TEST REPORT

		DT&C Co.,	Ltd.		
Dt&C		42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042 Tel : 031-321-2664, Fax : 031-321-1664			
1. Report No: DRTFCC1904-	0081				
2. Customer					
• Name (FCC) : POINTMOBIL	E CO., LTD. / Name	(IC) : POINTMOBILE	CO.,LTD		
 Address (FCC) : B-9F, Kabul Gr Address (IC) : B-9F Kabul Grea 					
3. Use of Report : FCC & IC Or	iginal Grant				
4. Product Name / Model Name FCC ID : V2X-PM85W / IC :		′ PM85W			
5. Test Method Used : ANSI C6	3.10-2013				
Test Specification : FCC Part	15 Subpart C.247	<i>,</i>			
RSS-247	Issue 2 (2017-02), F	RSS-GEN Issue 5 (20	18-04)		
6. Date of Test : 2018.11.20 ~ 2	018.12.21				
7. Testing Environment : See ap	pended test report.				
8. Test Result : Refer to the atta	ched test result.				
Affirmation		Reviewed by	ANT		
Name : SunGeun Lee	(Signature)	Name : GeunKi Son	(Signature)		
The test results presented in this the use of this test report is inhil					
		pproval of DT&C Co., Lt	7		
2019.04.09.					
	DT&C Co	Ltd.			

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



Test Report Version

Test Report No.	Date	Description
DRTFCC1904-0081	Apr. 09, 2019	Initial issue



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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

- IC Test site No. : 5740A

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

1.2 Testing Environment

Ambient Condition		
Temperature	+17 ℃ ~ +22 ℃	
 Relative Humidity 	35 % ~ 39 %	

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	0.7 dB (The confidence level is about 95 %, k = 2)
Conducted spurious emission	0.9 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 (FCC)	:	POINTMOBILE CO., LTD.
Applicant (IC)		POINTMOBILE CO.,LTD
Address (FCC)	:	B-9F, Kabul Great Valley 32 Digital-ro 9-gil, Geumcheon-gu Seoul South Korea 153-709
Address (IC)		B-9F Kabul Great Valley, 32, Digital-ro 9-gil, Geumcheon-gu Seoul Korea (Republic Of)
Contact person (FCC)	:	Wilson Park
Contact person (IC)	:	Wilson Park

1.5 Description of EUT

EUT	Mobile Computer	
Model Name(FCC, IC)	PM85W	
Add Model Name(FCC)	XT200WB	
Add Model Name(IC)	-	
Hardware Version	MP	
Software Version	85.M00	
Serial Number	Identical prototype	
Power Supply	DC 3.85 V	
Frequency Range	2402 MHz ~ 2480 MHz	
Modulation Technique	GFSK, π/4DQPSK, 8DPSK	
Number of Channels 79		
Antenna Type	PIFA Antenna	
Antenna Gain	PK : 2.22 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 sequence 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	18/07/09	19/07/09	MY50200834
Spectrum Analyzer	Agilent Technologies	N9020A	18/01/03	19/01/03	MY48011700
DC Power Supply	Agilent Technologies	66332A	18/07/02	19/07/02	US37473422
Multimeter	FLUKE	17B	17/12/26	18/12/26	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	17/12/27	18/12/27	255571
Signal Generator	ANRITSU	MG3695C	18/02/12	19/02/12	173501
BlueTooth Tester	TESCOM	TC-3000C	18/07/06	19/07/06	3000C000563
Thermohygrometer	BODYCOM	BJ5478	18/01/03	19/01/03	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/01/03	19/01/03	120612-2
Thermohygrometer	BODYCOM	BJ5478	18/07/09	19/07/09	N/A
HYGROMETER	TESTO	608-H1	18/02/10	19/02/10	34862883
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	18/07/13	20/07/13	3359
Horn Antenna	ETS-Lindgren	3115	17/01/13	19/01/13	9202-3820
Horn Antenna	Schwarzbeck	BBHA 9120C	17/12/04	19/12/04	9120C-561
Horn Antenna	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
PreAmplifier	tsj	MLA-0118-J01- 45	18/02/08	19/02/08	17138
PreAmplifier	tsj	MLA-1840-J02- 45	18/07/06	19/07/06	16966-10728
PreAmplifier	H.P	8447D	17/12/26	18/12/26	2944A07774
Power Divider	Anritsu	K240B	18/07/04	19/07/04	1701099
Attenuator	SMAJK	SMAJK-2-3	18/07/02	19/07/02	3
Attenuator	Aeroflex/Weinschel	56-3	18/07/02	19/07/02	Y2370
Attenuator	SRTechnology	F01-B0606-01	18/07/02	19/07/02	13092403
Attenuator	Hefei Shunze	SS5T2.92-10-40	18/07/03	19/07/03	16012202
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5- 6SS	18/07/03	19/07/03	3
High Pass Filter	Wainwright Instruments	WHKX12-935- 1000-15000- 40SS	18/07/02	19/07/02	8
High Pass Filter	Wainwright Instruments	WHKX10-2838- 3300-18000- 60SS	18/07/02	19/07/02	1
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	18/04/17	19/04/17	1306007 1249001
EMI Test Receiver	Rohde Schwarz	ESR7	18/02/13	19/02/13	101061
EMI Test Receiver	Rohde Schwarz	ESCI7	18/02/12	19/02/12	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	18/09/27	19/09/27	101333
LISN	SCHWARZBECK	NNLK 8121	18/03/20	19/03/20	06183
Cable	Radiall	TESTPRO3	18/07/06	19/07/06	M-01
Cable	Junkosha	MWX315	18/11/19	19/11/19	M-05
Cable	Junkosha	MWX221	18/11/19	19/11/19	M-06
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-04
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-07
Cable	DT&C	Cable	18/07/06	19/07/06	G-13
Cable	DT&C	Cable	18/07/06	19/07/06	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	18/07/06	19/07/06	G-15
Cable	DT&C	Cable	18/07/05	19/07/05	RF-82

Note 1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.

Note 2: 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
100 247(0.1)	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		С
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.
- §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

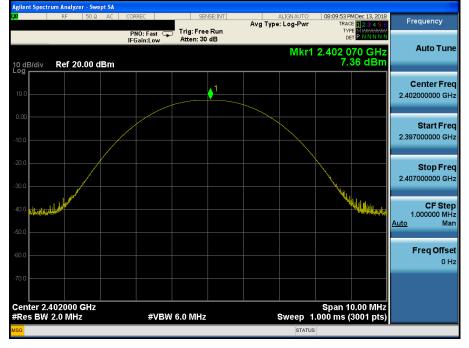
2.4 Test Results

Modulation	Tested Channel		Average t Power	Peak Output Power					
Woddiation		dBm	mW	dBm	mW				
	Lowest	6.41	4.38	7.36	5.45				
<u>GFSK</u>	Middle	7.87	6.12	8.68	7.38				
	Highest	6.10	4.07	7.19	5.24				
	Lowest	4.89	3.08	7.40	5.50				
<u>π/4DQPSK</u>	Middle	6.70	4.68	8.73	7.46				
	Highest	3.93	2.47	7.23	5.28				
	Lowest	4.89	3.08	7.62	5.78				
<u>8DPSK</u>	Middle	6.69	4.67	8.95	7.85				
	Highest	3.92	2.47	7.44	5.55				

Note 1 : The Frame 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



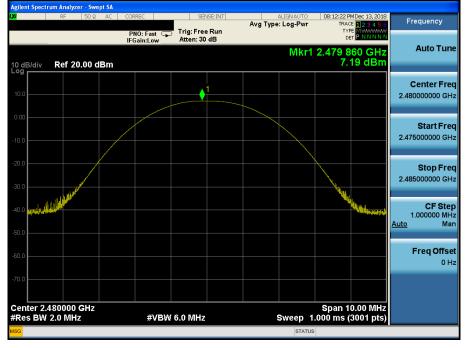
Peak Output Power

Middle Channel & Modulation : GFSK



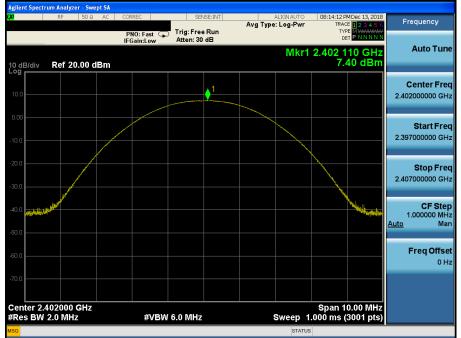


Highest Channel & Modulation : GFSK



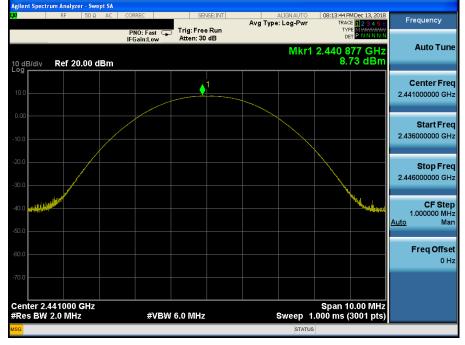
Peak Output Power

Lowest Channel & Modulation : π/4DQPSK



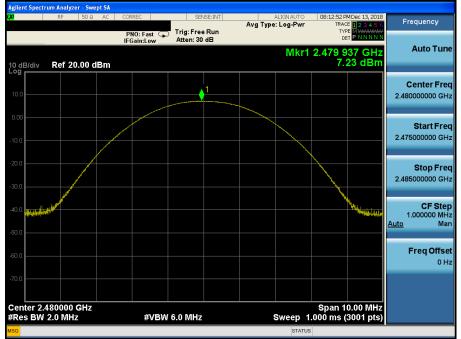


Middle Channel & Modulation : π/4DQPSK



Peak Output Power

Highest Channel & Modulation : π/4DQPSK



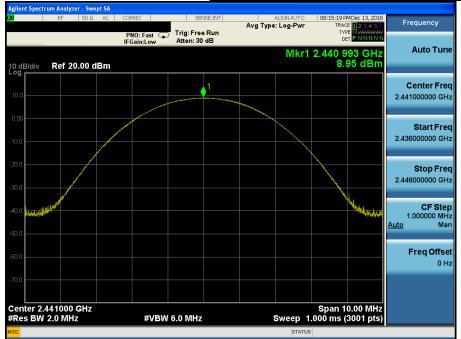


Lowest Channel & Modulation : 8DPSK



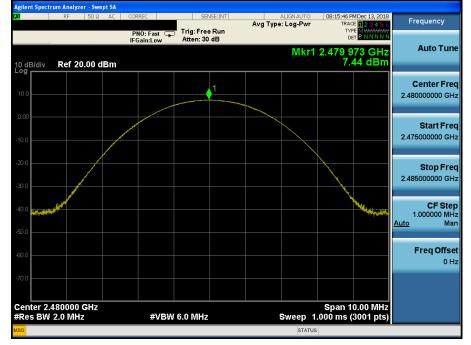
Peak Output Power

Middle Channel & Modulation : 8DPSK





Highest Channel & Modulation : 8DPSK



3. 20 dB BW & Occupied 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

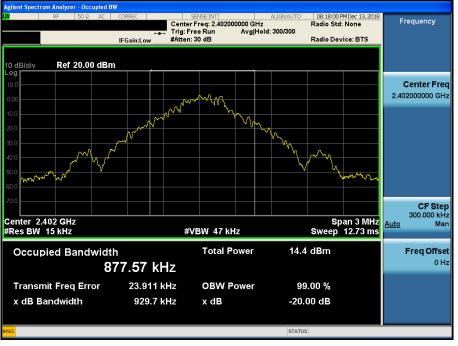
Detector function = peak

Trace = max hold

3.4 Test Results

Modulation	Tested Channel	20 dB BW (MHz)	Occupied BW (MHz)
	Lowest	0.930	0.878
<u>GFSK</u>	Middle	0.929	0.885
	Highest	0.928	0.884
	Lowest	1.320	1.180
<u>π/4DQPSK</u>	Middle	1.322	1.176
	Highest	1.281	1.172
	Lowest	1.268	1.172
<u>8DPSK</u>	Middle	1.279	1.176
	Highest	1.290	1.180



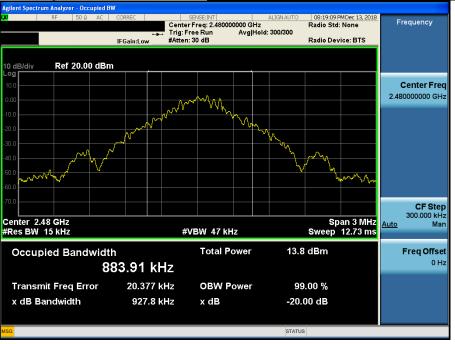


20 dB BW & Occupied BW



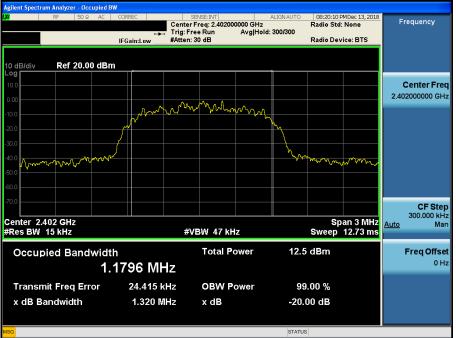






20 dB BW & Occupied BW





Middle Channel & Modulation : π/4DQPSK



20 dB BW & Occupied BW

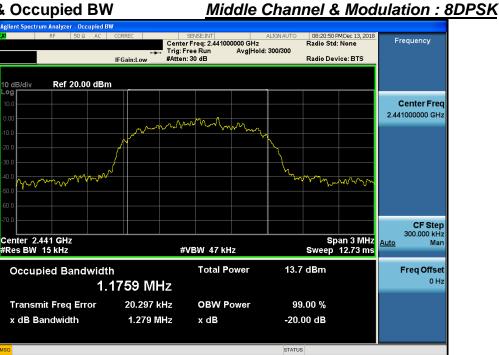
Highest Channel & Modulation : π/4DQPSK







20 dB BW & Occupied BW









4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : \geq 25 kHz or \geq 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 ≥ 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	2440.925	2441.927	1.002
Enable	π/4DQPSK	2441.018	2442.017	0.999
	8DPSK	2441.009	2442.008	0.999

AFH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2440.922	2441.921	0.999
Enable	π/4DQPSK	2441.024	2442.023	0.999
	8DPSK	2441.021	2442.020	0.999

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)



	nt Spec			yzer -	Swep	ot SA														
L XI			RF	5	ΩC	AC	COP	REC		SE	NSE:INT			OTUAN		0 PM Dec 13,		F	requency	
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Carrier Frequency Separation (FH)

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





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

Main Alignation Disisson Mode: 13,2016 Frequency PN0: Wile IFGein:Lew Trig: Free Run Atten: 30 dB Aug Type: Log-Pwr Tree: Frequency Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Auto Tune 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Auto Tune 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Auto Tune 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Auto Tune 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Auto Tune 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency 100 Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency Aug Type: Log-Pwr Tree: Frequency 100 Aug Type: Log-Pwr Tree: Frequency Start Freq 2.439500000 GHz Start Freq 2.441000000 GHz Start Freq 2.442500000 GHz Start Freq 300.000 KHz 101 Freq Offset 0 Hz Aug Type: Log-Pwr Tr	Agrient Spectrum Analyzer - Swept SA					
Auto Tune Atten: 30 dB Atten: 40 dB Atten	KA RF 50Ω AC				TRACE 1 2 3 4 5 6	Frequency
100 122 Center Freq 2.44100000 GHz 300 <th>10 dB/div Ref 20.00 dBm</th> <th>PNO: Wide 😱 IFGain:Low</th> <th></th> <th></th> <th>DET PINNNN AMkr1 999 kHz</th> <th>Auto Tune</th>	10 dB/div Ref 20.00 dBm	PNO: Wide 😱 IFGain:Low			DET PINNNN AMkr1 999 kHz	Auto Tune
300 Start Freq 2.43950000 GHz 500 Start Freq 2.43950000 GHz 500 Start Freq 2.43950000 GHz 600 Start Freq 2.44250000 GHz 700 Span 3.000 MHz 700 Span 3.000 MHz 700 Span 3.000 MHz 8 9 9 1 10 2.441000 GHz 9 10 2.441000 GHz 9 10 2.441000 GHz 5.54 dBm 7 8 9 10 10 10 10 10 11 9 10 10 10 10 10 10 10 10	10.0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
Stop Freq 2.44250000 GHz Stop Freq 2.44250000 GHz Center 2.441000 GHz Span 3.000 MHz Span 3.000 MHz #Res BW 51 kHz VBW 150 kHz Sweep 1.133 ms (1001 pts) MRR MODE TRC Scl Y Function Function value 1 Δ2 1 f 2.441 009 GHz Function Function value Man 1 Δ2 1 f 2.441 009 GHz 5.54 dBm Freq Offset O Hz 3 0 0 0 1 dB 0	-30.0					
#Res BW 51 kHz VBW 150 kHz Sweep 1.133 ms (1001 pts) MKR MODE X Y FUNCTION FUNCTION VALUE Auto Man 1 Δ2 f f 2.441 009 GHz 5.54 dBm Function Function Value Freq Offset 3 6 7 7	-60.0					
MRR MODE TRC Still X Y Y PUNCTION FUNCTION FUNCTION VALUE 1 1 f (Δ) 999 HHz (Δ) -0.11 dB Function Function Value Function Value <th>#Res BW 51 kHz</th> <td>VBW 1</td> <td></td> <td></td> <td>.133 ms (1001 pts)</td> <td>300.000 kHz</td>	#Res BW 51 kHz	VBW 1			.133 ms (1001 pts)	300.000 kHz
2 F 1 f 2.441 009 GHz 5.54 dBm 3 4 5 5.54 dBm 6 6 4 5 5 6 6 6 6 7 6		999 kHz (A)		INCTION FUNCTION WIDTH	FUNCTION VALUE	
	2 F 1 f 2.441 3 4 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		5.54 dBm		1	
	7 8 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10					
MSG STATUS	11					
	MSG			STATU	s	



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



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable & $\pi/4DQPSK$ </u>

Agilent Spectrum Analyzer - Swept SA			
ΓΧ΄ RF 50 Ω AC	CORREC SENSE:INT	ALIGNAUTO 08:51:48 PMDec 13, 2018 Avg Type: Log-Pwr TRACE 123456	Frequency
10 dB/div Ref 20.00 dBm	PNO: Wide Trig: Free Run IFGain:Low Atten: 30 dB	түре Милики ост Р ИНИИ И ФИКИТ 999 KHz -0.05 dB	Auto Tune
Log 10.0 0.00	X2~		Center Fred 2.441000000 GHz
-20.0			Start Fred 2.439500000 GH;
-50.0 -60.0 -70.0			Stop Fred 2.442500000 GH;
Center 2.441000 GHz #Res BW 51 kHz	VBW 150 kHz	Span 3.000 MHz Sweep 1.133 ms (1001 pts)	CF Step 300.000 kH Auto Mar
1 Δ2 1 f (Δ)	999 kHz (Δ) -0.05 dB I 024 GHz 6.03 dBm		Freq Offse 0 Ha
8 9 10 11 4		STATUS	



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

igilent Spec																
	RI	- 1	50 Ω	AC	CORRE	:C		ENSE:INT	Avg		GNAUTO	TR	L PM Dec 13, 2 ACE 1234	5 6	Frequenc	
					PNO:	:Wide ⊂ in:Low	Trig: Fr						DET P N N N	N N		
					IFGa	In:Low	Atten. v					A BAlcod	000 14		Auto 1	Гur
10 dB/div	Re	ef 20.0	00 di	3m									999 kF -0.08 d			
-og 10.0												1Δ:	2		Center	Ere
0.00	~ ~	\sim	\sim	\sim	\sim			X2				\sim	~~~~		2.441000000	
~~~	· · · ·					$\sim$	Ť			~~~					2.44100000	, G
10.0																
20.0															Start	Fn
30.0															2.439500000	) G
40.0																
50.0																_
60.0															Stop	
70.0															2.442500000	) G
enter :			Hz				450 1-11-					Span	3.000 MI	lz	CF	
Res Bl						VBW	150 kHz			SV	veep		(1001 pt		300.00 Auto	0 k M
IKR MODE		ι (Δ)		Х	000	kHz (Δ	Y	FI B d B	JNCTION	FUNCT	ION WIDTH	FUNC	TION VALUE	<u>^</u>	<u>luto</u>	IWI
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6																
8																
9																
11														~		
						_	10			_			>			
^{SG}											STATU	s				

## 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 = 2415.0 MHz,	Stop Frequency = 2465.0 MHz								
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 ≥ 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



# **T**Dt&C

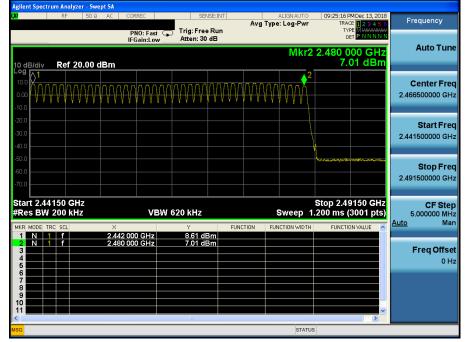
## Number of Hopping Frequencies 1(FH)

## Hopping mode : Enable & GFSK

	nt spec		RF			AC		COR	REC					SEI	VSE:I	NT					ALIGN	VAU	то	0	9:14:	53 P	MDec	13.20	18		-	_	_	
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		_						IFG	io: F iain:	ast Low	•			n: 30												DE	T P N	NNN	N N				_	
																						VIk	( <b>r</b> 2	2.4			00					Aut	o Tu	ine
10 c	B/div Ref 20.00 dBm 8.45 dBm																																	
Log 10.0						$\Diamond^1$																										Cent	or Ei	
0.01						٨ſ	M	M	Λſ	N	M	Λſ	M	ŊΠ	$\cap$	١M	Λſ	W	M	Λſ	١٨٢	M	ΛΛ	ΔP	M	M	ΛΛ	ΛΛ	Δ			6500		- 1
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					ļ																												rt Fr	
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-40.0					1																													
-50.0	1000	heriopol	-hogen	antrone	wa																											Sto	p Fr	rea
-60.0																															2.44	1500		
-70.0																																		
Sta	rt 2.3	391(	50 C	SHz																				Sto	p 2	.44	150	GH	IZ				F St	en
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3							441	000	J Gr	12			0.4	2 (1)	5111																	Fred	Off	set
4																													=				0	Hz
6																																		
7																																		
9 10																																		
11																												_	~					
K MSG	_	_	_	_	_	_	_	_	_	_	_	_	10	_	_	_	_	_	_	_	_	07	ATUS		_	_		>						
MSG	_																					SI	ATUS	·								_		

## Number of Hopping Frequencies 2(FH)

## Hopping mode : Enable & GFSK



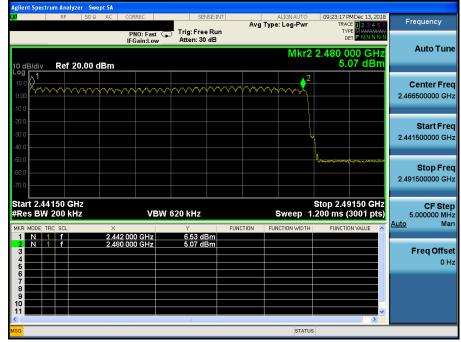
## Number of Hopping Frequencies 1(FH)

## Hopping mode : Enable & π/4DQPSK

F	F 50 Ω	AC COR	REC		ISE:INT	Avg T	ALIGNAUTO ype: Log-Pwr	TRA	PM Dec 13, 2018 CE 123456	Frequency
		PN IFG	10: Fast 🕞 Gain:Low	Trig: Free Atten: 30				0	PE M <del>UMUMUM</del> ET P N N N N N	Auto Tune
) dB/div 🛛 🤻	ef 20.00 dE	3m					MKr		)00 GHz 68 dBm	
og 10.0 1.00 0.0	<u> </u>	1	~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	~~~~	~~~~~~	*****	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Center Fred 2.416500000 GH
20.0 30.0 40.0										<b>Start Fred</b> 2.391500000 GH:
50.0 <mark></mark>	and value									<b>Stop Fred</b> 2.441500000 GHz
Start 2.39150 FRes BW 200	kHz	X	VBW	620 kHz Y	5.000	CTION	-	1.200 ms (	4150 GHz (3001 pts)	CF Step 5.000000 MH Auto Mar
1 N 1 f 2 N 1 f 3 4 5		× 2.402 000 2.441 000		5.39 dE 6.68 dE	3m		FUNCTION WIDTH	FUNCTI		Freq Offset
6 7 8 9 10 11										
sg				111			STATU	IS	>	

## Number of Hopping Frequencies 2(FH)

## Hopping mode : Enable & π/4DQPSK





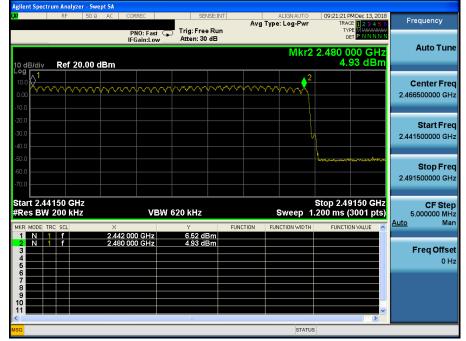
## Number of <u>Hopping Frequencies 1(FH)</u>

## Hopping mode : Enable & 8DPSK

XI		RF	alyzer -	JΩ		CORRE	=c		SE	VSE:INT				ALIGNAUTO	09:19:1	3 PM Dec 13.	2018	_	
	1		-						Trig: Fre			Avg		: Log-Pwr	TF		156		Frequency
10 dl	3/div	Rei	f 20.0	0 d	Зm	PNC IFGa	): Fast ( in:Low	♪	Atten: 30					Mkr2	2.441	DET PNN	nnn Hz		Auto Tun
Log 10.0 0.00 -10.0					<mark>\1</mark>	~~~	~~~~	~~	~~~~	v~~~	$\sim$	~~~	V~VM	~~~~	$\sim \sim \sim \sim$	$\sim \sim $	<b>~</b>	2.4	Center Free 416500000 GH
-20.0 -30.0 -40.0				N														2.3	<b>Start Free</b> 391500000 GH
-50.0 -60.0 -70.0			ar go mar an an A	1														2.4	<b>Stop Fre</b> 441500000 GH
#Re	t 2.39 s BW	200			× 2.402			/ 62	0 kHz Y 5.31 d		FUNC	TION		Sweep 1	.200 ms	44150 G (3001 p		Auto	CF Step 5.000000 MH Mar
2 3 4 5	N 1	f			2.402	000	GHz		6.40 d	Bm							=		Freq Offse 0 H
6 7 9 10 11																			
<				_					III						-1		>		
MSG														STATU	5				

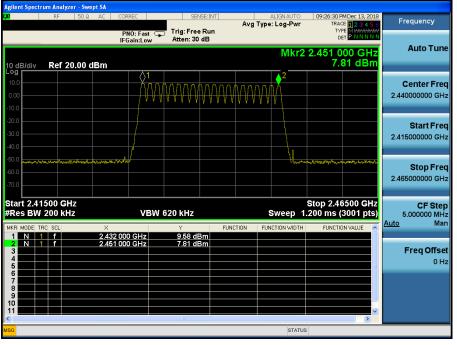
## Number of Hopping Frequencies 2(FH)

## Hopping mode : Enable & 8DPSK



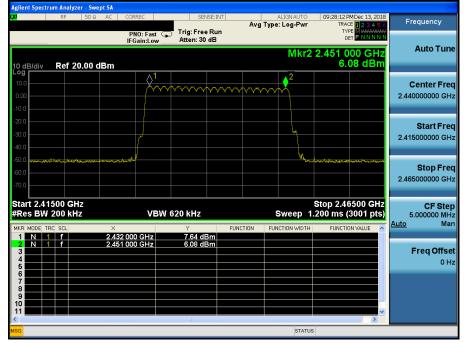
## Number of Hopping Frequencies 1(AFH)





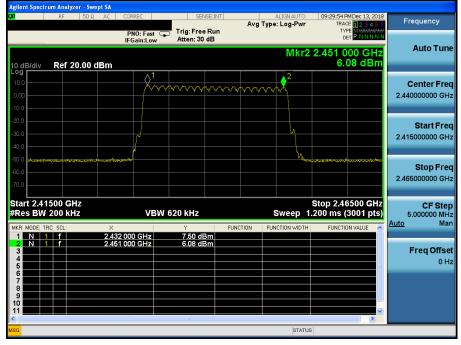
## Number of Hopping Frequencies 1(AFH)

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



## Number of Hopping Frequencies 1(AFH)

## Hopping mode : Enable & 8DPSK





## 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)
Enable	DH 5	79	2.880	3.750	0.307
	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)
Enable	DH 5	20	2.880	3.750	0.154
	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)

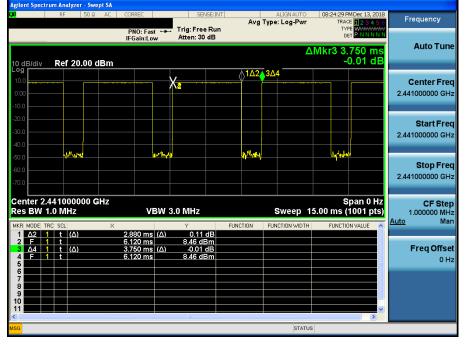
- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

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



## Hopping mode : Enable & DH5

## Time of Occupancy (FH)



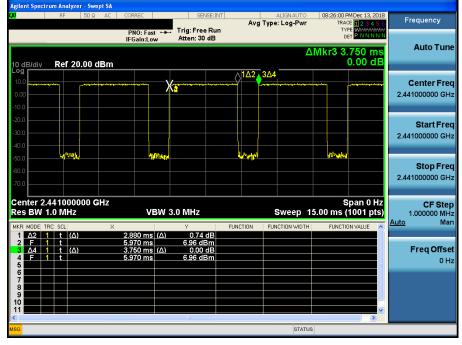
## Time of Occupancy (FH)

#### Hopping mode : Enable & 2-DH5 lent Spectrum Analyzer - Swept S/ Frequency Avg Type: Log-Pwr RA TYPE DET Trig: Free Run Atten: 30 dB PNO: Fast ↔ IFGain:Low Auto Tune ΔMkr3 3.750 ms 0.00 dB Ref 20.00 dBm ∆1<u>∆2</u>,3<u>∆</u>4 **Center Freq** Xã 2.441000000 GHz Start Freq 2.441000000 GHz Laid. 10 dr.w Stop Freq 2.441000000 GHz **CF Step** 1.000000 MHz Man Center 2.441000000 GHz Res BW 1.0 MHz Span 0 Hz Sweep 15.00 ms (1001 pts) VBW 3.0 MHz <u>Auto</u> FUNCTION FUNCTION WIDT Δ2 1 F 1 (Δ) (Δ) 6.81 Freq Offset ∆4 F s (Δ) (Δ) 0.00 dB 6.81 dBm 6.0 0 Hz



## Hopping mode : Enable & 3-DH5

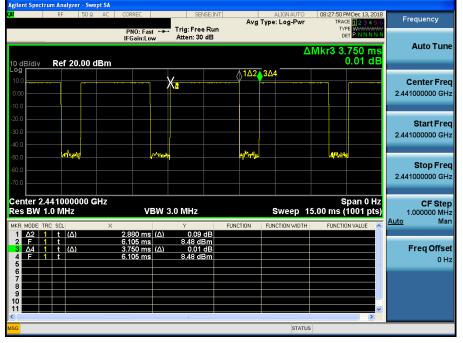
## Time of Occupancy (FH)





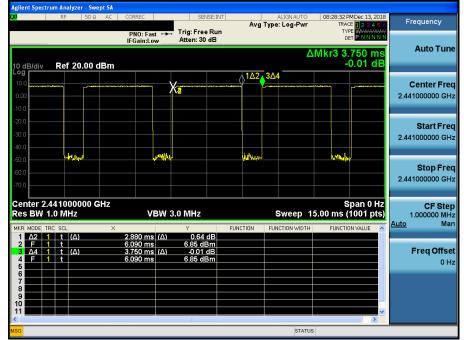
#### Hopping mode : Enable & DH5

## Time of Occupancy (AFH)



#### Time of Occupancy (AFH)

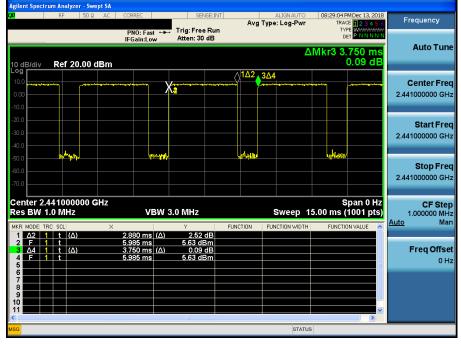
#### Hopping mode : Enable & 2-DH5





### Hopping mode : Enable & 3-DH5

## Time of Occupancy (AFH)





# 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	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.25	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
6.215 ~ 6.218	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.26775 ~ 6.26825	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.31175 ~ 6.31225	123 ~ 138	2200 ~ 2300	14.47 ~ 14.5
8.291 ~ 8.294	149.9 ~ 150.05	2310 ~ 2390	15.35 ~ 16.2
8.362 ~ 8.366	156.52475 ~ 156.52525	2483.5 ~ 2500	17.7 ~ 21.4
8.37625 ~ 8.38675	156.7 ~ 156.9	2690 ~ 2900	22.01 ~ 23.12
8.41425 ~ 8.41475	162.0125 ~ 167.17	3260 ~ 3267	23.6 ~ 24.0
12.29 ~ 12.293	167.72 ~ 173.2	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	240 ~ 285	3345.8 ~ 3358	36.43 ~ 36.5
12.57675 ~ 12.57725	322 ~ 335.4	3600 ~ 4400	Above 38.6
13.36 ~ 13.41			

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**

- 1. Frequency Range Below 1GHz RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak
- 2. Frequency Range Range > 1 GHz Peak Measurement RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes Average Measurement> 1GHz RBW = 1MHz, VBW ≥ 1/T, Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes



#### 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 ~ 26.5 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)
2388.69	Н	Z	PK	53.48	2.69	N/A	N/A	56.17	74.00	17.83
2388.72	Н	Z	AV	42.31	2.69	-24.79	N/A	20.21	54.00	33.79
4804.14	Н	Z	PK	50.39	1.44	N/A	N/A	51.83	74.00	22.17
4804.41	Н	Z	AV	38.87	1.44	-24.79	N/A	15.52	54.00	38.48

#### 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)
4882.19	Н	Z	PK	50.16	1.63	N/A	N/A	51.79	74.00	22.21
4881.93	Н	Z	AV	38.83	1.63	-24.79	N/A	15.67	54.00	38.33

#### 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)
2484.06	Н	Z	PK	54.03	3.10	N/A	N/A	57.13	74.00	16.87
2483.53	Н	Z	AV	42.57	3.10	-24.79	N/A	20.88	54.00	33.12
4959.73	Н	Z	PK	49.43	1.87	N/A	N/A	51.30	74.00	22.70
4959.89	Н	Z	AV	38.42	1.87	-24.79	N/A	15.50	54.00	38.50

#### Note.

1. The radiated emissions were investigated 9kHz 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 =  $\Delta t$  = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms

- 100 ms /  $\Delta t$  [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 : $\pi$ /4DQPSK)

#### 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)
2389.60	Н	Z	PK	53.54	2.70	N/A	N/A	56.24	74.00	17.76
2389.51	Н	Z	AV	42.32	2.70	-24.79	N/A	20.23	54.00	33.77
4803.56	Н	Z	PK	49.91	1.44	N/A	N/A	51.35	74.00	22.65
4803.62	Н	Z	AV	38.82	1.44	-24.79	N/A	15.47	54.00	38.53

#### 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)
4881.92	Н	Z	PK	49.98	1.63	N/A	N/A	51.61	74.00	22.39
4881.87	Н	Z	AV	38.91	1.63	-24.79	N/A	15.75	54.00	38.25

#### 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)
2485.32	Н	Z	PK	54.71	3.10	N/A	N/A	57.81	74.00	16.19
2483.54	Н	Z	AV	42.57	3.10	-24.79	N/A	20.88	54.00	33.12
4960.22	Н	Z	PK	49.72	1.87	N/A	N/A	51.59	74.00	22.41
4960.25	Н	Z	AV	38.43	1.87	-24.79	N/A	15.51	54.00	38.49

#### Note.

1. The radiated emissions were investigated 9kHz 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 =  $\Delta t$  = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms

- 100 ms /  $\Delta t$  [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>8DPSK</u>)

Lowest Cl     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)
2388.86	Н	Z	PK	53.92	2.69	N/A	N/A	56.61	74.00	17.39
2388.94	Н	Z	AV	42.25	2.69	-24.79	N/A	20.15	54.00	33.85
4803.99	Н	Z	PK	50.49	1.44	N/A	N/A	51.93	74.00	22.07
4804.17	Н	Z	AV	38.91	1.44	-24.79	N/A	15.56	54.00	38.44

#### 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)
4881.66	Н	Z	PK	50.04	1.63	N/A	N/A	51.67	74.00	22.33
4881.60	Н	Z	AV	38.82	1.63	-24.79	N/A	15.66	54.00	38.34

#### 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)
2483.69	Н	Z	PK	52.99	3.10	N/A	N/A	56.09	74.00	17.91
2483.57	Н	Z	AV	42.57	3.10	-24.79	N/A	20.88	54.00	33.12
4959.59	Н	Z	PK	49.83	1.87	N/A	N/A	51.70	74.00	22.30
4959.74	Н	Z	AV	38.45	1.87	-24.79	N/A	15.53	54.00	38.47

Note.

1. The radiated emissions were investigated 9kHz 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 =  $\Delta t$  = T [ms] X 20 minimum hopping channels , where T = pulse width = 2.88 ms
  - 100 ms /  $\Delta t$  [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**

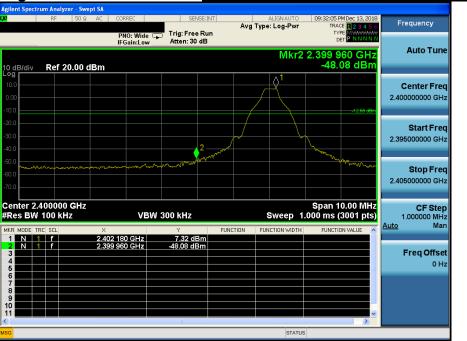
- D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log( 5.76 / 100 )** = <u>-24.79 dB</u> 4. Sample Calculation.

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.



#### Low Band-edge



#### Lowest Channel & Modulation : GFSK

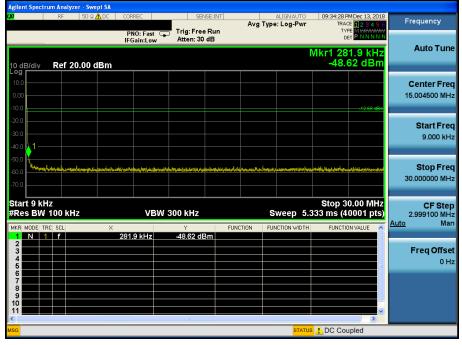
#### Low Band-edge

## Hopping mode & Modulation : GFSK





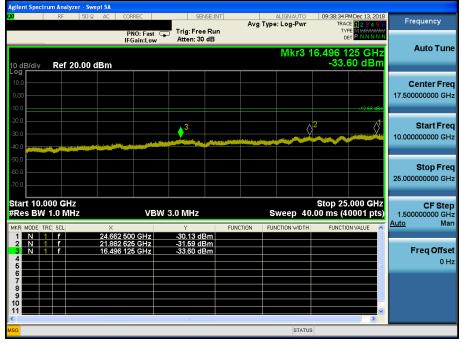
### Lowest Channel & Modulation : GFSK



Log       Image: Control of the second	Agilent Spectrum A											
PR0: Fast IFGsintLow       Trig: Free Run Atten: 30 dB       Mkr3 5.566 09 GHz         0 dB/div       Ref 20.00 dBm       -38.93 dBm         0 dD       -42.854       -38.93 dBm         1 DD       1 f       -38.93 dBm       -38.93 dBm         1 M       1 f       -2402 11 GHz       -38.93 dBm       -38.93 dBm         1 M       1 f       -5.666 09 GHz       -38.93 dBm       -38.93 dBm         1 M       1 f       -5.666 09 GHz       -38.93 dBm       -40.454	<b>XI</b> R	F 50 Ω	AC C	ORREC	SENS	BE:INT	Ava Tvp		TRAC	E 123456	Frequency	
Inclusion       Kkein so dia       Mikr3 5.566 09 GHz       Auto Tune         0 dB/div       Ref 20.00 dBm       -38.93 dBm       -38.93 dBm       Center Freq         0 00       000       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1				PNO: Fast					TY	PE MWAWAAAA FT P N N N N N		
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100       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	10 dB/div Re	ef 20.00 d	Bm					IVIKE	-38.5	09 GHZ 93 dBm		
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700     10.00000000 GHz       Start 30 MHz     VBW 3.0 MHz     Sweep 18.67 ms (40001 pts)       Mrr. MODE TRC Scl.     X       1     1     1       2     N     1       1     1       3     N       1     1       4     5.666 09 GHz       5     5.666 09 GHz       38.93 dBm       1       1											Stop Freq	
Start 30 MHz     VBW 3.0 MHz     Stop 10.000 GHz       #Res BW 1.0 MHz     VBW 3.0 MHz     Sweep 18.67 ms (40001 pts)       MKR MODE TRC ScL     Y     FUNCTION FUNCTION WIDTH       1     1     1       2     N     1       1     1     1       2     N     1       3     N     1       4     5       5     5       6     3       9     3       10     1											10.00000000 GHz	
#Res         BW         1.0         MHz         VBW         3.0         MHz         Sweep         18.67         ms (40001 pts)           MKR         MODE         TCC         SCL         X         Y         FUNCTION         FUNCTION VIDTH         FUNCTION VIDTH <t< td=""><td>-70.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	-70.0											
MKR         MODE         TAC         SEL         X         Y         FUNCTION         FUNCTION VIDTH         FUNCTION VALUE         Auto         Man           1         N         1         F         2.402.11 GHz         7.47 dBm         F         3.155 10 GHz         38 68 dBm         F         F         3.155 10 GHz         38 68 dBm         F         F         G         F         G         G         F         G         G         F         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G         G	Start 30 MHz			_					Stop 10	.000 GHz	CF Step	
MRR MODE THE SEC	#Res BW 1.0	MHz		VBV	/ 3.0 MHz		s	weep 18	.67 ms (4	0001 pts)		
2       N       1       f       3.155 10 GHz       -38.68 dBm		l I					TION FU	NCTION WIDTH	FUNCTIO	ON VALUE	Auto Man	
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#### Lowest Channel & Modulation : GFSK





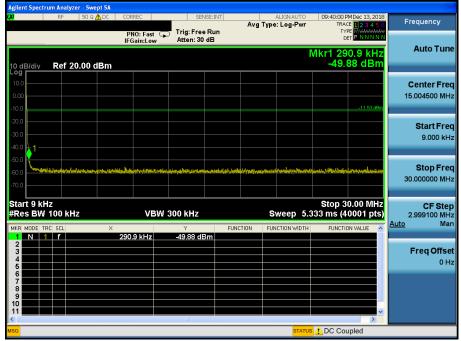
**Reference for limit** 

#### Middle Channel & Modulation : GFSK



#### **Conducted Spurious Emissions**











Agilent Spectrum Analyzer - Swept							
<b>ιχι</b> RF 50 Ω		SENSE:INT	Avg Ty	ALIGNAUTO	09:41:35 PMD TRACE	ec 13, 2018	Frequency
	PNO: Fast 🕞 IFGain:Low	Trig: Free Run Atten: 30 dB				NNNNN	
10 dB/div Ref 20.00 dB	Sm			Mkr4 1	6.807 000 -34.28	) GHz dBm	Auto Tune
Log 10.0 0.00 -10.0						_11.53 dBm	<b>Center Freq</b> 17.50000000 GHz
-20.0 -30.0 -40.0					3 <u>2</u>		<b>Start Freq</b> 10.000000000 GHz
-50.0 -60.0 -70.0							<b>Stop Freq</b> 25.000000000 GHz
Start 10.000 GHz #Res BW 1.0 MHz	VBW	3.0 MHz		Sweep 40	Stop 25.00 00 ms (400	01 pts)	CF Step 1.50000000 GHz
MKR MODE TRC SCL	× 4.640 375 GHz	Y -30.77 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION V	ALUE 🔼	<u>Auto</u> Man
2 N 1 f 2 3 N 1 f 2	23.204 125 GHz 21.856 750 GHz 6.807 000 GHz	-31.06 dBm -31.74 dBm -34.28 dBm					<b>Freq Offset</b> 0 Hz
0         7           8         9           9         10           11         11							
<							
MSG				STATUS			



#### High Band-edge

### Highest Channel & Modulation : GFSK



## High Band-edgeHopping mode & Modulation : GFSK





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

#### )ec 13.2 45 TRACL TYPE DET Frequency Avg Type: Log-Pwr Trig: Free Run Atten: 30 dB PNO: Fast 🖵 IFGain:Low Auto Tune Mkr1 284.9 kHz -48.77 dBm Ref 20.00 dBm **Center Freq** 15.004500 MHz Start Freq 9.000 kHz Stop Freq 30.000000 MHz **CF Step** 2.999100 MHz Man Start 9 kHz #Res BW 100 kHz Stop 30.00 MHz Sweep 5.333 ms (40001 pts) VBW 300 kHz <u>Auto</u> 284.9 kHz -48.77 dBm N 1 f Freq Offset 0 Hz s 🚹 DC Coupled

ilent Spectrum Analyzer - Sv RF 50 :		SENSE:INT		NAUTO 09:45:50 PM Dec 13, 2018						
	PNO: Fast IFGain:Low		Avg Type: Lo	g-Pwr TRACE 12345 TYPE MWWWWW DET P NNNN						
) dB/div Ref 20.00	Mkr4 4.110 97 GHz iiv Ref 20.00 dBm -40.57 dBm									
og 0.0 0.00	↓ ↓ 1 			-13.60 «Din	Center Free 5.015000000 GH					
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0.0					<b>Stop Fre</b> 10.000000000 GH					
tart 30 MHz Res BW 1.0 MHz		W 3.0 MHz		Stop 10.000 GHz ep 18.67 ms (40001 pts)	CF Ste 997.000000 MH Auto Ma					
KR MODE TRC SCL	× 2.480 13 GHz	7.16 dBm	FUNCTION FUNCTION	N WIDTH FUNCTION VALUE						
3 N 1 f 4 N 1 f 5 M 1 f	9.704 39 GHz 6.409 80 GHz 4.110 97 GHz	-39.21 dBm -39.25 dBm -40.57 dBm			Freq Offse 0 H					
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### Highest Channel & Modulation : GFSK





#### Low Band-edge

## Lowest Channel & Modulation : π/4DQPSK

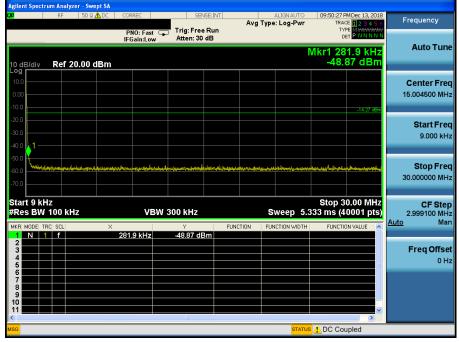


#### Low Band-edge

#### Hopping mode & Modulation : π/4DQPSK



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





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



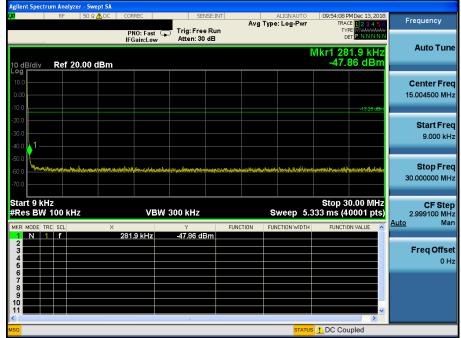


#### Reference for limit

### Middle Channel & Modulation : π/4DQPSK

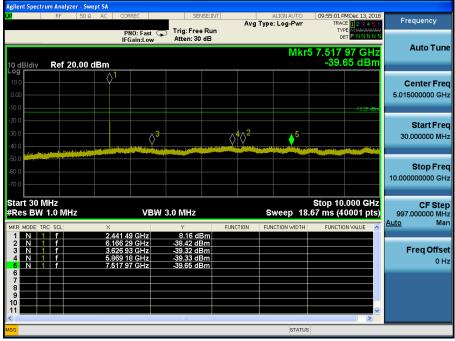


#### Conducted Spurious Emissions <u>Middle Channel & Modulation : π/4DQPSK</u>





#### Middle Channel & Modulation : π/4DQPSK

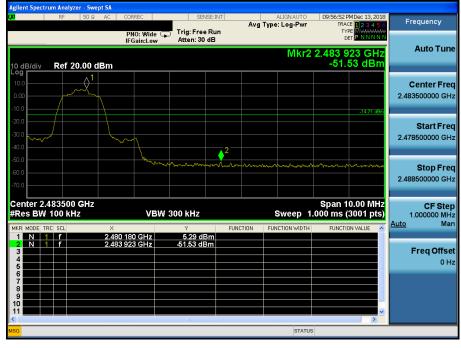


Agilent Spectru										
<mark>XI</mark>	RF	50Ω AC	CORREC	SEN	SE:INT	Ανα Τι	ALIGNAUTO		4Dec 13, 2018	Frequency
			PNO: Fast IFGain:Lov				,	TYP	T P N N N N N	
10 dB/div	Ref 20.0	0 dBm					Mkr5 1	6.854 6 -34.4	25 GHz 2 dBm	Auto Tune
										Contor Ero
0.00										Center Free 17.50000000 GH
-10.0									-13:25 dBm	
-20.0				▲5				A3	⊼ <b>1</b>	Start Fre
-30.0					والمحمد والمساولة	The survey of		X Y X	V V	10.00000000 GH
-40.0										
-60.0										Stop Fre
-70.0										25.00000000 GH
Start 10.0	00 GH7							Stop 25	000 GHz	CF Ster
#Res BW			VE	3W 3.0 MHz			Sweep 40	.00 ms (4)	0001 pts)	1.500000000 GH
MKR MODE TR	IC SCL	×		Y		CTION	FUNCTION WIDTH	FUNCTIO	N VALUE	<u>Auto</u> Ma
1 N 1 2 N 1	f f		375 GHz 125 GHz	-29.88 dB -31.15 dB						
3 N 1	f	23.270	875 GHz 750 GHz	-31.36 dB	m					Freq Offse
4 N 1 5 N 1	f		750 GHZ 625 GHZ	-31.41 dB -34.42 dB	m				=	0 H
6										
8										
9	+									
11									~	
<				III						
SG							STATUS			



#### **High Band-edge**

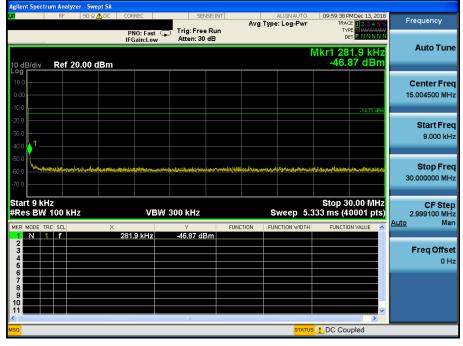
## Highest Channel & Modulation : π/4DQPSK



## High Band-edge Hopping mode & Modulation : π/4DQPSK



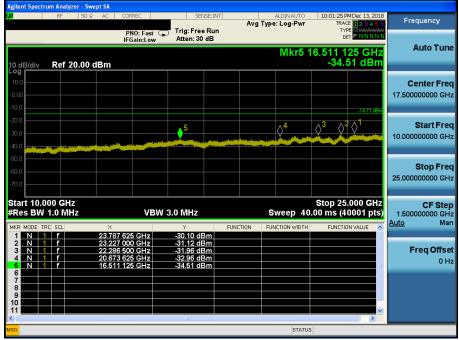
### Highest Channel & Modulation : π/4DQPSK



Agilent Spectrum Analyze											
RF RF	50 Ω AC CORREC	SENSE:INT	Avg Type:		10:36 PM Dec 13, 2018 TRACE 1 2 3 4 5 6	Frequency					
	PNO: Fast G IFGain:Low	Trig: Free Run Atten: 30 dB			DET PNNNN	Auto Tune					
10 dB/div Ref 20	Mkr5 8.010 24 GHz 3/div Ref 20.00 dBm -39.66 dBm										
10.0 0.00 -10.0	↓ 				-14.71 dBm	Center Freq 5.015000000 GHz					
-20.0 -30.0 -40.0		\$ ²	3	5		Start Freq 30.000000 MHz					
-50.0						<b>Stop Freq</b> 10.000000000 GHz					
Start 30 MHz #Res BW 1.0 MHz	z VBW	3.0 MHz	Sw	Sto /eep 18.67 m	p 10.000 GHz is (40001 pts)	CF Step 997.000000 MHz Auto Man					
MKR MODE TRC SCL	× 2.480 13 GHz	Y FL 6.60 dBm	JNCTION FUNC	TION WIDTH F	UNCTION VALUE	Auto Man					
2 N 1 F 3 N 1 F 4 N 1 F 5 N 1 F 6	5,289 42 GHz 6,276 21 GHz 7,561 34 GHz 8,010 24 GHz	-38.30 dBm -39.14 dBm -39.59 dBm -39.66 dBm			=	<b>Freq Offset</b> 0 Hz					
7 8 9 10											
<					<u> </u>						
MSG				STATUS							



### Highest Channel & Modulation : π/4DQPSK





#### Low Band-edge

#### Lowest Channel & Modulation : 8DPSK

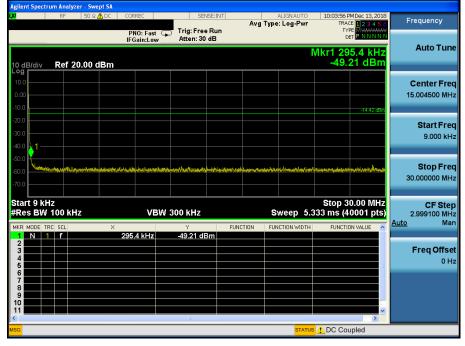


### Low Band-edge <u>Hopping mode & Modulation : 8DPSK</u>

#### Frequency Avg Type: Log-Pwr PNO: Wide Trig: Free Run IFGain:Low Atten: 30 dB TYP Auto Tune Mkr1 2.399 687 GHz -51.55 dBm Ref 20.00 dBm **Center Freq** 2.40000000 GHz Start Freq 2.395000000 GHz **♦**¹ Stop Freq 2.40500000 GHz Center 2.400000 GHz #Res BW 100 kHz Span 10.00 MHz 1.000 ms (3001 pts) **CF Step** 1.000000 MHz Man VBW 300 kHz Sweep <u>Auto</u> 2.399 687 GHz -51.55 dBm N 1 Freq Offset 0 Hz STATUS



#### Lowest Channel & Modulation : 8DPSK



1	rum Analyzer RF	50 Ω AC	CORREC	SENSE	INT	ALIGNAUTO	10:04:57 PMDec 13, 20	10
<b>V</b>	RF	JO & AC			Avg	g Type: Log-Pwr	TRACE 1 2 3 4 5	Frequency
			PNO: Fast IFGain:Low	Atten: 30 dE	3		TYPE MWAAAA DET PNNN	
10 dB/div	Ref 20.	00 dBm				Mkr	3 2.764 02 GH -39.39 dBr	
10.0								Center Free
0.00		Ĭ						5.015000000 GH
10.0							-14.42 dE	37
20.0								Start Fre
30.0			3			<mark>2</mark>		30.000000 MH
40.0				Contracting provide the second				
50.0								Stop Fre
50.0 70.0								10.00000000 GH
/0.0								
Start 30 Res BW	MHz / 1.0 MHz		٧B١	V 3.0 MHz		Sweep 18	Stop 10.000 GH .67 ms (40001 pt	s) 997.000000 MH
KR MODE T	RC SCL	Х		Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto Ma
1 N 1	1 f 1 f	6.95	02 11 GHz 53 92 GHz	7.14 dBm -39.23 dBm				
3 N 4	1 f	2.76	64 02 GHz	-39.39 dBm				Freq Offse 0 H
5								
7								
9								
							>	<b>~</b>



#### Lowest Channel & Modulation : 8DPSK



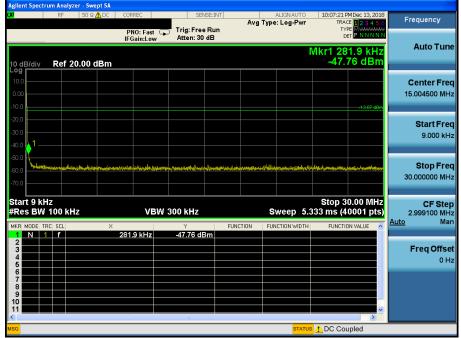


#### Reference for limit

#### Middle Channel & Modulation : 8DPSK

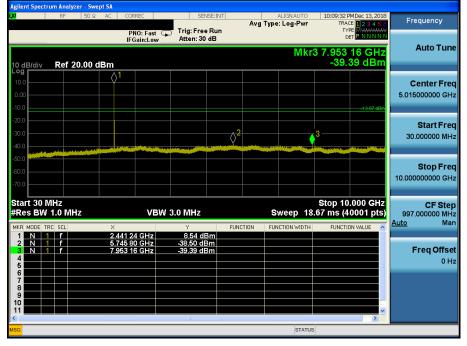








#### Middle Channel & Modulation : 8DPSK

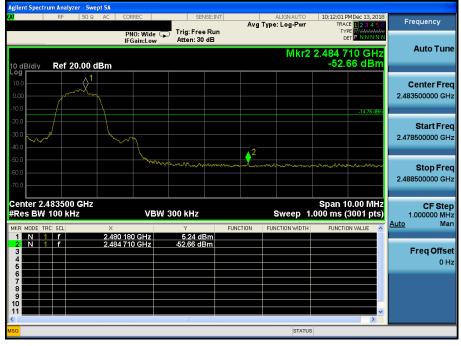


04 RF 50 Ω AC CORREC SENSE:INT ALIGN AUTO 10:10:54 PMDec 13, 2018	
	quency
PNO: Fast Trig: Free Run Tyre Mutana Det PNNNNN	
	uto Tune
10 dB/div Ref 20.00 dBm -31.69 dBm	
	nter Freq 00000 GHz
-10.0	00000 GH2
	Start Freq
	00000 GHz
	Stop Freq
-70.0	00000 GHz
Start 10.000 GHz Stop 25.000 GHz #Res BW 1.0 MHz VBW 3.0 MHz Sweep 40.00 ms (40001 pts)	CF Step 00000 GHz
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE ALL	Man
1 N 1 f 24.731 125 GHz -29.97 dBm 2 N 1 f 23.208 625 GHz -30.74 dBm	
3 N 1 f 22.247 875 GHz -30.75 dBm Fi	eq Offset
4         N         1         f         21.350 125 GHz         -31.69 dBm           5	0 Hz
MSG STATUS	



#### **High Band-edge**

### Highest Channel & Modulation : 8DPSK

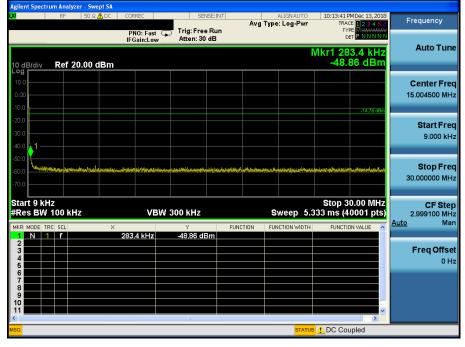


## High Band-edge <u>Hopping mode & Modulation : 8DPSK</u>





### Highest Channel & Modulation : 8DPSK



Agilent Spe	ectrun																
LXI		RF	50 Ω	AC	COR	REC		SEN	VSE:IN	Г	Avg		LIGN AUTO	TR.	PMDec 13, 2 ACE 1234	5.6	Frequency
						lO:Fast ain:Low		Trig: Free Atten: 30						т	YPE MWAATA DET PINNN	N N	
	_	_		_	ire	am.Low		Theorem of				_	Mkr	4 9 603	94 GI	17	Auto Tune
10 dB/di																	
10.0					$\rangle^1$												Center Freq
0.00																	5.015000000 GHz
-10.0																-	
-20.0															-14.76	10/11	
-30.0						<del>ر 3</del>					<u>^2</u>					4 -	Start Freq 30.000000 MHz
-40.0					Mar	<u> </u>	Manager and	and the second states			<u> </u>		Contraction of the local division of the loc	and the second states in the			30.000000 MH2
-50.0								A COLONIA COLONIA									
-60.0																_	Stop Freq 10.00000000 GHz
-70.0																_	10.000000000 GHz
Start 3	0 MI	17												Stop 1	0.000 GI	-17	CF Step
#Res B			Hz			VB	W 3.	0 MHz				S	weep 18	.67 ms (	40001 p	ts)	997.000000 MHz
MKR MODE	E TRC	SCL		×				Y		FUNC	TION	FUN	CTION WIDTH	FUNCT	ION VALUE	^	<u>Auto</u> Man
1 N 2 N	1	f			480 13 313 84	3 GHz 1 GHz		7.08 dE									
3 N	1	f		3.		1 GHz		-38.59 dE	3m								Freq Offset
5				3.	003.34	+ 982		-53.24 ut	5111							Ξ	0 Hz
6																	
8		$\rightarrow$															
10																	
<								Ш									
MSG													STATUS				

#### 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.

Frequency Range (MHz)	Conducted Limit (dBuV)						
Trequency Range (wriz)	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

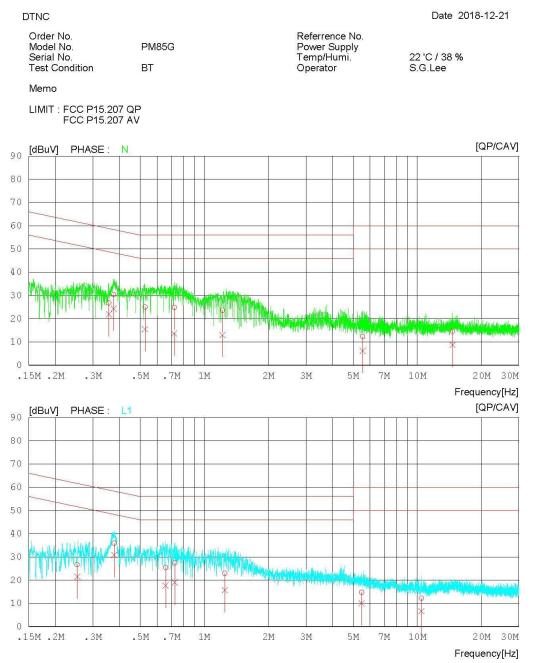
Conducted emissions from the EUT were measured according to the ANSI C63.10.

- 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)



## **Results of Conducted Emission**

DTNC

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

## **Results of Conducted Emission**

Date 2018-12-21

	Order No. Model No. PM850 Serial No. Test Condition BT		PM85G BT		F F C	22 'C / 38 % S.G.Lee	22 'C / 38 % S.G.Lee		
	Memo	C							
	LIMIT	: FCC P15. FCC P15.							
	NO	FREQ	READING	C.FACTOR			MIT	MARGIN	PHASE
_		[MHz]	QP CAV [dBuV] [dBuV]	] [dB]	QP CAV [dBuV][dBuV	QP /] [dBuV	CAV ] [dBuV	QP CAV ] [dBuV][dBuV	]
	1		16.7811.84	10.03	26.8121.87		48.80	31.99 26.93	Ν
	2		20.3814.40	10.02	30.4024.42	58.38	48.38	27.9823.96	N
	3 4		14.98 5.51	10.03	25.01 15.54		46.00	30.9930.46	N
	4 5	0.72330	14.84 3.67 13.52 2.98	10.05 10.06	24.8913.72 23.5813.04	56.00 56.00	46.00	31.11 32.28 32.42 32.96	N N
	6	5.53840	2.01-4.07	10.00	12.26 6.18	60.00	40.00	47.7443.82	N
		14.64500	4.11 -1.79	10.52	14.63 8.73		50.00	45.3741.27	N
	8		16.74 11.52	9.98	26.72 21.50		51.65	34.93 30.15	L1
	9		25.92 20.78	9.99	35.91 30.77		48.33	22.4217.56	L1
	10	0.65816	15.38 7.58	10.01	25.3917.59	56.00	46.00	30.6128.41	L1
	11	0.72712	17.43 8.95	10.01	27.44 18.96	56.00	46.00	28.5627.04	L1
	12	1.25000		10.04	22.9215.69		46.00	33.08 30.31	L1
	13	5.47820	4.55-0.17	10.21	14.7610.04		50.00	45.24 39.96	L1
	14	10.45960	1.94 -3.69	10.33	12.27 6.64	60.00	50.00	47.7343.36	L1



## 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 :

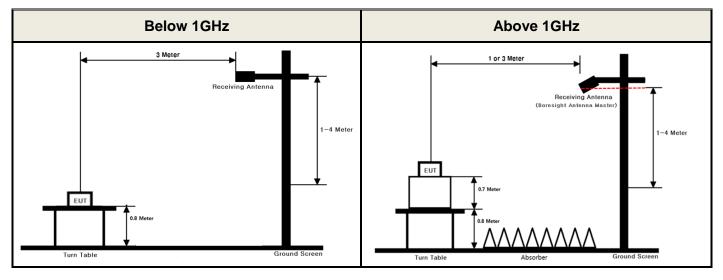
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.



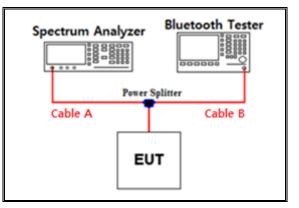
## **APPENDIX I**

#### Test set up diagrams

#### Radiated Measurement



#### Conducted Measurement



#### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	6.05	15	8.75
1	6.50	20	9.29
2.402 & 2.441 & 2.480	7.05	25	9.82
5	7.84	-	-
10	8.25	-	-

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

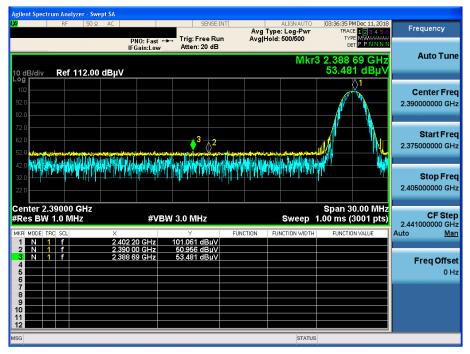
Path loss (S/A's Correction factor) = Cable A+ Power splitter



## **APPENDIX II**

#### **Unwanted Emissions (Radiated) Test Plot**

#### GFSK & Lowest & Z & Hor



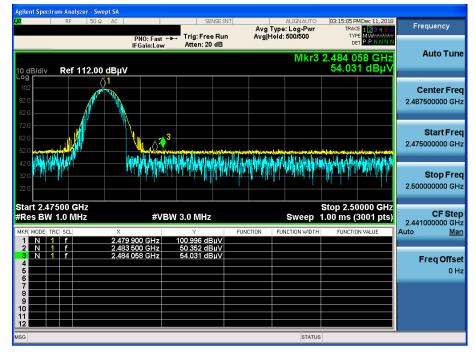
#### GFSK & Lowest & Z & Hor



#### **Detector Mode : AV**



#### GFSK & Highest & Z & Hor



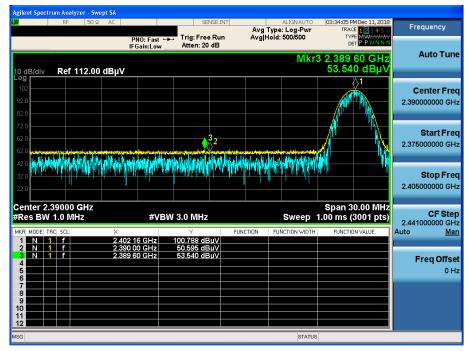
#### **Detector Mode : AV**

#### GFSK & Highest & Z & Hor



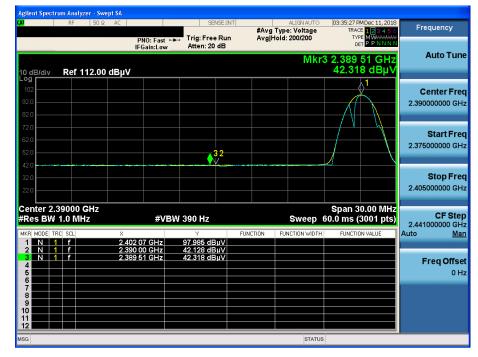


#### $\pi/4DQPSK$ & Lowest & Z & Hor



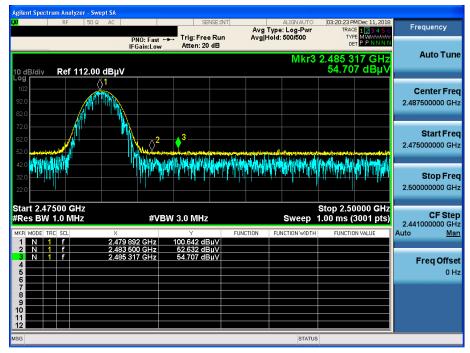
#### $\pi$ /4DQPSK & Lowest & Z & Hor

#### **Detector Mode : AV**





#### $\pi/4DQPSK$ & Highest & Z & Hor



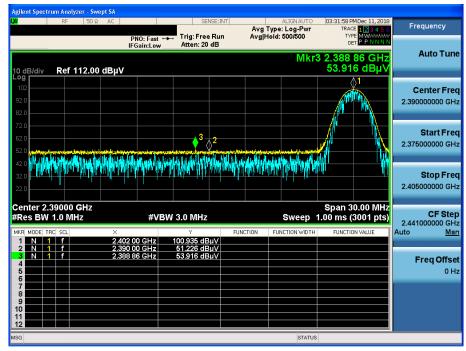
#### $\pi/4DQPSK$ & Highest & Z & Hor

#### ent Spectrum Analyzer - Swept SA Frequency #Avg Type: Voltage Avg|Hold: 200/200 TYPE MWANN DET P P N N Trig: Free Run Atten: 20 dB PNO: Fast +> IFGain:Low Mkr3 2.483 542 GHz 42.567 dBµV Auto Tune Ref 112.00 dBµV 10 dB/div **Center Freq** 2.487500000 GHz Start Freq 2.475000000 GH **▲**3 Stop Freq 2.50000000 GHz Stop 2.50000 GHz 50.0 ms (3001 pts) 2.47500 GHz BW 1.0 MHz CF Step 2.441000000 GHz #VBW 390 Hz Sweep #Res Man FUNCTION FUNCT \uto 97.817 dBµ 42.513 dBµ 42.567 dBµ 2.480 050 2.483 500 2.483 542 Freq Offset 0 H

**Detector Mode : AV** 



#### 8DPSK & Lowest & Z & Hor



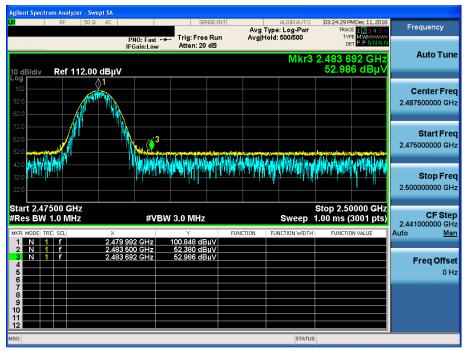
#### **Detector Mode : AV**

#### 8DPSK & Lowest & Z & Hor





#### 8DPSK & Highest & Z & Hor



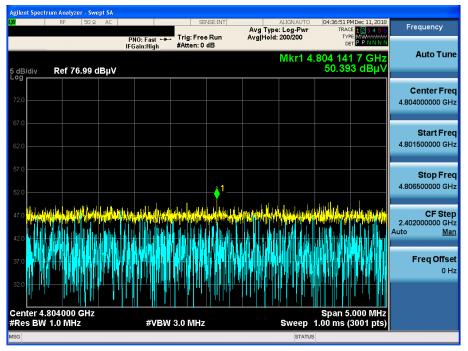
#### Detector Mode : AV

#### 8DPSK & Highest & Z & Hor

	RF	50 Ω	AC	9	ENSE:INT		ALIGN AUTO		4Dec 11, 2018	Frequency
			PNO: Fas IFGain:Lo				ype: Voltage Id: 200/200	TYP	E 123456 E MW <del>MMMM</del> T P P N N N N	Frequency
dB/div	Ref 11	2.00 d		N HIGHI I			Mkr3	2.483 5 42.57	67 GHz 0 dBµV	Auto Tun
2.0		Å								Center Fre 2.487500000 GF
2.0 2.0 2.0 2.0				3						<b>Start Fre</b> 2.475000000 GF
2.0										<b>Stop Fre</b> 2.500000000 Gi
	2500 GH 1.0 MH:		#\	/BW 390 Hz			Sweep (	Stop 2.50 i0.0 ms (:	0000 GHz 3001 pts)	<b>CF Ste</b> 2.441000000 GI
(R MODE T	RC SCL		× 2.480 058 GHz 2.483 500 GHz	97.791 d 42.481 d	BµV	UNCTION	FUNCTION WIDTH	FUNCTIO	N VALUE	Auto <u>Ma</u>
3 N /	f		2.483 567 GHz	42.570 d	BuV					Freq Offs 0 I
7										
1										



#### GFSK & Lowest & Z & Hor



#### $\pi/4DQPSK$ & Middle & Z & Hor

#### Frequency Avg Type: Log-Pwi Avg|Hold: 200/200 PNO: Fast ---- Trig: Free Run IFGain:High #Atten: 0 dB TYP DE Mkr1 4.881 921 7 GHz 49.977 dBµ\ Auto Tune Ref 76.99 dBµV 5 dB/div **Center Freq** 4.882000000 GHz Start Freq 4.879500000 GHz Stop Freq 4.884500000 GHz CF Step 2.44100000 GHz Auto Man Freq Offset 0 Hz Center 4.882000 GHz #Res BW 1.0 MHz Span 5.000 MHz Sweep 1.00 ms (3001 pts) #VBW 3.0 MHz

#### **Detector Mode : PK**



#### 8DPSK & Lowest & Z & Hor

