

Test Report

FCC ID: 2AT7I-S2

Date of issue: Apr. 02, 2020

Report Number: MTi19081312-9E1

Sample Description: 4G Wireless Data Terminal

Model(s): S2

Applicant: iFREE GROUP (HK) Ltd

Address: Suite 06, 19/F, Mira Place Tower A, 132 Nathan Road, Tsim Sha Tsui, Kowloon, Hong Kong.

Date of Test: Sept. 19, 2019 - Apr. 02, 2020

Shenzhen Microtest Co., Ltd.
<http://www.mtitest.com>

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Table of Contents

1	GENERAL INFORMATION	5
1.1	DESCRIPTION OF EUT	5
1.2	OPERATION CHANNEL LIST	6
1.3	TEST CHANNEL LIST	6
1.4	ANCILLARY EQUIPMENT LIST	6
1.5	DESCRIPTION OF SUPPORT UNITS	7
2	SUMMARY OF TEST RESULTS	8
3	TEST FACILITIES AND ACCREDITATIONS	9
3.1	TEST LABORATORY	9
3.2	ENVIRONMENTAL CONDITIONS	9
3.3	MEASUREMENT UNCERTAINTY	9
3.4	TEST SOFTWARE	9
4	EQUIPMENT LIST	10
5	TEST RESULT	12
5.1	ANTENNA REQUIREMENT	12
5.1.1	<i>Standard requirement</i>	12
5.1.2	<i>EUT Antenna</i>	12
5.2	PEAK OUTPUT POWER	13
5.2.1	<i>Limit</i>	13
5.2.2	<i>Test setup</i>	13
5.2.3	<i>Test procedure</i>	13
5.2.4	<i>Test results</i>	14
5.3	POWER SPECTRAL DENSITY	15
5.3.1	<i>Limit</i>	15
5.3.2	<i>Test Setup</i>	15
5.3.3	<i>Test Procedure</i>	15
5.3.4	<i>Test Results</i>	16
5.4	CONDUCTED EMISSION	24
5.4.1	<i>Limits</i>	24
5.4.2	<i>Test setup</i>	24
5.4.3	<i>Test procedure</i>	25
5.4.4	<i>Test results</i>	26
5.5	RADIATED SPURIOUS	30
5.5.1	<i>Limits</i>	30
5.5.2	<i>Test setup</i>	31
5.5.3	<i>Test procedure</i>	32
5.5.4	<i>Test results</i>	32
5.5.4.1	<i>Radiation emission</i>	32
5.5.4.2	<i>Band edge - radiated</i>	37
5.6	BAND EDGE - CONDUCTED	40
5.6.1	<i>Limits</i>	40
5.6.2	<i>Test setup</i>	40
5.6.3	<i>Test procedure</i>	40
5.6.4	<i>Test results</i>	41
5.7	6DB BANDWIDTH	45
5.7.1	<i>Limit</i>	45
5.7.2	<i>Test setup</i>	45
5.7.3	<i>Test procedure</i>	45
5.7.4	<i>Test results</i>	46
5.8	DUTY CYCLE	54
5.8.1	<i>Conformance Limit</i>	54
5.8.2	<i>Measuring Instruments</i>	54

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5.8.3 Test Setup.....54
5.8.4 Test Procedure.....54
5.8.5 Test Results.....55

PHOTOGRAPHS OF THE TEST SETUP 56

PHOTOGRAPHS OF THE EUT 58

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Test Result Certification

Applicant's name: iFREE GROUP (HK) Ltd

Address: Suite 06, 19/F, Mira Place Tower A, 132 Nathan Road, Tsim Sha Tsui, Kowloon, Hong Kong.

Manufacture's Name: iFREE GROUP (HK) Ltd

Address: Suite 06, 19/F, Mira Place Tower A, 132 Nathan Road, Tsim Sha Tsui, Kowloon, Hong Kong.

Product name: 4G Wireless Data Terminal

Trademark: MOGO

Model name: S2

Standards: FCC Part 15.247

Test Procedure: ANSI C63.10-2013
KDB 558074 v05r02
KDB662911 D01 v02r01

This device described above has been tested by Shenzhen Microtest Co., Ltd. and the test results show that the equipment under test (EUT) compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

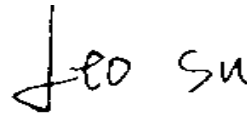
Tested by:



Danny Xu

Apr. 02, 2020

Reviewed by:



Leo Su

Apr. 02, 2020

Approved by:



Tom Xue

Apr. 02, 2020

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1 General information

1.1 Description of EUT

Product name	4G Wireless Data Terminal
Model name	S2
Series model:	N/A
Difference of series model:	N/A
Operation Frequency	802.11b/g/n20:2412~2462 MHz 802.11n40:2422~2452 MHz
Modulation Type:	11b: DQPSK, DBPSK, DSSS, CCK 11g: BPSK, QPSK, 16QAM, 64QAM, OFDM 11n: BPSK, QPSK, 16QAM, 64QAM with OFDM
Bit Rate of Transmitter	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n:65/52/6.5Mbps
Antenna Type	FPC Antenna
Antenna Gain (dBi)	For 802.11b/g, working in SISO mode, then the antenna gain as below: 802.11b/g: Antenna A :3dBi 802.11b/g: Antenna B :3dBi
	For 802.11n, working in MIMO mode, the antenna gains should be calculated by the formula: Directional Gain = $G_{ANT} + 10 \cdot \log(N_{ANT})$ dBi $= 3 \text{ dBi} + 10 \cdot \log(2) \text{ dBi} = 6.01 \text{ dBi}$
Max. Output Power:	14dBm
Hardware Version:	S2M1_VER.A
Software Version:	S2_V03.02.07.19101T
Power Supply:	DC 5V from adapter or DC 3.8V from battery
Battery information:	N/A
Adapter information:	DC 3.8V 2000mAh

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1.2 Operation channel list

Channel List for 802.11b/g/n(20)

Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	07	2442
02	2417	08	2447
03	2422	09	2452
04	2427	10	2457
05	2432	11	2462
06	2437	\	\

Channel List for 802.11n(40)

Channel	Frequency (MHz)	Channel	Frequency (MHz)
03	2422	07	2442
04	2427	08	2447
05	2432	09	2452
06	2437	\	\

1.3 Test channel list

Channel List for 802.11b/g/n(20)

Channel	Channel	Frequency (MHz)
Low	01	2412
Middle	06	2437
High	11	2462

Channel List for 802.11n(40)

Channel	Channel	Frequency (MHz)
Low	03	2422
Middle	06	2437
High	09	2452

1.4 Ancillary equipment list

Equipment	Model	S/N	Manufacturer	Certificate type
/	/	/	/	/

1.5 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model/Type No.	Series No.	Note
/	/	/	/	/	/

Note:

- (1)The support equipment was authorized by Declaration of Confirmation.
- (2)For detachable type I/O cable should be specified the length in cm in 『Length』 column.

2 Summary of Test Results

Test procedures according to the technical standards:

No.	Standard Section	Test Item	Result	Remark
1	15.203	Antenna Requirement	Pass	
2	15.247 (b)	Peak Output Power	Pass	
3	15.247 (d)	Power Spectral Density	Pass	
4	15.207	Conducted Emission	Pass	
5	15.247 (c)	Radiated Spurious Emission	Pass	
6	15.205	Band Edge Emission	Pass	
7	15.247 (a)(2)	6dB Bandwidth	Pass	

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3 Test Facilities and Accreditations

3.1 Test laboratory

Test Laboratory	Shenzhen Microtest Co., Ltd
Location	No.102A & 302A, East Block, Hengfang Industrial Park, Xingye Road, Xixiang, Bao'an District, Shenzhen, Guangdong, China
FCC Registration No.:	448573

3.2 Environmental conditions

Temperature:	15°C~35°C
Humidity	20%~75%
Atmospheric pressure	98kPa~101kPa

3.3 Measurement uncertainty

The reported uncertainty of measurement $y \pm U$ where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$ providing a level of confidence of approximately 95 %

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power, conducted	$\pm 0.16\text{dB}$
3	Spurious emissions, conducted	$\pm 0.21\text{dB}$
4	All emissions, radiated(<1G)	$\pm 4.68\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.89\text{dB}$
6	Temperature	$\pm 0.5^\circ\text{C}$
7	Humidity	$\pm 2\%$

3.4 Test software

Software Name	Manufacturer	Model	Version
Bluetooth and WiFi Test System	Shenzhen JS tonscond co.,ltd	JS1120-3	2.5.77.0418

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4 Equipment list

Equipment No.	Equipment Name	Manufacturer	Model	Serial No.	Calibration date	Due date
MTI-E004	EMI Test Receiver	Rohde&schwarz	ESPI7	100314	2018/10/09	2019/10/08
					2019/10/09	2020/10/08
MTI-E006	TRILOG Broadband Antenna	schwarzbeck	VULB 9163	9163-872	2018/10/15	2019/10/14
					2019/10/15	2020/10/14
MTI-E014	amplifier	Hewlett-Packard	8447D	3113A06150	2018/10/09	2019/10/08
					2019/10/09	2020/10/08
MTI-E036	Single path vehicle AMN(LISN)	Schwarzbeck	NNBM 8124	01175	2018/10/09	2019/10/08
					2019/10/09	2020/10/08
MTI-E038	Low noise active vertical monopole antenna	Schwarzbeck	VAMP 9243	#565	2018/10/16	2019/10/15
					2019/10/16	2020/10/15
MTI-E039	Biconical antenna	Schwarzbeck	BBA 9106	#164	2018/10/15	2019/10/14
					2019/10/15	2020/10/14
MTI-E041	MXG Vector Signal Generator	Agilent	N5182A	MY49060455	2019/04/16	2020/04/15
MTI-E042	ESG Series Analog signal generator	Agilent	E4421B	GB40051240	2019/05/21	2020/05/20
MTI-E044	Thermometer clock humidity monitor	-	HTC-1	/	2019/04/17	2020/04/16
MTI-E062	Log Periodic Antenna	Schwarzbeck	VUSLP 9111B	#312	2018/04/11	2020/04/10
MTI-E063	Log Periodic Dipole Array Antenna	ETS-LINDGREN	3148B	00224524	2018/04/11	2020/04/10
MTI-E065	Amplifier	EMtrace	RP06A	00117	2019/04/29	2020/04/28
MTI-E066	Comprehensive test instrument	Rohde&schwarz	CMW500	149155	2019/04/16	2020/04/15
MTI-E071	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2018/10/25	2019/10/24
					2019/10/25	2020/10/24
MTI-E076	EMI Test Receiver	Rohde&schwarz	ESIB26	100273	2019/04/16	2020/04/15
MTI-E078	Synthesized Sweeper	Agilent	83752A	3610A01957	2019/04/16	2020/04/15
MTI-E079	DC Power Supply	Agilent	E3632A	MY40027695	2019/04/16	2020/04/15
MTI-E093	Artificial mains network	3ctest	LISN J50	ES3911805	2019/04/16	2020/04/15
MTI-E096	Power amplifier	Space-Dtronics	EWLNA0 118G-P40	1852001	2019/04/29	2020/04/28
MTI-E097	Current Probe	SOLAR ELECTRONICS CO.	9207-1	220095-1	2019/04/17	2020/04/16
MTI-E098	Loop Sensor	SOLAR ELECTRONICS CO.	7334-1	220095-2	2019/04/21	2020/04/20

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MTI-E080	Temperature & Humidity test chamber	Safety test	AG80L	171200018	2019/04/16	2020/04/15
Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).						

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5 Test Result

5.1 Antenna requirement

5.1.1 Standard requirement

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

5.1.2 EUT Antenna

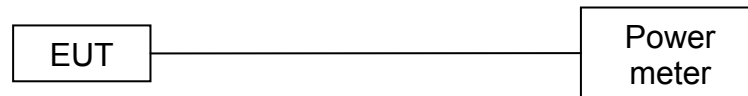
The EUT antenna is FPC antenna. It comply with the standard requirement. In case of replacement of broken antenna the same antenna type must be used.

5.2 Peak output power

5.2.1 Limit

Section	Test Item	Limit	Frequency Range (MHz)
15.247(b)(3)	Peak output power	1 watt or 30dBm	2400-2483.5

5.2.2 Test setup



5.2.3 Test procedure

The EUT was directly connected to the Power meter.

5.2.4 Test results
802.11b

Test Channel	Frequency (MHz)	Output Power (ANT A)		Output Power (ANT B)		Limit (dBm)	
		dBm	mW	dBm	mW	dBm	mW
01	2412	12.01	15.89	13.29	21.33	30	1000
06	2437	12.70	18.62	12.92	19.59		
11	2462	12.64	18.37	13.68	23.33		

802.11g

Test Channel	Frequency (MHz)	Output Power (ANT A)		Output Power (ANT B)		Limit (dBm)	
		dBm	mW	dBm	mW	dBm	mW
01	2412	11.09	12.85	10.99	12.56	30	1000
06	2437	10.38	10.91	11.89	15.45		
11	2462	9.66	9.25	12.03	15.96		

802.11n20

Test Channel	Frequency (MHz)	Output Power (ANT A)		Output Power (ANT B)		Total Power (ANT A + ANT B)		Limit (dBm)	
		dBm	mW	dBm	mW	dBm	mW	dBm	mW
01	2412	10.12	10.28	10.66	11.64	13.41	21.92	29.99	997.70
06	2437	9.03	8.00	9.98	9.95	12.54	17.95		
11	2462	8.75	7.50	12.06	16.07	13.72	23.57		

Note: if transmitting antennas of directional gain greater than 6 dBi are used, then the limit should be reduced.

Because the directional gain = 6.01dB > 6.0 dBi, the limit should be calculated as below:

$$\begin{aligned} \text{Limit} &= 30 \text{ dBm} - (\text{ANT Gain} + 10 \cdot \log(N=2)) \\ &= 30 \text{ dBm} - (3 + 3.01-6) \text{ dBi} = 29.99\text{dBm} \end{aligned}$$

802.11n40

Test Channel	Frequency (MHz)	Output Power (ANT A)		Output Power (ANT B)		Total Power (ANT A + ANT B)		Limit (dBm)	
		dBm	mW	dBm	mW	dBm	mW	dBm	mW
03	2422	10.61	11.51	11.33	13.58	14.00	25.09	29.99	997.70
06	2437	9.37	8.65	10.63	11.56	13.06	20.21		
09	2452	9.04	8.02	9.84	9.64	12.47	17.66		

Note: if transmitting antennas of directional gain greater than 6 dBi are used, then the limit should be reduced.

Because the directional gain = 6.11dB > 6.0 dBi, the limit should be calculated as below:

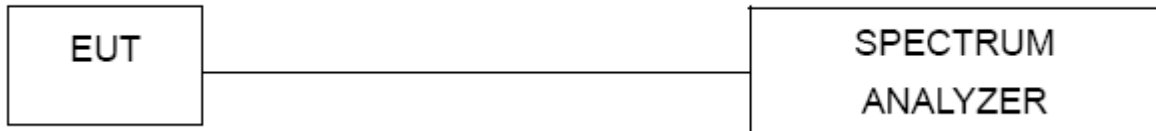
$$\begin{aligned} \text{Limit} &= 30 \text{ dBm} - (\text{ANT Gain} + 10 \cdot \log(N=2)) \\ &= 30 \text{ dBm} - (3.1 + 3.01-6) \text{ dBi} = 29.99\text{dBm} \end{aligned}$$

5.3 Power spectral density

5.3.1 Limit

Section	Test Item	Limit	Frequency Range (MHz)
15.247	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5

5.3.2 Test Setup



5.3.3 Test Procedure

- a. The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing.
- b. Set analyzer center frequency to DTS channel center frequency.
- c. Set the span to 1.5 times the DTS channel bandwidth.
- d. Set the RBW \geq 3 kHz.
- e. Set the VBW \geq 3 x RBW.
- f. Detector = peak.
- g. Sweep time = auto couple.
- h. Trace mode = max hold.
- i. Allow trace to fully stabilize.
- j. Use the peak marker function to determine the maximum amplitude level.
- k. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.4 Test Results

802.11b

ANT A:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-8.602	8	Pass
CH06	2437	-7.243	8	Pass
CH11	2462	-8.726	8	Pass

TX CH01



TX CH06



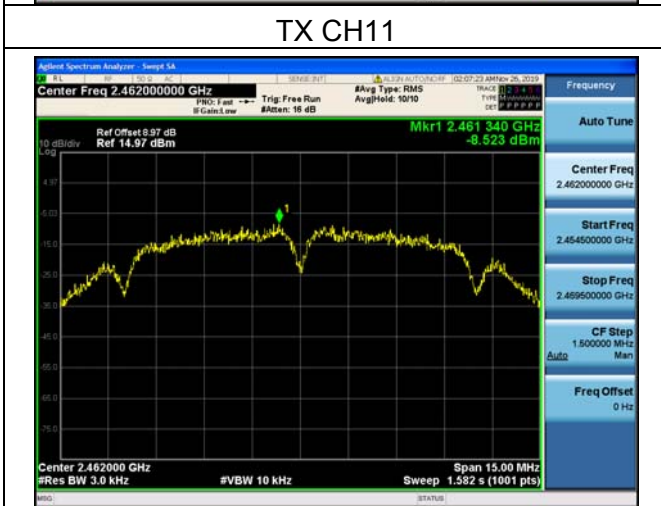
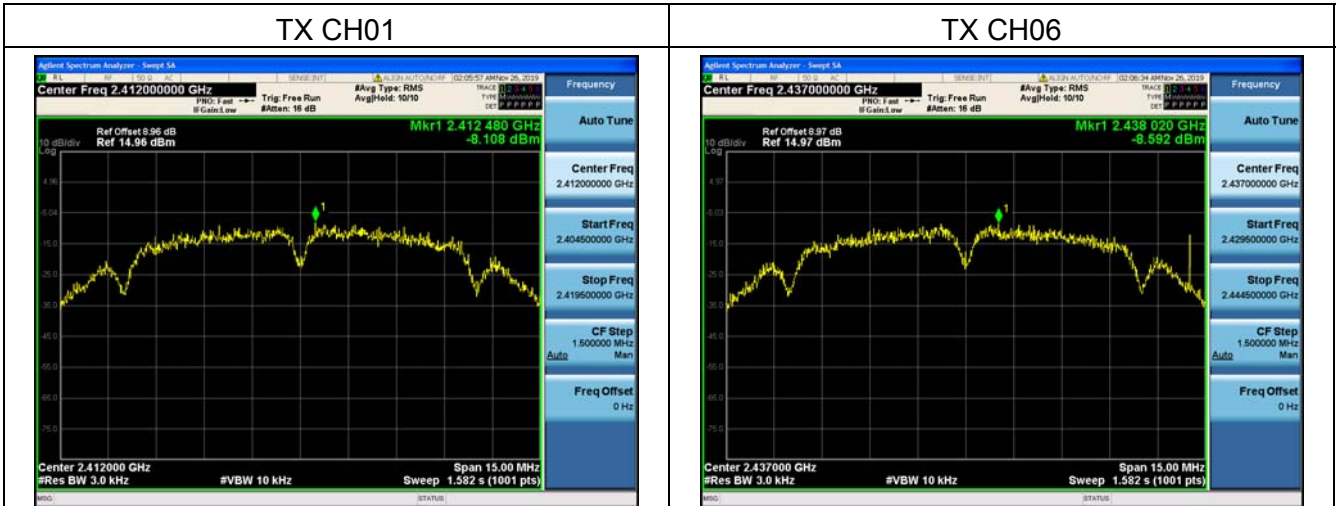
TX CH11



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ANT B:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-8.108	8	Pass
CH06	2437	-8.592	8	Pass
CH11	2462	-8.523	8	Pass

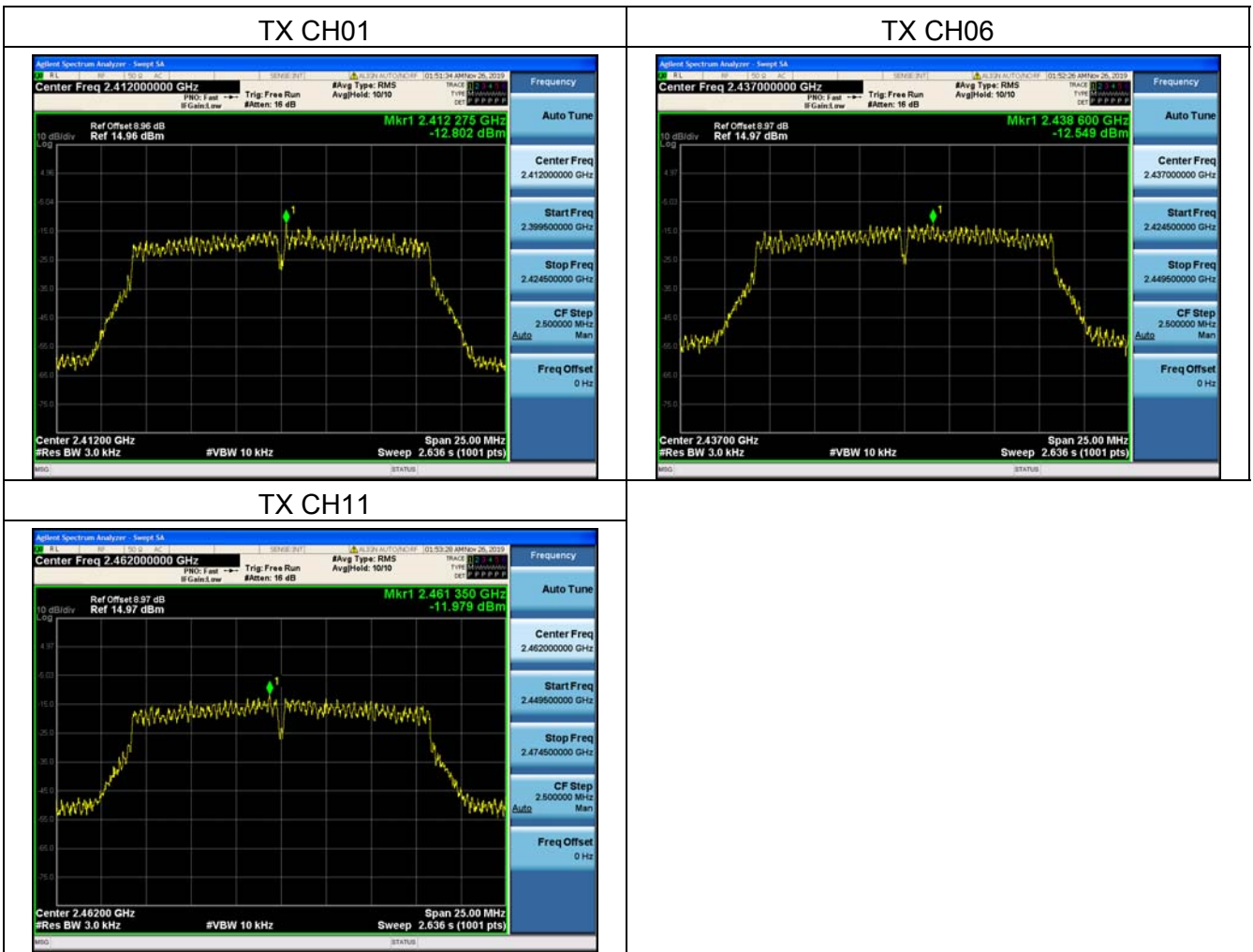


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802.11g

ANT A:

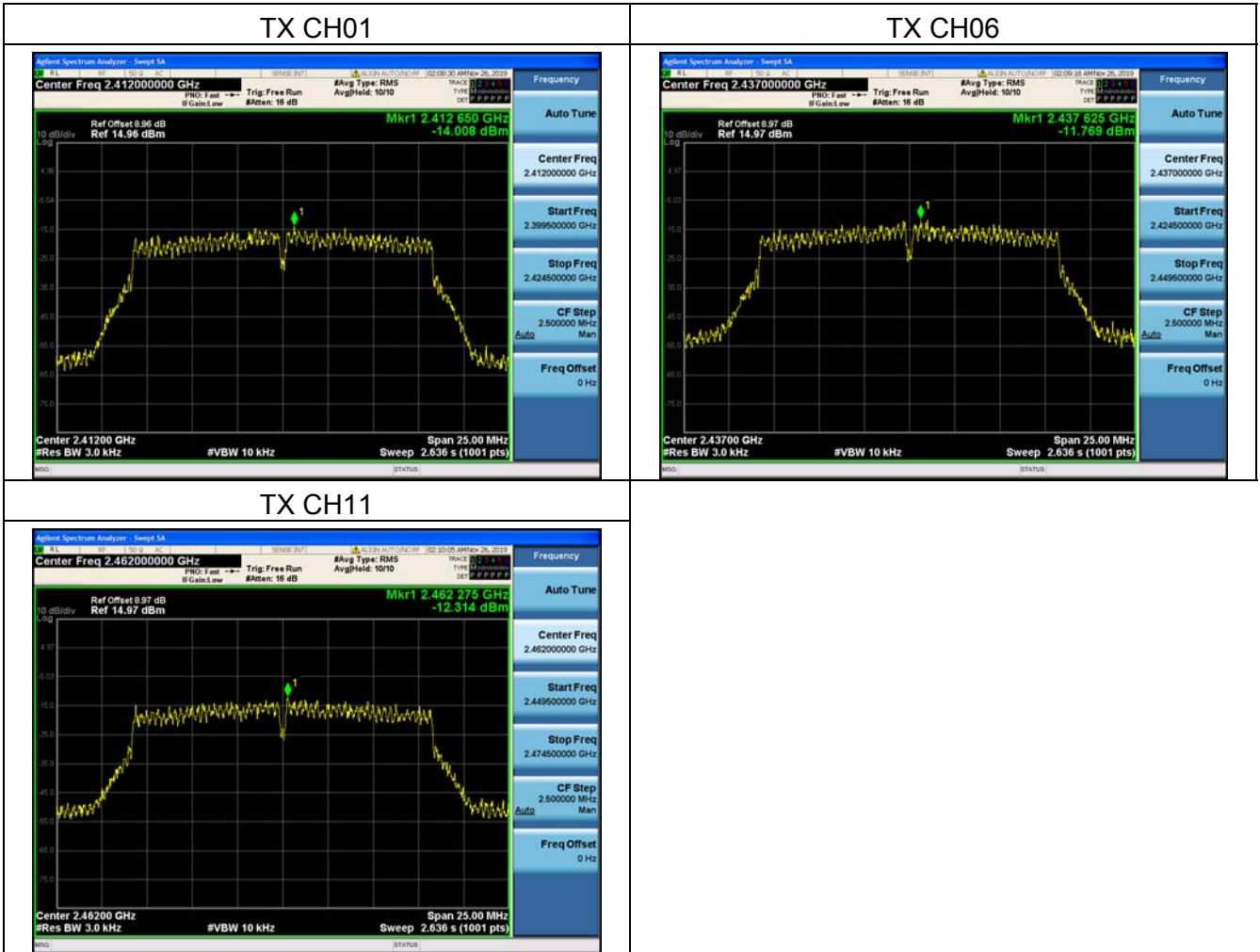
Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-12.802	8	Pass
CH06	2437	-12.549	8	Pass
CH11	2462	-11.979	8	Pass



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ANT B:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-14.008	8	Pass
CH06	2437	-11.769	8	Pass
CH11	2462	-12.314	8	Pass



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802.11n20

ANT A+ANT B

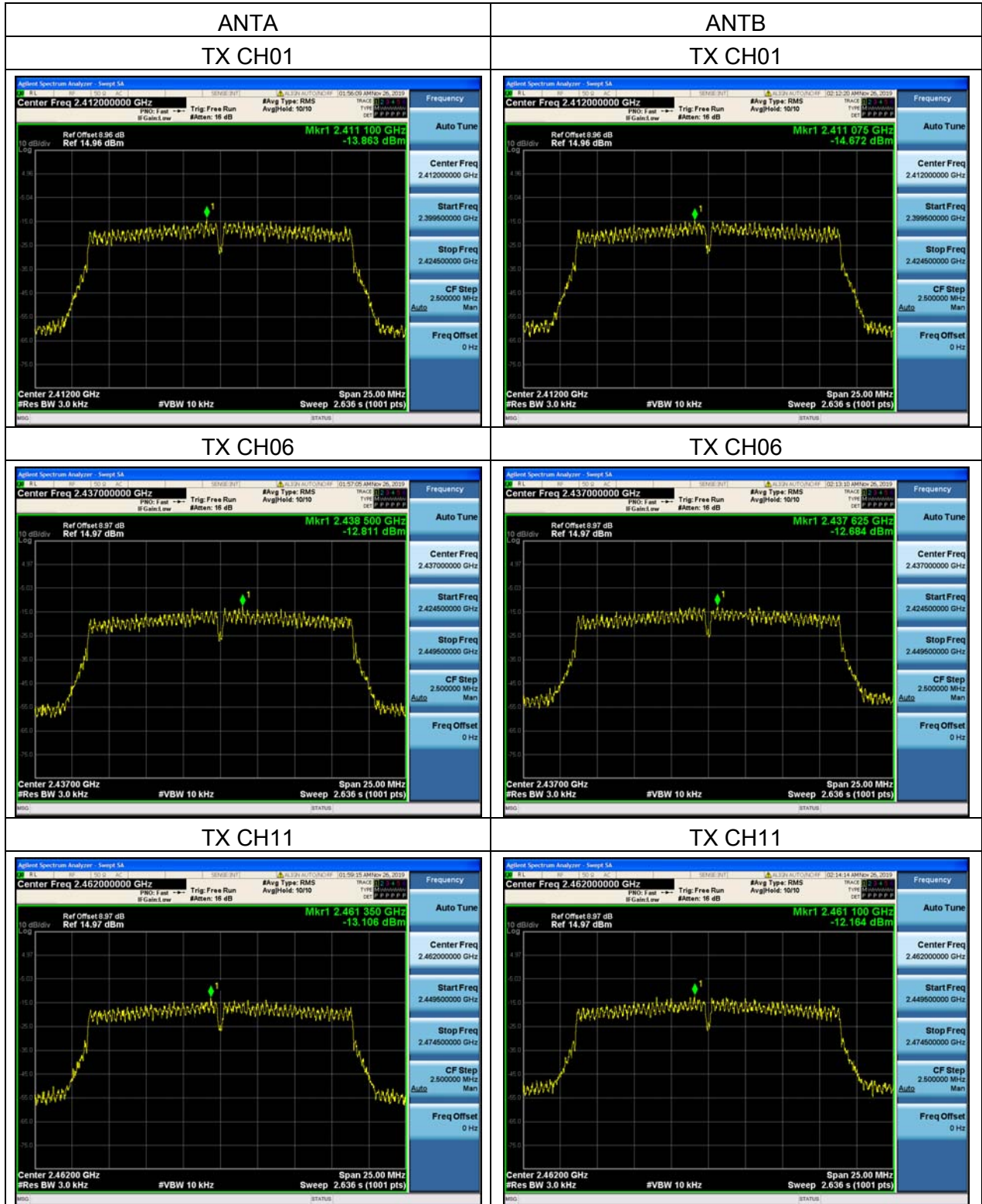
Test Channel	Frequency (MHz)	Power Density of ANT A (dBm/3kHz)	Power Density of ANT B (dBm/3kHz)	Total Power Density of (ANT A + ANT B) (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-13.863	-14.672	-11.24	7.99	Pass
CH06	2437	-12.811	-12.684	-9.74	7.99	Pass
CH11	2462	-13.106	-12.164	-9.60	7.99	Pass

Note: if transmitting antennas of directional gain greater than 6 dBi are used, then the limit should be reduced.

Because the directional gain = 6.01dB > 6.0 dBi, the limit should be calculated as below:

Limit = 8 dBm/3kHz - (ANT Gain + 10*Log(N=2) - 6dBi)

= 8 dBm/3kHz - (3 + 3.01 - 6) dBi = 7.99 dBm/3kHz



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802.11n40

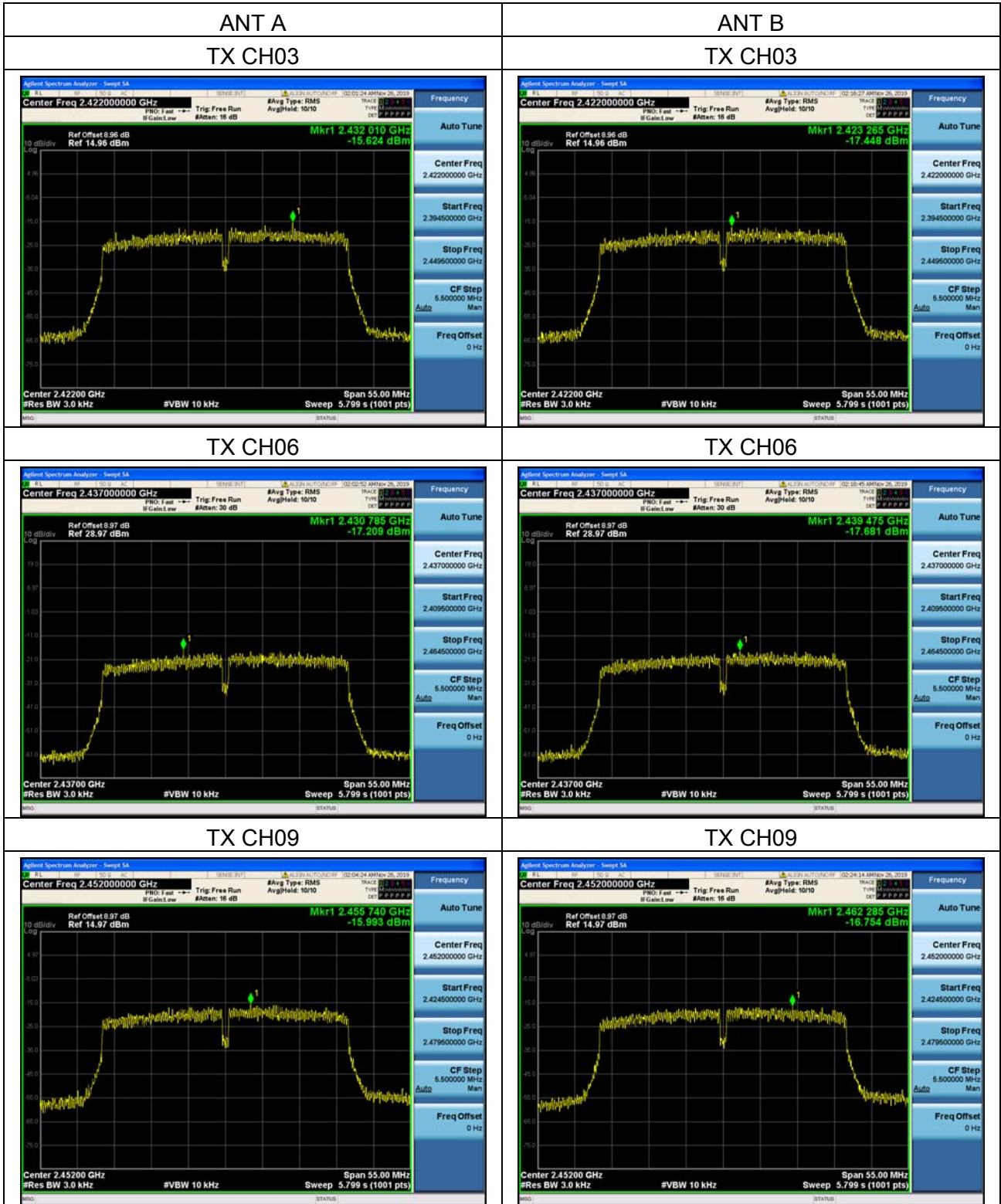
Test Channel	Frequency (MHz)	Power Density of ANTA (dBm/3kHz)	Power Density of ANTB (dBm/3kHz)	Total Power Density of (ANTA + ANTB) (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH03	2422	-15.624	-17.448	-13.43	7.99	Pass
CH06	2437	-17.209	-17.681	-14.43	7.99	Pass
CH09	2452	-15.993	-16.754	-13.35	7.99	Pass

Note: if transmitting antennas of directional gain greater than 6 dBi are used, then the limit should be reduced.

Because the directional gain = 6.01dB > 6.0 dBi, the limit should be calculated as below:

Limit = 8 dBm/3kHz - (ANT Gain + 10*Log(N=2) - 6dBi)

= 8 dBm/3kHz - (3 + 3.01 - 6) dBi = 7.99 dBm/3kHz



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5.4 Conducted emission

5.4.1 Limits

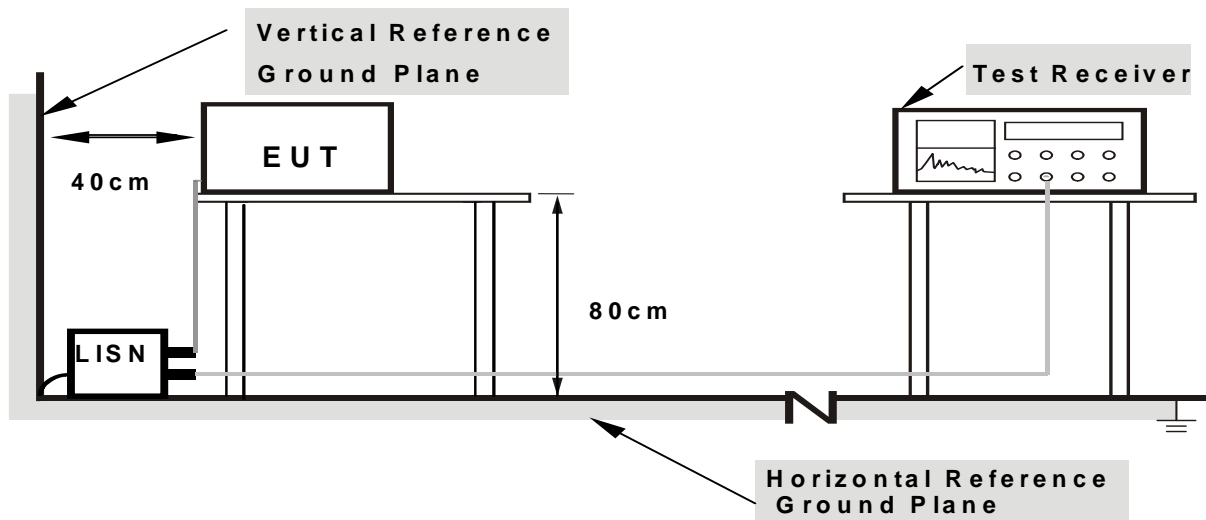
FREQUENCY (MHz)	Class B (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note

(1)The tighter limit applies at the band edges.

(2)The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

5.4.2 Test setup



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

5.4.3 Test procedure

a. EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b. The following table is the setting of the receiver

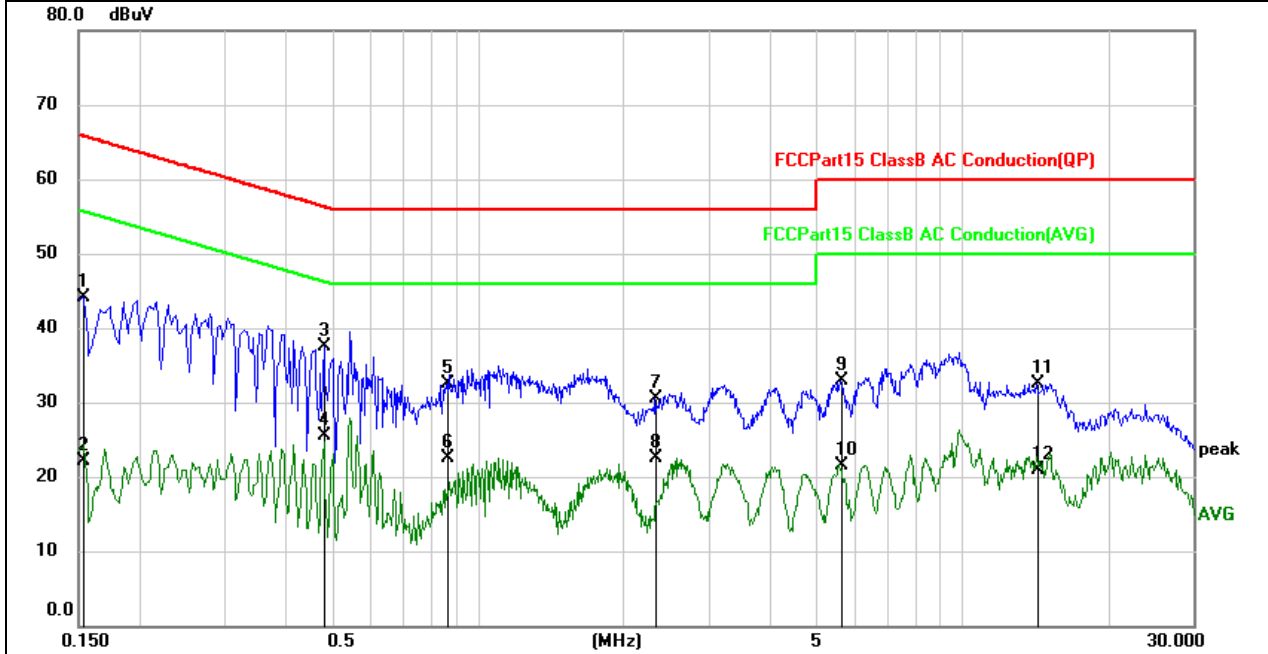
Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

- c. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- d. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- e. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- f. LISN at least 80 cm from nearest part of EUT chassis.

For the actual test configuration, please refer to the related Item –EUT Test Photos.

5.4.4 Test results

EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase :	L
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging+TX Mode

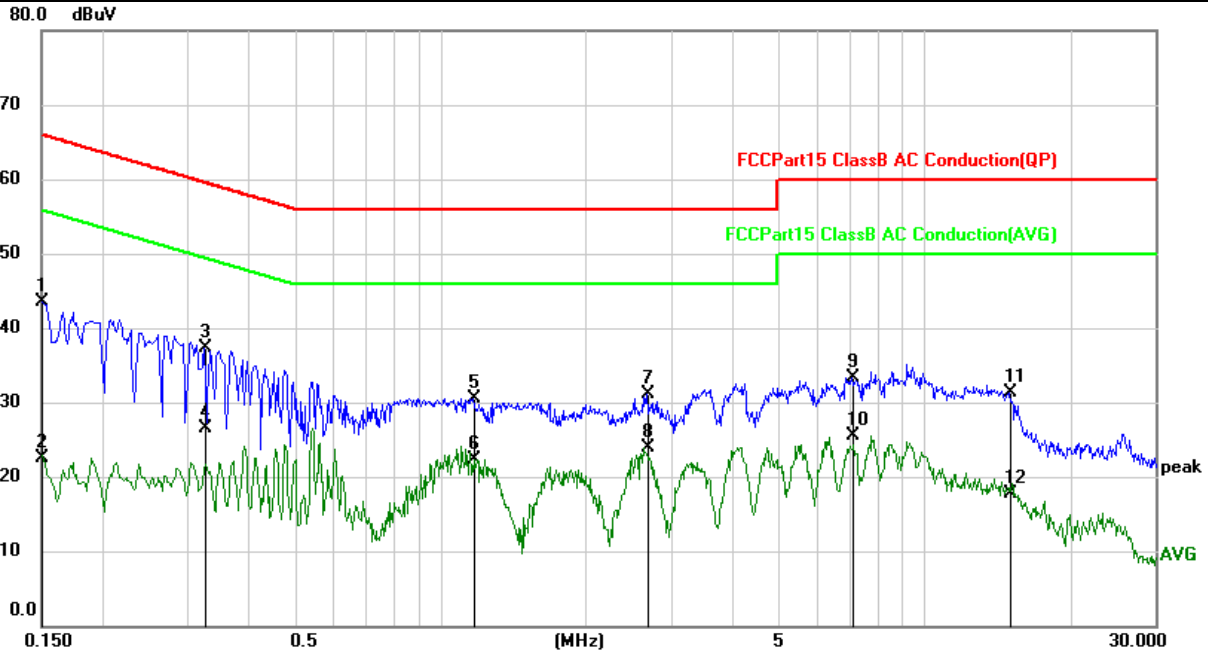


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV	dBuV	dB	
1		0.1539	34.42	9.73	44.15	65.79	-21.64	QP
2		0.1539	12.37	9.73	22.10	55.79	-33.69	AVG
3	*	0.4818	27.60	9.91	37.51	56.31	-18.80	QP
4		0.4818	15.56	9.91	25.47	46.31	-20.84	AVG
5		0.8659	22.52	9.96	32.48	56.00	-23.52	QP
6		0.8659	12.60	9.96	22.56	46.00	-23.44	AVG
7		2.3220	20.57	10.01	30.58	56.00	-25.42	QP
8		2.3220	12.44	10.01	22.45	46.00	-23.55	AVG
9		5.6059	22.80	10.10	32.90	60.00	-27.10	QP
10		5.6059	11.41	10.10	21.51	50.00	-28.49	AVG
11		14.2459	22.20	10.28	32.48	60.00	-27.52	QP
12		14.2459	10.56	10.28	20.84	50.00	-29.16	AVG

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EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase:	N
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging+TX Mode

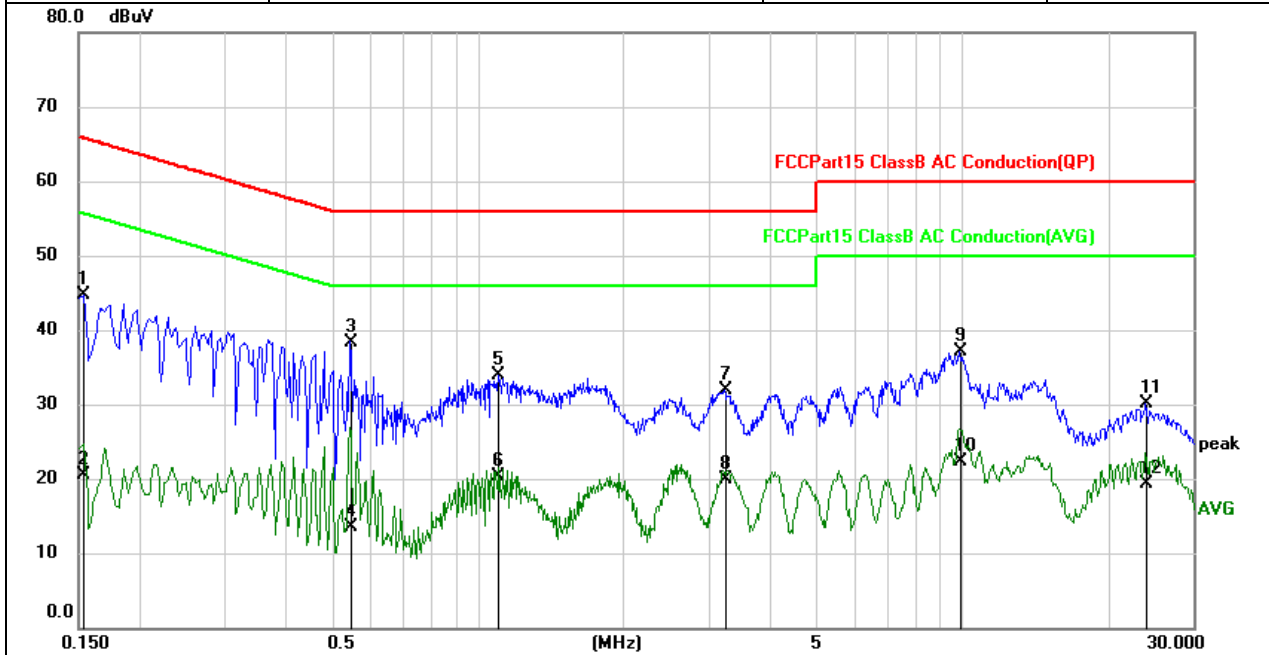


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1500	33.80	9.73	43.53	66.00	-22.47	QP
2		0.1500	12.75	9.73	22.48	56.00	-33.52	AVG
3		0.3260	27.51	9.79	37.30	59.55	-22.25	QP
4		0.3260	16.67	9.79	26.46	49.55	-23.09	AVG
5		1.1700	20.50	9.98	30.48	56.00	-25.52	QP
6		1.1700	12.29	9.98	22.27	46.00	-23.73	AVG
7		2.6700	21.06	10.02	31.08	56.00	-24.92	QP
8	*	2.6700	13.80	10.02	23.82	46.00	-22.18	AVG
9		7.0937	23.16	10.18	33.34	60.00	-26.66	QP
10		7.0937	15.37	10.18	25.55	50.00	-24.45	AVG
11		15.0579	21.01	10.27	31.28	60.00	-28.72	QP
12		15.0579	7.34	10.27	17.61	50.00	-32.39	AVG

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EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase :	L
Test Voltage :	DC 5V from adapter AC 240V/60Hz	Test Mode:	Charging+TX Mode

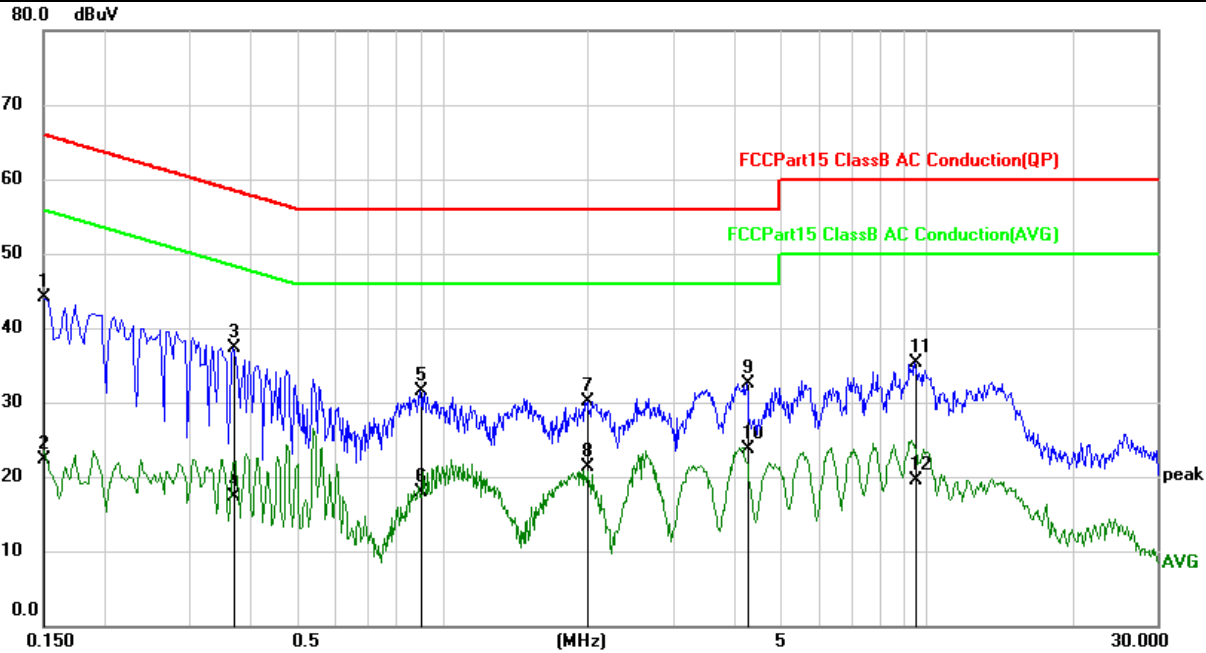


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1539	34.92	9.73	44.65	65.79	-21.14	QP
2		0.1539	10.83	9.73	20.56	55.79	-35.23	AVG
3	*	0.5460	28.47	9.93	38.40	56.00	-17.60	QP
4		0.5460	3.64	9.93	13.57	46.00	-32.43	AVG
5		1.1019	23.88	9.98	33.86	56.00	-22.14	QP
6		1.1019	10.34	9.98	20.32	46.00	-25.68	AVG
7		3.2380	21.84	10.03	31.87	56.00	-24.13	QP
8		3.2380	9.80	10.03	19.83	46.00	-26.17	AVG
9		9.9020	26.81	10.33	37.14	60.00	-22.86	QP
10		9.9020	11.88	10.33	22.21	50.00	-27.79	AVG
11		23.9420	19.85	10.31	30.16	60.00	-29.84	QP
12		23.9420	8.94	10.31	19.25	50.00	-30.75	AVG

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EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase:	N
Test Voltage:	DC 5V from adapter AC 240V/60Hz	Test Mode:	Charging+TX Mode



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV	dBuV	dB	
1		0.1500	34.30	9.73	44.03	66.00	-21.97	QP
2		0.1500	12.66	9.73	22.39	56.00	-33.61	AVG
3	*	0.3700	27.57	9.82	37.39	58.50	-21.11	QP
4		0.3700	7.39	9.82	17.21	48.50	-31.29	AVG
5		0.9020	21.44	9.97	31.41	56.00	-24.59	QP
6		0.9020	7.93	9.97	17.90	46.00	-28.10	AVG
7		1.9980	20.12	10.00	30.12	56.00	-25.88	QP
8		1.9980	11.23	10.00	21.23	46.00	-24.77	AVG
9		4.2619	22.53	10.05	32.58	56.00	-23.42	QP
10		4.2619	13.64	10.05	23.69	46.00	-22.31	AVG
11		9.4660	24.98	10.30	35.28	60.00	-24.72	QP
12		9.4660	9.11	10.30	19.41	50.00	-30.59	AVG

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5.5 Radiated spurious

5.5.1 Limits

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (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

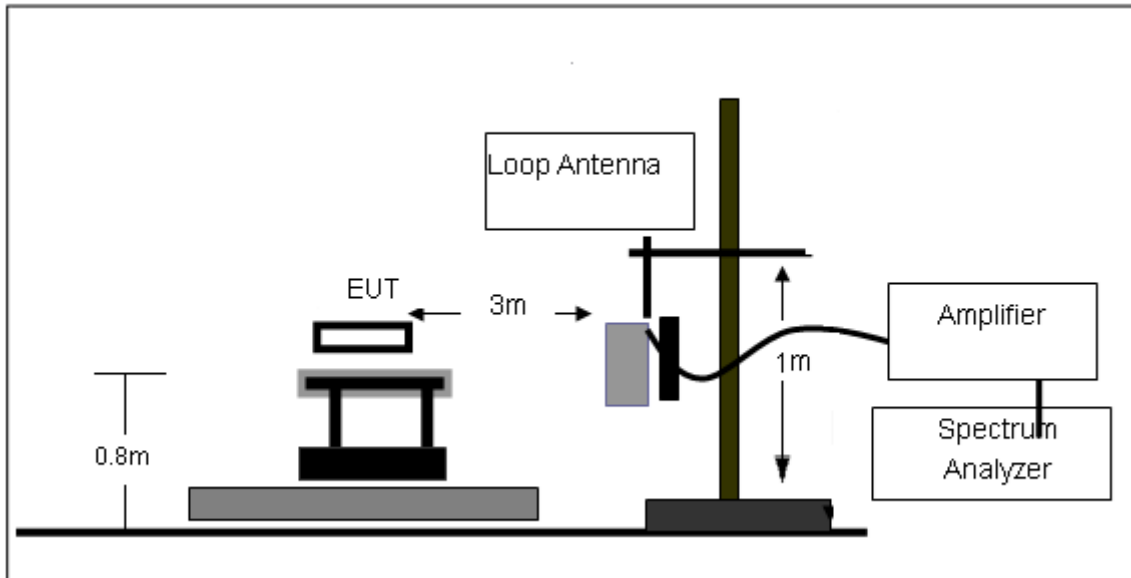
Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

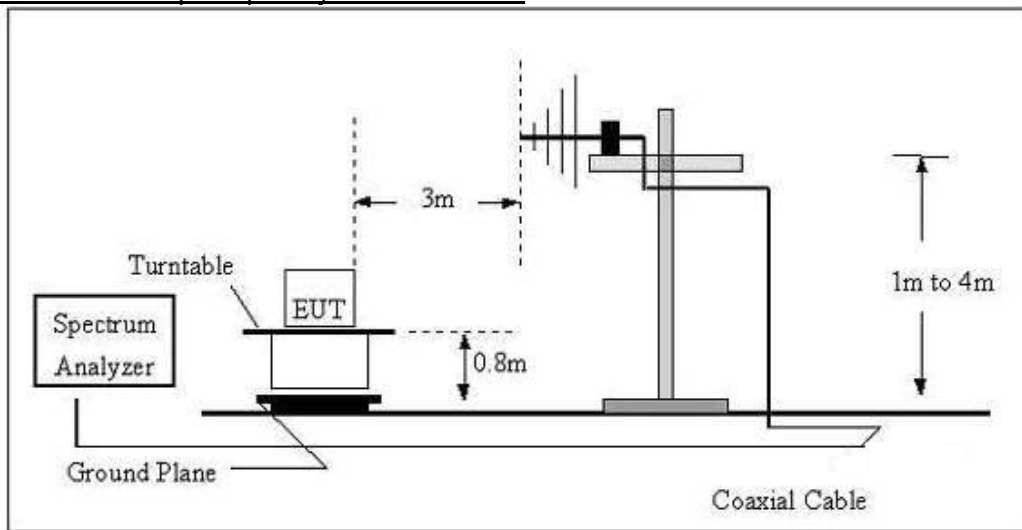
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5.5.2 Test setup

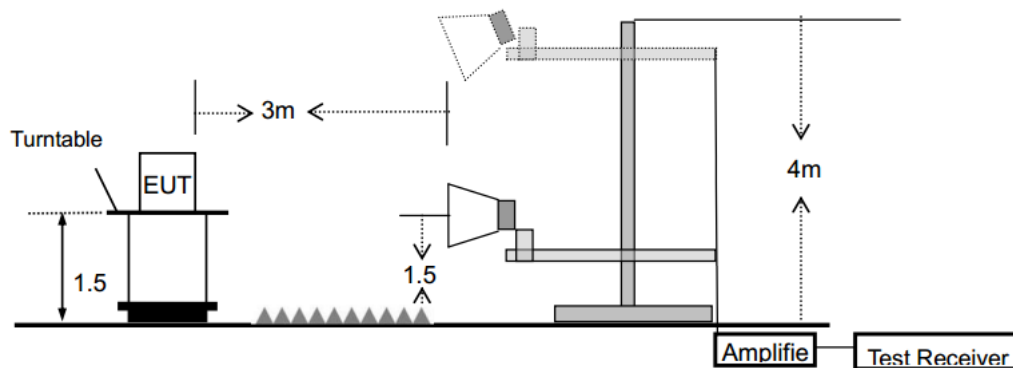
Radiated emission test-up frequency below 30MHz



Radiated emission test-up frequency 30MHz~1GHz



Radiated emission test-up frequency above 1GHz



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5.5.3 Test procedure

- a. The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range below 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.
- b. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- c. Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured, RBW = 1 MHz for $f \geq 1\text{GHz}$, 100 kHz for $f < 1\text{GHz}$, VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- d. Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- e. The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = RMS for AV value, while maintaining all of the other instrument settings.
- f. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- g. For the actual test configuration, please refer to the related Item –EUT Test photos.

Note: Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

5.5.4 Test results

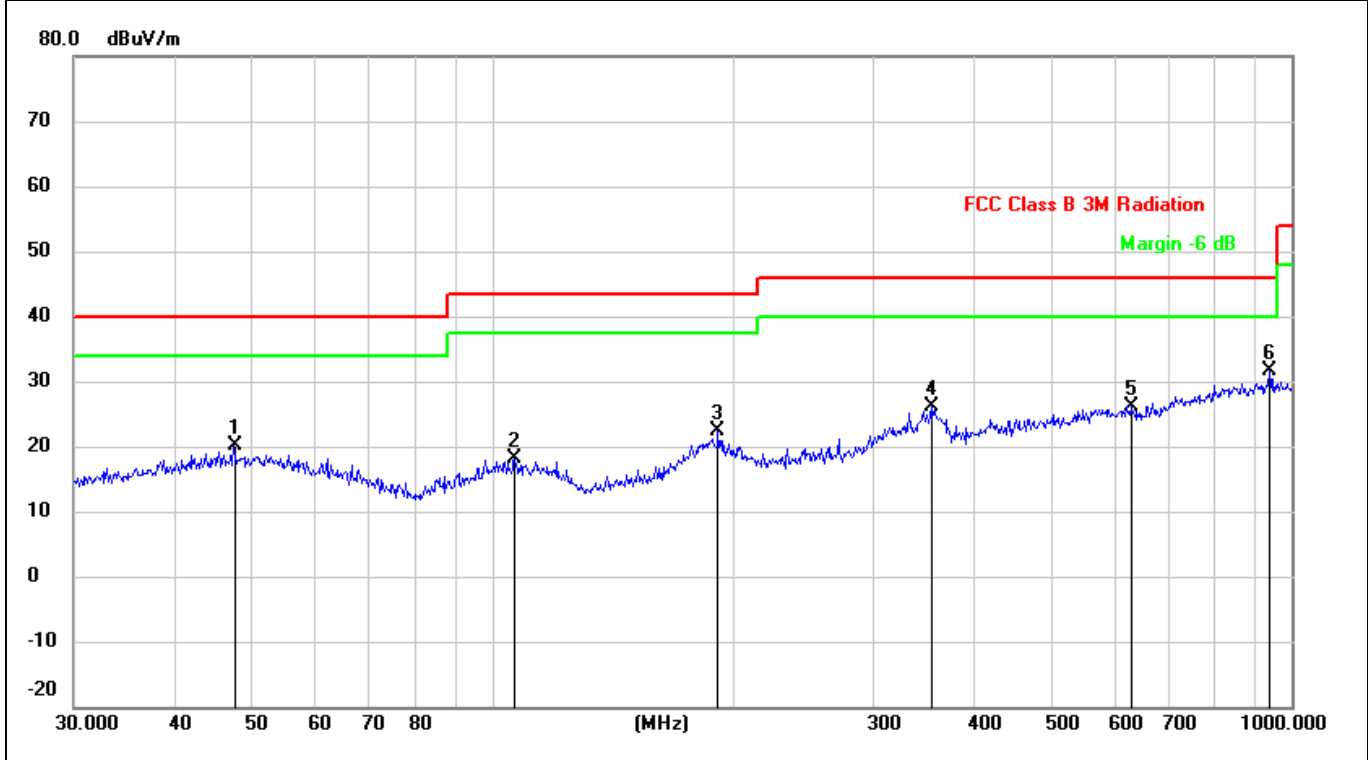
5.5.4.1 Radiation emission

Between 30MHz – 1GHz

Note1: Emission Level = Meter Reading + Factor, Margin= Emission Level- Limit, Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note2: The following data is the worst mode. The worst data is antenna B 802.11 b 2462MHz.

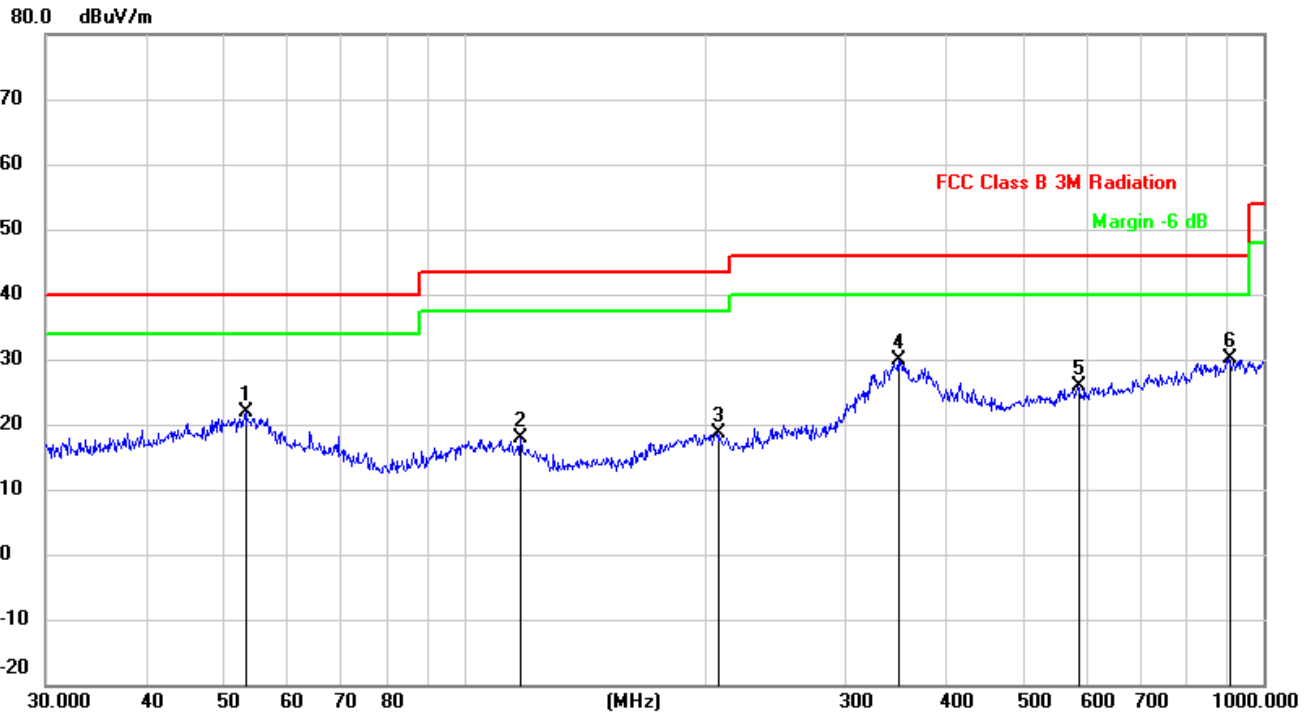
EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dBuV/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		47.4918	26.66	-6.55	20.11	40.00	-19.89	QP
2		106.7587	25.83	-7.81	18.02	43.50	-25.48	QP
3		191.7450	29.94	-7.63	22.31	43.50	-21.19	QP
4		354.1831	29.91	-3.77	26.14	46.00	-19.86	QP
5		629.4772	26.58	-0.34	26.24	46.00	-19.76	QP
6	*	938.8326	27.89	3.71	31.60	46.00	-14.40	QP

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EUT:	4G Wireless Data Terminal	Model Name:	S2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	
1		53.3179	29.02	-7.08	21.94	40.00	-18.06	QP
2		117.7725	26.26	-8.40	17.86	43.50	-25.64	QP
3		207.1226	25.57	-6.99	18.58	43.50	-24.92	QP
4		349.2500	33.67	-3.77	29.90	46.00	-16.10	QP
5		584.7895	26.35	-0.44	25.91	46.00	-20.09	QP
6	*	903.3094	26.40	3.65	30.05	46.00	-15.95	QP

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1G-25GHz

Note1: Emission Level = Meter Reading + Factor, Margin= Emission Level- Limit, Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note2: Pre-scan with 802.11b/g/n modes, both antenna A and antenna B have been tested and the report only shows the worst mode. The worst case data is Antenna B with 802.11b and 802.11n40 MIMO mode

Frequency	Read Level	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Remark	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
Low Channel (2412 MHz)(802.11b)--Above 1G									
4824.161	62.62	4.36	32.92	45.53	54.37	74.00	-19.63	Pk	Vertical
4824.161	44.06	4.36	32.92	45.53	35.81	54.00	-18.19	AV	Vertical
7236.396	60.34	5.02	37.63	45.56	57.43	74.00	-16.57	Pk	Vertical
7236.396	40.96	5.02	37.63	45.56	38.05	54.00	-15.95	AV	Vertical
4824.154	63.37	4.36	32.92	45.53	55.12	74.00	-18.88	Pk	Horizontal
4824.154	43.30	4.36	32.92	45.53	35.05	54.00	-18.95	AV	Horizontal
7236.168	64.01	5.02	37.63	45.56	61.10	74.00	-12.90	Pk	Horizontal
7236.168	42.70	5.02	37.63	45.56	39.79	54.00	-14.21	AV	Horizontal
Middle Channel (2437 MHz)(802.11b)--Above 1G									
4874.112	62.38	4.41	33.01	45.76	54.04	74.00	-19.96	Pk	Vertical
4874.112	44.04	4.41	33.01	45.76	35.70	54.00	-18.30	AV	Vertical
7311.247	60.40	5.02	37.68	45.59	57.51	74.00	-16.49	Pk	Vertical
7311.247	41.20	5.02	37.68	45.59	38.31	54.00	-15.69	AV	Vertical
4874.132	63.09	4.41	33.01	45.76	54.75	74.00	-19.25	Pk	Horizontal
4874.132	44.00	4.41	33.01	45.76	35.66	54.00	-18.34	AV	Horizontal
7311.085	61.54	5.02	37.68	45.59	58.65	74.00	-15.35	Pk	Horizontal
7311.085	42.52	5.02	37.68	45.59	39.63	54.00	-14.37	AV	Horizontal
High Channel (2462 MHz)(802.11b)--Above 1G									
4924.169	64.16	4.50	33.26	46.07	55.85	74.00	-18.15	Pk	Vertical
4924.169	44.02	4.50	33.26	46.07	35.71	54.00	-18.29	AV	Vertical
7386.215	60.56	5.02	37.78	45.77	57.59	74.00	-16.41	Pk	Vertical
7386.215	40.63	5.02	37.78	45.77	37.66	54.00	-16.34	AV	Vertical
4924.045	63.44	4.50	33.26	46.07	55.13	74.00	-18.87	Pk	Horizontal
4924.045	44.58	4.50	33.26	46.07	36.27	54.00	-17.73	AV	Horizontal
7386.132	61.32	5.02	37.78	45.77	58.35	74.00	-15.65	Pk	Horizontal
7386.132	42.43	5.02	37.78	45.77	39.46	54.00	-14.54	AV	Horizontal

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802.11n40:

Frequency	Read Level	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Remark	Comment
(MHz)	(dB μ V)	(dB)	dB/m	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)		
Low Channel (2422 MHz) -Above 1G									
4844.102	63.47	5.21	35.59	44.30	59.97	74.00	-14.03	Pk	Vertical
4844.102	40.14	5.21	35.59	44.30	36.64	54.00	-17.36	AV	Vertical
7266.319	60.35	6.48	36.27	44.60	58.50	74.00	-15.50	Pk	Vertical
7266.319	44.03	6.48	36.27	44.60	42.18	54.00	-11.82	AV	Vertical
4844.354	60.88	5.21	35.55	44.30	57.34	74.00	-16.66	Pk	Horizontal
4844.354	43.27	5.21	35.55	44.30	39.73	54.00	-14.27	AV	Horizontal
7266.257	63.36	6.48	36.27	44.52	61.59	74.00	-12.41	Pk	Horizontal
7266.257	47.13	6.48	36.27	44.52	45.36	54.00	-8.64	AV	Horizontal
Low Channel (2437 MHz) -Above 1G									
4874.112	62.65	5.21	35.66	44.20	59.32	74.00	-14.68	Pk	Vertical
4874.112	43.17	5.21	35.66	44.20	39.84	54.00	-14.16	AV	Vertical
7311.247	59.50	7.10	36.50	44.43	58.67	74.00	-15.33	Pk	Vertical
7311.247	47.47	7.10	36.50	44.43	46.64	54.00	-7.36	AV	Vertical
4874.132	61.33	5.21	35.66	44.20	58.00	74.00	-16.00	Pk	Horizontal
4874.132	48.58	5.21	35.66	44.20	45.25	54.00	-8.75	AV	Horizontal
7311.085	59.22	7.10	36.50	44.43	58.39	74.00	-15.61	Pk	Horizontal
7311.085	41.50	7.10	36.50	44.43	40.67	54.00	-13.33	AV	Horizontal
Low Channel (2452 MHz) --Above 1G									
4904.139	65.48	5.21	35.52	44.21	62.00	74.00	-12.00	Pk	Vertical
4904.139	42.40	5.21	35.52	44.21	38.92	54.00	-15.08	AV	Vertical
7356.211	60.62	7.10	36.53	44.60	59.65	74.00	-14.35	Pk	Vertical
7356.211	45.00	7.10	36.53	44.60	44.03	54.00	-9.97	AV	Vertical
4904.147	66.98	5.21	35.52	44.21	63.50	74.00	-10.50	Pk	Horizontal
4904.147	46.67	5.21	35.52	44.21	43.19	54.00	-10.81	AV	Horizontal
7356.162	60.62	7.10	36.53	44.60	59.65	74.00	-14.35	Pk	Horizontal
7356.162	44.32	7.10	36.53	44.60	43.35	54.00	-10.65	AV	Horizontal

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5.5.4.2 Band edge - radiated

Note1: Emission Level = Meter Reading + Factor, Margin= Emission Level- Limit, Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note2: Both antenna A and antenna B have been tested and the report only shows the worst mode.

Frequency	Meter Reading	Cable Loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
802.11b									
2310.00	59.01	2.40	27.70	40.40	48.71	74	-25.29	Pk	Horizontal
2310.00	43.10	2.40	27.70	40.40	32.80	54	-21.20	AV	Horizontal
2310.00	58.67	2.40	27.70	40.40	48.37	74	-25.63	Pk	Vertical
2310.00	41.66	2.40	27.70	40.40	31.36	54	-22.64	AV	Vertical
2390.00	57.66	2.44	28.30	40.10	48.30	74	-25.70	Pk	Vertical
2390.00	41.58	2.44	28.30	40.10	32.22	54	-21.78	AV	Vertical
2390.00	57.07	2.44	28.30	40.10	47.71	74	-26.29	Pk	Horizontal
2390.00	42.12	2.44	28.30	40.10	32.76	54	-21.24	AV	Horizontal
2483.50	57.86	2.48	28.70	39.80	49.24	74	-24.76	Pk	Vertical
2483.50	43.22	2.48	28.70	39.80	34.60	54	-19.40	AV	Vertical
2483.50	58.45	2.48	28.70	39.80	49.83	74	-24.17	Pk	Horizontal
2483.50	42.23	2.48	28.70	39.80	33.61	54	-20.39	AV	Horizontal
2500.00	58.73	2.48	29.05	39.80	50.46	74	-23.54	Pk	Vertical
2500.00	41.27	2.48	29.05	39.80	33.00	54	-21.00	AV	Vertical
2500.00	59.01	2.48	29.05	39.80	50.74	74	-23.26	Pk	Horizontal
2500.00	41.29	2.48	29.05	39.80	33.02	54	-20.98	AV	Horizontal

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802.11g									
2310.00	59.13	2.40	27.70	40.40	48.83	74	-25.17	Pk	Horizontal
2310.00	44.04	2.40	27.70	40.40	33.74	54	-20.26	AV	Horizontal
2310.00	56.89	2.40	27.70	40.40	46.59	74	-27.41	Pk	Vertical
2310.00	43.10	2.40	27.70	40.40	32.80	54	-21.20	AV	Vertical
2390.00	57.71	2.44	28.30	40.10	48.35	74	-25.65	Pk	Vertical
2390.00	42.43	2.44	28.30	40.10	33.07	54	-20.93	AV	Vertical
2390.00	58.01	2.44	28.30	40.10	48.65	74	-25.35	Pk	Horizontal
2390.00	43.37	2.44	28.30	40.10	34.01	54	-19.99	AV	Horizontal
2483.50	58.63	2.48	28.70	39.80	50.01	74	-23.99	Pk	Vertical
2483.50	43.86	2.48	28.70	39.80	35.24	54	-18.76	AV	Vertical
2483.50	59.12	2.48	28.70	39.80	50.50	74	-23.50	Pk	Horizontal
2483.50	41.63	2.48	28.70	39.80	33.01	54	-20.99	AV	Horizontal
2500.00	58.80	2.48	29.05	39.80	50.53	74	-23.47	Pk	Vertical
2500.00	41.85	2.48	29.05	39.80	33.58	54	-20.42	AV	Vertical
2500.00	58.73	2.48	29.05	39.80	50.46	74	-23.54	Pk	Horizontal
2500.00	42.22	2.48	29.05	39.80	33.95	54	-20.05	AV	Horizontal
802.11n20									
2310.00	58.38	2.40	27.70	40.40	48.08	74	-25.92	Pk	Horizontal
2310.00	43.67	2.40	27.70	40.40	33.37	54	-20.63	AV	Horizontal
2310.00	58.41	2.40	27.70	40.40	48.11	74	-25.89	Pk	Vertical
2310.00	42.30	2.40	27.70	40.40	32.00	54	-22.00	AV	Vertical
2390.00	57.68	2.44	28.30	40.10	48.32	74	-25.68	Pk	Vertical
2390.00	42.07	2.44	28.30	40.10	32.71	54	-21.29	AV	Vertical
2390.00	57.00	2.44	28.30	40.10	47.64	74	-26.36	Pk	Horizontal
2390.00	42.46	2.44	28.30	40.10	33.10	54	-20.90	AV	Horizontal
2483.50	58.29	2.48	28.70	39.80	49.67	74	-24.33	Pk	Vertical
2483.50	42.80	2.48	28.70	39.80	34.18	54	-19.82	AV	Vertical
2483.50	58.51	2.48	28.70	39.80	49.89	74	-24.11	Pk	Horizontal
2483.50	41.98	2.48	28.70	39.80	33.36	54	-20.64	AV	Horizontal
2500.00	58.71	2.48	29.05	39.80	50.44	74	-23.56	Pk	Vertical
2500.00	42.26	2.48	29.05	39.80	33.99	54	-20.01	AV	Vertical
2500.00	59.09	2.48	29.05	39.80	50.82	74	-23.18	Pk	Horizontal
2500.00	41.36	2.48	29.05	39.80	33.09	54	-20.91	AV	Horizontal

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802.11n40									
2310.00	58.67	2.40	27.70	40.40	48.37	74	-25.63	Pk	Horizontal
2310.00	44.36	2.40	27.70	40.40	34.06	54	-19.94	AV	Horizontal
2310.00	57.31	2.40	27.70	40.40	47.01	74	-26.99	Pk	Vertical
2310.00	43.52	2.40	27.70	40.40	33.22	54	-20.78	AV	Vertical
2390.00	58.24	2.44	28.30	40.10	48.88	74	-25.12	Pk	Vertical
2390.00	42.50	2.44	28.30	40.10	33.14	54	-20.86	AV	Vertical
2390.00	58.34	2.44	28.30	40.10	48.98	74	-25.02	Pk	Horizontal
2390.00	43.58	2.44	28.30	40.10	34.22	54	-19.78	AV	Horizontal
2483.50	58.68	2.48	28.70	39.80	50.06	74	-23.94	Pk	Vertical
2483.50	44.04	2.48	28.70	39.80	35.42	54	-18.58	AV	Vertical
2483.50	58.43	2.48	28.70	39.80	49.81	74	-24.19	Pk	Horizontal
2483.50	41.85	2.48	28.70	39.80	33.23	54	-20.77	AV	Horizontal
2500.00	59.07	2.48	29.05	39.80	50.80	74	-23.20	Pk	Vertical
2500.00	41.88	2.48	29.05	39.80	33.61	54	-20.39	AV	Vertical
2500.00	59.20	2.48	29.05	39.80	50.93	74	-23.07	Pk	Horizontal
2500.00	42.26	2.48	29.05	39.80	33.99	54	-20.01	AV	Horizontal

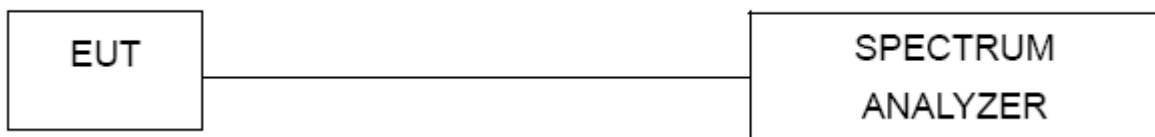
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5.6 Band edge - Conducted

5.6.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

5.6.2 Test setup

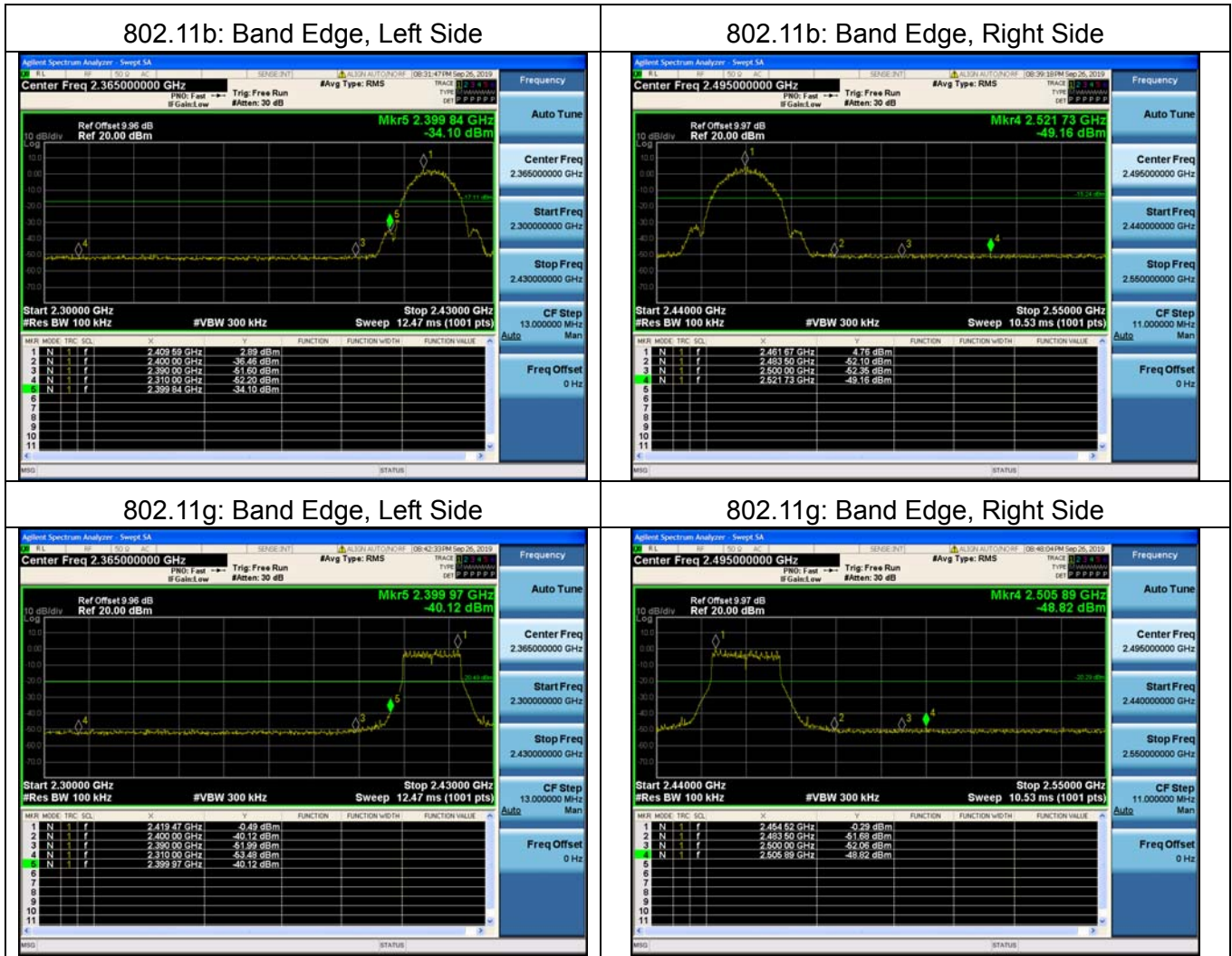


5.6.3 Test procedure

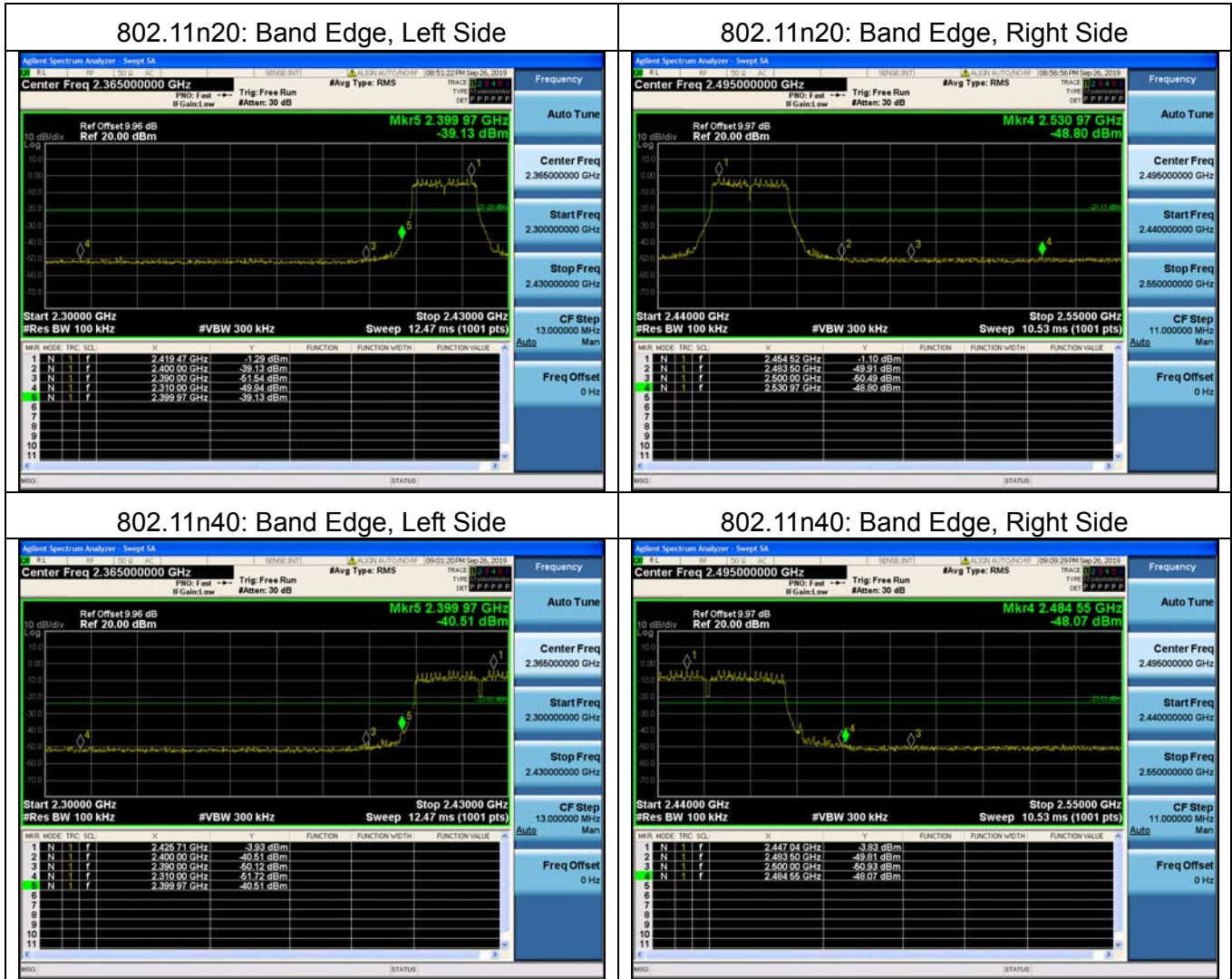
- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- e) Repeat above procedures until all measured frequencies were complete.

5.6.4 Test results

For ANT A

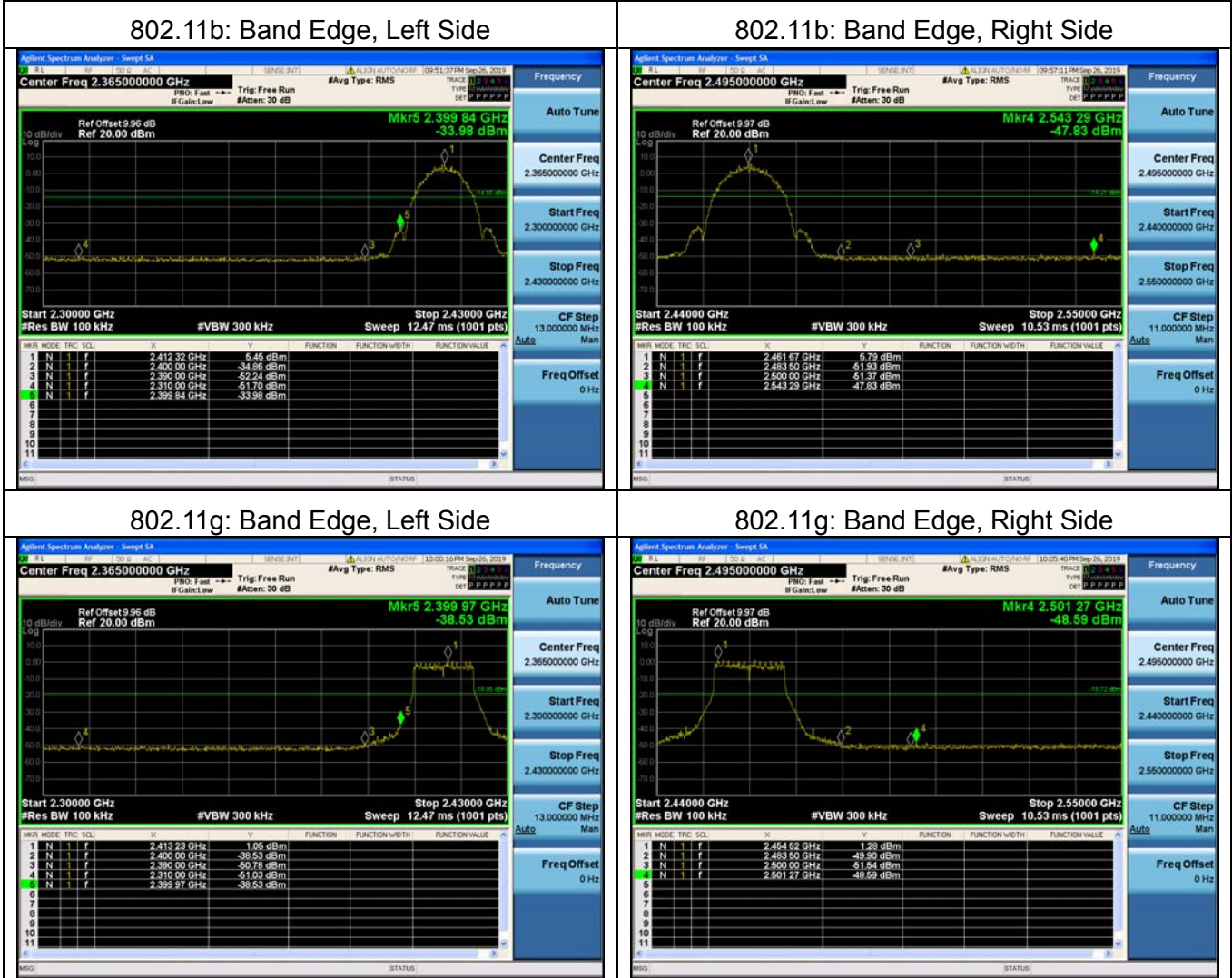


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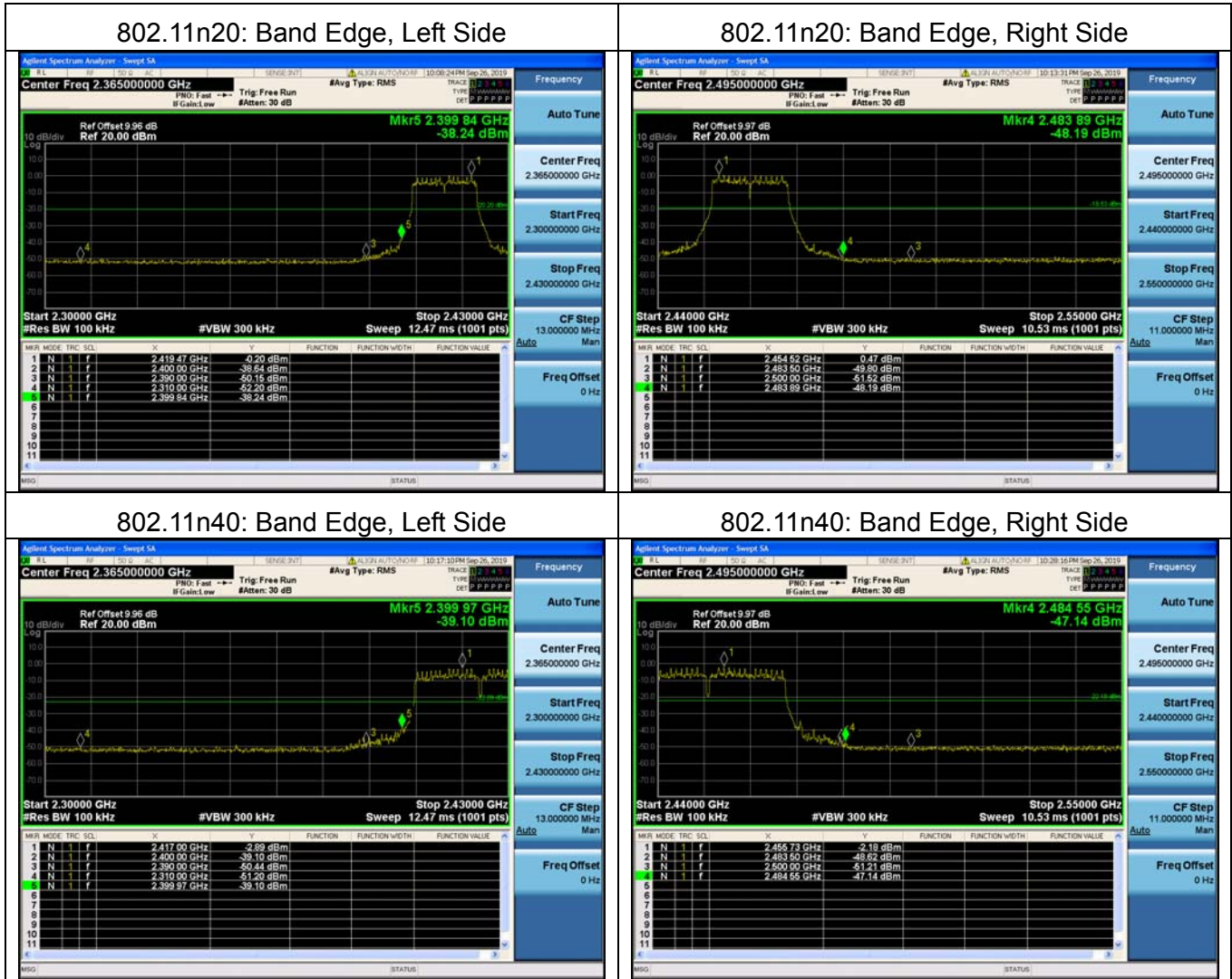


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For ANT B



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5.7 6dB bandwidth

5.7.1 Limit

Section	Test Item	Limit	Frequency Range (MHz)
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5

5.7.2 Test setup



5.7.3 Test procedure

- a. Set RBW= 100 kHz.
- b. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c. Detector = Peak.
- d. Trace mode = max hold.
- e. Sweep = auto couple.
- f. Allow the trace to stabilize.
- g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

EUT Operation Conditions

The EUT tested system was configured as the statements of 2.4 unless otherwise a special operating condition is specified in the follows during the testing.

5.7.4 Test results

802.11b

ANT A:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	9.087	500	Pass
CH06	2437	8.761	500	Pass
CH11	2462	8.789	500	Pass



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ANT B:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	9.076	500	Pass
CH06	2437	9.091	500	Pass
CH11	2462	8.610	500	Pass

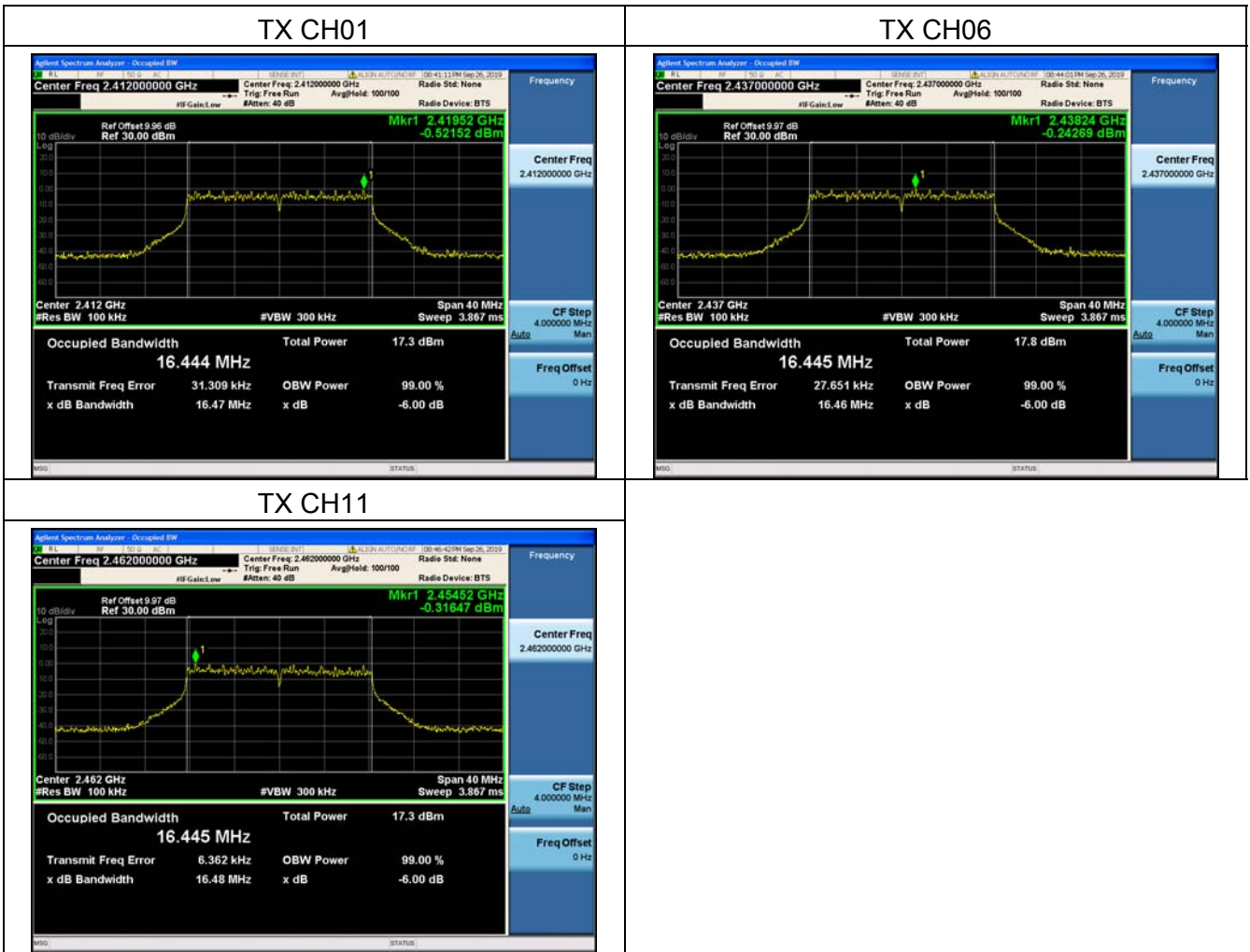


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802.11g

ANT A:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	16.47	500	Pass
CH06	2437	16.46	500	Pass
CH11	2462	16.48	500	Pass



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ANT B:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	16.45	500	Pass
CH06	2437	16.49	500	Pass
CH11	2462	16.41	500	Pass



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For 802.11n20

ANTA

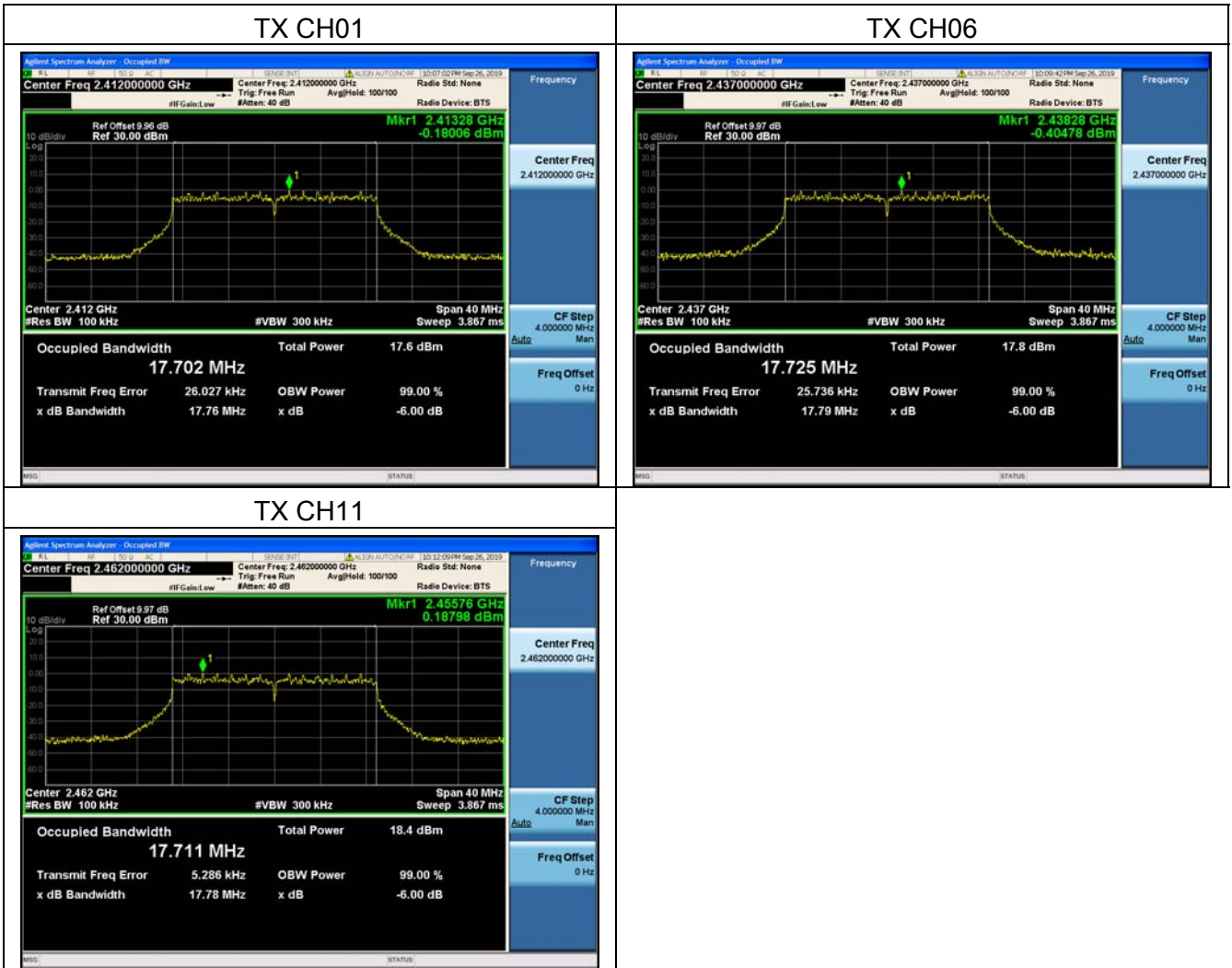
Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	17.79	500	Pass
CH06	2437	17.75	500	Pass
CH11	2462	17.37	500	Pass



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ANTB

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	17.76	500	Pass
CH06	2437	17.79	500	Pass
CH11	2462	17.78	500	Pass

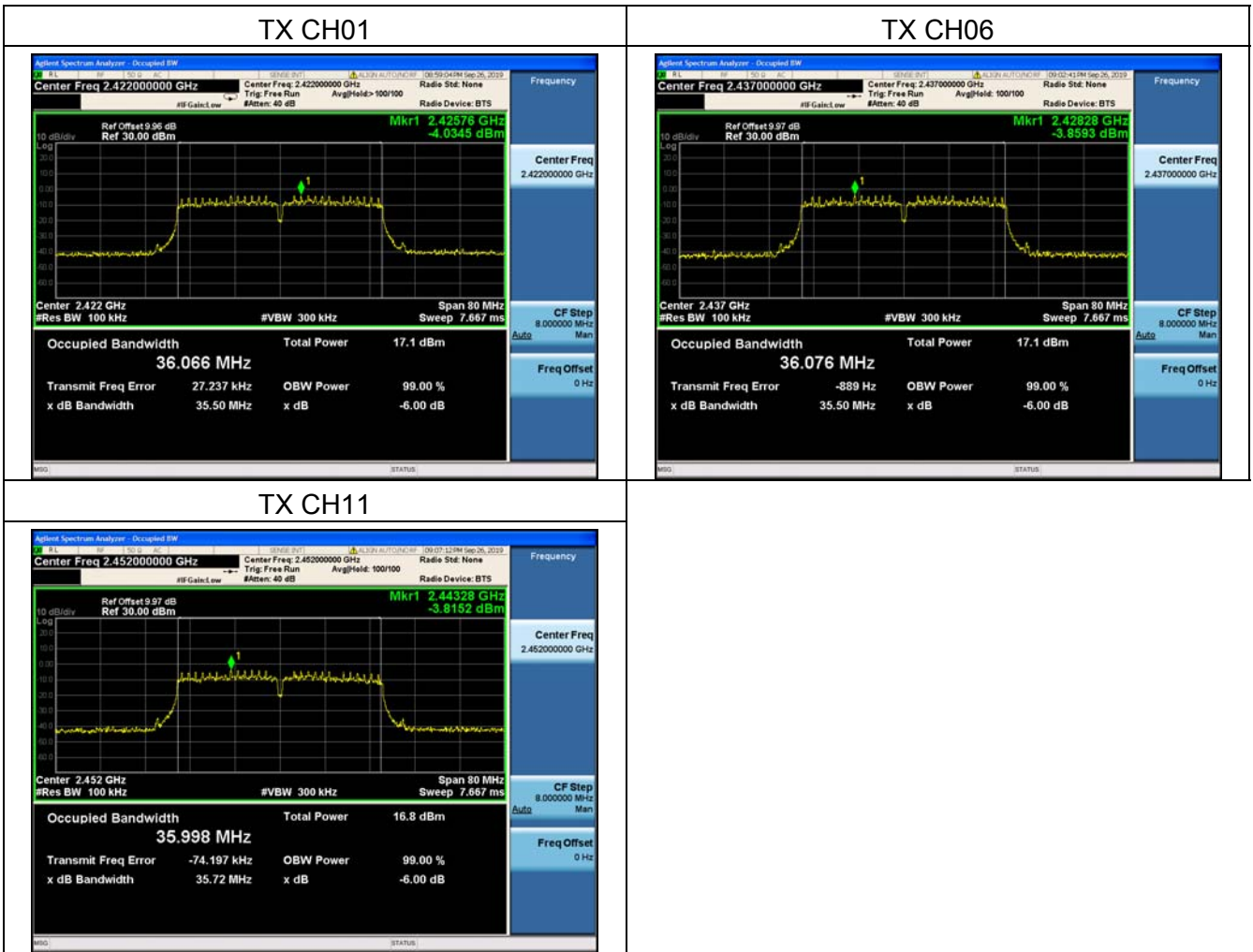


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For 802.11n40

ANTA

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH03	2422	35.50	500	Pass
CH06	2437	35.50	500	Pass
CH09	2452	35.72	500	Pass



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ANTB

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH03	2422	35.32	500	Pass
CH06	2437	35.78	500	Pass
CH09	2452	35.45	500	Pass



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5.8 Duty Cycle

5.8.1 Conformance Limit

No limit requirement.

5.8.2 Measuring Instruments

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

5.8.3 Test Setup



5.8.4 Test Procedure

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0(b) in KDB 558074

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ microseconds. ($50/6.25 = 8$)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are $> 50/T$.

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.

Set to the maximum power setting and enable the EUT transmit continuously.

The EUT was operating in controlled its channel.

Use the following spectrum analyzer settings:

Span = Zero Span

RBW = 8MHz (the largest available value)

VBW = 8MHz (\geq RBW)

Number of points in Sweep > 100

Detector function = peak

Trace = Clear write

Measure Ttotal and Ton

Calculate Duty Cycle = $Ton / Ttotal$

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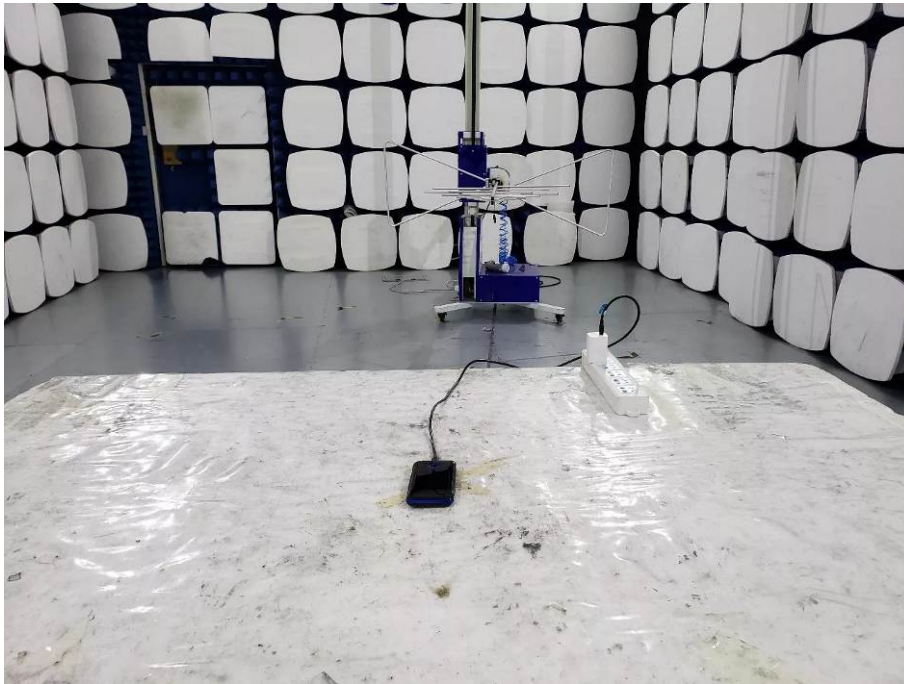
5.8.5 Test Results

Mode	Data rate	Channel	Ton	Ttotal	Duty Cycle	Duty Cycle Factor (dB)	VBW Setting
802.11b	1Mbps	6	-	-	100%	0	10Hz
802.11g	6Mbps	6	-	-	100%	0	10Hz
802.11n HT20	MCS0	6	-	-	100%	0	10Hz
802.11n HT40	MCS0	6	-	-	100%	0	10Hz

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Photographs of the Test Setup

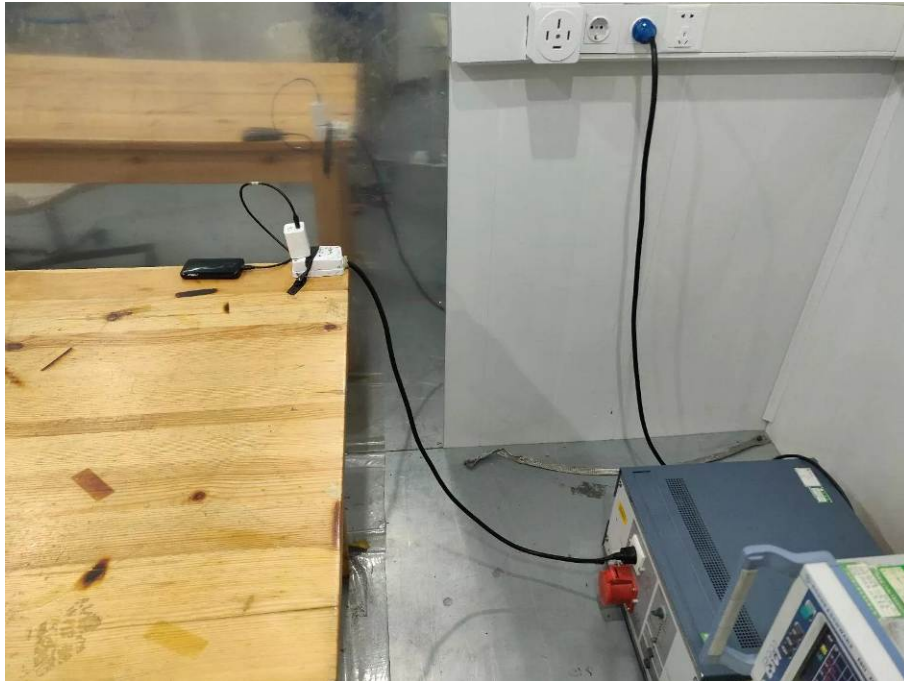
Radiated emission



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Conducted emission



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Photographs of the EUT

See the APPENDIX 1: EUT PHOTO in the report No.: MTi19081312-9E1-1.

----END OF REPORT----