Shenzhen LIZE Electronic Technology Co., Ltd

SPECIFICATION

MX8860

USB/PS2 Single Chip Optical Mouse Sensor

VERSION 1.1

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1. General Description

The MX8860 chip is a high performance, 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/PS2 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 PS/2 and low-speed USB combo mouse
- ●Microsoft 3D Intellimouse and IBM PS/2 mouse compatible
- ●Internal switch for USB DP/DM and PS2 CLK/Data I/O
- ●Universal Serial Bus Specification, version 2.0
- ●USB HID Specification, version 1.1
- ●USB-IF and WHQL(HCK) compliable
- ●5V Power Supply
- ●Power Saving During No Motion
- ●On Chip LED Drive with Regulated Current
- ●Crystal-less
- ●Resolution 1000(Default)/1600/2000 /2400CPI
- ●In-use sensitivity switching to 1000/1600/2000/2400 CPI through **DPI** key
- ●Support 2/3LED for CPI inducting
- ●Low EMI radiation
- ●Supports 3D (X, Y, Z) input
- ●Supports 5 buttons and mechanical wheel encoding

3. Pin Assignment

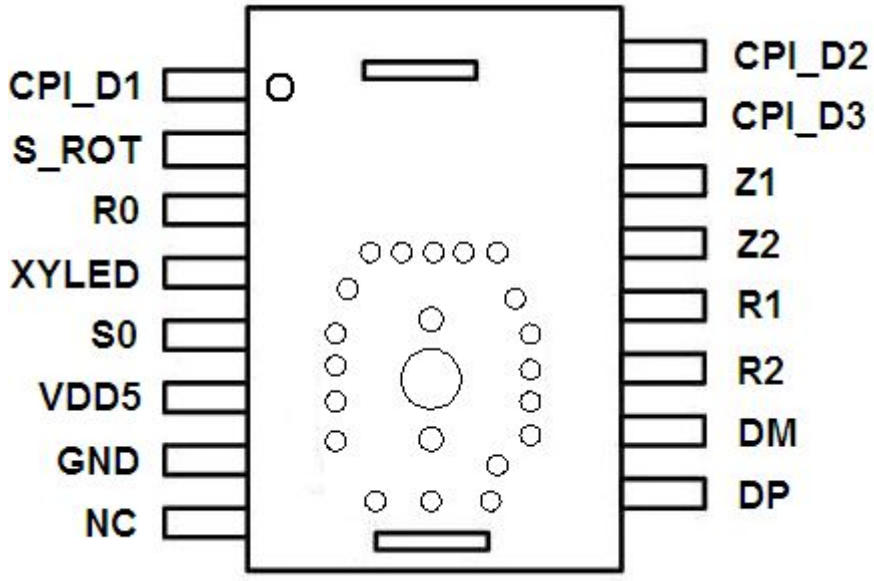


Chart 1 **Pin Assignment**

Pin No.	Symbol	I/O	Function
1	CPI_D1	O	LED1 for CPI inducting
2	S_ROT	I	Option for sensor clockwise rotation angle.
3	R0	I	Key Scan input0 (Left button/B4)
4	XYLED	O	LED control (sink current)
5	S0	I/O	Key Scan Output0 (B4/B5/DPI)
6	VDD5	P	5V Power Input
7	GND	P	GND
8	NC	--	
9	DP/CLK	I/O	USB D+ / PS2 CLK
10	DM/DATA	I/O	USB D- / PS2 DATA
11	R2	I	Key Scan input2 (Right button/DPI Key)
12	R1	I	Key Scan input1 (Middle button/B5)
13	Z2	I	Z axis Input 2
14	Z1	I	Z axis Input 1

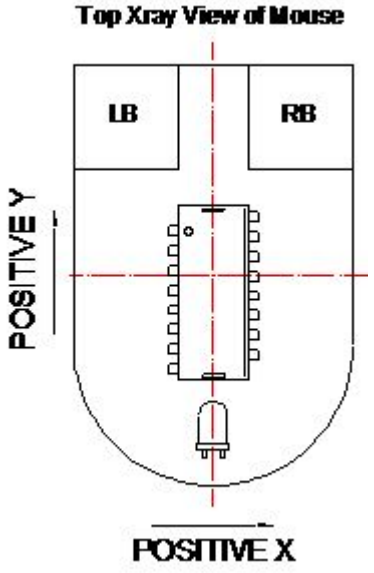
Pin No.	Symbol	I/O	Function
15	CPI_D3	I/O	2/3LED mode option or LED3 for CPI inducting
16	CPI_D2	O	LED2 for CPI inducting

3.1 Led for CPI Inducting

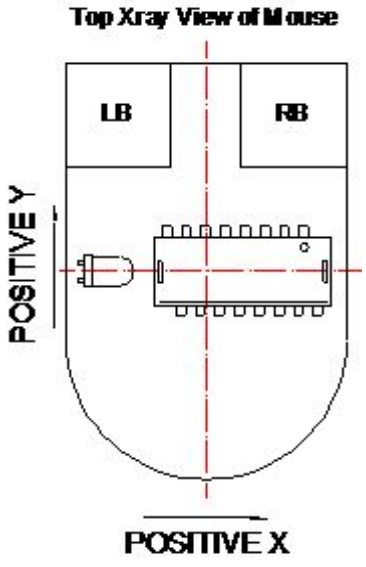
LED / CPI	2 LED for 4 Segment CPI Inducting			3 LED for 4 Segment CPI Inducting		
	CPI_D1 (LED1)	CPI_D2 (LED2)	CPI_D3 (Input)	CPI_D1 (LED1)	CPI_D2 (LED2)	CPI_D3 (LED3)
1000(Default)	0	0	GND	0	0	0
1600	1	0	GND	1	0	0
2000	0	1	GND	1	1	0
2400	1	1	GND	1	1	1

3.2 Option for sensor rotation table

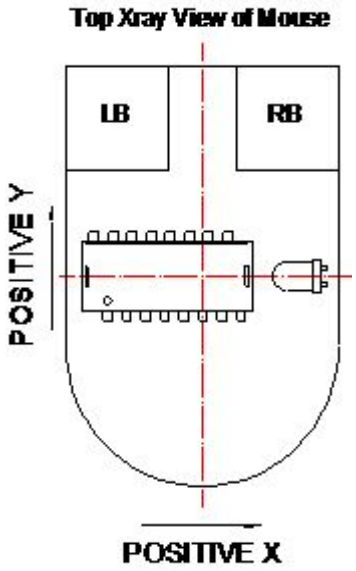
S_ROT	Sensor rotation angle
0	90 degree
1	270 degrees
Input Floating	0 degrees



Package pinout at 0˚

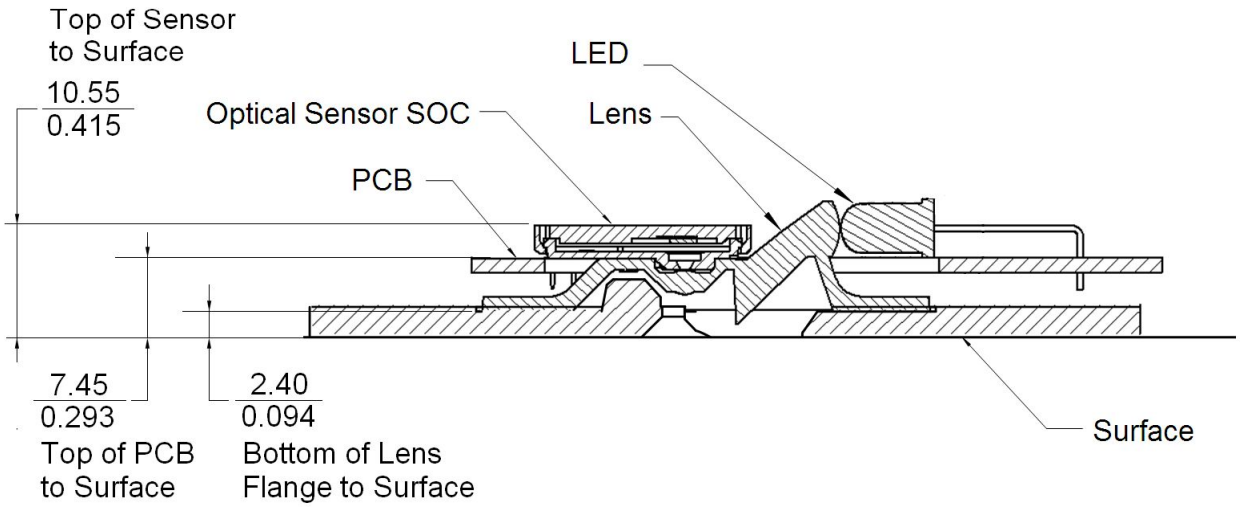


Package pinout at 90˚



Package pinout at 270˚

3.3 2D/3D Assembly



Notes:

(1) Dimensions in mm/inchs

(2) All tolerance ±0.1mm

Chart 2 **Assembly drawing of MX8860**

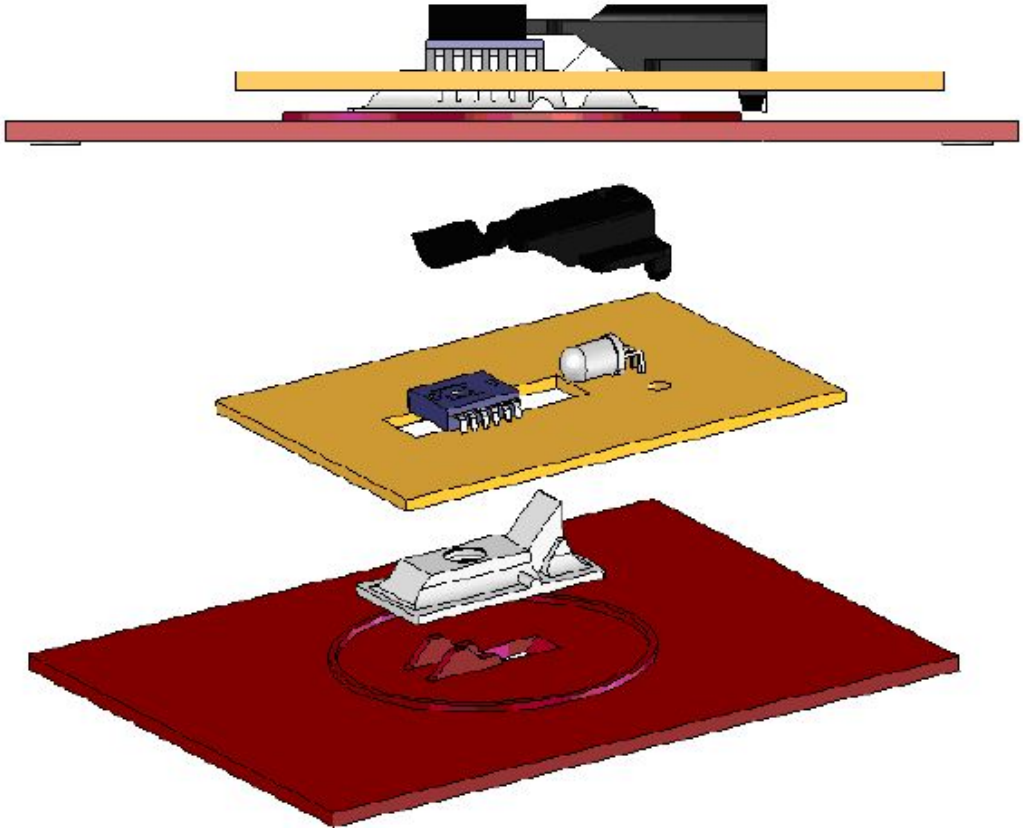


Chart 3 **3D Assembly for Mounting Instructions**

4. Block Diagram and Operation

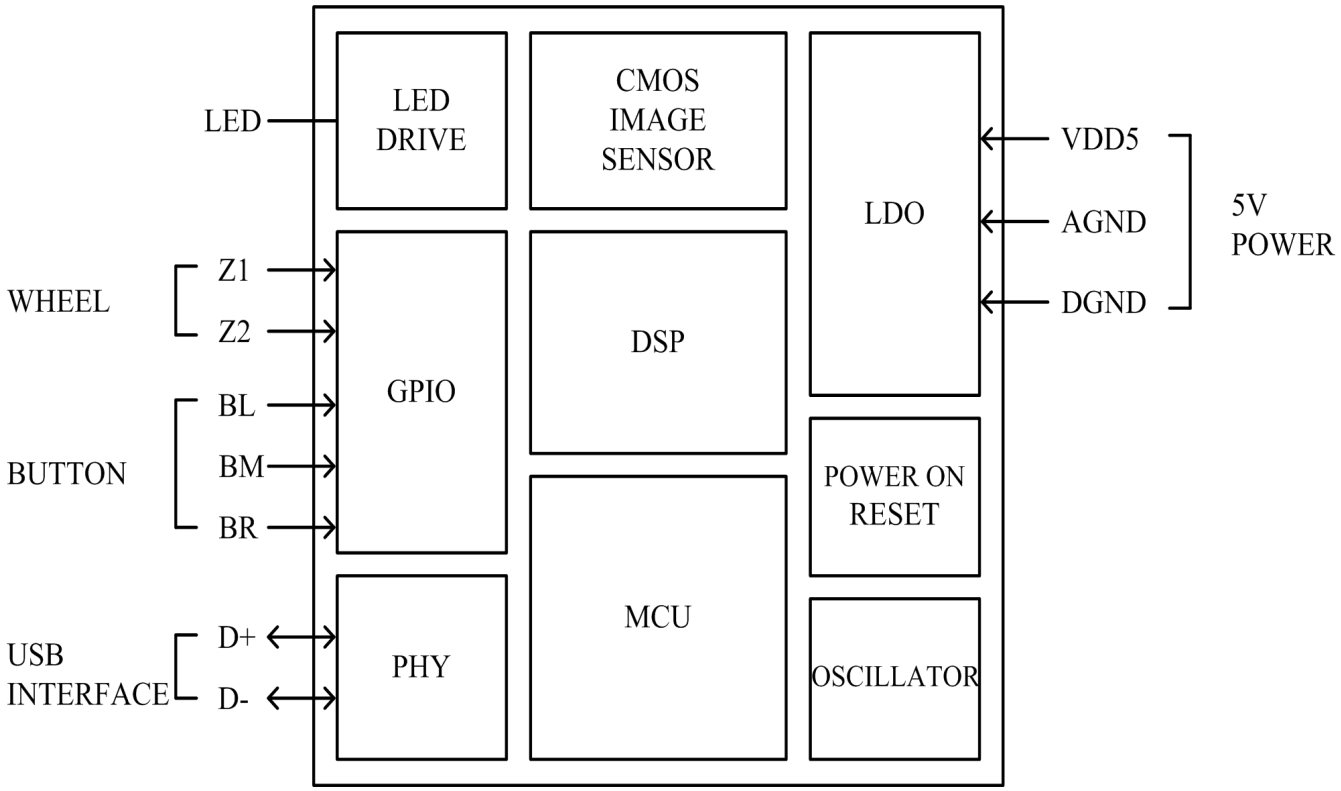


Chart 4 **Block Diagram**

The MX8860 supports X, Y, Z three axes, and L, R, M, 4, 5 five buttons under USB/PS2 mode. It is a CMOS process optical mouse sensor single chip with USB/PS2 interface that serves as a non-mechanical motion estimation engine for implementing a computer mouse.

The MX8860 is in a 12-pin optical package and comes with the resolution of 1000/1600/2000/2400 counts Per inch (CPI). It includes USB/PS2 interface so that no mouse controller is needed and it is a cost effective solution to support USB/PS2 Mouse.

5. Specifications

5.1 Absolute Maximum Rating

Symbol	Min.	Max.	Unit
Operating Temperature	0	70	ºC
Storage Temperature	–65	150	ºC
Input voltage	–0.5	6.0	V
Output voltage	–0.5	6.0	V

5.2 Recommend Operating Condition

Parameters	Sym.	Min.	Typ.	Max.	Unit
Operating voltage	VDD	4.5	5.0	5.5	V
Supply Noise	Vn	-	-	0.1	V
Distance from Lens Reference Plane to Surface	Z	2.3	2.4	2.5	mm
Acceleration	A	2	-	-	g
Frame Rate	FR	-	3000	-	Frames/sec
Speed	S	-	-	28	Inches/sec

5.3 DC Electrical Characteristic

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

Symbol	Parameter	Condition	Min	Type	Max	Unit
Iop	Operating Current Mouse moving		-	-	15	mA
Isleep	Sleep Current Mouse not moving		-	7.5	-	mA
Isuspend	USB Suspend Current		-	-	500	uA
Tb	Button debounce time		8	-	-	ms
Tz	Z-axis debounce time		700	-	-	us
3.3V Regulator						
Vreg	Output voltage of 3.3v Regulator	Vdd=4.4V~5.25V	3.0	3.3	3.6	V
VresetL	Low Power Reset detecting low Voltage	-	-	-	3.3	V
VresetH	Low Power Reset detecting high Voltage	-	3.6	-	-	V
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

5.4 Button and Z-Wheel Debounce Timing

Buttons and Z-wheel of MX8860 include detect and debounce function which are software implemented. When press button input signals need keeping low level up to 5.9ms. Button function just can catch data otherwise debounce function will judge it is bounce issue. When scroll Z-wheel input signals need keeping turning level up to 0.80ms. Z-wheel function just can catch data otherwise debounce function will judge it is bounce issue. And the sample rate is 40us so if bounce time is less than 40us the debounce function will ignore it. Following the below specifications Buttons and Z wheel will work normally.

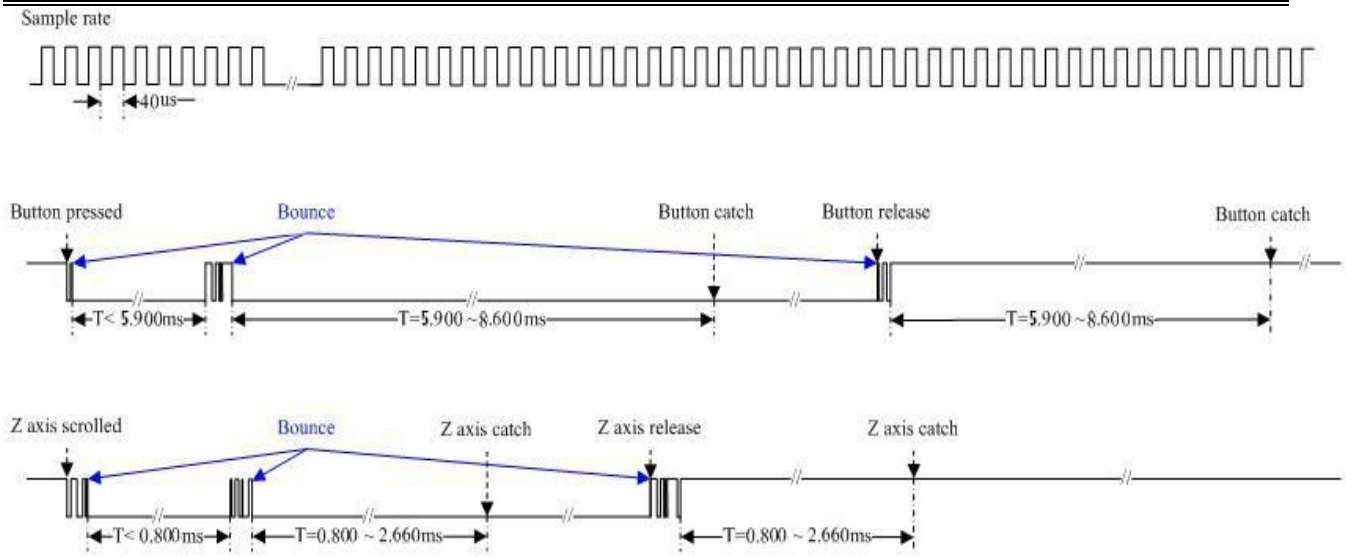
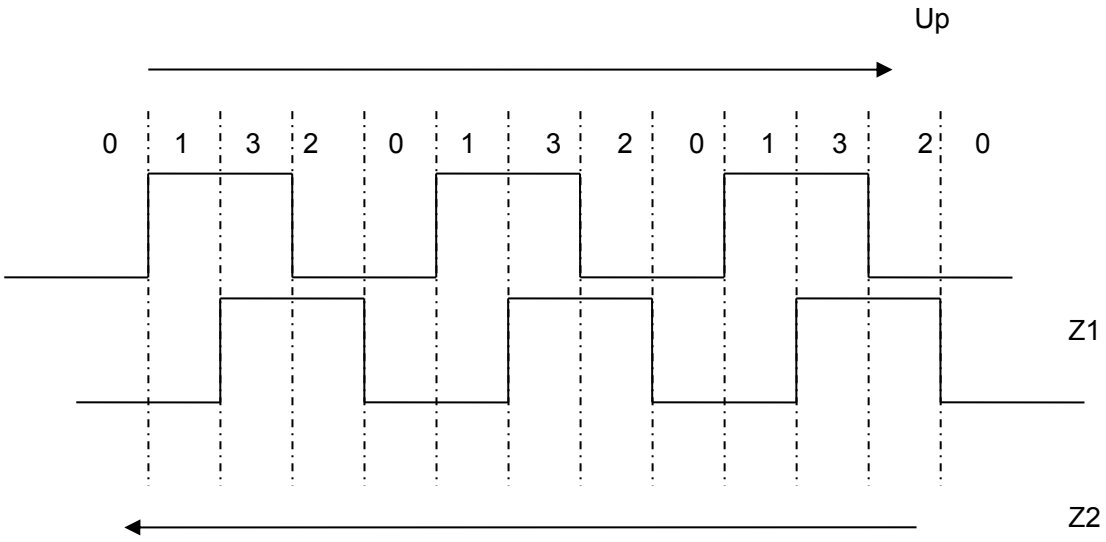


Chart 5 **Debounce Timing**

5.5 Z-axis Waveform



STATE	Z-axis input	
	Z2	Z1
0	0	0
1	0	1
2	1	0
3	1	1

Chart 6 **Z-axis waveform**

6. USB Interface

6.1 USB Command Set Description

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 devie 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 button value and motion to the USB host.

Descriptor Type	Byte	Byte	Byte	Byte	Byte	Byte	Byte	Byte
Device Descriptor(18bytes)	12	01	10	01	00	00	00	08
	4F	1C	51	00	10	01	01	02
	00	01						
Configuration Descriptor(9bytes)	09	02	22	00	01	01	00	A0
	31							
Interface Descriptor(9bytes)	09	04	00	00	01	03	01	02
	00							
HID Descriptor(9bytes)	09	21	10	01	00	01	22	34
	00							
Endpoint Descriptor(7bytes)	07	05	81	03	04	00	0A	
Human Interface Device Report Descriptor(52bytes)	05	01	09	02	A1	01	09	01
	A1	00	05	09	19	01	29	05
	15	00	25	01	95	05	75	01
	81	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 Descriptor(4bytes)	04	03	09	04				
Manufacture String Descriptor	SIGMACHIP							
Product String Descriptor	USB Mouse							

6.2 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 7.2.1. The other kind of data format is

USB report protocol format which includes Z-wheel movement data in the fourth byte as 7.2.2. 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.

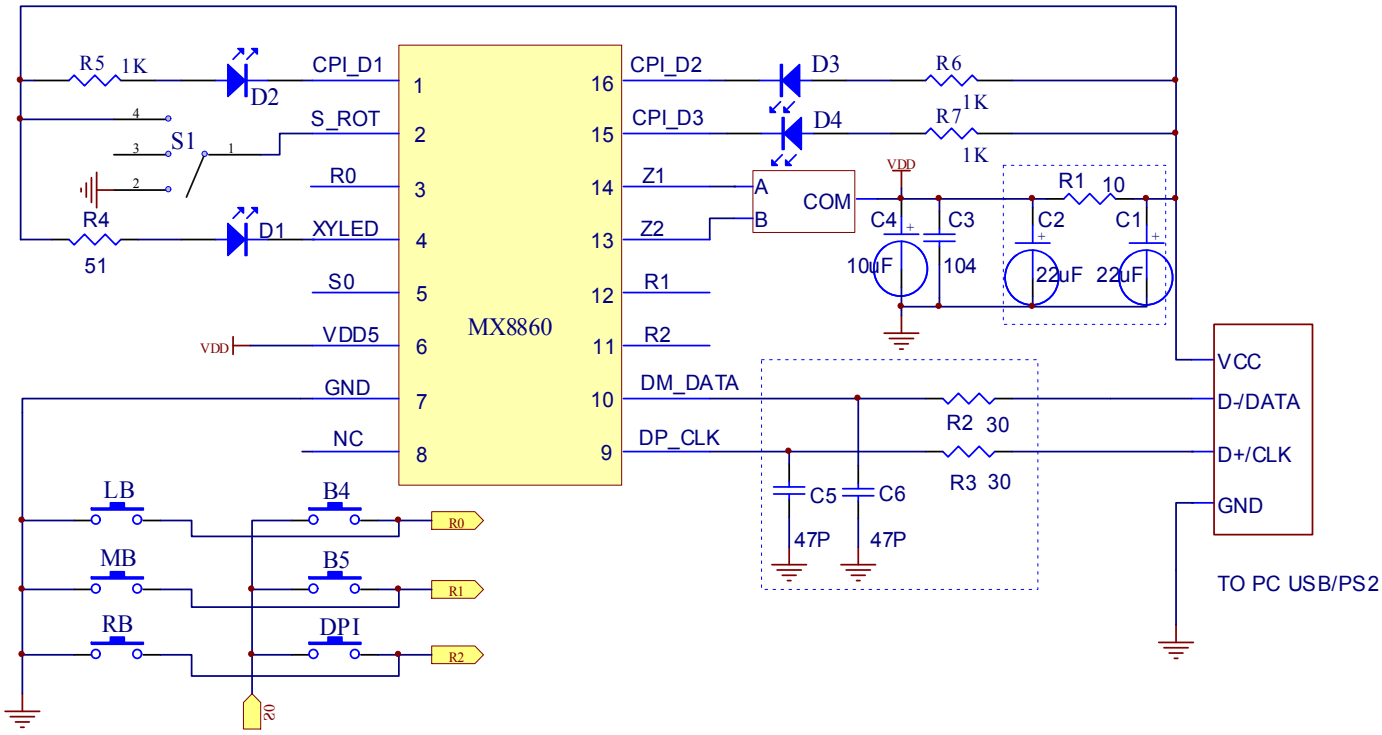
6.2.1 USB Boot Protocol

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.

6.2.2 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	B4	1 = 4th button pressed
	4	B5	1 = 5th button pressed
	5 ~ 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.

7. Application Circuit (3LED for CPI inducting)



Note: 1. Components in dotted line are used for EMC issue;

2. Pin15 (CPI_D3) need to be tied to GND for 2 CPI LED mode.

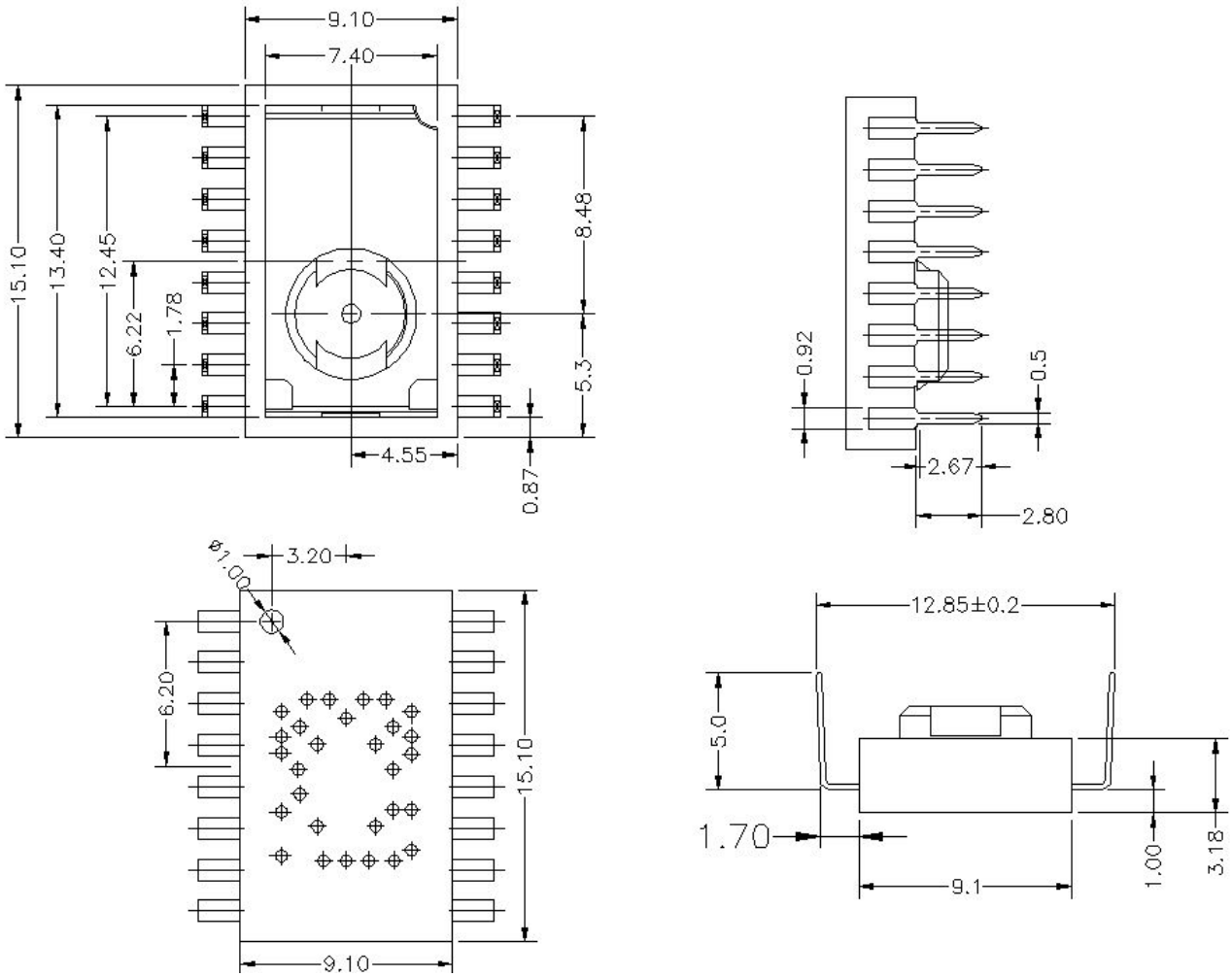
8. PCB Layout Guideline

The following guidelines apply to component placement and routing on the PCB. That will get an optimum EMC solution and tracking performance.

8.1 Key Components Placement Rules

1. C1, R1 as close USB/PS2 line solder pad on PCB as possible, PCB layout should be designed in such a way as to ensure that the VDD is stable and pass through RC filter.
2. Place C3 & C4 near sensor's pin6 (VDD5 Pin).
3. D+/CLK and D-/DATA signal line have the short trace to IC.
4. The C5/C6 and R2/R3 should be placed as close to the USB cable.
5. Recommend to have ground grid on the PCB periphery.

9. Package (Dimension In mm)



10. Revision History

Version	Update date	Revised Content	Revised by	Confirmed by
V1.0	2013-9-3	Original	LiuXing	
V1.1	2014-4-15	Update Package	LiuXing	