

FCC Test Report

Report No.: RF151030E03

FCC ID: I88USG20W-VPN

Test Model: USG20W-VPN

Received Date: Oct. 30, 2015

Test Date: Nov. 20 ~ Dec. 04, 2015

Issued Date: Dec. 15, 2015

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Release Control Record

Issue No.	Description	Date Issued
RF151030E03	Original release	Dec. 15, 2015

1 Certificate of Conformity

Product: VPN Firewall

Brand: ZyXEL

Test Model: USG20W-VPN

Sample Status: Engineering Sample

Applicant: ZyXEL Communications Corporation

Test Date: Nov. 20 ~ Dec. 04, 2015

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

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Celine Chou , **Date:** Dec. 15, 2015
Celine Chou / Specialist

Approved by : Ken Liu , **Date:** Dec. 15, 2015
Ken Liu / Senior Manager

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	Pass	Meet the requirement of limit. Minimum passing margin is -10.92dB at 0.36414MHz
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 2390.00MHz.
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 i-pex(MHF) not a standard connector.

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) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.44 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.59 dB
	200MHz ~1000MHz	3.60 dB
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	VPN Firewall
Brand	ZyXEL
Test Model	USG20W-VPN
Sample Status	Engineering Sample
Power Supply Rating	12Vdc (adapter)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n: up to 450Mbps
Operating Frequency	2412 ~ 2462MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Output Power	971.600mW
Antenna Type	Dipole antenna with 2dBi gain
Antenna Connector	i-pex(MHF)
Accessory Device	Adapter
Data Cable Supplied	0.9m non-shielded console cable without core

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides three completed transmitters and three receivers.

Modulation Mode	TX Function
802.11b	1TX (Diversity)
802.11g	1TX (Diversity)
802.11n (HT20)	3TX
802.11n (HT40)	3TX

* For 802.11b and 802.11g: ant. 2 was for the final test.

2. The EUT uses following adapter.

Brand	ASIAN POWER DEVICES INC.
Model	WA-24Q12R
Input Power	100-240Vac, 50-60Hz, 0.7A
Output Power	12Vdc, 2A
Power Line	1.5m cable without core attached on adapter

3. Power Setting as below.

	802.11b	802.11g	802.11n (HT20)		802.11n (HT40)
CH01	21.5	19.5	16	CH03	10.5
CH06	27	27	23	CH06	17
CH11	23.5	20	17	CH09	11

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	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where **RE≥1G**: Radiated Emission above 1GHz & Bandedge Measurement
RE<1G: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission
APCM: Antenna Port Conducted Measurement

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.

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	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	7.2
-	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	15.0

Radiated Emission Test (Below 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	DATA RATE (Mbps)
-	802.11b	1 to 11	1	DSSS	DBPSK	1.0

Power Line Conducted Emission Test:

- ☒ 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	DATA RATE (Mbps)
-	802.11b	1 to 11	1	DSSS	DBPSK	1.0

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	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	7.2
-	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	15.0

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	24deg. C, 63%RH	120Vac, 60Hz	Alan Wu
RE<1G	26deg. C, 65%RH	120Vac, 60Hz	Alan Wu
PLC	25deg. C, 60%RH	120Vac, 60Hz	Tank Wu
APCM	25deg. C, 60%RH	120Vac, 60Hz	Leo Tsai

3.3 Duty Cycle of Test Signal

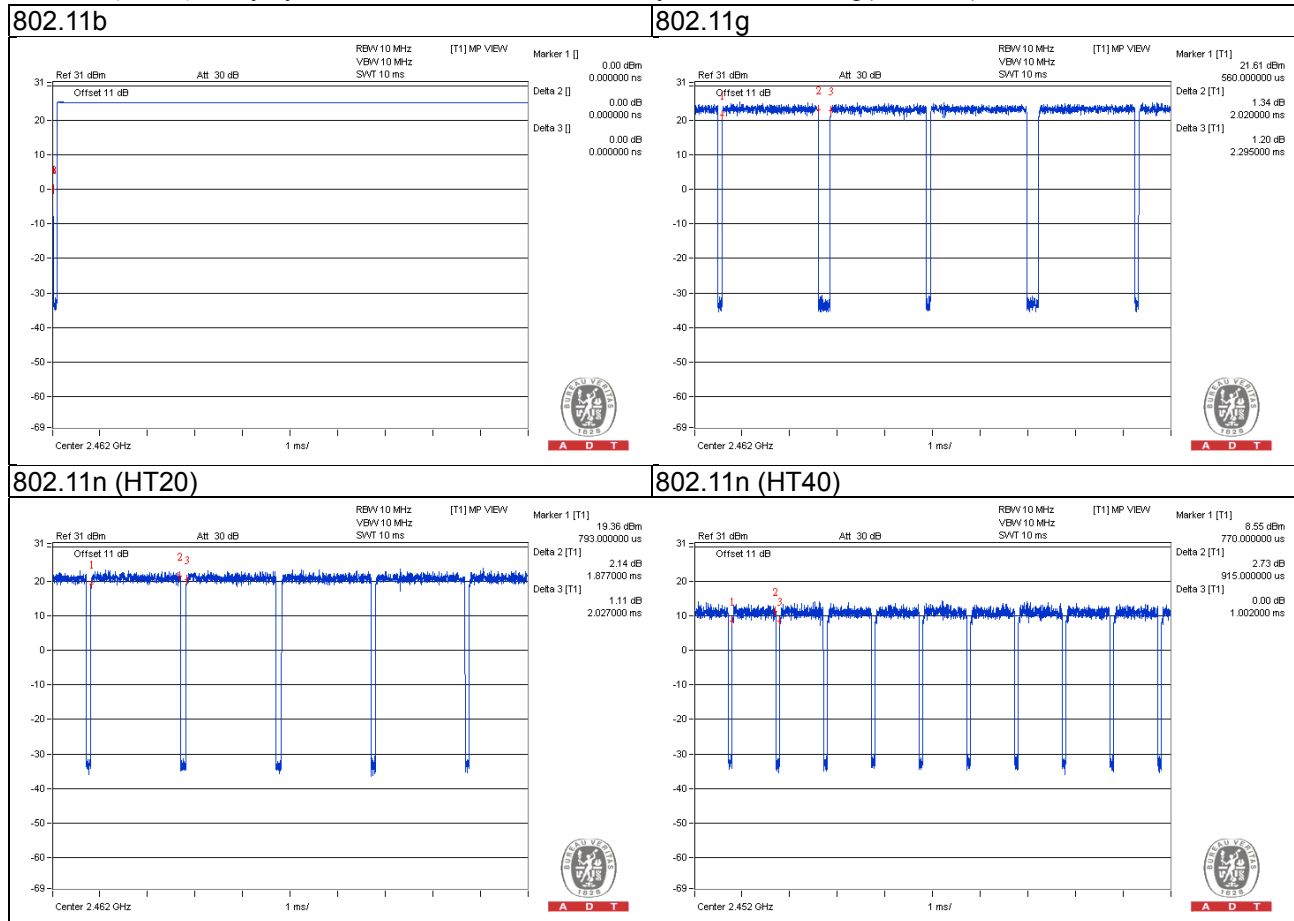
802.11b: Duty cycle of test signal is > 98%.

802.11g, 802.11n (HT20), 802.11n (HT40): Duty cycle of test signal is < 98%.

802.11g: Duty cycle = $2.020/2.295 = 0.880$, Duty factor = $10 * \log(1/0.880) = 0.55$

802.11n (HT20): Duty cycle = $1.877/2.027 = 0.926$, Duty factor = $10 * \log(1/0.926) = 0.33$

802.11n (HT40): Duty cycle = $0.915/1.002 = 0.913$, Duty factor = $10 * \log(1/0.913) = 0.39$



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.

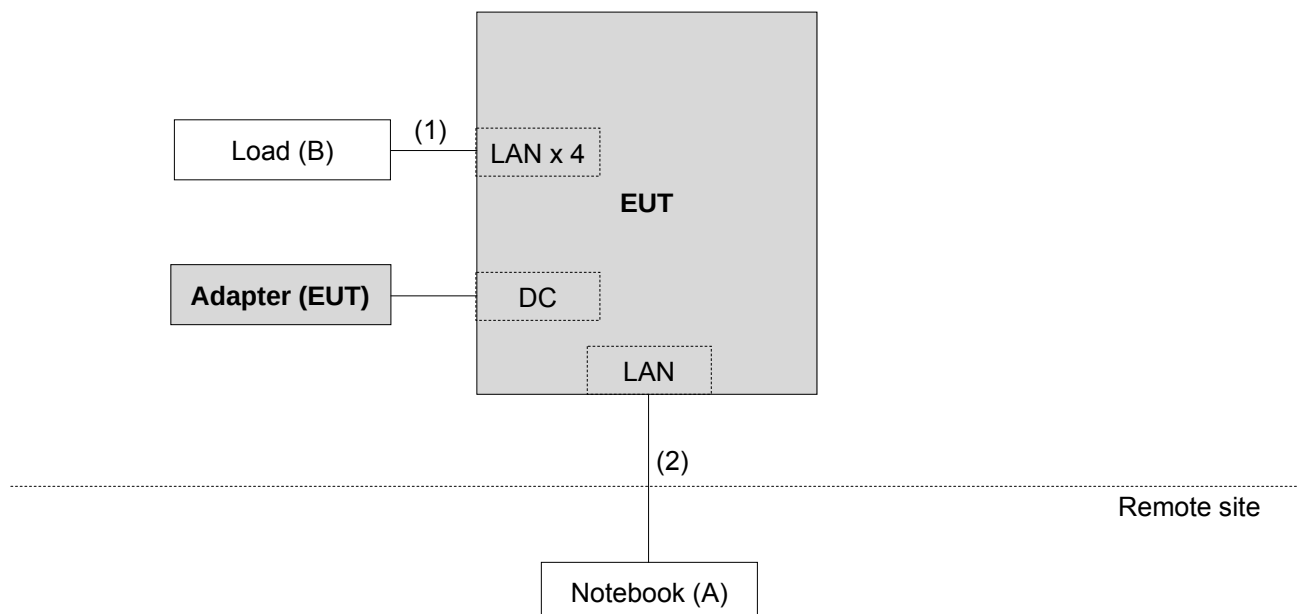
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	E5410	6RP2YM1	FCC DoC Approved	-
B.	Load	NA	NA	NA	NA	-

Note:

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Cat5e cable	4	1.8	N	0	-
2.	Cat5e cable	1	10	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 specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)

558074 D01 DTS Meas Guidance v03r03

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 is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use. It 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 20dB 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 20dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100424	Oct. 12, 2015	Oct. 11, 2016
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100040	Jul. 08, 2015	Jul. 07, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-155	Feb. 06, 2015	Feb. 05, 2016
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-1170	Feb. 05, 2015	Feb. 04, 2016
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Feb. 09, 2015	Feb. 08, 2016
Preamplifier Agilent	8449B	3008A01960	Aug. 09, 2015	Aug. 08, 2016
Preamplifier Agilent	8447D	2944A10631	Aug. 09, 2015	Aug. 08, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH4-02(295012+309220)	Aug. 09, 2015	Aug. 08, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH4-03(250724)	Aug. 09, 2015	Aug. 08, 2016
Software BV ADT	ADT_Radiated_V7.6.15.9.4	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	010303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021703	NA	NA
Turn Table BV ADT	TT100	TT93021703	NA	NA
Turn Table Controller BV ADT	SC100.	SC93021703	NA	NA
High Speed Peak Power Meter	ML2495A	0824011	Jul. 09, 2015	Jul. 08, 2016
Power Sensor	MA2411B	0738171	Jul. 09, 2015	Jul. 08, 2016

- 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 4.
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 460141.
5. The IC Site Registration No. is IC7450F-4.

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:

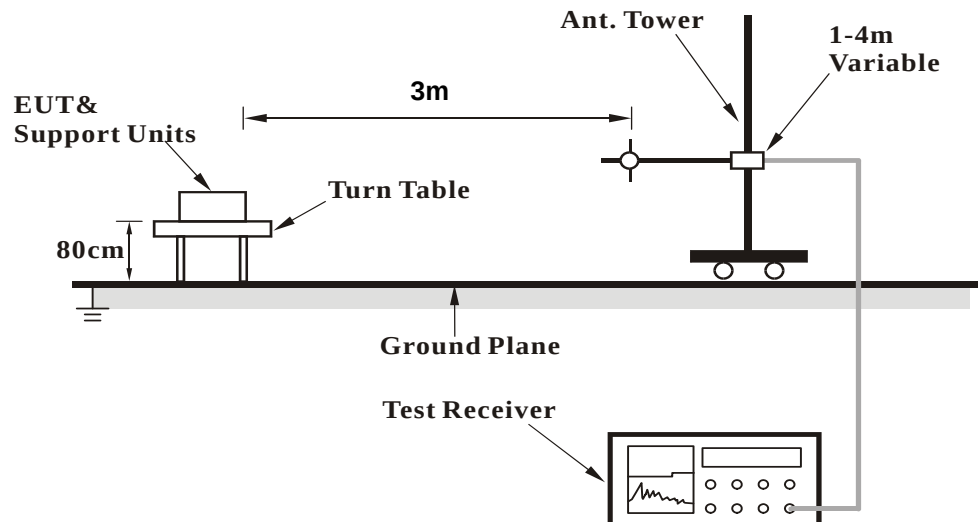
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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 ($10 \log(1/\text{duty cycle})$).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle $\geq 98\%$) 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

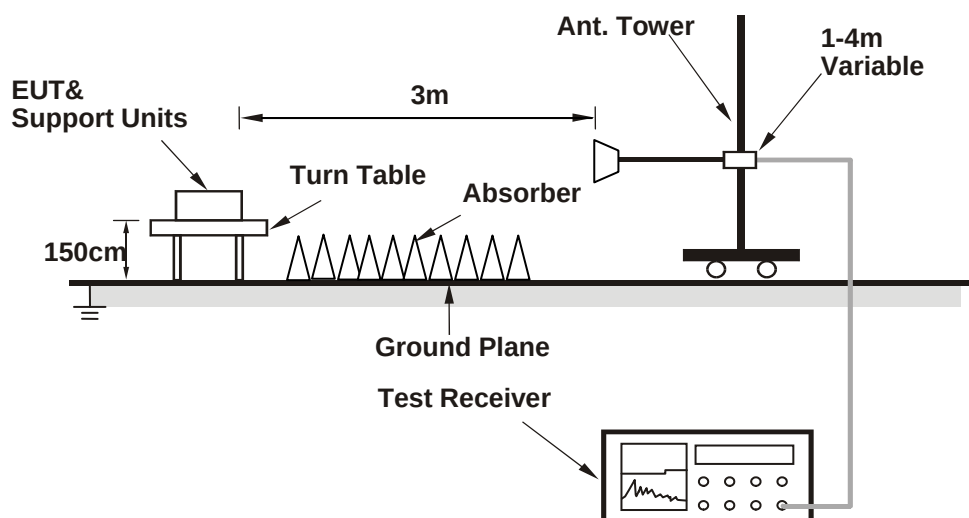
No deviation.

4.1.5 Test Set Up

<Frequency Range below 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

- Placed the EUT on the testing table.
- Prepared notebook to act as communication partner and placed it outside of testing area.
- 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.
- The communication partner sent data to EUT by command "PING".
- The necessary accessories enable the system in full functions.

4.1.7 Test Results

Above 1GHz Worst-Case data:

802.11b

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

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	55.3 PK	74.0	-18.7	1.00 H	224	23.70	31.60
2	2390.00	44.2 AV	54.0	-9.8	1.00 H	224	12.60	31.60
3	*2412.00	101.1 PK			1.00 H	222	69.30	31.80
4	*2412.00	97.7 AV			1.00 H	222	65.90	31.80
5	4824.00	47.2 PK	74.0	-26.8	1.00 H	215	42.30	4.90
6	4824.00	35.4 AV	54.0	-18.6	1.00 H	215	30.50	4.90
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	60.4 PK	74.0	-13.6	1.70 V	179	28.80	31.60
2	2390.00	52.7 AV	54.0	-1.3	1.70 V	179	21.10	31.60
3	*2412.00	111.9 PK			1.76 V	178	80.10	31.80
4	*2412.00	108.1 AV			1.76 V	178	76.30	31.80
5	4824.00	48.0 PK	74.0	-26.0	1.00 V	89	43.10	4.90
6	4824.00	37.4 AV	54.0	-16.6	1.00 V	89	32.50	4.90

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)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	54.4 PK	74.0	-19.6	1.00 H	217	22.80	31.60
2	2390.00	43.9 AV	54.0	-10.1	1.00 H	217	12.30	31.60
3	*2437.00	106.1 PK			1.00 H	219	74.20	31.90
4	*2437.00	102.7 AV			1.00 H	219	70.80	31.90
5	4874.00	47.8 PK	74.0	-26.2	1.00 H	211	42.80	5.00
6	4874.00	35.9 AV	54.0	-18.1	1.00 H	211	30.90	5.00
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	61.4 PK	74.0	-12.6	2.38 V	177	29.80	31.60
2	2390.00	53.0 AV	54.0	-1.0	2.38 V	177	21.40	31.60
3	*2437.00	115.0 PK			2.31 V	180	83.10	31.90
4	*2437.00	111.7 AV			2.31 V	180	79.80	31.90
5	4874.00	48.4 PK	74.0	-25.6	1.00 V	88	43.40	5.00
6	4874.00	38.2 AV	54.0	-15.8	1.00 V	88	33.20	5.00

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	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	102.1 PK			1.00 H	216	70.10	32.00
2	*2462.00	98.9 AV			1.00 H	216	66.90	32.00
3	2488.00	56.3 PK	74.0	-17.7	1.00 H	214	24.30	32.00
4	2488.00	45.1 AV	54.0	-8.9	1.00 H	214	13.10	32.00
5	4924.00	47.3 PK	74.0	-26.7	1.00 H	213	42.20	5.10
6	4924.00	35.7 AV	54.0	-18.3	1.00 H	213	30.60	5.10
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	113.6 PK			1.93 V	190	81.60	32.00
2	*2462.00	109.7 AV			1.93 V	190	77.70	32.00
3	2488.00	61.4 PK	74.0	-12.6	1.90 V	190	29.40	32.00
4	2488.00	52.5 AV	54.0	-1.5	1.90 V	190	20.50	32.00
5	4924.00	48.2 PK	74.0	-25.8	1.00 V	80	43.10	5.10
6	4924.00	37.6 AV	54.0	-16.4	1.00 V	80	32.50	5.10

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.

802.11g

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

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	58.3 PK	74.0	-15.7	1.00 H	216	26.70	31.60
2	2390.00	44.6 AV	54.0	-9.4	1.00 H	216	13.00	31.60
3	*2412.00	100.9 PK			1.00 H	220	69.10	31.80
4	*2412.00	90.2 AV			1.00 H	220	58.40	31.80
5	4824.00	46.0 PK	74.0	-28.0	1.00 H	213	41.10	4.90
6	4824.00	34.6 AV	54.0	-19.4	1.00 H	213	29.70	4.90
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	69.1 PK	74.0	-4.9	2.10 V	179	37.50	31.60
2	2390.00	52.7 AV	54.0	-1.3	2.10 V	179	21.10	31.60
3	*2412.00	111.1 PK			2.62 V	180	79.30	31.80
4	*2412.00	100.8 AV			2.62 V	180	69.00	31.80
5	4824.00	47.2 PK	74.0	-26.8	1.00 V	81	42.30	4.90
6	4824.00	36.9 AV	54.0	-17.1	1.00 V	81	32.00	4.90

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)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	1.04 H	212	25.00	31.60
2	2390.00	43.9 AV	54.0	-10.1	1.04 H	212	12.30	31.60
3	*2437.00	108.3 PK			1.04 H	218	76.40	31.90
4	*2437.00	98.1 AV			1.04 H	218	66.20	31.90
5	4874.00	47.1 PK	74.0	-26.9	1.00 H	216	42.10	5.00
6	4874.00	35.3 AV	54.0	-18.7	1.00 H	216	30.30	5.00
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	67.4 PK	74.0	-6.6	1.77 V	185	35.80	31.60
2	2390.00	52.2 AV	54.0	-1.8	1.77 V	185	20.60	31.60
3	*2437.00	117.4 PK			1.74 V	187	85.50	31.90
4	*2437.00	106.9 AV			1.74 V	187	75.00	31.90
5	4874.00	48.1 PK	74.0	-25.9	1.00 V	82	43.10	5.00
6	4874.00	37.9 AV	54.0	-16.1	1.00 V	82	32.90	5.00

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	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	101.6 PK			1.00 H	218	69.60	32.00
2	*2462.00	91.5 AV			1.00 H	218	59.50	32.00
3	2483.50	64.7 PK	74.0	-9.3	1.00 H	212	32.70	32.00
4	2483.50	47.2 AV	54.0	-6.8	1.00 H	212	15.20	32.00
5	4924.00	46.7 PK	74.0	-27.3	1.00 H	202	41.60	5.10
6	4924.00	35.0 AV	54.0	-19.0	1.00 H	202	29.90	5.10
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	111.2 PK			1.56 V	187	79.20	32.00
2	*2462.00	101.2 AV			1.56 V	187	69.20	32.00
3	2483.50	68.5 PK	74.0	-5.5	1.51 V	189	36.50	32.00
4	2483.50	52.7 AV	54.0	-1.3	1.51 V	189	20.70	32.00
5	4924.00	47.4 PK	74.0	-26.6	1.00 V	88	42.30	5.10
6	4924.00	37.4 AV	54.0	-16.6	1.00 V	88	32.30	5.10

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 (HT20)

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

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	57.8 PK	74.0	-16.2	1.17 H	227	26.20	31.60
2	2390.00	44.9 AV	54.0	-9.1	1.17 H	227	13.30	31.60
3	*2412.00	106.9 PK			1.12 H	228	75.10	31.80
4	*2412.00	96.2 AV			1.12 H	228	64.40	31.80
5	4824.00	46.6 PK	74.0	-27.4	1.00 H	234	41.70	4.90
6	4824.00	33.6 AV	54.0	-20.4	1.00 H	234	28.70	4.90
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	67.6 PK	74.0	-6.4	1.32 V	159	36.00	31.60
2	2390.00	53.0 AV	54.0	-1.0	1.32 V	159	21.40	31.60
3	*2412.00	116.9 PK			1.33 V	180	85.10	31.80
4	*2412.00	106.9 AV			1.33 V	180	75.10	31.80
5	4824.00	46.6 PK	74.0	-27.4	1.00 V	203	41.70	4.90
6	4824.00	34.0 AV	54.0	-20.0	1.00 V	203	29.10	4.90

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)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	62.1 PK	74.0	-11.9	1.56 H	224	30.50	31.60
2	2390.00	45.8 AV	54.0	-8.2	1.56 H	224	14.20	31.60
3	*2437.00	113.2 PK			1.60 H	224	81.30	31.90
4	*2437.00	103.1 AV			1.60 H	224	71.20	31.90
5	4874.00	47.2 PK	74.0	-26.8	1.00 H	230	42.20	5.00
6	4874.00	34.1 AV	54.0	-19.9	1.00 H	230	29.10	5.00
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	67.5 PK	74.0	-6.5	1.67 V	183	35.90	31.60
2	2390.00	52.7 AV	54.0	-1.3	1.67 V	183	21.10	31.60
3	*2437.00	122.1 PK			2.21 V	183	90.20	31.90
4	*2437.00	112.5 AV			2.21 V	183	80.60	31.90
5	4874.00	47.5 PK	74.0	-26.5	1.00 V	205	42.50	5.00
6	4874.00	34.7 AV	54.0	-19.3	1.00 V	205	29.70	5.00

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	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	108.2 PK			1.09 H	226	76.20	32.00
2	*2462.00	97.9 AV			1.09 H	226	65.90	32.00
3	2483.50	60.7 PK	74.0	-13.3	1.03 H	220	28.70	32.00
4	2483.50	46.1 AV	54.0	-7.9	1.03 H	220	14.10	32.00
5	4924.00	46.8 PK	74.0	-27.2	1.00 H	233	41.70	5.10
6	4924.00	33.8 AV	54.0	-20.2	1.00 H	233	28.70	5.10
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	117.0 PK			1.46 V	179	85.00	32.00
2	*2462.00	106.9 AV			1.46 V	179	74.90	32.00
3	2483.50	69.2 PK	74.0	-4.8	1.62 V	191	37.20	32.00
4	2483.50	52.9 AV	54.0	-1.1	1.62 V	191	20.90	32.00
5	4924.00	47.0 PK	74.0	-27.0	1.00 V	207	41.90	5.10
6	4924.00	34.5 AV	54.0	-19.5	1.00 V	207	29.40	5.10

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)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	57.8 PK	74.0	-16.2	1.00 H	223	26.20	31.60
2	2390.00	44.8 AV	54.0	-9.2	1.00 H	223	13.20	31.60
3	*2422.00	97.1 PK			1.00 H	229	65.30	31.80
4	*2422.00	86.9 AV			1.00 H	229	55.10	31.80
5	4844.00	45.8 PK	74.0	-28.2	1.00 H	232	40.90	4.90
6	4844.00	33.0 AV	54.0	-21.0	1.00 H	232	28.10	4.90
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	66.1 PK	74.0	-7.9	1.33 V	157	34.50	31.60
2	2390.00	52.5 AV	54.0	-1.5	1.33 V	157	20.90	31.60
3	*2422.00	108.1 PK			1.83 V	179	76.30	31.80
4	*2422.00	98.0 AV			1.83 V	179	66.20	31.80
5	4844.00	46.4 PK	74.0	-27.6	1.00 V	206	41.50	4.90
6	4844.00	33.8 AV	54.0	-20.2	1.00 V	206	28.90	4.90

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	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	1.59 H	222	27.20	31.60
2	2390.00	47.2 AV	54.0	-6.8	1.59 H	222	15.60	31.60
3	*2437.00	104.9 PK			1.59 H	224	73.00	31.90
4	*2437.00	95.0 AV			1.59 H	224	63.10	31.90
5	2483.50	56.9 PK	74.0	-17.1	1.59 H	222	24.90	32.00
6	2483.50	43.4 AV	54.0	-10.6	1.59 H	222	11.40	32.00
7	4874.00	46.3 PK	74.0	-27.7	1.00 H	237	41.30	5.00
8	4874.00	33.5 AV	54.0	-20.5	1.00 H	237	28.50	5.00
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	66.8 PK	74.0	-7.2	1.18 V	182	35.20	31.60
2	2390.00	52.7 AV	54.0	-1.3	1.18 V	182	21.10	31.60
3	*2437.00	113.4 PK			1.63 V	181	81.50	31.90
4	*2437.00	103.2 AV			1.63 V	181	71.30	31.90
5	2483.50	66.2 PK	74.0	-7.8	1.16 V	128	34.20	32.00
6	2483.50	51.7 AV	54.0	-2.3	1.16 V	128	19.70	32.00
7	4874.00	46.9 PK	74.0	-27.1	1.00 V	202	41.90	5.00
8	4874.00	34.5 AV	54.0	-19.5	1.00 V	202	29.50	5.00

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	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	97.9 PK			1.10 H	232	66.00	31.90
2	*2452.00	87.4 AV			1.10 H	232	55.50	31.90
3	2483.50	57.6 PK	74.0	-16.4	1.14 H	236	25.60	32.00
4	2483.50	45.1 AV	54.0	-8.9	1.14 H	236	13.10	32.00
5	4904.00	45.9 PK	74.0	-28.1	1.00 H	230	40.90	5.00
6	4904.00	33.1 AV	54.0	-20.9	1.00 H	230	28.10	5.00
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	107.5 PK			1.61 V	187	75.60	31.90
2	*2452.00	96.9 AV			1.61 V	187	65.00	31.90
3	2483.50	67.5 PK	74.0	-6.5	1.62 V	152	35.50	32.00
4	2483.50	52.9 AV	54.0	-1.1	1.62 V	152	20.90	32.00
5	4904.00	46.2 PK	74.0	-27.8	1.00 V	207	41.20	5.00
6	4904.00	33.9 AV	54.0	-20.1	1.00 V	207	28.90	5.00

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.

Below 1GHz worst-case data: 802.11b

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

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	35.72	31.8 QP	40.0	-8.2	1.50 H	160	46.70	-14.90
2	183.19	32.9 QP	43.5	-10.6	1.00 H	262	48.40	-15.50
3	375.29	33.9 QP	46.0	-12.1	1.00 H	135	45.30	-11.40
4	499.48	33.2 QP	46.0	-12.8	1.50 H	151	42.50	-9.30
5	625.60	34.2 QP	46.0	-11.8	1.50 H	217	40.70	-6.50
6	875.91	34.5 QP	46.0	-11.5	2.00 H	109	36.60	-2.10
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	60.95	35.0 QP	40.0	-5.0	2.00 V	13	49.60	-14.60
2	105.58	31.5 QP	43.5	-12.0	1.00 V	89	48.90	-17.40
3	375.29	30.0 QP	46.0	-16.0	1.50 V	104	41.40	-11.40
4	499.48	31.1 QP	46.0	-14.9	1.24 V	260	40.40	-9.30
5	625.60	34.9 QP	46.0	-11.1	1.00 V	11	41.40	-6.50
6	875.91	35.5 QP	46.0	-10.5	1.00 V	172	37.60	-2.10

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

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCS 30	100288	Apr. 27, 2015	Apr. 26, 2016
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Dec. 26, 2014	Dec. 25, 2015
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Dec. 30, 2014	Dec. 29, 2015
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Jul. 21, 2015	Jul. 20, 2016
Software ADT	BV ADT_Cond_ V7.3.7.3	NA	NA	NA

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 Shielded Room 2.
3. The VCCI Site Registration No. is C-2047.

4.2.3 Test Procedures

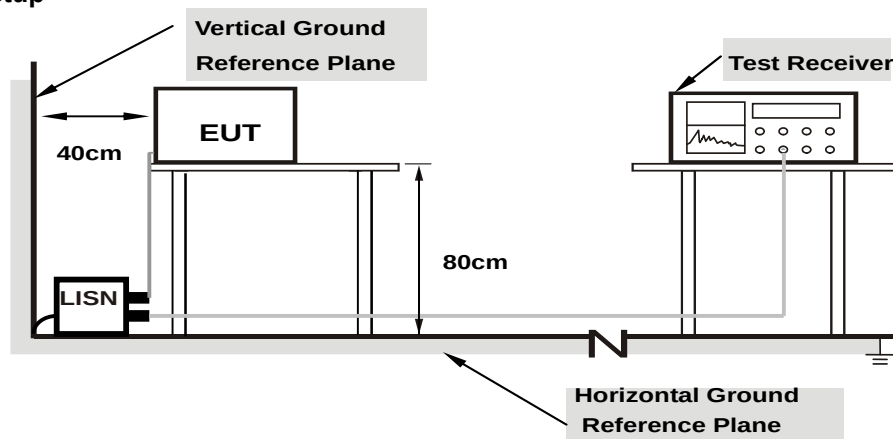
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



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

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

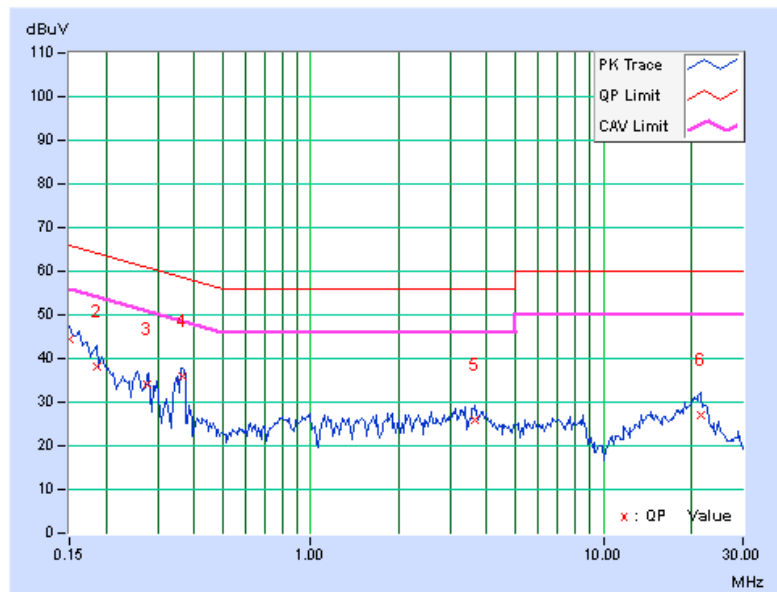
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
-------	----------	-------------------	--------------------------------

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15003	9.91	34.40	22.16	44.31	32.07	66.00	56.00	-21.69	-23.93
2	0.18516	9.91	28.23	16.94	38.14	26.85	64.25	54.25	-26.11	-27.40
3	0.27732	9.92	24.08	19.27	34.00	29.19	60.90	50.90	-26.89	-21.70
4	0.36538	9.93	25.96	23.84	35.89	33.77	58.61	48.61	-22.72	-14.84
5	3.65625	10.17	15.88	7.09	26.05	17.26	56.00	46.00	-29.95	-28.74
6	21.51172	10.58	16.64	10.99	27.22	21.57	60.00	50.00	-32.78	-28.43

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

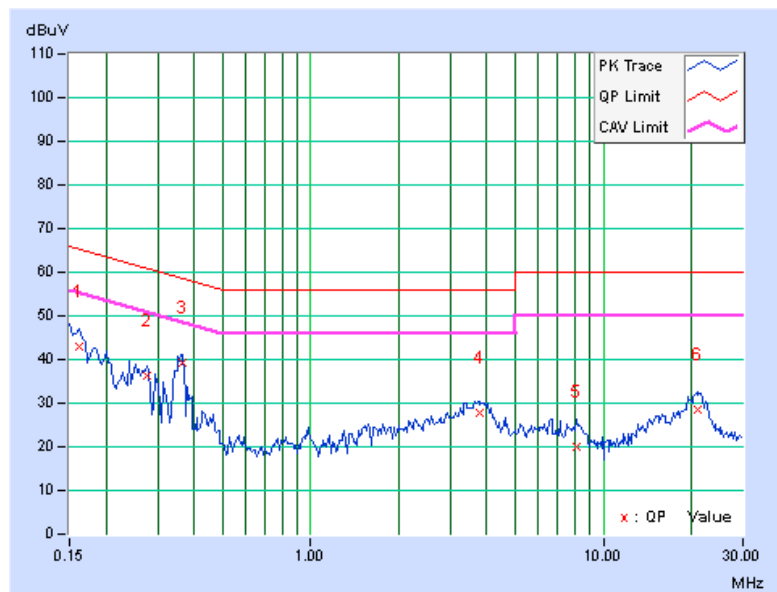


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
-------	-------------	-------------------	--------------------------------

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16172	9.92	32.95	21.48	42.87	31.40	65.38	55.38	-22.50	-23.97
2	0.27500	9.94	26.40	22.55	36.34	32.49	60.97	50.97	-24.63	-18.48
3	0.36414	9.95	29.36	27.77	39.31	37.72	58.63	48.63	-19.33	-10.92
4	3.77344	10.21	17.40	9.89	27.61	20.10	56.00	46.00	-28.39	-25.90
5	8.06250	10.38	9.60	4.35	19.98	14.73	60.00	50.00	-40.02	-35.27
6	20.89453	10.75	17.75	12.02	28.50	22.77	60.00	50.00	-31.50	-27.23

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

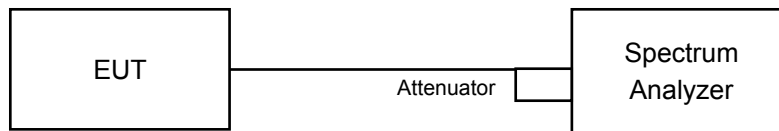


4.3 6dB Bandwidth Measurement

4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

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 Procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- 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

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

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

4.3.7 Test Result

802.11b

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	10.11	0.5	Pass
6	2437	10.13	0.5	Pass
11	2462	10.12	0.5	Pass

802.11g

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	16.38	0.5	Pass
6	2437	16.35	0.5	Pass
11	2462	16.37	0.5	Pass

802.11n (HT20)

Channel	Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
1	2412	17.21	16.97	17.33	0.5	Pass
6	2437	15.79	17.33	16.93	0.5	Pass
11	2462	15.78	17.09	17.56	0.5	Pass

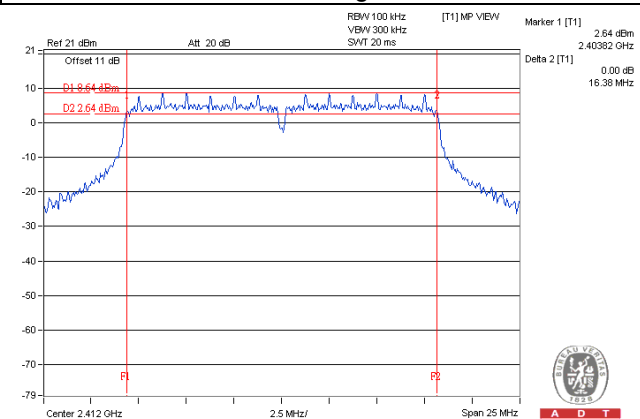
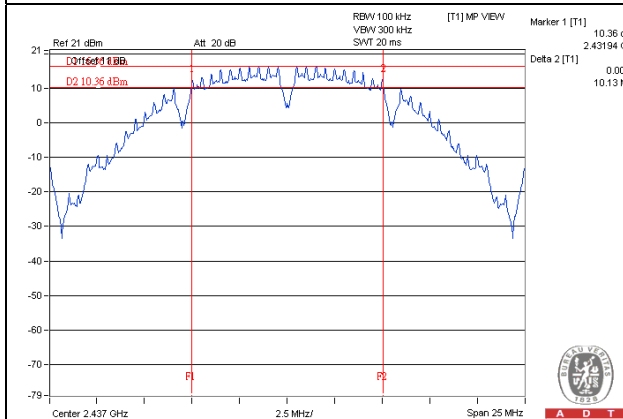
802.11n (HT40)

Channel	Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
3	2422	35.29	35.60	36.42	0.5	Pass
6	2437	35.56	35.29	35.79	0.5	Pass
9	2452	35.56	35.87	36.36	0.5	Pass

Spectrum Plot of Worst Value

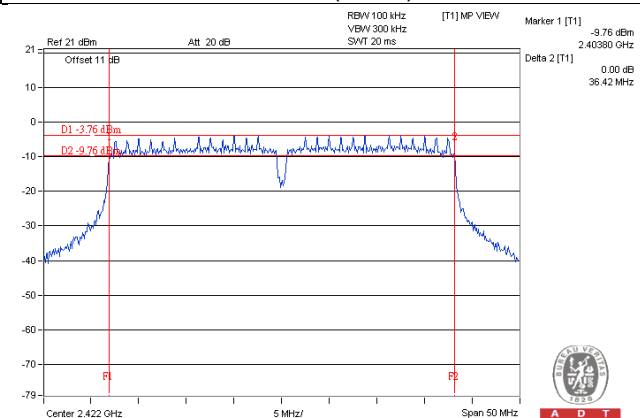
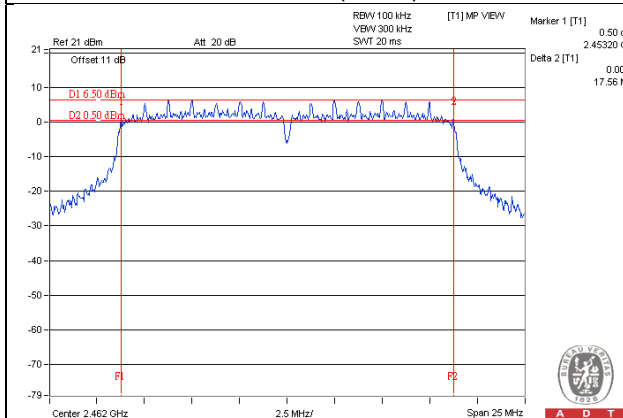
802.11b

802.11g



802.11n (HT20)

802.11n (HT40)



4.4 Conducted Output Power Measurement

4.4.1 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,

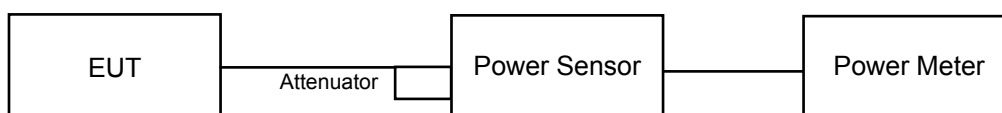
Array Gain = 0 dB (i.e., no array gain) for $NANT \leq 4$;

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 $NANT \geq 5$.

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

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 Procedures

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

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

Same as Item 4.3.6.

4.4.7 Test Results

For Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	234.963	23.71	30	Pass
6	2437	487.528	26.88	30	Pass
11	2462	325.087	25.12	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	306.902	24.87	30	Pass
6	2437	620.869	27.93	30	Pass
11	2462	316.957	25.01	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (dBm)			Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2				
1	2412	22.35	22.49	22.30	519.034	27.15	30	Pass
6	2437	25.10	25.17	25.04	971.600	29.87	30	Pass
11	2462	22.59	23.71	22.40	590.295	27.71	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Peak Power (dBm)			Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2				
3	2422	16.73	17.06	16.67	144.366	21.59	30	Pass
6	2437	22.55	23.20	22.38	561.799	27.50	30	Pass
9	2452	16.97	17.66	16.80	155.982	21.93	30	Pass

For Average Power

802.11b

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2412	142.561	21.54
6	2437	218.273	23.39
11	2462	209.894	23.22

802.11g

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2412	86.696	19.38
6	2437	315.500	24.99
11	2462	94.842	19.77

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)			Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1	Chain 2		
1	2412	16.33	16.35	16.44	130.161	21.14
6	2437	21.82	22.29	21.80	472.845	26.75
11	2462	17.04	17.55	17.17	159.586	22.03

802.11n (HT40)

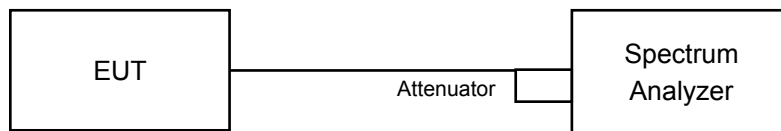
Channel	Frequency (MHz)	Average Power (dBm)			Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1	Chain 2		
3	2422	10.73	10.94	10.70	35.996	15.56
6	2437	16.64	16.82	16.61	140.030	21.46
9	2452	11.14	11.41	11.02	39.485	15.96

4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm.

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

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

Same as Item 4.3.6

4.5.7 Test Results

802.11b

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass / Fail
1	2412	-1.35	8.00	Pass
6	2437	2.79	8.00	Pass
11	2462	0.10	8.00	Pass

802.11g

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass / Fail
1	2412	-6.34	8.00	Pass
6	2437	-0.57	8.00	Pass
11	2462	-5.45	8.00	Pass

802.11n (HT20)

TX chain	Channel	Frequency (MHz)	PSD (dBm)	10 log (N=3) dB	Total PSD (dBm)	Limit (dBm)	Pass / Fail
0	1	2412	-8.10	4.77	-3.33	7.23	Pass
	6	2437	-1.68	4.77	3.09	7.23	Pass
	11	2462	-7.29	4.77	-2.52	7.23	Pass
1	1	2412	-9.14	4.77	-4.37	7.23	Pass
	6	2437	-2.68	4.77	2.09	7.23	Pass
	11	2462	-8.35	4.77	-3.58	7.23	Pass
2	1	2412	-8.33	4.77	-3.56	7.23	Pass
	6	2437	-3.17	4.77	1.60	7.23	Pass
	11	2462	-9.06	4.77	-4.29	7.23	Pass

Note:

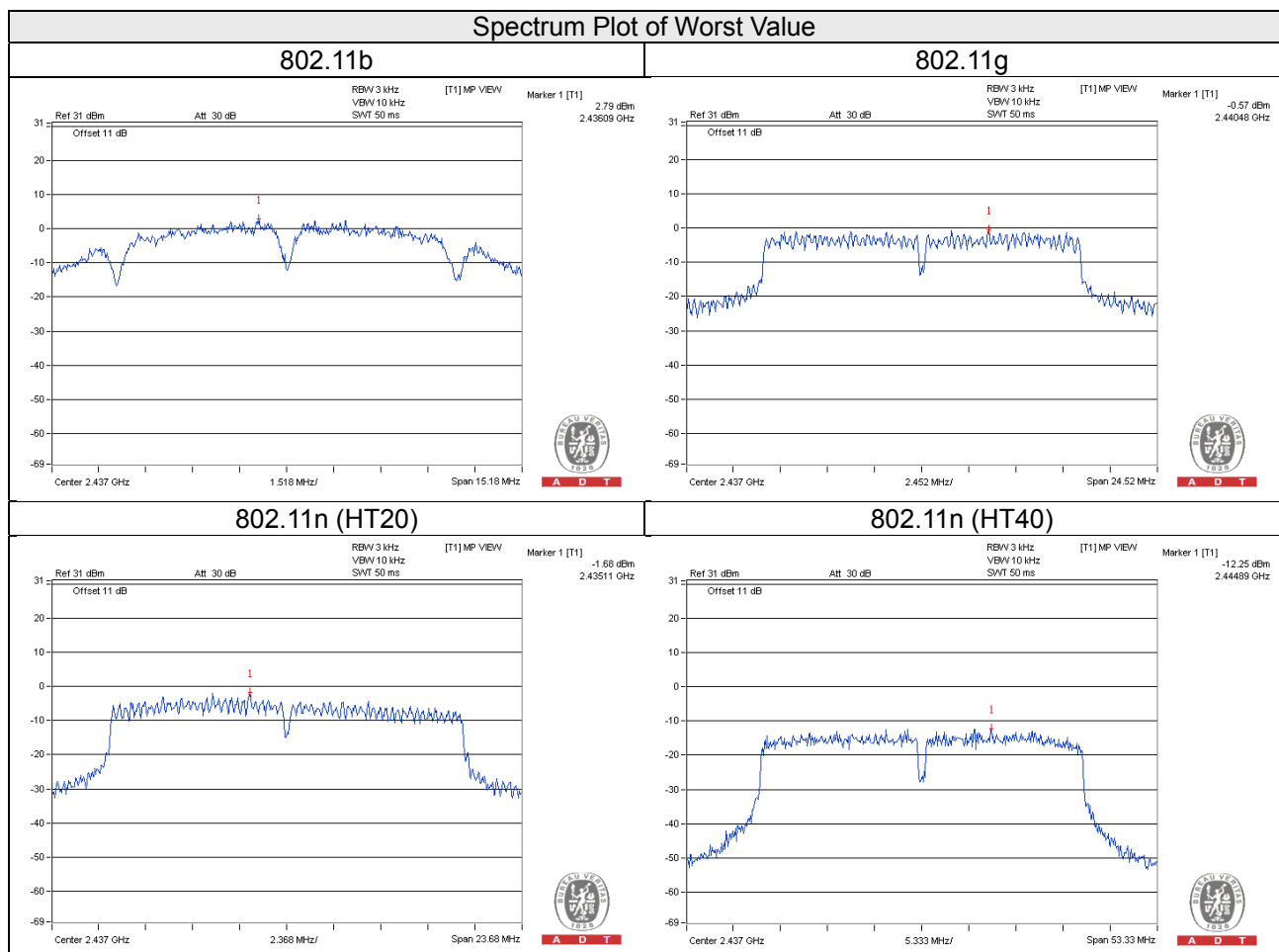
- Method 1 of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
- Directional gain = 2dBi + 10log(3) = 6.77dBi > 6dBi , so the power density limit shall be reduced to 8-(6.77-6) = 7.23dBm.

802.11n (HT40)

TX chain	Channel	Frequency (MHz)	PSD (dBm)	10 log (N=3) dB	Total PSD (dBm)	Limit (dBm)	Pass / Fail
0	3	2422	-17.72	4.77	-12.95	7.23	Pass
	6	2437	-12.25	4.77	-7.48	7.23	Pass
	9	2452	-18.33	4.77	-13.56	7.23	Pass
1	3	2422	-19.28	4.77	-14.51	7.23	Pass
	6	2437	-12.63	4.77	-7.86	7.23	Pass
	9	2452	-18.24	4.77	-13.47	7.23	Pass
2	3	2422	-18.62	4.77	-13.85	7.23	Pass
	6	2437	-12.44	4.77	-7.67	7.23	Pass
	9	2452	-19.01	4.77	-14.24	7.23	Pass

Note:

- 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.
- Directional gain = 2dBi + 10log(3) = 6.77dBi > 6dBi , so the power density limit shall be reduced to 8-(6.77-6) = 7.23dBm.

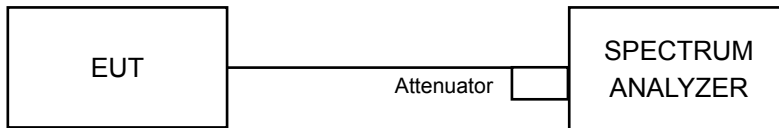


4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

MEASUREMENT PROCEDURE REF

- Set the RBW = 100 kHz.
- Set the VBW $\geq$ 300 kHz.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

- Set RBW = 100 kHz.
- Set VBW $\geq$ 300 kHz.
- Ensure that the number of measurement points $\geq$ span/RBW
- According to measurement points to set differ measurement span.
- Detector = peak.
- Trace Mode = max hold.
- Sweep = auto couple.

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

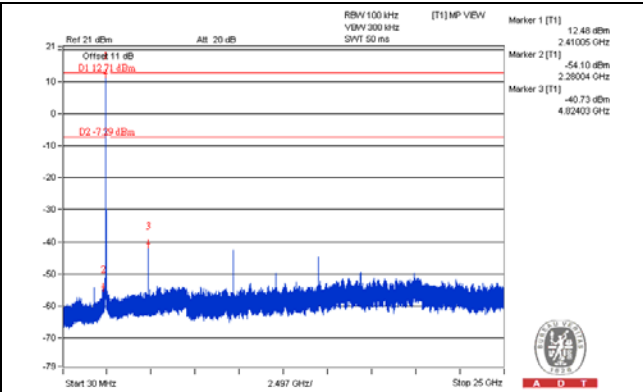
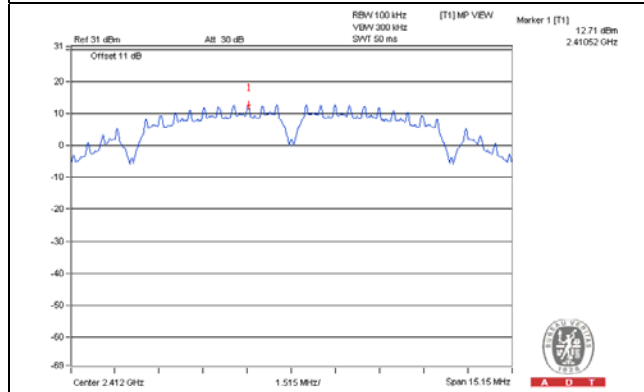
Same as Item 4.3.6

4.6.7 Test Results

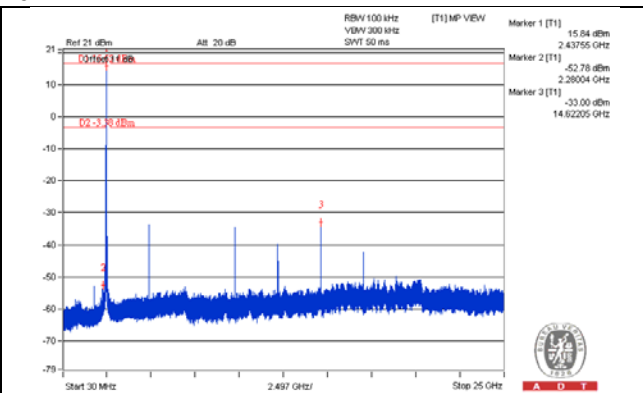
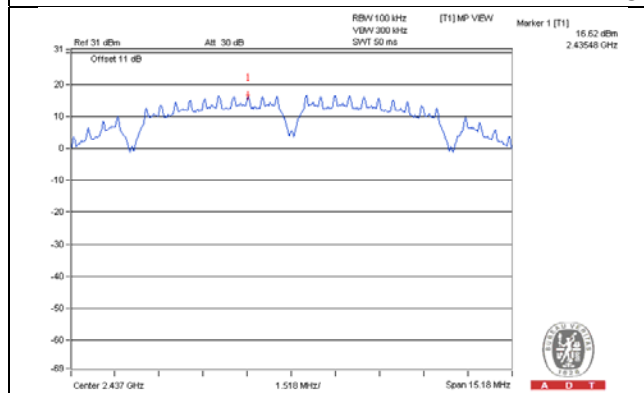
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

802.11b

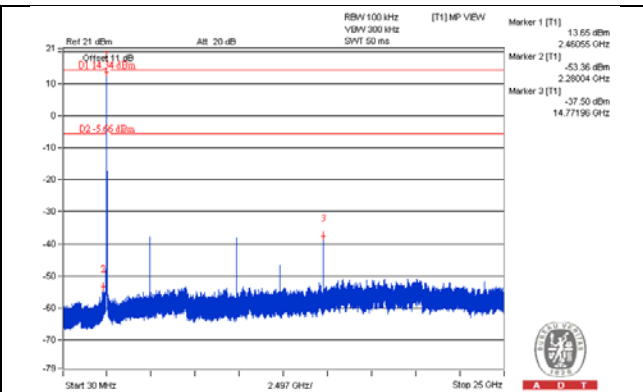
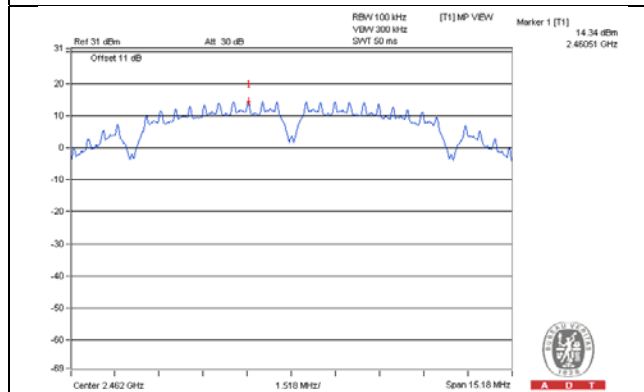
CH 1



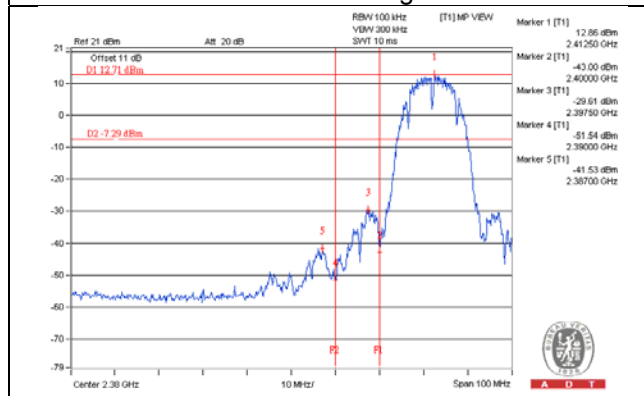
CH 6



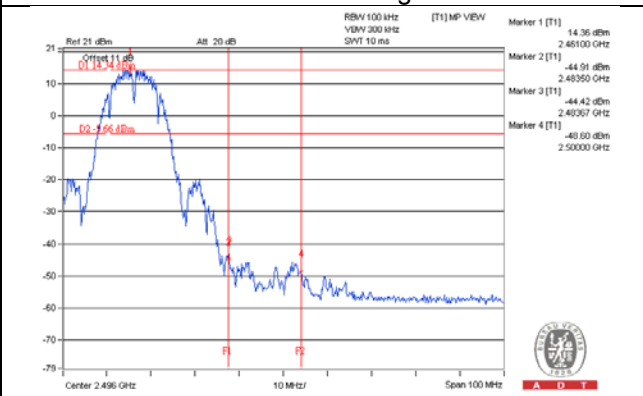
CH 11



CH 1 Band edge

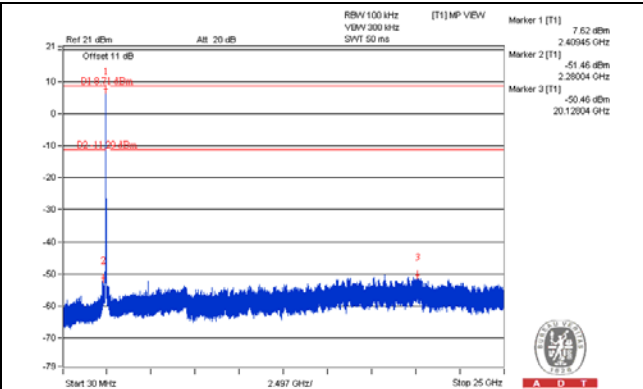
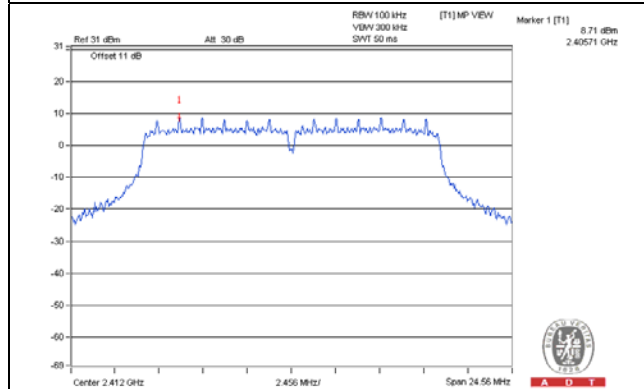


CH 11 Band edge

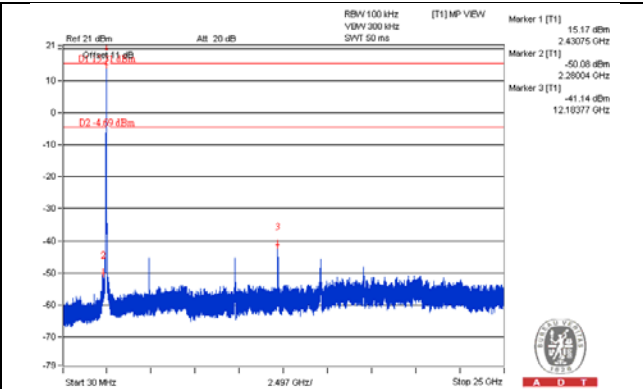
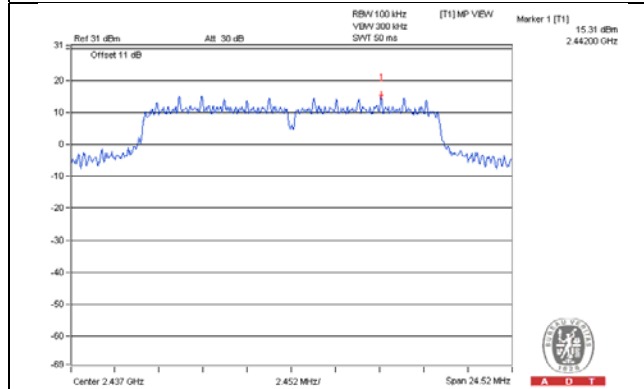


802.11g

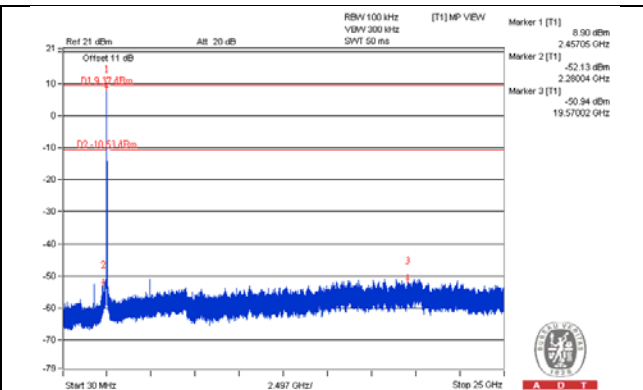
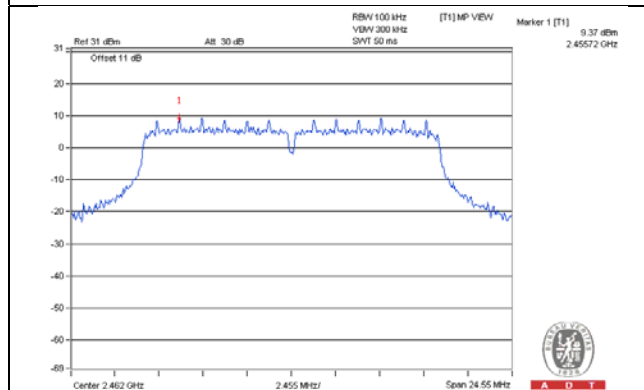
CH 1



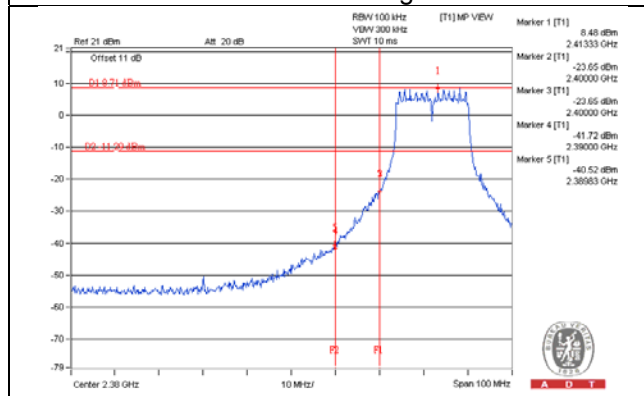
CH 6



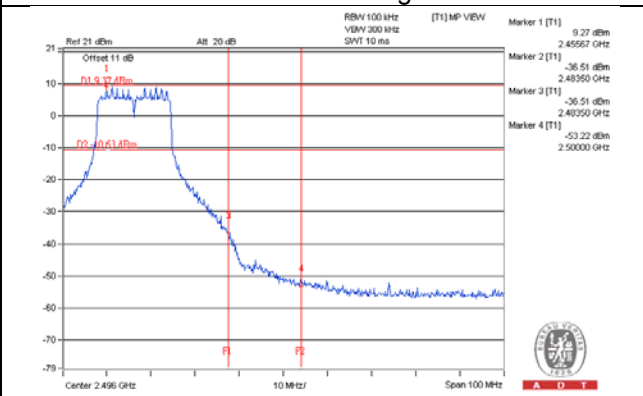
CH 11



CH 1 Band edge

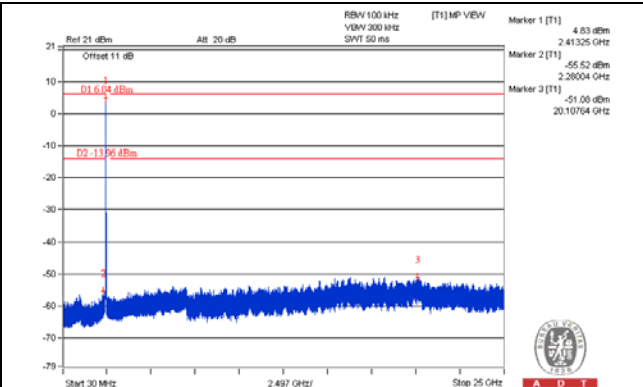
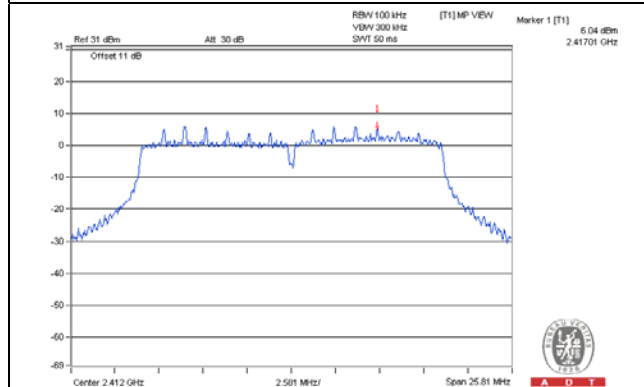


CH 11 Band edge

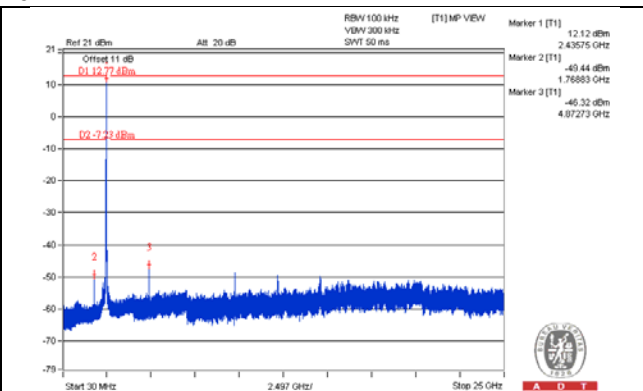
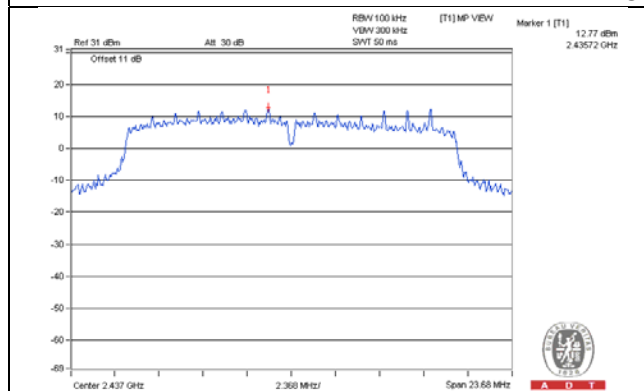


802.11n (HT20)_Chain 0

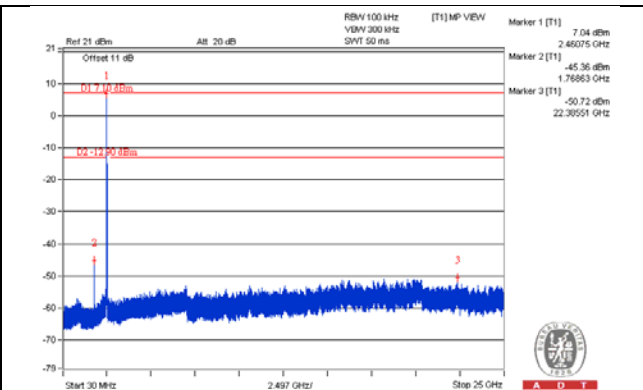
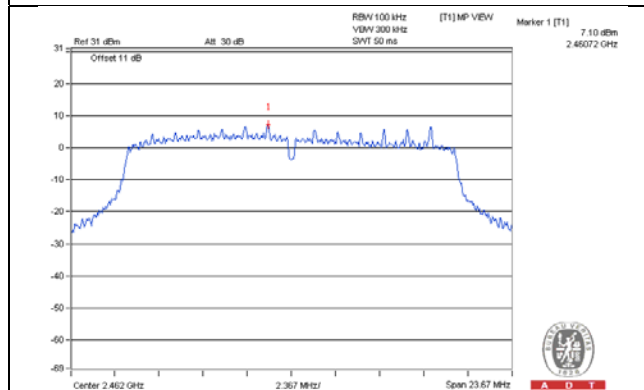
CH 1



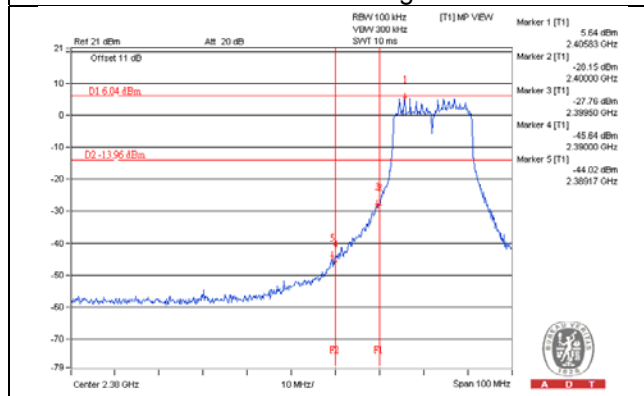
CH 6



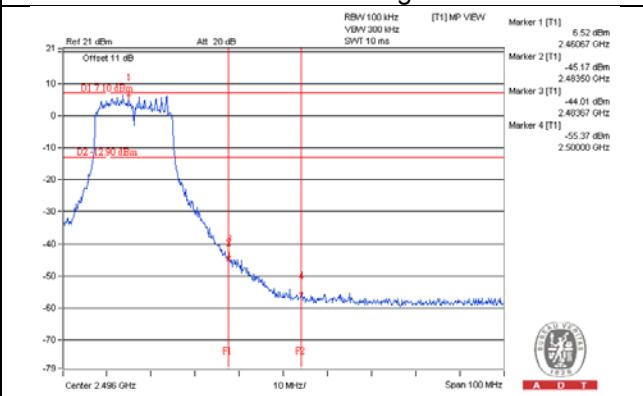
CH 11



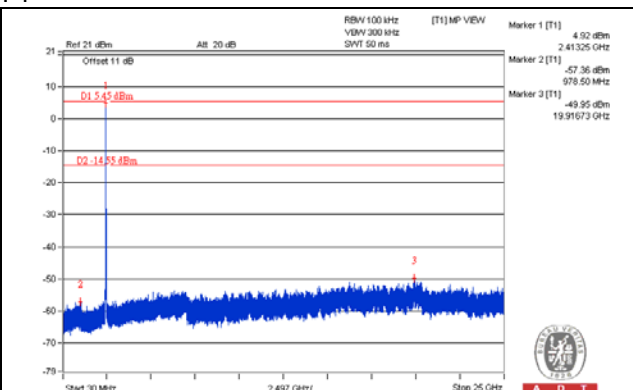
CH 1 Band edge



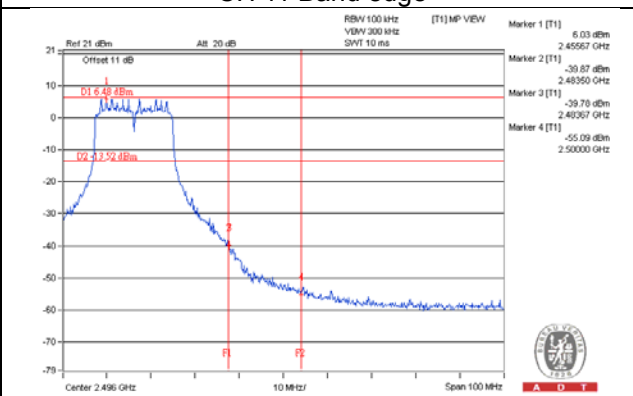
CH 11 Band edge



CH 1

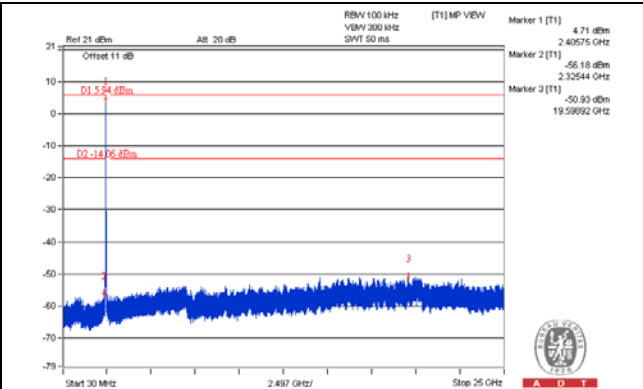
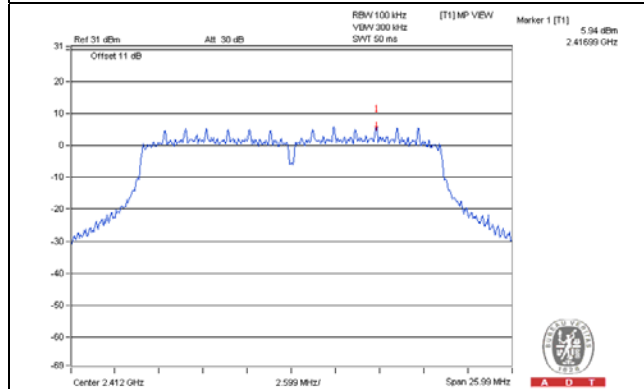


CH 11 Band edge

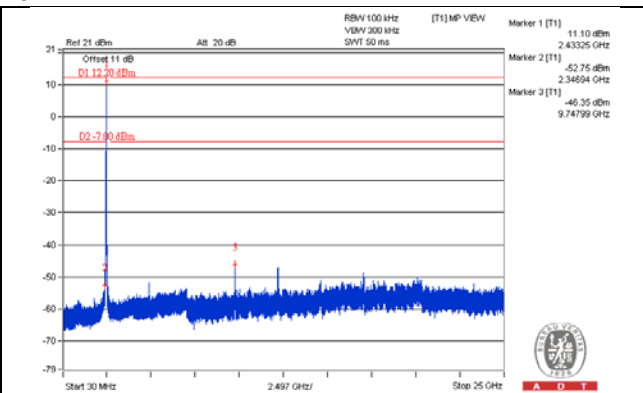
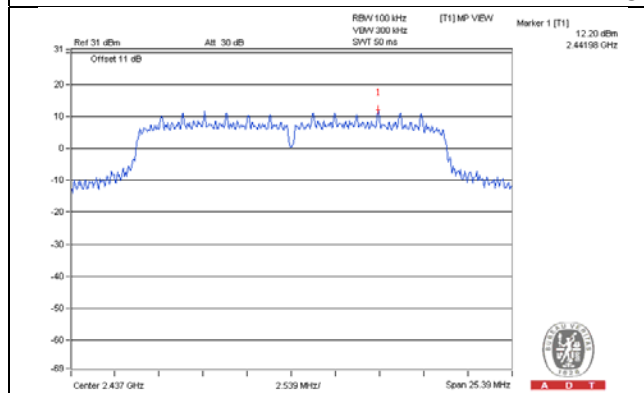


802.11n (HT20)_Chain 2

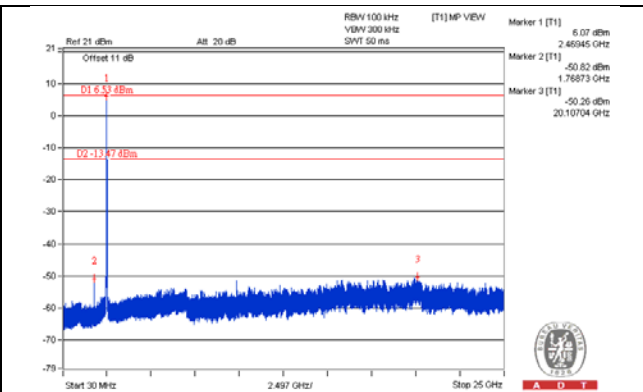
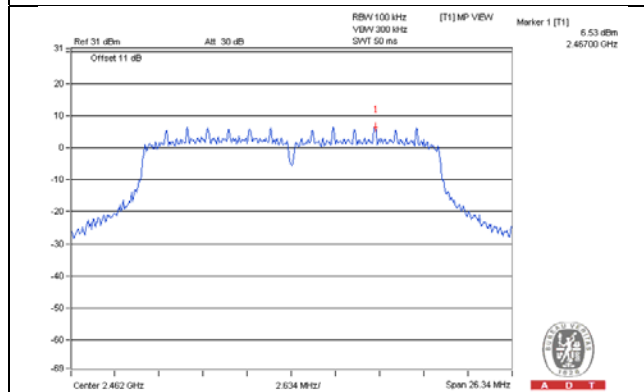
CH 1



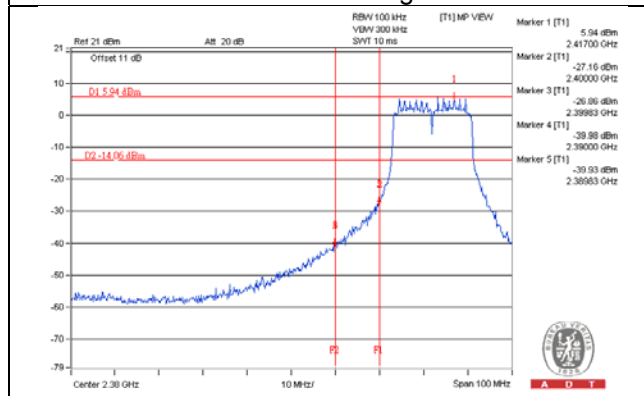
CH 6



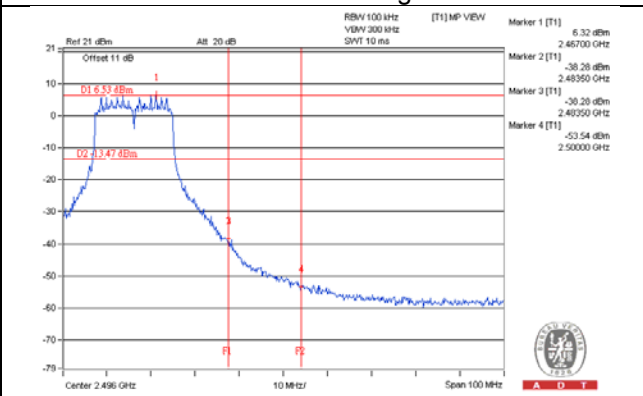
CH 11



CH 1 Band edge

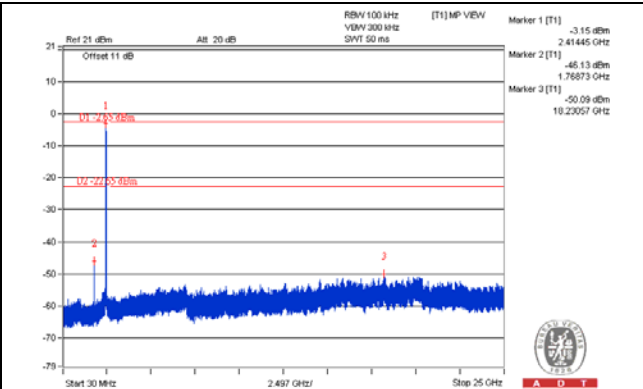
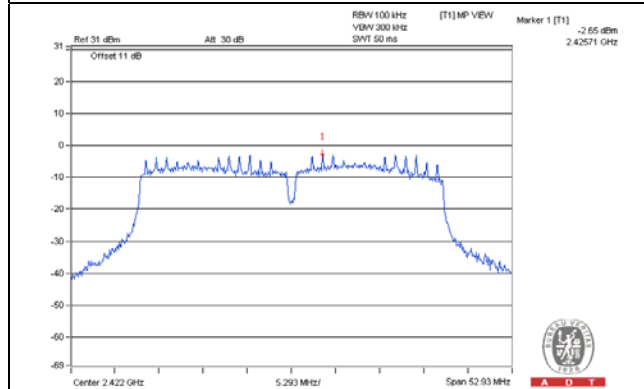


CH 11 Band edge

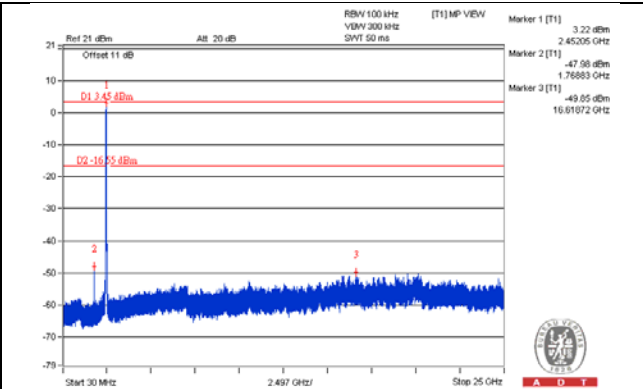
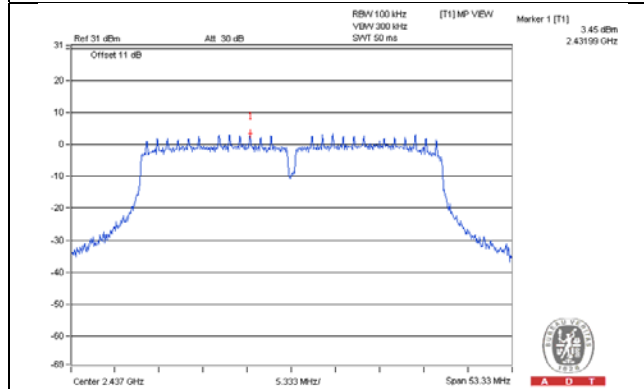


802.11n (HT40) _Chain 0

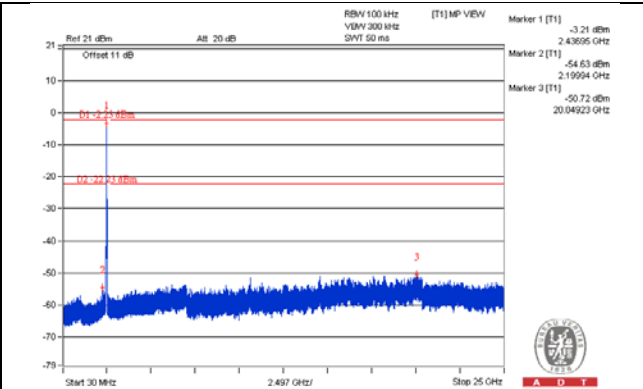
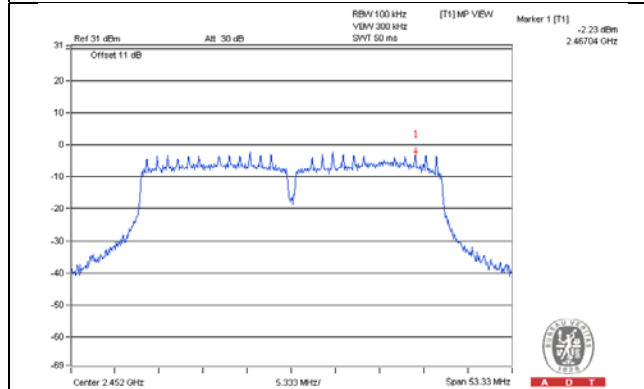
CH 3



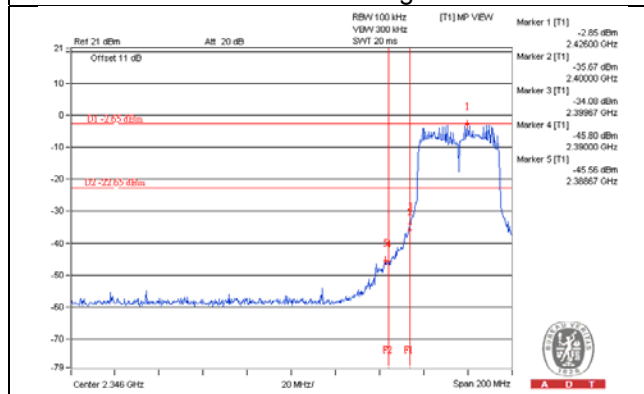
CH 6



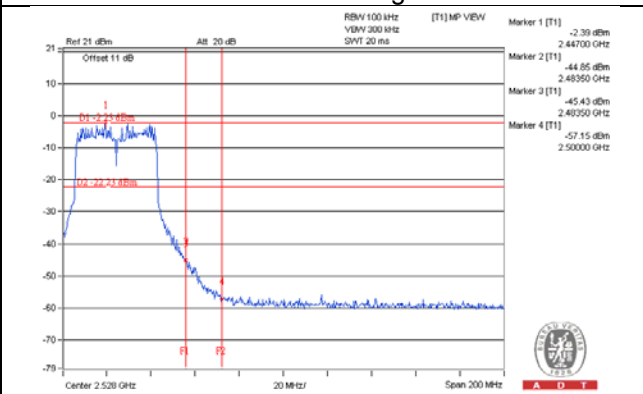
CH 9



CH 3 Band edge

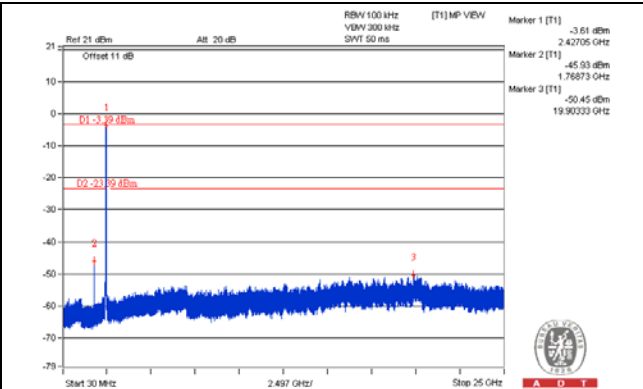
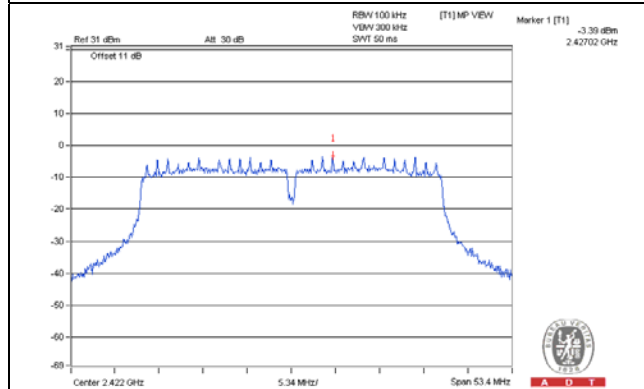


CH 9 Band edge

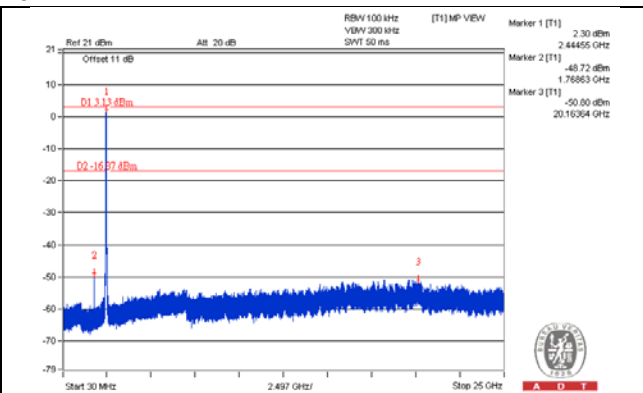
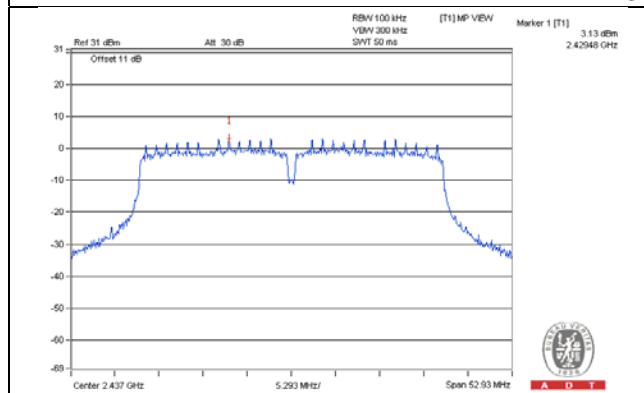


802.11n (HT40) _Chain 1

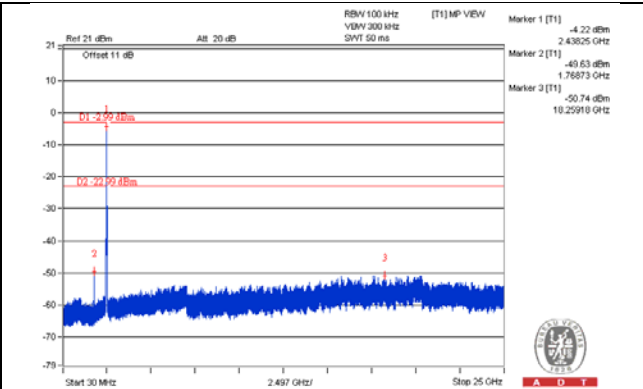
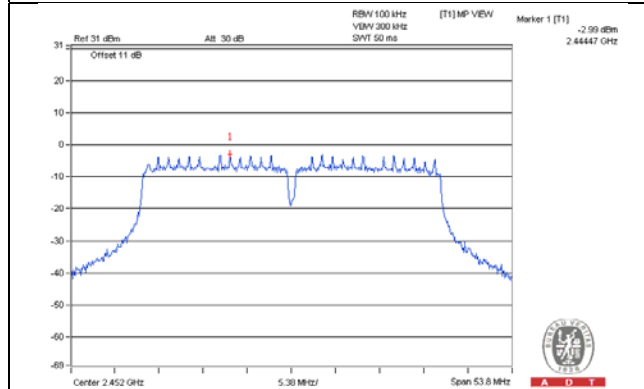
CH 3



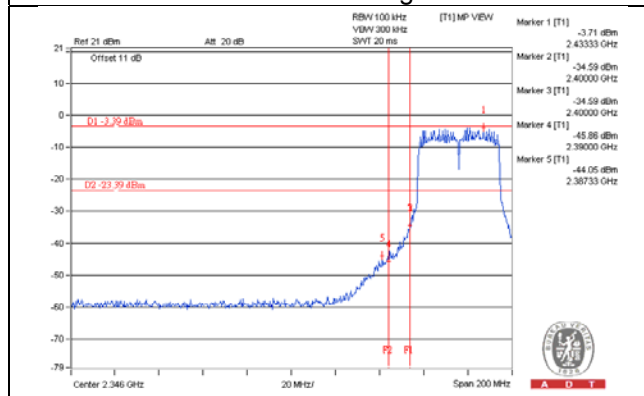
CH 6



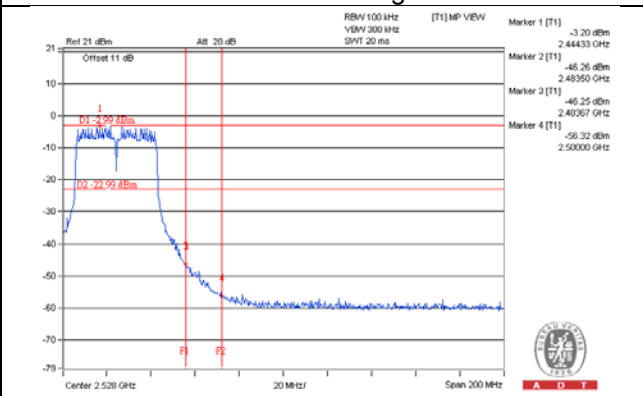
CH 9



CH 3 Band edge

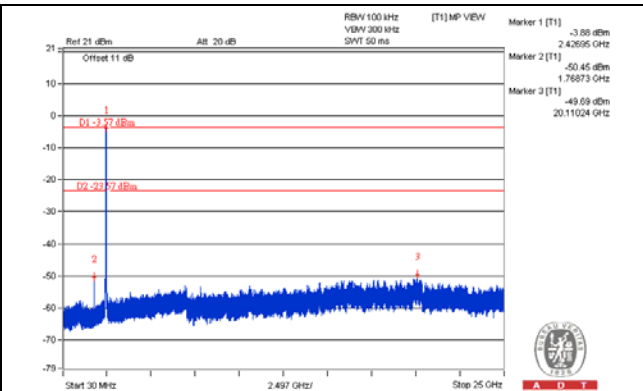
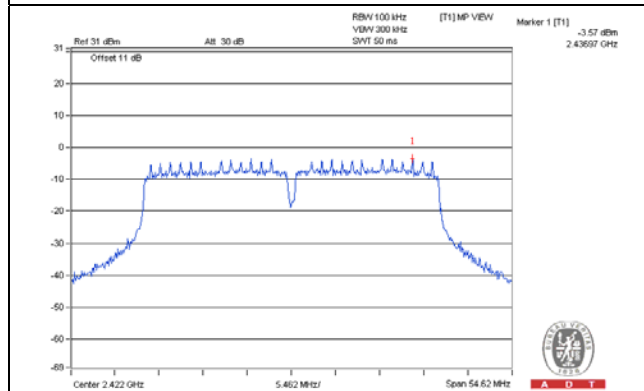


CH 9 Band edge

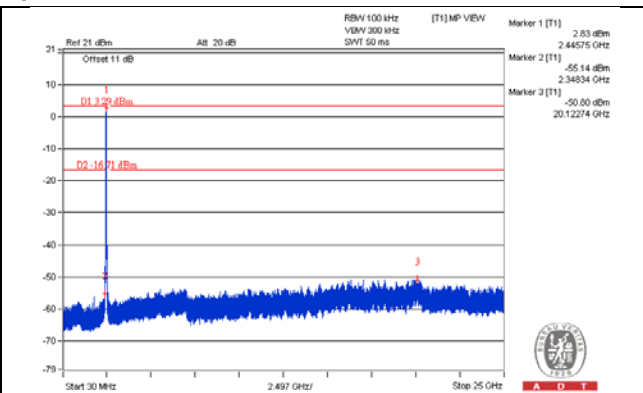
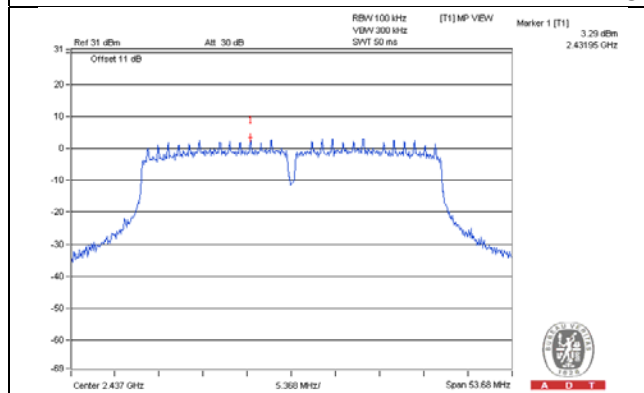


802.11n (HT40) _Chain 2

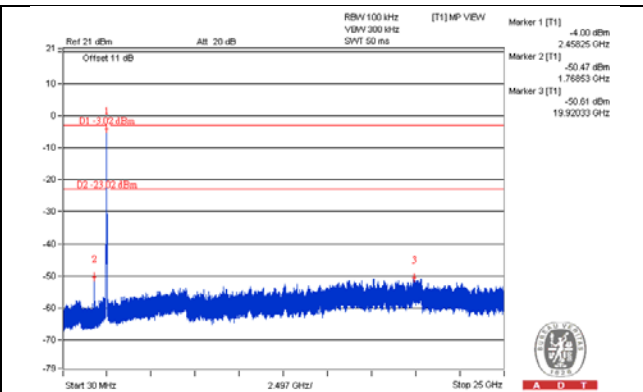
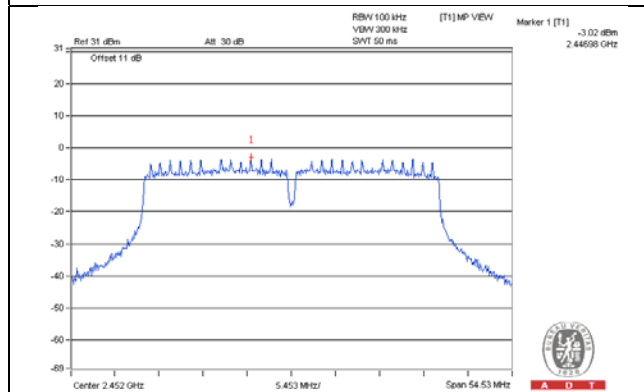
CH 3



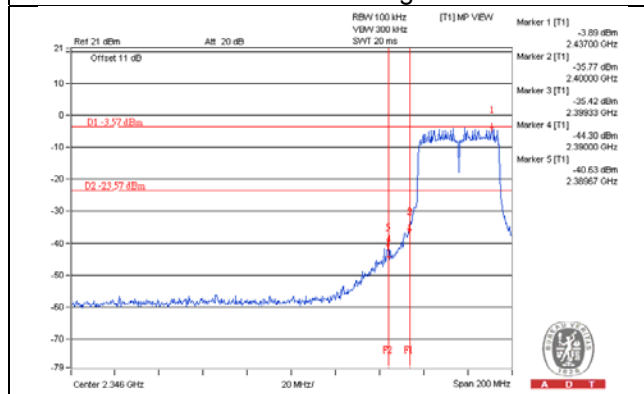
CH 6



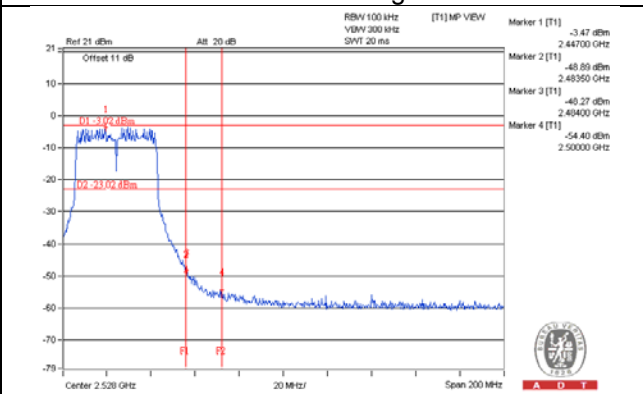
CH 9



CH 3 Band edge



CH 9 Band edge



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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