SiGma Micro
IC Solution Designing

SPECIFICATION

MX84511

PS/2 Mouse Controller

VERSION 1.4

Sigma reserves the right to change this documentation without prior notice

TABLE OF CONTENTS

1. GENERAL DESCRIPTION....3

2. FEATURES....3

3. PIN ASSIGNMENT....4

3.1 PIN OUTS....4

3.2 PIN DESCRIPTIONS....4

4. PAD LOCATION & BONDING DIAGRAM....5

5. FUNCTION BLOCK DIAGRAM....6

6. FUNCTION DESCRIPTIONS....6

6.1 PS/2 mouse operating....6

6.2 PS/2 Mouse Commands Description....9

6.3 Microsoft PS/2 scrolling mouse mode....12

6.4 Z-axis Input Function....13

7. ABSOLUTE MAXIMUM RATING....13

8. DC ELECTRICAL CHARACTERISTICS....14

9. AC ELECTRICAL CHARACTERISTICS....15

10. APPLICATION CIRCUIT....16

10.1 BALL TYPE CIRCUIT....16

10.2 TYPICAL OPTICAL SENSOR CIRCUIT1....16

10.3 TYPICAL OPTICAL SENSOR CIRCUIT2....17

11. REVISION HISTORY....17

1. GENERAL DESCRIPTION

The MX84511 series is the most powerful PS2 combo mouse controller. MX84511 is suit for 3D3B (buttons) application. It can adopt with Agilent HDNS-2000, ADNS-2051, ADNS-2610, ADNS-2620, PixArt PAN101B and PAN3101 optical sensor or the traditional ball type mouse. Embeded Self-Adapter function can make the production of ball type mouse easily. The user may use the MX84511 to design almost all style of mouse easily.

2. FEATURES

- 8 Bits RISC-like Micro Controller
- 6MHz external clock with 82Kohm resistance
- 5V operation voltage
- Internal power-on reset (POR)
- Z axis can support two kinds of scroller input (mechanical and optomechanical)
- Embeded Self-Adapter function
- Low-cost and powerful solution for PS/2 combo mouse
- 400DPI & 800DPI can be set by bonding option for 400DPI sensor

➢ **Mouse Function**

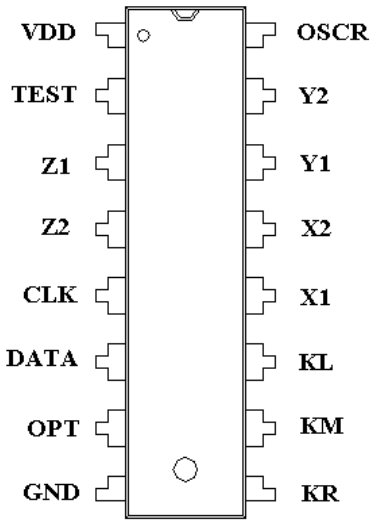
- Microsoft 3D Intellimouse and IBM PS/2 mouse compatible
- MX84511 supports 3D3B

➢ **Sensor Support**

- Support Traditional Ball Type Sensor
- Support PixArt PAN101B Series Optical Sensor
- Support PixArt PAN3101DB Optical Sensor
- Support Agilent HDNS-2000, ADNS-2051, ADNS-2610, ADNS-2620 Optical Sensor
- Support Unity MCS-12085 Optical Sensor

3. PIN ASSIGNMENT

3.1 PIN OUTS

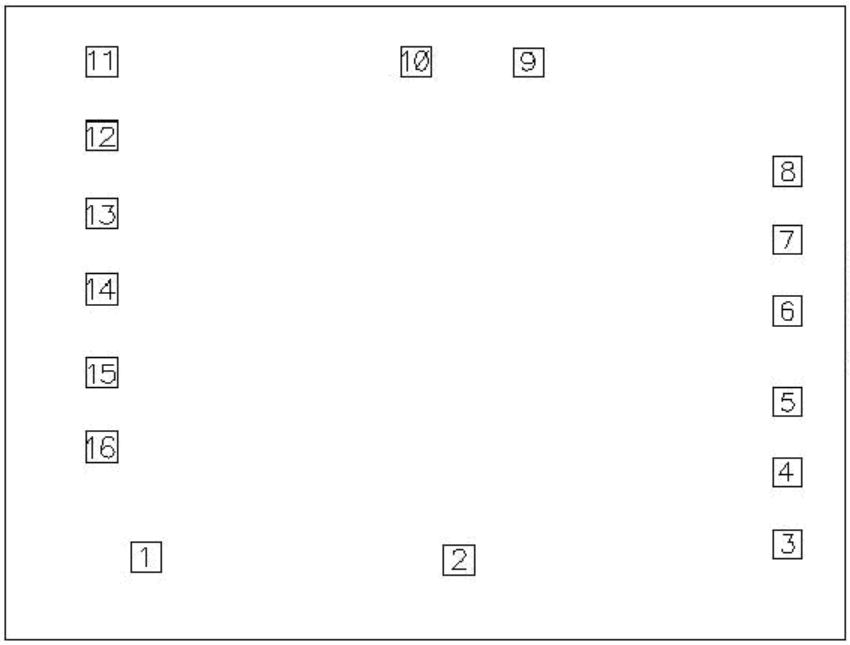


3.2 PIN DESCRIPTIONS

Pin Name	Type	Function description
VDD	Power	+5V power input
TEST	I	For test only
X1, X2 Y1, Y2	I/O	Self-adapt input pins. 13kohm resistor pull low. Use current comparator to measure photo-couples “ON”,or “OFF”. Under Serial transmission: X1 – Serial sclk with sensor X2 – Serial data with sensor Y1 – Power down pin for ADNS-2051 optical mouse Y2 – DPI selector for ADNS-2051 optical mouse.And 400DPI & 800DPI bonding option,this option is only valid for 400DPI sensor.
Z1, Z2	I	Z axis input1
KL/KR/KM	I	Left, Middle, Right button input 15kohm resistor pull low.
CLK	I/O	Connect to 8042 auxiliary port CLK line.
DATA	I/O	Connect to 8042 auxiliary port DATA line.
GND	Power	Power Ground
OPT	I/O	Option pin
OSCR	I	RC mode oscillation with 82Kohm resistor.

4. PAD LOCATION & BONDING DIAGRAM

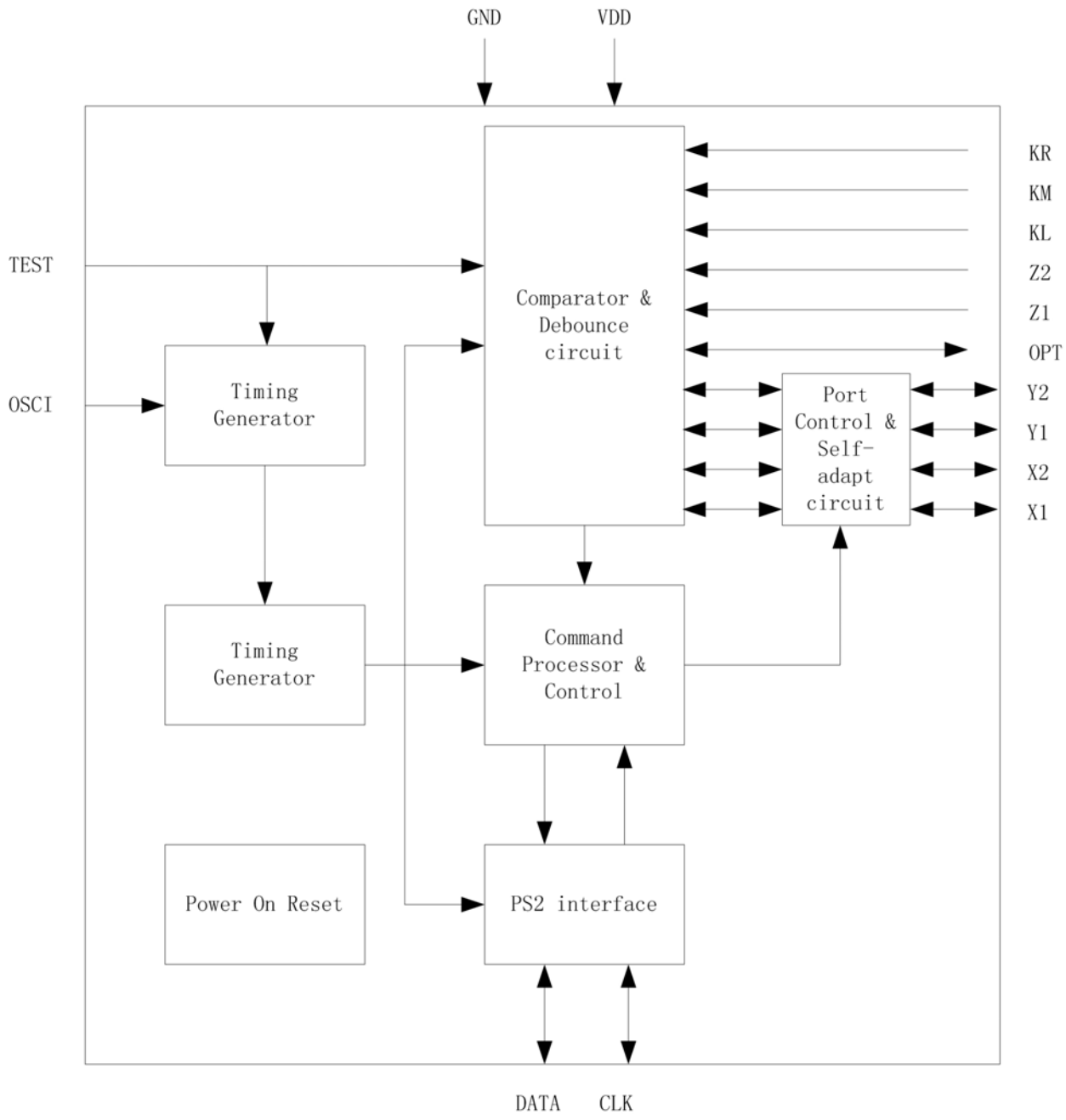
PIN NO	NAME	PIN NO	NAME
1	GND	9	OSCR
2	KR	10	VDD
3	KM	11	TEST
4	KL	12	Z1
5	X1	13	Z2
6	X2	14	CLK
7	Y1	15	DATA
8	Y2	16	OPT



Substrate Size: 2800μm×2100μm

Substrate Connect GND

5. FUNCTION BLOCK DIAGRAM



6. FUNCTION DESCRIPTIONS

6.1 PS/2 mouse operating

6.1.1 Operating mode

There are four operating modes in PS/2 mouse:

a. Reset Mode:

In this mode a self-test is initiated during power-on or by a Reset command. After reset signal, PS/2 mouse will send:

(a) Completion code AA & ID code 00.

(b) Set default :

sampling rate: 100 reports/s

non-auto speed

stream mode

2 dot/count

disable

b. Stream Mode

The maximum rate of transfer is the programmed sample rate.

Data report is transmitted if

(a) switch is pressed

(b) movement has been detect

c. Remote Mode

Data is transmitted only in response to a Read Data command.

d. Wrap Mode

Any byte of data sent by the system, except hex EC (Reset wrap mode) or hex FF (Reset), is returned by MX84511.

6.1.2 PS/2 Mouse Data Report

i). In stream mode: A data report is sent at the end of a sample interval.

ii). In remote mode: A data report is sent in response to Read Data command.

iii). Data report format:

Byte	Bit	Description
1	0	Left button status; 1 = pressed
	1	Right button status; 1 = pressed
	2	Middle button status; 1 = pressed
	3	Reserve
	4	X data sign; 1 = negative
	5	Y data sign; 1 = negative
	6	X data overflow; 1 = overflow
	7	Y data overflow; 1 = overflow
2	0-7	X data (D0 - D7)

3	0-7	Y data (D0 - D7)

6.1.3 PS/2 mouse Data Transmission

i). MX84511 generates the clocking signal when sending data to and receiving data from the system.

ii). The system requests MX84511 receive system data output by forcing the DATA line to an inactive level and allowing CLK line to go to an active level.

iii). Data transmission frame:

Bit	Function
1	Start bit (always 0)
2-9	Data bits (D0 - D7)
10	Parity bit (odd parity)
11	Stop bit (always 1)

iv). Data Output (data from MX84511 to system):

If CLK is low (inhibit status), data is no transmission.

If CLK is high and DATA is low (request-to-send), data is updated. Data is received from the system and no transmission are started by MX84511 until CLK and DATA both high.

If CLK and DATA are both high, the transmission is ready. DATA is valid prior to the falling edge of CLK and beyond the rising edge of CLK. During transmission, MX84511 check for line contention by checking for an inactive level on CLK at intervals not to exceed 100u sec. Contention occurs when the system lowers CLK to inhibit MX84511 output after MX84511 has started a transmission. If this occurs before the rising edge of the tenth clock, MX84511 internal store its data in its buffer and returns DATA and CLK to an active level. If the contention does not occur by the tenth clock, the transmission is complete.

Following a transmission, the system inhibits MX84511 by holding CLK low until it can service the input or until the system receives a request to send a response from MX84511.

v). Data Input (from system to MX84511):

System first check if MX84511 is transmitting data. If MX84511 is transmitting, the system can override the output forcing CLK to an inactive level prior to the tenth clock. If MX84511 transmission is beyond the tenth clock, the system receives the data. If MX84511 is not transmitting or if the system choose to override the output, the system force CLK to an inactive level for a period of not less than 100μsec while preparing for output. When the system is ready to output start bit (0), it allows CLK go to active level. If request-to-send is detected, MX84511 clocks 11 bits. Following the tenth clock MX84511 checks for an active level on the DATA line, and if found, force DATA low , and clock

once more. If occurs framing error, MX84511 continue to clock until DATA is high, then clocks the line control bit and request a Resend. When the system sends out a command or data transmission that requires a response, the system waits for MX84511 to response before sending its next output.

6.1.4 PS/2 Mouse Error Handling

i). A Resend command (FE) following receipt of an invalid input or any input with incorrect parity.

ii). If two invalid input are received in succession, an error code of hex FC send to the system.

iii).The counter accumulators are cleared after receiving any command except "Resend".

iv).MX84511 receives a Resend command(FE), it transmit its last packet of data..

v). A response is sent within 25 ms if

a). The system requires a response

b). An error is detected in the transmission

iv). When a command requiring a response is issued by the system ,another command should not be issue until either the response is received or 25ms has passed.

6.2 PS/2 Mouse Commands Description

There are 16 valid commands that transmits between the system and MX84511. The "FA" code is always the first response to any valid input received from the system other than a Set Wrap Mode or Resend command.

The following table list the commands:

Hex Code	Command	MX84511 echo code
FF	Reset	FA,AA,00
FE	Resend	XX,(XX,XX)
F6	Set Default	FA
F5	Disable	FA
F4	Enable	FA
F3,XX	Set Sampling Rate	FA,FA
F2	Read Device Type	FA,00
F0	Set Remote Mode	FA
EE	Set Wrap Mode	FA
EC	Reset Wrap Mode	FA
EB	Read Data	FA,XX,XX,XX
EA	Set Stream Mode	FA
E9	Status Request	FA,XX,XX,XX

E8,XX	Set Resolution	FA,FA
E7	Set Autospeed	FA
E6	Reset Autospeed	FA

The following describes valid commands:

a). Reset (FF)

MX84511 operation:

i). Completion the reset.

ii). Transmitted FA,AA,00 to the system.

iii). Set default:

sampling rate: 100 reports/s

non-autospeed

stream mode

2 dots/count

disable

b). Resend (FE)

i).Any time MX84511 receives an invalid command, it returns a Resend command to the system.

ii).When MX84511 receives a Resend command, it retransmits its last packet of data .If the last packet was a Resend command, it transmits the packet just prior to the Resend command.

iii).In stream mode, if a Resend command is received by MX84511 immediately following a 3-byte data packet transmission to the system.

iv).The ACK(FA) byte sent to acknowledge a command is not stored in any buffer or resent; however, if the last output from the device was an ACK with no additional data bytes,Resend responds with an ACK.

c). Set Default (F6)

The command reinitializes all conditions to the power-on defaults.

d). Disable (F5)

This command is used in the stream mode to stop transmissions from MX84511.

e). Enable (F4)

Begins transmissions, if in stream mode.

f). Set Sampling Rate (F3,XX)

In the stream mode, this command sets the sampling rate to the value indicated by byte hex

XX,

show in following:

Second byte XX	Sample Rate
0A	10/sec
14	20/sec
28	40/sec
3C	60/sec
50	80/sec
64	100/sec
C8	200/sec

g). Read Device Type (F2)

MX84511 always echoes “FA,00” in 2D mode,“FA,03”in 3D mode.

h). Set Remote Mode (F0)

Data value are reported only in response to a Read Data command.

i). Set Wrap Mode (EE)

Wrap mode remains until Reset (FF) or Reset Wrap Mode(EC) is received.

j). Reset Wrap Mode (EC)

MX84511 returns to the previous mode of operation after receiving this command.

k). Read Data (EB)

This command is executed in either remote or stream mode. The data is transmitted even if there has been no movement since the last report or the button status is unchanged. Following a Read Data command, the registers are cleared after a data transmission.

l). Set Stream Mode (EA)

This command sets MX84511 in stream mode.

m). Status Request (E9)

When this command is issued by the system, MX84511 respond with a 3-byte status report as follows:

Byte	Bit	Description
1	0	1 = Right button pressed
	1	1 = Middle button pressed
	2	1 = Left button pressed
	3	Reserved
	4	0 = Normal speed, 1 = Autospeed
	5	0 = Disabled, 1 = Enabled
	6	0 = Stream mode, 1 = Remote mode
	7	Reserved

2	0-7	Current resolution setting (D0 - D7)
3	0-7	Current sampling rate (D0 - D7)

n). Set Resolution (E8,XX)

MX84511 provides four resolutions selected by the second byte of this command as follows:

Second Byte XX	Resolution
00	8 dot/count
01	4 dot/count
02	2 dot/count
03	1 dot/count

o). Set Auto speed (E7)

At the end of a sample interval in the stream mode, he current X and Y data values are converted New values. The sign bits are not involved in this conversion. The conversion is only in stream mode.

The relationship between the input and output count follows:

Input	Output
0	0
1	1
2	1
3	3
4	6
5	9
N(≥6)	2.0*N

p). Reset Auto speed (E6)

This command restore normal speed.

6.3 Microsoft PS/2 scrolling mouse mode

(A) Entering procedure: Except in WRAP mode, while MX84511 received the following consecutive command.

i. F3 C8 ---- set sampling rate 200/sec

ii. F3 64 ---- set sampling rate 100/sec

iii. F3 50 ---- set sampling rate 80/sec

(B) Operating:

a. All of the commands in 2D mode still be valid.

b. The ID code of read device type command (F2) will changed from "00" to be "03".

c. Data report will be four bytes format:

Byte	Bit	Description
1	0	Left button status; 1 = pressed
	1	Right button status; 1 = pressed
	2	Middle button status; 1 = pressed
	3	Reserve
	4	X data sign; 1 = negative
	5	Y data sign; 1 = negative
	6	X data overflow; 1 = overflow
	7	Y data overflow; 1 = overflow
2	0-7	X data (D0 - D7)
3	0-7	Y data (D0 - D7)
4	0-7	Z data (D0 - D7)

(C) Exiting Microsoft scrolling mode:

There are two ways to exit:

a. Power off.

b. Reset command (FF).

6.4 Z-axis Input Function

6.4.1 Photo Couples Input

Z-axis counter accumulates the Z1, Z2 phase changed by movement. This mode includes noise immunity.

Z/4 : 4 dots per count. Counted by Z1=1, Z2=1 phase, the wheel should stay at Z1=0, Z2=0 phase.

6.4.2 Mechanical Mode

The function is the same as photo couples input mode, except there is no noise immunity.

Z/2 : 2 dot per count. Counted by Z2 changing phase.

7. ABSOLUTE MAXIMUM RATING

Parameter	Sym.	Min.	Max.	Unit
Supply Voltage	V_{DD}	-0.3	5.5	V
Input Voltage	V_{IN}	V_{SS}-0.3	V_{DD}+0.3	V
Operating Temperature	T_{OP}	0.0	70.0	℃
Storage Temperature	T_{STG}	-25.0	100.0	℃

8. DC ELECTRICAL CHARACTERISTICS

Item	Sym.	Min.	Typ.	Max.	Unit	Test Condition
Operating Voltage	V_{DD}	4.5	5.0	5.5	V	
Operating current (no load)	I_{OP}	-	3.6	-	mA	V_{DD}=5V
Z1, Z2 (photo mode) Low input reference current	I_{PL}	60	-	-	μA	V_{DD}=5V
Z1, Z2 (photo mode) High input reference current	I_{PH}	-	-	110	μA	V_{DD}=5V
Z1, Z2 (photo mode) Input current (input impedance) (80uA)	V_{PI}	0.8	1.0	1.2	V	V_{DD}=5V
Z1, Z2 (photo mode) Input current (input impedance) (500uA)	V_{PI}	1.5	2.4	2.8	V	V_{DD}=5V
X1, X2, input voltage	V_{IX}	0	-	V_{DD}	V	
Y1, Y2, input voltage	V_{IY}	0	-	V_{DD}	V	
X1,X2, Peak to peak voltage.	V_{PPX}	0.6	1.3		V	
Y1,Y2,Peak to peak voltage.	V_{PPY}	0.6	1.3		V	
DATA, CLK positive-going threshold voltage	V_{t+}	0.6 V_{DD}	-	0.8 V_{DD}	V	
DATA, CLK negative-going threshold voltage	V_{t-}	0.2 V_{DD}	-	0.4 V_{DD}	V	
KL, KM, KR input low voltage	V_{IL1}	-	-	0.3 V_{DD}	V	
KL, KM, KR input high voltage	V_{IH1}	0.7 V_{DD}	-	-	V	
KL, KM, KR input resistor (V_{IN}= V_{DD})	R_{i1}	-	18	-	KΩ	
Z1, Z2 input resistor (mechanical input, V_{IN}= V_{DD})	R_{i2}	-	3.0	-	KΩ	
DATA, CLK input current (pull up resistor) (V_{IN}= 0)	I_{dc}	0.5	-	2.0	mA	V_{DD}=5V
DATA, CLK low output voltage (Iprl=-4mA)	V_{prl}	-	-	0.4	V	V_{DD}=5V

KL, KM, KR, X1, X2, Y1, Y2, Z1, Z2 Input leakage current (Vin=0V)	I_{il}	0	-	-1.0	μ A	V_{DD}=5V
OPT input low voltage	V_{IL1}	-	-	0.8	V	
OPT input high voltage	V_{IH1}	2	-	-	V	
OPT output low voltage	VOL	-	-	0.4	V	V_{DD}=5V I_O=4mA
OPT output high voltage	VOH	2.4	-	-	V	V_{DD}=5V I_O=4mA

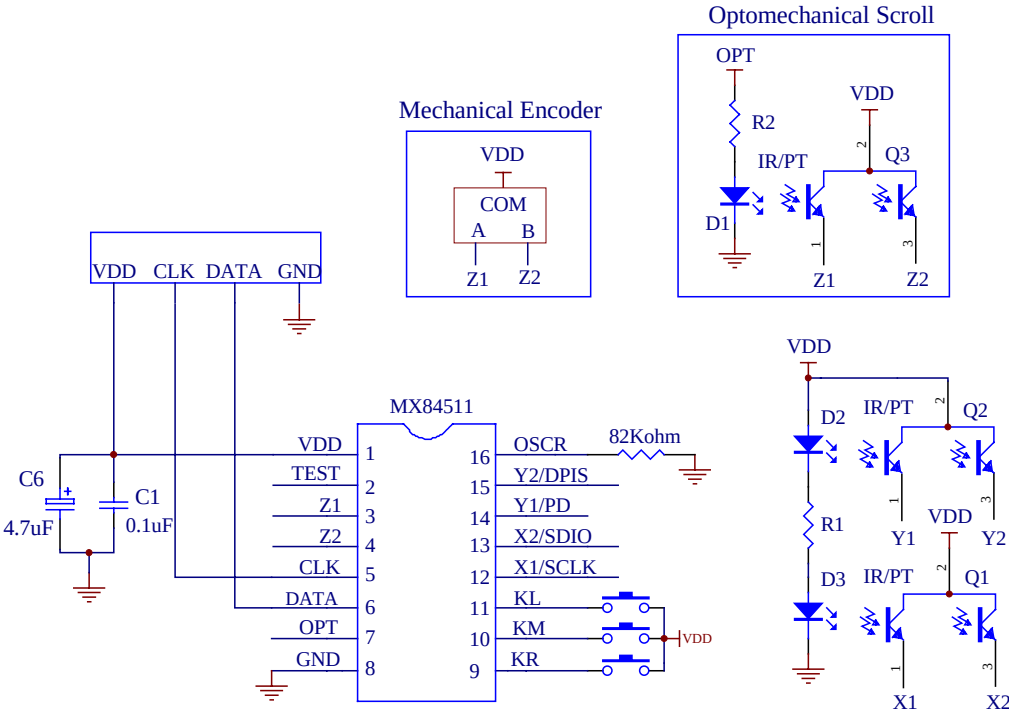
9. AC ELECTRICAL CHARACTERISTICS

Parameters	Sym.	Min.	Typ.	Max.	Unit
Oscillation Freq. (OSCR=82K)	F_{OSC}	-	6	-	MHz
Mouse CLK Active Time	T_8	-	40	-	us
Mouse CLK Inactive Time	T_7	-	40	-	us
Mouse Sample DATA from CLK rising Edge	T_6	-	18	-	us
System CLK Active Time	T_4	-	40	-	us
System CLK Inactive Time	T_3	-	40	-	us
Time from DATA Transition to Falling Edge of CLK	T_1	-	16	-	us
Time from rising Edge of CLK to DATA Transition	T_2	-	24	-	us

PS. The AC timings are measured under using 24MHz system clock signal.

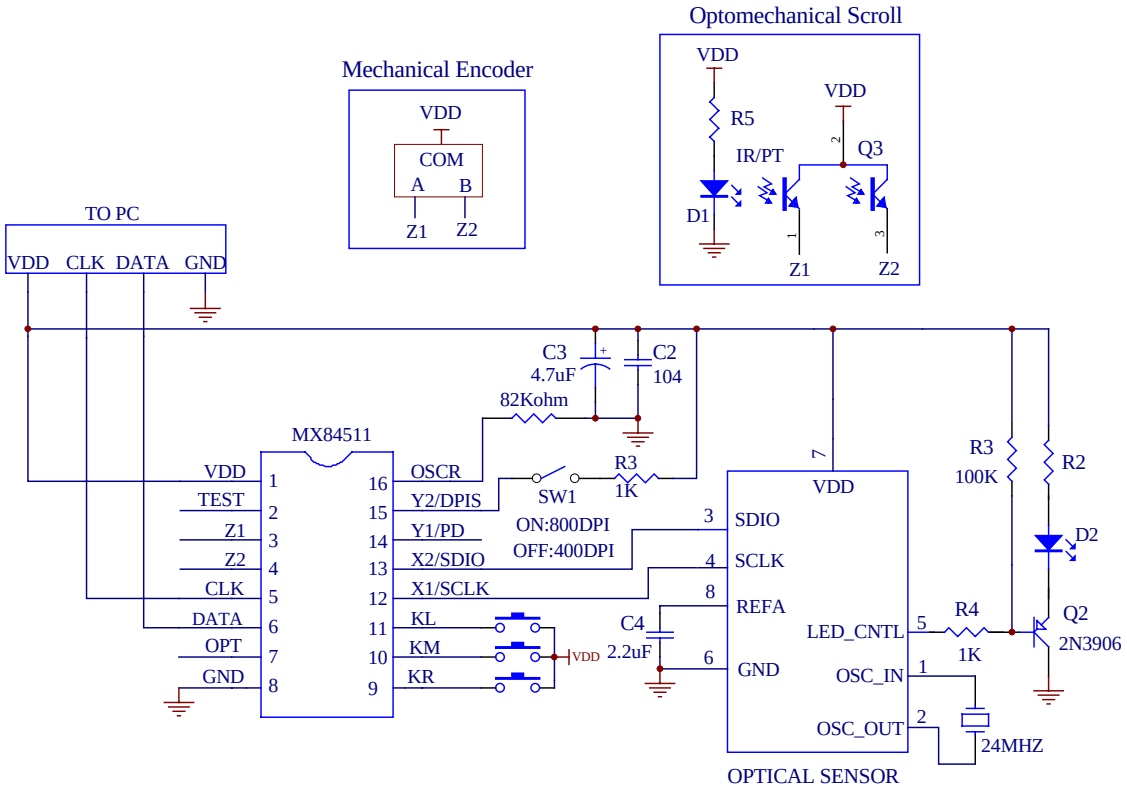
10. APPLICATION CIRCUIT

10.1 BALL TYPE CIRCUIT

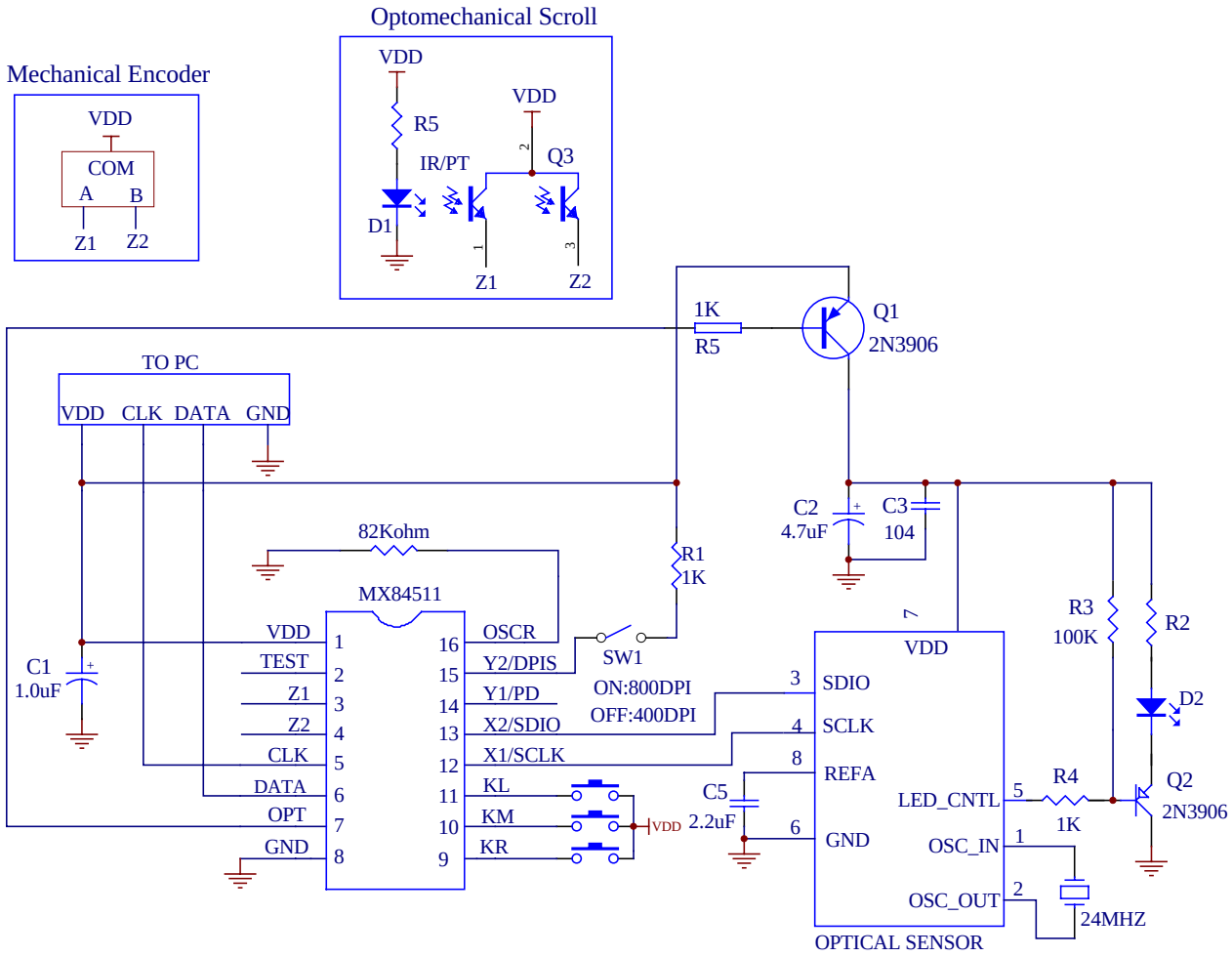


R1=1.8Kohm（参考值）

10.2 TYPICAL OPTICAL SENSOR CIRCUIT1



10.3 TYPICAL OPTICAL SENSOR CIRCUIT2



11. REVISION HISTORY

Version	Update date	Revised Content	Revised by	Confirmed by	Confirmed date
V1.0	2006.2.24	Original	Yokinno	Alan	2006.2.25
V1.1	2006.4.4	Virefy PAD Location	Yokinno	Alan	2006.4.4
V1.2	2006.4.15	Virefy Application circuit	Yokinno	Alan	2006.4.15
V1.3	2006.6.1	Add PAN3101 Optical Sensor Circuit	Yokinno	Alan	2006.6.2
V1.4	2006.6.14	Virefy Application circuit	Yokinno	Alan	2006.6.15