.6V)
10	GND	GND	Ground	Ground
11	VDD18V	VDD18V	Power	Internal regulator output and should be connected a 0.22μF capacitor to ground
12	VDD28V	VDD28V	Power	Internal regulator output and should be connected a 0.1μF capacitor to ground
13	NC	NC	NC	No connection
14	NC	NC	NC	No connection
15	NRESET	NRESET	Input	System reset (active low)
16	NC	NC	NC	No connection
17	MOTION	MOTION	Output	Motion interrupt (active low)
18	GND_ESD	GND_ESD	Ground	Ground for enhancing ESD.

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

2.0 Operating Specification

2.1 Absolute Maximum Ratings

Table 1. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	T_{STG}	-40	85	°C	
DC Supply Voltage	VDDM	3.0	3.6	V	VDDIO ≤ VDDM
DC Input Voltage	VDDIO	1.62	3.6	V	All I/O pin, VDDIO ≤ VDDM
Air ESD for I^2C	ESD_{I2C_A}		± 25	kV	Air ESD for I^2C interface
Contact ESD for I^2C	ESD_{I2C_C}		± 15	kV	Contact ESD for I^2C interface
Air ESD for 4SPI	ESD_{4SPI_A}		± 25	kV	Air ESD for 4-wire SPI interface
Contact ESD for 4SPI	ESD_{4SPI_C}		± 15	kV	Contact ESD for 4-wire SPI interface

Notes:

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

2.2 Recommended Operating Conditions

Table 2. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Ambient Temperature	T_A	-40	-	85	°C	
Power Supply Voltage	VDDM	3.0	3.3	3.6	V	VDDIO ≤ VDDM
IO Supply Voltage	VDDIO	1.62	3.3	3.6	V	VDDIO ≤ VDDM
Supply Noise	V_{Npp}	-	-	100	mV	Peak to peak within 10k – 80 MHz
Resolution (CPI: Counts per inch)	RES	200	1000	2000	CPI	1000 CPI ± 10% for both X and Y axis Based on X_CPI_Setting = 20 Y_CPI_Setting = 20 @ 25°C on PORON® Surface (P#: 4790-92-12039-04p)
SPI Clock Frequency	F_{SCLK}	-	-	1	MHz	
I^2C Clock Frequency	F_{SCL}	-	-	400	kHz	
Tracking Speed	TS	-	-	24	IPS	Inch per second (IPS) @ 25°C on PORON®surface (P#: 4790-92-12039-04p)
Acceleration	ACC	6	-	-	g	@ 25°C on PORON®surface (P#: 4790-92-12039-04p)

Note: PixArt does not guarantee the performance if the operating temperature is beyond the specified limit.

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

2.3 DC Electrical Characteristics

Electrical Characteristics are defined under recommended operating conditions. Typical working temperature is 25°C and VDDM=VDDIO=3.3V

Table 3. DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply current for chip when finger is moving on OFN	I_{DDN}	-	1.7		mA	Not including LED current, without interface I/O toggle
Supply current for LED when finger is moving on OFN	I_{LEDN}	-	2.3		mA	
Supply current for device when finger leaves OFN	I_{N_FINGER}		13		mA	Including chip and LED
Supply current for device at Sleep state	I_{sleep}		2		mA	Including chip and LED
Supply current for device at Power Down state	I_{DDPD}	-	10	-	µA	Including chip and LED
Input voltage HIGH	V_{IH}	0.8 x VDDIO	-		V	
Input voltage LOW	V_{IL}			0.2 x VDDIO	V	
Output voltage HIGH	V_{OH}	0.8 x VDDIO	-		V	
Output voltage LOW	V_{OL}			0.2 x VDDIO	V	

2.4 AC Electrical Characteristics

Electrical Characteristics are defined under recommended operating conditions. Typical values at 25 °C and VDDM=VDDIO = 3.3V

Table 4. AC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Power Down Delay Time	t_{PDR}	-	-	800	µs	After setting *PD_EnH* bit in the *Configuration* register
Address and data delay time	t_{delay}	2.75			µs	
Rise and Fall Time	t_r , t_f		-	300	ns	SDA
Data ready time after Reset	t_{reset}	1			ms	Data ready time after Software or Hardware Reset

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

2.5 Effective Operation Region

The effective operation region of the device is a small square region which located around the center of the top cover and is depicted as Figure 3.

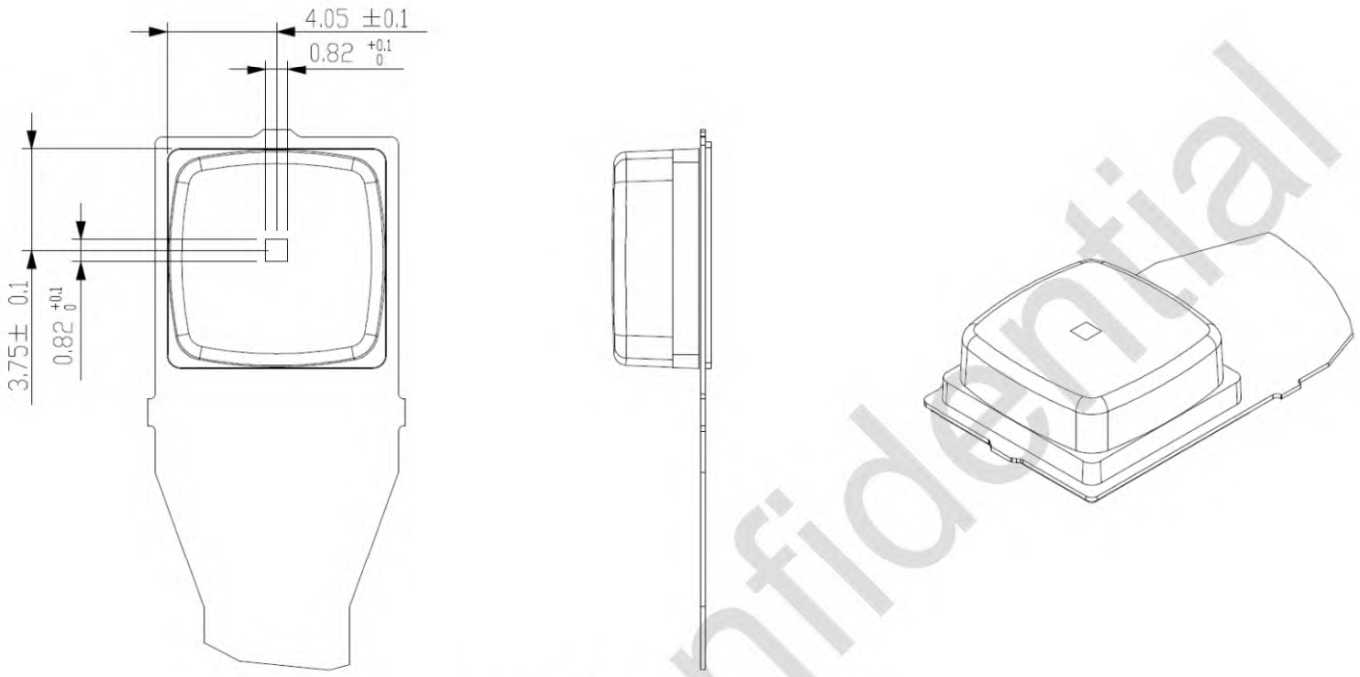


Figure 3. Effective Operation Region

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

3.0 Mechanical Specifications

3.1 Mechanical Dimension

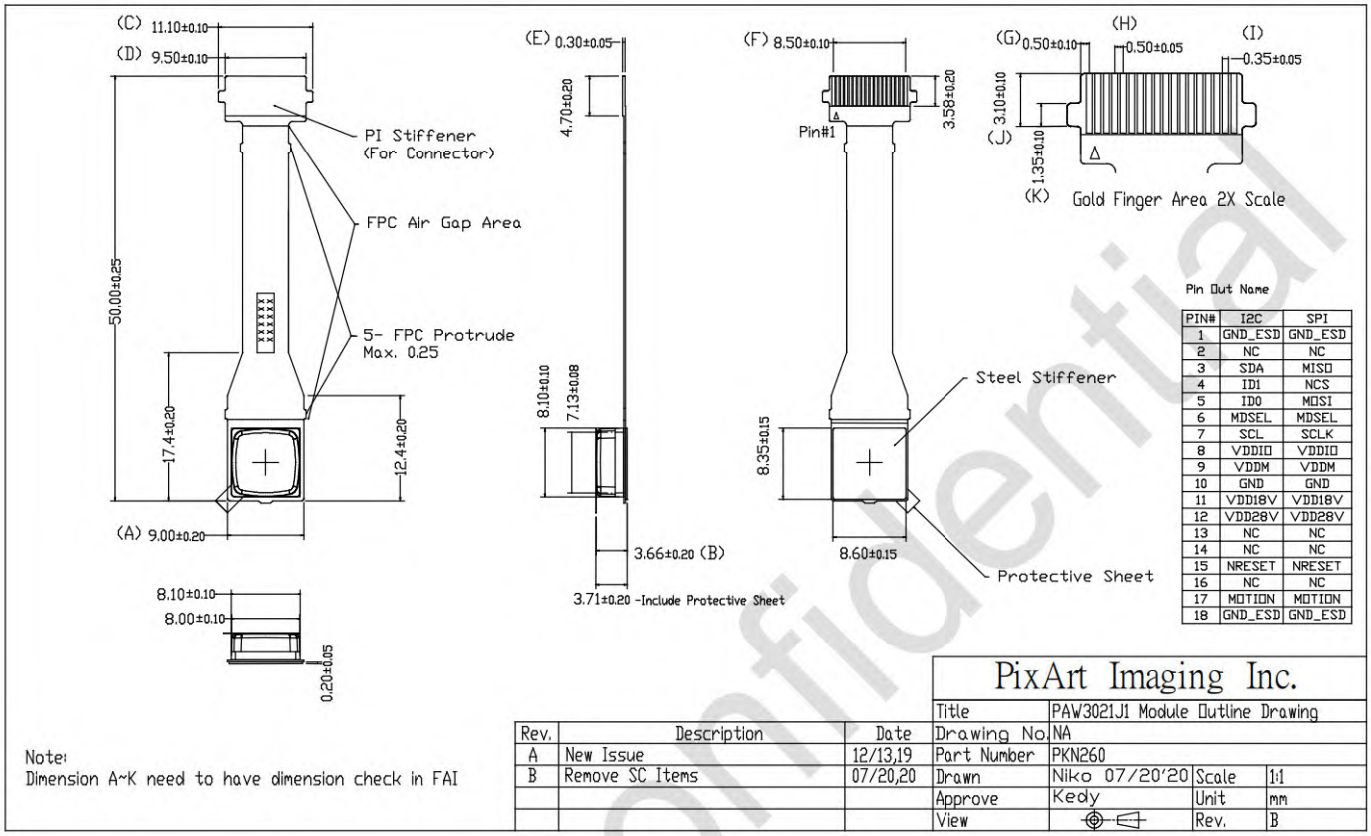


Figure 4. OFN Device Outline Drawing

3.2 Package Marking Identification

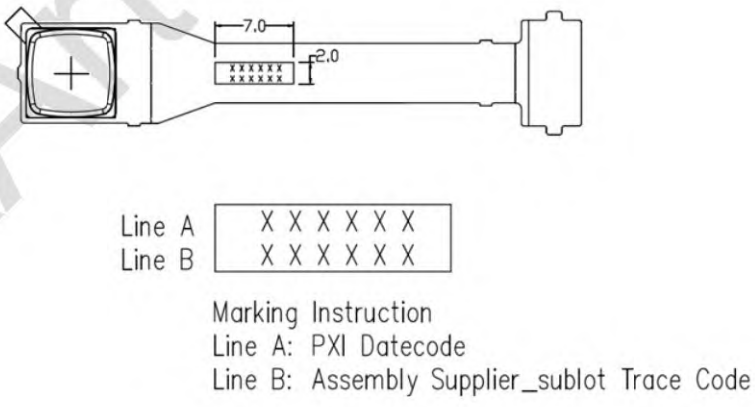


Figure 5. Marking Location Information

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

3.3 Packing Information

3.3.1 Device Orientation

Each tray loaded with maximum 30 units. The device's Black Cover is always place at the top relatively. See Figure 6.

Figure 6. Device Orientation and Order on the Tray

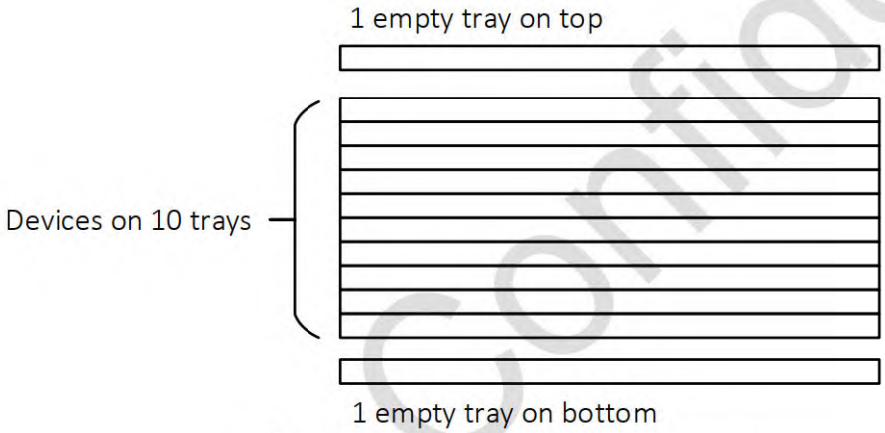


Figure 7. Tray Stack Definition

An inner packing box consists of 10 trays of devices. (maximum 300 units).

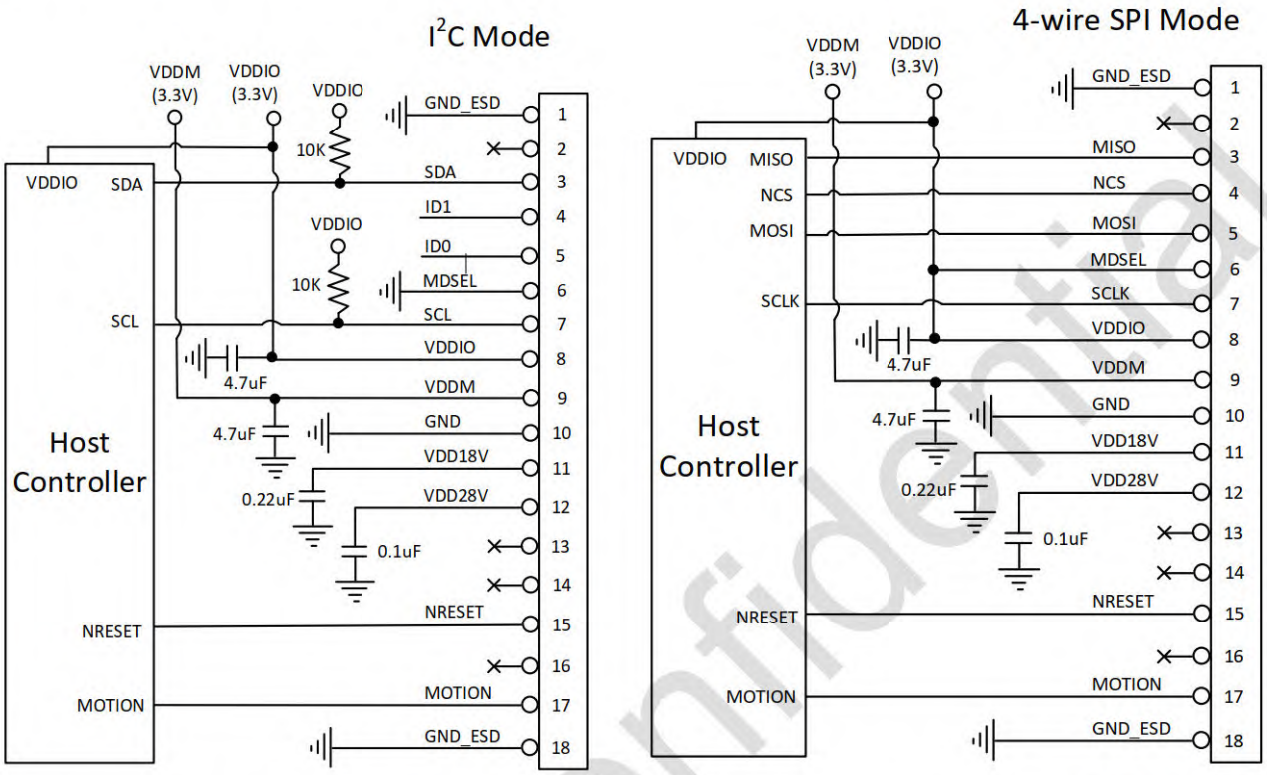
An outer box consists of six inner packing boxes. Maximum 1800 units per shipment box (the outer box).

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

4.0 Design References

4.1 Reference Schematic



ID0	ID1	7-bit slave ID (hex)
0	0	33
0	1	37
1	0	53
1	1	57

Figure 8. Reference Schematic

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.

4.2 FPC Bending Requirement

If the FPC is required for bending, the requirements below need to be followed.

1. Distance from the bending region to cover edge must be at least 2.0mm
2. Bending radius must be at least 0.75mm
3. The allowable bending count must be less than 5 times.

FPC bending definition as shown in Figure 9.

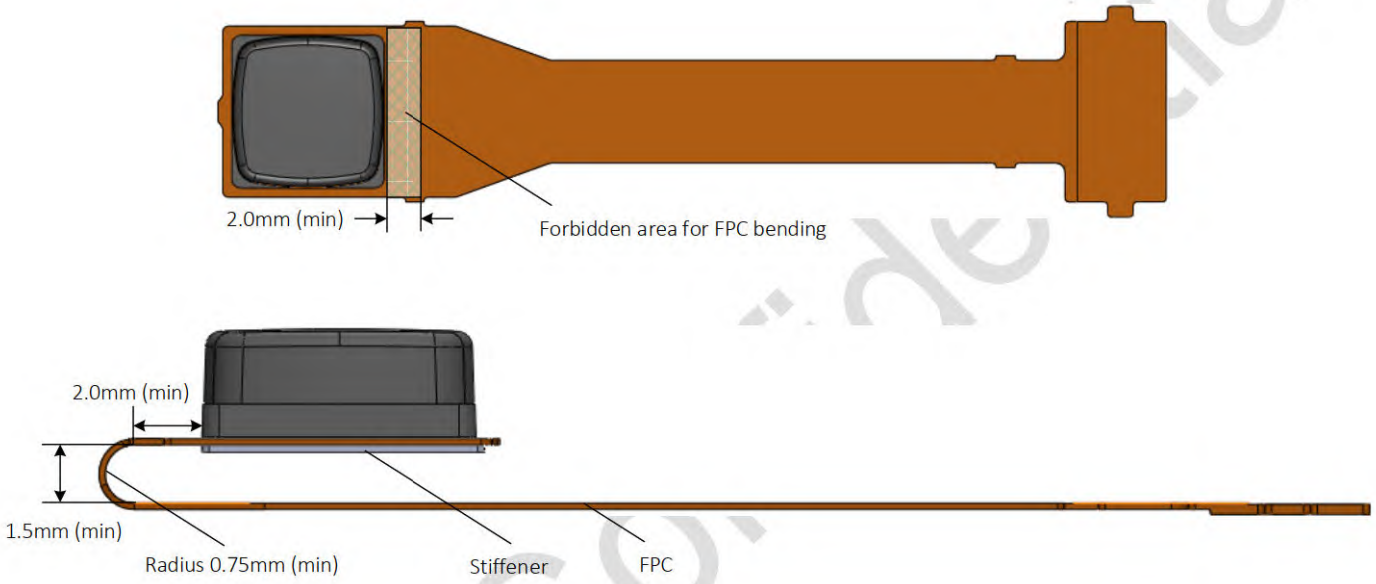


Figure 9. FPC Bending Requirement

PixArt Confidential

All rights reserved. Any portion in this paper shall not be reproduced, copied, or transformed to any other forms without permission.