

# **FCC Test Report**

FCC ID : ZTT-REA20V2

Equipment : High Power AC1200 Wi-Fi Range Extender

Model No. : REA20v2

Brand Name : Amped Wireless

Applicant : Amped Wireless

Address : 13089 Peyton Dr. #C307 Chino Hills, California

91709 United State

Standard : 47 CFR FCC Part 15.247

Received Date : Mar. 06, 2015

Tested Date : Mar. 26 ~ Apr. 10, 2015

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:

Gary Chang / Manager

Iac-MRA



Page: 1 of 63

Report No.: FR530604-02AC Report Version: Rev. 01



# **Table of Contents**

1	GENERAL DESCRIPTION	5
1.1	Information	5
1.2	Local Support Equipment List	
1.3	Test Setup Chart	
1.4	The Equipment List	
1.5	Test Standards	10
1.6	Measurement Uncertainty	10
2	TEST CONFIGURATION	11
2.1	Testing Condition	11
2.2	The Worst Test Modes and Channel Details	11
3	TRANSMITTER TEST RESULTS	12
3.1	Conducted Emissions	12
3.2	6dB and Occupied Bandwidth	15
3.3	RF Output Power	18
3.4	Power Spectral Density	20
3.5	Unwanted Emissions into Restricted Frequency Bands	22
3.6	Emissions in Non-Restricted Frequency Bands	50
4	TEST LABORATORY INFORMATION	63



# **Release Record**

Report No.	Version	Description	Issued Date
FR530604-02AC	Rev. 01	Initial issue	Apr. 17, 2015

Report No.: FR530604-02AC Page: 3 of 63



# **Summary of Test Results**

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.150MHz 64.85 (Margin -1.15dB) - QP	Pass
15.247(d)	Radiated Emissions	[dBuV/m at 3m]: 45.35MHz	Pass
15.209	Natiated Liffissions	39.69 (Margin -0.31dB) - QP	rass
15.247(b)(3)	Maximum Output Power	Max Power [dBm]: 29.79	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

Report No.: FR530604-02AC Page: 4 of 63



# 1 General Description

# 1.1 Information

### 1.1.1 Specification of the Equipment under Test (EUT)

RF General Information							
Frequency Range (MHz)	Transmit Chains (N <sub>TX</sub> )	Data Rate / MCS					
2400-2483.5	b	2412-2462	1-11 [11]	2	1-11 Mbps		
2400-2483.5	g	2412-2462	1-11 [11]	2	6-54 Mbps		
2400-2483.5	n (HT20)	2412-2462	1-11 [11]	2	MCS 0-15		
2400-2483.5	n (HT40)	2422-2452	3-9 [7]	2	MCS 0-15		

Note 1: RF output power specifies that Maximum Peak Conducted Output Power.

Note 2: 802.11b uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.

Note 3: 802.11g/n uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.

#### 1.1.2 Antenna Details

Ant. No.	Type	Connector		Antenna Gain (dBi)		
AIII. NO.	Туре	Connector	2400~2483.5MHz 5150~5250 MHz 5725~5850 MHz			
1	Dipole	R-SMA	2	3	3	

#### 1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	12Vdc from AC adapter
-------------------	-----------------------

Report No.: FR530604-02AC Page: 5 of 63



### 1.1.4 Accessories

	Accessories				
No.	Equipment	Description			
		Brand Name: ATW			
		Model Name: ATW-1225US			
1	AC Adapter 1	Power Rating: I/P: 100-240Vac, 50-60Hz, 0.5A O/P: 12Vdc, 2.5A			
		Power Line: 1.73m non-shielded cable w/o core			
		Brand Name: ATW			
		Model Name: ATW-1215AUS			
2	AC Adapter 2	Power Rating: I/P: 100-240Vac, 50-60Hz, 0.5A O/P: 12Vdc, 1.5A			
		Power Line: 1.73m non-shielded cable w/o core			

# 1.1.5 Channel List

Frequency	band (MHz)	2400~	2483.5	
802.11 b /	g / n HT20	802.11n HT40		
Channel	Frequency(MHz)	Channel	Frequency(MHz)	
1	2412	3	2422	
2	2417	4	2427	
3	2422	5	2432	
4	2427	6	2437	
5	2432	7	2442	
6	2437	8	2447	
7	2442	9	2452	
8	2447			
9	2452			
10	2457			
11	2462			

Report No.: FR530604-02AC Page: 6 of 63



# 1.1.6 Test Tool and Duty Cycle

Test Tool	ART2-GUI, ver. 2.3				
	Mode	Duty cycle (%)	Duty factor (dB)		
	11b	100.00%	0.00		
Duty Cycle and Duty Factor	11g	98.25%	0.08		
	HT20	98.13%	0.08		
	HT40	96.86%	0.14		

# 1.1.7 Power Setting

Modulation Mode	Test Frequency (MHz)	Power Set
11b	2412	17.5
11b	2437	18
11b	2462	18
11g	2412	18.5
11g	2437	19
11g	2462	19
HT20	2412	18
HT20	2437	19
HT20	2462	17.5
HT40	2422	13.5
HT40	2437	18.5
HT40	2452	14

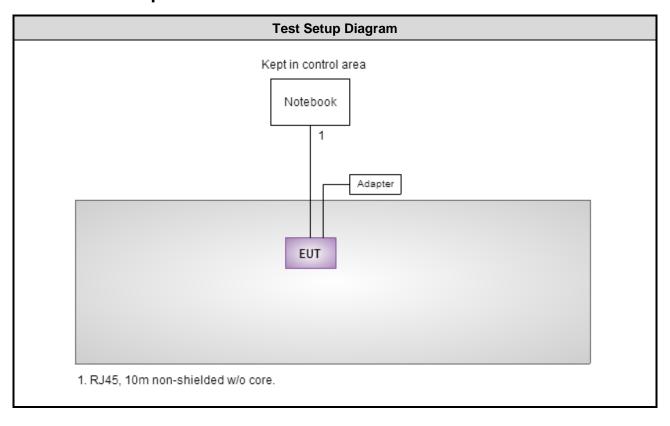
Report No.: FR530604-02AC Page: 7 of 63



# 1.2 Local Support Equipment List

	Support Equipment List							
No. Equipment Brand Model FCC ID Signal cable / Length (m								
1	1 Notebook DELL Latitude E5420 DoC RJ45, 10m non-shielded w/o c							

# 1.3 Test Setup Chart



Report No.: FR530604-02AC Page: 8 of 63



# 1.4 The Equipment List

Test Item	Conducted Emission  Conduction room 1 / (CO01-WS)						
Test Site							
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until		
EMC Receiver	R&S	ESCS 30	100169	Oct. 17, 2014	Oct. 16, 2015		
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 17, 2014	Nov. 16, 2015		
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 26, 2014	Nov. 25, 2015		
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Dec. 31, 2014	Dec. 30, 2015		
50 ohm terminal (Support Unit)	NA	50	04	Apr. 18, 2014	Apr. 17, 2015		
Measurement Software	AUDIX	e3	6.120210k	NA	NA		

Test Item	Radiated Emission								
Test Site	966 chamber 2 / (03CH02-WS)								
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until				
Spectrum Analyzer	R&S	FSV40	101499	Dec. 31, 2014	Dec. 30, 2015				
Receiver	R&S	ESR3	101657	Jan. 15, 2015	Jan. 14, 2016				
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-524	Oct. 16, 2014	Oct. 15, 2015				
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Oct. 14, 2014	Oct. 13, 2015				
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 10, 2014	Nov. 09, 2015				
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 10, 2014	Nov. 09, 2015				
Preamplifier	Burgeon	BPA-530	100218	Nov. 10, 2014	Nov. 09, 2015				
Preamplifier	Agilent	83017A	MY39501309	Sep. 29, 2014	Sep. 28, 2015				
Preamplifier	EMC	EMC184045B	980192	Aug. 26, 2014	Aug. 25, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 16, 2014	Dec. 15, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 16, 2014	Dec. 15, 2015				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 16, 2014	Dec. 15, 2015				
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Dec. 16, 2014	Dec. 15, 2015				
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-004	Dec. 16, 2014	Dec. 15, 2015				
Measurement Software	AUDIX	e3	6.120210g	NA	NA				
Note: Calibration Inter	rval of instruments listed	d above is one year.							

Test Item	RF Conducted						
Test Site	(TH01-WS)						
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until		
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016		
Power Meter	Anritsu	ML2495A	1241002	Sep. 29, 2014	Sep. 28, 2015		
Power Sensor	Anritsu	MA2411B	1207366	Sep. 29, 2014	Sep. 28, 2015		
Signal Generator	R&S	SMB100A	175727	Oct. 08, 2014	Oct. 07, 2015		
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA		
Note: Calibration Interval of instruments listed above is one year.							

Report No.: FR530604-02AC Page: 9 of 63



#### 1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247
ANSI C63.10-2013
FCC KDB 558074 D01 DTS Meas Guidance v03r02
FCC KDB 662911 D01 Multiple Transmitter Output v02r01

# 1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty						
Parameters	Uncertainty					
Bandwidth	±34.134 Hz					
Conducted power	±0.808 dB					
Power density	±0.463 dB					
Conducted emission	±2.670 dB					
AC conducted emission	±2.92 dB					
Radiated emission ≤ 1GHz	±3.62 dB					
Radiated emission > 1GHz	±5.6 dB					

Report No.: FR530604-02AC Page: 10 of 63



# 2 Test Configuration

# 2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	19°C / 66%	Kevin Ma
Radiated Emissions	03CH02-WS	23-25°C / 65-66%	Aska Huang Brad Wu
RF Conducted	TH01-WS	22°C / 63%	Felix Sung

FCC site registration No.: 657002IC site registration No.: 10807A-2

### 2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Data Rate (Mbps) / MCS	Test Configuration
Conducted Emissions	HT20	2437	6 Mbps	
Radiated Emissions ≤1GHz	HT20	2437	6 Mbps	
Radiated Emissions >1GHz	11b	2412 / 2437 / 2462	1 Mbps	
Maximum Output Power	11g	2412 / 2437 / 2462	6 Mbps	
6dB bandwidth	HT20	2412 / 2437 / 2462	MCS 0	
Power spectral density	HT40	2422 / 2437 / 2452	MCS 0	

#### NOTE:

Report No.: FR530604-02AC Page: 11 of 63

<sup>1. 2</sup> AC adapters had been covered during pretest. The worst model is ATW-1225US

<sup>2.</sup> The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.



### 3 Transmitter Test Results

#### 3.1 Conducted Emissions

#### 3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit							
Frequency Emission (MHz) Quasi-Peak Average							
0.15-0.5	66 - 56 *	56 - 46 *					
0.5-5	56	46					
5-30	60	50					
Note 1: * Decreases with the logarithm of the frequency.							

#### 3.1.2 Test Procedures

- 1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
- 2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50  $\Omega$  LISN port.
- 3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
- 4. This measurement was performed with AC 120V / 60Hz.

#### 3.1.3 Test Setup



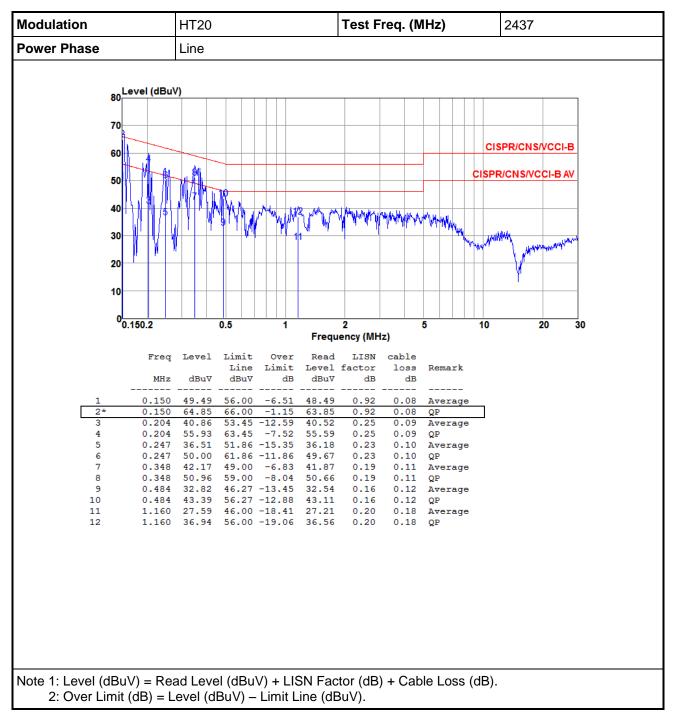
Note: 1. Support units were connected to second LISN.

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

Report No.: FR530604-02AC Page: 12 of 63

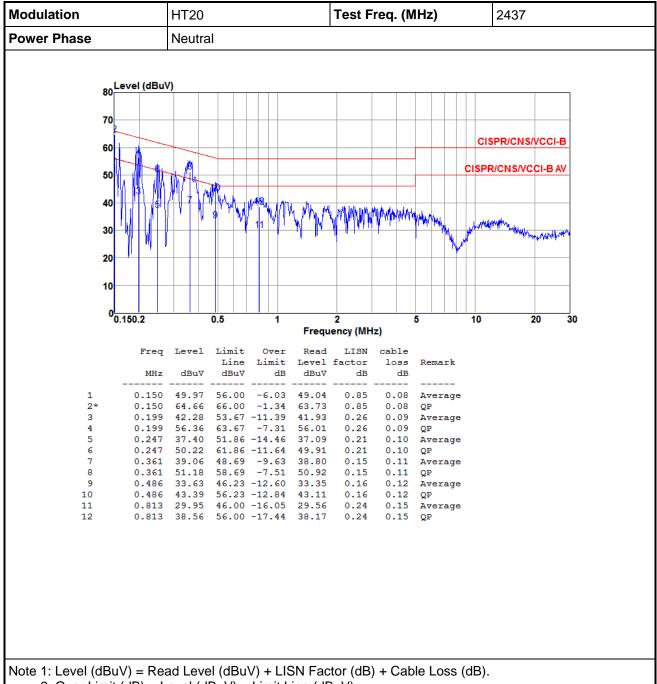


#### 3.1.4 Test Result of Conducted Emissions



Report No.: FR530604-02AC Page: 13 of 63





2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Report No.: FR530604-02AC Page: 14 of 63



### 3.2 6dB and Occupied Bandwidth

#### 3.2.1 Limit of 6dB Bandwidth

The minimum 6dB bandwidth shall be at least 500 kHz.

#### 3.2.2 Test Procedures

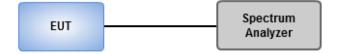
#### 6dB Bandwidth

- 1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
- 2. Detector = Peak, Trace mode = max hold.
- 3. Sweep = auto couple, Allow the trace to stabilize.
- 4. 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 6dB relative to the maximum level measured in the fundamental emission.

#### Occupied Bandwidth

- 1. Set resolution bandwidth (RBW) = 1 MHz, Video bandwidth = 3 MHz.
- 2. Detector = Sample, Trace mode = max hold.
- 3 Sweep = auto couple, Allow the trace to stabilize.
- 4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

#### 3.2.3 Test Setup

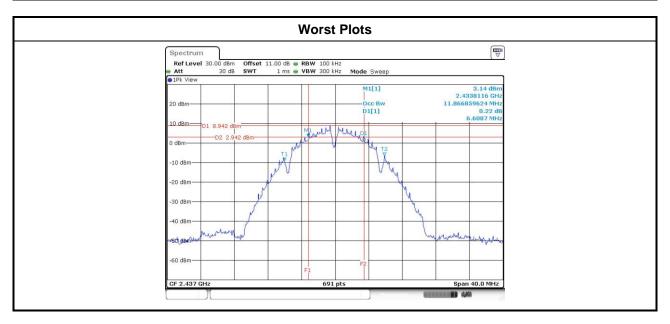


Report No.: FR530604-02AC Page: 15 of 63



# 3.2.4 Test Result of 6dB and Occupied Bandwidth

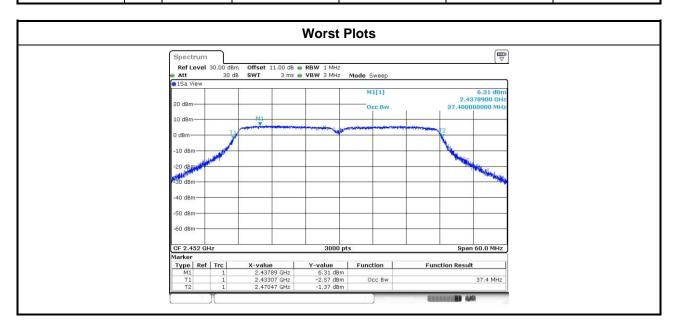
Modulation	NI.	Eron (MU=)			Limit (ItU=)		
Mode	N <sub>TX</sub>	Freq. (MHz)	Chain 0	Chain 1	Chain 2	Chain 3	Limit (kHz)
11b	2	2412	7.07	7.01			500
11b	2	2437	6.61	7.07			500
11b	2	2462	7.07	7.07			500
11g	2	2412	16.35	16.35			500
11g	2	2437	16.35	16.35			500
11g	2	2462	16.35	16.35			500
HT20	2	2412	17.57	17.62			500
HT20	2	2437	17.62	17.62			500
HT20	2	2462	17.22	17.62			500
HT40	2	2422	36.06	36.29			500
HT40	2	2437	36.29	36.29			500
HT40	2	2452	35.71	36.41			500



Report No.: FR530604-02AC Page: 16 of 63



Modulation	N	Freq.	99% Occupied Bandwidth (MHz)					
Mode	N <sub>TX</sub>	(MHz)	Chain 0	Chain 1	Chain 2	Chain 3		
11b	2	2412	11.98	11.88				
11b	2	2437	11.86	11.94				
11b	2	2462	11.89	11.98				
11g	2	2412	16.83	17.06				
11g	2	2437	16.81	17.23				
11g	2	2462	16.88	17.02				
HT20	2	2412	17.99	18.13				
HT20	2	2437	17.99	18.12				
HT20	2	2462	17.96	18.15				
HT40	2	2422	37.08	37.24				
HT40	2	2437	36.96	37.28				
HT40	2	2452	37.28	37.40				



Report No.: FR530604-02AC Page: 17 of 63



# 3.3 RF Output Power

#### 3.3.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

Antenna gain <= 6dBi, no any corresponding reduction is in output power limit.

Antenna gain > 6dBi

Non Fixed, point to point operations.
The conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dB

Fixed, point to point operations
Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point Operations, maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations, no any corresponding reduction is in transmitter peak output power

#### 3.3.2 Test Procedures

Maximum Peak Conducted Output Power

#### 

- 1. Set RBW = 1MHz, VBW = 3MHz, Detector = Peak.
- 2. Sweep time = auto, Trace mode = max hold, Allow trace to fully stabilize.
- 3. Use the spectrum analyzer channel power measurement function with the band limits set equal to the DTS bandwidth edges.

#### Nower meter

- A broadband Peak RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.
- Maximum Conducted Output Power (For reference only)

#### Nower meter

 A broadband Average RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

#### 3.3.3 Test Setup



Report No.: FR530604-02AC Page: 18 of 63



# 3.3.4 Test Result of Maximum Output Power

Modulation Mode	N <sub>TX</sub>	Freq.	Peak	Peak conducted output power (dBm)			Total Power	Total Power	Limit
Wiode		(IVITIZ)	Chain 0	Chain 1	Chain 2	Chain 3	(mW)	(dBm)	(dBm)
11b	2	2412	19.51	19.10			170.614	22.32	30.00
11b	2	2437	19.42	19.90			185.222	22.68	30.00
11b	2	2462	19.53	19.79			185.022	22.67	30.00
11g	2	2412	26.00	26.45			839.678	29.24	30.00
11g	2	2437	26.78	26.58			931.419	29.69	30.00
11g	2	2462	26.66	26.45			905.017	29.57	30.00
HT20	2	2412	26.18	25.80			795.143	29.00	30.00
HT20	2	2437	26.82	26.73			951.817	29.79	30.00
HT20	2	2462	25.06	25.41			668.163	28.25	30.00
HT40	2	2422	22.51	22.34			349.634	25.44	30.00
HT40	2	2437	26.88	26.54			938.345	29.72	30.00
HT40	2	2452	22.29	22.36			341.621	25.34	30.00

Modulation Mode	N <sub>TX</sub>	Freq.	Conduc	Conducted (average) output power (dBm)			Total Power	Total Power	Limit
Wiode		(IVITIZ)	Chain 0	Chain 1	Chain 2	Chain 3	(mW)	(dBm)	(dBm)
11b	2	2412	16.51	16.05			85.043	19.30	30.00
11b	2	2437	16.33	16.91			92.044	19.64	30.00
11b	2	2462	16.32	16.75			90.170	19.55	30.00
11g	2	2412	17.26	17.41			108.292	20.35	30.00
11g	2	2437	18.11	17.92			126.658	21.03	30.00
11g	2	2462	17.67	17.72			117.635	20.71	30.00
HT20	2	2412	17.21	16.63			98.627	19.94	30.00
HT20	2	2437	18.15	18.02			128.700	21.10	30.00
HT20	2	2462	15.82	16.18			79.690	19.01	30.00
HT40	2	2422	12.75	12.52			36.701	15.65	30.00
HT40	2	2437	17.18	16.86			100.768	20.03	30.00
HT40	2	2452	12.90	13.10			39.916	16.01	30.00

Note: Conducted average output power is for reference only.

Report No.: FR530604-02AC Page: 19 of 63



### 3.4 Power Spectral Density

#### 3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

#### 3.4.2 Test Procedures

- Maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit.
  - 1. Set the RBW = 30kHz, VBW = 100kHz.
  - Detector = Peak, Sweep time = auto couple.
  - 3. Trace mode = max hold, allow trace to fully stabilize.
  - 4. Use the peak marker function to determine the maximum amplitude level.
- Maximum (average) conducted output power was used to demonstrate compliance to the fundamental output power limit.
  - Set the RBW = 100kHz, VBW = 300 kHz.
  - 2. Detector = RMS, Sweep time = auto couple.
  - 3. Set the sweep time to: ≥ 10 x (number of measurement points in sweep) x (maximum data rate per stream).
  - 4. Perform the measurement over a single sweep.
  - 5. Use the peak marker function to determine the maximum amplitude level.

### 3.4.3 Test Setup



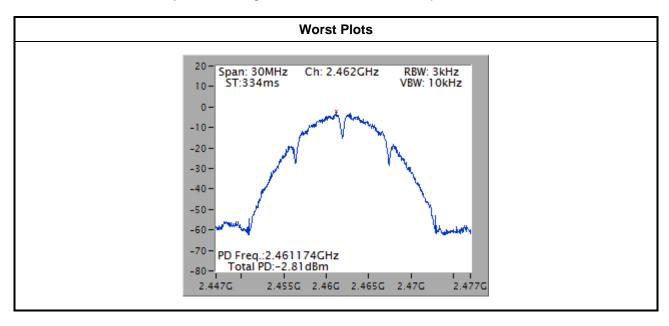
Report No.: FR530604-02AC Page: 20 of 63



### 3.4.4 Test Result of Power Spectral Density

Modulation Mode	N <sub>TX</sub>	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
11b	2	2412	-2.97	8.00
11b	2	2437	-2.83	8.00
11b	2	2462	-2.81	8.00
11g	2	2412	-5.72	8.00
11g	2	2437	-5.43	8.00
11g	2	2462	-5.63	8.00
HT20	2	2412	-6.16	8.00
HT20	2	2437	-6.08	8.00
HT20	2	2462	-7.67	8.00
HT40	2	2422	-13.69	8.00
HT40	2	2437	-8.50	8.00
HT40	2	2452	-13.08	8.00

Note: Test results are bin-by-bin summing measured value of each TX port.



Report No.: FR530604-02AC Page: 21 of 63



### 3.5 Unwanted Emissions into Restricted Frequency Bands

#### 3.5.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit								
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)					
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300					
0.490~1.705	24000/F(kHz)	33.8 - 23	30					
1.705~30.0	30	29	30					
30~88	100	40	3					
88~216	150	43.5	3					
216~960	200	46	3					
Above 960	500	54	3					

#### Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit **Note 2:** 

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

#### 3.5.2 Test Procedures

- 1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
- 2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- 3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

#### Note:

- 1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
- 2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
- RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

Report No.: FR530604-02AC Page: 22 of 63



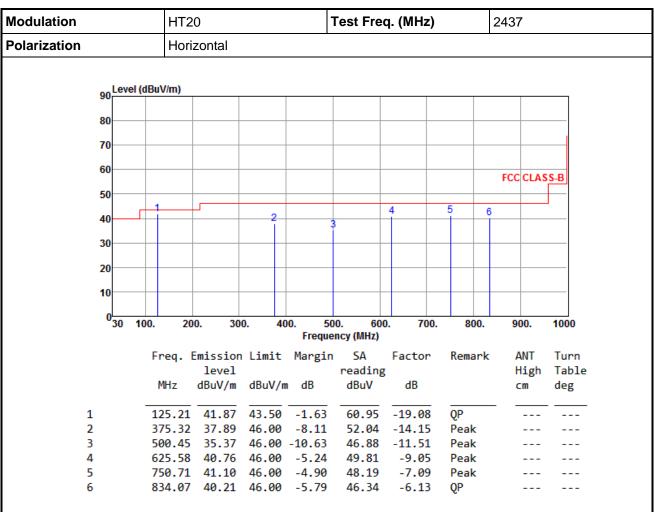
### 3.5.3 Test Setup



Report No.: FR530604-02AC Page: 23 of 63



### 3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

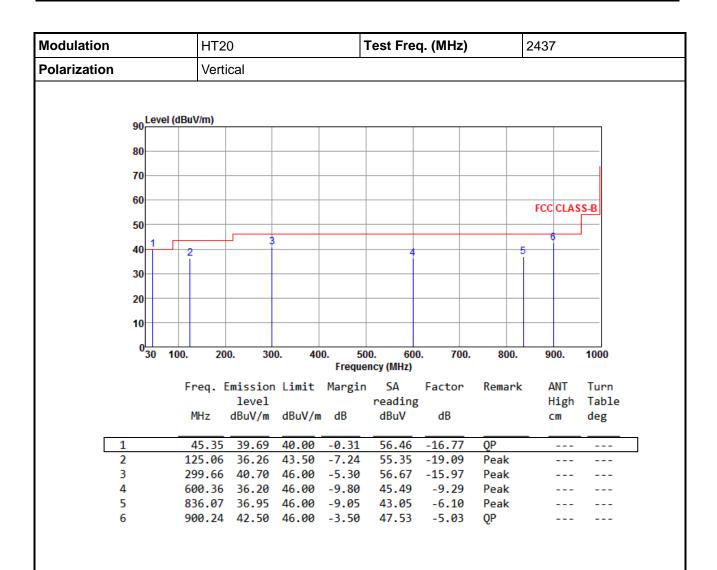
\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Report No.: FR530604-02AC Page: 24 of 63





\*Factor includes antenna factor, cable loss and amplifier gain

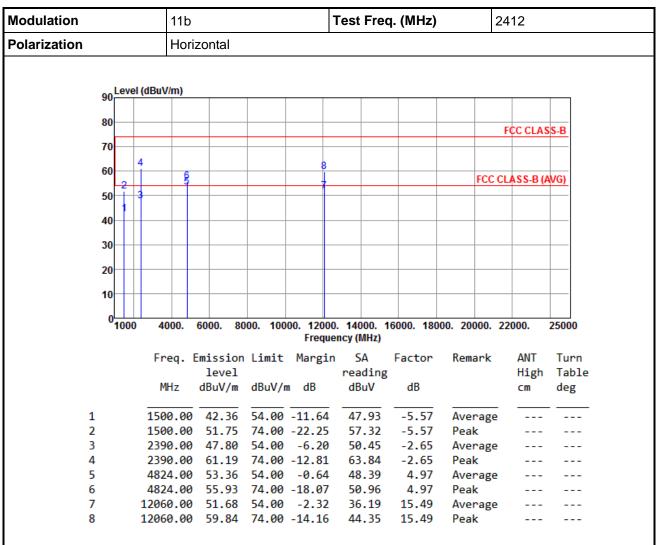
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Report No.: FR530604-02AC Page: 25 of 63



### 3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11b



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 26 of 63



Modulation	11b	Т	est Freq.	24	2412							
Polarization	Vertical											
90 Level (dBu	uV/m)						_					
80												
					F	CC CLASS-E	3					
70							-					
60 4					500.01	66 D (A) (C	_					
50 3	6				FCC CL	ASS-B (AVG	<u>)</u>					
50 1 3		1										
40							-					
30							_					
20												
10							-					
0 1000	4000. 6000. 8000	D. 10000. 12000.	14000 160	00 10000	20000 22	000. 250						
1000	4000. 0000. 8000		icy (MHz)	00. 10000.	20000. 22	000. 230	000					
F	req. Emission l	Limit Margin	SA F	actor F	Remark	ANT T	urn					
	level		reading			_	able					
	MHz dBuV/m o	dBuV/m dB	dBuV	dB		cm d	eg					
1 15	00.00 43.95	54.00 -10.05	49.52	-5.57	verage							
		74.00 -21.92			Peak							
	90.00 45.56				verage							
	90.00 58.68 7				eak							
	324.00 47.48 5 324.00 51.35 7		42.51 46.38		lverage Peak							

12060.00 45.04 54.00 -8.96 29.55 15.49

12060.00 57.97 74.00 -16.03 42.48 15.49

Average

Peak

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor, cable loss and amplifier gain

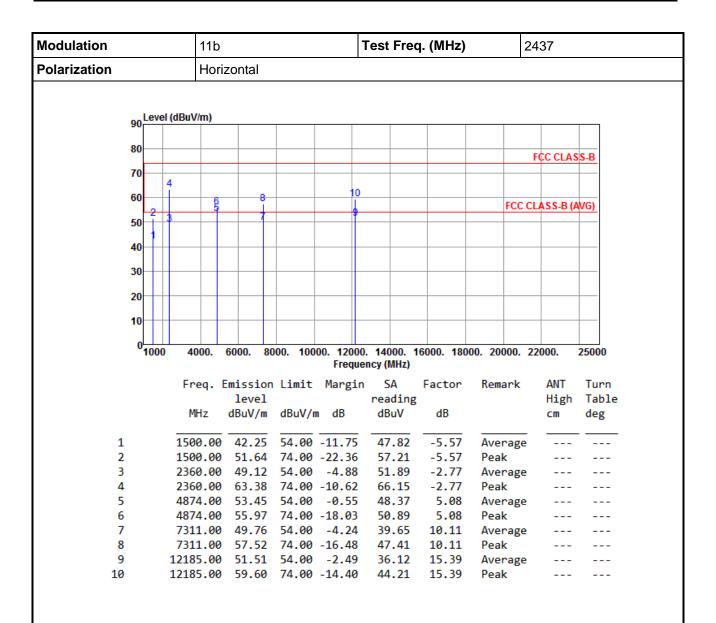
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 27 of 63

Report Version: Rev. 01

7



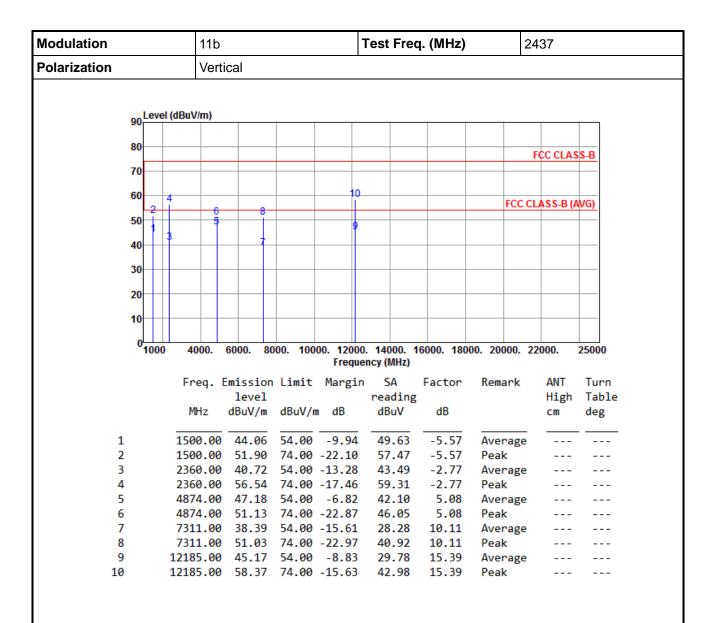


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 28 of 63



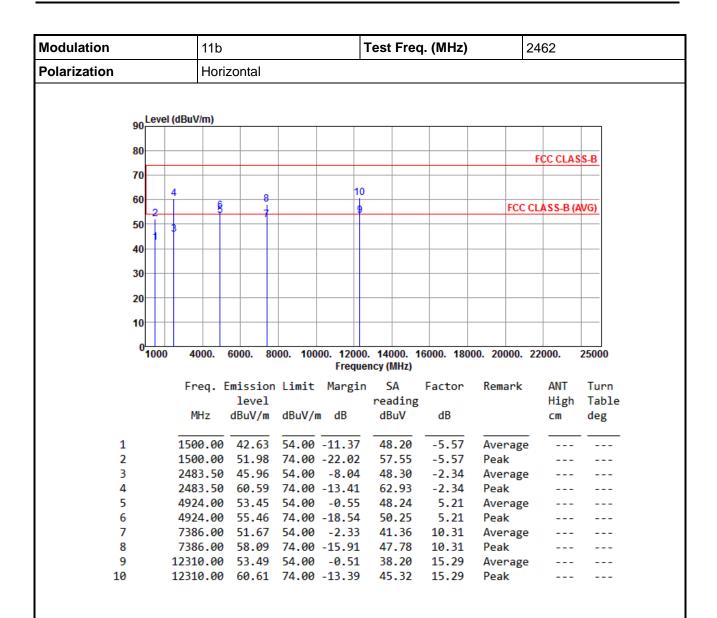


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 29 of 63



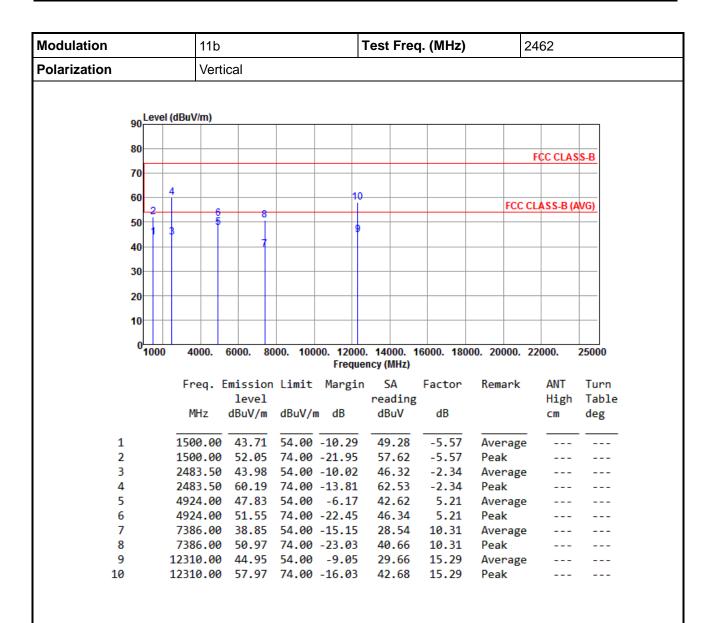


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 30 of 63





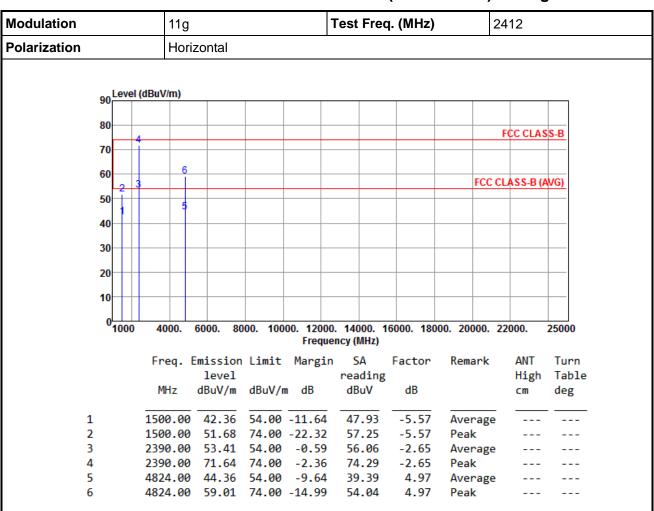
\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 31 of 63



### 3.5.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11g



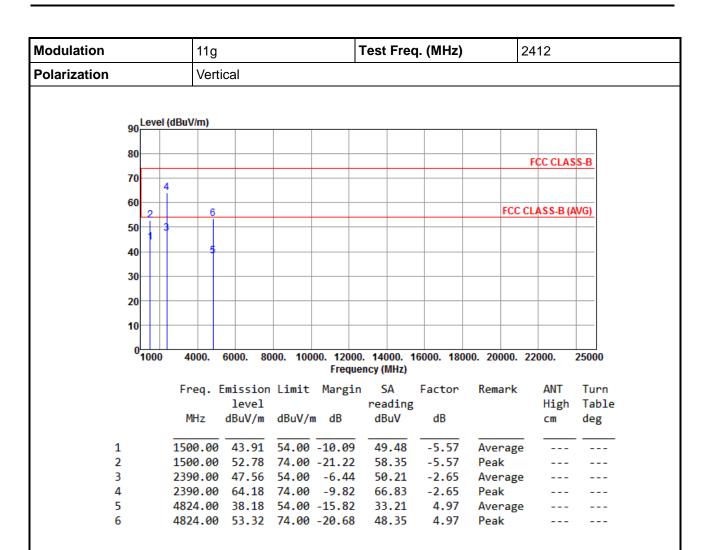
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

Report No.: FR530604-02AC Page: 32 of 63



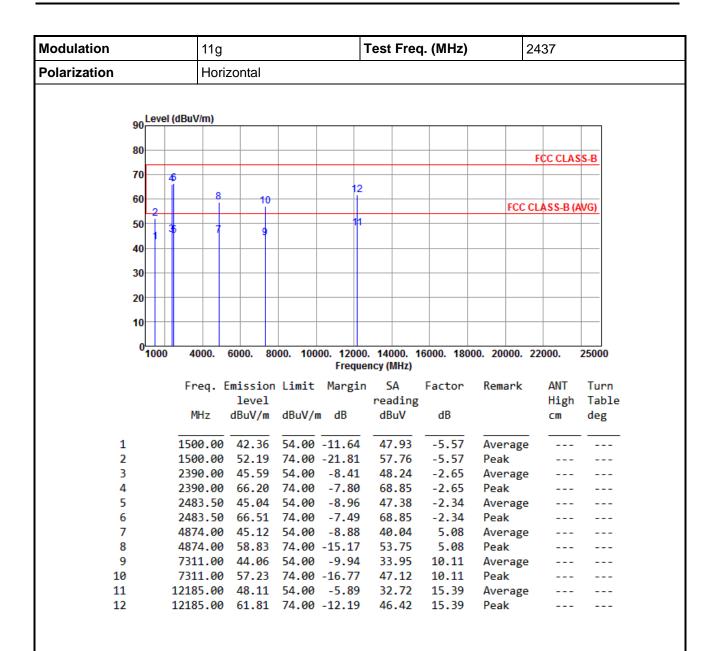


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 33 of 63



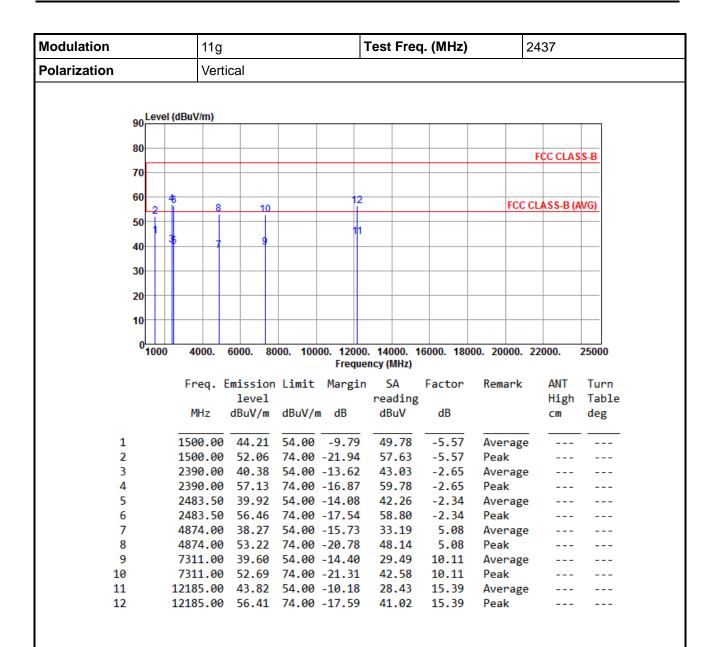


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 34 of 63





\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 35 of 63



Modulation				11g					Test	Test Freq. (MHz)					2462		
Polarization				Horizontal													
	90	Leve	el (dBi	uV/m)				I		1							
	80		4											FCC CLAS	SS-B		
	70	⊢	H		-										-		
	60					8											
	00	2	3	'	5								FCC (	CLASS-B (A	AVG)		
	50	1		<u> </u>		7	-										
	40	Ц															
	30																
	20														-		
	40																
	10																
	0	100	0	4000.	600	0. 8	3000. 100	000. 120	000. 14	000. 1	6000. 1	8000. 2	20000.	22000.	25000		
									quency (								
			F	req.	Emi:	ssio	n Limit	Marg	in S	A	Factor	n Re	mark	ANT	Tur		
						evel				ding				High			
				MHz	dBi	uV/m	dBuV/	m dB	dE	₿uV	dB			cm	deg		
	1		19	00.00	a	2 48	54.00	_11 5	2 //5	3.05	-5.57	7 /	erage				
	2			00.00						.36	-5.57		ak				
	3						54.00			.68	-2.34		erage				
	4			183.50						.02	-2.34		ak				
	5			24.0	-					.94	5.21		erage				
	5						74.00			.82	5.21		ak				
	7 8						54.00 74.00			.03 3.66	10.31		erage ak				
'	5		/-	00.00	0 0	5.5/	74.00	-15.0	40 د	.00	10.31	r re	aK				

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 36 of 63



Modulation				11g					Test	Fred	q. (MHz	)	24	162	
Polarization				Vert	ical				•						
	90	Leve	l (dBu\	//m)											
	80												F	CC CLAS	SS-B
	70		_												
			4												
	60	2		6		8							FCC CL	ASS-B (A	AVG)
	50	Ĺ	3	Ŧ		Ĭ									
		1	I			+									
	40														
	30														+-
	20														
	20														
	10														+-
	0														
		1000	) 4	000.	6000.	80	00. 100		100. 14 Juency (		16000. 18	3000. 20	0000. 22	2000.	25000
			Fr	еп	Fmissi	on	Limit				Factor	Rem	ıark	ANT	Turr
				-4.	leve			8		 ding				High	Tab]
			M	Hz			dBuV/ı	m dB		BuV	dB			cm	deg
	1		150	0.00	43.7	71	54.00	-10.2	9 49	28	-5.57	Ave	rage		
	2		150	0.00	52.3	39	74.00	-21.6		.96	-5.57		_		
	3				46.6		54.00			3.38	-2.34		rage		
	4				65.9		74.00			3.24	-2.34				
	5						54.00			3.41	5.21		rage		
	6 7				52.8		74.00 54.00			7.67 9.53	5.21 10.31				
	_		/30	0.00	35.0	)4	34.00	-14.1	0 2		10.51	AVE	rage		

10.31

Peak

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

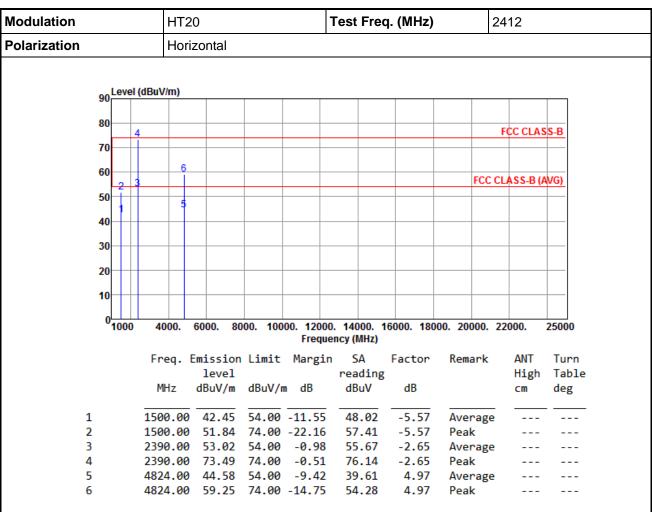
7386.00 52.52 74.00 -21.48 42.21

\*Factor includes antenna factor, cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 37 of 63



## 3.5.7 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT20



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

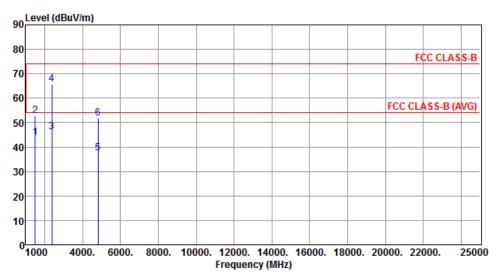
\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 38 of 63



Modulation	HT20	Test Freq. (MHz)	2412
Polarization	Vertical		

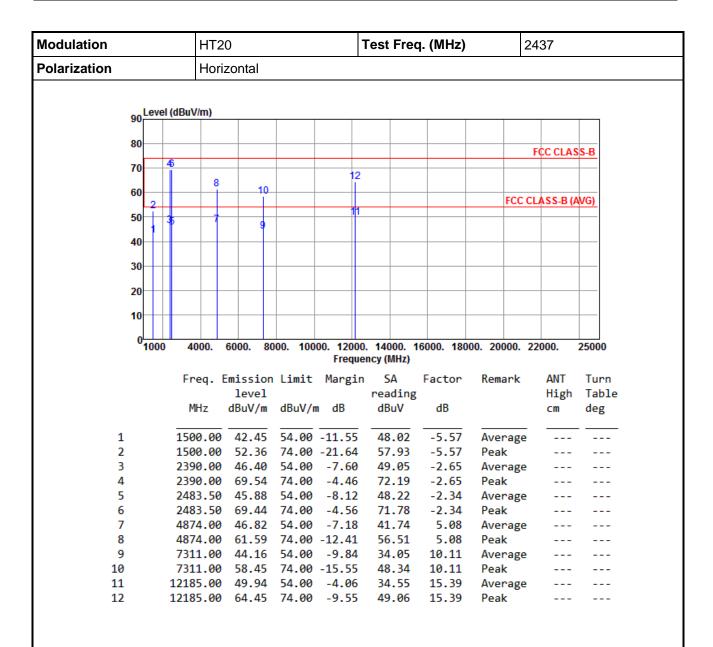


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	43.75	54.00	-10.25	49.32	-5.57	Average		
2	1500.00	52.67	74.00	-21.33	58.24	-5.57	Peak		
3	2390.00	46.03	54.00	-7.97	48.68	-2.65	Average		
4	2390.00	65.88	74.00	-8.12	68.53	-2.65	Peak		
5	4824.00	37.53	54.00	-16.47	32.56	4.97	Average		
6	4824.00	51.93	74.00	-22.07	46.96	4.97	Peak		

\*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 39 of 63



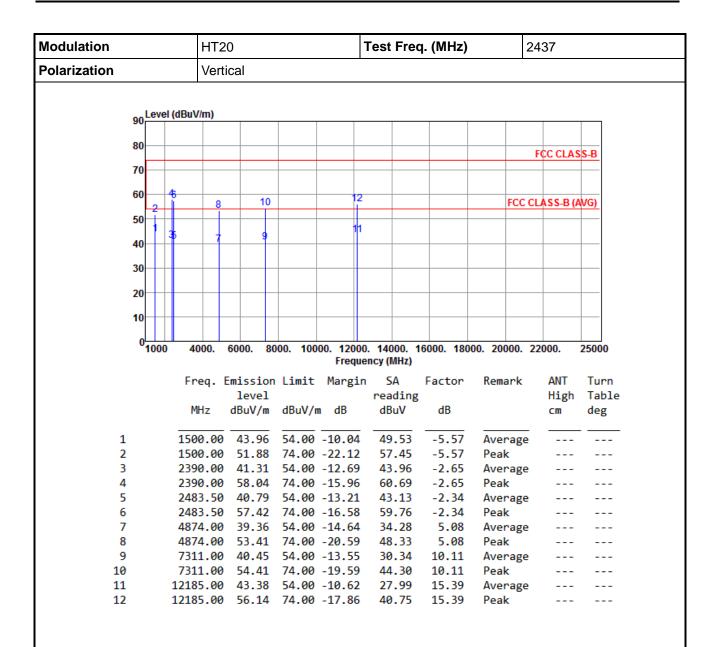


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 40 of 63



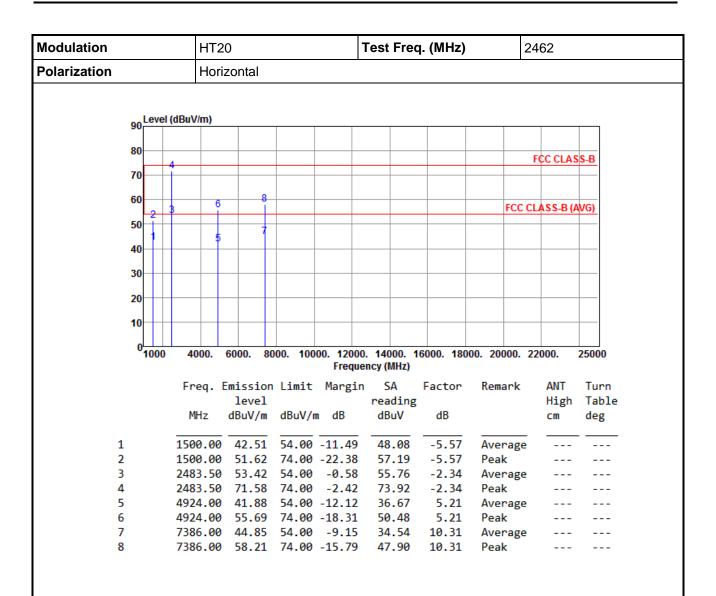


\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 41 of 63





\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 42 of 63



Modulation			HT2	0		٦	Test Fred	q. (MHz)	2	2462	
Polarization			Verti	cal							
			•								
		Level	(dBuV/m)								
	90		(								
	80										
	70									FCC CLAS	S-B
	70	1	4								
	60								FCC	CLASS D //	1401
		2	6	8					FCC	CLASS-B (A	WG)
	50	1	3								
	40	++	5	+ 7							
	30										
	30										
	20	++									
	10										
	0	1000	4000.	6000. 80	00. 100	00. 12000	. 14000. 1	6000. 180	00. 20000.	22000.	25000
						Freque	ncy (MHz)				
			Freq. [		Limit	Margin		Factor	Remark	ANT	Turn
				level			reading			High	Table
			MHz	dBuV/m	dBuV/r	n dB	dBuV	dB		cm	deg
	1		1500.00	43.75	54.00	-10.25	49.32	-5.57	Average		
	2		1500.00				57.55	-5.57	Peak		
	3		2483.50	46.29	54.00	-7.71	48.63	-2.34	Average		
	4		2483.50				68.41	-2.34	Peak		
	5		4924.00				33.33	5.21	Average		
	6		4924.00				48.15	5.21	Peak		
	7		7386.00	30.0/	34.00	-15.13	28.56	10.31	Average		

10.31

Peak

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

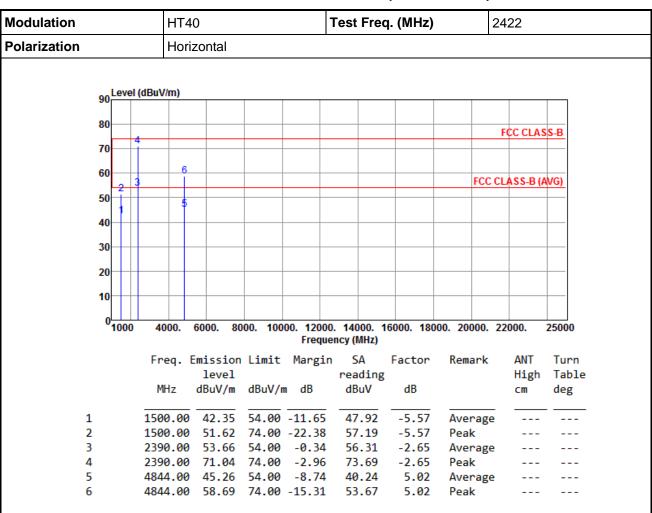
7386.00 52.24 74.00 -21.76 41.93

\*Factor includes antenna factor, cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 43 of 63



## 3.5.8 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT40



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

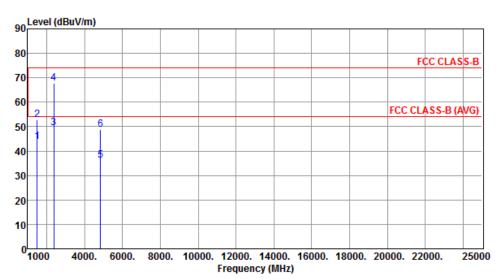
\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

Report No.: FR530604-02AC Page: 44 of 63



Modulation	HT40	Test Freq. (MHz)	2422
Polarization	Vertical		

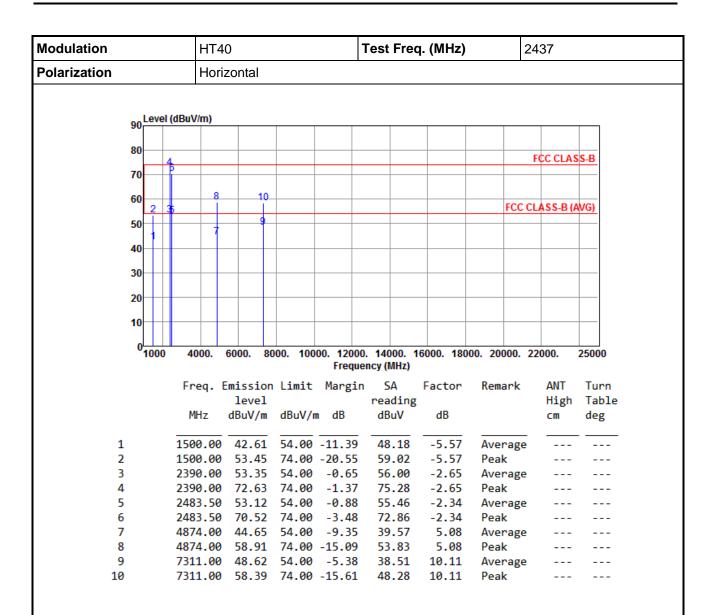


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	43.84	54.00	-10.16	49.41	-5.57	Average		
2	1500.00		74.00		58.31	-5.57	Peak		
3	2390.00	49.56	54.00	-4.44	52.21	-2.65	Average		
4	2390.00	67.68	74.00	-6.32	70.33	-2.65	Peak		
5	4844.00	36.08	54.00	-17.92	31.06	5.02	Average		
6	4844.00	48.87	74.00	-25.13	43.85	5.02	Peak		

\*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 45 of 63





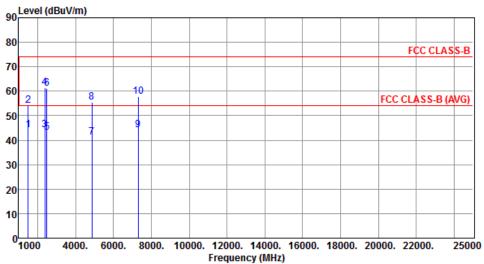
\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 46 of 63



Modulation	HT40	Test Freq. (MHz)	2437
Polarization	Vertical		
Level (dRu	iV/m)		

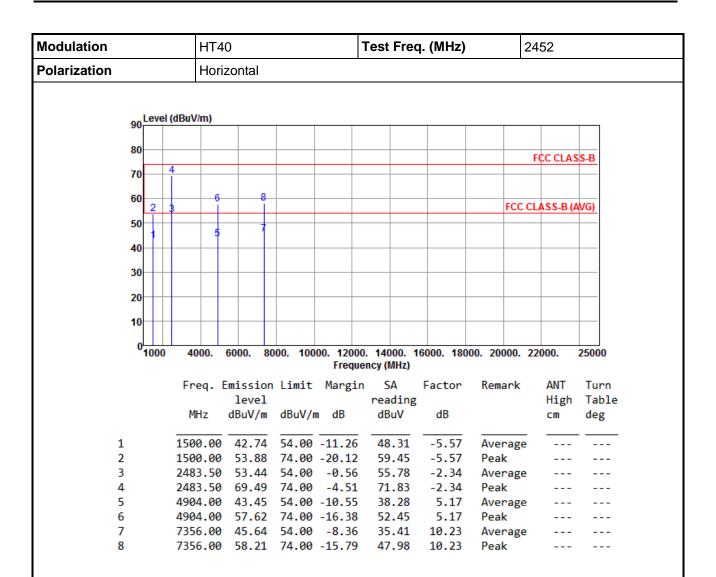


	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	1500.00	44.25	54.00	-9.75	49.82	-5.57	Average		
2	1500.00	54.08	74.00	-19.92	59.65	-5.57	Peak		
3	2390.00	44.29	54.00	-9.71	46.94	-2.65	Average		
4	2390.00	61.45	74.00	-12.55	64.10	-2.65	Peak		
5	2483.50	43.22	54.00	-10.78	45.56	-2.34	Average		
6	2483.50	60.95	74.00	-13.05	63.29	-2.34	Peak		
7	4874.00	41.25	54.00	-12.75	36.17	5.08	Average		
8	4874.00	55.38	74.00	-18.62	50.30	5.08	Peak		
9	7311.00	44.21	54.00	-9.79	34.10	10.11	Average		
10	7311.00	57.66	74.00	-16.34	47.55	10.11	Peak		

\*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 47 of 63





\*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 48 of 63



2

3

4

5

6

7

8

Modulation	HT40	Test Freq. (MHz)	2452
Polarization	Vertical		-1
90 Level (dB	uV/m)		
80			
80			FCC CLASS-B
70 4			
60			
2	8	FC	CC CLASS-B (AVG)
50	6		
40			
30			
20			
20			
10			
0			
°1000		000. 14000. 16000. 18000. 2000 quency (MHz)	0. 22000. 25000
F	req. Emission Limit Mar	gin SA Factor Remar	k ANT Turn
·	level	reading	High Table
	MHz dBuV/m dBuV/m dB		cm deg
1 15	500.00 43.97 54.00 -10.	33 49.54 -5.57 Avera	

58.63

51.42

67.63

31.41

44.15

28.49

42.38

-5.57

-2.34

-2.34

5.17

5.17

10.23

10.23

Peak

Peak

Peak

Peak

Average

Average

Average

---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB) \*Factor includes antenna factor, cable loss and amplifier gain

1500.00 53.06 74.00 -20.94

4904.00 36.58 54.00 -17.42

4904.00 49.32 74.00 -24.68

7356.00 38.72 54.00 -15.28

7356.00 52.61 74.00 -21.39

54.00 -4.92

74.00 -8.71

2483.50 49.08

2483.50 65.29

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR530604-02AC Page: 49 of 63



# 3.6 Emissions in Non-Restricted Frequency Bands

## 3.6.1 Emissions in Non-Restricted Frequency Bands Limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz

### 3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

#### 3.6.3 Test Procedures

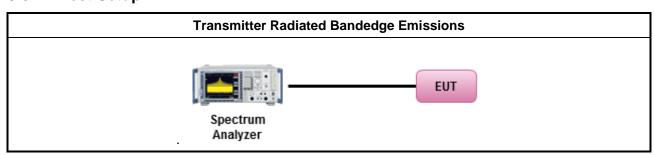
#### Reference level measurement

- 1. Set RBW=100kHz, VBW = 300kHz, Detector = Peak, Sweep time = Auto
- 2. Trace = max hold, Allow Trace to fully stabilize
- 3. Use the peak marker function to determine the maximum PSD level

#### **Emission level measurement**

- Set RBW=100kHz, VBW = 300kHz, Detector = Peak, Sweep time = Auto
- 2. Trace = max hold, Allow Trace to fully stabilize
- 3. Scan Frequency range is up to 25GHz
- 4. Use the peak marker function to determine the maximum amplitude level

### 3.6.4 Test Setup



# 3.6.5 Test Result of Emissions in non-restricted frequency bands

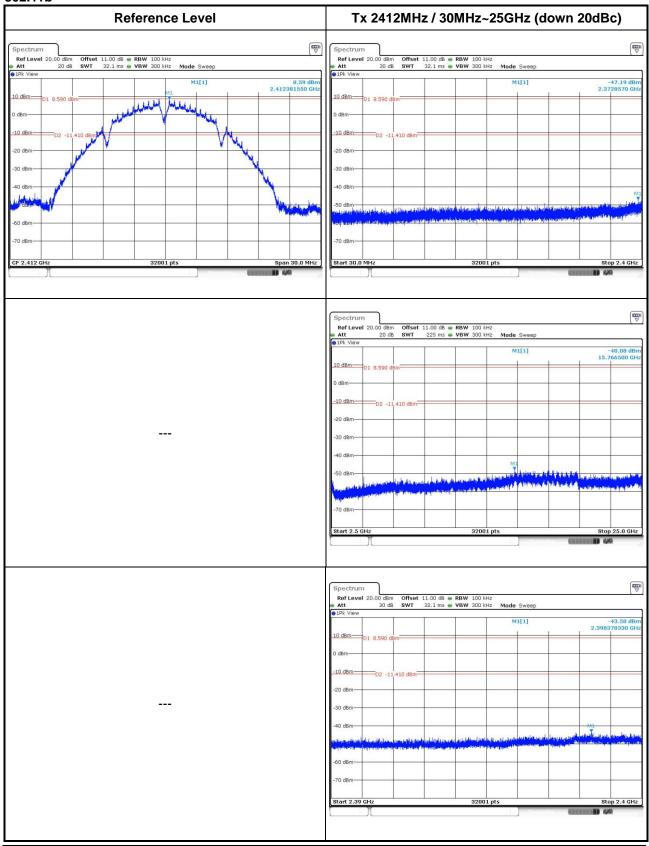
This test item is performed on each TX output individually without summing or adding 10  $log(N_{ANT})$  since measurements are made relative to the in-band emissions on the individual outputs. Only worst test result of each operating mode is presented.

Report No.: FR530604-02AC Page: 50 of 63



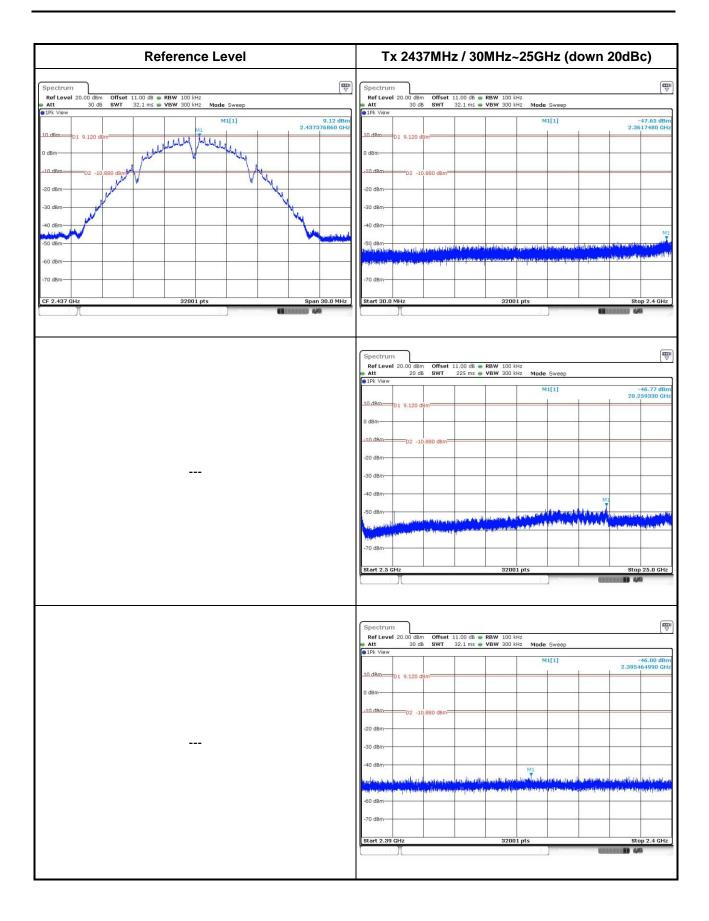
# 3.6.6 Unwanted Emissions into Non-Restricted Frequency Bands

### 802.11b



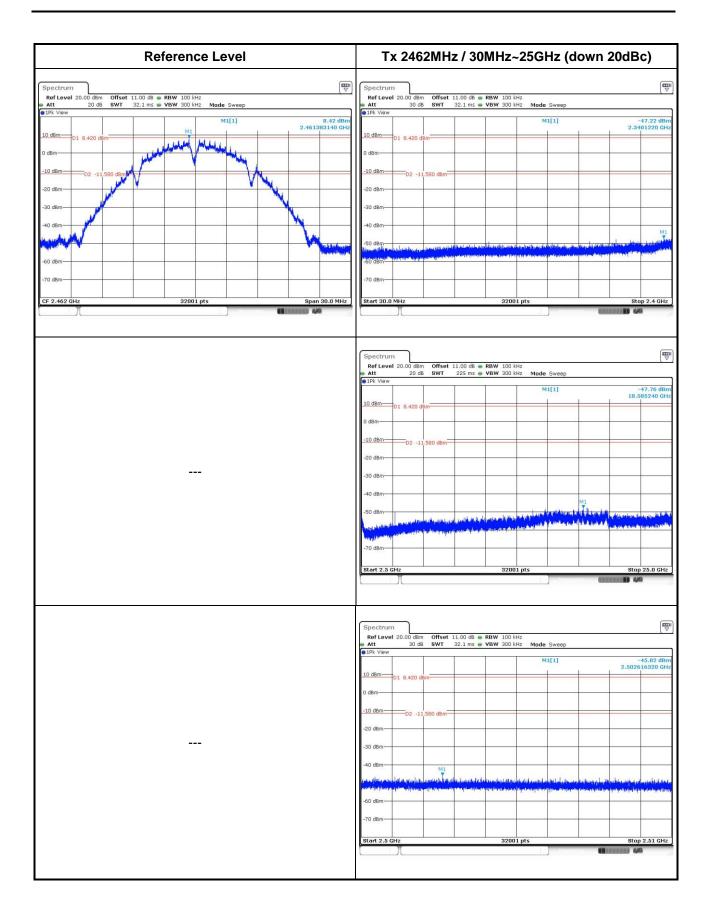
Report No.: FR530604-02AC Report Version: Rev. 01





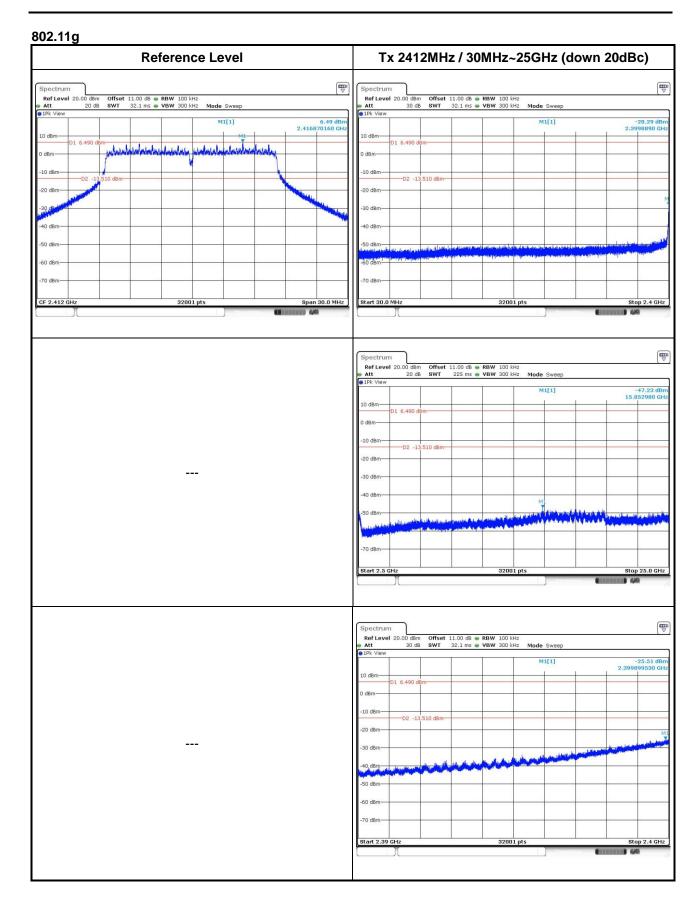
Report No.: FR530604-02AC Page: 52 of 63





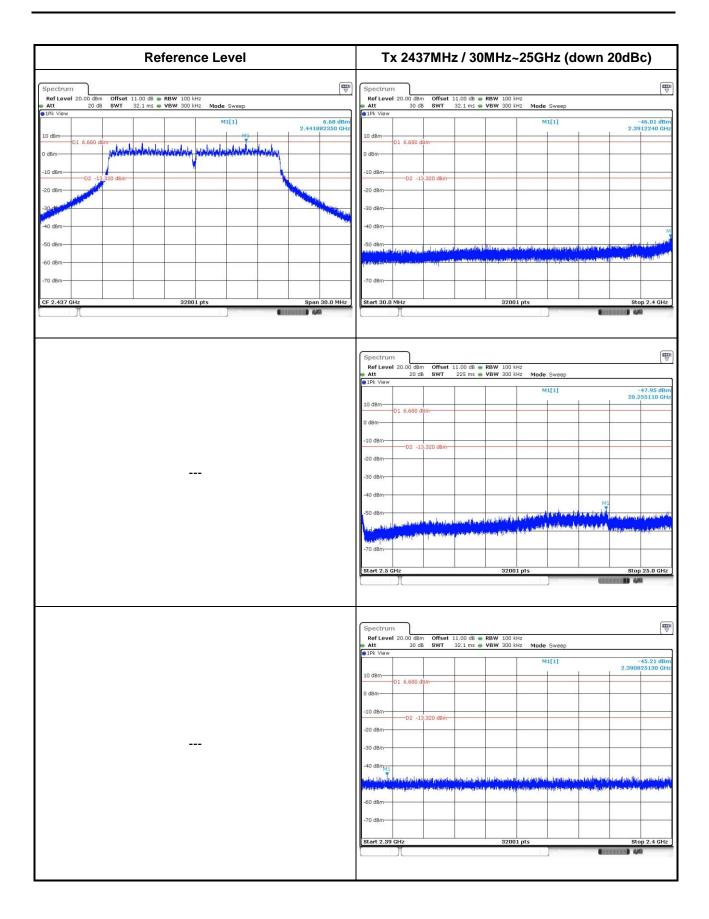
Report No.: FR530604-02AC Page: 53 of 63





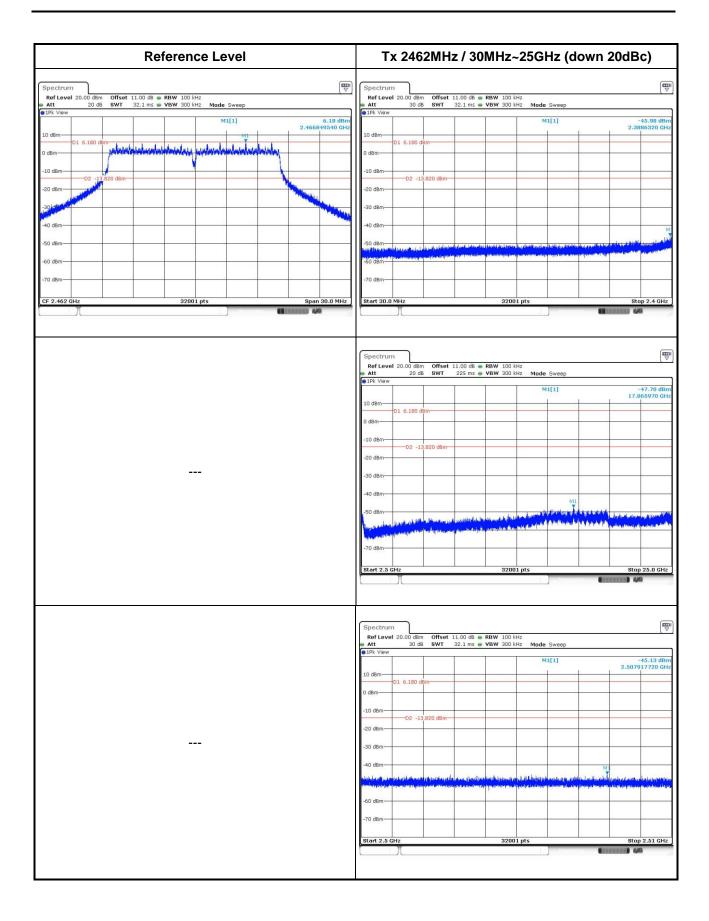
Report No.: FR530604-02AC Page: 54 of 63





Report No.: FR530604-02AC Page: 55 of 63

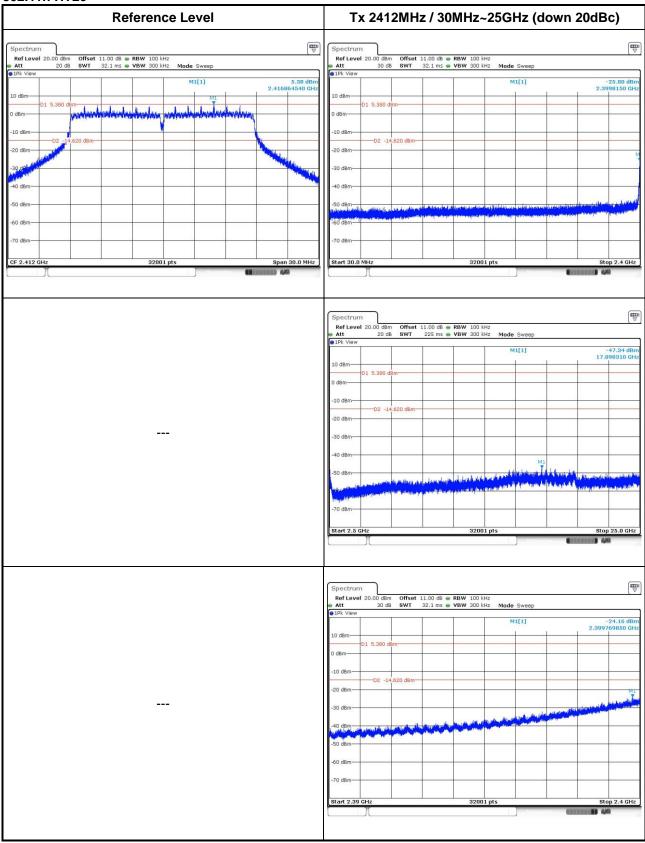




Report No.: FR530604-02AC Page: 56 of 63

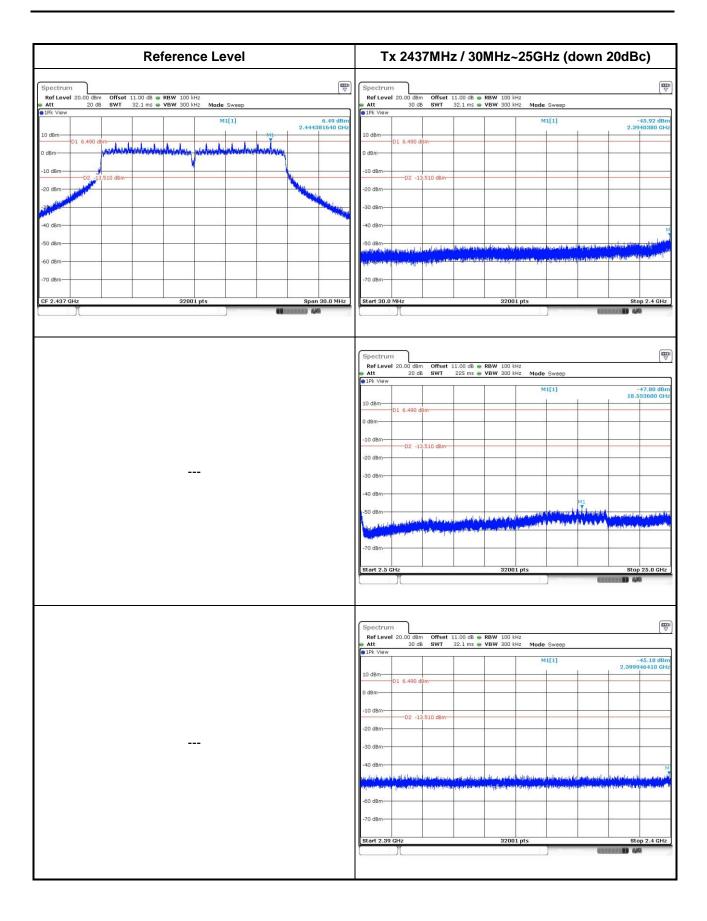


### 802.11n HT20



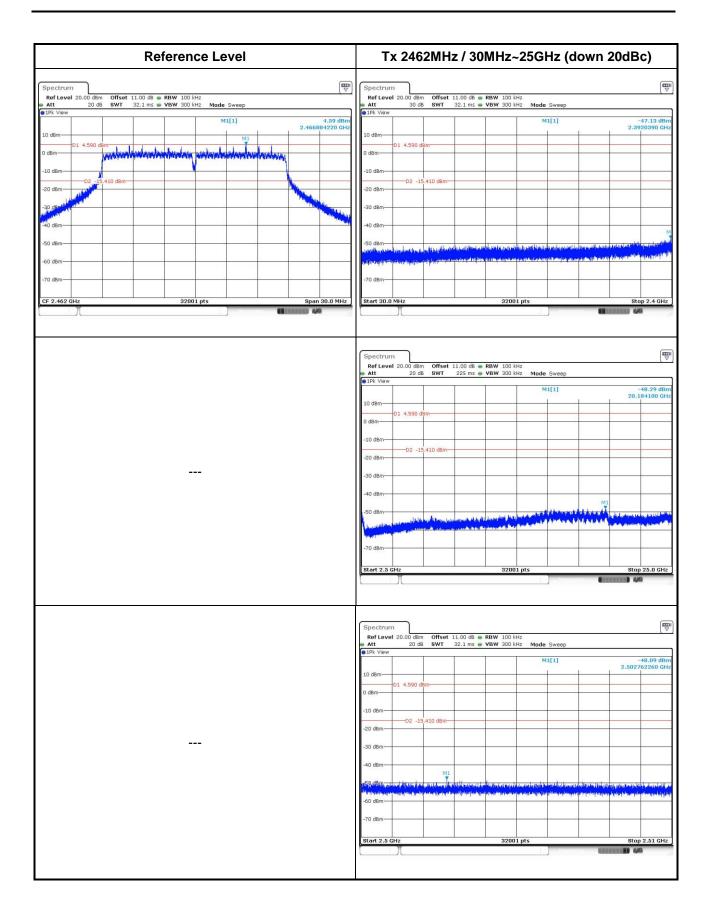
Report No.: FR530604-02AC Page: 57 of 63





Report No.: FR530604-02AC Page: 58 of 63

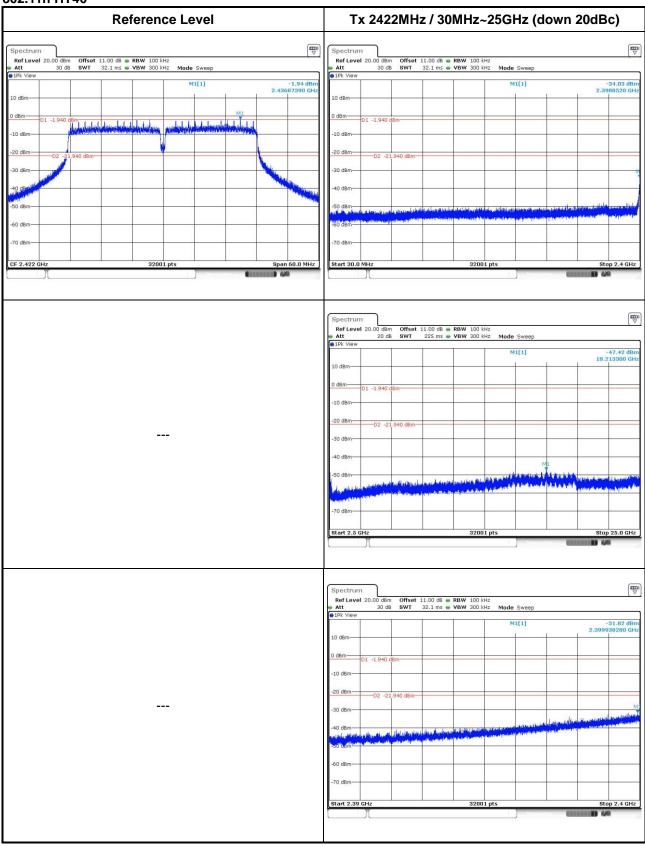




Report No.: FR530604-02AC Page: 59 of 63

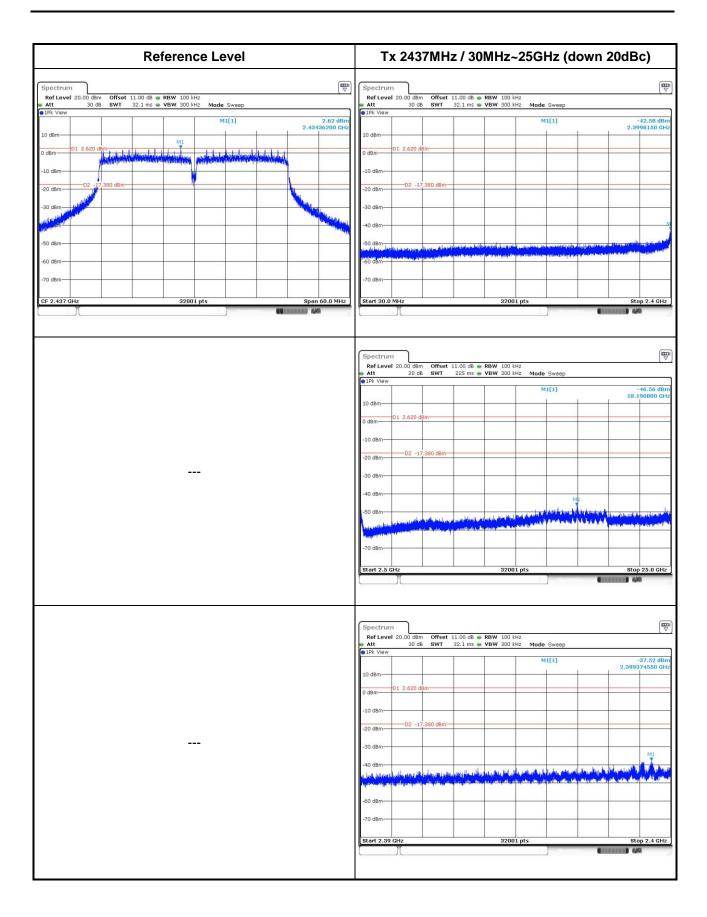


### 802.11n HT40



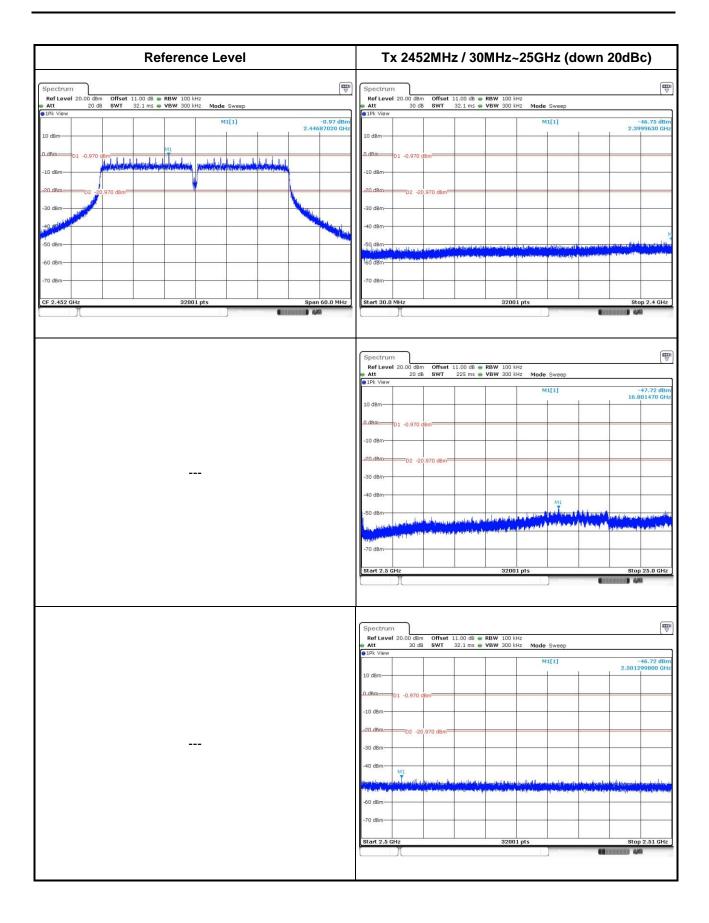
Report No.: FR530604-02AC Page: 60 of 63





Report No.: FR530604-02AC Page: 61 of 63





Report No.: FR530604-02AC Page: 62 of 63



# 4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website <a href="http://www.icertifi.com.tw">http://www.icertifi.com.tw</a>.

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan,

R.O.C.

Kwei Shan

Tel: 886-3-271-8666 No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C. Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666 Fax: 886-3-318-0155

Email: ICC\_Service@icertifi.com.tw

<u>==END</u>==

Report No.: FR530604-02AC Page: 63 of 63