



FCC Test Report

Equipment : AirStation
Trade Name : BUFFALO INC.
Model No. : WHR-600D
FCC ID : FDI000000011
Standard : 47 CFR FCC Part 15.407
Operating Band : 5150 MHz – 5250 MHz
FCC Classification : NII
Applicant : BUFFALO INC.
Manufacturer : Akamon-dori Bldg, 30-20, Ohsu 3-chome, Naka-ku,
Nagoya 460-8315, Japan
Operate Mode : Master

The product sample received on Mar. 01, 2013 and completely tested on Mar. 19, 2013. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2009 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

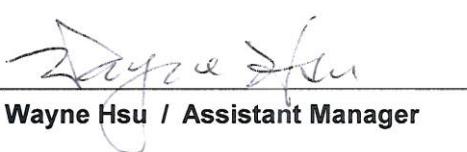

Wayne Hsu / Assistant Manager





Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information.....	5
1.2	Accessories and Support Equipment.....	7
1.3	Testing Applied Standards	7
1.4	Testing Location Information	8
1.5	Measurement Uncertainty	9
2	TEST CONFIGURATION OF EUT.....	10
2.1	The Worst Case Modulation Configuration	10
2.2	Test Channel Frequencies Configuration.....	10
2.3	The Worst Case Power Setting Parameter	10
2.4	The Worst Case Measurement Configuration.....	11
2.5	Test Setup Diagram	12
3	TRANSMITTER TEST RESULT	13
3.1	AC Power-line Conducted Emissions	13
3.2	Emission Bandwidth	16
3.3	RF Output Power.....	19
3.4	Peak Power Spectral Density.....	22
3.5	Peak Excursion.....	26
3.6	Transmitter Radiated Bandedge Emissions	28
3.7	Transmitter Radiated Unwanted Emissions	35
3.8	Frequency Stability	57
4	TEST EQUIPMENT AND CALIBRATION DATA	59
APPENDIX A. TEST PHOTOS		A1
APPENDIX B. PHOTOGRAPHS OF EUT		B1



Summary of Test Result

Conformance Test Specifications					
Report Clause	Ref. Std. Clause	Description	Measured	Limit	Result
1.1.2	15.203	Antenna Requirement	Antenna connector mechanism complied	FCC 15.203	Complied
3.1	15.207	AC Power-line Conducted Emissions	[dBuV]: 0.3692040MHz 30.75 (Margin 17.77dB) - AV 37.57 (Margin 20.95dB) - QP	FCC 15.207	Complied
3.2	15.407(a)	Emission Bandwidth	Bandwidth [MHz] 20M:19.48 / 40M:41.39	Information only	Complied
3.3	15.407(a)	RF Output Power (Maximum Conducted Output Power)	Power [dBm] 5150-5250MHz:16.51	Power [dBm] 5150-5250MHz:17	Complied
3.4	15.407(a)	Peak Power Spectral Density	PPSD [dBm/MHz] 5150-5250MHz:2.54	PPSD [dBm/MHz] 5150-5250MHz:4	Complied
3.5	15.407(a)	Peak Excursion	8.08 dB	13 dB	Complied
3.6	15.407(b)	Transmitter Radiated Bandedge Emissions	Restricted Bands [dBuV/m at 3m]: 5128.10MHz 60.32 (Margin 13.68dB) - PK 44.88 (Margin 9.12dB) - AV	Non-Restricted Bands: ≤ -27dBm (68.3dBuV/m@3m) Restricted Bands: FCC 15.209	Complied
3.7	15.407(b)	Transmitter Radiated Unwanted Emissions	Restricted Bands [dBuV/m at 3m]: 63.95MHz 38.52 (Margin 1.48dB) - QP	Non-Restricted Bands: ≤ -27dBm (68.3dBuV/m@3m) Restricted Bands: FCC 15.209	Complied
3.8	15.407(g)	Frequency Stability	11.18 ppm	Signal shall remain in-band	Complied



Revision History



1 General Description

1.1 Information

1.1.1 RF General Information

RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N _{TX})	RF Output Power (dBm)	Co-location
5150-5250	a	5180-5240	36-48 [4]	2	15.40	Yes
5150-5250	n (HT20)	5180-5240	36-48 [4]	2	15.44	Yes
5150-5250	n (HT40)	5190-5230	38-46 [2]	2	16.51	N/A

Note 1: RF output power specifies that Maximum Conducted Output Power.
 Note 2: 802.11a/n uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
 Note 3: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

1.1.2 Antenna Information

Antenna Category	
<input type="checkbox"/>	Equipment placed on the market without antennas
<input checked="" type="checkbox"/>	Integral antenna (antenna permanently attached)
<input type="checkbox"/>	<input checked="" type="checkbox"/> Temporary RF connector provided
<input type="checkbox"/>	<input type="checkbox"/> No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.
<input type="checkbox"/>	External antenna (dedicated antennas)
<input type="checkbox"/>	<input type="checkbox"/> Single power level with corresponding antenna(s). <input type="checkbox"/> Multiple power level and corresponding antenna(s). <input type="checkbox"/> RF connector provided
	<input type="checkbox"/> Unique antenna connector. (e.g., MMCX, U.FL, IPX, and RP-SMA, RP-N type...) <input type="checkbox"/> Standard antenna connector. (e.g., SMA, N, BNC, and TNC type...)

Antenna General Information					
No.	Ant. Cat.	Ant. Type	Brand	Model	Gain (dBi)
1	Integral	Dipole	-	-	2.89
2	Integral	PIFA	-	-	3.42



1.1.3 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	<input type="checkbox"/> Production ; <input checked="" type="checkbox"/> Pre-Production ; <input type="checkbox"/> Prototype
Type of EUT	
<input checked="" type="checkbox"/> Stand-alone	
<input type="checkbox"/> Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: ...	
<input type="checkbox"/> Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: ...	
<input type="checkbox"/> Other:	

1.1.4 Test Signal Duty Cycle

Operated Mode for Worst Duty Cycle	
<input type="checkbox"/> Operated normally mode for worst duty cycle	
<input checked="" type="checkbox"/> Operated test mode for worst duty cycle	
Test Signal Duty Cycle (x)	Power Duty Factor [dB] – (10 log 1/x)
<input checked="" type="checkbox"/> 100% - IEEE 802.11a	0
<input checked="" type="checkbox"/> 100% - IEEE 802.11n (HT20)	0
<input checked="" type="checkbox"/> 100% - IEEE 802.11n (HT40)	0

1.1.5 EUT Operational Condition

Supply Voltage	<input checked="" type="checkbox"/> AC mains	<input type="checkbox"/> DC	
Type of DC Source	<input type="checkbox"/> Internal DC supply	<input checked="" type="checkbox"/> External DC adapter	<input type="checkbox"/> Battery
Operational Voltage	<input checked="" type="checkbox"/> V _{nom} (110 V)	<input checked="" type="checkbox"/> V _{max} (126.5 V)	<input checked="" type="checkbox"/> V _{min} (93.5 V)
Operational Climatic	<input checked="" type="checkbox"/> T _{nom} (20°C)	<input checked="" type="checkbox"/> T _{max} (45°C)	<input checked="" type="checkbox"/> T _{min} (-5°C)



1.2 Accessories and Support Equipment

Accessories				
No.	Equipment	Brand Name	Model Name	Serial No.
1	Adapter	APD	WA-12M12FU	-

Support Equipment AC Line Conducted Emission				
No.	Equipment	Brand Name	Model Name	Serial No.
1	Notebook	DELL	E5430	DoC
2	Notebook	DELL	E5430	DoC
3	Load	-	-	-

Support Equipment Radiated Below 1GHz Test				
No.	Equipment	Brand Name	Model Name	Serial No.
1	Notebook	DELL	E5420	DoC
2	Notebook	DELL	E5420	DoC
3	Load	-	-	-

Support Equipment Radiated Above 1GHz Test				
No.	Equipment	Brand Name	Model Name	Serial No.
1	Notebook	DELL	E5420	DoC

1.3 Testing Applied Standards

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

- 47 CFR FCC Part 15
- ANSI C63.10-2009
- FCC KDB 789033
- FCC KDB 662911
- FCC KDB 412172



1.4 Testing Location Information

Testing Location				
		ADD	FAX	
<input checked="" type="checkbox"/>	HWA YA	ADD : No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-327-3456	886-3-318-0055	
<input type="checkbox"/>	JHUBEI	ADD : No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065	886-3-656-9085	
Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
RF Conducted	TH01-HY	Ian Du	23°C / 62%	07-Mar-13 ~ 19-Mar-13
AC Conduction	CO04-HY	Bill Hsiao	24.3°C / 65%	18-Mar-13
Radiated Emission	03CH05-HY	Daniel Hsu	25°C / 65%	07-Mar-13

Test site registered number [643075] with FCC.
Test site registered number [4086B-1] with IC.



1.5 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			
Test Item		Uncertainty	Limit
AC power-line conducted emissions		±2.26 dB	N/A
Emission bandwidth		±1.42 %	N/A
RF output power, conducted		±0.63 dB	N/A
Power density, conducted		±0.81 dB	N/A
Unwanted emissions, conducted	30 – 1000 MHz	±0.51 dB	N/A
	1 – 18 GHz	±0.67 dB	N/A
	18 – 40 GHz	±0.83 dB	N/A
	40 – 200 GHz	N/A	N/A
All emissions, radiated	30 – 1000 MHz	±2.56 dB	N/A
	1 – 18 GHz	±3.59 dB	N/A
	18 – 40 GHz	±3.82 dB	N/A
	40 – 200 GHz	N/A	N/A
Temperature		±0.8 °C	N/A
Humidity		±3 %	N/A
DC and low frequency voltages		±3 %	N/A
Time		±1.42 %	N/A
Duty Cycle		±1.42 %	N/A



2 Test Configuration of EUT

2.1 The Worst Case Modulation Configuration

Worst Modulation Used for Conformance Testing (5150-5250MHz)				
Modulation Mode	Transmit Chains (N _{TX})	Data Rate / MCS	Worst Data Rate / MCS	Output Power (dBm)
11a,6-54Mbps	2	6-54Mbps	6 Mbps	15.40
HT20,M0-15	2	M0-15	MCS 0	15.44
HT40,M0-15	2	M0-15	MCS 0	16.51

Note 1: IEEE Std. 802.11n modulation consists of HT20 and HT40 (HT: High Throughput). Then EUT support HT20 and HT40.

Note 2: Modulation modes consist of below configuration:
11a: IEEE 802.11a, HT20/HT40: IEEE 802.11n.

2.2 Test Channel Frequencies Configuration

Test Channel Frequencies Configuration		
Frequency Range (MHz)	IEEE Std. 802.11	Test Channel Freq. (MHz) – FX (Frequencies Abbreviations)
5150-5250	a, n (HT20)	5180-(F1), 5200-(F2), 5240-(F3)
5150-5250	n (HT40)	5190-(F1'), 5230-(F2')

2.3 The Worst Case Power Setting Parameter

The Worst Case Power Setting Parameter (5150-5250 MHz band)							
Test Software Version	Ralink QA 1.0.9.0						
Modulation Mode	N _{TX}	Test Frequency (MHz)					
		NCB: 20MHz			NCB: 40MHz		
		5180	5200	5240	5190	5230	-
11a,6-54Mbps	2	11,13	12,13	12,13	-	-	-
HT20,M0-M15	2	12,13	13,14	13,14	-	-	-
HT40,M0-M15	2	-	-	-	0D,0F	1B,1C	-



2.4 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	Operating Mode Description
1	Radio link (WLAN)

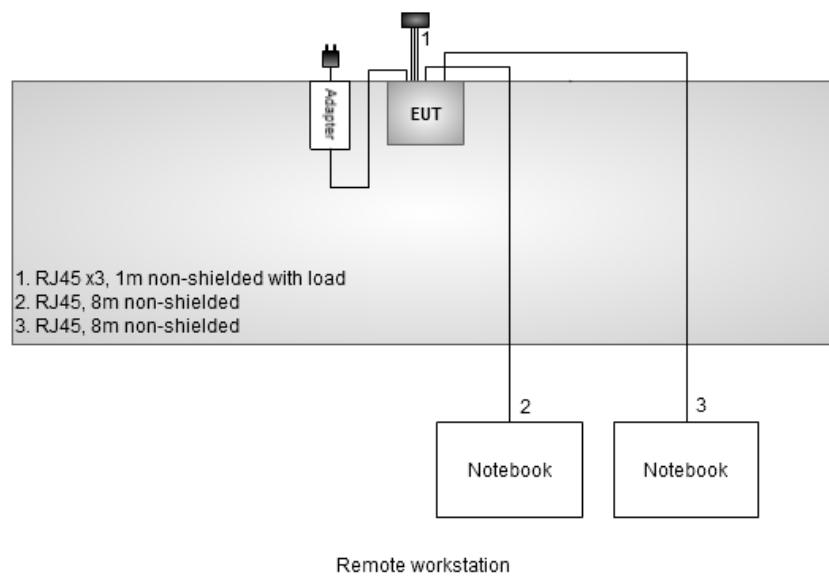
The Worst Case Mode for Following Conformance Tests	
Tests Item	RF Output Power, Peak Power Spectral Density, Emission Bandwidth, Peak Excursion
Test Condition	Conducted measurement at transmit chains
Modulation Mode	11a, HT20, HT40

The Worst Case Mode for Following Conformance Tests							
Tests Item	Transmitter Radiated Unwanted Emissions Transmitter Radiated Bandedge Emissions						
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.						
User Position	<input checked="" type="checkbox"/> EUT will be placed in fixed position. <input type="checkbox"/> EUT will be placed in mobile position and operating multiple positions. EUT shall be performed two orthogonal planes. The worst planes is X. <input type="checkbox"/> EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions. EUT shall be performed two or three orthogonal planes. The worst planes is X.						
Operating Mode < 1GHz	<input checked="" type="checkbox"/> 1. Radio link (WLAN)						
Modulation Mode	11a, HT20, HT40						
Orthogonal Planes of EUT	<table><thead><tr><th>X Plane</th><th>Y Plane</th><th>Z Plane</th></tr></thead><tbody><tr><td></td><td></td><td></td></tr></tbody></table>	X Plane	Y Plane	Z Plane			
X Plane	Y Plane	Z Plane					

2.5 Test Setup Diagram

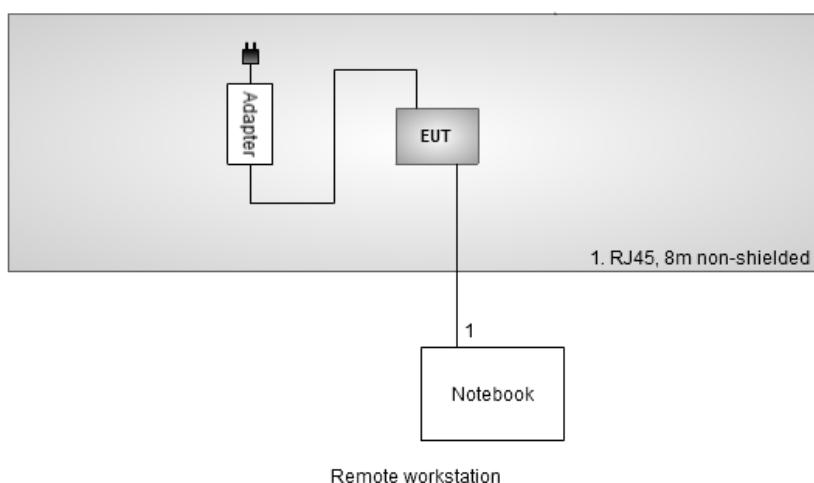
Test Setup Diagram – AC Line Conducted Emission And Radiated Below 1GHz Test

Operating Mode 1 | Radio link (WLAN)



Test Setup Diagram - Radiated Above 1GHz Test

Operating Mode 1 | Radio link (WLAN)



3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line 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.

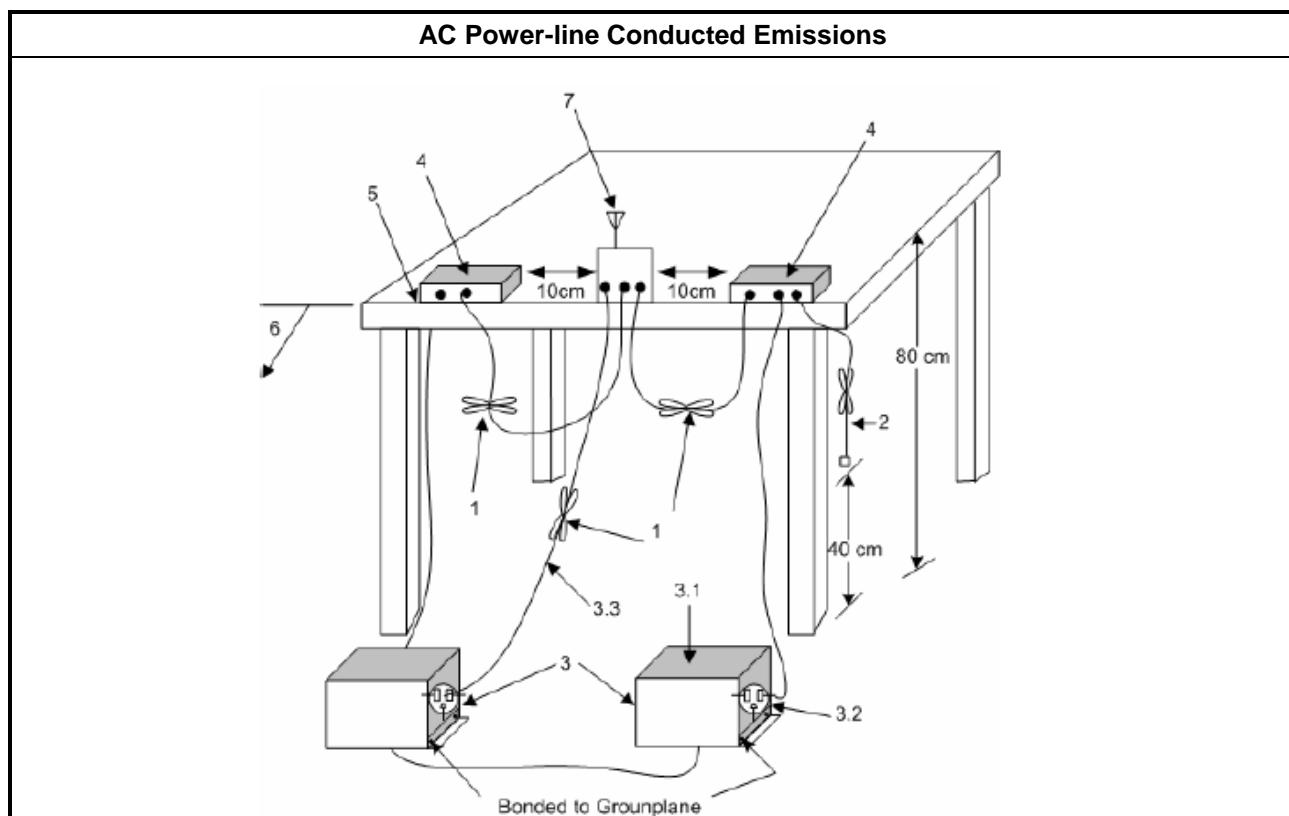
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

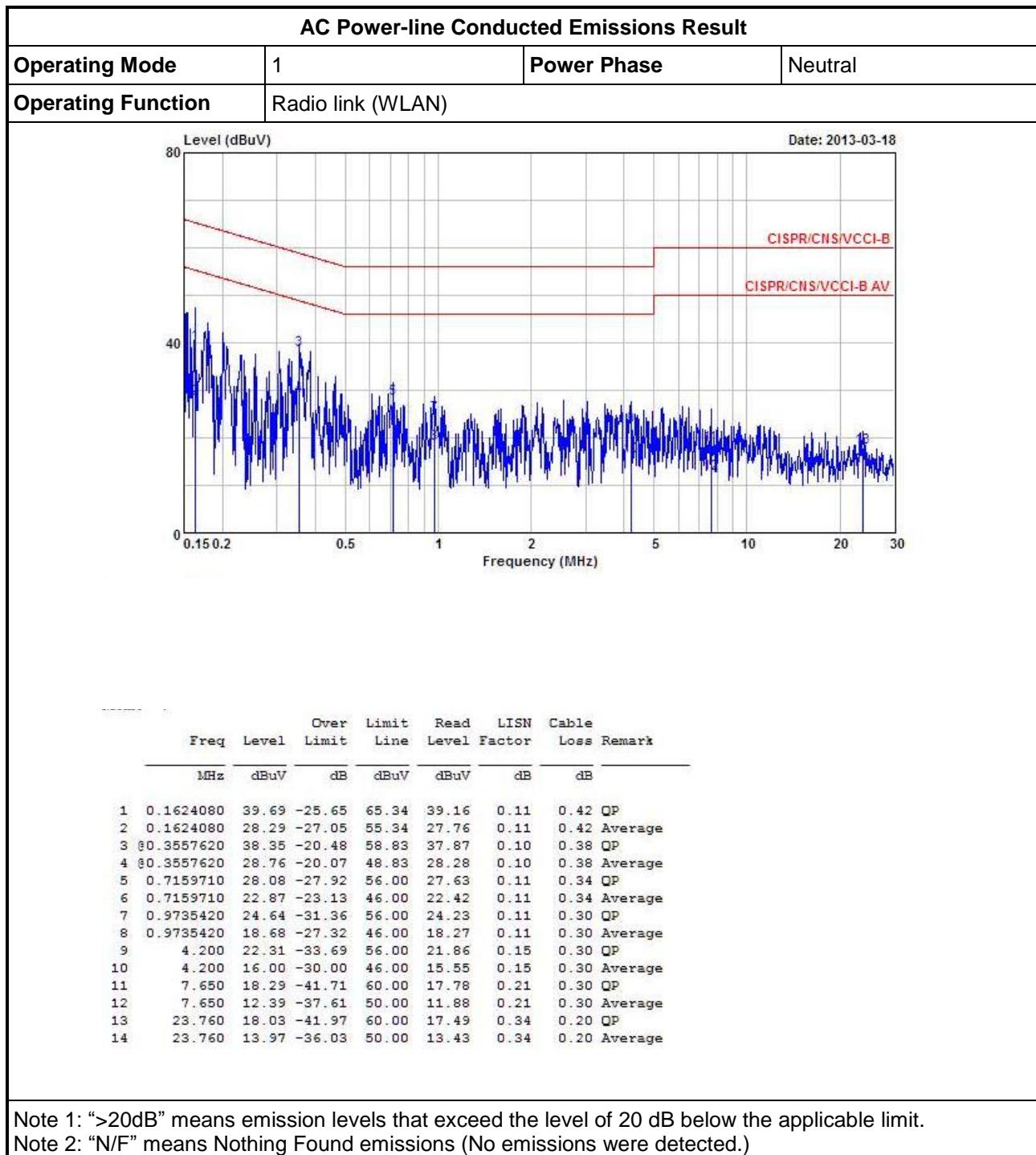
Test Method
<input checked="" type="checkbox"/> Refer as ANSI C63.10-2009, clause 6.2 for AC power-line conducted emissions.

3.1.4 Test Setup



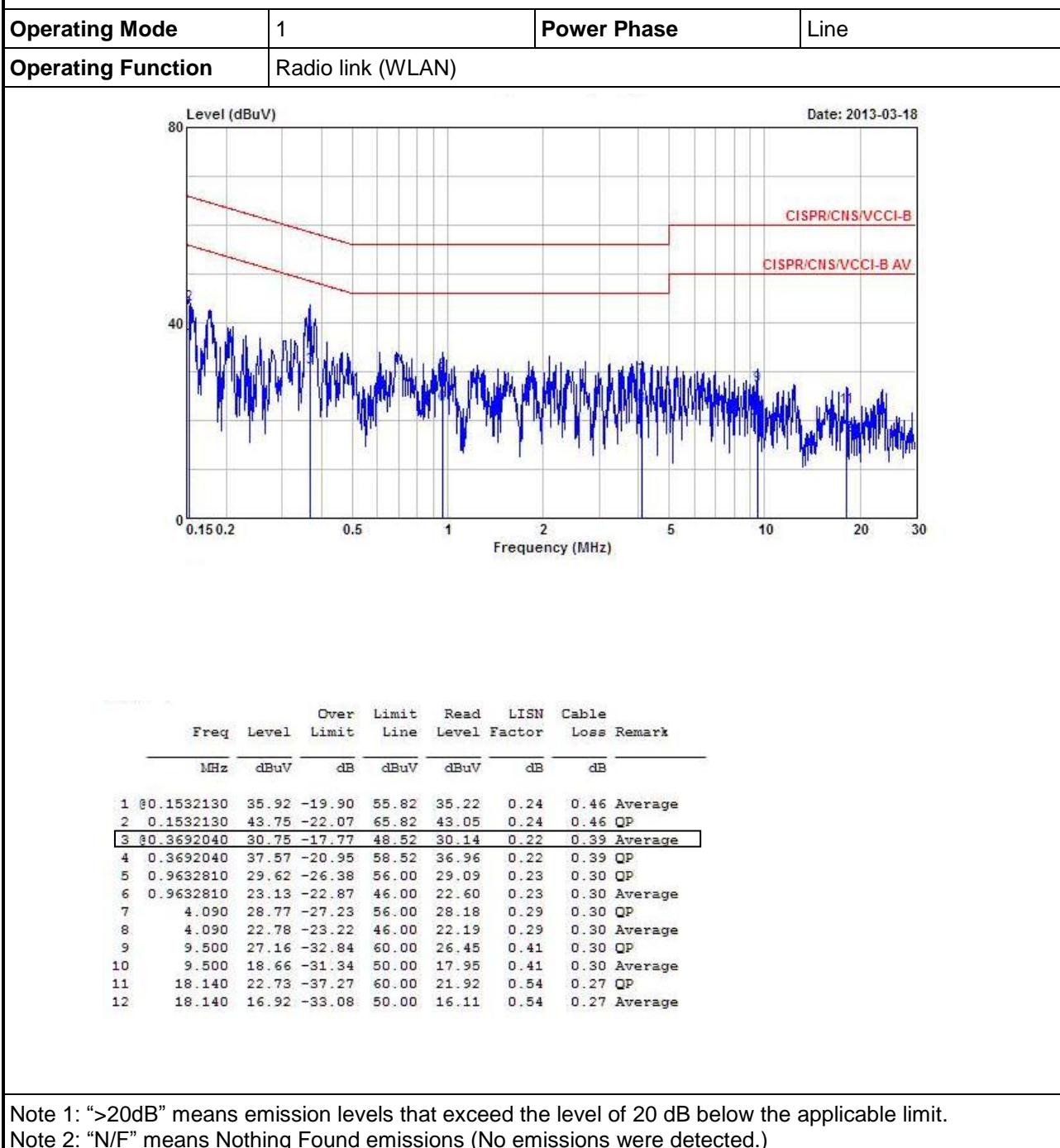


3.1.5 Test Result of AC Power-line Conducted Emissions





AC Power-line Conducted Emissions Result





3.2 Emission Bandwidth

3.2.1 Emission Bandwidth (EBW) Limit

Emission Bandwidth (EBW) Limit	
UNII Devices	
<input checked="" type="checkbox"/>	For the 5.15-5.25 GHz band, the maximum conducted output power shall not exceed the lesser of 50 mW or $4 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the maximum conducted output power shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz.
<input type="checkbox"/>	For the 5.47-5.725 GHz band, the maximum conducted output power shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz.
<input type="checkbox"/>	For the 5.725-5.825 GHz band, the maximum conducted output power shall not exceed the lesser of 1 W or $17 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz
LE-LAN Devices	
<input type="checkbox"/>	For the band 5.15-5.25 GHz, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz
<input type="checkbox"/>	For the 5.47-5.6 GHz band and 5.65-5.725 GHz band, the maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz
<input type="checkbox"/>	For the 5.725-5.825 GHz band, the maximum e.i.r.p. shall not exceed 4.0 W or $23 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

3.2.2 Measuring Instruments

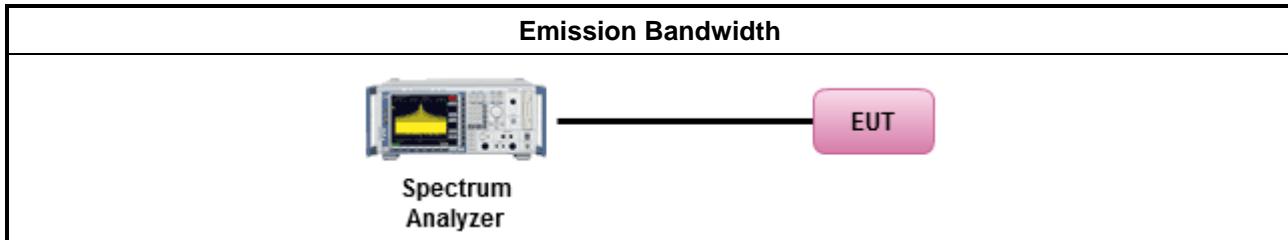
Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/>	For the emission bandwidth shall be measured using one of the options below:
<input checked="" type="checkbox"/>	Refer as FCC KDB 789033, clause D for EBW measurement.
<input type="checkbox"/>	Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.
<input checked="" type="checkbox"/>	Refer as IC RSS-Gen, clause 4.6 for bandwidth testing.
<input checked="" type="checkbox"/>	For conducted measurement.
<input type="checkbox"/>	The EUT supports single transmit chain and measurements performed on this transmit chain.
<input type="checkbox"/>	The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.
<input checked="" type="checkbox"/>	The EUT supports multiple transmit chains using options given below:
	<input type="checkbox"/> Option 1: Multiple transmit chains measurements need to be performed on one of the active transmit chains (antenna outputs). All measurement had be performed on transmit chains 1.
	<input checked="" type="checkbox"/> Option 2: Multiple transmit chains measurements need to be performed on each transmit chains individually (antenna outputs). All measurement had be performed on all transmit chains.



3.2.4 Test Setup



3.2.5 Test Result of Emission Bandwidth

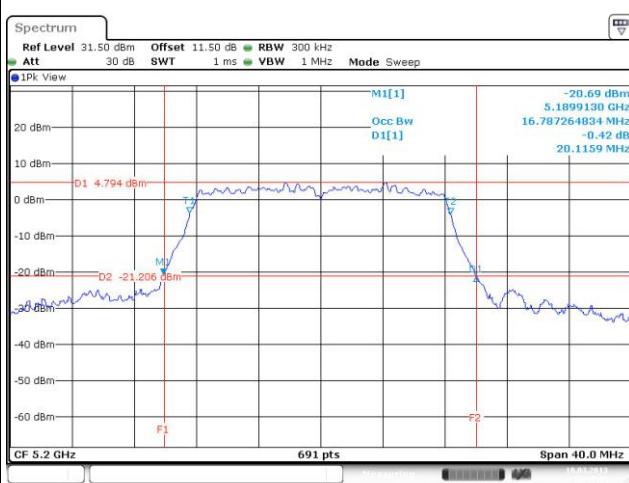
UNII Emission Bandwidth Result (5150-5250MHz band)												
Condition			Emission Bandwidth (MHz)									
Modulation Mode	N _{TX}	Freq. (MHz)	99% Bandwidth				26dB Bandwidth				Power Limit	
			Chain-Port 1	Chain-Port 2	Chain-Port 3	Chain-Port 4	Chain-Port 1	Chain-Port 2	Chain-Port 3	Chain-Port 4	99% BW	26dB BW
11a	2	5180	16.67	16.56	-	-	19.71	19.48	-	-	16.19	16.90
11a	2	5200	16.78	16.67	-	-	20.12	19.88	-	-	16.22	16.99
11a	2	5240	16.67	16.56	-	-	19.71	19.59	-	-	16.19	16.92
HT20	2	5180	17.54	17.42	-	-	20.35	20.06	-	-	16.41	17.00
HT20	2	5200	17.54	17.54	-	-	20.29	20.35	-	-	16.44	17.00
HT20	2	5240	17.54	17.48	-	-	20.23	20.06	-	-	16.43	17.00
HT40	2	5190	36.35	36.35	-	-	41.62	41.51	-	-	17.00	17.00
HT40	2	5230	36.35	36.47	-	-	43.59	41.39	-	-	17.00	17.00
Result			Complied									



5150-5250MHz

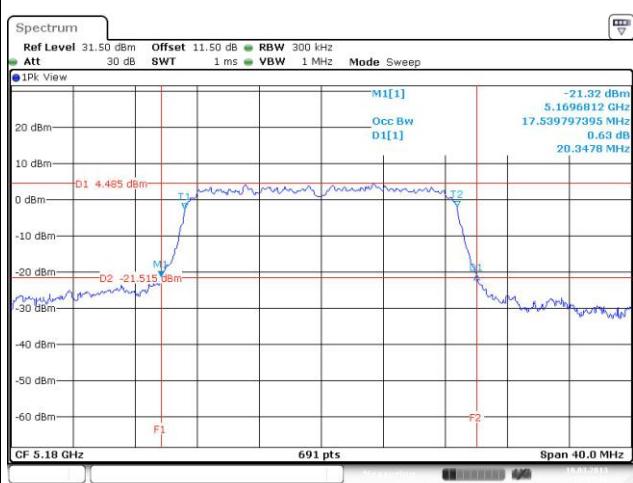
Worst Emission Bandwidth Plots

11a



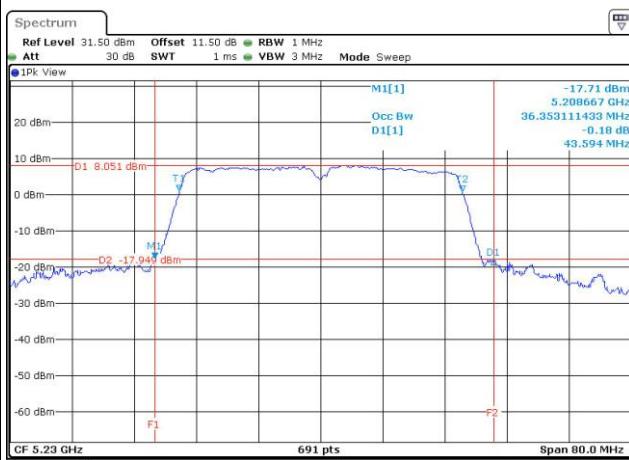
Date: 19.MAR.2013 16:41:46

HT20



Date: 19.MAR.2013 16:33:16

HT40



Date: 19.MAR.2013 16:50:36



3.3 RF Output Power

3.3.1 RF Output Power Limit

Maximum Conducted Output Power Limit	
UNII Devices	
<input checked="" type="checkbox"/>	For the 5.15-5.25 GHz band, the maximum conducted output power (P_{Out}) shall not exceed the lesser of 50 mW or $4 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz. If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 17 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the maximum conducted output power (P_{Out}) shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz. If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 24 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.47-5.725 GHz band, the maximum conducted output power (P_{Out}) shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz. If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 24 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.725-5.825 GHz band: <ul style="list-style-type: none"><input type="checkbox"/> Point-to-multipoint systems (P2M): the maximum conducted output power (P_{Out}) shall not exceed the lesser of 1 W or $17 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz. If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 6)$.<input type="checkbox"/> Point-to-point systems (P2P): the maximum conducted output power (P_{Out}) shall not exceed the lesser of 1 W or $17 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz. If $G_{TX} > 23 \text{ dBi}$, then $P_{Out} = 30 - (G_{TX} - 23)$.
LE-LAN Devices	
<input checked="" type="checkbox"/>	For the 5.15-5.25 GHz band, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz
<input type="checkbox"/>	For the 5.47-5.6 GHz band and 5.65-5.725 GHz band, the maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz
<input type="checkbox"/>	For the 5.725-5.825 GHz band, the maximum e.i.r.p. shall not exceed 4.0 W or $23 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.
<input type="checkbox"/>	Point-to-multipoint systems (P2M): the maximum e.i.r.p. shall not exceed 4.0 W or $23 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.
<input type="checkbox"/>	Point-to-point systems (P2P): the maximum e.i.r.p. shall not exceed 4.0 W or $23 + 10 \log B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. If e.i.r.p. > 36 dBm, $G_{TX} \leq P_{Out}$
P_{Out} = maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi.	

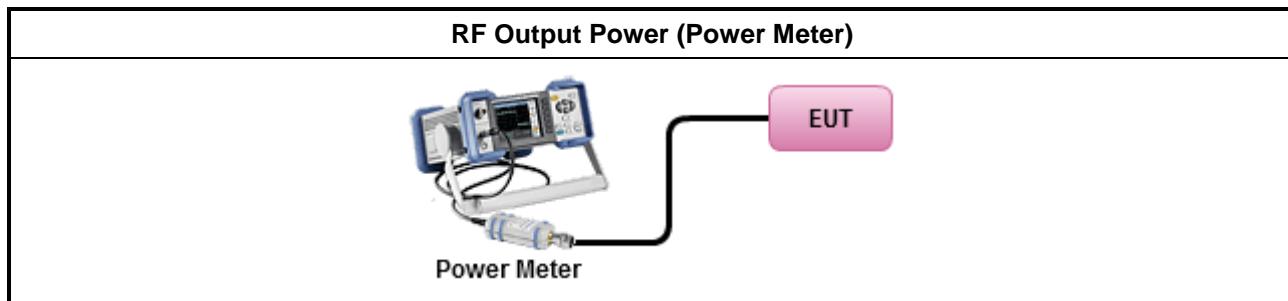
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

Test Method
<input checked="" type="checkbox"/> Maximum Conducted Output Power
[duty cycle \geq 98% or external video / power trigger]
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-1 (spectral trace averaging).
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-1 Alt. (RMS detection with slow sweep speed)
duty cycle $<$ 98% and average over on/off periods with duty factor
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-2 (spectral trace averaging).
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-2 Alt. (RMS detection with slow sweep speed)
Wideband RF power meter and average over on/off periods with duty factor
<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause C Method PM (using an RF average power meter).
<input checked="" type="checkbox"/> For conducted measurement.
<input type="checkbox"/> The EUT supports single transmit chain and measurements performed on this transmit chain.
<input type="checkbox"/> The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.
<input checked="" type="checkbox"/> The EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.
<input checked="" type="checkbox"/> If multiple transmit chains, EIRP calculation could be following as methods: $P_{total} = P_1 + P_2 + \dots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$

3.3.4 Test Setup





3.3.5 Directional Gain for Power Measurement

Directional Gain (DG) Result					
Transmit Chains No.		1	2	-	-
Maximum G _{ANT} (dBi)		2.89	3.42	-	-
Modulation Mode	DG (dBi)	N _{TX}	N _{SS}	STBC	Array Gain (dB)
11a,6-54Mbps	3.42	2	1	-	-
HT20,MCS 0-7	3.42	2	1	-	-
HT20,MCS 8-15	3.42	2	2	-	-
HT40,M0-M15	3.42	2	1	-	-
HT40,MCS 8-15	3.42	2	2	-	-

Note 1: For all transmitter outputs with equal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = G_{ANT} + 10 log(N_{TX})
All transmit signals are completely uncorrelated, Directional Gain = G_{ANT}

Note 2: For all transmitter outputs with unequal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = 10 log[(10^{G1/20} + ... + 10^{GN/20})² / N_{TX}]
All transmit signals are completely uncorrelated, Directional Gain = 10 log[(10^{G1/10} + ... + 10^{GN/10}) / N_{TX}]

Note 3: For Spatial Multiplexing, Directional Gain (DG) = G_{ANT} + 10 log(N_{TX}/N_{SS}),
where N_{SS} = the number of independent spatial streams data.

Note 4: For CDD transmissions, directional gain is calculated as power measurements:
Directional Gain (DG) = G_{ANT} + Array Gain, where Array Gain is as follows:
Array Gain = 0 dB (i.e., no array gain) for N_{TX} ≤ 4;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{TX};

3.3.6 Test Result of Maximum Conducted Output Power

Maximum Conducted Output Power (5150-5250MHz band)												
Condition			RF Output Power (dBm)									
Modulation Mode	N _{TX}	Freq. (MHz)	Chain Port 1	Chain Port 2	Chain Port 3	Chain Port 4	Sum Chain	Power Limit	DG (dBi)	EIRP Power	EIRP Limit	
11a	2	5180	12.01	12.12	-	-	15.08	17.0	3.42	18.50	23.0	
11a	2	5200	12.00	12.01	-	-	15.02	17.0	3.42	18.44	23.0	
11a	2	5240	12.05	12.71	-	-	15.40	17.0	3.42	18.82	23.0	
HT20	2	5180	12.37	12.06	-	-	15.23	17.0	3.42	18.65	23.0	
HT20	2	5200	12.31	12.01	-	-	15.17	17.0	3.42	18.59	23.0	
HT20	2	5240	12.31	12.55	-	-	15.44	17.0	3.42	18.86	23.0	
HT40	2	5190	9.17	9.57	-	-	12.38	17.0	3.42	15.80	23.0	
HT40	2	5230	13.56	13.44	-	-	16.51	17.0	3.42	19.93	23.0	
Result			Complied									



3.4 Peak Power Spectral Density

3.4.1 Peak Power Spectral Density Limit

Peak Power Spectral Density Limit	
UNII Devices	
<input checked="" type="checkbox"/>	For the 5.15-5.25 GHz band, the peak power spectral density (PPSD) ≤ 4 dBm/MHz. If $G_{TX} > 6$ dBi, then $PPSD = 4 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the peak power spectral density (PPSD) ≤ 11 dBm/MHz. If $G_{TX} > 6$ dBi, then $PPSD = 11 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.47-5.725 GHz band, the peak power spectral density (PPSD) ≤ 11 dBm/MHz. If $G_{TX} > 6$ dBi, then $PPSD = 11 - (G_{TX} - 6)$.
<input type="checkbox"/>	For the 5.725-5.825 GHz band: <ul style="list-style-type: none"><input type="checkbox"/> Point-to-multipoint systems (P2M): the peak power spectral density (PPSD) ≤ 17 dBm/MHz. If $G_{TX} > 6$ dBi, then $PPSD = 17 - (G_{TX} - 6)$.<input type="checkbox"/> Point-to-point systems (P2P): the peak power spectral density (PPSD) ≤ 17 dBm/MHz. If $G_{TX} > 23$ dBi, then $PPSD = 17 - (G_{TX} - 23)$.
LE-LAN Devices	
<input checked="" type="checkbox"/>	For the 5.15-5.25 GHz band, the peak power spectral density (PPSD) ≤ 4 dBm/MHz and the e.i.r.p. peak power spectral density (PPSD) ≤ 10 dBm/MHz.
<input type="checkbox"/>	For the 5.25-5.35 GHz band, the peak power spectral density (PPSD) ≤ 11 dBm/MHz and the e.i.r.p. peak power spectral density (PPSD) ≤ 17 dBm/MHz.
<input type="checkbox"/>	For the 5.47-5.6 GHz band and 5.65-5.725 GHz band, the peak power spectral density (PPSD) ≤ 11 dBm/MHz and the e.i.r.p. peak power spectral density (PPSD) ≤ 17 dBm/MHz.
<input type="checkbox"/>	For the 5.725-5.825 GHz band, the peak power spectral density (PPSD) ≤ 17 dBm/MHz and the e.i.r.p. peak power spectral density (PPSD) ≤ 23 dBm/MHz.
PPSD = peak power spectral density that the same method as used to determine the conducted output power shall be used to determine the power spectral density. And power spectral density in dBm/MHz G_{TX} = the maximum transmitting antenna directional gain in dBi.	

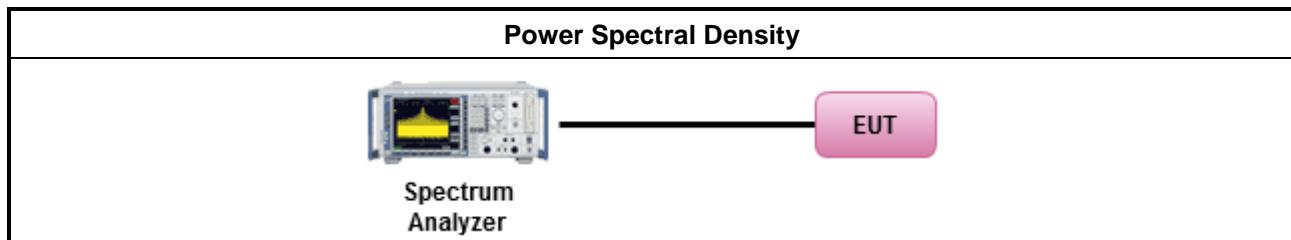
3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/> Peak power spectral density procedures that the same method as used to determine the conducted output power shall be used to determine the peak power spectral density and use the peak search function on the spectrum analyzer to find the peak of the spectrum. For the peak power spectral density shall be measured using below options:	
[duty cycle \geq 98% or external video / power trigger]	
<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-1 (spectral trace averaging).	
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-1 Alt. (RMS detection with slow sweep speed)	
duty cycle $<$ 98% and average over on/off periods with duty factor	
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-2 (spectral trace averaging).	
<input type="checkbox"/> Refer as FCC KDB 789033, clause C Method SA-2 Alt. (RMS detection with slow sweep speed)	
<input checked="" type="checkbox"/> For conducted measurement.	
<input type="checkbox"/> The EUT supports single transmit chain and measurements performed on this transmit chain.	
<input type="checkbox"/> The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.	
<input checked="" type="checkbox"/> The EUT supports multiple transmit chains using options given below:	
	<input checked="" type="checkbox"/> Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.
	<input type="checkbox"/> Option 2: Measure and add $10 \log(N)$ dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with $10 \log(N)$. Or each transmit chains shall be add $10 \log(N)$ to compared with the limit.
<input checked="" type="checkbox"/>	If multiple transmit chains, EIRP PPSD calculation could be following as methods: $PPSD_{total} = PPSD_1 + PPSD_2 + \dots + PPSD_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = PPSD_{total} + DG$
<input checked="" type="checkbox"/>	Each individually PPSD plots refer as test report clause 3.3.5 with each individually PPSD plots.

3.4.4 Test Setup





3.4.5 Directional Gain for Power Spectral Density Measurement

Directional Gain (DG) Result					
Transmit Chains No.		1	2	-	-
Maximum G_{ANT} (dBi)		2.89	3.42	-	-
Modulation Mode	DG (dBi)	N_{TX}	N_{SS}	STBC	Array Gain (dB)
11a,6-54Mbps	6.43	2	1	-	3.01-
HT-20,M0-M7	6.43	2	1	-	3.01-
HT-20,M8-M15	3.42	2	2	-	0-
HT-40,M0-M7	6.43	2	1	-	3.01-
HT-40,M8-M15	3.42	2	2	-	0-

Note 1: For all transmitter outputs with equal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = $G_{ANT} + 10 \log(N_{TX})$
All transmit signals are completely uncorrelated, Directional Gain = G_{ANT}

Note 2: For all transmitter outputs with unequal antenna gains, directional gain is to be computed as follows:
Any transmit signals are correlated, Directional Gain = $10 \log[(10^{G_{1/20}} + \dots + 10^{G_{N/20}})^2 / N_{TX}]$
All transmit signals are completely uncorrelated, Directional Gain = $10 \log[(10^{G_{1/10}} + \dots + 10^{G_{N/10}}) / N_{TX}]$

Note 3: For Spatial Multiplexing, Directional Gain (DG) = $G_{ANT} + 10 \log(N_{TX}/N_{SS})$,
where N_{SS} = the number of independent spatial streams data.

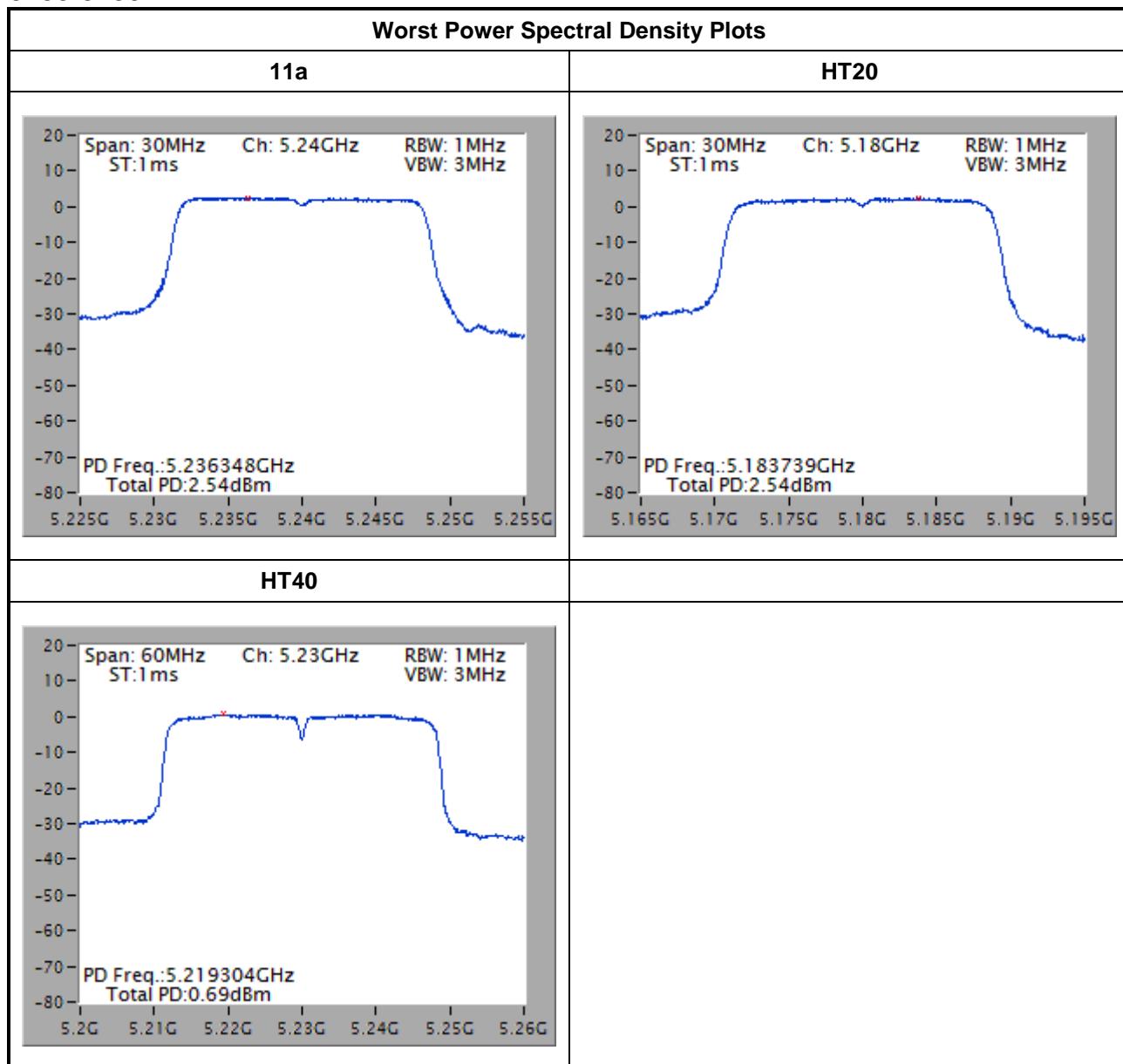
Note 4: For CDD transmissions, directional gain is calculated as power spectral density measurements:
Directional Gain (DG) = $G_{ANT} + \text{Array Gain}$, where Array Gain is as follows:
Array Gain = $10 \log(N_{TX}/N_{SS})$;

3.4.6 Test Result of Peak Power Spectral Density

Peak Power Spectral Density Result (5150-5250MHz band)											
Condition			Peak Power Spectral Density (dBm/MHz)								
Modulation Mode	N_{TX}	Freq. (MHz)	Sum Chain	-	-	-	Sum Chain	PSD Limit	DG (dBi)	EIRP PSD	EIRP Limit
11a	2	5180	2.42	-	-	-	2.42	3.57	6.43	8.85	9.57
11a	2	5200	2.33	-	-	-	2.33	3.57	6.43	8.76	9.57
11a	2	5240	2.54	-	-	-	2.54	3.57	6.43	8.97	9.57
HT20	2	5180	2.54	-	-	-	2.54	3.57	6.43	8.97	9.57
HT20	2	5200	2.28	-	-	-	2.28	3.57	6.43	8.71	9.57
HT20	2	5240	2.51	-	-	-	2.51	3.57	6.43	8.94	9.57
HT40	2	5190	-3.10	-	-	-	-3.10	3.57	6.43	3.33	9.57
HT40	2	5230	0.69	-	-	-	0.69	3.57	6.43	7.12	9.57
Result			Complied								



5150-5250MHz



Note 1: Power Density Plots w/o Duty Factor



3.5 Peak Excursion

3.5.1 Peak Excursion Limit

Peak Excursion Limit	
UNII Devices	
<input checked="" type="checkbox"/>	Peak excursion \leq 13 dB. The ratio of the maximum of the peak-max-hold spectrum to the maximum of the average spectrum for continuous transmission does not exceed 13 dB. (Earlier procedures that required computing the ratio of the two spectra at each frequency across the emission bandwidth can lead to unintended failures at band edges and will no longer be required.)
LE-LAN Devices	
<input checked="" type="checkbox"/>	N/A

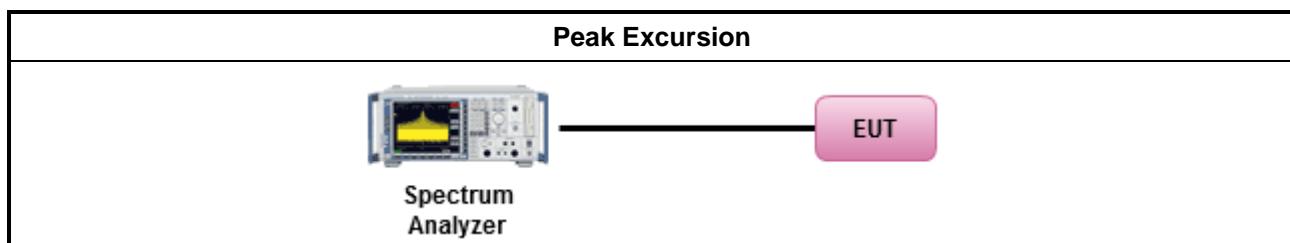
3.5.2 Measuring Instruments

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

3.5.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/>	Refer as FCC KDB 789033, clause F peak excursion method.
<input checked="" type="checkbox"/>	Testing each modulation mode on a single channel is sufficient to demonstrate compliance with the peak excursion requirement
<input checked="" type="checkbox"/>	For conducted measurement. <ul style="list-style-type: none"><input checked="" type="checkbox"/> The EUT supports single transmit chain and measurements performed on this transmit chain.<input type="checkbox"/> The EUT supports diversity transmitting and the results on transmit chain port 1 is the worst case.<input checked="" type="checkbox"/> The EUT supports multiple transmit chains using given below method: Refer as FCC KDB 662911, when testing in-band (peak to average ratio) against relative emission limits, tests may be performed on each output individually without summing or adding $10 \log(N)$.<input checked="" type="checkbox"/> Test result plots refer as test report clause 3.3.5 with peak excursion ratio of the maximum of the peak-max-hold spectrum to the maximum of the average spectrum.

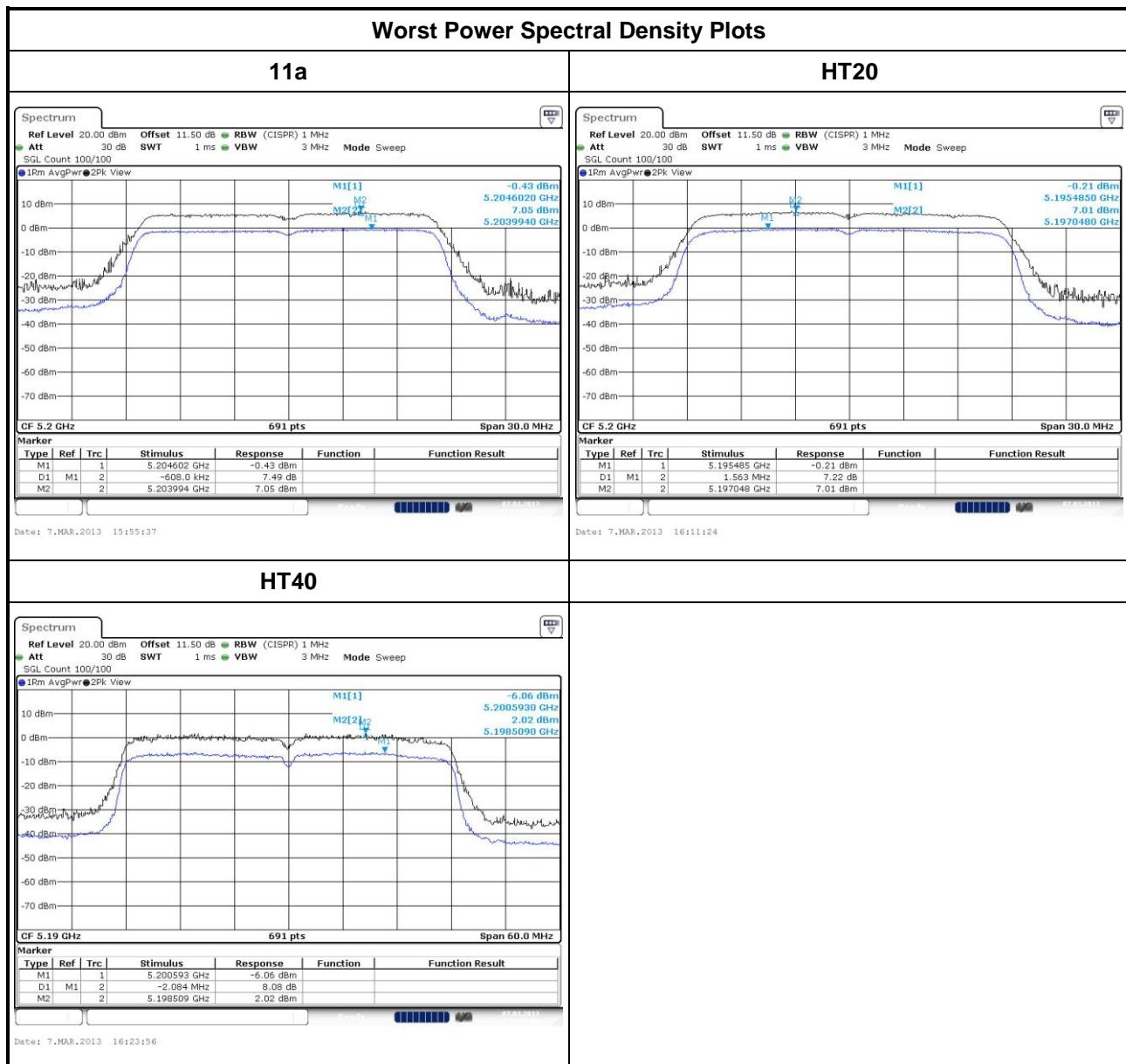
3.5.4 Test Setup





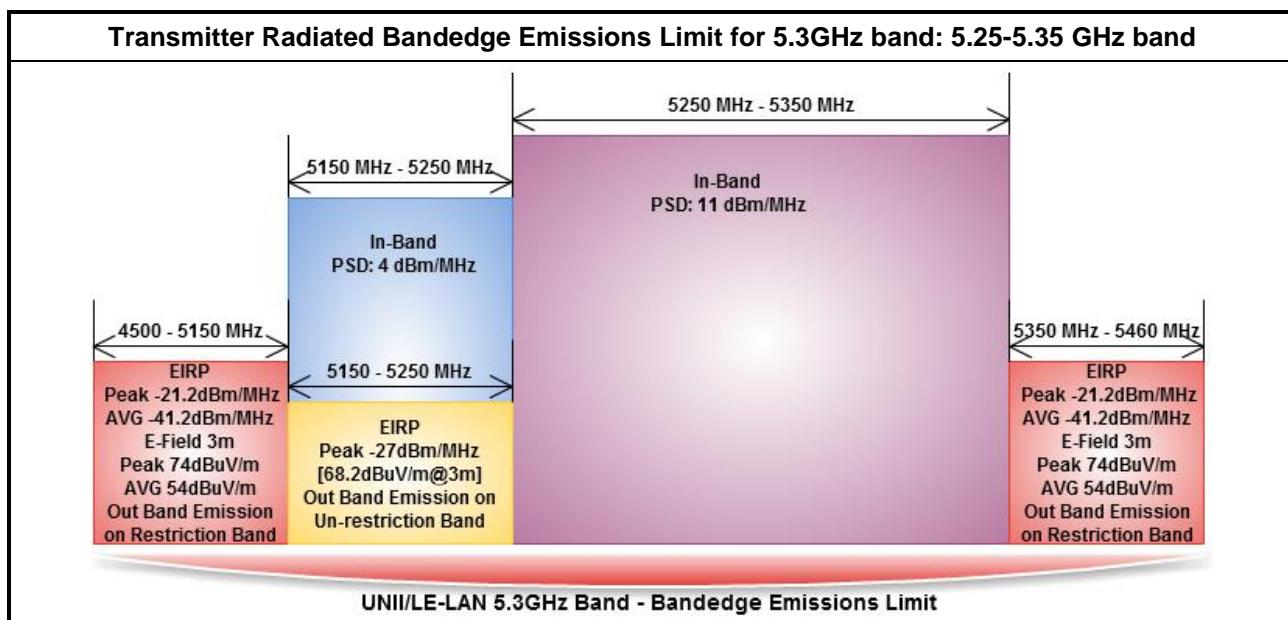
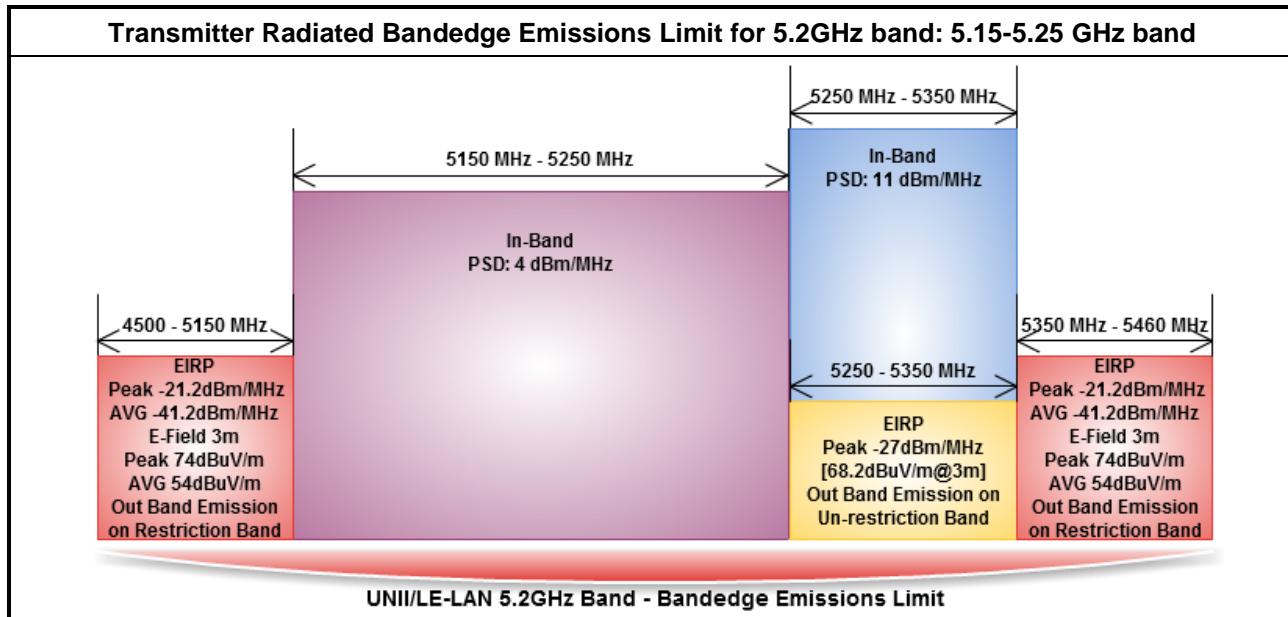
3.5.5 Test Result of Peak Excursion

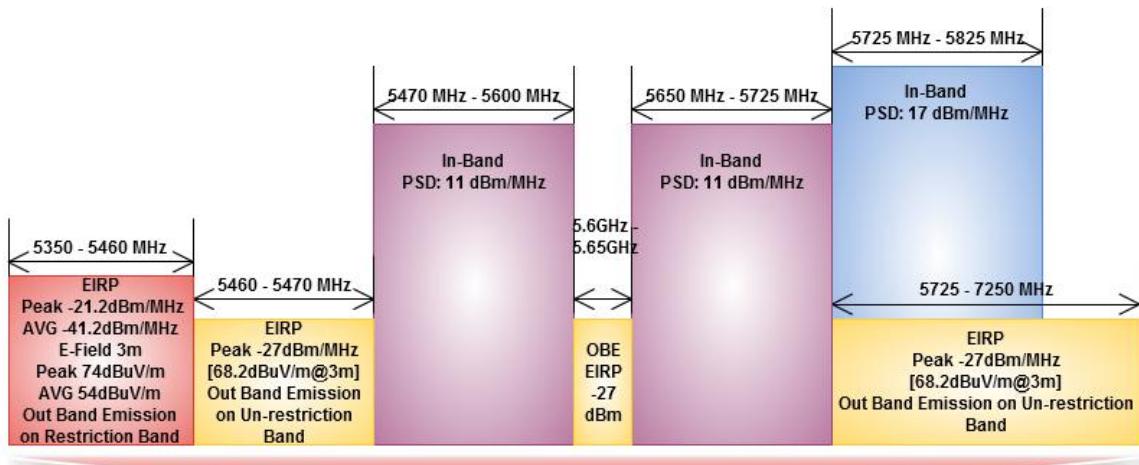
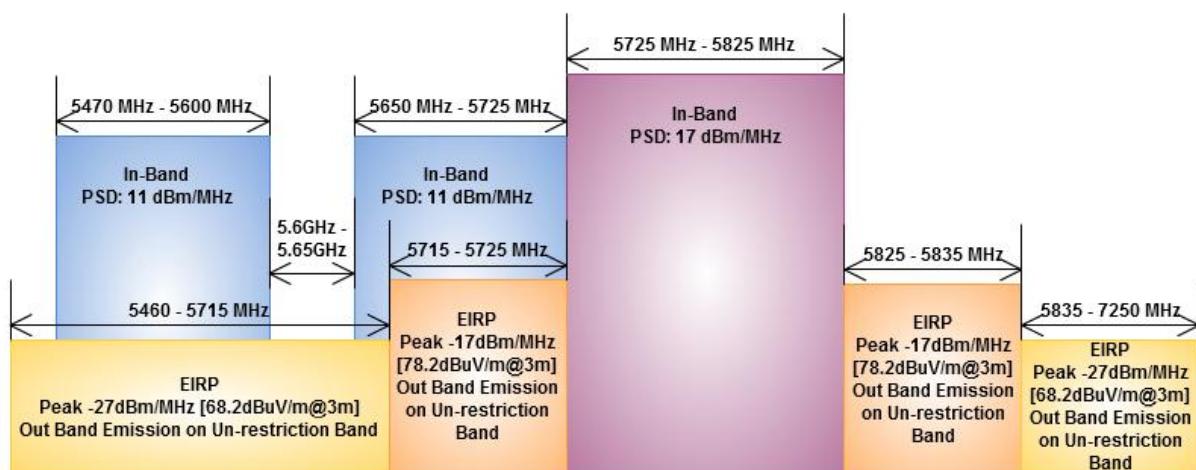
UNII Peak Excursion Result (5150-5250MHz band)							
Condition			Peak Excursion (dB)				
Modulation Mode	N _{TX}	Freq. (MHz)	Chain-Port 1	Chain-Port 2	Chain-Port 3	Chain-Port 4	Limit
11a	2	5200	7.02	7.49	-	-	13.0
HT20	2	5200	7.22	6.64	-	-	13.0
HT40	2	5190	8.08	7.96	-	-	13.0
Result			Complied				



3.6 Transmitter Radiated Bandedge Emissions

3.6.1 Transmitter Radiated Bandedge Emissions Limit



Transmitter Radiated Bandedge Emissions Limit for 5.6GHz band: 5.47-5.725 GHz band

Transmitter Radiated Bandedge Emissions Limit for 5.8GHz band: 5.725-5.825 GHz band


3.6.2 Measuring Instruments

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

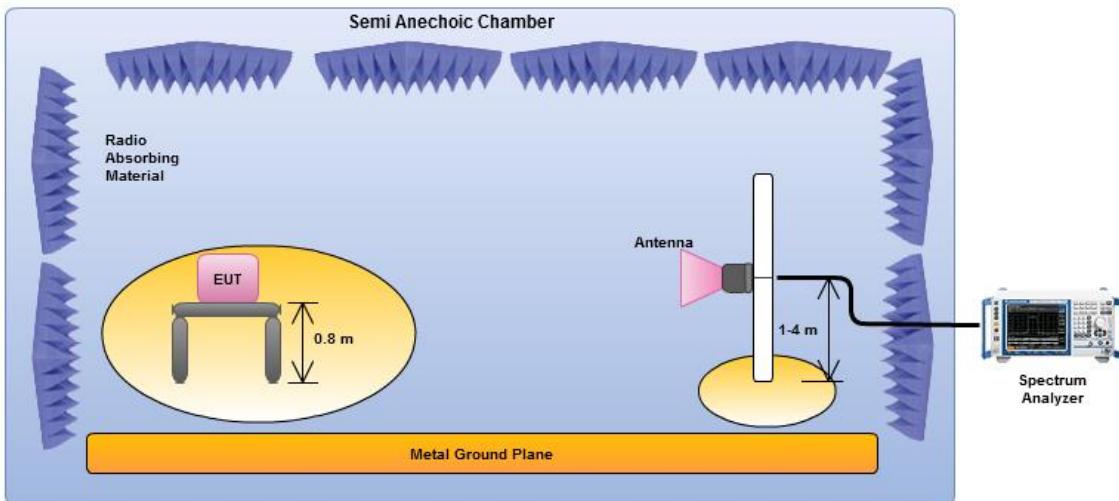


3.6.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/> Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements). Measurements in the bandedge are typically made at a closer distance 3m, because the instrumentation noise floor is typically close to the radiated emission limit.	
<input checked="" type="checkbox"/> The average emission levels shall be measured in [duty cycle \geq 98 or duty factor].	
<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.9.2.2 bandedge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.	
<input type="checkbox"/> If EUT operate in adjacent contiguous bands, bandedge testing performed at the lowest frequency channel at lower-band and highest frequency channel at higher-band. Transmitter in-band emissions will consist of adjacent contiguous bands (e.g., IEEE 802.11ac VHT160 The lowest frequency channel at lower-band and highest frequency channel at higher-band in-band emissions will consist of two adjacent contiguous bands.)	
	<input type="checkbox"/> Operating in 5.15-5.25 GHz band (lower-band) and 5.25-5.35 GHz band (higher-band).
	<input type="checkbox"/> Operating in 5.47-5.725 GHz band (lower-band) and 5.725-5.825 GHz band (higher-band).
<input type="checkbox"/> If EUT operate in individual non-contiguous bands, bandedge testing performed at the lowest frequency channel and highest frequency channel within lower-band and higher-band. (e.g., (e.g., IEEE 802.11ac VHT160)	
	<input type="checkbox"/> Operating in 5.25-5.35 GHz band (lower-band) and 5.47-5.725 GHz band (higher-band).
	<input type="checkbox"/> Operating in 5.15-5.25 GHz band (lower-band) and 5.725-5.825 GHz band (higher-band).
<input checked="" type="checkbox"/> For the transmitter unwanted emissions shall be measured using following options below:	
<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause G2) for unwanted emissions into non-restricted bands.	
<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause G1) for unwanted emissions into restricted bands.	
	<input type="checkbox"/> Refer as FCC KDB 789033, G6) Method AD (Trace Averaging).
	<input type="checkbox"/> Refer as FCC KDB 789033, G6) Method VB (Reduced VBW).
	<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW $\geq 1/T$, where T is pulse time.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
	<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause G5) measurement procedure peak limit.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.2 measurement procedure peak limit.
<input checked="" type="checkbox"/> For the transmitter bandedge emissions shall be measured using following options below:	
	<input type="checkbox"/> Refer as FCC KDB 789033, clause G3)d) marker-delta method for band-edge measurements.
	<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.9.2 for band-edge testing.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 6.9.3 for marker-delta method for band-edge measurements.
<input checked="" type="checkbox"/> For radiated measurement, refer as ANSI C63.10, clause 6.5 for radiated emissions from above 1 GHz.	

3.6.4 Test Setup

Transmitter Radiated Bandedge Emissions



Electric field tests shall be performed in transmitter bandedge emissions using a calibrated horn antenna.



3.6.5 Test Result of Transmitter Radiated Bandedge Emissions

Transmitter Radiated Bandedge Emissions Result								
Modulation	11a		Restricted Band Emissions					
Restricted Band (MHz)	Test Ch. Freq. (MHz)	In-band PSD [i] (dBuV/1MHz)	RBE Freq. (MHz)	Measure Distance (m)	Out-Band Level (dBuV/m)	Limit (dBuV/m)	Level Type	Pol. note 1
4500-5150	5180	107.89	5149.90	3	59.21	74	PK	H
4500-5150	5180	98.11	5127.70	3	43.11	54	AV	H
5350-5460	5240	107.12	5352.60	3	50.75	74	PK	H
5350-5460	5240	96.98	5366.10	3	37.06	54	AV	H
5.2GHz Lower-band (Lowest Ch.)				5.2GHz Higher-band (Highest Ch.)				
Note 1: Measurement worst emissions of receive antenna polarization: H (Horizontal).								



Transmitter Radiated Bandedge Emissions Result								
Modulation	HT20		Restricted Band Emissions					
Restricted Band (MHz)	Test Ch. Freq. (MHz)	In-band PSD [i] (dBuV/1MHz)	RBE Freq. (MHz)	Measure Distance (m)	Out-Band Level (dBuV/m)	Limit (dBuV/m)	Level Type	Pol. note 1
4500-5150	5180	106.34	5149.00	3	60.32	74	PK	H
4500-5150	5180	96.14	5128.10	3	44.88	54	AV	H
5350-5460	5240	108.49	5380.80	3	51.10	74	PK	H
5350-5460	5240	98.24	5352.30	3	37.80	54	AV	H
5.2GHz Lower-band (Lowest Ch.)				5.2GHz Higher-band (Highest Ch.)				
Note 1: Measurement worst emissions of receive antenna polarization: H (Horizontal).								



Transmitter Radiated Bandedge Emissions Result								
Modulation	HT40		Restricted Band Emissions					
Restricted Band (MHz)	Test Ch. Freq. (MHz)	In-band PSD [i] (dBuV/1MHz)	RBE Freq. (MHz)	Measure Distance (m)	Out-Band Level (dBuV/m)	Limit (dBuV/m)	Level Type	Pol. note 1
4500-5150	5190	99.47	5149.94	3	58.82	74	PK	H
4500-5150	5190	89.28	5149.94	3	43.20	54	AV	H
5350-5460	5230	108.29	5363.40	3	53.63	74	PK	H
5350-5460	5230	98.32	5351.70	3	40.52	54	AV	H
5.2GHz Lower-band (Lowest Ch.)				5.2GHz Higher-band (Highest Ch.)				
Note 1: Measurement worst emissions of receive antenna polarization: H (Horizontal).								



3.7 Transmitter Radiated Unwanted Emissions

3.7.1 Transmitter Radiated Unwanted Emissions Limit

Unwanted emissions below 1 GHz and restricted band emissions above 1GHz 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: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Un-restricted band emissions above 1GHz Limit	
Operating Band	Limit
5.15 - 5.25 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.25 - 5.35 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.47 - 5.725 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.725 - 5.825 GHz	5.715 5.725 GHz: e.i.r.p. -17 dBm [78.2 dBuV/m@3m] 5.825 5.835 GHz: e.i.r.p. -17 dBm [78.2 dBuV/m@3m] Other un-restricted band: e.i.r.p. -27 dBm [68.2 dBuV/m@3m]

Note 1: Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).



3.7.2 Measuring Instruments

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

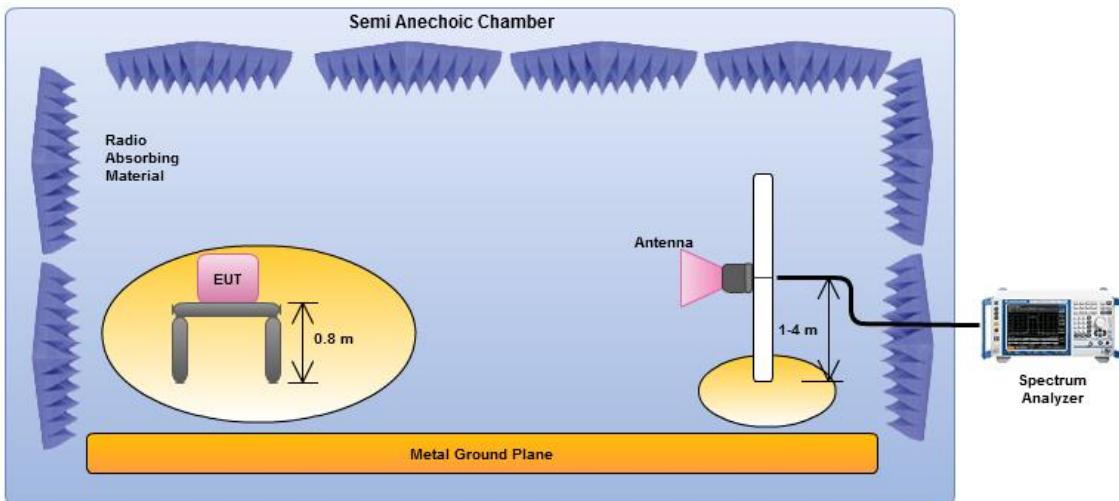


3.7.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/>	Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).
<input checked="" type="checkbox"/>	Measurements in the frequency range 5 GHz - 10GHz are typically made at a closer distance 3m, because the instrumentation noise floor is typically close to the radiated emission limit.
<input checked="" type="checkbox"/>	Measurements in the frequency range 10 GHz - 18GHz are typically made at a closer distance 1m, because the instrumentation noise floor is typically close to the radiated emission limit.
<input checked="" type="checkbox"/>	Measurements in the frequency range above 18 GHz - 40GHz are typically made at a closer distance 0.5m, because the instrumentation noise floor is typically close to the radiated emission limit.
<input checked="" type="checkbox"/>	The average emission levels shall be measured in [duty cycle \geq 98 or duty factor].
<input checked="" type="checkbox"/>	For the transmitter unwanted emissions shall be measured using following options below:
<input checked="" type="checkbox"/>	Refer as FCC KDB 789033, clause G)2) for unwanted emissions into non-restricted bands.
<input checked="" type="checkbox"/>	Refer as FCC KDB 789033, clause G)1) for unwanted emissions into restricted bands.
<input checked="" type="checkbox"/>	<input type="checkbox"/> Refer as FCC KDB 789033, G)6) Method AD (Trace Averaging).
	<input type="checkbox"/> Refer as FCC KDB 789033, G)6) Method VB (Reduced VBW).
	<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). $VBW \geq 1/T$, where T is pulse time.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
	<input checked="" type="checkbox"/> Refer as FCC KDB 789033, clause G)5) measurement procedure peak limit.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.2 measurement procedure peak limit.
<input checked="" type="checkbox"/>	For radiated measurement.
<input checked="" type="checkbox"/>	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz.
<input checked="" type="checkbox"/>	Refer as ANSI C63.10, clause 6.5 for radiated emissions from 30 MHz to 1000 MHz.
<input checked="" type="checkbox"/>	Refer as ANSI C63.10, clause 6.6 for radiated emissions from above 1 GHz.

3.7.4 Test Setup

Transmitter Radiated Unwanted Emissions



Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna and the frequency range of 1 GHz to 40 GHz using a calibrated horn antenna.

3.7.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.



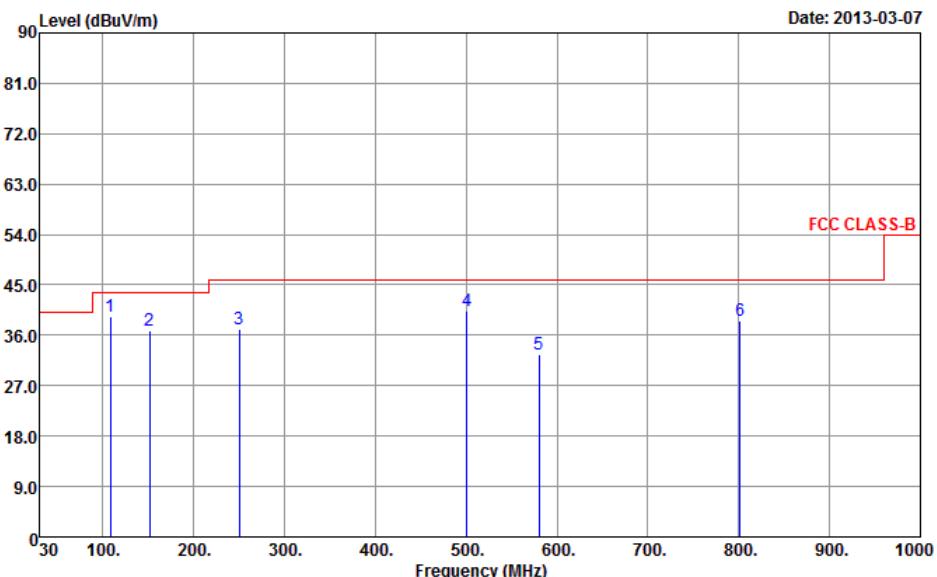
3.7.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Transmitter Radiated Unwanted Emissions (Below 1GHz)																																																																												
Operating Mode	1			Polarization	V																																																																							
Operating Function	Radio link (WLAN)																																																																											
Level (dB _{uV/m})										Date: 2013-03-07																																																																		
- - - - -																																																																												
Freq Level Over Limit ReadAntenna Cable Preamp A/Pos T/Pos MHz dB _{uV/m} Limit Line Level Factor Loss Factor cm deg Remark																																																																												
----- MHz dB _{uV/m} ----- dB ----- dB _{uV/m} ----- dB ----- dB ----- cm ----- deg -----																																																																												
<table border="1"><tr><td>1</td><td>63.95</td><td>38.52</td><td>-1.48</td><td>40.00</td><td>63.28</td><td>5.92</td><td>0.87</td><td>31.55</td><td>---</td><td>--- QP</td></tr><tr><td>2</td><td>106.63</td><td>41.42</td><td>-2.08</td><td>43.50</td><td>60.93</td><td>10.86</td><td>1.14</td><td>31.51</td><td>---</td><td>--- QP</td></tr><tr><td>3</td><td>151.25</td><td>37.66</td><td>-5.84</td><td>43.50</td><td>56.52</td><td>11.12</td><td>1.27</td><td>31.25</td><td>---</td><td>--- Peak</td></tr><tr><td>4</td><td>250.19</td><td>33.52</td><td>-12.48</td><td>46.00</td><td>50.19</td><td>12.62</td><td>1.61</td><td>30.90</td><td>---</td><td>--- Peak</td></tr><tr><td>5</td><td>500.45</td><td>38.26</td><td>-7.74</td><td>46.00</td><td>48.32</td><td>18.10</td><td>2.42</td><td>30.58</td><td>---</td><td>--- Peak</td></tr><tr><td>6</td><td>802.12</td><td>42.96</td><td>-3.04</td><td>46.00</td><td>47.82</td><td>22.12</td><td>2.82</td><td>29.80</td><td>---</td><td>--- Peak</td></tr></table>											1	63.95	38.52	-1.48	40.00	63.28	5.92	0.87	31.55	---	--- QP	2	106.63	41.42	-2.08	43.50	60.93	10.86	1.14	31.51	---	--- QP	3	151.25	37.66	-5.84	43.50	56.52	11.12	1.27	31.25	---	--- Peak	4	250.19	33.52	-12.48	46.00	50.19	12.62	1.61	30.90	---	--- Peak	5	500.45	38.26	-7.74	46.00	48.32	18.10	2.42	30.58	---	--- Peak	6	802.12	42.96	-3.04	46.00	47.82	22.12	2.82	29.80	---	--- Peak
1	63.95	38.52	-1.48	40.00	63.28	5.92	0.87	31.55	---	--- QP																																																																		
2	106.63	41.42	-2.08	43.50	60.93	10.86	1.14	31.51	---	--- QP																																																																		
3	151.25	37.66	-5.84	43.50	56.52	11.12	1.27	31.25	---	--- Peak																																																																		
4	250.19	33.52	-12.48	46.00	50.19	12.62	1.61	30.90	---	--- Peak																																																																		
5	500.45	38.26	-7.74	46.00	48.32	18.10	2.42	30.58	---	--- Peak																																																																		
6	802.12	42.96	-3.04	46.00	47.82	22.12	2.82	29.80	---	--- Peak																																																																		
<p>Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit. Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.) Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)</p>																																																																												



Transmitter Radiated Unwanted Emissions (Below 1GHz)

Operating Mode	1	Polarization	H
Operating Function	Radio link (WLAN)		



	Freq	Level	Over Limit	Line	Read	Antenna	Cable	Preamp	A/Pos	T/Pos	Remark
	MHz	dB _{uV/m}	dB	dB _{uV/m}	dB _{uV}	dB _{uV/m}	dB	dB	cm	deg	
1	108.57	39.45	-4.05	43.50	58.77	11.06	1.15	31.53	---	---	Peak
2	151.25	36.75	-6.75	43.50	55.61	11.12	1.27	31.25	---	---	Peak
3	250.19	37.22	-8.78	46.00	53.89	12.62	1.61	30.90	---	---	Peak
4	500.45	40.35	-5.65	46.00	50.41	18.10	2.42	30.58	---	---	Peak
5	579.99	32.63	-13.37	46.00	41.05	19.80	2.44	30.66	---	---	Peak
6	801.15	38.52	-7.48	46.00	43.42	22.11	2.80	29.81	---	---	Peak

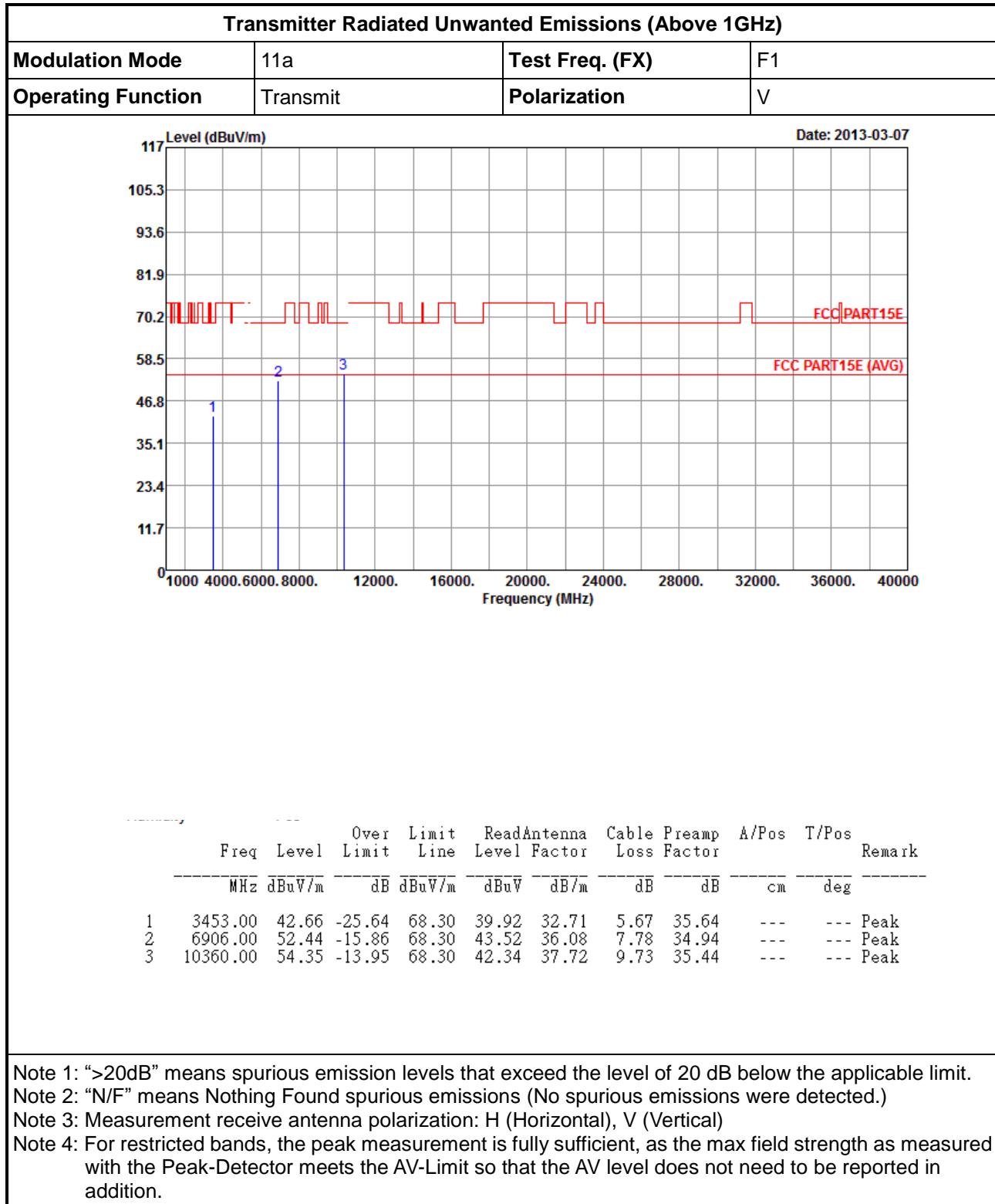
Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

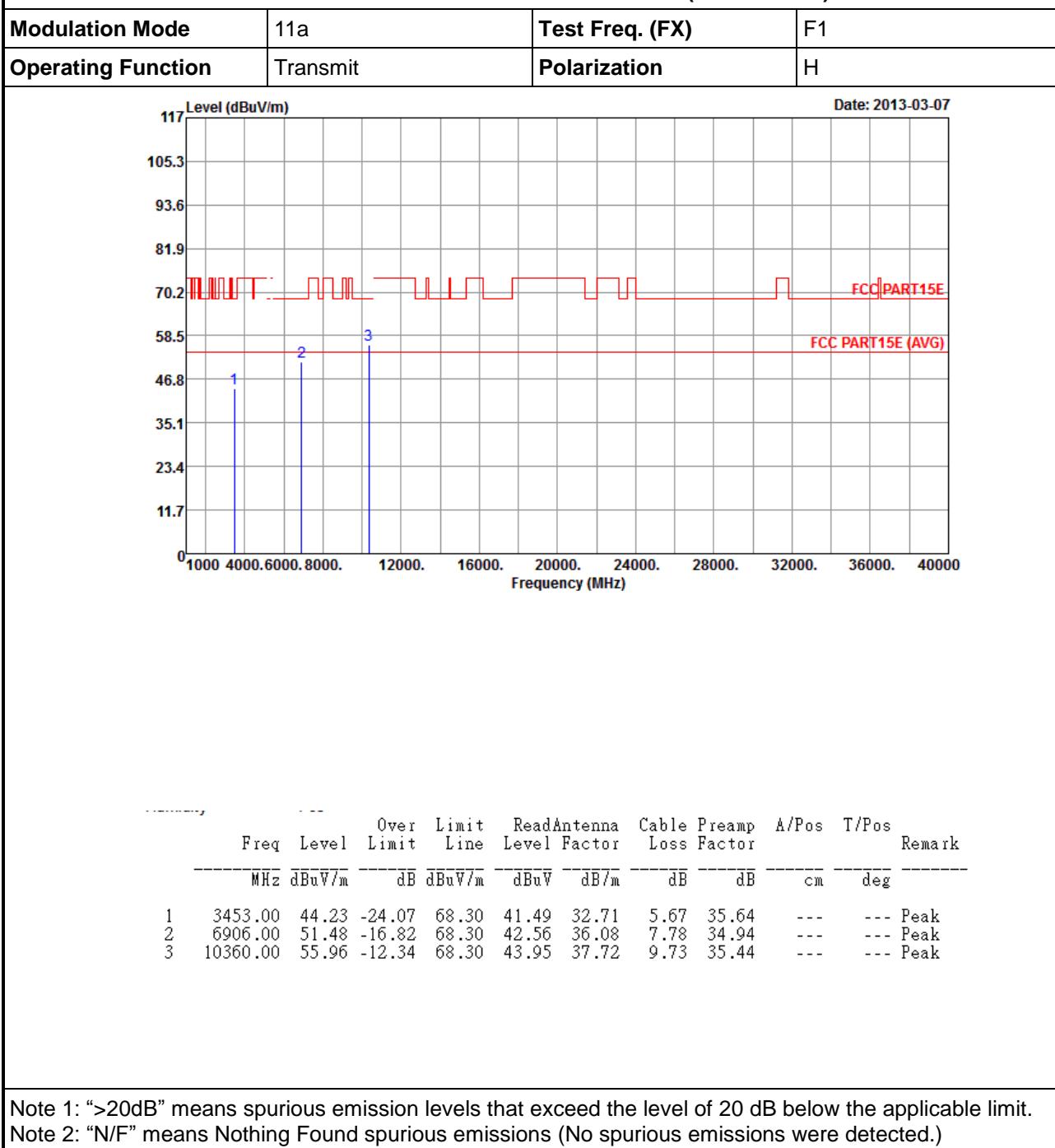


3.7.7 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 11a



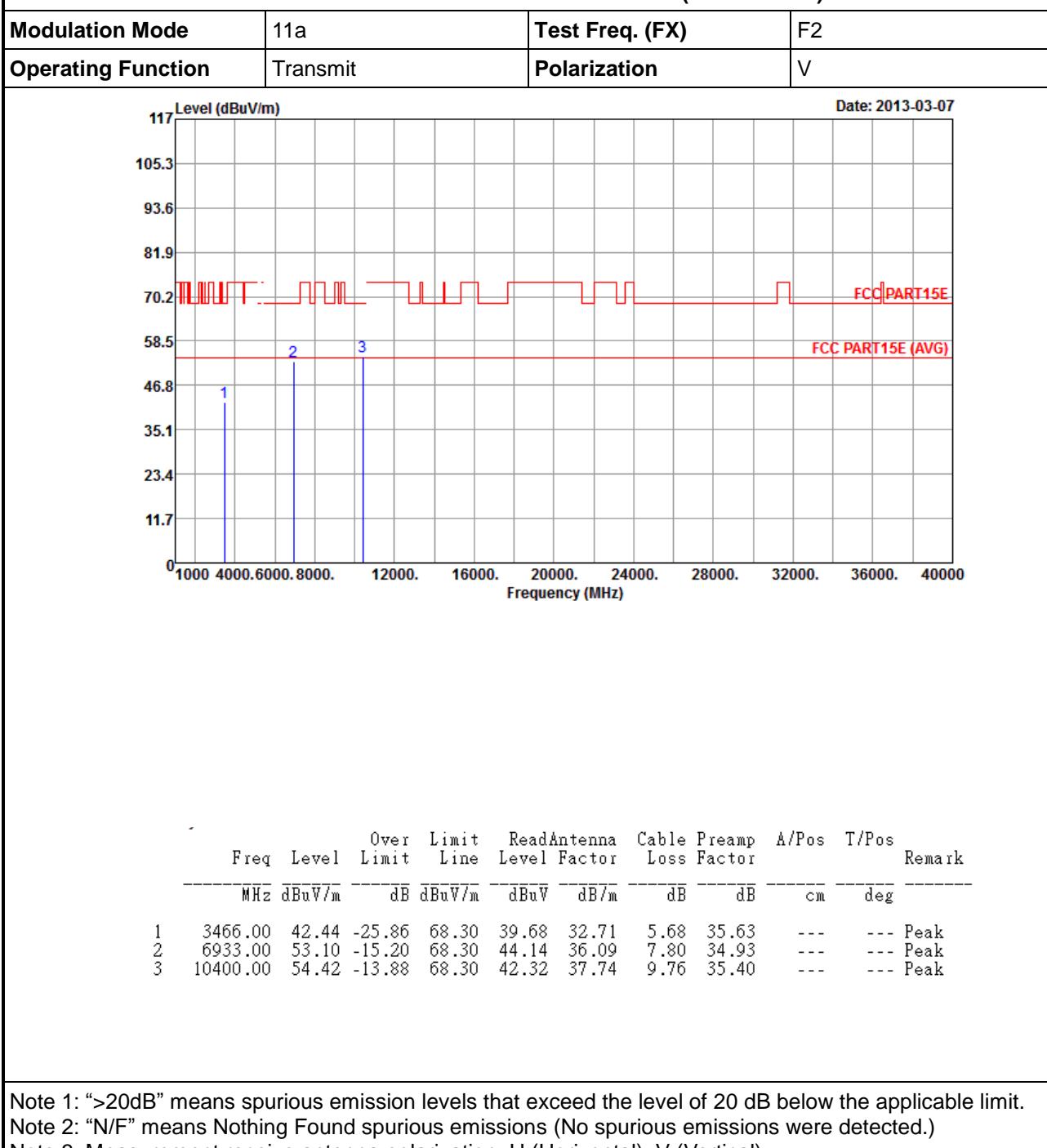


Transmitter Radiated Unwanted Emissions (Above 1GHz)



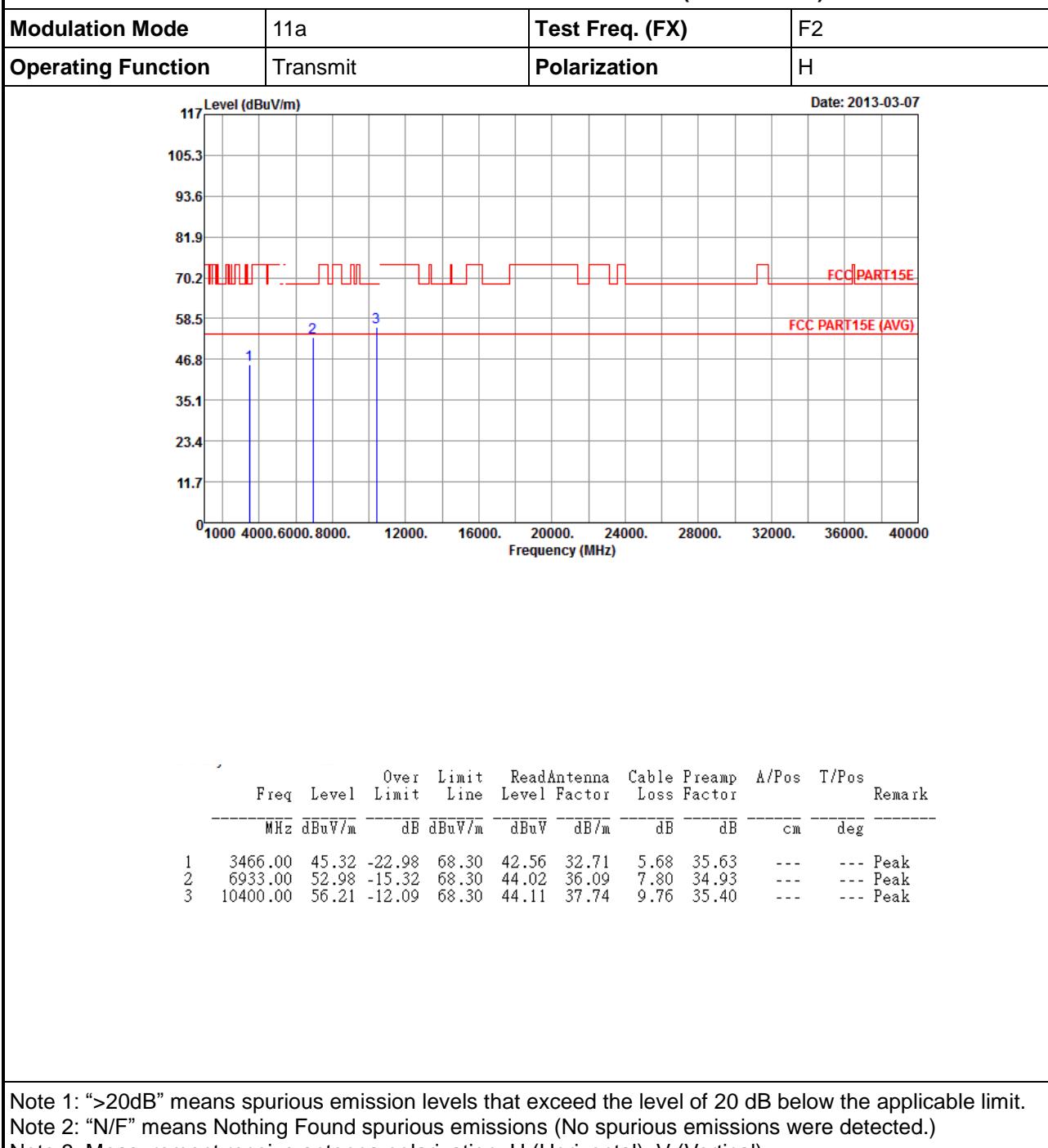


Transmitter Radiated Unwanted Emissions (Above 1GHz)



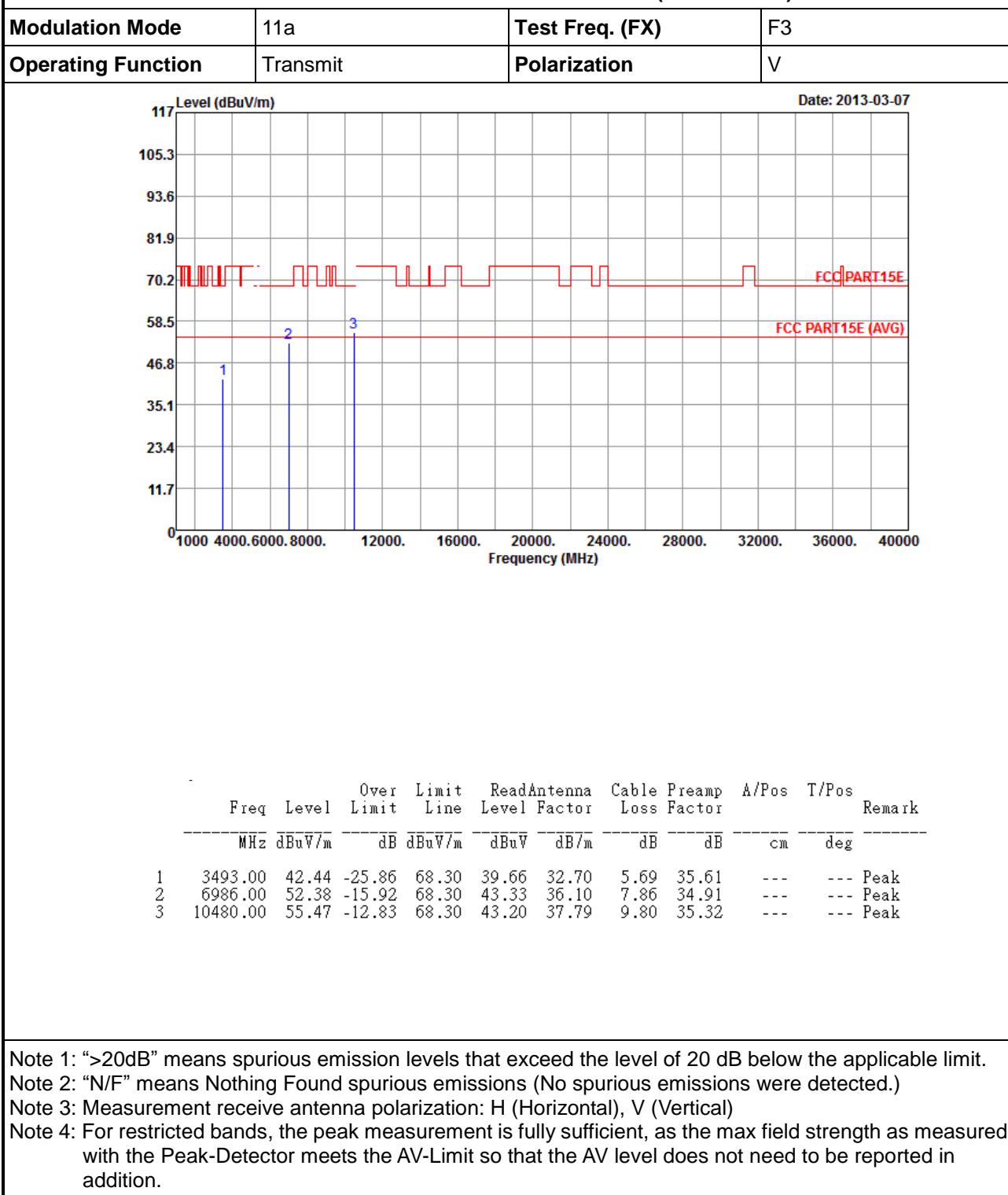


Transmitter Radiated Unwanted Emissions (Above 1GHz)



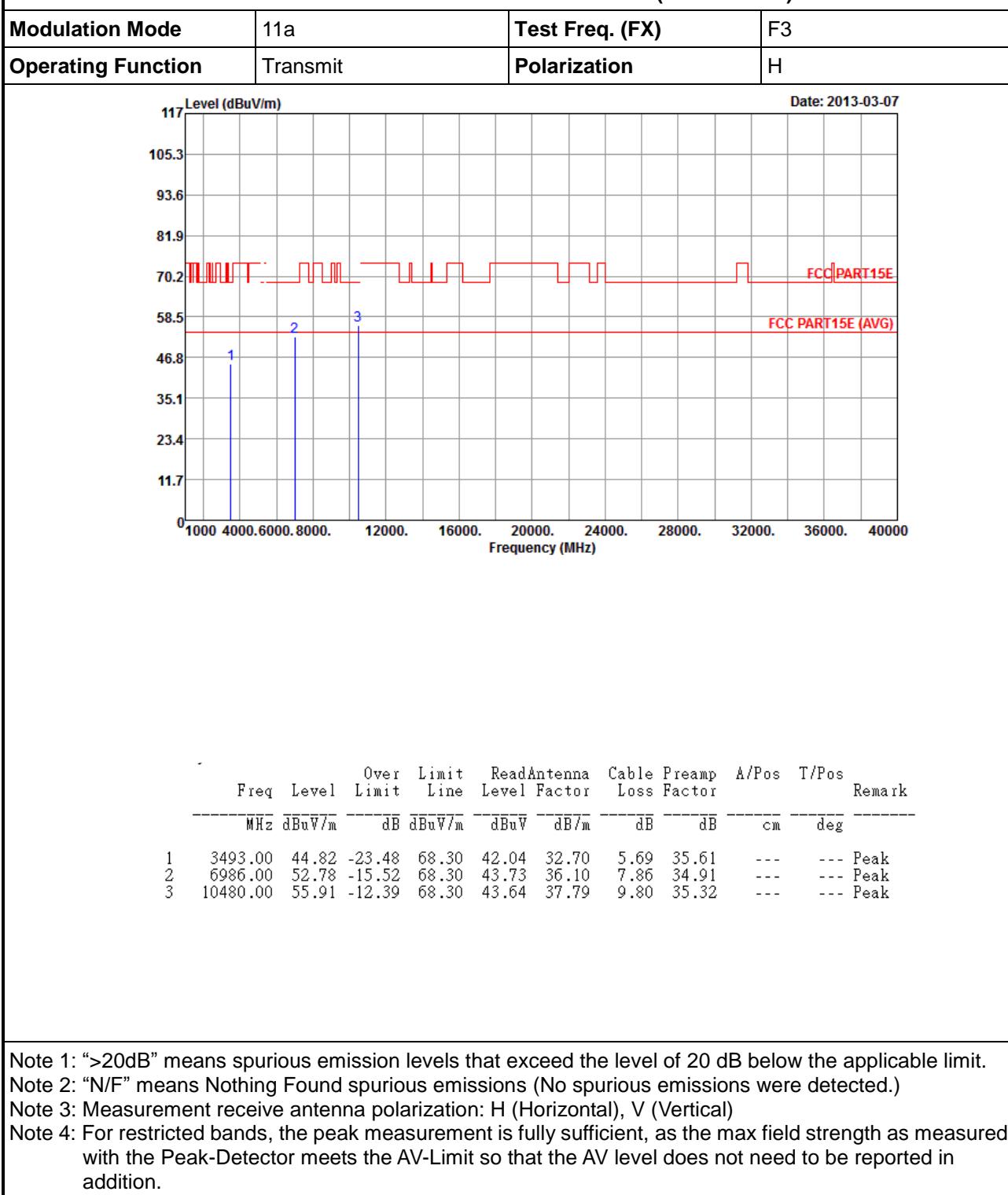


Transmitter Radiated Unwanted Emissions (Above 1GHz)



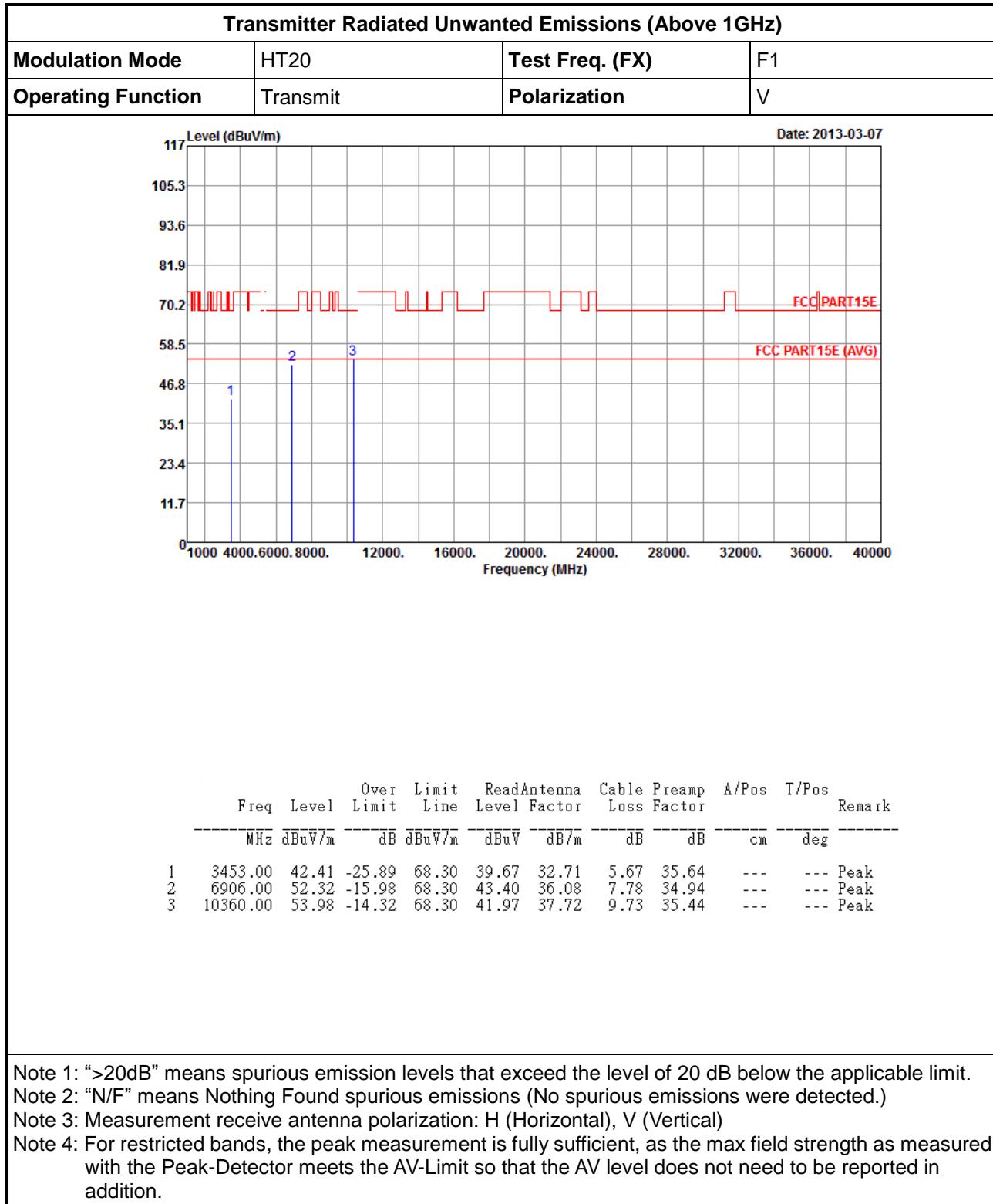


Transmitter Radiated Unwanted Emissions (Above 1GHz)



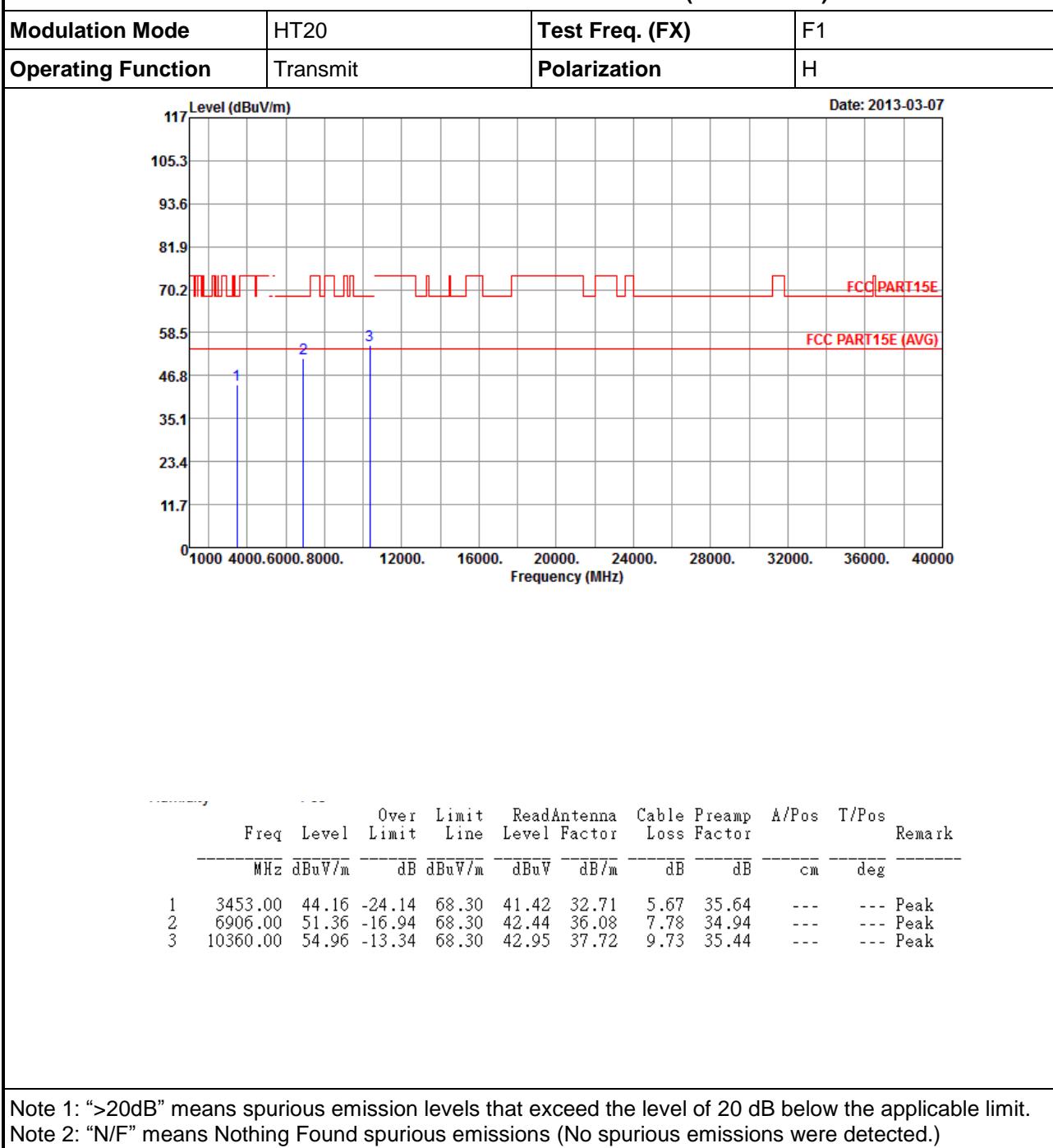


3.7.8 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT20



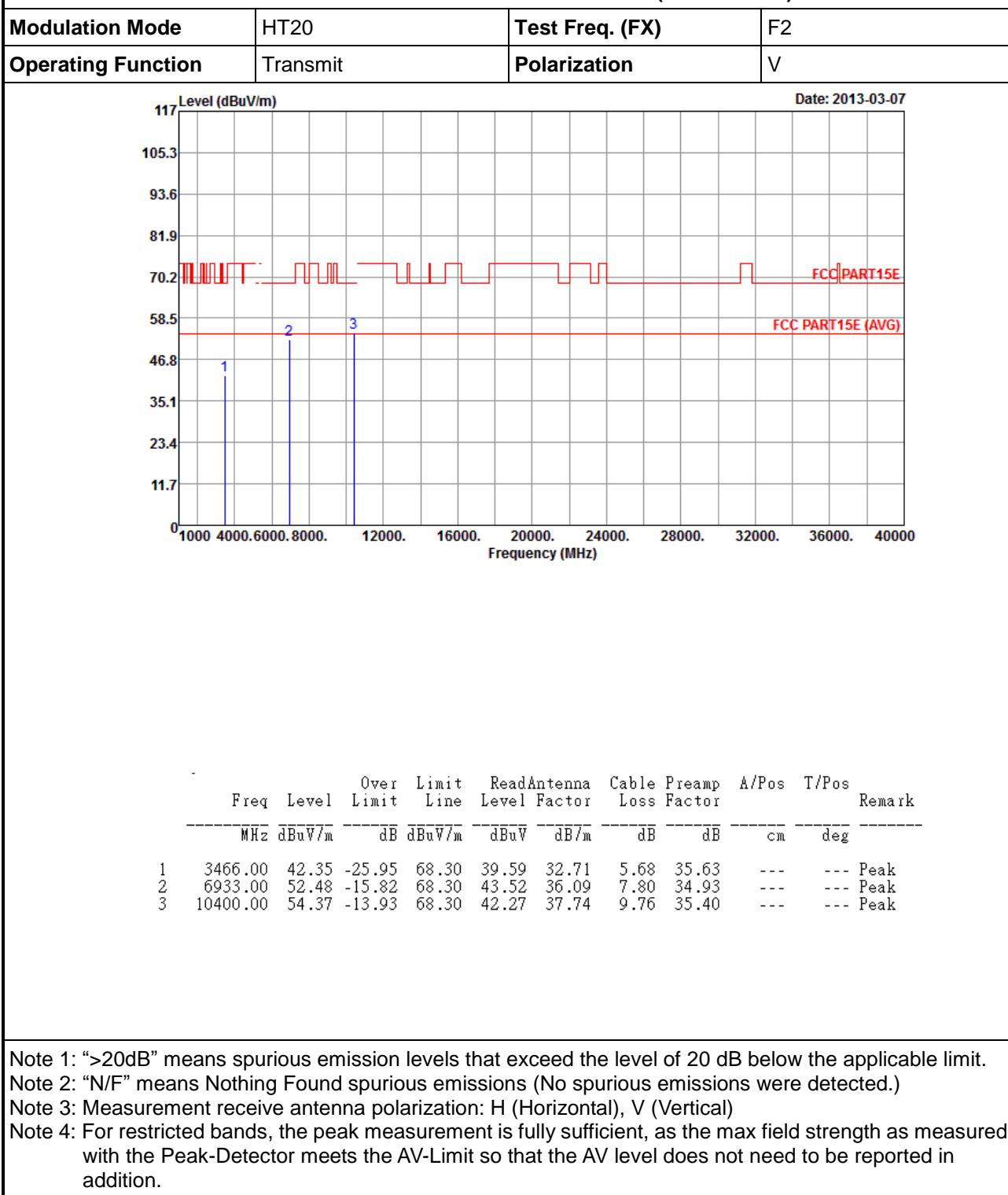


Transmitter Radiated Unwanted Emissions (Above 1GHz)



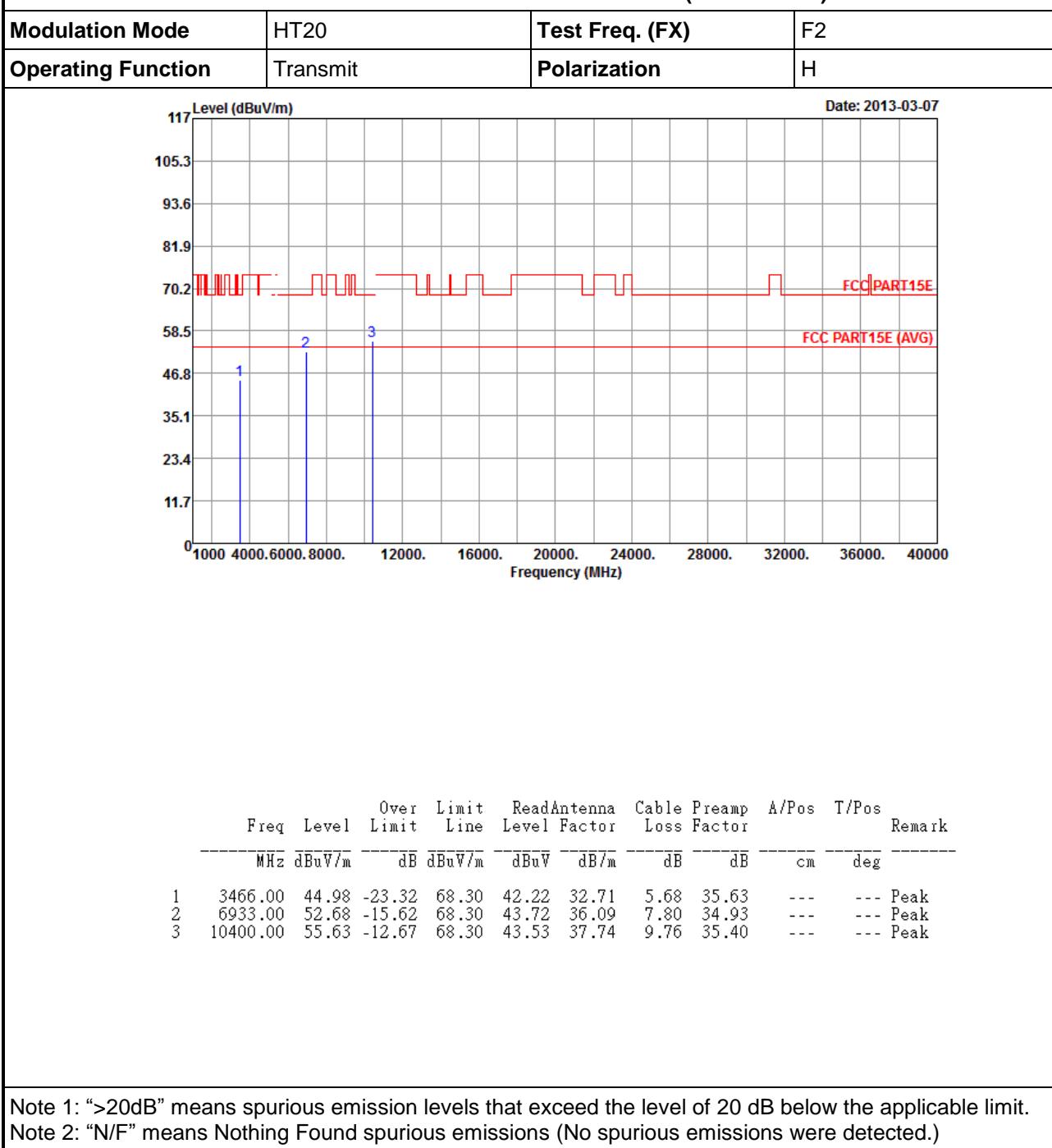


Transmitter Radiated Unwanted Emissions (Above 1GHz)





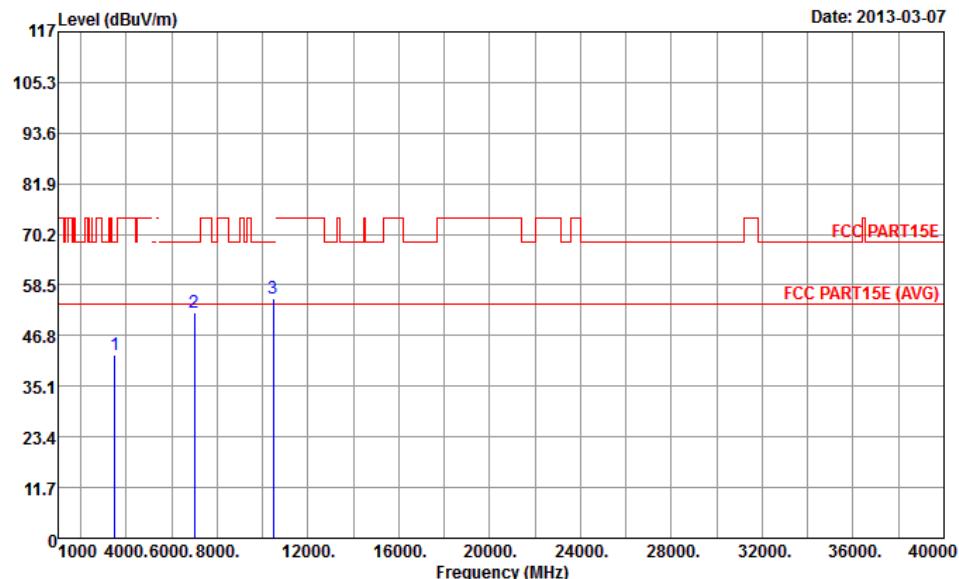
Transmitter Radiated Unwanted Emissions (Above 1GHz)





Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation Mode	HT20	Test Freq. (FX)	F3
Operating Function	Transmit	Polarization	V



	Freq	Level	Over Limit	Line	Read	Antenna	Cable	Preamp	A/Pos	T/Pos	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	
1	3493.00	42.38	-25.92	68.30	39.60	32.70	5.69	35.61	---	---	Peak
2	6986.00	52.11	-16.19	68.30	43.06	36.10	7.86	34.91	---	---	Peak
3	10480.00	55.31	-12.99	68.30	43.04	37.79	9.80	35.32	---	---	Peak

Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

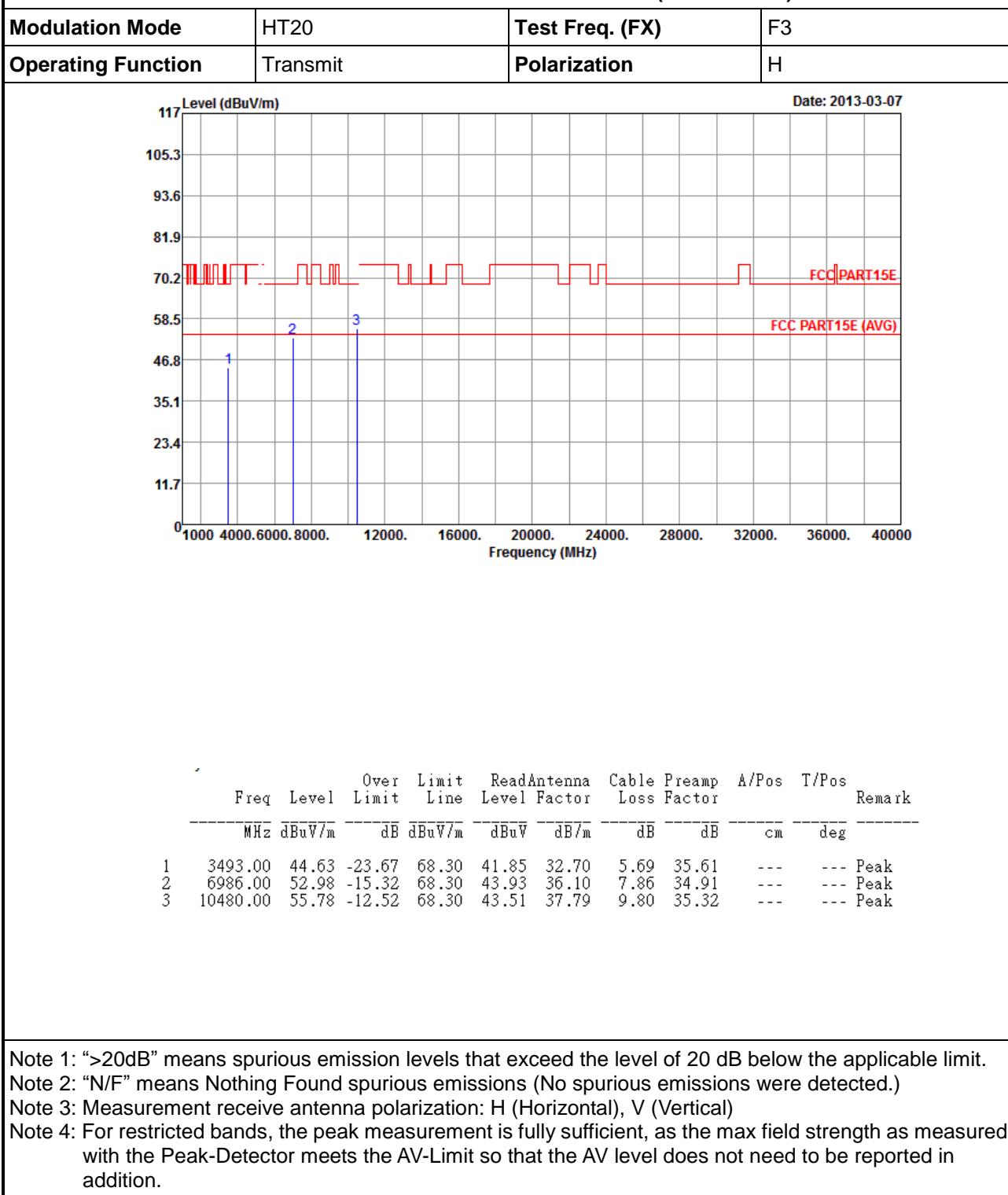
Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.

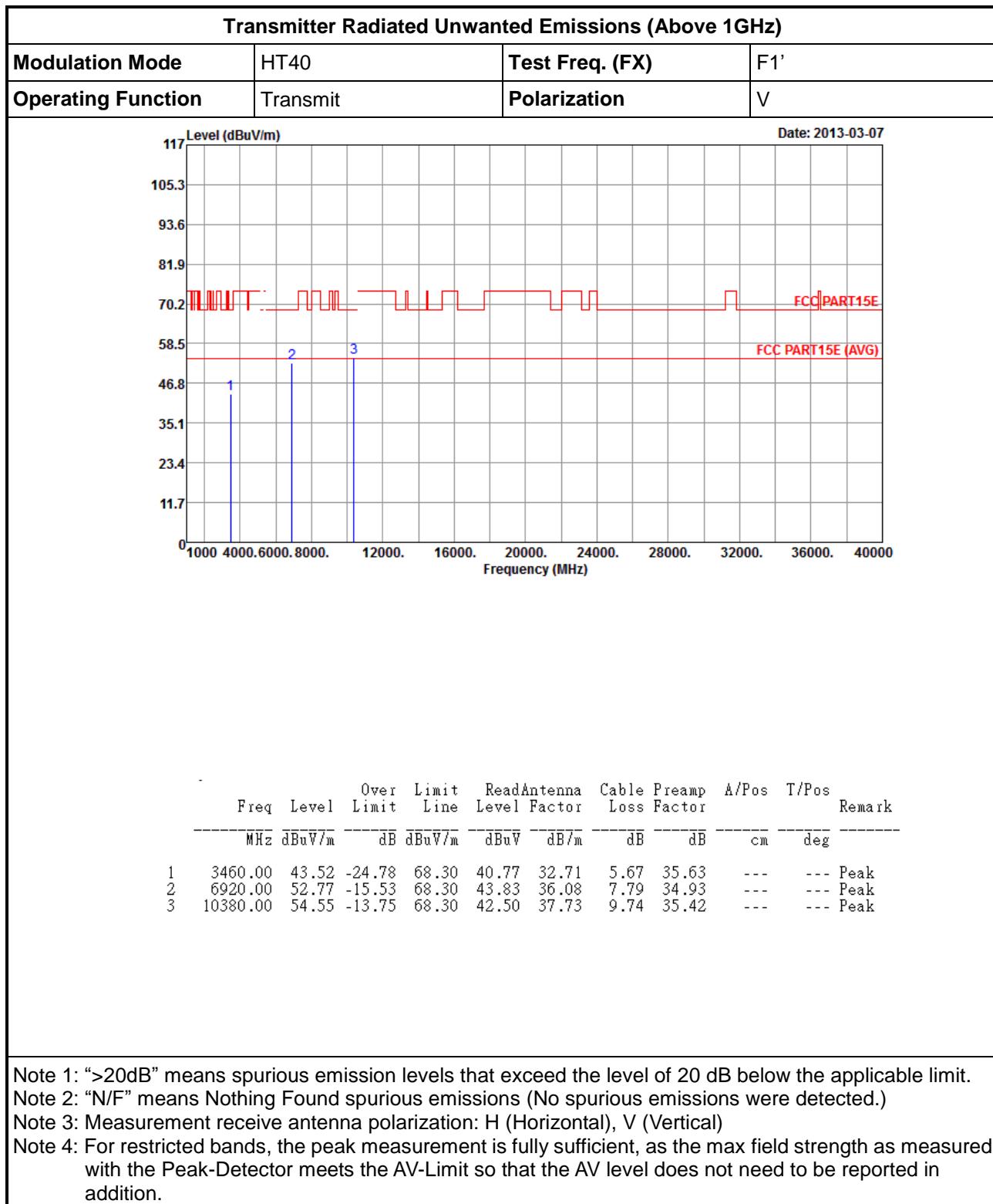


Transmitter Radiated Unwanted Emissions (Above 1GHz)



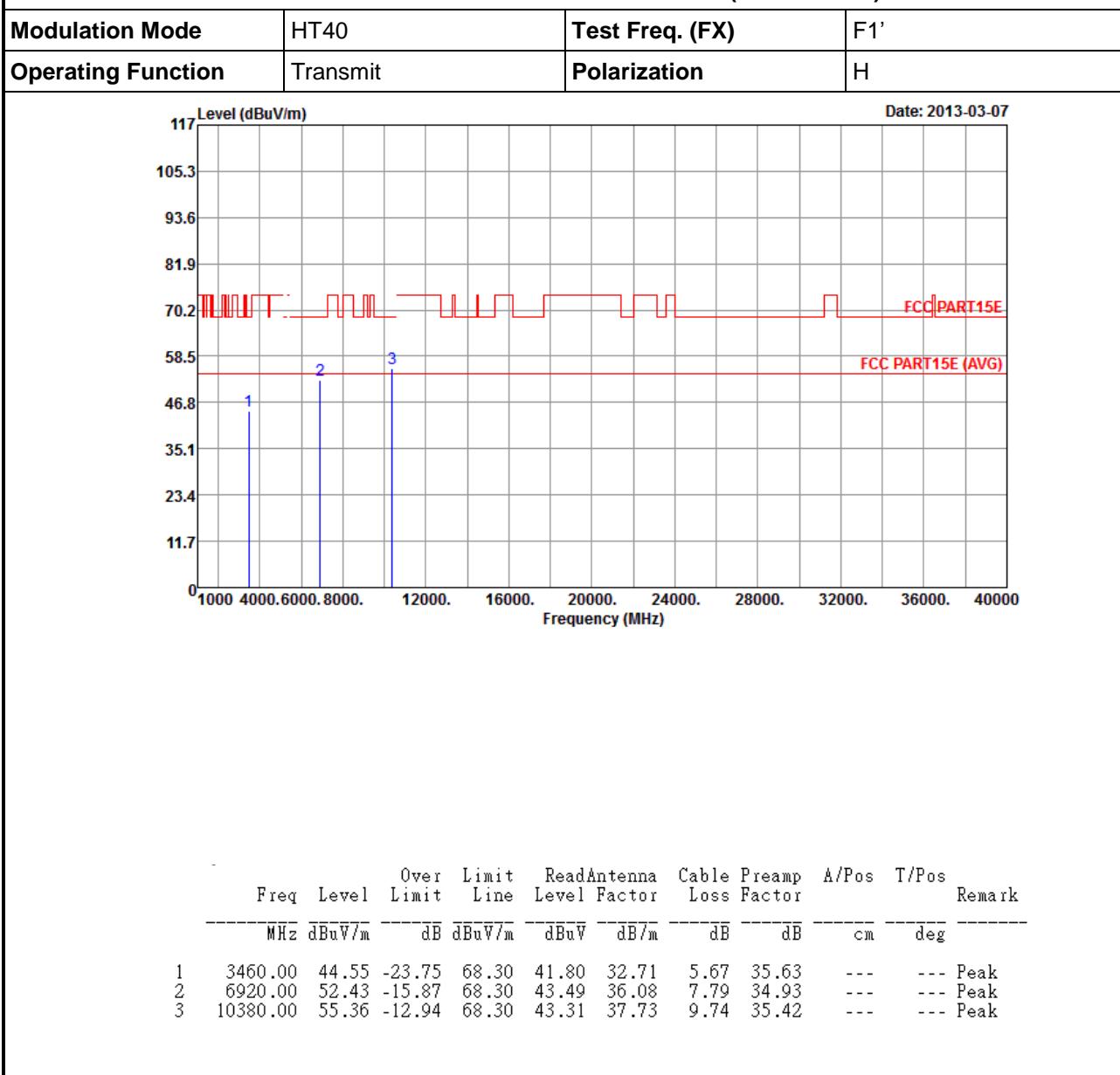


3.7.9 Transmitter Radiated Unwanted Emissions (Above 1GHz) for HT40





Transmitter Radiated Unwanted Emissions (Above 1GHz)



Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

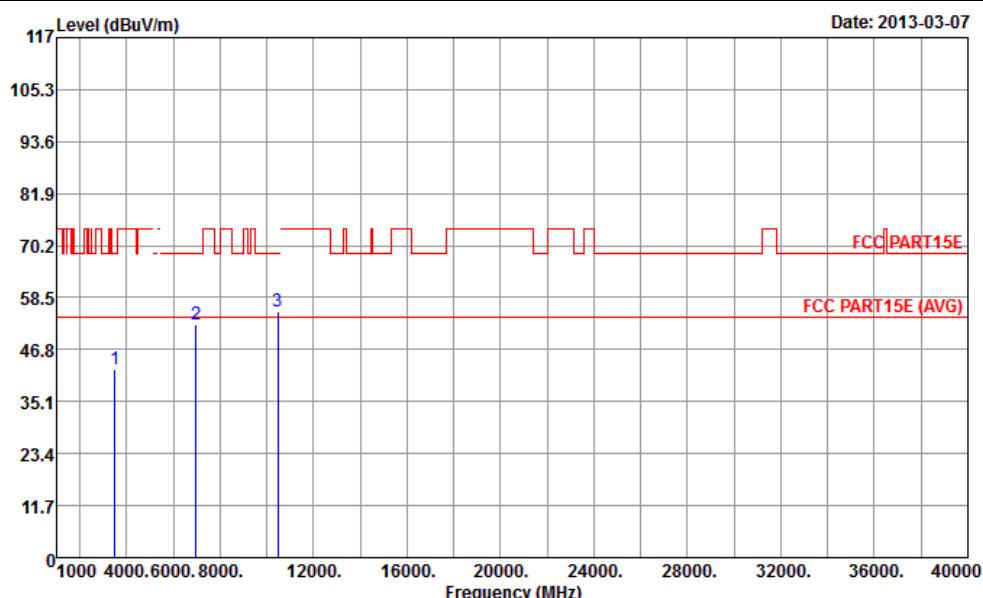
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.



Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation Mode	HT40	Test Freq. (FX)	F2'
Operating Function	Transmit	Polarization	V



Freq	Level	Over Limit	Line Limit	Read	Antenna Level	Cable Factor	Preamp	A/Pos	T/Pos	Remark
MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	
1	3486.00	42.53	-25.77	68.30	39.76	32.70	5.68	35.61	---	--- Peak
2	6973.00	52.55	-15.75	68.30	43.53	36.09	7.84	34.91	---	--- Peak
3	10460.00	55.44	-12.86	68.30	43.21	37.78	9.79	35.34	---	--- Peak

Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.

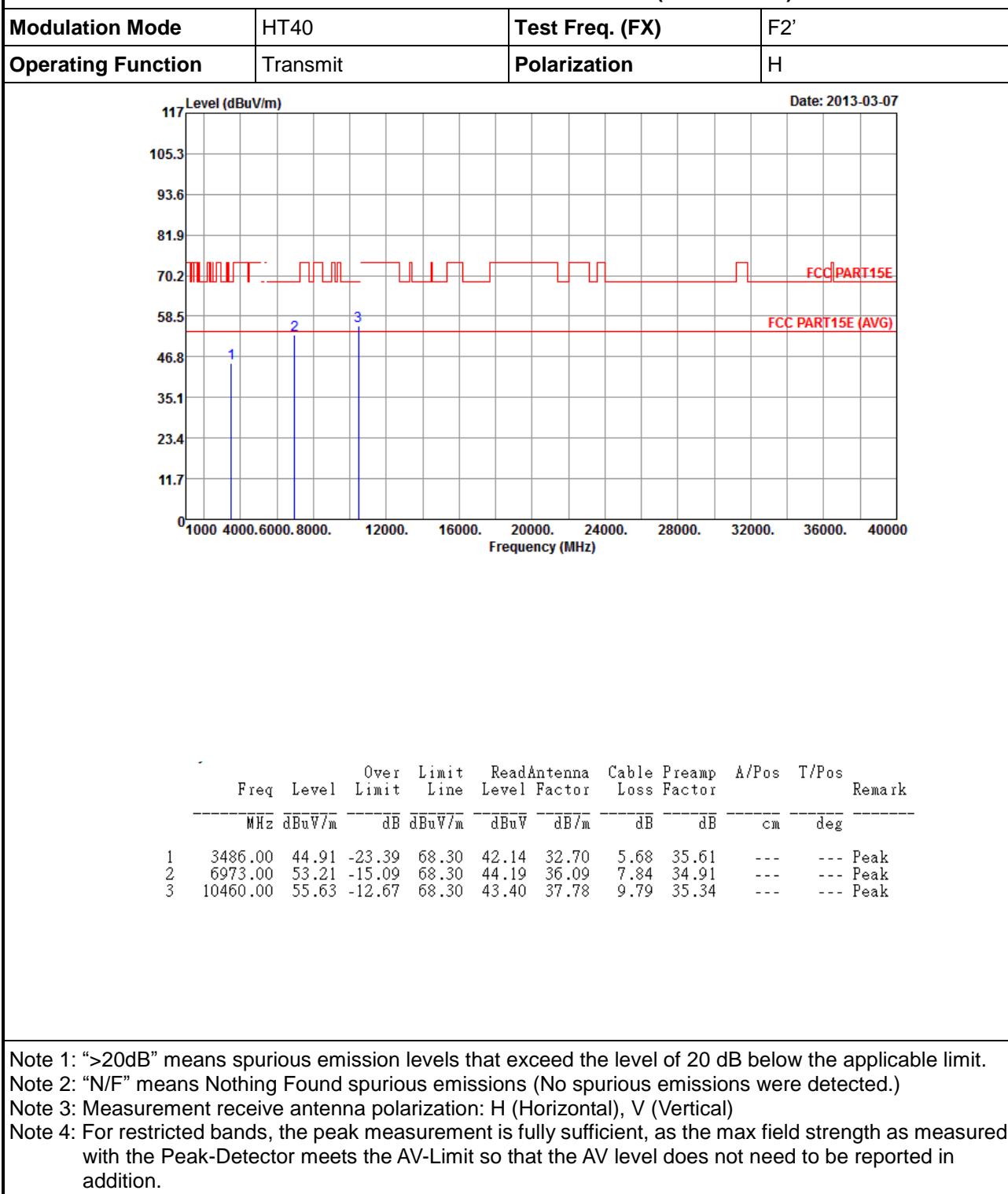
Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)

Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.



Transmitter Radiated Unwanted Emissions (Above 1GHz)



3.8 Frequency Stability

3.8.1 Frequency Stability Limit

Frequency Stability Limit	
UNII Devices	
<input checked="" type="checkbox"/> In-band emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.	
LE-LAN Devices	
<input checked="" type="checkbox"/> N/A	
IEEE Std. 802.11n-2009	
<input checked="" type="checkbox"/> The transmitter center frequency tolerance shall be ± 20 ppm maximum for the 5 GHz band and ± 25 ppm maximum for the 2.4 GHz band.	

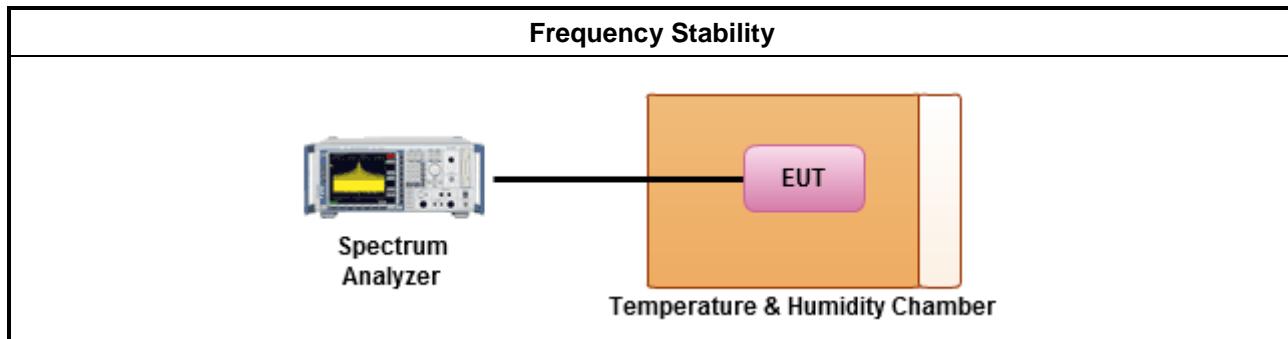
3.8.2 Measuring Instruments

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

3.8.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/>	Refer as ANSI C63.10, clause 6.8 for frequency stability tests
<input checked="" type="checkbox"/>	Frequency stability with respect to ambient temperature
<input checked="" type="checkbox"/>	Frequency stability when varying supply voltage
<input checked="" type="checkbox"/>	For conducted measurement.
<input checked="" type="checkbox"/>	For conducted measurements on devices with multiple transmit chains: Measurements need only to be performed on one of the active transmit chains (antenna outputs)
<input type="checkbox"/>	For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.

3.8.4 Test Setup





3.8.5 Test Result of Frequency Stability

Frequency Stability Result						
Mode		Frequency Stability (ppm)				
Condition	Freq. (MHz)	0 min	2 min	5 min	10 min	Limit
T _{20°C} Vmax	5180	4.10	4.63	4.52	4.19	20.0
T _{20°C} Vmin	5180	6.12	6.00	6.72	5.86	20.0
T _{45°C} Vnom	5180	10.90	11.18	11.10	11.13	20.0
T _{40°C} Vnom	5180	10.26	10.26	10.12	10.40	20.0
T _{30°C} Vnom	5180	6.11	6.35	5.84	6.47	20.0
T _{20°C} Vnom	5180	4.47	5.02	5.04	4.96	20.0
T _{10°C} Vnom	5180	3.02	3.28	3.47	3.35	20.0
T _{0°C} Vnom	5180	1.26	0.79	1.17	1.40	20.0
T _{-5°C} Vnom	5180	0.43	0.73	0.78	0.77	20.0
Result		Complied				

Note 1: Measure at 85 % [Vmin] and 115 % [Vmax] of the nominal voltage [Vnom].
Note 2: The nominal voltage refer test report clause 1.1.5 for EUT operational condition.



4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100174	9 kHz ~ 2.75 GHz	Mar. 23, 2012	Conduction (CO04-HY)
LISN	SCHWARZBECK MESS-ELEKTRO NIK	NSLK 8127	8127-477	9kHz – 30MHz	Jan. 21, 2013	Conduction (CO04-HY)
LISN (Support Unit)	EMCO	3810/2NM	9703-1839	9 kHz ~ 30 MHz	Apr. 20, 2012	Conduction (CO04-HY)
RF Cable-CON	HUBER+SUHNE R	RG213/U	CB049	9 kHz ~ 30 MHz	Apr. 25, 2012	Conduction (CO04-HY)

Note: Calibration Interval of instruments listed above is one year.

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Remark
Spectrum Analyzer	R&S	FSP 30	100023/030	9KHz ~ 30GHz	Apr. 27, 2012	Conducted (TH01-HY)
DC Power Source	G.W.	GPC-6030D	C671845	DC 1V ~ 60V	Jun. 19, 2012	Conducted (TH01-HY)
AC Power Source	G.W	APS-9102	EL920581	AC 0V ~ 300V	Jul. 02, 2012	Conducted (TH01-HY)
Temp. and Humidity Chamber	Giant Force	GTH-225-20-S P-SD	MAA1112-007	-20 ~ 100°C	Nov. 21, 2012	Conducted (TH01-HY)
Signal Generator	R&S	SMR40	100116	10MHz ~ 40GHz	Jun. 26, 2012	Conducted (TH01-HY)
Power Sensor	Anritsu	MA2411B	0917017	300MHz ~ 40GHz	Feb. 02, 2013	Conducted (TH01-HY)
Power Meter	Anritsu	ML2495A	0949003	300MHz ~ 40GHz	Feb. 02, 2013	Conducted (TH01-HY)
RF Cable-2m	HUBER+SUHNE R	SUCOFLEX_10_4	SN 345675/4	1GHz ~ 26.5GHz	NA	Conducted (TH01-HY)
RF Cable-3m	HUBER+SUHNE R	SUCOFLEX_10_4	SN 345669/4	1GHz ~ 26.5GHz	NA	Conducted (TH01-HY)

Note: Calibration Interval of instruments listed above is one year.



Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Remark
Spectrum Analyzer	R&S	FSP	100055	9Kz – 40GHz	Jun. 06, 2012	Radiation (03CH05-HY)
Receiver	R&S	ESIB26	100337	20Hz – 26.5GHz	Jun.21, 2012	Radiation (03CH05-HY)
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH05-HY	30 MHz - 1 GHz 3m	N/A	Radiation (03CH05-HY)
Amplifier	COM-POWER	PA-103	161050	1 MHz ~ 1 GHz	Mar. 20, 2012	Radiation (03CH05-HY)
Amplifier	Agilent	8449B	3008A02665	1GHz – 26.5 GHz	Aug. 28, 2012	Radiation (03CH05-HY)
Horn Antenna	ETS-LINDGREN	3117	66584	1GHz~18GHz	Aug. 09, 2012	Radiation (03CH05-HY)
Horn Antenna	SCHWARZBEC K	BBHA9170	BBHA9170154	15GHz ~ 40GHz	Jan. 08, 2013	Radiation (03CH05-HY)
RF Cable-R03m	Jye Bao	RG142	03CH05-HY	30 MHz - 1 GHz	Oct. 14, 2012	Radiation (03CH05-HY)
RF Cable-HIGH	SUHNER	SUCOFLEX104	03CH05-HY	1GHz~40GHz	Oct. 14, 2012	Radiation (03CH05-HY)
Bilog Antenna	SCHAFFNER	CBL6111C	2725	30 MHz - 1 GHz	Oct. 06, 2012	Radiation (03CH05-HY)
Turn Table	HD	HD100	420/611	0 - 360 degree	N/A	Radiation (03CH05-HY)
Antenna Mast	HD	HD100	240/666	1 m - 4 m	N/A	Radiation (03CH05-HY)

Note: Calibration Interval of instruments listed above is one year.

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Remark
Loop Antenna	R&S	HFH2-Z2	860004/0001	9 kHz - 30 MHz	Jul. 03, 2012	Radiation (03CH05-HY)
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz ~ 40GHz	Apr. 19, 2011	Radiation (03CH05-HY)

Note: Calibration Interval of instruments listed above is two year.