Data Sheet

PAW3335DB-TZDU: Low Power Optical Gaming Navigation Chip

General Description

PAW3335DB-TZDU is PixArt Imaging's new low power gaming navigation chip suitable for wired and wireless gaming application. It has the latest state-of-the-art low-power architecture and automatic power management modes, making it ideal for battery-operated, power-sensitive cordless gaming devices. It provides excellent gaming experience with the features of high speed and high resolution even in low power mode to fulfill gamers' need. It is packaged in an 8pin staggered dual-in-line package (DIP) and designed to be used with L0AC-LSG1 lens to achieve optimum performance.

Key Features

- Low power consumption of typical 1.7mA @ run mode
- Programmable rest modes
- Small form factor PDIP 8L molded lead-frame package
- Operating Voltage: 1.80V - 2.10V
- High speed motion detection 400ips and acceleration 40g
- Selectable resolutions up to 16000cpi
- Three-wire serial port interface (SDIO)
- Internal oscillator — no clock input needed
- Customizable response time and downshift time for rest modes
- Angle snapping
- Lift detection options
    - 1mm setting
    - 2mm setting

Applications

- Wired and wireless Gaming Optical Mouse
- Trackball application

Key Parameters

Parameter	Value
Power Supply Voltage (V)	VDD: 1.80 – 2.10V
Interface	3-wire Serial Peripheral Interface
Supply Current @ VDD = 1.9V *Note: includes LED current*	Run: 1.7 mA Power Down: 3uA
Resolution (cpi)	Up to 16000
Tracking Speed (ips)	400
Acceleration (g)	40
Package Type (mm)	8L PDIP, 9.9 x 12.85 x 6.1

Ordering Information

Part Number	Package Type
PAW3335DB-TZDU	8L PDIP
L0AC-LSG1	Small Trim Lens

RoHS compliant

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

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1.0 Introduction

1.1 Overview

PAW3335DB-TZDU is based on Optical Navigation Technology, which measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the direction and magnitude of movement. PAW3335DB-TZDU contains an Image Acquisition System (IAS), a Digital Signal Processor (DSP), and a three-wire serial port. The IAS acquires microscopic surface images via the lens and illumination system. These images are processed by the DSP to determine the direction and distance of motion. The DSP calculates the ΔX and ΔY relative displacement values. An external microcontroller reads and translates the ΔX and ΔY information from the chip serial port into PS2, USB, or RF signals before sending them to the host PC.

Note: Throughout this document PAW3335DB-TZDU is referred to as the chip.

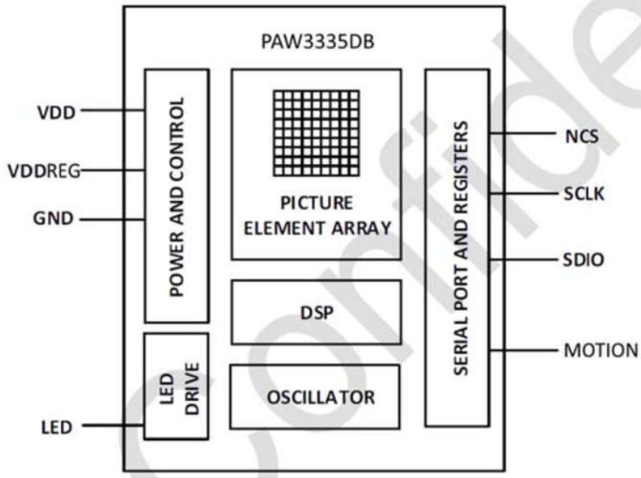


Figure 1. Functional Block Diagram

1.2 Terminology

Term	Description
DSP	Digital Signal Processing
LED	Light Emitting Diode
NCS	Chip Select
VDDREG	LDO output for digital core
VDD	Supply voltage
SCLK	Serial Clock
SDIO	Serial Data In & Out
SPI	Serial Peripheral Interface
GND	Ground
MOTION	Motion Detect

Pins Description

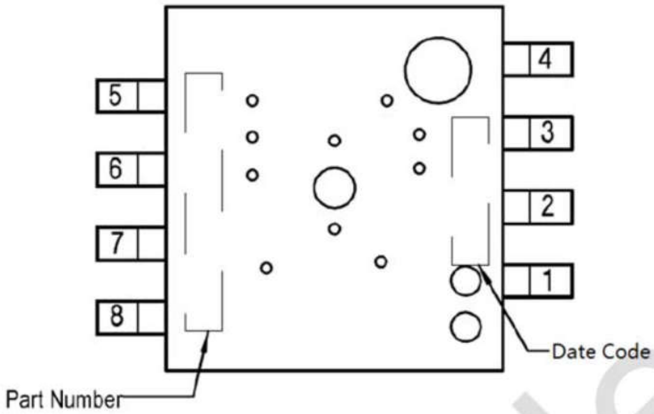


Figure 2. Pin Configuration

Table 1. PAW3335DB-TZDU Pins Description

Pin No.	Name	Type	Description
1	LED	Input	LED Illumination Control input
2	VDDREG	Power	LDO output (only for sensor internal usage).
3	VDD	Power	Power supply
4	SCLK	Input	Serial clock input
5	MOTION	Output	Motion Detect
6	GND	Gnd	Ground
7	SDIO	Input/Output	Serial data in/out
8	NCS	Input	Chip select (active low)

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	°C	
Lead Solder Temperature	T_{SOLDER}		260	°C	For 10 seconds, 1.6mm below seating plane
Supply Voltage	V_{DD}	-0.5	2.1	V	Including V_{NA} of 100 mV_{pp}
ESD	ESD_{HBM}		2	kV	All pins, Human Body Model
Input Voltage	V_{IN}	-0.5	VDD	V	All I/O pins

Notes:

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are the stress ratings only and functional operation of the device at these or any other condition beyond those indicated for extended period of time may affect device reliability.
2. The maximum ratings do not reflect eye-safe operation.
3. The inherent design of this component causes it to be sensitive to electrostatic discharge. The ESD threshold is listed above. To prevent ESD induced damage, take adequate ESD precautions when handling this product

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}	1.8	1.9	2.1	V	Including V_{NA} of 100 mV_{pp}
Power Supply Rise Time	t_{RT}	0.15		20	ms	0 to Min. VDD
Supply Noise	V_{NA}			100	mV_{p-p}	10kHz – 75MHz
Serial Port Clock Frequency	f_{SCLK}			8	MHz	Active drive, 50% duty cycle
Distance from Lens Reference Plane to Tracking Surface	Z	2.20	2.40	2.60	mm	
Speed	S	400			ips	PixArt standard gaming surfaces
Acceleration	A	40			g	In run mode PixArt standard gaming surfaces
Load Capacitance	C_L			20	pF	SDIO, MOTION
Lift Cutoff 1mm setting	$Lift_{1mm}$		1		mm	LOAC-LSG1
Lift Cutoff 2mm setting	$Lift_{2mm}$		2		mm	LOAC-LSG1

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

2.3 Thermal Specifications

Table 4. Thermal Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature	T_S	-25	-	80	°C	
Lead-free Solder Temperature	T_P	-	-	260	°C	For 10 seconds, 1.6mm below seating plane for wave soldering

2.4 DC Characteristics

Table 5. DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Condition
DC Supply Current in various modes	I_{DD_RUN}		1.7		mA	Average Run current
Note: Includes I_{LED}	I_{DD_REST1} I_{DD_REST2} I_{DD_REST3}		610 25 5		uA uA uA	No load on SDIO & MOTION
Power Down Current	I_{PD}		3		uA	
Input Low Voltage	V_{IL}			0.3* VDD	V	SCLK, SDIO, NCS
Input High Voltage	V_{IH}	0.7* VDD			V	SCLK, SDIO, NCS
Input Hysteresis	V_{I_HYS}		100		mV	SCLK, SDIO, NCS,
Input Leakage Current	I_{LEAK}		± 1	± 10	uA	Vin=VDD or 0V, SCLK, SDIO, NCS
Output Low Voltage	V_{OL}			0.45	V	I_{OUT} = 1mA, SDIO, MOTION
Output High Voltage	V_{OH}	VDD-0.45			V	I_{OUT} = -1mA, SDIO, MOTION
Input Capacitance	C_{in}		10		pF	SCLK, SDIO, NCS

Note: All the parameters are tested under recommended operating conditions. Typical values at 25 °C, V_{DD} = 1.9 V & LED current = 24mA

2.5 AC Characteristics

Table 6. AC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Motion Delay After Reset	$t_{MOT-RST}$	50			ms	From reset to valid motion, assuming motion is present
Shutdown	t_{STDWN}			500	ms	From Shutdown mode active to low current This timing could be affected by Rest3 period
Wake up from Shutdown	t_{WAKEUP}	50			ms	From Shutdown mode inactive to valid motion. Notes: A RESET must be asserted after a shutdown. Refer to section "5.2 Power Down Sequence", also note $t_{MOT-RST}$.
SDIO Output Rise Time	t_{r-SDIO}		6		ns	C_L = 20pF
SDIO Output Fall Time	t_{f-SDIO}		6		ns	C_L = 20pF
SDIO Output Delay After SCLK	$t_{DLY-SDIO}$			38	ns	From SCLK falling edge to SDIO output data valid C_L = 20pF
SDIO Output Hold Time	$t_{hold-SDIO}$	31.25			ns	Data held until next falling SCLK edge
SDIO input Hold Time	$t_{hold-SDIO\ input}$	31.25			ns	Amount of time data is valid after SCLK rising edge
SDIO input Setup Time	$t_{setup-SDIO\ input}$	31.25			ns	From data valid to SCLK rising edge
SPI Time Between Write Commands	t_{SWW}	5			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}	5			µs	From rising SCLK for last bit of the 1st data byte, to rising SCLK for last bit of the second address byte
SPI Time Between Read And Subsequent Commands	t_{SRW} t_{SRR}	2			µs	From rising SCLK for last bit of the 1st data byte, to falling SCLK for the 1st bit of data being read.
SPI Read Address-Data Delay	t_{SRAD}	2			µs	From rising SCLK for last bit of the address byte, to falling SCLK for the 1st bit of data being read.
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 1st SCK rising edge.

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
SCLK To NCS Inactive SDIO Read	$t_{SCLK\text{-}NCS\ read}$	120			ns	From last SCLK rising edge to NCS rising edge, for valid SDIO data transfer
SCLK To NCS Inactive SDIO Write	$t_{SCLK\text{-}NCS\ write}$	1			µs	From last SCLK rising edge to NCS rising edge, for valid SDIO data transfer
NCS To SDIO High-Z	$t_{NCS\text{-}SDIO}$			500	ns	From NCS rising edge to SDIO high-Z state
Transient Supply Current	IDDT		70		mA	Max supply current during the supply ramp from 0V to V_{DD} with min 150us and max 20ms rise time. (Does not include charging currents of bypass capacitors)

Note: All the parameters are tested under recommended operating conditions. Typical values at 25 °C & VDD=1.9V

3.0 Mechanical Specifications

3.1 Mechanical Dimension

Table 7. Package Dimensions

Parameters	Nominal	Min.	Max.	Unit
Package Body Dimension X	9.90	9.80	10.00	mm
Package Body Dimension Y	9.10	9.00	9.20	mm
Package Width (inclusive pins)	12.85	12.35	13.35	mm
Lead Length	5.15	5.05	5.25	mm
Lead Pitch	2.00	1.85	2.15	mm
Total Lead Count	8	-	-	-
Lead Offset	1.00	-	-	mm
Lead Width	0.50	0.40	0.60	mm
Hole Diameter	0.70	0.65	0.75	mm
Center of Hole from edge of body X	4.55	4.45	4.65	mm
Center of Hole from edge of body Y	3.92	3.82	4.02	mm

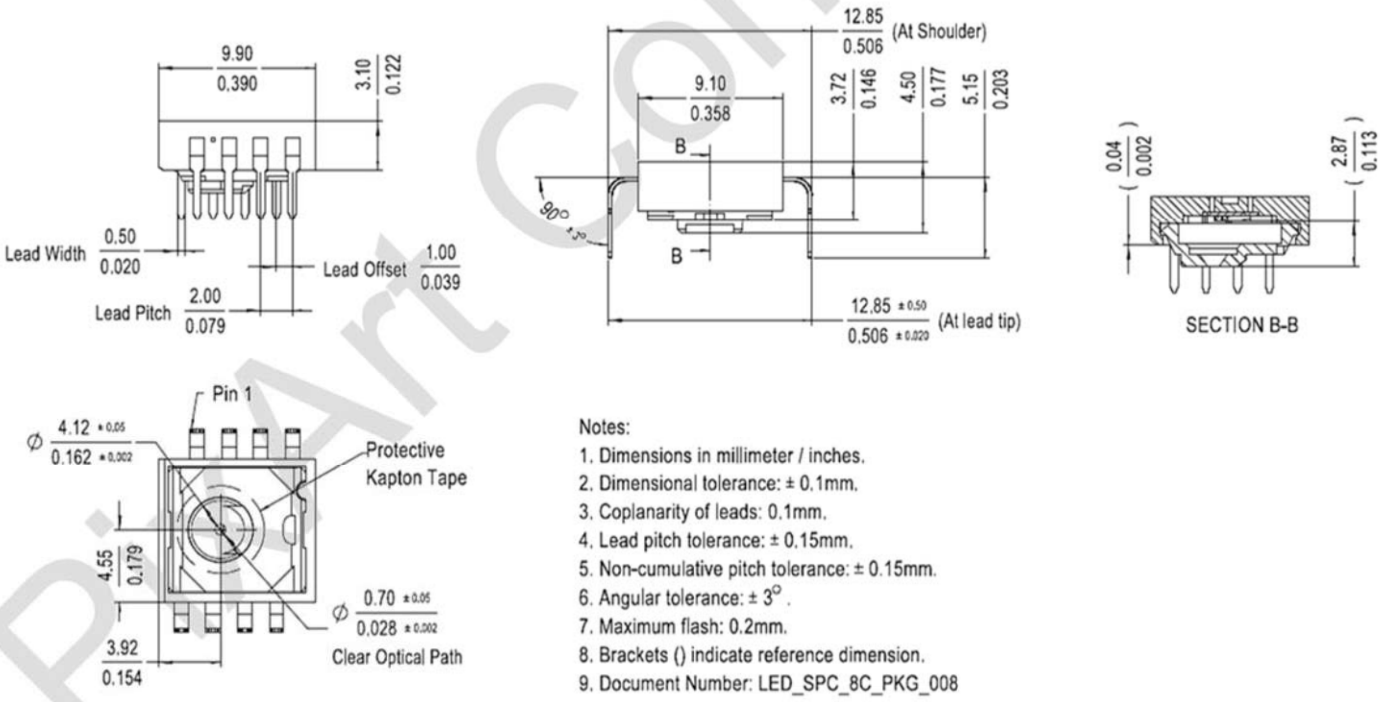


Figure 3. Package Drawing Outline

3.2 Assembly Drawings

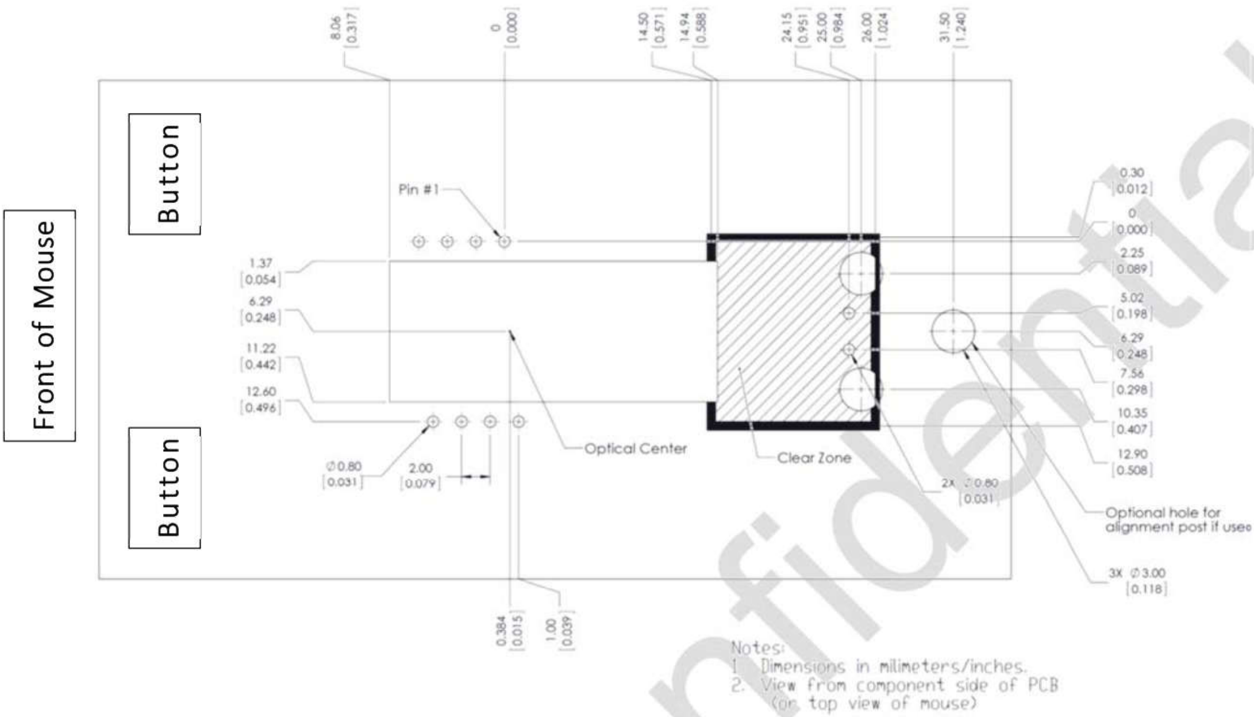


Figure 4. Recommended chip orientation, mechanical cutouts & spacing (Top View)

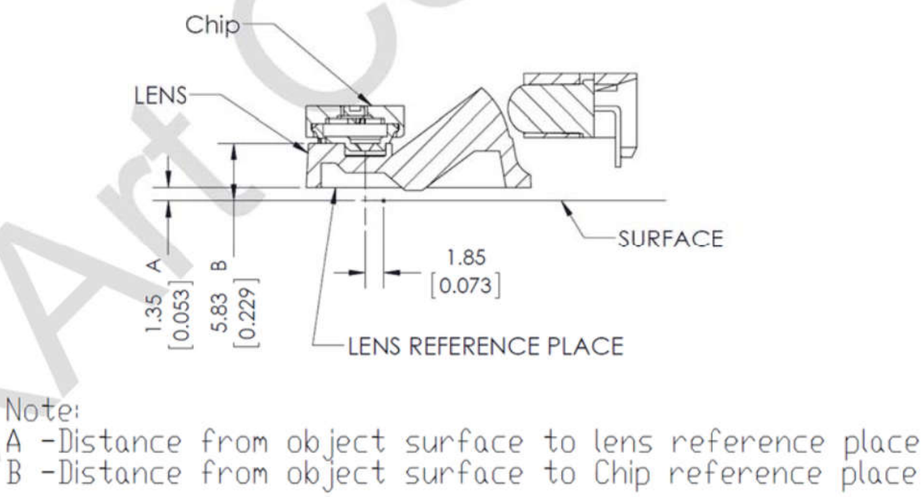


Figure 5. Distance from Lens Reference Plane to Surface

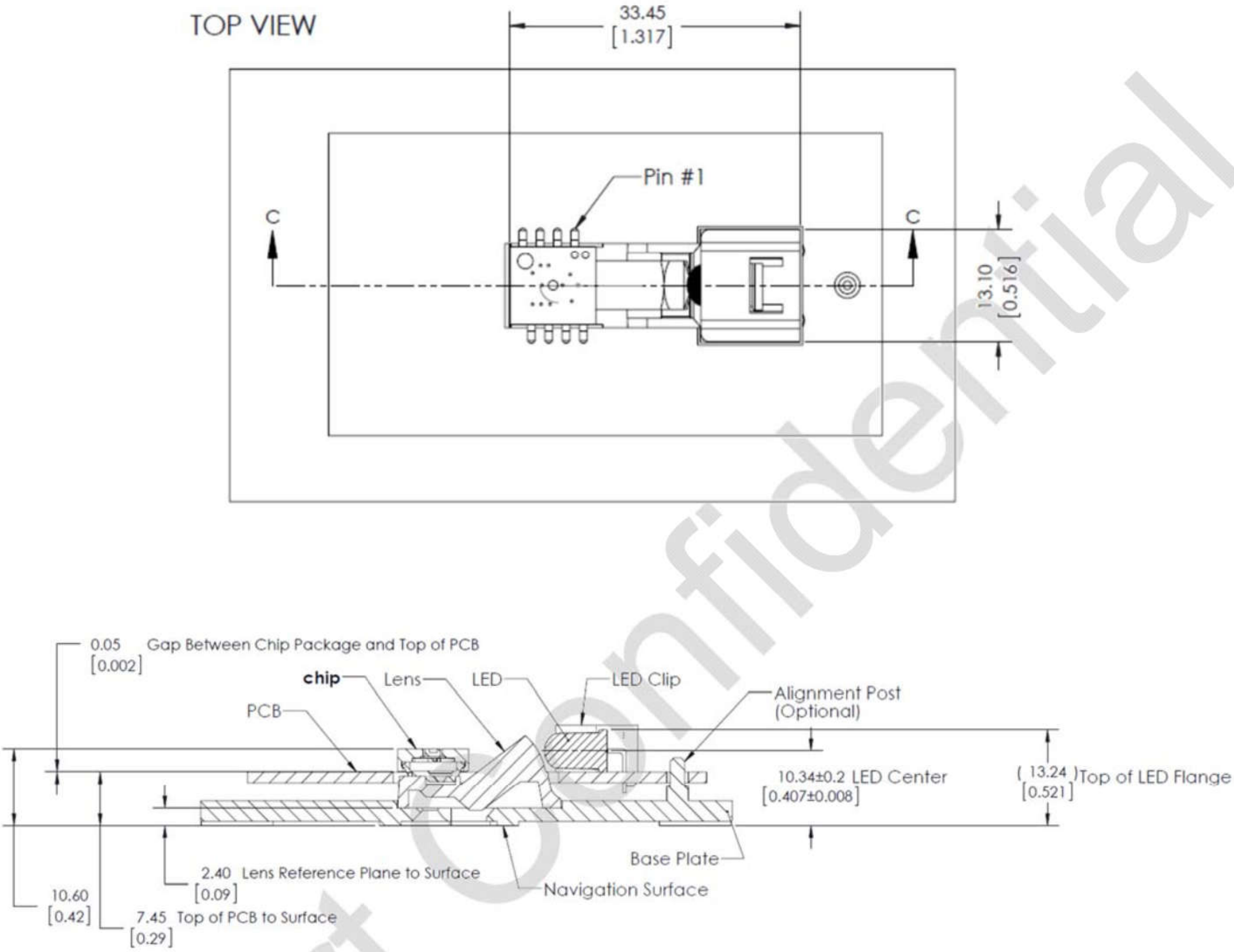


Figure 6. 2D Assembly

Note: The LED should be bent 90 degree with LED flange touching the PCB.

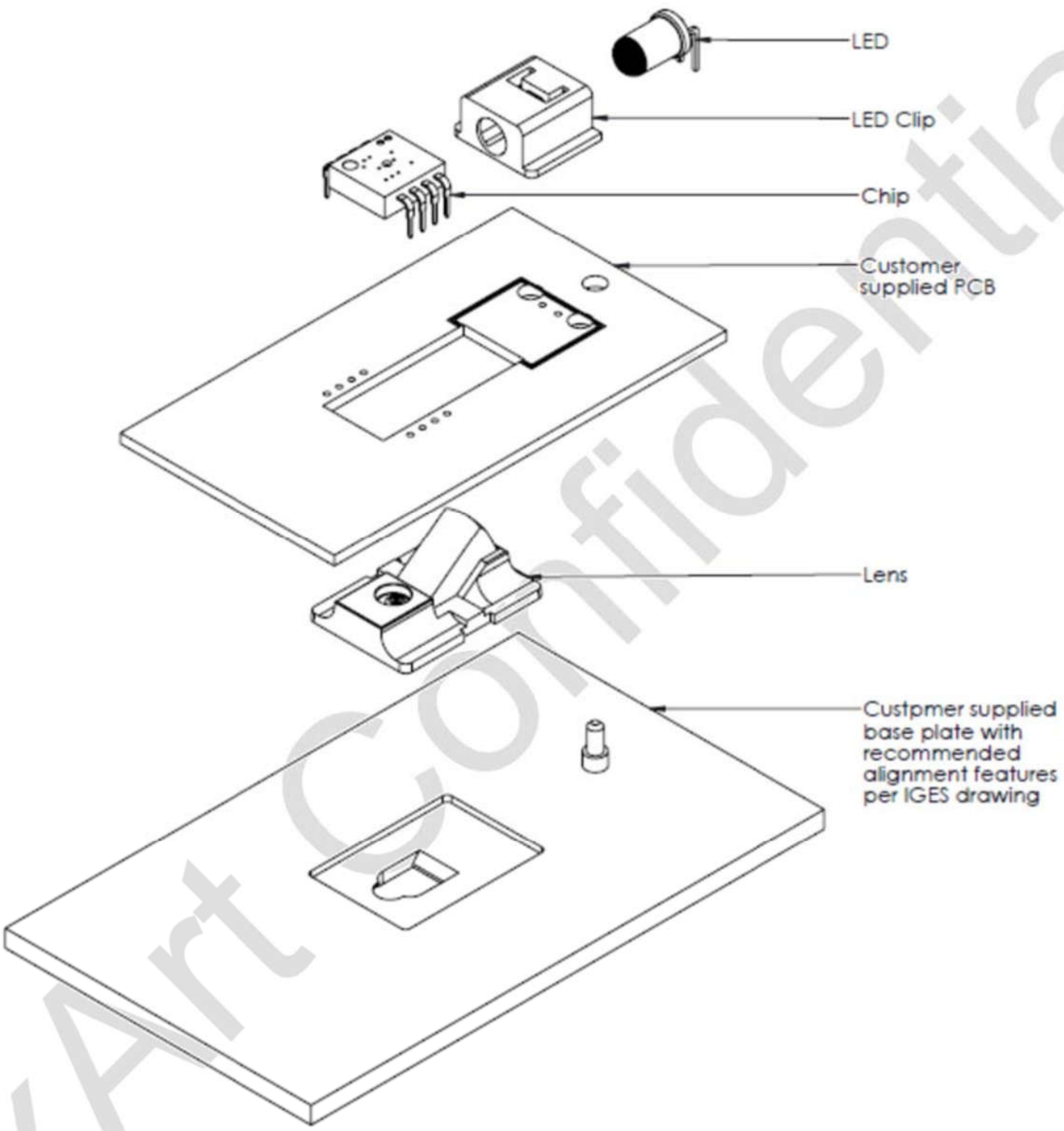
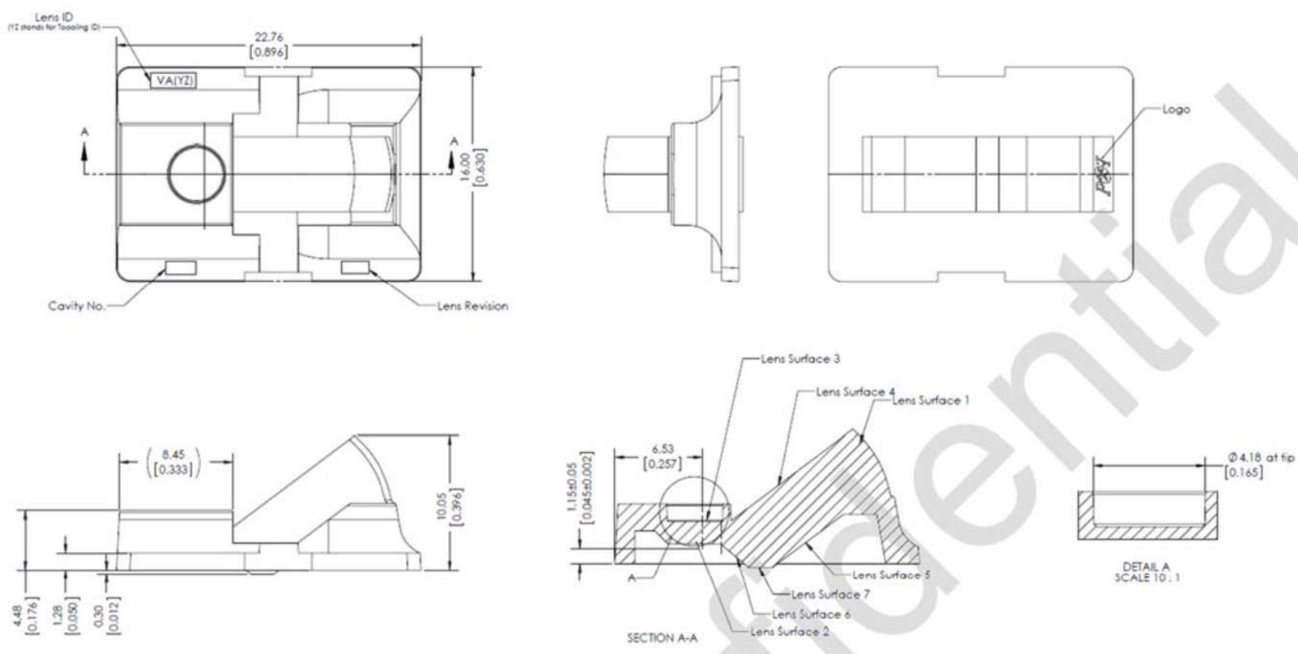


Figure 7. 2D Mouse Assembly



Notes:
1.0 Dimension in millimeters [inches]
2.0 General dimension tolerance: ±0.10mm
unless specified otherwise
3.0 Angular tolerance: ±3.0°
4.0 Maximum flash: 0.20mm
5.0 Bracket ( ) indicates reference dimension
6.0 Optical details removed
7.0 Document Number: L0AC-LSG-G8_002

Figure 8. L0AC-LSG1 Lens Outline Drawing

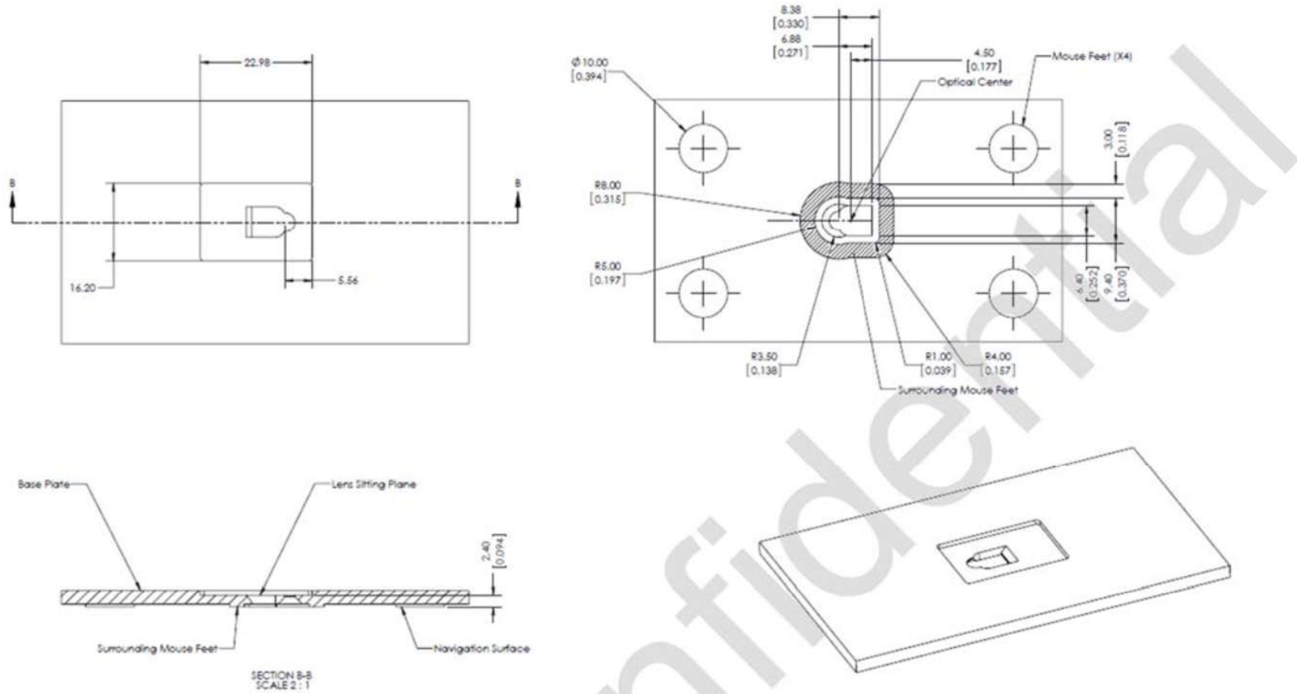


Figure 9. Recommended Base Plate Design with L0AC-LSG1 Lens

3.3 Package Marking

Refer to Figure 2. Pin Configuration

Table 8. Code Identification

Code	Marking	Description
Product Number	PAW3335DB-TZDU	Part number label
Lot Code	YYWWXXXXX	YYWW=Date code XXXXX= PixArt Reserved

4.0 System Level Description

4.1 Reference Application Schematic Diagram

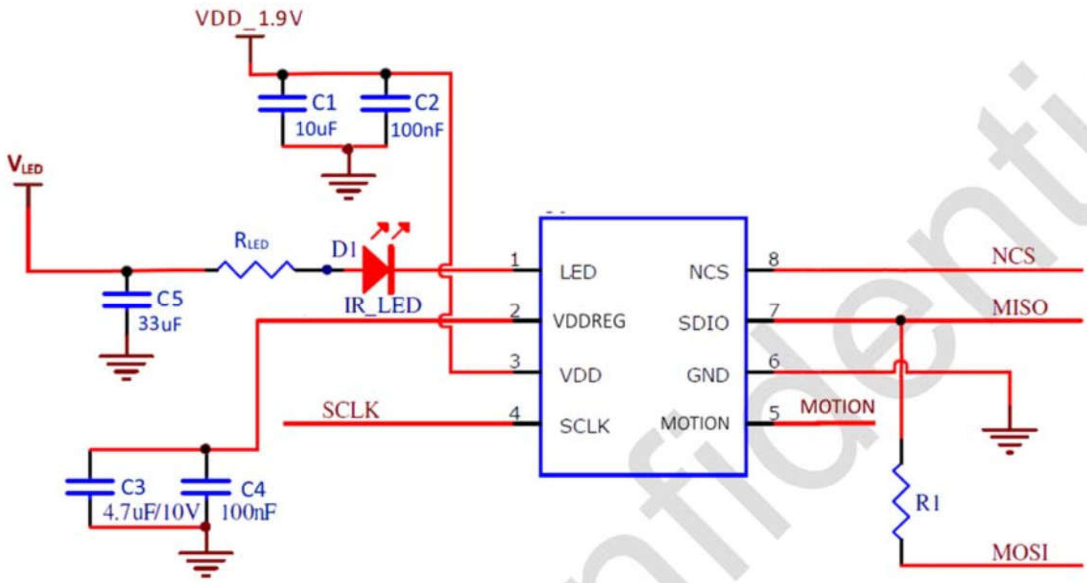


Figure 10. PAW3335DB-TZDU Reference Mouse Schematic

PixArt recommends to use HSDL-4261IR LED with the PAW3335DB-TZDU chip. Table 9 shows the recommended value of R_{LED} and V_{LED} to obtain 24mA current for LED. Recommend to use R_{LED} with 1% tolerance.

Table 9. Recommended R_{LED}

V_{LED} (V)	Recommended R_{LED} (Ω)
1.9	18

Table 10 shows the recommended value of R1 for 2MHz, 4MHz and 8MHz of serial port clock frequency. Recommend to use R1 with 1% tolerance.

Table 10. Recommended R1

Serial Port Clock Frequency (MHz)	Recommended R1 (Ω)
2	3.3k
4	1.0k
8	240

4.2 PCB Assembly Recommendation

1. Insert the integrated chip and all other electrical components into PCB.
2. Wave-solder the entire assembly in a no-wash solder process utilizing solder-fixture. A solder-fixture is required to protect the chip from flux spray and wave solder.
3. Avoid getting any solder flux onto the chip body as there is potential for flux to seep into the chip package. The solder fixture should be designed to expose only the chip leads to flux spray & molten solder while shielding the chip body and optical apertures. The fixture should also set the chip at the correct position and height on the PCB.
4. Place the lens onto the base plate. Care must be taken to avoid contamination on the optical surfaces.
5. Remove the protective kapton tapes from optical apertures of the chip. Care must be taken to prevent contaminants from entering the apertures. Do not place the PCB with the chip facing up during the entire product assembly process. Hold the PCB vertically when removing kapton tape.
6. Remove the protective kapton tapes from optical apertures of the chip. Care must be taken to prevent contaminants from entering the apertures. Do not place the PCB with the chip facing up during the entire mouse assembly process. Hold the PCB vertically when removing kapton tape.
7. Insert PCB assembly over the lens onto the base plate aligning post to retain PCB assembly. The chip package will self-align to the lens via the guide posts. The optical position reference for the PCB is set by the base plate and lens. Note that the PCB motion due to button presses must be minimized to maintain optical alignment.
8. Install mouse top case. There must be a feature in the top case to press down onto the PCB assembly to ensure all components are stacked or interlocked to the correct vertical height