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GL901Rx

Wireless Mouse USB+PS2 Receiver Controller

Version 1.1

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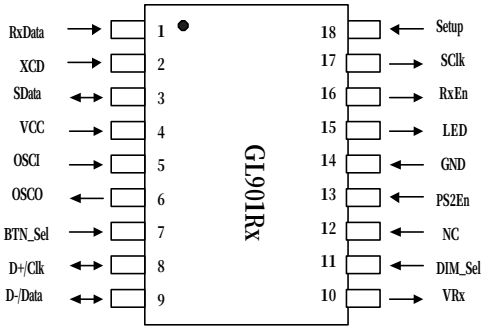
Genesys Logic, Inc.
10F, No. 11, Ln. 155, Sec. 3, Peishen Rd., Taipei, Taiwan
Tel: (886 2) 2664 6655Fax: (886 2) 2664 5757
http://www.genesyslogic.com

GL901Rx

Wireless Mouse USB/PS2 Receiver Controller

Package Type : PDIP/SOIC18



Features

- Fully CMOS Static Design
- 8 Bits RISC-like Micro Controller
- 1.5Mbps USB SIE engine
- 2.75K *14 bits ROM / 64 Bytes RAM
- 6Mhz external clock
- Internal switch for USB D+/D- and PS2 CLK/Data I/O
- On chip 3.3V output for RF Receiver
- 5V operation voltage
- 18 pin PDIP, SOIC Package
- 0-40º C operation temperature

Functions

- Built in Genesyslogic's proprietary wireless link protocol
- Support up to 3D / 5Buttons (Standard)
- Support 4D / 5Buttons (Driver need)
- RF transmission rate: 4800 BPS
- Host Auto Detection: USB & PS2
- Ultra High Mouse Response
- Support I2C EEPROM Interface for 8 bits RID & USB VID/PID setting
- Suspend wireless remote wake up

Power Management

- Normal mode : OTP <15 mA ,Mask < 10mA
- Suspend mode : < 500 uA , include suspend wireless remote wake up

Genesyslogic's proprietary wireless protocol

- Provide 8 bits Random ID to avoid co-channel interference
- Provide 2bits packet ID
- Provide 2bits user product ID
- Provide 4 bits CRC (Cyclic Redundancy Check) for packet protection

1. Overview

GL901Rx/GL911Tx RF-USB is the high performance and low cost ASSP solution for wireless mouse application. Genesys Logic' s RF-USB mouse series support USB and PS2 interface and provide ultra high response for wheel scrolling type mouse up to 100 packets per second. They are designed to support up to 4 Dimension and 5 buttons to cover most of the pointing device applications.

GL911Tx is the mouse controller and RF transmitter encoder for portable wireless Mouse body. This chip is a high speed RISC-Like MCU can perform high tracking speed for wheel mouse moving and encode the mouse data with Genesys Logic' s proprietary protocol. GL911Tx can support 2D/3D/4D and up to 5 buttons. With 4800BPS high transmission rate it can report 2.5 times data rate than traditional tethered Rs-232 mouse and almost the same rate as general tethered PS2 or USB mouse. It means the overall excellent performance would give better mouse operation' s feeling just like the tethered mouse.

GL901Rx is a bridge between RF demodulated base band signal to USB or PS/2 interface. It can adopt any RF wireless receiver easily and decode the RF Genesys Logic' s proprietary protocol to host site. This chip is also a high speed RISC-Like MCU with robust low speed USB SIE transceiver. With Genesys Logic' s proprietary wireless link protocol, which can distinguish up to 255 different ID code to avoid other RF interference and insure the error-free data to host.

2. Feature

- Fully CMOS Static Design
- 8 Bits RISC-like Micro Controller
- 1.5Mbps USB SIE engine
- 2.75K *14 bits ROM / 64 Bytes RAM
- 6Mhz external clock
- Internal switch for USB D+/D- and PS2 CLK/Data I/O
- 5V operation voltage
- On chip 3.3V output for RF Receiver
- Built in Genesys Logic' s proprietary wireless link protocol (GLPWP)
- RF data rate: 4800 BPS
- Interface Auto Detection: USB & PS2
- Ultra High Mouse Response
- Suspend wireless remote wake up
- 18 pin PDIP, SOIC Package
- 0-40º C operation temperature

Flexible Mouse Mode Setting

- W/ EEPROM : User' s USB VID/PID and 8 bits RID and mouse setting.
- W/O EEPROM : Default VID/PID and 2D/3D, 3B/5B hardware Setting.
- USB Mode : Support 2D-3D / 1-5 Buttons (HID1.1Standard)
- PS2 Mode : Support 2D/3B (Standard) , 3D/3B (Intelli Mouse) , 3D/5B (Intelli2 Mouse)
- Special Mode : Support 4D / 3Buttons , 4D/5B (Need driver)

Power Management

- Normal mode: OTP <15 mA, Mask < 10mA
- Suspend mode: < 500ì A, include suspend wireless remote wake up

Genesys Logic' s Proprietary Wireless Protocol

- Provide 8 bits Random ID to avoid Co-channel interference
- Provide 2bits packet ID (Broadcast packet, X/Y packet, Button+ZW packet, ..)
- Provide 2bits user product ID (Keyboard, Joystick, ...)
- Provide 4 bits CRC (Cyclic Redundancy Check) for packet protection

3. Function Description

3.1 Function Block

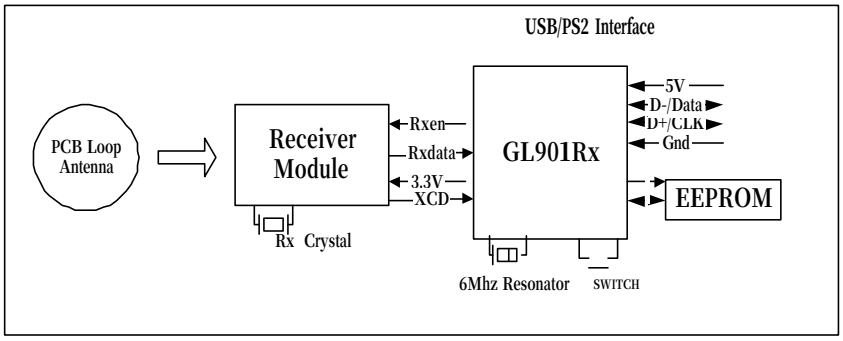


Figure 3-1: Block Diagram of RF Receiver System

3.2 Power Supply

The nominal operation voltage of GL901Rx is between 4.5~5.5V and it is built in Power Fail Reset when power voltage below 3.6V+_0.3V. Normal working current is less than 10 mA at 6Mhz.

(a) **USB Interface :** GL901Rx supports remote wake function, i.e. when USB host send suspend command, GL901Rx will enter suspend mode and draw a little current. In suspend state GL901Rx is still active and listening RF signal periodically to scan valid packet. If there is any RF packet is received, GL901Rx will send remote wake signal to USB host and leave suspend mode. When GL901Rx enters suspend mode it will stop the oscillator around 750ms then scan RF packet 30ms periodically.

Table 3-2: Current budget of the Receiver & GL901Rx (Mask)

Mode	Normal Current	Suspend Current
GL901Rx current	8mA	308uA
RF Receiver current	3mA	115uA
Average current	11mA	423uA

(b) **PS2 Interface:** GL901Rx do not support suspend function in PS2 interface

(c) **Regulated 3.3V: VRx** (Pin 10) is a regulated 3.3V output for receiver. Notice the pin only can supply 4mA maximum. And it must be tied a capacitor not less than 1uf to stabilize the output voltage. This pin is always output 3.3V even in USB suspend mode.

(d) **Receiver power control: RxEn** (Pin 16 Active high) is the receiver power control pin to enable or disable receiver. Be sure the current drawing by the receiver must be as little as possible when **RxEn** is disable(Low condition)

3.3 Resonator

6Mhz crystal or resonator is required for GL901Rx.

3.4 Setup Button

Co-channel interference will happens if two or more closer device working on the same frequency and same ID. Genesyslogic's proprietary wireless link protocol provides 8bits Identification code (RID) to distinguish the wanted and unwanted Transmitter set. When receiver is in "Setup phase" and receives valid "Broadcast packet" then it will store the RID into EEPROM. GL901Rx will only accept the unique RID packet and ignore other packet after "setup phase".

There are two methods for receiver to enter "Setup phase".

(a) **Button setup mode:** When "Setup pin" (Pin 18 Active High) is changed from low to high the GL901Rx will enter the "Setup mode" for 30 seconds.

(b) **Wireless setup mode:** If the RF receiver provides carrier detector output, this function will be available. The XCD Pin(2) must be tied with RF receiver's Carrier Detector (active Low), GL901Rx will enter "setup phase" when and receive a legal "Broadcast packet" and active CD signal (Low). GL911Rx will also store the RID into EEPROM and memory immediately.

Note: *This function is available when the transmitter sends "Broadcast Packet" with enough field strength. The RF Carrier Detector sensitivity must be tuned by experiment.*

3.5 I2C EEPROM Interface

GL901RX supports I2C EEPROM for 24C00, 24C01 and 24C02. GL901Rx can read or write the EEPROM. There are only 8 bytes EEPROM data available for setting. The contents can be programmed by PS2 interface directly or programmed before manufacture. After power on reset GL901Rx will to read the EEPROM for system setting.

Table 3-3: EEPROM Data Definition

Address	Description	Bits Contents								RF Setup	ISP (PS2)
0	Check Field	0xBBH								-	O
1	Random ID	RID7- RID0								O	O
2	Axis & Button	D3	D2	D1	D0	B3	B2	B1	B0	-	O
3	Misc table									-	O
4	User VIDH	VIDH7-VIDH0								-	O
5	User VIDL	VIDL7-VIDL0								-	O

6	User PIDH	PIDH7-PIDH0	-	O
7	User PIDL	PIDL7-PIDL0	-	O

Note1 : Address 2 : High nibble presents dimension number and low nibble presents button number.
These setting will affect USB & PS2 report data format to the host.
[D3:D0] = Dimension number . Valid Setting : 2=2D , 3=3D, 4=4D,
[B3:B0] = Buttons number Valid Setting : 1=1B, 2=2B, 3=3B, 4=4B , 5=5B
Genesyslogic suggests to use 2D3B , 3D3B , 3D5B setting.

Note2 : Mark area is not available now.

I2c EEPROM ISP Procedure (For Manufacturing)

GL901Rx can do "In System Program" directly through PS2 command when GL901Rx Setup pin is set high. GL901Rx use only 3 commands to control the R/W of EEPROM.

(a) 0xF3 : Set current EEPROM Address pointer.

(b) 0xE8: Set Data and execute EEPROM write to current Address pointer then increase EEPROM Address pointer.

(c) 0xEB: Read EEPROM 8 bytes from current Address pointer

Table 3-5: EEPROM PS2 ISP Command Table Example 3D5B (Be sure the Setup pin is =1)

Host Command	Host Command	Device Response	Description
Set Setup =1			Manual Pressed the Setup Button or Using Test Bench to set high
Reset	0xFF	0xFA 0xAA 0x00	System Reset
Write EEPROM Address pointer	0xF3 0x00	0xFA 0xFA	Set EEPROM Address=0
Write Data to EEPROM	0xE8 0xBB	0xFA 0xFA	EEPROM Address 0 =0xA0 Address automatic increase 1
Wait 5ms			Wait 5 ms for EEPROM Write
Write Data to EEPROM	0xE8 0x45	0xFA 0xFA	EEPROM Address 0 =0xA1 Address automatic increase 1
Wait 5ms			Wait 5 ms for EEPROM Write
Write Data to EEPROM	0xE8 0x35	0xFA 0xFA	EEPROM Address 0 =0xA2 Address automatic increase 1
Wait 5ms			Wait 5 ms for EEPROM Write
Write Data to EEPROM	0xE8 0x00	0xFA 0xFA	EEPROM Address 0 =0xA3 Address automatic increase 1
Write EEPROM Address pointer	0xF3 0x00	0xFA 0xFA	Set EEPROM Address=0
Read EEPROM Data	0xEB	0xBB 0x45 0x35 0x00 0xXX,0xXX,0xXX,0xXX	Address 0 Address 1 Address 2 Address 3 Address 4, 5, 6, 7

3.6 W/O EEPROM

GL901Rx can detect the EEPROM automaticly. If there is no EEPROM, GL901 use default Genesyslogic VID (0x5e3) /PID(1207) and check the hardware pin setting for mouse type.

Table 3-6: Hardware Setting without EEPROM mode

Pin	NC	1K connect to LED(pin 15)
DIM_sel	3D	2D
BTN_sel	3B	5B

3.7 PS2 Command Set

Table 3-6: PS2 Command Set

Host Command	Command Code	Device Response	Description Setup pin =0	GL901Rx ISP Command Setup pin =1
Reset	0xFF	0xFA 0xAA 0x00	(a) Device responds: "acknowledge" (0xFA) (b) Enters Reset Mode. (c) After 390ms device send 0xAA,ox00 (ID)	
Resend	0xFE	last package	Device responds: resend the last package	
Set Defaults	0xF6	0xFA	Device responds: "acknowledge" (0xFA) set the default values. (a) Sampling rate = 100, (b) Resolution = 4 counts/mm (c) Scaling = 1:1 (d) Disable Data Reporting (e) The mouse then resets its movement counters and enters stream mode.	
Disable Data Reporting	0xF5	0xFA	(a) Device responds: "acknowledge" (0xFA) (b) Disables data reporting (c) Resets movement counters. This only effects data reporting in Stream mode and does not disable sampling. Disabled stream mode functions the same as remote mode.	
Enable Data Reporting	0xF4	0xFA	(a) Device responds: "acknowledge" (0xFA) (b) Enables data reporting (c) Resets movement counters. This command may be issued while the mouse is in Remote Mode (or Stream mode), but it will only effect data reporting in Stream mode.	
Set Sample Rate	0xF3 Sample_rate	0xFA 0xFA	Device responds with "acknowledge" (0xFA) then reads one more byte from the host. The GL901Rx saves this byte as the new sample rate. (a) Valid sample rate: 10, 20, 40, 60, 80, 100,200 Samples/sec. (b) Device resets movement counters.	EEPROM Address set command
Get Device ID	0xF2	0xFA 0x00	(a) Device responds: "acknowledge" (0xFA) (b) Standard PS2 Mouse ID = 0x00 (2D/3B)	

<table>
<tr><td></td><td></td><td></td><td>Intellimouse1 Mouse ID =0x03 (3D/3B)
IntelliMouse2 Mouse ID = 0x04 (3D/5B)
(c) The device resets its movement counters.</td><td></td></tr>
<tr><td>Set Remote Mode</td><td>0xF0</td><td>0xFA</td><td>Device responds with "acknowledge" (0xFA) and resets the movement counters then enters remote mode.</td><td></td></tr>
<tr><td>Set Wrap Mode</td><td>0xEE</td><td>0xFA</td><td>(a) Device responds: "acknowledge" (0xFA)
(b) Resets movement counters
(c) Enters wrap mode. (Echo Mode)</td><td></td></tr>
<tr><td>Reset Wrap Mode</td><td>0xEC</td><td>0xFA</td><td>(a) Device responds: "acknowledge" (0xFA)
(b) Resets movement counters
Enters the mode it was in prior to wrap mode (Stream Mode or Remote Mode.)</td><td></td></tr>
<tr><td>Read Data</td><td>0xEB</td><td>0xFA
Report</td><td>(a) Device responds: acknowledge (0xFA)
(b) Sends movement data packet.</td><td>EEPROM Read 8 bytes from Address +0
To Address +7</td></tr>
<tr><td>Set Stream Mode</td><td>0xEA</td><td>0xFA</td><td>(a) Device responds: "acknowledge"
(b) Resets movement counters
(c) Enters stream mode.</td><td></td></tr>
<tr><td>Status Request</td><td>0xE9</td><td>0xFA</td><td>(a) Device responds: "acknowledge"
(b) Sends 3-byte status packet
(c) Resets movement counters.
<table>
<tr><td></td><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr>
<tr><td>Byte0</td><td>0</td><td>Mode</td><td>Enable</td><td>Scaling</td><td>0</td><td>LBtn</td><td>MBtn</td><td>RBtn</td></tr>
<tr><td>Byte1</td><td colspan="8">Resolution</td></tr>
<tr><td>Byte1</td><td colspan="8">Sample Rate</td></tr>
</table></td><td></td></tr>
<tr><td>Set Resolution</td><td>0xE8</td><td>0xFA</td><td>Valid Resolution:
0x00 = 1 count/mm
0x01 = 2 count/mm
0x10 = 4 count/mm
0x11 = 8 count/mm
(a) Device responds: acknowledge (0xFA)
(b) Reads one byte from the host as Resolution
(c) Responds with acknowledge (0xFA) again
(d) Resets movement counters.</td><td>Write Data & & Execute write into EEPROM</td></tr>
<tr><td>Set Scaling 2:1</td><td>0xE7</td><td>0xFA</td><td>(a) Device responds: “acknowledge” (0xFA)
(b) Enables 2:1 scaling
Table of Scaling ratio
<table>
<tr><td>Actual Movement</td><td>Report with scaling</td></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>2</td><td>1</td></tr>
<tr><td>3</td><td>3</td></tr>
<tr><td>4</td><td>6</td></tr>
<tr><td>5</td><td>8</td></tr>
<tr><td>N>5</td><td>N*2</td></tr>
</table></td><td></td></tr>
<tr><td>Set Scaling 1:1</td><td>0xE6</td><td>0xFA</td><td>(a) Device responds: “acknowledge” (0xFA)
(b) Enables 1:1 scaling</td><td></td></tr>
</table>

PS2 Packet

Table 3-3: The standard PS/2 mouse Packet

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte0	Y overflow	X overflow	Y sign bit	X sign bit	Always 1	Middle Btn	Right Btn	Left Btn
Byte1	X Movement							
Byte1	Y Movement							

The movement counters are 9-bit 2's complement integers, where the most significant bit appears as a sign bit in Byte 1 of the movement data packet. The range of values that can be expressed by the movement counters is -255 to +255. If this range is exceeded, the appropriate overflow bit is set and the counter is not incremented/decremented until it is reset.

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Intellimouse1 Extensions (3D/3B):

Microsoft Intellimouse1 is an extension to the standard PS/2 mouse. This includes support for a total of three mouse buttons and three axis of movement (right-left, up-down, and a scrolling wheel). These additional features require the use of a 4-byte movement data packet rather than the standard 3-byte packet. Since standard PS/2 mouse drivers cannot recognize this packet format, the Microsoft Intellimouse1 is required to operate exactly like a standard PS/2 mouse unless it knows the drivers support the extended packet format.

The Microsoft Intellimouse1 operates just like a standard PS/2 mouse (ie, it uses a 3-byte movement data packet, responds to all commands in the same way as a standard PS/2 mouse, and reports a device ID of 0x00.) To enter scrolling wheel mode, the host sends the following command sequence:

Table 3-4: IntelliMouse1 enable sequence

Host Command	Host Command	Device Response	Description
Set sample rate	0xF3 0xC8 0xF3 0x64 0xF3 0x50	0xFA 0xFA 0xFA 0xFA 0xFA 0xFA	Set sample rate 200 =0xC8 Set sample rate 100 =0x64 Set sample rate 80 =0x50
Get Device ID	0xF2	0xFA 0x03	Get Device ID 00 = Not support

Notice: If the device doesn't support IntelliMouse then it will return 0x00 (Device ID) after the host issues the "Get device ID" command (0xF2)

Table 3-5: The PS/2 Intellimouse1 mouse Packet (3D3B)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte0	Y overflow	X overflow	Y sign bit	X sign bit	Always 1	Middle Btn	Right Btn	Left Btn
Byte1	X Movement							
Byte1	Y Movement							
Byte1	Z Movement							

Z Movement is a 2's complement number that represents the scrolling wheel's movement since the last data report. Valid values are in the range of -128 to +127.

Intellimouse2 Extensions (3D/5B):

To enter Intellimouse2 , the host sends the following command sequence:

Table 3-6: IntelliMouse1 enable sequence

Host Command	Host Command	Device Response	Description
Set sample rate	0xF3 0xC8 0xF3 0x64 0xF3 0x50	0xFA 0xFA 0xFA 0xFA 0xFA 0xFA	Set sample rate 200 =0xC8 Set sample rate 100 =0x64 Set sample rate 80 =0x50
Get Device ID	0xF2	0xFA 0x04	Get Device ID 00 = Not support

Notice : If the device doesn' t support IntelliMouse2 then it will return 0x00 (Device ID) after the host issues the "Get device ID" command (0xF2)

Table 3-7: The PS/2 Intellimouse2 mouse Packet (3D5B)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte0	Y overflow	X overflow	Y sign bit	X sign bit	Always 1	Middle Btn	Right Btn	Left Btn
Byte1	X Movement							
Byte1	Y Movement							
Byte1	0	0	5th Btn	4th Btn	Z Movement			

Z0-Z3 is a 2's complement number which represents the amount of movement that has occurred since the last data report. Valid values range from -8 to +7.

4th Btn: 1 = 4th mouse button is pressed; 0 = 4th mouse button is not pressed.

5th Btn: 1 = 5th mouse button is pressed; 0 = 5th mouse button is not pressed

Special Mode (4D/3B, 4D/5B):

For more information about special mode, please contact Genesys' s FAE.

3.8 LED Indicator

GL901Rx provides a LED to monitor some internal information. There are three kind of message can be recognized by user.

(a) **Setup period** : The LED will blink every 300ms and last 30 seconds when the Setup button is toggled. The LED will extinguish after 30 sec or receive 100 valid packet.

(b) **Tx signal :** When a good packet is received the LED will flush 8ms to indicate packet good signal.

(c) **Suspend monitor (USB only)** : When system send suspend command from USB interface, GL901Rx will go into suspend mode after 4 second. In suspend phase the GL901Rx will scan the RF signal 30ms and flush LED 30ms for every 750ms.

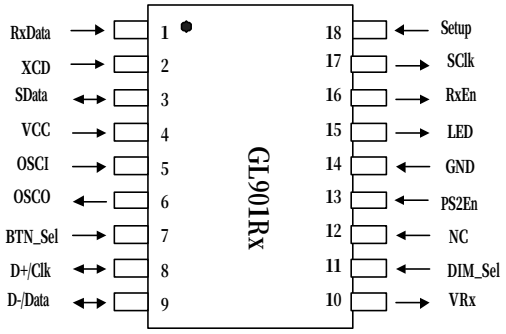
3.9 RF Interface

(a) **RxEn**: The RxEn is a RF receiver enable pin (Active high). Be sure the receiver must be stable within 1ms after Rxen is enabled. The driving capability is 12ma.

(b) **RxData**: The RxData is the serial input for RF demodulated signal.

(c) **XCD :** Carrier detector Input pins (Active Low). The CD sensitivity must be defined by experiment.

4. Pin Assignment



No.	Pin Name	I/O	Function description	Note
Power Supply				
4	VCC	I	Power supply Pin. 4.5v < VDD < 5.5v	Recommend: 5.0V
14	GND	I	Ground Pin	
10	VRx	O	3.3±0.3V regulated output . Maximum output < 4mA	External capacitor (> 1uf) is required.
5	OSCI	I	Oscillator input pin	6M resonator or crystal
6	OSCO	O	Oscillator output pin	6M resonator or crystal
RF Interface				
1	RxData	I	RF demodulated baseband signal input	Internal pull up resistor = 10K ohm
2	XCD	I	Carrier detector , Default: Active Low input	Internal pull up resistor = 10K ohm Optional for Wireless Setup (Note 1)
18	Setup	I	Button setup input for "Broadcast packet" listening(Change RID code)	Internal pull down resistor = 16K ohm TTL Level
16	RxEn	O	Receiver enable control output, Active High	
15	Led	O	Receiver Status LED	1: Setup enable : 300ms blinking 30 seconds 2: Data Packet Valid : Flush 8us
EEPROM I/F				
3	SData	I/O	I2C EEPROM Data I/O	Internal pull up resistor = 10K ohm Recommend: 24C00~24C02
17	SClk	O	I2C EEPROM clock output	Recommend: 24C00~24C02.
Hardware Setting				
11	DIM_sel	I	Dimension select : NC = 3D , tied to Pin15 = 2D **Valid when No EEPROM exists**	Internal pull down resistor = 10K ohm Please Tight to LED (pin17) or open
7	BTN_sel	I	Buttons select : NC = 3B , tied to pin15 = 5B **Valid when No EEPROM exists**	Internal pull down resistor = 10K ohm Please Tight to LED (pin17) or open
Interface				
13	PS2En	I/O	PS2 : Output High USB : Input = Floating	PS2 interface is detected : PS2En will be set output high for the pull up source of PS2 CLK pin USB interface is detected : PS2En will be floating
8	D+/Clk	I/O	PS2: Clock open drain pin USB :D+	Need 1 7.5K pull up resistor to PS2En
9	D-/Data	I/O	PS2: Data pin USB :D-	Need a 7.5K Pull up resistor to 5V or 1.5K to 3.3V

5. Electrical Characteristics

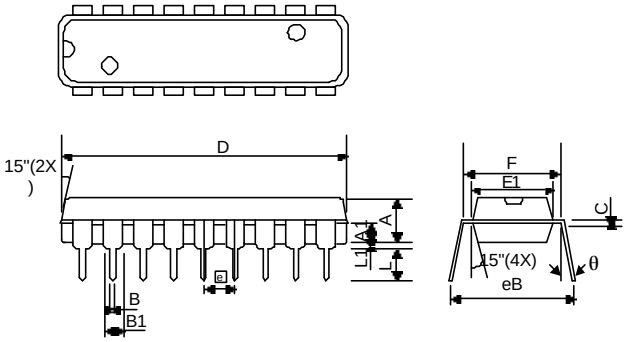
Table 5-1: Electrical Characteristics

Symbol	Operating Temperature = 0 to 85°C; F_{OSC} = 6MHz, V_{CC} = 4.4 to 5.5V Characteristic	Min	Max	Units	Conditions
	General				
I_{CC}	Operating supply current		20	mA	
I_{SB}	Supply current – suspend mode		360	µA	See note 1
	USB Interface				
V_{OH}	Static output high	2.8	3.6	V	R_L of 15KΩ to GND
V_{OL}	Static output low		0.3	V	R_L of 15KΩ to V3.3
V_{DI}	Differential input sensitivity	0.2		V	|(D+) – (D-)|
V_{CM}	Differential common mode range	0.8	2.5	V	Include V_{DI} range
V_{SE}	Single ended receiver threshold	0.8	2.0	V	
I_{LO}	Hi-Z state data line leakage	-10	+10	V	0V < V_{IN} < 3.3V
V3.3	Regulator supply voltage	3.0	3.6	V	I_L = 4mA
	GPIO Interface				
R_{UP}	PORT2.2-4 pull-up resistance	68	120	KΩ	
R_{DOWN}	PORT1.0-7 pull-down resistance	4	32	KΩ	Code option
V_{OH1}	Static output high for PORT1.2-4, PORT2.0-7	2.4		V	V_{CC} = 5V; I_{OH} = 4mA
V_{OL1}	Static output low for PORT1.2-4, PORT2.0-7		0.4	V	V_{CC} = 5V; I_{OL} = 4mA
V_{OH2}	Static output high for PORT1.0-1	2.4		V	V_{CC} = 5V; I_{OH} = 20mA
V_{OL2}	Static output low for PORT1.0-1		0.4	V	V_{CC} = 5V; I_{OL} = 20mA
V_{IH}	Static input high	2.0		V	V_{CC} = 5V
V_{IL}	Static input low		0.9	V	V_{CC} = 5V
I_{SINK1}	Sink current for PORT1.2-4, PORT2.0-7	4		mA	V_{OUT} = 0.4V;
I_{SINK2}	Sink current for PORT1.0-1	20		mA	V_{OUT} = 0.4V;
I_{IN}	Input leakage current	-1	+1	µA	V_{OUT} = 0V or V_{CC}
	USB Low-speed Source				
f_{OP}	Internal operating frequency	1.5	1.5	MHz	
	Transition time				
t_R	Rise time	75		ns	C_L = 50pF
			300	ns	C_L = 350pF
t_F	Fall time	75		ns	C_L = 50pF
			300	ns	C_L = 350pF
t_{RFM}	Rise/Fall time matching	80	120	%	t_R / t_F
V_{CRS}	Output signal crossover voltage	1.3	2.0	V	
t_{DRATE}	Low speed data rate	1.4775 676.8	1.5225 666.0	Mbs ns	1.5Mbs ± 1.5%
	Source differential driver jitter				
t_{UDJ1}	To next transition	-25	25	ns	C_L = 350pF measured at crossover point
t_{UDJ2}	For paired transition	-10	10	ns	
	Receiver data jitter tolerance				
t_{DJR1}	To next transition	-75	75	ns	C_L = 350pF measured at crossover point
t_{DJR2}	For paired transition	-45	45	ns	
t_{EOPT}	Source EOP width	1.25	1.50	µs	Measured at crossover point
t_{DEOP}	Differential to EOP transition skew	-40	100	ns	Measured at crossover point
	Receiver EOP width				
t_{EOPR1}	Must reject as EOP	330		ns	Measured at crossover point
t_{EOPR2}	Must accept	675		ns	

Notes: I_{SB} measured with USB in suspend mode; using external square wave clock source (F_{OSC} = 6MHz); transceiver pull-up resistor of 1.5KΩ between V3.3 and D- and 15KΩ termination resistors on D+ and D- pins; no port pins sourcing current. The I_{SB} value is including power consumed by external resistors.

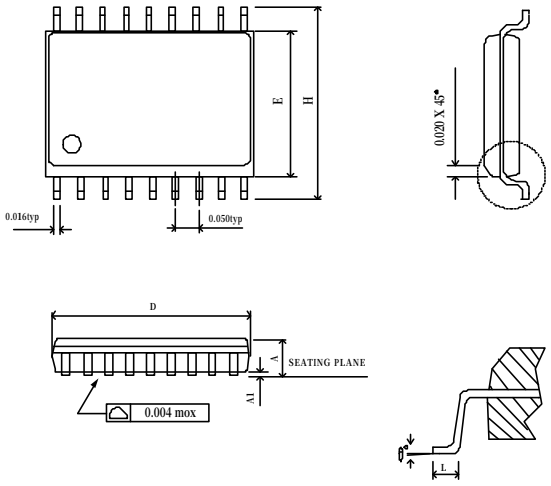
6. Package Dimension

6.1 PDIP-18



Symbol	Dimension in mil			Dimension in mm		
	Min	Nom	Max	Min	Nom	Max
A	--	130	--	--	3.302	--
A1	59	60	61	1.499	1.524	1.549
B	--	18	--	--	0.457	--
B1	--	60	--	--	1.524	--
C	--	10	--	--	0.254	--
D	890	900	910	22.606	22.860	23.114
E1	259	260	--	6.579	6.604	--
F	290	300	310	7.366	7.620	7.874
e	--	100	--	--	2.540	--
eB	345	355	365	8.763	9.017	9.271
θ	4°	5.5°	7°	4°	5.5°	7°

6.2 SOP-18



SYMBOLS	MIN	MAX
A	0.093	0.104
A1	0.004	0.012
D	0.447	0.463
E	0.291	0.299
H	0.394	0.419
L	0.016	0.050
è	0	8