PixArt Imaging Inc.

ADNS-3050
Entry-level Gaming Optical Navigation Sensor

Data Sheet

Lead (Pb) Free
RoHS 6 fully compliant

Description

The PixArt ADNS-3050 is a small form factor entry-level gaming optical navigation sensor. It is housed in an 8-pin staggered dual in-line package (DIP). It is capable of high-speed motion detection typically at 60ips and acceleration up to 20g; suitable for both wired and wireless gaming navigation system. The low power management in wireless mode can be customized to suit user preferences. In addition, it has an on-chip oscillator and LED driver to minimize external components.

The ADNS-3050 sensor along with the ADNS-5110-001 lens, or ADNS-5120-002 trim lens LED clip, and HLMP-EG3E red LED forms a complete and compact mouse tracking system. There are no moving parts, which translates to high reliability and less maintenance for the end user. Precision optical alignment is not required, thus facilitating high volume assembly.

Theory of Operation

The ADNS-3050 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-3050 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.

Features

- Small Form Factor Package - 8-pin DIP
- Operating Voltage: 2.8V-3.0V
- High Speed Motion Detection at typical of 60ips and acceleration up to 20g.
- Selectable Resolutions up to 2000cpi
- Four wire Serial Port Interface
- External Interrupt Output for Motion Detection
- Internal Oscillator — no clock input needed
- On-chip LED driver
- Minimal number of passive components
- Programmable power-saving modes for selectable wired or wireless application
- Customizable response time and downshift time for rest modes
- Configurable LED operating modes and drive current

Applications

- Wired and Wireless Optical gaming mice and trackballs
- Integrated input devices
- Battery-powered input devices

NOTE: The ADNS-3050 sensor is not designed for use with blue LED navigation system.

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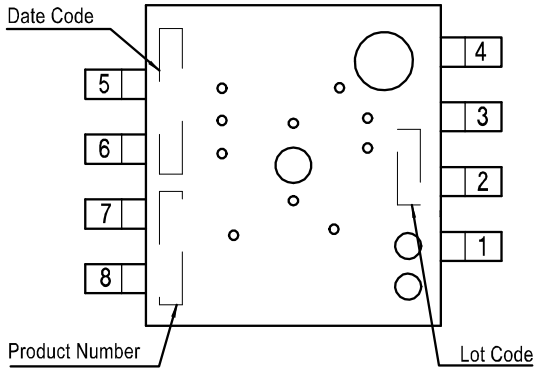
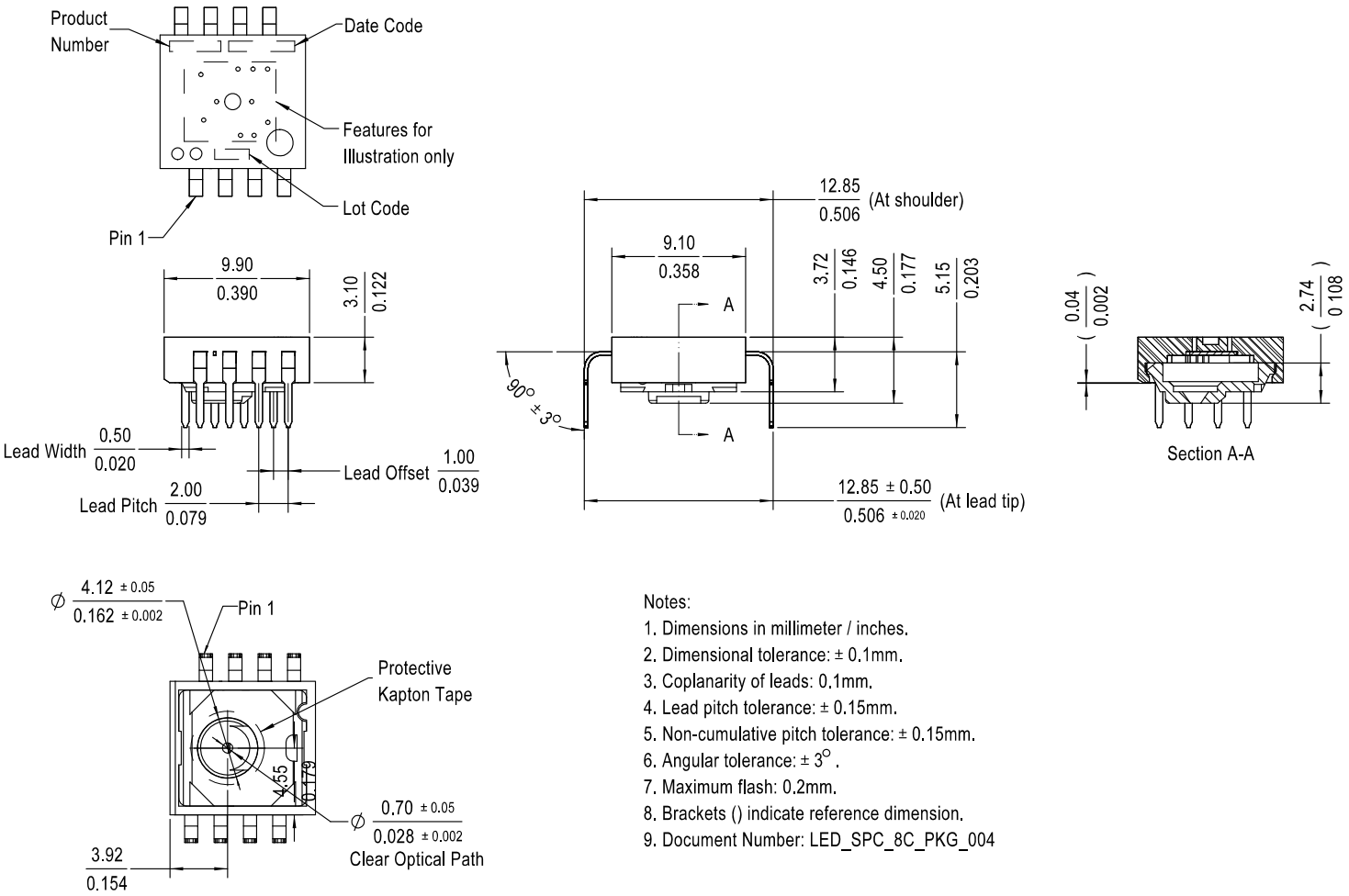
Pinout of ADNS-3050 Optical Mouse Sensor

Pin	Name	Input/Output	Description
1	MISO	O	Serial Data Output (Master In/Slave Out)
2	LED	I	LED Illumination Control Input
3	MOTION	O	Motion Interrupt Output (Active low,)
4	NCS	I	Chip Select (Active low)
5	SCLK	I	Serial Clock Input
6	GND	I	Ground
7	VDD	I	Supply Voltage
8	MOSI	I	Serial Data Input (Master Out/Slave In)



Item	Marking	Remarks
Product Number	A3050	
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 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_SPC_8C_PKG_004

Figure 2. Package Outline Drawing

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

Overview of Optical Mouse Sensor Assembly

PixArt provides an IGES file drawing describing the base plate molding features for lens and PCB alignment
The ADNS-3050 sensor is designed for mounting on a through-hole PCB. There is an aperture stop and features on the package that align to the lens. The ADNS-5110-001 lens and ADNS-5120-002 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 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 red LED is recommended for illumination.

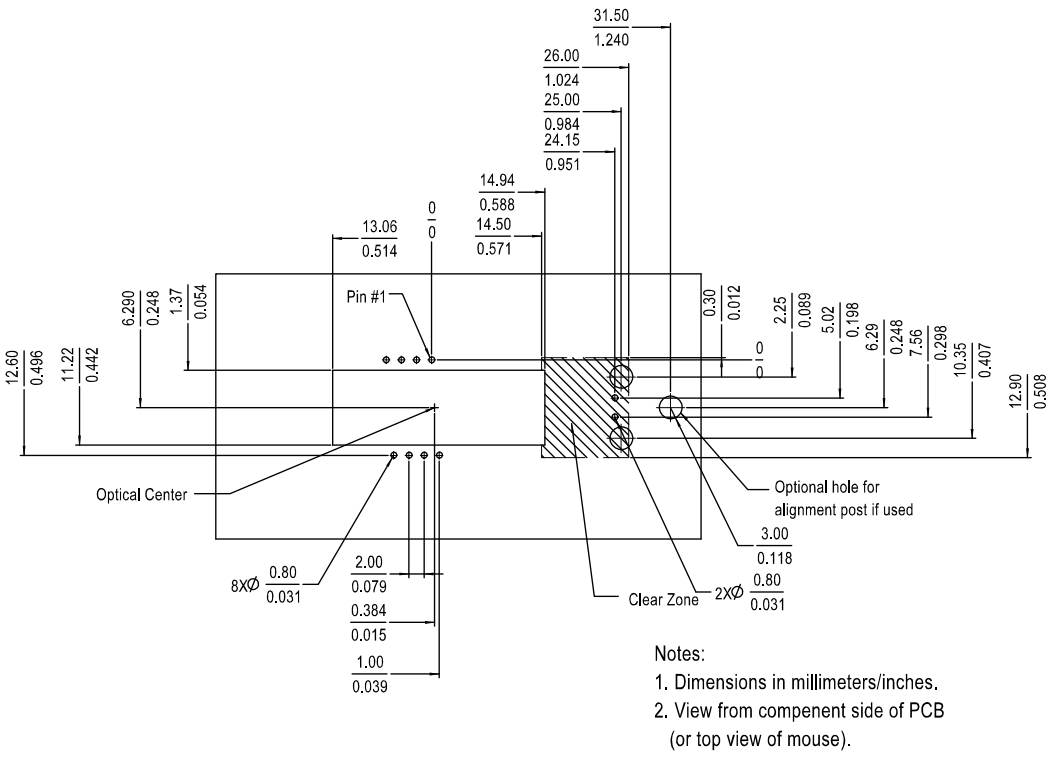


Figure 3. Recommended PCB Mechanical Cutouts and Spacing

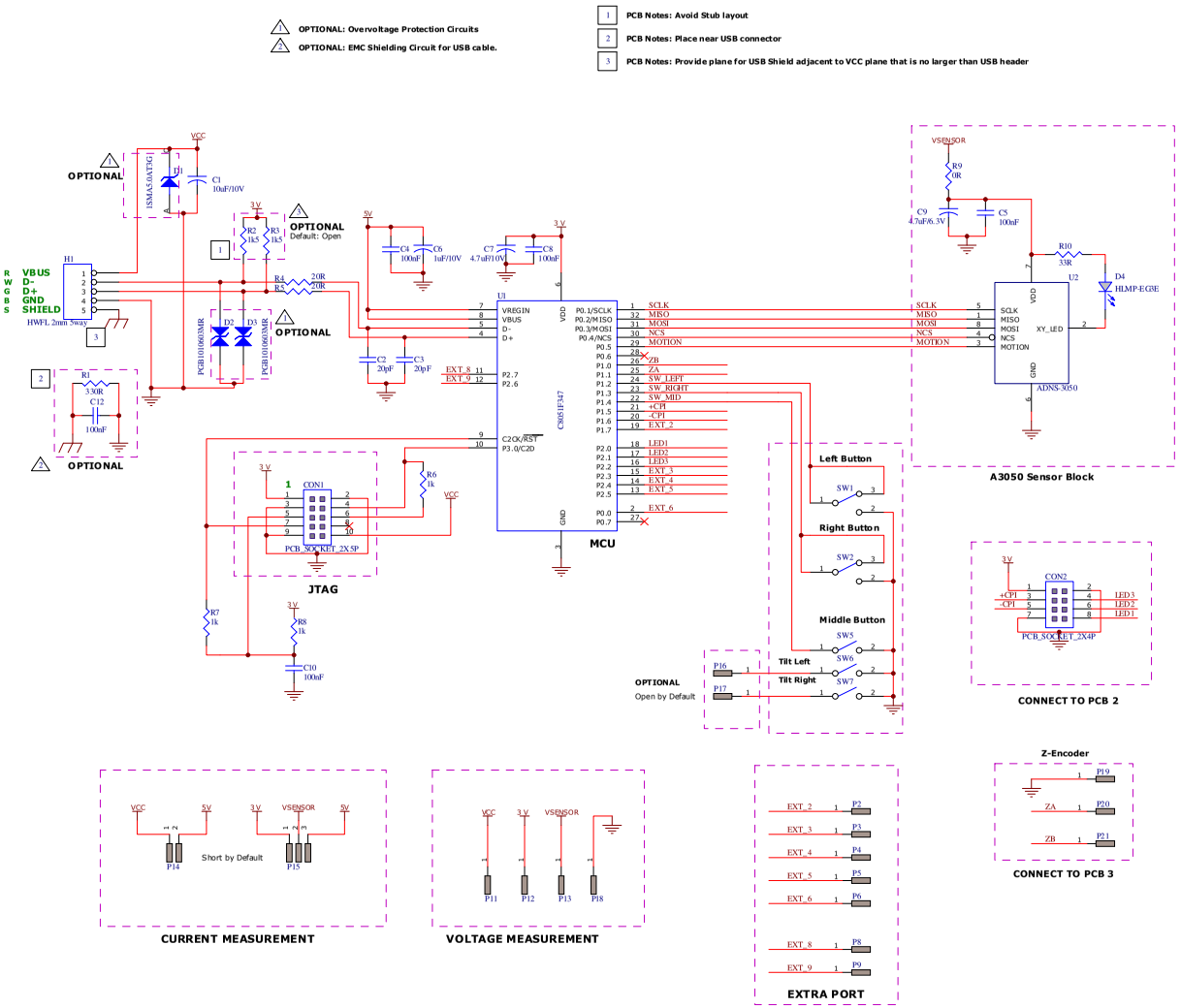


Figure 8. Schematic diagram for interface between ADNS-3050 and microcontroller with HLMP-EG3E Red LED on a corded solution NOTE: The ADNS-3050 optical mouse sensor is not designed for use with the blue LED navigation system.

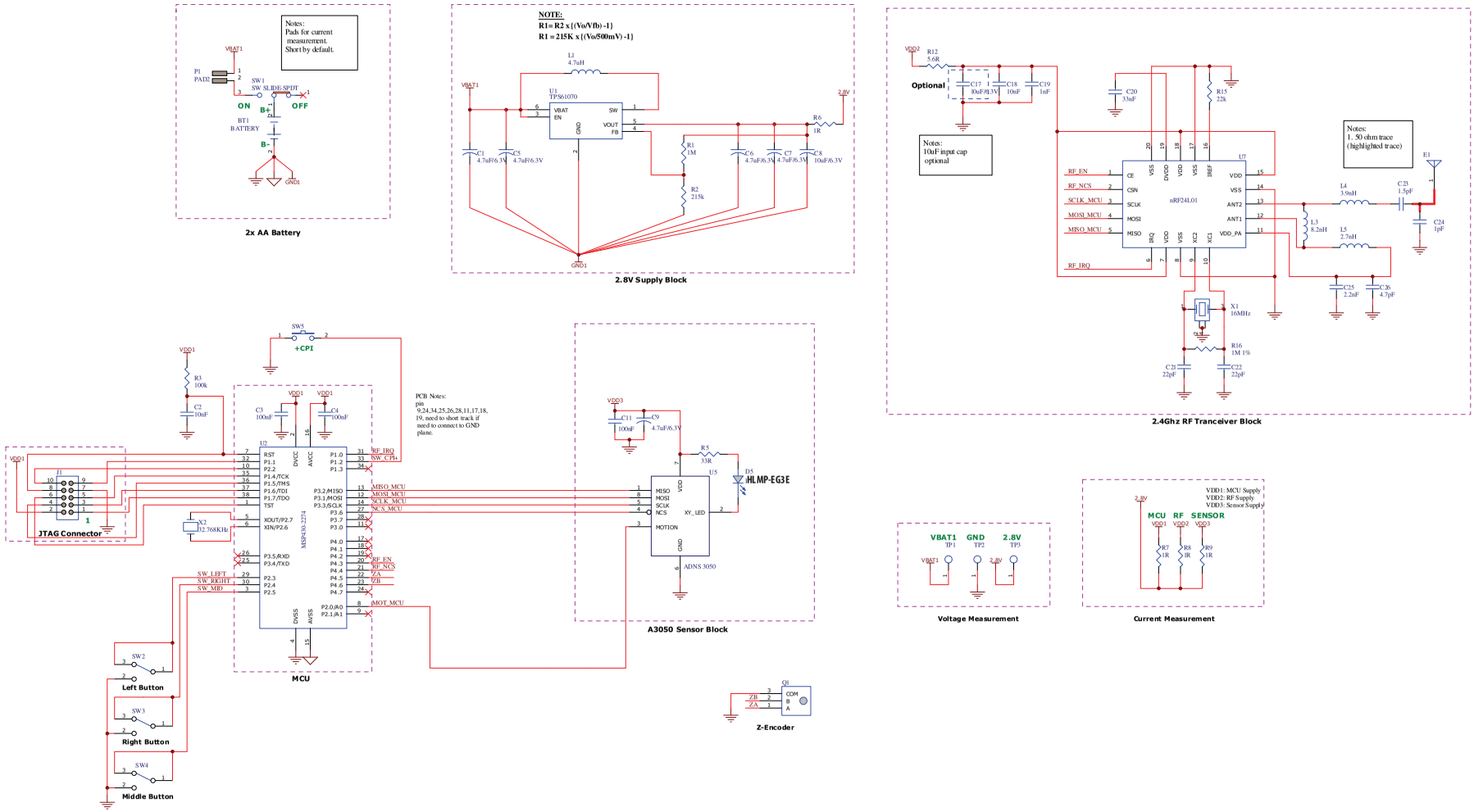


Figure 9. Schematic diagram for interface between ADNS-3050 and microcontroller with HLMP-EG3E Red LED on a wireless solution
NOTE: The ADNS-3050 Optical Mouse Sensor is not designed for use with blue LED navigation system.

Design Considerations for Improved ESD Performance

For improved electrostatic discharge performance, typical creepage and clearance distance are shown in the table below. Assumption: base plate construction is as per the PixArt supplied IGES file and ADNS-5110-001 or ADNS-5120-002 trim lens. Note that the lens material is polycarbonate or polystyrene HH30. Therefore, cyanoacrylate based adhesives or other adhesives that may damage the lens should NOT be used.

ADNS-5110-001 Lens	Typical Distance (mm)
Creepage	15.43
Clearance	7.77

Regulatory Requirements

- Passes FCC B and worldwide analogous emission limits when assembled into a mouse with shielded cable and following PixArt's recommendations.
- Passes IEC-1000-4-3 radiated susceptibility level when assembled into a mouse with shielded cable and following PixArt's recommendations.
- Passes EN61000-4-4/IEC801-4 EFT tests when assembled into a mouse with shielded cable and following PixArt recommendations.
- Provides sufficient ESD creepage/clearance distance to withstand discharge up to 15KV when assembled into a mouse according to usage instructions above.

Table 1. Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units	Notes
Storage Temperature	T_S	-40	85	°C	
Operating Temperature	T_A	-15	55	°C	
Lead Solder Temperature	T_{SOLDER}		260	°C	For 7 seconds, 1.6mm below seating plane.
Supply Voltage	V_{DD}	-0.5	3.7	V	
ESD (Human Body Model)			2	kV	All pins
Input Voltage	V_{IN}	-0.5	VDD + 0.5	V	All I/O pins
Output Current	I_{out}		7	mA	MISO pin

Table 2. Recommended Operating Condition

Parameter	Symbol	Min	Typ.	Max	Units	Notes
Operating Temperature	T_A	0		40	°C	
Power Supply Voltage	V_{DD}	2.8		3.0	V	
Power Supply Rise Time	tRT	0.005		100	ms	0 to VDD min
Supply Noise (Sinusoidal)	V_{NA}			100	mVp-p	10kHz —50MHz
Serial Port Clock Frequency	f_{SCLK}			1	MHz	50% duty cycle
Distance from Lens Reference	Z	2.3	2.4	2.5	mm	
Plane to Tracking Surface						
Speed	S		60		ips	
Acceleration	A			20	g	In run mode
Load Capacitance	C_{out}			100	pF	MISO

Table 4. DC Electrical Specifications

Electrical characteristics over recommended operating conditions. Typical values at 25° C, VDD_{LED} = 2.8 V, IRLED HLMP-EG3E, R_{LED} = 33 Ω.

Parameter	Symbol	Min	Typ.	Max	Units	Notes
DC Supply Current	$I_{DD\_RUN\_DC}$ $I_{DD\_RUN\_WIRELESS}$ I_{DD_REST1} I_{DD_REST2} I_{DD_REST3}		26.604 14.236 0.817 0.105 0.022		mA	Including LED current. No load on MISO Default sensor setting for Rest 1, Rest 2 and Rest 3 modes
Power Down Current	I_{PD}		10		µA	
Input Low Voltage	V_{IL}			0.5	V	SCLK, MOSI, NCS
Input High Voltage	V_{IH}	Vdd-0.5			V	SCLK, MOSI, NCS
Input Hysteresis	V_{I_HYS}		200		mV	SCLK, MOSI, NCS
Input Leakage Current	I_{leak}		±1	±10	µA	Vin=VDD-0.6V, SCLK, MOSI, NCS
Output Low Voltage	V_{OL}			0.7	V	Iout=1mA, MISO, MOTION
Output High Voltage	V_{OH}	Vdd-0.7			V	Iout=-1mA, MISO, MOTION
Input Capacitance	Cin		50		pF	MOSI, NCS, SCLK

Synchronous Serial Port

The synchronous serial port is used to set and read parameters in the ADNS-3050, and to read out the motion information. The port is a four wire serial port. The host micro-controller always initiates communication; the ADNS-3050 never initiates data transfers. SCLK, MOSI, and NCS may be driven directly by a micro-controller. The port pins may be shared with other SPI slave devices. When the NCS pin is high, the inputs are ignored and the output is at tri-state.

The lines that comprise the SPI port:

SCLK: Clock input. It is always generated by the master (the micro-controller).

MOSI: Input data. (Master Out/Slave In)

MISO: Output data. (Master In/Slave Out)

NCS: Chip select input (active low). NCS needs to be low to activate the serial port; otherwise, MISO will be high Z, and MOSI & SCLK will be ignored. NCS can also be used to reset the serial port in case of an error.

Chip Select Operation

The serial port is activated after NCS goes low; otherwise, MISO will be high-Z, while MOSI and SCLK will be ignored. If NCS is raised during a transaction, the entire transaction is aborted and the serial port will be reset. This is true for all transactions. After a transaction is aborted, the normal address-to-data or transaction-to-transaction delay is still required before beginning the next transaction. To improve communication reliability, all serial transactions should be framed by NCS. NCS can also be used to reset the serial port in case of an error occurs.

Registers

The ADNS-3050 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 Name	Register Description	Read/Write	Default Value
0x00	PROD_ID	Product ID	R	0x09
0x01	REV_ID	Revision ID	R	0x00
0x02	MOTION_ST	Motion Status	R/W	0x00
0x03	DELTA_X	Delta_X	R	0x00
0x04	DELTA_Y	Delta_Y	R	0x00
0x05	SQUAL	Squal Quality	R	0x00
0x06	SHUT_HI	Shutter Open Time (Upper 8-bit)	R	0x01
0x07	SHUT_LO	Shutter Open Time (Lower 8-bit)	R	0x00
0x08	PIX_MAX	Maximum Pixel Value	R	0x00
0x09	PIX_ACCUM	Average Pixel Value	R/W	0x00
0x0a	PIX_MIN	Minimum Pixel Value	R	0x00
0x0b	PIX_GRAB	Pixel Grabber	R/W	0x00
0x0d	MOUSE_CTRL	Mouse Control	R/W	0x01
0x0e	RUN_DOWNSHIFT	Downshift Time from Run to Rest 1	R/W	0x46
0x0f	REST1_PERIOD	Time Period of Rest 1	R/W	0x00
0x10	REST1_DOWNSHIFT	Downshift Time from Rest 1 to Rest 2	R/W	0x4f
0x11	REST2_PERIOD	Time Period of Rest 2	R/W	0x09
0x12	REST2_DOWNSHIFT	Downshift Time from Rest 2 to Rest 3	R/W	0x2f
0x13	REST3_PERIOD	Time Period of Rest 3	R/W	0 x31
0x1c	SHUT_THR	Shutter Threshold	R/W	0x41
0x1d	SQUAL_THRESHOLD	Squal Threshold	R/W	0x3d
0x22	NAV_CTRL2	LED Mode Configuration	R/W	0x00
0x25	MISC_SETTINGS	DCR and wakeup settings Register	R/W	0x61
0x34	LED_PRECHARGE	LED precharge time Register	R/W	0xa0
0x3a	RESET	Reset	W	0x00
0x3b	SHUTDOWN	Shutdown Register	W	0x00
0x3f	NOT_REV_ID	Inverted Revision ID	R	0xff
0x45	REST_MODE_CONFIG	Rest Mode Configuration	R/W	0x00