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# FCC UNII REPORT

## Class II Permissive Change

**Applicant Name:**
SAMSUNG Electronics Co., Ltd.

**Address:**
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

**Date of Issue:**
April 30, 2019
**Location:**
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
**Report No.:** HCT-RF-1904-FC054

| | |
|---|---|
| **FCC ID:** | **A3LSMA6060** |
| **APPLICANT:** | **SAMSUNG Electronics Co., Ltd.** |

| | |
|---|---|
| **Model:** | SM-A6060 |
| **Additional Model:** | SM-M405F/DS |
| **EUT Type:** | Mobile Phone |
| **Modulation type** | OFDM |
| **FCC Classification:** | Unlicensed National Information Infrastructure(UNII) |
| **FCC Rule Part(s):** | Part 15.407 |

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. 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)

**Report prepared by : Jung Ki Lim**
**Engineer of Telecommunication testing center**

**Approved by : Jong Seok Lee**
**Manager of Telecommunication testing center**

# Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|---|---|---|
| HCT-RF-1904-FC054 | April 30, 2019 | - First Approval Report |
| | | |
| | | |

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# 1. GENERAL INFORMATION

## EUT DESCRIPTION

| | | |
|---|---|---|
| Model | SM-A6060 | |
| Additional Model | SM-M405F/DS | |
| EUT Type | Mobile Phone | |
| Power Supply | DC 3.85 V | |
| Battery Information | Model: EB-BA606ABN<br>Type: Li-ion battery | |
| Travel Adapter Information | Model : EP-TA200<br>Manufacture: DYREL | |
| Modulation Type | OFDM : 802.11a, 802.11n, 802.11ac | |
| Frequency Range (MHz) | UNII 1 | 20MHz BW : 5180 - 5240<br>40MHz BW : 5190 - 5230<br>80MHz BW : 5210 |
| | UNII 2A | 20MHz BW : 5260 - 5320<br>40MHz BW : 5270 - 5310<br>80MHz BW : 5290 |
| | UNII 2C | 20MHz BW : 5500 - 5720<br>40MHz BW : 5510 - 5710<br>80MHz BW : 5530 – 5690 |
| | UNII 3 | 20MHz BW : 5745 - 5825<br>40MHz BW : 5755 - 5795<br>80MHz BW : 5775 |
| Antenna Type | FPCB | |
| Antenna Peak gain (dBi) | -0.68 dBi | |
| Straddle channel | Supported | |
| TDWR Band | Supported | |
| Dynamic Frequency Selection | Slave without radar detection | |
| Date(s) of Tests | January 31, 2019 ~ March 11, 2019 (SM-A6060)<br>April 15, 2019 ~ April 26, 2019 (SM-M405F/DS) | |

# 2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

| Band | Mode | RF Output Power (dBm) | RF Output Power (W) |
|---|---|---|---|
| UNII1 | 802.11a | 14.25 | 0.027 |
| | 802.11n (HT20) | 13.25 | 0.021 |
| | 802.11n (HT40) | 11.05 | 0.013 |
| | 802.11ac (VHT20) | 11.34 | 0.014 |
| | 802.11ac (VHT40) | 8.99 | 0.008 |
| | 802.11ac (VHT80) | 9.59 | 0.009 |
| UNII2A | 802.11a | 14.31 | 0.027 |
| | 802.11n (HT20) | 13.57 | 0.023 |
| | 802.11n (HT40) | 11.38 | 0.014 |
| | 802.11ac (VHT20) | 11.64 | 0.015 |
| | 802.11ac (VHT40) | 9.10 | 0.008 |
| | 802.11ac (VHT80) | 9.82 | 0.010 |
| UNII2C | 802.11a | 14.32 | 0.027 |
| | 802.11n (HT20) | 13.36 | 0.022 |
| | 802.11n (HT40) | 11.17 | 0.013 |
| | 802.11ac (VHT20) | 11.58 | 0.014 |
| | 802.11ac (VHT40) | 8.94 | 0.008 |
| | 802.11ac (VHT80) | 9.90 | 0.010 |
| UNII3 | 802.11a | 14.11 | 0.026 |
| | 802.11n (HT20) | 13.57 | 0.023 |
| | 802.11n (HT40) | 10.97 | 0.012 |
| | 802.11ac (VHT20) | 11.30 | 0.014 |
| | 802.11ac (VHT40) | 9.25 | 0.008 |
| | 802.11ac (VHT80) | 9.58 | 0.009 |

# 3. TEST METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part15, Subpart E” and ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’ were used in the measurement.

## EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

## EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

## GENERAL TEST PROCEDURES

**Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

**Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013)

## DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

# 4. 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's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

# 5. FACILITIES AND ACCREDITATIONS

## 5.1 FACILITIES

The SAC(Semi-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. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

## 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

# 6. ANTENNA REQUIREMENTS

**According to FCC 47 CFR §15.203, §15.407:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

* The antennas of this E.U.T are permanently attached.
* The E.U.T Complies with the requirement of §15.203, §15.407

# 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k$ = 2 to indicate a 95 % level of confidence.

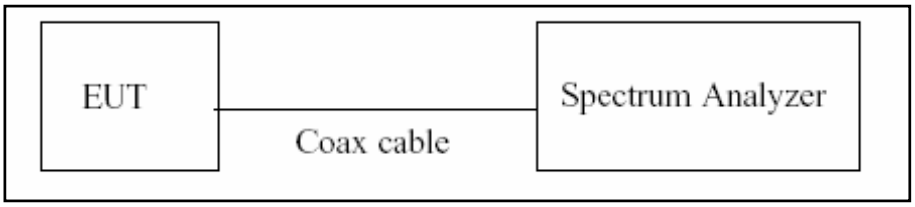
The measurement data shown herein meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded Uncertainty (±dB) |
|---|---|
| Conducted Disturbance (150 kHz ~ 30 MHz) | 1.82 |
| 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) | 5.71 |

# 8. DESCRIPTION OF TESTS

### 8.1. Duty Cycle

**Test Configuration**




**Test Procedure**

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure B.2 in KDB 789033 D02 v02r01.

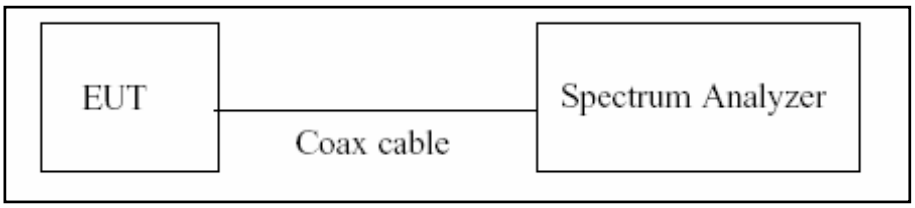
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure $T_{total}$ and $T_{on}$
8. Calculate Duty Cycle = $T_{on}$/ $T_{total}$ and Duty Cycle Factor = 10*log(1/Duty Cycle)

### 8.2. Bandwidth Measurement

**Limit**

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

**Test Configuration**




**Test Procedure(26dB Bandwidth)**

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure C.1 in KDB 789033 D02 v02r01.

1. RBW = approximately 1 % of the emission bandwidth
2. VBW > RBW
3. Detector = Peak
4. Trace mode = max hold
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

**Test Procedure(6dB Bandwidth)**

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure C.2 in KDB 789033 D02 v02r01.

1. RBW = 100 kHz
2. VBW ≥ 3*RBW
3. Detector = Peak
4. Trace mode = max hold
5. Allow the trace to stabilize
6. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points(upper and lower frequencies) that are attenuated by 6 dB relative to the maximum lever measured in the fundamental emission.

**Note:**

1. We tested X dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer.
2. DFS test channels should be defined. So, We performed the OBW test to prove that no part of the fundamental emissions of any channels belong to UNII1 and UNII3 band for DFS.
3. The 26 dB bandwidth is used to determine the conducted power limits.

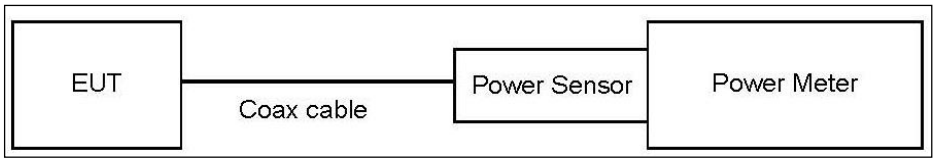
### 8.3. Output Power Measurement

**Limit**

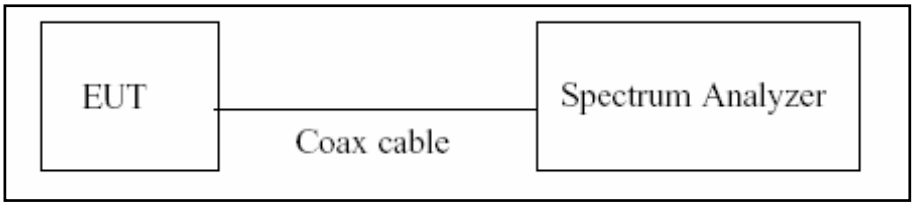
| Band | Limit |
|---|---|
| UNII 1 | - Master : Not exceed 1 W(=30dBm)<br>- Slave : Not exceed 250 mW(=23.98 dBm) |
| UNII 2A, 2C | Not exceed the lesser of 250 mW or 11 dBm + 10 log B,<br>(where B is the 26 dB emission bandwidth in megahertz.) |
| UNII 3 | Not exceed 1 W(=30dBm) |

**Test Configuration**

Power Meter




Spectrum Analyzer(Only Straddle Channel)




**Test Procedure(Power Meter)**

We tested according to Procedure E.3.a in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

**Test Procedure(Spectrum Analyzer)**

The transmitter output is connected to the Spectrum Analyzer.

We use the spectrum analyzer's integrated band power measurement function.

We tested according to Procedure E.2.d) in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Set span to encompass the 26 dB EBW of the signal.
3. RBW = 1 MHz.
4. VBW ≥ 3 MHz.
5. Number of points in sweep ≥ 2*span/RBW.
6. Sweep time = auto.
7. Detector = RMS.
8. Do not use sweep triggering. Allow the sweep to "free run".
9. Trace average at least 100 traces in power averaging(RMS) mode
10. Integrated bandwidth = OBW
11. Add 10log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

**Sample Calculation**

Total Power(dBm) = Reading Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

**Note**

1. Spectrum reading values are not plot data.
   The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. Actual value of loss for the attenuator and cable combination is below table.

| Band | Loss(dB) |
|---|---|
| UNII 1 | 11.1 |
| UNII 2A | 11.1 |
| UNII 2C | 11.1 |
| UNII 3 | 11.1 |

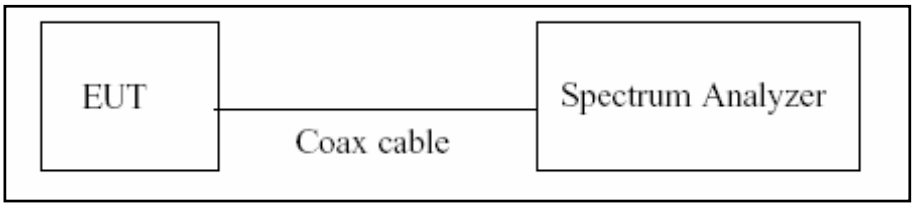
(Actual value of loss for the attenuator and cable combination)

### 8.4. Power Spectral Density

**Limit**

| Band | Limit |
|---|---|
| UNII 1 | 11 dBm/MHz |
| UNII 2A, 2C | 11 dBm/MHz |
| UNII 3 | 30 dBm/500 kHz |

**Test Configuration**




**Test Procedure**

We tested according to Procedure F in KDB 789033 D02 v02r01.

1. Set span to encompass the entire emission bandwidth(EBW) of the signal.
2. RBW = 1 MHz(510 kHz for UNII 3)
3. VBW ≥ 3 MHz
4. Number of points in sweep ≥ 2*span/RBW.
5. Sweep time = auto.
6. Detector = RMS(i.e., power averaging), if available. Otherwise, use sample detector mode.
7. Do not use sweep triggering. Allow the sweep to “free run”.
8. Trace average at least 100 traces in power averaging(RMS) mode
9. Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
10. If Method SA-2 was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.

**Sample Calculation**

Total PSD(dBm) = Reading Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

**Note**

1. Spectrum reading values are not plot data.
   The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. Actual value of loss for the attenuator and cable combination is below table.

| Band | Loss(dB) |
|---|---|
| UNII 1 | 11.1 |
| UNII 2A | 11.1 |
| UNII 2C | 11.1 |
| UNII 3 | 11.1 |

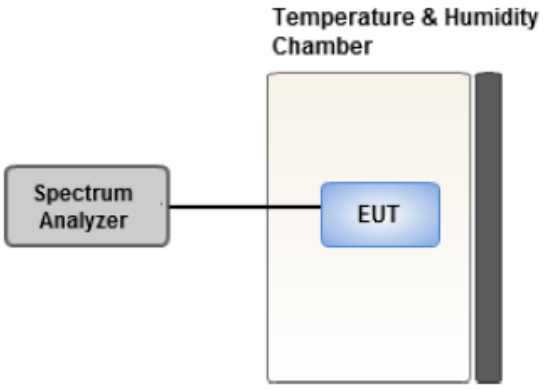
(Actual value of loss for the attenuator and cable combination)

### 8.5. Frequency Stability

**Limit**

Maintained within the band

**Test Configuration**




**Test Procedure**

1. The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between -30 ℃ and 50 ℃.
2. The temperature was incremented by 10 ℃ intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.
3. The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battety operating end point which shall be specified by the manufacturer.
4. While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

### 8.6. AC Power line Conducted Emissions

**Limit**

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

| Frequency Range (MHz) | Limits (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56* | 56 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

**Test Configuration**

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

**Test Procedure**

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

**Sample Calculation**

Quasi-peak(Final Result) = Reading Value + Correction Factor

**8.7. Radiated Test**

**Limit**

1. UNII 1: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

2. UNII 2A, 2C: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

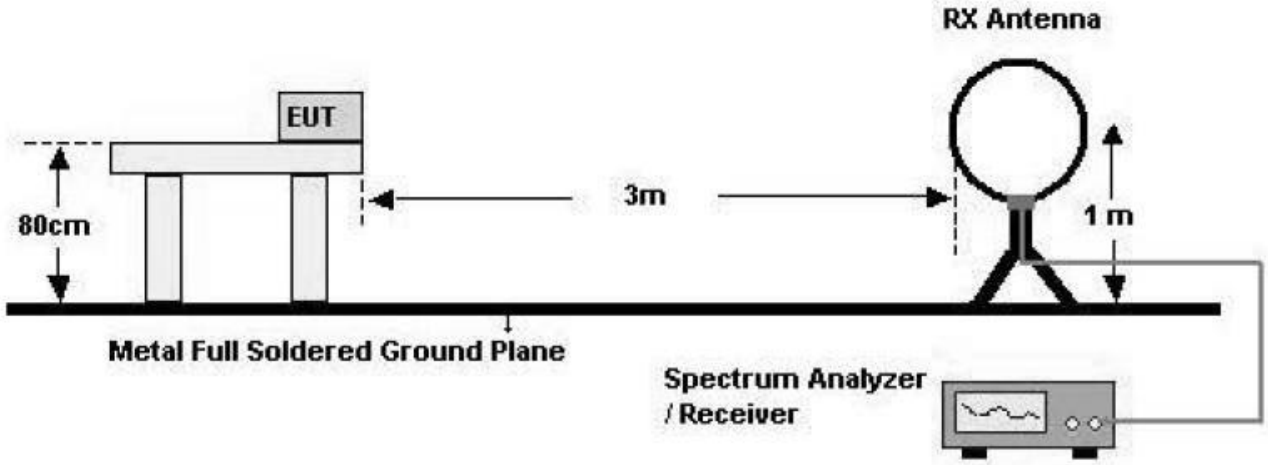
3. UNII 3: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

4. All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Section 15.209.

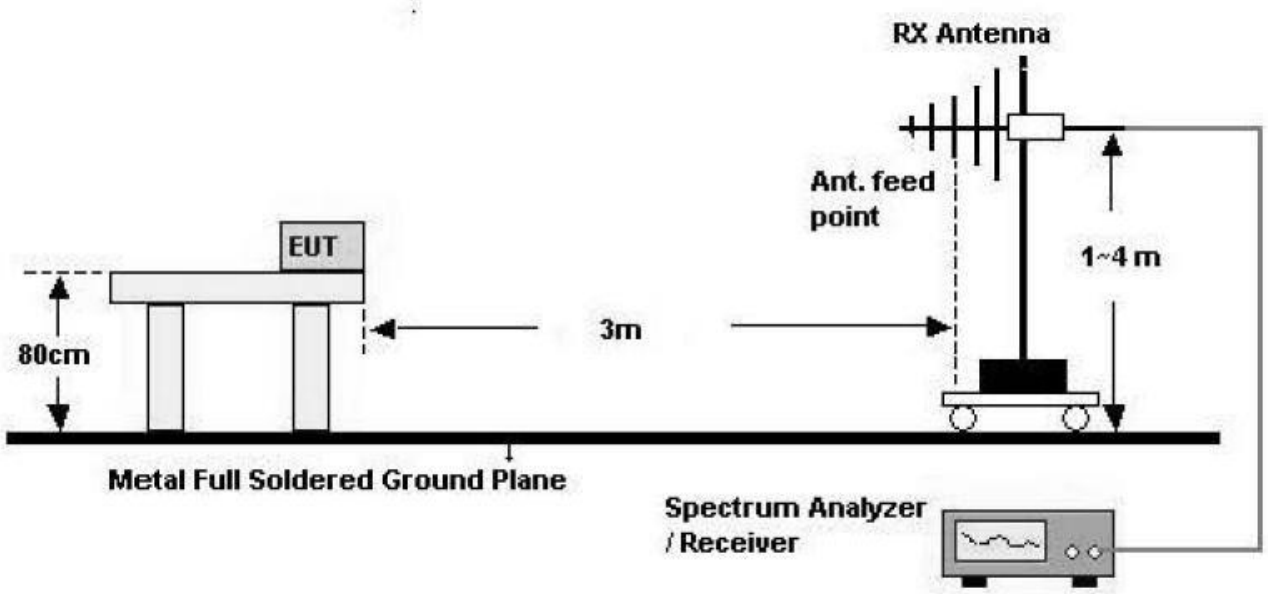
| Frequency (MHz) | Field Strength (uV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Test Configuration**

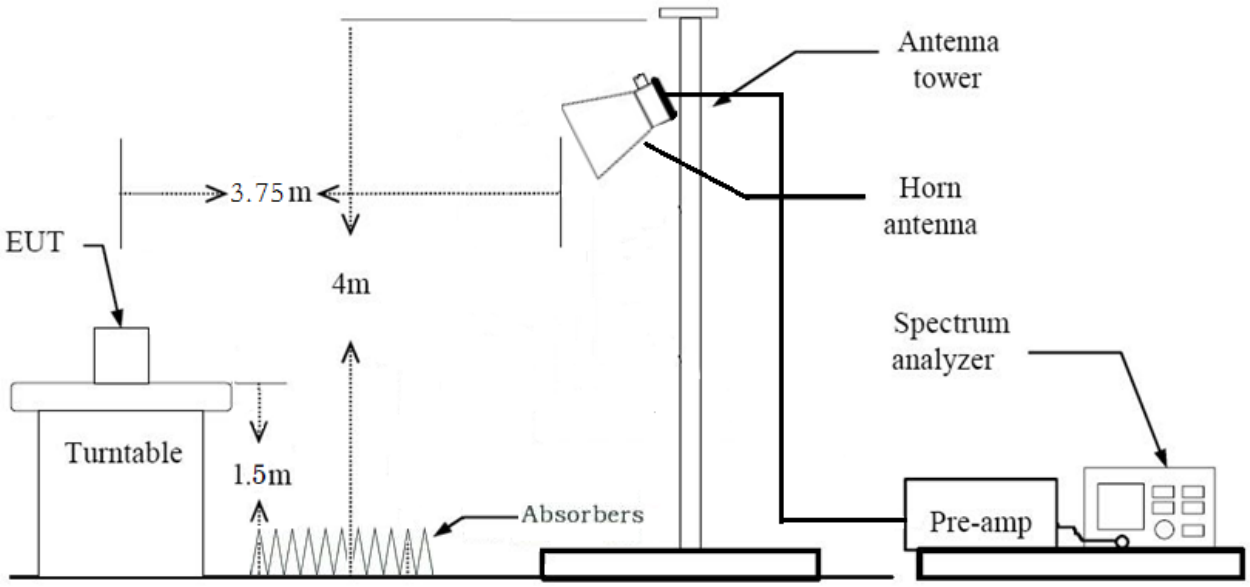
Below 30 MHz




30 MHz - 1 GHz



Above 1 GHz


Antenna
tower
Horn
antenna
Spectrum
analyzer
3.75m
EUT
4m
Turntable
1.5m
Absorbers
Pre-amp

**Test Procedure of Radiated spurious emissions(Below 30 MHz)**

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW
9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. The test results for below 30 MHz is correlated to an open site.
    The result on OFS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

**Test Procedure of Radiated 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 ≥ 3*RBW

   (2) Measurement Type(Quasi-peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Quasi-Peak
   - RBW = 120 kHz

   *In general, (1) is used mainly
6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

**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 (test distance / 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, G.5 in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep Time = auto
   - Trace mode = max hold
   - Allow sweeps to continue until the trace stabilizes.
     Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

   (2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   - VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
   - The analyzer is set to linear detector mode.
   - Detector = Peak.
   - Sweep time = auto.
   - Trace mode = max hold.
   - Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimym number of traces by a factor of 1/x, where x is the duty cycle.
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. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency
12. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

**Test Procedure of Radiated Restricted Band Edge**

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 (test distance / 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, G.5 in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep Time = auto
   - Trace mode = max hold
   - Allow sweeps to continue until the trace stabilizes.
     Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

   (2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   - VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
   - The analyzer is set to linear detector mode.
   - Detector = Peak.
   - Sweep time = auto.
   - Trace mode = max hold.
   - Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimym number of traces by a factor of 1/x, where x is the duty cycle.

10. Measured Frequency Range :

- 4500MHz ~ 5150MHz
- 5350MHz ~ 5460MHz
- 5460MHz ~ 5470MHz
- (75 MHz or more below the 5725MHz) ~ 5725MHz
- 5850MHz ~ (75 MHz or more above the 5850MHz)

11. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

**The actual setting value of VBW**

| Mode | Worst Data rate (Mbps) | Duty Cycle | Duty Cycle Factor (dB) | The actual setting value of VBW (Hz) |
|---|---|---|---|---|
| 802.11a | 6 | 0.975 | 0.111 | 1000 |
| 802.11n(HT20) | MCS 0 | 0.973 | 0.119 | 1000 |
| 802.11ac(VHT20) | MCS 0 | 0.975 | 0.109 | 1000 |
| 802.11n(HT40) | MCS 0 | 0.950 | 0.224 | 3000 |
| 802.11ac(VHT40) | MCS 0 | 0.950 | 0.221 | 3000 |
| 802.11ac(VHT80) | MCS 0 | 0.904 | 0.437 | 10000 |

### 8.8. Worst case configuration and mode

**Radiated test**

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + external accessories(earphone, etc)
   - Worstcase : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : Y
   - Radiated Restricted Band Edge : Y,Z
3. All datarate of operation were investigated and the worst case datarate results are reported
   - 802.11a : 6Mbps
   - 802.11n : MCS0
   - 802.11ac : MCS0

**AC Power line Conducted Emissions**

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone+Earphone+Travel Adapter, Stand alone+Travel Adapter
   - Worstcase : Stand alone+Travel Adapter

**Conducted test**

1. All datarate of operation were investigated and the worst case datarate results are reported

**Test scenario**

: The test scenario for spot check is based on the worst-case of original report results.

# 9. SUMMARY OF TEST RESULTS

| Test Description | FCC Part Section(s) | Test Limit | Test Condition | Test Result | Status |
|---|---|---|---|---|---|
| 26dB Bandwidth | §15.407 (for Power Measurement) | N/A | Conducted | PASS | NT Note2 |
| 6 dB Bandwidth | §15.407(e) | >500 kHz (5725-5850 MHz) | | PASS | NT Note2 |
| Maximum Conducted Output Power | §15.407(a)(1) | < 250 mW(5150-5250 MHz)<br>< 250 mW or 11+10 log log $_{10}$ (BW) dBm (5250-5350 MHz)<br>< 250 mW or 11+10 log log $_{10}$ (BW) dBm (5470-5725 MHz)<br><1 W(5725-5850 MHz) | | **See Note4** | C Note5 |
| Peak Power Spectral Density | §15.407(a)(1),(5) | <11 dBm/ MHz (5150-5250 MHz)<br><11 dBm/ MHz (5250-5350 MHz)<br><11 dBm/ MHz (5470-5725 MHz)<br><30 dBm/500 kHz(5725-5850 MHz) | | PASS | NT Note2 |
| Frequency Stability | §15.407(g) §2.1055 | Maintained within the band | | PASS | NT Note2 |
| AC Conducted Emissions 150 kHz-30 MHz | 15.207 | <FCC 15.207 limits | | PASS | PASS |
| Undesirable Emissions | §15.407(b) | <-27 dBm/MHz EIRP (UNII1, 2A, 2C) cf. Section 8.7 (UNII 3) | Radiated | PASS | C Note3 |
| General Field Strength Limits(Restricted Bands and Radiated Emission Limits) | 15.205, 15.407(b)(5), (6) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | | PASS | C Note3 |

**Note:**

1. C = Comply, NT = Not Tested, NA = Not Applicable, NC = Not Comply
2. C2PC model is electrically identical to the Original model.
   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 10
4. See SAR Report
5. Output power was verified to be within the expected tune up tolerances prior to performing the spot checks for radiated spurious emissions and band edge to confirm that the proposed changes to the digital circuitry had not adversely affected the previously reported values in the original filing.
6. Original model : SM-A6060
   C2PC model : SM-M405F/DS

## 10. TEST RESULT

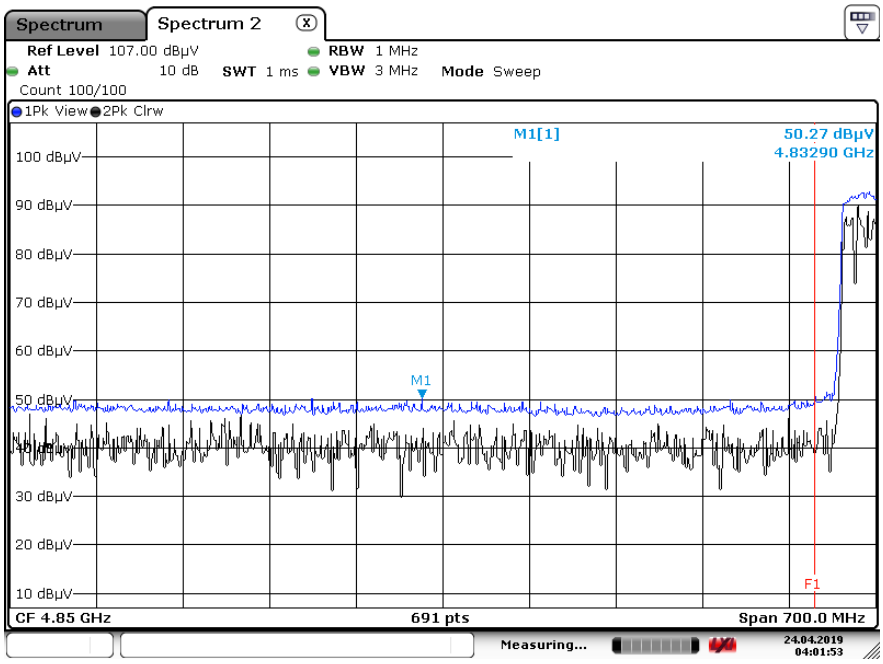
| Test Item | Mod/ Channel | Measured Frequency (MHz) | SM-A6060 (dBuV/m) | | SM-M405F/DS (dBuV/m) | | Deviation (dB) | |
|---|---|---|---|---|---|---|---|---|
| | | | Average | Peak | Average | Peak | Average | Peak |
| Band Edge | 802.11n (HT40) / Ch.38 | 4500.0 ~ 5150.0 | 51.29 | 61.59 | 41.42 | 54.16 | 9.87 | 7.43 |
| | | 5420.0 | 51.41 | 61.75 | No Critical peaks found | | - | |
| RSE | 802.11a / Ch.120 | 11200.0 | 43.48 | 52.74 | 39.78 | 51.91 | 3.70 | 0.83 |

# 11. TEST PLOT

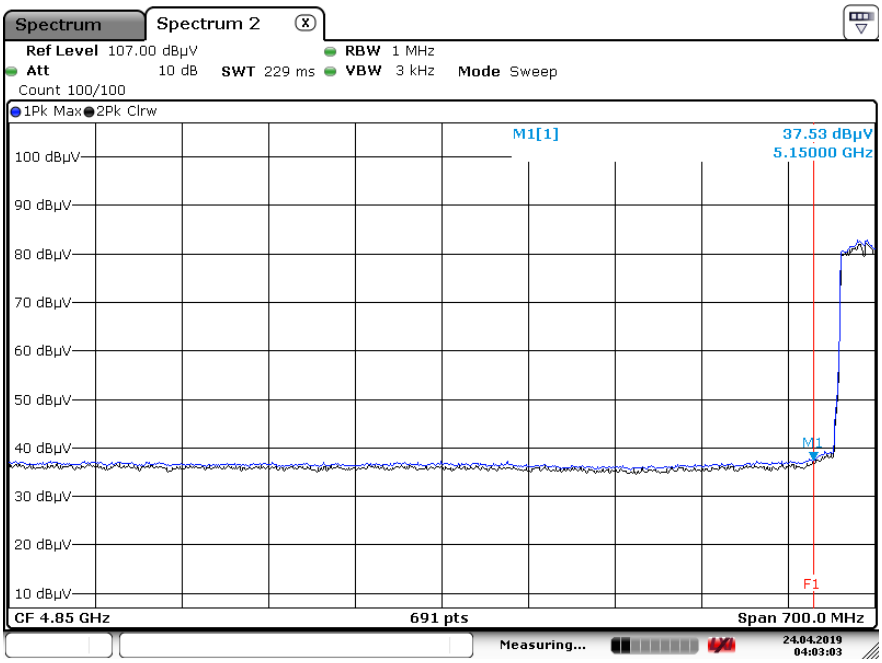
**Bandedge**

| Frequency [MHz] | Reading dBuV | AN.+CL+AMP+ATT. +D.F. [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 5150 | 50.27 | 3.89 | H | 54.16 | 73.98 | 19.82 | PK |
| 5150 | 37.53 | 3.89 | H | 41.42 | 53.98 | 12.56 | AV |

Detect : PK



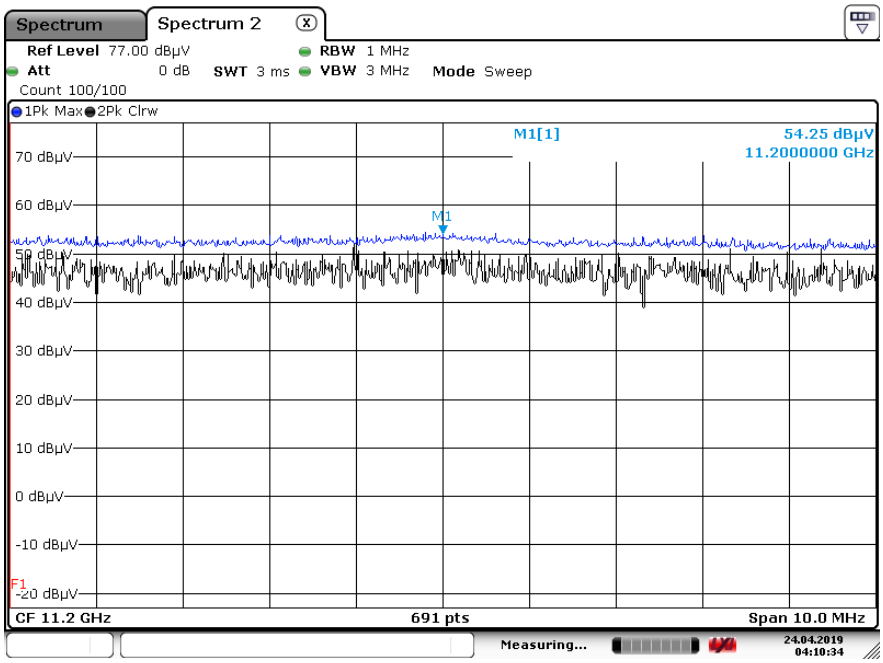
Detect : AV


Spectrum
Spectrum 2
Ref Level 107.00 dBµV
RBW 1 MHz
Att 10 dB
SWT 229 ms
VBW 3 kHz
Mode Sweep
Count 100/100
1Pk Max
2Pk Clrw
M1[1]
37.53 dBµV
5.15000 GHz
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
M1
F1
CF 4.85 GHz
691 pts
Span 700.0 MHz
Measuring...
24.04.2019
04:03:03

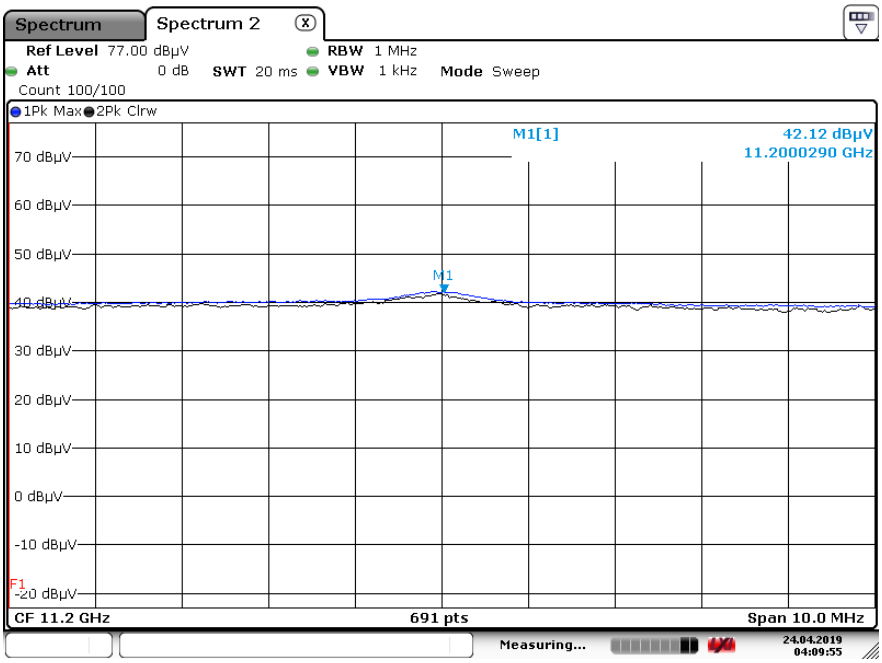
**RSE**

| Frequency [MHz] | Reading [dBuV] | A.F.+C.L.-A.G+D.F. [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 11200 | 54.25 | -2.34 | H | 51.91 | 73.98 | 22.07 | PK |
| 11200 | 42.12 | -2.34 | H | 39.78 | 53.98 | 14.20 | AV |

Detect : PK



Detect : AV


Spectrum
Spectrum 2
Ref Level 77.00 dBµV
RBW 1 MHz
Att 0 dB
SWT 20 ms
VBW 1 kHz
Mode Sweep
Count 100/100
1Pk Max
2Pk Clrw
M1[1]
42.12 dBµV
11.2000290 GHz
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
-10 dBµV
-20 dBµV
M1
F1
CF 11.2 GHz
691 pts
Span 10.0 MHz
Measuring...
24.04.2019
04:09:55

# 12. POWERLINE CONDUCTED EMISSIONS

**Conducted Emissions (Line 1)**

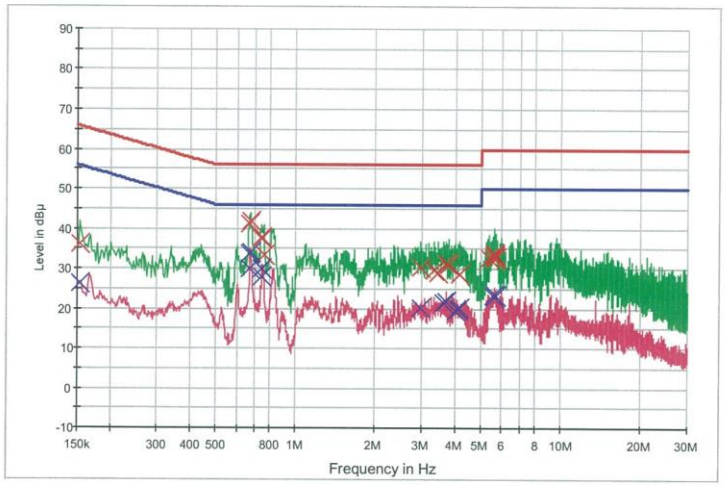
5G WLAN MODE N 1 / 2

## HCT TEST Report

### Common Information

| | |
|---|---|
| EUT: | SM-M405FDS |
| Manufacturer: | SAMSUNG |
| Test Site: | SHIELD ROOM |
| Operating Conditions: | 5G WLAN MODE N |

FCC CLASS B_Exten Cable




### Final Result 1

| Frequency (MHz) | QuasiPeak (dBuV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|---|
| 0.154000 | 36.1 | 9.000 | Off | N | 9.8 | 29.7 | 65.8 |
| 0.672000 | 41.4 | 9.000 | Off | N | 9.9 | 14.6 | 56.0 |
| 0.676000 | 41.7 | 9.000 | Off | N | 9.9 | 14.3 | 56.0 |
| 0.744000 | 37.5 | 9.000 | Off | N | 9.9 | 18.5 | 56.0 |
| 0.748000 | 37.8 | 9.000 | Off | N | 9.9 | 18.2 | 56.0 |
| 0.758000 | 33.5 | 9.000 | Off | N | 9.9 | 22.5 | 56.0 |
| 2.956000 | 30.2 | 9.000 | Off | N | 10.1 | 25.8 | 56.0 |
| 3.342000 | 29.8 | 9.000 | Off | N | 10.1 | 26.2 | 56.0 |
| 3.442000 | 29.1 | 9.000 | Off | N | 10.1 | 26.9 | 56.0 |
| 3.712000 | 31.5 | 9.000 | Off | N | 10.2 | 24.5 | 56.0 |
| 3.784000 | 30.9 | 9.000 | Off | N | 10.2 | 25.1 | 56.0 |
| 4.140000 | 28.7 | 9.000 | Off | N | 10.2 | 27.3 | 56.0 |
| 5.390000 | 32.8 | 9.000 | Off | N | 10.2 | 27.2 | 60.0 |
| 5.608000 | 32.3 | 9.000 | Off | N | 10.3 | 27.7 | 60.0 |
| 5.616000 | 33.6 | 9.000 | Off | N | 10.3 | 26.4 | 60.0 |
| 5.630000 | 33.1 | 9.000 | Off | N | 10.3 | 26.9 | 60.0 |
| 5.640000 | 33.3 | 9.000 | Off | N | 10.3 | 26.7 | 60.0 |
| 5.696000 | 32.8 | 9.000 | Off | N | 10.3 | 27.2 | 60.0 |

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5G WLAN MODE N

2 / 2

## Final Result 2

| Frequency (MHz) | CAverage (dBuV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|---|
| 0.154000 | 26.3 | 9.000 | Off | N | 9.8 | 29.5 | 55.8 |
| 0.670000 | 30.1 | 9.000 | Off | N | 9.9 | 15.9 | 46.0 |
| 0.674000 | 33.8 | 9.000 | Off | N | 9.9 | 12.2 | 46.0 |
| 0.678000 | 34.1 | 9.000 | Off | N | 9.9 | 11.9 | 46.0 |
| 0.744000 | 27.9 | 9.000 | Off | N | 9.9 | 18.1 | 46.0 |
| 0.748000 | 30.0 | 9.000 | Off | N | 9.9 | 16.0 | 46.0 |
| 2.956000 | 20.2 | 9.000 | Off | N | 10.1 | 25.8 | 46.0 |
| 3.632000 | 21.4 | 9.000 | Off | N | 10.1 | 24.6 | 46.0 |
| 3.712000 | 21.9 | 9.000 | Off | N | 10.2 | 24.1 | 46.0 |
| 4.006000 | 19.4 | 9.000 | Off | N | 10.2 | 26.6 | 46.0 |
| 4.106000 | 19.9 | 9.000 | Off | N | 10.2 | 26.1 | 46.0 |
| 4.140000 | 20.3 | 9.000 | Off | N | 10.2 | 25.7 | 46.0 |
| 5.544000 | 23.3 | 9.000 | Off | N | 10.3 | 26.7 | 50.0 |
| 5.608000 | 22.8 | 9.000 | Off | N | 10.3 | 27.2 | 50.0 |
| 5.616000 | 23.6 | 9.000 | Off | N | 10.3 | 26.4 | 50.0 |
| 5.630000 | 23.6 | 9.000 | Off | N | 10.3 | 26.4 | 50.0 |
| 5.640000 | 23.5 | 9.000 | Off | N | 10.3 | 26.5 | 50.0 |
| 5.698000 | 23.1 | 9.000 | Off | N | 10.3 | 26.9 | 50.0 |

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**Conducted Emissions (Line 2)**

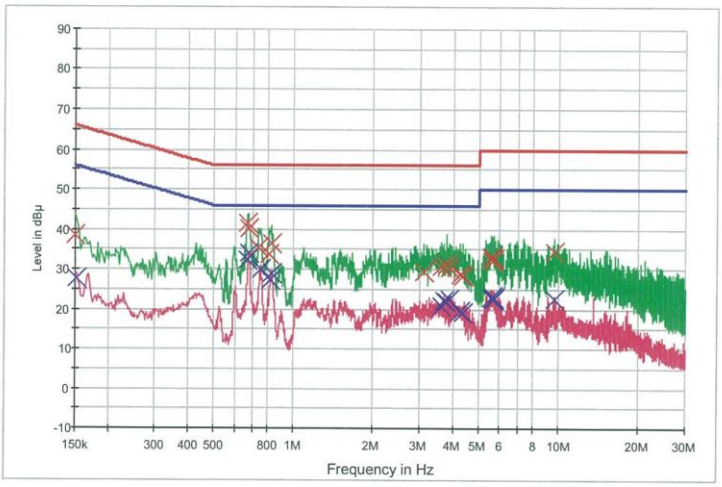
5G WLAN MODE L1 1 / 2

# HCT TEST Report

## Common Information

| | |
|---|---|
| EUT: | SM-M405FDS |
| Manufacturer: | SAMSUNG |
| Test Site: | SHIELD ROOM |
| Operating Conditions: | 5G WLAN MODE L1 |

FCC CLASS B_Exten Cable




## Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 0.150000 | 38.5 | 9.000 | Off | L1 | 9.7 | 27.5 | 66.0 |
| 0.674000 | 41.7 | 9.000 | Off | L1 | 9.8 | 14.3 | 56.0 |
| 0.678000 | 40.3 | 9.000 | Off | L1 | 9.8 | 15.7 | 56.0 |
| 0.740000 | 35.4 | 9.000 | Off | L1 | 9.8 | 20.6 | 56.0 |
| 0.808000 | 33.8 | 9.000 | Off | L1 | 9.8 | 22.2 | 56.0 |
| 0.824000 | 36.4 | 9.000 | Off | L1 | 9.8 | 19.6 | 56.0 |
| 3.104000 | 29.4 | 9.000 | Off | L1 | 9.9 | 26.6 | 56.0 |
| 3.630000 | 30.6 | 9.000 | Off | L1 | 9.9 | 25.4 | 56.0 |
| 3.794000 | 30.9 | 9.000 | Off | L1 | 10.0 | 25.1 | 56.0 |
| 3.876000 | 30.3 | 9.000 | Off | L1 | 10.0 | 25.7 | 56.0 |
| 4.252000 | 28.6 | 9.000 | Off | L1 | 10.0 | 27.4 | 56.0 |
| 4.370000 | 28.5 | 9.000 | Off | L1 | 10.0 | 27.5 | 56.0 |
| 5.574000 | 32.9 | 9.000 | Off | L1 | 10.1 | 27.1 | 60.0 |
| 5.616000 | 33.1 | 9.000 | Off | L1 | 10.1 | 26.9 | 60.0 |
| 5.660000 | 32.2 | 9.000 | Off | L1 | 10.1 | 27.8 | 60.0 |
| 5.684000 | 32.3 | 9.000 | Off | L1 | 10.1 | 27.7 | 60.0 |
| 5.688000 | 32.5 | 9.000 | Off | L1 | 10.1 | 27.5 | 60.0 |
| 9.626000 | 34.3 | 9.000 | Off | L1 | 10.2 | 25.7 | 60.0 |

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5G WLAN MODE L1 2 / 2

## Final Result 2

| Frequency (MHz) | CAverage (dBuV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|---|---|---|---|---|---|---|---|
| 0.152000 | 27.5 | 9.000 | Off | L1 | 9.7 | 28.4 | 55.9 |
| 0.672000 | 32.3 | 9.000 | Off | L1 | 9.8 | 13.7 | 46.0 |
| 0.676000 | 34.0 | 9.000 | Off | L1 | 9.8 | 12.0 | 46.0 |
| 0.750000 | 30.1 | 9.000 | Off | L1 | 9.8 | 15.9 | 46.0 |
| 0.816000 | 27.2 | 9.000 | Off | L1 | 9.8 | 18.8 | 46.0 |
| 0.824000 | 29.0 | 9.000 | Off | L1 | 9.8 | 17.0 | 46.0 |
| 3.624000 | 20.8 | 9.000 | Off | L1 | 9.9 | 25.2 | 46.0 |
| 3.710000 | 22.1 | 9.000 | Off | L1 | 10.0 | 23.9 | 46.0 |
| 3.796000 | 22.0 | 9.000 | Off | L1 | 10.0 | 24.0 | 46.0 |
| 3.890000 | 22.4 | 9.000 | Off | L1 | 10.0 | 23.6 | 46.0 |
| 4.252000 | 19.6 | 9.000 | Off | L1 | 10.0 | 26.4 | 46.0 |
| 4.370000 | 19.0 | 9.000 | Off | L1 | 10.0 | 27.0 | 46.0 |
| 5.574000 | 23.0 | 9.000 | Off | L1 | 10.1 | 27.0 | 50.0 |
| 5.616000 | 23.2 | 9.000 | Off | L1 | 10.1 | 26.8 | 50.0 |
| 5.660000 | 22.5 | 9.000 | Off | L1 | 10.1 | 27.5 | 50.0 |
| 5.684000 | 22.7 | 9.000 | Off | L1 | 10.1 | 27.3 | 50.0 |
| 5.688000 | 22.8 | 9.000 | Off | L1 | 10.1 | 27.2 | 50.0 |
| 9.626000 | 22.5 | 9.000 | Off | L1 | 10.2 | 27.5 | 50.0 |

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# 13. LIST OF TEST EQUIPMENT

**Conducted Test**

| Manufacturer | Model / Equipment | Calibration Date | Calibration Interval | Serial No. |
|---|---|---|---|---|
| Rohde & Schwarz | ENV216 / LISN | 12/12/2018 | Annual | 102245 |
| Rohde & Schwarz | ESCI / Test Receiver | 06/27/2018 | Annual | 100033 |
| ESPAC | SU-642 /Temperature Chamber | 08/07/2019 | Annual | 93000718 |
| Agilent | N9020A / Signal Analyzer | 06/08/2018 | Annual | MY51110085 |
| Agilent | N9020A / Signal Analyzer | 06/08/2018 | Annual | MY52090906 |
| Agilent | N9030A / Signal Analyzer | 01/10/2019 | Annual | MY49431210 |
| Rohde & Schwarz | OSP 120 / Power Measurement Set | 07/26/2018 | Annual | 101231 |
| Agilent | N1911A / Power Meter | 04/10/2019 | Annual | MY45100523 |
| Agilent | N1921A / Power Sensor | 04/10/2019 | Annual | MY52260025 |
| Agilent | 87300B / Directional Coupler | 11/20/2018 | Annual | 3116A03621 |
| Hewlett Packard | 11667B / Power Splitter | 06/07/2018 | Annual | 05001 |
| Hewlett Packard | E3632A / DC Power Supply | 06/26/2018 | Annual | KR75303960 |
| Agilent | 8493C / Attenuator(10 dB) | 07/10/2018 | Annual | 07560 |
| Rohde & Schwarz | EMC32 / Software | N/A | N/A | N/A |
| HCT CO., LTD. | FCC WLAN&BT&BLE Conducted Test Software v3.0 | N/A | N/A | N/A |

**Note:**

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

**Radiated Test**

| Manufacturer | Model / Equipment | Calibration Date | Calibration Interval | Serial No. |
|---|---|---|---|---|
| Innco system | CO3000 / Controller(Antenna mast) | N/A | N/A | CO3000-4p |
| Innco system | MA4640/800-XP-EP / Antenna Position Tower | N/A | N/A | N/A |
| Audix | EM1000 / Controller | N/A | N/A | 060520 |
| Audix | Turn Table | N/A | N/A | N/A |
| Rohde & Schwarz | Loop Antenna | 08/23/2018 | Biennial | 1513-175 |
| Schwarzbeck | VULB 9168 / Hybrid Antenna | 03/22/2019 | Biennial | 760 |
| Schwarzbeck | VULB 9160 / TRILOG Antenna | 08/09/2018 | Biennial | 9160-3368 |
| Schwarzbeck | BBHA 9120D / Horn Antenna | 08/01/2017 | Biennial | 1151 |
| Schwarzbeck | BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz) | 12/04/2017 | Biennial | BBHA9170541 |
| Rohde & Schwarz | FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer | 09/03/2018 | Annual | 100688 |
| Rohde & Schwarz | FSV40-N / Spectrum Analyzer | 09/28/2018 | Annual | 101068-SZ |
| Agilent | N9020A / Signal Analyzer | 06/08/2018 | Annual | MY51110085 |
| Wainwright Instruments | WHK3.0/18G-10EF / High Pass Filter | 06/07/2018 | Annual | 8 |
| Wainwright Instruments | WHKX7.0/18G-8SS / High Pass Filter | 05/09/2018 | Annual | 29 |
| Wainwright Instruments | WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter | 06/29/2018 | Annual | 2 |
| Wainwright Instruments | WRCJV5100/5850-40/50-8EEK / Band Reject Filter | 01/03/2019 | Annual | 2 |
| Api tech. | 18B-03 / Attenuator (3 dB) | 06/07/2018 | Annual | 1 |
| Agilent | 8493C-10 / Attenuator(10 dB) | 07/17/2018 | Annual | 08285 |
| CERNEX | CBLU1183540 / Power Amplifier | 07/10/2018 | Annual | 22964 |
| CERNEX | CBL06185030 / Power Amplifier | 07/10/2018 | Annual | 22965 |
| CERNEX | CBL18265035 / Power Amplifier | 01/03/2019 | Annual | 22966 |
| CERNEX | CBL26405040 / Power Amplifier | 06/29/2018 | Annual | 25956 |

**Note:**

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

# 14. ANNEX A_ TEST SETUP PHOTO

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

| No. | Description |
|---|---|
| 1 | HCT-RF-1904-FC054-P |