Internal Use

MEDIATEK

# MT6620 Combo Module Application Note_V2







WCN/SE/SA/Wangwei

# Outline

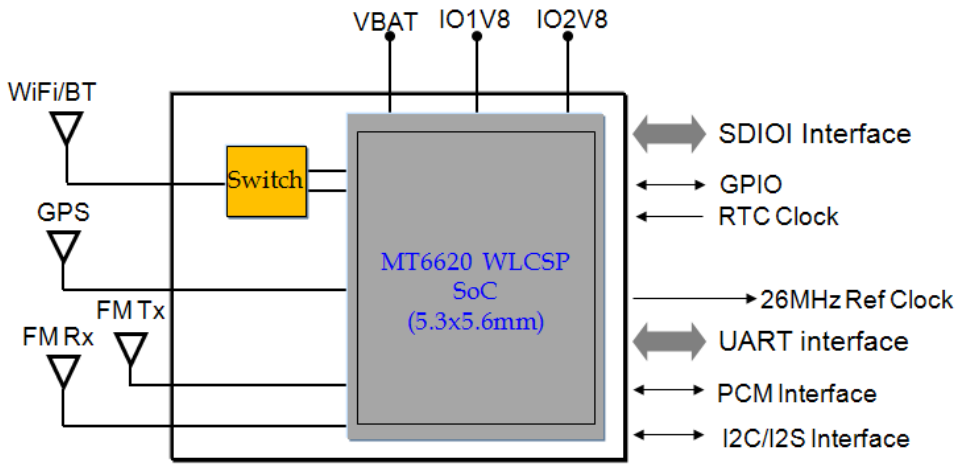
- Module features overview
- Module  block diagram and interface
- Module pin description and reference design
- MT6620 ATE test instrument support
- PCB /Antenna layout guide.
- Apply for WiFi MAC address numbers

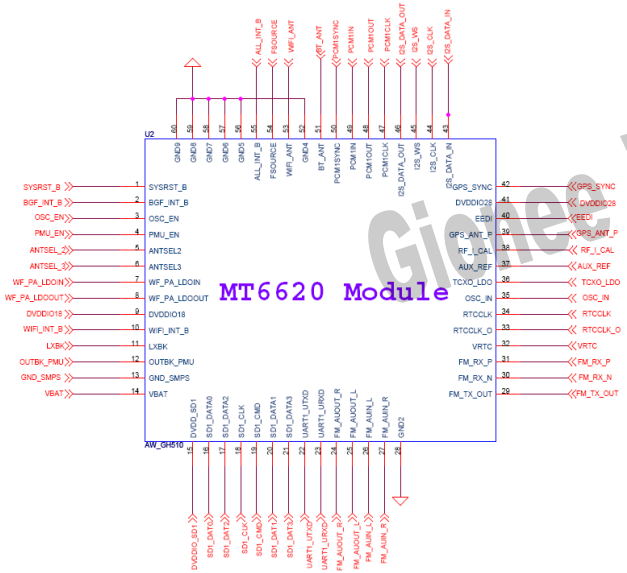
# MT6620 Combo Module Overview

- WiFi/BT/GPS/FM Tx/Rx full-featured combo module
  - WiFi self-calibration function embedded
  - Supported WiFi 11b/g /n features
  - Supported WiFi SDIO 2.0 (4-bits and 1-bit up to 50MHz)
  - Bluetooth specification 3.0+HS (802.11 AMP) compliance (W1126 ready)
  - Supported Bluetooth 4.0, BT Low Energy (LE)
  - GPS/GALILEO/QZSS/SBAS(WAAS/MSAS/EGNOS/GAGAN) support
  - Best GPS sensitivity : -165 dBm tracking sensitivity, -160 hot start sensitivity.
  - Supported FM 76-108MHz band with 50KHz step.
  - Supported FM RDS/RBDS
- Smallest form factor: 8.3×7.4×1.0 mm
- WiFi/BT/GPS share one Ref. clock source.
- Single antenna support for WiFi/Bluetooth/GPS
- RoHS complaint

# MT6620 Module Block Diagram Overview

- Block Diagram



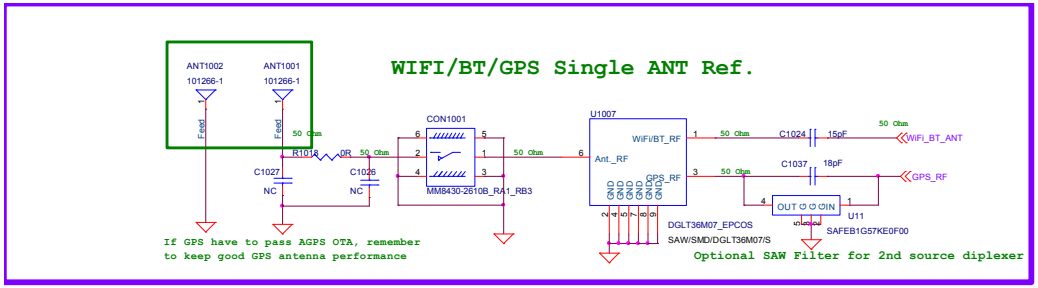



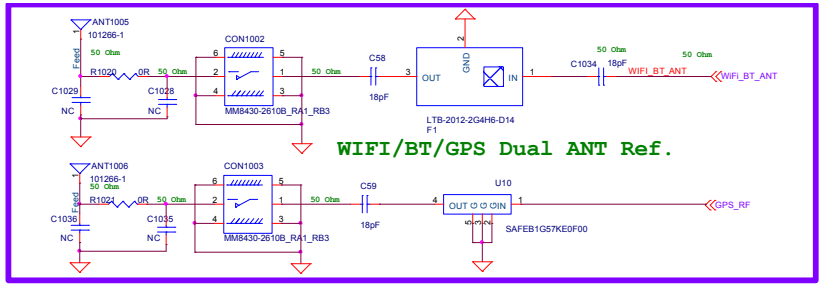

- WiFi / BT / GPS / FM combo
- Size : 8.3 x 7.4x1.0 mm
- Pad Pitch : 0.5mm
- Support Interface:
  - SDIO (WiFi)
  - UART (BT / GPS / FM)
  - PCM / I2S (BT)
  - I2C (FM)
  - FM analog audio input/output
- Ref Clock Source
  - Supported Xtal / TCXO / PCTCXO

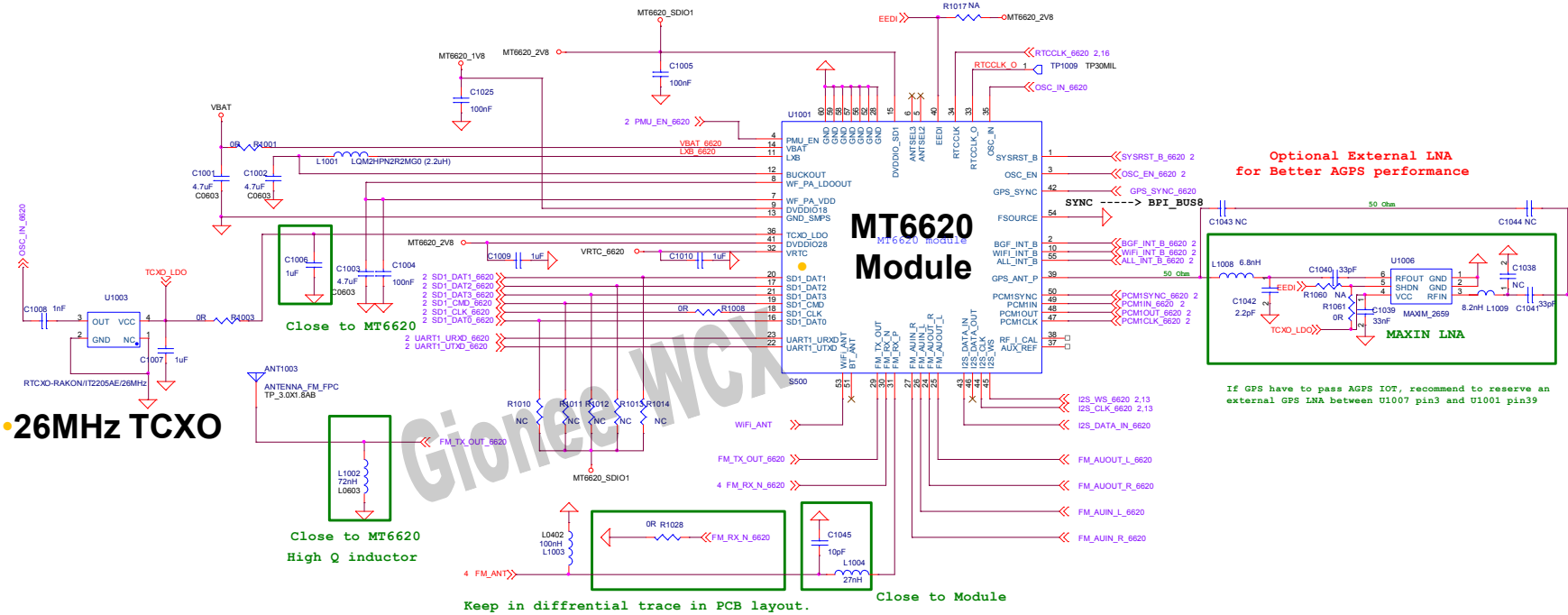
# MT6620 Module Pin Description

| Pin No | Pin name | Pin description | Pin No | Pin name | Pin description | Pin No | Pin name | Pin description |
|---|---|---|---|---|---|---|---|---|
| 1 | SYSRST_B | System reset pin | 21 | SD1_DATA3 | Data pin of SDIO1 | 41 | DVDDIO28 | VDD for EEDI / Antenna selection interface |
| 2 | BGF_INT_B | BT/GPS/FM interrupt pin | 22 | UART1_UTXD | TX pin of UART interface | 42 | GPS_SYNC | external GPS SYNC signal |
| 3 | OSC_EN | external clock request | 23 | UART1_URXD | RX pin of UART interface | 43 | I2S_DATA_IN | I2S_DATA_IN |
| 4 | PMU_EN | PMU enable pin | 24 | FM_AUOUT_R | FM analog output, R channel | 44 | I2S_CLK | I2S_CLK |
| 5 | ANTSEL2 | antenna selection pin use for external swtich control | 25 | FM_AUOUT_L | FM analog output, L channel | 45 | I2S_WS | I2S_WS |
| 6 | ANTSEL3 | antenna selection pin use for external swtich control | 26 | FM_AUIN_L | FM analog input, L channel | 46 | I2S_DATA_OUT | I2S_DATA_OUT |
| 7 | WF_PA_VDD | WiFi PA VDD supply input, 3.3V | 27 | FM_AUIN_R | FM analog input, R channel | 47 | PCM1CLK | PCM CLK |
| 8 | WF_PA_LDOOUT | WiFi PA 3.3V VDD supply output, external 4.7uF required | 28 | GND2 | Ground pin | 48 | PCM1OUT | PCM OUT |
| 9 | DVDDIO18 | VDD for digital interface IO | 29 | FM_TX_OUT | FM TX port / FM short antenna input port | 49 | PCM1IN | PCM IN |
| 10 | WIFI_INT_B | WiFI interrupt pin | 30 | FM_RX_N | FM differential input- N port.<br>A short trace should be reserved and connected to ground | 50 | PCM1SYNC | PCM SYNC |
| 11 | LXBK | Built-in SMPS feedback pin, 4.7uF and 2.2uH required | 31 | FM_RX_P | FM long antenna input port | 51 | BT_ANT | BT input/output port |
| 12 | OUTBK_PMU | Built-in SMPS output pin, 4.7uF and 2.2uH required | 32 | VRTC | VDD of RTC domain | 52 | GND4 | Ground pin |
| 13 | GND_SMPS | Built-in SMPS ground pins | 33 | RTCCLK_O | RTC xtal | 53 | WIFI_ANT | WiFi input/output port |
| 14 | VBAT | Vbat input pin | 34 | RTCCLK | RTC xtal / external RTC clock input port | 54 | FSOURCE | Efuse enable pin |
| 15 | DVDD_SD1 | VDD for SDIO interface | 35 | OSC_IN | Xtal / TCXO input port | 55 | ALL_INT_B | All system interrupt pin |
| 16 | SD1_DATA0 | Data pin of SDIO1 | 36 | TCXO_LDO | 2.8V / 1.8V output for external TCXO VDD supply | 56 | GND5 | Ground pin |
| 17 | SD1_DATA2 | Data pin of SDIO1 | 37 | AUX_REF | support PCTCXO temperature voltage measurement | 57 | GND6 | Ground pin |
| 18 | SD1_CLK | Clock pin of SDIO1 | 38 | RF_I_CAL | support PCTCXO temperature voltage measurement | 58 | GND7 | Ground pin |
| 19 | SD1_CMD | Command pin of SDIO1 | 39 | GPS_ANT_P | GPS input port | 59 | GND8 | Ground pin |
| 20 | SD1_DATA1 | Data pin of SDIO1 | 40 | EEDI | stripping pin for TCXO_LDO voltage selection | 60 | GND9 | Ground pin |

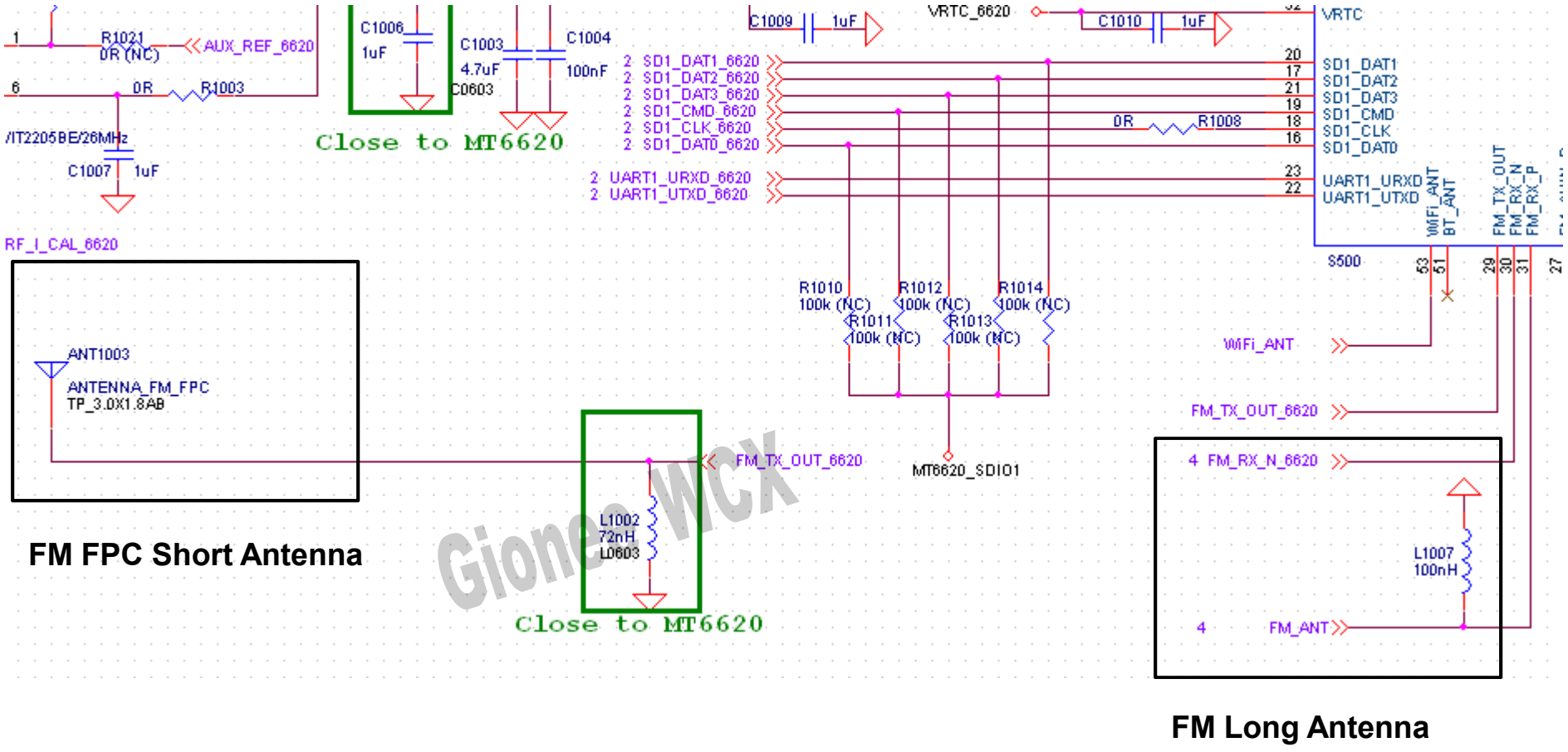
# MT6620 Module Reference Design (1/4)



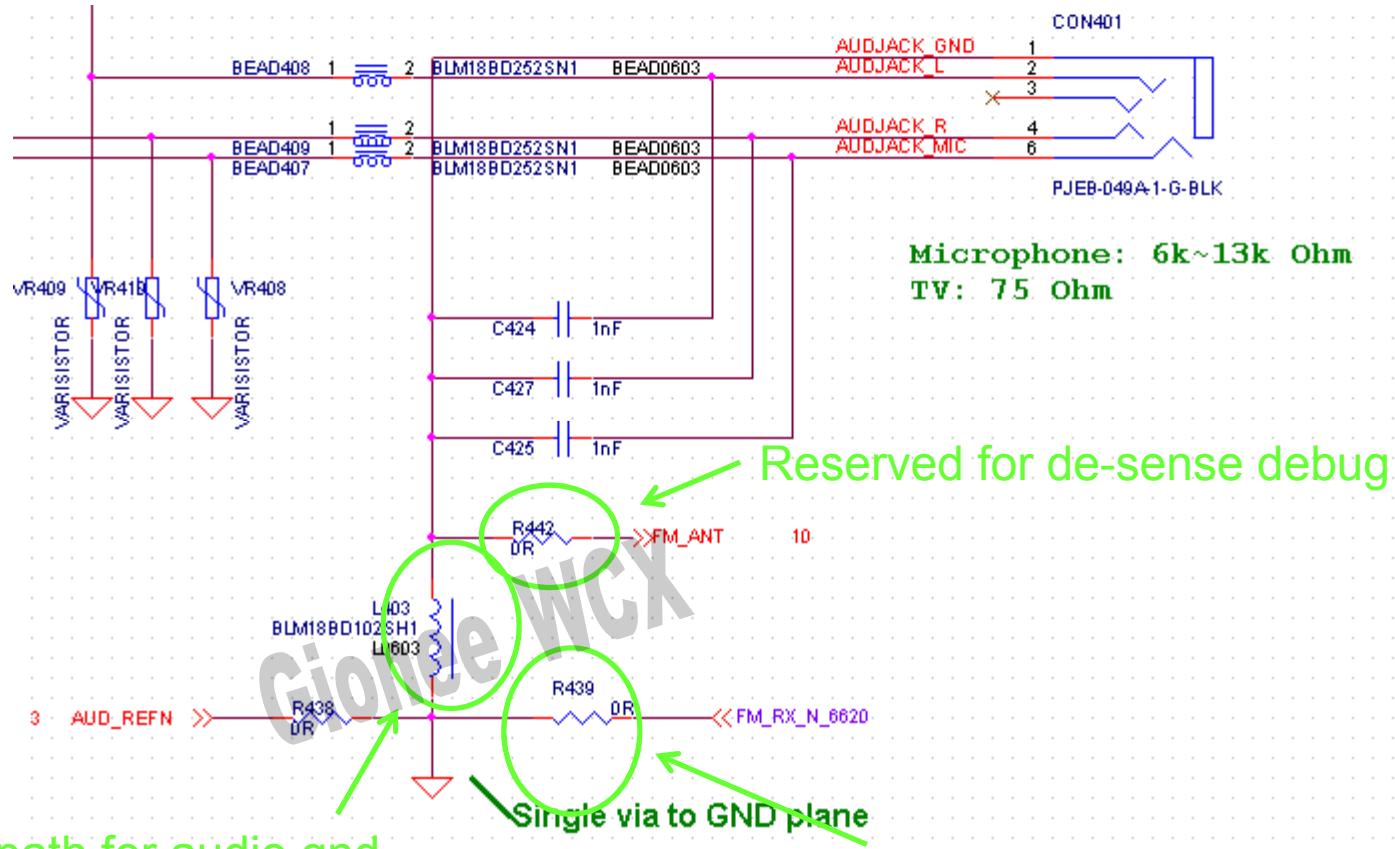
# MT6620 FM Application Circuit (2/4)



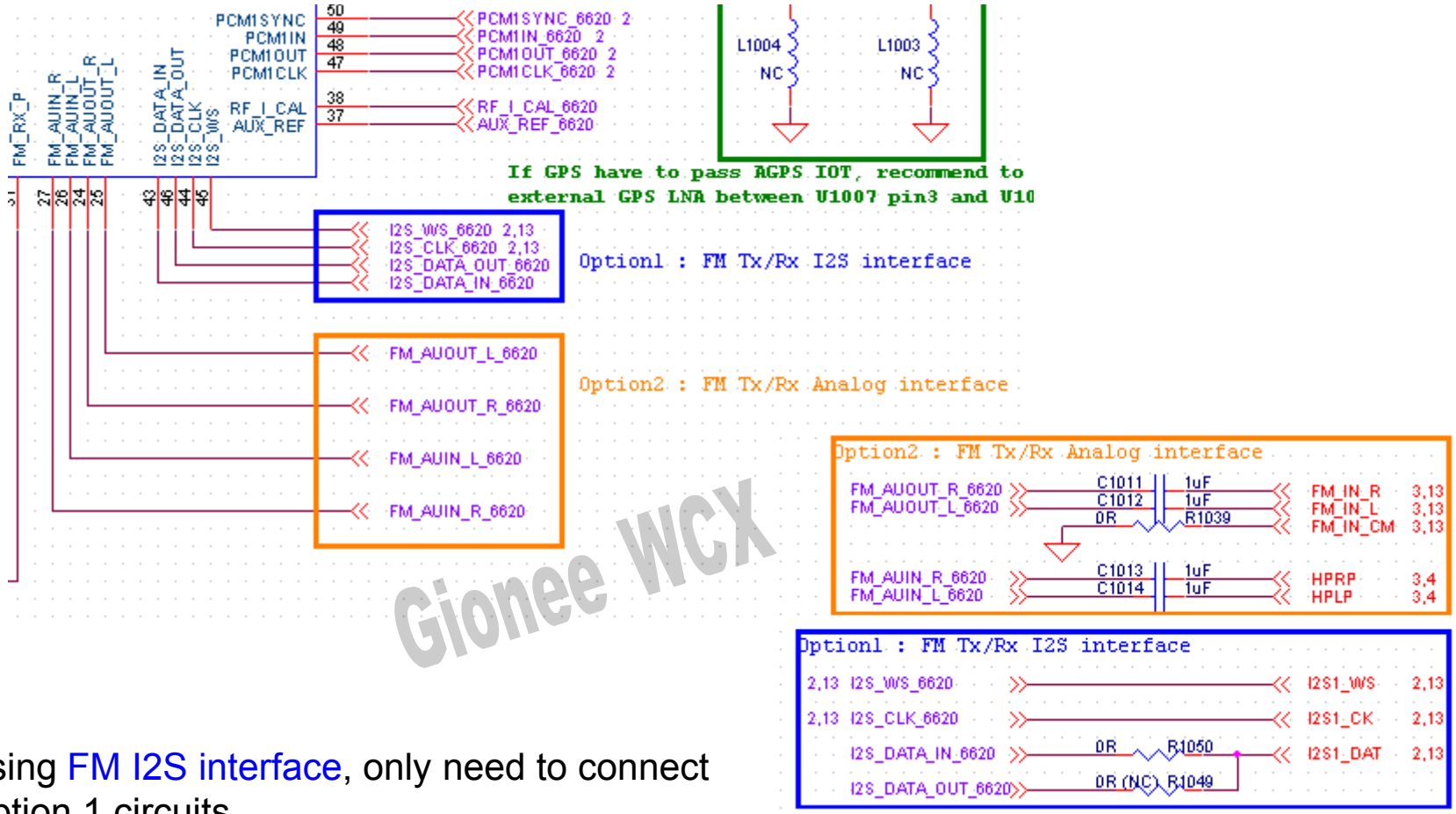

FM FPC Short Antenna

FM Long Antenna

# MT6620 FM Application Circuit (3/4)



# MT6620 FM Application Circuit (4/4)

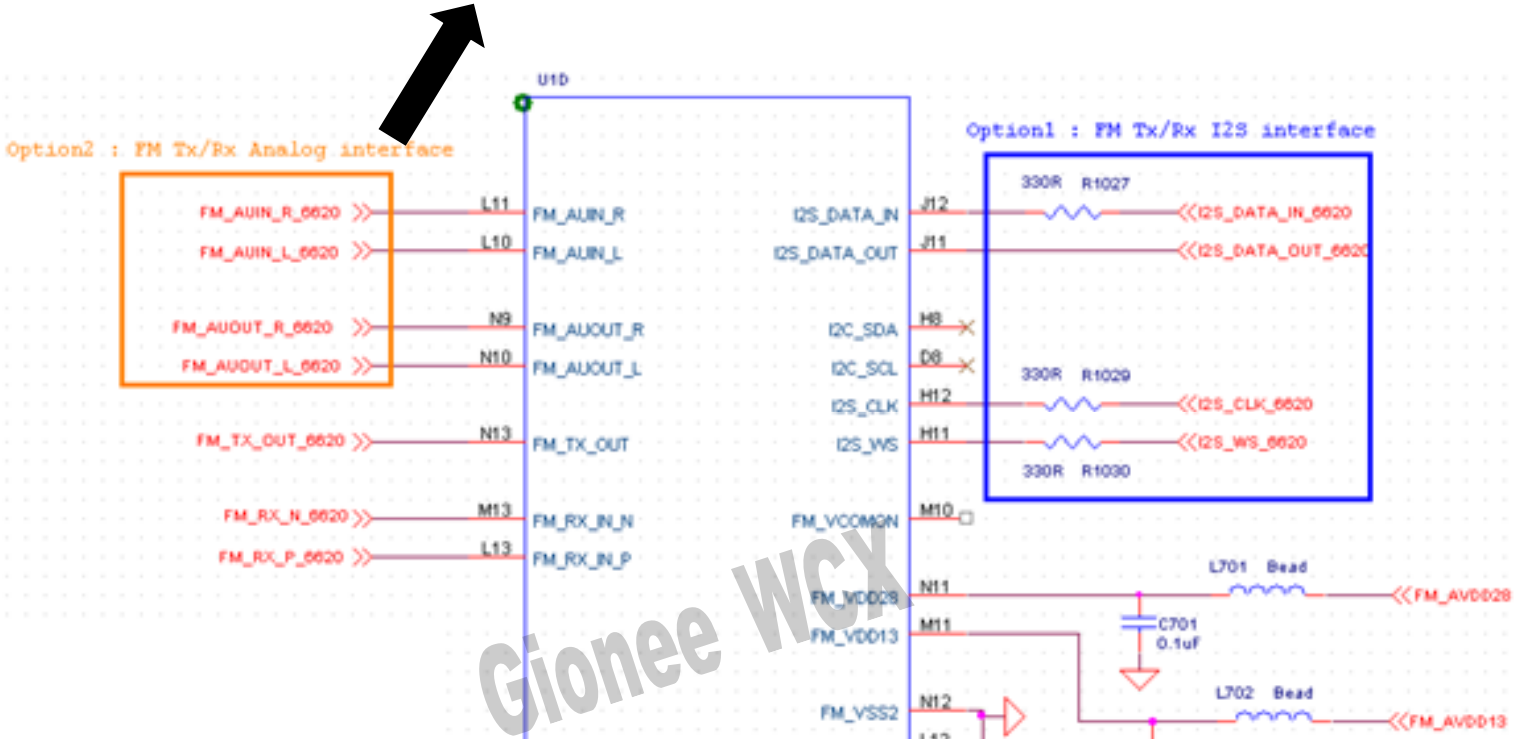



Using FM I2S interface, only need to connect Option 1 circuits.

Using FM Analog interface, only need to connect Option 2 circuits.

# FM Audio Interface selection

--如果phone沒有ATV function, FM Audio interface 請選用 analog  audio interface 享有較小的耗電流.




ProjectConfig.mk 中只要修改底下兩項就可以轉換 interface

[Analog Interface]

MTK_FM_AUDIO = FM_ANALOG_INPUT

[I2S Interface]

MTK_FM_AUDIO = FM_DIGITAL_INPUT

# FM Short Antenna Design Guide

- FPC Type FM Short Antenna
- FM Short Antenna Matching

# FPC Type FM Short Antenna (1)

- The FM Short Antenna is made of FPC.
- The material of FPC is flexible, easy to bend, and can be designed as arbitrary shapes. It is easy to fit different ID/ME design.
- It is suggested to paste the FPC on the inside wall of the housing or a plastic antenna carrier.
- Reserve the suitable space of FPC in ID/ME design phase.
- It is suggested to locate the FPC near the FM chip for shortening RF trace.

# FPC Type FM Short Antenna (2)

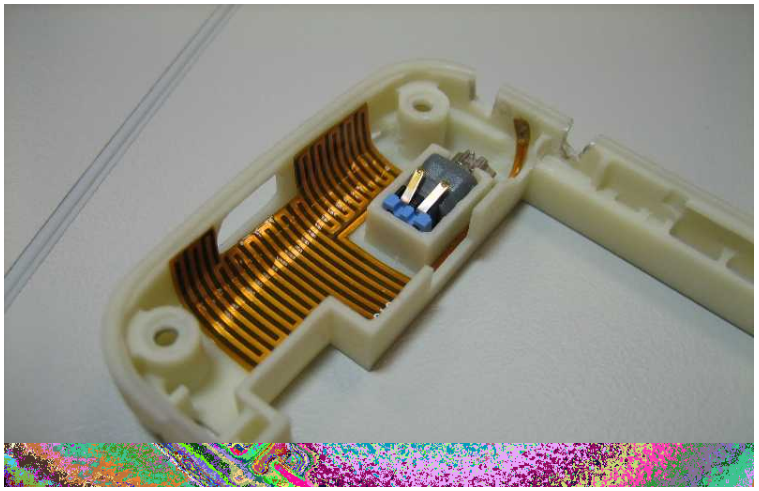
- Suggestion of ID/ME Design
  - FPC is perpendicular to PCBA
    - Distance 1~2mm from PCBA.
    - Distance 3~4mm from Battery.

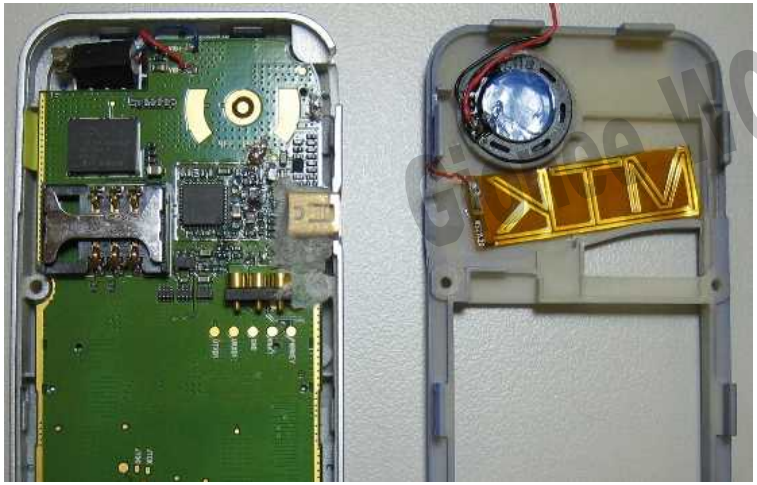

  - FPC is parallel to PCBA
    - Distance 3~4mm from PCBA
    - **DO NOT** overlap with Battery.


- Reserve over 300mm$^2$ area for PFC.
- Keep away from any metal mechanical components, such as shielding cases, speakers, vibrators, card holders, and cameras.
- Only one feed point is enough for FPC type FM short antenna.
- For the layout on FPC, it is an around 500mm~1000mm long and 0.5mm wide strip meandering on the both side of FPC.
- The antenna operates as a monopole.

# FPC Type FM Short Antenna (3)

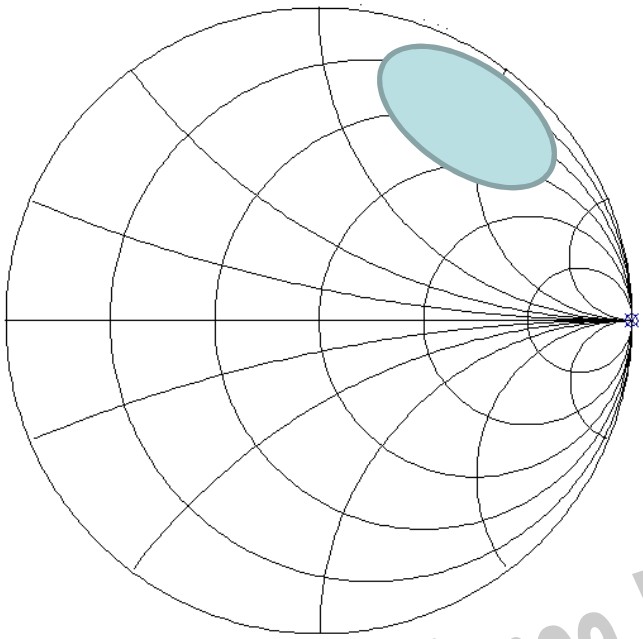
- Examples of Implementation

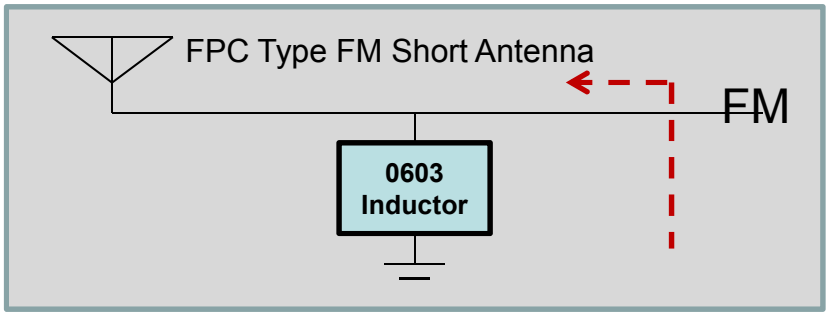




# FM Short Antenna Matching

- The suitable region of FM short antenna matching on smith chart as shown below.








- Usually an parallel 0603 inductor can complete the matching. The possible range of the 0603 inductor is 60nH ~ 90nH. Typically, 72nH(LQW18AN72NG00) is suggested.
- Customers should double check the accuracy of the impedance.

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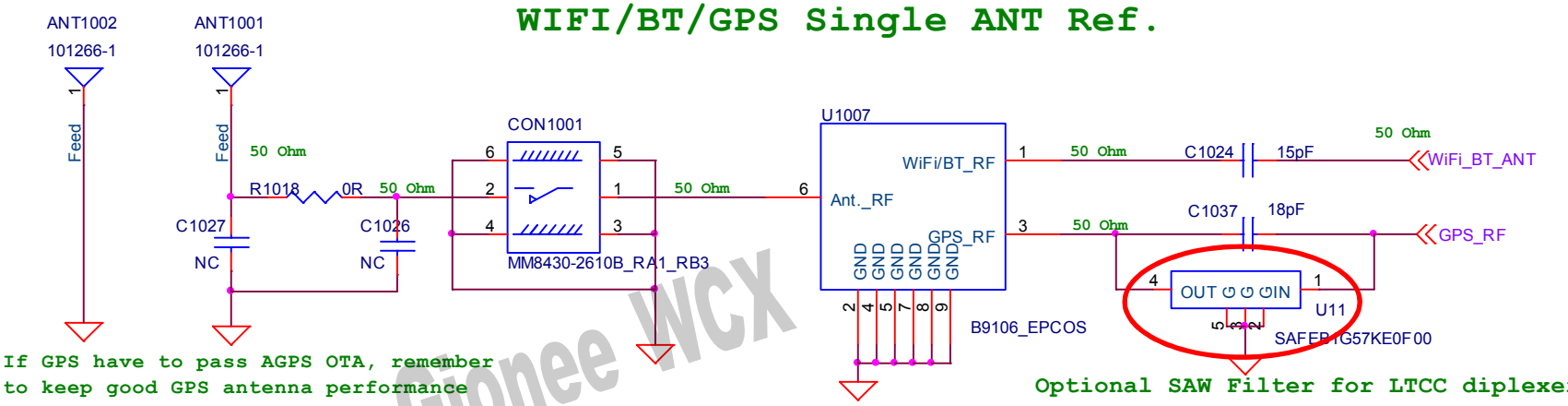
# WiFi/BT/GPS Single Antenna Design Guide and QVL

# MT6620 WiFi/BT/GPS Single ANT Solution

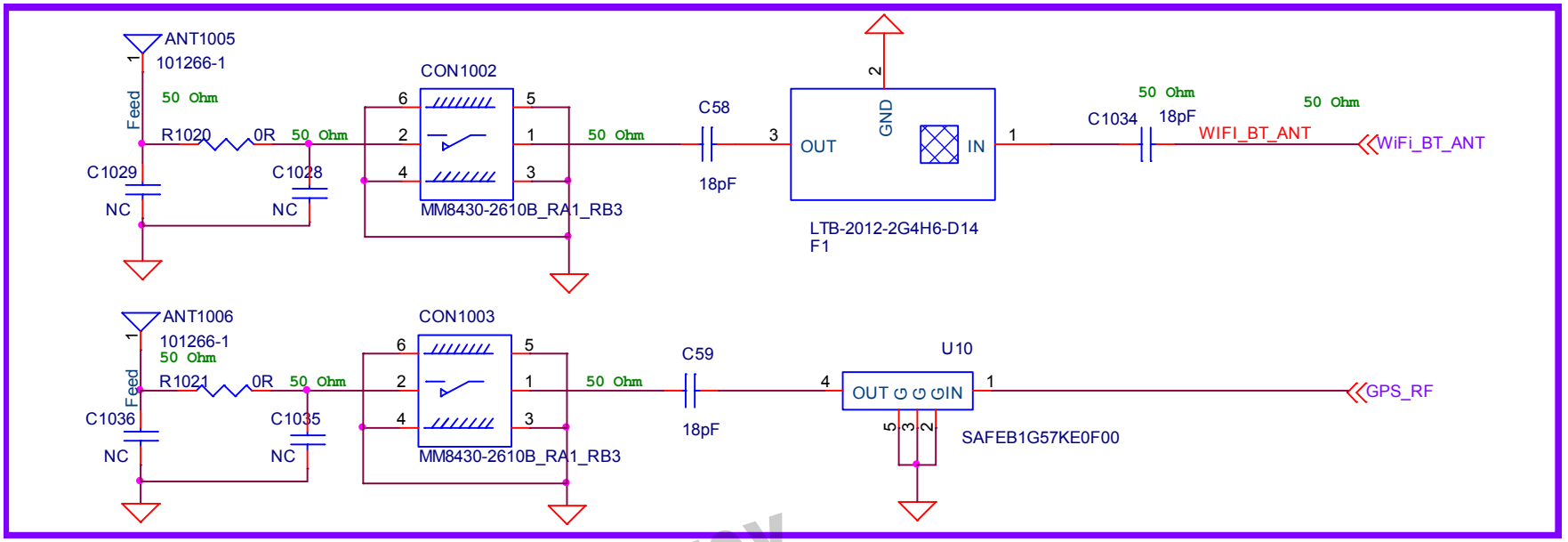
- Single antenna SAW-Diplexer 目前只有EPCOS single source (B9106)
- 請客戶預留external GPS SAW for LTCC 2nd source diplexer (pin-to-pin with EPCOS)
- GPS Antenna total efficiency >50%, Efficiency in hemisphere>30%
- WIFI /BT Antenna total efficiency >50%




- 使用LTCC diplexer (integrated ISM BPF)需要外加GPS SAW filter, LTCC diplexer 與 EPCOS B9106 pin-to-pin.

# MT6620 WiFi/BT/GPS Dual ANT Solution

- 客戶可根據phone機構本身設計選擇雙天線架構.

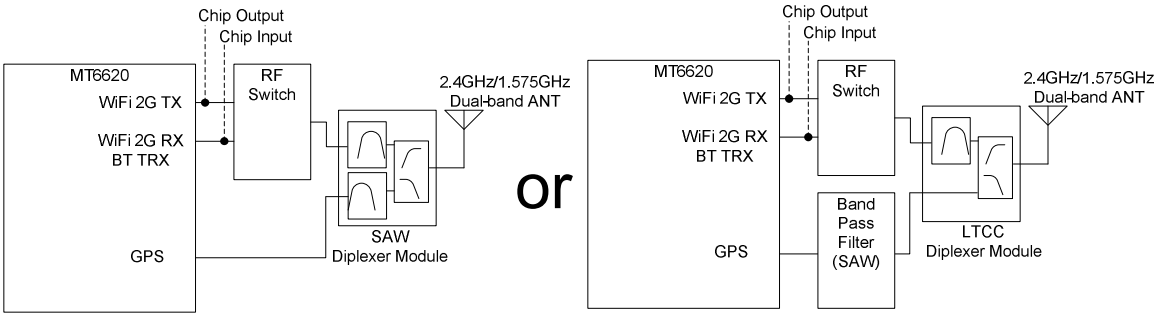



- MT6620 SAW QVL for GPS only using

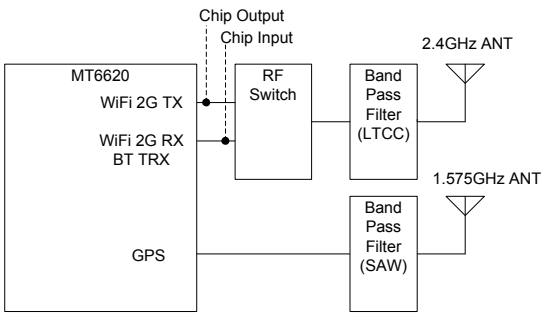
| Component | Part Number | Manufacturer | Vendor |
|---|---|---|---|
| SAW | SAFEB1G57KE0F00 | Murata | Murata |
| | B9440(LV01A) | EPCOS | EPCOS |
| | 856561 | SAWTEK | SAWTEK |
| | TA0757A | TAI_SAW | TAI_SAW |

# The ISM/GPS Antenna Topology

- ISM/GPS Single Antenna




- ISM/GPS Dual Antenna




- Summary
  - 2.4GHz/1.575GHz **dual antenna** shows **better performance** with **less insertion loss**
  - 2.4GHz/1.575GHz **single antenna** is optional for **compact layout** with **less BOM count**
  - Cost does not show much difference

# MT6620 WIFI BPF QVL

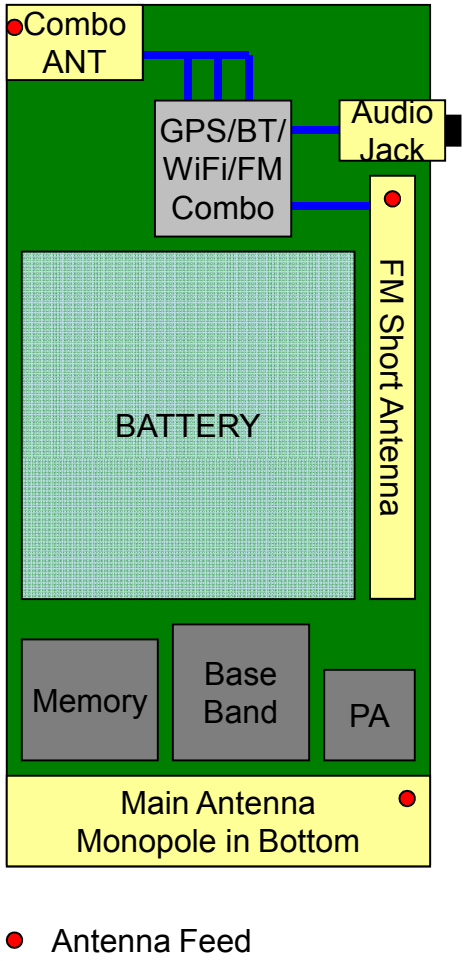
| MT6620 2.4GHz Filter Qualified Parts | | | | | | |
|---|---|---|---|---|---|---|
| | | Vendor | | | | |
| | | 美磊科技 | 華新科技 | 璟德電子 | Murata | TDK |
| | | MAG.LAYERS Scientific Technics Co.,Ltd | PSA | ACX | muRata | TDK |
| | Frequency | LTB-2012-2G4H6-D14 | RFBPF2012080AM0T62 | BF2012-L2R4NDA | --- | --- |
| Insertion Loss | 2400 – 2500MHz | -1.1~-1.3dB | -1.6~ -1.4 dB | -1.6~-1.2dB | --- | --- |
| Attenuation | 860 – 960MHz | -37.1~-36.5dB | -38.4~-37.9dB | -38~-37.3dB | --- | --- |
| | 1545 – 1605MHz | -37.4~-36.5dB | -38.3~-37.4dB | -37.9 ~ -39dB | --- | --- |
| | 1710 – 1990MHz | -44.3~-39.7dB | -44.9~-40.5dB | -43.4 ~ -35.6dB | --- | --- |
| | 2170MHz | -34dB | -32.5dB | -33.8dB | --- | --- |
| | 4800 – 5000MHz | -65~-48.5dB | -59.8~-48.4dB | -65 ~-49.9dB | --- | --- |

# MediaTek TCXO QVL for MT6620

| Component | Part Number | Manufacturer | Vendor |
|---|---|---|---|
| TCXO 2520 2.8V (26MHZ, 0.5ppm) | IT2205AE 26.0MHZ (TX6217) | Rakon | Aurum Tech Inc. |
| | 7L26002009 | TXC | TXC |
| TCXO 2520 1.8V (26MHZ, 0.5ppm) | IT2205AE 26.0MHZ (TX6131) | Rakon | Aurum Tech Inc. |
| | 7L26002009 | TXC | TXC |

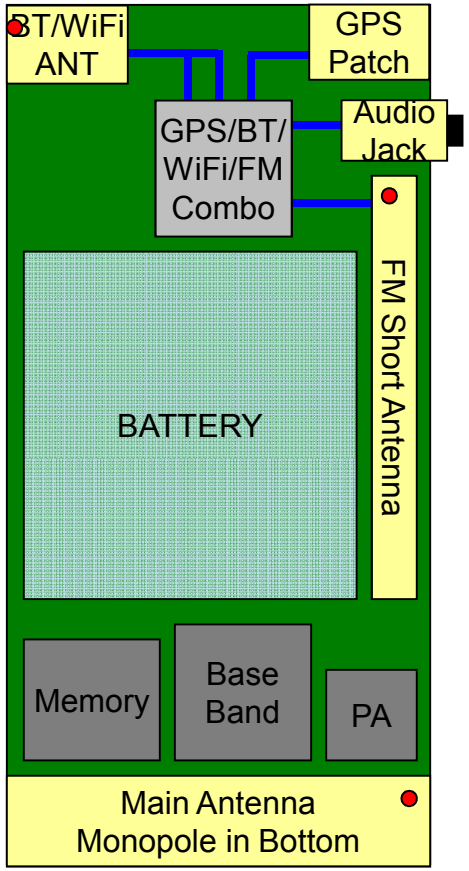
# Placement 1 (recommended)

- GPS/BT/WiFi Co-Antenna Application is recommended for effective space utilization and antenna location arrangement.
- The best antenna location of Combo Antenna is in the top of the mobile phone.
- It is also recommended the phone jack and FM short antenna pad near combo chip and in the proper side of combo chip for shortening FM RF traces.
- The combo antenna is recommended to be a dual-band PIFA for GPS and ISM band. Reserve enough space (at least 200 $mm^2$ x 6 mm) for dual-band PIFA.
- For better radiation pattern in GPS band, the antenna trace of GPS along top edge is recommended.
- Keep more than 5 mm spacing between combo antenna and other metal and ferromagnetic material components.
- Combo antenna trace can NOT overlap with audio jack or USB connector, otherwise it would cause FM de-sense.



# Placement 2

- BT/WiFi Co-Antenna application with a GPS Patch Antenna is also an antenna solution.
- The best antenna location of Combo Antenna and GPS Antenna are in the top of the mobile phone.
- It is also recommended the phone jack and FM short antenna pad near combo chip and in the proper side of combo chip for shortening FM RF traces.



# Criteria

- GPS Antenna
  - VSWR < 2, Return Loss < -10 dB
  - Total Efficiency > 50 %
  - Efficiency in hemisphere > 30%
- BT/WiFi Antenna
  - VSWR < 2, Return Loss < -10 dB
  - Total Efficiency > 50 %

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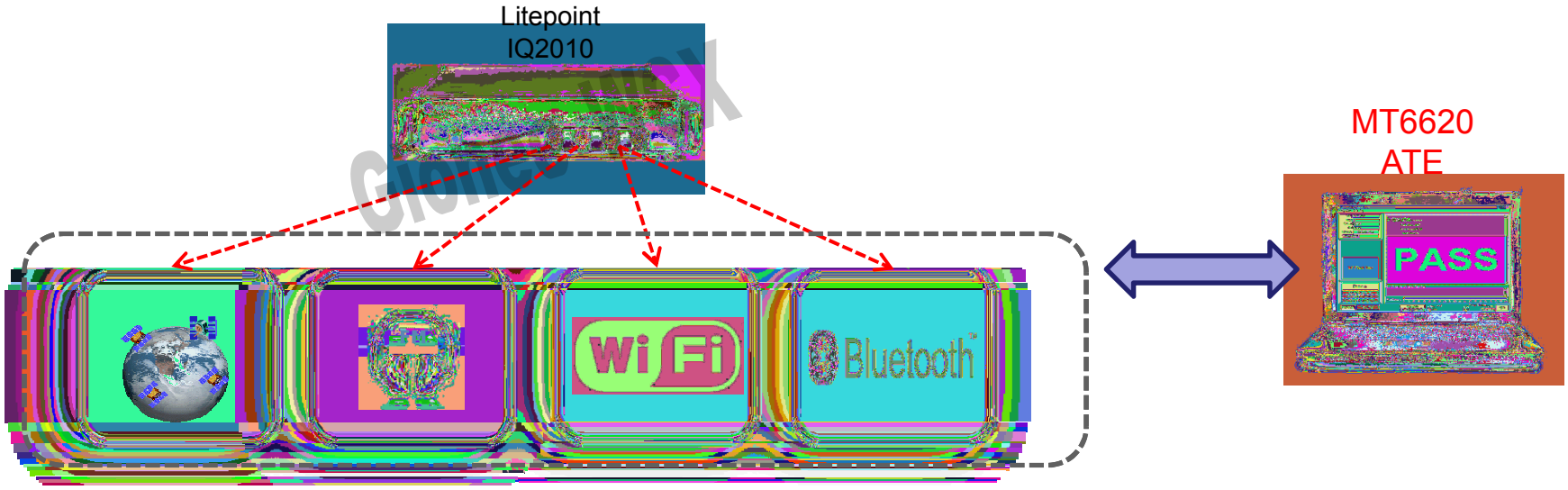
# MT6620 ATE Test Instrument Support

# MT6620 MP ATE Instrument Supported

- MT6620 ATE support Multi-tasking. It can test the performance of ISM band(Including WiFi and BT), GPS and FM simultaneously.
- MT6620 ATE support WiFi 11b/g/n, BT Signaling / non-signaling mode testing.
- MT6620 ATE support to use several kinds of instruments for testing.

| Functionality | Test Item | Instrument Support |
|---|---|---|
| WiFi | 11b/g/n TX/RX Performance | - Agilent N4010A<br>- Litepoint IQ2010 |
| Bluetooth | BDR/EDR TX performance and Sensitivity | - R&S CBT<br>- Litepoint IQ2010 |
| FM | RX Performance (Audio SINAD, Sensitivity, RSSI)<br>TX performance (TX power, SNR, OBW) | - Litepoint IQ2010 |
| GPS | CNR, Clock stability | - Litepoint IQ2010<br>- Areoflex GPS-101 |



# MT6620 Conductive Spec For WiFi/BT/GPS Dual Antenna solution

| Function | item | Spec (ANT out) |
|---|---|---|
| WiFi | Output Power | >14dBm (11g)<br>>16dBm(11b) |
| | Modulation Accuracy | <-28dB (11g/n/)<br><-15 dB (11B) |
| | Frequency Tolerance | 10 ppm |
| | Spectrum Mask | Follow IEEE |
| | Rx Sensitivity | -73 dBm(54M)<br><-90 dBm (2M) |
| Bluetooth | Output Power | >8 dBm |
| | EDR Relative Transmit Power | Max : 6dB |
| | Sensitivity-single slot packets | <-90 dBm |
| | EDR Sensitivity | <-90 dBm for 2M<br><-82 dBm for 3M |
| GPS | C/N (-130dBm) | 38 dB |

# MT6620 Conductive Spec For WiFi/BT/GPS Single Antenna solution (with SAW diplexer)

| Function | item | Spec (ANT out) |
|---|---|---|
| WiFi | Output Power | >13dBm (11g)<br>>15dBm(11b) |
| | Modulation Accuracy | <-28dB (11g/n/)<br><-15 dB (11B) |
| | Frequency Tolerance | 10 ppm |
| | Spectrum Mask | Follow IEEE |
| | Rx Sensitivity | <-72 dBm(54M)<br><-90 dBm (2M) |
| Bluetooth | Output Power | >7 dBm |
| | EDR Relative Transmit Power | Max : 6dB |
| | Sensitivity-single slot packets | <-90 dBm |
| | EDR Sensitivity | <-90 dBm for 2M<br><-80 dBm for 3M |
| GPS | C/N (-130dBm) | 37 dB |

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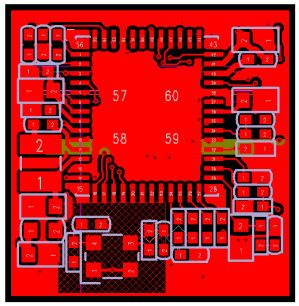
# MT6620 Module Layout Guide

# MT6620 Module Layout Guideline

- RF/Analog Part :
  - The line width and ground layer reference for RF traces should be kept for better impedance control, which **is close to 50ohm line.**
  - The matching BOMs should be placed **as close to chip as possible** for better RF performance.
  - Using **qualified components (ex. switch ,diplexer… ) for peripheral devices.**
- Power Line Part :
  - The decoupling cap. should be placed as close to chip as possible and using SMD type 2.2uH for bulk out to avoid to de-sense FM performance.
  - GND_SMPS, which is DC-DC power ground, should be directly connected to battery ground, instead of sharing ground plane with RF. (important)
  - The width of GND_SMPS and AVDD55_SMPS should be wide enough for tolerating 400mA current rating and keep the parasitic resistance smaller than 0.2 ohm
  - Keep power trace rule as below .(important)
  - WiFi_PA_LDO trace>20mil, VBAT input(M1&L2):25mil, Bulk out trace>20 mil, OUTBK : 4mil.(important)



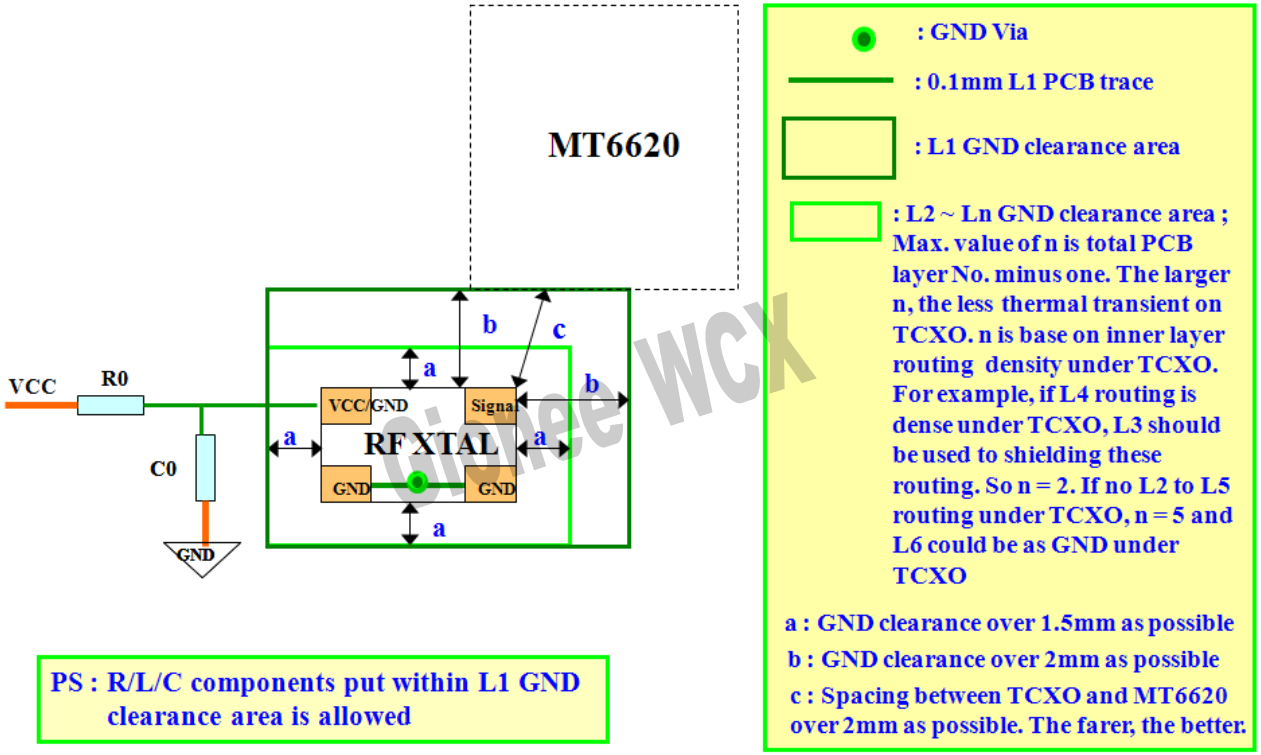


## Others Layout suggestions:

1. keep SDIO/I2S trace routing in a group.
2. Give GND via as more as possible for MT6620 in each layer
3. Please enclose the SDIO_CLK/SDIO_CLK_FB with GND copper. (Important)
4. Follow TCXO layout rule.

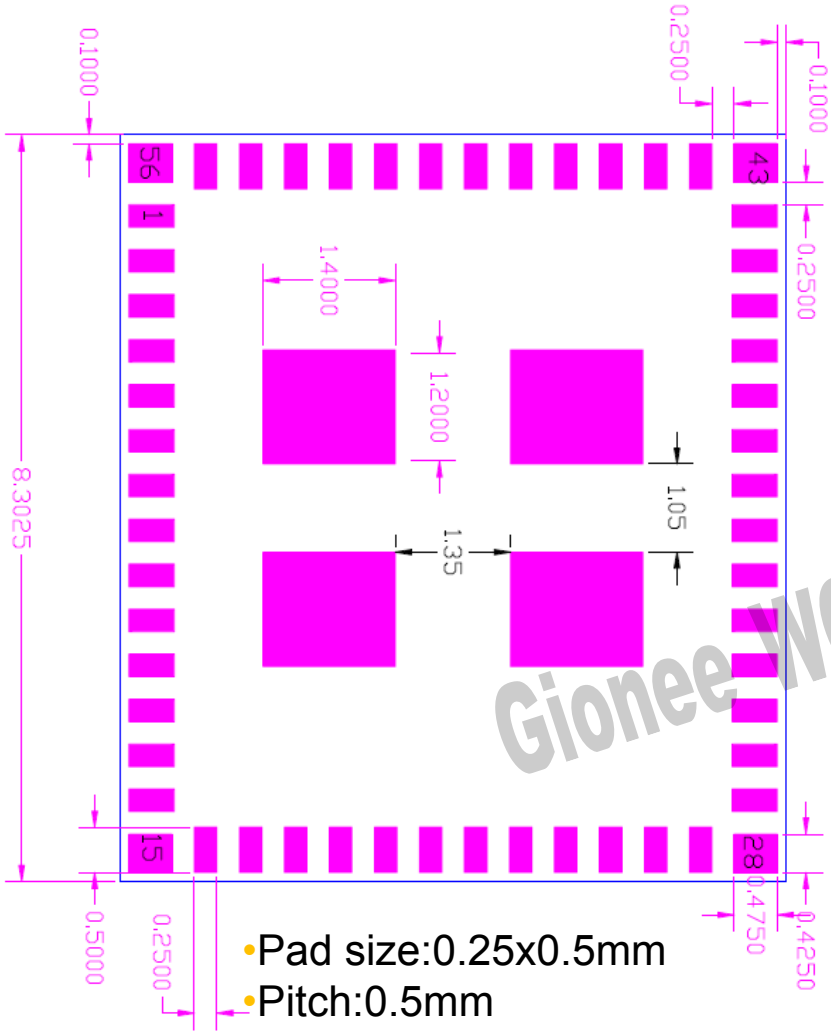
## MT6620 TCXO Layout Rule

Internal Use



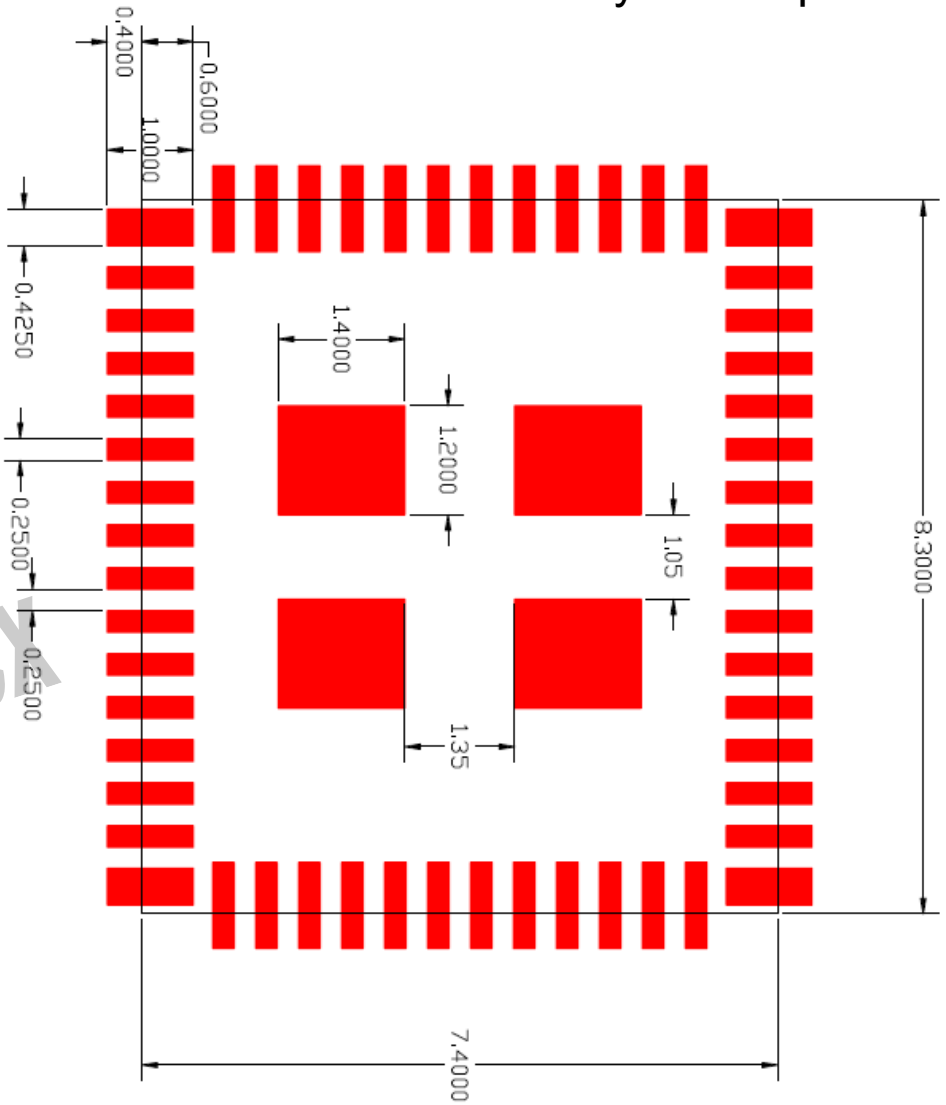
# MT6620 Module Outline Drawing

- MT6620 module footprint

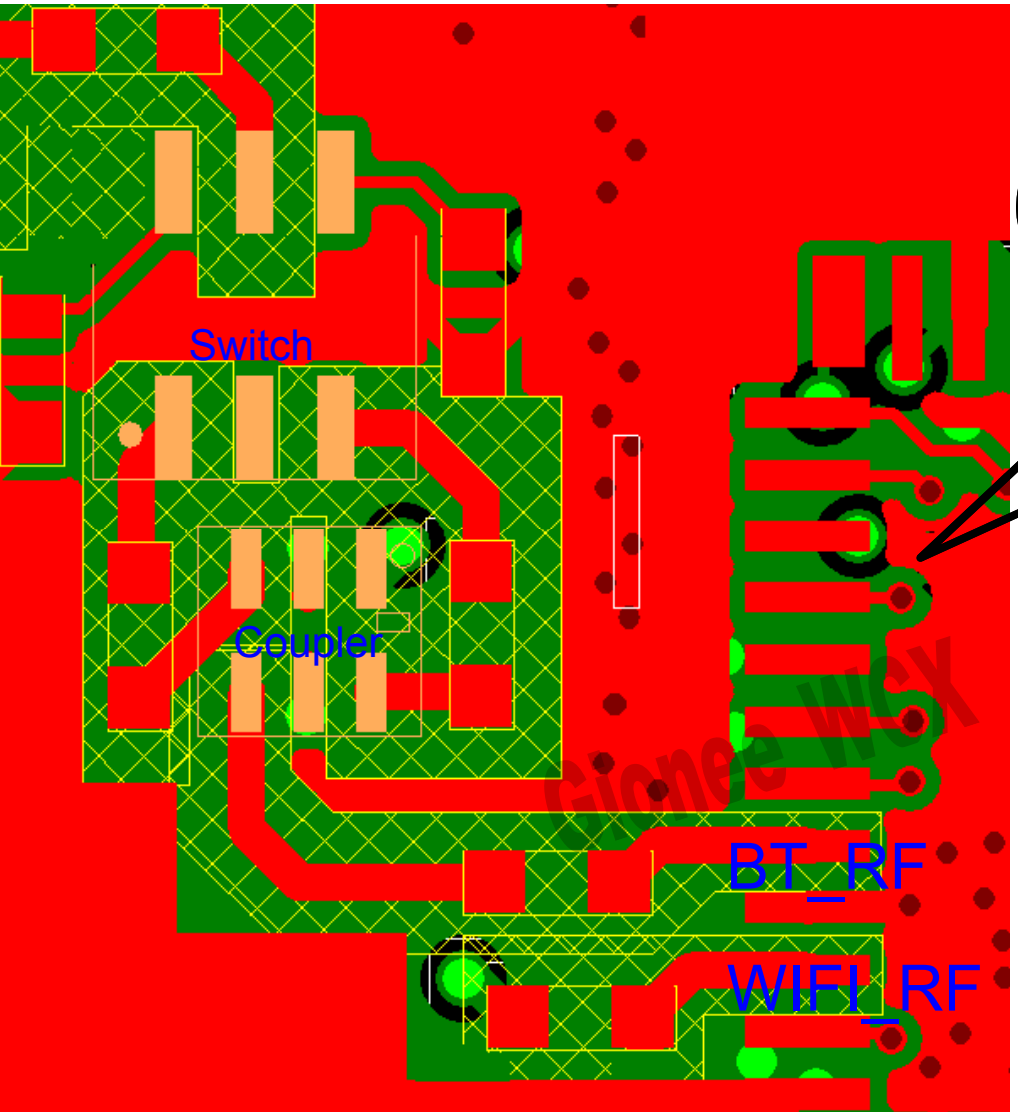


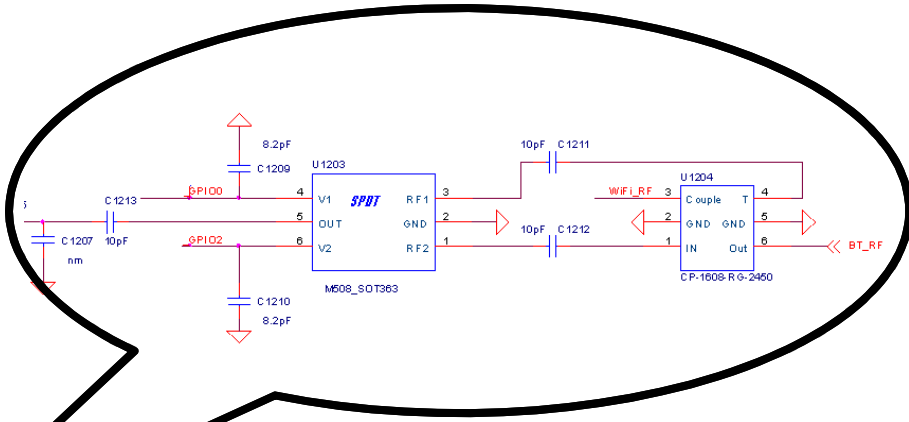

- Pad size:0.25x0.5mm
- Pitch:0.5mm

- Recommend module layout footprint



# FDD Single Antenna Layout Guide




- 連接coupler RF trace 要走表層 而且訊號線越短越好.
- Ref. GND 請參考第3層. 第2層GND 鋪銅要留禁止區.
- Switch天線端匹配一定要維持 50 ohm, 天線端匹配50 ohm於否對coupler isolation 及co-existence performance 有非常重要的影響, 請務必遵守.另外天線端S11 return loss deep 最好要在中心頻率2437~2442.

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# WIFI MAC Address Application

# WiFi IEEE MAC Address Application

◆為何需要申請MAC address？

◆ MAC address又稱MAC位址、硬體位址，用來定義網路設備的位置,若出現與別人MAC address重複的現象，AP(熱點)也許會認為被攻擊,因此出現**無預警的斷線**或是導致網路裝置錯失大量封包，導致難以追查的問題， 因此MAC address必須具有唯一性，不可重複。

◆MAC位址定義

◆共48位元（6個位元組），以十六進位表示。

◆高24位元由貴司與IEEE組織申請，低24位元由貴司實際生產時自行產生。

◆舉例來說: 假設貴司申請到的IEEE OUI是0x00-0x01-0x02 ，貴司可以使用0x00-0x01-0x02-XX-YY-ZZ當作完整MAC address，只要生產時能確定產品XX-YY-ZZ流水號具惟一性，則此MAC address一定不會發生與他人MAC address產生衝突問題，進而可避免導致網路功能異常。

◆適用對象

◆任何有WiFi產品生產之公司.

◆寫入方式

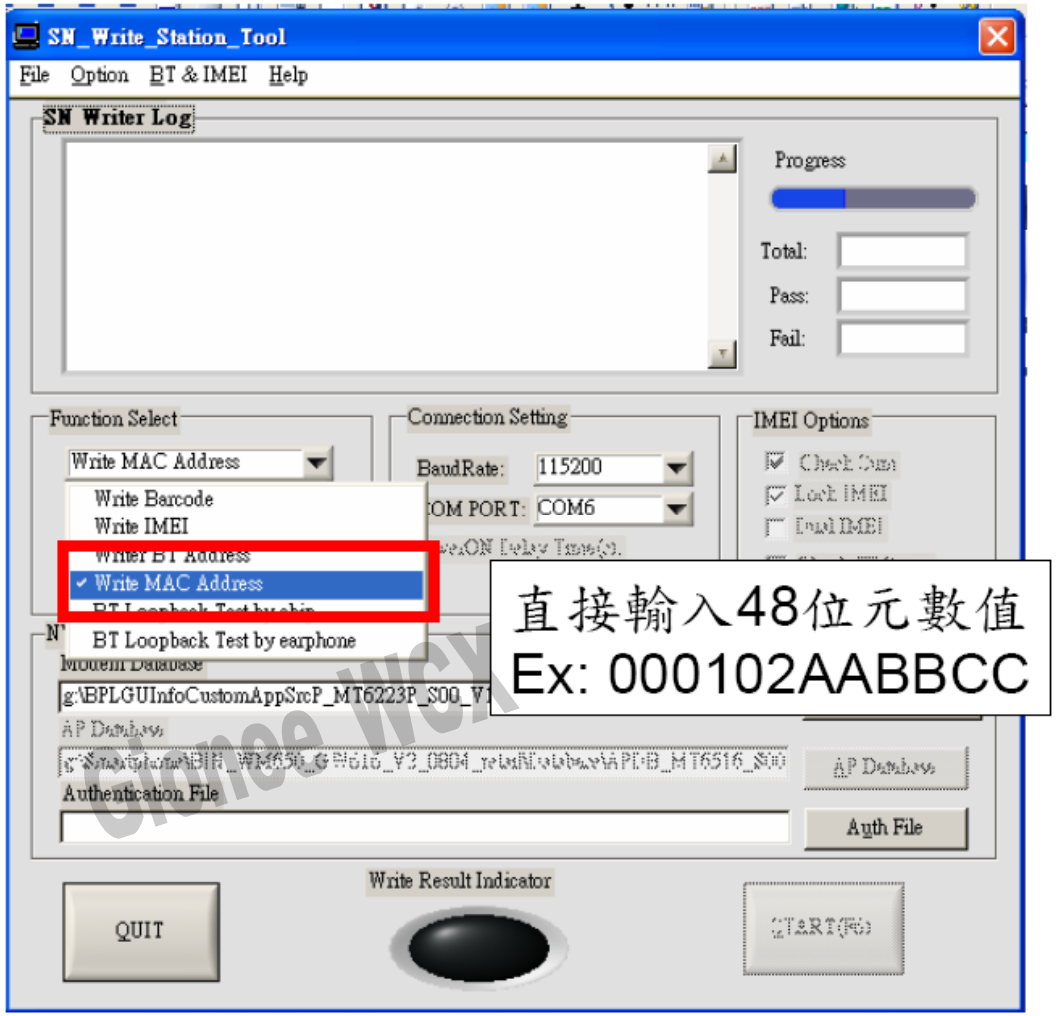
◆**WiFi CoB客戶：請利用MTK SN writer tool.**

◆**WiFi module客戶：請利用ATE “EEPROM copy" function.**

# WiFi IEEE MAC Address Application

- 申請步驟
  - http://standards.ieee.org/regauth/oui/forms/
    - 1.填寫線上表單
    - https://standards.ieee.org/cgi-bin/wtp/request?rt=OUI
    - 2.繳費
    - 選擇 (支票/ 匯款/ 採購單/ 信用卡)
    - 3.費用
    - Publicly Registered OUI (company name and address on the public listing)費用為$1,650.00(US)，相當於一組OUI費用為美金USD $1,650，每組OUI可有256*256*256 = 16777216個address。**相當於一塊美金就可以擁有壹萬個MAC address**.
  - 完成繳費後,**七日內**可透過電郵收到IEEE指派給貴司之OUI號碼.
  - 其他相關資訊可至下列網站查找.
  - http://standards.ieee.org/regauth/oui/index.shtml

# MTK SN Writer Tool 可支援Write MAC Address功能



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# Thanks