

# USB extension control chip CH315G

## USB signal isolation control chip CH315H

DataSheet  
Version: 1A  
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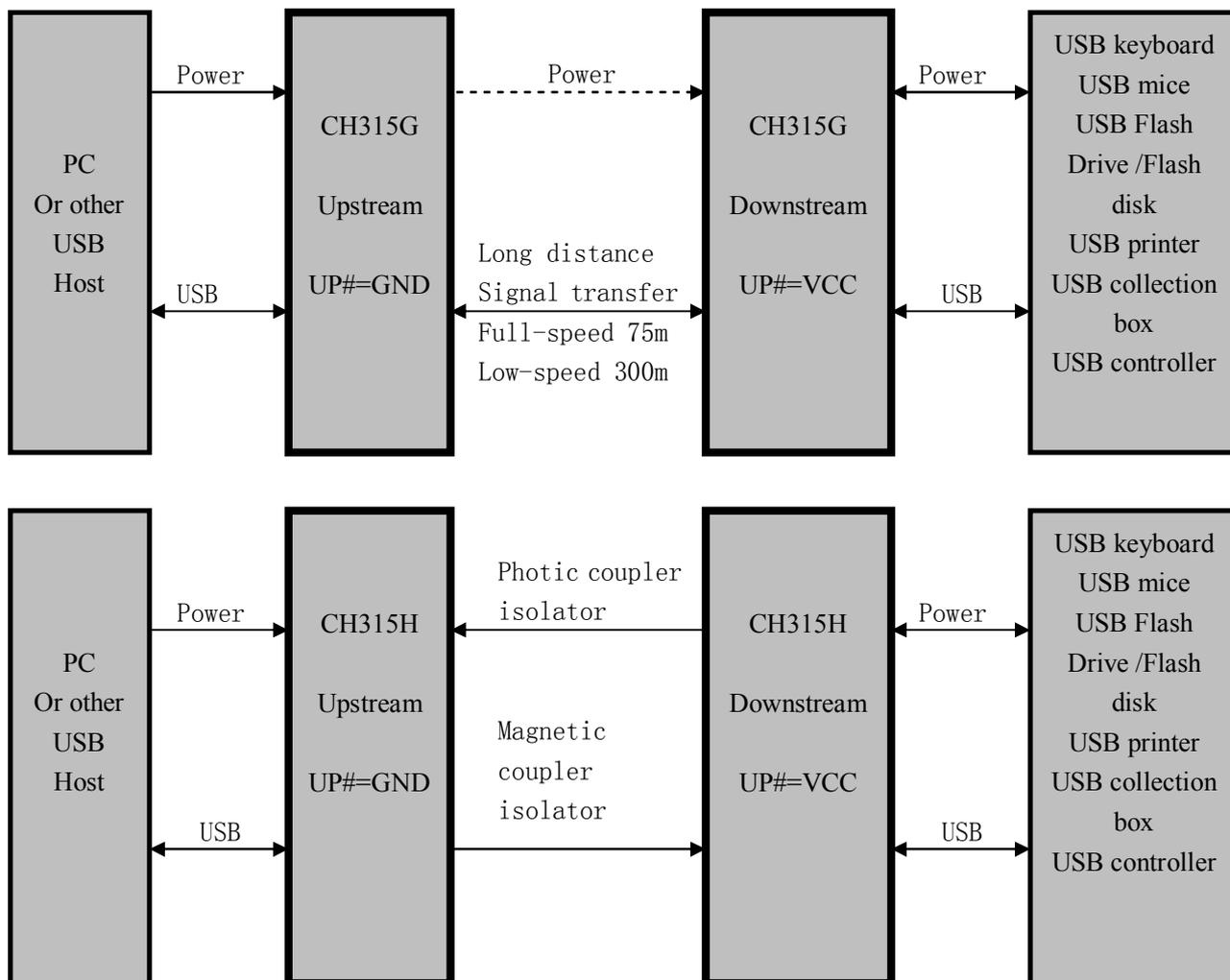
### 1. Introduction

CH315G is USB extension control chip, used for USB signal real time transmit and extend transfer distance.

CH315H is USB signals isolation control chip, used for USB bus optical isolator or magnetic isolator.

CH315 supports full-speed and low-speed transfer, support USB device dynamic insert and remove.

The following is application image.

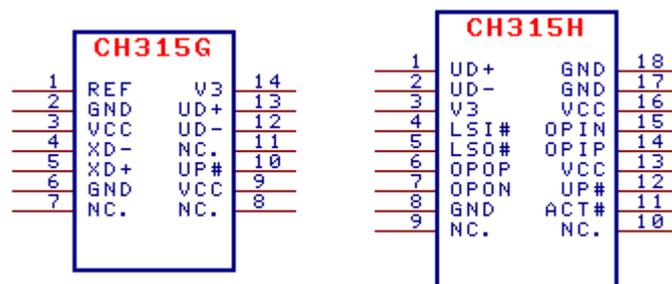


### 2. Features

- supports 12Mbps full-speed and 1.5Mbps low-speed USB transfer, compatible with USB 2.0.
- supports USB control transfer, bulk transfer, interrupt transfer, synchronous/isochronous transfer.

- automatically detect USB Full-Speed or USB Low-Speed, CH315H offer USB transfer status indication.
- the same chip can be configured as upstream mode and downstream mode, connect to USB-Host and USB-Device.
- the downstream mode can automatically detect USB device connection and removal, the upstream mode can automatically simulate USB device connection and removal.
- set impedance matching serial resistor of USB signal, pull-up resistor of USB device port, pull-down resistor of USB host port.
- set PLL and 12MHz USB clock internal, no need crystal or crystal resonator, the peripheral circuit is simply.
- set USB signal extension circuit in the CH315G, support category 5 or category 5 unshielded twisted-pair super, the transfer distance is no less than 75m of 12Mbps full-speed USB signal, the transfer distance is no less than 300m of 1.5Mbps.
- set current driven circuit of photic coupler in CH315H, support the low-cost 6N137, the photic coupler can not influenced by electromagnetism.
- only hardware project, real time of USB protocol, no need other drive program, support Windows 98/ME/2000/XP/Vista/Server200X/64bit-Vista and Linux.
- set 3.3V power manostat in the internal. Support 5V power (default) and 3.3V power.
- CH315G adopt SOP-14 lead-free package, CH315H adopt SOP-18 lead-free package, compatible with RoHS.

### 3. Package



Package shape	Width of plastic		Pitch of pin		Instruction of package	Ordering type
SOP-14	3.9mm	150mil	1.27mm	50mil	Small outline package of 14-pin	CH315G
SOP-18	7.62mm	300mil	1.27mm	50mil	Small outline package of 18-pin	CH315H

### 4. Pins

CH315G Pin No.	CH315H Pin No.	Pin Name	Pin Type	Pin Description
3,9	13,16	VCC	POWER	Positive power input port, requires an external 0.1uF power decoupling capacitance
2,6	8,17,18	GND	POWER	Public ground, ground connection for USB
14	3	V3	POWER	Attachment of VCC input external power while 3.3V;connects of 0.01uF decoupling capacitance outside while 5V
13	1	UD+	USB signal	Directly connect to USB bus D+ data bus

12	2	UD-	USB signal	Directly connect to USB bus D- data bus
1	No	REF	Consult power	Consult power of internal simulate circuit, require an resistor and decoupling capacitance
5	No	XD+	Simulate signal	Directly connect to difference extension wire positive port
4	No	XD-	Simulate signal	Directly connect to difference extension wire negative port
No	14	OPIP	IN	Separate transfer P signal input, connect with photic coupler or magnetism coupler P logic output port
No	15	OPIN	IN	Separate transfer N signal input, connect with photic coupler or magnetism coupler N logic output port
No	6	OPOP	OUT	Separate transfer P signal output, connect with photic coupler or magnetism coupler P control input port
No	7	OPON	OUT	Separate transfer N signal output, connect with photic coupler or magnetism coupler N control input port
No	5	LSO#	OUT	USB transfer speed automatically check the result ouput. Low-level is USB low-speed 1.5Mbps, high-level is USB full-speed 12Mbps
No	4	LSI#	IN	USB transfer speed select input, Low-level is USB-low speed 1.5Mbps, high-level is USB full-speed 12Mbps.
10	12	UP#	IN	Mode select input, with pull-up resistor, Low-level is upstream mode, high-level is downstream mode
No	11	ACT#	Drain open OUT	USB transfer status output, active with low-level, with pull-up resistor
7,8,9	9,10	NC.	Un-connect	Forbid to connect

## 5. Function

CH315 can direct use USB power. When using 5V power, V3 pin must connect with about 0.01 $\mu$ F decoupling capacitance. When using 3.3V power, V3 must connect with VCC, and input the outside 3.3V power.

CH315G using category 5 or category 5 unshielded twisted-pair super (net wire) or USB signal wire and similar difference signal twisted-pair. If the characteristic impedance is not matching, need to parallel connect resistor to ground of output port XD+/XD-.

The transfer distance of CH315G is relative with transfer wire quality. When using common net wire, the transfer distance is no less than 300m of low-speed USB signal, the transfer distance is no less than 75m of full-speed USB signal. The current resistor of common net wire is less than 10 $\Omega$ /100m. If the current resistor is too big, it will influence on transfer distance, and influence on USB supply power, upgrade ground power of device port.

The transfer distance of CH315G has relative with USB host time characteristics of computer chip groups. For full-speed USB signal, the trip acknowledge time of electron in transfer wire does not pass computer waiting time (several ns), so the transfer distance is limited.

The ACT# is USB transfer current status output of CH315H, connect with LED to indicate USB

transfer.

CH315H support the common type 6N137 single channel high-speed photic coupler (need four) or the type is HCPL-2630,2631,0630,0631 double channels (only need two). The isolate power is determined by photic coupler, the typical isolate power is 5000V of 6N137. CH315H also support magnetism coupler, recommended to use photic coupler, not influenced by the electromagnetism. In order to support 12Mbps USB full-speed signal, the transfer speed is more than 10Mbps of photic coupler or magnetism coupler.

CH315 is hardware project of USB signal extension and USB signal electric isolation, compatible with the relative criterion, completely transparent to the USB protocol. For the CH315, no need any drive, but the USB device may need to install driver, the method is the same with the no isolation. The common USB Flash Drive, keyboard, mice and other USB device may no need driver.

CH315 can automatically detect USB full-speed and USB low-speed, support plug and play, automatically detect and simulate the USB device connect and disconnect. CH315G can be used to produce active USB extension cable, extension USB transmission distance, signal acquisition and on-line remote control; CH315G can be used to produce optical isolator USB signals and reduce signal interference, improve signal acquisition accuracy.

## 6. Parameter

**6.1. Absolute maximum rating** (Stresses above those listed can cause permanent damage to the device. Exposure to maximum rated conditions can affect device operation and reliability.)

Name	Parameter note	Min.	Max.	Units
TA	Ambient operating temperature	-40	85	°C
TS	Storage temperature	-55	125	°C
VCC	Voltage source (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 parameter** (test conditions: TA=25°C, VCC=5V, excluding pin connection of USB bus)

Name	Note of parameter	Min.	Typ.	Max.	Units
VCC	Power voltage	3.2	5	5.3	V
ICCs	Static source current		2	5	mA
ICCa	Source current when working		20	50	mA
VIL	Input Voltage LOW OPIN/N	-0.5		0.8	V
VIH	Input Voltage HIGH OPIP/N	2.0		VCC+0.5	V
VOL	Output Voltage LOW (draw 8mA current) OPOP/N			0.5	V
VOH	Output Voltage HIGH (output 8mA current) OPOP/N	VCC-0.5			V
IUPup	Input current in UP# pin with internal pull-up resistor	3	150	300	uA
IUPact	Input current in ACT# pin with internal pull-up resistor	100	230	400	uA
Lfs	Extension distance of full-speed USB signal		75		m
Lls	Extension distance of low-speed USB signal	300			m

## 7. Application

### 7.1. Active USB extension cable (following image)

The following USB extension cable is composed by two groups CH315G circuit.

The upstream contains U3, P3 etc. the up port P3 is used to connect to computer or other USB-Host, U3 etc upstream circuit share power with computer or USB host through P3, at least public ground.

The downstream contains U4, P4 etc, the down port P4 is used to connect to USB-Device, such as USB keyboard, USB mice, USB Flash Drive, USB data acquisition box, USB controller etc. USB device, U4 etc. downstream circuit share power with USB device, at least public ground.

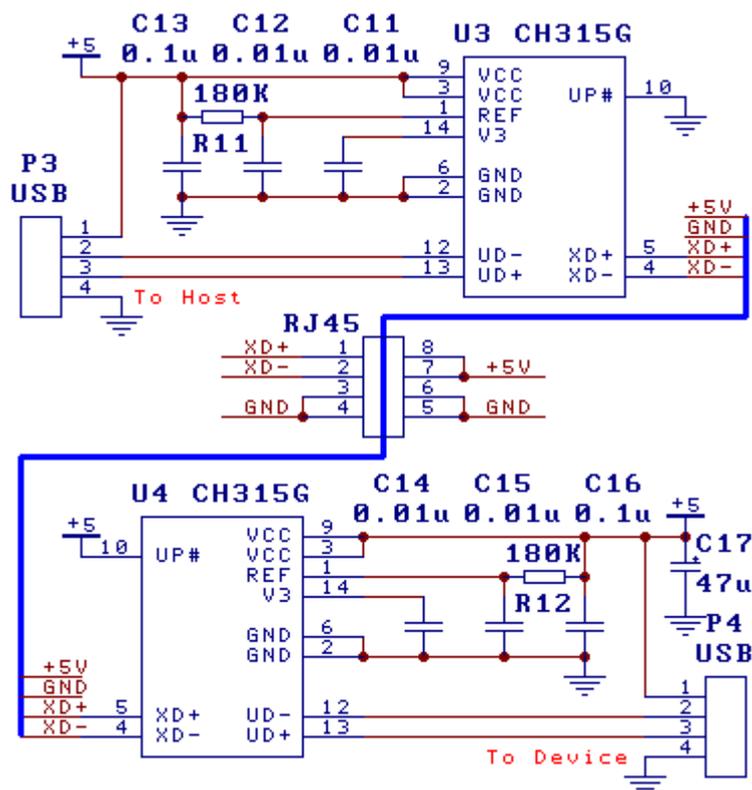
There is one group electrical wire between upstream U3 and downstream U4, using common network cable (category 5 or category 5 unshielded twisted-pair super) connection. The cable included XD+ and XD- two differential signaling lines and at least one public ground. If there are remaining signal lines, it can also be used an additional ground wire and power wire.

For the normal eight core cable, please consult to the figure RJ45: two differential signal lines, four ground wires, two power wires. The power wire can offer +5V source to USB device port, but impact by the network cable DC resistance of the voltage drop, especially when the USB device draws more current, the USB device port of the actual supply voltage is usually less than 5V, and even individual USB device may be unable to work, then need to provide independent power for the downstream.

The capacitance of C11, C12, C14, C15 is from 4700pF to 0.02uF, used to decoupling of internal power. C13 and C16 is 0.1uF, used to decoupling of power of CH315. C17 is decoupling of the USB device on P4 port. R11 and R12 are used to adjust the internal consult power.

USB port contains P3 and P4, USB bus contain one pair of 5V power wire and one pair of data signal. Usually, +5V power wire is red, the ground wire is black, D+ signal wire is green, D- signal wire is white.

When designing the PCB, pay much attention to some notes: C11, C12, C13, C14, C15 and C16 connected to the pin as close as possible CH315G, makes sure D+ and D- are parallel, XD+ and XD- are parallel, and supply ground net or pour copper beside them to decrease the disturbance from outside signal.



## 7.2. USB signal isolator (following image)

The following USB isolator is composed by two groups CH315H circuit.

LSI# pin directly connect to LSO# pin in CH315H, automatically detect USB speed. In actual, if need to support certain speed, such as, support low-speed USB keyboard, make LSI# as low-level.

The upstream contains U1, P1 etc. the up port P1 is used to connect to computer or other USB-Host, U1 etc upstream circuit share power with computer or USB host through P1, at least public ground.

The downstream contains U2, P2 etc, the down port P2 is used to connect to USB-Device, such as USB keyboard, USB mice, USB Flash Drive, USB data acquisition box, USB controller etc. USB device, U2 etc. downstream circuit share power with USB device, at least public ground.

There is one group signal isolator circuit between upstream U1 and downstream U2, select magnetic or optical isolation. The image id optical isolation, the signal isolation is composed by O1+O2 and O3+O4 two pairs of photic coupler and associated resistance R1~R8, capacitor C7~C10. The type of photic coupler can select single channel 6N137 or double channels HCPL2631 etc. high-speed photic coupler may require decoupling capacitors between power pin and ground pin, the figure is not drawn). Used in 12Mbps full-speed USB signal, need to consider the speed and the speed symmetry, influence on signal slow-moving and balance, recommended to select the transmission rate is greater than 10Mbit, and adjust the R1/C7, R2/C8, R5/C9, R6/C10, to optimize the output signal between rising edge and falling edge.

L1 indicates the USB data transfer in progress. The capacitance of C1 and C4 is from 4700pF to 0.02uF, for Ch315H decoupling the internal power node, C2 and C5 has a capacity of 0.1uF, for Ch315H chip power supply decoupling.

When designing the PCB, pay much attention to some notes: decoupling capacitors C1, C2, C4 and C5 connect to the pin as close as possible CH315H, makes sure D+ and D- are parallel, and supply ground net or pour copper beside them to decrease the disturbance from outside signal.

