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Report No.: GZEM201101673702  
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FCC ID: OJFDLRU1719235

## TEST REPORT

**Application No.:** GZEM2011016737CR  
**Applicant:** Corning Optical Communication Wireless  
**Address of Applicant:** 8253 1st Ave, Vienna, Virginia, United States, 22182  
**Manufacturer:** Comba Network Systems Company Limited  
**Address of Manufacturer:** No.10 Shenzhou Road, Guangzhou Science City, Guangzhou, Guangdong  
**Factory:** Comba Telecom Technology (Guangzhou)Ltd.  
**Address of Factory:** No.6, Jinbi Road, Economics and Technology Development District,  
Guangzhou, Guangdong, China

**Equipment Under Test (EUT):**

**EUT Name:** Medium Band dRAU

**Model No.:** dLRU-17192325

**Standard(s) :**  
47 CFR Part 2  
47 CFR Part 24  
47 CFR Part 27

**Date of Receipt:** 2020-11-24

**Date of Test:** 2020-12-08 to 2020-12-23

**Date of Issue:** 2020-12-30

|                     |              |
|---------------------|--------------|
| <b>Test Result:</b> | <b>Pass*</b> |
|---------------------|--------------|

\* In the configuration tested, the EUT complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EU Declaration of Conformity and compliance with all relevant EU Directives.

Kobe Jian  
EMC Laboratory Manager



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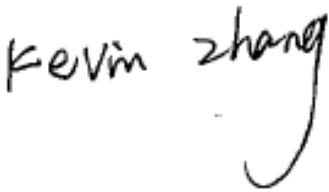
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| Revision Record |         |            |          |          |
|-----------------|---------|------------|----------|----------|
| Version         | Chapter | Date       | Modifier | Remark   |
| 01              |         | 2020-12-30 |          | Original |
|                 |         |            |          |          |
|                 |         |            |          |          |

|                          |                                                                                     |                          |      |
|--------------------------|-------------------------------------------------------------------------------------|--------------------------|------|
| Authorized for issue by: |                                                                                     |                          |      |
| Tested By                |  | 2020-12-08 to 2020-12-23 | Date |
|                          | Kevin_Zhang /Project Engineer                                                       |                          |      |
| Checked By               |  | 2020-12-30               | Date |
|                          | Jerry_Chan /Reviewer                                                                |                          |      |



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## 2 Test Summary

### 2.1 AWS-1 (1710-1755MHz paired with 2110-2155MHz)

| Item                                                                                         | Requirement                                | Method                                                                                     | Result |
|----------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| AGC threshold level                                                                          | /                                          | KDB935210 D05 v01r04<br>clause 3.2                                                         | PASS   |
| Out-of-band rejection                                                                        | /                                          | KDB935210 D05 v01r04<br>clause 3.3                                                         | PASS   |
| Input-versus-output signal<br>comparison                                                     | 47 CFR Part 2.1049                         | KDB935210 D05 v01r04<br>clause 3.4                                                         | PASS   |
| Mean output power and<br>amplifier/booster gain                                              | 47 CFR Part 27.50(d)                       | KDB935210 D05 v01r04<br>clause 3.5<br>ANSI C63.26-2015<br>Clause 5.2.3                     | PASS   |
| Out-of-band/out-of-block (including<br>intermodulation) emissions and<br>spurious esmissions | 47 CFR Part 27.53(h)                       | KDB935210 D05 v01r04<br>clause 3.6                                                         | PASS   |
| Frequency stability                                                                          | 47 CFR Part 27.54                          | 47 CFR Part 2.1055<br>KDB935210 D05 v01r04<br>clause 3.7<br>ANSI C63.26-2015<br>Clause 5.6 | PASS   |
| Radiated spurious emissions                                                                  | 47 CFR Part 2.1053<br>47 CFR Part 27.53(h) | KDB935210 D05 v01r04<br>clause 3.8<br>ANSI C63.26-2015<br>Clause 5.5                       | PASS   |



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## 2.2 AWS-3 (1755-1780MHz paired with 2155-2180MHz)

| Item                                                                                         | Requirement                                | Method                                                                                     | Result |
|----------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| AGC threshold level                                                                          | /                                          | KDB935210 D05 v01r04<br>clause 3.2                                                         | PASS   |
| Out-of-band rejection                                                                        | /                                          | KDB935210 D05 v01r04<br>clause 3.3                                                         | PASS   |
| Input-versus-output signal<br>comparison                                                     | 47 CFR Part 2.1049                         | KDB935210 D05 v01r04<br>clause 3.4                                                         | PASS   |
| Mean output power and<br>amplifier/booster gain                                              | 47 CFR Part 27.50(d)                       | KDB935210 D05 v01r04<br>clause 3.5                                                         | PASS   |
| Out-of-band/out-of-block (including<br>intermodulation) emissions and<br>spurious esmissions | 47 CFR Part 27.53(h)                       | KDB935210 D05 v01r04<br>clause 3.6                                                         | PASS   |
| Frequency stability                                                                          | 47 CFR Part 27.54                          | 47 CFR Part 2.1055<br>KDB935210 D05 v01r04<br>clause 3.7<br>ANSI C63.26-2015<br>Clause 5.6 | PASS   |
| Radiated spurious emissions                                                                  | 47 CFR Part 2.1053<br>47 CFR Part 27.53(h) | KDB935210 D05 v01r04<br>clause 3.8<br>ANSI C63.26-2015<br>Clause 5.5                       | PASS   |
| Remark :<br>Fixed stations prohibited from operating in the 1755-1780 MHz band.              |                                            |                                                                                            |        |





## 2.3 Broadband PCS (1850-1915MHz paired with 1930-1995MHz)

| Item                                                                                         | Requirement                              | Method                                                                                     | Result |
|----------------------------------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| AGC threshold level                                                                          | /                                        | KDB935210 D05 v01r04<br>clause 3.2                                                         | PASS   |
| Out-of-band rejection                                                                        | /                                        | KDB935210 D05 v01r04<br>clause 3.3                                                         | PASS   |
| Input-versus-output signal<br>comparison                                                     | 47 CFR Part 2.1049                       | KDB935210 D05 v01r04<br>clause 3.4                                                         | PASS   |
| Mean output power and<br>amplifier/booster gain                                              | 47 CFR Part 24.232                       | KDB935210 D05 v01r04<br>clause 3.5                                                         | PASS   |
| Out-of-band/out-of-block (including<br>intermodulation) emissions and<br>spurious esmissions | 47 CFR Part 24.238                       | KDB935210 D05 v01r04<br>clause 3.6                                                         | PASS   |
| Frequency stability                                                                          | 47 CFR Part 24.235                       | 47 CFR Part 2.1055<br>KDB935210 D05 v01r04<br>clause 3.7<br>ANSI C63.26-2015<br>Clause 5.6 | PASS   |
| Radiated spurious emissions                                                                  | 47 CFR Part 2.1053<br>47 CFR Part 24.238 | KDB935210 D05 v01r04<br>clause 3.8<br>ANSI C63.26-2015<br>Clause 5.5                       | PASS   |



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## 2.4 WCS (2305-2315MHz paired with 2350-2360MHz)

| Item                                                                                         | Requirement                                | Method                                                                                     | Result |
|----------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| AGC threshold level                                                                          | /                                          | KDB935210 D05 v01r04<br>clause 3.2                                                         | PASS   |
| Out-of-band rejection                                                                        | /                                          | KDB935210 D05 v01r04<br>clause 3.3                                                         | PASS   |
| Input-versus-output signal<br>comparison                                                     | 47 CFR Part 2.1049                         | KDB935210 D05 v01r04<br>clause 3.4                                                         | PASS   |
| Mean output power and<br>amplifier/booster gain                                              | 47 CFR Part 27.50(a)                       | KDB935210 D05 v01r04<br>clause 3.5                                                         | PASS   |
| Out-of-band/out-of-block (including<br>intermodulation) emissions and<br>spurious esmissions | 47 CFR Part 27.53(a)                       | KDB935210 D05 v01r04<br>clause 3.6                                                         | PASS   |
| Frequency stability                                                                          | 47 CFR Part 27.54                          | 47 CFR Part 2.1055<br>KDB935210 D05 v01r04<br>clause 3.7<br>ANSI C63.26-2015<br>Clause 5.6 | PASS   |
| Radiated spurious emissions                                                                  | 47 CFR Part 2.1053<br>47 CFR Part 27.53(a) | KDB935210 D05 v01r04<br>clause 3.8<br>ANSI C63.26-2015<br>Clause 5.5                       | PASS   |



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## 2.5 BRS/EBS (2496-2690MHz unpaired)

| Item                                                                                         | Requirement                                | Method                                                                                     | Result |
|----------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| AGC threshold level                                                                          | /                                          | KDB935210 D05 v01r04<br>clause 3.2                                                         | PASS   |
| Out-of-band rejection                                                                        | /                                          | KDB935210 D05 v01r04<br>clause 3.3                                                         | PASS   |
| Input-versus-output signal<br>comparison                                                     | 47 CFR Part 2.1049                         | KDB935210 D05 v01r04<br>clause 3.4                                                         | PASS   |
| Mean output power and<br>amplifier/booster gain                                              | 47 CFR Part 27.50(h)                       | KDB935210 D05 v01r04<br>clause 3.5                                                         | PASS   |
| Out-of-band/out-of-block (including<br>intermodulation) emissions and<br>spurious esmissions | 47 CFR Part 27.53(m)                       | KDB935210 D05 v01r04<br>clause 3.6                                                         | PASS   |
| Frequency stability                                                                          | 47 CFR Part 27.54                          | 47 CFR Part 2.1055<br>KDB935210 D05 v01r04<br>clause 3.7<br>ANSI C63.26-2015<br>Clause 5.6 | PASS   |
| Radiated spurious emissions                                                                  | 47 CFR Part 2.1053<br>47 CFR Part 27.53(m) | KDB935210 D05 v01r04<br>clause 3.8<br>ANSI C63.26-2015<br>Clause 5.5                       | PASS   |



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## 4 General Information

### 4.1 Details of E.U.T.

|                              |                                           |                                            |                                                                                       |
|------------------------------|-------------------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------|
| Power Supply:                | DC 36-57V                                 |                                            |                                                                                       |
| Test Voltage:                | DC 48V                                    |                                            |                                                                                       |
| Cable:                       | N/A                                       |                                            |                                                                                       |
| Operating Temperature:       | -40 to +55 °C                             |                                            |                                                                                       |
| Operating Humidity:          | 5 to 95 %                                 |                                            |                                                                                       |
| Frequency Range:             | AWS-1                                     | Uplink:                                    | 1710MHz to 1755MHz                                                                    |
|                              |                                           | Downlink:                                  | 2110MHz to 2155MHz                                                                    |
|                              | AWS-3                                     | Uplink:                                    | 1755MHz to 1780MHz                                                                    |
|                              |                                           | Downlink:                                  | 2155MHz to 2180MHz                                                                    |
|                              | Broadband PCS                             | Uplink:                                    | 1850MHz to 1915MHz                                                                    |
|                              |                                           | Downlink:                                  | 1930MHz to 1995MHz                                                                    |
|                              | WCS                                       | Uplink:                                    | 2305MHz to 2315MHz                                                                    |
|                              |                                           | Downlink:                                  | 2350MHz to 2360MHz                                                                    |
|                              | BRS/EBS                                   | Uplink:                                    | 2496MHz to 2690MHz                                                                    |
|                              |                                           | Downlink:                                  |                                                                                       |
|                              |                                           |                                            |                                                                                       |
|                              |                                           |                                            |                                                                                       |
| Radio System Type:           | <input type="checkbox"/> GSM              |                                            |                                                                                       |
|                              | <input checked="" type="checkbox"/> WCDMA |                                            |                                                                                       |
|                              | <input checked="" type="checkbox"/> LTE   |                                            |                                                                                       |
|                              | <input checked="" type="checkbox"/> 5G NR |                                            |                                                                                       |
| Interface:                   | RF Port:                                  | 2 (4.3-10-Female, ANT1~ANT2)               |                                                                                       |
|                              | Management Port:                          | 1 (RJ45)                                   |                                                                                       |
|                              | Power Jack:                               | 1                                          |                                                                                       |
|                              | Optical Port:                             | 1 (SFP+)                                   |                                                                                       |
| Supported Channel Bandwidth: | GSM                                       | <input type="checkbox"/> 200 kHz           |                                                                                       |
|                              | WCDMA                                     | <input checked="" type="checkbox"/> 5MHz   |                                                                                       |
|                              | LTE                                       | <input type="checkbox"/> 1.4 MHz           | <input type="checkbox"/> 3 MHz <input checked="" type="checkbox"/> 5 MHz              |
|                              |                                           | <input checked="" type="checkbox"/> 10 MHz | <input checked="" type="checkbox"/> 15 MHz <input checked="" type="checkbox"/> 20 MHz |
|                              | 5G NR                                     | <input checked="" type="checkbox"/> 5 MHz  | <input checked="" type="checkbox"/> 10 MHz <input checked="" type="checkbox"/> 15 MHz |
|                              |                                           | <input checked="" type="checkbox"/> 20 MHz | <input checked="" type="checkbox"/> 40 MHz <input checked="" type="checkbox"/> 60 MHz |
|                              |                                           |                                            |                                                                                       |
|                              |                                           |                                            |                                                                                       |



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FCC ID: OJFDLRU1719235

Detailed Band, technology and bandwidth :

| Band                       | Technology | Supported Bandwidth |
|----------------------------|------------|---------------------|
| AWS-1/AWS-3/ Broadband PCS | 3G         | 5MHz                |
|                            | 4G/5G      | 5/10/15/20MHz       |
| WCS                        | 4G/5G      | 5/10MHz             |
| BRS/EBS                    | 4G         | 5/10/15/20MHz       |
|                            | 5G         | 5/10/15/20/40/60MHz |

Output Power Max. 20dBm (Downlink)  
(per antenna port): Max. 18dBm (Downlink, for WCS)  
EUT MIMO property: 2X2 MIMO  
ANT1 and ANT2 are MIMO port, and the internal circuit design is identical, the intend output power for antenna ports are identical.

System Gain: Max. 20dB (Downlink)  
Max. 18dB (Downlink, for WCS)

Antenna Type: External Dedicated Antenna

Permission Antenna Gain: 12.5dBi or less

Software Version: DRAUM\_AV01.01.13.00

Note: 1. The EUT is a remote unit of a fiber DAS. The fiber DAS are typically comprised of three components (host unit, fiber-optic expansion unit and remote unit), which will be interconnected via fiber-optic.

The host unit connects directly to a base station via coaxial cable but cannot connect to antenna for receiving downlink and transmitting uplink, the EUT connects to antenna for transmitting downlink and receiving uplink. Therefore, only performed the test for downlink.

2. In additional, the host unit and fiber-optic expansion unit will be used as support unit for test in the report.

3. ANT1 and ANT2 are MIMO port, and the internal circuit design is identical, the intend output power for antenna ports are identical. Therefore only perform test at antenna port 1 and record the data in this report.



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## 4.2 Description of Support Units

| Description                          | Manufacturer | Model No. | Serial No.        |
|--------------------------------------|--------------|-----------|-------------------|
| Notebook                             | IBM          | T30       | S/N78-3VMLX 06/01 |
| IHU/HEU supplied by the manufacturer | Corning      | /         | /                 |
| DRU supplied by the manufacture      | Corning      | /         | /                 |

## 4.3 Test Environment

| Environment Parameter | Selected Values During Test |             |
|-----------------------|-----------------------------|-------------|
| Ralative Humidity     | Ambient                     |             |
| Value                 | Temperature (°C)            | Voltage (V) |
| TNVN                  | +20                         | DC 48V      |
| TLVL                  | -30                         | DC 40.8V    |
| TLVH                  | -30                         | DC55.2V     |
| THVL                  | +50                         | DC 40.8V    |
| THVH                  | +50                         | DC55.2V     |

VN: Normal Voltage

TN: Normal Teperature

VL: Lower Extreme Voltege

HL: Higher Extreme Voltage

TL: Lower Extreme Teperature

TH: Higher Extreme Teperature



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#### 4.4 Test Configuration

##### AWS-1 (1710-1755MHz paired with 2110-2155MHz)

| RF Ch. | Test Conf.   | Test Freq. (MHz) | Test Signal              | Remark                    |
|--------|--------------|------------------|--------------------------|---------------------------|
| B      | DL_1S_B_AWGN | 2112.5           | AWGN(99% OBW of 4.1MHz ) | a single test signal      |
| M      | DL_1S_M_AWGN | 2132.5           |                          |                           |
| T      | DL_1S_T_AWGN | 2152.5           |                          |                           |
| B      | DL_2S_B_AWGN | 2112.5, 2117.5   |                          | two adjacent test signals |
| T      | DL_2S_T_AWGN | 2147.5, 2152.5   |                          |                           |
| B      | DL_1S_B_GSM  | 2110.4           | GSM-TDMA                 | a single test signal      |
| M      | DL_1S_M_GSM  | 2132.5           |                          |                           |
| T      | DL_1S_T_GSM  | 2154.6           |                          |                           |
| B      | DL_2S_B_GSM  | 2110.4, 2110.8   |                          | two adjacent test signals |
| T      | DL_2S_T_GSM  | 2154.2, 2154.6   |                          |                           |

##### AWS-3 (1755-1780MHz paired with 2155-2180MHz)

| RF Ch. | Test Conf.   | Test Freq. (MHz) | Test Signal              | Remark                    |
|--------|--------------|------------------|--------------------------|---------------------------|
| B      | DL_1S_B_AWGN | 2157.5           | AWGN(99% OBW of 4.1MHz ) | a single test signal      |
| M      | DL_1S_M_AWGN | 2167.5           |                          |                           |
| T      | DL_1S_T_AWGN | 2177.5           |                          |                           |
| B      | DL_2S_B_AWGN | 2157.5, 2162.5   |                          | two adjacent test signals |
| T      | DL_2S_T_AWGN | 2172.5, 2177.5   |                          |                           |
| B      | DL_1S_B_GSM  | 2155.4           | GSM-TDMA                 | a single test signal      |
| M      | DL_1S_M_GSM  | 2167.5           |                          |                           |
| T      | DL_1S_T_GSM  | 2179.6           |                          |                           |
| B      | DL_2S_B_GSM  | 2155.4, 2155.8   |                          | two adjacent test signals |
| T      | DL_2S_T_GSM  | 2179.2, 2179.6   |                          |                           |



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# SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

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FCC ID: OJFDLRU1719235

## Broadband PCS (1850-1915MHz paired with 1930-1995MHz)

| RF Ch. | Test Conf.   | Test Freq. (MHz) | Test Signal              | Remark                    |
|--------|--------------|------------------|--------------------------|---------------------------|
| B      | DL_1S_B_AWGN | 1932.5           | AWGN(99% OBW of 4.1MHz ) | a single test signal      |
| M      | DL_1S_M_AWGN | 1962.5           |                          |                           |
| T      | DL_1S_T_AWGN | 1992.5           |                          |                           |
| B      | DL_2S_B_AWGN | 1932.5, 1937.5   |                          | two adjacent test signals |
| T      | DL_2S_T_AWGN | 1987.5, 1992.5   |                          |                           |
| B      | DL_1S_B_GSM  | 1930.4           | GSM-TDMA                 | a single test signal      |
| M      | DL_1S_M_GSM  | 1962.5           |                          |                           |
| T      | DL_1S_T_GSM  | 1994.6           |                          |                           |
| B      | DL_2S_B_GSM  | 1930.4, 1930.8   |                          | two adjacent test signals |
| T      | DL_2S_T_GSM  | 1994.2, 1994.2   |                          |                           |

## WCS (2305-2315MHz paired with 2350-2360MHz)

| RF Ch. | Test Conf.   | Test Freq. (MHz) | Test Signal              | Remark                    |
|--------|--------------|------------------|--------------------------|---------------------------|
| B      | DL_1S_B_AWGN | 2352.5           | AWGN(99% OBW of 4.1MHz ) | a single test signal      |
| M      | DL_1S_M_AWGN | 2355             |                          |                           |
| T      | DL_1S_T_AWGN | 2357.5           |                          |                           |
| /      | DL_2S_B_AWGN | 2352.5, 2357.5   |                          | two adjacent test signals |
| B      | DL_2S_T_AWGN | 2350.4           | GSM-TDMA                 | a single test signal      |
| M      | DL_1S_B_GSM  | 2355             |                          |                           |
| T      | DL_1S_M_GSM  | 2359.6           |                          |                           |
| B      | DL_1S_T_GSM  | 2350.4, 2350.8   |                          | two adjacent test signals |
| T      | DL_2S_B_GSM  | 2359.2, 2359.6   |                          |                           |



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**SGS-CSTC Standards Technical Services Co., Ltd.**  
**Guangzhou Branch**

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**BRS/EBS (2496-2690MHz unpaired)**

| RF Ch. | Test Conf.   | Test Freq. (MHz) | Test Signal              | Remark                    |
|--------|--------------|------------------|--------------------------|---------------------------|
| B      | DL_1S_B_AWGN | 2498.5           | AWGN(99% OBW of 4.1MHz ) | a single test signal      |
| M      | DL_1S_M_AWGN | 2593             |                          |                           |
| T      | DL_1S_T_AWGN | 2687.5           |                          |                           |
| B      | DL_2S_B_AWGN | 2498.5, 2503.5   |                          | two adjacent test signals |
| T      | DL_2S_T_AWGN | 2682.5, 2687.5   |                          |                           |
| B      | DL_1S_B_GSM  | 2496.4           | GSM-TDMA                 | a single test signal      |
| M      | DL_1S_M_GSM  | 2593             |                          |                           |
| T      | DL_1S_T_GSM  | 2689.6           |                          |                           |
| B      | DL_2S_B_GSM  | 2496.4, 2496.8   |                          | two adjacent test signals |
| T      | DL_2S_T_GSM  | 2689.2, 2689.6   |                          |                           |



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#### 4.5 Measurement Uncertainty

| No. | Item                            | Measurement Uncertainty         |
|-----|---------------------------------|---------------------------------|
| 1   | Radio Frequency                 | $\pm 5.5 \times 10^{-8}$        |
| 2   | RF Conducted power              | $\pm 0.68\text{dB}$             |
| 3   | Conducted Spurious Emissions    | $\pm 1.04\text{dB}$             |
| 4   | RF Radiated Power               | $\pm 4.5\text{dB}$ (below 1GHz) |
|     |                                 | $\pm 4.8\text{dB}$ (above 1GHz) |
| 5   | Radiated Spurious Emission Test | $\pm 4.5\text{dB}$ (30MHz-1GHz) |
|     |                                 | $\pm 4.8\text{dB}$ (1GHz-18GHz) |
| 6   | Temperature                     | $\pm 0.4^\circ\text{C}$         |
| 7   | Humidity                        | $\pm 1.3\%$                     |
| 8   | Supply Voltages                 | $\pm 1.5\%$                     |
| 9   | Time                            | $\pm 3\%$                       |

#### 4.6 Test Location

All tests were performed at:

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198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,  
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## 4.7 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2018 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of Testing Laboratories.

- **FCC Recognized 2.948 Listed Test Firm(Registration No.: 282399)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818, Jul 13, 2017.

- **Industry Canada (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-10449 and T-11179)**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-10449 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.



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#### **4.8 Deviation from Standards**

None

#### **4.9 Abnormalities from Standard Conditions**

None



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## 5 Equipment List

| Conducted Test                      |                             |               |              |            |              |
|-------------------------------------|-----------------------------|---------------|--------------|------------|--------------|
| Equipment                           | Manufacturer                | Model No      | Inventory No | Cal Date   | Cal Due Date |
| MXA Signal Analyzer                 | AgilentTechnologies         | N9020A        | SEM004-10    | 2020-03-02 | 2021-03-01   |
| ESG Vector Signal Generator         | Keysight                    | E4438C        | SEM006-03    | 2020-03-31 | 2021-03-30   |
| Signal Generator                    | Rohde & Schwarz             | SMB100A       | EMC2093      | 2020-01-10 | 2021-01-09   |
| Signal Generator                    | R & S                       | SMR20         | EMC0516      | 2020-01-10 | 2021-01-09   |
| 6dB Attenuator                      | HP                          | 8491A         | EMC2062      | 2020-04-15 | 2022-04-14   |
| MI CABLE                            | SGS-EMC                     | 0.8M          | EMC2136      | 2019-11-02 | 2021-11-01   |
| MI CABLE                            | SGS-EMC                     | 0.8M          | EMC2137      | 2019-11-02 | 2021-11-01   |
| Temperature Chamber                 | GZ GongWen Co.Ltd.          | GDJW-100      | EMC0039      | 2020-07-01 | 2021-06-30   |
| High-low temperature control box    | GZ GongWen Co.Ltd           | GDJW-100      | EMC0039      | 2020-06-29 | 2021-06-28   |
| Radiated Test                       |                             |               |              |            |              |
| Equipment                           | Manufacturer                | Model No      | Inventory No | Cal Date   | Cal Due Date |
| Chamber cable                       | HangTianXing                | N/A           | EMC0542      | 2019-06-28 | 2021-06-27   |
| Horn Antenna 1GHz-18GHz             | Rohde & Schwarz             | HF906         | EMC0518      | 2018-09-02 | 2021-09-01   |
| 1GHz-26.5 GHz Pre-Amplifier         | Agilent                     | 8449B         | EMC0521      | 2020-01-10 | 2021-01-09   |
| Amplifier                           | HP                          | 8447F         | EMC2065      | 2020-05-26 | 2021-05-25   |
| 2.4GHz Filter                       | Micro-Tronics               | BRM 50702     | EMC2069      | 2020-01-10 | 2021-01-09   |
| 966 Anechoic Chamber                | C.R.T                       | 9m x 6m x 6m  | EMC2142      | 2020-12-19 | 2023-12-18   |
| MXE EMI Receiver                    | Keysight                    | N9038A        | EMC2139      | 2020-11-13 | 2021-11-12   |
| EXA Signal Analyzer                 | Keysight                    | N9010A        | EMC2138      | 2020-11-13 | 2021-11-12   |
| Trilog Broadband Antenna 30MHz-1GHz | SCHWARZBECKME SS-ELEKTRONIK | VULB 9168     | SEM003-18    | 2019-02-22 | 2022-02-22   |
| Test Software E3                    | Audix                       | Ver.6.120110a | GZE100-61    | N/A        | N/A          |



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## 6 Radio Spectrum Matter Test Result for AWS-1

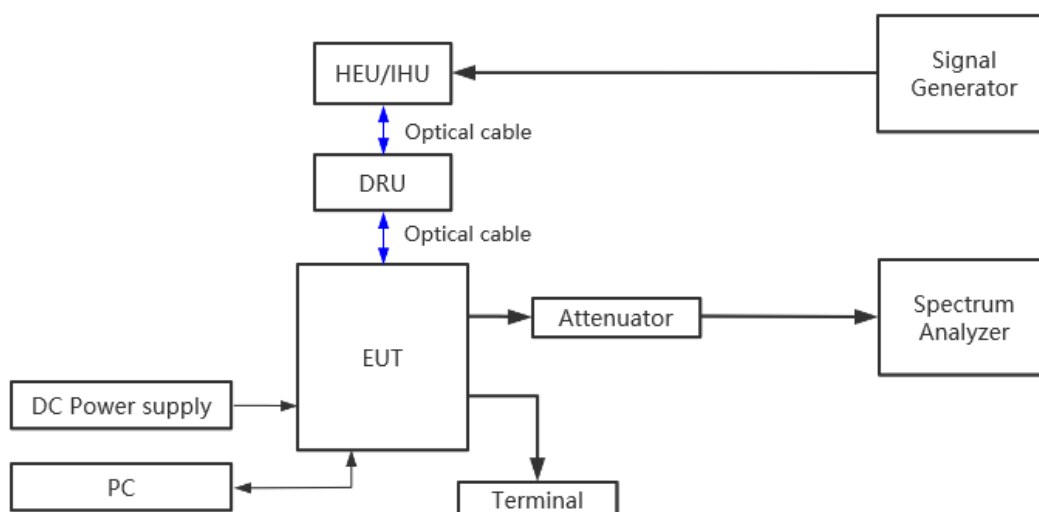
### 6.1 AGC Threshold level

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.2  
 Limit: No limit

#### 6.1.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 Test Configuration: Refer to clause 4.4 in this report.

#### 6.1.2 Test Setup



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### 6.1.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
- d) Set the signal generator frequency to the center frequency of the EUT operating band.
- e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- f) Record this level as the AGC threshold level.
- g) Repeat the procedure with the remaining test signal

### 6.1.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 6.2 Out-of-band rejection

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.3  
 Limit: No limit

### 6.2.1 E.U.T. Operation

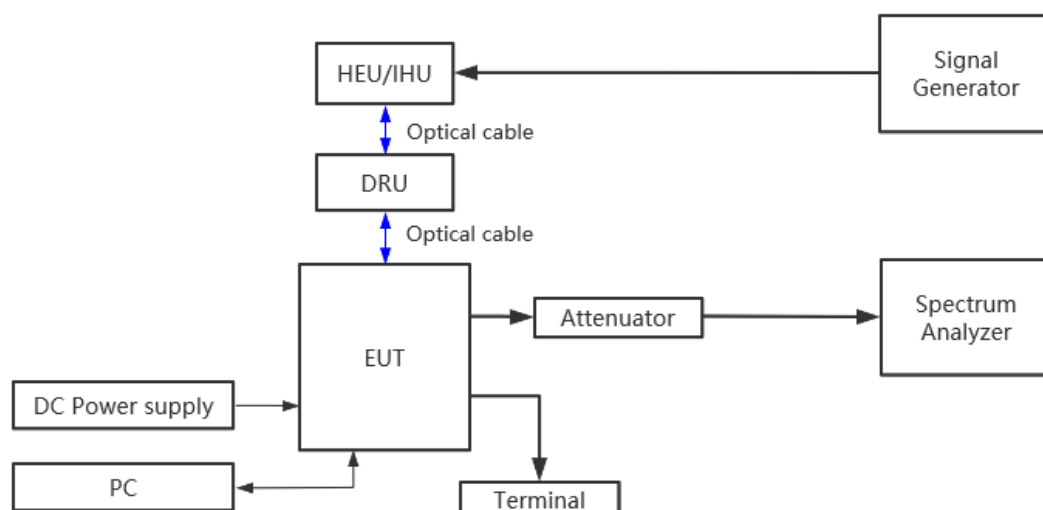
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 6.2.2 Test Setup



### 6.2.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).
  - 2) Level = a sufficient level to affirm that the out-of-band rejection is  $> 20$  dB above the noise floor and will not engage the AGC during the entire sweep.
  - 3) Dwell time = approximately 10 ms.
  - 4) Number of points =  $\text{SPAN}/(\text{RBW}/2)$ .
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.
- e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be  $1\%$  to  $5\%$  of the EUT passband, and the video bandwidth (VBW) shall be set to  $\geq 3 \times \text{RBW}$ .
- f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.
- g) Place a marker to the peak of the frequency response and record this frequency as  $f_0$ .
- h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the  $-20$  dB down amplitude, to determine the 20 dB bandwidth.
- i) Capture the frequency response of the EUT.
- j) Repeat for all frequency bands applicable for use by the EUT.

### 6.2.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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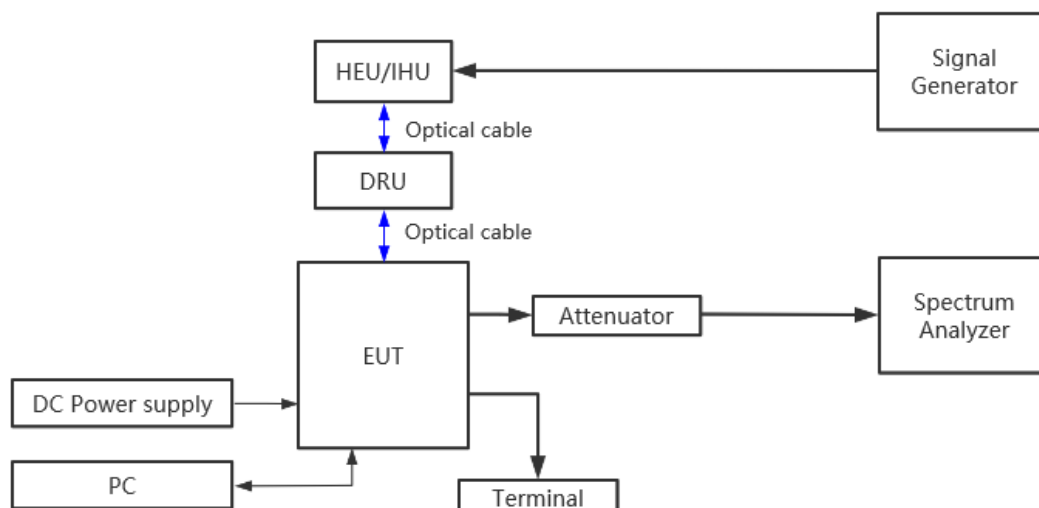
### 6.3 Input-versus-output signal comparison

Test Requirement: 47 CFR Part 2.1049  
 Test Method: KDB 935210 D05 clause 3.4  
 Limit: Compare the spectral plot of input signal to the output signal to affirm that they are similar

#### 6.3.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

#### 6.3.2 Test Setup



### 6.3.3 Test procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between  $2 \times$  to  $5 \times$  the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be  $\geq 3 \times$  RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than  $[10 \log (OBW / RBW)]$  below the reference level.  
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.

- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

### 6.3.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 6.4 Mean output power and amplifier/booster gain

Test Requirement: 47 CFR Part 27.50(d)

Test Method: KDB 935210 D05 clause 3.5

Limit: An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less  
 An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz  
 In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

### 6.4.1 E.U.T. Operation

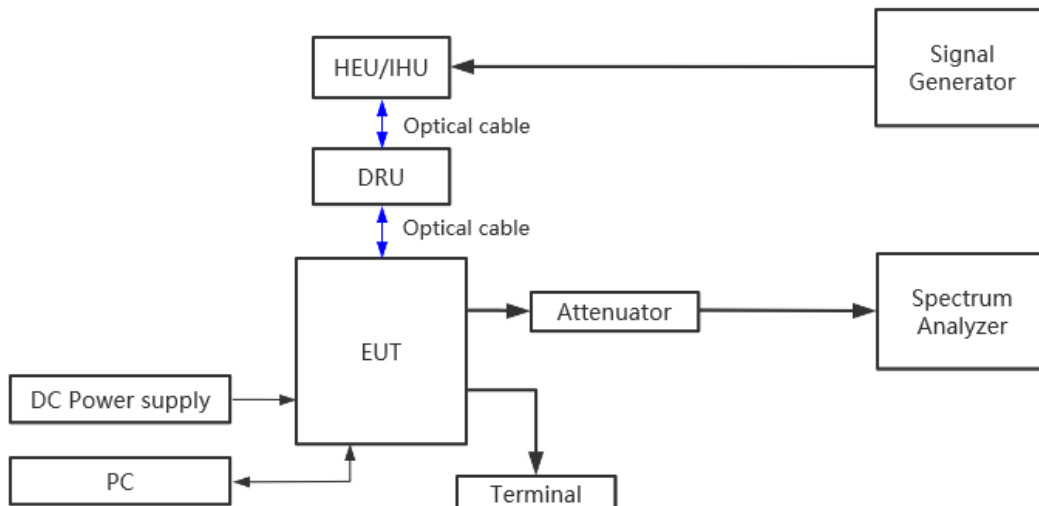
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 6.4.2 Test Setup



### 6.4.3 Test procedure

Test procedure of output power:

- a) Connect a signal generator to the input of the EUT.
- b) Configure to generate the AWGN (broadband) test signal.
- c) The frequency of the signal generator shall be set to the frequency  $f_0$  as determined from 3.3.
- d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.
- 1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.
- 2) Take the measurement of the rise of the output signal.
- 3) Repeat the measurement for the opposite path of the Repeater.

Calculating the mean gain:

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:

Gain (dB) = output power (dBm) – input power (dBm).

Test procedure of PAPR:

- a) Set resolution/measurement bandwidth  $\geq$  OBW or specified reference bandwidth.
- b) Set the number of counts to a value that stabilizes the measured CCDF curve.
- c) Set the measurement interval as follows:



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- 1) For continuous transmissions, set to the greater of  $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$  or 1 ms.
- 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
- 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d) Record the maximum PAPR level associated with a probability of 0.1%.
- e) The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.

#### **6.4.4 Measurement Record**

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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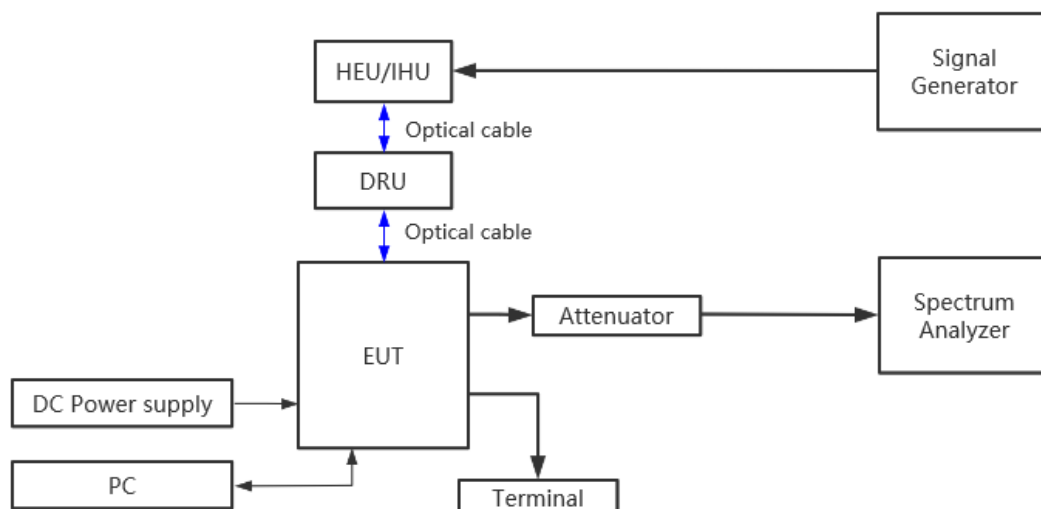
## 6.5 Out-of-band/out-of-block (including intermodulation) emissions and spurious

Test Requirement: 47 CFR Part 27.53(h)  
 Test Method: KDB 935210 D05 clause 3.6  
 Limit: the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10} (P)$  dB  
 (reduce 3.01dB when on 2×2 MIMO mode)

### 6.5.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 6.5.2 Test Setup



### 6.5.3 Test procedure

Test procedure of Out-of-band/out-of-block emissions:

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.



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- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

Test procedure of Spurious emissions

- a) Connect a signal generator to the input of the EUT.
- b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
- c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
- d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
- g) Set the VBW  $\geq 3 \times$  RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.4

- j) Select the power averaging (rms) detector function.
- k) Trace average at least 10 traces in power averaging (rms) mode.
- l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.



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- m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to  $10 \times$  the highest frequency of the fundamental emission (see Section 2.1057). The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
- n) Trace average at least 10 traces in power averaging (rms) mode.
- o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.
- p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
- q) Repeat steps c) to p) with the narrowband test signal.
- r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

#### 6.5.4 Measurement Record

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## 6.6 Frequency stability

Test Requirement: 47 CFR Part 27.54

Test Method: 47 CFR Part 2.1055

KDB 935210 D05 clause 3.7

ANSI C63.26-2015 clause 5.6

Limit:

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 6.6.1 E.U.T. Operation

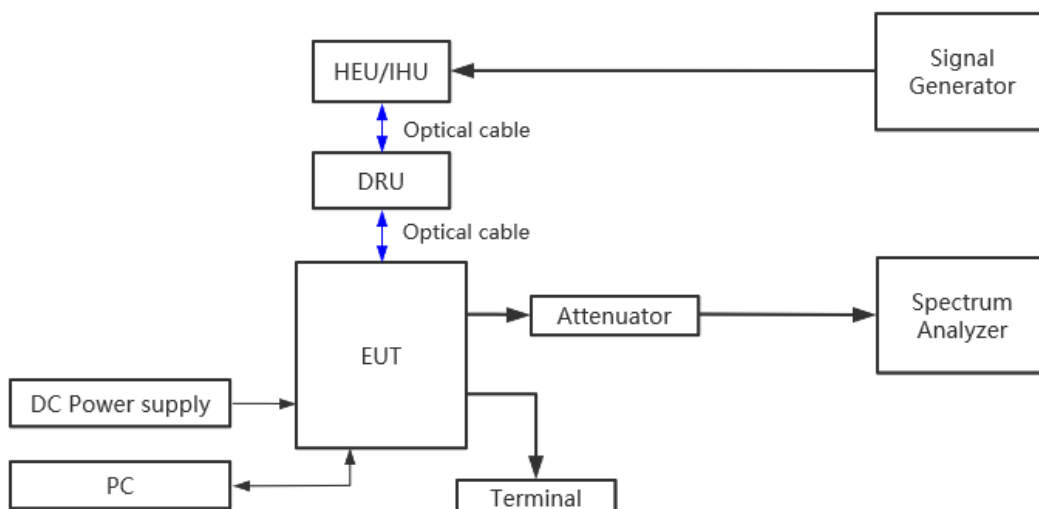
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 6.6.2 Test Setup



### 6.6.3 Test procedure

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

- At 10 °C intervals of temperatures between –30 °C and +50 °C at the manufacturer's rated supply voltage, and
- At +20 °C temperature and  $\pm 15\%$  supply voltage variations. If a product is specified to operate over a range of input voltage then the –15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

### 6.6.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 6.7 Radiated spurious emission

Test Requirement: 47 CFR Part 2.1053, 27.53(h)

Test Method: KDB 935210 D05 clause 3.7

ANSI C63.26-2015 clause 5.6

Limit: the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10} (P)$  dB

### 6.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 59 % RH Atmospheric Pressure: 1010 mbar

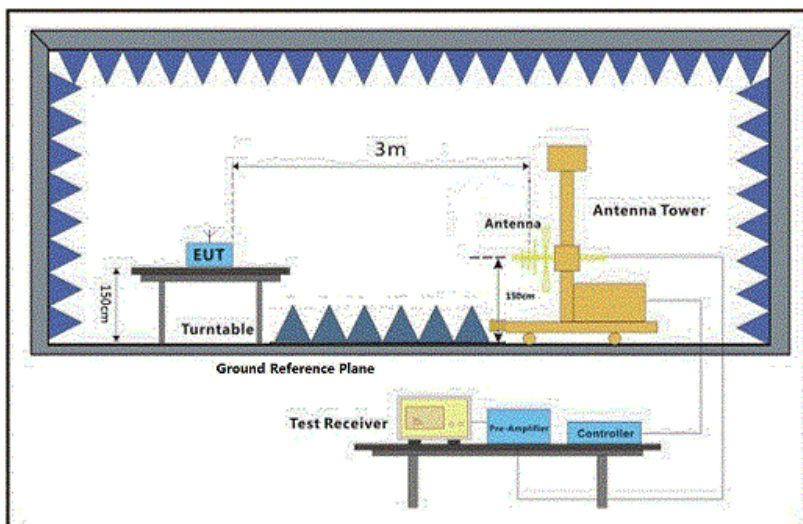
Test Mode: Set the EUT to maximum output power and maximum gain (activate MIMO mode simultaneously).



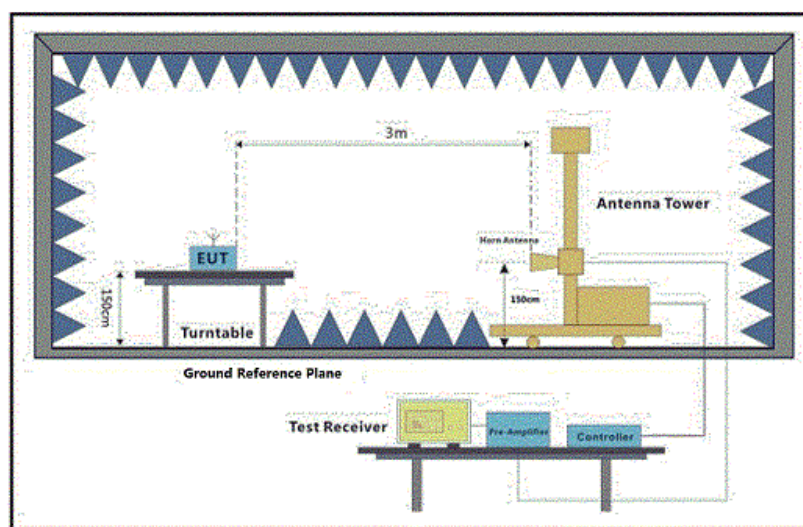
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## 6.7.2 Test Setup



30MHz-1GHz



Above 1GHz

### 6.7.3 Test procedure

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6) The output power into the substitution antenna was then measured.
- 7) Steps 5) and 6) were repeated with both antennas vertically polarized.
- 8) Calculate power in dBm by the following formula:  

$$\text{Level (dBm)} = \text{Read Level (dBm)} + \text{Correction Factor (dB)}$$

### 6.7.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



## 7 Radio Spectrum Matter Test Result for AWS-3

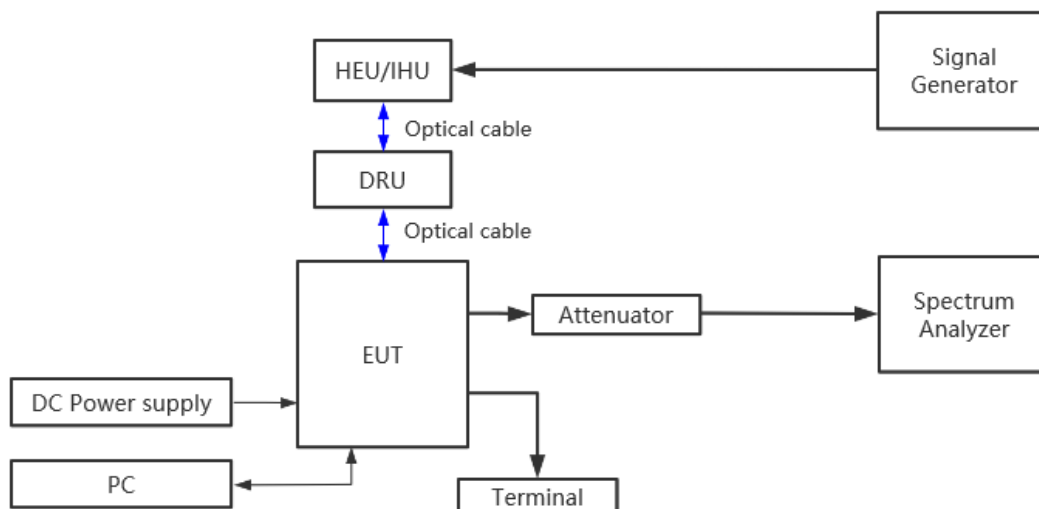
### 7.1 AGC Threshold level

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.2  
 Limit: No limit

#### 7.1.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 Test Configuration: Refer to clause 4.4 in this report.

#### 7.1.2 Test Setup



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### 7.1.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
- d) Set the signal generator frequency to the center frequency of the EUT operating band.
- e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- f) Record this level as the AGC threshold level.
- g) Repeat the procedure with the remaining test signal

### 7.1.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 7.2 Out-of-band rejection

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.3  
 Limit: No limit

### 7.2.1 E.U.T. Operation

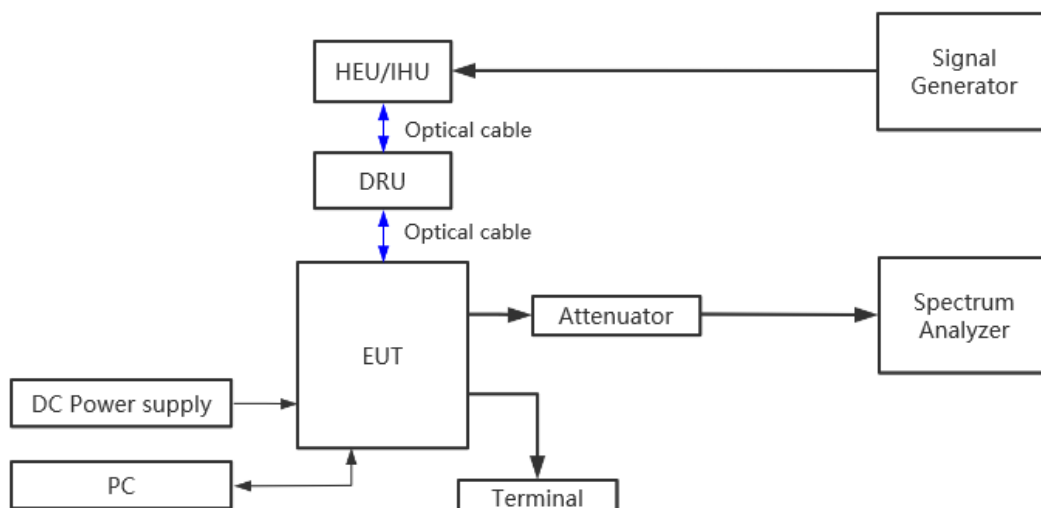
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 7.2.2 Test Setup



### 7.2.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).
  - 2) Level = a sufficient level to affirm that the out-of-band rejection is  $> 20$  dB above the noise floor and will not engage the AGC during the entire sweep.
  - 3) Dwell time = approximately 10 ms.
  - 4) Number of points =  $\text{SPAN}/(\text{RBW}/2)$ .
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.
- e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be  $1\%$  to  $5\%$  of the EUT passband, and the video bandwidth (VBW) shall be set to  $\geq 3 \times \text{RBW}$ .
- f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.
- g) Place a marker to the peak of the frequency response and record this frequency as  $f_0$ .
- h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the  $-20$  dB down amplitude, to determine the 20 dB bandwidth.
- i) Capture the frequency response of the EUT.
- j) Repeat for all frequency bands applicable for use by the EUT.

### 7.2.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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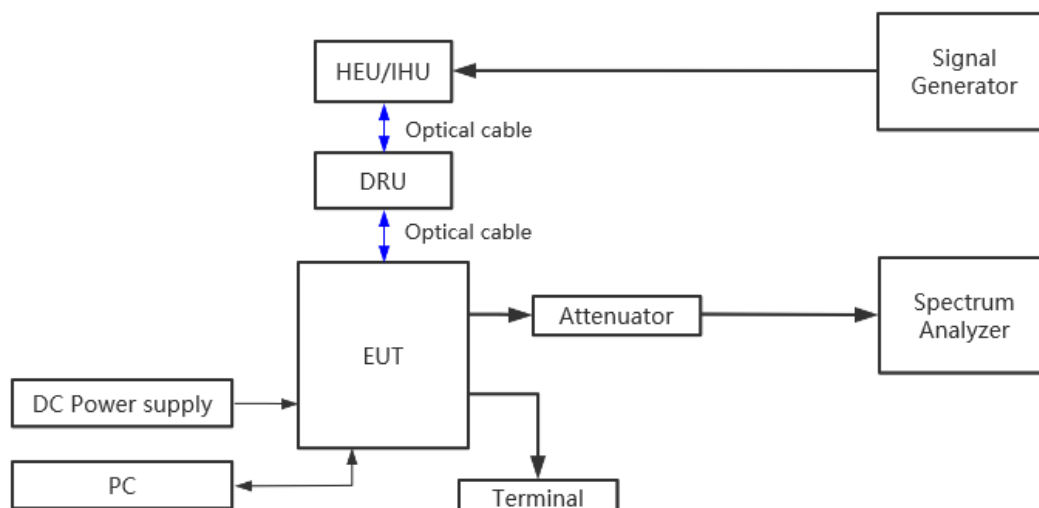
### 7.3 Input-versus-output signal comparison

Test Requirement: 47 CFR Part 2.1049  
 Test Method: KDB 935210 D05 clause 3.4  
 Limit: Compare the spectral plot of input signal to the output signal to affirm that they are similar

#### 7.3.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

#### 7.3.2 Test Setup



### 7.3.3 Test procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between  $2 \times$  to  $5 \times$  the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be  $\geq 3 \times$  RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than  $[10 \log (OBW / RBW)]$  below the reference level.  
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.



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- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

### 7.3.4 Measurement Record

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## 7.4 Mean output power and amplifier/booster gain

Test Requirement: 47 CFR Part 27.50(d)

Test Method: KDB 935210 D05 clause 3.5

Limit: An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less

An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz

In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

### 7.4.1 E.U.T. Operation

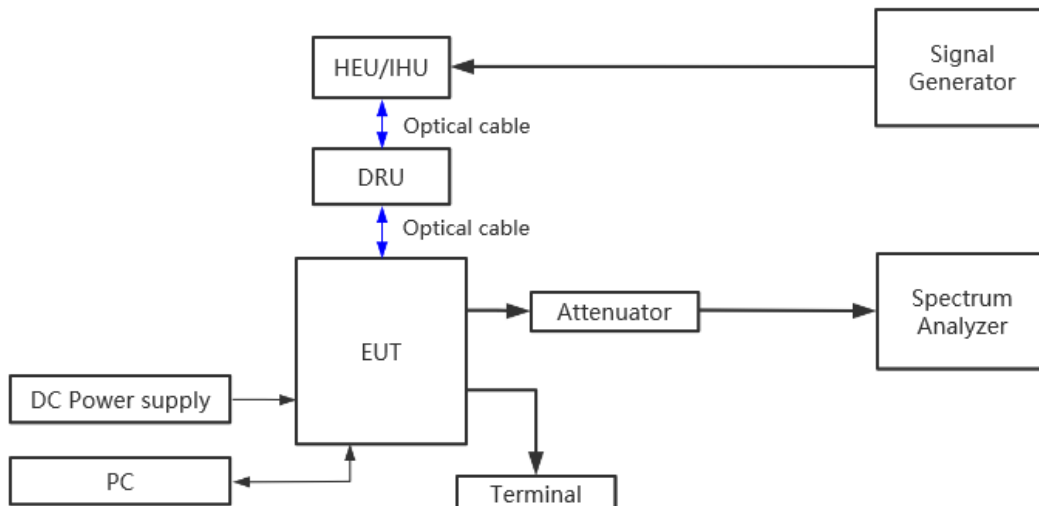
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 7.4.2 Test Setup



### 7.4.3 Test procedure

Test procedure of output power:

- a) Connect a signal generator to the input of the EUT.
- b) Configure to generate the AWGN (broadband) test signal.
- c) The frequency of the signal generator shall be set to the frequency  $f_0$  as determined from 3.3.
- d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.
- 1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.
- 2) Take the measurement of the rise of the output signal.
- 3) Repeat the measurement for the opposite path of the Repeater.

Calculating the mean gain:

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:

Gain (dB) = output power (dBm) – input power (dBm).

Test procedure of PAPR:

- a) Set resolution/measurement bandwidth  $\geq$  OBW or specified reference bandwidth.
- b) Set the number of counts to a value that stabilizes the measured CCDF curve.
- c) Set the measurement interval as follows:



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- 1) For continuous transmissions, set to the greater of  $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$  or 1 ms.
- 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
- 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d) Record the maximum PAPR level associated with a probability of 0.1%.
- e) The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.

#### **7.4.4 Measurement Record**

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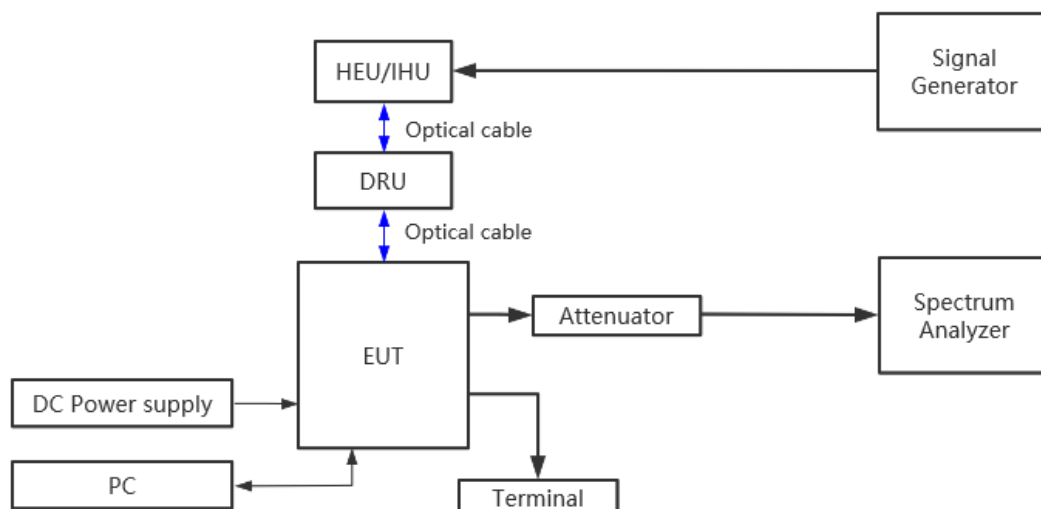
## 7.5 Out-of-band/out-of-block (including intermodulation) emissions and spurious

Test Requirement: 47 CFR Part 27.53(h)  
 Test Method: KDB 935210 D05 clause 3.6  
 Limit: the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10} (P)$  dB  
 (reduce 3.01dB when on 2×2 MIMO mode)

### 7.5.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 7.5.2 Test Setup



### 7.5.3 Test procedure

Test procedure of Out-of-band/out-of-block emissions:

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.



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- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

Test procedure of Spurious emissions

- a) Connect a signal generator to the input of the EUT.
- b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
- c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
- d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
- g) Set the VBW  $\geq 3 \times$  RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.4

- j) Select the power averaging (rms) detector function.
- k) Trace average at least 10 traces in power averaging (rms) mode.
- l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.



- m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to  $10 \times$  the highest frequency of the fundamental emission (see Section 2.1057). The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
- n) Trace average at least 10 traces in power averaging (rms) mode.
- o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.
- p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
- q) Repeat steps c) to p) with the narrowband test signal.
- r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

#### 7.5.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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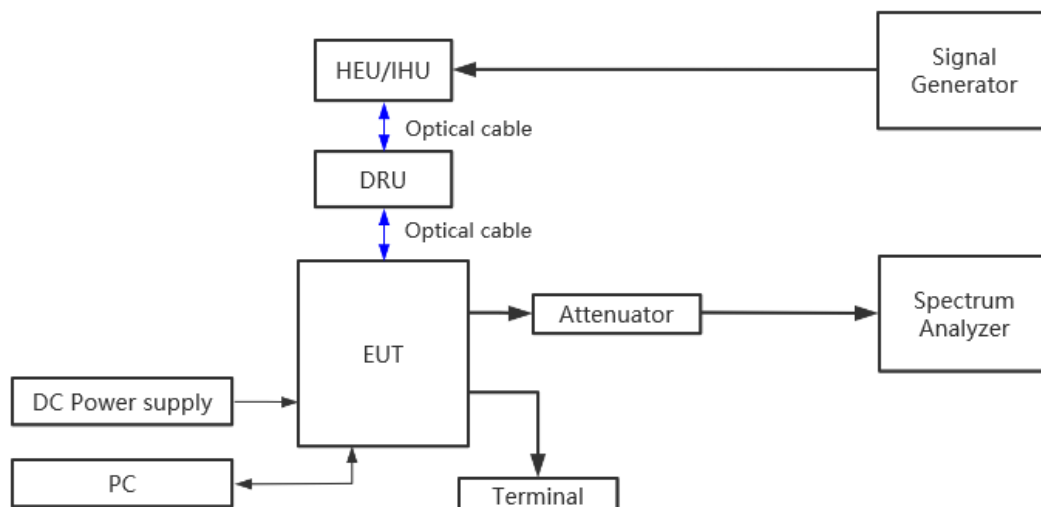
## 7.6 Frequency stability

Test Requirement: 47 CFR Part 27.54  
 Test Method: 47 CFR Part 2.1055  
 KDB 935210 D05 clause 3.7  
 ANSI C63.26-2015 clause 5.6  
 Limit: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 7.6.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 7.6.2 Test Setup



### 7.6.3 Test procedure

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

- a) At 10 °C intervals of temperatures between –30 °C and +50 °C at the manufacturer's rated supply voltage, and
- b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the –15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

### 7.6.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 7.7 Radiated spurious emission

Test Requirement: 47 CFR Part 2.1053, 27.53(h)

Test Method: KDB 935210 D05 clause 3.7

ANSI C63.26-2015 clause 5.6

Limit: the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10} (P)$  dB

### 7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 59 % RH Atmospheric Pressure: 1010 mbar

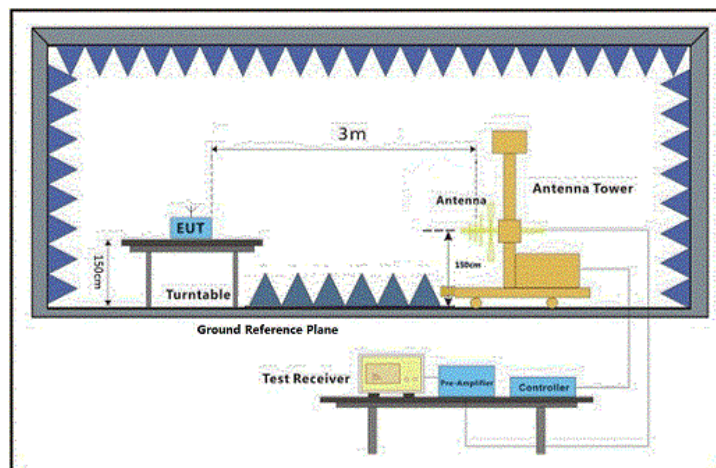
Test Mode: Set the EUT to maximum output power and maximum gain (activate MIMO mode simultaneously).



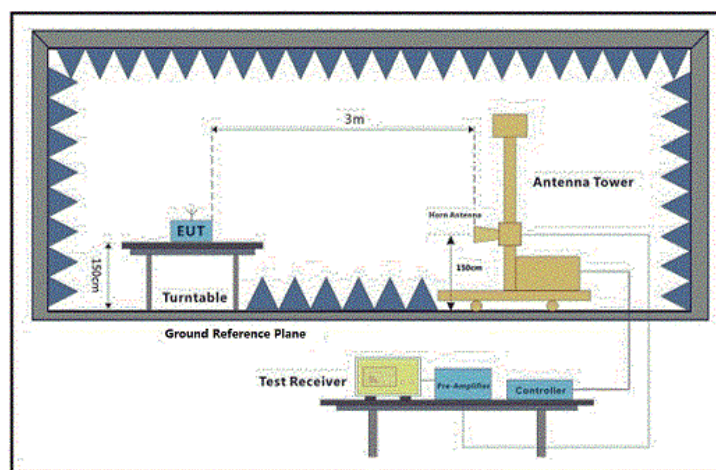
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## 7.7.2 Test Setup



30MHz-1GHz



Above 1GHz

### 7.7.3 Test procedure

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6) The output power into the substitution antenna was then measured.
- 7) Steps 5) and 6) were repeated with both antennas vertically polarized.
- 8) Calculate power in dBm by the following formula:  

$$\text{Level (dBm)} = \text{Read Level (dBm)} + \text{Correction Factor (dB)}$$

### 7.7.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



## 8 Radio Spectrum Matter Test Result for Broadband PCS

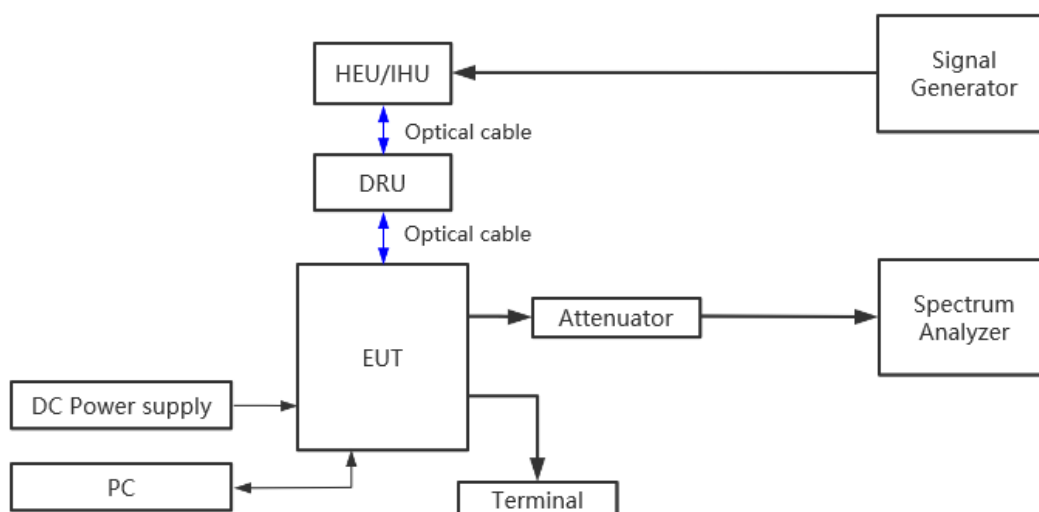
### 8.1 AGC Threshold level

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.2  
 Limit: No limit

#### 8.1.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 Test Configuration: Refer to clause 4.4 in this report.

#### 8.1.2 Test Setup



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### 8.1.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
- d) Set the signal generator frequency to the center frequency of the EUT operating band.
- e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- f) Record this level as the AGC threshold level.
- g) Repeat the procedure with the remaining test signal

### 8.1.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 8.2 Out-of-band rejection

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.3  
 Limit: No limit

### 8.2.1 E.U.T. Operation

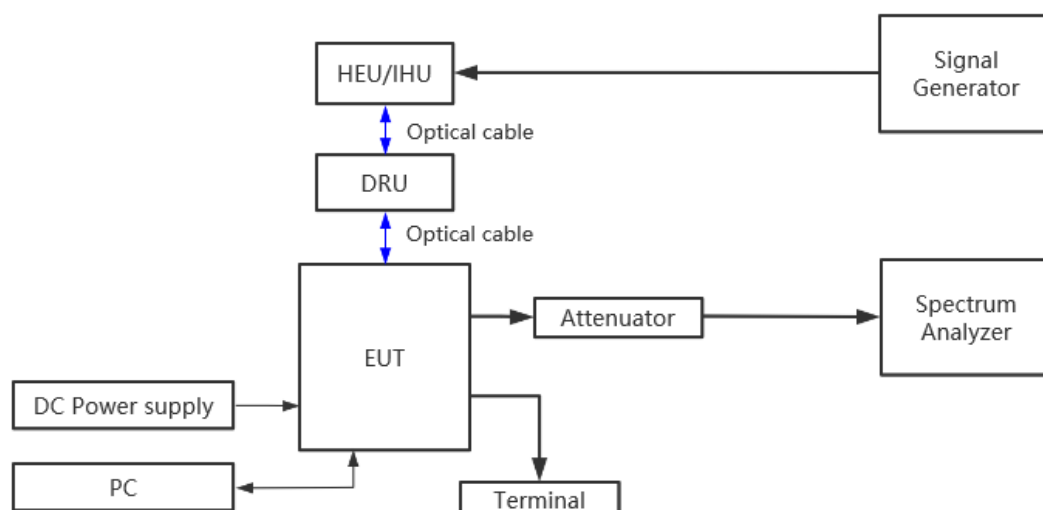
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 8.2.2 Test Setup



### 8.2.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).
  - 2) Level = a sufficient level to affirm that the out-of-band rejection is  $> 20$  dB above the noise floor and will not engage the AGC during the entire sweep.
  - 3) Dwell time = approximately 10 ms.
  - 4) Number of points =  $\text{SPAN}/(\text{RBW}/2)$ .
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.
- e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be  $1\%$  to  $5\%$  of the EUT passband, and the video bandwidth (VBW) shall be set to  $\geq 3 \times \text{RBW}$ .
- f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.
- g) Place a marker to the peak of the frequency response and record this frequency as  $f_0$ .
- h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the  $-20$  dB down amplitude, to determine the 20 dB bandwidth.
- i) Capture the frequency response of the EUT.
- j) Repeat for all frequency bands applicable for use by the EUT.

### 8.2.4 Measurement Record

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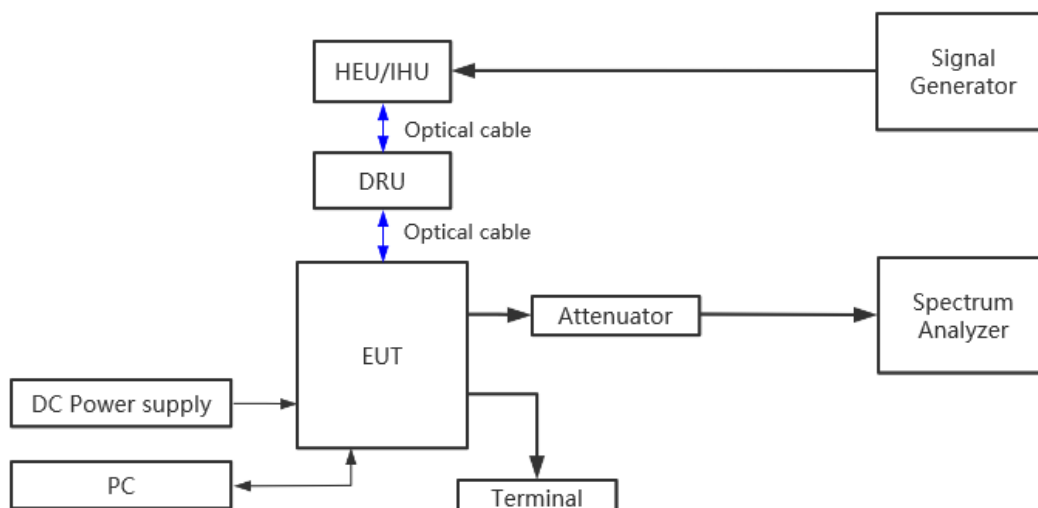
### 8.3 Input-versus-output signal comparison

Test Requirement: 47 CFR Part 2.1049  
 Test Method: KDB 935210 D05 clause 3.4  
 Limit: Compare the spectral plot of input signal to the output signal to affirm that they are similar

#### 8.3.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

#### 8.3.2 Test Setup



### 8.3.3 Test procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between  $2 \times$  to  $5 \times$  the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be  $\geq 3 \times$  RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than  $[10 \log (OBW / RBW)]$  below the reference level.  
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.

- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

### 8.3.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 8.4 Mean output power and amplifier/booster gain

Test Requirement: 47 CFR Part 24.232

Test Method: KDB 935210 D05 clause 3.5

Limit: Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT

Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT

In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB

### 8.4.1 E.U.T. Operation

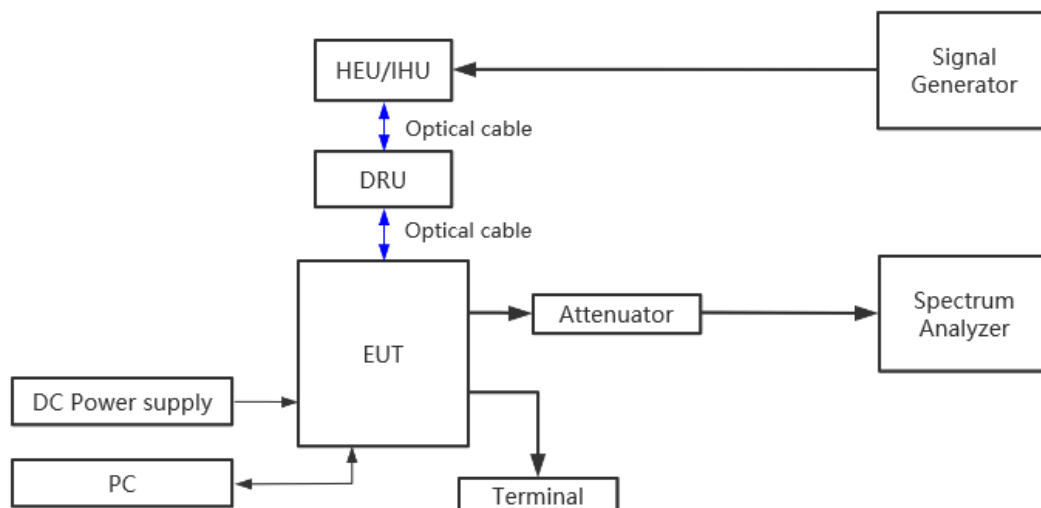
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 8.4.2 Test Setup



### 8.4.3 Test procedure

Test procedure of output power:

- a) Connect a signal generator to the input of the EUT.
- b) Configure to generate the AWGN (broadband) test signal.
- c) The frequency of the signal generator shall be set to the frequency  $f_0$  as determined from 3.3.
- d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.
- 1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.
- 2) Take the measurement of the rise of the output signal.
- 3) Repeat the measurement for the opposite path of the Repeater.

Calculating the mean gain:

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:

Gain (dB) = output power (dBm) – input power (dBm).

Test procedure of PAPR:

- a) Set resolution/measurement bandwidth  $\geq$  OBW or specified reference bandwidth.
- b) Set the number of counts to a value that stabilizes the measured CCDF curve.
- c) Set the measurement interval as follows:



- 1) For continuous transmissions, set to the greater of  $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$  or 1 ms.
- 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
- 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d) Record the maximum PAPR level associated with a probability of 0.1%.
- e) The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.

#### **8.4.4 Measurement Record**

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 8.5 Out-of-band/out-of-block (including intermodulation) emissions and spurious

Test Requirement: 47 CFR Part 24.238

Test Method: KDB 935210 D05 clause 3.6

Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.  
(reduce 3.01dB when on 2×2 MIMO mode)

### 8.5.1 E.U.T. Operation

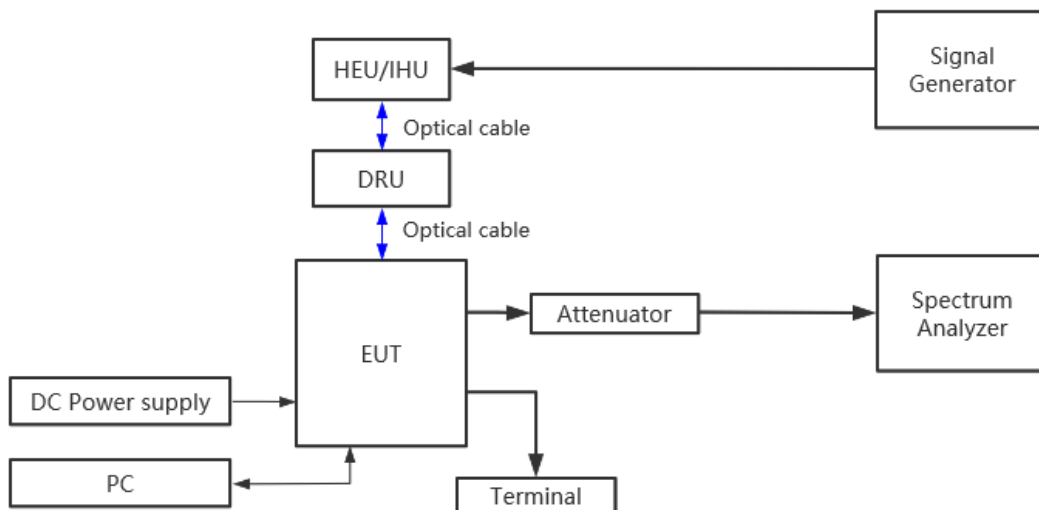
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 8.5.2 Test Setup



### 8.5.3 Test procedure

Test procedure of Out-of-band/out-of-block emissions:

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.



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- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

Test procedure of Spurious emissions

- a) Connect a signal generator to the input of the EUT.
- b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
- c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
- d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
- g) Set the VBW  $\geq 3 \times$  RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.4

- j) Select the power averaging (rms) detector function.
- k) Trace average at least 10 traces in power averaging (rms) mode.
- l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.



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- m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to  $10 \times$  the highest frequency of the fundamental emission (see Section 2.1057). The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
- n) Trace average at least 10 traces in power averaging (rms) mode.
- o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.
- p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
- q) Repeat steps c) to p) with the narrowband test signal.
- r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

#### 8.5.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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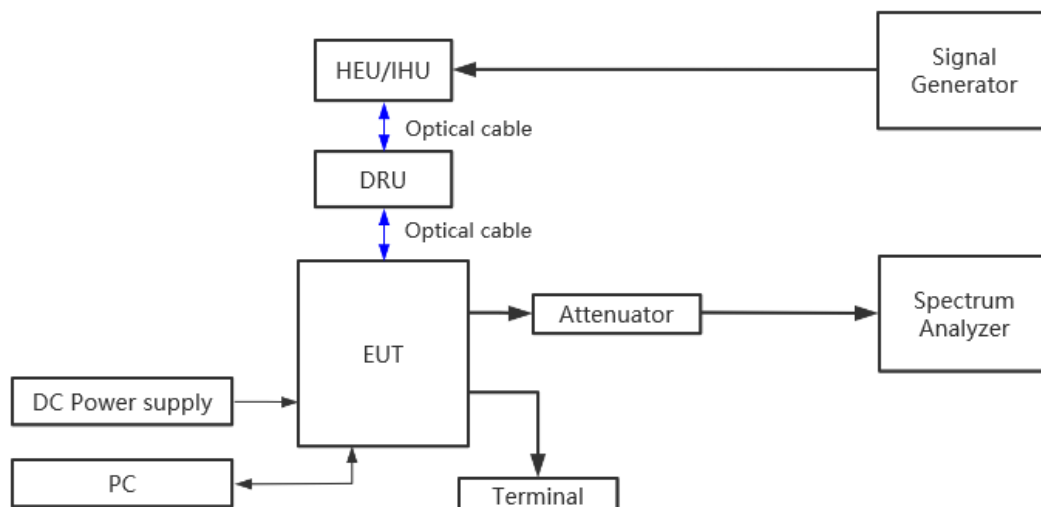
## 8.6 Frequency stability

Test Requirement: 47 CFR Part 24.235  
 Test Method: 47 CFR Part 2.1055  
 KDB 935210 D05 clause 3.7  
 ANSI C63.26-2015 clause 5.6  
 Limit: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 8.6.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 8.6.2 Test Setup



### 8.6.3 Test procedure

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

- a) At 10 °C intervals of temperatures between –30 °C and +50 °C at the manufacturer's rated supply voltage, and
- b) At +20 °C temperature and  $\pm 15\%$  supply voltage variations. If a product is specified to operate over a range of input voltage then the –15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

### 8.6.4 Measurement Record

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## 8.7 Radiated spurious emission

Test Requirement: 47 CFR Part 2.1053, 24.238

Test Method: KDB 935210 D05 clause 3.7  
ANSI C63.26-2015 clause 5.6

Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### 8.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 59 % RH Atmospheric Pressure: 1010 mbar

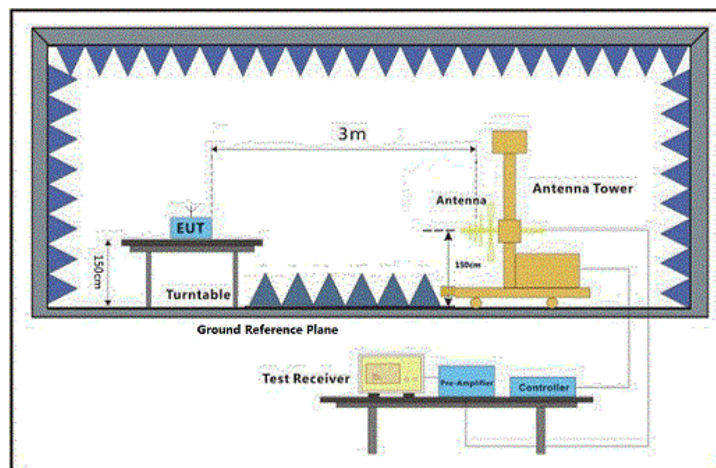
Test Mode: Set the EUT to maximum output power and maximum gain (activate MIMO mode simultaneously).



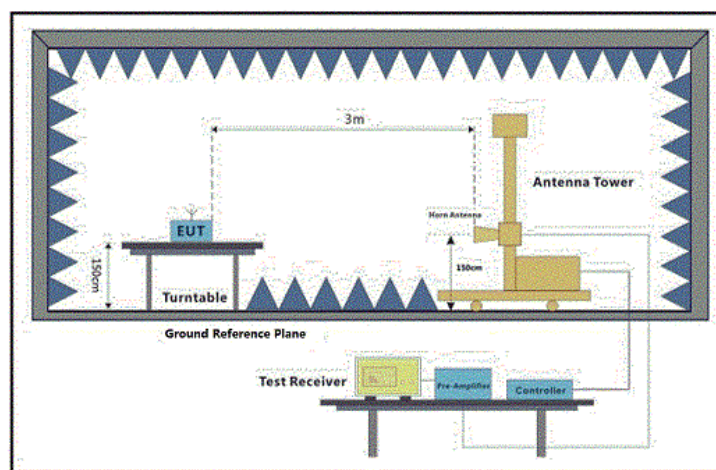
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## 8.7.2 Test Setup



30MHz-1GHz



Above 1GHz

### 8.7.3 Test procedure

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6) The output power into the substitution antenna was then measured.
- 7) Steps 5) and 6) were repeated with both antennas vertically polarized.
- 8) Calculate power in dBm by the following formula:  

$$\text{Level (dBm)} = \text{Read Level (dBm)} + \text{Correction Factor (dB)}$$

### 8.7.4 Measurement Record

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## 9 Radio Spectrum Matter Test Result for WCS

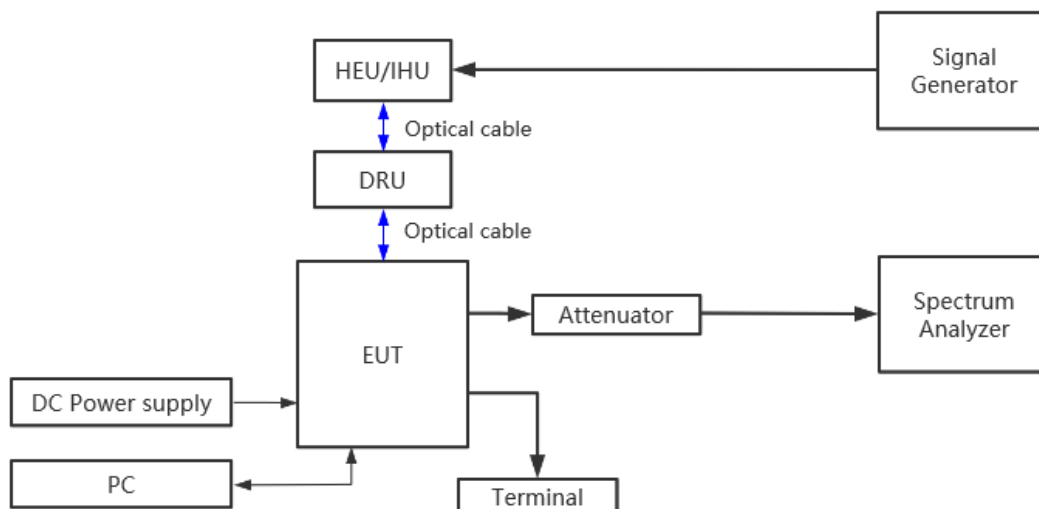
### 9.1 AGC Threshold level

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 4.2  
 Limit: No limit

#### 9.1.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 Test Configuration: Refer to clause 4.4 in this report.

#### 9.1.2 Test Setup



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### 9.1.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
- d) Set the signal generator frequency to the center frequency of the EUT operating band.
- e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- f) Record this level as the AGC threshold level.
- g) Repeat the procedure with the remaining test signal

### 9.1.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 9.2 Out-of-band rejection

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 4.3  
 Limit: No limit

### 9.2.1 E.U.T. Operation

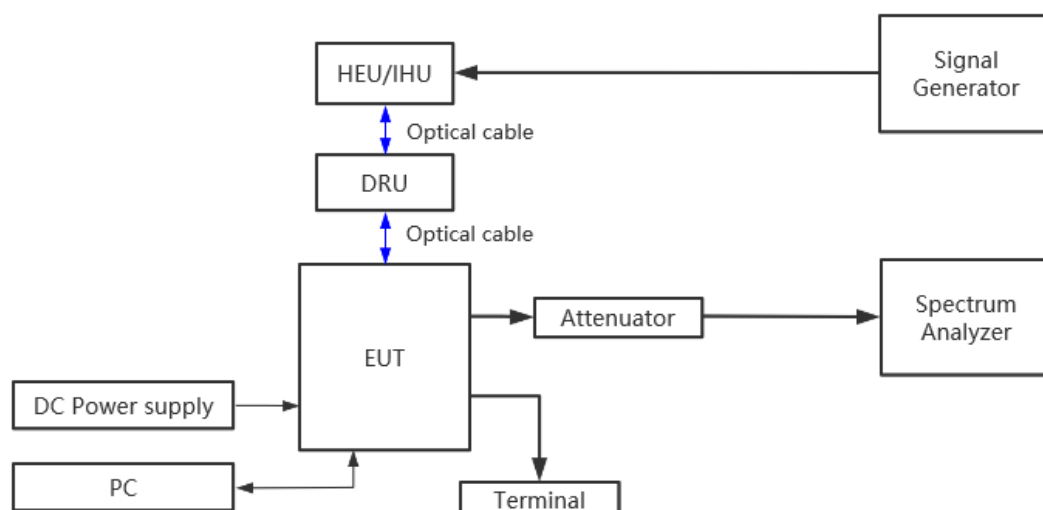
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 9.2.2 Test Setup



### 9.2.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the manufacturer's specified pass band.
  - 2) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
  - 3) Dwell time = approximately 10 ms.
  - 4) Frequency step = 50 kHz.
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW =  $3 \times$  RBW.
- e) Set the detector to Peak and the trace to Max-Hold.
- f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as  $f_0$ , and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).
- g) Capture the frequency response plot for inclusion in the test report.

### 9.2.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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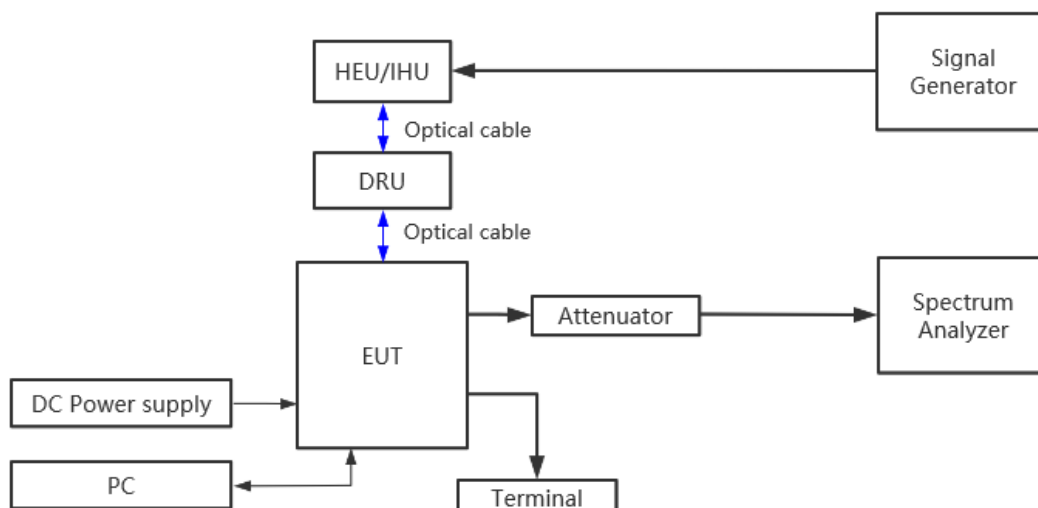
### 9.3 Input-versus-output signal comparison

Test Requirement: 47 CFR Part 2.1049  
 Test Method: KDB 935210 D05 clause 3.4  
 Limit: Compare the spectral plot of input signal to the output signal to affirm that they are similar

#### 9.3.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

#### 9.3.2 Test Setup



### 9.3.3 Test procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between  $2 \times$  to  $5 \times$  the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be  $\geq 3 \times$  RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than  $[10 \log (OBW / RBW)]$  below the reference level.  
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.

- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

#### **9.3.4 Measurement Record**

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 9.4 Mean output power and amplifier/booster gain

**Test Requirement:** 47 CFR Part 27.50(a)

**Test Method:** KDB 935210 D05 clause 3.4

**Limit:** The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

### 9.4.1 E.U.T. Operation

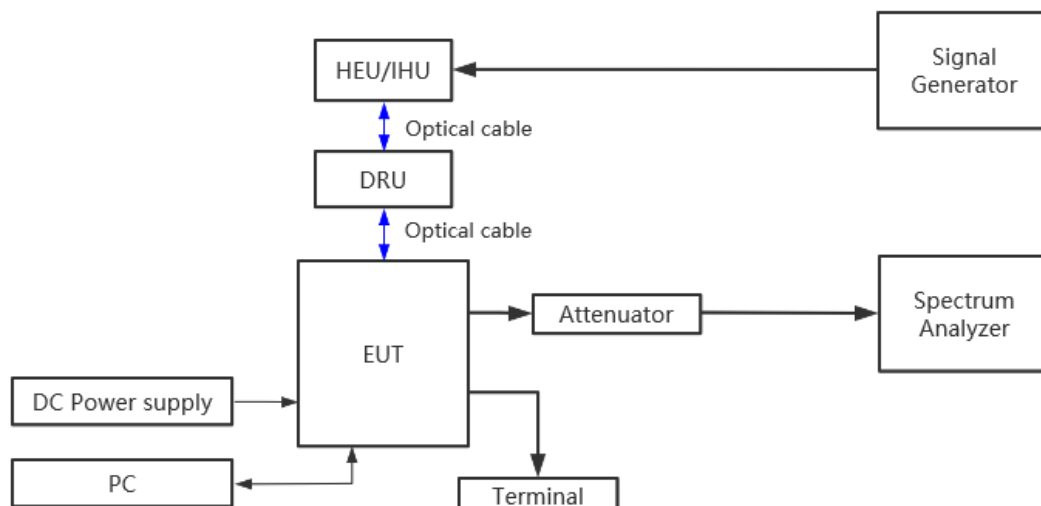
**Operating Environment:**

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

**Test Mode:** Set the EUT to maximum output power and maximum gain.

**EUT Configuration:** Refer to clause 4.4 in this report.

### 9.4.2 Test Setup



#### 9.4.3 Test procedure

Test procedure of output power:

- a) Connect a signal generator to the input of the EUT.
- b) Configure to generate the AWGN (broadband) test signal.
- c) The frequency of the signal generator shall be set to the frequency  $f_0$  as determined from 3.3.
- d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.
- 1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.
- 2) Take the measurement of the rise of the output signal.
- 3) Repeat the measurement for the opposite path of the Repeater.

Calculating the mean gain:

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:

Gain (dB) = output power (dBm) – input power (dBm).

Test procedure of PAPR:

- a) Set resolution/measurement bandwidth  $\geq$  OBW or specified reference bandwidth.
- b) Set the number of counts to a value that stabilizes the measured CCDF curve.
- c) Set the measurement interval as follows:

- 1) For continuous transmissions, set to the greater of  $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$  or 1 ms.
- 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
- 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d) Record the maximum PAPR level associated with a probability of 0.1%.
- e) The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.

#### **9.4.4 Measurement Record**

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## **9.5 Out-of-band/out-of-block (including intermodulation) emissions and spurious**

- Test Requirement: 47 CFR Part 27.53(a)(1)
- Test Method: KDB 935210 D05 clause 3.6
- Limit:
- (i) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than  $75 + 10 \log (P)$  dB on all frequencies between 2320 and 2345 MHz
  - (ii) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2300 and 2305 MHz,  $70 + 10 \log (P)$  dB on all frequencies between 2287.5 and 2300 MHz,  $72 + 10 \log (P)$  dB on all frequencies between 2285 and 2287.5 MHz, and  $75 + 10 \log (P)$  dB below 2285 MHz
  - (iii) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2360 and 2362.5 MHz,  $55 + 10 \log (P)$  dB on all frequencies between 2362.5 and 2365 MHz,  $70 + 10 \log (P)$  dB on all frequencies between 2365 and 2367.5 MHz,  $72 + 10 \log (P)$  dB on all frequencies between 2367.5 and 2370 MHz, and  $75 + 10 \log (P)$  dB above 2370 MHz  
(reduce 3.01dB when on 2×2 MIMO mode)



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### 9.5.1 E.U.T. Operation

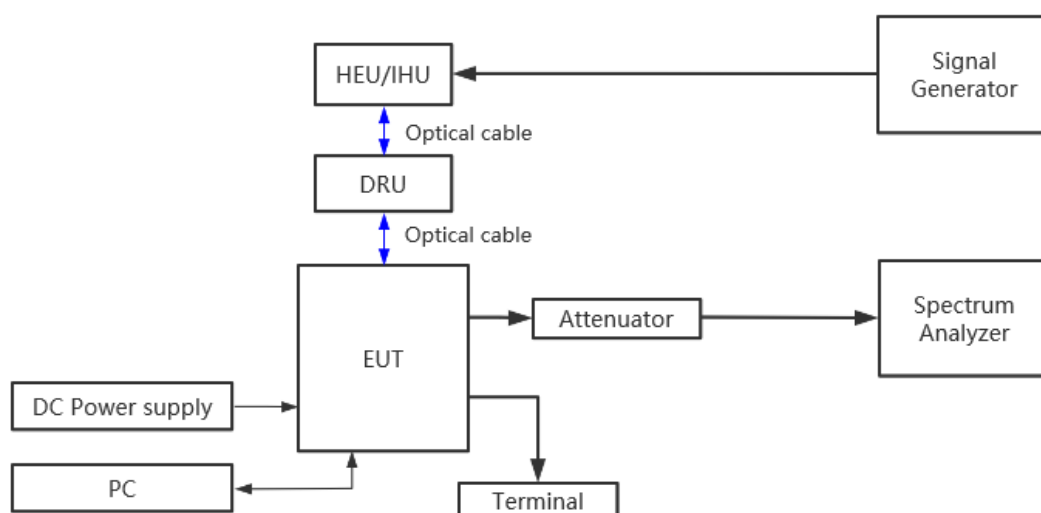
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 9.5.2 Test Setup



### 9.5.3 Test procedure

Test procedure of Out-of-band/out-of-block emissions:

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.



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- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

#### Test procedure of Spurious emissions

- a) Connect a signal generator to the input of the EUT.
- b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
- c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
- d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
- g) Set the VBW  $\geq 3 \times$  RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.4

- j) Select the power averaging (rms) detector function.
- k) Trace average at least 10 traces in power averaging (rms) mode.
- l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.

#### 9.5.4 Measurement Record

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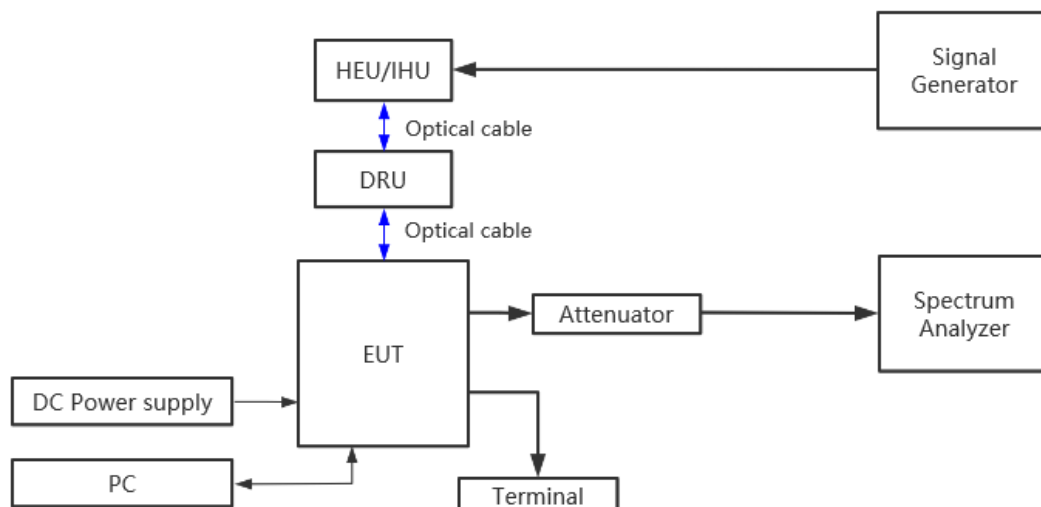
## 9.6 Frequency stability

Test Requirement: 47 CFR Part 27.54  
 Test Method: 47 CFR Part 2.1055  
 KDB 935210 D05 clause 3.7  
 ANSI C63.26-2015 clause 5.6  
 Limit: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 9.6.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 9.6.2 Test Setup



### 9.6.3 Test procedure

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

- At 10 °C intervals of temperatures between –30 °C and +50 °C at the manufacturer's rated supply voltage, and
- At +20 °C temperature and  $\pm 15\%$  supply voltage variations. If a product is specified to operate over a range of input voltage then the –15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

### 9.6.4 Measurement Record

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## 9.7 Radiated spurious emission

Test Requirement: 47 CFR Part 27.53(a)

Test Method: KDB 935210 D05 clause 3.7  
ANSI C63.26-2015 clause 5.6

Limit:

(i) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than  $75 + 10 \log (P)$  dB on all frequencies between 2320 and 2345 MHz

(ii) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2300 and 2305 MHz,  $70 + 10 \log (P)$  dB on all frequencies between 2287.5 and 2300 MHz,  $72 + 10 \log (P)$  dB on all frequencies between 2285 and 2287.5 MHz, and  $75 + 10 \log (P)$  dB below 2285 MHz

(iii) By a factor of not less than  $43 + 10 \log (P)$  dB on all frequencies between 2360 and 2362.5 MHz,  $55 + 10 \log (P)$  dB on all frequencies between 2362.5 and 2365 MHz,  $70 + 10 \log (P)$  dB on all frequencies between 2365 and 2367.5 MHz,  $72 + 10 \log (P)$  dB on all frequencies between 2367.5 and 2370 MHz, and  $75 + 10 \log (P)$  dB above 2370 MHz

(reduce 3.01dB when on 2×2 MIMO mode)

### 9.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 59 % RH Atmospheric Pressure: 1010 mbar

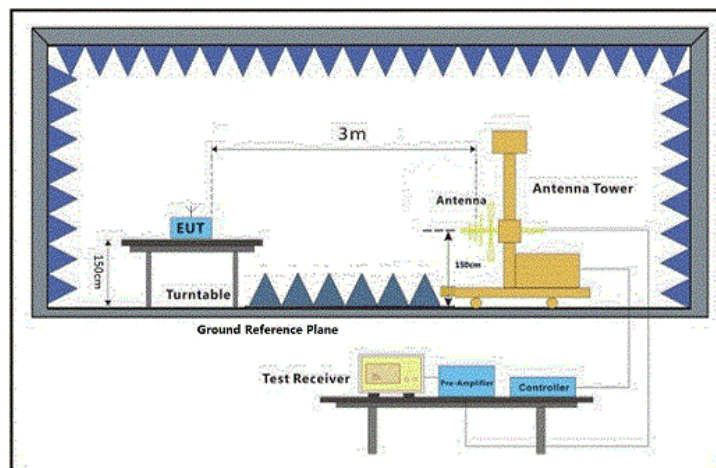
Test Mode: Set the EUT to maximum output power and maximum gain (activate MIMO mode simultaneously).



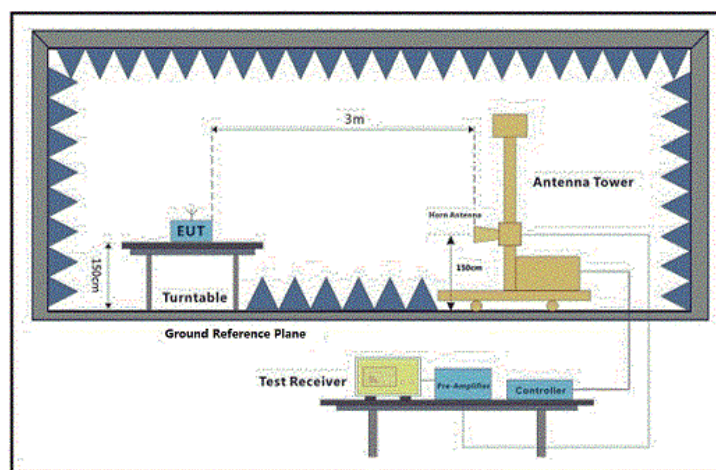
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## 9.7.2 Test Setup



30MHz-1GHz



Above 1GHz

### 9.7.3 Test procedure

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6) The output power into the substitution antenna was then measured.
- 7) Steps 5) and 6) were repeated with both antennas vertically polarized.
- 8) Calculate power in dBm by the following formula:  

$$\text{Level (dBm)} = \text{Read Level (dBm)} + \text{Correction Factor (dB)}$$

### 9.7.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 10 Radio Spectrum Matter Test Result for BRS/EBS

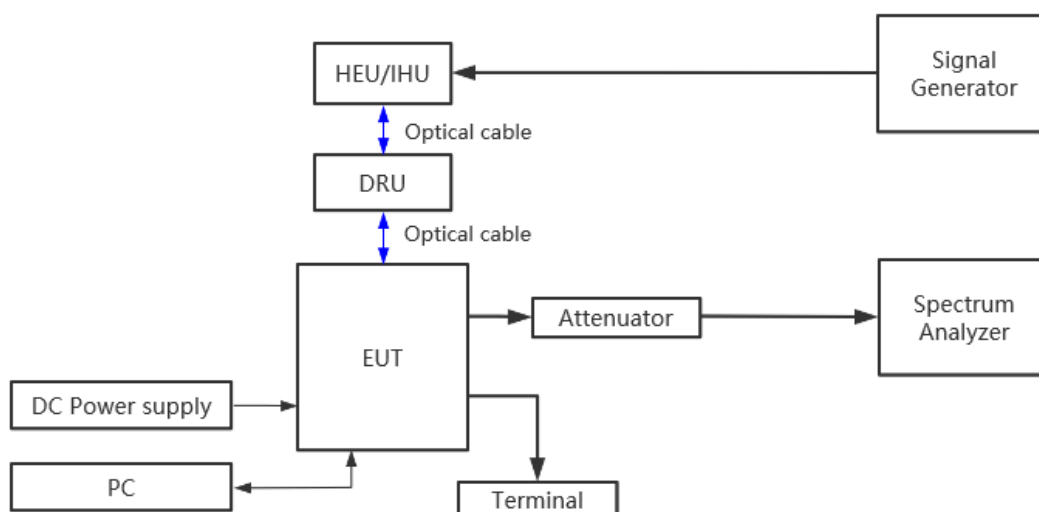
### 10.1 AGC Threshold level

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.2  
 Limit: No limit

#### 10.1.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 Test Configuration: Refer to clause 4.4 in this report.

#### 10.1.2 Test Setup



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### 10.1.3 Test Procedure

- a) Connect a signal generator to the input of the EUT.
- b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).
- d) Set the signal generator frequency to the center frequency of the EUT operating band.
- e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- f) Record this level as the AGC threshold level.
- g) Repeat the procedure with the remaining test signal

### 10.1.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 10.2 Out-of-band rejection

Test Requirement: Not specified  
 Test Method: KDB 935210 D05 clause 3.2  
 Limit: No limit

### 10.2.1 E.U.T. Operation

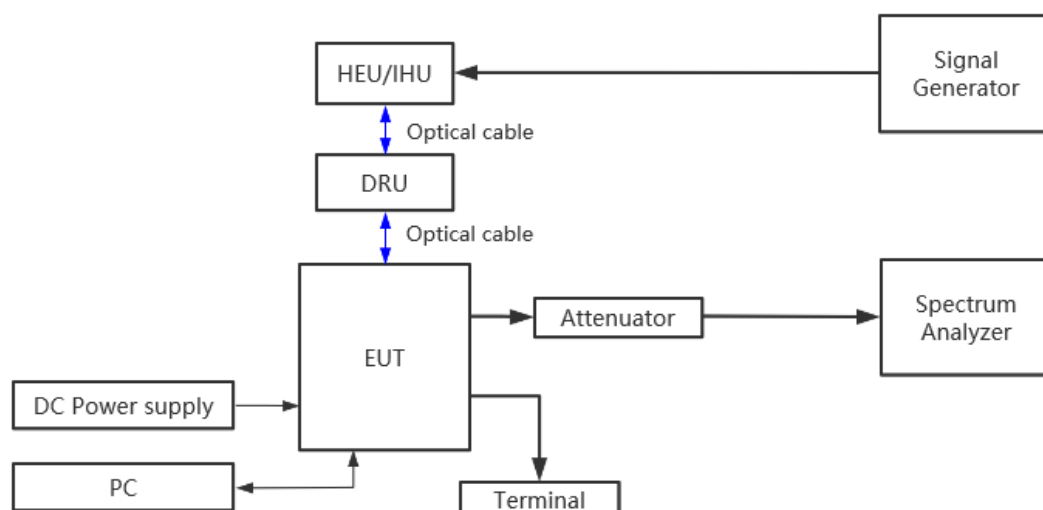
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

### 10.2.2 Test Setup



### 10.2.3 Test Procedure

Test procedure from clause 3.2

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).
  - 2) Level = a sufficient level to affirm that the out-of-band rejection is  $> 20$  dB above the noise floor and will not engage the AGC during the entire sweep.
  - 3) Dwell time = approximately 10 ms.
  - 4) Number of points =  $\text{SPAN}/(\text{RBW}/2)$ .
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.
- e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to  $\geq 3 \times \text{RBW}$ .
- f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.
- g) Place a marker to the peak of the frequency response and record this frequency as  $f_0$ .
- h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the  $-20$  dB down amplitude, to determine the 20 dB bandwidth.
- i) Capture the frequency response of the EUT.
- j) Repeat for all frequency bands applicable for use by the EUT.

Test procedure from clause 4.2

- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
  - 1) Frequency range =  $\pm 250\%$  of the manufacturer's specified pass band.
  - 2) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
  - 3) Dwell time = approximately 10 ms.
  - 4) Frequency step = 50 kHz.
- c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.



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- d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer' s rated passband, and  $VBW = 3 \times RBW$ .
- e) Set the detector to Peak and the trace to Max-Hold.
- f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as  $f_0$ , and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).
- g) Capture the frequency response plot for inclusion in the test report.

#### 10.2.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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### 10.3 Input-versus-output signal comparison

Test Requirement: 47 CFR Part 2.1049

Test Method: KDB 935210 D05 clause 3.4

Limit: Compare the input signal to the output signal to affirm that they are similar

#### 10.3.1 E.U.T. Operation

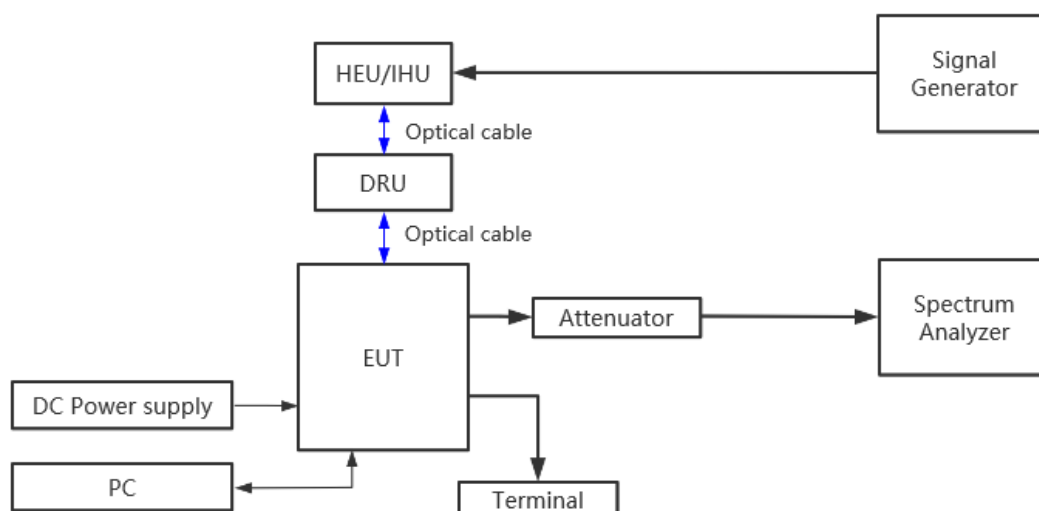
Operating Environment:

Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar

Test Mode: Set the EUT to maximum output power and maximum gain.

EUT Configuration: Refer to clause 4.4 in this report.

#### 10.3.2 Test Setup



### 10.3.3 Test procedure

- a) Connect a signal generator to the input of the EUT.
- b) Configure the signal generator to transmit the AWGN signal.
- c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
- d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between  $2 \times$  to  $5 \times$  the emission bandwidth (EBW) or alternatively, the OBW.
- f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be  $\geq 3 \times$  RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than  $[10 \log (OBW / RBW)]$  below the reference level.  
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
- l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the -26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the -26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the -26 dB down amplitude point.



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- m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
- p) Repeat steps e) to o) with the signal generator set to the narrowband signal.
- q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

#### 10.3.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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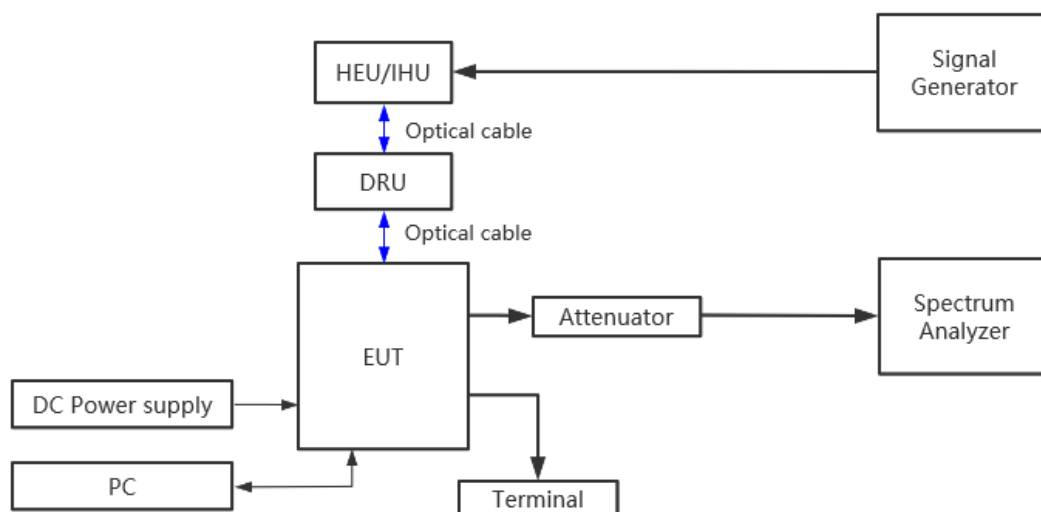
## 10.4 Mean output power and amplifier/booster gain

Test Requirement: 47 CFR Part 27.50(h)  
 Test Method: KDB 935210 D05 clause 3.5  
 Limit: Main, booster and base stations. (i) The maximum EIRP of a main, booster or base station shall not exceed  $33 \text{ dBW} + 10\log(X/Y) \text{ dBW}$ , where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

### 10.4.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 10.4.2 Test Setup



### 10.4.3 Test procedure

Test procedure of output power:

- a) Connect a signal generator to the input of the EUT.
- b) Configure to generate the AWGN (broadband) test signal.
- c) The frequency of the signal generator shall be set to the frequency  $f_0$  as determined from 3.3.
- d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
- g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
- h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
- i) Repeat steps e) to h) with the narrowband test signal.
- j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.
- 1) Adjust the frequency of the input signals, either below or above the pass band, so that the lowest order intermodulation product is positioned in the centre of the pass band, according to clause 4.2.5.2.
- 2) Take the measurement of the rise of the output signal.
- 3) Repeat the measurement for the opposite path of the Repeater.

Calculating the mean gain:

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:

Gain (dB) = output power (dBm) – input power (dBm).

### 10.4.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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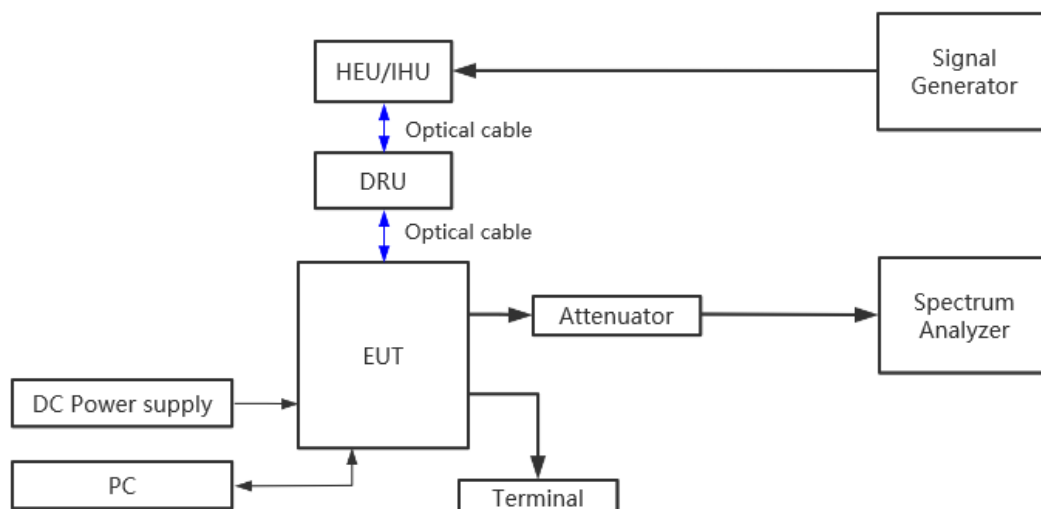
## 10.5 Out-of-band/out-of-block (including intermodulation) emissions and spurious

Test Requirement: 47 CFR Part 27.53(m)  
 Test Method: KDB 935210 D05 clause 3.6  
 Limit: For digital base stations, the attenuation shall be not less than  $43 + 10 \log(P)$  dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area (reduce 3.01dB when on 2×2 MIMO mode)

### 10.5.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 10.5.2 Test Setup



### 10.5.3 Test procedure

Test procedure of Out-of-band/out-of-block emissions:

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW). Set the signal generator amplitudes so that the power from each into the EUT is equivalent.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.



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- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

#### Test procedure of Spurious emissions

- a) Connect a signal generator to the input of the EUT.
- b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
- c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
- d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
- g) Set the VBW  $\geq 3 \times$  RBW.
- h) Set the Sweep time = auto-couple.
- i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.4

- j) Select the power averaging (rms) detector function.
- k) Trace average at least 10 traces in power averaging (rms) mode.
- l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.



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- m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to  $10 \times$  the highest frequency of the fundamental emission (see Section 2.1057). The number of measurement points in each sweep must be  $\geq (2 \times \text{span}/\text{RBW})$ , which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
- n) Trace average at least 10 traces in power averaging (rms) mode.
- o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.
- p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
- q) Repeat steps c) to p) with the narrowband test signal.
- r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

#### 10.5.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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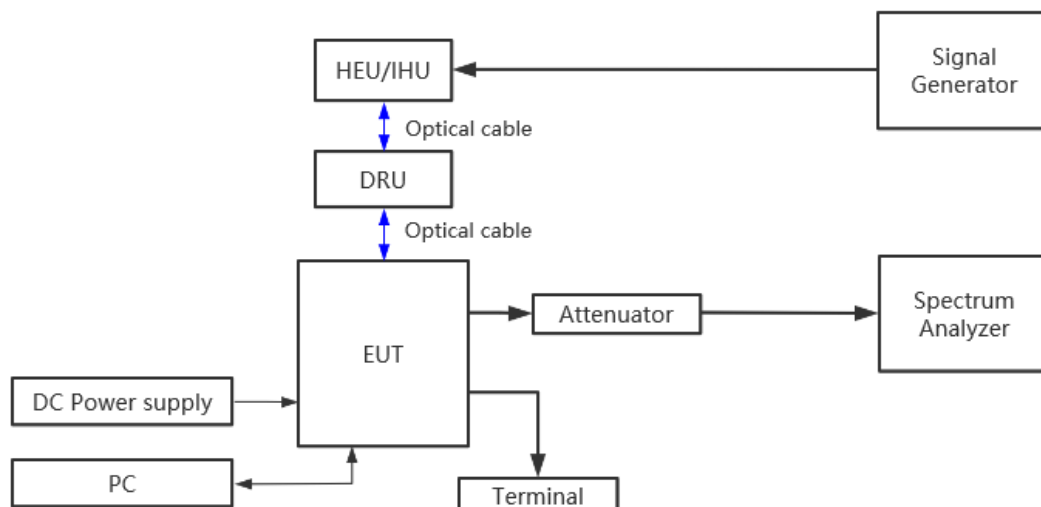
## 10.6 Frequency stability

Test Requirement: 47 CFR Part 27.54  
 Test Method: 47 CFR Part 2.1055  
 KDB 935210 D05 clause 3.7  
 ANSI C63.26-2015 clause 5.6  
 Limit: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 10.6.1 E.U.T. Operation

Operating Environment:  
 Temperature: 24.6 °C Humidity: 59 % RH Atmospheric Pressure: 1020 mbar  
 Test Mode: Set the EUT to maximum output power and maximum gain.  
 EUT Configuration: Refer to clause 4.4 in this report.

### 10.6.2 Test Setup



### 10.6.3 Test procedure

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

- At 10 °C intervals of temperatures between –30 °C and +50 °C at the manufacturer's rated supply voltage, and
- At +20 °C temperature and  $\pm 15\%$  supply voltage variations. If a product is specified to operate over a range of input voltage then the –15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

When performing frequency stability measurements on booster, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing this isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter to confirm that any frequency instability is associated with the EUT, but is not due to differences between the reference oscillators internal to the measurement instrumentation.

### 10.6.4 Measurement Record

Please refer to Appendix B – Test data and result details of GZEM2011016737CR for detail



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## 10.7 Radiated spurious emission

Test Requirement: 47 CFR Part 2.1053, 27.53(m)

Test Method: KDB 935210 D05 clause 3.7

ANSI C63.26-2015 clause 5.6

Limit: For digital base stations, the attenuation shall be not less than  $43 + 10 \log(P)$  dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area

### 10.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 59 % RH Atmospheric Pressure: 1010 mbar

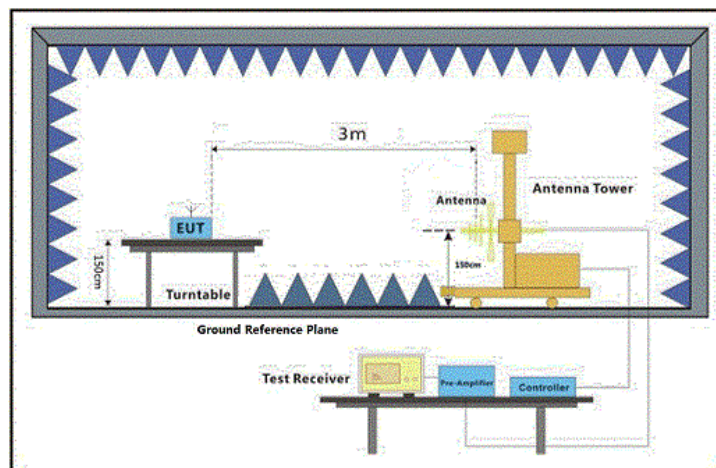
Test Mode: Set the EUT to maximum output power and maximum gain (activate MIMO mode simultaneously).



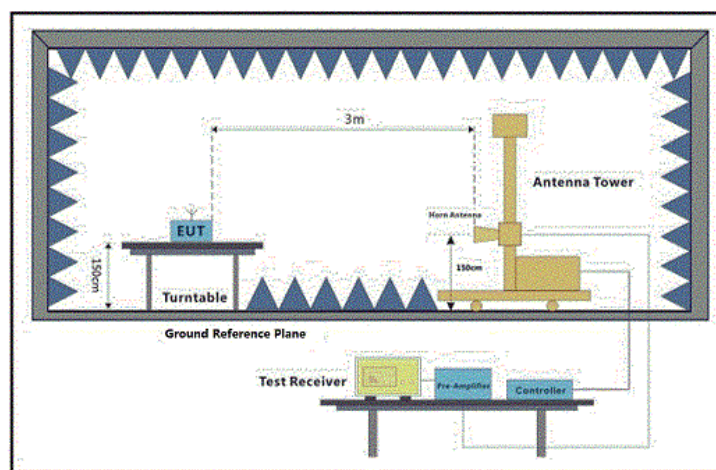
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## 10.7.2 Test Setup



30MHz-1GHz



Above 1GHz



### 10.7.3 Test procedure

1. Scan from 30MHz to 12.75GHz, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.  
Below 1GHz test procedure as below:
  - 1) The EUT was powered on and placed on a table in the chamber. The antenna of the transmitter was extended to its maximum length. modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
  - 2) Rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
  - 3) Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
  - 4) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
  - 5) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
  - 6) The output power into the substitution antenna was then measured.
  - 7) Steps 5) and 6 )were repeated with both antennas vertically polarized.
  - 8) Calculate power in dBm by the following formula:  
Level (dBm) = Read Level (dBm) + Correction Factor (dB)

### 10.7.4 Measurement Record

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--Report End--



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