ADNS-5712
USB1.1 FULL SPEED SOC MOUSE SENSOR

RoHS compliant

General Description

The PixArt ADNS-5712 is optimized for red LED based USB SoC mouse applications. It supports the USB1.1 Full-Speed with programmable report rate up to 1000/sec, up to twelve programmable versatile buttons, wide and flexible range of CPI resolution selection and programmable RGB LED indicator to match different CPI resolutions. The Internal OTP ROM can be programmed to cater for different features and functions. The ADNS-5712 is capable of high-speed motion detection up to the velocity of 48 inches/sec and acceleration of 10g.

General Features

- Single power with wide voltage range: 4.25V to 5.25V
- Support USB 1.1 Full-Speed interface
- Selectable USB report rate 1000 / 500 / 250 / 125 Hz
- Supports standard five mouse buttons (L, M, R, B4, B5)
- Selectable 4-level or 3-level segment for CPI resolution switch and each CPI resolution can be programmed individually
- Support CPI resolution switch button and RGB LED indicator to match each CPI resolution
- Support breathing RGB LED and Logo LED functions
- Support six extra buttons for advanced functions
- Support Media mode (Play/Pause, Stop, Mute/unMute, Volume up, Volume down, Open Media, Next Track, Prev Track)
- Support USB HID Keyboard function
- Support USB HID Consumer function
- Support flexible OTP ROM for versatile features
- Selectable CPI resolution up to 2400 cpi
- Tracking speed up to 48 ips (inches/sec) and 10g acceleration
- Frame rate up to 4000 fps (frames per sec)
- Programmable USB VID / PID : xxxx / xxxx
- Programmable USB Product String : xxxxxxxxxx Gaming Mouse

Key Specifications

Supply Voltage	4.25V ~ 5.25V
Interface	USB 1.1 (Full-Speed)
USB Report Rate	1000(default) / 500 / 250 / 125 Hz.
Tracking Speed	Up to 48ips (inches/sec)
Acceleration	Up to 10g
CPI Resolution	400/800/1000/1200/1600/2400
Frame Rate	Up to 4000 fps (frames per sec)
Operating Current	10 mA @ mouse active 700 uA @ USB suspend *Not including any LED current
Package	iDIP 14

Ordering Information

Part Number	Application
ADNS-5712	iDIP 14 packaged optical mouse sensor using red LED

1. Overview

Functional Block Diagram and Operation

ADNS-5712 is an USB1.1 Full Speed interfaced mouse sensor with a CMOS-processed image sensor, mixed-mode analog front-end circuits, integrated digital image processing circuits and versatile digital functional circuits for various mouse applications. It is based on an optical navigation technology which measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the speed, the direction and the magnitude of motion. The displacement delta_X and delta_Y information are available in registers which are accessible through USB interface.

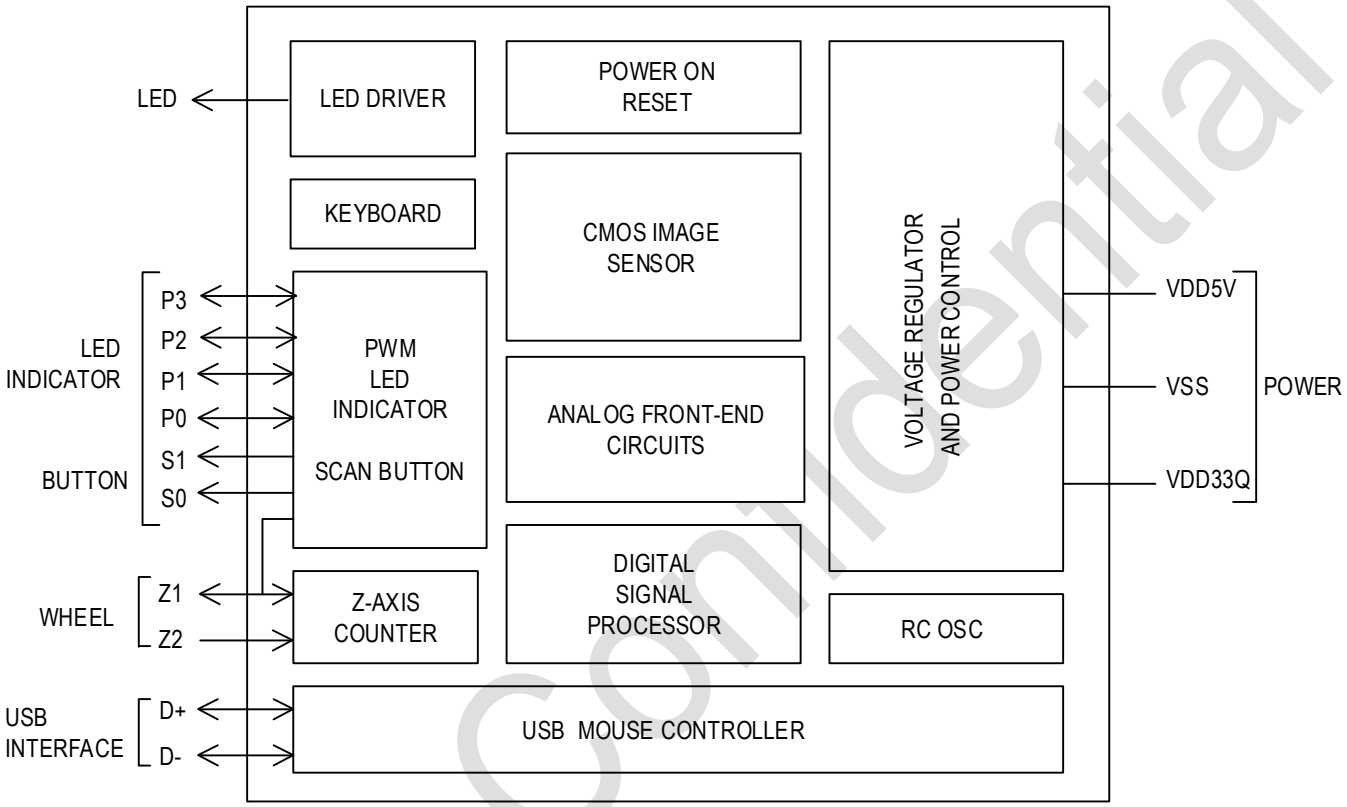


Figure 1. Function Block Diagram

Pin Descriptions and Sensor Orientation

Pin Descriptions

Pin	Name	Type	Definition
1	S1	OUT	Button scan output pin
2	D+	I/O	Full Speed USB D+
3	D-	I/O	Full Speed USB D-
4	VDD5V	PWR	Chip power VDD, 4.25V~5.25V
5	VSS	GND	Chip ground
6	VDD33Q	GND	Chip I/O and digital power 3.3V. Please connect 22uF and 0.1uF Capacitor to VSS
7	LED	OUT	LED control for sensor lighting
8	S0	OUT	Button scan output pin
9	Z1	I/O	Button scan output pin and Z wheel function
10	P0	I/O	Button scan input pin and RGB LED control pin
11	P1	I/O	Button scan input pin and RGB LED control pin
12	P2	I/O	Button scan input pin and RGB LED control pin
13	Z2	INPUT	Z wheel function
14	P3	I/O	Button scan input pin and Logo LED control pin

Sensor Orientation

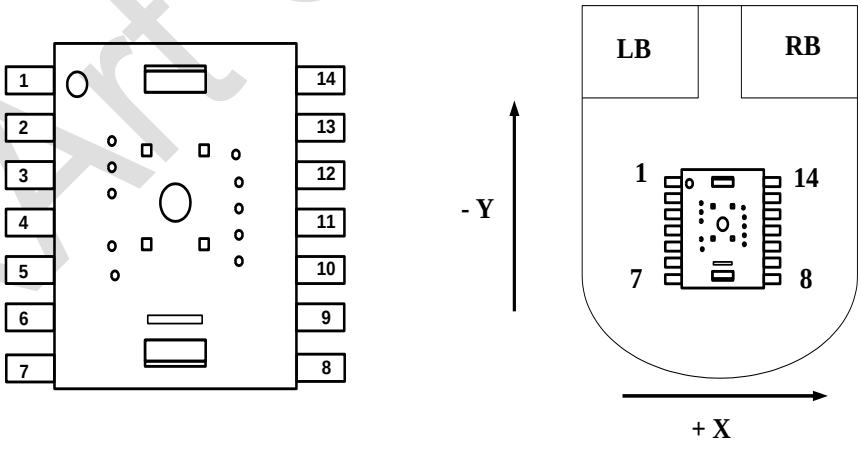
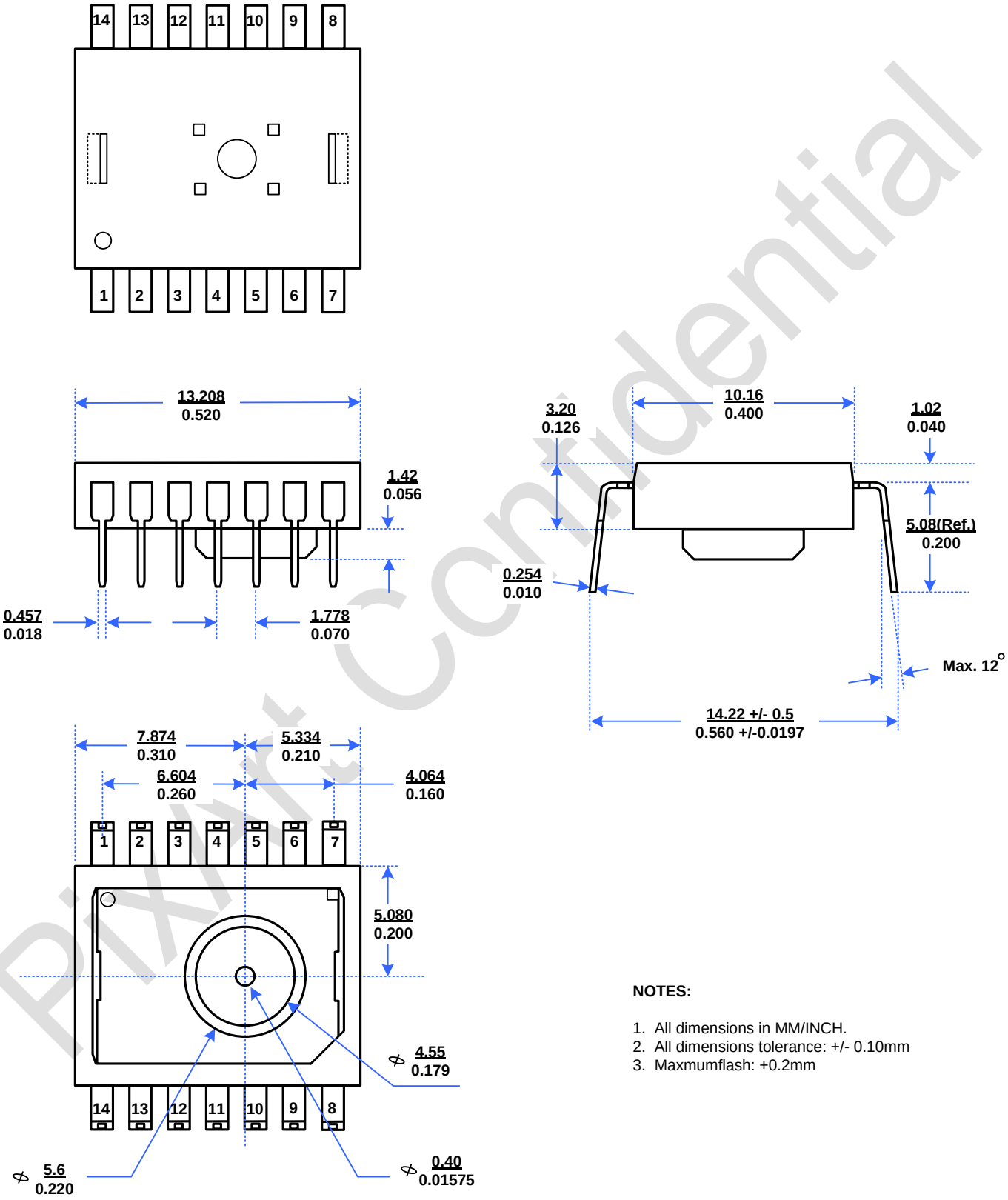


Figure 2. Orientation Relationship between Sensor and Mouse

2. Package Information

Package Outline Drawing

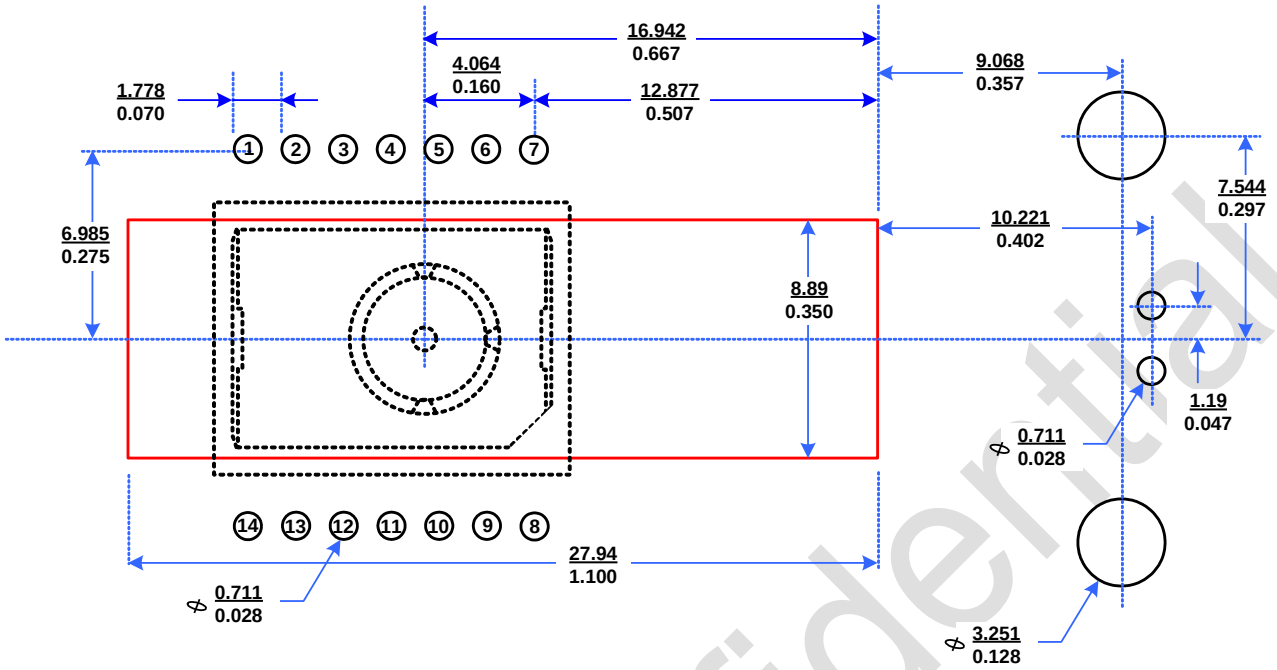


NOTES:

1. All dimensions in MM/INCH.
2. All dimensions tolerance: +/- 0.10mm
3. Maxmumflash: +0.2mm

Figure 3. Package Outline Drawing

Recommended PCB Mechanical Cutouts and Spacing



All Dimension : mm/inch

Back Side

Figure 4. Recommended PCB Mechanical Cutouts and Spacing

Z and 2D/3D Assembly

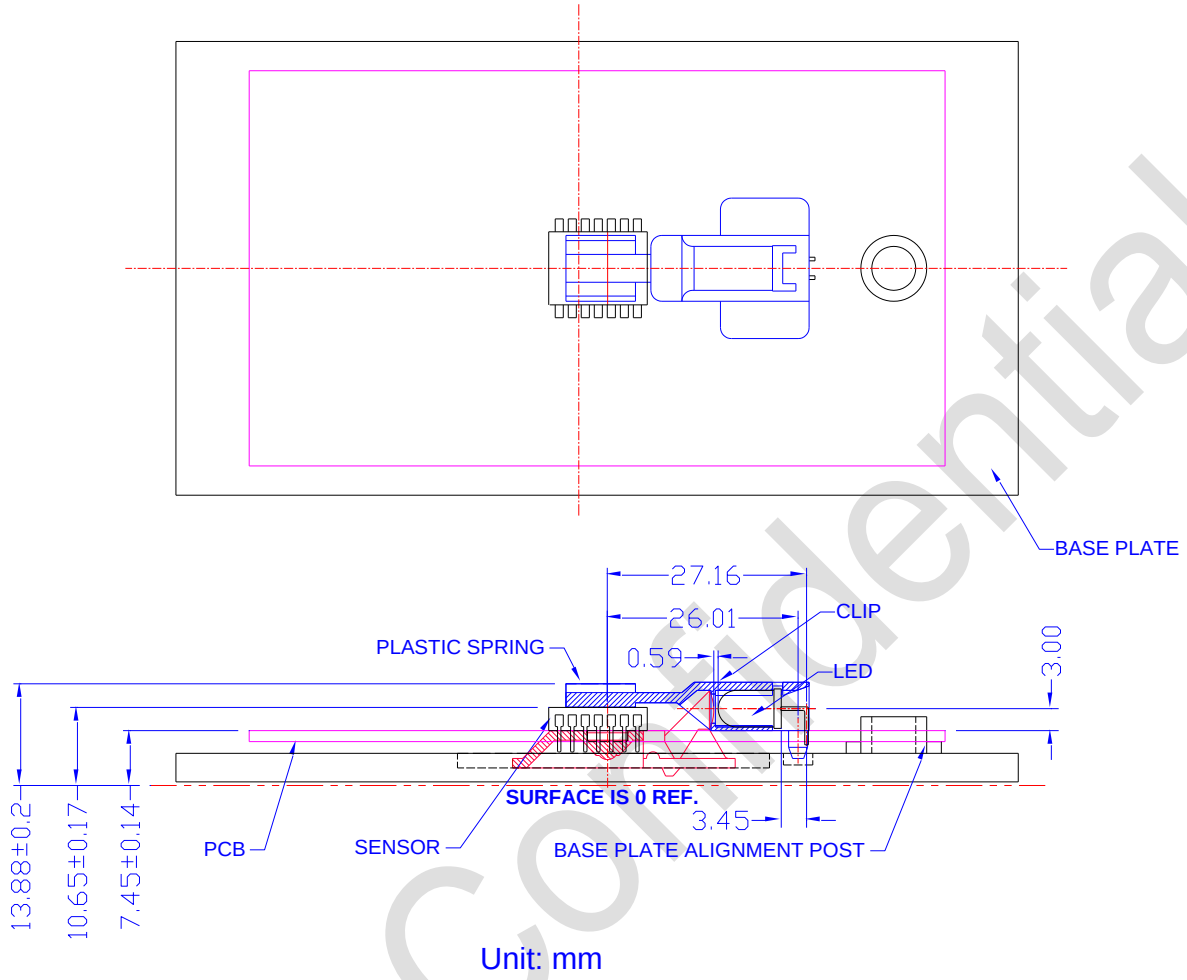


Figure 5. 2D Assembly

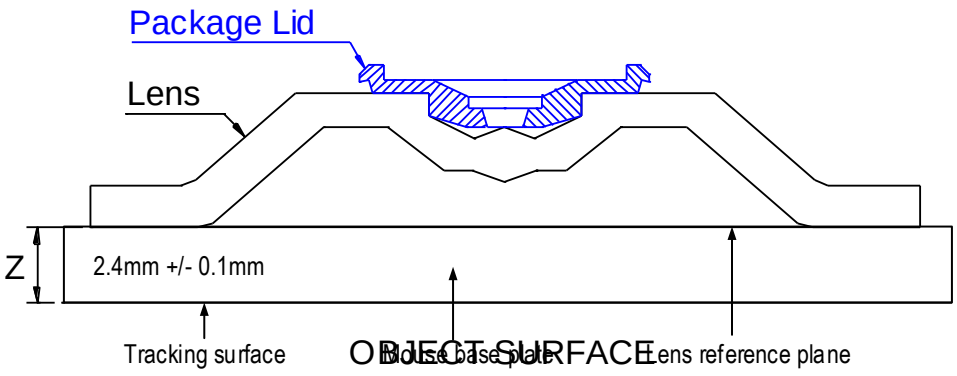


Figure 6. Distance from Lens Reference Plane to Tracking Surface

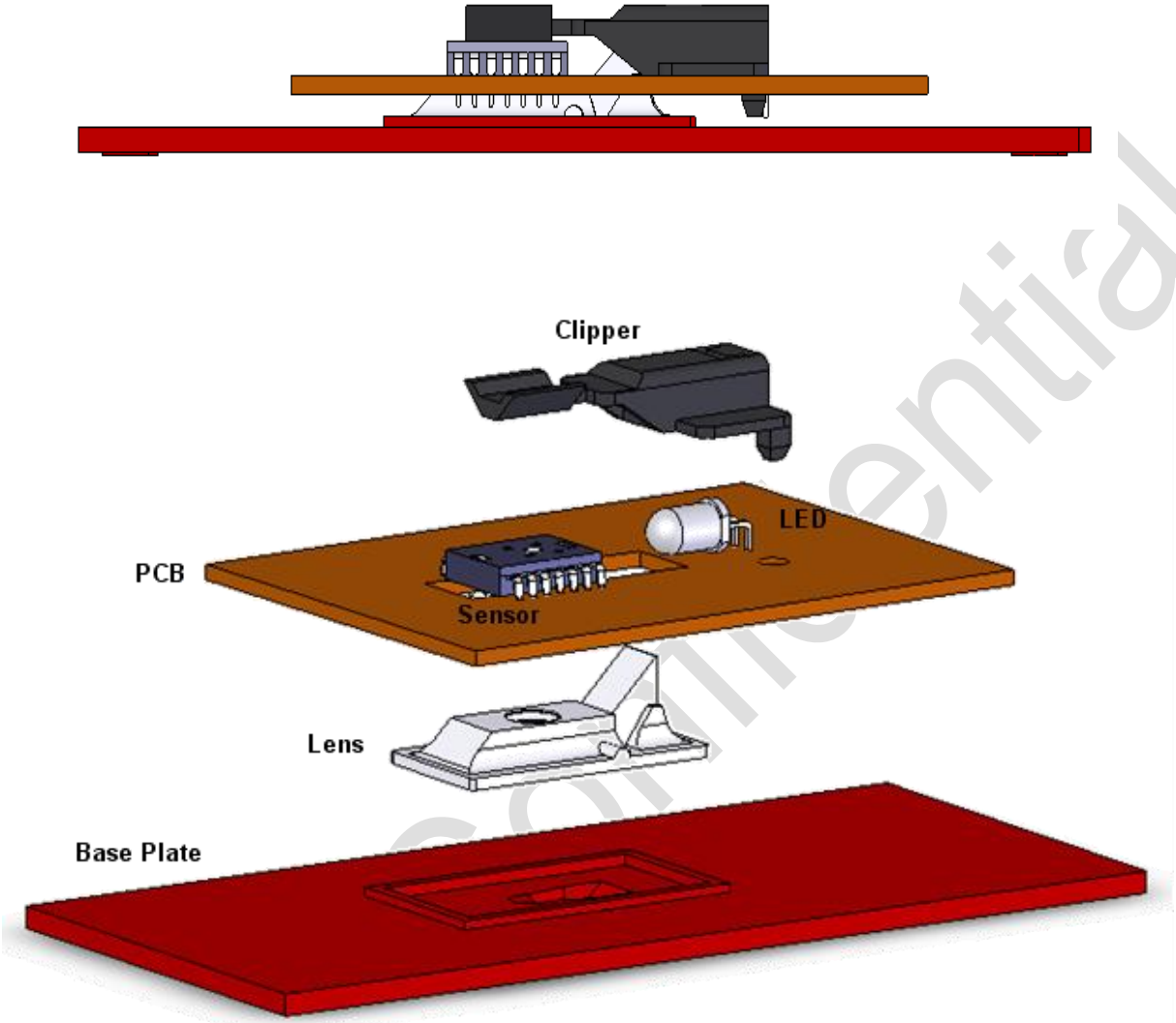


Figure 7. 3D Assembly for Mounting Instructions

3. Reference Circuit Schematics

The reference circuit below is an example for a red LED based mouse application with 12 buttons, one Logo LED, one set of basic RGB LED and 3 sets of additional RGB LED.

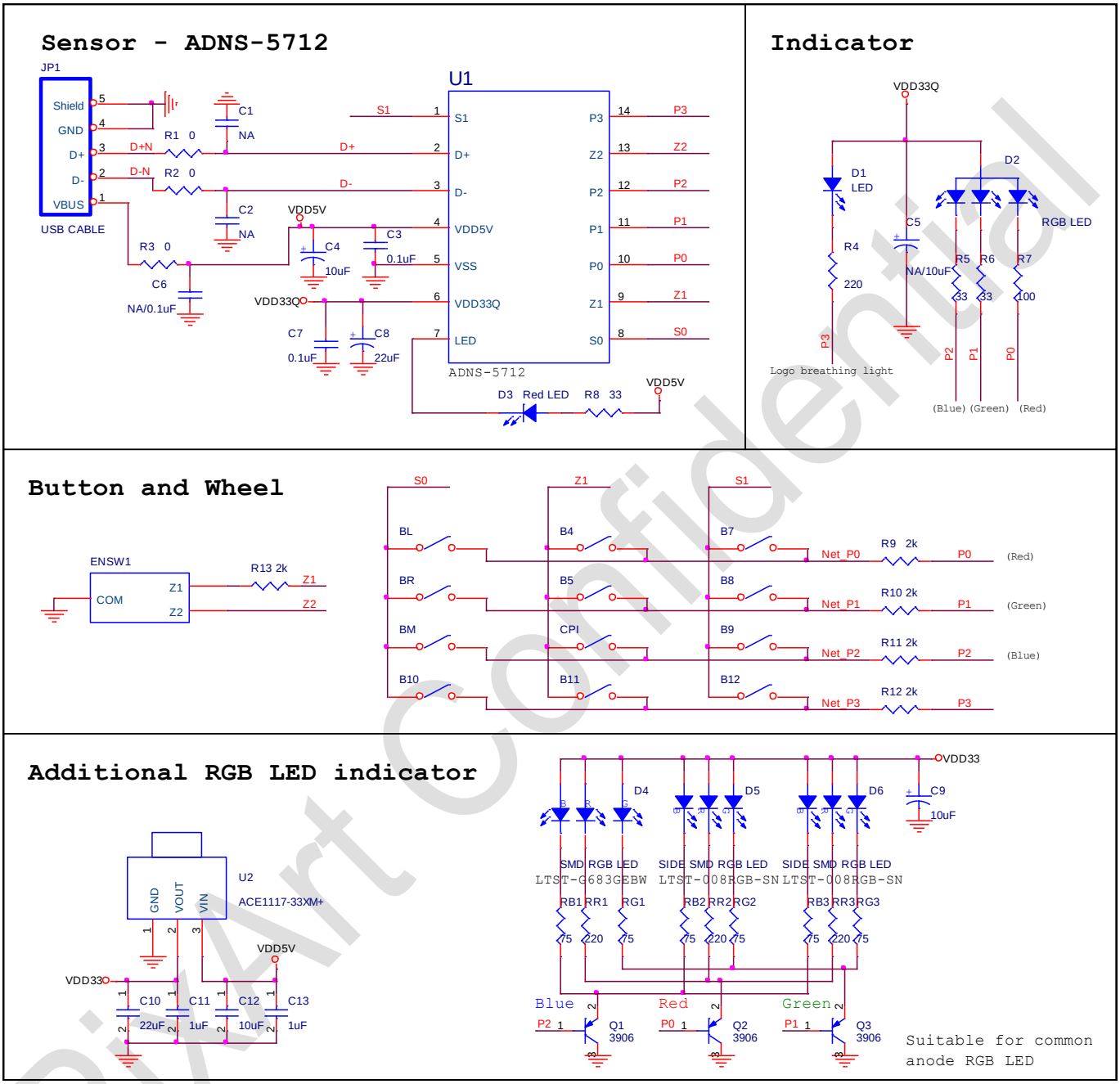


Figure 8. Application Circuit

Cautions of the circuit adjustment of the EMI test

Please observe the following rules to make sure pass the USB IF test.

Part	Typ	Max	Unit	Part	Typ	Max	Unit
R1	0	51	ohm	R3	0	1	ohm
R2	0	51	ohm	C4	10	22	uF
C1	NA	47	pF	C8	22	22	uF
C2	NA	47	pF	C5	NA	NA	uF

4. Specifications

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.

Symbol	Parameter	Min	Max	Unit	Notes
T_{STG}	Storage Temperature	-40	85	°C	
TA	Operating Temperature	-15	55	°C	
V_{DC}	DC Supply Voltage	-0.5	5.5	V	
V_{IN}	DC Input Voltage	-0.5	5.5	V	All I/O pin
	Lead Solder Temp	-	260	°C	For 10 seconds, 1.6mm below seating plane.
ESD		-	2.0	kV	All pins, human body model MIL 883 Method 3015

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit	Notes
T_A	Operating Temperature	0	-	40	°C	
V_{DD}	Power Supply Voltage	4.25	5.0	5.5	V	
V_{NPP}	Supply Noise	-	-	150	mV	Peak to peak voltage within 10kHz - 80 MHz
FR	Frame Rate	-	4000	-	frames/s	@ Run mode, +/- 5% tolerance
SP	Tracking speed	0	-	48	inches/s	
AC	Tracking acceleration	0	-	10	g	

5. USB Interface

USB Descriptor

The USB host controller detects the USB mouse device plug-in and assigns a new unique address to USB mouse device, then asks USB mouse device for information about the device description, configuration description, and assigning a configuration value for USB mouse device during enumeration period. After enumeration, the USB mouse device is able to transfer motion and button value to the USB host controller.

Descriptor Type	Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Device Descriptor (18 bytes)	12	01	00	02	00	00	00	08
	3A	09	32	25	00	01	01	02
	00	01						
Configuration Descriptor (9 bytes)	09	02	3B	00	02	01	00	A0
	32							
Interface 0 Descriptor (9 bytes)	09	04	00	00	01	03	01	02
	00							
HID 0 Descriptor (9 bytes)	09	21	11	01	00	01	22	4F
	00							
Endpoint 0 Descriptor (7 bytes)	07	05	81	03	08	00	01	
Interface 1 Descriptor (9 bytes)	09	04	01	00	01	03	00	01
	00							
HID 1 Descriptor (9 bytes)	09	21	11	01	00	01	22	71
	00							
Endpoint 1 Descriptor (7 bytes)	07	05	82	03	08	00	01	
Language String Descriptor (4 bytes)	04	03	09	04				
String Descriptor (26 bytes)	Gaming Mouse							
HID 0 Report Descriptor (79 bytes)	05	01	09	02	A1	01	09	01
	A1	00	05	09	19	01	29	05
	15	00	25	01	75	01	95	05
	81	02	75	03	95	01	81	03
	06	00	FF	09	40	95	02	75
	08	15	81	25	7F	81	02	05
	01	09	38	15	81	25	7F	75
	08	95	01	81	06	09	30	09
	31	16	01	80	26	FF	7F	75
	10	95	02	81	06	C0	C0	
HID 1 Report Descriptor (113 bytes)	06	00	FF	09	01	A1	01	15
	00	26	FF	00	75	08	09	02
	95	02	85	01	81	02	09	01
	95	01	85	10	B1	02	09	01
	96	44	01	85	11	B1	02	09
	01	95	02	85	12	B1	02	C0
	05	01	09	06	A1	01	85	03
	05	07	19	E0	29	E7	15	00
	25	01	75	01	95	08	81	02
	19	00	29	FF	15	00	26	FF
	00	75	08	95	01	81	00	C0
	05	0C	09	01	A1	01	85	02
	19	00	2A	9C	02	15	00	26
	9C	02	75	10	95	01	81	00
	C0							

USB Data Report Format

Two types of USB report data format are supported, boot protocol and report protocol. The boot protocol is used for legacy PC environment which supports 8-bit delta_X, delta_Y motion data and 3 basic buttons only. Report protocol is the more common format which supports 16-bit delta_X and delta_Y motion data, 8-bit Z-wheel scrolling data and 5 buttons. If the Z-wheel is scrolled upward, the corresponding report data will be 01H. If the Z-wheel is scrolled downward, the corresponding report data will be FFH. And the report data will be 00H if Z-wheel is idle.

USB Boot Protocol for Legacy Operation

Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3 ~ 7	NC	Reserved
2	0 ~ 7	X0 ~ X7	Delta_X[7:0] motion data. For 8-bit mode
3	0 ~ 7	Y0 ~ Y7	Delta_Y[7:0] motion data. For 8-bit mode

USB Report Protocol

Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3	B4	1 = Prev Page button pressed
	4	B5	1 = Next Page button pressed
	5 ~ 7	NC	Reserved
2	0 ~ 7	X0 ~ X7	Delta_X[7:0] motion data. For 8-bit mode
3	0 ~ 7	Y0 ~ Y7	Delta_Y[7:0] motion data. For 8-bit mode
4	0 ~ 7	Z0 ~ Z7	Z-Wheel[7:0] scrolling data
5	0 ~ 7	X0 ~ X7	Delta_X[7:0] motion data. For 16-bit mode
6	0 ~ 7	X8 ~ X15	Delta_X[15:8] motion data. For 16-bit mode
7	0 ~ 7	Y0 ~ Y7	Delta_Y[7:0] motion data. For 16-bit mode
8	0 ~ 7	Y8 ~ Y15	Delta_Y[15:8] motion data. For 16-bit mode

6. System Default Feature

Default Feature Mapping Table for Different Operation Mode

Default Feature	Standard Mode (default)	Trimming Mode	Gaming Mode
Report Rate	1000		
CPI Segment	4 (800/1000/1600/2400)		8
CPI Resolution	1000		800
CPI Indicator Color	Aquamarine		Coral
CPI SW	CPI Rotation		CPI+ / CPI-
RGB LED Mode	RGB LED3 (CPI Indicator breathing / 6-color rotation breathing)		
Mode SW	Available	NA	
Fn key	Available		NA
Double/Attack	Available (Double Click)		
Browser	Available		
Win	Available		
Sniper	NA	Available (1/4 CPI)	

7. Flexible OTP Mapping Table

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
[7:0]	PWM_MODE	CPI_SEGMENT	MOVXY_SW	MOVY_INV	MOVX_INV	CPI_LEVEL_INIT[2:0]		
[15:8]	KEY_TIME[1:0]		RSVD	REPORT_RATE[1:0]		RSVD[2:0]		
[23:16]	RSVD[1:0]		RSVD[5:0]					
[31:24]	RSVD	RSVD	RSVD[1:0]		PWM_TIME[3:0]			
[39:32]	PID[15:0]							
[47:40]								
[55:48]	VID[15:0]							
[63:56]								
[71:64]	PSTR[55:0]							
[79:72]								
[87:80]								
[95:88]								
[103:96]								
[111:104]								
[119:112]								
[127:120]	OTP_PROT	RSVD	SLP_EN	RSVD	PSTR[59:56]			
[135:128]	CPI1_COLOR[3:2]		CPI2_RES[2:0]			CPI1_RES[2:0]		
[143:136]	CPI1_COLOR[1:0]		CPI4_RES[2:0]			CPI3_RES[2:0]		
[151:144]	RSVD[7:0]							
[159:152]	CPI3_COLOR[3:0]				CPI2_COLOR[3:0]			
[167:160]	FN_TYPE	RGB_LED_INIT[2:0]			CPI4_COLOR[3:0]			
[175:168]	B4_SEL[2:0]			BREATH_NUM[1:0]		OPERATION_MODE[2:0]		
[183:176]	FNL_CODE[7:0]							
[191:184]	B5_SEL[2:0]			FNL_TYPE	FNL_CODE[11:8]			
[199:192]	FNR_CODE[7:0]							
[207:200]	B7_SEL[2:0]			FNR_TYPE	FNR_CODE[11:8]			
[215:208]	RSVD	RSVD[1:0]		RSVD[4:0]				
[223:216]	SNIPER_TYPE	ATTACK_TYPE	RSVD[5:0]					
[231:224]	FNM_CODE[7:0]							
[239:230]	B8_SEL[2:0]			FNM_TYPE	FNM_CODE[11:8]			
[247:240]	IDLE_ENTER_TIME[3:2]		B10_SEL[2:0]			B9_SEL[2:0]		
[255:248]	IDLE_ENTER_TIME[1:0]		B12_SEL[2:0]			B11_SEL[2:0]		

Note: RSVD – Reserved

8. Optical Criterion

Recommended Red LED Angle Criterion

Recommend using Chang-Yu LED goniophotometer V110 to measure the LED viewing angle.

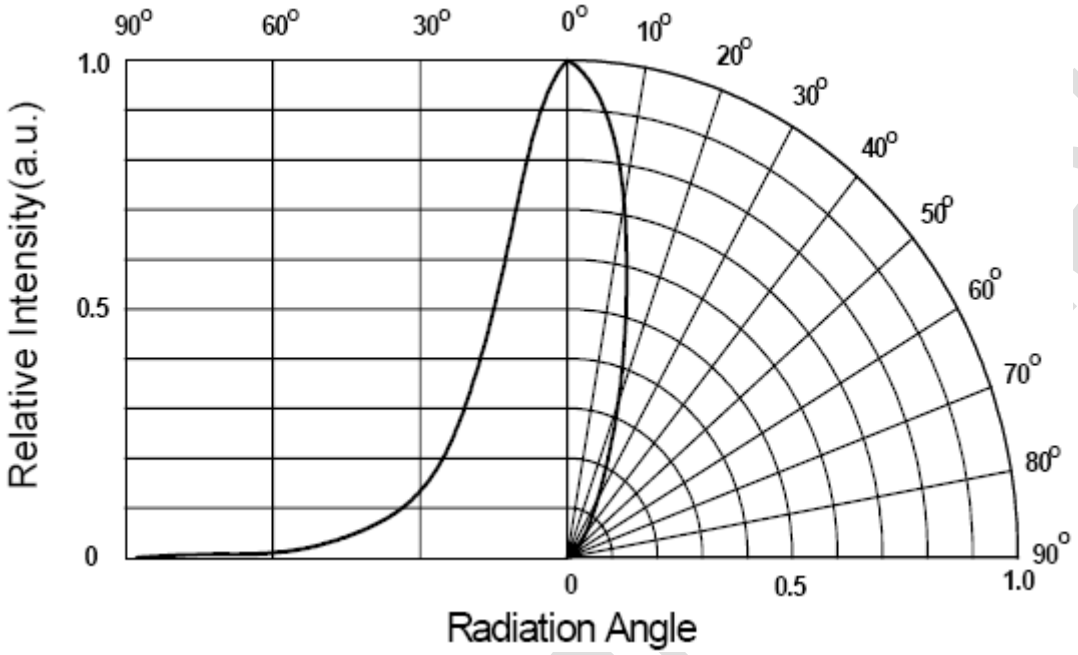


Figure 9. Radiation Characteristics

LED Viewing Angle	Min.	Typ.	Max.
2θ1/2	24	30	36

Recommended Red LED Optical Power

In order to optimize the tracking performance and minimize the LED power consumption, PixArt recommends the LED optical power conform with the table listed below. LED optical power is measured through the base plate opening of the mouse casing with the LED set to continuous mode. Recommend using ADCMT power meter 8230E to measure the LED optical power. The sequence to set LED to continuous mode is as followed.

Parameter	Min.	Typ.	Max.	Unit
Red LED Optical Power	1600	-	-	uW

9. Revision History

Revision No.	Date	Notes
R1.2	2016.09.02	New creation based on DS R1.2