

# **FCC REPORT**

## **(WCDMA)**

**Applicant:** Neutron Holdings, Inc.

**Address of Applicant:** 85 2nd St, San Francisco, CA 94105 USA

**Equipment Under Test (EUT)**

Product Name: Central controller

Model No.: Lime-4.0-US

Trade mark: Lime

**FCC ID:** 2APB2-LIME40US

**Applicable standards:** FCC CFR Title 47 Part 2  
FCC CFR Title 47 Part 22 Subpart H  
FCC CFR Title 47 Part 24 Subpart E

**Date of sample receipt:** 21 Feb., 2021

**Date of Test:** 21 Feb., to 30 Mar., 2021

**Date of report issued:** 30 Mar., 2021

**Test Result:** PASS\*

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

Authorized Signature:



Bruce Zhang  
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the JYT product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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## 2. Version

| Version No. | Date          | Description |
|-------------|---------------|-------------|
| 00          | 30 Mar., 2021 | Original    |
|             |               |             |
|             |               |             |
|             |               |             |
|             |               |             |

Tested by:



Date:

30 Mar., 2021

Test Engineer

Reviewed by:



Date:

30 Mar., 2021

Project Engineer

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## 4. Test Summary

| Test Item                                                                                                                                                                                                                                                                                                   | Section in CFR 47                                    | Result                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------|
| RF Exposure (SAR)                                                                                                                                                                                                                                                                                           | Part 1.1307<br>Part 2.1093                           | Pass<br>(Please refer to SAR Report) |
| RF Output Power                                                                                                                                                                                                                                                                                             | Part 2.1046<br>Part 22.913 (a)(5)<br>Part 24.232 (c) | Pass                                 |
| Peak-to-Average Power Ratio                                                                                                                                                                                                                                                                                 | Part 24.232 (d)                                      | Pass                                 |
| Modulation Characteristics                                                                                                                                                                                                                                                                                  | Part 2.1047                                          | Pass                                 |
| 99% & -26 dB Occupied Bandwidth                                                                                                                                                                                                                                                                             | Part 2.1049<br>Part 22.917(b)<br>Part 24.238(b)      | Pass                                 |
| Out of band emission at antenna terminals                                                                                                                                                                                                                                                                   | Part 2.1053<br>Part 22.917 (a)<br>Part 24.238 (a)    | Pass                                 |
| Field strength of spurious radiation                                                                                                                                                                                                                                                                        | Part 22.917 (a)<br>Part 24.238 (a)                   | Pass                                 |
| Frequency stability vs. temperature                                                                                                                                                                                                                                                                         | Part 22.355<br>Part 24.235<br>Part 2.1055(a)(1)(b)   | Pass                                 |
| Frequency stability vs. voltage                                                                                                                                                                                                                                                                             | Part 22.355<br>Part 24.235<br>Part 2.1055(d)(2)      | Pass                                 |
| <b>Remark:</b><br>1. Pass: The EUT complies with the essential requirements in the standard.<br>2. The cable insertion loss used by "RF Output Power" and other conduction measurement items is 0.5dB(Fundamental Frequency below 1GHz)/1.0dB(Fundamental Frequency above 1GHz) (provided by the customer). |                                                      |                                      |
| <b>Test Method:</b>                                                                                                                                                                                                                                                                                         | ANSI/TIA-603-E-2016<br>ANSI C63.26-2015              |                                      |

## 5. General Information

### 5.1 Client Information

|                        |                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Applicant:             | Neutron Holdings, Inc.                                                                                                               |
| Address:               | 85 2nd St, San Francisco, CA 94105 USA                                                                                               |
| Manufacturer/ Factory: | MeiG Smart Technology Co., Ltd.                                                                                                      |
| Address:               | 1/2/3F A, Building A, B, No.5 Lingxia Road, 4th Fenghuang Industrial Park, Fuyong Street, Baoan District, Shenzhen, Guangdong, China |

### 5.2 General Description of E.U.T.

|                            |                                                                                                                                                        |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name:              | Central controller                                                                                                                                     |
| Model No.:                 | Lime-4.0-US                                                                                                                                            |
| Operation Frequency range: | WCDMA Band V: 826.4MHz-846.6MHz<br>WCDMA Band II: 1852.4 MHz-1907.6 MHz                                                                                |
| Modulation type:           | 3G <input checked="" type="checkbox"/> RMC(QPSK) <input checked="" type="checkbox"/> HSUPA(QPSK) <input checked="" type="checkbox"/> HSDPA(QPSK,16QAM) |
| Antenna type:              | Internal Antenna                                                                                                                                       |
| Antenna gain:              | WCDMA Band V: 2 dBi(declare by Applicant)<br>WCDMA Band II: 2 dBi(declare by Applicant)                                                                |
| Power supply:              | Rechargeable Li-ion Battery DC3.7V, 1250mAh                                                                                                            |
| External power supply:     | DC 36V                                                                                                                                                 |
| Test Sample Condition:     | The test samples were provided in good working order with no visible defects.                                                                          |

#### Operation Frequency List:

| WCDMA Band V |                 | WCDMA Band II |                 |
|--------------|-----------------|---------------|-----------------|
| Channel      | Frequency (MHz) | Channel       | Frequency (MHz) |
| 4132         | 826.40          | 9262          | 1852.40         |
| 4133         | 826.60          | 9263          | 1852.60         |
| ....         | ....            | ....          | ....            |
| 4182         | 836.40          | 9399          | 1879.80         |
| 4183         | 836.60          | 9400          | 1880.00         |
| 4184         | 836.80          | 9401          | 1880.20         |
| ...          | ...             | ...           | ...             |
| 4232         | 846.40          | 9537          | 1907.40         |
| 4233         | 846.60          | 9538          | 1907.60         |

Regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| WCDMA Band V |      |                | WCDMA Band II |      |                |
|--------------|------|----------------|---------------|------|----------------|
| Channel      |      | Frequency(MHz) | Channel       |      | Frequency(MHz) |
| Lowest       | 4132 | 826.40         | Lowest        | 9262 | 1852.40        |
| Middle       | 4183 | 836.60         | Middle        | 9400 | 1880.00        |
| Highest      | 4233 | 846.60         | Highest       | 9538 | 1907.60        |

### 5.3 Test environment and mode, and test samples plans

| Operating Environment:                                                                                                                                                                                                                                                                                                                                                           |                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Temperature:                                                                                                                                                                                                                                                                                                                                                                     | Normal: 15°C ~ 35°C, Extreme: -30°C ~ +50°C                     |
| Humidity:                                                                                                                                                                                                                                                                                                                                                                        | 20 % ~ 75 % RH                                                  |
| Atmospheric Pressure:                                                                                                                                                                                                                                                                                                                                                            | 1008 mbar                                                       |
| Voltage:                                                                                                                                                                                                                                                                                                                                                                         | Nominal: 3.7Vdc, Extreme: Low 3.5 Vdc, High 4.2 Vdc             |
| Test mode:                                                                                                                                                                                                                                                                                                                                                                       |                                                                 |
| RMC mode                                                                                                                                                                                                                                                                                                                                                                         | Keep the EUT communication with simulated station in RMC mode   |
| HSDPA                                                                                                                                                                                                                                                                                                                                                                            | Keep the EUT communication with simulated station in HSDPA mode |
| HSUPA                                                                                                                                                                                                                                                                                                                                                                            | Keep the EUT communication with simulated station in HSUPA mode |
| Remark: The EUT has been tested under continuous transmitting mode. Channel Low, Mid and High for each type band with rated data rate were chosen for full testing. The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for these modes. Just the worst case position (H mode) shown in report. |                                                                 |
| Test Samples Plans:                                                                                                                                                                                                                                                                                                                                                              |                                                                 |
| Samples Number                                                                                                                                                                                                                                                                                                                                                                   | Used for Test Items                                             |
| 1#                                                                                                                                                                                                                                                                                                                                                                               | Conducted measurements test method                              |
| 2#                                                                                                                                                                                                                                                                                                                                                                               | Radiated measurements test method                               |
| 3#                                                                                                                                                                                                                                                                                                                                                                               | EUT constructional details                                      |
| Remark: JianYan Testing Group Shenzhen Co., Ltd. is only responsible for the test project data of the above samples, and will keep the above samples for a month.                                                                                                                                                                                                                |                                                                 |

### 5.4 Description of Test Auxiliary Equipment

| Test Equipment    | Manufacturer | Model No. | Serial No. |
|-------------------|--------------|-----------|------------|
| Simulated Station | Anritsu      | MT8820C   | 6201026545 |

### 5.5 Measurement Uncertainty

| Parameters                          | Expanded Uncertainty |
|-------------------------------------|----------------------|
| Radiated Emission (9kHz ~ 30MHz)    | ±3.12 dB (k=2)       |
| Radiated Emission (30MHz ~ 1000MHz) | ±4.32 dB (k=2)       |
| Radiated Emission (1GHz ~ 18GHz)    | ±5.16 dB (k=2)       |
| Radiated Emission (18GHz ~ 40GHz)   | ±3.20 dB (k=2)       |

### 5.6 Additions to, deviations, or exclusions from the method

|    |
|----|
| No |
|----|

## 5.7 Laboratory Facility

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

● **FCC - Designation No.: CN1211**

JianYan Testing Group Shenzhen Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551.

● **ISED – CAB identifier.: CN0021**

The 3m Semi-anechoic chamber of JianYan Testing Group Shenzhen Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

● **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: <https://portal.a2la.org/scopepdf/4346-01.pdf>

## 5.8 Laboratory Location

JianYan Testing Group Shenzhen Co., Ltd.

Address: No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.

Tel: +86-755-23118282, Fax: +86-755-23116366

Email: [info@ccis-cb.com](mailto:info@ccis-cb.com), Website: <http://www.ccis-cb.com>

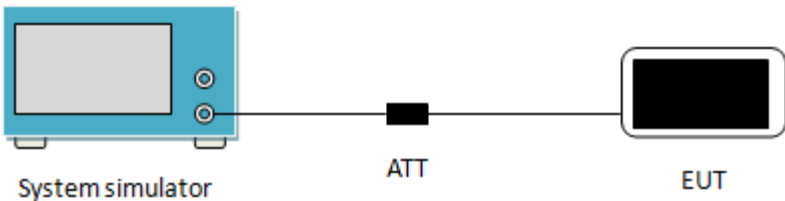
## 5.9 Test Instruments list

| Test Equipment    | Manufacturer    | Model No.     | Serial No.         | Cal. Date (mm-dd-yy) | Cal. Due date (mm-dd-yy) |
|-------------------|-----------------|---------------|--------------------|----------------------|--------------------------|
| 3m SAC            | ETS             | 9m*6m*6m      | 966                | 01-19-2021           | 01-18-2024               |
| BiConiLog Antenna | SCHWARZBECK     | VULB9163      | 497                | 03-03-2020           | 03-02-2021               |
| Biconical Antenna | SCHWARZBECK     | VUBA9117      | 359                | 03-03-2021           | 03-02-2022               |
| Horn Antenna      | SCHWARZBECK     | BBHA9120D     | 916                | 06-18-2020           | 06-17-2021               |
| Horn Antenna      | SCHWARZBECK     | BBHA9120D     | 1805               | 03-03-2020           | 03-02-2021               |
| Horn Antenna      | SCHWARZBECK     | BBHA 9170     | BBHA9170582        | 03-03-2021           | 03-02-2022               |
| EMI Test Software | AUDIX           | E3            | Version: 6.110919b |                      |                          |
| Pre-amplifier     | HP              | 8447D         | 2944A09358         | 06-18-2020           | 06-17-2021               |
| Pre-amplifier     | CD              | PAP-1G18      | 11804              | 03-03-2020           | 03-02-2021               |
| Spectrum analyzer | Rohde & Schwarz | FSP30         | 101454             | 03-03-2021           | 03-02-2022               |
| Spectrum analyzer | Rohde & Schwarz | FSP40         | 100363             | 03-03-2020           | 03-02-2021               |
| EMI Test Receiver | Rohde & Schwarz | ESRP7         | 101070             | 03-03-2021           | 03-02-2022               |
| Spectrum Analyzer | Agilent         | N9020A        | MY50510123         | 11-18-2020           | 11-17-2021               |
| Signal Generator  | Rohde & Schwarz | SMX           | 835454/016         | 03-03-2020           | 03-02-2021               |
| Signal Generator  | R&S             | SMR20         | 1008100050         | 03-03-2021           | 03-02-2022               |
| RF Switch Unit    | MWRFTTEST       | MW200         | N/A                | 03-03-2020           | 03-02-2021               |
| Test Software     | MWRFTTEST       | MTS8200       | Version: 2.0.0.0   |                      |                          |
| Cable             | ZDECL           | Z108-NJ-NJ-81 | 1608458            | 03-03-2020           | 03-02-2021               |
| Cable             | MICRO-COAX      | MFR64639      | K10742-5           | 03-03-2021           | 03-02-2022               |
| Cable             | SUHNER          | SUCOFLEX100   | 58193/4PE          | 03-03-2020           | 03-02-2021               |
|                   |                 |               |                    | 03-03-2021           | 03-02-2022               |

|                              |                 |            |               |            |            |
|------------------------------|-----------------|------------|---------------|------------|------------|
| DC Power Supply              | XinNuoEr        | WYK-10020K | 1409050110020 | 09-25-2020 | 09-24-2021 |
| Temperature Humidity Chamber | HengPu          | HPGDS-500  | 20140828008   | 11-01-2020 | 10-31-2021 |
| Simulated Station            | Rohde & Schwarz | CMW500     | 140493        | 07-22-2020 | 07-21-2021 |

## 6. Test results

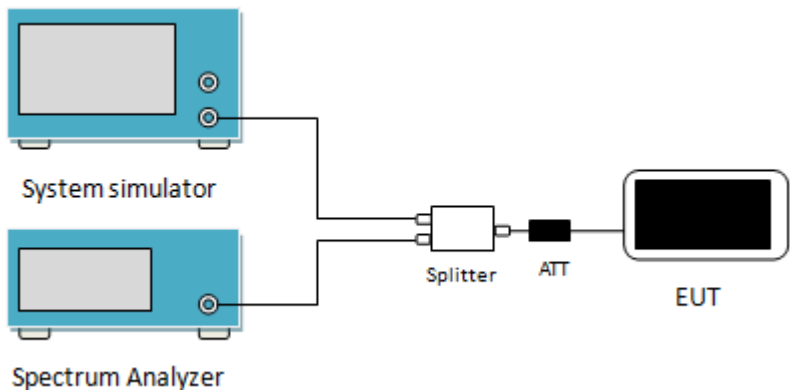
### 6.1 Conducted Output Power, ERP and EIRP

|                   |                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC part 22.913(a)(5), FCC part 24.232(c)                                                                                                                                                                                                                                                                                                                                              |
| Limit:            | WCDMA Band V: 7W, WCDMA Band II: 2W                                                                                                                                                                                                                                                                                                                                                    |
| Test setup:       |  <p>The diagram illustrates the test setup. On the left is a blue 'System simulator' box with two ports. A line connects one of its ports to a black 'ATT' (attenuator) block. Another line connects the other side of the 'ATT' block to a black 'EUT' (Equipment Under Test) box on the right.</p> |
| Test Procedure:   | The transmitter output was connected to a calibrated attenuator, the other end of which was connected to the simulated station. Transmitter output power was read off in dBm.                                                                                                                                                                                                          |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                       |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                       |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                 |

**Measurement Data:**

| EUT Mode                                                           |           | Burst Average power (dBm) |               |               |
|--------------------------------------------------------------------|-----------|---------------------------|---------------|---------------|
|                                                                    |           | 4132                      | 4183          | 4233          |
|                                                                    |           | 826.40 (MHz)              | 836.60 (MHz)  | 846.60 (MHz)  |
| UMTS 850<br>HSDPA                                                  | Subtest 1 | 22.26                     | 22.16         | 22.43         |
|                                                                    | Subtest 2 | 22.39                     | 22.45         | 22.19         |
|                                                                    | Subtest 3 | 21.56                     | 21.53         | 21.41         |
|                                                                    | Subtest 4 | 20.56                     | 20.36         | 20.42         |
| UMTS 850<br>HSUPA                                                  | Subtest 1 | 22.26                     | 22.43         | 22.19         |
|                                                                    | Subtest 2 | 21.63                     | 21.46         | 21.87         |
|                                                                    | Subtest 3 | 21.50                     | 21.26         | 21.33         |
|                                                                    | Subtest 4 | 19.98                     | 19.74         | 19.75         |
|                                                                    | Subtest 5 | 19.56                     | 19.52         | 19.36         |
| UMTS 850 RMC                                                       | 12.2kbps  | 22.74                     | 22.65         | 22.61         |
| Antenna Gain (dBi)                                                 |           | 2.0                       |               |               |
| Max. ERP (dBm)                                                     |           | 22.59                     |               |               |
| ERP Limit (dBm)                                                    |           | 38.45                     |               |               |
|                                                                    |           |                           |               |               |
| EUT Mode                                                           |           | Burst Average power (dBm) |               |               |
|                                                                    |           | 9262                      | 9400          | 9538          |
|                                                                    |           | 1852.40 (MHz)             | 1880.00 (MHz) | 1907.60 (MHz) |
| UMTS 1900<br>HSDPA                                                 | Subtest 1 | 21.29                     | 21.67         | 21.55         |
|                                                                    | Subtest 2 | 21.57                     | 21.34         | 21.33         |
|                                                                    | Subtest 3 | 20.19                     | 20.21         | 20.15         |
|                                                                    | Subtest 4 | 19.66                     | 19.84         | 19.98         |
| UMTS 1900<br>HSUPA                                                 | Subtest 1 | 21.48                     | 21.46         | 21.34         |
|                                                                    | Subtest 2 | 21.69                     | 21.26         | 21.22         |
|                                                                    | Subtest 3 | 20.74                     | 20.64         | 20.69         |
|                                                                    | Subtest 4 | 20.39                     | 20.43         | 20.54         |
|                                                                    | Subtest 5 | 19.99                     | 19.84         | 19.87         |
| UMTS 1900 RMC                                                      | 12.2kbps  | 22.74                     | 22.87         | 22.69         |
| Antenna Gain (dBi)                                                 |           | 2.0                       |               |               |
| Max. EIRP (dBm)                                                    |           | 24.87                     |               |               |
| EIRP Limit (dBm)                                                   |           | 33.00                     |               |               |
| Note: EIRP (dBm) = Burst Average power (dBm) + Antenna Gain (dBi). |           |                           |               |               |
| ERP (dBm) = EIRP (dBm) - 2.15 (dB).                                |           |                           |               |               |

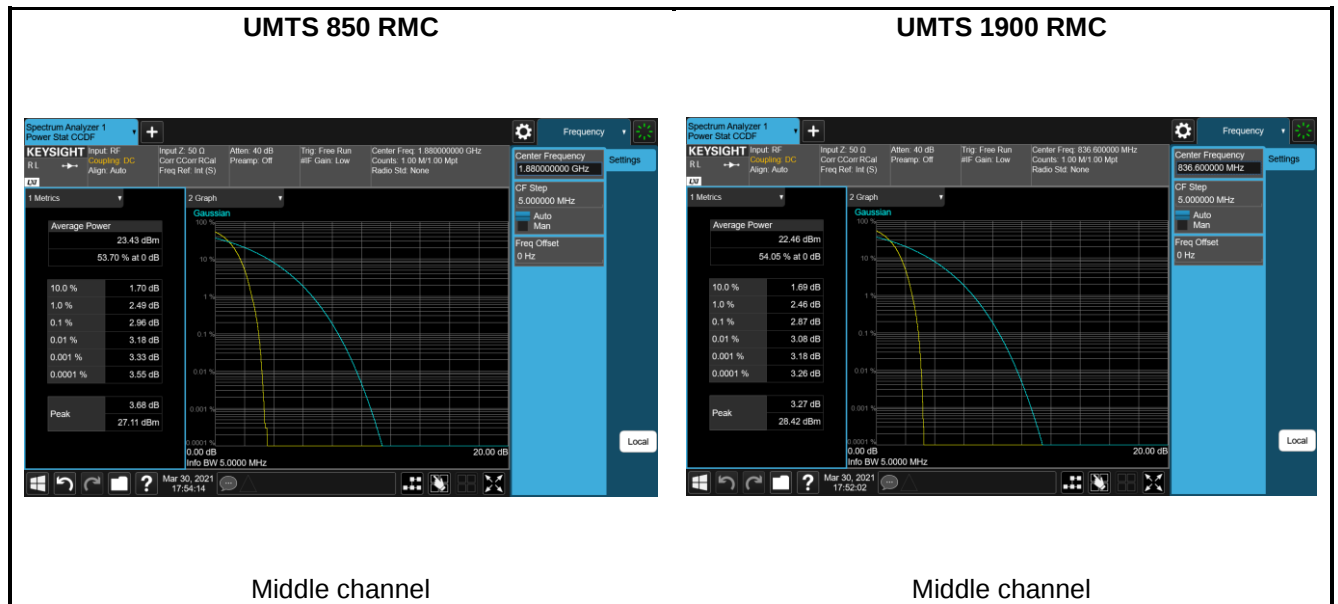
## 6.2 Peak-to-Average Power Ratio

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC part 24.232(d)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Limit:            | The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Test setup:       |  <p>The diagram illustrates the test setup. On the left, there are two blue rectangular devices: the top one is labeled 'System simulator' and the bottom one is labeled 'Spectrum Analyzer'. Both have a single output port. These two ports are connected to a single input port of a white rectangular 'Splitter'. The other output port of the 'Splitter' is connected to a black rectangular 'ATT' (Attenuator). Finally, the output of the 'ATT' is connected to the input of a black rectangular 'EUT' (Equipment Under Test).</p> |
| Test Procedure:   | <ol style="list-style-type: none"> <li>1 The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.</li> <li>2 Set the CCDF option in spectrum analyzer, RBW <math>\geq</math> OBW,</li> <li>3 Set the EUT working in highest power level, measured and recorded the 0.1% as PAPR level.</li> <li>4 Repeat step 1~3 at other frequency and modulations.</li> </ol>                                                                                                                                                                                                              |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

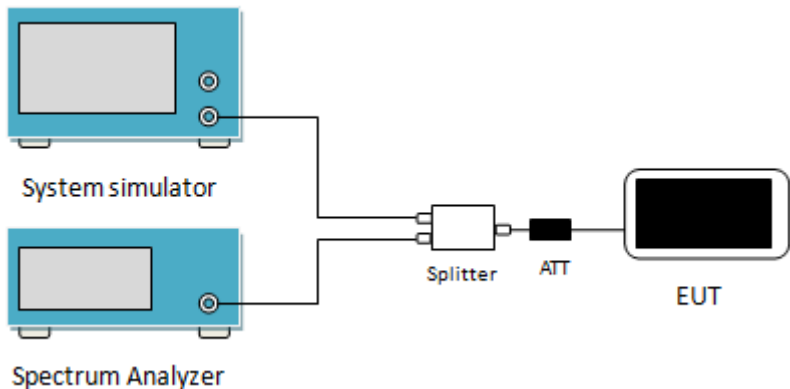
### Measurement Data:

| Modulation    | Test channel | PAPR |
|---------------|--------------|------|
| UMTS 850 RMC  | 4183         | 2.96 |
| UMTS 1900 RMC | 9400         | 2.87 |

Test plots as below:



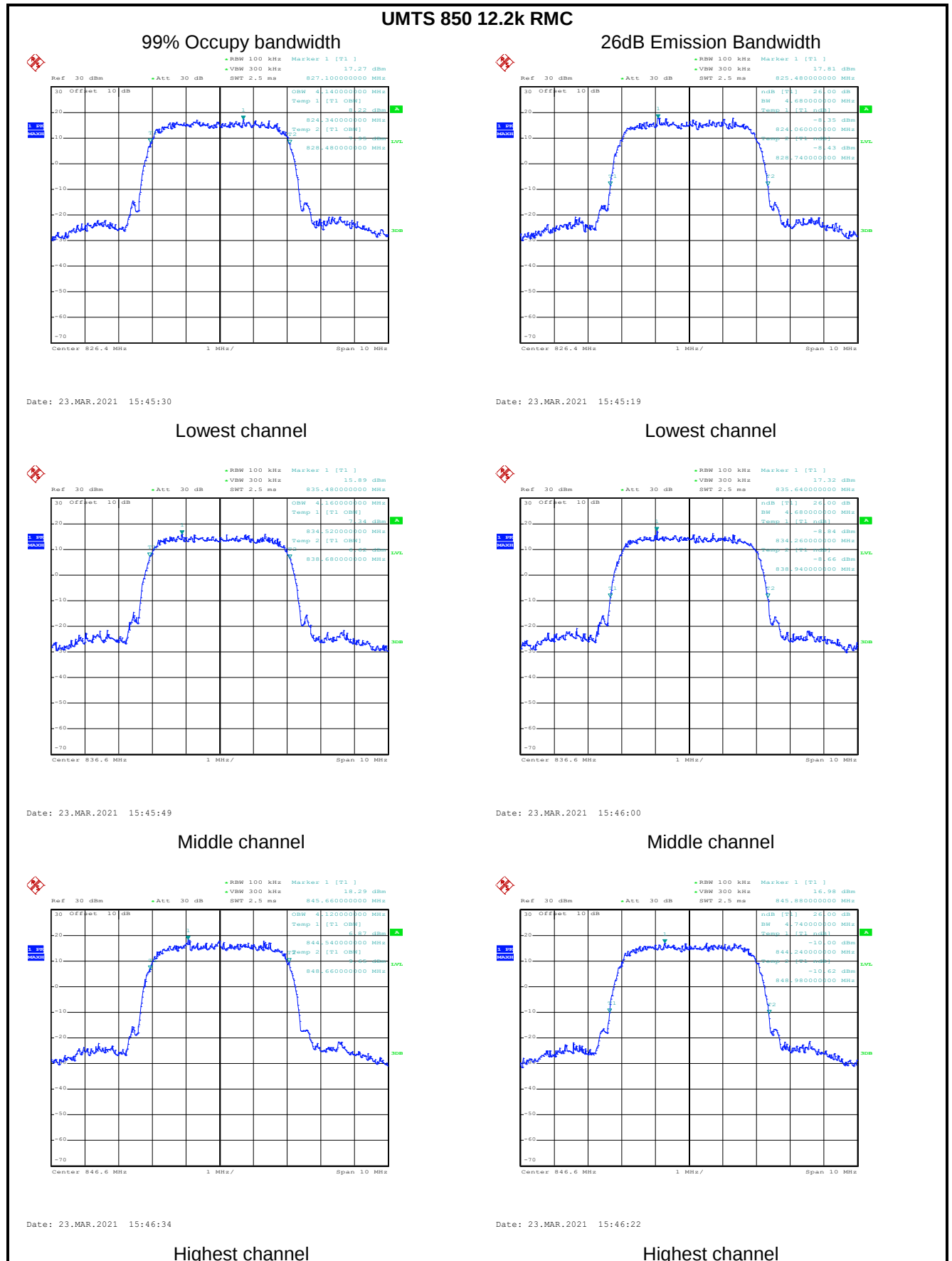
## 6.3 Occupy Bandwidth

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC part 22.917(b), FCC part 24.238(b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Test setup:       |  <p>The diagram illustrates the test setup. On the left, there are two blue rectangular units: the top one is labeled 'System simulator' and the bottom one is labeled 'Spectrum Analyzer'. Both have a single output port. These two ports are connected to a central 'Splitter' unit. From the 'Splitter', one line goes to an 'ATT' (Attenuator) unit, and another line goes to the 'EUT' (Equipment Under Test), which is represented by a black rectangle with rounded corners.</p> |
| Test Procedure:   | <ol style="list-style-type: none"> <li>1. The EUT's output RF connector was connected with a short cable to the spectrum analyzer</li> <li>2. RBW was set to about 1% of emission BW, VBW= 3 times RBW.</li> <li>3. -26dBc display line was placed on the screen (or 99% bandwidth), the occupied bandwidth is the delta frequency between the two points where the display line intersects the signal trace.</li> </ol>                                                                                                                                                   |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Measurement Data:**

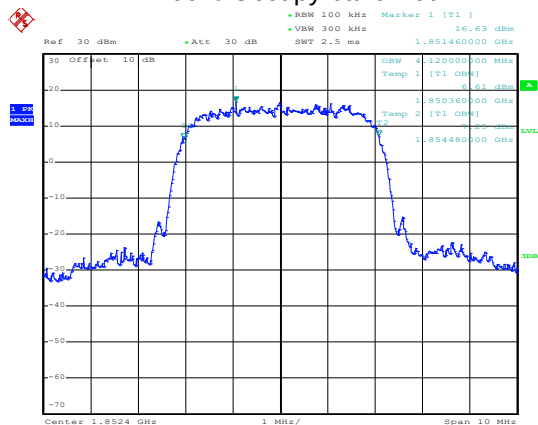
| EUT Mode               | Channel | Frequency (MHz) | 99% Occupy bandwidth (kHz) | -26dB bandwidth (kHz) |
|------------------------|---------|-----------------|----------------------------|-----------------------|
| UMTS 850<br>12.2k RMC  | 4132    | 826.4           | 4140                       | 4680                  |
|                        | 4183    | 836.6           | 4160                       | 4680                  |
|                        | 4233    | 846.6           | 4120                       | 4740                  |
| UMTS 1900<br>12.2k RMC | 9262    | 1852.4          | 4120                       | 4700                  |
|                        | 9400    | 1880.0          | 4140                       | 4700                  |
|                        | 9538    | 1907.6          | 4140                       | 4720                  |

Test plot as follows:



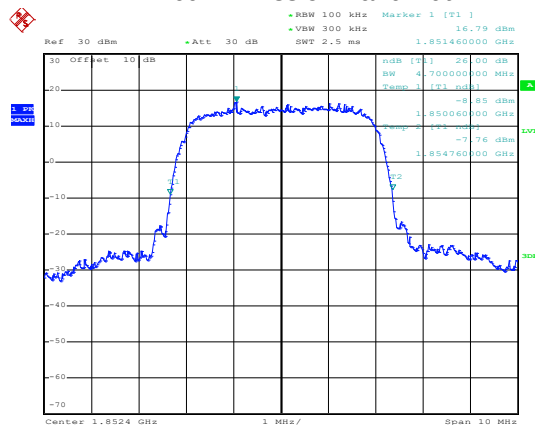
## UMTS 1900 12.2k RMC

## 99% Occupy bandwidth



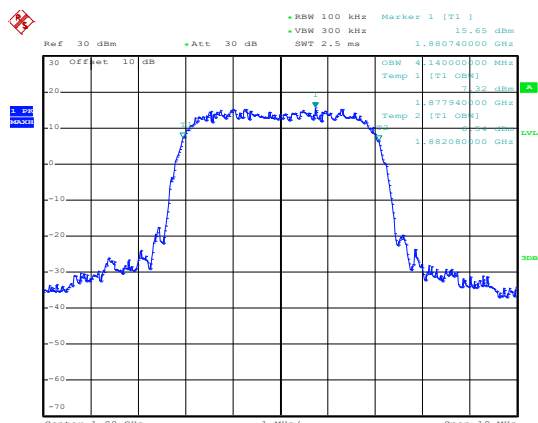
Date: 23.MAR.2021 15:42:14

## 26dB Emission Bandwidth



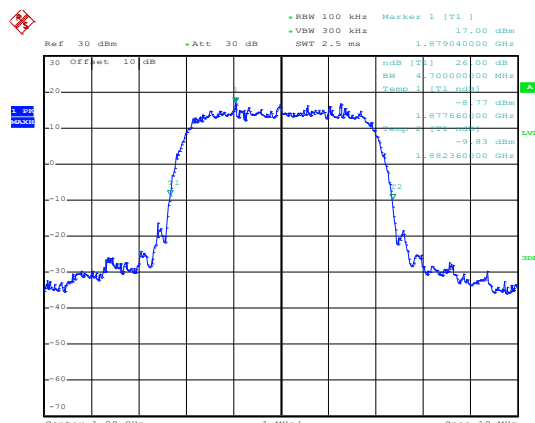
Date: 23.MAR.2021 15:42:00

## Lowest channel



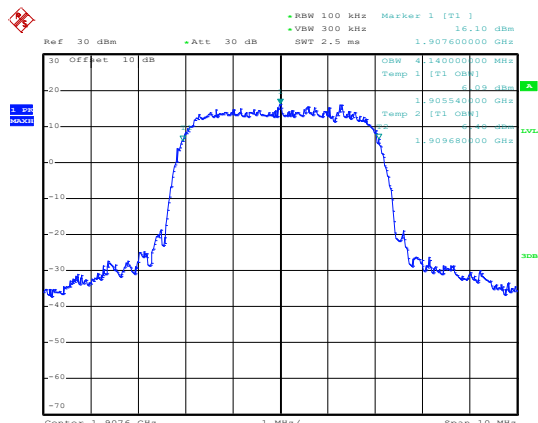
Date: 23.MAR.2021 15:42:31

## Lowest channel



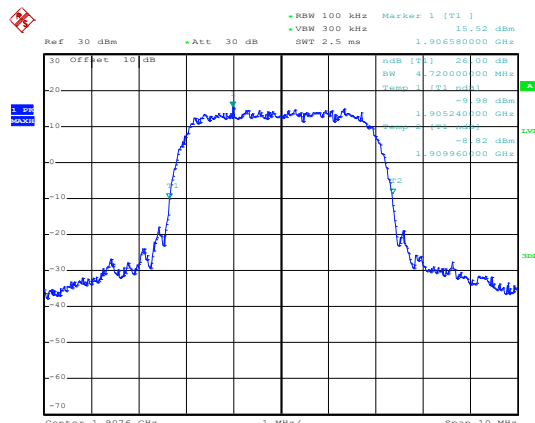
Date: 23.MAR.2021 15:42:43

## Middle channel



Date: 23.MAR.2021 15:44:41

## Middle channel



Date: 23.MAR.2021 15:44:29

## Highest channel



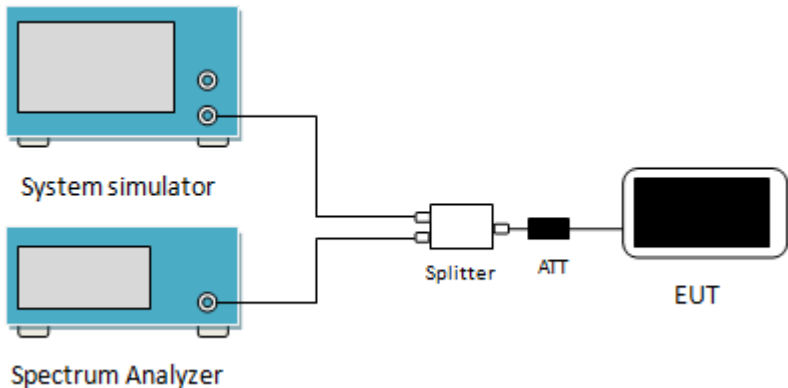
## Highest channel



## 6.4 Modulation Characteristic

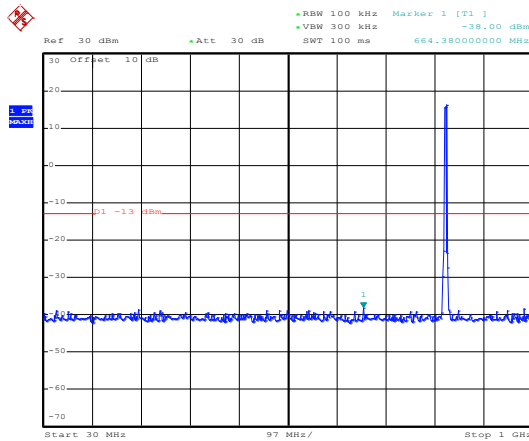
According to FCC § 2.1047(d), Part 22H & 24E there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

## 6.5 Out of band emission at antenna terminals

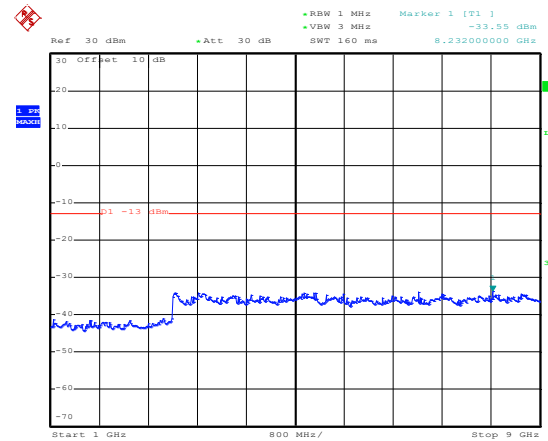
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC part 22.917(a), FCC part 24.238(a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Limit:            | -13dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Test setup:       |  <p>The diagram shows a test setup for measuring out-of-band emissions. A System simulator and a Spectrum Analyzer are connected to a Splitter. The Splitter is connected to an ATT (Attenuator) and then to the EUT (Equipment Under Test).</p>                                                                                                                                                                                                                                                                                                                                                                    |
| Test Procedure:   | <ol style="list-style-type: none"> <li>1 The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.</li> <li>2 For the out of band: For GSM850&amp;WCDMA850 set the RBW=100 kHz, VBW=300 kHz and for PCS1900 &amp; WCDMA1900 set the RBW=1MHz, VBW=3MHz when below 1 GHz, RBW =1 MHz, VBW=3 MHz when above 1 GHz, Start=30MHz, Stop= 10th harmonic.</li> <li>3 Band Edge Requirements: In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to measure the out of band Emissions.</li> </ol> |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Test plots as follows (Spurious emission):

## UMTS 850 12.2k RMC Lowest Channel

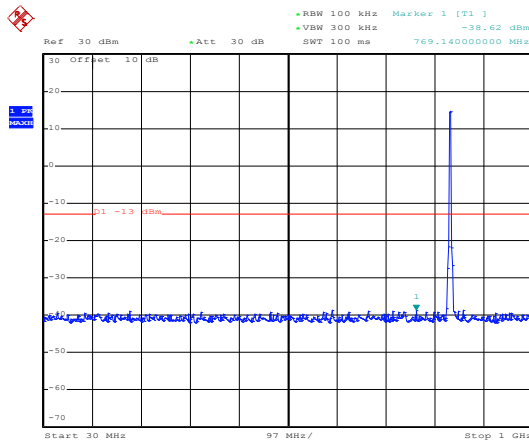


Date: 23.MAR.2021 16:03:12

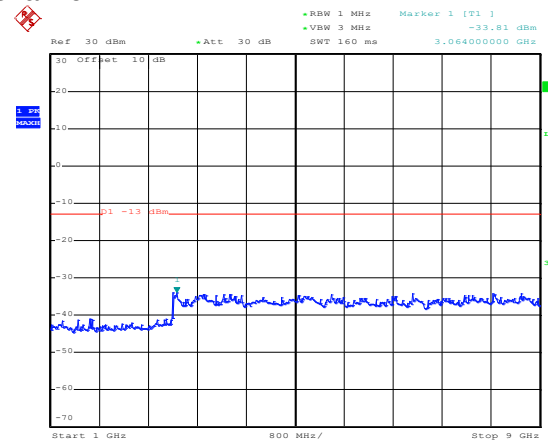


Date: 23.MAR.2021 15:58:42

## Middle Channel

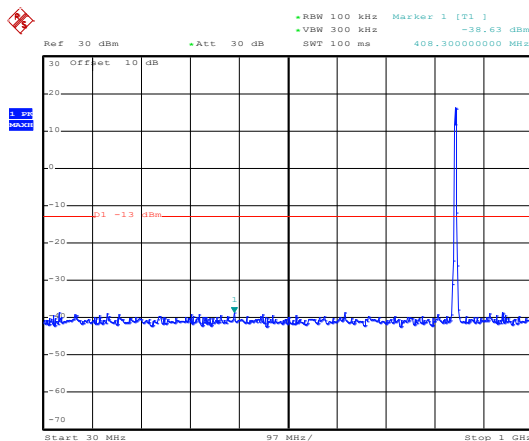


Date: 23.MAR.2021 16:03:44

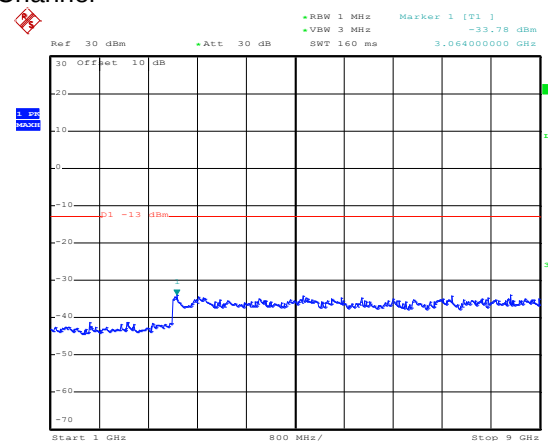


Date: 23.MAR.2021 15:58:56

## Highest Channel

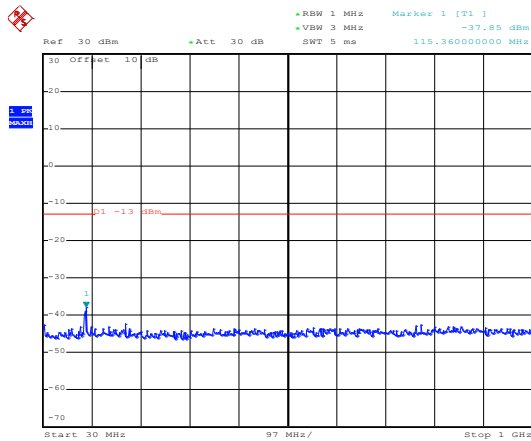


Date: 23.MAR.2021 16:04:12

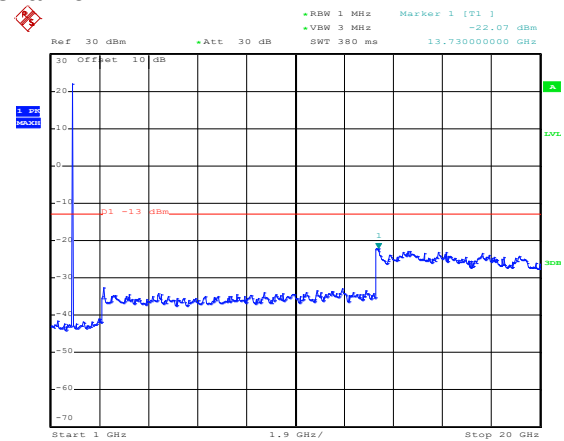


Date: 23.MAR.2021 15:59:12

### UMTS 1900 12.2k RMC Lowest Channel

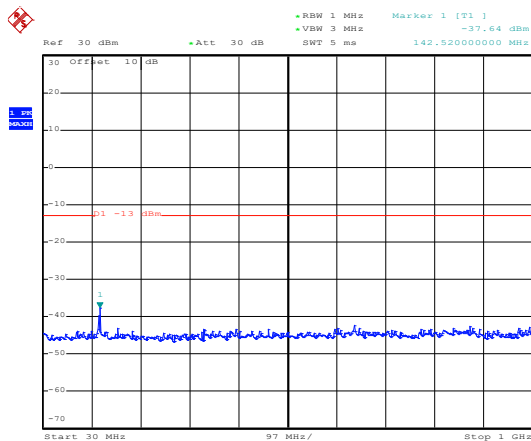


Date: 23.MAR.2021 16:01:32

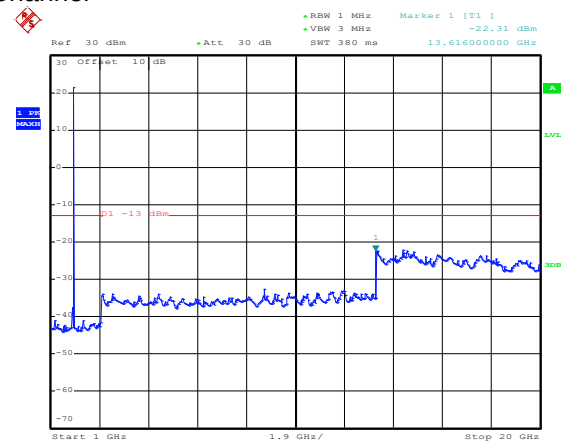


Date: 23.MAR.2021 15:50:55

### Middle Channel

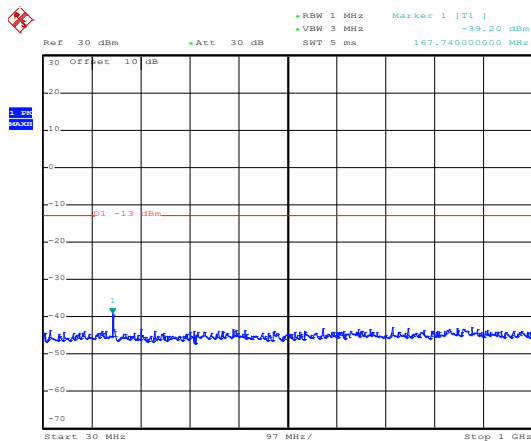


Date: 23.MAR.2021 16:01:46

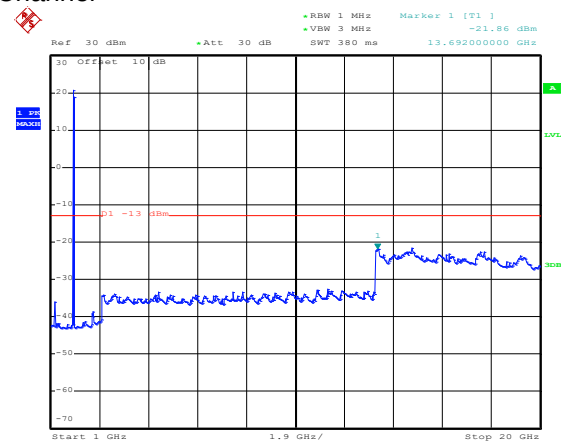


Date: 23.MAR.2021 15:57:52

### Highest Channel



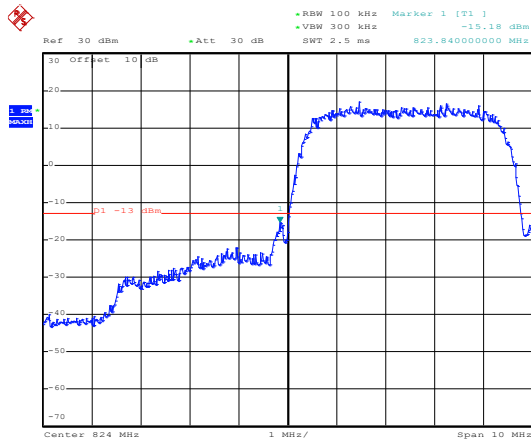
Date: 23.MAR.2021 16:02:02



Date: 23.MAR.2021 15:50:32

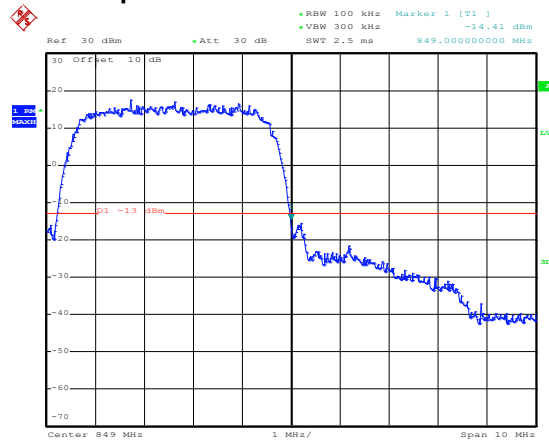
## Band edge emission:

### UMTS 850 RMC 12.2kbps



Date: 23.MAR.2021 15:47:56

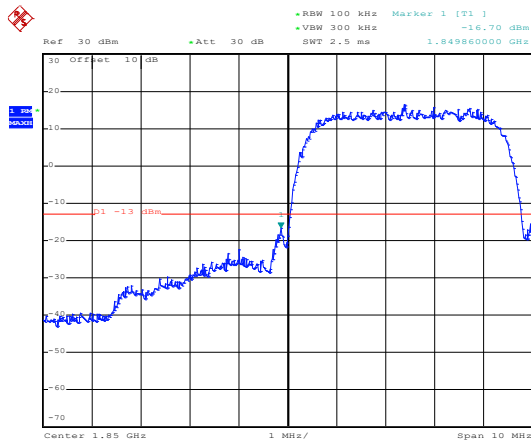
Lowest channel



Date: 23.MAR.2021 15:47:16

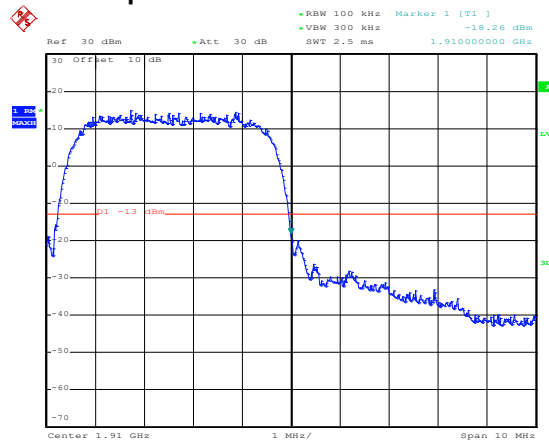
Highest channel

### UMTS 1900 RMC 12.2kbps



Date: 23.MAR.2021 15:49:12

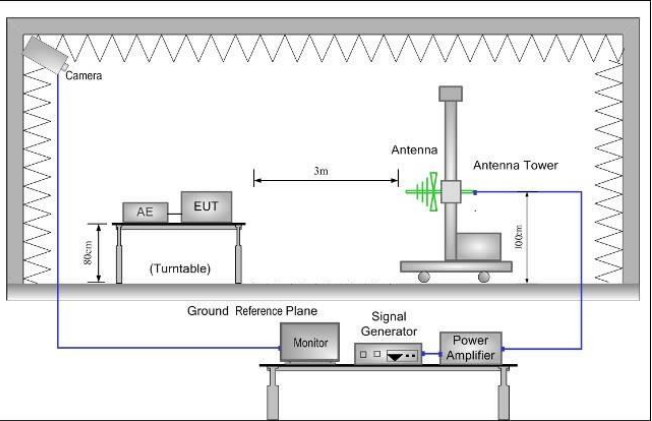
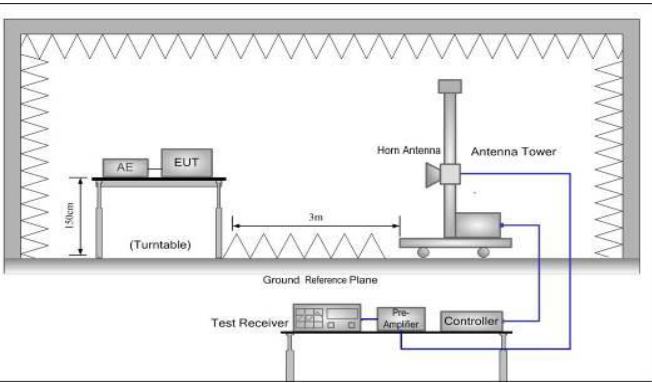
Lowest channel



Date: 23.MAR.2021 15:48:42

Highest channel

## 6.6 Field strength of spurious radiation measurement

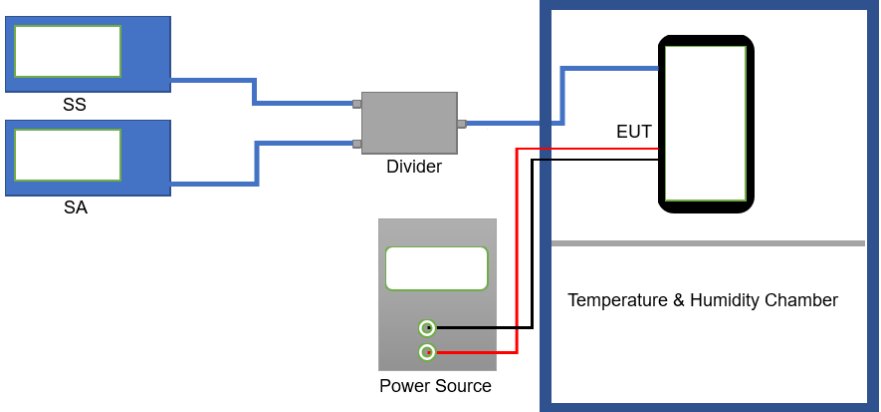
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC part 22.917(a), FCC part 24.238(a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Limit:            | -13dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Test setup:       | <p>Below 1GHz</p>  <p>Above 1GHz</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Test Procedure:   | <ol style="list-style-type: none"> <li>1. The EUT was placed on the top of a rotating table 0.8m(below 1GHz)/1.5m(above 1GHz) above the ground at a 3 meter camber. The radiated emission at the fundamental frequency was measured at 3 m with a test antenna and EMI spectrum analyzer.</li> <li>2. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.</li> <li>3. The frequency range up to tenth harmonic was investigated for each of three fundamental frequency (low, middle and high channels). Once spurious emission was identified, the power of the emission was determined using the substitution method.</li> <li>4. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and the spurious emissions frequency.<br/> <math display="block">ERP / EIRP = S.G. \text{ output (dBm) } + \text{Antenna Gain(dB/dBi) } - \text{Cable Loss (dB)}</math> </li> </ol> |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Test mode:        | Refer to section 5.3 for details.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Measurement Data (worst case):**

| WCDMA BAND V 12.2k RMC                                                                           |                                  |                               |                  |                               |                  |                  |              |
|--------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------|------------------|-------------------------------|------------------|------------------|--------------|
| Lowest channel                                                                                   |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 1652.80                                                                                          | -59.03                           | 9.58                          | 0.20             | -49.65                        | -13.00           | -36.65           | Vertical     |
| 2479.20                                                                                          | -45.59                           | 10.87                         | 0.44             | -35.16                        | -13.00           | -22.16           | Vertical     |
| 3305.60                                                                                          | -43.52                           | 12.01                         | 0.65             | -32.16                        | -13.00           | -19.16           | Vertical     |
| 1652.80                                                                                          | -59.87                           | 9.58                          | 0.20             | -50.49                        | -13.00           | -37.49           | Horizontal   |
| 2479.20                                                                                          | -44.99                           | 10.87                         | 0.44             | -34.56                        | -13.00           | -21.56           | Horizontal   |
| 3305.60                                                                                          | -43.34                           | 12.01                         | 0.65             | -31.98                        | -13.00           | -18.98           | Horizontal   |
| Middle channel                                                                                   |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 1673.20                                                                                          | -58.10                           | 9.66                          | 0.21             | -48.65                        | -13.00           | -35.65           | Vertical     |
| 2509.80                                                                                          | -50.40                           | 10.91                         | 0.46             | -39.95                        | -13.00           | -26.95           | Vertical     |
| 3346.40                                                                                          | -46.94                           | 12.09                         | 0.66             | -35.51                        | -13.00           | -22.51           | Vertical     |
| 1673.20                                                                                          | -58.60                           | 9.66                          | 0.21             | -49.15                        | -13.00           | -36.15           | Horizontal   |
| 2509.80                                                                                          | -51.97                           | 10.91                         | 0.46             | -41.52                        | -13.00           | -28.52           | Horizontal   |
| 3346.40                                                                                          | -46.62                           | 12.09                         | 0.66             | -35.19                        | -13.00           | -22.19           | Horizontal   |
| Highest channel                                                                                  |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 1697.60                                                                                          | -57.45                           | 9.74                          | 0.24             | -47.95                        | -13.00           | -34.95           | Vertical     |
| 2546.40                                                                                          | -50.15                           | 12.09                         | 0.50             | -38.56                        | -13.00           | -25.56           | Vertical     |
| 3395.20                                                                                          | -47.62                           | 12.19                         | 0.68             | -36.11                        | -13.00           | -23.11           | Vertical     |
| 1697.60                                                                                          | -60.01                           | 9.74                          | 0.24             | -50.51                        | -13.00           | -37.51           | Horizontal   |
| 2546.40                                                                                          | -54.95                           | 12.09                         | 0.50             | -43.36                        | -13.00           | -30.36           | Horizontal   |
| 3395.20                                                                                          | -53.29                           | 12.19                         | 0.68             | -41.78                        | -13.00           | -28.78           | Horizontal   |
| Remark:                                                                                          |                                  |                               |                  |                               |                  |                  |              |
| 1. The emission levels of below 1 GHz are lower than the limit 20dB and not show in test report. |                                  |                               |                  |                               |                  |                  |              |

| WCDMA Band II 12.2k RMC                                                                          |                                  |                               |                  |                               |                  |                  |              |
|--------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------|------------------|-------------------------------|------------------|------------------|--------------|
| Lowest channel                                                                                   |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 3704.80                                                                                          | -47.54                           | 12.65                         | 0.76             | -35.65                        | -13.00           | -22.65           | Vertical     |
| 5557.20                                                                                          | -47.79                           | 12.77                         | 1.14             | -36.16                        | -13.00           | -23.16           | Vertical     |
| 3704.80                                                                                          | -50.54                           | 12.65                         | 0.76             | -38.65                        | -13.00           | -25.65           | Horizontal   |
| 5557.20                                                                                          | -46.80                           | 12.77                         | 1.14             | -35.17                        | -13.00           | -22.17           | Horizontal   |
| Middle channel                                                                                   |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 3760.00                                                                                          | -51.59                           | 12.71                         | 0.77             | -39.65                        | -13.00           | -26.65           | Vertical     |
| 5640.00                                                                                          | -45.83                           | 12.87                         | 1.15             | -34.11                        | -13.00           | -21.11           | Vertical     |
| 3760.00                                                                                          | -61.89                           | 12.71                         | 0.77             | -49.95                        | -13.00           | -36.95           | Horizontal   |
| 5640.00                                                                                          | -44.98                           | 12.87                         | 1.15             | -33.26                        | -13.00           | -20.26           | Horizontal   |
| Highest channel                                                                                  |                                  |                               |                  |                               |                  |                  |              |
| Frequency (MHz)                                                                                  | Level at antenna terminals (dBm) | Substitute antenna gain (dBi) | Cable Loss (dBi) | Spurious Emission level (dBm) | Limit Line (dBm) | Over Limit (dBm) | Polarization |
| 3815.20                                                                                          | -50.63                           | 12.78                         | 0.80             | -38.65                        | -13.00           | -25.65           | Vertical     |
| 5722.80                                                                                          | -43.00                           | 12.97                         | 1.19             | -31.22                        | -13.00           | -18.22           | Vertical     |
| 3815.20                                                                                          | -49.43                           | 12.78                         | 0.80             | -37.45                        | -13.00           | -24.45           | Horizontal   |
| 5722.80                                                                                          | -47.99                           | 12.97                         | 1.19             | -36.21                        | -13.00           | -23.21           | Horizontal   |
| Remark:                                                                                          |                                  |                               |                  |                               |                  |                  |              |
| 1. The emission levels of below 1 GHz are lower than the limit 20dB and not show in test report. |                                  |                               |                  |                               |                  |                  |              |

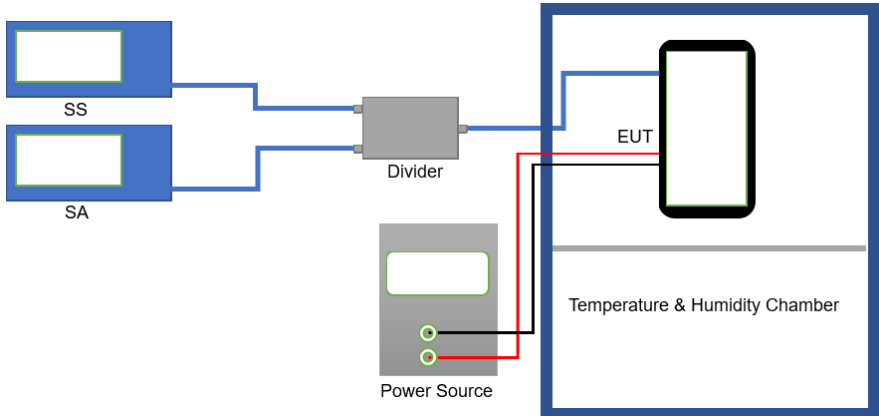
## 6.7 Frequency stability V.S. Temperature measurement

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC Part 22.355, FCC Part 24.235, FCC Part 2.1055(a)(1)(b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Limit:            | ±2.5 ppm for WCDMA 850<br>Within authorized band for WCDMA 1900                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Test setup:       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Test procedure:   | <ol style="list-style-type: none"> <li>1. The equipment under test was connected to an external DC power supply and input rated voltage.</li> <li>2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators.</li> <li>3. The EUT was placed inside the temperature chamber.</li> <li>4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency.</li> <li>5. Turn EUT off and set the chamber temperature to –30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency.</li> <li>6. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached</li> </ol> |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**Measurement Data (the worst channel):**

| Reference Frequency: WCDMA BAND V 12.2k RMC Middle channel=4183 channel=836.6MHz |                  |                 |          |                                       |        |
|----------------------------------------------------------------------------------|------------------|-----------------|----------|---------------------------------------|--------|
| Power supplied (Vdc)                                                             | Temperature (°C) | Frequency error |          | Limit (ppm)                           | Result |
|                                                                                  |                  | Hz              | ppm      |                                       |        |
| 3.70                                                                             | -30              | 198             | 0.236672 | ±2.5                                  | Pass   |
|                                                                                  | -20              | 188             | 0.224719 |                                       |        |
|                                                                                  | -10              | 123             | 0.147024 |                                       |        |
|                                                                                  | 0                | 165             | 0.197227 |                                       |        |
|                                                                                  | 10               | 144             | 0.172125 |                                       |        |
|                                                                                  | 20               | 176             | 0.210375 |                                       |        |
|                                                                                  | 30               | 124             | 0.148219 |                                       |        |
|                                                                                  | 40               | 133             | 0.158977 |                                       |        |
|                                                                                  | 50               | 101             | 0.120727 |                                       |        |
| Reference Frequency: WCDMA BAND II 12.2k RMC Middle channel=9400 channel=1880MHz |                  |                 |          |                                       |        |
| Power supplied (Vdc)                                                             | Temperature (°C) | Frequency error |          | Limit (ppm)                           | Result |
|                                                                                  |                  | Hz              | ppm      |                                       |        |
| 3.70                                                                             | -30              | 197             | 0.104787 | Within authorized band for WCDMA 1900 | Pass   |
|                                                                                  | -20              | 181             | 0.096277 |                                       |        |
|                                                                                  | -10              | 165             | 0.087766 |                                       |        |
|                                                                                  | 0                | 173             | 0.092021 |                                       |        |
|                                                                                  | 10               | 151             | 0.080319 |                                       |        |
|                                                                                  | 20               | 148             | 0.078723 |                                       |        |
|                                                                                  | 30               | 131             | 0.069681 |                                       |        |
|                                                                                  | 40               | 128             | 0.068085 |                                       |        |
|                                                                                  | 50               | 114             | 0.060638 |                                       |        |
| Note: Only the worst case shown in the report.                                   |                  |                 |          |                                       |        |

## 6.8 Frequency stability V.S. Voltage measurement

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC Part 22.355, FCC Part 24.235, FCC Part 2.1055(d)(2)                                                                                                                                                                                                                                                                                                                                                                                        |
| Limit:            | ±2.5 ppm for WCDMA 850<br>Within authorized band for WCDMA 1900                                                                                                                                                                                                                                                                                                                                                                                |
| Test setup:       |                                                                                                                                                                                                                                                                                                                                                              |
| Test procedure:   | <ol style="list-style-type: none"> <li>1. Set chamber temperature to 25°C. Use a variable DC power source to power the EUT and set the voltage to rated voltage.</li> <li>2. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.</li> <li>3. Reduce the input voltage to specify extreme voltage variation (+/- 15%) and endpoint, record the maximum frequency change.</li> </ol> |
| Test Instruments: | Refer to section 5.9 for details                                                                                                                                                                                                                                                                                                                                                                                                               |
| Test mode:        | Refer to section 5.3 for details                                                                                                                                                                                                                                                                                                                                                                                                               |
| Test results:     | Passed                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Measurement Data (the worst channel):**

| Reference Frequency: UMTS 850 12.2k RMC Middle channel=4183 channel=836.6MHz |                      |                 |          |                                       |        |
|------------------------------------------------------------------------------|----------------------|-----------------|----------|---------------------------------------|--------|
| Temperature (°C)                                                             | Power supplied (Vdc) | Frequency error |          | Limit (ppm)                           | Result |
|                                                                              |                      | Hz              | ppm      |                                       |        |
| 25                                                                           | 4.20                 | 98              | 0.117141 | ±2.5                                  | Pass   |
|                                                                              | 3.70                 | 78              | 0.093235 |                                       |        |
|                                                                              | 3.50                 | 80              | 0.095625 |                                       |        |
| Reference Frequency: UMTS 1900 12.2k RMC Middle channel=9400 channel=1880MHz |                      |                 |          |                                       |        |
| Temperature (°C)                                                             | Power supplied (Vdc) | Frequency error |          | Limit (ppm)                           | Result |
|                                                                              |                      | Hz              | ppm      |                                       |        |
| 25                                                                           | 4.20                 | 99              | 0.052660 | Within authorized band for WCDMA 1900 | Pass   |
|                                                                              | 3.70                 | 86              | 0.045745 |                                       |        |
|                                                                              | 3.50                 | 60              | 0.031915 |                                       |        |
| Note: Only the worst case shown in the report.                               |                      |                 |          |                                       |        |