

ANNEX B_EMI TEST RESULT

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	August 07, 2019	Initial Release

The device bearing the trade name and model specified above, has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2014. (See Test Report if any modifications were made for compliance)

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

HCT certifies that no party to application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 862

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1. GENERAL INFORMATION

1.1 Details of Support Equipment

All equipment descriptions used in the tested system (including inserted cards) are:

Device Type	Model Name	Manufacturer	Tech. Information
EUT	SM-A507FN/DS	SAMSUNG	-
TA	EP-TA200	-	Input: AC 100~240 V, 50~60 Hz, 0.5 A Output: DC 9.0 V, 1.67 A or DC 5.0 V, 2.0 A
Data Cable	EP-DR140ABE	-	-
Earphone	EHS61ASFBE	-	-
Micro SD Card	-	-	-

1.2 Cable Description

Product Name	Port	Power Cord Shielded (Y/N)	I/O Cable Shielded (Y/N)	Length (m)
EUT	USB Type C	Y	N/A	(P) 1.0
	Earphone	N/A	N	(D) 1.2

NOTE. The marked “(D)” means the data cable and “(P)” means the power cable.

1.3 Noise Suppression Parts on Cable (I/O Cable)

Product Name	Port	Ferrite Bead (Y/N)	Location	Metal Hood (Y/N)	Location
EUT	USB Type C	N	N/A	Y	Both End
	Earphone	N	N/A	Y	EUT End

1.4 Test Facility

Test site is located at 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, South Korea. Those measurement facilities are constructed in conformance with the requirements of ANSI C63.4-2014. The Normalized site attenuations (30 MHz to 1 GHz) and Site validation (1 GHz to 18 GHz) were performed in accordance with the standard in ANSI C63.4-2014

Measurement Facilities	Designation No.
Radiated Field strength measurement facility 3 m Semi Anechoic chamber	KR0032
Radiated Field strength measurement facility 10 m Semi Anechoic chamber #1	
Radiated Field strength measurement facility 10 m Semi Anechoic chamber #2	

1.5 Calibration of Measuring Instrument

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturers recommendations for utilizing calibration equipment, which is traceable to recognized national standards. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5:2017

1.6 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
Conducted Emission (0.15 MHz to 30 MHz)	1.8 dB
Radiated Emissions (30 MHz to 1 GHz)	4.8 dB
Radiated Emissions (1 GHz to 18 GHz)	5.4 dB
Radiated Emissions (18 GHz to 40 GHz)	5.7 dB

2. DESCRIPTION OF TEST

2.1 Measurement of Conducted Emission

The test procedure was in accordance with ANSI C63.4-2014, Clause 7.3

- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN).
If the EUT is connected to the PC through USB, the AC power-line adapter of the PC is directly connected to a line impedance stabilization network (LISN).
Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both conducted lines are measured in Quasi-Peak and Average mode, including the worst-case data points for each tested configuration.
- c. The frequency range from 150 kHz to 30 MHz was searched.

Conducted Emission Limits

Frequency (MHz)	Resolution Bandwidth (kHz)	Class A		Class B	
		Quasi-Peak (dB V)	Average (dB V)	Quasi-Peak (dB V)	Average (dB V)
0.15 to 0.5	9	79	66	66 to 56*	56 to 46*
0.5 to 5	9	73	60	56	46
5 to 30	9	73	60	60	50

NOTE. Decreases with the logarithm of the frequency.

2.2 Measurement of Radiated Emission

The test procedure was in accordance with ANSI C63.4-2014, Clause 8.3

- a. The EUT was placed on the top of a turn table 0.8 meters above the ground at a semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from 1 m to 4 m above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 m to 4 m and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to Peak and Average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.
- g. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. (1 GHz to 40 GHz)

Radiated Emission Limits

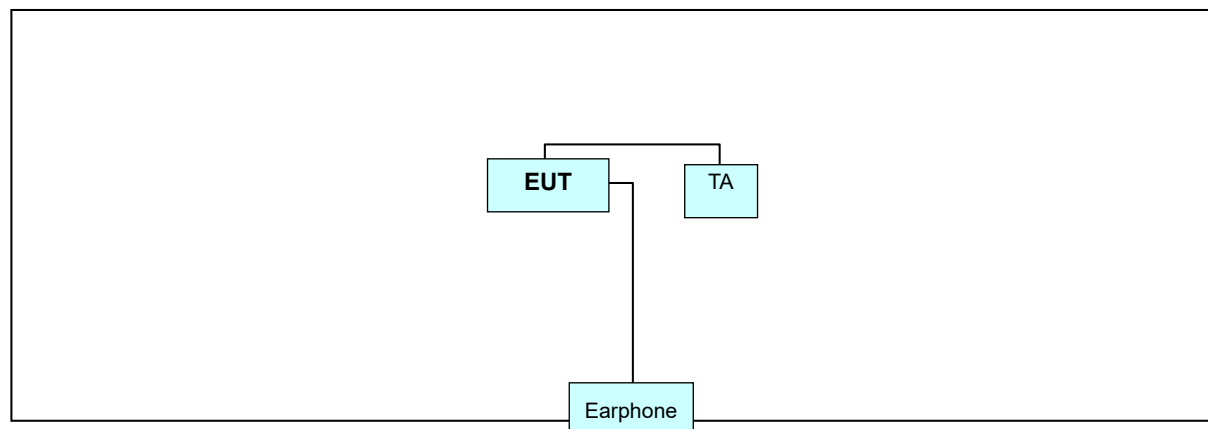
Frequency (MHz)	Class A			Class B		
	Antenna Distance (m)	Field Strength (V/m)	Quasi-Peak (dB V/m)	Antenna Distance (m)	Field Strength (V/m)	Quasi-Peak (dB V/m)
30 to 88	10	90	39.0	3	100	40.0
88 to 216	10	150	43.5	3	150	43.5
216 to 960	10	210	46.4	3	200	46.0
Above 960	10	300	49.5	3	500	54.0
Frequency (MHz)	Antenna Distance (m)	Class A		Class B		
		Peak (dB V/m)	Average (dB V/m)	Peak (dB V/m)	Average (dB V/m)	
Above 1 000	3	80	60	74	54	

2.2.1 Frequency Range of Radiated Measurements

An unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a Radiated Emission limit is specified, up to the frequency shown in the following table

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 to 108	1 000
108 to 500	2 000
500 to 1 000	5 000
Above 1 000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

2.3 Configuration of Tested System



Non-Conductive Table

Power Line: 120 VAC, 60 Hz

3. PRELIMINARY TEST

During preliminary tests, the following operating mode was investigated.

GSM 850 Idle (Low/Middle/High CH)

WCDMA 850 (Low/Middle/High CH)

LTE B5 Idle (Low/Middle/High CH)

NOTE. The worst band is tested.

3.1 Conducted Emission

It was tested the following operating mode, after connecting all peripheral devices.

Operating Mode: Receiver mode (LTE B5 Low CH Idle)

3.2 Radiated Emission

It was tested the following operating mode, after connecting all peripheral devices.

Operating Mode:

30 MHz to 1 GHz

Receiver mode (LTE B5 Low CH Idle)

Receiver mode (LTE B5 Middle CH Idle)

Receiver mode (LTE B5 High CH Idle)

1 GHz to 30 GHz

Receiver mode (LTE B5 Low CH Idle)

NOTE.

1. Three orientations have been investigated and the worst case orientation is reported.

2. The worst case of operating mode is reported.

4. CONDUCTED EMISSION AND RADIATED EMISSION TEST SUMMARY

4.1 Conducted Emission

4.1.1 Measuring instruments

	Type	Manufacturer	Model Name	Serial Number	Calibration Cycle	Calibration Date
☒	EMI Test Receiver	Rohde & Schwarz	ESCI	100584	1 year	06.18.2019
☒	LISN	Rohde & Schwarz	ENV216	102245	1 year	12.12.2018
☒	RADIO COMMUNICATION ANALYZER	ANRITSU	MT8820C	6201138643	1 year	08.21.2018
☒	ANTENNA(for Communication)	USLP9142	Schwarzbeck	VSLP 9142-200	-	-
☒	Software	Rohde & Schwarz	EMC32	-	-	-

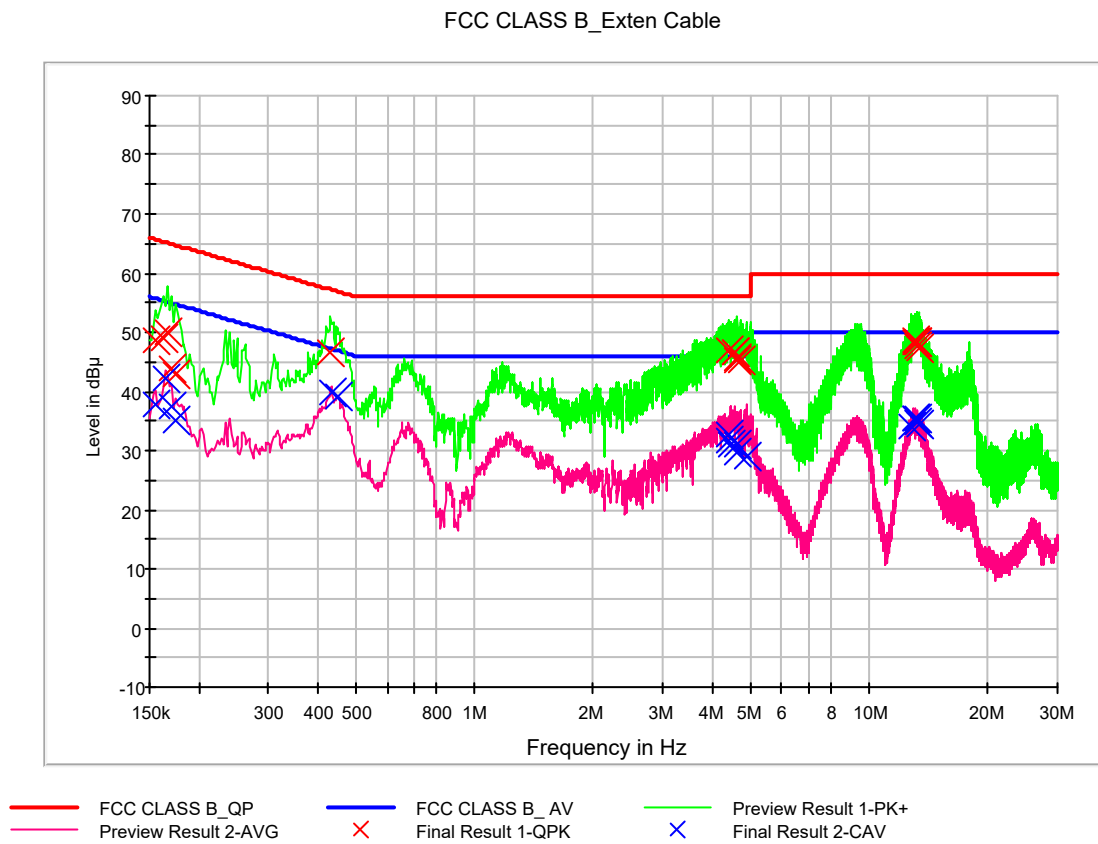
4.1.2 Operating Condition

The test results of conducted emission at mains ports provide the following information:

Test Standard Used	FCC CFR 47 PART 15 Subpart B Class B ANSI C63.4-2014
Detector	Quasi-Peak, CISPR-Average
Bandwidth	9 kHz (6 dB)
Operating Mode	Receiver mode (LTE B5 Low CH Idle)
Kind of Test Site	Shielded Room
Temperature	22.5 °C
Relative Humidity	43.7 %
Test Date	August 06, 2019

4.1.3 Measuring Data

Figure 1: Conducted Emission, Receiver mode(LTE B5 Low ch Idle), Line (L1)



QuasiPeak Final Result, Line (L1)

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.156000	48.8	9.000	L1	9.8	16.9	65.7
0.162000	49.0	9.000	L1	9.8	16.3	65.4
0.166000	50.0	9.000	L1	9.8	15.2	65.2
0.170000	43.8	9.000	L1	9.8	21.2	65.0
0.174000	42.8	9.000	L1	9.8	21.9	64.8
0.432000	46.7	9.000	L1	9.8	10.5	57.2
4.418000	46.8	9.000	L1	10.0	9.2	56.0
4.556000	46.4	9.000	L1	10.0	9.6	56.0
4.576000	46.6	9.000	L1	10.0	9.4	56.0
4.620000	45.4	9.000	L1	10.0	10.6	56.0
4.644000	45.7	9.000	L1	10.0	10.3	56.0
4.738000	45.4	9.000	L1	10.1	10.6	56.0
13.046000	48.7	9.000	L1	10.4	11.3	60.0
13.152000	48.3	9.000	L1	10.4	11.7	60.0
13.226000	48.2	9.000	L1	10.4	11.8	60.0
13.232000	48.3	9.000	L1	10.4	11.7	60.0
13.286000	47.7	9.000	L1	10.4	12.3	60.0
13.308000	47.3	9.000	L1	10.4	12.7	60.0

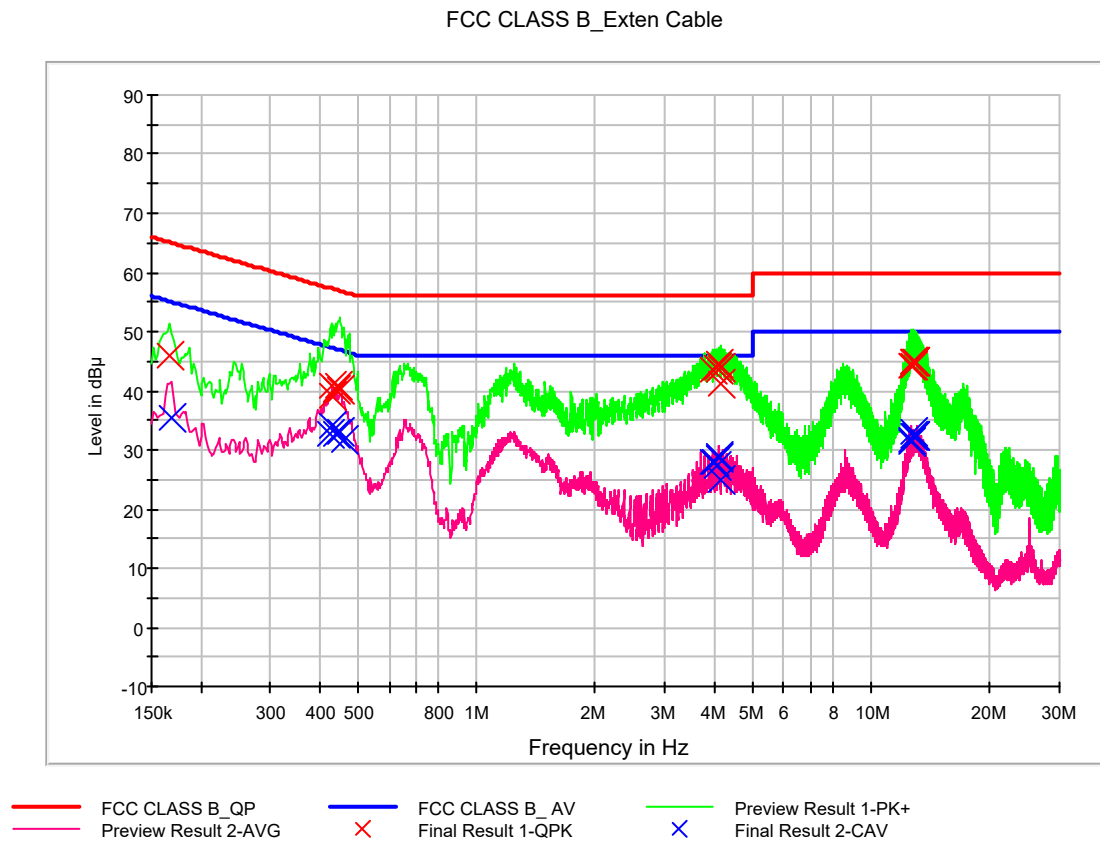
-Calculation Formula:

1. Conductor L1 = Hot, Conductor N = Neutral
2. Corr. = LISN Factor + Cable Loss
3. QuasiPeak or CAverage= Receiver Reading + Corr.
4. Margin = Limit – QuasiPeak or CAverage

CAverage Final Result, Line (L1)

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.156000	37.9	9.000	L1	9.8	17.8	55.7
0.164000	42.1	9.000	L1	9.8	13.2	55.3
0.170000	37.4	9.000	L1	9.8	17.5	55.0
0.174000	35.2	9.000	L1	9.8	19.6	54.8
0.434000	39.8	9.000	L1	9.8	7.4	47.2
0.450000	39.2	9.000	L1	9.8	7.6	46.9
4.386000	31.9	9.000	L1	10.0	14.1	46.0
4.396000	32.8	9.000	L1	10.0	13.2	46.0
4.470000	31.1	9.000	L1	10.0	14.9	46.0
4.604000	29.7	9.000	L1	10.0	16.3	46.0
4.620000	31.0	9.000	L1	10.0	15.0	46.0
4.896000	29.1	9.000	L1	10.1	16.9	46.0
12.746000	34.2	9.000	L1	10.4	15.8	50.0
13.046000	35.4	9.000	L1	10.4	14.6	50.0
13.152000	35.4	9.000	L1	10.4	14.6	50.0
13.160000	35.3	9.000	L1	10.4	14.7	50.0
13.232000	34.8	9.000	L1	10.4	15.2	50.0
13.308000	34.4	9.000	L1	10.4	15.6	50.0

Figure 2: Conducted Emission, AC Main Port, Line (N)



QuasiPeak Final Result, Line (N)

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.166000	45.9	9.000	N	9.9	19.3	65.2
0.428000	39.2	9.000	N	9.9	18.1	57.3
0.432000	40.7	9.000	N	9.9	16.5	57.2
0.438000	40.0	9.000	N	10.0	17.1	57.1
0.444000	40.8	9.000	N	10.0	16.2	57.0
0.450000	40.3	9.000	N	10.0	16.6	56.9
3.968000	43.7	9.000	N	10.2	12.3	56.0
4.050000	43.9	9.000	N	10.2	12.1	56.0
4.122000	43.5	9.000	N	10.2	12.5	56.0
4.130000	44.6	9.000	N	10.2	11.4	56.0
4.134000	44.0	9.000	N	10.2	12.0	56.0
4.142000	41.3	9.000	N	10.2	14.7	56.0
12.698000	44.1	9.000	N	10.6	15.9	60.0
12.816000	44.9	9.000	N	10.6	15.1	60.0
12.820000	44.8	9.000	N	10.6	15.2	60.0
12.834000	44.1	9.000	N	10.6	15.9	60.0
12.902000	44.9	9.000	N	10.6	15.1	60.0
12.906000	44.7	9.000	N	10.6	15.3	60.0

-Calculation Formula:

1. Conductor L1 = Hot, Conductor N = Neutral
2. Corr. = LISN Factor + Cable Loss
3. QuasiPeak or CAverage= Receiver Reading + Corr.
4. Margin = Limit – QuasiPeak or CAverage

CAverage Final Result, Line (N)

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.168000	35.5	9.000	N	9.9	19.6	55.1
0.424000	32.7	9.000	N	9.9	14.6	47.4
0.432000	33.9	9.000	N	9.9	13.3	47.2
0.442000	32.7	9.000	N	10.0	14.3	47.0
0.452000	33.2	9.000	N	10.0	13.6	46.8
0.462000	31.5	9.000	N	10.0	15.1	46.7
3.968000	27.8	9.000	N	10.2	18.2	46.0
4.026000	28.0	9.000	N	10.2	18.0	46.0
4.050000	27.2	9.000	N	10.2	18.8	46.0
4.122000	28.5	9.000	N	10.2	17.5	46.0
4.130000	29.1	9.000	N	10.2	16.9	46.0
4.142000	25.0	9.000	N	10.2	21.0	46.0
12.686000	31.5	9.000	N	10.6	18.5	50.0
12.698000	31.8	9.000	N	10.6	18.2	50.0
12.816000	33.1	9.000	N	10.6	16.9	50.0
12.820000	32.4	9.000	N	10.6	17.6	50.0
12.898000	32.2	9.000	N	10.6	17.8	50.0
12.936000	32.5	9.000	N	10.6	17.5	50.0

4.2 Radiated Emission Below 1 GHz

4.2.1 Measuring instruments

	Type	Manufacturer	Model Name	Serial Number	Calibration Cycle	Calibration Date
☒	EMI test receiver	Rohde & Schwarz	ESU40	100524	1 year	2019.05.17
☒	Trilog antenna	Schwarzbeck	VULB 9168	255	2 year	03.26.2019
☒	Antenna master	INNCO Systems	MA4640-XP-ET	-	N/A	-
☒	Antenna master controller	INNCO Systems	CO 3000	CO3000/870/ 35990515/L	N/A	-
☒	Turn Table	INNCO Systems	1060	-	N/A	-
☒	Turn table controller	INNCO Systems	CO2000	CO2000/095/ 7590304/L	N/A	-
☒	RADIO COMMUNICATION ANALYZER	ANRITSU	MT8820C	6201138643	1 year	08.21.2018
☒	Antenna (for Communication)	Schwarzbeck	USLP9142	VSLP 9142-200	-	-
☒	Software	Rohde & Schwarz	EMC32	-	-	-

4.2.2 Operating Condition

The test results of radiated emission provide the following information:

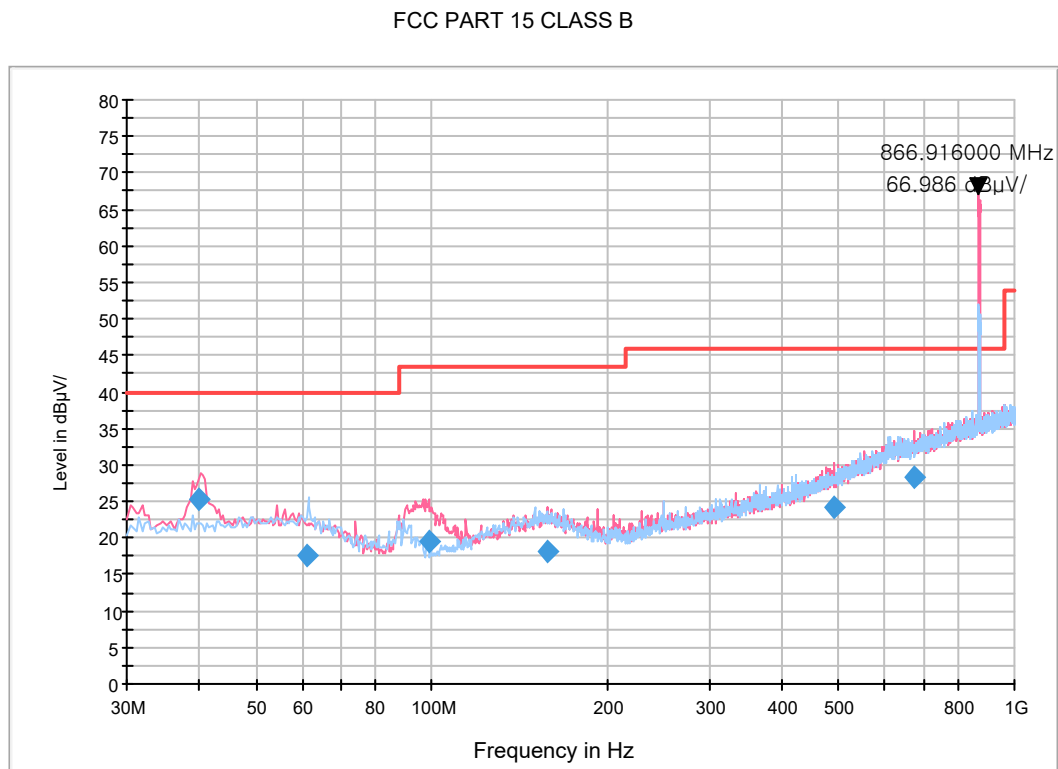
Used Test Standard	FCC CFR 47 PART 15 Subpart B Class B ANSI C63.4-2014
Detector	Quasi-Peak
Bandwidth	120 kHz (6 dB)
Worst Case of Operating Mode	Receiver mode (LTE B5 Low CH Idle)
Kind of Test Site	3 m semi anechoic chamber
Temperature	22.9 °C
Relative Humidity	41.5 %
Test Date	August 02, 2019

- Calculation Formula:

1. POL. H = Horizontal, POL. V = Vertical
2. QuasiPeak = Reading (Receiver Reading) + Corr.
3. Corr. (Correction Factor) = Antenna Factor + Cable Loss
4. Margin = Limit - QuasiPeak

4.2.3 Measuring Data

Figure 3: Radiated Emission, Receiver mode (LTE B5 Low CH Idle)



- note. 1. LTE B5 Low ch Rx Frequency: 866.916 MHz
 2. These are signals for fundamental frequency from the base station

Frequency (MHz)	Quasi Peak (dB V/m)	Antenna Height (cm)	POL. (H/V)	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB V/m)
39.959200	25.3	100.0	V	76.0	19.0	14.7	40.0
60.938400	17.7	174.9	H	319.0	19.3	22.3	40.0
98.836800	19.6	100.0	V	6.0	15.1	23.9	43.5
158.342400	18.2	191.8	V	286.0	19.8	25.3	43.5
491.516000	24.3	174.8	V	239.0	25.1	21.7	46.0
675.072000	28.4	100.0	V	246.0	28.5	17.6	46.0

4.3 Radiated Emission Above 1 GHz

4.3.1 Measuring instruments

	Type	Manufacturer	Model Name	Serial Number	Calibration Cycle	Calibration Date
☒	EMI test receiver	Rohde & Schwarz	ESU40	100524	1 year	2019.05.17
☒	Antenna master	INNCO Systems	MA4640-XP-ET	-	N/A	-
☒	Antenna master controller	INNCO Systems	CO3000	CO3000/870/ 35990515/L	N/A	-
☒	Turn table	INNCO Systems	1060	-	N/A	-
☒	Turn table controller	INNCO Systems	CO2000	CO2000/095/ 7590304/L	N/A	-
☒	Horn antenna	Schwarzbeck	BBHA 9120D	01836	1 year	07.19.2019
☒	Low Noise amplifier	TESTEK	TK-PA18H	170034-L	1 year	03.04.2019
☒	Power Amplifier	TESTEK	TK-PA1840H	170030-L	1 year	12.17.2019
☒	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170 #786	2 year	12.05.2017
☒	RADIO COMMUNICATION ANALYZER	ANRITSU	MT8820C	6201138643	1 year	08.21.2018
☒	ANTENNA (for Communication)	Schwarzbeck	USLP9142	VSLP 9142-200	-	-
☒	Software	Rohde & Schwarz	EMC32	-	-	-

4.3.2 Operating Condition

The test results of radiated emission provide the following information:

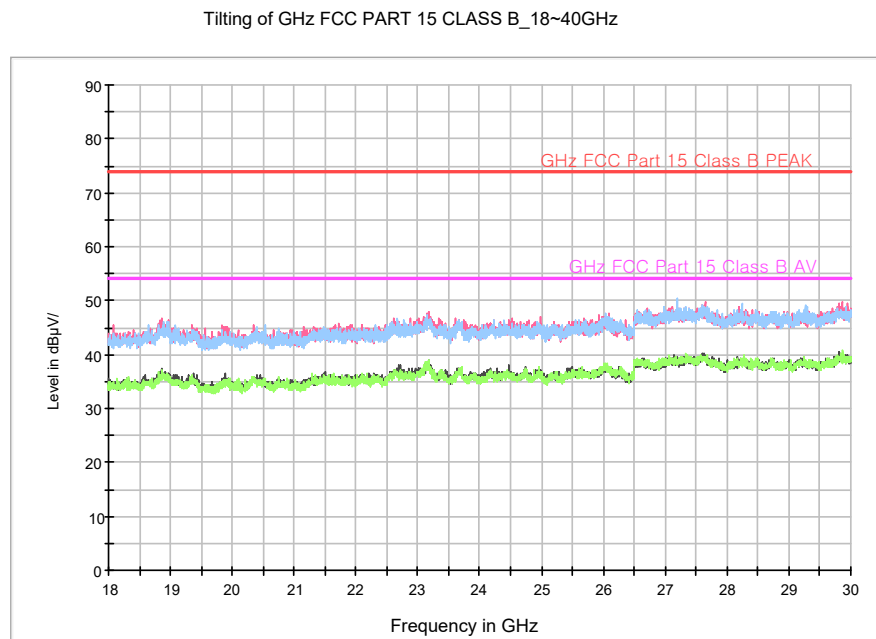
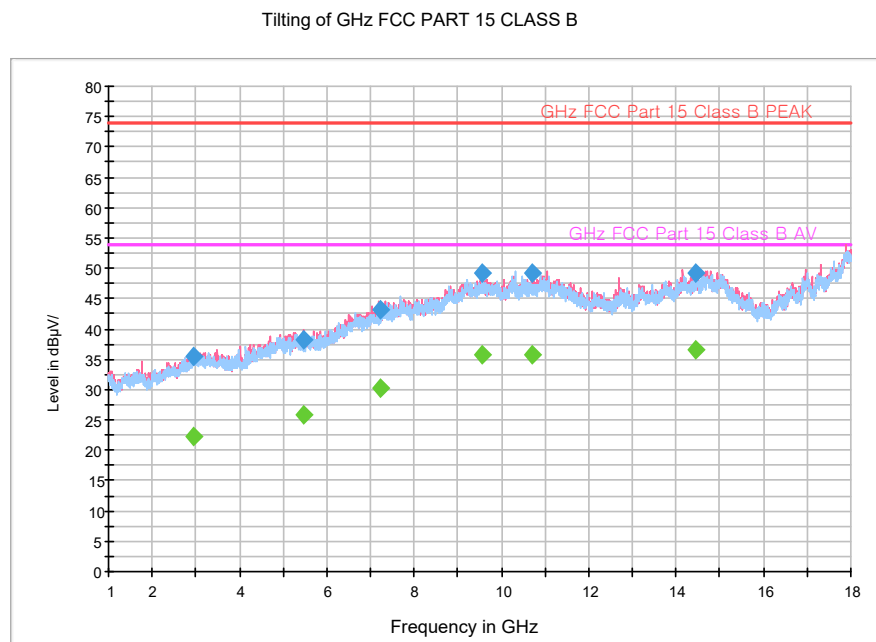
Used Test Standard	FCC CFR 47 PART 15 Subpart B Class B ANSI C63.4-2014
Detector	Peak mode: Peak (RBW: 1 MHz, VBW: 3 MHz) CISPR-Average mode: Peak (RBW: 1 MHz, VBW: 10 Hz)
Highest Frequency	5 825 MHz
Tested Frequency Range	1 GHz to 30 GHz
Operation Mode	Receiver mode (LTE B5 Low CH Idle)
Kind of Test Site	3 m semi anechoic chamber
Temperature	22.9 °C
Relative Humidity	41.5 %
Test Date	August 02, 2019

- Calculation Formula:

1. POL. H = Horizontal, POL. V = Vertical
2. Peak or CAverage = Reading (Receiver Reading) + Corr.
3. Corr. (Correction Factor) = Antenna Factor+ Cable Loss –Amplifier Gain
4. Margin = Limit - Peak or CAverage

4.3.3 Measuring Data

Figure 4: Radiated Emission, Receiver mode (LTE B5 Low CH Idle)



Frequency (MHz)	Peak (dB V/m)	Antenna Height (cm)	POL. (H/V)	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB V/m)
2961.03500	35.3	149.6	V	208.0	-21.2	38.7	74.0
5458.16000	38.3	139.6	V	0.0	-15.2	35.7	74.0
7224.03500	43.2	174.5	V	230.0	-10.0	30.8	74.0
9553.54000	49.2	139.6	V	21.0	-5.1	24.8	74.0
10690.36500	49.3	113.4	V	3.0	-3.0	24.7	74.0
14451.42500	49.1	149.6	H	269.0	0.6	24.9	74.0

Frequency (MHz)	CAverage (dB V/m)	Antenna Height (cm)	POL. (H/V)	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB V/m)
2961.03500	22.2	149.6	V	208.0	-21.2	31.8	54.0
5458.16000	26.0	139.6	V	0.0	-15.2	28.0	54.0
7224.03500	30.4	174.5	V	230.0	-10.0	23.6	54.0
9553.54000	35.7	139.6	V	21.0	-5.1	18.3	54.0
10690.36500	35.6	113.4	V	3.0	-3.0	18.4	54.0
14451.42500	36.5	149.6	H	269.0	0.6	17.5	54.0

5. EMI Test Setup Photo

Please refer to EMI Test Setup Photo file no. as follows;

Revision No.	Date of Issue	File No.
0	August 07, 2019	HCT-RF-1908-FC010-P

End of report