TEST REPORT

Report Number		**RAPA11-O-120**
Type of Equipment		**IT Helmet Bluetooth**
Model Name		**HSB-R100**
FCC ID		**ZMZ-HSB-R100**
Applicant	**Name**	**HUROB Co., Ltd.**
	Logo	HuRob
	Address	**203, BIC. Polytechnic Univ. 2121, Jeongwang-dong, Siheung-si, Gyeonggi-do, Korea**
Manufacturer	**Name**	**HUROB Co., Ltd.**
	Address	**203, BIC. Polytechnic Univ. 2121, Jeongwang-dong, Siheung-si, Gyeonggi-do, Korea**
Application date		**March 28, 2011**
Date of test		**April 25, 2011 to May 25, 2011**
Date of issue		**May 25, 2011**
Total Page		**50 pages (including this page)**

SUMMARY

The equipment complies with FCC Part 15.247 : Operation within the bands 902 MHz - 928 MHz, 2 400 MHz - 2 483.5 MHz, and 5 725 MHz - 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 : May 25, 2011

Tested by **Chang Young, Choi**
Deputy General Manager

Date : May 25, 2011

Reviewed by **Sukil, Park**
Executive Managing Director

CONTENTS

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1. General description of EUT

1.1 Applicant

- Company name : HUROB Co., Ltd.
- Address : 203, BIC. Polytechnic Univ. 2121, Jeongwang-dong, Siheung-si, Gyeonggi-do, Korea
- Contact person : Park Dong Young
- Phone/Fax : 82-31-8041-1703 / 82-31-8041-0899

1.2 Manufacturer

- Company name : HUROB Co., Ltd.
- Address : 203, BIC. Polytechnic Univ. 2121, Jeongwang-dong, Siheung-si, Gyeonggi-do, Korea
- Contact person : Park Dong Young
- Phone / Fax : 82-31-8041-1703 / 82-31-8041-0899

1.3 Basic description of EUT

- Product name : IT Helmet Bluetooth
- Model name : HSB-R100
- FCC ID : ZMZ-HSB-R100
- Serial number : Not available(Proto Type)
- Frequency : 2 402 ~ 2 483.5 MHz
- Channel number : 79 Channels
- Modulation method : QPSK
- FCC Rule Part(s) : FCC Part 15 Subpart C Section 15.247
- FCC classification : DTS / Digital Transmission System
- Date of test : April 25, 2011 to May 25, 2011
- Date of issue : May 25, 2011
- Place of test : Head office

  C-3601, Dongil Technotown, 889-1, Gwanyang-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea, 483-060

  Open area test site

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

  (FCC Registration Number : 337229)

  (IC Submission Number : 143881)

  (KCC Designation Number : KR0027)

1.4 Technical specification of EUT

Product Name	HSB-R100
Specifications of Bluetooth	2.1 version
Frequency range	2 402 MHz ~ 2 480 MHz
Communication distance	Max. 200 m
Transmission Power	Max. 7mW
Mobile phone mode	Supporting HSP1.5
Intercom mode	Supporting other kinds of equipment
MP3 mode	Supporting Stereo
Charging time	About 2.5 hours
Multi tasking	Support
MIC type	Embedded in main body or external device support
Call conversation time	Max. 9 H
Waiting time	Max. 150 H
Profile	A2DP, AVRCP, HFP
External view	60(L) X 25(W) X 12(H)
Weight	Max. 30 g
Output power of adapter	DC 5 V / 500 mA

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2. General information of test

2.1 Standards applied for testing

Applied Standard : 47 CFR Part 15, Subpart C			
FCC Rule	**Description of Test**	**Limit**	**Result**
15.203 / 15.204	Antenna information	Confirmation	Pass
15.207	Power line conducted emission	Variation	N/A
15.247(a)	Hopping sequence	Confirmation	Pass
15.247(a)	Equal hopping frequency use	Confirmation	Pass
15.247(a)	Receiver input bandwidth	Confirmation	Pass
15.247(a)	Receiver hopping capability	Confirmation	Pass
15.247(a)	20 dB bandwidth	≥ 0.667	Pass
15.247(a)	Average time of occupancy	< 0.4 second	Pass
15.247(a)	Carrier frequency separation	1 MHz	Pass
15.247(a)	Minimum hopping channels	> 75 channels	Pass
15.247(b)	Maximum peak output power	< 30dBm	Pass
15.247(d)	Conducted emission and 100kHz bandwidth of frequency band edges	> 20dBc	Pass
15.247(d) / 15.209	Radiated emission	Variation	Pass

2.2 Description of EUT modification

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

2.3 Peripheral equipments and cables used for testing

• Type of peripheral equipment used

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	GMR-FW	N/A	GS Instruments	ZMZ-HSB-R100
Control PC	2652-C3K	99-FHKFV	LG Electronics	-

• Type of cable used

Device from	Device to	Type of Interface	Type of Cable	Length
EUT	Control PC	SPI Interface	Non-Shield	1.0 m

3. Technical information of equipment

3.1 Antenna information

Manufacturer of Antenna	HUROB
Antenna Name	HSB-S100
Antenna Type	Ceramic Chip Antenna
Maximum Antenna Gain	2.05 dBi
Frequency Range	2 400.0 MHz ~ 2 483.5 MHz
VSWR	2.0 Max.
Polarization	Linear

3.2 Hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master.

The frequency-hopping schemes

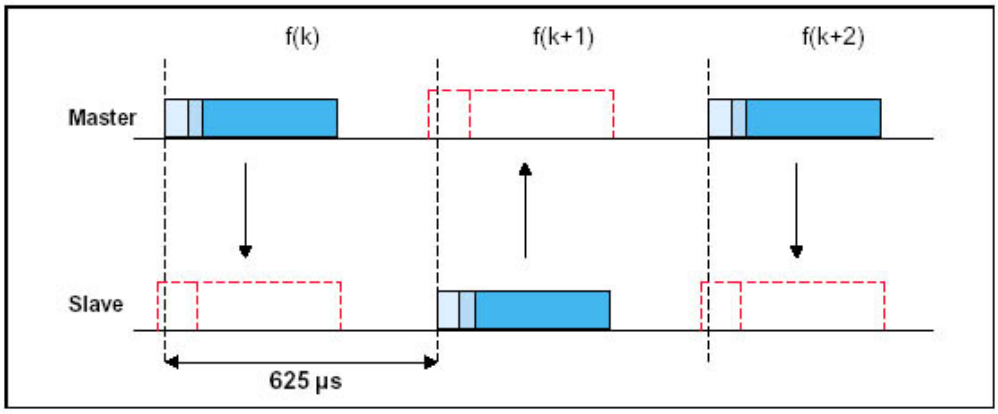
1. A page hopping sequence with 32 unique wake-up frequencies, distributed equally over the 79 MHz, with a period length of 32.
2. A page response sequence covering 32 unique response frequencies that are all in a one-to-one correspondence to the current hopping sequence. Master & Slave use different rules to obtain the same sequence.
3. An inquiry sequence with 32 unique wake-up frequencies, distributed equally over the 79 MHz, with a period length of 32.
4. A inquiry response sequence covering 32 unique response frequencies that are all in a one-to-one correspondence to the current inquiry hopping sequence.
5. A channel hopping sequence with very long period, which does not show repetitive patterns over a short time interval, but which distributes the hop frequencies equally.

Bluetooth device operate on an unlicensed frequency band between 2.4 to 2.483 5 GHz. To avoid interference with other devices operating on the same band, the technology uses a frequency hopping algorithm with 1 600 frequency hops per second.

The time during which devices operate in a frequency is called a time slot and is 625 μs in during.

Units in a piconet change frequency at the same time on command from the master unit, based on pseudo-random hopping sequence. The frequency band is broken up into 79 channels spaced 1MHz apart. Data is transmitted in frames, which can span 1,3 or 5 slots.

The first type of connection is used to transferring data in real time, e.g. for transmitting voice data. A slave unit can have up to 3 SCO links with the main unit, each with a rate of 64kb/sec.



3.3 Equal hopping frequency use

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.

3.4 Receiver input bandwidth

The receiver bandwidth is equal to the receiver bandwidth in the 79 hopping channel mode, which is 1 MHz. The receiver bandwidth was verified during Bluetooth RF conformance testing.

3.5 Receiver hopping capability

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.

4. Measurement data

4.1 20 dB bandwidth

4.1.1 Definition

A 20 dB Bandwidth is width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each lower 20 dB of the total mean power of a given emission

4.1.2 Specification

FCC Rules Part 15, Section 15.247(a)(1)

4.1.3 Method of measurement

Public Notice “DA 00-705”
ANSI/TIA-603-D-2010 Section 2.2.11

4.1.4 Measurement set-up

4.1.5 Test equipments

Equipment	Model name	Manufacture
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz

4.1.6 Test procedure

① Connect the equipment as “Measurement set-up”.
② Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level.
③ RBW 30 kHz, VBW 100 kHz, Max Hold

4.1.7 Test condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.1.8 Test result

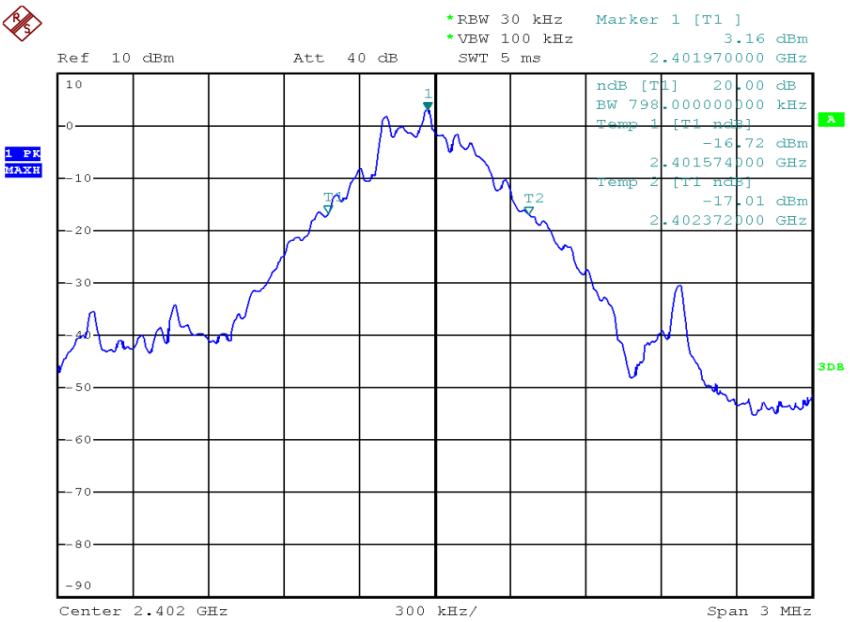
Channel	Frequency (MHz)	Packet type	Measured bandwidth (MHz)
Low	2 402	DH1	0.798
		DH3	0.822
		DH5	0.894
Middle	2 441	DH1	0.804
		DH3	0.822
		DH5	0.870
High	2 480	DH1	0.840
		DH3	0.828
		DH5	0.876

4.1.9 Limit

Frequency hopping systems operating in the 2 400 MHz - 24 83.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

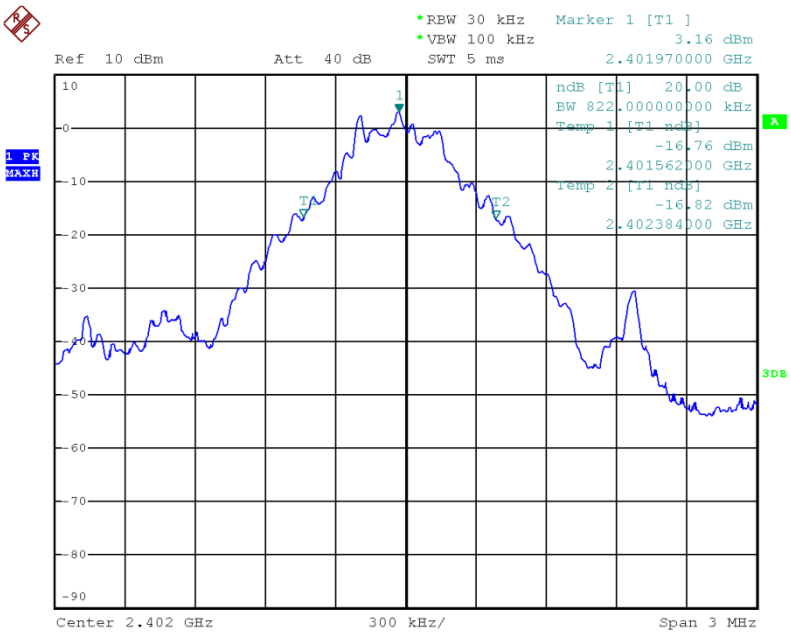
4.1.10 Plots of 20 dB bandwidth

① DH1 of 2 402 MHz



→ 20 dB bandwidth : 0.798 MHz

② DH3 of 2 402 MHz



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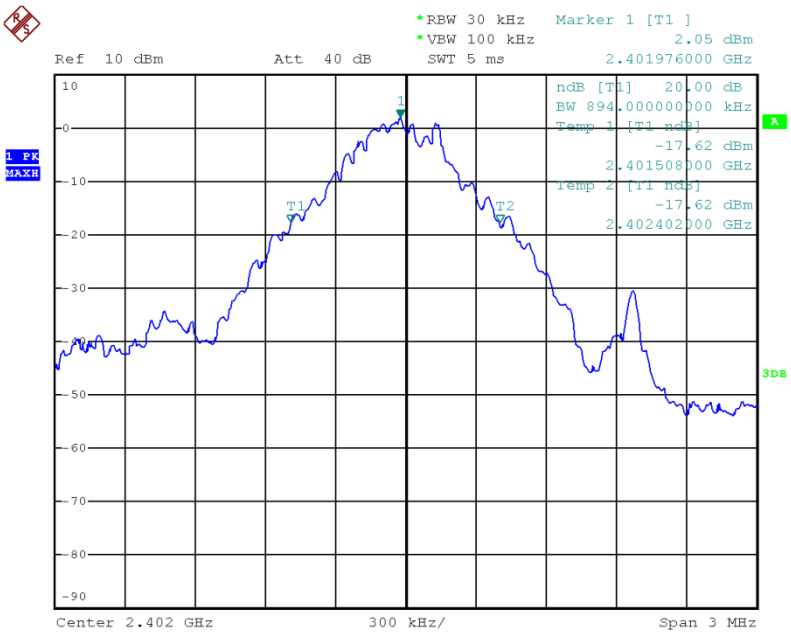
→ 20 dB bandwidth : 0.822 MHz

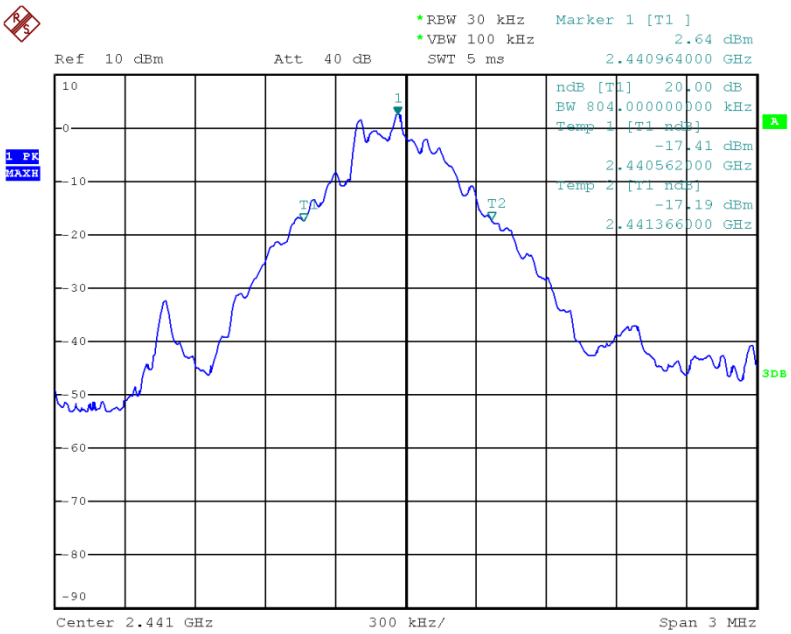
③ DH5 of 2 402 MHz



Date: 3.MAY.2011 21:48:24

→ 20 dB bandwidth : 0.894 MHz

④ DH1 of 2 441 MHz



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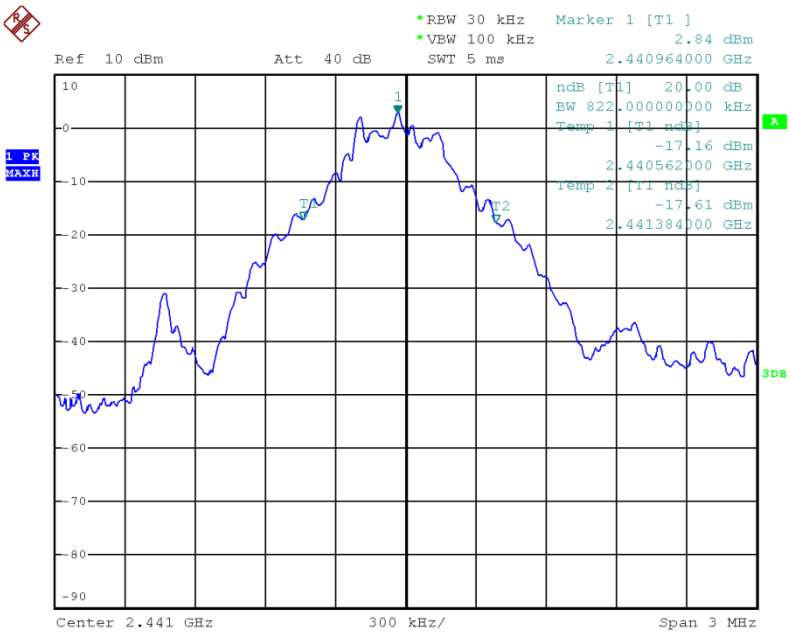
→ 20 dB bandwidth : 0.804 MHz

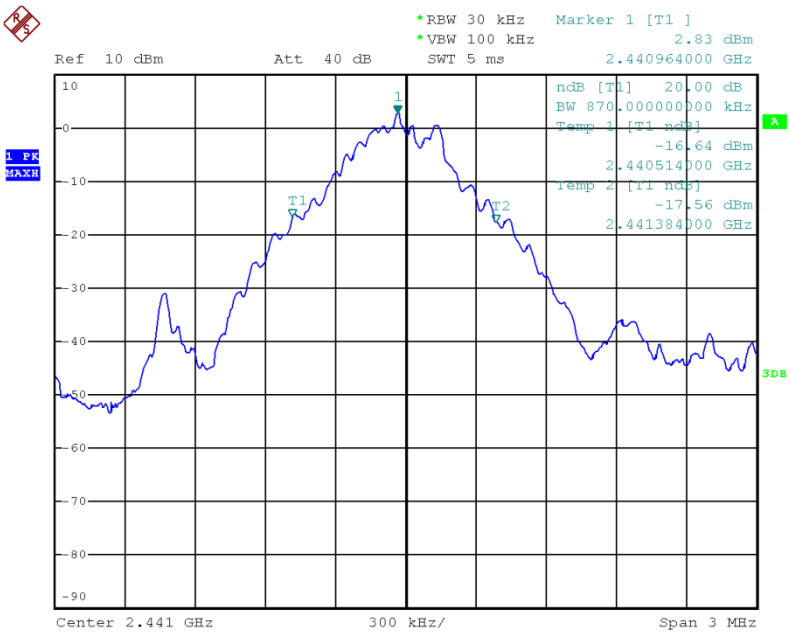
⑤ DH3 of 2 441 MHz



Date: 3.MAY.2011 21:41:58

→ 20 dB bandwidth : 0.822 MHz

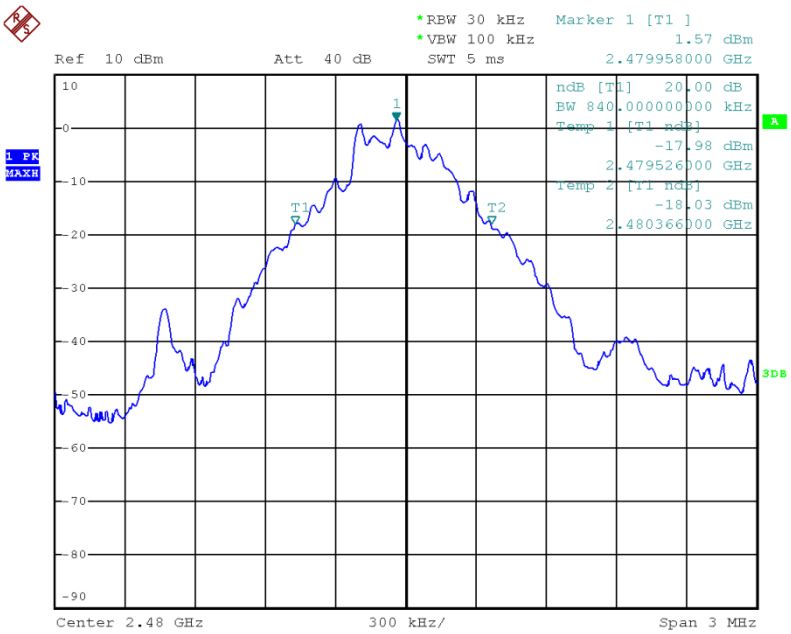
⑥ DH5 of 2 441 MHz



Date: 3.MAY.2011 21:47:09

→ 20 dB bandwidth : 0.870 MHz

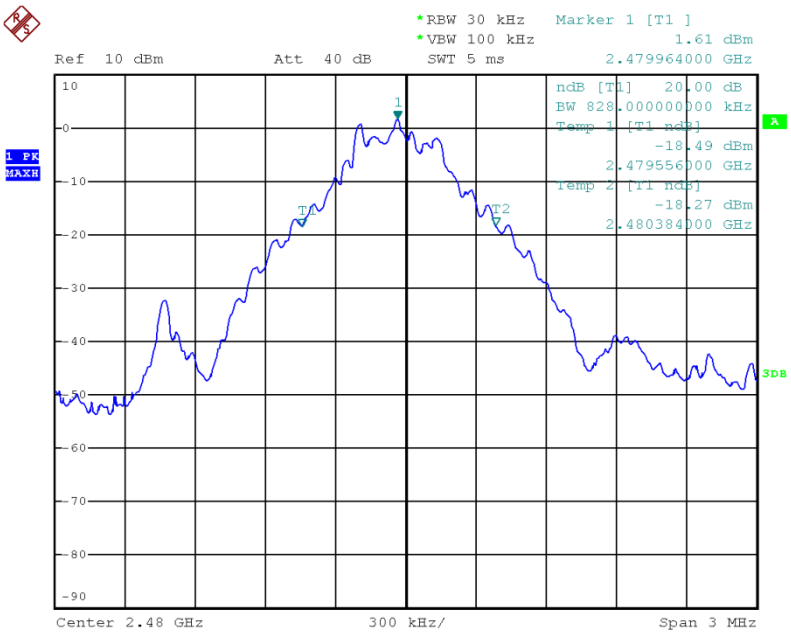
⑦ DH1 of 2 480 MHz



Date: 3.MAY.2011 21:38:26

→ 20 dB bandwidth : 0.840 MHz

⑧ DH3 of 2 480 MHz



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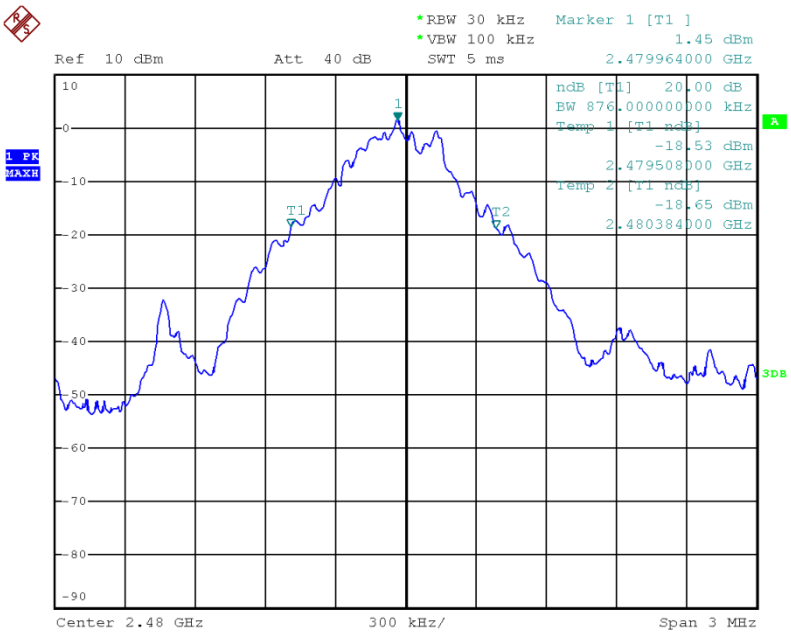
→ 20 dB bandwidth : 0.828 MHz

⑨ DH5 of 2 480 MHz



Date: 3.MAY.2011 21:44:42

→ 20 dB bandwidth : 0.876 MHz

4.2 Average time of occupancy

4.2.1 Definition

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

4.2.2 Specification

FCC Rules Part 15, Section 15.247(a)(a)(iii)

4.2.3 Method of measurement

Public Notice “DA 00-705”

4.2.4 Measurement set-up

4.2.5 Test equipment list

Equipment	Model name	Manufacture
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz

4.2.6 Test procedure

① According to Section 15.247(a)(1)(iii) the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

② The time period to be observed is “0.4 s x 79 = 31.6 seconds”.

③ According to the Bluetooth specification the system transmits at a rate of 1 600 hops per second. For DH5 packet five time slot is used for TX and one time slot for RX.

④ That means a total of (1600 / 6) transmissions occurs in one second. The average time of occupancy is calculated as following: “[{(1 600 / 6) x 2.920 ms} x (0.4 x 79)] / 79 = 311.47 ms”

⑤ Dwell time = [hop/s] X [observed time] X [transmission time]

4.2.7 Test condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.2.8 Test result

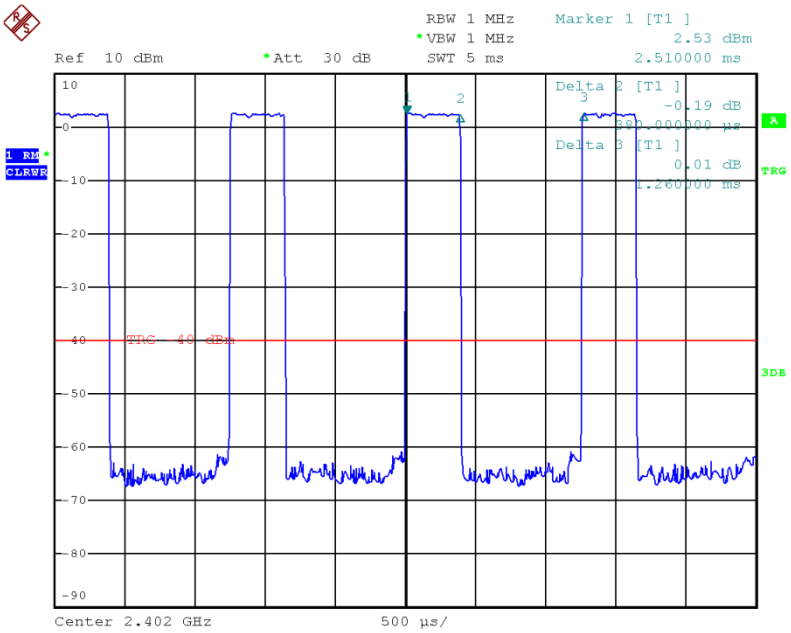
Channel	Frequency (MHz)	Packet type	Transmission time (ms)	Hop per second (Hop/s)	Dwell time (ms)	Limit (ms)
Low	2 402	DH1	0.380	10.44	125.36	≤ 400
		DH3	1.620	5.38	275.41	
		DH5	2.920	3.48	321.10	
Middle	2 441	DH1	0.380	10.44	125.36	
		DH3	1.620	5.38	275.41	
		DH5	2.920	3.48	321.10	
High	2 480	DH1	0.380	10.44	125.36	
		DH3	1.620	5.38	275.41	
		DH5	2.920	3.48	321.10	

4.2.9 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds multiplied by the number of hopping channels employed.

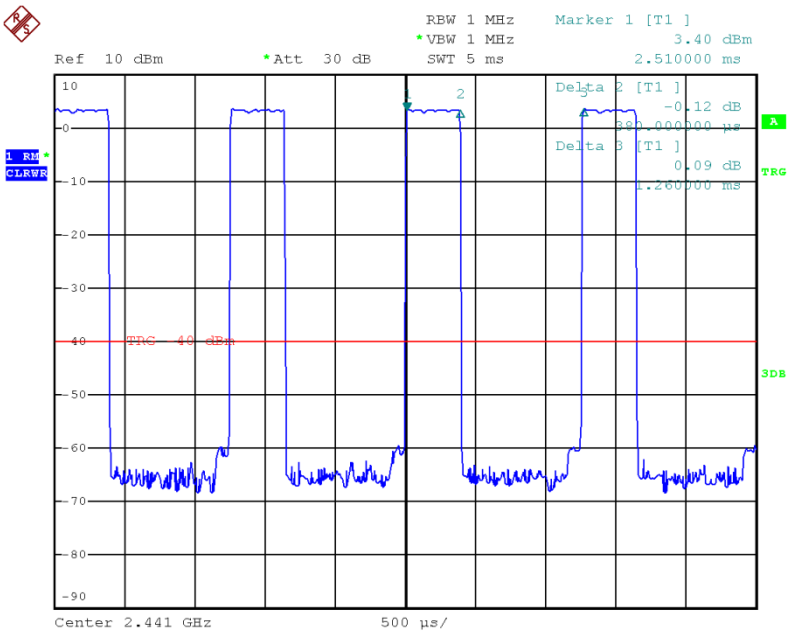
4.2.10 Plot of average time of occupancy

① DH1 of 2 402 MHz



Transmission Time → 0.380 ms

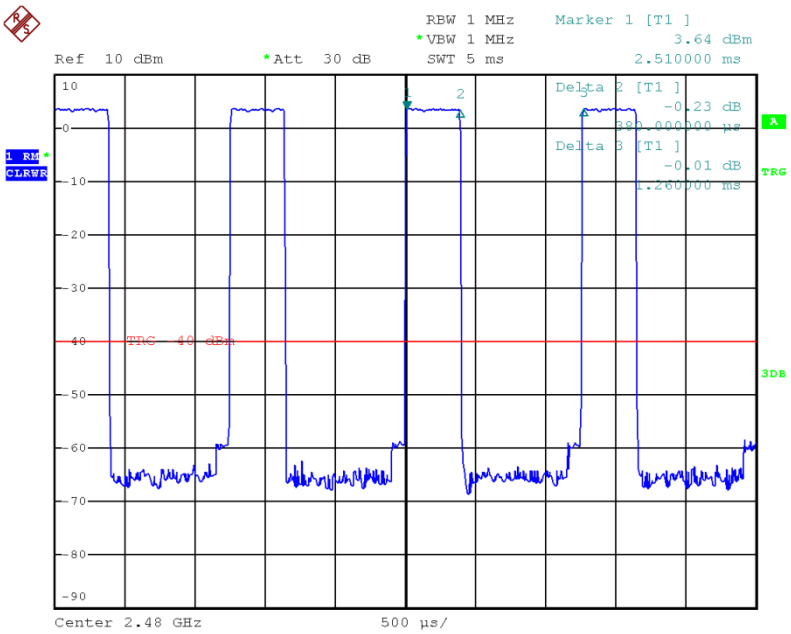
② DH1 of 2 441 MHz



Date: 23.MAY.2011 01:35:40

Transmission Time → 0.380 ms

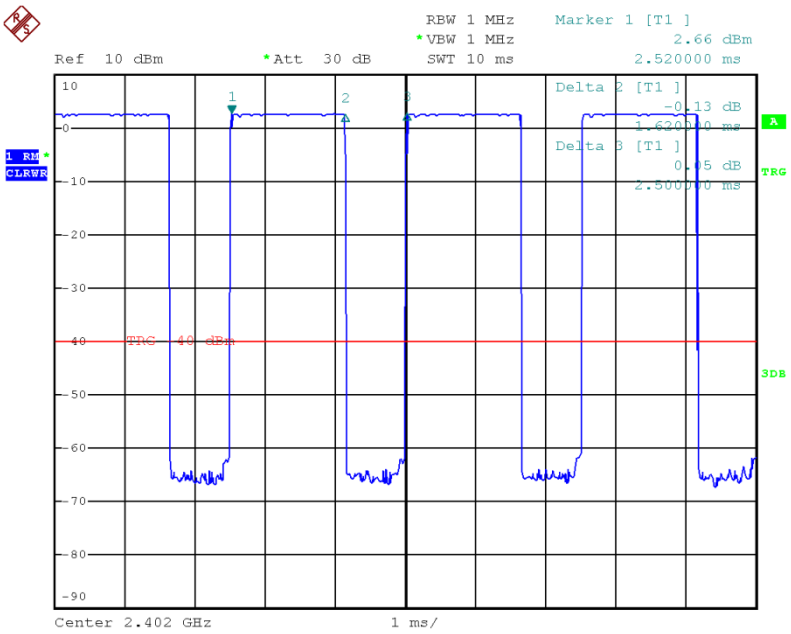
③ DH1 of 2 480 MHz



Date: 23.MAY.2011 01:35:07

Transmission Time → 0.380 ms

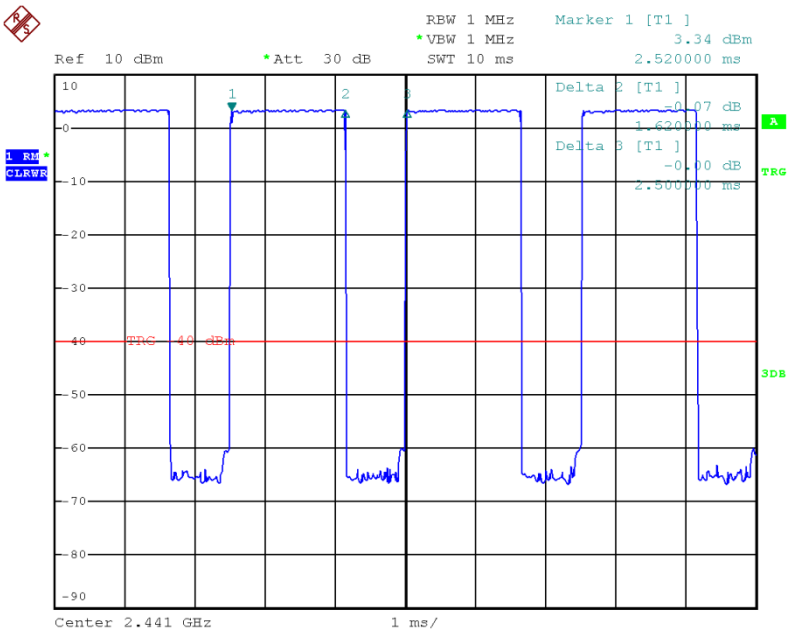
④ DH3 of 2 402 MHz



Date: 23.MAY.2011 01:40:53

Transmission Time → 1.620 ms

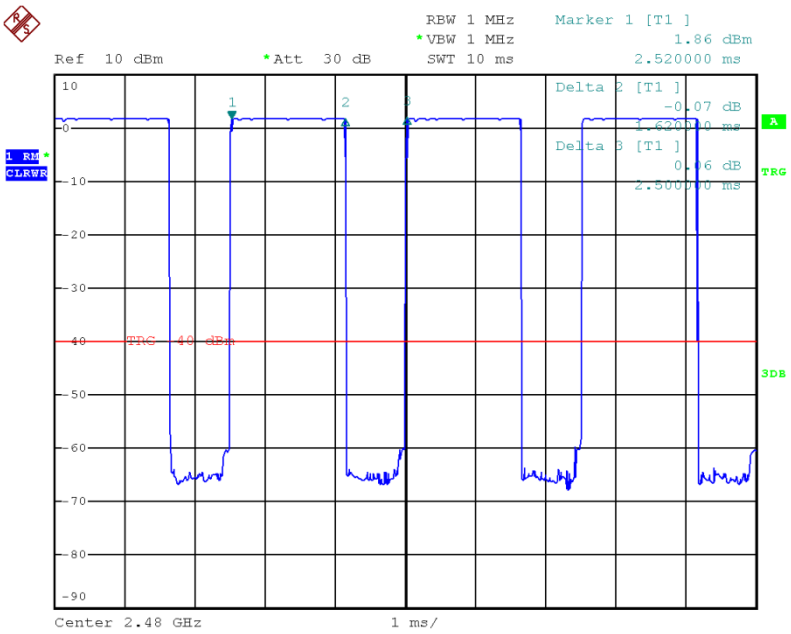
⑤ DH3 of 2 441 MHz



Date: 23.MAY.2011 01:41:39

Transmission Time → 1.620 ms

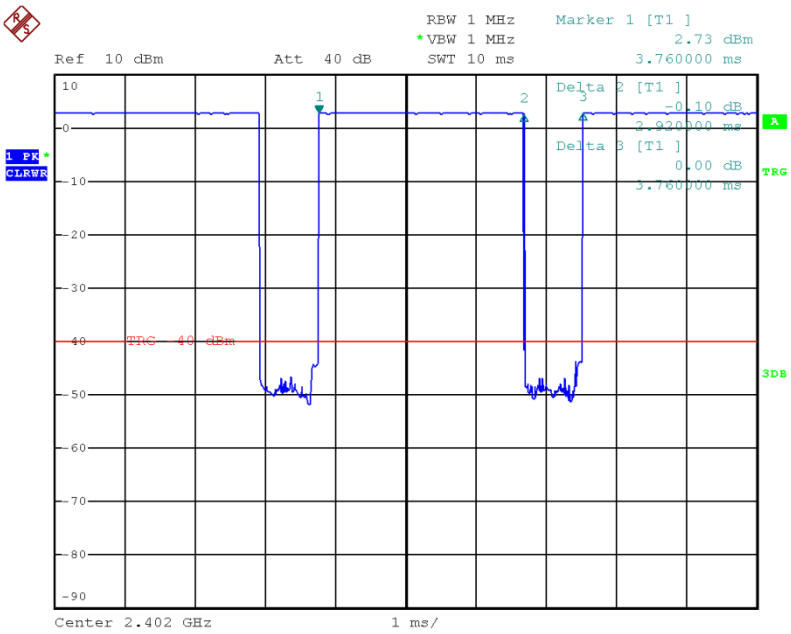
⑥ DH5 of 2 480 MHz



Date: 23.MAY.2011 01:42:10

Transmission Time → 1.620 ms

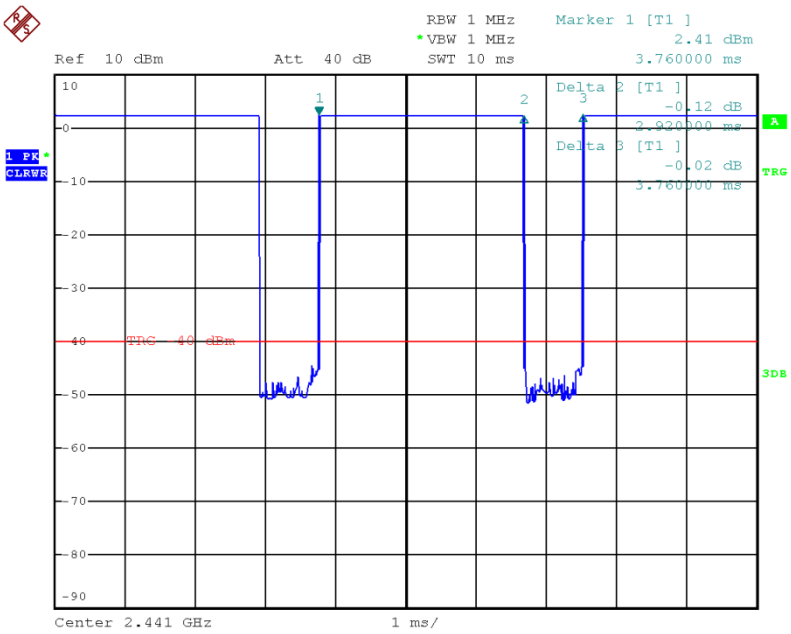
⑦ DH5 of 2 402 MHz



Date: 3.MAY.2011 21:51:19

Transmission Time → 2.920 ms

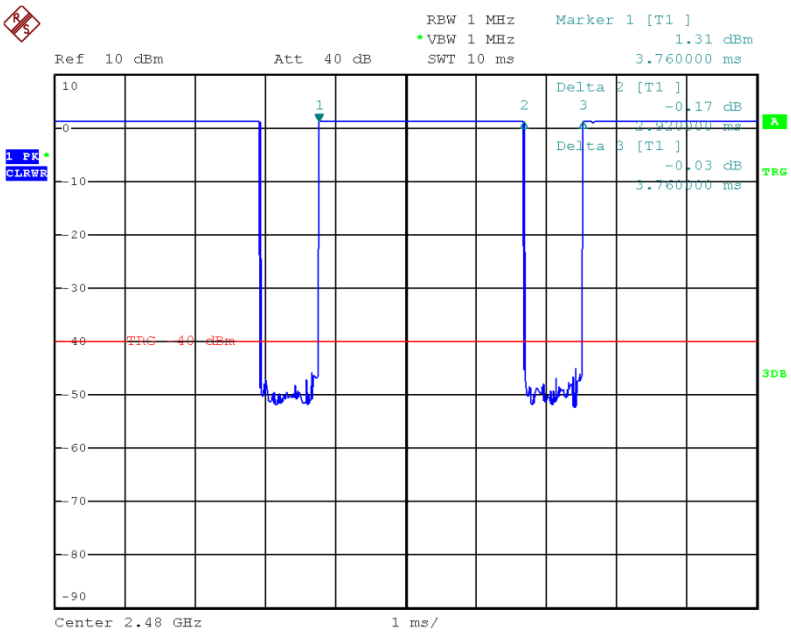
⑧ DH5 of 2 441 MHz



Date: 3.MAY.2011 21:51:45

Transmission Time → 2.920 ms

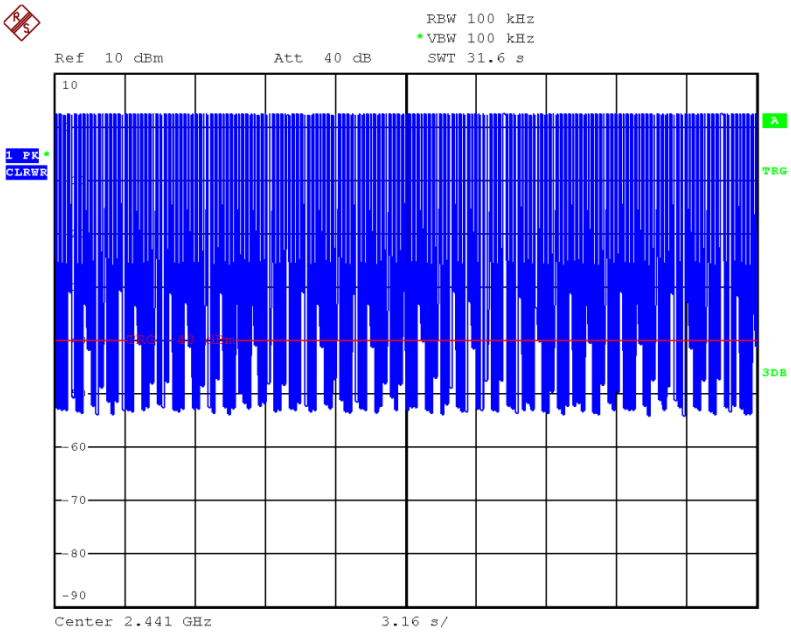
⑨ DH5 of 2 480 MHz



Date: 3.MAY.2011 21:52:02

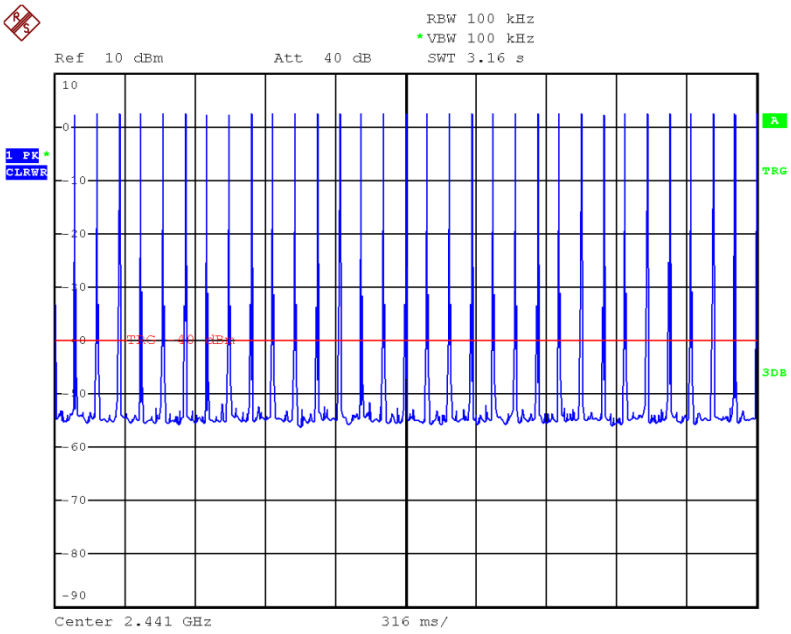
Transmission Time → 2.920 ms

⑩ Hoppings of DH1 in 31.6 s



Date: 3.MAY.2011 22:02:32

⑪ Hoppings of DH1 in 3.16 s

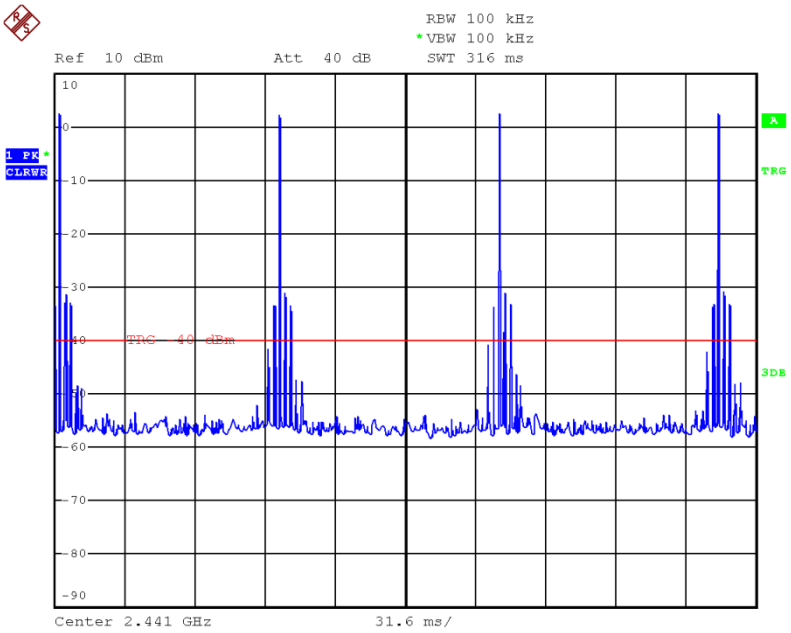


Date: 3.MAY.2011 22:02:55

Number of hops in 3.16 s → 33 times

Hop per second → 10.44 times

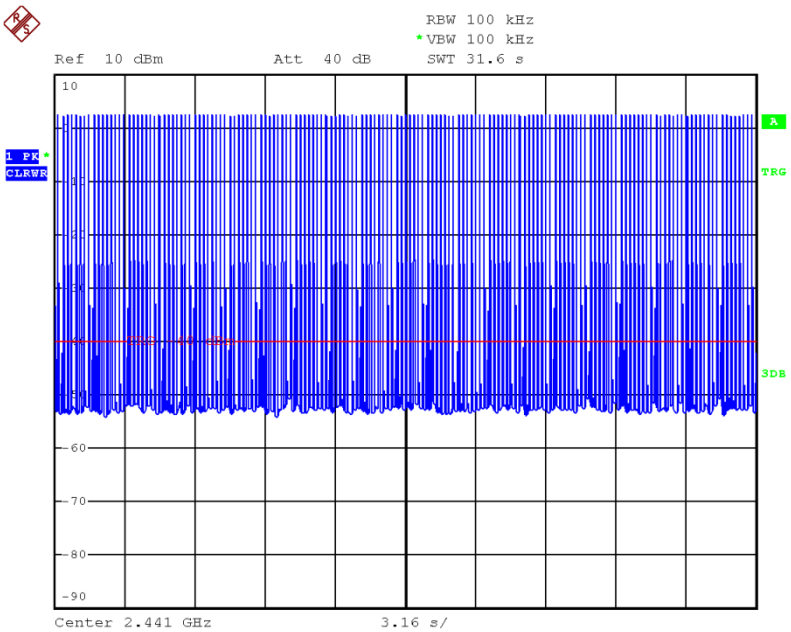
⑫ Hopping of DH1 in 0.316 s



Date: 3.MAY.2011 22:03:26

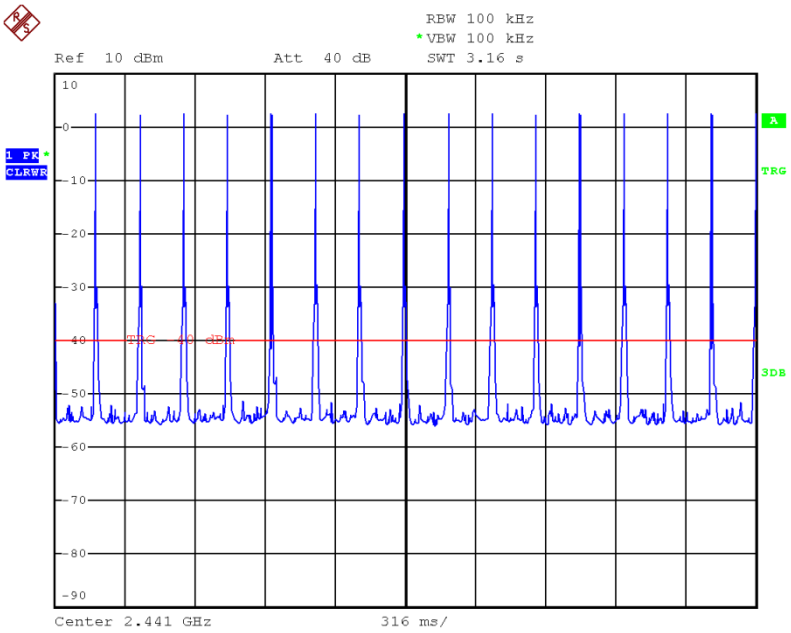
Number of hops in 0.316 s → 4 times

⑬ Hopping of DH3 in 31.6 s



Date: 3.MAY.2011 22:01:39

⑭ Hopping of DH3 in 3.16 s

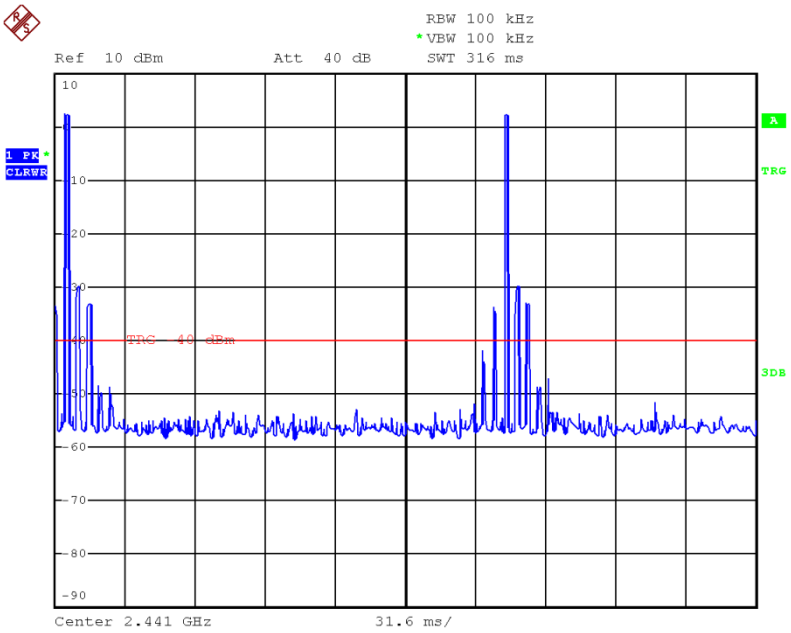


Date: 3.MAY.2011 22:00:35

Number of hops in 3.16 s → 17 times

Hop per second → 5.38 times

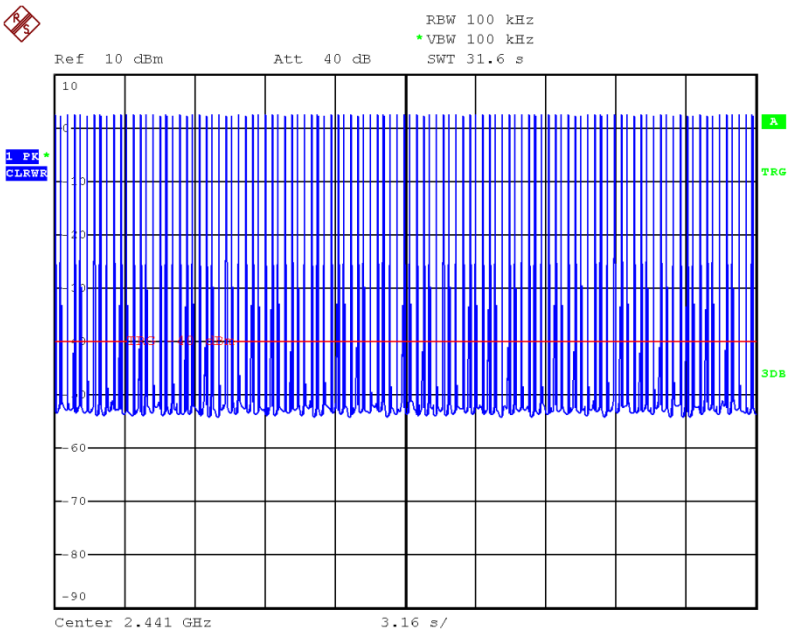
⑮ Hopping of DH3 in 0.316 s



Date: 3.MAY.2011 22:03:49

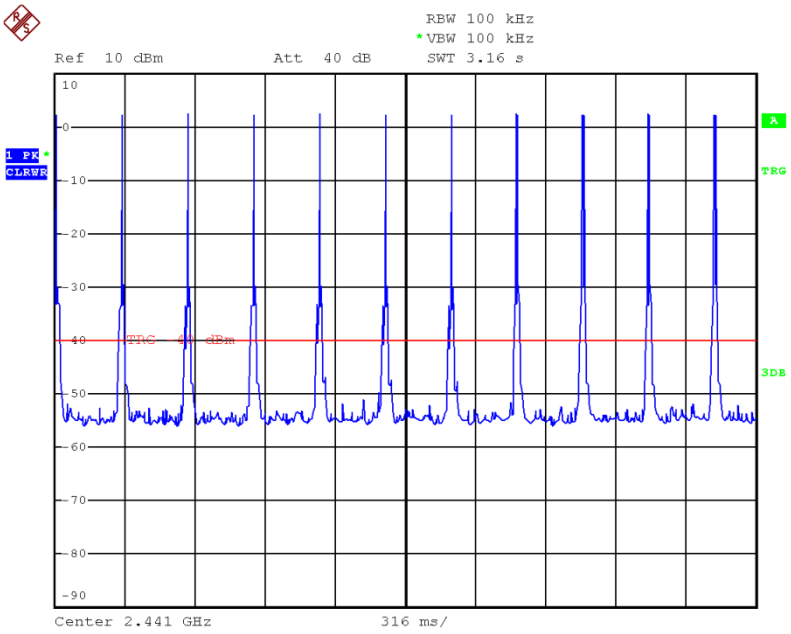
Number of hops in 0.316 s → 2 times

⑯ Hopping of DH5 in 31.6 s



Date: 3.MAY.2011 21:59:09

⑰ Hopping of DH5 in 3.16 s

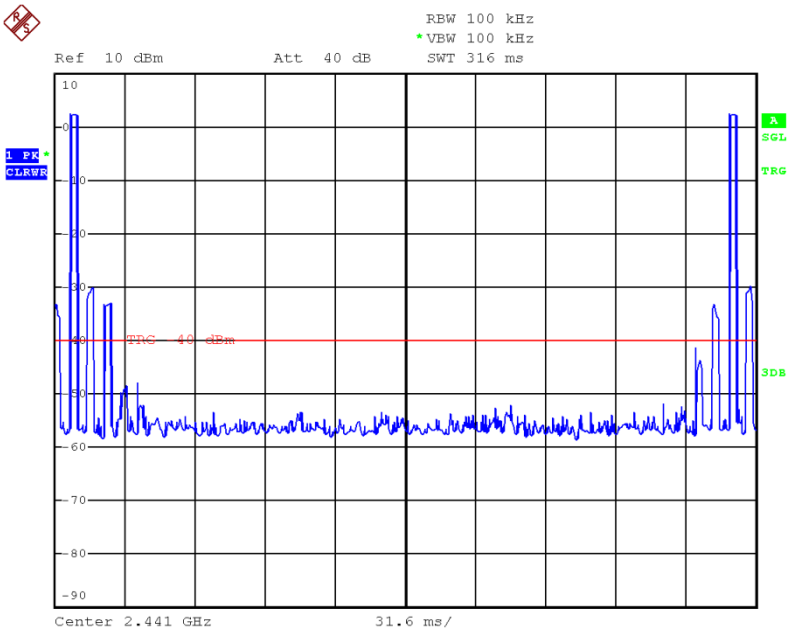


Date: 3.MAY.2011 21:59:52

Number of hops in 3.16 s → 11 times

Hop per second → 3.48 times

⑱ Hopping of DH5 in 0.316 s



Number of hops in 0.316 s → 2 times

4.3 Carrier frequency separation

4.3.1 Definition

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

4.3.2 Specification

FCC Rules Part 15, Section 15.247(a)(1)

4.3.3 Method of measurement

Public Notice “DA 00-705”

4.3.4 Measurement set-up

4.3.5 Test equipment list

Equipment	Model name	Manufacture
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz

4.3.6 Test procedure

① The output of EUT was connected to the spectrum analyzer.

② The Hopping channel separation is defined as the channel is separated with next channel.

4.3.7 Test condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.3.8 Test Result

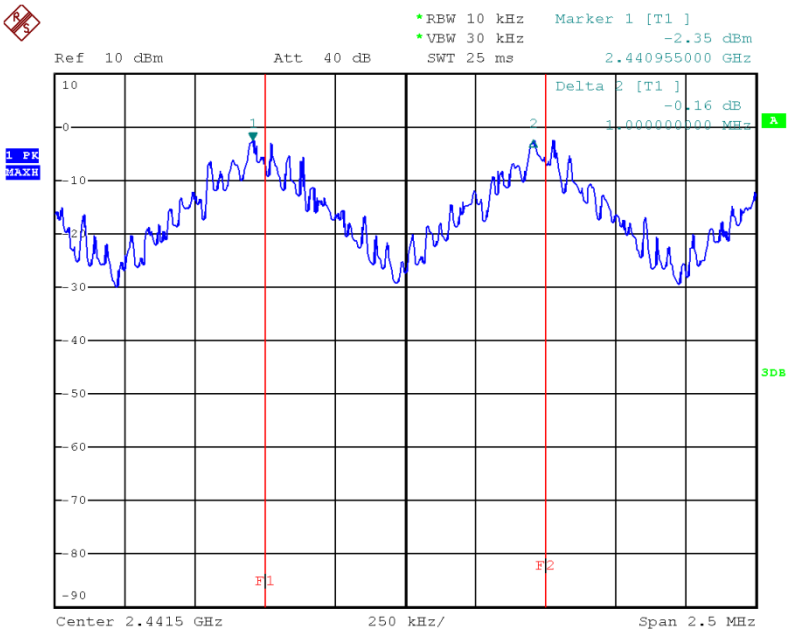
Channel	Frequency separation (MHz)	20 dB bandwidth (MHz)	Limit (MHz)
Full hopping	1.000	0.894	≥ 0.596

4.3.9 Limit

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

The frequency separation shall not be less than 0.596 MHz, because maximum of 20 dB bandwidth is 0.894 MHz.

4.3.10 Plot of carrier frequency separation



Carrier frequency separation → 1 MHz

4.4 Minimum hopping channels

4.4.1 Definition

For frequency hopping systems operating in the 2 400 MHz - 2 483.5 MHz employing at least 75 hopping Channels.

4.4.2 Specification

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

4.4.3 Method of measurement

Public Notice “DA 00-705”

4.4.4 Measurement set-up

4.4.5 Test equipment list

Equipment	Model name	Manufacture
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz

4.4.6 Test procedure

① Connect the equipment as “Measurement set-up”.
② Minimum hopping channels using Spectrum analyzer.
③ With the analyzer set to MAX HOLD readings were taken for 1 ~ 2 minutes in each band.

4.4.7 Test condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.4.8 Test result

Number of hopping channels	**Limit**
79	≥ 75

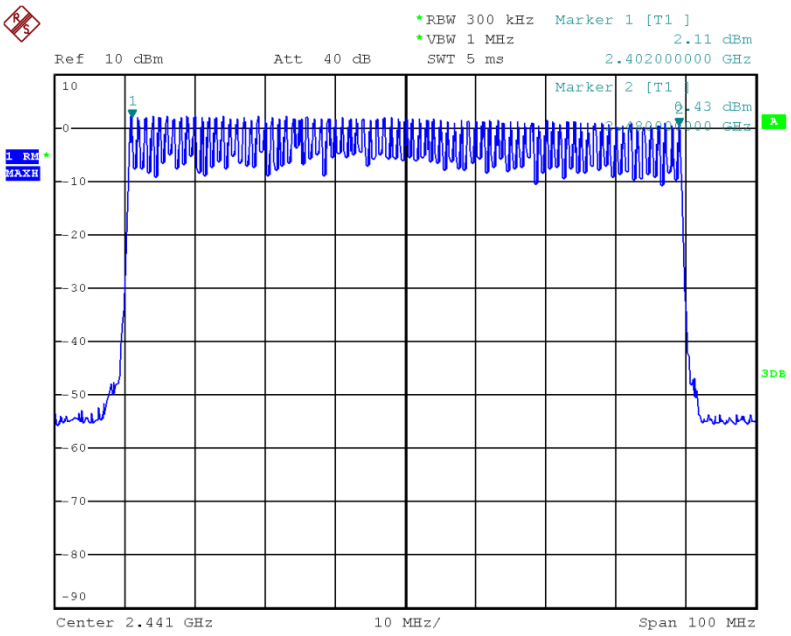
4.4.9 Limit

Frequency hopping systems operating in the 2 400 MHz - 2483.5 MHz shall use at least 15 channels.

Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

For frequency hopping systems operating in the 2 400 MHz - 2483.5 MHz employing at least of 75 non-overlapping hopping channels.

4.4.10 Plot of minimum hopping channels



Date: 3.MAY.2011 20:09:31

Hopping channels → 79

4.5 Maximum peak output power

4.5.1 Definition

For frequency hopping systems operating in the 2 400 MHz – 2 483.5 MHz employing at least 75 hopping channels: 1 Watt.

4.5.2 Specification

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

4.5.3 Method of measurement

Public Notice “DA 00-705”,
ANSI/TIA-603-D-2010 Section 2.2.17

4.5.4 Measurement set-up

4.5.5 Test equipment list

Equipment	Model name	Manufacture
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz

4.5.6 Test procedure

① Connect the equipment as “Measurement set-up”.

② Measure conducted Maximum peak output of relevant channel using Spectrum analyzer.

③ RBW 1 MHz, VBW 3 MHz, Max Hold

4.5.7 Test condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.5.8 Test result

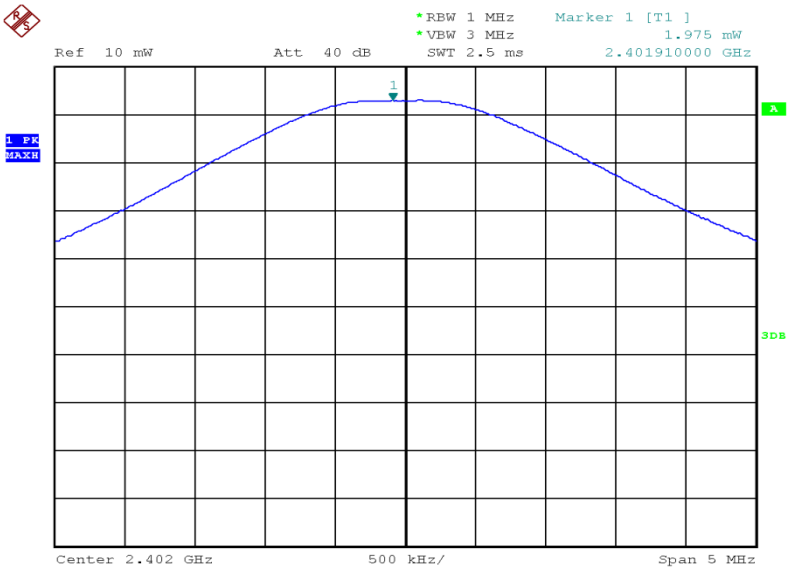
Channel	Frequency (MHz)	Packet type	Measured output power (mW)	Limit (mW)
Low	2 402	DH1	1.975	≤ 125
		DH3	1.943	
		DH5	1.940	
Middle	2 441	DH1	1.839	
		DH3	1.821	
		DH5	1.813	
High	2 480	DH1	1.445	
		DH3	1.423	
		DH5	1.409	

4.5.9 Limit

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 Watt.
For all other frequency hopping systems in the 2400 – 2483.5 MHz band: 0.125 Watts.

4.5.10 Plot of output power

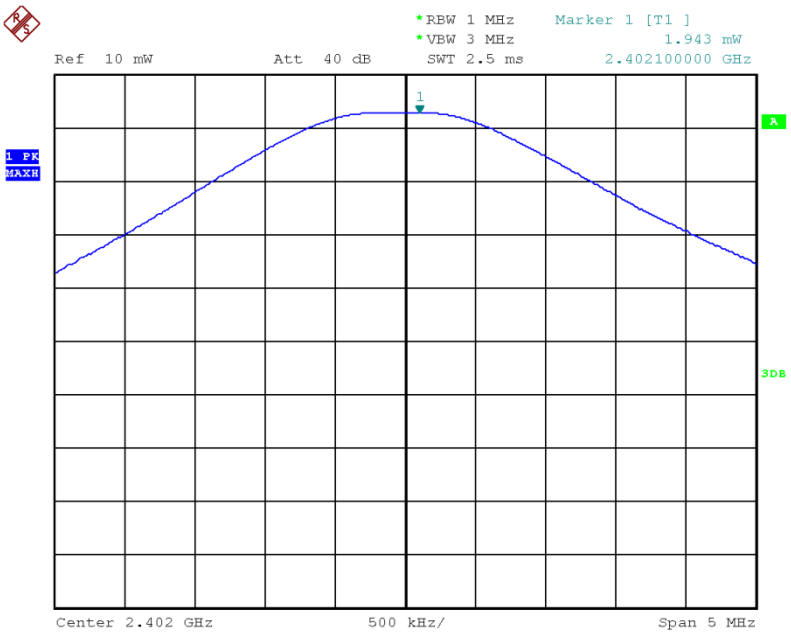
① DH1 of 2 402 MHz



Date: 3.MAY.2011 22:18:59

Output Power → 1.975 mW

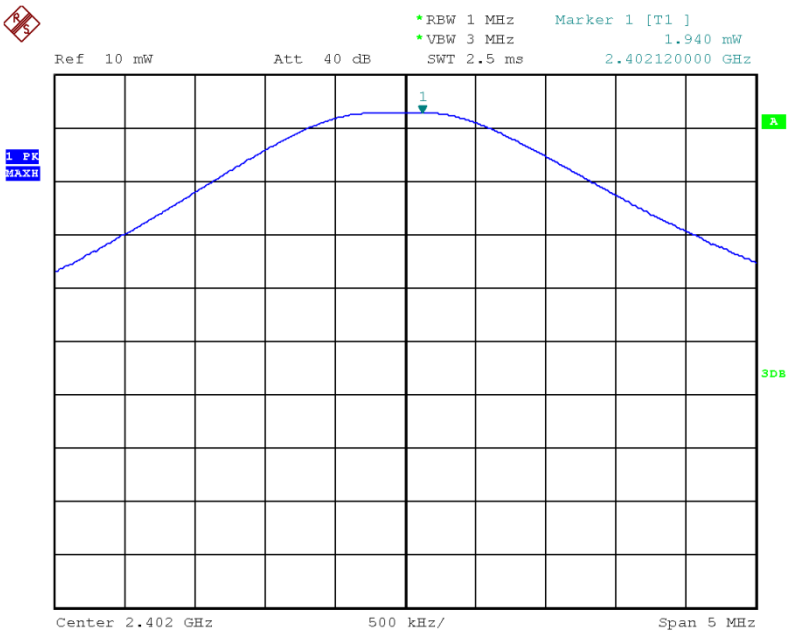
② DH3 of 2 402 MHz



Date: 3.MAY.2011 22:16:32

Output Power → 1.943 mW

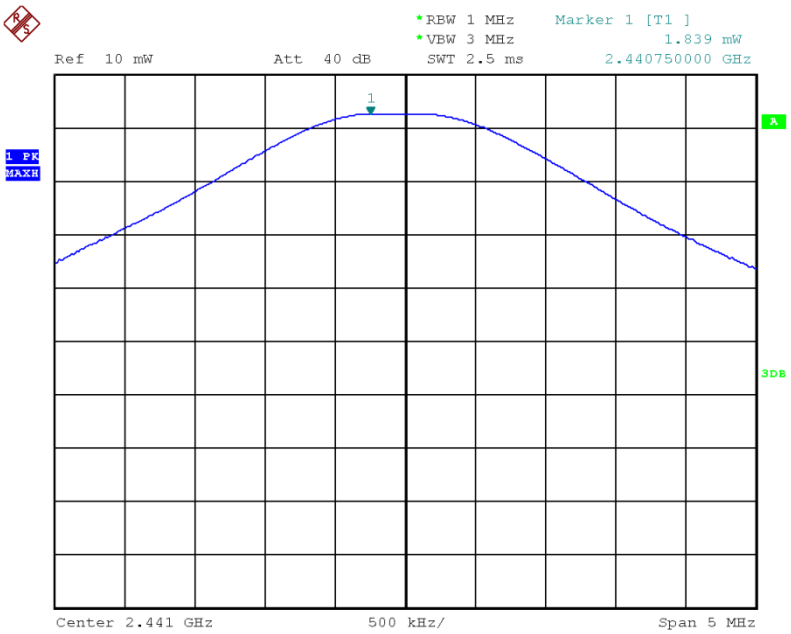
③ DH5 of 2 402 MHz



Date: 3.MAY.2011 22:16:06

Output Power → 1.940 mW

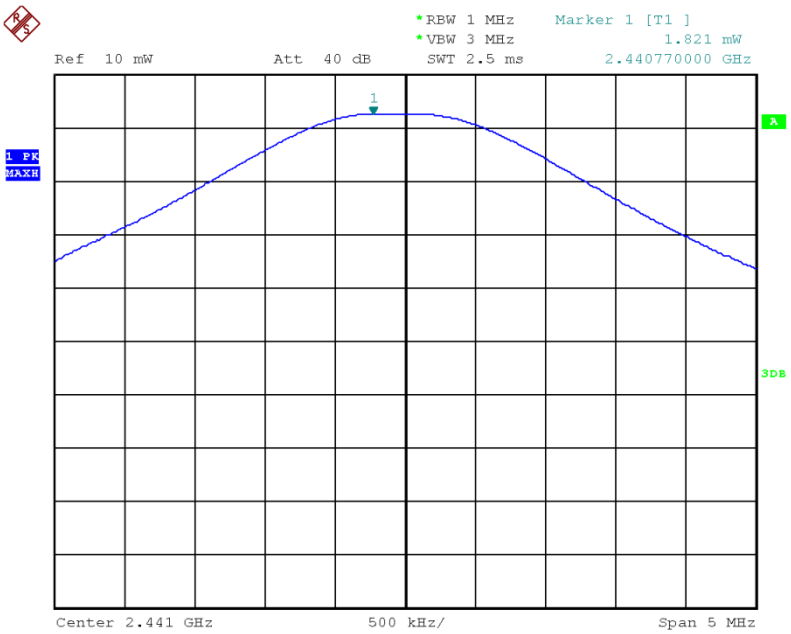
④ DH1 of 2 441 MHz



Date: 3.MAY.2011 22:18:39

Output Power → 1.839 mW

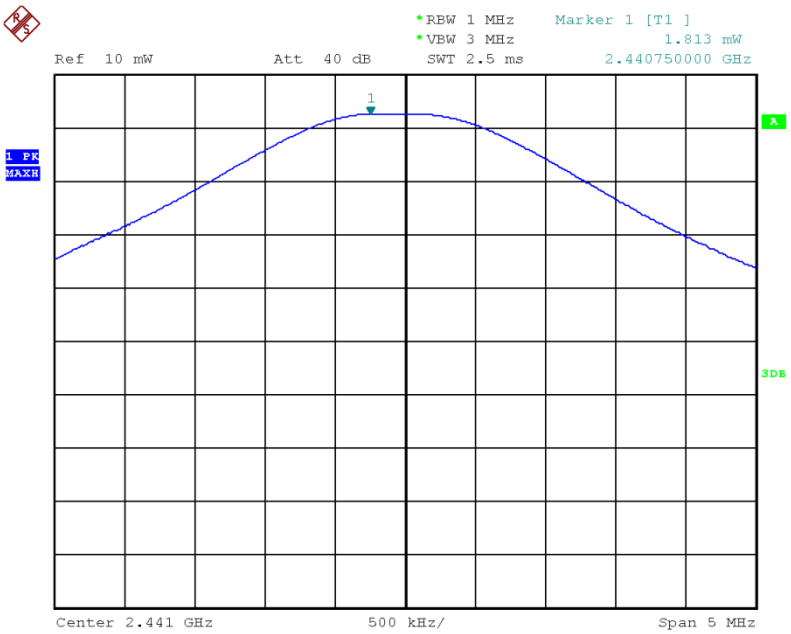
⑤ DH3 of 2 441 MHz



Date: 3.MAY.2011 22:17:06

Output Power → 1.821 mW

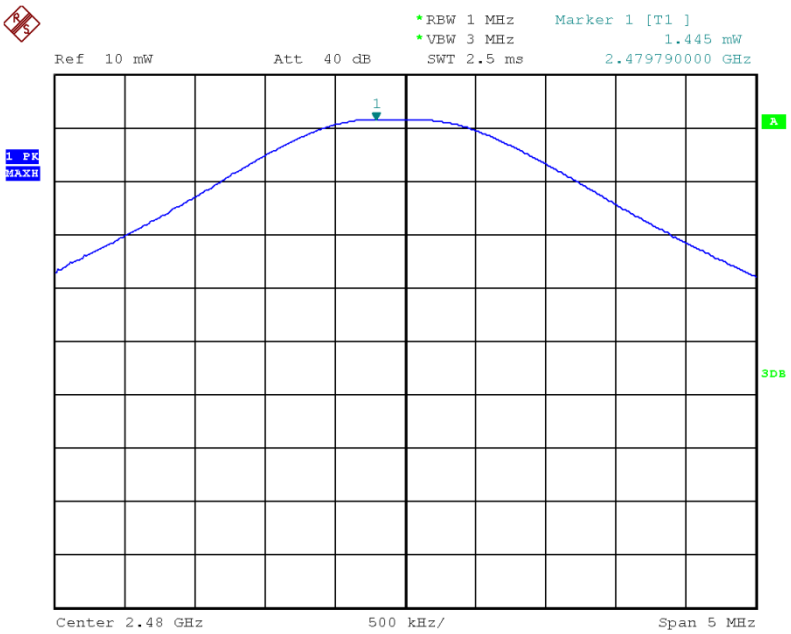
⑥ DH5 of 2 441 MHz



Date: 3.MAY.2011 22:15:41

Output Power → 1.813 mW

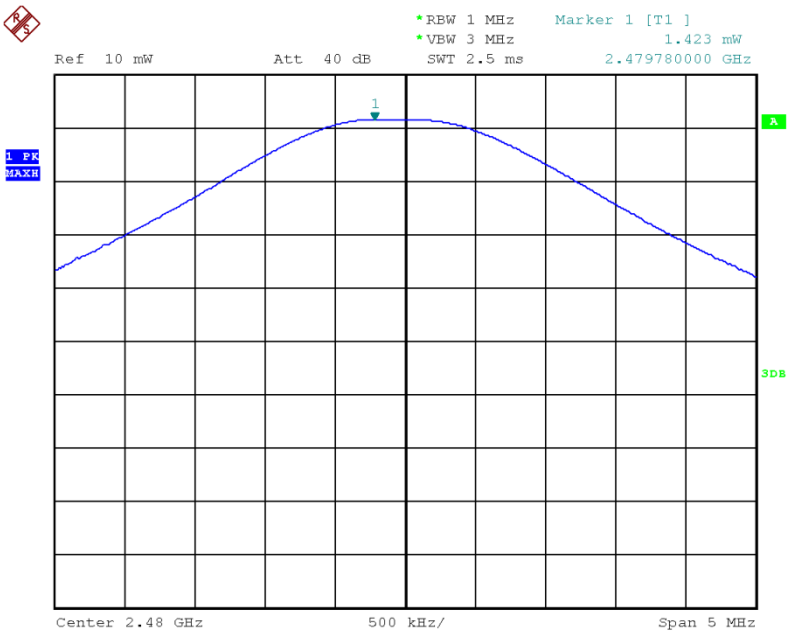
⑦ DH1 of 2 480 MHz



Date: 3.MAY.2011 22:18:14

Output Power → 1.445 mW

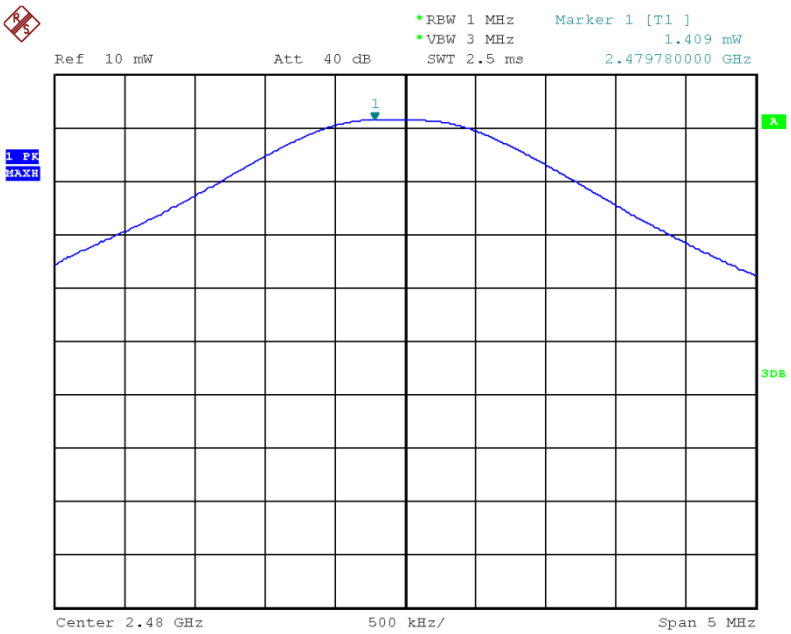
⑧ DH3 of 2 480 MHz



Date: 3.MAY.2011 22:17:33

Output Power → 1.423 mW

⑨ DH5 of 2 480 MHz



Date: 3.MAY.2011 22:15:16

Output Power → 1.409 mW

4.6 Conducted emission and 100 kHz bandwidth of frequency band edges

4.6.1 Definition

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted measurement.

4.6.2 Specification

FCC Rules Part 15, Section 15.247(d)

4.6.3 Method of measurement

Public Notice “DA 00-705”,
ANSI/TIA-603-D-2010 Section 2.2.13

4.6.4 Measurement set-up

4.6.5 Test equipment list

Equipment	Model name	Manufacture
EUT	HSB-S100	HuRob Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz
Spectrum Analyzer	N9020A	Agilent

4.6.6 Test Procedure

① Connect the equipment as “Measurement set-up”.

② Set the center frequency of the spectrum analyzer to the assigned transmitter frequency, key the transmitter, and set the level of the carrier to the full scale reference line.

③ Measure the spurious emission.

④ RBW 100kHz, VBW 100kHz, Max Hold

⑤ The other emissions is not found.

4.6.7 Test Condition

- Test place : Shield room
- Test mode : Normal operation
- Test environment : 25 ℃, 56 %R.H.

4.6.8 Test result

Conducted spurious emission				
Frequency (MHz)	Level (dBm)	Factor (dBc)	Limit (dBc)	Margin (dB)
Low channel / 2402 MHz				
2402.0	3.53	-	-	-
2400.0	-49.41	52.94	20.00	32.94
*4804.0	-38.12	41.65		21.65
Middle channel / 2441 MHz				
2441.0	2.98	-	-	-
*4882.0	-42.90	45.88	20.00	25.88
High channel / 2480 MHz				
2480.0	1.94	-	-	-
*2483.5	-55.18	56.12	20.00	36.12
*4960.0	-42.12	44.06		24.06

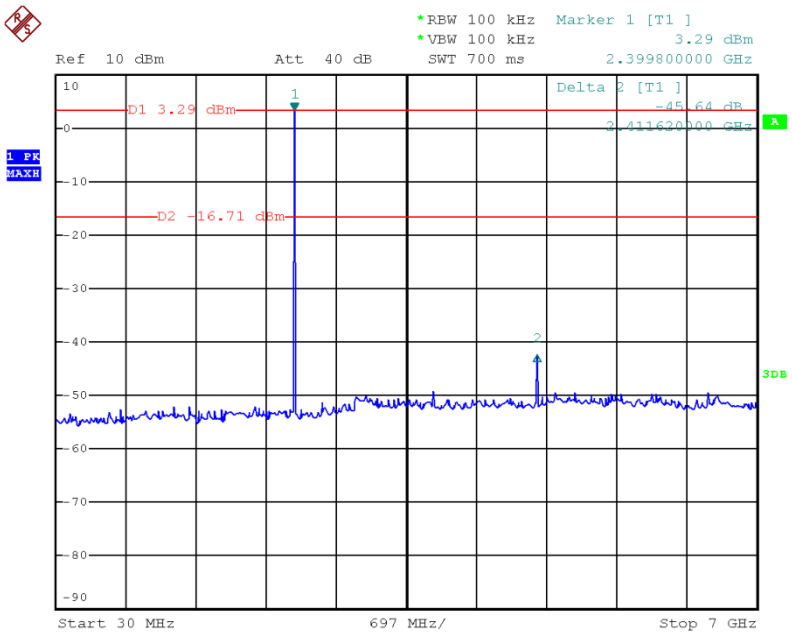
The test was performed to make a direct field strength measurement at the bandedge frequencies. Radiated emissions which fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified in Section 15.209. There is a restricted band starting at 2 483.5 MHz and another restricted band from 2 310 MHz to 2 390 MHz.

4.6.9 Limit

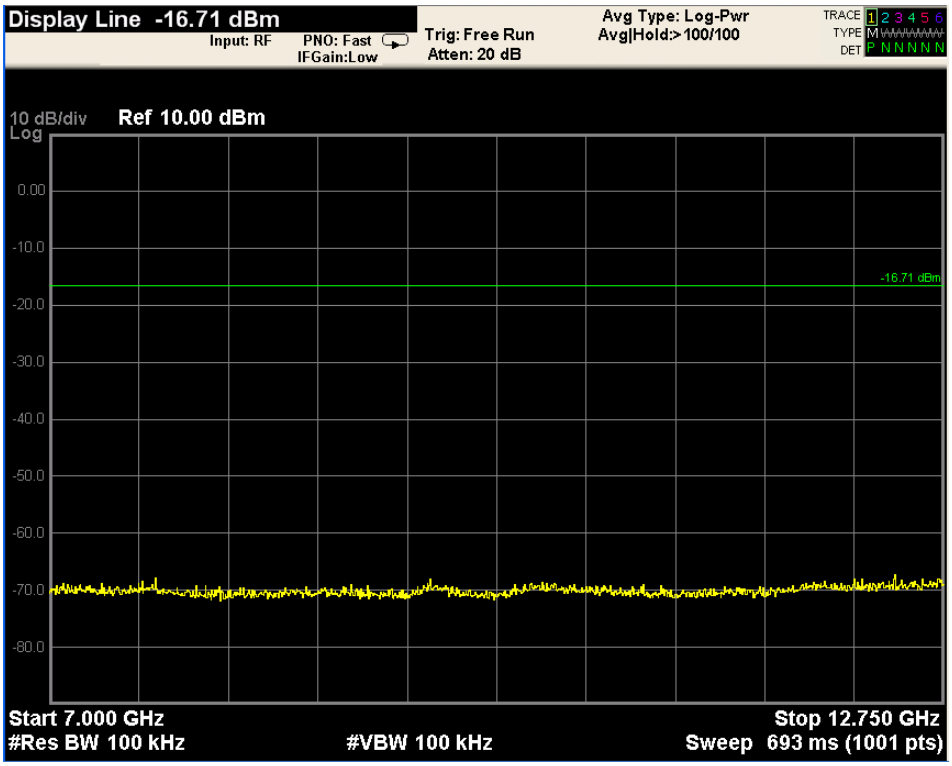
The conducted spurious emission is less than 20 dBc.

4.6.10 Plot of conducted spurious emission

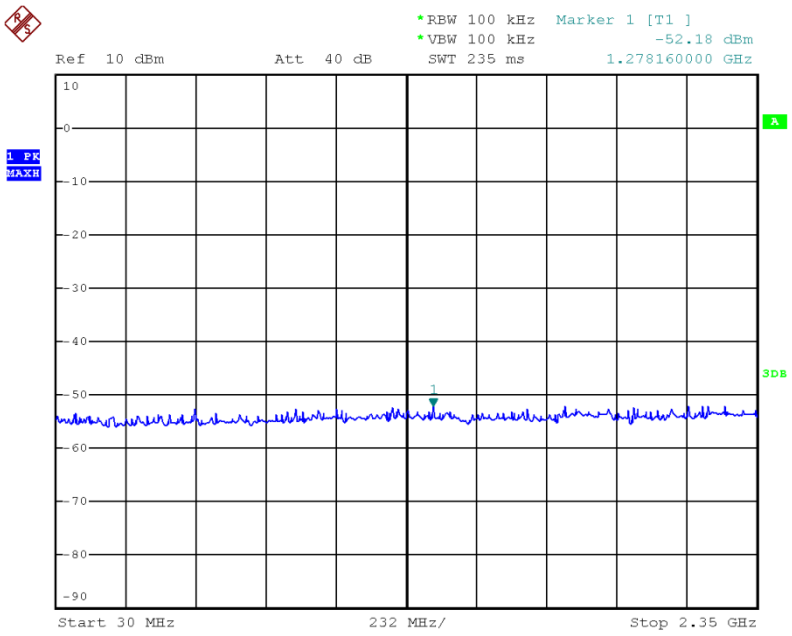
① 2 402 MHz (30 MHz to 7 GHz)



② 2 402 MHz (7 GHz to 12.75 GHz)

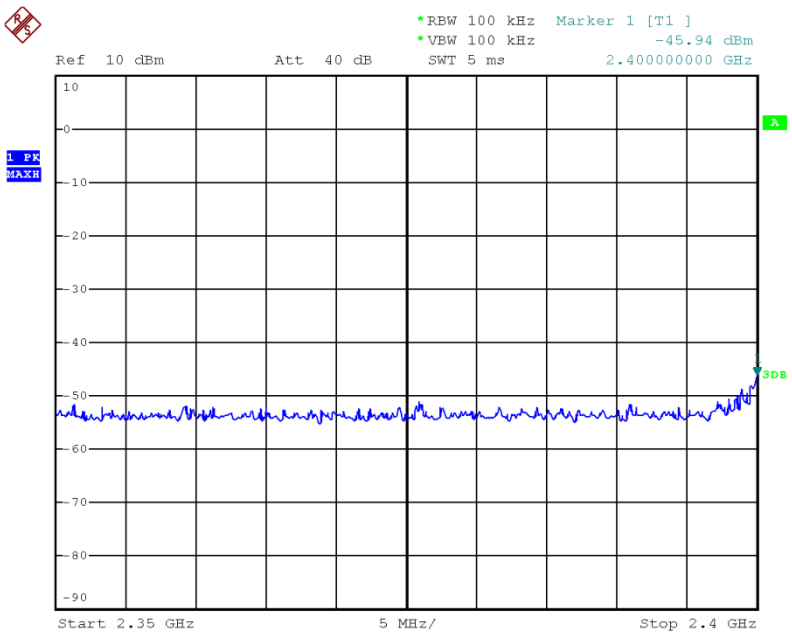


③ 2 402 MHz (30 MHz to 2.35 GHz)



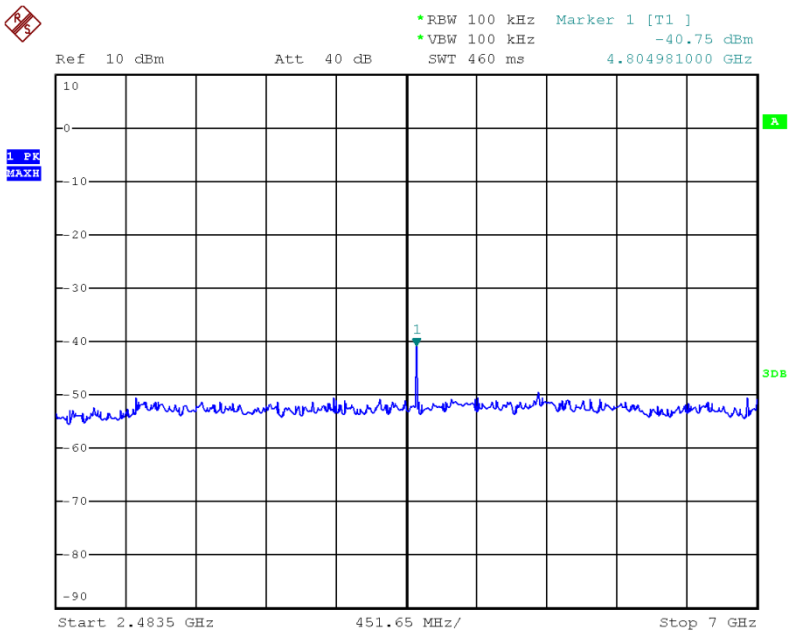
Date: 3.MAY.2011 22:41:05

④ 2 402 MHz (2.35 GHz to 2.4 GHz)



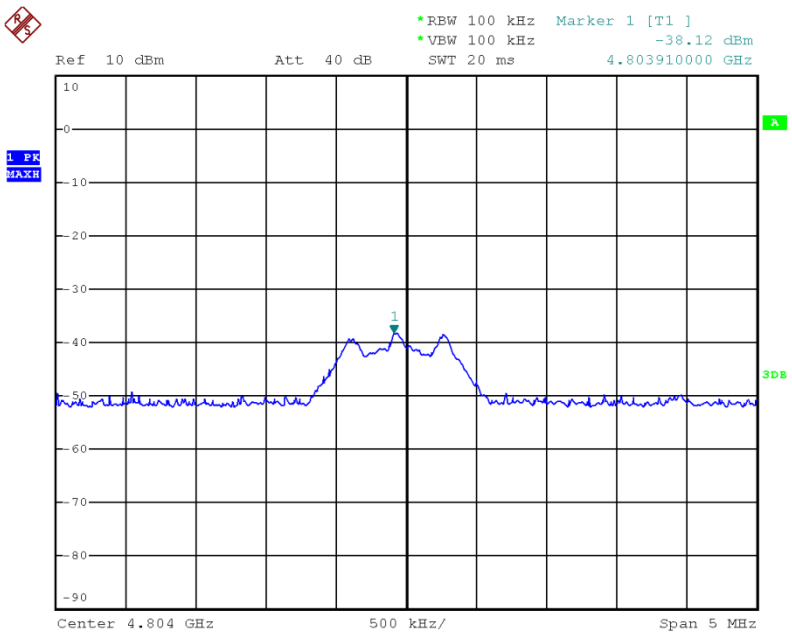
Date: 3.MAY.2011 22:41:58

⑤ 2 402 MHz (2.4835 GHz to 7 GHz)



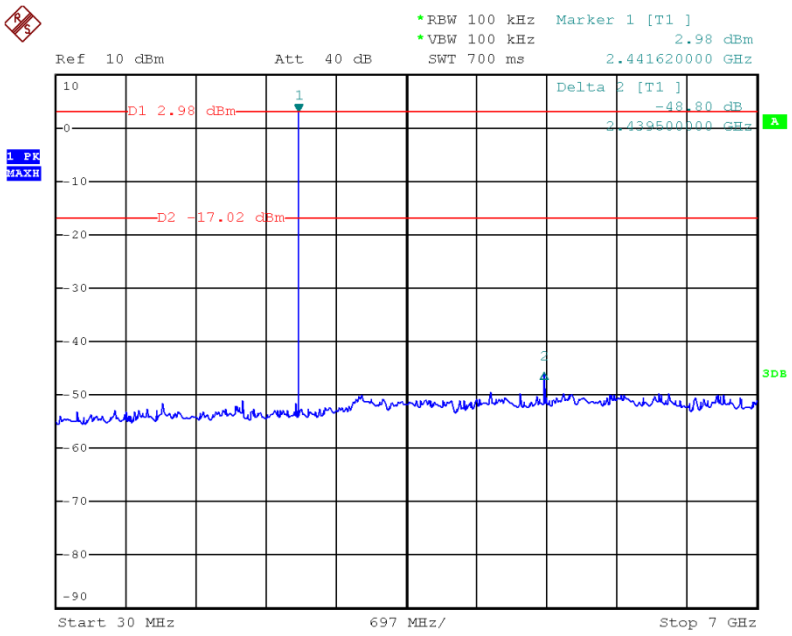
Date: 3.MAY.2011 22:42:41

⑥ 2 402 MHz (2nd Harmonic at 4804 MHz)



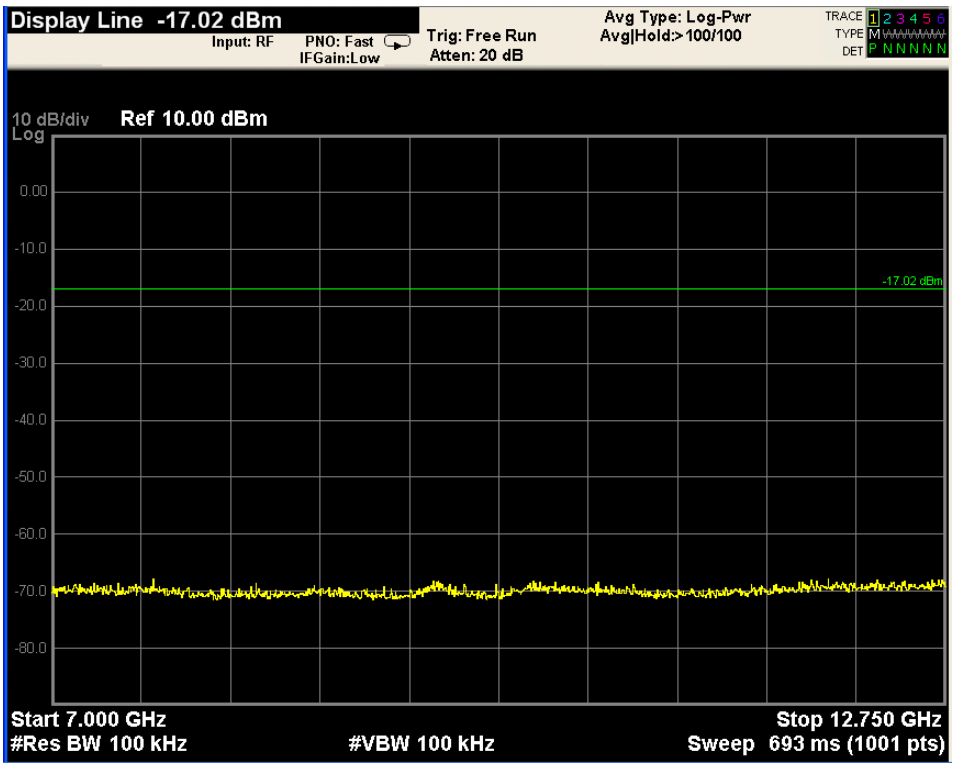
Date: 3.MAY.2011 22:44:50

⑦ 2 441 MHz (30 MHz to 7 GHz)

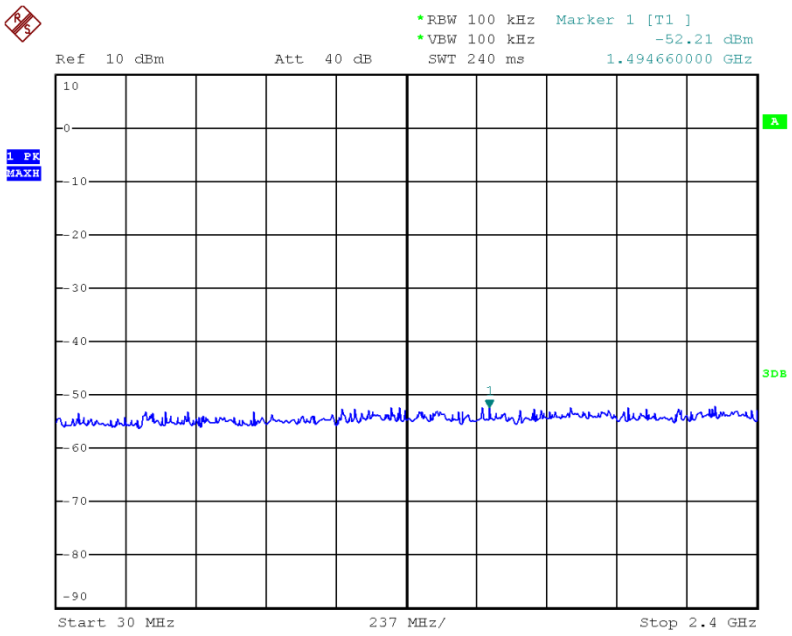


Date: 3.MAY.2011 22:49:46

⑧ 2 441 MHz (7 GHz to 12.75 GHz)

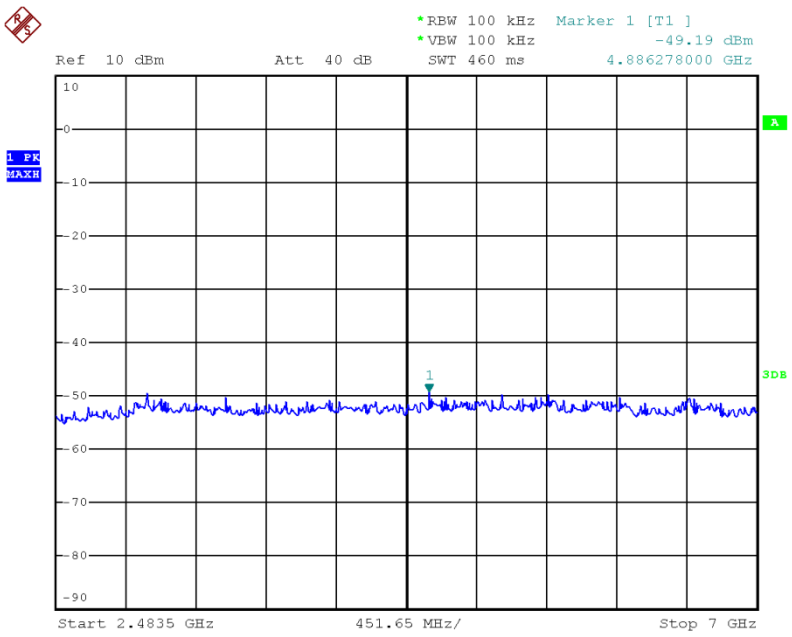


⑨ 2 441 MHz (30 MHz to 2.4 GHz)



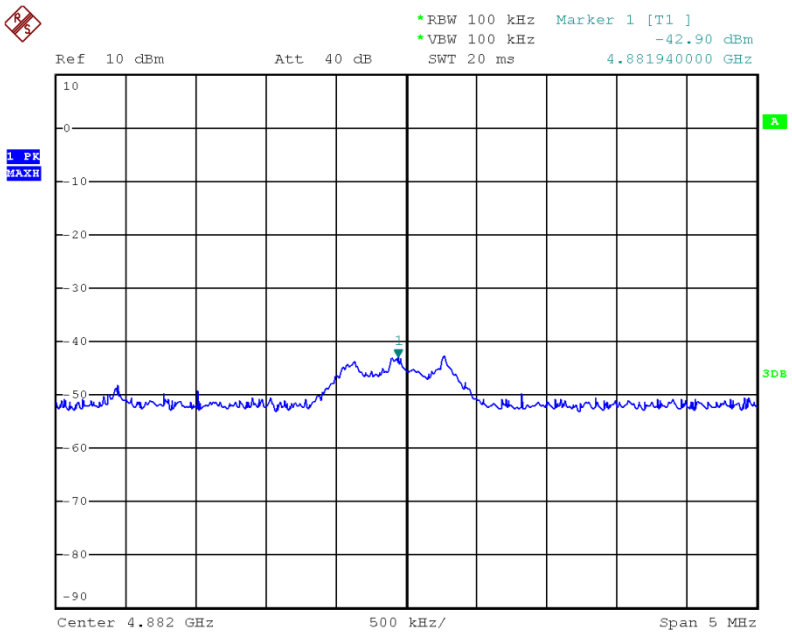
Date: 3.MAY.2011 22:46:54

⑩ 2 441 MHz (2.4835 GHz to 12.75 GHz)



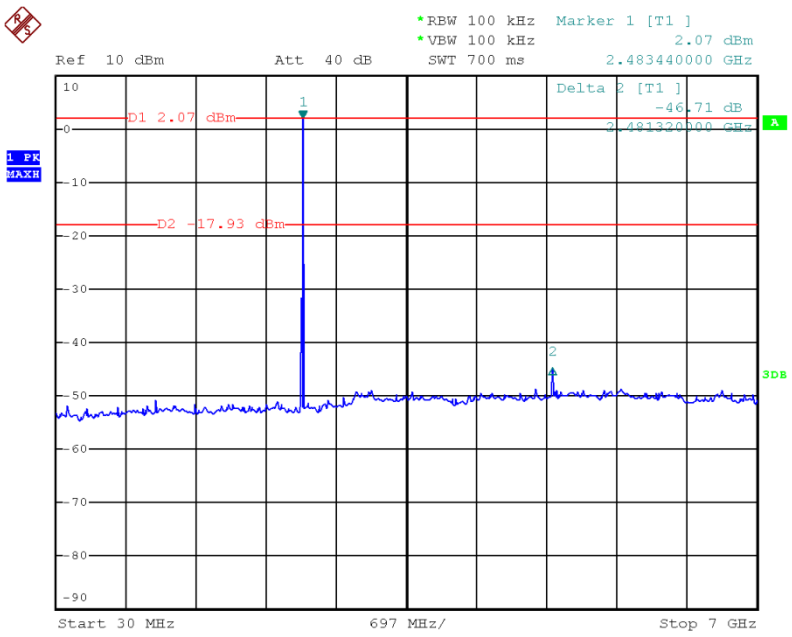
Date: 3.MAY.2011 22:47:52

⑪ 2 441 MHz (2nd Harmonic at 4882 MHz)



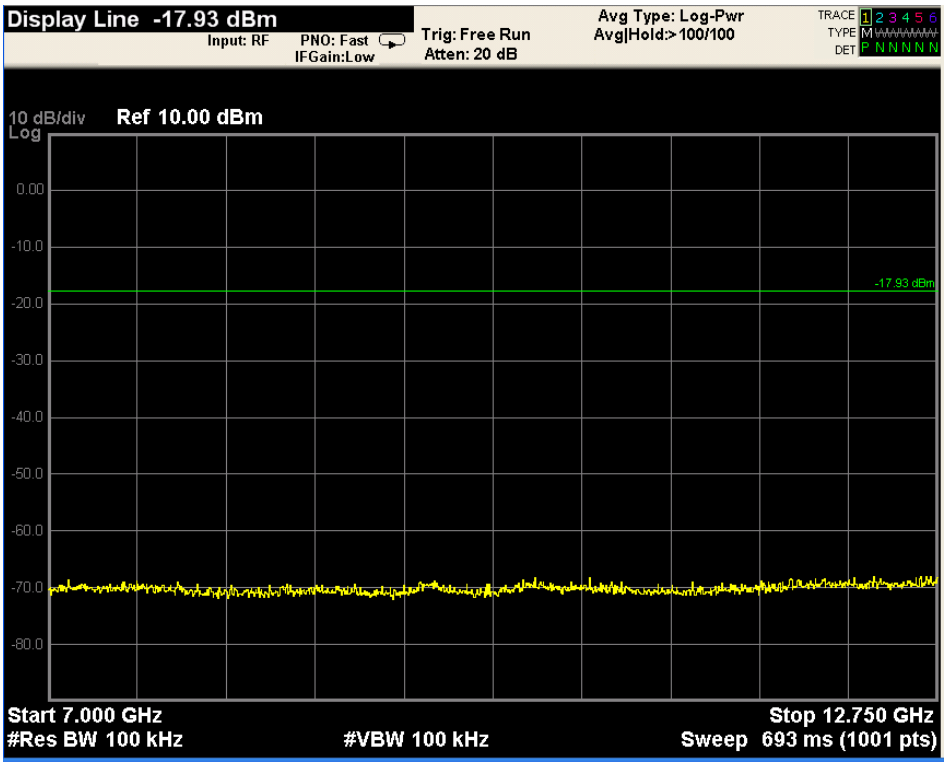
Date: 3.MAY.2011 22:46:24

⑫ 2 480 MHz (30 MHz to 7 GHz)

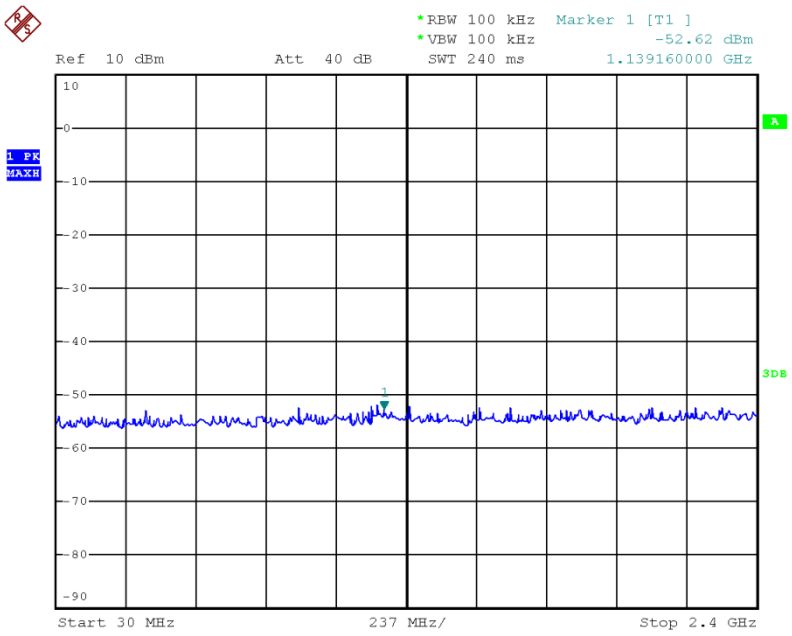


Date: 3.MAY.2011 23:20:39

⑬ 2 480 MHz (7 GHz to 12.75 GHz)

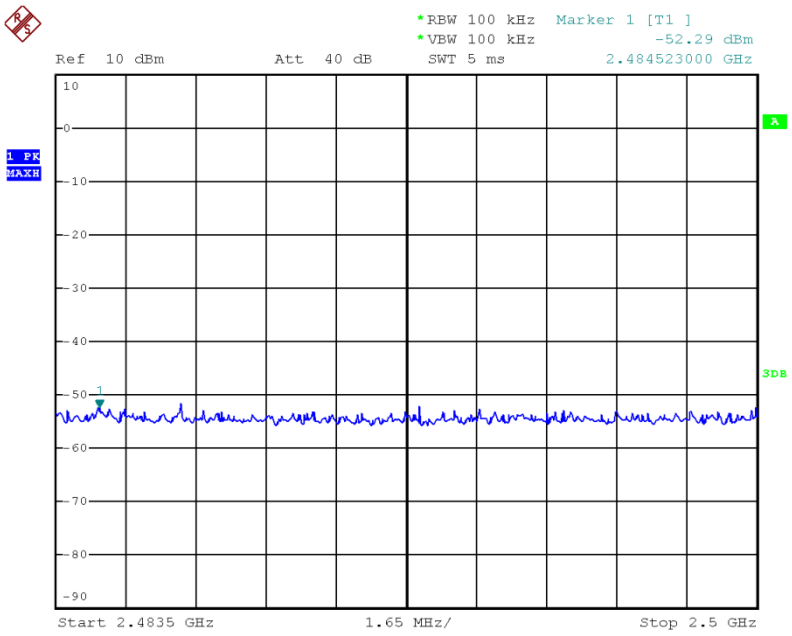


⑭ 2 480 MHz (30 MHz to 2.4 GHz)



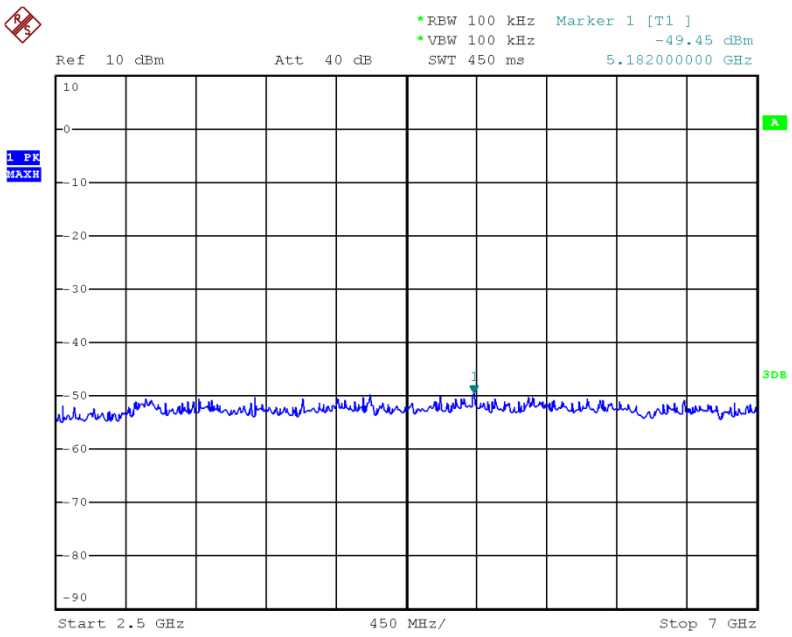
Date: 3.MAY.2011 23:21:11

⑮ 2 480 MHz (2.4835 GHz to 2.5 GHz)



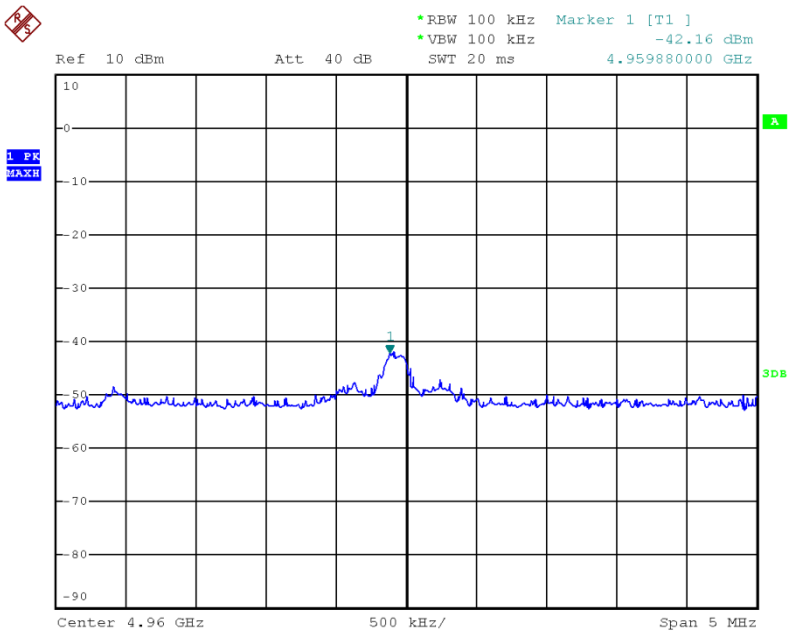
Date: 3.MAY.2011 23:22:12

⑯ 2 480 MHz (2.5 GHz to 7 GHz)



Date: 3.MAY.2011 23:23:14

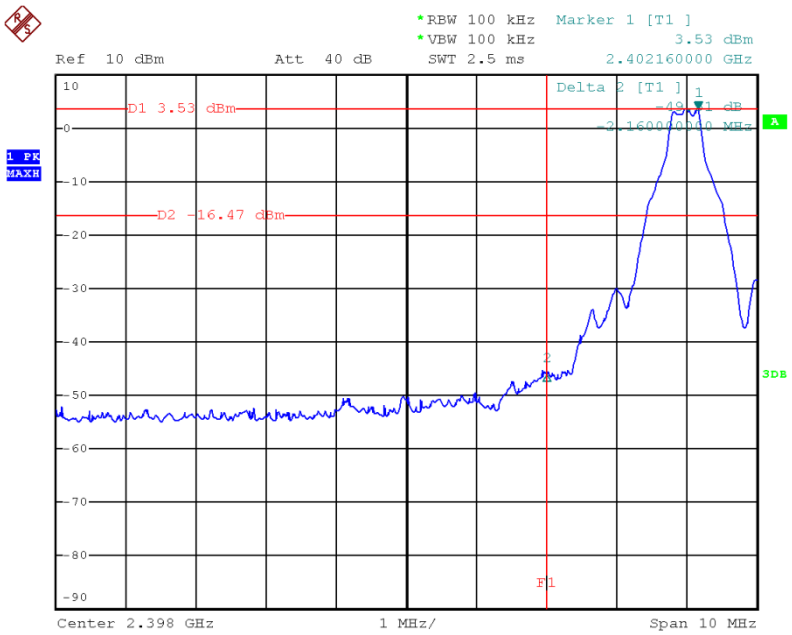
⑰ 2 480 MHz (2nd Harmonic at 4960 MHz)



Date: 3.MAY.2011 23:24:19

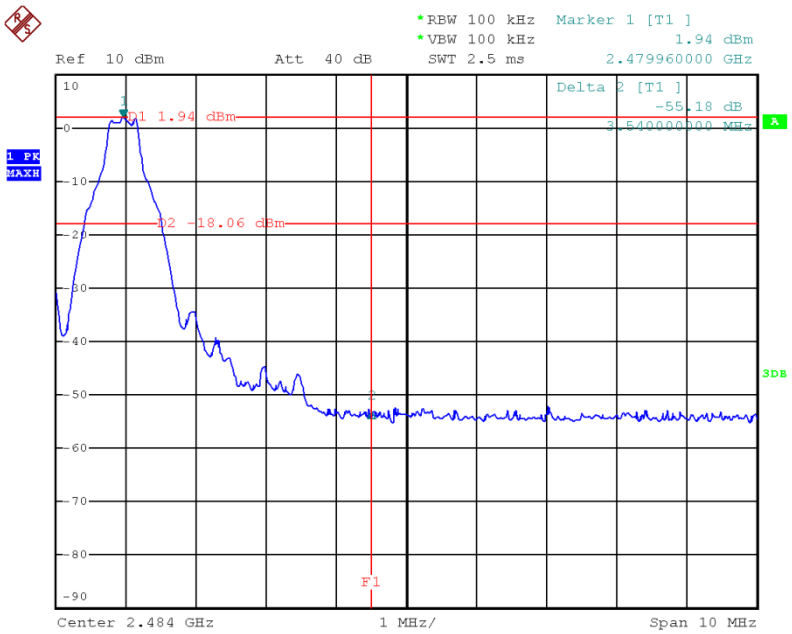
4.6.11 Plot of band edge

① 2 402 MHz



Date: 3.MAY.2011 22:32:42

② 2 483.5 MHz



Date: 3.MAY.2011 22:29:59

4.7 Radiated emission

4.7.1 Definition

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

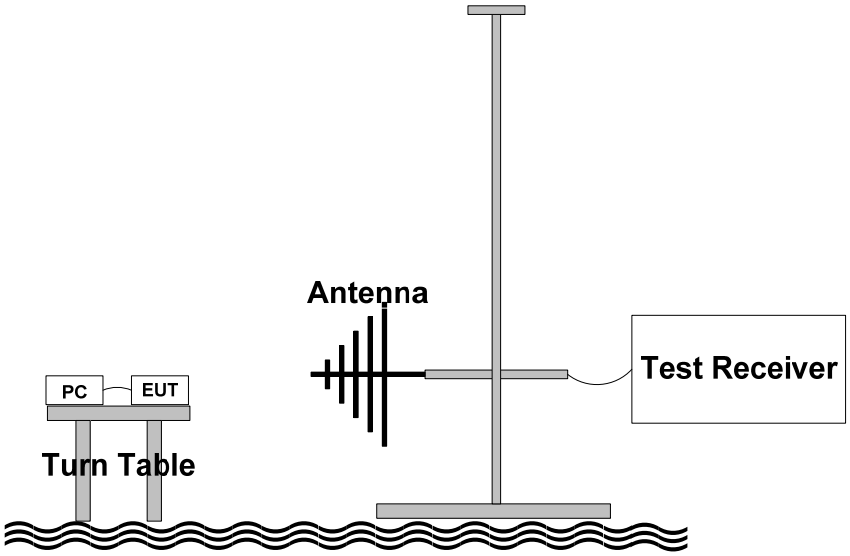
4.7.2 Specification

FCC Rules Part 15, Section 15.247(d)

4.7.3 Method of measurement

ANSI/TIA-603-D-2010 Section 2.2.12

4.7.4 Measurement set-up



4.7.5 Test equipment list

Equipment	Model name	Manufacturer
EUT	HSB-S100	HUROB Co., Ltd.
Control PC	2652-C3K	LG Electronics
Spectrum Analyzer	ESPI7	Rohde & Schwarz
Loop Antenna	EMCO 6502	EMCO
Bi-conical Antenna	VHA9103	Schwarzbeck
Log Periodic Antenna	VULP9118A	Schwarzbeck
Horn Antenna	BBHA-9120D	Schwarzbeck
Pre-Amplifier	8449B	Agilent

4.7.6 Test procedure

① Connect the equipment as “Measurement set-up”.

② Place the transmitter to be tested on the turntable in the standard test site.

③ The transmitter is transmitting into a non-radiating load that is placed on the turntable. The RF cable to this load should be of minimum length. For transmitters with integral antennas, the tests are to be run with the unit operating into the integral antenna.

④ For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth.

⑤ Key the transmitter.

⑥ For each spurious frequency, raise and lower the test antenna from 1 m to 4m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360° to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.

⑦ Repeat step ⑥ for each spurious frequency with the test antenna polarized vertically.

4.7.7 Test condition

- Test place : OATS
- Test mode : Normal operation
- Test environment : 27 ℃, 49 %R.H.

4.7.8 Test result of spurious emission and band edge

Radiated spurious emission and band edge										
Frequency (MHz)	Detect Mode	RBW	Reading (dBμV)	Polarization (H/V)	Pre-Amp Gain (dB)	Ant. Factor (dB/m)	Cable Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Low Channel / 2 402 MHz										
2 402.0	Peak	1 MHz	80.5	V	26.4	27.6	10.6	92.3	-	-
*2 390.0	Peak	1 MHz	23.5	V	26.4	27.6	10.6	35.3	74.0	38.7
	AVG		-	-				-	54.0	-
2 400.0	Peak	1 MHz	24.7	V	26.4	27.6	10.6	36.5	72.3	35.8
*4 804.0	Peak	1 MHz	27.9	V	27.1	31.9	20.8	54.2	74.0	19.8
	AVG		20.5	V				46.8	54.0	7.2
Middle Channel / 2 441 MHz										
2 441.0	Peak	1 MHz	80.6	V	26.4	27.6	10.7	92.5	-	-
*4 882.0	Peak	1 MHz	28.2	V	27.3	31.9	21.0	53.8	74.0	20.2
	AVG		20.8	V				46.4	54.0	7.6
High Channel / 2 480 MHz										
2 480.0	Peak	1 MHz	78.8	V	26.4	27.6	10.9	90.9	-	-
*2 483.5	Peak	1 MHz	26.5	V	26.4	27.6	10.9	38.6	74.0	35.4
	AVG		-	V				-	-	-
*4 960.0	Peak	1 MHz	23.5	V	27.4	31.9	21.1	49.1	74.0	24.9
	AVG		-	V				-	54.0	-

NOTES:

1. All modes of operation were investigated and the worst-case emissions are reported.
2. Polatization : H = Horizontal, V = Vertical
3. The average measurement was not performed when the peak measured data under the limit of average detection.
4. There is a restricted band starting at 2 483.5 MHz and another restricted band from 2 310 to 2 390 MHz and 4 500 to 5 150 MHz.

4.7.9 Limit

The radiated spurious emission at restricted bands is compliance with FCC Part 15.209.
And other bands shall be 20 dBc.

5. Test equipments list

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

No.	Equipment	Model	Manufacturer	Serial number	Calibration due date
1	Spectrum Analyzer	ESPI7	Rohde & Schwarz	101002	07/02/11
2	Spectrum Analyzer	N9020A	Agilent	MY48010456	03/10/12
3	Power Supply	E3633A	Agilent	SG400022272	10/02/11
4	Loop Antenna	6502	EMCO	9609-9087	03/03/12
5	Bi-conical Antenna	VHA9103	Schwarzbeck	2217	02/23/12
6	Log-Periodic Antenna	VULP9118A	Schwarzbeck	382	02/23/12
7	Horn Antenna	BBHA 9120 D	Schwarzbeck	395	08/13/12
8	Pre-Amplifier	SCU01	Rohde & Schwarz	10020	09/28/11
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

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