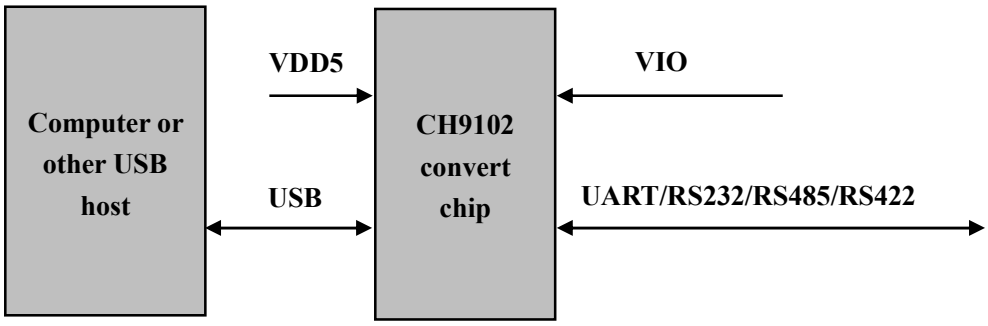
USB to High Speed Serial Port Chip CH9102

DataSheet
Version: 1A
http://wch.cn

1. Introduction

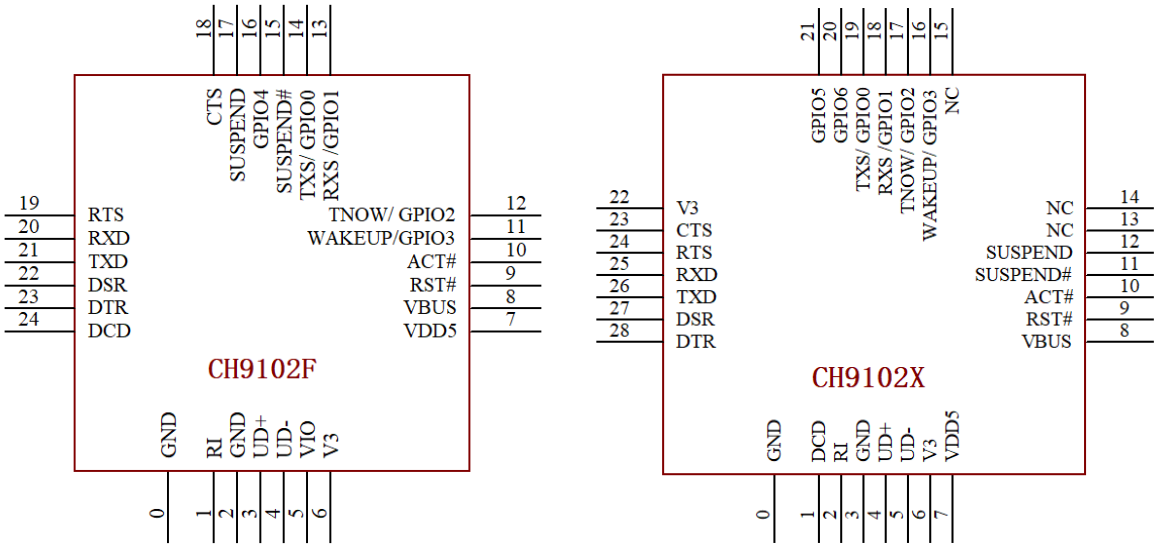
CH9102 is a USB bus converter chip, which converts USB to serial UART interface. CH9102 provides common MODEM signal, to expand UART interface of computer or upgrade common serial devices or MCU to USB bus directly.



2. Features

- Full speed USB device interface, USB 2.0 compatible.
- Built-in firmware, 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.
- Support free-installation operating system built-in CDC driver or multi-functional high-speed VCP manufacturer driver.
- Hardware full duplex serial UART interface, integrated transmit-receive buffer, supports communication baud rate varies from 50bps to 4Mbps.
- Supports 5, 6, 7 or 8 data bits, supports odd, even, blank, mark and no parity.
- Supports common MODEM interface signals RTS, DTR, DCD, RI, DSR and CTS.
- Supports CTS and RTS hardware automatic flow control.
- Supports half-duplex, provides sending status TNOW supports RS485 switch.
- Provides further RS232 interface, through external voltage conversion chip.
- Supports 5V and 3.3V power supply.
- CH9102F serial port interface I/O powered independently, support 5V, 3.3V, 2.5V, 1.8V power supply voltage.
- CH9102X serial port interface I/O only supports 3.3V voltage.
- Built-in power-on reset, built-in clock, no external crystal required.
- RoHS compliant QFN24 and QFN28 PB-free package.

3. Packages



Package	Width Of Plastic	Pitch Of Pin		Instruction Of Package	Ordering Information
QF24_4X4	4*4mm	0.5mm	19.7mil	Ultra-small square without lead 24-pin	CH9102F
QF28_5X5	5*5mm	0.5mm	19.7mil	Ultra-small square without lead 28-pin	CH9102X

Note:

The backplane of the CH9102F and CH9102X is 0# pin GND, which is an optional connection, but suggested connection; other GND are necessary connections.

CH9102X VIO pins and V3 pins have been short-circuited internally.

4. Pin Out

QNF24 Pin No.	QNF28 Pin No.	Pin Name	Pin Type	Pin Description
7	7	VDD5	POWER	Power supply voltage input, requires an external 0.1uF decoupling capacitor
5	V3 Connected to VIO internally	VIO	POWER	I/O power supply voltage input, requires an external 0.1uF decoupling capacitor
2,0	3, 0	GND	POWER	Ground
6	6, 22	V3	POWER	Internal voltage regulator output and kernel and USB power supply input. When VDD5 voltage is less than 3.6V, connects to VDD5. When VDD5 voltage is more than 3.6V, connects to external 0.1uF decoupling capacitor
9	9	RST	IN	Input of external reset, active low, integrated pull-up

				resistor
3	4	UD+	USB signal	Connect to USB D+ Signal directly
4	5	UD-	USB signal	Connect to USB D- Signal directly
8	8	VBUS	IN	VBUS status detection input of USB bus, integrated pull-down resistor
21	26	TXD	OUT	Transmit asynchronous data output, idle state is high level
20	25	RXD	IN	Receive asynchronous data input, integrated pull-up resistor
18	23	CTS	IN	MODEM input signal, clear to send, active low
22	27	DSR	IN	MODEM input signal, data set ready, active low
1	2	RI	IN	MODEM input signal, ring indicator , active low
24	1	DCD	IN	MODEM input signal, data carrier detect, active low
23	28	DTR	OUT	MODEM output signal, data terminal ready, active low
19	24	RTS	OUT	MODEM output signal, request to send, active low
15	11	SUSPEND#	OUT	USB suspend state output, active low, normal working state output high level, output low level after suspension
17	12	SUSPEND	OUT	USB suspend state output, active high, normal working state output low level, output high level after suspension
11	16	WAKEUP/ GPIO3	IN/ (IN/OUT)	USB wake-up event detects input, low active, built-in pull-up resistor GPIO3, configurable input or output
12	17	TNOW/ GPIO2	OUT/ (IN/OUT)	The serial port sends the status indication in progress, active high GPIO2, configurable input or output
13	18	RXS/GPIO1	OUT/ (IN/OUT)	The RXD pin input state indicator GPIO1, configurable input or output
14	19	TXS/GPIO0	OUT/ (IN/OUT)	The TXD pin output state indicator GPIO0, configurable input or output
NONE	20	GPIO6	IN/OUT	GPIO6, configurable input or output
NONE	21	GPIO5	IN/OUT	GPIO5, configurable input or output
16	NONE	GPIO4	IN/OUT	GPIO4, configurable input or output
10	10	ACT#	OUTPUT	USB configuration completed state output, active low, invalid when suspended
NONE	13, 14, 15	NC	NONE	No Connection, must be suspended

5. Function Description

5.1. Power and power consumption

The CH9102 has 3 power supplies and a built-in voltage regulator which generates 3.3V. VDD5 is the input of the power regulator, V3 is the output of the voltage regulator and USB transceiver and core power supply input, and VIO is the I/O pin power supply.

The CH9102 supports 5V or 3.3V supply voltage, and the V3 pin should be externally connected to a power decoupling capacitor with a capacity of about 0.1uF. When using 5V power supply(greater than 3.8V), VDD5 inputs external 5V power supply (for example, the USB bus power supply), the internal voltage regulator generates 3.3V on V3 which used by USB transceivers. When using 3.3V or lower operating voltage (less than 3.6V), V3 should be connected to VDD5, while input external 3.3V power supply. V3 still requires an external decoupling capacitor.

VIO pin of CH9102 provides I/O power for serial port I/O and RST pin. It supports 1.8V～5V power supply voltage. VIO should use the same power supply as MCU and other peripherals. UD+, UD- and VBUS pins use V3 power supply, not VIO power supply.

CH9102 automatically supports USB device suspension to save power consumption. In the USB suspend state, if the I/O output pin has no external load and the I/O input pin is floating (internally pulled up) or in a high level state, the VIO power supply will not consume current. In addition, when V3 and VDD5 lose power and are at a voltage of 0V, the current consumption of VIO is the same as above, and VIO will not flow backwards current to VDD5 or V3.

VBUS should be connected to USB bus power supply, and when the loss of USB power is detected, CH9102 will turn off the USB and sleep (hang up). CH9102 provides VIO low-voltage protection mechanism when VBUS connects with resistor in series and used to control VIO power through PMOS. During the shutdown of the VBUS pull down resistance, if VIO voltage is detected to be lower than about 1.4V, then CH9102 will automatically absorb about 300uA discharge current on VBUS, until the end of the discharge current after the VIO voltage rises, and enables the pull-down resistance automatically.

Several power connection schemes for reference here:

<table>
<tr><td rowspan="2">Power supply scheme</td><td rowspan="2">UART signals voltage
MCU operating voltage</td><td>VDD5</td><td>V3</td><td>VIO</td><td>MCU or peripheral power supply</td></tr>
<tr><td>Not less than V3 voltage</td><td>Rated around 3.3V</td><td colspan="2">Both use the same power supply, 1.8V～5V</td></tr>
<tr><td rowspan="4">All USB power supply</td><td>5V</td><td>USB powered 5V</td><td>Connects to capacitor only</td><td colspan="2">USB powered 5V</td></tr>
<tr><td>3.3V</td><td>USB powered 5V</td><td>Connects to capacitor</td><td colspan="2">Powered by V3 for 3.3V, up to 10mA</td></tr>
<tr><td>3.3V</td><td colspan="4">USB 5V power stepped down to 3.3V via external LDO power regulator, V3 connects to external capacitor</td></tr>
<tr><td>1.8V～4V</td><td>USB powered 5V</td><td>Connects to capacitor only</td><td colspan="2">USB powered by external LDO regulator</td></tr>
</table>

USB+ self-powered Dual power supply	1.8V～5V	USB powered 5V	Connects to capacitor only	Self-powered 1.8V～5V (1.8V,2.5V,3.3V,5V)
All self-powered	4V～5V	Self-powered 4V～5V	Connects to capacitor only	Self-powered 4V～5V
	1.8V～5V	Self-powered, rated 3.3V, connects to external capacitor		Self-powered 1.8V～5V

VIO and V3 of CH9102X have been shorted internally. VIO uses the 3.3V power output by the internal voltage regulator LDO. CH9102X only supports 3.3V serial port signals.

5.2. UART

In serial UART mode, CH9102 contains: data transfer pins, MODEM interface signals and assistant pins.

Data transfer pins contain: TXD and RXD. RXD should be high when UART input is idle. When UART output is idle, TXD is high level.

MODEM interface signals contain: CTS, DSR, RI, DCD, DTR and RTS. All these MODEM interface signals are controlled and function defined by computer applications.

Assistant pins contain: SUSPEND#, SUSPEND, WAKEUP, RXS, TXS, ACT#, etc.

SUSPEND# and SUSPEND are the output signals to indicate suspend states of the chip. When the chip is in the normal working state, the SUSPEND# pin outputs a high level, and the SUSPEND pin outputs a low level; when the chip is in a suspend state, the SUSPEND# pin outputs low level, SUSPEND pin outputs high level.

WAKEUP is the USB wake-up event detection input pin. It is low active and has a built-in pull-up resistor.

RXS is the output pin of UART receiving data status, TXS is the output pin of UART sending data status.

ACT# is USB device configuration complete status output, which can be used to notify the MCU or drive the LED which connects to the VIO through the current limiting resistor.

CH9102 supports CTS and RTS hardware automatic flow control, which can be enabled by software. If enabled, UART will continue to send the next data only when CTS is valid (active low), otherwise the UART transmission will be suspended; when the receiving buffer is empty, UART will automatically set RTS to be valid (active low), it will automatically invalidate RTS until the data in the receiving buffer is nearly full, and RTS will be valid again when the buffer is empty. While using hardware automatic flow control, CTS of CH9102 should connect to RTS of the other side, and RTS of CH9102 should connect to CTS of the other side.

CH9102 has integrated separate transmit-receive buffer and supports simplex, half-duplex and full duplex UART communication. UART 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 parity. CH9102 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, 256000, 307200, 460800, 921600, 1M, 1.5M, 2M,

3M 4M etc.

In applications with high communication baud rate, it is recommended to enable hardware automatic flow control. Full-speed USB is only 12Mbps, considering the protocol overhead and other factors, the serial port should be avoided in a continuous or full-duplex high-speed communication state of 3Mbps and above in applications.

The allowable baud rate error of CH9102 UART reception is less than 2%, the baud rate error of UART transmission is less than 1.5%.

On operating systems, CH9102 supports CDC class driver that comes with system, and VCP manufacturer driver could be installed to support high speed communication and other functions. It can simulate the standard serial port, so most serial port applications are fully compatible, usually without any modification.

CH9102 can be used to upgrade the UART peripherals, or expand extra serial ports for computers via USB bus, provides further RS232, RS485, RS422 interface, etc. through external voltage conversion chip.

5.3. Clock and reset and others

CH9102 has a built-in USB pull-up resistor, and the UD+ and UD- pins should be directly connected to the USB bus.

CH9102 has built-in power-on reset circuit and a low-voltage reset circuit. It also monitors the voltage of the V3 pin and the VIO pin. When the V3 voltage is lower than VRV3 or the VIO voltage is lower than VRVIO, the chip will automatically reset by hardware.

CH9102 has built-in clock generator, without external crystal and oscillation capacitor.

In larger batch applications, the manufacturer identification such as VID, PID, product information and pin definition of CH9102 can be customized.

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	-40	85	℃
TS	Storage Temperature	-55	105	℃
VDD5	USB power supply voltage (VDD5 connects to power, GND to ground)	-0.5	6.0	V
VIO	Serial port I/O power supply voltage (VIO connects to power, GND to ground)	-0.5	6.0	V
VVBUS	Voltage on VBUS	-0.5	6.5	V
VUSB	Voltage on USB signals	-0.5	V3+0.5	V
VUART	Voltage on UART and other pins	-0.5	VIO+0.5	V

6.2. Electrical Parameters

(test conditions: TA=25℃,VCC=5V OR VDD5=V3=3.3V, VIO1.8～5V, exclude pins connected to USB

bus)

Name	Parameter Description		Min.	Typical	Max.	Unit
VDD5	USB power supply voltage	V3 doesn't connect to VDD5, V3 connected to capacitor	4.0	5	5.3	V
		V3 connected to VDD5, VDD5=V3	3.0	3.3	3.6	
VIO	Serial port I/O power supply voltage		1.7	5	5.5	V
IVDD	Operating VDD5 or V3 power supply current			3	15	mA
IVIO	Operating VIO Supply current			0	10	mA
ISLP	Operating Supply Current(USB Suspend)	VDD5 power supply =5V		0.09	0.16	mA
		VDD5=V3 power supply =3.3V		0.005	0.02	mA
		VIO power supply, no I/O load/pull up		0.002	0.05	mA
ILDO	External load capacity of internal power regulator				10	mA
VIL	Low-level input voltage	VIO=5V	0		1.5	V
		VIO=3.3V	0		0.9	V
		VIO=1.8V	0		0.5	V
VIH	High-level input voltage	VIO=5V	2.5		VIO	V
		VIO=3.3V	1.9		VIO	V
		VIO=1.8V	1.2		VIO	V
VIHVBS	VBUS pin high level voltage	VIO=1.8～5V	1.7		5.8	V
VOL	Output Low Voltage	VIO=5V, 15mA draw current		0.4	0.5	V
		VIO=3.3V, 8mA draw current		0.3	0.4	V
		VIO=1.8V, 3mA draw current		0.3	0.4	V
VOH	Output High Voltage	VIO=5V, 10mA output current	VIO-0.5	VIO-0.4		V
		VIO=3.3V, 5mA output current	VIO-0.4	VIO-0.3		V
		VIO=1.8V, 2mA output current	VIO-0.4	VIO-0.3		V
IPUP	Pull-up current of serial port and RST pin (pull up to VIO voltage)	VIO=5V	35	150	220	uA
		VIO=3.3V	15	60	90	uA
		VIO=1.8V	3	14	21	uA
IPDN	Pull-down current on VBUS	VBUS>1.6V	6	10	16	uA
		VBUS<1.3V	50	140	200	uA
VRV3	V3 Power-on reset/low voltage reset voltage threshold		2.5	2.7	2.9	V
VRVIO	VIO power supply low voltage reset voltage threshold		0.8	1.0	1.15	V

VESD	HBM ESD withstand voltage on USB or I/O pins	5	6		KV

6.3. Timing Parameters

(test conditions: TA=25℃,VDD5=5V or VDD5=V3=3.3V, VIO=1.8V～5V)

Name	Parameter Description		Min.	Typ.	Max.	Unit
FD	Error of internal clock (affecting baud rate year-on-year)	TA=-15℃～60℃	-1.0	±0.5	+1.0	%
		TA=-40℃～85℃	-1.5	±0.8	+1.5	%
TRSTD	Reset delay after power on or external reset input		9	15	25	mS
TSUSP	Detect USB automatic hang time		3	5	9	mS
TWAKE	Wake-up completion time after chip sleep		1.2	1.5	5	uS

7. Applications

7.1. USB to 9-wire TTL serial port

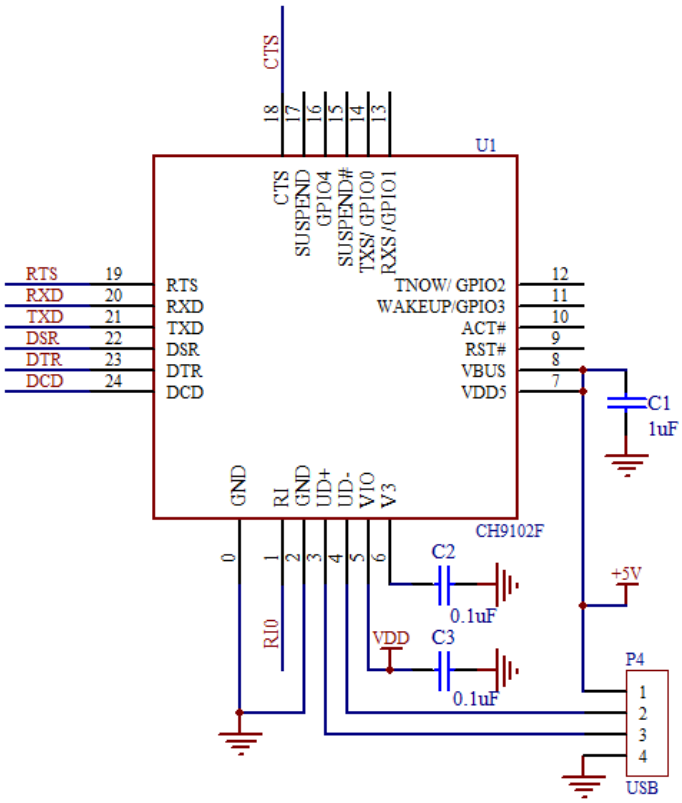
The figure below is the USB to TTL converter realized by CH9102F. Only RXD, TXD and public ground are necessary connection, while the others are optional.

P4 is USB port, USB bus contains a pair of 5V power lines and a pair of data signals. 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.The VBUS pin detects the USB power supply status here.

The capacitor C2 on V3 is 0.1uF, used to CH9102 internal power decoupling. C1 and C3 are used for external power decoupling.

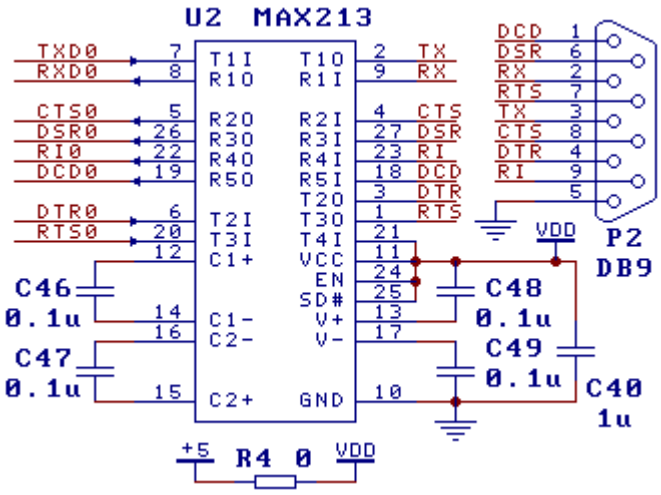
Three power supply schemes: One is all USB power supply, CH9102 chip and USB products directly use the 5V power supply provided by the USB bus, that is, VDD5=VBUS=USB 5V power, VIO=VMCU=USB 5V or 1.8V~4V after step-down; The second is separate and independent power supply. The VIO of CH9102 and the MCU of the product use self-supplied standing power VDD, while CH9102 uses USB power, and its VDD5 is connected to the USB power VBUS, that is, VDD5=VBUS=USB 5V power, VIO=VMCU=VDD= self-supply 1.8V~5V; The third is all self-powered, only detecting but not using USB power, USB products provide power VDD through self-powered mode, mainly VDD5=VIO=VMCU=VDD=self-supplied 5V or VDD5=V3=VIO=VMCU=VDD=self-supplied 3.3 V two kinds.

When designing the PCB, pay attention to: the decoupling capacitors C1, C2 and C3 should be as close as possible to the connected pins of CH9102; The D+ and D- signal lines are placed close to the parallel wiring, and ground or copper should be provided on both sides to reduce signal interference from the other parts.

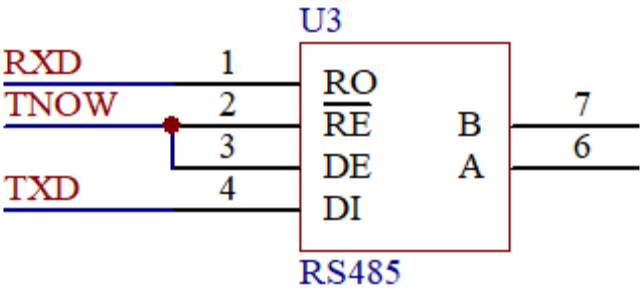


7.2. USB to 9-wire RS232 converter configuration

CH9102 provides common UART and MODEM signals, converts TTL to RS232 through level conversion chip U2. Port P2 is DB9 connector, the pins and their functions are the same as common PC DB9 connector, the chips similar with U2 have MAX213/ADM213/SP213/MAX211 etc.U2 in the image is uniformly powered by the USB bus through R4.



7.3. USB to RS485 Converter Configuration



In the figure, TNOW is the switch pin, the TNOW pin can be used to control DE (send enable, high active) and RE# (receive enable, low active) pin of RS485 transceiver. RS485 transceiver should use the same power supply as VIO.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for USB Interface IC ***category:***

Click to view products by Qin Heng ***manufacturer:***

Other Similar products are found below :

CY7C69356-48LTXC CYUSB2304-68LTXI USB2227-NU-11 USB2251-NU-06 CYPD2120-24LQXI CYUSB3014-BZXCT CYWB0164BB-BZXI CYWB0224ABS-BZXI USB3321C-GL-TR LIF-UC120-SWG36ITR50 CP2102NP1174GM DPO2039DABQ-13 UPD720115K8-611-BAK-A USB7216C-I/KDX UPD720115K8-711-BAK-A UPD720211K8-711-BAL-A PI2DPX1217XUAEX CYPD6127-48LQXIT CH340X CH343P SY6307BSCC SY6974QCC SY6818PLC FE1.1S-BQFN24B ME1502CM5G XPD920APS25 SY6288C30AAC WUSB3801Q-12/TR FT232RNL-REEL GL850G-HHY60 FT232BL-JSM PL2303GC MA8621 PL2303GT XPD319BP XPD738BP XPD767DP45 GL852G-HHY12 PL2303GL PL2586 RTL8192FC-CG RTS5411S-GR RTS5306E-GR XPD720BP25 TUSB213IRGYT TUSB213RGYT TUSB214RWBT TUSB4020BIPHPRQ1 USB2517I-JZX-TR USB3318-CP