

FCC RF Test Report

APPLICANT	: HMD Global Oy
EQUIPMENT	: Mobile phone
BRAND NAME	: Nokia
MODEL NAME	: TA-1222
FCC ID	: 2AJOTTA-1222
STANDARD	: FCC Part 15 Subpart C §15.247
CLASSIFICATION	: (DSS) Spread Spectrum Transmitter

The product was received on Dec. 31, 2019 and testing was completed on Feb. 08, 2020. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.

Doque Cher

Reviewed by: Derreck Chen / Supervisor

File Shih

ACCREDITED Cert #5145.01

Approved by: Eric Shih / Manager

Sporton International (ShenZhen) Inc. 1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR9D3107A	Rev. 01	Initial issue of report	Mar. 05, 2020



Report Section	FCC Rule	Description	Limit	Result	Remark	
3.1	15.247(a)(1)	Number of Channels	≥ 15Chs	Pass	-	
3.2	15.247(a)(1)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-	
3.3	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec in 31.6sec period	Pass	-	
3.4	15.247(a)(1)	20dB Bandwidth	NA	Pass	-	
3.4	-	99% Bandwidth	-	Not Required	-	
3.5	15.247(b)(1)	Peak Output Power	≤ 125 mW	Pass	-	
3.6	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-	
3.7	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	-	
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 8.47 dB at 53.280 MHz	
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 8.23 dB at 0.180 MHz	
3.10	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-	
Remark: N	Remark: Not required means after assessing, test items are not necessary to carry out.					

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Sporton International (Shenzhen) Inc. TEL : 86-755-8637-9589 FAX : 86-755-8637-9595 FCC ID: 2AJOTTA-1222



1 General Description

1.1 Applicant

HMD Global Oy

Bertel Jungin aukio 9, 02600 Espoo, Finland

1.2 Manufacturer

HMD Global Oy

Bertel Jungin aukio 9, 02600 Espoo, Finland

1.3 Product Feature of Equipment Under Test

Product Feature				
Equipment Mobile phone				
Brand Name	Nokia			
Model Name	TA-1222			
FCC ID	2AJOTTA-1222			
	GSM/WCDMA/LTE			
FUT our north Radian application	WLAN 2.4GHz 802.11b/g/n HT20			
EUT supports Radios application	Bluetooth BR/EDR/LE			
	FM Receiver, GNSS			
	Conducted: 355787100002925			
IMEI Code	Conduction: 355787100003485			
	Radiation: 355787100004129			
HW Version	V1.0			
SW Version	00CUS_0_18Q			
EUT Stage	Production Unit			

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification				
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz			
Number of Channels	79			
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78			
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 10.30 dBm (0.0107 W) Bluetooth EDR (2Mbps) : 9.60 dBm (0.0091 W) Bluetooth EDR (3Mbps) : 9.90 dBm (0.0098 W)			
Antenna Type / Gain	Coupling type (LDS) Antenna with gain -0.47 dBi			
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) :π/4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK			



1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

<FCC>-SZ

Sporton International (Shenzhen) Inc. is accredited to ISO/IEC 17025:2017 by American Association for

Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International (Shenzhen) Inc.				
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595				
Toot Site No	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.		
Test Site No.	CO01-SZ	CN1256	421272		
Test Firm	Sporton International (Shenzhen) Inc.				
Test Site Location	No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan Shenzhen, 518055 People's Republic of China TEL: +86-755-33202398				
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.		

<FCC>-TW

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications			
Test Site	Laboratory			
	No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)			
Test Site Location	TEL: +886-3-327-3456			
	FAX: +886-3-328-4978			
	Sporton Site No. :			
Test Site No.	TH05-HY			
	TAF Lab Code: 1190			

Test data subcontracted: conducted test items in this report



1.7 Test Software

ltem	Site	Manufacture	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24
2.	CO01-SZ	AUDIX	E3	6.120613b

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

- 1. All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
	0	2402	27	2429	54	2456
	1	2403	28	2430	55	2457
	2	2404	29	2431	56	2458
	3	2405	30	2432	57	2459
	4	2406	31	2433	58	2460
	5	2407	32	2434	59	2461
	6	2408	33	2435	60	2462
	7	2409	34	2436	61	2463
	8	2410	35	2437	62	2464
	9	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
2400-2483.5 MHz	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	-	-
	26	2428	53	2455	-	-



2.2 Test Mode

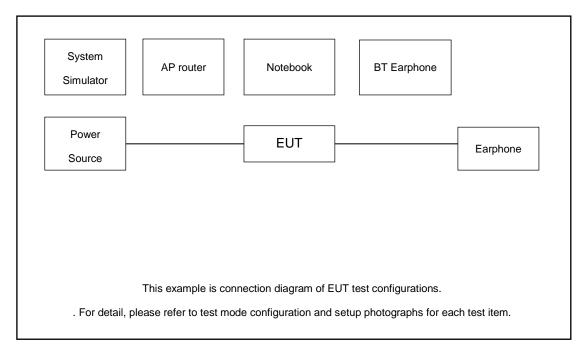
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

	Summa	ry table of Test Cases			
		Data Rate / Modulation			
Test Item	Bluetooth BR 1Mbps	Bluetooth EDR 2Mbps	Bluetooth EDR 3Mbps		
	GFSK	π/4-DQPSK	8-DPSK		
Conductod	Mode 1: CH00_2402 MHz	Mode 4: CH00_2402 MHz	Mode 7: CH00_2402 MHz		
Conducted	Mode 2: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 8: CH39_2441 MHz		
Test Cases	Mode 3: CH78_2480 MHz	Mode 6: CH78_2480 MHz	Mode 9: CH78_2480 MHz		
	Bluetooth BR 1Mbps GFSK				
Radiated		Mode 1: CH00_2402 MHz			
Test Cases	Mode 2: CH39_2441 MHz				
	Mode 3: CH78_2480 MHz				
AC					
Conducted	Mode 1 : GSM 850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable (Charging				
Emission	from Adapter) + Battery + Earphone				
Remark:					
1. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate					
has the highest RF output power at preliminary tests, and no other significantly frequencies found in					
conducted spurious emission.					

The following summary table is showing all test modes to demonstrate in compliance with the standard.



2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

ltem	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Base Station	R&S	CBT32	N/A	N/A	Unshielded,1.8m
2.	Base Station(LTE)	Anritsu	MT8820C	N/A	N/A	Unshielded,1.8m
3.	WLAN AP	Dlink	DIR-820L	KA2IR820LA1	N/A	Unshielded,1.8m
4.	NOTE BOOK	Lenovo	E540	FCC DoC	AC I/P : Unshielded, 1.2m DC O/P : Shielded, 1.8m	N/A
5.	Earphone	apple	A1285	N/A	N/A	N/A
6.	Bluetooth Earphone	Samsung	EO-MG900	PYAHS-107W	N/A	N/A



2.5 EUT Operation Test Setup

For Bluetooth function, the engineering test program was provided and enabled to make EUT connect with Bluetooth base station to continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 15.40dB and 10.00 dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 15.40 + 10.00 = 25.40 (dB)



3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedure

- 1. The testing follows ANSI C63.10-2013 clause 7.8.3.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.
- Use the following spectrum analyzer settings: Span = the frequency band of operation;
 RBW = 300kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
- 6. The number of hopping frequency used is defined as the number of total channel.
- 7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup

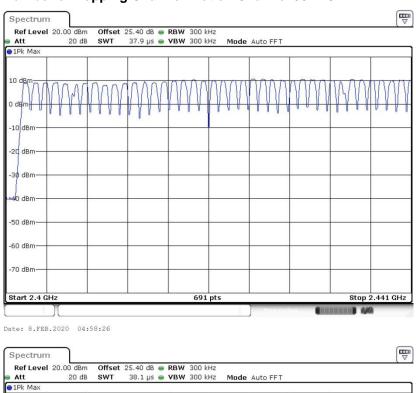


Spectrum Analyzer

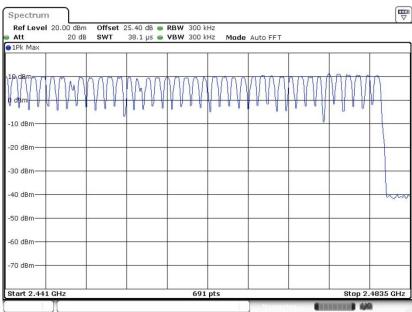
3.1.5 Test Result of Number of Hopping Frequency

Please refer to Appendix A.





Number of Hopping Channel Plot on Channel 00 - 78



Date: 8.FEB.2020 04:58:46



3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

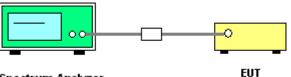
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 7.8.2.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.
- Use the following spectrum analyzer settings:
 Span = wide enough to capture the peaks of two adjacent channels;
 RBW = 300kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
- 6. Measure and record the results in the test report.

3.2.4 Test Setup



Spectrum Analyzer

3.2.5 Test Result of Hopping Channel Separation

Please refer to Appendix A.

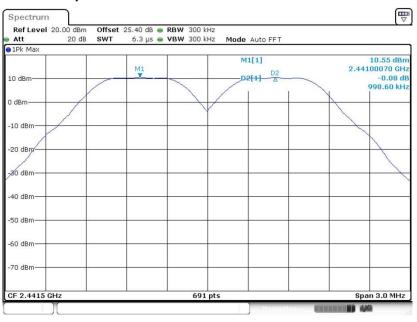


<1Mbps>

Spectrum Offset 25.40 dB ● RBW 300 kHz SWT 6.3 µs ● VBW 300 kHz Ref Level 20.00 dBm Mode Auto FFT 20 dB Att ●1Pk Max M1[1] 9.44 dBm 2.40200070 GHz M1 D2[1] D2 10 dBn -0.02 dB 998.60 kH 0 dBm -10 dBm -20 dBn -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm Span 3.0 MHz CF 2.4025 GHz 691 pts Date: 8.FEB.2020 05:16:48

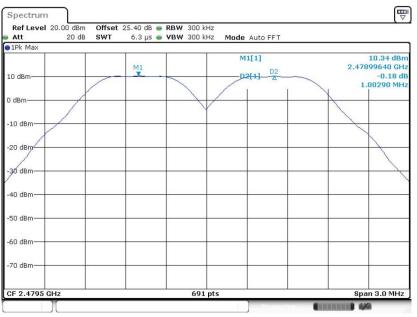
Channel Separation Plot on Channel 00 - 01

Channel Separation Plot on Channel 39 - 40



Date: 8.FEB.2020 05:22:23



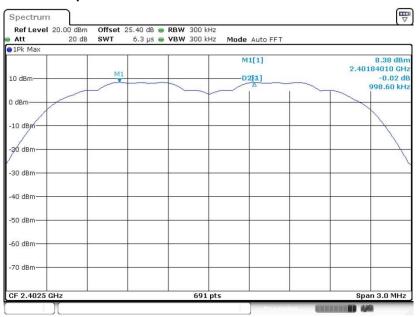


Channel Separation Plot on Channel 77 - 78

Date: 8.FEB.2020 05:28:37

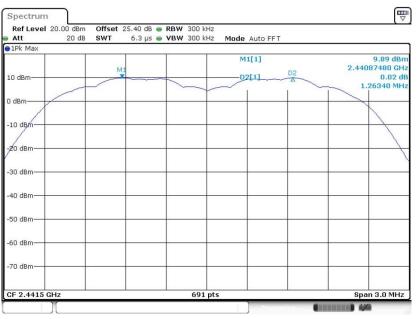
<2Mbps>

Channel Separation Plot on Channel 00 - 01



Date: 8.FEB.2020 05:34:00

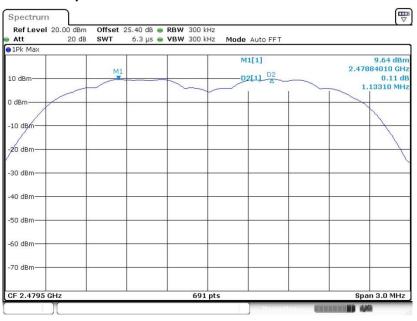




Channel Separation Plot on Channel 39 - 40

Date: 8.FEB.2020 05:43:30

Channel Separation Plot on Channel 77 - 78

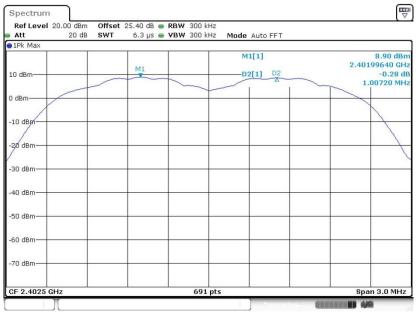


Date: 8.FEB.2020 05:50:56



<3Mbps>

Channel Separation Plot on Channel 00 - 01



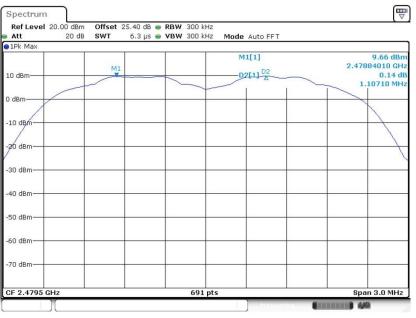
Date: 8.FEB.2020 05:55:48

Channel Separation Plot on Channel 39 - 40



Date: 8.FEB.2020 06:01:36





Channel Separation Plot on Channel 77 - 78

Date: 8.FEB.2020 06:11:37



3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 7.8.4.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.
- 5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW ≥ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
- 6. Measure and record the results in the test report.

3.3.4 Test Setup

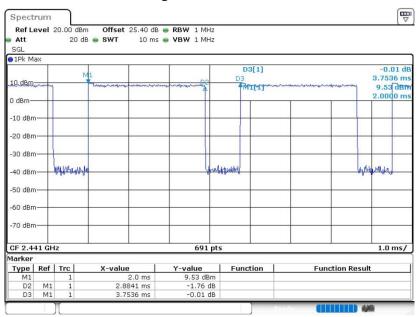


Spectrum Analyzer



3.3.5 Test Result of Dwell Time

Please refer to Appendix A.



Package Transfer Time Plot

Date: 8.FEB.2020 04:50:16

Remark:

 In normal mode, hopping rate is 1600 hops/s with 6 slots (5 Transmit and 1 Receive slot) in 79 hopping channels.

With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4×79) (s), Hops Over Occupancy Time comes to $(1600 / 6 / 79) \times (0.4 \times 79) = 106.67$ hops.

- In AFH mode, hopping rate is 800 hops/s with 6 slots in 20 hopping channels.
 With channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 x 20) (s),
 Hops Over Occupancy Time comes to (800 / 6 / 20) x (0.4 x 20) = 53.33 hops.
- 3. Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time



3.4 20dB Bandwidth Measurement

3.4.1 Limit of 20dB Bandwidth

Reporting only

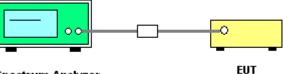
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
 Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;
 RBW ≥ 1% of the 20 dB bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak;
 Trace = max hold.
- 5. Measure and record the results in the test report.

3.4.4 Test Setup



Spectrum Analyzer

3.4.5 Test Result of 20dB Bandwidth

Please refer to Appendix A.



<1Mbps>

20 dB Bandwidth Plot on Channel 00



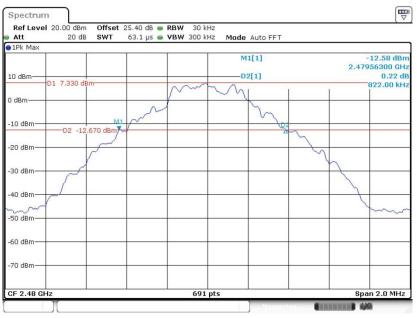
Date: 8.FEB.2020 05:09:19





Date: 8.FEB.2020 05:18:44





20 dB Bandwidth Plot on Channel 78

Date: 8.FEB.2020 05:23:45

<2Mbps>

20 dB Bandwidth Plot on Channel 00



Date: 8.FEB.2020 05:30:13

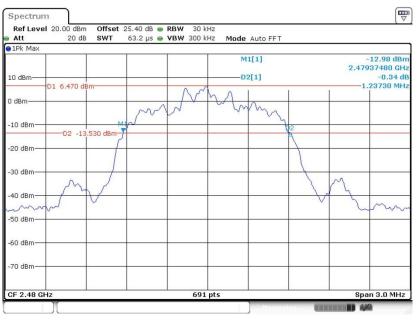




20 dB Bandwidth Plot on Channel 39

Date: 8.FEB.2020 05:35:25

20 dB Bandwidth Plot on Channel 78

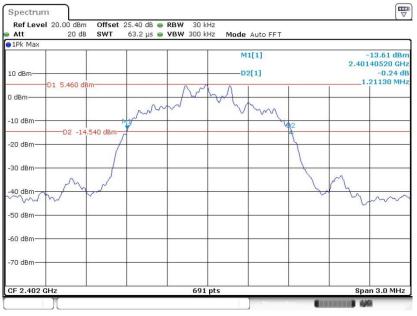


Date: 8.FEB.2020 05:45:11



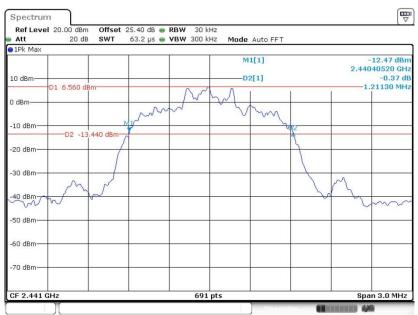
<3Mbps>

20 dB Bandwidth Plot on Channel 00



Date: 8.FEB.2020 05:52:32





Date: 8.FEB.2020 05:56:58





20 dB Bandwidth Plot on Channel 78

Date: 8.FEB.2020 06:03:27



3.5 Output Power Measurement

3.5.1 Limit of Output Power

The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

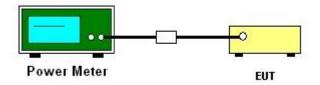
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 7.8.5.
- 2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Measure the conducted output power with cable loss and record the results in the test report.
- 5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.5.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.



3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

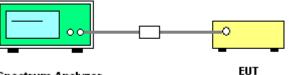
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 7.8.6.
- 2. Set to the maximum power setting and enable the EUT transmit continuously.
- 3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
- 4. Enable hopping function of the EUT and then repeat step 2. and 3.
- 5. Measure and record the results in the test report.

3.6.4 Test Setup



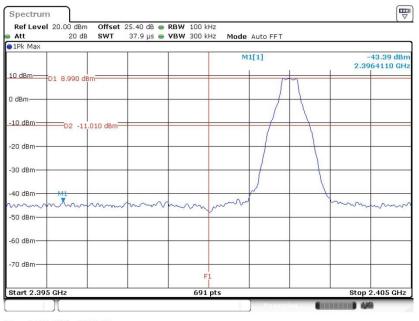
Spectrum Analyzer



3.6.5 Test Result of Conducted Band Edges

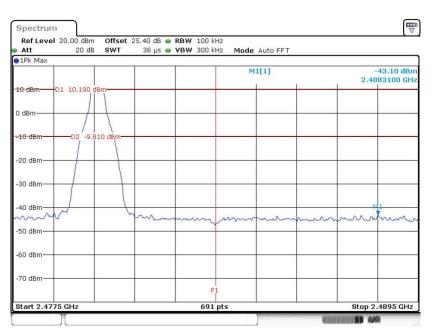
<1Mbps>

Low Band Edge Plot on Channel 00



Date: 8.FEB.2020 05:13:47

High Band Edge Plot on Channel 78

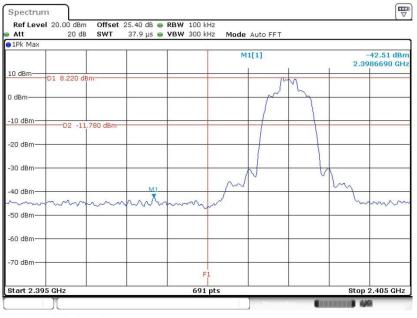


Date: 8.FEB.2020 05:22:47



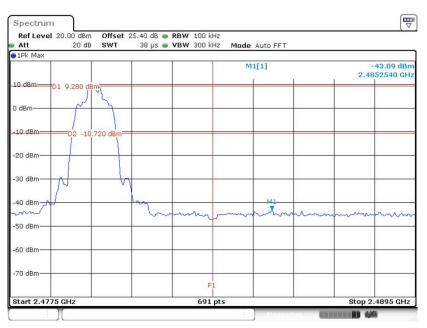
<2Mbps>

Low Band Edge Plot on Channel 00



Date: 8.FEB.2020 05:30:42

High Band Edge Plot on Channel 78

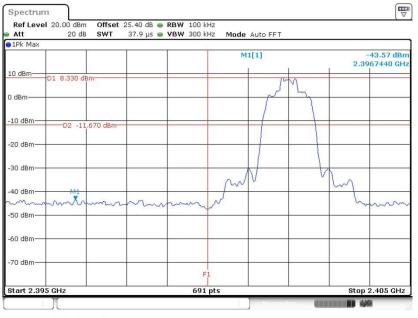


Date: 8.FEB.2020 05:46:11



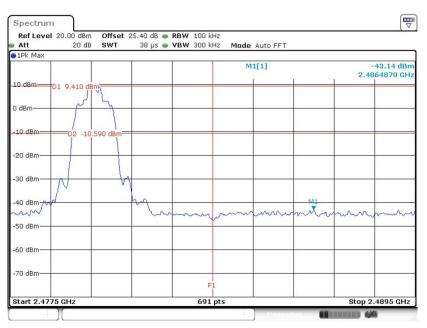
<3Mbps>

Low Band Edge Plot on Channel 00



Date: 8.FEB.2020 05:53:21

High Band Edge Plot on Channel 78

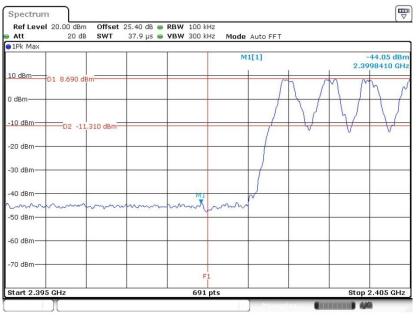


Date: 8.FEB.2020 06:04:03

3.6.6 Test Result of Conducted Hopping Mode Band Edges

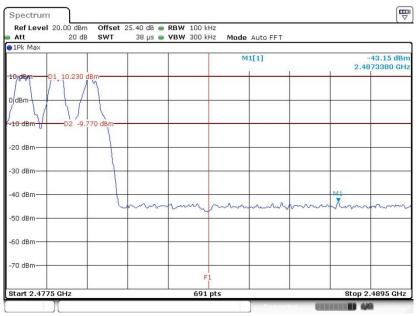
<1Mbps>

Hopping Mode Low Band Edge Plot



Date: 8.FEB.2020 04:59:24

Hopping Mode High Band Edge Plot

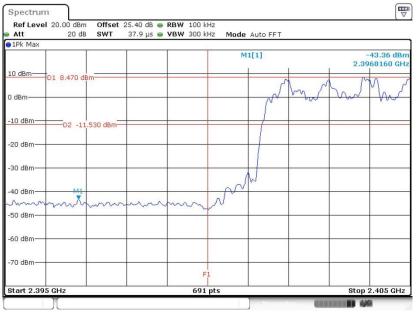


Date: 8.FEB.2020 04:59:50



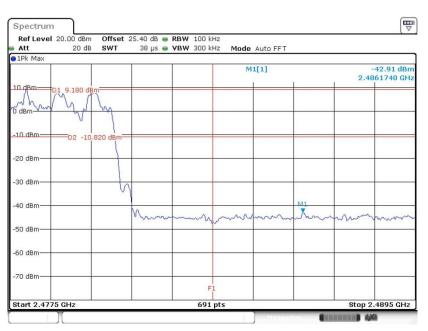
<2Mbps>

Hopping Mode Low Band Edge Plot



Date: 8.FEB.2020 05:00:20

Hopping Mode High Band Edge Plot

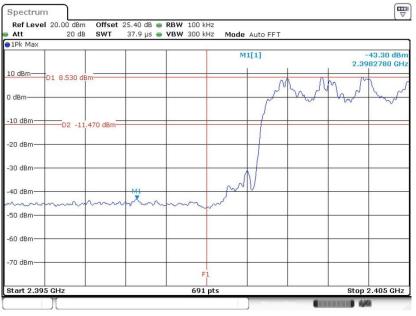


Date: 8.FEB.2020 05:00:36



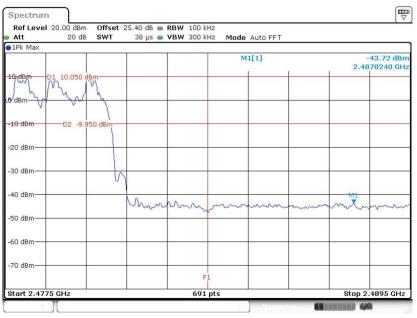
<3Mbps>

Hopping Mode Low Band Edge Plot



Date: 8.FEB.2020 05:01:01

Hopping Mode High Band Edge Plot



Date: 8.FEB.2020 05:01:25



3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

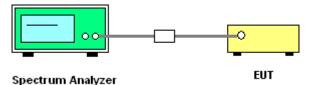
3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.7.3 Test Procedure

- 1. The testing follows ANSI C63.10-2013 clause 7.8.8.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
- 5. Measure and record the results in the test report.
- 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.7.4 Test Setup



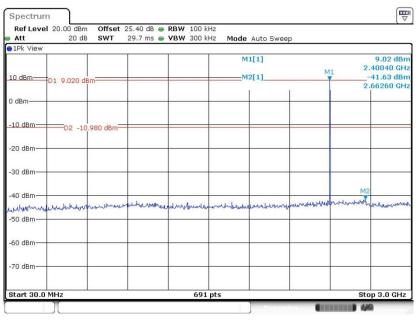
Sporton International (Shenzhen) Inc. TEL : 86-755-8637-9589 FAX : 86-755-8637-9595 FCC ID: 2AJOTTA-1222



3.7.5 Test Result of Conducted Spurious Emission

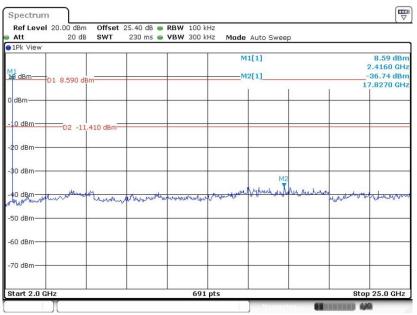
<1Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 8.FEB.2020 05:15:11

1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 8.FEB.2020 05:15:48



Att	20 dB SWT	29.7 ms 👄	VBW 300 k	Hz Mode Auto Sv	меер		
1Pk View	1						
				M1[1]		M1 2	10.19 dBm
10 dBm D1	10.190 dBm-			M2[1]		1.1.2	-41.80 dBn
							.61530 GH
) dBm							
-10 dBm	-D2 -9.810 dBm						
20 dBm							
-30 dBm							
						M2	
-40 dBm		6	1				
Anthe and the	uluburnyunum	returneturnet	monthereld	unentertengunsettert	mananan	an anna an cr	waterender
-50 dBm			Q				
-60 dBm							
70 dBm							

CSE Plot on Ch 39 between 30MHz ~ 3 GHz

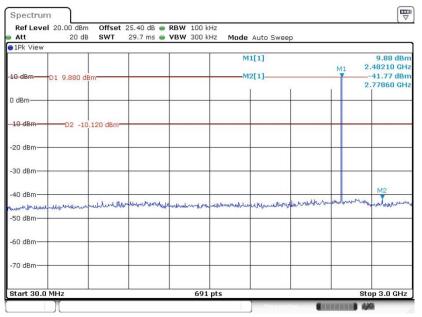
Date: 8.FEB.2020 05:19:59

CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

Ref Level 20. Att	.00 dBm Offse 20 dB SWT	et 25.40 dB 👄 RE 230 ms 👄 VE				
1Pk View	20 UB SWI	230 ms 🖷 Vi	SW SUUKHZ N	lode Auto Sweep		
M1	10.220 dBm			M1[1] M2[1]		10.22 dBr 2.4490 GH 36.09 dBr 17.8600 GH
) dBm						_
10 d8m	-D2 -9.780 dBm-					
20 dBm						_
30 dBm				M2		
40 dBm	wer wer Angrow	- derect - ver return	which with most	and marker fill	By ay worked with the program of the	out and a second
50 dBm						
60 dBm						
70 dBm						_
Start 2.0 GHz			691 pts			top 25.0 GHz

Date: 8.FEB.2020 05:20:32





CSE Plot on Ch 78 between 30MHz ~ 3 GHz

Date: 8.FEB.2020 05:25:06

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

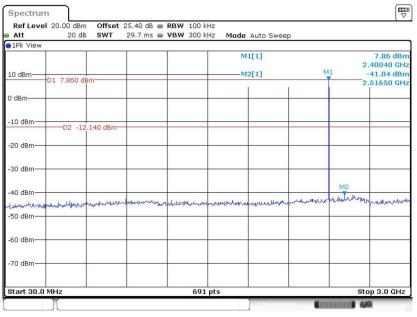
Att	l 20.00 dBm 20 dB	SWT		RBW 100 k VBW 300 k		Auto Sweep	5		
1Pk View	c		2		~				
M1 L <mark>0</mark> dBm	D1 9.680 dB	m				1[1] 2[1]			9.68 dBr 2.4830 GH 36.87 dBr 17.8600 GH
dBm									
10 d8m	D2 -10	320 dBm-							
20 dBm									
30 dBm						M2			
40 dBm	walker	Mulmurther	Maynanth	buttontoath	When we will be	Morrison	Maryman	bounderthe	markana
50 dBm									
60 dBm									
70 dBm									
Start 2.0 G				691	nte			Sto	p 25.0 GHz

Date: 8.FEB.2020 05:25:35



<2Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 8.FEB.2020 05:31:56

CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

		Inde Auto Sween	
011 200 mb		IDde Adto Sweep	
r		M1[1] —M2[1]	7.77 dBn 2.4160 GH: -35.69 dBn 17.8600 GH:
30 dBm			
		M2	
town and the weather the	have and the second	wout grandered by marine	nearly war ward and for a
	691 pts		Stop 25.0 GHz
	SWT 230 ms	30 dBm	SWT 230 ms VBW 300 kHz Mode Auto Sweep Image: Sweet and

Date: 8.FEB.2020 05:32:34



Att	20 dB	SWT	29.7 ms 🧉	• VBW 300 k	Hz Mode	Auto Sweep	0		
1Pk View									
					M	1[1]			9.28 dBm
						1110			.43910 GH:
10 dBm	D1 9.280 dBm				(Y)	2[1]			.61960 GH:
						1		~	
0 dBm						-			
-10 dBm	D2 -10.7	20 dBm-		-				-	
-20 dBm						-			-
-30 dBm									
00 000									
-40 dBm								M2	
40 ubiii	white many white		above untertail	de a contesta anti-	n hal alkenness that		Northantende	Moundary	Marchine Justiment
	and all and a state of the second	MO-0-0-0-0-0		and a deriver		0~0000000000000000000000000000000000000	Cardon Articolo		
-50 dBm									
-60 dBm									
70 dBm			-						
	MHz				pts				op 3.0 GHz

CSE Plot on Ch 39 between 30MHz ~ 3 GHz

Date: 8.FEB.2020 05:41:18

CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

Ref Level 20.00 dBm Att 20 dB		25.40 dB 👄 230 ms 👄	VBW 300		Auto Sweep	5		
1Pk View								
dBmD1 8.140 df					1[1] 2[1]			8.14 dBr 2.4490 GH -36.56 dBr
) dBm	500							L7.8600 GH
10 dBmD2 -11	.860 dBm			-				
20 dBm								
30 dBm					M2			
40 dBm	Hurmu	Murenally	workness	and way we	Mynon all	Angewood	www.	Muntur
50 dBm								
60 dBm			-					
70 dBm	- 							
Start 2.0 GHz			60	L pts			Sto	p 25.0 GHz

Date: 8.FEB.2020 05:41:48



Att	20 dB	SWT	29.7 ms 🖷	VBW 300 1	Hz Mode	Auto Sweep			
1Pk View									
					M1	[1]		0	8.87 dBn 48210 GH;
10 dBm	D1 8.870 dB				M2	[1]	1	V1	41.79 dBn
	DI 8.870 UB						Ť	2.	59380 GH:
0 dBm									2
-10 dBm	D2 -11.	130 dBm							
20 dBm									
20 0011									
-30 dBm									
								140	
-40 dBm				1				M2	L h
	nutritetener	handlanderthaste	March March Marcy	nthitritute	mutalliphim	ubulthere	mannen	A COLORIDA AND	and the second of the second o
-50 dBm									
-60 dBm									
oo abiii									
70 dBm									

CSE Plot on Ch 78 between 30MHz ~ 3 GHz

Date: 8.FEB.2020 05:48:30

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

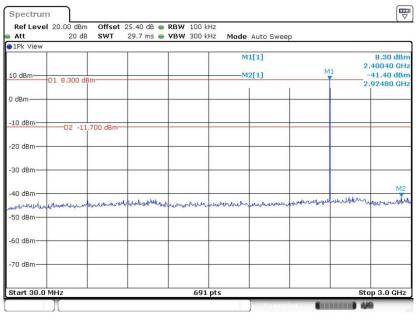
Att	20.00 dBm 20 dB	SWT		RBW 100 k VBW 300 k		Auto Sweer	5		
1Pk View									
					M	1[1]			9.14 dBr 2.4830 GH
dBm-	01 9.140 dB	.m			M	2[1]			-36.10 dBi
						I		1	7.8600 GH
dBm-									
10.dBm-		.860 dBm							
20 dBm-									
30 dBm									
						M2			
40 dBm	martilette	muliched	and how the	huntren	where we have have been been been been been been been be	provenuelle	1 m Holling have	Ludow Hotel	mentering
50 dBm									
60 dBm									
70 dBm			+						
tart 2.0 Gl	-17			691	nts			Stor	0 25.0 GHz

Date: 8.FEB.2020 05:48:59



<3Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 8.FEB.2020 05:54:32

CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

Ref Level Att	20.00 dBm 20 dB	Offset SWT	25.40 dB 👄 230 ms 👄	RBW 100 WBW 300 WBW 30		Auto Sweep	,		
1Pk View									
dBm	D1 7.810 dB	n	-	6		1[1]			7.81 dBn 2.4160 GH -36.55 dBn 7.8270 GH
dBm									
10 dBm	D2 -12.	190 dBm—							
20 dBm									
30 dBm						M2			
10 dBm	www.www.	muurun	Munit	al where	without the	homoly	John marched	maanda	allutionphyto
50 dBm									
60 dBm									
70 dBm									
Start 2.0 G	Hz			691	pts			Stor	25.0 GHz

Date: 8.FEB.2020 05:55:01



Att	l 20.00 dBm 20 dB	SWT		RBW 100		Auto Sweep			
1Pk View	n								
						1[1]	M		9.39 dBn 43910 GH
10 dBm	D1 9.390 dBr	n 	-		M	2[1]			40.77 dBn
0 dBm								2	
-10 dBm	D2 -10.6	510 dBm=		_					
-20 dBm									
-30 dBm									
-40 dBm								M2	
merentelen	henderworth	www.yet	www.while.	unhummen	hulpotraliera	mandernet	mohuman	lahedwerky	mullimmed
-50 dBm									
-60 dBm									
-70 dBm			-						

CSE Plot on Ch 39 between 30MHz ~ 3 GHz

Date: 8.FEB.2020 05:58:59

CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

Att	20.00 dBm 20 dB	SWT		RBW 100 k		Auto Sweep				
1Pk View			2							
dBm	18m-D1 8.420 dBm					1[1] 2[1]		8.42 dBn 2.4490 GH -36.23 dBn		
) dBm									.7.7940 GH	
10 dBm	D2 -11.	580 dBm-								
20 dBm										
30 dBm		4				M2	had and short of			
40 dBm ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	when at all a flat	haynan	Mandre	Autohanna	- Margare	1	- G.W.	www.hullmache	- Byparinger	
60 dBm										
70 dBm										
Start 2.0 G				691	nts			Sto	p 25.0 GHz	

Date: 8.FEB.2020 06:00:09



Ref Leve Att	el 20.00 dBm 20 dB	Offset SWT		RBW 100 k		Auto Sweep			
1Pk View	1. (And 1. (1. (1. (1. (1. (1. (1. (1. (1. (1.	3111	29.7 115	4044 300 K	m2 Moue	Auto Sweep			
	D1 9.350 dB	m				L[1] 2[1]		MI1	9.35 dBm 2.47780 GHz 41.55 dBm
0 dBm									2.65830 GHz
-10 dBm—	D2 -10.	650 dBm=							
-20 dBm—									
-30 dBm—									
-40 dBm-	Manualana	www.www.	Lanustration	upper and	unerry	Uneared Abertander Aco	philipping		12 Induction
-50 dBm—									
-60 dBm—									
-70 dBm									
Start 30.0					pts				top 3.0 GHz

CSE Plot on Ch 78 between 30MHz ~ 3 GHz

Date: 8.FEB.2020 06:05:13

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

Ref Level : Att	20.00 uBm 20 dB	SWT		RBW 100 k VBW 300 k		Auto Sweer	0		
1Pk View									
10 dBm-D	1 8.210 dB	m				1[1] 2[1]			8.21 dBr 2.4830 GH 36.55 dBr 7.8270 GH
dBm									
-10 dBm	—D2 -11.	790 dBm—							
20 dBm									
30 dBm						M2			
40 dBm	John March	Junia	Munhorth	hunnand	all an adjunt	Anna	Jack Muthalia	when	mondernant
50 dBm									
60 dBm									
70 dBm									
Start 2.0 GH				691					25.0 GHz

Date: 8.FEB.2020 06:09:19



3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.8.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



3.8.3 Test Procedures

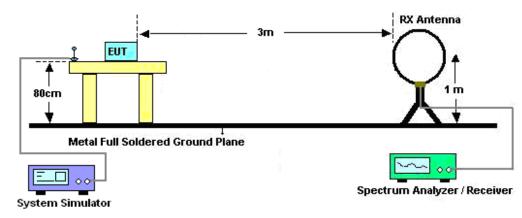
- 1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 4. Set to the maximum power setting and enable the EUT transmit continuously.
- 5. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
 - (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time = N₁*L₁+N₂*L₂+...+N_{n-1}*LN_{n-1}+N_n*L_n Where N₁ is number of type 1 pulses, L₁ is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
- 6. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
- 8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79 dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

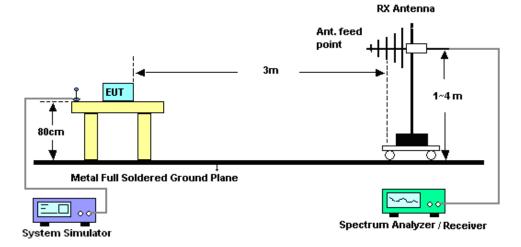


3.8.4 Test Setup

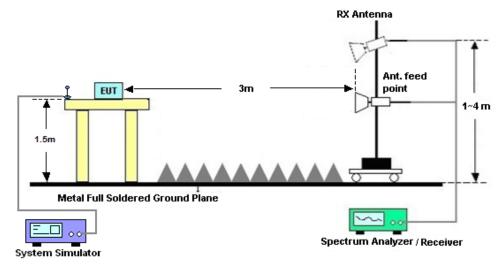
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 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 line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.8.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C.

3.8.8 Duty cycle correction factor for average measurement

Please refer to Appendix D.



3.9 AC Conducted Emission Measurement

3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted	limit (dBµV)
Frequency of emission (MHZ)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

3.9.2 Measuring Instruments

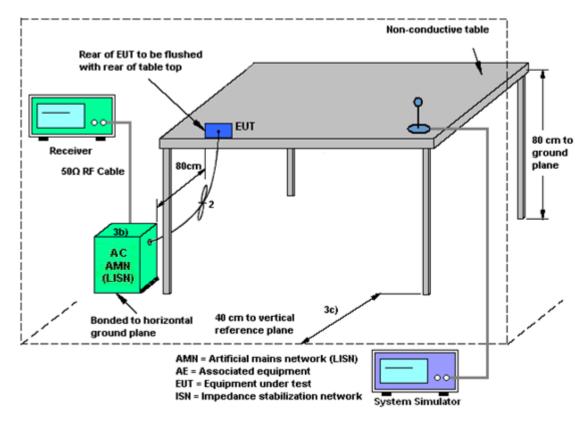
The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.10 Antenna Requirements

3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	608-H2	41410069	N/A	Jun. 17, 2019	Feb. 08, 2020	Jun. 16, 2020	Conducted (TH05-HY)
Power Meter	Agilent	E4416A	GB412923 44	N/A	Dec. 27, 2019	Feb. 08, 2020	Dec. 26, 2020	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US404415 48	50MHz~18GHz	Dec. 27, 2019	Feb. 08, 2020	Dec. 26, 2020	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Jul. 15, 2019	Feb. 08, 2020	Jul. 14, 2020	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC120838 2	N/A	Mar. 27, 2019	Feb. 08, 2020	Mar. 26, 2020	Conducted (TH05-HY)
BT Base Station	Rohde & Schwarz	СВТ	101136	BT 3.0	Oct. 27, 2019	Feb. 08, 2020	Oct. 26, 2020	Conducted (TH05-HY)
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY544500 83	20Hz~8.4GHz	Apr. 18, 2019	Jan. 16, 2020	Apr. 17, 2020	Radiation (03CH03-SZ)
EXA Spectrum Anaiyzer	KEYSIGHT	N9010A	MY551502 46	10Hz~44GHz;	Apr. 18, 2019	Jan. 16, 2020	Apr. 17, 2020	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	May. 29, 2018	Jan. 16, 2020	May.28, 2020	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz-2GHz	Apr. 19, 2019	Jan. 16, 2020	Apr. 18, 2020	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBE CK	BBHA9120D	9120D-135 5	1GHz~18GHz	Apr. 01 2019	Jan. 16, 2020	Mar. 31, 2020	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35- HG	1871923	18GHz~40GHz	Jul. 22. 2019	Jan. 16, 2020	Jul. 21. 2020	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18Ghz-40GHz	Apr. 18 2019	Jan. 16, 2020	Apr. 17 2020	Radiation (03CH03-SZ)
Amplifier	Burgeon	BPA-530	102210	0.01Hz ~3000MHz	Oct. 18,2019	Jan. 16, 2020	Oct. 17,2020	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-0010 1800-30-10P- R	1943528	1GHz~18GHz	Oct. 18,2019	Jan. 16, 2020	Oct. 17,2020	Radiation (03CH03-SZ)
Amplifier	Agilent Technologies	83017A	MY395013 02	500MHz~26.5G Hz	Dec. 23,2019	Jan. 16, 2020	Dec. 22,2020	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010001 985	N/A	NCR	Jan. 16, 2020	NCR	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Jan. 16, 2020	NCR	Radiation (03CH03-SZ)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Dec. 26, 2019	Jan. 05, 2020	Dec. 25, 2020	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2SH	00103912	9kHz~30MHz	Oct. 17, 2019	Jan. 05, 2020	Oct. 16, 2020	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	EMCO	3816/2SH	00103892	9kHz~30MHz	Dec. 26, 2019	Jan. 05, 2020	Dec. 25, 2020	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000 891	100Vac~250Vac	Jul. 23, 2019	Jan. 05, 2020	Jul. 22, 2020	Conduction (CO01-SZ)

NCR: No Calibration Required



5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence	2.6 dB
of 95% (U = 2Uc(y))	2.0 dB

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence	5.0 dB
of 95% (U = 2Uc(y))	5.0 dB

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence	4.8 dB
of 95% (U = 2Uc(y))	4.0 d B

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence	4.6 dB
of 95% (U = 2Uc(y))	4.0 UB



Appendix A. Conducted Test Results

Report Number : FR9D3107A

<u>Bluetooth</u>

Test Engineer:	Derek Hsu	Temperature:	21~25	°C
Test Date:	2020/2/8	Relative Humidity:	51~54	%

			20d	B and S	99% Occu		<u>ULTS DATA</u> th and Hopping (Channel Separat	ion
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
DH	1Mbps	1	0	2402	0.828	0.735	0.999	0.5519	Pass
DH	1Mbps	1	39	2441	0.825	0.735	0.999	0.5499	Pass
DH	1Mbps	1	78	2480	0.822	0.732	1.003	0.5480	Pass
2DH	2Mbps	1	0	2402	1.242	1.140	0.999	0.8278	Pass
2DH	2Mbps	1	39	2441	1.242	1.140	1.263	0.8278	Pass
2DH	2Mbps	1	78	2480	1.237	1.140	1.133	0.8249	Pass
3DH	3Mbps	1	0	2402	1.211	1.123	1.007	0.8075	Pass
3DH	3Mbps	1	39	2441	1.211	1.123	0.999	0.8075	Pass
3DH	3Mbps	1	78	2480	1.211	1.120	1.107	0.8075	Pass

TEST RESULTS DATA Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec) (MHz)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Nomal	79	106.67	2.88	0.31	0.4	Pass
AFH	20	53.33	2.88	0.15	0.4	Pass

					<u>ST RESUL</u> eak Powe
DH	CH.	NTX	Peak Power	Power Limit	Test
DIT	OH.	MIX	(dBm)	(dBm)	Result
	0	1	8.90	20.97	Pass
DH1	39	1	10.30	20.97	Pass
	78	1	10.20	20.97	Pass
2DH	CH.	NTX	Peak Power	Power Limit	Test
			(dBm)	(dBm)	Result
	0	1	8.20	20.97	Pass
2DH1	39	1	9.60	20.97	Pass
	78	1	9.60	20.97	Pass
			Peak Power	Power Limit	Test
3DH	CH.	NTX			Result
	0	1	<u>(dBm)</u> 8.40	(dBm) 20.97	Pass
3DH1	39	1	9.90	20.97	Pass
00111	78	1	9.70	20.97	Pass

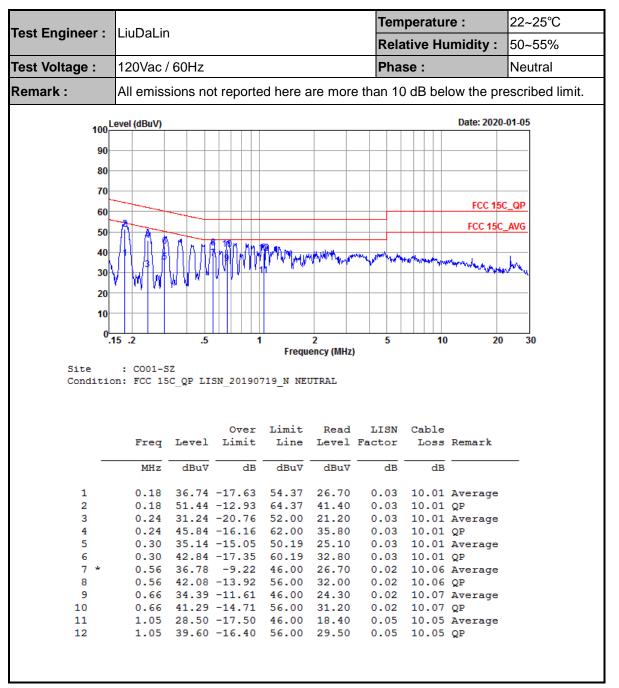
<u>TEST RESULTS DATA</u> Number of Hoppina Frequency											
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail								
79	20	> 15	Pass								



Appendix B. AC Conducted Emission Test Results

Test Voltage :120Vac / 60HzPhase :LineRemark :All emissions not reported here are more than 10 dB below the prescribedDate: 2020-01-05Date: 2020-01-05Date: 2020-01-05Tec (dBuV)Date: 2020-01-05Date: 2020-01-05Tec (dBuV)Date: 2020-01-05Fec (dBuV)Date: 2020-01-05Tec (dBuV)Tec (dBuV)Date: 2020-01-05Tec (dBuV)Tec (dBuV) <t< th=""><th>Relative Humidity :50-55%LineAll emissions not reported here are more than 10 dB below the prescribed limit.Date: 2020-01-05Date: 2020-01-05Optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05FECC 15C_OPFCC 15C_OPFrequency (MHz)Cool-szItion: FCC 15C_OP LISN_20190719_L LINETerequency (MHz)Cool-szItin to be the deuv deuv deuv deuv deuMHz deuv deuv deuv deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuvItin tere level factor</th><th>rest Engineer :</th><th>L in Dollin</th><th></th><th></th><th></th><th></th><th>Tem</th><th>peratu</th><th>re :</th><th>22~25°C</th></t<>	Relative Humidity :50-55%LineAll emissions not reported here are more than 10 dB below the prescribed limit.Date: 2020-01-05Date: 2020-01-05Optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05Total optimized for the prescribed limit.Date: 2020-01-05FECC 15C_OPFCC 15C_OPFrequency (MHz)Cool-szItion: FCC 15C_OP LISN_20190719_L LINETerequency (MHz)Cool-szItin to be the deuv deuv deuv deuv deuMHz deuv deuv deuv deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuvItin to be the deuv deuv deuv deuvItin to be the deuv deuv deuvItin tere level factor	rest Engineer :	L in Dollin					Tem	peratu	re :	22~25°C
Remark : All emissions not reported here are more than 10 dB below the prescribed Date: 2020-01-05 Date: 2020-01-05 Date: 2020-01-05 Operation of the prescribed Operation of the prescribed Date: 2020-01-05 Operation of the prescribed Site::::::::::::::::::::::::::::::::::::	All emissions not reported here are more than 10 dB below the prescribed limit. a All emissions not reported here are more than 10 dB below the prescribed limit. b a b b b b b c b c b c c c c c d b c d b c d b c d b c d c d d d d d d d d d d			1				Rela	ative Hu	umidity :	50~55%
$\frac{100}{90} \frac{1}{90} \frac{1}{90}$	$\frac{1000}{100} \frac{1}{100} \frac$	Test Voltage :	120Vac	/ 60Hz				Pha	se :		Line
$\frac{100}{90} \frac{100}{90} \frac{100}{90$	$\frac{100}{90}$ $\frac{1000}{90}$ $\frac{100}{90}$ $$	Remark :	All emiss	sions no	t reporte	e than 10) dB be	low the pr	escribed limit.		
$\frac{1}{90} + \frac{1}{90} $	$\frac{1}{1000} = \frac{1}{1000} + \frac{1}{1000} + \frac{1}{1000} + \frac{1}{10000} + \frac{1}{10000000000000000000000000000000000$	100	_evel (dBuV)						-01-05		
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c} .15.2 & .5 & 1 & 2 & .5 & 10 & 20 & 30 \\ \hline Frequency (MHz) \\ \hline Frequency (MHz) \\ \hline Freq & Level & Limit & Line & Level & Factor & Loss & Remark \\ \hline MHz & dBuV & dB & dBuV & dBuV & dB & dB & dB \\ \hline \hline MHz & 0.18 & 40.34 & -14.03 & 54.37 & 30.30 & 0.03 & 10.01 & Average \\ \hline 0.18 & 56.14 & -8.23 & 64.37 & 46.10 & 0.03 & 10.01 & Average \\ 0.24 & 33.44 & -18.56 & 52.00 & 23.40 & 0.03 & 10.01 & Average \\ 0.24 & 48.04 & -13.96 & 62.00 & 38.00 & 0.03 & 10.01 & Average \\ 0.30 & 35.64 & -14.55 & 50.19 & 25.60 & 0.03 & 10.01 & Average \\ 0.30 & 45.34 & -14.85 & 60.19 & 35.30 & 0.03 & 10.01 & Average \\ 0.35 & 33.58 & -12.42 & 46.00 & 23.50 & 0.02 & 10.06 & Average \\ 0.55 & 43.48 & -12.52 & 56.00 & 33.40 & 0.02 & 10.06 & Average \\ 0.66 & 31.09 & -14.91 & 46.00 & 21.00 & 0.02 & 10.07 & Average \\ 0.66 & 43.89 & -12.11 & 56.00 & 33.80 & 0.02 & 10.07 & Average \\ 1.02 & 25.62 & -20.38 & 46.00 & 15.50 & 0.07 & 10.05 & Average \\ \hline \end{array}$	10					+ +				
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Note:

1. Level(dBµV) = Read Level(dBµV) + LISN Factor(dB) + Cable Loss(dB)

2. Over Limit(dB) = Level(dBµV) – Limit Line(dBµV)



Appendix C. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

вт	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		2389.695	37.91	-36.09	74	41.27	27.8	4.82	35.98	291	231	Ρ	Н
		2389.695	13.12	-40.88	54	-	-	-	-	-	-	А	Н
DT	*	2402	100.34	-	-	103.7	27.8	4.82	35.98	291	231	Р	Н
ВТ СН00	*	2402	75.55	-	-	-	-	-	-	-	-	А	Н
2402MHz		2387.385	38.84	-35.16	74	42.22	27.8	4.82	36	137	264	Р	V
240211112		2387.385	14.05	-39.95	54	-	-	-	-	-	-	А	V
	*	2402	104.3	-	-	107.66	27.8	4.82	35.98	137	264	Ρ	V
	*	2402	79.51	-	-	-	-	-	-	-	-	А	V
		2367.96	38.32	-35.68	74	41.69	27.85	4.78	36	244	335	Р	н
		2367.96	13.53	-40.47	54	-	-	-	-	-	-	А	н
	*	2441	101.75	-	-	105.12	27.71	4.86	35.94	244	335	Р	Н
	*	2441	76.96	-	-	-	-	-	-	-	-	А	н
		2490.69	38.18	-35.82	74	41.55	27.63	4.9	35.9	244	335	Р	Н
BT		2490.69	13.39	-40.61	54	-	-	-	-	-	-	А	Н
CH 39 2441MHz		2350.32	37.67	-36.33	74	41.03	27.88	4.78	36.02	168	251	Ρ	V
∠┭┭╷┉⊓∠		2350.32	12.88	-41.12	54	-	-	-	-	-	-	А	V
	*	2441	103.99	-	-	107.36	27.71	4.86	35.94	168	251	Р	V
	*	2441	79.2	-	-	-	-	-	-	-	-	А	V
		2486.63	37.84	-36.16	74	41.2	27.66	4.9	35.92	168	251	Р	V
		2486.63	13.05	-40.95	54	-	-	-	-	-	-	А	V

BT (Band Edge @ 3m)



	*	2480	102.37	-	-	105.73	27.66	4.9	35.92	252	302	Р	Н
ВТ СН 78	*	2480	77.58	-	-	-	-	-	-	-	-	А	Н
		2483.96	42.18	-31.82	74	45.54	27.66	4.9	35.92	252	302	Р	Н
		2483.96	17.39	-36.61	54	-	-	-	-	-	-	А	Н
2480MHz	*	2480	104.46	-	-	107.82	27.66	4.9	35.92	155	265	Р	V
-	*	2480	79.67	-	-	-	-	-	-	-	-	А	V
		2483.56	44.38	-29.62	74	47.74	27.66	4.9	35.92	155	265	Р	V
		2483.56	19.59	-34.41	54	-	-	-	-	-	-	А	V
		o other spurio I results are P		st Peak	and Averaç	ge limit lind	е.						



2.4GHz 2400~2483.5	MHz
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BT (Harmonic	@ 3m)
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BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBµV/m)	Limit (dB)	Line (dBµV/m)	Level (dBµV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
		4804	42.65	-31.35	74	61.49	31.1	7.53	57.47	151	219	P	H
BT		4804	17.86	-36.14	54	-	-	-	-	-	-	А	Н
CH 00 2402MHz		4804	41.55	-32.45	74	60.39	31.1	7.53	57.47	151	219	Р	V
240211112		4804	16.76	-37.24	54	-	-	-	-	-	-	А	V
		4882	41	-33	74	59.73	31.17	7.62	57.52	159	251	Ρ	Н
		4882	16.21	-37.79	54	-	-	-	-	-	-	А	Н
		7323	44.96	-29.04	74	58.75	36.08	9.06	58.93	188	331	Ρ	Н
BT CH 39 2441MHz		7323	20.17	-33.83	54	-	-	I	-	-	-	А	Н
		4882	41.4	-32.6	74	60.13	31.17	7.62	57.52	150	258	Ρ	V
244111172		4882	16.61	-37.39	54	-	-	I	-	-	-	А	V
		7323	45.71	-28.29	74	59.5	36.08	9.06	58.93	152	309	Ρ	V
		7323	20.92	-33.08	54	-	-	-	-	-	-	А	V
		4960	42.58	-31.42	74	61.19	31.25	7.72	57.58	118	289	Р	Н
		4960	17.79	-36.21	54	-	-	-	-	-	-	А	Н
вт		7440	45.48	-28.52	74	58.94	36.44	9.08	58.98	158	273	Ρ	Н
ы СН 78		7440	20.69	-33.31	54	-	-	-	-	-	-	А	Н
2480MHz		4960	41.41	-32.59	74	60.02	31.25	7.72	57.58	192	213	Ρ	V
240010172		4960	16.62	-37.38	54	-	-	-	-	-	-	А	V
		7440	45.94	-28.06	74	59.4	36.44	9.08	58.98	114	202	Ρ	V
		7440	21.15	-32.85	54	-	-	-	-	-	-	А	V
Remark		o other spurio I results are P		st Peak	and Averag	je limit lin	е.						



Emission below 1GHz

2.4GHz BT (LF)

ВТ	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
	*	30	24.11	-15.89	40	30.79	25.2	0.52	32.4	100	202	Р	Н
		54.25	20.27	-19.73	40	38.38	13.58	0.71	32.4	-	-	Р	н
		106.63	23.39	-20.11	43.5	37.07	17.53	0.99	32.2	-	-	Р	Н
		301.6	21.11	-24.89	46	31.71	19.44	1.66	31.7	-	-	Р	Н
0.4011-		700.27	28.53	-17.47	46	31.58	25.2	2.55	30.8	-	-	Р	Н
2.4GHz BT		954.41	29.55	-16.45	46	30.9	27.15	2.97	31.47	-	-	Р	Н
LF		30	30.62	-9.38	40	37.3	25.2	0.52	32.4	-	-	Р	V
	*	53.28	31.53	-8.47	40	49.46	13.76	0.71	32.4	124	162	Р	V
		152.22	22.43	-21.07	43.5	36.98	16.46	1.18	32.19	-	-	Р	V
		407.33	23.72	-22.28	46	31.1	22.07	1.94	31.39	-	-	Р	V
		766.23	29.22	-16.78	46	31.76	25.97	2.66	31.17	-	-	Р	V
		993.21	30.02	-23.98	54	30.54	27.53	3.04	31.09	-	-	Р	V
	1. No	o other spurio	us found.										
Remark	2. Al	I results are F	ASS agains	st limit li	ne.								



Note symbol

*	Fundamental Frequency which can be ignored. However, the level of any
	unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is over limit line.
P/A	Peak or Average
H/V	Horizontal or Vertical



A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	Р	н
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	А	Н

1. Level(dBµV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

For Peak Limit @ 2390MHz:

1. Level(dBµV/m)

```
= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)
```

```
= 32.22(dB/m) + 4.58(dB) + 54.51(dBµV) - 35.86 (dB)
```

- = 55.45 (dBµV/m)
- 2. Over Limit(dB)
- = Level(dBµV/m) Limit Line(dBµV/m)
- $= 55.45(dB\mu V/m) 74(dB\mu V/m)$
- = -18.55(dB)

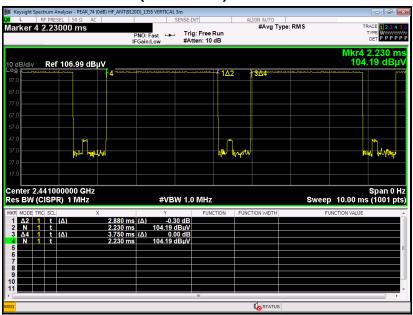
For Average Limit @ 2390MHz:

- 1. Level(dBµV/m)
- = Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) Preamp Factor(dB)
- = 32.22(dB/m) + 4.58(dB) + 42.6(dBµV) 35.86 (dB)
- = 43.54 (dBµV/m)
- 2. Over Limit(dB)
- = Level(dBµV/m) Limit Line(dBµV/m)
- $= 43.54(dB\mu V/m) 54(dB\mu V/m)$
- = -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

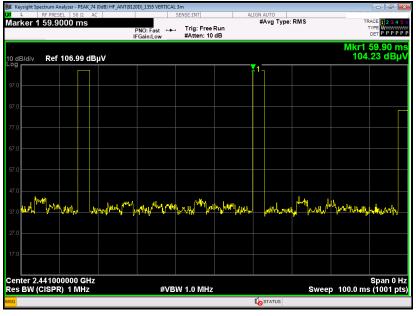


Appendix D. Duty Cycle Plots



DH5 on time (One Pulse) Plot on Channel 39

DH5 on time (Count Pulses) Plot on Channel 39



Note:

- 1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.88 / 100 = 5.76 %
- 2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
- 3. DH5 has the highest duty cycle worst case and is reported.