



QRZ-5300

Sub 1GHz 無線模塊

使用手冊

Version 0.1

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修訂日期: 2013.9.17

1. 一般資訊

QRZ-5300模塊是採用low-IF架構FSK/GFSK調變的Sub 1GHz無線應用產品,使用433MHz ISM頻帶.它具有射頻硬體以及一個微控制器來管理通訊連線,所有的通訊工作包含了配置,數據封裝,空閒頻道選取等,形成一個完整的無線資料通訊解決方案.

QRZ-5300模塊非常適於長距離視線通訊,因為它具有超過17dBm的高輸出功率放大器,低相位雜訊接收機(-114dBm @ 10Kbps, -110dBm @ 50Kbps).兩種天線型式可供選擇: 內建式彈簧天線或外接式偶極天線(鎖於SMA接頭).API可供客戶作編輯上層軟體程式.沒有一個競爭產品可以提供如此彈性方便並且容易整合的解決方案.QRZ-5300非常適於擔任無線感測網路(WSN)中的協調器,另有USB Type-A公接頭的選項,提供USB虛擬串口取代UART功能

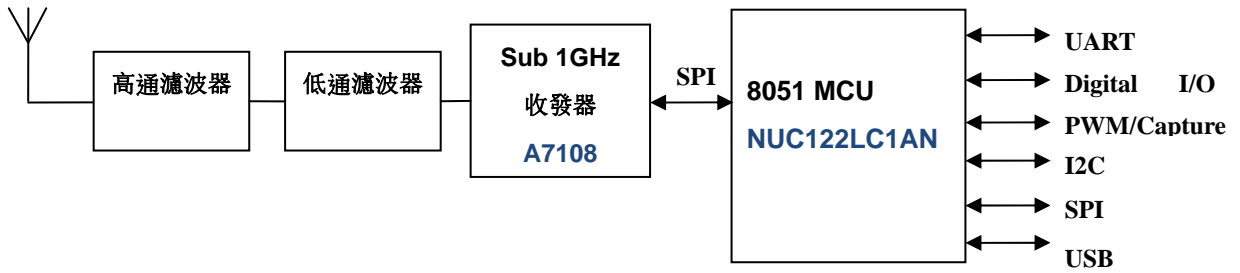
特徵

- 模塊尺寸: 42 x 23 mm², 厚度 2.7mm (不包括SMA接頭,天線,USB接頭,排針)
- 使用全球通用的433 MHz ISM頻帶
- 以UART命令控制和配置
- 並且提供PWM/Capture x 4, I2C, SPI master/slave, ICE除錯接口, USB虛擬串口(Full-Speed)
- 可程式化發射輸出功率,最大17.5dBm
- 接收機靈敏度典型值 -117dBm @ 2Kbps
- 多種低功率操作模式
- 符合RoHS要求



2. 方塊圖

433MHz 天線





3. 印刷電路板組裝照片和模塊機構尺寸圖

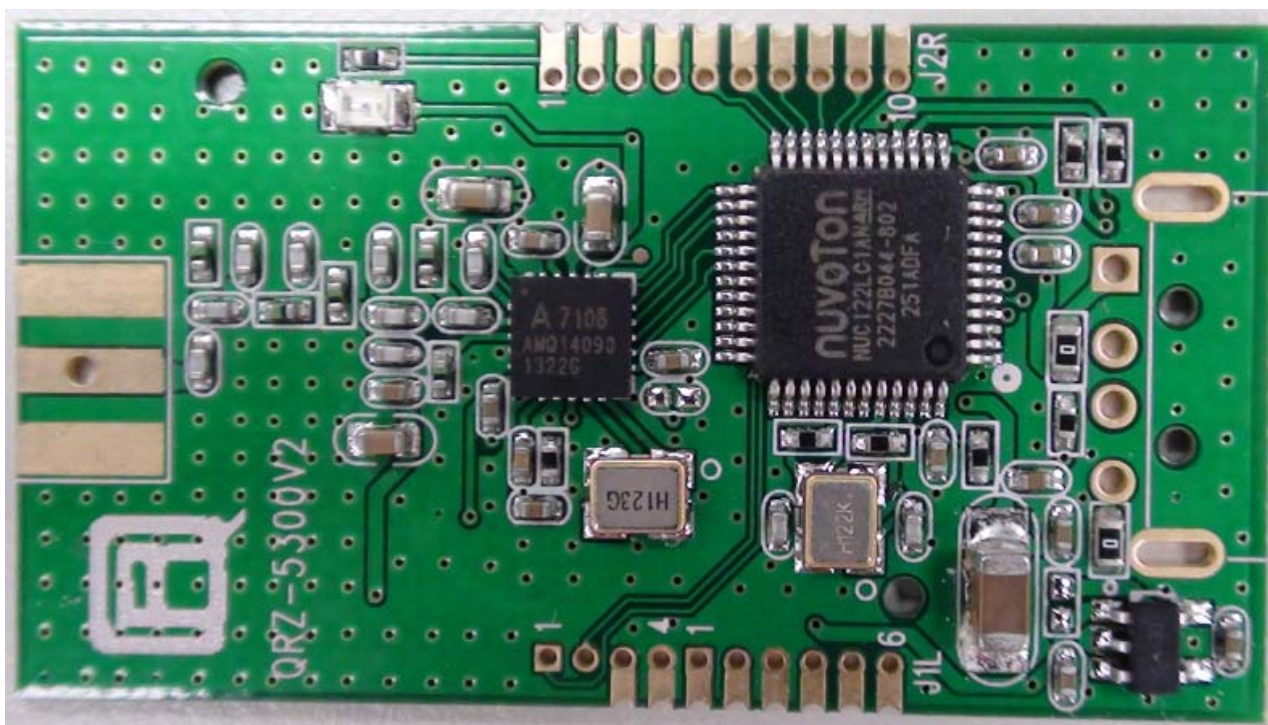


圖 1. QRZ-5300 印刷電路板零件面組裝照片

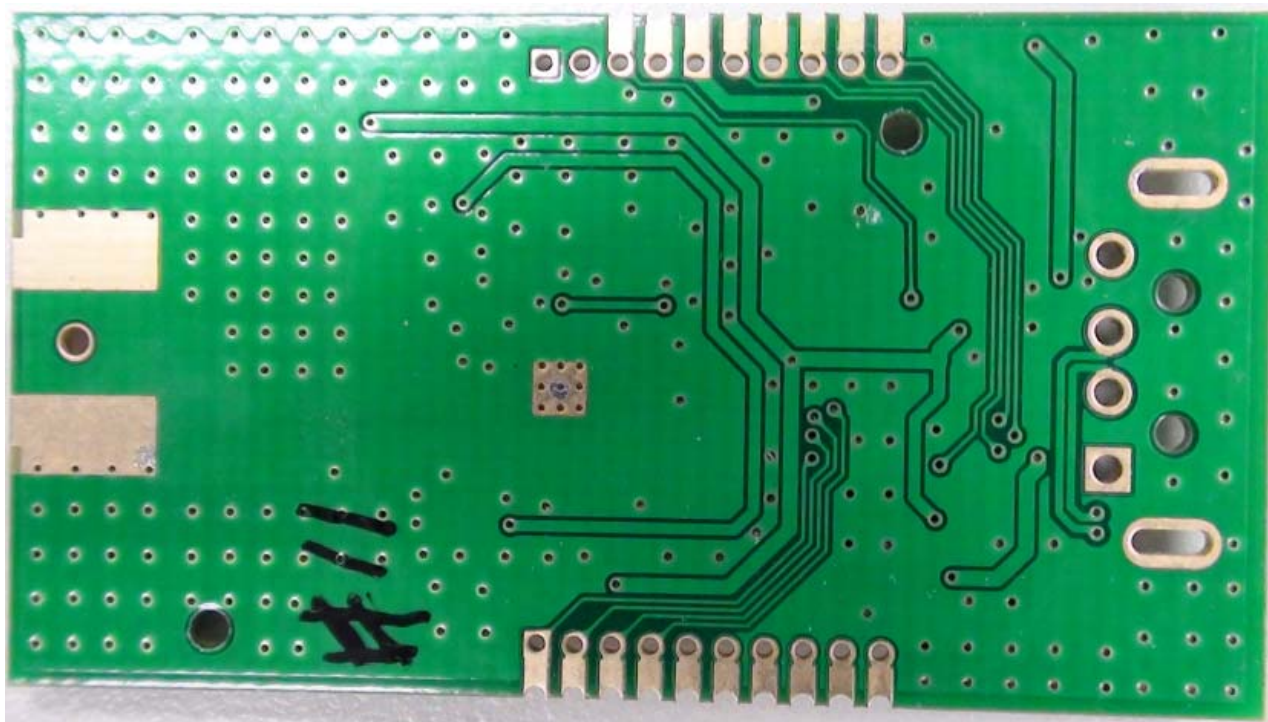


圖 2. QRZ-5300 印刷電路板背面組裝照片

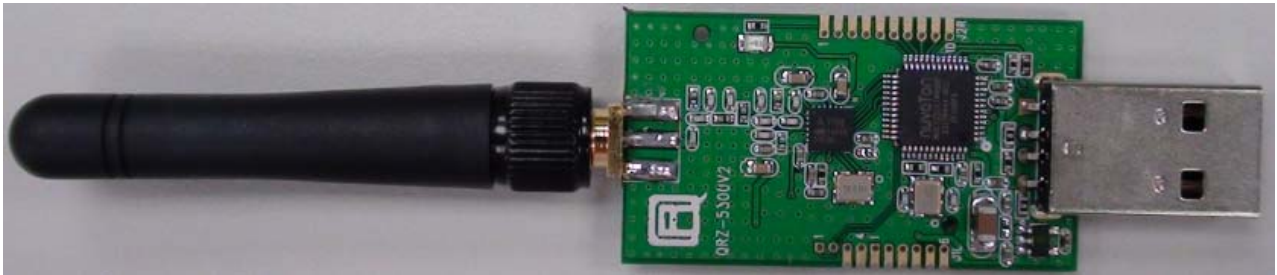


圖 3. QRZ-5300 印刷電路板零件面組裝照片(含偶極天線、USB)

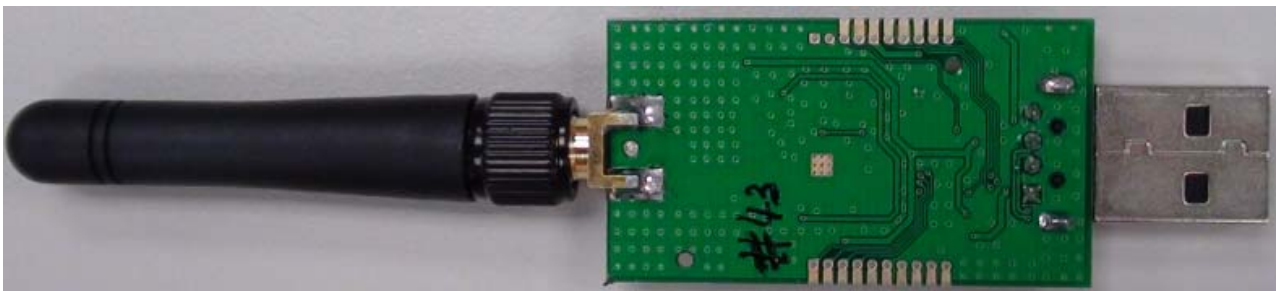
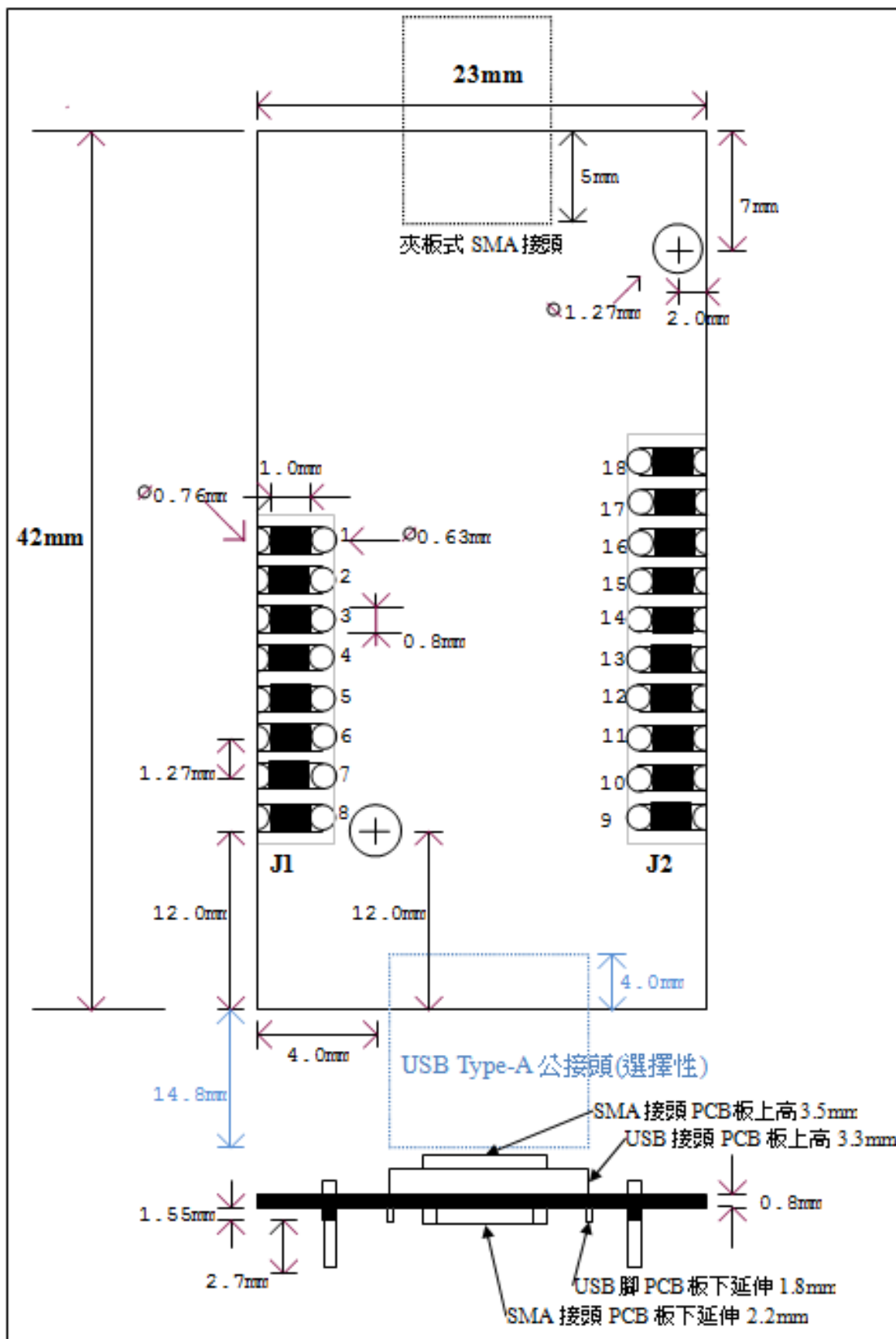


圖 4. QRZ-5300 印刷電路板背面組裝照片(含偶極天線、USB)



QRZ-5300 Sub 1GHz 模塊機構尺寸圖





附註1: 模塊尺寸: $42 \times 23 \text{ mm}^2$, 厚度 2.7mm (不包括SMA接頭, 天線, USB接頭, 排針)

附註2: 當使用SMD類型的郵票孔而不是DIP類型的排針, 注意PCB板下組裝高度 (SMA接頭, 天線):

SMA 接頭 板上高度: 3.5mm, 板下高度: 2.2mm

偶極天線 直徑: 10mm, 板上高度: 5.25mm, 板下高度: 3.95mm, 伸出板外長度: $54.7 \pm 2 \text{ mm}$

彈簧天線 直徑: 5~6mm, 伸出板外長度: 23.4mm.



4. 省電模式

QRZ-5300 包括幾種低功率操作模式允許對可用電力作最高效率的利用。下面描述可用的模式：

活動(ACTIVE)：在活動模式下，QRZ-5300 所有電路是被供電的且可以立刻採取動作。這包括主動監測空中即將到來之通信請求的 RF 接收機。二個子模式被分類為 TX-ACTIVE 和 RX-ACTIVE。TX-ACTIVE 消耗電流^{*1} 為 82.5mA @17.5dBm，而 RX-ACTIVE 消耗電流為 19mA。

休眠(內部喚醒)：在這個模式下，MCU 電路中止，RF 芯片電路運轉並且起動計數。當設定時間一到，RF 芯片自動地醒來，然後該芯片使用中斷訊號喚醒 MCU。此模式消耗電流典型值為 15 uA。

休眠(外部喚醒)：在這個模式下，MCU 和 RF 芯片電路停止。使用者可以使用中斷訊號喚醒 MCU，MCU 醒來後，使用命令喚醒 RF 芯片。此模式消耗電流典型值為 15 uA。

附註1：消耗電流數據皆參考IC的規格書, ACTIVE TX/RX Mode皆是在全時間發射/接收狀態下之消耗電流

**5. 模塊引腳配置及功能說明**

QRZ-5300 使用 Nuvoton NUC122LC1AN 作為 MCU。它是 32 位元微控制器，具 ARM Cortex™-M0 核心並且預留 12 GPIO 引腳作外部控制應用，每個引腳可以是一個一般 I/O 腳供用戶直接編程。此外，這些引腳大部分可以用來作為專用功能。TX，RX 引腳可以被編程為 UART 作數據通信；例如，用戶很容易連接這兩個引腳到 RS485 收發器，如 75176，MAX485。其他專用功能引腳包括 PWM / Capture、I2C 和 SPI，SPI 可以被設置為 master，驅動 2 個外部 slave 裝置，並且可以配置為 slave 裝置由一個芯片外的 master 裝置控制。另外，ICE 除錯接口讓程式開發者容易除錯，而 USB 虛擬串口(Full-Speed)是個選擇性接口，方便使用。

J1 引腳配置

Signal	Pin	Description
RESET	1	External reset input, low active.
GND	2	Common voltage reference for the QRZ-5300
VCC	3	3.3 Volt power for the QRZ-5300
TX	4	GPIO, also used as UART TX, transmits data from QRZ-5300 to UART
GND	5	Common voltage reference for the QRZ-5300
RX	6	GPIO, also used as UART RX, receives data from UART to QRZ-5300.
GPIO	7	GPIO PA.11, may be programmed as either a digital input or digital output. It also can be programmed as I2C clock.
GPIO	8	GPIO PA.10, may be programmed as either a digital input or digital output. It also can be programmed as I2C data.

J2 引腳配置

Signal	Pin	Description
GPIO	18	GPIO PA.15, may be programmed as either a digital input or digital output. It also can be programmed as PWM3 output or Capture input.
GPIO	17	GPIO PA.14, may be programmed as either a digital input or digital output. It also can be programmed as PWM2 output or Capture input.
GPIO	16	GPIO PA.13, may be programmed as either a digital input or digital output. It also can be programmed as PWM1 output or Capture input.
GPIO	15	GPIO PA.12, may be programmed as either a digital input or digital output. It also can be programmed as PWM0 output or Capture input.
GPIO	14	GPIO PB.9, may be programmed as either a digital input or digital output. It also can be programmed as Timer 1 external counter input.
GPIO	13	GPIO PB.10, may be programmed as either a digital input or digital output. It also can be programmed as Timer 2 external counter input, as SPI0 2'nd slave select pin.



GPIO	12	GPIO PC.0, may be programmed as either a digital input or digital output. It also can be programmed as SPI0 slave select pin.
GPIO	11	GPIO PC.1, may be programmed as either a digital input or digital output. It also can be programmed as SPI0 serial clock.
GPIO	10	GPIO PC.2, may be programmed as either a digital input or digital output. It also can be programmed as SPI0 MISO
GPIO	9	GPIO PC.3, may be programmed as either a digital input or digital output. It also can be programmed as SPI0 MOSI

**6. 電子規格**

Absolute Maximum Rating	
VCC ^{*1}	3.6 V
Storage temperature	-40°C to +120°C
Operating temperature Range	-30°C to +80°C

警告：超出這些而額定值中的任一個將使質量保證無效，且可能損壞裝置

Parameters	Min	Typ	Max	Units
Overall Specifications				
Supply Voltage for RF, analog and digital circuits	2.5	3.3	3.6	V
Digital I/O Pin Input High Voltage	1.5			V
Digital I/O Pin Input Low Voltage	-0.3		0.6	V
I/O Pin Output High Current	4	6	8	mA
I/O Pin Output Low Current	7	10	13	mA
I/O Pin Input High Current			15	uA
I/O Pin Input Low Current			15	uA
Current Consumption ^{*2}				
ACTIVE TX Mode @ 17.5 dBm		82.5		mA
ACTIVE RX Mode		19		mA
SLEEP(Internal wakeup)		15		uA
SLEEP(external wakeup)		15		uA
RF Specifications				
Frequency Band of FCC ^{*3}	433.5	434	434.5	MHz
Frequency Band of CE ^{*3}	433.05	433.92	434.79	MHz
TX Maximum Output Power ^{*3}		17.5		dBm
Antenna Impedance		50		Ohms
RX Sensitivity				
2Kbps mode, Dev=8KHz, IFBW=50KHz		-117		dBm
2Kbps mode, Dev=8KHz, IFBW=100KHz		-114		dBm
10Kbps mode, Dev=18.75KHz, IFBW=50KHz		-114		dBm
10Kbps mode, Dev=37.5KHz, IFBW=100KHz		-112		dBm
50Kbps mode, Dev=18.75KHz, IFBW=50KHz		-110		dBm
100Kbps mode, Dev=37.5KHz, IFBW=100KHz		-107		dBm



150Kbps mode, Dev=56.25KHz, IFBW=150KHz		-106		dBm
250Kbps mode, Dev=93.75KHz, IFBW=250KHz ^{*4}		-103		dBm
Current consumption				
Deep Sleep mode		0.2		uA
Sleep mode		2		uA
Idle mode		0.25		mA
Stand-by mode		1.5		mA
PLL mode		8.5		mA
Rx mode(AGC ON)		14.5		mA
TX mode (-12dBm, TBG=0,TDC=0,PAC=0)		16		mA
TX mode (1dBm, TBG=1,TDC=0,PAC=0)		20		mA
TX mode (5dBm, TBG=2,TDC=0,PAC=0)		22		mA
TX mode (10dBm, TBG=3,TDC=0,PAC=0)		30		mA
TX mode (13dBm, TBG=4,TDC=0,PAC=0)		39		mA
TX mode (15dBm, TBG=5,TDC=0,PAC=0)		48		mA
TX mode (16dBm, TBG=6,TDC=0,PAC=0)		55		mA
TX mode (17dBm, TBG=7,TDC=2,PAC=1)		70		mA
TX mode (17.5dBm, TBG=7,TDC=3,PAC=3)		78		mA

附註 1：此處指出 IC 的工作電壓，在帶有 USB 的款式，USB VBUS 會經 LDO 穩壓器轉成 3.3V 電壓。

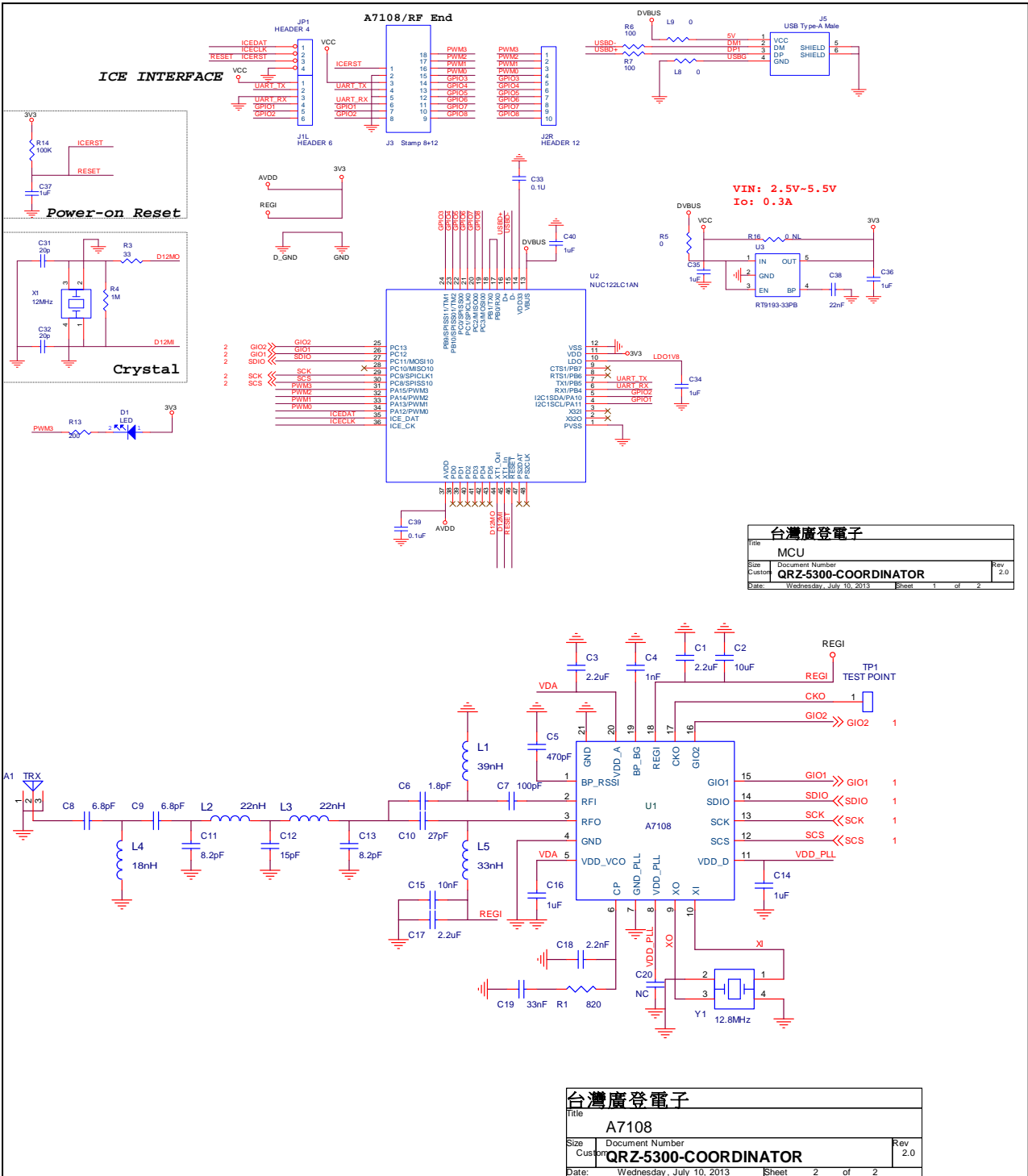
附註 2：消耗電流數據皆參考 IC 的規格書，ACTIVE TX/RX Mode 皆是在全時間發射/接收狀態下之消耗電流。

附註 3：發射輸出功率(TX Output Power)和頻帶(Frequency Band)可以依從每個國家的法規去設置。為了通過法規的發射輸出功率和發射副波輻射(TX Spurious Emission)限制值，可以因應不同天線改變 TBG，TDC 和 PAC 設定值。

附註 4：要使用 250Kbps 數據速率模式，應該使用 16MHz 石英元件。詳細參見 A7108 規格書。



7. 電路圖



台灣廣登電子			
Title	MCU		
Size	Document Number		Rev
Custom	QRZ-5300-COORDINATOR		2.0
Date:	Wednesday, July 10, 2013	Sheet	1 of 2

台灣廣登電子			
Title	A7108		
Size	Document Number		Rev
Custom	QRZ-5300-COORDINATOR		2.0
Date:	Wednesday, July 10, 2013	Sheet	2 of 2



8. 零件表				
Item	Quantity	Reference	Part	Description
1	1	C6	1.8pF	0402
2	2	C8,C9	6.8pF	0402
3	2	C11,C13	8.2pF	0402
4	1	C12	15pF	0402
5	2	C31,C32	20pF	0402
6	1	C10	27pF	0402
7	1	C7	100pF	0402
8	1	C5	470pF	0402
9	1	C4	1nF	0402
10	1	C18	2.2nF	0402
11	1	C15	10nF	0402
12	1	C38	22nF	0402
13	1	C19	33nF	0402
14	2	C33,C39	0.1U	0402
15	3	C1,C3,C17	2.2uF	0603
16	7	C14,C16,C34,C35,C36,C37,C40	1uF	0402
17	1	C2	10uF	1206
18	1	L4	18nH	0402
19	2	L2,L3	22nH	0402
20	1	L5	33nH	0402
21	1	L1	39nH	0402
22	1	R5	0R	0402
23	2	L8,L9	0R	0603
24	1	R3	33R	0402
25	2	R6,R7	100R	0402
26	1	R13	200R	0402
27	1	R1	820R	0402
28	1	R14	100K	0402
29	1	R4	1M	0402
30	1	D1	LED RED	0805
31	1	U3	RT9193-33PB	SOT-23-5
32	1	X1	12MHz	3.2*2.5mm 4Pin
33	1	Y1	12.8MHz	3.2*2.5mm 4Pin

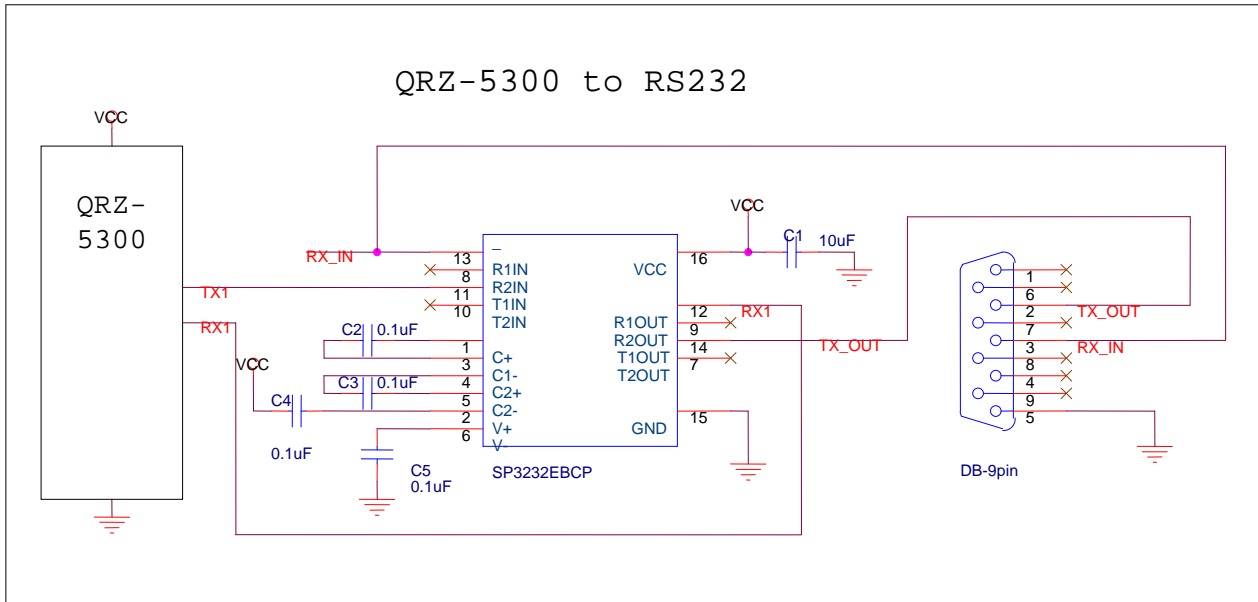


34	1	U1	A7108	QFN20
35	1	U2	NUC122LC1AN	LQFP48
36	1	J5	USB Type-A Male	Optional
37	1	A1	Edge-type SMA	
38	1		Dipole Antenna	
39	1	C20	NL	C0402
40	1	R16	0R_NL	R0402

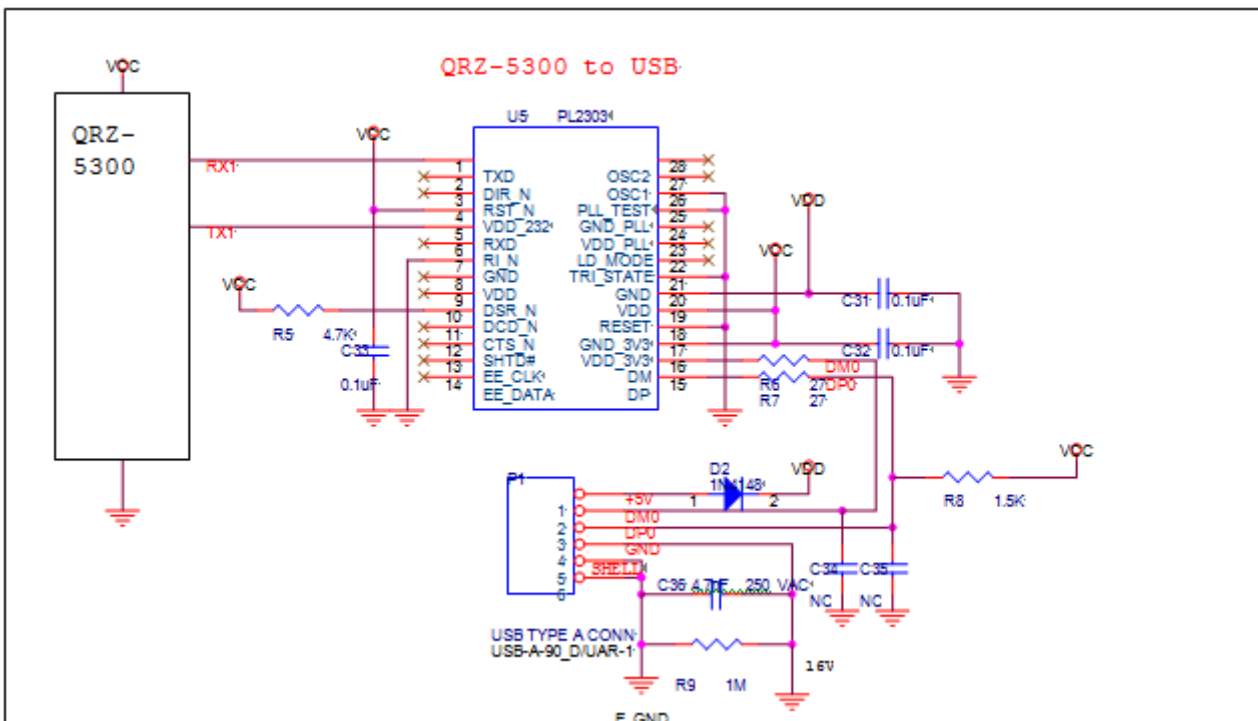


9. 應用電路圖

SIPEX SP3232EBCP 應用電路



PROLIFIC PL2303 應用電路

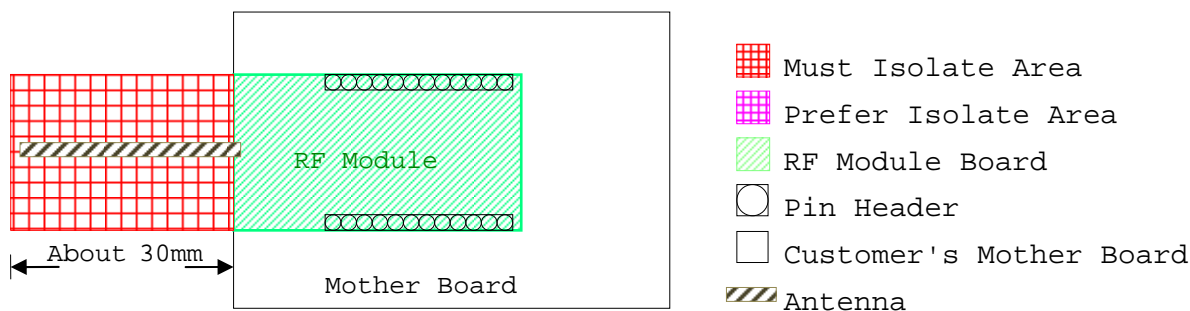




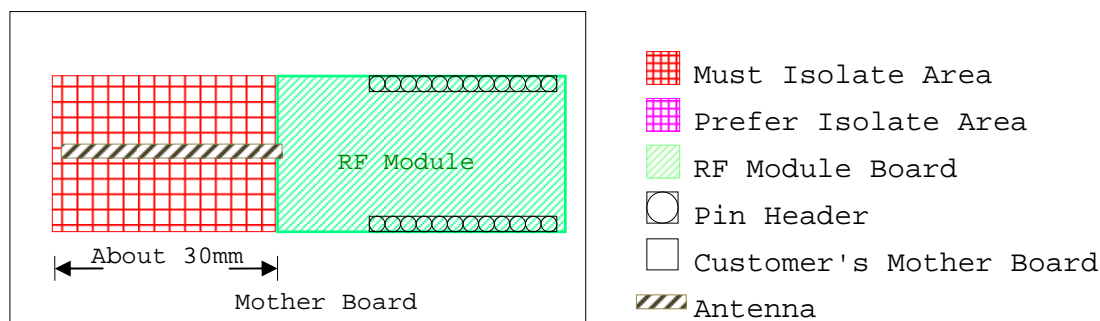
10. 避免RF干擾設計準則

當 RF 模塊被放在應用板(主板)上，欲使 RF 信號干涉減到最小，最佳的方式是定義隔離區域。這個區域不應該有任何電路走線或接地平面。這裡有一些主板的佈局建議。

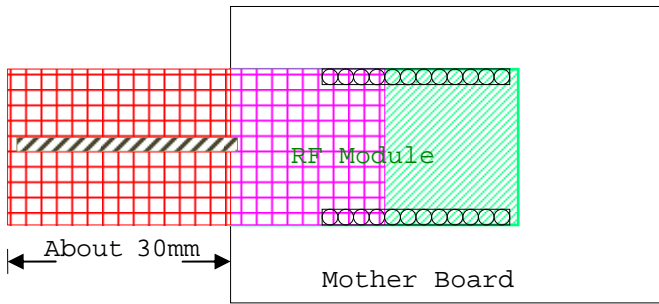
射頻電路板放置於主板的預留區域(最好是將天線區塊置與主板以外)，另外請確保隔離區的下方沒有電路線路和接地區。請看下圖所示。









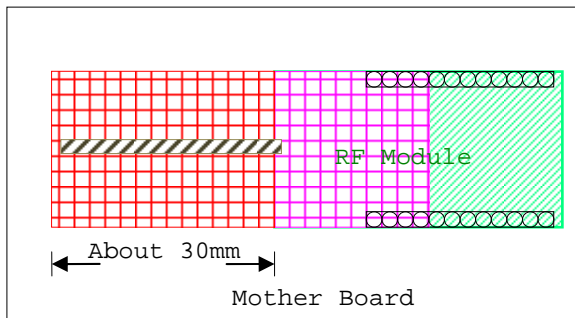
建議 2：如果無法將射頻電路板至於主板的角落或單邊，請確保沒有任何電路線路與接地區於隔離區下方。至少請保留周遭 3 mm 的安全區域避免干擾，請看下圖所示。









對於上述建議，必須盡量延長隔離區的面積。更多的隔離區可以使 RF 性能更好，請參閱如下圖。



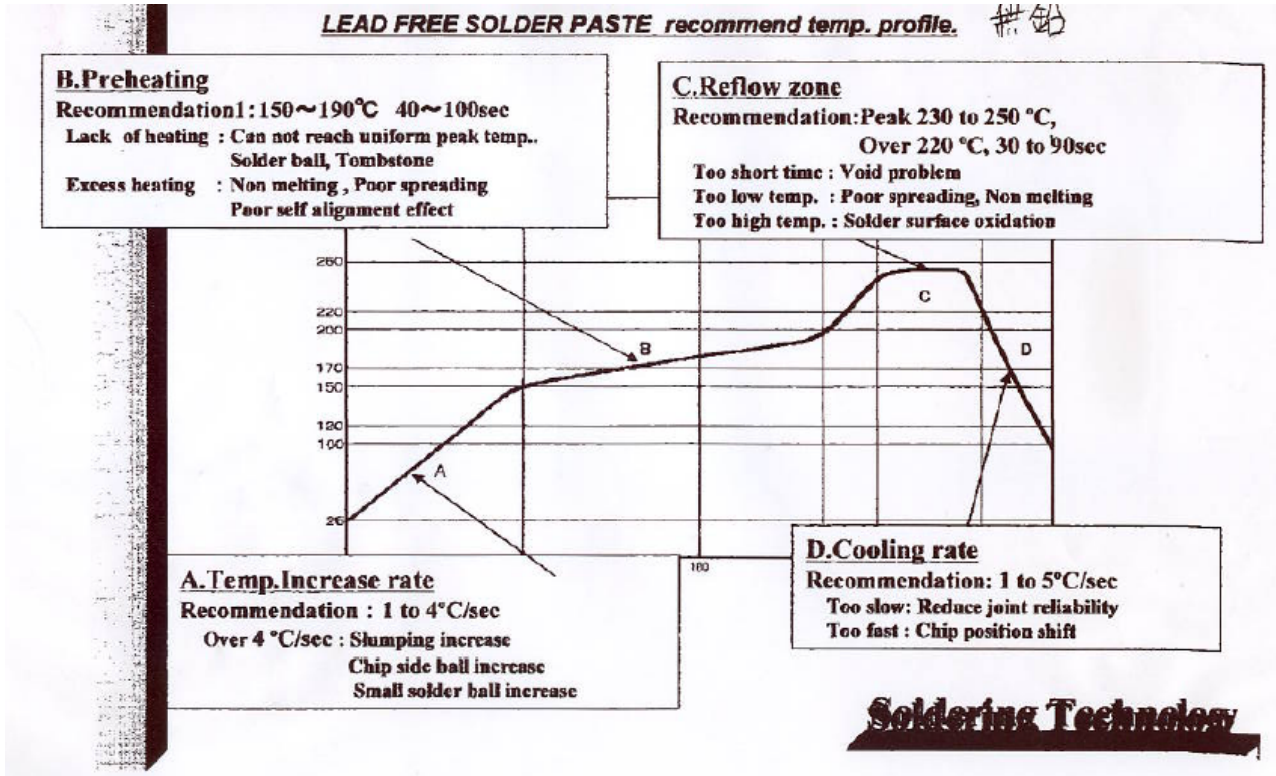
-  Must Isolate Area
-  Prefer Isolate Area
-  RF Module Board
-  Pin Header
-  Customer's Mother Board
-  Antenna



-  Must Isolate Area
-  Prefer Isolate Area
-  RF Module Board
-  Pin Header
-  Customer's Mother Board
-  Antenna



11. 參考REFLOW溫度曲線





12. 參考文件

12.1 AMICCOM A7108 datasheet v0.92

12.2 NUVOTON NUC122 datasheet V1.08

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