FCC Part 15
EMI TEST REPORT

of

E.U.T. : Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier

FCC ID. : M82-ADAM-2051PZ

Model No. : ADAM-2051PZ

for

APPLICANT : Advantech Co., Ltd.

ADDRESS : No.1, Aly. 20, Ln. 26, Ruiguang Rd., Neihu Dist., Taipei City

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 34. LIN 5. DINGFU, LINKOU DIST.,
NEW TAIPEI CITY, TAIWAN, 24442, R.O.C.
Tel : (02)26023052 Fax : (02)26010910
http://www.etc.org.tw ; e-mail: emc@etc.org.tw
Report Number : 12-03-RBF-182-01

TEST REPORT CERTIFICATION

Applicant : Advantech Co., Ltd.
No.1, Aly. 20, Ln. 26, Ruiguang Rd., Neihu Dist., Taipei City

Manufacturer : Advantech Co., Ltd.
No.1, Aly. 20, Ln. 26, Ruiguang Rd., Neihu Dist., Taipei City

Description of EUT

a) Type of EUT : Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier
b) Trade Name : Advantech
c) Model No. : ADAM-2051PZ
d) Power Supply : DC 24V
e) Frequency Range : 2405.000-2480.000 MHz

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.4, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Date Test Item Received	:	Mar 21, 2012
Date Test Campaign Completed	:	Mar 21, 2012
Date of Issue	:	Mar 23, 2012

Test Engineer : 

(Vincent Chang, Engineer)

Approve & Authorized Signer : 

S. S. Liou, Section Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

Table of Contents Page

1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier

b) Trade Name : Advantech

c) Model No. : ADAM-2051PZ

d) Power Supply : DC 24V

1.2 Characteristics of Device

Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier

Modulation Type: DSSS (OQPSK)
Frequency Band: ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz)
Channels: 16 channels
RF Data Rate: 250 Kbps
Transmit Power: Typ. 19 ± 1 dBm

1.3 Test Methodology

Both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.4 (2003). Other required measurements were illustrated in separate sections of this test report for details.

For radiated emission test, the antenna of EUT was swiveled to 180 degree horizontal and 90 degree of up, down, right and left repectively for pretesting. The worst case, antenna 90 degree up, was chosen to perform the final test and the data was reported.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Dingfu Vil., Linkou Dist., New Taipei City, Taiwan 24442, R.O.C.
This site has been fully described in a report submitted to your office, and accepted in a letter dated Jan. 11, 2011.

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:
A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:
A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :
A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

Except for Class A digital devices, for equpment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency MHz	Quasi Peak dB μV	Average dB μV
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

* Decreases with the logarithm of the frequency

(2) Radiated Emission Requirement

For unintentional device, according to §15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dB μV/m	Radiated μV/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
Above 960	3	54.0	500

For intentional device, according to §15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

(4) Bandwidth Requirement

For direct sequence system, according to 15.247(a)(2), the minimum 6dB bandwidth shall be at least 500 kHz.

(5) Output Power Requirement

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(6) 100 kHz Bandwidth of Frequency Band Edges Requirement

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in §15.209(a), whichever results in the lesser attenuation.

(7) Power Density Requirement

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3360-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set to maximum allowed by EUT. Three highest emissions were verified with varying placement of the cables connected to EUT to maximize the emission from EUT.

For conducted and radiated spurious emissions, whichever RF channel is operated, the digital circuits function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with channel 7 by transmitting mode.

3.2 Devices for Tested System

Device	Manufacture	Model	Cable Description
Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier*	Advantech Co., Ltd.	ADAM-2051PZ / M82-ADAM-2051PZ	0.6m Unshielded DC Power Line

Remark "*" means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For unintentional radiator, the radiated emission shall comply with §15.109(a).
For intentional radiators, according to §15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with §15.247 (c)

4.2 Measurement Procedure

A. Preliminary Measurement

The following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

B. Final Measurement

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.

2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.

3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.

4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

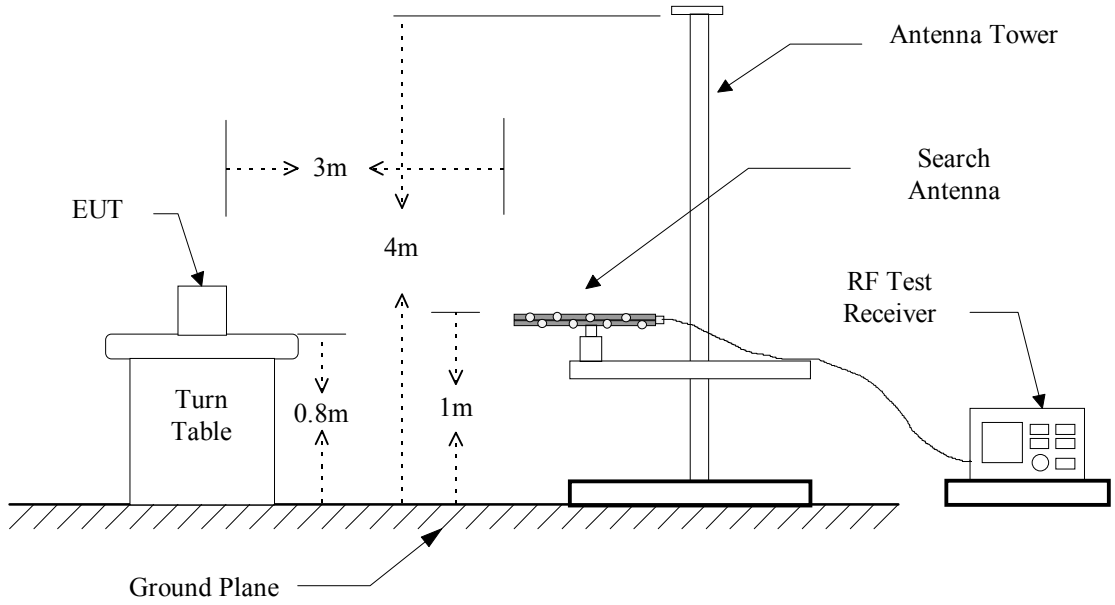
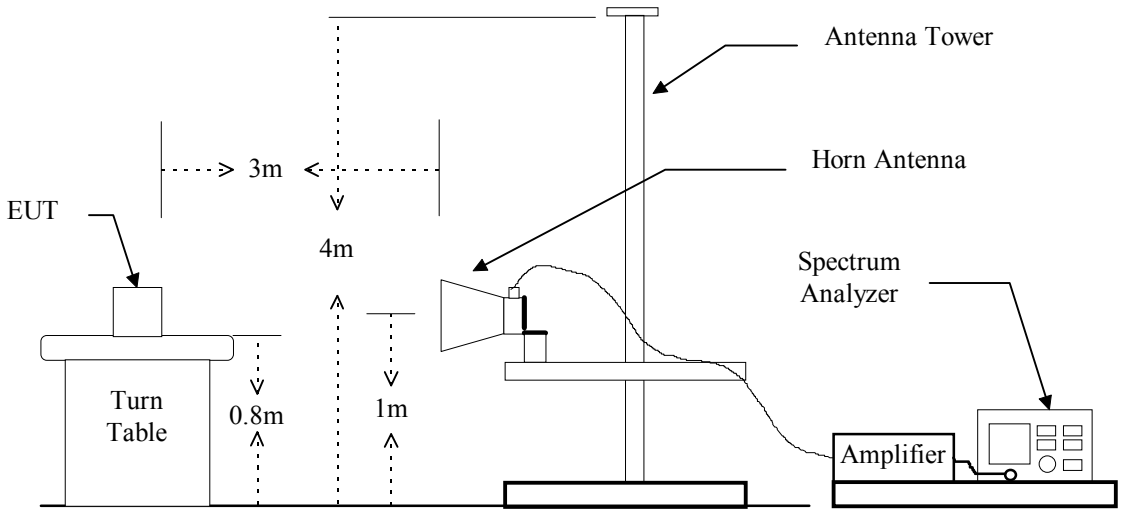


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

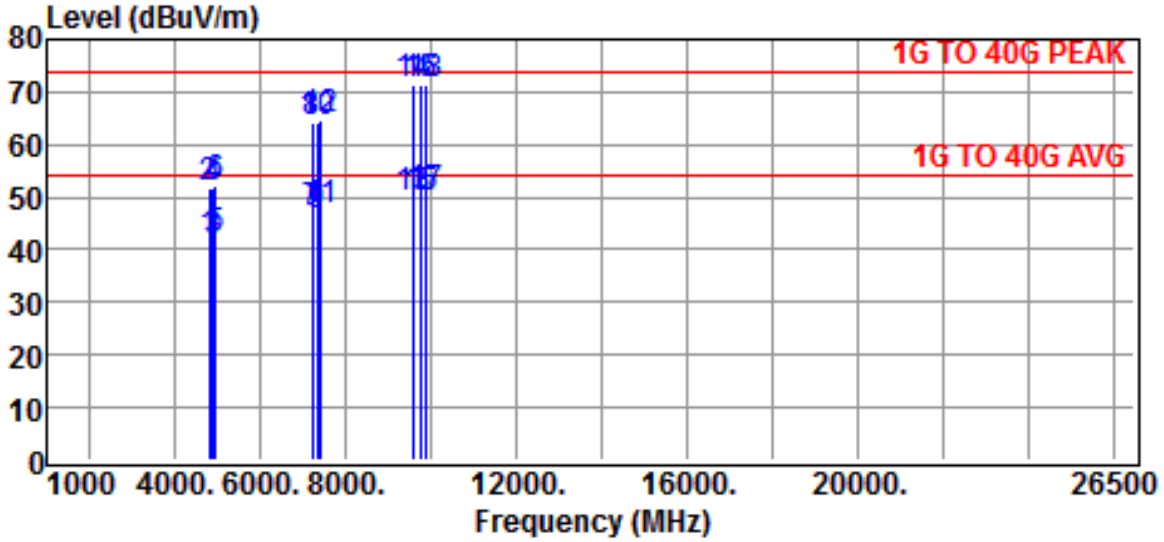
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19
EMI Test Receiver	Rohde & Schwarz	ESCI	2011/05/09	2012/05/07
Double Ridged Antenna	EMCO	3115	2011/05/30	2012/05/28
Double Ridged Antenna	EMCO	3116	2011/10/24	2012/10/23
Log-periodic Antenna	EMCO	3146	2010/11/11	2011/11/10
Biconical Antenna	EMCO	3110B	2011/10/10	2012/10/09
Amplifier	HP	8449B	2010/12/29	2011/12/28
Amplifier	HP	8447D	2011/05/27	2012/05/26
Amplifier	HP	83051A	2011/05/31	2012/05/29

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz

4.4 Radiated Emission Data

4.4.1 RF Portion



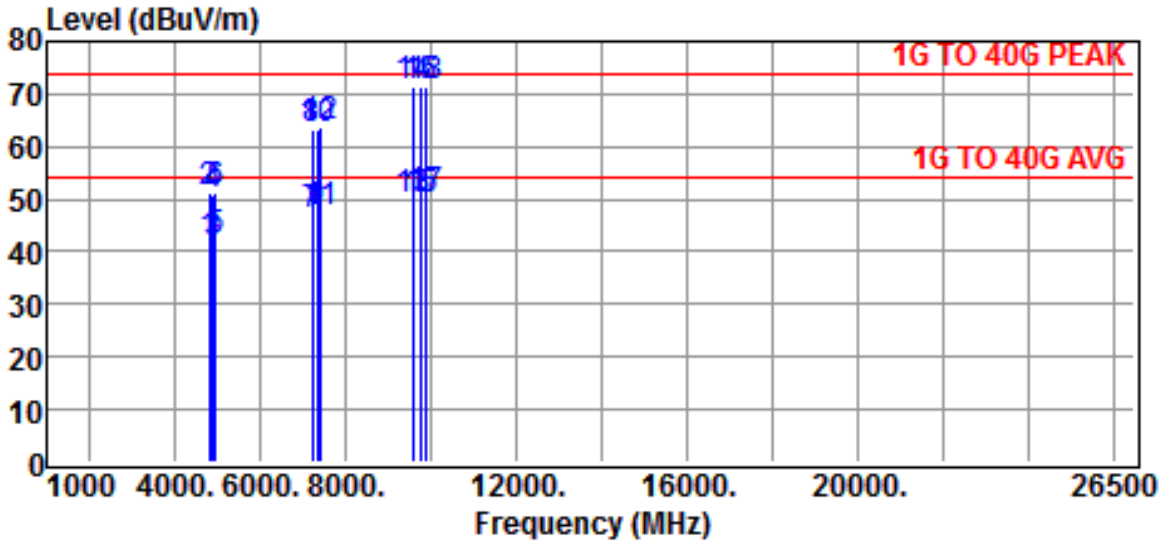
Site	:chamber #2	Date	:2012-03-21
EUT	:2.4GHz	Ant. Pol.	:HORIZONTAL
Model	:ADAM-2051PZ	Detector	:
Power Rating	:DC24V	Engineer	:VC
Limit	:1G TO 40G PEAK	Temp.	:20˚C
Memo	:TX RX-CH11:2405MHz,19:2445MHz,26:2480MHz	Humi.:	65 %

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4810.0000	41.1	0.6	41.7	54.0	-12.3	Average
4810.0000	51.3	0.6	51.9	74.0	-22.1	Peak
4890.0000	41.0	0.8	41.8	54.0	-12.2	Average
4890.0000	51.1	0.8	51.9	74.0	-22.1	Peak
4960.0000	41.1	1.0	42.1	54.0	-11.9	Average
4960.0000	51.0	1.0	52.0	74.0	-22.0	Peak
7215.0000	42.1	4.9	47.0	54.0	-7.0	Average
7215.0000	59.2	4.9	64.1	74.0	-9.9	Peak
7335.0000	41.2	5.2	46.4	54.0	-7.6	Average
7335.0000	59.1	5.2	64.3	74.0	-9.7	Peak
7440.0000	42.0	5.5	47.5	54.0	-6.5	Average
7440.0000	59.1	5.5	64.6	74.0	-9.4	Peak
9620.0000	42.1	7.6	49.7	54.0	-4.3	Average
9620.0000	63.8	7.6	71.4	74.0	-2.6	Peak
9780.0000	42.2	7.8	50.0	54.0	-4.0	Average
9780.0000	63.6	7.8	71.4	74.0	-2.6	Peak

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
9920.0000	42.0	8.2	50.2	54.0	-3.8	Average
9920.0000	63.1	8.2	71.3	74.0	-2.7	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The expanded uncertainty of the radiated emission tests is 3.53 dB.
4. The margin value=Limit - Result



Site	:chamber #2	Date	:2012-03-21
EUT	:2.4GHz	Ant. Pol.	:VERTICAL
Model	:ADAM-2051PZ	Detector	:
Power Rating	:DC24V	Engineer	:VC
Limit	:1G TO 40G PEAK	Temp.	:20˚C
Memo	:TX RX-CH11:2405MHz,19:2445MHz,26:2480MHz	Humi.:	65 %

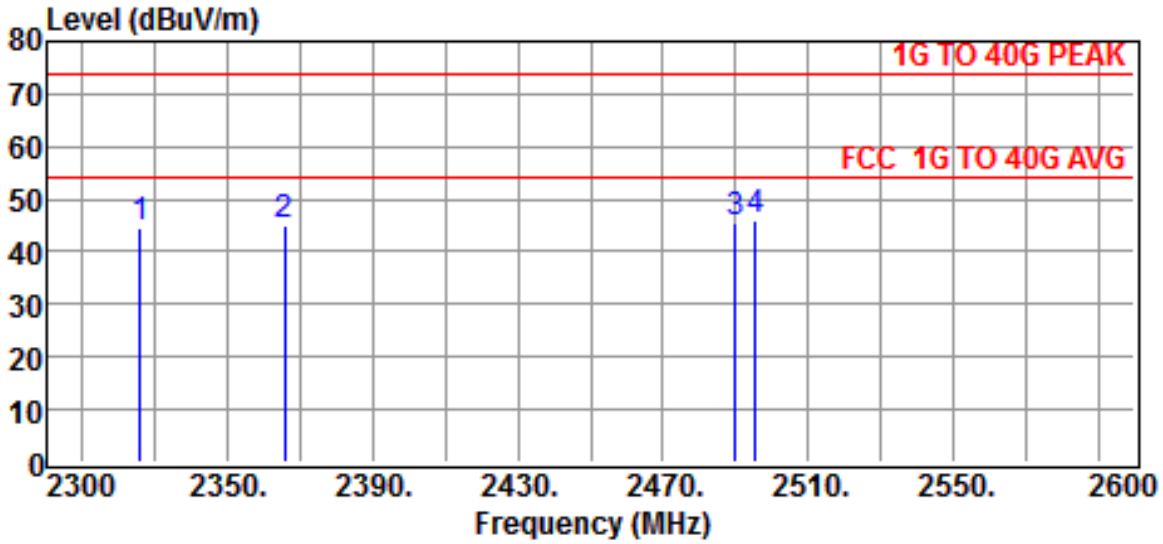
Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4810.0000	41.1	0.6	41.7	54.0	-12.3	Average
4810.0000	50.5	0.6	51.1	74.0	-22.9	Peak
4890.0000	41.0	0.8	41.8	54.0	-12.2	Average
4890.0000	50.0	0.8	50.8	74.0	-23.2	Peak
4960.0000	41.0	1.0	42.0	54.0	-12.0	Average
4960.0000	50.1	1.0	51.1	74.0	-22.9	Peak
7215.0000	42.2	4.9	47.1	54.0	-6.9	Average
7215.0000	58.5	4.9	63.4	74.0	-10.6	Peak
7335.0000	42.0	5.2	47.2	54.0	-6.8	Average
7335.0000	58.1	5.2	63.3	74.0	-10.7	Peak
7440.0000	42.0	5.5	47.5	54.0	-6.5	Average
7440.0000	58.1	5.5	63.6	74.0	-10.4	Peak
9620.0000	42.0	7.6	49.6	54.0	-4.4	Average
9620.0000	63.5	7.6	71.1	74.0	-2.9	Peak
9780.0000	42.2	7.8	50.0	54.0	-4.0	Average
9780.0000	63.6	7.8	71.4	74.0	-2.6	Peak

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
9920.0000	42.1	8.2	50.3	54.0	-3.7	Average
9920.0000	63.1	8.2	71.3	74.0	-2.7	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The expanded uncertainty of the radiated emission tests is 3.53 dB.
4. The margin value=Limit - Result

4.4.2 Radiated Eimssion of Restricted bands

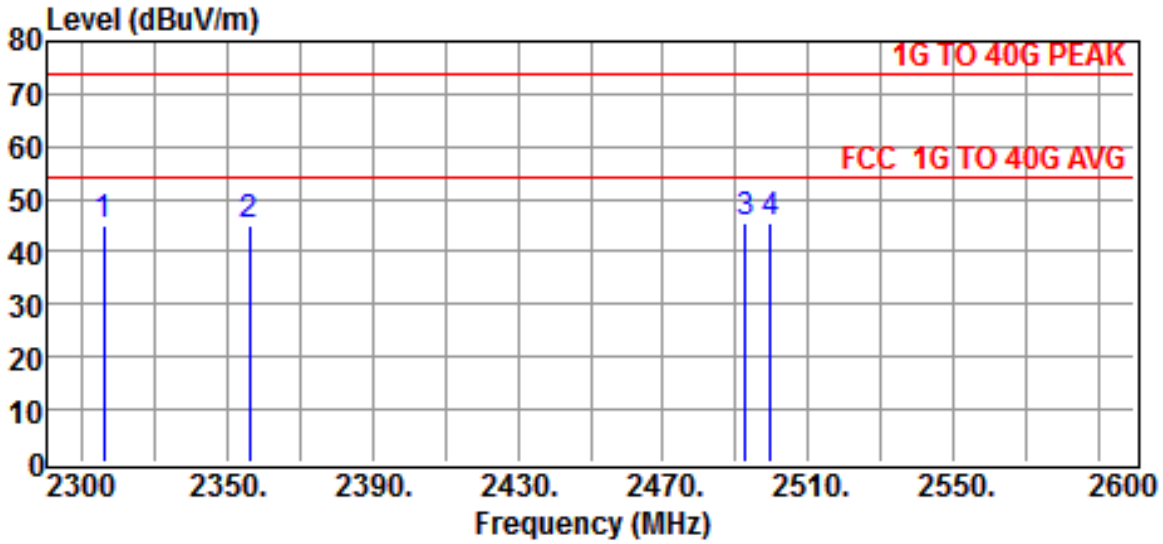


Site	:chamber #2	Date	:2012-03-21
EUT	:2.4GHz	Ant. Pol.	:HORIZONTAL
Model	:ADAM-2051PZ	Detector	:
Power Rating	:DC24V	Engineer	:VC
Limit	:1G TO 40G PEAK	Temp.	:20˚C
Memo	:CH LO & HI - BANDEDGE	Humi.	:65 %

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2325.6500	50.9	-6.4	44.5	74.0	-29.5	Peak
2365.5200	51.2	-6.3	44.9	74.0	-29.1	Peak
2489.9600	51.5	-5.9	45.6	74.0	-28.4	Peak
2495.6500	51.7	-5.9	45.8	74.0	-28.2	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The expanded uncertainty of the radiated emission tests is 3.53 dB.
4. The margin value=Limit - Result



Site	:chamber #2	Date	:2012-03-21
EUT	:2.4GHz	Ant. Pol.	:VERTICAL
Model	:ADAM-2051PZ	Detector	:
Power Rating	:DC24V	Engineer	:VC
Limit	:1G TO 40G PEAK	Temp.	:20˚C
Memo	:CH LO & HI - BANDEDGE	Humi.	:65 %

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2315.6500	51.5	-6.4	45.1	74.0	-28.9	Peak
2355.8400	51.3	-6.3	45.0	74.0	-29.0	Peak
2492.6500	51.3	-5.9	45.4	74.0	-28.6	Peak
2499.6500	51.5	-5.9	45.6	74.0	-28.4	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The expanded uncertainty of the radiated emission tests is 3.53 dB.
4. The margin value=Limit - Result

4.4.3 Other Emission

a) Emission frequencies below 1 GHz

Operation Mode : Tx/Rx; EUT lay on table evenly (Worst Case)

Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
39.45	V	19.2	12.6	31.8	40.0	-8.2	178	1.0
175.26	V	19.7	15.6	35.3	43.5	-8.2	192	1.0
225.21	V	17.9	18.9	36.8	46.0	-9.2	179	1.0
349.00	H	19.2	17.8	37.0	46.0	-9.0	79	1.5
500.20	H	16.1	21.7	37.8	46.0	-8.2	63	1.5
699.70	H	13.7	25.3	39.0	46.0	-7.0	94	1.5

Note :

1. Remark "---" means that the emissions level is too low to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

where

Corrected Factor = Antenna FACTOR + Cable Loss + High Pass Filter Loss - Amplifier Gain

4.6 Photos of Radiation Measuring Setup

5 CONDUCTED EMISSION MEASUREMENT

5.1 Description

This EUT is excused from investigation of conducted emission, for it is powered by DC only. According to § 15.207 (d), measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to §15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.2 Antenna Construction and Directional Gain

Please see photos submitted in Exhibits.

The antenna specifications are provided in application document. The maximum antenna gain is 2.0 dBi. No need to reduce the peak output power.

7 EMISSION BANDWIDTH MEASUREMENT

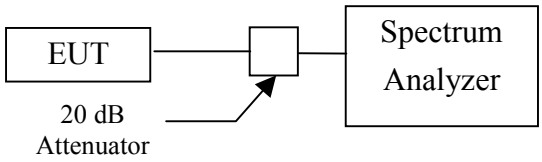
7.1 Standard Applicable

According to 15.247(a)(2), for direct sequence system, the minimum 6dB bandwidth shall be at least 500 kHz.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Figure 4: Emission bandwidth measurement configuration.



7.3 Measurement Equipment

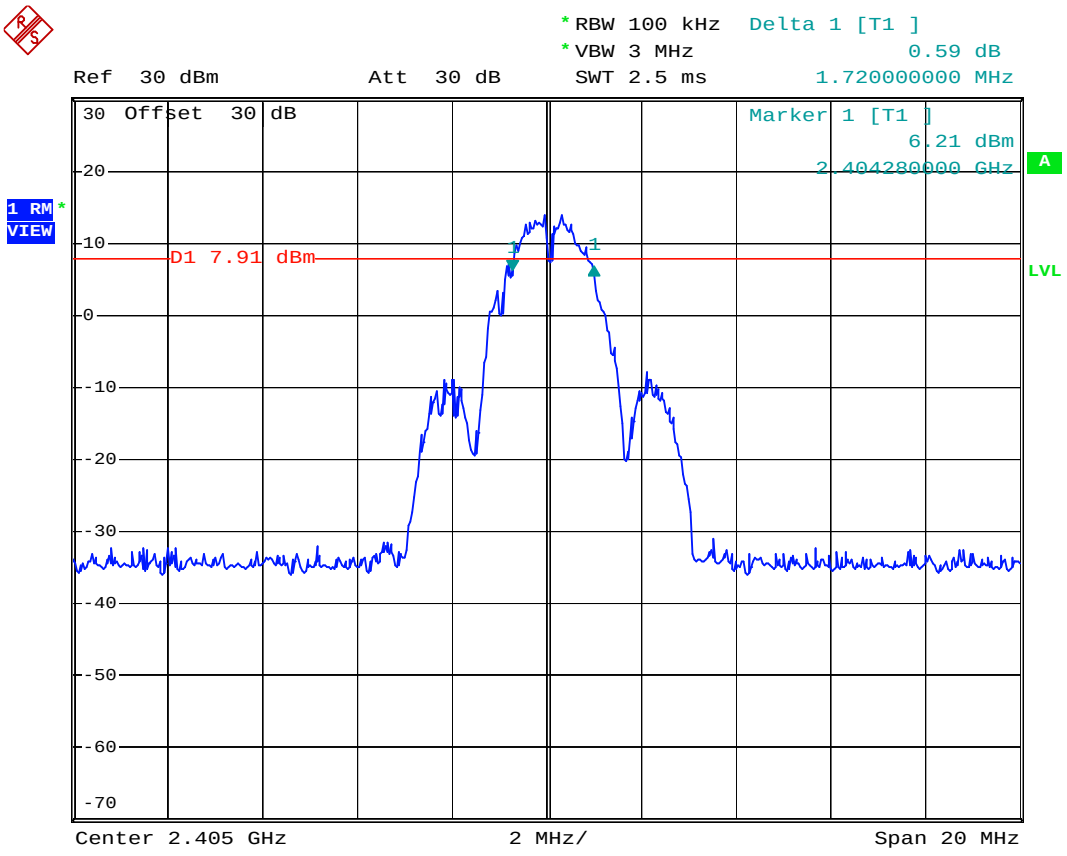
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19

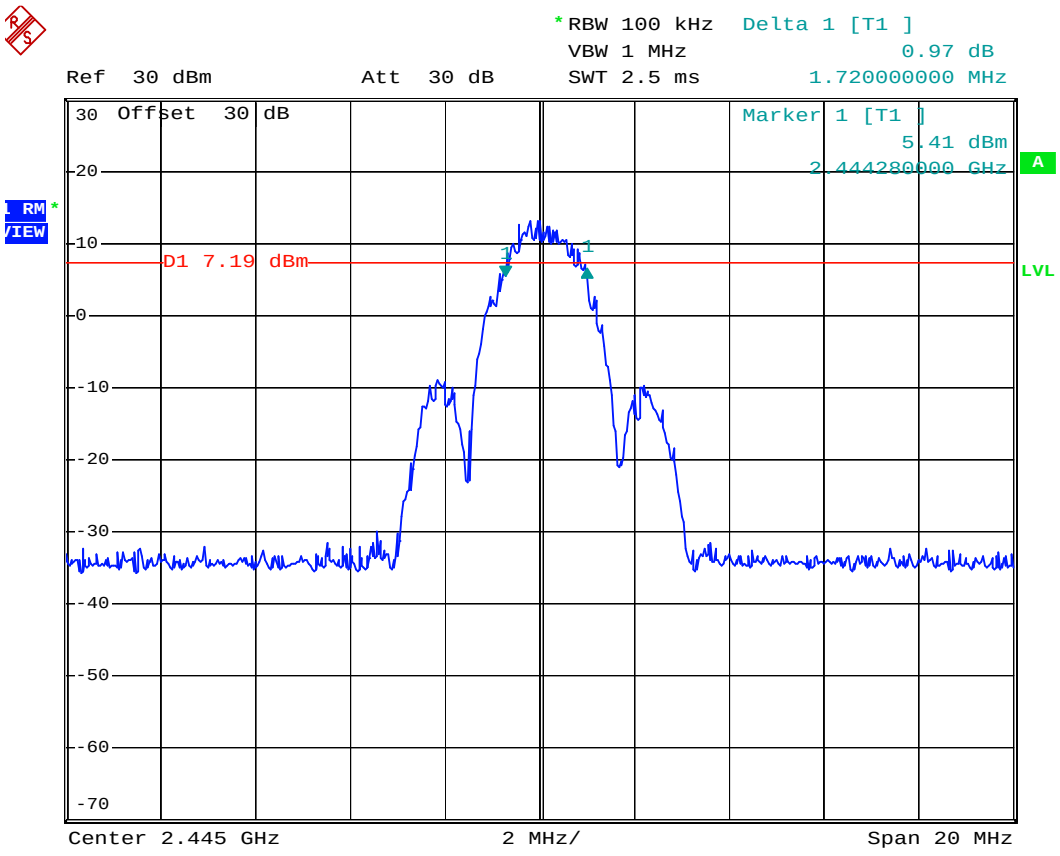
7.4 Measurement Data

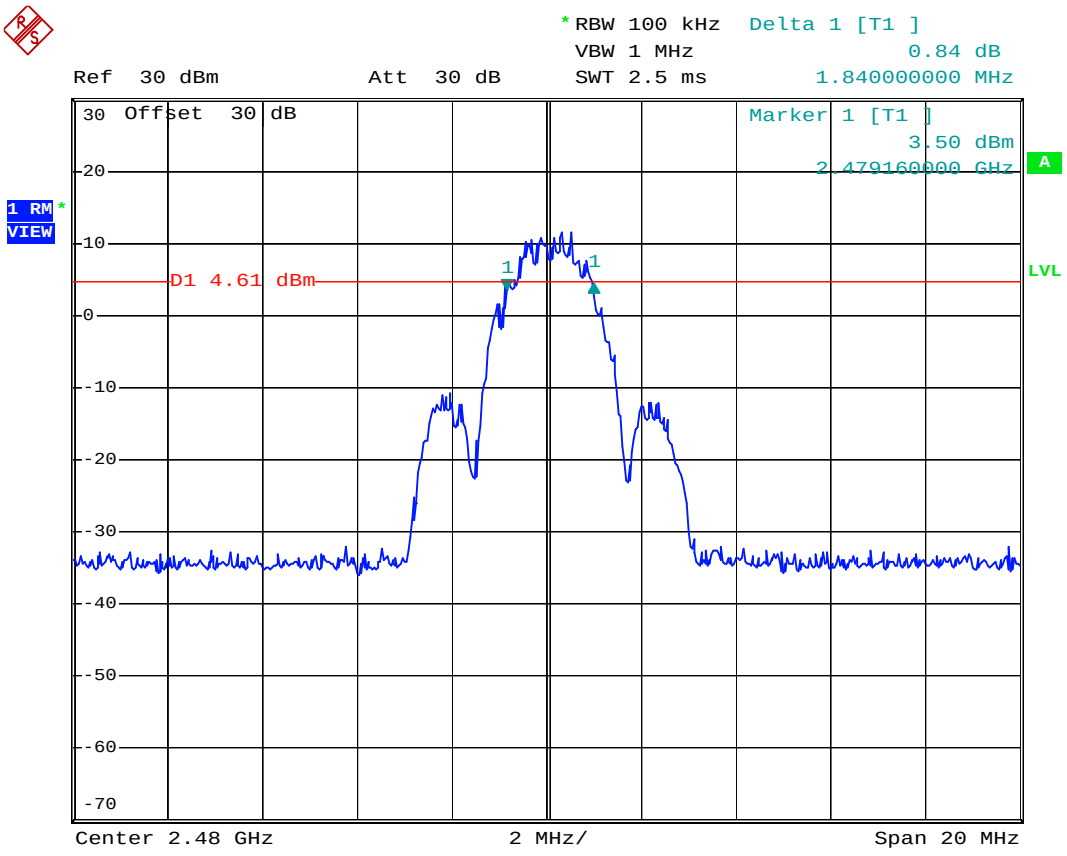
Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

a) Channel Low: 6 dB Emission Bandwidth is 1.72 MHz
b) Channel Mid: 6 dB Emission Bandwidth is 1.72 MHz
c) Channel High: 6 dB Emission Bandwidth is 1.84 MHz

Note : The expanded uncertainty of the emission bandwidth tests is 1500Hz.


*RBW 100 kHz
*VBW 3 MHz
SWT 2.5 ms
Delta 1 [T1]
0.59 dB
1.720000000 MHz
Ref 30 dBm
Att 30 dB
30 Offset 30 dB
Marker 1 [T1]
6.21 dBm
2.404280000 GHz
A
1 RM
VIEW
D1 7.91 dBm
LVL
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.405 GHz
2 MHz/
Span 20 MHz


*RBW 100 kHz
VBW 1 MHz
SWT 2.5 ms
Delta 1 [T1]
0.97 dB
1.720000000 MHz
Ref 30 dBm
Att 30 dB
Offset 30 dB
Marker 1 [T1]
5.41 dBm
2.444280000 GHz
D1 7.19 dBm
LVL
A
RM
VIEW
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.445 GHz
2 MHz/
Span 20 MHz


*RBW 100 kHz
VBW 1 MHz
SWT 2.5 ms
Delta 1 [T1]
0.84 dB
1.840000000 MHz
Ref 30 dBm
Att 30 dB
30 Offset 30 dB
Marker 1 [T1]
3.50 dBm
2.479160000 GHz
1 RM
VIEW
A
LVL
D1 4.61 dBm
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.48 GHz
2 MHz/
Span 20 MHz

8 OUTPUT POWER MEASUREMENT

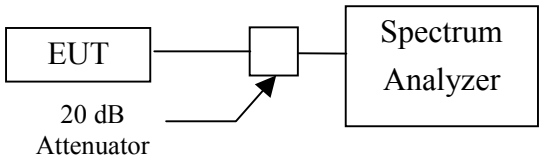
8.1 Standard Applicable

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.
3. Record the level displayed.
4. Repeat above procedures until all frequencies measured were complete.

Figure 4: Emission bandwidth measurement configuration.



8.3 Measurement Equipment

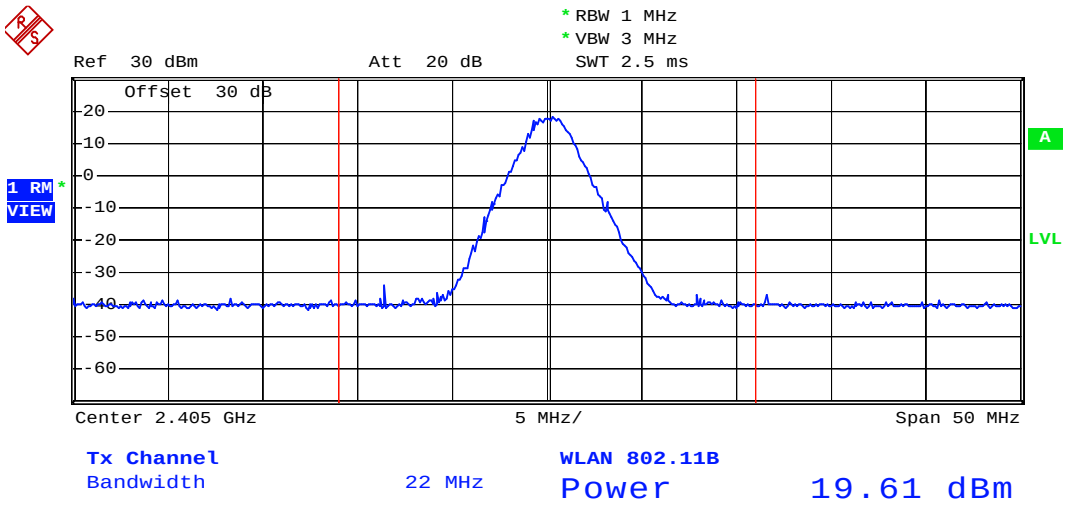
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19

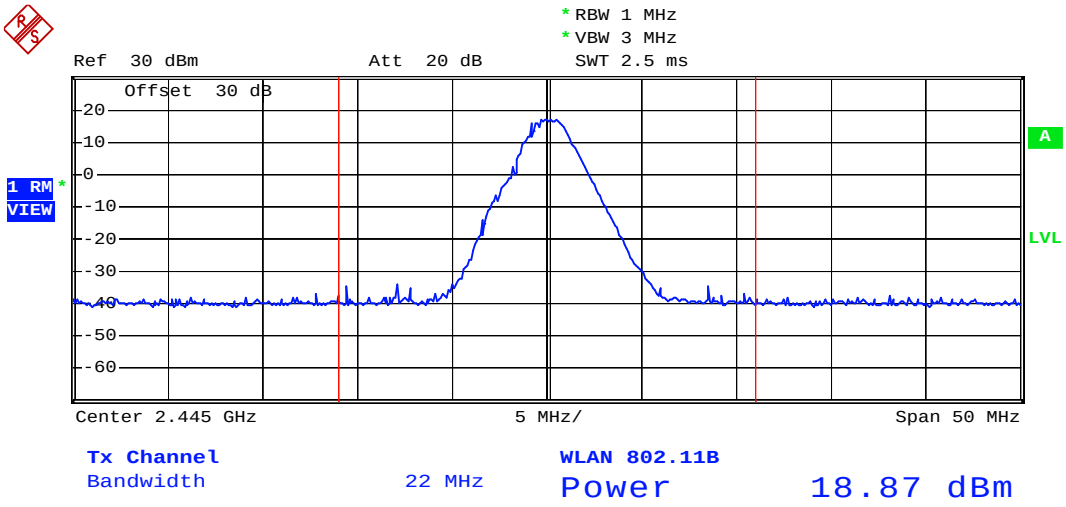
8.4 Measurement Data

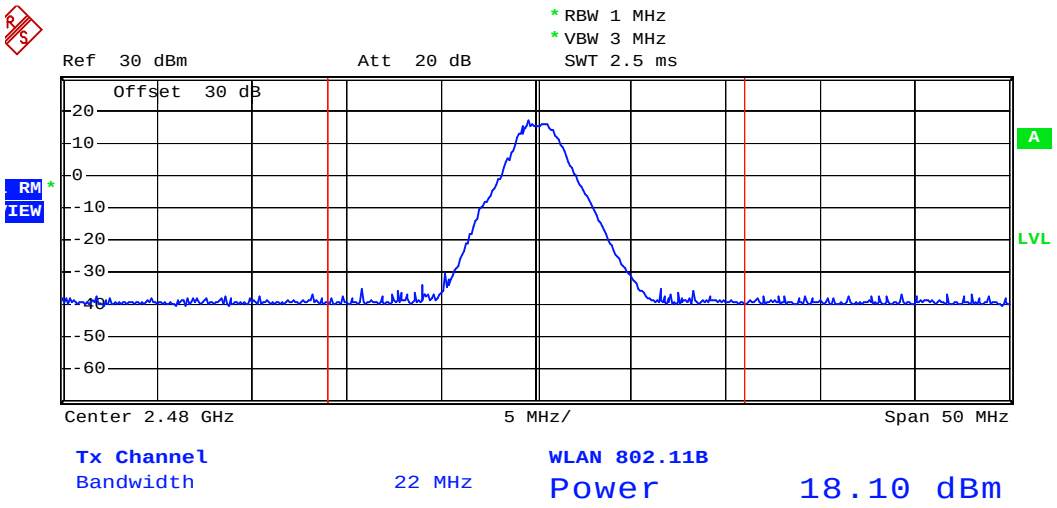
Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

a) Channel Low: Output Peak Power is 19.61 dBm **91.411** mW
b) Channel Mid: Output Peak Power is 18.87 dBm **77.090** mW
c) Channel High: Output Peak Power is 18.10 dBm **64.565** mW

Note : The expanded uncertainty of the output power tests is 2dB.


*RBW 1 MHz
*VBW 3 MHz
Ref 30 dBm
Att 20 dB
SWT 2.5 ms
Offset 30 dB
20
10
0
-10
-20
-30
-40
-50
-60
1 RM
VIEW
A
LVL
Center 2.405 GHz
5 MHz/
Span 50 MHz
Tx Channel
Bandwidth
22 MHz
WLAN 802.11B
Power
19.61 dBm


*RBW 1 MHz
*VBW 3 MHz
Ref 30 dBm
Att 20 dB
SWT 2.5 ms
Offset 30 dB
20
10
0
-10
-20
-30
-40
-50
-60
1 RM *
VIEW
A
LVL
Center 2.445 GHz
5 MHz/
Span 50 MHz
Tx Channel
Bandwidth
22 MHz
WLAN 802.11B
Power
18.87 dBm


* RBW 1 MHz
* VBW 3 MHz
Ref 30 dBm
Att 20 dB
SWT 2.5 ms
Offset 30 dB
20
10
0
-10
-20
-30
-40
-50
-60
A
LVL
Center 2.48 GHz
5 MHz/
Span 50 MHz
Tx Channel
Bandwidth
22 MHz
WLAN 802.11B
Power
18.10 dBm

9 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

9.1 Standard Applicable

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in §15.209(a), whichever results in the lesser attenuation.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW of spectrum analyzer to 100kHz and VBW to 1 MHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Equipment

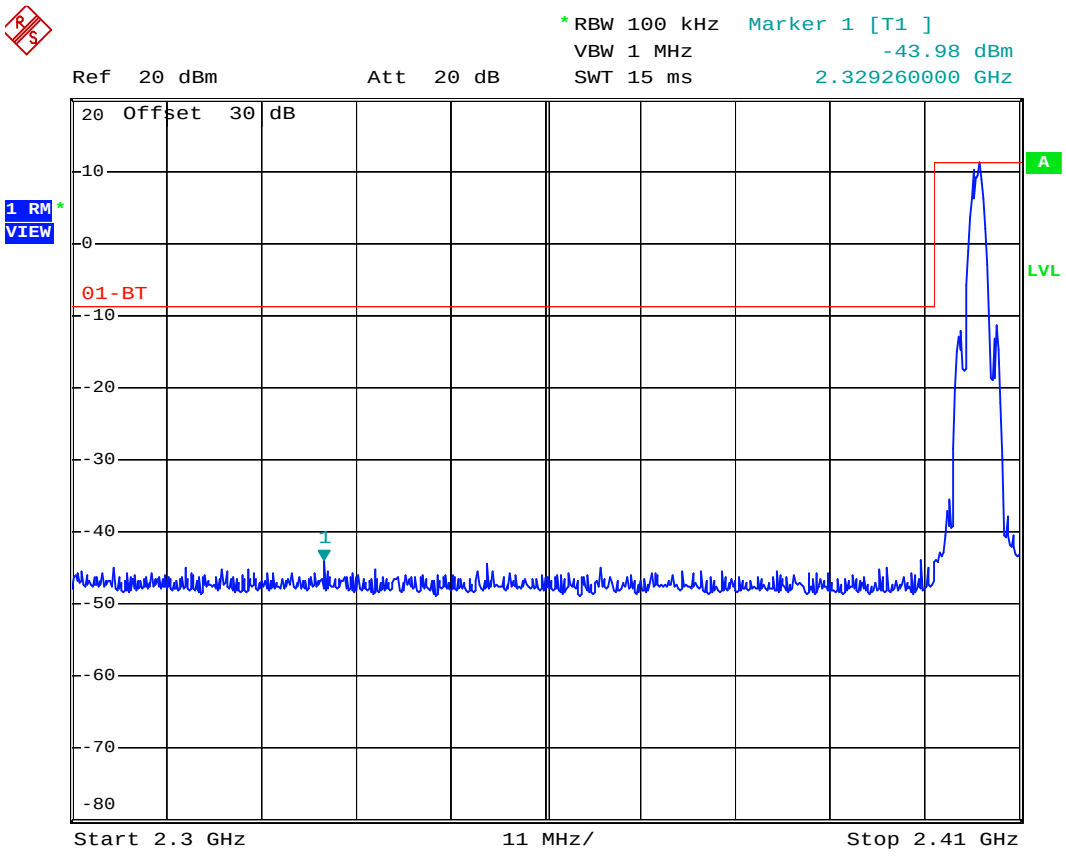
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19

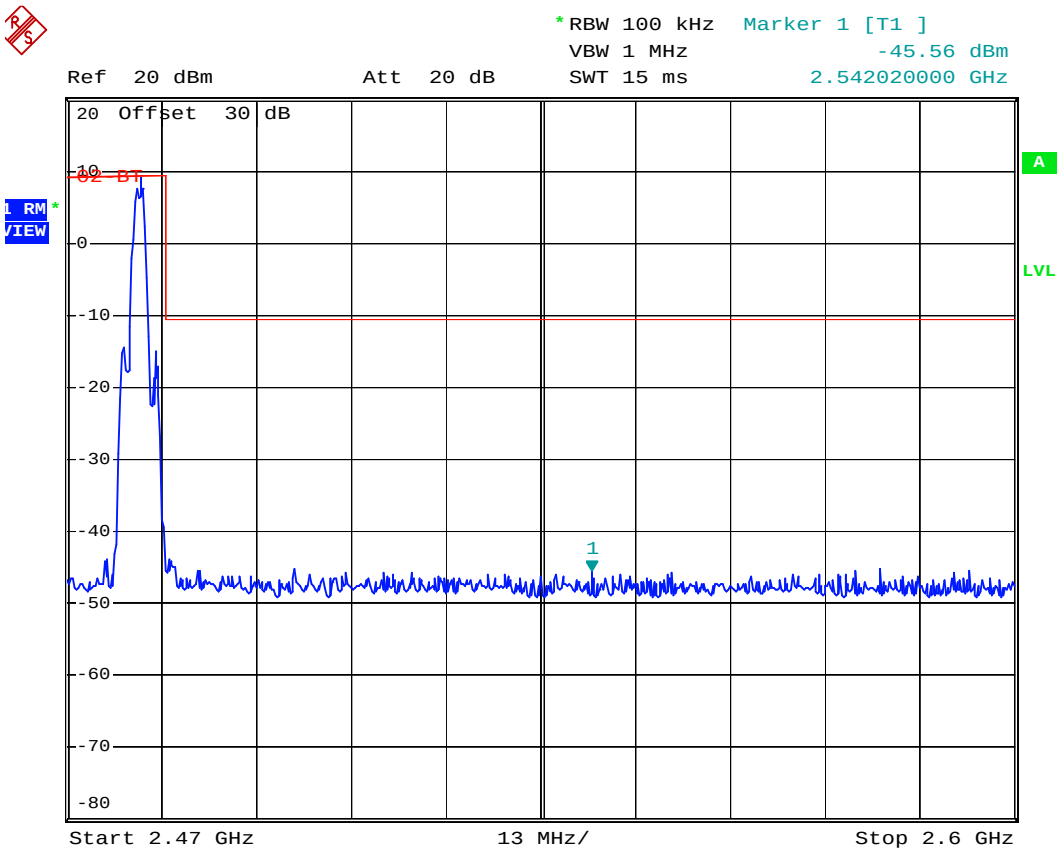
9.4 Measurement Data

Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

a) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.
b) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

Note : The expanded uncertainty of the 100 khz bandwidth of band edges tests is 2dB.


*RBW 100 kHz
VBW 1 MHz
SWT 15 ms
Marker 1 [T1]
-43.98 dBm
2.329260000 GHz
Ref 20 dBm
Att 20 dB
20 Offset 30 dB
1 RM
VIEW
A
LVL
01-BT
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1
Start 2.3 GHz
11 MHz/
Stop 2.41 GHz


*RBW 100 kHz
Marker 1 [T1]
VBW 1 MHz
-45.56 dBm
SWT 15 ms
2.542020000 GHz
Ref 20 dBm
Att 20 dB
20 Offset 30 dB
-02 Bt
1 RM *
VIEW
A
LVL
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1
Start 2.47 GHz
13 MHz/
Stop 2.6 GHz

10 POWER DENSITY MEASUREMENT

10.1 Standard Applicable

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on highest level appearing on spectral display within a 300 kHz frequency span.
4. Set the spectrum analyzer on a 3 kHz resolution bandwidth and 300 kHz video bandwidth as well as max hold function.
5. Repeat above procedures until all measured frequencies were complete.

10.3 Measurement Equipment

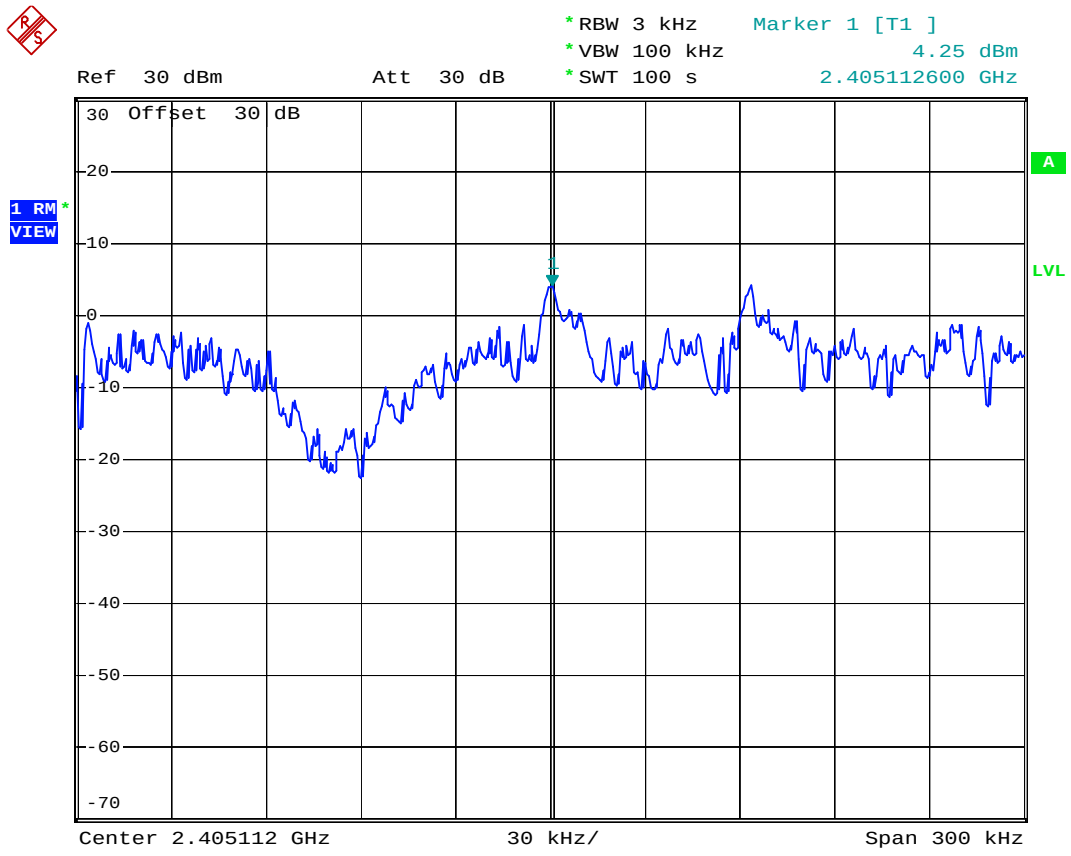
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19

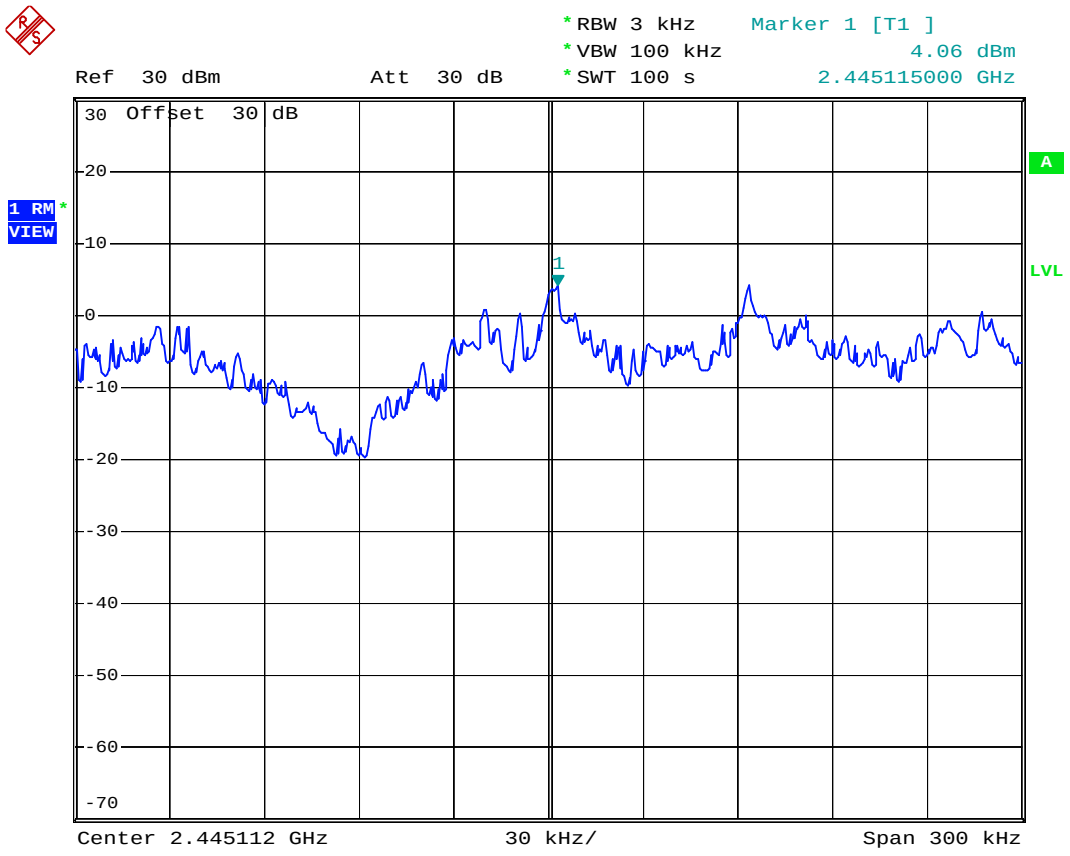
10.4 Measurement Data

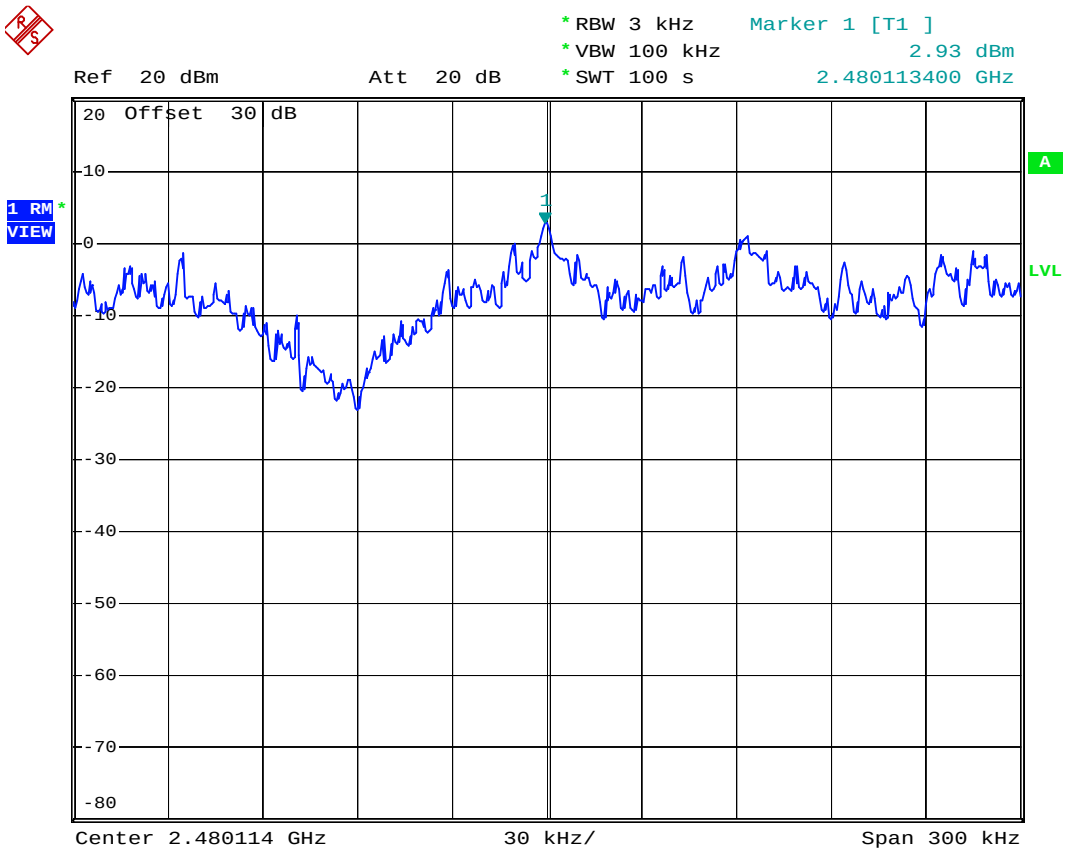
Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

a) Channel Low: Maximun Power Density of 3 kHz Bandwidth is 4.25 dBm
b) Channel Mid: Maximun Power Density of 3 kHz Bandwidth is 4.06 dBm
c) Channel High: Maximun Power Density of 3 kHz Bandwidth is 2.93 dBm

Note : The expanded uncertainty of the power density tests is 2dB.


*RBW 3 kHz
*VBW 100 kHz
*SWT 100 s
Marker 1 [T1]
4.25 dBm
2.405112600 GHz
Ref 30 dBm
Att 30 dB
30 Offset 30 dB
1 RM *
VIEW
A
LVL
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.405112 GHz
30 kHz/
Span 300 kHz


*RBW 3 kHz
*VBW 100 kHz
*SWT 100 s
Marker 1 [T1]
4.06 dBm
2.445115000 GHz
Ref 30 dBm
Att 30 dB
30 Offset 30 dB
1 RM *
VIEW
A
LVL
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.445112 GHz
30 kHz/
Span 300 kHz


*RBW 3 kHz
Marker 1 [T1]
*VBW 100 kHz
2.93 dBm
Ref 20 dBm
Att 20 dB
*SWT 100 s
2.480113400 GHz
20 Offset 30 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1 RM
VIEW
A
LVL
Center 2.480114 GHz
30 kHz/
Span 300 kHz

11. OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT

11.1 Standard Applicable

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold.
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2011/09/21	2012/09/19

11.4 Measurement Data

Test Date : Mar. 21, 2012 Temperature : 20 °C Humidity : 65 %

Model : Channel Low

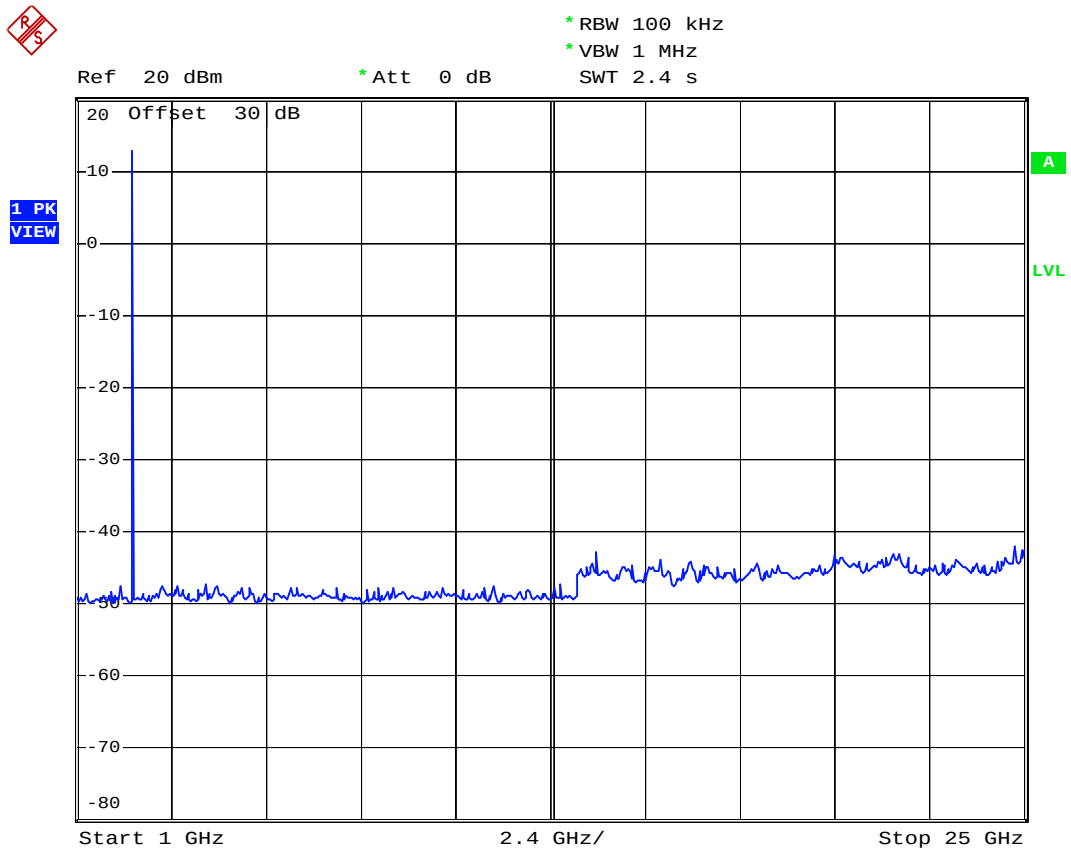
a) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

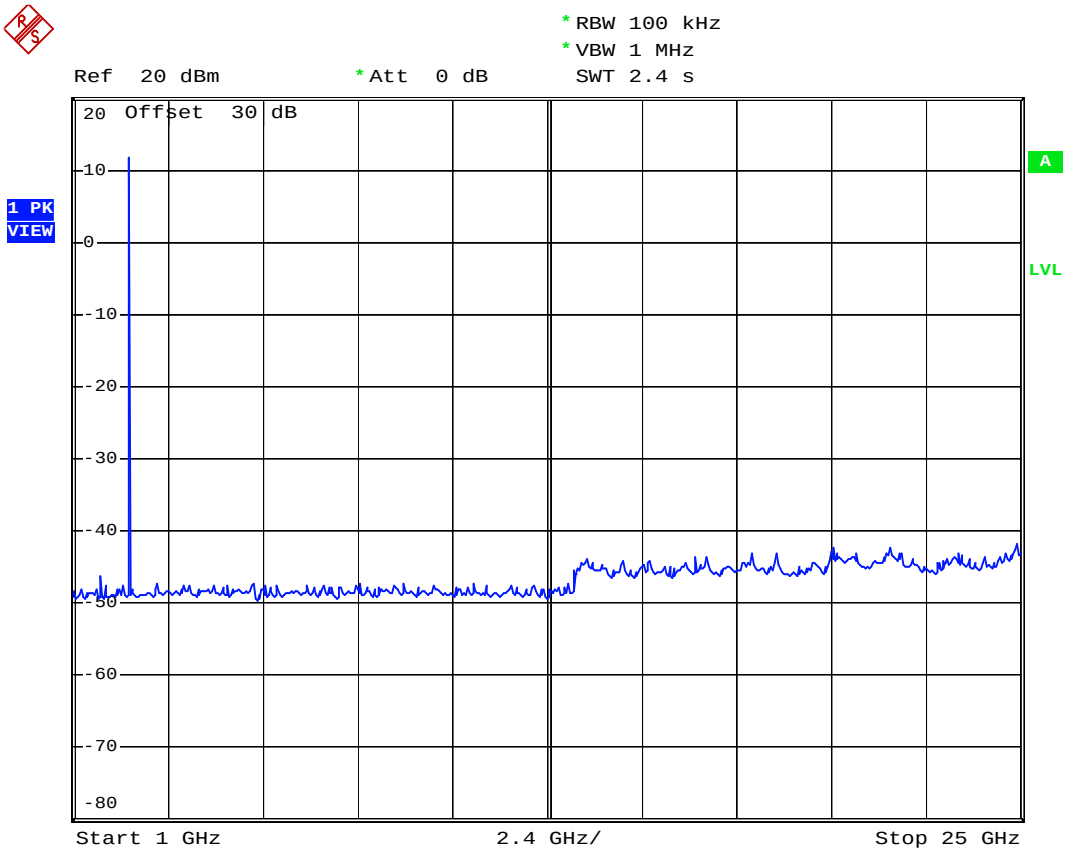
Model : Channel Mid

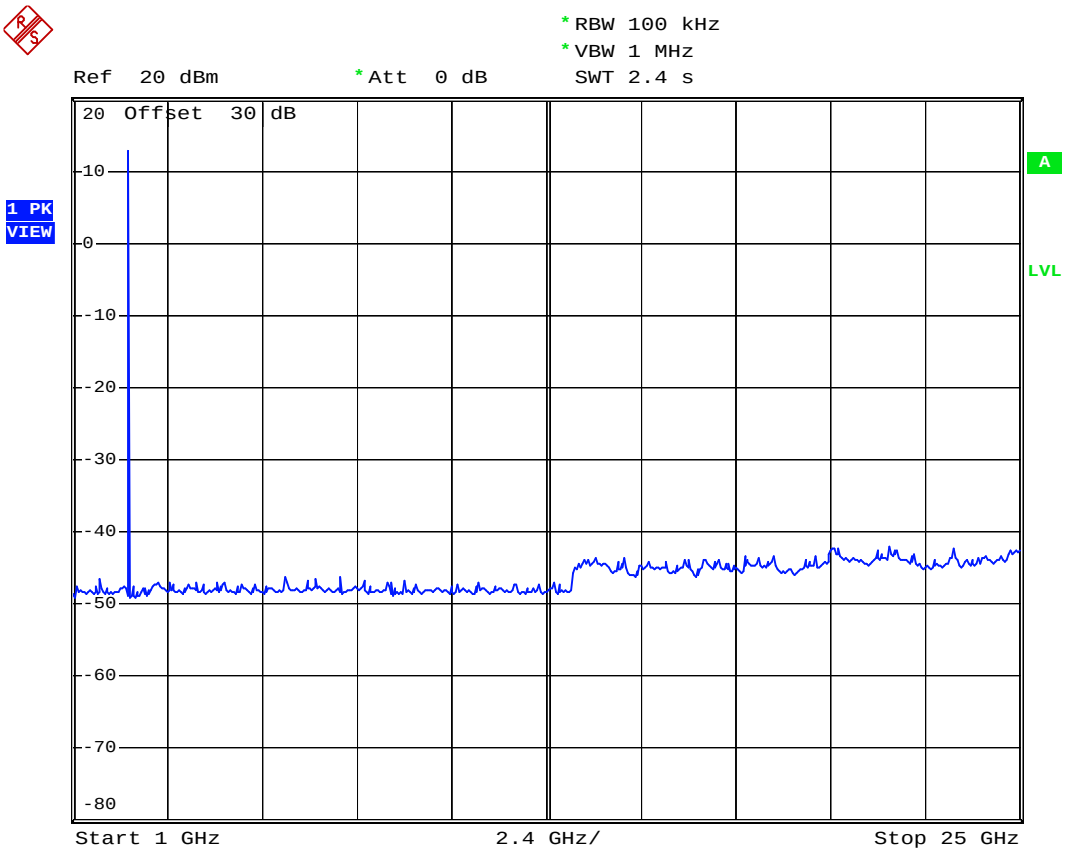
a) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Model : Channel High

a) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.


*RBW 100 kHz
*VBW 1 MHz
Ref 20 dBm
*Att 0 dB
SWT 2.4 s
20 Offset 30 dB
1 PK
VIEW
A
LVL
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Start 1 GHz
2.4 GHz/
Stop 25 GHz


*RBW 100 kHz
*VBW 1 MHz
Ref 20 dBm
*Att 0 dB
SWT 2.4 s
20 Offset 30 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1 PK
VIEW
A
LVL
Start 1 GHz
2.4 GHz/
Stop 25 GHz


*RBW 100 kHz
*VBW 1 MHz
Ref 20 dBm
*Att 0 dB
SWT 2.4 s
20 Offset 30 dB
1 PK
VIEW
A
LVL
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Start 1 GHz
2.4 GHz/
Stop 25 GHz