PMW3260DB-TPOU: Ultra Low Power LED Optical Mouse Sensor

General Description

The PixArt Imaging PMW3260DB-TPOU is a low power, small form factor optical mouse sensor. It has a new low-power architecture and automatic power management modes, making it ideal for battery, power-sensitive applications such as cordless input devices.

The PMW3260DB-TPOU along with the LM31-LNG lens, LED clip and HSDL-4261 IR LED form a complete and compact mouse tracking system. There are no moving parts and this translates to high reliability and less maintenance for the end user. In addition, precision optical alignment is not required, facilitating high volume assembly.

Key Features

- Small form factor molded lead frame 8-pin PDIP package
- Single low operating voltage: 1.70 – 2.00V
- 12-bits motion data registers
- High speed motion detection 30ips and acceleration 10g
- Motion detect pin output
- Internal Oscillator – no clock input needed
- 3-wire SPI communication
- Enhanced Programmability
  - Resolution up to 2000cpi
  - Downshift and wake up time
  - Sensor orientation

Applications

- Wireless Optical Mouse
- Trackball Application

Key Parameters

Parameter	Value
Supply Voltage (V)	VDD: 1.70 – 2.00 V
Interface	3-Wire SPI Max clock speed: 2 MHz
Supply Current (µA) (Average)	Run Avg : 335 µA Rest1 : 30 µA Rest2 : 15 µA Rest3 : 5µA
Resolution (cpi)	Up to 2000 cpi
Tracking Speed (ips)	30 ips
Acceleration (g)	10 g
Package Type	8L PDIP
Package Dimension (mm)	9.90 x 12.85 x 6.15

Ordering Information

Part Number	Package Type
PMW3260DB-TPOU	8-pin DIP Package
LM31-LNG	Trim Lens

RoHS compliant

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

1.0 Introduction

1.1 Overview

PMW3260DB-TPOU 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. PMW3260DB-TPOU contains an Image Acquisition System (IAS), a Digital Signal Processor (DSP), and a four 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 sensor serial port into PS2, USB, or RF signals before sending them to the host PC.

Note: Throughout this document PMW3260DB-TPOU is referred to as the sensor.

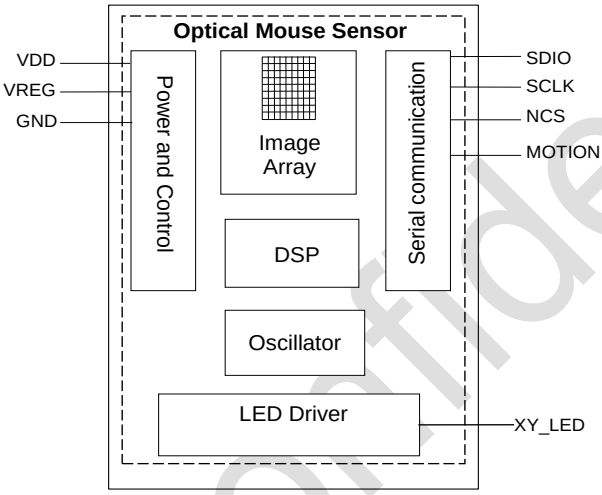


Figure 1. Functional Block Diagram

1.2 Terminology

Term	Description
DSP	Digital Signal Processing
LED	Light Emitting Diode
NCS	Nen Chip Select
VREG	Internal Regulator Output
VDD	Supply voltage
SCLK	Serial Clock
SDIO	Serial Data In & Out
SPI	Serial Peripheral Interface
GND	Ground

1.3 Pins Description

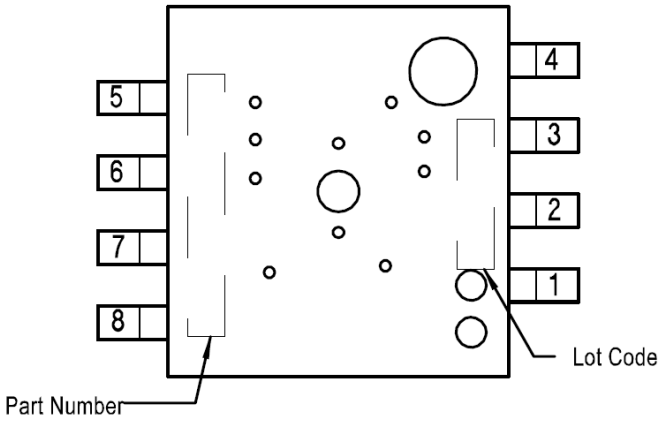


Figure 2. Pin Configuration

Table 1. PMW3260DB Pins Description

Pin No.	Name	Type	Description
1	SCLK	Input	Serial clock input
2	VDD	Power	Input power supply
3	VREG	Power	Regulator output for internal sensor usage only
4	SDIO	In/Out	Bi-directional I/O for SPI
5	XYLED	In	LED Control
6	GND	Gnd	Ground
7	NCS	Input	SPI Chip select for 3-wire SPI (active low)
8	MOTION	Output	Motion detect output (active low)

2.0 Operating Specifications

2.1 Absolute Maximum Ratings

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.

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	2.05	V	Including V_{NA} of 100 mV_{pp}
ESD	ESD_{HBM}		2	kV	All pins, Human Body Model MIL 883 Method 3015
Input Voltage	V_{IN}	-0.5	Vdd+0.5	V	All digital pins
Output Latch up Current	mA		200		All digital 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}	1.70	1.8	2.00	V	Including V_{NA} of 100 mV_{pp}
Power Supply Rise Time	t_{RT}	0.15		20	ms	0 to VDD
Supply Noise (Sinusoidal)	V_{NA}			100	mV_{p-p}	10kHz – 50MHz
Serial Port Clock Frequency	f_{SCLK}			2	MHz	Active drive, 50% duty cycle
Distance from Lens Reference Plane to Tracking Surface	Z	2.20	2.40	2.60	mm	Results in +/-0.2 mm minimum DOF.
Speed	S		30		ips	
Acceleration	A		10		g	
Load Capacitance	C_{out}			100	pF	SDIO and MOTION

Note: PixArt does not guarantee the sensor 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

2.4 DC Characteristics

Table 5. DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
DC Supply Current in various modes	I_{DD_Run} I_{DD_Rest1} I_{DD_Rest2} I_{DD_Rest3}		0.335 30 15 5		mA µA µA µA	Average current, including LED current. No load on SDIO
Shutdown Supply Current	I_{PD}		3		µA	
Input Low Voltage	V_{IL}			0.2* V_{DD}	V	SCLK, SDIO
Input High Voltage	V_{IH}	0.8* V_{DD}			V	SCLK, SDIO
Input Hysteresis	V_{I_HYS}		100		mV	SCLK, SDIO
Input Leakage Current	I_{LEAK}		± 1	± 10	µA	V_{in} = 0.7*V_{DD}, SCLK, SDIO
Output Low Voltage, SDIO,MOTION	V_{OL}			0.2*VDD	V	I_{OUT} = 1mA, SDIO, MOTION
Output Low Voltage, SDIO,MOTION	V_{OH}	0.8* V_{DD}			V	I_{OUT} = -1mA, SDIO, MOTION
Input Capacitance	C_{in}			10	pF	SCLK, SDIO

Note: All electrical parameters are tested under recommended operating conditions. Typical values at 25 °C, VDD=1.8V

2.5 AC Characteristics

Table 6. AC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Motion Delay After Reset	$t_{MOT-RST}$	3.5			ms	From SW_RESET register write to valid motion, assuming motion is present
Shutdown	t_{STDWN}			50	ms	From Shutdown mode active to low current
Wake from Shutdown	t_{WAKEUP}	16	23		ms	From Shutdown mode inactive to valid motion. Notes: A RESET must be asserted after a shutdown. Refer to section “Notes on Shutdown”, also note $t_{MOT-RST.}$
SDIO Output Rise Time	$t_{r\text{-SDIO output}}$		40	200	ns	C_L = 100pF
SDIO Output Fall Time	$t_{f\text{-SDIO output}}$		40	200	ns	C_L = 100pF
SDIO Output Delay After SCLK	$t_{DLY\text{-SDIO output}}$			120	ns	From SCLK falling edge to SDIO output data valid, no load conditions
SDIO Output Hold Time	$t_{hold\text{- SDIO output}}$	250			ns	Data held until next falling SCLK edge
SDIO input Hold Time	$t_{hold\text{- SDIO input}}$	200			ns	Amount of time data is valid after SCLK rising edge
SDIO input Setup Time	$t_{setup\text{- SDIO input}}$	120			ns	From data valid to SCLK rising edge
SPI Time Between Write Commands	t_{SWW}	30			µs	From rising SCLK for last bit of the first data byte, to rising

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
						SCLK for last bit of the second data byte.
SPI Time Between Write And Read Commands	t_{SWR}	20			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}	250			ns	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}	4			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}	250			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.
SCLK To NCS Inactive SDIO Write	$t_{SCLK-NCS\ write}$	10			ns	From last SCLK falling edge to NCS rising edge, for valid SDIO data transfer
SCLK To NCS Inactive SDIO Read	$t_{SCLK-NCS\ read}$	120			µs	From last SCLK falling edge to NCS rising edge, for valid SDIO data transfer
NCS To SDIO High-Z	$t_{NCS-SDIO}$			250	ns	From NCS rising edge to SDIO high-Z state
MOTION Rise Time	$t_{r-MOTION}$		40	200	ns	C_L = 100pF
MOTION Fall Time	$t_{f-MOTION}$		40	200	ns	C_L = 100pF
Transient Supply Current	IDDT			60	mA	Max supply current during a VDD ramp from 0 to 1.8V

Note: All the parameters are tested under recommended operating conditions. Typical values at 25 °C & VDD=1.8V

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

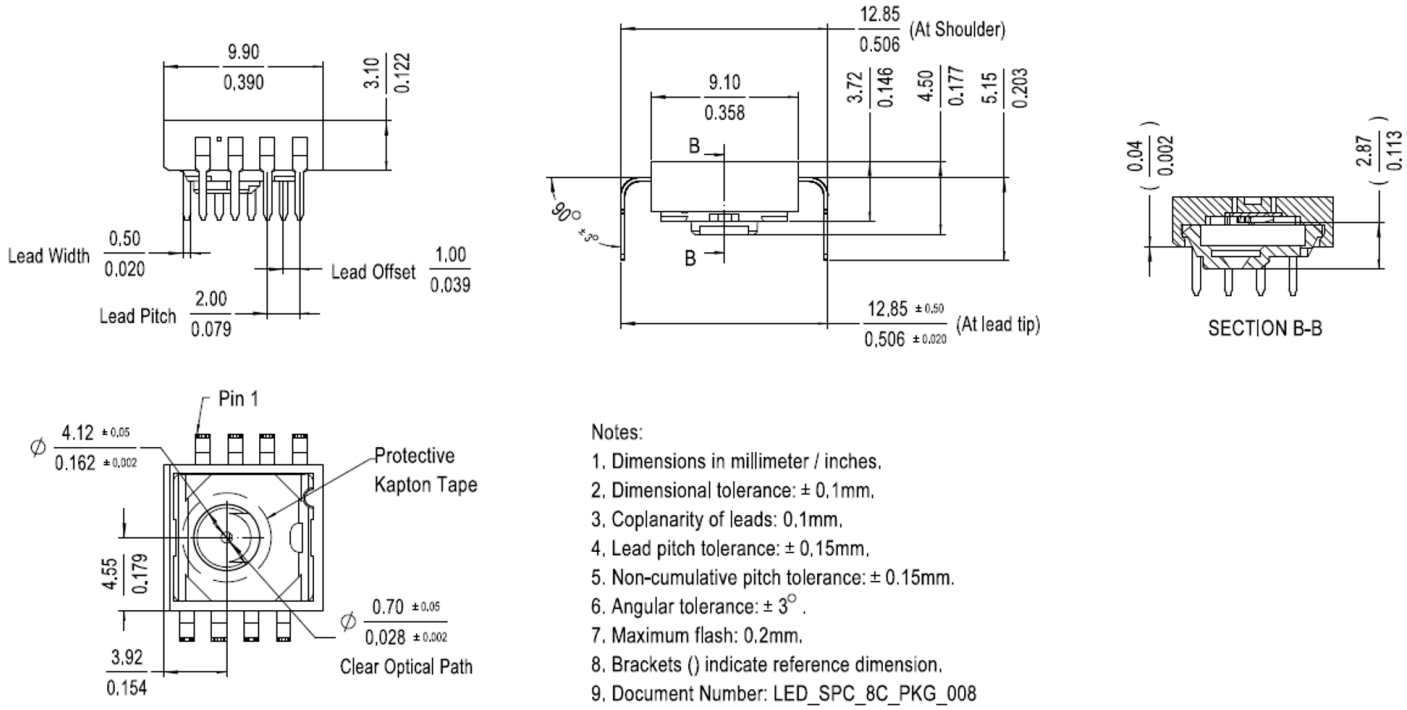


Figure 3. Package Drawing Outline

3.2 Assembly Drawings

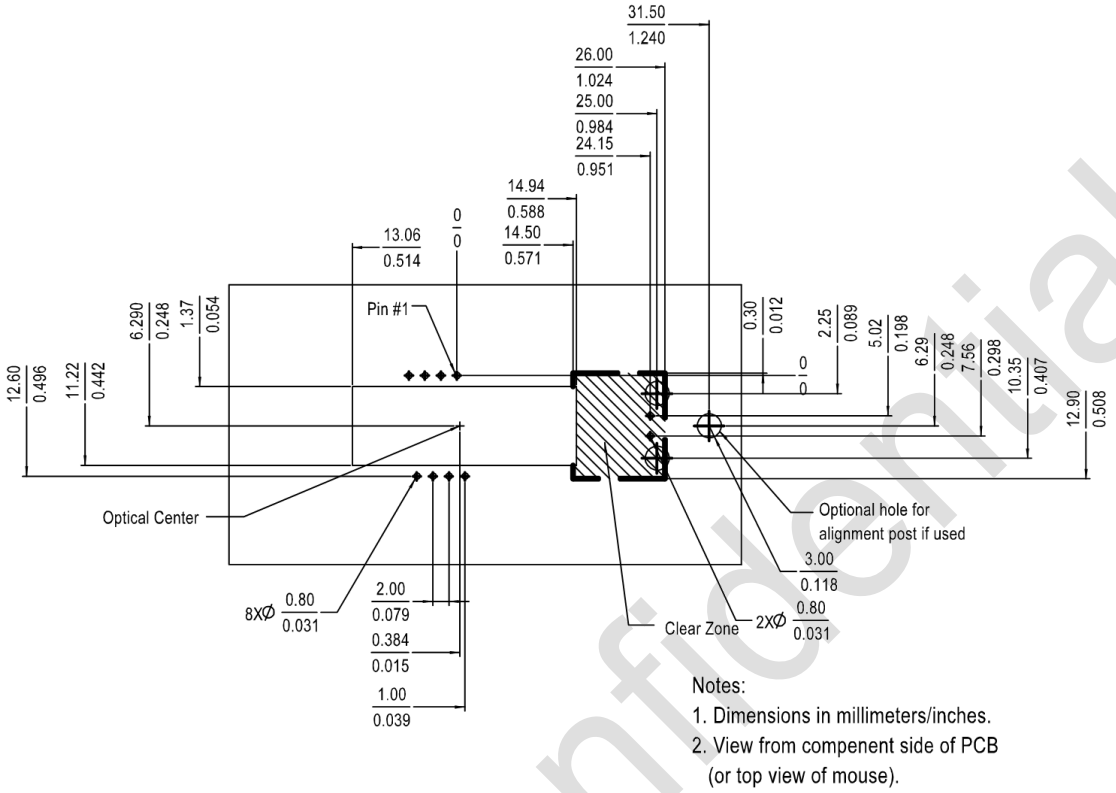
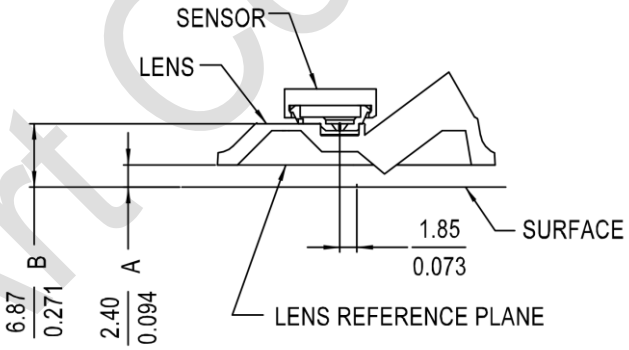


Figure 4. Recommended Sensor Orientation, Mechanical Cutouts & Spacing (Top View)



Note:
A - Distance from object surface to lens reference plane
B - Distance from object surface to sensor reference plane

Figure 5. Distance from Lens Reference Plane to Surface

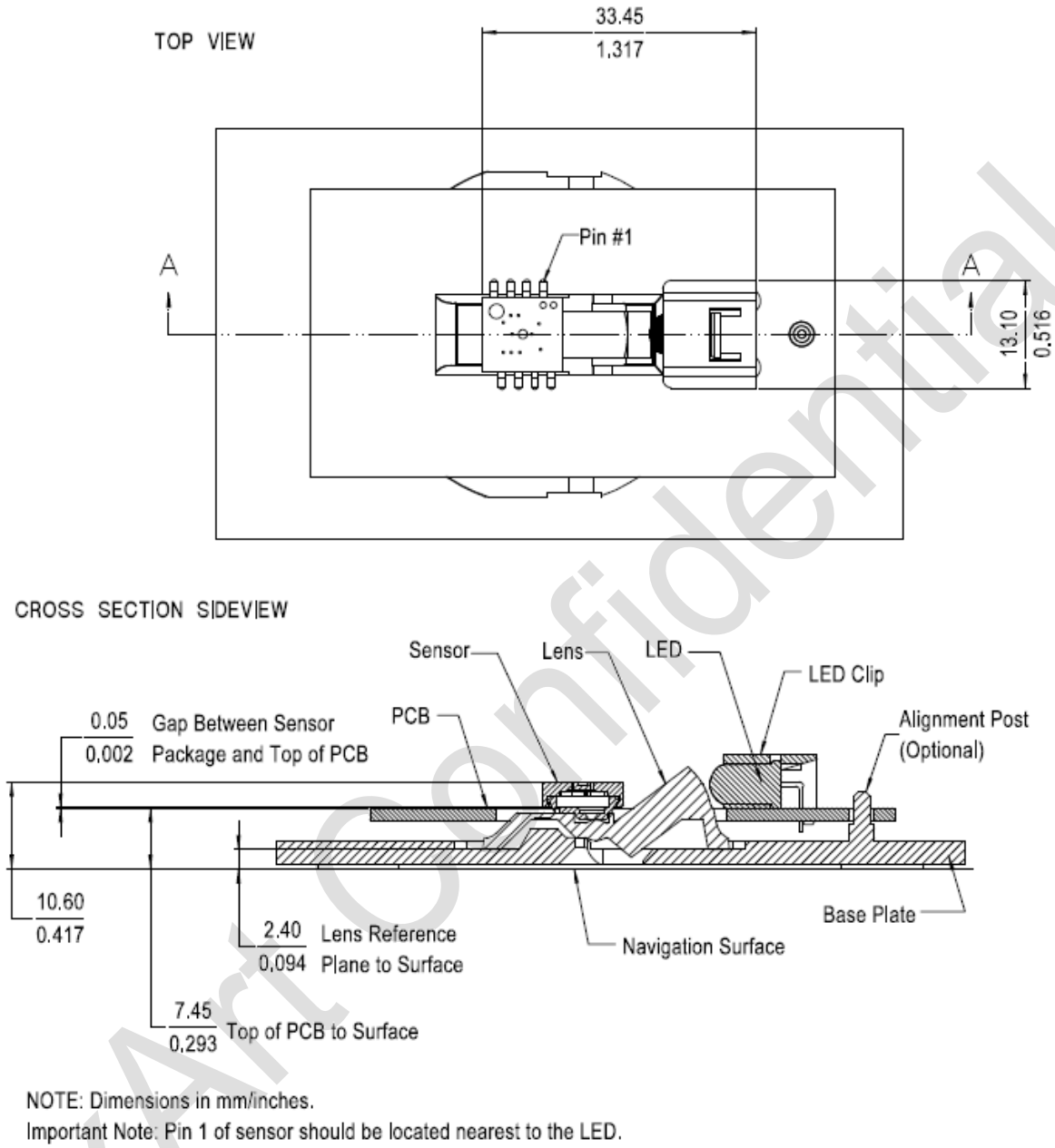


Figure 6. 2D Assembly

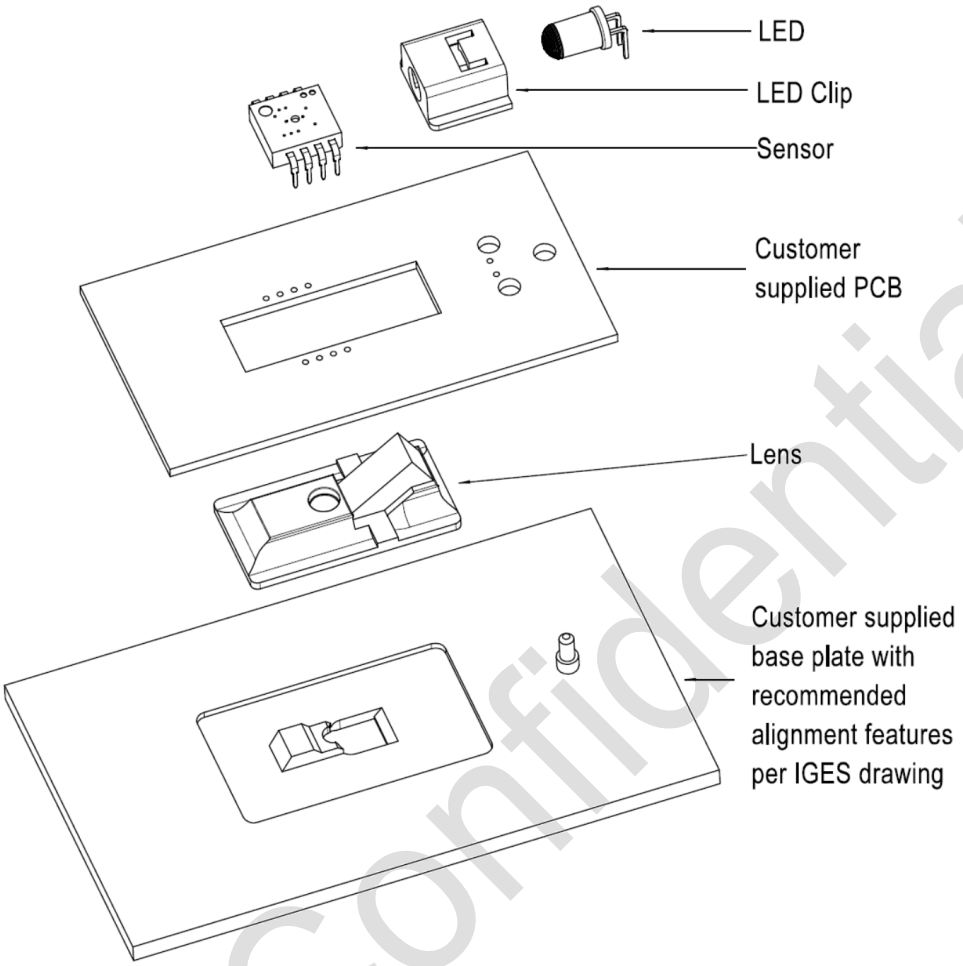
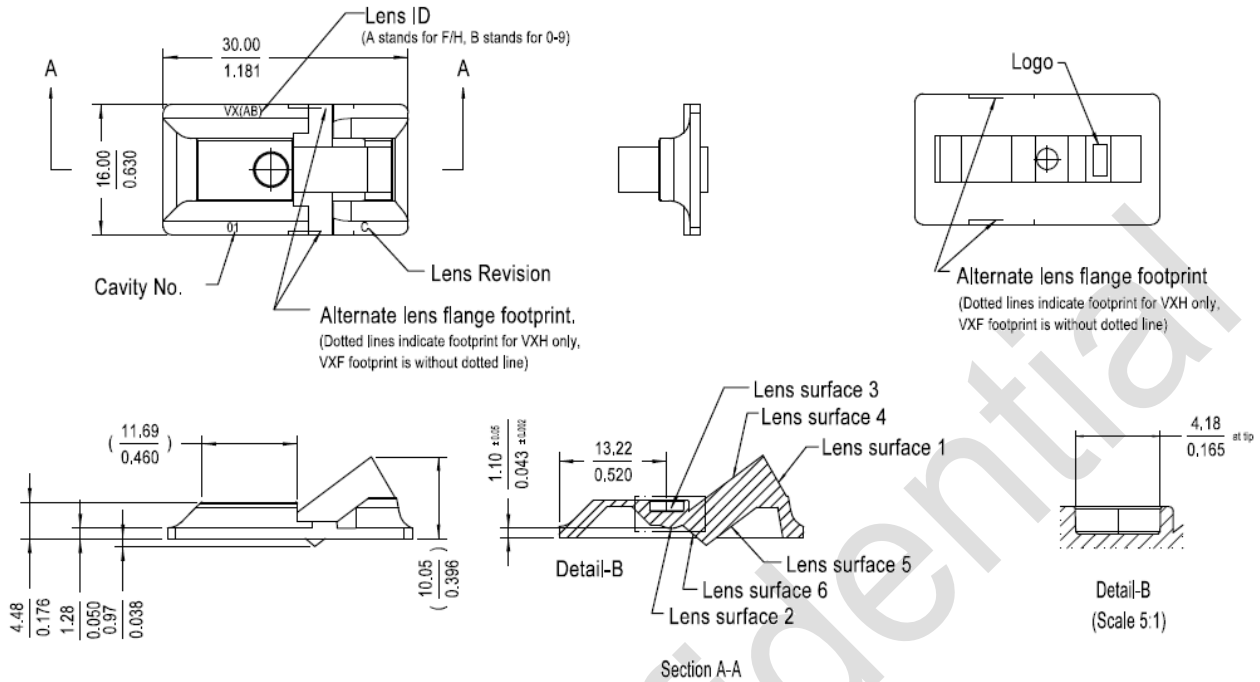


Figure 7. 2D Mouse Assembly



Notes:
1. Dimensions in milimeter / inches
2. Dimensional tolerance: ± 0.1mm
3. Angular tolerance: ± 3°
4. Maximum flash: +0.20mm
5. () reference dimension
6. Optical details of lens not shown.
7. Dotted line indicate alternate lens flange footprint
8. Document number: LM31-LNG-G8_002

Figure 8. LM31-LNG Lens Outline Drawing

3.3 Package Marking

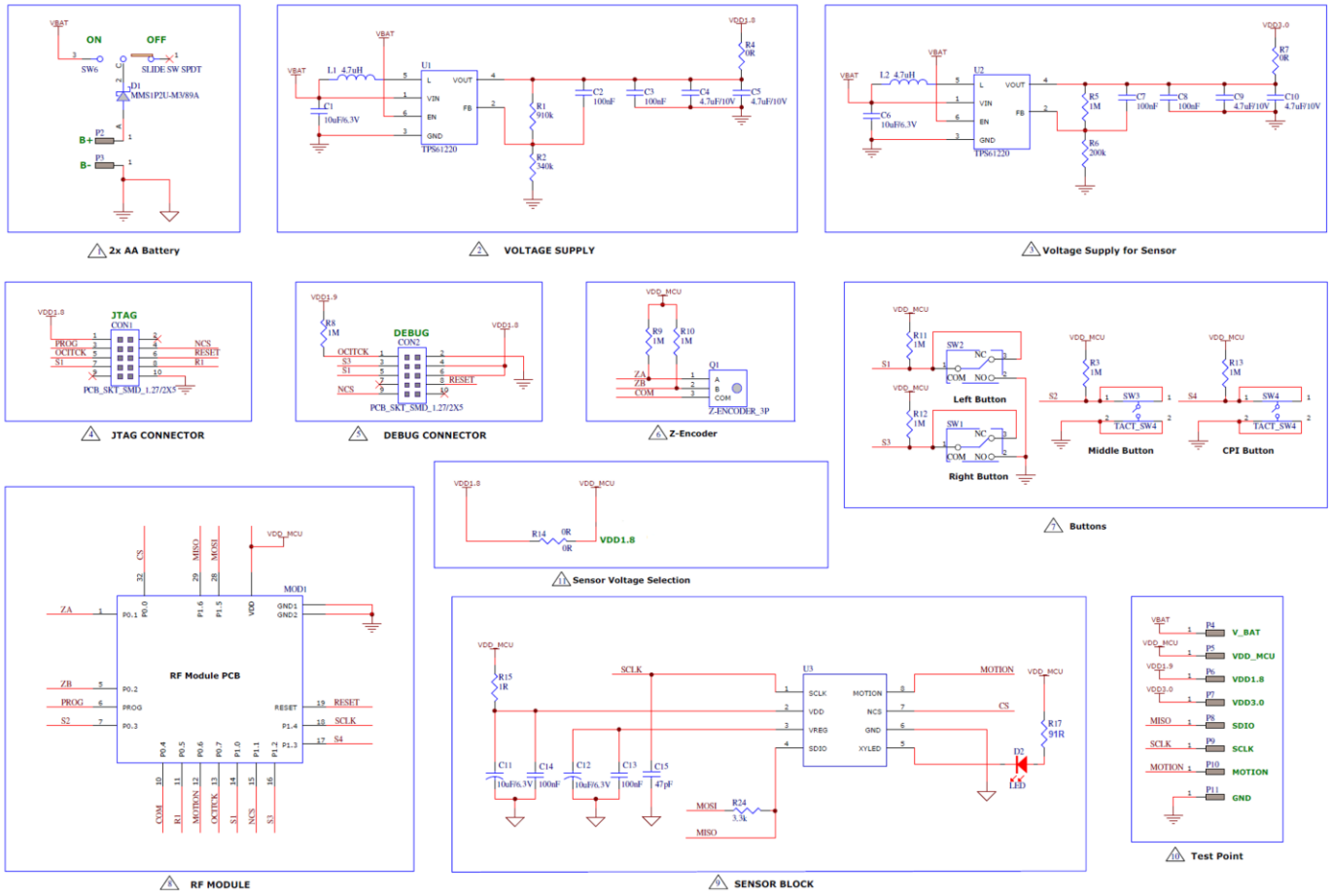
Refer to Figure 2. Pin Configuration.

Table 8. Code Identification

Code	Marking	Description
Product Number	PMW3260DB-TPOU	Part number label
Lot Code	YYWWXXXXX	YYWW = Date code XXXXX = PixArt Reserved

4.0 System Level Description

4.1 Reference Application Schematic Diagram



Note:-Components required by the sensor are C11, C14, C12, C13, C15, D2 and R17

Figure 9. PMW3260 Reference Mouse Application Circuit

In order to obtain the recommended 5mA LED drive current, a set of resistor value is provided with the different VDD levels.

Table 9. Recommended Resistor Values for R_{led}

VDD LED (V)	1.70	1.80	1.90	2.00
R LED [Ω]	68	91	110	130

4.2 Layout Guidelines

- Insert the integrated sensor and all other electrical components into PCB.
- Wave-solder the entire assembly in a no-wash solder process utilizing solder-fixture. A solder-fixture is required to protect the sensor from flux spray and wave solder.
- Avoid getting any solder flux onto the sensor body as there is potential for flux to seep into the sensor package. The solder fixture should be designed to expose only the sensor leads to flux spray & molten solder while shielding the sensor body and optical apertures. The fixture should also set the sensor at the correct position and height on the PCB.
- Place the lens onto the base plate. Care must be taken to avoid contamination on the optical surfaces.
- Remove the protective kapton tapes from optical apertures of the sensor. Care must be taken to prevent contaminants from entering the apertures. Do not place the PCB with the sensor facing up during the entire product assembly process. Hold the PCB vertically when removing kapton tape.
- Remove the protective kapton tapes from optical apertures of the sensor. Care must be taken to prevent contaminants from entering the apertures. Do not place the PCB with the sensor facing up during the entire mouse assembly process. Hold the PCB vertically when removing kapton tape.
- Insert PCB assembly over the lens onto the base plate aligning post to retain PCB assembly. The sensor 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.
- 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

5.0 Registers

5.1 Registers List

The PMW3260DB-TPOU 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 10. Register List

Address	Register Name	Access	Reset
0x00	PRODUCT_ID	R	0x41
0x01	REVISION_ID	R	0x01
0x02	MOTION	R/W	0x00
0x03	DELTA_X_L	R	0x00
0x04	DELTA_Y_L	R	0x00
0x05	DELTA_XY_H	R	0x00
0x06	SQUAL	R	0x00
0x07	SHUTTER_HIGHER	R/W	0x00
0x08	SHUTTER_LOWER	R/W	0x22
0x09	PIX_MAX	R	0x60
0x0A	PIX_AVG	R	0x4F
0x0B	PIX_MIN	R	0x7F
0x11	PERFORMANCE	R/W	0x00
0x12	BURST_READ	R/W	0x00
0x14	RUN_DOWNSHIFT	R/W	0x02
0x15	REST1_RATE	R/W	0x04
0X16	REST1_ DOWNSHIFT	R/W	0x10
0X17	REST2_RATE	R/W	0X0A
0x18	REST2_ DOWNSHIFT	R/W	0X2F
0x1D	OBSERVATION1	R/W	0X00
0x21	DTEST_PAD	R/W	0x00
0x24	FRAME_GRAB1	R/W	0X00
0x25	FRAME_GRAB2	R	0x4F
0x3A	POWER_UP_RESET	W	0X00
0x3B	SHUTDOWN	W	0X00
0x41	SPI_CLK_ON_REQ	W	NA
0x48	RESOLUTION_STEP	R/W	0x0B
0x4D	XY_DIRECTION	R/W	0x7A
0x56	WAKEUP_SQUAL	R/W	0x11
0x65	WAKEUP_STAT_CONTROL	R/W	0x20
0x75	LIFT DETECTION SQUAL THRESHOLD	R/W	0x28
0x76	LIFT BRIGHTROW THRESHOLD	R/W	0x13
0x7A	LIFT DETECTION HIGH SQUAL THRESHOLD	R/W	0x0A
0x7B	LIFT DETECTION LOW SQUAL THRESHOLD	R/W	0x45