FCC Test Report

Report No.: RF160613C30A

FCC ID: TVE-281BB022

Test Model: FAP-U421EV, FAP-U423EV

Series Model: FortiAP U421EVxxxxxx, FAP-U421EVxxxxxx, FORTIAP-U421EVxxxxxx, FortiAP U423EVxxxxxx, FAP-U423EVxxxxxx, FORTIAP-U423EVxxxxxx (where “x” can be used as “A-Z” or “0-9” or “-“ or blank for software changes or marketing purposes only) (refer to item 3.1 for more details)

Received Date: Jun. 13, 2016

Test Date: Jul. 11 ~ Jul. 21, 2016

Issued Date: Aug. 12, 2016

Applicant: Fortinet Inc.

Address: 899 Kifer Road Sunnyvale, CA 94086 USA

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)

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The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

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Release Control Record

Issue No.	Description	Date Issued
RF160613C30A	Original release.	Aug. 12, 2016

1 Certificate of Conformity

Product: Secured Wireless Access Point

Brand: Fortinet Inc.

Test Model: FAP-U421EV, FAP-U423EV

Series Model: FortiAP U421EVxxxxxx, FAP-U421EVxxxxxx, FORTIAP-U421EVxxxxxx, FortiAP U423EVxxxxxx, FAP-U423EVxxxxxx, FORTIAP-U423EVxxxxxx (where “x” can be used as “A-Z” or “0-9” or “-“ or blank for software changes or marketing purposes only) (refer to item 3.1 for more details)

Sample Status: Engineering sample

Applicant: Fortinet Inc.

Test Date: Jul. 11 ~ Jul. 21, 2016

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

This report is issued as a supplementary report of RF160613C30. This report shall be used combined together with its original report.

Prepared by : _____ , **Date:** Aug. 12, 2016
Suntee Liu / Specialist

Approved by : _____ , **Date:** Aug. 12, 2016
Ken Liu / Senior Manager

Note: All test items except radiated emission below 1GHz and conducted emission are performed for the addendum. Refer to original report for the other test data.

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	N/A	Refer to Note
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -1.0dB at 2483.50MHz.
15.247(d)	Antenna Port Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is IPEX or RPSMA not a standard connector.

Note: All test items except radiated emission below 1GHz and conducted emission are performed for the addendum. Refer to original report for the other test data.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Secured Wireless Access Point
Brand	Fortinet Inc.
Test Model	FAP-U421EV, FAP-U423EV
Series Model	FortiAP U421EVxxxxxx, FAP-U421EVxxxxxx, FORTIAP-U421EVxxxxxx, FortiAP U423EVxxxxxx, FAP-U423EVxxxxxx, FORTIAP-U423EVxxxxxx (where “x” can be used as “A-Z” or “0-9” or “-“ or blank for software changes or marketing purposes only) (refer to Note for more details)
Model Difference	Refer to Note
Sample Status	Engineering sample
Power Supply Rating	12Vdc (adapter) 54Vdc (POE)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11/5.5/2/1Mbps 802.11g: 54/48/36/24/18/12/9/6Mbps 802.11n: up to 600Mbps
Operating Frequency	2412~2462MHz
Number of Channel	802.11b, 802.11g, 802.11n (HT20): 11 802.11n (HT40): 7
Output Power	223.782mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Cable Supplied	NA

Note:

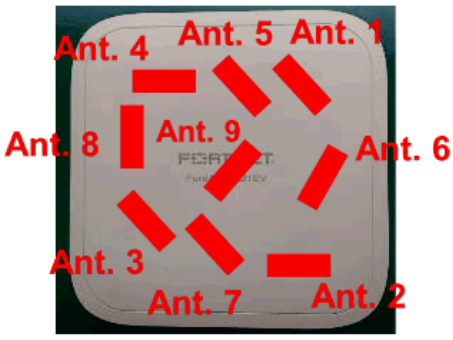
1. This report is prepared for FCC class II permissive change. The differences compared with the original report of BV ADT report no. RF160613C30 are changing WLAN external antenna 5GHz gain to 3.18dBi, changing 2 models and adding beamforming function.

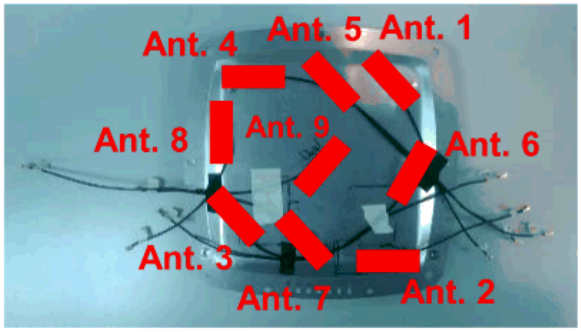
   Radiated emission above 1GHz & Antenna port conducted measurements with beamforming function are re-tested for beamforming function addition in this report. Refer to original report for the other test data.
2. The EUT incorporates a MIMO function. Physically, the EUT provides 4 completed transmitters and 4 receivers.

Modulation Mode	TX Function	Beamforming Mode
802.11b	4TX	Not Support
802.11g	4TX	Not Support
802.11a	4TX	Not Support
802.11n (HT20)	4TX	Support
802.11n (HT40)	4TX	Support
802.11ac (VHT20)	4TX	Support
802.11ac (VHT40)	4TX	Support
802.11ac (VHT80)	4TX	Support

3. The EUT uses following antennas.

Antenna Type	Printed	Antenna Connector	IPEX
Gain (dBi)	Frequency (MHz)		
	2400~2500	5150~5850	
WLAN Internal Ant. 1	3.81	-	
WLAN Internal Ant. 2	3.98	-	
WLAN Internal Ant. 3	3.47	-	
WLAN Internal Ant. 4	3.75	-	
WLAN Internal Ant. 5	-	5.65	
WLAN Internal Ant. 6	-	5.50	
WLAN Internal Ant. 7	-	5.84	
WLAN Internal Ant. 8	-	5.84	
Gain (dBi)	Frequency (MHz)		
	2400	2450	2500
BT Internal Ant. 9	2.56	2.91	2.62





Antenna Type	Dipole	Antenna Connector	RPSMA
Gain (dBi)	Frequency (MHz)		
	2400~2500	5150~5850	
WLAN External Ant.	4.42	3.18	

4. All models are listed as below (where “x” can be used as “A-Z” or “0-9” or “-“ or blank for software changes or marketing purposes only). Models FAP-U421EV and FAP-U423EV are the representatives for final test.

Brand	Model	Difference
Fortinet Inc.	FortiAP U421EVxxxxxx	Internal antenna
	FAP-U421EVxxxxxx	
	FORTIAP-U421EVxxxxxx	
	FortiAP U423EVxxxxxx	External antenna
	FAP-U423EVxxxxxx	
	FORTIAP-U423EVxxxxx	

5. WLAN 2.4GHz and WLAN 5GHz and BT technologies can transmit at same time.
6. Spurious emission of the simultaneous operation (WLAN 2.4GHz and WLAN 5GHz and BT) has been evaluated and no non-compliance was found.

3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz		

7 channels are provided for 802.11n (HT40):

Channel	Frequency	Channel	Frequency
3	2422MHz	7	2442MHz
4	2427MHz	8	2447MHz
5	2432MHz	9	2452MHz
6	2437MHz		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to		Description
	RE≥1G	APCM	
A	√	√	Internal antenna, Power from adapter
B	√	-	External antenna, Power from adapter

Where RE≥1G: Radiated Emission above 1GHz & Bandedge Measurement APCM: Antenna Port Conducted Measurement

Note:
1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on Y-plane.
2. "-" means no effect.

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Date Rate (Mbps)
A, B	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	7.2
A, B	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	15.0

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Date Rate (Mbps)
A	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	7.2
A	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	15.0

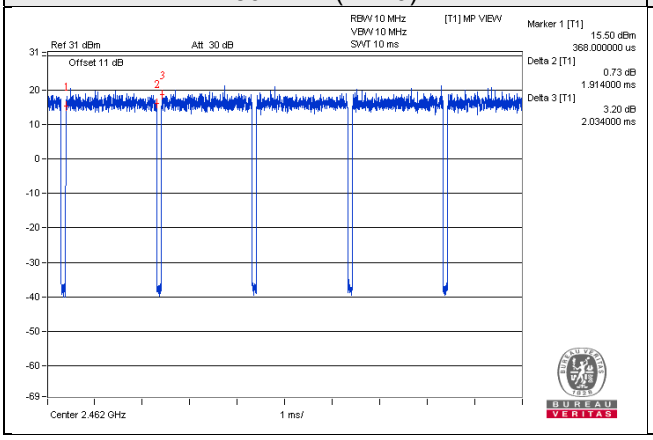
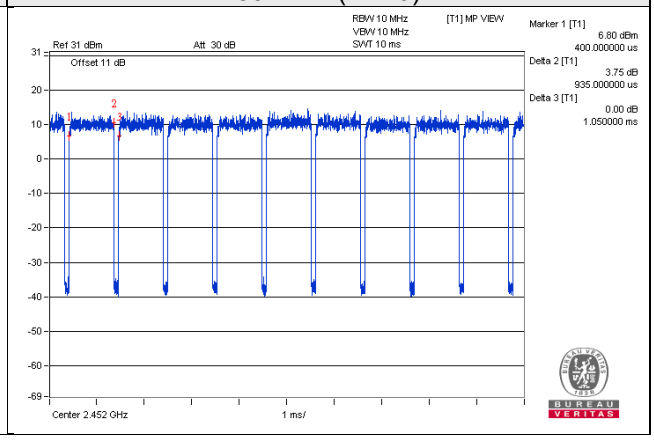
Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE≥1G	18 deg. C, 70% RH	120Vac, 60Hz	Jones Chang
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Antony Lee

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is ≥ 98%, duty factor is not required.
Duty cycle of test signal is < 98%, duty factor shall be considered.

802.11n (HT20): Duty cycle = 1.914/2.034 = 0.941, Duty factor = 10 * log(1/0.941) = 0.26
802.11n (HT40): Duty cycle = 0.935/1.05 = 0.890, Duty factor = 10 * log(1/0.890) = 0.50

802.11n (HT20)	802.11n (HT40)
	

3.4 Description of Support Units

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

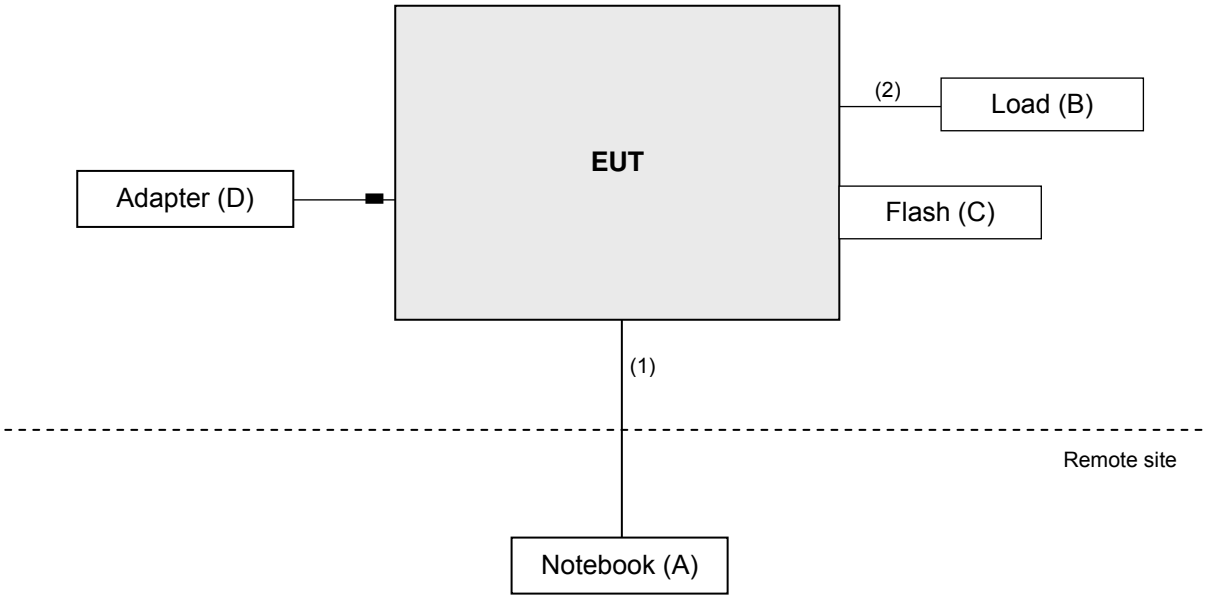
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	E5410	1HC2XM1	FCC DoC Approved	-
B.	Load	NA	NA	NA	NA	-
C.	Flash	Transcend	8GB	NA	NA	-
D.	Adapter	Asian Power Devices Inc.	WA-36A12R	NA	NA	Option of EUT I/P: 100-240Vac, 50-60Hz, 0.9A Max. O/P: 12Vdc, 3A 1.8m DC cable with 1 core

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A acted as a communication partner to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ45	1	5	N	0	-
2.	RJ45	2	1	N	0	-

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specification of the EUT declared by the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
558074 D01 DTS Meas Guidance v03r05
662911 D01 Multiple Transmitter Output v02r01
ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 30dB below the highest level of the desired power:

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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 30dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESIB7	100187	Apr. 18, 2016	Apr. 17, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100041	Sep. 02, 2015	Sep. 01, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-171	Jan. 07, 2016	Jan. 06, 2017
HORN Antenna SCHWARZBECK	9120D	209	Jan. 20, 2016	Jan. 19, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Jan. 18, 2016	Jan. 17, 2017
Preamplifier Agilent	8447D	2944A10738	Oct.18, 2015	Oct. 17, 2016
Preamplifier Agilent	8449B	3008A01964	Aug. 22, 2015	Aug. 21, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (214378)	Aug. 22, 2015	Aug. 21, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 106	Cable-CH3-03 (309224+12738)	Aug. 22, 2015	Aug. 21, 2016
Software BV ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Turn Table Controller BV ADT	SC100	SC93021702	NA	NA
High Speed Peak Power Meter	ML2495A	1145013	Mar. 22, 2016	Mar. 21, 2017
Power Sensor	MA2411B	0738171	Mar. 22, 2016	Mar. 21, 2017

Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 3.
3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 988962.
5. The IC Site Registration No. is IC 7450F-3.

4.1.3 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

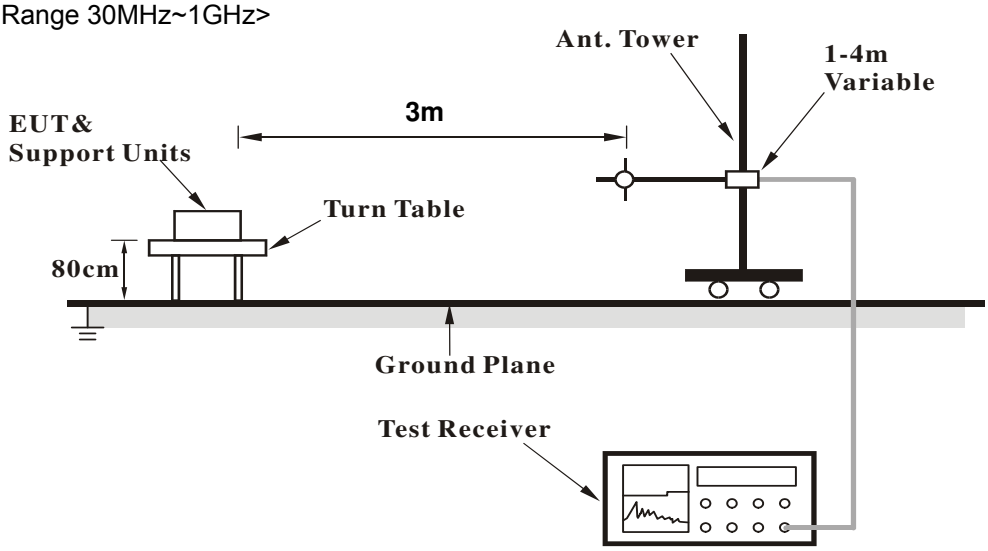
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (10 log(1/duty cycle)).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

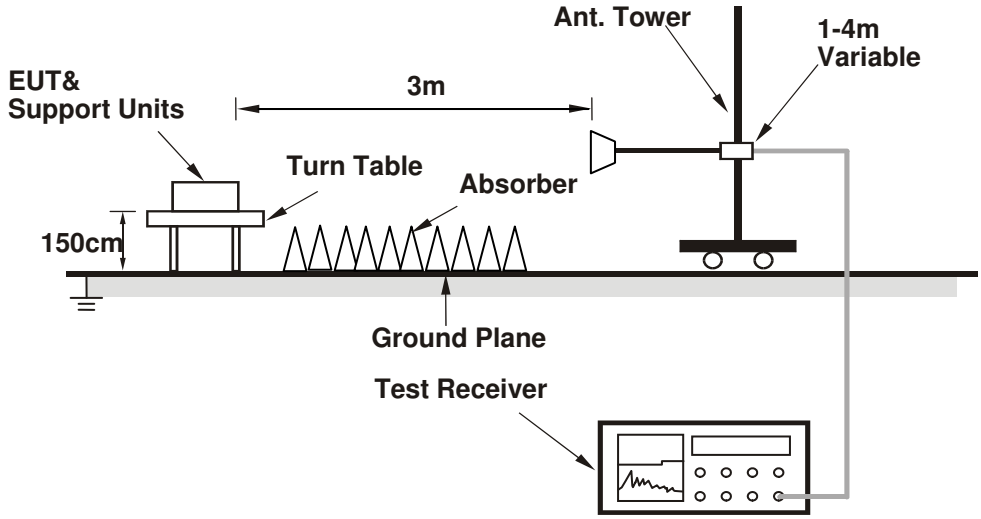
No deviation.

4.1.5 Test Setup

<Frequency Range 30MHz~1GHz>



<Frequency Range above 1GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.
b. Prepared a notebook to act as a communication partner and placed it outside of testing area.
c. The communication partner connected with EUT via a RJ45 cable and ran a test program (provided by manufacturer) to enable EUT under transmission condition continuously at specific channel frequency.
d. The communication partner sent data to EUT by command "PING".

4.1.7 Test Results

Above 1GHz Data:

Mode A

802.11n (HT20)

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	72.1 PK	74.0	-1.9	2.29 H	300	39.3	32.8
2	2390.00	49.5 AV	54.0	-4.5	2.29 H	300	16.7	32.8
3	*2412.00	115.1 PK			1.72 H	302	82.2	32.9
4	*2412.00	104.8 AV			1.72 H	302	71.9	32.9
5	4824.00	47.5 PK	74.0	-26.5	1.79 H	243	41.6	5.9
6	4824.00	34.9 AV	54.0	-19.1	1.79 H	243	29.0	5.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	64.2 PK	74.0	-9.8	2.34 V	340	31.4	32.8
2	2390.00	48.6 AV	54.0	-5.4	2.34 V	340	15.8	32.8
3	*2412.00	111.2 PK			2.54 V	339	78.3	32.9
4	*2412.00	101.2 AV			2.54 V	339	68.3	32.9
5	4824.00	46.9 PK	74.0	-27.1	2.42 V	320	41.0	5.9
6	4824.00	34.0 AV	54.0	-20.0	2.42 V	320	28.1	5.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 6	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	65.8 PK	74.0	-8.2	1.90 H	307	33.0	32.8
2	2390.00	47.8 AV	54.0	-6.2	1.90 H	307	15.0	32.8
3	*2437.00	121.1 PK			1.69 H	290	88.2	32.9
4	*2437.00	112.0 AV			1.69 H	290	79.1	32.9
5	4874.00	49.4 PK	74.0	-24.6	2.02 H	178	43.4	6.0
6	4874.00	37.0 AV	54.0	-17.0	2.02 H	178	31.0	6.0
7	7311.00	56.0 PK	74.0	-18.0	2.94 H	304	42.7	13.3
8	7311.00	43.2 AV	54.0	-10.8	2.94 H	304	29.9	13.3
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	61.0 PK	74.0	-13.0	2.44 V	333	28.2	32.8
2	2390.00	50.8 AV	54.0	-3.2	2.44 V	333	18.0	32.8
3	*2437.00	116.7 PK			2.54 V	339	83.8	32.9
4	*2437.00	105.0 AV			2.54 V	339	72.1	32.9
5	4874.00	48.2 PK	74.0	-25.8	2.77 V	260	42.2	6.0
6	4874.00	36.3 AV	54.0	-17.7	2.77 V	260	30.3	6.0
7	7311.00	54.8 PK	74.0	-19.2	2.18 V	20	41.5	13.3
8	7311.00	42.6 AV	54.0	-11.4	2.18 V	20	29.3	13.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 11	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2462.00	115.4 PK			1.80 H	279	82.5	32.9
2	*2462.00	105.9 AV			1.80 H	279	73.0	32.9
3	2483.50	72.5 PK	74.0	-1.5	1.90 H	292	39.5	33.0
4	2483.50	50.6 AV	54.0	-3.4	1.90 H	292	17.6	33.0
5	4924.00	47.6 PK	74.0	-26.4	1.89 H	272	41.6	6.0
6	4924.00	34.8 AV	54.0	-19.2	1.89 H	272	28.8	6.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2462.00	114.0 PK			2.62 V	19	81.1	32.9
2	*2462.00	102.6 AV			2.62 V	19	69.7	32.9
3	2483.50	69.8 PK	74.0	-4.2	2.02 V	0	36.8	33.0
4	2483.50	47.8 AV	54.0	-6.2	2.02 V	0	14.8	33.0
5	4924.00	48.6 PK	74.0	-25.4	2.50 V	189	42.6	6.0
6	4924.00	36.6 AV	54.0	-17.4	2.50 V	189	30.6	6.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

802.11n (HT40)

CHANNEL	TX Channel 3	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	71.9 PK	74.0	-2.1	1.80 H	49	39.1	32.8
2	2390.00	52.8 AV	54.0	-1.2	1.80 H	49	20.0	32.8
3	*2422.00	111.1 PK			1.87 H	314	78.2	32.9
4	*2422.00	100.4 AV			1.87 H	314	67.5	32.9
5	4844.00	47.7 PK	74.0	-26.3	1.97 H	209	41.9	5.8
6	4844.00	35.2 AV	54.0	-18.8	1.97 H	209	29.4	5.8
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	65.6 PK	74.0	-8.4	2.21 V	324	32.8	32.8
2	2390.00	51.5 AV	54.0	-2.5	2.21 V	324	18.7	32.8
3	*2422.00	108.8 PK			2.21 V	331	75.9	32.9
4	*2422.00	95.9 AV			2.21 V	331	63.0	32.9
5	4844.00	47.5 PK	74.0	-26.5	1.90 V	220	41.7	5.8
6	4844.00	34.9 AV	54.0	-19.1	1.90 V	220	29.1	5.8

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 6	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ.	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	71.6 PK	74.0	-2.4	1.79 H	305	38.8	32.8
2	2390.00	52.3 AV	54.0	-1.7	1.79 H	305	19.5	32.8
3	*2437.00	113.1 PK			1.61 H	307	80.2	32.9
4	*2437.00	102.9 AV			1.61 H	307	70.0	32.9
5	2483.50	69.3 PK	74.0	-4.7	1.98 H	282	36.3	33.0
6	2483.50	50.8 AV	54.0	-3.2	1.98 H	282	17.8	33.0
7	4874.00	49.5 PK	74.0	-24.5	1.89 H	233	43.5	6.0
8	4874.00	36.6 AV	54.0	-17.4	1.89 H	233	30.6	6.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	70.2 PK	74.0	-3.8	2.23 V	337	37.4	32.8
2	2390.00	51.3 AV	54.0	-2.7	2.23 V	337	18.5	32.8
3	*2437.00	110.4 PK			1.91 V	332	77.5	32.9
4	*2437.00	99.4 AV			1.91 V	332	66.5	32.9
5	2483.50	67.1 PK	74.0	-6.9	1.91 V	326	34.1	33.0
6	2483.50	49.6 AV	54.0	-4.4	1.91 V	326	16.6	33.0
7	4874.00	47.8 PK	74.0	-26.2	2.55 V	166	41.8	6.0
8	4874.00	34.9 AV	54.0	-19.1	2.55 V	166	28.9	6.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 9	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2452.00	111.4 PK			1.91 H	300	78.4	33.0
2	*2452.00	100.5 AV			1.91 H	300	67.5	33.0
3	2483.50	72.2 PK	74.0	-1.8	1.81 H	298	39.2	33.0
4	2483.50	50.1 AV	54.0	-3.9	1.81 H	298	17.1	33.0
5	4904.00	48.4 PK	74.0	-25.6	2.30 H	177	42.5	5.9
6	4904.00	35.4 AV	54.0	-18.6	2.30 H	177	29.5	5.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2452.00	109.2 PK			2.07 V	325	76.2	33.0
2	*2452.00	97.1 AV			2.07 V	325	64.1	33.0
3	2483.50	59.3 PK	74.0	-14.7	2.11 V	301	26.3	33.0
4	2483.50	48.6 AV	54.0	-5.4	2.11 V	301	15.6	33.0
5	4904.00	47.7 PK	74.0	-26.3	2.32 V	150	41.8	5.9
6	4904.00	34.9 AV	54.0	-19.1	2.32 V	150	29.0	5.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

Mode B

802.11n (HT20)

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	56.6 PK	74.0	-17.4	1.84 H	269	23.8	32.8
2	2390.00	45.6 AV	54.0	-8.4	1.84 H	269	12.8	32.8
3	*2412.00	102.1 PK			1.84 H	269	69.2	32.9
4	*2412.00	92.4 AV			1.84 H	269	59.5	32.9
5	4824.00	46.8 PK	74.0	-27.2	1.66 H	312	40.9	5.9
6	4824.00	33.9 AV	54.0	-20.1	1.66 H	312	28.0	5.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	72.3 PK	74.0	-1.7	1.82 V	323	39.5	32.8
2	2390.00	51.4 AV	54.0	-2.6	1.82 V	323	18.6	32.8
3	*2412.00	116.5 PK			1.41 V	325	83.6	32.9
4	*2412.00	105.4 AV			1.41 V	325	72.5	32.9
5	2487.00	60.1 PK	74.0	-13.9	1.48 V	105	27.1	33.0
6	2487.00	52.7 AV	54.0	-1.3	1.48 V	105	19.7	33.0
7	4824.00	48.3 PK	74.0	-25.7	1.38 V	183	42.4	5.9
8	4824.00	35.5 AV	54.0	-18.5	1.38 V	183	29.6	5.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 6	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	56.2 PK	74.0	-17.8	1.86 H	359	23.4	32.8
2	2390.00	45.9 AV	54.0	-8.1	1.86 H	359	13.1	32.8
3	*2437.00	106.7 PK			1.91 H	352	73.8	32.9
4	*2437.00	95.4 AV			1.91 H	352	62.5	32.9
5	2483.50	56.8 PK	74.0	-17.2	1.76 H	312	23.8	33.0
6	2483.50	45.8 AV	54.0	-8.2	1.76 H	312	12.8	33.0
7	4874.00	47.1 PK	74.0	-26.9	2.01 H	86	41.1	6.0
8	4874.00	34.3 AV	54.0	-19.7	2.01 H	86	28.3	6.0
9	7311.00	55.8 PK	74.0	-18.2	2.12 H	167	42.5	13.3
10	7311.00	46.8 AV	54.0	-7.2	2.12 H	167	33.5	13.3
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	68.4 PK	74.0	-5.6	2.12 V	222	35.6	32.8
2	2390.00	50.9 AV	54.0	-3.1	2.12 V	222	18.1	32.8
3	*2437.00	121.9 PK			1.48 V	236	89.0	32.9
4	*2437.00	109.0 AV			1.48 V	236	76.1	32.9
5	2483.50	67.3 PK	74.0	-6.7	1.47 V	223	34.3	33.0
6	2483.50	49.6 AV	54.0	-4.4	1.47 V	223	16.6	33.0
7	4874.00	50.6 PK	74.0	-23.4	2.22 V	4	44.6	6.0
8	4874.00	41.0 AV	54.0	-13.0	2.22 V	4	35.0	6.0
9	7311.00	58.0 PK	74.0	-16.0	2.01 V	207	44.7	13.3
10	7311.00	52.3 AV	54.0	-1.7	2.01 V	207	39.0	13.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 11	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2462.00	102.2 PK			1.76 H	358	69.3	32.9
2	*2462.00	92.2 AV			1.76 H	358	59.3	32.9
3	2483.50	56.6 PK	74.0	-17.4	1.76 H	358	23.6	33.0
4	2483.50	45.9 AV	54.0	-8.1	1.76 H	358	12.9	33.0
5	4924.00	47.4 PK	74.0	-26.6	1.65 H	111	41.4	6.0
6	4924.00	35.1 AV	54.0	-18.9	1.65 H	111	29.1	6.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2462.00	117.5 PK			1.62 V	237	84.6	32.9
2	*2462.00	105.4 AV			1.62 V	237	72.5	32.9
3	2483.50	72.4 PK	74.0	-1.6	1.66 V	235	39.4	33.0
4	2483.50	50.4 AV	54.0	-3.6	1.66 V	235	17.4	33.0
5	4924.00	48.3 PK	74.0	-25.7	1.44 V	145	42.3	6.0
6	4924.00	35.5 AV	54.0	-18.5	1.44 V	145	29.5	6.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

802.11n (HT40)

CHANNEL	TX Channel 3	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	58.8 PK	74.0	-15.2	1.57 H	349	26.0	32.8
2	2390.00	48.0 AV	54.0	-6.0	1.57 H	349	15.2	32.8
3	*2422.00	98.7 PK			1.57 H	349	65.8	32.9
4	*2422.00	89.8 AV			1.57 H	349	56.9	32.9
5	4844.00	46.6 PK	74.0	-27.4	1.79 H	233	40.8	5.8
6	4844.00	33.8 AV	54.0	-20.2	1.79 H	233	28.0	5.8
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	65.8 PK	74.0	-8.2	2.08 V	99	33.0	32.8
2	2390.00	52.7 AV	54.0	-1.3	2.08 V	99	19.9	32.8
3	*2422.00	111.9 PK			1.62 V	329	79.0	32.9
4	*2422.00	101.8 AV			1.62 V	329	68.9	32.9
5	4844.00	47.8 PK	74.0	-26.2	1.77 V	96	42.0	5.8
6	4844.00	34.8 AV	54.0	-19.2	1.77 V	96	29.0	5.8

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 6	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	58.4 PK	74.0	-15.6	1.60 H	356	25.6	32.8
2	2390.00	48.2 AV	54.0	-5.8	1.60 H	356	15.4	32.8
3	*2437.00	101.5 PK			1.61 H	353	68.6	32.9
4	*2437.00	91.9 AV			1.61 H	353	59.0	32.9
5	4874.00	47.4 PK	74.0	-26.6	1.70 H	256	41.4	6.0
6	4874.00	34.5 AV	54.0	-19.5	1.70 H	256	28.5	6.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	72.8 PK	74.0	-1.2	1.62 V	315	40.0	32.8
2	2390.00	52.9 AV	54.0	-1.1	1.62 V	315	20.1	32.8
3	*2437.00	116.1 PK			1.66 V	231	83.2	32.9
4	*2437.00	105.6 AV			1.66 V	231	72.7	32.9
5	4874.00	47.9 PK	74.0	-26.1	1.76 V	32	41.9	6.0
6	4874.00	34.7 AV	54.0	-19.3	1.76 V	32	28.7	6.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 9	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2452.00	100.6 PK			1.61 H	350	67.6	33.0
2	*2452.00	90.6 AV			1.61 H	350	57.6	33.0
3	2483.50	56.8 PK	74.0	-17.2	1.61 H	350	23.8	33.0
4	2483.50	46.1 AV	54.0	-7.9	1.61 H	350	13.1	33.0
5	4904.00	46.9 PK	74.0	-27.1	1.66 H	90	41.0	5.9
6	4904.00	34.1 AV	54.0	-19.9	1.66 H	90	28.2	5.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2452.00	113.7 PK			1.61 V	322	80.7	33.0
2	*2452.00	103.2 AV			1.61 V	322	70.2	33.0
3	**2483.50**	**73.0 PK**	**74.0**	**-1.0**	**1.61 V**	**145**	**40.0**	**33.0**
4	2483.50	51.7 AV	54.0	-2.3	1.61 V	145	18.7	33.0
5	4904.00	47.8 PK	74.0	-26.2	1.70 V	22	41.9	5.9
6	4904.00	34.8 AV	54.0	-19.2	1.70 V	22	28.9	5.9

Remarks:

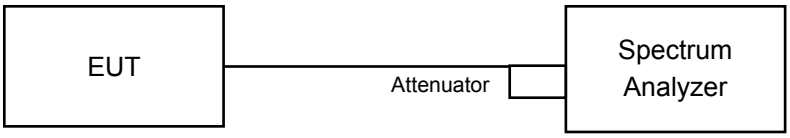
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

4.2 6dB Bandwidth Measurement

4.2.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 Test Result

802.11n (HT20)

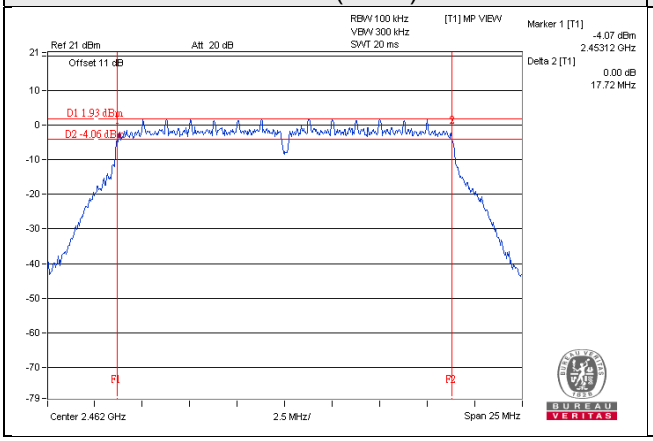
Channel	Frequency (MHz)	6dB Bandwidth (MHz)				Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3		
1	2412	15.15	17.67	17.67	17.67	0.5	Pass
6	2437	15.17	17.66	17.66	17.65	0.5	Pass
11	2462	17.72	17.67	17.64	17.65	0.5	Pass

802.11n (HT40)

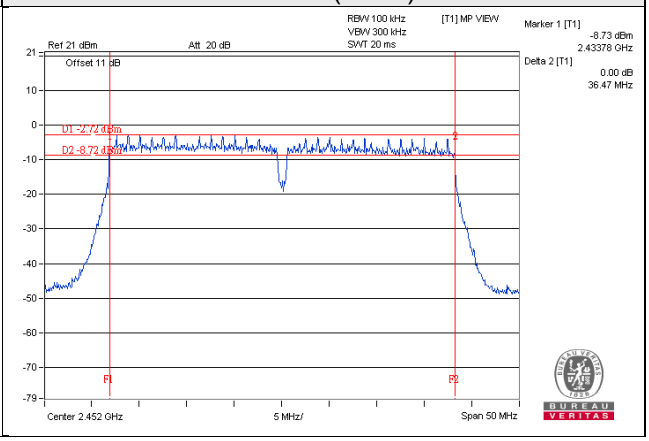
Channel	Frequency (MHz)	6dB Bandwidth (MHz)				Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3		
3	2422	36.42	36.46	36.45	36.42	0.5	Pass
6	2437	36.38	36.41	36.36	36.37	0.5	Pass
9	2452	36.42	36.47	36.41	36.46	0.5	Pass

Spectrum Plot of Worst Value

802.11n (HT20)



802.11n (HT40)



4.3 Conducted Output Power Measurement

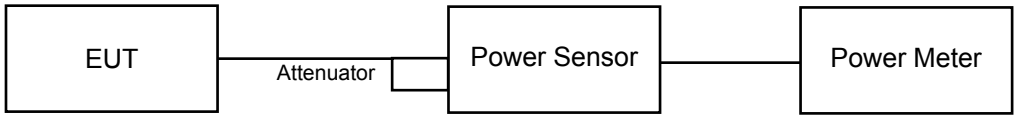
4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)
Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any NANT;
Array Gain = 5 log(NANT/NSS) dB or 3 dB, whichever is less for 20-MHz channel widths with NANT ≥ 5.

For power measurements on all other devices: Array Gain = 10 log(NANT/NSS) dB.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

An average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor. Record the power level.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

Same as 4.3.6.

4.3.7 Test Results

Average Power:

802.11n (HT20)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
1	2412	12.47	12.58	12.54	13.05	73.904	18.69	25.56	Pass
6	2437	17.14	17.15	17.39	18.15	**223.782**	23.50	25.56	Pass
11	2462	13.10	13.15	13.26	14.14	88.197	19.45	25.56	Pass

Note: Directional gain = 4.42dBi + 10log(4) = 10.44dBi > 6dBi, so the limit shall be reduced to 30-(10.44-6) = 25.56dBm.

802.11n (HT40)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
3	2422	10.16	11.23	10.90	11.38	49.692	16.96	25.56	Pass
6	2437	13.18	13.91	13.87	14.54	98.224	19.92	25.56	Pass
9	2452	10.97	11.55	11.46	12.09	56.969	17.56	25.56	Pass

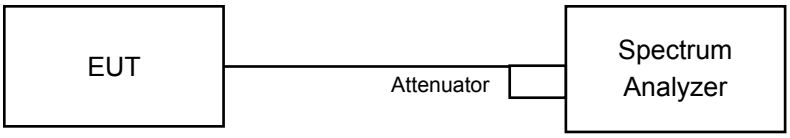
Note: Directional gain = 4.42dBi + 10log(4) = 10.44dBi > 6dBi, so the limit shall be reduced to 30-(10.44-6) = 25.56dBm.

4.4 Power Spectral Density Measurement

4.4.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedure

For AVG. power (duty cycle ≥ 98%)
a) Set instrument center frequency to DTS channel center frequency.
b) Set span to at least 1.5 times the OBW.
c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set VBW ≥3 x RBW.
e) Detector = power averaging (RMS) or sample detector (when RMS not available).
f) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
g) Sweep time = auto couple.
h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
i) Use the peak marker function to determine the maximum amplitude level.

For AVG. power (duty cycle < 98%)
a) Measure the duty cycle (x).
b) Set instrument center frequency to DTS channel center frequency.
c) Set span to at least 1.5 times the OBW.
d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
e) Set VBW ≥3 x RBW.
f) Detector = power averaging (RMS) or sample detector (when RMS not available).
g) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
h) Sweep time = auto couple.
i) Do not use sweep triggering. Allow sweep to “free run”.
j) Employ trace averaging (RMS) mode over a minimum of 100 traces.
k) Use the peak marker function to determine the maximum amplitude level.
l) Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Condition

Same as 4.3.6

4.4.7 Test Results

802.11n (HT20)

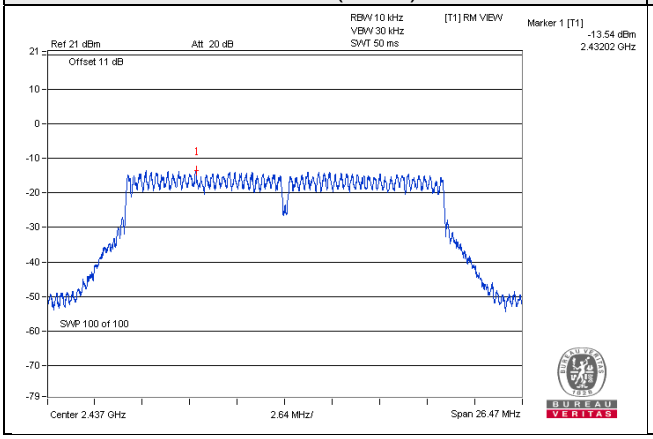
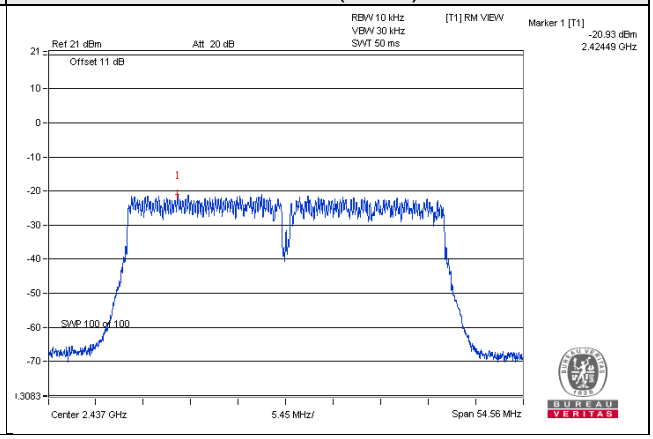
TX chain	Channel	Freq. (MHz)	PSD (dBm)	10 log (N=4) dB	Duty Factor	Total PSD with Duty Factor (dBm)	Limit (dBm)	Pass/Fail
0	1	2412	-18.73	6.02	0.26	-12.45	3.56	Pass
	6	2437	-14.11	6.02	0.26	-7.83	3.56	Pass
	11	2462	-18.58	6.02	0.26	-12.30	3.56	Pass
1	1	2412	-19.58	6.02	0.26	-13.30	3.56	Pass
	6	2437	-14.04	6.02	0.26	-7.76	3.56	Pass
	11	2462	-19.70	6.02	0.26	-13.42	3.56	Pass
2	1	2412	-19.09	6.02	0.26	-12.81	3.56	Pass
	6	2437	-15.06	6.02	0.26	-8.78	3.56	Pass
	11	2462	-19.40	6.02	0.26	-13.12	3.56	Pass
3	1	2412	-19.97	6.02	0.26	-13.69	3.56	Pass
	6	2437	-13.54	6.02	0.26	-7.26	3.56	Pass
	11	2462	-17.91	6.02	0.26	-11.63	3.56	Pass

Note:
1. Method 1 of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = 4.42dBi + 10log(4) = 10.44dBi > 6dBi, so the limit shall be reduced to 8-(10.44-6) = 3.56dBm.
3. Refer to section 3.3 for duty cycle spectrum plot.

802.11n (HT40)

TX chain	Channel	Freq. (MHz)	PSD (dBm)	10 log (N=4) dB	Duty Factor	Total PSD with Duty Factor (dBm)	Limit (dBm)	Pass/Fail
0	3	2422	-26.02	6.02	0.50	-19.50	3.56	Pass
	6	2437	-21.87	6.02	0.50	-15.35	3.56	Pass
	9	2452	-24.34	6.02	0.50	-17.82	3.56	Pass
1	3	2422	-25.80	6.02	0.50	-19.28	3.56	Pass
	6	2437	-21.08	6.02	0.50	-14.56	3.56	Pass
	9	2452	-22.23	6.02	0.50	-15.71	3.56	Pass
2	3	2422	-25.72	6.02	0.50	-19.20	3.56	Pass
	6	2437	-22.05	6.02	0.50	-15.53	3.56	Pass
	9	2452	-23.99	6.02	0.50	-17.47	3.56	Pass
3	3	2422	-24.12	6.02	0.50	-17.60	3.56	Pass
	6	2437	-20.93	6.02	0.50	-14.41	3.56	Pass
	9	2452	-28.32	6.02	0.50	-21.80	3.56	Pass

Note:
1. Method 1 of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = 4.42dBi + 10log(4) = 10.44dBi > 6dBi, so the limit shall be reduced to 8-(10.44-6) = 3.56dBm.
3. Refer to section 3.3 for duty cycle spectrum plot.

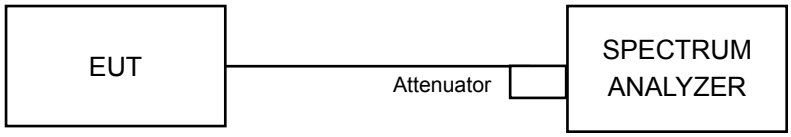
Spectrum Plot of Worst Value	
802.11n (HT20)	802.11n (HT40)
	

4.5 Conducted Out of Band Emission Measurement

4.5.1 Limits of Conducted Out of Band Emission Measurement

Below 30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

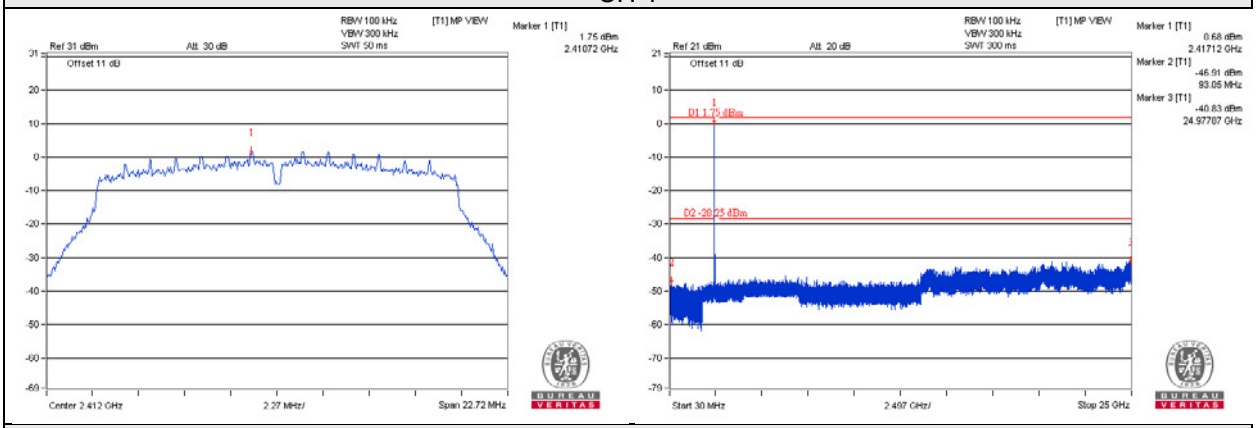
Same as 4.3.6

4.5.7 Test Results

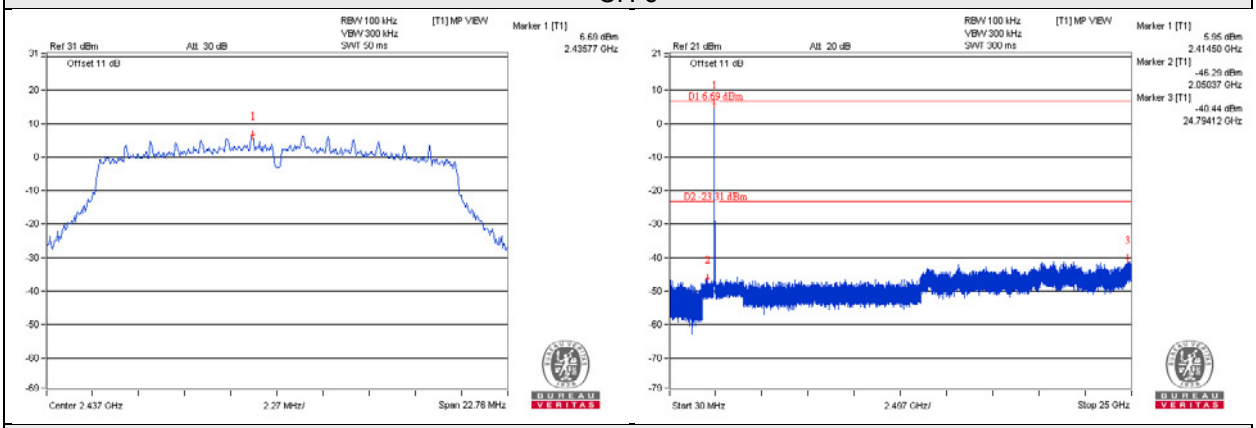
The conducted emission test is performed on each TX port of operating mode without summing or adding 10log (N) since the limit is relative emission limit.
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

802.11n (HT20)_Chain 0

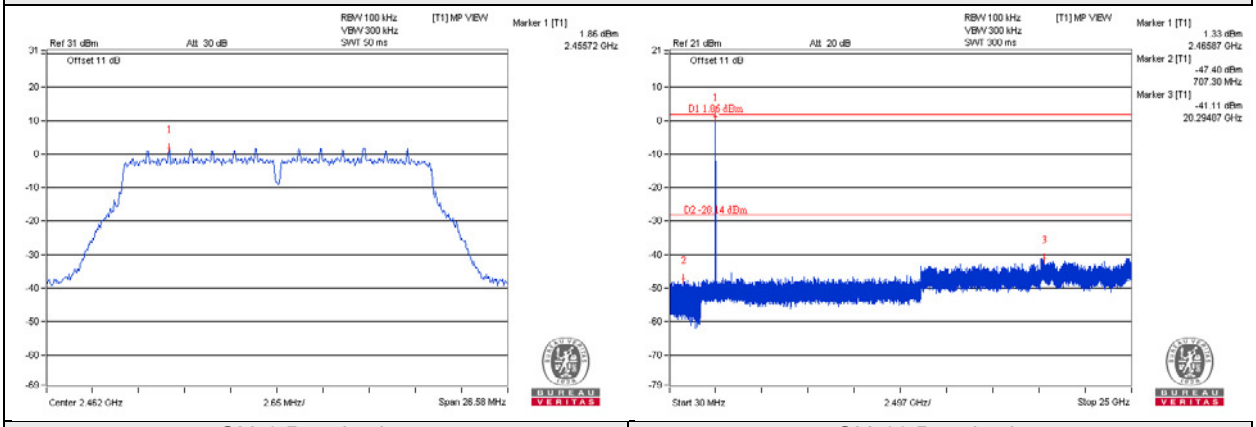
CH 1



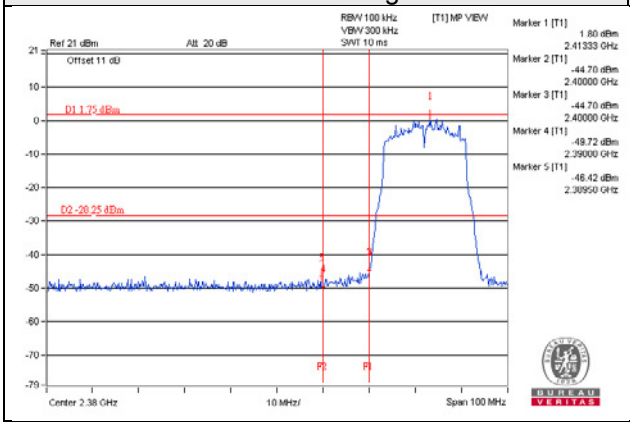
CH 6



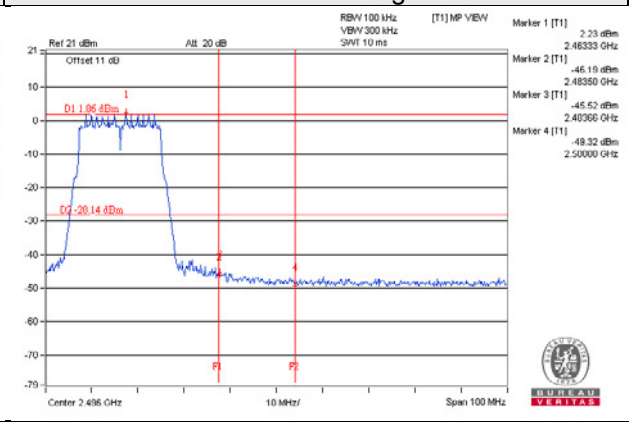
CH 11



CH 1 Band edge

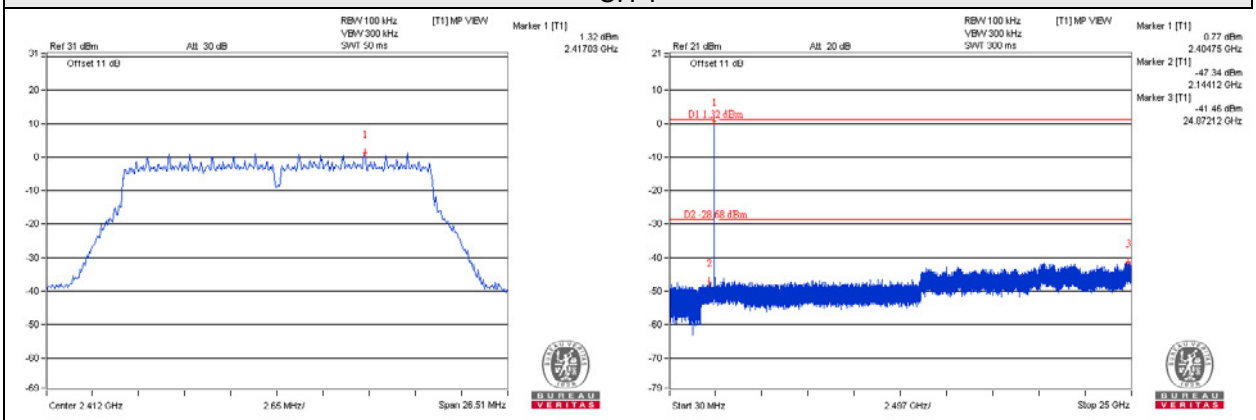


CH 11 Band edge

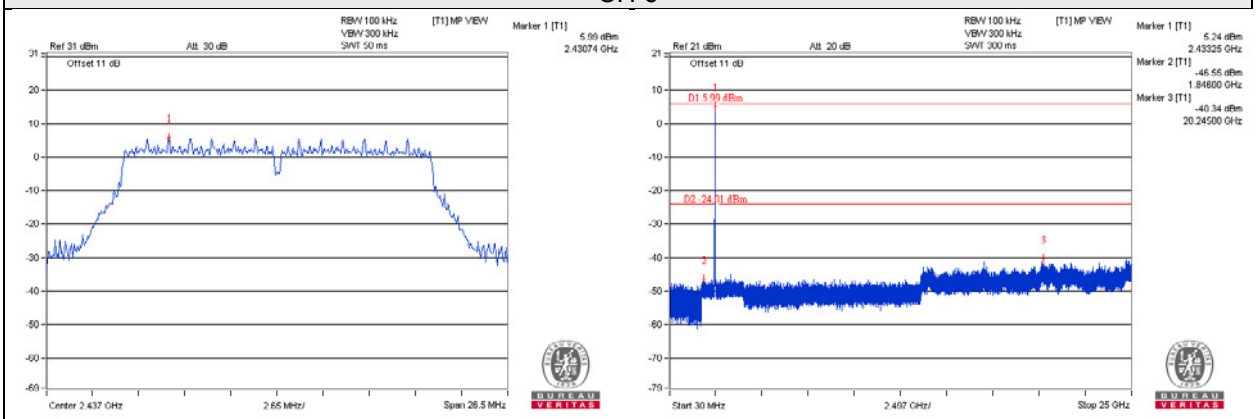


802.11n (HT20)_Chain 1

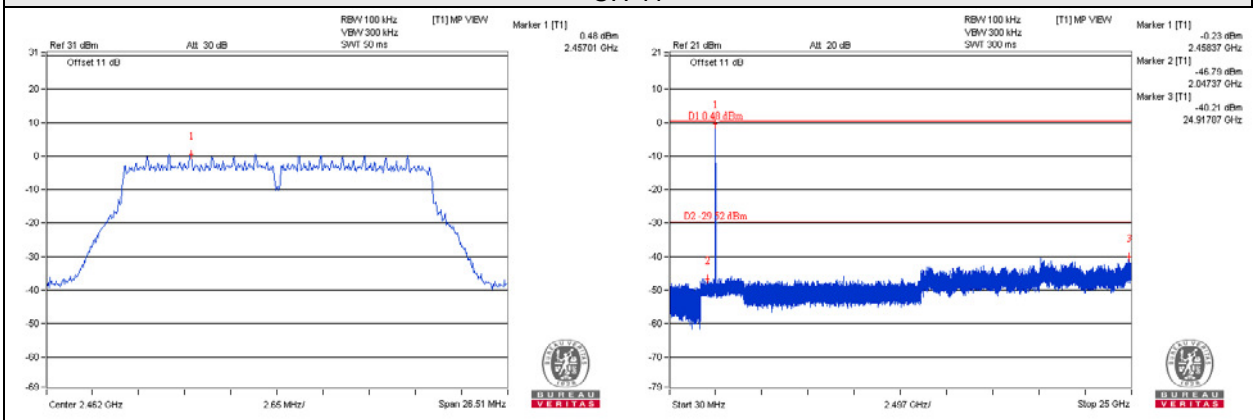
CH 1



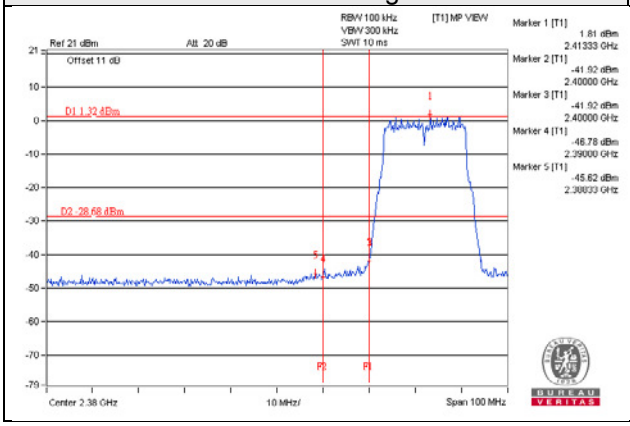
CH 6



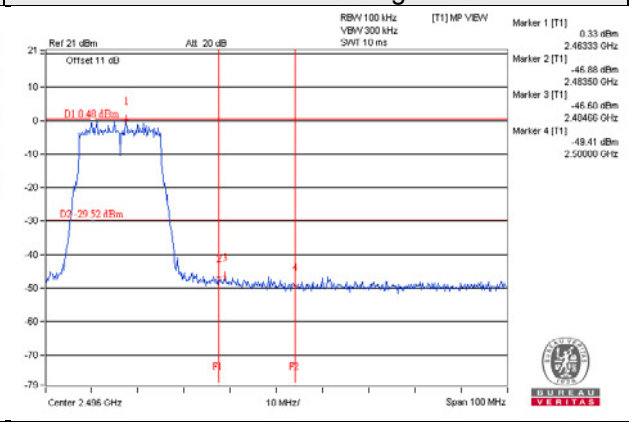
CH 11



CH 1 Band edge

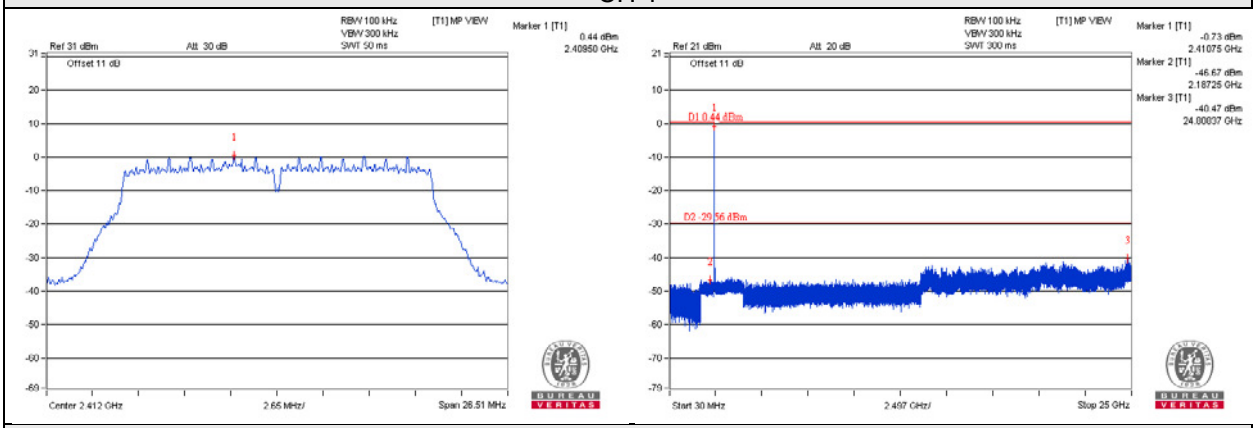


CH 11 Band edge

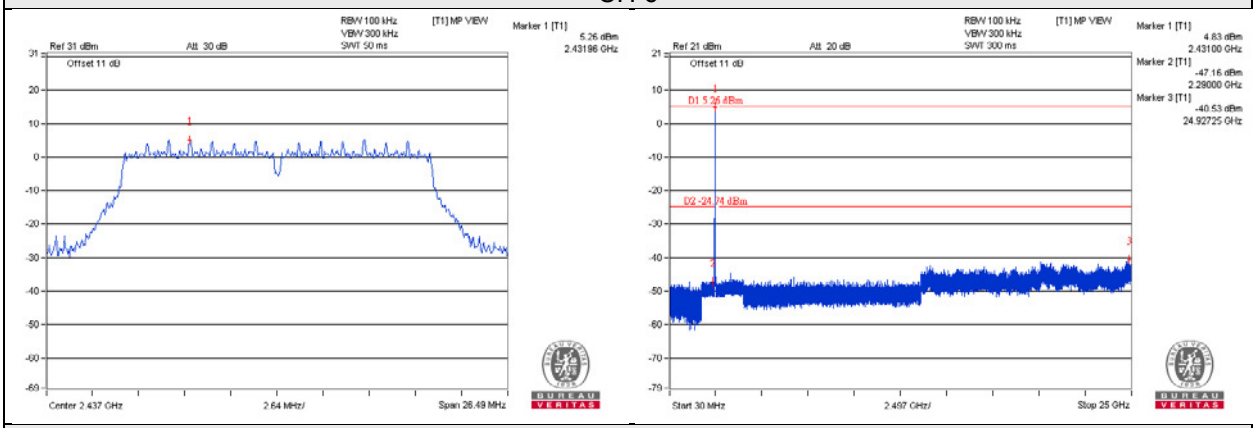


802.11n (HT20)_Chain 2

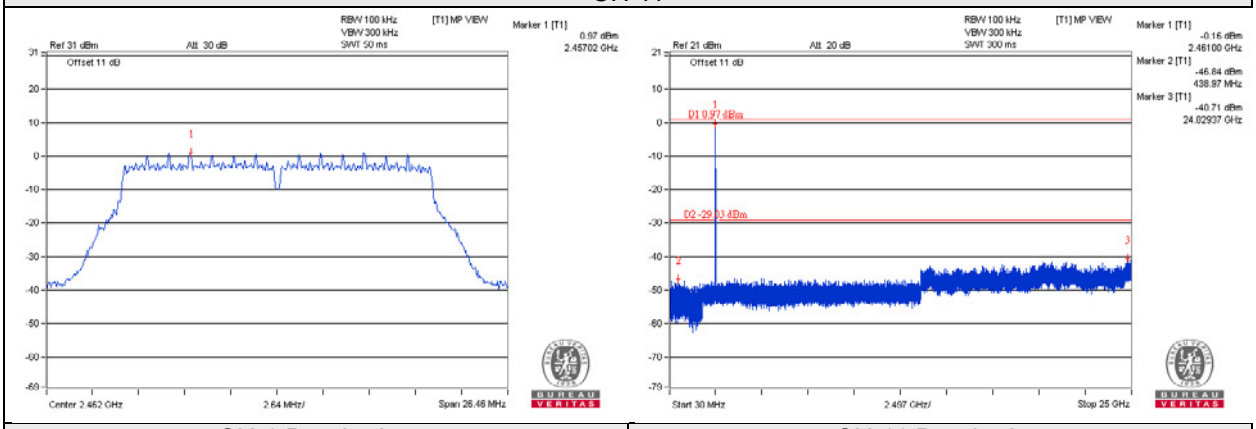
CH 1



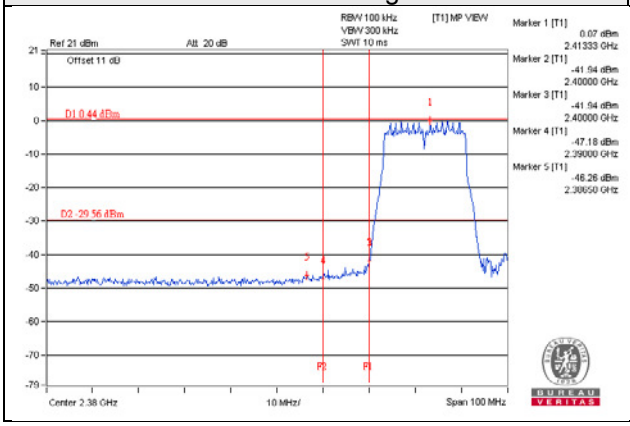
CH 6



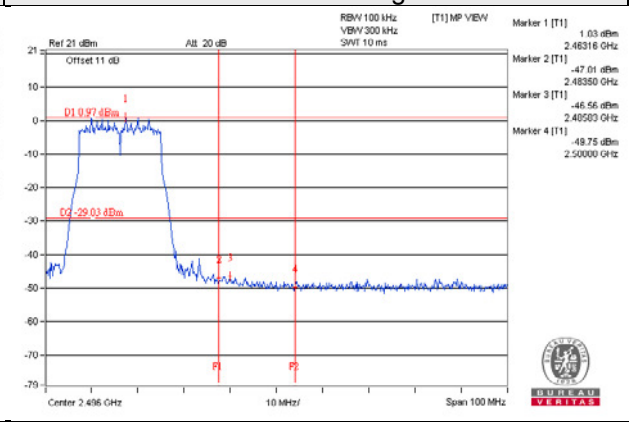
CH 11



CH 1 Band edge

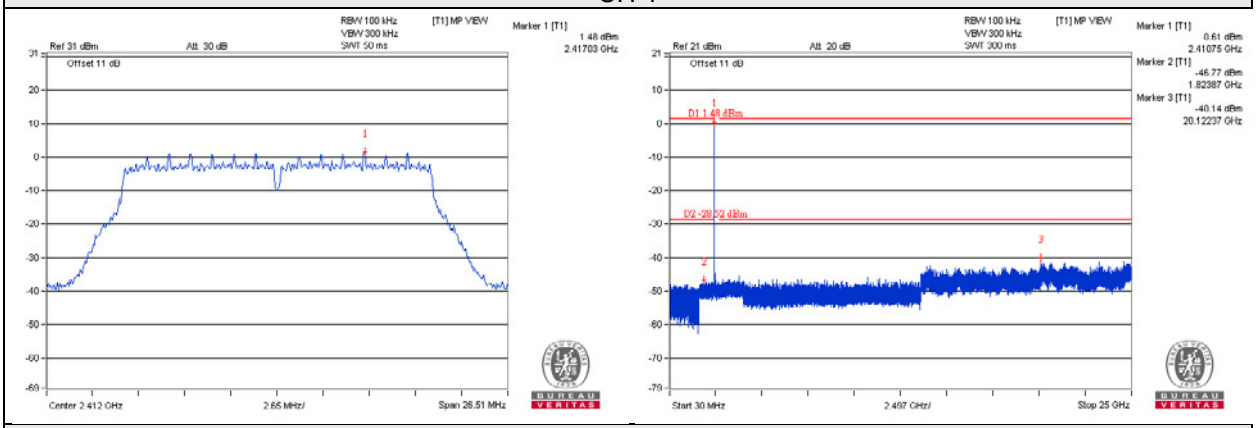


CH 11 Band edge

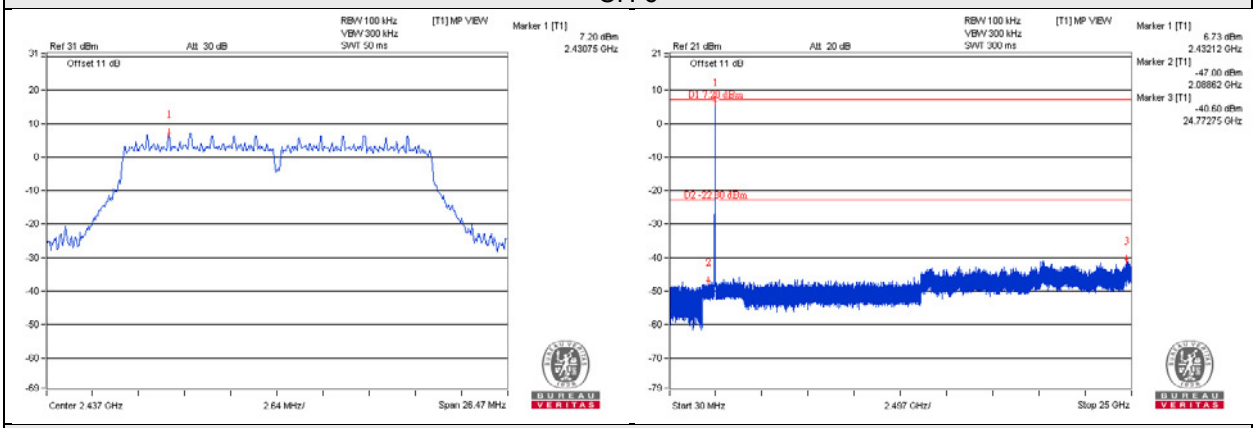


802.11n (HT20)_Chain 3

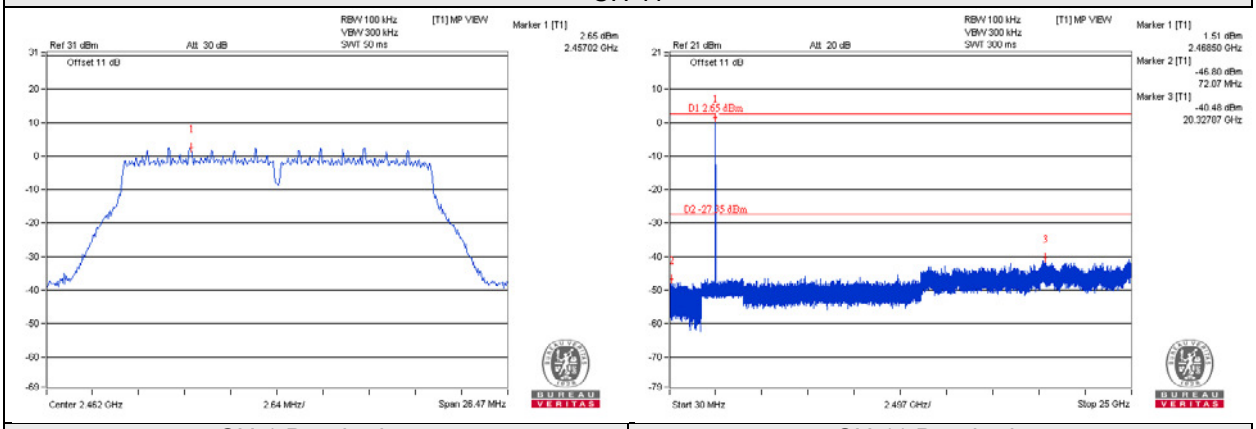
CH 1



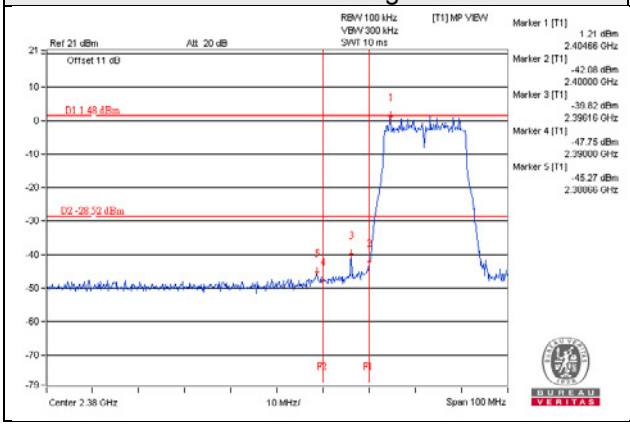
CH 6



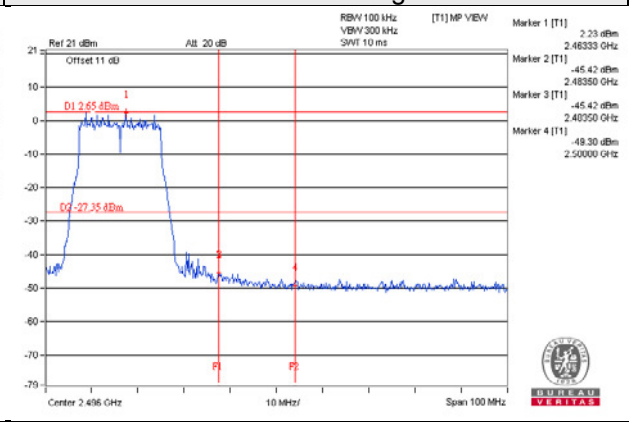
CH 11



CH 1 Band edge

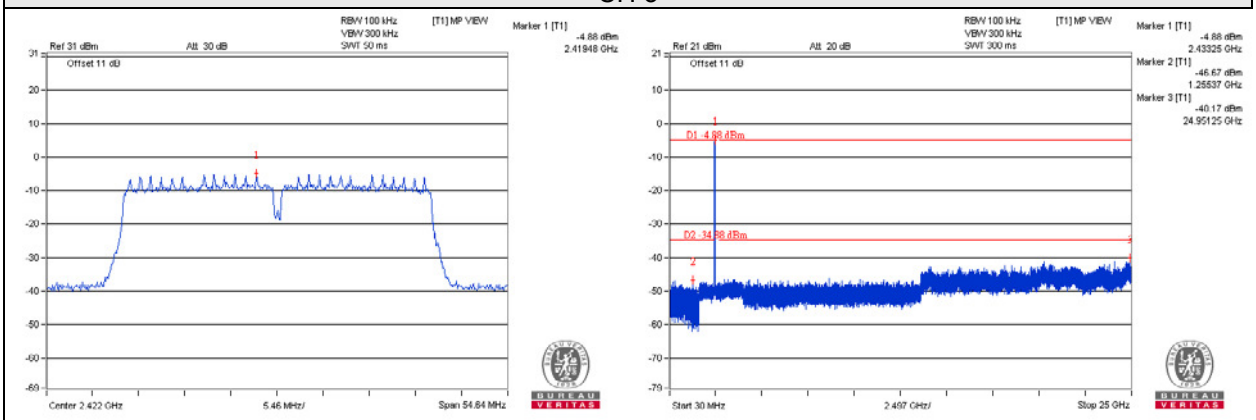


CH 11 Band edge

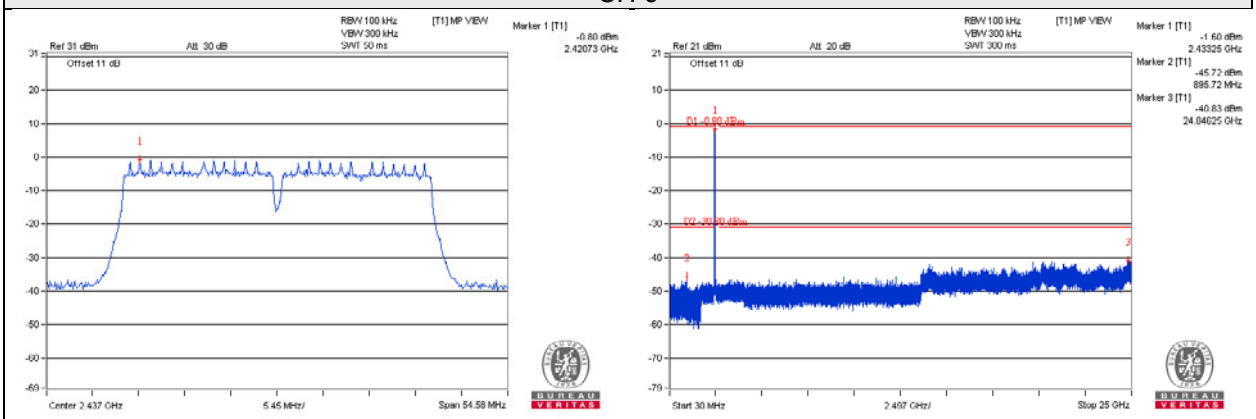


802.11n (HT40)_Chain 0

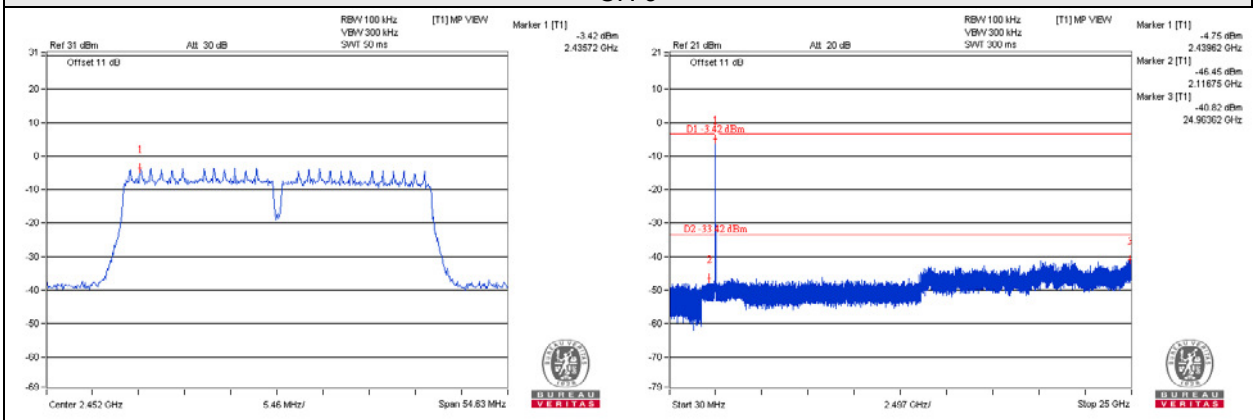
CH 3



CH 6



CH 9



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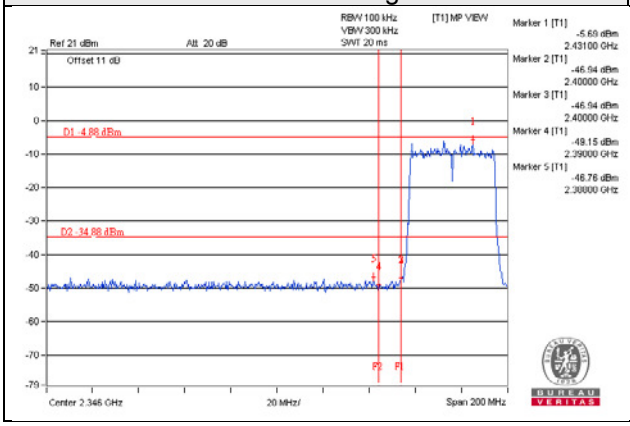

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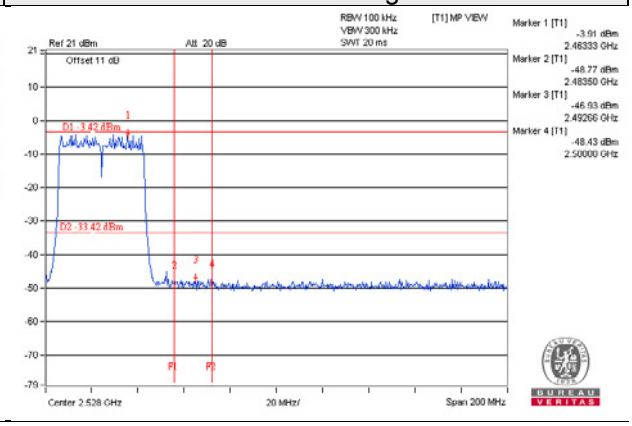
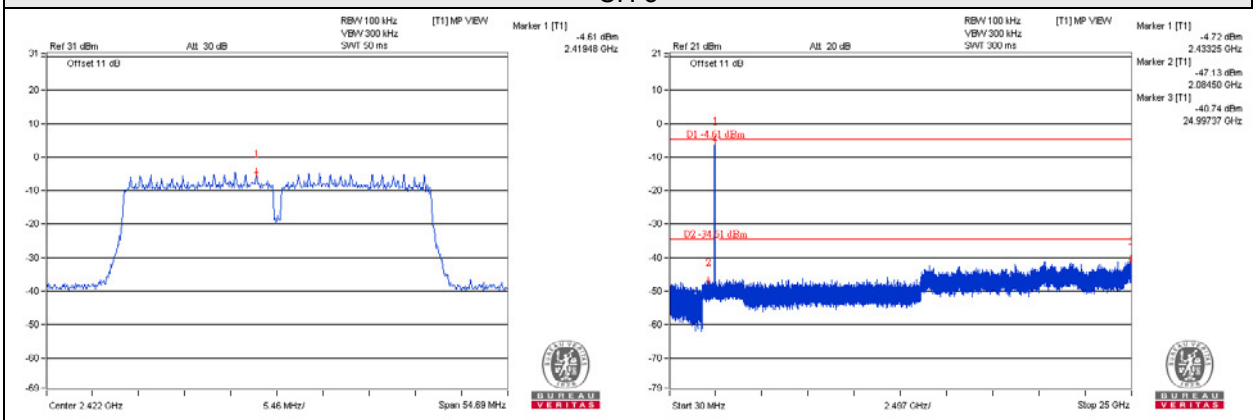


802.11n (HT40)_Chain 1

CH 3



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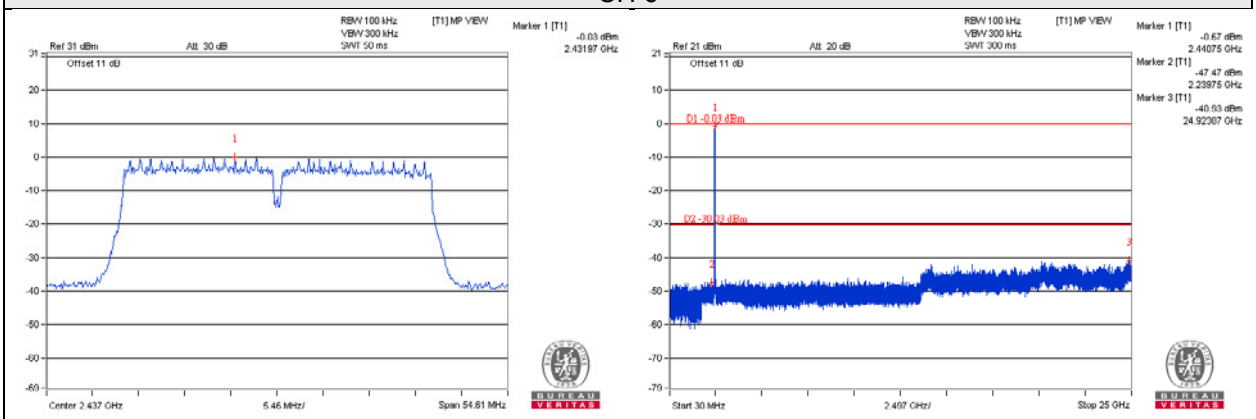
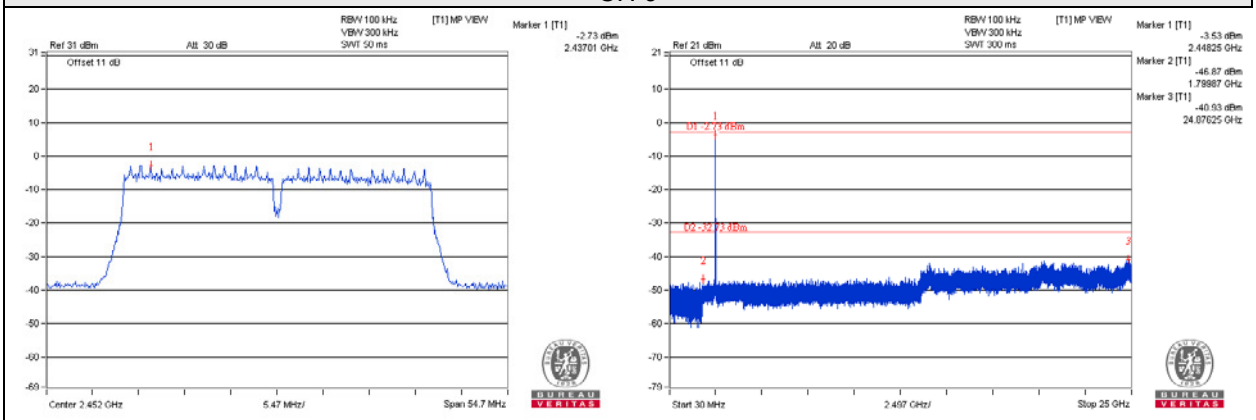
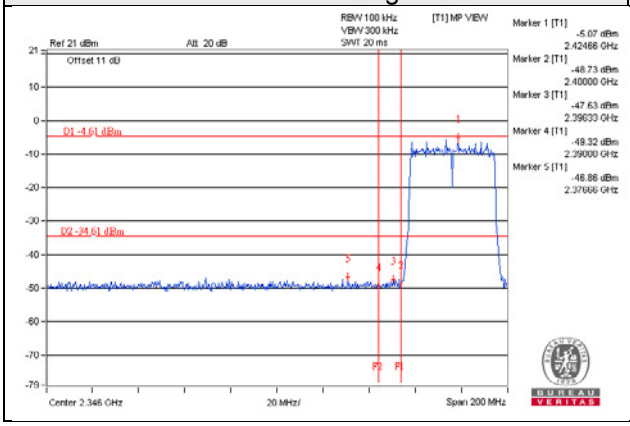


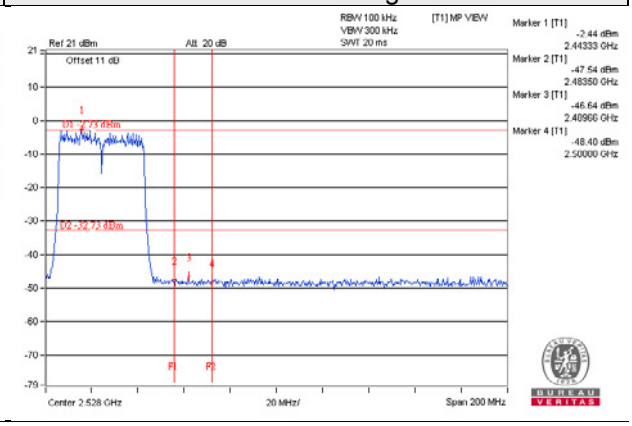
CH 9



CH 3 Band edge

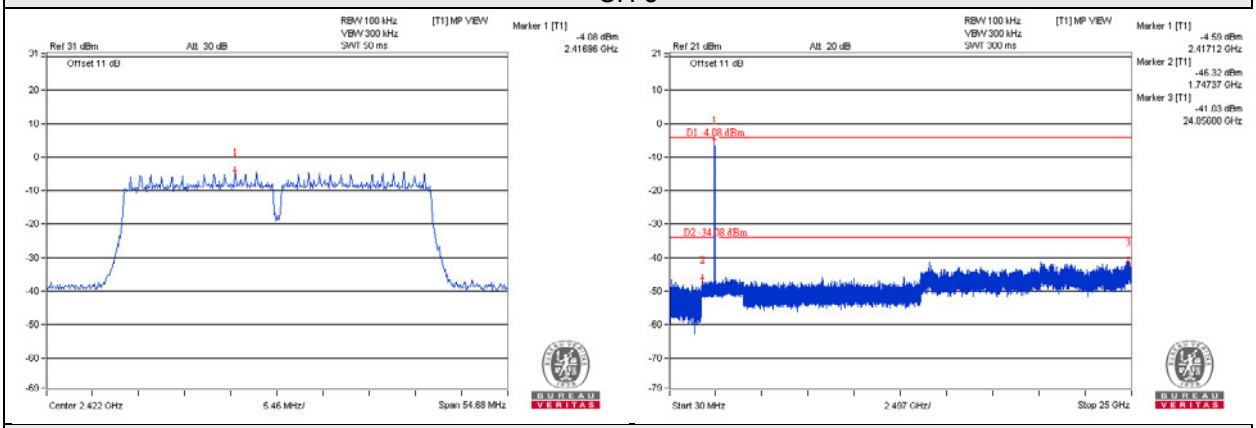


CH 9 Band edge

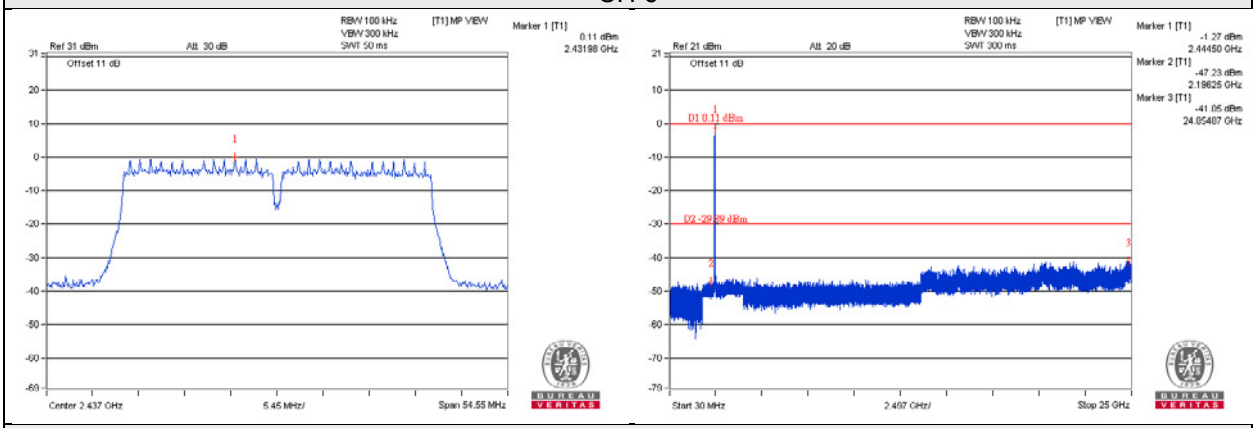


802.11n (HT40)_Chain 2

CH 3



CH 6



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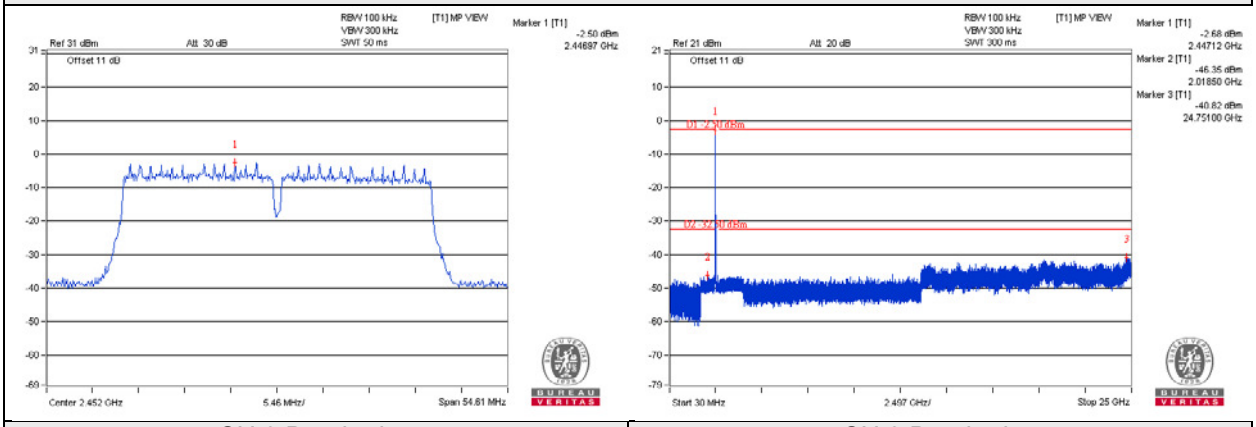

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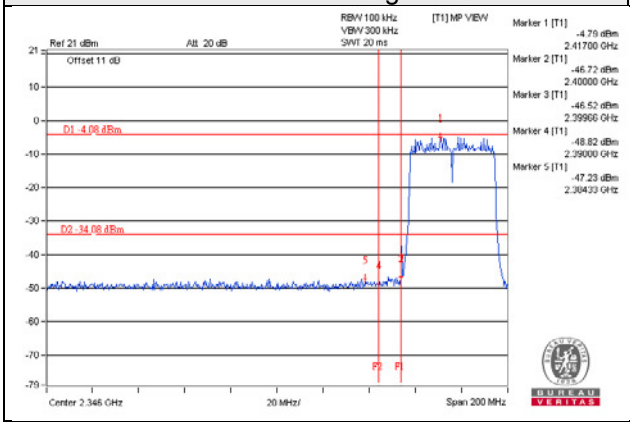

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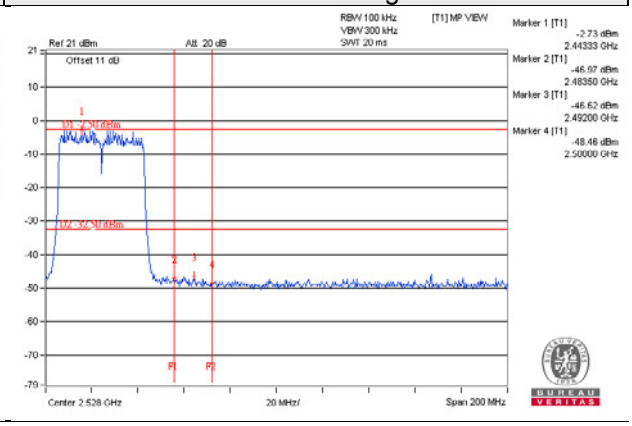
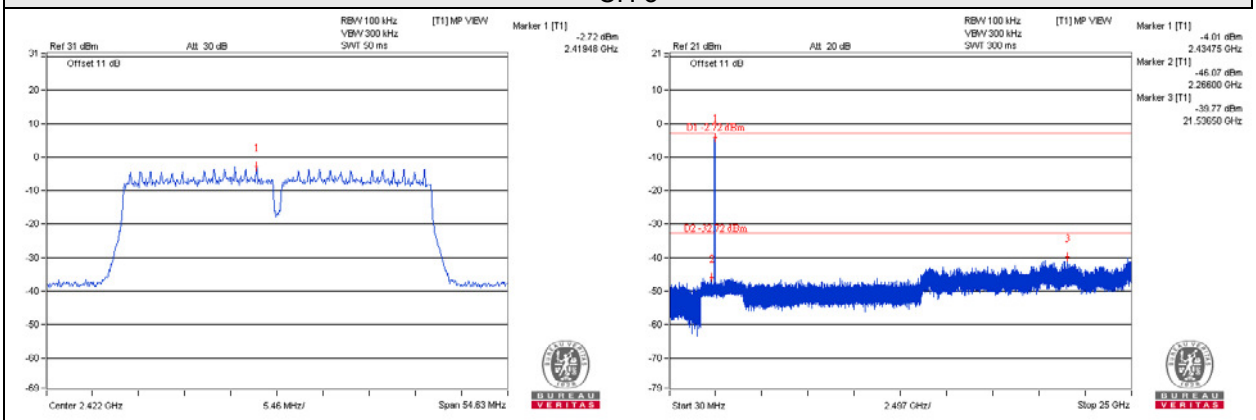
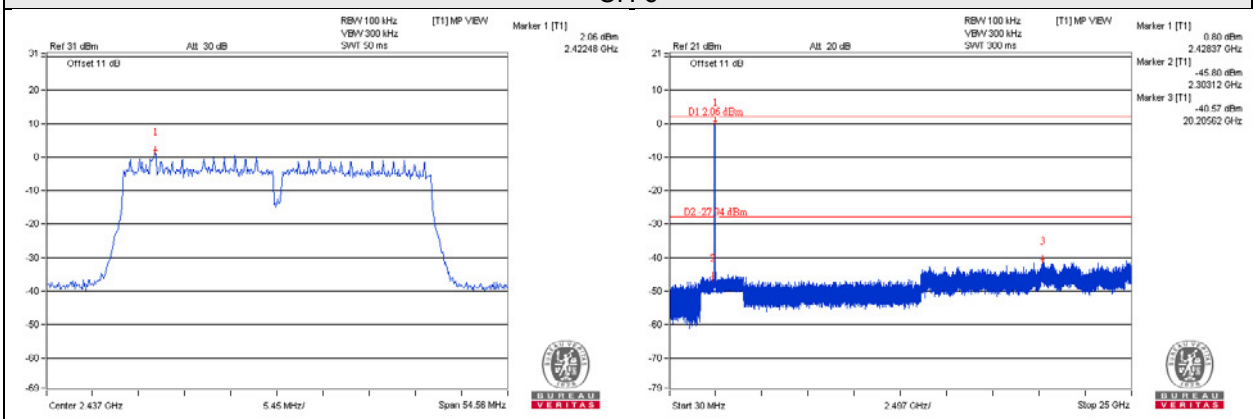


802.11n (HT40)_Chain 3

CH 3



CH 6



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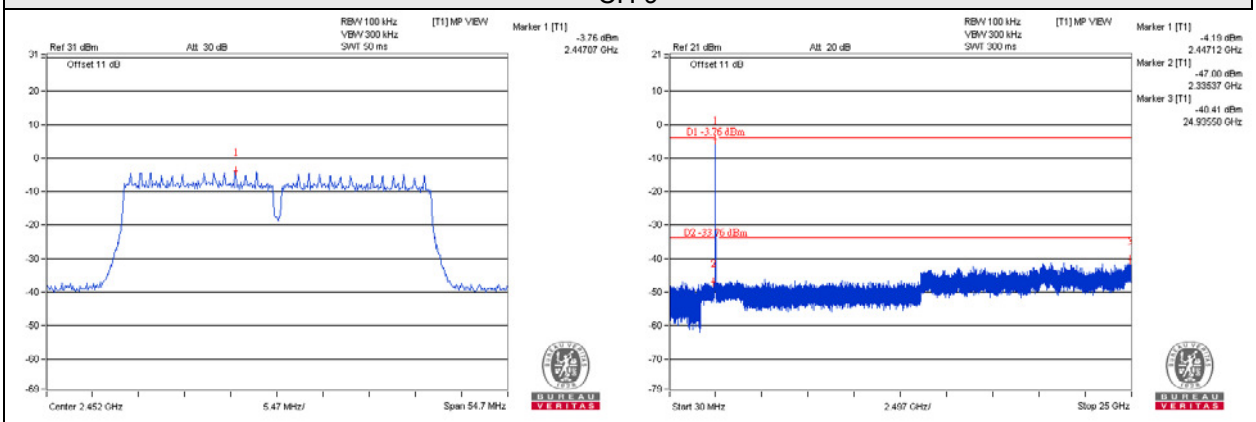

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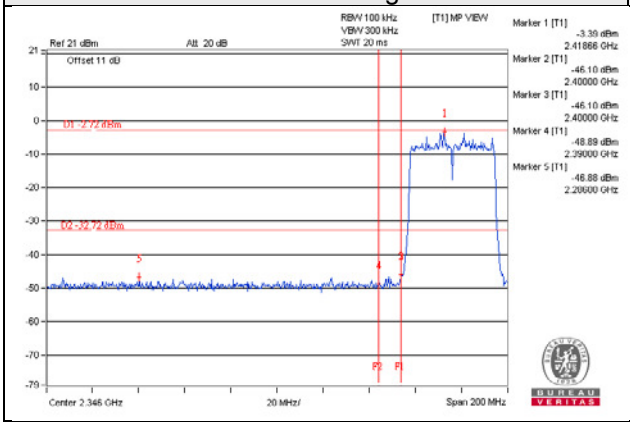

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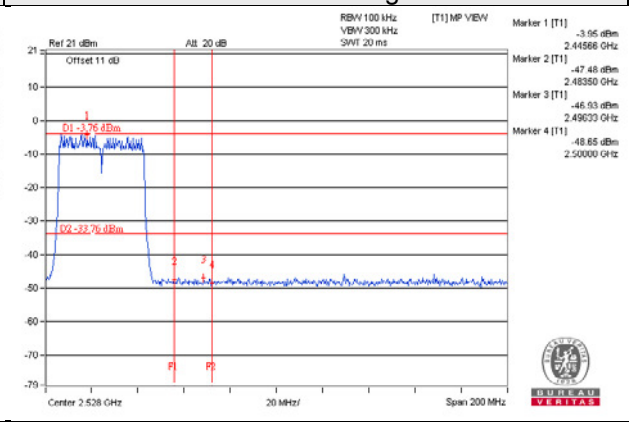

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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