

# 設計和產生印刷電路板 (PCB)

# USB to RS232 訊號轉換器



裡面藏有印刷電路板  
，後面會做粗略解析

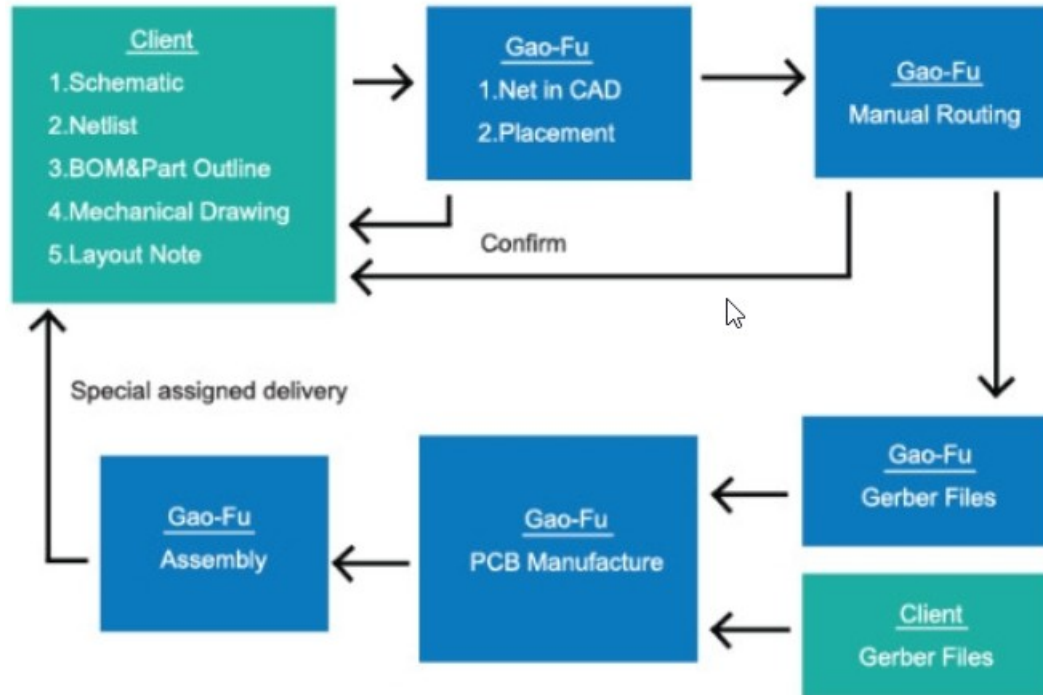
USB to RS-232訊號轉換器

# 流程 ( 系統應用工程師的觀點 )

- 板子的電路設計
  - OrCAD Capture ( 只是選項之一，也可以用其它軟體 )
  - 了解 IC 的 datasheet 或應用電路 ( 拿得到參考電路或有人問最好，不然得仔細 K 相關文件 )
  - 決定 IC 的包裝 ( package，例如 DIP、SMD 等 )，這樣合作的 layout 公司才能選對元件的尺寸
- 板子的 layout
  - 元件的擺置和繞線 ( placement and route ) by 專門的 layout 公司，這過程會和設計者來回溝通多次
  - layout 公司最後和設計電路的工程師確認後，會接洽板廠洗板子，並向客戶報價和約交貨日期
- 實際產品 ( 板子 )
  - 空板子 ( layout 公司會問說要做些測試，例如短路、開路，記得這些都得另外算錢 )
  - 元件 ( IC、電阻、電容、排針、接頭、LED、開關等等 ) 的採購：BOM ( Bill Of Materials ) 請專人幫忙
  - 板子的上件：外面機器上件 或 實驗室工讀師 ( 生 ) 人工焊接 ( prototyping 常會碰到 )

# 流程 (Layout 公司的觀點)

PCB 設計、製作及組裝流程:



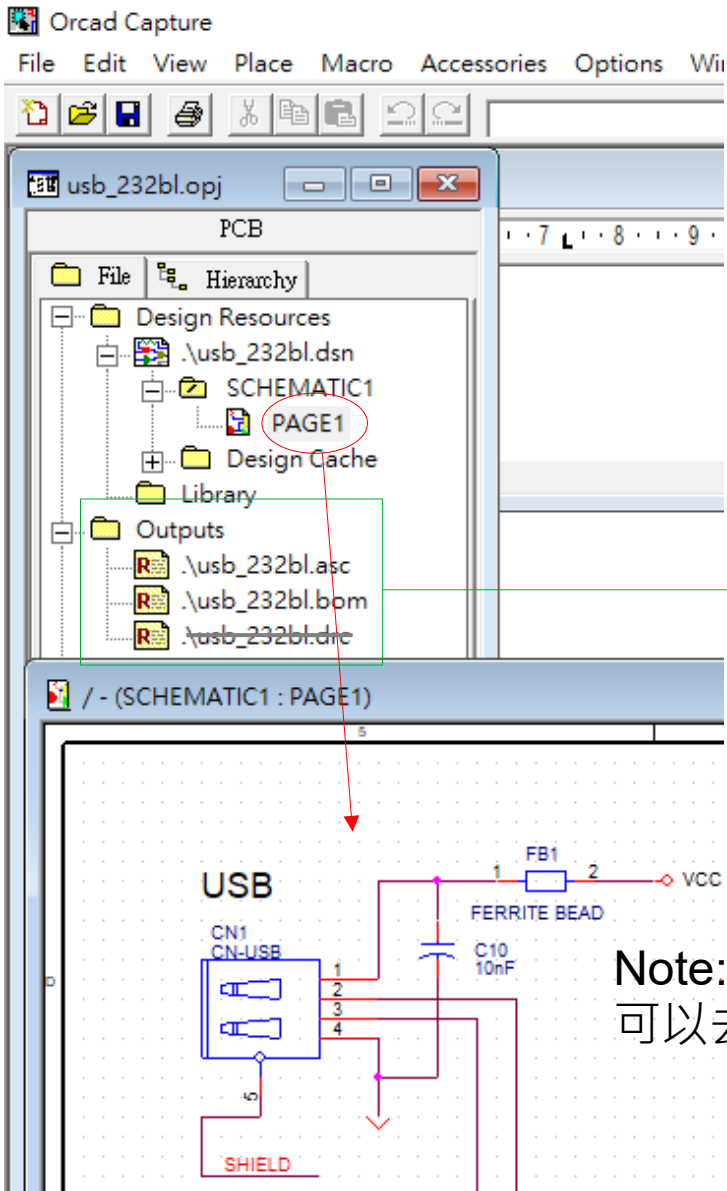
- Installation Guides
- Technical Notes
- Technical Publications
- Schematics
- PCB Data
- Solder Profiles
- Quality Documents
- Programming Guides
- PCNs
- Software Examples
- Utilities
- Community
- Related Links
- FAQs
- Android
- EVE
- MCU
- Sales Network
- Web Shop
- Newsletter
- Corporate
- Contact Us

Relevant Devices	Title	Revision	Formats
<a href="#">FT90x</a>	<a href="#">MMFT900EV1A Schematic</a>	1.2	PDF
<a href="#">FT90x</a>	<a href="#">MM900EV2A / MM900EV3A Schematic</a>	1.2	PDF
<a href="#">VNC2 - Vinculum-II</a>	<a href="#">VNCLO-MB1A Schematic</a>	1.4	PDF
<a href="#">FT2232H</a>	<a href="#">Morph-IC-II Schematic</a>	1.2	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VDIP1 Schematic</a>	1.1	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VDIP2 Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VDRIVE1 Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VDRIVE2 Schematic</a>	1.0	PDF
<a href="#">VNC2 - Vinculum-II</a>	<a href="#">VDRIVE3 Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VF2F Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VF2F2A Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VF2F2A Gerber</a>	1.0	OrCAD
<a href="#">VNC1L - Vinculum</a>	<a href="#">VF2F2B Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VF2F2B Gerber</a>	1.0	OrCAD
<a href="#">VNC1L - Vinculum</a>	<a href="#">VMUSIC1 Schematic</a>	1.0	PDF
<a href="#">VNC1L - Vinculum</a>	<a href="#">VMUSIC2 Schematic</a>	1.0	PDF
<a href="#">VNC2 - Vinculum-II</a>	<a href="#">VMUSIC3 Schematic</a>	1.1	PDF
<a href="#">FT232R</a>	<a href="#">FT232R Example</a>	1.0	OrCAD, PDF
<a href="#">FT232R</a>	<a href="#">ChiPi PCB Gerber</a>	1.0	OrCAD
<a href="#">FT232R</a>	<a href="#">ChiPi Schematic</a>	1.1	PDF
<a href="#">FT2232C</a>	<a href="#">FT2232C Examples</a>	1.0	OrCAD, PDF
<a href="#">FT2232C</a>	<a href="#">USB - Dual RS232</a>	1.0	OrCAD, PDF

Google Custom Search

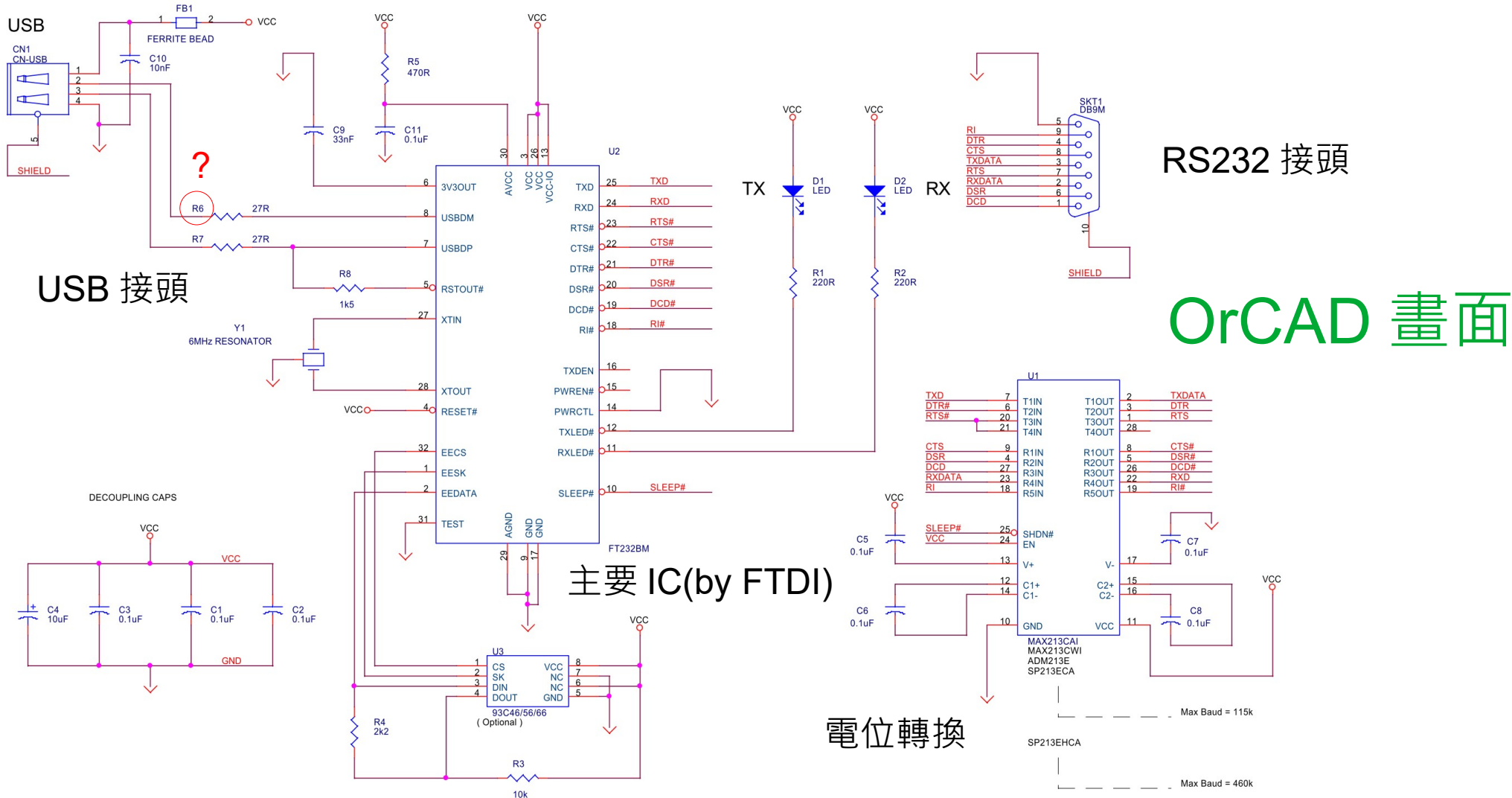
<a href="#">FT232BM, FT232BL</a>	<a href="#">US232B PCB Gerber</a>	1.0	OrCAD
<a href="#">FT232BM, FT232BL</a>	<a href="#">US232B Schematic</a>	1.0	PDF
<a href="#">FT232BM, FT232BL</a>	<a href="#">US232B Top Layer</a>	1.0	PDF
<a href="#">FT232BM, FT232BL</a>	<a href="#">US232B Bottom Layer</a>	1.0	PDF
<a href="#">FT232BM, FT232BL</a>	<a href="#">FT232BM Examples</a>	1.0	OrCAD, PDF

UTN411  
USB to RS232  
訊號轉換器  
似乎有參考  
的電路板相  
關資料可下載



1. Design Rule Check
2. Create Netlist
3. Bill Of Materials

Note: 這是 OrCAD 舊版的畫面，  
可以去註冊免費的 trial 新版



USB 接頭

RS232 接頭

OrCAD 畫面

主要 IC (by FTDI)

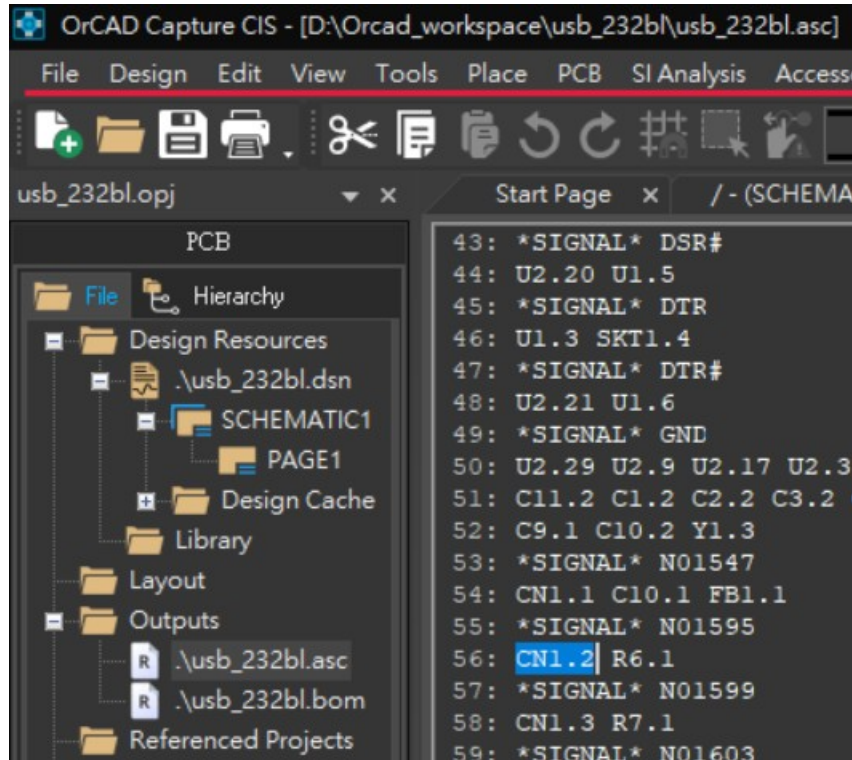
電位轉換

FT232B APPLICATION SCHEMATIC

USB <=> RS232 SERIAL CONVERTER ( 300 to 115k/460k baud )

這個 OrCAD 版本和 layout 圖對不起來

# Checking Netlist



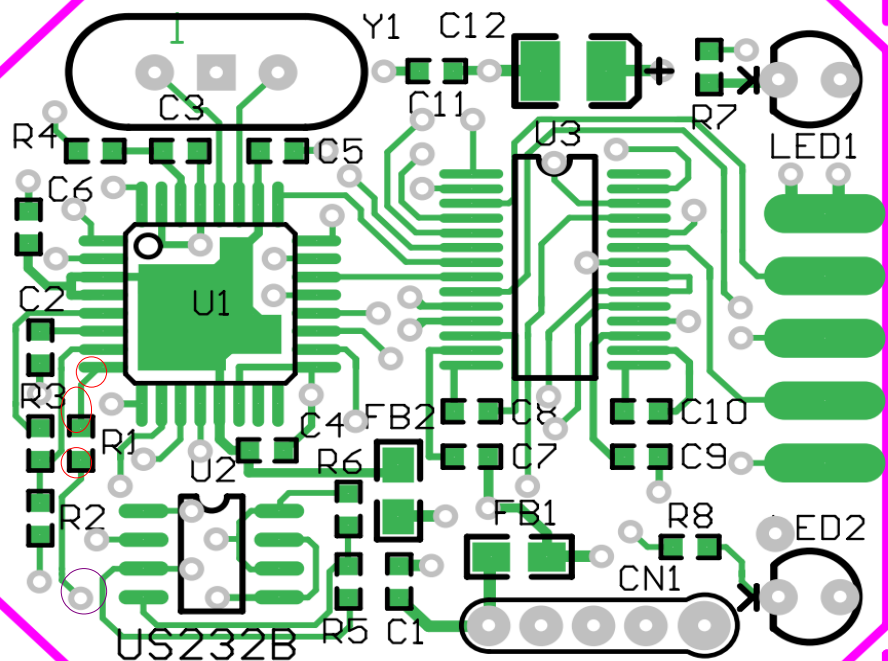
為何檢查 netlist 很基本很重要？  
因為人的記憶不準確，常犯的錯誤  
就是線 (net) 沒連對，舉例取名 1  
和 I、0 和 O，很容易產生混淆。

檢查 netlist 的 R6( 電阻 ) 的兩端  
是否連到搭配的元件腳位， SIGNAL  
右邊的編號是 net 的名字，由於沒有  
命名，軟體會自動安排一個名字。

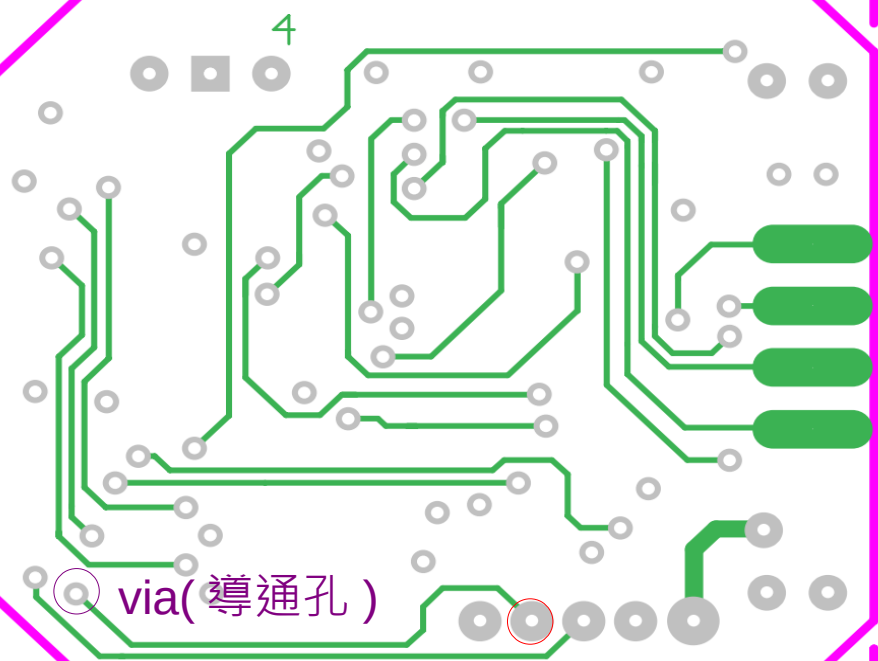
```
63: *SIGNAL* N01697
64: U2.8 R6.2 I
```



# US232B Layout (PDF , 沒顯示 VCC 和 GND 兩層)

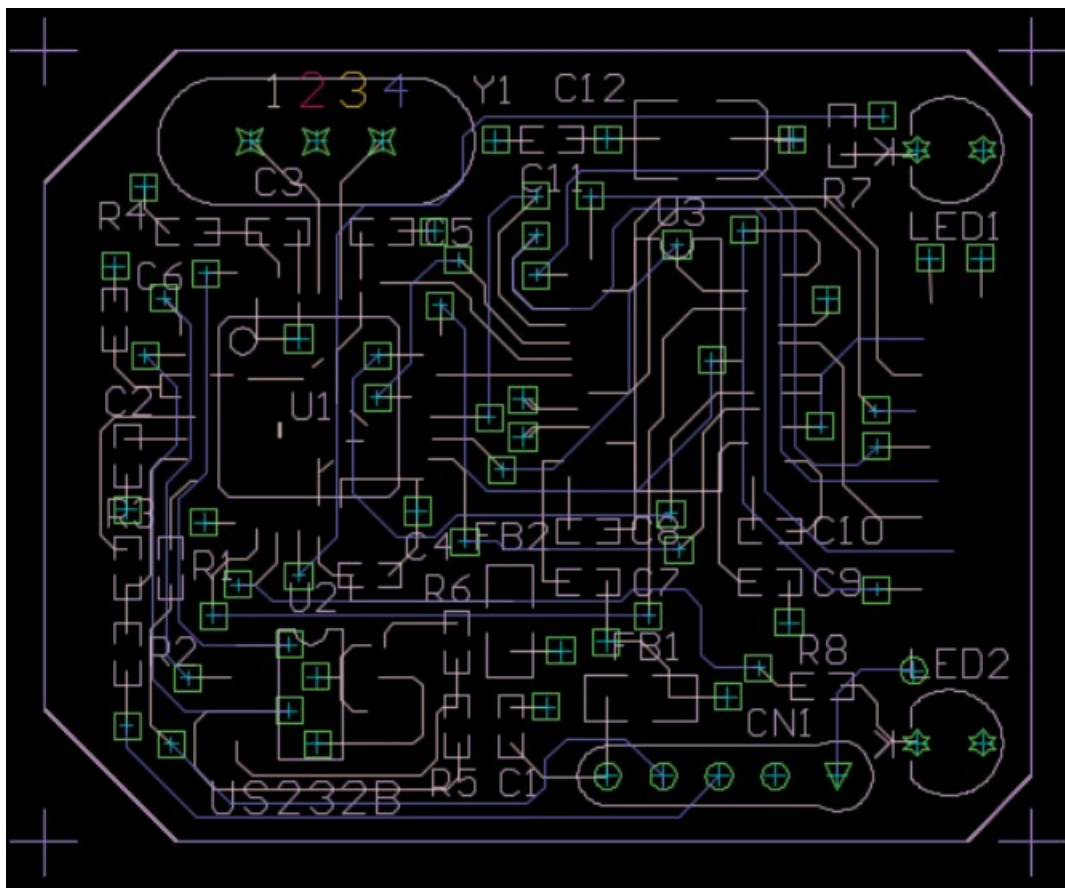


top



bottom

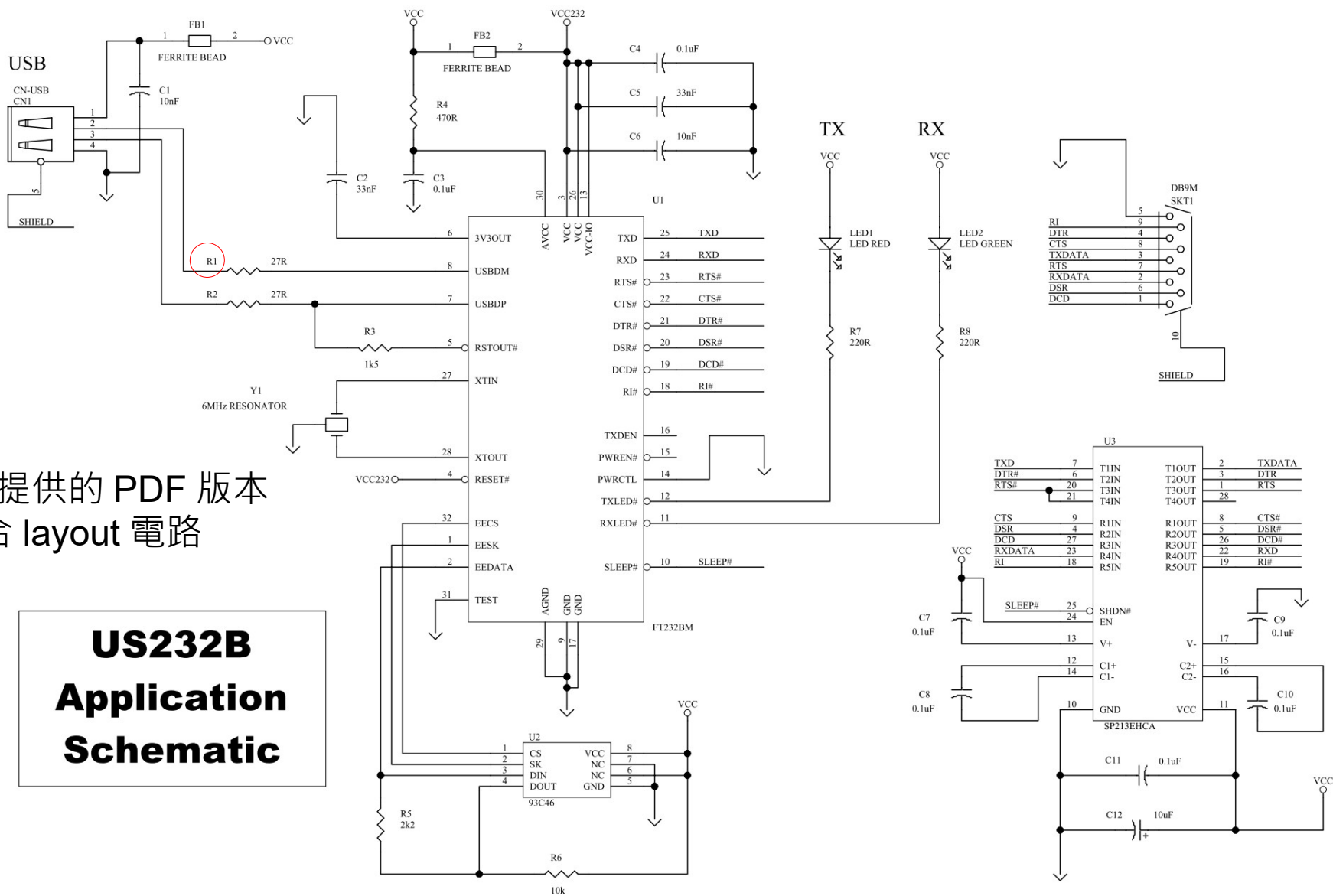
# US232B Layout (Failed to Open Gerber Files by GerbV)



不全！

FTDI 提供的 PDF 版本  
才符合 layout 電路

# US232B Application Schematic



# FT232BL Datasheet (Features)



## FT232BL USB UART ( USB - Serial) I.C.

The FT232BL is the lead free version of the 2<sup>nd</sup> generation of FTDI's popular USB UART I.C. This device not only adds extra functionality to its FT8U232AM predecessor and reduces external component count, but also maintains high degree of pin compatibility with the original, making it easy to upgrade or cost reduce existing designs as well increasing the potential for using the device in new application areas.

### 1.0 Features

#### HARDWARE FEATURES

- Single Chip USB ↔ Asynchronous Serial Data Transfer
- Full Handshaking & Modem Interface Signals
- UART I/F Supports 7 / 8 Bit Data, 1 / 2 Stop Bits and Odd/Even/Mark/Space/No Parity
- Data rate 300 => 3M Baud (TTL)
- Data rate 300 => 1M Baud (RS232)
- Data rate 300 => 3M Baud (RS422/RS485)
- 384 Byte Receive Buffer / 128 Byte Transmit Buffer for high data throughput
- Adjustable RX buffer timeout
- Fully Assisted Hardware or X-On / X-Off Handshaking
- In-built support for event characters and line break condition
- Auto Transmit Buffer control for RS485

#### VIRTUAL COM PORT (VCP) DRIVERS for

- Windows 98 and Windows 98 SE
- Windows 2000 / ME / Server 2003 / XP
- Windows XP 64 Bit
- Windows XP Embedded
- Windows CE 4.2
- MAC OS-8 and OS-9
- MAC OS-X
- Linux 2.40 and greater

#### D2XX (USB Direct Drivers + DLL S/W Interface)

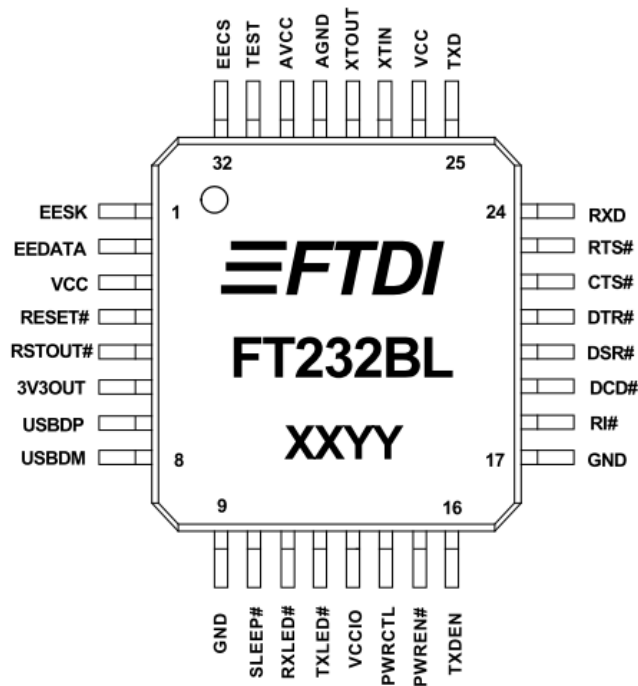
- Windows 98 and Windows 98 SE
- Windows 2000 / ME / Server 2003 / XP
- Windows XP 64 Bit
- Windows XP Embedded
- Windows CE 4.2
- Linux 2.40 and greater

- Support for USB Suspend / Resume through SLEEP# and RI# pins
- Support for high power USB Bus powered devices through PWREN# pin
- Integrated level converter on UART and control signals for interfacing to 5V and 3.3V logic
- Integrated 3.3V regulator for USB IO
- Integrated Power-On-Reset circuit
- Integrated 6MHz – 48Mhz clock multiplier PLL
- USB Bulk or Isochronous data transfer modes
- 4.35V to 5.25V single supply operation
- UHCI / OHCI / EHCI host controller compatible
- USB 1.1 and USB 2.0 compatible
- USB VID, PID, Serial Number and Product Description strings in external EEPROM
- EEPROM programmable on-board via USB
- Compact Lead free RoHS compliant 32-LD LQFP package.

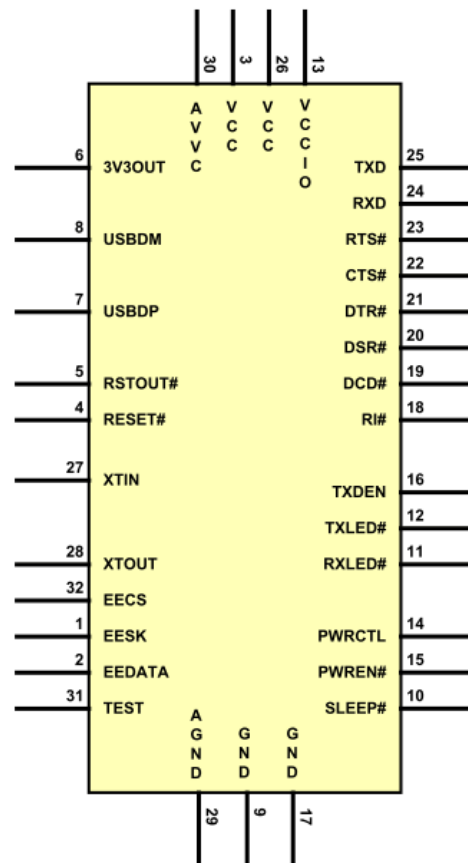
#### APPLICATION AREAS

- [USB ↔ RS232 Converters](#)
- [USB ↔ RS422 / RS485 Converters](#)
- [Upgrading RS232 Legacy Peripherals to USB](#)
- Cellular and Cordless Phone USB data transfer cables and interfaces
- Interfacing MCU based designs to USB
- USB Audio and Low Bandwidth Video data transfer
- PDA ↔ USB data transfer
- USB Smart Card Readers
- Set Top Box (S.T.B.) PC - USB interface
- USB Hardware Modems
- USB Wireless Modems
- USB Instrumentation
- USB Bar Code Readers

實際的包裝



**Figure 1**  
**Pin-Out**  
**( Lead free LQFP-32 Package )**

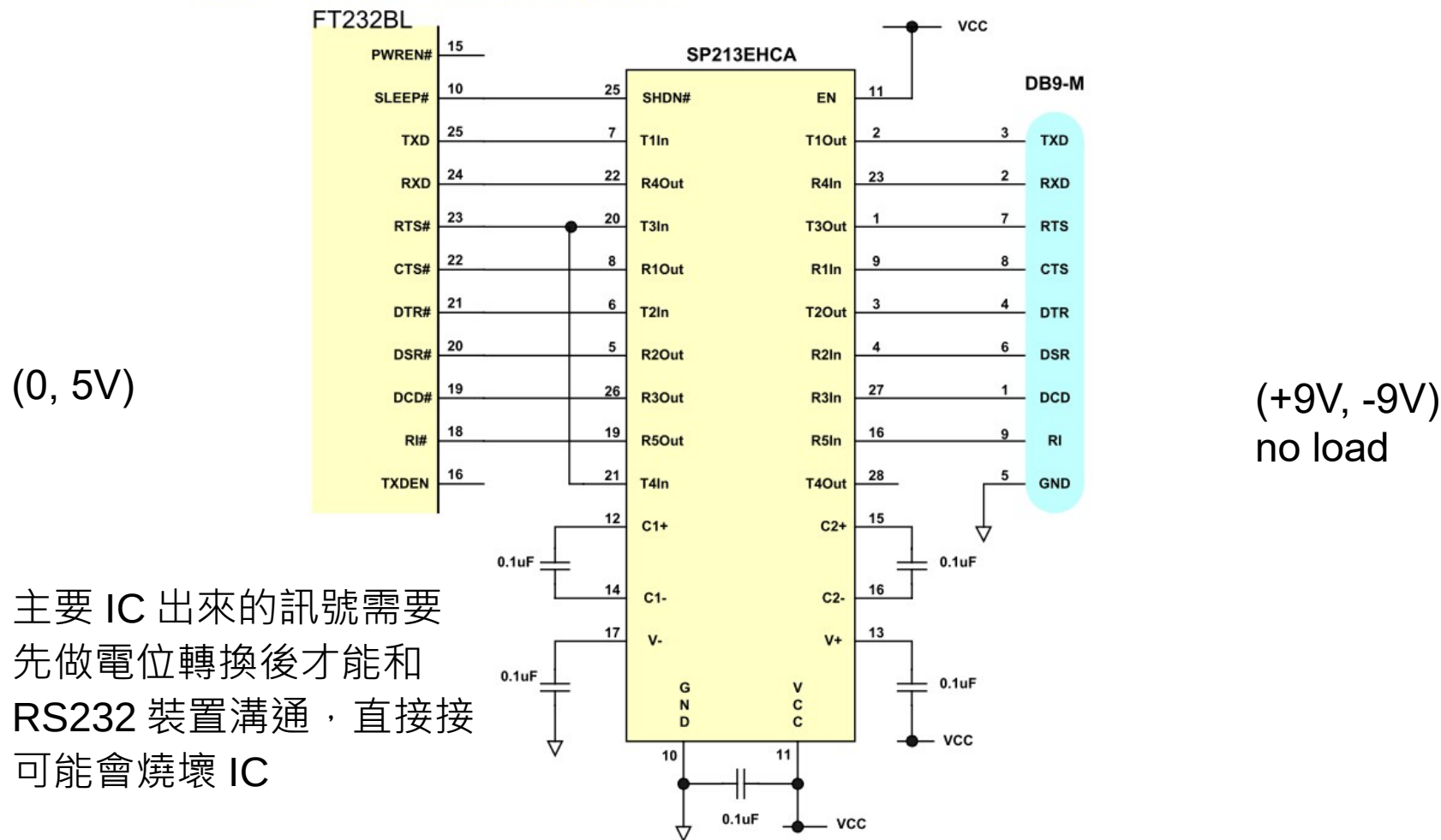


**Figure 2**  
**Pin-Out**  
**( Schematic Symbol )**

設計用到的示意圖  
( 沒規定一定如此 )

## 7.4 UART Interface Configuration

Figure 9  
USB <=> RS232 Converter Configuration



# Types of IC Packages(DIP, SMD)







## QUOTATION

TO: 華邦電子(股)公司

FAX:

ATTN: 張明 先生

TEL: 5678168

CUSTOMER P/N :

EXT: 6745

SP P/N : A23-

DATE: 12/30/03

茲向 貴公司提供製作P.C.B. 之報價如下, 敬請參酌!

ITEM	DESCRIPTION	QUANTITY	UNIT PRICE	AMOUNT
1.	ENGINEERING CHARGE	1 SET	\$15,000	\$15,000
2.	OPEN/SHORT CHARGE	1 SET	\$4,000	\$4,000
3.	AOI CHARGE	0 SET	\$0	\$0
4.	LASSER PLOTTER	1 SET	\$4,800	\$4,800
5.	P.C.B CHARGE	10 PCS	\$1,000	\$10,000
6.	OTHERS : V-CUT 費用	0 SET	0	\$0
TOTAL				\$33,800

(未含稅)

REMARK :

1.MATERIAL: FR-4 2.0 mm 4 layer 噴錫

2.DIMENSION: 併版尺寸: 296\*210 mm 非版尺寸: mm

3.DELIVERY DATE:  急件三個工作天。  一般件六個工作天。

4.以上報價有效期限為三個月。

5.謝謝您的支持與指教, 不勝感激。

6.板厚 2.0 mm 為特殊規格。

TEL:

APPROVED BY :

PREPARED BY : 朱秀琴 6662503

P-SS-01-01A

## GF 高夫科技股份有限公司

新竹市長春街123-6號 1樓

電話:(03)5784628

傳真:(03)5784750

E-mail : golf8515@ms2.hinet.net

報價單  
QUOTATION

TO : 華邦電子(股)公司

編號: OCT-9413-3

ATTN: 吳榮豪 先生(華邦四廠)

報價日期: 94/10/13

TEL : 03-5678168 EXT : 6275

FAX : 03-5796145

項次	品名	數量/單位	單價	金額
	板名: W55VA7X_EBI_MODULE.JOB 層數: 二層板 板厚:1.6mm 尺寸: 2.44"X4.65" 1oz			
<input type="checkbox"/> 01	PCB LAYOUT	PTH 150 PIN SMD 274 PIN	NT\$ 16.00 NT\$ 21.00	NT\$ 2,400.00 NT\$ 5,754.00
<input type="checkbox"/> 02	PCB FILM/7pcs	1 SET	NT\$ 500.00	NT\$ 500.00
<input type="checkbox"/> 03	PCB SETUP CHARGE	1 SET	NT\$ 5,500.00	NT\$ 5,500.00
<input type="checkbox"/> 04	PCB SAMPLE	20 PCS	NT\$ 45.00	NT\$ 900.00
<input type="checkbox"/> 05	單面測	1 SET	NT\$ 4,000.00	NT\$ 4,000.00
<input type="checkbox"/> 06	急件費	1 SET	NT\$ 5,500.00	NT\$ 5,500.00

合計: NT\$ 24,554.00

營業稅: NT\$ 1,228.00

總計: NT\$ 25,782.00

## 【備註】

E

部門代號:

一.交期: 10/17

二.付款方式: 月結三十天

三.本報價單有效期限三十天



主管: 林憲慶

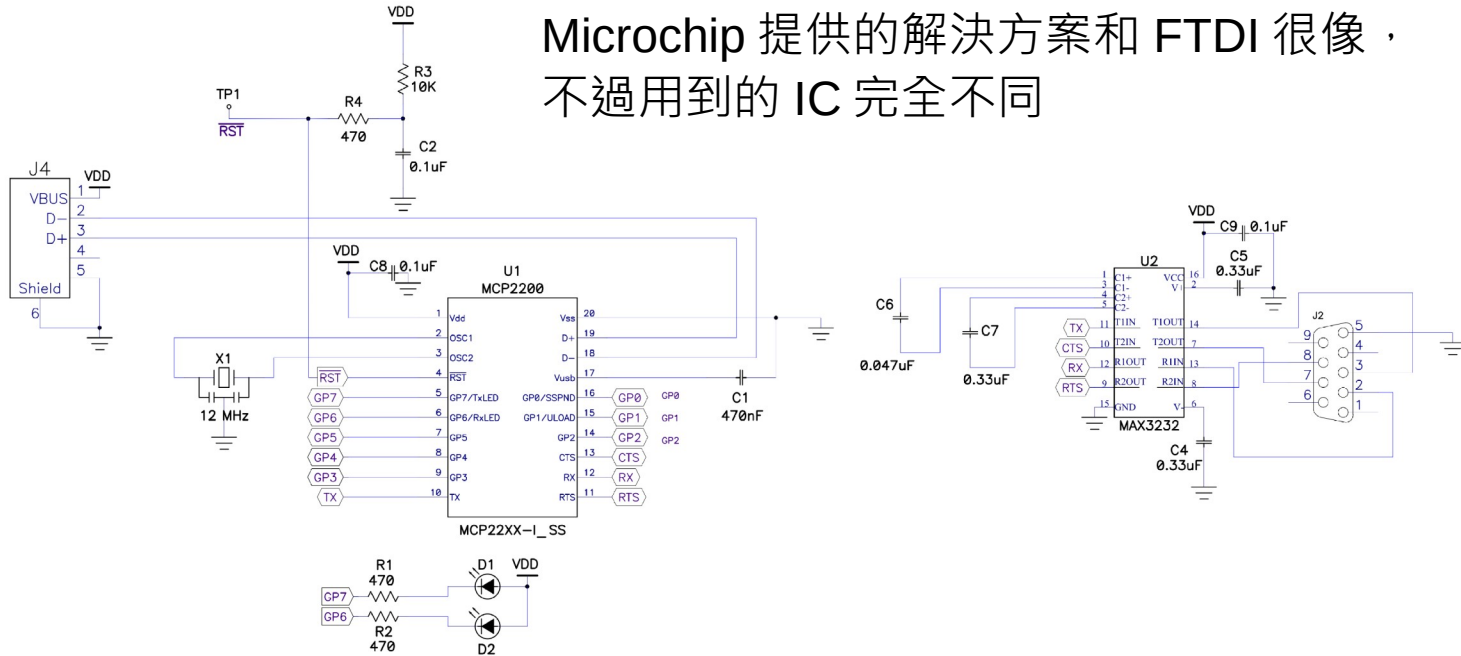
承辦人: 鄭嵐嵐 (分機102)

報價單範例 左右兩張分屬不同板子



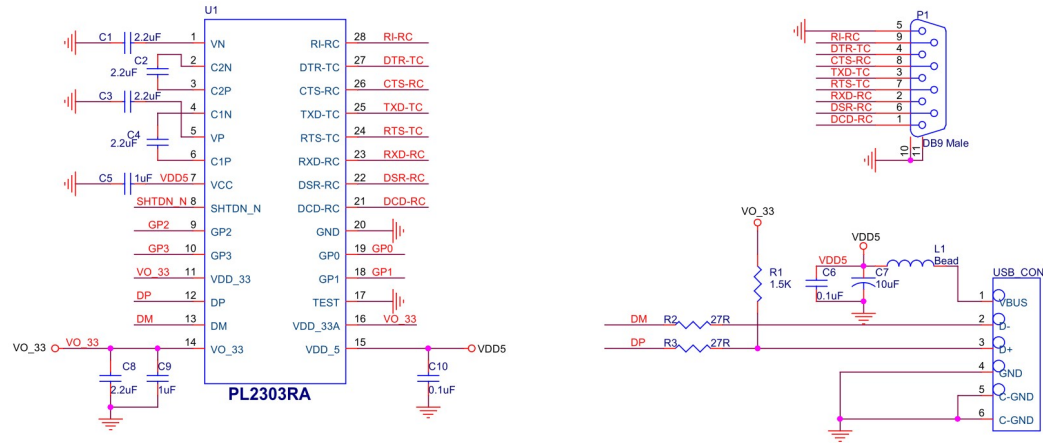
# FT232BL Alternative by Microchip

Microchip 提供的解決方案和 FTDI 很像，  
不過用到的 IC 完全不同

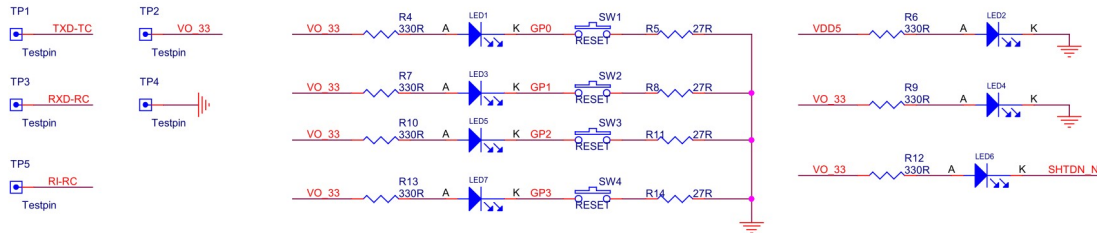


Title USB to UART VCP Bd.		
Size A	103-00266	Rev 2
Date 11/17/2009		Engineer Pat Richards
Filename 103-00266R2.sch		Drawn By J. Garcia
Sheet 1		of 1

# Built-in RS232 Transceiver



Prolific 將 RS232 transceiver 整合到主要 IC 內，但有人批評它的方案不穩



PROLIFIC		
Title <b>PL2303RA Demo Board</b>		
Size B	Document Number <b>PL2303RA</b>	Rev 1.1
Date:	Wednesday, November 12, 2014	Sheet 2 of 2

# Isolator

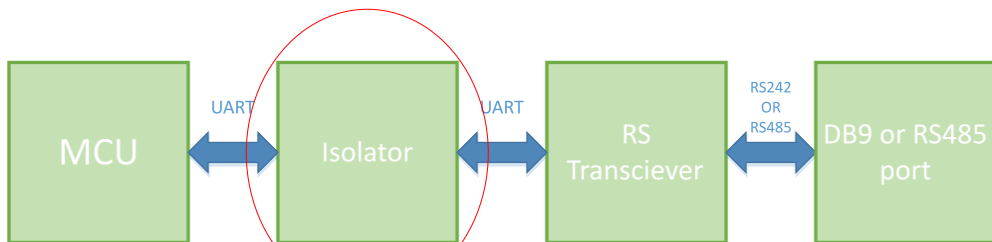
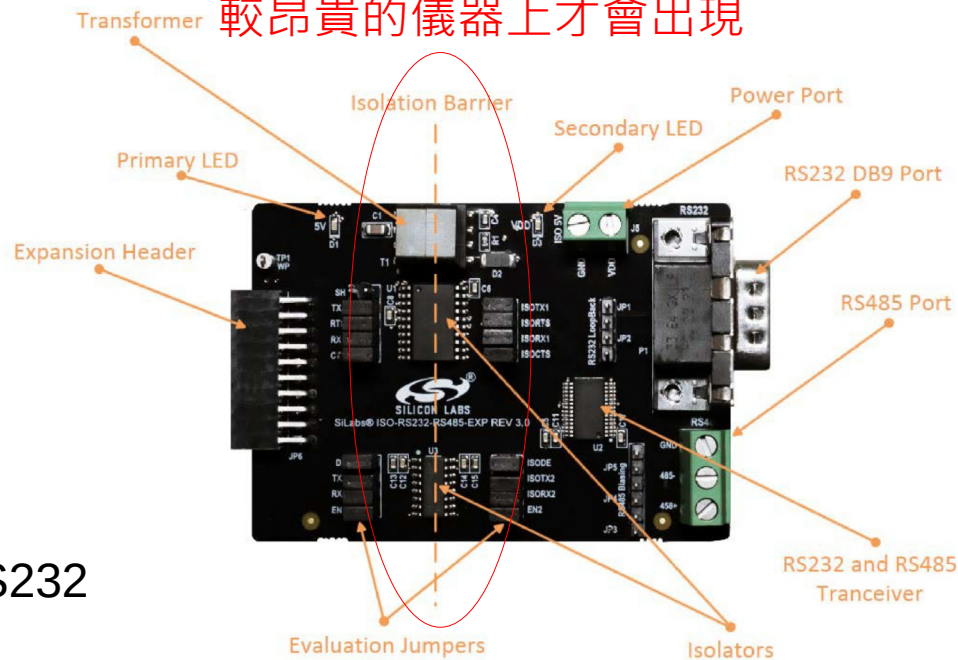
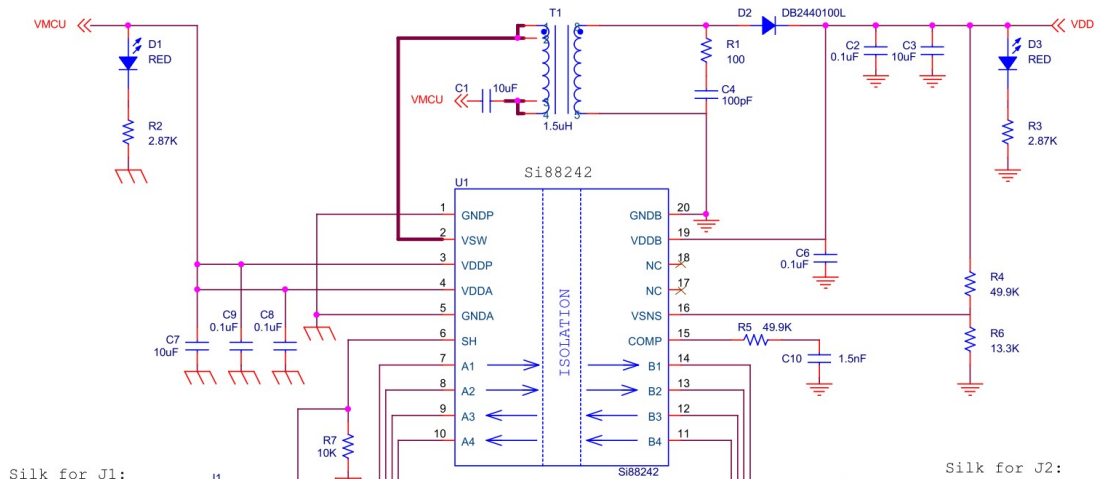


Figure 2.1. Isolated RS232 and RS485 EXP and MCU STK block diagram

TI 提供了 isolator 擴充板，隔絕主要 IC 與 RS232 /RS485 transceiver 之間的訊號和電源

隔絕左右兩邊，這種設計可能是在較昂貴的儀器上才會出現





Silk for J1:

JS3	SH	VMCU
JS2	TX1	TXD_232
JS5	RTS	RTS_232
JS7	RX1	RXD_232
	CTS	CTS_232

Silk for J2:

Silk for J2:

ISO_TXD_232	ISO_TX1	JS1
ISO_RTS_232	ISO_RTS1	JS4
ISO_RXD_232	ISO_RX1	JS6
ISO_CTS_232	ISO_CTS1	JS8

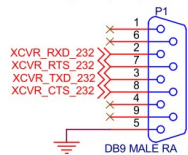
Silk for J3:

JS10	DE	DE_485
JS12	TX2	TXD_485
JS15	RX2	RXD_485
JS16	EN1	VMCU

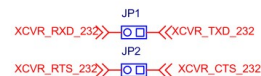
Silk for J4:

ISO_DE_485	ISO_DE	JS9
ISO_TXD_485	ISO_TX2	JS11
ISO_RXD_485	ISO_RX2	JS13
VDD	EN2	JS14

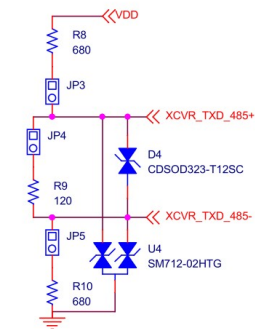
Silk: RS232



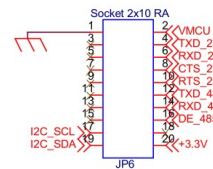
Silk: RS232 LoopBack



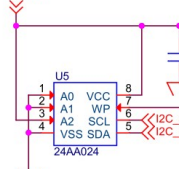
Silk: RS485 Biasing



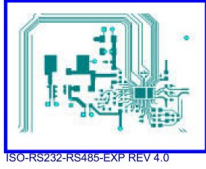
EXP Female Header



Board ID



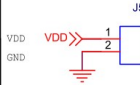
PCB1



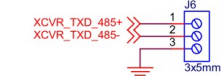
isolator 版本 (SiliconLabs)  
的電路設計明顯複雜許多



Silk: ISO 5V



Silk: RS485



400 W Cesar Chavez  
Austin, TX 78701

SILICON LABS  
Title ISO RS232/RS485 MCU EXP

Size Document Number Rev 4.0

Date: Thursday, May 25, 2017 Sheet 1 of 1