On your side

고 객 비 밀
CUSTOMER SECRET

# TEST REPORT

FCC ULCA Test for TFGMEIBBCD4
Class II Permissive Change

**APPLICANT**
LG Electronics Inc.

**REPORT NO.**
HCT-RF-2310-FC080-R1

**DATE OF ISSUE**
October 30, 2023

**Tested by**
Jung Ki Lim

**Technical Manager**
Jong Seok Lee

HCT CO., LTD.
BongJai Huh / CEO

**HCT CO., LTD.**
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

고 객 비 밀
CUSTOMER SECRET

**HCT Co., Ltd.**
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

# TEST REPORT

FCC ULCA Test for TFGMEIBBCD4

REPORT NO.
HCT-RF-2310-FC080-R1

DATE OF ISSUE
October 30, 2023

Additional Model
TFGMEIBBCD5, TFGMEIBBCD6, TFGMEIBBCD7, TFGMEIBBCD8, TFGMEIBBCD9, TFGMEIBBCDA, TFGMEIBBCDB, TFGMEIBBCDC

| | |
|---|---|
| Applicant | **LG Electronics Inc.**<br>10, MagokJungang-ro, Gangseo-gu, Seoul 07796, Republic of Korea |
| Eut Type<br>Model Name | GM Onstar Gen12 ROW<br>TFGMEIBBCD4 |
| FCC ID | BEJTFGMEIBBCD4 |
| FCC Classification: | PCS Licensed Transmitter (PCB) |
| **FCC Rule Part(s):** | § 22, § 27 |

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

## REVISION HISTORY

The revision history for this test report is shown in table.

| Revision No. | Date of Issue | Description |
|---|---|---|
| 0 | October 20, 2023 | Initial Release |
| 1 | October 30, 2023 | Revised the 25 page. (Note 3) |

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section § 2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.
HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Test Report Statement:
The above Test Report is not related to the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme) / A2LA(American Association for Laboratory Accreditation), which signed the ILAC-MRA.

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

## CONTENTS

1. GENERAL INFORMATION 5
2. INTRODUCTION 6
2.1. DESCRIPTION OF EUT 6
2.2. MEASURING INSTRUMENT CALIBRATION 6
2.3. TEST FACILITY 6
3. DESCRIPTION OF TESTS 7
3.1 TEST PROCEDURE 7
3.2 CONDUCTED OUTPUT POWER 8
3.3 RADIATED TEST 9
3.3.1 RADIATED POWER 10
3.3.2 RADIATED SPURIOUS EMISSIONS 11
3.4 PEAK- TO- AVERAGE RATIO 13
3.5 OCCUPIED BANDWIDTH. 15
3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL 16
3.7 BAND EDGE 17
3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE 19
3.9 WORST CASE (RADIATED TEST) 20
4. LIST OF TEST EQUIPMENT 21
5. MEASUREMENT UNCERTAINTY 23
6. SUMMARY OF TEST RESULTS 24
7. EMISSION DESIGNATOR 26
8. TEST DATA 27
8.1 Inter Band ULCA 27
8.1.1 External Antenna 27
8.1.2 Internal Antenna 29
9. ANNEX A_ TEST SETUP PHOTO 31

# MEASUREMENT REPORT

## 1. GENERAL INFORMATION

| | |
|---|---|
| Applicant Name: | LG Electronics Inc. |
| Address: | 10, Magok Jungang-ro, Gangseo-gu, Seoul 07796, Republic of Korea |
| FCC ID: | BEJTFGMEIBBCD4 |
| Application Type: | Class II Permissive Change |
| FCC Classification: | PCS Licensed Transmitter (PCB) |
| FCC Rule Part(s): | § 22, § 27 |
| EUT Type: | GM Onstar Gen12 ROW |
| Model(s): | TFGMEIBBCD4 |
| Additional Model: | TFGMEIBBCD5,TFGMEIBBCD6,TFGMEIBBCD7,TFGMEIBBCD8, TFGMEIBBCD9, TFGMEIBBCDA, TFGMEIBBCDB, TFGMEIBBCDC |
| ULCA Combination | 5A-7A |
| Tx Frequency: | 824.7 MHz – 848.3 MHz : 1.4 MHz / LTE B5<br>825.5 MHz – 847.5 MHz : 3 MHz / LTE B5<br>826.5 MHz – 846.5 MHz : 5 MHz / LTE B5<br>829.0 MHz – 844.0 MHz : 10 MHz / LTE B5<br><br>2502.5 – 2567.5 : 5 MHz / LTE B7<br>2505.0 – 2565.0 : 10 MHz / LTE B7<br>2507.5 – 2562.5 : 15 MHz / LTE B7<br>2510.0 – 2560.0 : 20 MHz / LTE B7 |
| Date(s) of Tests: | August 01, 2023 ~ October 05, 2023 |
| Serial number: | Radiated<br>- External Antenna : EBR36018942_#30<br>- Internal Antenna : EBR36018942K_#14 |
| External Antenna Information | ANT5 : 86531607<br>ANT4 : 86575530<br>DUT4 : 85608774 |

# 2. INTRODUCTION

## 2.1. DESCRIPTION OF EUT

The EUT was a GM Onstar Gen12 ROW with GSM/GPRS/EGPRS/UMTS and LTE, Sub6.

## 2.2. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

## 2.3. TEST FACILITY

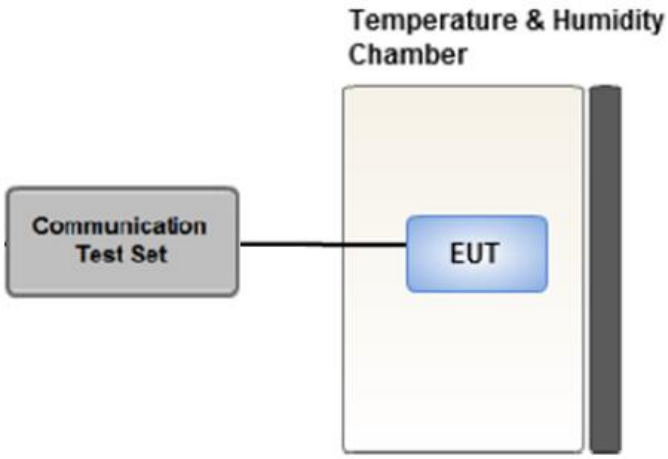
The Fully-anechoic chamber and conducted measurement facility used to collect the radiated data are located at the **74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.**

# 3. DESCRIPTION OF TESTS

## 3.1 TEST PROCEDURE

| Test Description | Test Procedure Used |
|---|---|
| Occupied Bandwidth | - KDB 971168 D01 v03r01 – Section 4.3<br>- ANSI C63.26-2015 – Section 5.4.4 |
| Band Edge | - KDB 971168 D01 v03r01 – Section 6.0<br>- ANSI C63.26-2015 – Section 5.7 |
| Spurious and Harmonic Emissions at Antenna Terminal | - KDB 971168 D01 v03r01 – Section 6.0<br>- ANSI C63.26-2015 – Section 5.7 |
| Conducted Output Power | - KDB 971168 D01 v03r01 – Section 5.2 |
| Peak- to- Average Ratio | - KDB 971168 D01 v03r01 – Section 5.7<br>- ANSI C63.26-2015 – Section 5.2.3.4 |
| Frequency stability | - ANSI C63.26-2015 – Section 5.6 |
| Effective Radiated Power/<br>Effective Isotropic Radiated Power | - KDB 971168 D01 v03r01 – Section 5.2 & 5.8<br>- ANSI/TIA-603-E-2016 – Section 2.2.17 |
| Radiated Spurious and Harmonic Emissions | - KDB 971168 D01 v03r01 – Section 6.2<br>- ANSI/TIA-603-E-2016 – Section 2.2.12 |

## 3.2 CONDUCTED OUTPUT POWER




Test setup

**Test Overview**

When an average power meter is used to perform RF output power measurements, the fundamental condition that measurements be performed only over durations of active transmissions at maximum output power level applies.

Conducted Output Power was tested in accordance with KDB971168 D01 Power Meas License Digital Systems v03r01, Section 5.2.

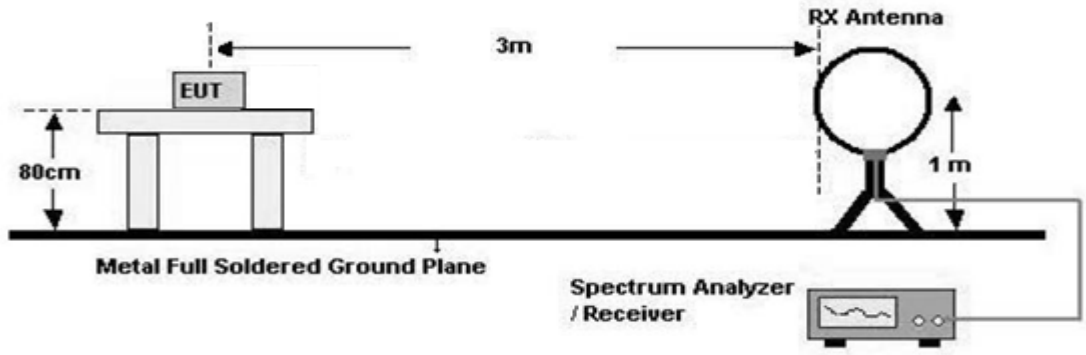
## 3.3 RADIATED TEST

### Test Overview

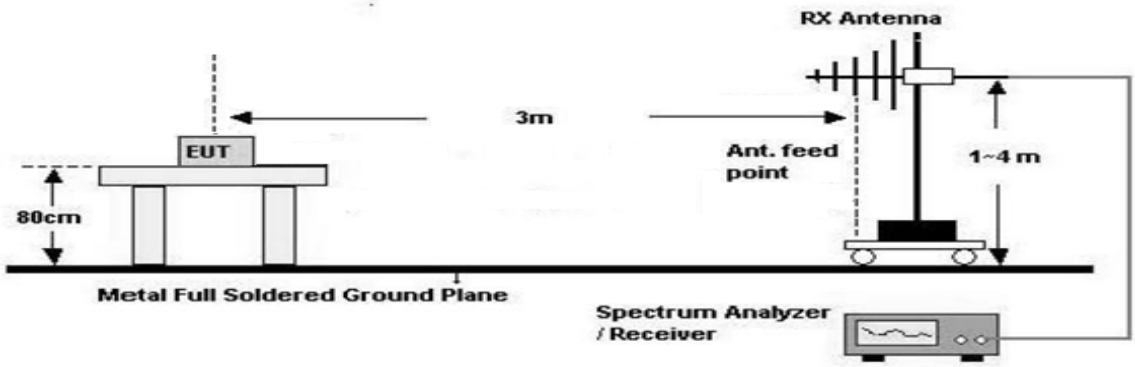
Radiated tests are performed in the semi-anechoic chamber. The equipment under test is placed on a non-conductive table on semi-anechoic chamber.

### Test Configuration

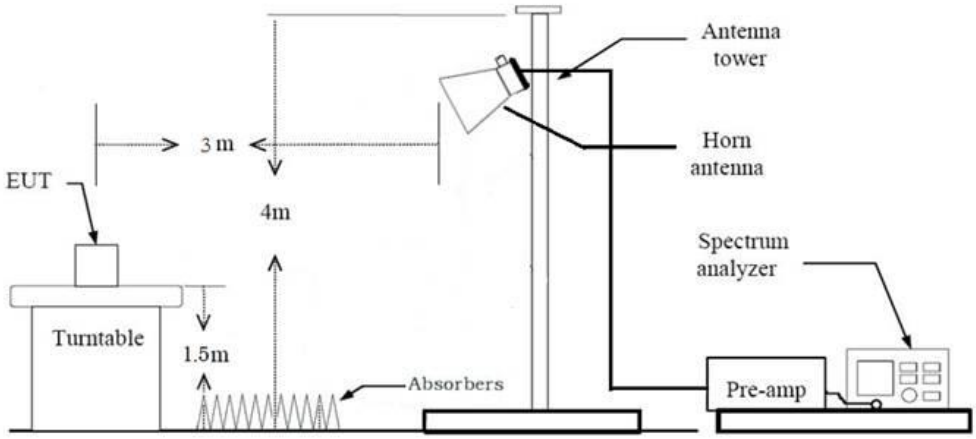
Below 30 MHz




30 MHz - 1 GHz




Above 1 GHz



### 3.3.1 RADIATED POWER

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5 % of the expected OBW, not to exceed 1 MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points > 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Note

1. The EUT is placed on a turntable, which is 0.8 m above ground plane. (Below 1 GHz)
2. The EUT is placed on a turntable, which is 1.5 m above ground plane. (Above 1 GHz)
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
6. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.
7. Total(dBμV/m) = Measured Value(dBμV) + Cable Loss(dB) + Antenna Factor(dB/m) + Distance Factor(D.F)
8. EIRP (dBm)
   = Total (dBμV/m) + 20 log D − 104.8 (where D is the measurement distance in meters. D=3)
   = Total (dBμV/m) - 95.2(dB)
9. ERP(dBm) = EIRP(dBm) - 2.15(dB)

### 3.3.2 RADIATED SPURIOUS EMISSIONS

**Test Settings**

1. RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1 GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points > 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10$^{th}$ harmonics from 9 kHz.

**Test Note**

1. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
   The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets,
   and channel bandwidth configurations shown in the test data
2. Measurements value show only up to 3 maximum emissions noted, or would be lesser
   if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit)
   and considered that's already beyond the background noise floor.

**Below 30 MHz**

1. The loop antenna was placed at a location 3 m from the EUT
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
6. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
8. EIRP (dBm)
   = Total (dBμV/m) + 20 log D − 104.8 (where D is the measurement distance in meters. D=3)
   = Total (dBμV/m) - 95.2(dB)
9. ERP(dBm) = EIRP(dBm) - 2.15(dB)

**KDB 414788 OFS and Chamber Correlation Justification**

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

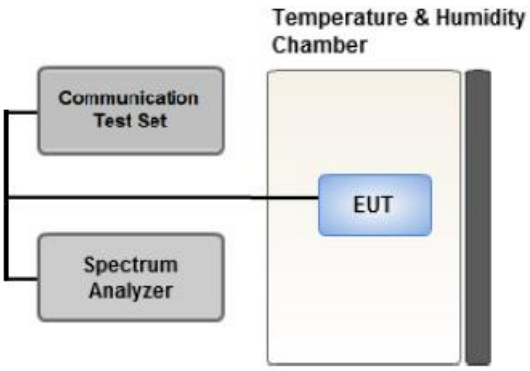
**Below 1 GHz**

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
7. Total(dBμV/m) = Measured Value(dBμV) + Cable Loss(dB) + Antenna Factor(dB/m) + Distance Factor(D.F)
8. EIRP (dBm)
   = Total (dBμV/m) + 20 log D − 104.8 (where D is the measurement distance in meters. D=3)
   = Total (dBμV/m) - 95.2(dB)
9. ERP(dBm) = EIRP(dBm) - 2.15(dB)

**Above 1 GHz**

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Total(dBμV/m) = Measured Value(dBμV) + Cable Loss(dB) + Antenna Factor(dB/m) + Distance Factor(D.F) + H.P.F(dB) - Amp Gain(dB)
8. EIRP (dBm)
   = Total (dBμV/m) + 20 log D − 104.8 (where D is the measurement distance in meters. D=3)
   = Total (dBμV/m) - 95.2(dB)

## 3.4 PEAK- TO- AVERAGE RATIO




Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Set the measurement interval as follows:
   .- for continuous transmissions, set to 1 ms,
   .- or burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1 %.

② Alternate Procedure for PAPR

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as as $P_{Pk}$.

Use one of the applicable procedures presented 5.2(ANSI C63.26-2015) to measure the total average power and record as $P_{Avg}$. Determine the P.A.R. from:

$$P.A.R_{(dB)} = P_{Pk(dBm)} - P_{Avg(dBm)} \quad (P_{Avg} = \text{Average Power} + \text{Duty cycle Factor})$$

Test Settings(Peak Power)

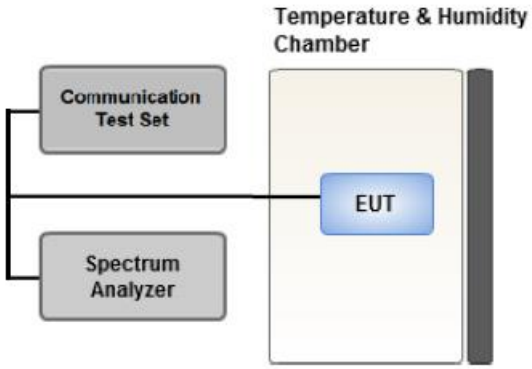
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW ≥ 3 × RBW.

1. Set the RBW ≥ OBW.
2. Set VBW ≥ 3 × RBW.
3. Set span ≥ 2 × OBW.
4. Sweep time ≥ 10 × (number of points in sweep) × (transmission symbol period).
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the peak amplitude level.

Test Settings(Average Power)

1. Set span to 2 × to 3 × the OBW.
2. Set RBW ≥ OBW.
3. Set VBW ≥ 3 × RBW.
4. Set number of measurement points in sweep ≥ 2 × span / RBW.
5. Sweep time:
   Set ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. The transmission period is the (on + off) time.
6. Detector = power averaging (rms).
7. Set sweep trigger to “free run.”
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. (To accurately determine the average power over the on and off period of the transmitter, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.)
9. Use the peak marker function to determine the maximum amplitude level.
10. Add [10 log (1/duty cycle)] to the measured maximum power level to compute the average power during continuous transmission. For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is a constant 25 %.

## 3.5 OCCUPIED BANDWIDTH.




Test setup

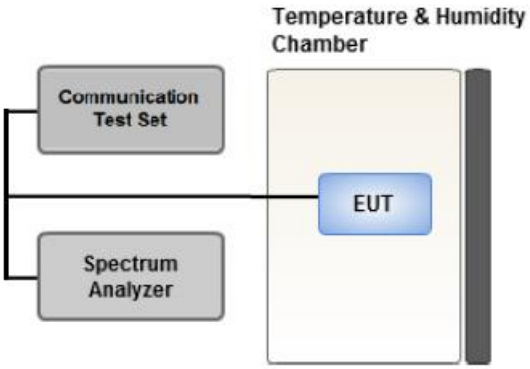
The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

The EUT makes a call to the communication simulator.
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99 % occupied bandwidth and the 26 dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5 % of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5 % of the 99 % occupied bandwidth observed in Step 7

## 3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL




Test setup

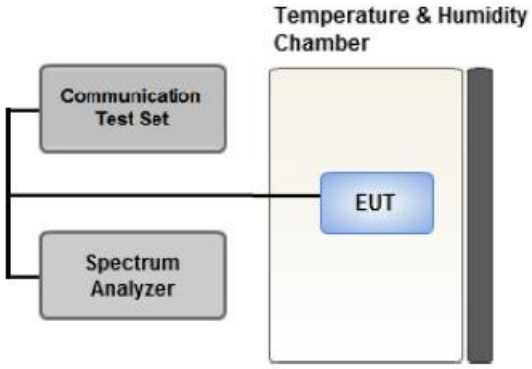
### Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

### Test Settings

1. RBW = 1 MHz
2. VBW ≥ 3 MHz
3. Detector = RMS
4. Trace Mode = Average
5. Sweep time = auto
6. Number of points in sweep ≥ 2 x Span / RBW

## 3.7 BAND EDGE




Test setup

**Test Overview**

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

**Test Settings**

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW > 1 % of the emission bandwidth
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

**Test Notes § 22.917(a)**

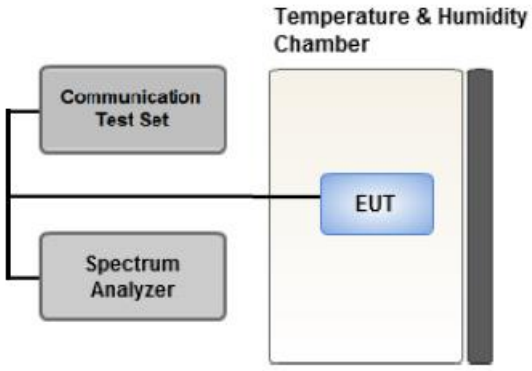
According to FCC 22.917, 24.238, 27.53 specified that power of any emission outside of The authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.
All measurements were done at 2 channels(low and high operational frequency range.)
The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

Where Margin < 1 dB the emission level is either corrected by 10 log(1 MHz/ RB) or the emission is integrated over a 1 MHz bandwidth to determine the final result. When using the integration method the integration window is either centered on the emission or, for emissions at the band edge, centered by an offset of 500 kHz from the block edge so that the integration window is the 1 MHz adjacent to the block edge.

Test Notes (§ 27.53(m)(4))

1. The attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge,
2. 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge.
3. 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge.
4. The attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz.
5. 55 + 10 log (P) dB at or below 2490.5 MHz.
6. X is the greater of 6MHz or the actual emission bandwidth
7. The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer

## 3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE




Test setup

### Test Overview

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015.

The frequency stability of the transmitter is measured by:

1. Temperature:

   The temperature is varied from -30 °C to +50 °C in 10 °C increments using an environmental chamber.

2. Primary Supply Voltage:

   .- Unless otherwise specified, vary primary supply voltage from 85 % to 115 % of the nominal value for other than hand carried battery equipment.

   .- For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

### Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20 °C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10 °C intervals ranging from -30 °C to +50 °C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

## 3.9 WORST CASE (RADIATED TEST)

- The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
- All modes of operation were investigated and the worst case configuration results are reported.
  Mode : Internal Antenna, External Antenna (ANT 5, ANT 4, DUT 4)
  Worst case : Internal Antenna, External Antenna (ANT 5)
- The worst case is reported with the EUT positioning, modulations, and paging service configurations shown in the test data.
- Please refer to the table below.
- In the case of radiated spurious emissions, all bandwidth of operation were investigated and the worst case bandwidth results are reported.
  External Antenna Worst case
  5A : 3 MHz
  7A : 10 MHz
  Internal Antenna Worst case
  5A : 10 MHz
  7A : 15 MHz
- TFGMEIBBCD4 & additional models were tested and the worst case results are reported.
  (Worst case : TFGMEIBBCD4)

[ External Antenna Worst case ]

| Test Description | Modulation | RB size | RB offset | Axis |
|---|---|---|---|---|
| Radiated Spurious and Harmonic Emissions | QPSK | 1 | 0 | X |

[ Internal Antenna Worst case ]

| Test Description | Modulation | RB size | RB offset | Axis |
|---|---|---|---|---|
| Radiated Spurious and Harmonic Emissions | QPSK | 1 | 0 | Y |

## 4. LIST OF TEST EQUIPMENT

| Equipment | Model | Manufacturer | Serial No. | Due to Calibration | Calibration Interval |
|---|---|---|---|---|---|
| Antenna Position Tower | MA4640/800-XP-ET | Innco systems | N/A | N/A | N/A |
| Turn Table | DS2000-S | Innco systems | N/A | N/A | N/A |
| Turn Table | Turn Table | Ets | N/A | N/A | N/A |
| Controller (Antenna mast & Turn Table) | CO3000 | Innco systems | CO3000/1251/489 20320/P | N/A | N/A |
| Amp & Filter Bank Switch Controller | FBSM-01B | TNM system | TM20090002 | N/A | N/A |
| RF Switch System | TMX0132C | TNM System | TM21100002 | N/A | N/A |
| RF Switch System | FBSR-04C(3G HPF+LNA) | TNM System | S4L1 | 08/18/2024 | Annual |
| RF Switch System | FBSR-04C(LNA) | TNM System | S4L4 | 08/18/2024 | Annual |
| RF Switch System | FBSR-04C(Thru) | TNM System | S4L6 | 08/18/2024 | Annual |
| HIGHPASS FILTER | WHKX10-900-1000-15000-40SS | WAINWRIGHT INSTRUMENTS | 16 | 08/01/2024 | Annual |
| HIGHPASS FILTER | WHNX6.0/26.5G-6SS | WAINWRIGHT INSTRUMENTS | 1 | 01/19/2024 | Annual |
| Power Amplifier | CBL18265035 | CERNEX | 22966 | 12/01/2023 | Annual |
| Power Amplifier | CBL26405040 | CERNEX | 25956 | 03/02/2024 | Annual |
| Loop Antenna(9 kHz ~ 30 MHz) | FMZB1513 | Schwarzbeck | 1513-333 | 03/17/2024 | Biennial |
| Horn Antenna(1 ~ 18 GHz) | BBHA 9120 | Schwarzbeck | 937 | 02/13/2025 | Biennial |
| Horn Antenna(15 ~ 40 GHz) | BBHA 9170 | Schwarzbeck | BBHA9170342 | 09/29/2024 | Biennial |
| Bilog Antenna | VULB9160 | Schwarzbeck | 3150 | 03/09/2025 | Biennial |
| Hybrid Antenna | VULB9160 | Schwarzbeck | 760 | 02/24/2025 | Biennial |
| Trilog Broadband Antenna | VULB 9168 | Schwarzbeck | 895 | 08/16/2024 | Biennial |
| Chamber | SU-642 | ESPEC | 93008124 | 02/22/2024 | Annual |
| Power Splitter(DC~26.5 GHz) | 11667B | Hewlett Packard | 11275 | 03/02/2024 | Annual |
| DC Power Supply | E3632A | Agilent | MY40010147 | 06/23/2024 | Annual |
| 4-Way Divider | ZC4PD-K1844+ | Mini-Circuits | 942907 | 09/19/2024 | Annual |
| ATTENUATOR(20 dB) | 8493C | Hewlett Packard | 17280 | 04/19/2024 | Annual |
| Spectrum Analyzer(10 Hz ~ 40 GHz) | FSV40 | REOHDE & SCHWARZ | 101436 | 02/22/2024 | Annual |
| Base Station | 8960 (E5515C) | Agilent | MY48360800 | 08/10/2024 | Annual |
| Wideband Radio Communication Tester | MT8821C | Anritsu Corp. | 6262287701 | 05/22/2024 | Annual |
| Wideband Radio Communication Tester | MT8000A | Anritsu Corp. | 6262302511 | 05/23/2024 | Annual |
| SIGNAL GENERATOR (100 kHz ~ 40 GHz) | SMB100A | REOHDE & SCHWARZ | 177633 | 06/22/2024 | Annual |

| | | | | | |
|---|---|---|---|---|---|
| Signal Analyzer(10 Hz ~ 26.5 GHz) | N9020A | Agilent | MY52090906 | 04/20/2024 | Annual |
| Signal Analyzer(5 Hz ~ 40.0 GHz) | N9030B | KEYSIGHT | MY55480167 | 05/24/2024 | Annual |
| FCC LTE Mobile Conducted RF Automation Test Software | - | HCT CO., LTD., | - | - | - |

Note:

1. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
2. Espectially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

## 5. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded Uncertainty (±dB) |
|---|---|
| Conducted Disturbance (150 kHz ~ 30 MHz) | 1.90 (Confidence level about 95 %, *k*=2) |
| Radiated Disturbance (9 kHz ~ 30 MHz) | 4.14 (Confidence level about 95 %, *k*=2) |
| Radiated Disturbance (30 MHz ~ 1 GHz) | 5.82 (Confidence level about 95 %, *k*=2) |
| Radiated Disturbance (1 GHz ~ 18 GHz) | 5.74 (Confidence level about 95 %, *k*=2) |
| Radiated Disturbance (18 GHz ~ 40 GHz) | 5.76 (Confidence level about 95 %, *k*=2) |
| Radiated Disturbance (Above 40 GHz) | 5.52 (Confidence level about 95 %, *k*=2) |

## 6. SUMMARY OF TEST RESULTS

6.1 Test Condition : Conducted Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result | Status |
|---|---|---|---|---|
| Occupied Bandwidth | § 2.1049 | N/A | PASS | NT Note2 |
| Band Edge / Spurious and Harmonic Emissions at Antenna Terminal. | § 2.1051, § 22.917(a) | < 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions | PASS | NT Note2 |
| | § 2.1051, § 27.53(m)(4) | ■ < 40 + 10log10 (P[Watts]) at Channel edges<br>■ < 43 + 10log10 (P[Watts]) between 5 and X MHz from Channel edges<br>■ < 55 + 10log10 (P[Watts]) beyond X MHz beyond from Channel edges<br>■ < 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz | PASS | NT Note2 |
| Conducted Output Power | § 2.1046 | N/A | PASS | NT Note2 |
| Peak- to- Average Ratio | § 22.913(d) § 27.50(d)(5) | < 13 dB | PASS | NT Note2 |
| Frequency stability / variation of ambient temperature | § 2.1055, § 22.355 § 27.54 | < 2.5 ppm | PASS | NT Note2 |

**Note:**

1. C = Comply, NT = Not Tested, NA = Not Applicable, NC = Not Comply
2. The conducted tests were not tested because they were the same as the original report data.
3. Original report nomber:
   -. LTE B5: HCT-RF-2308-FC005-R1
   -. LTE B7: HCT-RF-2308-FC006-R1

6.2 Test Condition : Radiated Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result | Status |
|---|---|---|---|---|
| Effective Radiated Power | § 22.913(a)(5) | < 7 Watts max. ERP | PASS | NT[Note3] |
| Equivalent Isotropic Radiated Power | § 27.50(h)(2) | < 2 Watts max. EIRP | PASS | NT[Note3] |
| Radiated Spurious and Harmonic Emissions | § 2.1053, § 22.917(a) | < 43 + 10log10 (P[Watts]) for all out-of band emissions | PASS | C[Note2] |
| | § 2.1053, § 27.53(m)(4) | < 55 + 10log10 (P[Watts]) | PASS | C[Note2] |

**Note:**

1. C = Comply, NT = Not Tested, NA = Not Applicable, NC = Not Comply
2. The data from that application has been verified through appropriate spot checks to demonstrate compliance for this device as shown in the test result of section 8
3. Output power was verified to be within the expected tune up tolerances prior to performing the spot checks for radiated spurious emissions, E.R.P and E.I.R.P to confirm that the proposed changes to Adding Inter-band ULCA capability had not adversely affected the previously reported values in the original filing.

## 7. EMISSION DESIGNATOR

### GSM Emission Designator

**Emission Designator = 249KGXW**

GSM BW = 249 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

### EDGE Emission Designator

**Emission Designator = 249KG7W**

GSM BW = 249 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

### WCDMA Emission Designator

**Emission Designator = 4M17F9W**

WCDMA BW = 4.17 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

### QPSK Modulation

**Emission Designator = 4M48G7D**

LTE BW = 4.48 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

### QAM Modulation

**Emission Designator = 4M48W7D**

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

# 8. TEST DATA

## 8.1 Inter Band ULCA

### 8.1.1 External Antenna

▣ MODE: 5A-7A

▣ MODULATION SIGNAL: 3 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -13.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20635 (846.24) | 1 692.48 | 58.96 | -18.55 | V | 40.41 | -54.79 | -13.00 | 41.79 |
| | 2 538.72 | 54.82 | -14.82 | V | 40.00 | -55.20 | -13.00 | 42.20 |
| | 3 384.96 | 55.05 | -13.26 | V | 41.79 | -53.41 | -13.00 | 40.41 |

▣ MODE: 5A-7A

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -25.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20800 (2509.8) | 5 019.60 | 62.10 | -7.42 | V | 54.68 | -40.52 | -25.00 | 15.52 |
| | 7 529.40 | 52.14 | -0.83 | V | 51.31 | -43.89 | -25.00 | 18.89 |
| | 10 039.20 | 48.87 | 4.67 | V | 53.54 | -41.66 | -25.00 | 16.66 |

▣ MODE: 7A-5A

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -25.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20800 (2509.8) | 5 019.60 | 64.07 | -7.42 | V | 56.65 | -38.55 | -25.00 | 13.55 |
| | 7 529.40 | 52.28 | -0.83 | V | 51.45 | -43.75 | -25.00 | 18.75 |
| | 10 039.20 | 47.13 | 4.67 | V | 51.80 | -43.40 | -25.00 | 18.40 |

▣ MODE: 7A-5A

▣ MODULATION SIGNAL: 3 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -13.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20635 (846.24) | 1 692.48 | 56.74 | -18.55 | V | 38.19 | -57.01 | -13.00 | 44.01 |
| | 2 538.72 | 54.12 | -14.82 | V | 39.30 | -55.90 | -13.00 | 42.90 |
| | 3 384.96 | 54.51 | -13.26 | V | 41.25 | -53.95 | -13.00 | 40.95 |

### 8.1.2 Internal Antenna

▣ MODE: 5A-7A

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -13.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20450 (829.0) | 1 658.00 | 57.81 | -18.56 | V | 39.25 | -55.95 | -13.00 | 42.95 |
| | 2 487.00 | 62.22 | -15.05 | V | 47.17 | -48.03 | -13.00 | 35.03 |
| | 3 316.00 | 57.45 | -13.43 | H | 44.02 | -51.18 | -13.00 | 38.18 |
| | 4 145.00 | 59.39 | -11.02 | H | 48.37 | -46.83 | -13.00 | 33.83 |

▣ MODE: 5A-7A

▣ MODULATION SIGNAL: 15 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -25.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 21375 (2562.5) | 5 125.00 | 67.97 | -7.06 | H | 60.91 | -34.29 | -25.00 | 9.29 |
| | 7 687.50 | 51.13 | -1.08 | V | 50.05 | -45.15 | -25.00 | 20.15 |
| | 10 250.00 | 44.27 | 5.04 | V | 49.31 | -45.89 | -25.00 | 20.89 |

▣ MODE: 7A-5A

▣ MODULATION SIGNAL: 15 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -25.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 21375 (2562.5) | 5 125.00 | 71.75 | -7.06 | H | 64.69 | -30.51 | -25.00 | 5.51 |
| | 7 687.50 | 52.05 | -1.08 | H | 50.97 | -44.23 | -25.00 | 19.23 |
| | 10 250.00 | 45.44 | 5.04 | H | 50.48 | -44.72 | -25.00 | 19.72 |

▣ MODE: 7A-5A

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: -13.00 dBm

| Ch | Freq.(MHz) | Measured Level (dBμV) | A.F+C.L+ D.F-A.G (dB/m) | Pol. | Total (dBμV/m) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 20450 (829.0) | 1 658.00 | 57.29 | -18.56 | V | 38.73 | -56.47 | -13.00 | 43.47 |
| | 2 487.00 | 60.91 | -15.05 | V | 45.86 | -49.34 | -13.00 | 36.34 |
| | 3 316.00 | 56.58 | -13.43 | H | 43.15 | -52.05 | -13.00 | 39.05 |
| | 4 145.00 | 58.54 | -11.02 | H | 47.52 | -47.68 | -13.00 | 34.68 |

## 9. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

| No. | Description |
|---|---|
| 1 | HCT-RF-2310-FC080-P |