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ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT





Applicant: Quanta Computer Inc.

No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City

33377, Taiwan

Product Name: Clover Station Solo

Brand Name: clover Model No.: C501

Model Difference: N/A

Report Number: E2/2021/70040

FCC ID HFS-C501F

Issue Date: August 24, 2021

Date of Test: July 16, 2021 \sim August 6, 2021

Date of EUT Received: July 15, 2021

Approved By

Jav Lin

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	
E2/2021/70040	00	Original	August 24, 2021	Ariel Chang	

Note:

1. Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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GENERAL INFORMATION

Product Description 1.1

Product Name:	Clover Station Solo
Brand Name:	clover
Model No.:	C501
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	C051UQ12570003
Power Supply:	24V from AC/DC Adapter or 3.8V from Rechargeable Li-ion Polymer Battery

RF Specification 1.2

Radio Technology:	BT BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + π/π/4-DQPSK + 8DPSK
Transmit Power:	6.63 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	≦ 0.4s

1.3 **Antenna Designation**

Antenna Type	Freq. (MHz)	Antenna No.	Peak Antenna Gain (dBi)	Worst Antenna Gain
PIFA	2402 – 2480	WIFI-1	-1.04	
PIFA	2402 – 2400	WIFI-2	1.27	V

Note:

- Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
- 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 ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designa- tion number	IC CAB identifier
		SAC 1		
		SAC 3		
		Conduction 1		
	No.134, Wu Kung Road, New Taipei	Conducted 1		
	Industrial Park, Wuku District, New	Conducted 2	TW0027	TW3702
	Taipei City, Taiwan.	Conducted 3	_	
		Conducted 4		
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		
Central RF Lab.		Conduction C		
(TAF code 3702)		SAC C		
(1A1 code 3702)		SAC D		
		SAC G		
	No.2, Keji 1st Rd., Guishan District,	Conducted A		
	Taoyuan City, Taiwan 333	Conducted B	TW0028	
	ladydaii City, Taiwaii 333	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*9m*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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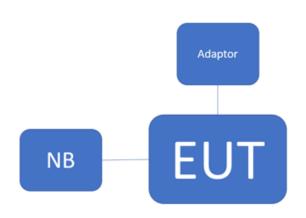
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2.5 **Test Configuration**

2.5.1 **Conducted Setup & Radiated Setup**



2.5.2 **Conduction Setup**



2.6 Control Unit(s)

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER
Notebook	Lenovo	L430	P0000195
Notebook	Lenovo	T470	P0001293
Adaptor	N/A	N/A	N/A

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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

- The EUT has been tested under operating condition.
- Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- The field strength of radiation emission was measured as EUT three orthogonal planes, E1 / E2 / H, are positioned to pre-scan the emission generating the highest one. The worst position is tested and recorded.
- 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 Bar	nd Width			
	0 to 78	0,39,78	GFSK	DH5		
Bluetooth	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	1			
Bluetooth	0 to 78	0,1,2,38,39,40,76,77,78	GFSK/8-DPSK	DH5/3DH5		
	N	lumber of hopping freque	ency			
Bluetooth	0 to 78	0 to 78	GFSK/8-DPSK	DH5/3DH5		
	Time of Occupancy(Dwell time)					
			GFSK	DH1/DH3/DH5		
Bluetooth	tooth 0 to 78	39	π/4-DQPSK	2DH1/2DH3/2DH5		
			8-DPSK	3DH1/3DH3/3DH5		

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MEASUREMENT UNCERTAINTY

Test Items	l	Jncertair	nty
AC Power Line Conducted Emission	+/-	2.34	dB
Peak Output Power	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
100 kHz Bandwidth Of Frequency Band Edges	+/-	1.69	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							
	+/-	2.64	dB	9kHz~30MHz			
Polarization: Vertical	+/-	4.93	dB	30MHz - 1000MHz			
Polarization. Vertical	+/-	4.81	dB	1GHz - 18GHz			
	+/-	4.52	dB	18GHz - 40GHz			
	+/-	2.64	dB	9kHz~30MHz			
Polarization: Horizontal	+/-	4.45	dB	30MHz - 1000MHz			
Fularization. Hunzuntal	+/-	4.81	dB	1GHz - 18GHz			
	+/-	4.52	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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CONDUCTED EMISSION TEST

6.1 **Standard Applicable**

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

Fraguency range	Limits dB(uV)				
Frequency range	UD((uv)			
MHz	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.

6.2 **Measurement Equipment Used**

Radiated Emission Test Site: Conduction C									
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
Test Software	audix	e3	Ver. 6.11- 20180419c	N.C.R	N.C.R				
LISN	SCHWARZ- BECK Mess- Elektronik	NSLK8127	974	04/19/2021	04/18/2022				
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	20923 sgs Ver.6	N.C.R	N.C.R				

6.3 **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.

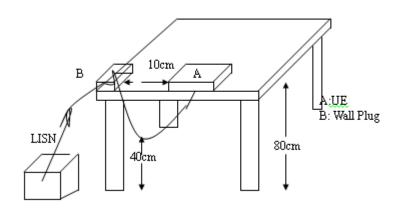
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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 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.

6.6 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

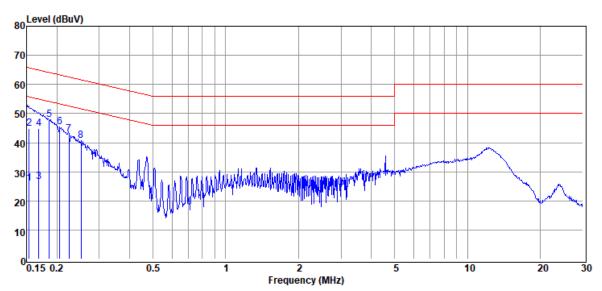
Report Number :E2/2021/70040 Test Site :Conduction Room C

Test Mode :BT **Test Date** :2021-07-27

Power :120V/60Hz Temp./Humi. :24.4/55

Probe :L1 Engineer :Jack Tseng

: Adapter:FSP120-AABN3 Note:



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dΒμV	dΒμV	dB
0.15	Average	15.81	10.30	26.11	55.78	-29.67
0.15	QP	34.61	10.30	44.91	65.78	-20.87
0.17	Average	16.41	10.30	26.71	55.03	-28.32
0.17	QP	34.61	10.30	44.91	65.03	-20.12
0.19	Peak	37.52	10.30	47.82	64.20	-16.38
0.21	Peak	34.97	10.30	45.27	63.36	-18.09
0.22	Peak	32.52	10.30	42.82	62.66	-19.84
0.25	Peak	30.39	10.31	40.70	61.69	-20.99

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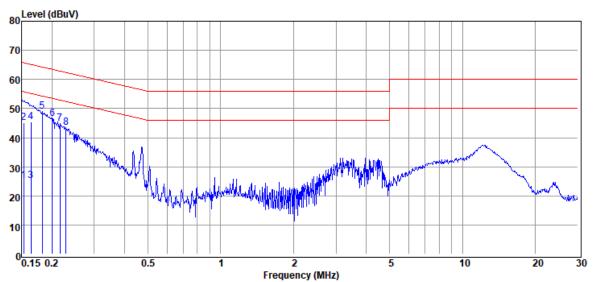
Report Number :E2/2021/70040 Test Site :Conduction Room C

Test Mode :BT **Test Date** :2021-07-27

Power :120V/60Hz Temp./Humi. :24.4/55

Probe :N Engineer :Jack Tseng

: Adapter:FSP120-AABN3 Note:



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dΒμV	dΒμV	dB
0.15	Average	15.00	10.31	25.31	55.82	-30.51
0.15	QP	34.80	10.31	45.11	65.82	-20.71
0.16	Average	15.00	10.31	25.31	55.25	-29.94
0.16	QP	35.00	10.31	45.31	65.25	-19.94
0.18	Peak	38.60	10.30	48.90	64.37	-15.47
0.20	Peak	36.31	10.30	46.61	63.58	-16.97
0.22	Peak	34.49	10.30	44.79	62.96	-18.17
0.23	Peak	33.10	10.30	43.40	62.48	-19.08

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7 PEAK OUTPUT POWER MEASUREMENT

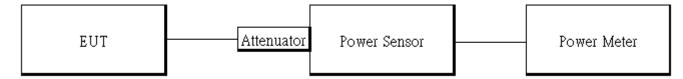
7.1 Standard Applicable

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.

7.2 Measurement Equipment Used

	Conducted Emission Test Site: Conducted G									
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.					
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					
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021					
Attenuator	Marvelous	MVE2213-10	RF10	11/19/2020	11/18/2021					
Coaxial Cables	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021					
Coaxial Cables	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021					

7.3 Test Set-up:



7.4 Measurement Procedure:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10 Measurement Guidelines.
- 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 bandwidth)
- 4. Record the max. reading.
- 5. Repeat above procedures until all default test channel is completed.

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7.5 Peak & Average Power Measurement Result

1M BR mode (Peak):

INI DIL IIIOUE	(i cary.				
СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	6.37	4.335	1000
Mid	2441	8	5.66	3.681	1000
High	2480	8	6.63	4.603	1000

1M BR mode (Average)

TIVI DK Mode	(Average).				
СН	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	6.33	4.292	1000
Mid	2441	8	5.63	3.653	1000
High	2480	8	6.27	4.233	1000

2M EDR mode (Peak):

ZIVI EDIT IIIOG	- (
СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	5.31	3.396	125
Mid	2441	8	4.52	2.831	125
High	2480	8	5.64	3.664	125

2M EDR mode (Average):

ZIVI EDR MOQ	e (Average):				
СН	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	3.06	2.024	125
Mid	2441	8	2.36	1.723	125
Hiah	2480	8	3.34	2.159	125

3M FDR mode (Peak):

SIVI EDR HIGGE (FEAR).							
СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)		
Low	2402	8	5.51	3.556	125		
Mid	2441	8	4.70	2.951	125		
High	2480	8	5.74	3.750	125		

NOTE: cable loss as 10.9dB that offsets in the spectrum

3M EDR mode (Average):

JIVI EDIN IIIOU	ic (Average).				
СН	Freq. (MHz)	Power set	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	3.15	2.067	125
Mid	2441	8	2.45	1.759	125
High	2480	8	3.47	2.225	125

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

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EMISSION BANDWIDTH MEASUREMENT

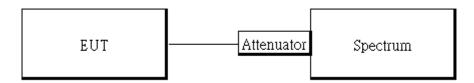
8.1 **Standard Applicable**

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

Measurement Equipment Used 8.2

	Conducted Emission Test Site: Conducted G							
EQUIPMENT TYPE	MFR	MODEL NUMBER SERIAL NUMBER		LAST CAL.	CAL DUE.			
Spectrum Ana- lyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022			
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021			
DC Block	PASTER- NACK	PE8210	RF151	11/19/2020	11/18/2021			
Coaxial Cables	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021			
Coaxial Cables	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021			
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N/A	N/A			

8.3 **Test Set-up**



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8.4 **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

20dB Bandwidth 8.5

GFSK

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.7589	0.51
Mid	0.7583	0.51
High	0.7595	0.51

π/4-DQPSK

СН	20 dB BW	2/3 BW
СП	(MHz)	(MHz)
Low	1.153	0.77
Mid	1.156	0.77
High	1.151	0.77

8-DPSK

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.154	0.77
Mid	1.150	0.77
High	1.156	0.77

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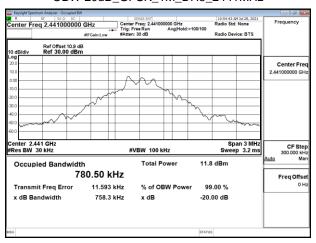


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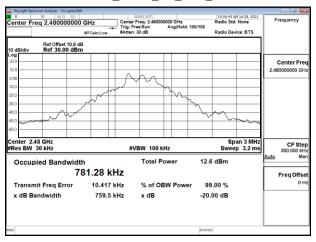
OBW 20dB_GFSK_1M_DH5_2402MHz



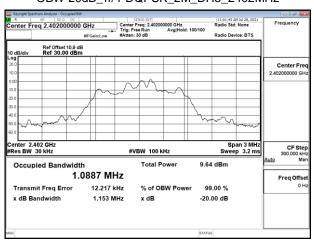
OBW 20dB GFSK 1M DH5 2441MHz



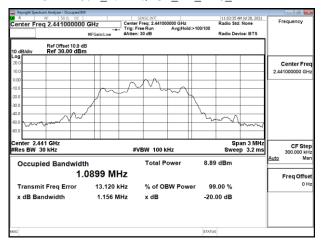
OBW 20dB_GFSK_1M_DH5_2480MHz



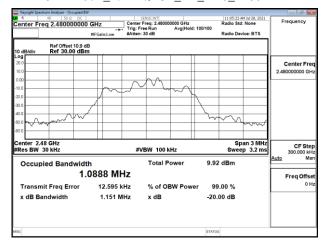
OBW 20dB_π/4-DQPSK_2M_DH5_2402MHz



OBW $20dB_\pi/4$ -DQPSK_2M_DH5_2441MHz



OBW $20dB_{\pi}/4$ -DQPSK_2M_DH5_2480MHz



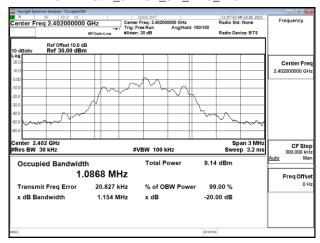
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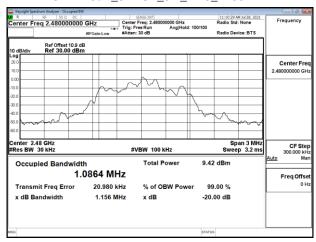
OBW 20dB 8DPSK 3M DH5 2402MHz



OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB 8DPSK 3M DH5 2480MHz



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

9.1 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).

9.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted G						
EQUIPMENT TYPE	MFR	MODEL NUMBER SERIAL NUMBER		LAST CAL.	CAL DUE.	
Spectrum Ana- lyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022	
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021	
DC Block	PASTER- NACK	PE8210	RF151	11/19/2020	11/18/2021	
Coaxial Cables	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021	
Coaxial Cables	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021	
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N/A	N/A	

9.3 Test SET-UP



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9.4 **Measurement Procedure**

9.4.1 **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.

9.4.2 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.

9.5 **Measurement Result**

See next page for test plots.

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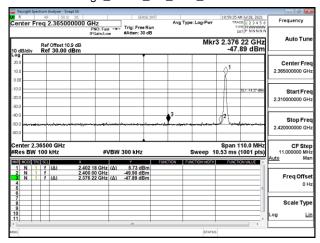
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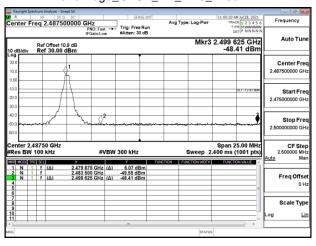


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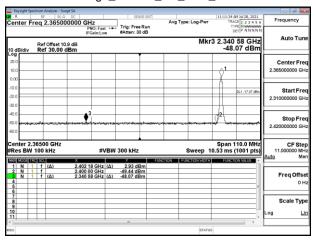
Band Edge_GFSK_1M_DH5_2402MHz



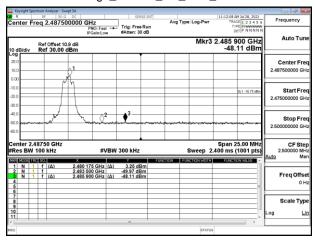
Band Edge_GFSK_1M_DH5_2480MHz



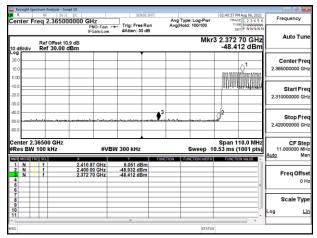
Band Edge_8DPSK_3M_DH5_2402MHz



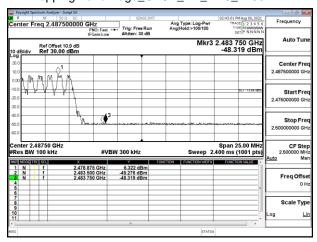
Band Edge_8DPSK_3M_DH5_2480MHz



Hopping Band Edge_GFSK_1M_DH5_2402MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz



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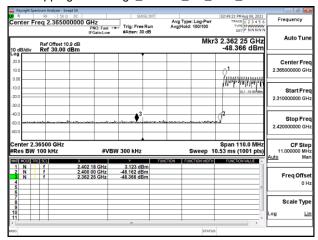
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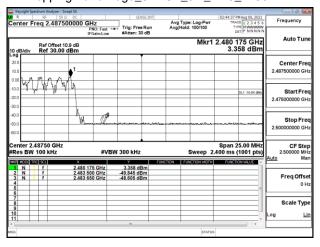


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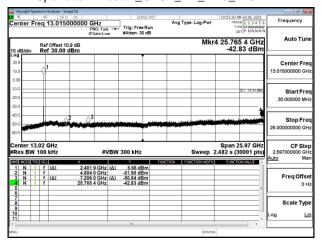
Hopping Band Edge_8DPSK_3M_DH5_2402MHz



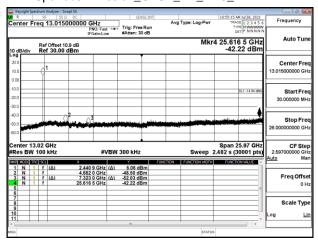
Hopping Band Edge_8DPSK_3M_DH5_2480MHz



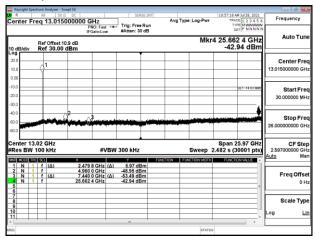
Spurious Emission_GFSK_1M_DH5_2402MHz



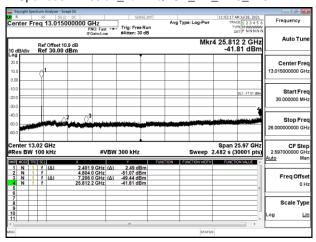
Spurious Emission_GFSK_1M_DH5_2441MHz



Spurious Emission_GFSK_1M_DH5_2480MHz



Spurious Emission_π/4-DQPSK_2M_DH5_2402MHz



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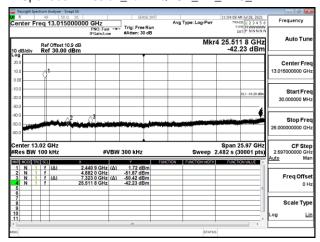
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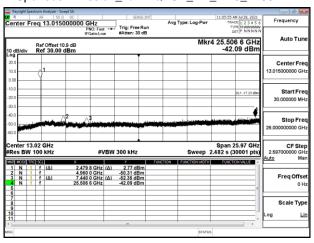


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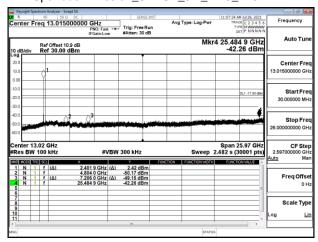
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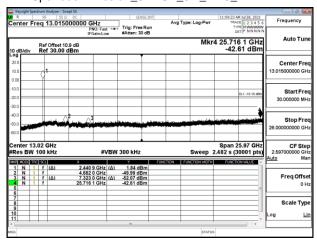
Spurious Emission_ $\pi/4$ -DQPSK_2M_DH5_2480MHz



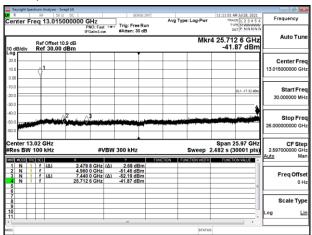
Spurious Emission_8DPSK_3M_DH5_2402MHz



Spurious Emission_8DPSK_3M_DH5_2441MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



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10 RADIATED BANDEDGE 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 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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10.2 Measurement Equipment Used

Radiated Emission Test Site: SAC D								
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUMBER	LAST CAL.	CAL DUE.			
Broadband An- tenna	TESEQ	CBL 6112D	35240	09/08/2020	09/07/2021			
Horn Antenna	Schwarz- beck	BBHA9120D	1341	06/04/2021	06/03/2022			
Horn Antenna	Schwarz- beck	BBHA9170	184	12/11/2020	12/10/2021			
Loop Antenna	ETS.LIND- GREN	6502	143303	05/07/2021	05/06/2022			
3m Site NSA	SGS	966 chamber D	N/A	07/12/2021	07/11/2022			
Spectrum Ana- lyzer	KEYSIGHT	N9010A	MY54510568	03/22/2021	03/21/2022			
Pre-Amplifier	EMC Instru- ments	EMC184045B	980135	10/27/2020	10/26/2021			
Pre-Amplifier	EMC Instru- ments	EMC9135	980234	11/19/2020	11/18/2021			
Pre-Amplifier	EMC Instru- ments	EMC12630SE	980271	11/19/2020	11/18/2021			
Attenuator	Marvelous	WATT-218FS- 10	RF25	11/19/2020	11/18/2021			
High Pass Filter	R&S	F13 HPF 3GHz	RF175	11/19/2020	11/18/2021			
Lowpass Filter	Woken	EWT-56-0019	RF173	11/19/2020	11/18/2021			
Notch Filter	Woken	EWT-54-0038	RF178	11/19/2020	11/18/2021			
Coaxial Cable	Huber Su- hner	EMC106-SM- SM-7200	150703	11/19/2020	11/18/2021			
Coaxial Cable	Huber+Su- hner	RG 214/U	W21.01	11/19/2020	11/18/2021			
Coaxial Cable	Huber Su- hner	SUCOFLEX 104	MY17413/4	11/19/2020	11/18/2021			
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R			
USB Cable	廣寰	Z2110	N/A	N.C.R	N.C.R			
Notebook	Lenovo	T470	P0001293	N/A	N/A			

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

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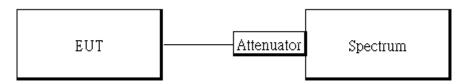
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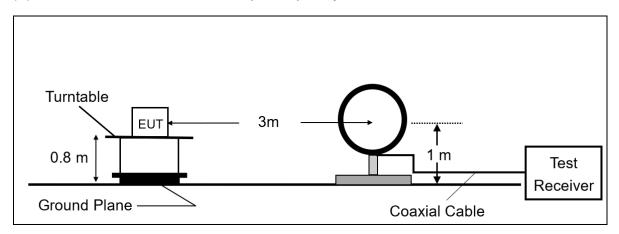
10.3 **Test SET-UP**

10.3.1 Duty Cycle Correction Factor

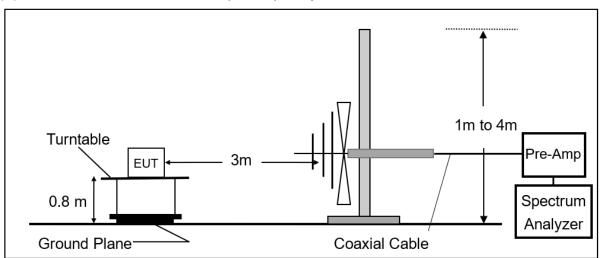


10.3.2 Radiated Emission

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



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



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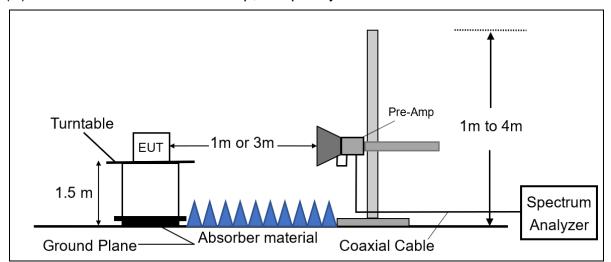
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(C) Radiated Emission Test Set-Up, Frequency Above 1 GHz.



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10.4 Measurement Procedure

- 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.
- 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.

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10.5 **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

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

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

Actual $FS(dB\mu V/m) = SPA$. Reading level(dB μV) + Factor(dB)

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

Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz 10.6

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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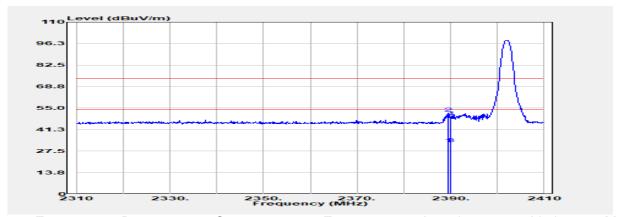
10.7 Measurement Result: 10.7.1 Bandedge Result

Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70
Test Mode :BE CH LOW Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2389.600	Average	40.01	-7.88	32.13	54.00	-21.87
2389.600	Peak	59.61	-7.88	51.74	74.00	-22.26
2390.000	Average	40.06	-7.89	32.17	54.00	-21.83
2390.000	Peak	57.15	-7.89	49.26	74.00	-24.74

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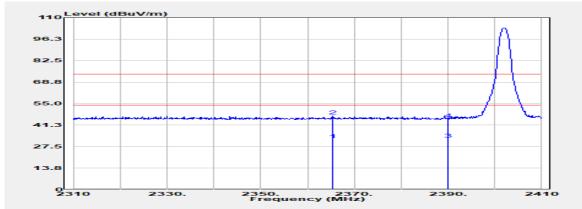
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode :BE CH LOW Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2365.300	Average	39.77	-7.73	32.04	54.00	-21.96
2365.300	Peak	54.86	-7.73	47.13	74.00	-26.87
2390.000	Average	40.07	-7.89	32.18	54.00	-21.82
2390.000	Peak	53.13	-7.89	45.24	74.00	-28.76

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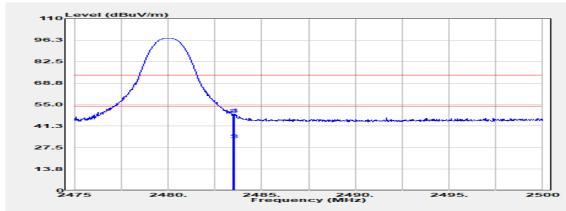
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT BR Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Vertical

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2483.500	Average	40.78	-8.15	32.63	54.00	-21.37
2483.500	Peak	56.89	-8.15	48.74	74.00	-25.26
2483.525	Average	40.75	-8.15	32.60	54.00	-21.40
2483.525	Peak	57.12	-8.15	48.97	74.00	-25.03

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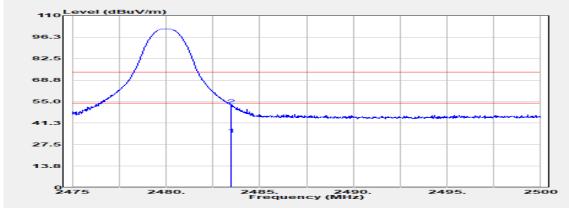
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
 MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	42.43	-8.15	34.28	54.00	-19.72
2483.500	Peak	61.19	-8.15	53.04	74.00	-20.96

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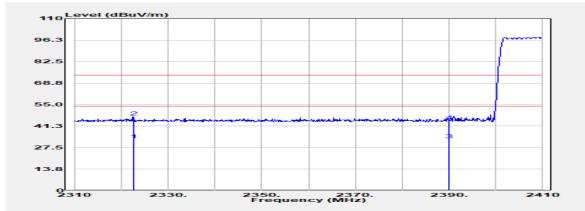
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode :BT BR HOPPING Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode Antenna Pol. :Vertical :BE CH LOW

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2322.600	Average	40.32	-7.67	32.65	54.00	-21.35
2322.600	Peak	54.91	-7.67	47.25	74.00	-26.75
2390.000	Average	40.36	-7.89	32.47	54.00	-21.53
2390.000	Peak	52.46	-7.89	44.57	74.00	-29.43

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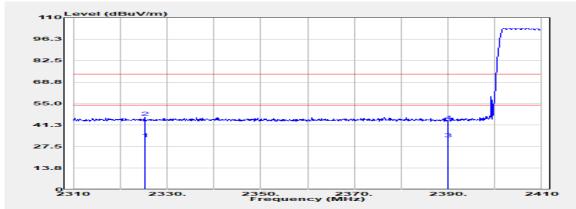
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR HOPPING Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode :BE CH LOW Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2325.200	Average	40.17	-7.66	32.51	54.00	-21.49
2325.200	Peak	54.04	-7.66	46.38	74.00	-27.62
2390.000	Average	40.45	-7.89	32.57	54.00	-21.43
2390.000	Peak	51.76	-7.89	43.87	74.00	-30.13

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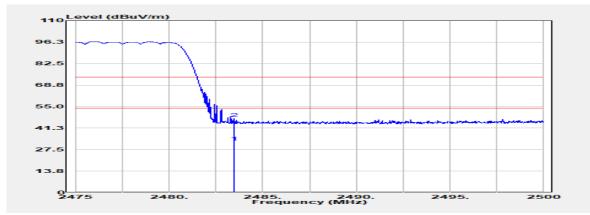
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode :BT BR HOPPING Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode Antenna Pol. :Vertical :BE CH HIGH

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	40.33	-8.15	32.18	54.00	-21.82
2483.500	Peak	55.60	-8.15	47.44	74.00	-26.56

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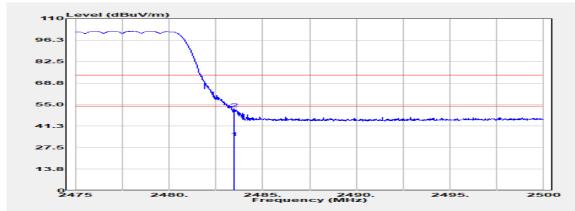
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR HOPPING Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	41.95	-8.15	33.79	54.00	-20.21
2483.500	Peak	60.46	-8.15	52.31	74.00	-21.69

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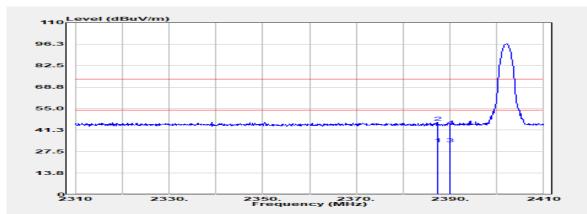
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode :BE CH LOW Antenna Pol. :Vertical

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2387.300	Average	40.35	-7.81	32.54	54.00	-21.46
2387.300	Peak	54.09	-7.81	46.28	74.00	-27.72
2390.000	Average	40.48	-7.89	32.60	54.00	-21.40
2390.000	Peak	51.70	-7.89	43.81	74.00	-30.19

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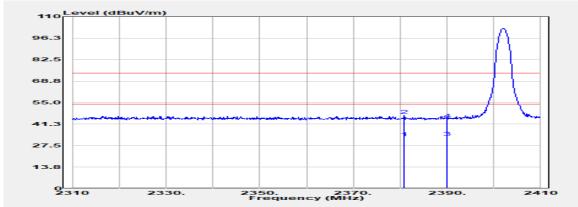
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Operation Mode :BT EDR Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode :BE CH LOW Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBµV/m	dB
2380.900	Average	40.16	-7.61	32.55	54.00	-21.45
2380.900	Peak	54.42	-7.61	46.81	74.00	-27.19
2390.000	Average	40.56	-7.89	32.67	54.00	-21.33
2390.000	Peak	52.17	-7.89	44.28	74.00	-29.72

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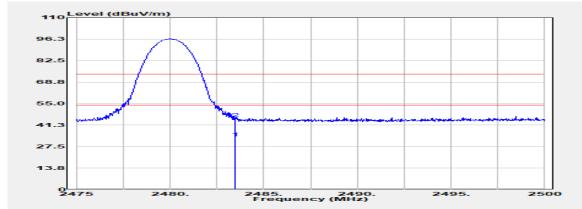
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Vertical

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2483.500	Average	41.33	-8.15	33.17	54.00	-20.83
2483.500	Peak	53.73	-8.15	45.57	74.00	-28.43

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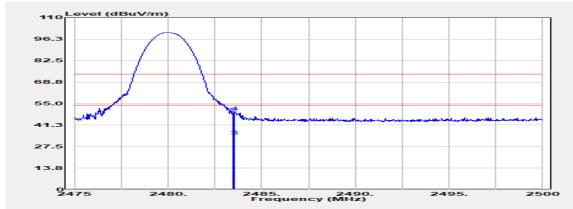
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT EDR Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	42.48	-8.15	34.33	54.00	-19.67
2483.500	Peak	57.00	-8.15	48.85	74.00	-25.15
2483.525	Average	42.47	-8.15	34.32	54.00	-19.68
2483.525	Peak	57.76	-8.15	49.61	74.00	-24.39

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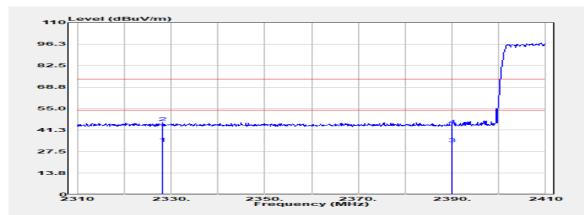
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode :BT EDR HOPPING Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode Antenna Pol. :Vertical :BE CH LOW

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2328.300	Average	40.39	-7.64	32.74	54.00	-21.26
2328.300	Peak	53.74	-7.64	46.10	74.00	-27.90
2390.000	Average	40.51	-7.89	32.62	54.00	-21.38
2390.000	Peak	52.40	-7.89	44.52	74.00	-29.48

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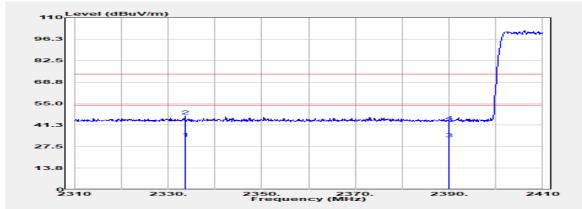
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode :BT EDR HOPPING Test Date :2021-08-04

Test Frequency :2402 MHz Temp./Humi. :21.4/70

Test Mode :BE CH LOW Antenna Pol. :Horizontal

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBµV/m	dBμV/m	dB
2333.700	Average	40.30	-7.63	32.67	54.00	-21.33
2333.700	Peak	54.70	-7.63	47.07	74.00	-26.93
2390.000	Average	40.48	-7.89	32.60	54.00	-21.40
2390.000	Peak	51.45	-7.89	43.56	74.00	-30.44

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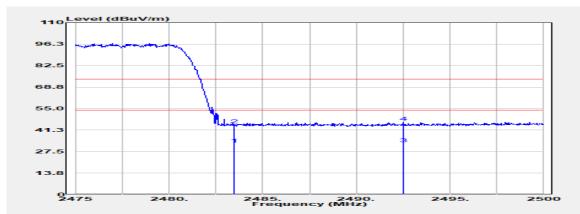
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR HOPPING Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode Antenna Pol. :Vertical :BE CH HIGH

EUT Pol :H Plane :Andy Wang Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.500	Average	40.51	-8.15	32.36	54.00	-21.64
2483.500	Peak	52.68	-8.15	44.53	74.00	-29.47
2492.500	Average	40.53	-8.02	32.52	54.00	-21.48
2492.500	Peak	54.20	-8.02	46.19	74.00	-27.81

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:H Plane

EUT Pol

Report No.: E2/2021/70040

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:Andy Wang

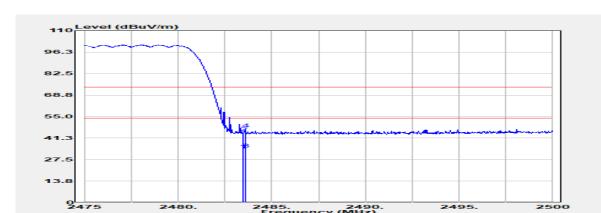
Engineer

Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT EDR HOPPING Test Date :2021-08-04

Test Frequency :2480 MHz Temp./Humi. :21.4/70

Test Mode :BE CH HIGH Antenna Pol. :Horizontal



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
	MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
_							
	2483.500	Average	41.86	-8.15	33.71	54.00	-20.29
	2403.300	Average	41.00	-0.13	33.7 1	34.00	-20.29
	2483.500	Peak	52.85	-8.15	44.70	74.00	-29.30
	2483.575	Average	42.23	-8.15	34.08	54.00	-19.92
	2483.575	Peak	55.36	-8.15	47.21	74.00	-26.79

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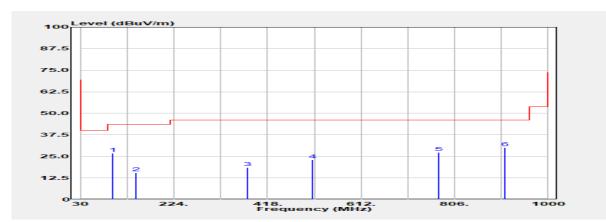
10.7.2 Radiated Spurious Emission

Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode: BT BR Test Date :2021-07-26

Test Frequency :2441 MHz Temp./Humi. :22.1/67 Test Mode :TX CH MID Antenna Pol. :Vertical

:H Plane **EUT Pol** Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
N 41 1—		•	٩D	_	_	٦D
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB_
97.900	Peak	49.18	-22.38	26.79	43.50	-16.71
146.400	Peak	32.45	-16.91	15.53	43.50	-27.97
376.290	Peak	33.02	-14.46	18.55	46.00	-27.45
511.120	Peak	33.91	-10.93	22.98	46.00	-23.02
772.050	Peak	33.98	-6.57	27.41	46.00	-18.59
909.790	Peak	35.86	-5.79	30.07	46.00	-15.93

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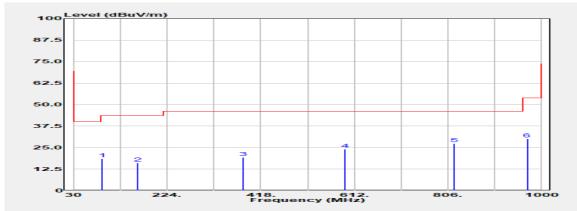
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-07-26

Test Frequency :2441 MHz Temp./Humi. :22.1/67

Test Mode :TX CH MID Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
89.170	Peak	41.83	-23.23	18.60	43.50	-24.90
163.860	Peak	32.98	-16.87	16.11	43.50	-27.39
381.140	Peak	33.59	-14.27	19.32	46.00	-26.68
592.600	Peak	33.56	-9.55	24.01	46.00	-21.99
819.580	Peak	33.96	-6.72	27.24	46.00	-18.76
969.930	Peak	33.86	-3.85	30.01	54.00	-23.99

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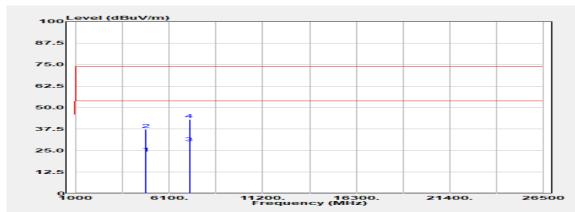
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-07-31

Test Frequency :2402 MHz Temp./Humi. :21.9/62

Test Mode :TX CH LOW Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBµV/m	dB
4804.000	Average	26.73	-3.04	23.68	54.00	-30.32
4804.000	Peak	40.28	-3.04	37.24	74.00	-36.76
7206.000	Average	26.53	2.98	29.51	54.00	-24.49
7206.000	Peak	40.19	2.98	43.17	74.00	-30.83

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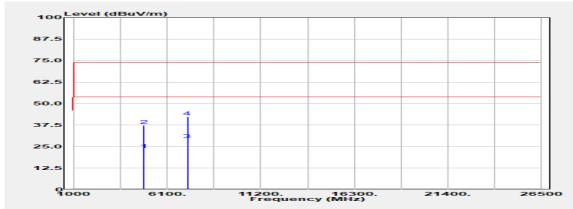
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-07-31

Test Frequency :2402 MHz Temp./Humi. :21.9/62

Test Mode :TX CH LOW Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4804.000	Average	26.47	-3.04	23.43	54.00	-30.57
4804.000	Peak	40.28	-3.04	37.24	74.00	-36.76
7206.000	Average	26.19	2.98	29.17	54.00	-24.83
7206.000	Peak	39.31	2.98	42.29	74.00	-31.71

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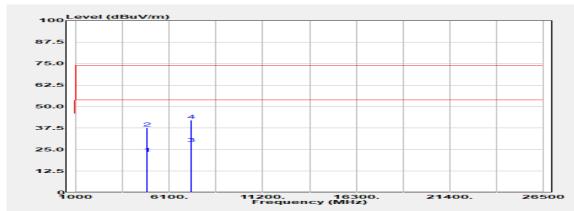
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT BR Test Date :2021-07-31

Test Frequency :2441 MHz Temp./Humi. :21.9/62

Test Mode :TX CH MID Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4882.000	Average	25.95	-3.06	22.89	54.00	-31.11
4882.000	Peak	40.77	-3.06	37.71	74.00	-36.29
7323.000	Average	25.31	3.37	28.68	54.00	-25.32
7323.000	Peak	38.73	3.37	42.09	74.00	-31.91

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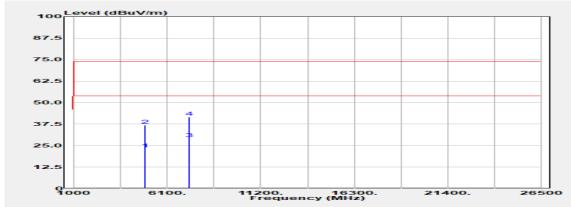
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-07-31

Test Frequency :2441 MHz Temp./Humi. :21.9/62

Test Mode :TX CH MID Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4882.000	Average	26.04	-3.06	22.99	54.00	-31.01
4882.000	Peak	39.98	-3.06	36.92	74.00	-37.08
7323.000	Average	25.76	3.37	29.13	54.00	-24.87
7323.000	Peak	38.14	3.37	41.51	74.00	-32.49

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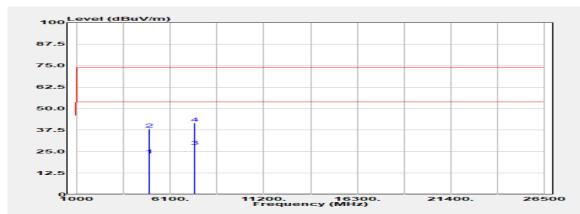
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT BR Test Date :2021-07-31

Test Frequency :2480 MHz Temp./Humi. :21.9/62

Test Mode :TX CH HIGH Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4960.000	Average	25.86	-2.87	22.99	54.00	-31.01
4960.000	Peak	40.97	-2.87	38.09	74.00	-35.91
7440.000	Average	24.22	3.85	28.07	54.00	-25.93
7440.000	Peak	37.78	3.85	41.62	74.00	-32.38

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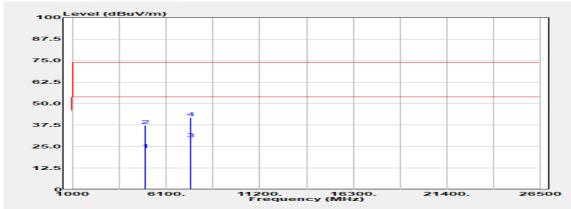
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT BR Test Date :2021-07-31

Test Frequency :2480 MHz Temp./Humi. :21.9/62

Test Mode :TX CH HIGH Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4960.000	Average	26.24	-2.87	23.37	54.00	-30.63
4960.000	Peak	40.15	-2.87	37.28	74.00	-36.72
7440.000	Average	25.77	3.85	29.62	54.00	-24.38
7440.000	Peak	38.00	3.85	41.85	74.00	-32.15

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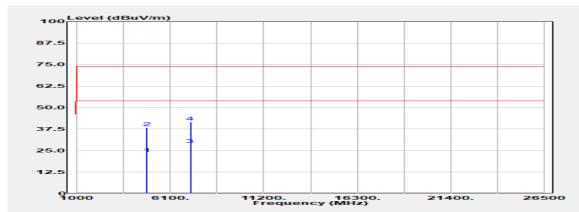
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT EDR Test Date :2021-07-31

Test Frequency :2402 MHz Temp./Humi. :21.9/62

Test Mode :TX CH LOW Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBµV/m	dB
4804.000	Average	26.37	-3.04	23.33	54.00	-30.67
4804.000	Peak	41.48	-3.04	38.44	74.00	-35.56
7206.000	Average	25.64	2.98	28.62	54.00	-25.38
7206.000	Peak	38.61	2.98	41.59	74.00	-32.41

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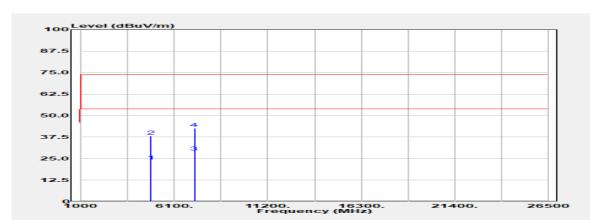
Engineer

Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR Test Date :2021-07-31

Test Frequency :2402 MHz Temp./Humi. :21.9/62

Test Mode :TX CH LOW Antenna Pol. :Horizontal **EUT Pol** :H Plane :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4804.000	Average	26.54	-3.04	23.50	54.00	-30.50
4804.000	Peak	41.15	-3.04	38.11	74.00	-35.89
7206.000	Average	25.82	2.98	28.80	54.00	-25.20
7206.000	Peak	39.50	2.98	42.48	74.00	-31.52

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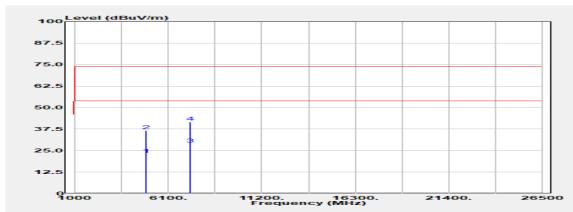
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT EDR Test Date :2021-07-31

Test Frequency :2441 MHz Temp./Humi. :21.9/62

Test Mode :TX CH MID Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμ̈V	dB	dBµV/m	dBµV/m	dB
4882.000	Average	25.93	-3.06	22.87	54.00	-31.13
4882.000	Peak	39.68	-3.06	36.63	74.00	-37.37
7323.000	Average	25.37	3.37	28.74	54.00	-25.26
7323.000	Peak	38.22	3.37	41.59	74.00	-32.41

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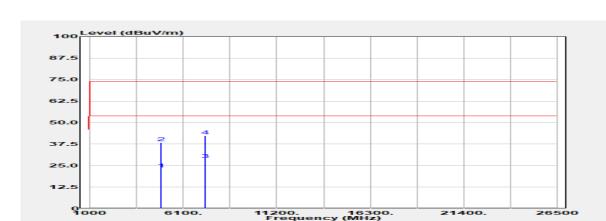
Engineer

Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR Test Date :2021-07-31

Test Frequency :2441 MHz Temp./Humi. :21.9/62

Test Mode :TX CH MID Antenna Pol. :Horizontal **EUT Pol** :H Plane :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4882.000	Average	26.00	-3.06	22.95	54.00	-31.05
4882.000	Peak	41.35	-3.06	38.29	74.00	-35.71
7323.000	Average	25.26	3.37	28.63	54.00	-25.37
7323.000	Peak	39.08	3.37	42.44	74.00	-31.56

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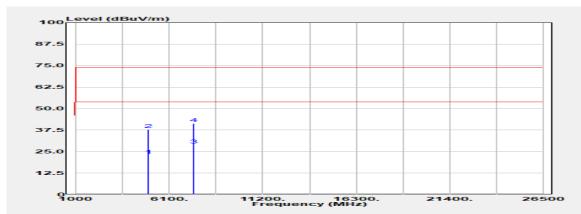
Test Site :SAC D Report Number :E2/2021/70040

Operation Mode: BT EDR Test Date :2021-07-31

Test Frequency :2480 MHz Temp./Humi. :21.9/62

Test Mode :TX CH HIGH Antenna Pol. :Vertical

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBµV/m	dBμV/m	dB
4960.000	Average	25.67	-2.87	22.80	54.00	-31.20
4960.000	Peak	40.59	-2.87	37.72	74.00	-36.28
7440.000	Average	25.08	3.85	28.93	54.00	-25.07
7440.000	Peak	37.43	3.85	41.28	74.00	-32.72

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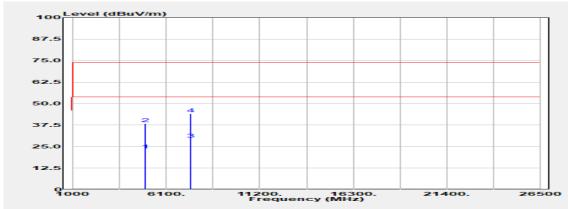
Report Number :E2/2021/70040 Test Site :SAC D

Operation Mode :BT EDR Test Date :2021-07-31

Test Frequency :2480 MHz Temp./Humi. :21.9/62

Test Mode :TX CH HIGH Antenna Pol. :Horizontal

EUT Pol :H Plane Engineer :Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4960.000	Average	25.83	-2.87	22.95	54.00	-31.05
4960.000	Peak	41.17	-2.87	38.30	74.00	-35.70
7440.000	Average	25.42	3.85	29.27	54.00	-24.73
7440.000	Peak	40.17	3.85	44.02	74.00	-29.98

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11 FREQUENCY SEPARATION

11.1 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.

11.2 Measurement Equipment Used

	Conducted Emission Test Site: Conducted G								
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
Spectrum An- alyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022				
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021				
DC Block	PASTER- NACK	PE8210	RF151	11/19/2020	11/18/2021				
Coaxial Ca- bles	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021				
Coaxial Ca- bles	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021				
Test Software	SGS Taiwan	Radio Test Soft- ware	Ver.21	N/A	N/A				

11.3 Test Set-up



11.4 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 spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
- 6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

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11.5 Measurement Result

Modulation	Channel separation (MHz)	Limit	Result
GFSK	1	≥25 kHz or 2/3 times 20dB bandwidth	PASS
8DPSK	1	≥25 kHz or 2/3 times 20dB bandwidth	PASS

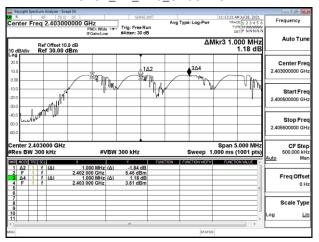
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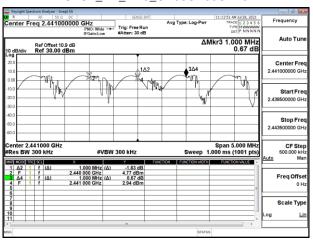


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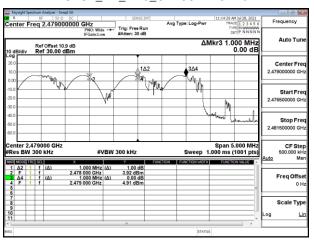
GFSK_1M_DH5_CH0CH1CH2



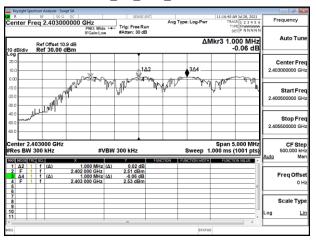
GFSK_1M_DH5_CH38CH39CH40



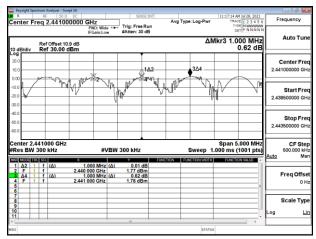
GFSK_1M_DH5_CH76CH77CH78



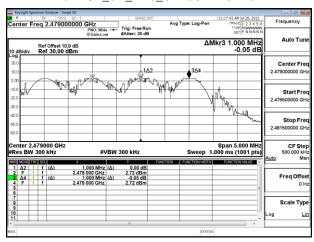
8DPSK_3M_DH5_CH0CH1CH2



8DPSK_3M_DH5_CH38CH39CH40



8DPSK_3M_DH5_CH76CH77CH78



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12 NUMBER OF HOPPING FREQUENCY

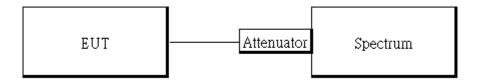
Standard Applicable 12.1

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

12.2 **Measurement Equipment Used**

	Conducted Emission Test Site: Conducted G							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUM- BER	LAST CAL.	CAL DUE.			
Spectrum Ana- lyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022			
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021			
DC Block	PASTER- NACK	PE8210	RF151	11/19/2020	11/18/2021			
Coaxial Cables	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021			
Coaxial Cables	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021			
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N/A	N/A			

12.3 **Test Set-up**



12.4 **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.

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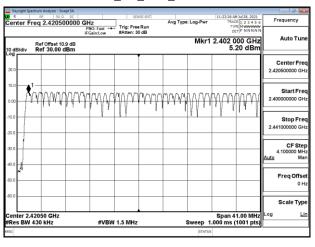
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12.5 Measurement Result

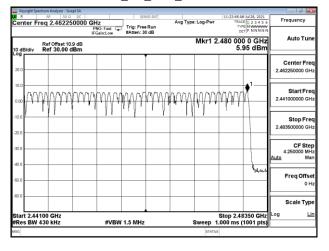
Tabular Data of Total Channel Number

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

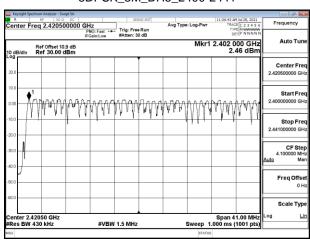
GFSK_1M_DH5_2400-2441



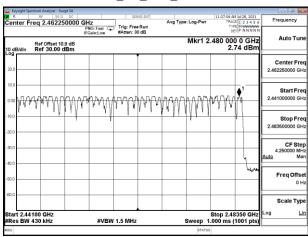
GFSK_1M_DH5_2441-2480



8DPSK_3M_DH5_2400-2441



8DPSK_3M_DH5_2441-2480



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13 TIME OF OCCUPANCY (DWELL TIME)

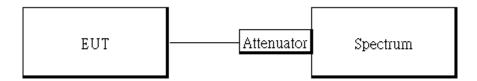
13.1 Standard Applicable

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.

13.2 Measurement Equipment Used

	Conducted Emission Test Site: Conducted G								
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
Spectrum An- alyzer	KEYSIGHT	N9010A	MY57120290	04/06/2021	04/05/2022				
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021				
DC Block	PASTER- NACK	PE8210	RF151	11/19/2020	11/18/2021				
Coaxial Ca- bles	Woken	00100A1F2A196C	RF59	11/19/2020	11/18/2021				
Coaxial Ca- bles	Woken	00100A1F2A196C	RF68	11/19/2020	11/18/2021				
Test Software	SGS Taiwan	Radio Test Soft- ware	Ver.21	N/A	N/A				

13.3 Test Set-up



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13.4 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 = $2\sim8$ ms.
- 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

In AFH mode, hopping rate is 800 hop/s with 6 slots in 20 hopping channels with channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 * 20) (S), Hop Over Occupancy Time comes to (800 / 6 / 20)*(0.4 * 20) = 53.33

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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13.5 Tabular Result of the Measurement GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	VBW setting (kHz)
	DH1	121.60	400ms	3.00
Mid	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)
	2DH1	123.20	400ms	3.00
Mid	2DH3	262.40	400ms	1.00
	2DH5	307.20	400ms	1.00

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	VBW setting (kHz)
	3DH1	123.20	400ms	3.00
Mid	3DH3	262.40	400ms	1.00
	3DH5	308.80	400ms	1.00

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GFSK (1Mbps):

CH Mid	DH1 time slot =	0.380 *	(1600/2/79) *	31.6 =	121.60	(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)

$\pi/4$ -DQPSK (2Mbps):

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

8-DPSK (3Mbps):

CH Mid	3DH1 time slo =	0.385	*	(1600/2/79) *	31.6 =	123.20	(ms)
	3DH3 time slo =	1.640	*	(1600/4/79) *	31.6 =	262.40	(ms)
	3DH5 time slo =	2.895	*	(1600/6/79) *	31.6 =	308.80	(ms)

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

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GFSK (1Mbps) for AFH Mode							
Hopping Channel Number	PACKET TYPE	Measuremen t Result (ms)	Limit (ms)				
20	DH5	153.60	400				
π/4 DQPSK (2Mbps) for AFH Mode							
Hopping Channel Number	PACKET TYPE	Measuremen t Result (ms)	Limit (ms)				
20	2DH5	153.60	400				
8-DPSK (3Mbps) for AFH Mode							
Hopping Channel Number	PACKET TYPE	Measuremen t Result (ms)	Limit (ms)				
20	3DH5	154.40	400				

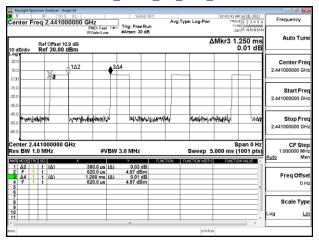
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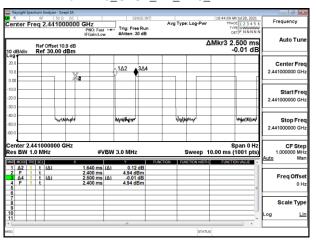


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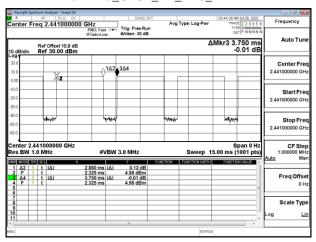
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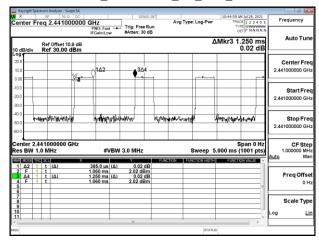
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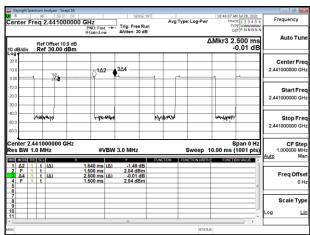
Dwell Time_GFSK_1M_DH5_2441MHz



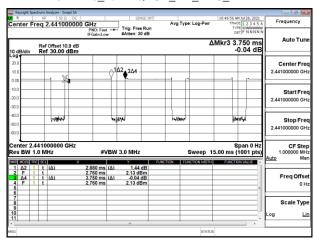
Dwell Time_ $\pi/4$ -DQPSK_2M_DH1_2441MHz



Dwell Time_ $\pi/4$ -DQPSK_2M_DH3_2441MHz



Dwell Time_π/4-DQPSK_2M_DH5_2441MHz



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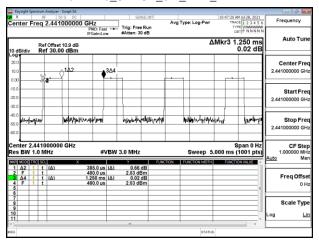
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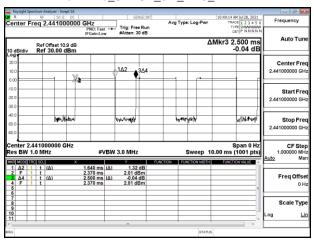


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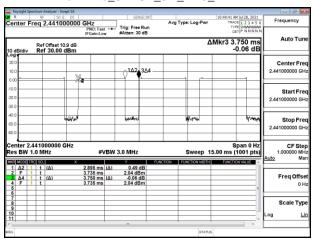
Dwell Time 8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz



Dwell Time_8DPSK_3M_DH5_2441MHz



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14 ANTENNA REQUIREMENT

14.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

14.2 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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