

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Product Name:	ORtek Technology Inc. 13F, Number 150, Jian-Yi Rd., Zhonghe Dist., New Taipei City, Taiwan Bluetooth & USB Controller
Brand Name:	Dragonframe
Model No.:	DFB-02
Model Difference:	N/A
Report Number:	E2/2020/30024
FCC ID:	GM8DFB02
FCC Rule Part:	§15.247, Cat: DSS
Issue Date:	Apr. 13, 2020
Date of Test:	Mar. 05, 2020 ~ Apr. 06, 2020
Date of EUT Received: We hereby certify tha	Mar. 05, 2020 t:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory 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 tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By:

Men lay

Blue Yang / Asst. Manager



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Revision History				
Report Number Revision Description Issue Date Remark				
E2/2020/30024	Rev.00	Original.	Apr. 13, 2020	Revised By: Susan Lin

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GENERAL INFORMATION 1

1.1 **Product description**

Product Name:	Bluetooth & USB Controller	
Brand Name:	Dragonframe	
Model No.:	DFB-02	
Model Difference:	N/A	
Hardware Version:	1.0	
Software Version:	1.0	
Power Supply:	1.5Vdc AA Battery*2 or 5Vdc from USB port	

Radio Technology:	Bluetooth BR
Channel number:	79 channels
Modulation type:	GFSK
Transmit Power:	4.58 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	\leq 0.4s
Antenna Designation:	PCB Antenna, Gain: 2.8561dBi

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1.2 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

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513) No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0002

1.4 Special Accessories

There is no special accessory used while test was conducted.

1.5 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-anechoic 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 Configuration of Tested System Fig. 2-1 Radiated Emission & Conducted (AC powerline) Emission





Fig. 2-2 Conducted (Antenna Port)

Configuration

Table 2-1 Equipment Used in Tested System

ltem	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	T470	P0001293	Shielded	Unshielded

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SUMMARY OF TEST RESULTS 3

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)	20dB 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 Investigation has been done on all the possible configurations for searching the worst case.

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE	
	RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth	2402 to 2480	2441	GFSK	DH5	
	RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and High, the worst case E2 position was reported.					

	ANTENNA PORT CONDUCTED TEST				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE	
	l	Peak Output Power,	20dB Band Width		
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH1/DH3/DH5	
	Band Edge				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
	Frequency Separation				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
	Number of hopping frequency				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
	Time of Occupancy (Dwell time)				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH1/DH3/DH5	

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
20dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Frequency Separation	+/- 51.33 Hz
Number of hopping frequency	+/- 51.33 Hz
Time of Occupancy	+/- 51.33 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty			
	9kHz~30MHz: +-2.3dB		
	30MHz - 180MHz: +/- 3.37dB		
Polarization: Vertical	180MHz -417MHz: +/- 3.19dB		
Foldrization. Vertical	0.417GHz-1GHz: +/- 3.19dB		
	1GHz - 18GHz: +/- 4.04dB		
	18GHz - 40GHz: +/- 4.04dB		
	9kHz~30MHz: +-2.3dB		
	30MHz - 167MHz: +/- 4.22dB		
Polarization: Horizontal	167MHz -500MHz: +/- 3.44dB		
Polarization. Horizontal	0.5GHz-1GHz: +/- 3.39dB		
	1GHz - 18GHz: +/- 4.08dB		
	18GHz - 40GHz: +/- 4.08dB		

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.

Frequency range	Limits dB(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	•			

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

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUM- BER	LAST CAL.	CAL DUE.		
LISN	TESEQ	NNB 51	36062	04/10/2019	04/09/2020		
EMI Test Receiver	R&S	ESCI	101342	04/26/2019	04/25/2020		

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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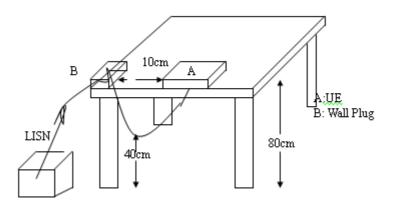
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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

- 1. The EUT was placed on a table which is 0.8m above ground plan.
- 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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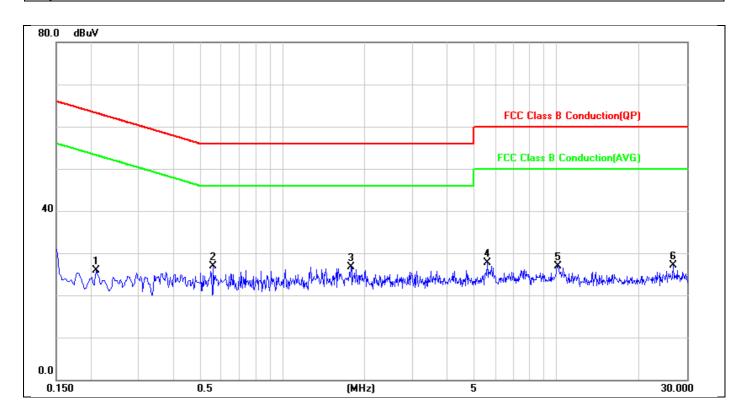
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Description:	Operation	Date:	2020/03/17
Line:	L1	Temp.(°C)/Hum.(%):	22.6(°C)/47%
Test Voltage:	AC 120V/60Hz	Test By:	Kailin
Report Number:	E2/2020/30024		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Commont
NO.	IVIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Detector	Comment
1		0.2100	5.97	19.86	25.83	63.21	-37.38	peak	
2	*	0.5620	6.80	20.04	26.84	56.00	-29.16	peak	
3		1.7820	6.57	20.23	26.80	56.00	-29.20	peak	
4		5.6060	7.42	20.21	27.63	60.00	-32.37	peak	
5		10.1700	6.71	20.27	26.98	60.00	-33.02	peak	
6		26.7980	6.61	20.49	27.10	60.00	-32.90	peak	

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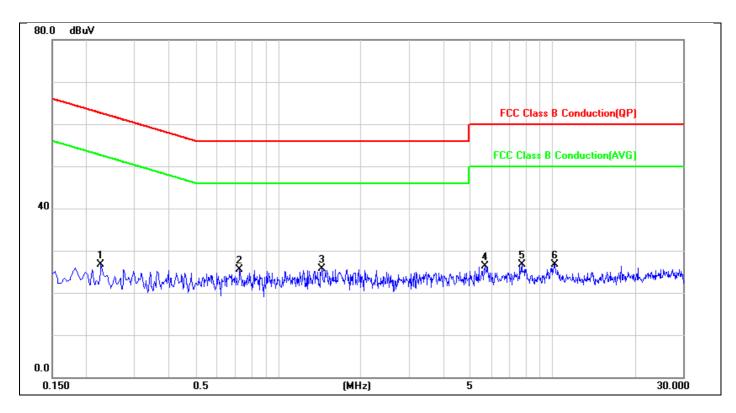
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Description: Line:	Operation N	Date: Temp.(°C)/Hum.(%):	2020/03/17 22.6(°C)/47%
Test Voltage:	AC 120V/60Hz	Test By:	Kailin
Report Number:	E2/2020/30024		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
NO.	WIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Detector	Comment
1		0.2260	6.76	19.87	26.63	62.60	-35.97	peak	
2		0.7260	5.47	20.05	25.52	56.00	-30.48	peak	
3	*	1.4420	5.56	20.14	25.70	56.00	-30.30	peak	
4		5.7100	6.04	20.21	26.25	60.00	-33.75	peak	
5		7.7380	6.46	20.23	26.69	60.00	-33.31	peak	
6		10.2380	6.47	20.26	26.73	60.00	-33.27	peak	

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7 PEAK OUTPUT POWER MEASUREMENT

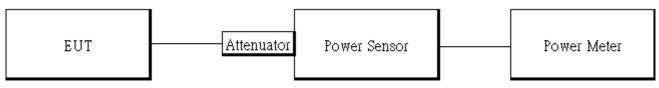
7.1 Standard Applicable

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							
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.			
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021			
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020			
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020			
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020			
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020			
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020			
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020			

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.
- 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 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):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	4.51	2.825	125
Mid	2441	4.56	2.858	125
High	2480	4.58	2.871	125

1M BR mode (Average):

сн	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	4.48	2.805	125
Mid	2441	4.52	2.831	125
High	2480	4.57	2.864	125

NOTE: cable loss as 4.3dB that offsets in the spectrum *Note: Max. Output include tune up tolerance Power measured by using average detector.

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8 20dB BANDWIDTH MEASUREMENT

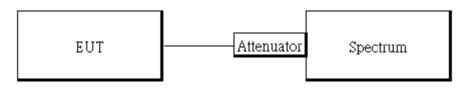
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.		
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021		
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020		
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020		
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020		

8.3 Test Set-up



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=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= large enough to capture all products of the modulation process, 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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8.5 20dB Bandwidth

GFSK

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9331	0.62
Mid	0.9207	0.61
High	0.8792	0.59

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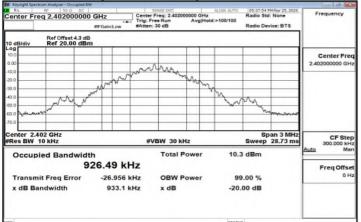
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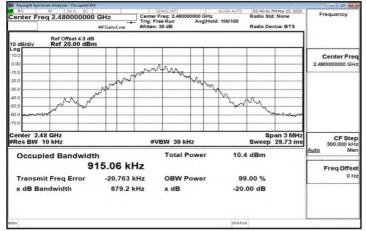
BW CH-Low (GFSK mode)



CH-Mid (GFSK mode)



CH-High (GFSK mode)



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

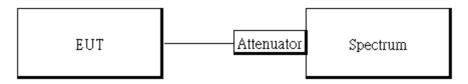
9.1 Standard Applicable

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							
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.		
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021		
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020		
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020		
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020		

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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Hopping mode BR Band Edge CH-Low

Center Freq 2.3650		AUGU AUTO 00:05:22 PM Mar 25, 2020 Avg Type: Log-Pwr TRACE 1 2 3 4 5 5 TTPE IN WWWWW	Frequency
Ref Offset 4	IFGain:Low #Atten: 30 dB	Mkr3 2.390 00 GHz -57.31 dBm	Auto Tun
		Remainin A	Center Fre 2.365000000 GH
20.0		1156 2646	Start Fre 2.310000000 GH
50.0 60.0	- Augustud Anti-antibal Salah - an ang an a	**************************************	Stop Fre 2.420000000 GH
Center 2,36500 GHz #Res BW 100 kHz	#VBW 300 kHz	Span 110.0 MHz Sweep 10.53 ms (1001 pts)	CF Ste 11.000000 MH
Model Model Filled 1 N 1 f 2 N 1 f 3 N 1 f 4 5 6 7	2.417 91 GHz 3.76 dBm 2.399 90 GHz -67.62 dBm 2.390 00 GHz -67.31 dBm	FUNCTION FUNCTION WADTH FUNCTION VALUE -	Freq Offse
8 9 10 11			

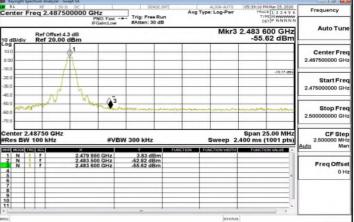
BR Band Edge CH-High

Frequency	Mar 25, 2020	TRAD	Log-Pwr	Avg T	Run Run		łz	0000 GI	48750	q 2.	r Fre	IL
Auto Tune	Trig: Free Run #Atten: 30 dB Мkr3 2.483 600 GHz -56.91 dBm					PNO: Fast IFGainLow Ref Offset 4.3 dB						
Center Free 2.487500000 GH								1	A	20	21	00
Start Free 2.475000000 GH	(16,26 dBn							ł	¥ ¥	Y	4	
Stop Fre 2.500000000 GH	-boten	lonner	n n n			- 10- ang ta (12- ang	2ª-	he		+		0.0
CF Step 2.500000 MH Auto Mai		.400 ms (V 300 kHz	#VBI			00 k	r 2.48 BW 1	les
Freq Offse 0 H	*	PUNETE	(=nox/wont	C19/	3m 3m	3,72 df -56 55 df -66,91 df	6 GHz	2,475 97 2,483 50 2,483 60		1 1 1		
	-	*	STATUS			n						

Non-Hopping BR Band Edge CH-Low

Keynight Spectrum Analyzer - Swept SA				
Center Freq 2.365000000 GHz	Trig: Free Run	Avg Type: Log-Pwr	05:36:30 PMMar 25, 2020 TRACE 1, 2, 3, 4, 5, 5 TYPE MWWWW DETP NNNNN	Frequency
IFGain:Low Ref Offset 4.3 dB ID dB/div Ref 20.00 dBm	#Atten: 30 dB	Mkr	3 2.390 00 GHz -56.62 dBm	Auto Tun
				Center Fre 2.36500000 GH
20.0 31.0 40.0			-16.25 dDn	Start Fre 2.310000000 GH
50.0	ric metry month by the stand of the second	mark to a mark the second second	huma	Stop Fre 2.420000000 GH
enter 2.36500 GHz Res BW 100 kHz #VE	W 300 kHz	Sweep 1	Span 110.0 MHz 0.53 ms (1001 pts)	CF Ste 11,000000 Mi- Auto Ma
1 N 1 f 240196 GHz 2 N 1 f 2399 90 GHz 3 N 1 f 2399 90 GHz 4 5	3,61 dBm -41,69 dBm -56,62 dBm	Powerion work	FUNCTION WEDE	Freq Offse 0 H
6 7 7 8 9 9 10 11				
*	π	STATUS	1.1	

BR Band Edge CH-High



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Spurious Emission GFSK 1M DH5 2402MHz

							im Anelyner - Sie	Spectra	
Frequency	05:38:38 PMMar 25, 2020 TRACE 1 2 3 4 5 5 TVPE MWWWW DET P INNNN	ALIGN AUTO Type: Log-Pwr		Trig: Free Ru	Hz	000000 GI		Fre	nter
Auto Tur				#Atten: 30 dB	iain:Low	IFG			
	4 4.804 2 GHz -26.00 dBm	Mk					tef Offset 4.		B/div
Center Fre							1		
13,015000000 G							4	_	-
	-18,16 (894		-			4 2			
Start Fre							•		
30.000000 MH					1			_	1
Stop Fre	and the second division of the second divisio		dial.						
26.00000000 G								-	1
CF Ste	Span 25.97 GHz						2 GHz		
2.597000000 Gi	.482 s (30001 pts)			/ 300 kHz	#VBI		0 kHz		
	FUNCTION WADE	FUNCTION WOTH	FUNCTION	1.82 dBm	GHz	2,401 9		1	
Freq Offs				-26.00 dBm -27.20 dBm -26.00 dBm	GHz	4.804 0 7.205 0 4.804 2	{	1	N N N
					-		-		
			_		-		-		
							-		_

Spurious Emission_GFSK_1M_DH5_2441MHz

E Keysight Spectrum Analyzer - Swept SA					
Center Freq 13.01500000	0 GHz PNC: Fast Trig: Free Run	Aug Type: Log-Pwr	25:43:31 PMMar 25, 2020 TRACE 1 2 3 4 5 6 TVPE M WWWWW	Frequency	
Ref Offset 4.3 dB	Ref Offset 4.3 dB Mkr4 7.323 2 GHz				
10.0 0.00				Center Fre 13.015000000 GH	
10.0 20.0 30.0 40.0	↓ ⁴		-16,74 albr.	Start Fre 30,000000 Mil	
52 0 (0 0 70.0				Stop Fre 26.00000000 GH	
Center 13.02 GHz Res BW 100 kHz	#VBW 300 kHz		Span 25.97 GHz 82 s (30001 pts)	CF Ste 2.597000000 Gł Auto Ma	
1 N I f 2. 2 N I f 4. 3 N I f 7. 4 N I f 7. 6 6	440 9 GHz 3.26 dBm 882 0 GHz -26.86 dBm 323 0 GHz -23.88 dBm 323 2 GHz -23.88 dBm		P02010W-9202	Freq Offs 0 H	
7 8 9 9 10 11 1					

Spurious Emission_GFSK_1M_DH5_2480MHz

Center Freq 1	30 D DC	0 GHz	Trig: Free Run	Avg Type: Log-Pwr	05:41:24 PM Mar 25, 2020 TRACE 1 2 3 4 5 5 TVPE M WWWWW	Frequency
Ref	Offset 4.3 dB	PNO: Fast ++ IFGain:Low	#Atten: 30 dB	MI	kr4 7.440 1 GHz	Auto Tune
	20.00 dBm				-25,04 dBm	
0.00						Center Fre 13.015000000 GH
-10.0					-17.15 dBm	
20.0 30.0 40.0	02	1				Start Fre 30.000000 MH
50.0	Non-		Lange La Contraction		and the second se	Stop Fre
-70.0						26.000000000 GH
Center 13.02 C Res BW 100	kHz	#VBV	V 300 kHz		Span 25.97 GHz 2.482 s (30001 pts)	CF Ste 2.597000000 GH Auto Ma
	2	479 8 GHz	2.85 dBm	UNCTION FUNCTION WIDTH	FUNCTION VALUE	
3 N 1 f 4 N 1 f	7.	960 0 GHz 440 0 GHz 440 1 GHz	-30.18 dBm -25.04 dBm -25.04 dBm			Freq Offse 0 H
6 7 8 9						
10						
11					•	
eg l				STATU	+	

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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.
- 2. Emission level ($dB\mu V/m$) = 20 log Emission level ($\mu V/m$)

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Measurement Equipment Used 10.2

966 Chamber										
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUM- BER	LAST CAL.	CAL DUE.					
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	11/04/2019	11/03/2020					
Horn Antenna	Schwarzbeck	BBHA9170	185	08/07/2019	08/06/2020					
Horn Antenna	Schwarzbeck	BBHA9120D	1341	06/12/2019	06/11/2020					
Loop Antenna	ETS.LINDGREN	6502	143303	04/25/2019	04/24/2020					
3m Site NSA	SGS	966 chamber D	N/A	07/12/2019	07/11/2020					
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/15/2019	07/14/2020					
Pre-Amplifier	EMC Instruments	EMC184045B	980135	11/20/2019	11/19/2020					
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/20/2019	11/19/2020					
Pre-Amplifier	EMC Instruments	EMC12630SE	980271	11/20/2019	11/19/2020					
Attenuator	Woken	WATT-218FS-10	RF25	11/20/2019	11/19/2020					
High Pass Filter	R&S	F13 HPF 3GHz	RF64	11/20/2019	11/19/2020					
Low Pass Filter	EWT	EWT-56-0019	RF46	11/20/2019	11/19/2020					
Notch Filter	EWT	EWT-54-0038	RF55	11/20/2019	11/19/2020					
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/20/2019	11/19/2020					
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/20/2019	11/19/2020					
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/20/2019	11/19/2020					

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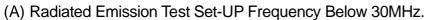
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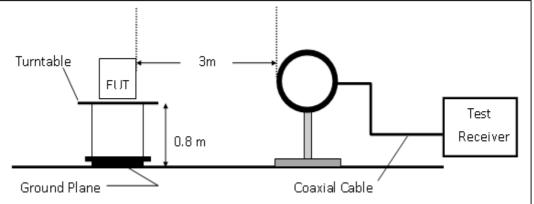
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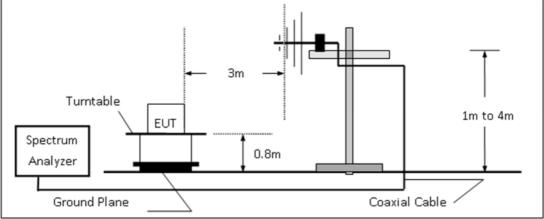


10.3 Test SET-UP

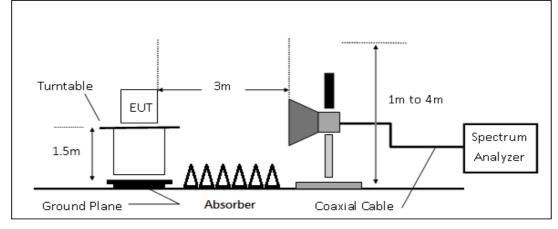




(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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10.4 Measurement Procedure

10.4.1 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 plan.
- 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=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 8. 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.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 11. 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 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($dB\mu V/m$) = SPA. Reading level($dB\mu V$) + Factor(dB) Factor(dB) = Antenna Factor($dB\mu V/m$) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

10.6 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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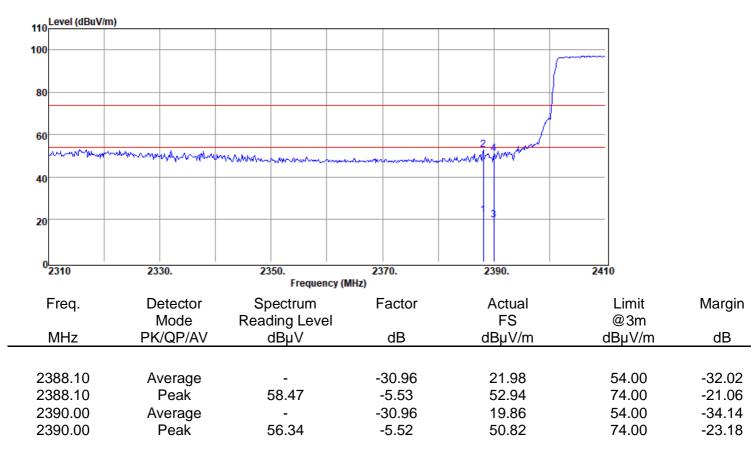


10.7 Measurement Result:

10.7.1 Radiated Bandedge Result (Hopping Mode)

Report Number	:E2/2020/30024
Operation Mode	:BT BR Hopping
Test Frequency	:2402 MHz
Test Mode	:BE CH LOW
EUT Pol	:E2 Plan

Test Date	:2020-03-18
Temp./Humi.	:22.7/46
Antenna Pol.	:VERTICAL
Engineer	:Kailin



Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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Test Date



:E2/2020/30024

Report Number

	,			1001 2 0.10		
Operation Mode	:BT BR Hoj	pping		Temp./Humi.	:22.7/46	
Test Frequency	:2402 MHz			Antenna Pol.	:HORIZONTA	L
Test Mode	:BE CH LO	W		Engineer	:Kailin	
EUT Pol	:E2 Plan					
110 Level (dBuV/m)						
100						
100						
80						
60						
Markan Markan	man man hand and	when when the second	unnuk mush munimum	warman		
40						
20				3		
0						
02310	2330.	2350. Frequency (2370. [MHz]	2390.	2410	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	-
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
	<u>.</u>					
2389.70	Average	-	-30.96	23.61	54.00	-30.39
2389.70 2390.00	Peak Average	60.09	-5.52 -30.96	54.57 22.21	74.00 54.00	-19.43 -31.79
2390.00	Peak	- 58.69	-5.52	53.17	74.00	-20.83
		00.00	0.02			_0.00

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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54.00

74.00

-26.83

-15.87

Test Date

27.17

58.13



:E2/2020/30024

Report Number

2483.50

2483.50

Operation Mode Test Frequency Test Mode EUT Pol	:BT BR Hopp :2480 MHz :BE CH HIGI :E2 Plan	-		Temp./Humi. Antenna Pol. Engineer	:22.7/46 :VERTICAL :Kailin	
110 Level (dBuV/m)						
100						
80						
60		2	Monneyman			
40			Mr			
20						
0 <mark></mark> 2475	2480.	2485. Frequency	2490. (MHz)	2495.	2500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
		ŀ		ł	ł	

-30.96

-5.42

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

Average

Peak

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

63.55

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f (886-2) 2298-0488



Report Number Operation Mode Test Frequency Test Mode EUT Pol	:E2/2020/30024 :BT BR Hopping :2480 MHz :BE CH HIGH :E2 Plan			Test Date Temp./Humi. Antenna Pol. Engineer	:2020-03-18 :22.7/46 :HORIZONTA :Kailin	L
110 Level (dBuV/m)						
100						
80	\rightarrow					
60		2				
		and have a second	man	manument	water	
40						
20						
0						
⁰ 2475	2480.	2485. Frequency (MI	2490. Iz)	2495.	2500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
						40
2483.50	Average	-	-30.96	27.89	54.00	-26.11
2483.50	Peak	64.27	-5.42	58.85	74.00	-15.15

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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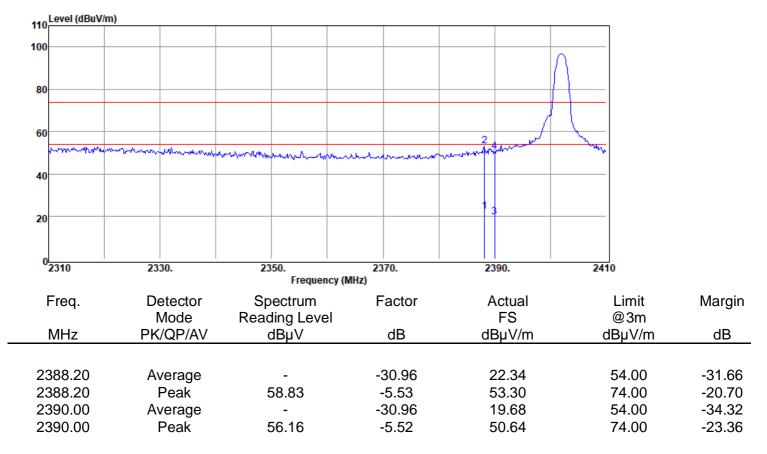
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10.7.2 Radiated Bandedge Result (Non-Hopping Mode)

Report Number	:E2/2020/30024	Test Date	:2020-03-18
Operation Mode	:BT BR	Temp./Humi.	:22.7/46
Test Frequency	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:BE CH LOW	Engineer	:Kailin
EUT Pol	:E2 Plan		



Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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54.00

74.00

-32.72

-21.76

Test Date



:E2/2020/30024

Report Number

2390.00

2390.00

ation Mode	e :BT BR			Temp./Humi.	:22.7/46	
requency	:2402 MHz			Antenna Pol.	:HORIZONTA	L
/lode	:BE CH LO	W		Engineer	:Kailin	
Pol	:E2 Plan					
Level (dBuV/m	1)					
				2 4	<u></u>	
A growing and	warman - warman	- Martin Martin and Martin	and marker and	and the second s		
				13		
2310	2330.			2390.	2410	
Freq.	Detector		Factor	Actual	Limit	Margin
	Mode	Reading Level	15	FS	@3m	-
MHZ	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
387 20	Average	_	-30.96	23 17	54 00	-30.83
	Peak	59.65	-5.52	54.13	74.00	-19.87
	Frequency Aode Pol	Frequency :2402 MHz Mode :BE CH LO Pol :E2 Plan Level (dBuV/m) 2310 2330. Freq. Detector Mode MHz PK/QP/AV 387.20 Average	Frequency :2402 MHz Aode :BE CH LOW Pol :E2 Plan Level (dBuV/m) 2310 2330. 2350. Frequency (Freq. Detector Spectrum Mode MHz PK/QP/AV dBµV 387.20 Average -	Frequency :2402 MHz Mode :BE CH LOW Pol :E2 Plan Level (dBuV/m)	Frequency :2402 MHz Antenna Pol. Aode :BE CH LOW Engineer Pol :E2 Plan Image: Chick of the second se	requency :2402 MHz Antenna Pol. :HORIZONTA Aode :BE CH LOW Engineer :Kailin Pol :E2 Plan Level (dBuV/m) 2310 2330. 2350. 2370. 2390. 2410 Freq. Detector Spectrum Factor Actual Limit Mode Reading Level dB dBµV/m dBµV/m 387.20 Average30.96 23.17 54.00

-30.96

-5.52

21.28

52.24

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

Average

Peak

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

-

57.76

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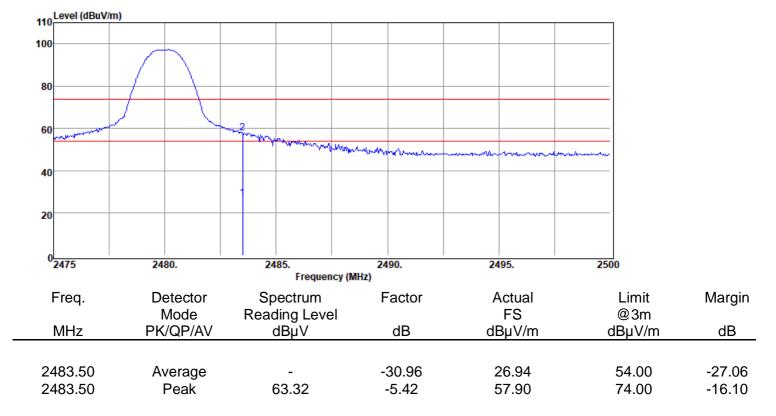
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Report Number	:E2/2020/30024	Test Date	:2020-03-18
Operation Mode	:BT BR	Temp./Humi.	:22.7/46
Test Frequency	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:BE CH HIGH	Engineer	:Kailin
EUT Pol	:E2 Plan		



Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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Test Date



:E2/2020/30024

Report Number

Operation Mo	Operation Mode :BT BR			Temp./Hum	ni. :22.7/46	:22.7/46		
Test Frequen	cy :2480 MH	7		Antenna Po	ol. :HORIZONT/	71		
-	-							
Test Mode	:BE CH H	IGH		Engineer	:Kailin			
EUT Pol	:E2 Plan							
110 Level (dBu	V/m)							
100								
80								
00	+/-+							
60		- manuna - m						
			and and and the second	manument	utortoon -			
40								
20								
20								
0 2475	2480.	2485.	2490.	2495.	2500			
			icy (MHz)					
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin		
	Mode	Reading Leve		FS	@3m			
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB		
2483.50	Average	-	-30.96	27.80	54.00	-26.20		
2483.50	Peak	64.18	-5.42	58.76	74.00	-15.24		

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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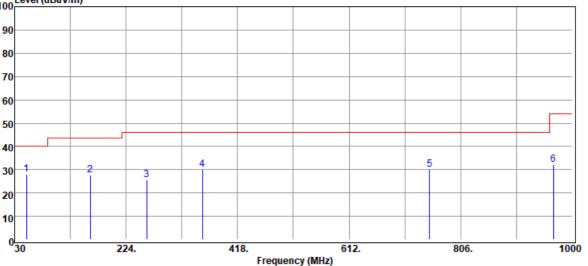
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10.7.3 Radiated Spurious Emission form 30MHz to 1000MHz:

Report Number	:E2/2020/30024	Test Date	:2020-03-17
Operation Mode	:BT BR	Temp./Humi.	:22.6/46
Test Frequency	:2441 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX CH MID	Engineer	:Kailin
EUT Pol	:E2 Plan		

100 Level (dBuV/m)



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
	_					
50.37	Peak	44.98	-16.87	28.11	40.00	-11.89
161.92	Peak	43.67	-16.09	27.58	43.50	-15.92
259.89	Peak	42.54	-16.99	25.55	46.00	-20.45
356.89	Peak	44.18	-13.99	30.19	46.00	-15.81
751.68	Peak	36.80	-6.70	30.10	46.00	-15.90
967.02	Peak	36.43	-4.15	32.28	54.00	-21.72

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Report Number	:E2/2020/30024	Test Date	:2020-03-17
Operation Mode	:BT BR	Temp./Humi.	:22.6/46
Test Frequency	:2441 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:TX CH MID	Engineer	:Kailin
EUT Pol	:E2 Plan		

	/m)					
100 Level (dBuV						
90						
80						
70						
60						
50						
40						
30 1	2 3 4 5	6				
20						
10						
0 <mark>30</mark>	224.	418. Frequency (M	612. Hz)	806.	1000	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
Freq. MHz			Factor dB			Margin dB
MHz	Mode PK/QP/AV	Reading Level dBµV	dB	FS dBµV/m	@3m dBµV/m	dB
MHz 64.92	Mode PK/QP/AV Peak	Reading Level dBµV 48.24	dB -18.23	FS <u>dBµV/m</u> 30.01	@3m dBµV/m 40.00	dB -9.99
MHz 64.92 161.92	Mode PK/QP/AV Peak Peak	Reading Level dBµV 48.24 48.44	dB -18.23 -16.09	FS dBµV/m 30.01 32.35	@3m dBµV/m 40.00 43.50	dB -9.99 -11.15
MHz 64.92 161.92 195.87	Mode PK/QP/AV Peak Peak Peak	Reading Level dBµV 48.24 48.44 51.36	dB -18.23 -16.09 -18.43	FS dBµV/m 30.01 32.35 32.93	@3m dBµV/m 40.00 43.50 43.50	dB -9.99 -11.15 -10.57
MHz 64.92 161.92 195.87 264.74	Mode PK/QP/AV Peak Peak Peak Peak	Reading Level dBµV 48.24 48.44 51.36 50.90	dB -18.23 -16.09 -18.43 -16.76	FS dBµV/m 30.01 32.35 32.93 34.14	@3m dBµV/m 40.00 43.50 43.50 46.00	dB -9.99 -11.15 -10.57 -11.86
MHz 64.92 161.92 195.87	Mode PK/QP/AV Peak Peak Peak	Reading Level dBµV 48.24 48.44 51.36	dB -18.23 -16.09 -18.43	FS dBµV/m 30.01 32.35 32.93	@3m dBµV/m 40.00 43.50 43.50	dB -9.99 -11.15 -10.57

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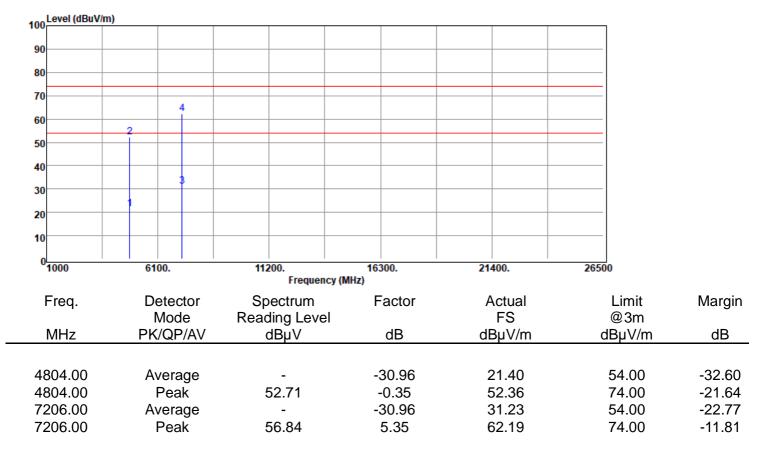
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10.7.4 Radiated Spurious Emission above 1 GHz:

Report Number	:E2/2020/30024	Test Date	:2020-03-17
Operation Mode	:BT BR	Temp./Humi.	:22.7/48
Test Frequency	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX CH LOW	Engineer	:Kailin
EUT Pol	:E2 Plan		



Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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Test Date



:E2/2020/30024

Report Number

Report Number	.22/2020/00	0024		Test Date	.2020 00 17	
Operation Mode	:BT BR			Temp./Humi.	:22.7/48	
Test Frequency	:2402 MHz			Antenna Pol.	:HORIZONTA	L
Test Mode	:TX CH LO	W		Engineer	:Kailin	
EUT Pol	:E2 Plan			0		
Lough (dBu)//m)						
100 Level (dBuV/m)						
90						
80						
70	4					
60	2					
50						
40	3					
30						
20						
10						
0 <mark></mark>	6100.	11200. Frequency (N	16300. IHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	5
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Average	-	-30.96	24.80	54.00	-29.20
4804.00	Peak	56.11	-0.35	55.76	74.00	-18.24
7206.00	Average	-	-30.96	37.14	54.00	-16.86
7206.00	Peak	62.75	5.35	68.10	74.00	-5.90

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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Test Date



:E2/2020/30024

Report Number

-		:BT BR :2441 MH :TX CH M :E2 Plan			Temp./Humi. Antenna Pol Engineer		
100	Level (dBuV/m)						
90							
80							
70							
60		4					
50		2					
40							
30							
20							
10							
0	1000	6100.	11200. Frequenc	16300. y (MHz)	21400.	26500	
F	Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
48	82 00	Average	<u>-</u>	-30.96	19.67	54 00	-34 33

-34.33 4882.00 Average -30.96 19.67 54.00 4882.00 -23.37 Peak 51.07 -0.44 50.63 74.00 7323.00 -30.96 28.22 54.00 -25.78 Average 7323.00 Peak 53.38 5.80 59.18 74.00 -14.82

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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f (886-2) 2298-0488

Test Date



:E2/2020/30024

Report Number

Operation Mode Test Frequency Test Mode EUT Pol	:BT BR :2441 MHz :TX CH MII :E2 Plan			Temp./Humi. Antenna Pol. Engineer	:22.6/47 :HORIZONTA :Kailin	L
100 Level (dBuV/m)						
90						
80						
70	4					
60	2					
50						
40	3					
30						
20						
10						
0	6100.	11200.	16300.	21400	26500	
1000	6100.	Frequency		21400.	20000	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
·	Mode	Reading Level		FS	@3m	-
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4882.00	Average	-	-30.96	26.67	54.00	-27.33
4882.00	Peak	58.07	-0.44	57.63	74.00	-16.37
7323.00	Average	-	-30.96	38.58	54.00	-15.42
7323.00	Peak	63.74	5.80	69.54	74.00	-4.46

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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74.00

-16.63

Test Date



:E2/2020/30024

Report Number

7440.00

Operation Mode	:BT BR		Temp./Humi.	:22.7/47		
Test Frequency	:2480 MHz			Antenna Pol.	:VERTICAL	
Test Mode	:TX CH HIC	ЭH		Engineer	:Kailin	
EUT Pol	:E2 Plan					
100 Level (dBuV/m)						
90						
80						
70						
60	2					
50	Í					
40						
30	3					
20						
10						
0 <mark>1000</mark>	<mark>6100.</mark>	11200. Frequency (16300. (MHz)	21400.	26500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	-	-30.96	17.51	54.00	-36.49
4960.00 7440.00	Peak	49.22	-0.75 -30.96	48.47 26.41	74.00 54.00	-25.53 -27.59
7440.00	Average	-	-30.90	20.41	04.00	-27.09

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

Peak

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51.71

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57.37

Test Date



:E2/2020/30024

Report Number

Operation Mode :BT BR		-	Temp./Humi. :22.7/47									
Test Frequen	су	:2480	MHz						Antenna Po	ol. :H0	ORIZONTA	\L
Test Mode		:TX C	H HIC	GΗ				I	Engineer	:Ka	ailin	
EUT Pol		:E2 Pl	an									
Level (dBu	V/m)											
100	·////]	
90												
80												
70			4									
60	2											
50												
40		:	3									
30												
20												
10												
0												
0 ^L 1000		6100.		112	200. Frequend	16: cy (MHz)	300.		21400.	2650	0	
Freq.		Detect	or	Sp	ectrum	F	actor		Actual		Limit	Margin
		Mode			ling Leve	l			FS		@3m	-
MHz		PK/QP/	/AV	(dBμV		dB		dBµV/m	C	lBμV/m	dB
4000.00		A							05.54		F 4 00	00.40
4960.00 4960.00		Avera Peak		F	- 57.22		30.96 0.75		25.51 56.47		54.00 74.00	-28.49 -17.53
7440.00		Avera		τ,	-		30.96		34.41		54.00	-17.53
7440.00		Peak	-	5	59.71		5.66		65.37		74.00	-8.63

Note: Avg correct Factor = 20 log (0.0283)=-30.96dB

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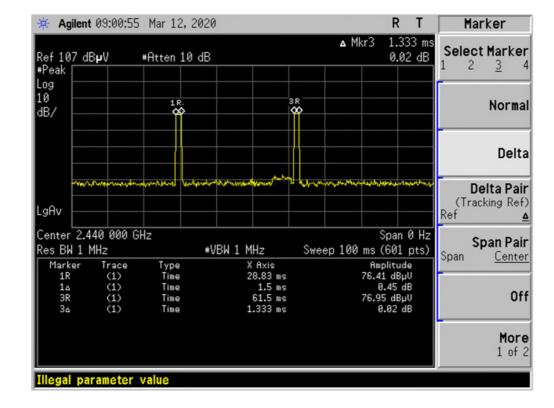
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Duty Cycle



Avg correct Factor:

(1.5+1.33)/100ms=0.0283

20 log (0.0283)=-30.96dB

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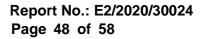
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11 FREQUENCY SEPARATION

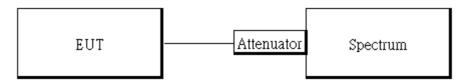
11.1 Standard Applicable

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												
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.								
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021								
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020								
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020								
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020								

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.

11.5 Measurement Result

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

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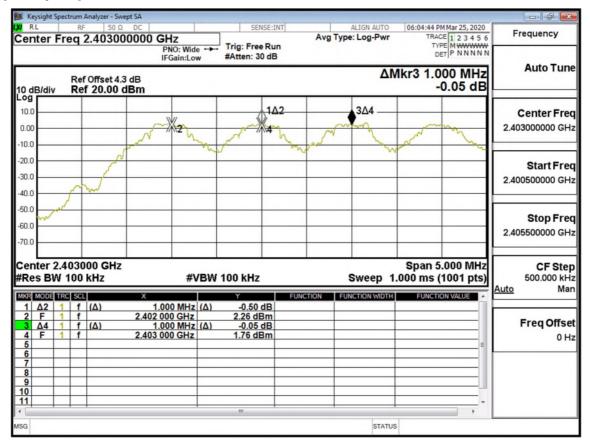
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11.6 Frequency Separation Test Plots



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12 NUMBER OF HOPPING FREQUENCY

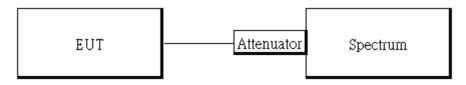
12.1 Standard Applicable

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												
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.								
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021								
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020								
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020								
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020								

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.

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	

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Channel Number Test Plots 12.6

Keysight Spectrum Analyzer - Swept SA RL RF 50 Ω DC Image: Compare the system of the	SENSE:INT			- 6 2
			0.0 00 00 00000 00 0000	
PNO: Fast		ALIGN AUTO Avg Type: Log-Pwr	06:05:56 PM Mar 25, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW	Frequency
Ref Offset 4.3 dB 0 dB/div Ref 20.00 dBm		Mkr1	2.402 000 GHz 3.29 dBm	Auto Tur
				Center Fre 2.420500000 Gi
				Start Fr 2.40000000 G
0.0				Stop Fr 2.441000000 G
				CF St 4.100000 M <u>Auto</u> M
				Freq Offs 0
70.0				
enter 2.42050 GHz Res BW 430 kHz #V	BW 1.5 MHz	Sweep 1	Span 41.00 MHz .000 ms (1001 pts)	

2.402GHz-2.441GHz

2.441GHz-2.4835GHz

-	Mar 25, 2020 E 1 2 3 4 5 6 E MWWWWW	TRAC	ALIGN AUTO :: Log-Pwr			Trig: Fre	Hz PNO: Fast	Ω DC	RF 50	RL
Auto Tur	0 0 GHz 45 dBm	480 000	Mkr1 2		: 30 dB	#Atten: 3	IFGain:Low		Ref Offset	0 dB/div
Center Fre 2.462250000 GH	↓1									og 10.0
Start Fre 2.441000000 GH		XXXX	YYYY	mm	YAAA	YYYY	YYYYY			0.00 YYY 10.0
Stop Fre 2.483500000 GH										20.0
CF Ste 4.250000 Mi <u>Auto</u> Mi										40.0
Freq Offs	- MALA									50.0
	350 GHz	Stop 2.48							100 GHz	70.0
	1001 pts)				lz	(1.5 MHz	#VBW			Res BW

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13 TIME OF OCCUPANCY (DWELL TIME)

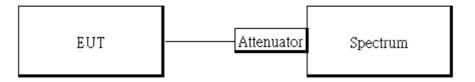
13.1 Standard Applicable

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												
EQUIPMENT TYPE	MFR	MODEL NUM- BER	SERIAL NUM- BER	LAST CAL.	CAL DUE.								
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/17/2020	03/16/2021								
Bluetooth Test Set	R&S	CBT	101140	04/22/2019	04/21/2020								
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	11/20/2019	11/19/2020								
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020								

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 C6310:2015.
- 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 = $2 \sim 8ms$.

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

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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Tabular Result of the Measurement 13.5

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	DH1	140.80	400ms	2.273	3.00
Low	DH3	270.40	400ms	0.592	1.00
	DH5	313.60	400ms	0.340	1.00
	DH1	139.20	400ms	2.299	3.00
Mid	DH3	270.40	400ms	0.592	1.00
	DH5	313.60	400ms	0.340	1.00
	DH1	139.20	400ms	2.299	3.00
High	DH3	270.40	400ms	0.592	1.00
	DH5	313.60	400ms	0.003	1.00

GFSK (1Mbps):

CHLow	DH1 time slot	=	0.440 *	(1600/2/79)	*	31.6 =	140.80 (ms)
	DH3 time slot	=	1.690 *	(1600/4/79)	*	31.6 =	270.40 (ms)
	DH5 time slot	=	2.940 *	(1600/6/79)	*	31.6 =	313.60 (ms)
CH Mid	DH1 time slot	=	0.435 *	(1600/2/79)	*	31.6 =	139.20 (ms)
	DH3 time slot	=	1.690 *	(1600/4/79)	*	31.6 =	270.40 (ms)
	DH5 time slot	=	2.940 *	(1600/6/79)	*	31.6 =	313.60 (ms)
CH High	DH1 time slot	=	0.435 *	(1600/2/79)	*	31.6 =	139.20 (ms)
	DH3 time slot	=	1.690 *	(1600/4/79)	*	31.6 =	270.40 (ms)
	DH5 time slot	=	2.940 *	(1600/6/79)	*	31.6 =	313.60 (ms)

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GFSK (1Mbps) for AFH Mode										
Hopping Channel	PACKET TYPE	Measurement Result	Limit							
Number		(ms)	(ms)							
20	DH5	156.80	400ms							

13.6 Measurement Result

Note: Refer to next page for plots.

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Dwell Time_GFSK_1M_DH1_2402MHz

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Cente	er l	Fre	rif rq 2	2.402		000	GH	z	_	1		ISE INT		A	g Typ		og-P		05:13	TRA	MMar 2	349	71	Frequency
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ers																	1	anin			-		-	

Dwell Time_GFSK_1M_DH1_2441MHz

Keysight Spectrum Analyzer - Swept SA				- 01 -
Center Freq 2.441000000 GHz		Type: Log-Pwr TR	CE 1 2 3 4 5 6	Frequency
PHO: Fast IFGein:Low Ref Offset 4.3 dB 10 dB/div Ref 20.00 dBm	#Atten: 30 dB	ΔMkr3 1	.250 ms	Auto Tun
	364			Center Fre 2.441000000 GH
20.0				Start Fre 2.441000000 GH
50.0 York 4 19 19 19 19 19 19 19 19 19 19 19 19 19	after an	an a		Stop Fre 2.441000000 G8
	3.0 MHz	Sweep 5.000 ms	A.	CF Ste 1,000000 M
1 Δ2 1 t (Δ) 435.0 us (Δ)	0.02 dB	FUNCTION WOTH FUNCT	ION WALSIE	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	-1.17 dBm -0.01 dB -1.17 dBm			Freq Offs 01
6 7 8 9 10				
11				
ng l		STATUS		

Dwell Time_GFSK_1M_DH1_2480MHz

Frequency	Mar 25, 2020	THAC	Log-Pwr	Avg Type:		96456		GHz		2.48000	rea		l a Cen
Auto Tur	250 ms	5.5	-			Trig: Free R #Atten: 30 d	st	PNO: Fast IFGain:Lov			_		_
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Center Fre 2.480000000 GH					1	3 ∆4	_	-@ ^{1Δ2}	Ka -	3	-	h	10.0
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Stop Fre 2.480000000 GH	nery)	whetpoloniclipye	۴	ndynforffradaid	myi44	Nurd	and the second	Mar Anthen		THE SHOP	tosta		0.0
CF Ste 1.000000 Ms Auto Mi	pan 0 Hz 1001 pts)	000 ms (1				3.0 MHz	VBW	#\	Hz		.0 M	BW	es
	HWALUE .	FUNCTIO	TION WOTH	TIGH Fund		-3.84 dB	(<u>A</u>)	435.0 µs	x	(A)			
Freq Offs 01						-0.02 dBm 0.42 dBm	(Δ)	1.250 ms 1.005 ms		(Δ)		A4 F	3 4 5
													6 7 8 9 10
						π	1						11
			STATUS										sia

Dwell Time_GFSK_1M_DH3_2402MHz

treysight Spectrum An						10 l # 🖬
Center Freq 2.	402000000 GHz		Run	vg Type: Log-Pwr	13:14:40 PM Mar 25, 2020 TRACE 1 2 3 4 5 6 TVPE WWWWWWWW DET P NNNNN	Frequency
10 dB/div Ref	Fiset 4.3 dB 20,00 dBm		0 dB	ΔΜ	kr3 2.500 ms -0.02 dB	Auto Tun
10.0						Center Fre 2,402000000 GH
20.0						Start Fre 2.402000000 GH
50.0 07-0 60.0 70.0	April and a state	- Ven	www.r	per plashasili	-apage	Stop Fre 2.402000000 GH
Center 2.40200 Res BW 1.0 MH		VBW 3.0 MHz		Sweep 10.0	Span 0 Hz 10 ms (1001 pts)	CF Str 1.000000 Mi Auto Mi
	Δ) 1.690 ms	(Δ) -5.76	FUNCTION	FUNCTION/WOTH	FUNCTION WAVE	
2 F 1 t Δ Δ4 1 t (4 F 1 t 5	440.0 µs	3.10 de	3m dB			Freq Offs 01
6 7 8 9						
11		п	1	1	*	
50				STATUS		

Dwell Time_GFSK_1M_DH3_2441MHz

TOP TOP T	5/19 PH Nar 25, 2020	ALION AUTO 103	SENSEDUT		0.0.00	and the second second	sparmon		R R
Frequency	TRACE 1 2 3 4 5 6	Avg Type: Log-Pwr	Trig: Free Run	Hz	000000 G		Freq		
Auto Tu	DET P NNNNN		#Atten: 30 dB	PNO: Fast	1				
Auto Tu	3 2.500 ms -0.03 dB	AMM				f Offset 4		B/div	0 d
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2.441000000 G									0.0
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Auto M	ms (1001 pts)			#VBW	3		1.0 1		_
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Freq Offs			1.48 dBm -0.03 dB 1.48 dBm	150.0 μs 500 ms (Δ) 150.0 μs	2	(Δ)		A4 F	4
									5 6 7 8
						-			9
		1 1				-	-	-	11

Dwell Time_GFSK_1M_DH3_2480MHz

Center Freq						
	2.40000000	GHZ	Trig: Free Run	Avg Type: Log-Pwr	03:13/48 PM Mar 25, 2020 TRACE 1:2 3 4 5 6 TUPE WWW	Frequency
		IFGain:Low	#Atten: 30 dB		DET P MNNNN	Auto Tun
0 dB/div Re	offset 4.3 dB			Δ	Mkr3 2.500 ms -0.03 dB	
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.00	Xa					2.480000000 GH
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0.0						Start Fre
0.0						2.480000000 GH
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0.0		_				Stop Fre 2.48000000 GH
0.0						
enter 2.480 es BW 1.0 N	000000 GHz /Hz	#VBV	3.0 MHz	Sweep 1	Span 0 Hz 0.00 ms (1001 pts)	CF Ste 1.000000 MH
	ά (Δ)	1.690 ms (A)	0.88 dB	INCTION FUNCTION WIDTH	FUNCTION VALUE	Auto Ma
2 F 1 t		2.210 ms (Δ)	2.28 dBm -0.03 dB			Freq Offs
	101	2.210 ms	2.28 dBm			01
4 F 1 t 6 7 8 9						
8						
10						
101 101					1.4	

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Dwell Time GFSK 1M DH5 2402MHz

Frequency	05:36:54 PMMar 25, 2020	ALIGN AUTO	SEMSE 1NT1			14		. R. I
Frequency	TYPE WWWWWWW	Avg Type: Log-Pwr	Trig: Free Run	00000 GHz	2.40200	req	ter Fr	en
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2.402000000 GH				Y Y		-	×a-	00
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		approva.	100 March	Walker			M	0.0
Stop Fre 2.402000000 GH								0.0
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Auto Ma	FUNCTION WARDER	TION FUNCTION WOTH		×				
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0 P			o,es outilit			+	-	5
						-		6 7 8 9 0
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Dwell Time_GFSK_1M_DH5_2441MHz

RL IP ISO BCC Center Freq 2.441000000 GHz PROC Fast PROC Fast Id dB/div Ref Offset 4.3 dB If Calification Id Id Id Id Id Id Id Id Id Id Id Id Id Id Id Id Id Id Id <thi< th=""><th>2.2020 Frequency MINNA Auto Tu dB Center Fi 2.441000000 0 Start Fi Start Fi Start Fi Start Fi Start Fi</th></thi<>	2.2020 Frequency MINNA Auto Tu dB Center Fi 2.441000000 0 Start Fi Start Fi Start Fi Start Fi Start Fi
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	=1

Dwell Time_GFSK_1M_DH5_2480MHz

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Center Freq 2.48000000	PNO: Fant Trig: Free Run IFGain:Low #Atten: 30 dB	wog Type: Log-rwr	TYPE WWWWWW	
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100 0.00 100	¢1∆2,3∆4			Center Fre 2.480000000 GH
-20.0				Start Fre 2.460000000 GH
60.0 70.0	404.10		wread	Stop Fre 2.48000000 GH
			Span 0 Hz	CF Ste
Res BW 1.0 MHz	#VBW 3.0 MHz		00 ms (1001 pts)	1.000000 MH
$\begin{array}{c c} \text{Center 2.48000000 GHz} \\ \text{Res BW 1.0 MHz} \\ \hline & & & & & & & & & & & & & & & & & &$		Sweep 15.0	00 ms (1001 pts)	1.000000 MH

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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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