

FCC Part 15 EMI TEST REPORT of

E.U.T. : ZigBee/IEEE802.15.4 RF
Module

FCC ID : NRH-ZB-Z100A

MODEL No. : Z100A

for

APPLICANT : NETVOX TECHNOLOGY CO., LTD.

ADDRESS : No. 21-1, Sec. 1, Chung Hua West Road, Tainan,
Taiwan

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN

NO. 34. LIN 5. DINGFU TSUEN, LINKOU SHIANG
TAIPEI COUNTY, TAIWAN, 24442, R.O.C.

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Report Number : 10-08-RBF-195

TEST REPORT CERTIFICATION

Applicant : NETVOX TECHNOLOGY CO., LTD.
No. 21-1, Sec. 1, Chung Hua West Road, Tainan, Taiwan

Manufacturer : NETVOX TECHNOLOGY CO., LTD.
No. 21-1, Sec. 1, Chung Hua West Road, Tainan, Taiwan

Description of EUT :

a) Type of EUT : ZigBee/IEEE802.15.4 RF Module

b) Trade Name : NETVOX

c) Model No. : Z100A

d) Power Supply : 2.0V to 3.6V

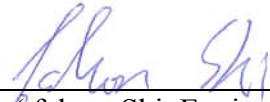
e) Frequency Range : 2405.000-2480.000 MHz

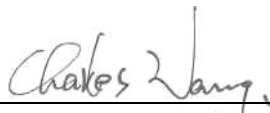
Regulation Applied : FCC Rules and Regulations Part 15 Subpart C (2009)

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003), 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 of Issue : Sep. 29, 2010

Test Engineer : 
(falcon Shi, Engineer)

Check By : 
(Charles Wang, Supervisor)

Approve & Authorized Signer : 
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

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1 GENERAL INFORMATION

1.1 Product Description

- a) Type of EUT : ZigBee/IEEE802.15.4 RF Module
- b) Trade Name : NETVOX
- c) Model No. : Z100A
- d) Power Supply : 2.0V to 3.6V

1.2 Characteristics of Device

The Zigbee RF module Z100A offered from NETVOX is low power, 2.4GHz ISM band transceiver, based on the TI CC2530 single chip ZigBee Pro / IEEE 802.15.4 solution. The Z100A comes in two different versions. The on-board chip antenna and the on-board metal antenna.

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.

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 TSUEN, LINKOU SHIANG TAIPEI COUNTY, TAIWAN, 24442, R.O.C.

This site has been fully described in a report submitted to your office, and accepted in a letter dated Aug. 05, 2008.

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 equipment 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 50 μ H/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 μ V	Average dB μ V
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 μ V/m	Radiated μ V/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 radiator device, per §15.249(a), the field strength of emissions shall comply with the following :

Frequency MHz	Distance Meters	Fundamental		Harmonic	
		dB μ V/m	mV/m	dB μ V/m	μ V/m
902 - 928	3	94	50	54	500
2400 - 2483.5	3	94	50	54	500
5725 - 5875	3	94	50	54	500
24000 - 24250	3	108	250	68	2500

In accordance with §15.249(d), limits shown in above table are based on average limits for frequencies above 1000 MHz, and frequencies below 1000 MHz are based on quasi peak. However, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20 dB.

(3) Spurious in Out Band Requirement

For intentional device, according to §15.249 (c), emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits in §15.209.

(4) 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.

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

All measurement were intentional to maximum the emissions from EUT by varying the connection cables, therefore, the test result is sure to meet the applicable requirement.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Description
ZigBee/IEEE802.15.4 RF Module *	NETVOX TECHNOLOGY CO., LTD.	Z100A /NRH-ZB-Z100A	----

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For intentional radiators, according to §15.249 (a), operation within the frequency band of 2.4 to 2.4835 GHz, the fundamental field strength shall not exceed 94 dBuV/m and the harmonics shall not exceed 54 dBuV/m. For out band emission except for harmonics shall be comply with §15.209 or at least attenuated by 50 dB below the level of the fundamental.

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

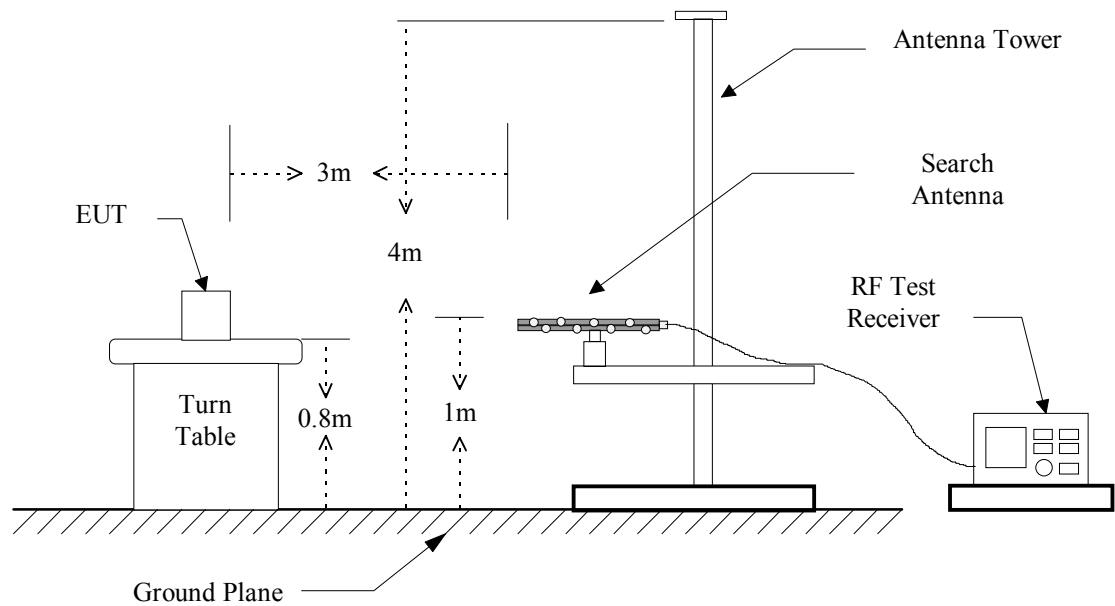
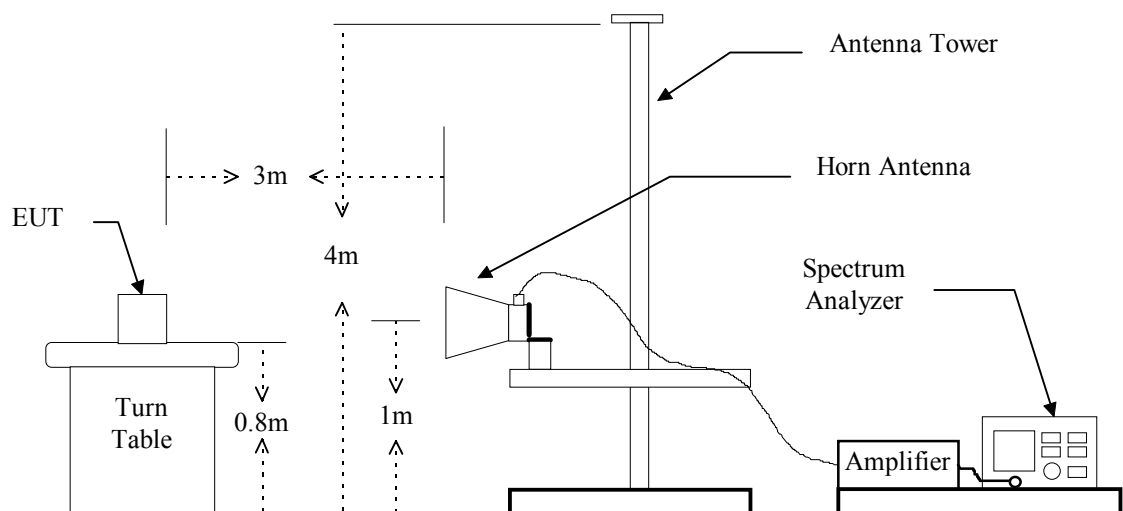


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Test Receiver	Rohde & Schwarz	ESCI	2010/02/03	2011/02/02
Spectrum	Advantest	R3162	2010/03/01	2011/02/28
Bi-Log Antenna	Schaffner	CBL 6111	2010/05/21	2011/05/20
Log-periodic Antenna	EMCO	3146	2009/09/30	2010/09/29
Biconical Antenna	EMCO	3110B	2009/09/22	2010/09/21
Double Ridged Antenna	EMCO	3115	2010/05/11	2011/05/10
Amplifier	HP	8449B	2009/12/16	2010/12/15
Amplifier	HP	83051A	2010/05/10	2011/05/09
Amplifier	HP	8447D	2010/05/10	2011/05/09
Spectrum	Rohde & Schwarz	FSP40	2009/09/10	2010/09/09

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 Tx Portion

4.4.1.1 Chip Antenna

A. CH Low

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2405.000 MHz

Test Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
2405.480	94.5	***	87.3	***	-7.0	87.5	***	114.0	94.0	-6.5	67	1.0
4810.170	50.8	***	51.7	***	-0.2	51.5	45.0	74.0	54.0	-2.5	96	1.0
7214.860	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9619.550	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12024.240	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14428.930	---	---	---	---	---	---	---	74.0	54.0	---	---	---
16833.620	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19238.310	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21643.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24047.690	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : Receiving

Fundamental Frequency : Local Frequency : 2405.000 MHz

Test Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
* 2405.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 4810.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 7215.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 9620.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 12025.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

B. CH Middle

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2440.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
2440.510	94.5	***	90.8	***	-6.9	87.6	***	114.0	94.0	-6.4	66	1.1
4879.180	50.1	***	51.9	***	0.1	52.0	***	74.0	54.0	-2.0	54	1.0
7317.850	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9756.520	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12195.190	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14633.860	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17072.530	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19511.200	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21949.870	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24388.540	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : ReceivingFundamental Frequency : Local Frequency : 2440.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
* 2440.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 4880.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 7320.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 9760.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 12200.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

C. Channel High

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2480.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
2479.490	97.6	***	92.5	***	-6.8	90.8	***	114.0	94.0	-3.2	76	1.2
4960.240	51.1	***	52.4	***	0.3	52.7	***	74.0	54.0	-1.3	84	1.1
7440.990	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9921.740	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12402.490	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14883.240	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17363.990	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19844.740	---	---	---	---	---	---	---	74.0	54.0	---	---	---
22325.490	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24806.240	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : ReceivingFundamental Frequency : Local Frequency : 2480.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
* 2480.000	---	---	---	---	-2.8	---	---	74.0	54.0	---	---	---
* 4960.000	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
* 7440.000	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
* 9920.000	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
* 12400.000	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "****" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.1.2 Metal Antenna**A. CH Low**

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2405.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBUV)				Factor (dB) Corr.	Result @3m (dBUV/m)		Limit @3m (dBUV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
2404.970	100.1	***	93.6	***	-7.0	93.1	***	114.0	94.0	-0.9	66	1.0
4810.980	50.2	***	***	***	-0.2	50.0	***	74.0	54.0	-4.0	55	1.1
7216.990	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9623.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12029.010	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14435.020	---	---	---	---	---	---	---	74.0	54.0	---	---	---
16841.030	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19247.040	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21653.050	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24059.060	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : ReceivingFundamental Frequency : Local Frequency : 2405.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBUV)				Factor (dB) Corr.	Result @3m (dBUV/m)		Limit @3m (dBUV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V			Peak	Ave	Peak	Ave			
	Peak	Ave	Peak	Ave								
* 2405.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 4810.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 7215.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 9620.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 12025.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

B. CH Middle

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2440.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
2439.470	99.9	***	92.9	***	-7.0	92.9	***	114.0	94.0	-1.1	95	1.0
4879.650	49.6	***	52.6	***	0.1	52.7	48.9	74.0	54.0	-1.3	87	1.1
7319.830	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9760.010	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12200.190	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14640.370	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17080.550	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19520.730	---	---	---	---	---	---	---	74.0	54.0	---	---	---
21960.910	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24401.090	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : ReceivingFundamental Frequency : Local Frequency : 2440.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
* 2440.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 4880.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 7320.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 9760.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---
* 12200.000	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "***" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

C. CH High

Operation Mode : Transmitting, EUT orientation: keep flat horizontally

Fundamental Frequency : 2480.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
2480.430	99.2	***	92.1	***	-6.8	92.4	***	114.0	94.0	-1.6	77	1.1
4959.880	49.7	***	51.8	***	0.3	52.1	***	74.0	54.0	-1.9	74	1.0
7439.330	---	---	---	---	---	---	---	74.0	54.0	---	---	---
9918.780	---	---	---	---	---	---	---	74.0	54.0	---	---	---
12398.230	---	---	---	---	---	---	---	74.0	54.0	---	---	---
14877.680	---	---	---	---	---	---	---	74.0	54.0	---	---	---
17357.130	---	---	---	---	---	---	---	74.0	54.0	---	---	---
19836.580	---	---	---	---	---	---	---	74.0	54.0	---	---	---
22316.030	---	---	---	---	---	---	---	74.0	54.0	---	---	---
24795.480	---	---	---	---	---	---	---	74.0	54.0	---	---	---

Operation Mode : ReceivingFundamental Frequency : Local Frequency : 2480.000 MHzTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H Peak	V Ave	H Peak	V Ave		Peak	Ave	Peak	Ave			
* 2480.000	---	---	---	---	-2.8	---	---	74.0	54.0	---	---	---
* 4960.000	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
* 7440.000	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
* 9920.000	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
* 12400.000	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---

Note :

1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "****" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Remark "*" means the local oscillator frequency and its harmonics.
5. Item "Margin" referred to Average limit while there is only peak result.
6. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.2 Other Emissions

a) Emission frequencies below 1 GHz

Chip AntennaOperation Mode: Chip Ant

EUT orientation: keep flat horizontally

Test Date : Sep. 03, 2010

Temperature : 23 °C

Humidity : 50 %

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)
99.66	H	25.5	11.2	36.7	43.5	-6.8	197	1.5
123.69	V	27.8	13.1	40.9	43.5	-2.6	346	1.0
135.30	H	21.9	13.8	35.7	43.5	-7.8	18	1.4
181.74	H	20.7	16.6	37.3	43.5	-6.2	50	1.5
210.09	H	17.5	18.6	36.1	43.5	-7.4	234	1.0
245.46	H	18.8	20.0	38.8	46.0	-7.2	318	1.1

Metal AntennaOperation Mode: Metal Ant

EUT orientation: keep flat horizontally

Test Date : Sep. 03, 2010

Temperature : 23 °C

Humidity : 50 %

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)
129.09	V	13.5	14.9	40.1	43.5	-3.4	27	1.0
177.42	H	16.0	17.8	37.5	43.5	-6.0	158	1.5
181.74	H	16.6	18.7	38.5	43.5	-5.0	268	1.4
200.10	H	18.6	19.7	35.8	43.5	-7.7	278	1.5
240.33	H	19.7	21.4	36.3	46.0	-9.7	289	1.5
268.14	H	22.1	24.1	36.4	46.0	-9.6	263	1.2

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.

b) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured with a pre-amplifier of 35 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:

$$\textbf{Result} = \textbf{Reading} + \textbf{Corrected Factor}$$

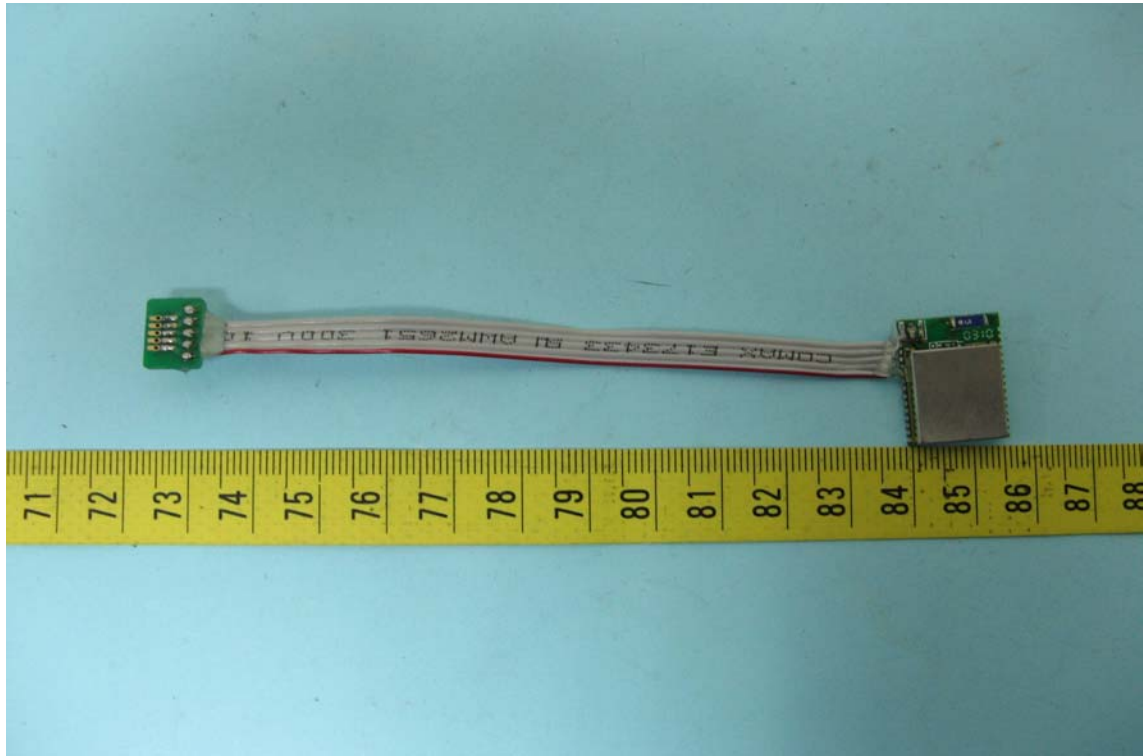
where Corrected Factor

$$= \text{Antenna FACTOR} + \text{Cable Loss} + \text{High Pass Filter Loss} - \text{Amplifier Gain}$$

4.6 Photos of Radiation Measuring Setup

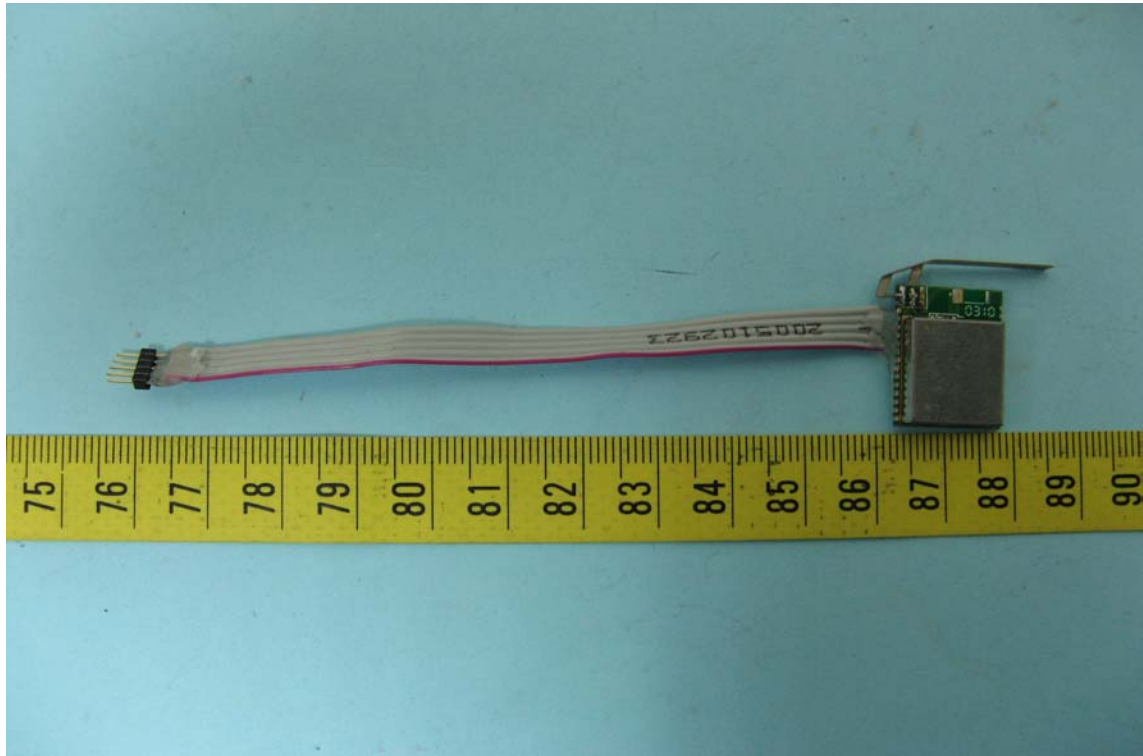
Chip Antenna





Metal Antenna





5 CONDUCTED EMISSION MEASUREMENT

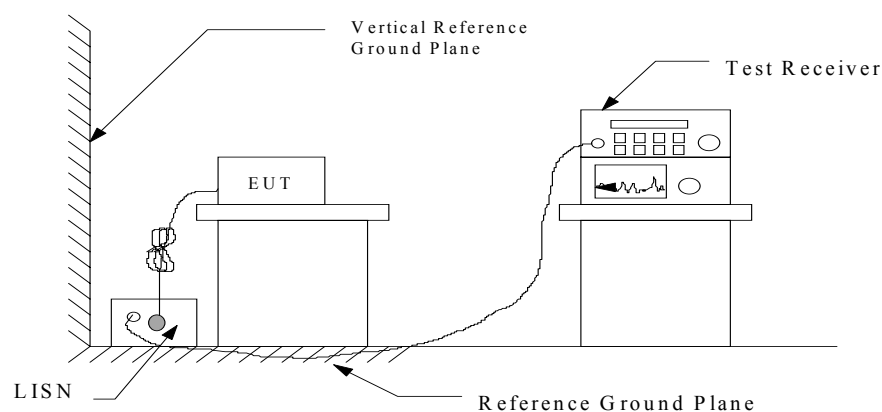
5.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to § 15.107(a) and § 15.207(a) respectively. Both Limits are identical specification.

5.2 Measurement Procedure

1. Setup the configuration per figure 3.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 6 or 8 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 3 : Conducted emissions measurement configuration



5.3 Conducted Emission Data

Chip Antenna

Operation Mode : Chip AntTest Date : Sep 03, 2010 Temperature : 23 °C Humidity : 53 %

Mode: Chip Ant

N1

Frequency (MHz)	Meter Reading (dBμV)		Factor (dB)	Result (dBμV)		Limit (dBμV)		Margin (dBμV)	
	Q.P	AVG		Q.P	AVG	Q.P	AVG	Q.P	AVG
0.173	53.4	----	0.4	53.8	----	64.8	54.8	-11.0	----
0.240	45.2	----	0.4	45.6	----	62.1	52.1	-16.5	----
0.361	36.3	----	0.4	36.7	----	58.7	48.7	-22.0	----
3.759	27.6	----	0.5	28.1	----	56.0	46.0	-27.9	----
4.037	28.3	----	0.5	28.8	----	56.0	46.0	-27.2	----
4.287	29.0	----	0.5	29.5	----	56.0	46.0	-26.5	----

Mode: Chip Ant

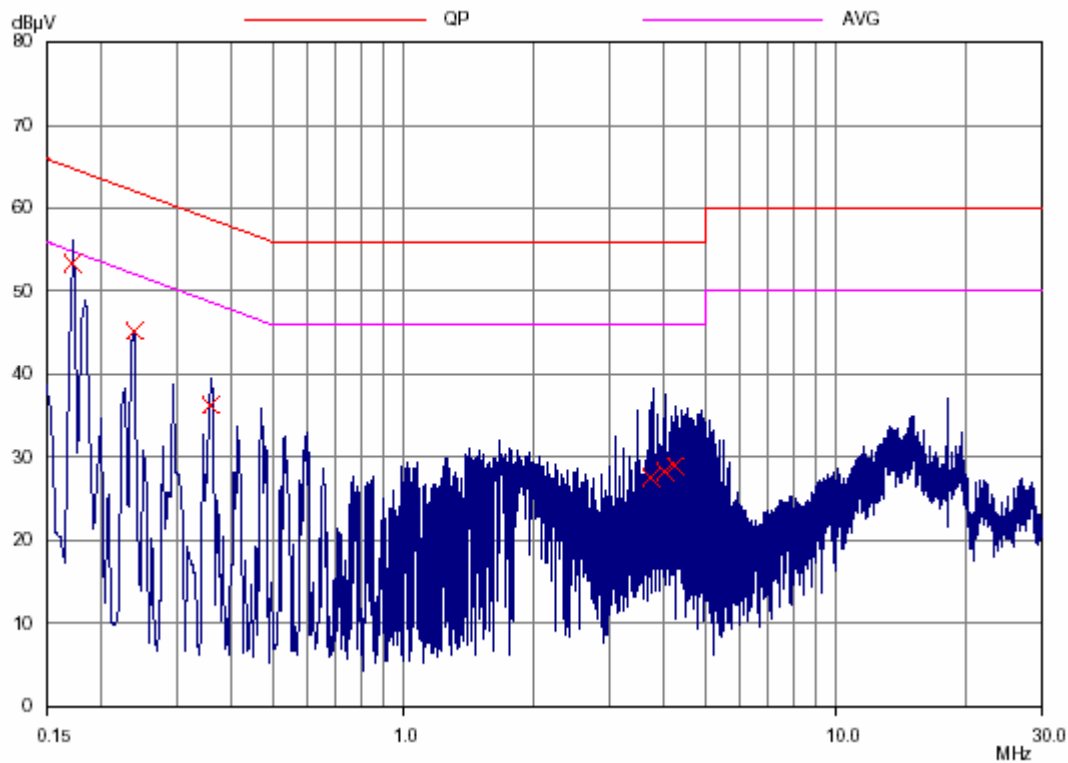
L1

Frequency (MHz)	Meter Reading (dBμV)		Factor (dB)	Result (dBμV)		Limit (dBμV)		Margin (dBμV)	
	Q.P	AVG		Q.P	AVG	Q.P	AVG	Q.P	AVG
0.170	45.0	----	0.3	45.3	----	65.0	55.0	-19.7	----
0.181	52.9	----	0.3	53.2	----	64.4	54.4	-11.2	----
0.240	44.0	----	0.3	44.3	----	62.1	52.1	-17.8	----
3.974	26.7	----	0.5	27.2	----	56.0	46.0	-28.8	----
4.275	28.3	----	0.5	28.8	----	56.0	46.0	-27.2	----
4.443	29.2	----	0.5	29.7	----	56.0	46.0	-26.3	----

Note : The expanded uncertainty of the conducted emission tests is 2.45 dB

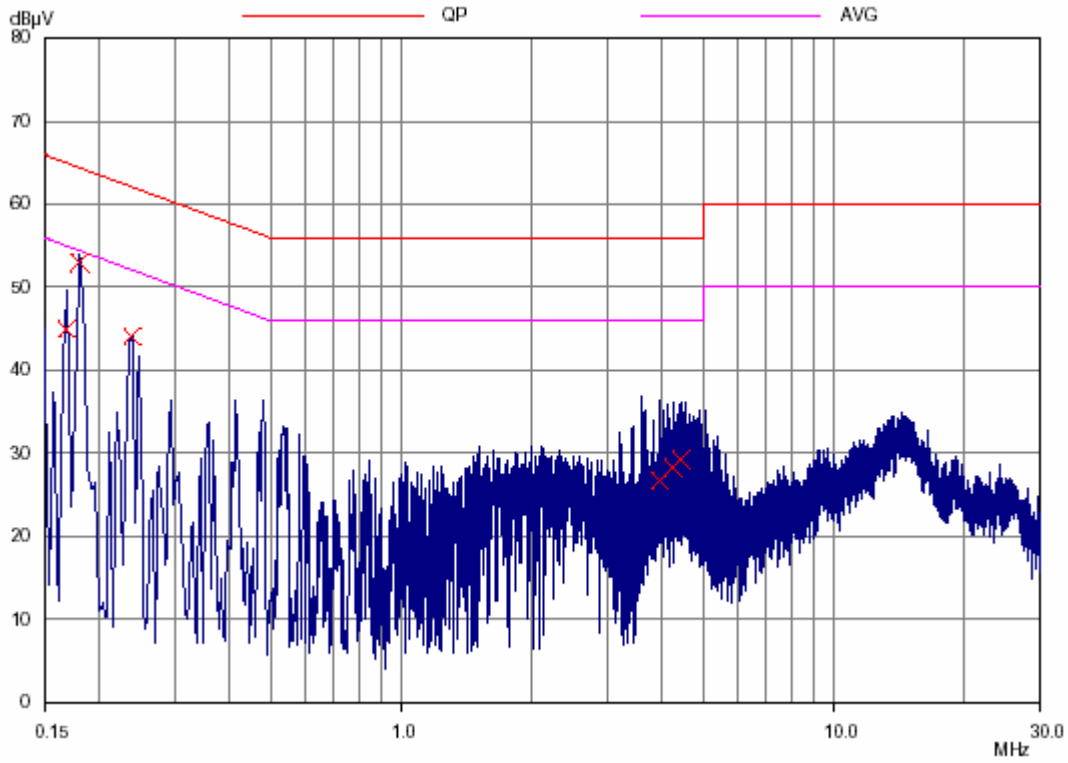
Mode: Chip Ant

N1



Mode: Chip Ant

L1



Metal AntennaOperation Mode : Metal AntTest Date : Sep 03, 2010 Temperature : 23 °C Humidity : 53 %

Mode: Flat Ant

N1

Frequency (MHz)	Meter Reading (dBμV)		Factor (dB)	Result (dBμV)		Limit (dBμV)		Margin (dBμV)	
	Q.P	AVG		Q.P	AVG	Q.P	AVG	Q.P	AVG
0.170	44.8	----	0.4	45.2	----	65.0	55.0	-19.8	----
0.177	52.8	----	0.4	53.2	----	64.6	54.6	-11.4	----
0.236	44.6	----	0.4	45.0	----	62.2	52.2	-17.2	----
0.248	37.6	----	0.4	38.0	----	61.8	51.8	-23.8	----
0.408	31.9	----	0.4	32.3	----	57.7	47.7	-25.4	----
0.545	31.6	----	0.4	32.0	----	56.0	46.0	-24.0	----

Mode: Flat Ant

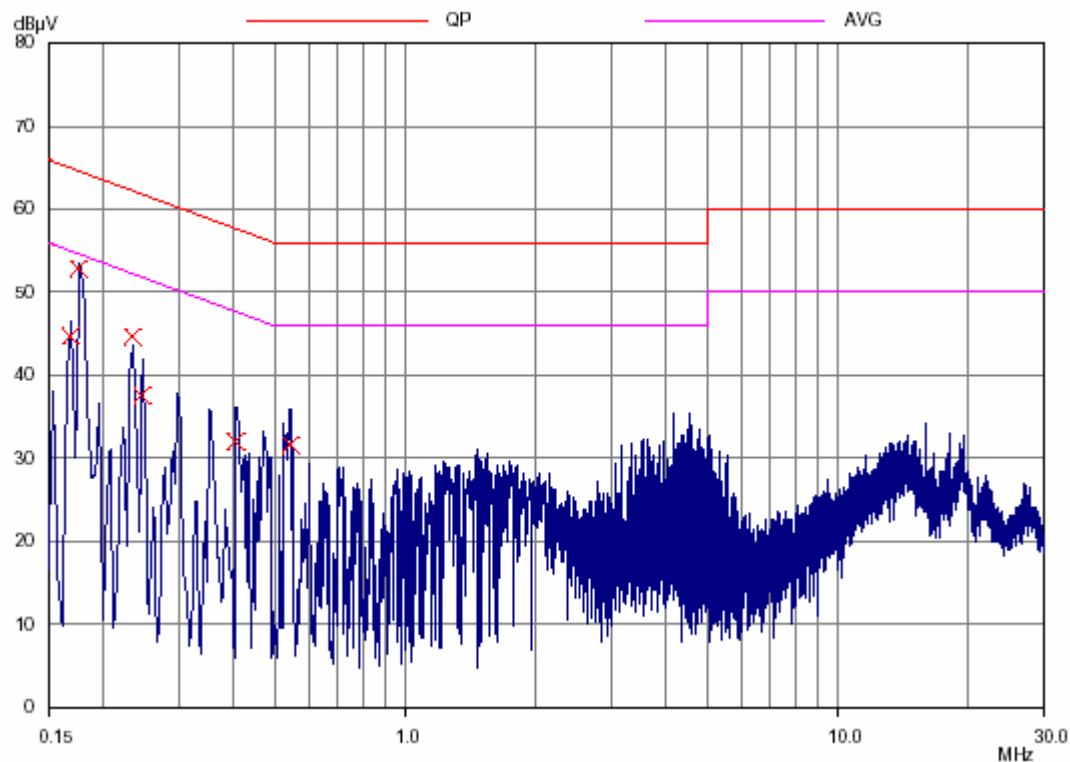
L1

Frequency (MHz)	Meter Reading (dBμV)		Factor (dB)	Result (dBμV)		Limit (dBμV)		Margin (dBμV)	
	Q.P	AVG		Q.P	AVG	Q.P	AVG	Q.P	AVG
0.181	52.4	----	0.3	52.7	----	64.4	54.4	-11.7	----
0.236	44.3	----	0.3	44.6	----	62.2	52.2	-17.6	----
0.533	33.3	----	0.4	33.7	----	56.0	46.0	-22.3	----
3.732	26.6	----	0.5	27.1	----	56.0	46.0	-28.9	----
3.927	26.7	----	0.5	27.2	----	56.0	46.0	-28.8	----
4.314	29.0	----	0.5	29.5	----	56.0	46.0	-26.5	----

Note : The expanded uncertainty of the conducted emission tests is 2.45 dB

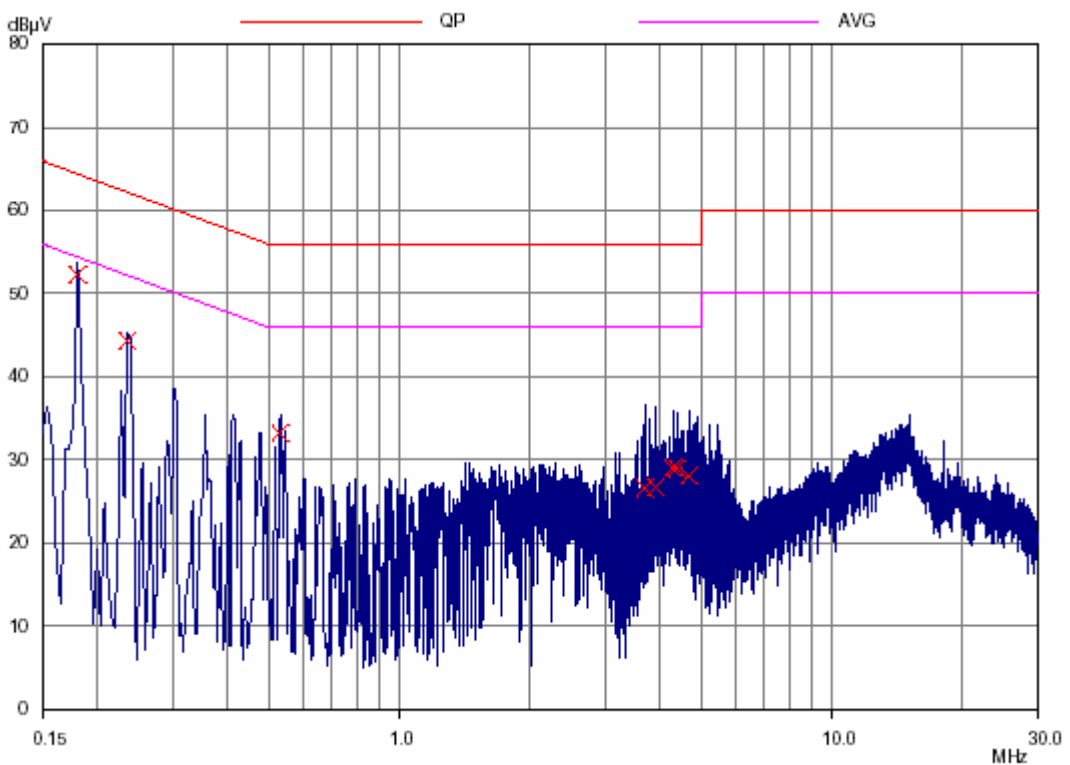
Mode: Flat Ant

N1



Mode: Flat Ant

L1



5.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

$$\text{RESULT} = \text{READING} + \text{LISN FACTOR}$$

Assume a receiver reading of 22.5 dB μ V is obtained, and LISN Factor is 0.1 dB, then the total of disturbance voltage is 22.6 dB μ V.

$$\text{RESULT} = 22.5 + 0.1 = 22.6 \text{ dB } \mu \text{ V}$$

$$\begin{aligned} \text{Level in } \mu \text{ V} &= \text{Common Antilogarithm}[(22.6 \text{ dB } \mu \text{ V})/20] \\ &= 13.48 \mu \text{ V} \end{aligned}$$

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCI	2010/02/03	2011/02/02
LISN	EMCO	3625/2	2010/02/08	2011/02/07
LISN	Rohde & Schwarz	ESH2-Z5	2010/08/10	2011/08/09

5.6 Photos of Conduction Measuring Setup

Chip Antenna



Metal Antenna



6 ANTENNA REQUIREMENT

6.1 Standard Applicable

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.

6.2 Antenna Construction

The antenna was integrated on the main PCB and no consideration of replacement. There are two antenna used: (1) SMD type antenna with 4dBi antenna gain and, (2) PIFA antenna with 2 dBi antenna gain. Please refer to Exhibits L for antenna specifications.

7 BAND EDGES MEASUREMENT

7.1 Standard Applicable

According to 15.249(c), out band emission except for harmonics shall be comply with § 15.209 or at least attenuated by 50 dB below the level of the fundamental.

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 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. 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.
4. Repeat above procedures until all measured frequencies were complete.

7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Test Receiver	Rohde & Schwarz	ESCI	2010/02/03	2011/02/02
Spectrum	Advantest	R3162	2010/03/01	2011/02/28
Bi-Log Antenna	Schaffner	CBL 6111	2010/05/21	2011/05/20
Log-periodic Antenna	EMCO	3146	2009/09/30	2010/09/29
Biconical Antenna	EMCO	3110B	2009/09/22	2010/09/21
Double Ridged Antenna	EMCO	3115	2010/05/11	2011/05/10
Amplifier	HP	8449B	2009/12/16	2010/12/15
Amplifier	HP	83051A	2010/05/10	2011/05/09
Amplifier	HP	8447D	2009/10/01	2010/09/30
Spectrum	Rohde & Schwarz	FSP40	2009/09/10	2010/09/09

7.4 Measurement Data

Test Result:

1. *Lower band edge: Emission radiated outside of the lower band edge which is not attenuated by at least 50dB below the level of the fundamental was found comply with §15.209.*
2. *Upper band edge: Emission radiated outside of the lower band edge which is not attenuated by at least 50dB below the level of the fundamental was found comply with §15.209.*

Note : The expanded uncertainty of the band edges tests is 1000Hz.

Radiated Emission Test Results of the Band Edges**(1) Chip Antenna**Operation Mode : TransmittingTest Date : Sep. 02, 2010 Temperature : 21 °C Humidity : 65 %**Operation Mode : CH Low**

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V									
	Peak	Ave	Peak	Ave		Peak	Ave	Peak	Ave			
2384.300	48.5	***	47.9	***	-7.1	41.4	***	74.0	54.0	-32.6	54	1.1
2387.900	48.6	***	47.8	***	-7.1	41.5	***	74.0	54.0	-32.5	33	1.0

Operation Mode : CH High

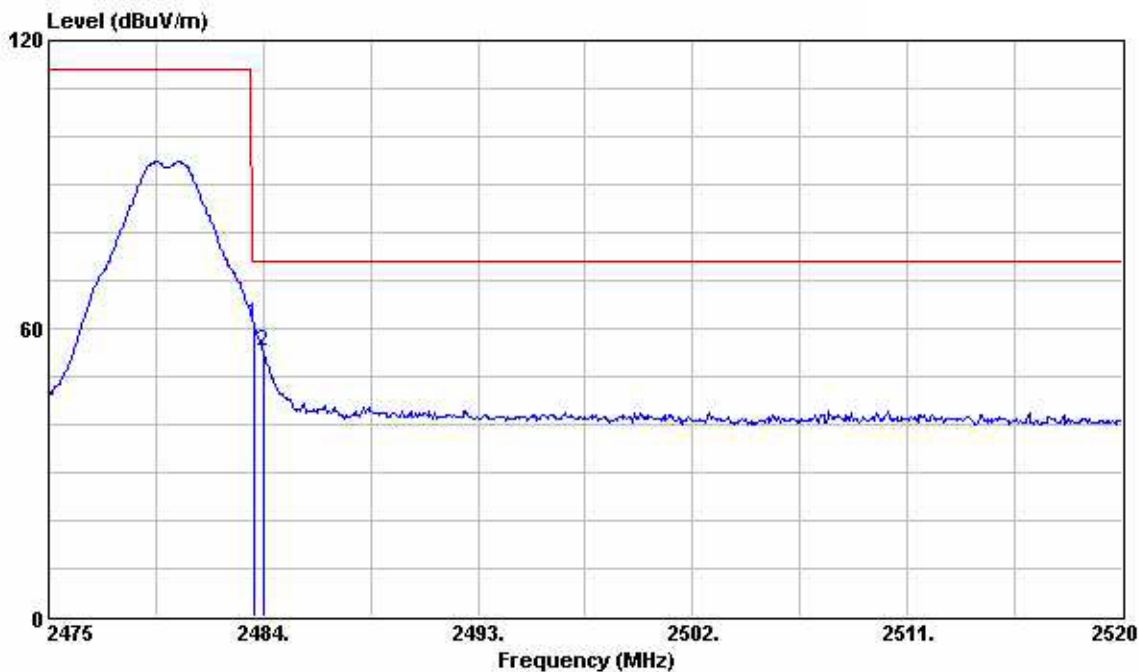
Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V									
	Peak	Ave	Peak	Ave		Peak	Ave	Peak	Ave			
2483.600	67.6	55.0	64.9	54.7	-6.8	60.8	48.2	74.0	54.0	-5.8	92	1.2
2484.010	61.9	50.6	60.8	50.0	-6.8	55.1	43.8	74.0	54.0	-10.8	79	1.5

Note :

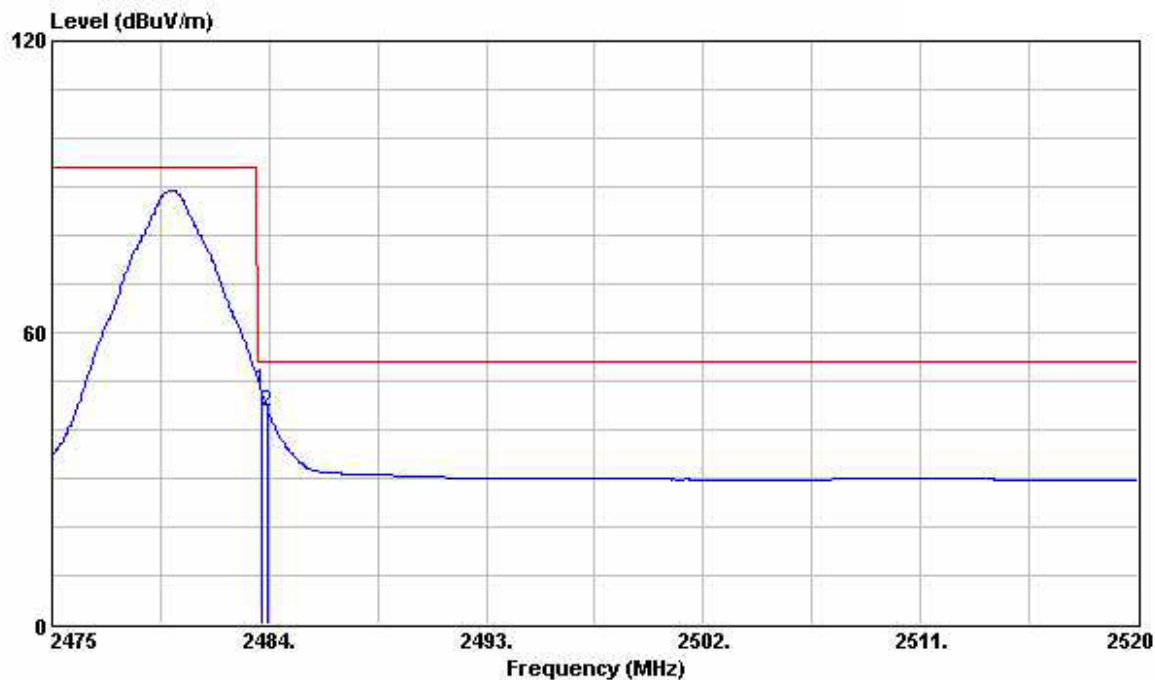
1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark “***” means that Peak result is meet average limit.
3. Remark “---” means that the emissions level is too low to be measured.
4. Item “Margin” referred to Average limit while there is only peak result.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

Mode: Chip Antenna

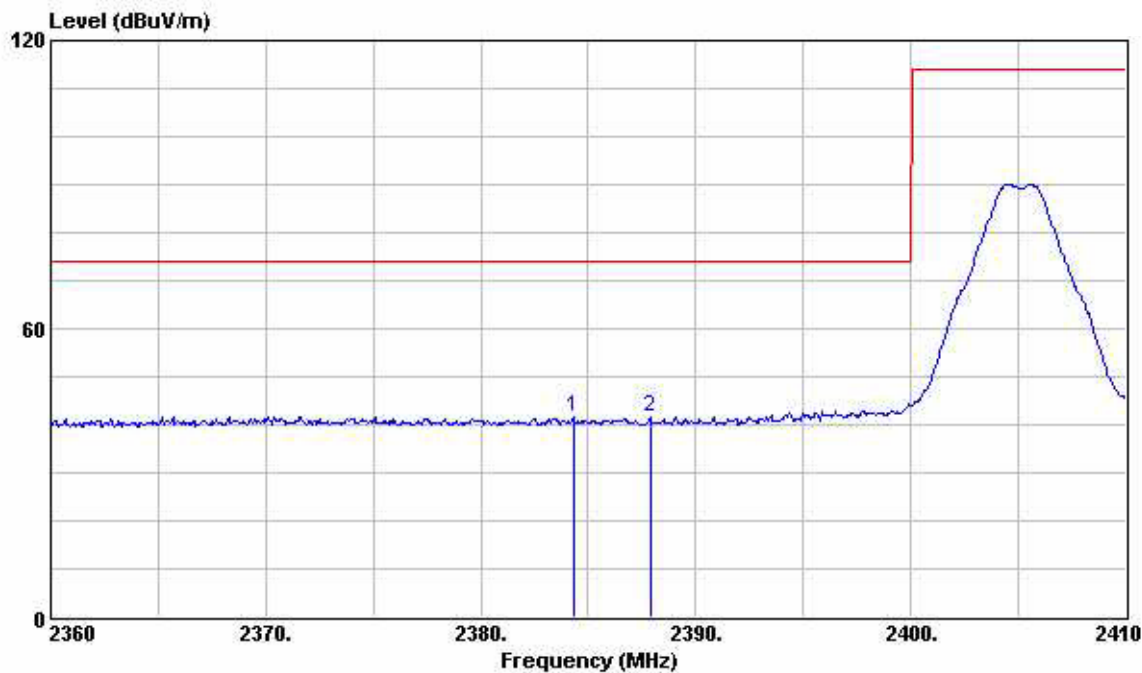
Data#: 2996 File#: D:\e3\FCC諧波.emi



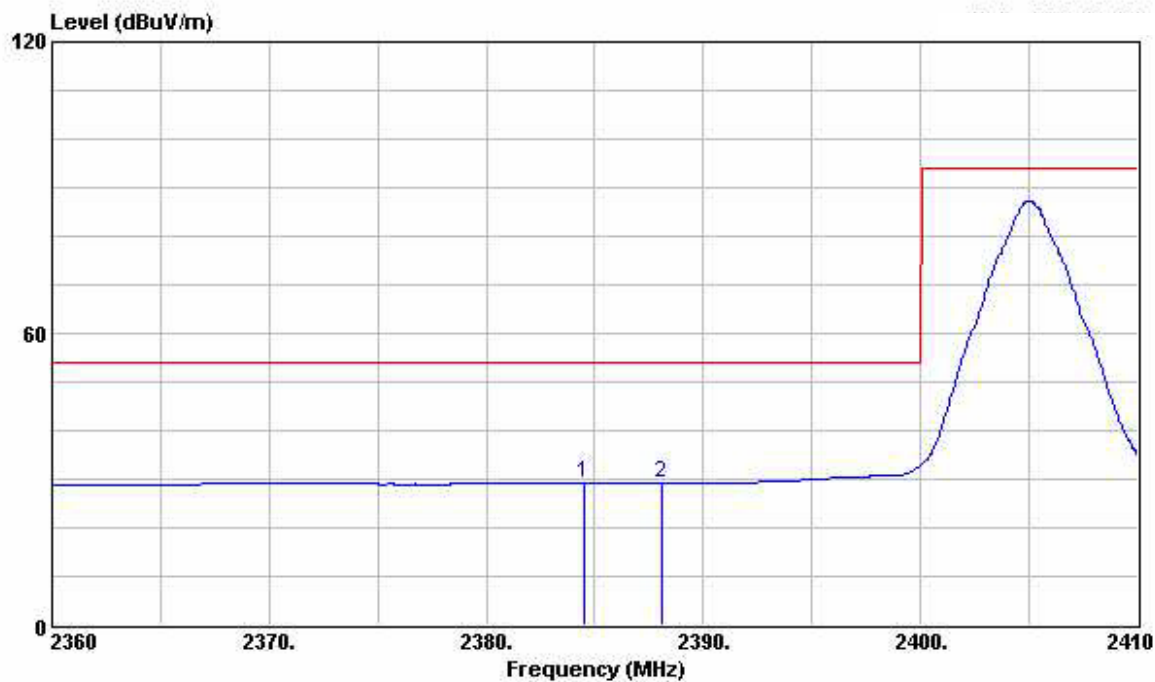
Data#: 2997 File#: D:\e3\FCC諧波.emi



Data#: 2998 File#: D:\e3\FCC諧波.emi



Data#: 2999 File#: D:\e3\FCC諧波.emi



(2) Metal AntennaOperation Mode : TransmittingTest Date : Sep. 02, 2010 Temperature : 24 °C Humidity : 53 %**Operation Mode : CH Low**

Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V									
	Peak	Ave	Peak	Ave		Peak	Ave	Peak	Ave			
2374.300	49.6	***	49.3	***	-7.1	42.5	***	74.0	54.0	-11.5	83	1.0
2382.950	50.8	***	50.4	***	-7.1	43.7	***	74.0	54.0	-10.3	69	1.1

Operation Mode : CH High

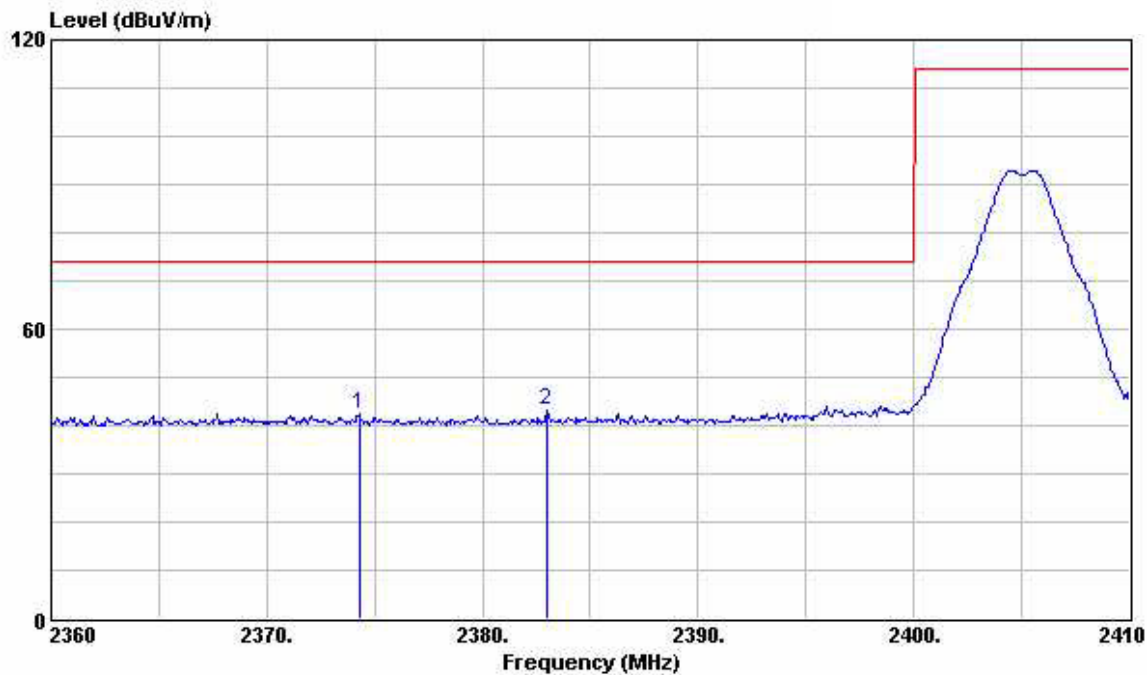
Frequency (MHz)	Reading (dBuV)				Factor (dB) Corr.	Result @3m (dBuV/m)		Limit @3m (dBuV/m)		Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
	H		V									
	Peak	Ave	Peak	Ave		Peak	Ave	Peak	Ave			
2483.870	60.7	54.0	58.2	52.3	-6.8	53.9	47.2	74.0	54.0	-6.8	66	1.0
2484.180	56.2	***	***	***	-6.8	49.4	***	74.0	54.0	-4.6	53	1.1

Note :

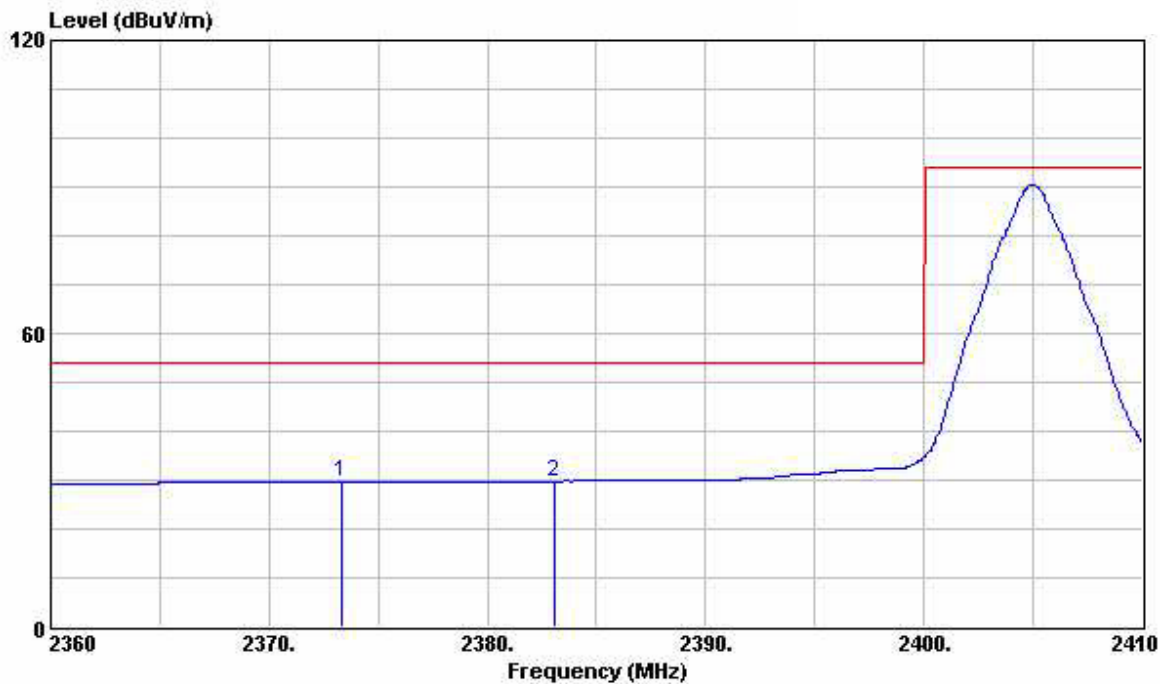
1. Item of margin shown in above table refer to average limit.
2. It is considered that the results of average comply with average limit when measuring data with a peak function detector meet the average limit. Mark "****" means that Peak result is meet average limit.
3. Remark "---" means that the emissions level is too low to be measured.
4. Item "Margin" referred to Average limit while there is only peak result.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

Mode: Metal Antenna

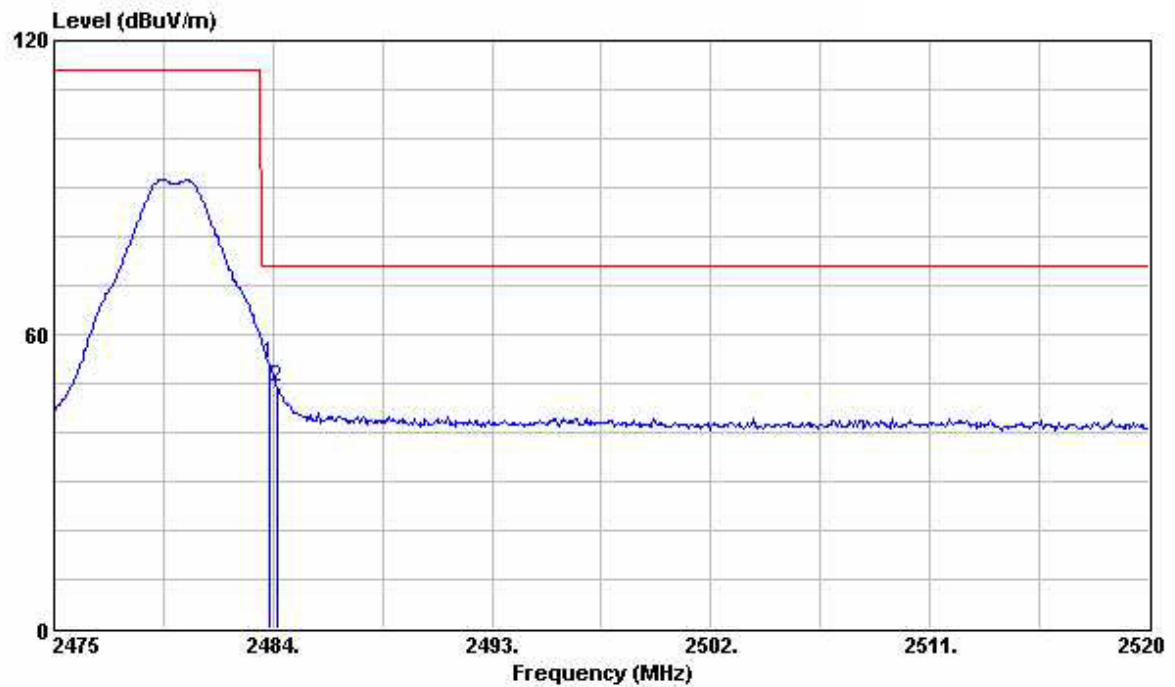
Data#: 2992 File#: D:\e3\FCC諧波.emi



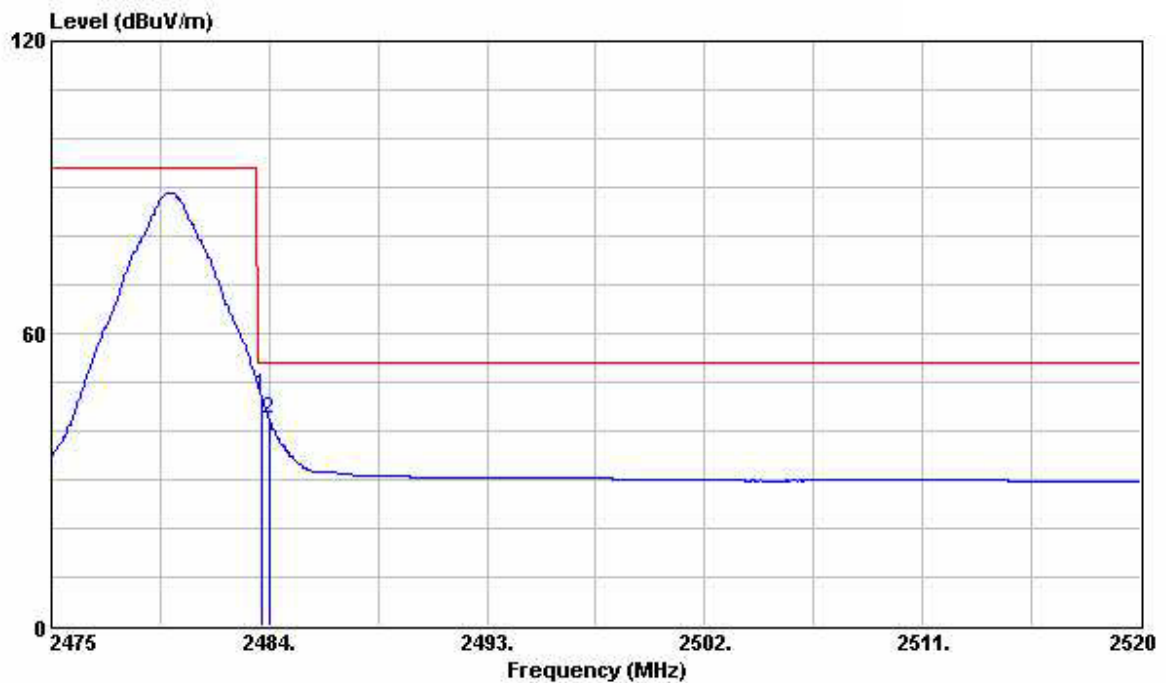
Data#: 2993 File#: D:\e3\FCC諧波.emi



Data#: 2994 File#: D:\e3\FCC諧波.emi



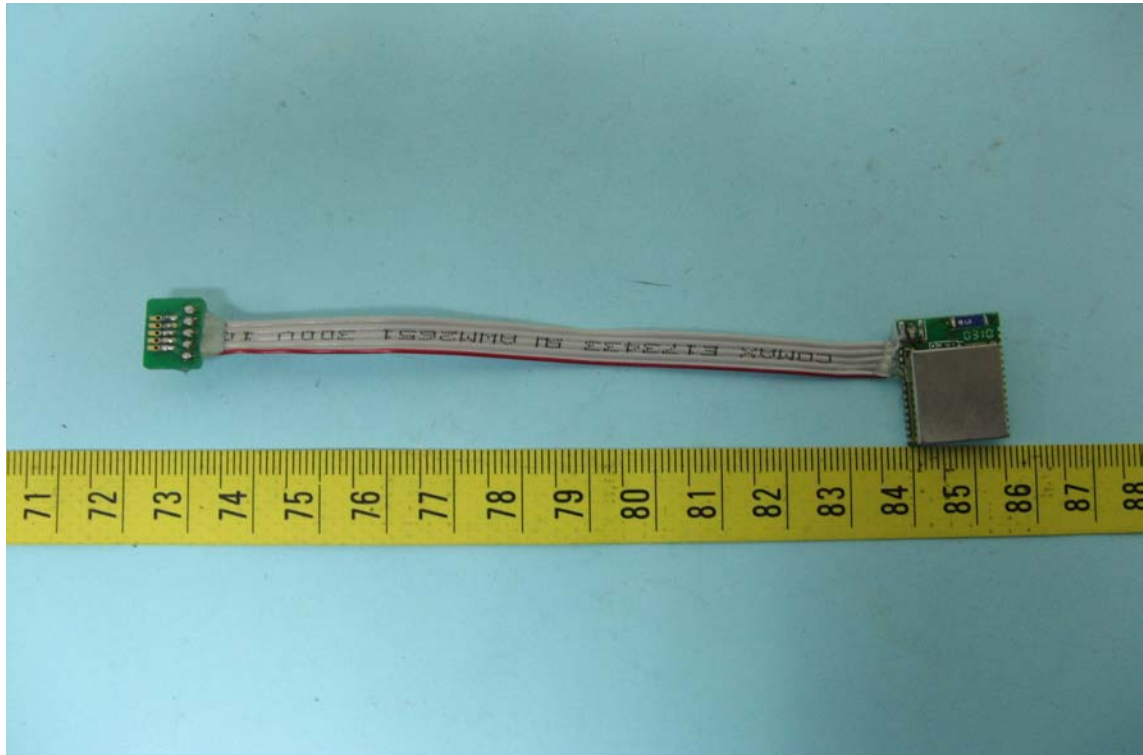
Data#: 2995 File#: D:\e3\FCC諧波.emi



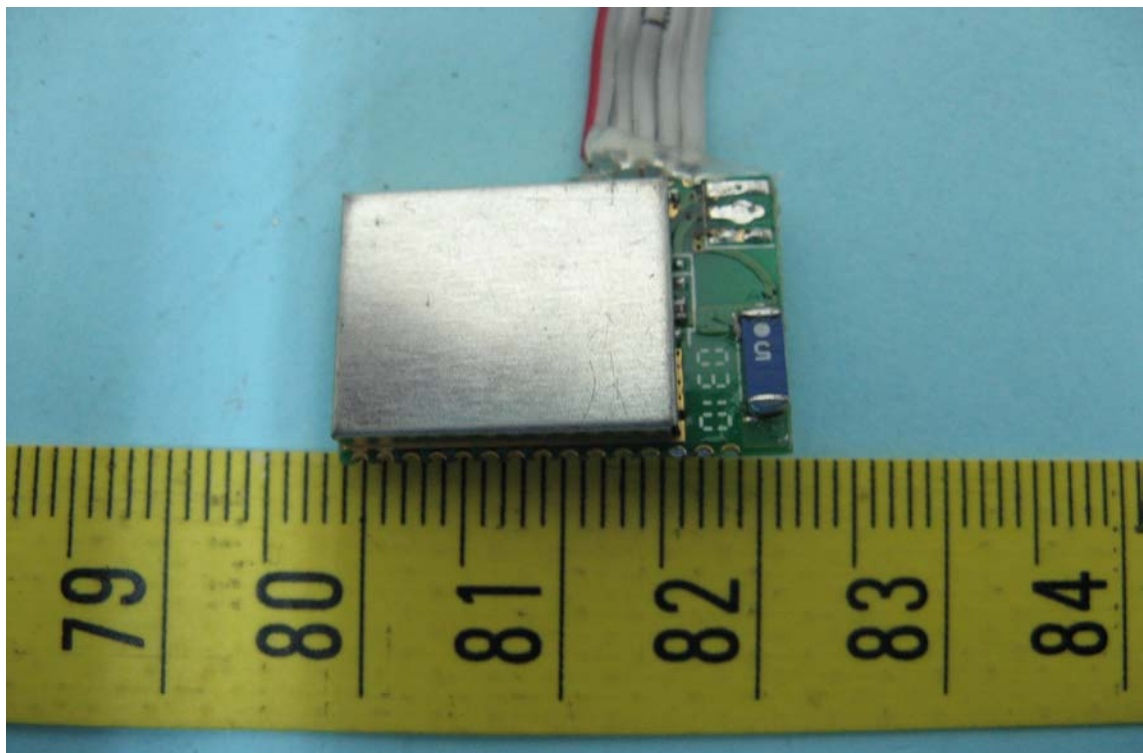
CONSTRUCTED PHOTOS of EUT

Chip Antenna

1. Total View of EUT

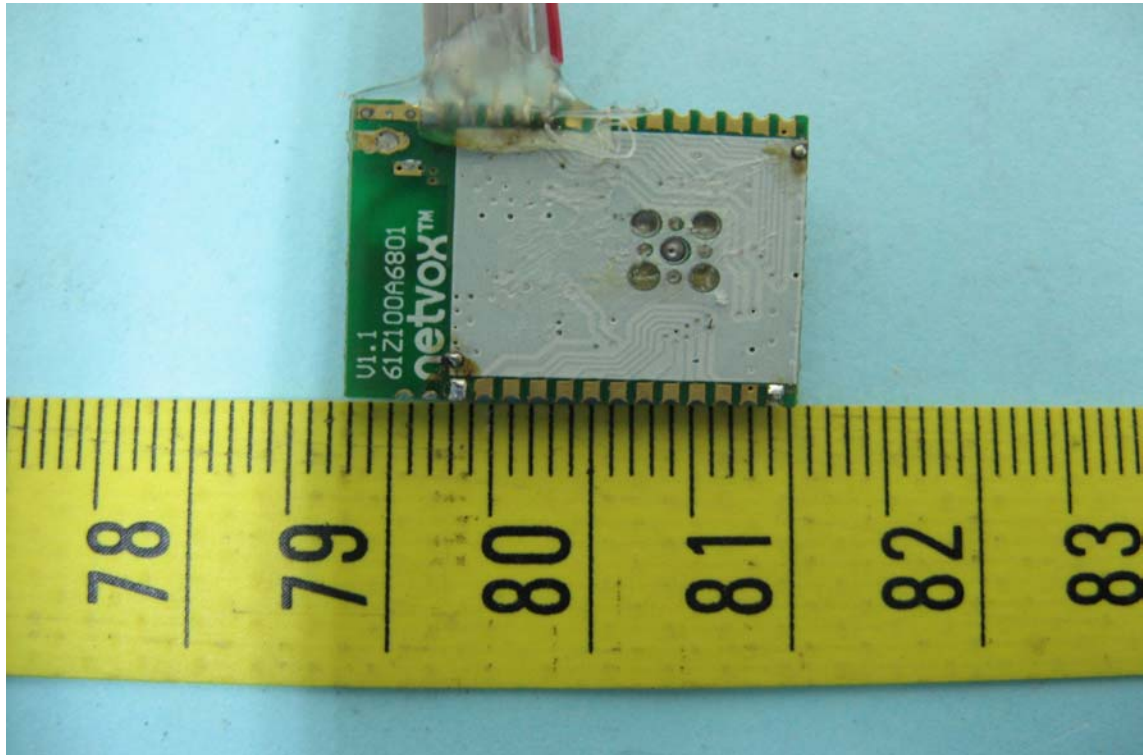


2. Top View of EUT

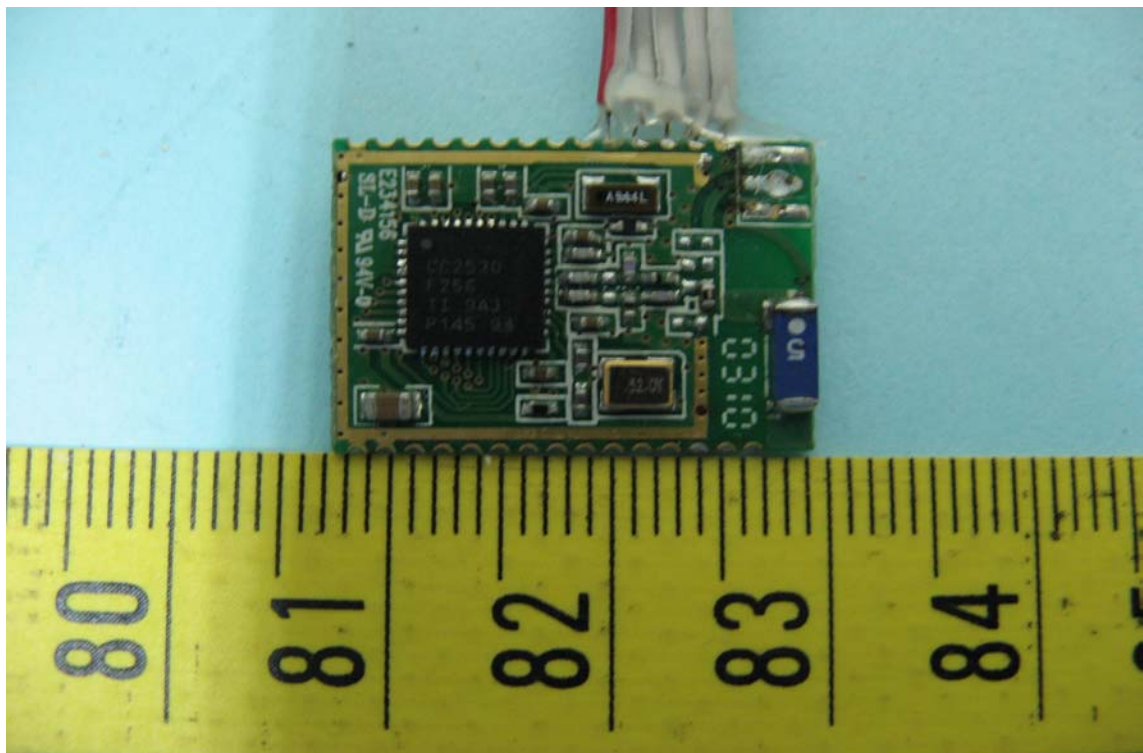


CONSTRUCTED PHOTOS of EUT

3. Bottom View of EUT



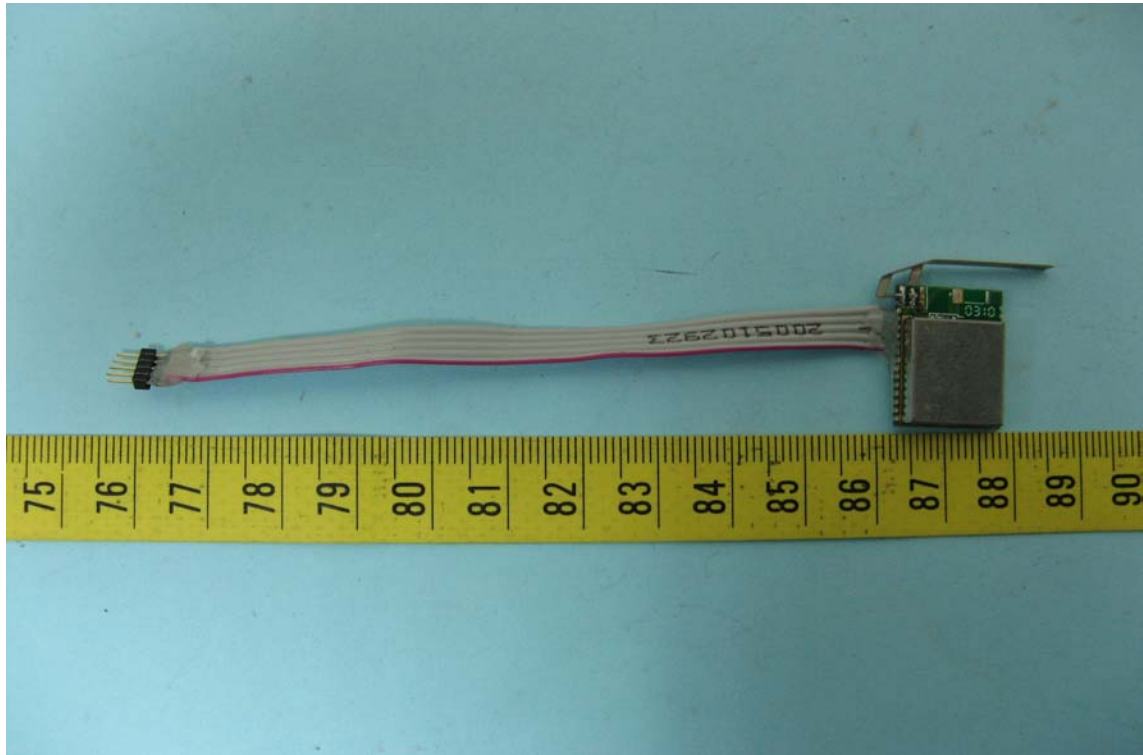
4. Component View of PCB



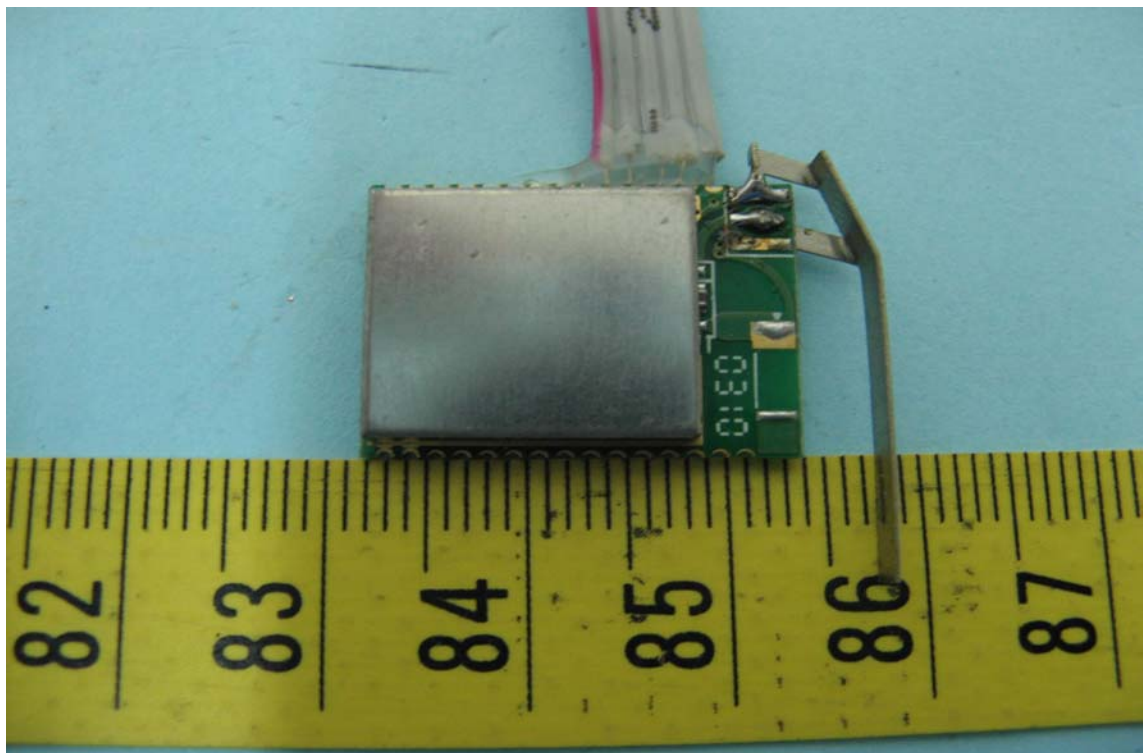
CONSTRUCTED PHOTOS of EUT

Metal Antenna

1. Total View of EUT

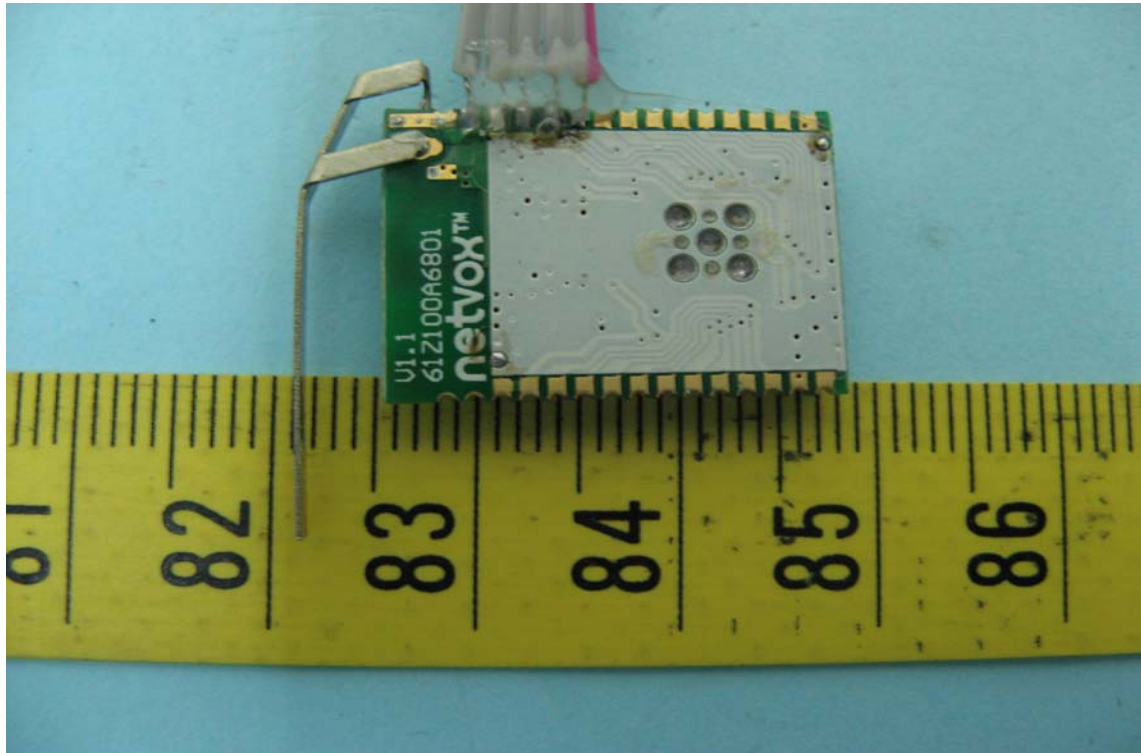


2. Top View of EUT



CONSTRUCTED PHOTOS of EUT

3. Bottom View of EUT



4. Component View of PCB

