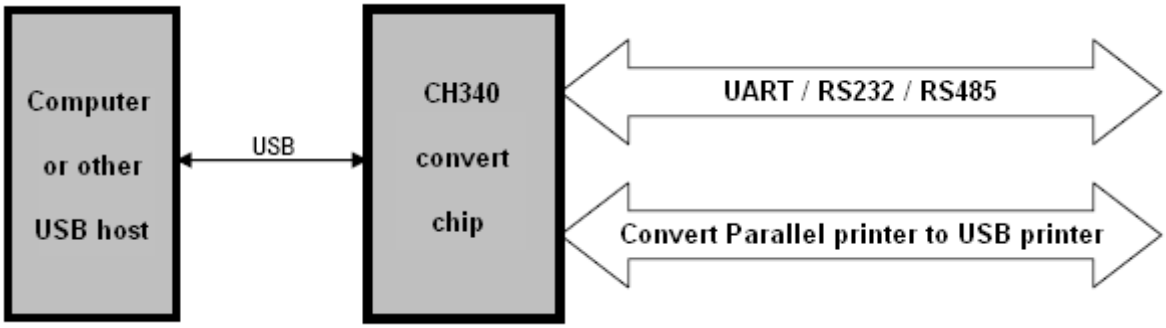
USB to serial chip CH340

Datasheet
Version: 2G
http://wch.cn

1. Introduction

CH340 is a USB bus converter chip, which converts USB to serial UART interface or to printer interface.

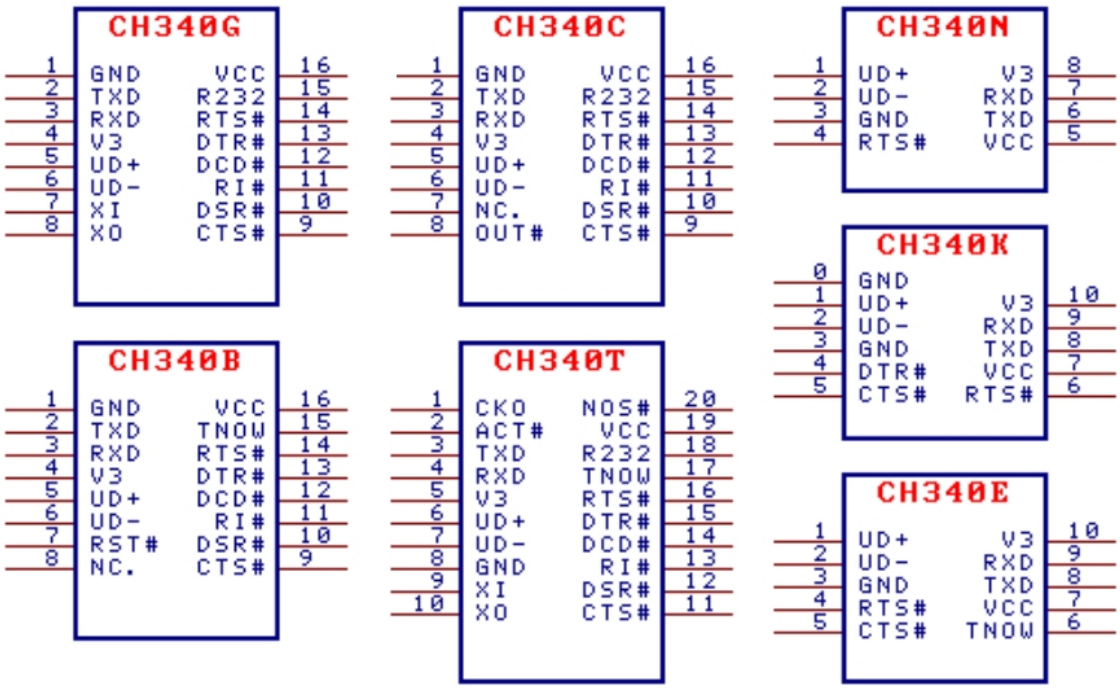
In serial UART mode, CH340 provides common MODEM signal, to expand UART interface of computer or upgrade common serial devices to USB bus directly. For more information about converting USB to printer interface, please refer to the manual CH340DS2.



2. Features

- Full speed USB device interface, USB 2.0 compatible.
- Emulate standard UART interface, used to upgrade the original serial peripherals or expand additional serial UART via USB.
- Original serial applications are totally compatible without any modification.
- Hardware full duplex serial UART interface, integrated transmit-receive buffer, supports communication baud rate varies from 50bps to 2Mbps.
- Supports common MODEM interface signals RTS, DTR, DCD, RI, DSR and CTS.
- Provides further RS232, RS485, RS422 interface, etc. through external voltage conversion chip.
- CH340R supports IrDA criterion SIR infrared communication, supports baud rate varies from 2400bps to 115200bps.
- Built-in firmware, software compatible with CH341, use VCP driver of CH341 directly.
- Supports 5V and 3.3V power supply even 3V.
- CH340C/N/K/E and CH340B have integrated 12MHz clock, no external crystal required, CH340B also integrates EEPROM used to configure the serial number, etc.
- RoHS compliant SOP-16, SOP-8, SSOP-20 and ESSOP-10, MSOP-10 lead-free package.

3. Packages



Package	Width Of Plastic		Pitch Of Pin		Instruction Of Package	Ordering Information
SOP-16	3.9mm	150mil	1.27mm	50mil	Small outline 16-pin patch	CH340G
SOP-16	3.9mm	150mil	1.27mm	50mil	Small outline 16-pin patch	CH340C
SOP-8	3.9mm	150mil	1.27mm	50mil	Small outline 8-pin patch	CH340N
ESSOP-10	3.9mm	150mil	1.00mm	39mil	Shrink Small outline 10-pin patch with backplane	CH340K
SOP-16	3.9mm	150mil	1.27mm	50mil	Small outline 16-pin patch	CH340B
MSOP-10	3.0mm	118mil	0.50mm	19.7mil	Miniature Small outline 10-pin patch	CH340E
SSOP-20	5.30mm	209mil	0.65mm	25mil	Shrink Small outline 20-pin patch	CH340T
SSOP-20	5.30mm	209mil	0.65mm	25mil	Shrink Small outline 20-pin patch	CH340R

Model differences:

CH340C, CH340N, CH340K, CH340E and CH340B have integrated clock, no external crystal required.

CH340B has also integrated EEPROM used to configure the serial number, etc. Some functions can be customized.

The CH340K has three diodes built in to reduce current flow backwards between the I/O pins of the MCU.

The backplane of the CH340K is 0# pin GND, which is an optional connection; the 3# pin GND is the necessary connection.

CH340R provides reverse polarity TXD and MODEM interface signals. (Discontinued)

4. Pin Out

SSOP20 Pin No.	SOP16 Pin No.	ESSOP10 Pin No.	SOP8 Pin No.	Pin Name	Pin Type	Pin Description (description in bracket is only about CH340R)
19	16	7	5	VCC	POWER	Power supply voltage input, requires an external 0.1uF decoupling capacitor
8	1	3, 0	3	GND	POWER	Ground
5	4	10	8	V3	POWER	Connect to VCC when VCC is 3V3, connect to 0.1uF decoupling capacitor when VCC is 5V
9	7	NONE	NONE	XI	IN	CH340T/R/G: Input of crystal oscillator, connect to 12MHz crystal and capacitor
				NC.	NONE	CH340C: No Connection, must be suspended
				RST#	IN	CH340B: Input of external reset, active low, integrated pull-up resistor
10	8	NONE	NONE	XO	OUT	CH340T/R/G: Output of crystal oscillator, connect to crystal and capacitor
				OUT#	OUT	CH340C: MODEM output IO, software controlled, active low
				NC.	NONE	CH340B: No Connection, must be suspended
6	5	1	1	UD+	USB signal	Connect to USB D+ Signal directly
7	6	2	2	UD-	USB signal	Connect to USB D- Signal directly
20	NONE	NONE	NONE	NOS#	IN	Forbid USB device suspending, active low, integrated pull-up resistor
3	2	8	6	TXD	OUT	Transmit asynchronous data output(reverse output for CH340R)
4	3	9	7	RXD	IN	Receive asynchronous data input, integrated configurable pull-up and pull-down resistor
11	9	5	NONE	CTS#	IN	MODEM input signal, clear to send, active low(high)
12	10	NONE	NONE	DSR#	IN	MODEM input signal, data set ready, active low(high)
13	11	NONE	NONE	RI#	IN	MODEM input signal, ring indicator , active low(high)
14	12	NONE	NONE	DCD#	IN	MODEM input signal, data carrier detect, active low(high)
15	13	4	NONE	DTR#	OUT	MODEM output signal, data terminal ready, active low(high)
16	14	6	4	RTS#	OUT	MODEM output signal, request to send, active low(high)
2	NONE	NONE	NONE	ACT#	OUT	USB configuration completed state output, active low
18	15	NONE	NONE	R232	IN	CH340T/R/G/C: Assistant RS232 enable,

						active high, integrated pull-down resistor
17	15	NONE	NONE	TNOW	OUT	CH340T/E/B: Ongoing data transmission status indicator, active high
				IR#	IN	CH340R:Serial mode input setting, integrated pull-up resistor, SIR infrared serial interface when low, common serial interface when high
1	NONE	NONE	NONE	CK0	OUT	CH340T: clock output
				NC.	NONE	CH340R:No Connection, must be suspended

5. Function Description

CH340 has integrated USB pull-up resistor, UD+ and UD- pins should be connected to USB bus directly.

CH340 has integrated power-on reset circuit. CH340B also provides low active external reset pin.

CH340G/CH340T/CH340R need to work with 12MHz clock signal supplied to XI pin. Generally, clock signal is generated by the inverter in CH340 through crystal oscillation. The peripheral circuit needs to place a crystal of 12MHz between XI and XO, and connect to a capacitor to ground separately.

CH340C, CH340N, CH340K, CH340E and CH340B have integrated clock generator, no external crystal and oscillating capacitor required.

CH340B also provides EEPROM for configuring data area, product serial number and other information could be customized for each chip by specific software tools, configurable data area is shown in the table below.

Byte Address	Abbreviation	Description Of Chip Configuration Data Area	Default
00H	SIG	For CH340B: internal configuration information valid reg, must be 58H. For CH340H/S: external configuration information valid reg, must be 53H. Invalid for other value	00H
01H	MODE	Serial mode, must be 23H	23H
02H	CFG	Specific configuration of chip, bit5 is used to configure product Serial Number: 0= valid; 1= invalid.	FEH
03H	WP	Internal configuration information write protect flag，57H imply read only, otherwise can be rewrite	00H
05~04H	VID	Vendor ID, high byte is behind, any value. Set to 0000H or 0FFFFH implies VID and PID using vendor default value	1A86H
07~06H	PID	Product ID, high byte is behind, any value	7523H
0AH	PWR	Max Power, The maximum supply current in 2mA units	31H
17~10H	SN	Serial Number, the length of ASCII string is 8, disable the Serial number when the first byte is not ASCII character (21H~7FH)	12345678

3FH~1AH	PROD	For CH340B: Product String, Unicode string for product description. The first byte is by total bytes (less than 26H), the next byte is 03H, Unicode string after that, using vendor default description when do not meet characteristics above.	Using product default description when the first byte is 00H
Others		(Reserved)	00H or FFH

CH340 supports 5V and 3.3V power voltage. When using 5V power supply, the VCC pin connects 5V power and the V3 pin should connect with decoupling 0.1uF capacitor. When using 3.3V power supply, connects V3 with VCC, both powered with 3.3V power supply, and the other circuit voltage which connected with CH340 cannot exceed 3.3V.

CH340 supports USB device suspending automatically to save power. USB device suspend is forbidden when NOS# is driven low.

The DTR# pin of CH340 is used as a configuration input pin before the USB configuration completion. An external 4.7KΩ pull-down resistor can be connected with this pin to generate default low during USB enumeration, to apply larger supply current to the USB bus via the configuration descriptor for CH340.

In serial UART mode, CH340 contains these pins: data transfer pins, MODEM interface signals and assistant pins.

Data transfer pins contain: TXD and RXD. RXD keeps high when UART reception is idle. For CH340G/C/T/R, If pin R232 is driven high, assistant RS232 function will be enabled, an internal inverter will automatically insert to the RXD, and the pin becomes low by default. When UART transmission is idle, the TXD of CH340G/C/N/E/B/T keeps high, CH340K is weak high, while CH340R keeps low.

MODEM interface signals contain: CTS#, DSR#, RI#, DCD# and RTS#, CH340C also provides OUT# pin. All these MODEM interface signals are controlled and function defined by computer applications.

Assistant pins contain: IR#, R232, CK0, ACT# and TNOW. When IR# is low, infrared serial interface mode is enabled. R232 is used to control assistant RS232 function. If R232 is driven high, the RXD input will be reversed automatically. ACT# is USB device configuration complete status output (such as USB infrared adapter ready). TNOW indicates CH340 is transmitting data from UART when it is high and becomes low when transmits over. In RS485 and other half-duplex mode, TNOW could be used to indicate UART transmit-receive status. IR# and R232 are detected only once when chip powered on and reset.

CH340 has integrated separate transmit-receive buffer and supports simplex, half-duplex and full duplex UART communication. Serial data contains one low-level start bit , 5, 6, 7 or 8 data bits and 1 or 2 high-level stop bits, supports odd/even/mark/space check. CH340 supports common baud rate: 50, 75, 100, 110, 134.5, 150, 300, 600, 900, 1200, 1800, 2400, 3600, 4800, 9600, 14400, 19200, 28800, 33600, 38400, 56000, 57600, 76800, 115200, 128000, 153600, 230400, 460800, 921600, 1500000, 2000000 etc.

The baud rate error of CH340 UART reception is about 2%, the baud rate error of CH340G/CH340T/CH340R UART transmission is less than 0.3%, less than 1% for CH340C/CH340N/CH340K/CH340E/CH340B.

In the Windows OS, CH340 driver can emulate standard serial port. So the mostly original serial applications are totally compatible, without any modification.

CH340 can be used to upgrade the serial interface peripherals, or expand extra serial port for computers via USB bus, through external level conversion chip provide further RS232, RS485, RS422 interface, etc.

Through extra infrared transceiver, CH340R can expand SIR infrared adapter for computer via USB bus, realize infrared communication between computers and peripheral equipment that comply with IrDA specifications.

6. Parameters

6.1. Absolute Maximum Ratings

(critical state or exceeding maximum can cause chip to not work or even be damaged)

Name	Parameter Description		Min.	Max.	Unit
TA	Operating Ambient Temperature	CH340G/CH340T/CH340R	-40	85	℃
		CH340C/CH340N/CH340K/ CH340E/CH340B	-20	70	℃
TS	Storage Temperature		-55	125	℃
VCC	Supply Voltage(VCC connects to power, GND to ground)		-0.5	6.0	V
VIO	The voltage of input or output pin		-0.5	VCC+0.5	V

6.2. Electrical Parameters

(test conditions: TA=25℃,VCC=5V, exclude pins connected to USB bus)
(all the current parameters should multiply the coefficient of 40% when the supply voltage is 3.3V)

Name	Parameter Description			Min.	Typical	Max.	Unit
VCC	Supply Voltage	V3 doesn't connect to VCC		4.0	5	5.3	V
		V3 connects to VCC	CH340G/T/R	2.8	3.3	3.6	
			CH340C/N/K/E/B	3.1	3.3	3.6	
ICC	Operating Supply Current(Normal Operation)		CH340G/C/N/K/E/ T/R		7	20	mA
			CH340B		6	15	
ISLP	Operating Supply Current(USB Suspend)		VCC=5V		0.1	0.2	mA
			VCC=3.3V		0.09	0.15	
VIL	Input Low Voltage			0		0.7	V
VIH	Input High Voltage			2.0		VCC	V
VOL	Output Low Voltage(4mA draw current)					0.5	V
VOH	Output High Voltage(3mA output current) (Output 100uA current during chip reset)			VCC-0.5			V
IUP	Draw current of input with integrated pull-up			3	150	300	uA

	resistor				
IDN	Draw current of input with integrated pull-down resistor	-50	-150	-300	uA
VR	Voltage threshold when power-up reset	2.4	2.6	2.8	V

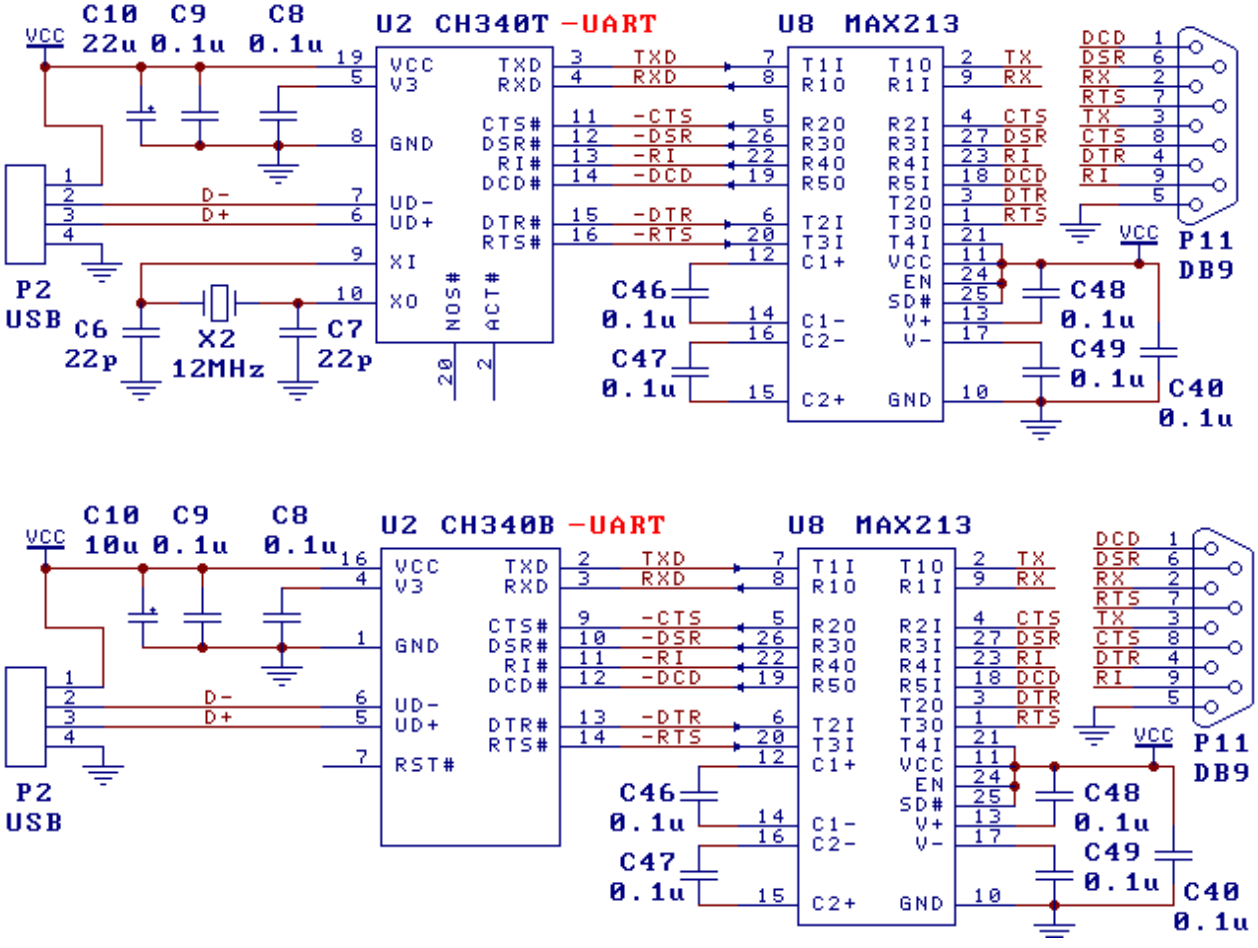
6.3. Timing Parameters

(test conditions: TA=25℃,VCC=5V)

Name	Parameter Description	Min.	Typ.	Max.	Unit
FCLK	Frequency of input clock in XI	11.98	12.00	12.02	MHz
TPR	Reset time of power-up	20	35	50	mS

7. Applications

7.1. USB to RS232 converter configuration



The image above use CH340T/CH340B (or CH340C) to realize USB to RS232 converter. CH340 provides common UART and MODEM signals, converts TTL to RS232 through level conversion chip U8. Port P11 is DB9 connector, the pins and their functions are the same as common PC DB9 connector, the chips similar with U8 have MAX213/ADM213/SP213/MAX211 etc.

U8 and C46/C47/C48/C49/C40 could be removed when realize USB to TTL converter only. The signal lines

in the image only RXD、TXD and public ground need connected, the other signal lines should suspend when not use.

P2 is USB port, USB bus contains a pair of 5V power lines and a pair of data signal lines . Usually, the color of +5V power line is red, the black one is ground. D+ signal line is green and the D- signal line is white. The max supply current of USB bus is up to 500mA. Generally, CH340 and low power consumption USB products can use the 5V power supplied by USB bus directly. If the USB products supply standing power by other manner, CH340 should use this power too. If the USB bus power and standing power are necessary at the same time, connect a 1Ω resistor between USB bus 5V power line and USB products 5V standing power line, and connect the ground lines of these two power directly.

The capacitor C8 on V3 is 0.1uF, used to CH340 internal power node decoupling. The capacitor C9 is 0.1uF, used to external power decoupling.

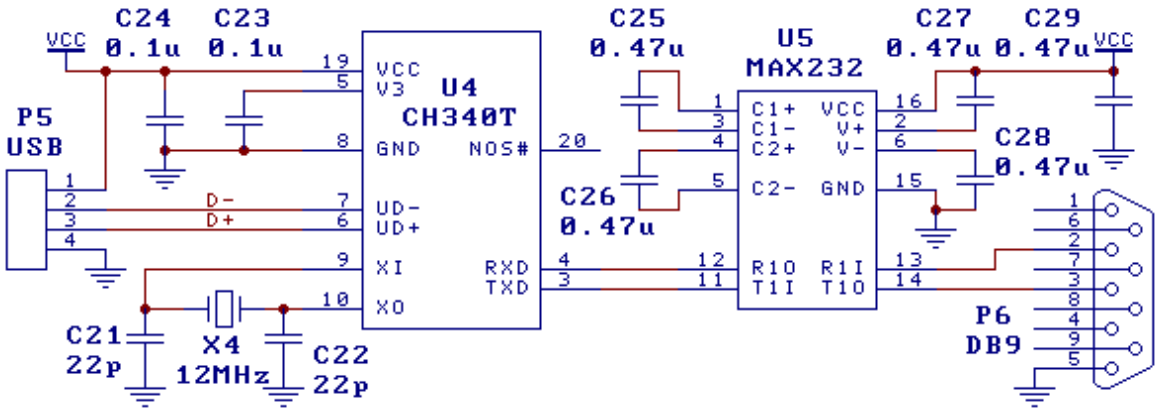
For CH340G/T/R, Crystal X2, capacitor C6 and C7 are used for clock oscillation circuit. The X2 is 12MHz quartz crystal, C6 and C7 are monolithic or high frequency ceramic capacitors with 22pF. If X2 is ceramic with low cost, C6 and C7 must use the recommended value of crystal manufacturer and generally is 47pF. For the crystal which is difficult to oscillate, halved value is suggested for C6.

For CH340C/N/K/E/B, crystal X2 and capacitor C6, C7 are not required.

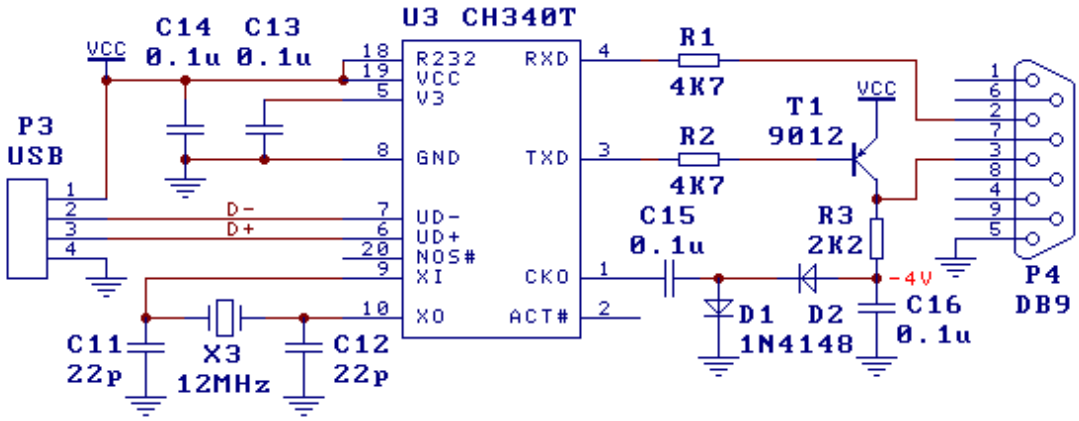
When designing the PCB, pay attention to: decoupling capacitor C8 and C9 must keep near to connection pin of CH340; make sure D+ and D- signal lines are parallel and provide ground or pour copper on both sides to reduce outside interference; the signal lines relevant to XI and XO should be kept as short as possible. In order to reduce the high frequency interference, around the ground or pour copper around the relevant components.

7.2. USB to RS232 converter configuration (3-wire)

The image below is USB to 3-wire RS232 converter design which is the most basic and most commonly used, U5 uses MAX232/ICL232/SP232 etc.



7.3. USB to RS232 converter configuration (simplified version using RS232)

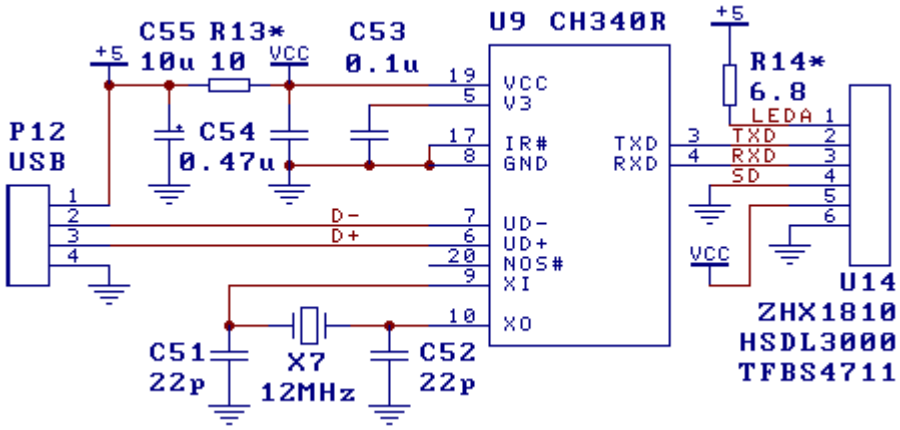


The image above is USB to RS232 converter design too, the function of this circuit is the same with 7.2 section except the range of output RS232 is narrower. When R232 pin is driven high, the assistant RS232 function will be enabled, just need to add some diodes, transistors, resistors and capacitors, the special level conversion chip U5 in section 7.2 could be replaced and the hardware cost is lower.

7.4. USB to RS485 Converter Configuration

The TNOW pin can be used to control DE (high active send enable) and RE# (low active receive enable) pin of RS485 transceiver.

7.5. USB to Infrared Adapter

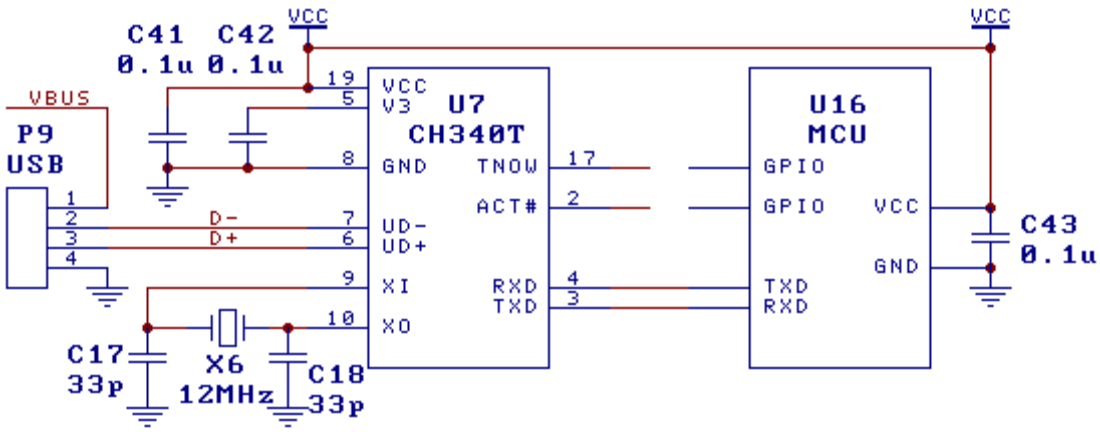


The image above is a USB to infrared adapter design which is composed with USB convert IrDA infrared chip CH340R and infrared transceiver U14 (ZHX1810/HSDL3000 etc). The resistor R13 is used to weaken influence of large current in infrared transmitting. The current limiting resistor R14 should be adjusted according to the manufacturer's recommended value of the infrared transceiver U14.

7.6. Connect CH340 to MCU and supply power together

The image below is a sample design to achieve USB connection on an MCU by connecting it to a CH340 via TTL serial port. Here we use self-power mode, VCC supports 5V or 3.3V(V3 shorted to VCC if VCC is 3.3V), and don't use USB bus power VBUS at all(Can be tested by connecting series resistor to I/O of MCU if needed). CH340 shares the same power source with MCU, hence there would be no current inrush through I/O between CH340 and MCU.

Unused CH340 pins can be suspended. For CH340C, CH340N, CH340E, CH340B, X6 , C17 and C18 are unused.



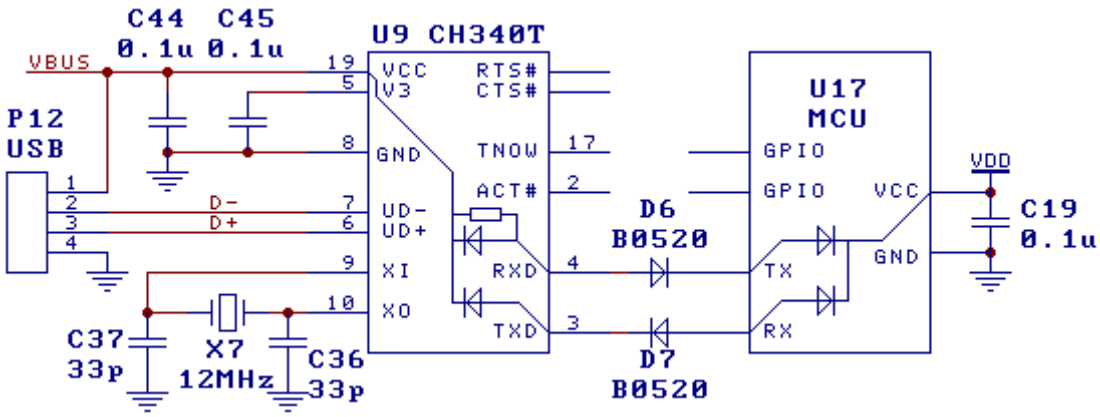
7.7. Connect CH340 to MCU and supply power separately

The image below is a sample design to achieve USB connection on an MCU by connecting it to a CH340 via TTL serial port. CH340 is powered by USB bus VBUS. MCU is powered by another power source VDD, VDD supports 5V, 3.3V and even 2.5V, 1.8V. The diodes D6 and D7 are used to help relieve current inrush problems between CH340 and MCU through RXD or diode within RX. The RX pin of the MCU should enable internal pull-up resistor. If not, we suggest adding an 8kΩ ~ 30kΩ pull-up resistor to RX pin.

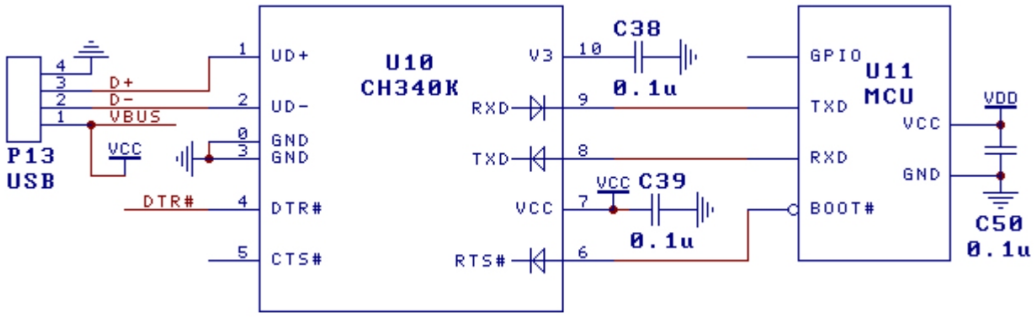
Diode D6 is meant for circumstances when CH340 is not powered but MCU is powered, and TX high level causes current inrush through RXD internal diode; Diode D7 is meant for circumstances when MCU is not powered but CH340 is powered, and TXD high level causes current inrush through RX internal diode. If certain circumstance can be ensured to be avoided, the corresponding diode can be removed. For example, if the MCU has a permanent power source, then D7 can be short-circuited.

Prioritized choice for diode is low power Schottky diode.

Generally, it is not recommended that CH340 and MCU be powered separately. If it is really necessary, it is recommended to use CH340K or a chip with VIO power pins supporting I/O independent power supply.



7.8. Connect CH340K to MCU and supply power separately



The figure above shows the reference circuit for USB communication between the MCU and the CH340K via UART. CH340K is powered by the USB bus VBUS (VCC), the MCU uses another power supply VDD, which supports 5V, 3.3V or even 2.5V, 1.8V. The backplane of the CH340K package is an optional GND pin that can be easily connected to GND or left floating depending on the PCB trace.

The TXD and RTS# pins of the CH340K and the RXD pin have built-in diodes to prevent current flow backwards (as shown), and a weak pull-up resistor of about 75KΩ is built in to maintain the default or idle state high level (in the figure). Not marked), this can achieve low-level drive and weak high-level drive, as well as reduce current flow backwards when the CH340K and MCU are independently powered. The CH340K can completely prevent the MCU power supply from powering down the current of the CH340K, and can also greatly reduce the current flow backwards of the MCU power supply to the power-off CH340K(up to 150μA). When used for communication baud rate above 120Kbps, it is recommended to enable built-in or external 2KΩ ~22KΩ pull-up resistor for the RX pin of the MCU. Or select chips which have VIO power pins that support I/O independent power supply.

The DTR# pin of the CH340K is a normal push-pull output, and the CTS# pin is a normal input with a built-in pull-up resistor. These two pins have no built-in diodes and do not have the function of preventing current flow backwards. They are generally not used to connect to the MCU.

DTR# can be used to control the power switch that VCC supplies to VDD. Four power control schemes are available as shown below. The T4 scheme and the Q1 scheme (Q1 should choose a lower Vth N-OSFET) is a simplified scheme. The VDD output voltage is about VCC-0.8V and the current does not exceed 200mA. The T6 scheme and the Q3 scheme are complete solutions. In the figure, D10 is used to prevent VDD from flow backwards to VCC, which is optional.

