# **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 :	DRTFCC1909-0261
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**D**Dt&C

- 2. Customer
- Name (FCC) : SENA TECHNOLOGIES, Inc. / Name (IC) : Sena Technologies, Inc.
- Address (FCC) : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea Address (IC) : 210 Yangjae-dong, Seocho-gu Seoul 137-130 Korea (Republic Of)
- 3. Use of Report : FCC & IC Original Grant
- 4. Product Name / Model Name : SMART HJC 10B / SP70 FCC ID : S7A-SP70 / IC : 8154A-SP70
- 5. Test Method Used : ANSI C63.10-2013, KDB 558074D01v05r02
  - Test Specification : FCC Part 15 Subpart C.247

RSS-247 Issue 2, RSS-GEN Issue 5

- 6. Date of Test : 2019.09.09 ~ 2019.09.20
- 7. Testing Environment : See appended test report.
- 8. Test Result : Refer to the attached test result.

Affine ation	Tested by	Ale	Reviewed by	(Ao
Affirmation	Name : JaeJin Lee	MAS	nature) Name : GeunKi Son	(Signature)

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

2019.09.30.

### 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
DRTFCC1909-0261	Sep. 30, 2019	Initial issue



## **Table of Contents**

1. General Information	
1.1 Testing Laboratory	
1.2 Testing Environment	4
1.3 Measurement Uncertainty	4
1.4 Details of Applicant	5
1.5 Description of EUT	5
1.6 Information about the FHSS characteristics	
1.7 Test Equipment List	7
1.8 Summary of Test Results	8
1.9 Conclusion of worst-case and operation mode	9
2. Maximum Peak Output Power Measurement	10
2.1 Test Setup	10
2.2 Limit	
2.3 Test Procedure	
2.4 Test Results	
3. 20 dB BW & Occupied BW	
3.1 Test Setup	
3.2 Limit	
3.3 Test Procedure	
3.4 Test Results	
4. Carrier Frequency Separation	
4.1 Test Setup	
4.2 Limit	
4.3 Procedure	
4.5 Frocedure	
5. Number of Hopping Frequencies	
5.1 Test Setup	
5.1 Test Setup 5.2 Limit	
5.3 Procedure	
5.4 Test Results 6. Time of Occupancy (Dwell Time)	28
6.1 Test Setup	
6.2 Limit	
6.3 Test Procedure	
6.4 Test Results	
7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	
7.1 Test Setup	
7.2 Limit	
7.3. Test Procedures	
7.3.1. Test Procedures for Radiated Spurious Emissions	
7.3.2. Test Procedures for Conducted Spurious Emissions	
7.4. Test Results	
7.4.1. Radiated Emissions	
7.4.2. Conducted Spurious Emissions	
8. Transmitter AC Power Line Conducted Emission	
8.1 Test Setup	
8.2 Limit	-
8.3 Test Procedures	
8.4 Test Results	
9. Antenna Requirement	
APPENDIX I	
APPENDIX II	75

### **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	+20 °C ~ +25 °C
<ul> <li>Relative Humidity</li> </ul>	35 % ~ 45 %

#### **1.3 Measurement Uncertainty**

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

Test items	Measurement uncertainty
Transmitter Output Power	0.7 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)	:	SENA TECHNOLOGIES.Inc
Applicant (IC)	:	Sena Technologies, Inc.
Address (FCC)	:	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
Address (IC)	:	210 Yangjae-dong, Seocho-gu Seoul 137-130 Korea (Republic Of)
Contact person	:	Seunghyun Kim

### 1.5 Description of EUT

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EUT	SMART HJC 10B
Model Name	SP70
Add Model Name	NA
Hardware Version	1.0
Software Version	1.0
Serial Number	Identical prototype
Power Supply	DC 3.7 V
Frequency Range	2402 MHz ~ 2480 MHz
Modulation Technique (bit rate)	GFSK (1 Mbit/s) π/4DQPSK (2 Mbit/s) 8DPSK (3 Mbit/s)
Number of Channels	79
Antenna Type	PCB Pattern Antenna
Antenna Gain	PK : -0.21 dBi

### **1.6 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.

### **1.7 Test Equipment List**

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY48010133
Spectrum Analyzer	Agilent Technologies	N9020A	19/06/26	20/06/26	MY48011700
DC Power Supply	Agilent Technologies	66332A	18/12/19	19/12/19	US37476998
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
Signal Generator	ANRITSU	MG3695C	18/12/10	19/12/10	173501
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-2
Thermohygrometer	BODYCOM	BJ5478	19/07/03	20/07/03	N/A
HYGROMETER	TESTO	608-H1	19/01/31	20/01/31	34862883
Loop Antenna	ETS	6502	19/03/21	21/03/21	3471
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3115	18/01/30	20/01/30	6419
Horn Antenna	A.H.Systems Inc.	SAS-574	19/07/03	21/07/03	155
PreAmplifier	tsj	8447D	18/12/18	19/12/18	2944A07774
PreAmplifier	tsj	MLA-0118-J01-45	18/12/19	19/12/19	17138
PreAmplifier	tsj	MLA-1840-J02-45	19/06/27	20/06/27	16966-10728
Attenuator	SMAJK	SMAJK-2-3	19/06/25	20/06/25	4
Attenuator	SMAJK	SMAJK-2-3	19/0627	20/06/27	3
Attenuator	SRTechnology	F01-B0606-01	19/06/27	20/06/27	13092403
Attenuator	Hefei Shunze	SS5T2.92-10-40	19/06/27	20/06/27	16012202
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	19/06/27	20/06/27	3
High Pass Filter	Wainwright Instruments	WHKX12-935-1000- 15000-40SS	19/06/26	20/06/26	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300- 18000-60SS	19/06/26	20/06/26	1
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A ML2495A	18/12/20	19/12/20	1338004 1306007
EMI Test Receiver	Rohde Schwarz	ESCI7	19/01/30	20/01/30	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	18/09/27	19/09/27	101333
LISN	SCHWARZBECK	NNLK 8121	19/03/19	20/03/19	06183
Cable	DTNC	Cable	19/01/14	20/01/14	M-01
Cable	Junkosha	MWX315	19/01/14	20/01/14	M-05
Cable	Junkosha	MWX221	19/01/14	20/01/14	M-06
Cable	Junkosha	MWX241	19/01/14	20/01/14	G-04
Cable	Junkosha	MWX241	19/01/14	20/01/14	G-07
Cable	DT&C	Cable	19/01/14	20/01/14	G-13
Cable	DT&C	Cable	19/01/14	20/01/14	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	19/01/14	20/01/14	G-15
Cable	DT&C	Cable	19/01/16	20/01/16	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.



### **1.8 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)	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 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.

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### 1.9 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

#### Operation test setup for EUT

- Software: Bluetest 3
- Power setting: 12



### 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 ≥ 20 dB BW
  VBW ≥ RBW
  Sweep = auto
  Detector function = peak
  Trace = max hold

### 2.4 Test Results

Modulation	Tested Channel		Average t Power	Peak Output Power	
		dBm	mW	dBm	mW
	Lowest	15.43	34.91	16.74	47.21
<u>GFSK</u>	Middle	15.65	36.73	17.41	55.08
	Highest	15.61	36.39	17.17	52.12
	Lowest	4.50	2.82	8.03	6.35
<u>π/4DQPSK</u>	Middle	4.65	2.92	8.79	7.57
	Highest	4.58	2.87	8.69	7.40
<u>8DPSK</u>	Lowest	4.51	2.82	8.24	6.67
	Middle	4.63	2.90	8.94	7.83
	Highest	4.57	2.86	8.80	7.59

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.







#### **Peak Output Power**











#### **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

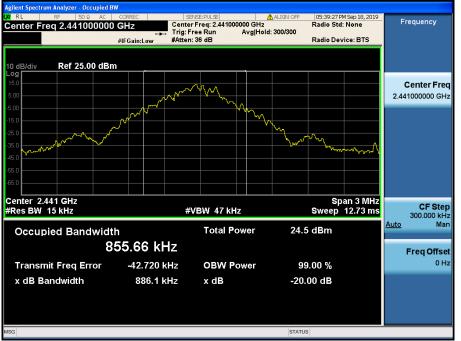
Modulation	Tested Channel	20 dB BW (MHz)	Occupied BW (MHz)	
	Lowest	0.886	0.862	
<u>GFSK</u>	Middle	0.886	0.856	
	Highest	0.926	0.857	
	Lowest	1.319	1.285	
<u>π/4DQPSK</u>	Middle	1.320	1.290	
	Highest	1.319	1.289	
	Lowest	1.323	1.271	
<u>8DPSK</u>	Middle	1.305	1.276	
	Highest	1.324	1.276	





### 20 dB BW & Occupied BW



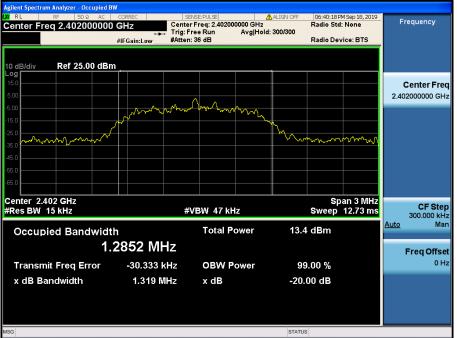




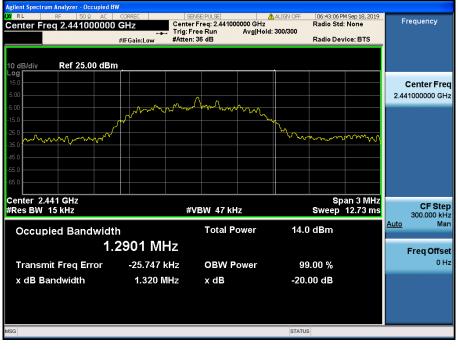


### 20 dB BW & Occupied BW

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



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

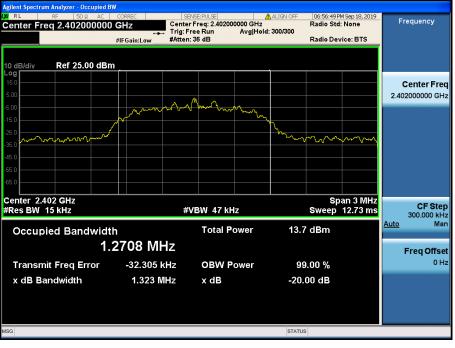


### 20 dB BW & Occupied BW

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

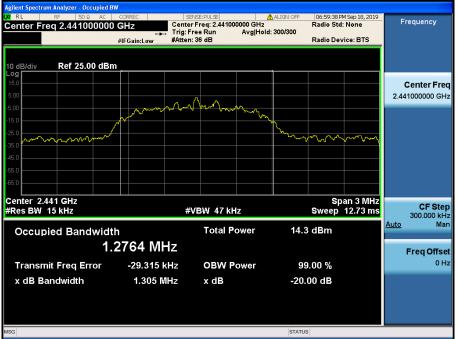






### 20 dB BW & Occupied BW











### 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

### 4.4 Test Results

#### FH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2440.964	2441.963	0.999
Enable	π/4DQPSK	2440.968	2441.968	1.000
	8DPSK	2440.968	2441.968	1.000

#### AFH mode

Hopping Mode	Modulation	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
	GFSK	2440.967	2441.967	1.000
Enable	π/4DQPSK	2440.968	2441.969	1.001
	8DPSK	2440.971	2441.970	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)



Agilent Spectrum Analyzer - Swept SA				
LXVI T RF 50Ω AC	CORREC SENSE:PU	Avg Type: Log-Pwr	08:21:37 PM Sep 18, 2019 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Frequency
10 dB/div Ref 20.00 dBm	PNO: Wide 🖵 Trig: Free R IFGain:Low Atten: 30 dB		DET PINNNNN Mkr1 1.000 MHz 0.05 dB	Auto Tune
10.0 0.00 -10.0	X2	^		Center Freq 2.441000000 GHz
-20.0				<b>Start Freq</b> 2.439500000 GHz
-50.0 -60.0 -70.0				<b>Stop Freq</b> 2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz	#VBW 150 kHz	Sweep	Span 3.000 MHz 1.200 ms (3001 pts)	CF Step 300.000 kHz <u>Auto</u> Man
1 Δ2 1 f (Δ)	1.000 MHz (Δ) 0.05 dB 10 968 GHz 7.04 dBm			<b>Freq Offset</b> 0 Hz
8 9 10 11			~	
MSG		STATU	JS	



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



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



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



### 5. Number of Hopping Frequencies

### 5.1 Test Setup

Refer to the APPENDIX I.

### 5.2 Limit

Limit : >= 15 hops

### 5.3 Procedure

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

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

The spectrum analyzer is set to :

Span for FH mode = 50 MHz	Start Frequency = 2391.5 MHz,	Stop Frequency = 2441.5 MHz			
	Start Frequency = 2441.5 MHz,	Stop Frequency = 2491.5 MHz			
Span for AFH mode = 30 MHz	Start Frequency = 2426.0 MHz,	Stop Frequency = 2456.0 MHz			
RBW = To identify clearly the 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

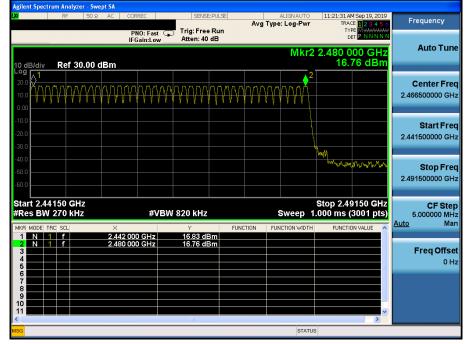
### Number of <u>Hopping Frequencies 1(FH)</u>

### Hopping mode : Enable & GFSK

Agnent spectrum Analyzer - Swept		SENSE:PULSE	ALIGNAUTO Avg Type: Log-Pwr	11:19:08 AM Sep 19, 2019 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 30.00 dB	PNO: Fast G	Trig: Free Run Atten: 40 dB	Mkr2	2.441 000 GHz 17.31 dBm	Auto Tune
20.0 10.0 0.00		MANAMAA	wwwww	AMAMA	Center Freq 2.416500000 GHz
-10.0					<b>Start Freq</b> 2.391500000 GHz
-40.0					<b>Stop Freq</b> 2.441500000 GHz
Start 2.39150 GHz #Res BW 270 kHz	×			Stop 2.44150 GHz .000 ms (3001 pts)	CF Step 5.000000 MHz <u>Auto</u> Man
2         N         1         f           3         -         -         -           4         -         -         -           5         -         -         -           6         -         -         -           7         -         -         -           8         -         -         -           9         -         -         -           10         -         -         -	2.402 000 GHz 2.441 000 GHz	16.55 dBm 17.31 dBm			Freq Offset 0 Hz
11 MSG		inti	STATUS	<b>3</b>	

### Number of <u>Hopping Frequencies 2(FH)</u>

### Hopping mode : Enable & GFSK



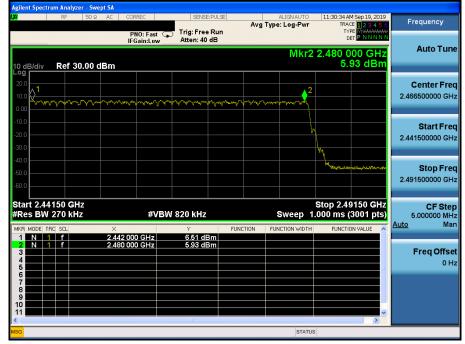
### Number of <u>Hopping Frequencies 1(FH)</u>

### Hopping mode : Enable & π/4DQPSK

Agitent Spectrum An XI RF		RREC	SENSE:PULS	Avg 1	ALIGNAUTO Type: Log-Pwr	11:26:27 AM Sep TRACE		Frequency
10 dB/div Re	ہ ۱F f 30.00 dBm	NO: Fast 😱 Gain:Low	Trig: Free Run Atten: 40 dB		Mkr2	2.441 000 6.44	GHz	Auto Tune
		ᢣ᠆ᠬ᠕ᢆ᠂ᠰ	ᠬᢧᢧᡎ	ᠰᢧᠬ᠕ᢆ᠆	way the free ways		v me	Center Freq 2.416500000 GHz
-10.0 -20.0 -30.0	- John							Start Freq 2.391500000 GHz
-40.0 -50.0 -60.0	~oth <sup>the</sup>							<b>Stop Freq</b> 2.441500000 GHz
Start 2.39150 #Res BW 270	kHz ×		820 kHz Y	FUNCTION	Sweep 1.	Stop 2.4415 000 ms (300 FUNCTION VAL	1 pts)	<b>CF Step</b> 5.000000 MHz <u>Auto</u> Man
1 N 1 f 2 N 1 f 3 4 5 6 6 7 7 8 9 9 10	2.402.00 2.441.00	0 GHz 0 GHz	5.66 dBm 6.44 dBm					Freq Offset 0 Hz
MSG			aut		STATUS		>	

### Number of Hopping Frequencies 2(FH)

### Hopping mode : Enable & π/4DQPSK



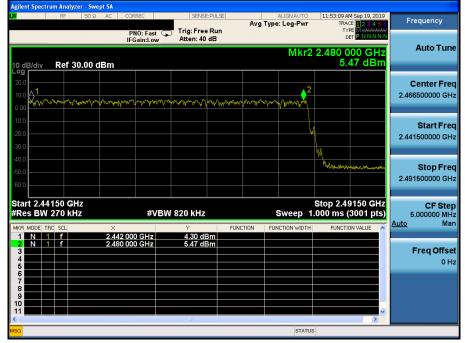
### Number of <u>Hopping Frequencies 1(FH)</u>

### Hopping mode : Enable & 8DPSK

Agnent Spectrum Anaryzer - Swept SA (χ) RF 50 Ω AC	PNO: Fast	SENSE:PULSE	ALIGNAUTO Avg Type: Log-Pwr	11:34:04 AM Sep 19, 2019 TRACE 12 3 4 5 6 TYPE MWWWWW DET P N N N N N	Frequency
10 dB/div Ref 30.00 dBm	IFGain:Low	Atten: 40 dB	Mkr2	2.441 000 GHz 6.38 dBm	Auto Tune
20.0 10.0 0.00	an start and the layer	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	an and a contraction of the second	m	Center Freq 2.416500000 GHz
-10.0 -20.0 -30.0					Start Freq 2.391500000 GHz
-40.0 -50.0 -60.0					<b>Stop Freq</b> 2.441500000 GHz
Start 2.39150 GHz #Res BW 270 kHz		820 kHz		Stop 2.44150 GHz .000 ms (3001 pts)	CF Step 5.000000 MHz <u>Auto</u> Man
1 N 1 F 24 2 N 1 F 24 3 4 5 6 7 7 8	02 000 GHz 141 000 GHz	5.97 dBm 6.38 dBm			Freq Offset 0 Hz
10 11 MSG		m	STATUS		

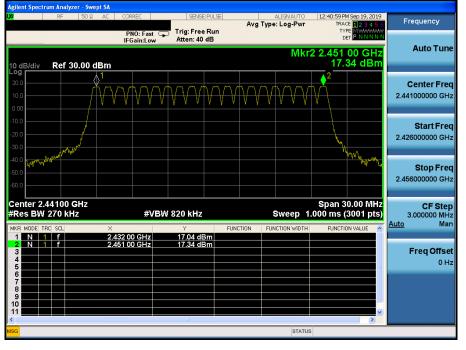
### Number of Hopping Frequencies 2(FH)

### Hopping mode : Enable & 8DPSK



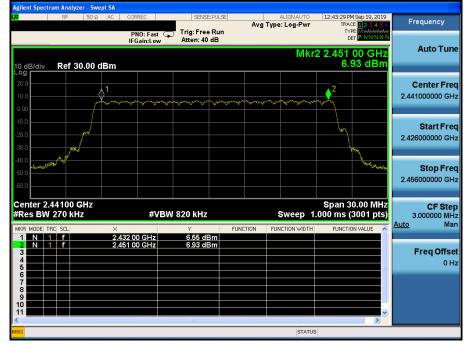
### Number of Hopping Frequencies 1(AFH)

### Hopping mode : Enable & GFSK

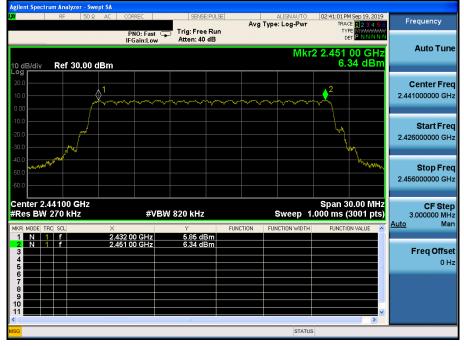


#### Number of Hopping Frequencies 1(AFH)

### <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 ×

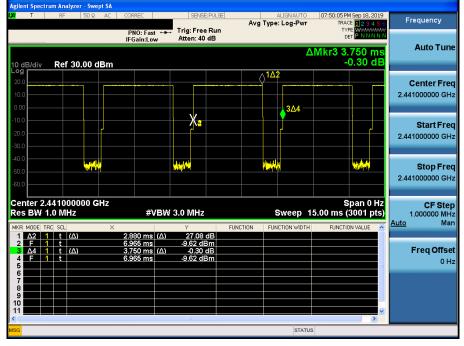
((Hopping rate ÷ Time slots) ÷ Hopping channel)

- 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.



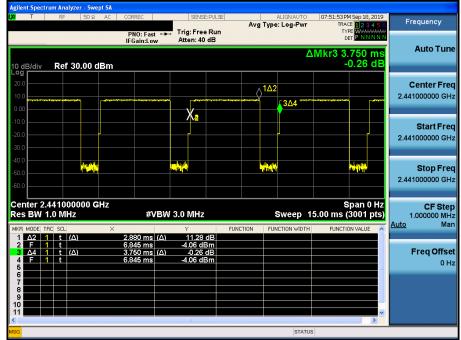
### Time of Occupancy (FH)



#### Time of Occupancy (FH)

### Hopping mode : Enable & 2-DH5

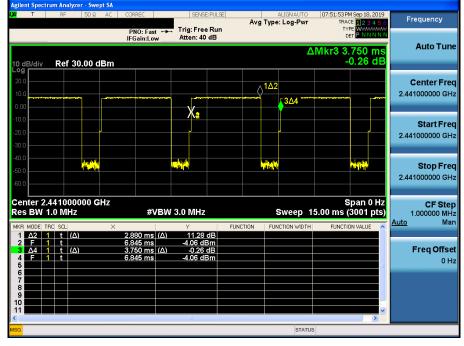
Hopping mode : Enable & DH5





### Hopping mode : Enable & 3-DH5

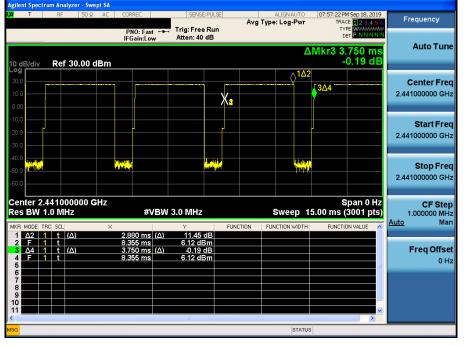
### Time of Occupancy (FH)



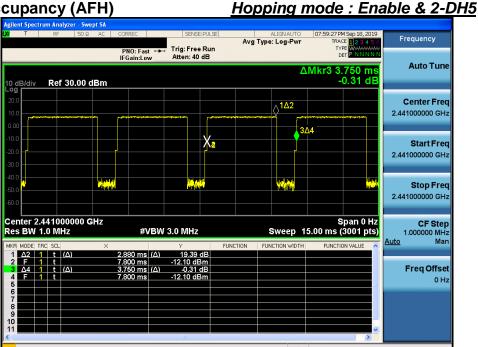


## Hopping mode : Enable & DH5

## Time of Occupancy (AFH)



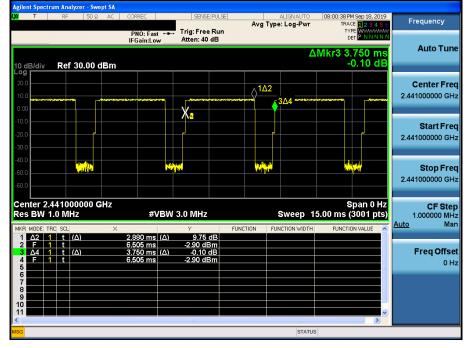
#### Time of Occupancy (AFH)





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**

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



#### 7.3.2. Test Procedures for Conducted Spurious Emissions

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

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

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 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)
2388.59	V	Х	PK	53.31	2.32	N/A	N/A	55.63	74.00	18.37
2388.59	V	Х	AV	53.31	2.32	-24.79	N/A	30.84	54.00	23.16
4803.74	Н	Y	PK	58.09	1.24	N/A	N/A	59.33	74.00	14.67
4803.74	Н	Y	AV	58.09	1.24	-24.79	N/A	34.54	54.00	19.46
7206.15	Н	Z	PK	53.16	5.40	N/A	N/A	58.56	74.00	15.44
7206.15	Н	Z	AV	53.16	5.40	-24.79	N/A	33.77	54.00	20.23
12010.06	Н	Z	PK	47.53	12.98	N/A	N/A	60.51	74.00	13.49
12010.06	Н	Z	AV	47.53	12.98	-24.79	N/A	35.72	54.00	18.28

#### 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)
4882.26	Н	Y	PK	56.58	1.48	N/A	N/A	58.06	74.00	15.94
4882.26	Н	Y	AV	56.58	1.48	-24.79	N/A	33.27	54.00	20.73
7323.39	Н	Z	PK	50.63	8.76	N/A	N/A	59.39	74.00	14.61
7323.39	Н	Z	AV	50.63	8.76	-24.79	N/A	34.60	54.00	19.40
12204.40	Н	Z	PK	47.62	12.75	N/A	N/A	60.37	74.00	13.63
12204.40	Н	Z	AV	47.62	12.75	-24.79	N/A	35.58	54.00	18.42

#### 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)
2484.51	V	Х	PK	57.91	2.64	N/A	N/A	60.55	74.00	13.45
2484.51	V	Х	AV	57.91	2.64	-24.79	N/A	35.76	54.00	18.24
4960.55	Н	Y	PK	56.37	1.79	N/A	N/A	58.16	74.00	15.84
4960.55	Н	Y	AV	56.37	1.79	-24.79	N/A	33.37	54.00	20.63
7440.25	Н	Z	PK	54.16	8.73	N/A	N/A	62.89	74.00	11.11
7440.25	Н	Z	AV	54.16	8.73	-24.79	N/A	38.10	54.00	15.90
12400.77	V	Х	PK	47.61	13.14	N/A	N/A	60.75	74.00	13.25
12400.77	V	Х	AV	47.61	13.14	-24.79	N/A	35.96	54.00	18.04

#### 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 ) =  $20 \log(1 \text{ m / } 3 \text{ m }) = -9.54 \text{ dB}$ When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

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

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

- 100 ms /  $\Delta t$  [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 ) = -24.79 dB



4. Sample Calculation.			
Margin = Limit – Result /	Result = Reading + T.I	= + 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 : π/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)
2388.60	V	Х	PK	52.94	2.32	N/A	N/A	55.26	74.00	18.74
2388.60	V	Х	AV	52.94	2.32	-24.79	N/A	30.47	54.00	23.53
4804.01	Н	Y	PK	53.63	1.24	N/A	N/A	54.87	74.00	19.13
4804.01	Н	Y	AV	53.63	1.24	-24.79	N/A	30.08	54.00	23.92

#### 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)
4881.62	Н	Y	PK	52.94	1.48	N/A	N/A	54.42	74.00	19.58
4881.62	Н	Y	AV	52.94	1.48	-24.79	N/A	29.63	54.00	24.37

#### 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)
2485.05	V	Х	PK	54.52	2.63	N/A	N/A	57.15	74.00	16.85
2485.05	V	Х	AV	54.52	2.63	-24.79	N/A	32.36	54.00	21.64
4960.32	Н	Y	PK	53.43	1.79	N/A	N/A	55.22	74.00	18.78
4960.32	Н	Y	AV	53.43	1.79	-24.79	N/A	30.43	54.00	23.57

#### 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 ) = -24.79 dB

4. Sample Calculation.

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

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



#### 9 kHz ~ 25 GHz Data (Modulation : <u>8DPSK</u>)

#### Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2388.90	V	Х	PK	52.93	2.32	N/A	N/A	55.25	74.00	18.75
2388.90	V	Х	AV	52.93	2.32	-24.79	N/A	30.46	54.00	23.54
4803.79	Н	Y	PK	52.96	1.24	N/A	N/A	54.20	74.00	19.80
4803.79	Н	Y	AV	52.96	1.24	-24.79	N/A	29.41	54.00	24.59

#### 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)
4881.68	Н	Y	PK	54.00	1.48	N/A	N/A	55.48	74.00	18.52
4881.68	Н	Y	AV	54.00	1.48	-24.79	N/A	30.69	54.00	23.31

#### 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)
2484.16	V	Х	PK	55.01	2.64	N/A	N/A	57.65	74.00	16.35
2484.16	V	Х	AV	55.01	2.64	-24.79	N/A	32.86	54.00	21.14
4959.74	Н	Y	PK	53.09	1.79	N/A	N/A	54.88	74.00	19.12
4959.74	Н	Y	AV	53.09	1.79	-24.79	N/A	30.09	54.00	23.91

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 ) = -24.79 dB

4. Sample Calculation.

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

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



#### Low Band-edge

Lowest Channel & Modulation : GFSK



#### Low Band-edge

## Hopping mode & Modulation : GFSK



## Lowest Channel & Modulation : GFSK

			alyzer - Sv												
LXI RL		RF	50 \$	Ω 🧘 DC	CORREC		SENSE	:PULSE			ALIGN OFF		M Sep 18, 2019		requency
Cent	ter Fr	'ea	15.004	500 N	IHz				Avg	Type:	Log-Pwr	TRA	CE 123456	F	requency
					PNO: Fast		Trig: Free	Run				T) r	ET P P P P P P		
					IFGain:Lov	N	Atten: 36	dB					-		
												Mkr1 29	2.4 kHz		Auto Tune
													22 dBm		
10 dE Log	3/div	Re	f 25.00	aBm					_				22 0011		
15.0															Center Freq
5.00														1	5.004500 MHz
-5.00													-3.40 dBm	_	
-5.00															
-15.0															Otort From
-25.0	<b>\</b>														Start Freq
															9.000 kHz
-35.0	1-														
-45.0	•														
															Stop Freq
-55.0	Million	ال عديد ال	فالملاماة ومحي	the self plants	a the fact of the fact of the second	hansa ata	a hata ana statut	I CARLO AND LAN	of antiday	(Anna hu	ومراجع ورياني	الصاحية فالتدلية	والمتعالم أجار والمعادية	_	
-65.0			A DAY DAMAGE	And Address	A line is not in the second second	A REAL PROPERTY.	A SALE OF THE OWNER OF THE OWNER	(all all particular and			Stratburger das 1	William for particularia	and the second	3	0.000000 MHz
00.0															
Ctor	t 9 kH											Oton 2	0.00 MHz	_	
															CF Step
#Res	s BW	100	KHZ		#\	/BW 3	00 kHz			SW	eep 5.	333 ms (4	0001 pts)		2.999100 MHz
MKB N	IODE TF	ici sci		×			Y	ELIN	ICTION	ELINC	TION WIDTH	FUNCTI	ON VALUE	Auto	Man
	N 1				292.4 kHz		-46.22 dE		ionioni	1 I I I I I I I I I I I I I I I I I I I	mont mo m	1011011			
2	<u>``</u>				202.4 1112										
3															Freq Offset
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Agilent Spectr			RREC	SENSE:	DULSE		ALIGN OFF	05-20-22.0	4 Sep 18, 2019	
		5000000 GI		Trig: Free	Run		: Log-Pwr	TRAC	CE 1 2 3 4 5 6 PE MWWWWW ET P P P P P P	Frequency
			Gain:Low	Atten: 36	B		Mkr		35 GHz	Auto Tune
10 dB/div Log	Ref 25.	00 dBm							53 dBm	
15.0		\ <b>\</b> 1								Center Freq
5.00									-3.40 dBm	5.015000000 GHz
-5.00										
-25.0										Start Freq 30.000000 MHz
-35.0					a a se a sta da da se al.	فليدد الد المعالي	ر بر بالطبيطية (تـــالد بر ا		. datas	
-45.0 -55.0						and the second second				Stop Freq
-65.0										10.00000000 GHz
Start 30 N	/IHz							Stop 10	.000 GHz	CF Step
#Res BW			#VB\	W 3.0 MHz		S	weep 18	.67 ms (4	0001 pts)	997.000000 MHz Auto Man
MKR MODE TF	f	× 2.402 <sup>-</sup>	1 GHz	۲ 16.70 dB	FUNCT	ION FUI	ICTION WIDTH	FUNCTIO	ON VALUE	
2 N 1 3 N 1	f f	2.376 '	91 GHz	-37.37 dB -39.00 dB -39.26 dB	m					Freq Offset
4 N 1 5 N 1 6	f	2.655	13 GHz 35 GHz	-39.53 dB					=	0 Hz
7 8										
9										
11				Ш					<b>&gt;</b>	
MSG							STATUS	6		



## Lowest Channel & Modulation : GFSK





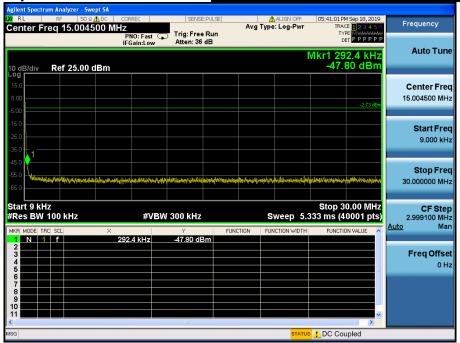
#### **Reference for limit**



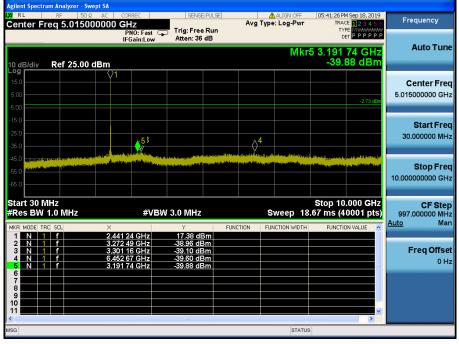


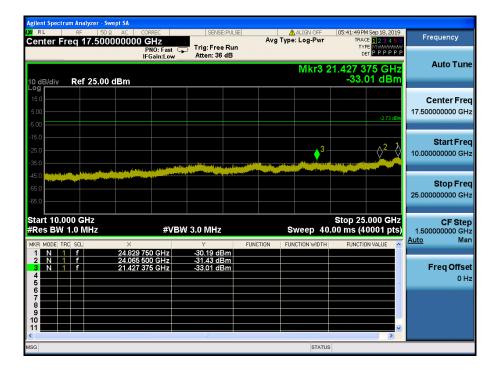
#### Conducted Spurious Emissions <u>Midd</u>













## **High Band-edge**

## Highest Channel & Modulation : GFSK



#### High Band-edge

## Hopping mode & Modulation : GFSK



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

## Highest Channel & Modulation : GFSK

	nt Spectr														
l <b>xi</b> R		RF		। ର 🧥 DC	CORREC		SENS	E:PULSE			ALIGN OFF		M Sep 18, 2019	F	requency
Cen	iter Fr	eq 1	5.004	4500 I			Trig: Fre		Av	д Туре	: Log-Pwr	TRA TV	CE 123456		requeries
					PNO: F IFGain:	ast 🔾	Atten: 36	dB							
					iroain.	LUW	Theorem of								Auto Tune
													91.7 kHz		Auto Tune
10 d	B/div	Ref	25.00	) dBm								-47.	71 dBm		
Log															
15.0	<u> </u>														Center Freq
5.00														1	5.004500 MHz
													-2.98 dBm		
-5.00															
-15.0															Start Freq
-25.0															
															9.000 kHz
-35.0	<u>t</u> 1														
-45.0													+		
-55.0	<u> </u>														Stop Freq
	A MARKED	eteriain a	and the second	nitivity assessed	han humaniture	with the	devide this fairly the	waynessed.	( the share that former	and a state	terrist litranet	الماجع والمناطقة والم	and for the state	3	0.000000 MHz
-65.0															
	rt 9 kH												30.00 MHz		CF Step
#Re	s BW	100	kHz			#VBV	V 300 kHz			s	weep 5.3	333 ms (4	10001 pts)		2.999100 MHz
мкв	MODE TF	ici sci i		×			Y	1	FUNCTION	ELIN	ICTION WIDTH	ELINCTI	ION VALUE	Auto	Man
1	N 1				291.7 kł	17	-47.71 d		rononon	101		Tenteri			
2															
3															Freq Offset
4						_				_					0 Hz
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MSG											STATUS	DC Co	upled		
		_				_				_		<u>-</u> 2000	abioa		

Agilent Spectrum Analyzer - Swept S					
RL RF 50 Ω A     Center Freq 5.0150000		SENSE:PULSE	ALIGN OFF	05:44:19 PM Sep 18, 2019 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast G	Trig: Free Run Atten: 36 dB	• // •	TYPE MWWWWWW DET PPPPP	
	IFGaIn:Low	Atten: 56 dB	Mice	5 3.193 23 GHz	Auto Tune
10 dB/div Ref 25.00 dBr			IVINI	-39.53 dBm	
15.0	Q1				Center Freq
5.00					5.015000000 GHz
-5.00				-2.98 dBm	
-15.0					
-25.0					Start Freq 30.000000 MHz
-35.0	53				30.000000 WH2
-45.0 manufacture with the output of the	and the second state of the second	a tradie of the special free basis as set of a	and the state of the second state of the second state of the	and the terror provides and the descention	
-65.0 Marchilles and his balance and the		a finality in a particular state		i kilden om en starte beren her som starte hande som et starte beren starte beren starte beren starte beren st	Stop Freq
-65.0					10.00000000 GHz
				84	
Start 30 MHz #Res BW 1.0 MHz	#VBV	/ 3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MHz
MKR MODE TRC SCL	×		FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
	2.480 13 GHz 3.155 60 GHz	17.09 dBm -38.85 dBm			
3 N 1 f	3.296 67 GHz 3.101 51 GHz	-39.41 dBm -39.50 dBm			Freq Offset
5 N 1 f	3.193 23 GHz	-39.53 dBm		=	0 Hz
6 7					
8					
10					
<				>	
MSG			STATUS		

## Highest Channel & Modulation : GFSK





#### Low Band-edge

## Lowest Channel & Modulation : π/4DQPSK



#### Low Band-edge

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





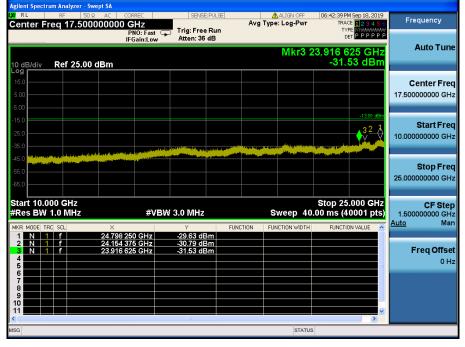
### Conducted Spurious Emissions <u>Lowest Channel & Modulation : π/4DQPSK</u>

#### 03:00:51 PM en 19, 2019 Frequency Avg Type: Log-Pwr RACE 23 TO TYPE MWWWW DET P N N N N Trig: Free Run Atten: 36 dB PNO: Fast 🖵 IFGain:Low Auto Tune Mkr1 281.9 kHz -47.980 dBm Ref 25.00 dBm **Center Freq** 15.004500 MHz Start Freq 9.000 kHz Stop Freq 30.000000 MHz Stop 30.00 MHz Sweep 5.333 ms (40001 pts) Start 9 kHz #Res BW 100 kHz **CF Step** 2.999100 MHz <u>Man</u> #VBW 300 kHz <u>Auto</u> 281.9 kHz -47.980 dBm N 1 f Freq Offset 0 Hz STATUS 1 DC Coupled

RL RE 501	Ω AC CORREC	SENSE:PULS	F	ALIGN OFF	06:42:15 PM Se	n 18, 2019	
Center Freg 5.0150			Avg Ty	/pe: Log-Pwr	TRACE	23456	Frequency
	PNO: Fast	Trig: Free Run Atten: 36 dB	l.		TYPE M DET P	PPPPP	
	IFGain:Low	Atten: 36 dB					Auto Tune
				Mkr	5 3.291 69		/ aro / aro
10 dB/div Ref 25.00	dBm				-40.15	aBm	
15.0	.1						O antan Ema
	\						Center Fre
5.00							5.015000000 GH
-5.00							
-15.0				_		-13.81 dBm	Start Free
-25.0							30.000000 MH
-35.0	3 _2_45						30.00000 WH:
	I Y YIM						
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-45.0			en en en en filmen en en filme	and the second state of the second	يا د ايو کېږي وارد کېږي. د د و د د اس و د د کارک	antisleastan. Antisleastan	Stop Free
-45.0 Alternative and the second seco			n an an an Anna an Ann An Anna an Anna	and first to prove the belief of a second		ngalitikangkani Jahawan Jai	
and the state of the second state of the secon						gafiel oostate gaterooostat	
-55.0							10.000000000 GH
-55.0	#\/D				Stop 10.00	00 GHz	10.000000000 GH CF Step
-55.0 -65.0 Start 30 MHz #Res BW 1.0 MHz		W 3.0 MHz		Sweep 18	.67 ms (400	01 pts)	10.00000000 GH CF Step 997.000000 MH
65.0 Start 30 MHz #Res BW 1.0 MHz MKR MODE  TRC  SCL	×	Y			Stop 10.00 .67 ms (400	01 pts)	10.00000000 GH CF Step 997.000000 MH
-55.0 -65.0 Start 30 MHz #Res BW 1.0 MHz	× 2.401 86 GHz	Y 7.09 dBm -39.84 dBm		Sweep 18	.67 ms (400	01 pts)	10.00000000 GH CF Ster 997.000000 MH <u>Auto</u> Ma
65.0         0	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz	7.09 dBm -39.84 dBm -40.02 dBm		Sweep 18	.67 ms (400	01 pts)	10.00000000 GH CF Ster 997.000000 MH <u>Auto</u> Ma
65.0         Start 30 MHz           #Res BW 1.0 MHz           1         1           2         1           1         1           2         1           1         1           2         1           3         1           4         1           5         1	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz 3.157 59 GHz	7.09 dBm -39.84 dBm -40.02 dBm -40.09 dBm		Sweep 18	.67 ms (400	01 pts)	10.000000000 GH CF Step 997.000000 MH <u>Auto</u> Mai Freq Offse
65.0         Start 30 MHz           #Res BW 1.0 MHz           1         1           2         1           1         1           2         1           1         1           2         1           3         1           4         1           5         1	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz	7.09 dBm -39.84 dBm -40.02 dBm		Sweep 18	.67 ms (400	01 pts)	10.000000000 GH CF Step 997.000000 MH <u>Auto</u> Mai Freq Offse
4         1         1         1           4         N         1         1         1           6         N         1         1         1           7         1         7         1         7	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz 3.157 59 GHz	7.09 dBm -39.84 dBm -40.02 dBm -40.09 dBm		Sweep 18	.67 ms (400	01 pts)	10.000000000 GH CF Stej 997.000000 MH <u>Auto</u> Ma Freq Offse
4         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           4         N         1         F           8         N         1         F           9         9         9         9         9	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz 3.157 59 GHz	7.09 dBm -39.84 dBm -40.02 dBm -40.09 dBm		Sweep 18	.67 ms (400	01 pts)	10.000000000 GH CF Stej 997.000000 MH <u>Auto</u> Ma Freq Offse
65.0         1	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz 3.157 59 GHz	7.09 dBm -39.84 dBm -40.02 dBm -40.09 dBm		Sweep 18	.67 ms (400	01 pts)	10.000000000 GH CF Stej 997.000000 MH <u>Auto</u> Ma Freq Offse
4         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           3         N         1         F           4         N         1         F           8         N         1         F           9         9         9         9         9	× 2.401 86 GHz 2.871 20 GHz 2.386 91 GHz 3.157 59 GHz	7.09 dBm -39.84 dBm -40.02 dBm -40.09 dBm		Sweep 18	.67 ms (400	01 pts)	Stop Frec           10.000000000 GH;           CF Step           997.000000 MH; <u>Auto</u> Mar           Freq Offse           0 H;

## Conducted Spurious Emissions <u>Lowest Channel & I</u>

## Lowest Channel & Modulation : π/4DQPSK



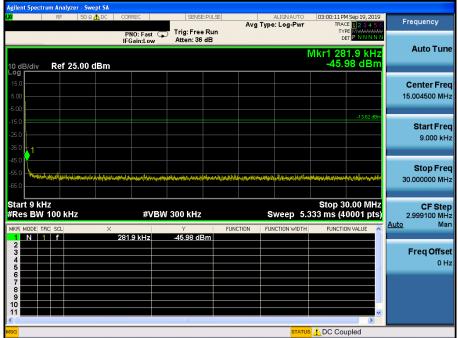


#### Reference for limit

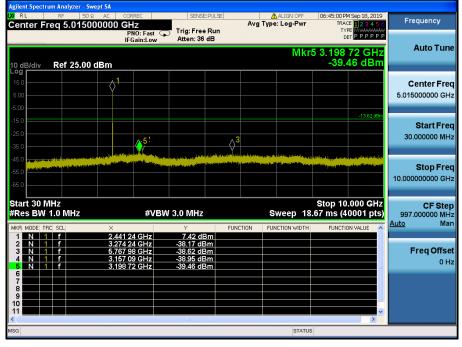
## Middle Channel & Modulation : π/4DQPSK



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



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



	um Analyzer - Sv	vept SA								
Center E	RF 50 s req 17.500			SENSE:F	PULSE	Ανα Τι	ALIGN OFF		E 1 2 3 4 5 6	Frequency
Center	eq 17.300	PN	0:Fast ⊂ ain:low	Trig: Free F				TYP	E MWWWWW TPPPPP	
		IFG	ain:Low	Atten: 30 d	.0		Miles 2	4 004 0		Auto Tune
10 dB/div	Ref 25.00	dBm					IVIKIƏ 2	4.921 2 -30.4	50 GH2 10 dBm	
Log 15.0										Center Freq
5.00										17.500000000 GHz
-5.00										
-15.0									-13.62 dBm	
-25.0									3	Start Freq 10.00000000 GHz
-35.0				to the second		line results	Name and Address of the Owner of Street, or other	a sharefun and a fakilmin		10.00000000 GHz
-45.0 4	and the strength of the strength	personal and the second second				Station white	and addition of the owner	and the second little		
-55.0	And the second sec									Stop Freq
-65.0										25.00000000 GHz
Start 10.0 #Res BW			#VBV	/ 3.0 MHz			Sweep 40		000 GHz 0001 pts)	CF Step 1.50000000 GHz
MKR MODE TR	RC SCL	×		Y	FUNC	TION I	UNCTION WIDTH	FUNCTIO	N VALUE	<u>Auto</u> Man
1 N 1 2 N 1	f	24.789 250 24.970 375		-29.56 dBr -30.01 dBr						
3 N 1	f	24.921 250	GHz	-30.40 dBr						Freq Offset
5									=	0 Hz
6					+					
8										
10										
11									>	
MSG							STATUS			
the second s										



### **High Band-edge**

## Highest Channel & Modulation : π/4DQPSK



## High Band-edge

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



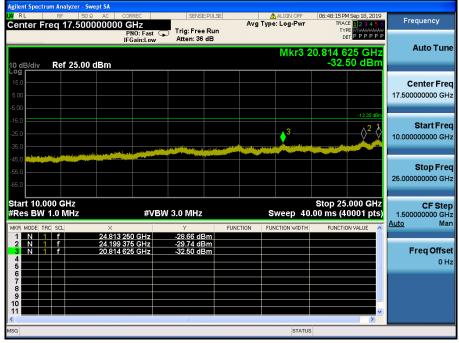


## <u>Highest Channel & Modulation : π/4DQPSK</u>

Agilent Spectr	um Analyzer - Swi									-
	req 15.0045			SENSE:			ALIGN OFF	TRAC	4 Sep 18, 2019 E <mark>1 2 3 4 5 6</mark>	Frequency
10 dB/div	Ref 25.00	IFGa	:Fast ⊊ in:Low	Trig: Free I Atten: 36 d				DE Vikr1 28	7.9 kHz	Auto Tun
15.00										Center Fre 15.004500 MH
-15.0 -25.0 -35.0									-13.35 dBm	Start Fre 9.000 kH
-45.0 -55.0 -65.0	darimet with a basis south	ى مەرىكى بىرىيە بېرىمەر <i>بارگا</i> يە	VIAN HANN	harfulstered arred	nelftikknifterjile	Pandy range de Montefficher	ilenenneill feisigt eine	an maaska hahainiyin	naturial filts danhari.	Stop Fre 30.000000 MH
Start 9 kH #Res BW	100 kHz		#VBV	V 300 kHz				333 ms (4		CF Ste 2.999100 MH Auto Ma
MKR MODE TF 1 N 1 2 3 4 5		× 287.9	kHz	47.18 dBr	FUNC		ICTION WIDTH	FUNCTIC	IN VALUE	Freq Offse
6 7 8 9 10										
<				m						
MSG							STATUS	DC Cou	ipiea	

Agilent Spectrum Analyzer - Swe					
RL RF 50 Ω     Center Freq 5.01500		SENSE:PULSE	ALIGN OFF Avg Type: Log-Pwr	06:47:53 PM Sep 18, 2019 TRACE 1 2 3 4 5 6 TYPE MMAAAAAAA	Frequency
	PNO: Fast G IFGain:Low	Atten: 36 dB		TYPE MWWWWW DET PPPPP	Auto Tune
10 dB/div Ref 25.00 d	dBm		Mkr:	5 2.578 83 GHz -39.61 dBm	Auto Tune
15.0 5.00					Center Freq 5.015000000 GHz
-15.0 -25.0 -35.0				-13.35 dBm	Start Freq 30.000000 MHz
-45.0 -55.0 -65.0					<b>Stop Freq</b> 10.00000000 GHz
Start 30 MHz #Res BW 1.0 MHz	#VBV	/ 3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Step 997.000000 MHz Auto Man
MKR MODE TRC SCL	× 2.480 13 GHz	Y 7.50 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
2 N 1 F 3 N 1 F 4 N 1 F 5 N 1 F	3.307 14 GHz 6.402 82 GHz 5.989 82 GHz 2.578 83 GHz	-38.96 dBm -39.05 dBm -39.39 dBm -39.61 dBm			Freq Offset 0 Hz
6 7 8 9 10					
11				×	
MSG			STATUS		

## Highest Channel & Modulation : π/4DQPSK





#### Low Band-edge

## Lowest Channel & Modulation : 8DPSK



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





## Lowest Channel & Modulation : 8DPSK

Agilent Spectrum Analyzer - Swept SA					
RL RF 50 Ω ▲DC     Center Freq 15.004500 M		SENSE:PULSE		06:58:15 PM Sep 18, 2019 TRACE 1 2 3 4 5 6	Frequency
Center Freq 15.004500 M	PNO: Fast 😱 Tr	ig: Free Run		TYPE MWWWWWWW DET P P P P P P	
	IFGain:Low At	ten: 36 dB			Auto Tuno
				Vikr1 281.9 kHz	Auto Tune
10 dB/div Ref 25.00 dBm				-47.15 dBm	
Log					
15.0					Center Freq
5.00					15.004500 MHz
-5.00					
-15.0				-13.69 dBm	
-25.0					Start Freq
					9.000 kHz
-35.0 1					
-45.0					Oton From
-55.0	فالمحمد مناديدين واللا مديد وتقافه	and and total efficiency follows and to	المعالمية مستعل بالمعم معدا	han an an an the state of the second by	Stop Freq
-65.0		a de la claime de la company de	and a second	and an office, she while for a collision in the statistic pair	30.000000 MHz
Start 9 kHz				Stop 30.00 MHz	CF Step
#Res BW 100 kHz	#VBW 30	) kHz	Sweep 5.3	333 ms (40001 pts)	2.999100 MHz
MKR MODE TRC SCL X		Y FUNCTI	ON FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
1 N 1 f	281.9 kHz -4	7.15 dBm			
2					Freq Offset
4					0 Hz
6				=	
7					
8					
10 10					
11				×	
×					
MSG			STATUS	DC Coupled	

Agilent Spectrum Analyzer						
Center Freq 5.01	50 Ω AC CORREC 5000000 GHz	SENSE:PULSE		ALIGN OFF e: Log-Pwr	06:58:38 PM Sep 18, 2019 TRACE 1 2 3 4 5 (	Frequency
	PNO: Fast C IEGain:Low	Trig: Free Run Atten: 36 dB			DET P P P P P	
				Mkr	5 2.630 92 GHz	Auto Tune
10 dB/div Ref 25.	00 dBm				-39.57 dBm	
Log 15.0	1					Center Freq
5.00						5.015000000 GHz
-5.00						
-15.0					-13.69 dBm	Start Freq
-25.0	<b>E</b> 0.2					30.000000 MHz
-35.0	<b>\</b> °\$°\$2′					
-45.0 monthshild and the			and a second			Stop Freq
-55.0						10.000000000 GHz
-65.0						
Start 30 MHz					Stop 10.000 GHz	CF Step
#Res BW 1.0 MHz	#VB	W 3.0 MHz	S	Sweep 18	.67 ms (40001 pts)	997.000000 MHz
MKR MODE TRC SCL	×	Y	FUNCTION FU	NCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
1 N 1 f 2 N 1 f	2.402 11 GHz 3.283 96 GHz	7.06 dBm -38.32 dBm				
3 N 1 f	2.996 08 GHz 2.948 22 GHz	-39.03 dBm -39.29 dBm				Freq Offset 0 Hz
5 N 1 f	2.630 92 GHz	-39.57 dBm			=	0 Hz
7						
9						
10					~	
<					>	
MSG				STATUS		

#### Lowest Channel & Modulation : 8DPSK





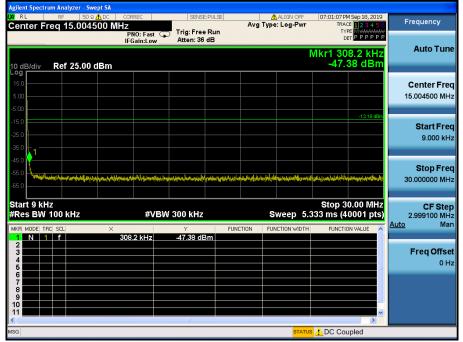
### Reference for limit



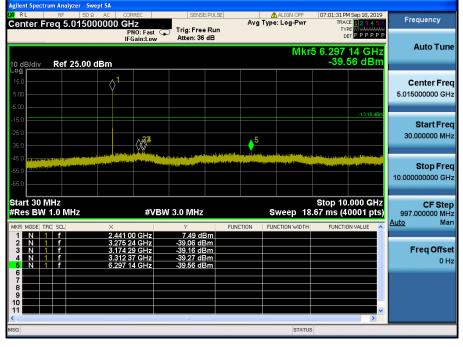


#### Conducted Spurious Emissions





#### Middle Channel & Modulation : 8DPSK



Agilent Spectrum Analyzer - Swept SA				
Center Freq 17.500000000	PNO: Fast 😱 Trig: Free Run	Avg Type: Log-Pwr	07:01:55 PM Sep 18, 2019 TRACE 1 2 3 4 5 6 TYPE M WWWWWW DET P P P P P P	Frequency
10 dB/div Ref 25.00 dBm	IFGain:Low Atten: 36 dB	Mkr3 2	4.128 875 GHz -30.85 dBm	Auto Tune
Log 15.0 5.00				Center Freq 17.50000000 GHz
-15.0 -25.0 -35.0		Abdistance ())	-13.18 dBm	<b>Start Freq</b> 10.000000000 GHz
-45.0				<b>Stop Freq</b> 25.000000000 GHz
Start 10.000 GHz #Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 40.	Stop 25.000 GHz 00 ms (40001 pts)	CF Step 1.50000000 GHz Auto Man
MKR MODE TRC SCL X	750 GHz -29.96 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	Man
3 N 1 f 24.1288	000 GHz -30.77 dBm 375 GHz -30.85 dBm			<b>Freq Offset</b> 0 Hz
6 7 8 9 10				
	nu		×	
MSG		STATUS		



### **High Band-edge**

## Highest Channel & Modulation : 8DPSK



## High Band-edge

#### Hopping mode & Modulation : 8DPSK





## Highest Channel & Modulation : 8DPSK

Agilent Spectrum Ana						
W RL RF	50 Ω <u>∧</u> DC COR 5.004500 MHz		Avg T	ALIGN OFF	07:03:55 PM Sep 18, 2019 TRACE 1 2 3 4 5 6	Frequency
	Pi IF@	NO: Fast 🖵 Trig: Free F Gain:Low Atten: 36 d		N	TYPE MUMM DET P P P P P P /kr1 281.9 kHz -47.66 dBm	Auto Tune
10 dB/div Ref 15.0 5.00	25.00 dBm					Center Freq 15.004500 MHz
-15.0 -25.0 -35.0					-13.34 dBm	Start Freq 9.000 kHz
-45.0 -55.0 -65.0	Ad ught yn Maasta ar dy af tad ar ac ulystr	förstattal sakoning tal stationen för	Mariento Amaria	teorist Liddensetsbergensetsberge	สุดปัญห์วิจุราชีอซางุษระ	Stop Freq 30.000000 MHz
Start 9 kHz #Res BW 100 H	(Hz ×	#VBW 300 kHz	FUNCTION	Sweep 5.3	Stop 30.00 MHz 33 ms (40001 pts)	CF Step 2.999100 MHz <u>Auto</u> Man
1 N 1 f 2 3 3 4 5 5 6	281.	.9 kHz -47.66 dBr			=	Freq Offset 0 Hz
7 8 9 9 9 10 11 11 11 11 11 11 11 11 11 11 11 11						
MSG		mi		STATUS	DC Coupled	

Agilent Spectrum Analyzer - Swept SA					
RL RF 50 Ω AC     Center Freq 5.0150000		SENSE:PULSE	ALIGN OFF	07:04:19 PM Sep 18, 2019 TRACE 1 2 3 4 5 6	Frequency
Certifier Freq 5.0150000	PNO: Fast 🕞	Trig: Free Run Atten: 36 dB		TYPE MWWWWWWW DET PPPPP	
	IFGain:Low	Atten: 36 dB			Auto Tune
			IVII	r5 804.17 MHz -44.50 dBm	
10 dB/div Ref 25.00 dBn	<u>1</u>			-44.30 UBIII	
15.0					Center Freq
5.00	¥				5.015000000 GHz
-5.00					
-15.0				-13.34 dBm	Otherst Frank
-25.0					Start Freq 30.000000 MHz
-35.0 5 - 3 - 4					30.000000 WHZ
-45.0	. Yasalan tehinta tahun tah		والموالية ومعمدانة والإستعرار والمتاه	ويسأله فالارد والاردو ومالحو ومعادرين ومالحا أتتبه	
-55.0		And in case of the line of the	and in the second s	a historia ya na mana na mana ka n	Stop Freq
-65.0					10.00000000 GHz
-03.0					
Start 30 MHz				Stop 10.000 GHz	CF Step
#Res BW 1.0 MHz	#VBW	3.0 MHz	Sweep 18	.67 ms (40001 pts)	997.000000 MHz
	×		FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
	2.479 88 GHz 2.576 34 GHz	7.64 dBm -39.49 dBm			
3 N 1 f	1.224 66 GHz 1.716 67 GHz	-44.42 dBm -44.44 dBm			Freq Offset
5 N 1 f	804.17 MHz	-44.44 dBm -44.50 dBm		=	0 Hz
6					
8					
9					
				~	
MSG			STATUS		
			STATUC		

## Highest Channel & Modulation : 8DPSK

Agilent Spectrum Analyzer - Swept SA		SE ALIGN OFF	07:04:42 PM Sep 18, 2019	
Center Freq 17.5000000	000 GHz	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE MWWWWW	Frequency
10 dB/div Ref 25.00 dBm	IFGain:Low Atten: 36 dB		24.458 875 GHz -31.80 dBm	Auto Tune
Log 15.0 5.00				Center Fred 17.500000000 GH;
-15.0			-13.34 dBm	<b>Start Fred</b> 10.000000000 GH:
-45.0 40 - 20 - 20 - 20 - 20 - 20 - 20 - 20				Stop Free 25.000000000 GH:
Start 10.000 GHz #Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep 40	Stop 25.000 GHz .00 ms (40001 pts)	CF Stej 1.500000000 GH <u>Auto</u> Ma
1 N 1 f 24. 2 N 1 f 24.	750 625 GHz -28.88 dBm 244 750 GHz -30.50 dBm 458 875 GHz -31.80 dBm			Freq Offse 0 Hi
6 7 8 9 10				
KSG	m	STATUS		



## 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

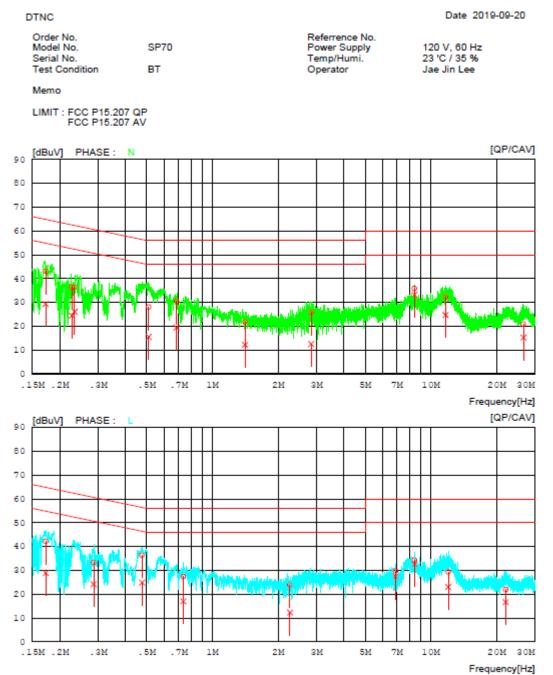
## 8.3 Test Procedures

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>GFSK</u>

## Results of Conducted Emission

Date 2019-09-20

Order No. Model No. SP70 Serial No. Test Condition BT		Referrence No. Power Supply Temp/Humi. Operator		120 V, 60 Hz 23 'C / 35 % Jae Jin Lee				
Mem	0							
LIMI	LIMIT : FCC P15.207 QP FCC P15.207 AV							
NC	FREQ	READING	C.FACTOR	RESULT		TIM	MARGIN	PHASE
	[MHz]	QP CAV [dBuV][dBuV	] [dB]	QP CAV [dBuV][dBu	_		QP CAV ] [dBuV][dBuV	ני
1	0.17227	33.15 19.39	9.94	43.09.29.33	64.85	54.85	21.7625.52	N
2	0.22715	26.5114.53	9.94	36.4524.47	62.55	52.55	26.10 28.08	N
3	0.23379	26.3816.13	9.94	36.32 26.07	62.31	52.31	25.9926.24	N
4	0.51069	18.07 5.56	9.95	28.02 15.51	56.00	46.00	27.98 30.49	N
5	0.68520	20.57 9.43	9.97	30.5419.40		46.00	25.4626.60	N
6	1.41120		9.99	21.84 12.14		46.00	34.1633.86	N
7			10.07	25.78 12.57		46.00	30.22 33.43	N
8		25.49 22.99		35.7633.26			24.2416.74	N
9		21.9314.33		32.32.24.72			27.68 25.28	N
10		10.17 4.57		20.8615.26			39.14 34.74	N
11				42.0828.87			22.7625.97	L
12		23.3614.19		33.30 24.13		50.64	27.3426.51	L
13		26.4214.82		36.37 24.77		46.41	20.0421.64	L
14		17.37 7.05	9.96	27.3317.01			28.67 28.99	L
15	2.26440		10.04	23.78 12.27		46.00	32.22 33.73	L
16		19.4817.20 24.0122.27	10.22	29.7027.42 34.2832.54		50.00	30.3022.58 25.7217.46	L
18		18.94 12.53	10.27	29.33 22.92		50.00	30.6727.08	L
19		11.31 5.98	10.39	21.88 16.55		50.00	38.12 33.45	L
1.5	22.02000	11.01 0.90	10.07	21.0010.00	00.00	00.00	00.12 00.70	-



## 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 connector. Therefore this E.U.T Complies with the requirement of §15.203

#### - Minimum Standard :

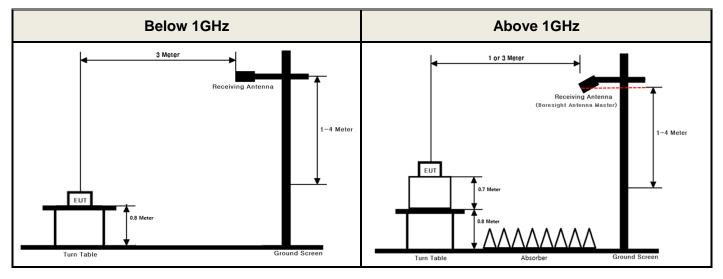
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply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



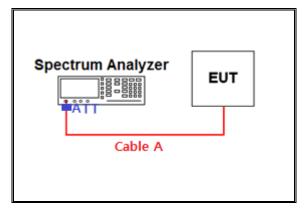
## **APPENDIX I**

### Test set up diagrams

#### Radiated Measurement



#### Conducted Measurement



#### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	3.21	15	4.67
1	3.53	20	5.28
2.402 & 2.441 & 2.480	4.05	25	5.8
5	4.17	-	-
10	4.5	-	-

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

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



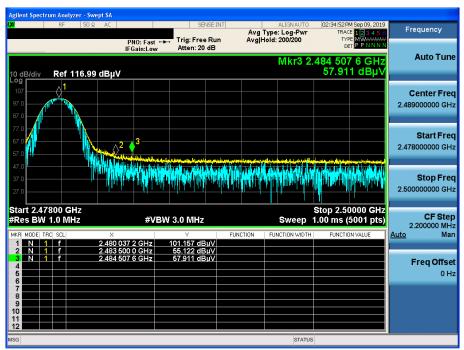
## **APPENDIX II**

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

#### GFSK & Lowest & X & Ver

Frequency Avg Type: Log-Pwi Avg|Hold: 200/200 TRACE TYPE MWH PNO: Fast +++ Trig: Free Run IFGain:Low Atten: 20 dB Auto Tune Mkr3 2.388 593 GH: 53.306 dBµ\ Ref 116.99 dBµV **Center Freq** 2.387500000 GHz Start Freq 2.370000000 GHz **litah mitik** Stop Freq 2.40500000 GHz Stop 2.40500 GHz 1.00 ms (5001 pts) rt 2.37000 GHz es BW 1.0 MHz CF Step 3.500000 MHz #VBW 3.0 MHz Sweep Auto Mar 49.483 dBµ 53.306 dBµ Freq Offset 0 Hz

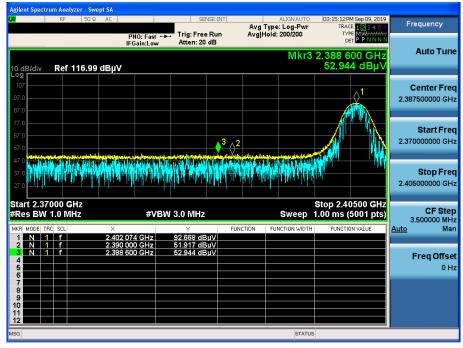
#### GFSK & Highest & X & Ver



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

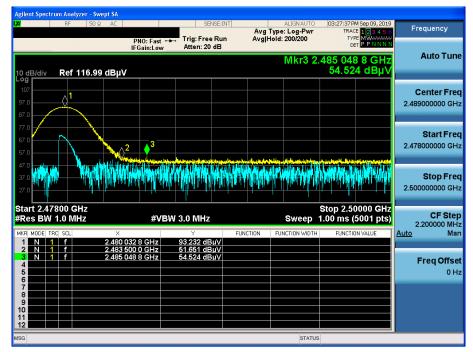


#### $\pi/4DQPSK$ & Lowest & X & Ver



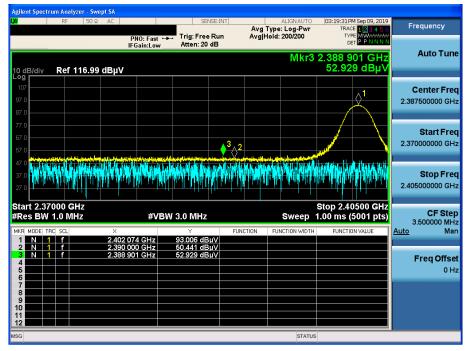
#### **Detector Mode : PK**

#### $\pi/4DQPSK$ & Highest & X & Ver



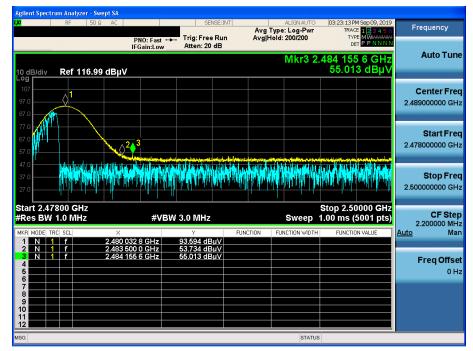


#### 8DPSK & Lowest & X & Ver



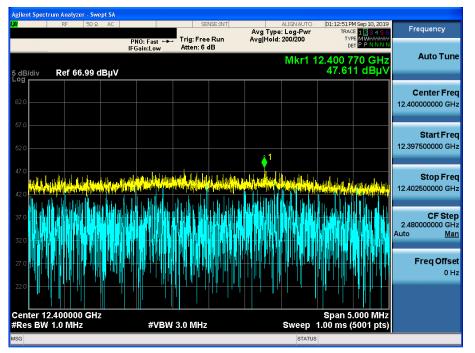
#### **Detector Mode : PK**

#### 8DPSK & Highest & X & Ver

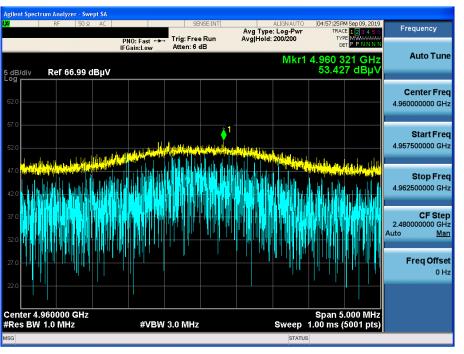




#### GFSK & Middle & Z & Hor



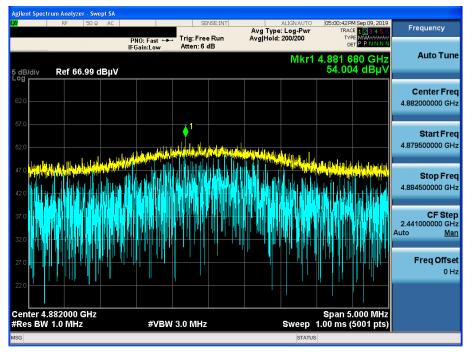
 $\pi$ /4DQPSK & Highest & Y & Hor



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



### 8DPSK & Highest & Y & Hor



### **Detector Mode : PK**