

TEST REPORT

FCC/ISED LTE B4 Test for TM03LNCAHK0
Class II Permissive Change

APPLICANT

LG Electronics Inc.

REPORT NO.

HCT-RF-2107-FI006

DATE OF ISSUE

July 26, 2021

Tested by
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Additional Model

-

Applicant

LG Electronics Inc.

2621, Nambusunhwan-ro, Gangnam-gu, Seoul, Republic of Korea

**Eut Type
Model Name**

AVN Modem Module
TM03LNCAHK0

**FCC ID
IC**

BEJGEN21CA
2703H-GEN21CA

FCC Classification:

PCS Licensed Transmitter (PCB)

FCC Rule Part(s):

§ 27, § 2

ISED Rule(s):

RSS-Gen Issue5, RSS-139 Issue3

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	July 26, 2021	Initial Release

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)

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

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MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	LG Electronics Inc.
Address:	2621, Nambusunhwan-ro, Gangnam-gu, Seoul, Republic of Korea
FCC ID:	BEJGEN21CA
IC:	2703H-GEN21CA
Application Type:	Class II Permissive Change
FCC Rule Part(s):	§ 27, § 2
ISED Rule(s):	RSS-Gen Issue5, RSS-139 Issue3
EUT Type:	AVN Modem Module
Model(s):	TM03LNCAHK0
Additional Model:	-
Tx Frequency:	1712.5 MHz – 1752.5 MHz (LTE – Band 4 (5 MHz)) 1715.0 MHz – 1750.0 MHz (LTE – Band 4 (10 MHz)) 1717.5 MHz – 1747.5 MHz (LTE – Band 4 (15 MHz)) 1720.0 MHz – 1745.0 MHz (LTE – Band 4 (20 MHz))
Date(s) of Tests:	July 12, 2021 ~ July 23, 2021
PMN (Product Marketing Number)	AVN Modem Module
HVIN (Hardware Version Identification Number)	TM03LNCAHK0
FVIN (Firmware Version Identification Number)	HMD21D69
HMN (Host Marketing Name)	N/A
Serial number:	106PV025835

1.1. MAXIMUM OUTPUT POWER

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	Conducted output power		EIRP	
				Max. Power (W)	Max. Power (dBm)	Max. Power (W)	Max. Power (dBm)
LTE – Band4 (5)	1712.5 – 1752.5	4M50G7D	QPSK	0.207	23.17	0.075	18.76
		4M50W7D	16QAM	0.163	22.11	0.055	17.40
LTE – Band4 (10)	1715.0 – 1750.0	8M96G7D	QPSK	0.230	23.62	0.081	19.10
		8M93W7D	16QAM	0.162	22.10	0.060	17.75
LTE – Band4 (15)	1717.5 – 1747.5	13M5G7D	QPSK	0.215	23.33	0.085	19.32
		13M4W7D	16QAM	0.157	21.95	0.064	18.06
LTE – Band4 (20)	1720.0 – 1745.0	17M9G7D	QPSK	0.217	23.37	0.085	19.29
		17M9W7D	16QAM	0.158	21.99	0.063	18.00

2. INTRODUCTION

2.1. DESCRIPTION OF EUT

The EUT was a AVN Modem Module with UMTS and LTE.

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.**

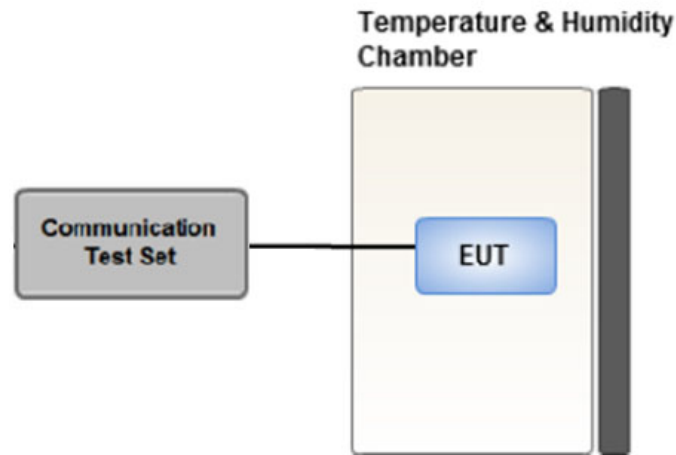
For ISED, test facility was accepted dated January 26, 2021 (CAB identifier: KR0032).

3. DESCRIPTION OF TESTS

3.1 TEST PROCEDURE

Test Description	Test Procedure Used
Occupied Bandwidth	- KDB 971168 D01 v03r01 – Section 4.3 - ANSI C63.26-2015 – Section 5.4.4
Band Edge	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Spurious and Harmonic Emissions at Antenna Terminal	- KDB 971168 D01 v03r01 – Section 6.0 - 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 - ANSI C63.26-2015 – Section 5.2.3.4 - ANSI C63.26-2015 – Section 5.2.6(only GSM)
Frequency stability	- ANSI C63.26-2015 – Section 5.6
Effective Radiated Power/ Effective Isotropic Radiated Power	- KDB 971168 D01 v03r01 – Section 5.2 & 5.8 - ANSI/TIA-603-E-2016 – Section 2.2.17
Radiated Spurious and Harmonic Emissions	- KDB 971168 D01 v03r01 – Section 6.2 - 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 POWER

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-E-2016 Clause 2.2.17.

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 1MHz
3. VBW $\geq 3 \times$ RBW
4. Span = 1.5 times the OBW
5. No. of sweep points $> 2 \times$ 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 turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission.
2. A half wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is calculated by the following formula;

$$P_{d(dBm)} = P_{g(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dB)}$$

Where: P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.

3. The maximum value is calculated by adding the forward power to the calibrated source plus its appropriate gain value.

These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration

4. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
5. 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.

3.4 RADIATED SPURIOUS EMISSIONS

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA-603-E-2016.

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $> 2 \times$ 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 10th harmonics from 9 kHz.

Test Note

1. 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.
2. 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 dat
3. For spurious emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated. The spurious emissions is calculated by the following formula;

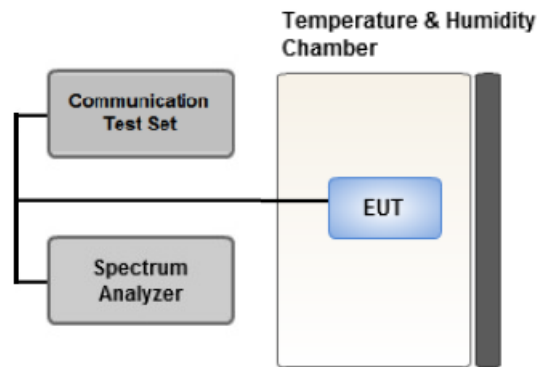
$$\text{Result}_{(\text{dBm})} = P_{g(\text{dBm})} - \text{cable loss}_{(\text{dB})} + \text{antenna gain}_{(\text{dBi})}$$

Where: P_g is the generator output power into the substitution antenna.

If the fundamental frequency is below 1GHz, RF output power has been converted to EIRP.

$$\text{EIRP}_{(\text{dBm})} = \text{ERP}_{(\text{dBm})} + 2.15$$

3.5 PEAK- TO- AVERAGE RATIO



Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth $\geq$ 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 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)

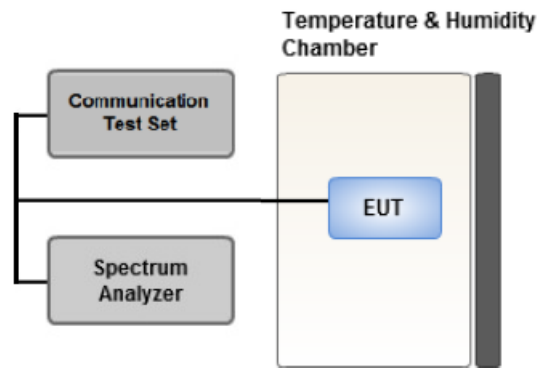
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW $\geq 3 \times$ RBW.

1. Set the RBW $\geq$ OBW.
2. Set VBW $\geq 3 \times$ RBW.
3. Set span $\geq 2 \times$ OBW.
4. Sweep time $\geq 10 \times$ (number of points in sweep) $\times$ (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 $2 \times$ to $3 \times$ the OBW.
2. Set RBW $\geq$ OBW.
3. Set VBW $\geq 3 \times$ RBW.
4. Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
5. Sweep time:
Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$ 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 $[10 \times \log (1/\text{duty cycle})]$ to the measured maximum power level to compute the average power during continuous transmission. For example, add $[10 \times \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25%.

3.6 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.

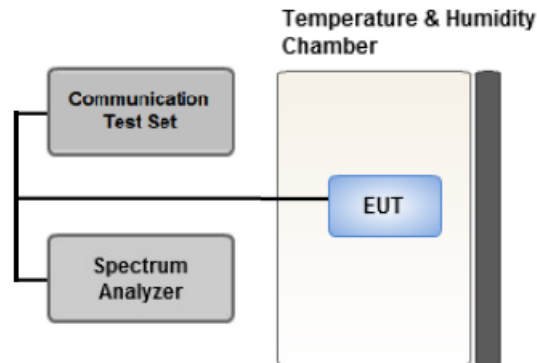
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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 26dB 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 $\geq 3 \times$ 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

3.7 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

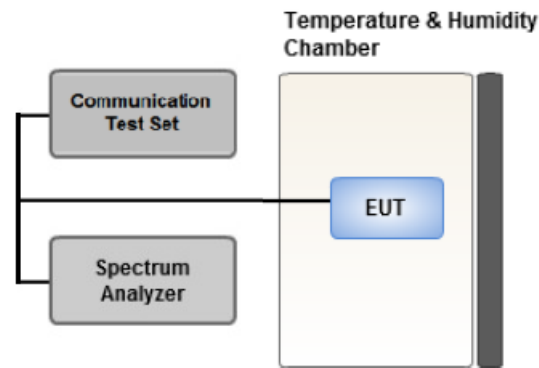
Test Overview

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 $\geq$ 3 MHz
3. Detector = RMS
4. Trace Mode = trace average
5. Sweep time = auto
6. Number of points in sweep $\geq 2 \times \text{Span} / \text{RBW}$

3.8 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 $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

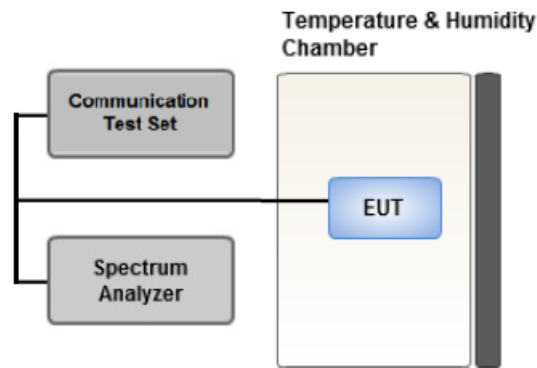
Test Notes

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 $43 + 10 \times \log(P)$ 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.

3.9 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.

3.10 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.
- The worst case is reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the test data.
- Please refer to the table below.

[Worst case]

Test Description	Modulation	RB size	RB offset	Axis
Effective Isotropic Radiated Power	QPSK, 16QAM	1	0	X
Radiated Spurious and Harmonic Emissions	QPSK	1	0	X

3.11 WORST CASE(CONDUCTED TEST)

- All modes of operation were investigated and the worst case configuration results are reported.

[Worst case]

Test Description	Modulation	Bandwidth (MHz)	Frequency	RB size	RB offset
Occupied Bandwidth	QPSK, 16QAM	5, 10, 15, 20	Mid	Full RB	0
Peak-To-Average Ratio	QPSK, 16QAM	5, 10, 15, 20	Mid	Full RB	0
Band Edge	QPSK	5	Low	1	0
			High	1	24
		10	Low	1	0
			High	1	49
		15	Low	1	0
			High	1	74
		20	Low	1	0
			High	1	99
		5, 10, 15, 20	Low, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	QPSK	5, 10, 15, 20	Low, Mid, High	1	0

3.12 RECEIVER SPURIOUS EMISSIONS

Test Procedure of Receiver Spurious Emissions (Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
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. Spectrum Setting
 - (1) Measurement Type(Peak):
 - Measured Frequency Range : 30 MHz – 1 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 100 kHz
 - VBW $\geq$ 3 x RBW
 - (2) Measurement Type(Quasi-peak):
 - Measured Frequency Range : 30 MHz – 1 GHz
 - Detector = Quasi-Peak
 - RBW = 120 kHz
6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

Above 1 GHz

Test Procedure of Radiated spurious emissions (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 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
 - ◆ Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
 - (1) Measurement Type(Peak):
 - Measured Frequency Range : 1 GHz – 25 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW $\geq 3 \times$ RBW
 - (2) Measurement Type(Average):
 - We performed using a reduced video BW method was done with the analyzer in linear mode
 - Measured Frequency Range : 1 GHz – 25 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW $\geq 1/\tau$ Hz, where τ = pulse width in seconds

The actual setting value of VBW = 1 kHz
10. Measurement value only up to 6 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.
11. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Date	Calibration Interval	Calibration Due
Schwarzbeck	UHAP / Precision Dipole Antenna	01273	05/30/2020	Biennial	05/30/2022
Schwarzbeck	UHAP / Precision Dipole Antenna	01274	05/30/2020	Biennial	05/30/2022
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	02289	05/08/2020	Biennial	05/08/2022
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	9120D-1299	05/04/2020	Biennial	05/04/2022
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170342	10/13/2020	Biennial	10/13/2022
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170124	02/11/2020	Biennial	02/11/2022
Rohde & Schwarz	FMZB1513/ Loop Antenna(9kHz~30MHz)	1513-175	05/18/2020	Biennial	05/18/2022
Schwarzbeck	VULB9160/ Bilog Antenna	3150	03/03/2021	Biennial	03/03/2023
Schwarzbeck	VULB9160/ Hybrid Antenna	760	02/22/2021	Biennial	02/22/2023
Wainwright Instruments	WHKX10-900-1000-15000-40SS/ High Pass Filter	15	06/15/2021	Annual	06/15/2022
Wainwright Instruments	WHKX10-2700-3000-18000-40SS/ High Pass Filter	145	06/15/2021	Annual	06/15/2022
Wainwright Instruments	WHNX6-4740-6000-26500-40CC/ High Pass Filter	11	06/15/2021	Annual	06/15/2022
CERNEX	LOW NOISE AMP (100MHz ~ 18GHz)	26822	06/15/2021	Annual	06/15/2022
CERNEX	CBL18265035 / Power Amplifier	22966	12/04/2020	Annual	12/04/2021
CERNEX	CBL26405040 / Power Amplifier	25956	03/23/2021	Annual	03/23/2022
Hewlett Packard	E3632A/DC Power Supply	MY40004427	09/16/2020	Annual	09/16/2021
Hewlett Packard	11667B / Power Splitter(DC~26.5 GHz)	11275	04/07/2021	Annual	04/07/2022
ESPEC	SU-642 / Chamber	93008124	03/15/2021	Annual	03/15/2022
Agilent	N9020A/Signal Analyzer(10Hz~26.5GHz)	MY51110063	04/22/2021	Annual	04/22/2022
Hewlett Packard	8493C/ATTENUATOR(20dB)	17280	06/01/2021	Annual	06/01/2022
REOHDE & SCHWARZ	FSV40/Spectrum Analyzer(10Hz~40GHz)	101436	03/02/2021	Annual	03/02/2022
Agilent	8960 (E5515C)/ Base Station	MY48360800	08/26/2020	Annual	08/26/2021
Anritsu Corp.	MT8821C/Wideband Radio Communication Tester	6262116770	07/12/2021	Annual	07/12/2022
Anritsu Corp.	MT8820C/Wideband Radio Communication Tester	6201026545	01/07/2021	Annual	01/07/2022
REOHDE & SCHWARZ	SMB100A/ SIGNAL GENERATOR (100kHz~40GHz)	177633	07/05/2021	Annual	07/05/2022
KEYSIGHT	N9030B / Signal Analyzer(5Hz~40.0GHz)	MY55480167	06/02/2021	Annual	06/02/2022
HCT CO., LTD.,	FCC LTE Mobile Conducted RF Automation Test Software	-	-	-	-

Note:

- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
- Especially, 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 ($\pm$ dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05

6. SUMMARY OF TEST RESULTS

6.1 Test Condition : Conducted Test

Test Description	FCC Part Section(s)	ISED Section(s)	Test Limit	Test Result
Occupied Bandwidth	§ 2.1049	RSS Gen(6.7)	N/A	NT ^{Note3}
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§ 2.1051, § 27.53(h)	RSS 139(6.6)	< 43 + 10log ₁₀ (P[Watts]) at Band Edge and for all out-of-band emissions	NT ^{Note3}
Conducted Output Power	§ 2.1046	-	N/A	C ^{Note5}
Peak- to- Average Ratio	§ 27.50(d)(5)	RSS 139(6.5)	< 13 dB	NT ^{Note3}
Frequency stability / variation of ambient temperature	§ 2.1055, § 27.54	RSS 139(6.4)	Emission must remain in band	NT ^{Note3}

Note:

1. See SAR Report
2. C = Comply, NT = Not Tested, NA = Not Applicable, NC = Not Comply
3. C2PC models are electrically identical to the Original models.
The Product Equality Declaration includes detailed information about the changes between the devices.
4. 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 the digital circuitry had not adversely affected the previously reported values in the original filing.
5. The same samples were used for EMC

6.2 Test Condition : Radiated Test

Test Description	FCC Part Section(s)	ISED Section(s)	Test Limit	Test Result
Equivalent Isotropic Radiated Power	§ 27.50(d)(4)	RSS 139(6.5)	< 1 Watts max. EIRP	C ^{Note3}
Radiated Spurious and Harmonic Emissions	§ 2.1053, § 27.53(h)	RSS 139(6.6)	< 43 + 10log10 (P[Watts]) for all out-of band emissions	C ^{Note3}
Receiver Spurious Emissions	-	RSS Gen(7)	Section 8.4	PASS

Note:

1. C = Comply, NT = Not Tested, NA = Not Applicable, NC = Not Comply

2. C2PC models are electrically identical to the Original models.

The Product Equality Declaration includes detailed information about the changes between the devices.

3. 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

4. The same samples were used for EMC

7. SAMPLE CALCULATION

7.1 ERP Sample Calculation

Ch./ Freq.		Measured Level(dBm)	Substitute Level(dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
channel	Freq.(MHz)						W	dBm
128	824.20	-21.37	38.40	-10.61	0.95	H	0.483	26.84

$$\text{ERP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test , the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power.

7.2 EIRP Sample Calculation

Ch./ Freq.		Measured Level(dBm)	Substitute Level(dBm)	Ant. Gain (dBi)	C.L	Pol.	EIRP	
channel	Freq.(MHz)						W	dBm
20175	1,732.50	-15.75	18.45	9.90	1.76	H	0.456	26.59

$$\text{EIRP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test , the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of equivalent isotropic radiated power.

7.3. 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 CONDUCTED OUTPUT POWER

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				19975	20175	20375
				1712.5 MHz	1732.5 MHz	1752.5 MHz
5 MHz	QPSK	1	0	22.42	22.52	22.61
		1	12	22.69	22.74	22.64
		1	24	22.53	22.44	22.64
		12	0	21.36	21.42	21.62
		12	6	21.52	21.55	21.61
		12	11	21.58	21.58	21.49
		25	0	21.48	21.53	21.57
	16QAM	1	0	21.41	21.57	21.62
		1	12	21.46	21.31	21.70
		1	24	21.55	21.09	21.82
		12	0	20.51	20.64	20.91
		12	6	20.61	20.83	20.99
		12	11	20.68	20.83	20.87
		25	0	20.58	20.90	20.95

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20000	20175	20350
				1715 MHz	1732.5 MHz	1750 MHz
10 MHz	QPSK	1	0	22.86	23.03	23.12
		1	24	23.19	23.07	23.08
		1	49	22.90	22.91	23.10
		25	0	21.81	21.82	21.87
		25	12	21.91	21.94	21.84
		25	24	21.83	21.85	21.77
		50	0	21.84	21.83	21.81
	16QAM	1	0	21.92	21.59	21.73
		1	24	21.66	21.59	21.70
		1	49	21.52	21.42	21.85
		25	0	20.97	20.88	21.10
		25	12	21.09	21.09	21.00
		25	24	20.97	20.80	20.93
		50	0	20.91	20.79	20.97

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20025	20175	20325
				1717.5 MHz	1732.5 MHz	1747.5 MHz
15 MHz	QPSK	1	0	22.55	22.61	22.90
		1	36	22.83	22.91	23.06
		1	74	22.63	22.76	22.84
		36	0	21.65	21.72	21.72
		36	18	21.69	21.71	21.61
		36	39	21.60	21.68	21.57
		75	0	21.55	21.66	21.61
	16QAM	1	0	20.33	20.89	21.66
		1	36	20.57	20.87	21.03
		1	74	20.95	20.29	21.10
		36	0	19.98	20.15	20.13
		36	18	19.99	20.24	20.11
		36	39	20.12	20.11	19.97
		75	0	20.07	20.10	20.13

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20050	20175	20300
				1720 MHz	1732.5 MHz	1745 MHz
20 MHz	QPSK	1	0	22.72	22.88	23.15
		1	49	23.15	22.93	22.99
		1	99	22.93	22.87	22.98
		50	0	21.86	21.91	21.96
		50	25	21.87	21.91	21.91
		50	49	21.78	21.75	21.85
		100	0	21.82	21.83	21.97
	16QAM	1	0	20.81	20.95	21.29
		1	49	21.06	20.82	21.02
		1	99	21.02	20.94	21.08
		50	0	20.11	20.17	20.29
		50	25	20.12	20.26	20.15
		50	49	20.03	20.10	20.02
		100	0	19.97	20.07	20.04

Mode	Original		C2PC	
	(W)	(dBm)	(W)	(dBm)
LTE Band4 - 5 MHz (QPSK)	0.207	23.17	0.188	22.74
LTE Band4 - 5 MHz (16-QAM)	0.163	22.11	0.152	21.82
LTE Band4 - 10 MHz (QPSK)	0.230	23.62	0.208	23.19
LTE Band4 - 10 MHz (16-QAM)	0.162	22.10	0.156	21.92
LTE Band4 - 15 MHz (QPSK)	0.215	23.33	0.202	23.06
LTE Band4 - 15 MHz (16-QAM)	0.157	21.95	0.147	21.66
LTE Band4 - 20 MHz (QPSK)	0.217	23.37	0.207	23.15
LTE Band4 - 20 MHz (16-QAM)	0.158	21.99	0.135	21.29

8.2 EQUIVALENT ISOTROPIC RADIATED POWER

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBi)	C.L	Pol	Limit	EIRP	
								W	W	dBm
1717.5	LTE B4 15 MHz	QPSK	-21.61	11.38	9.82	2.07	V	< 1.00	0.082	19.13
		16-QAM	-22.85	10.14	9.82	2.07	V		0.062	17.89
QPSK		-21.86	11.38	9.88	2.01	V	0.084		19.25	
16-QAM		-23.05	10.19	9.88	2.01	V	0.064		18.06	
1747.5		QPSK	-21.00	12.36	10.00	2.00	V		0.109	20.36
		16-QAM	-22.27	11.09	10.00	2.00	V		0.081	19.09

Modulation	Ch./ Freq.		Mode	Original	C2PC	Gap
	channel	Freq.(MHz)		dBm	dBm	dB
LTE B4 (15 MHz)	20025	1717.5	QPSK	17.50	19.13	-1.63
			16-QAM	16.33	17.89	-1.56
	20175	1732.5	QPSK	19.32	19.25	0.07
			16-QAM	18.06	18.06	0.00
	20325	1747.5	QPSK	17.80	20.36	-2.56
			16-QAM	16.49	19.09	-2.60

8.3 RADIATED SPURIOUS EMISSIONS

□ MODE: LTE B4
 □ MODULATION SIGNAL: 5 MHz QPSK
 □ DISTANCE: 3 meters

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit (dBm)
19975 (1712.5)	3 425.00	-46.09	11.30	-47.18	3.02	V	-38.90	-13.00
	5 137.50	-47.38	11.36	-41.91	3.70	V	-34.25	-13.00
	6 850.00	-62.77	11.20	-51.78	4.39	V	-44.97	-13.00
20175 (1732.5)	3 465.00	-43.03	11.36	-44.75	3.02	V	-36.40	-13.00
	5 197.50	-49.52	11.50	-44.59	3.88	V	-36.97	-13.00
	6 930.00	-63.03	11.10	-50.98	4.32	V	-44.20	-13.00
20375 (1752.5)	3 505.00	-41.19	11.52	-43.09	3.06	V	-34.63	-13.00
	5 257.50	-48.72	11.62	-44.03	3.73	V	-36.14	-13.00
	7 010.00	-64.44	11.20	-51.66	4.33	H	-44.79	-13.00

Mode	Ch.	Freq.(MHz)	Result (dBm)	Margin (dB)	Original Result	Gap
					(dBm)	(dB)
LTE B4 QPSK 5 MHz	19975	3 425.00	-38.90	25.90	-43.69	-4.79
	1712.5	5 137.50	-34.25	21.25	-28.04	6.21
		6 850.00	-44.97	31.97	-41.94	3.03
	20175	3 465.00	-36.40	23.40	-38.96	-2.56
	1732.5	5 197.50	-36.97	23.97	-35.09	1.88
		6 930.00	-44.20	31.20	-39.12	5.08
	20375	3 505.00	-34.63	21.63	-37.97	-3.34
	1752.5	5 257.50	-36.14	23.14	-31.67	4.47
		7 010.00	-44.79	31.79	-43.22	1.57

8.4 RECEIVER SPURIOUS EMISSIONS

Frequency Range : 30 MHz ~ 1 GHz

Frequency	Reading	Ant. factor+Cable loss- Amp Gain	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	(H/V)	dB μ V/m	dB μ V/m	dB

No Peak Found

Frequency Range : Above 1 GHz

Frequency	Reading	Ant. factor+Cable loss- Amp Gain	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	(H/V)	dB μ V/m	dB μ V/m	dB

No Peak Found

Limit

Frequency (MHz)	Field Strength (μ V/m at 3 meters)
30 – 88	100
88 - 216	150
216 – 960	200
Above 960	500

9. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2107-FI006-P