



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.: KR19-SRF0161-C Page (1) of (49)			
1. Client ◦ Name : Samsung Electronics Co., Ltd. ◦ Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea ◦ Date of Receipt : 2019-09-27 2. Use of Report : -				
3. Name of Product and Model : Mobile Phone / SM-A515F/DSN 4. Manufacturer and Country of Origin : SAMSUNG ELECTRONICS VIETNAM CO.,LTD./ Vietnam 5. FCC ID : A3LSMA515FN 6. Date of Test : 2019-10-07 to 2019-11-10 7. Test Standards : FCC Part 15 Subpart C, 15.247 8. Test Results : Refer to the test result in the test report				
Affirmation	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Tested by Name : Kwonse Kim (Signature) </td> <td style="width: 50%; padding: 5px;"> Technical Manager Name : Gyungnam Park (Signature) </td> </tr> </table>		Tested by Name : Kwonse Kim (Signature)	Technical Manager Name : Gyungnam Park (Signature)
Tested by Name : Kwonse Kim (Signature)	Technical Manager Name : Gyungnam Park (Signature)			
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Report revision history

Date	Revision	Page No
2019-11-11	Initial report	-
2019-11-16	Updated	10,15,18,21,26
2019-11-21	Updated	4, 6, 7, 8, 18
2019-11-22	Updated	17

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Note. The report No. KR19-SRF0161-B is superseded by the report No. KR19-SRF0161-C.



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1. General information

Client : Samsung Electronics Co., Ltd.
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 Manufacturer : SAMSUNG ELECTRONICS VIETNAM CO.,LTD.
 Address : Kcn Yen Binh1, huyen pho Yen Tinh Thai Nguyen Vietnam
 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-A515F/DSN
 Derivative model : SM-A515F/N
 Modulation technique : Bluetooth(BDR/EDR)_ GFSK, $\pi/4$ DQPSK, 8DPSK
 Bluetooth(BLE), ANT+_GFSK
 WIFI(802.11b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM
 NFC_ASK
 LTE_QPSK, 16QAM
 WCDMA_QPSK
 GSM_GMSK, 8-PSK
 Number of channels : Bluetooth(BDR/EDR), ANT+_79ch / Bluetooth(BLE)_40ch
 11 ch: 802.11b/g/n_HT20
 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/WCDMA_FPCB Antenna
 WIFI/Bluetooth(BDR/EDR/BLE)/ANT+_FPCB Antenna
 NFC_FPCB Antenna
 Antenna gain : WIFI/Bluetooth(BDR/EDR/BLE)/ANT+ : -4.70 dBi
 UNII-1 -4.10 dBi
 UNII-2A -4.74 dBi
 UNII-2C -3.92 dBi
 UNII-3 -4.40 dBi

Frequency range : Bluetooth(BDR/EDR/BLE), ANT+_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)
NFC_13.56 MHz
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 : A515F.001
Hardware version : REV0.1
Test device serial No. : Conducted(R38M908K75A, 352349/11/002988/6,
352349/11/002989/4)
Radiated(R38M90ATJRB, R38M90ATDEX, R38MAOA8WJE)
Operation temperature : -30 °C ~ 50 °C

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Earphone	Samsung Electronics Co., Ltd.	EHS61ASFBE	-	-
Travel Adapter	Samsung Electronics Co., Ltd.	EP-TA200	R37M6LAKG31DK3	AC 100-240V 50-60 Hz, 9.0V-1.67A 5.0V-2.0A
Micro USB Data Cable	Samsung Electronics Co., Ltd.	-	-	-

2.2. Information about derivative model

The difference between basic model and derivative models is:

SM-A515F/N

- It does not support Dual-Sim card, support Single-Sim card and changed from Dual SIM tray to single SIM tray.

2.3. 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), NFC, ANT+

LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 13, LTE Band 17, LTE Band 26, LTE Band41, WCDMA 850, WCDMA 1700, WCDMA 1900, GSM 850, GSM 1900

Ch.	Frequency (MHz)
00	2 402
.	.
39	2 441
.	.
78	2 480

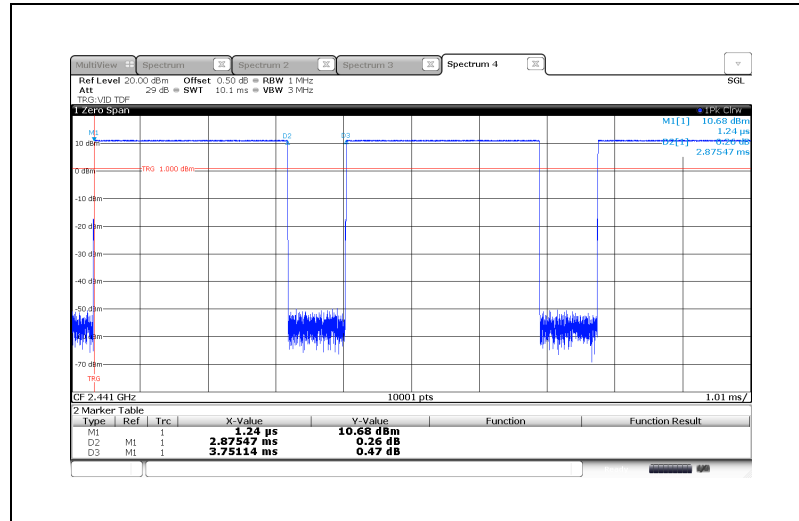
Table 2.3.1. Bluetooth(BDR/EDR) mode

15.247 Requirements for Bluetooth transmitter:

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
 - 1) This system is hopping pseudo-randomly.
 - 2) Each frequency is used equally on the average by each transmitter.
 - 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
 - 4) The receiver shifts frequencies in synchronization with the transmitted signals.
- 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.
- 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

2.4. Duty Cycle

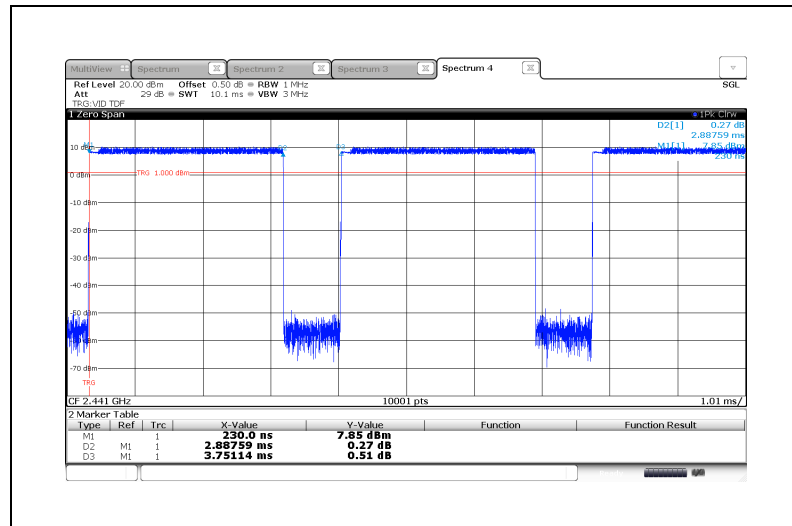
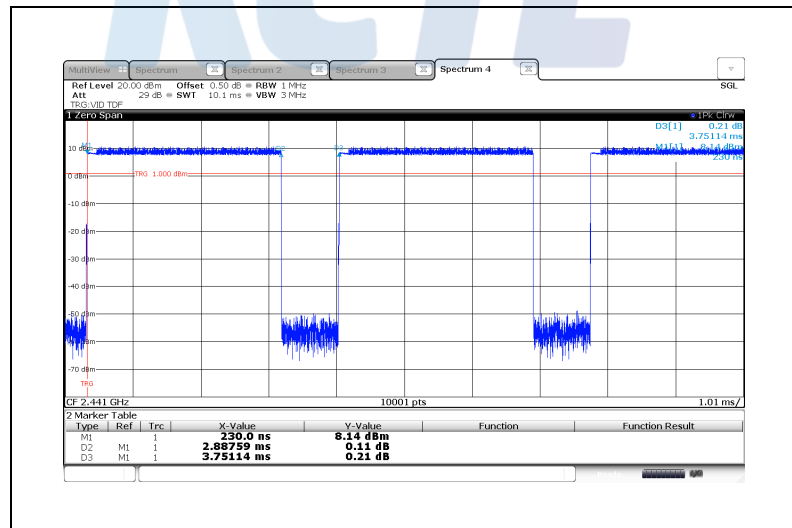
- GFSK (DH5)



Note₁) : Period : 3.751 14 ms, On time : 2. 875 47 ms

Note₂) : reduced VBW : $1 / T = 1 / 0.00287547 = 347.7692 \text{ Hz}$

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- $\pi/4$ DQPSK(2-DH5)Note₁) : Period : 3.751 14 ms, On time : 2.887 59 msNote₂) : reduced VBW : $1 / T = 1 / 0.00287547 = 346.3096 \text{ Hz}$ **- 8DPSK(3-DH5)**Note₁) : Period : 3.751 14 ms, On time : 2.887 59 msNote₂) : reduced VBW : $1 / T = 1 / 0.00287547 = 346.3096 \text{ Hz}$

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 FPCB Antenna (internal antenna) on board.

4. Summary of tests

FCC Part section(s)	Parameter	Test results
15.247(b)(1), (4)	Maximum peak output power	Pass
15.247(a)(1)	Carrier frequency separation	Pass
15.247(a)(1)	20dB channel bandwidth	Pass
15.247(a)(iii) 15.247(b)(1)	Number of hopping channel	Pass
15.247(a) (iii)	Time of occupancy(dwell time)	Pass
15.205(a), 15.209(a) 15.247(d),	Spurious emission	Pass
	Band-edge, restricted band	Pass
15.207(a)	Conducted Emissions	Pass

Notes:

- All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 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.
- 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.
- The test procedure(s) in this report were performed in accordance as following.
 - ANSI C63.10-2013
 - KDB 558074 D01 v05r02

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 indicated 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	1.76 dB	
Conducted spurious emissions	4.03 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.28 dB
	30 MHz ~ 300 MHz	4.98 dB
	300 MHz ~ 1 000 MHz	5.14 dB
	1 GHz ~ 6 GHz	6.70 dB
	Above 6 GHz	6.60 dB
Conducted emissions	9 kHz ~ 150 kHz	3.66 dB
	150 kHz ~ 30 MHz	3.26 dB



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	6.08	9 000	8.56
50	6.12	10 000	9.02
100	6.21	11 000	8.72
200	6.27	12 000	8.52
300	6.38	13 000	8.74
400	6.43	14 000	9.58
500	6.50	15 000	10.51
600	6.56	16 000	10.64
700	6.62	17 000	10.17
800	6.69	18 000	9.71
900	6.73	19 000	10.95
1 000	6.77	20 000	11.70
2 000	7.16	21 000	10.50
3 000	7.41	22 000	10.76
4 000	7.61	23 000	12.61
5 000	7.82	24 000	12.10
6 000	8.06	25 000	11.42
7 000	8.17	26 000	10.18
8 000	8.36	26 500	11.11

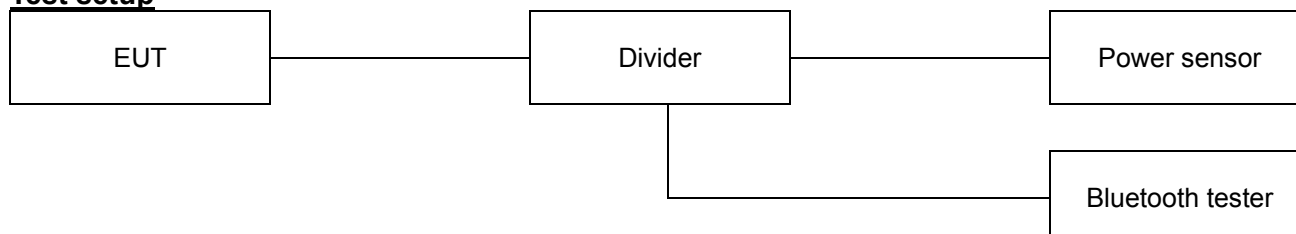
Note.

Offset(dB) = RF cable loss(dB) + Power Divider(dB)

7 Test results

7.1. Maximum peak output power

Test setup



Limit

According to §15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

According to §15.247(b)(1), for frequency hopping systems operating in the 2 400-2 483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725-5 850 MHz band: 1 watt. For all other frequency hopping systems in the 2 400-2 483.5 MHz band: 0.125 watts.

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 C63.10-2013 - Section 7.8.5

Test settings

The test follows ANSI C63.10-2013 – Section 7.8.5. Using the power sensor instead of a spectrum analyzer.

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

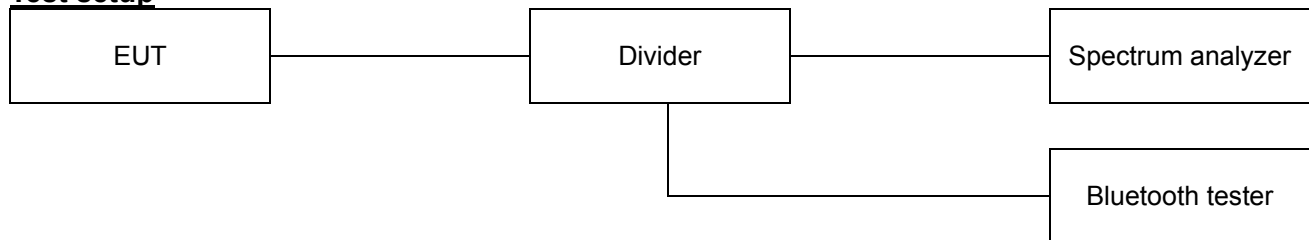
TTest results

Frequency(MHz)	Data rate(Mbps)	Measured output power(dBm)		Limit(dBm)
		Peak	Average	
2 402	1	10.47	9.09	20.97
2 441	1	10.47	9.05	
2 480	1	10.37	8.98	
2 402	2	10.47	6.99	20.97
2 441	2	10.47	6.84	
2 480	2	10.17	6.59	
2 402	3	10.97	7.01	20.97
2 441	3	10.97	6.86	
2 480	3	10.67	6.56	

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7.2. Carrier frequency separation

Test setup



Limit

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test procedure

ANSI C63.10-2013 - Section 7.8.2

Test settings

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30 % of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW) $\geq$ RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

Test results

Frequency(MHz)	Data rate(Mbps)	Carrier frequency separation(MHz)	Limit(MHz)
2 402	1	0.992	0.707
2 441	1	1.007	0.641
2 480	1	0.968	0.713
2 402	3	0.968	0.887
2 441	3	0.977	0.887
2 480	3	1.004	0.887

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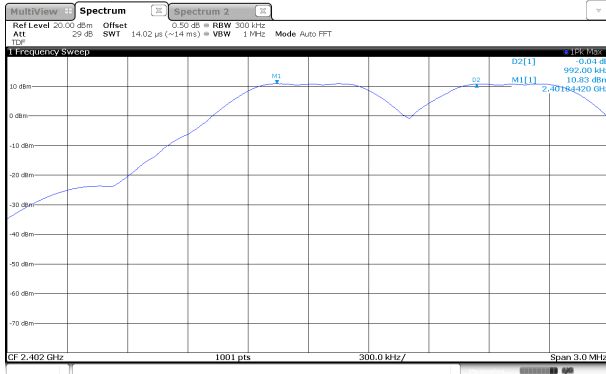
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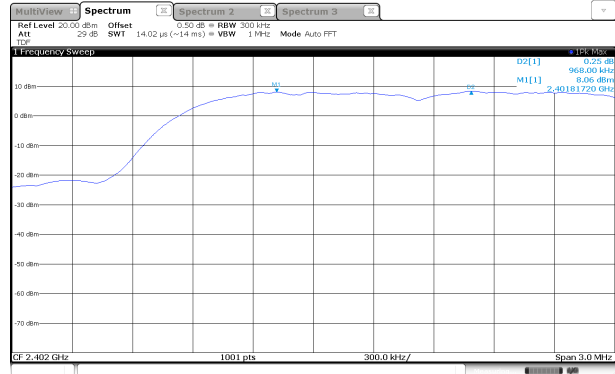
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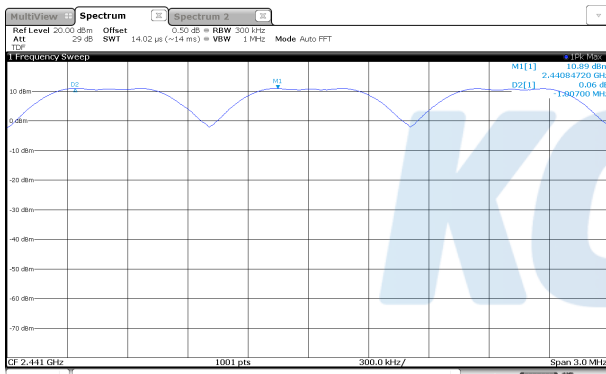
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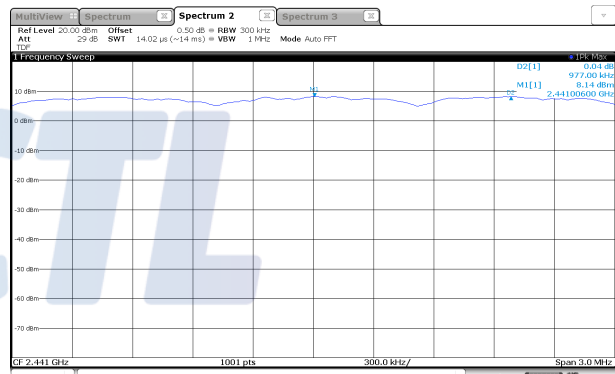
8DPSK / Low ch.



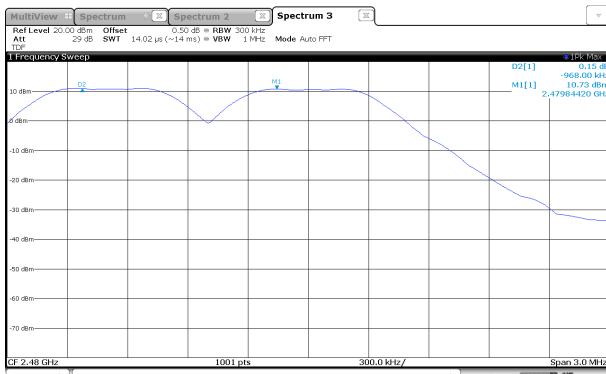
GFSK / Mid ch.



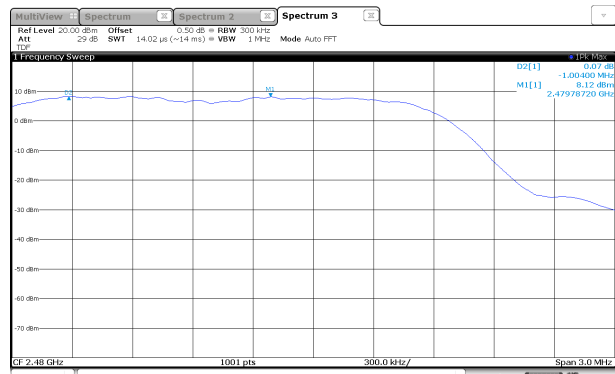
8DPSK / Mid ch.



GFSK / High ch.

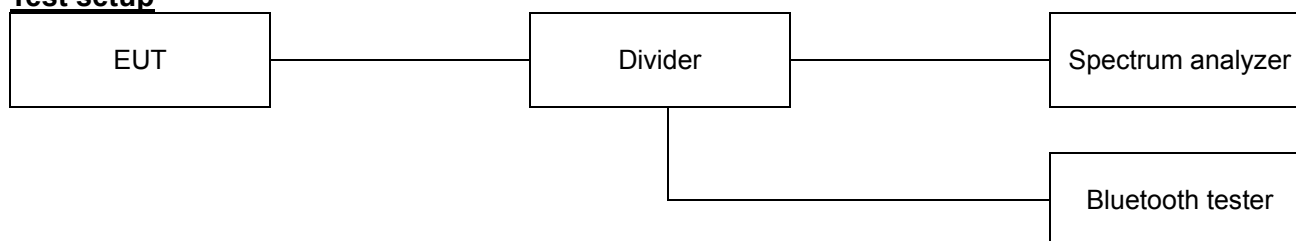


8DPSK / High ch.



7.3. 20dB channel bandwidth

Test setup



Limit

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test procedure

ANSI C63.10-2013 - Section 6.9.2

Test settings

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are -6 dB, -20 dB, and -26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this subclause, the ratio is designated by “-xx dB.” The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the “-xx dB” bandwidth; other requirements might specify that the “-xx dB” bandwidth be entirely contained within the authorized or designated frequency band.

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency.
Span: Two times and five times the OBW.
- b) RBW = 1 % to 5 % of the OBW and VBW ≥ 3 x RBW
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation.
- d) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- e) Detector: peak
- f) Trace mode: max hold.
- g) Allow the trace to stabilize.
- h) Determine the “-xx dB down amplitude” using ((reference value) - xx). Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
- j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then

it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

Test results

20 dB Bandwidth

Frequency(MHz)	Data rate (Mbps)	20 dB Bandwidth (MHz)
2 402	1	1.060
2 441	1	0.962
2 480	1	1.070
2 402	3	1.330
2 441	3	1.330
2 480	3	1.330



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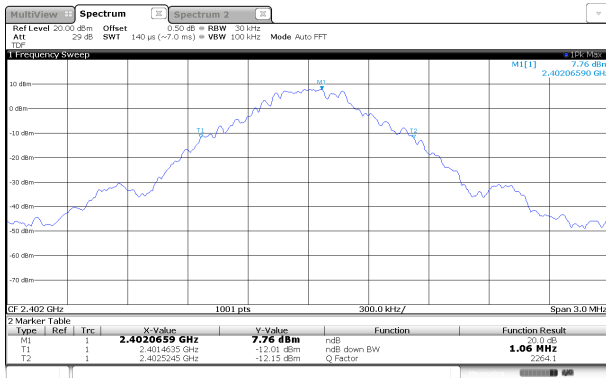
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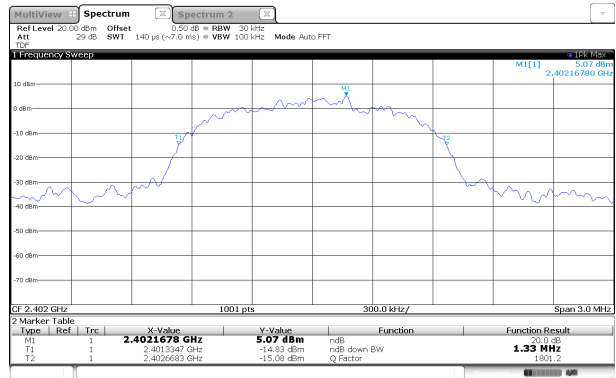


20 dB bandwidth(MHz)

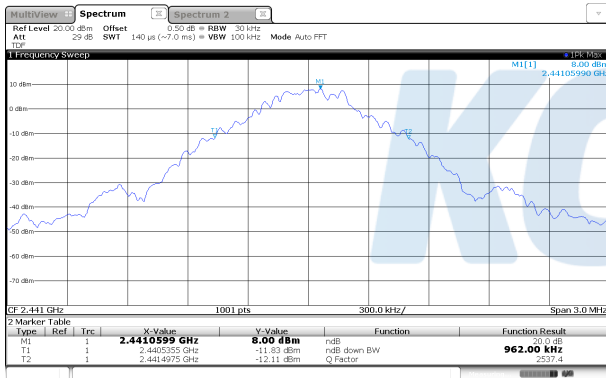
GFSK / Low ch.



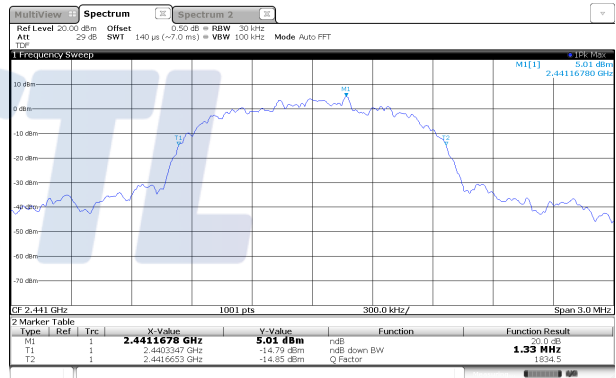
8DPSK / Low ch.



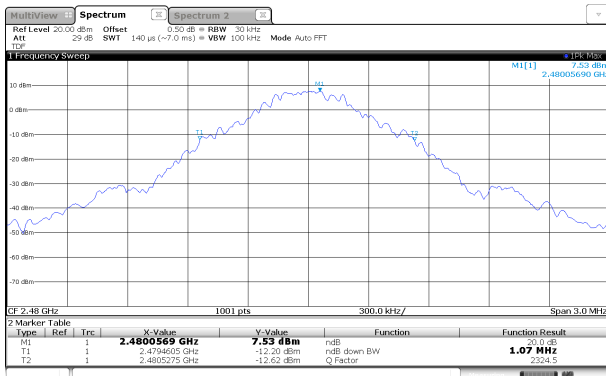
GFSK / Mid ch.



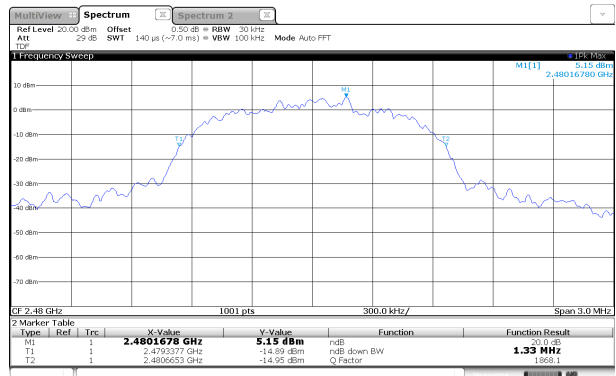
8DPSK / Mid ch.



GFSK / High ch.



8DPSK / High ch.

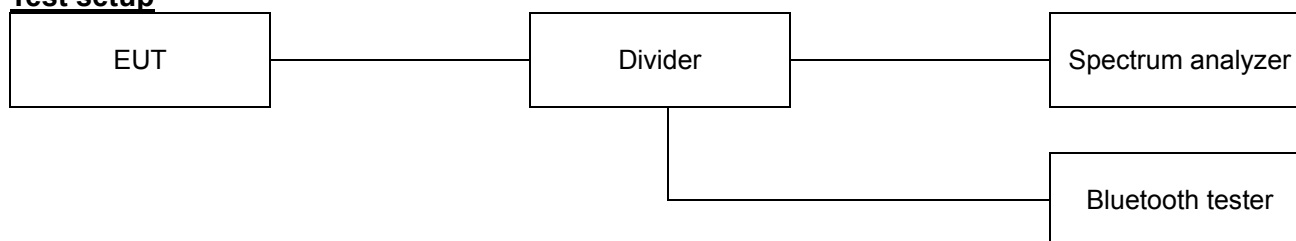


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7.4. Number of hopping channels

Test setup



Limit

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2 400-2 483.5 MHz band shall use at least 15 channels.

Test procedure

ANSI C63.10-2013 - Section 7.8.3

Test settings

- Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- VBW $\geq$ RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.
- Allow the trace to stabilize.

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

Test results

Mode	Number of hopping channel	Limit
GFSK	79	≥ 15
$\pi/4$ DQPSK	79	≥ 15
8DPSK	79	≥ 15

Note :

In case of AFH mode, minimum number of hopping channels is 20.

KCTL Inc.

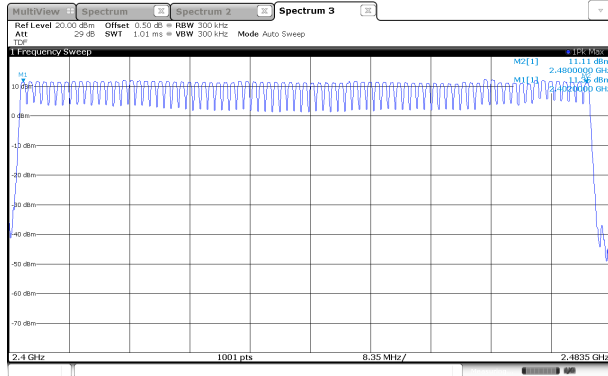
65, Sinwon-ro, Yeongtong-gu,
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KR19-SRF0161-C

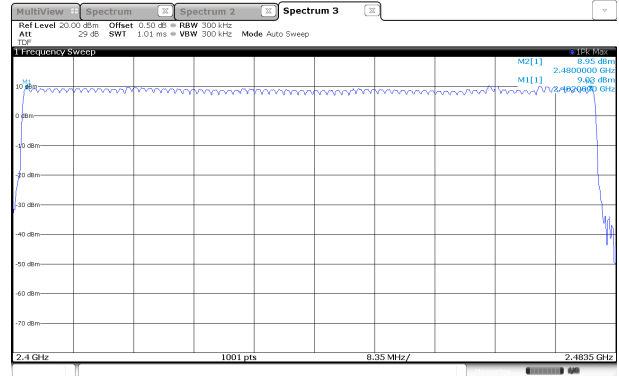
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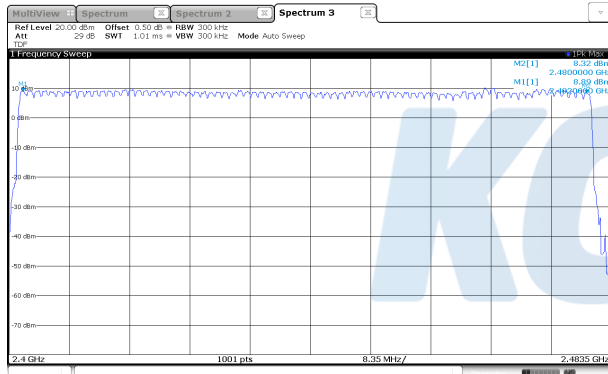
GFSK



$\pi/4$ DQPSK



8DPSK



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