

### Features

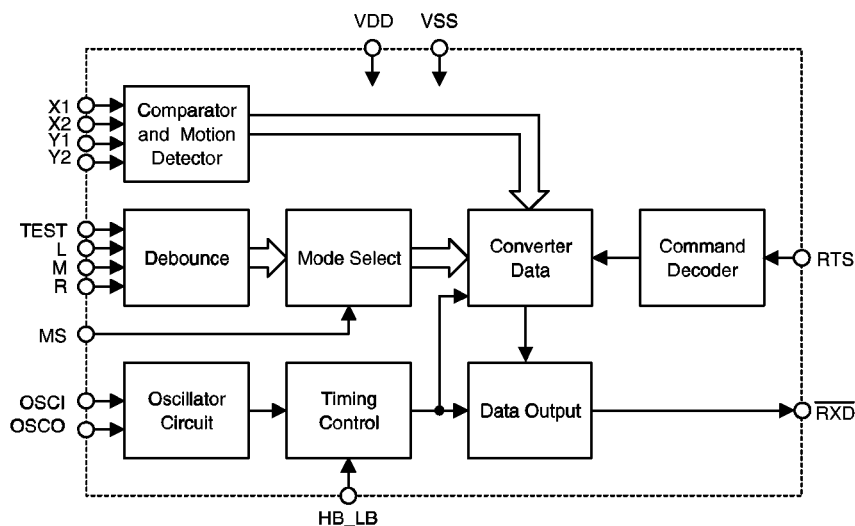
- Low power consumption
- Uses 32.768kHz crystal
- On-chip crystal oscillator circuits
- 1200/9600 baud rate serial output
- Power directly from RS-232C without external power supply
- Three key-switches and four photo-coupler inputs
- Key-in and key-release debounce interval 52 ms
- Executes two different outputs with any of the key-switch inputs
- RXD with heavy NMOS output

### General Description

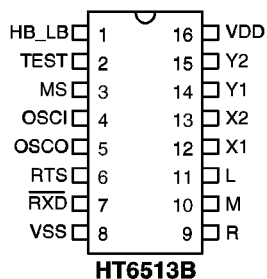
The HT6513 is a specially designed CMOS IC for mouse control applications. It is capable of driving up to three key-switches and four photo-couplers directly into a standard RS-232C line.

It can be operated without external power supply. It is compatible with both Microsoft and Mouse systems. False entries are prevented by internal debounce circuits.

### Block Diagram



## Pin Assignment

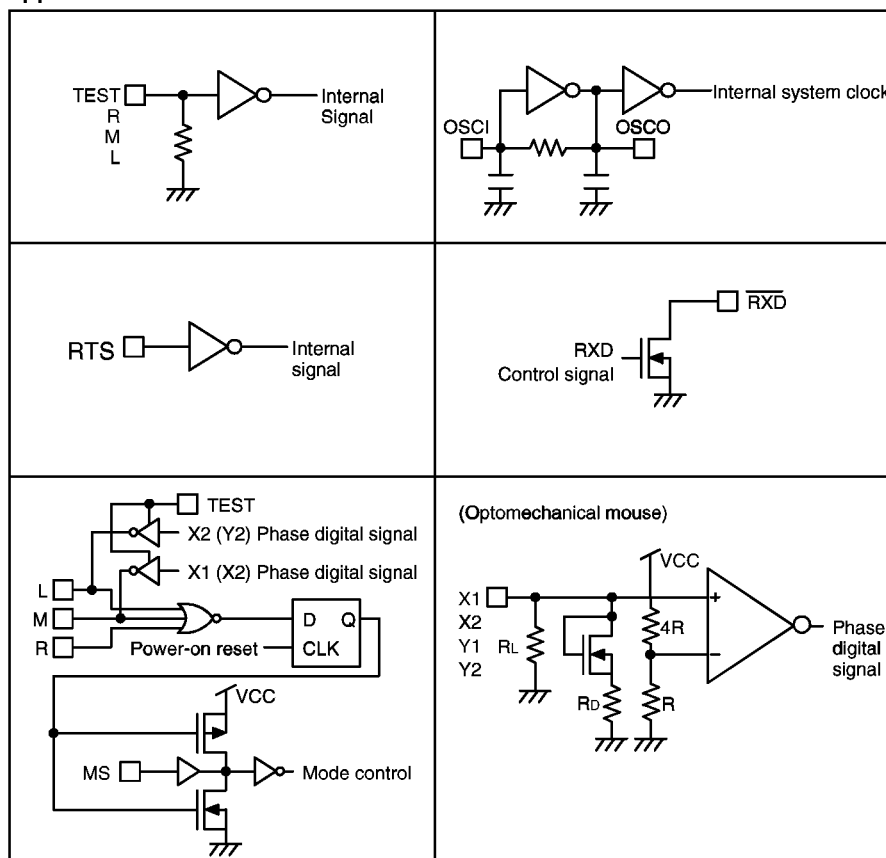


## Pin Description

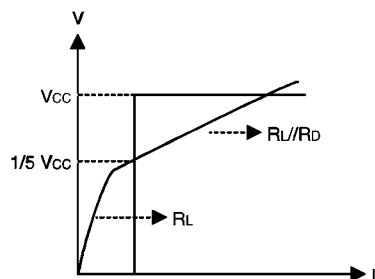
| Pin Name                | I/O | Internal connection | Description  |
|-------------------------|-----|---------------------|--|
| MS                      | I   | —                   | When this pin is connected to VDD, then HT6513 is assigned to operate under the Microsoft mode only. If the pin is 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 bits 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  |
| HB_LB                   | I   | Pull-low            | If this pin is connected to high level, the $\overline{\text{RXD}}$ can transmit data at a 9600 baud rate. The $\overline{\text{RXD}}$ can transmit at a 1200 baud rate if it is connected to low level or floating.   |

| Pin Name             | I/O | Internal connection | Description   |
|----------------------|-----|---------------------|---|
| R<br>M<br>L          | I   | Pull-low            | The three key-switches have a total of seven different combinations. 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 $\overline{RXD}$ . The debounce interval for both key-press and key-release is 13ms. |
| X1<br>X2<br>Y1<br>Y2 | I   | —                   | Four photo-coupler signals denote UP, DOWN, LEFT, and RIGHT state. During the scanning period, as long as the photo-couplers change their states, the value of the 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 6V      Storage Temperature..... -50°C to 125°C  
 Input Voltage.....  $V_{SS}-0.3V$  to  $V_{DD}+0.3$       Operating Temperature..... -20°C to 75°C

\*Note: These are stress ratings only. Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

**D.C. Characteristics**

$T_a=25^{\circ}C$

| Symbol    | Parameter                                  | Test conditions |                      | Min. | Typ. | Max. | Unit       |
|-----------|--|-----------------|----------------------|------|------|------|------------|
|           |  | $V_{DD}$        | Conditions           |      |      |      |            |
| $V_{DD}$  | Operating Voltage                          | —               | —                    | 2.5  | 5.1  | 6    | V          |
| $I_{DD}$  | Operating Current                          | 5.6V            | No load              | —    | 400  | 800  | $\mu A$    |
| $V_{IL}$  | X1, X2, Y1, Y2 Input Low Voltage           | 5.6V            | —                    | 0    | —    | 1    | V          |
| $V_{IH}$  | X1, X2, Y1, Y2 Input High Voltage          | 5.6V            | —                    | 1.5  | —    | 5.6  | V          |
| $V_{IL1}$ | Input Low Voltage, Other Pin               | 5.1V            | —                    | 0    | —    | 1    | V          |
| $V_{IH1}$ | Input High Voltage, Other Pin              | 5.1V            | —                    | 3.5  | —    | 5.1  | 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  | k $\Omega$ |

**A.C. Characteristics**

Ta=25°C

| Symbol           | Parameter  | Test Condition  |                         | Min. | Typ.   | Max. | Unit |
|------------------|--|-----------------|-------------------------|------|--------|------|------|
|                  |  | V <sub>DD</sub> | Condition               |      |        |      |      |
| f <sub>SYS</sub> | System Clock                                       | 5.6V            | Crystal Oscillator      | 30.8 | 32.768 | 34.2 | kHz  |
| f <sub>P</sub>   | Photo-couple Input Frequency                       | 5.6V            | —                       | —    | —      | 8.2  | kHz  |
| f <sub>N</sub>   | Photo-couple Operation Frequency                   | 5.6V            | —                       | 0    | —      | 8    | kHz  |
| t <sub>KD</sub>  | Key Debounce                                       | 5.6V            | —                       | —    | 52     | —    | ms   |
| t <sub>MS</sub>  | Transmission Time                                  | 5.6V            | Mouse system (1200 bps) | —    | 41.3   | —    | ms   |
| t <sub>MI</sub>  | Transmission Time                                  | 5.6V            | Microsoft (1200 bps)    | —    | 24.8   | —    | ms   |
| t <sub>S</sub>   | Start Bit Time                                     | 5.6V            | (1200 bps)              | —    | 0.85   | —    | ms   |
| t <sub>D</sub>   | Data Bit Time                                      | 5.6V            | (1200 bps)              | —    | 0.82   | —    | ms   |
| t <sub>P</sub>   | Stop Bit Time                                      | 5.6V            | (1200 bps)              | —    | 0.82   | —    | ms   |
| t <sub>RD</sub>  | Mode Code Delay Time (f <sub>SYS</sub> =32.768kHz) | 5.6V            | (1200 bps)              | 11.9 | —      | 14   | ms   |
| t <sub>R</sub>   | Rising Edge Crossed Width                          | 5.6V            | —                       | 31   | —      | —    | μs   |
| t <sub>F</sub>   | Falling Edge Crossed Width                         | 5.6V            | —                       | 31   | —      | —    | μs   |

## Functional Description

### 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 1200/9600 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: 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

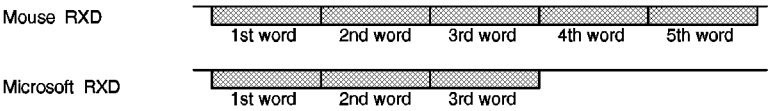
In the Microsoft mode, only three words are transmitted with each word divided into one start bit, seven data bits and two stop bits. Note that only two switch operations are available with the "M" switch being redundant in this mode. The "L" and "R" switch status together with the two most significant bits of both vertical and horizontal counters are transferred in the 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:

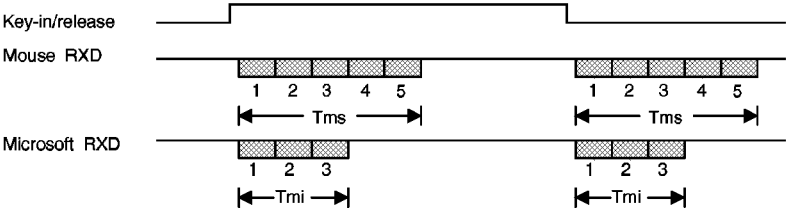
| Bit No.  | Mouse system word structures |     |     |     |     |     |     |
|----------|------------------------------|-----|-----|-----|-----|-----|-----|
|          | 6                            | 5   | 4   | 3   | 2   | 1   | 0   |
| 1st word | 1                            | L   | R   | V7' |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

Timing Diagrams

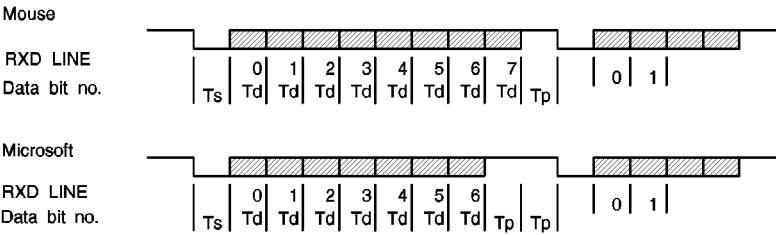
Word structure



Key output



Bit Structure



Mode select timing

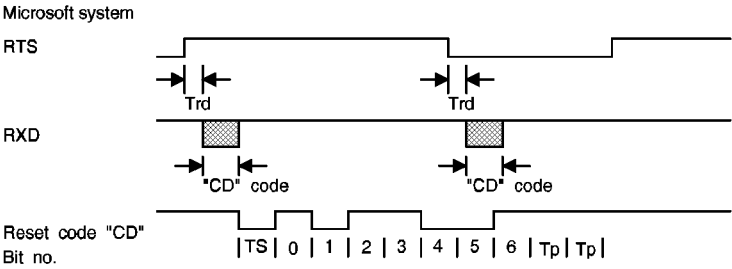
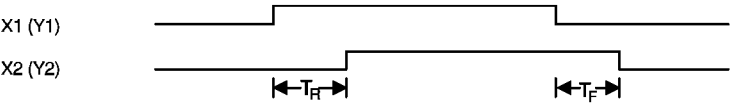
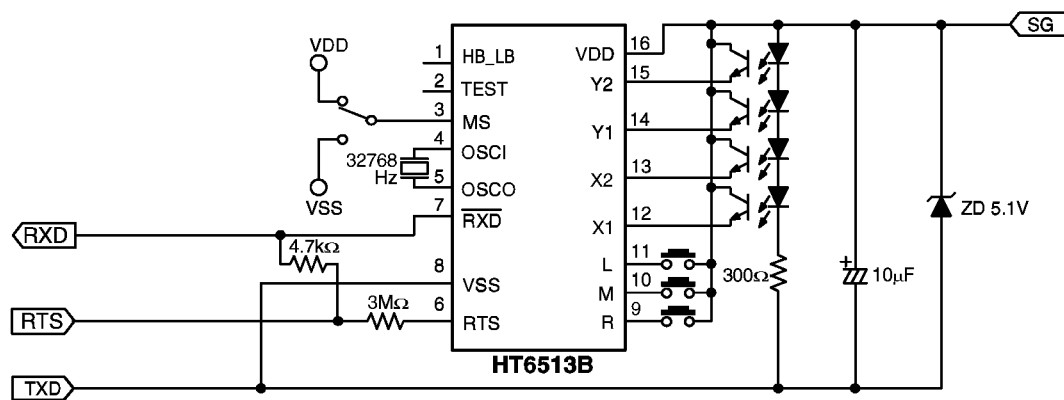


Photo-coupler crossed width



## Application Circuits

### RXD output



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