

MEASUREMENT REPORT

FCC Part 15B

Applicant Name:

Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:

01/23/2019 - 02/28/2019

Test Site/Location:

PCTEST Lab. Columbia, MD, USA

Test Report Serial No.:

1M1901240015-02.A3L

FCC ID:

A3LMT3204-48A

APPLICANT:

Samsung Electronics Co., Ltd.

Application Type:

Certification

Model:

MT3204-48A

EUT Type:

Massive MIMO CBSD

FCC Classification:

Part 15 Class A Digital Device (JAD)

FCC Rule Part(s):

FCC Part 15 Subpart B

Test Procedure(s):

ANSI C63.4-2014

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in ANSI C63.4-2014 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

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.



Randy Ortanez
President



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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISSED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISSED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Massive MIMO CBSD FCC ID: A3LMT3204-48A**. The test data contained in this report pertains only to the emissions due to the digital circuitry of the EUT.

Test Device Serial No.: 4816t

2.2 Device Capabilities

This device contains the following capabilities:

LTE B48

2.3 Test Configuration

The test configuration includes the EUT (MMU), a laptop PC, and a host Data Unit (DU). The EUT was exercised during testing by means of software installed on the PC. The host was connected to EUT via fiber optic cable and laptop PC via ethernet connection, thus satisfying the minimum system requirement of two different I/O interfaces. All equipment is placed on the test table top and arranged in a typical configuration in accordance with ANSI C63.4-2014 and manipulated to obtain worst case emissions.

For more information please see Section 7.0 for test data and the test setup photos document for the test setup photographs.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2014) was used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Clause 5, Figure 5.7 of ANSI C63.4-2014. A raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

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3.3 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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4.0 SAMPLE CALCULATIONS

4.1 Radiated Emission Measurement Sample Calculation

@ 66.7 MHz

Class B limit	= 100 $\mu\text{V/m}$ = 40.0 dB $\mu\text{V/m}$
Reading	= - 76.0 dBm (calibrated level)
Convert to dB μV	= - 76.0 + 107 = 31.0 dB μV
Antenna Factor + Cable Loss	= 5.8 dB/m
Total	= 36.8 dB $\mu\text{V/m}$
Margin	= 36.8 - 40.0 = - 3.2 dB
	= 3.2 dB below limit

Note:

$$\text{Level [dB}\mu\text{V]} = 20 \log_{10} (\text{Level } [\mu\text{V/m}])$$

$$\text{Level [dB}\mu\text{V]} = \text{Level [dBm]} + 107$$

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5.0 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 uncertainty shown below 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.

Contribution	Expanded Uncertainty ($\pm$ dB)
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07

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6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	9/17/2018	Annual	9/17/2019	441119
Emco	3115	Horn Antenna (1-18GHz)	3/28/2018	Biennial	3/28/2020	9704-5182
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	5/21/2018	Annual	5/21/2019	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	6/18/2018	Annual	6/18/2019	102134
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	4/19/2018	Biennial	4/19/2020	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

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7.0 TEST DATA

7.1 Summary

Test Date(s): 01/23/2019 - 02/28/2019

Test Engineer: Deepika Vaidya

FCC Part 15 Section	Description	Result
15.109	Radiated Emissions	PASS

Table 7-1. Summary of Test Results

7.2 Test Support Equipment

Dell Laptop	Model:	Latitude E5570	S/N:	H6TYTF2
DU	Model:	CBRS Data Unit	S/N:	UCBS960
Ethernet	Length (m):	1.5		
Fiber	Length (m):	5		

Table 7-2. Test Support Equipment Used

Note: See test setup photographs for actual system test setup.

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7.3 Radiated Measurement Data

§15.109:

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.105 of the Title 47 CFR and must not exceed the limits shown in Table 7-3 per Section 15.109.

Frequency [MHz]	Field Strength Limit [$\mu\text{V/m}$]
30 – 88	100
88 – 216	150
216 – 960	200
> 960	500

Table 7-3. 3-Meter Radiated Limits (Section 15.109)

Test Procedures Used

ANSI C63.4-2014

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer frequency set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown test setup photos provided.

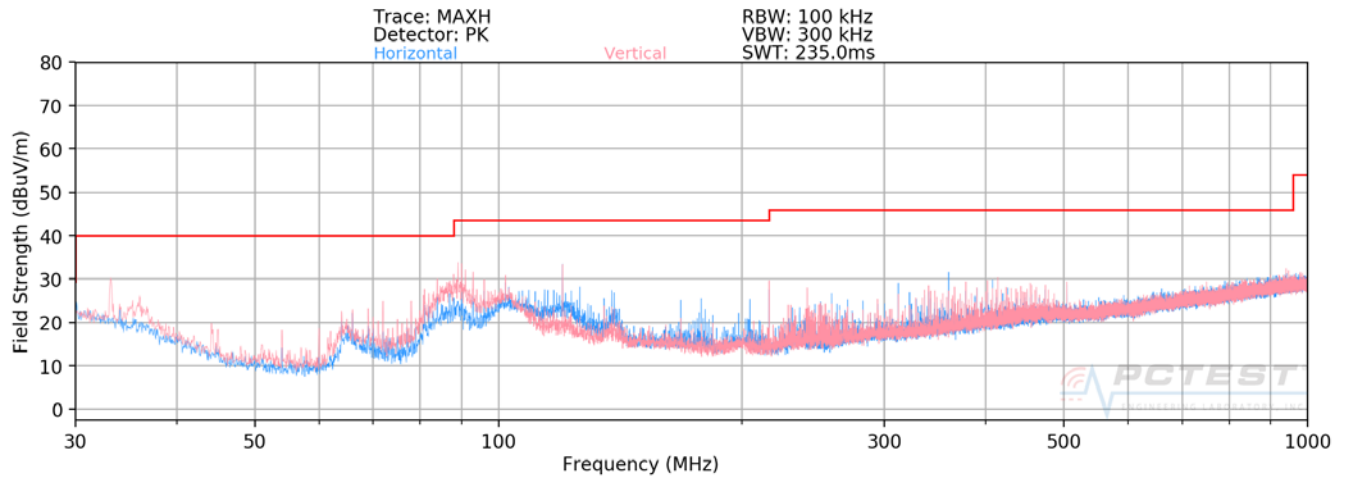
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Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported.
2. Radiated emissions were measured from 30MHz –18GHz to ensure that the provisions of 15.33(b)(1) are satisfied with respect to the upper frequency scanning range.
3. The radiated limits for unintentional radiators at a distance of 3 meters are used in the table above, as specified in 15.109(a).
4. All readings are calibrated by a signal generator with accuracy traceable to the National Institute of Standards and Technology (NIST).
5. $AFCL\ (dB/m) = Antenna\ Factor\ (dB/m) + Cable\ Loss\ (dB)$
6. $Level\ (dB\mu V/m) = Analyzer\ Reading\ (dBm) + AFCL\ (dB/m) + 107$
7. $Margin\ (dB) = Field\ strength\ (dB\mu V/m) - Limit\ (dB\mu V/m)$
8. Measurements are made using a CISPR quasi-peak detector with a 120kHz resolution bandwidth. Above 1GHz, peak measurements are made using a peak detector with a resolution bandwidth of 1MHz and a video bandwidth of 3MHz and average measurements are made with a RMS detector using a resolution bandwidth of 1MHz and a video bandwidth of 3MHz.
9. Calibrated linearly polarized broadband and horn antennas were used for measurements below and above 1GHz, respectively. For measurements made below 1GHz, the results recorded using the broadband antenna are known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antennas was found to be less than 2:1.
10. Calibrated low-loss microwaves cables and broadband amplifiers are used.
11. This unit was tested to the Class B limits and found to be compliant.

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Below 1GHz



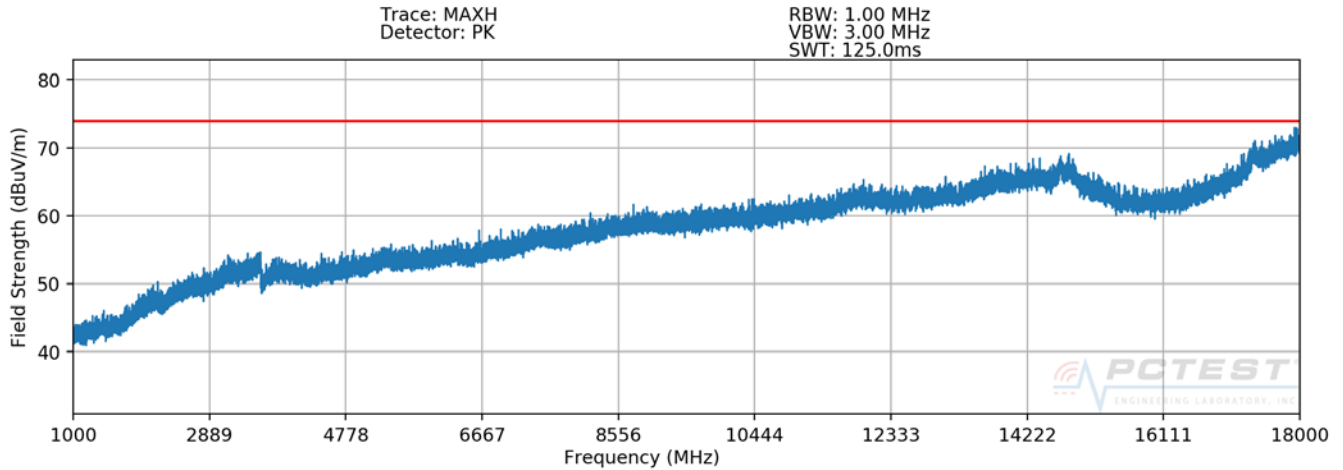
Plot 7-1. Radiated Spurious Plot below 1GHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	Limit [dBμV/m]	Margin [dB]
35.62	Quasi-Peak	V	265	7	-61.53	-12.72	32.75	40.00	-7.25
86.87	Quasi-Peak	V	280	10	-48.57	-21.81	36.62	40.00	-3.38
120.04	Quasi-Peak	V	295	10	-53.33	-15.59	38.08	43.52	-5.44
216.20	Quasi-Peak	V	300	6	-56.88	-17.91	32.21	46.02	-13.81
397.12	Quasi-Peak	V	292	10	-58.60	-11.91	36.49	46.02	-9.53
504.29	Quasi-Peak	V	298	10	-63.51	-9.16	34.33	46.02	-11.69

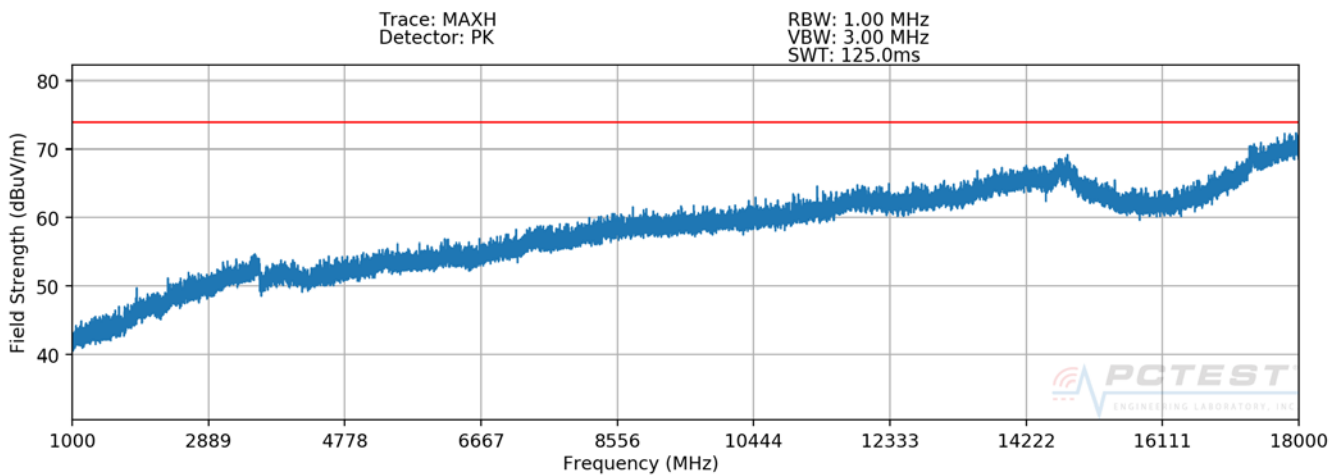
Table 7-4. Radiated Measurements at 3-meters below 1GHz

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Above 1GHz



Plot 7-2. Radiated Spurious Plot above 1GHz [Ant. H Orientation]



Plot 7-3. Radiated Spurious Plot above 1GHz [Ant. V Orientation]

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
2302.00	Peak	H	253	10	-72.31	-3.52	31.17	73.98	-42.81
6665.55	Peak	H	259	10	-68.87	6.20	44.33	73.98	-29.65
8599.10	Peak	H	272	3	-70.78	10.37	46.59	73.98	-27.39
11991.47	Peak	H	287	8	-67.65	15.52	54.87	73.98	-19.11
14899.80	Peak	H	302	2	-63.84	18.56	61.72	73.98	-12.26
17984.03	Peak	H	311	10	-61.15	23.73	69.58	73.98	-4.40

Table 7-5. Radiated Peak Measurements at 3-meters [Above 1GHz]

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Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	Limit [dBμV/m]	Margin [dB]
1487.05	Average	H	168	12	-75.54	-6.52	24.94	53.98	-29.04
3199.80	Average	H	160	10	-74.52	6.20	38.68	53.98	-15.30
5082.11	Average	H	265	140	-78.03	10.37	39.34	53.98	-14.64
10425.47	Average	H	266	6	-79.55	15.52	42.97	53.98	-11.01
15080.80	Average	H	273	21	-80.24	18.56	45.32	53.98	-8.66
17976.28	Average	H	280	30	-80.61	23.73	50.12	53.98	-3.86

Table 7-6. Radiated Average Measurements at 3-meters [Above 1GHz]

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Massive MIMO CBS** **FCC ID: A3LMT3204-48A** has been tested to comply with the requirements specified in §15.109 of the FCC rules.

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