HT6515
Mouse Controller

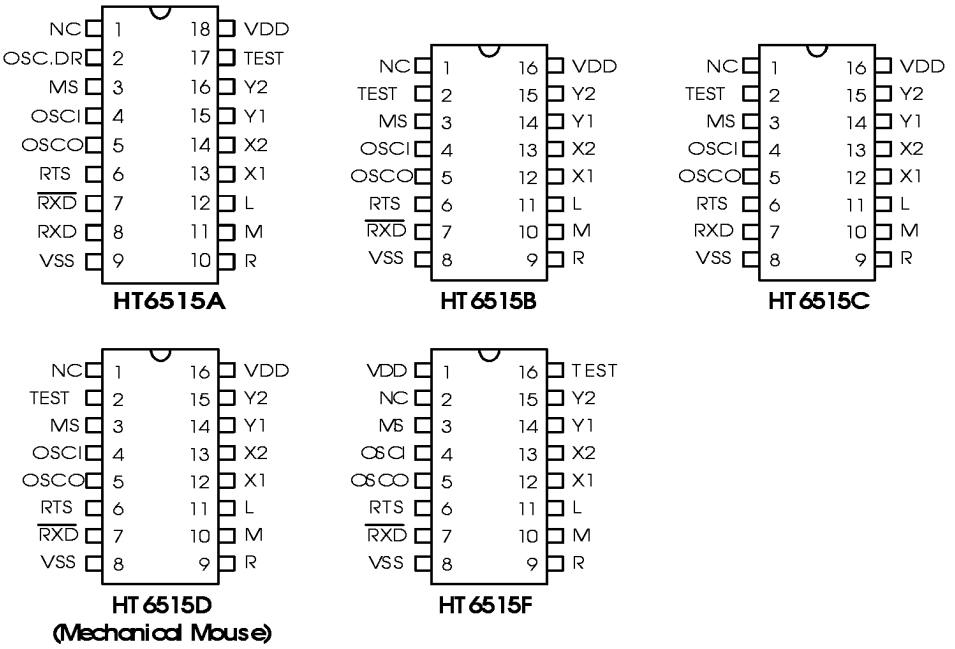
Features

- Supports optomechanical (HT6515A/B /C/F) or Mechanical (HT6515D) mouse
- Plug and Play compatible
- Fit a defined Windows 95 class name
- 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-couplers inputs
- Compatible with both Microsoft and Mouse systems
- Mouse mode (MS/PC) changable in powe on reset
- $\overline{\text{RXD}}$ with heavy NMOS open drain or CMOS output

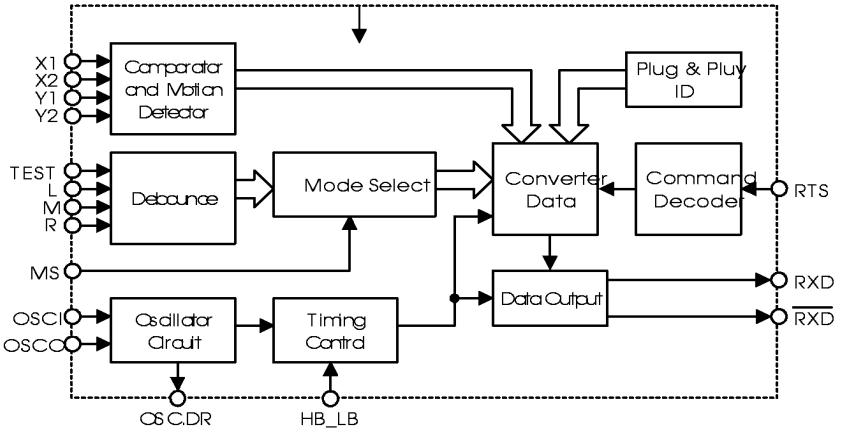
General Description

The HT6515 is a specially designed for PnP compatible mouse controller. Capable of driving up to 3 key-switches and 4 photo-couplers (Optomechanical Mouse)/Micro switch (Mechanical Mouse) 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



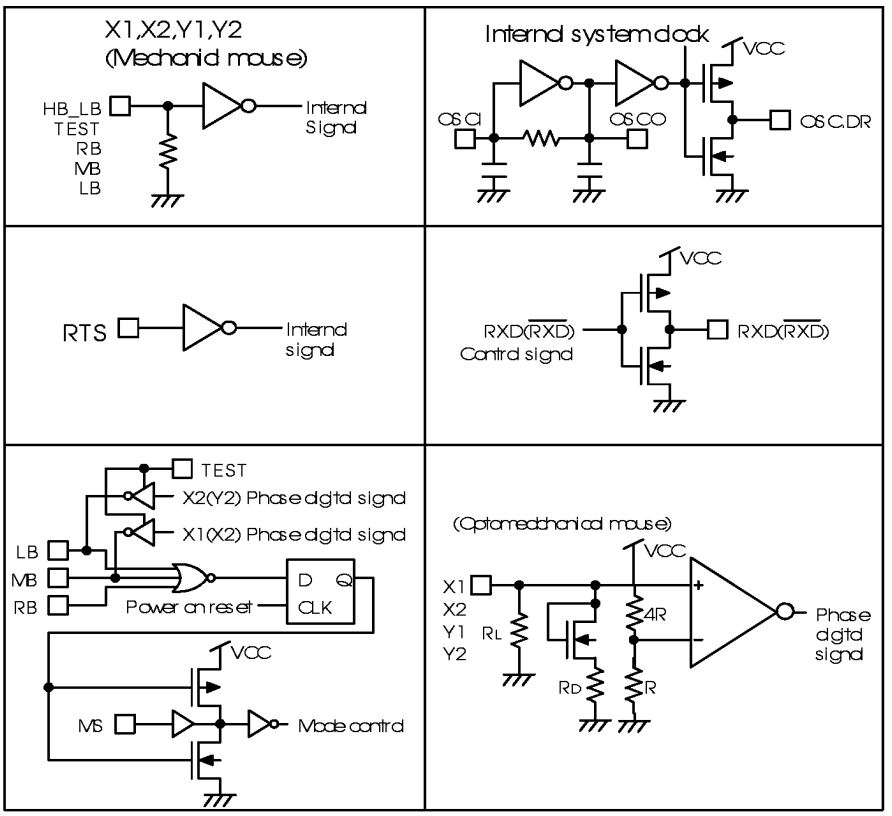
Block Diagram



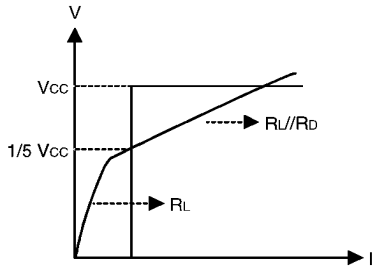
Pad Description

Pin Name	I/O	Description
MS	I	When this pin is connected to V_{DD} , operate under the microsoft mode only. If the pin is connected to V_{SS}, then will operate under the mouse system mode. If MS pin is "floating" , the product is on the power on initiation mode.
OSCO	O	Oscillator output pin
OSCI	I	Oscillator input pin
RTS	I	When a rising edge sent to RTS then the mouse will return a series ID code to identify the mouse mode. The RTS must be kept to high while mouse is in normal operating.
RXD	O	CMOS, serial data output (HT6515A/C) or NMOS, Serial data output (HT6515B/D/F)
RXD	O	CMOS, Serial data output
VSS	I	Negative power supply
R M L	I	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 counter will present at RXD and $\overline{RXD}$.
X1 X2 Y1 Y2	I	Four photo-couplers/micro-switchs signals denote UP, DOWN, LEFT and RIGHT state. During the scaning period, as long as the photo-couplers/micro-switch change their states, the value of vertical or horizontal counter will increase or decrease accordingly.
TEST	I	For IC test only. The test pin must be connected to V_{SS}, while the chip is under normal usage.
VDD	I	Positive power supply
OSC.DR	O	The OSC.DR is an output driver with 32.768KHz frequency. It provides driving ability to generate V_{DD} above signal ground in the power converter circuits outside the chip.

Approximate internal connection circuits



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



Absolute Maximum Ratings

Supply Voltage.....–0.3V to 6.5V
Input Voltage..... V_{SS}–0.3V TO V_{DD}+0.3V
Storage Temperature.....–50°C to 125°C
Operating Temperature.....–25°C to 70°C

D.C. Characteristics

(Ta=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating Voltage	—	—	5	5.6	6.5	V
I_{DD}	Operating Current	5.6V	No load	—	400	600	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}	OSC.DR Output Sink Current	5.6V	V_{OL}=0.56V	1.3	2.2	—	mA
I_{OH}	OSC.DR, RXD Output Source Current	5.6V	VOH=5.04V	–1.3	2.2	—	mA
I_{OL1}	$\overline{RXD}$ 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	100	—	400	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)	—	41.3	—	ms
		5.6V	Mouse system (9600)	—	5.3	—	ms
t_{MI}	Transmission Time	5.6V	Microsoft (1200)	—	24.8	—	ms
		5.6V	Microsoft (9600)	—	3.18	—	ms
t_S	Start Bit Time	5.6V	(1200)	—	0.85	—	ms
			(9600)	—	0.106	—	ms
t_D	Data Bit Time	5.6V	(1200)	—	0.82	—	ms
			(9600)	—	0.106	—	ms
t_P	Stop Bit Time	5.6V	(1200)	—	0.82	—	ms
			(9600)	—	0.106	—	ms
t_{RD}	Mode Code Delay Time (f_{SYS}=32.768KHz)	5.6V	(1200)	11.9	–	14	ms
			(9600)	1.48	–	1.7	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 chip 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: 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 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.	Microsoft 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'

Win 95 PnP ID fields

For compatibility with old serial mouse drivers, all mouse-compatible pointing devices must restrict themselves to a 6 bit character set, for all fields except the mouse ID. Therefore, all old-mouse-compatible strings are limited to values of 0x00 to 0x3f, character strings are ASCII-codes from 0x20 to 0x5f, offset by subtracting 0x20.

Microsoft mode

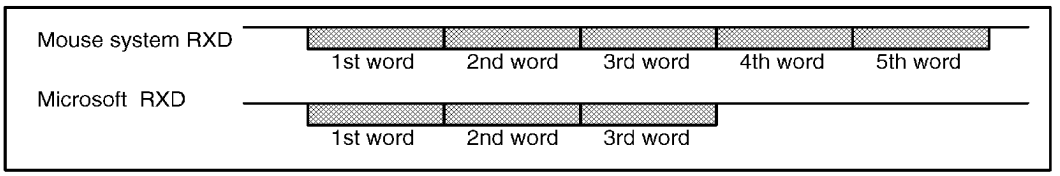
Field Name	Size	Field Data	Description
Old Mouse ID	1	4D	Identifies a mouse for old microsoft mode drivers
Begin Pnp	1	08	"(" indicates PnP IDs will follow
Pnp Rev	2	01, 24	Identifies PnP version 1.0
EISA ID	3	28, 34, 2B	"HTK" (A mouse company)
Product ID	4	16, 15, 11, 21	"651A" (Unique product identifier)
Extended	1	3C	"\"
Class Name	6	3C, 2D,2F, 35, 33, 25	"\MOUSE" fits a defined Windows 95 class name
Driver ID	8	3C, 30, 2E, 30, 10, 26,10, 23	"$\overline{\text{PNP0F0C}}$" fits a defined Windows 95 microsoft mouse compatible ID
Check sum	2	21, 25	Checksum of all characters from begin PnP to End PnP, exclusive of the checksum characters themselves.
End PnP	1	09	")" indicates PnP IDs complete

Mouse system mode

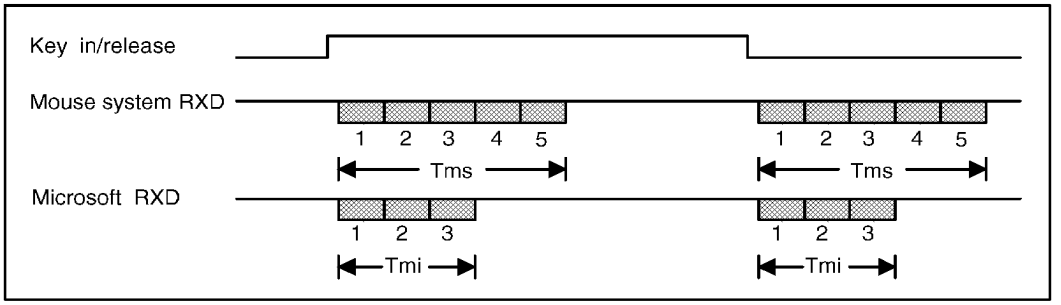
Field Name	Size	Field Data	Description
Old Mouse ID	1	6D	Identifies a mouse for old mouse system mode drivers
Begin Pnp	1	08	"(" indicates PnP IDs will follow
Pnp Rev	2	01, 24	Identifies PnP version 1.0
EISA ID	3	28, 34, 2B	"HTK" (A mouse company)
Product ID	4	16, 15, 11, 21	"651A" (Unique product identifier)
Extended	1	3C	"\"
Class Name	6	3C, 2D, 2F, 35, 33, 25	"\MOUSE" fits a defined Windows 95 class name
Driver ID	8	3C, 30, 2E, 30, 10, 26,10, 14	"$\overline{\text{PNP0F04}}$" fits a defined Windows 95 mouse system mouse compatible ID
Check sum	2	19, 26	Checksum of all characters from begin PnP to End PnP, exclusive of the checksum characters themselves.
End PnP	1	09	")" indicates PnP IDs complete

Timing Diagrams

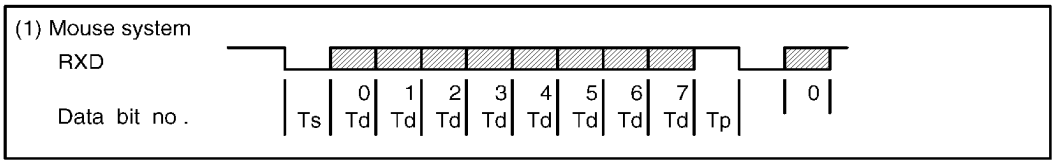
Word structure :

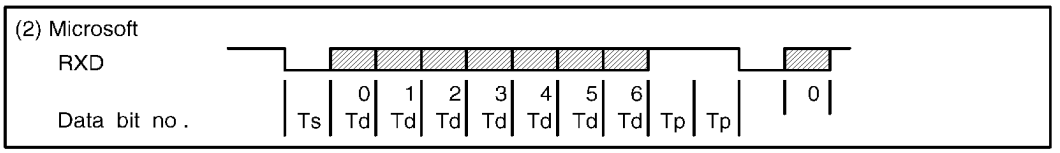


Key output :

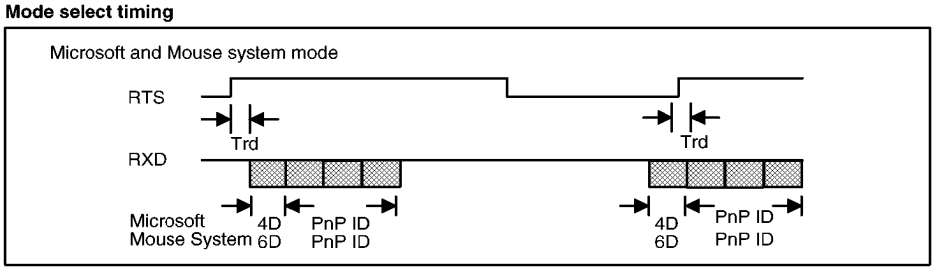


Bit Structure :

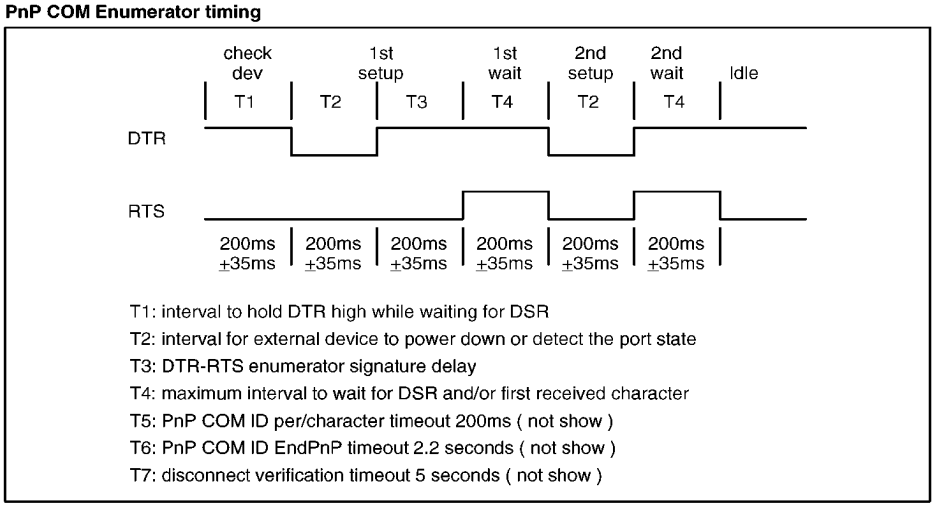




Mode select timing



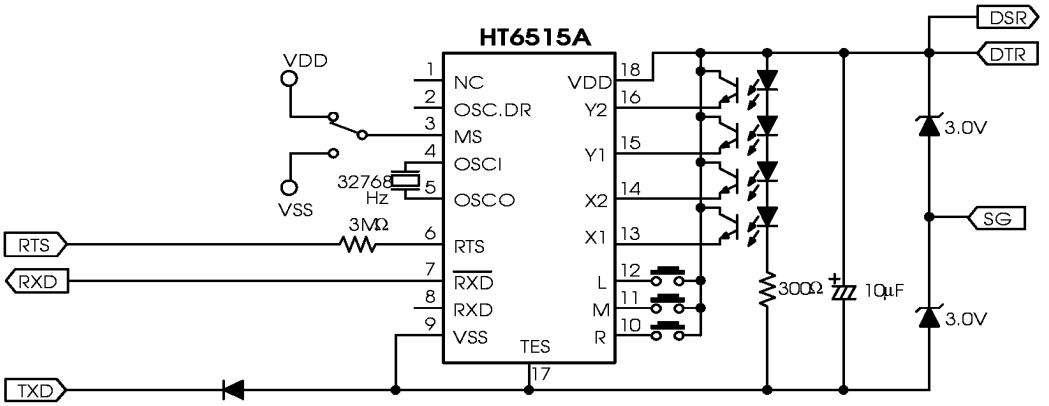
PnP COM Enumerator timing



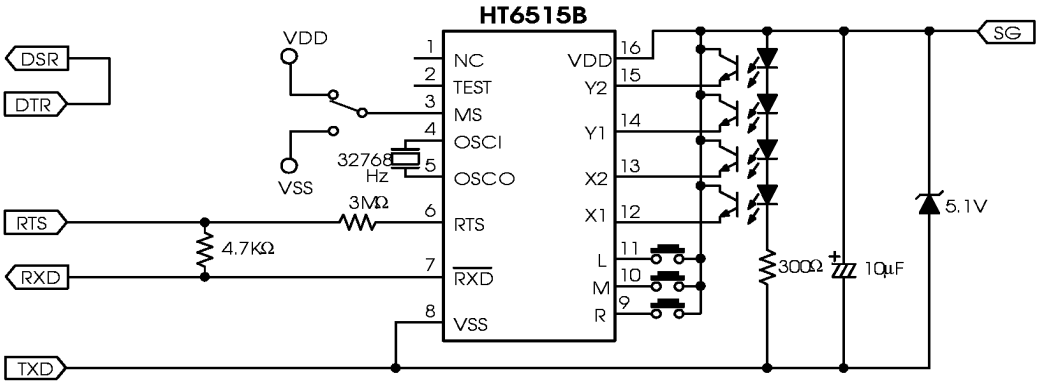
T1: interval to hold DTR high while waiting for DSR
T2: interval for external device to power down or detect the port state
T3: DTR-RTS enumerator signature delay
T4: maximum interval to wait for DSR and/or first received character
T5: PnP COM ID per/character timeout 200ms (not show)
T6: PnP COM ID EndPnP timeout 2.2 seconds (not show)
T7: disconnect verification timeout 5 seconds (not show)

Photo-coupler crossed width

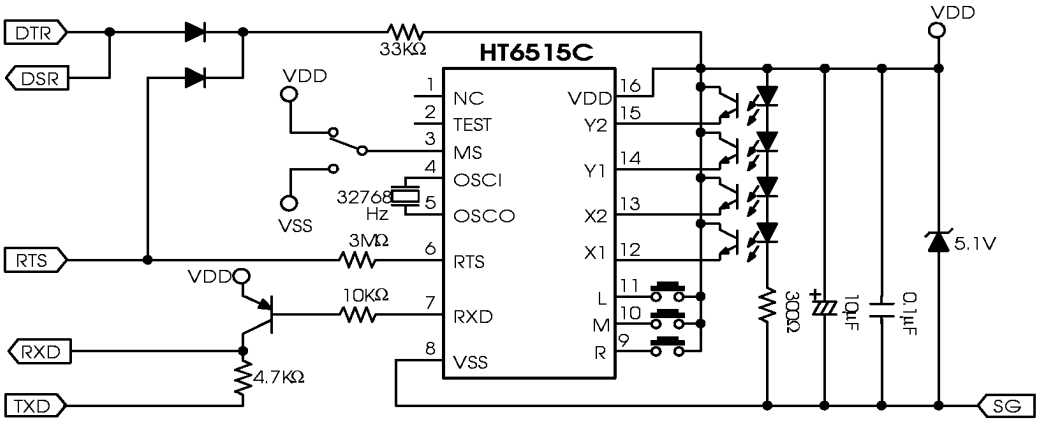
Application Circuit



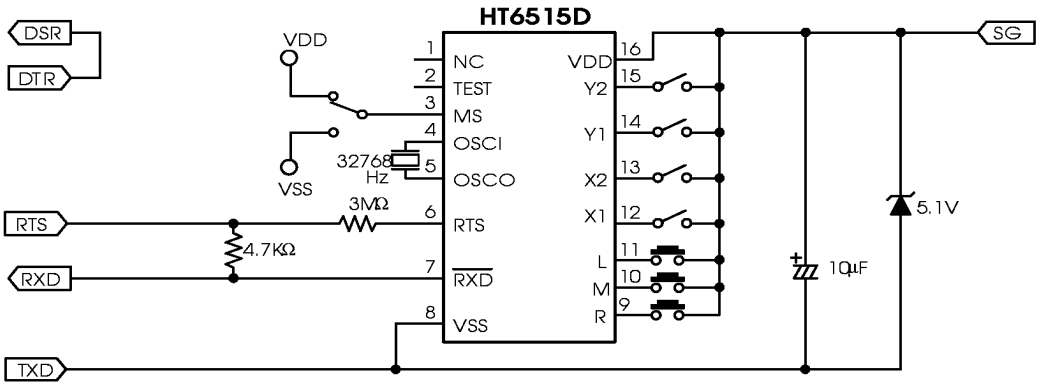
The $\overline{RXD}$ pin is NMOS open drain output.



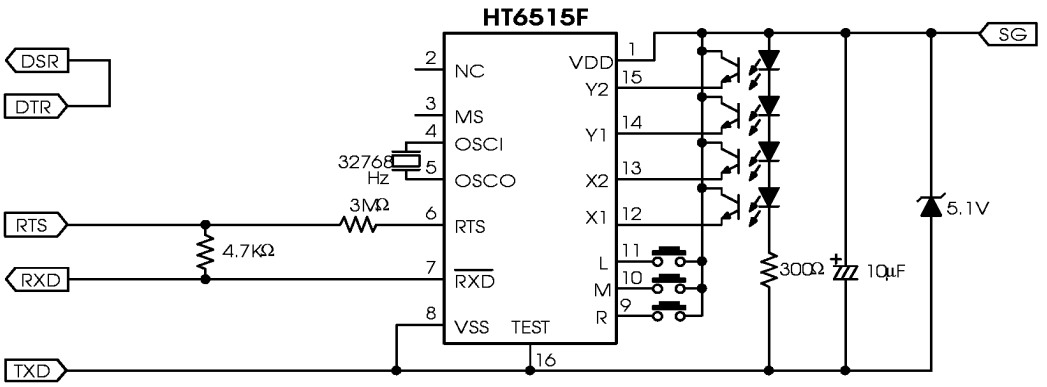
The $\overline{RXD}$ pin is NMOS open drain output.



The RXD pin is CMOS output.



(Mechanical mouse) The RXD pin is NMOS open drain output.



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