HT6513
Mouse Controller

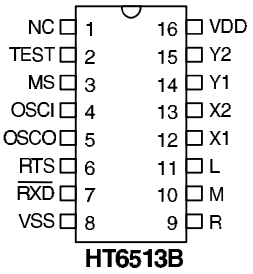
Features

- Low power dissipation
- Use 32.768KHz crystal
- Crystal oscillator circuits on-chip
- 1200 baud rate serial output
- Power directly from RS-232C without external power supply
- Three key-switches and four photo-couples inputs
- Key-in and key-release debounce interval 52 ms
- The HT6513 can execute two different outputs with any of the key-switch inputs
- $\overline{\text{RXD}}$ with heavy NMOS output

General Description

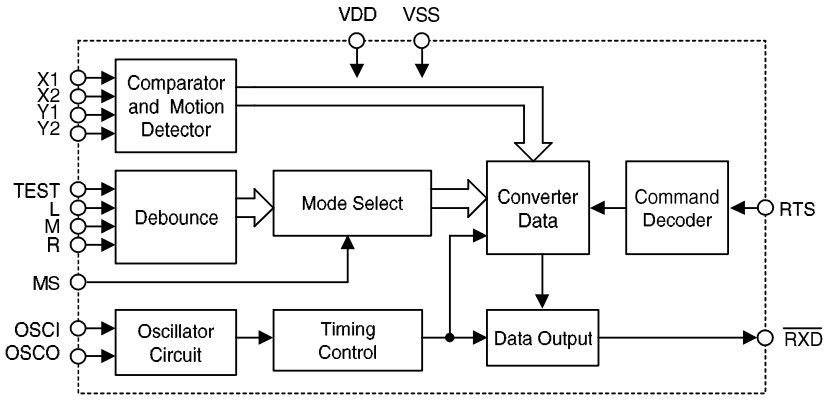
The HT6513 is a specially designed CMOS IC for mouse control applications. Capable of driving up to 3 key-switches and 4 photo-couplers directly into a standard RS-232C line, and it can be operated without an external power supply. It is compatible with both Microsoft and Mouse systems with false entries being prevented by internal debounce circuits.

Pin Assignment



HT6513B

Block Diagram

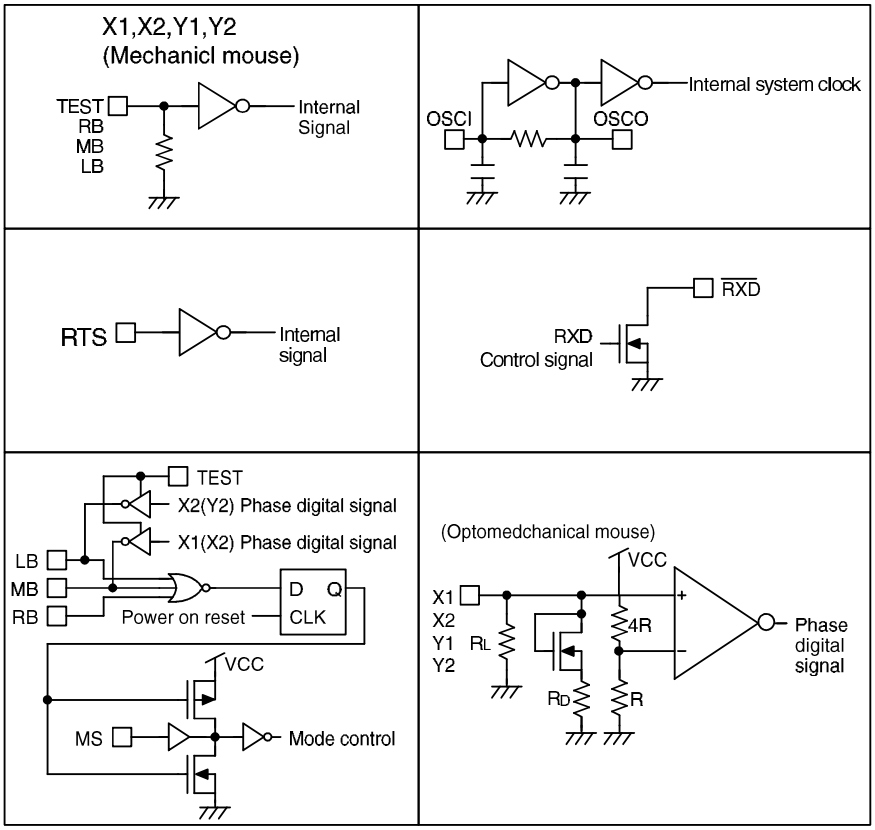


Pin Description

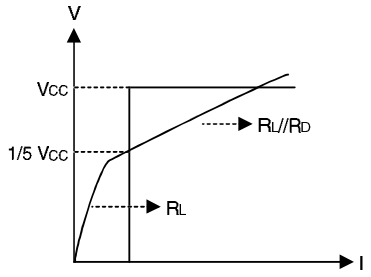
Pin Name	I/O	Internal connection	Description
MS	I	—	When this pin is connected to VDD, then HT6513 is assigned to operate under the microsoft mode only. If the pin is connected to VSS, then HT6513 will operate under the mouse system mode. If MS pin is "floating", the HT6513 is on the power on initiation mode.
TEST	I	Pull-Low	For IC test only. The test pin must be connected to VSS, while the chip is under normal usage.
OSCI	I	—	Oscillator input pin
OSCO	O	—	Oscillator output pin
RTS	I	—	The signal is sent by the mouse driver from the computer to select the mode. The HT6513 replies with the selected mode to the RXD line after the pulse signal of the RTS line. RXD will send out "CD"H code under the microsoft mode.
$\overline{\text{RXD}}$	O	NMOS Open Drain	There are 7 or 8 bits in each data byte. Using parallel-in and serial-out circuit, the data bytes are shifted out from bit 0 through the most significant bit. HT6513 will transmit the data when the status of the three key-switches or the state of the horizontal counter or vertical counter change.
VSS	I	—	Negative power supply

Pin Name	I/O	Internal connection	Description
R M L	I	Pull-Low	Three key-switches have seven different combinations in total. Both key-pressed and key-released signals will be sent accompanied with horizontal and vertical state. The status of the key-switches, the values of horizontal or vertical counters will be present at RXD and $\overline{\text{RXD}}$. The debounce interval for both key-press and key-release is 13ms.
X1 X2 Y1 Y2	I	—	Four photo-couplers signals denote UP, DOWN, LEFT, and RIGHT state. During the scaning period, as long as the photo-couplers change their states, the value of vertical or horizontal counter will increase or decrease accordingly.
VDD	I	—	Position power supply

Approximate Internal connection circuits



X1/X2/Y1/Y2 Input pin I/V curve (optomechanical mouse)



Absolute Maximum Ratings

Supply Voltage ..... –0.3V to 7V
Input Voltage..... V_{SS}–0.3V to V_{DD}+0.3
Storage Temperature..... –50°C to 125°C
Operating Temperature..... –20°C to 75°C

D.C. Characteristics

(Ta=25°C)

Symbol	Parameter	Test condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating voltage	—	—	4.0	5.1	6.1	V
I_{DD}	Operating current	5.6V	No load	—	400	760	μA
V_{IL}	X1,X2,Y1,Y2 Input low voltage	5.6V	—	0	—	1.1	V
V_{IH}	X1,X2,Y1,Y2 Input high voltage	5.6V	—	1.8	—	5.6	V
V_{IL1}	Input low voltage, other pin	5.6V	—	0	—	1	V
V_{IH1}	Input high voltage, other pin	5.6V	—	3.5	—	5.6	V
I_{OL}	$\overline{RXD}$ output sink current	5.6V	V_{OL}=0.56V	3.5	6	—	mA
V_{OH}	$\overline{RXD}$ high-level output voltage	—	—	—	—	16	V
R_{PL}	Pull-low resistance	5.6V	L, M, R key-switches	65	—	200	KΩ

A.C. Characteristics

(Ta=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
f_{SYS}	System Clock	5.6V	Crystal Oscillator	30.8	32.768	34.2	KHz
f_P	Photo-Couple input frequency	5.6V	—	—	—	8.2	KHz
f_N	Photo-Couple operation frequency	5.6V	—	0	—	8	KHz
t_{KD}	Key debounce	5.6V	—	—	52	—	ms
t_{MS}	Transmission time	5.6V	mouse system (1200 bps)	—	41.3	—	ms
t_{MI}	Transmission time	5.6V	microsoft (1200 bps)	—	24.8	—	ms
t_S	Start bit time	5.6V	(1200 bps)	—	0.85	—	ms
t_D	Data bit time	5.6V	(1200 bps)	—	0.82	—	ms
t_P	Stop bit time	5.6V	(1200 bps)	—	0.82	—	ms
t_{RD}	Mode code delay Time (f_{SYS}=32.768KHz)	5.6V	(1200 bps)	11.9	—	14	ms
t_R	Rising edge crossed width	5.6V	—	31	—	—	μs
t_F	Falling edge crossed width	5.6V	—	31	—	—	μs

Function Descriptions

Mouse system mode

Any change of state of the mouse key-switches or photo-couplers will be detected by the HT6513 and transmitted over the RS-232C. The mouse system protocol will send five words at a 1200 baud rate with each word containing 10 bits, one start bit, one stop bit and eight data bits. The first, second and third words correspond to key switch-status, horizontal counter and vertical counter respectively. The auto-speed sensing circuits ensure detection of higher mouse speeds resulting in the use of the 4th and 5th words for extra horizontal and vertical overflow counts respectively. For lower mouse speeds the 4th and 5th words remain at zero.

Output word format:

Bit No.	Mouse system word structures							
	7	6	5	4	3	2	1	0
1st word	1	0	0	0	0	L'	M'	R'
2nd word	H7	H6	H5	H4	H3	H2	H1	H0
3rd word	V7	V6	V5	V4	V3	V2	V1	V0
4th word	EH7	EH6	EH5	EH4	EH3	EH2	EH1	EH0
5th word	EV7	EV6	EV5	EV4	EV3	EV2	EV1	EV0

': denotes complement
H0~H7: The values of horizontal counter.
V0~V7: The values of vertical counter.
EH0~EH7: The values of extra horizontal counter.
EV0~EV7: The values of extra vertical counter.

Microsoft system mode

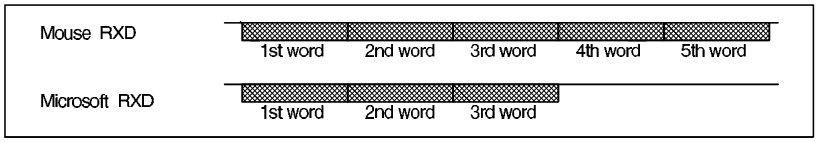
In the microsoft mode only 3 words are transmitted with each word divided into one start bit, seven data bits and two stop bits. Note that only 2 switch operation is available with the "M" switch being redundant in this mode. The "L" and "R" switch status together with the two most significant bits of both vertical and horizontal counters are transferred in this first word. The second and third word represent the horizontal and vertical counters respectively. Note that this vertical data is recorded in 2's complement format.

Output word format:

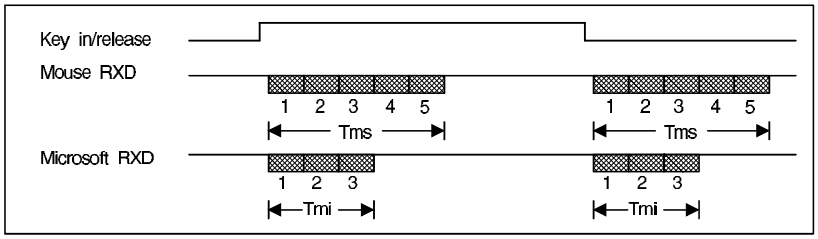
Bit No.	Mouse system word structures						
	6	5	4	3	2	1	0
1st word	1	L	R	V7'	V6'	H7	H6
2nd word	0	H5	H4	H3	H2	H1	H0
3rd word	0	V5'	V4'	V3'	V2'	V1'	V0'

Timing Diagrams

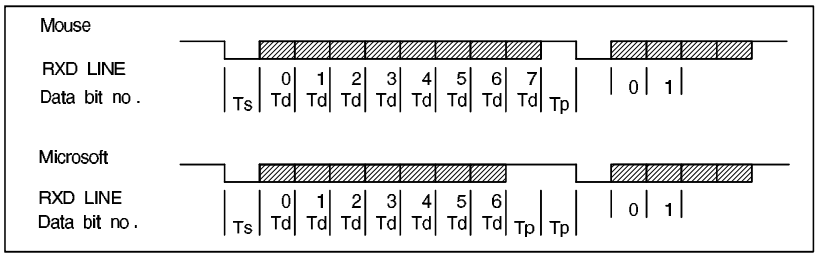
Word structure



Key output



Bit Structure



Mode select timing

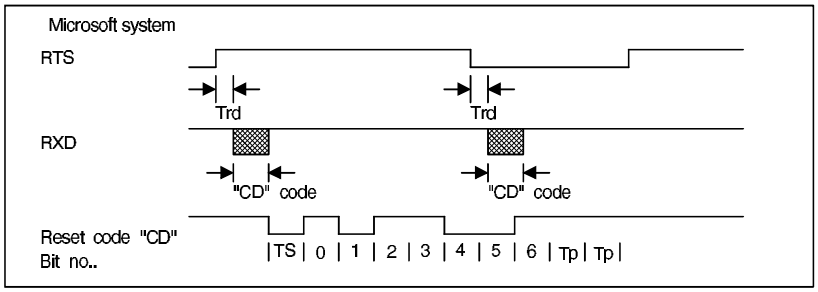
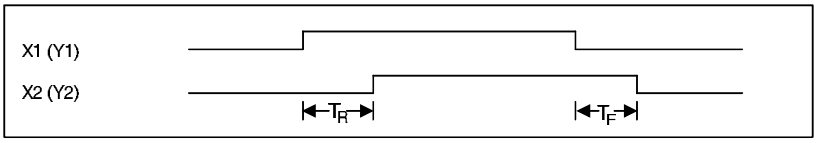
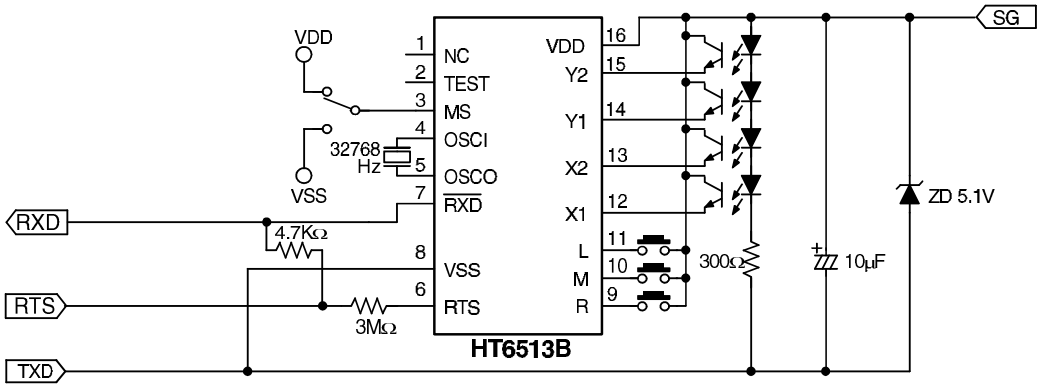


Photo – coupler crossed width



Application Circuit

$\overline{\text{RXD}}$ output



The $\overline{\text{RXD}}$ pin is NMOS open drain output.