



 <b>ESTECH Co., Ltd.</b> Rm 1015, World Venture Center II, 426-5 Gasan-dong, Guncheon-gu, Seoul, 158-803, Korea	   		<b>Electromagnetic Interference Test Report</b>

# Test Report for FCC

FCC ID:W6H-24GHZDSM

Report Number		ESTF150903-005		
Applicant	Company name	PROELECOM CO.,LTD.		
	Address	#964-1 SINWALL-DONG YANGCHEON-GU SEOUL KOREA		
	Telephone	82-2-2607-0846		
Product	Product name	REMOCON RH PCB A'SSY		
	Model No.	2.4GHZ-DSM	Manufacturer	PROELECOM CO.,LTD.
	Serial No.	None	Country of origin	KOREA
Test date	2009-02-20 - 2009-3-2		Date of issue	5-Mar-09
Testing location	ESTECH. Co., Ltd. 97-1 Hoiuk-Ri Majang-Myon, Icheon-city, KyungKi-Do, Korea			
Standard	FCC PART 15 2007 , ANSI C 63.4 2003			
Measurement facility registration number		94696		
Tested by	Senior Engineer H.H.Lee  (Signature)			
Reviewed by	Engineering Manager J.M.Yang  (Signature)			
Abbreviation	OK, Pass = Passed, Fail = Failed, N/A = not applicable			
* Note - This test report is not permitted to copy partly without our permission - This test result is dependent on only equipment to be used - This test result based on a single evaluation of one sample of the above mentioned				

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## 1. Laboratory Information

### 1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.

ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.

ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

### 1.2 Test Lab.

Corporation Name : ESTECH Co. Ltd

Head Office : Rm 1015, World Venture Center II, 426-5, Gasan-dong, Geumcheon-gu, Seoul, Korea  
(Safety & Telecom. Test Lab)

EMC Test Lab : 58-1 Osan-Ri, GaNam-Myon, YeoJoo-Gun, KyungKi-Do, Korea  
97-1 Hoiuk-Ri Majang-Myon, Icheon-city, KyungKi-Do, Korea

### 1.3 Official Qualification(s)

KCC : Granted Accreditation from Ministry of Information & Communication for EMC, Safety and Telecommunication

KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements

FCC : Filed Laboratory at Federal Communications Commission

VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

## 2. Description of EUT

### 2.1 Summary of Equipment Under Test

Product Name	: REMOCON RH PCB A'SSY
Model Number	: 2.4GHZ - DSM
Modulation Type	: ZigBee(DSSS)
Transfer Rate	: up to 250kbps
Number of Channel	: 16
Channel Spacing	: 5MHz
Serial Number	: NONE
Manufacturer	: PROELECTRON CO.,LTD.
Country of origin	: KOREA
Rating	: 4.5 Vd.c.(battery power)
X - tal list	: 32MHz
Receipt Date	: 2009 - 02 - 17

### 2.2 General descriptions of EUT

This device fully compatible with the DSSS standard to provide a wireless data rate of 250kbps. For the detailed features, please refer to the manufacturer's specifications or User's Manual.

### 3. Test Standards

#### Test Standard : FCC PART 15 (2007)

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

#### Test Method : ANSI C 63.4 (2003)

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain devices that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment. These methods apply to the measurement of individual units or systems comprised of multiple units.

#### Summary of Test Results

Applied Standard : 47 CFR Part 15, Subpart C				
Standard	Test Type	Result	Remark	Limit
15.207	AC Power Conducted Emission	N/A	Meet the requirement	
15.209	Radiated Emission	Pass	Meet the requirement	
15.247(a)(2)	Spectrum Bandwidth of a DSSS System	Pass	Meet the requirement	Min. 500kHz
15.247(b)	Maximum Peak output power	Pass	Meet the requirement	Max. 30dBm
15.247(c)	Transmitter Radiated Emission	Pass	Meet the requirement	Table 15.209
15.247(d)	Power Spectral Density	Pass	Meet the requirement	Max. 8dBm
15.247(c)	Band Edge Measurement	Pass	Meet the requirement	20dB less

## 4. Measurement Condition

### 4.1 EUT Operation(ZigBee)

#### a. Channel

Ch.	Frequency	Ch.	Frequency
11	2405MHz	19	2445MHz
12	2410MHz	20	2450MHz
13	2415MHz	21	2455MHz
14	2420MHz	22	2460MHz
15	2425MHz	23	2465MHz
16	2430MHz	24	2470MHz
17	2435MHz	25	2475MHz
18	2440MHz	26	2480MHz

b. Measurement Channel : ZigBee: Low(2405MHz), Middle(2445MHz),High(2480MHz)

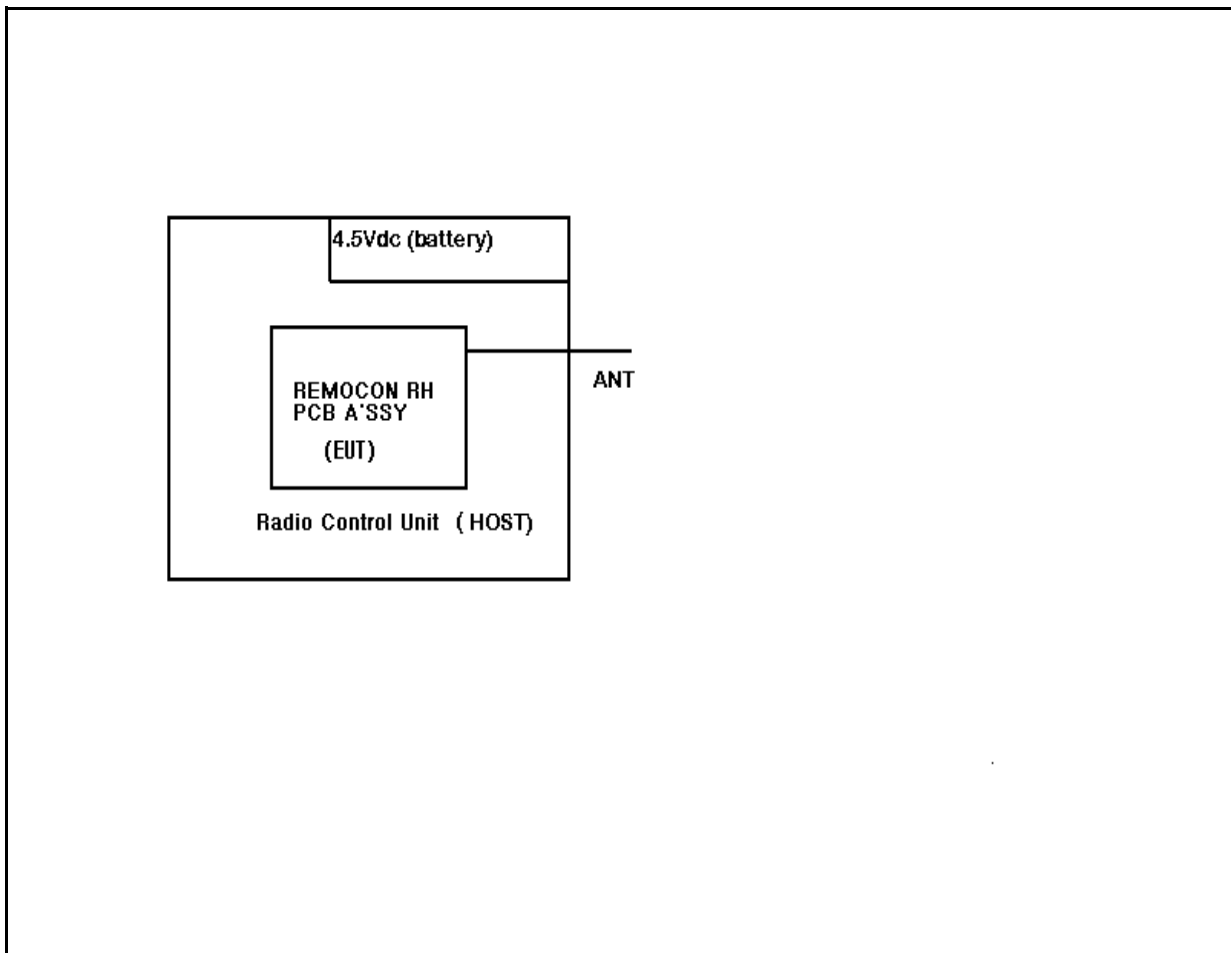
c. Test Mode : Continuous Output, DSSS

d. Test rate : the worst case of rate 250kbps

## 4.2 EUT Operation.

- \* The EUT was in the following operation mode during all testing
- \* The operational conditions of the EUT was determined by the manufacturer according to the typical use of the EUT with respect to the expected highest level of emission
- \* The EUT under transmission/receiving condition continuously at specific channel frequency.

## 4.3 Configuration and Peripherals



#### 4.4 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark (FCC ID)
REMOCON RH PCB A'SSY	2.4GHZ-DSM	NONE	PROELECTRON CO.,LTD.	EUT
Radio Control Unit	CREST CRE 5700	NONE	PROELECTRON CO.,LTD.	Host for EUT

#### 4.5 Cable Connecting

Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
REMOCON RH PCB A'SSY	Connector	Radio Control Unit	Connector	0	Unshielded	



## 5. 6dB Bandwidth Measurement

### 5.1 Test procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measured by spectrum analyzer. The 6dB bandwidth is defined as the bandwidth at 6dB below from peak power point. The minimum of 6dB bandwidth measurement is 0.5MHz.

### 5.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- . RBW= 100KHz
- . VBW= 100KHz
- . Span= 20MHz
- . Sweep= suitable duration based on the EUT specification.

#### 6dB Bandwidth Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4407B	US42041281	2009-09-11
RF Cable	Length: 20cm	-	
- Spectrum Analyzer <=> EUT	Loss: 1.0dB	-	

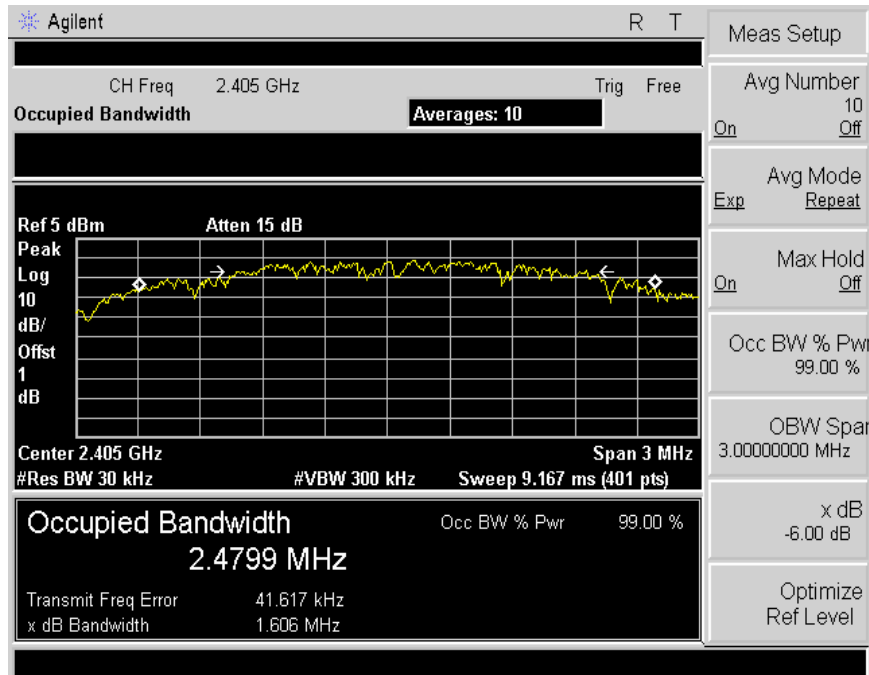
### 5.3 Measurement results

EUT	REMOCON RH PCB A'SSY	MODEL	2.4GHZ-DSM
MODE	DSSS	ENVIRONMENTAL CONDITION	24 , 44%RH
INPUT POWER			

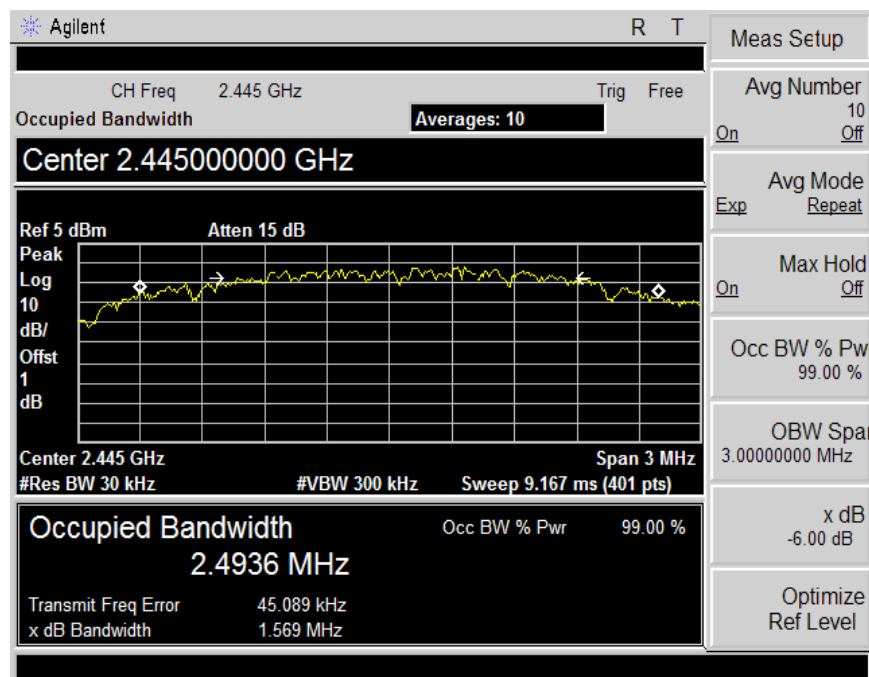
CHANNEL	Channel Frequency (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
11	2405	1.61	0.5	PASS
19	2445	1.57	0.5	PASS
26	2480	1.59	0.5	PASS

## 5.4 Trace data

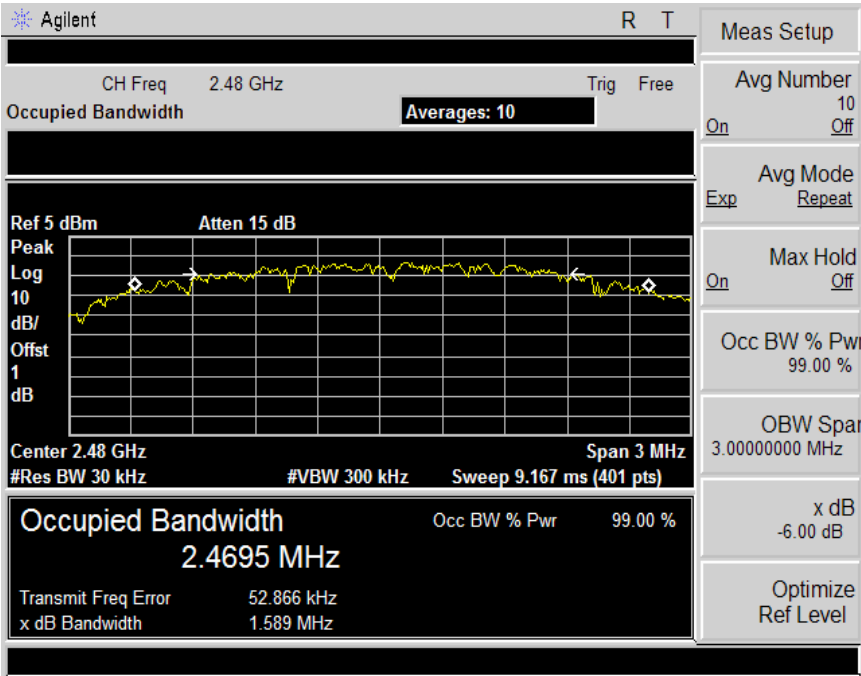
### 11ch



### 19ch



26ch



## 6. MAXIMUM PEAK OUTPUT POWER

### 6.1 Test procedure

The transmitter antenna terminal is connected to the input of a RF power sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30dBm.

#### Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	EPM-442A	GB37170412	2009-10-13
Power Sensor	8481A	3318A96476	2009-10-13
RF Cable:	Length: 20cm	-	
-Spectrum Analyzer <=> EUT	Loss: 1.0dB	-	

### 6.2 Measurement results

EUT	REMOCON RH PCB A'SSY	MODEL	2.4GHZ -DSM
MODE	DSSS	ENVIRONMENTAL CONDITION	24 , 43%RH
INPUT POWER			

CHANNEL	Channel Frequency (MHz)	Peak Power Output(dBm)		Limit[1W] (dBm)	PASS/FAIL
		(dBm)	(W)		
11	2405	3.1	0.002	30.0	PASS
19	2445	2.5	0.002	30.0	PASS
26	2480	1.9	0.002	30.0	PASS

## 7. Transmitter power spectral density

### 7.1 Test procedure

The peak power density was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The maximum of power spectral density measurement is 8dBm.

### 7.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- . RBW= 3KHz
- . VBW= 30KHz
- . Span= 1.5MHz
- . Sweep= 500 seconds (It is allowed to be longer than span/3kHz.)

#### The peak power density Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4407B	US42041281	2009-09-11
RF Cable	Length: 20cm	-	
-Spectrum Analyzer <=> EUT	Loss: 1.2dB	-	

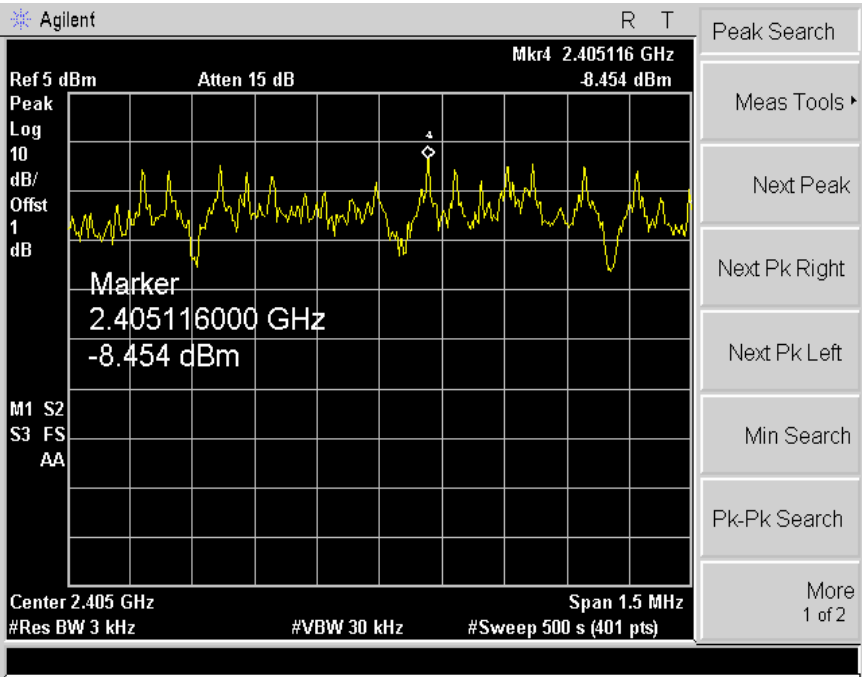
### 7.3 Measurement results

EUT	REMOCON RH PCB A'SSY	MODEL	2.4GHZ - DSM
MODE	DSSS	ENVIRONMENTAL CONDITION	23 , 43%RH
INPUT POWER			

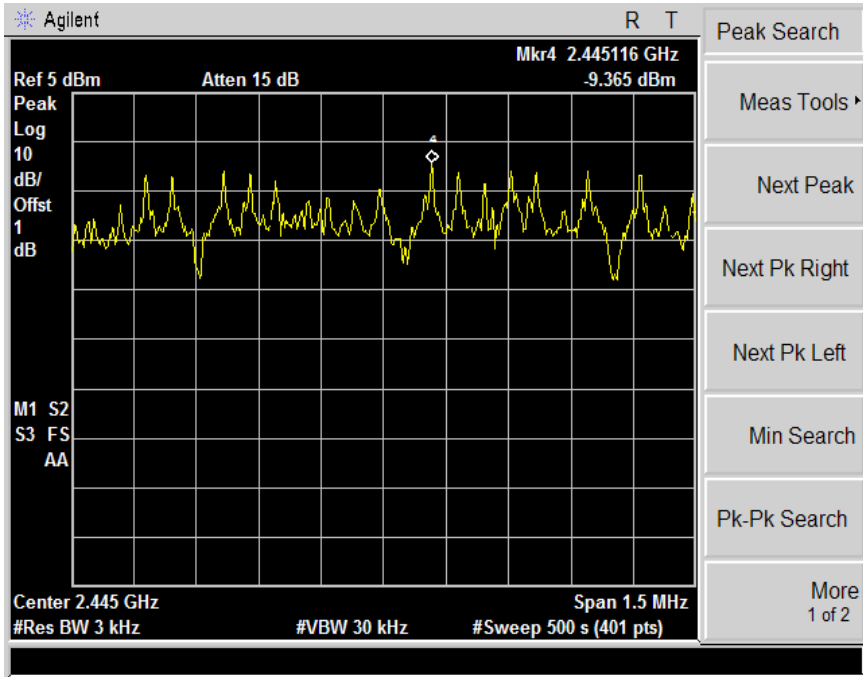
  

CHANNEL	Channel Frequency (MHz)	RF Power Spectral Density (dBm)	Maximum Limit (dBm)	PASS/FAIL
11	2405	-8.45	8.0	PASS
19	2445	-9.37	8.0	PASS
26	2480	-10.18	8.0	PASS

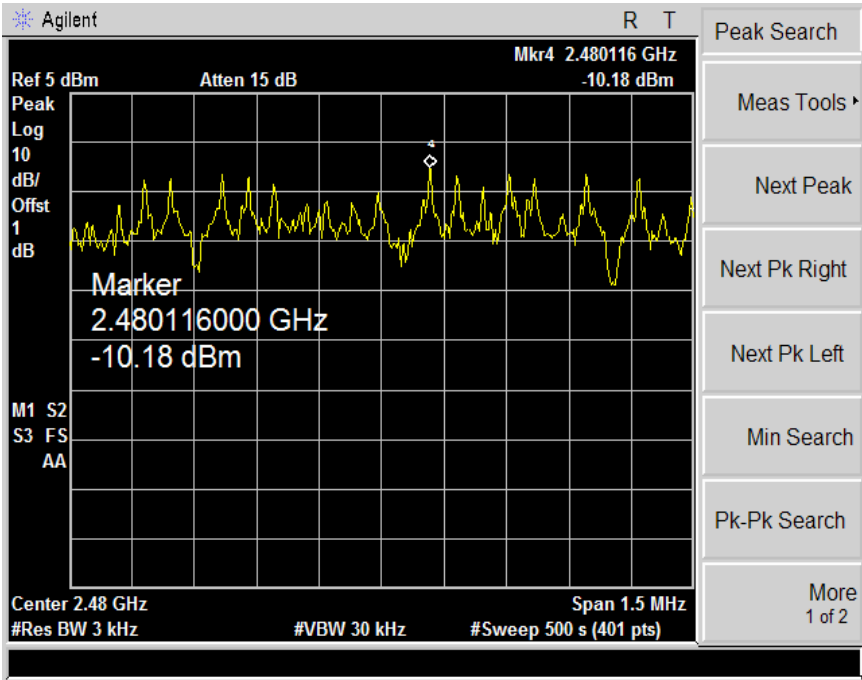
7.4 Trace data  
11ch



19ch



26ch



## 8. band-edge and out of band emissions.

### 8.1 Test procedure

The radio frequency power at 20dB down from the highest inband power level is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The band edge&out of band emission shall be at least 20dB below of the highest inband power level.

### 8.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- . RBW= 100KHz
- . VBW= 100KHz
- . Span= suitable frequency span
- . Sweep= suitable duration based on the EUT specification.

#### Band Edge&Out of Emission Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4407B	US42041281	2009-09-11
RF Cable	Length: 20cm		-
-Spectrum Analyzer <=> EUT	Loss: 1.0dB		-

### 8.3 Measurement results of band-edge & out of emission

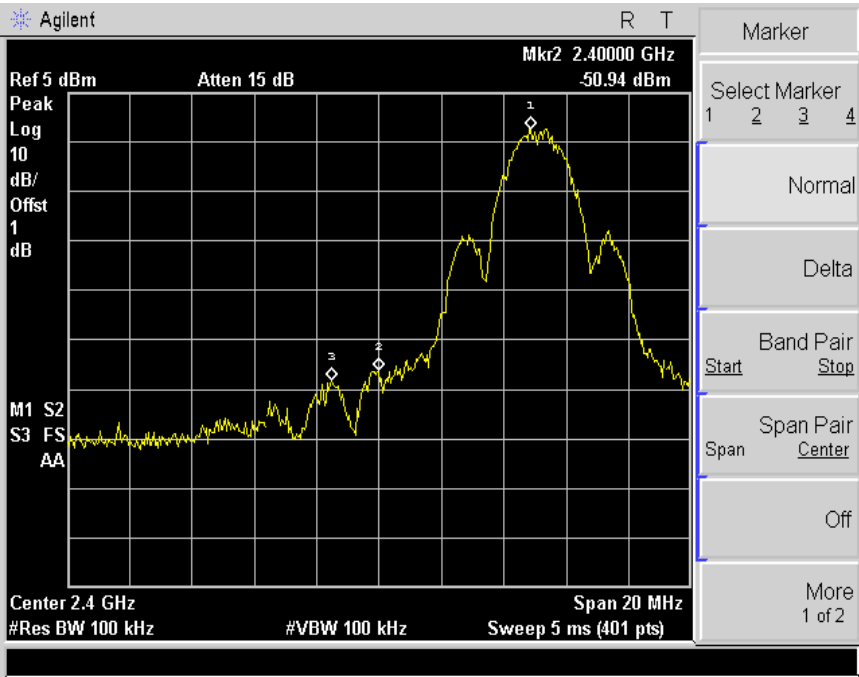
EUT	REMOCON RH PCB A'SSY	MODEL	2.4GHZ-DSM
MODE	DSSS	ENVIRONMENTAL CONDITION	23 , 43%RH
INPUT POWER			

CHANNEL	Channel Frequency (MHz)	Measurement Frequency (MHz)	Peak Level at 20dB below(dBm)	Limit (MHz)
11	2405	2400.0	-50.94	Below 20dB from peak power level to band edge
26	2480	2483.8	-49.20	Below 20dB from peak power level to band edge

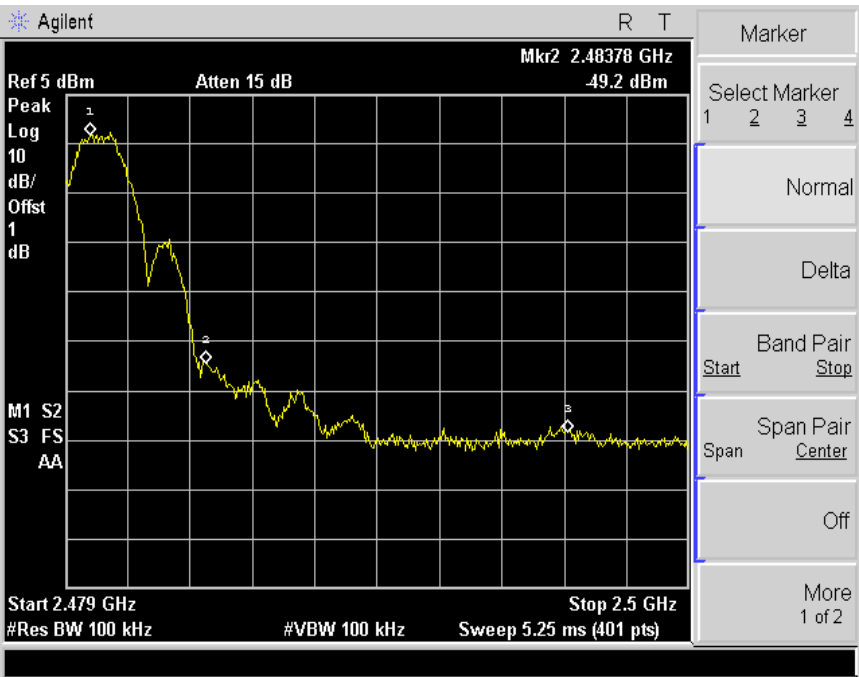


8.4 Trace data of band -edge & Out of Emission

11ch



26ch



## 9. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC Part 15 (2007) & ANSI C 63.4 (2003). The test setup was made according to FCC Part 15 (2007) & ANSI C 63.4 (2003) on an open test site, which allows a 3m distance measurement. The EUT was placed in the center of wooden turntable. The height of this table was 0.8m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

### 9.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESVS10	Rohde & Schwarz	838562/002	2010. 1. 29
LogBicon Antenna	VULB 9160	SCHWARZBECK	3142	2009. 5. 15
Amplifier	8447F	HP	2805A02972	2009. 6. 26
Spectrum Analyzer	R3273	ADVANTEST	110600592	2009. 6. 9
Horn Antenna	BBHA 9120 D	S/B	352	2009. 6. 13
PREAMPLIFIER	8449B	HP	3008A00581	2009. 3. 6
TEST Receiver	ESPI7	Rohde & Schwarz	100185	2009. 8. 27
Turn Table	2087	EMCO	2129	-
Antenna Mast	2070-01	EMCO	9702-203	-
ANT Mast Controller	2090	EMCO	1535	-
Turn Table Controller	2090	EMCO	1535	-

### 9.2 Environmental Condition

Test Place : Open site(3m)  
 Temperature (°C) : 11  
 Humidity (%) : 39 %

### 9.3 Test Data

Test Date : 2-Mar-09

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB $\mu$ V)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dB $\mu$ V/m)	Result (dB $\mu$ V/m)	Margin (dB)
120.01	13.10	H	2.0	11.18	1.8	43.5	26.04	-17.46
191.97	20.30	H	1.5	10.38	2.3	43.5	32.97	-10.53
224.03	20.00	H	2.0	10.71	2.5	46.0	33.20	-12.80
256.13	20.00	H	1.3	11.85	2.7	46.0	34.54	-11.46
271.97	15.40	H	1.3	12.18	3.0	46.0	30.53	-15.47
288.03	17.50	H	1.3	12.87	2.9	46.0	33.24	-12.76
304.03	18.00	H	1.2	13.09	3.1	46.0	34.23	-11.77
Remark	*Checked in all 3 axis and the maximum measured data were reported. *CL = Cable Loss - Amplifier Gain(In case of above1000MHz) *CL = Cable Loss(In case of below1000MHz) *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120KHz for Quasi-peak detection at frequency below 1GHz.							

### 9.3- 1 Test Data

Test Date : 2-Mar-09

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1MHz  VBW:1MHz)								
2388	23.77	H	1.6	27.31	4.5	74.0	55.58	-18.42
2388	23.93	V	1.6	27.31	4.5	74.0	55.74	-18.26
2405	42.30	H	1.6	27.31	4.5	*OB	74.11	-
2405	53.46	V	1.6	27.31	4.5	*OB	85.27	-
4810	44.17	H	1.4	29.95	-29.0	74.0	45.08	-28.92
4810	46.71	V	1.6	29.95	-29.0	74.0	47.62	-26.38
AV(RBW:1MHz  VBW:10Hz)								
2388	11.57	H	1.5	27.31	4.5	54.0	43.38	-10.62
2388	11.60	V	1.6	27.31	4.5	54.0	43.41	-10.59
2405	18.66	H	1.5	27.31	4.5	*OB	50.47	-
2405	20.03	V	1.6	27.31	4.5	*OB	51.84	-
4810	32.43	H	1.4	29.95	-29.0	54.0	33.34	-20.66
4810	31.00	V	1.6	29.95	-29.0	54.0	31.91	-22.09
Remark	H : Horizontal,  V : Vertical  TEST MODE : ZigBee-CH11(2405MHz) *The TX signal isn't detected from 3th harmonics. *OB = Operating band *Checked in all 3 axis and the maximum measured data were reported. *CL = Cable Loss-Amplifier Gain(In case of above1000MHz) *CL = Cable Loss(In case of below1000MHz)							

## 9.3-2 Test Data

Test Date : 2-Mar-09

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1MHz VBW:1MHz)								
2445	43.17	H	1.5	27.31	4.5	*OB	74.98	-
2445	52.11	V	1.7	27.31	4.5	*OB	83.92	-
4890	44.57	H	1.4	29.95	-29.0	74.0	45.48	-28.52
4890	43.01	V	1.6	29.95	-29.0	74.0	43.92	-30.08
AV(RBW:1MHz VBW:10Hz)								
2445	20.01	H	1.5	27.31	4.5	*OB	51.82	-
2445	20.18	H	1.7	27.31	4.5	*OB	51.99	-
4890	30.41	V	1.4	29.95	-29.0	54.0	31.32	-22.68
4890	30.56	V	1.6	29.95	-29.0	54.0	31.47	-22.53
Remark	H : Horizontal, V : Vertical TEST MODE : ZigBee-CH19(2445MHz) *The TX signal isn't detected from 3th harmonics. *OB = Operating band *Checked in all 3 axis and the maximum measured data were reported. *CL = Cable Loss-Amplifier Gain(In case of above1000MHz) *CL = Cable Loss(In case of below1000MHz)							

### 9.3-3 Test Data

Test Date : 2-Mar-09

Measurement Distance : 3 m

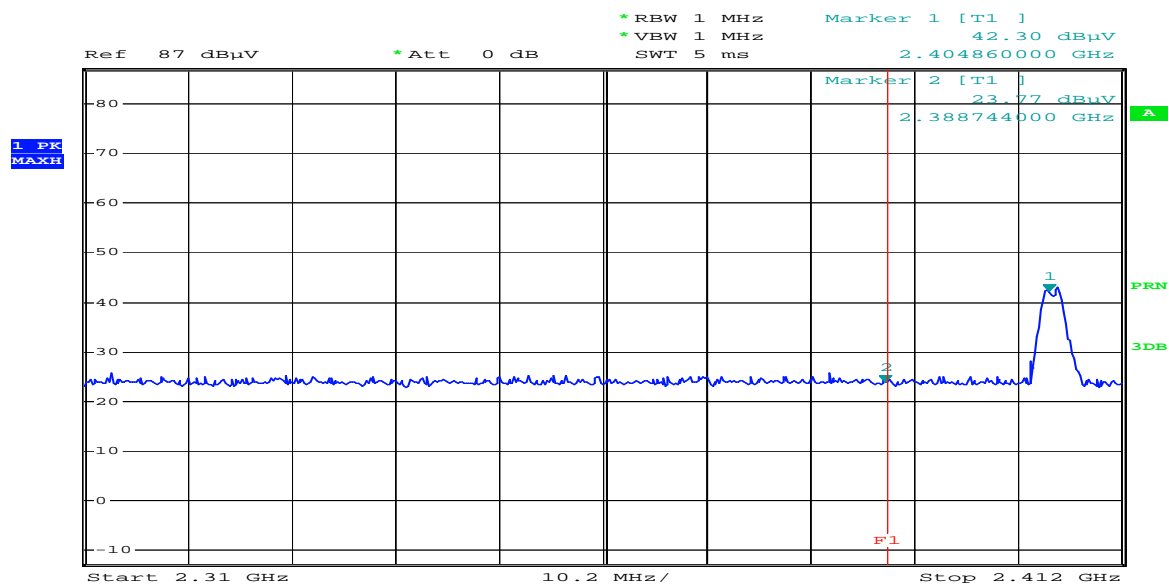
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW:1MHz  VBW:1MHz)								
2480	43.01	H	1.4	27.31	4.5	*OB	74.82	-
2480	47.70	V	1.5	27.31	4.5	*OB	79.51	-
2483.8	22.13	H	1.4	27.31	4.5	74.0	53.94	-20.06
2483.8	22.01	V	1.5	27.31	4.5	74.0	53.82	-20.18
4960	42.01	H	1.3	29.95	-29.0	74.0	42.92	-31.08
4960	42.70	V	1.5	29.95	-29.0	74.0	43.61	-30.39
AV(RBW:1MHz  VBW:10Hz)								
2480	17.31	H	1.4	27.31	4.5	*OB	49.12	-
2480	20.00	V	1.5	27.31	4.5	*OB	51.81	-
2483.8	10.03	H	1.4	27.31	4.5	54.0	41.84	-12.16
2483.8	10.20	V	1.5	27.31	4.5	54.0	42.01	-11.99
4960	29.17	H	1.3	29.95	-29.0	54.0	30.08	-23.92
4960	32.50	V	1.5	29.95	-29.0	54.0	33.41	-20.59
Remark	H : Horizontal,  V : Vertical  TEST MODE : ZigBee-CH26(2480MHz) *The TX signal isn't detected from 2th harmonics. *OB = Operating band *Checked in all 3 axis and the maximum measured data were reported. *CL = Cable Loss -Amplifier Gain(In case of above1000MHz) *CL = Cable Loss(In case of below1000MHz)							

## 9.3-4 Restricted Band Edges

Band Edges(CH Low)

Detector mode:Peak

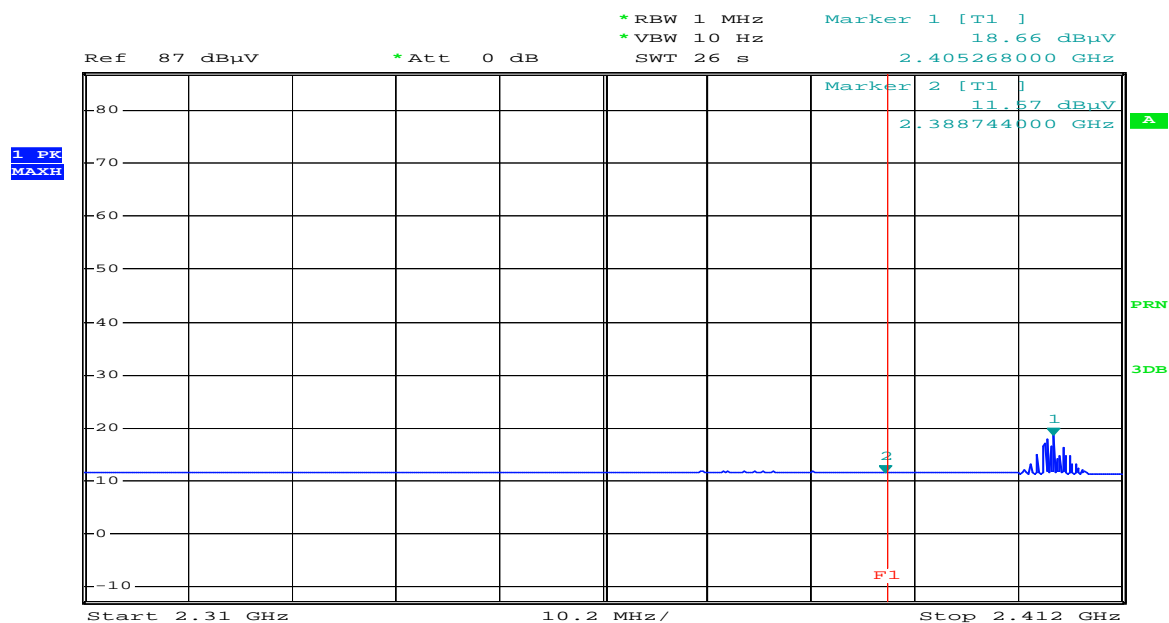
Polarity:Horizontal



Comment: CH.11 PK\_HOR  
 Date: 2.MAR.2009 10:06:52

Detector mode:Average

Polarity:Horizontal

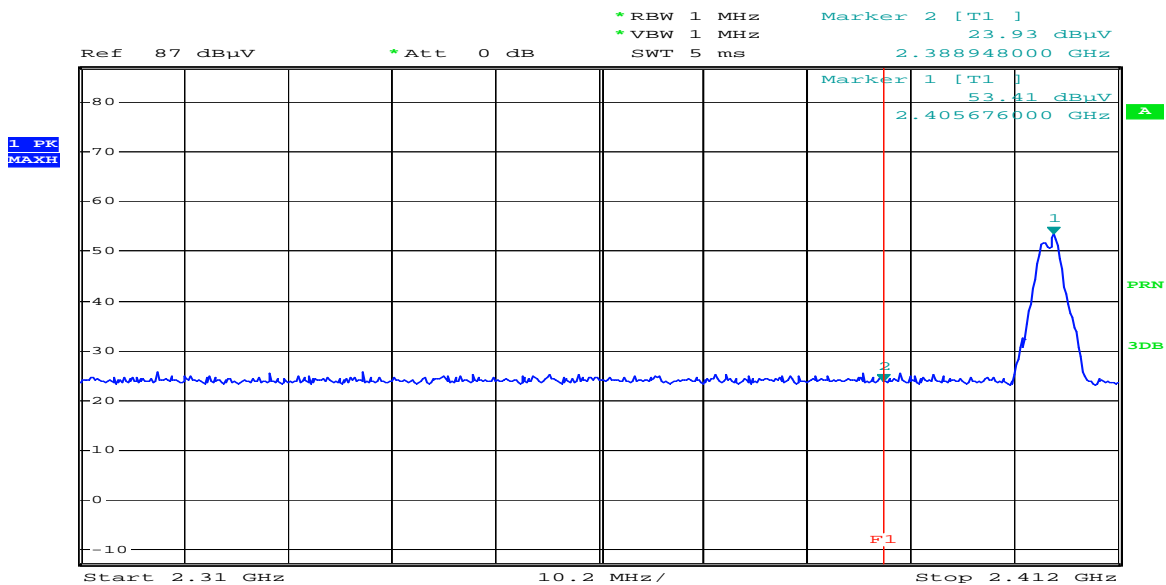


Comment: CH.11 AV\_HOR  
 Date: 2.MAR.2009 10:12:01

Band Edges(CH Low)

Detector mode:Peak

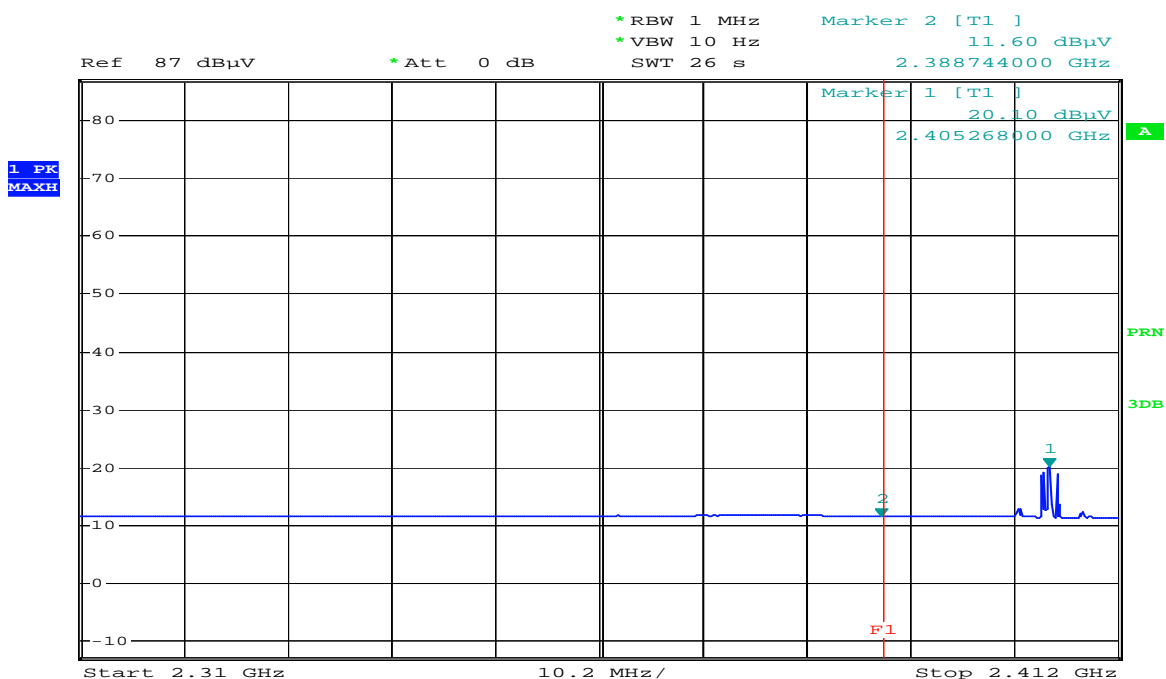
Polarity:Vertical



Comment: CH.11 PK\_VER  
 Date: 2.MAR.2009 10:00:27

Detector mode:Average

Polarity:Vertical



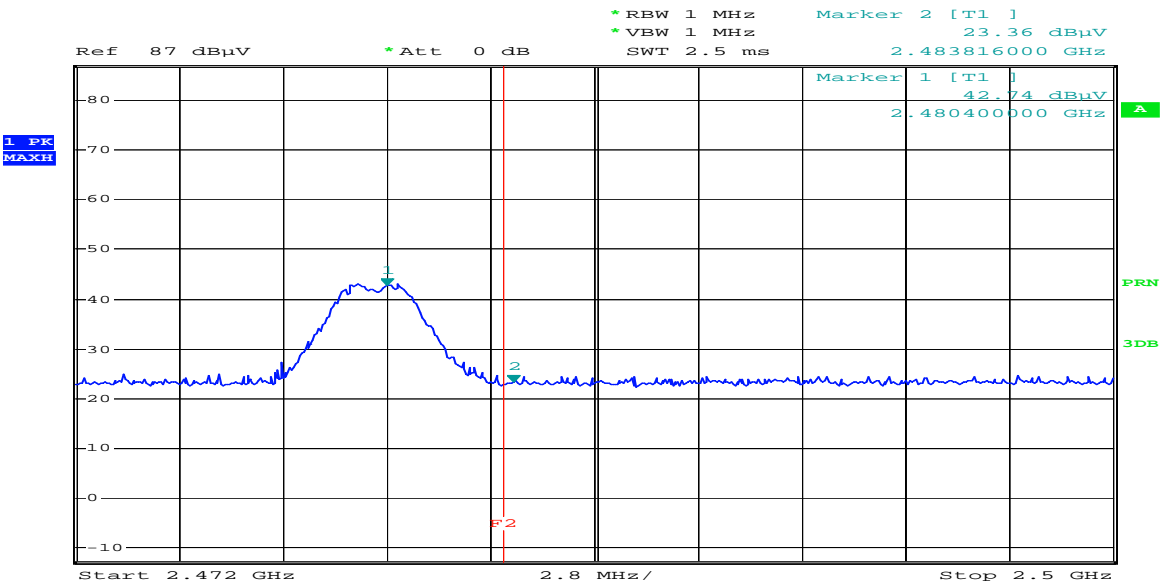
Comment: CH.11 AV\_VER  
 Date: 2.MAR.2009 10:04:18



Band Edges(CH High)

Detector mode:Peak

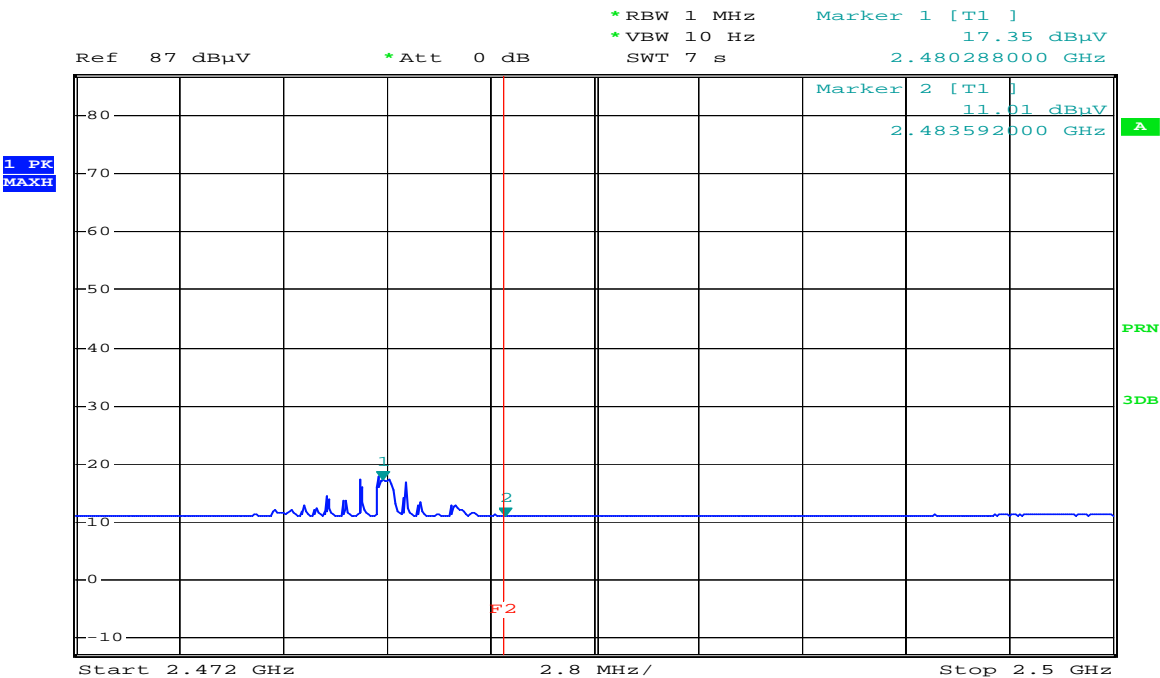
Polarity:Horizontal



Comment : CH.26      PK\_HOR  
Date :      2.MAR.2009      10:16:26

Detector mode:Average

Polarity:Horizontal

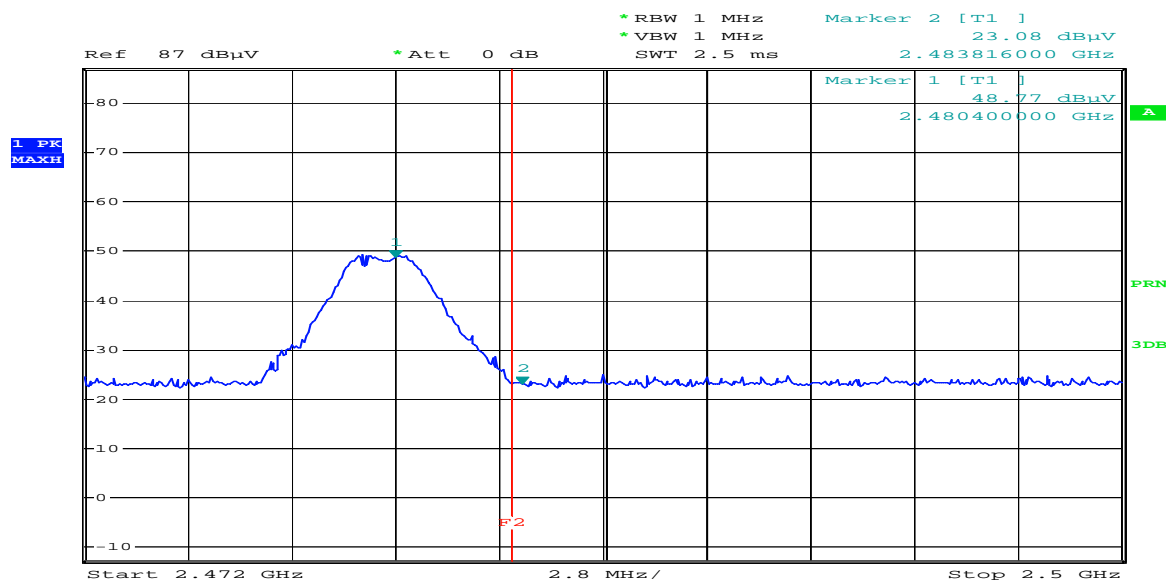


Comment : CH.26      AV\_HOR  
Date :      2.MAR.2009      10:28:56

Band Edges(CH High)

Detector mode:Peak

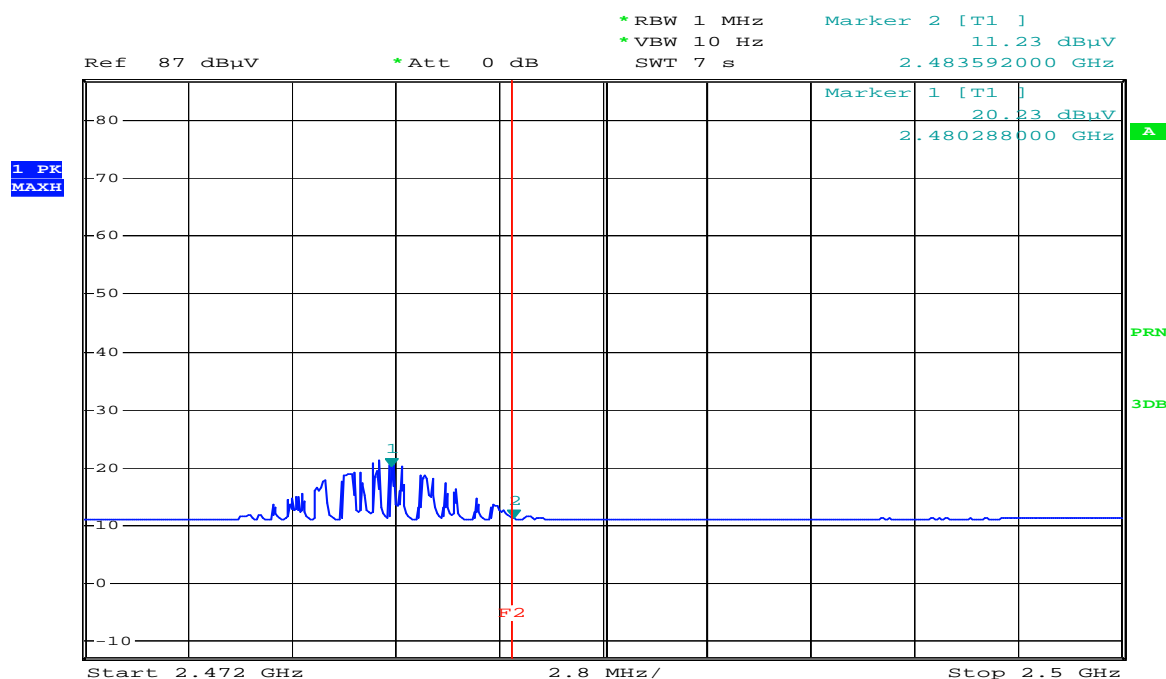
Polarity:Vertical



Comment: CH.26 PK\_VER  
 Date: 2.MAR.2009 10:19:00

Detector mode:Average

Polarity:Vertical



Comment: CH.26 AV\_VER  
 Date: 2.MAR.2009 10:24:08

## 10. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 to 30 MHz was measured in accordance to FCC Part 15 (2006) & ANSI C 63.4 (2003). The test setup was made according to FCC Part 15 (2006) & ANSI C 63.4 (2003) in a shielded. The EUT was placed on a non-conductive table at least 80 above the ground plan. A grounded vertical reference plane was positioned in a distance of 40cm from the EUT. The distance from the EUT to other metal surfaces was at least 0.8m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0m.. The test receiver with Quasi Peak detector complies with CISPR 16.

### 10.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
LISN	ESH3-Z5	Rohde & Schwarz	838979/010	2010. 2. 21
LISN	NNLA8120A	Schwarzbeck	NONE	2010. 2. 21
TEST Receive	ESPI7	Rohde & Schwarz	100185	2009. 8. 27
Pulse Limiter	ESH3Z2	Rohde & Schwarz	NONE	2009. 9. 10

### 10.2 Environmental Condition

Test Place : Shield Room

Temperature (°C) :

Humidity (%) : %

### 10.3 Test Data (N/A)

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dBμV)	Reading (dBμV)	Result (dBμV)	Limit (dBμV)	Reading (dBμV)	Result (dB)
Remark	H : Hot Line, N : Neutral Line *It does not need to test this requirement, because of the power of the EUT is supplied from battery Power								