

PS/2 3D SCROLLING MOUSE CONTROLLER

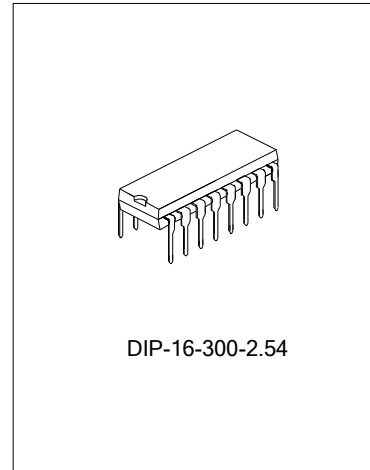
DESCRIPTION

The SC84512 Scrolling Mouse Controller is specially designed to control PS/2 mouse device. This single chip can interface three key-switches four photo-couples plus x-axis direct to 8042 controller.

Containing a self-adjusting circuit, SC84512 can adapt to receive photo-couples inputs of XYZ in a wide range of voltage.

Key debouncing circuit is provided to prevent false entry and improve the accuracy.

The test module in SC84512 will run into function when the pin of OPT is connected to VDD. The pin named L is the output of X1, while M used for X2. Triggering by button of R, the pin of L and M will be the output of Y1Y2 or Z1Z2.



FEATURES

- * Using $50k \pm 5\%$ resistor for RC oscillation.
- * Compatible with legacy PS/2 mouse.
- * Compatible with Microsoft scrolling mouse.
- * Built-in noise immunity circuit.
- * Built-in testing circuit.
- * Built-in key debouncing circuit.
- * Self-adjusting circuit for photo-couples input.
- * The sampling rate of motion detector is about 65KHz.
- * Low power dissipation.

* Six types Z direction input:

1. Photo couples input. (Z/1)
2. Key-switches input.
3. Voltage-sensing input.
4. Mechanical input. (Z/1)
5. Photo couples input. (Z/4)
6. Mechanical input. (Z/2)

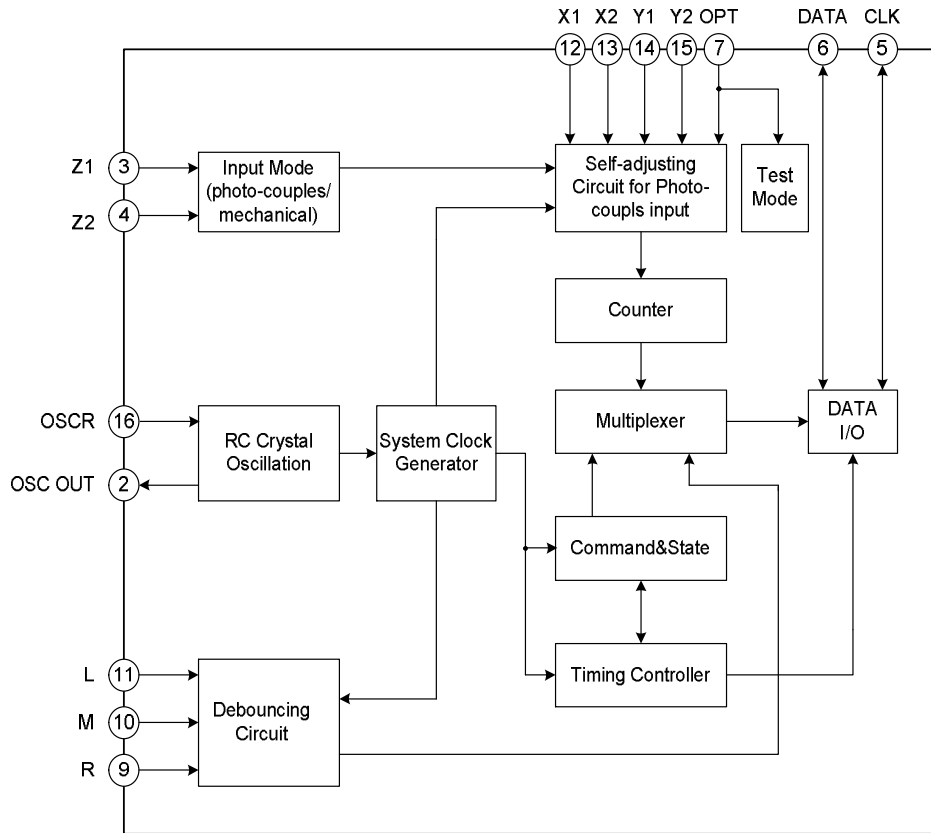
APPLICATIONS

- * PS/2 mouse device

ORDERING INFORMATION

Device	Package
SC84512AP	DIP-16 Package, Photo couples input. (Z/1)
SC84512BP	DIP-16 Package, Key-switches input.
SC84512CP	DIP-16 Package, Voltage-sensing input.
SC84512DP	DIP-16 Package, Mechanical input. (Z/1)
SC84512EP	DIP-16 Package, Photo couples input. (Z/4)
SC84512FP	DIP-16 Package, Mechanical input. (Z/2)

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS ($T_{amb}=25^{\circ}C$, unless otherwise specified)

Characteristics	Symbol	Value	Unit
Temperature Under Bias	TOPR	0 ~ 70	$^{\circ}C$
Storage Temperature range	TSTR	-65 ~ +150	$^{\circ}C$
Input Voltage	VIN	-0.3 ~ +6.0	V
Output Voltage	Vo	-0.3 ~ +6.0	V

DC ELECTRICAL CHARACTERISTICS ($T_{amb}=25\sim 70^{\circ}\text{C}$, $V_{DD}=5.0\text{V}$)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	
Operating Voltage	V_{DD}	4.5	5	5.5	V	
Operating Current (No Load)	I_{op}	--	--	1.2	mA	
CLK, DATA Positive-going Threshold Voltage	V_{t+}	0.6 V_{DD}	--	0.8 V_{DD}	V	
CLK, DATA Negative-going Threshold Voltage	V_{t-}	0.2 V_{DD}	--	0.4 V_{DD}	V	
DATA, CLK Input Current (pull up resistor) ($V_{in}=0\text{V}$)	I_{dc}	0.56	--	1.86	mA	
DATA, CLK Low Output Voltage $I_{pri}=-4\text{mA}$	V_{pri}	--	--	0.4	V	
X1, X2, Y1, Y2, Z1, Z2 (Photo Mode) Low Input Reference Current	I_{pl}	60	--	--	μA	
X1, X2, Y1, Y2, Z1, Z2 (Photo Mode) High Input Reference Current	I_{ph}	--	--	110	μA	
X1, X2, Y1, Y2, Z1, Z2 (Photo Mode) Input Current (Input Impedance 80 μA)	V_{pi}	0.8	--	1.2	V	
X1, X2, Y1, Y2, Z1, Z2 (Photo Mode) Input Current (Input Impedance 500 μA)	V_{pi}	1.5	--	2.8	V	
L, M, R, OPT, Z1, Z2 (Key Mode) Input Low Voltage	V_{ail}	--	--	0.3 V_{DD}	V	
L, M, R, OPT, Z1, Z2 (Key Mode) Input High Voltage	V_{aih}	0.7 V_{DD}	--	--	V	
L, M, R, Z1, Z2 (Key & Voltage Mode) Input Resistor ($V_{in}=V_{DD}$)	R_{mi}	92	--	310	$\text{k}\Omega$	
OPT Input Resistor ($V_{in}=V_{DD}$)	R_{xi}	133	--	400	$\text{k}\Omega$	
OPT High Output Current ($V_{in}=V_{DD}$)	V_{opt}	4.5	--	--	V	
L, M, R, X1, X2, Y2, Z1, Z2 Input Leakage Current ($V_{in}=0\text{V}$)	I_{il}	0	--	-1.0	μA	
OPT High Output Current ($I_{opt}=10\text{mA}$)	$V_{DD}=4.5\text{V}$	I_{dc}	3.2	--	--	V
	$V_{DD}=5\text{V}$		4.5	--	--	
	$V_{DD}=5.5\text{V}$		5.5	--	--	

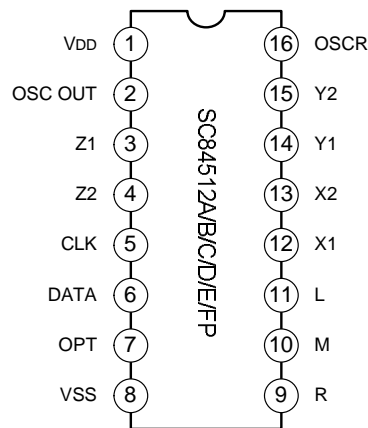
- Note:
1. All voltage in above table are compared with V_{SS} .
 2. All parameters in above table are tested under $V_{DD}=5\text{V}$.
 3. CLK & DATA output gates are open drains that connect to pull up resistors.

AC ELECTRICAL CHARACTERISTICS (T_{amb}=25~70°C)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Oscillating Frequency	F _{osc}		34.3-10%	34.3	34.3+10%	kHz
Key Debounce	T _{kd}		--	12	--	ms
Rising Edge Crossed Width F _{osc} =35KHz	T _r		14.3	--	--	μs
Falling Edge Crossed Width	T _f		14.3	--	--	μs
Mouse CLK Active Time	T _{mca}		--	42.9	--	μs
Mouse CLK Inactive Time	T _{mci}		--	42.9	--	μs
Mouse Sample DATA from CLK rising Edge	T _{mdc}		--	14.3	--	μs
System CLK Active Time	T _{sca}		--	42.9	--	μs
System CLK Inactive Time	T _{sci}		--	42.9	--	μs
Time from DATA Transition to Falling Edge of CLK	T _{sdc}		--	14.3	--	μs
Time from rising Edge of CLK to DATA Transition	T _{sdc}		--	28.6	--	μs
Time to mouse Inhibit after the 11th CLK to ensure mouse does not start another Transmission	T _{pi}		0	--	50	μs

The AC timings are measured under using 35 KHz system clock signal.

PIN CONFIGURATIONS



PIN DESCRIPTIONS

Pin No	Pin Name	Description
1	VDD	Power line.
2	OSC OUT	RC mode oscillation with 50kΩ resistor.
3	Z1	Z-axis input.
4	Z2	Photo mode: Three steps dynamic input impedance. Current comparator input. Key mode: 200kΩ resistor pull low. 7 levels increased by "M" key. Voltage mode: 200kΩ resistor pull low. 7 levels voltage comparator. Mechanical mode: 13.2kΩ resistor pull low.
5	CLK	Connect to 8042 auxiliary port CLK line.
6	DATA	Connect to 8042 auxiliary port DATA line.
7	OPT	INPUT: 200kΩ pull low to VSS. When OPT is connected to VDD, SC84512 will enter test mode. In test mode, L will be the output of X1, while M will be the output of X2. Toggling R key can change these output to be Y1, Y2 or Z1, Z2 respectively. OUTPUT: 2kHz Z-axis LED-driving source. "1" = VDD, "0" = floating; High duty is about 60μs.
8	VSS	Negative power.
9	R	Three key-switches inputs. 200kΩ resistors pull low.
10	M	
11	L	
12	X1	Three step dynamic input impedance. Use current comparator to measure photo-couples "ON", or "OFF".
13	X2	
14	Y1	
15	Y2	
16	OSCR	RC mode oscillation with 50kΩ resistor.

FUNCTION DESCRIPTIONS
1. LEGACY PS/2 MOUSE OPERATING
(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
 - * 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 SC84512.

(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:

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
2	7	Y data overflow; 1 = overflow
	0~7	X data (D0~D7)
3	0~7	Y data (D0~D7)

(C) PS/2 mouse Data Transmission

(a) SC84512 generates the clocking signal when sending data to and receiving data from the system.

(b) The system requests SC84512 receive system data output by forcing the DATA line to an inactive level and 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 and Input:

If required to send data (When CLK is high and DATA is low), SC84512 receive data from the system. and no transmission are started by SC84512 until CLK and DATA both high. DATA is valid at the falling edge of CLK and is read by system at the rising edge of CLK.

During transmission, SC84512 check for line contention by checking for an inactive level on CLK at intervals not to exceed 100 μ sec. During data transmission, if system lowers CLK before the rising edge of

the tenth clock, SC84512 will store the data in its internal 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 SC84512 by holding CLK low until it can service the input or until the system receives a request to send a response from SC84512.

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

(D) PS/2 Mouse Error Handling

- (a) A Resend command (FE) following receipt of an invalid input or any input with incorrect parity.
- (b) If two invalid input are received in succession, an error code of hex FC send to the system.
- (c) The counter accumulators are cleared after receiving any command except "Resend".
- (d) SC84512 receives a Resend command (FE), it transmit its last packet of data.
- (e) In the stream mode "Resend" is received by SC84512 following a 3-byte data packet transmission to the system. SC84512 resend the 3-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 in the transmission
- (g) 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.

2. MICROSOFT PS/2 SCROLLING MOUSE MODE

(A) Entering procedure: Except in WRAP mode, While SC84512 received the following consecutive command.

- (a) F3 C8 ---- set sampling rate 200/sec
- (b) F3 64 ---- set sampling rate 100/sec
- (c) F3 50 ---- set sampling rate 80/sec

(B) Operating:

- (a) All of the command in legacy mode still is 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
2	7	Y data overflow; 1 = overflow
	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).

3. Z-AXIS INPUT FUNCTION: The Z0 ~ Z7 limit value is ± 7

(A) Photo couples input: Z-axis counter accumulates the Z1, Z2 phase changed by movement. This mode includes noise immunity.

Z/1: 1 dot per count.

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

(B) Key-switches input: Pressing Z1, Z2 will start to fill the Z-axis counter with the value beginning at one. Toggling “M” key can increase the value any time by one. The limit value is ± 7 .

The relationship between the value and the transmission rate as follow:

Value	Rate per second
1	2.7
2	6.4
3	9.2
4	12.8
5	15
6	18
7	20

(C) Voltage-sensing mode: There are 7 voltage levels in Z1, Z2 input. The transmission table is the same as key-switch mode. The relationship between the value of Z-axis counter and the voltage as follows:

Value	Voltage
0	1V ↓
1	1.0V – 1.6V
2	1.6V – 2.2V
3	2.2V - 2.8V
4	2.8V – 3.4V
5	3.4V – 4.0V
6	4.0V – 4.6V
7	4.6V ↑

Under VDD = 5V condition

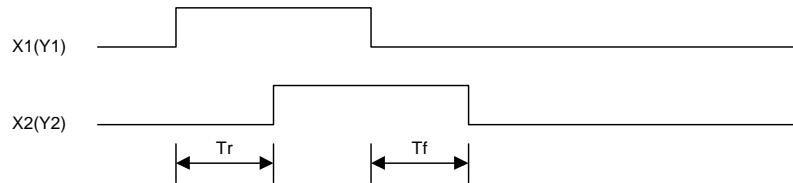
(D) Mechanical mode: The function is the same as photo couples input mode, except there is no noise immunity.

Z/1: 1 dot per count.

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

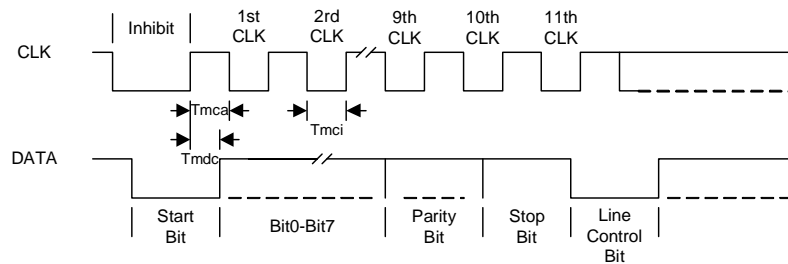
TIMING DIAGRAM

(1) Photo-couples pulse width

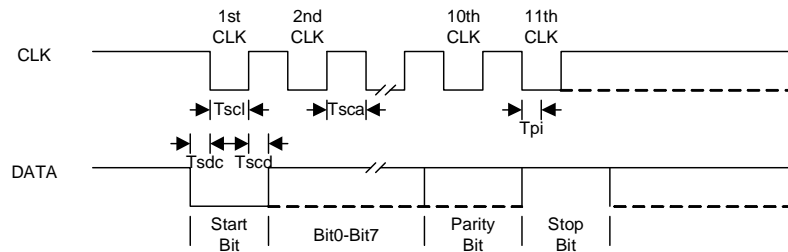


(2) PS/2 Mouse

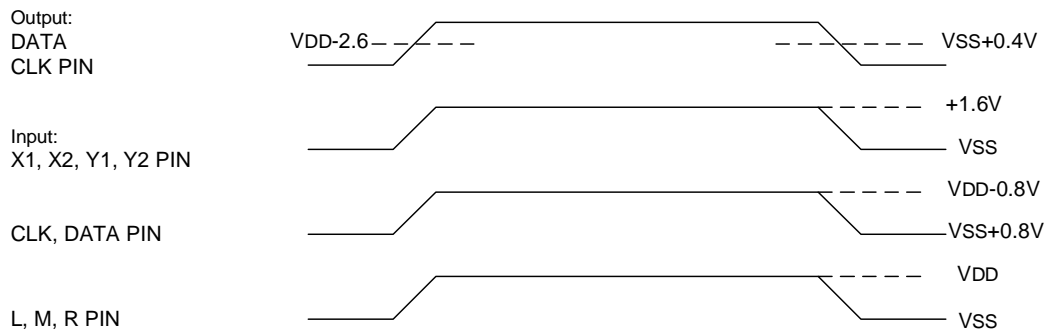
(A) Receiving Data



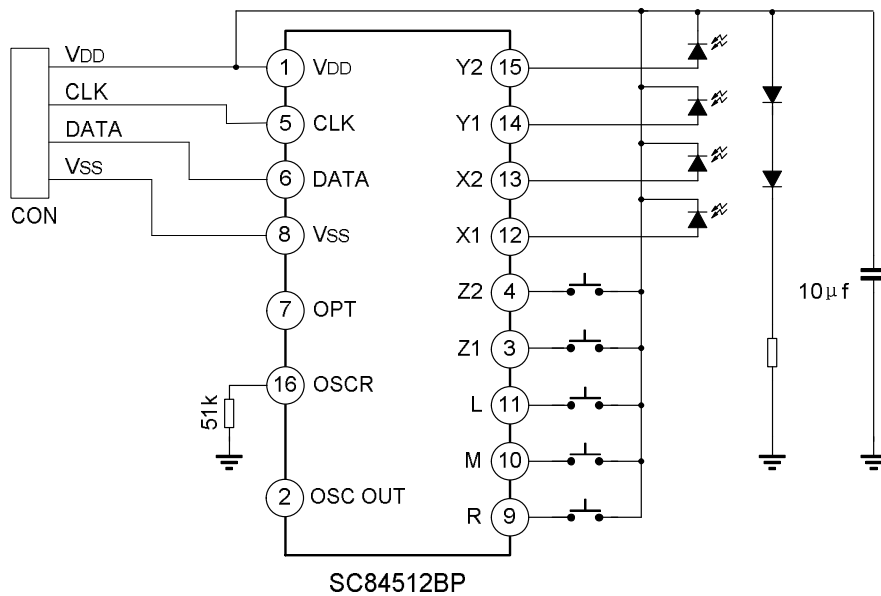
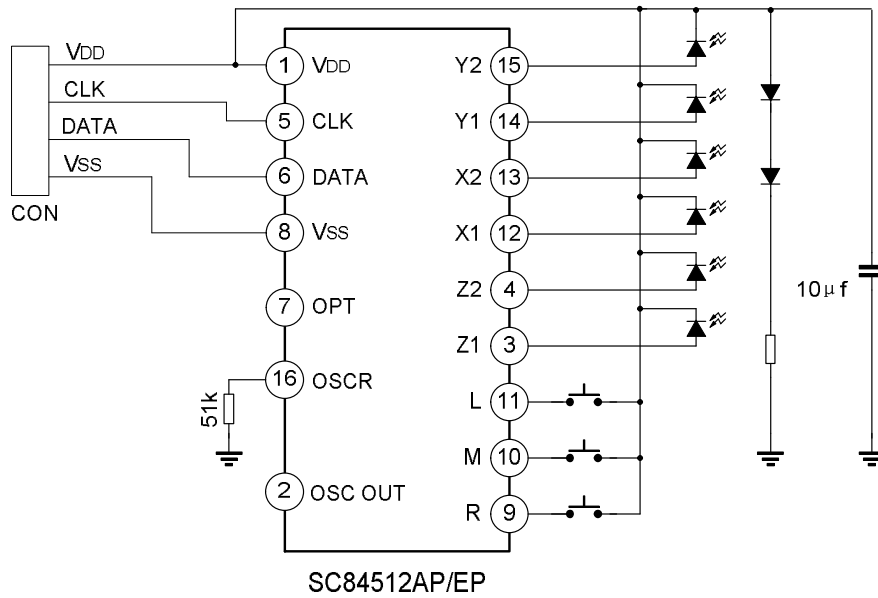
(B) Sending Data



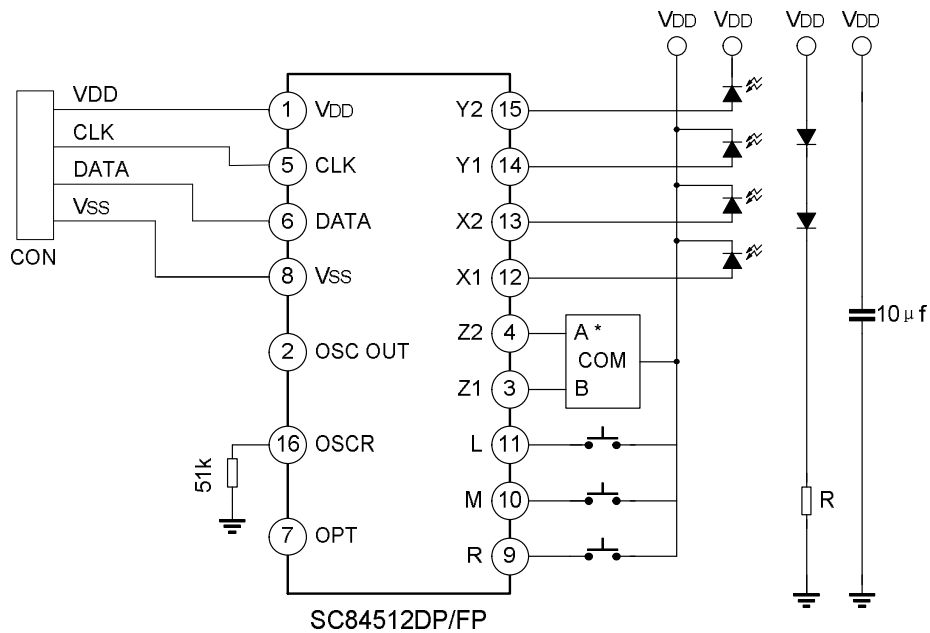
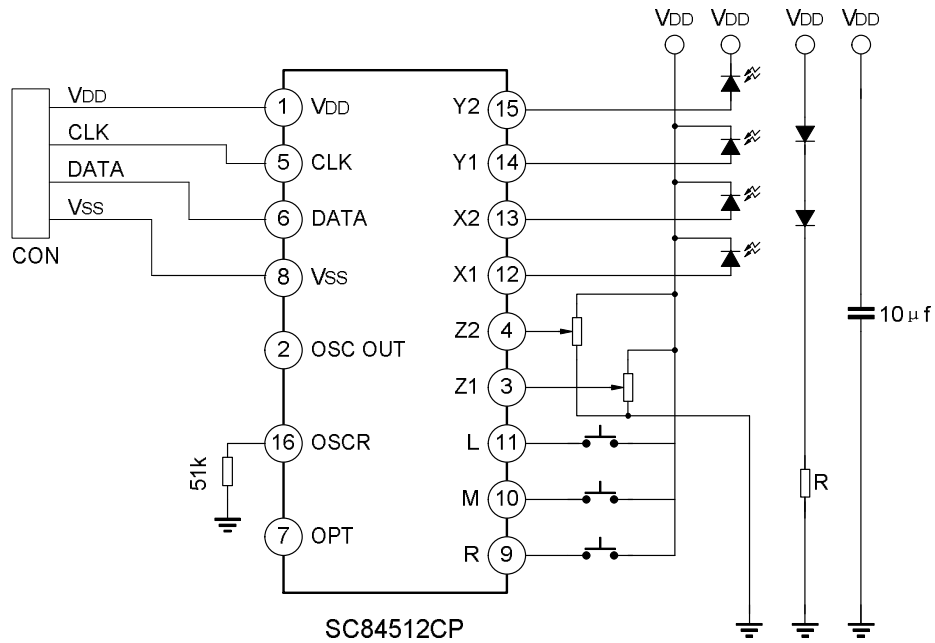
AC TIMING POINT



APPLICATIONS CIRCUITS



APPLICATIONS CIRCUITS (Continued)

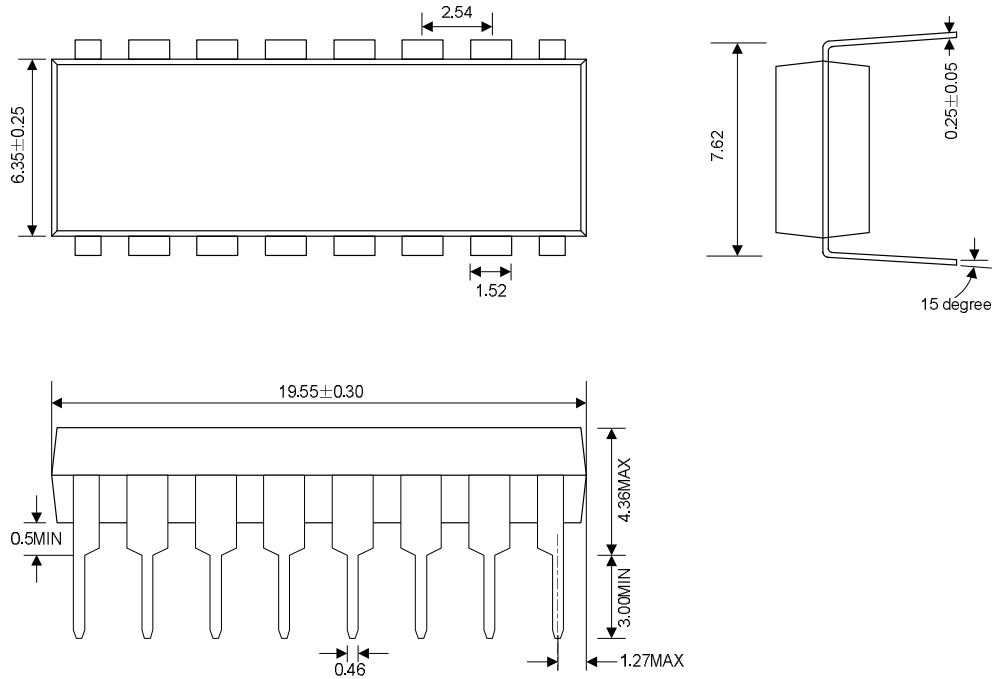


* Mechanical Encoder

PACKAGE OUTLINE

DIP-16-300-2.54

UNIT: mm



HANDLING MOS DEVICES:

Electrostatic charges can exist in many things. All of our MOS devices are internally protected against electrostatic discharge but they can be damaged if the following precautions are not taken:

- Persons at a work bench should be earthed via a wrist strap.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed for dispatch in antistatic/conductive containers.