EM91 Series

Customer Production Test Guide

SIERRA WIRELESS®

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Revision History

Revision number	Release date	Changes
1.0	February 24, 2020	Creation
1.1	May 12, 2020	Added 3G/4G/5G AUX port checking; Added 4G/5G MIMO ports checking; Added 5G mmW IF ports checking; Updated GNSS part; Added note for DV4 MIMO index change; Updated Tx and Rx power range; Removed LTE B21.
1.2	July 23, 2020	Added one action (AT!DASUB6TECHACT) for 5G-Sub6 RF test; Updated the usage of AT!DAUPDATEPARAM for sub-band B; Added notes for WCDMA B6 and LTE B46; Added LTE band support; Added MIMO support in Table 1.
1.3	September 02, 2020	Added some band supports that are under planning for future release. Changed Tx/Rx channel for n258. Corrected some typos for mmW Tx. Changed bandwidth support for n77/n79. Added a step for RF device scanning in production test procedure.

Revision number	Release date	Changes
1.4	November 04, 2020	Added B41B. Changed Tx/Rx channel for B28/N28. Removed references to earlier hardware versions, adding applicability statement to Overview.
1.5	November 30, 2020	Changed RX center channel/frequency for B66/n66.
2	November, 2021	Removed !DAMMWACT & !DAMMWDEACT commands from procedures. Updated formats for AT!DARCONFIG and AT!DATXCONTROL

Contents

List of Tables

1: Overview

Developers of OEM devices integrating Sierra Wireless embedded modules should test the integration in their factory to make sure their devices work properly with the embedded modules.

This document aims to help Sierra Wireless customers develop a factory production test procedure for products containing EM91 series embedded modules:

- EM9190 ES3 and newer
- EM9191
- EM7690

Note: In this document:
• EM91 refers to the EM91 module series, which includes EM9190, EM9191, and EM7690.
• EM919x refers to EM9190 and EM9191.

Test cases are described for each supported technology (3G, 4G, 5G Sub6, 5G mmw, GNSS):

- 3G/4G/GNSS tests apply to all module variants
- 5G Sub6 tests apply to EM919x
- 5G mmw tests apply to EM9190

For supported bands, GNSS specifications, etc., refer to [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174).

Note: The procedures and values identified in this document are intended for testing at room temperature.

2: AT Command Entry Timing Requirement

Some commands require time to process before additional commands are entered. For example, the modem returns OK when it receives AT!DAFTMACT. If AT!DARCONFIG is received too soon after this, the modem returns an error.

When building automated test scripts, ensure that enough delays (e.g. 5s) are embedded where necessary to avoid these types of errors.

3: Production Testing

The EM91 module should be installed correctly (I/O signals are passed between the host and module) on each assembled device, and the antenna is connected and performing to specifications (RF tests).

Note: Production testing typically continues for the life cycle of the product.

Typical items to test include:
- Host connectivity
- Baseband (host/module connectors)
- RF assembly (Tx and/or Rx, as appropriate)
- Network availability
- Host/device configuration issues

Use an appropriate test station for your testing environment (e.g. an EM91 Development Kit for test bench usage, full test fixture for factory production testing, etc.), and use AT commands to control the module.

Note: Tests described in this chapter are suggestions only. Make sure the types (and quantity) of tests you perform exercise functionality to the degree that your situation requires.

Your test location must be protected from ESD to avoid interference with the module and antenna(s), assuming that your test computer is in a disassembled state. Also, consider using an RF shielding box, since local government regulations may prohibit unauthorized transmissions.

Suggested Testing Platform Equipment

To perform production tests, use an appropriate testing platform. Suggested equipment includes:
- PC with Windows 10
- Power supply (e.g. Agilent 66311)
- Call box (e.g. CMW500 for basic RF functions such as generating or receiving required frequency signal, CMW100 for mmW IF tests that require a higher-frequency callbox)

Note: Procedures in this document describe general required callbox configurations, with some examples provided for CMW500 and CMW100 callboxes. Adapt the procedures as necessary based on the callbox type(s) used in your testing platform.
You can also use a Power Meter and Signal Generator to replace the call box. (e.g. Power Meter Gigatronics 8651A (with Option 12 and Power Sensor 80701), and Signal Generator Agilent 8648C)

Functional Production Test

This section presents a suggested procedure for performing a basic manual functional test on a laboratory bench using an EM91 embedded module and an EM91 Series Development Kit. As you become familiar with the testing method, use it to develop your own automated production testing procedures.

Note: This document describes conducted power testing. For radiated (over the air) testing, modify the suggested procedures as appropriate to your requirements.

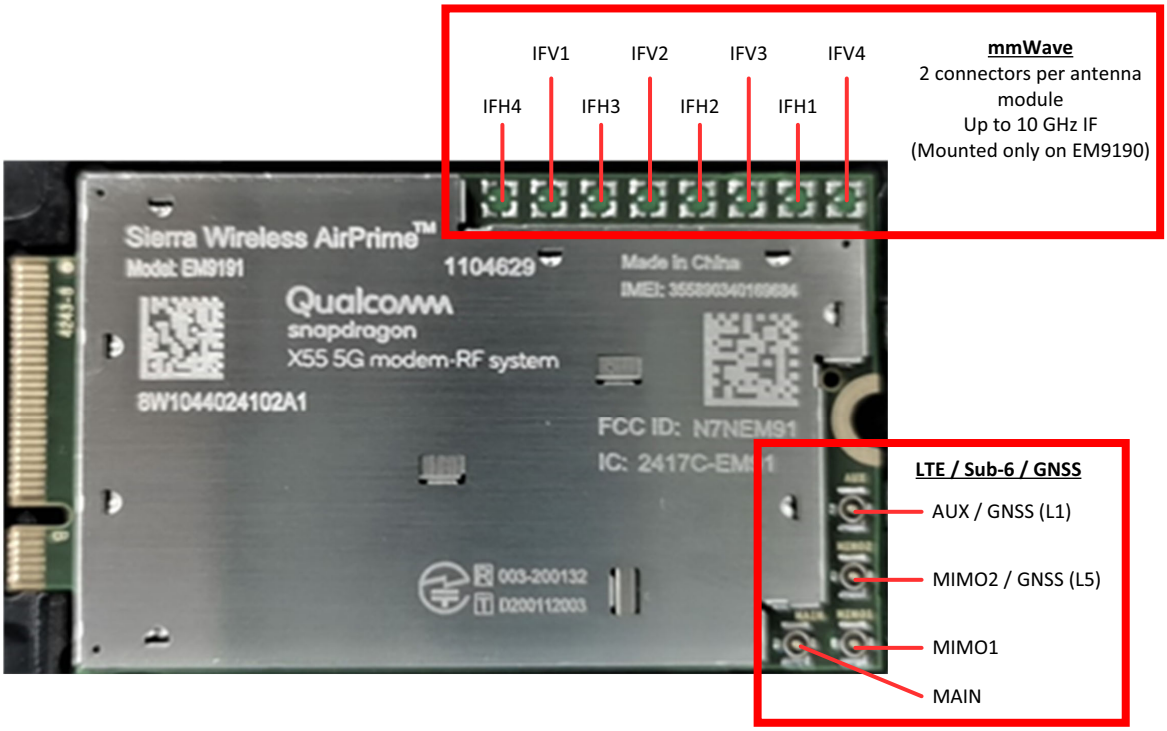


Figure 3-1: RF Connectors (EM9191 shown)

The following is a suggested test plan—you must decide which tests are appropriate for your product. You can also add additional tests that fully exercise your product's capabilities.

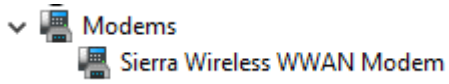
Using an appropriate hardware connection on the development kit (e.g. the USB-C connector CN204), and referring to [1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480) for command details:

1. Visually inspect the module's connectors and RF assemblies for obvious defects before installing it in the development kit.
2. Make sure the module is powered off (no voltage on VCC).
3. Provide power to the module—For the power on/off sequence, refer to the [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174) section "Full_-Card_Power_Off# and RESET#".

4. Test host functionality—Check for port enumeration.

   In Device Manager, the module appears under Modems as a Sierra Wireless WWAN Modem port.

   For example:

   Check the device properties to determine the COM port used for the modem.

5. Use a terminal emulator (e.g. HyperTerminal, TeraTerm, PuTTY, etc.) to set up a serial connection to the modem COM port (speed = 115200 baud, or set as appropriate).

   In the emulator, type **AT**. If the connection is established, the command returns `OK`.

   *Note: Use **ATE1** to enable echo if necessary.*

6. Display the firmware version to confirm the module is loaded with the expected firmware:

   ATI

7. Unlock the extended AT command set:

   AT!ENTERCND="<key>"

8. Scan for any RF device problems:

   AT!RFDEVSTATUS?

   ```
   instance, manufacture id, product id, present
   0 ,<manufacture id>,<product id>, <present> ← Instance list
   …                                             3G/4G/5G Sub6
   x ,<manufacture id>,<product id>, <present >
   0 ,<manufacture id>,<product id>, <present> ← Instance list
   …                                             5G mmw
   8 ,<manufacture id>,<product id>, <present>
   ```

   The response displays two 'instance' lists: (0~x) for 3G/4G/5G Sub6, and (0~8) for 5G mmw.

   If there are no RF device problems:
   - First list (3G/4G/5G Sub6)—Each <present> will be "TRUE".
   - Second list (5G mmw)—Instance 0 <present> will be "TRUE".

9. Enter test mode:

   AT!DAFTMACT

10. Use a test platform (as described in Suggested Testing Platform Equipment) to perform RF tests:

    a. Test RF transmission if desired:
       - WCDMA—see WCDMA RF Transmission Path Test.
       - LTE—see LTE RF Transmission Path Test.
       - 5G Sub6—see 5G Sub6 RF Transmission Path Test.
       - 5G mmw—see 5G mmw RF Transmission Path Test.

    b. Test RF reception if desired:
       - WCDMA—see WCDMA RF Receive Path Test.
       - LTE—see LTE RF Receive Path Test.

- 5G Sub6—see 5G Sub6 RF Receive Path Test.
- 5G mmw—see 5G mmw RF Receive Path Test.

c. Test standalone GNSS functionality—see GNSS RF Receive Path Test.

WCDMA RF Tests

WCDMA Test Parameters

The following table is used for the WCDMA Tx and Rx tests described below.

Table 3-1: Test Parameters—WCDMA Transmission Path

Mode	Test Category (MHz)	Band Number	Tx Channel[a]	Tx Frequency (MHz)	Rx Frequency with Offset (MHz)[b]
WCDMA	2100	1 (B1)	9750	1950	2141.2
	1900	2 (B2)	9400	1880	1961.2
	1800	3 (B3)	1112	1747.4	1843.6
	1700	4 (B4)	1450	1740	2141.2
	850	5 (B5)	4175	835	881.2
	850	5 (B6[c])	4175	835	881.2
	900	8 (B8)	2788	897.6	943.8
	1840	9 (B9)	8837	1767.4	1863.6
	850	19 (B19)	412	837.5	883.7

a. Tx channel values shown are at the center of the corresponding bands, and are used by AT!DARCONFIG.
b. RF frequency to set on the call box. Rx frequencies shown include a 1.2 MHz offset from the Rx channel of the modem, which is set to the middle of the band in this table.
c. WCDMA B6 is a sub-band of B5—use WCDMA B5 instead (B6 will return ERROR)

WCDMA RF Transmission Path Test

(Test applies to: EM9190/EM9191/EM7690)

To test the DUT's transmitter (Tx) path:

1. Make sure an RF load (e.g. test set) is connected to the Antenna port before turning on the RF transmitter.
2. Connect the RF cable to the MAIN port—see Figure 3-1 on page 10.
   (Do not connect MIMO1, MIMO2, or AUX.)
3. Set up the callbox for Tx testing—make sure to set:
   - Initial Tx frequency being tested
   - Expected Tx power (corresponds to <power_dbm10> in step 3)
   - Filter type—Gauss
   - Pathloss (i.e. cable loss from antenna port of the module to the callbox)
   - Signal receiving path—On (e.g. in CMW500, press On/Off button)

Note: WCDMA has only one bandwidth (3.84 MHz), which is set by default (i.e., the value cannot be changed on the callbox).

For examples using a CMW500, see CMW500 Setup on page 35.

4. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

      AT!DAUPDATEPARAM=<technology_family>,<band>

      (e.g. AT!DAUPDATEPARAM=1,2 to select WCDMA Band 2)

   d. Configure the WCDMA band and channel:

      AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>

      (e.g. AT!DARCONFIG=0,1,2,9400. For values, see Table 3-1 on page 13.)

   e. Set the Tx power. (Note that *<power_dbm10> = 10 × power* must be an integer, and <enable>=1.)

      AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>

      (e.g. AT!DATXCONTROL=0,1,1,-505 to transmit -50.5 dBm)

      Caution: *To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (for values, refer to [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174)).*

   f. Take the measurement.

      If the measured value is not close to the expected value, make sure the CMW500 options and the configurations above are set properly.

      Note: The measured (output power) value is significantly influenced by the test setup (e.g. host RF cabling loss, choice of shield box, etc.).

      When performing the same test over the air in an RF chamber (i.e. radiated power testing), values are likely to be significantly lower, and will also be influenced by antenna and test antenna gain, efficiency and pattern.

   g. Disable the transmitter (using <enable>=0). Make sure all other configuration parameters are the same as in step e.)

      AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>

      (e.g. AT!DATXCONTROL=0,1,0,-505)

   h. Drop the current WCDMA configuration.

      AT!DARCONFIGDROP=<technology>

      (e.g. AT!DARCONFIGDROP=1)

   i. To test the next WCDMA band:
      i. Change appropriate settings (e.g. Tx frequency, expected power, etc.) on the callbox for the next band to test.
      ii. Go back to step c.

WCDMA RF Receive Path Test

(Test applies to: EM9190/EM9191/EM7690)

To test the DUT's receive (Rx) path:

1. Connect RF cables to the MAIN and AUX ports—see Figure 3-1 on page 10.
   (Do not connect MIMO1 or MIMO2.)
2. Set up the callbox for Rx testing—make sure to set:
   - Signal generator (select the appropriate signal generator)
   - Initial Rx frequency being tested
   - Expected Rx power level (corresponds to <expected_AGC> in step 3)
   - Signal transmit path—On

   For examples using a CMW500, see CMW500 Setup on page 35.
3. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

      AT!DAUPDATEPARAM=<technology_family>,<band>

      (e.g. AT!DAUPDATEPARAM=1,2 to select WCDMA Band 2)

   d. Configure the WCDMA band and channel:

      AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>

      (e.g. AT!DARCONFIG=0,1,2,9400. For values, see Table 3-1 on page 13.)

   e. Repeat this step for each path that you want to test: Set the expected Rx power (<expected_AGC>) and check that *<rssi> = <expected_AGC>* (i.e. actual FTM AGC matches the expected AGC).

      (Note that *<expected_AGC> = 10 × power* must be an integer.)

      AT!DAGFTMRXAGC=<carrier>,<technology>,<expected_AGC>,<path>
      <rssi>
      OK

      e.g. (Testing paths for -50.5 dBm, response shown for 1st example only):
      - Check the MAIN path Rx (Note: Make sure the module's MAIN antenna port (path 0) is connected to the CMW500.):

        AT!DAGFTMRXAGC=0,1,-505,0
        -50.5
        OK
      - Check the AUX path Rx (Note: Make sure the module's AUX antenna port (path 3) is connected to the CMW500.):

        AT!DAGFTMRXAGC=0,1,-505,3

   f. Drop the current WCDMA configuration:

      AT!DARCONFIGDROP=<technology>

      (e.g. AT!DARCONFIGDROP=1)

g. To test the next WCDMA band:

i. Change appropriate settings (e.g. Rx frequency, expected power, etc.) on the callbox for the next band to test.

ii. Go back to step c.

LTE RF Tests

LTE Test Parameters

The following table is used for the LTE Tx and Rx tests described below.

Table 3-2: Test Parameters—LTE Transmission Path

Mode	Band Number	Bandwidth Index[a]	Tx Channel[b]	Tx Frequency (MHz)	Rx Channel	Rx Frequency with Offset (MHz)[c]
LTE	1 (B1)	3 (10 MHz)	18300	1950	300	2142
	2 (B2)	3 (10 MHz)	18900	1880	900	1962
	3 (B3)	3 (10 MHz)	19575	1747.5	1575	1844.5
	4 (B4)	3 (10 MHz)	20175	1732.5	2175	2134.5
	5 (B5)	3 (10 MHz)	20525	836.5	2525	883.5
	7 (B7)	3 (10 MHz)	21100	2535	3100	2657
	8 (B8)	3 (10 MHz)	21625	897.5	3625	944.5
	12 (B12)	3 (10 MHz)	23095	707.5	5095	739.5
	13 (B13)	3 (10 MHz)	23230	782	5230	753
	14 (B14)	3 (10 MHz)	23330	793	5330	765
	17 (B17)	3 (10 MHz)	23790	710	5790	742
	19 (B19)	3 (10 MHz)	24075	837.5	6075	884.5
	20 (B20)	3 (10 MHz)	24300	847	6300	808
	25 (B25)	3 (10 MHz)	26365	1882.5	8365	1964.5
	26 (B26)	3 (10 MHz)	26865	831.5	8865	878.5
	28 (B28A)	5 (20 MHz)	27310	713	9310	770
	28 (B28B)	5 (20 MHz)	27560	738	9560	795
	29 (B29)[d]	N/A[d]	N/A[d]	N/A[d]	9715	722.5
	30 (B30)	3 (10 MHz)	27710	2310	9820	2357
	32 (B32)[d]	N/A[d]	N/A[d]	N/A[d]	10140	1474
	34 (B34)	3 (10 MHz)	36275	2017.5	36275	2019.5
	38 (B38)	3 (10 MHz)	38000	2595	38000	2597
	39 (B39)	3 (10 MHz)	38450	1900	38450	1902
	40 (B40)	3 (10 MHz)	39150	2350	39150	2352
	41 (B41A)	3 (10 MHz)	39700	2501	39700	2503
	41 (B41B)	3 (10 MHz)	41540	2685	41540	2687
	42 (B42)	3 (10 MHz)	42590	3500	42590	3502

Table 3-2: Test Parameters—LTE Transmission Path (Continued)

Mode	Band Number	Bandwidth Index[a]	Tx Channel[b]	Tx Frequency (MHz)	Rx Channel	Rx Frequency with Offset (MHz)[c]
	43 (B43[e])	3 (10 MHz)	44590	3700	44590	3702
	46 (B46[f]	3 (10 MHz)	0	N/A	50690	5542
	48 (B48)	3 (10 MHz)	55990	3625	55990	3627
	66 (B66)	3 (10 MHz)	132322	1745	66786	2147
	71 (B71)	3 (10 MHz)	133297	680.5	68761	636.5

a. Bandwidth index values are defined in the !DARCONFIG command—refer to [1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480).
b. Channel values shown are at the center of the corresponding bands.
c. RF frequency to set on the call box. Receive frequencies shown include a 2 MHz offset from the Rx channel of the modem, which is set to the middle of the band in this table.
d. B29/B32 are downlink only. No Tx test required.
e. Band support is firmware and SKU-dependent.
f. LTE-LAA B46 (Downlink only; i.e. no transmission path, no Tx test required)

LTE RF Transmission Path Test

(Test applies to: EM9190/EM9191/EM7690)

To test the DUT's transmitter (Tx) path:

1. Make sure an RF load (e.g. test set) is connected to the Antenna port before turning on the RF transmitter.
2. Connect the RF cable to the MAIN port—see Figure 3-1 on page 10.

   (Do not connect MIMO1, MIMO2, or AUX.)
3. Set up the callbox for Tx testing—make sure to set:
   - Initial Tx frequency being tested
   - Expected Tx power (corresponds to <power_dbm10> in step 4)
   - Bandwidth (corresponds to <bw> in step 4)
   - Filter type—Gauss
   - Pathloss (i.e. cable loss from antenna port of the module to the callbox)
   - Signal receiving path—On (e.g. in CMW500, press On/Off button)

   For examples using a CMW500, see CMW500 Setup on page 35.
4. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

      AT! DAUPDATEPARAM=<technology_family>,<band>[<subband_type>]

      (e.g. AT!DAUPDATEPARAM=10,28,1 to select LTE B28. Note in this example that the <subband_type> is only available for sub-band B, e.g. B28B.)

d. Configure the LTE band and channels:

AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>[,<mimo_mode>[,<beam_ID>[,<continuous_mode>]]]

(e.g. AT!DARCONFIG=0,3,1,18300,3,1. For values, see Table 3-2 on page 17. Note that in LTE mode, either the specific Rx channel can be set or the channel can be set to '1' and the actual channel will be calculated from the Tx channel.)

Note: The <beam_ID> and <continuous_mode> parameters are used only to switch between continuous mode transmission (the default mode) and burst mode. Leave <beam_ID> blank (parameter is used only for 5G mmw) and set <continuous_mode>=0 for burst mode or =1 to switch back to continuous mode.

e. Set the Tx power (using <enable>=1). (Note that *<power_dbm10> = 10 × power* must be an integer.)

AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>[,<beam_ID>[,<duty_cycle>]]

(e.g. AT!DATXCONTROL=0,3,1,-505,1,0,1,0,10,,2 to transmit -50.5 dBm with a 20% duty cycle. See the table below for supported <duty_cycle> values.)

<duty_cycle>	Duty Cycle
1	10%
2	20%
3	30%
4	40%
5	50%
6	60%
7	70%
8	80%
9	90%

Caution: *To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (for values, refer to [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174)).*

f. Take the measurement.

If the measured value is not close to the expected value, make sure the CMW500 options and the configurations above are set properly.

Note: The measured (output power) value is significantly influenced by the test setup (e.g. host RF cabling loss, choice of shield box, etc.).

When performing the same test over the air in an RF chamber (i.e. radiated power testing), values are likely to be significantly lower, and will also be influenced by antenna and test antenna gain, efficiency and pattern.

g. Disable the transmitter (using <enable>=0). Make sure all other configuration parameters are the same as in step e.

AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>[,<beam_ID>[,<duty_cycle>]]

(e.g. AT!DATXCONTROL=0,3,0,-505,1,0,1,0,10,,2)

h. Drop the current LTE configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=3)

i. To test the next LTE band:

i. Change appropriate settings (e.g. Tx frequency, expected power, etc.) on the callbox for the next band to test.

ii. Go back to step c.

LTE RF Receive Path Test

(Test applies to: EM9190/EM9191/EM7690)

To test the DUT's receive (Rx) paths:

1. Connect RF cables to the Main, AUX, MIMO1 and MIMO2 ports—see Figure 3-1 on page 10.
2. Set up the callbox for Rx testing—make sure to set:
   - Signal generator (select the appropriate signal generator)
   - Initial Rx frequency being tested
   - Expected Rx power level (corresponds to <expected_AGC> in step 3)
   - Signal transmit path—On

   For examples using a CMW500, see CMW500 Setup on page 35.
3. Set up and test the DUT using the following AT commands:

   a. Unlock the extended AT command set:

   AT!ENTERCND="<key>"

   b. Enter test mode:

   AT!DAFTMACT

   c. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

   AT!DAUPDATEPARAM=<technology_family>,<band>[,<subband_type>]

   (e.g. AT!DAUPDATEPARAM=10,28,1 to select LTE B28. Note in this example that the <subband_type> is only available for sub-band B, e.g. B28B.)

   d. Configure the LTE band, channels, and related parameters (for values, see Table 3-2 on page 17):

   AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>[,<mimo_mode>]

Note that <rx channel> and <mimo mode> are used to check MIMO ports. For additional details, refer to the !DARCONFIG description in [1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480).)

e.g.:

- Configure the MAIN/AUX Rx paths:

  AT!DARCONFIG=0,3,1,18300,3,1
- Configure the MIMO Rx paths (make sure your test band supports MIMO mode):

  AT!DARCONFIG=0,3,1,18300,3,1,1

Note: For bands that are Rx-only (i.e. do not have a Tx path), the Tx channel must be set to 0 and the Rx channel must be specified (non-zero).
*For example, to test B46: AT!DARCONFIG=0,3,46,**0**,3,**50670**.*

e. Repeat this step for each path that you want to test: Set the expected Rx power (<expected_AGC>) and check that *<rssi> = <expected_AGC>* (i.e. actual FTM AGC matches the expected AGC).

(Note that *<expected_AGC> = 10 × power* must be an integer.)

AT!DAGFTMRXAGC=<carrier>,<technology>,<expected_AGC>,<path>
<rssi>
OK

e.g. (Testing paths for -50.5 dBm, response shown for 1st example only):

- Check the MAIN path Rx (Note: Make sure the module's MAIN antenna port (path 0) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,3,-505,0
  -50.5
  OK
- Check the AUX path Rx (Note: Make sure the module's AUX antenna port (path 3) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,3,-505,3
- Check the MIMO1 path Rx (Note: Make sure your test band supports MIMO mode, and make sure the module's MIMO1 antenna port (path 1) is connected to the CMW500.)

  AT!DAGFTMRXAGC=0,3,-505,1
- Check the MIMO2 path Rx (Note: Make sure your test band supports MIMO mode, and make sure the module's MIMO2 antenna port (path 2) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,3,-505,2

f. Drop the current LTE configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=3)

g. To test the next LTE band:

i. Change appropriate settings (e.g. Rx frequency, expected power, etc.) on the callbox for the next band to test.

ii. Go back to step c.

Note: The value measured from the DUT is significantly influenced by the test setup and DUT design (host RF cabling loss, antenna efficiency and pattern, test antenna efficiency and pattern, and choice of shield box).

5G Sub6 RF Tests

5G Sub6 Test Parameters

The following table is used for the 5G Sub6 Tx and Rx tests described below.

Table 3-3: Test Parameters — 5G Sub6 Transmission Path

Mode	Band Number	Bandwidth Index[a]	Tx/Rx Channel[b]	Tx Frequency (MHz)	Rx Frequency with Offset (MHz)[c]
5G Sub6	1 (n1)	5 (20 MHz)	390000/428000	1950	2142
	2 (n2)	5 (20 MHz)	376000/392000	1880	1962
	3 (n3)	5 (20 MHz)	349500/368500	1747.5	1844.5
	5 (n5)	5 (20 MHz)	167300/176300	836.5	883.5
	7 (n7[d])	5 (20 MHz)	507000/531000	2535	2657
	8 (n8[d])	5 (20 MHz)	179500/188500	897.5	944.5
	12 (n12[d])	3 (10 MHz)	141500/147500	707.5	739.5
	20 (n20[d])	5 (20 MHz)	169400/161200	847	808
	25 (n25[d])	5 (20 MHz)	376500/392500	1882.5	1964.5
	28 (n28A)	5 (20 MHz)	142600/153600	713	772.5
	28 (n28B)	5 (20 MHz)	147600/158600	738	795
	38 (n38[d])	5 (20 MHz)	519000/519000	2595	2597
	40 (n40[d])	8 (40 MHz)	470000/470000	2350	2352
	41 (n41A)	5 (20 MHz)	518601/518601	2593.005	2595
	48 (n48[d])	5 (20 MHz)	TBD[e]	TBD[e]	TBD[e]
	66 (n66)	5 (20 MHz)	349000/429000	1745	2147
	71 (n71)	5 (20 MHz)	136100/126900	680.5	636.5
	77 (n77)	13 (100 MHz)	650000/650000	3750	3752
	78 (n78)	9 (50 MHz)	636667/636667	3550.005	3551.99
	79 (n79)	13 (100 MHz)	713333/713333	4699.995	4701.995

a. Bandwidth index values defined in the !DARCONFIG command—refer to [1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480).
b. Channel values shown are at the center of the corresponding bands.
c. RF frequency to set on the call box. Rx frequencies shown include a 2 MHz offset from the Rx channel of the modem, which is set to the middle of the band in this table.
d. Band support is firmware and SKU-dependent.
e. Pending specification by 3GPP

5G Sub6 RF Transmission Path Test

(Test applies to: EM9190/EM9191)

To test the DUT's transmitter (Tx) path:

1. Make sure an RF load (e.g. test set) is connected to the Antenna port before turning on the RF transmitter.
2. Connect the RF cable to the MAIN port—see Figure 3-1 on page 10.

   (Do not connect MIMO1, MIMO2, or AUX.)
3. Set up the callbox for Tx testing—make sure to set:
   - Initial Tx frequency being tested
   - Expected Tx power (corresponds to <power_dbm10> in step 4)
   - Bandwidth (corresponds to <bw> in step 4)
   - Filter type—Gauss
   - Pathloss (i.e. cable loss from antenna port of the module to the callbox)
   - Signal receiving path—On (e.g. in CMW500, press On/Off button)

   For examples using a CMW500, see CMW500 Setup on page 35.
4. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Start 5G Sub6 technology (using <enable>=1):

      AT!DASUB6TECHACT=<enable>

      (e.g. AT!DASUB6TECHACT=1.)

   d. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

      AT!DAUPDATEPARAM=<technology_family>,<band>[,<subband_type>]

      (e.g. AT!DAUPDATEPARAM=18,28,1 to select 5G band n28B. Note in this example that the <subband_type> is only available for sub-band B—e.g. n28B)

   e. Configure the 5G Sub6 band and channels:
      AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>[,<mimo_mode>[,<beam_ID>[,<continous_mode>]]]

      (e.g. AT!DARCONFIG=0,6,2,376000,5,392000,0,,0). For values, see Table 3-3 on page 23.)

      (Note—By default, <continuous_mode>=1 (continuous mode). To perform TDD burst mode testing, set <continuous_mode>=0.)

      Note: The <beam_ID> and <continuous_mode> parameters are used only to switch between continuous mode transmission (the default mode) and burst mode. Leave <beam_ID> blank (parameter is used only for 5G mmw) and set <continuous_mode>=0 for burst mode or =1 to switch back to continuous mode.

   f. Set the Tx power (using <enable>=1). (Note that *<power_dbm10> = 10 × power* must be an integer.)

AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>[,<beam_ID>[,<duty_cycle>]]]

(e.g. AT!DATXCONTROL=0,6,1,-505,10,0,1,0,10,,0 to transmit -50.5 dBm with a 20% duty cycle. See the table below for supported <duty_cycle> values.)

<duty_cycle>	Duty Cycle
0	20%
1	25%
2	40%
3	50%

Caution: *To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (refer to [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174).*

g. Take the measurement.

If the measured value is not close to the expected value, make sure the CMW500 and the configurations above are set properly.

Note: The measured (output power) value is significantly influenced by the test setup (e.g. host RF cabling loss, choice of shield box, etc.).

When performing the same test over the air in an RF chamber (i.e. radiated power testing), values are likely to be significantly lower, and will also be influenced by antenna and test antenna gain, efficiency and pattern.

h. Disable the transmitter (using <enable>=0). Make sure all other configuration parameters are the same as in step f.

AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dbm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>[,<beam_ID>[,<duty_cycle>]]]

(e.g. AT!DATXCONTROL=0,6,0,-505,10,0,1,0,10,,0)

i. Drop the current 5G Sub6 configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=6)

j. To test the next 5G Sub6 band:

i. Change appropriate settings (e.g. Tx frequency, expected power, etc.) on the callbox for the next band to test.

ii. Go back to step d.

k. Stop 5G Sub6 technology (using <enable>=0):

AT!DASUB6TECHACT=<enable>

(e.g. AT!DASUB6TECHACT=0)

5G Sub6 RF Receive Path Test

(Test applies to: EM9190/EM9191)

To test the DUT's receive (Rx) paths:

1. Connect the RF cables to the MAIN, AUX, MIMO1 and MIMO2 ports—see Figure 3-1 on page 10.
2. Set up the callbox for Rx testing—make sure to set:
   - Signal generator (select the appropriate signal generator)
   - Initial Rx frequency being tested
   - Expected Rx power level (corresponds to <expected_AGC> in step 3)
   - Signal transmit path—On

   For examples using a CMW500, see CMW500 Setup on page 35.
3. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Start 5G Sub6 technology (using <enable>=1):

      AT!DASUB6TECHACT=<enable>

      (e.g. AT!DASUB6TECHACT=1.)

   d. Set the technology (RAT) and band parameters for the test (this must be done before calling !DARCONFIG in the next step):

      AT!DAUPDATEPARAM=<technology_family>,<band>[,<subband_type>]

      (e.g. AT!DAUPDATEPARAM=18,28,1 to select 5G band n28B. Note in this example that the <subband_type> is only available for sub-band B—e.g. n28B)

   e. Configure the 5G Sub6 band and channels (for values, see Table 3-3 on page 23):

      AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>[,<mimo_mode>]

      e.g.:
      - Configure the MAIN/AUX Rx paths:

        AT!DARCONFIG=0,6,2,376000,5,392000
      - Configure the MIMO Rx paths (make sure your test band supports MIMO mode):

        AT!DARCONFIG=0,6,2,376000,5,392000,1

   f. Repeat this step for each path that you want to test: Set the expected Rx power (<expected_AGC>) and check that *<rssi> = <expected_AGC>* (i.e. actual FTM AGC matches the expected AGC).

      (Note that *<expected_AGC> = 10 × power* must be an integer.)

      AT!DAGFTMRXAGC=<carrier>,<technology>,<expected_AGC>,<path>
      <rssi>
      OK

      e.g. (Testing paths for -50.5 dBm, response shown for 1st example only):

- Check the MAIN path Rx (Note: Make sure the module's MAIN antenna port (path 0) is connected to the CMW500.):

  ```
  AT!DAGFTMRXAGC=0,6,-505,0
  -50.5
  OK
  ```

- Check the AUX path Rx (Note: Make sure the module's AUX antenna port (path 3) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,6,-505,3

- Check the MIMO1 path Rx (Note: Make sure the module's MIMO1 antenna port (path 1) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,6,-505,1

- Check the MIMO2 path Rx (Note: Make sure the module's MIMO2 antenna port (path 2) is connected to the CMW500.):

  AT!DAGFTMRXAGC=0,6,-505,2

g. Drop the current 5G Sub6 configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=6)

h. Stop 5G Sub6 technology (using <enable>=0):

AT!DASUB6TECHACT=<enable>

(e.g. AT!DASUB6TECHACT=0)

i. To test the next 5G Sub6 band:

i. Change appropriate settings (e.g. Rx frequency, expected power, etc.) on the callbox for the next band to test.

ii. Go back to step c.

Note: The value measured from the DUT is significantly influenced by the test setup and DUT design (host RF cabling loss, antenna efficiency and pattern, test antenna efficiency and pattern, and choice of shield box).

5G mmw RF Tests

5G mmw Test Platform Hardware Configuration

To perform the 5G mmw IF tests, set up an appropriate test environment. For example:

1. Download the mmW QCN (codebook).
2. Set up the test hardware, which includes a mmW IF frequency callbox (e.g. CMW100).

   Figure 3-2 illustrates a suggested mmW IF test bench configuration that functions as described below:

   - To test the EM9190's Rx path:
     - The callbox's Tx AUX is used as the signal source. The Tx signal is generated at half the mmW IF frequency (i.e. $\frac{IF}{2}$).
     - A power splitter routes the signal for mmW IF testing or GNSS testing.
     - The signal is routed to an amplifier and a harmonic filter.
     - The signal is then injected to a passive frequency doubler to generate the mmW IF signal source.
     - The signal passes through an attenuator to achieve good broadband return loss and avoid overloading the EM9190 mmW IF Rx.
     - A second harmonic filter passes the IF signal and filters out unwanted harmonics.
     - The signal passes through a second attenuator.
     - Finally, the signal is routed through switches to allow selection of any of the module's 8 mmW IF ports for measurement.

       (The module's IF ports are connected to a 2×4 switch matrix's 8 RF connectors, and the matrix's two multiplexed connectors connect to two connectors on a 2×transfer switch matrix. The transfer switch matrix's other two connectors are connected to the frequency doubler output and a power sensor.)
   - To test the EM9190's Tx path:
     - The module's signal is routed through the same switches as the Tx path, allowing any of the module's 8 mmW IF ports to be tested.
     - The signal is then passed to an RF power sensor.

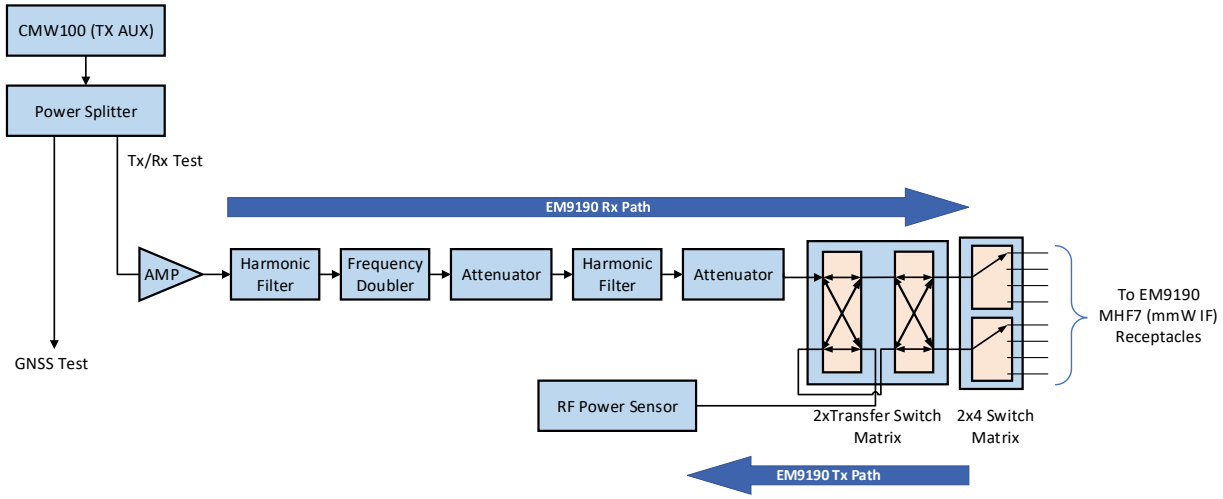


Figure 3-2: mmW IF Setup

5G mmw Test Parameters

The following tables are used for the 5G mmw Tx and Rx tests described below.

Table 3-4: Test Parameters — 5G mmw Transmission Path

Mode	Band Number	Bandwidth Index[a]	Tx/Rx Channel	IF Frequency (MHz)
5G mmw	257 (n257)	13 (100 MHz)	2079167/2079167	8646.48
	258 (n258)	13 (100 MHz)	2043759/2043759	8262.2
	260 (n260)	13 (100 MHz)	2279165/2279165	9180.6
	261 (n261)	13 (100 MHz)	2077949/2077949	8573.4

a. Bandwidth index values defined in the !DARCONFIG command – refer to [1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480).

Table 3-5: Test Parameters — 5G mmw Beam ID to IF Port Mapping[a]

Mode	QTM527 (High Power)		QTM525 (Low Power)	
	Beam ID[b]	IF Port ↔ QTM	Beam ID[b]	IF Port ↔ QTM
5G mmw	0	IFV4 ↔ QTM0_V	0	IFV4 ↔ QTM0_V
	128	IFH1 ↔ QTM0_H	128	IFH1 ↔ QTM0_H
	1	IFV3 ↔ QTM1_V	2	IFV3 ↔ QTM2_V
	129	IFH2 ↔ QTM1_H	130	IFH2 ↔ QTM2_H
	2	IFV2 ↔ QTM2_V	3	IFV2 ↔ QTM3_V
	130	IFH3 ↔ QTM2_H	131	IFH3 ↔ QTM3_H
	3	IFV1 ↔ QTM3_V	1	IFV1 ↔ QTM1_V
	131	IFH4 ↔ QTM3_H	129	IFH4 ↔ QTM1_H

a. The Beam ID to IF port mapping is different for each QTM type. This table applies to mmW antenna types: QTM527 and QTM525.
b. Beam ID is determined by the RFC (Radio File Configuration) that follows your HW design, the beam ID range is 0–59, 128–187.

5G mmw RF Transmission Path Test

(Test applies to: EM9190)

To test the DUT's transmitter (Tx) path:

1. Set up and test the DUT using the following AT commands:
   a. Unlock the extended AT command set:

      AT!ENTERCND="<key>"

   b. Enter test mode:

      AT!DAFTMACT

   c. Configure the 5G mmw band, channels, and related parameters:

      AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>,<mimo_mode>,<beam_ID>[,<continuous_mode>]

      (Note—By default, <continuous_mode>=1 (continuous mode). To perform TDD burst mode testing, set <continuous_mode>=0.)

e.g., The following configures the eight beam IDs that are mapped to the module's IF ports (see Table 3-5 on page 29 for mappings):

- Beam ID 0: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,0
- Beam ID 1: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,1
- Beam ID 2: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,2
- Beam ID 3: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,3
- Beam ID 128: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,128
- Beam ID 129: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,129
- Beam ID 130: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,130
- Beam ID 131: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,131

d. Set the Tx power (using <enable>=1). (Note that *<power_dbm10> = 10 × power* must be an integer.)

`AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dBm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>,<beam_ID>[,<duty_cycle>]`

(Note—By default, <duty_cycle>=3 (50% duty cycle). See the table below for supported <duty_cycle> values.)

<duty_cycle>	Duty Cycle
0	20%
1	25%
2	40%
3	50%

e.g., For each example below, paths are tested with +10 to transmit 1 dBm:

- Beam ID 0: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,0
- Beam ID 1: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,1
- Beam ID 2: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,2
- Beam ID 3: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,3
- Beam ID 128: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,128
- Beam ID 129: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,129
- Beam ID 130: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,130
- Beam ID 131: AT!DATXCONTROL=0,6,1,10,10,0,1,0,66,131

Caution: *To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (refer to [2] EM919X/EM7690 Product Technical Specification (Doc# 41113174)).*

e. Take the measurement to verify that the transmission path is functioning.

Note: If power is measured at the Tx frequency, the transmission path is functioning. The actual measured Tx power will not be equivalent to the <power_dBm10> used in the !DATXCONTROL command because the mmW PAs are located on the QTM mmW modules, which are not present when conducting IF testing.

f. Disable the transmitter (using <enable>=0). Make sure all other configuration parameters are the same as in step d.

AT!DATXCONTROL=<carrier>,<technology>,<enable>,<power_dBm10>,<waveform>,<mod>,<ns_value>,<start_RB>,<num_RB>,<beam_ID>

e.g.:

- Beam ID 0: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,0
- Beam ID 1: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,1
- Beam ID 2: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,2
- Beam ID 3: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,3
- Beam ID 128: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,128
- Beam ID 129: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,129
- Beam ID 130: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,130
- Beam ID 131: AT!DATXCONTROL=0,6,0,10,10,0,1,0,66,131

g. Drop the current 5G mmw configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=6)

h. To test the next 5G mmw band, go back to step c.

5G mmw RF Receive Path Test

(Test applies to: EM9190)

To test the DUT's receive (Rx) path:

1. Set up and test the DUT using the following AT commands:

a. Unlock the extended AT command set:

AT!ENTERCND="<key>"

b. Enter test mode:

AT!DAFTMACT

c. Configure the 5G mmw band, channels, and related parameters:

AT!DARCONFIG=<carrier>,<technology>,<band>,<tx_channel>,<bw>,<rx_channel>,<mimo_mode>,<beam_ID>

e.g.:

- Beam ID 0: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,0
- Beam ID 1: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,1
- Beam ID 2: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,2
- Beam ID 3: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,3
- Beam ID 128: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,128
- Beam ID 129: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,129
- Beam ID 130: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,130
- Beam ID 131: AT!DARCONFIG=0,6,261,2077949,13,2077949,0,131

d. Set the expected Rx power. (Note that *<expected_AGC> = 10 × power* must be an integer.)

AT!DAGFTMRXAGC=<carrier>,<technology>,<expected_AGC>,<path>,<beam_ID>

e.g., For each example below, paths are tested with +10 to receive 1.0 dBm:

- Beam ID 0: AT!DAGFTMRXAGC=0,6,10,4,0
- Beam ID 1: AT!DAGFTMRXAGC=0,6,10,4,0,1
- Beam ID 2: AT!DAGFTMRXAGC=0,6,10,4,0,2
- Beam ID 3: AT!DAGFTMRXAGC=0,6,10,4,0,3
- Beam ID 128: AT!DAGFTMRXAGC=0,6,10,4,0,128
- Beam ID 129: AT!DAGFTMRXAGC=0,6,10,4,0,129
- Beam ID 130: AT!DAGFTMRXAGC=0,6,10,4,0,130
- Beam ID 131: AT!DAGFTMRXAGC=0,6,10,4,0,131

Note: Check the returned value—This is the Rx AGC value, which should be the same as the <expected_AGC> entered in the command.

e. Drop the current 5G mmw configuration:

AT!DARCONFIGDROP=<technology>

(e.g. AT!DARCONFIGDROP=6)

f. To test the next 5G mmw band, go back to step c.

GNSS RF Receive Path Test

(Test applies to: EM9190/EM9191/EM7690)

GNSS receive paths use the connectors indicated in Table 3-6.

Table 3-6: Test Parameters—GNSS L1 and L5 Paths

GNSS Path	Connector[a]	Test Frequency[b] (MHz)	Notes
L1	AUX/GNSS	1575.52	TestFreq = 1575.42 MHz + 100 KHz
L5	MIMO2/GNSS	1177.45	TestFreq = 1176.45 MHz + 1000 KHz

a. For connector locations, see Figure 3-1 on page 10.
b. Includes offset from center (as indicated in Notes column)

To test one or both GNSS receive paths (L1, L5):

1. Set up the DUT using the following AT commands:
   a. Unlock the extended AT command set:

   AT!ENTERCND="<key>"

   b. Enter test mode:

   AT!DAFTMACT

   c. Start CGPS (Continuous Global Positioning System) diagnostic task mode:

   AT!DACGPSTESTMODE=1

   d. Enter standalone RF mode:

   AT!DACGPSSTANDALONE=1
2. Connect the RF cable to the appropriate connector for the path to test (L1—AUX, or L5—MIMO2).

3. Set up the callbox—Refer to Table 3-6 and configure the callbox's signal generator to inject a -110 dBm carrier signal (using the indicated test frequency) into the GNSS Rx path at the connector.
4. Test the signal carrier-to-noise level at the GNSS receiver:
   a. Connect the module's <GNSS_PATH> to the signal generator and check the returned signal-to-noise (<CtoN>) and frequency (<freq>) measurements:

      AT!DACGPSCTON=<GNSS_PATH>
      CtoN=<CtoN>, Freq=<freq>
      OK

      i.e.:
      - Check the GNSS L1 path (example output shown):

        AT!DACGPSCTON=1
        CtoN=60.7, Freq=99945
        OK
      - Check the GNSS L5 path (example output shown):

        AT!DACGPSCTON=5
        CtoN=60.1, Freq=999963
        OK

      Note: The frequency (Freq) returned by !DACGPSCTON should be within the following limits:
      - *L1: 100,000 Hz ± 1000 Hz*
      - *L5: 1,000,000 Hz ± 1000 Hz*

   b. Repeat step a 5–10 times to ensure the measurements are repeatable and stable.
   c. Keep the RF connection to the module device intact, and turn off the signal generator.
   d. Repeat the **AT!DACGPSCTON** command several times to demonstrate a bad signal, to set limits for testing if needed.
   e. Optionally, simulate marginal/poor signals:
      i. Turn on the signal generator and reduce the level to -120 dBm.
      ii. Optionally, repeat the **AT!DACGPSCTON** command several times to obtain results to use as references for marginal/poor signals.

          i.e.:
          - Check the GNSS L1 path (example output shown):

            AT!DACGPSCTON=1
            CtoN=50.8, Freq=99946
            OK
          - Check the GNSS L5 path (example output shown):

            AT!DACGPSCTON=5
            CtoN=50.0, Freq=999969
            OK

      iii. Turn off the signal generator.
   f. To test a different GNSS receive path, go back to step 2.

4: References

Sierra Wireless Documents

The Sierra Wireless documents listed below are available from source.sierrawireless.com.

[1] Sierra Wireless EM919X AT Command Reference (Doc# 41113480)

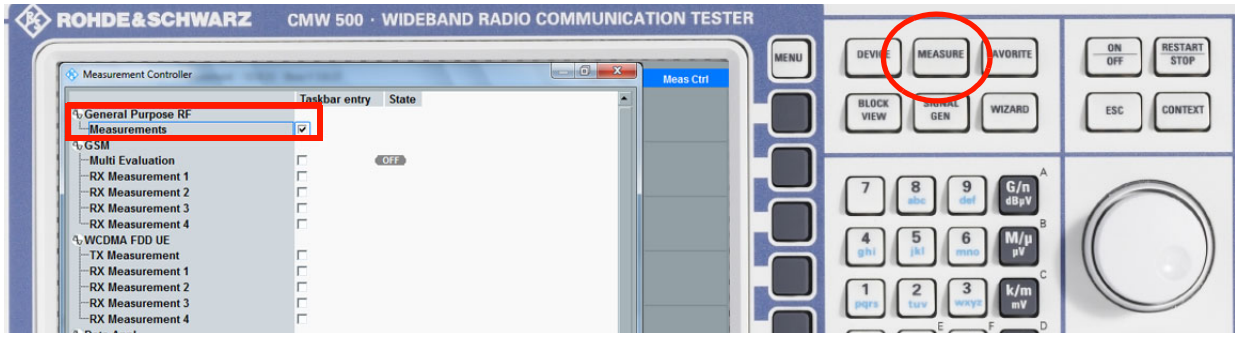
[2] EM919X/EM7690 Product Technical Specification (Doc# 41113174)

A: CMW500 Setup

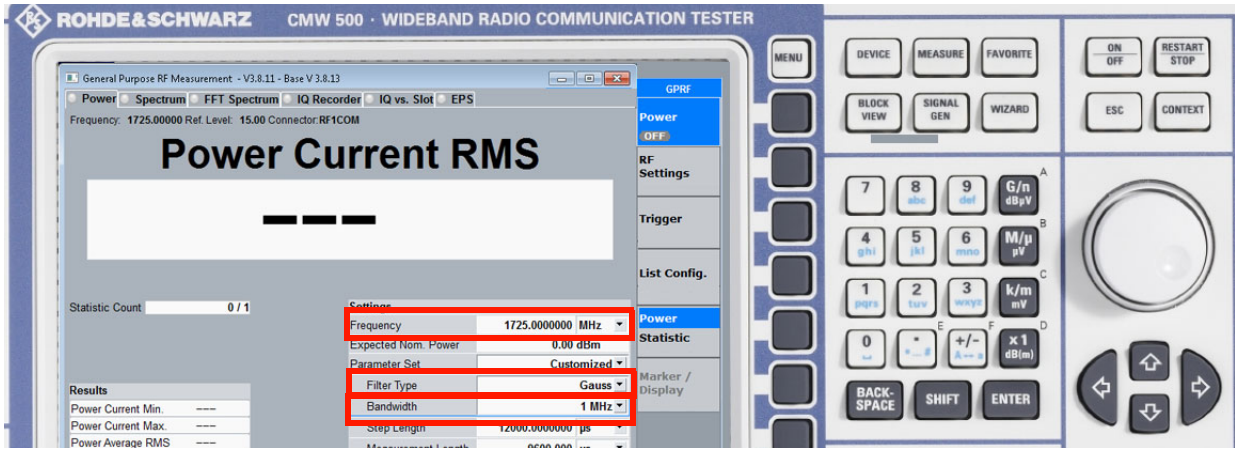
This chapter briefly describes how to set up the CMW500 callbox for WCDMA, LTE, and 5G Sub6 Rx and Tx measurements described in Production Testing.

CMW500 Transmission Path Test Setup

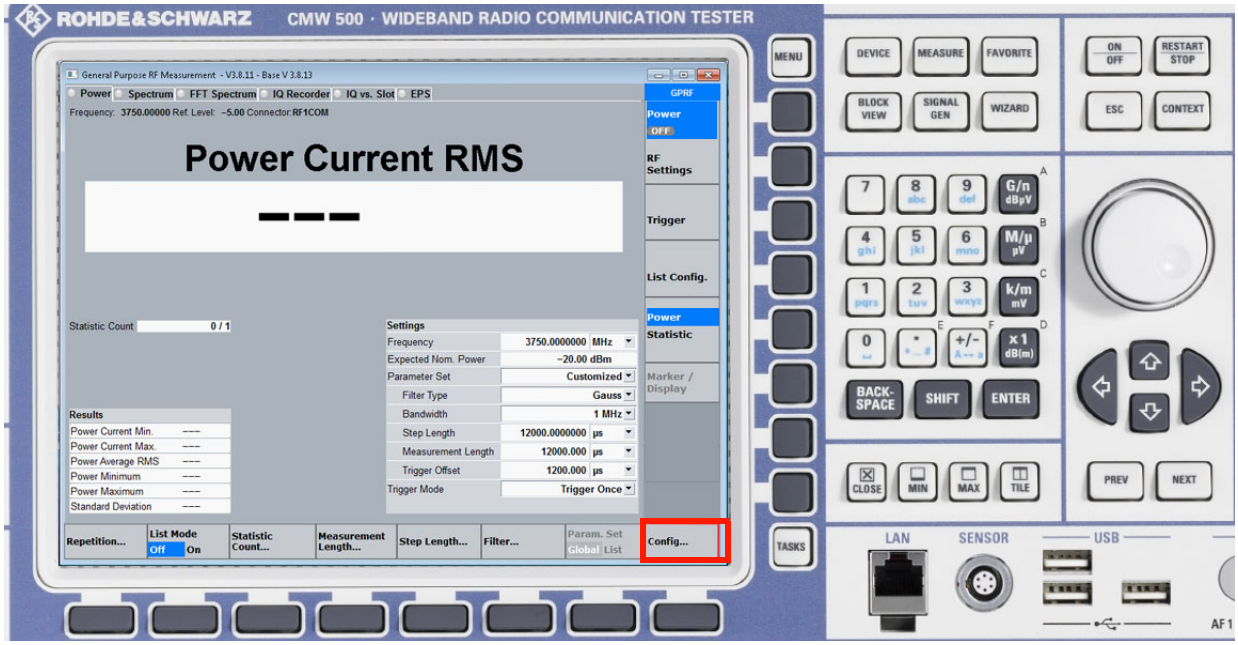
1. Press the MEASURE button and select “Measurements”.

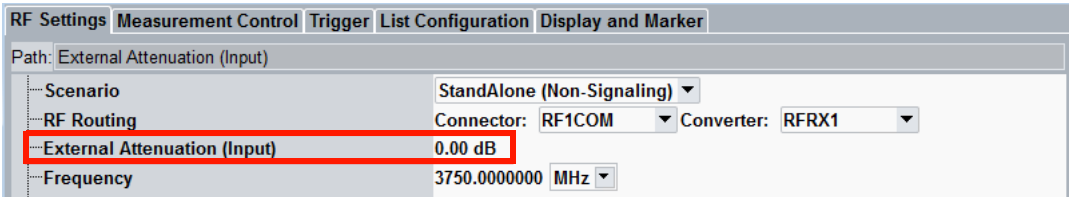


2. Input the appropriate Tx Frequency, select "Gauss" as the “Filter Type”, and select the appropriate “Bandwidth”.

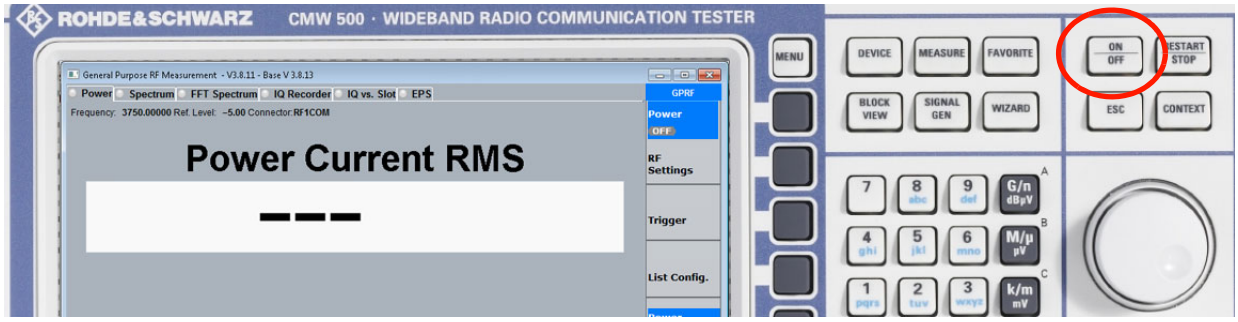


3. Press Config... and then in the RF Settings tab, enter the pathloss in External Attenuation (input).





4. Press the On/Off button to turn on the signal receiving path.



CMW500 Receive Path Test Setup

1. Press the SIGNAL GEN button and select “Generator 1”.

2. Press the Frequency button and input the appropriate Rx frequency, then press the Level button and input the required power level value.

3. Press the On/Off button to turn on this signal (the transmit path) and direct the output to the device's RF path.

A: Abbreviations

Table A-1: Abbreviations

Abbreviation	Description
GNSS	Global Navigation Satellite System
LTE	Long Term Evolution
WCDMA	Wideband Code Division Multiple Access
5G mmw	5G millimeter Wave
RFM	Radio Frequency Module
RFC	Radio Frequency Card