TEST REPORT

Dt&C

DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042 Tel : 031-321-2664, Fax : 031-321-1664

1. Report No: DRTFCC2003-0053

- 2. Customer
 - Name : LG Electronics USA, Inc.
 - Address : 1000 Sylvan Ave. Englewood Cliffs, New Jersey, United States 07632
- 3. Use of Report : FCC Original Grant
- 4. Product Name / Model Name : Mobile Phone / OA2006 FCC ID : ZNFOA2006
- 5. Test Method Used : KDB558074 D01v05r02, ANSI C63.10-2013 Test Specification : FCC Part 15 Subpart C.247
- 6. Date of Test : 2020.02.10 ~ 2020.02.20
- 7. Testing Environment : See appended test report.
- 8. Test Result : Refer to the attached test result.

Affirmation	Tested by		Reviewed by	NAST
	Name : JungWoo Kim	Sathats	Name : GeunKi Son	(Signature)

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2020.03.05.



If this report is required to confirmation of authenticity, please contact to report@dtnc.net



Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2003-0053	Mar. 05, 2020	Initial issue	JungWoo Kim	GeunKi Son



Table of Contents

1. General Information	
1.1 Testing Laboratory	4
1.2 Testing Environment	4
1.3 Measurement Uncertainty	4
1.4 Details of Applicant	
1.5 Description of EUT	5
1.6 Declaration by the applicant / manufacturer	
1.7 Information about the FHSS characteristics	
1.8 Test Equipment List	
1.9 Summary of Test Results	
1.10 Conclusion of worst-case and operation mode	
2. Maximum Peak Output Power Measurement	
2.1 Test Setup	
2.2 Limit	
2.3 Test Procedure	
2.4 Test Results	
3. 20 dB BW	
3. 1 Test Setup	
3.1 Test Setup	
3.3 Test Procedure	
3.4 Test Results	
4. Carrier Frequency Separation	
4.1 Test Setup	
4.2 Limit	
4.3 Procedure	
4.4 Test Results	
5. Number of Hopping Frequencies	
5.1 Test Setup	
5.2 Limit	28
5.3 Procedure	
5.4 Test Results	28
6. Time of Occupancy (Dwell Time)	34
6.1 Test Setup	34
6.2 Limit	34
6.3 Test Procedure	34
6.4 Test Results	
7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	39
7.1 Test Setup	39
7.2 Limit	39
7.3. Test Procedures	
7.3.1. Test Procedures for Radiated Spurious Emissions	
7.3.2. Test Procedures for Conducted Spurious Emissions	
7.4. Test Results	
7.4.1. Radiated Emissions	
7.4.2. Conducted Spurious Emissions	
8. Transmitter AC Power Line Conducted Emission	
8.1 Test Setup	
8.2 Limit	
8.3 Test Procedures	
8.4 Test Results	
9. Antenna Requirement	
9. Antenna Requirement	
	74

1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.

- FCC MRA Accredited Test Firm No. : KR0034

www.dtnc.net	www.dtnc.net			
Telephone	•	+ 82-31-321-2664		
FAX	X : + 82-31-321-1664			

1.2 Testing Environment

Ambient Condition		
 Temperature 	+20 °C ~ +25 °C	
 Relative Humidity 	35 % ~ 45 %	

1.3 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.9 dB (The confidence level is about 95 %, $k = 2$)
Conducted spurious emission	1.0 dB (The confidence level is about 95 %, $k = 2$)
AC conducted emission	2.4 dB (The confidence level is about 95 %, k=2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, $k = 2$)



1.4 Details of Applicant

Applicant	:	LG Electronics USA, Inc
Address	:	1000 Sylvan Ave. Englewood Cliffs, New Jersey, United States 07632
Contact person	:	Kyung-Su Han

1.5 Description of EUT

EUT	Mobile Phone
Model Name	OA2006
Add Model Name	NA
Serial Number	Identical prototype
Power Supply	DC 3.87 V
Frequency Range	2402 MHz ~ 2480 MHz
Modulation Technique	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79
Antenna Type	PIFA Antenna
Antenna Gain	PK : -3.07 dBi

1.6 Declaration by the applicant / manufacturer

- NA

1.7 Information about the FHSS characteristics

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following :
 - A) The hopping sequence is pseudorandom
 - Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:
 - Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25, 33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

The System receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchroniztation with the transmit ted signals.

- B) All channels are used equally on average
- C) The receiver input bandwidth equals the transmit bandwidth
- D) The receiver hops in sequenc e with the transmit signal
- 15.247(g) : In accordance with the Bluetooth Industry Standard, the system is designed to comply with all
 of the regulations in Section 15.247 when the transmitter is presented with a continuous data
 (or information) system.
- 15.247(h) : In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection / hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h) : The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.



1.8 Test Equipment List

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	19/06/26	20/06/26	US47360812
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48010133
DC power supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43001172
Multimeter	FLUKE	17B	19/12/16	20/12/16	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-1
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-2
Thermohygrometer	BODYCOM	BJ5478	19/07/03	20/07/03	N/A
Power Divider	Weinschel	WA1574	19/06/25	20/06/25	WA1574-4
BlueTooth Tester	Tescom	TC-3000C	19/06/24	20/06/24	3000C000563
Loop Antenna	ETS-Lindgren	6502	19/09/18	21/09/18	00226186
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3115	19/01/11	21/01/11	9202-3820
Horn Antenna	A.H.Systems Inc.	SAS-574	19/07/03	21/07/03	155
PreAmplifier	tsj	MLA-0118-B01-40	19/12/16	20/12/16	1852267
PreAmplifier	tsj	MLA-1840-J02-45	19/06/27	20/06/27	16966-10728
PreAmplifier	H.P	8447D	19/12/16	20/12/16	2944A07774
High Pass Filter	Wainwright Instruments	WHKX12-935-1000- 15000-40SS	19/06/26	20/06/26	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300- 18000-60SS	19/06/26	20/06/26	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	19/06/27	20/06/27	3
Attenuator	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
Attenuator	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
Attenuator	Aeroflex/Weinschel	20515	19/06/27	20/06/27	Y2370
Attenuator	SMAJK	SMAJK-2-3	19/06/27	20/06/27	2
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	19/06/24	20/06/24	1306007 1249001
EMI Receiver	ROHDE&SCHWARZ	ESW44	19/07/30	20/07/30	101645
HYGROMETER	TESTO	608-H1	20/01/21	21/01/21	34862883
EMI Test Receiver	Rohde Schwarz	ESCI7	20/01/20	21/01/20	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	19/09/17	20/09/17	101333
LISN	SCHWARZBECK	NNLK 8121	19/05/23	20/05/23	6183
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-04
Cable	Junkosha	MWX241	20/01/13	21/01/13	G-07
Cable	DT&C	Cable	20/01/13	21/01/13	G-13
Cable	DT&C	Cable	20/01/13	21/01/13	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	20/01/13	21/01/13	G-15
Cable	Radiall	TESTPRO3	20/01/16	21/01/16	M-01
Cable	Junkosha	MWX315	20/01/16	21/01/16	M-05
Cable	Junkosha	MWX221	20/01/16	21/01/16	M-06
Cable	DT&C	Cable	20/01/16	21/01/16	RF-82
Cubic		ted in accordance to t			11-02

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017 Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.



1.9 Summary of Test Results

FCC Part RSS Std.	Parameter	Limit (Using in 2400~ 2483.5 MHz)	Test Condition	Status Note 1
	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.		с
15.247(a) RSS-247(5.1)	Number of Hopping Frequencies >= 15 hops			С
	20 dB Bandwidth	N/A		С
	Dwell Time	=< 0.4 seconds		С
15.247(b) RSS-247(5.4)	Transmitter Output Power	For FCC =< 1 Watt , if CHs >= 75 Others =< 0.125 W For IC if CHs >= 75 =< 1 Watt For Conducted Power =< 4 Watt For e.i.r.p, Others =< 0.125 W For Conducted Power. =< 0.5 Watt For e.i.r.p	Conducted	С
15.247(d) RSS-247(5.5)	Conducted Spurious Emissions	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		с
RSS Gen(6.7)	Occupied Bandwidth (99 %)	N/A	-	NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits	Radiated	C Note3
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	С
15.203	Antenna Requirements	FCC 15.203	-	С
Note 1 : C = Comply NC = Not Comply NT = Not Tested NA = Not Applicable Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated With OATS. With OATS. Note 3 : This test item was performed in each axis and the worst case data was reported.				



1.10 Conclusion of worst-case and operation mode

The EUT has three types of modulation (GFSK, π /4DQPSK and 8DPSK).

Therefore all applicable requirements were tested with all the modulations.

And packet type was tested at the worst case(DH5).

The field strength of spurious emission was measured in three orthogonal EUT positions (X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function : Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	2402 ~ 2480	2402 ~ 2480

- Hopping Function : Disable

	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	2402	2402
Middle Channel	2441	2441
Highest Channel	2480	2480



2. Maximum Peak Output Power Measurement

2.1 Test Setup

Refer to the APPENDIX I.

2.2 Limit

FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

- 1. §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 2400-2483.5 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.
- 2. §15.247(b)(1), For frequency hopping systems operating in the 2400 2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725 5805 MHz band : 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

IC Requirements

 RSS-247(5.4) (b), For FHSS operating in the band 2400 - 2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p shall not exceed 4 W, except as provided in section 5.4(e)

2.3 Test Procedure

- 1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
- 2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using ;

Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel

 $RBW \ge 20 \text{ dB BW}$ $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold

2.4 Test Results

Modulation	Tested Channel		verage Power	Peak Output Power			
Modulation	rested Ghaimer	dBm	mW	dBm	mW		
	Tested Channel dBm mW dBm MW 10.54 11.32 EFSK Middle 10.87 12.22 Highest 9.82 9.59 Lowest 9.97 9.93				11.46		
<u>GFSK</u>	Middle	10.87	12.22	10.96	12.47		
	Highest	9.82	9.59	10.48	11.17		
	Lowest	9.97	9.93	11.96	15.70		
<u>π/4DQPSK</u>	Middle	10.32	10.76	12.60	18.20		
	Highest	9.27	8.45	12.08	16.14		
	Lowest	9.98	9.95	12.25	16.79		
<u>8DPSK</u>	Middle	10.32	10.76	13.05	20.18		
	Highest	9.27	8.45	12.51	17.82		

Note 1: The burst average output power was tested using an average power meter for reference only. Note 2: See next pages for actual measured spectrum plots.



Lowest Channel & Modulation : GFSK



Peak Output Power

Middle Channel & Modulation : GFSK



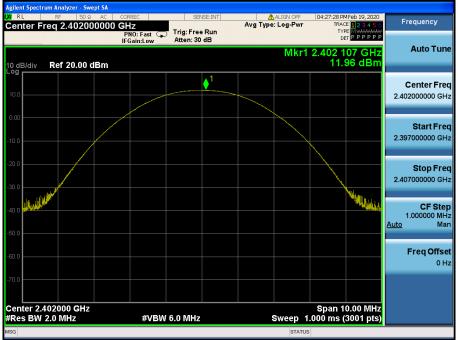






Peak Output Power

Lowest Channel & Modulation : π/4DQPSK





Middle Channel & Modulation : π/4DQPSK



Peak Output Power

Highest Channel & Modulation : π/4DQPSK









Peak Output Power

Middle Channel & Modulation : 8DPSK





Highest Channel & Modulation : 8DPSK





3. 20 dB BW

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

Limit : Not Applicable

3.3 Test Procedure

- 1. The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
- 2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
 - RBW = 1% to 5% of the 20 dB BW & Occupied BW

 $VBW \ge 3 \times RBW$

Span = between two times and five times the 20 dB bandwidth & Occupied BW

Sweep = auto

Detector function = peak

Trace = max hold

3.4 Test Results

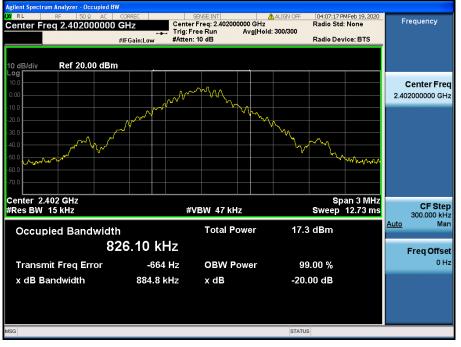
Modulation	Tested Channel	20 dB BW (MHz)
	Lowest	0.885
<u>GFSK</u>	Middle	0.884
	Highest	0.885
	Lowest	1.321
<u>π/4DQPSK</u>	Middle	1.318
	Highest	1.321
	Lowest	1.296
<u>8DPSK</u>	Middle	1.289
	Highest	1.313



TDt&C

20 dB BW

Lowest Channel & Modulation : GFSK



20 dB BW

Middle Channel & Modulation : GFSK Analyzer - Occupied BW r servst::INT ▲ ALIGN OFF Center Freq: 2.441000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 04:09:47 PM Feb 19, 2020 Radio Std: None Center Freq 2.441000000 GHz Frequency #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** ነለስ 2.441000000 GHz Center 2.441 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Mar Occupied Bandwidth Total Power 17.6 dBm 825.47 kHz Freq Offset 0 Hz -3.106 kHz 99.00 % Transmit Freq Error **OBW Power** x dB Bandwidth 884.2 kHz x dB -20.00 dB STATUS



20 dB BW

Highest Channel & Modulation : GFSK

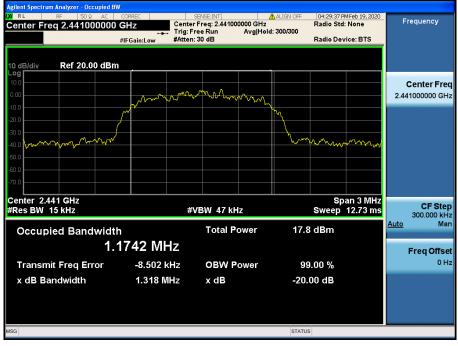


20 dB BW

Lowest Channel & Modulation : π/4DQPSK Analyzer - Occupied BW GHz Center Freq: 2.40200000 GHz #IFGain:Low #Atten: 30 dB 04:27:07 PM Feb 19, 2020 Radio Std: None Center Freq 2.402000000 GHz Frequency Radio Device: BTS Ref 20.00 dBm **Center Freq** wh 2.402000000 GHz m _Λ Center 2.402 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Mar Occupied Bandwidth Total Power 17.4 dBm 1.1803 MHz Freq Offset 0 Hz -6.489 kHz **OBW Power** 99.00 % Transmit Freq Error x dB Bandwidth 1.321 MHz x dB -20.00 dB STATUS

20 dB BW

Middle Channel & Modulation : π/4DQPSK



20 dB BW

Highest Channel & Modulation : π/4DQPSK Occupied BW Lenvel:INT ALIGN OF Center Freq: 2.48000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 04:32:07 PM Feb 19, 2020 Radio Std: None Center Freq 2.480000000 GHz Frequency #IFGain:Low Radio Device: BTS Ref 20.00 dBm **Center Freq** ሳሌ www 2.48000000 GHz ~~~ ww ma m. Center 2.48 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Mar Occupied Bandwidth Total Power 17.4 dBm 1.1747 MHz Freq Offset 0 Hz -8.734 kHz 99.00 % Transmit Freq Error **OBW Power** x dB Bandwidth 1.321 MHz x dB -20.00 dB STATUS



Dt&C

20 dB BW

Lowest Channel & Modulation : 8DPSK

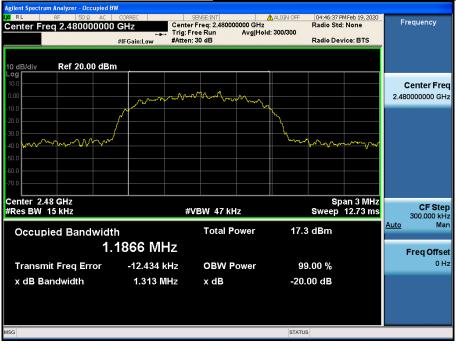


20 dB BW

Middle Channel & Modulation : 8DPSK Analyzer - Occupied BW r servst::INT ▲ ALIGN OFF Center Freq: 2.441000000 GHz Trig: Free Run Avg|Hold: 300/300 #Atten: 30 dB 04:44:06 PM Feb 19, 2020 Radio Std: None Center Freq 2.441000000 GHz Frequency #IFGain:Low Radio Device: BTS Ref 20.00 dBm dB/div **Center Freq** 2.441000000 GHz \sim Center 2.441 GHz #Res BW 15 kHz Span 3 MHz Sweep 12.73 ms CF Step 300.000 kHz #VBW 47 kHz Auto Mar Occupied Bandwidth Total Power 17.8 dBm 1.1829 MHz Freq Offset 0 Hz 99.00 % Transmit Freq Error -11.491 kHz **OBW Power** x dB Bandwidth 1.289 MHz x dB -20.00 dB STATUS

20 dB BW

Highest Channel & Modulation : 8DPSK





4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater.

4.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the markerdelta function was recorded as the measurement results.

The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels

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.

 $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold

4.4 Test Results

FH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2441.048	2442.049	1.001
Enable	π/4DQPSK	2441.000	2441.991	0.991
	8DPSK	2440.990	2441.991	1.001

AFH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2440.991	2442.047	1.056
Enable	π/4DQPSK	2440.992	2441.992	1.000
	8DPSK	2439.989	2440.990	1.001

Note 1 : See next pages for actual measured spectrum

- Minimum Standard :

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 2400 - 2483.5 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





Carrier Frequency Separation (FH)





Carrier Frequency Separation (FH)

<u>Hopping mode : Enable & π/4DQPSK</u>





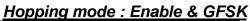


Carrier Frequency Separation (FH) <u>Hopping mode : Enable & 8DPSK</u>

Agilent Spectrum Analyzer - Swept SA				
LXI RL RF 50 Ω AC CORREC	SENSE:INT	ALIGN OFF	04:56:50 PM Feb 19, 2020	Frequency
Center Freq 2.441000000 GHz	Trig: Free Run	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE M WWWWWW	rioquonoy
PNO: Wide ⊂ IFGain:Low	Atten: 30 dB		DETPPPPP	
				Auto Tune
		ΔΝ	1kr1 1.001 MHz	
10 dB/div Ref 20.00 dBm			0.48 dB	
Log	V			
10.0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		vin	Center Freq
0.00		~~~ ·		2.441000000 GHz
-10.0				
-20.0				Start Freq
-30.0				2.439500000 GHz
-40.0				2.455500000 GHZ
-50.0				Oton Eron
-60.0				Stop Freq
-70.0				2.442500000 GHz
Center 2.441000 GHz			Span 3.000 MHz	OF Otom
	W 150 kHz	Sween 1	.200 ms (3001 pts)	CF Step 300.000 kHz
				Auto Man
MKR MODE TRC SCL X		CTION FUNCTION WIDTH	FUNCTION VALUE	Adio
1 Δ2 1 f (Δ) 1.001 MHz (Δ) 2 F 1 f 2.440 990 GHz 2.440 990 GHz) 0.48 dB 9.99 dBm			
2 F 1 1 2.440 990 GH2	9.99 dBm			Freq Offset
4				0 Hz
5				0112
6				
8				
9				
10				
			~	
MSG		STATUS		
mod		STATUS		



Carrier Frequency Separation (AFH)





Carrier Frequency Separation (AFH)

Hopping mode : Enable & π/4DQPSK

Agilent Spectrum Analyzer - Swept !					
X RL RF 50Ω A Center Freg 2.4410000		SENSE:INT	ALIGN OFF Avg Type: Log-Pwr	06:09:25 PM Feb 19, 2020 TRACE 1 2 3 4 5 6	Frequency
	PNO: Wide IFGain:Low	Trig: Free Run Atten: 30 dB			Auto Tune
10 dB/div Ref 20.00 dB	m			0.50 dB	
10.0	<u> </u>	X2^		·*···	Center Freq 2.441000000 GHz
-20.0					Start Freq 2.439500000 GHz
-50.0					Stop Freq 2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz	#VBW	150 kHz	Sweep 1	Span 3.000 MHz .200 ms (3001 pts)	CF Step 300.000 kHz Auto Mar
MKR MODE TRC SCL	× 1.000 MHz (Δ)	Y FL 0.50 dB	JNCTION FUNCTION WIDTH	FUNCTION VALUE	Auto Mar
	2.440 992 GHz	10.00 dBm			Freq Offset 0 Hz
6					
10 11 11				~	
ISG			STATUS		

Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & 8DPSK</u>

	um Analyzer - Swe						
enter Fr	RF 50 Ω req 2.44100	AC CORREC			ALIGN OFF	06:16:20 PM Feb 19, 2020 TRACE 1 2 3 4 5 6	Frequency
0 dB/div	Ref 20.00 c	PNO: Wid IFGain:Lo			ΔΝ	1kr1 1.001 MHz 0.01 dB	Auto Tun
	X_2	^	~~~~	1Δ2		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Center Fre 2.441000000 GH
20.0 30.0 10.0							Start Fre 2.439500000 G⊦
i0.0 i0.0 i0.0							Stop Fre 2.442500000 G⊢
Res BW	RC SCL	Х	VBW 150 kHz	FUNCTION	Sweep 1	Span 3.000 MHz .200 ms (3001 pts) FUNCTION VALUE	CF Ste 300.000 kH <u>Auto</u> Ma
1 Δ2 1 2 F 1 3 4 5 5	f (Δ) f	1.001 MHz 2.439 989 GHz					Freq Offso 0 ⊦
6 7 8 9 0							
G					STATUS		



5. Number of Hopping Frequencies

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit : >= 15 hops

5.3 Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 2400 ~ 2483.5 MHz were examined.

The spectrum analyzer is set to :

Span for FH mode = 50 MHz	Start Frequency = 2391.5 MHz,	Stop Frequency = 2441.5 MHz
	Start Frequency = 2441.5 MHz,	Stop Frequency = 2491.5 MHz
Span for AFH mode = 30 MHz	Start Frequency = 2426.0 MHz,	Stop Frequency = 2456.0 MHz
RBW = To identify clearly the ind or the 20 dB bandwidth, w		less than 30% of the channel spacing
VBW ≥ RBW	Sweep = auto	
Detector function = peak	Trace = max hold	

5.4 Test Results

FH mode

Hopping mode	Modulation	Test Result (Total Hops)
	GFSK	79
Enable	π/4DQPSK	79
	8DPSK	79

AFH mode

Hopping mode	Modulation	Test Result (Total Hops)
	GFSK	20
Enable	π/4DQPSK	20
	8DPSK	20

Note 1 : See next pages for actual measured spectrum plots.

- Minimum Standard :

At least 15 hopes



Number of Hopping Frequencies 1(FH) Hopping mode : Enable & GFSK

			alyzer - Sw										_									-		
X/RL		RF	2.4165	AC AC	COR				SEP	VSE:IN	11	A			ALIGN	-Pwr		04:10		MFeb 19, CE 1 2 3			Frequ	ency
Gent		54 2		50000	PN	10: Fa	st 🖵		g: Free		۱								TY		HARARAN			
					IFG	iain:Le	ow	Att	en: 30	dB													A.,	to Tune
															N	lkr2	2 2			00 G			Au	
10 dE	3/div	Ref	20.00	dBm															10.	82 d	Вm			
Log 10.0				⊘1							~ ~	- <u>-</u> .					_	_						_
				AAA	M	I V V	ΥV	VVV	ΥV	/ // 1	(V V	٧V	ΥV	٧١	M	I VI VI	W١	N	VV.	VVV	ιM			ter Fred
0.00				 	í i I	ŢΪ	11	Ť Ť Ť	ŤŤ	Ηř	ŦŦĬ	11	ŤŤ		F#	Ϋ́ĭ	T	Ť	11	T F F	ŤŤ		2.416500	000 GH2
-10.0				1				-																
-20.0				╂────										_							_		St	art Fred
-30.0																							2.391500	
-40.0			/																				2.031000	000 0112
-50.0	angen al alors	mond	menudel																					
-60.0																							St	op Fred
																							2.441500	
-70.0																								
Star	t 2.391	50 (GH7														S	ton	24	4150 (GHz			DE Oton
	s BW 2					#	VBM	820	kHz					5	Swe	ep ′	1.0	001	ms (3001	pts)			CF Step 000 MHz
	MODE TRO	i cert	1	×			1		,	1	EL IP	ICTION				WIDTH				DN VALUE		A	uto	Mar
1	N 1	f		2.402	2 000) GHz			.46 di	3m	FUI	action	•	FUN	CHON	WIDTH	1	L.	UNCH	UN VALUE	-			
2	N 1	f		2.44′				10	.82 di	3m													Ero	q Offset
3										\rightarrow							+						Free	0 Hz
5																					=			0 H2
6																								
8																								
9 10							+																	
11																					~			
									00								_				2			
MSG																STATU	JS							

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & GFSK

RL RF 50 Q AC enter Freq 2.466500000	CORREC GHZ PNO: Fast IFGain:Low	Trig: Free Ru Atten: 30 dB	Avg T	ALIGN OFF	04:19:42 PM Feb 19, 2 TRACE 1234 TYPE MWW DET P P F	Frequency
dB/div Ref 20.00 dBm	IFGain:Low	Atten: 30 dB		Mkr2	2.480 000 G 10.40 dE	
	WW					Center Fre 2.466500000 GH
D.0 .0 .0						Start Fre 2.441500000 GH
3.0 3.0 .0					have a second and the second s	Stop Fre 2.491500000 Gi
tart 2.44150 GHz Res BW 270 kHz	#VBW	/ 820 kHz	FUNCTION	Sweep 1	Stop 2.49150 G .000 ms (3001 p	Hz ts) Auto
1 N 1 f 2.442 2 N 1 f 2.480 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	000 GHz	<u>11.36 dBm</u> 10.40 dBm	Toricitori		Force for the be	Freq Offs
6 7 8 9 9 0						



Number of Hopping Frequencies 1(FH)

Hopping mode : Enable & π/4DQPSK

XI RL Center Fi	r eq 2. 4	50 Ω 41650	AC 0	CORREC		SENSE		Avg		ALIGN OFF : Log-Pwr	TRA	MFeb 19, 2020 CE 12345 (equency
10 dB/div		20.00 c		PNO: Fast IFGain:Lov		ig: Free F tten: 30 d				Mkr2	2.441 0	000 GHz		Auto Tune
10.0 0.00			Q1 Vrym	****			ᢦ᠆᠈ᢁ᠆᠆	ᡩᢇᠧᡣᢁ	y"+~~	ᠬᡇᡐᢦᠰᠧᠯᢦ᠉	~~~~ ~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Center Freq 6500000 GHz
-20.0 -30.0 -40.0													2.39 [.]	Start Fred 1500000 GHz
-50.0 -60.0 -70.0		pany//r.q./											2.44	Stop Freq 1500000 GHz
Start 2.39 #Res BW	270 k			#V	BW 82						.000 ms (4150 GHz 3001 pts)		CF Step 000000 MHz Man
MKR MODE TF 1 N 1 2 N 1 3	IC SCL			000 GHz 000 GHz		Y 0.40 dBn 0.69 dBn	n	CTION	FUN	CTION WIDTH	FUNCTI	DN VALUE		Freq Offset 0 Hz
8 9 10 11						-				STATIS		~		
MSG										STATUS	5			

Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & π/4DQPSK

LXI RL	um Analyzer - Swep RF 50 Ω req 2.466500	AC CORREC	SENSE:IN	Avg	ALIGN OFF	04:38:49 PM Feb 19, 2020 TRACE 123456	Frequency
10 dB/div	Ref 20.00 di	PNO: Fast ⊂ IFGain:Low 3M	Trig: Free Run Atten: 30 dB		Mkr2	2.480 000 GHz 9.55 dBm	Auto Turo
10 dB/div Log 1 10.0 4,000 0.00	৵৻৵৵৵৵৵৵৵	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	ayamayanya ya y		×*************************************		Center Fred 2.466500000 GHz
-20.0 -30.0 -40.0							Start Free 2.441500000 GH:
-50.0 -60.0 -70.0							Stop Fred 2.491500000 GH;
Start 2.44 #Res BW	270 kHz	×	N 820 kHz	FUNCTION	Sweep 1	Stop 2.49150 GHz .000 ms (3001 pts) FUNCTION VALUE	CF Step 5.000000 MH: Auto Mar
1 N 1 2 N 1 3 4 5 5	f f	2.442 000 GHz 2.480 000 GHz	11.05 dBm 9.55 dBm				Freq Offse 0 Ha
7 8 9 10 11							
MSG			Ш		STATUS	3	



Number of Hopping Frequencies 1(FH) Hopping mode : Enable & 8DPSK

	i Spectru																
L <mark>XI</mark> RL		RF)Ω A		ORREC		SEI	ISE:INT				ALIGN OFF		MFeb 19, 2020		Frequency
Cen	ter Fr	eq 2	.416	5000	000 G			Trig: Free	Dun		Avg	Туре	: Log-Pwr	TR4	CE 12345 (/PE M WWWWWW		requeitcy
						PNO: Fas IFGain:Lo		Atten: 30							DET P P P P P		
						IFGalli.Lu	w	Theefile of		_		_				-	Auto Tune
													Mkr2		000 GHz		nato rano
10 dE	3/div	Ref	20.0	0 dBi	m									10.	38 dBm		
Lõg				0	1												
10.0				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	\sim	مكريميك	\sim	$\sim \sim $	\sim	\sim	مراسيكي	See Auro	ᡊ᠕᠇ᠰ᠕᠆ᠰ	᠕᠕᠕᠕᠕	And March		Center Freq
0.00																	2.416500000 GHz
-10.0																	
-20.0				N													Start Freq
-30.0				<u> '</u>													
																	2.391500000 GHz
-40.0																	
-50.0	munum	Naga da da	Marphul														
-60.0																	Stop Freq
-70.0																	2.441500000 GHz
-70.0																	
Otor	t 2.39	150 /	<u>-u-</u>											Stop 2.4	4150 GHz		
	5 BW :					-#*	(D)A	820 kHz					woon 1		(3001 pts)		CF Step
#Rea	5 699	2701	NΠZ			#	V D V V	0ZU KHZ					sweep	.000 IIIS	(300 i hrs)		5.000000 MHz uto Man
MKR N	IODE TR	C SCL			Х			Y		FUNC	TION	FUN	CTION WIDTH	FUNCT	ION VALUE	AL	<u>uto</u> Man
1	<u>N 1</u>	f			2.402 (000 GHz		9.80 dl	3m								
2	<u>N 1</u>	1			2.441 (000 GHz		10.38 dl	3m								Freq Offset
4																	0 Hz
5															=		UHZ
6																	
7																	
9																	
10																	
11															~		
	_	_	_	_	_	_	_		_	_	_	_		_			
MSG													STATU	s			

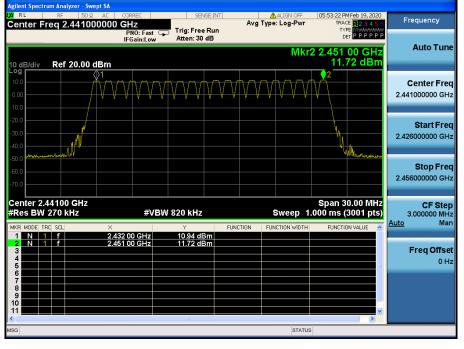
Number of Hopping Frequencies 2(FH)

Hopping mode : Enable & 8DPSK

Agilent Spectr	um Analy RE	<mark>zer - Swe</mark> 50 Ω									
Center F	10			RREC Z		E:INT	Avg 1	ALIGN OFF	TRAC	MFeb 19, 2020 25 1 2 3 4 5 6 PE M 444444	Frequency
				NO:Fast G Gain:Low	Trig: Free Atten: 30				DI	T P P P P P P	
								Mkr2	2.480 0	00 GHz	Auto Tune
10 dB/div	Ref 2	20.00 d	Bm							35 dBm	
10.0	mont	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim \sim \sim \sim$	Aurora		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			Center Freq
0.00											2.466500000 GHz
-10.0											
-20.0									h		Start Freq
-30.0									1		2.441500000 GHz
-40.0									Verbury which	And the could be the	
-50.0											Stop Freq
-70.0											2.491500000 GHz
Start 2.44 #Res BW				#VB۱	N 820 kHz			Sweep 1	Stop 2.49 1.000 ms (9150 GHz 3001 pts)	CF Step 5.000000 MHz
MKR MODE TH			×		Y	FU	NCTION	FUNCTION WIDTH		DN VALUE	<u>Auto</u> Man
1 N 1 2 N 1	f		2.442.00	0 GHz	10.99 dB 10.35 dB	m					
3			2.400 00		10.00 00						Freq Offset
5										=	0 Hz
7											
9											
10										~	
< NSG					000			STATU	10	>	
190								STATU	0		

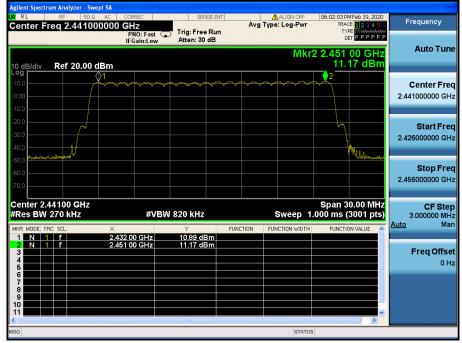
Number of Hopping Frequencies 1(AFH)

Hopping mode : Enable & GFSK



Number of Hopping Frequencies 1(AFH)

Hopping mode : Enable & π/4DQPSK



Number of Hopping Frequencies 1(AFH) Hopping mode : Enable & 8DPSK

enter Fre	RF 50Ω AC	00 GHz	SENSE:IN	Avg	ALIGN OFF	06:11:04 PM Feb 19, 2020 TRACE 123456 TYPE MWWWWW	Frequency
0 dB/div	Ref 20.00 dBn	PNO: Fast IFGain:Low	Atten: 30 dB		Mkr	_{рет} реререр 2 2.451 00 GHz 11.63 dBm	Auto Tun
og 10.0 0.00				∽∽∽∽∽∽		~ ²	Center Fre 2.441000000 GH
20.0 30.0 40.0						Whenan	Start Fre 2.426000000 G⊦
50.0 50.0 70.0						* 1964bytvatyte	Stop Fre 2.456000000 GH
Center 2.44 Res BW 2	270 kHz	#VE ×	W 820 kHz	FUNCTION	Sweep 1	Span 30.00 MHz .000 ms (3001 pts) FUNCTION VALUE	CF Ste 3.000000 M⊦ <u>Auto</u> Ma
1 N 1 2 N 1 3 4 5 5		2.432 00 GHz 2.451 00 GHz	10.93 dBm 11.63 dBm				Freq Offso 0 ⊦
6 7 8 9 0							
G			ш		STATUS		



6. Time of Occupancy (Dwell Time)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

The maximum permissible time of occupancy is 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.

6.3 Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 2441 MHz

Span = zero

RBW = 1 MHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW

Detector function = peak

Trace = max hold

6.4 Test Results

FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	79	2.880	3.750	0.307
Enable	2 DH 5	79	2.880	3.750	0.307
	3 DH 5	79	2.880	3.750	0.307

AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	20	2.880	3.750	0.154
Enable	2 DH 5	20	2.880	3.750	0.154
	3 DH 5	20	2.880	3.750	0.154

Note 1 : Dwell Time = 0.4 × Hopping channel × Burst ON time ×

((Hopping rate ÷ Time slots) ÷ Hopping channel)

- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2 : See next pages for actual measured spectrum plots.

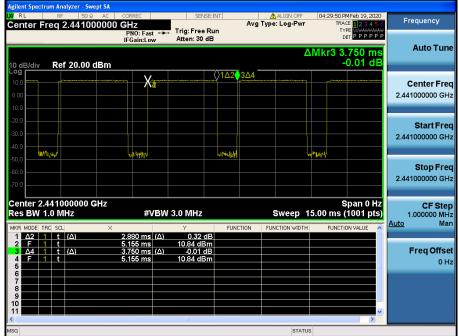


Time of Occupancy (FH)

Agilent Spectrum Analyzer - Swept SA					
RL RF 50 Ω AC Center Freq 2.4410000		SENSE:INT	ALIGN OFF	04:10:00 PM Feb 19, 2020 TRACE 123456	Frequency
	PNO: Fast ↔ IFGain:Low	Trig: Free Run Atten: 30 dB		TYPE WWWWWWW DET PPPPP	Auto Turo
10 dB/div Ref 20.00 dBn	n		Δ	Mkr3 3.750 ms -0.16 dB	Auto Tune
Log 10.0 0.00	Xa				Center Freq 2.441000000 GHz
-20.0	4btmja		interiori		Start Freq 2.441000000 GHz
-50.0					Stop Freq 2.441000000 GHz
Center 2.441000000 GHz Res BW 1.0 MHz		/ 3.0 MHz	Sweep 1	Span 0 Hz 5.00 ms (1001 pts)	CF Step 1.000000 MHz <u>Auto</u> Man
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	2.880 ms (Δ) 3.986 ms 3.750 ms (Δ) 3.986 ms	2.56 dB 8.28 dBm 0.16 dB 8.28 dBm			Freq Offset 0 Hz
MSG			STATUS		

Time of Occupancy (FH)

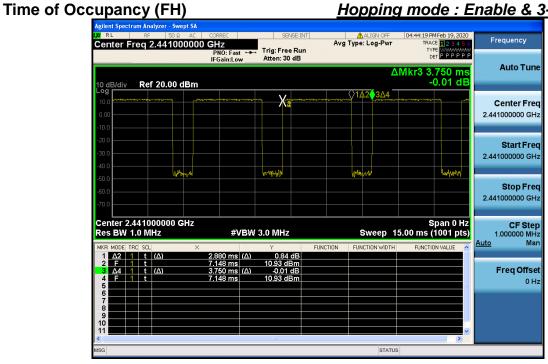
Hopping mode : Enable & 2-DH5



Hopping mode : Enable & DH5



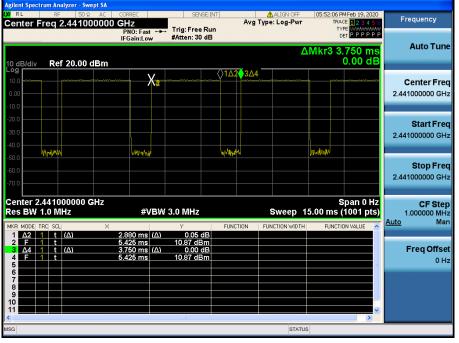
Hopping mode : Enable & 3-DH5





Hopping mode : Enable & DH5

Time of Occupancy (AFH)



Time of Occupancy (AFH)

Hopping mode : Enable & 2-DH5 Avg Type: Log-Pwr Frequency Center Freq 2.441000000 GHz PNO: Fast ---- Trig: Free Run IFGain:Low Atten: 30 dB TYPE DET Auto Tune ΔMkr3 3.750 ms -0.01 dB B/div Ref 20.00 dBm X **Center Freq** 2.441000000 GHz Start Freq 2.441000000 GHz /hashes man hand 1/10mphylls Stop Freq 2.441000000 GHz Center 2.441000000 GHz Res BW 1.0 MHz CF Step 1.000000 MHz Man Span 0 Hz Sweep 15.00 ms (1001 pts) #VBW 3.0 MHz Auto FUNCTION FUNCTION WIDT IS (A) 0.40 dB 10.85 dBm -0.01 dB 10.85 dBm is is (∆) Freq Offset 4 705 mg 0 Hz



Time of Occupancy (AFH)

Hopping mode : Enable & 3-DH5

RL RF	50 Ω AC CORREC	SENSE:INT	ALIGN OFF Avg Type: Log-Pwr	06:09:47 PM Feb 19, 2020 TRACE 1 2 3 4 5 6	Frequency
enter Freq 2.44	PNO: Fast IFGain:Low		Avg Type: Log-Pwr	TYPE WAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	
dB/div Ref 20	.00 dBm		Δ	Mkr3 3.750 ms -0.01 dB	Auto Tur
	Xa				Center Fre 2.441000000 G⊦
0.0			N state		Start Fre 2.441000000 GH
0.0 719	түлек уул		ktyratytytyt		Stop Fre 2.441000000 GF
enter 2.4410000 es BW 1.0 MHz	#V	BW 3.0 MHz		Span 0 Hz 5.00 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi
KR MODE TRC SCL 1 Δ2 1 t (Δ) 2 F 1 t (Δ) 3 Δ4 1 t (Δ) 4 F 1 t 5	× 2.880 ms 4.076 ms 3.750 ms 4.076 ms	(<u>A) 0.85 dB</u> 10.91 dBm	CTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offs
6 7 8 9 9 0					
G			STATUS	>	



7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

7.1 Test Setup

Refer to the APPENDIX I.

7.2 Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 - 72 MHz, 76 - 88 MHz, 174 - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		
			3600 ~ 4400		

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.



7.3. Test Procedures

7.3.1. Test Procedures for Radiated Spurious Emissions

- The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
- 3. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Measurement Instrument Setting

- Frequencies less than or equal to 1000 MHz The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
- Frequencies above 1000 MHz
 The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
 The result of Average measurement is calculated using PK result and duty correction factor.



7.3.2. Test Procedures for Conducted Spurious Emissions

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 25 GHz RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.



7.4. Test Results

7.4.1. Radiated Emissions

9 kHz ~ 25 GHz Data (Modulation : GFSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.11	Н	Х	PK	52.30	5.23	N/A	N/A	57.53	74.00	16.47
2389.11	Н	Х	AV	52.30	5.23	-24.79	N/A	32.74	54.00	21.26
4804.22	V	Х	PK	50.00	1.47	N/A	N/A	51.47	74.00	22.53
4804.22	V	Х	AV	50.00	1.47	-24.79	N/A	26.68	54.00	27.32

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4881.58	V	Х	PK	50.56	2.02	N/A	N/A	52.58	74.00	21.42
4881.58	V	Х	AV	50.56	2.02	-24.79	N/A	27.79	54.00	26.21

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.92	Н	Х	PK	52.03	5.80	N/A	N/A	57.83	74.00	16.17
2484.92	Н	Х	AV	52.03	5.80	-24.79	N/A	33.04	54.00	20.96
4959.95	V	Х	PK	49.56	2.17	N/A	N/A	51.73	74.00	22.27
4959.95	V	Х	AV	49.56	2.17	-24.79	N/A	26.94	54.00	27.06

<u>Note.</u>

1. The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.

- Calculation of distance factor = 20 log(applied distance / required distance) = 20 log(1 m / 3 m) = -9.54 dB

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.88 X 20) = 1.74 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.88 ms X 2 = 5.76 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.76 / 100)** = <u>-24.79 dB</u> 4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + D.C.F / T.F = AF + CL – AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.



9 kHz ~ 25 GHz Data (Modulation : <u>π/4DQPSK</u>)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2387.75	Н	Х	PK	52.03	5.22	N/A	N/A	57.25	74.00	16.75
2387.75	Н	Х	AV	52.03	5.22	-24.79	N/A	32.46	54.00	21.54
4804.10	V	Х	PK	50.79	1.47	N/A	N/A	52.26	74.00	21.74
4804.10	V	Х	AV	50.79	1.47	-24.79	N/A	27.47	54.00	26.53

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4881.81	V	Х	PK	50.07	2.02	N/A	N/A	52.09	74.00	21.91
4881.81	V	Х	AV	50.07	2.02	-24.79	N/A	27.30	54.00	26.70

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.63	Н	Х	PK	52.06	5.80	N/A	N/A	57.86	74.00	16.14
2484.63	Н	Х	AV	52.06	5.80	-24.79	N/A	33.07	54.00	20.93
4960.05	V	Х	PK	49.46	2.17	N/A	N/A	51.63	74.00	22.37
4960.05	V	Х	AV	49.46	2.17	-24.79	N/A	26.84	54.00	27.16

Note.

1. The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.

- Calculation of distance factor = 20 log(applied distance / required distance) = 20 log(1 m / 3 m) = -9.54 dB

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.88 X 20) = 1.74 = 2

- The Worst Case Dwell Time = T [ms] x H' = 2.88 ms X 2 = 5.76 ms

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.76 / 100) = -24.79 dB

4. Sample Calculation.

Margin = Limit - Result / Result = Reading + T.F + D.C.F / T.F = AF + CL - AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.



9 kHz ~ 25 GHz Data (Modulation : 8DPSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.36	Н	Х	PK	51.92	5.23	N/A	N/A	57.15	74.00	16.85
2389.36	Н	Х	AV	51.92	5.23	-24.79	N/A	32.36	54.00	21.64
4804.08	V	Х	PK	50.31	1.47	N/A	N/A	51.78	74.00	22.22
4804.08	V	Х	AV	50.31	1.47	-24.79	N/A	26.99	54.00	27.01

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4881.74	V	Х	PK	50.32	2.02	N/A	N/A	52.34	74.00	21.66
4881.74	V	Х	AV	50.32	2.02	-24.79	N/A	27.55	54.00	26.45

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.31	Н	Х	PK	51.74	5.79	N/A	N/A	57.53	74.00	16.47
2484.31	Н	Х	AV	51.74	5.79	-24.79	N/A	32.74	54.00	21.26
4959.98	V	Х	PK	49.82	2.17	N/A	N/A	51.99	74.00	22.01
4959.98	V	Х	AV	49.82	2.17	-24.79	N/A	27.20	54.00	26.80

Note.

1. The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.

- Calculation of distance factor = 20 log(applied distance / required distance) = 20 log(1 m / 3 m) = -9.54 dBWhen distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.88 X 20) = 1.74 = 2

- The Worst Case Dwell Time = T [ms] x H' = **2.88 ms X 2** = **5.76 ms**

- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.76 / 100) = -24.79 dB

4. Sample Calculation.

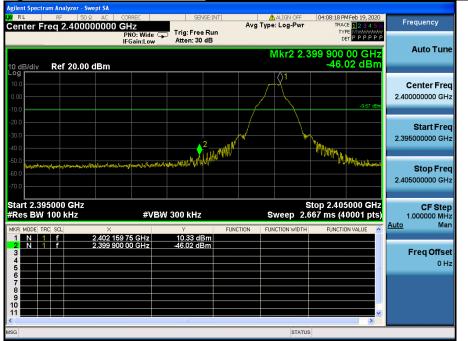
Margin = Limit - Result / Result = Reading + T.F + D.C.F / T.F = AF + CL - AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain.



Low Band-edge

Dt&C



Low Band-edge

Hopping mode & Modulation : GFSK

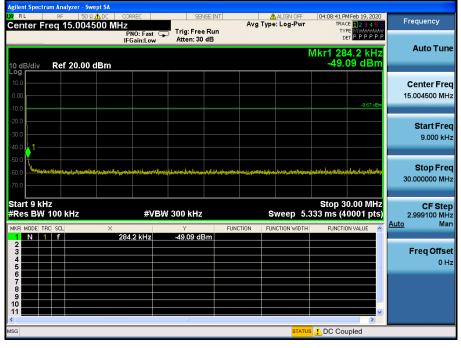
Lowest Channel & Modulation : GFSK







Lowest Channel & Modulation : GFSK



	um Analyzer - !				ea (m)				
Center Fi		0 Ω AC CORF 000000 GH	z	SENSE:	Avg	ALIGN OF	VI TRA	MFeb 19, 2020 CE 123456	Frequency
			0: Fast 🔾 ain:Low	Atten: 30 dB			C	ET P P P P P P	
10 dB/div	Ref 20.0	0 dBm				М	kr5 6.883 -39.	38 GHz 18 dBm	Auto Tune
Log 10.0 0.00		<u></u> ↓1						-9.67 dBm	Center Freq 5.015000000 GHz
-20.0						2 ³ 5			Start Freq 30.000000 MHz
-50.0 -60.0 -70.0									Stop Freq 10.000000000 GHz
Start 30 M #Res BW			#VBV	V 3.0 MHz		Sweep	Stop 10 18.67 ms (4	.000 GHz 0001 pts)	CF Step 997.000000 MHz Auto Man
MKR MODE TF	RC SCL	× 2.402 36	GHz	۲ 10.61 dBm	FUNCTION	FUNCTION WID	TH FUNCTI	ON VALUE	<u>Auto</u> Man
2 N 1 3 N 1 4 N 1 5 N 1 6	f f f f	6.410 05 6.579 54 9.650 55 6.883 38	GHz GHz GHz	-38.39 dBm -39.06 dBm -39.16 dBm -39.18 dBm				====	Freq Offset 0 Hz
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Lowest Channel & Modulation : GFSK



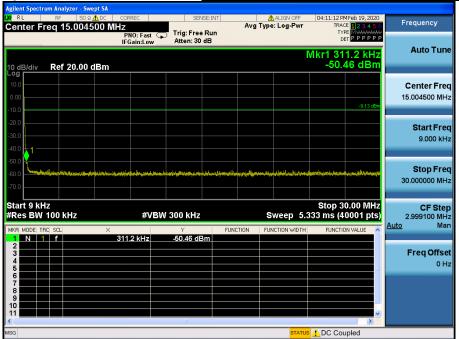


Reference for limit





Conducted Spurious Emissions <u>Middle Channel & Modulation : GFSK</u>









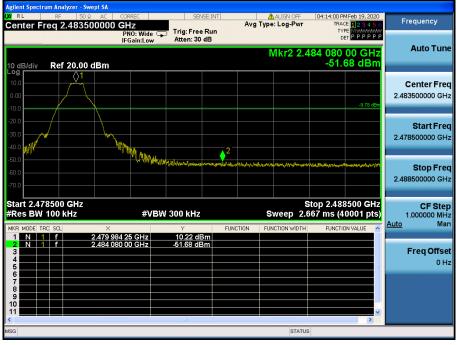






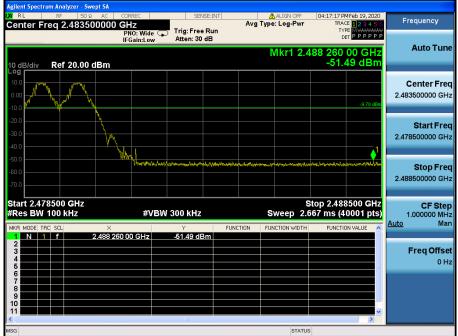
High Band-edge

Highest Channel & Modulation : GFSK



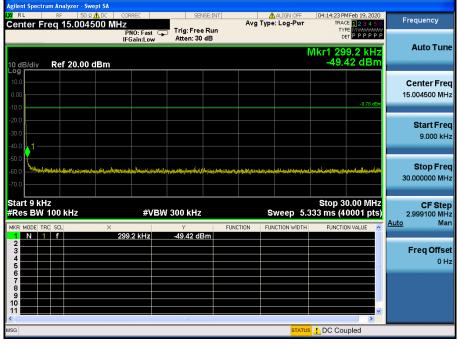
High Band-edge

Hopping mode & Modulation : GFSK



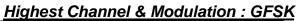


Highest Channel & Modulation : GFSK



Agilent Spectrum Analyzer - Swept SA								
RL RF 50 Ω AC Center Freq 5.01500000		SENSE:INT	ALIGN OFF Avg Type: Log-Pwr	04:14:46 PM Feb 19, 2020 TRACE 1 2 3 4 5 6	Frequency			
	PNO: Fast G	Trig: Free Run Atten: 30 dB		TYPE MWWWWW DET PPPPP				
	IFGain:Low	Atten: 00 ub	Mkr	5 5.045 41 GHz	Auto Tune			
10 dB/div Ref 20.00 dBm			IVINI	-38.93 dBm				
Log 10.0	∲ 1				Center Freq			
0.00					5.015000000 GHz			
-10.0				-9.78 dBm				
-20.0								
-30.0		54	1 <u>3 1</u> 2		Start Freq 30.000000 MHz			
-40.0	AND IN THE REAL PROPERTY OF A DESCRIPTION OF A DESCRIPTIO	• · · · · · · · · · · · · · · · · · · ·	$1 \land 9$		30.000000 MHz			
-50.0		And a second s						
-60.0					Stop Freq			
-70.0					10.00000000 GHz			
Start 30 MHz #Res BW 1.0 MHz	#VBW	3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MHz			
MKR MODE TRC SCL			CTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man			
	2.480 13 GHz 5.950 43 GHz	10.51 dBm -38.16 dBm						
3 N 1 f 6	5.436 47 GHz 5.775 21 GHz	-38.75 dBm -38.86 dBm			Freq Offset			
5 N 1 f 5	5.045 41 GHz	-38.93 dBm		=	0 Hz			
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8								
10								
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MSG			STATUS	6				









Low Band-edge

Lowest Channel & Modulation : π/4DQPSK



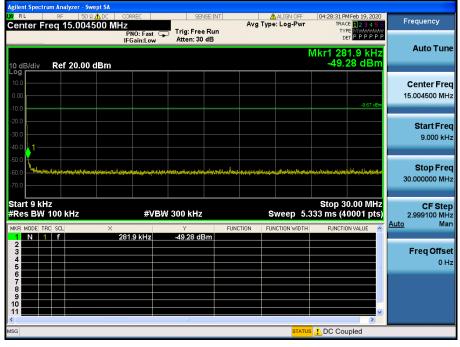
Low Band-edge

Hopping mode & Modulation : π/4DQPSK





Lowest Channel & Modulation : π/4DQPSK



Agilent Spectr X/ RL Center F	RF 5	Swept SA 10 Ω AC COR 5000000 GH		SENSE			ALIGN OFF	TRAC	4Feb 19, 2020 ≅ <mark>1</mark> 2 3 4 5 6	Frequency
10 dB/div	Ref 20.0	PI IFC	IO: Fast ⊊ Sain:Low	Trig: Free F Atten: 30 d			Mkr	5 3.329	32 GHz 9 dBm	Auto Tune
10.0 0.00		\\ 1 							-9.67 dBm	Center Fred 5.015000000 GH:
-20.0 -30.0		a fa			\$	³ 👋 ²	ر الأراغ (المراجع (ality data and yes a second with the	Start Free 30.000000 MH
-50.0 -60.0 -70.0						na bil Paris Barra (de				Stop Free 10.000000000 GH
Start 30 M #Res BW	1.0 MHz	×		₩ 3.0 MHz	FUNC		Sweep 18	.67 ms (4	.000 GHz 0001 pts) IN VALUE	CF Stej 997.000000 MH <u>Auto</u> Ma
1 N 1 2 N 1 3 N 1 4 N 1 5 N 1	f f f f	2.401 86 6.366 93 5.912 80 6.278 49 3.329 3	3 GHz D GHz 5 GHz	11.50 dBn -37.78 dBn -38.60 dBn -38.69 dBn -38.79 dBn	n n					Freq Offse 0 H
7 8 9 10 11										
4 ISG							STATUS		>	



Lowest Channel & Modulation : π/4DQPSK



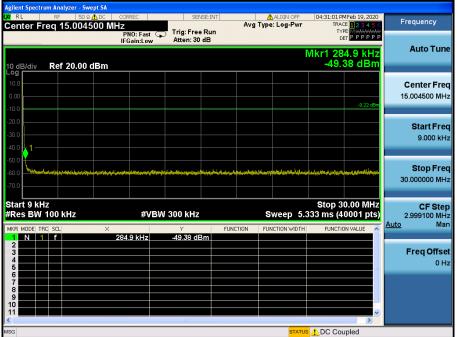


Reference for limit

Middle Channel & Modulation : π/4DQPSK



Conducted Spurious Emissions <u>Middle Channel & Modulation : π/4DQPSK</u>





Middle Channel & Modulation : π/4DQPSK

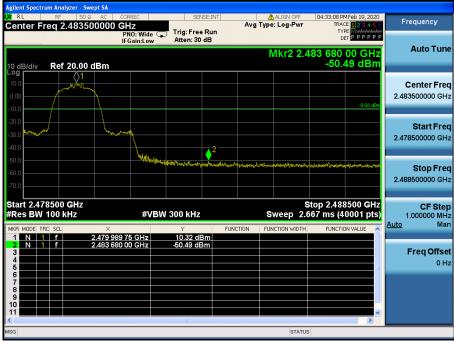


Agilent Spectrum Analyzer - Swept SA				
Center Freq 17.500000000 G	Trig: Free Run	Avg Type: Log-Pwr	04:31:47 PM Feb 19, 2020 TRACE 2 3 4 5 6 TYPE MWWWWW DET P P P P P P	Frequency
	ain:Low Atten: 30 dB	Mkr3 2	23.367 625 GHz	Auto Tune
10 dB/div Ref 20.00 dBm			-25.59 dBm	
0.00			-9.22 dBm	Center Freq 17.50000000 GHz
-20.0				Start Freq
-30.0 -40.0				10.000000000 GHz
-60.0				Stop Freq 25.00000000 GHz
-70.0				
Start 10.000 GHz #Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 40	Stop 25.000 GHz .00 ms (40001 pts)	CF Step 1.50000000 GHz
MKR MODE TRC SCL X 1 N 1 f 24.845 125	GHz -23.70 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
2 N 1 f 24.175 750 3 N 1 f 23.367 625 4 5	GHz -24.44 dBm GHz -25.59 dBm			Freq Offset 0 Hz
6 7 8 9				
10 11			×	
MSG		STATUS	3	



High Band-edge

Highest Channel & Modulation : π/4DQPSK



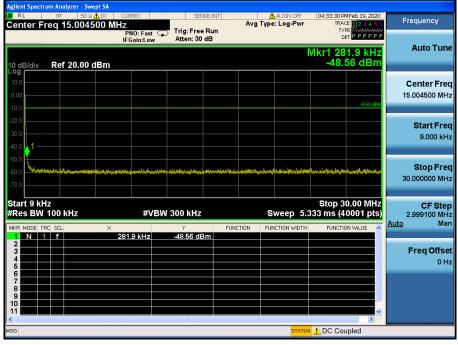
High Band-edge

Hopping mode & Modulation : π/4DQPSK





Highest Channel & Modulation : π/4DQPSK



Agilent Spectrum Analy						
Center Freq 5.	50 Ω AC CORRE 015000000 GHz			ALIGN OFF	04:33:54 PM Feb 19, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWWWW	Frequency
		: Fast Trig: Free in:Low Atten: 30			DET	
10 dB/div Ref 2	20.00 dBm			Mkr	5 3.183 26 GHz -39.42 dBm	Auto Tune
Log 10.0 0.00 -10.0					-9.68 dBm	Center Freq 5.015000000 GHz
-20.0 -30.0 -40.0		- 5	$\uparrow^2 \diamondsuit^3$	4	alation particular in the advantagement	Start Freq 30.000000 MHz
-50.0 -60.0 -70.0						Stop Freq 10.000000000 GHz
Start 30 MHz #Res BW 1.0 MI	Hz	#VBW 3.0 MHz		Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MHz
MKR MODE TRC SCL	× 2.480 13 (Y GHz 11.37 dF	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
2 N 1 f 3 N 1 f 4 N 1 f 5 N 1 f 6	5.724 61 0 6.217 13 0 6.827 80 0 3.183 26 0	GHz -38.00 dE GHz -38.69 dE GHz -38.97 dE	3m 3m 3m		E	Freq Offset 0 Hz
7 8 9 10 11						
<						
MSG				STATUS		





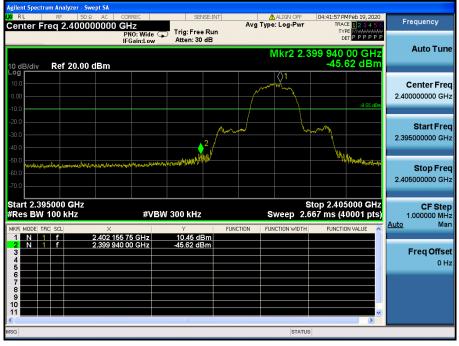
Highest Channel & Modulation : π/4DQPSK





Low Band-edge

Lowest Channel & Modulation : 8DPSK



Low Band-edge

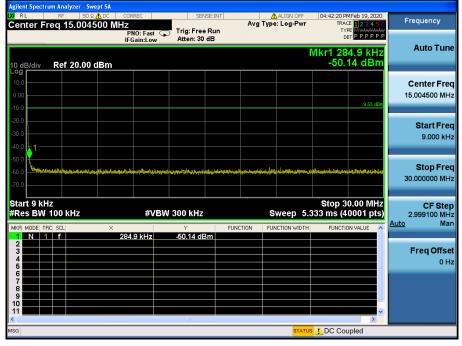
Hopping mode & Modulation : 8DPSK







Lowest Channel & Modulation : 8DPSK



Agilent Spectrum Analyzer - S					
RE SO Center Freg 5.0150		SENSE:INT	ALIGN OFF Avg Type: Log-Pwr	04:42:43 PM Feb 19, 2020 TRACE 12 3 4 5 6	Frequency
	PNO: Fast G IFGain:Low	Trig: Free Run Atten: 30 dB			Auto Tune
10 dB/div Ref 20.00	dBm		Mkr	5 5.568 34 GHz -38.94 dBm	Auto Tune
10.0 0.00 -10.0	<u></u>			-9.55 dBm	Center Fred 5.015000000 GHz
-20.0 -30.0 -40.0		4,5	$\wedge^2 \wedge^3$		Start Free 30.000000 MH;
-50.0 -60.0 -70.0					Stop Fred 10.000000000 GHz
Start 30 MHz #Res BW 1.0 MHz	#VB\	V 3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MH Auto Mar
MKR MODE TRC SCL	× 2.402 36 GHz	Y FUI 11.33 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Adto</u> Mai
2 N 1 F 3 N 1 F 4 N 1 F 5 N 1 F	6.223 11 GHz 6.777 45 GHz 5.343 26 GHz 5.568 34 GHz	-38.64 dBm -38.72 dBm -38.74 dBm -38.94 dBm			Freq Offset 0 Hz
6 7 8 9 10					
11				~	
ISG			STATUS	3	



Lowest Channel & Modulation : 8DPSK



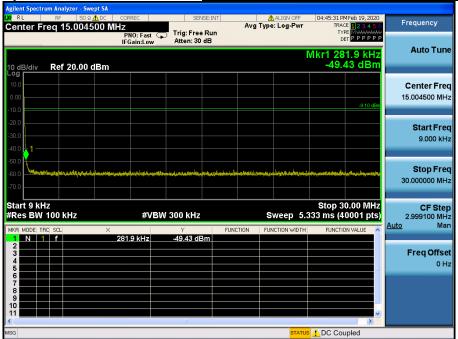


Reference for limit





Conducted Spurious Emissions <u>Middle Channel & Modulation : 8DPSK</u>





Middle Channel & Modulation : 8DPSK

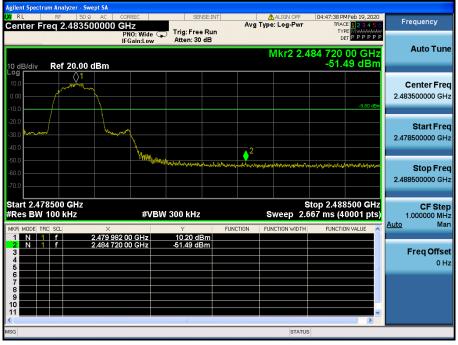






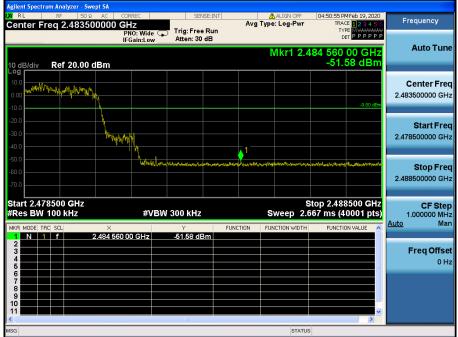
High Band-edge

Highest Channel & Modulation : 8DPSK



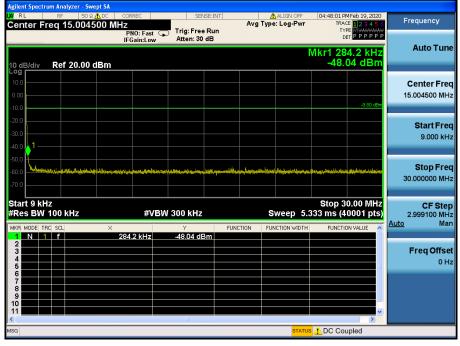
High Band-edge

Hopping mode & Modulation : 8DPSK





Highest Channel & Modulation : 8DPSK





Highest Channel & Modulation : 8DPSK





8. Transmitter AC Power Line Conducted Emission

8.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

8.2 Limit

According to §15.207(a) 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 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

	Conducted Limit (dBuV)				
Frequency Range (MHz)	Quasi-Peak	Average			
0.15 ~ 0.5	66 to 56 *	56 to 46 *			
0.5 ~ 5	56	46			
5 ~ 30	60	50			

* Decreases with the logarithm of the frequency

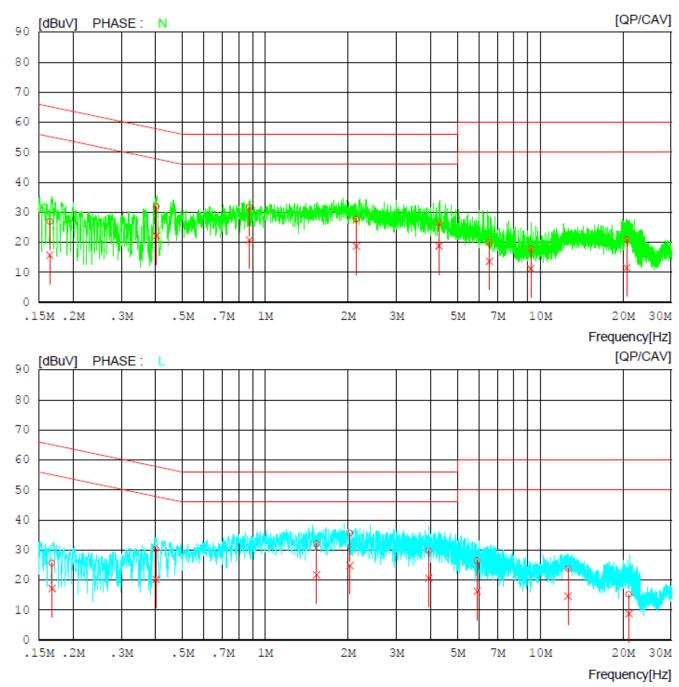
8.3 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

- The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
- 2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
- 3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
- 4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.



8.4 Test Results



AC Line Conducted Emissions (Graph) = Modulation : <u>8DPSK</u>



AC Line Conducted Emissions (List) = Modulation : <u>8DPSK</u>

Results of Conducted Emission

DTNC						Date	2020-02-14
Order Model Serial Test C	No.	0A2006 BT	6	F	Referrence No. Power Supply Femp/Humi. Operator	120 V, 60 F 23 'C / 35 9 J.W.Kim	Hz %
Memo							
	FCC P15.	207 AV	C. E3.CEO.	DECIT		NEECTN	D
NO	FREQ [MHz]	READING QP CAV [dBuV][dBuV	C.FACTOR] [dB]	RESULT QP CAV [dBuV] [dBuV	LIMIT QP CAV [dBuV][dBu]		PHASE]
1	0.16478	17.00 5.77	9.94	26.9415.71	65.22 55.22	38.2839.51	N
2		21.98 12.25	9.95	31.9322.20	57.81 47.81	25.88 25.61	N
3	0.87745	21.67 10.82	9.97	31.64 20.79	57.81 47.81 56.00 46.00	25.8825.61 24.3625.21	N N
3 4	0.87745 2.14453	21.6710.82 17.72 8.71	9.97 10.03	31.6420.79 27.7518.74	57.81 47.81 56.00 46.00 56.00 46.00	25.8825.61 24.3625.21 28.2527.26	N N N
3	0.87745 2.14453	21.67 10.82	9.97	31.64 20.79	57.81 47.81 56.00 46.00	25.8825.61 24.3625.21 28.2527.26 29.5927.18	N N
3 4 5	0.87745 2.14453 4.27954	21.6710.82 17.728.71 16.288.69	9.97 10.03 10.13	31.6420.79 27.7518.74 26.4118.82	57.81 47.81 56.00 46.00 56.00 46.00 56.00 46.00	25.88 25.61 24.36 25.21 28.25 27.26 29.59 27.18 39.86 36.27	N N N
3 4 5 6 7	0.87745 2.14453 4.27954 6.54268	21.6710.82 17.72 8.71 16.28 8.69 9.94 3.53 7.55 0.87 10.30 0.99	9.97 10.03 10.13 10.20 10.31 10.56	31.6420.79 27.7518.74 26.4118.82 20.1413.73	57.81 47.81 56.00 46.00 56.00 46.00 56.00 46.00 56.00 46.00 60.00 50.00	25.8825.61 24.3625.21 28.2527.26 29.5927.18 39.8636.27 42.1438.82	N N N N N N
3 4 5 7 8 9	0.87745 2.14453 4.27954 6.54268 9.24063 20.61427 0.16789	21.6710.82 17.72 8.71 16.28 8.69 9.94 3.53 7.55 0.87 10.30 0.99 15.68 7.26	9.97 10.03 10.13 10.20 10.31 10.56 9.94	31.64 20.79 27.75 18.74 26.41 18.82 20.14 13.73 17.86 11.18 20.86 11.55 25.62 17.20	57.81 47.81 56.00 46.00 56.00 46.00 56.00 46.00 60.00 50.00 60.00 50.00 60.00 50.00 60.00 50.00 65.06 55.06	25.8825.61 24.3625.21 28.2527.26 29.5927.18 39.8636.27 42.1438.82 39.1438.45 39.4437.86	N N N N N L
3 4 5 7 8 2 9 10	0.87745 2.14453 4.27954 6.54268 9.24063 20.61427 0.16789 0.40115	$\begin{array}{c} 21.6710.82\\ 17.728.71\\ 16.288.69\\ 9.943.53\\ 7.550.87\\ 10.300.99\\ 15.687.26\\ 20.3610.28 \end{array}$	9.97 10.03 10.13 10.20 10.31 10.56 9.94 9.95	31.64 20.79 27.75 18.74 26.41 18.82 20.14 13.73 17.86 11.18 20.86 11.55 25.62 17.20 30.31 20.23	57.81 47.81 56.00 46.00 56.00 46.00 60.00 50.00 60.00 50.00 60.00 50.00 60.00 50.00 65.06 55.06 57.83 47.83	$\begin{array}{c} 25.88\ 25.61\\ 24.36\ 25.21\\ 28.25\ 27.26\\ 29.59\ 27.18\\ 39.86\ 36.27\\ 42.14\ 38.82\\ 39.14\ 38.45\\ 39.44\ 37.86\\ 27.52\ 27.60\\ \end{array}$	N N N N N L L
3 4 5 7 8 2 9 10 11	0.87745 2.14453 4.27954 6.54268 9.24063 20.61427 0.16789 0.40115 1.53747	$\begin{array}{c} 21.6710.82\\ 17.72\ 8.71\\ 16.28\ 8.69\\ 9.94\ 3.53\\ 7.55\ 0.87\\ 10.30\ 0.99\\ 15.68\ 7.26\\ 20.3610.28\\ 21.9611.72 \end{array}$	9.97 10.03 10.13 10.20 10.31 10.56 9.94 9.95 10.01	31.64 20.79 27.75 18.74 26.41 18.82 20.14 13.73 17.86 11.18 20.86 11.55 25.62 17.20 30.31 20.23 31.97 21.73	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c} 25.88\ 25.61\\ 24.36\ 25.21\\ 28.25\ 27.26\\ 29.59\ 27.18\\ 39.86\ 36.27\\ 42.14\ 38.82\\ 39.14\ 38.45\\ 39.44\ 37.86\\ 27.52\ 27.60\\ 24.03\ 24.27\\ \end{array}$	N N N N N L L L
3 4 5 7 8 9 10 11 12	$\begin{array}{c} 0.87745\\ 2.14453\\ 4.27954\\ 6.54268\\ 9.24063\\ 20.61427\\ 0.16789\\ 0.40115\\ 1.53747\\ 2.02951 \end{array}$	$\begin{array}{c} 21.6710.82\\ 17.728.71\\ 16.288.69\\ 9.943.53\\ 7.550.87\\ 10.300.99\\ 15.687.26\\ 20.3610.28\\ 21.9611.72\\ 25.5914.76 \end{array}$	9.97 10.03 10.13 10.20 10.31 10.56 9.94 9.95 10.01 10.03	31.64 20.79 27.75 18.74 26.41 18.82 20.14 13.73 17.86 11.18 20.86 11.55 25.62 17.20 30.31 20.23 31.97 21.73 35.62 24.79	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c} 25.88\ 25.61\\ 24.36\ 25.21\\ 28.25\ 27.26\\ 29.59\ 27.18\\ 39.86\ 36.27\\ 42.14\ 38.82\\ 39.14\ 38.45\\ 39.44\ 37.86\\ 27.52\ 27.60\\ 24.03\ 24.27\\ 20.38\ 21.21\\ \end{array}$	N N N N N L L L
3 5 6 7 8 9 10 11 12 13	0.87745 2.14453 4.27954 6.54268 9.24063 20.61427 0.16789 0.16789 0.16789 1.53747 2.02951 3.92967	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	9.97 10.03 10.13 10.20 10.31 10.56 9.94 9.95 10.01 10.03 10.11	31.6420.79 27.7518.74 26.4118.82 20.1413.73 17.8611.18 20.8611.55 25.6217.20 30.3120.23 31.9721.73 35.6224.79 29.7820.55	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25.8825.61 24.3625.21 28.2527.26 29.5927.18 39.8636.27 42.1438.82 39.1438.45 39.4437.86 27.5227.60 24.0324.27 20.3821.21 26.2225.45	N N N N N L L L L
3 5 6 7 8 9 10 11 12 13 14	0.87745 2.14453 4.27954 6.54268 9.24063 20.61427 0.16789 0.16789 0.16789 1.53747 2.02951 3.92967	$\begin{array}{c} 21.6710.82\\ 17.728.71\\ 16.288.69\\ 9.943.53\\ 7.550.87\\ 10.300.99\\ 15.687.26\\ 20.3610.28\\ 21.9611.72\\ 25.5914.76 \end{array}$	9.97 10.03 10.13 10.20 10.31 10.56 9.94 9.95 10.01 10.03	31.64 20.79 27.75 18.74 26.41 18.82 20.14 13.73 17.86 11.18 20.86 11.55 25.62 17.20 30.31 20.23 31.97 21.73 35.62 24.79	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25.8825.61 24.3625.21 28.2527.26 29.5927.18 39.8636.27 42.1438.82 39.1438.45 39.4437.86 27.5227.60 24.0324.27 20.3821.21 26.2225.45 33.6033.78	N N N N N L L L



9. Antenna Requirement

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

Conclusion: Comply

The antenna is attached on the device by means of unique coupling method (Spring Tension). Therefore this E.U.T Complies with the requirement of §15.203

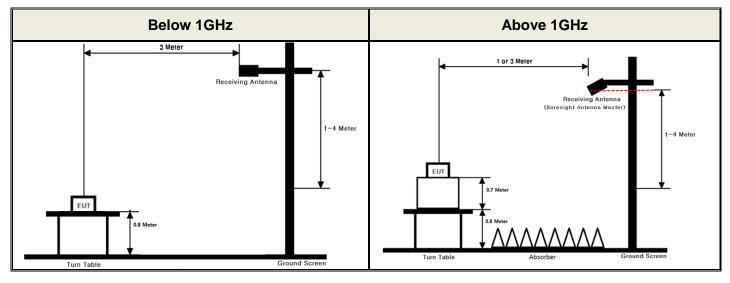
- Minimum Standard :

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.

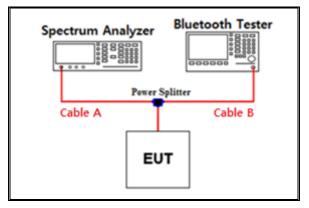
APPENDIX I

Test set up diagrams

Radiated Measurement



Conducted Measurement



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	6.09	15	9.42
1	6.52	20	13.70
2.402 & 2.440 & 2.480	7.19	25	17.40
5	7.87	-	-
10	9.00	-	-

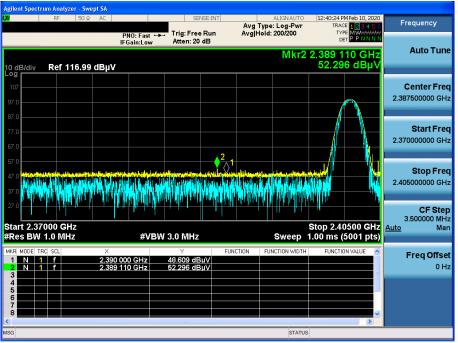
Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test. Path loss (S/A's Correction factor) = Cable A + Power splitter



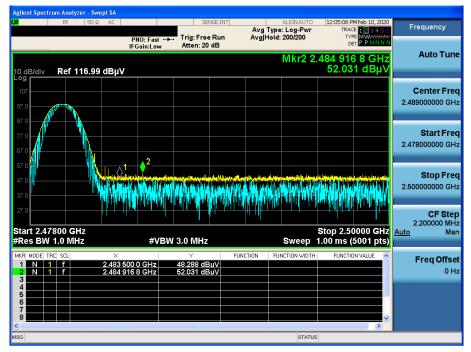
APPENDIX II

Unwanted Emissions (Radiated) Test Plot

GFSK & Lowest & X & Hor



GFSK & Highest & X & Hor



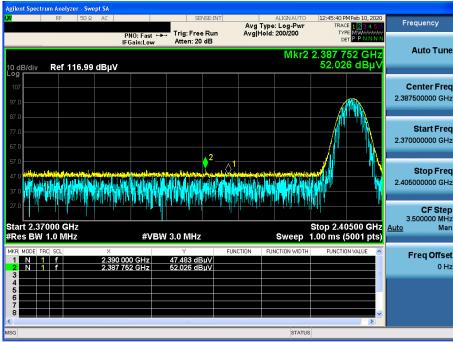
Detector Mode : PK

Detector Mode : PK



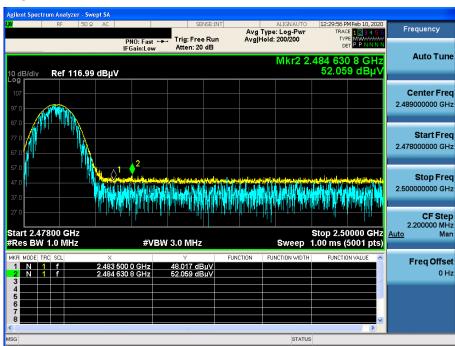
π /4DQPSK & Lowest & X & Hor

Detector Mode : PK



π/4DQPSK & Highest & X & Hor

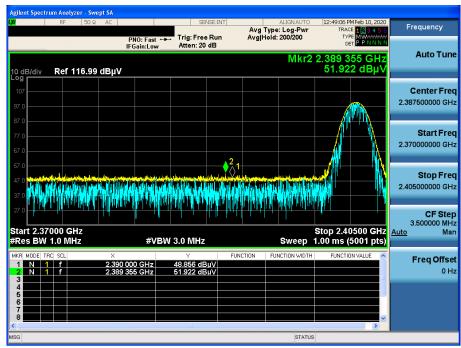
Detector Mode : PK





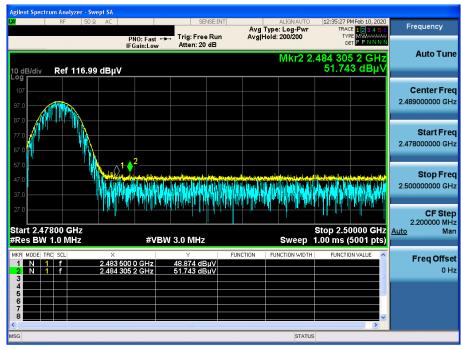
8DPSK & Lowest & X & Hor

Detector Mode : PK



Detector Mode : PK

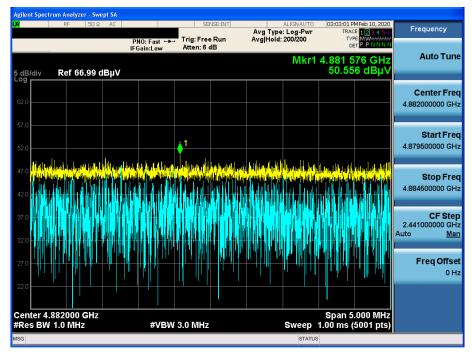
8DPSK & Highest & X & Hor





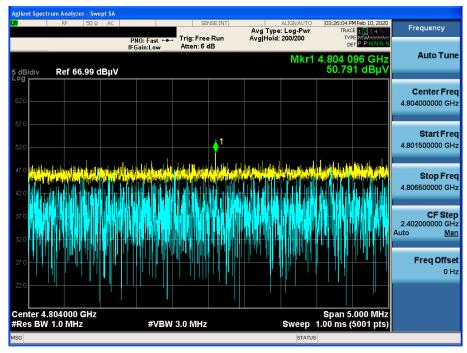
GFSK & Middle & X & Ver

Detector Mode : PK



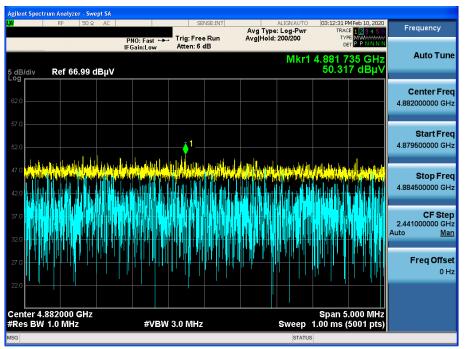
$\pi/4DQPSK$ & Lowest & X & Ver

Detector Mode : PK





8DPSK & Middle & X & Ver



Detector Mode : PK