
ADNS-5050 Optical Mouse Sensor

Data Sheet



Lead (Pb) Free
RoHS 6 fully
compliant



Description

The ADNS-5050 is a mainstream, small form factor optical mouse sensor. It is a user-friendly product with many built-in features and optimized for LED-based corded products.

The ADNS-5050 is capable of high-speed motion detection – up to 30ips and 8g. In addition, it has an on-chip oscillator and built-in LED driver to minimize external components. Frame rate is also adjusted internally.

The ADNS-5050 along with the 5100-001 lens, LED clip and HLMP-EG3E-xxxxx LED form a complete and compact mouse tracking system. There are no moving parts, which mean high reliability and less maintenance for the end user. In addition, precision optical alignment is not required, facilitating high volume assembly.

The sensor is programmed via registers through a three-wire SPI interface. It is housed in an 8-pin staggered dual in-line package (DIP).

Theory of Operation

The ADNS-5050 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.

The ADNS-5050 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 the Δx and Δy information from the sensor serial port. The microcontroller then translates the data into PS2 or USB signals before sending them to the host PC.

Features

- Small form factor, pin-to-pin compatible with ADNS-5020-EN
- Register-to-register compatible with ADNS-5020-EN
- Built-in LED driver for simpler circuitry
- High speed motion detection at 30 ips and up to 8g
- Self-adjusting frame rate for optimum performance
- Internal oscillator – no clock input needed
- Default 500 cpi resolution, adjustable from 125 to 1375 cpi via 125 cpi step
- Operating voltage: 5V nominal
- Three-wire serial interface
- Only 4 capacitors and no transistor required

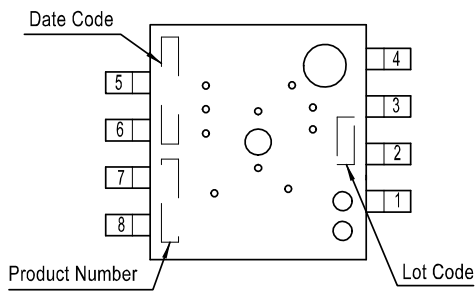
Applications

- Optical Mice
- Optical trackballs
- Integrated input devices

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Pinout of ADNS-5050 Optical Mouse Sensor

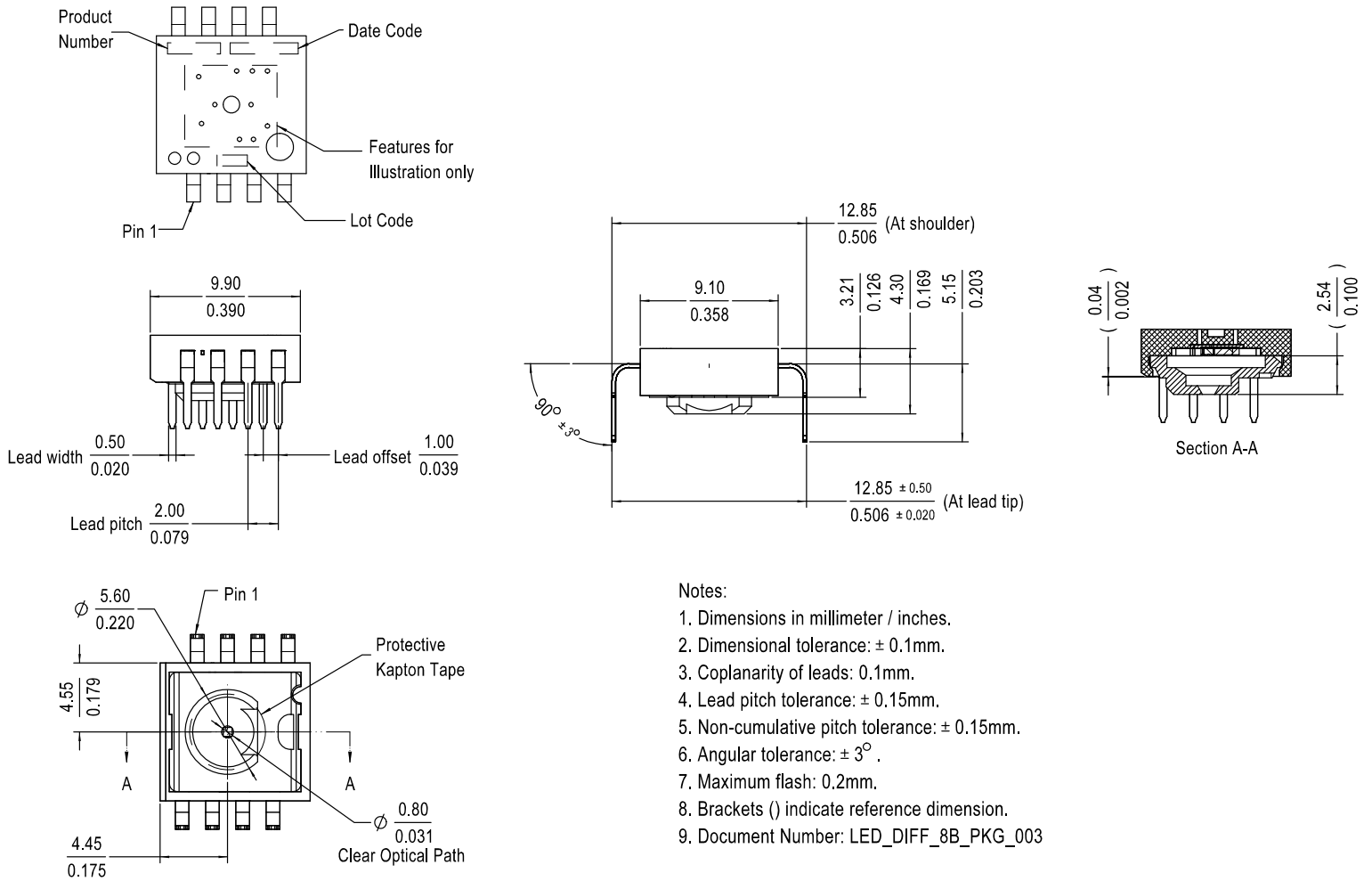
Pin	Name	Description	I/O type
1	SDIO	Serial Port Data Input and Output	I/O
2	XY_LED	LED Control	O
3	NRESET	Reset Pin (active low input)	I
4	NCS	Chip Select (active low input)	I
5	V _{DD5}	Supply Voltage	Power
6	GND	Ground	Ground
7	REGO	Regulator Output	O
8	SCLK	Serial Clock Input	I



Item	Marking	Remarks
Product Number	A5050	
Date Code	XYWWZ	X = Subcon Code YYWW = Date Code Z = Sensor Die Source
Lot Code	VVV	Numeric

Figure 1. Package outline drawing (top view).

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Notes:

1. Dimensions in millimeter / inches.
2. Dimensional tolerance: ± 0.1mm.
3. Coplanarity of leads: 0.1mm.
4. Lead pitch tolerance: ± 0.15mm.
5. Non-cumulative pitch tolerance: ± 0.15mm.
6. Angular tolerance: ± 3°.
7. Maximum flash: 0.2mm.
8. Brackets () indicate reference dimension.
9. Document Number: LED_DIFF_8B_PKG_003

Figure 2. Package outline drawing

CAUTION: It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

Overview of Optical Mouse Sensor Assembly

PixArt Imaging provides an IGES file drawing describing the base plate molding features for lens and PCB alignment.

The ADNS-5050 sensor is designed for mounting on a through-hole PCB, looking down. There is an aperture stop and features on the package that align to the lens.

The ADNS-5100-001 lens provides optics for the imaging of the surface as well as illumination of the surface at the optimum angle. Features on the lens align it to the sensor, base plate, and clip with the LED.

The LED clip holds the LED in relation to the lens. The LED must be inserted into the clip and the LED's leads formed prior to loading on the PCB.

The HLMP-EG3E-xxxxx LED is recommended for illumination.

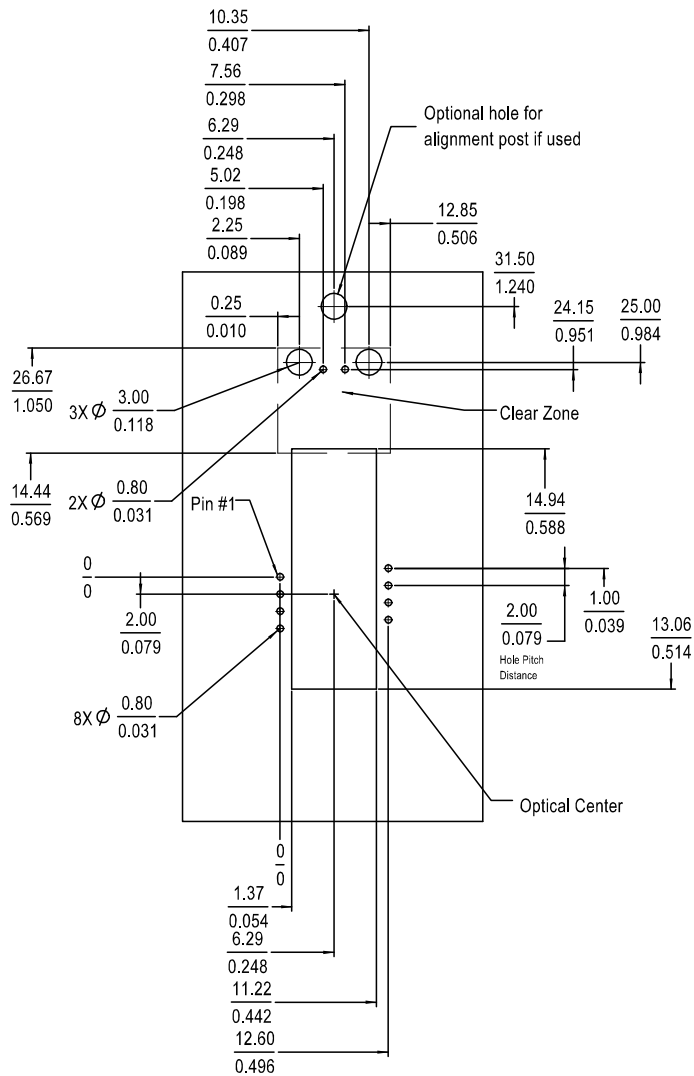


Figure 3. Recommended PCB mechanical cutouts and spacing.

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PixArt Imaging Inc.

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Regulatory Requirements

- Passes FCC B and worldwide analogous emission limits when assembled into a mouse with shielded cable and following PixArt Imaging recommendations.
- Passes IEC-1000-4-3 radiated susceptibility level when assembled into a mouse with shielded cable and following PixArt Imaging recommendations.
- Passes EN61000-4-4/IEC801-4 EFT tests when assembled into a mouse with shielded cable and following PixArt Imaging recommendations.
- UL flammability level UL94 HB.
- Provides sufficient ESD creepage/clearance distance to avoid discharge up to 15 kV when assembled into a mouse using lens according to usage instructions above.

Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units	Notes
Storage Temperature	T _S	-40	85	°C	
Lead Solder Temp			260	°C	
Supply Voltage	V _{DD}	-0.5	5.5	V	
ESD			2	kV	All pins, human body model MIL 883 Method 3015
Input Voltage	V _{IN}	-0.5	V _{DD} +0.5	V	All I/O pins
Output Current	I _{out}		7	mA	SDIO pin

Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Operating Temperature	T _A	0		40	°C	
Power Supply	V _{DD}	4.0	5.0	5.25	V	
Power Supply Rise Time	V _{RT}	0.005		100	ms	0 to V _{DD}
Supply Noise (Sinusoidal)	V _{NA}			100	mV p-p	10 kHz-50 MHz
Serial Port Clock Frequency	f _{SCLK}			3	MHz	50% duty cycle.
Distance from Lens Reference Plane to Tracking Surface (Z)	Z	2.3	2.4	2.5	mm	
Speed	S		30		ips	
Acceleration	a			8	g	
Load Capacitance	C _{out}			100	pF	SDIO

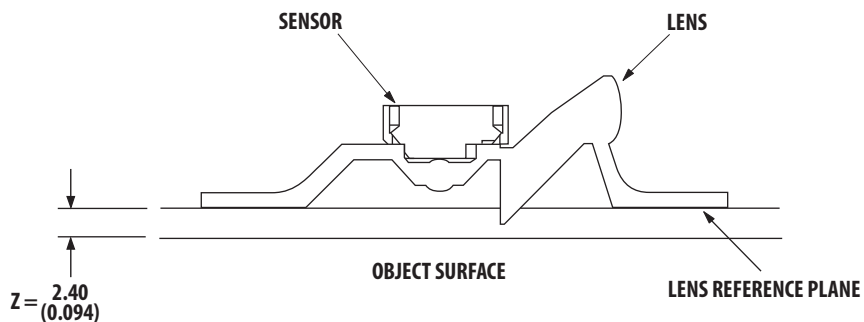


Figure 9. Distance from lens reference plane to tracking surface (Z).

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DC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, $V_{DD} = 5.0$ V.

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
DC Supply Current	I_{DD_AVG}		13.0	16.0	mA	Average sensor current, at max frame rate. No load on SDIO.
Idle Supply Current	I_{DD_IDLE}		11.0		mA	
Power Down Supply Current	I_{DD_PD}		180	250	μ A	SCLK, NCS, NRESET, SDIO=VDD
Input Low Voltage	V_{IL}			0.5	V	SCLK, SDIO, NCS, NRESET
Input High Voltage	V_{IH}	$V_{DD} - 0.5$			V	SCLK, SDIO, NCS, NRESET
Input Hysteresis	V_{I_HYS}		200		mV	SCLK, SDIO, NCS, NRESET
Input Leakage Current	I_{leak}		± 1	± 10	μ A	$V_{in} = V_{DD} - 0.6$ V, SCLK, SDIO, NCS, NRESET
XY_LED Current (pin voltage range should be greater than 0.8 V.)	I_{XY_LED}		45		mA	Average current at maximum frame rate.
XY_LED Current (pin voltage range should be greater than 0.8 V.)	I_{XY_PK}		45	51.5	mA	Peak current at maximum frame rate. Follow recommended schematics in Figure 8 to ensure DC current flowing through LED during run mode is within LED's absolute maximum limit.
Output Low Voltage	V_{OL}			0.7	V	$I_{out} = 1$ mA, SDIO
Output High Voltage	V_{OH}	$V_{DD} - 0.7$			V	$I_{out} = -1$ mA, SDIO
Input Capacitance	C_{in}		50		pF	
Frame Rate	F_R		4500		fps	Internally adjusted by sensor (value shown is based on internal oscillator frequency of 28MHZ)

Registers

The ADNS-5050 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.

Address	Register	Read/Write	Default Value
0x00	Product_ID	R	0x12
0x01	Revision_ID	R	0x01
0x02	Motion	R	0x00
0x03	Delta_X	R	Any
0x04	Delta_Y	R	Any
0x05	SQUAL	R	Any
0x06	Shutter_Upper	R	Any
0x07	Shutter_Lower	R	Any
0x08	Maximum_Pixel	R	Any
0x09	Pixel_Sum	R	Any
0x0a	Minimum_Pixel	R	Any
0x0b	Pixel_Grab	R/W	Any
0x0c	Reserved		
0x0d	Mouse_Control	R/W	0x00
0x0e – 0x18	Reserved		
0x19	Mouse_Control2	R/W	0x08
0x1a – 0x21	Reserved		
0x22	LED_DC_Mode	R/W	0x00
0x23 – 0x39	Reserved		
0x3a	Chip_Reset	W	N/A
0x3b – 0x3d	Reserved		
0x3e	Product ID2	R	0x26
0x3f	Inv_Rev_ID	R	0xfe
0x40 – 0x62	Reserved		
0x63	Motion_Burst	R	0x00