

# **TEST REPORT**

# KCTL KCTL Inc.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311

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Report No.: KR20-SRF0127-B

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1. Client

Name

: Samsung Electronics Co., Ltd.

Address

: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677,

Rep. of Korea

Date of Receipt : 2020-04-03

2. Use of Report

: Certification

3. Name of Product / Model

: Smart Wearable / SM-R845U

4. Manufacturer / Country of Origin: Samsung Electronics Co., Ltd. / Vietnam

5. FCC ID

: A3LSMR845

6. IC Certificate No.

: 649E-SMR845

7. Date of Test

: 2020-04-13 to 2020-05-25

**8.** Location of Test : ■ Permanent Testing Lab □ On Site Testing (Address: Address of testing location)

9. Test method used: FCC Part 15 Subpart C, 15.247

RSS-247 Issue 2 February 2017

RSS-Gen Issue 5 March 2019

10. Test Result

: Refer to the test result in the test report

Tested by Affirmation

**Technical Manager** 

Name: Kwonse Kim

Name: Seungyong Kim

2020-05-25

# KCTL Inc.

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KCTL-TIR001-003/3 KP20-01775

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#### REPORT REVISION HISTORY

Date	Revision	Page No
2020-05-22	Originally issued	-
2020-05-24	Updated	5
2020-05-25	Updated	5,22,26,27,28,34

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Note. The report No. KR20-SRF0127-A is superseded by the report No. KR20-SRF0127-B.

#### General remarks for test reports

Nothing significant to report.



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# **General information**

Client : Samsung Electronics Co., Ltd.

Address 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677,

Rep. of Korea

Samsung Electronics Co., Ltd. Manufacturer

129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Address

Rep. of Korea

: KCTL Inc. Laboratory

Address 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea : FCC Site Designation No: KR0040, FCC Site Registration No: 687132 Accreditations

VCCI Registration No.: R-20080, G-20078, C-20059, T-20056

Industry Canada Registration No.: 8035A

KOLAS No.: KT231

# **Device information**

Equipment under test **Smart Wearable** 

Model SM-R845U Derivative model SM-R845F

Modulation technique Bluetooth(BDR/EDR) GFSK, π/4DQPSK, 8DPSK

Bluetooth(BLE) GFSK

WIFI(802.11b/g/n20) DSSS, OFDM

LTE\_QPSK, 16QAM

Number of channels : Bluetooth(BDR/EDR) 79 ch

Bluetooth(BLE) 40 ch

WIFI(802.11b/g/n20) 13 ch

Power source : DC 3.85 V

: LTE/WCDMA PIFA (Housing metal) Antenna Antenna specification

WIFI/Bluetooth(BDR/EDR/BLE) LDS Antenna

Antenna gain : WIFI/Bluetooth(BDR/EDR/BLE): -8.31 dBi

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Frequency range : Bluetooth(BDR/EDR/BLE) 2 402 Mb ~ 2 480 Mb

WIFI(802.11b/g/n20) 2 412 MHz ~ 2 472 MHz

LTE Band 2\_1 850.7 Mb ~ 1 909.3 Mb LTE Band 4\_1 710.7 Mb ~ 1 754.3 Mb LTE Band 5 824.7 Mb ~ 848.3 Mb

LTE Band 12\_699.7 Mb ~ 715.3 Mb LTE Band 13\_779.5 Mb ~ 784.5 Mb LTE Band 25 1 850.7 Mb ~ 1 914.3 Mb

LTE Band 26 824.7 Mb ~ 848.3 Mb, 814.7 Mb ~ 823.3 Mb

LTE Band 66\_1 710.7 Mb ~ 1 779.3 Mb LTE Band 71\_665.5 Mb ~ 688.0 Mb WCDMA 850\_826.4 Mb ~ 846.6 Mb

WCDMA 1700\_1 712.4 Mb ~ 1 752.6 Mb WCDMA 1900 1 852.4 Mb ~ 1 907.6 Mb

Software version : SM-R845U\_R845U.001, SM-R845F\_R845F.001

Hardware version : REV1.0

Test device serial No. : Conducted(R3AN3003ZWM)

Radiated(R3AN400CXFL, R3AN400CWVZ, R3AN400CTXA)

Operation temperature : -30 °C ~ 50 °C

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source	FCC ID & IC
Wireless charger	Samsung Electronics Co., Ltd.	EP-OR825	-	DC 5.0 V, 1.0 A	A3LEPOR825 / 649E-EPOR825

# 2.2. Model Information

The difference between basic model (SM-R845U) and derivative model (SM-R845F) is:

a. RF Supported Band is Different.

(R845U: 3G (B2, B4, B5), 4G (B2, B4, B5, B12, B13, B25, B26, B66, B71))

(R845F: 3G (B1, B2, B4, B5, B8), 4G (B1, B2, B3, B4, B5, B7, B8, B12, B13, B20, B25, B28, B66))

- In EUR R845F : 3G (B1, B5, B8), 4G (B1, B3, B5, B7, B8, B20, B28)
- b. All other protocol part is same.
- c. All other features of Volte, SUPL is same.
- d. In USA & Canada, 4G (B7) disabled by MCC code.

Because device doesn't support B7 roaming in USA & Canada.

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# 2.3. Frequency/channel operations

This device contains the following capabilities:

2.4 WIFI(802.11b/g/n(HT20)), Bluetooth(BDR/EDR/BLE), LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 13, LTE Band 25, LTE Band 26, LTE Band 66, LTE Band 71, WCDMA 850, WCDMA 1700, WCDMA 1900

Ch.	Frequency (Mb)
01	2 412
06	2 437
·	
11	2 462
12	2 467
13	2 472

Table 2.3.1. 802.11b/g/n HT20 mode



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# 2.4. Duty Cycle Factor

Test mode	Period	On time	Duty cycle		Duty Cycle Factor
rest mode	(ms)	(ms)	(Linear)	(%)	(dB)
802.11b	8.706 0	8.601 5	0.988 0	98.80	0.05
802.11g	1.529 5	1.421 0	0.929 1	92.91	0.32
802.11n_HT20	1.441 2	1.330 8	0.923 4	92.34	0.35

#### Notes.

- 1. Duty cycle (Linear) = Ton time / Period
- 2. DCF(Duty cycle factor) = 10log(1/duty cycle)



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# 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.

# Requirement of RSS-Gen Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

- The transmitter has permanently attached LDS Antenna (internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.247.

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Summary of tests

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FCC Part section(s)	IC Rule Referene	Parameter	Test results
15.247(b)(3)	RSS-247 (5.4)(d)	Maximum Peak Output Power	Pass
15.247(e)	RSS-247 (5.2)(b)	Peak Power Spectral Density	Pass
15.247(a)(2)	RSS-247 (5.2)(a)	6 dB Channel Bandwidth	Pass
-	RSS-Gen (6.7)	Occupied Bandwidth	Pass
15.247(d),	RSS-Gen	Spurious emission	Pass
15.205(a), 15.209(a)	(8.9), (8.10) RSS-247(5.5)	Band-edge, restricted band	Pass
15.207(a)	RSS-Gen (8.8)	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. All the radiated tests have been performed two modes (with charger and without charger) and the with charger is the worst case mode.
- 5. The worst-case data rate were:

802.11b mode: 1 Mbps 802.11g mode: 6 Mbps 802.11n HT20 mode: MCS0

- 6. The test procedure(s) in this report were performed in accordance as following.
  - ANSI C63.10-2013
  - KDB 558074 D01 V05r02

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# 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 indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the  $U_{\text{CISPR}}$  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 RF power	1.3 dB		
Conducted spurious emissions	<b>1.3</b> dB		
	9 kHz ~ 30 MHz:	<b>2.3</b> dB	
Radiated spurious emissions	30 MHz ~ 300 MHz	<b>5.4</b> dB	
Nadiated spurious emissions	300 MHz ~ 1 000 MHz	<b>5.5</b> dB	
	Above 1 @bz	<b>6.7</b> dB	
Conducted emissions	9 kHz ~ 150 kHz	<b>3.7</b> dB	
Conducted emissions	150 kHz ~ 30 MHz	<b>3.3</b> dB	



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# 6. Measurement results explanation example

Frequency (Mb)	Factor(dB)	Frequency (쌘)	Factor(dB)
30	9.85	9 000	12.05
50	10.09	10 000	12.10
100	10.15	11 000	12.15
200	10.25	12 000	12.33
300	10.33	13 000	12.40
400	10.40	14 000	12.65
500	10.45	15 000	12.71
600	10.49	16 000	12.89
700	10.55	17 000	12.90
800	10.59	18 000	13.01
900	10.63	19 000	12.88
1 000	10.65	20 000	13.12
2 000	11.15	21 000	13.27
3 000	11.38	22 000	13.41
4 000	11.54	23 000	13.57
5 000	11.60	24 000	13.61
6 000	11.79	25 000	13.59
7 000	11.99	26 000	13.60
8 000	12.05	26 500	13.79

Note:

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

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7. Test	results					
7.1. Max	. Maximum peak output power					
<u>Test setup</u>						
EUT		- Attenuator		Power sensor		

#### Limit

#### **FCC**

According to §15.247(b)(3), For systems using digital modulation in the 902-928 Mb, 2 400-2 483.5 Mb, and 5 725-5 850 Mb 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.

#### IC

According to RSS-247 5.4(d), For DTSs employing digital modulation techniques operating in the bands 902-928 Mb and 2400-2483.5 Mb, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

#### **Test procedure**

ANSI C63.10 - Section 11.9 Used test method is section 11.9.1.3 and 11.9.2.3.1

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#### 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 ≤ 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 ≥ 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:

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

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# 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:

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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#### **Test results**

Test	Frequency		output power 3m)	Conducted Power	Ant. Gain	Max. E.I.R.P.(dB m)		Max. E.I.R.P.
mode	(MHz)	Peak	Average	Limit (dBm)	(dBi)	Peak	Average	Limit (dBm)
	2 412	20.30	17.38			11.99	9.07	
	2 437	19.02	16.02			10.71	7.71	1
802.11b	2 462	19.82	16.75	30	-8.31	11.51	8.44	36.02
	2 467	12.28	8.95			3.97	0.64	1
	2 472	12.13	8.77			3.82	0.46	
	2 412	24.09	15.94	30		15.78	7.63	
	2 437	22.75	14.73			14.44	6.42	1
802.11g	2 462	24.60	15.77		-8.31	16.29	7.46	36.02
	2 467	19.90	9.64			11.59	1.33	
	2 472	19.98	9.41			11.67	1.10	1
	2 412	23.95	14.77			15.64	6.46	
	2 437	22.77	13.49			14.46	5.18	
802.11n HT20	2 462	23.93	14.61	30	-8.31	15.62	6.30	36.02
	2 467	18.89	9.55			10.58	1.24	1
	2 472	20.42	9.37			12.11	1.06	

#### Notes:

- 1. Measured output power(Average) = reading value of average power + D.C.F
- 2. E.I.R.P. Calculation: E.I.R.P. (dB m) = Conducted output power (dB m) + Antenna gain (dB i)

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# 7.2. Peak Power Spectral Density

Test setup	_		
EUT		Attenuator	Spectrum analyzer
201		Attenuator	Spectrum analyzer

# Limit

According to §15.247(e) and RSS-247(5.2), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8  $\,\mathrm{dBm}$  in any 3  $\,\mathrm{klz}$  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 kHz ≤ RBW ≤ 100 kHz.
- 4) Set the VBW  $\geq$  3 x 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 klb) and repeat.

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## **Test results**

Test mode	Frequency()版)	Result(dBm/ 3kHz)	Limit(dBm/ 3號)
	2 412	-6.24	
	2 437	-7.20	
802.11b	2 462	-6.34	
	2 467	-13.36	
	2 472	-14.02	
	2 412	-8.89	
	2 437	-11.24	
802.11g	2 462	-8.92	8.00
	2 467	-16.62	
	2 472	-15.74	
	2 412	-10.90	
	2 437	-12.06	
802.11n HT20	2 462	-11.63	
	2 467	-15.46	
	2 472	-15.07	

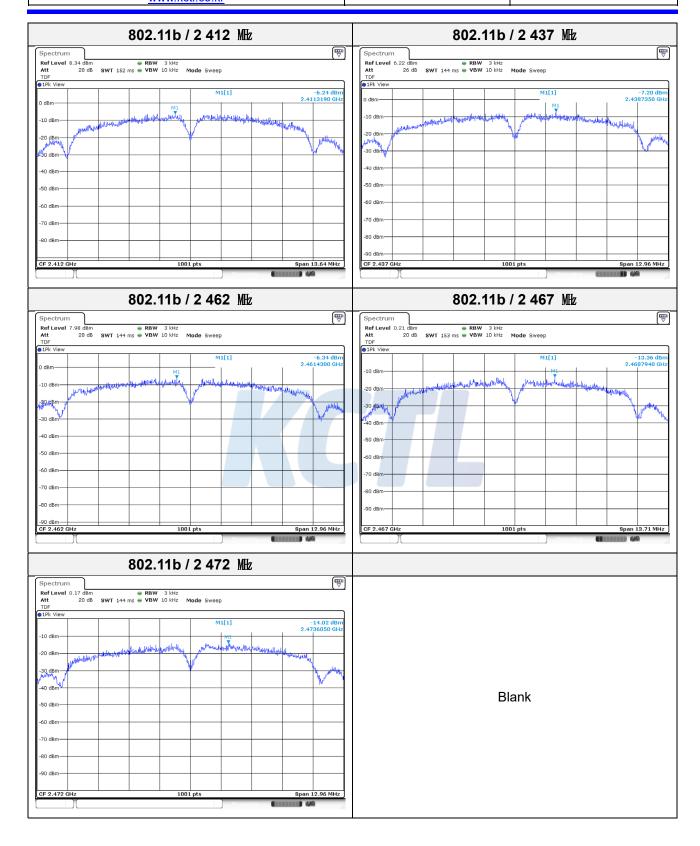
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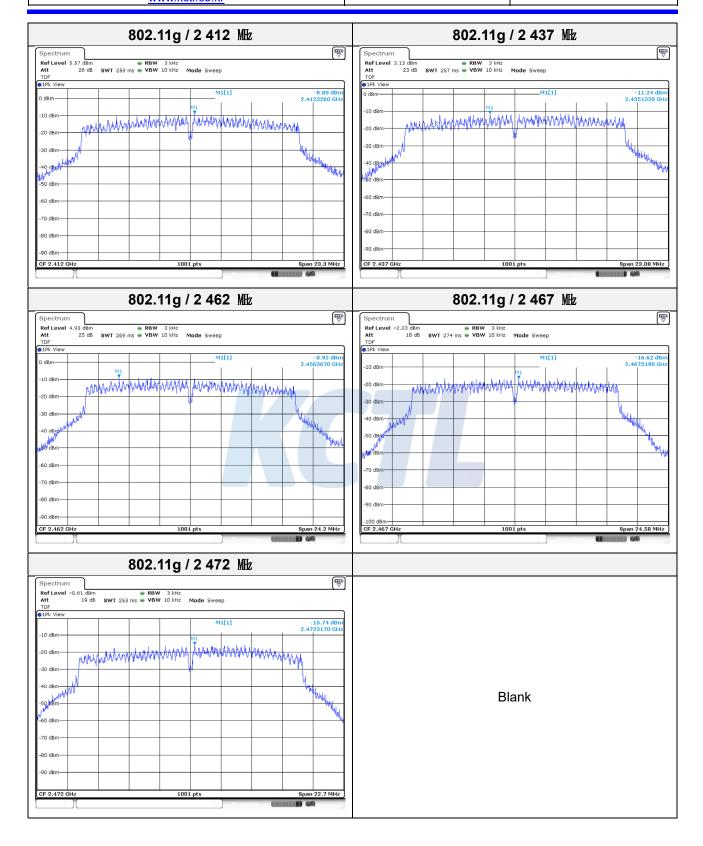
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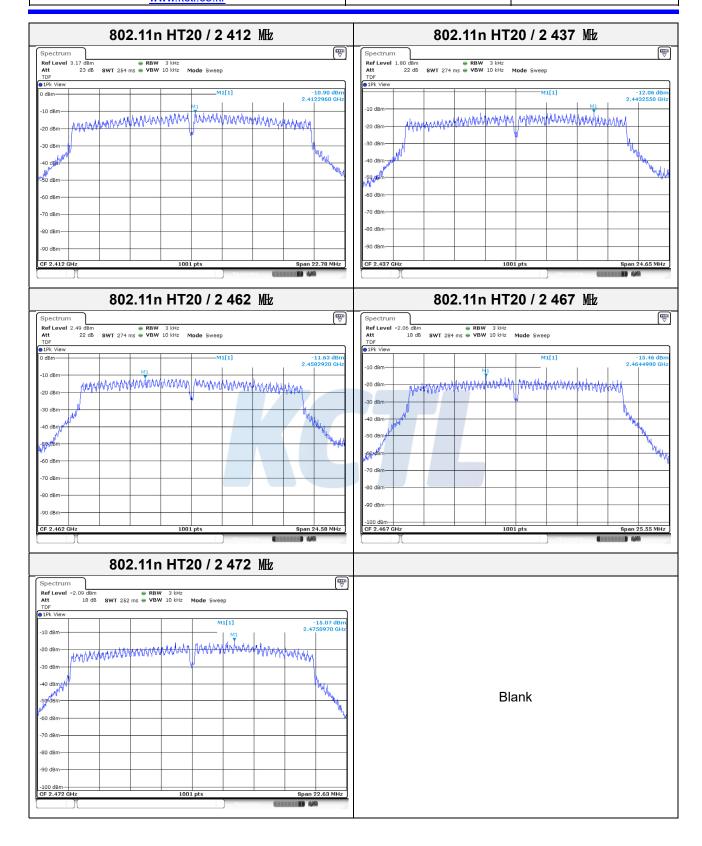
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# 7.3. 6 dB Bandwidth(DTS Channel Bandwidth)

<u>Test setup</u>	_		_	
EUT		Attenuator		Spectrum analyzer
				,

# <u>Limit</u>

According to §15.247(a)(2) and RSS-247(5.2) Systems using digital modulation techniques may operate in the 902–928 Mb, 2 400–2 483.5 Mb, and 5 725–5 850 Mb bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

#### Test procedure

ANSI C63.10 - Section 11.8.2

#### **Test settings**

#### **DTS** bandwidth

One of the following procedures may be used to determine the modulated DTS bandwidth.

#### Option 1

- 1) Set RBW = 100 kHz.
- 2) Set the video bandwidth (VBW) ≥ 3 x RBW.
- 3) Detector = Peak.
- 4) Trace mode = max hold.
- 5) Sweep = auto couple.
- 6) Allow the trace to stabilize.
- 7) 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 level measured in the fundamental emission.

# Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X  $\rm dB$  bandwidth mode with X set to 6  $\rm dB$ , if the functionality described in 11.8.1 (i.e., RBW = 100  $\rm kHz$ , VBW  $\geq$  3  $\times$  RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\geq$ 6  $\rm dB$ .

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## **Test results**

## 6 dB bandwidth

Test mode	Frequency(Mb)	6 dB bandwidth (Mb)
	2 412	9.09
	2 437	8.64
802.11b	2 462	8.64
	2 467	9.14
	2 472	8.64
	2 412	15.53
	2 437	15.38
802.11g	2 462	16.13
	2 467	16.38
	2 472	15.13
	2 412	15.18
	2 437	16.43
802.11n HT20	2 462	16.38
	2 467	17.03
	2 472	15.08

99% bandwidth

Test mode	Frequency(Mb)	99 % bandwidth (∰z)
	2 412	11.94
	2 437	11.94
802.11b	2 462	11.94
	2 467	11.94
	2 472	11.29
	2 412	16.43
	2 437	16.57
802.11g	2 462	16.57
	2 467	16.57
	2 472	16.35
	2 412	17.51
	2 437	17.73
802.11n HT20	2 462	17.66
	2 467	17.73
	2 472	17.51

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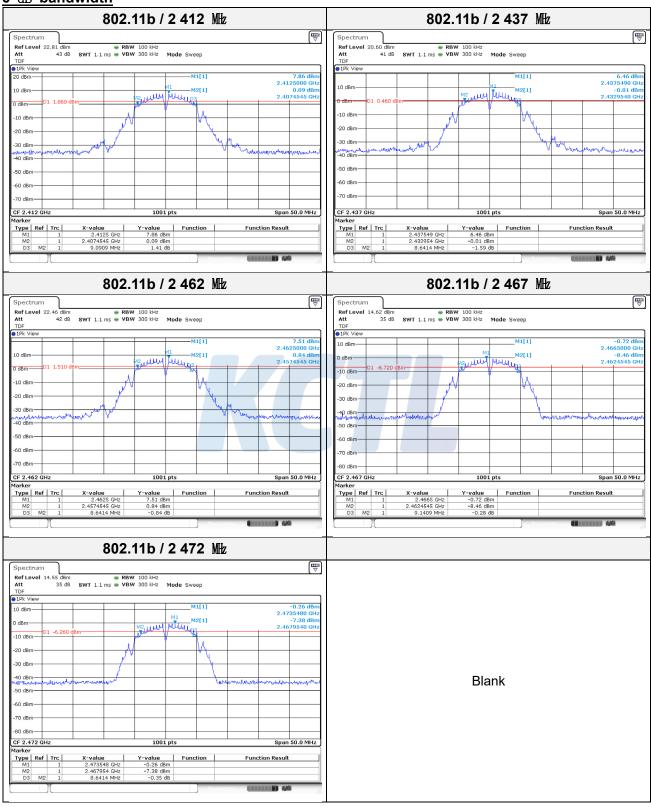
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# 6 dB bandwidth



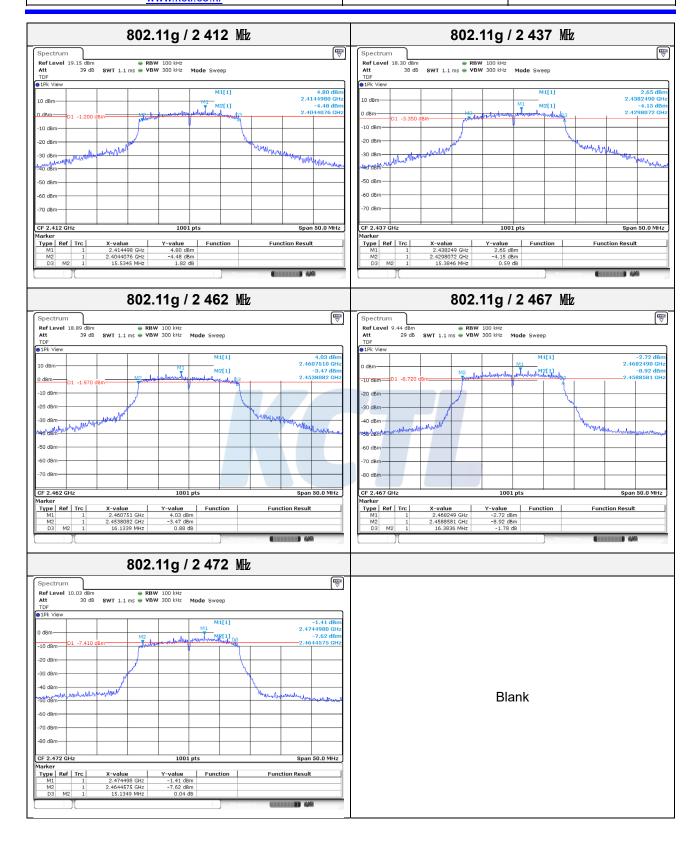
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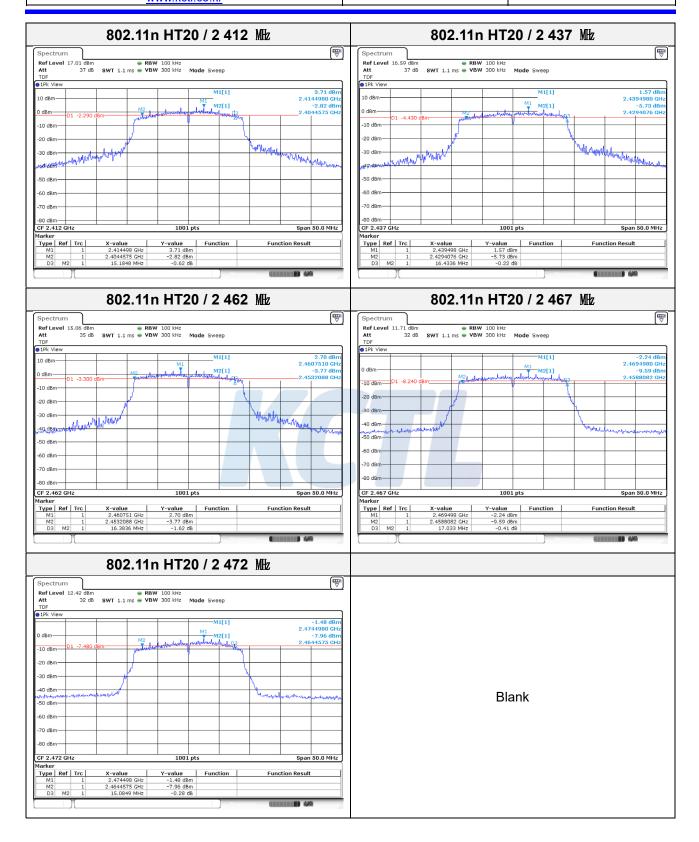
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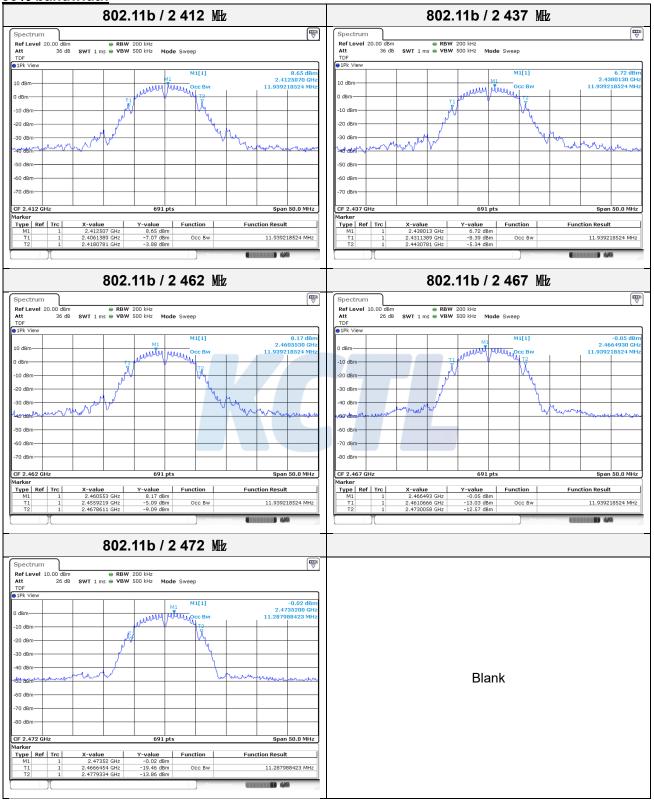
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#### 99% bandwidth



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