ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	RelaJet Tech (Taiwan) Co., Ltd. 8F., No. 150, Sec. 4, Nanjing E. Rd., Songshan Dist., Taipei City 105, Taiwan (R.O.C.)
Manufacturer:	Dongguan Tymphany Acoustic Technology Co. Ltd. Liuwu Sect, Sanheng Road, Xincheng District,Shekkit Town, Dongguan City, Guangdong Province, P.R.C (TYDG) 523290
Product Name:	RelaJet Tech Hearing Aid(Non-Sterile)
Brand Name:	RelaJet Tech
Model No.:	HFE-001
Model Difference:	N/A
Report Number:	E2/2021/90040
FCC ID	2AX9Z-HFE-001
Issue Date:	July 25, 2022
Date of Test:	October 19, 2021 ~ March 8, 2022
Date of EUT Received:	October 19, 2021

Approved By Jazz Huang

Jazz Huang

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
E2/2021/90040	00	Original	May 13, 2022	Yuri Tsai	
E2/2021/90040	01	Add manufacturer's information	July 25, 2022	Yuri Tsai	*

Note:

1、 The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	RelaJet Tech Hearing Aid(Non-Sterile)
Brand Name:	RelaJet Tech
Model No.:	HFE-001
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
Power Supply:	3.7V
Test Software (Name/Version)	Blue Test3 3.3.5

1.2 RF Specification

Radio Technology:	BT BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + π/4DQPSK + 8DPSK
Transmit Power:	6.78 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	≦ 0.4s

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Monopole	2402-2480	-0.58

Note: Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas. Guidance v05r02
ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.6 Special Accessories

There is no special accessory used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*6m*6m semi-ane choic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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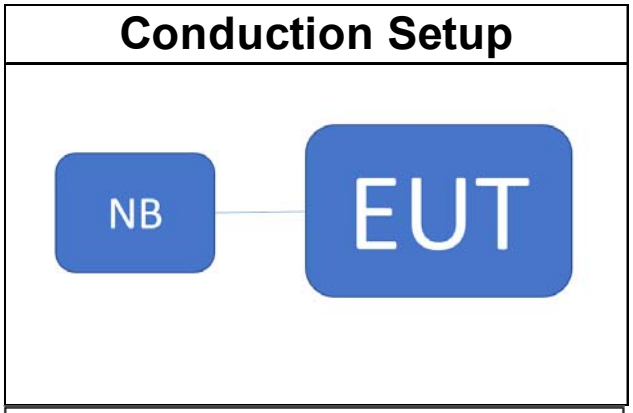
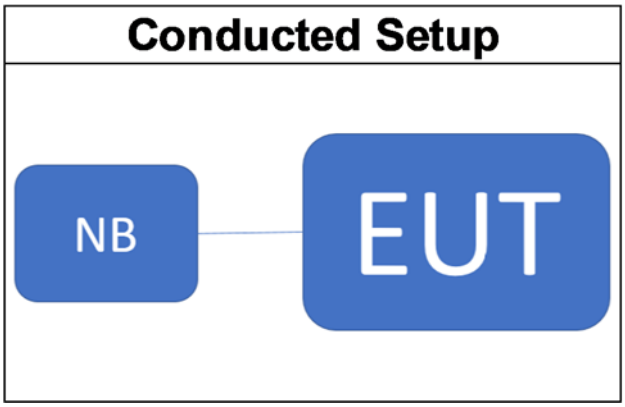
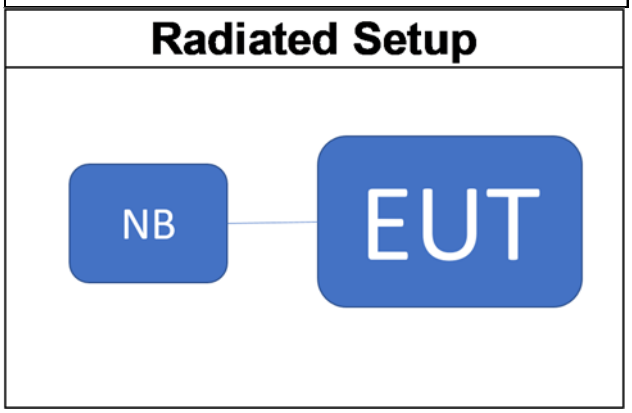
2.5 Test Configuration







2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
Notebook	Lenovo	T470	P0001293	N/A	N/A

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Programing Cable	RelaJet Tech	SO-001	N/A	N.C.R	N.C.R
Notebook	Lenovo	L420	S0011721	N/A	N/A

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R
Notebook	Lenovo	T470	P0001293	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(a)(1)	Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	Conducted & Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequency Time of Occupancy	Compliant
§15.203	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	21	2422 MHz	41	2442 MHz	71	2462 MHz
2	2403 MHz	22	2423 MHz	42	2443 MHz	72	2463 MHz
3	2404 MHz	23	2424 MHz	43	2444 MHz	73	2464 MHz
4	2405 MHz	24	2425 MHz	44	2445 MHz	74	2465 MHz
5	2406 MHz	25	2426 MHz	45	2446 MHz	75	2466 MHz
6	2407 MHz	26	2427 MHz	46	2447 MHz	76	2467 MHz
7	2408 MHz	27	2428 MHz	47	2448 MHz	77	2468 MHz
8	2409 MHz	28	2429 MHz	48	2449 MHz	78	2469 MHz
9	2410 MHz	29	2430 MHz	49	2450 MHz	79	2470 MHz
10	2411 MHz	30	2431 MHz	50	2451 MHz	70	2471 MHz
11	2412 MHz	31	2432 MHz	51	2452 MHz	71	2472 MHz
12	2413 MHz	32	2433 MHz	52	2453 MHz	72	2473 MHz
13	2414 MHz	33	2434 MHz	53	2454 MHz	73	2474 MHz
14	2415 MHz	34	2435 MHz	54	2455 MHz	74	2475 MHz
15	2416 MHz	35	2436 MHz	55	2456 MHz	75	2476 MHz
16	2417 MHz	36	2437 MHz	56	2457 MHz	76	2477 MHz
17	2418 MHz	37	2438 MHz	57	2458 MHz	77	2478 MHz
18	2419 MHz	38	2439 MHz	58	2459 MHz	78	2479 MHz
19	2420 MHz	39	2440 MHz	59	2460 MHz	79	2480 MHz
20	2421 MHz	40	2441 MHz	60	2461 MHz		

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4.2 The Worst Test Modes and Channel Details

1 The EUT has been tested under operating condition.
2 Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3 The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
4 Investigation has been done on all the possible configurations for searching the worst case.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth	0 to 78	39	GFSK	DH5
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth	0 to 78	0,39,78	GFSK/8-DPSK	DH5/3DH5
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case position was reported.				

ANTNNA PORT CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE
Peak Output Power, 20dB Band Width				
Bluetooth	0 to 78	0,39,78	GFSK	DH5
	0 to 78	0,39,78	π/4-DQPSK	2DH5
	0 to 78	0,39,78	8-DPSK	3DH5
Band Edge				
Bluetooth	0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5
Frequency Separation				
Bluetooth	0 to 78	0,1,2,38,39,40,76,77,78	GFSK π/4-DQPSK 8-DPSK	DH5 2DH5 3DH5
Number of hopping frequency				
Bluetooth	0 to 78	0 to 78	GFSK/8-DPSK	DH5/3DH5
Time of Occupancy(Dwell time)				
Bluetooth	0 to 78	39	GFSK	DH1/DH3/DH5
			π/4-DQPSK	2DH1/2DH3/2DH5
			8-DPSK	3DH1/3DH3/3DH5

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.34	dB
Output Power measurement	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
Undesignable radiated emission measurement	+/-	1.68	dB
Frequency Separation	+/-	1.53	Hz
Number of hopping frequency	+/-	1.53	Hz
Time of Occupancy	+/-	1.53	Hz
Temperature	+/-	0.4	°C
Humidity	+/-	3.5	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**2.57**	**dB**	9kHz~30MHz
	+/-	**4.85**	**dB**	30MHz - 1000MHz
	+/-	**4.45**	**dB**	1GHz - 18GHz
	+/-	**4.24**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**2.57**	**dB**	9kHz~30MHz
	+/-	**4.37**	**dB**	30MHz - 1000MHz
	+/-	**4.45**	**dB**	1GHz - 18GHz
	+/-	**4.24**	**dB**	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	03/25/2021	03/24/2022
EMI Test Receiver	R&S	ESCI	101342	04/28/2021	04/27/2022
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2021	03/26/2022
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2021	03/26/2022
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071574	06/25/2021	06/25/2022
Power Meter	Anritsu	ML2496A	1804002	04/14/2021	04/13/2022
Power Sensor	Anritsu	MA2411B	1726105	04/14/2021	04/13/2022
Power Sensor	Anritsu	MA2411B	1726106	04/14/2021	04/13/2022
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Marvelous	WATT-218FS-10	RF15	11/19/2020	11/18/2021
Attenuator	Marvelous	WATT-218FS-10	RF16	11/19/2020	11/18/2021
DC Block	PASTERNACK	PE8210	RF158	11/19/2020	11/18/2021
Attenuator	Marvelous	WATT-218FS-10	RF15	11/18/2021	11/17/2022
Attenuator	Marvelous	WATT-218FS-10	RF16	11/18/2021	11/17/2022
DC Block	PASTERNACK	PE8210	RF158	11/18/2021	11/17/2022

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6.3 Radiated Measurement

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	10/19/2021	10/18/2022
Horn Antenna	SCHWARZBECK	BBHA9170	185	08/06/2021	08/05/2022
Horn Antenna	SCHWARZBECK	BBHA9120D	1187	01/06/2022	01/05/2023
Loop Antenna	ETS.LINDGREN	6502	143303	05/07/2021	05/06/2022
EMI Test Receiver	R&S	ESU 40	100363	04/28/2021	04/27/2022
Bluetooth Test Set	Anritsu	MT8852B	1329002	04/09/2021	04/08/2022
Bluetooth Test Set	R&S	CBT	101140	05/09/2021	05/08/2022
Pre-Amplifier	EMC Instruments	EMC330	980096	11/18/2021	11/17/2022
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/18/2021	11/17/2022
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2021	10/26/2022
Attenuator	Marvelous	WATT-218FS-10	RF20	11/18/2021	11/17/2022
Band Rejection Filter	Micro-Tronics	BRM50701-01	RF201	11/18/2021	11/17/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/18/2021	11/17/2022
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/18/2021	11/17/2022
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R

NOTE: *N.C.R refers to Not Calibrated Required.*

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7 CONDUCTED EMISSION TEST

7.1 Standard Applicable

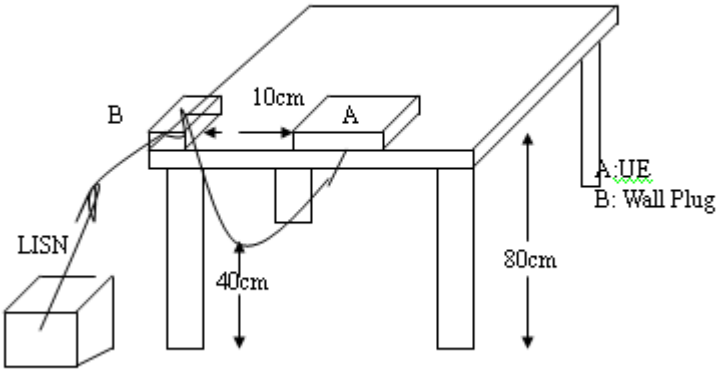
Frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

7.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test Setup



7.4 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

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7.5 Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The * reveals the worst-case results that closet to the limit.

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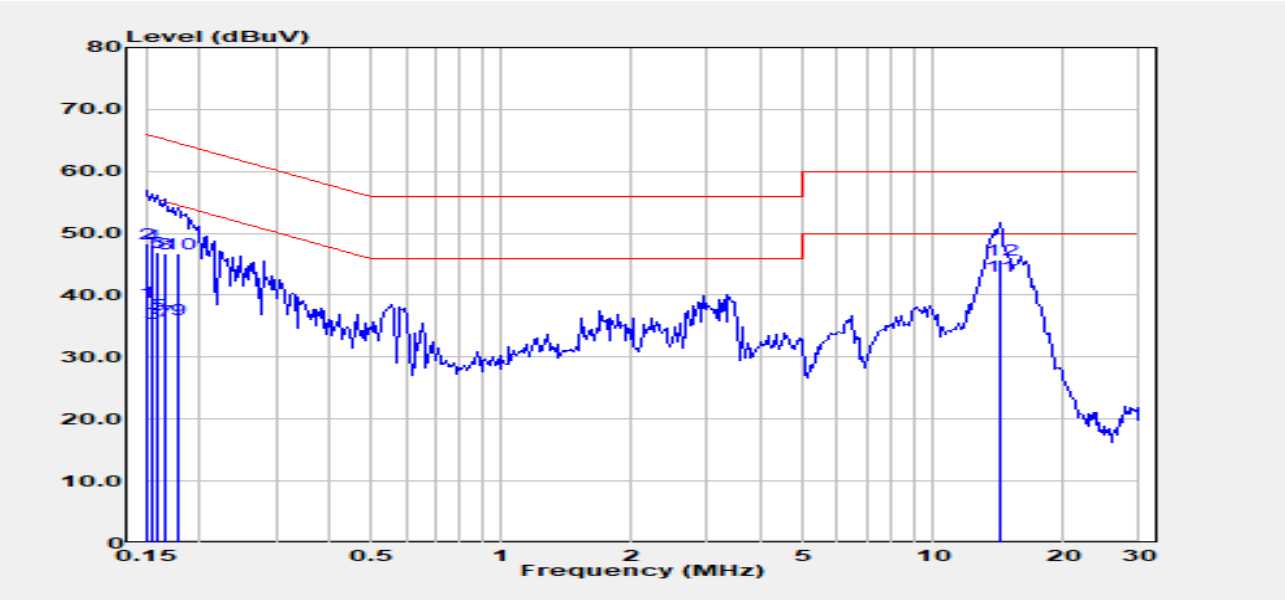
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:E2/2021/90040	Test Site	:Conduction C
Test Mode	:BT	Test Date	:2022-03-08
Power	:120V60Hz	Temp./Humi.	:18.9/49
Probe	:L	Engineer	:Andy wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.152	Average	28.60	10.30	38.90	55.91	-17.01
0.152	QP	38.10	10.30	48.40	65.91	-17.51
0.155	Average	25.10	10.30	35.40	55.74	-20.34
0.155	QP	37.80	10.30	48.10	65.74	-17.64
0.160	Average	26.50	10.30	36.80	55.47	-18.67
0.160	QP	36.70	10.30	47.00	65.47	-18.47
0.167	Average	25.60	10.30	35.90	55.12	-19.22
0.167	QP	36.50	10.30	46.80	65.12	-18.32
0.178	Average	25.70	10.30	36.00	54.59	-18.59
0.178	QP	36.40	10.30	46.70	64.59	-17.89
14.288	Average	32.30	10.77	43.07	50.00	-6.93
14.288	QP	35.00	10.77	45.77	60.00	-14.23

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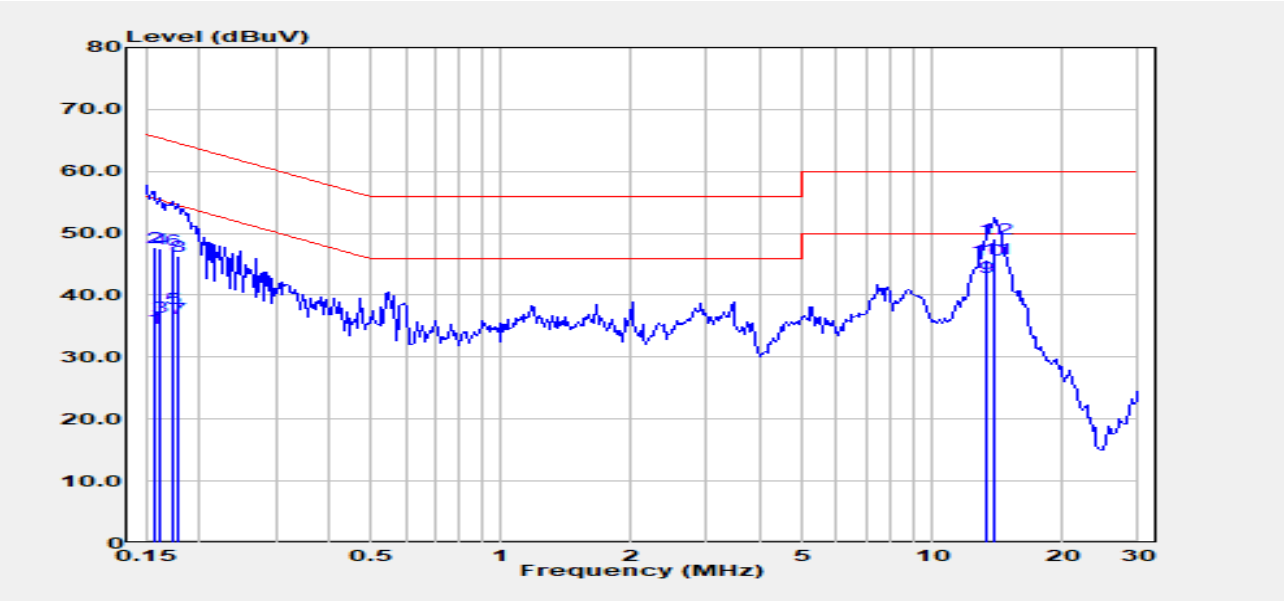
Report Number	:E2/2021/90040	Test Site	:Conduction C
Test Mode	:BT	Test Date	:2022-03-08
Power	:120V60Hz	Temp./Humi.	:18.9/49
Probe	:N	Engineer	:Andy wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.156	Average	24.30	10.31	34.61	55.65	-21.04
0.156	QP	37.40	10.31	47.71	65.65	-17.94
0.162	Average	26.10	10.31	36.41	55.38	-18.98
0.162	QP	37.20	10.31	47.51	65.38	-17.88
0.172	Average	27.50	10.31	37.81	54.86	-17.05
0.172	QP	37.00	10.31	47.31	64.86	-17.55
0.178	Average	26.00	10.30	36.30	54.59	-18.29
0.178	QP	36.10	10.30	46.40	64.59	-18.19
13.408	Average	32.00	10.83	42.83	50.00	-7.17
13.408	QP	34.90	10.83	45.73	60.00	-14.27
13.989	Average	35.10	10.85	45.95	50.00	-4.05
13.989	QP	38.30	10.85	49.15	60.00	-10.85

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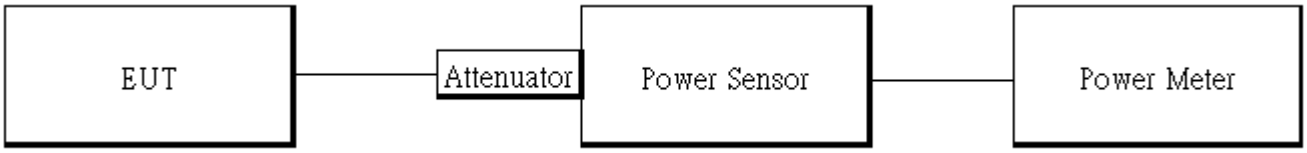
8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

8.2 Test Setup



8.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB band-width)
4. Record the max. reading.
5. Repeat above procedures until all default test channel is completed.

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8.4 Peak & Average Power Measurement Result

1M BR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	6.57	4.539	1000
Mid	2441	5	**6.78**	4.764	1000
High	2480	5	6.69	4.667	1000

1M BR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	6.45	4.411	1000
Mid	2441	5	6.59	4.555	1000
High	2480	5	6.52	4.482	1000

2M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	4.81	3.027	125
Mid	2441	5	**5.04**	3.192	125
High	2480	5	4.98	3.148	125

2M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	2.22	1.665	125
Mid	2441	5	2.35	1.716	125
High	2480	5	2.29	1.692	125

3M EDR mode (Peak):

CH	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	5.33	3.412	125
Mid	2441	5	**5.59**	3.622	125
High	2480	5	5.48	3.532	125

NOTE: cable loss as 11dB that offsets in the spectrum

3M EDR mode (Average):

CH	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	5	2.35	1.716	125
Mid	2441	5	2.50	1.776	125
High	2480	5	2.46	1.760	125

**Note: Max. Output include tune up tolerance Power measured by using average detector.*

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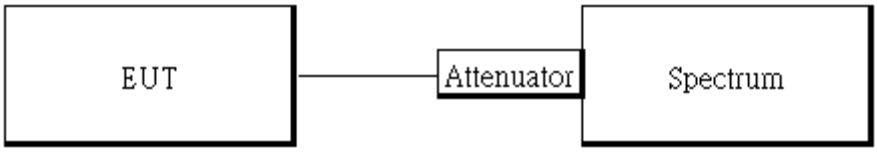
9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

For frequency hopping systems operating in the 2400 MHz-2483.5 MHz no limit for 20dB bandwidth.

9.2 Test Setup



9.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as
   RBW= 1 % to 5% of OBW ,
   VBW = 3 X RBW,
   Span= 2 to 5 times of the OBW,
   Sweep=auto,
   Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and –20dB (upper and lower) frequency
6. Repeat above procedures until all test default channel is completed

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9.4 20dB Bandwidth

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.962	0.64
Mid	0.9625	0.64
High	0.9604	0.64

π/4-DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.336	0.89
Mid	1.336	0.89
High	1.334	0.89

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.313	0.88
Mid	1.312	0.87
High	1.311	0.87

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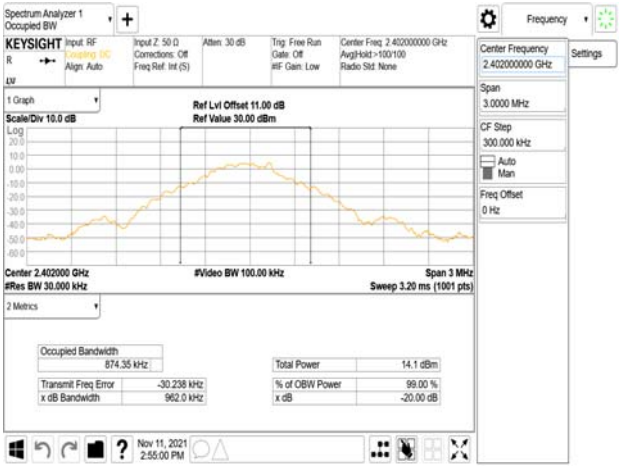
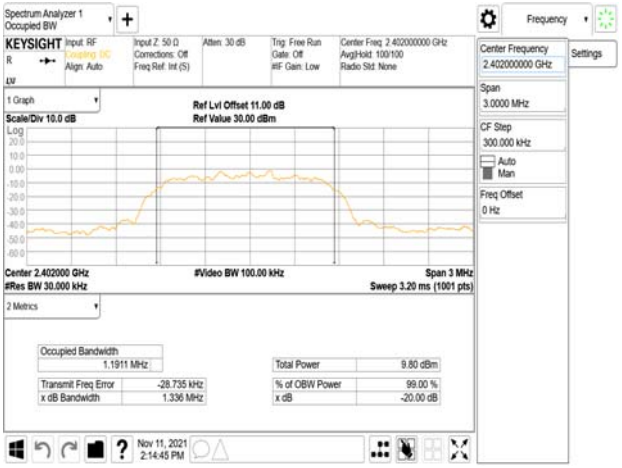
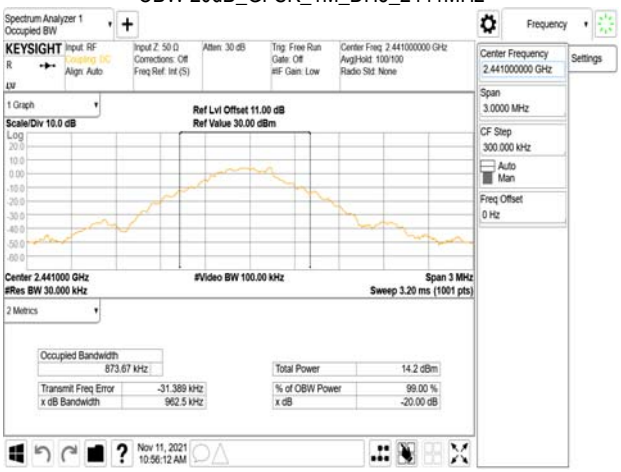
OBW 20dB_GFSK_1M_DH5_2402MHz



OBW 20dB_π/4DQPSK_2M_DH5_2402MHz



OBW 20dB_GFSK_1M_DH5_2441MHz



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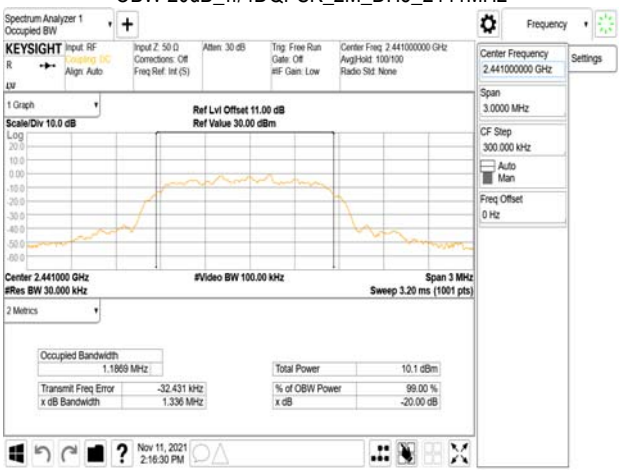

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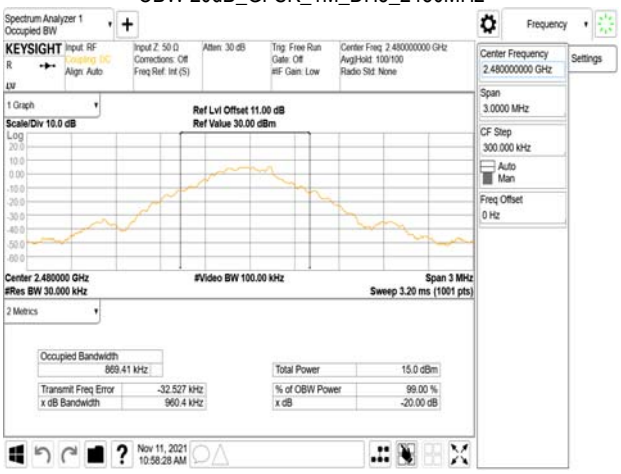

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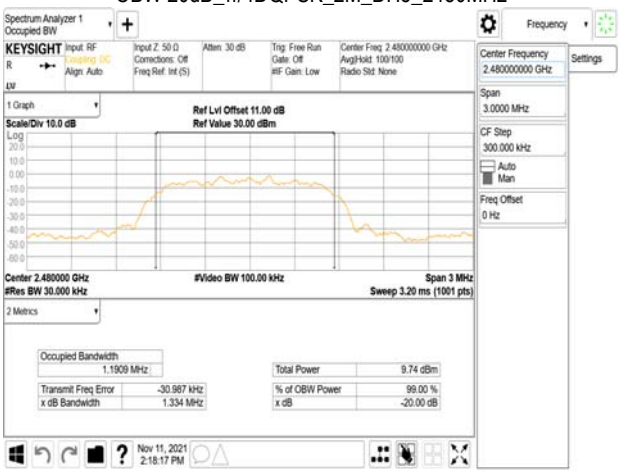

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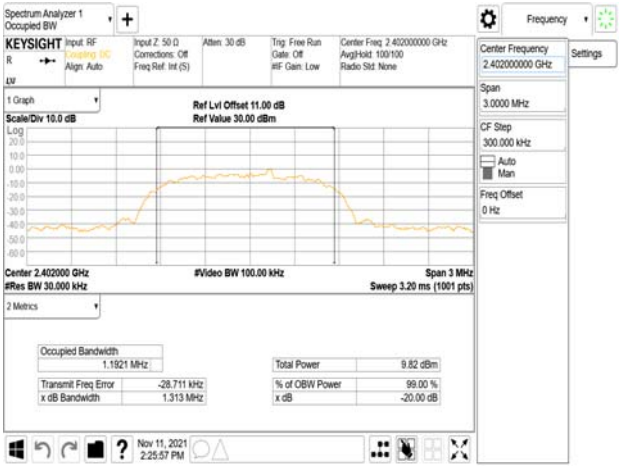
OBW 20dB_8DPSK_3M_DH5_2402MHz



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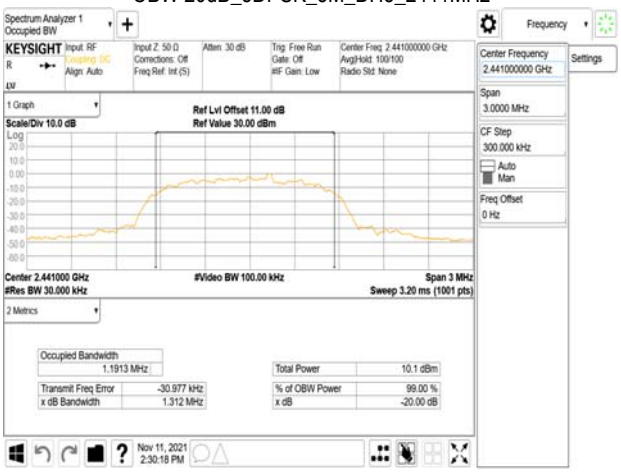
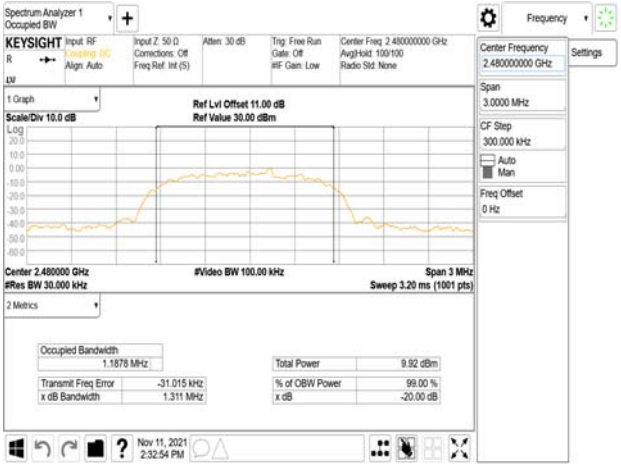


OBW 20dB_8DPSK_3M_DH5_2480MHz



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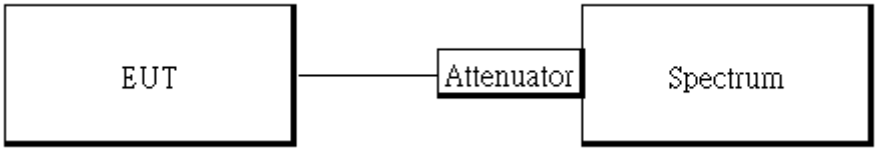
10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Test Setup



10.3 Measurement Procedure

10.3.1 Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
6. Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
7. Repeat above procedures until all frequency measured were complete.

10.3.2 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows ANSI C63.10:2013.
3. Set RBW = 100 kHz & VBW = 300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

See next page for test plots.

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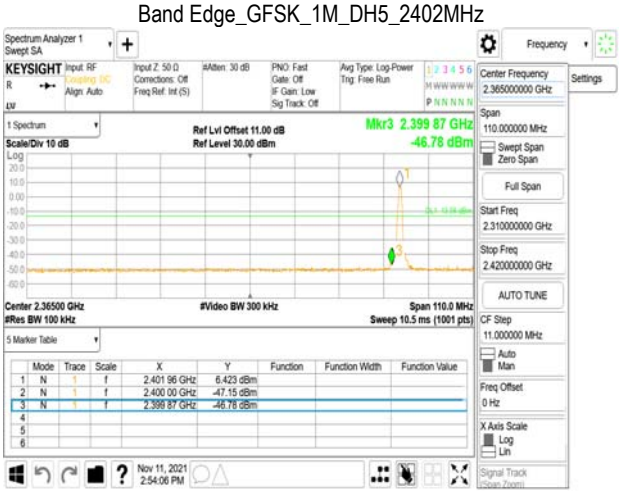
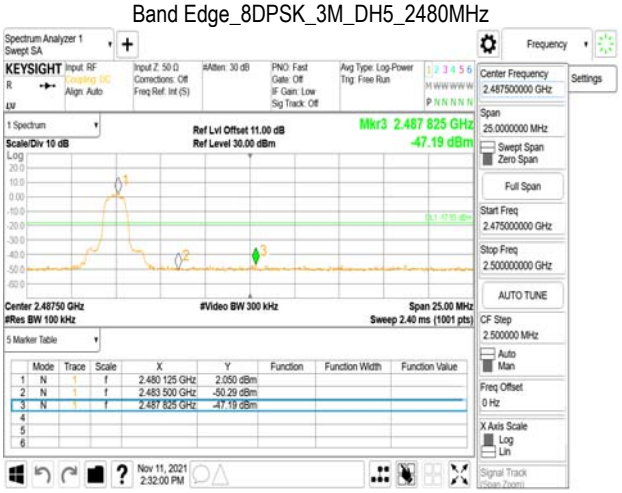
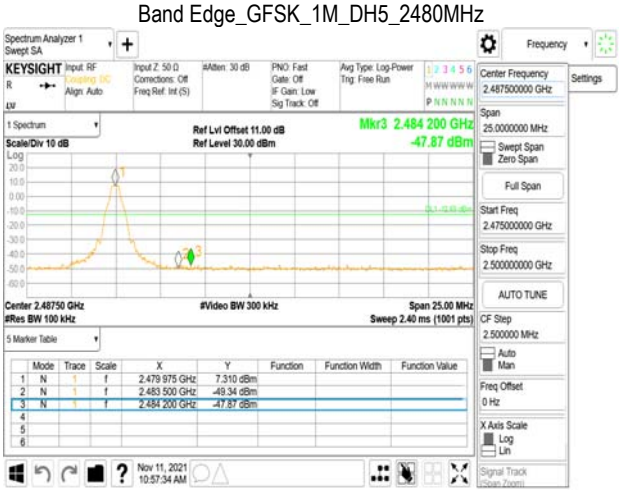
Band Edge_GFSK_1M_DH5_2402MHz



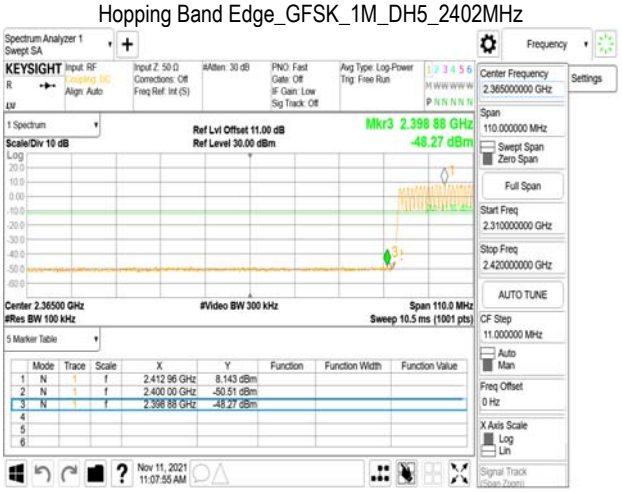
Band Edge_8DPSK_3M_DH5_2480MHz



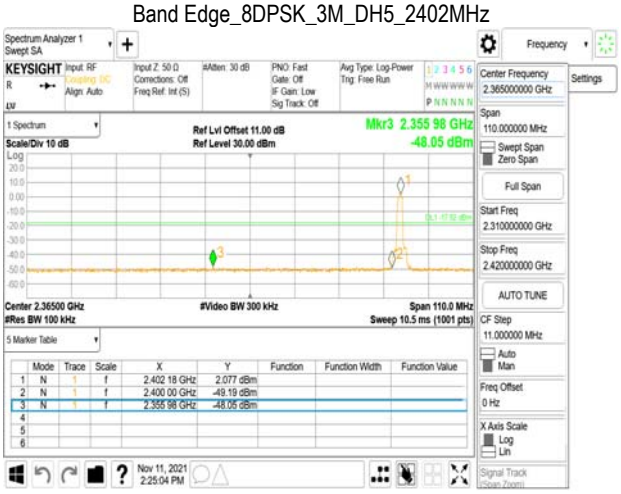
Band Edge_GFSK_1M_DH5_2480MHz



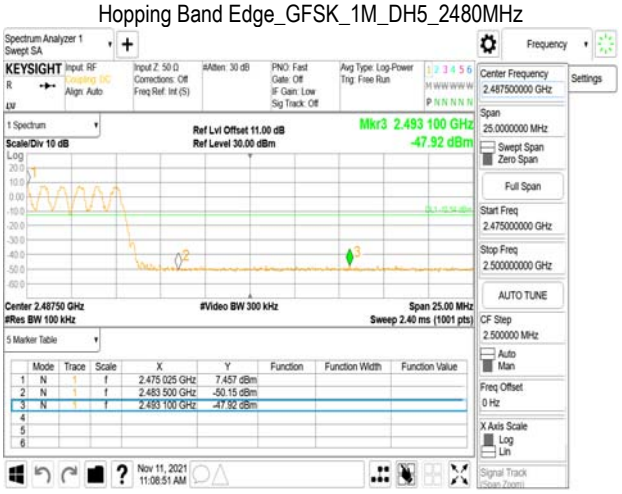
Hopping Band Edge_GFSK_1M_DH5_2402MHz



Band Edge_8DPSK_3M_DH5_2402MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz



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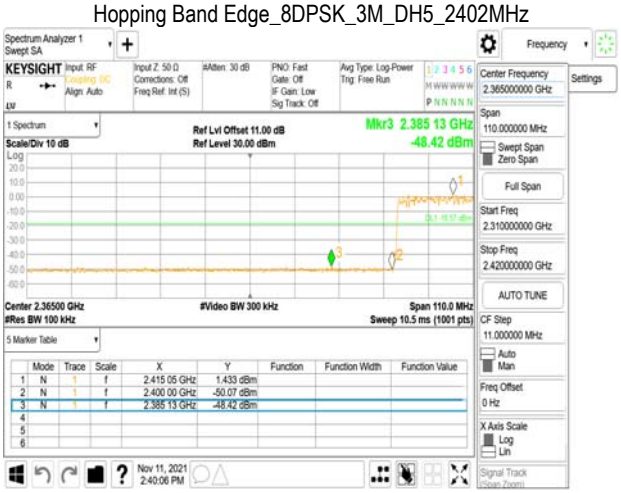
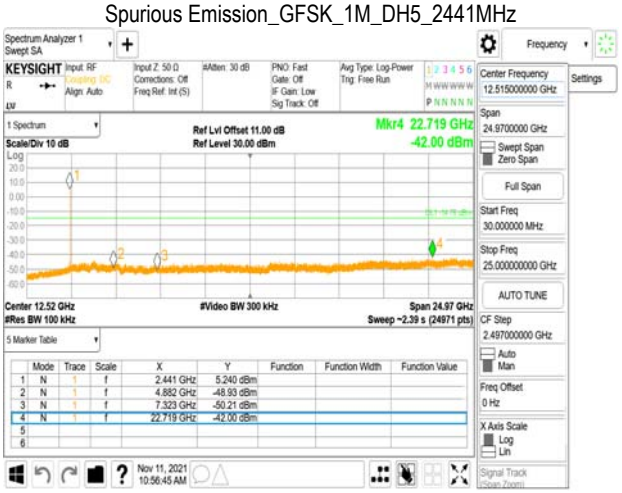
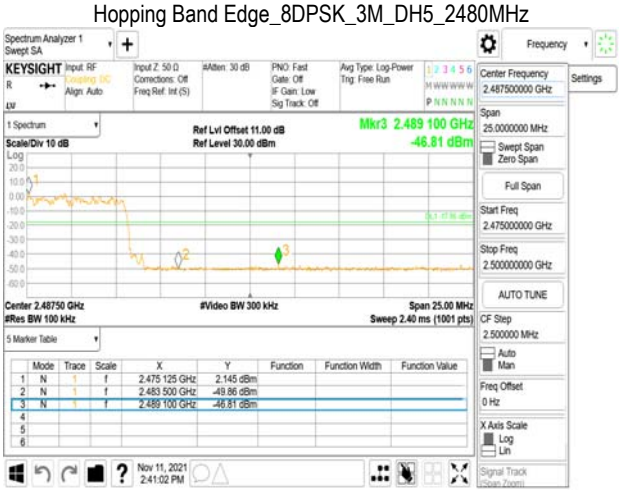
Hopping Band Edge_8DPSK_3M_DH5_2402MHz



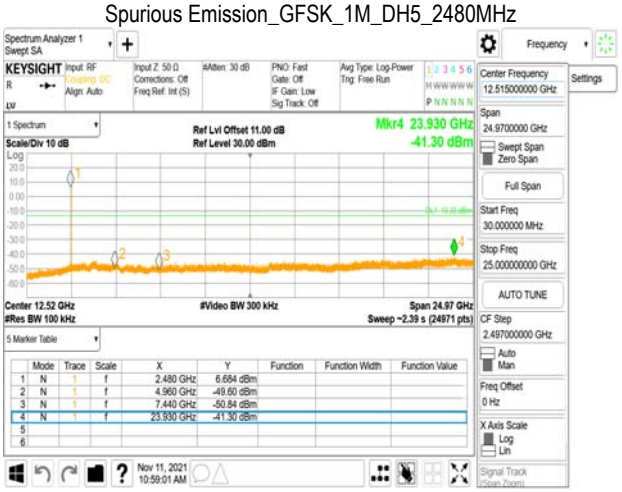
Spurious Emission_GFSK_1M_DH5_2441MHz



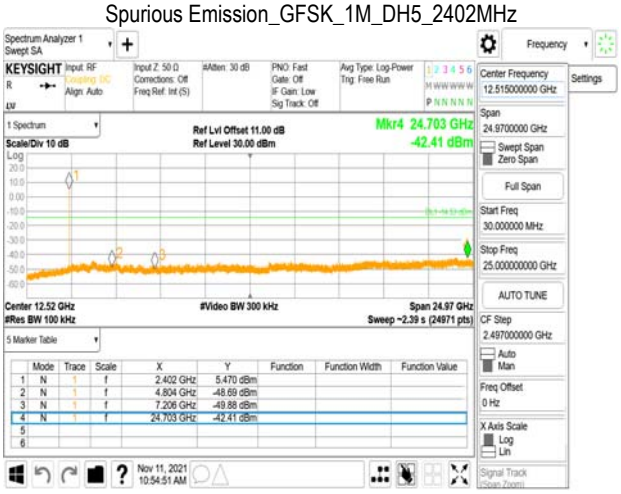
Hopping Band Edge_8DPSK_3M_DH5_2480MHz



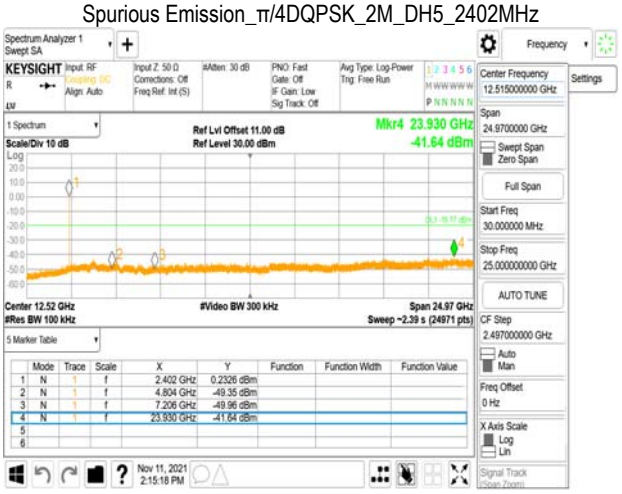
Spurious Emission_GFSK_1M_DH5_2480MHz



Spurious Emission_GFSK_1M_DH5_2402MHz



Spurious Emission_π/4DQPSK_2M_DH5_2402MHz



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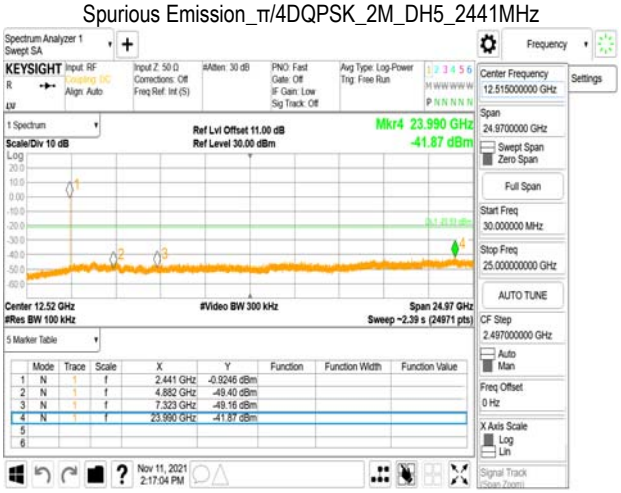
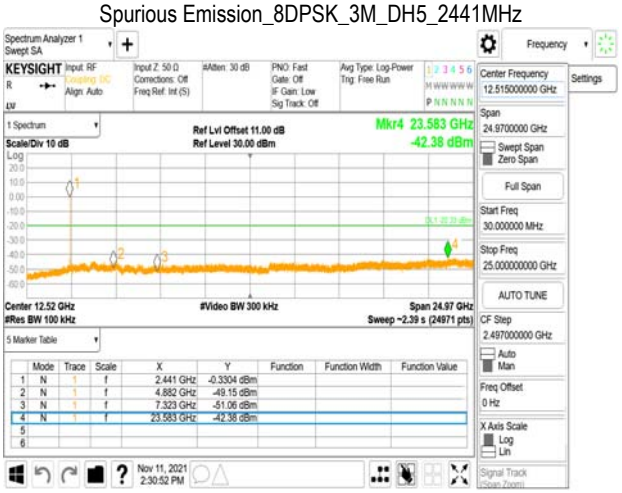
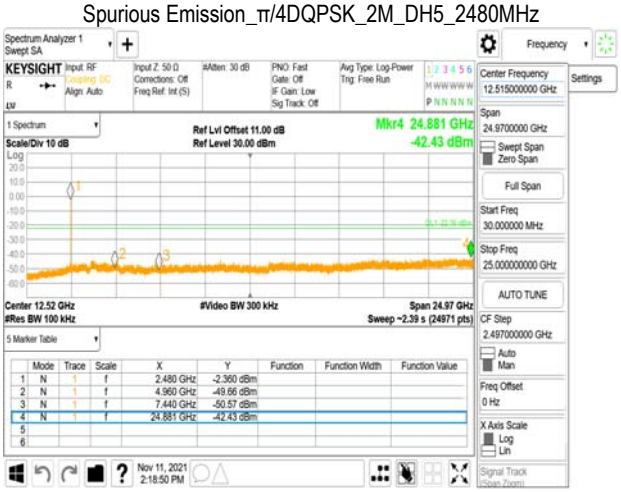
Spurious Emission_π/4DQPSK_2M_DH5_2441MHz



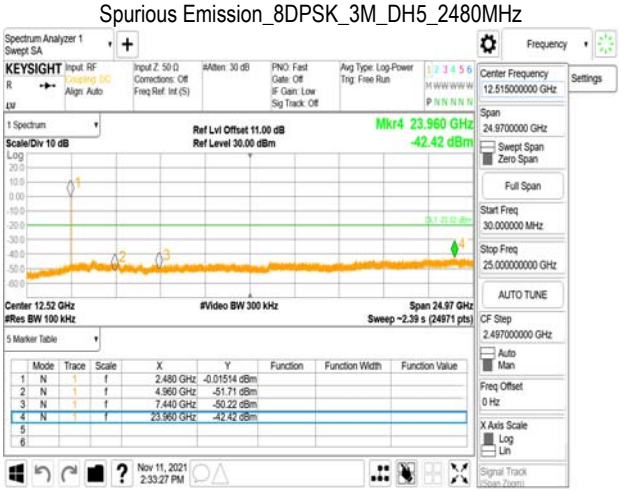
Spurious Emission_8DPSK_3M_DH5_2441MHz



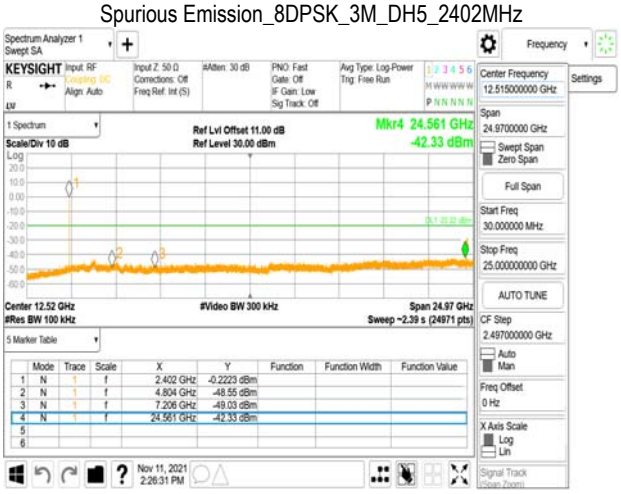
Spurious Emission_π/4DQPSK_2M_DH5_2480MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



Spurious Emission_8DPSK_3M_DH5_2402MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

11.1.1 Duty Cycle Correction Factor

According to 15. 35(c), the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification.

11.1.2 Spurious Emission

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. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.
And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. *The lower limit shall apply at the transition frequencies.*

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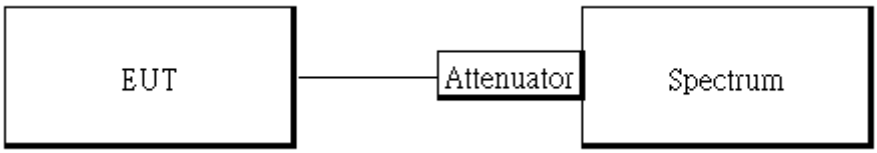
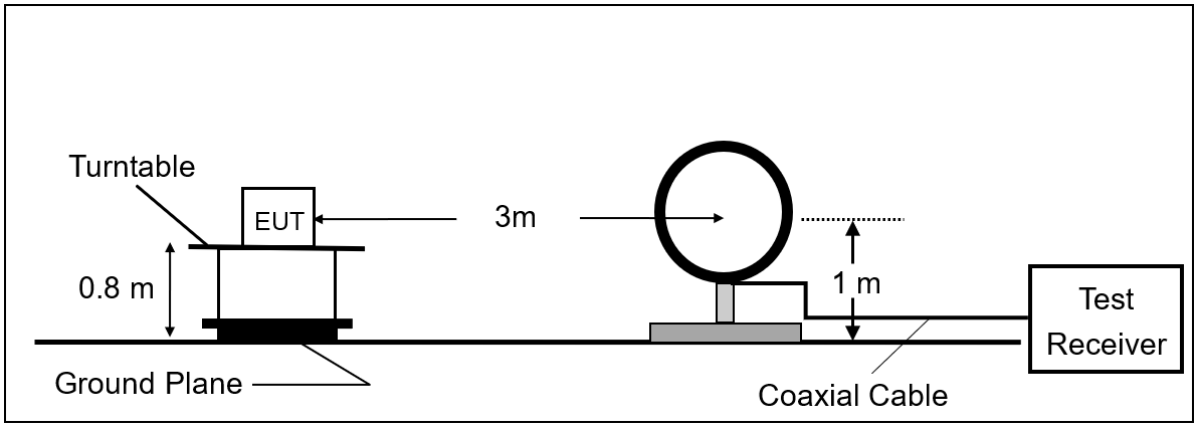
11.2 Test Setup

11.2.1 Duty Cycle Correction Factor

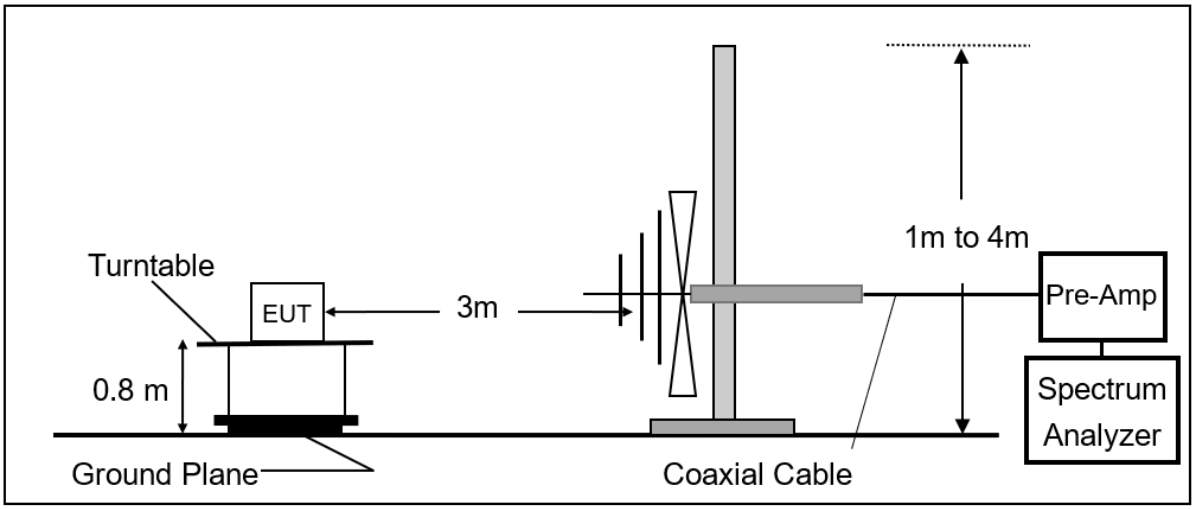


11.2.2 Radiated Emission

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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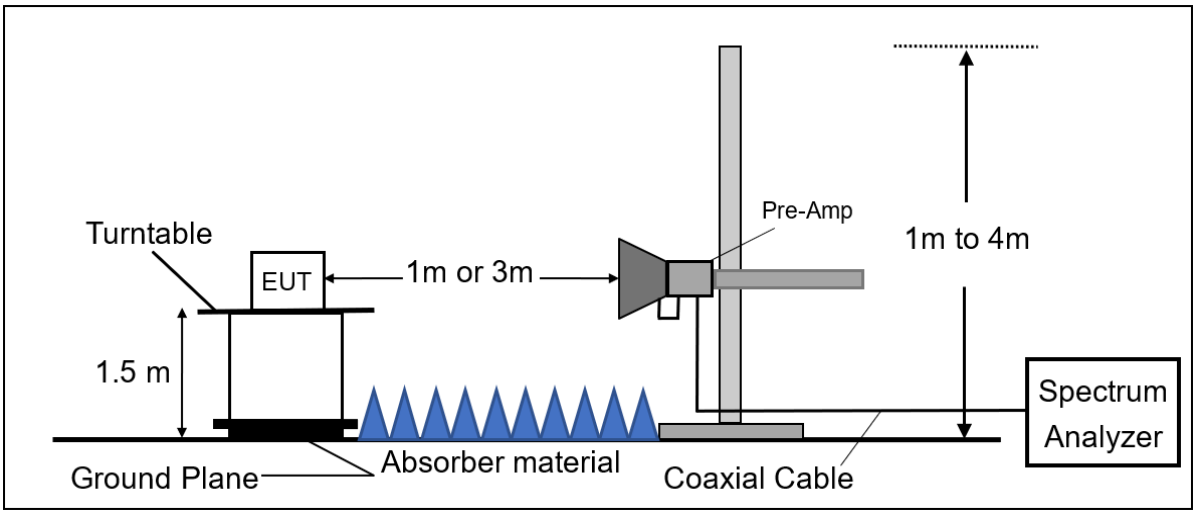
(C) Radiated Emission Test Set-Up, Frequency Above 1 GHz.



11.3 Measurement Procedure

11.3.1 Duty Cycle Correction Factor

1. Adjust and configure any EUT switches, controls, or input data streams to ensure that the EUT is transmitting or encoded to obtain the “worst-case” pulse ON time.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~8ms.
6. Repeat above procedures until all frequency of the interest measured were complete.

11.3.2 Radiated Emission

1. The testing follows the Measurement Procedure of ANSI C63.10:2013.
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=100 kHz and VBW=300 kHz for Peak Detector (PK) at frequency between 30MHz and 1 GHz.
6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.

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7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
8. According to C63.10:2013 Section 7.5 Procedure for determining the average value of pulsed emissions with duty cycle correction factor 20 log (T_{on}/100ms).
9. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
12. Repeat above procedures until all default test channel measured were complete.

11.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS = Field Strength*
RA = Reading Amplitude
AF = Antenna Factor
CL = Cable Attenuation Factor (Cable Loss)
AG = Amplifier Gain

*The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)*

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Average value(dBμV/m)=Peak Actual FS(dBμV/m)+ Duty Cycle Correction Factor(dB)

Duty Cycle Correction Factor(dB) = 20 log (T_{on}/100 ms)

11.5 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

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11.6 Measurement Result:

11.6.1 Duty Cycle Correction Factor

BR			
Time ON of 100ms:	58.333	ms	
Duty Cycle=58.3334ms / 100ms=	0.583334	%	
Duty Cycle correction factor=20 LOG 0.583334=		-4.68	dB

EDR			
Time ON of 100ms:	74.999	ms	
Duty Cycle=74.999ms / 100	0.74999	%	
Duty Cycle correction factor=20 LOG 0.74999		-2.50	dB

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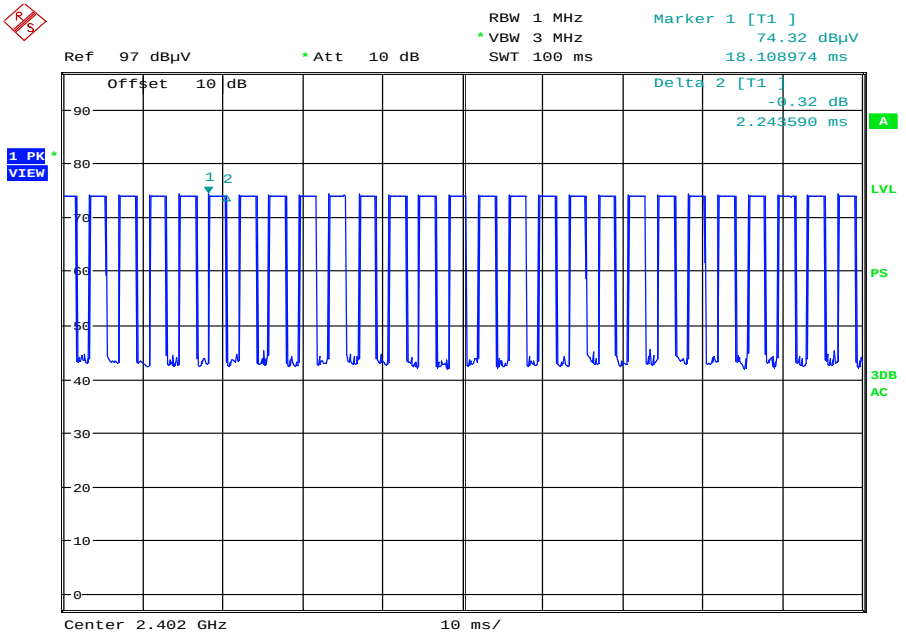
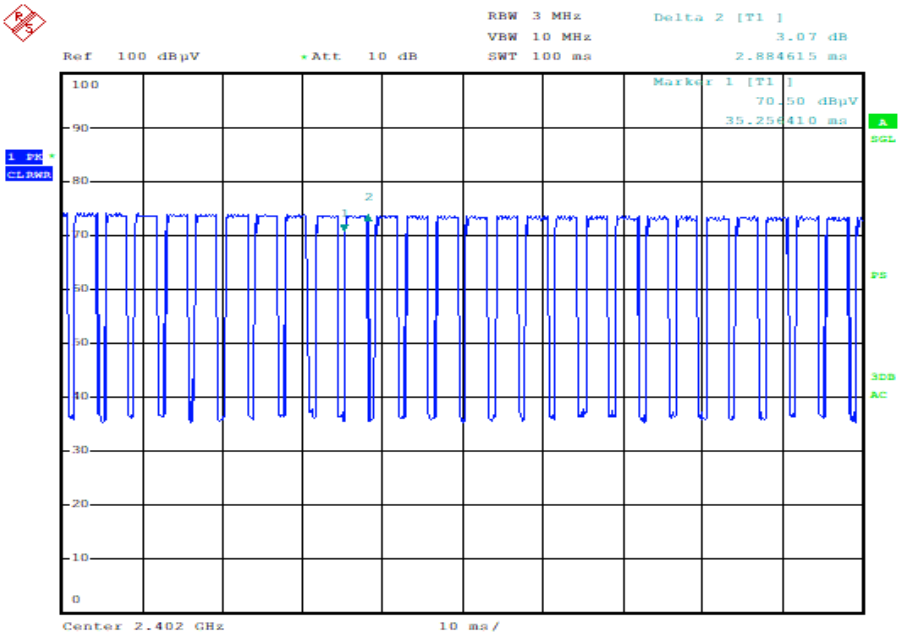
11.6.2 Duty Cycle test plot

BR



Date: 2.MAR.2022 12:05:37

EDR



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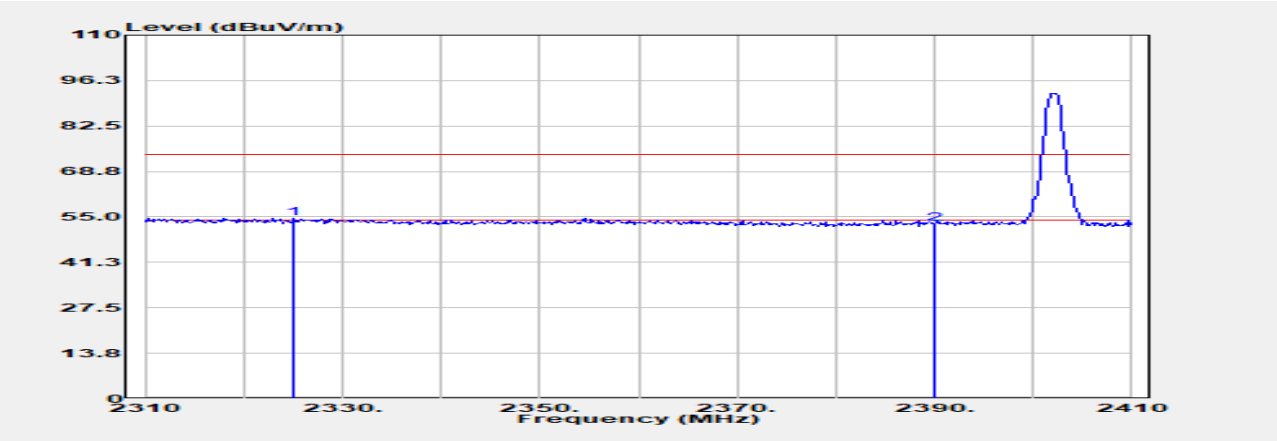
11.6.3 Bandedge Result

Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2325.064	Peak	48.87	5.76	54.62	74.00	-19.38
2390.000	Peak	47.82	5.18	53.00	74.00	-21.00

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2325.064	Average	54.62	-4.68	49.94	54.00	-4.06
2390.000	Average	53.00	-4.68	48.32	54.00	-5.68

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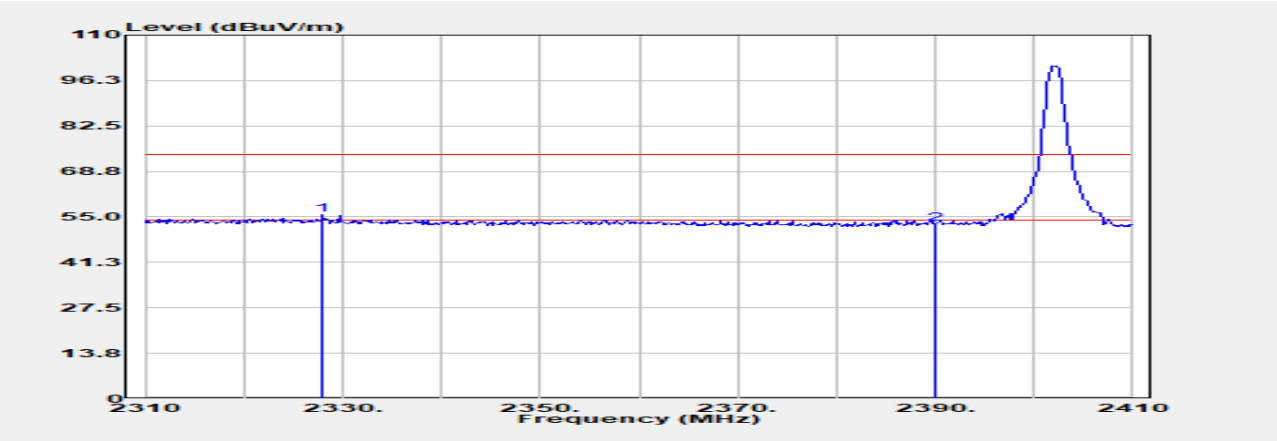
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2327.949	Peak	49.94	5.72	55.66	74.00	-18.34
2390.000	Peak	47.71	5.18	52.89	74.00	-21.11

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2327.949	Average	55.66	-4.68	50.98	54.00	-3.02
2390.000	Average	52.89	-4.68	48.21	54.00	-5.79

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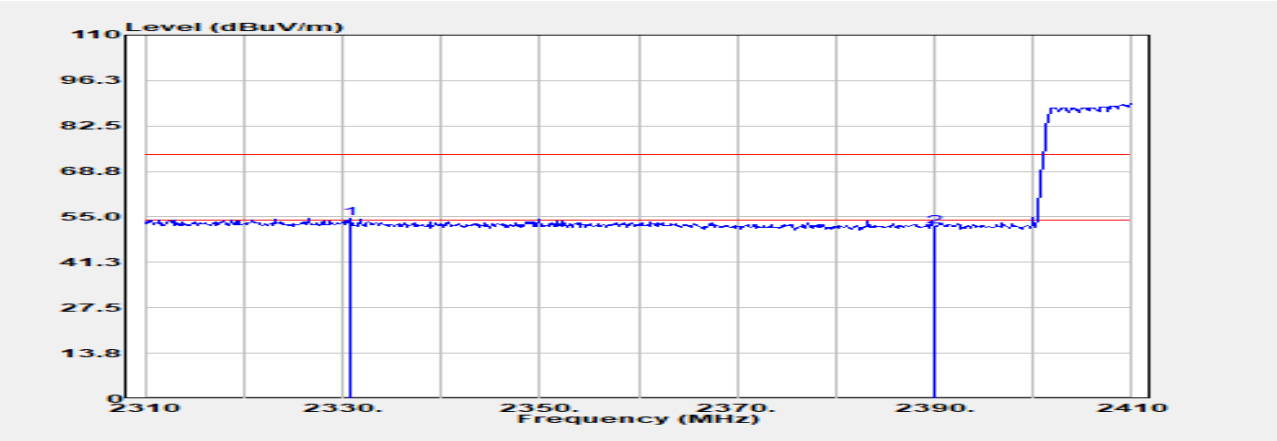
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR Hopping	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2330.673	Peak	48.93	5.67	54.60	74.00	-19.40
2390.000	Peak	47.04	5.18	52.22	74.00	-21.78

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2330.673	Average	54.60	-4.68	49.92	54.00	-4.08
2390.000	Average	52.22	-4.68	47.54	54.00	-6.46

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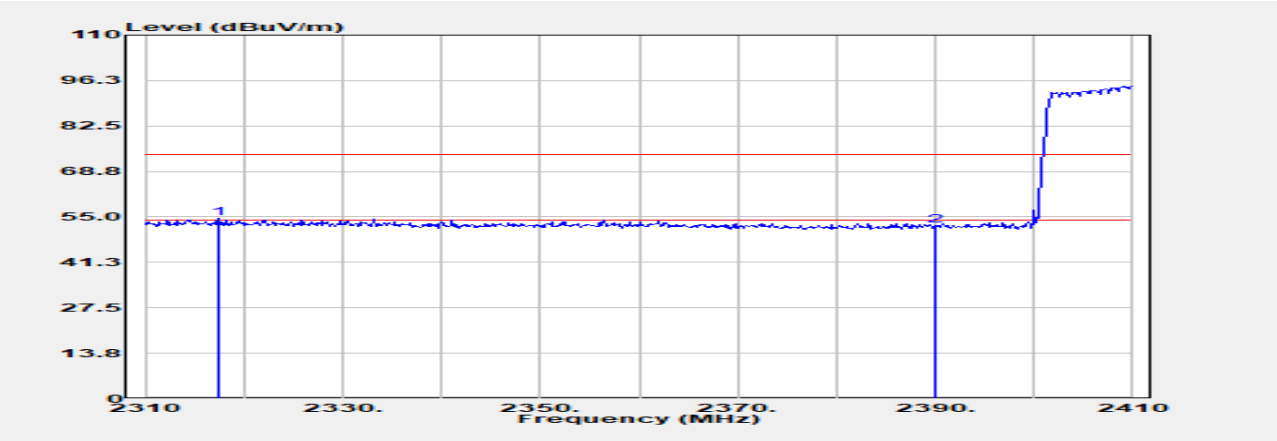
Operation Mode	:BT BR Hopping	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2317.532	Peak	48.69	5.80	54.49	74.00	-19.51
2390.000	Peak	47.30	5.18	52.48	74.00	-21.52

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2317.532	Average	54.49	-4.68	49.81	54.00	-4.19
2390.000	Average	52.48	-4.68	47.80	54.00	-6.20

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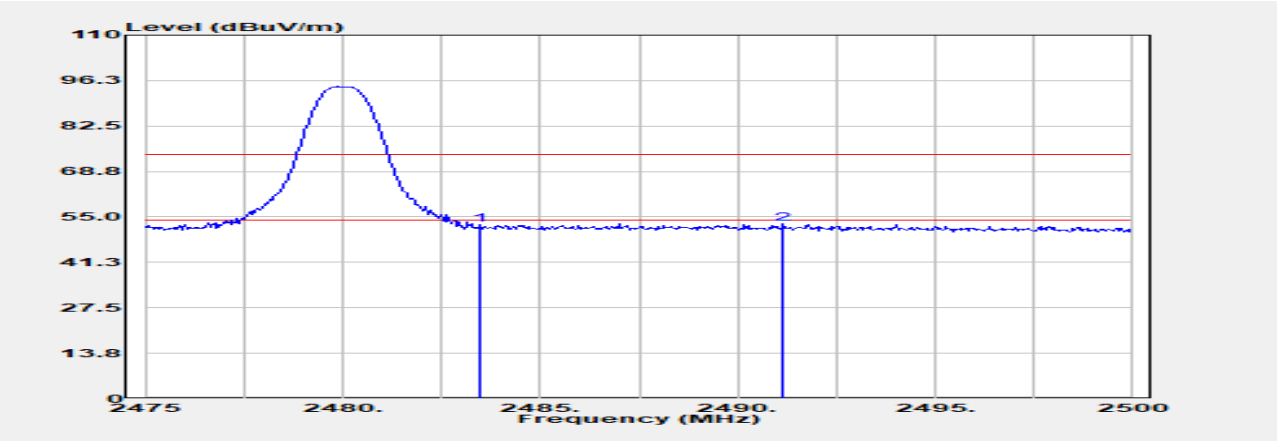
Operation Mode	:BT BR	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	48.56	4.04	52.60	74.00	-21.40
2491.146	Peak	48.99	3.91	52.90	74.00	-21.10

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	52.60	-4.68	47.92	54.00	-6.08
2491.146	Average	52.90	-4.68	48.22	54.00	-5.78

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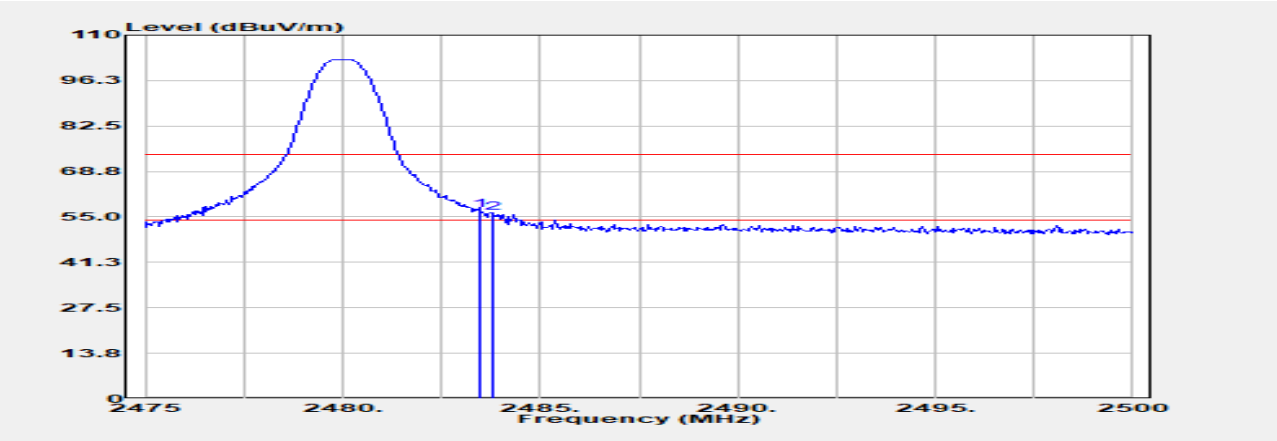
Operation Mode	:BT BR	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	53.11	4.04	57.15	74.00	-16.85
2483.774	Peak	52.19	4.03	56.22	74.00	-17.78

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	57.15	-4.68	52.47	54.00	-1.53
2483.774	Average	56.22	-4.68	51.54	54.00	-2.46

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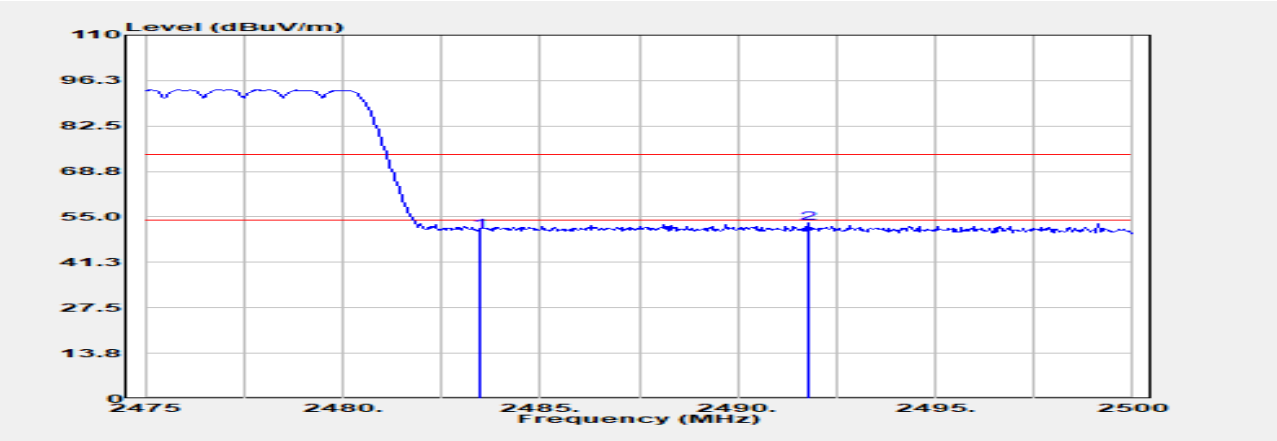
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR Hopping	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	47.10	4.04	51.14	74.00	-22.86
2491.787	Peak	49.25	3.87	53.12	74.00	-20.88

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	51.14	-4.68	46.46	54.00	-7.54
2491.787	Average	53.12	-4.68	48.44	54.00	-5.56

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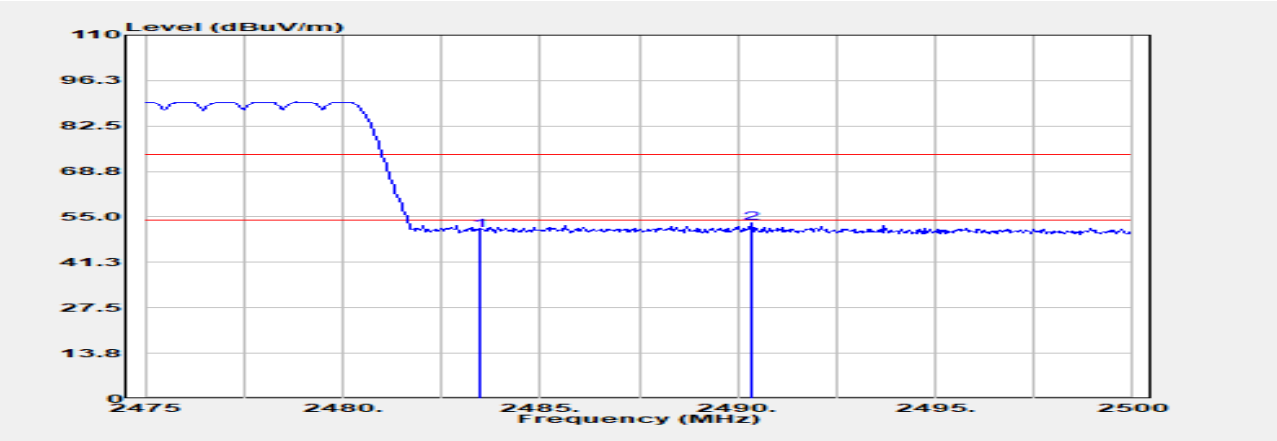
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR Hopping	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	47.01	4.04	51.04	74.00	-22.96
2490.344	Peak	49.14	3.96	53.09	74.00	-20.91

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	51.04	-4.68	46.36	54.00	-7.64
2490.344	Average	53.09	-4.68	48.41	54.00	-5.59

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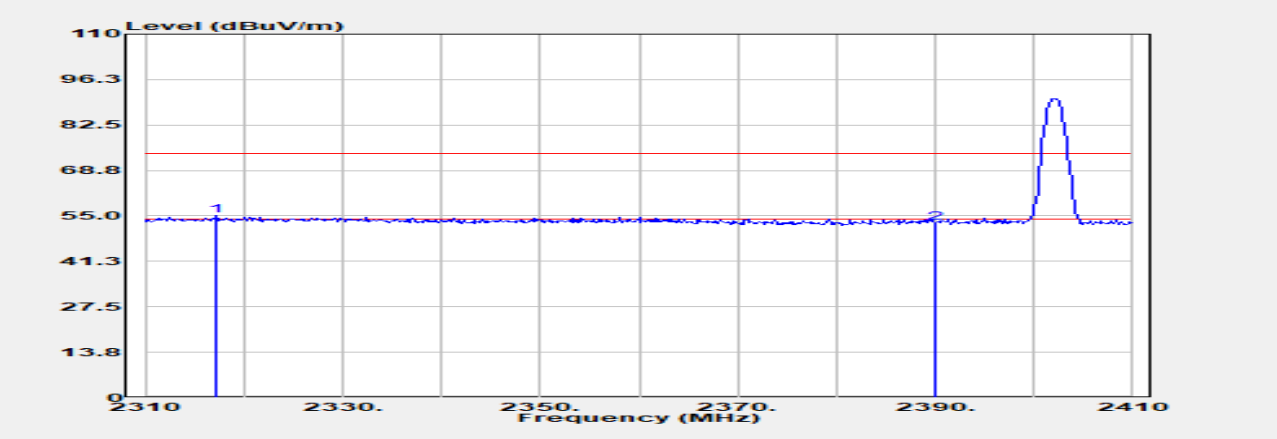
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2317.211	Peak	49.28	5.80	55.08	74.00	-18.92
2390.000	Peak	47.84	5.18	53.02	74.00	-20.98

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2317.211	Average	55.08	-2.50	52.58	54.00	-1.42
2390.000	Average	53.02	-2.50	50.52	54.00	-3.48

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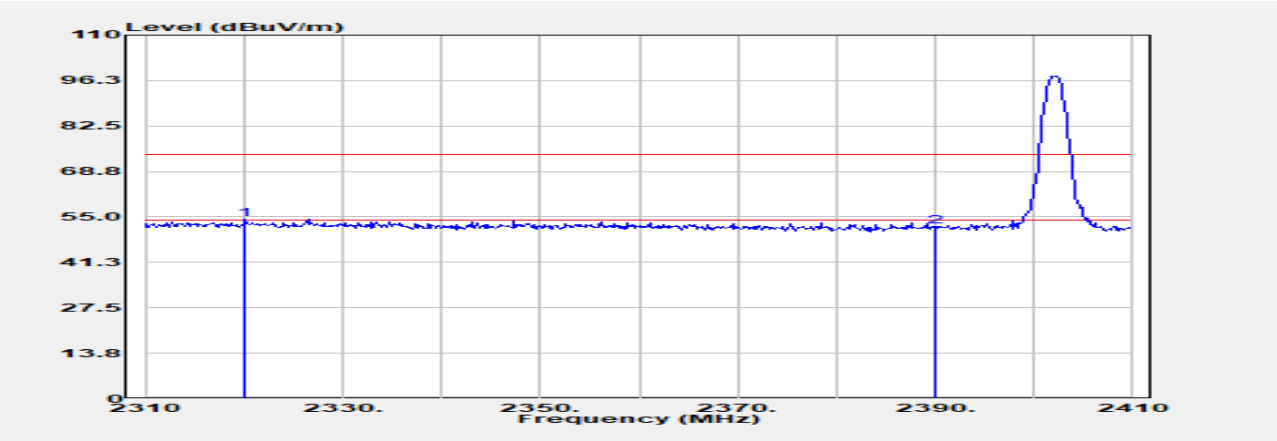
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2320.096	Peak	48.57	5.82	54.39	74.00	-19.61
2390.000	Peak	46.95	5.18	52.13	74.00	-21.87

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2320.096	Average	54.39	-2.50	51.89	54.00	-2.11
2390.000	Average	52.13	-2.50	49.63	54.00	-4.37

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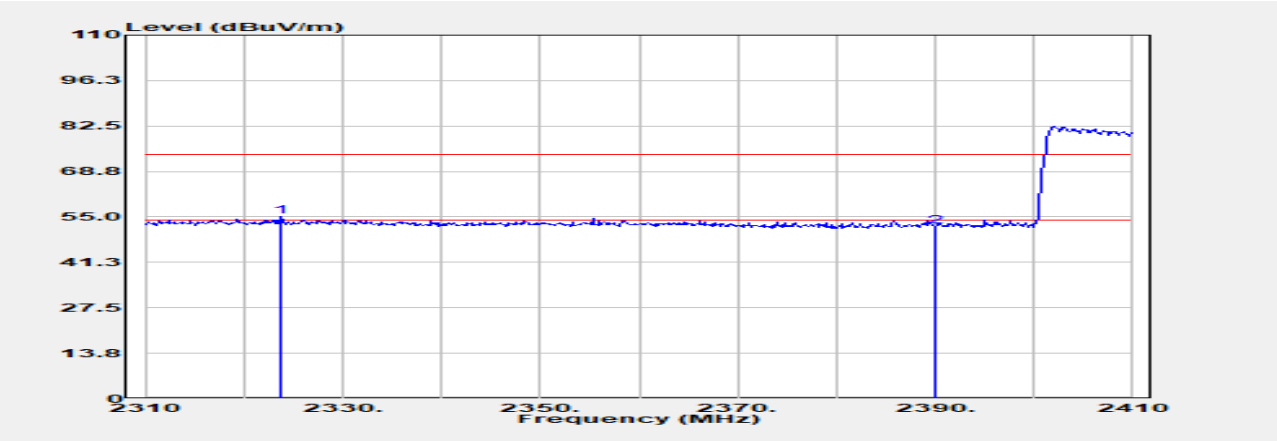
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M Hopping	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2323.622	Peak	49.28	5.78	55.06	74.00	-18.94
2390.000	Peak	47.03	5.18	52.21	74.00	-21.79

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2323.622	Average	55.06	-2.50	52.56	54.00	-1.44
2390.000	Average	52.21	-2.50	49.71	54.00	-4.29

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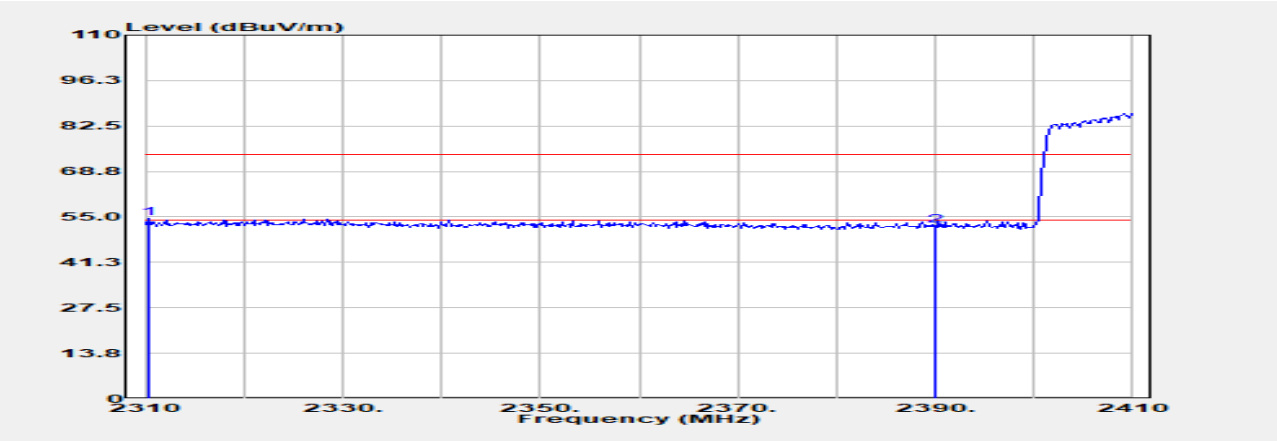
Operation Mode	:BT EDR 3M Hopping	Test Date	:2022-03-02
Test Frequency	:2402 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2310.481	Peak	48.91	5.75	54.66	74.00	-19.34
2390.000	Peak	47.24	5.18	52.42	74.00	-21.58

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2310.481	Average	54.66	-2.50	52.16	54.00	-1.84
2390.000	Average	52.42	-2.50	49.92	54.00	-4.08

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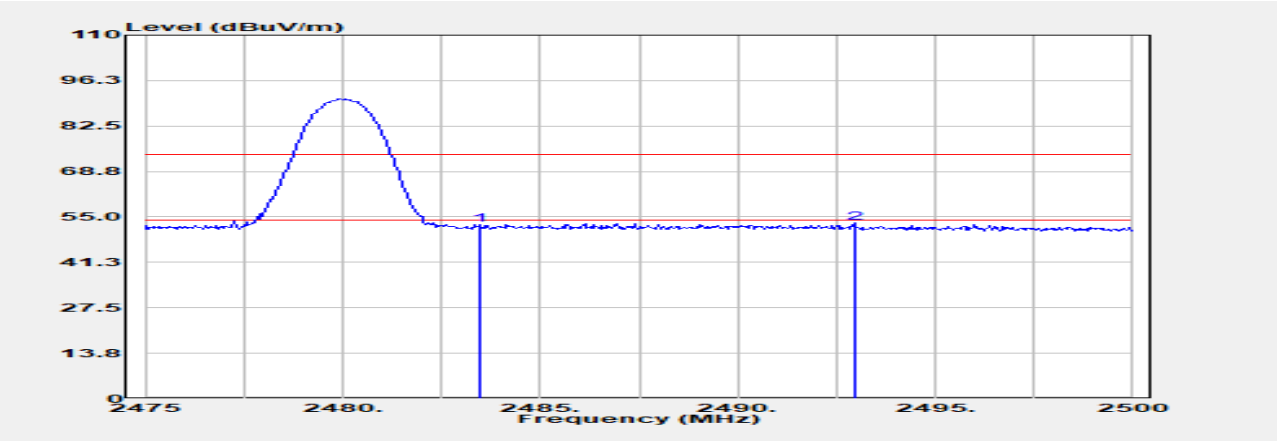
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	48.52	4.04	52.55	74.00	-21.45
2492.949	Peak	49.38	3.81	53.19	74.00	-20.81

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	52.55	-2.50	50.05	54.00	-3.95
2492.949	Average	53.19	-2.50	50.69	54.00	-3.31

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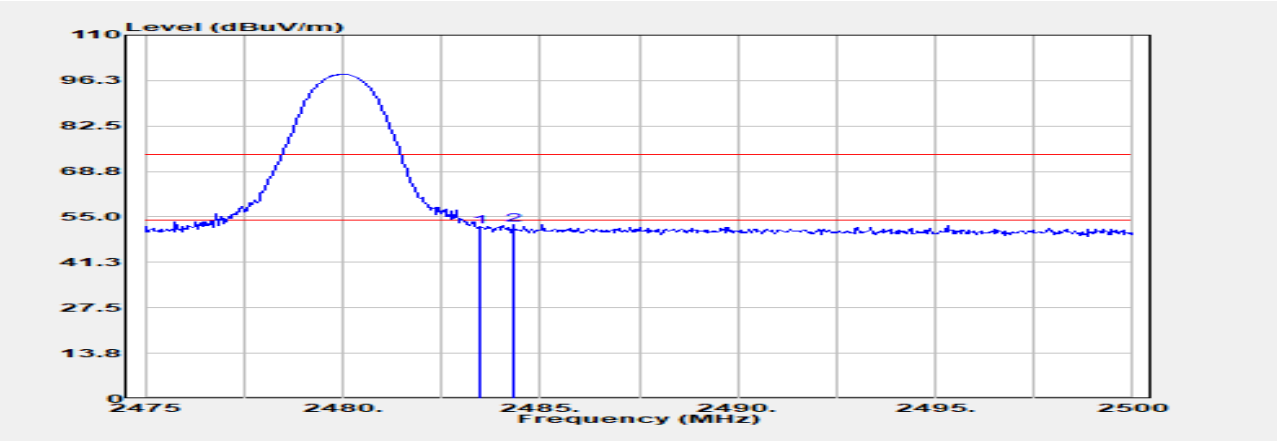
Operation Mode	:BT EDR 3M	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	48.06	4.04	52.09	74.00	-21.91
2484.295	Peak	48.67	4.03	52.70	74.00	-21.30

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	52.09	-2.50	49.59	54.00	-4.41
2484.295	Average	52.70	-2.50	50.20	54.00	-3.80

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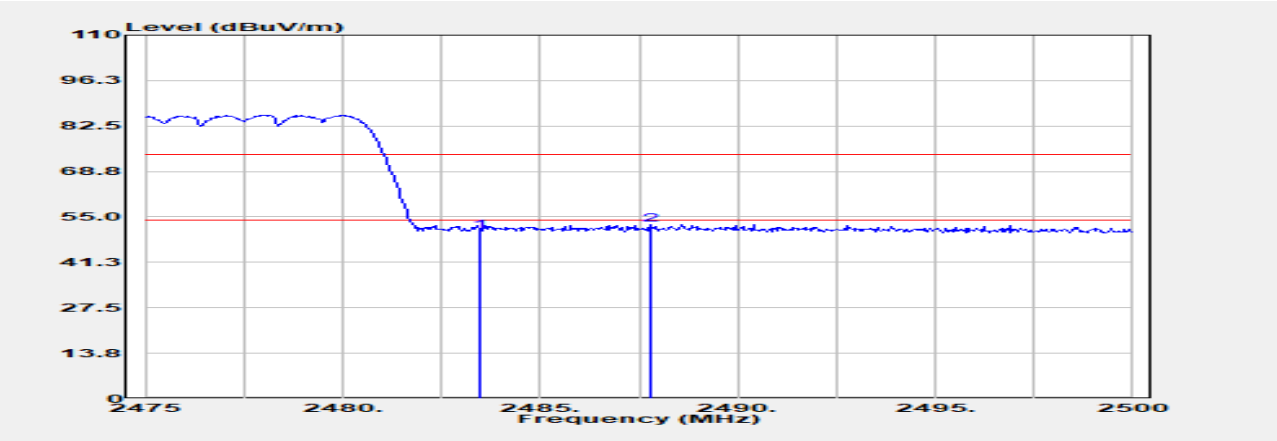
Operation Mode	:BT EDR 3M Hopping	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	46.73	4.04	50.77	74.00	-23.23
2487.781	Peak	48.68	4.00	52.68	74.00	-21.32

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	50.77	-2.50	48.27	54.00	-5.73
2487.781	Average	52.68	-2.50	50.18	54.00	-3.82

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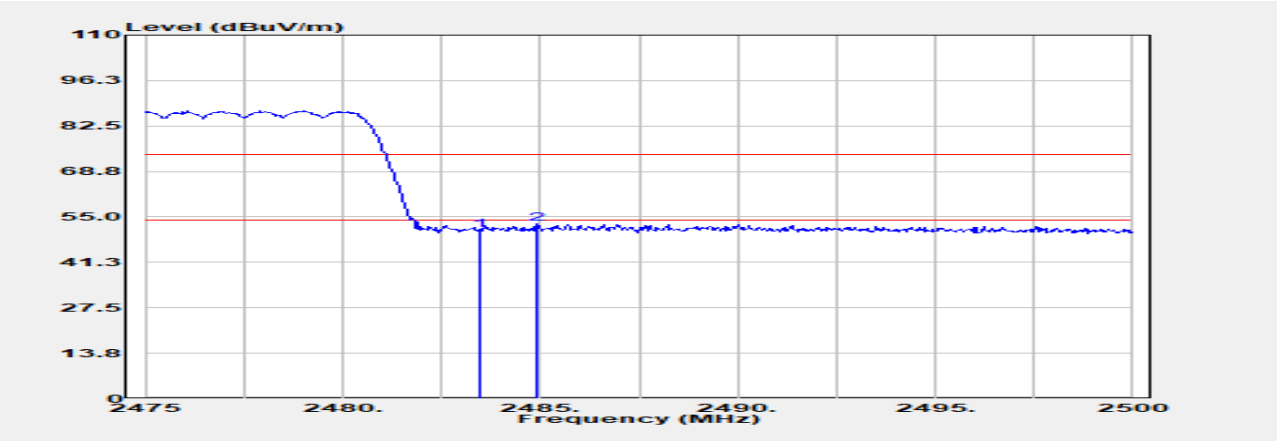
Operation Mode	:BT EDR 3M Hopping	Test Date	:2022-03-02
Test Frequency	:2480 MHz	Temp./Humi.	:21.0/67.0
Test Mode	:BE CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.500	Peak	47.10	4.04	51.14	74.00	-22.86
2484.936	Peak	48.84	4.02	52.87	74.00	-21.13

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500	Average	51.14	-2.50	48.64	54.00	-5.36
2484.936	Average	52.87	-2.50	50.37	54.00	-3.63

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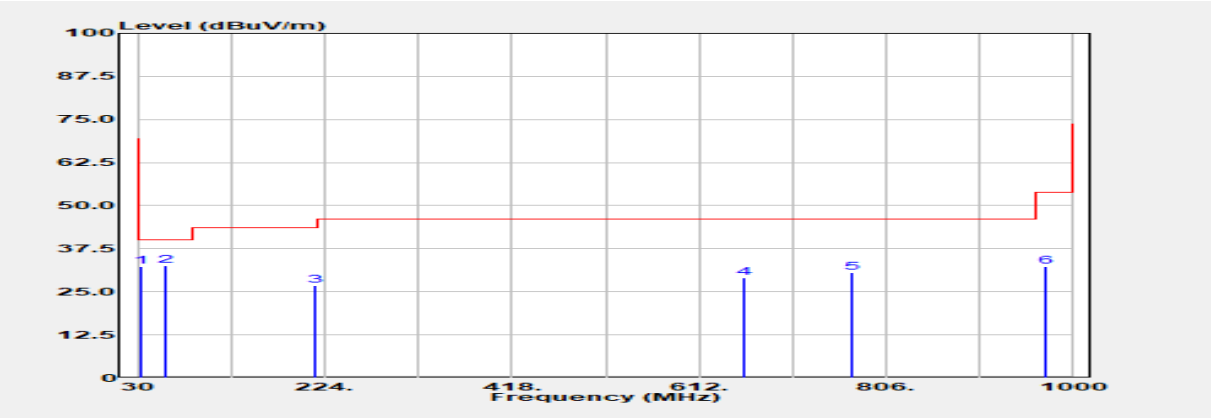
11.6.4 Radiated Spurious Emission

Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-07
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
34.663	Peak	48.38	-16.03	32.35	40.00	-7.65
57.981	Peak	47.56	-14.91	32.64	40.00	-7.36
214.984	Peak	43.89	-17.09	26.80	43.50	-16.70
658.013	Peak	31.99	-2.88	29.11	46.00	-16.89
771.490	Peak	31.44	-0.78	30.66	46.00	-15.34
972.019	Peak	30.02	2.25	32.27	54.00	-21.73

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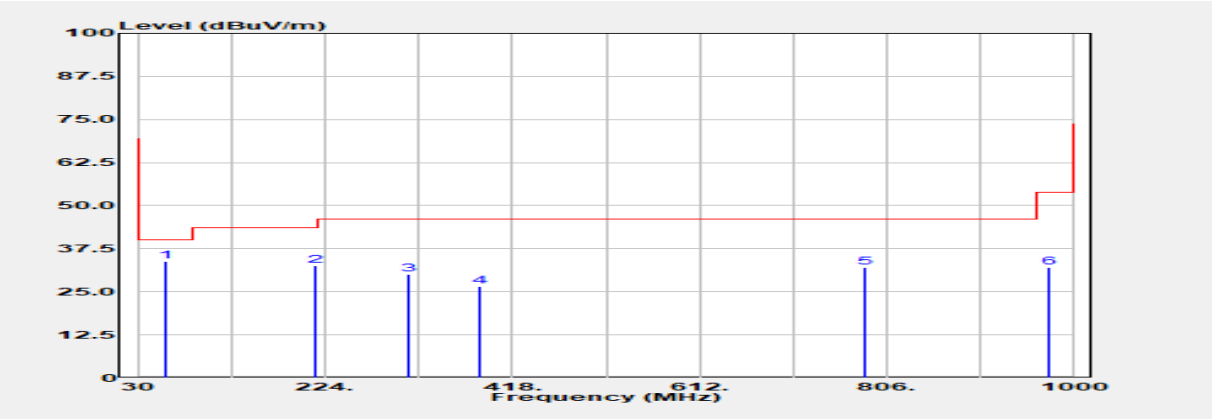
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-07
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
57.981	Peak	48.64	-14.91	33.73	40.00	-6.27
214.984	Peak	49.65	-17.09	32.55	43.50	-10.95
311.362	Peak	42.69	-12.65	30.05	46.00	-15.95
384.423	Peak	37.14	-10.59	26.55	46.00	-19.45
783.926	Peak	32.56	-0.56	32.00	46.00	-14.00
973.574	Peak	29.79	2.22	32.01	54.00	-21.99

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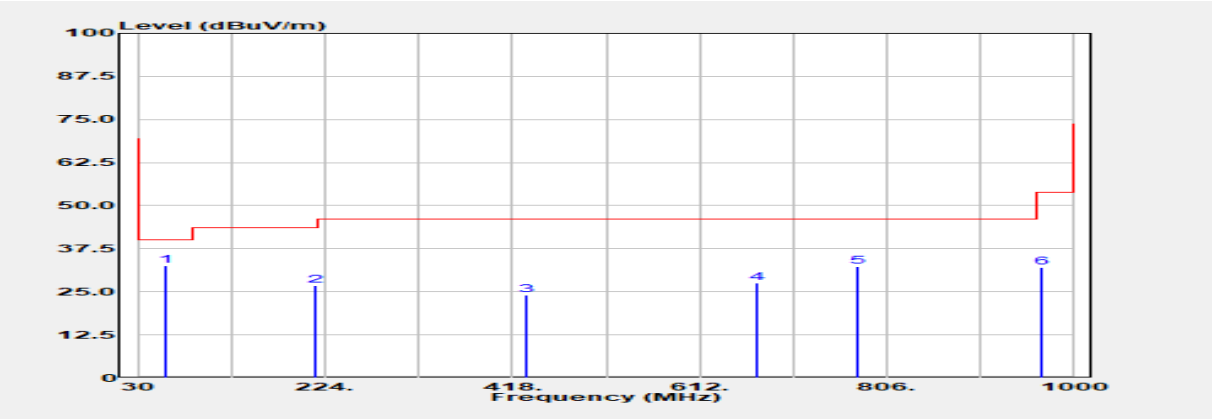
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-07
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
57.981	Peak	47.49	-14.91	32.57	40.00	-7.43
214.984	Peak	43.91	-17.09	26.82	43.50	-16.68
432.612	Peak	32.95	-8.81	24.14	46.00	-21.86
672.003	Peak	30.35	-2.67	27.68	46.00	-18.32
774.599	Peak	32.95	-0.69	32.26	46.00	-13.74
965.801	Peak	29.93	2.06	31.99	54.00	-22.01

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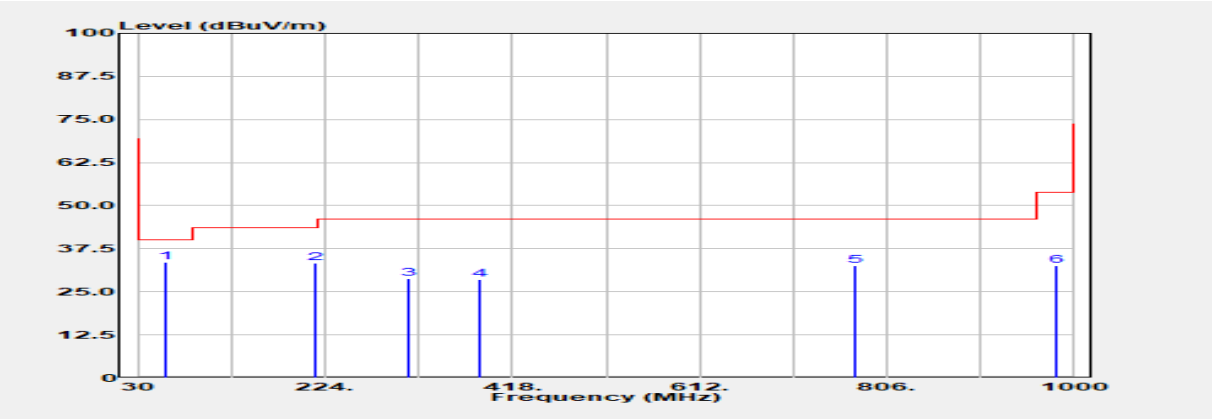
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-07
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
57.981	Peak	48.42	-14.91	33.51	40.00	-6.49
214.984	Peak	50.53	-17.09	33.44	43.50	-10.06
311.362	Peak	41.42	-12.65	28.77	46.00	-17.23
384.423	Peak	39.25	-10.59	28.66	46.00	-17.34
773.045	Peak	33.29	-0.73	32.56	46.00	-13.44
981.346	Peak	30.42	2.27	32.69	54.00	-21.31

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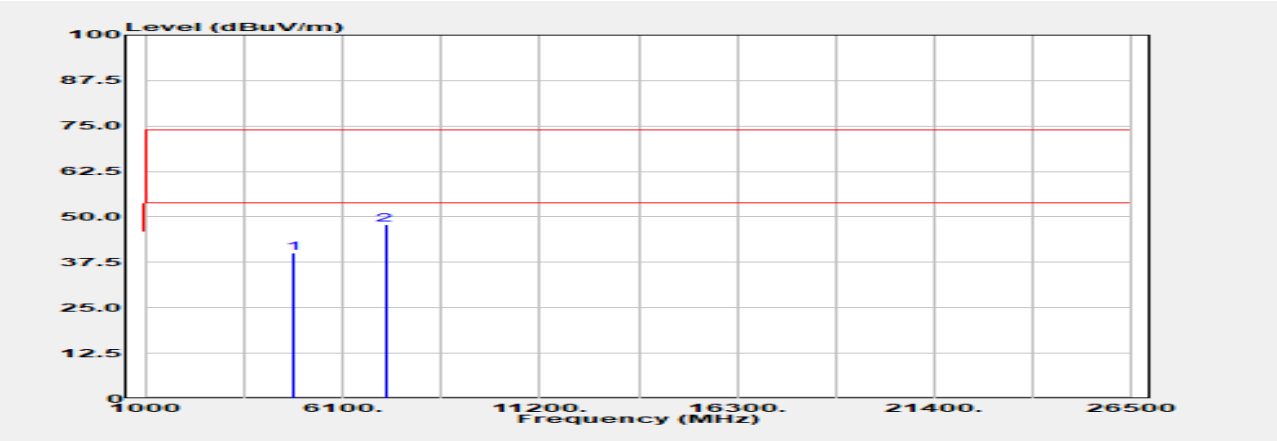
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-04
Test Frequency	:2402 MHz	Temp./Humi.	:24.5/61
Test Mode	:TX CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.000	Peak	30.63	9.50	40.14	74.00	-33.86
7206.000	Peak	30.39	17.49	47.88	74.00	-26.12

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4804.000	Average	40.14	-4.68	35.46	54.00	-18.54
7206.000	Average	47.88	-4.68	43.20	54.00	-10.80

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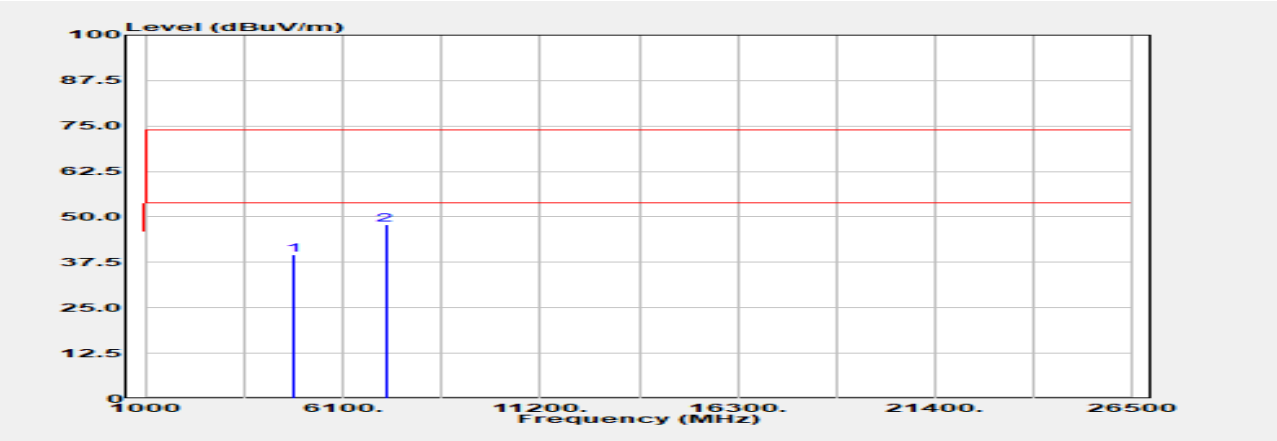
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-04
Test Frequency	:2402 MHz	Temp./Humi.	:24.5/61
Test Mode	:TX CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.000	Peak	30.10	9.50	39.60	74.00	-34.40
7206.000	Peak	30.27	17.49	47.76	74.00	-26.24

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4804.000	Average	39.60	-4.68	34.92	54.00	-19.08
7206.000	Average	47.76	-4.68	43.08	54.00	-10.92

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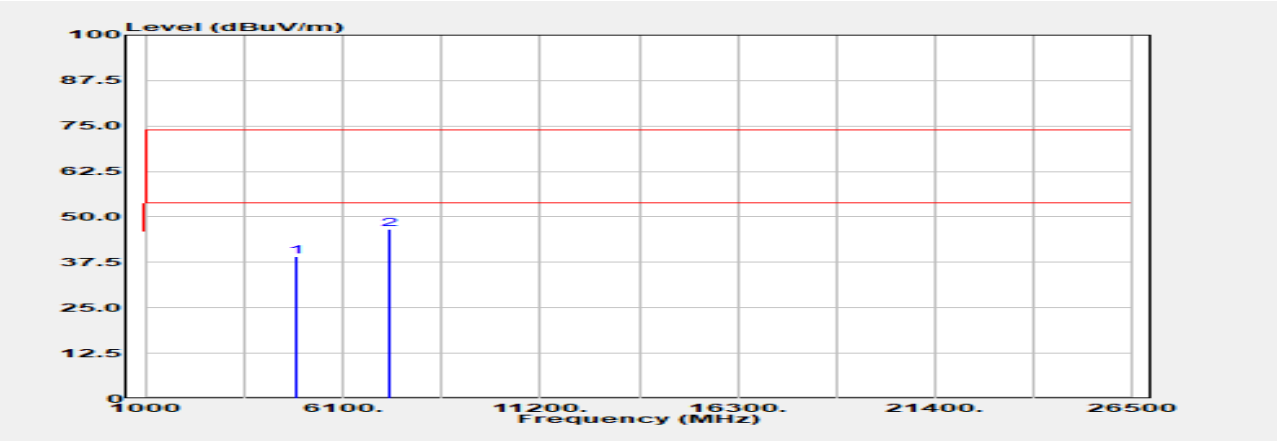
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-04
Test Frequency	:2441 MHz	Temp./Humi.	:24.5/61
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4882.000	Peak	29.78	9.28	39.06	74.00	-34.94
7323.000	Peak	28.52	18.02	46.55	74.00	-27.45

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4882.000	Average	39.06	-4.68	34.38	54.00	-19.62
7323.000	Average	46.55	-4.68	41.87	54.00	-12.13

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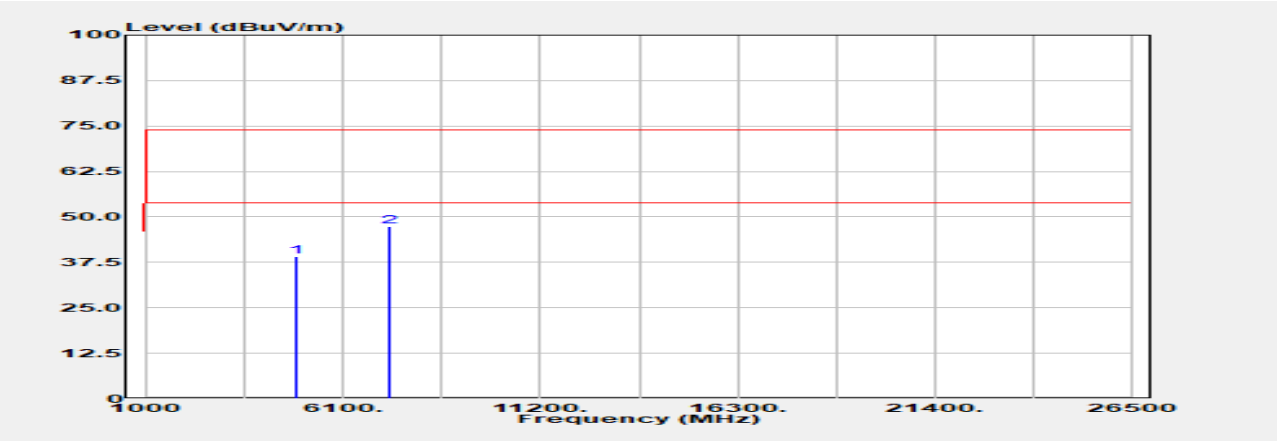
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-04
Test Frequency	:2441 MHz	Temp./Humi.	:24.5/61
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4882.000	Peak	29.94	9.28	39.22	74.00	-34.78
7323.000	Peak	29.29	18.02	47.32	74.00	-26.68

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4882.000	Average	39.22	-4.68	34.54	54.00	-19.46
7323.000	Average	47.32	-4.68	42.64	54.00	-11.36

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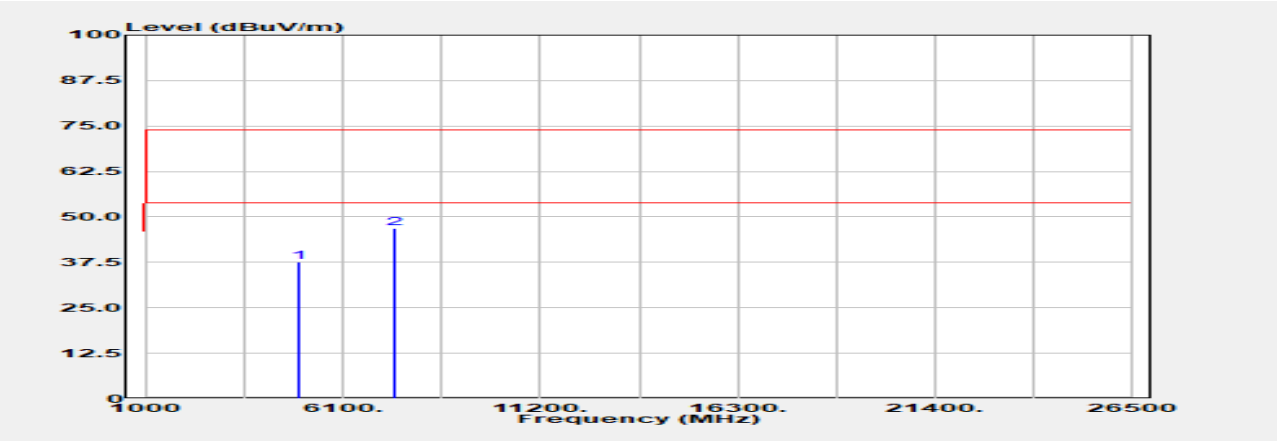
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-05
Test Frequency	:2480 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Peak	27.48	10.03	37.51	74.00	-36.49
7440.000	Peak	28.70	18.23	46.92	74.00	-27.08

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4960.000	Average	37.51	-4.68	32.83	54.00	-21.17
7440.000	Average	46.92	-4.68	42.24	54.00	-11.76

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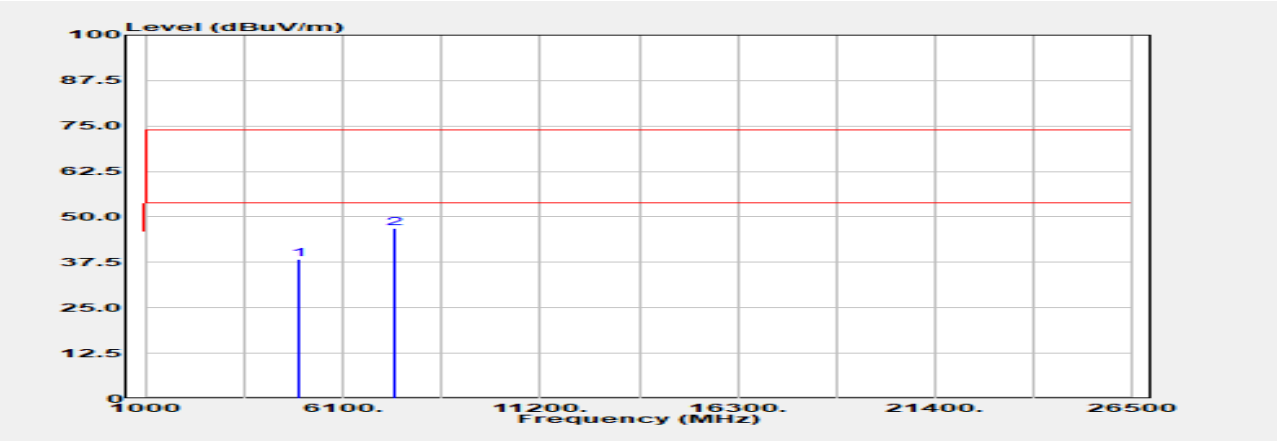
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT BR	Test Date	:2022-03-05
Test Frequency	:2480 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Peak	28.33	10.03	38.36	74.00	-35.64
7440.000	Peak	28.58	18.23	46.81	74.00	-27.19

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4960.000	Average	38.36	-4.68	33.68	54.00	-20.32
7440.000	Average	46.81	-4.68	42.13	54.00	-11.87

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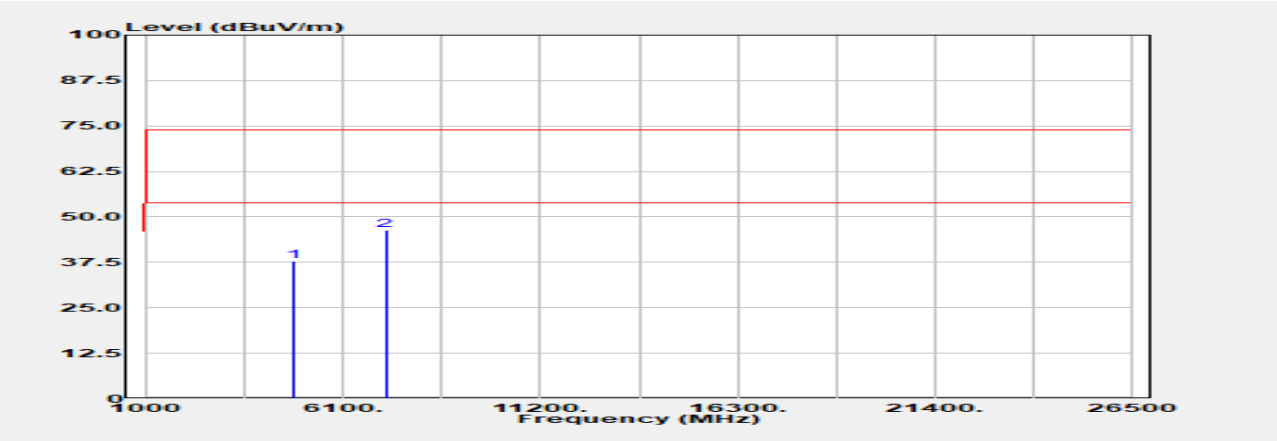
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2402 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.000	Peak	28.33	9.50	37.83	74.00	-36.17
7206.000	Peak	28.76	17.49	46.26	74.00	-27.74

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4804.000	Average	37.83	-2.50	35.33	54.00	-18.67
7206.000	Average	46.26	-2.50	43.76	54.00	-10.24

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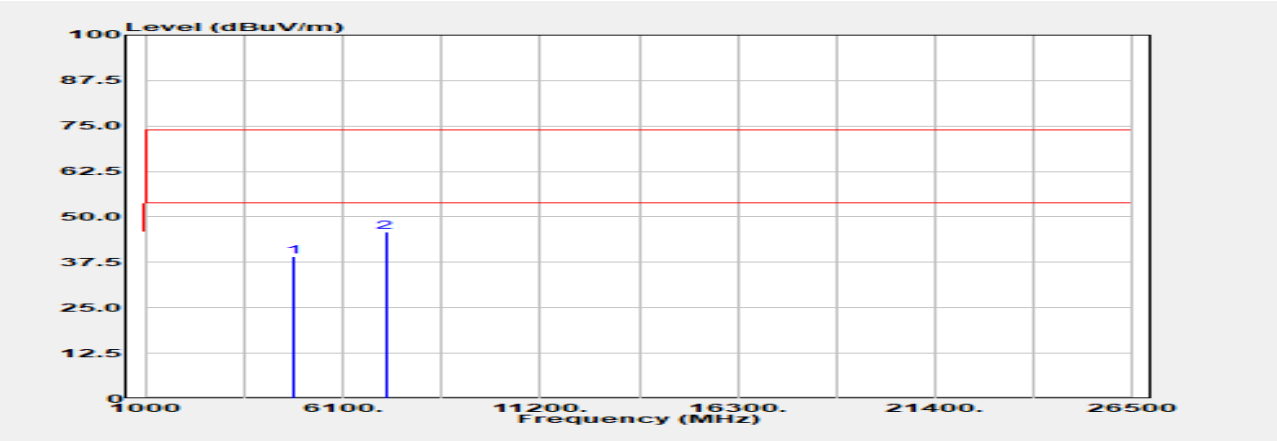
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2402 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH LOW	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.000	Peak	29.60	9.50	39.10	74.00	-34.90
7206.000	Peak	28.35	17.49	45.84	74.00	-28.16

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4804.000	Average	39.10	-2.50	36.60	54.00	-17.40
7206.000	Average	45.84	-2.50	43.34	54.00	-10.66

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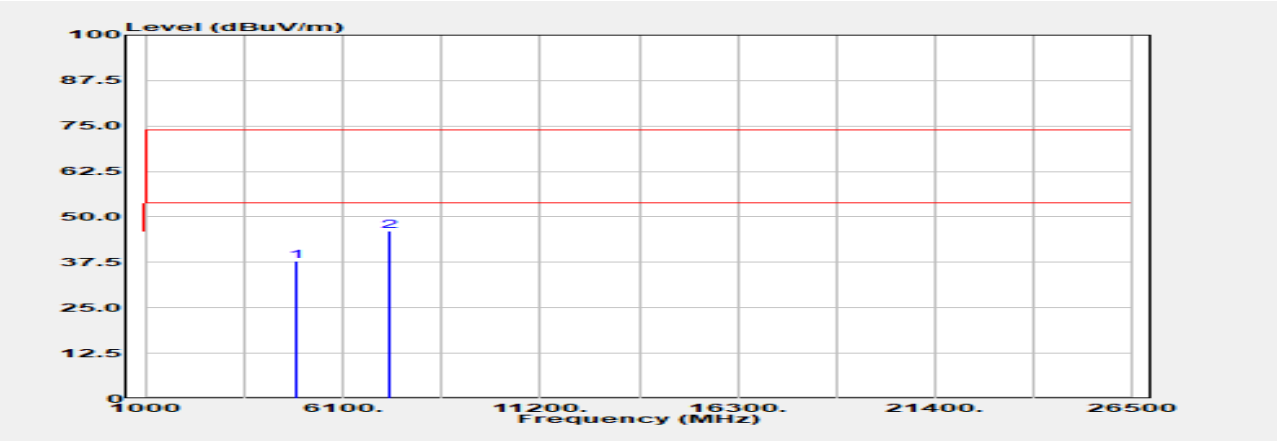
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4882.000	Peak	28.61	9.28	37.89	74.00	-36.12
7323.000	Peak	28.06	18.02	46.08	74.00	-27.92

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4882.000	Average	37.89	-2.50	35.39	54.00	-18.61
7323.000	Average	46.08	-2.50	43.58	54.00	-10.42

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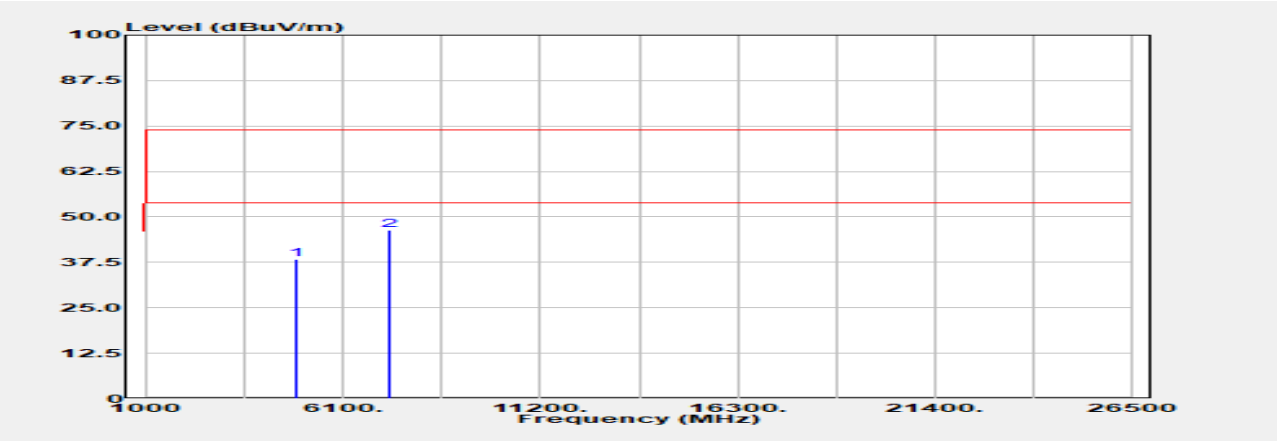
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2441 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH MID	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4882.000	Peak	29.06	9.28	38.34	74.00	-35.66
7323.000	Peak	28.23	18.02	46.25	74.00	-27.75

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4882.000	Average	38.34	-2.50	35.84	54.00	-18.16
7323.000	Average	46.25	-2.50	43.75	54.00	-10.25

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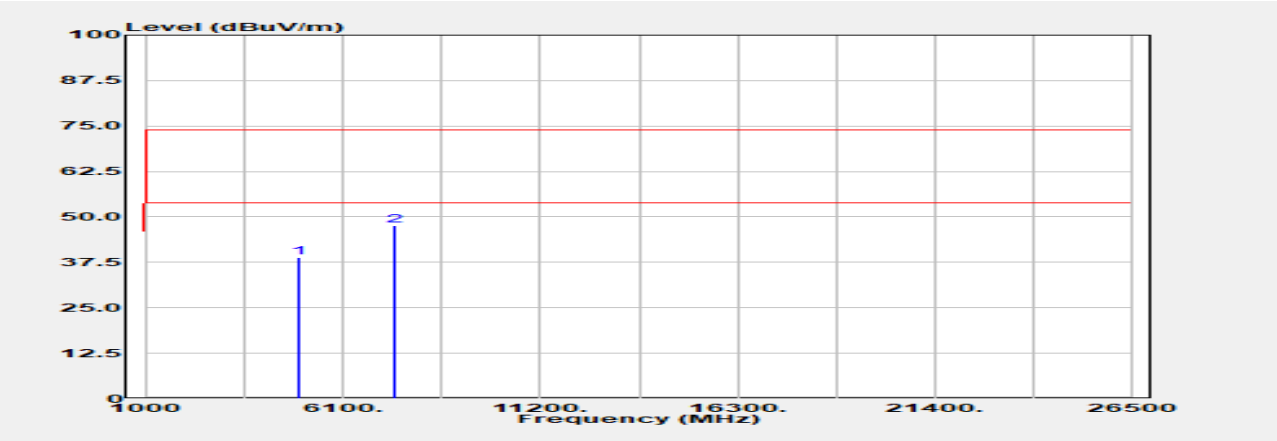
Report Number	:E2/2021/90040	Test Site	:SAC C
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2480 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH HIGH	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Peak	28.82	10.03	38.85	74.00	-35.15
7440.000	Peak	29.41	18.23	47.64	74.00	-26.36

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4960.000	Average	38.85	-2.50	36.35	54.00	-17.65
7440.000	Average	47.64	-2.50	45.14	54.00	-8.86

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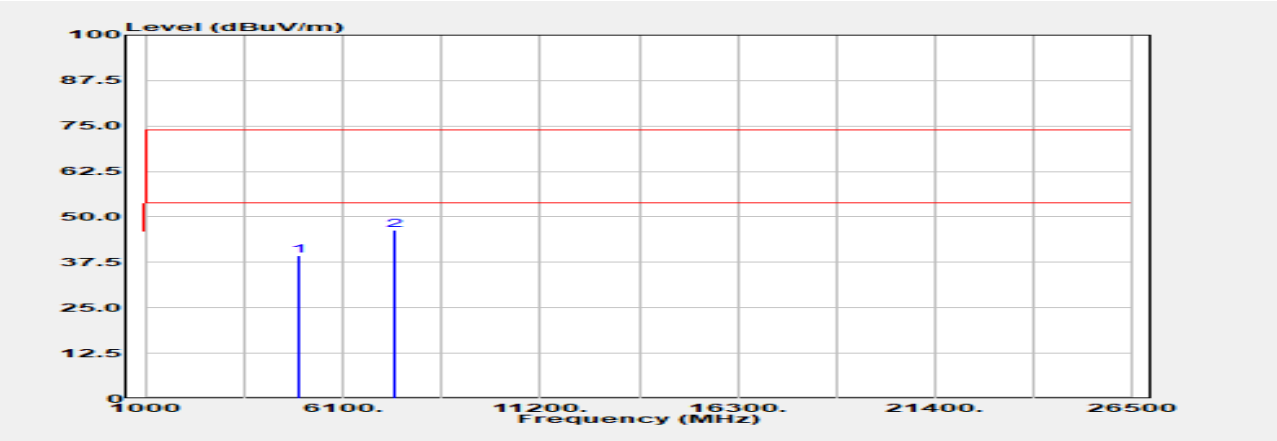
Operation Mode	:BT EDR 3M	Test Date	:2022-03-05
Test Frequency	:2480 MHz	Temp./Humi.	:22.4/67
Test Mode	:TX CH HIGH	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Andy Wang



Freq. MHz	Detector Mode PK/QP	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.000	Peak	29.28	10.03	39.31	74.00	-34.69
7440.000	Peak	28.11	18.23	46.34	74.00	-27.66

Freq. MHz	Detector Mode AV	Peak Actual FS (dBμV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
4960.000	Average	39.31	-2.50	36.81	54.00	-17.19
7440.000	Average	46.34	-2.50	43.84	54.00	-10.16

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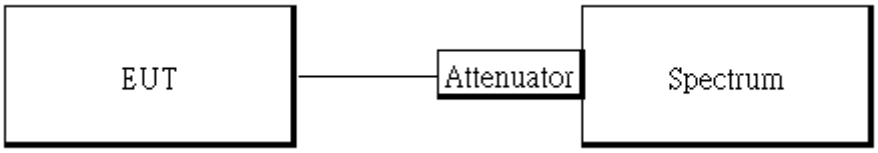
12 FREQUENCY SEPARATION

12.1 Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

12.2 Test Setup



12.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = middle of hopping channel.
5. Set the RBW approximately 30% of the channel spacing, VBW≥ RBW.
6. Adjust Span to Wide enough to capture the peaks of two adjacent channels.
7. Sweep = auto.
8. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

12.4 Measurement Result

Channel separation (MHz)	Limit	Result
1	≧25 kHz or 2/3 times 20dB bandwidth	PASS

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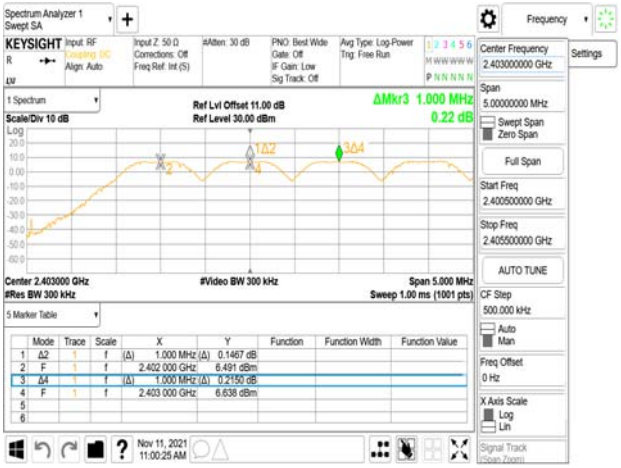
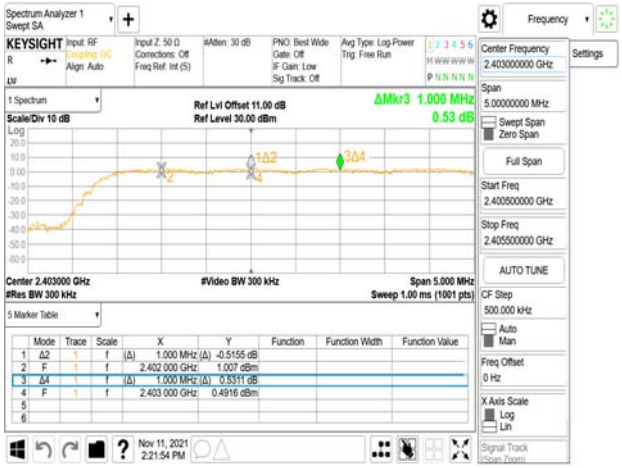
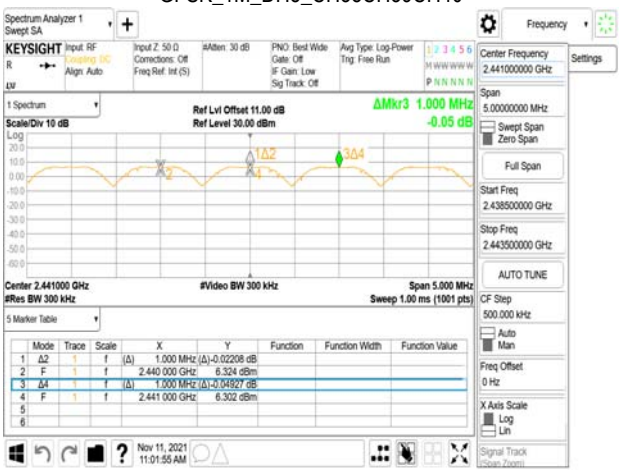
GFSK_1M_DH5_CH0CH1CH2



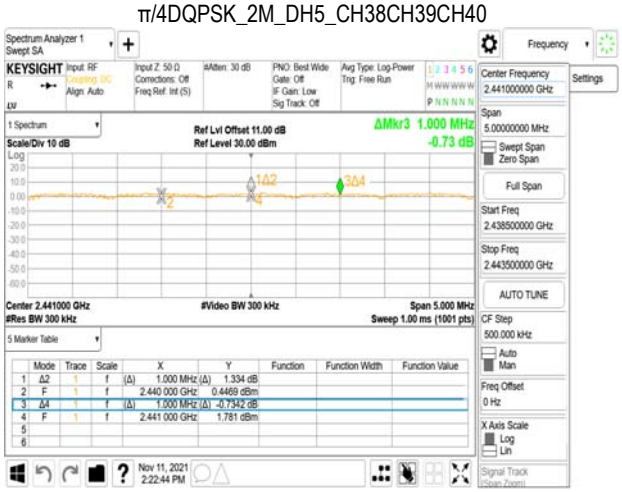
π/4DQPSK_2M_DH5_CH0CH1CH2



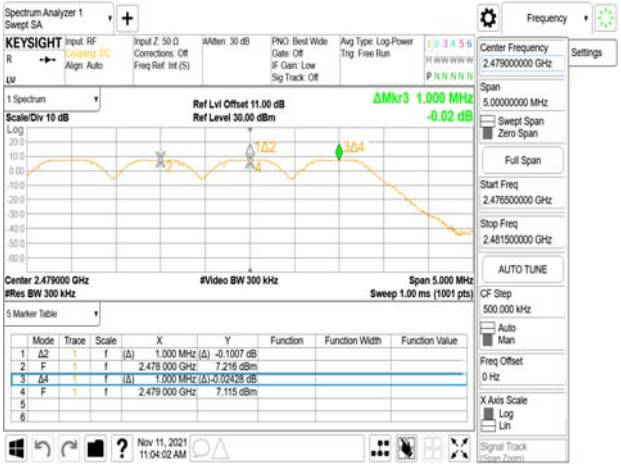
GFSK_1M_DH5_CH38CH39CH40



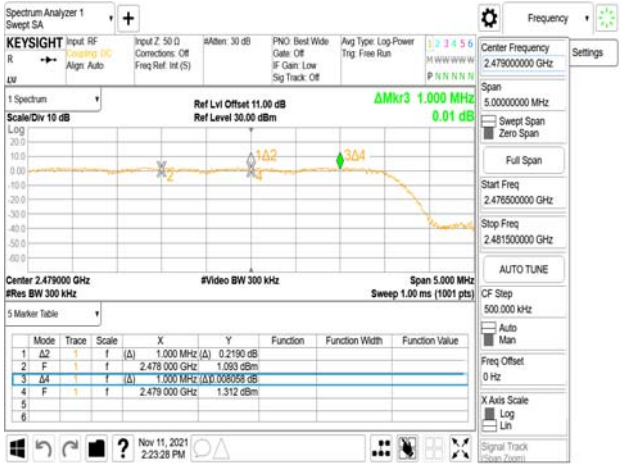
π/4DQPSK_2M_DH5_CH38CH39CH40



GFSK_1M_DH5_CH76CH77CH78



π/4DQPSK_2M_DH5_CH76CH77CH78



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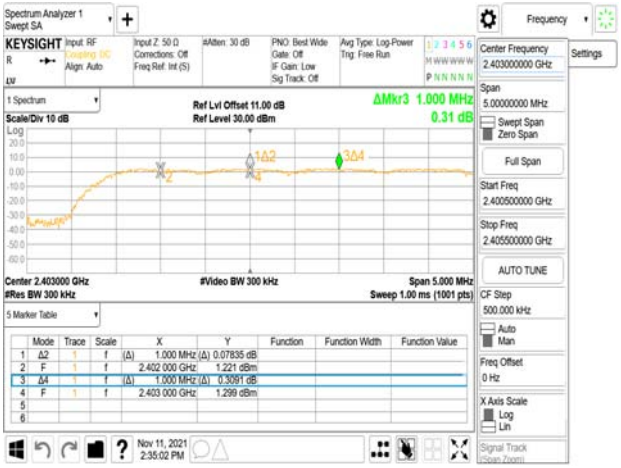
8DPSK_3M_DH5_CH0CH1CH2



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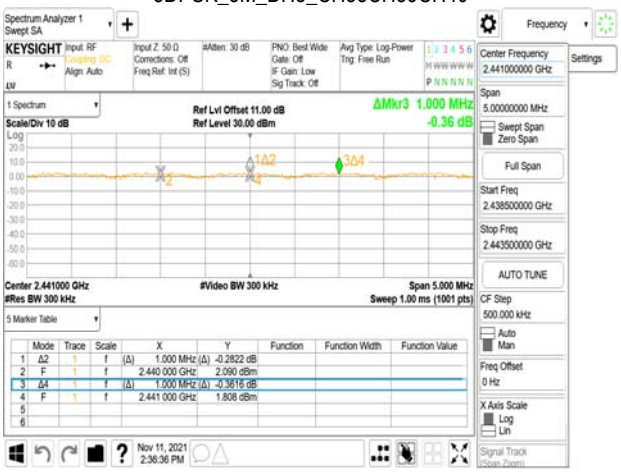
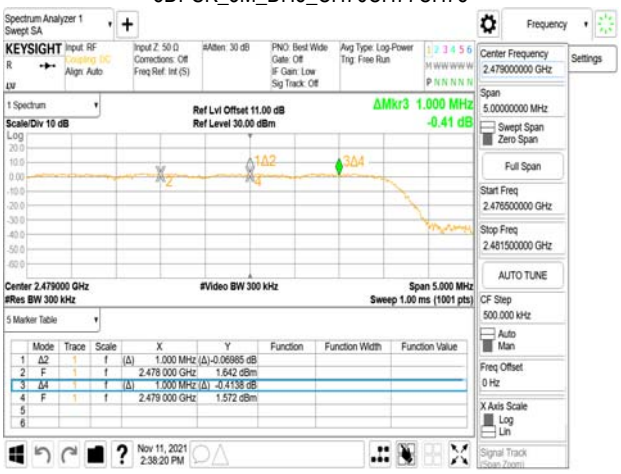


8DPSK_3M_DH5_CH76CH77CH78



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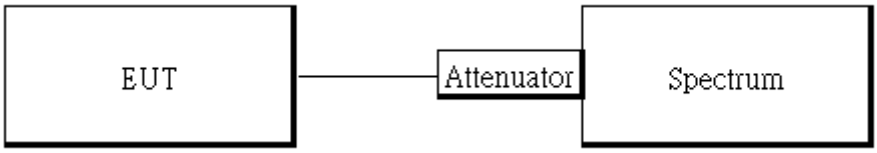
13 NUMBER OF HOPPING FREQUENCY

13.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

13.2 Test Setup



13.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
5. Set the spectrum analyzer as RBW=430kHz, VBW=1.5MHz., Detector = Peak
6. Max hold, view and count how many channel in the band.

13.4 Measurement Result

Tabular Data of Total Channel Number

	Channel Number	**Limit**
2.4 GHz – 2.441 GHz	**40**	**>15**
2.441 GHz – 2.4835 GHz	**39**	
2.4 GHz ~2.4835 GHz	**(40+39) = 79**	

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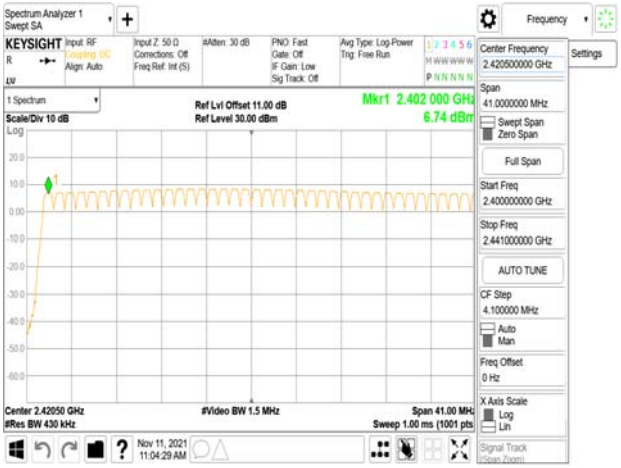
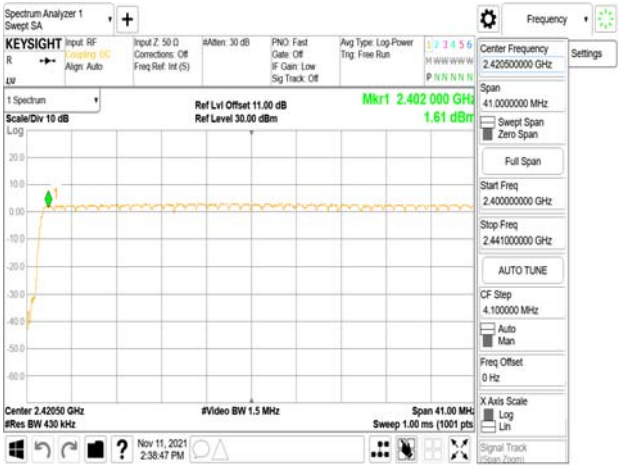
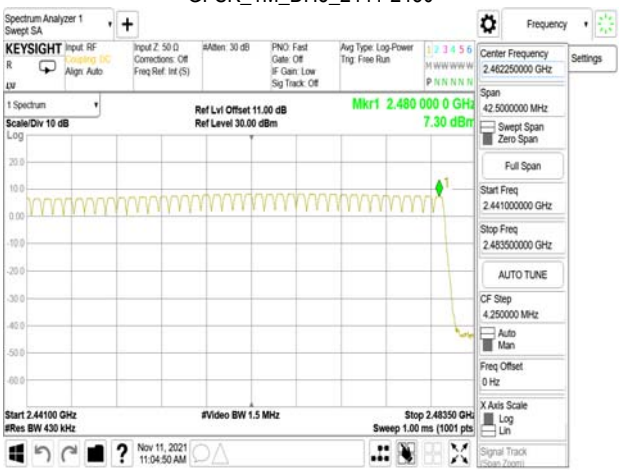
GFSK_1M_DH5_2400-2441



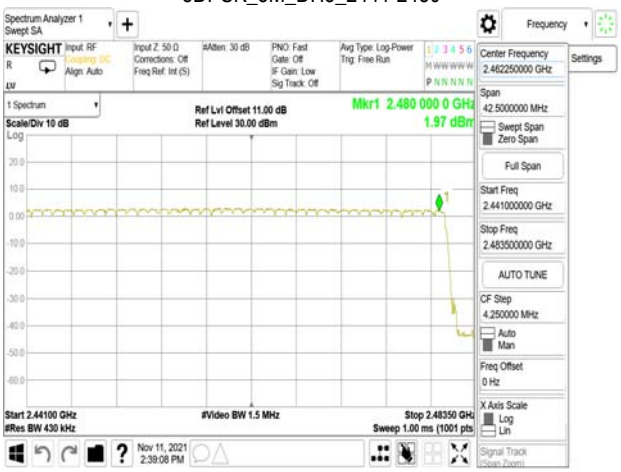
8DPSK_3M_DH5_2400-2441



GFSK_1M_DH5_2441-2480



8DPSK_3M_DH5_2441-2480



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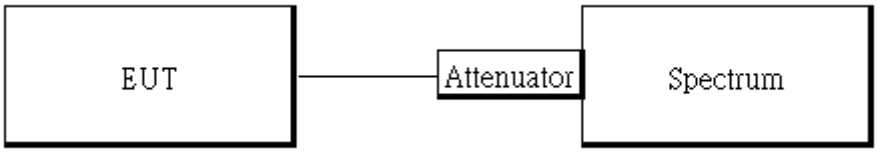
14 TIME OF OCCUPANCY (DWELL TIME)

14.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

14.2 Test Setup



14.3 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2015.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~8ms.
6. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2

DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4

DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

Note: the result of the complete test default channel at 1Mbps is recorded on the test report, 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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14.4 Measurement Result

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	VBW setting (kHz)
Mid	DH1	123.20	400ms	3.00
	DH3	262.40	400ms	1.00
	DH5	307.20	400ms	1.00

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	VBW setting (kHz)
Mid	2DH1	124.80	400ms	3.00
	2DH3	262.40	400ms	1.00
	2DH5	308.80	400ms	1.00

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	VBW setting (kHz)
Mid	3DH1	123.20	400ms	3.00
	3DH3	260.80	400ms	1.00
	3DH5	308.80	400ms	1.00

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GFSK (1Mbps):

CH Mid	DH1 time slot	=	0.385	*	(1600/2/79)	*	31.6	=	123.20	(ms)
	DH3 time slot	=	1.640	*	(1600/4/79)	*	31.6	=	262.40	(ms)
	DH5 time slot	=	2.880	*	(1600/6/79)	*	31.6	=	307.20	(ms)

π/4 -DQPSK (2Mbps):

CH Mid	2DH1 time slot	=	0.390	*	(1600/2/79)	*	31.6	=	124.80	(ms)
	2DH3 time slot	=	1.640	*	(1600/4/79)	*	31.6	=	262.40	(ms)
	2DH5 time slot	=	2.895	*	(1600/6/79)	*	31.6	=	308.80	(ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot	=	0.385	*	(1600/2/79)	*	31.6	=	123.20	(ms)
	3DH3 time slot	=	1.630	*	(1600/4/79)	*	31.6	=	260.80	(ms)
	3DH5 time slot	=	2.895	*	(1600/6/79)	*	31.6	=	308.80	(ms)

A period time = 0.4 (s) * 79 = 31.6 (s)

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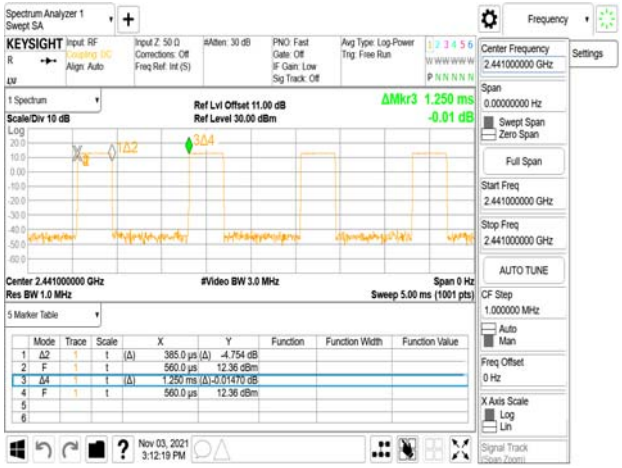
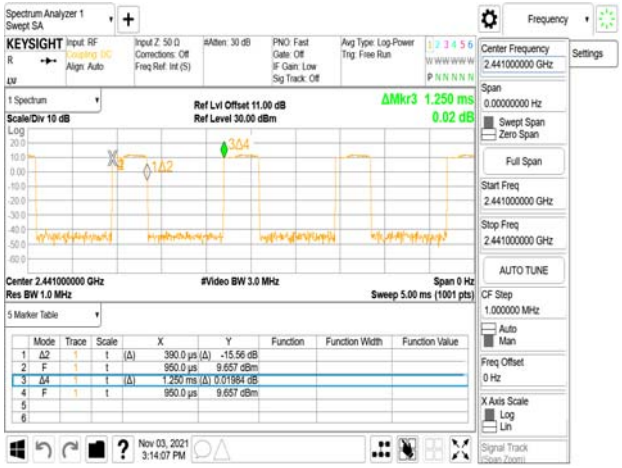
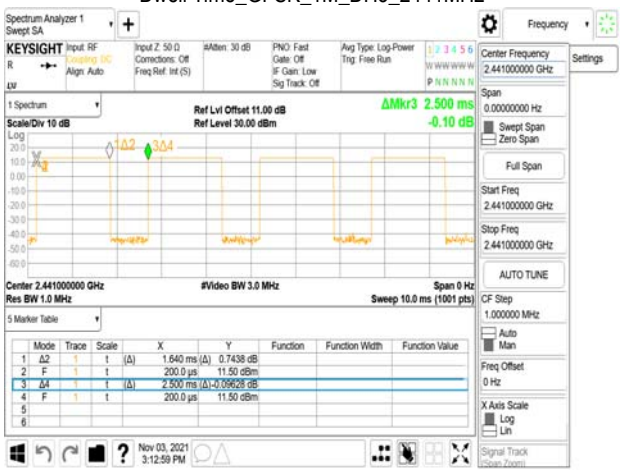
Dwell Time_GFSK_1M_DH1_2441MHz



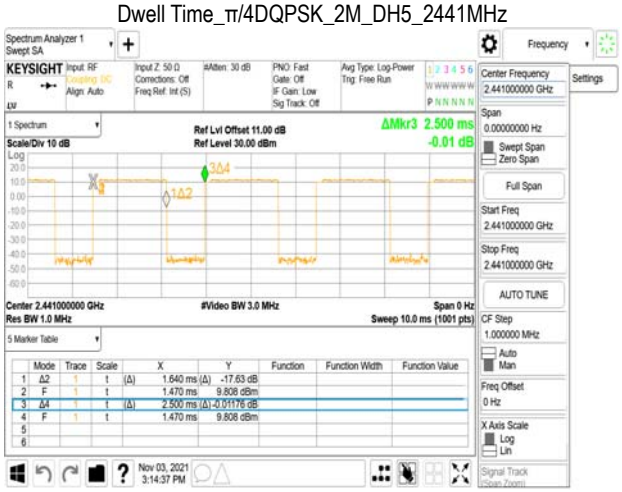
Dwell Time_π/4DQPSK_2M_DH5_2441MHz



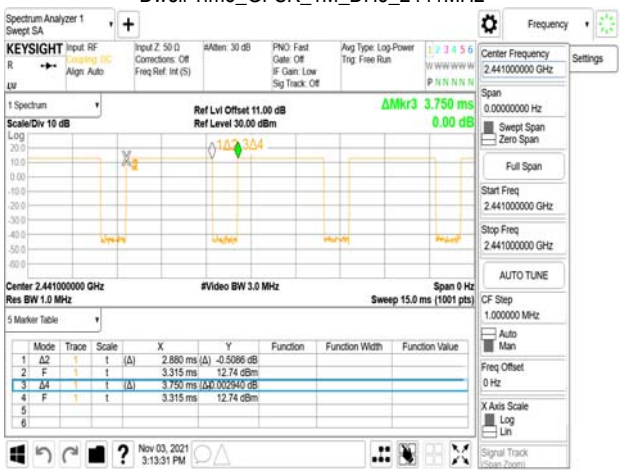
Dwell Time_GFSK_1M_DH3_2441MHz



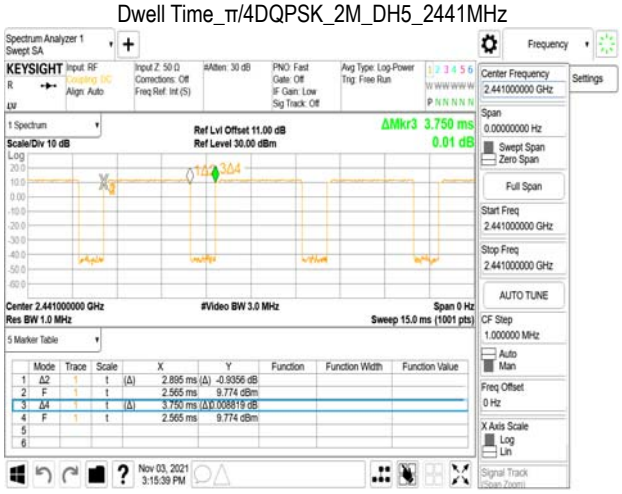
Dwell Time_π/4DQPSK_2M_DH5_2441MHz



Dwell Time_GFSK_1M_DH5_2441MHz



Dwell Time_π/4DQPSK_2M_DH5_2441MHz



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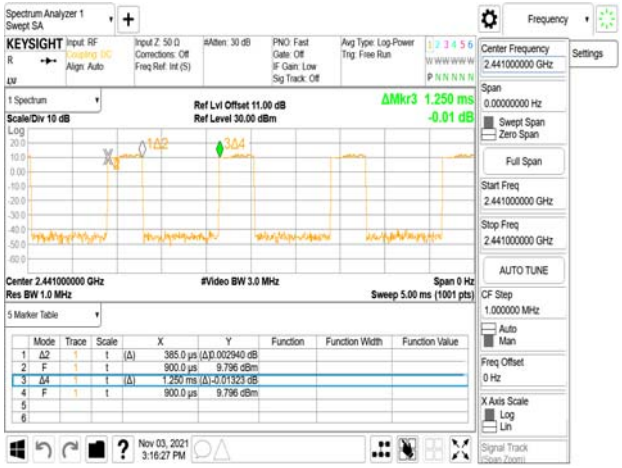
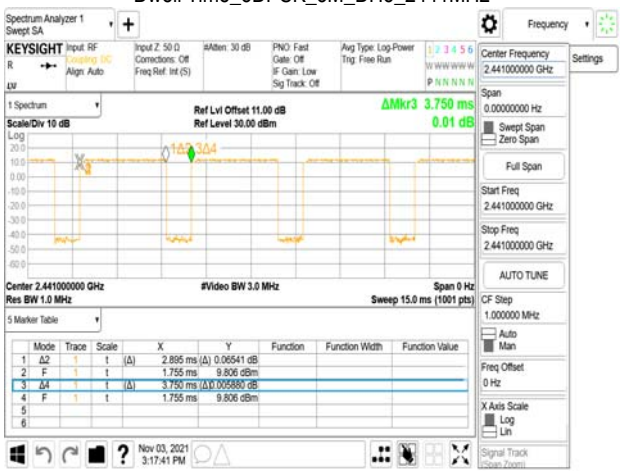
Dwell Time_8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz

Dwell Time_8DPSK_3M_DH5_2441MHz



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15 ANTENNA REQUIREMENT

15.1 Standard Applicable

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

15.2 Antenna Connected Construction

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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