



EM92 Series

Customer Production Test Guide

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Sierra Wireless

Semtech Corporation purchased Sierra Wireless in January 2023. The Sierra Wireless brand is gradually being phased out. During the phase-out period, references to both “Semtech” and “Sierra Wireless” may appear in product documentation.

Contact Information

Sales information and technical support, including warranty and returns	Web: sierrawireless.com/company/contact-us/ Global toll-free number: 1-877-687-7795 6:00 am to 5:00 pm PST
Corporate and product information	Web: sierrawireless.com

Revision History

Revision number	Release date	Changes
1	Jun 2023	Creation
2	February 2025	<p>Removed references to !DAUPDATEPARAM (command has been deprecated)</p> <p>Replaced all !DAFTMACT calls with +CFUN calls</p> <p>Updated Table 3-1, Suggested Testing Platform Equipment (example power supply)</p> <p>Updated Table 3-2, 5G NR Sub-6G GHz/LTE/WCDMA/GNSS Antenna Receptacles — RF Technology Support (B77/78/79 Tx antenna; added B106; B41 Tx antenna; clarified GNSS antenna entries; added/updated footnotes (c–k))</p> <p>Added Table 3-3, !DAGFTMRXAGC <path> to Rx Antenna Connector Mapping (Single Band Operation)</p> <p>Updated Table 3-4, Test Parameters — WCDMA (updated Tx test channels)</p> <p>Updated Table 3-5, Test Parameters — LTE (added B106)</p> <p>Updated LTE RF Transmission Path Test (updated usage description for !DARCONFIG step; updated details for repeating test for the next LTE band)</p> <p>Updated LTE RF Receive Path Test (updated usage description and example descriptions for !DARCONFIG step)</p> <p>Updated Table 3-6, Test Parameters — 5G Sub6 (added Resource Block Settings; updated n48/n79 Tx and Rx test channels)</p> <p>Updated 5G Sub6 RF Transmission Path Test (updated usage description for !DARCONFIG step; updated !DATXCONTROL examples and notes; updated details for repeating test for the next 5G Sub6 band; added final step to disable 5G Sub6)</p> <p>Updated 5G Sub6 RF Receive Path Test (updated usage description and examples for !DARCONFIG step)</p>

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1: Overview

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

This document aims to help developers set up a factory production test procedure for products containing EM92 series embedded modules:

- EM9291
- EM9293

Note: In this document, EM92 refers to the EM92 module series, which includes EM9291 and EM9293.

Important: *The tests in this document are performed using AT commands as implemented in firmware version SWIX65C_02.17.08.00 (Release 6).*

Suggested test procedures are described for each supported technology as indicated in [Table 1-1](#):

Table 1-1: Test Procedures

RAT test cases	EM9291	EM9293
WCDMA RF Tests	Y	Y
LTE RF Tests	Y	Y
5G Sub6 RF Tests	Y	Y
Shared GNSS RF Receive Path Test	Y	Y
Dedicated GNSS RF Receive Path Test	—	Y

For supported bands, GNSS specifications, etc., refer to [\[2\] EM92XX Product Technical Specification \(Doc# 41114313\)](#).

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+CFUN=5**. If **AT!DARCONFIG** is received too soon after this, the modem returns an error.

When building automated test scripts, ensure that sufficient delays are embedded where necessary to avoid these types of errors.

3: Production Testing

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

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

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

Your test station 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.

3.1 Suggested Testing Platform Equipment

To perform production tests, use an appropriate testing platform.

Table 3-1: Suggested Testing Platform Equipment

Equipment	Details
PC with Windows	Windows 11 22H2 or later
Power supply	e.g., Rohde & Schwarz HMP2020
Call box	CMW500 (or equivalent) for basic RF functions such as generating or receiving required frequency signal

Note: Procedures in this document describe general required callbox configurations (e.g., for CMW500 and CMW100). 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)

3.2 Functional Production Test

This section presents a suggested basic manual functional test procedure for a host platform with an EM92 embedded module. 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 WCDMA, LTE and 5G NR Sub-6G GHz. For radiated testing, modify the suggested procedures as appropriate to your requirements.

3.2.1 RF Receptacles

EM92 modules include several receptacles for use with host-supplied antennas. The host must mate the RF receptacles (PCB connectors) with corresponding RF plugs (cable connectors).

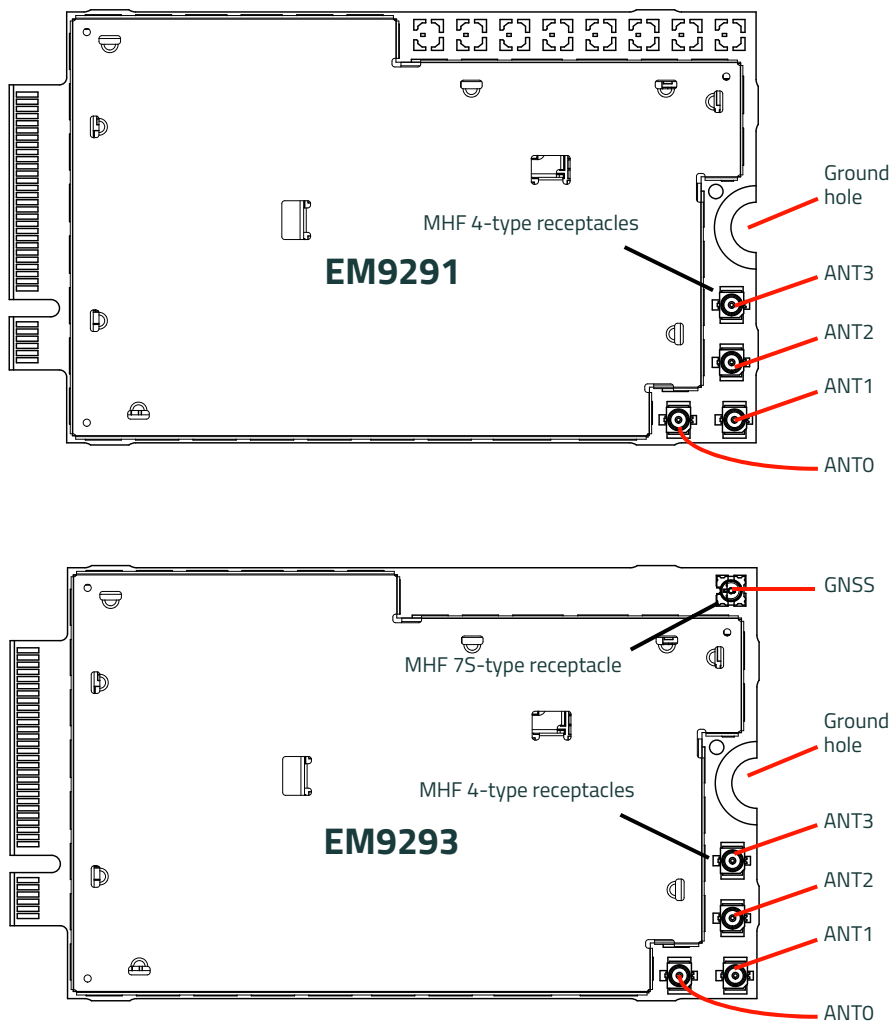


Figure 3-1: EM92 Module RF Receptacles

Table 3-2: 5G NR Sub-6G GHz / LTE/WCDMA / GNSS Antenna Receptacles — RF Technology Support

RAT ^a	Bands	Tx Antennas ^{b,c,d,e}		Rx Antennas ^f				GNSS Antenna
		Default	Alternate Path ^g	ANT0	ANT1	ANT2	ANT3	(EM9293 only) GNSS
5G NR Sub-6G GHz	29 ⁱ	—	—	Y	—	Y	—	—
	38, 41	ANT2	ANT0	Y	Y	Y	Y	—
	48	ANT3	ANT1	Y	Y	Y	Y	—
	75 ⁱ , 76 ⁱ	—	—	Y	Y	Y	Y	—
	77, 78	ANT3	ANT1 ANT2	Y	Y	Y	Y	—
	79	ANT3	ANT1	Y	Y	Y	Y	—
LB LTE/ 5G NR Sub-6G GHz	5, 8, 12, 13, 14, 17, 18, 19, 20, 26, 28, 71, 106	ANT0	—	Y	—	Y	—	—
MB LTE/ 5G NR Sub-6G GHz	1, 2, 3, 4, 7, 25, 30 ^h , 39, 40, 66, 70	ANT0	—	Y	Y	Y	Y	—
LTE	29 ⁱ	—	—	Y	—	Y	—	—
	34 ^j	ANT0	—	Y	—	Y	—	—
	46 ⁱ	—	—	Y	—	—	Y	—
	32 ⁱ	—	—	Y	Y	Y	Y	—
	38, 41	ANT0	—	Y	Y	Y	Y	—
	42, 43, 48	ANT3	ANT1	Y	Y	Y	Y	—
WCDMA	1, 2, 4, 5, 8, 19	ANT0	—	Y	—	Y	—	—
GNSS	L1 ^k /L5	—	—	—	L1 ^k /L5	—	—	L1 ^k

- a. LB=Low Band (<1 GHz), MB=Mid Band (1–2.2 GHz), HB=High Band (2.2–3. GHz), UHB (3–6 GHz)
- b. The indicated Tx antenna is used to carry the Tx PUSCH channel.
- c. SRS antenna switching is supported on certain bands (refer to the 'Sounding Reference Signal' topic in [2] *EM92XX Product Technical Specification (Doc# 41114313)*).
- d. Tx antenna assignments are for SA mode. For NSA mode, the antenna depends on the RAT, bands and resource allocation, and the device firmware dynamically assigns the antenna based on those factors.
- e. In NSA and ULCA/MIMO modes, a maximum of two Tx antennas can transmit at the same time.
- f. The !DAGFTMRXAGC <path> argument specifies an Rx path (PRx, DRx, MIMO1, MIMO2). See [Table 3-3](#) below for the specific antenna used for the <path> for each band.
- g. Alternate Tx path is used only in ENDC and CA modes. For ENDC and CA, the module firmware chooses the Tx chain (antenna) based on resource allocation.
- h. LTE B30 DL only; n30 DL/UL
- i. DL only band
- j. B34 is restricted to 2x2 by FW (not HW)
- k. GNSS is populated on EM9293 only — the EM9293 can use either ANT1 or GNSS (software-selectable, ANT1 by default). Note that GNSS is used for GNSS L1 only.

Table 3-3: !DAGFTMRXAGC <path> to Rx Antenna Connector Mapping (Single Band Operation)

!DAGFTMRXAGC <path> value	Antenna function	Band-specific ^{ab} Connector Use (ANT0–ANT3)		
		LB / MB bands		UHB bands
		(All except n38 / n41)	(n38, n41)	(All)
0	PRx	ANT0	ANT2	ANT3
1	MIMO1	ANT1	ANT3	ANT2
2	MIMO2	ANT3	ANT1	ANT1
3	DRx	ANT2	ANT0	ANT0

a. Per [Table 3-2](#).

b. LB=Low Band (<1 GHz), MB=Mid Band (1–2.2 GHz), HB=High Band (2.2–3. GHz), UHB (3–6 GHz)

3.2.2 Functional Production Test Plan

The following is a suggested test plan using a Windows PC with an EM92 Development Kit substituting as the host platform device under test (DUT).

Note:

- You must decide which tests are appropriate for your product.
- You can also add additional tests that fully exercise your product’s capabilities.

To perform these tests, use an appropriate hardware connection on the host platform under test (e.g., the development kit’s USB-C connector CN204), and refer to *[1] EM9 Series AT Command Reference (Doc# 41113480)* for command details:

1. Before installing the module in the host platform, visually inspect the module’s connectors and RF assemblies for obvious defects.
2. Install the module in the host platform.
3. Make sure the module is powered off (i.e., no voltage on VCC).
4. Provide power to the module.

Note— For EM92 power on/off details, refer to the *[2] EM92XX Product Technical Specification (Doc# 41114313)* sections "Full_Card_Power_Off_N and RESET_N" and "Power Interface".

5. Test host platform functionality— Check that the module enumerates correctly.

Note— In this test example, check the port enumeration with Windows Device Manager. In Device Manager, the module appears under Modems as a Sierra Wireless WWAN Modem port.

For example:



Note: Windows drivers are available from the module’s device page at source.sierrawireless.com.

6. Determine the COM port used for the modem.

Note— In this test example, check the enumerated port’s device properties.
7. Set up a serial connection to the modem COM port (speed = 115200 baud, or set as appropriate) using a terminal emulator (e.g., HyperTerminal, TeraTerm, PuTTY, etc.).

8. In the emulator, confirm the connection established correctly:

```
AT
```

If the connection is established, the command returns OK.

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

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

```
ATI
```

10. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

11. Scan for any RF device problems:

```
AT!RFDEVSTATUS?
```

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

If there are no RF device problems, all <present> values will be "TRUE".

12. Enter test mode:

```
AT+CFUN=5
```

13. Use the test platform (see [Suggested Testing Platform Equipment](#)) to perform RF tests:

- a. Test RF transmission:

- WCDMA — See [WCDMA RF Transmission Path Test](#).
- LTE — See [LTE RF Transmission Path Test](#).
- 5G Sub6 — See [5G Sub6 RF Transmission Path Test](#).

- b. Test RF reception:

- WCDMA — See [WCDMA RF Receive Path Test](#).
- LTE — See [LTE RF Receive Path Test](#).
- 5G Sub6 — See [5G Sub6 RF Receive Path Test](#).

- c. Test standalone GNSS functionality — see [Shared GNSS RF Receive Path Test](#).

- d. (EM9293 only) Test dedicated GNSS functionality — see [Dedicated GNSS RF Receive Path Test](#).

3.3 WCDMA RF Tests

WCDMA RF tests apply to EM9291/EM9293.

3.3.1 WCDMA Test Parameters

Use the parameters in [Table 3-4](#) for the WCDMA Tx and Rx tests described below.

Table 3-4: Test Parameters — WCDMA

Band		Tx		Rx	
Number	Name	Test Channel	Test Frequency ^a (MHz)	Test Channel	Test Frequency ^b (MHz)
1 (B1)	2100	9750	1950	WCDMA Rx test channel is calculated automatically by the module firmware based on the Tx channel. ^c	2141.2
2 (B2)	1900 PCS	9400	1880		1961.2
4 (B4)	1700 AWS-1	1450	1740		2141.2
5 (B5)	850	4175	835		881.2
8 (B8)	900 GSM	2788	897.6		943.8
19 (B19)	800 Japan	412	837.5		883.7

- Testing Tx frequency to set on the callbox.
- Testing Rx frequency to set on the callbox.
This frequency includes a required 1.2 MHz offset on the call box from the Rx channel, for testing with an unmodulated (continuous wave (CW)) waveform. (e.g., for band B1, use 2141.2 MHz)
If testing with a modulated waveform, remove the offset. (e.g., for band B1, use 2140 MHz)
- The WCDMA receive path test uses only the Tx channel with the **!DARCONFIG** command. (The module firmware automatically calculates the Rx channel based on the Tx channel.)

3.3.2 WCDMA RF Transmission Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

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

- Connect the RF cable from the call box (e.g., the CMW500) to the module's ANTO receptacle — see [Figure 3-1](#) on page 10. (Note — Do not turn on the RF transmitter yet.)
Do not connect ANT1, ANT2, or ANT3.
- 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 2](#))
 - Filter type — Gauss
 - Pathloss (i.e., cable loss from antenna port of the module to the callbox)
 - Signal receiving path — ON (e.g., on the 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 36.

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

- a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- b. Enter test mode:

```
AT+CFUN=5
```

- c. Configure the Tx channel for the selected band:

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

e.g.:

```
AT!DARCONFIG=0,1,2,9400 ← Tx channel 9400. For values, see Table 3-4.
```

- d. Set the Tx power and enable the transmitter (<enable>=1):

Note: <power_dbm10> = 10 × power must be an integer.)

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

e.g.:

```
AT!DATXCONTROL=0,1,1,-505 ← Transmit with -50.5 dBm Tx power.
```

Caution: To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (for values, refer to [2] EM92XX Product Technical Specification (Doc# 41114313)).

- e. 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.

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

Note: This procedure is for conducted power testing. If the same test is performed over the air in an RF chamber (i.e., radiated power testing), the measured values are likely to be significantly lower, and will also be influenced by various test antenna characteristics (e.g., antenna gain, position, efficiency, pattern).

- f. Disable the transmitter—Set <enable>=0 and make sure all other configuration parameters are the same as in [step d.](#))

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

e.g.:

```
AT!DATXCONTROL=0,1,0,-505
```

- g. Drop the current WCDMA configuration.

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=1
```

- h. 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.](#)

3.3.3 WCDMA RF Receive Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

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

1. Connect RF cables to the ANT0 and ANT2 receptacles — see [Figure 3-1](#) on page 10.
(Do not connect ANT1 or ANT3.)
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 36.

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

- a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- b. Enter test mode:

```
AT+CFUN=5
```

- c. Configure the channel for the selected band:

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

e.g.:

```
AT!DARCONFIG=0,1,2,9400 ← Rx channel 9400. For values, see Table 3-4.
```

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

Note: <expected_AGC> = 10 × power must be an integer.

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

e.g. To test an Rx path for -50.5 dBm:

- Check the ANT0 path Rx (i.e., when the ANT0 receptacle (path index 0) is connected to the CMW500):

```
AT!DAGFTMRXAGC=0,1,-505,0
-50.5
OK
```

- Check the ANT2 path Rx (i.e., when the ANT2 antenna port (path index 3) is connected to the CMW500.):

```
AT!DAGFTMRXAGC=0,1,-505,3
-50.5
OK
```

- e. Drop the current WCDMA configuration:

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=1
```

- f. 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](#).

3.4 LTE RF Tests

LTE RF tests apply to EM9291/EM9293.

3.4.1 LTE Test Parameters

Use the parameters in [Table 3-5](#) for the LTE Tx and Rx tests described below.

Table 3-5: Test Parameters — LTE

Band Number	Bandwidth Index ^a	Tx		Rx	
		Test Channel ^b	Test Frequency ^c (MHz)	Test Channel ^b	Test Frequency ^d (MHz)
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
18 (B18)	3 (10 MHz)	23925	822.5	5925	869.5
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) ^e	N/A ^e	N/A ^e	N/A ^e	9715	722.5
30 (B30)	3 (10 MHz)	27710	2310	9820	2357
32 (B32) ^e	N/A ^e	N/A ^e	N/A ^e	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

Table 3-5: Test Parameters — LTE (Continued)

Band Number	Bandwidth Index ^a	Tx		Rx	
		Test Channel ^b	Test Frequency ^c (MHz)	Test Channel ^b	Test Frequency ^d (MHz)
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
43 (B43) ^f	3 (10 MHz)	44590	3700	44590	3702
46 (B46) ^g	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
106 (B106)	1 (3 MHz)	134317	898.5	70681	937.5

a. Bandwidth index values are defined in the **!DARCONFIG** command — refer to [1] *EM9 Series AT Command Reference (Doc# 41113480)*.

b. Tx and Rx channel values shown are based on the test frequency, and are used by **!DARCONFIG** command.

c. Testing Tx frequency to set on the call box.

d. Testing Rx Frequency to set on the callbox.

This frequency includes a required 2 MHz offset on the call box from the Rx channel, for testing with an unmodulated (continuous wave (CW)) waveform. (e.g., for band B1, use 2142 MHz)

If testing with a modulated waveform, remove the offset. (e.g., for band B1, use 2140 MHz)

e. B29/B32 are downlink only. No Tx test required.

f. B43 support is firmware and SKU-dependent.

g. LTE-LAA B46 (Downlink only; i.e., no transmission path, no Tx test required)

3.4.2 LTE RF Transmission Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

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

1. Connect the RF cable from the call box (e.g. the CMW500) to the module's ANTO receptacle (depending on the band to test, see note below) — see [Figure 3-1](#) on page 10 and [Table 3-2](#) on page 11. (Note — Do not turn on the RF transmitter yet.)

Do not connect the other receptacles.

Note: As shown in [Table 3-2](#) on page 11, the module uses ANTO for most LTE bands, and ANT3 is used for bands B42, B43 and B48.

2. 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](#))
 - Bandwidth (corresponds to <bw> 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., on the CMW500, press On/Off button)

For examples using a CMW500, see [CMW500 Setup](#) on page 36.

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

a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

b. Enter test mode:

```
AT+CFUN=5
```

c. Use the !DARCONFIG command shown below to configure the Tx/Rx channels and bandwidth for the selected band.

Note:

- <rx_channel>, <tx_channel>— Either:
[a] set the specific Rx channel, or [b]
set the channel to '1' (which calculates the actual Rx channel from the Tx channel— note that this behavior applies only to LTE).
- <beam_ID>— Leave this blank. (It is used only for 5G mmW.)
- <continuous_mode>— Set the appropriate transmission mode (0=burst mode; 1 (or blank) = continuous mode (default))
- <tx_ant>— Leave this blank. (It is used only for 5G Sub6).
- <subband_type>— Leave this blank. (It is used only for 5G Sub6).
- <mimo_mode>:
Important: For firmware versions earlier than SWIX65C_02.17.08.00 (Release 6), leave <mimo_mode> blank or set it to 0.

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

e.g.:

```
AT!DARCONFIG=0,3,28,27560,5,1,0,,,,1
```

← Technology 3 (LTE), Tx channel 27560, bandwidth 5, Rx channel 1 (see note below for Rx channel), Subband B (i.e., B28B. If <subband_type>=1 was not specified, B28A would be used.)

For values, see [Table 3-5](#).

d. Set the Tx power and enable the transmitter (<enable>=1):

Note: <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
```

← Technology 3 (LTE); Transmit with -50.5 dBm Tx power, 20% duty cycle (see table below)

<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] EM92XX Product Technical Specification (Doc# 41114313)).

- e. 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.

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

Note: This procedure is for conducted power testing. If the same test is performed over the air in an RF chamber (i.e., radiated power testing), the measured values are likely to be significantly lower, and will also be influenced by various test antenna characteristics (e.g., antenna gain, position, efficiency, pattern).

- f. Disable the transmitter — Set <enable>=0 and 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>[,<duty_cycle>]]
```

e.g.:

```
AT!DATXCONTROL=0,3,0,-505,1,0,1,0,10,,2
```

- g. Drop the current LTE configuration:

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=3
```

- h. 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. If the next band uses the same antenna receptacle or if it uses a different receptacle that is already connected (directly or via a combiner), go back to [step c](#).
- iii. Otherwise (i.e., the next band uses a different antenna receptacle that is not already connected, either through direct connection or via a combiner):
 - i. Power off the DUT and any signal generators.
 - ii. Connect the RF cable from the call box to the correct receptacle.

- iii. Power on the DUT.
- iv. Go back to [step a](#).

3.4.3 LTE RF Receive Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

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

1. Connect RF cables to all four antenna receptacles (ANT0, ANT1, ANT2, ANT3) — 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 36.

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

- a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- b. Enter test mode:

```
AT+CFUN=5
```

- c. Configure the channels and related parameters for the selected band:

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

Note:

- <rx_channel>, <tx_channel> — Either:
 - [a] set the specific Rx channel and Tx channel, or
 - [b] set the <rx_channel> to '1' and set the specific <tx_channel>. In this case, the actual Rx channel is calculated from the Tx channel — note that this behavior applies only to LTE.
- **Important:** For Rx-only bands (e.g., bands like B29 that do not have a Tx path), the Tx channel must be set to 0 and the Rx channel must be specified.
For example, to test B46: AT!DARCONFIG=0,3,46,0,3,50670
- **Important:**
For firmware versions earlier than SWIX65C_02.17.08.00 (Release 6), make sure to set <mimo_mode> correctly for the receive path being tested:
 - <mimo_mode>=0 or blank: Configures the PRx or DRx path
 - <mimo_mode>=1: Configures the MIMO1 and MIMO2 paths. (Does not configure the PRx or DRx paths)

Firmware version SWIX65C_02.17.08.00 (Release 6) and later use different behavior for <mimo_mode>:

- <mimo_mode>=0 or blank: Configures the PRx or DRx path, and the Tx path (if applicable).
- <mimo_mode>=1: Configures the PRx, DRx, MIMO1 and MIMO2 paths, and the Tx path (if applicable).

e.g., To configure band B4 with MIMO, enable MIMO mode (set <mimo_mode>=1):

```
AT!DARCONFIG=0,3,4,20175,3,1,1 ← Technology 3 (LTE), Band 4, Tx channel 20175, bandwidth 3, Rx channel 1 (see note below for Rx channel), enable the MIMO flag (1).
```

For values, see [Table 3-5](#).

e.g., To configure band B28 without MIMO, disable MIMO mode (set <mimo_mode>=0 or omit the parameter):

```
AT!DARCONFIG=0,3,28,27560,5,1 ← Technology 3 (LTE), Band 28, Tx channel 27560, bandwidth 5, Rx channel 1 (see note below for Rx channel), disable the MIMO flag (omitted in this example).
```

For values, see [Table 3-5](#).

- d. Repeat this step for each path that you want to test (see [Table 3-2](#))— Set the expected Rx power (<expected_AGC>) and check that the measured <rssi> = <expected_AGC> (i.e., actual FTM AGC matches the expected AGC).

Note: <expected_AGC> = 10 × power must be an integer.

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

e.g. To test Rx paths for -50.5 dBm:

- Use !DAGFTMRXAGC to check a supported path for the current band— set the Rx <path> parameter to indicate the path being tested.

Note: Antenna port mappings vary between bands. Test an Rx path and if !DAGFTMRXAGC returns an unexpected result (e.g., -99.9), repeat the test using different Rx <path> values until the correct one is found.

Note: An AT command will be added in a future firmware release to list the antenna port assignments for a specific band.

e.g., Check MIMO1:

```
AT!DAGFTMRXAGC=0,3,-505,1 ← Assume MIMO1 is using Rx path 1
-99.9 ← Value is not near the expected result, MIMO1 is not using Rx path 1
OK

AT!DAGFTMRXAGC=0,3,-505,3 ← Repeat test on Rx path 3
-50.9 ← Value is near the expected result, MIMO1 is using Rx path 3
OK
```

- e. Drop the current LTE configuration:

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=3
```

- f. To test the next LTE band:

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

3.5 5G Sub6 RF Tests

5G Sub6 tests apply to EM9291/EM9293.

3.5.1 5G Sub6 Test Parameters

Use the parameters in [Table 3-6](#) for the 5G Sub6 Tx and Rx tests described below.

Table 3-6: Test Parameters — 5G Sub6

Band Number	Bandwidth Index ^a	Tx		Rx		Resource Block Settings ^b	
		Test Channel ^c	Test Freq ^d (MHz)	Test Channel ^c	Test Freq ^e (MHz)	Start_RB	Num_RB
1 (n1)	5 (20 MHz)	390000	1950	428000	2142	25	50
2 (n2)	5 (20 MHz)	376000	1880	392000	1962	25	50
3 (n3)	5 (20 MHz)	349500	1747.5	368500	1844.5	25	50
5 (n5)	5 (20 MHz)	167300	836.5	176300	883.5	25	50
7 (n7 ^f)	5 (20 MHz)	507000	2535	531000	2657	25	50
8 (n8 ^f)	5 (20 MHz)	179500	897.5	188500	944.5	25	50
12 (n12 ^f)	3 (10 MHz)	141500	707.5	147500	739.5	12	25
13 (n13)	3 (10 MHz)	156400	782	150200	753	12	25
14 (n14)	3 (10 MHz)	158600	793	152600	765	12	25
18 (n18)	4 (15 MHz)	164500	822.5	173500	869.5	18	36
20 (n20 ^f)	5 (20 MHz)	169400	847	161200	808	25	50
25 (n25 ^f)	5 (20 MHz)	376500	1882.5	392500	1964.5	25	50
26 (n26)	5 (20 MHz)	166300	831.5	175300	878.5	25	50
28 (n28A)	5 (20 MHz)	142600	713	153600	772.5	25	50
28 (n28B)	5 (20 MHz)	147600	738	158600	795	25	50
29 (n29)	3 (10 MHz)	—	—	144500	724.5	12	25
30 (n30)	3 (10 MHz)	462000	2310	471000	2357	12	25
38 (n38 ^f)	5 (20 MHz)	519000	2595	519000	2597	12	25
40 (n40 ^f)	8 (40 MHz)	470000	2350	470000	2352	25	50
41 (n41A)	5 (20 MHz)	518601	2593.005	518601	2595	12	25
41 (n41B)	5 (20 MHz)	525000	2625	525000	2627	12	25
48 (n48 ^f)	5 (20 MHz)	641667	3625	641667	3627	12	25
66 (n66)	5 (20 MHz)	349000	1745	429000	2147	25	50

Table 3-6: Test Parameters — 5G Sub6 (Continued)

Band Number	Bandwidth Index ^a	Tx		Rx		Resource Block Settings ^b	
		Test Channel ^c	Test Freq ^d (MHz)	Test Channel ^c	Test Freq ^e (MHz)	Start_RB	Num_RB
70 (n70)	4 (15 MHz)	340500	1702.5	401500	2009.5	18	36
71 (n71)	5 (20 MHz)	136100	680.5	126900	636.5	25	50
75 (n75)	5 (20 MHz)	—	—	294900	1476.5	25	50
76 (n76)	2 (5 MHz)	—	—	285900	1431.5	—	—
77 (n77)	13 (100 MHz)	650000	3750	650000	3752	67	135
78 (n78)	9 (50 MHz)	636667	3550.005	636667	3551.99	32	64
79 (n79)	13 (100 MHz)	713334	4699.995	713334	4701.995	67	135

- Bandwidth index values are defined in the !DARCONFIG command—refer to [1] *EM9 Series AT Command Reference (Doc# 41113480)*.
- Recommended resource block settings for use in the !DATXCONTROL command in the [5G Sub6 RF Transmission Path Test](#) procedure.
- Tx and Rx channel values shown are based on the test frequency, and are used by !DARCONFIG.
- Testing Tx frequency to set on the call box.
- Testing Rx frequency to set on the call box. This frequency includes a 2 MHz offset on the call box from the Rx channel for testing with an unmodulated (continuous wave (CW)) waveform. (e.g., for band n1, use 2142 MHz)
If testing with a modulated waveform, remove the offset. (e.g., for band n1, use 2140 MHz)
- Band support is firmware and SKU-dependent.

3.5.2 5G Sub6 RF Transmission Path Test

Test applies to EM9291/EM9293.

*Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] *EM9 Series AT Command Reference (Doc# 41113480)*.*

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

- Connect the RF cable from the call box (e.g. the CMW500) to the module's ANTO receptacle (depending on the band to test, see note below)—see [Figure 3-1](#) on page 10 and [Table 3-2](#) on page 11. (Note—Do not turn on the RF transmitter yet.)

The other receptacles (ANT1, ANT2, ANT3) can be left connected.

Note: As shown in [Table 3-2](#), the module uses ANTO for most 5G NR Sub-6G GHz bands; ANT2 is used for bands n38 and n41, and ANT3 is used for bands n48 and n75–n79.

- 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](#))
 - Bandwidth (corresponds to <bw> 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., on the CMW500, press On/Off button)

For examples using a CMW500, see [CMW500 Setup](#) on page 36.

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

- a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- b. Enter test mode:

```
AT+CFUN=5
```

- c. Enable 5G Sub6 technology (<enable>=1):

```
AT!DASUB6TECHACT=<enable>
```

e.g.,

```
AT!DASUB6TECHACT=1
```

- d. Use the !DARCONFIG command shown below to configure the Tx/Rx channels, bandwidth and related parameters for the selected band.

Note:

- <beam_ID> — Leave this blank. (It is used only for 5G mmW.)
- <continuous_mode> — Set the appropriate transmission mode (0=burst mode; 1 (or blank) = continuous mode (default))
- <tx_ant> — If testing alternate Tx antennas for bands that support Sounding Reference Signal (SRS), set this to the the required antenna.
- <subband_type>:
 - If <tx_ant> is specified (i.e., not blank) and the <band> supports subbands (e.g., n28, n41), set the type = '1' for subband B, or set the type = 0 (or leave it blank) for subband A.
 - For all other cases, leave <subband_type> blank.
- <mimo_mode>:

Important: For firmware versions earlier than SWIX65C_02.17.08.00 (Release 6), leave <mimo_mode> blank or set it to 0.

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

Example 1: Configure for band n28 (does not support SRS):

```
AT!DARCONFIG=0,6,28,147600,5,158600,0,,0
```

← Technology 6 (5G Sub6), Tx channel 147600, bandwidth 5, Rx channel 158600, MIMO disabled 0, burst mode enabled 0, No <tx_ant> specified since B28 does not support SRS.

For values, see [Table 3-6](#).

Example 2: Configure for band n41 (supports SRS), default Tx antenna:

```
AT!DARCONFIG=0,6,41,518601,5,518601
```

← Technology 6 (5G Sub6), Tx channel 518601, bandwidth 5, Rx channel 518601, MIMO disabled (by default since not specified), continuous mode enabled (by default since not specified), default antenna selected since no <tx_ant> is specified.

For values, see [Table 3-6](#).

Type	RFM	dev	Path	ASP	Ant	PLL
Tx	11		505	46	2	←Default antenna 2 selected
PRx	1		634	46	2	0
DRx	0		458	5	0	0

Example 3: Configure for band n41 (supports SRS), select Tx antenna:

```
AT!DARCONFIG=0,6,41,518601,5,518601,,,,0
    ← Technology 6 (5G Sub6), Tx channel 518601, bandwidth 5, Rx channel 518601,
    MIMO disabled (by default since not specified), continuous mode enabled (by default
    since not specified), select specific Tx antenna (0).
    For values, see Table 3-6.
```

Type	RFM dev	Path	ASP	Ant	PLL	
Tx	11	505	46	0	4	←Antenna 0 selected
PRx	1	634	46	2	0	
DRx	0	458	5	0	0	

- e. Set the Tx power and enable the transmitter (<enable>=1):

Note:

- For <start_RB> and <num_RB>, use the band-specific values in Table 3-6.
- <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., assuming band n28 was selected in step d above:

```
AT!DATXCONTROL=0,6,1,-505,10,0,1,25,50,,0
    ← Technology 6 (5G Sub6), Transmit with -50.5 dBm Tx power,
    Start RB 25, Num RB 50, 20% duty cycle (see table below)
```

<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] EM92XX Product Technical Specification (Doc# 41114313)).

- f. 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.

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

Note: This procedure is for conducted power testing. If the same test is performed over the air in an RF chamber (i.e., radiated power testing), the measured values are likely to be significantly lower, and will also be influenced by various test antenna characteristics (e.g., antenna gain, position, efficiency, pattern).

- g. Disable the transmitter — Set `<enable>=0` and 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., assuming band n28 was selected in [step d](#) above:

```
AT!DATXCONTROL=0,6,0,-505,10,0,1,25,50,,0
```

- h. Drop the current 5G Sub6 configuration:

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=6
```

- i. 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. If the next band uses the same antenna receptacle or if it uses a different receptacle that is already connected (directly or via a combiner), go back to [step d](#).
- iii. Otherwise (i.e., the next band uses a different antenna receptacle that is not already connected through either a direct connection or via a combiner):
 - i. Power off the DUT.
 - ii. Connect the RF cable from the call box to the correct receptacle.
 - iii. Power on the DUT.
 - iv. Go back to [step a](#).

- j. When there are no more bands to test, disable 5G Sub6 technology (`<enable>=0`):

```
AT!DASUB6TECHACT=<enable>
```

e.g.:

```
AT!DASUB6TECHACT=0
```

3.5.3 5G Sub6 RF Receive Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

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

1. Connect RF cables to all four antenna receptacles (ANT0, ANT1, ANT2, ANT3) — 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 36.

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

- a. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- b. Enter test mode:

```
AT+CFUN=5
```

- c. Enable 5G Sub6 technology (<enable>=1):

```
AT!DASUB6TECHACT=<enable>
```

e.g.,

```
AT!DASUB6TECHACT=1
```

- d. Configure the channels and related parameters for the selected band:

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

Note:

• **Important:**

For firmware versions earlier than SWIX65C_02.17.08.00 (Release 6), make sure to set <mimo_mode> correctly for the receive path being tested:

- <mimo_mode>=0 or blank: Configures the PRx or DRx path
- <mimo_mode>=1: Configures the MIMO1 and MIMO2 paths. (Does not configure the PRx or DRx paths)

Firmware version SWIX65C_02.17.08.00 (Release 6) and later use different behavior for <mimo_mode>:

- <mimo_mode>=0 or blank: Configures the PRx or DRx path, and the Tx path (if applicable).
- <mimo_mode>=1: Configures the PRx, DRx, MIMO1 and MIMO2 paths, and the Tx path (if applicable).

e.g., To configure band n3 with MIMO, enable MIMO mode:

```
AT!DARCONFIG=0,6,3,349500,5,368500,1 ← Technology 6 (5G Sub6), Band 3,
Tx channel 349500, bandwidth 5, Rx channel 368500,
MIMO enabled (1)
For values, see Table 3-6.
```

e.g., To configure band n28 without MIMO, disable MIMO mode (set <mimo_mode>=0 or omit the parameter):

```
AT!DARCONFIG=0,6,28,147600,5,158600
← Technology 6 (5G Sub6), Band 28, Tx channel 147600,
bandwidth 5, Rx channel 158600, MIMO disabled (omitted in
this example)
For values, see Table 3-6.
```

- e. Repeat this step for each path that you want to test (see [Table 3-2](#))— Set the expected Rx power (<expected_AGC>) and check that the measured <rssi> = <expected_AGC> (i.e., actual FTM AGC matches the expected AGC).

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

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

e.g. To test Rx paths for -50.5 dBm:

- Use !DAGFTMRXAGC to check a supported path for the current band— set the Rx <path> parameter to indicate the path being tested.

Note: Antenna port mappings vary between bands. Test an Rx path and if !DAGFTMRXAGC returns an unexpected result (e.g., -99.9), repeat the test using different Rx <path> values until the correct one is found.

Note: An AT command will be added in a future firmware release to list the antenna port assignments for a specific band.

e.g., Check MIMO1:

```
AT!DAGFTMRXAGC=0,6,-505,1 ← Assume MIMO1 is using Rx path 1
-99.9 ← Value is not near the expected result, MIMO1 is not using Rx path 1
OK

AT!DAGFTMRXAGC=0,6,-505,3 ← Repeat test on Rx path 3
-50.9 ← Value is near the expected result, MIMO1 is using Rx path 3
OK
```

- f. Drop the current 5G Sub6 configuration:

```
AT!DARCONFIGDROP=<technology>
```

e.g.:

```
AT!DARCONFIGDROP=6
```

- g. Disable 5G Sub6 technology (<enable>=0):

```
AT!DASUB6TECHACT=<enable>
```

e.g.:

```
AT!DASUB6TECHACT=0
```

- h. To test the next 5G Sub6 band:

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

3.6 GNSS Tests

3.6.1 Shared GNSS RF Receive Path Test

This test applies to EM9291/EM9293.

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

Shared GNSS receive paths use the RF receptacles indicated in [Table 3-7](#). (Note — The EM9293 can be software-configured to use either shared GNSS (L1, L5) on the ANT1 receptacle, or dedicated GNSS (L1 only) on the GNSS receptacle. To test the dedicated GNSS path, see [Dedicated GNSS RF Receive Path Test](#) below.)

Table 3-7: Test Parameters — GNSS L1 and L5 Paths

GNSS Path	Receptacle ^a	Test Frequency ^b (MHz)	Notes
L1	ANT1	1575.52	TestFreq = 1575.42 MHz + 100 KHz
L5	ANT1	1177.45	TestFreq = 1176.45 MHz + 1000 KHz

- a. For receptacle 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. (EM9293 only) Make sure the shared GNSS is selected:
 - i. Display the current module customization settings:

```

AT!CUSTOM?
!CUSTOM:
...
GPSSEL 1 ← If GPSSEL appears, shared GNSS is selected.
...
OK

```

- ii. If GPSSEL does not appear in the response, unlock the extended AT command set, select the shared GNSS, and reset the module for the customization change to take effect:

```

AT!ENTERCND="<key>" ← <key>—Unlock key code
OK

AT!CUSTOM="GPSSEL",1
OK

AT!RESET
[wait for the module to reset]

AT!CUSTOM? ← Optional step to make sure the change took effect
!CUSTOM:
...
GPSSEL 1 ← Shared GNSS is selected
...
OK

```

- b. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- c. Enter test mode:

```
AT+CFUN=5
```

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

```
AT!DACGPSTESTMODE=1
```

- e. Enter standalone RF mode:

```
AT!DACGPSSTANDALONE=1
```

2. Connect the RF cable to the ANT1 receptacle.

3. Set up the callbox — Refer to [Table 3-7](#) 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 receptacle.

4. Test the signal carrier-to-noise (CTN) 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!DACGPSTON=<GNSS_PATH>
CtoN=<CtoN>, Freq=<freq>
OK
```

e.g.:

- Check the GNSS **L1** path (example output shown):

```
AT!DACGPSTON=1
CtoN=60.7, Freq=99945
OK
```

- Check the GNSS **L5** path (example output shown):

```
AT!DACGPSTON=5
CtoN=60.1, Freq=999963
OK
```

Note: The frequency returned by !DACGPSTON should be within the following limits:

- L1: 100,000 ± 1000 Hz
- L5: 1,000,000 ± 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 **!DACGPSTON** 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 **!DACGPSTON** command several times to obtain results to use as references for marginal/poor signals.

e.g.:

- Check the GNSS **L1** path (example output shown):

```
AT!DACGPSTON=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](#).

3.6.2 Dedicated GNSS RF Receive Path Test

This test applies to EM9293.

Note: Reminder—For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM9 Series AT Command Reference (Doc# 41113480).

The dedicated GNSS receive path uses the RF receptacle indicated in [Table 3-8](#).

(Note—The EM9293 can be software-configured to use either GNSS (L1 only) on the dedicated GNSS receptacle, or shared GNSS (L1, L5) on the ANT1 receptacle. To test the shared GNSS path, see [Shared GNSS RF Receive Path Test](#) above.)

Table 3-8: Test Parameters — GNSS L1 Path

GNSS Path	Receptacle ^a	Test Frequency ^b (MHz)	Notes
L1	GNSS	1575.52	TestFreq = 1575.42 MHz + 100 KHz

- a. For receptacle location, see [Figure 3-1](#) on page 10.
- b. Includes offset from center (as indicated in Notes column)

To test the dedicated GNSS receive path (L1):

1. Set up the DUT using the following AT commands:
 - a. Make sure the dedicated GNSS is selected:
 - i. Display the current module customization settings:

```
AT!CUSTOM?
!CUSTOM:
...
GPSSEL 1 ← If GPSSEL appears, shared GNSS is selected.
...      ← If GPSSEL does not appear, dedicated GNSS is selected.
OK
```

- ii. If GPSSSEL appears in the response, the shared GNSS is currently selected. Unlock the extended AT command set, select the dedicated GNSS, and reset the module for the customization change to take effect:

```

AT!ENTERCND="<key>" ← <key>—Unlock key code
OK

AT!CUSTOM="GPSSSEL" , 0
OK

AT!RESET
[wait for the module to reset]

AT!CUSTOM? ← Optional step to make sure the change took effect.
!CUSTOM:
. . . ← GPSSSEL does not appear. Dedicated GNSS is selected.

OK

```

- b. Unlock the extended AT command set:

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```

- c. Enter test mode:

```
AT+CFUN=5
```

- d. Optionally, if DC bias power will be applied to the dedicated GNSS connector to enhance the received RF signal, turn on the LDO to apply the bias:

```
AT+WANT=1
```

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

```
AT!DACGPSSTESTMODE=1
```

- f. Enter standalone RF mode:

```
AT!DACGPSSTANDALONE=1
```

2. Connect the RF cable to the GNSS receptacle.
3. Set up the callbox—Refer to [Table 3-7](#) 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 receptacle.
4. Test the signal carrier-to-noise (CTN) 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

```

e.g., Check the GNSS L1 path (example output shown):

```

AT!DACGPSCTON=1
CtoN=60.7, Freq=99945
OK

```

Note: The frequency (Freq) returned by !DACGPSCTON should be within 100,000 ± 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 **!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 **!DACGPSCTON** command several times to obtain results to use as references for marginal/poor signals.
e.g., Check the GNSS **L1** path (example output shown):

```
AT!DACGPSCTON=1
CtoN=50.8, Freq=99946
OK
```
 - iii. Turn off the signal generator.

A: CMW500 Setup

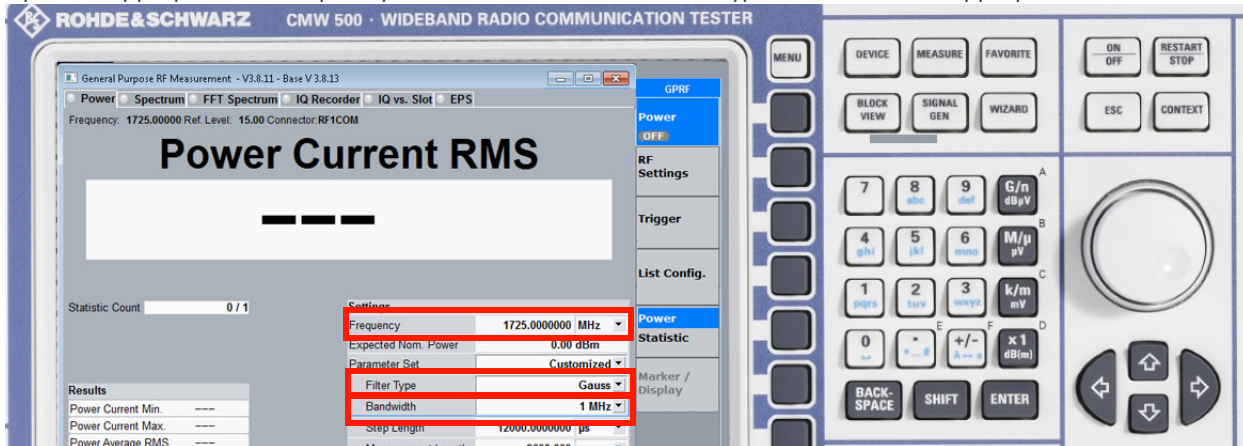
This chapter briefly describes how to set up the CMW500 callbox for the WCDMA, LTE, and 5G Sub6 Rx and Tx measurements described in [Production Testing](#).

A.1 CMW500 Transmission Path Test Setup

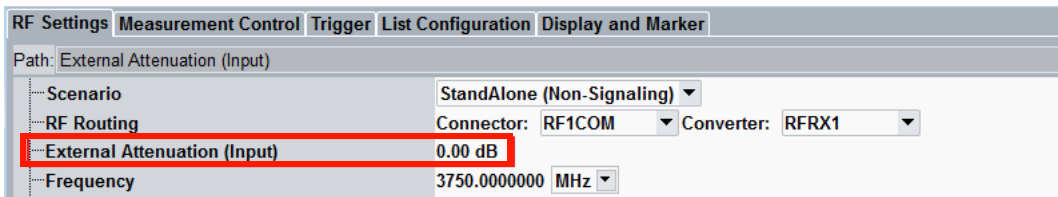
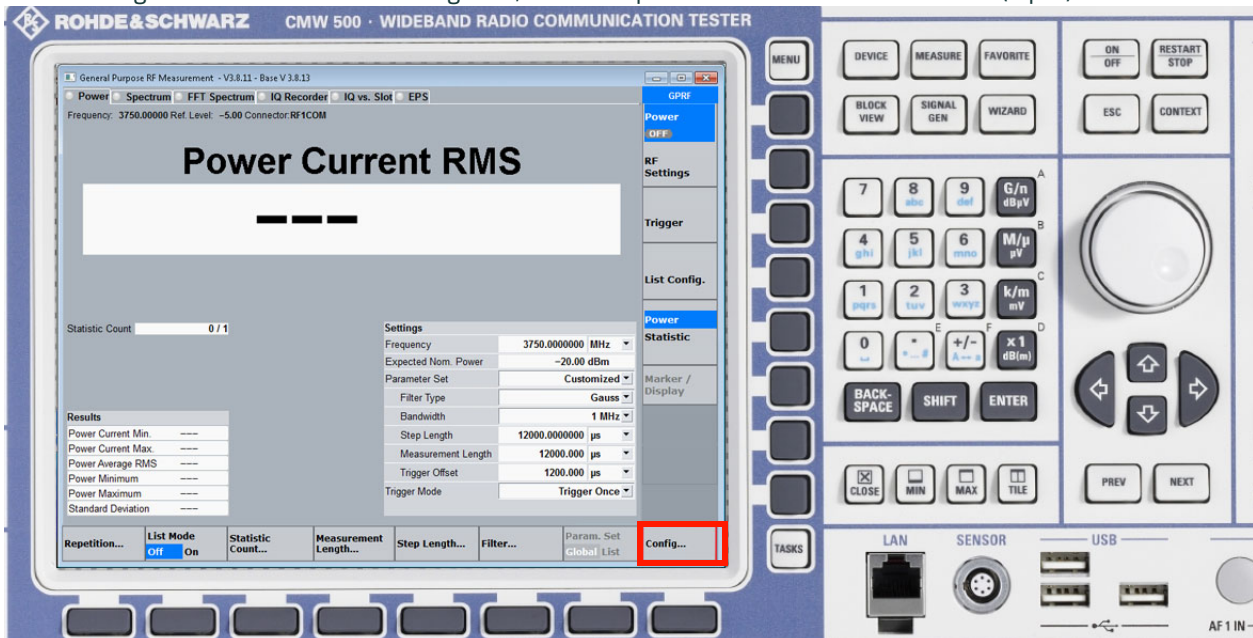
1. Press the MEASURE button and select "Measurements".



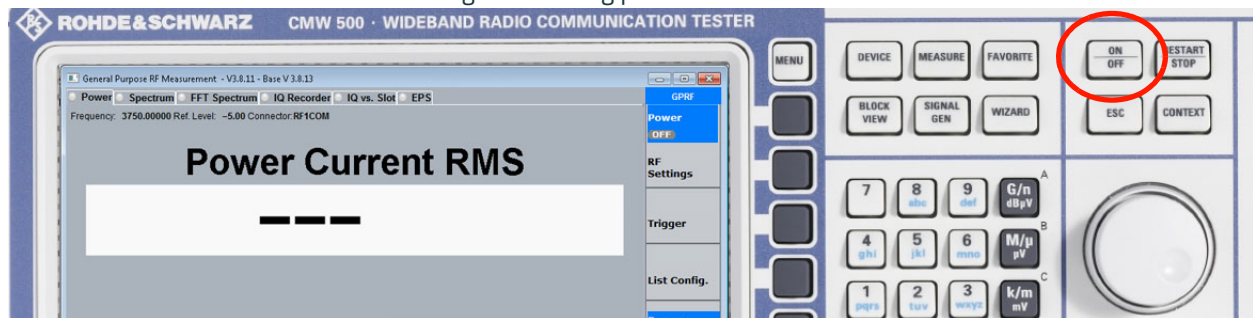
2. Input the appropriate Tx Frequency, select "Gauss" as the "Filter Type", and select the appropriate "Bandwidth".



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



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



A.2 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.



B: References

B.1 Sierra Wireless Documents

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

- [1] EM9 Series AT Command Reference (Doc# 41113480)
- [2] EM92XX Product Technical Specification (Doc# 41114313)
- [3] Sierra Wireless EM919x / EM7690 Development Kit User Guide (Doc# 41113875)

C: Abbreviations

Table C-1: Abbreviations

Abbreviation	Description
GNSS	Global Navigation Satellite System
IF	Intermediate Frequency
LTE	Long Term Evolution
RFC	Radio Frequency Card
RFM	Radio Frequency Module
WCDMA	Wideband Code Division Multiple Access
FTM	Factory Test Mode