



# EM8695

## 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: <a href="https://sierrawireless.com/company/contact-us/">sierrawireless.com/company/contact-us/</a> Global toll-free number: 1-877-687-7795 6:00 am to 5:00 pm PST
Corporate and product information	Web: <a href="https://sierrawireless.com">sierrawireless.com</a>

## Revision History

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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 EM8695 embedded modules.

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**Important:** *The tests in this document are performed using AT commands as implemented in firmware version SWIX35C\_01.01.01.00 (Release 1).*

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

**Table 1-1: Test Procedures**

RAT test cases	EM8695
<a href="#">LTE RF Tests</a>	Y
<a href="#">5G Sub6 RF Tests</a>	Y
<a href="#">Dedicated GNSS RF Receive Path Test</a>	Y

For supported bands, GNSS specifications, etc., refer to [\[2\] EM8695 Product Technical Specification \(Doc# 41114813\)](#).

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

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## 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.

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*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.*

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### 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 EM8695 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 LTE and 5G NR Sub-6G GHz. For radiated testing, modify the suggested procedures as appropriate to your requirements.

### 3.2.1 RF Receptacles

EM8695 modules include several receptacles for use with host-supplied antennas.

Note: In this document, the RF receptacles are referred to using the names marked on the module shield:

- AUX—Auxiliary RF (Diversity/MIMO)
- GPS—GNSS
- MAIN—Main RF (Rx/Tx)

The host must mate the RF receptacles (PCB connectors) with corresponding RF plugs (cable connectors).

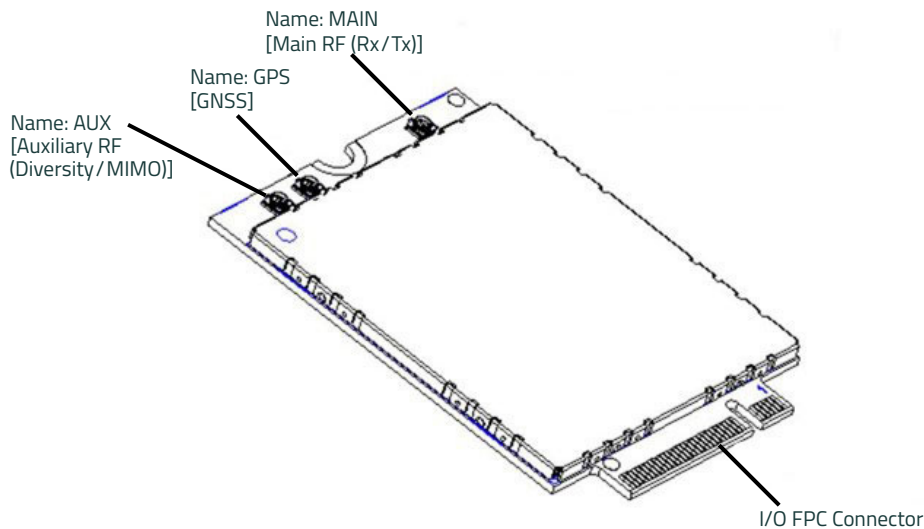


Figure 3-1: EM8695 Module RF Receptacles

Table 3-2: RF Receptacles — RF Technology Support

RAT <sup>a</sup>	Bands	Tx	Rx		GNSS
		MAIN <sup>b</sup>	MAIN <sup>b</sup>	AUX <sup>b</sup>	GPS <sup>c</sup>
5G NR Sub-6G	n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n25, n26, n28, n30, n38, n40, n41, n48, n66, n70, n71, n77, n78, n79	Y	Y	Y	—
LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B34, B38, B39, B40, B41, B42, B43, B48, B66, B70, B71, B106	Y	Y	Y	—
GNSS	L1, L5	—	—	—	Y

a. LB=Low Band (<1 GHz), MB=Mid Band (1–3 GHz), HB=High Band (>3 GHz)  
 b. The Main RF port (MAIN) is used for both Tx and Rx. The Auxiliary RF port (AUX) is used for Rx only.  
 c. The GNSS RF port (GPS) can be used for both GNSS L1 and L5.

## 3.2.2 Functional Production Test Plan

The following is a suggested test plan using a Windows PC with an EM8695 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] *EM8695 AT Command Reference (Doc# 41114815)* for command details:

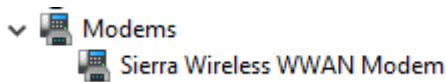
1. Before installing the module in the host platform, visually inspect the module's connectors and RF assemblies for obvious defects.
2. Install the module in the host platform.
3. Make sure the module is powered off (i.e., no voltage on VCC).
4. Provide power to the module.

Note — For power on/off details, refer to the [2] *EM8695 Product Technical Specification (Doc# 41114813)* 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](http://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 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 if desired:
  - LTE— See [LTE RF Transmission Path Test](#).
  - 5G Sub6— See [5G Sub6 RF Transmission Path Test](#).
- b. Test RF reception if desired:
  - LTE— See [LTE RF Receive Path Test](#).
  - 5G Sub6— See [5G Sub6 RF Receive Path Test](#).
- c. Test standalone GNSS functionality— see [Dedicated GNSS RF Receive Path Test](#).

## 3.3 LTE RF Tests

### 3.3.1 LTE Test Parameters

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

**Table 3-3: Test Parameters — LTE**

Band Number	Bandwidth Index <sup>a</sup>	Tx		Rx	
		Test Channel <sup>b</sup>	Test Frequency <sup>c</sup> (MHz)	Test Channel <sup>b</sup>	Test Frequency <sup>d</sup> (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
30 (B30)	3 (10 MHz)	27710	2310	9820	2357
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

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

Band Number	Bandwidth Index <sup>a</sup>	Tx		Rx	
		Test Channel <sup>b</sup>	Test Frequency <sup>c</sup> (MHz)	Test Channel <sup>b</sup>	Test Frequency <sup>d</sup> (MHz)
42 (B42)	3 (10 MHz)	42590	3500	42590	3502
43 (B43) <sup>e</sup>	3 (10 MHz)	44590	3700	44590	3702
48 (B48)	3 (10 MHz)	55990	3625	55990	3627
66 (B66)	3 (10 MHz)	132322	1745	66786	2147
70 (B70)	3 (10 MHz)	133047	1702.5	68461	2007.5
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] *EM8695 AT Command Reference (Doc# 41114815)*.
- 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. B43 support is firmware and SKU-dependent.

### 3.3.2 LTE RF Transmission Path Test

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] *EM8695 AT Command Reference (Doc# 41114815)*.

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 MAIN antenna receptacle — see [Figure 3-1 on page 9](#). (Note — Do not turn on the RF transmitter yet.)

Do not connect the AUX or GPS receptacles.

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 the On/Off button)

For examples using a CMW500, see [CMW500 Setup on page 26](#).

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!DAFTMACT
```

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

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

e.g.:

```
AT!DARCONFIG=0,3,1,18300,3,300 ←Technology 3 (LTE), Band 1 (B1), Tx channel 18300,
bandwidth 3 (10 MHz), Rx channel 300
For supported values, see Table 3-3.
```

Note:

- <mimo\_mode> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
- <beam\_ID> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
- <continuous\_mode> — Set the appropriate transmission mode:  
0 — Burst mode  
1 — Continuous mode (default)

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

Note: The value (<power\_dbm10> = 10 × power) must be an integer.

Note: If the !DARCONFIG <continuous\_mode> setting used in Step c (above) was:

- 1 (Continuous mode)—Do not use the <beam\_id> and <duty\_cycle> parameters (refer to Example 1 below)
- 0 (Burst mode)—Specify the <duty\_cycle> parameter (refer to Example 2 below)

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

Example 1: Continuous mode (No duty cycle specified)

```
AT!DATXCONTROL=0,3,1,230,1,0,1,0,10
←Technology 3 (LTE); Enable 1 (On); Power dBm10 230 (23 dBm);
Waveform 1 (LTE PUSCH); Mod 0 (QPSK); NS Value 1; Start RB 0;
Num RB 10
```

Example 2: Burst mode (Duty cycle 50% specified)

```
AT!DATXCONTROL=0,3,1,230,1,0,1,0,10,,5
←Technology 3 (LTE); Enable 1 (On); Power dBm10 230 (23 dBm);
Waveform 1 (LTE PUSCH); Mod 0 (QPSK); NS Value 1; Start RB 0;
Num RB 10, Duty Cycle 5 (50%)
```

	Duty cycle %									
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100% (default)
<duty_cycle>	1	2	3	4	5	6	7	8	9	10

**Caution:** To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (for values, refer to [2] EM8695 Product Technical Specification (Doc# 41114813)).

- 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](#) (e.g., using the continuous mode example):

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

e.g.:

```
AT!DATXCONTROL=0,3,0,230,1,0,1,0,10
```

- 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](#).

### 3.3.3 LTE RF Receive Path Test

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*Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM8695 AT Command Reference (Doc# 41114815).*

---

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

1. Connect RF cables to the MAIN and AUX RF antenna receptacles — see [Figure 3-1 on page 9](#).
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 26](#).

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!DAFTMACT
```

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

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

e.g.:

```
AT!DARCONFIG=0,3,1,18300,3,300 ← Technology 3 (LTE), Band 1, Tx channel 18300,
bandwidth 3 (10 MHz), Rx channel 300
For values, see Table 3-3.
```

Note:

- <mimo\_mode> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
  - <beam\_ID> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
  - <continuous\_mode> — Set the appropriate transmission mode:  
0 — Burst mode  
1 — Continuous mode (default)
- 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: The value (<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.

e.g., Check Rx0 (MAIN) and Rx1 (AUX):

```
AT!DAGFTMRXAGC=0,3,-505,0 ← Primary Rx (MAIN)
-50.9 dbm
OK
```

```
AT!DAGFTMRXAGC=0,3,-505,1 ← Diversity Rx (AUX)
-50.1 dbm
OK
```

- e. Drop the current LTE configuration:

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

e.g.:

```
AT!DARCONFIGDROP=3
```

- f. 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).*

---

## 3.4 5G Sub6 RF Tests

### 3.4.1 5G Sub6 Test Parameters

Use the parameters in [Table 3-4](#) for the 5G Sub6 Tx and Rx tests described below.

**Table 3-4: Test Parameters — 5G Sub6**

Band Number	Bandwidth Index <sup>a</sup>	Tx		Rx		Resource Block Settings <sup>b</sup>	
		Test Channel <sup>c</sup>	Test Freq <sup>d</sup> (MHz)	Test Channel <sup>c</sup>	Test Freq <sup>e</sup> (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 <sup>f</sup> )	5 (20 MHz)	507000	2535	531000	2657	25	50
8 (n8 <sup>f</sup> )	5 (20 MHz)	179500	897.5	188500	944.5	25	50
12 (n12 <sup>f</sup> )	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 <sup>f</sup> )	5 (20 MHz)	169400	847	161200	808	25	50
25 (n25 <sup>f</sup> )	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
30 (n30)	3 (10 MHz)	462000	2310	471000	2357	12	25
38 (n38 <sup>f</sup> )	5 (20 MHz)	519000	2595	519000	2597	12	25
40 (n40 <sup>f</sup> )	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 <sup>f</sup> )	5 (20 MHz)	641667	3625	641667	3627	12	25
66 (n66)	5 (20 MHz)	349000	1745	429000	2147	25	50
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

Table 3-4: Test Parameters — 5G Sub6 (Continued)

Band Number	Bandwidth Index <sup>a</sup>	Tx		Rx		Resource Block Settings <sup>b</sup>	
		Test Channel <sup>c</sup>	Test Freq <sup>d</sup> (MHz)	Test Channel <sup>c</sup>	Test Freq <sup>e</sup> (MHz)	Start_RB	Num_RB
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] EM8695 AT Command Reference (Doc# 41114815).
- 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.

### 3.4.2 5G Sub6 RF Transmission Path Test

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM8695 AT Command Reference (Doc# 41114815).

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

- Connect the RF cable from the call box (e.g. the CMW500) to the module's MAIN RF (Rx/Tx) receptacle— see [Figure 3-1 on page 9](#). (Note— Do not turn on the RF transmitter yet.)  
The other receptacles (AUX, GPS) can be left connected.

Note: As shown in [Table 3-2](#), the module uses MAIN for 5G NR Sub-6G GHz.

- 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 26](#).

- Set up and test the DUT using the following AT commands:

- Unlock the extended AT command set:

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

- Enter test mode:

```
AT!DAFTMACT
```

- c. Configure the Tx/Rx channels and bandwidth for the selected band.

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

e.g.:

```
AT!DARCONFIG=0,6,1,390000,3,428000
```

← Technology 6 (5G Sub6), Band 1 (nr1); Tx channel 390000, bandwidth 3 (10 MHz), Rx channel 428000  
For values, see Table 3-4.

Note:

- <mimo\_mode> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
- <beam\_ID> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
- <continuous\_mode> — Set the appropriate transmission mode:  
0 — Burst mode  
1 — Continuous mode (default)

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

Note:   
 • For <start\_RB> and <num\_RB>, use the band-specific values in Table 3-4.  
 • The value (<power\_dbm10> = 10 × power) must be an integer.

Note: If the !DARCONFIG <continuous\_mode> setting used in Step c (above) was:

- 1 (Continuous mode) — Do not use the <beam\_id> and <duty\_cycle> parameters (refer to Example 1 below)
- 0 (Burst mode) — Specify the <duty\_cycle> parameter (refer to Example 2 below)

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

Example 1: Continuous mode (No duty cycle specified)

```
AT!DATXCONTROL=0,6,1,230,10,0,1,25,50
```

← Technology 6 (5G Sub6); Enable 1 (On); Power dBm10 230 (23 dBm);  
Waveform 10 (PUSCH); Mod 0 (QPSK); NS Value 1; Start RB 25;  
Num RB 50

Example 2: Burst mode (Duty cycle 50% specified)

```
AT!DATXCONTROL=0,6,1,230,10,0,1,25,50,,3
```

← Technology 3 (5G Sub6); Enable 1 (On); Power dBm10 230 (23 dBm);  
Waveform 1 (LTE PUSCH); Mod 0 (QPSK); NS Value 1; Start RB 25;  
Num RB 50, Duty Cycle 3 (50%)

	Duty cycle %			
	20%	25%	40%	50% (Default)
<duty_cycle>	0	1	2	3

**Caution:** To avoid possible damage to the module, do not transmit above the module's conducted maximum Tx power (refer to [2] EM8695 Product Technical Specification (Doc# 41114813)).

- e. 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).*

---

- 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>]]
```

Example 1: Continuous mode (No duty cycle specified)

```
AT!DATXCONTROL=0,6,0,230,10,0,1,0,10
```

Example 2: Burst mode (Duty cycle 30% specified)

```
AT!DATXCONTROL=0,6,0,230,10,0,1,0,10,,3
```

- g. Drop the current 5G Sub6 configuration:

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

e.g.:

```
AT!DARCONFIGDROP=6
```

- h. 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 c](#).
- 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](#).

### 3.4.3 5G Sub6 RF Receive Path Test

---

*Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM8695 AT Command Reference (Doc# 41114815).*

---

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

1. Connect RF cables to the MAIN and AUX RF antenna receptacles — see [Figure 3-1 on page 9](#).

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 26](#).

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!DAFTMACT
```

- c. Configure the Tx/Rx channels and bandwidth for the selected band.

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

e.g.:

```
AT!DARCONFIG=0,6,1,390000,3,428000
```

← Technology 6 (5G Sub6), Band 1 (nr1); Tx channel 390000,  
bandwidth 3 (10 MHz), Rx channel 428000  
For values, see [Table 3-4](#).

Note:

- <mimo\_mode> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
  - <beam\_ID> (Reserved)  
Leave this parameter blank. (The value is ignored.)  
This parameter is included for command format compatibility with other Semtech modules.
  - <continuous\_mode>—Set the appropriate transmission mode:  
0—Burst mode  
1—Continuous mode (default)
- d. Repeat this step for each path that you want to test (see [Table 3-4](#))—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—The value (<expected\_AGC> = 10 × power) must be an integer.)

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

e.g. To test Rx paths for -65.0 dBm:

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

e.g., Check Rx0 (MAIN) and Rx1 (AUX):

```
AT!DAGFTMRXAGC=0,6,-650,0 ← Primary Rx (MAIN)
```

```
-65.8 dbm
```

```
OK
```

```
AT!DAGFTMRXAGC=0,6,-650,1 ← Diversity Rx (AUX)
```

```
-66.3 dbm
```

```
OK
```

- 
- e. Drop the current 5G Sub6 configuration:

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

e.g.:

```
AT!DARCONFIGDROP=6
```

- f. 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).*

---

## 3.5 GNSS Tests

### 3.5.1 Dedicated GNSS RF Receive Path Test

Note: For details of each AT command used in this test (including usage, format and parameter details), refer to [1] EM8695 AT Command Reference (Doc# 41114815).

The GNSS receive path uses the GPS RF receptacle as indicated in Table 3-5.

**Table 3-5: Test Parameters — GNSS L1 and L5 Paths**

GNSS Path	Receptacle <sup>a</sup>	Test Frequency <sup>b</sup> (MHz)	Notes
L1	GPS	1575.52	TestFreq = 1575.42 MHz + 100 KHz
L5	GPS	1177.45	TestFreq = 1176.45 MHz + 1000 KHz

- a. For receptacle location, see Figure 3-1 on page 9.  
 b. Includes offset from center (as indicated in Notes column)

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

- Set up the DUT using the following AT commands:
  - Unlock the extended AT command set:  

```
AT!ENTERCND="<key>" ← <key>—Unlock key code
```
  - Enter test mode:  

```
AT+CFUN=5
```
  - Start CGPS (Continuous Global Positioning System) diagnostic task mode:  

```
AT!DACGPSTESTMODE=1
```
  - Enter standalone RF mode:  

```
AT!DACGPSSTANDALONE=1
```
- Connect the RF cable to the GPS receptacle.
- Set up the callbox — Refer to Table 3-5 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.
- Test the signal carrier-to-noise (CTN) level at the GNSS receiver:
  - 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!DACGPSCTON=5
CtoN=60.1, Freq=999963
OK
```

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

- L1:  $100,000 \pm 1000$  Hz
- L5:  $1,000,000 \pm 1000$  Hz

- Repeat [step a](#) 5–10 times to ensure the measurements are repeatable and stable.
- Keep the RF connection to the module device intact, and turn off the signal generator.
- Repeat the **!DACGPSCTON** command several times to demonstrate a bad signal, to set limits for testing if needed.
- Optionally, simulate marginal/poor signals:
  - Turn on the signal generator and reduce the level to -120 dBm.
  - 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
```

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

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

- Turn off the signal generator.

# A: CMW500 Setup

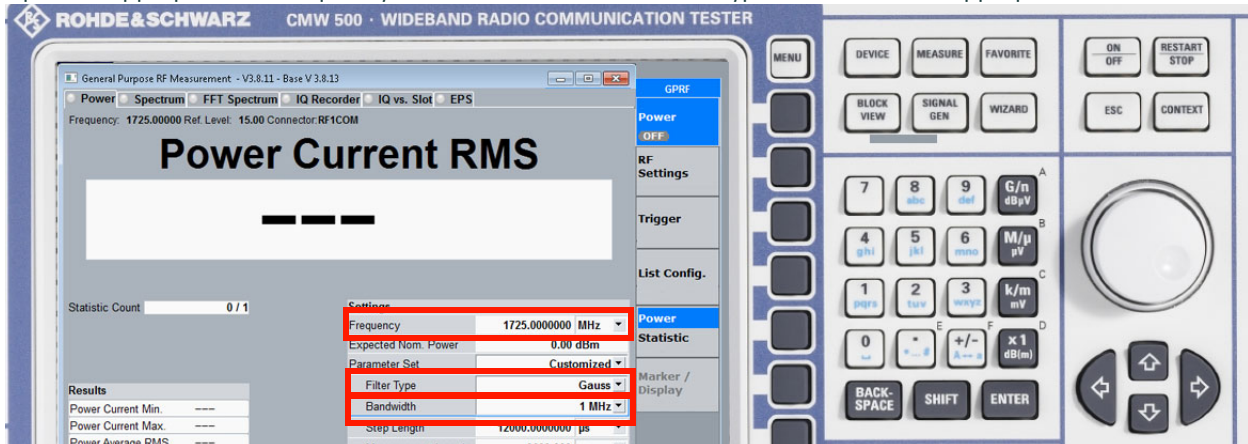
This chapter briefly describes how to set up the CMW500 callbox for the LTE and 5G Sub6 Rx and Tx measurements described in [Production Testing](#).

## A.1 CMW500 Transmission Path Test Setup

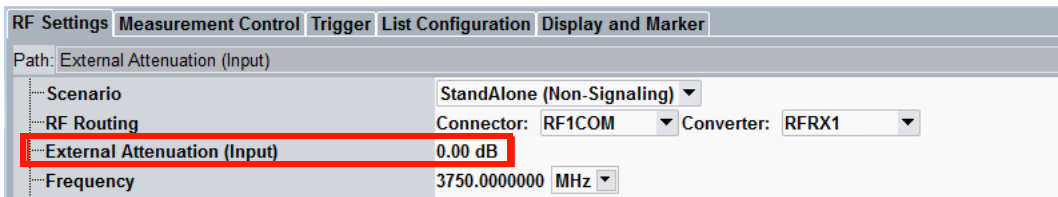
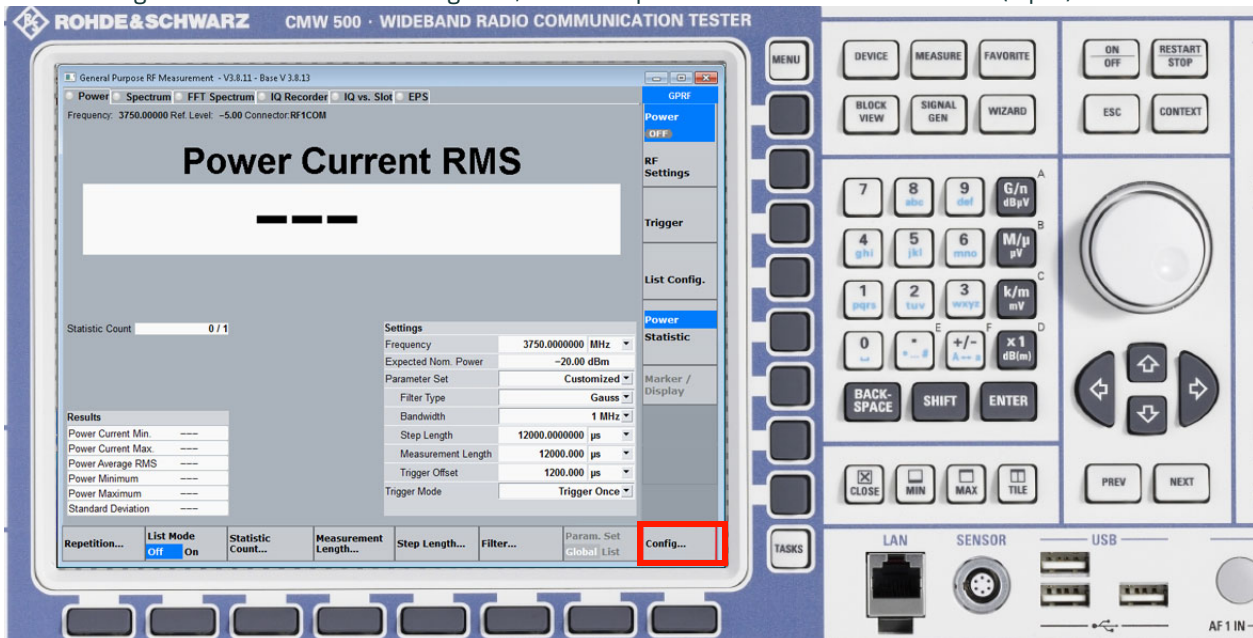
1. Press the MEASURE button and select "Measurements".



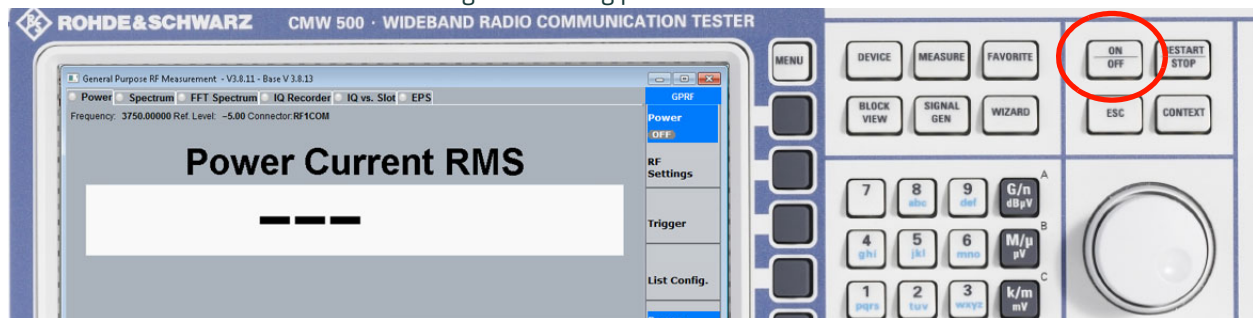
2. Input the appropriate Tx Frequency, select "Gauss" as the "Filter Type", and select the appropriate "Bandwidth".



- 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](https://source.sierrawireless.com).

- [1] EM8695 AT Command Reference (Doc# 41114815)
- [2] EM8695 Product Technical Specification (Doc# 41114813)

# 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
FTM	Factory Test Mode