

Test Report

FCC ID: 2AT7I-T2

Date of issue: Nov. 10, 2020

Report Number: MTi20061009-2E2

Sample Description: 4G Wireless Data & GPS Tracking Device

Model(s): T2

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: July. 07, 2020 to Nov. 10, 2020

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

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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 & GPS Tracking Device
Trademark:	MOGO
Model name:	T2
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.

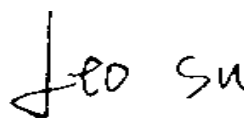
Tested by:



Danny Xu

Nov. 10, 2020

Reviewed by:



Leo Su

Nov. 10, 2020

Approved by:



Tom Xue

Nov. 10, 2020

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1 General information

1.1 Description of EUT

Product name	4G Wireless Data & GPS Tracking Device
Model name	T2
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 dBi + $10 \cdot \log(2)$ dBi = 6.01 dBi
Max. Output Power:	13.86dBm
Hardware Version:	T2M1_VER.A
Software Version:	T2_V01.01.02.23115T
Power Supply:	DC 5V from adapter or DC 3.8V from battery
Battery information:	DC 3.8V 2000mAh
Adapter information:	N/A

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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
Adapter	HW-090200CH0	/	Huizhou BYD Electronics Co., Ltd.	/

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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	
8	KDB 558074 (6)	Duty Cycle	Pass	

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3 Test Facilities and Accreditations

3.1 Test laboratory

Test Laboratory	Shenzhen Microtest Co., Ltd
Location	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, 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	2020/10/09	2021/10/08
MTI-E006	TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	9163-872	2020/10/15	2021/10/14
MTI-E014	amplifier	Hewlett-Packard	8447D	3113A06150	2020/10/09	2021/10/08
MTI-E036	Single path vehicle AMN(LISN)	Schwarzbeck	NNBM 8124	01175	2020/10/09	2021/10/08
MTI-E038	Low noise active vertical monopole antenna	Schwarzbeck	VAMP 9243	#565	2020/10/16	2021/10/15
MTI-E039	Biconical antenna	Schwarzbeck	BBA 9106	#164	2020/10/15	2021/10/14
MTI-E041	MXG Vector Signal Generator	Agilent	N5182A	MY49060455	2020/04/16	2021/04/15
MTI-E042	ESG Series Analog signal generator	Agilent	E4421B	GB40051240	2020/05/21	2021/05/20
MTI-E044	Thermometer clock humidity monitor	-	HTC-1	/	2020/04/17	2021/04/16
MTI-E062	Log Periodic Antenna	Schwarzbeck	VUSLP 9111B	#312	2020/04/11	2021/04/10
MTI-E063	Log Periodic Dipole Array Antenna	ETS-LINDGREN	3148B	00224524	2020/04/11	2021/04/10
MTI-E065	Amplifier	EMtrace	RP06A	00117	2020/04/29	2021/04/28
MTI-E066	Comprehensive test instrument	Rohde&schwarz	CMW500	149155	2020/04/16	2021/04/15
MTI-E071	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2020/10/25	2021/10/24
MTI-E076	EMI Test Receiver	Rohde&schwarz	ESIB26	100273	2020/04/16	2021/04/15
MTI-E078	Synthesized Sweeper	Agilent	83752A	3610A01957	2020/04/16	2021/04/15
MTI-E079	DC Power Supply	Agilent	E3632A	MY40027695	2020/04/16	2021/04/15
MTI-E093	Artificial mains network	3ctest	LISN J50	ES3911805	2020/04/16	2021/04/15
MTI-E096	Power amplifier	Space-Dtronics	EWLNA0 118G-P40	1852001	2020/04/29	2021/04/28
MTI-E097	Current Probe	SOLAR ELECTRONICS CO.	9207-1	220095-1	200/04/17	2021/04/16
MTI-E098	Loop Sensor	SOLAR ELECTRONICS CO.	7334-1	220095-2	2020/04/21	2021/04/20

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MTI-E080	Temperature& Hu- midity test chamber	Safety test	AG80L	171200018	2020/04/16	2021/04/15
MTI-E095	Horn Antenna	Schwarzbe ck	BBHA 9170	9170-181	2019/04/16	2021/04/15
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.

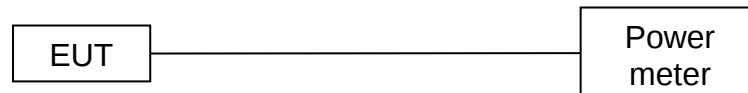
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5.2 Peak output power

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.

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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	12.77	18.92	13.05	20.18	30	1000
06	2437	12.42	17.46	13.84	24.21		
11	2462	12.61	18.24	13.86	24.32		

802.11g

Test Channel	Frequency (MHz)	Output Power (ANT A)		Output Power (ANT B)		Limit (dBm)	
		dBm	mW	dBm	mW	dBm	mW
01	2412	10.26	10.62	11.70	14.79	30	1000
06	2437	10.39	10.94	11.16	13.06		
11	2462	10.26	10.62	11.82	15.21		

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	8.53	7.13	10.31	10.74	12.52	17.86	29.99	997.70
06	2437	8.51	7.10	10.15	10.35	12.42	17.46		
11	2462	8.25	6.68	10.72	11.80	12.67	18.49		

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	8.40	6.92	9.17	8.26	11.81	15.18	29.99	997.70
06	2437	9.68	9.29	9.13	8.18	12.42	17.47		
09	2452	9.52	8.95	9.35	8.61	12.45	17.56		

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:

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

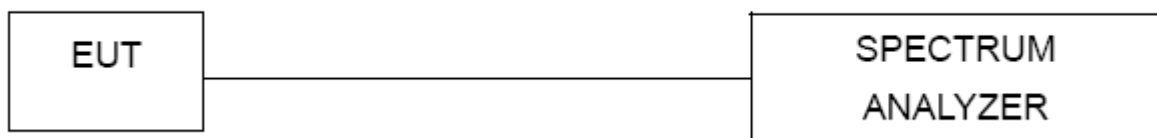
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5.3 Power spectral density

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

- 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.
- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS channel bandwidth.
- Set the RBW ≥ 3 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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5.3.4 Test Results

802.11b

ANT A:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-9.942	8	Pass
CH06	2437	-9.717	8	Pass
CH11	2462	-8.793	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	-9.342	8	Pass
CH06	2437	-8.065	8	Pass
CH11	2462	-8.84	8	Pass

TX CH01

TX CH06

TX CH11

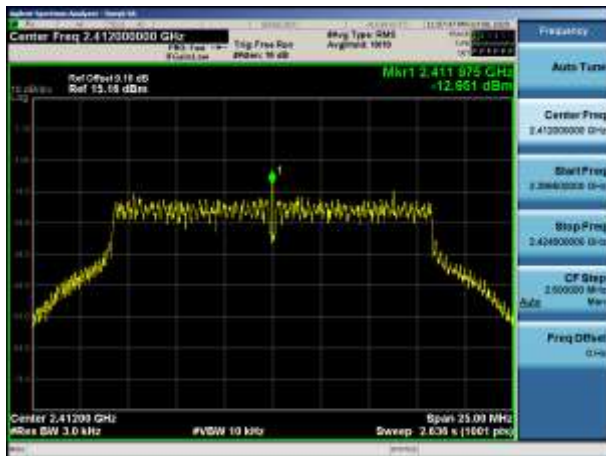

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802.11g

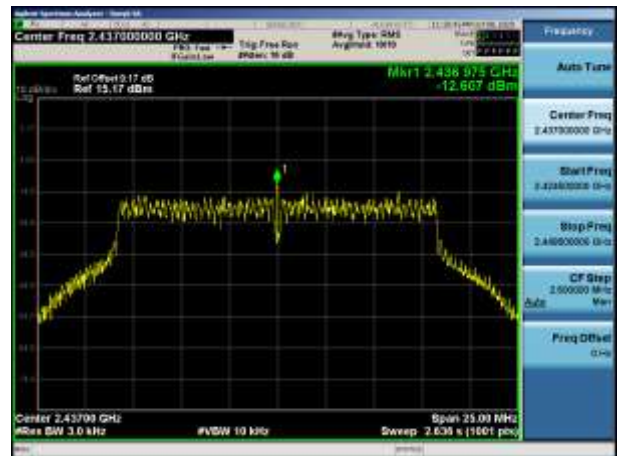
ANT A:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-12.951	8	Pass
CH06	2437	-12.607	8	Pass
CH11	2462	-12.511	8	Pass

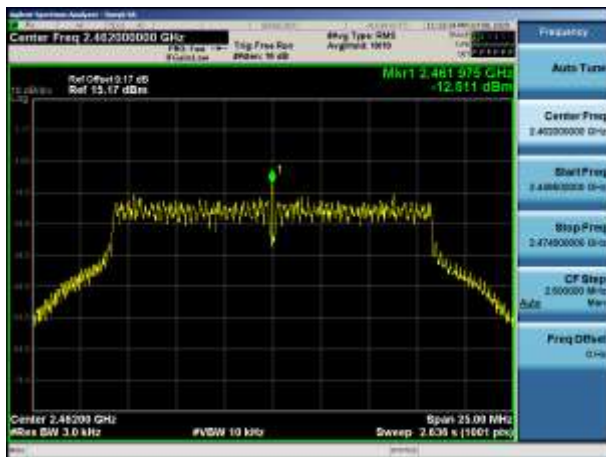
TX CH01



TX CH06



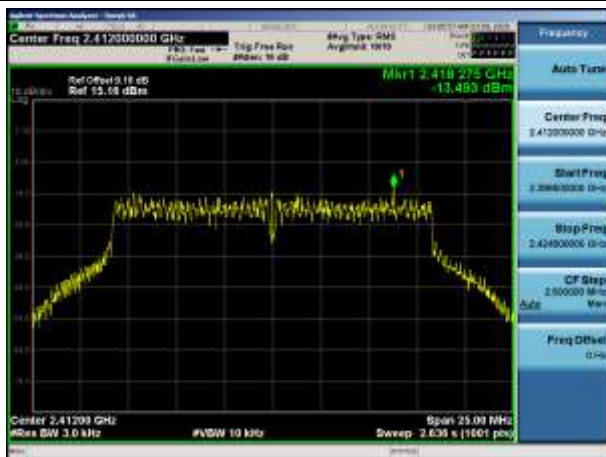
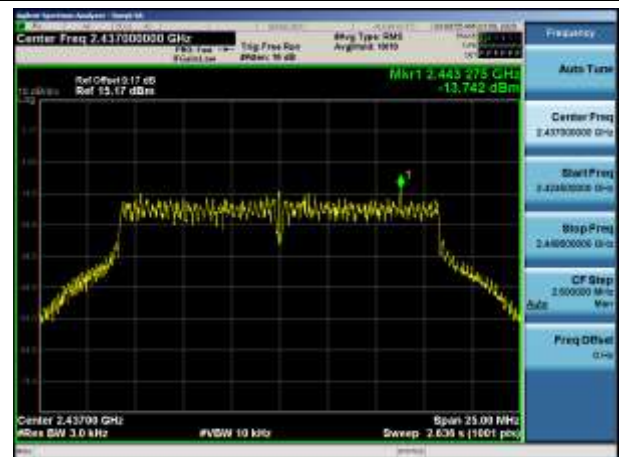
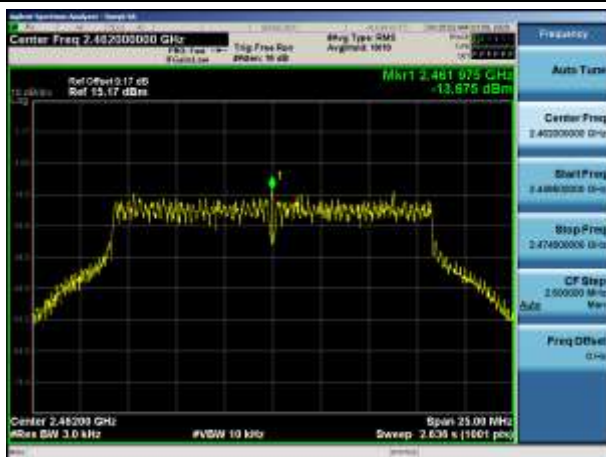
TX CH11



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ANT B:

Test Channel	Frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-13.493	8	Pass
CH06	2437	-13.742	8	Pass
CH11	2462	-13.675	8	Pass

TX CH01

TX CH06

TX CH11


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802.11n20
ANT A+ANT B

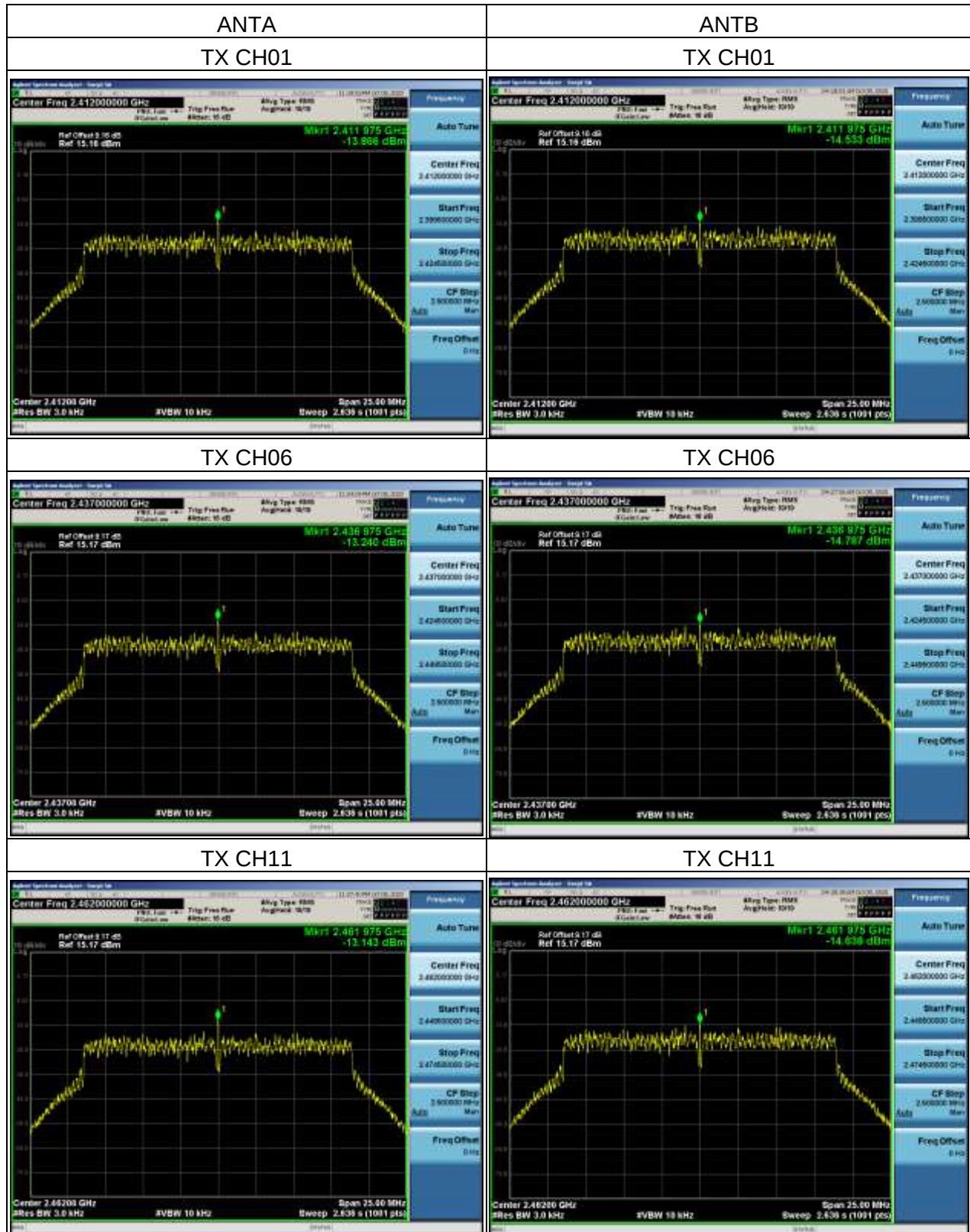
Test Channel	Frequency (MHz)	Power Density of ANT A (dBm/3kHz)	Power Density of ANT B (dBm/3kHz)	Total Power Density of (ANT A + ANT B) (dBm/3kHz)	Limit (dBm/3kHz)	Result
CH01	2412	-13.866	-14.533	-11.18	7.99	Pass
CH06	2437	-13.240	-14.787	-10.93	7.99	Pass
CH11	2462	-13.143	-12.638	-9.87	7.99	Pass

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	-13.142	-14.417	-10.72	7.99	Pass
CH06	2437	-13.328	-13.735	-10.52	7.99	Pass
CH09	2452	-13.147	-14.095	-10.58	7.99	Pass

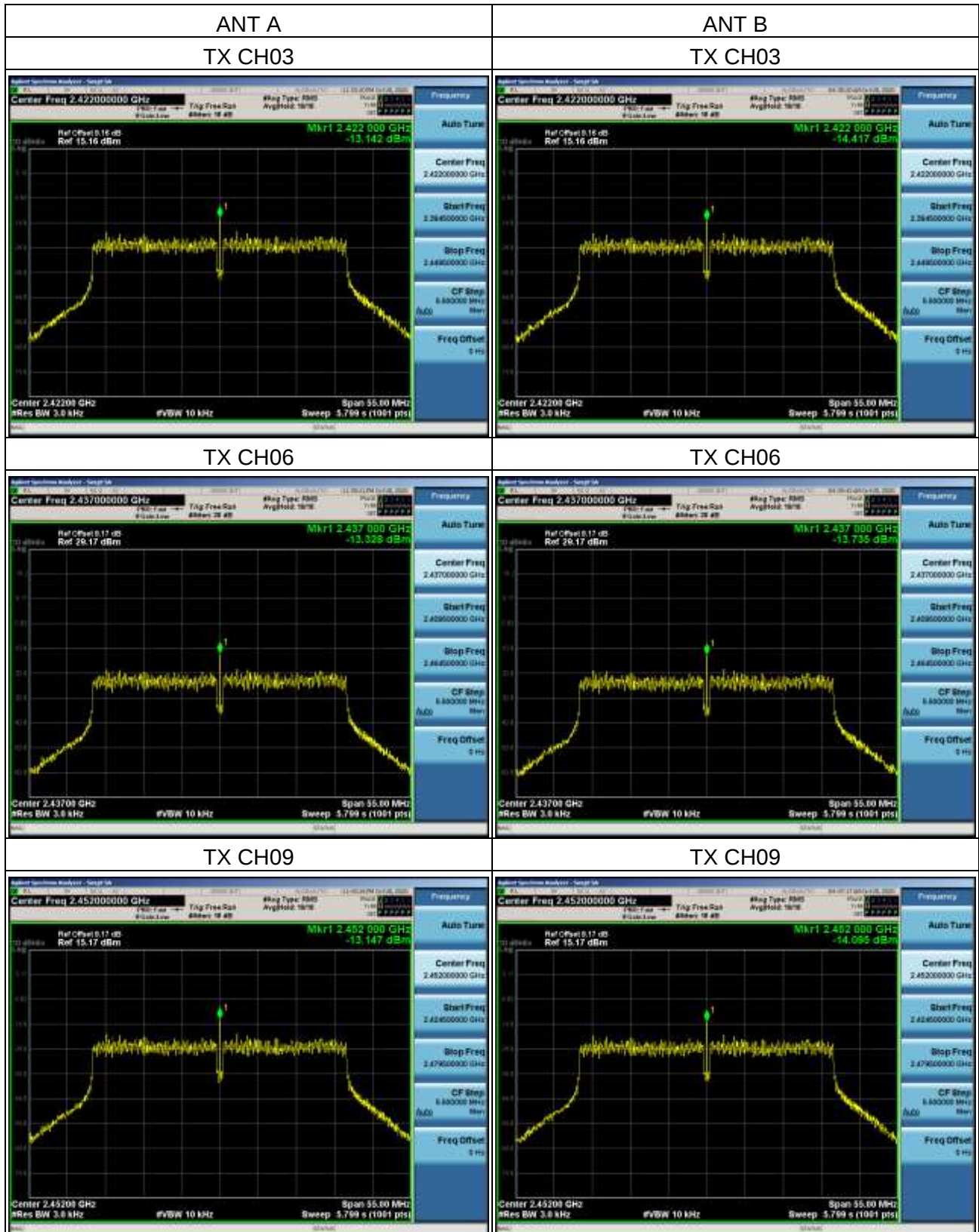
Note: if transmitting antennas of directional gain greater than 6 dBi are used, then the limit should be reduced.

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

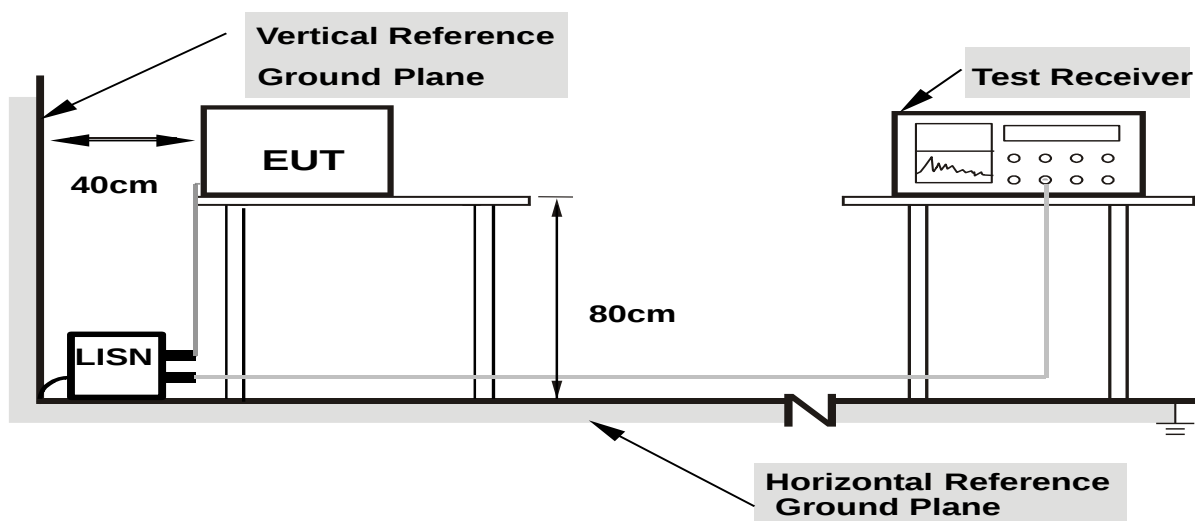
FREQUENCY (MHz)	Class B (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

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

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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.

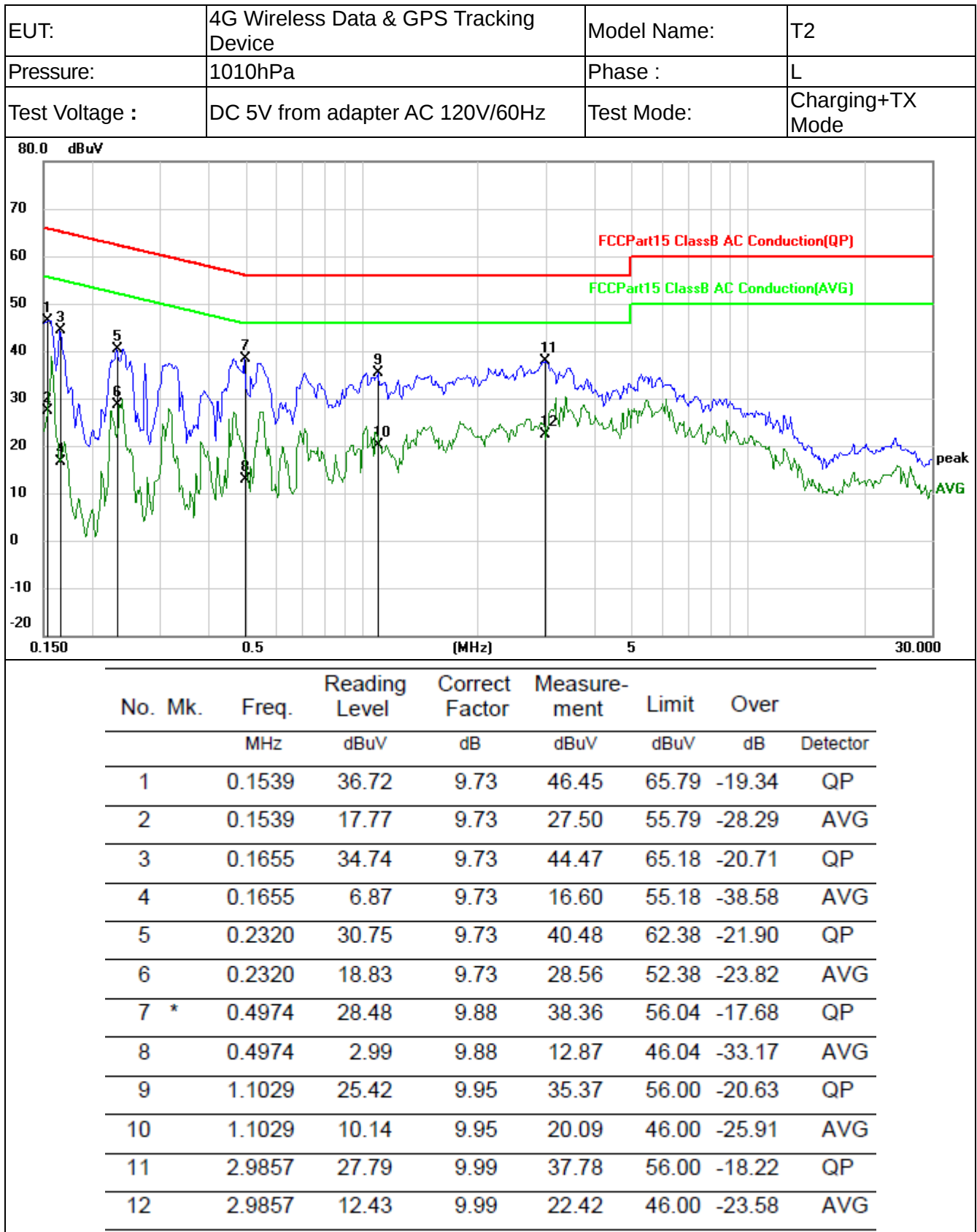
b. The following table is the setting of the receiver

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.

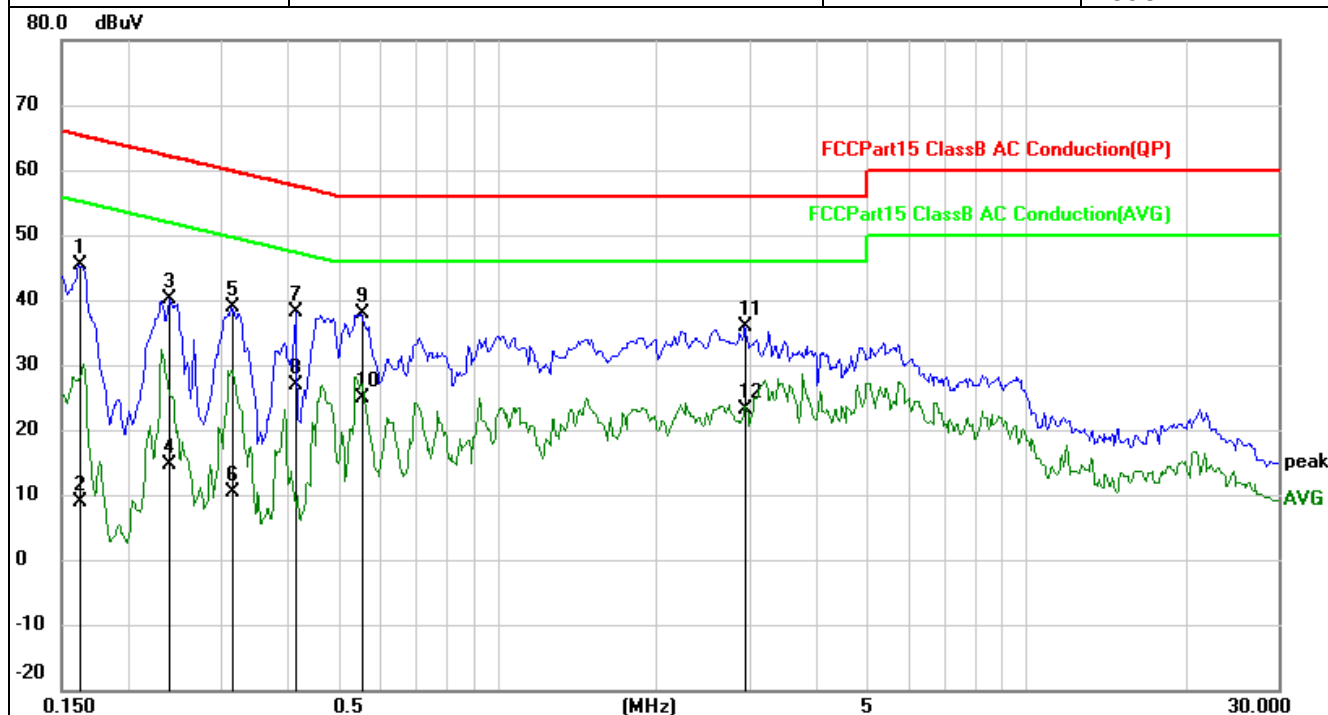
For the actual test configuration, please refer to the related Item –EUT Test Photos.

5.4.4 Test results



This test report is valid for the tested samples only. It cannot be reproduced except in full without prior written consent of Shenzhen Microtest Co., Ltd.

EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	N
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging+TX Mode

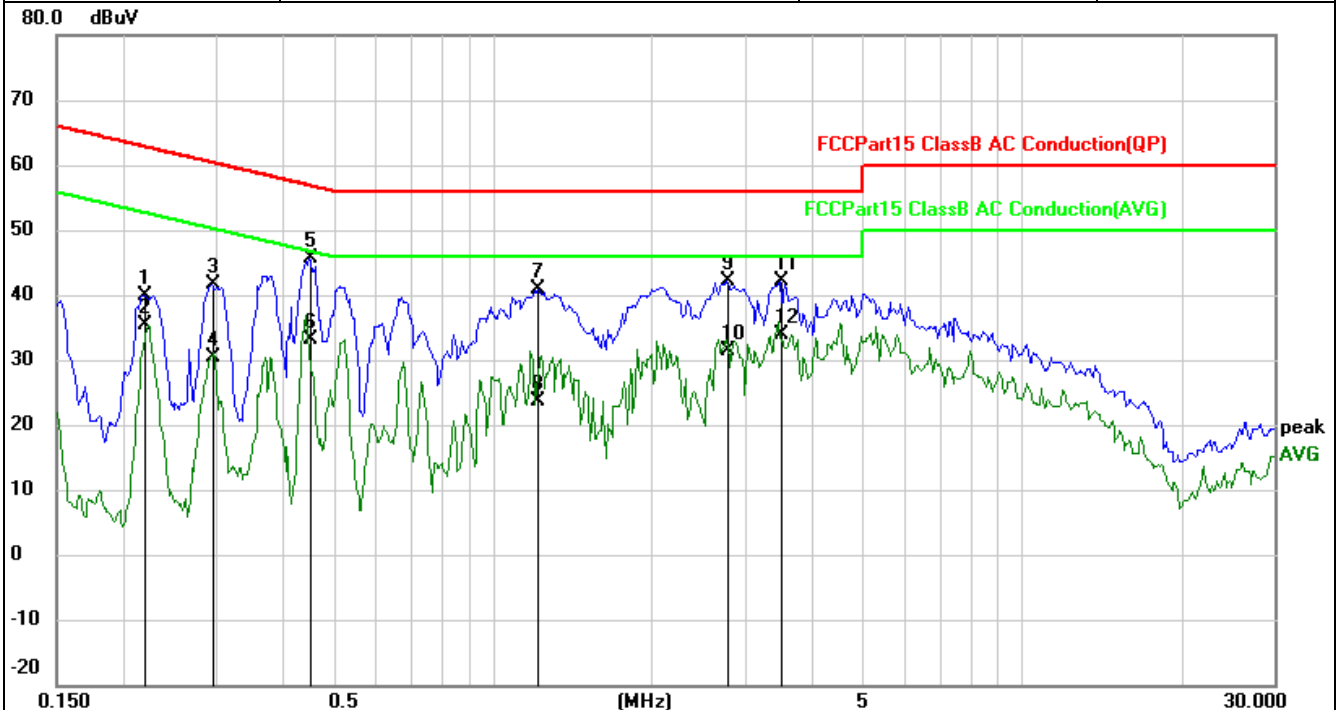


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1617	35.60	9.73	45.33	65.38	-20.05	QP
2		0.1617	-0.75	9.73	8.98	55.38	-46.40	AVG
3		0.2398	30.35	9.73	40.08	62.10	-22.02	QP
4		0.2398	4.98	9.73	14.71	52.10	-37.39	AVG
5		0.3140	29.08	9.77	38.85	59.86	-21.01	QP
6		0.3140	0.58	9.77	10.35	49.86	-39.51	AVG
7		0.4156	28.18	9.83	38.01	57.54	-19.53	QP
8		0.4156	17.00	9.83	26.83	47.54	-20.71	AVG
9	*	0.5523	27.87	9.89	37.76	56.00	-18.24	QP
10		0.5523	14.95	9.89	24.84	46.00	-21.16	AVG
11		2.9428	26.01	9.99	36.00	56.00	-20.00	QP
12		2.9428	13.21	9.99	23.20	46.00	-22.80	AVG

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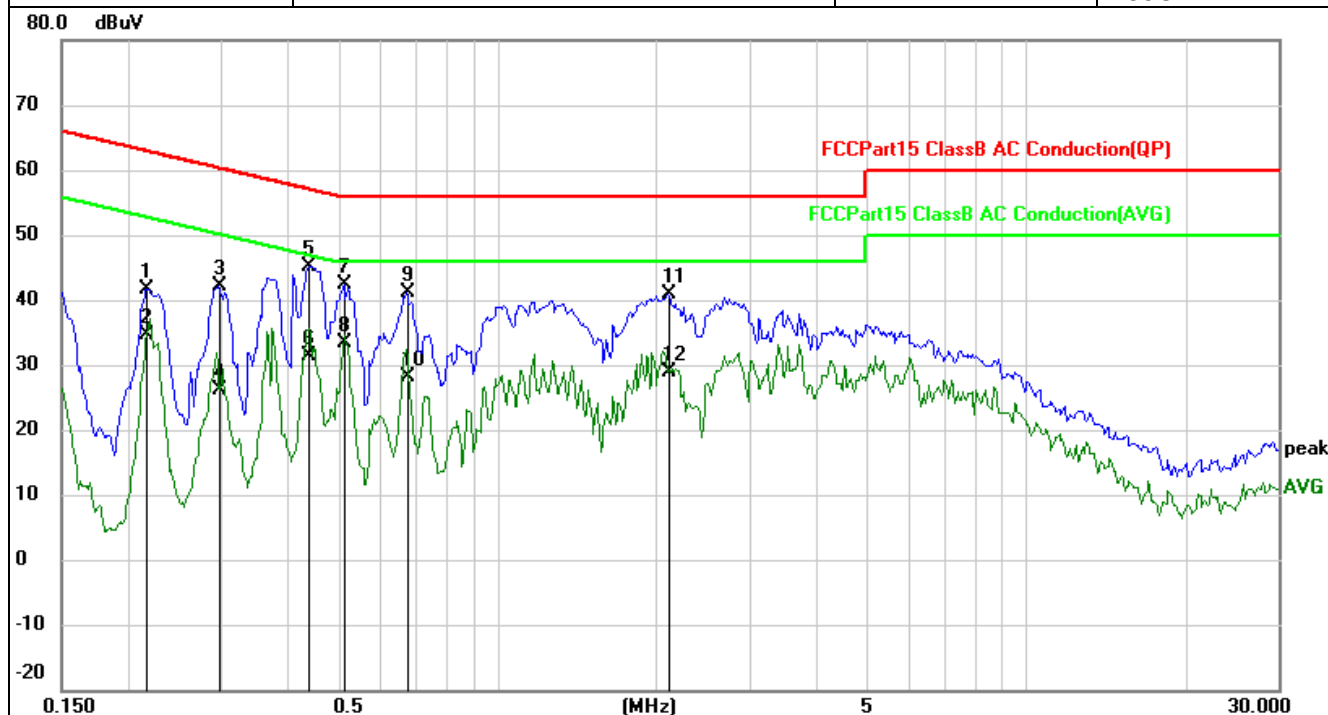
EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	L
Test Voltage :	DC 5V from adapter AC 240V/60Hz	Test Mode:	Charging+TX Mode



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.2202	30.13	9.73	39.86	62.81	-22.95	QP
2		0.2202	25.60	9.73	35.33	52.81	-17.48	AVG
3		0.2943	31.88	9.75	41.63	60.40	-18.77	QP
4		0.2943	20.52	9.75	30.27	50.40	-20.13	AVG
5	*	0.4506	35.80	9.85	45.65	56.86	-11.21	QP
6		0.4506	23.32	9.85	33.17	46.86	-13.69	AVG
7		1.2159	30.86	9.95	40.81	56.00	-15.19	QP
8		1.2159	13.69	9.95	23.64	46.00	-22.36	AVG
9		2.7671	32.13	9.99	42.12	56.00	-13.88	QP
10		2.7671	21.41	9.99	31.40	46.00	-14.60	AVG
11		3.4958	32.07	10.02	42.09	56.00	-13.91	QP
12		3.4958	23.91	10.02	33.93	46.00	-12.07	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
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	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2164	32.01	9.73	41.74	62.96	-21.22	QP
2		0.2164	25.01	9.73	34.74	52.96	-18.22	AVG
3		0.2983	32.32	9.76	42.08	60.29	-18.21	QP
4		0.2983	16.35	9.76	26.11	50.29	-24.18	AVG
5	*	0.4395	35.39	9.84	45.23	57.07	-11.84	QP
6		0.4395	21.62	9.84	31.46	47.07	-15.61	AVG
7		0.5131	32.52	9.88	42.40	56.00	-13.60	QP
8		0.5131	23.41	9.88	33.29	46.00	-12.71	AVG
9		0.6733	31.22	9.90	41.12	56.00	-14.88	QP
10		0.6733	18.35	9.90	28.25	46.00	-17.75	AVG
11		2.1030	30.81	9.97	40.78	56.00	-15.22	QP
12		2.1030	18.98	9.97	28.95	46.00	-17.05	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

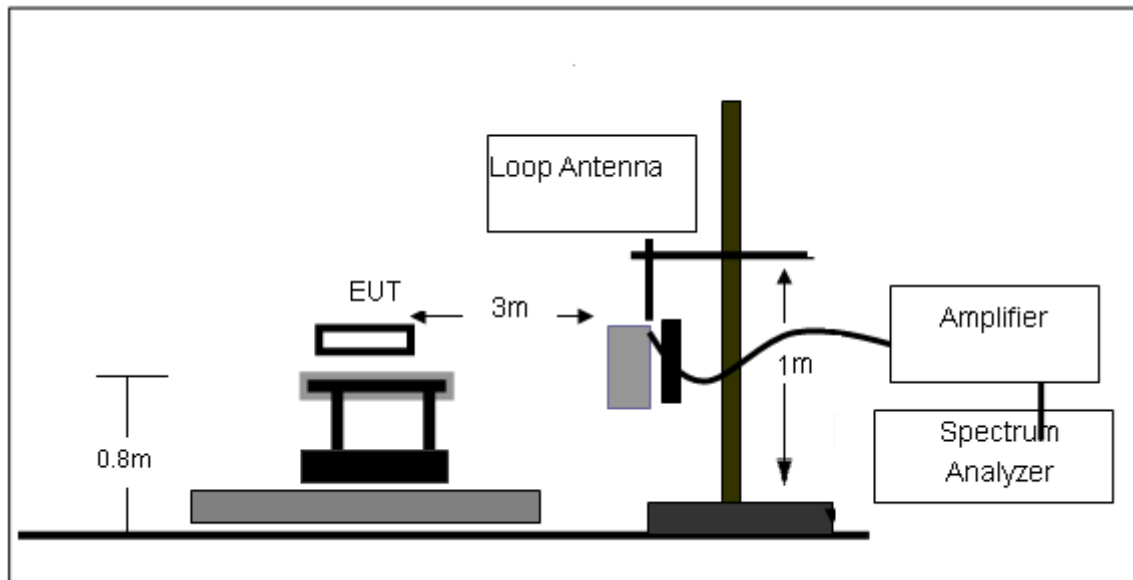
Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

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

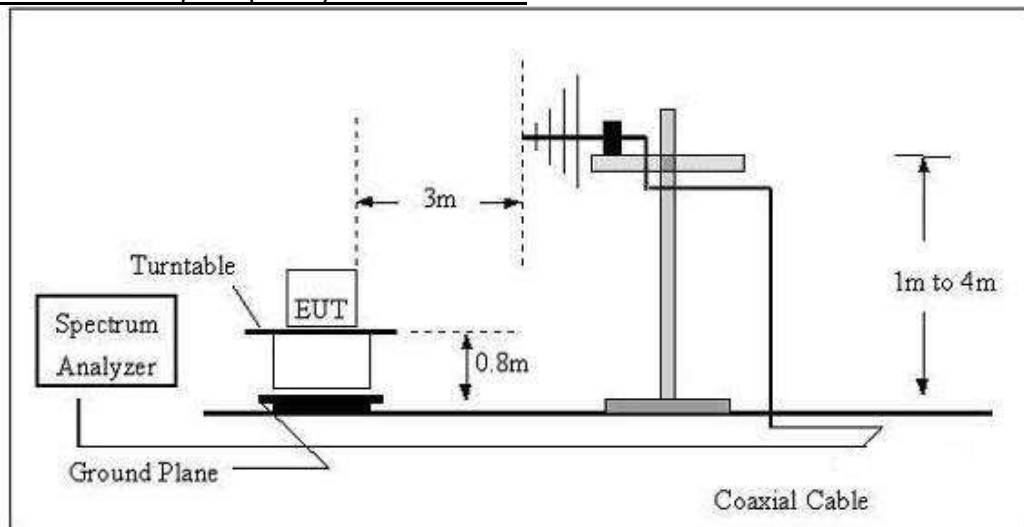
This test report is valid for the tested samples only. It cannot be reproduced except in full without prior written consent of Shenzhen Microtest Co., Ltd.

5.5.2 Test setup

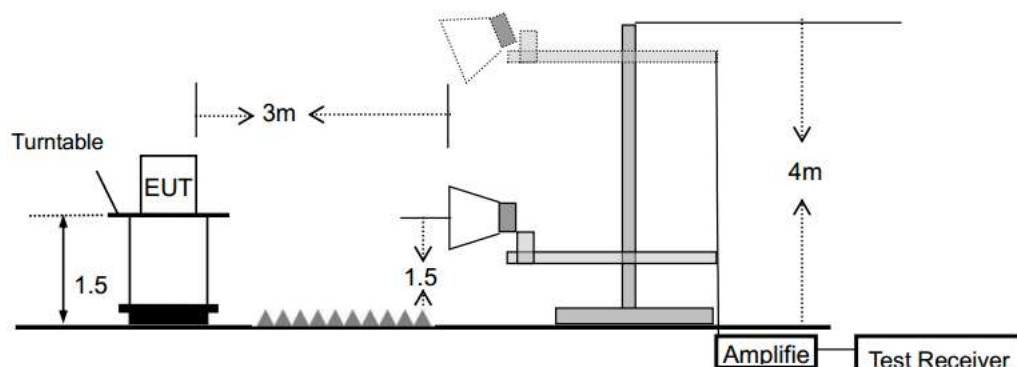
Radiated emission test-up frequency below 30MHz



Radiated emission test-up frequency 30MHz~1GHz



Radiated emission test-up frequency above 1GHz



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5.5.3 Test procedure

- 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.
- EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- Use the following spectrum analyzer settings:
 Span = wide enough to fully capture the emission being measured, RBW = 1 MHz for $f \geq 1\text{GHz}$, 10 kHz for $f < 1\text{GHz}$, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 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.
- 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.
- 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.
- 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 Spurious Emission Below 30MHz

EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010 hPa	Test Voltage:	DC 5V from adapter AC 120V/60Hz
Test Mode:	Charging + TX (2462MHz)	Polarization::	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	Pass
--	--	--	--	Pass

Note:

For 9kHz-30MHz, the amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance}/\text{test distance})$ (dB);

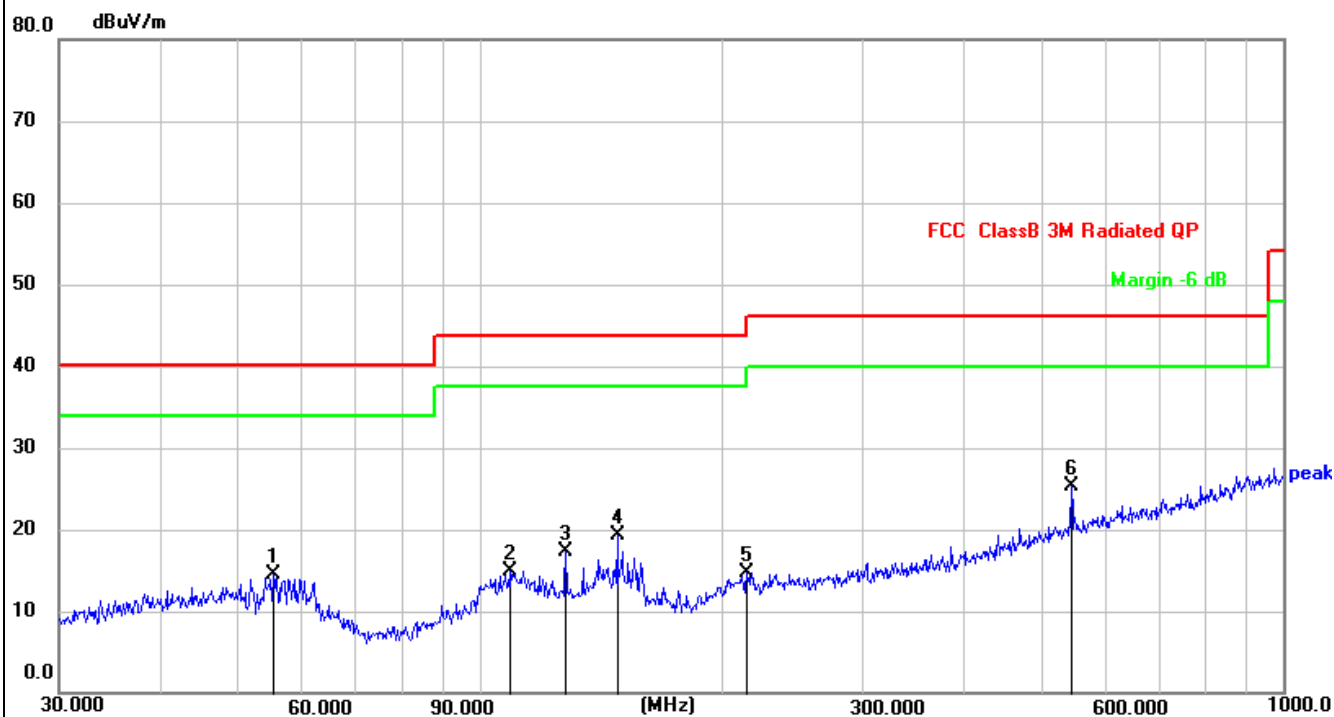
Limit line = specific limits (dBuV) + distance extrapolation factor.

The report only shows the worst mode. The worst mode is antenna B 802.11 b 2462MHz.

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5.5.4.2 Spurious Emission 30–1000MHz

EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)

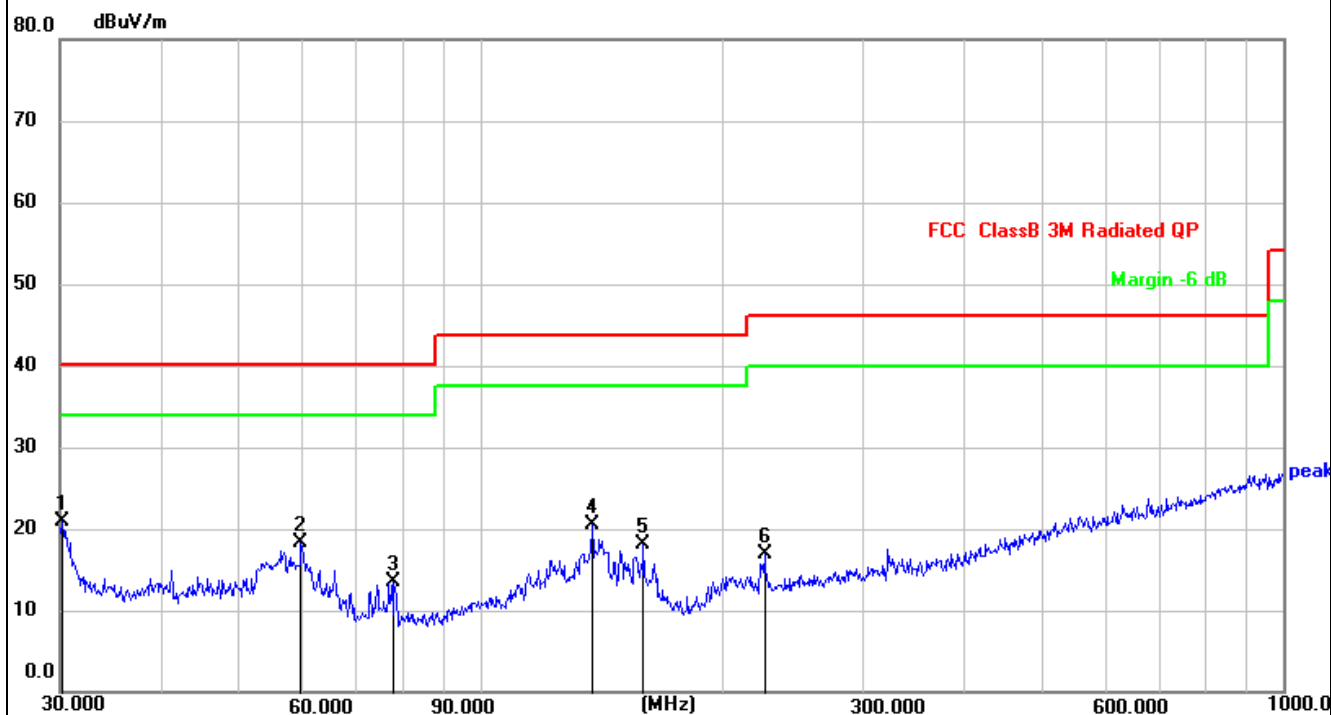


Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
55.4147	29.12	-14.60	14.52	40.00	-25.48	QP
109.0284	29.87	-15.04	14.83	43.50	-28.67	QP
128.1125	34.47	-17.11	17.36	43.50	-26.14	QP
148.4410	37.01	-17.78	19.23	43.50	-24.27	QP
215.2675	28.32	-13.56	14.76	43.50	-28.74	QP
545.1825	31.90	-6.58	25.32	46.00	-20.68	QP

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)



Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
30.2109	37.93	-17.01	20.92	40.00	-19.08	QP
59.8588	33.38	-15.08	18.30	40.00	-21.70	QP
78.1388	31.96	-18.41	13.55	40.00	-26.45	QP
137.9028	38.11	-17.63	20.48	43.50	-23.02	QP
159.7844	35.08	-16.91	18.17	43.50	-25.33	QP
226.0994	30.19	-13.21	16.98	46.00	-29.02	QP

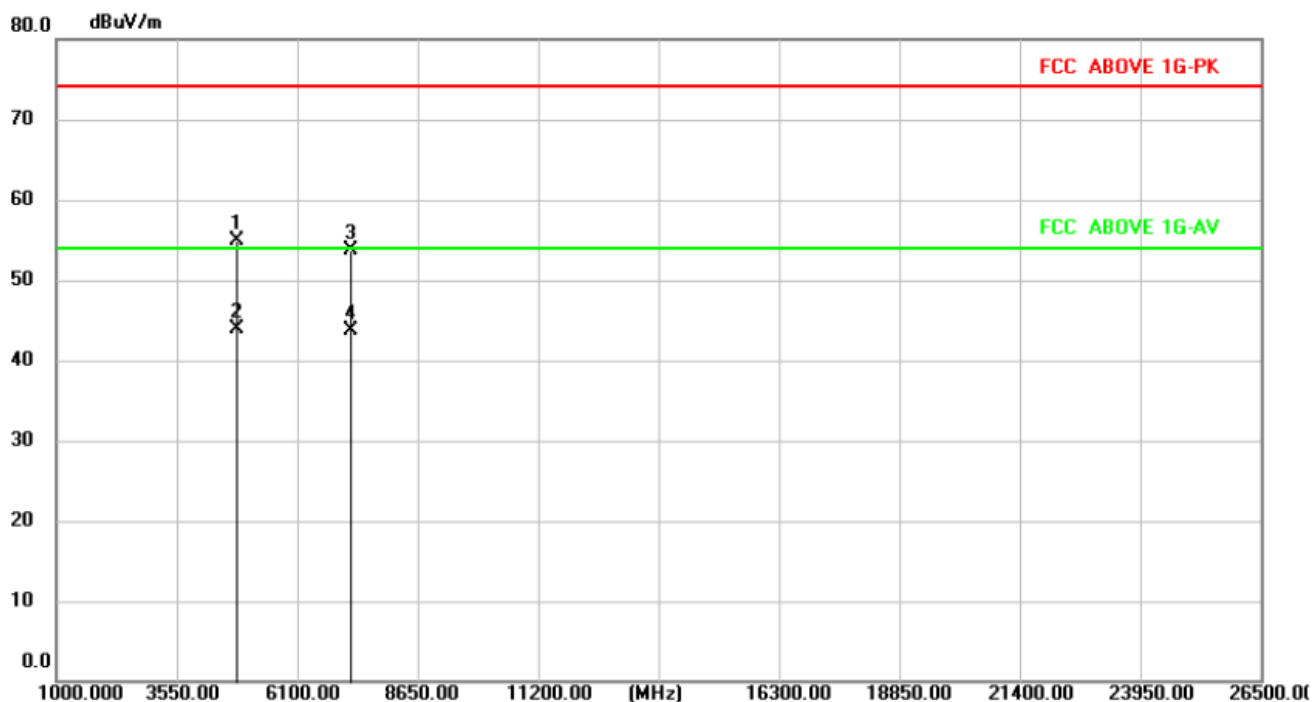
Note:

1. Emission Level = Meter Reading + Factor, Margin = Emission Level - Limit, Factor = Antenna Factor + Cable Loss - Pre-amplifier.
2. The following data is the worst mode. The worst data is antenna B 802.11 b mode 2462MHz.

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5.5.4.3 Spurious Emission 1000–26500MHz

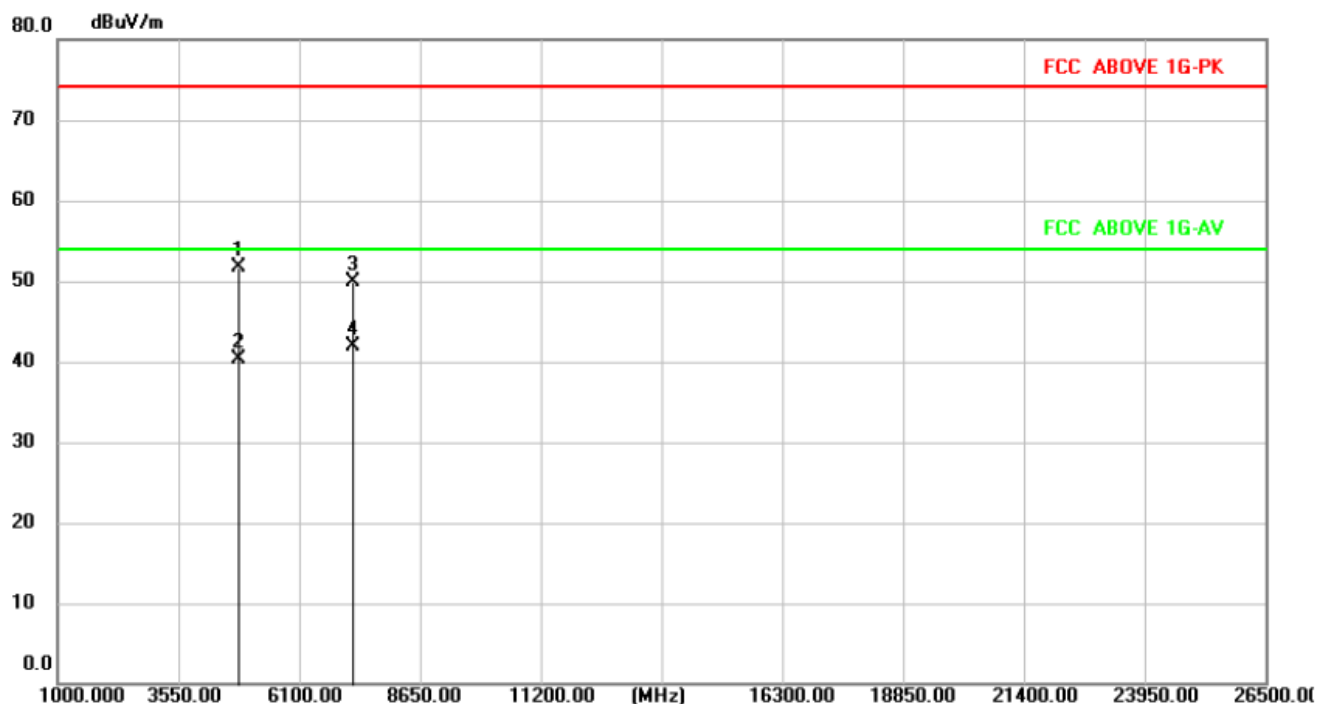
EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2412MHz)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4824.000	49.74	5.21	54.95	74.00	-19.05	peak
2 *	4824.000	38.74	5.21	43.95	54.00	-10.05	AVG
3	7236.000	47.16	6.63	53.79	74.00	-20.21	peak
4	7236.000	37.16	6.63	43.79	54.00	-10.21	AVG

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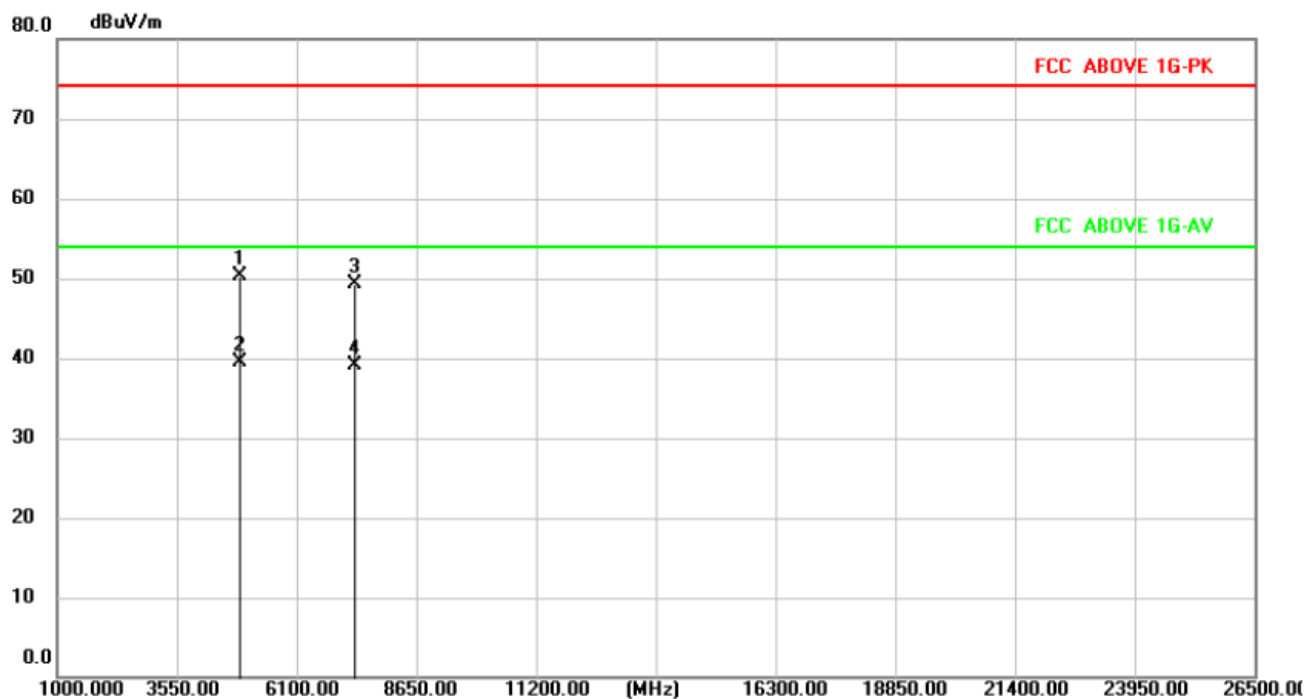
EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2412MHz)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4824.000	46.46	5.21	51.67	74.00	-22.33	peak
2	4824.000	35.11	5.21	40.32	54.00	-13.68	AVG
3	7236.000	43.30	6.63	49.93	74.00	-24.07	peak
4 *	7236.000	35.31	6.63	41.94	54.00	-12.06	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2437MHz)

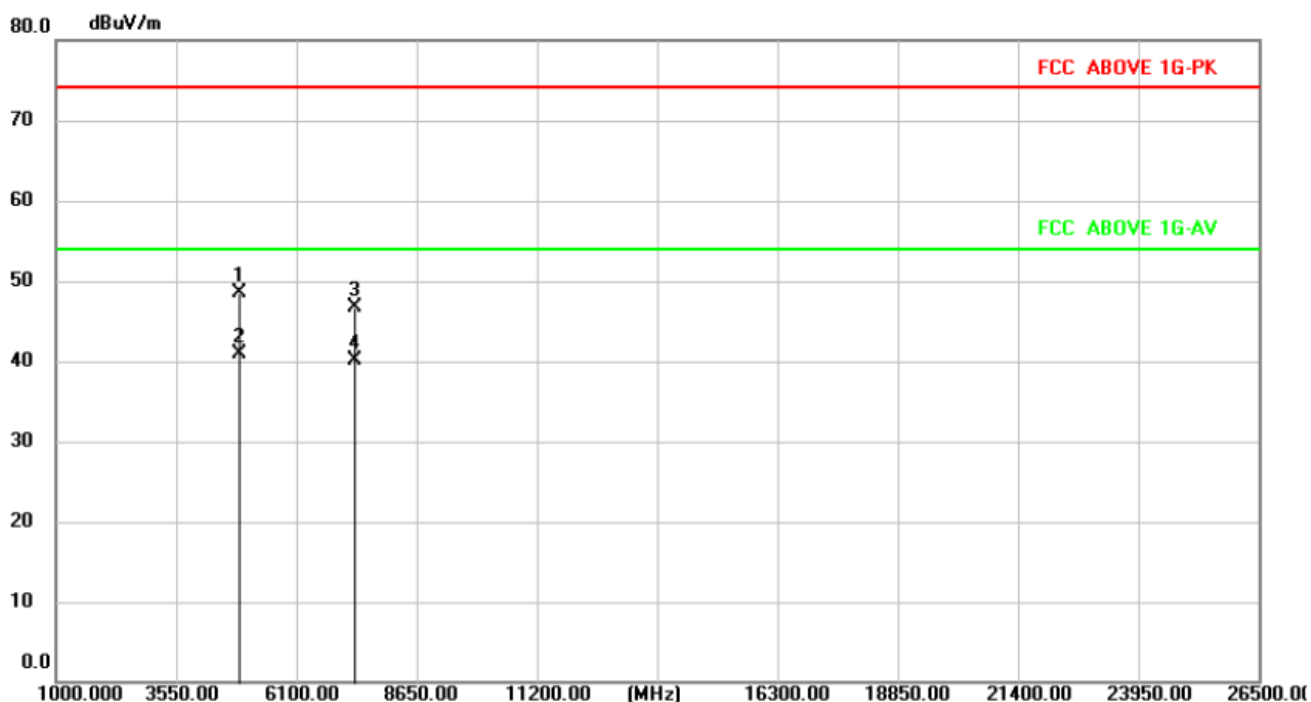


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4874.000	44.93	5.39	50.32	74.00	-23.68	peak
2 *	4874.000	34.05	5.39	39.44	54.00	-14.56	AVG
3	7311.000	42.62	6.66	49.28	74.00	-24.72	peak
4	7311.000	32.45	6.66	39.11	54.00	-14.89	AVG

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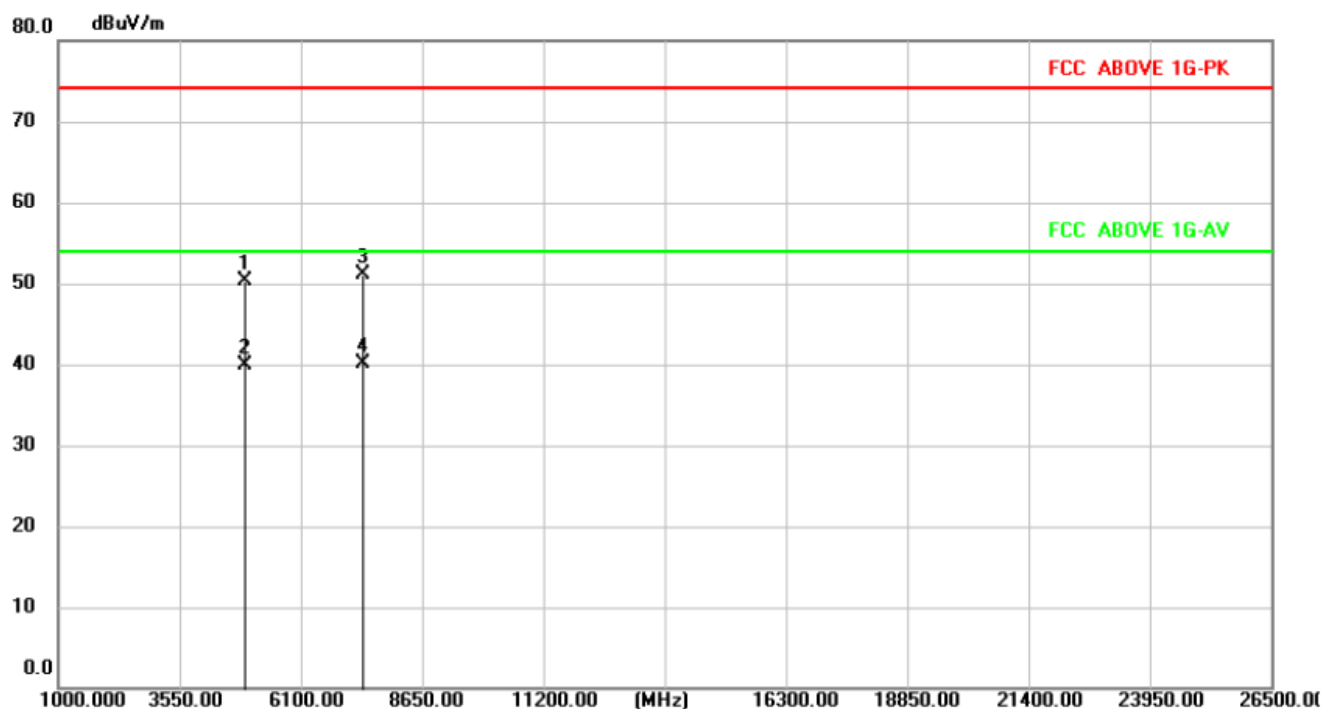
EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2437MHz)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4874.000	43.12	5.39	48.51	74.00	-25.49	peak
2 *	4874.000	35.51	5.39	40.90	54.00	-13.10	AVG
3	7311.000	39.99	6.66	46.65	74.00	-27.35	peak
4	7311.000	33.46	6.66	40.12	54.00	-13.88	AVG

This test report is valid for the tested samples only. It cannot be reproduced except in full without prior written consent of Shenzhen Microtest Co., Ltd.

EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)

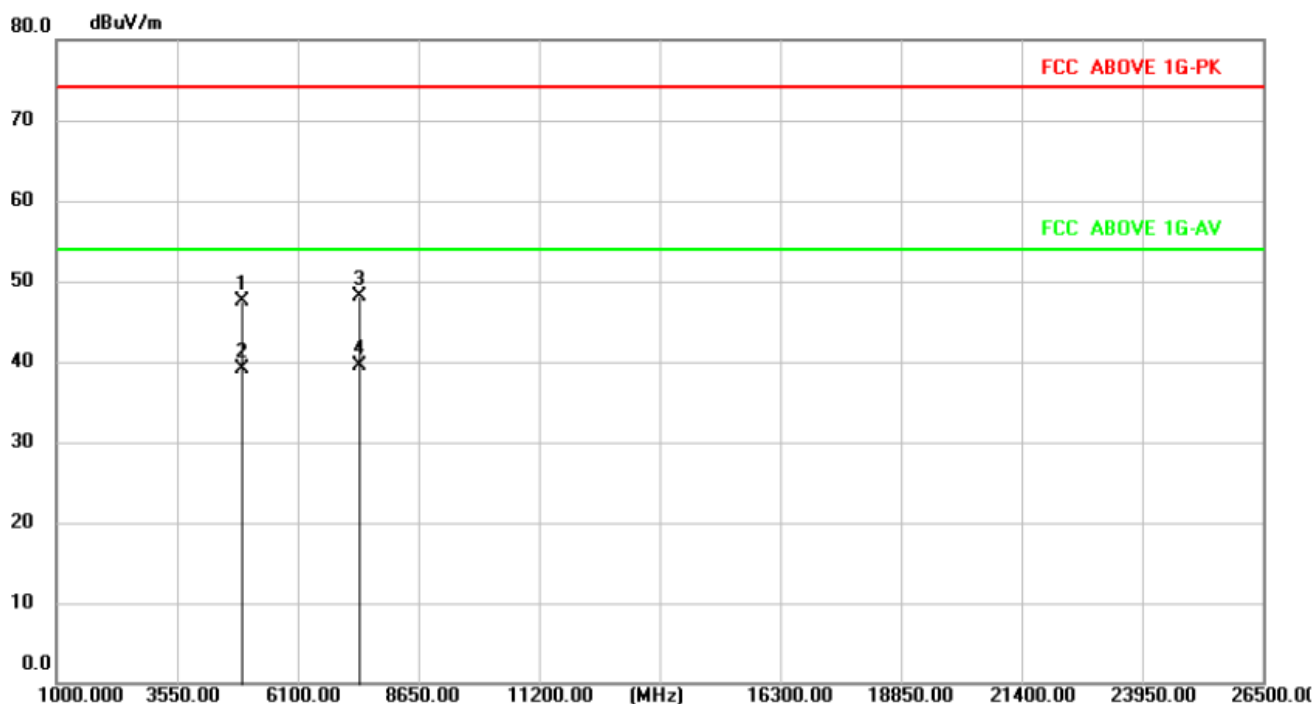


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4924.000	44.79	5.48	50.27	74.00	-23.73	peak
2	4924.000	34.34	5.48	39.82	54.00	-14.18	AVG
3	7386.000	44.34	6.70	51.04	74.00	-22.96	peak
4 *	7386.000	33.45	6.70	40.15	54.00	-13.85	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4924.000	42.11	5.48	47.59	74.00	-26.41	peak
2	4924.000	33.62	5.48	39.10	54.00	-14.90	AVG
3	7386.000	41.38	6.70	48.08	74.00	-25.92	peak
4 *	7386.000	32.71	6.70	39.41	54.00	-14.59	AVG

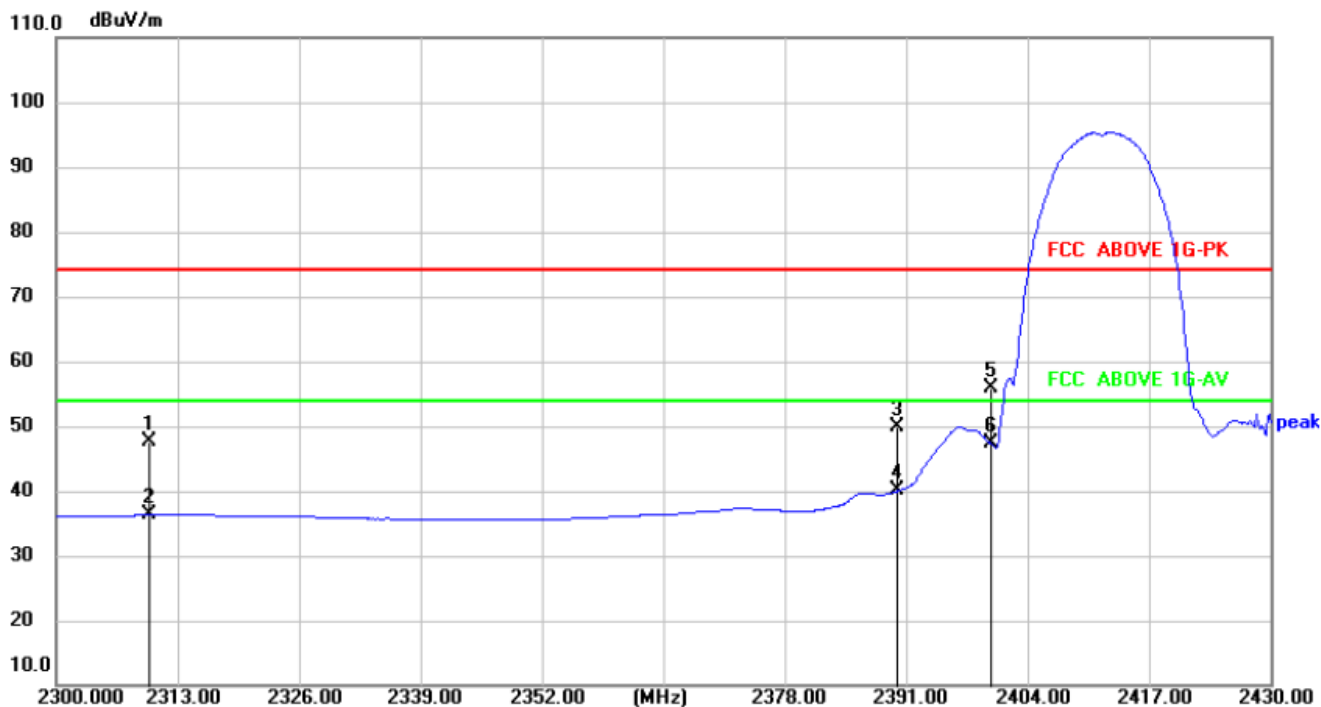
Note:

1. Emission Level = Meter Reading + Factor, Margin = Emission Level - Limit, Factor = Antenna Factor + Cable Loss - Pre-amplifier.
2. The following data is the worst mode. The worst data is antenna B 802.11 b mode.

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5.5.4.4 Band edge - radiated

EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2412MHz)

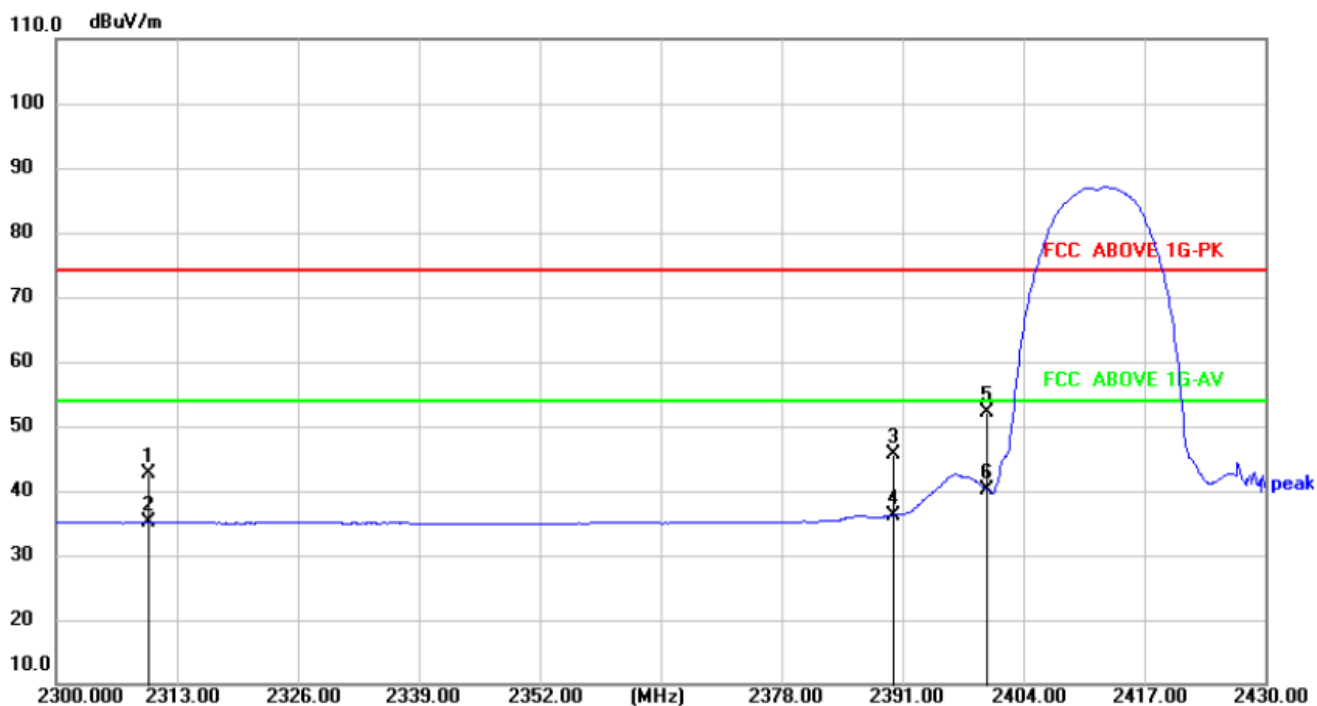


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2310.000	44.12	3.44	47.56	74.00	-26.44	peak
2	2310.000	32.91	3.44	36.35	54.00	-17.65	AVG
3	2390.000	46.41	3.54	49.95	74.00	-24.05	peak
4	2390.000	36.49	3.54	40.03	54.00	-13.97	AVG
5	2400.000	52.44	3.55	55.99	74.00	-18.01	peak
6 *	2400.000	43.74	3.55	47.29	54.00	-6.71	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2412MHz)

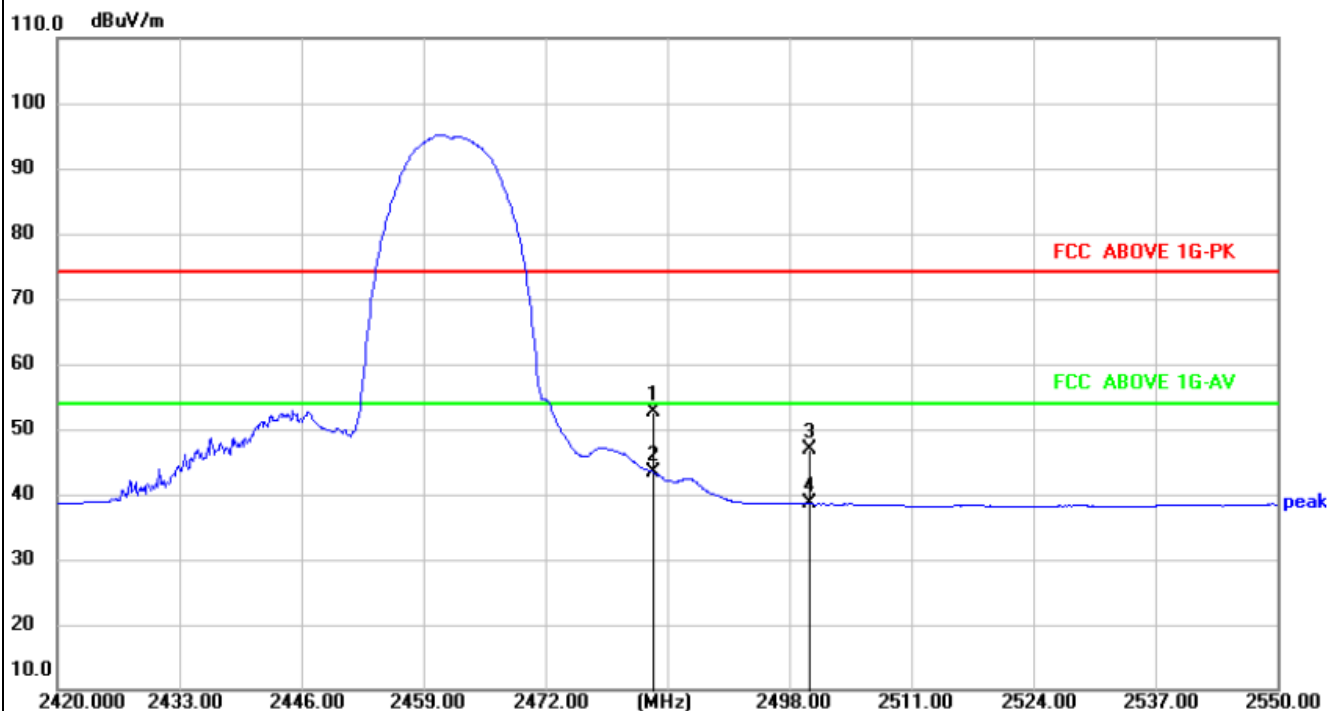


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2310.000	39.16	3.44	42.60	74.00	-31.40	peak
2	2310.000	31.65	3.44	35.09	54.00	-18.91	AVG
3	2390.000	42.06	3.54	45.60	74.00	-28.40	peak
4	2390.000	32.68	3.54	36.22	54.00	-17.78	AVG
5	2400.000	48.50	3.55	52.05	74.00	-21.95	peak
6 *	2400.000	36.66	3.55	40.21	54.00	-13.79	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase:	H
Test Voltage :	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)

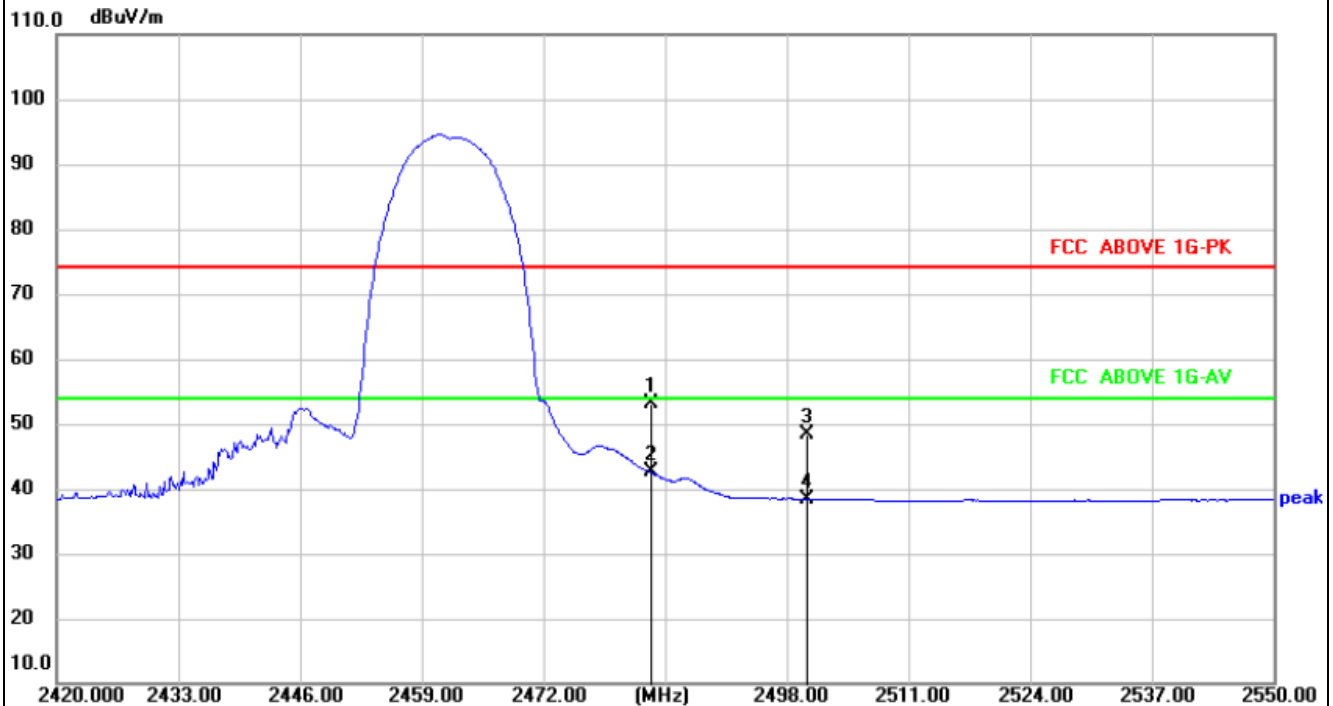


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	49.02	3.61	52.63	74.00	-21.37	peak
2 *	2483.500	39.70	3.61	43.31	54.00	-10.69	AVG
3	2500.000	43.37	3.62	46.99	74.00	-27.01	peak
4	2500.000	34.91	3.62	38.53	54.00	-15.47	AVG

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EUT:	4G Wireless Data & GPS Tracking Device	Model Name:	T2
Pressure:	1010hPa	Phase :	V
Test Voltage:	DC 5V from adapter AC 120V/60Hz	Test Mode:	Charging + TX Mode (2462MHz)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2483.500	49.42	3.61	53.03	74.00	-20.97	peak
2 *	2483.500	38.91	3.61	42.52	54.00	-11.48	AVG
3	2500.000	44.65	3.62	48.27	74.00	-25.73	peak
4	2500.000	34.79	3.62	38.41	54.00	-15.59	AVG

Note:

1. Emission Level = Meter Reading + Factor, Margin = Emission Level - Limit, Factor = Antenna Factor + Cable Loss - Pre-amplifier.
2. The following data is the worst mode. The worst data is antenna B 802.11 b mode.

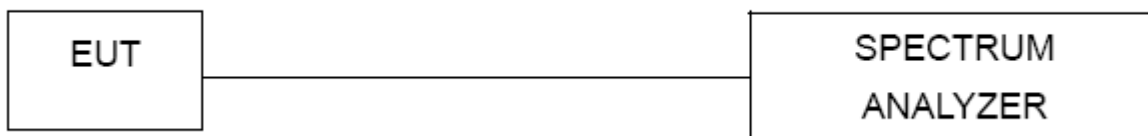
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5.6 Band edge - Conducted

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

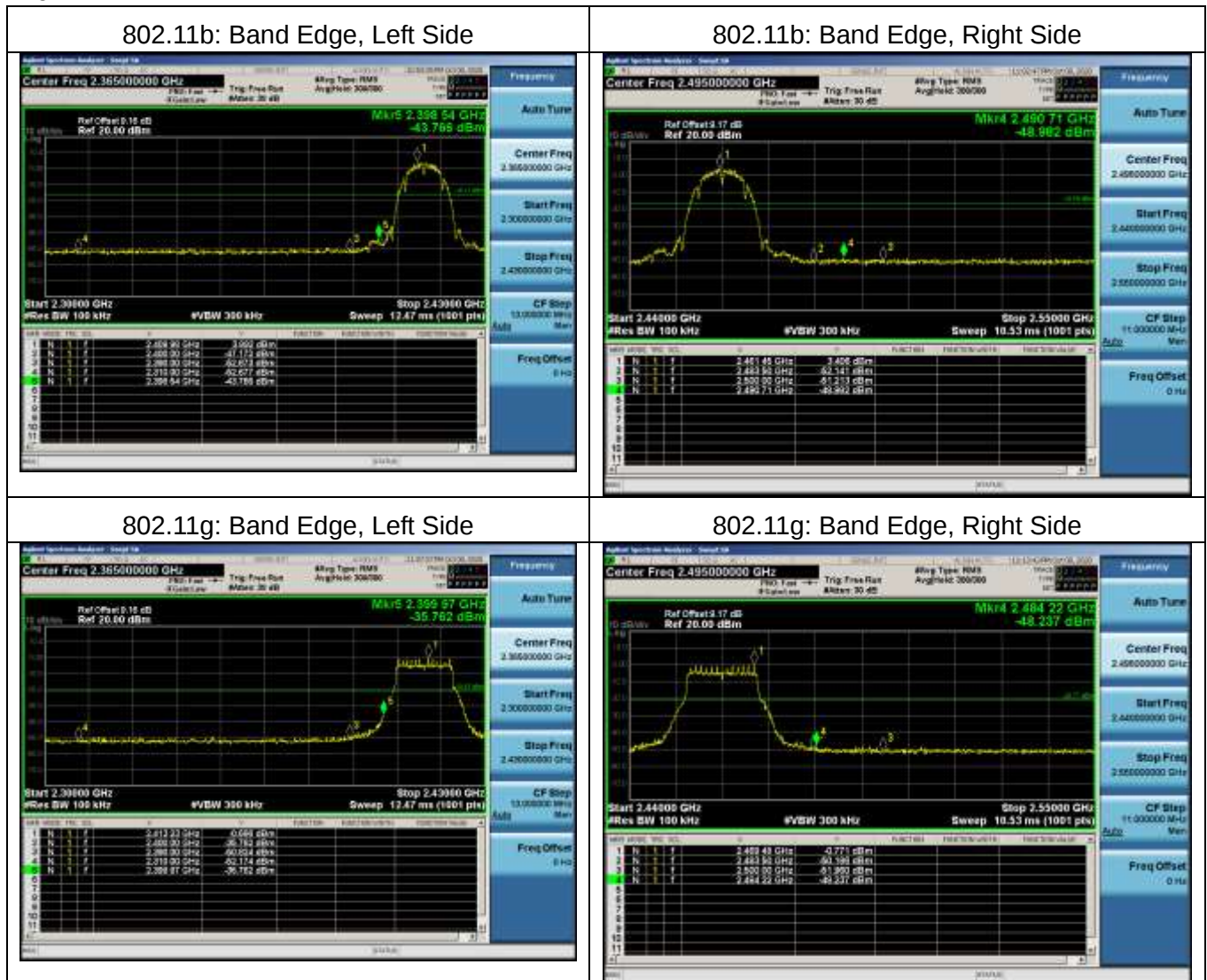


5.6.3 Test procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 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.
- 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.
- 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.
- Repeat above procedures until all measured frequencies were complete.

5.6.4 Test results

For ANT A



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802.11n20: Band Edge, Left Side



802.11n20: Band Edge, Right Side



802.11n40: Band Edge, Left Side



802.11n40: Band Edge, Right Side



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For ANT B

802.11b: Band Edge, Left Side



802.11b: Band Edge, Right Side



802.11g: Band Edge, Left Side

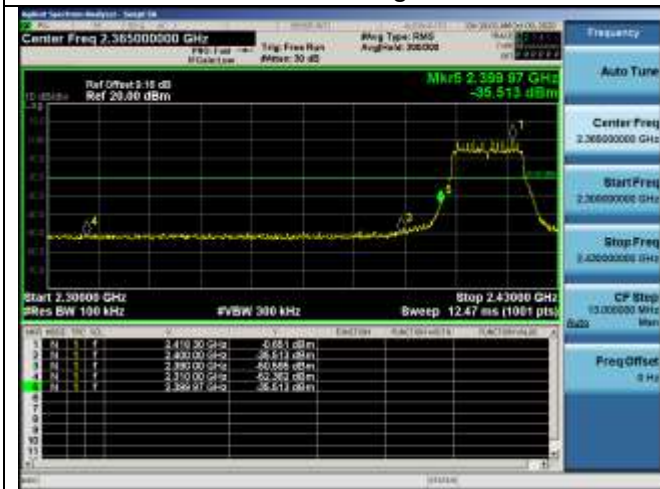


802.11g: Band Edge, Right Side



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802.11n20: Band Edge, Left Side



802.11n20: Band Edge, Right Side



802.11n40: Band Edge, Left Side



802.11n40: Band Edge, Right Side



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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

- Set RBW= 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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	9.059	500	Pass
CH06	2437	10.17	500	Pass
CH11	2462	9.593	500	Pass

TX CH01



TX CH06



TX CH11



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ANT B:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	9.630	500	Pass
CH06	2437	9.611	500	Pass
CH11	2462	9.349	500	Pass

TX CH01



TX CH06



TX CH11



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802.11g

ANT A:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	16.36	500	Pass
CH06	2437	16.36	500	Pass
CH11	2462	16.34	500	Pass

TX CH01



TX CH06



TX CH11



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ANT B:

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	16.35	500	Pass
CH06	2437	16.31	500	Pass
CH11	2462	16.37	500	Pass

TX CH01



TX CH06



TX CH11



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For 802.11n20

ANTA

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	17.55	500	Pass
CH06	2437	17.56	500	Pass
CH11	2462	17.57	500	Pass

TX CH01



TX CH06



TX CH11



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ANTB

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH01	2412	17.35	500	Pass
CH06	2437	17.57	500	Pass
CH11	2462	17.57	500	Pass

TX CH01



TX CH06



TX CH11



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For 802.11n40

ANTA

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH03	2422	35.96	500	Pass
CH06	2437	35.72	500	Pass
CH09	2452	36.20	500	Pass



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ANTB

Test Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
CH03	2422	36.02	500	Pass
CH06	2437	36.34	500	Pass
CH09	2452	35.96	500	Pass

TX CH01



TX CH06



TX CH11



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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

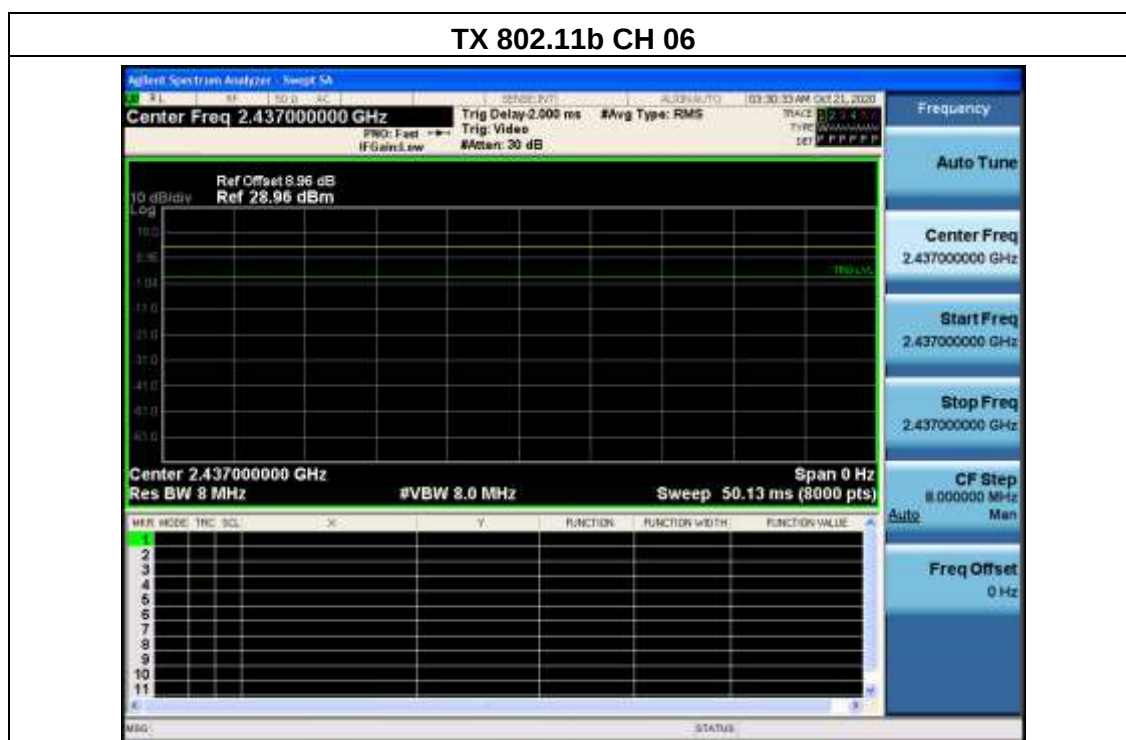
Measure Ttotal and Ton

Calculate Duty Cycle = $Ton / Ttotal$

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5.8.5 Test Results

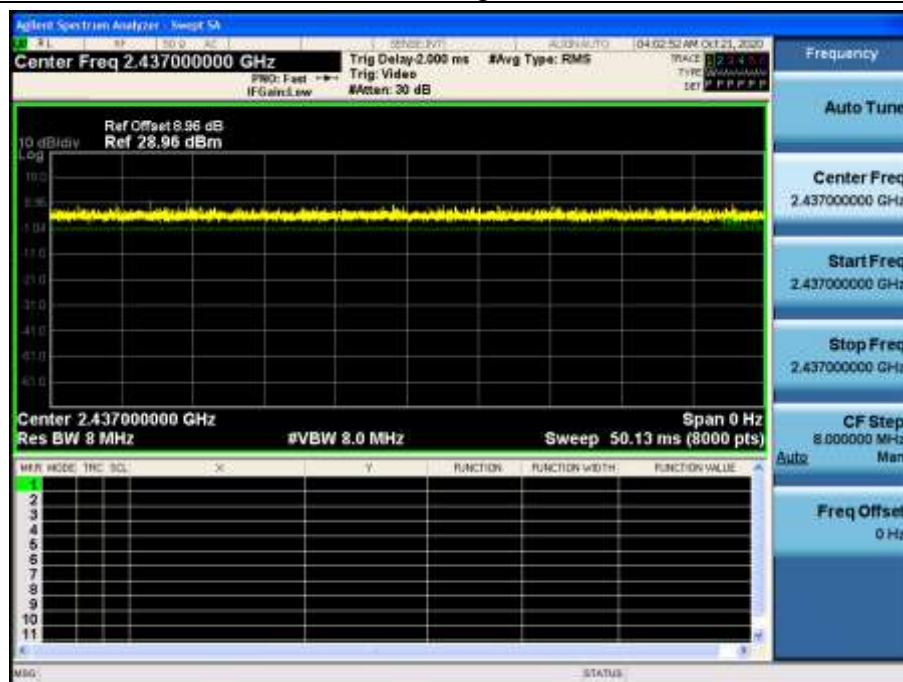
Mode	Data rate	Channel	Ton	Ttotal	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1Mbps	6	-	-	100%	0
802.11g	6Mbps	6	-	-	100%	0
802.11n HT20	MCS0	6	-	-	100%	0
802.11n HT40	MCS0	6	-	-	100%	0



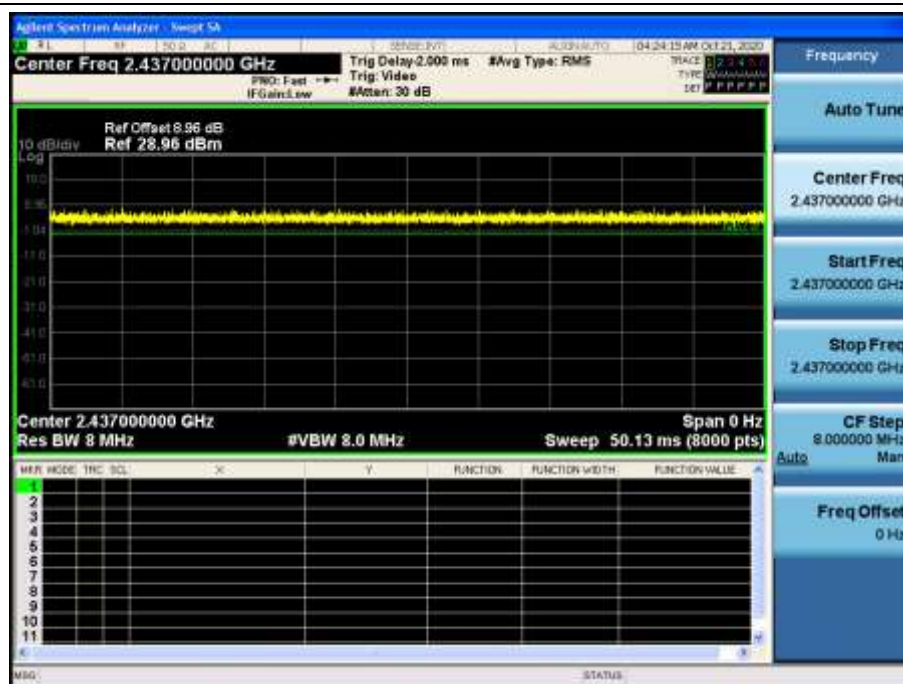
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TX 802.11g CH 06



TX 802.11n HT20 CH 06



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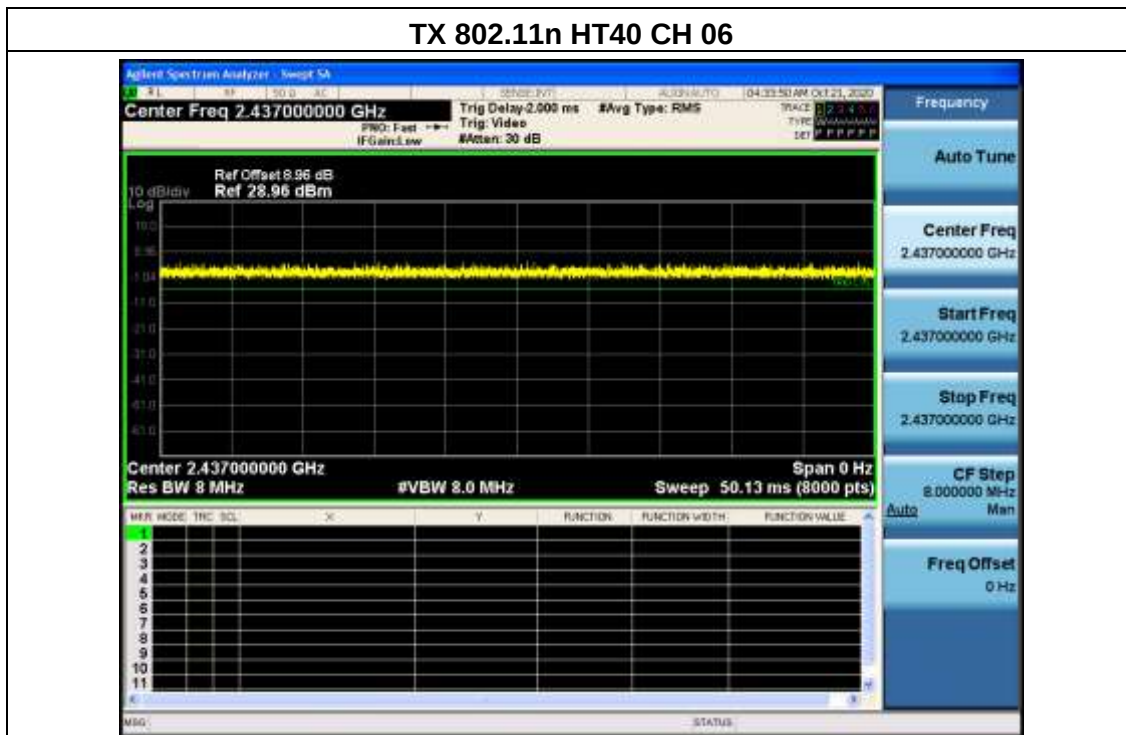
Tel: (86-755) 88850135

Fax: (86-755) 88850136

Web: <http://www.mttest.com>

E-mail: mti@51mti.com

Address: 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao' an District, Shenzhen, Guangdong, China.



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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.: MTi20061009-2E1-1.

----END OF REPORT----

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