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凌越科技
Topro Technology Inc.

TP8482
PS/2 3D 5Key Mouse Controller

DataSheet

Version: 1.0
Apr/2002

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TP8482
PS/2 3D 5Key Mouse Controller

General Specification

General Description

The TP8482 3D Mouse Controller is specially designed to control 3D PS/2 mouse device. This single chip can interface five key-switches and six photo-couples direct to 8042. TP8482 can receive command and echo status or data format which are compatible with IBM PS/2 mode mouse and Microsoft 3D PS2 mouse. .Key de-bouncing circuit is provided to prevent false entry and improve TP8482 accuracy.

In the conventional mouse, a great number of noises are generated when the grid is partially closed or opened. These noises are usually mistaken for movement signals by conventional mouse controller and the cursor of the display screen is thus moved frequently up and down or back and forth. This will consumes a great amount of energy. The TP8482 3D PS/2 mouse controller provides noise immunity circuits to eliminate these noises in order to reduce energy consumption. Using the auto-speed adjusting circuits, TP8482 promotes the power of the mouse in movement. When TP8482 moves at low speed, it will be very smooth. While at high speed, TP8482 can change the scanning ability of the motion and detects more dots than that of at low speed. According to different speed, the horizontal and vertical counters acquire different dots in the same distance.

Features

* Being compatible with 2D & 3D (3/5 keys) mouse mode.
* Including buyer testing mode.
* Auto speed with dynamic resolutions.
* Built-in noise immunity circuit.
* Low power dissipation.
* Clocked by build-in RC oscillating circuit.
* Five key-switches and six photo-couples inputs.
* Both key-press and key-release debounce interval 12 ms.
* Improved ESD protection.
* Built-in auto-reference function.

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Applications

    * Optical mouse or pen-mouse.

    * Mechanical mouse or pen-mouse.

    * Optomechanical mouse or pen-mouse.

    * Mechanical track ball.

    * Optomechanical track ball.

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Contents：

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Pin Configurations and Package Type

Pin Assignment

TP8482AP/BP/AM/BM

VDD	1	18	OSCR
OSCOUT	2	17	Y2
Z1	3	16	Y1
Z2	4	15	X2
CLK	5	14	X1
DATA	6	13	L
TEST	7	12	M
VSS	8	11	R
B4	9	10	B5

PDIP18:

TP8472AP(Resolution in Z direction =1/2)

TP8472BP(Resolution in Z direction =1/4)

SOP18

TP8472AM(Resolution in Z direction =1/2)

TP8472BM(Resolution in Z direction =1/4)

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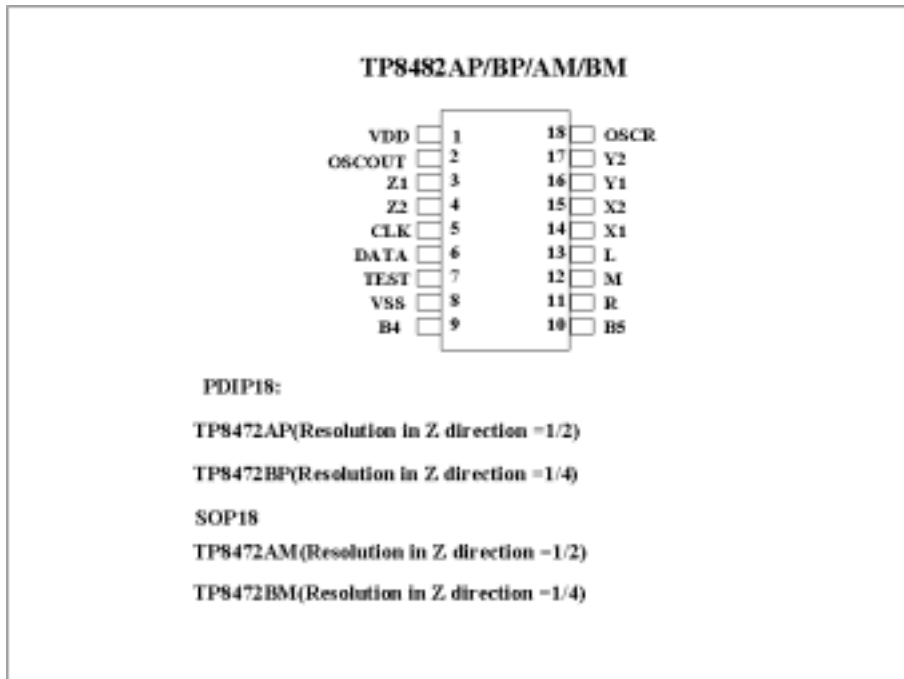
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Package Type :
(SOP18)

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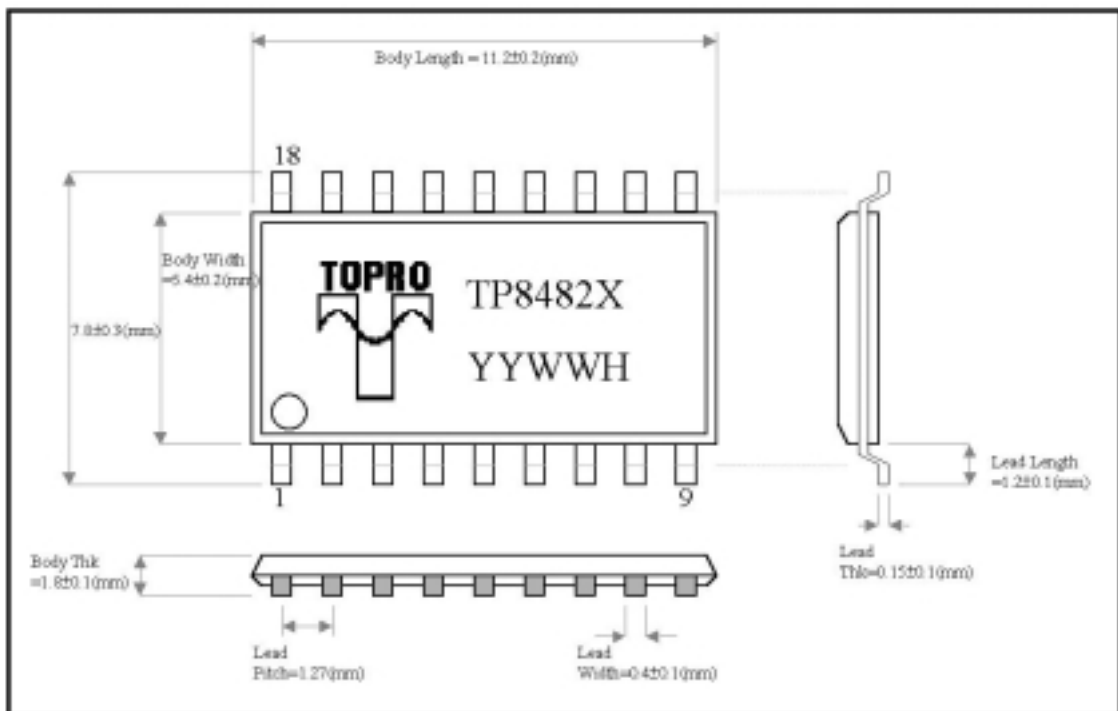
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Pin Description

Pin	Name	I/O	Function
1.	VDD.	I.	Power.
2.	OSCOUT.	I/O.	Clock output. In test mode it is clock input.
5.	CLK.	I/O.	8042 auxiliary port CLK line
6.	DATA I/O.		8042 auxiliary port DATA line
7.	Test.	I.	If it is connected to GND or floated,TP8482 will work on normal operation. While it is connect to VDD, TP8482 will enter testing mode, you can use OSCR to select two types of testing mode.
8.	VSS.		Ground.
9.	B4.	I	The fourth key of Microsoft 5 key mouse spec.
10.	B5.	I	The fifth key of Microsoft 5 key mouse spec.
11.	R.	I	Three key-switches exert seven different combinations totally.
12.	M.	I/O.	Both key-pressed and key-released signals accompanied with
13.	L.	I/O.	horizontal and vertical state will be sent to the host. The status of the key-switches will be preserved when RXD is transmitting. The debounce interval for both key-press and key-release is 12 ms. In testing mode, L and M are the outputs of motion detector. Use R key can select the two outputs from X1, X2 or Y1, Y2. This feature can help manufacture to adjust the phase of four photo-couples for improving the yield.
3.	Z1.	I	Six photo-couple signals denote UP, DOWN,LEFT, RIGHT,
4.	Z2.		Scrolling UP and Scrolling down state. During the scanning period,
14.	X1.		as long as the photo-couples change their states, the value of vertical or

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15.	X2.		horizontal counter will accordingly increase or decrease.
16.	Y1.		
17.	Y2.		
18.	OSCR.	I	If it is connected a 1Mohm resistor to ground, TP8482 will employ a built in RC ckt to generate clock. While it is connected to VDD,and Test connect to VDD, it will enter testing mode, you can observe X/Y input on L/M pin.

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Functional Block Diagram

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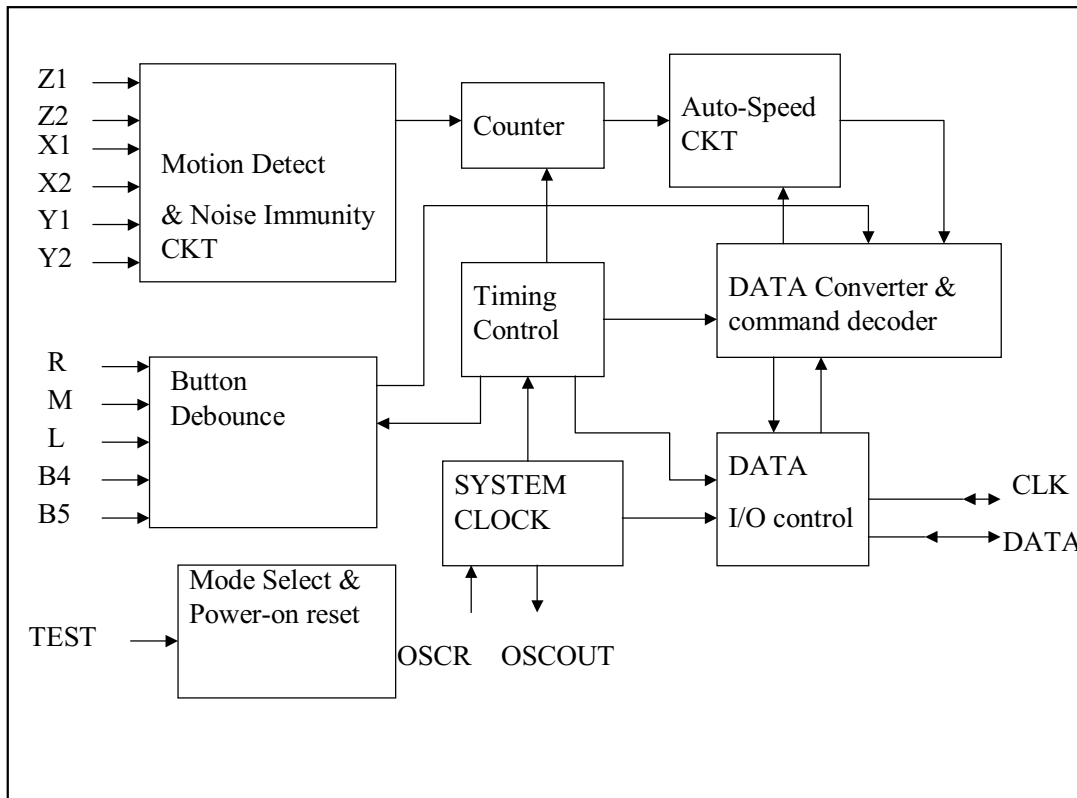
Function Descriptions

(1) PS/2 Mouse Mode

      5-button Activation (or "Knocking") Method

The method used by Windows 2000 to activate the new 5-button wheel mode is an extension of the method used to activate the third button and the wheel in IntelliMouse-compatible mice:

First, the mouse is set to the 3-button wheel mode, which is accomplished by setting the report rate consecutively to 200/second, then to 100/second, then to 80/second, and then reading the ID from the mouse. The mouse should report an ID of 3 when this sequence is completed.

Next, the mouse is set to the 5-button wheel mode, which is accomplished by setting the report rate consecutively to 200/second, then to 200/second again, then to 80/second, and then reading the ID from the mouse. Once this sequence is completed, a 5-button wheel mouse should report an ID of 4 (whereas an IntelliMouse-compatible 3-button wheel mouse would still report an ID of 3).

(A) 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-autospeed

    stream mode

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4 counts/mm

disable

b. Stream Mode:

The maximum rate of transfer is the programmed sampling rate.

Data report is transmitted if

(a) switch is pressed

(b) movement has been detected

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 TP8482.

(B) PS/2 Mouse Data Report:

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

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

c. Data report format:

For reference, the standard PS/2-compatible mouse data packet format is as shown in the

following table.

Data Packet Format for PS/2-compatible Mouse

BYTE	D7	D6	D5	D4	D3	D2	D1	D0	Comment
1	YO	XO	XS	YS	Tag	M	R	L	Sign,button
2	X7	X6	X5	X4	X3	X2	X1	X0	Data byte
3	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Data byte

The Windows 2000 mouse drivers do not check the overflow bits. In case of overflow, the mouse

should simply send the maximal signed displacement value.

Also for reference, the data packet format for an IntelliMouse-compatible 3-button wheel mouse

is as shown in the following table.

Data Packet Format for 3-button Wheel Mouse

BYTE	D7	D6	D5	D4	D3	D2	D1	D0	Comment
1	0	0	XS	YS	1	M	R	L	Sign,button

BYTE	D7	D6	D5	D4	D3	D2	D1	D0	Comment
2	X7	X6	X5	X4	X3	X2	X1	X0	X data byte
3	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Y data byte
4	Z7	Z6	Z5	Z4	Z3	Z2	Z1	Z0	Wheel data

The new data packet format for a 5-button wheel mouse should be as shown in the following table.

Data Packet Format for 5-button Wheel Mouse

BYTE	D7	D6	D5	D4	D3	D2	D1	D0	Comment
1	0	0	XS	YS	1	M	R	L	Sign,button
2	X7	X6	X5	X4	X3	X2	X1	X0	X data byte
3	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Y data byte
4	0	0	B5	B4	Z3	Z2	Z1	Z0	Wheel data

Notice that the Z/wheel data for a 5-button wheel mouse has been reduced to four bits instead of the 8 bits used in the IntelliMouse-compatible 3-button wheel mode. This reduction is made possible by the fact that the wheel typically cannot generate values beyond the range +7/-8 during any given interrupt period. The Windows 2000 mouse drivers will sign extend the four Z/wheel data bits when the mouse is in the 5-button wheel mode, and the full Z/wheel data byte when the mouse operates in the 3-button wheel mode.

(C) PS/2 mouse Data Transmission:

a. TP8482 generates the clocking signal when sending data to and receiving data from the system.

b. The system requests TP8482 to receive system data output by forcing the DATA line to an inactive level then allowing CLK line to go to an active level.

c. 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 |

d. Data Output (data from TP8482 to system):

If CLK keep low (inhibit status), data will not transmit.

If CLK raised to high and DATA is low(request-to-send),data is updated.

After receiving data from system, TP8482 will not start transmitting until CLK and DATA are 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, TP8482 check for line contention by checking for an inactive level on CLK lasting for no more than 100m sec.

Contention occurs when the system lowers CLK to inhibit TP8482 output after TP8482 has started a transmission. If this occurs before the rising edge of the tenth clock, TP8482 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 completed.

Following a transmission, the system inhibits TP8482 by holding CLK low until it can service the input or until the system receives a request to send a response from TP8482.

e. Data Input (from system to TP8482):

System first check if TP8482 is transmitting data. If TP8482 is transmitting, the system can override the output by forcing CLK to an inactive level prior to the tenth clock. If the transmission of TP8482 beyond the tenth clock ,the system must receive the data.

If TP8482 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 100u sec while preparing for output. When the system is ready to output start bit (0), it allows CLK to go to active level.

If request-to-send is detected, TP8482 clocks in 11 bits. Following the tenth clock,TP8482 checks for an active level on the DATA line, and if found, force DATA low , and clock once more.

If framing error occurs, TP8482 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 a data that requires a response, the system must wait for TP8482 to response before sending its next output.

(D) PS/2 Mouse Error Handling:

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

b. If two invalid input are received in succession, an error code of hex FC will be sent to the system.

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

d. As TP8482 receives a Resend command (FE), it transmits its last packet of data.

e. In the stream mode "Resend" is received by TP8482 following a 4-byte data packet transmission to the system. TP8482 resend the 4-byte data packet prior to clearing the counter.

f. A response is sent within 25 ms if

    (a) The system requires a response

    (b) An error is detected during transmission

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

(E)   PS/2 Mouse Commands Description:

There are 16 valid commands that transmits between the system and TP8482. 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	TP8482 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(2D mode)/03(3D mode)/04(3D5Key)
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 continuance command sequence below will activate 3D mode.

F3,XX

F3,XX

F3,XX

A power on reset or reset command will reset the controller into 2D mode .

The following describes valid commands:

a. Reset (FF)

TP8482 operation:

(a) Complete the reset.

(b) Transmit FA,AA,00 to the system.

(c) Set default:

sampling rate: 100 reports/s

non-autospeed

stream mode

4 counts/mm

disable

b. Resend (FE)

(a) Any time TP8482 receives an invalid command, it returns a Resend command to the

system.

(b) When TP8482 receives a Resend command, it retransmits its last output. If th

last packet was a Resend command, it transmits the packet just prior to the Resend

command.

(c) In stream mode, if a Resend command is received by TP8482 immediately following a 4-byte data packet transmission to the system, TP8482 will resend the 4-byte data packet prior to cleaning the count accumulators.

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 disable transmissions from TP8482.

e. Enable (F4)

Enable 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, shown as follows:

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)

TP8482 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)

TP8482 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 or the button status is unchanged since the last report. Following a Read Data command, the registers are cleared after a data transmission.

l. Set Stream Mode (EA)

This command sets TP8482 in stream mode.

m. Status Request (E9)

When this command is issued by the system, TP8482 responds 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

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

n. Set Resolution (E8,XX)

TP8482 provides four resolutions selected by the second byte of this command as follows:

Second Byte XX	Resolution
00	1 counts/mm
01	2 counts/mm
02	4 counts/mm
03	8 counts/mm

o. Set Autospeed (E7)

At the end of a sample interval in the stream mode, the 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 is as follows:

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

p. Reset Autospeed (E6)

This command restore normal speed.

(2) Testing Mode

Whenever "Test" pin is connected to VDD, the chip will enter buyer's testing mode.

If OSCR (connect to VDD) = "1"：The X direction output signals of comparators will present to "L" and "M" pin. Pressing "R" key can toggle the output from X direction to Y direction.

If OSCR (connect to GND) = "0"：The TP8482'S Internal RC won't generate clock. you can input clock on OSC.OUT pin to let TP8482 work on normal operation

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Absolute Maximum Ratings

Parameter	Min.	Ratings	Max.	Unit
Supply voltage	-0.3		5.5	V
Temperature under bias	0		70	ºC
Storage temperature range	-65		150	ºC
Power dissipation	-		500	mW

DC Electrical Characterisitics (Ta=25 to 70 ºC)

Parameter	Sym.	Min.	Typ.	Max.	Unit
Operating voltage	V DD	4.5	5.0	5.5	V
Operating current (with load)@32kHz	Iop			5.5	mA
OSCR high input voltage	Vrh	4			V
X1,X2,Y1,Y2,Z1,Z2 input reference Current	Ipi	60(1v)		334(5v)	uA
CLK,DATA positive-going threshold voltage	Vt+	3.2		3.8	V
CLK,DATA negaitive-going threshold voltage	Vt-	1.2		1.9	V
Low input voltage, other pins	Vai			1.5	V
High input voltage , other pins	Vaih	3.5			V
L,M,R input current (pull low resistor, Vin=5V)	Imi	35		45	uA
DATA, CLK input current (pull up resistor, Vin=0V)	Idc	-0.6		-1.86	mA
DATA, CLK low output voltage (Iprl=4mA)	Vprl			0.4	V

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OSC IN input leakage current (Vin=5V)	Iih 0		1.0	uA
L,M,R input leakage current (Vin =0V)	Iil	-1	1	uA
X1, X2,Y1,Y2,Z1,Z2 input leakage current (Vin=0V)	Iipl	-1	1	uA
Input resistor of button(R/L/M, Vop=5V)	Rin(R/L/M)	30		KOhm
Input resistor of X/Y/Z(Vx=Vy=Vz=5V)	Rin(photo)	14		KOhm

_____

* All voltages in above table are compared with V $_{ss}$.

* All parameters in above table are tested under V $_{DD}$ =5V.

   CLK & DATA output gates are open drains that connect to pull up resistors.

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AC Electrical Characterisitics (Ta=25 to 70 ºC)

Parameter	Sym.	Min.	Typ.	Max.	Unit
Oscillating frequency	Fosc	40-10%	40	40+10%	KHz
Key debounce	Tkd		12		ms
Rising edge crossed width (Fosc=33KHz)	Tr	10			us
Falling edge crossed width (Fosc=33KHz)	Tf	10			us
Mouse CLK active time	Tmca		37.5		us
Mouse CLK inactive time	Tmci	37.5			us
Time that mouse sample	Tmdc				
DATA from CLK rising edge			12.25		us
System CLK active time	Tsca		37.5		us
System CLK inactive time	Tsci		37.5		us
Time from DATA	Tsdc				
transition to falling edge of CLK			12.25		us
Time from rising edge of	Tscd				
CLK to DATA transition			25.25		us
Time to mouse inhibit after the 11th CLK to	Tpi	0		50	us
ensure mouse does not start another transmission					

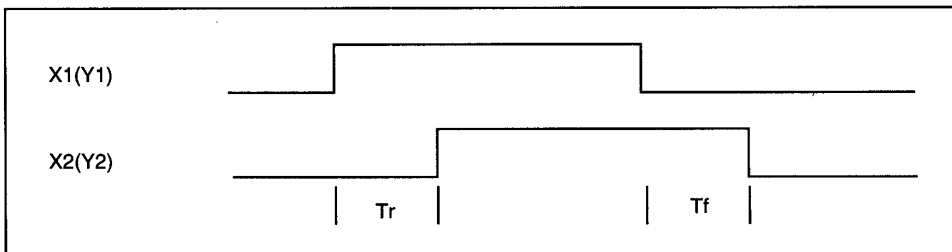_____

PS. The AC timings are measured with 40 KHz system clock signal.
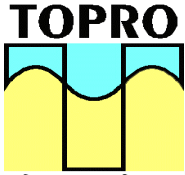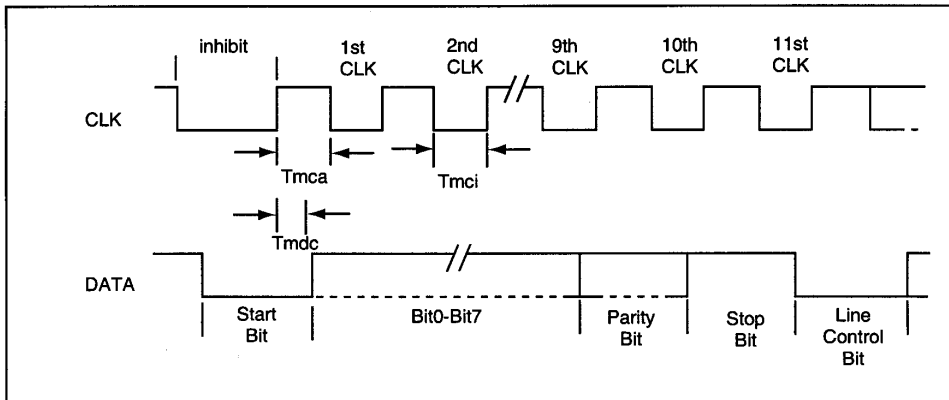
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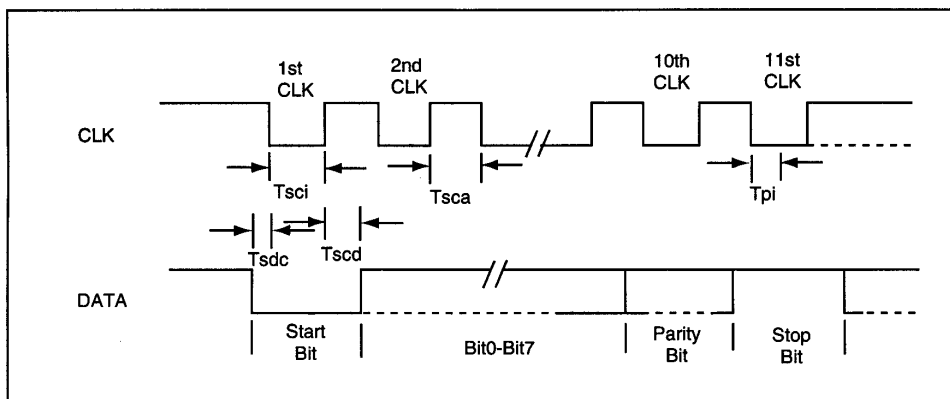
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Timing Diagram

(A) Photo-couples pulse width

(B) Receiving Data

(C) Sending Data

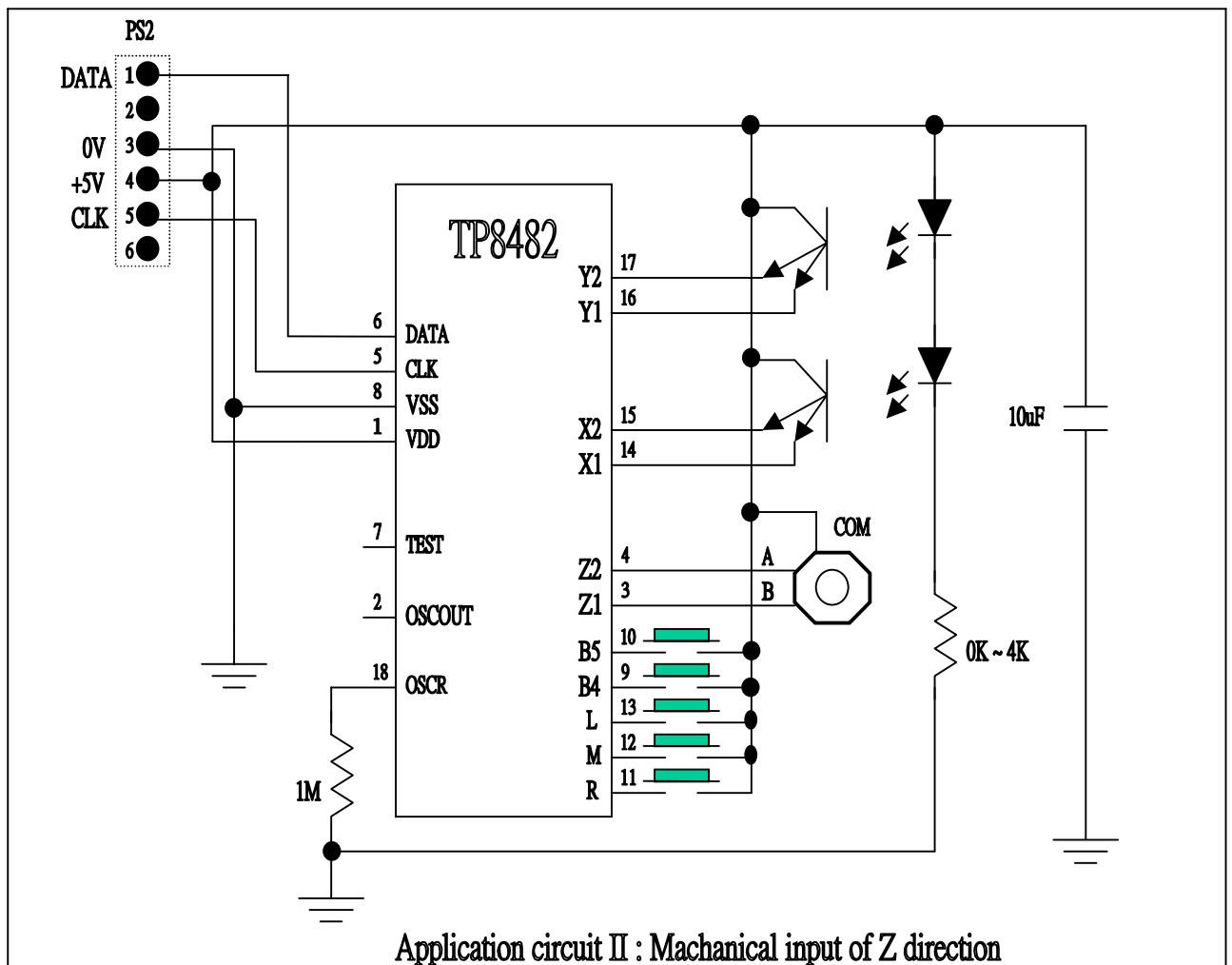# TP8482
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(1) Semi-photo Sensor for 3D:

Application circuit I : Semi-Optical input

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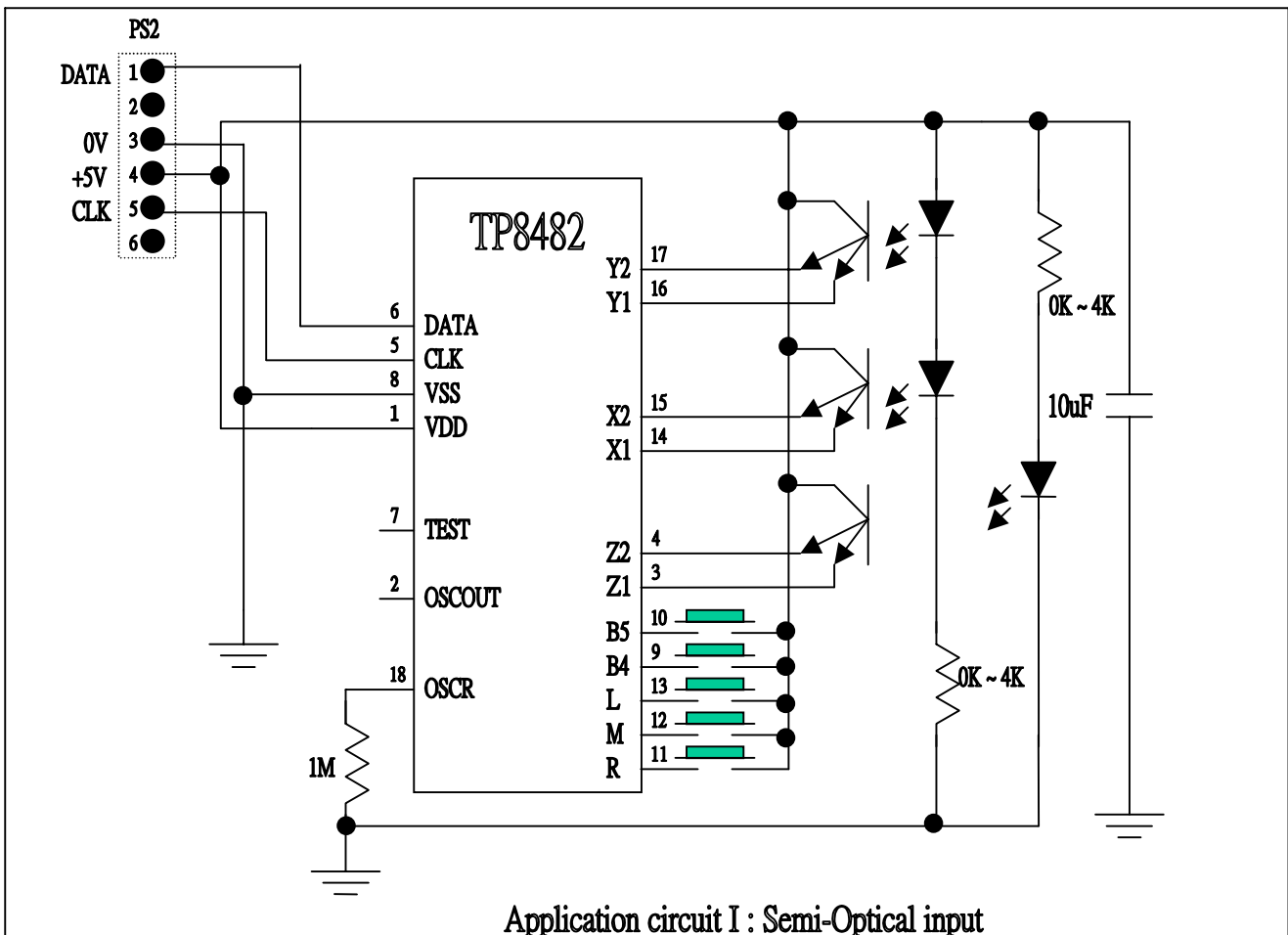
(2) Switch Encoder for 3D

Application circuit II : Machanical input of Z direction

(3) Optical Sensor for 3D :