SiGma Micro
IC Solution Designing

SPECIFICATION

MX8733B

USB Single Chip Optical Mouse Sensor

VERSION 1.3

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1. General Description

The MX8733B chip is a low cost single chip optical mouse solution used to implement a non-mechanical tracking engine for computer mice. It is based on optical navigation technology with USB combo MCU bundled. Which measures changes in position by optically acquiring sequential surface images(frames) and mathematically determining the direction and magnitude of movement. The single chip optical mouse sensor provides a complete and compact mouse solution, There are no moving parts, and precision optical alignment is not required, few outside components use and facilitate high volume assembly. It is a true crystal-less and ultra low cost solution.

2. Features

- ●Optical Navigation Technology
- ●Low-cost and powerful solution for low-speed USB combo mouse
- ●Universal Serial Bus Specification, version 2.0
- ●USB HID Specification, version 1.1
- ●USB-IF and WHQL compliable
- ●5V Power Supply
- ●Power Saving During No Motion
- ●On Chip LED Drive with Regulated Current
- ●Crystal-less
- ●Resolution 1000CPI
- ●Low EMI radiation
- ●Supports 3D (X, Y, Z) input
- ●Supports 3 buttons and mechanical wheel encoding

3. Pin Assignment

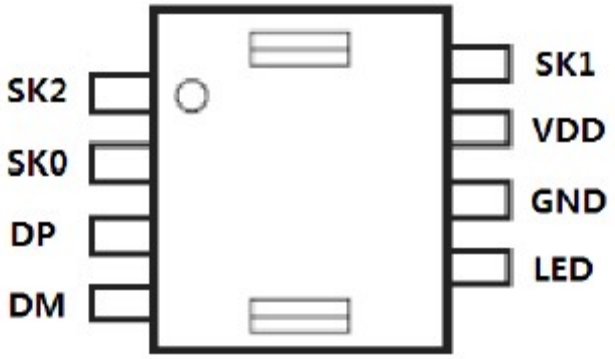


Figure 1. Pin Assignment

Pin No.	Symbol	I/O	Function
1	SK2	I/O	Z axis Input 2
2	SK0	I/O	Left button input and Middle button input
3	DP	I/O	USB D+
4	DM	I/O	USB D-
5	LED	OUT	LED control (sink current) and key scan
6	GND	P	GND
7	VDD	P	5V Power Input
8	SK1	I/O	Z axis Input 1 and Right button input

4. USB Interface

4.1 USB Command Set Description (USB Descriptor)

The USB HOST detects USB mouse device plug-in and assigns a new unique address to the USB mouse device, then asking USB mouse device for information about the device description, configuration description, and assigning a configuration value for USB mouse device during enumeration period. After enumeration, the USB mouse device is able to transfer motion and button value to the host.

Descriptor Type	Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Device Descriptor (18 bytes)	12	01	10	01	00	00	00	08
	4F	1C	48	00	10	01	01	02
	00	01						
Configuration Descriptor (9 bytes)	09	02	22	00	01	01	00	A0
	31							

Interface Descriptor (9 bytes)	09	04	00	00	01	03	01	02
	00							
Human Interface Device Descripter (9 bytes)	09	21	10	01	00	01	22	34
	00							
Endpoint Descriptor (7 bytes)	07	05	81	03	04	00	0A	
Human Interface Report Descriptor (52 bytes)	05	01	09	02	A1	01	09	01
	A1	00	05	09	19	01	29	05
	15	00	25	01	95	05	75	01
	01	02	95	01	75	03	81	01
	05	01	09	30	09	31	09	38
	15	81	25	7F	75	08	95	03
	81	06	C0	C0				
Language String Descripter (4 Bytes)	04	03	09	04				
Manufacture String Descriptor	SiGma Micro							
Product String Descriptor	USB Optical Mouse							

4.2 USB Data Report Format

The USB report has two data formats, depending on boot or report protocol is selected. One kind of data format is the boot protocol used in legacy environment as 4.2.1. The other kind of data format is USB report protocol format which includes Z-wheel movement data in the fourth byte as 4.2.2. The Z-wheel is moved forward the fourth byte data is 01H, the Z-wheel is moved backward the fourth byte data is FFH, and the Z-wheel is idle the fourth byte data is 00H.

4.2.1 USB Boot Protocol

Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3 ~ 7	NC	Reserved
2	0 - 7	X0 ~ X7	X Data. A positive value indicates motion to the right; a negative value indicates motion to the left. Bit0 = LSB.
3	0 - 7	Y0 ~ Y7	Y Data. A positive value indicates device motion downward; a negative value indicates motion upward. Bit0 = LSB.

4.2.2 USB Report Protocol

Byte	Bit	Symbol	Description
1	0	BL	1 = Left button pressed
	1	BR	1 = Right button pressed
	2	BM	1 = Middle button pressed
	3 ~ 7	NC	Reserved
2	0 ~ 7	X0 ~ X7	X Data. A positive value indicates motion to the right; a negative value indicates motion to the left. Bit0 = LSB.
3	0 ~ 7	Y0 ~ Y7	Y Data. A positive value indicates device motion downward; a negative value indicates motion upward. Bit0 = LSB.
4	0 ~ 7	Z0 ~ Z7	Z-wheel motion data. A positive value indicates device motion upward; a negative value indicates motion downward. The Z0~Z7 limit value is ±7; Bit0 = LSB.

5. Performance characteristics

5.1 Absolute Maximum Rating

Symbol	Min.	Max.	Unit
Operating Temperature	-10	55	ºC
Storage Temperature	–40	125	ºC
Input voltage	–0.5	6.0	V
Output voltage	–0.5	6.0	V

5.2 Electrical Characteristic

Test Condition: T = 25ºC, VDD=5.0V, VSS=0V

Parameters	Sym.	Min.	Typ.	Max.	Unit
Operating voltage	VDD	4.5	5.0	5.5	V
Operating Current (Normal operation)	IOP	–	15	-	mA
Operating Current (Sleep mode)	Isleep	–	7.5	-	mA
USB suspend current	Isuspend	-	-	500	uA
L, M, R, debounce time	Tb	17	–	–	ms
Z-axis debounce time	Tz	700	–	–	µs
Acceleration	A	2	–	8	g
Frame Rate	FR	–	3000	–	Frames/sec
Speed	S	–	–	30	Inches/sec

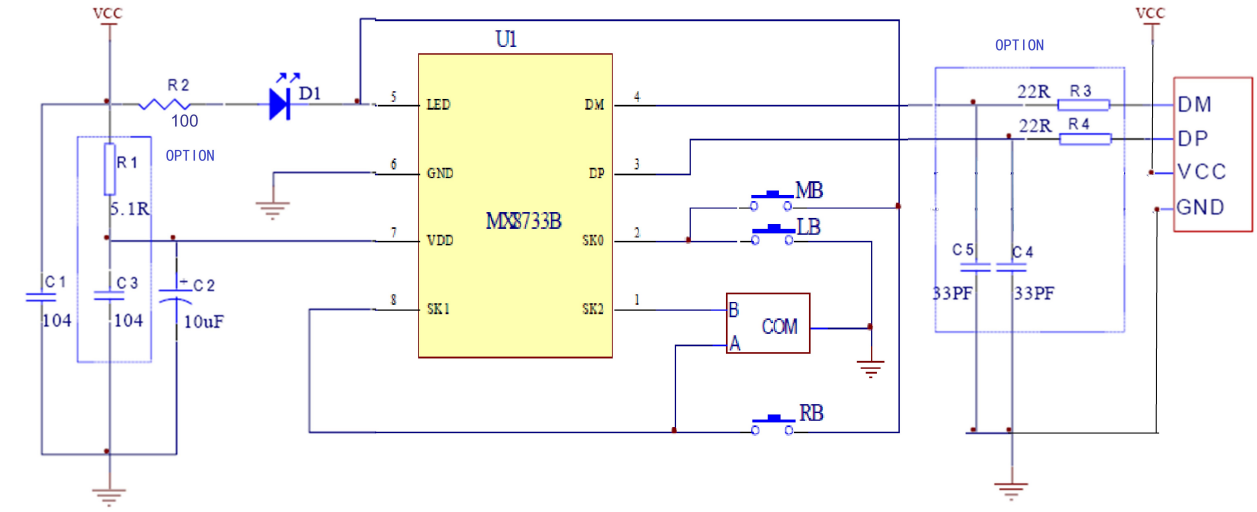
5.3 DC Electrical Characteristic

(T=25℃, Vdd=5V, Vss=0V)

Symbol	Parameter	Condition	Min	Type	Max	Unit
MCU operation						
Iil	Input Leakage Current for input pins	VIN=VDD, VSS	-	-	±1	uA
Icc	VDD operating supply current Normal frequency operation mode	Output pins floating	-	-	10	mA
USB Interface						
Voh	Static Output High	USB operation Mode	2.8	-	3.6	V
Vol	Static Output Low		-	-	0.3	V
Vdi	Differential Input Sensitivity		0.2	-	-	V
Vcm	Differential Input Command Mode Range		0.8	-	2.5	V
Vse	Single Ended Receiver Threshold		0.8	-	2.0	V
Cin	Transceiver Capacitance		-	-	20	PF
Vrg	Output Voltage of internal Regulator		3.0	-	3.6	V

6. Reference Schematics

6.1 Application Circuit



Note: (R1 for reference only)

1. The capacitance C1 & C2 have to close to IC.
2. DP and DM signal line have the short trace to IC.
3. Recommend to have ground grid on the PCB periphery.
4. Option is for EMI compatibility and work reliability.

6.2 PCB Layout Guideline

The following guidelines applay to component placement and routing on the PCB layout design for an optimum EMC solution and tracking performance.

6.2.1 Key Components Placement Rules

1.Place C1、C2 near the USB CABLE.

2. DP and DM signal line should be placed as close to the USB CABLE.

6.2.2 Routing Rules

The trace length for the capacitors on the PIN-7 must be less than 5mm.

6.3 Recommened Value for R1

Bin Q LED with the following radiometric LED intensity is recommended to be used.

LED Bin Grade	Min	Typ	Max	Unit	Conditions
Q	21.2	-	25.4	mW/Sr	Bin limit @ 20mA

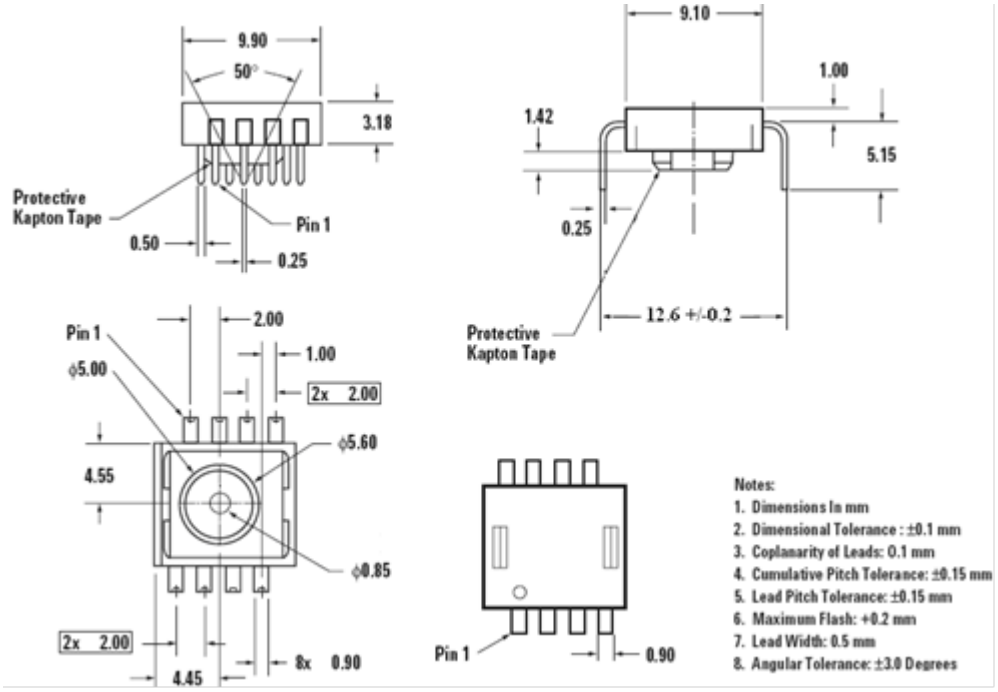
Note: Tolerance for each bin will be±15%

The recommended value for R1 value at V_{DD}=5.0V.

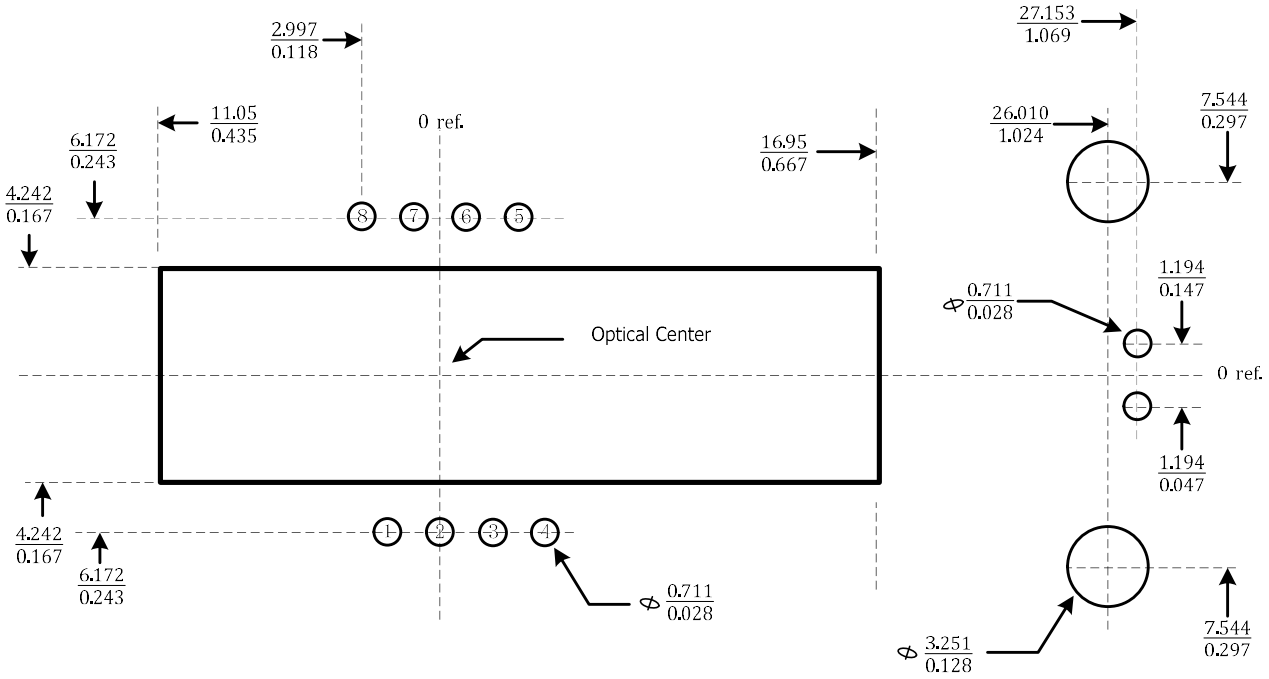
LED Bin Grade	Min	Typ	Max	Unit	Conditions
Q	-	100	-	ohm	@ V_{DD}=5.0V

7. Mechanical Specifications

7.1 Package (Dimension In mm)



7.2 Recommended PCB Mechanical Cutouts and Spacing



All Dimensions : mm/inch

8. Z and 2D/3D Assembly

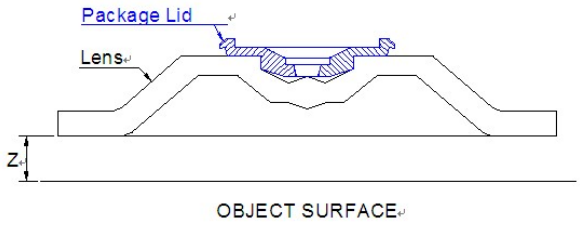


Figure 2. Distance from Lens Reference Plane to Surface

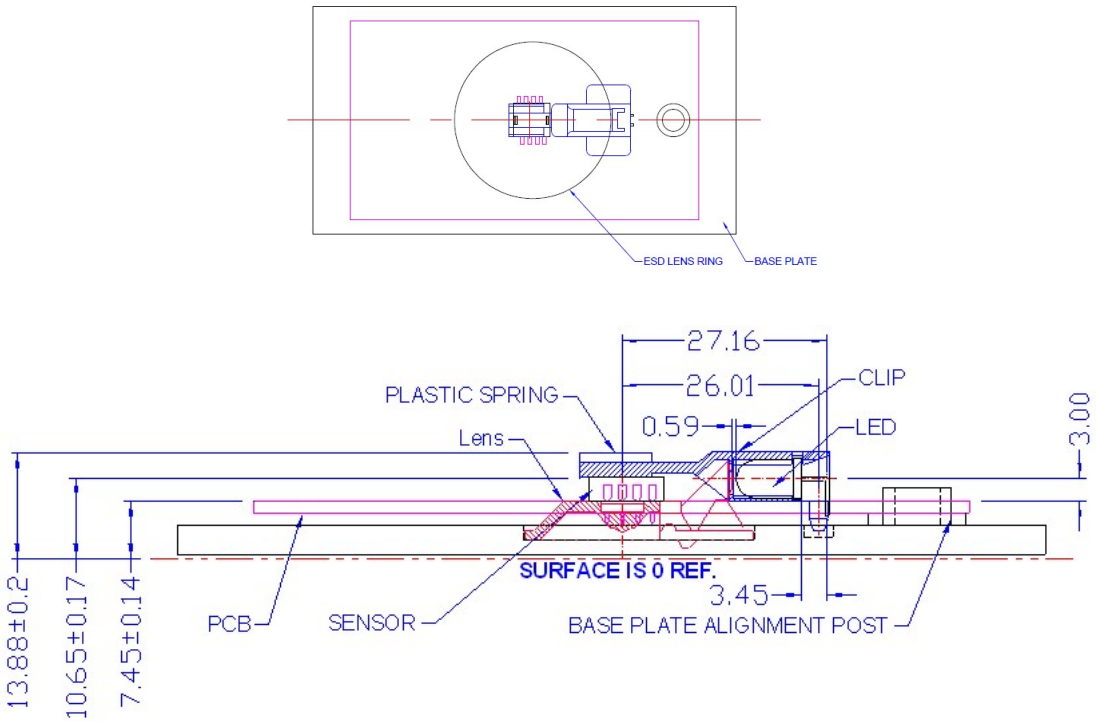


Figure 3. 2D Assembly

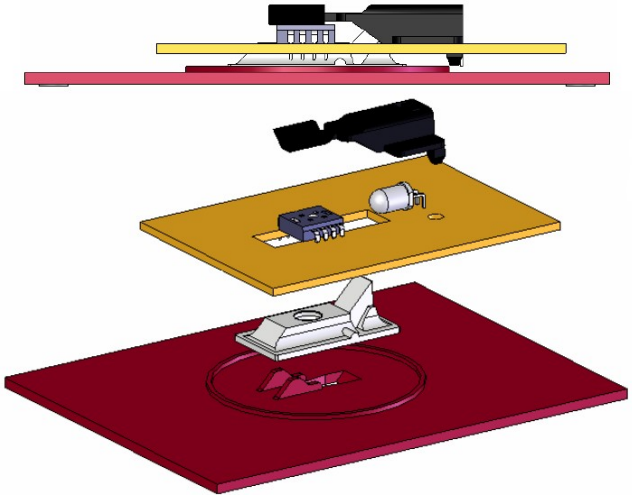


Figure 4. 3D Assembly