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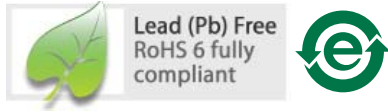


# ADNS-5700

## Optical Mouse Sensor



## Data Sheet



### Description

The ADNS-5700-XXXX is a compact, one chip USB optical mouse sensor for implementing a non-mechanical tracking engine for computer mice.

It is based on optical navigation technology that measures changes in position by optically acquiring sequential surface images (frames) and mathematically determining the direction and magnitude of movement.

The sensor is in a 18 -pin optical package that is designed to be used with the ADNS-5100-001 trim lens the ADNS-5200 Clip and the HLMP-EG3E-xxxxx LED. These parts provide a complete and compact mouse sensor. There are no moving parts, and precision optical alignment is not required, facilitating high volume assembly.

The output format is USB. This device meets HID Revision 1.11 specification and is compatible with USB Revision 2.0 specification.

Frame rate is varied internally to the sensor to achieve tracking and speed performance, eliminating the need for the use of many registers.

Default resolution is specified as 1000 counts per inch, with rates of motion up to 30 inches per second. Buttons and tilt wheel features are also available.

A complete mouse can be built with the addition of a PC board, switches and mechanical Z-wheel, plastic case and cable.

### Theory of Operation

The ADNS-5700-XXXX is based on Optical Navigation Technology. It contains an Image Acquisition System (IAS), a Digital Signal Processor (DSP) and USB stream output.

The IAS acquires microscopic surface images via the lens and illumination system provided by the ADNS-5100-001 trim lens, ADNS-5200 clip and HLMP-EG3E-xxxxx LED. These images are processed by the DSP to determine the direction and distance of motion. The DSP generates the x and y relative displacement values which are converted to USB motion data.

### Features

- Optical navigation technology
- Default resolution 1000cpi, selectable resolution 800cpi or 1200cpi through different part number
- High speed motion detection up to 30 inches per second (ips) and acceleration of 8g
- Accurate navigation over a wide variety of surfaces
- No precision optical alignment needed
- Wave Solderable
- Single 5.0 volt power supply
- Meets USB Revision 2.0 specification
- Meets HID Revision 1.11
- Tilt Wheel function
- Optical or Mechanical Z-Wheel function
- 12bits motion reporting
- 2 axis sensor rotation : 0° or 270°

### Applications

- Mice for desktop PC's, Workstations, and portable PC's
- Trackballs
- Integrated input devices

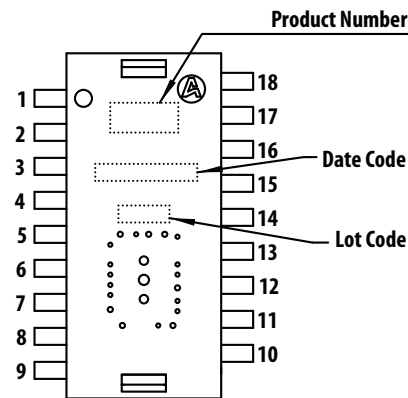
## Pinout 18pin PDIP

### ADNS-5700-XXXX

Pin Number	3 button	H4MB, H4NB	5 button
	H3MB, H3NB		H5MD, H5ND
1	D +	D +	D +
2	D -	D -	D -
3	ZA	ZA	ZA
4	ZB	ZB	ZB
5	LED_GND	LED_GND	LED_GND
6	XY_LED	XY_LED	XY_LED
7	V <sub>DD5</sub>	V <sub>DD5</sub>	V <sub>DD5</sub>
8	GND	GND	GND
9	REG0	REG0	REG0
10	V <sub>DD3</sub>	V <sub>DD3</sub>	V <sub>DD3</sub>
11	NC	TL	B4
12	NC	TR	OSC_IN
13	GND	GND	GND
14	OSC_IN	OSC_IN	OSC_OUT
15	OSC_OUT	OSC_OUT	B3
16	B3	B3	B2
17	B2	B2	B1
18	B1	B1	B5

### Pin description table

Pin Name	Description
D +	USB D+ line
D -	USB D- line
ZA	ZA Optical wheel quadrature input
ZB	ZB Optical wheel quadrature input
LED_GND	LED ground
XY_LED	XY_LED Input
V <sub>DD5</sub>	5 Volt Power (USB VBUS)
GND	System ground
ZLED	Z-Wheel LED input
REG0 / V <sub>DD3</sub>	3 Volt Power V <sub>DD3</sub>
NC	No Connect
OSC_IN	Ceramic resonator input
OSC_OUT	Ceramic resonator output
B5	Fifth Button
B4	Fourth Button
B3	Middle button input
B2	Right button input
B1	Left button input



Item	Marking	Remarks
Product Number	A5700	
Date Code	XYWWZ	X = Subcon Code YYWW = Date Code Z = Sensor Die Source
Lot Code	VVV	Numeric

Figure 1a. Package pinout

Note : See table for Part number marking

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## Strap (Jumper) Table

The PID/string strap matrix is the following:

Part Number	Description	Resolution (dpi)	Buttons	Tilt Wheel	Z-Wheel	Sensor Position	VID	PID	Mfg String	Product String
ADNS-5700-H3MB	Standard 3 buttons	1000	3	No	Mechanical	0°	0x192F	0x0416	Null	USB Optical Mouse
ADNS-5700-H4MB	Standard 3 buttons	1000	3	TW	Mechanical	0°	0x192F	0x0416	Null	USB Optical Mouse
ADNS-5700-H5MD	Standard 5 buttons	1000	5	No	Mechanical	0°	0x192F	0x0616	Null	USB Optical Mouse
ADNS-5700-H3NB	Standard 3 buttons	1000	3	No	Mechanical	270°	0x192F	0x0416	Null	USB Optical Mouse
ADNS-5700-H4NB	Standard 3 buttons	1000	3	TW	Mechanical	270°	0x192F	0x0416	Null	USB Optical Mouse
ADNS-5700-H5ND	Standard 5 buttons	1000	5	No	Mechanical	270°	0x192F	0x0616	Null	USB Optical Mouse

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The XY motion reporting direction when is lens is attached to the sensor is shown in Fig 1b for 0° and Fig 1c for 270° sensor orientation.

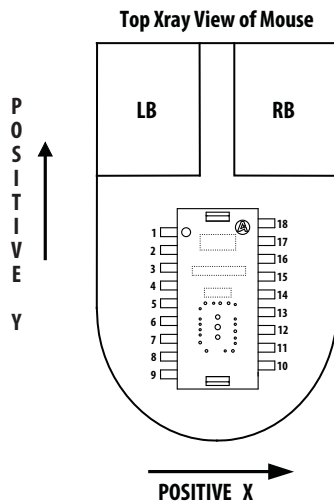


Figure 1b. Package pinout at 0°

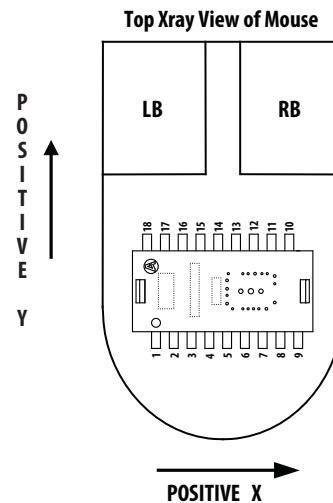
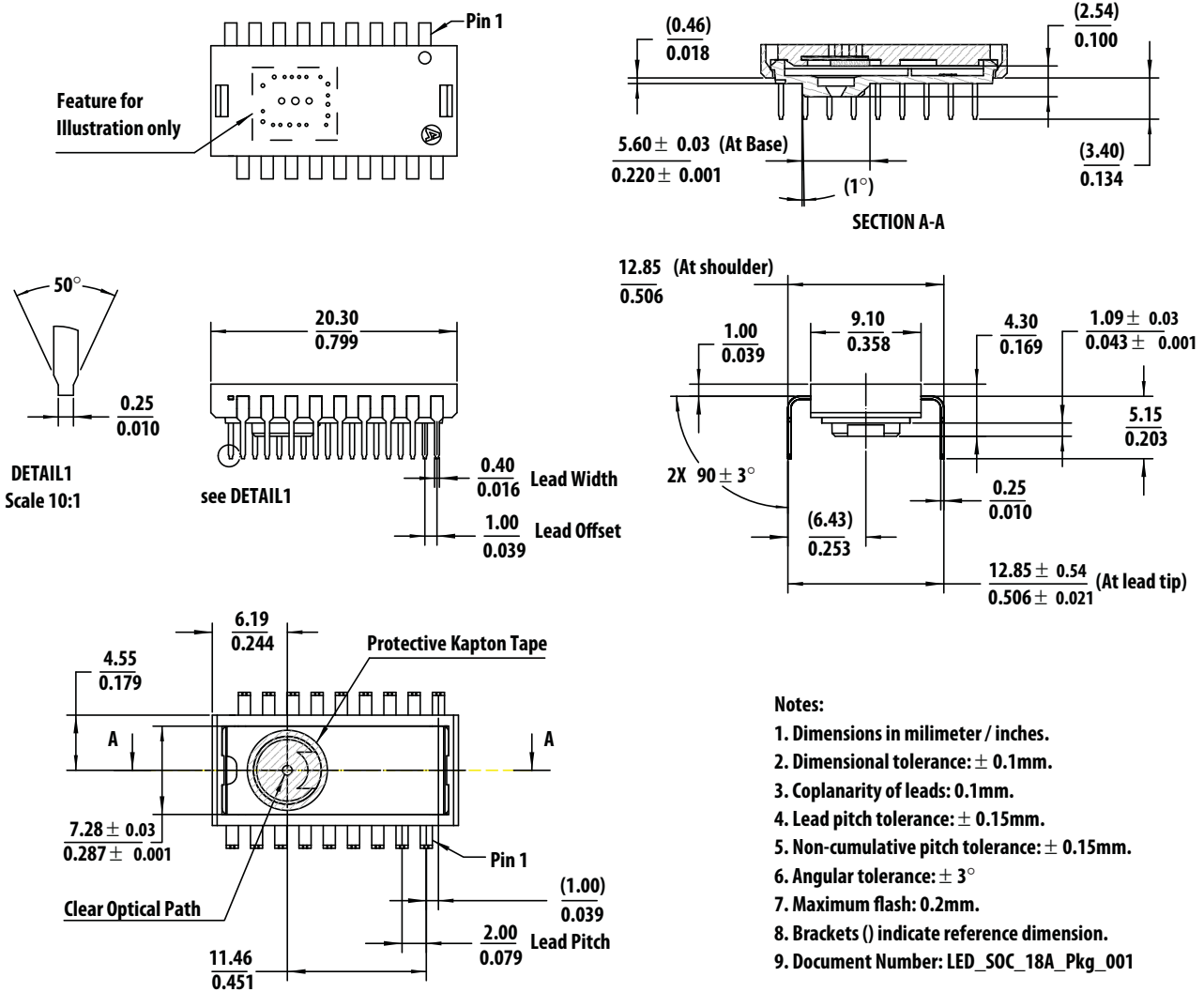


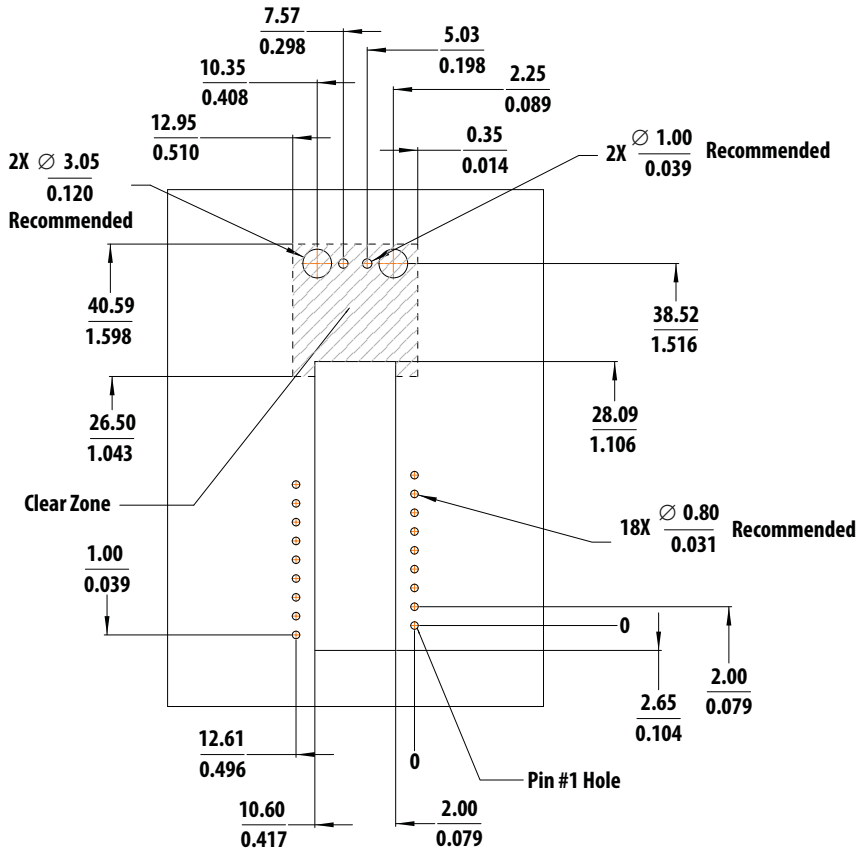
Figure 1c. Package pinout at 270°



- 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\_SOC\_18A\_Pkg\_001

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.

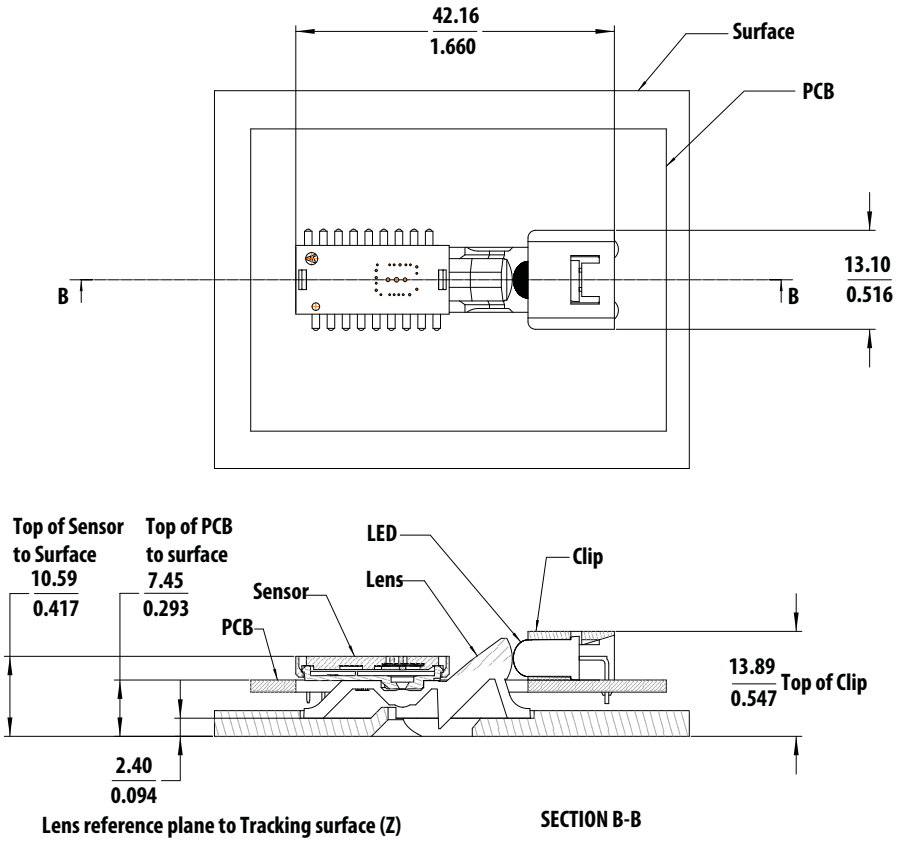


Notes:  
 1. Dimensions in millimeter / inches and for reference only.

Figure 3. Recommended PCB mechanical cutouts and spacing (Top view)

Note: The recommended pin hole dimension of the sensor is 0.7 mm. Shown with ADNS-5100-001 trim lens, ADNS-5200 clip and HLMP-EG3E-xxxxx.

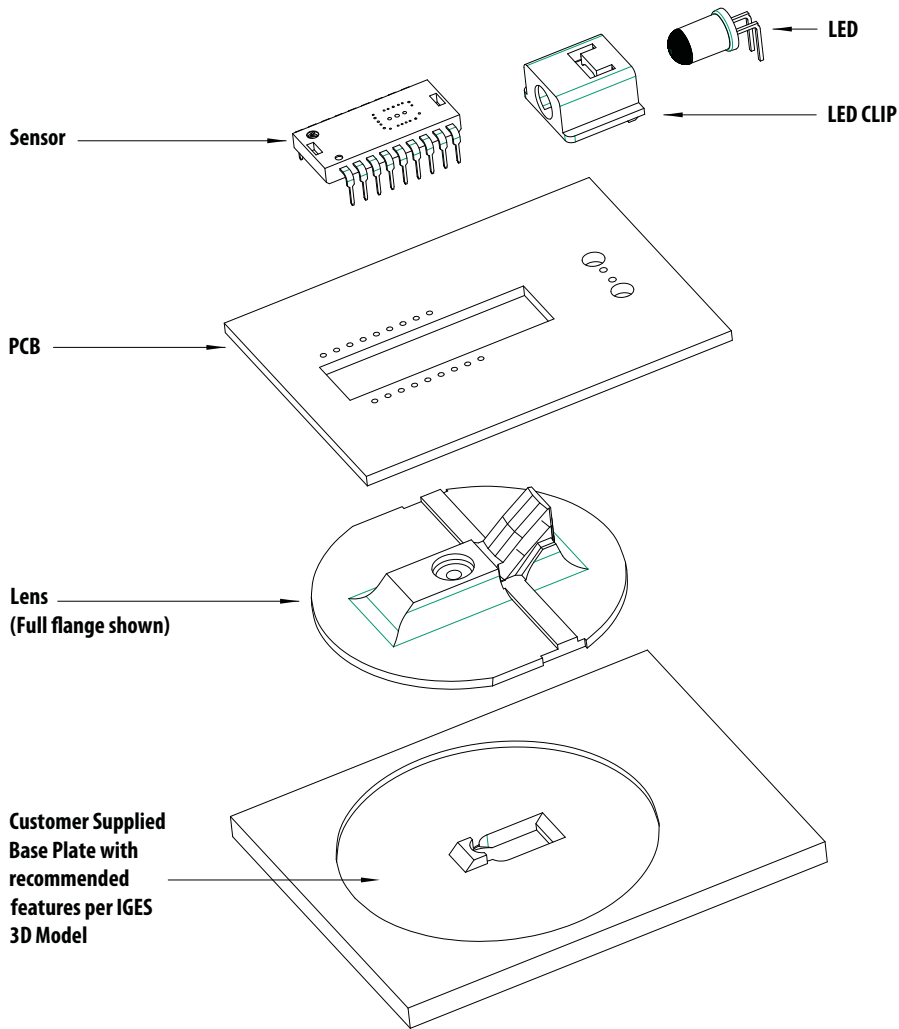
Avago Technologies provides an IGES file drawing describing the base plate molding features for lens and PCB alignment. Stand-off of the base plate shall not be larger than 5mm.



Notes:

1. All dimensions in millimeters/inches.
2. All tolerance  $\pm 0.1$  mm.

Figure 4. 2D assembly drawing of ADNS-5700-XXXX



**Figure 5. Exploded view drawing**

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

The ADNS-5700 sensor is designed for mounting on a through hole PCB, looking down. The aperture stop and features on the package align it to the lens (See figure 3).

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

The ADNS-5200 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.



## Block Diagram

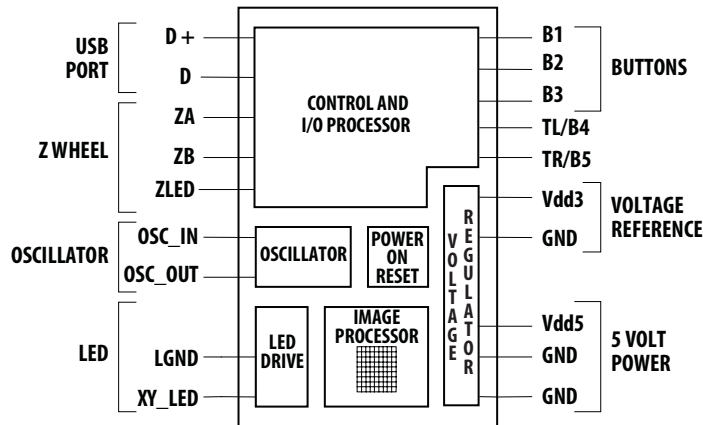


Figure 6. Block Diagram

## PCB Assembly Considerations

1. Insert the sensor and all other electrical components into PCB.
2. Bend the LED leads 90 degrees and then insert the LED into the assembly clip until the snap feature locks the LED base.
3. Insert the LED/clip assembly into PCB.
4. This sensor package is only qualified for wave-solder process.
5. Wave Solder the entire assembly in a no-wash solder process utilizing solder fixture. The solder fixture is needed to protect the sensor during the solder process. It also sets the correct sensor to PCB distance, as the lead shoulders do not normally rest on the PCB surface. The fixture should be designed to expose the sensor leads to solder while shielding the optical aperture from direct solder contact. A solder fixture **MUST** be used to set the correct sensor to PCB distance.
6. Place the lens onto the base plate.
7. Remove the protective Kapton tape from optical aperture of the sensor. Care must be taken to keep contaminants from entering the aperture. Recommend not placing the PCB facing up during the entire mouse assembly process. Recommend to hold the PCB first vertically for the Kapton removal process.
8. Insert PCB assembly over the lens onto base plate aligning post to retain PCB assembly. The sensor aperture ring should self-align to the lens.
9. 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.
10. Install mouse top case. There **MUST** be feature in the top case to press down onto the clip to ensure all components are interlocked to correct vertical height

## Design considerations for improving ESD Performance

The table below shows typical values assuming base plate construction per the Avago Technologies supplied IGES file and ADNS-5100-001 trim lens. Stand-off of the base plate shall not be larger than 5mm.

Typical Distance	ADNS-5100-001
Creepage	17.9mm
Clearance	9.2mm

Note that the lens material is polycarbonate or polystyrene HH30, therefore, cyanoacrylate based adhesives should not be used as they will cause lens material deformation

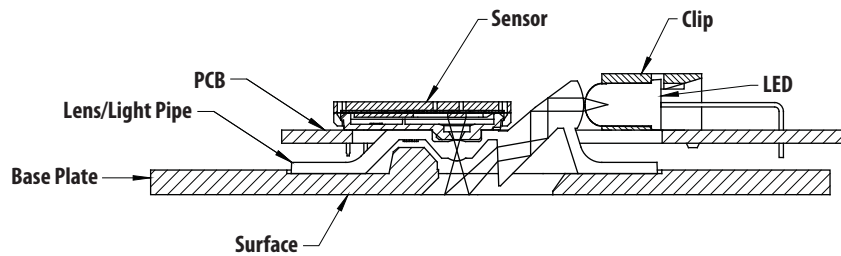
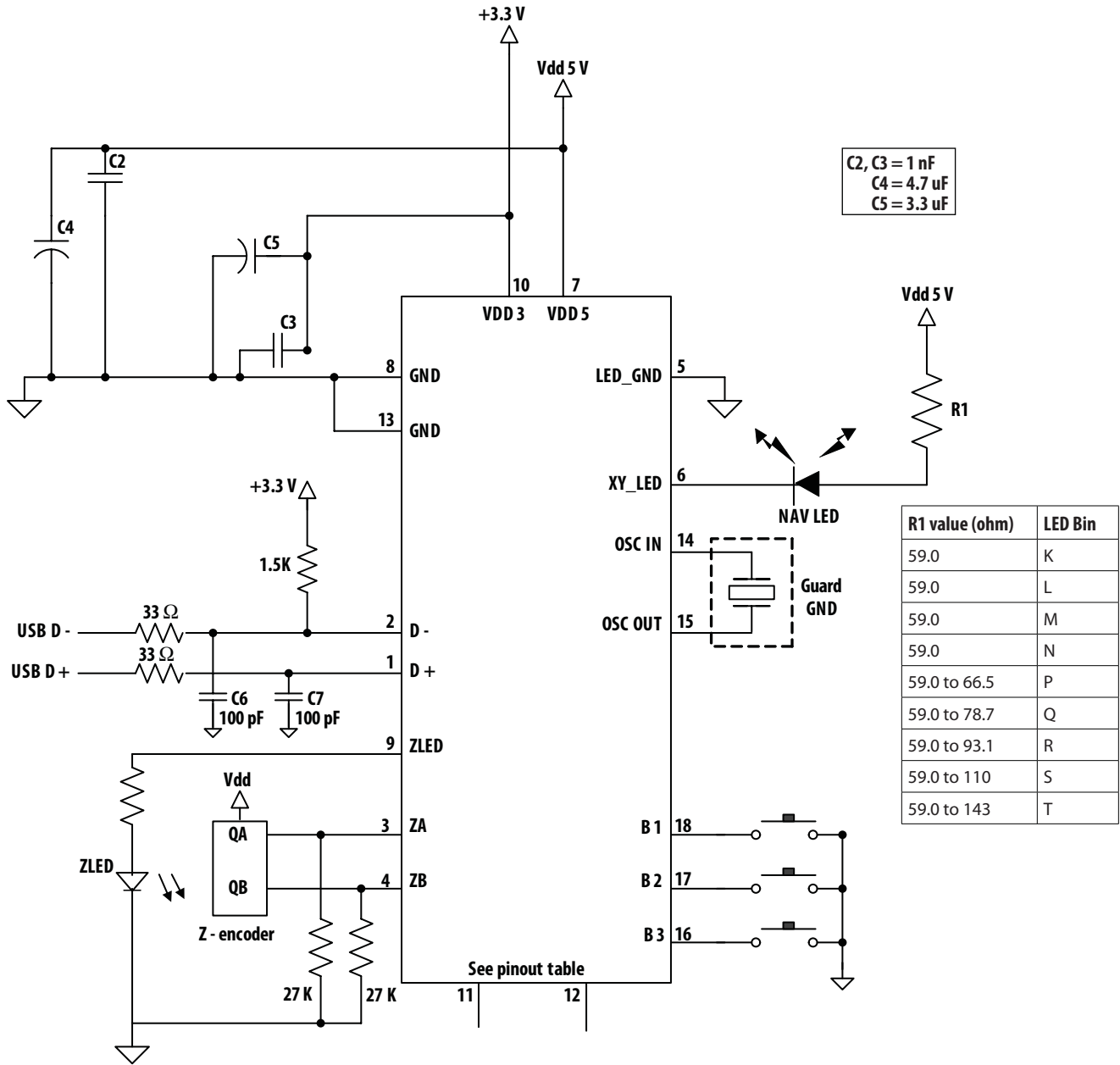


Figure 7. Typical Application



**Figure 8a. Application Circuit with ADNS-5700-HxxB with Optical Z-Wheel**

DISCLAIMER: ALL DESIGNERS AND MANUFACTURERS OF THIS DESIGN MUST ASSURE THAT THEY HAVE ALL NECESSARY INTELLECTUAL PROPERTY RIGHTS.

**Notes:**

- All caps (except C4) MUST be as close to the sensor pins as possible.
- C3 and C5 connected to pin 10 must be terminated at pin 13.
- Caps should be ceramic.
- Caps should have less than 5 nH of self inductance.
- Caps connected to V<sub>DD3</sub> MUST have less than 0.2Ω ESR.
- 1.5k resistor should be ± 1% tolerance.

Surface mount parts are recommended.

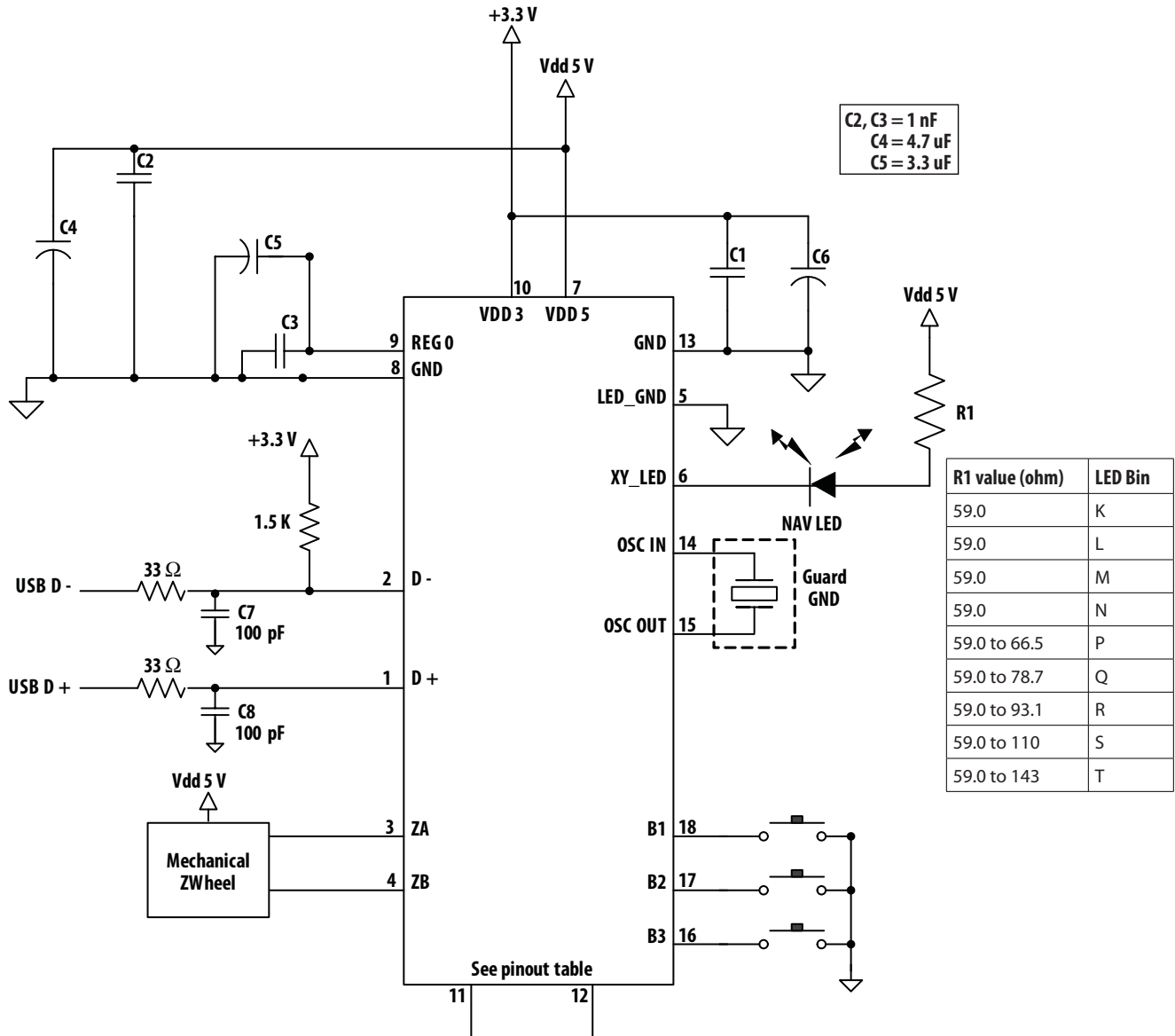


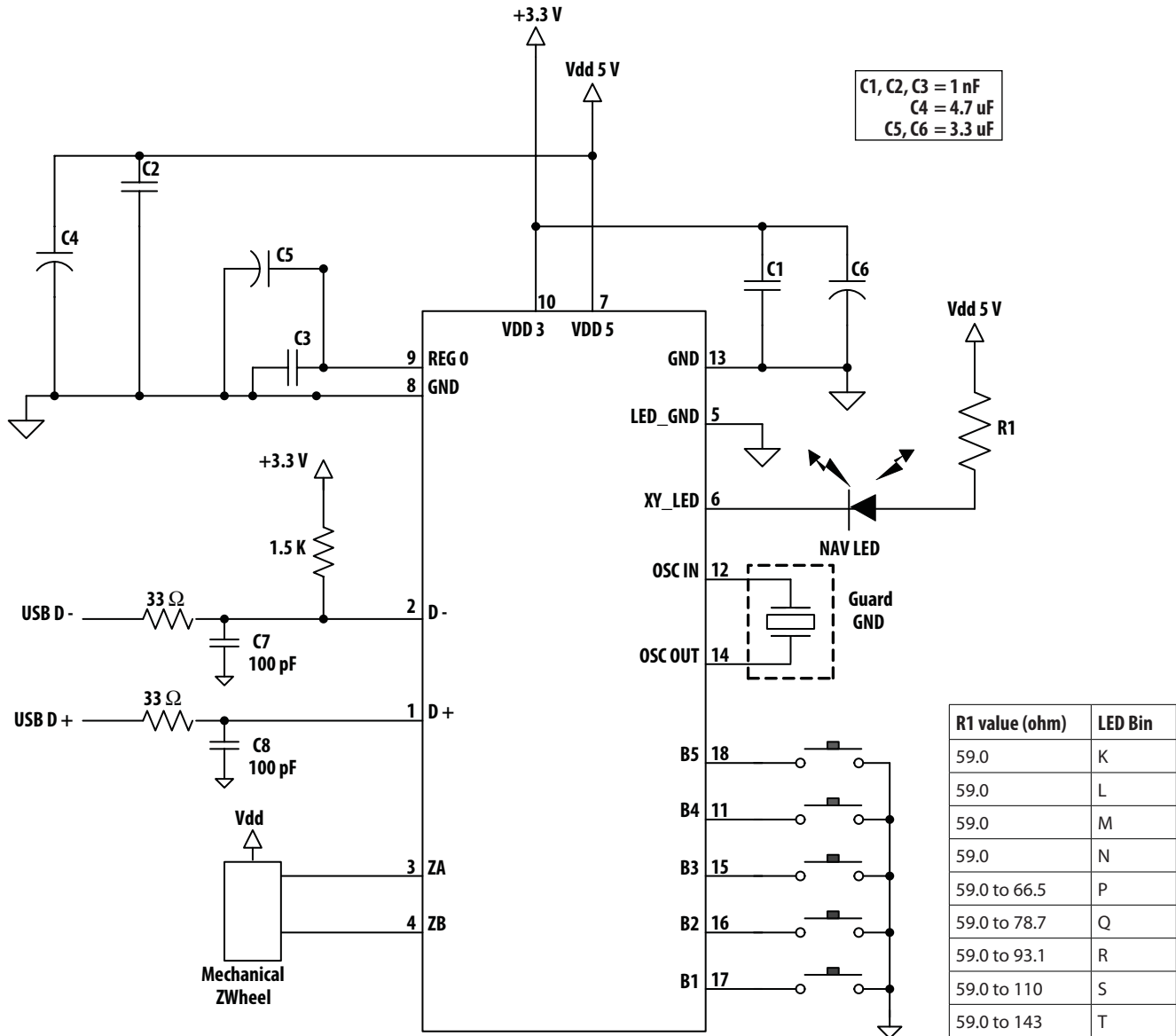
Figure 8b. Application Circuit with ADNS-5700-HxxB with Mechanical Z-Wheel

DISCLAIMER: ALL DESIGNERS AND MANUFACTURERS OF THIS DESIGN MUST ASSURE THAT THEY HAVE ALL NECESSARY INTELLECTUAL PROPERTY RIGHTS.

Notes:

- All caps (except C4) MUST be as close to the sensor pins as possible.
- C1 and C6 connected to pin 10 must be terminated at pin 13.
- C3 and C5 connected to pin 9 must be terminated at pin 8.
- Caps should be ceramic.
- Caps should have less than 5 nH of self inductance.
- Caps connected to V<sub>DD3</sub> MUST have less than 0.2Ω ESR.
- 1.5k resistor should be ± 1% tolerance.

Surface mount parts are recommended.



**Figure 8c. Application Circuit with ADNS-5700-H5MD and ADNS-5700-H5ND with 5 Button and Mechanical Z-Wheel**

DISCLAIMER: ALL DESIGNERS AND MANUFACTURERS OF THIS DESIGN MUST ASSURE THAT THEY HAVE ALL NECESSARY INTELLECTUAL PROPERTY RIGHTS.

**Notes:**

- All caps (except C4) MUST be as close to the sensor pins as possible.
- C1 and C6 connected to pin 10 must be terminated at pin 13.
- C3 and C5 connected to pin 9 must be terminated at pin 8.
- Caps should be ceramic.
- Caps should have less than 5 nH of self inductance.
- Caps connected to VDD3 MUST have less than 0.2Ω ESR.
- 1.5k resistor should be ± 1% tolerance.

## Regulatory Requirements

- Passes FCC B and worldwide analogous emission limits when assembled into a mouse with shielded cable and following Avago Technologies recommendations.
- Passes EN61000-4-4/IEC801-4 EFT tests when assembled into a mouse with shielded cable and following Avago Technologies recommendations.
- UL flammability level UL94 V-0.
- Provides sufficient ESD creepage/clearance distance to withstand discharge up to 15kV when assembled into a mouse with lens according to usage instructions above.

## Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units	Notes
Storage Temperature	T <sub>S</sub>	-40	85	°C	
Operating Temperature	T <sub>A</sub>	-15	55	°C	
Lead Solder Temp			260	°C	For 7 seconds, 1.6mm below seating plane.
Supply Voltage	V <sub>DD</sub>	-0.5	5.5	V	
ESD			2	kV	All pins, JESD22-A114
Input Voltage	V <sub>IN</sub>	-0.5	V <sub>DD</sub> +0.5	V	All I/O pins except OSC_IN and OSC_OUT, D+, D-
Input Voltage	V <sub>IN</sub>	-1.0	4.6	V	D+, D-, AC waveform, see USB specification (7.1.1)
Input Voltage	V <sub>IN</sub>	-0.5	3.6	V	OSC_IN and OSC_OUT
Input Short Circuit Voltage	V <sub>SC</sub>	0	V <sub>DD</sub>	V	D+, D-, see USB specification (7.1.1)

## Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Operating Temperature	T <sub>A</sub>	0		40	°C	
Power supply voltage	V <sub>DD</sub>	4.25	5.0	5.25	Volts	For accurate navigation and proper USB operation
Power supply voltage	V <sub>ddm</sub>	4	5.0	5.25	Volts	Maintains communication to USB host and internal register contents.
Power supply rise time	V <sub>RT</sub>	0.003		100	ms	
Supply noise	V <sub>N</sub>			100	mV	Peak to peak within 0-80 MHz bandwidth
Velocity	Vel		30		ips	
Acceleration	Acc			8	g	0.5g from Rest
Clock Frequency	f <sub>clk</sub>	23.64	24	24.36	MHz	Due to USB timing constraints
Resonator Impedance	X <sub>RES</sub>			55	Ω	
Distance from lens reference plane to surface	Z	2.3	2.4	2.5	mm	See Figure 9
Frame Rate			4000		fps	Internally adjusted by sensor

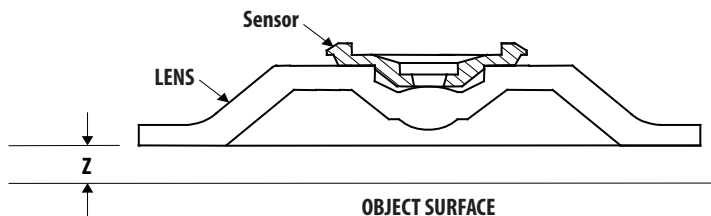


Figure 9. Distance from lens reference plane to object surface

## AC Electrical Specifications

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

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Wakeup delay from rest mode due to motion.	$T_{WUPP}$			2	ms	
Power up delay	$T_{PUP}$			50	ms	
Debounce delay on button inputs	$T_{DBB}$	5	10	17	ms	“Maximum” specified at 8ms polling rate.
Scroll wheel sampling period	$T_{SW}$	150	200	300	$\mu\text{s}$	ZA PIN for optical scroll wheel
		1.9	2.0	2.8	ms	ZA PIN for mechanical scroll wheel
Transient Supply Current	$I_{DDT}$			60	mA	Max. supply current during a $V_{DD}$ ramp from 0 to 5.0 V with > 500 $\mu\text{s}$ rise time. Does not include charging currents for bypass capacitors.
Input Capacitance (OSC Pins)	$C_{OSC\_IN}$		50		pF	OCS_IN, OSC_OUT to GND

## USB Electrical Specifications

Electrical Characteristics over recommended operating conditions.

Parameter	Symbol	Min.	Max.	Units	Notes
Output Signal Crossover Voltage	$V_{CRS}$	1.5	2.0	V	$C_L = 200$ to 600 pF (see Figure 10)
Input Signal Crossover Voltage	$V_{ICRS}$	1.2	2.1	V	$C_L = 200$ to 600 pF (see Figure 10)
Output High	$V_{OH}$	2.8	3.6	V	with 15 kohm to Ground and 7.5 k $\Omega$ to Vbus on D- (see Figure 11)
Output Low	$V_{OL}$	0.0	0.3	V	with 15 kohm to Ground and 7.5 k $\Omega$ to Vbus on D- (see Figure 11)
Single Ended Input	$V_{SEI}$		0.8	V	
Input High (Driven)	$V_{IH}$	2.0		V	
Input High (Floating)	$V_{IHZ}$	2.7	3.6	V	
Input Low	$V_{IL}$		0.8	V	7.5k $\Omega$ to $V_{DD5}$
Differential Input Sensitivity	$V_{DI}$	0.2		V	$ (D+)-(D-) $ See Figure 12
Differential Input Common Mode Range	$V_{CM}$	0.8	2.5	V	Includes $V_{DI}$ , See Figure 12
Single Ended Receiver Threshold	$V_{SE}$	0.8	2.0	V	
Transceiver Input Capacitance	$C_{IN}$		12	pF	D+ to $V_{BUS}$ , D- to $V_{BUS}$

## USB Timing Specifications

Timing Specifications over recommended operating conditions.

Parameter	Symbol	Min.	Max.	Units	Notes
D+/D- Transition rise time	$T_{LR}$	75		ns	$C_L = 200$ pF (10% to 90%), see Figure 10
D+/D- Transition rise time	$T_{LR}$		300	ns	$C_L = 600$ pF (10% to 90%), see Figure 10
D+/D- Transition fall time	$T_{LF}$	75		ns	$C_L = 200$ pF (90% to 10%), see Figure 10
D+/D- Transition fall time	$T_{LF}$		300	ns	$C_L = 600$ pF (90% to 10%), see Figure 10
Rise and Fall time matching	$T_{LRFM}$	80	125	%	$T_R/T_F$ ; $C_L = 200$ pF; Excluding the first transition from the Idle State
Wakeup delay from USB suspend mode due to buttons push	$T_{WUPB}$		17	ms	Delay from button push to USB operation Only required if remote wakeup enabled
Wakeup delay from USB suspend mode due to buttons push until accurate navigation	$T_{WUPN}$		50	ms	Delay from button push to navigation operation Only required if remote wakeup enabled
USB reset time	$T_{reset}$	18.7		$\mu$ s	
Data Rate	$t_{LDRATE}$	1.4775	1.5225	Mb/s	Average bit rate, 1.5 Mb/s +/- 1.5%
Receiver Jitter Tolerance	$t_{DJR1}$	-75	75	ns	To next transition, see Figure 13
Receiver Jitter Tolerance	$t_{DJR2}$	-45	45	ns	For paired transitions, see Figure 13
Differential to EOP Transition Skew	$t_{LDEOP}$	-40	100	ns	See Figure 14
EOP Width at Receiver	$t_{LEOPR}$	670		ns	Accepts EOP, see Figure 14
Source EOP Width	$t_{LEOPT}$	1.25	1.50	$\mu$ s	
Width of SE0 interval during Differential Transition	$t_{LST}$		210	ns	See Figure 11
Differential Output Jitter	$t_{UDJ1}$	-95	95	ns	To next transition, see Figure 15
Differential Output Jitter	$t_{UDJ2}$	-150	150		For paired transitions, see Figure 15

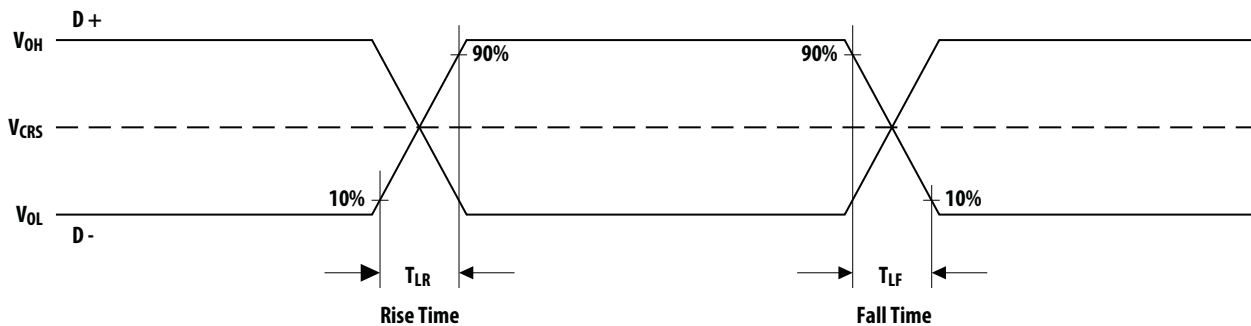


Figure 10. Data Signal Rise and Fall Times



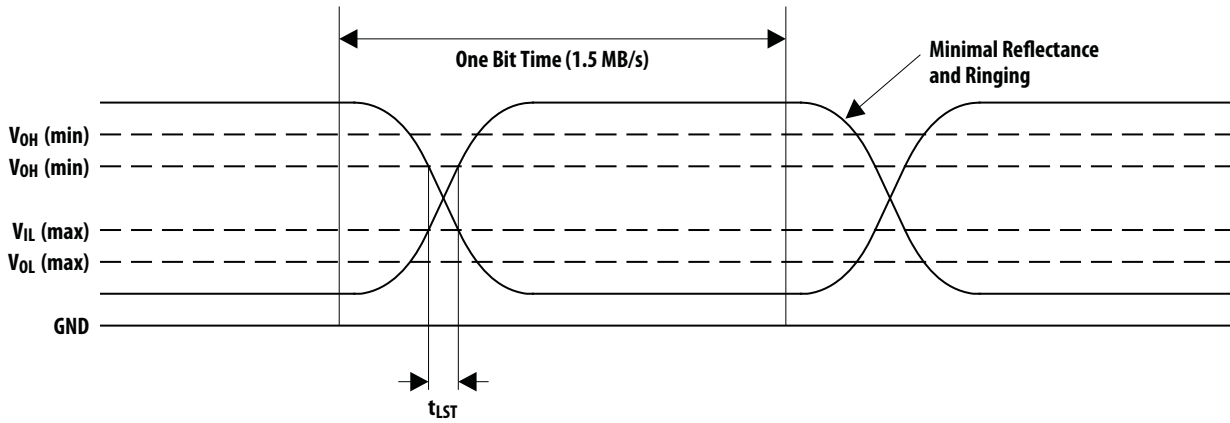


Figure 11. Data Signal Voltage Levels

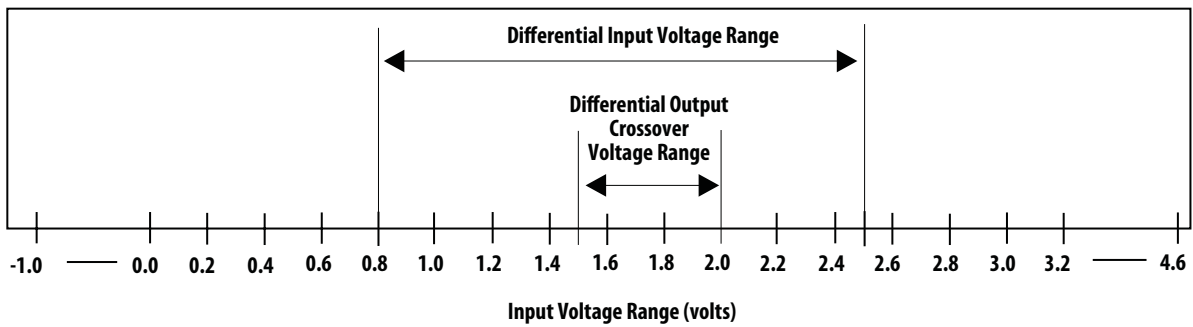


Figure 12. Differential Receiver Input Sensitivity vs. Common Mode Input Range

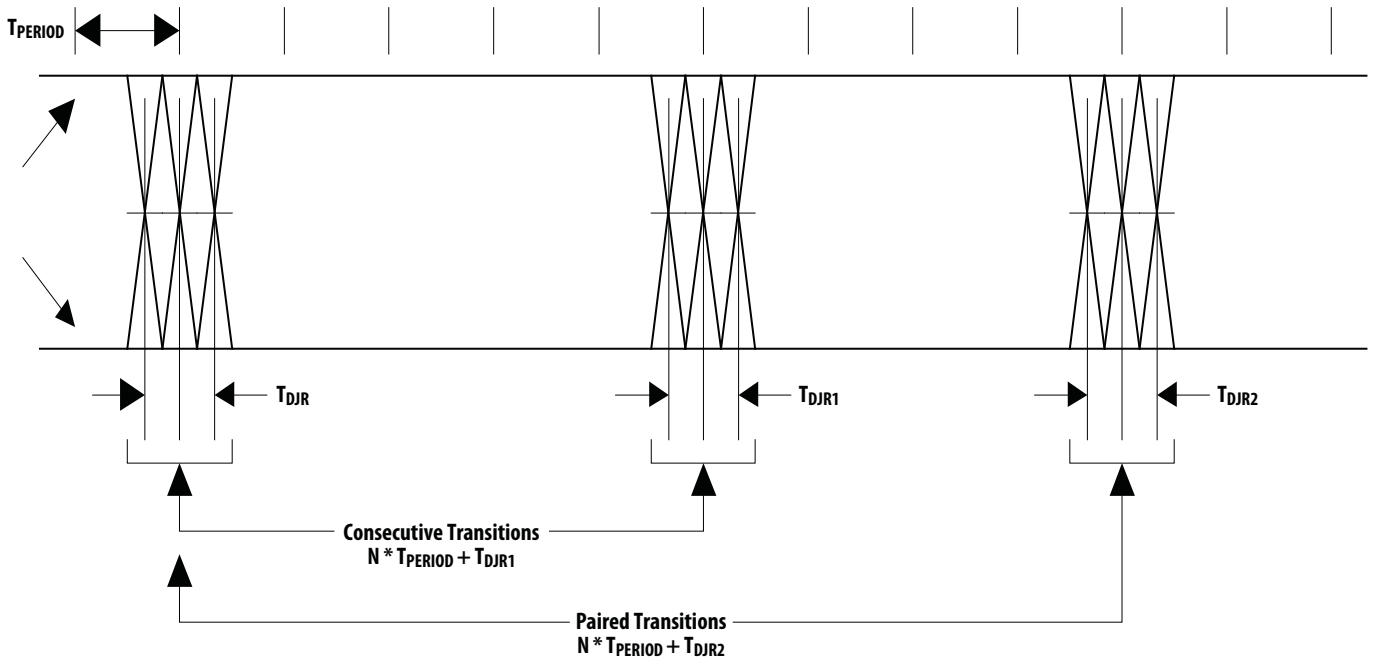


Figure 13. Receiver Jitter Tolerance

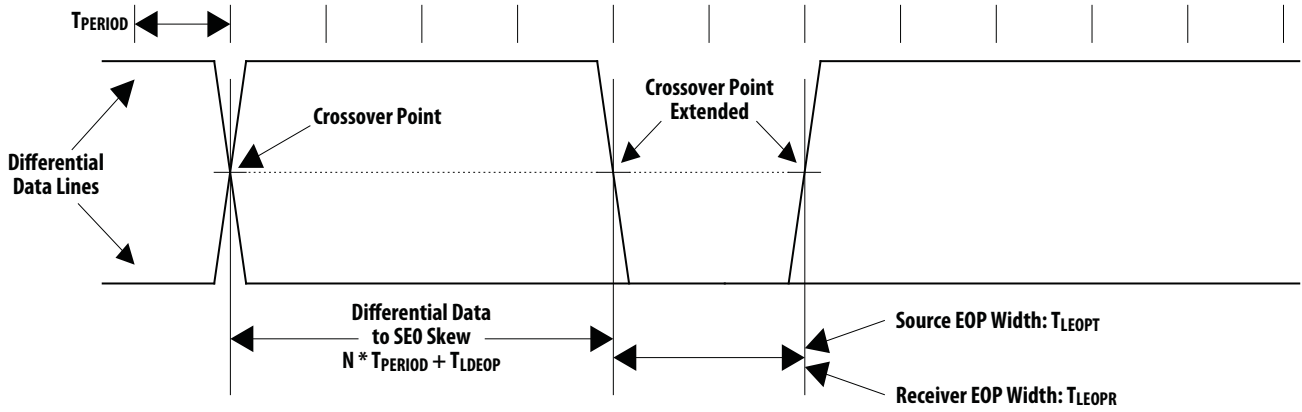


Figure 14. Differential to EOP Transition Skew and EOP Width

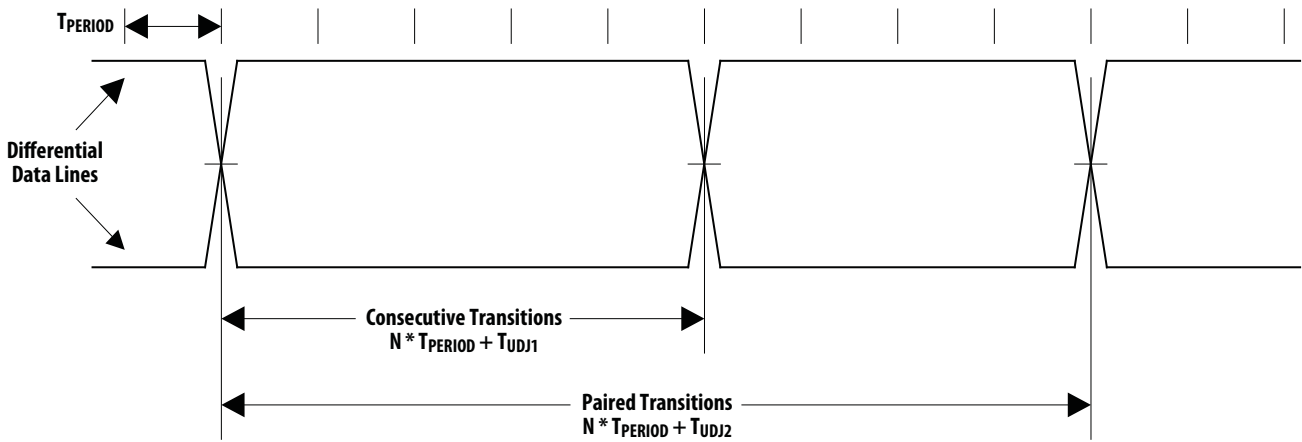


Figure 15. Differential Output Jitter

## 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
System Current, mouse moving	$I_{DD5}$			100	mA	Includes XY_LED current
System Current, mouse not moving	$I_{DD5N}$			100	mA	Includes XY_LED current
System current, USB suspend mode, Remote Wakeup Enabled	$I_{DD5S}$			500	$\mu$ A	Includes XY_LED current and D- pullup resistor.
Supply current (Sensor only), mouse moving	$I_{DD5}$		12	15	mA	No load on B1-B5, XY-LED, ZA, ZB, D+, D-
Supply current (Sensor only), mouse not moving	$I_{DD5N}$		11	14	mA	No load on B1-B5, XY-LED, ZA, ZB, D+, D-
Sensor supply current, USB suspend mode	$I_{DD5S}$			260	$\mu$ A	No load on B1-B5, XY-LED, ZA, ZB, D+,D-
XY_LED current	$I_{LED}$		40	49	mA	Typical at Rbin 59ohm with binP LED. Maximum DC current allowed through XY_LED pin and LED.
XY_LED Output Low Voltage	$V_{OL}$			1.1	V	Refer to Figure 16
Input Low Voltage	$V_{IL}$			0.5	V	Pins: ZA, ZB, B1-B5, $V_{IL}$ max of $0.5V_{DC}$ is at $V_{DD}$ min of $4V_{DC}$ , with a typical of $0.8V_{DC}$ at $V_{DD}$ of $5V_{DC}$
Input High Voltage	$V_{IH}$	$0.6*V_{DD}$			V	Pins: ZA, ZB, B1-B5
Input Hysteresis	$V_{HYST}$		285		mV	Pins: B1-B5, OPT 0, OPT 1
Button Pull Up Current	$B_{IOUT}$	125	275	500	$\mu$ A	Pins: B1-B5, OPT 0, OPT 1

## Buttons

The minimum time between button presses is TDBB. Buttons B1 through B5 are connected to a Schmidt trigger input with 100  $\mu$ A current sources pulling up to +3 volts during normal, sleep and USB suspend modes.

## Debounce Algorithm

- Button inputs B1, B2, B3, B4, B5 are sampled every 2ms.
- Three consecutive low create a button press event.
- Three consecutive high create a button release event.

## Typical Performance Characteristics

Performance Characteristics over recommended operating conditions. Typical values at 25 °C,  $V_{DD}=5.0$  V, 24MHz

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Path Error (Deviation)	$P_{Error}$		0.5		%	Average path error as percent of total 2.5" travel on various standard surfaces

The following graphs are the typical performance of the ADNS-5700 sensor, assembled as shown in the 2D assembly drawing with the ADNS-5100-001 trim lens/Prism, the ADNS-5200 clip, and the HLMP-EG3E-xxxxx LED.

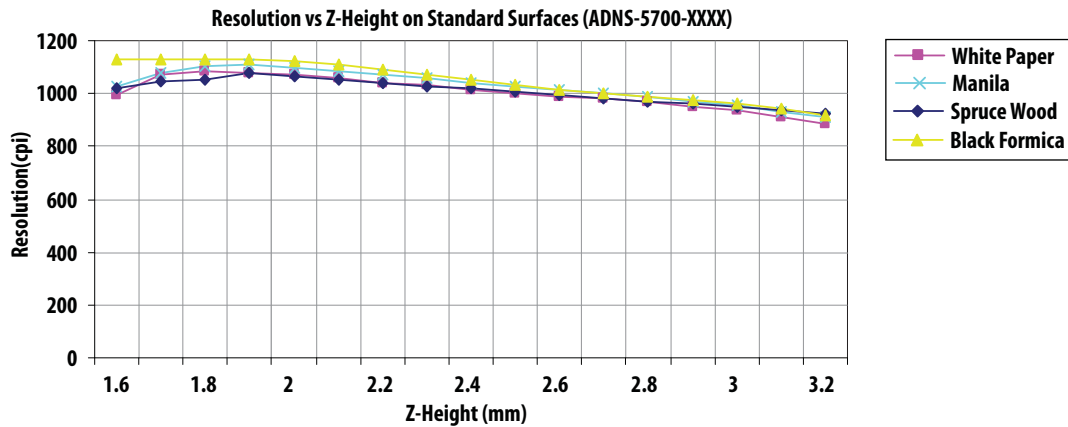


Figure 16. Typical Resolution vs. Z Height

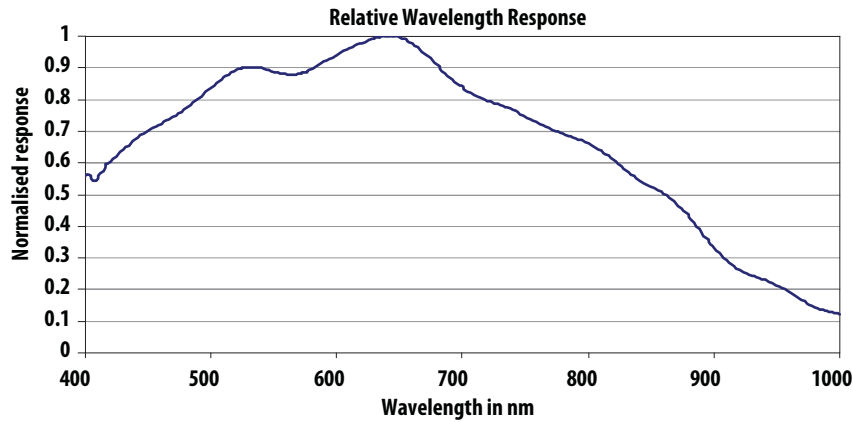


Figure 17. Wavelength responsivity,<sup>[1]</sup> (Comparative Surfaces)

Note:

1. The ADNS-5700 is designed for optimal performance when used with the HLMP-EG3E-xxxxx (Red LED 639nm).
2. Z = distance from Lens Reference Plane to Surface.
3. DOF = Depth of Field

## Configuration after Power up (Data Values)

<b>Signal Function</b>	<b>State from Figure 9-1 of USB spec: Powered or Default Address or Configured</b>	<b>State from Figure 9-1 of USB spec: Suspended from any other state</b>
B1	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use
B2	V <sub>DD3</sub> or GND if used as VID/PID jumper	V <sub>DD3</sub> or GND if used as VID/PID jumper
B3	V <sub>DD3</sub> or GND if used as VID/PID jumper	V <sub>DD3</sub> or GND if used as VID/PID jumper
B4	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use
B5	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use	V <sub>DD3</sub> or GND if used as VID/PID jumper else pullup active for button use
D-	USB I/O	Hi-Z input
D+	USB I/O	Hi-Z input
OSC_IN	24MHz	Logic '1'
OSC_OUT	24MHz	Logic '1'
XY_LED	Always ON / Pulsing	Pulled high (off)
ZB	Hi-Z input	Hi-Z input
ZA	Hi-Z if ZA tied to GND	Hi-Z input
Z_LED	Hi-Z input	Hi-Z input

## USB Commands

Mnemonic	Command	Notes
USB_RESET	D+/D- low > 18.7us	Device Resets; Address=0
USB_SUSPEND	Idle state > 3mS	Device enters USB low-power mode
USB_RESUME	Non-idle state	Device exits USB low-power mode
Get_Status_Device	80 00 00 00 00 00 02 00	Normally returns 00 00, Self powered 00 00, Remote wakeup 02 00
Get_Status_Interface	81 00 00 00 00 00 02 00	Normally returns 00 00
Get_Status_Endpt0	82 00 00 00 xx 00 02 00	OUT: xx=00, IN: xx=80 Normally returns 00 00
Get_Status_Endpt1	82 00 00 00 81 00 02 00	Normally returns 00 00, Halt 00 01
Get_Configuration	80 08 00 00 00 00 01 00	Return: 00=not config., 01=configured
Get_Interface	81 0A 00 00 00 00 01 00	Normally returns 00
Get_Protocol	A1 03 00 00 00 00 01 00	Normally returns 01, Boot protocol 00
Get_Desc_Device	80 06 00 01 00 00 nn 00	See USB command details
Get_Desc_Config	80 06 00 02 00 00 nn 00	See USB command details
Get_Desc_String	80 06 xx 03 00 00 nn 00	See USB command details
Get_Desc_HID	81 06 00 21 00 00 09 00	See USB command details
Get_Desc_HID_Report	81 06 00 22 00 00 nn 00	See USB command details
Get_HID_Input	A1 01 00 01 00 00 nn 00	Return depends on motion & config
Get_Idle	A1 02 00 00 00 00 01 00	Returns rate in multiples of 4ms
Get_Vendor_Test	C0 01 00 00 xx 00 01 00	Read register xx
Set_Address	00 05 xx 00 00 00 00 00	xx = address
Set_Configuration	00 09 xx 00 00 00 00 00	Not configured: xx=00 Configured: xx=01
Set_Interface	01 0B 00 00 00 00 00 00	Only one interface supported
Set_Protocol	21 0B xx 00 00 00 00 00	Boot: xx=00, Report: xx=01
Set_Feature_Device	00 03 01 00 00 00 00 00	Enable remote wakeup
Set_Feature_Endpt0	02 03 00 00 xx 00 00 00	Halt. OUT: xx=00, IN: xx=80
Set_Feature_Endpt1	02 03 00 00 81 00 00 00	Halt
Clear_Feature_Device	00 01 01 00 00 00 00 00	Disable Remote wakeup
Clear_Feature_Endpt0	02 01 00 00 xx 00 00 00	Clear Halt; OUT: xx=00, IN: xx=80
Clear_Feature_Endpt1	02 01 00 00 81 00 00 00	Clear Halt
Set_Idle	21 0A 00 rr 00 00 00 00	rr = report rate in multiples of 4ms
Set_Vendor_Test	40 01 00 00 xx yy 00 00	Write yy to address xx
Poll_Endpt1		Read buttons, motion, & Z-wheel

### Note:

The last two bytes in a command shown as "nn 00" specify the 16-bit data size in the order of "LowByte HighByte." For example a two-byte data size would be specified as "02 00." ADNS-5700-XXXX will not provide more bytes than the number requested in the command, but it will only supply up to a maximum of 8 bytes at a time. The ADNS-5700-XXXX will re-send the last packet if the transfer is not acknowledged properly.

## USB COMMAND DETAILS

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USB_RESET	D+/D- low for an extended period
USB Spec:	A device may reset after seeing an SE0 for more than 18.7 uS, and definitely after 10mS.
Notes:	After power up and prior to Reset, the device will not respond to any USB commands. After the device has been given a USB Reset, the device's address will be reset to zero and the device will be in the Default state. The chip will default to Report protocol and any pending output will be flushed.  All registers will be reset to a state that matches power-on-reset with the following exceptions: USB State register will be "Default" instead of "Attached".
USB_SUSPEND	Idle state for an extended period
USB Spec:	A device may suspend after seeing an idle for more than 3mS, and definitely after 10mS.
Notes:	The chip will take a minimum of 5mS to start Suspend, though will definitely start after 6mS. The chip may finish the current frame if necessary before stopping the clock. Thus, an additional frame time may be used to reach Suspend mode.
USB_RESUME	Non-idle state
USB Spec:	Remote Resume signalling from a device must be between 1mS and 15mS. The host is required to send Resume signaling for 20mS plus 10mS of resume recovery time in which it does not access any devices. This allows devices enough time to wake back up.
Notes:	The chip can cause a Resume if Remote Wakeup is enabled and a button has been pressed. Remote resume signalling from the chip will last 11.45mS to 12.45mS.
Get_Status_Device	80 00 00 00 00 00 02 00
Returns:	xx yy xx[0] = Self Powered xx[1] = Remote Wakeup xx[7:2] = 0 yy = 00 (Reserved)
Default:	Accept (undefined in USB Spec)
Addressed:	Accept
Configured:	Accept
Notes:	Use Set_Feature_Device/Clear_Feature_Device to set/clear remote wakeup.
Get_Status_Interface	81 00 00 00 00 00 02 00
Returns:	00 00
Default:	Stall (undefined in USB Spec)
Addressed:	Stall
Configured:	Accept
Notes:	Both return bytes are reserved and currently 00.

---

---

Get_Status_Endpt0	82 00 00 00 xx 00 02 00 82 00 00 00 00 00 02 00 82 00 00 00 80 00 02 00 xx = 00 = Endpt0 OUT xx = 80 = Endpt0 IN
Returns:	xx yy xx[0] = Halt xx[7:1] = 0 yy = 00 (Reserved)
Default:	Accept (undefined in USB Spec)
Addressed:	Accept
Configured:	Accept
Notes:	Use Set_Feature_Endpt0/Clear_Feature_Endpt0 to (try to) set/clear Halt bit. According to USB, "It is neither required or recommended that the Halt feature be implemented for the Default Control Pipe." Since a new SETUP command will clear any Endpt0 halt bit, it is impossible to tell if there really is a halt bit.

---

Get_Status_Endpt1	82 00 00 00 81 00 02 00
Returns:	xx yy xx[0] = Halt xx[7:1] = 0 yy = 00 (Reserved)
Default:	Stall (undefined in USB Spec)
Addressed:	Stall
Configured:	Accept
Notes:	Use Set_Feature_Endpt1/Clear_Feature_Endpt1 to set/clear Halt bit.

---

Get_Configuration	80 08 00 00 00 00 01 00
Returns:	xx xx = config value
Default:	Accept (undefined in USB Spec) – returns 00
Addressed:	Accept – returns 00
Configured:	Accept – returns 01
Notes:	Use Set_Configuration to change.

---

Get_Interface	81 0A 00 00 00 00 01 00
Returns:	00
Default:	Stall (undefined in USB Spec)
Addressed:	Stall
Configured:	Accept – returns 00
Notes:	Command has no alternate interfaces, so only valid value is 00

---



---

Get_Protocol	A1 03 00 00 00 00 01 00
Returns:	xx xx = 00 = Boot protocol xx = 01 = Report protocol
Default:	Accept
Addressed:	Accept
Configured:	Accept
Notes:	Defaults to Report protocol after USB Reset. Use Set_Protocol to change.

---

Get_Desc_Device	80 06 00 01 00 00 nn 00 80 06 00 01 00 00 12 00
Returns:	12 01 00 02 00 00 00 08 vv vv pp pp dd dd mm PP ss 01 vv vv = vendor id pp pp = product id (vendor specified) dd dd = device id (vendor specified) (bcd rev_id byte) mm = iManufacturer PP = iProduct ss = iSerialNumber (00 - no string)
Default:	Accept
Addressed:	Accept
Configured:	Accept Get_Desc_String will return "stall" if Manufacturer string is queried when iManufacturer = 0x00.

---

---

```

Get_Desc_Config  80 06 00 02 00 00 nn 00
                 80 06 00 02 00 00 22 00

Returns:         09 02 22 00 01 01 00 A0
                 32 09 04 00 00 01 03 01
                 02 00 09 21 11 01 00 01
                 22 rr 00 07 05 81 03 05
                 00 0A
                 rr = HID Report descriptor length
                 47 = 12 bit motion reporting

With Z-Wheel:   09 02 22 00 01 01 00 A0
                 32 09 04 00 00 01 03 01
                 02 00 09 21 11 01 00 01
                 22 3D 00 07 05 81 03 04
                 00 0A
                 // Config Descriptor
                 | 09 // bLength
                 | 02 // bDescriptorType
                 | 22 // wTotalLength (34 decimal)
                 | 00 // high byte of WTotalLength
                 | 01 // bNumInterfaces
                 | 01 // bConfigurationValue
                 | 00 // iConfiguration
                 | A0 // bmAttributes (bus powered/remote wakeup)
                 | 32 // MaxPower (in 100mA in 2mA units)
                 // Interface Descriptor
                 | 09 // bLength
                 | 04 // bDescriptorType
                 | 00 // bInterfaceNumber
                 | 00 // bAlternateSetting
                 | 01 // bNumEndpoints
                 | 03 // bInterfaceClass (HID Class)
                 | 01 // bInterfaceSubClass
                 | 02 // bInterfaceProtocol
                 | 00 // iInterface
                 // HID Descriptor
                 | 09 // bLength
                 | 21 // bDescriptorType
                 | 11 // bcdHID ( HID Release ###.###; HID 1.11 compliant )
                 | 01 //
                 | 00 // bCountry
                 | 01 // bAvailable
                 | 22 // bType
                 | 34 // wLength (Length of HID Report below)
                 | 00 //
                 // Endpoint Descriptor
                 | 07 // bLength
                 | 05 // bDescriptorType
                 | 81 // bEndpointAddress (IN & #=1)
                 | 03 // bmAttributes (Interrupt)
                 | 05 // wMaxPacketSize
                 | 00 // 12bit 0x06
                 | 0A // bInterval (10mS)

```