# **TEST REPORT**

## 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: DRTFCC1902-0	2-0049
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**Dt&C** 

- 2. Customer
- Name (FCC) : POINTMOBILE CO., LTD. / Name (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)
- 3. Use of Report : FCC & IC Original Grant
- 4. Product Name / Model Name : Mobile Computer / PM85G FCC ID : V2X-PM85G / IC : 10664A-PM85G
- 5. Test Method Used : ANSI C63.10-2013

Test Specification : FCC Part 15 Subpart C.247

RSS-247 Issue 2 (2017-02), RSS-GEN Issue 5 (2018-04)

- 6. Date of Test : 2018.11.20 ~ 2018.12.21
- 7. Testing Environment : See appended test report.
- 8. Test Result : Refer to the attached test result.

Affirmation	Tested by	Reviewed by	Da				
Ammadon	Name : SunGeun Lee (Signat	Name : GeunKi Son	P	(Signature)			
The test	results presented in this test report are limited	d only to the sample supp	olied by app	licant and			
the use	of this test report is inhibited other than its pu	rpose. This test report sh	all not be re	produced			
	except in full, without the written	approval of DT&C Co., Ltd	ł.				
2019.02.26.							
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
DRTFCC1902-0049	Feb. 26, 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-4, 5740A-5

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

#### **1.2 Testing Environment**

Ambient Condition			
Temperature	+17 ℃ ~ +22 ℃		
<ul> <li>Relative Humidity</li> </ul>	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)	PM85G
Add Model Name(FCC)	XT200WA
Add Model Name(IC)	-
Hardware Version	MP
Software Version	85.M00
Serial Number	Identical prototype
Power Supply	DC 3.85 V
Frequency Range2402 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	<b>Limit</b> (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)		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 - C				
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.       Note 3 : This test item was performed in each axis and the worst case data was reported.				

**Dt&C** 

## 1.10 Conclusion of worst-case and operation mode

The EUT has three types of modulation (GFSK,  $\pi$ /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				
woodlation		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.

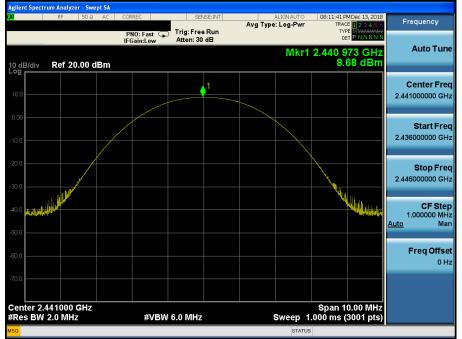


Lowest Channel & Modulation : GFSK



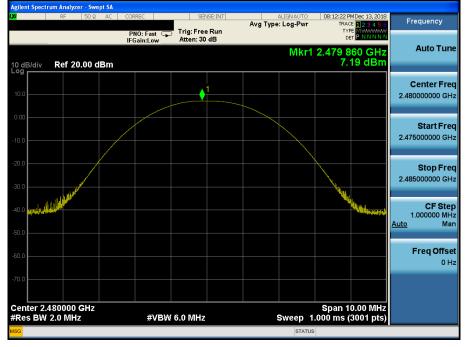
#### **Peak Output Power**





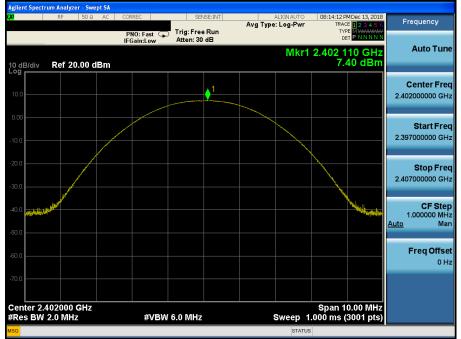


#### Highest Channel & Modulation : GFSK



#### **Peak Output Power**

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



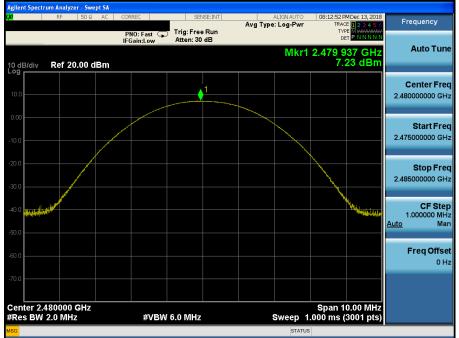


## Middle Channel & Modulation : π/4DQPSK



#### **Peak Output Power**

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





Lowest Channel & Modulation : 8DPSK



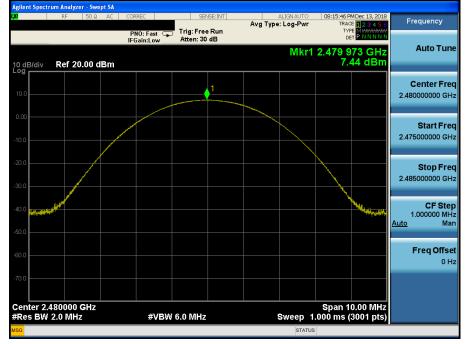
#### **Peak Output Power**







## 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

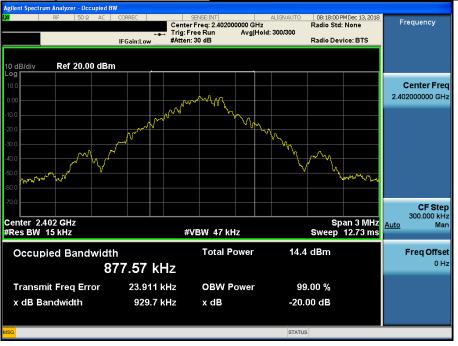
Detector function = peak

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



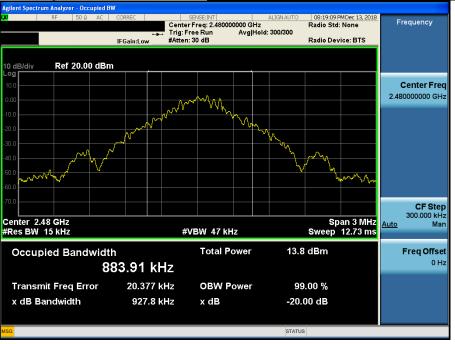


## 20 dB BW & Occupied BW







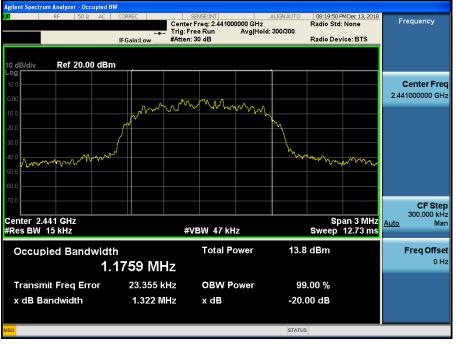


#### 20 dB BW & Occupied BW





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



#### 20 dB BW & Occupied BW

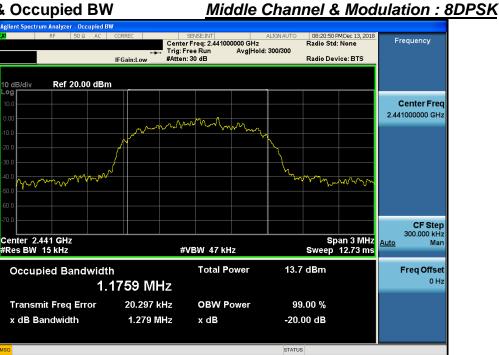
#### Highest Channel & Modulation : π/4DQPSK







#### 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.

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

#### Deteolor function - peak

#### 4.4 Test Results

#### FH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	GFSK	2440.925	2441.927	1.002
	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)





#### Carrier Frequency Separation (FH)

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





## Carrier Frequency Separation (FH)

## Hopping mode : Enable & 8DPSK

Agilent Spectrum Analyzer - Sw						
<mark>X/</mark> RF 50 ឆ	AC CORREC	SEI		ALIGNAUTO Type: Log-Pwr	09:13:30 PM Dec 13, 20 TRACE 1234	
	PNO: W		e Run		TYPE MWARAA	***
	IFGain:L	.owAtten: 30	dB			
					∆Mkr1 999 kH -0.11 d	Z
10 dB/div Ref 20.00	dBm					
10.0		,	v — —		1∆2	Center Freq
0.00	m	~~~~~~	K2nn	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mm	2.441000000 GHz
-10.0						
-20.0						01-15-
-30.0						Start Freq 2.439500000 GHz
-40.0						2.439500000 GH2
-50.0						
-60.0						Stop Freq
-70.0						2.442500000 GHz
-10.0						
Center 2.441000 GHz					Span 3.000 MH	
#Res BW 51 kHz	/	/BW 150 kHz		Sweep 1	.133 ms (1001 pt	
MKR MODE TRC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto Man
1 Δ2 1 f (Δ) 2 F 1 f	999 kH 2.441 009 GH					
3						Freq Offset
5						0 Hz
6						
8						
10						
					>	<b>×</b>
ISG				STATUS	,	



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



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

gilent Spectrum Analyzer - Swept SA			
RF 50 Ω AC	CORREC SENSE:INT	Avg Type: Log-Pwr TRAC	MDec 13, 2018 <b>1</b> 2 3 4 5 6 Frequency
10 dB/div Ref 20.00 dBm	PNO: Wide 🖵 Trig: Free Run IFGain:Low Atten: 30 dB	D≊ ΔMkr1 9	999 kHz 0.05 dB
-og 10.0 0.00 10.0	X2^	1Δ2	Center Free 2.441000000 GH:
20.0			<b>Start Fre</b> 2.439500000 GH
50.0 60.0 70.0			<b>Stop Fre</b> 2.442500000 GH
Center 2.441000 GHz #Res BW 51 kHz	VBW 150 kHz	Sweep 1.133 ms (*	Auto Ma
1         Δ2         1         f         (Δ)           2         F         1         f         2.4           3         -         -         -         -           4         -         -         -         -           5         -         -         -         -         -           6         -         -         -         -         -	999 kHz (Δ) -0.05 dB 41 024 GHz 6.03 dBm		Freq Offse
8 9 10 11			
			X

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

Agilent Spectrum Analyzer - Swept SA				
RF 50Ω AC	CORREC SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	08:53:01 PM Dec 13, 2018 TRACE 1 2 3 4 5 6 TYPE	Frequency
	PNO: Wide Trig: Free Run IFGain:Low Atten: 30 dB		DET P NNNNN AMkr1 999 kHz	Auto Tune
10 dB/div Ref 20.00 dBm			-0.08 dB	
10.0	~~~X2~			Center Freq 2.441000000 GHz
-20.0				Start Freq 2.439500000 GHz
-60.0				Stop Free 2.442500000 GH;
Center 2.441000 GHz #Res BW 51 kHz	VBW 150 kHz		Span 3.000 MHz .133 ms (1001 pts)	CF Step 300.000 kH Auto Mar
MKR MODE TRC SCL X	999 kHz (Δ) -0.08 dB	NCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> mu
2 F 1 f 2.441 3 4 5 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	021 GHz 6.02 dBm			<b>Freq Offse</b> 0 Hz
6 7 8 9				
10 11 <				
NSG		STATU	B	

## 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 in or the 20 dB bandwidth		b less than 30% of the channel spacing						
VBW ≥ RBW	Sweep = auto							
Detector function = peak	Trace = max hold	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

## **Dt&C**

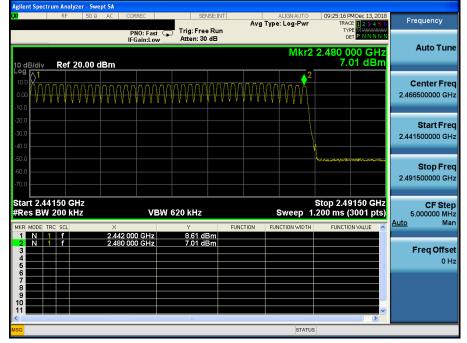
## Number of <u>Hopping Frequencies 1(FH)</u>

## Hopping mode : Enable & GFSK

IXI	n spectru	RF		IΩ		CO	RREC			_		SENS	E:IN	Г						AUTO		09			Dec 13			Γ.		
						PNO: Fast 😱 Trig: Free Run									Av	д Ту	pe:	Log	-Pwr		TRACE 123456 TYPE MWWWW DET PNNNN						Fre	equenc	.y	
						IF	Gair	Fast Low	<u> </u>		ten:					_								DET	PNN	NNN				
																			N	lkr:	2	2.4			)0 G				Auto '	Tune
10 di	IB/div Ref 20.00 dBm 8.45 dBm																													
10.0				(	)						0.0			~ ~	~ ~	4 6	M	_	5.6	~ ~	-	<b>~</b> ~	^ ^	-				C	enter	Fred
0.00				_/	W	W	M	ΛΛ	ŊΛ	$\Lambda \Lambda$	М	₩¥	W	{	W	Υl	Щ	A	ΥY	NΛ	N	ſΎΛ	$[\Lambda]$	N	W	ΛΛ			5500000	
-10.0					¥ ¥	Υ¥	YY	¥ ¥		1	łł	VY	11	Y	(	4.4	ΥY		¥ Y	14.1	1	¥ ų	Y Y	í Ý	ΥY.	¥ V				
-20.0																														
-30.0				ł																									Start	
-40.0				1																								2.391	150000	0 GHz
-50.0				1																										
-60.0	uniter the hase	بيوسالين																											Stop	Freq
-70.0																								T				2.441	150000	0 GHz
-70.0							T														T			T						_
	t 2.391																					Sto	o 2.4	44 <sup>·</sup>	150 0	GHz			CF	Step
#Re	s BW 2	200	kHz					VB	W	620	kН	z						S	we	ер	1.:	200	ms	(3	001	pts)			.000000	) MHz
MKR	MODE TRC				Х						Y			FL	INCT	ION	F	UNC	CTION	WIDTI	н		FUNC	TION	I VALUE	^	Ē	Auto		Man
1	N 1 N 1	f f			2.40	02 00 11 00	0 G 0 G	Hz Hz			7.13 8.45										╉						ŀ			
3							_																					F	Freq O	
5																										Ξ				0 Hz
6													╉																	
8																														
10																														
11			_																							>				
MSG			_	-			-		-			-	-	-	-	-			_	STAT	บร		_	-				_	-	
	_	_	_	_	_	_		_		_	_	_		_			_					_	_		_	_		_		_

#### Number of Hopping Frequencies 2(FH)

#### Hopping mode : Enable & GFSK



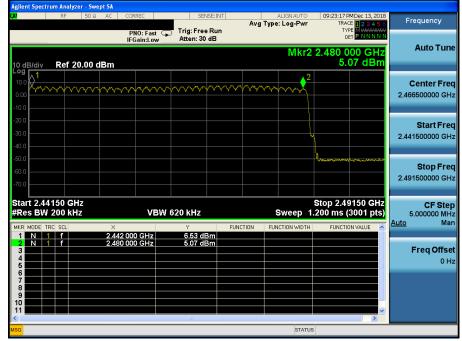
## Number of Hopping Frequencies 1(FH)

#### Hopping mode : Enable & π/4DQPSK

RF 50	Ω AC CORREC	SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	09:17:44 PMDec 13, 2018 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 20.00	PNO: Fast IFGain:Low	Trig: Free Run Atten: 30 dB	Mkr2	2.441 000 GHz 6.68 dBm	Auto Tune
10.0	<u>_1</u>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	*****	Center Freq 2.416500000 GHz
-20.0	N				Start Freq 2.391500000 GHz
-50.0					<b>Stop Freq</b> 2.441500000 GHz
Start 2.39150 GHz #Res BW 200 kHz	VB	W 620 kHz	Sweep 1	Stop 2.44150 GHz .200 ms (3001 pts)	CF Step 5.000000 MHz <u>Auto</u> Man
1 N 1 F 2 N 1 F 3 4 4 4 4	2.402 000 GHz 2.441 000 GHz	5.39 dBm 6.68 dBm			Freq Offset 0 Hz
6 7 8 9 10 11					
MSG		10	STATU	3	

#### Number of Hopping Frequencies 2(FH)

#### Hopping mode : Enable & π/4DQPSK



## **Dt&C**

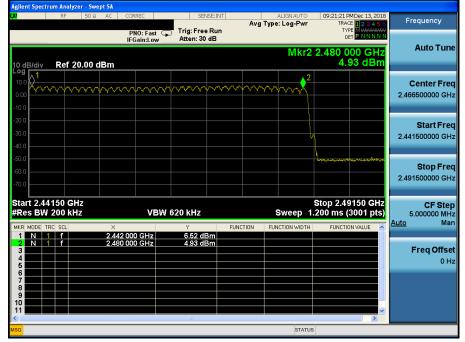
## Number of <u>Hopping Frequencies 1(FH)</u>

#### Hopping mode : Enable & 8DPSK

L <b>XI</b>		RF	50	Ω AC		REC			e Run		Avg		LIGNAUTO	TRA	PM Dec 13, 2018 ACE 123456 YPE M WAAAAAAA DET P N N N N	Frequency
10 dE	3/div	Ref	20.00	) dBn	IFO	NO: Fast Gain:Lov	<u> </u>	Atten: 3					Mkr2	2.441 (	000 GHz	Auto Tune
Log 10.0 0.00				¢1	$\sqrt{\sqrt{n}}$	~~~	~~~	~~~~~~	vvv	~~^	~~~	v~√~\	~~~~~	ᡝᠰᡗ᠋ᢆ᠆ᠬ	~~~~~	<b>Center Freq</b> 2.416500000 GHz
-20.0 -30.0 -40.0				N												<b>Start Freq</b> 2.391500000 GHz
-50.0 : -60.0 : -70.0 :	toor and the second		yran yr deferau yr def Yr deferau yr deferau y Yr deferau yr deferau y													<b>Stop Freq</b> 2.441500000 GHz
#Res	t 2.39 5 BW 2 10DE TR	200 k			× .402 00		SW 6	620 kHz		FUNC	TION		Sweep 1	.200 ms	4150 GHz (3001 pts)	CF Step 5.000000 MHz uto Man
2 3 4 5	N 1 N 1	f			441 00			5.31 c 6.40 c							====	<b>Freq Offset</b> 0 Hz
6 7 9 10 11																
< MSG								111					STATU	s		

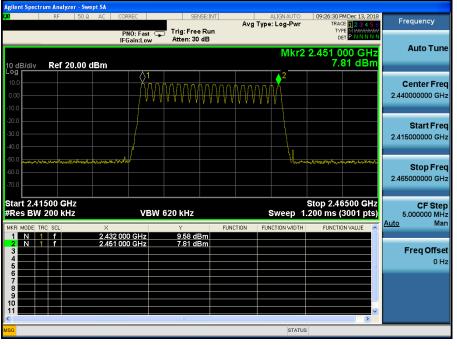
## Number of Hopping Frequencies 2(FH)

#### Hopping mode : Enable & 8DPSK



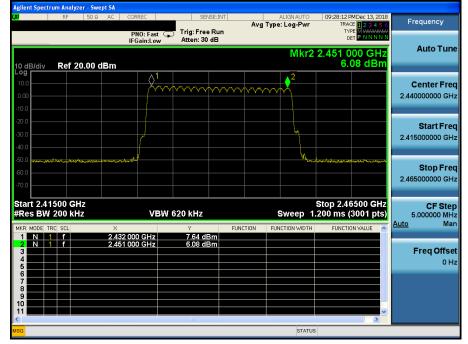
#### Number of Hopping Frequencies 1(AFH)





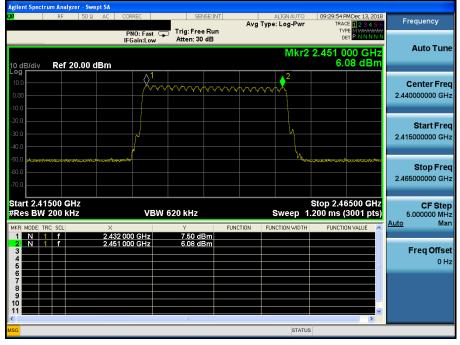
#### Number of Hopping Frequencies 1(AFH)





#### 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)

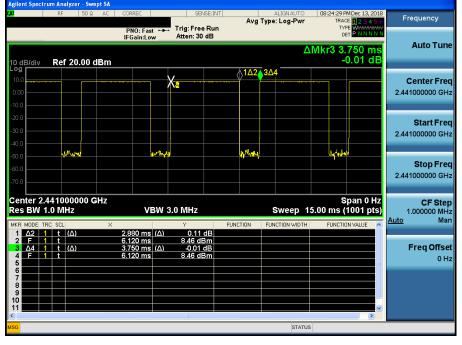
- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

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



#### <u>Hopping mode : Enable & DH5</u>

#### Time of Occupancy (FH)



## Time of Occupancy (FH)

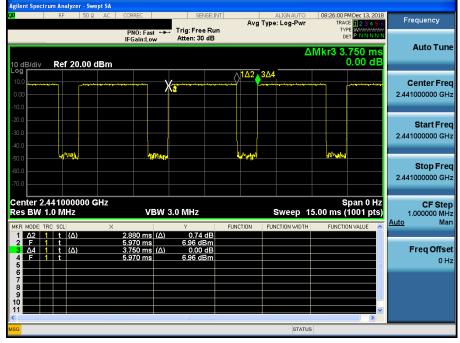
## Hopping mode : Enable & 2-DH5





#### Hopping mode : Enable & 3-DH5

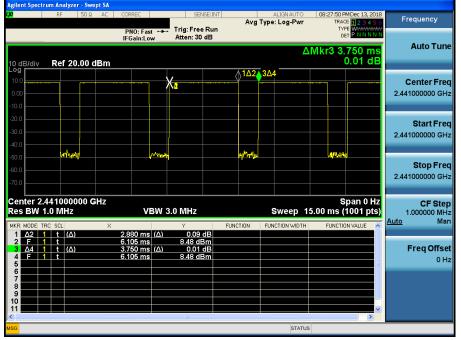
## Time of Occupancy (FH)





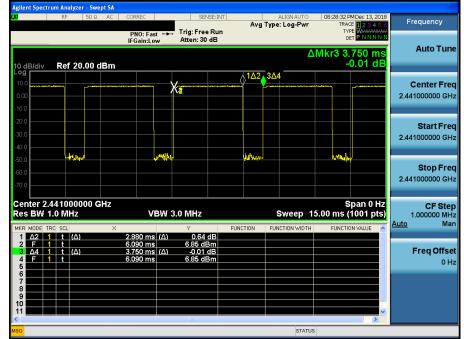
## Hopping mode : Enable & DH5

## Time of Occupancy (AFH)



#### Time of Occupancy (AFH)

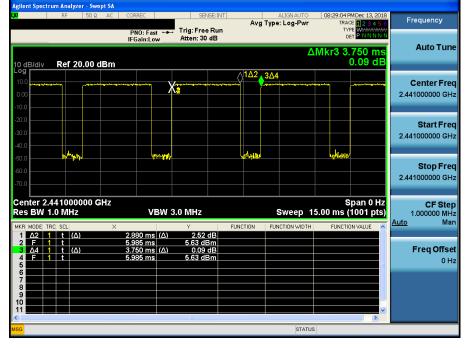
## Hopping mode : Enable & 2-DH5





## Time of Occupancy (AFH)

## Hopping mode : Enable & 3-DH5





# 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

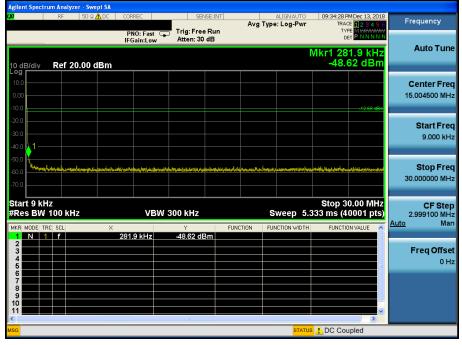
#### Low Band-edge

## Hopping mode & Modulation : GFSK





## Lowest Channel & Modulation : GFSK



Agilent Spectrum Analyzer - Swept S					
<b>Χ</b> RF 50Ω A	AC CORREC	SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	09:36:26 PM Dec 13, 2018 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast 🔾	Trig: Free Run Atten: 30 dB		TYPE MWAWAAAA DET P N N N N N	
	IFGain:Low	Atten: 30 dB			Auto Tune
10 dB/div Ref 20.00 dB			MIK	r3 5.566 09 GHz -38.93 dBm	
Log	<u></u> 1				
10.0	- <u>Ŷ</u>				Center Freq
0.00					5.015000000 GHz
-10.0				-12.68 dBm	
-20.0					Otart Fran
-30.0	<u>^2</u>				Start Freq
-40.0	<u> </u>			a de la companya de l	30.000000 MHz
-50.0					
-60.0					Stop Freq
					10.00000000 GHz
-70.0					
Start 30 MHz				Stop 10.000 GHz	CF Step
#Res BW 1.0 MHz	VBW	3.0 MHz	Sweep 1	3.67 ms (40001 pts)	997.000000 MHz
MKR MODE TRC SCL	x		UNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
1 N 1 f 2 N 1 f	2.402 11 GHz 3.155 10 GHz	7.47 dBm -38.68 dBm			
3 N 1 f	5.566 09 GHz	-38.93 dBm			Freq Offset
4					0 Hz
6					
8					
9					
11				~	
<		110			
MSG			STATL	IS	



#### Lowest Channel & Modulation : GFSK





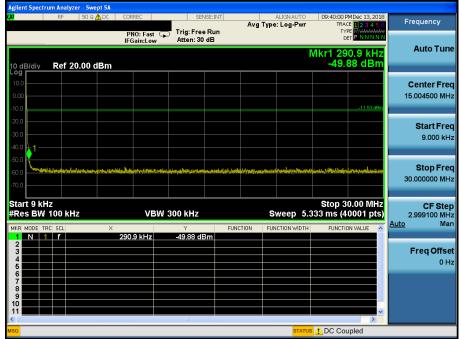
**Reference for limit** 

## Middle Channel & Modulation : GFSK



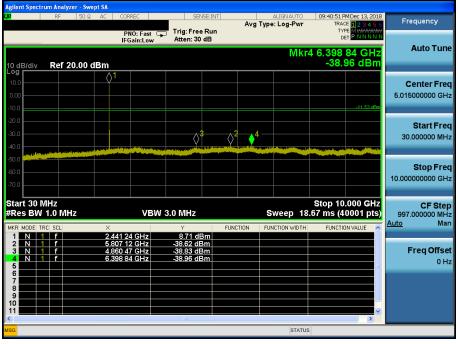
#### **Conducted Spurious Emissions**









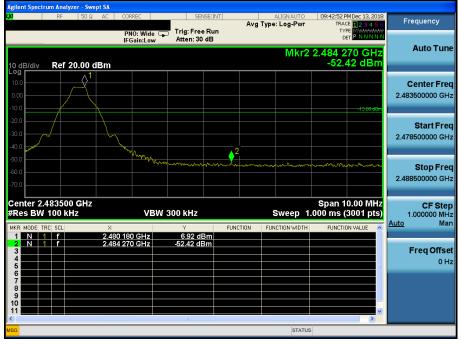






## High Band-edge

## Highest Channel & Modulation : GFSK



## High Band-edgeHopping mode & Modulation : GFSK

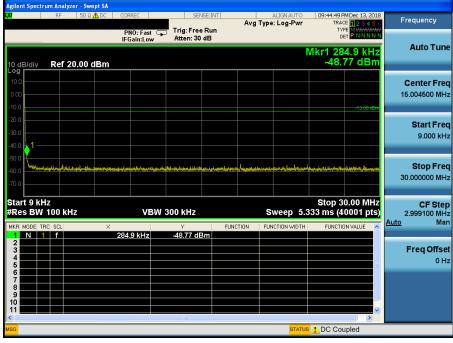






## Conducted Spurious Emissions <u>Highes</u>

## Highest Channel & Modulation : GFSK



Open Start	Agilent Spectr															
Pho: Fast Trig: Free Run Atter: 30 dB       Trig: Free Run Atter: 30 dB         Mkr4 4.110 97 GHz -40.57 dBm         Center Freq         100 dB/d/v       Ref 20.00 dBm       Center Freq         100 dB/d/v       Ref 20.00 dBm       Center Freq         100 dB/d/v       Center Freq         100 dB/d/v       Center Freq         Stop 10.000 GHz         Stop 10.000 GHz         Stop 10.000 GHz         Stop 10.000 GHz         Center Freq         Stop 10.000 GHz         Stop 10.000 GHz         Stop 10.000 GHz         Trig 6 dBm         A 1 f       2.1 dBm         A 1 f       Center Freq         Stop 10.000 GHz         Stop 10.000 GHz         A 1 f       Center Stop 10.000 GHz         A 1 f       Center Freq         Stop 10.000 GHz       Stop 10.000 GHz         A 1 f       Center Freq         Stop 10.000 GHz	LXI	RF	50 Ω	AC	CORREC		SE	INSE:IN	IT	Avg			TRA	ACE 1 2 3 4 5	6	Frequency
Mkr4 4.110 97 GHz -40.57 dBm         Auto Tune           0 dB/div         Ref 20.00 dBm         -40.57 dBm         Center Freq 5.01500000 GHz           0 00         -         -         -         -         -         -         -         5.01500000 GHz           0 00         -         -         -         -         -         -         -         5.01500000 GHz         -           0 00         -         -         -         -         -         -         -         -         -         -         5.015000000 GHz         - <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>n</td> <td>-</td> <td></td> <td>•</td> <td>T'</td> <td>YPE M WARNA</td> <td><del>144</del></td> <td></td>									n	-		•	T'	YPE M WARNA	<del>144</del>	
10       dB/div       Ref 20.00 dBm       -40.57 dBm         100       1					IFGair	1:L0W	Atten. 5					Miler	4 4 4 4 0			Auto Tune
100       1	10 dB/div	Ref 2	0.00 dE	3m												
000       1																Center Freg
Start 30 MHz         Start 5 req           Start 30 MHz         Start 5 req           Start 30 MHz         Start 5 req           MR MODE         TC 5cL         Y         Function         Function value         Start 5 req           1         1         f         6.09 Start 30 GHz         S39.26 dBm         Freq Offset         OHz           1         1         f         6.09 Start 30 GHz         S39.26 dBm         Freq Offset         OHz           1         1         f         6.09 Start 30 GHz         S39.26 dBm         Freq Offset         OHz           3         N         1         f         6.09 Start 30 GHz         S39.26 dBm         Freq Offset           3         N         1         f         6.00 Start 30 GHz         S39.26 dBm         Freq Offset           1         n         1         f         6.00 Start 30 GHz         S39.26 dBm         Freq Offset           1 <th1< th="">         1         1</th1<>	0.00															•
300       4       3       5       3	-10.0													-13.00 dB	Ŧ	
30.0       44       3       22       30.00000 MHz         40.0       50.0	-20.0															Otant Enga
40.0       50.0       10.00000000 GHz       10.00000000 GHz       50.0       50.0       50.0       50.0       99.7.000000 GHz       99.7.000000 GHz       99.7.000000 GHz       Auto       Man         1       N       1       f       2.490 13 GHz       7.16 dBm       2.99.21 dBm       2.99.21 dBm       2.99.21 dBm       2.99.21 dBm       4.10       Man         3       N       1       f       6.409.80 GHz       539.21 dBm       539.21 dBm       59.21 dBm       50.0       6.0	-30.0									<u> </u>					2	•
Stop Freq 10.00000000 GHz         Stop Freq 10.00000000 GHz           Start 30 MHz Res BW 1.0 MHz         VBW 3.0 MHz         Stop 10.000 GHz         Stop 10.000 GHz           1         39.21 GBm         1 </td <td>-40.0</td> <td></td> <td></td> <td></td> <td></td> <td>and the second states</td> <td></td> <td>al Baal</td> <td>علمي رو علا من</td> <td></td> <td>-</td> <td>States of the local division of the local di</td> <td></td> <td></td> <td></td> <td>30.000000 MH2</td>	-40.0					and the second states		al Baal	علمي رو علا من		-	States of the local division of the local di				30.000000 MH2
No.0         Stop 10.000 GHz         Stop 10.000 GHz           #Res BW 1.0 MHz         VBW 3.0 MHz         Sweep 18.67 ms (40001 pts)         97.00000 GHz           #Res BW 1.0 MHz         Y BW 3.0 MHz         Sweep 18.67 ms (40001 pts)         97.00000 MHz           1         1         f         2.4013 GHz         7.16 dBm         97.00000 Hz           1         1         f         2.4013 GHz         -39.21 dBm         6         6           3         N         1         f         6.409 80 GHz         -39.26 dBm         6         6           6         6         4.110 97 GHz         40.57 dBm         6         6         6           7         7         7         7         7         7         6         7           8         9         9         9         9         9         9         9           10         1         1         1         1         1         1         1	-50.0					Han . Mar.										
YOO         Stop 10.000 GHz         CF Step           Start 30 MHz         VBW 3.0 MHz         Stop 10.000 GHz         Grad Start 30 MHz           #Res BW 1.0 MHz         VBW 3.0 MHz         Stop 10.000 GHz         Grad Start 30 MHz         Stop 10.000 GHz         Grad Start 30 MHz         CF Step         997.000000 MHz           MKR MODE         Tric dBm         Function value         Function value         Auto         Man           1         N         1         f         6.409 80 GHz         539.21 dBm         Freq Offset         O Hz           3         N         1         f         6.409 80 GHz         539.21 dBm         Freq Offset         O Hz           5         F         4.110 97 GHz         40.57 dBm         Freq Offset         O Hz           9         9         9         F         F         F         F	-60.0															
#Res BW 1.0 MHz         VBW 3.0 MHz         Sweep 18.67 ms (40001 pts)         997.000000 MHz           MKR MODE TRC SCL         X         Y         FUNCTION FUNCTION WIDTH         FUNCTION VALUE         Auto         Man           1         N         1         f         2.480 13 GHz         7.16 dBm         FUNCTION WIDTH         FUNCTION VALUE         Auto         Man           1         N         1         f         6.409 80 GHz         539.21 dBm         For the state of th	-70.0															10.000000000 GHz
#Res BW 1.0 MHz         VBW 3.0 MHz         Sweep 18.67 ms (40001 pts)         997.000000 MHz           MKR MODE TRC SCL         X         Y         FUNCTION FUNCTION WIDTH         FUNCTION VALUE         Auto         Man           1         N         1         f         2.480 13 GHz         7.16 dBm         FUNCTION WIDTH         FUNCTION VALUE         Auto         Man           1         N         1         f         6.409 80 GHz         539.21 dBm         For the state of th	Otort 20 h	411-											Oton di	000 04		
MRR MODE         Inc study         Y         FUNCTION         FUNCTION VALUE         F           1			z			VBW	3.0 MHz				S	weep 18	5.0p 10 .67 ms (4	1000 GH	2 5)	
2       N       1       f       9.704 39 GHz       -39.21 dBm	MKR MODE TR	RC SCL		X			Y		FUNC	TION	FUN	CTION WIDTH	FUNCT	ION VALUE	~	<u>Auto</u> Man
3       N       1       f       6.409.80 GHz       -39.25 dBm       Freq Offset         4       N       1       f       4.110 97 GHz       -40.57 dBm       -         6       -       -       -       -       -       0 Hz         7       -       -       -       -       -       0 Hz         9       -       -       -       -       -       -       0 Hz         10       -	1 N 1	f														
6		f		6.40	9 80 G	Hz	-39.25 d	Bm								Freq Offset
				4.11	097G	HZ	-40.57 d	Bm							Ξ	0 Hz
	6															
	10															
MSG STATUS	11 <u> </u>						111								~	
	MSG				_	_		_	_		_	STATUS				







#### Low Band-edge

## Lowest Channel & Modulation : π/4DQPSK



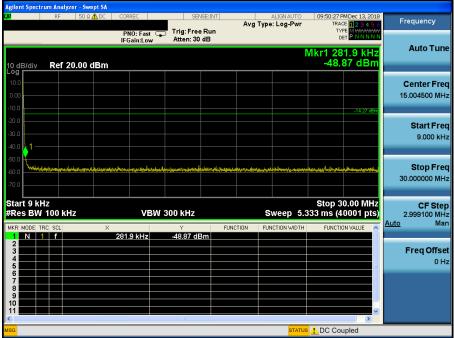
#### Low Band-edge

## Hopping mode & Modulation : π/4DQPSK





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



	RF	P	RREC	SENSE: Trig: Free Ru Atten: 30 dB	ın	Avg Ty	ALIGNAUTO pe: Log-Pwr	TRAC	MDec 13, 2018 E 1 2 3 4 5 6 E MAAAAAAA T P N N N N N	Frequency
0 dB/div	Ref 20.	00 dBm	Gain:Low	Atten: 30 dE			Mkr4		45 GHz 00 dBm	Auto Tur
0.00		1							-14.27 dBm	Center Fre 5.015000000 GH
20.0	In fac. III. security with					¢ <sup>2</sup>	43			<b>Start Fr</b> 30.000000 M
50.0 50.0 70.0										<b>Stop Fr</b> 10.000000000 G
itart 30 N Res BW			VBW	3.0 MHz			Sweep 18.	Stop 10. 67 ms (4	.000 GHz 0001 pts)	CF St 997.000000 M
MKR         MODE         TF           1         N         1           2         N         1           3         N         1           3         N         1           5         -         6           6         -         -           7         -         -           8         -         -           9         -         -           10         -         -	AC SCL f f f f 	7.586 2	86 GHz 22 GHz 26 GHz 15 GHz	7.00 dBm -38.87 dBm -38.97 dBm -39.00 dBm	FUNCTI	ON I	FUNCTION WIDTH	FUNCTIO	N VALUE	Auto M Freq Offs 0
Ţ				111					>	

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



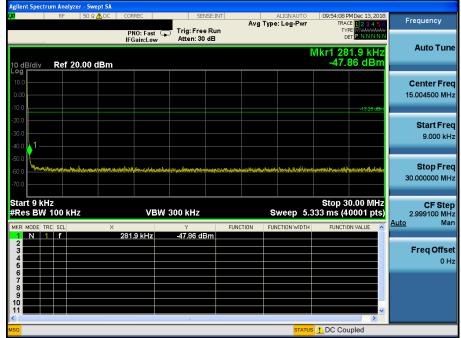


## Reference for limit

## Middle Channel & Modulation : π/4DQPSK



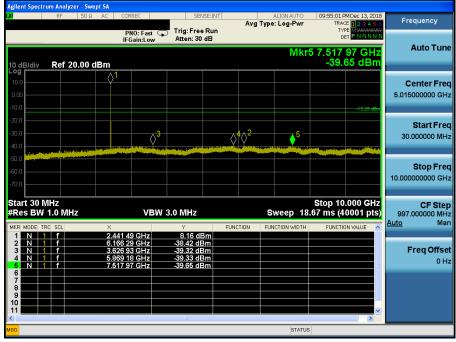
### Conducted Spurious Emissions <u>Middle Channel & Modulation : π/4DQPSK</u>







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

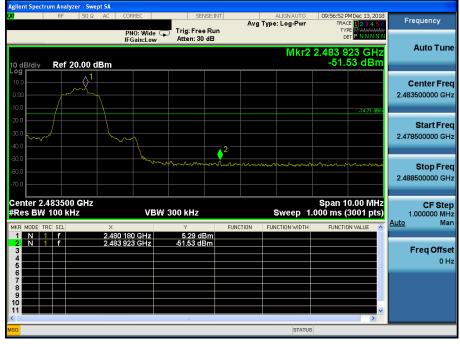


Agilent Spectr									
LXI	RF	50 Ω AC CC	DRREC	SENSE		ALIGNAUTO	TRAC	MDec 13, 2018	Frequency
			PNO:Fast ⊂ FGain:Low	Trig: Free R Atten: 30 dE			TYI	PE MWAAAAAA ET P N N N N N	
			-Gain:Low	Atten: 30 de		Milant			Auto Tune
10 dB/div	D .6 20	00 dBm				IVIKIƏ	6.854 6	25 GHZ 42 dBm	
Log	Rel 20.	νναδιτί							
10.0									Center Freq
0.00									17.50000000 GHz
-10.0								-13.25 dBm	
-20.0							.2.4 .	2 1	Otort Eror
-30.0				<mark>6</mark> 5			$\left  \begin{array}{c} 0 \\ 0 \end{array} \right  \right\rangle$	$\Diamond$	Start Freq 10.00000000 GHz
-40.0		and the second second second			All succession of the second s	and the state of the second			10.00000000 GH2
-50.0									
-60.0									Stop Freq
-70.0									25.00000000 GHz
-70.0									
Start 10.0							Stop 25	.000 GHz	CF Step
#Res BW	1.0 MHz		VBW	3.0 MHz		Sweep 40	.00 ms (4	0001 pts)	1.50000000 GHz
MKR MODE TR	RC SCL	Х		Y	FUNCTION	FUNCTION WIDTH	FUNCTIO	IN VALUE	<u>Auto</u> Man
1 N 1 2 N 1	f	23.800 3 22.298 1		-29.88 dBm -31.15 dBm					
3 N 1	f	23.270 8	75 GHz	-31.36 dBm					Freq Offset
4 N 1 5 N 1	f	<u>22.741 7</u> 16.854 6		-31.41 dBm -34.42 dBm				=	0 Hz
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#### High Band-edge

## Highest Channel & Modulation : π/4DQPSK

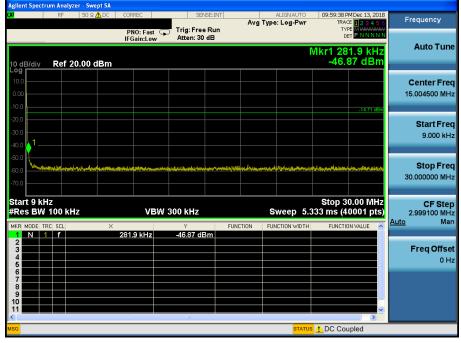


## High Band-edge <u>Hopping mode & Modulation : π/4DQPSK</u>





## Highest Channel & Modulation : π/4DQPSK



Agilent Spectrum And									
<b>LXI</b> RF	50 Ω AC	CORREC	SEN	ISE:INT	Ava Ti	ALIGNAUTO		PM Dec 13, 2018 CE 1 2 3 4 5 6	Frequency
		PNO: Fast	G Trig: Free			ype. Log i Mi	TY	PE MUMANANA ET PNNNNN	
		IFGain:Low	Atten: 30	dB					Auto Tune
						Mkr		24 GHz	Auto Func
10 dB/div Re	20.00 dBm						-39.	66 dBm	
10.0		<u>}</u> ¹							Center Freq
0.00									5.015000000 GHz
-10.0									
-20.0								-14.71 dBm	
-30.0					_		_		Start Freq
				$\diamond^2$	$\bigcirc$	$\wedge$	5		30.000000 MHz
-40.0	and the second se								
-50.0									Stop Freq
-60.0									10.000000000 GHz
-70.0									
Start 30 MHz							Ston 10	.000 GHz	CF Step
#Res BW 1.0 P	/Hz	VB	W 3.0 MHz			Sweep 18	.67 ms (4	0001 pts)	997.000000 MHz
MKR MODE TRC SCL	×		Y	FL	JNCTION	FUNCTION WIDTH	FUNCTI	ON VALUE	<u>Auto</u> Man
1 N 1 f		.480 13 GHz	6.60 dE						
2 N 1 f 3 N 1 f		.289 42 GHz .276 21 GHz	-38.30 dE -39.14 dE	3m					Freq Offset
4 N 1 f	7	.561 34 GHz .010 24 GHz	-39.59 dE -39.66 dE	3m					0 Hz
6	•	.010 24 GHZ	-59.66 GE	SIII					
7									
9									
10								~	
<			III					>	
MSG						STATUS			

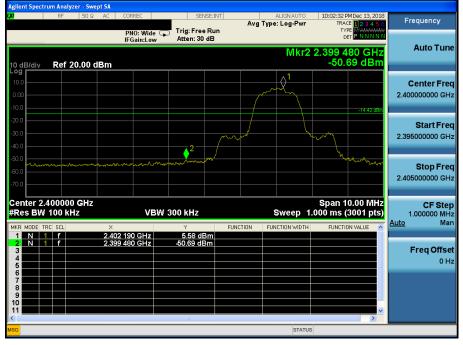
#### Highest Channel & Modulation : π/4DQPSK





#### Low Band-edge

## Lowest Channel & Modulation : 8DPSK

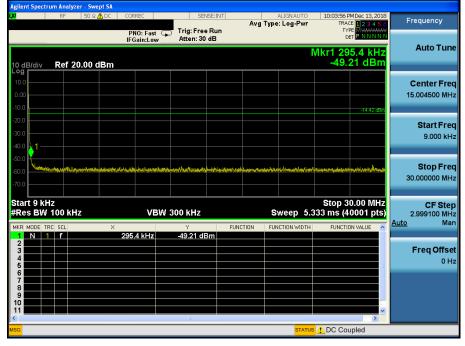


## Low Band-edge <u>Hopping mode & Modulation : 8DPSK</u>

#### Frequency Avg Type: Log-Pwr PNO: Wide Trig: Free Run IFGain:Low Atten: 30 dB TYPI DE Auto Tune Mkr1 2.399 687 GHz -51.55 dBm Ref 20.00 dBm **Center Freq** 2.40000000 GHz Start Freq 2.395000000 GHz **♦**<sup>1</sup> Stop Freq 2.405000000 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



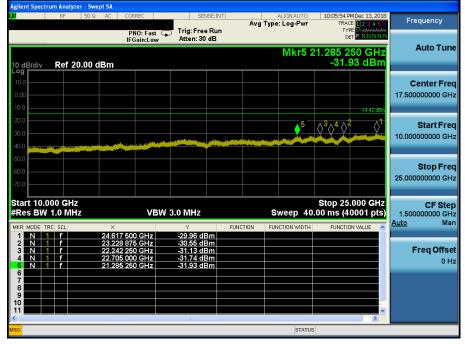
## Lowest Channel & Modulation : 8DPSK



RF	50 Ω AC CORREC	SENSE:IN	T	ALIGNAUTO	10:04:57 PMDec 13.	2018	
14	PNO: Fast	Trig: Free Run	Avg Typ	e: Log-Pwr	TRACE 123 TYPE MWAA DET P N N	456 Frequ	ency
	IFGain:Low	Atten: 30 dB		Mkr	3 2.764 02 G		ito Tun
dB/div Ref 2	20.00 dBm				-39.39 dE	3m	
0.0						Cen	ter Fr
						5.01500	
0.0					-14.42	2.65m	
0.0							and East
0.0	<b>3</b>			×2			art Fr 2000 м
0.0			and the second	9		30.000	
0.0							
0.0							op Fr
ro.o						10.00000	0000 G
tart 30 MHz Res BW 1.0 MH	lz VB	W 3.0 MHz	9	Sweep 18	Stop 10.000 G 67 ms (40001 p	ots) 997.00	
KR MODE TRC SCL	×	Y	FUNCTION FL	INCTION WIDTH	FUNCTION VALUE	Auto	N
1 N 1 f 2 N 1 f	2.402 11 GHz 6.953 92 GHz	7.14 dBm -39.23 dBm					
3 N 1 f	2.764 02 GHz	-39.39 dBm				Fre	q Offs
						=	0
4							
4							
4 5 6 6 7 7 6 7 7 6 7 7 6 7 7 7 7 7 7 7 7							
4 5 6 7 8 9 9 0							
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## Lowest Channel & Modulation : 8DPSK



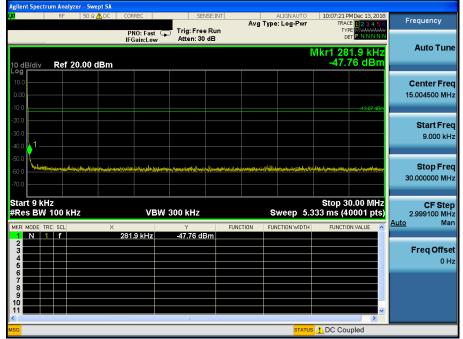


#### Reference for limit

#### Middle Channel & Modulation : 8DPSK

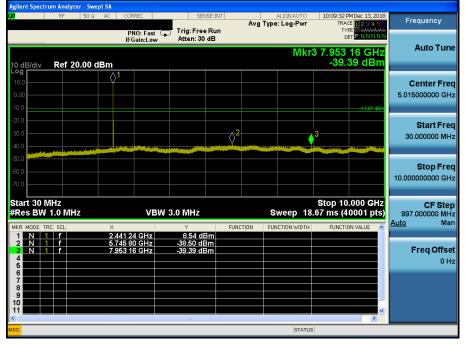


## Conducted Spurious Emissions <u>Middle Channel & Modulation : 8DPSK</u>





## Middle Channel & Modulation : 8DPSK







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

## Highest Channel & Modulation : 8DPSK

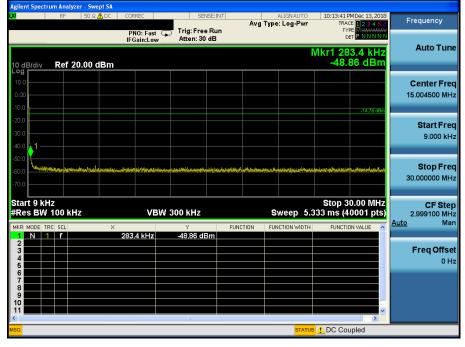


## High Band-edge <u>Hopping mode & Modulation : 8DPSK</u>



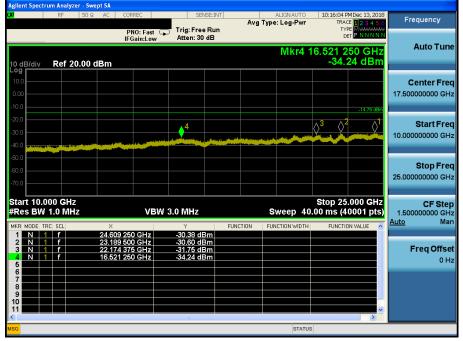


## Highest Channel & Modulation : 8DPSK



Agilent Spe		nalyzer - Sw								
L <mark>XI</mark>	F	F 50 Ω	2 AC COF	REC	SENSE	Avg	ALIGN AUTO	TRAC	MDec 13, 2018 E <b>1 2 3 4 5 6</b>	Frequency
			PI IF(	NO: Fast Gain:Low	Trig: Free F Atten: 30 d			TYF	E M <del>WAAAWAA</del> T P N N N N N	
							Mki	4 9.603		Auto Tune
10 dB/div Log r	R	ef 20.00	dBm					-39.2	24 dBm	
10.0										Center Fred
0.00										5.015000000 GHz
-10.0									-14.76 dBm	
-20.0										Start Fred
-30.0				_ <mark></mark> 3		^2			4-	30.000000 MHz
-40.0		المرودا والمراجع		X			The second s			
-50.0			التكالي المتعادي الم							Oton From
-60.0										Stop Fred 10.000000000 GHz
-70.0										
Start 30	) MHz							Stop 10	.000 GHz	CF Step
#Res B	W 1.0	MHz		VB	W 3.0 MHz		Sweep 18	3.67 ms (4	0001 pts)	997.000000 MHz
MKR MODE	TRC SO	CL	×		Y	FUNCTION	FUNCTION WIDTH	FUNCTIO	IN VALUE	Auto Mar
1 N 2 N	1 f		2.480 1 6.313 8	4 GHz	7.08 dBn -38.53 dBn	1				
3 N 4 N	1 f 1 f		3.149 6 9.603 9	1 GHz 4 GHz	-38.59 dBn -39.24 dBn	1				Freq Offset
5									=	
7										
9										
10 11									~	
< MSG	_				Ш		STATU	e .	>	
bon							STATU	3		

## 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 (WI12)	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

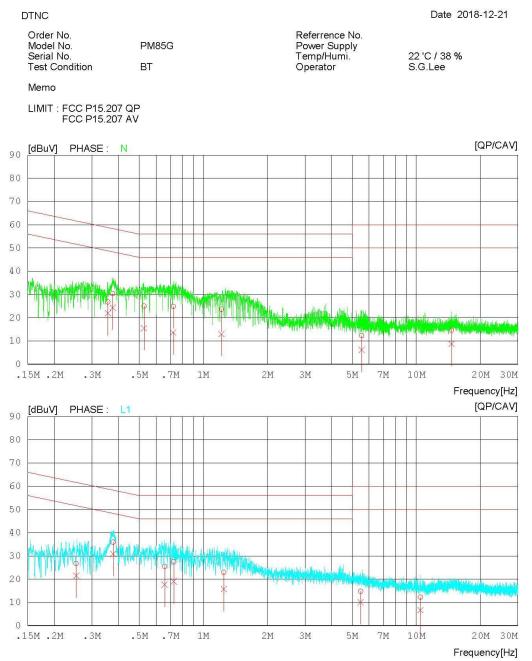
Conducted emissions from the EUT were measured according to the ANSI C63.10.

- 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>

PM85G

## Results of Conducted Emission

Referrence No. Power Supply Temp/Humi.

Operator

Date	2018-12-21

22 'C / 38 % S.G.Lee

PM
BT

LIMIT : FCC P15.207 QP FCC P15.207 AV

NC	) FREQ	READING QP CAV [dBuV][dBuV]	C.FACTOR	RESULT QP CAV [dBuV][dBuV]	LIM: QP [dBuV]	CAV	MARGIN QP CAV [dBuV][dBuV]	PHASE
	[1112]	[abai][abai]	[ [GD]	[abav][abav	] [abai]	[abav]		65
1	0.35680	16.7811.84	10.03	26.8121.87	58.80 4	8.80 31	1.9926.93	Ν
2	0.37550	20.3814.40	10.02	30.4024.42	58.38 4	8.38 27	7.9823.96	N
3	0.52686	14.98 5.51	10.03	25.0115.54	56.00 4	6.00 30	).9930.46	N
4	0.72330	14.84 3.67	10.05	24.8913.72	56.00 4	6.00 31	1.11 32.28	N
5	1.21640	13.52 2.98	10.06	23.5813.04	56.00 4	6.00 32	2.4232.96	N
6	5.53840	2.01-4.07	10.25	12.26 6.18	60.00 5	0.00 47	7.74 43.82	N
7	14.64500	4.11-1.79	10.52	14.63 8.73	60.00 5	0.00 45	5.37 41.27	N
8	0.25326	16.74 11.52	9.98	26.7221.50	61.65 5	1.65 34	1.93 30.15	L1
9	0.37770	25.92 20.78	9.99	35.9130.77	58.33 4	8.33 22	2.4217.56	L1
10	0.65816	15.38 7.58	10.01	25.3917.59	56.00 4	6.00 30	0.6128.41	L1
11	0.72712	17.43 8.95	10.01	27.44 18.96	56.00 4	6.00 28	3.5627.04	L1
12	1.25000	12.88 5.65	10.04	22.9215.69	56.00 4	6.00 33	3.0830.31	L1
13	5.47820	4.55-0.17	10.21	14.7610.04	60.00 5	0.00 45	5.2439.96	L1
14	10.45960	1.94 -3.69	10.33	12.27 6.64	60.00 5	0.00 47	7.7343.36	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 :

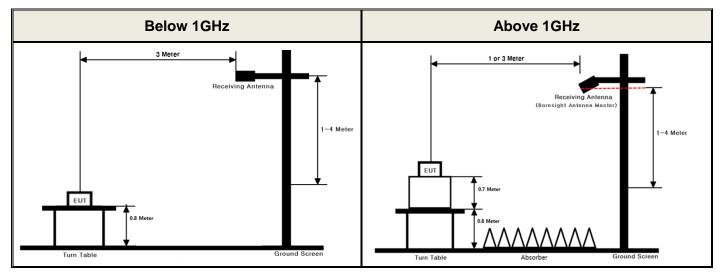
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply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



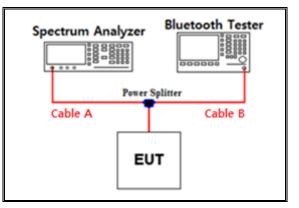
## **APPENDIX I**

#### 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.

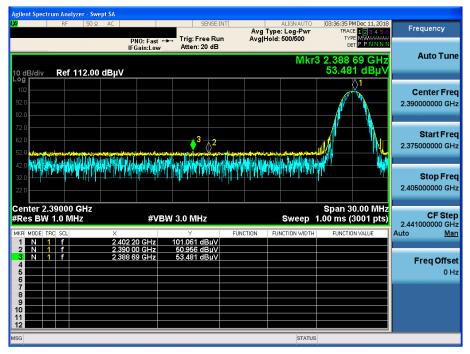
Path loss (S/A's Correction factor) = Cable A+ Power splitter



## **APPENDIX II**

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

#### GFSK & Lowest & Z & Hor



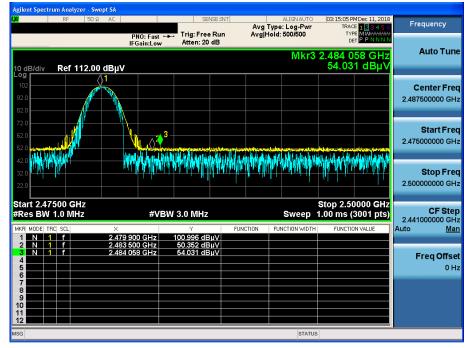
#### GFSK & Lowest & Z & Hor



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



#### GFSK & Highest & Z & Hor



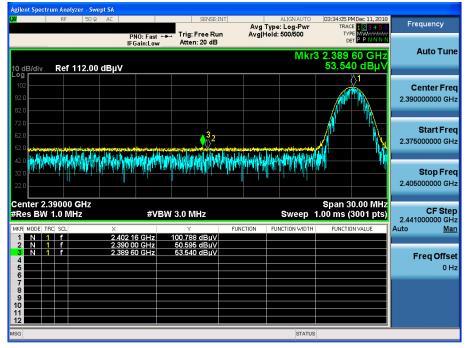
#### **Detector Mode : AV**

#### GFSK & Highest & Z & Hor

	RF	50 Ω	AC			SENSE:INT		ALIGN AUTO		MDec 11, 2018	-
				PNO: Fast	Trig: Fr Atten:			Fype: Voltage old: 200/200	TRAC TYP	E 123456 E MW <del>MMMM</del> T P P N N N N	Frequency
) dB/div	Ref 11	2.00		FGain:Low	Atten:	20 88		Mkr3	2.483 5	33 GHz 0 dBµV	Auto Ti
og 102 12.0 12.0		Â	1								Center F 2.487500000
2.0 ;2.0 ;2.0		_\		<b>3</b>							Start F 2.475000000
12.0											<b>Stop F</b> 2.500000000
tart 2.47 Res BW				#VI	3W 390 Hz			Sweep :	Stop 2.50 50.0 ms (	0000 GHz 3001 pts)	CF S 2.441000000
KR MODE TF	C SCL			42 GHz	Y 100.895 (	lBµV	UNCTION	FUNCTION WIDTH	FUNCTIO	IN VALUE	Auto <u>I</u>
2 N 1 3 N 1 4 5 6 1	f			00 GHz 33 GHz	42.456 42.570						Freq Off
7 8 9 0 1 2											
G								STATUS			

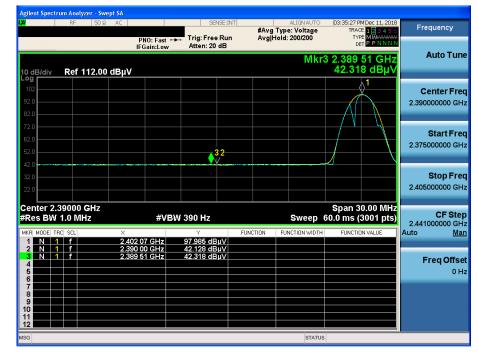


#### $\pi/4DQPSK$ & Lowest & Z & Hor



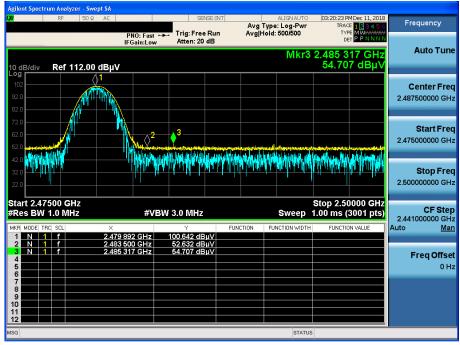
#### $\pi$ /4DQPSK & Lowest & Z & Hor

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



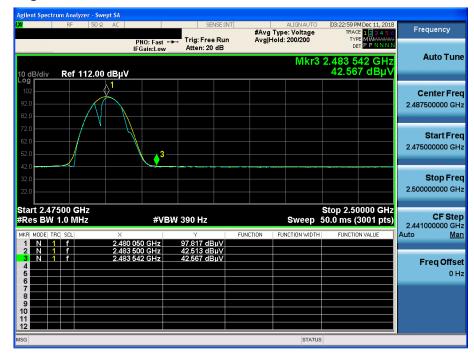


#### $\pi/4DQPSK$ & Highest & Z & Hor



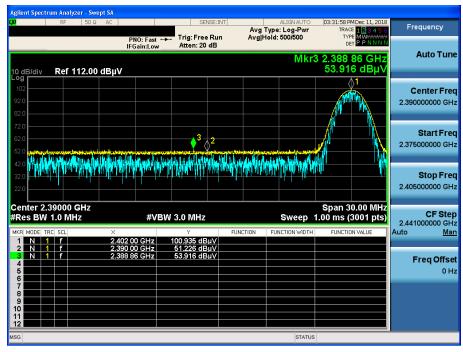
#### Detector Mode : AV

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



## 8DPSK & Lowest & Z & Hor

### **Detector Mode : PK**



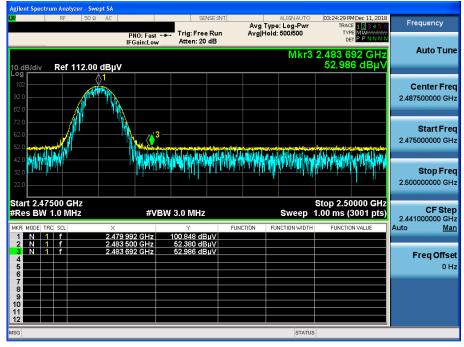
#### **Detector Mode : AV**

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



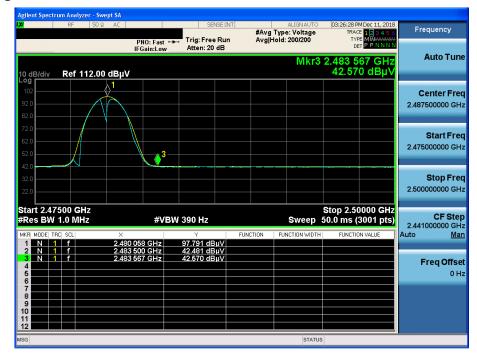


#### 8DPSK & Highest & Z & Hor



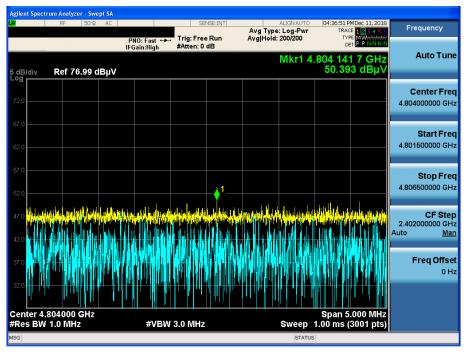
#### **Detector Mode : AV**

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



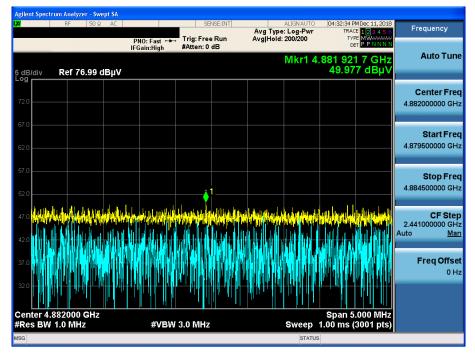


#### GFSK & Lowest & Z & Hor



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

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





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

