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A2639B

USB+PS/2 Optical Mouse Sensor SOC

1. Description

A2639B is a single-chip 3D3Key optical mouse sensor with USB and PS2 interface. It is compatible with Microsoft 3D IntelliMouse and USB V1.1. It supports mechanical scroll Z-axis input. A2639B supports 800/1200 CPI. It requires minimal external components to implement 3D USB+PS2 mouse. Furthermore, A2639B is pip-to-pin compatible with A2633 A2636 A2637, and saves PCB tooling cost and cuts down the time from testing to production.

1.1 Features

- Single 5V power supply
- Microsoft 3D and IBM PS/2 mouse compatible
- Single chip solution for both USB & PS/2 mouse function
- Designed for Vista, Windows 2000, XP, ME, and 98 and Linux
- Complete USB v1.1 1.5Mbps compatibility
- Supports three buttons (L, M, R) and 3D input
- High speed motion detection
- Support 800/1200 DPI and dynamic DPI toggle
- Adjustable frame rate
- Support USB-only and PS2-only mode
- Supports mechanical Z-axis scroll
- External-components-free internal oscillator
- WHQL certification
- Sleep mode(sensor not moving) function and wake-up feature
- Built-in de-bounce circuits
- Built-in power-on-reset
- Built-in regulators
- USB & PS/2 Plug and Play
- Minimal external components
- ROHS compliant
- 12-pin staggered DIP package

Key Specification

Power supply	4.25 V~5.5V
Interface	USB + PS2
Optical Lens	1:1
System clock	25MHz
Resolution	800/1200 CPI
Frame Rate	Adjustable frame rate
Operating Current	Less than 20mA at mouse moving
	Less than 5mA at mouse not moving
	Less than 0.5mA at USB suspend mode
Package	Staggered DIP12

Applications

Optical USB or PS/2 mice for desktop PC, workstation and laptop

Ordering Information

Part Number	Package	Description
A2639B	Staggered DIP12	USB or PS/2 optical mouse SOC

2. Block Diagram

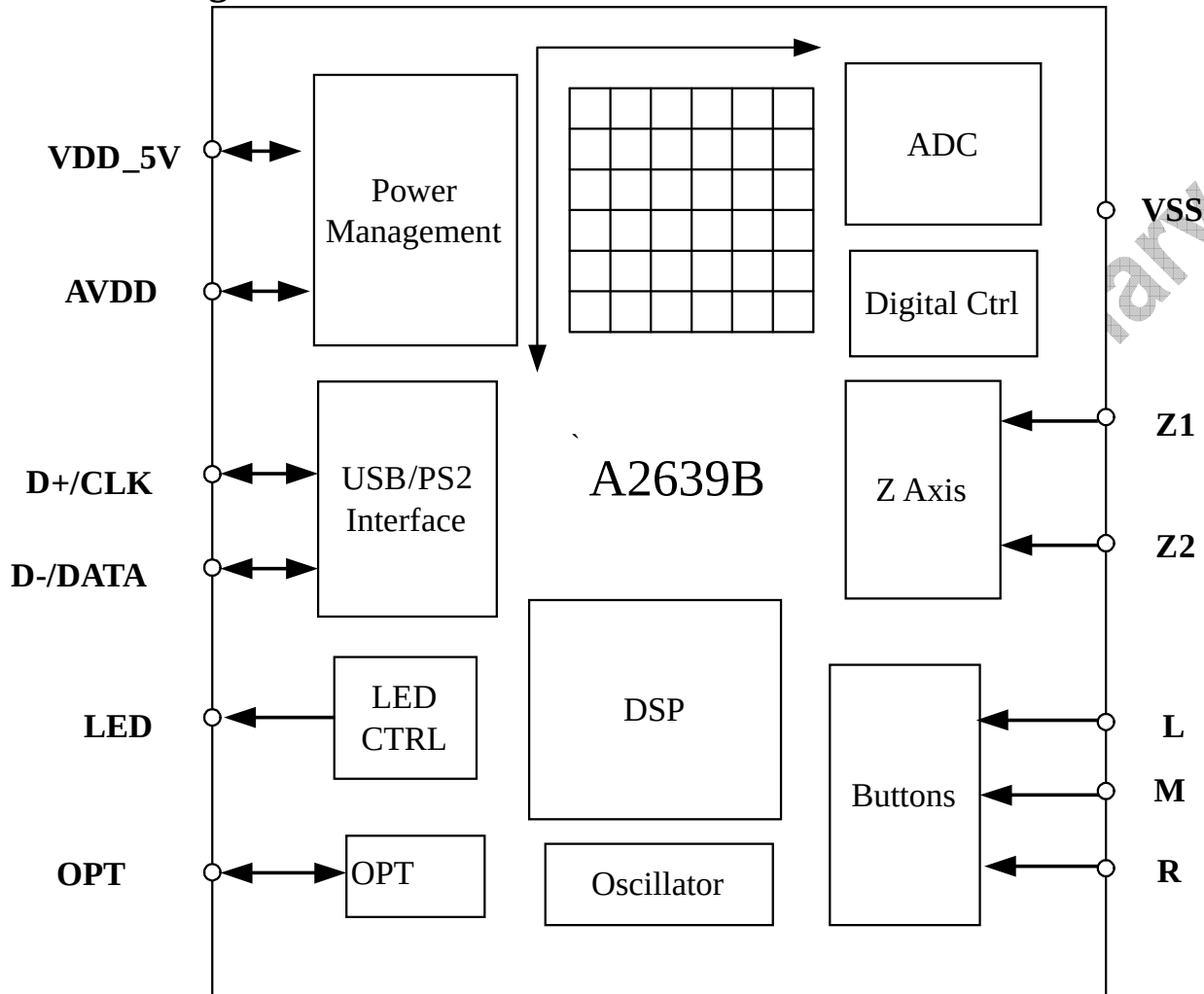


Fig. 2-1 The SDIP 12 PIN Package for USB/PS2 All-In-One Mouse A2639B

3. Pin Assignment

A2639B

USB+PS/2 Optical Mouse Sensor SOC



Fig. 3-1 Pin assignment of A2639B

4. Pin Description

Pin No.	Pin Name	I/O	Character	Description
1	VSS		0V	Negative power supply, ground
2,3	Z1, Z2	I	CMOS input, internal 100KΩ pull-down, 5V tolerance	Z axis, mechanical input
5	M	I	CMOS input, Strap-PIN for USB-only option	Middle key, option selectable with pull-down resistor
4,6	L,R	I	CMOS input, internal 40KΩ pull-up to 5V, 5V tolerance	Left and Right keys
7	OPT	I/O	5V tolerance CMOS I/O, internal 500KΩ pull-up to 5V	DPI selection and toggle
8	LED	O	5V tolerance open drain	LED driver
9	D-/DATA	I/O	5V tolerance input/output	USB D- and/or PS/2 Data
10	D+/CLK	I/O	5V tolerance input/output	USB D+ and/or PS/2 Clock
11	AVDD	I	Analog input/output	Analog Voltage Reference
12	VDD5V		5V DC	5V positive power supply

5. Function Definition

5.1 USB & PS/2 Plug and Play Function

A2639B supports USB and PS/2 bus, and it also supports USB & PS2 Plug and Play function by Power-On-Reset function.

5.1.1. Power-On-Reset function

When VDD connected to the power source, the POR block in analog section will generate a “0” to “1” reset signal about 800 μs or later from VDD voltage is larger than 2.9~3.4V.

5.1.2. Power-down-set function

When VDD voltage drops to lower than about 2.8V, the POR block in analog section will generate a “1” to “0” set signal and disable operations until VDD voltage is high enough to generate another reset signal. This function makes sure quick plug and play function works well.

5.2 De-bounce circuits

The minimum key press and release de-bounce interval is 12ms. The de-bounce is available in L, M, R, Z1, Z2, De-bounce is also available in USB suspend mode, but in a different clock frequency generated by wakeup block.

5.3 Built-in regulators

A2639B generates analog reference voltage and digital core power supply by LDO. The analog reference voltage is connected to external decoupling capacitor by pin AVDD. In order to guarantee the stability of LDO, the external capacitor is chose carefully to satisfy the spec illustrated in following figure.

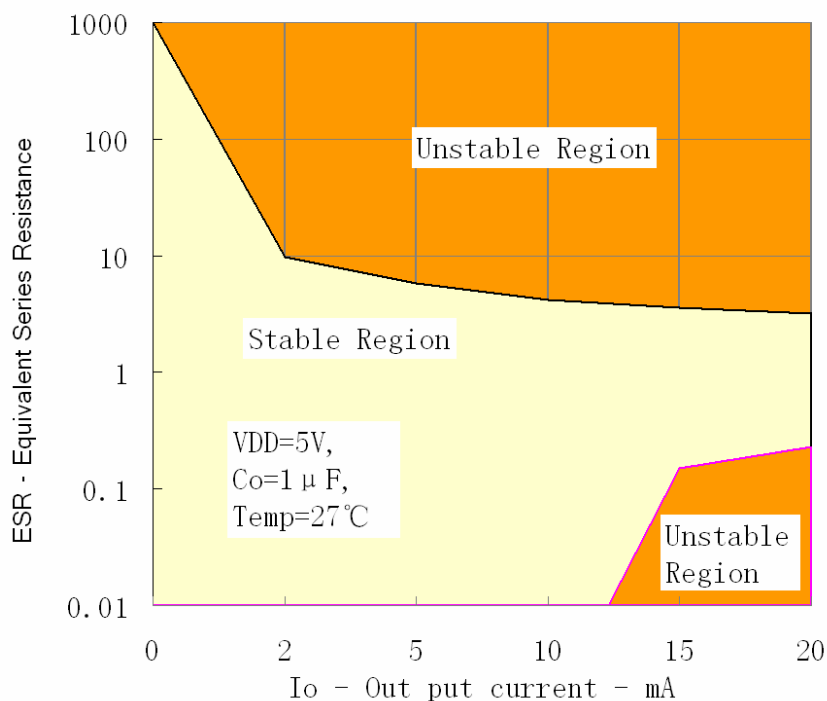


Fig. 5-1 Relationship 1 μ F decoupling capacitor ESR and LDO output current

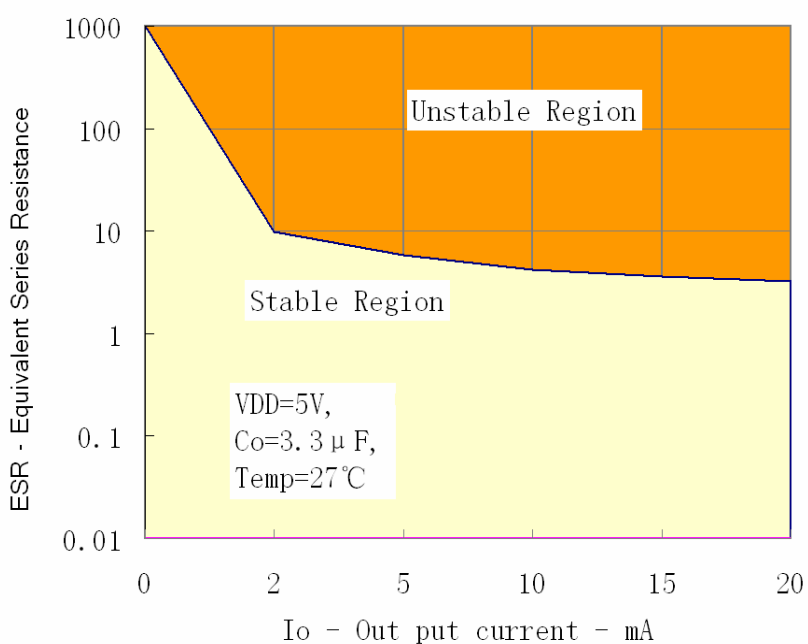


Fig. 5-2 Relationship 3.3 μ F decoupling capacitor ESR and LDO Output current

5.4 No Crystal Function

A2639B needs no external crystal or ceramic oscillator and no clock pins. It uses an internal oscillator with accuracy to guarantee the USB1.1 1.5M compatibility. Compared with previous products, the USB no crystal function is optimized. These techniques are the guarantee to completely pass USB-IF test.

5.5 External option for USB-only or USB/PS2 in A2639B

In default, A2639B supports USB and PS2 interfaces; A2639B also supports USB-only interface by external option configuration. The option is set to USB-only by a pull-down resistor of 510K($\pm 5\%$) in pin M.

5.6 Suspend function

A2639B support the suspend mode defined by USB specification. The total suspend current of the whole mouse system is within 470 μ A.

5.6.1. Suspend mode definition

Condition of suspend

A2639B will begin to shift to suspend mode when the USB is idle for 3ms. The whole mouse system will be to suspend mode within 10ms from the last bus activity.

Suspend status

When A2639B is in suspend mode, the recovery block will monitor the L/R/M buttons. If any button is pressed, it will wake up the whole system, by sending resume signal to USB bus. During suspend mode, A2639B will close the clock oscillator. The function of PAD Z will also be turned off to save the power consumption.

Suspend current

The suspend current of A2639B is typically 200 μ A. After summing up the pull-up resistor for D- of 200 μ A, the whole mouse system's suspend current can be limited to 470 μ A.

Resumed by host

A2639B can resumed from suspend mode by USB host. The resume signal is defined by USB specification as 20ms state "K" and one EOP followed.

Remote wakeup

A2639B can also resumed from suspend mode by L/M/R button pressing. Any button pressing will cause A2639B send a state "K" to USB bus for at least 5ms no more than 15ms. Then USB host will send 20ms state "K" and one EOP followed. Then the system wake up. This flow called remote wakeup.

6. Electrical Characteristics

6.1 Absolute Maximum Ratings

Typical values at 25 °C, VDD=5.0 V,					
Parameter	Symbol	Mini	Maximum	Units	Notes
		mum			
Storage Temperature	T _{STG}	-40	85	°C	
Operating Temperature	T _{OPR}	-15	55	°C	
Lead Solder Temp			260	°C	For 10 seconds, 1.6mm below seating plane.
Supply Voltage	V _{CC}	-0.3	5.5	V	
ESD			2	kV	All pins, human body model MIL 883 Method 3015

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Input Voltage	V_I	V_{SS}	5.5	V	All I/O pins except M
		-0.3			
Input Voltage	$V_{IUSB/PS2}$	V_{SS}	5.5	V	D+, D-,
		-0.3			
Input Voltage	V_{IM}	-0.5	3.6	V	M

Note: These are stress ratings only. Stresses exceeding the range specified under Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

6.2 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Operating Temperature	T_A	0		40	°C	
Power supply voltage	V_{DD}	4.25	5.0	5.5	Volts	For accurate navigation and proper USB operation
Power supply rise time	V_{RT}	0.1		100	ms	
Supply noise	V_N			100	mV	Peak to peak within 0-100 MHz bandwidth
Velocity	Vel		28		ips	
Acceleration	Acc			18	G	
Distance from lens reference plane to surface	Z	2.3	2.4	2.5	mm	See Figure 8-1
Light level onto IC	IRRINC	80		25,000	MW/m ²	$\lambda = 639 \text{ nm}$, $\lambda = 875 \text{ nm}$ (*Avago data, ref. only)
		100		30,000		
Frame Rate			2400		fps	Internally adjusted by sensor

6.3 AC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, VDD=5.0 V,

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Wakeup delay from rest mode due to motion.	T_{WUPP}			50	ms	
Power up delay	T_{PUP}			50	ms	
Debounce delay on button inputs	T_{DBB}		20		ms	.
Scroll wheel sampling period	T_{SW}		10		μs	Z PIN

6.4 USB Electrical Specifications

Electrical Characteristics over recommended operating conditions (see Fig. 6-1 ~ Fig. 6-5)

Parameter	Symbol	Min.	Max.	Units	Notes
Output Signal Crossover Voltage	VCRS	1.5	2.0	V	CL = 200 to 600 pF
Input Signal Crossover Voltage	VICRS	1.2	2.0	V	CL = 200 to 600 pF

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Output High	VOH	2.8	3.6	V	15K Ω resistor to ground and 1.5K Ω resistor to V33 on D-
Output Low	VOL	0.0	0.3	V	15K Ω resistor to ground and 1.5K Ω resistor to V33 on D-
Single Ended Input	VSEI		0.8	V	
Input High (Driven)	VIH	2.0		V	
Input High (Floating)	VIHZ	2.7	3.6	V	
Input Low	VIL		0.8V		
Differential Input Sensitivity	VDI	0.2		V	(D+)-(D-)
Differential Input Common Mode Range	VCM	0.8	2.5	V	
Single Ended Receiver Threshold	VSE	1.3	2.0	V	
Transceiver Input Capacitance	CIN		12	pF	D+ to VBUS, D- to VBUS

6.5 USB Timing Specifications

Timing Specifications over recommended operating conditions (see Fig. 6-1 ~ Fig. 6-5)

Parameter	Symbol	Min.	Max.	Unit	Notes
D+/D- Transition rise time	TLR	75		ns	CL = 200 pF (10% to 90%)
D+/D- Transition rise time	TLR		300	ns	CL = 600 pF (10% to 90%)
D+/D- Transition fall time	TLF	75		ns	CL = 200 pF (90% to 10%)
D+/D- Transition fall time	TLF		300	ns	CL = 600 pF (90% to 10%)
Rise and Fall time matching	TLRFM	80	125	%;	TR/TF CL = 200 pF; Excluding the first transition from the Idle state
Wakeup delay from USB suspend mode	TWUPB		30	ms	Delay from button push to USB operation due to buttons push Only required if remote wakeup enabled
Wakeup delay from USB suspend mode	TWUPN		32	ms	Delay from button push to navigation due to buttons push until accurate operation navigation Only required if remote wakeup enabled
USB reset time	Treset	2.5		μ s	
Data Rate	tLDRATE	1.4775	1.5225	Mb/s	Average bit rate, 1.5 Mb/s +/- 1.5%
Receiver Jitter Tolerance	tDJR1	-75	75	ns	To next transition
Receiver Jitter Tolerance	tDJR2	-45	45	ns	For paired transitions
Differential to EOP Transition Skew	tLDEOP	-40	100	ns	
EOP Width at Receiver	tLEOPR	670		ns	
Source EOP Width	tLEOPT	1.25	1.50	μ s	
Consecutive Output Jitter	tUDJ1	-20	20	ns	To next transition
Paired Output Jitter	tUDJ2	-10	10	ns	For paired transitions

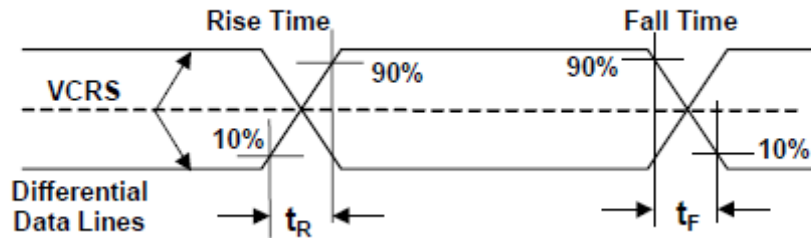


Fig. 6-1 Data Signal Rise and Fall Time

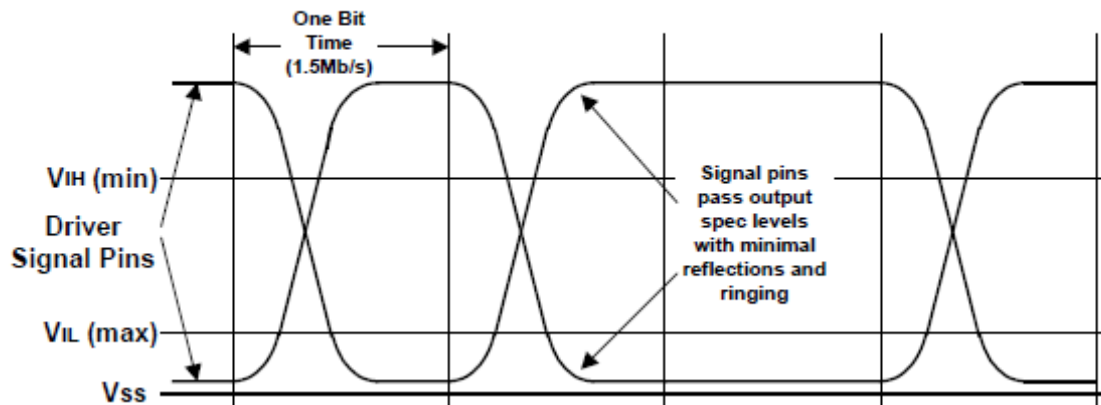


Fig. 6-2 Data Signal Voltage Levels

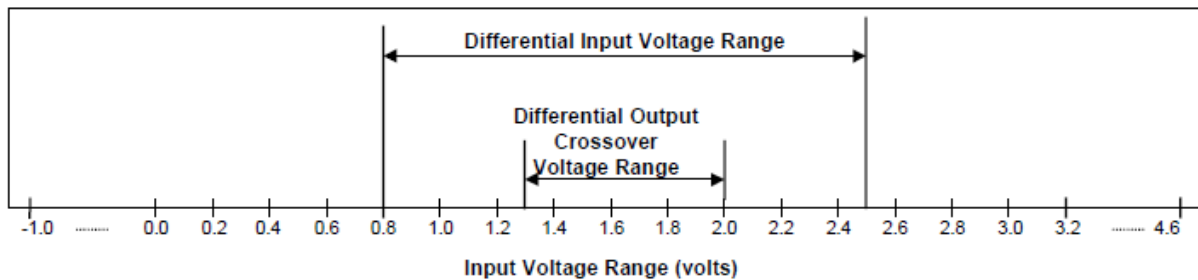


Fig. 6-3 Differential Receiver Input Sensitivity vs. Common Mode Input Range

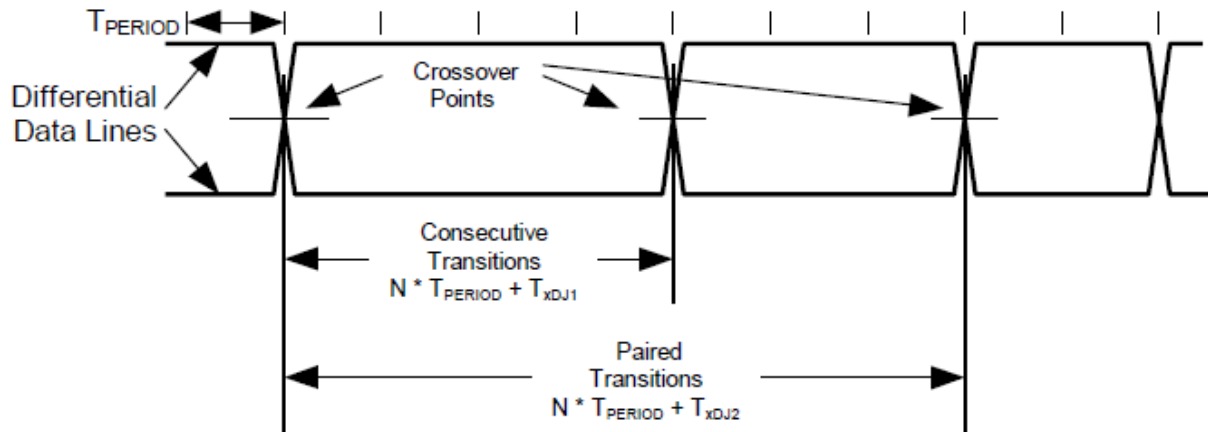


Fig. 6-4 Receiver Jitter Tolerance

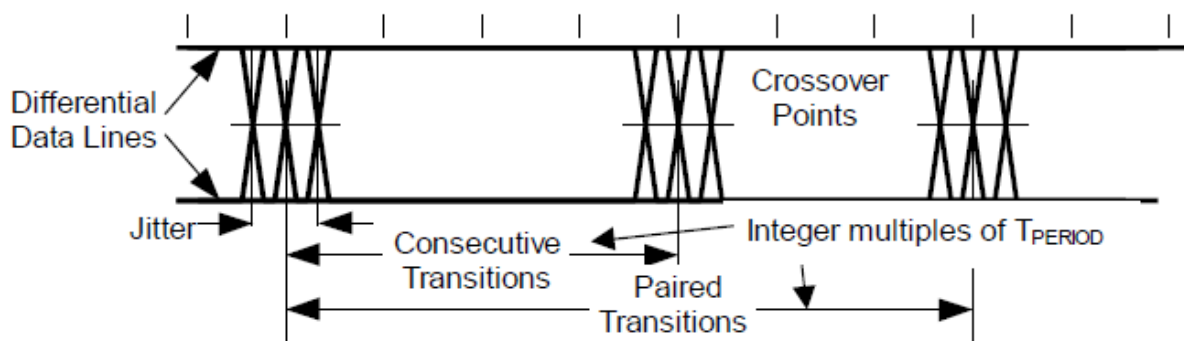


Fig. 6-5 Differential Output Jitter

6.6 DC Electrical Specifications

Electrical Characteristics over recommended operating conditions. Typical values at 25 °C, VDD=5.0 V,

Parameter	Symbol	Min.	Typical	Max.	Units	Notes
Operating Voltage	VDD	4.25		5.5	V	
Operating Current	IDD		10		mA	In active mode, no load on buttons, LED, D+, and D-
Operating Current	IDD		5		mA	In sleep mode, sensor not moving, no load on buttons, LED, D+, and D-
Operating Current	IDD			50	mA	In active mode, include LED current
Suspend current	IDD		400	500	uA	In suspend mode, include D- pull-up current
Input High Voltage	V _{IH}	2.0			V	for PS2 Ports
Input Low Voltage	V _{IL}			0.8	V	for PS2 Ports
Output Low Voltage	V _{OL}			0.5	V	For PS2 Ports, pull-up to VDD by 2K Ω
Power on Reset V _{DD} Detection	V _{POR}	2.5		3.1	V	VDD=5.0V

Voltage					
Output Port Sink Current	I_{OL1}	30	mA	$V_{OL}=1.0V$ for LED	
LED pad equivalent resistor	R_{LED}	14	22	Ω	$V_{OL}=1.0V$ for LED, see Fig. 6-6

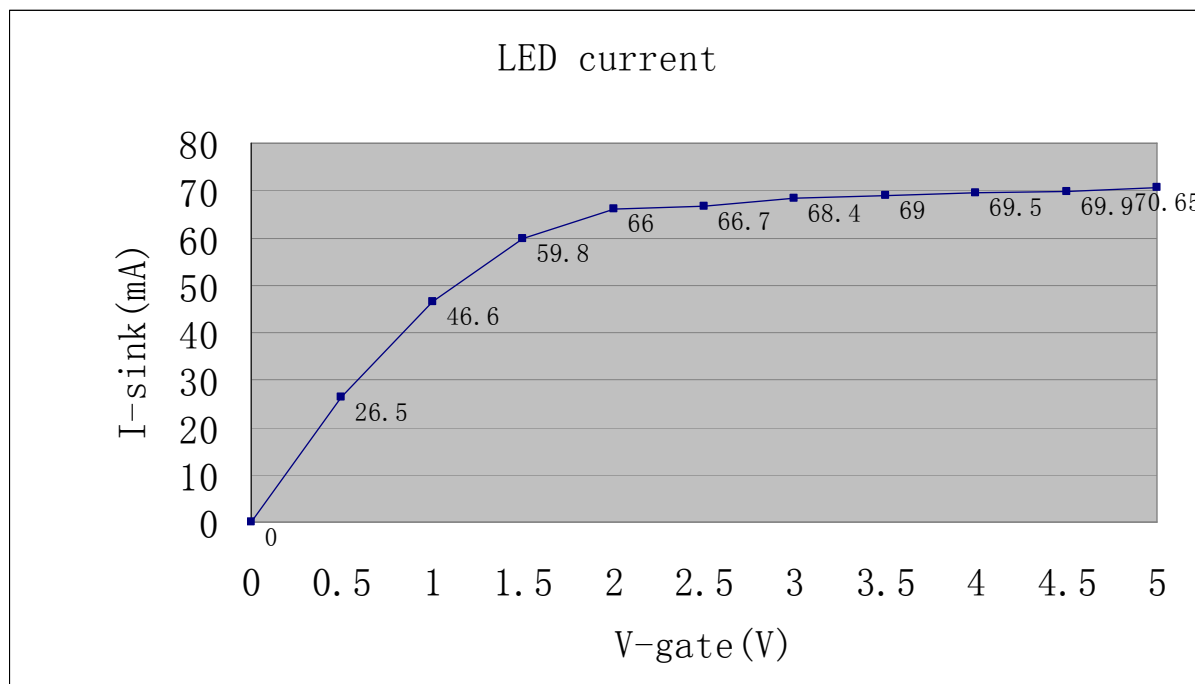


Fig. 6-6 LED pad typical sink current vs. V_{OL}

7. Typical Performance Characteristics

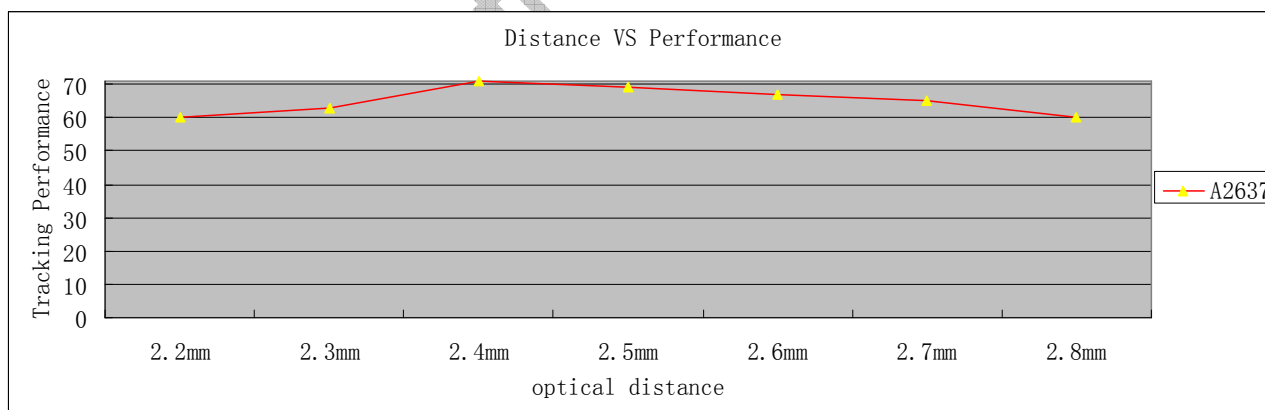


Fig. 7-1 Performance vs. the distance from surface to lens bottom

8. Typical Application (Z axis is mechanical)

8.1 Application circuit

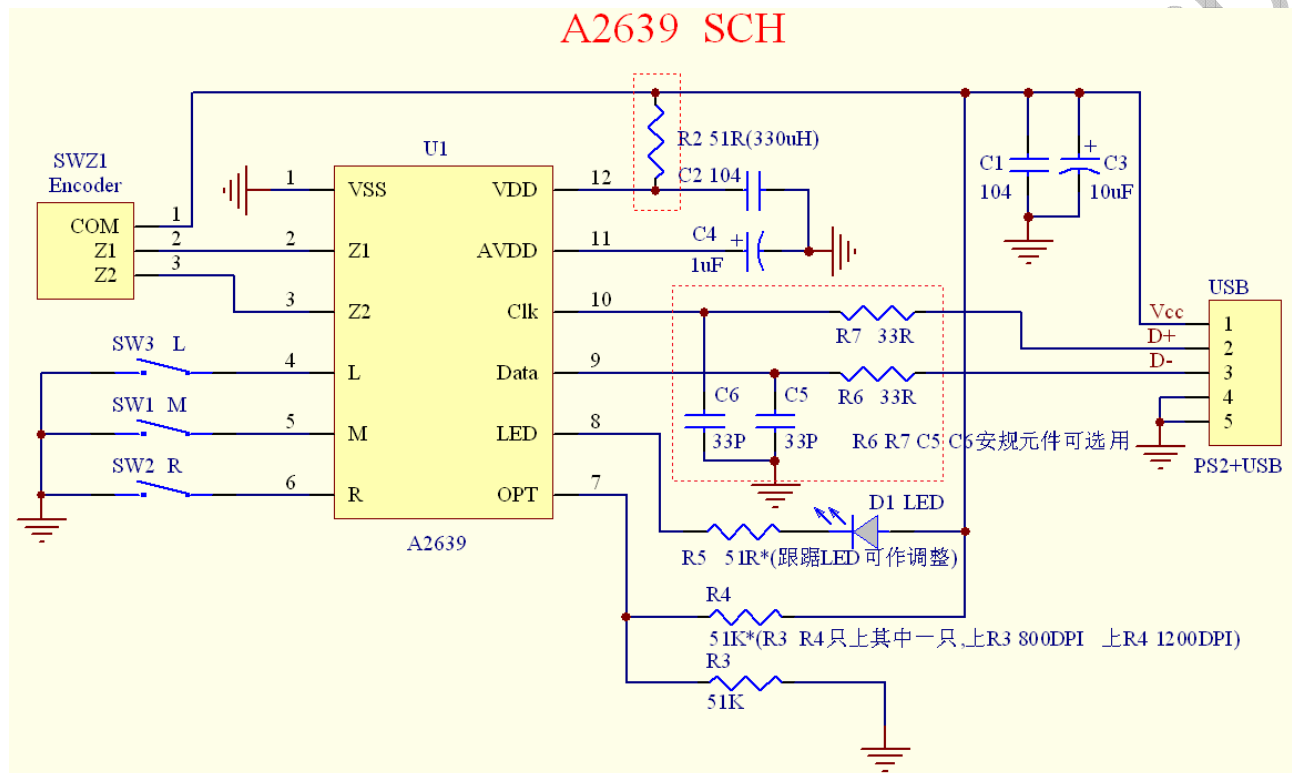


Fig. 8-1 Typical application of A2639B USB+PS2 interface

9. PCB Assembly

The distance “Z” (from the lens bottom to the object surface) is 2.3~2.5mm. A2639B has an aperture stopper to align the lens. In order to output a stable tracking performance, the PCBA should be limited to bounce upward, and the aperture stopper should be engaged firmly with the LENS. A proper LENS guarantees tracking performance, also proper assembling high and angle for LED guarantees tracking.

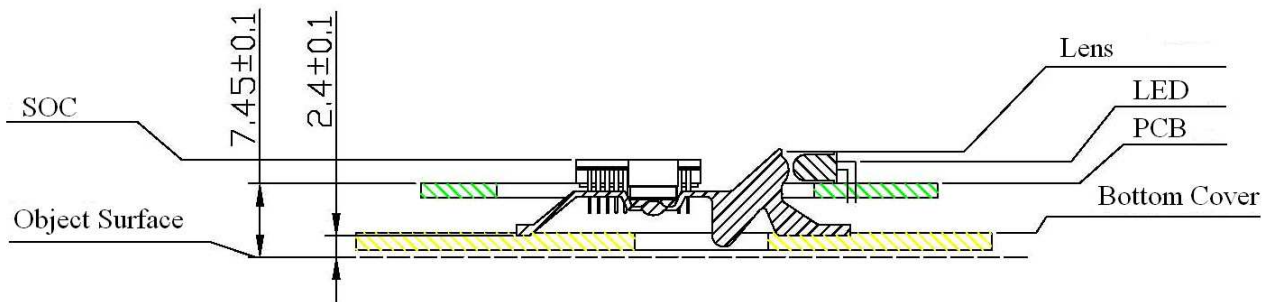


Fig. 9-1 Sectional view of PCB assembling

单位: 毫米

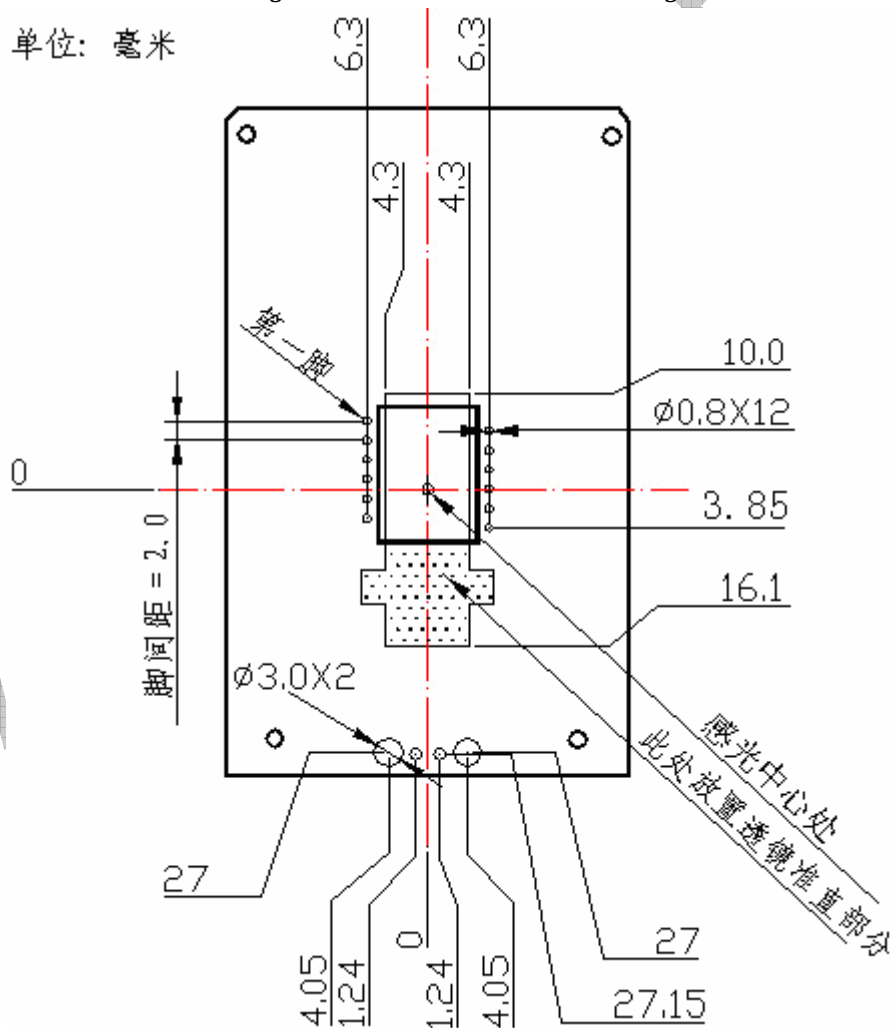
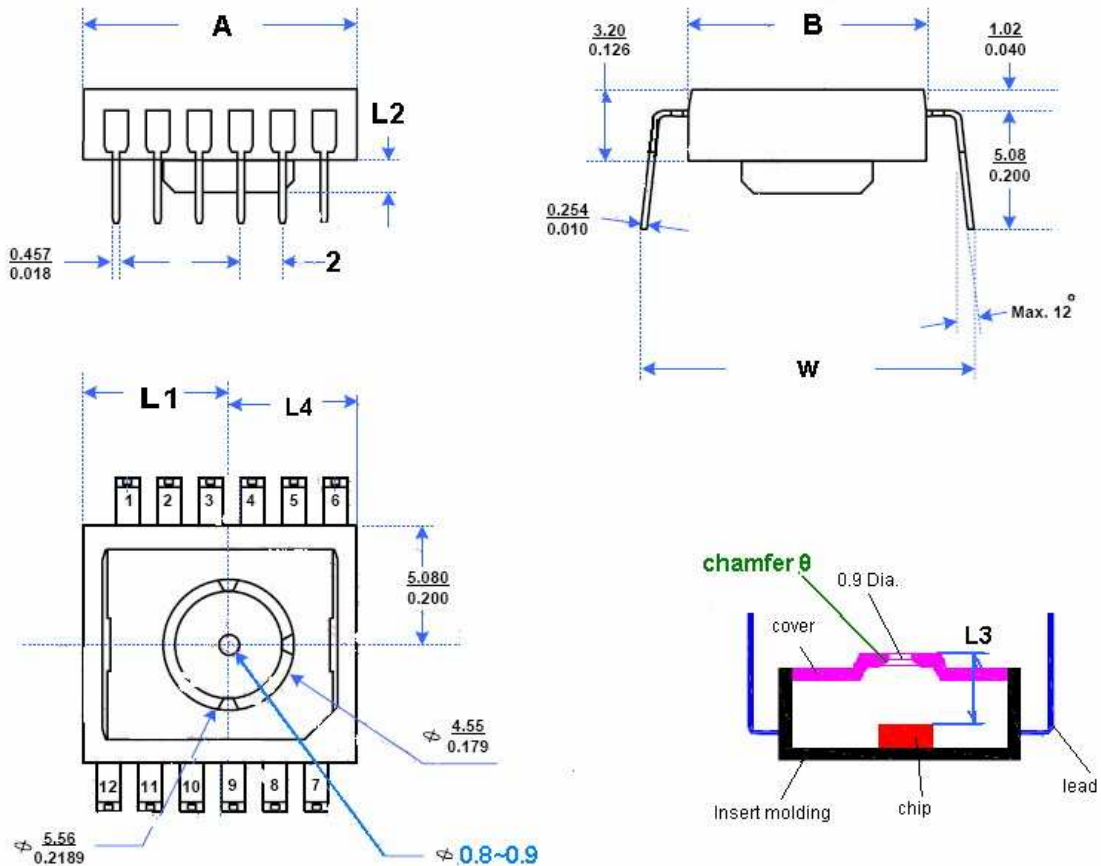


Fig. 9-2 All dimensions

10. Package and Assembly

The A2639B is fabricated with 12pin staggered dual inline package (staggered DIP12), and is ROHS compliant. The size is 13.9*9.1mm, and pin pitch is 2mm. The package outline is illustrated in following.



Remark:
This draft is just to be used for reference.

Fig. 10-1 Package outline

Revision History

Version	Date	Prepare By	Modification
V1.0	2011-5-11	Luck	First Created



A2639B

USB+PS/2 Optical Mouse Sensor SOC

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