

# TEST REPORT

Report Number	RAPA13-O-133	
Type of Equipment	Smart Alarm	
Model Name	HB4500	
FCC ID	SCV-HB4500	
Applicant	Name	HUMBLE
	Logo	
	Address	Business Incubator #201, 68, Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-816, Rep. of Korea
Manufacturer	Name	HUMBLE
	Address	Business Incubator #201, 68, Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-816, Rep. of Korea
Test period	February 25, 2013 to March 08, 2013	
Issuing date of report	March 12, 2013	
Total page	34 pages (including this page)	

## SUMMARY

The equipment complies with FCC Part 15.247: Operation within the bands 902 MHz to 928 MHz, 2 400 MHz to 2 483.5 MHz, and 5 725 MHz to 5 850 MHz.

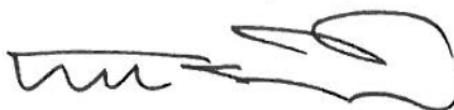
This test report contains only the results of a single test of the sample supplied for the examination.  
It is not a general valid assessment of the features of the respective products of the mass-production.

Date : March 12, 2013



Prepared and tested by Chang Young Choi  
Deputy General Manager /TCL of RAPA

Date : March 12, 2013



Reviewed by Sukil Park  
Executive Managing Director/TCL of RAPA

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## 1. GENERAL DESCRIPTION

### 1.1 Applicant

- Company name : HUMBLE
- Address : Business Incubator #201, 68, Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-816, Rep. of Korea
- Contact person : Caleb Choo / CEO
- Phone/Fax : 82-31-789-8090 / 82-31-395-0491

### 1.2 Manufacturer

- Company name : HUMBLE
- Address : Business Incubator #201, 68, Yatap-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-816, Rep. of Korea
- Phone / Fax : 82-31-789-8090 / 82-31-395-0491

### 1.3 Basic description of EUT

- Product name : Smart Alarm
- Model name : HB4500
- Frequency : 2 402 MHz to 2 480 MHz
- Output power : 1.67 dBm
- Modulation method : GFSK (Bluetooth 4.0 – LE)
- FCC Rule Part(s) : FCC Part 15 Subpart C Section 15.247
- FCC classification : DTS / Digital Transmission System
- Test period : February 25, 2013 to March 08, 2013
- Issuing date of report : March 12, 2013
- Place of test : Head office  
824, B104, Anyang Megavalley, 799, Gwanyang-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-767, Korea

#### Open area test site

80, Jeil-ri, Yangji-myun, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-825, Korea

(FCC Registration Number : 337229)

(IC Submission Number : 143881)

(KCC Designation Number : KR0027)

## 1.4 Electrical specification

Item	Specifications
Input power	DC 5 V 500 mA
Internal clock	16 MHz
RF frequency	2.4 GHz ISM band
Transmitter frequency	2 402 MHz to 2 480 MHz
Number of layer	2 Layer, 1.6 T
External connector	Micro USB
Working temperature	-10 to +50 °C
Storage temperature	-30 to +60 °C
Battery	Lithium Polymer 3.7 V rechargeable battery, 250 mAh
Relative humidity	0 % to 80 %
Dimensions (W x H x D)	45 mm x 45 mm x 17 mm
Sound	+90 dB
RF method	Bluetooth 4.0 profile specification

## 1.5 EUT operating conditions & test configuration

### 1.5.1 Client condition

- Temperature : -10 °C ~ +50 °C
- Relative humidity : 80 %

### 1.5.2 EUT operating condition

- TX Frequency Band : 2 400 MHz to 2 483.5 MHz
- Test Frequencies : 1<sup>st</sup> ; 2 402 MHz (Channel 0), 2<sup>nd</sup> ; 2 440 MHz (Channel 19), 3<sup>rd</sup> ; 2 480 MHz (Channel 39)
- Modulation : GFSK

## 2. General information of test

### 2.1 Standard for measurement methods

Applied Standard : 47 CFR Part 15, Subpart C 15.247			
FCC	Description of test	Limit	Result
15.203 / 15.204	Antenna information	Confirmation	Pass
15.207	Power line conducted emission	See 15.207	Pass
15.247(a)(2)	6 dB bandwidth	$\geq 500$ kHz	Pass
15.247(b)(1)	Maximum peak output power	$\leq 30$ dBm	Pass
15.247(e)	Power spectral density	$\leq 8$ dBm	Pass
15.247(d)	Conducted band edges and spurious emission	$\leq 20$ dBc	Pass
15.247(d) / 15.209	Radiated band edges and spurious emission	See 15.209	Pass

### 2.2 Description of EUT modification

During the test, there was no mechanical or circuitry modification to improve any RF specification including spurious characteristic, and any RF and spurious suppression device(s) were not added against the device tested.

### 2.3 Description of test system configuration

- Peripheral equipment used;

Description	Model name	Serial No.	Manufacturer	FCC ID
EUT	HB4500	Proto Type	HUMBLE	SCV-HB4500
Test fixer (JIG)	RS-232	Proto Type	WaveShare	-
Control PC	NT-P560-PS3M	ZV1U93MMZA00008	SAMSUNG	-

- Cables used

Device from	Device to	Type of cable	Type of connector	Length
EUT	Test fixer (JIG)	Non-shielded	Wire	0.15 m
Test fixer (JIG)	Control PC	Non-shielded	RS-232 to USB	2.00 m
Control PC	Test fixer (JIG)	Non-shielded	USB to RS-232	2.00 m
EUT	Spectrum analyzer	Shielded	SMA to SMA	1.00 m

### 3. Technical information of equipment

#### 3.1 Antenna information

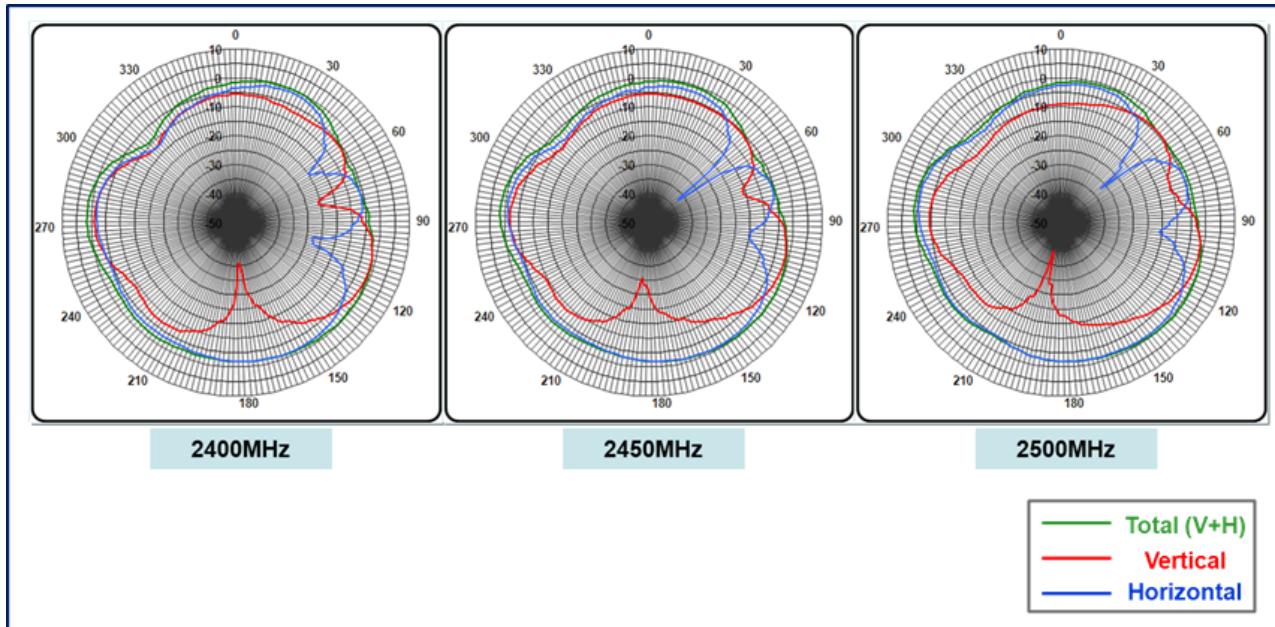
##### 3.1.1 Type and location



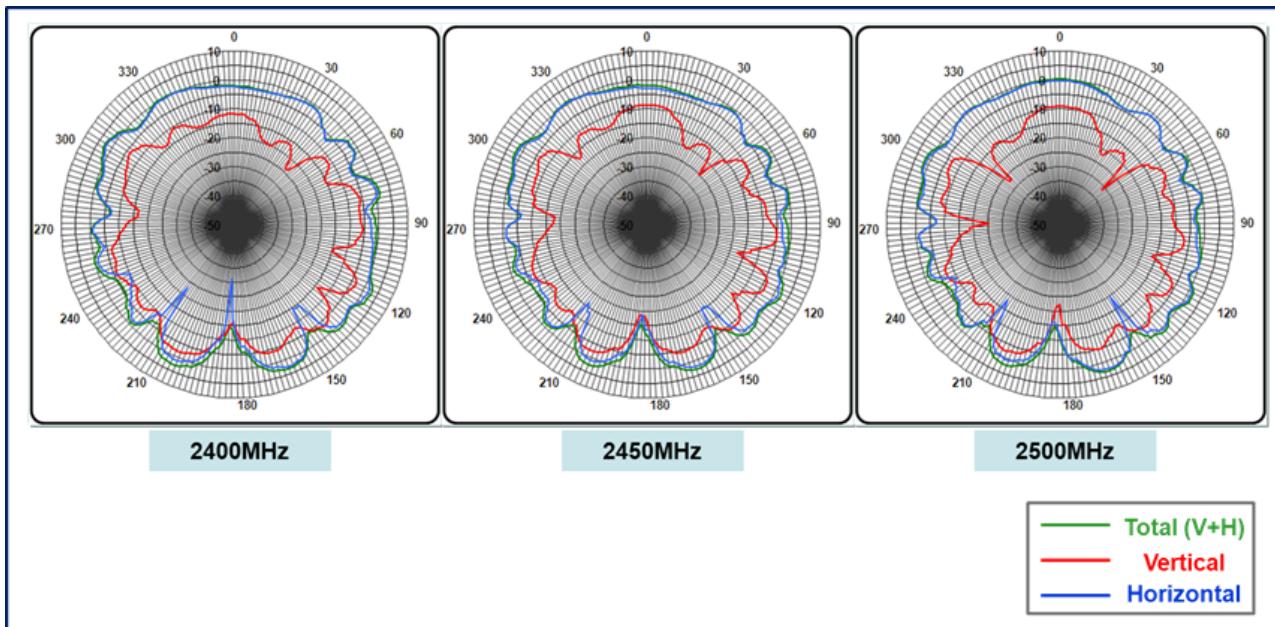
##### 3.1.2 Value of antenna gain

Frequency	Efficiency	Average Gain			Max Gain			Max Position
		Ver	Hor	Total	Ver	Hor	Total	
2400.000000 MHz	59.6 %	-6.7 dBi	-4.1 dBi	-2.2 dBi	0.2 dBi	3.9 dBi	4.4 dBi	Theta165/Pie315
2410.000000 MHz	61.3 %	-6.7 dBi	-4.0 dBi	-2.1 dBi	0.9 dBi	4.0 dBi	4.3 dBi	Theta165/Pie330
2420.000000 MHz	57.2 %	-7.0 dBi	-4.3 dBi	-2.4 dBi	0.5 dBi	3.7 dBi	4.1 dBi	Theta165/Pie315
2430.000000 MHz	59.9 %	-6.6 dBi	-4.2 dBi	-2.2 dBi	0.6 dBi	3.6 dBi	4.0 dBi	Theta165/Pie315
2440.000000 MHz	59.4 %	-6.6 dBi	-4.3 dBi	-2.3 dBi	0.5 dBi	3.4 dBi	3.7 dBi	Theta165/Pie315
2450.000000 MHz	58.6 %	-6.6 dBi	-4.4 dBi	-2.3 dBi	0.3 dBi	3.2 dBi	3.6 dBi	Theta165/Pie315
2460.000000 MHz	56.2 %	-6.8 dBi	-4.5 dBi	-2.5 dBi	-0.1 dBi	3.2 dBi	3.6 dBi	Theta165/Pie315
2470.000000 MHz	45.5 %	-7.9 dBi	-5.3 dBi	-3.4 dBi	-1.4 dBi	2.4 dBi	2.8 dBi	Theta165/Pie315
2480.000000 MHz	50.2 %	-7.7 dBi	-4.8 dBi	-3.0 dBi	-1.2 dBi	3.0 dBi	3.4 dBi	Theta165/Pie315
2490.000000 MHz	54.2 %	-7.4 dBi	-4.5 dBi	-2.7 dBi	-0.9 dBi	3.5 dBi	3.8 dBi	Theta165/Pie315
2500.000000 MHz	59.5 %	-6.8 dBi	-4.1 dBi	-2.3 dBi	-0.5 dBi	3.8 dBi	4.2 dBi	Theta165/Pie315

### 3.1.3 Antenna radiation at H-plane



### 3.1.4 Antenna radiation at E-plane



## 4. Measurement data

### 4.1 6 dB bandwidth

#### 4.1.1 Specification

- FCC Rules Part 15 Section 15.247(a)(2)

#### 4.1.2 Measurement method

- 558074 D01 DTS Meas Guidance v02, Section 7.0

#### 4.1.3 Set-up



#### 4.1.4 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Spectrum analyzer	FSV30	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	NT-P560-PS3M	SAMSUNG
Test fixer	RS232	WaveShare

#### 4.1.5 Test condition

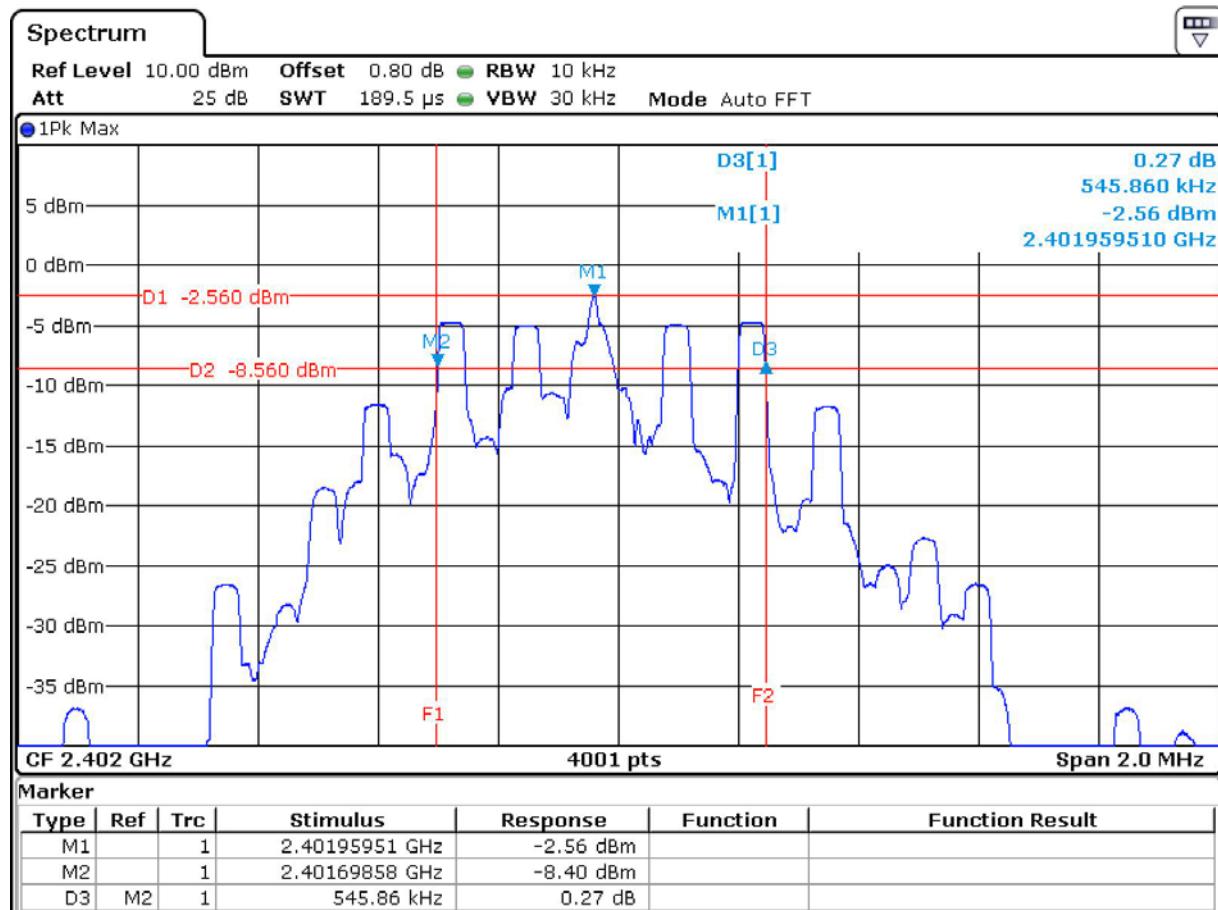
- Test place : Test room
- Test environment : 19 °C, 35 % R.H.
- Test mode : Operation at single channel

#### 4.1.6 Test Result

Channel number	Frequency [MHz]	Measured bandwidth [kHz]	Limit [kHz]
Channel 0	2 402	545.86	500.00
Channel 19	2 440	543.36	
Channel 39	2 480	545.36	

## 4.1.7 Plots of 6 dB bandwidth

### 4.1.7.1 Low frequency

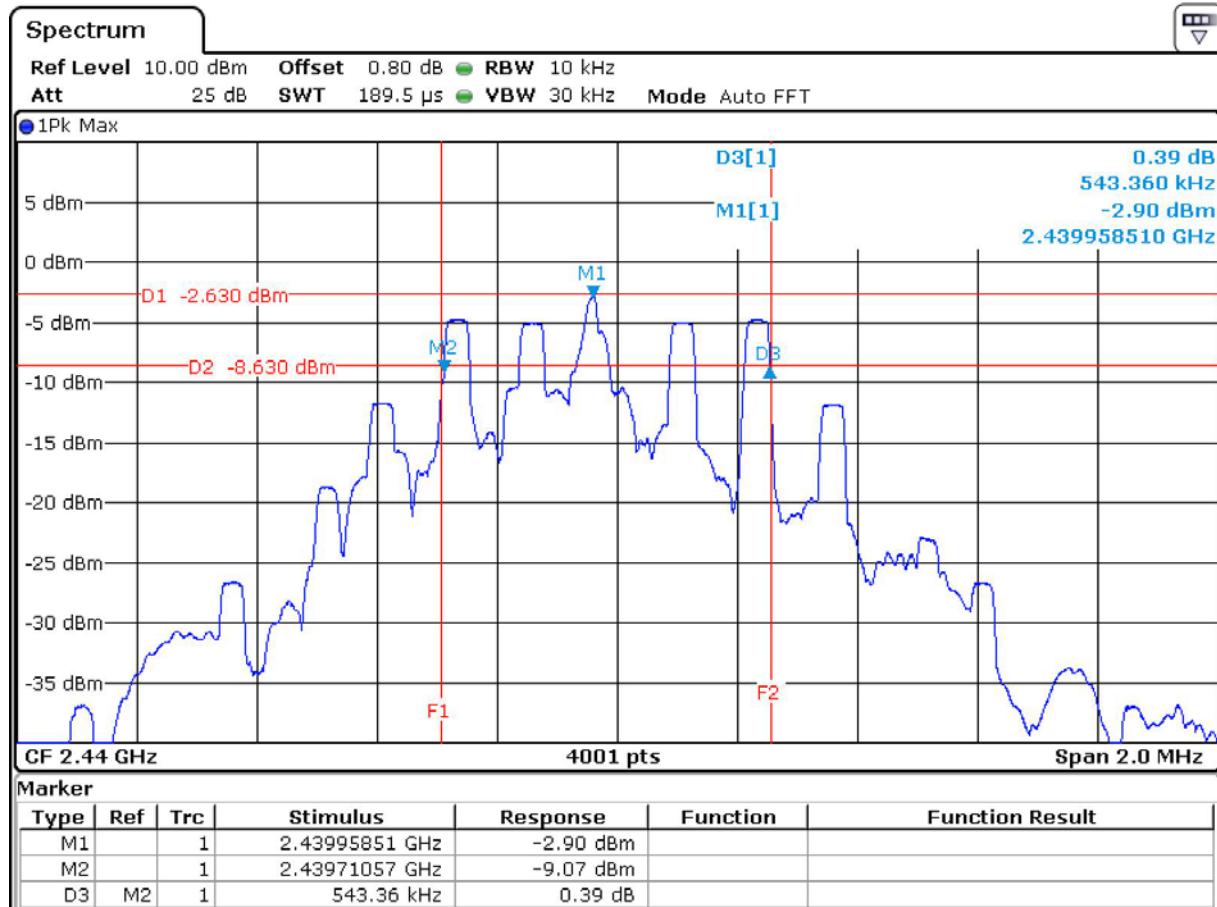


Date: 5.MAR.2013 21:00:00

Channel number : 0  
Operating frequency : 2 402 MHz  
RBW : 10 kHz  
VBW : 30 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

6 dB bandwidth : 545.86 kHz

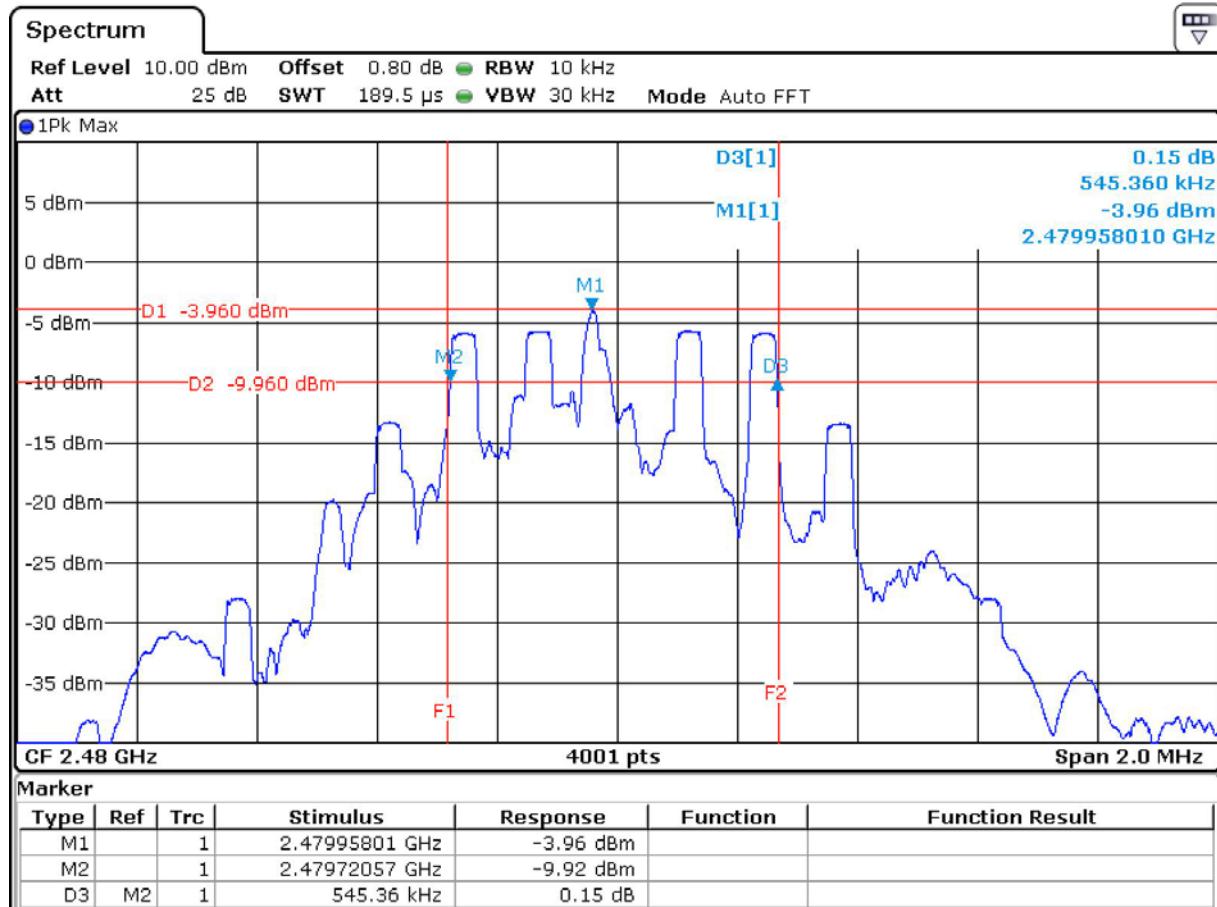
#### 4.1.7.2 Middle frequency



Date: 5.MAR.2013 20:51:37

Channel number : 19  
Operating frequency : 2 440 MHz  
RBW : 10 kHz  
VBW : 30 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto  
  
6 dB bandwidth : 543.36 kHz

#### 4.1.7.3 High frequency



Date: 5.MAR.2013 21:06:51

Channel number : 39  
Operating frequency : 2 480 MHz  
RBW : 10 kHz  
VBW : 30 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

6 dB bandwidth : 545.36 kHz

## 4.2 Maximum peak output power

### 4.2.1 Specification

- FCC Rules Part 15 Section 15.247(b)(1)

### 4.2.2 Measurement method

- 558074 D01 DTS Meas Guidance v02, Section 8.0

### 4.2.3 Set-up



### 4.2.4 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Spectrum analyzer	FSV30	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	NT-P560-PS3M	SAMSUNG
Test fixer	RS232	WaveShare

### 4.2.5 Test condition

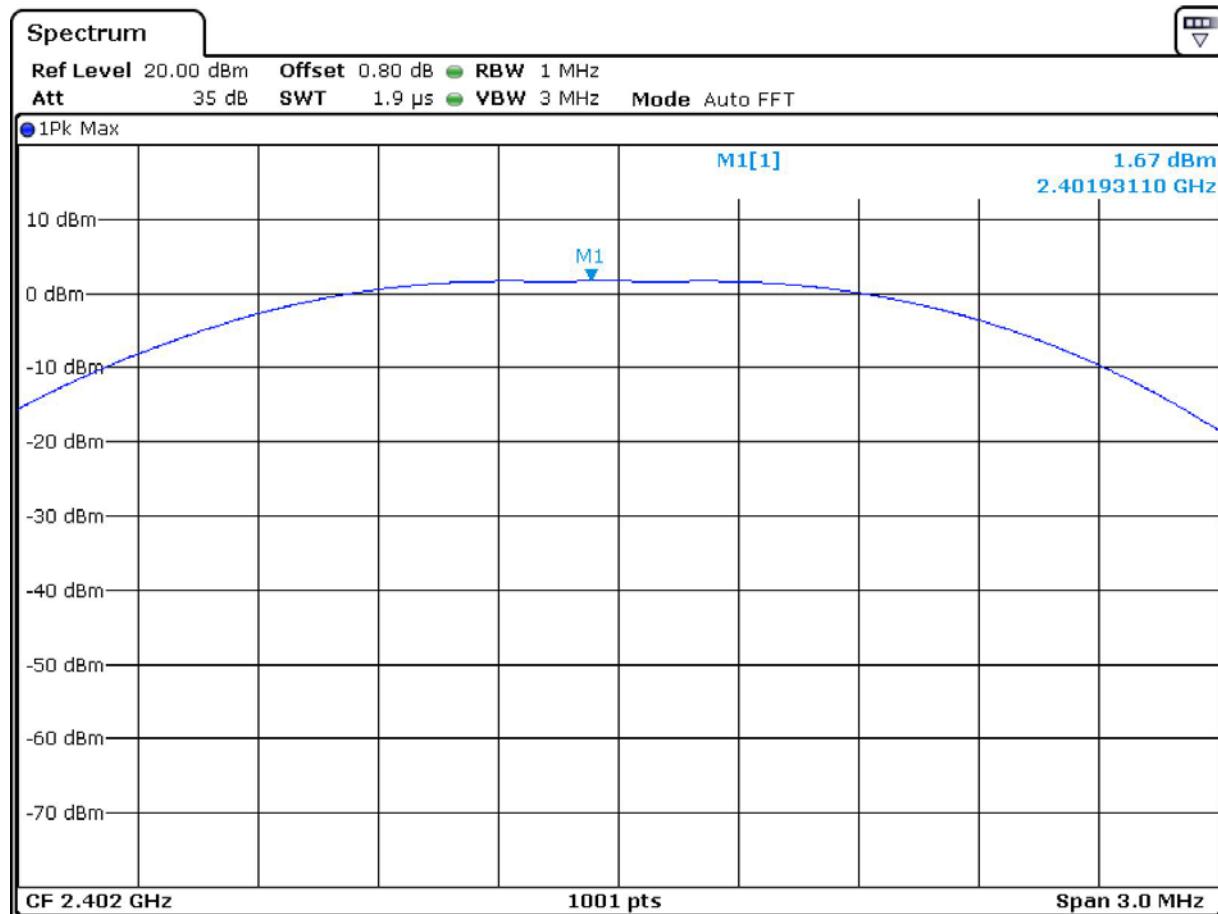
- Test place : Test room
- Test environment : 19 °C, 35 % R.H.
- Test mode : Operation at single channel

### 4.2.6 Test result

Channel number	Frequency [MHz]	Measured power [dBm]	Limit [dBm]
Channel 0	2 402	1.67	30.00
Channel 19	2 440	1.65	
Channel 39	2 480	0.65	

## 4.2.7 Plots of maximum peak output power

### 4.2.7.1 Low frequency

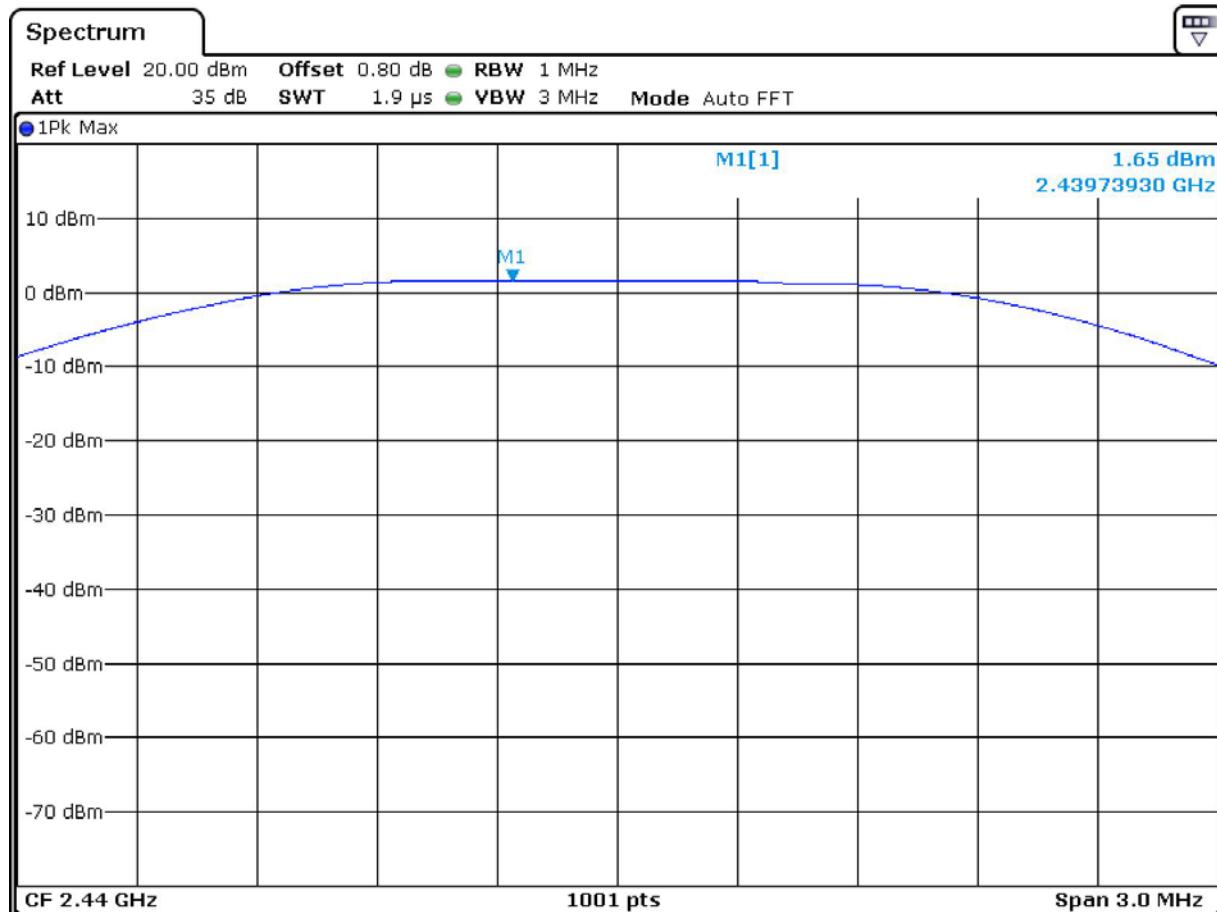


Date: 5.MAR.2013 04:18:00

Channel number : 0  
Operating frequency : 2 402 MHz  
RBW : 1 MHz  
VBW : 3 MHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

Peak output power : 1.67 dBm (=1.469 mW)

#### 4.2.7.2 Middle Frequency

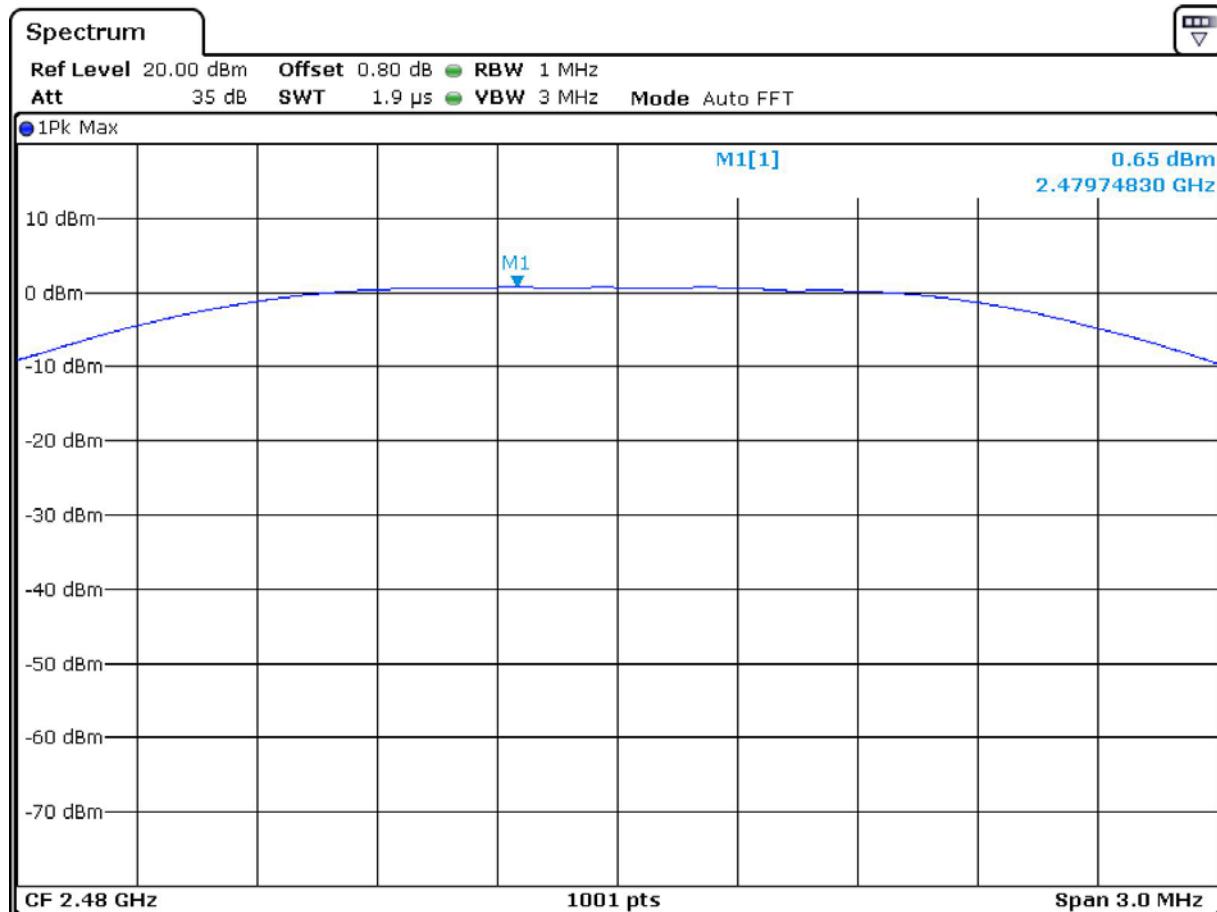


Date: 5.MAR.2013 04:17:25

Channel number : 19  
Operating frequency : 2 440 MHz  
RBW : 1 MHz  
VBW : 3 MHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

Peak output power : 1.65 dBm (=1.462 mW)

#### 4.2.7.3 High Frequency



Date: 5.MAR.2013 04:16:21

Channel number : 39  
Operating frequency : 2 480 MHz  
RBW : 1 MHz  
VBW : 3 MHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

Peak output power : 0.65 dBm (=1.161 mW)

### 4.3 Power spectral density

#### 4.3.1 Specification

- FCC Rules Part 15 Section 15.247(e)

#### 4.3.2 Measurement method

- 558074 D01 DTS Meas Guidance v02, Section 9.0

#### 4.3.3 Set-up



#### 4.3.4 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Spectrum analyzer	FSV30	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	NT-P560-PS3M	SAMSUNG
Test fixer	RS232	WaveShare

#### 4.3.5 Test condition

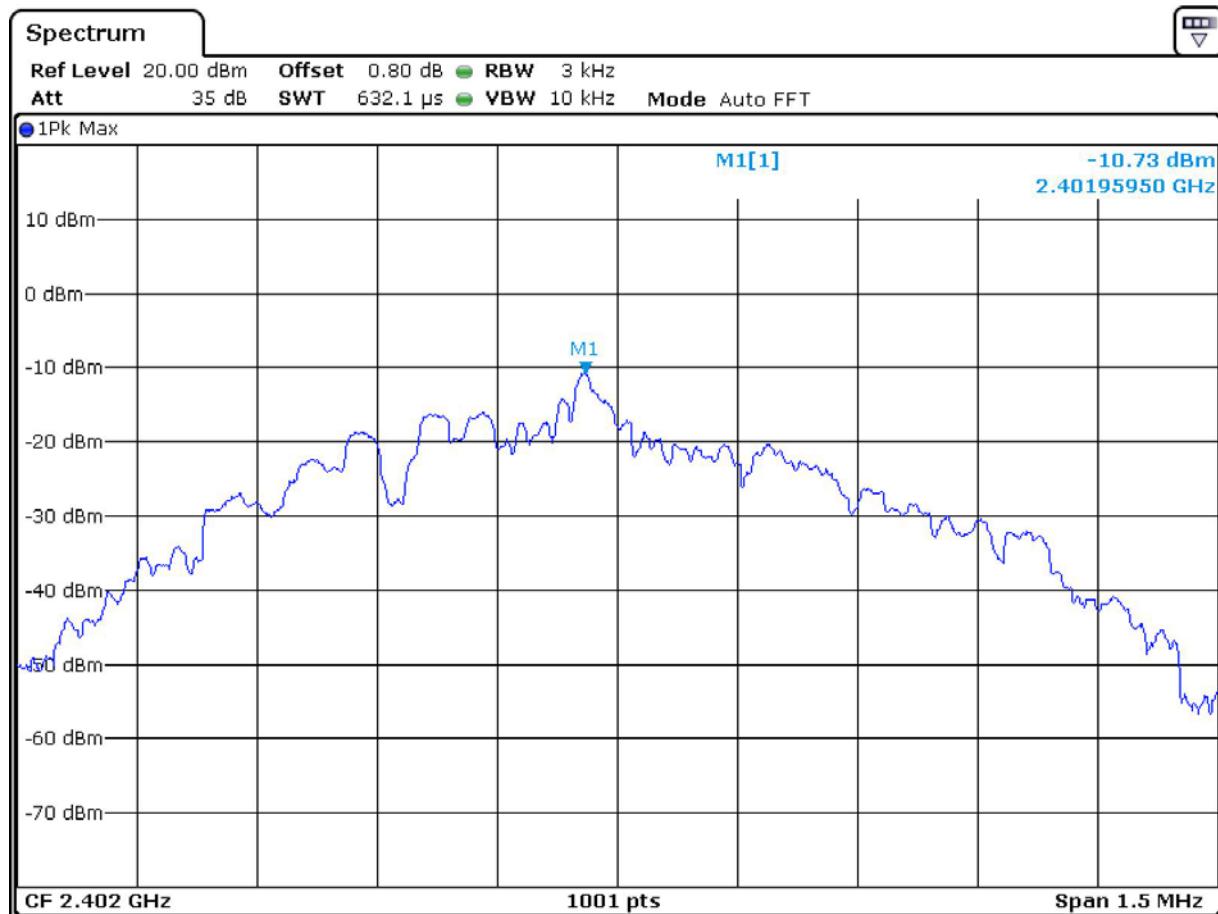
- Test place : Test room
- Test environment : 19 °C, 35 % R.H.
- Test mode : Operation at single channel

#### 4.3.6 Test result

Channel number	Frequency [MHz]	Measured power density [dBm]	Limit [dBm]
Channel 0	2 402	-10.73	8.00
Channel 19	2 440	-11.78	
Channel 39	2 480	-13.06	

### 4.3.7 Plots of power spectral density

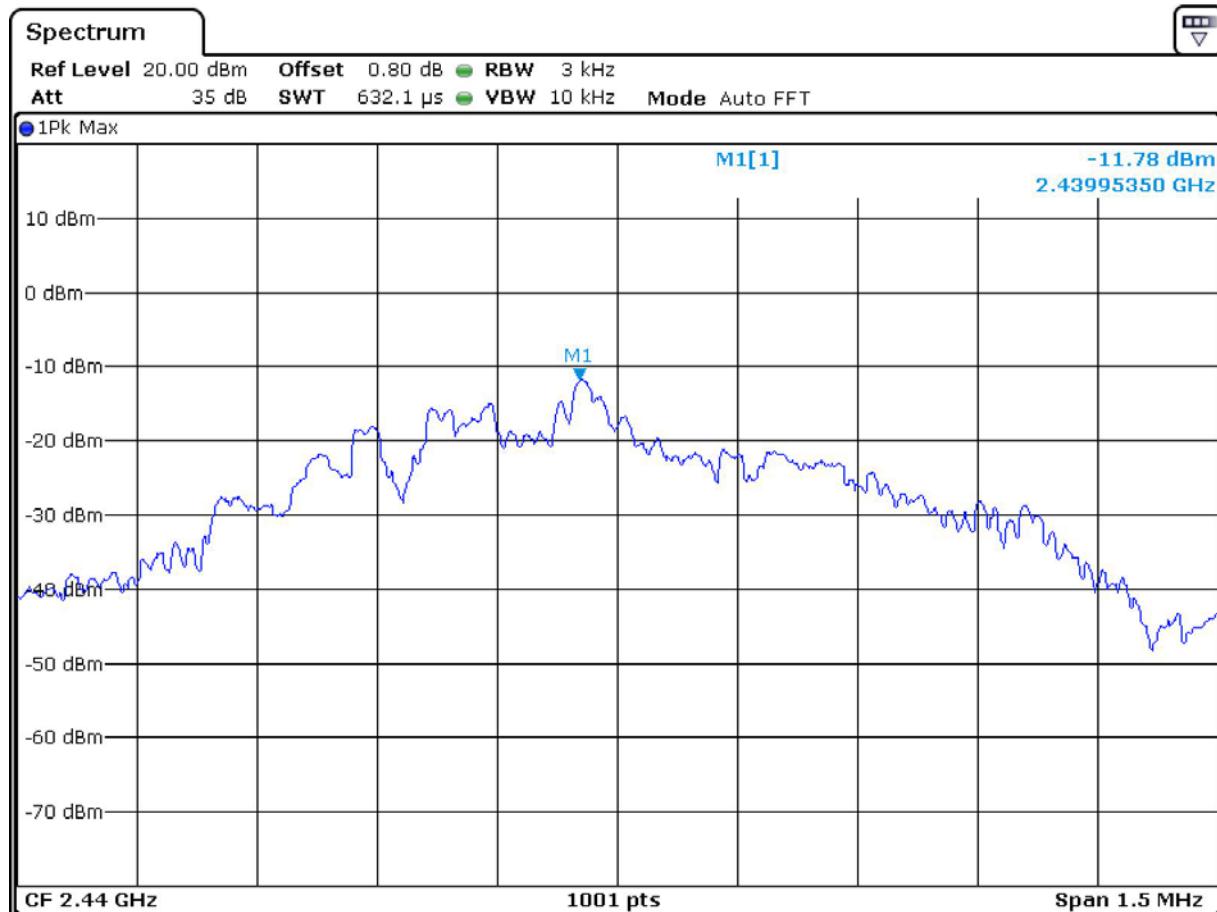
#### 4.3.7.1 Low frequency



Date: 5.MAR.2013 04:27:57

Channel number : 0  
Operating frequency : 2 402 MHz  
RBW : 3 kHz  
VBW : 10 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto  
  
Power spectral density : -10.73 dBm

#### 4.3.7.2 Middle frequency

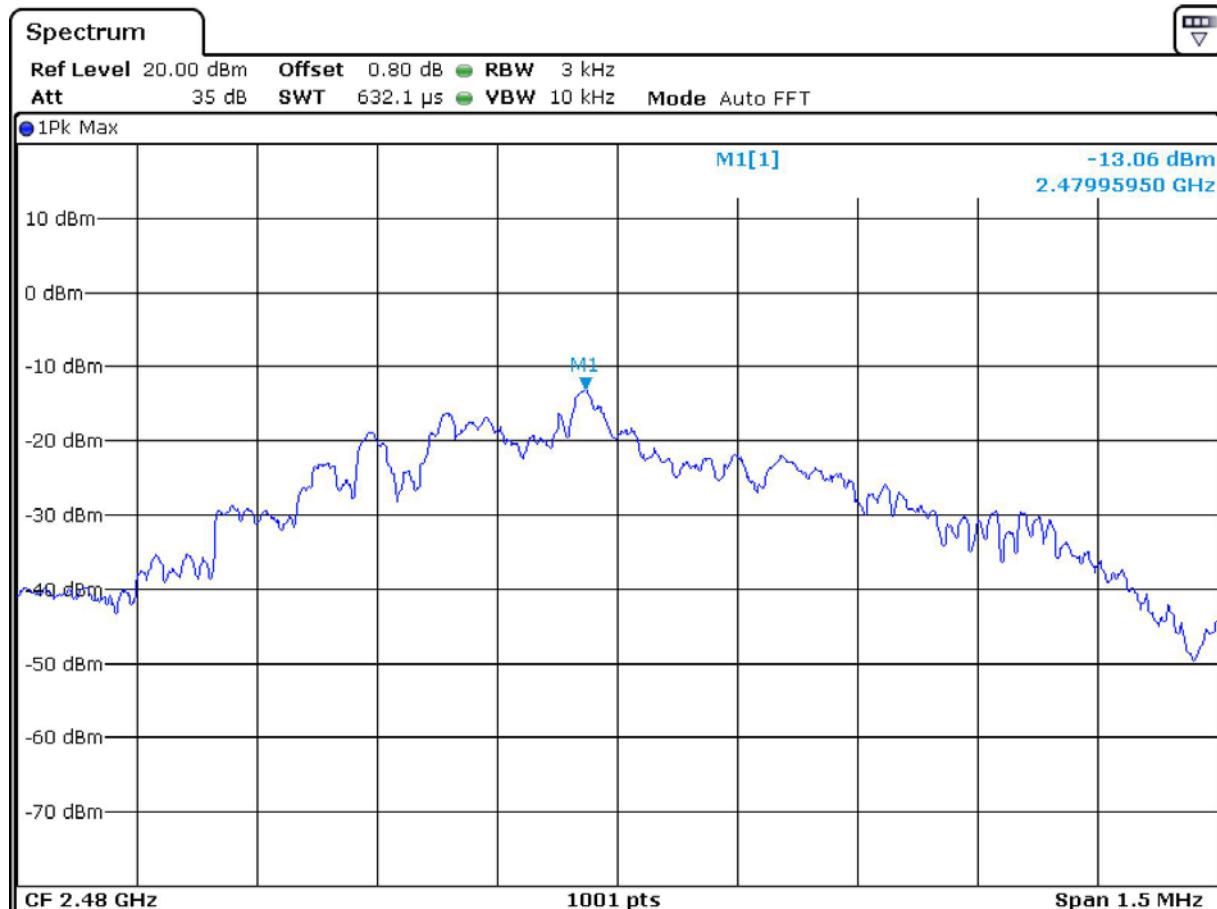


Date: 5.MAR.2013 04:28:58

Channel number : 19  
Operating frequency : 2 440 MHz  
RBW : 3 kHz  
VBW : 10 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

Power spectral density : -11.78 dBm

#### 4.3.7.3 High frequency



Date: 5.MAR.2013 04:29:30

Channel number : 39  
Operating frequency : 2 480 MHz  
RBW : 3 kHz  
VBW : 10 kHz  
Detector mode : Peak  
Trace mode : Max hold  
Sweep time : Auto

Power spectral density : -13.06 dBm

## 4.4 Conducted band edges and spurious emission

### 4.4.1 Specification

- FCC Rules Part 15 Section 15.247(d)

### 4.4.2 Measurement method

- 558074 D01 DTS Meas Guidance v02, Section 10.0

### 4.4.3 Set-up



### 4.4.4 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Spectrum analyzer	FSV30	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	NT-P560-PS3M	SAMSUNG
Test fixer	RS232	WaveShare

### 4.4.5 Test condition

- Test place : Test room
- Test environment : 19 °C, 35 % R.H.
- Test mode : Operation at single channel

### 4.4.6 Test result at low frequency

Frequency [MHz]	Level [dBm]	Deviation [dBc]	Limit [dBc]	Margin [dB]
1 201.0	-46.57	47.94	20.00	27.94
2 390.0	-63.48	64.85	20.00	44.85
<b>2 400.0</b>	<b>-43.18</b>	<b>44.85</b>	<b>20.00</b>	<b>24.85</b>
2 402.0	+1.37	-	-	-
4 804.0	-53.98	55.35	20.00	35.35
7 206.0	-49.87	51.24	20.00	31.24
9 608.0	-58.87	60.24	20.00	40.24

**Calculation formula** [Deviation = Level of fundamental frequency - Level of unwanted emission frequency]

#### 4.4.7 Test result at middle frequency

Frequency [MHz]	Level [dBm]	Deviation [dBc]	Limit [dBc]	Margin [dB]
1 220.0	-46.54	48.15	20.00	28.15
2 440.0	+1.61	-	-	-
4 880.0	-60.04	61.65	20.00	41.65
7 320.0	-49.26	50.87	20.00	30.87
9 760.0	-55.42	57.03	20.00	37.03

**Calculation formula** [Deviation = Level of fundamental frequency - Level of unwanted emission frequency]

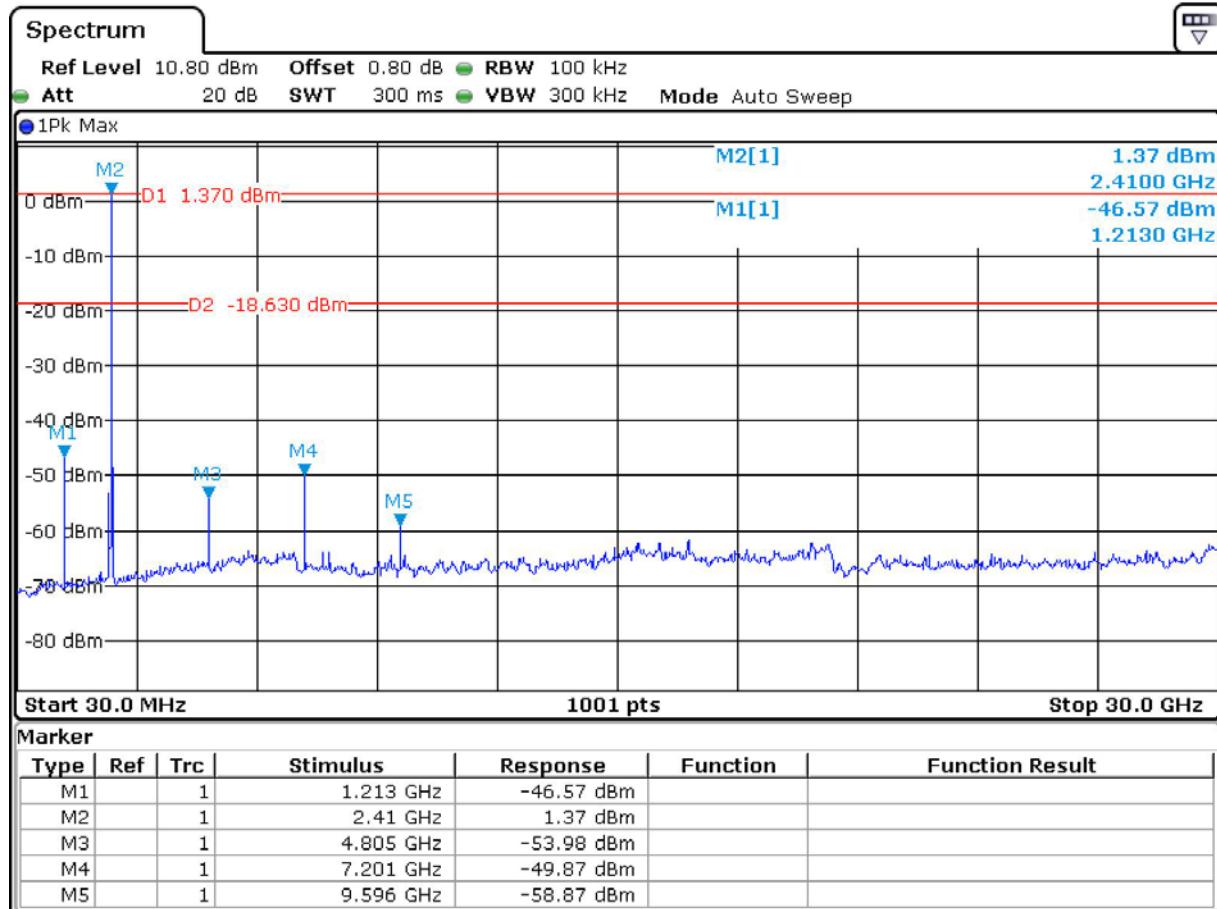
#### 4.4.8 Test result at high frequency

Frequency [MHz]	Level [dBm]	Deviation [dBc]	Limit [dBc]	Margin [dB]
1 240.0	-46.70	47.26	20.00	27.26
2 480.0	+0.56	-	-	-
2 483.5	-47.51	48.07	20.00	28.07
2 485.5	-48.47	49.03	20.00	29.03
4 960.0	-60.20	60.76	20.00	40.76
7 440.0	-46.81	47.37	20.00	27.37
9 920.0	-62.21	62.77	20.00	42.77

**Calculation formula** [Deviation = Level of fundamental frequency - Level of unwanted emission frequency]

## 4.4.9 Plots of Unwanted Emission

### 4.4.9.1 Spurious Emission at Low Frequency

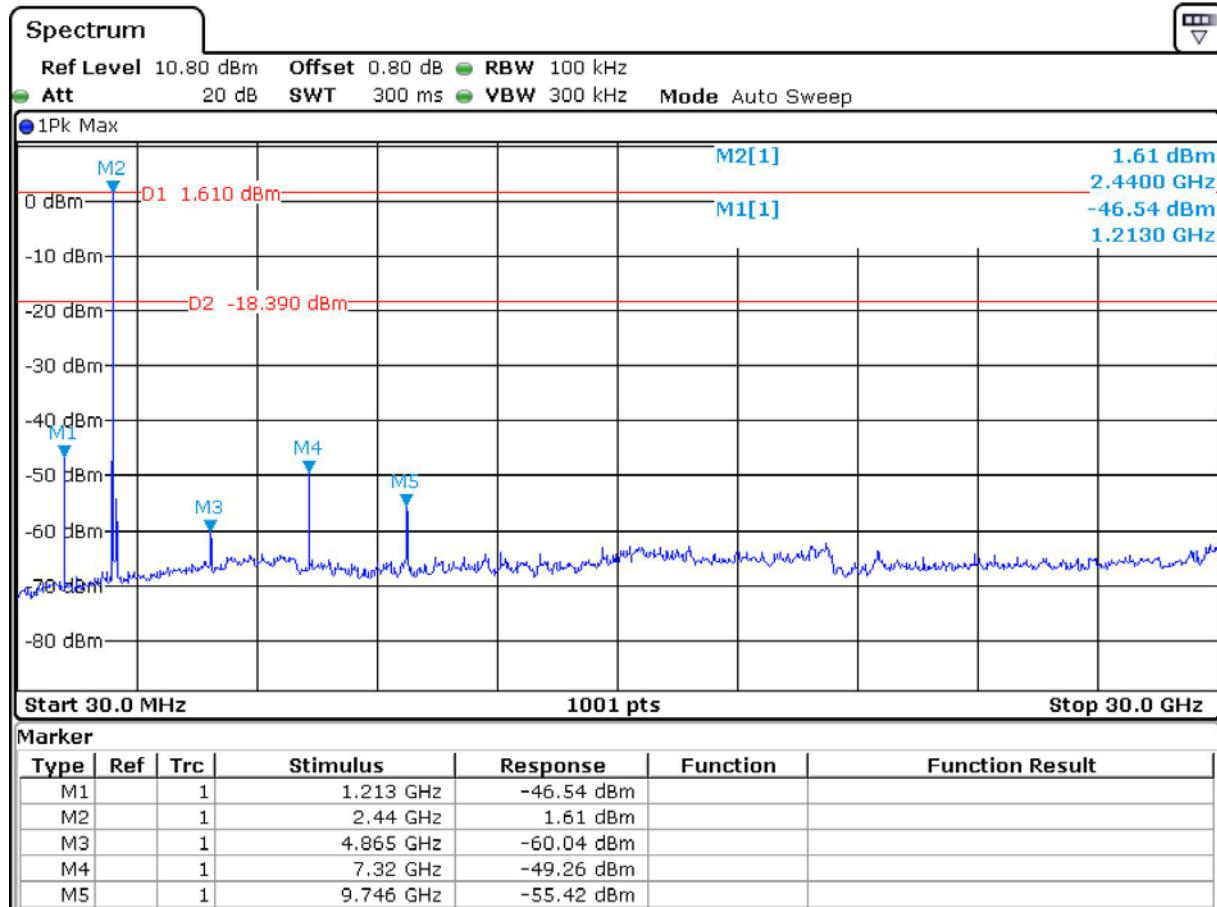


Date: 5.MAR.2013 05:17:22

Channel Number : 0  
Operating Frequency : 2 402 MHz  
RBW : 100 kHz  
VBW : 300 kHz  
Detector Mode : Peak  
Trace Mode : Max Hold  
Sweep Time : Auto

Unwanted Emission at Worst Case : 47.94 dBc

#### 4.4.9.2 Spurious Emission at Middle Frequency

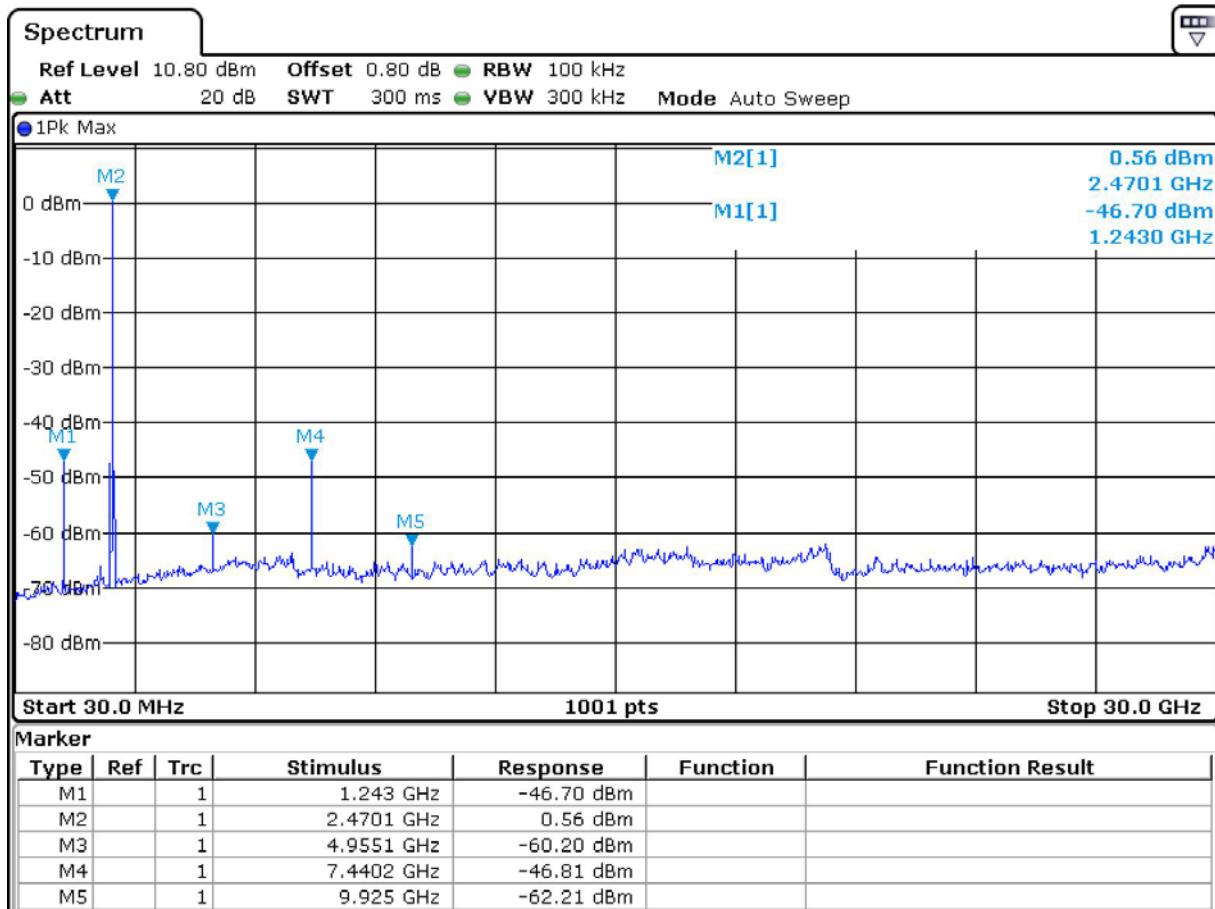


Date: 5.MAR.2013 04:44:13

Channel Number : 19  
Operating Frequency : 2 440 MHz  
RBW : 100 kHz  
VBW : 300 kHz  
Detector Mode : Peak  
Trace Mode : Max Hold  
Sweep Time : Auto

Unwanted Emission at Worst Case : 48.15 dBc

#### 4.4.9.3 Spurious Emission at High Frequency



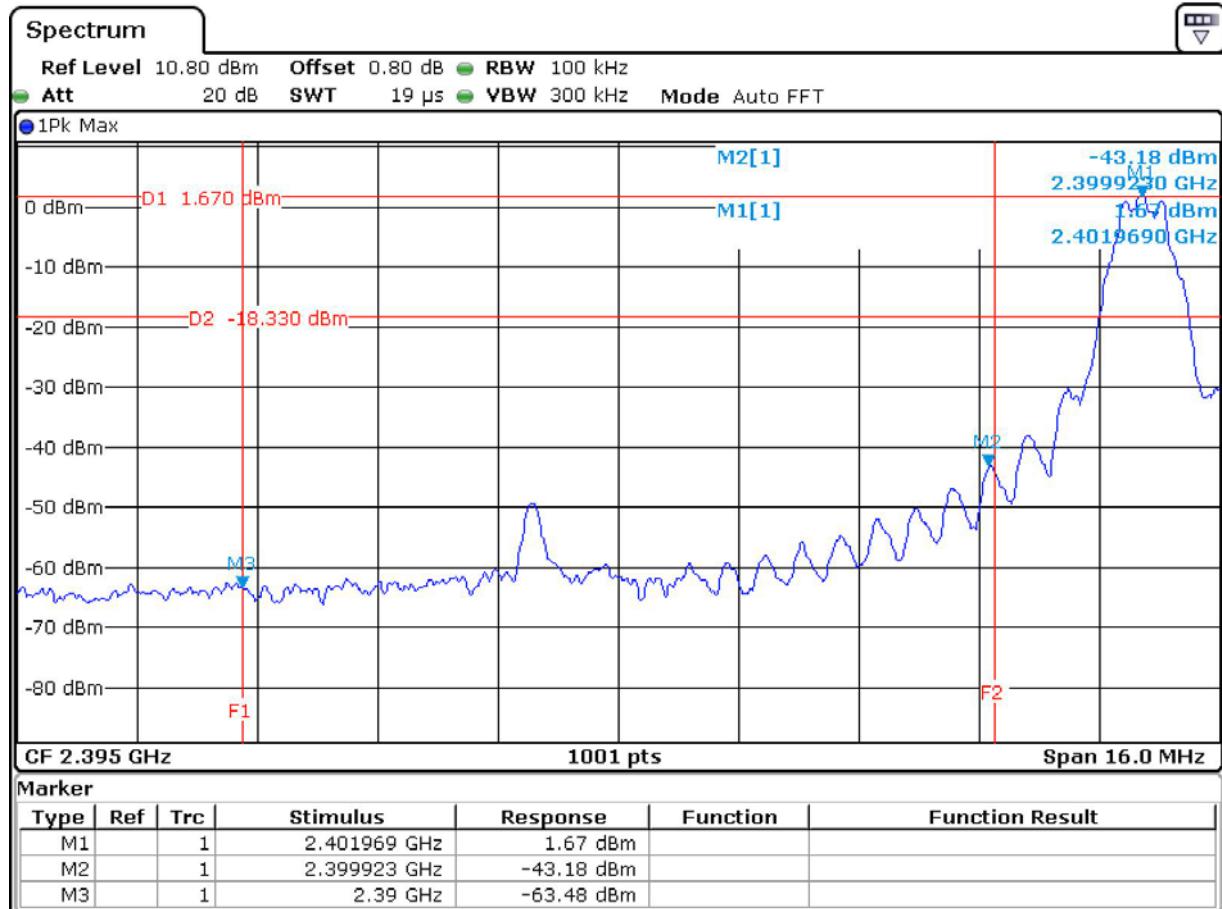
Date: 5.MAR.2013 04:40:51

Channel Number : 39  
Operating Frequency : 2 480 MHz  
RBW : 100 kHz  
VBW : 300 kHz  
Detector Mode : Peak  
Trace Mode : Max Hold  
Sweep Time : Auto

Unwanted Emission at Worst Case : 47.26 dBc

#### 4.4.10 Plots of Band Edge Emission

##### 4.4.10.1 Band Edge Emission at Low Frequency

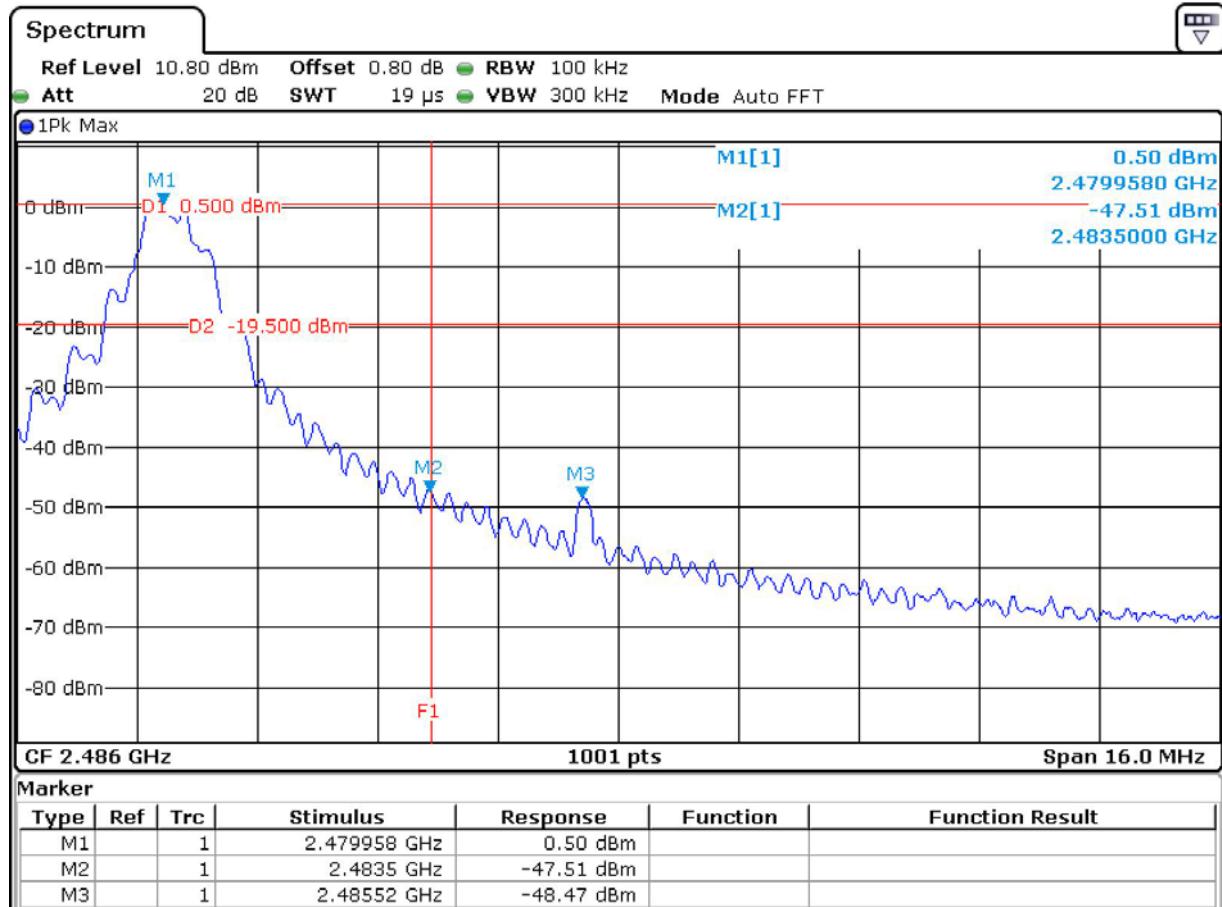


Date: 5.MAR.2013 05:31:30

Channel Number : 0  
Operating Frequency : 2 402 MHz  
RBW : 100 kHz  
VBW : 300 kHz  
Detector Mode : Peak  
Trace Mode : Max Hold  
Sweep Time : Auto

Unwanted Emission at Worst Case : 44.85 dBc

#### 4.4.10.2 Band Edge Emission at High Frequency



Date: 5.MAR.2013 05:35:13

Channel Number : 39  
Operating Frequency : 2 480 MHz  
RBW : 100 kHz  
VBW : 300 kHz  
Detector Mode : Peak  
Trace Mode : Max Hold  
Sweep Time : Auto

Unwanted Emission at Worst Case : 48.01 dBc

## 4.5 Radiated Band Edges and Spurious Emission

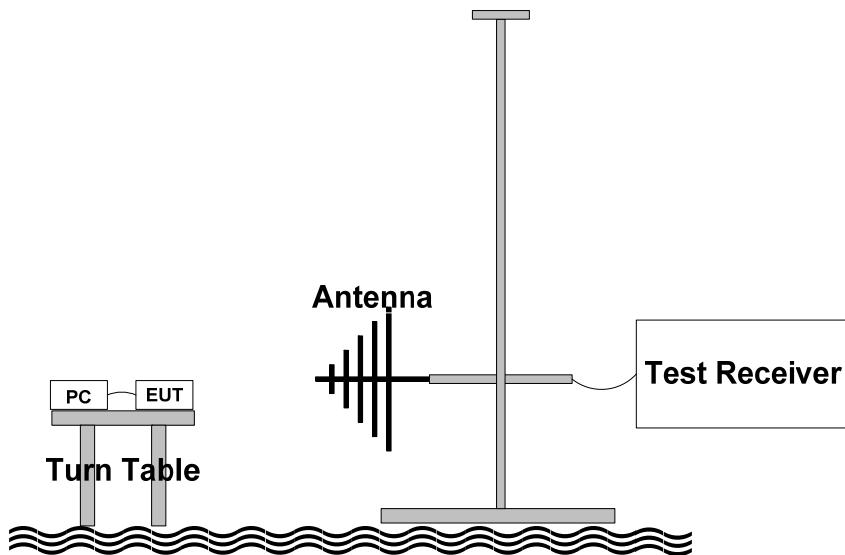
### 4.5.1 Specification

- FCC Rules Part 15 Section 15.247(d)

### 4.5.2 Measurement method

- 558074 D01 DTS Meas Guidance v02, Section 10.0
- ANSI C63.4-2003 Section 7

### 4.5.3 Set-up



### 4.5.4 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Test Receiver	ESCI 7	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	HP6560b	HP
Test fixer	RS232	WaveShare
Loop antenna	EMCO 6502	EMCO
Bi-conical antenna	VHA9103	Schwarzbeck
Log periodic antenna	VULP9118A	Schwarzbeck
Horn Antenna	BBHA-9120D	Schwarzbeck
Pre-amplifier	SCU01	Rohde & Schwarz
Pre-amplifier	JS4-00102600-26-5P	MITEQ

#### 4.5.5 Test procedure

The EUT is placed on a turntable, which is 0.8 meter high above ground.

The turntable rotates 360 degrees to determine the position of the maximum emission level.

EUT is set 3.0 meters away from the receiving antenna, broadband antenna, which is mounted on an antenna mast. The antenna moved up and down between 1 meter and 4 meters to find out the maximum emission level from the EUT. Both horizontal and vertical polarizations of the antenna are set on measurement.

In order to find out the maximum emission levels, all of the EUT location were manipulated according to ANSI 63.4 during the radiated emission measurement. The EUT was tested to 3 orthogonal planes.

The RBW of test receiver is 120 kHz between 30 to 1 000 MHz, and 1 MHz above 1 GHz.

For measurement peak mode, VBW is set to 3 times of RBW.

For measurement average mode, VBW is set to 10 Hz.

#### 4.5.6 Test condition

- Test place : Open area test site
- Test environment : 5 °C, 34 % R.H.
- Test mode : Operation at single channel

#### 4.5.7 Limit

Frequency [MHz]	Field Strength [ $\mu$ V/m]	Field Strength [dB $\mu$ V/m]	Measurement Distance [m]
0.009 – 0.490	2 400 / F(kHz)	48.52 to 13.80	300
0.490 – 1.705	2 4000 / F(kHz)	33.80 to 22.97	30
1.705 – 30.0	30	29.54	30
30 – 88	100	40.00	3
88 – 216	150	43.52	3
216 – 960	200	46.02	3
Above 470	500	53.98	3

Remark: Radiated emissions which fall in the restricted bands must also comply with the limits as this table.

#### 4.5.8 Test result

Frequency [MHz]	Pol. [H/V]	Plane [X/Y/Z]	Detect mode [Peak/AVG]	Reading [dB $\mu$ V]	Antenna factor [dB/m]	Cable loss [dB]	Pre-amp gain [dB]	Emission level [dB $\mu$ V]	Limit [dB $\mu$ V]	Margin [dB]
Operation Channel 0										
1 201.0	V	Y	Peak	46.4	24.7	4.7	30.8	45.0	74.0	29.0
<b>2 400.0</b>	<b>H</b>	<b>Y</b>	Peak	<b>47.3</b>	<b>27.3</b>	<b>6.7</b>	<b>31.0</b>	<b>50.3</b>	<b>74.5</b>	<b>24.2</b>
2 402.0	H	Y	Peak	91.5	27.3	6.7	31.0	94.5	-	-
4 804.0	H	Y	Peak	25.4	31.3	9.9	31.5	35.1	74.0	38.9
7 206.0	H	Y	Peak	22.9	36.5	12.2	31.3	40.3	74.5	34.2
Operation Channel 19										
<b>1 220.0</b>	<b>V</b>	<b>Y</b>	<b>Peak</b>	<b>45.6</b>	<b>24.7</b>	<b>4.8</b>	<b>30.8</b>	<b>44.3</b>	<b>73.9</b>	<b>29.6</b>
2 440.0	H	Y	Peak	90.8	27.4	6.7	31.0	93.9	-	-
4 880.0	H	Y	Peak	20.1	31.5	10.0	31.5	30.1	73.9	43.8
7 320.0	H	Y	Peak	24.4	36.9	12.3	31.3	42.1	73.9	31.8
Operation Channel 39										
<b>1 240.0</b>	<b>V</b>	<b>Y</b>	<b>Peak</b>	<b>45.2</b>	<b>24.8</b>	<b>4.8</b>	<b>30.8</b>	<b>44.0</b>	<b>71.9</b>	<b>27.9</b>
2 480.0	H	Y	Peak	88.6	27.5	6.8	31.0	91.9	-	-
2 483.5	H	Y	Peak	40.6	27.5	6.8	31.0	43.9	71.9	28.0
4 960.0	H	Y	Peak	19.8	31.7	10.1	31.6	30.0	71.9	41.9
7 440.0	H	Y	Peak	24.3	37.3	12.5	31.4	42.7	71.9	29.2
The other emissions were not detected.										

## 4.6 Power line conducted emission

### 4.6.1 Specification

- FCC Rules Part 15 Section 15.207

### 4.6.2 Measurement method

- ANSI C63.4-2003

### 4.6.3 Test equipment list

Equipment	Model name	Manufacturer
EUT	HB4500	HUMBLE
Test Receiver	ESS	Rohde & Schwarz
Power supply	E3633A	Agilent
Control PC	HP6560b	HP
Test fixer	RS232	WaveShare
LISN	ENV216	Rohde & Schwarz
LISN	NNBM 8125	Schwarzbeck
LISN	NNBM 8125	Schwarzbeck

### 4.6.4 Test procedure

The EUT was placed on a wooden table with 0.8 m height above the floor. The EUT was connected to AC power supply and the input power was supplied through a  $50 \Omega / 50 \mu\text{H} \pm 5 \Omega$  Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

### 4.6.5 Test condition

- Test place : Shield room
- Test environment : 19 °C, 34 % R.H.
- Test mode : Operation at single channel

### 4.6.6 Limit

Frequency of emission [MHz]	Conducted limit [dB $\mu$ V]	
	Quasi-peak	Average
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

#### 4.6.7 Test result

- Test mode : Notebook USB power charging mode / Continuous Transmit mode

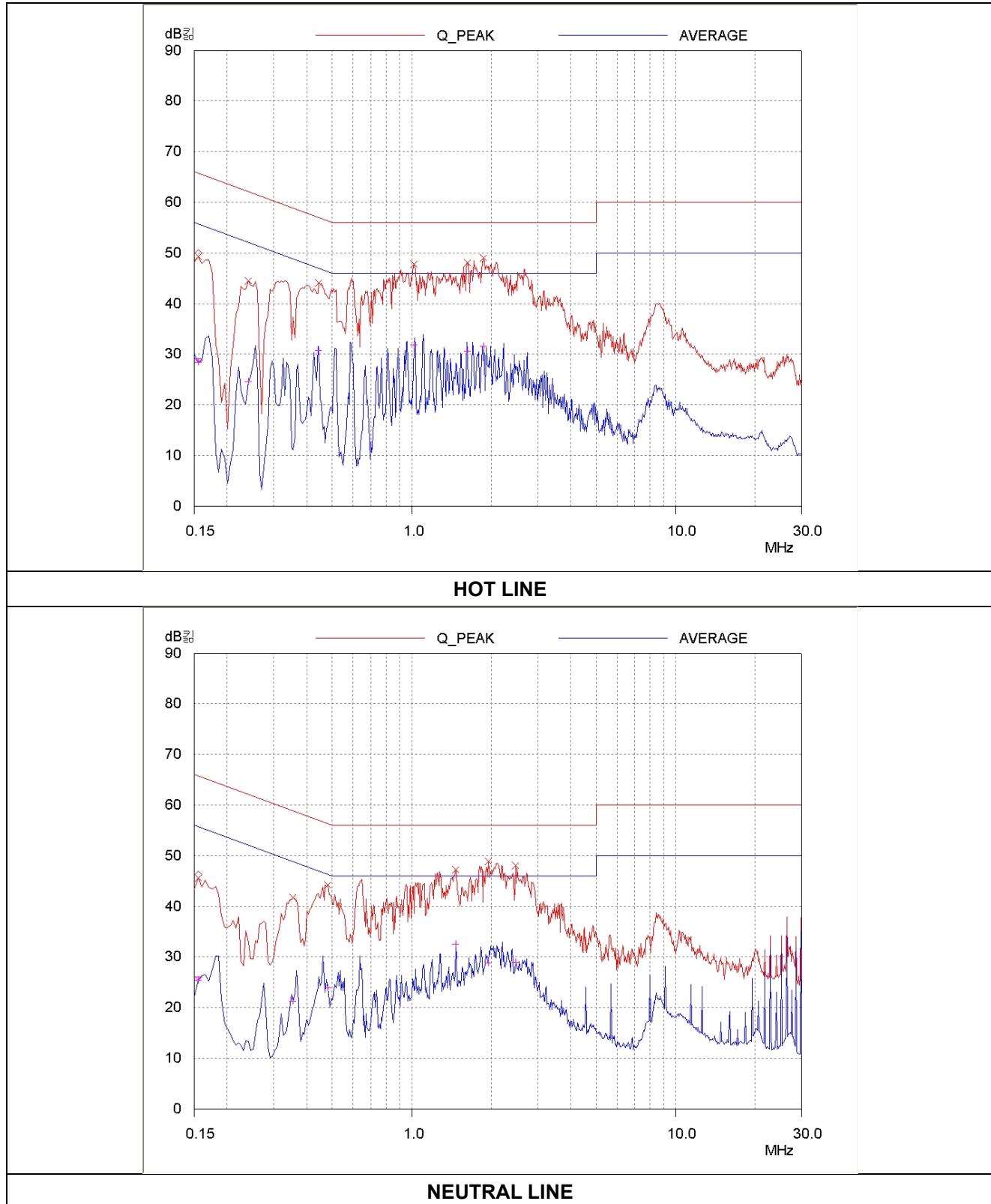
Frequency (MHz)	Line	Quasi Peak (dB $\mu$ V)			Average (dB $\mu$ V)		
		Emission Level	Limits	Margin (dB)	Emission Level	Q.P Limits	Margin (dB)
0.16	H	49.24	65.73	16.49	28.40	55.73	27.33
0.24	H	44.44	62.10	17.66	24.55	52.10	27.55
0.48	N	44.22	56.34	12.12	23.85	46.34	22.49
1.02	H	47.72	56.00	8.28	31.85	46.00	14.15
1.88	H	49.06	56.00	6.94	31.57	46.00	14.43
1.96	N	48.81	56.00	7.19	28.84	46.00	17.16

**Tabulated test data for Mains Terminal Continuous Disturbance Voltage**

Here, H: Hot Line, N: Neutral line

See next page for an overview sweep performed with quasi peak and average detector.

- Test mode : Notebook USB power charging mode / Continuous Transmit mode



## 5. RF exposure statement

According to §1.1307, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range [MHz]	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm <sup>2</sup> ]	Averaging Time [minute]
Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/f	2.19/f	180/f <sup>2</sup>	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	-	-	f/1500	30
<b>1500 – 100 000</b>	<b>-</b>	<b>-</b>	<b>1.0</b>	<b>30</b>

※ f = frequency in MHz

### 5.1 Friis transmission formula

$$P_d = \frac{P_{out} \times G}{4\pi \times R^2}$$

P<sub>d</sub> = Power density

P<sub>out</sub> = power input to antenna

G = power gain

R = distance to the center of radiation of the antenna

$$R = \sqrt{\frac{P_{out} \times G}{4\pi \times P_d}}$$

### 5.2 Calculation of MPE

Frequency [MHz]	Output power [dBm]	Antenna gain [dBi]	Average power		Power density at 20cm [mW/cm <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
			[dBm]	[mW]		
2 402.0	1.67	3.90	5.57	3.61	0.000 718	1.0
2 440.0	1.65	3.40	5.05	3.20	0.000 637	1.0
2 480.0	0.65	3.00	3.65	2.32	0.000 461	1.0

### 5.3 Evaluation of exclusion of SAR testing

The distance from EUT to human body can be below 5 mm.

For test separation distances ≤ 50 mm

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \\ = (3.61 / 5) \times \sqrt{2 402} = 1.12$$

The evaluation 1.12 is lower than 3.0 for 1-g SAR, and SAR test is not required.

## 6. Test equipment list

The listing below denotes the test equipment for the test(s).

No.	Equipment	Model	Manufacturer	Serial Number	Calibration Due date
1	Spectrum analyzer	FSV 30	Rohde & Schwarz	101673	02/04/14
2	Test receiver	ESCI 7	Rohde & Schwarz	1166.5950.07	01/30/14
3	Power supply	E3633A	Agilent	SG40002272	01/28/14
4	Loop antenna	6502	EMCO	9609-9087	02/26/14
5	Biconical antenna	VHA9103	Schwarzbeck	2217	11/29/13
6	Log-Periodic antenna	VULP9118A	Schwarzbeck	382	11/29/13
6	Horn antenna	BBHA 9120 D	Schwarzbeck	395	08/07/13
7	Pre-amplifier	SCU-01	R&S	10020	09/26/13
8	Pre-amplifier	JS4-00102600	MITEQ	383521	01/31/14
9	Turn table	N/A	Daeil EMC	N/A	N/A
10	Antenna mast	EAM4.5	Daeil EMC	N/A	N/A
11	Controller	DE200	Daeil EMC	AAA69813111	N/A