RL9xxx

Certification Testing Support Guide

FH0003253 - Rev1.0 April 27, 2022

ROLLING WIRELESS

Contents

VERSION	DATE	AUTHOR	UPDATES
1.0	2022.04.27	Wilson Lin	Initial version, based on AR759x Certification Testing Support Guide V1.0

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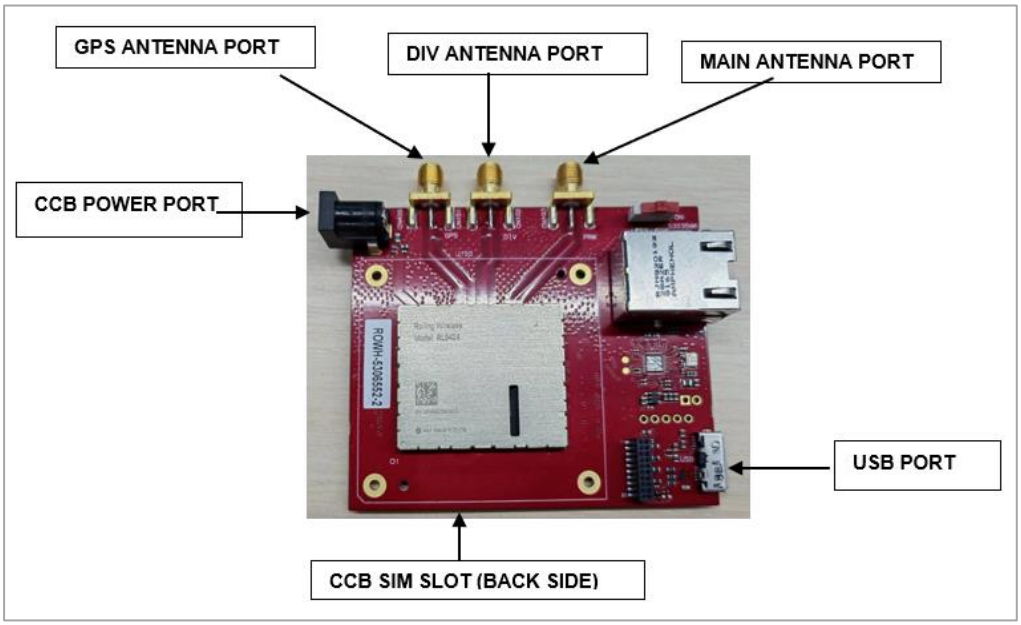
1 Purpose

This document was specifically written to support the RL9xxx product for certification testing.

2 Quick guide for HW setup

2.1 CCB Setup (for the testing without audio)

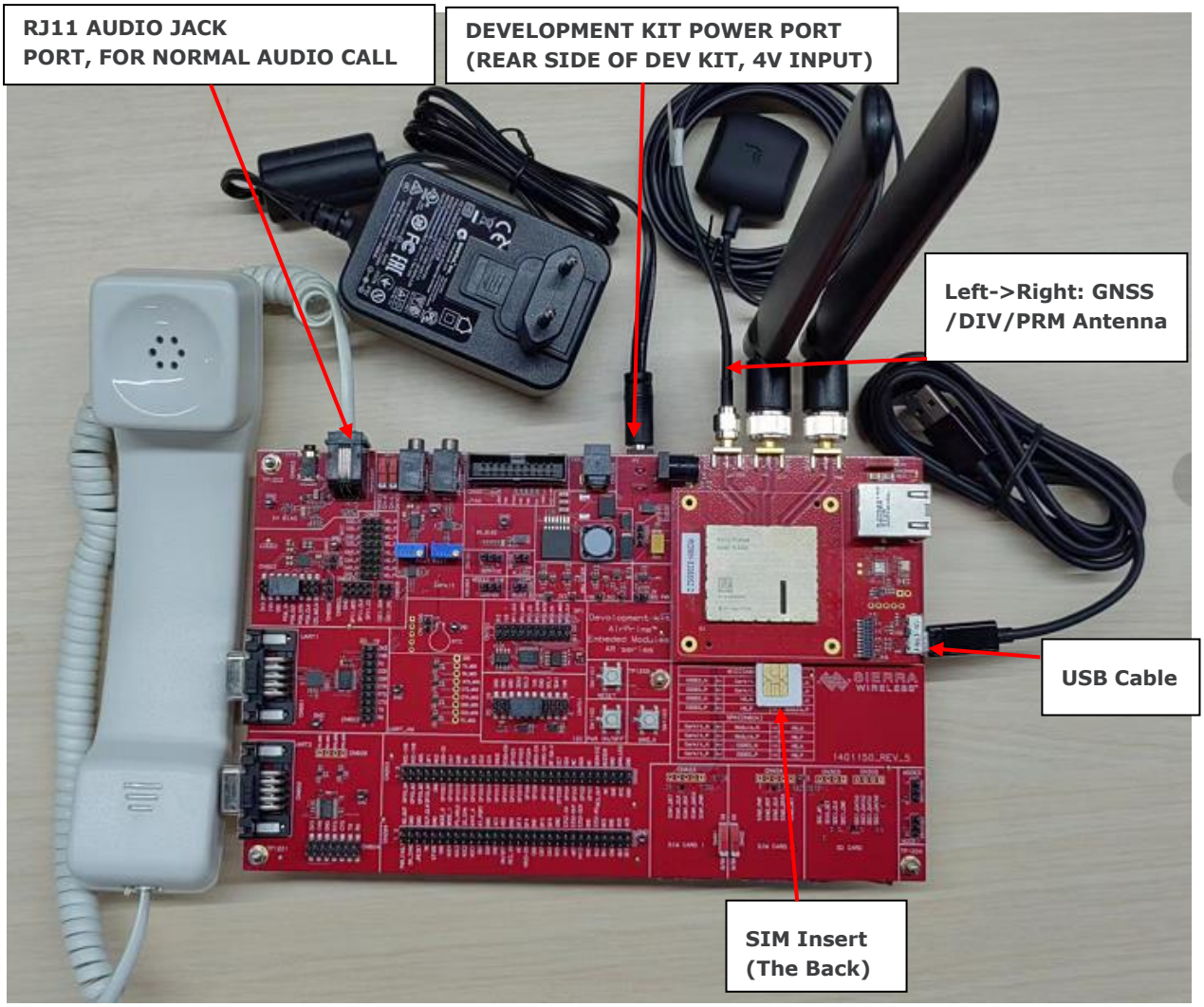


- WWAN/GNSS connectors:
- Main: Primary Tx/PRx path for 2G/3G/4G
- DIV: Diversity Rx for 2G/3G/4G

USB cable (Micro-USB)

2.2 CCB with antenna installed

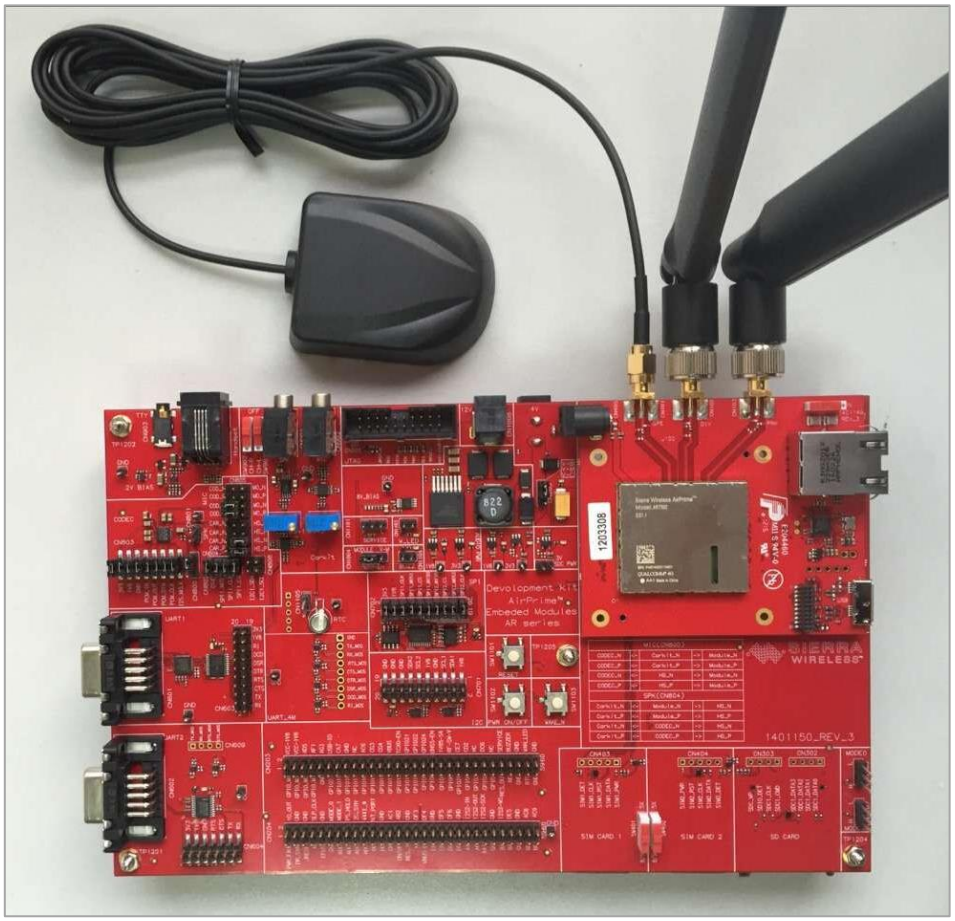
2.3 CCB with development kit (for voice and VOLTE relevant testing)



NOTE: For Testing, we suggest you use the ports listed below:

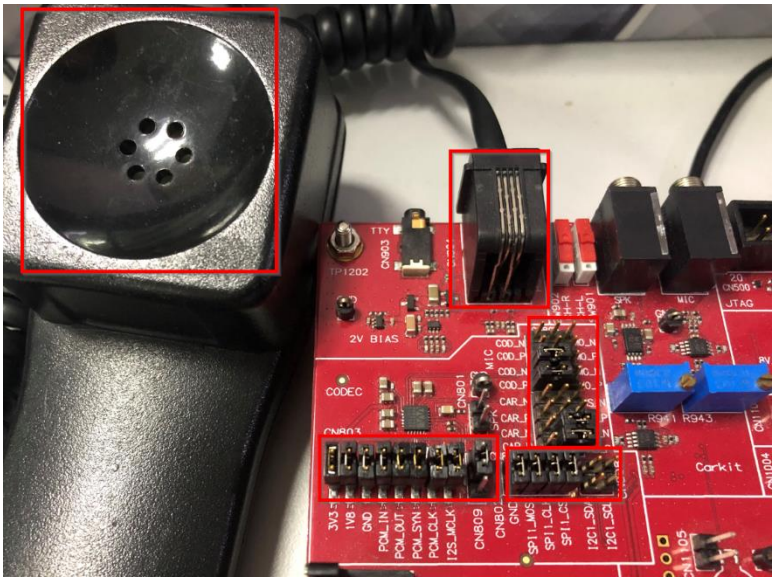
1. CCB POWER PORT (if use dev kit for audio test and VOLTE and field test, use DEVELOPMENT KIT POWER PORT instead)
2. USB PORT
3. CCB SIM SLOT
4. Main Antenna Port
5. DIV Antenna Port
6. GPS Antenna Port

1) CCB with development kit and antenna installed (For Field testing):



NOTE: The antenna must be oriented at 90 degrees, to get the optimal performance.

2) Connect the handset into RJ11 port as below.



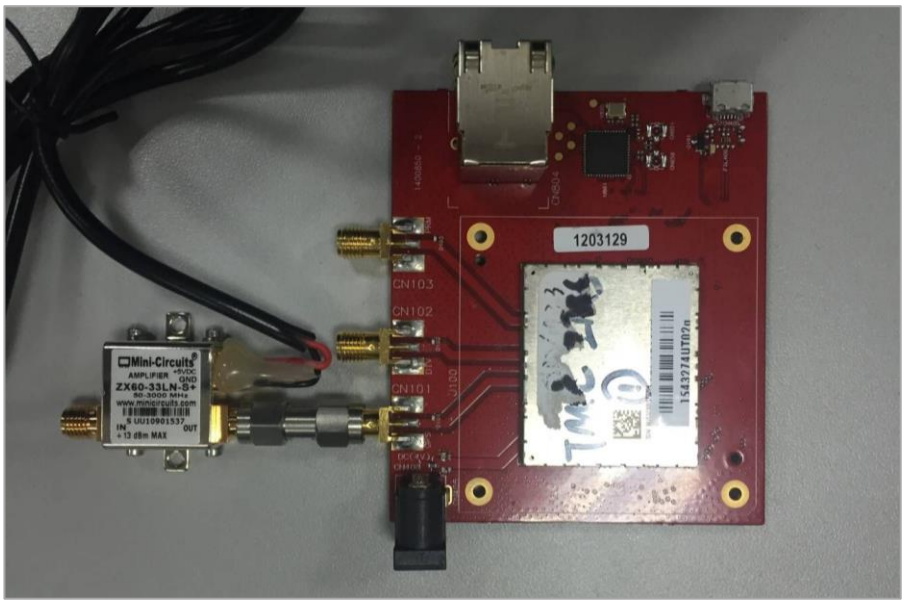
3) 4V Power Adaptor

Here is a photo of the 4V power adapter supplied with the Development Kit and CCB.

4) USB cable (Micro-USB)
Use default Micro-USB as the USB cable, as below.

2.4 CCB with ELNA for AGPS testing (ELNA is used to improve the GPS performance)

1) Please connect the below ELNA "out" port to the CCB GPS antenna port.



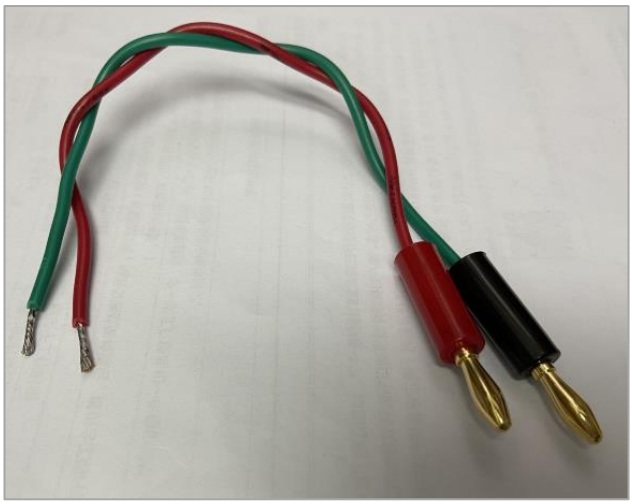
2.5 TTY test set up

(Please use the green dev kit and CCB which has a 2.5mm audio jack)

Please connect the below TTY adapter to the 2.5mm audio jack on the development kit.

2.6 Others: Power supply with power cable

The power cable can be used to connect DC power support to the development kit.



3 Install Device Drivers

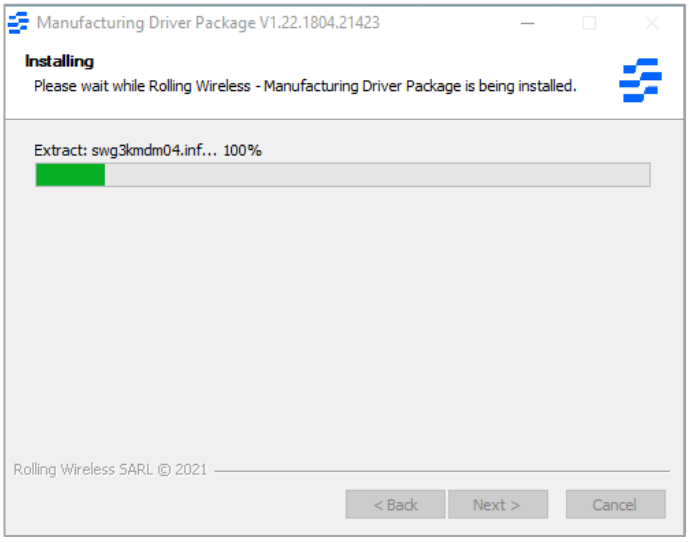
3.1 Install the USB Device Drivers

(Windows 10 1903 build and later)

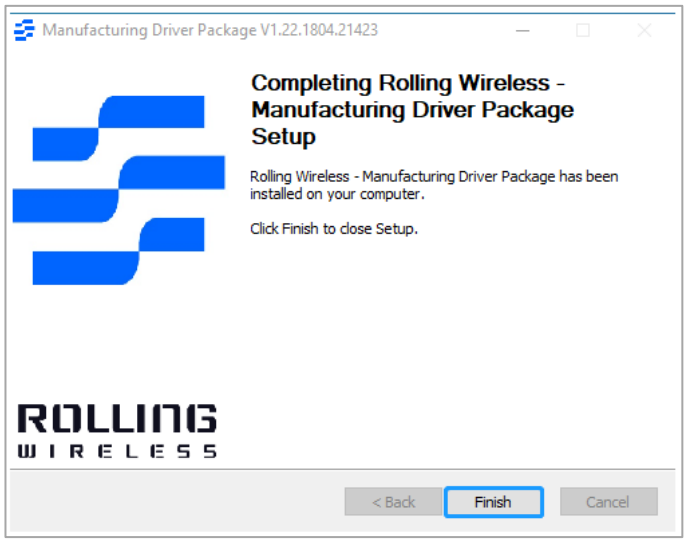
In general, Rolling Wireless will provide the recommended device driver for you to install. You will find it easy to follow the instructions (UI) to install the drivers before connecting the Rolling Wireless device. It will be recognized automatically as below.

Step 1: Download the driver RWS provided, such as Build21423_Manufacturing.
Please ensure the DUT is connected to the PC USB port. (Suggest using USB3.0 port or higher)
To install drivers for RL9xxx, run the ManufacturingDrivers.exe.

Step 2: You will see the following progress bar.



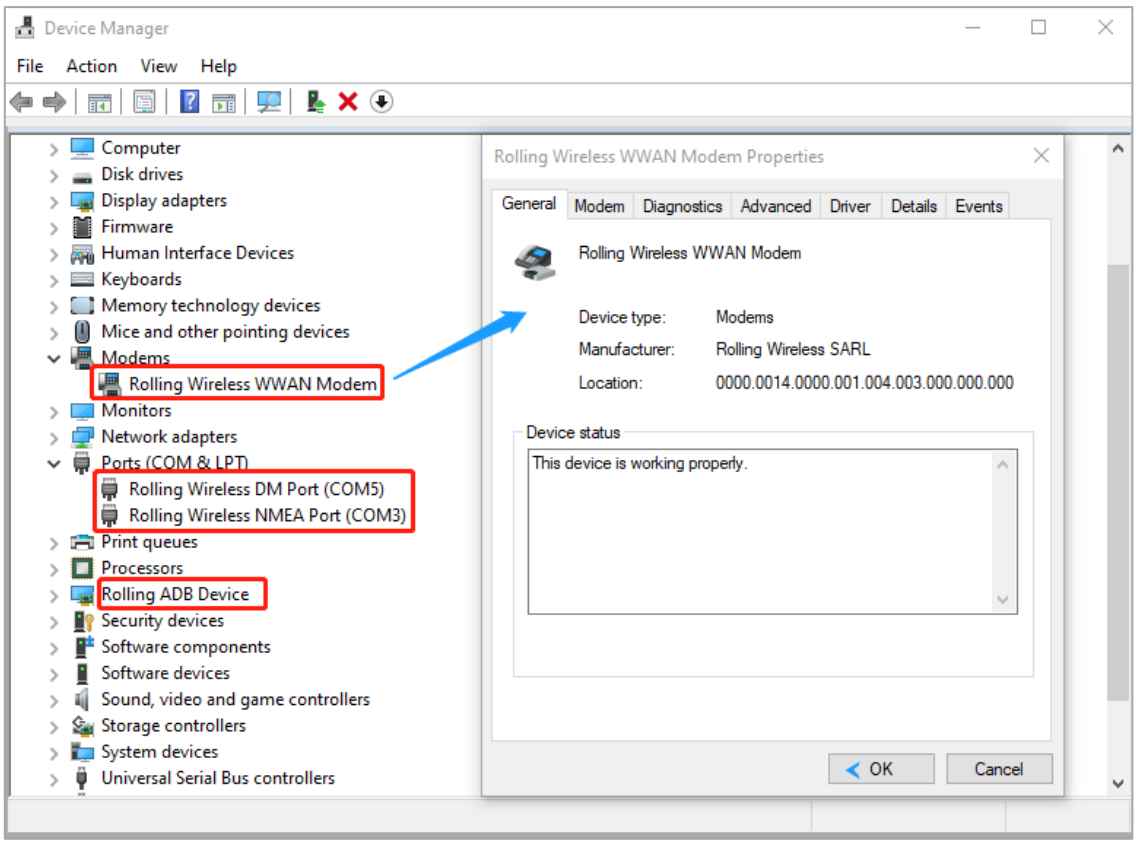
Step 3: Click **Finish** to complete the installation.



3.2 How to check the driver version

After the driver installation is complete, verify if the driver is operational by plugging the RL9xxx into your PC USB port. If you launch the device manager, you should see several USB ports (DM, NMEA…) in the PC device manager network adapter.

Right-click on the "Rolling Wireless WWAN Modem port", select "Properties", and then select the Driver Tab. The driver version will be shown as below.

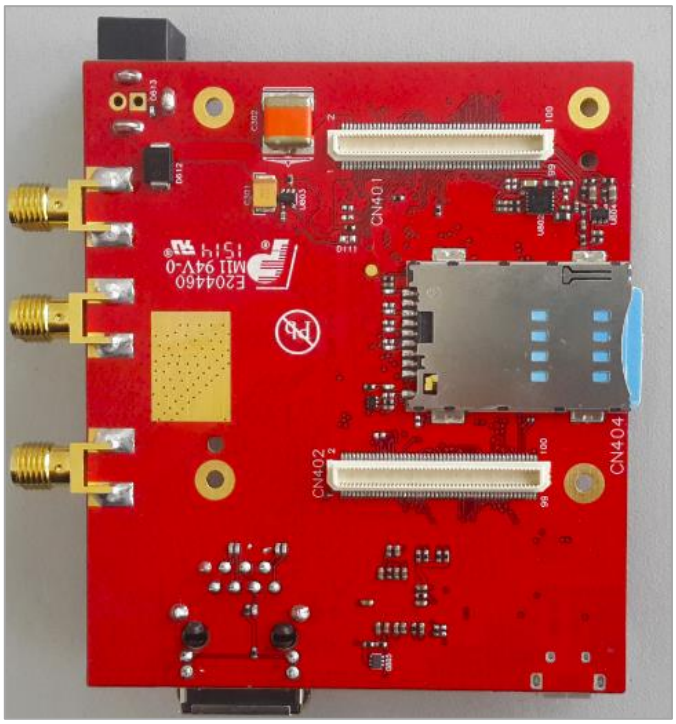


- Rolling Wireless WWAN Modem (for AT commands transmission)
- Rolling Wireless DM Port (For WWAN QXDM/EFS Explorer tools using)
- Rolling Wireless NMEA Port (For GNSS)
- Rolling ADB Device (For software upgrades)

4 Installing the SIM

Break the SIM out of the SIM Carrier.

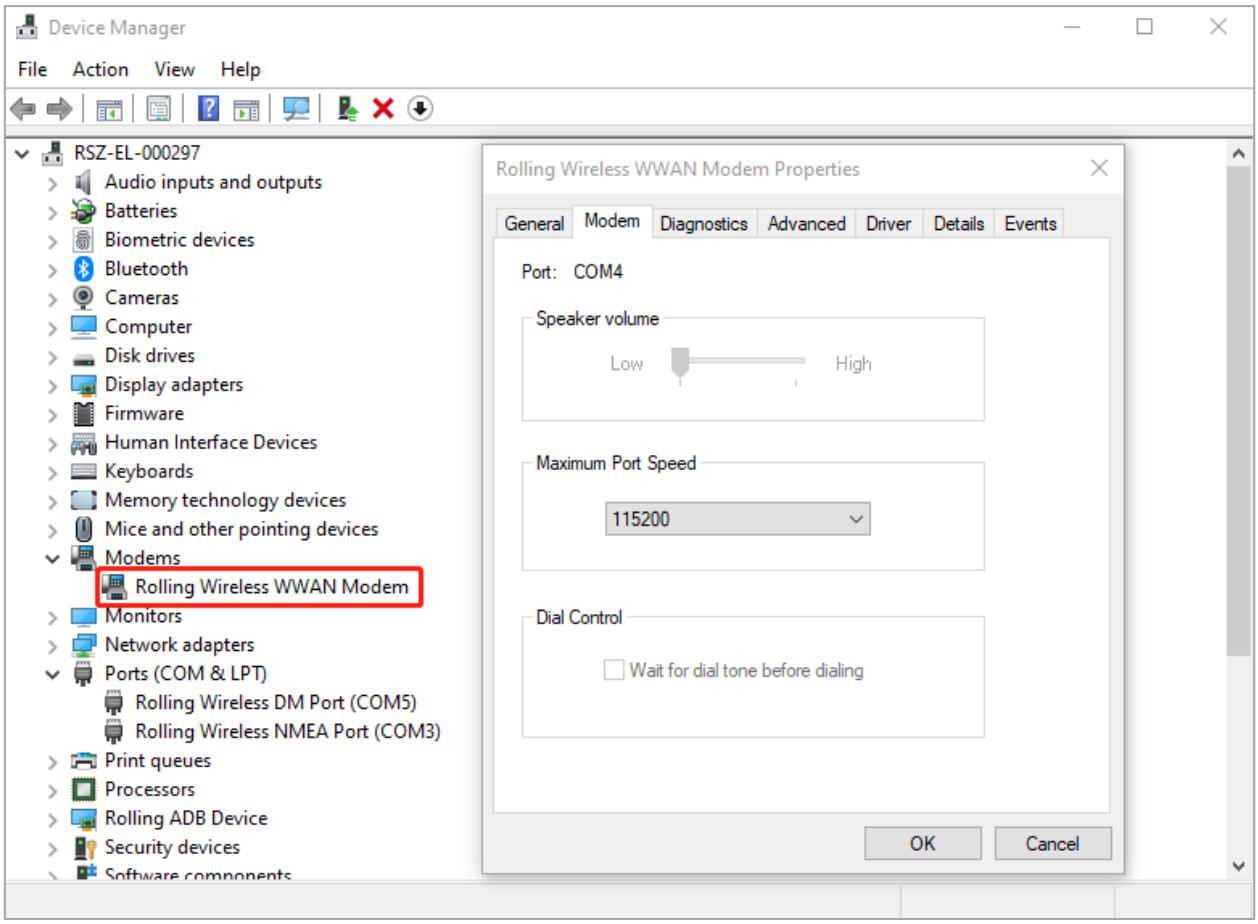
Install the SIM as the picture below.



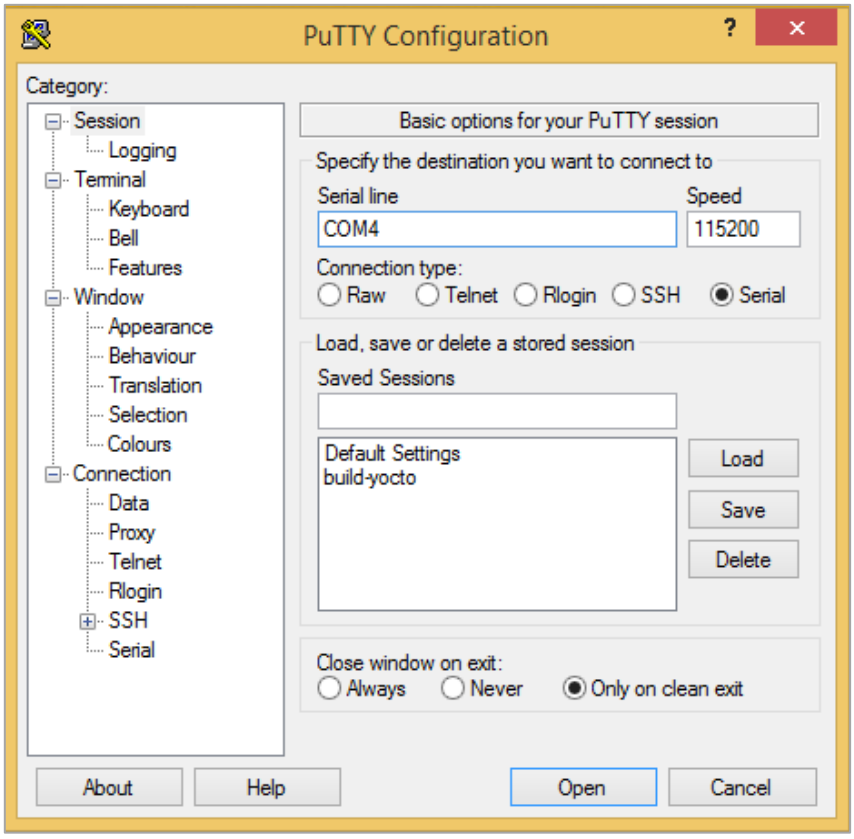
NOTE: The above picture is the SIM slot on CCB. If tested with dev. kit, the SIM slot on the dev. kit can also be used.

5 Accessing the modem AT Port

Find the modem AT port by checking the properties of the Rolling Wireless WWAN Modem in the Device Manager.



The properties show the WWAN Device is on COM4 (The modem enumeration port on your PC will vary). Launch your favourite terminal emulator program, select the correct port, and open the serial p ort.



Type "ATI" at the command prompt, to get the basic module information.

```
ATI

Manufacturer: Rolling Wireless
Model: RL9424
Revision: AFPQ9X40A_01.04.03.00 e72d5b jenkins 2022/04/06 04:17:59
IMEI: 001027009999999
IMEI SV:  1
FSN: 491484003408AD
+GCAP: +CGSM,+DS,+ES

OK
```

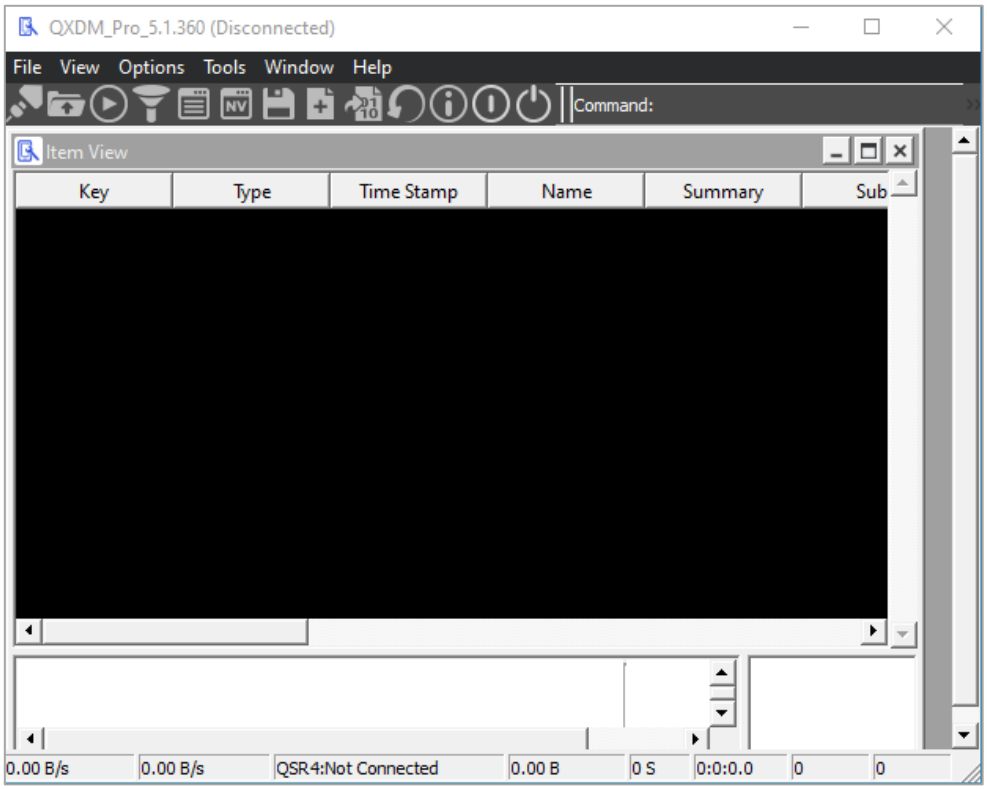
6 Firmware Upgrade Instructions

1) Check the firmware version prior to the upgrade using the AT command “ATI”.
2) Close any applications connected to the “DM” COM port prior to upgrading firmware such as QPST/QXDM.
3) Run one-click upgrade by double-clicking executable.
4) Wait while the firmware downloads and the module resets.
5) Verify the firmware version after the upgrade using the AT command “ATI”.

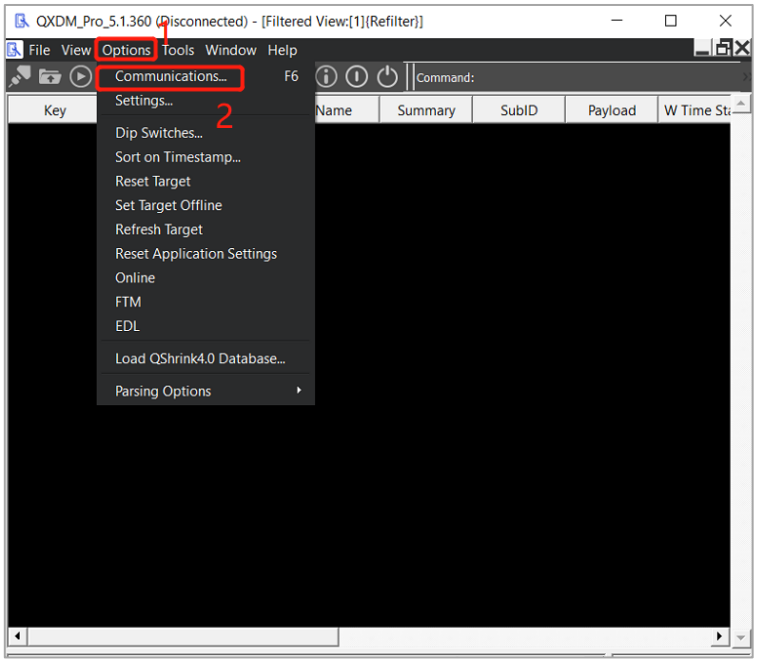
7 QXDM – Diagnostic Monitor

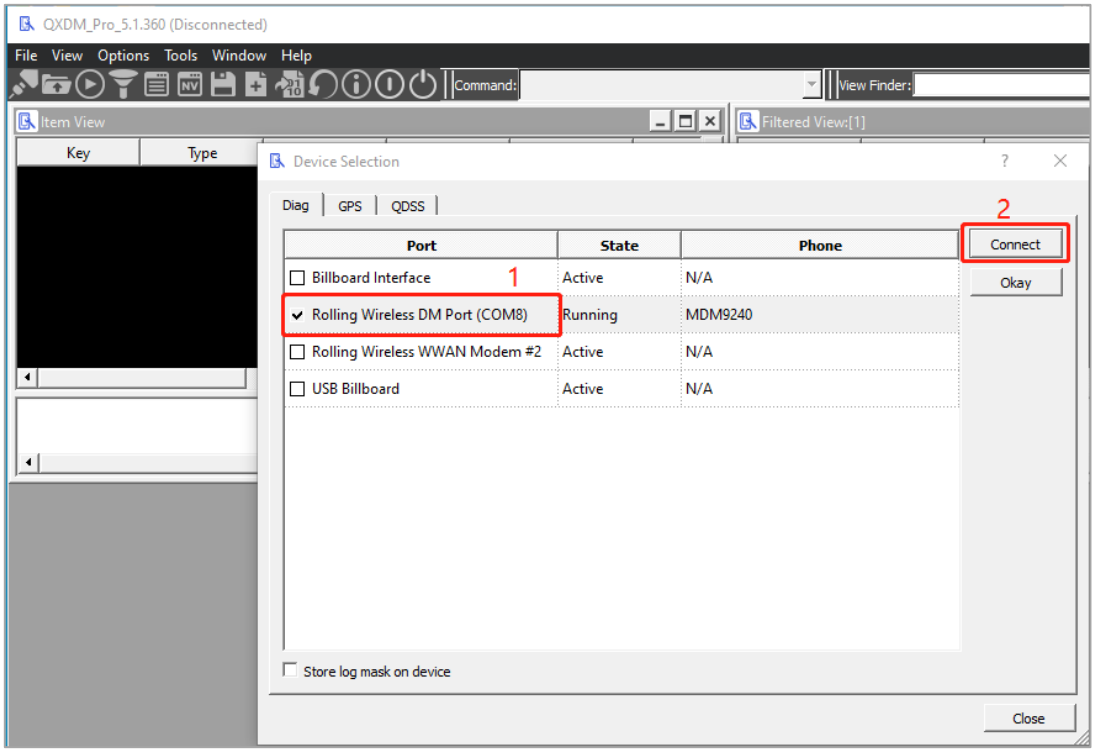
7.1 DM Logging

Step 1: Launch QXDM.

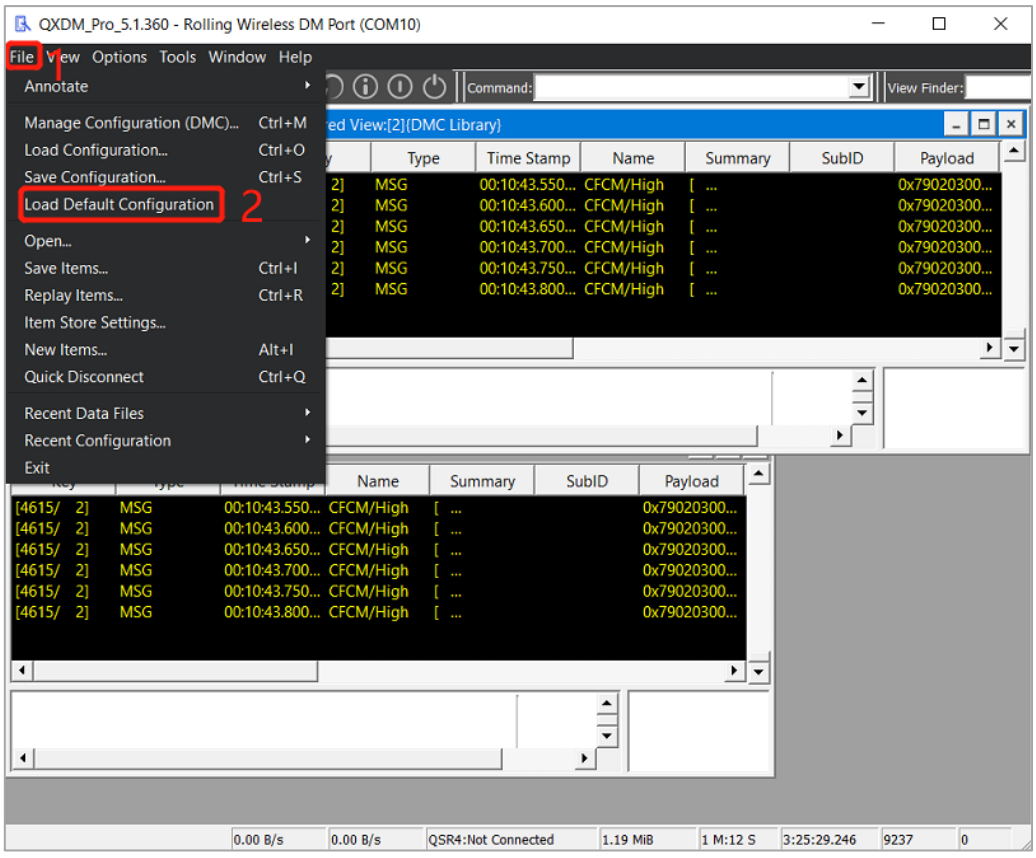


Step 2: Select **Options** -> **Communications**, select **Target DM Port**, and click **Connect**.

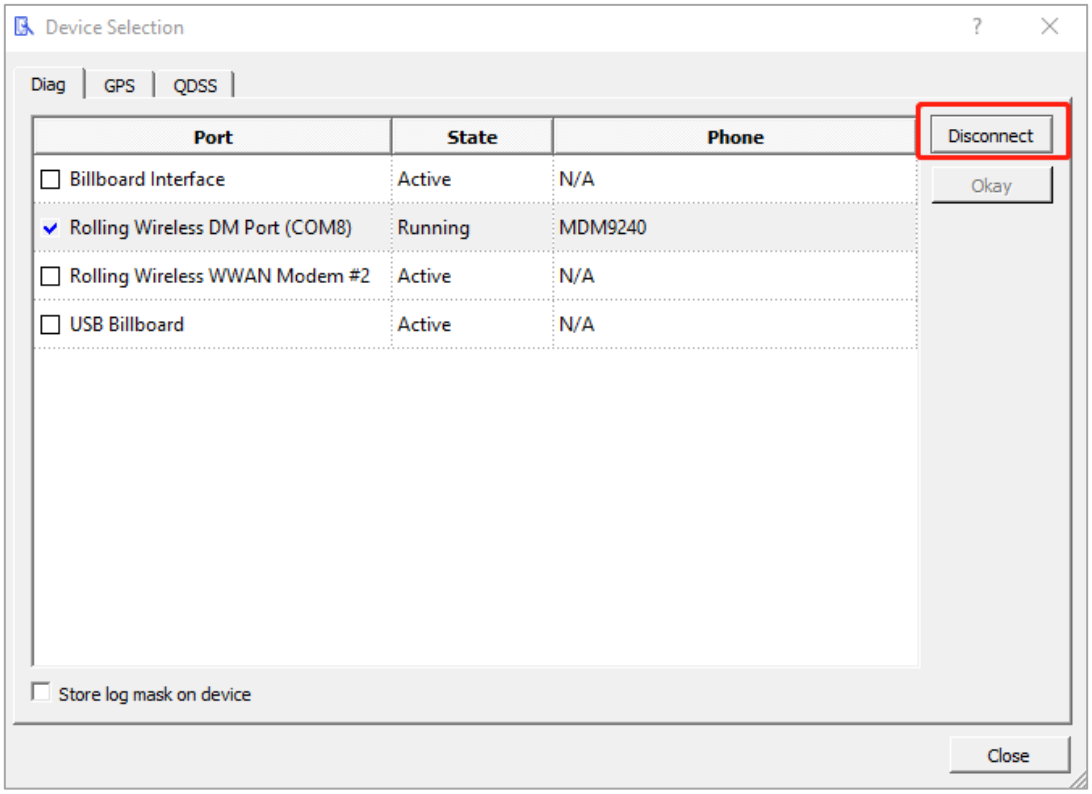


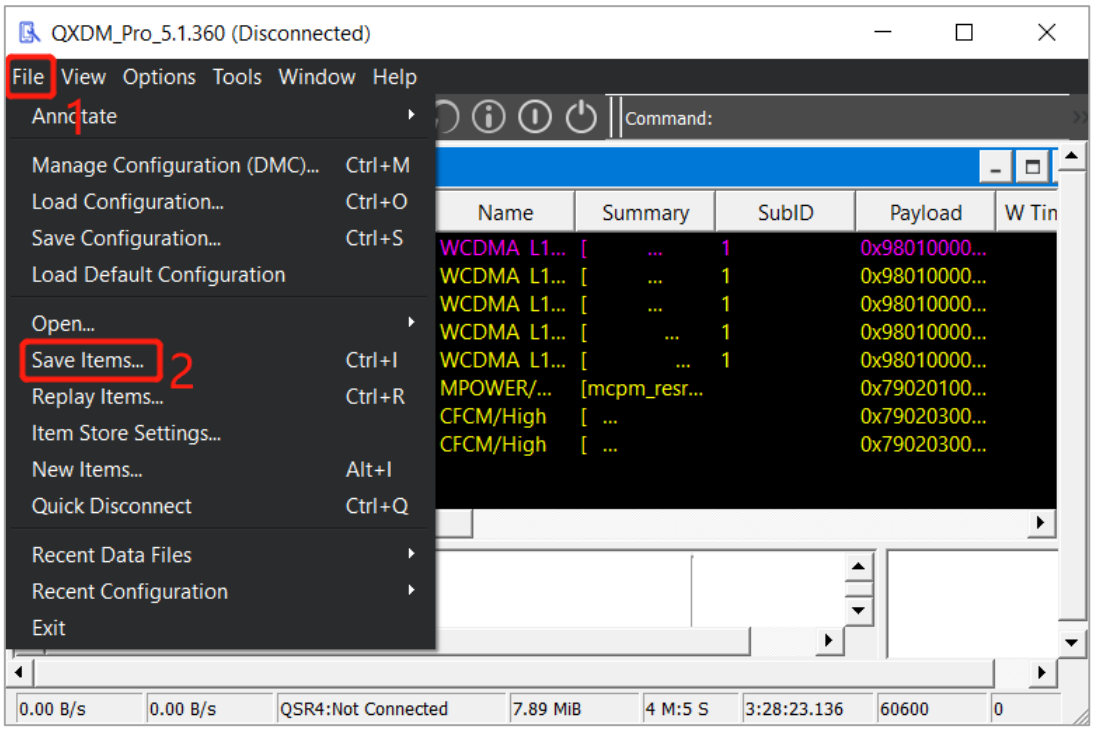


Step 3: Load the Default Configuration for capturing the DM log.



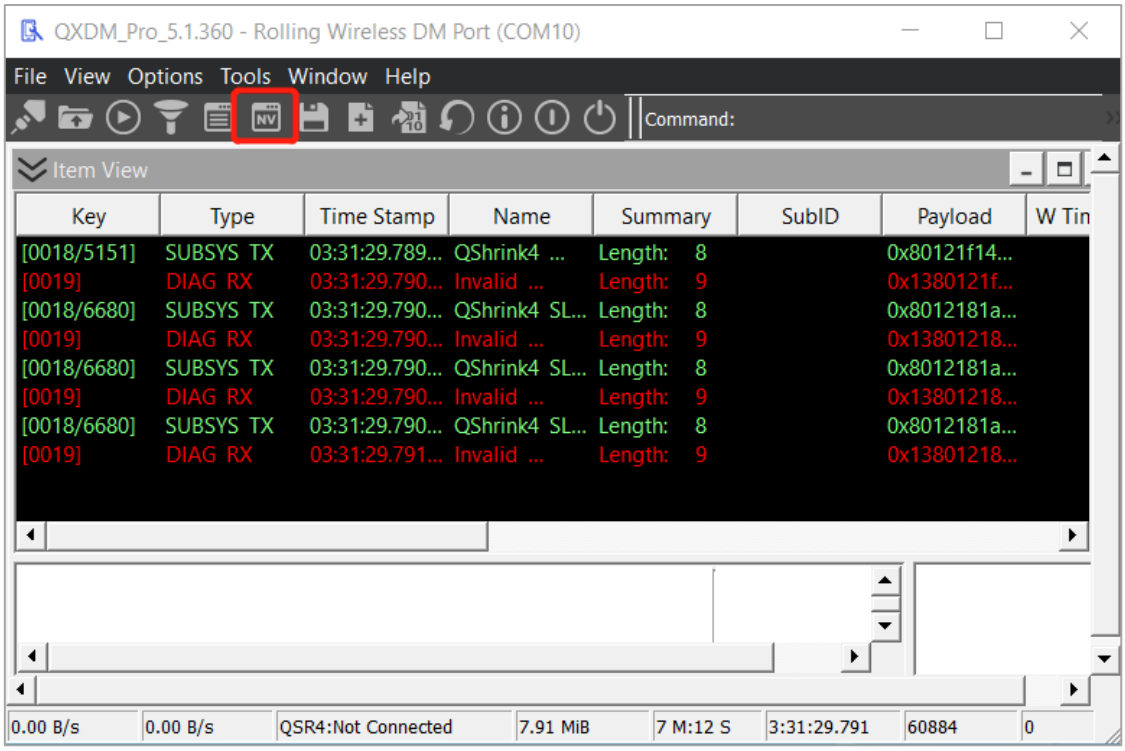
Step 4: When you complete the log capturing, you can **Disconnect** the DM port and then save the log into a local directory.





7.2 NVs modification

You also can modify the NVs in NV Browser by clicking the  when you have connected the DM port.



Search for the NV value you want to update, and click **READ**.

In the corresponding NAME line, enter the new NV value, and click **WRITE** to finish.

8 Reading the FSN and IMEI

AT command: ATI is for reading the FSN and IMEI

ATI
Manufacturer: Rolling Wireless
Model: RL9422
Revision: AFPQ9X40A_01.04.03.00 e72d5b jenkins 2022/04/06 04:17:59
IMEI: 001027009999999
IMEI SV: 1
FSN: 491484003408AD
+GCAP: +CGSM,+DS,+ES
OK

9 Changing Radio Mode Preference

AT!SELRAT is used to set/query mode preferences:

at!selrat=?

!SELRAT: Index, Name
00, Automatic
01, UMTS 3G Only
06, LTE Only
11, UMTS and LTE Only
OK

10 Making a Data Connection over windows 10 with cellular function

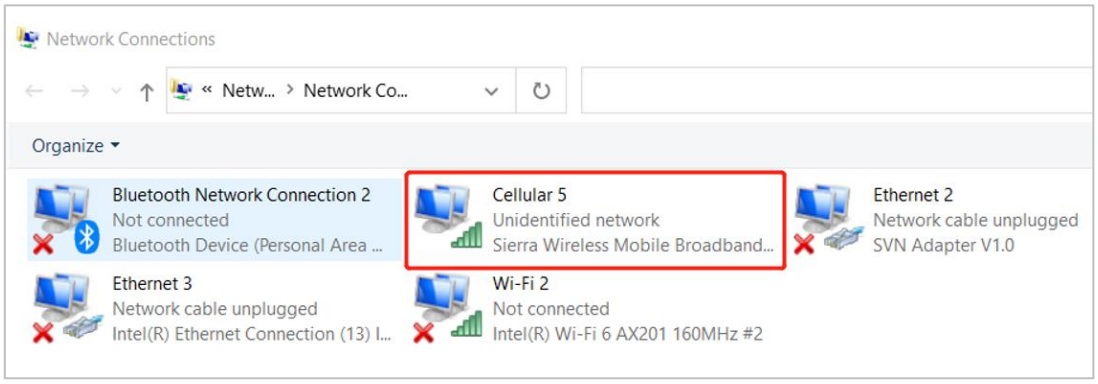
10.1 Establish a connection to the DUT and PC

Insert the SIM card and connect the power supply and USB port.

10.2 Connect the data call over PC

10.2.1 To enable UE register to the network, you could use below two AT command to trigger a new search of network:

AT+CFUN=0 (when the script prompts you to switch off the device/radio.)
AT+CFUN=1 (when the script prompts you to switch on the device/radio.)



10.2.2 To check if DUT registration status, you could issue “at!gstatus?” to query.

AT!GSTATUS?

!GSTATUS:
Current Time: 39 Temperature: 28
Modem Mitigate Level: 0 ModemProc Mitigate Level: 0
Reset Counter: 2 Mode: ONLINE
System mode: LTE PS state: Attached
IMS reg state: REGISTERED IMS mode: Normal
IMS Srv State: FULL SMS,FULL VoIP
LTE band: B1 LTE bw: 20 MHz
LTE Rx chan: 300 LTE Tx chan: 18300
LTE CA state: INACTIVE
EMM state: Registered Normal Service

RRC state: RRC Connected

PCC RxM RSSI: -87	RSRP (dBm): -112
PCC RxD RSSI: -90	RSRP (dBm): -116
Tx Power: 18	TAC: 2540 (9536)
RSRQ (dB): -5	Cell ID: 06F0C702 (116442882)
SINR (dB): 12.2	

OK

10.2.3 For data connection, you may issue below AT command to trigger data connection between DUT and PC (windows10).

AT!SCACT =<action>,<profile_id>

NOTE: action can be "0" or "1", "0" means disconnected and "1" means connected.

Example: for normal testing, such as PTCRB/GCF/most of the carriers, profile id is "1":

AT!SCACT=1,1 (setup with profiles 1)
AT!SCACT=0,1 (disconnect profiles 1)

The profile id of the carriers below is special:

For **Verizon testing**:
AT!SCACT=1,3 (setup with profiles 3)
AT!SCACT=0,3 (disconnect profiles 3)

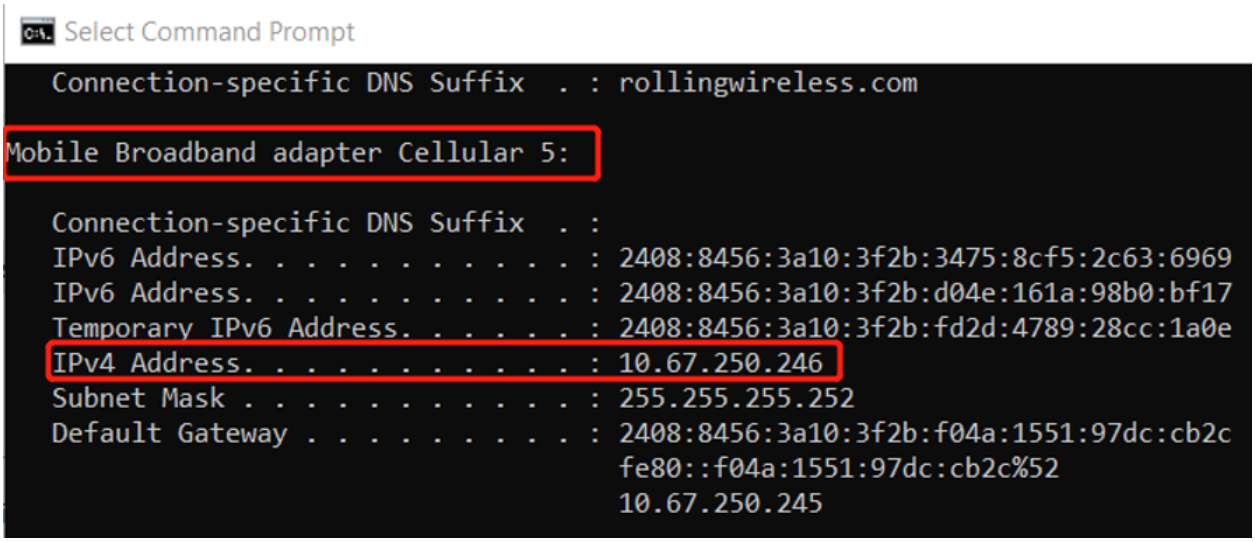
For **KT testing**:
AT!SCACT=1,2 (setup with profiles 2)
AT!SCACT=0,2 (disconnect profiles 2)

For **DCM(NTT) testing**:
AT!SCACT=1,2 (setup with profiles 2)
AT!SCACT=0,2 (disconnect profiles 2)

NOTE: To configure the APN on UE side, AT+CGDCONT (see the TS27.007 for the usage)

10.2.4 To make sure if the data call setup correctly between DUT and PC, issue "ipconfig" on cmd terminal(windows10).

Type "ipconfig", then click "Enter".



10.2.5 Disconnect the data call over PC

AT!SCACT =<0>,<profile_id>

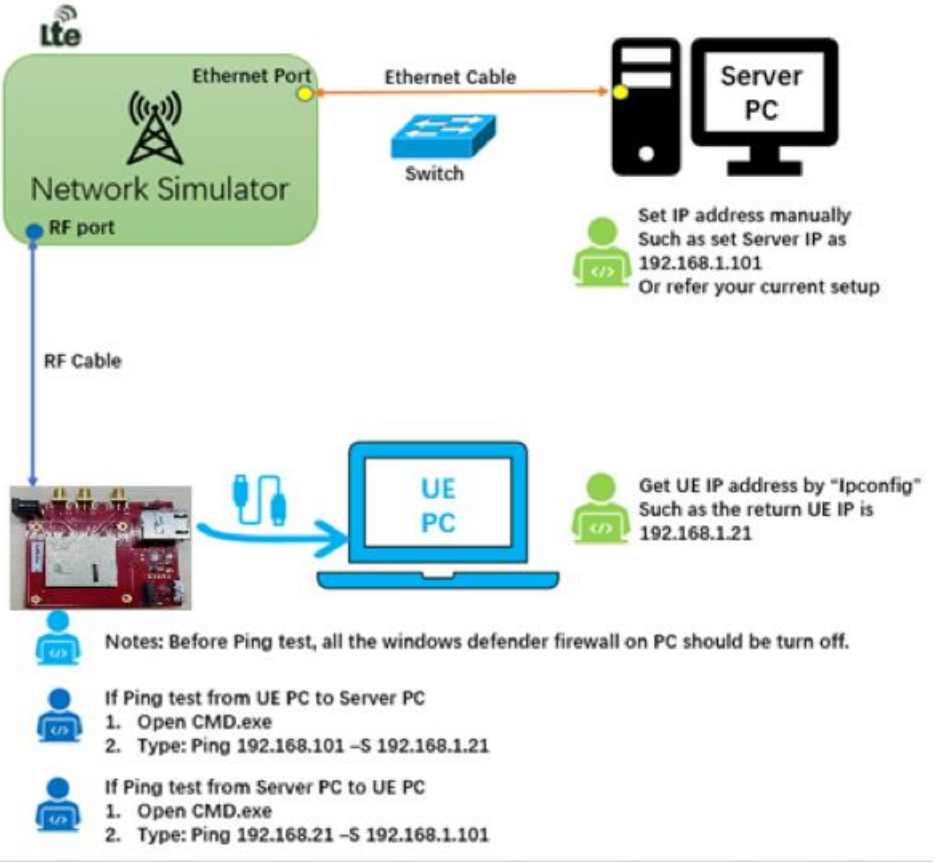
11 Ping between Simulation Network and UE

11.1 Ping destination IP address -S Source IP address

For example:

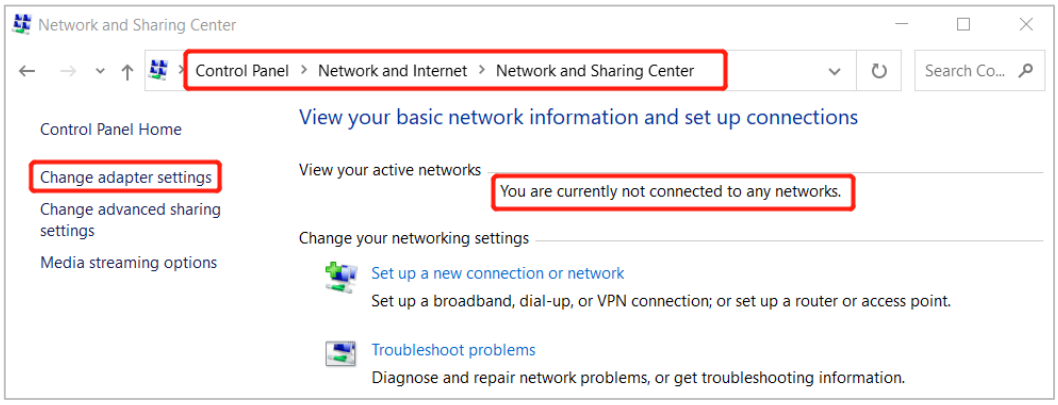
a) Disable the other connection on UE PC, such as WIFI/Ethernet (refer session 14.2, don't use airplane mode)
b) Disable all the firewall both on UE PC and Server PC (refer session 14.3)
c) Power on UE and have UE register to network
d) Make the Cellular connection and get connected
e) Figure out the UE IP address on UE PC by Ipconfig commend, such as 192.168.157.11
f) Figure out the server PC IP address by Ipconfig commend, such as 192.168.157.18
g) If require the ping from UE PC to Server PC, then Type: Ping 192.168.157.18 -S 192.168.157.11

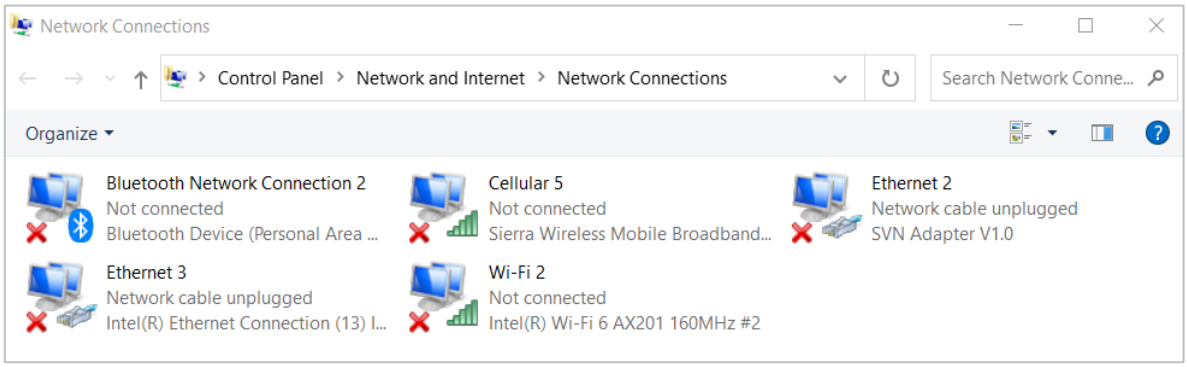
NOTE: All the Firewall need to be turn off on the destination side, and suggest disabling other network adapter before the testing, such as LAN & WIFI.



11.2 Disable the other networks

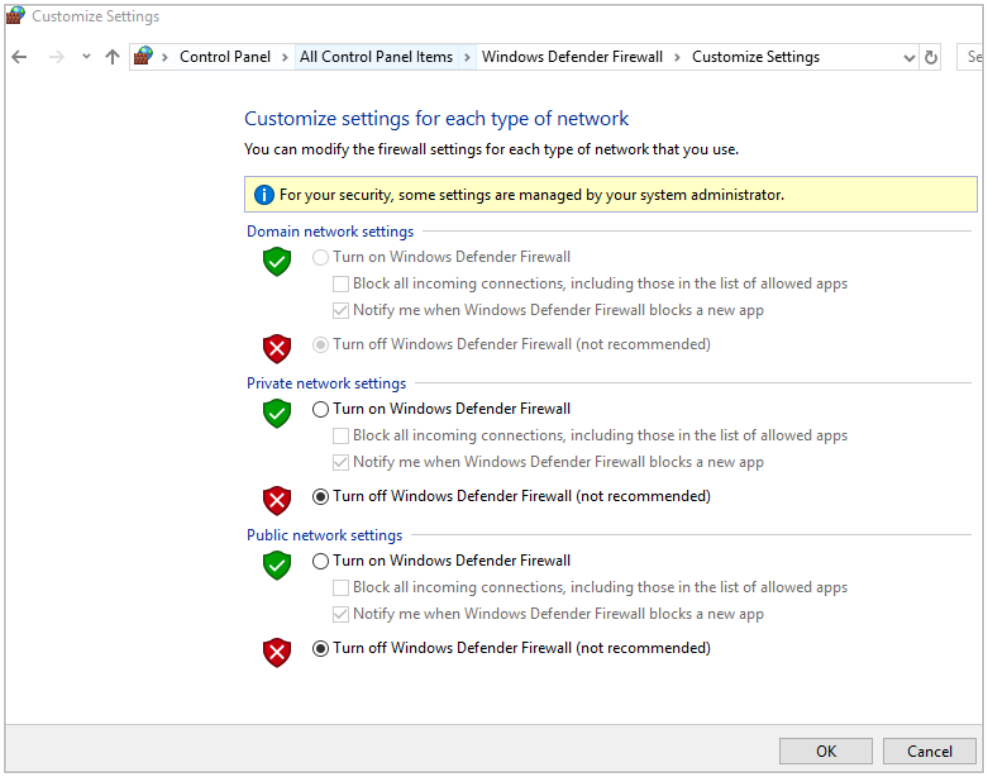
Control Panel\Network and Internet\Network and Sharing Center->click “Change adapter settings”, Disable the other connection on UE PC, such as WIFI/Ethernet (don’t use airplane mode)





11.3 Turn off Windows Defender Firewall

All the Firewall need to be turn off on the destination side.



12 Setting for VOLTE testing

To check APN setting:

AT+ CGDCONT?

+CGDCONT: 1,"IPV4V6","nxtgenphone","0.0.0.0",0,0
+CGDCONT: 2,"IPV4V6","**ims**","0.0.0.0",0,0
+CGDCONT: 3,"IPV4V6","**sos**","0.0.0.0",0,0

OK

To check P-CSCF Flag setting:

AT$QCPDPIMSCFGE?
AT$QCPDPIMSCFGE?

$QCPDPIMSCFGE: 1 , 0 , 0 , 0
$QCPDPIMSCFGE: 2 , **1** , 0 , 0
$QCPDPIMSCFGE: 3 , **1** , 0 , 0

To disable IMS

AT!UNLOCK=”A710”

AT!IMSTESTMODE=1

AT!RESET

To Enable IMS

AT!UNLOCK=”A710”

AT!IMSTESTMODE=0

AT!RESET

To Setup Normal or E911 Call:

ATDXXXXXXXXXX; or ATD911; /* XXXXXXXXXX is normal call number*/

To check if IMS VOLTE service is available:

AT!GSTATUS?

!GSTATUS:
Current Time: 401893 Temperature: 26
Bootup Time: 0 Mode: ONLINE
System mode: LTE PS state: Attached

LTE band: B7 LTE bw: 15 MHz
LTE Rx chan: 3280 LTE Tx chan: 65535
EMM state: Reregistered Attached
EMM connection:RRC Idle

RSSI (dBm): -70 Tx Power: 0
RSRP (dBm): -70 TAC: 0002 (0)
RSRQ (dB): 0 Cell ID: 00000001 (0)
SINR (dB): -20.0

IMS Reg State: REGISTERED IMS Mode: Normal
IMS Srv State: FULL SMS, FULL VoIP

OK

13 Setting for Audio related test

Device supports analog voice calls with the Dev-kit.

Please follow below 3 steps:

1) Configure the jumpers correctly on Dev-kit.(The jumpers should be well configurated by default)
2) Connect the handset into RJ11 port as below. (Refer to 2.3 CCB with development Kit)
3) Type the AT command as below.
   I. AT!AVSETPROFILE=5,0,0,0,6,0
   II. AT!AVMFTCODECMODE=5
   III. Note: Please set above two AT command again Once UE reset. (if audio needed)

AT commands for audio call:

###To enquiry the current audio configuration:
AT!AVCFG?

!AVCFG: 0,0,1
!AVCFG: 1,0,1
!AVCFG: 2,0,1
!AVCFG: 3,0,1
!AVCFG: 4,0,1
!AVCFG: 5,0,1
!AVCFG: 6,0,1
!AVCFG: 7,0,1
!AVCFG: 8,0,1
!AVCFG: 9,0,1

OK
To set the Audio profile to 5
AT!AVSETPROFILE=5,0,0,0,6,0

OK

###To set the Audio codec mode to 5
****Must run after each reset or power cycle or there will be no sound****

AT!AVMFTCODECMODE=5

OK

14 Setting for GPS and AGPS testing:

14.1 For UP test cases:

14.1.1 UE parameter setting:

(1). at!unlock="A710"
(2). At!gpssuplurl=”www.spirent-lcs.com:7275” -- replace the server URL if necessary.
(3). At!gpsmomethod = 1
(4). At!gpsmtlrsettings = 0
(5). at!gpsposmode=ff7f
(6). at!gpstranssec=1
(7). at!gpssuplver=2
(8). At!reset

If the test case has an NI message, the NI message will display in the AT port.
If the test case requires a manual response to the NI message, you can use At!gpssendniresp = 0 (accept) 1 (deny) to respond, if not, wait 25 seconds, and our device will auto-reply. The auto-reply timer setting by At!gpssuplnitimeout = 15(waiting time).

14.1.2 Cert file setting

The cert file in the server and UE should correspond.

(1). Update UE cert file:
1. Delete all the files in /SUPL and /CERT folder.
2. Copy the SuplRootCert to those two folders.
3. Use At!reset to reset the device
(2). Update the Server cert file if necessary:
1. TLS Server Certificate(*.cer) use *.cer
2. TLS privateKey(*.pen, *.pvk) use *.pem
3. TLS root Certificat(*cer) use *.cer

Parameter	Value
Supported SUPL Version	1.0.0
SUPL Initiation Method	WAP PUSH
SMS Destination Port	7275
SLP Address Choice	IP Address
SLP IP Address Type	IPv4
SLP FQDN	www.spirent-lcs.com
SLP IPv4 Address	192.168.0.35
SLP IPv6 Address	0:0:0:0:0:ffff:c0a8:0023
SLP Port Number	7275
SLP Mode	ProxyMode
Authentication Mode	AlternativeClient Authentication
ST1 Timer (s)	10.0
ST2 Timer (s)	30.0
Content Type (including length)	application/vnd.omaloc-supl-init
Application ID	x-oma-application:ulp.ua
Turn On Secure Session	Yes
TLS Version	Auto
TLS CipherSuite	Any of the above listed suites
TLS Library	GNU TLS
TLS Server Certificate(*.cer)	...\SERVERCERTIFICATES\spirent-lcs2048.cer
TLS PrivateKey (*.pem;*.pvk)	...\PRIVATEKEYS\spirent-lcskey2048.pem
TLS Root Certificate(*.cer)	...\SERVERCERTIFICATES\spirentroot2048.cer
TLS Server Certificate Hostname	www.spirent-lcs.com
TLS PrivateKey's Password	Spirent

14.2 CP test case setting

14.2.1 UE parameter setting:

(1). at!unlock="A710"
(2). At!gpssuplurl=”www.spirent-lcs.com:7275” -- replace the server URL if necessary.
(3). At!gpsmomethod = 0
(4). At!gpsmtlrsettings = 0
(5). at!gpsposmode=ff7f
(6). at!gpstranssec=1
(7). At!reset

If the test case has an NI message, the NI message will display in the AT port.
If the test case requires a manual response to the NI message, you can use At!gpssendniresp = 0 (accept) 1 (deny) to respond, if not, wait 25 seconds, and our device will auto-reply. The auto-reply timer setting by At!gpssuplnitimeout = 15(waiting time).

14.2.2 SBAS AT Command:

1. Unlock module
AT!UNLOCK="A710"
2. Enable GPS
AT!CUSTOM="GPSENABLE", 1
3. Reset the module for configuation activation
AT!RESET
4. Delete GPS Assistance Date
AT!GPSCOLDSTART
5. Enable all GNSS satellite capabilities
AT!GNSSCONFIG=1,1,1,1,1
6. Start GNSS fix

AT!GPSTRACK=1,255,255,1000,1
7. Check whether SBAS satellite found with
AT!GPSSATINFO?

SV ID 33-54 belongs to SBAS systems.
eg: SV:41 is SBAS satellite.
AT!GPSSATINFO?
Satellites in view: 4 (1980 01 06 6 00:09:08)
* SV: 5 ELEV: 49 AZI: 270 CN0: 36
* SV: 19 ELEV: 35 AZI: 136 CN0: 27
* SV: 20 ELEV: 60 AZI: 329 CN0: 34
* SV: 41 ELEV: 0 AZI: 0 CN0: 35
OK

15 Basic AT commands used for testing

15.1 Set Voice Auto Answer Mode

ITEMS	OPERATIONS	COMMENTS
AT commands	AT! NV=74, 1 ATS0=<value> /* Answers after the specified number of rings.*/	Note: You have to reset the device to make it work.

15.2 Programming Emergency Call Test Number

ITEMS	OPERATIONS	COMMENTS
AT commands	AT! NVENUM=1,"XXXXX" /* XXXXX means Emergency Number */	Note: You have to reset the device to make the Emergency number work.

15.3 Resetting the Device during Scripted Testing

ITEMS	OPERATIONS	COMMENTS
AT commands	Use AT+CFUN=0 when the script prompts you to switch off the device/radio. Use AT+CFUN=1 when the script prompts you to switch on the device/radio. AT!RESET is used for resetting the device. It will take longer to find service and initiate attach procedure.	Note: Close all Qualcomm tools (QXDM etc.) before performing AT!RESET. Keeping these tools running will sometime cause USB enumeration issues after AT!RESET is performed. If encounters a USB enumeration issue, rebooting OS will be required. All test cases that involve a refresh of the UICC or authentication information will need a full power-off reset. This is done by removing power from the Dev-Kit and waiting for 1 minute for the device to fully power off before applying power again.

15.4 Diversity Receiver Testing (for W and L)

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!ENTERCND="A710" AT!RXDEN=0 AT!RESET	Enable Primary Receiver Only
AT commands	AT!ENTERCND="A710" AT!RXDEN=1 AT!RESET	Enable Both Receivers
AT commands	AT!ENTERCND="A710" AT!RXDEN=2 AT!RESET	Enable Secondary Receiver Only

15.5 Data Service

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!SCACT =<action>,<profile_id> AT!SCACT? AT!SCACT =? **Example:** AT!SCACT=1,3	**For SCACT** Currently, this command supports both UMTS and CDMA profile id. For detail please check AT!SCACT=? Please check the response of AT!CGDCONT? for profile contents info. **Note: AT! SCACT=1 is preferable.**

15.6 Voice Call Service

ITEMS	OPERATIONS	COMMENTS
AT commands	ATD12345678;	Init MO voice call
	ATA	Answer MT voice call
	ATH	Hung up MT voice call

ITEMS	OPERATIONS	COMMENTS
	AT!ENTERCND=”A710” AT!AVTTY = <profile>, <mode>	<profile>: 0-5, 6 audio profiles in total By default, profile 0 is for TTY purpose <mode>: 0-2 0: Full mode 1: Voice Carry Over (VCO) mode 2: Hearing Cary Over (HCO) mode

15.7 SMS Service

ITEMS	OPERATIONS	COMMENTS
AT commands	**3GPP Mode SMS Command:** **1. Send SMS** **Text SMS:** AT+CMGF=1 OK AT+CMGS="+31628870634" > This is the text message.<Ctrl>+<Z> +CMGS: 45 OK **PDU SMS:** AT+CMGF=0 OK AT+CMGS=42 > 07915892000000F001000B915892214365F70000 21493A283D0795C3F33C88FE06CDCB6E32885EC 6D341EDF27C1E3E97E72E <Ctrl>+<Z> +CMGS: 12 **2. Read SMS** AT+CMGR=<index> **3. List SMS** AT+CMGL=<stat> **4. Delete SMS** AT+CMGD=<index>	For detailed usage of these AT commands please use "=?" to check. Note: For IMS SMS, the device should register to IMS first, if the module is set to send 3GPP format SMS, AT+CMGS should be used, otherwise AT$QCMGS should be used.

ITEMS	OPERATIONS	COMMENTS
AT commands	at^hsmsss=1,0,1,0	/* First '1' indicates status: 0:FALSE, 1:TRUE */ /* Second '1' in red color indicates encoding type: 0:GSM 7 bit, 1: ASCII 7-bit */
QMI Interface	Skylight: Menu à SMS Express	Skylight will need to be used if need to send concatenated SMS.

15.8 DTMF Service

ITEMS	OPERATIONS	COMMENTS

AT commands	AT+VTS=<0~9,*,#>
	
	Example:
	##### Test in GSM/WCDMA mode ###
	AT+VTD?
	+VTD: 20
	OK
	AT+VTD=3000
	OK
	ATD10086;
	OK
	AT+VTS=1
	OK
	
	ATH
	OK
		+VTS to issue continuous DTMF
		+VTD to configure continuous DTMF duration under GW mode.
		
		//current duration under GW mode
		
		//change the duration to 3000 milliseconds under GW mode if you want
		
		//input one digital continuous DTMF

15.9 Supplementary Services

The commands below are standard 3GPP AT commands. You can refer to TS 27.007 for detailed usage.

ITEMS	OPERATIONS	COMMENTS
AT commands	AT+CHLD = <n>	Control call hold functions

ITEMS	OPERATIONS	COMMENTS
AT commands	AT+CCFC = <reason>, <mode>	Control call forwarding functions.
AT commands	AT+CCWA = <n>	Check current module voltage.
AT commands	AT+CLIP = <n>	Control calling line identity (CLI) of the calling party when receiving a mobile terminated call
	AT+COLP = <n>	Control a calling subscriber to get the connected line identity (COL) of the called party after setting up a mobile originated call

15.10 Diag Commands

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!GSTATUS?	Shows a snapshot of what rat/band/channel the device is on.
AT commands	AT!ENTERCND="A710" AT!PCTEMP?	Check current module temperature.
AT commands	AT!ENTERCND="A710" AT!PCVOLT?	Check current module voltage.
AT commands	AT+CGDCONT?	Check the profile contents.

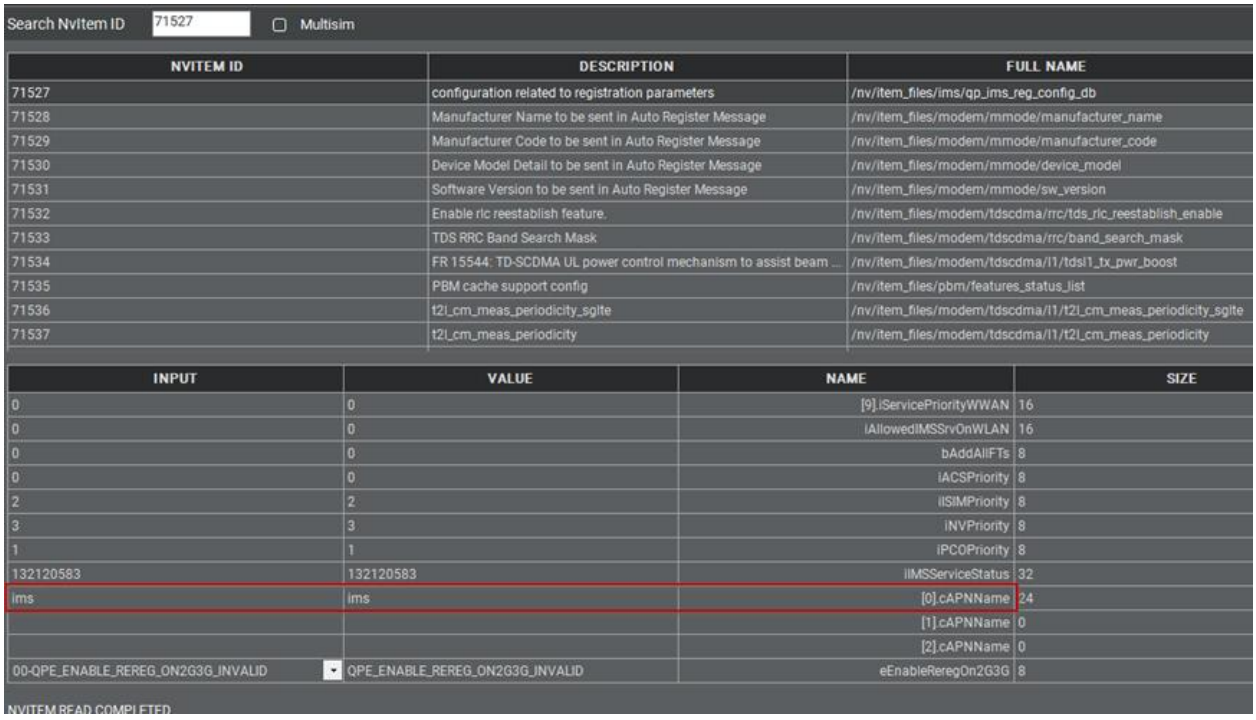
15.11 Enable/Disable IMS

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!UNLOCK=”A710” AT!IMSTESTMODE=1 AT!RESET	Disable IMS.
AT commands	AT!UNLOCK=”A710” AT!IMSTESTMODE=0 AT!RESET	Enable IMS.

15.12 Change IMS APN name per test purpose

To change the name of IMS APN, below AT command & NV change are required:

- at!unlock="A710"
- at+cgdcont?
  (figure out the current IMS APN profile in used)
- at+cgdcont=2,"IPV4V6","ims"
  (Take profile 2 as example and change IMS name as "ims")
- Configure NV71527 -> (0).cAPNNAME with value “ims” as below screenshot.
  (How to configure NV? Please refer to chapter 7.2)
- Reset device.



15.13 TTY command

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!AVCFG=5,2,1 (TTY device) AT!AVSETPROFILE=5 AT!AVMFTCODECMODE=5	Enable TTY, and deregister IMS.

ITEMS	OPERATIONS	COMMENTS
AT commands	AT! AVCFG? AT!AVSETPORFILE=1 (chose a none TTY device profile index, prefer to set it back to 1 as it is the default audio setting)	Disable TTY, and register IMS.
AT commands	AT! AVSETPROFILE? (query the current audio profile index) AT! AVCFG? (Query the audio profile configure if the second parameter of the current profile is '2', that means it is a TTY profile)	Query the TTY state #### Reference ### AT!AVSETPROFILE? !AVSETPROFILE: 5,0,0,0,3,0 OK ## 5 as current profile in use; AT!AVCFG? !AVCFG: 0,0,2 !AVCFG: 1,0,2 !AVCFG: 2,0,0,1,0,0,0,4 !AVCFG: 3,0,1 !AVCFG: 4,0,3 !AVCFG: 5,2,2 OK ## 2 mean current profile enable TTY;

NOTE: Do not forget to disable TTY after TTY testing is completed. Or else the module will fail to do IMS registration.

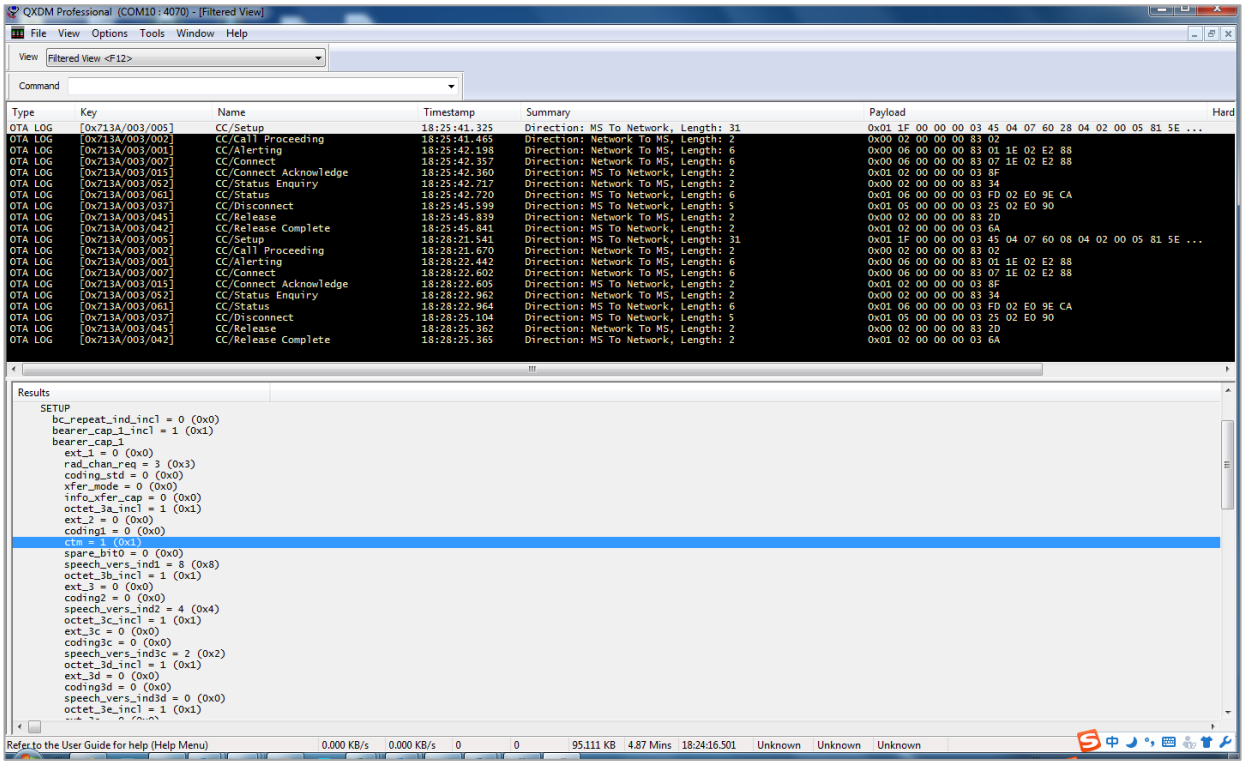
15.14 Caller ID display AT command

ITEMS	OPERATIONS	COMMENTS
AT commands	AT!IPCALLNAME?	To display caller ID per AT&T requirement.

16 Others

16.1 Get TTY state over QXDM

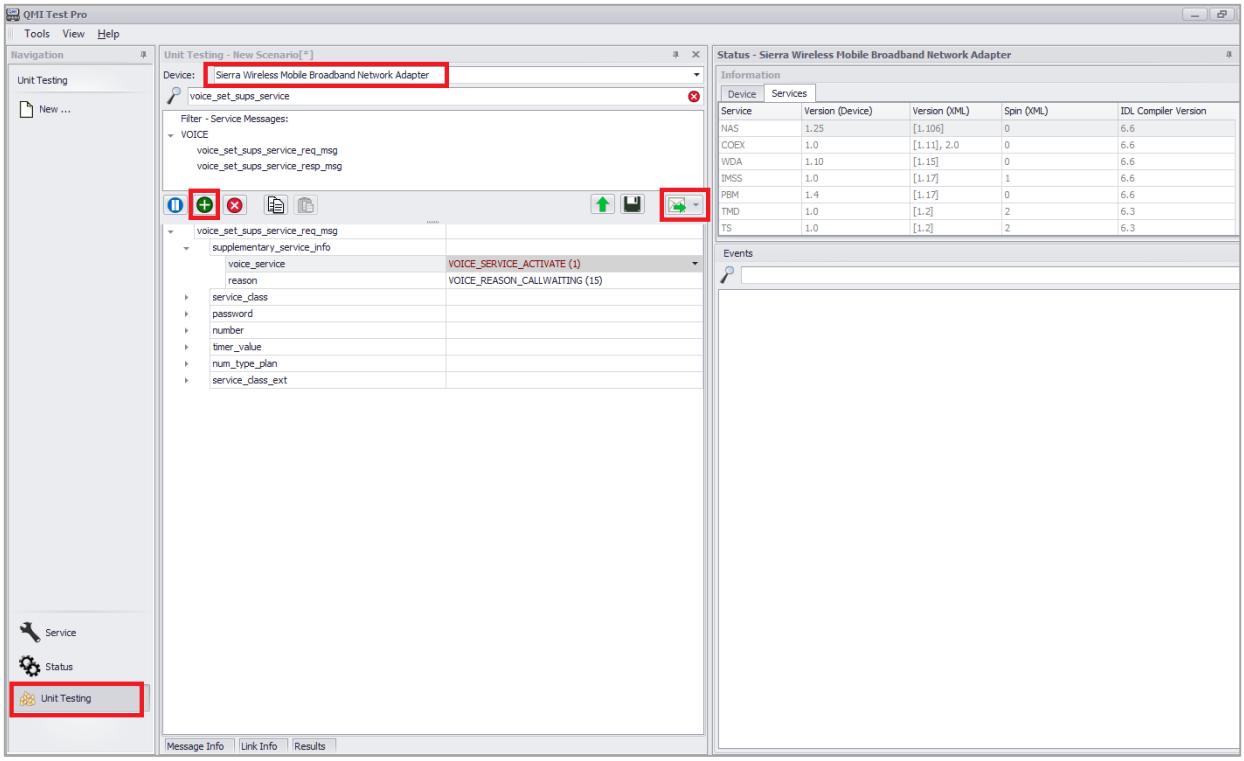
TTY state could be checked in the OTA message as below if the CTM in the CM setup message is set to "1", which means the TTY is enabled.



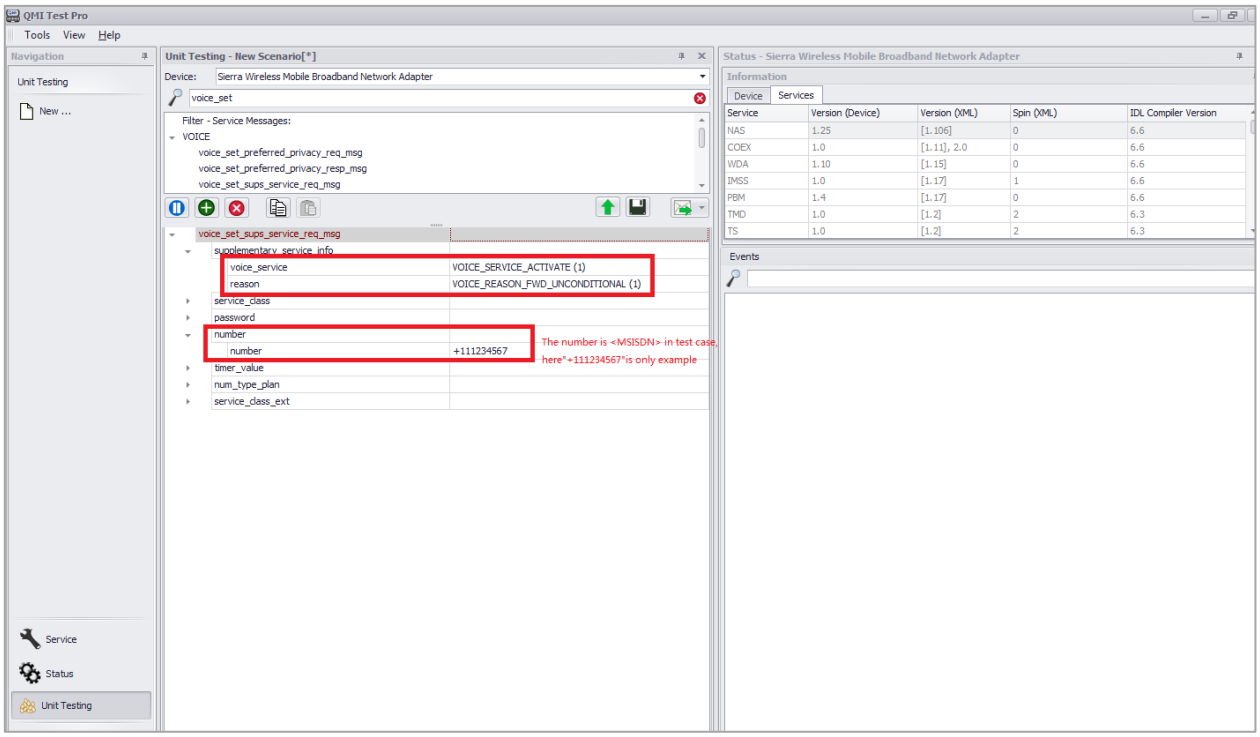
16.2 QMI Test Guide for UT interface Cases

For all Ut Interface Test Plan, keep NV70239 to 2 and use the QMI command "voice_set_sups_service_req_msg" with QMI test pro, but the QMI setting is different for all cases.

1. LTE-BTR-5-4200(TC5.1):
Set voice_service to VOICE_SERVICE_ACTIVATE (for *43#) or VOICE_SERVICE_DEACTIVATE(for #43#)
Set reason to VOICE_REASON_CALLWAITING

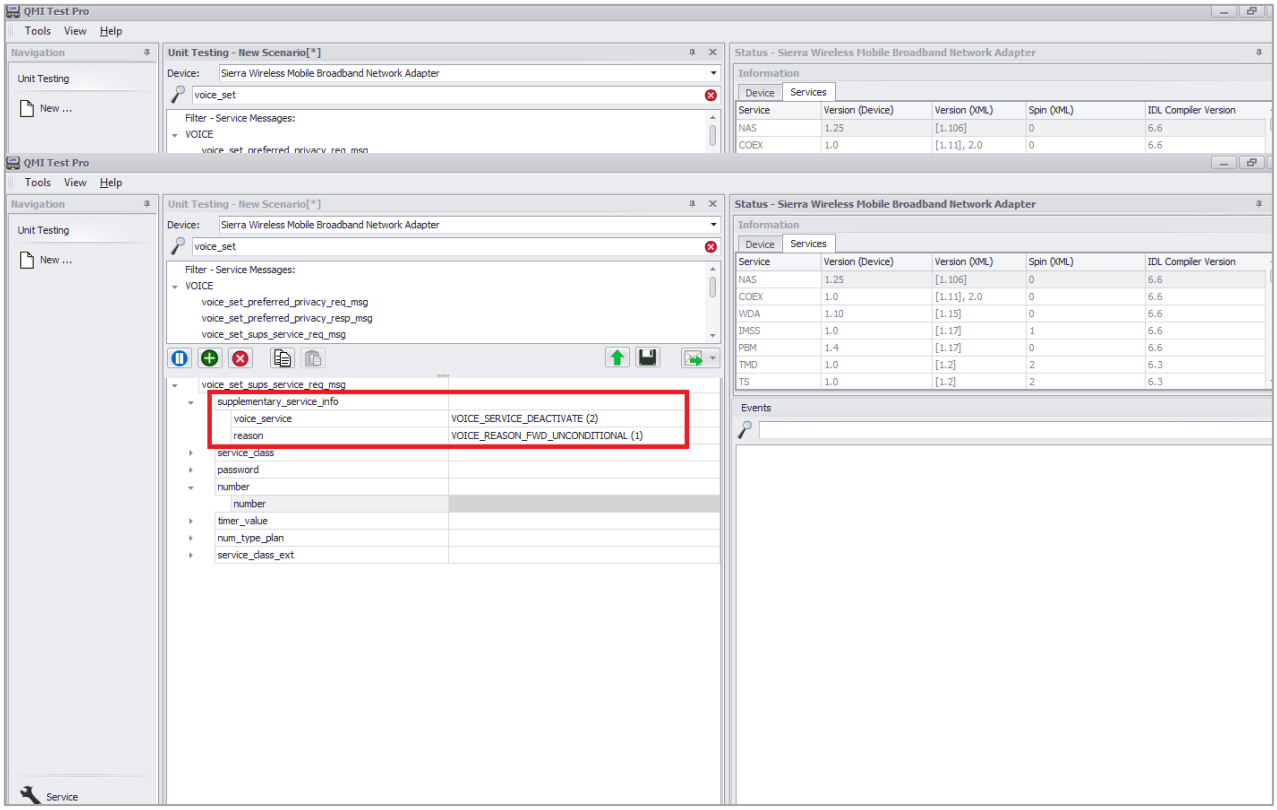


2. LTE-BTR-5-4212(TC5.2):
Dial *21*<MSISDN># from UE where <MSISDN> is in +11d format:
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_UNCONDITIONAL
Set number to <MSISDN> in test case.

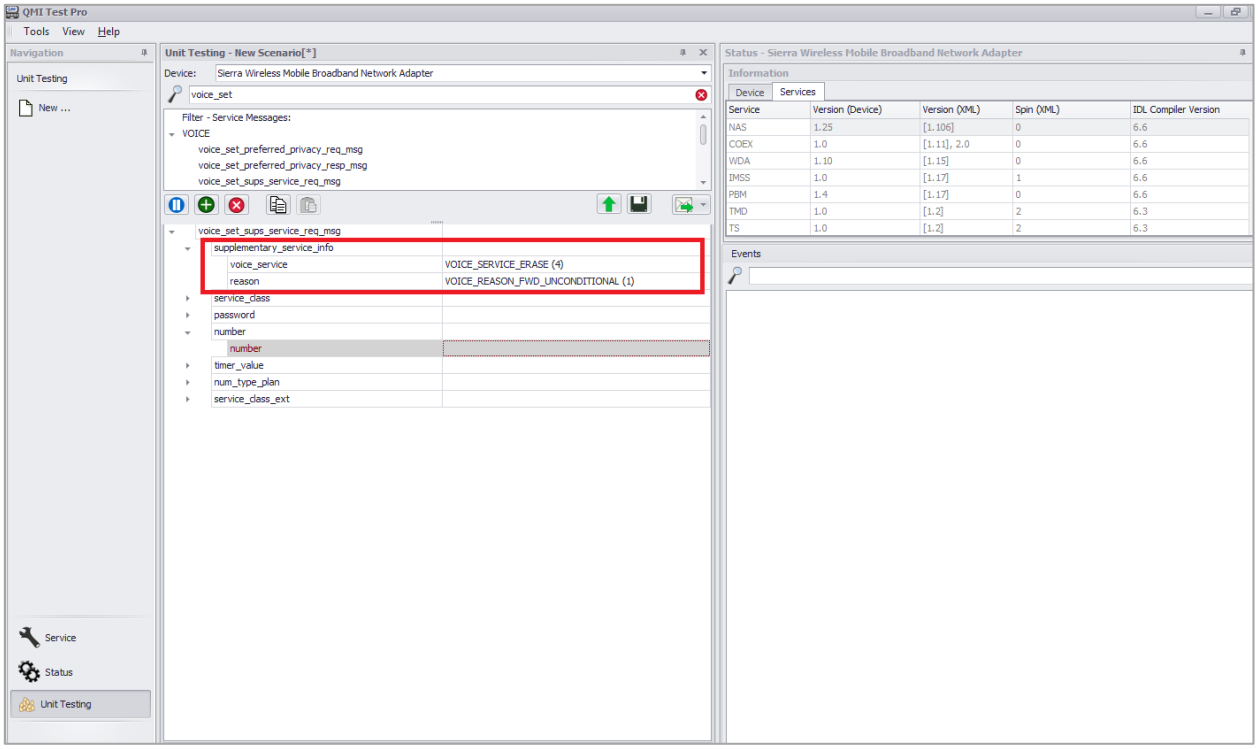


Dial #21# from UE and allow transactions to complete:

Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_UNCONDITIONAL
Do not set number



Dial ##21# from UE and allow transactions to complete:
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_UNCONDITIONAL
Do not set number



3. LTE-BTR-5-4210(TC5.3):
Dial *67*<MSISDN># from UE where <MSISDN> is in 10d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_MOBILEBUSY
Set number to <MSISDN> in test case.

Dial #67# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_MOBILEBUSY
Do not set number

Dial ##67# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_MOBILEBUSY
Do not set number

4. LTE-BTR-5-4202(TC5.4)
Dial *61*<MSISDN># from UE where <MSISDN> is in +11d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_NOREPLY
Set number to <MSISDN> in test case.

Dial #61# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_NOREPLY
Do not set number

Dial ##61# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_NOREPLY
Do not set number

5. LTE-BTR-5-4208(TC5.5)
Dial *61*<MSISDN>**25# from UE where <MSISDN> is in 10d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_NOREPLY
Set number to <MSISDN> in test case.
Set time_value to 25

Dial #61# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_NOREPLY
Do not set number and time_value

Dial ##61# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_NOREPLY
Do not set number and time_value

6. LTE-BTR-5-4204(TC5.6)
Dial *62*<MSISDN># from UE where <MSISDN> is in +11d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_UNREACHABLE
Set number to <MSISDN> in test case.

Dial #62# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_UNREACHABLE
Do not set number

Dial ##62# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_UNREACHABLE
Do not set number

7. LTE-BTR-5-4214(TC5.7)
Dial *004*<MSISDN># from UE where <MSISDN> is in 10d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Set number to <MSISDN> in test case.

Dial #004# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Do not set number

Dial ##004# from UE and allow transactions to complete

Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Do not set number

8. LTE-BTR-5-4206(TC5.8)
Dial *004*<MSISDN>**25# from UE where <MSISDN> is in +11d format
Set voice_service to VOICE_SERVICE_ACTIVATE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Set number to <MSISDN> in test case.
Set time_value to 25

Dial #004# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_DEACTIVATE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Do not set number and time_value

Dial ##004# from UE and allow transactions to complete
Set voice_service to VOICE_SERVICE_ERASE
Set reason to VOICE_REASON_FWD_ALLCONDITIONAL
Do not set number and time_value

16.3 AT Test Guide for eCall Cases(only for europe)

1. How to check eCall enable/disable
   AT!UNLOCK="A710"
   AT!NV?ECALL_ENABLED
   Return 00//disable
   01//enable
2. How to start/stop eCall
   AT! MECALL=<ecall_session>[,<type_of_ecall>]

< ecall_session >	0-1	0: stop eCall session 1: start eCall session
<type_of_call>	0-3	0: test call 1: reconfiguration call eCall 2: manually initiated eCall 3: automatically initiated eCall

3. How to config eCall
   AT!MECALLCFG=<voc_mode>,<host_build_msd>,<dial_type>,["<num>"],<modem_msd_type>[,<max_redial_attempt>[,<gnss_update_time>[,<nad_deregistration_time>[,<ecall_usim_slot_id>]]]]

<voc_mode>	0-1	0: Deregister the (speaker) Rx input of the vocoder 1: Do not deregister Rx input of the vocoder
<host_build_msd>	0-1	0: This instructs the modem to build the MSD blob without involving the Host.

		1: The Host is entirely responsible to provide the MSD blob.
<dial_type>	0-1	0: NORMAL, i.e., Read the number to dial from the FDN/SDN, depending upon the eCall operating mode 1: OVERRIDE, i.e., Override the operating mode; the eCall modem dials the number specified in the <num> field
<num>	string	Indicates the number to dial; specified only when <dial_type> is set to OVERRIDE; this number must be the number of the PSAP
<modem_msd_type>	0-1	0: Send real MSD; look for the GPS fix 1: Send canned MSD
<max_redial_attempt>	0-10	The number of attempts for IVS to redial the call if the initial eCall attempt fails to connect, or the call is dropped for any reason other than by the PSAP operator clearing the call down or T2 (IVS Call Clear-down Fallback Timer) ends. Default value: 0
<gnss_update_time>	1-255	The number of seconds to allow to capture satellite information, also it is the timer to start GPS location fix. Default value: 5
<nad_deregistration_time>	1-12	The number of hours that the IVS NAD shall remain registered on the serving network and available to receive calls from the PSAP and rescue workers after the call clear-down by the PSAP. Default values: 8
ecall_usim_slot_id	1-2	Indicates on which SIM slot the ECALL is triggered. 1: Directs the request to the USIM inserted in Slot 1. 2: Directs the request to the USIM inserted in Slot 2 Default value: 1

4. How to set PULL/PUSH tx mode
   AT!MECALLTXMODE=<tx_mode>

<tx_mode>	0-1	0: PULL mode 1: PUSH mode

5. How to send MSD when host_build_msd is 1
   AT!MECALLMSD="<msd_data>"

<msd_data>	string	Data as defined in the format as suggested in EN 15722. Must be enclosed in “”.

6. How to update MSD block

AT!MECALLMSDBLK=<blockNumber>,<data>

<blockNumber>	1-12	valid block number values are 1-12
<data>	string	Data as defined in the format as suggested in EN 15722. Must be enclosed in “”.

7. How to enable eCall/disable uslmsk and check eCall event

```
//enable eCall uslmsk
AT+WUSLMSK=FFFFFFFF,0
AT+WUSLMSK=FFFFFFFF,1
AT!MECALLUSLMSK=FFFFFFFFF
//disable eCall uslmsk
AT!MECALLUSLMSK=0

//check eCall event
!MECALL:<ind>[,<timer_id>]
```

<ind>	0-28	0: eCall session started 1: Get GPS Fix 2: GPS Fix Received 3: GPS Fix Timeout 4: MO call connected 5: MO call Disconnected 6: MT call connected 7: MT call Disconnected 8: Waiting for PSAP START indication 9: PSAP START received but no MSD available 10: PSAP START received and MSD available 11: PSAP START received and MSD sent 12: LL ack received 13: 2LL acks received 14: LL nack received 15: HL ack received 16: IVS Transmission completed 17: 2AL acks received 18: eCall session completed 19: eCall clear-down received 20: eCall session reset 21: eCall session failure 22: MSD update request available 23: eCall session stop 24: eCall operating mode is eCall and normal call mode 25: eCall operating mode is eCall only mode

		26: eCall transmission mode is PUSH mode 27: call transmission mode is PULL mode 28: eCall timer timeout reached
<timer_id>		2: T2 timer 5: T5 timer 6: T6 timer 7: T7 timer 9: T9 timer 10: T10 timer

16.4 AT Test Guide for Factory reset Cases (only for Verizon)

For some Verizon Motive test cases, need to execute Factory reset.
How to execute Factory reset,

1. at!unlock="A710"
2. at!mcfgselmode=0 //set it by manually mode
3. at!mcfgsel=0 //deactivate the Current MBN
4. at!mcfgsel=0 //deactivate the Current MBN

16.5 AT Command for MSB & MSA

16.5.1 GPS constant location

AGPS MSB: at!gpstrack=2,255,1000,1000,1
AGPS MSA: at!gpstrack=3,255,1000,1000,1

NOTE: As long as the power stays on, you only need to give a command once.

16.5.2 GPS stop location

AT!GPSEND=0

NOTE: If the power is not powered off, you need to send the GPS stop command before sending the GPS location command for the second time.

s

17 Rolling Wireless Lab Support Contacts

NAME	TITLE	PHONE NUMBER
Eva Zheng <eva.zheng@rollingwireless.com>	Certification Engineer	+86 755 8611 9884
Wilson Lin <Wilson.Lin@rollingwireless.com>	Certification Manager	+86 755 8611 9834

18 OEM/Integrators Installation Manual

18.1 FCC Statement

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to XXXX that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text:
"Contains FCC ID: 2AX2URL9422
The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
(2) The transmitter module may not be co-located with any other transmitter or antenna.
(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

Antenna type	GSM/WCDMA/LTE Band Peak Gain (dBi)
Dipole Antenna	2dbi

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with part 27 requirements for Modular Approval. The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

18.2 IC Statement

Industry Canada Statement

This device complies with Industry Canada’s licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC: 26644-RL9422”.

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 26644-RL9422 ".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

19 Routing Constraints and Recommendations

Layout and routing of the AirPrime RL942x Series in the application is critical to maintaining the performance of the radio. The following sections provide guidance to the developer when designing their application to include an AirPrime RL942x Series and achieve optimal system performance.

19.1 RF Routing Recommendations

To route the RF antenna signals, the following recommendations must be observed for PCB layout:
The RF signals must be routed using traces with a 50 Ω characteristic impedance.
Basically, the characteristic impedance depends on the dielectric constant (εr) of the material used, trace width (W), trace thickness (T), and height (H) between the trace and the reference ground plane.
In order to respect this constraint, Sierra Wireless recommends that a MicroStrip structure be used and trace width be computed with a simulation tool (such as AppCAD, shown in the figure below and available free of charge at http://www.avagotech.com).

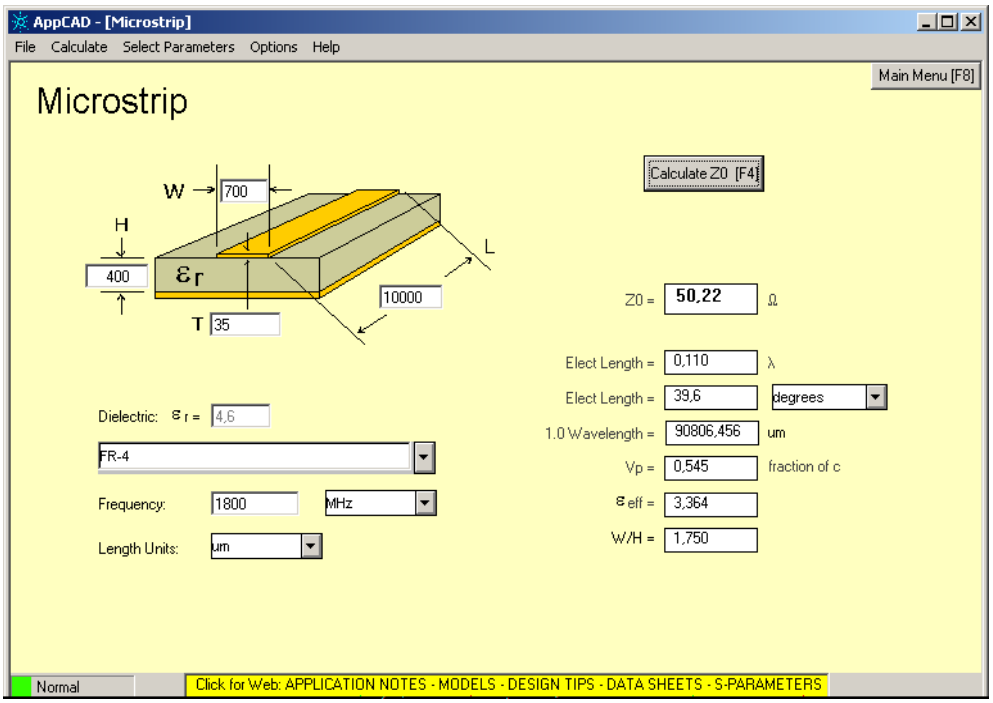


Figure 1. AppCAD Screenshot for Microstrip Design Power Mode Diagram

The trace width should be wide enough to maintain reasonable insertion loss and manufacturing reliability. Cutting out inner layers of ground under the trace will increase the effective substrate height; therefore, increasing the width of the RF trace.

Caution: *It is critical that no other signals (digital, analog, or supply) cross under the RF path. The figure below shows a generic example of good and poor routing techniques.*

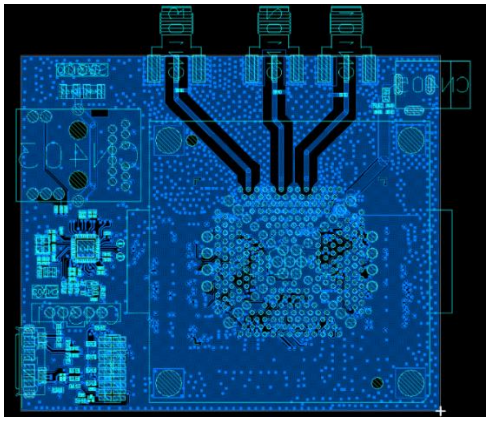


Figure 2. RF Routing Examples

- Fill the area around the RF traces with ground and ground vias to connect inner ground layers for isolation.
- Cut out ground fill under RF signal pads to reduce stray capacitance losses.
- Avoid routing RF traces with sharp corners. A smooth radius is recommended.
  E.g. Use of 45° angles instead of 90°.
- The ground reference plane should be a solid continuous plane under the trace.

- The coplanar clearance (G, below) from the trace to the ground should be at least the trace width (W) and at least twice the height (H). This reduces the parasitic capacitance, which potentially alters the trace impedance and increases the losses.
  E.g. If W = 100 microns then G = 200 microns in an ideal setup. G = 150 microns would also be acceptable is space is limited.

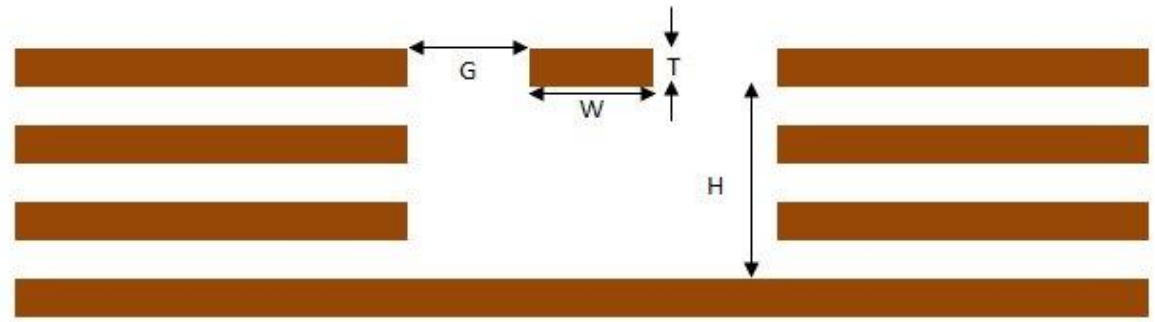


Figure 3. Coplanar Clearance Example

NOTE: *The figure above shows several internal ground layers cut out, which may not be necessary for every application.*

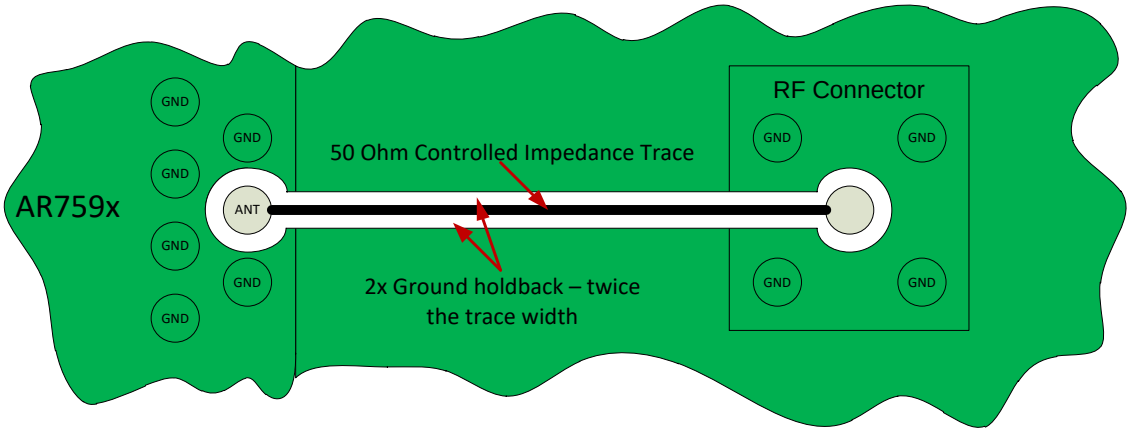


Figure 4. Antenna Microstrip Routing Example

19.2 USB Routing Recommendations

HighSpeed USB signals (USB_D_P / USB_D_M) are a differential pair and must be routed with the following considerations/constraints:

- 90 Ohm differential +/- 10% trace impedance,
- Differential trace length pair matching < 2mm (15 ps),
- Solid reference planes,
- Trace lengths < 120 mm,
- And 2x the trace width separation to all adjacent signals.

SuperSpeed USB adds two differential pairs (SSRX+ / SSRX- and SSTX+ / SSTX-). These pairs should be routed with the following considerations/constraints:

- 90 Ohm differential +/- 15% trace impedance,
- Differential trace length pair matching < 0.7mm (5 ps),
- Trace lengths < 112 mm,
- And GND isolation from other adjacent traces with minimum of 2x the SSRX/SSTX trace wdith.

19.3 Power and Ground Recommendations

Power and ground routing is critical to achieving optimal performance of the AirPrime RL942x Series when integrated into an application.
Recommendations:

- Do not use a separate GND for the Antennas.
- Connections to GND from the AirPrime RL942x Series should be flooded plane using thermal reliefs to ensure reliable solder joints.
- VBATT is recommended to be routed as a wide trace(s) directly from the power supply to the LGA pad.

19.4 Antenna Recommendations

Connecting the antenna ground reference to the vehicle chassis is not recommended since that has been known to cause noise from the engine to couple into the audio of the device. It is ultimately up to the integrator to evaluate this performance.