



TEST REPORT

| | | |
|---|--|---|
| KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr | Report No.: KR20-SRF0015-B Page (1) of (56) |  |
| 1. Client <ul style="list-style-type: none"> ◦ Name : Samsung Electronics Co., Ltd. ◦ Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea ◦ Date of Receipt : 2019-12-26 | | |
| 2. Use of Report : - | | |
| 3. Name of Product and Model : Mobile Phone / SM-M315F/DS | | |
| 4. Manufacturer and Country of Origin : Samsung Electronics Co., Ltd. / Korea | | |
| 5. FCC ID : A3LSMM315F | | |
| 6. Date of Test : 2020-01-14 to 2020-02-06 | | |
| 7. Test Standards : FCC Part 15 Subpart C, 15.247 | | |
| 8. Test Results : Refer to the test result in the test report | | |
| Affirmation | Tested by Name : Kwonse Kim (Signature)  | Technical Manager Name : Bobae Lee (Signature)  |
| 2020-02-07 | | |
| <h2>KCTL Inc.</h2> | | |
| As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc. | | |

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KR20-SRF0015-B

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**Report revision history**

| Date | Revision | Page No |
|------------|---|-----------|
| 2020-01-30 | Initial report | - |
| 2020-02-06 | Retest a output power and Added the measurement equipment | 12~15, 56 |
| 2020-02-07 | Typing error | 15 |
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Note. The report No. KR20-SRF0015-A is superseded by the report No. KR20-SRF0015-B.



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1. General information

Client : Samsung Electronics Co., Ltd.
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677,
Rep. of Korea
Manufacturer : Samsung Electronics Co., Ltd.
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677,
Rep. of Korea
Factory : Samsung Electronics Vietnam Thai Nguyen Co., Ltd
Address : 506-723 16000 Yen Phong 1 Industrial Zone, Yen Trung Commu Yen Phong
District Bac Ninh Province Vietnam
Factory : Samsung India Electronics PVT. Ltd
Address : B-1, Sector-8 NOIDA Uttar Pradeshe, India 201-305
Factory : Samsung Electronics Co., Ltd.
Address : 94-1, Imsu-dong, Gumi-si, Gyengsangbuk-do, 730-722, Republic of Korea
Laboratory : KCTL Inc.
Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
Industry Canada Registration No. : 8035A
KOLAS No.: KT231

2. Device information

Equipment under test : Mobile Phone
Model : SM-M315F/DS
Modulation technique : Bluetooth(BDR/EDR)_GFSK, $\pi/4$ DQPSK, 8DPSK
Bluetooth(BLE)_GFSK
WIFI(802.11b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM
LTE_QPSK, 16QAM
WCDMA_QPSK
GSM_GMSK, 8-PSK
Number of channels : Bluetooth(BDR/EDR)_79ch / Bluetooth(BLE)_40ch
802.11b/g/n_HT20 : 11 ch
UNII-1: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
UNII-2A: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
UNII-2C: 12 ch (20 MHz), 6 ch (40 MHz), 3 ch (80 MHz)
UNII-3: 5 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
Power source : DC 3.85 V
Antenna specification : LTE/GSM/WCDMA_LDS Antenna
WIFI/Bluetooth(BDR/EDR/BLE)_LDS Antenna

| | |
|------------------------|---|
| Antenna gain | : WIFI/Bluetooth(BDR/EDR/BLE) : -3.4 dBi UNII-1 -5.9 dBi UNII-2A -6.3 dBi UNII-2C -5.3 dBi UNII-3 -6.6 dBi |
| Frequency range | : Bluetooth(BDR/EDR/BLE)_2 402 MHz ~ 2 480 MHz 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20) UNII-1: 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20/ac_VHT20) UNII-1: 5 190 MHz ~ 5 230 MHz (802.11n_HT40/ac_VHT40) UNII-1: 5 210 MHz (802.11ac_VHT80) UNII-2A: 5 260 MHz ~ 5 320 MHz (802.11a/n_HT20/ac_VHT20) UNII-2A: 5 270 MHz ~ 5 310 MHz (802.11n_HT40/ac_VHT40) UNII-2A: 5 290 MHz (802.11ac_VHT80) UNII-2C: 5 500 MHz ~ 5 720 MHz (802.11a/n_HT20/ac_VHT20) UNII-2C: 5 510 MHz ~ 5 710 MHz (802.11n_HT40/ac_VHT40) UNII-2C: 5 530 MHz ~ 5 690 MHz (802.11ac_VHT80) UNII-3: 5 745 MHz ~ 5 825 MHz (802.11a/n_HT20/ac_VHT20) UNII-3: 5 755 MHz ~ 5 795 MHz (802.11n_HT40/ac_VHT40) UNII-3: 5 775 MHz (802.11ac_VHT80) LTE Band 2_1 850.7 MHz ~ 1 909.3 MHz LTE Band 4_1 710.7 MHz ~ 1 754.3 MHz LTE Band 5_824.7 MHz ~ 848.3 MHz LTE Band 12_699.7 MHz ~ 715.3 MHz LTE Band 13_779.5 MHz ~ 784.5 MHz LTE Band 17_706.5 MHz ~ 713.5 MHz LTE Band 26_824.7 MHz ~ 848.3 MHz, 814.7 MHz ~ 823.3 MHz LTE Band 41_2 498.5 MHz ~ 2 687.5 MHz LTE Band 66_1 710.7 MHz ~ 1 779.3 MHz GSM 850_824.2 MHz ~ 848.8 MHz GSM 1900_1 850.2 MHz ~ 1 909.8 MHz WCDMA 850_826.4 MHz ~ 846.6 MHz WCDMA 1700_1 712.4 MHz ~ 1 752.6 MHz WCDMA 1910_1 852.4 MHz ~ 1 907.6 MHz |
| Software version | : M315F.001 |
| Hardware version | : REV1.0 |
| Test device serial No. | : Conducted(R38MC0ANYKB, R38MC0ANZKH, R38MC0AP17A, R38MC0ANXTJ) Radiated(R38MC0ANYWL, R38MC0ANZHK) |
| Operation temperature | : -30 °C ~ 50 °C |

2.1. Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source |
|----------------------|-------------------------------|----------|----------------|--|
| Travel Adapter | Samsung Electronics Co., Ltd. | EP-TA200 | R37M4NR27T1SE3 | AC 100-240V 50-60 Hz, 0.5A, 9.0V-1.67A, 5.0V-2.0A |
| Micro USB Data Cable | Samsung Electronics Co., Ltd. | - | - | - |

2.2. Frequency/channel operations

This device contains the following capabilities:

WIFI(2.4GHz band 802.11b/g/n(HT20), 5GHz band 802.11a/n(HT20/HT40)/ac(VHT/20/40/80)),

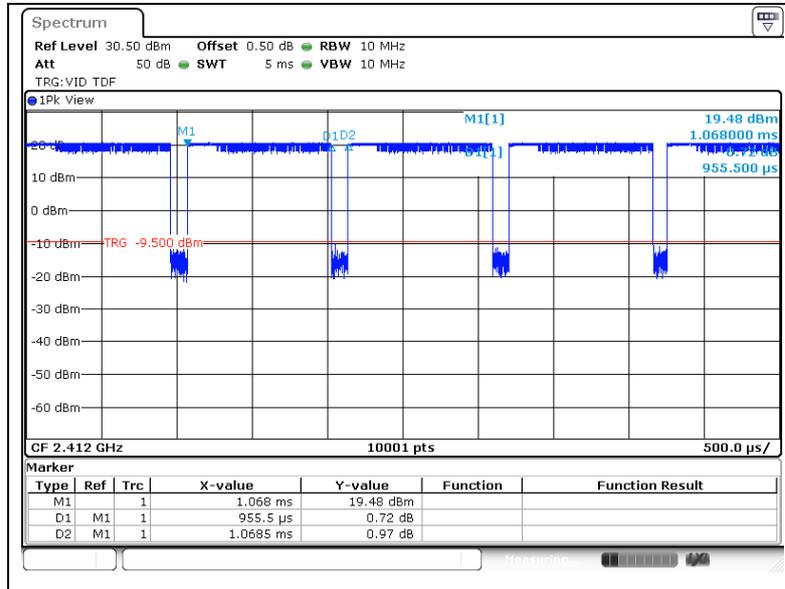
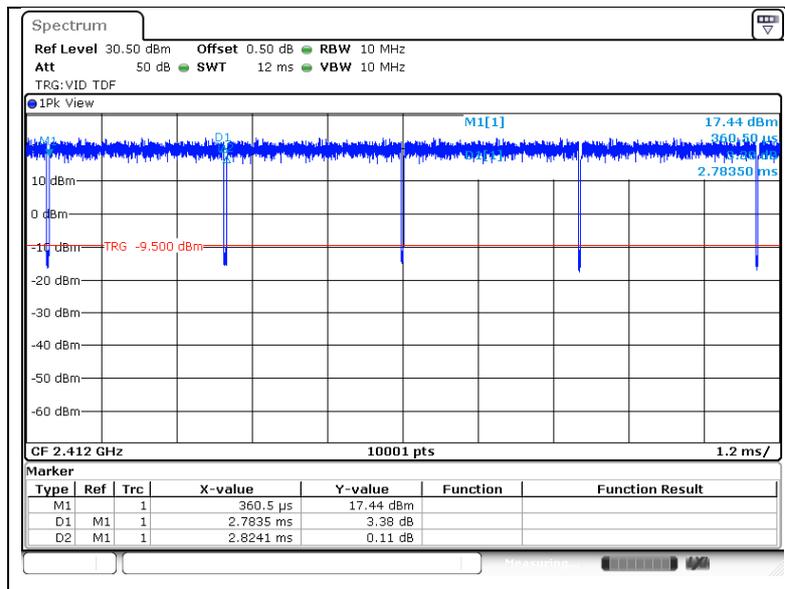
Bluetooth(BDR/EDR/BLE),

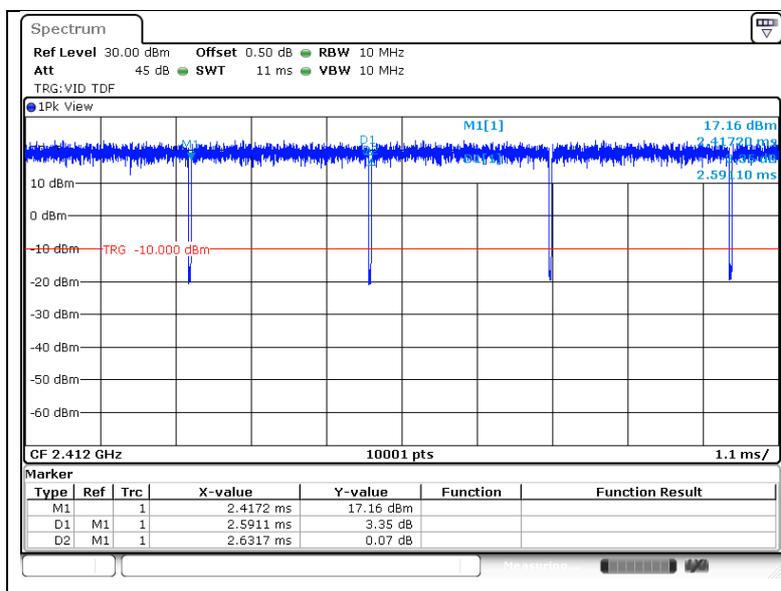
LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 13, LTE Band 17, LTE Band 26,

LTE Band41, LTE Band66, WCDMA 850, WCDMA 1700, WCDMA 1900, GSM 850, GSM 1900

| Ch. | Frequency (MHz) |
|-----|-----------------|
| 01 | 2 412 |
| . | . |
| 06 | 2 437 |
| . | . |
| 11 | 2 462 |

Table 2.2.1. 802.11b/g/n HT20 mode

2.3. Duty Cycle Correction Factor**- 802.11b**Note₁) : period : 1.068 5 ms, On time : 0.955 5 msNote₂) : DCCF = $10 \log(1/x) = 10 \log(1/0.894) = 0.49 \text{ dB}$, $x = 0.955 \text{ 5} / 1.068 \text{ 5} = 0.894 \text{ (89.4\%)}$ Note₃) : 802.11b is a non-continuous transmission (duty cycle < 98%)**- 802.11g**Note₁) : period : 2.824 1 ms, On time : 2.783 5 msNote₂) : DCCF = $10 \log(1/x) = 10 \log(1/0.986) = 0.06 \text{ dB}$, $x = 2.783 \text{ 5} / 2.824 \text{ 1} = 0.986 \text{ (98.6\%)}$ Note₃) : 802.11g is a continuous transmission (duty cycle >= 98 %)

- 802.11n HT20

Note₁) : period : 2.631 7 ms, On time : 2.591 1 ms

Note₂) : DCCF = $10 \log(1 / x) = 10 \log(1/0.985) = 0.07 \text{ dB}$, $x = 2.591 \text{ 1} / 2.631 \text{ 7} = 0.985 \text{ (98.5\%)}$

Note₃) : 802.11n HT20 is a continuous transmission (duty cycle $\geq 98 \%$)

3. Antenna requirement

Requirement of FCC part section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 transmitter has permanently attached LDS Antenna (internal antenna) on board.

4. Summary of tests

| FCC Part section(s) | Parameter | Test results |
|---------------------------------------|-----------------------------|--------------|
| 15.247(b)(3) | Maximum peak output power | Pass |
| 15.247(e) | Peak power spectral density | Pass |
| 15.247(a)(2) | 6 dB channel bandwidth | Pass |
| - | Occupied bandwidth | Pass |
| 15.247(d), 15.205(a), 15.209(a) | Spurious emission | Pass |
| | Band-edge, restricted band | Pass |
| 15.207(a) | Conducted emissions | Pass |

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **X** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **X** orientation
4. The test procedure(s) in this report were performed in accordance as following.
 - ◆ ANSI C63.10-2013
 - ◆ KDB 558074 D01 V05r02
5. The worst-case data rate were:
 - 802.11b mode : 11Mbps
 - 802.11g mode : 6Mbps
 - 802.11n HT20 mode : MCS0

5. 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 (\pm) | |
|------------------------------|--------------------------------|---------|
| Conducted RF power | 1.23 dB | |
| Conducted spurious emissions | 1.24 dB | |
| Radiated spurious emissions | 9 kHz ~ 30 MHz: | 2.28 dB |
| | 30 MHz ~ 1000 MHz | 5.02 dB |
| | 1 GHz ~ 18 GHz | 6.64 dB |
| Conducted emissions | 9 kHz ~ 150 kHz | 3.66 dB |
| | 150 kHz ~ 30 MHz | 3.26 dB |

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6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.

With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

| Frequency (MHz) | Factor(dB) | Frequency (MHz) | Factor(dB) |
|-----------------|------------|-----------------|------------|
| 30 | 9.78 | 9 000 | 12.06 |
| 50 | 9.99 | 10 000 | 12.15 |
| 100 | 10.05 | 11 000 | 12.27 |
| 200 | 10.15 | 12 000 | 12.24 |
| 300 | 10.23 | 13 000 | 12.43 |
| 400 | 10.30 | 14 000 | 12.68 |
| 500 | 10.35 | 15 000 | 12.81 |
| 600 | 10.39 | 16 000 | 12.70 |
| 700 | 10.44 | 17 000 | 12.71 |
| 800 | 10.49 | 18 000 | 12.94 |
| 900 | 10.54 | 19 000 | 13.43 |
| 1 000 | 10.55 | 20 000 | 13.09 |
| 2 000 | 10.86 | 21 000 | 13.18 |
| 3 000 | 11.07 | 22 000 | 13.72 |
| 4 000 | 11.24 | 23 000 | 13.54 |
| 5 000 | 11.48 | 24 000 | 13.47 |
| 6 000 | 11.66 | 25 000 | 13.64 |
| 7 000 | 11.78 | 26 000 | 13.80 |
| 8 000 | 12.05 | 26 500 | 13.63 |

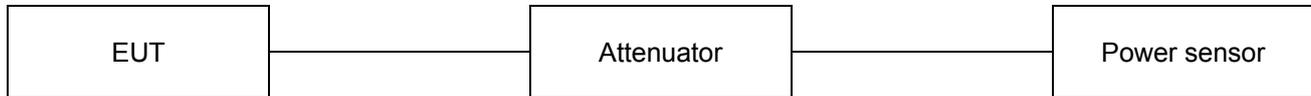
Note.

Offset(dB) = RF cable loss(dB) + Attenuator(dB)

7. Test results

7.1. Maximum peak output power

Test setup



Limit

According to §15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test procedure

ANSI C63.10 - Section 11.9

Test settings

General

Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).

When using a spectrum analyzer or EMI receiver to perform these measurements, it shall be capable of utilizing a number of measurement points in each sweep that is greater than or equal to twice the span/RBW to set a bin-to-bin spacing of $\leq RBW/2$ so that narrowband signals are not lost between frequency bins.

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle; however a small reduction in duty cycle (to no lower than 98 %) is permitted, if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

If continuous transmission (or at least 98 % duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible during which sweep triggering/signal gating techniques may be used to perform the measurement over the transmission duration.

11.9.1. Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

11.9.1.1. RBW \geq DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW $\geq [3 \times RBW]$.
- c) Set span $\geq [3 \times RBW]$.
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

11.9.1.3. PKPM1 Peak power meter method

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

11.9.2.3.1. Measurement using a power meter (PM)

Method AVGPM is a measurement using an RF average power meter, as follows:

- a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
 - 1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
 - 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
 - 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6.
- c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.
- d) Adjust the measurement in dBm by adding $[10 \log(1/D)]$, where D is the duty cycle

Notes:

1. A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

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KCTL**Test results**

| Test mode | Frequency(MHz) | Measured output power(dBm) | | Limit(dBm) |
|--------------|----------------|----------------------------|---------|------------|
| | | Peak | Average | |
| 802.11b | 2 412 | 20.35 | 17.92 | 30.00 |
| | 2 437 | 20.39 | 17.96 | |
| | 2 462 | 20.23 | 17.90 | |
| 802.11g | 2 412 | 23.72 | 16.09 | 30.00 |
| | 2 437 | 24.29 | 16.23 | |
| | 2 462 | 23.78 | 16.20 | |
| 802.11n HT20 | 2 412 | 23.63 | 15.70 | 30.00 |
| | 2 437 | 23.42 | 15.58 | |
| | 2 462 | 23.26 | 15.41 | |

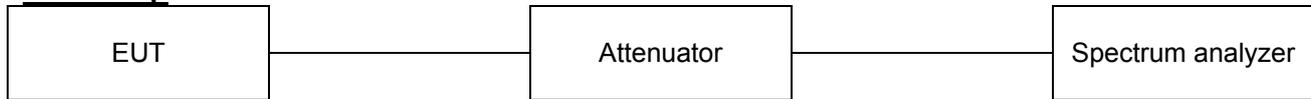
Notes:

1. Measured output power(Average) = Reading value of average power + D.C.C.F

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7.2. Peak Power Spectral Density

Test setup



Limit

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test procedure

ANSI C63.10 - Section 11.10.2

Test settings

Method PKPSD (peak PSD)

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

- 1) Set analyzer center frequency to DTS channel center frequency.
- 2) Set the span to 1.5 times the DTS bandwidth.
- 3) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- 4) Set the VBW $\geq 3 \times \text{RBW}$.
- 5) Detector = peak.
- 6) Sweep time = auto couple.
- 7) Trace mode = max hold.
- 8) Allow trace to fully stabilize.
- 9) Use the peak marker function to determine the maximum amplitude level within the RBW.
- 10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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KCTL**Test results**

| Test mode | Frequency(MHz) | Result(dBm) (RBW = 3 kHz) | Limit(dBm/ 3kHz) |
|--------------|----------------|---------------------------|------------------|
| 802.11b | 2 412 | -4.89 | 8.00 |
| | 2 437 | -5.17 | |
| | 2 462 | -4.68 | |
| 802.11g | 2 412 | -10.74 | |
| | 2 437 | -9.71 | |
| | 2 462 | -10.11 | |
| 802.11n HT20 | 2 412 | -9.25 | |
| | 2 437 | -9.14 | |
| | 2 462 | -9.01 | |

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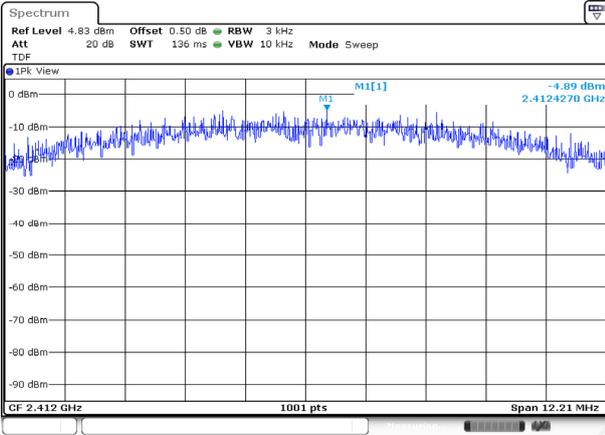
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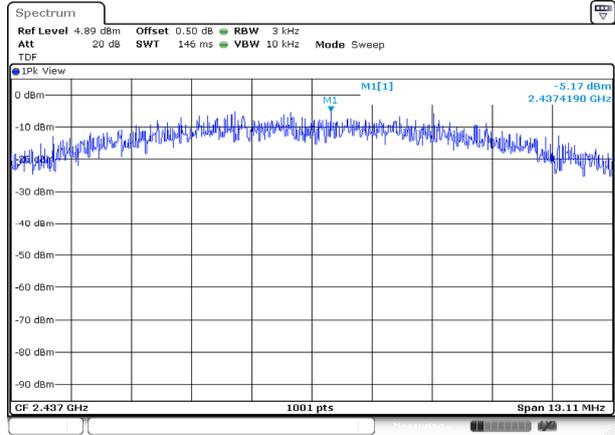
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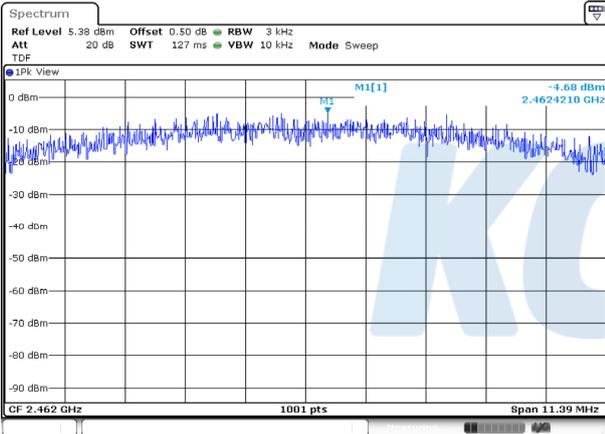
802.11b / 2 412 MHz



802.11b / 2 437 MHz



802.11b / 2 462 MHz



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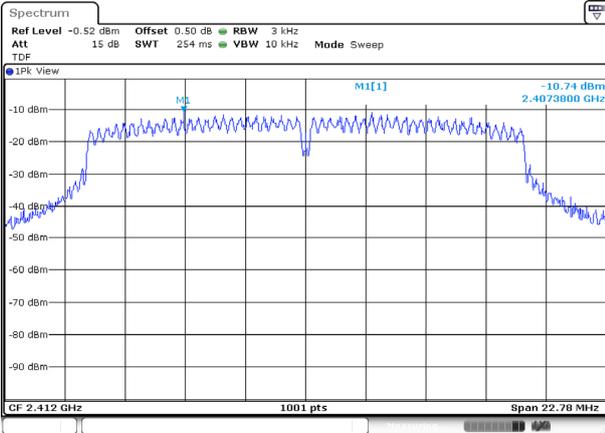
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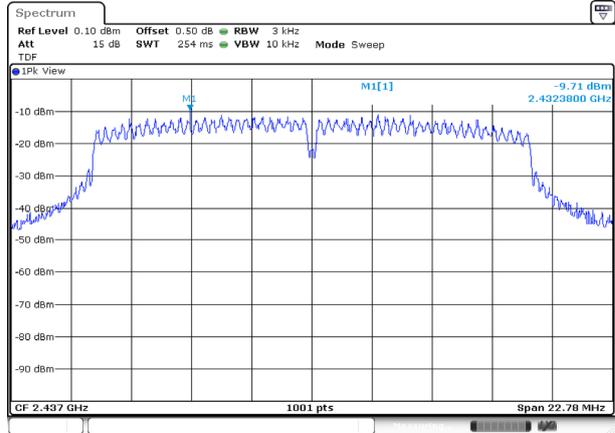
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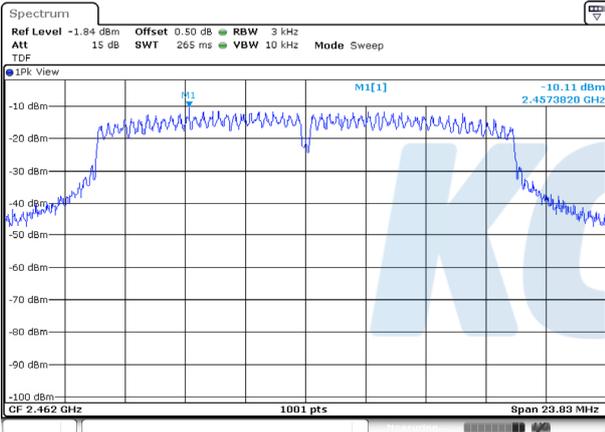
802.11g / 2 412 MHz



802.11g / 2 437 MHz



802.11g / 2 462 MHz



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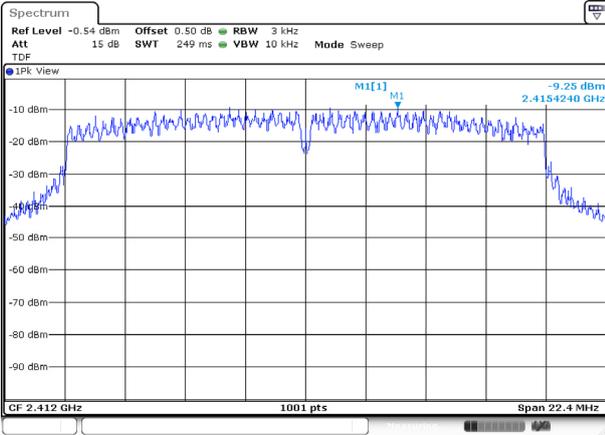
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KR20-SRF0015-B

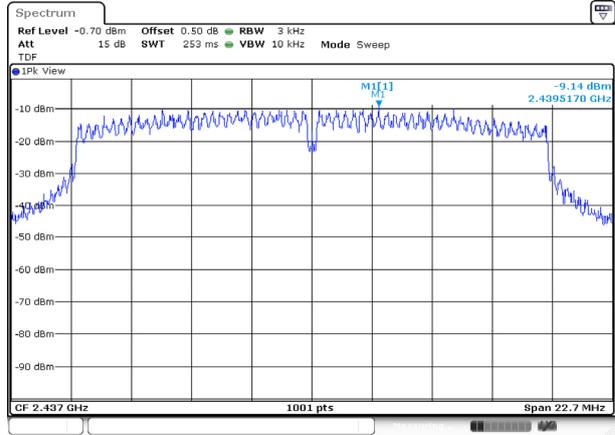
Page (20) of (56)



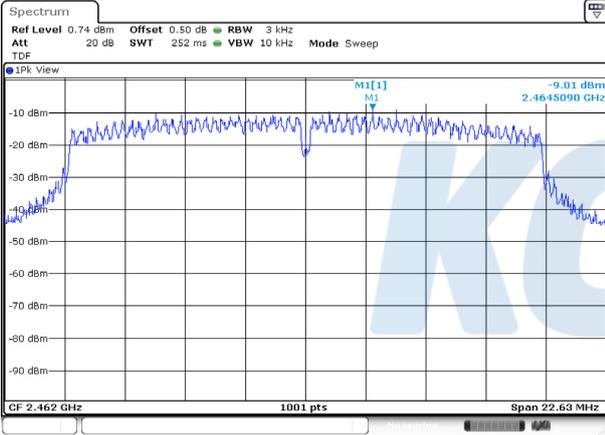
802.11n HT20 / 2 412 MHz



802.11n HT20 / 2 437 MHz



802.11n HT20 / 2 462 MHz



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