ADNS-3090

High-Performance Optical Mouse Sensor

Data Sheet

Lead (Pb) Free
RoHS 6 fully compliant

Description

The ADNS-3090 is a high performance addition to PixArt Imaging' popular ADNS family of optical mouse sensors.

The ADNS-3090 is based on a new, faster architecture with improved navigation. The sensor is capable of sensing high speed mouse motion - up to 60 inches per second and acceleration up to 20g – for increased user precision and smoothness.

The ADNS-3090 along with the ADNS-2120-001 trim lens, ADNS-2220-001 assembly clip and HLMP-EG3E-xxxxx led form a complete, compact optical mouse tracking system. There are no moving parts, which means 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 four-wire serial port. It is packaged in a 20-pin staggered dual inline package (DIP).

Theory of Operation

The ADNS-3090 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.

It 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 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 or game console.

Features

- High speed motion detection – up to 60 ips and 20g
- Enhanced architecture for greatly improved optical navigation technology
- Programmable frame rate over 6400 frames per second
- SmartSpeed self-adjusting frame rate for optimum performance
- Serial port burst mode for fast data transfer
- 1800 cpi or 3600 cpi selectable resolution
- Single 3.3 volt power supply
- Four-wire serial port along with Chip Select, Power Down, and Reset pins

Applications

- Mice for game consoles and computer games
- Mice for desktop PC's, Workstations, and portable PC's
- Trackballs
- Integrated input devices

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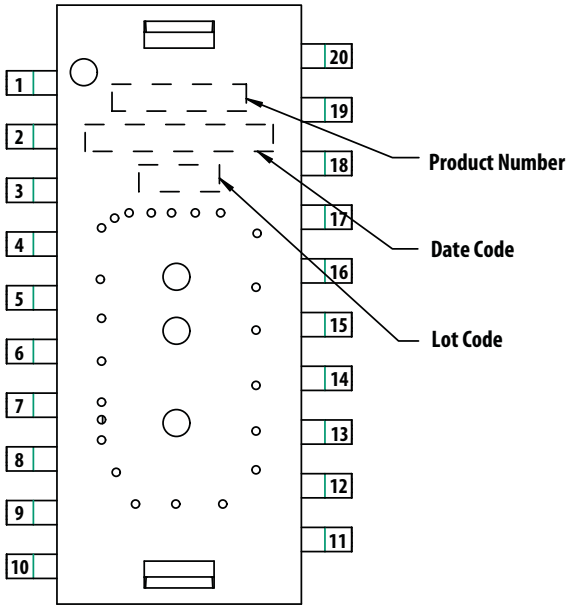
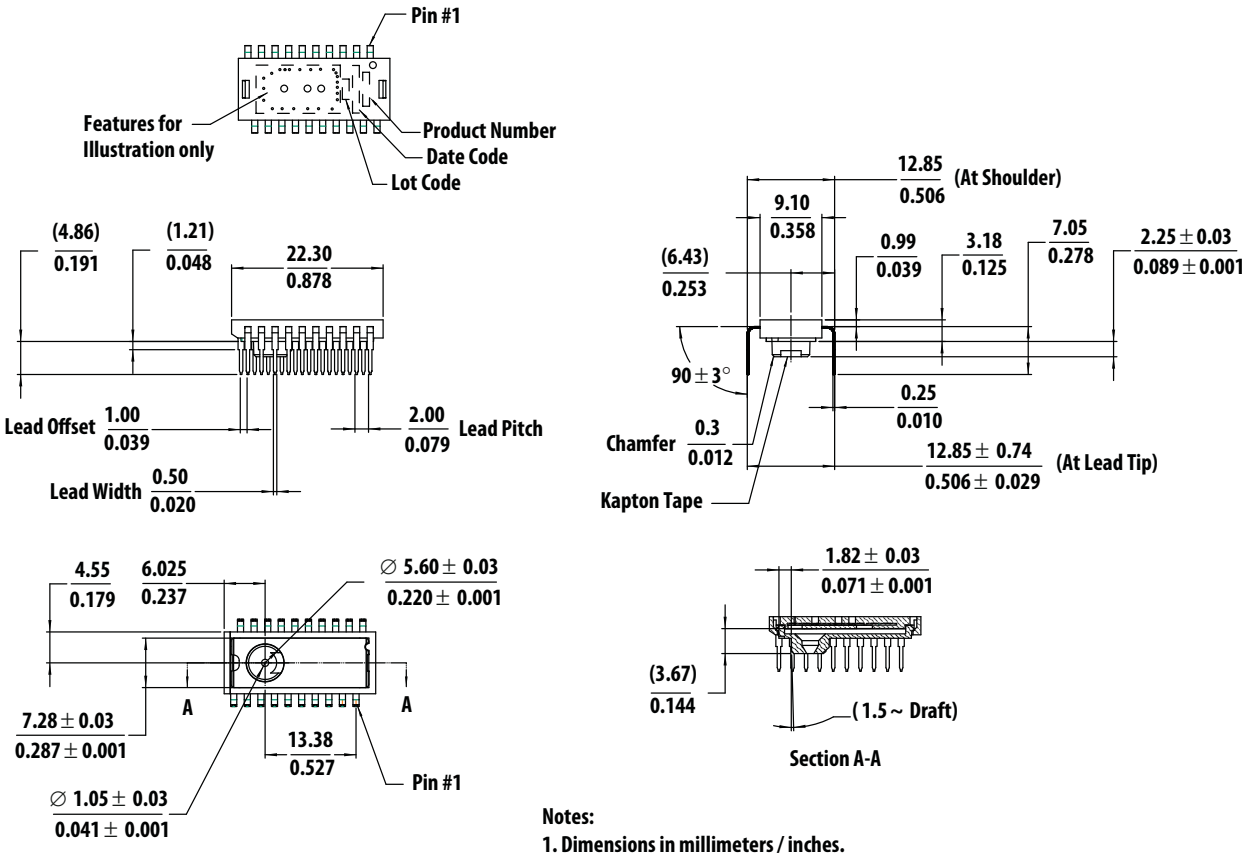
Pinout

Pin	Name	Description
1	NCS	Chip select (active low input)
2	MISO	Serial data output (Master In/Slave Out)
3	SCLK	Serial clock input
4	MOSI	Serial data input (Master Out/Slave In)
5	LED_CTRL	LED control output
6	RESET	Reset input
7	NPD	Power down (active low input)
8	OSC_OUT	Oscillator output
9	GUARD	Oscillator GND for PCB guard (optional)
10	OSC_IN	Oscillator input
11	NC	No connect
12	OPTP	Connect to VDD3
13	REFC	Reference capacitor
14	REFB	Reference capacitor
15	VDD3	Supply voltage
16	GND	Ground
17	VDD3	Supply voltage
18	NC	No connect
19	GND	Ground
20	NC	No connect



Item	Marking	Remarks
Product Number	A3090	
Date Code	XYYWWZ	X = Subcon Code YYWW = Date Code Z = Sensor Die Source
Lot Code	VVV	Numeric

Figure 1. Package outline drawing (top view)



Notes:

1. Dimensions in millimeters / 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: ±3.0°
7. Maximum flash: 0.2mm.
8. Chamfer (25 x 2) on the taper side of the lead.
9. () These dimensions are for reference only and should not be used to mechanically reference the sensor.
10. Document Number: LED_Spts_20A_Pkg_002.

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

2D Assembly Drawing of ADNS-3090

Shown with ADNS-2120-001, ADNS-2220-001 and HLMP-EG3E-xxxxx.

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

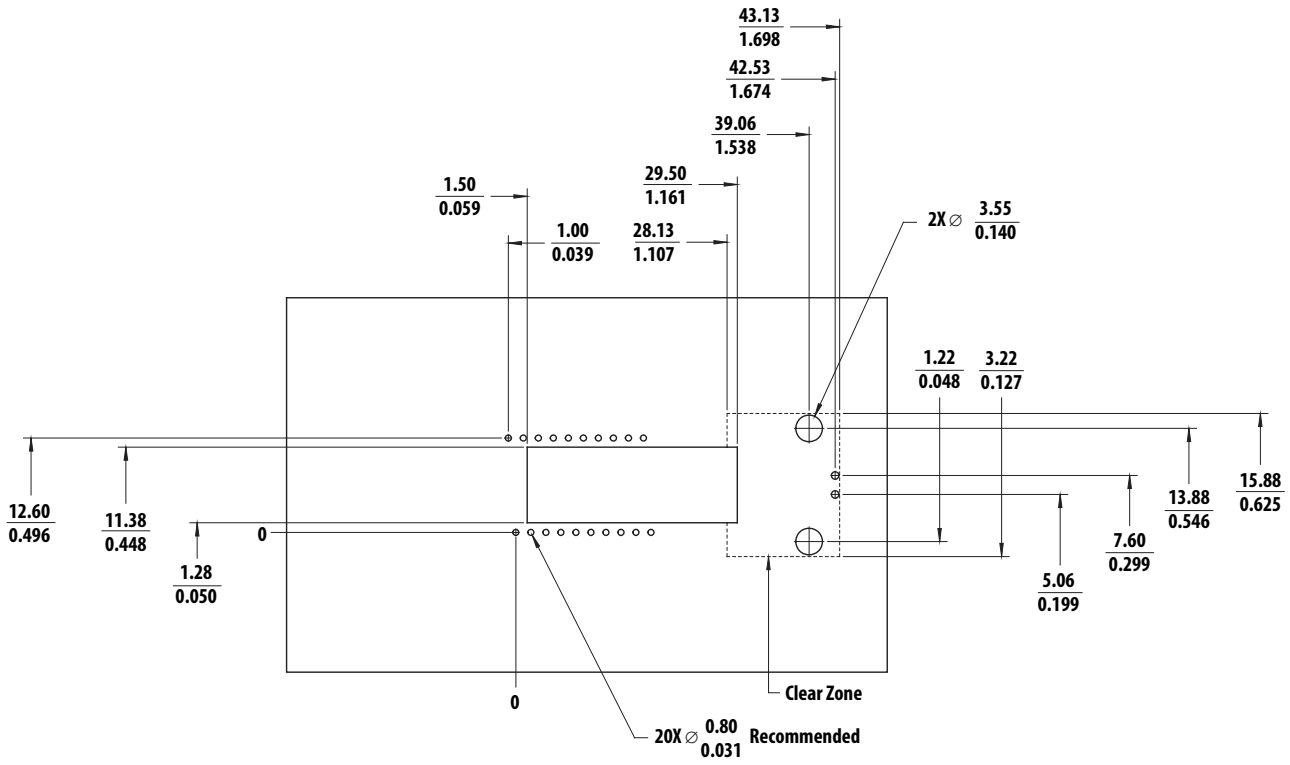
The components interlock as they are mounted onto defined features on the base plate.

The ADNS-3090 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-2120-001 trim 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 lens also has a large round flange to provide a long creepage path for any ESD events that occur at the opening of the base plate.

The ADNS-2220-001 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 clip interlocks the sensor to the lens, and through the lens to the alignment features on the base plate.

The HLMP-EG3E-xxxxx LED is recommended for illumination. If used with the bin table, sufficient illumination can be guaranteed.



Dimensions in millimeters / inches

Figure 3. Recommended PCB mechanical cutouts and spacing

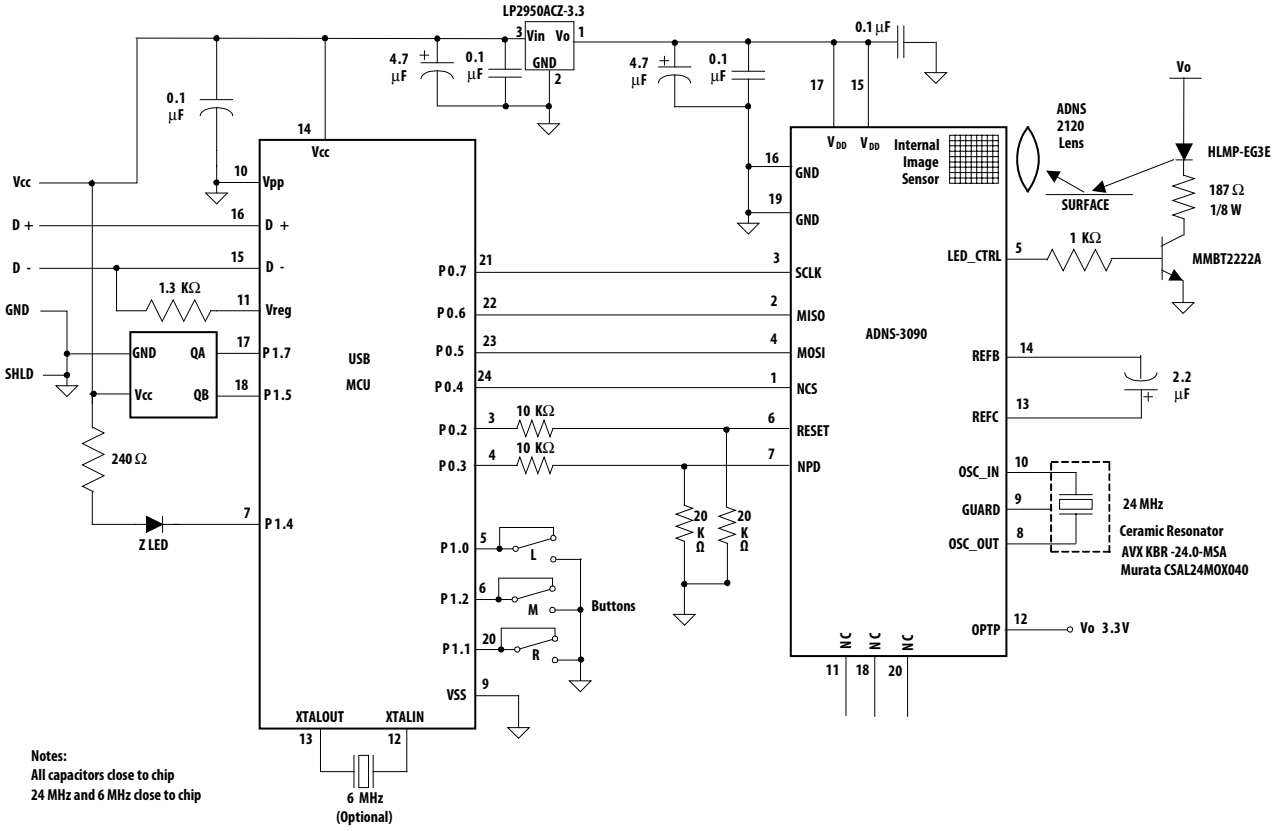


Figure 8. Schematic Diagram for USB, PS/2 mouse application with ADNS-3090

Notes

1. Caps for pins 15 and 17 MUST have trace lengths LESS than 5 mm to nearest ground pin.
2. Pins 15 and 17 caps MUST use pin 16 GND.
3. Pin 9, if used, should not be connected to PCB GND to reduce potential RF emissions.
4. The 0.1 uF caps must be ceramic.
5. Caps should have less than 5 nH of self inductance.
6. Caps should have less than 0.2 Ω ESR.
7. NC pins should not be connected to any traces.
8. Surface mount parts are recommended.
9. Care must be taken when interfacing a 5V microcontroller to the ADNS-3090. Serial port inputs on the sensor should be connected to open-drain outputs from the microcontroller or use an active drive level shifter. NPD and RESET should be connected to 5V microcontroller outputs through a resistor divider or other level shifting technique.
10. VDD3 and GND should have low impedance connections to the power supply.
11. Capacitors connected to pin 15 and 17 should be connected to pin 16 and then to pin 19.

Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Storage Temperature	T_S	-40		85	ºC	
Operating Temperature	T_A	-15		55	ºC	
Lead Solder Temp				260	ºC	For 7 second, 1.6mm below seating plane.
Supply Voltage	V_{DD3}	-0.5		3.7	V	
ESD				2	kV	All pins, human body model MIL 883 Method 3015
Input Voltage	V_{IN}	-0.5		V_{DD3}+0.5	V	NPD, NCS, MOSI, SCLK, RESET, OSC_IN, OSC_OUT, REFC.
Output current	I_{out}			20	mA	LED_CTRL, MISO

Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Operating Temperature	T_A	0		40	°C	
Power supply voltage	V_{DD3B}	3.10	3.30	3.60	Volts	
Power supply rise time	V_{RT}	1			us	0 to 3.0V
Supply noise (Sinusoidal)	V_{NB}			30 80	mV p-p	10kHz- 300KHZ 300KHz-50MHz
Oscillator capable Frequency	f_{CLK}	23	24	25	MHz	Set by ceramic resonator
Serial Port Clock Frequency	f_{SCLK}			2 500	MHz kHz	Active drive, 50% duty cycle Open drain drive with pull-ups on, 50 pF load
Resonator Impedance	X_{RES}			55	Ω	
Distance from lens reference plane to surface	Z	2.3	2.4	2.5	mm	Results in ±0.2 mm DOF, See Figure 9
Speed	S	0		60	in/sec	@ 6469fps
Acceleration	A			20	g	@ 6469fps
Light level onto IC	IRR_{INC}	20 24 100 120		6,000 7,200 6,000 7,200	mW/m2	l = 639 nm, FR=1500 fps l = 875 nm, FR=1500 fps l = 639 nm, FR=6469 fps l = 875 nm, FR=6469 fps
Frame Rate	FR	2000		6469	Frames/s	See Frame_Period register section
LED Drive Current	I_{LED}	10			mA	HLMP-EG3E-xxxxx, bin N and brighter. Maximum frame rate may not be maintained on dark surfaces at the minimum LED drive current

DC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, V_{DD3}=3.3V, fclk=24MHz.

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
DC Supply Current	I_{DD_AVG}			52	mA	DC average at 6469 fps. No DC load on LED_CTRL, MISO.
Power Down Supply Current	I_{DDPD}		5	90	µA	NPD=GND; SCLK, MOSI, NCS=GND or V_{DD3}; RESET=GND
Input Low Voltage	V_{IL}			0.8	V	SCLK, MOSI, NPD, NCS, RESE
Input High Voltage	V_{IH}	0.7 * V_{DD3}			V	SCLK, MOSI, NPD, NCS, RESET
Input hysteresis	V_{I_HYS}		200		mV	SCLK, MOSI, NPD, NCS, RESET
Input current, pull-up disabled	I_{IH_DPU}		0	±10	µA	Vin=0.8*V_{DD3}, SCLK, MOSI, NCS
Input current, CMOS inputs	I_{IH}	0		±10	µA	NPD, RESET, Vin=0.8*V_{DD3}
Output current, pulled-up inputs	I_{OH_PU}	150	300	600	µA	Vin=0.2V, SCLK, MOSI, NCS
Output Low Voltage LED_CTRL	$V_{OL,LED}$			0.5	V	Iout=2mA, LED_CTRL
Output High voltage, LED_CTRL	V_{OH_LED}	0.8*V_{DD3}			V	Iout=-2mA, LED_CTRL
Output Low Voltage, MISO	V_{OL}			0.5	V	Iout=2mA, MISO
Output High Voltage, MISO	V_{OH}	0.8*V_{DD3}			V	Iout=-2mA, MISO
Input Capacitance	C_{IN}		14-22		pF	OSC_IN, OSC_OUT

Registers

The ADNS-3090 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	SROM Default Value
0x00	Product_ID	R	0x07
0x01	Revision_ID	R	0xNN
0x02	Motion	R	0x00
0x03	Delta_X	R	0x00
0x04	Delta_Y	R	0x00
0x05	SQUAL	R	0x00
0x06	Pixel_Sum	R	0x00
0x07	Maximum_Pixel	R	0x00
0x08	Reserved		
0x09	Reserved		
0x0a	Configuration_bits	R/W	0x09
0x0b	Extended_Config	R/W	0x00
0x0c	Data_Out_Lower	R	Any
0x0d	Data_Out_Upper	R	Any
0x0e	Shutter_Lower	R	0x85
0x0f	Shutter_Upper	R	0x00
0x10	Frame_Period_Lower	R	Any
0x11	Frame_Period_Upper	R	Any
0x12	Motion_Clear	W	Any
0x13	Frame_Capture	R/W	0x00
0x14	SROM_Enable	W	0x00
0x15 - 0x18	Reserved		
0x19	Frame_Period_Max_Bound Lower	R/W	0xE0
0x1a	Frame_Period_Max_Bound_Upper	R/W	0x2E
0x1b	Frame_Period_Min_Bound_Lower	R/W	0x7E
0x1c	Frame_Period_Min_Bound_Upper	R/W	0x0E
0x1d	Shutter_Max_Bound_Lower	R/W	0x00
0x1e	Shutter_Max_Bound_Upper	R/W	0x20
0x1f	SROM_ID	R	0x00
0x20-0x3c	Reserved		
0x3d	Observation	R/W	0x00
0x3e	Reserved		
0x3f	Inverse Product ID	R	0xF8
0x40	Pixel_Burst	R	0x00
0x50	Motion_Burst	R	0x00
0x60	SROM_Load	W	Any