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CERTIFICATION OF COMPLIANCE

BTNetworks Co.,Ltd.

1F, Yoonjae Bldg., 1530-1, Seocho-Dong,
Seocho-Gu, Seoul, Korea 137-070

Dates of Tests: August 18 ~ August 26, 2005

Test Report S/N: DR50110508N

Test Site : DIGITAL EMC CO., LTD.

FCC ID

TLWBM1001

APPLICANT

BTNetworks Co., Ltd.

FCC Classification	:	FHSS Sequence Spread Spectrum (FHSS)
Device name	:	Bluetooth Serial Adapter
Manufacturer	:	BTNetworks Co., Ltd.
FCC ID	:	TLWBM1001
Model name	:	BM1001
Test Device Serial number	:	Identical prototype
FCC Rule Part(s)	:	FCC Part 15.247 Subpart C ANSI C-63.4-2003
Frequency Range	:	2402 ~ 2480 MHz
Max. Output power	:	12.12dBm Conducted
Data of issue	:	August 29, 2005

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



NVLAP LAB CODE 200559-0

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1. General information

This report contains the result of tests performed by:

DIGITAL EMC CO., LTD.

Address : 683-3, Yubang-Dong, Yongin-Si, Kyunggi-Do, Korea. 449-080

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Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the "General requirements for the competent of calibration and testing laboratory".

This laboratory is accredited by NVLAP for NVLAP Lab. Code : 200559-0.

Test operator: engineer

August 29, 2005

Won -Jung LEE



Data

Name

Signature

Report Reviewed By: manager

August 29, 2005

Harvay Sung



Data

Name

Signature

Ordering party:

Company name : BTNetworks Co., Ltd.

Address : 1F, Yoonjae Bldg., 1530-1, Seocho-Dong, Seocho-Gu

Zip code : 137-070

City/town : Seoul

Country : Korea

Date of order : August 29, 2005

2. Information about test item

TLWBM1001

2.1 Equipment information

Equipment model name	BM1001
Type of equipment	Bluetooth Serial Adapter
Frequency band	2402 ~ 2480 MHz
Type of Modulation	GFSK
Channel Spacing	1.0 MHz
Type of antenna	Dipole Antenna
Power	DC 4 ~ 12 V

2.2 Tested frequency

Frequency	TX	RX
Low frequency	2402MHz	2402MHz
Middle frequency	2441MHz	2441MHz
High frequency	2480MHz	2480MHz

TLWBM1001

2.4 Tested environment

Temperature	:	15 ~ 35 (°C)
Relative humidity content	:	20 ~ 75 %
Air pressure	:	86 ~ 103 kPa
Details of power supply	:	5 VDC (powered by USB Port of PC)

2.5 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
Printer	SRP-770	SRP77008060035	SAMSUNG
Notebook computer	ARMADA6500	6708BA0001B	LG
Mouse	SMOP5000WX	04010159130	CHIC TECHNOLOGY CORP

2.6 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing

-> none

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
I. Transmit mode(Tx)				
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	C
	Number of Hopping Frequencies	> 75 hops		C
	20 dB Bandwidth	< 1 MHz		C
	Dwell Time	0.4 seconds within a 30 second period per any frequency		C
15.247(b)	Transmitter Output Power	< 1Watt		C
15.247(c)	Band-edge /Conducted	The radiated emission to any 100 kHz of outband shall be at least 20dB below the highest inband spectral density.		C
	Conducted Spurious Emissions			C
15.205 15.209	Radiated Emissions	< FCC 15.209 limits	Radiated	C
15.207	AC Conducted Emissions	EN 55022	AC Line Conducted	C
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

Procedure:

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = 3 MHz (wide enough to capture the peaks of two adjacent channels)

RBW = 30 kHz (1% of the span or more) Sweep = auto

VBW = 30 kHz Detector function = peak

Trace = max hold

Measurement Data: **Comply**

Frequency of marker #1 (MHz)	Frequency of marker #2 (MHz)	Test Results	
		Carrier Frequency Separation (MHz)	Result
2441.015	2442.013	0.974	Comply

- See next pages for actual measured spectrum plots.

Minimum Standard:

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

Measurement Setup

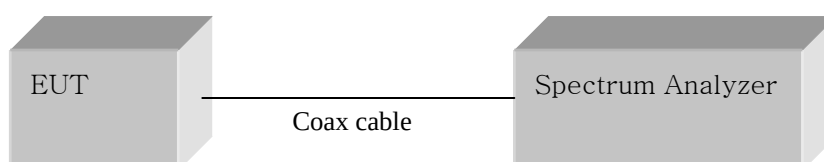
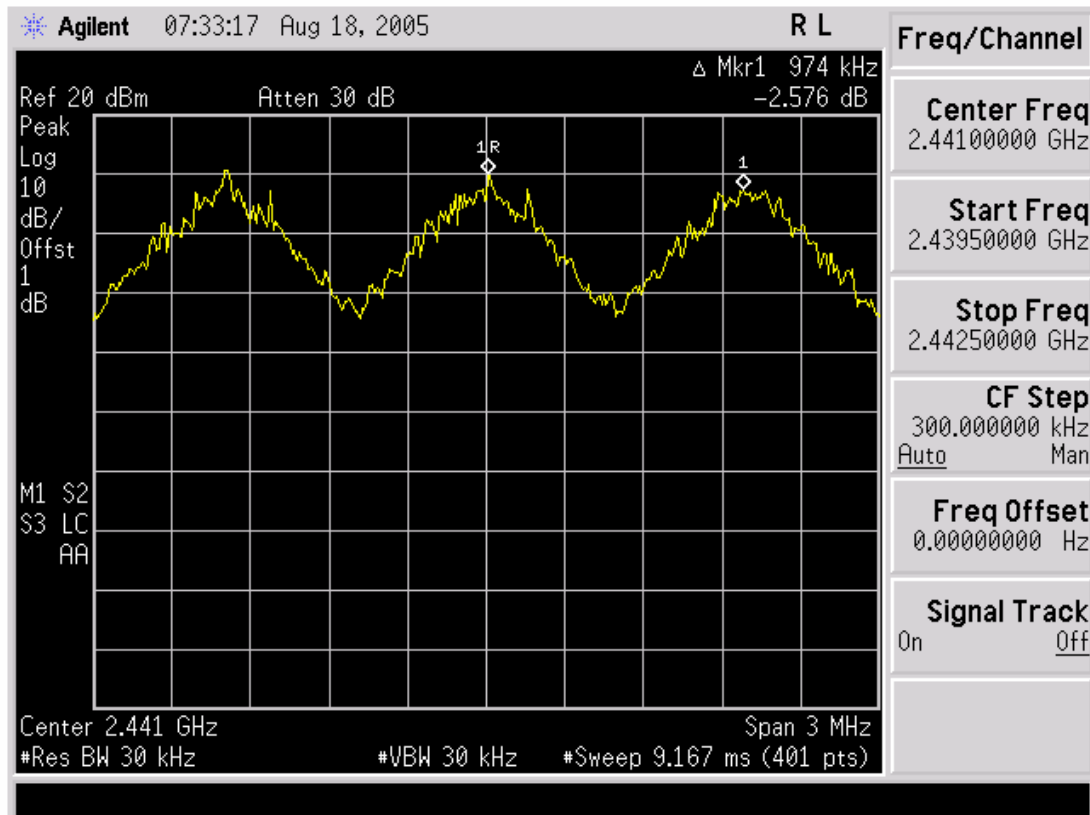


Figure 1: Measurement setup for the carrier frequency separation

TEST EQUIPMENT USED: 01, 17, 49

Carrier Frequency Separation



3.2.2 Number of Hopping Frequencies

Procedure:

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, four frequency ranges within the 2400 ~ 2483.5 MHz FH band were examined.

The spectrum analyzer is set to:

Frequency range 1: Start = 2389.5MHz, Stop = 2414.5 MHz

2: Start = 2414.5MHz, Stop = 2439.5 MHz

3: Start = 2439.5MHz, Stop = 2464.5 MHz

4: Start = 2464.5MHz, Stop = 2489.5 MHz

RBW = 300 kHz (1% of the span or more) Sweep = auto

VBW = 300 kHz (VBW $\geq$ RBW) Detector function = peak

Trace = max hold Span = 25MHz

Measurement Data: **Comply**

Total number of Hopping Channels	79
----------------------------------	----

- See next pages for actual measured spectrum plots.

Minimum Standard:

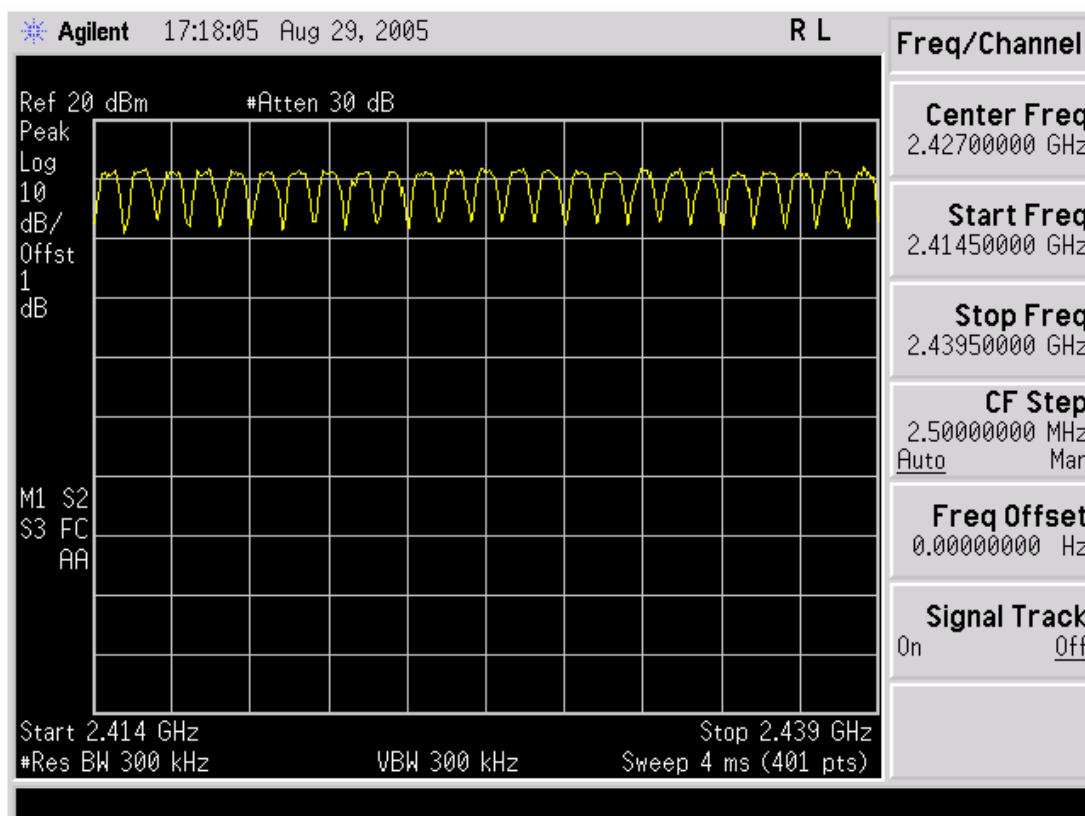
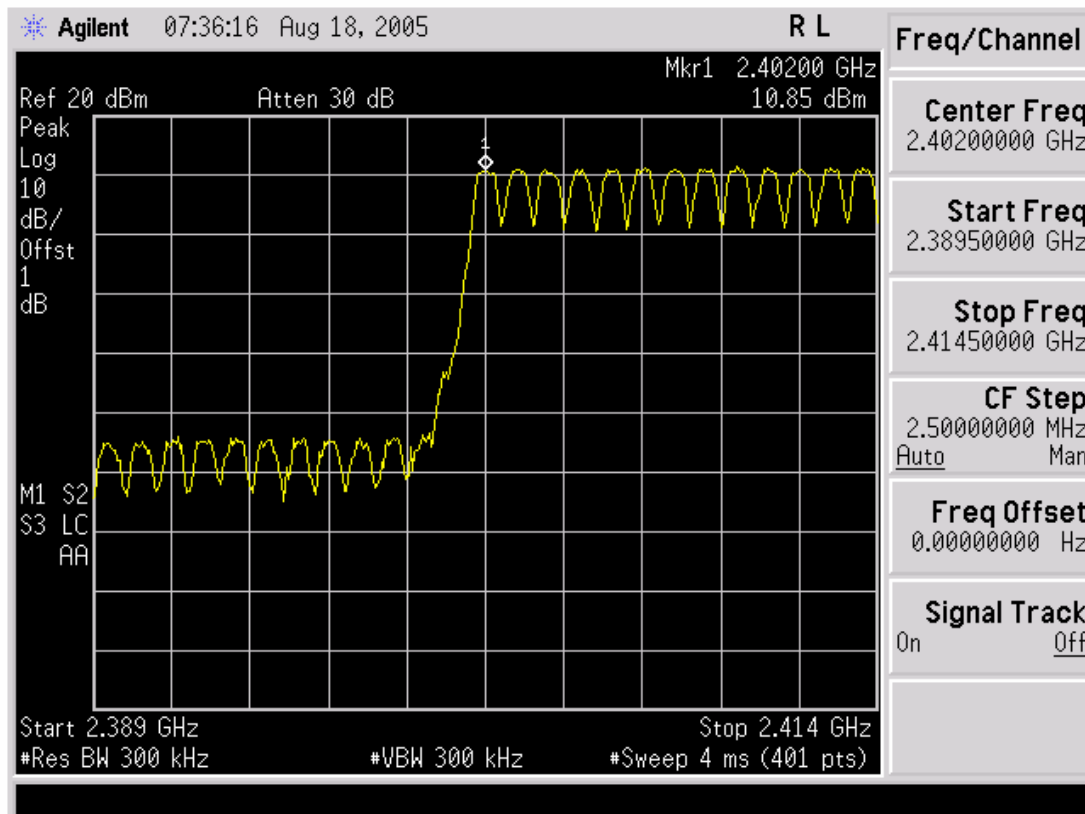
At least 75 hopes

Measurement Setup

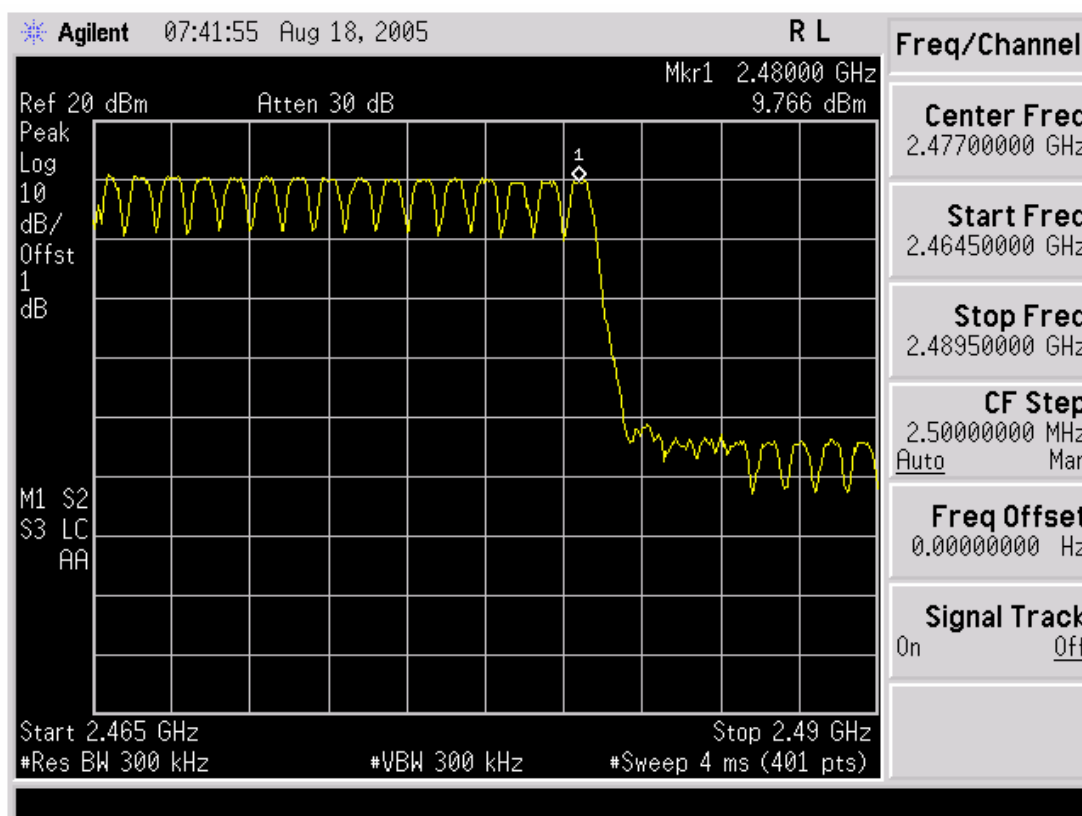
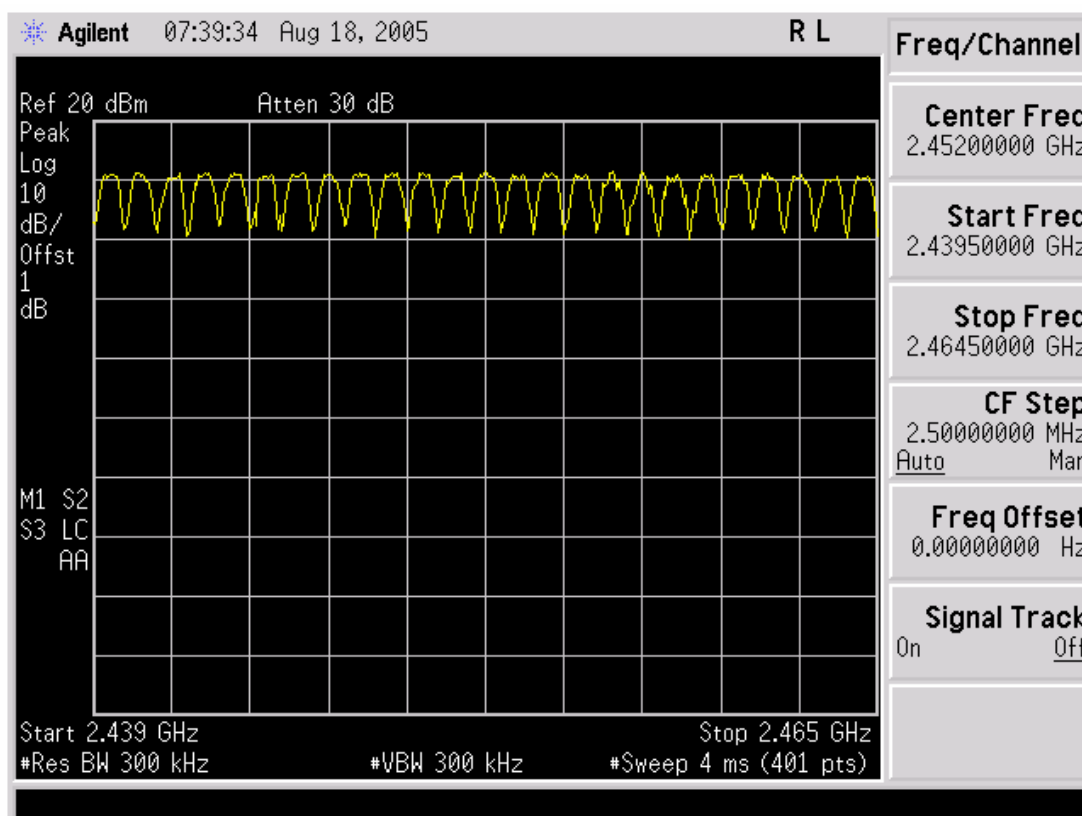
Same as the Chapter 3.2.1 (Figure 1)

TEST EQUIPMENT USED: 01, 17, 49

Number of Hopping Frequencies



Number of Hopping Frequencies



3.2.3 20 dB Bandwidth

Procedure:

The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 2 MHz (approximately 2 or 3 times of the 20 dB bandwidth)

RBW = 10 kHz (1% of the 20dB bandwidth or more) Sweep = auto

VBW = 30 kHz ($VBW \geq RBW$) Detector function = peak

Trace = max hold

Measurement Data: **Comply**

Frequency (MHz)	Channel No.	Test Results	
		Measured Bandwidth (MHz)	Result
2402	1	0.800	Comply
2441	40	0.800	Comply
2480	79	0.800	Comply

- See next pages for actual measured spectrum plots.

Minimum Standard:

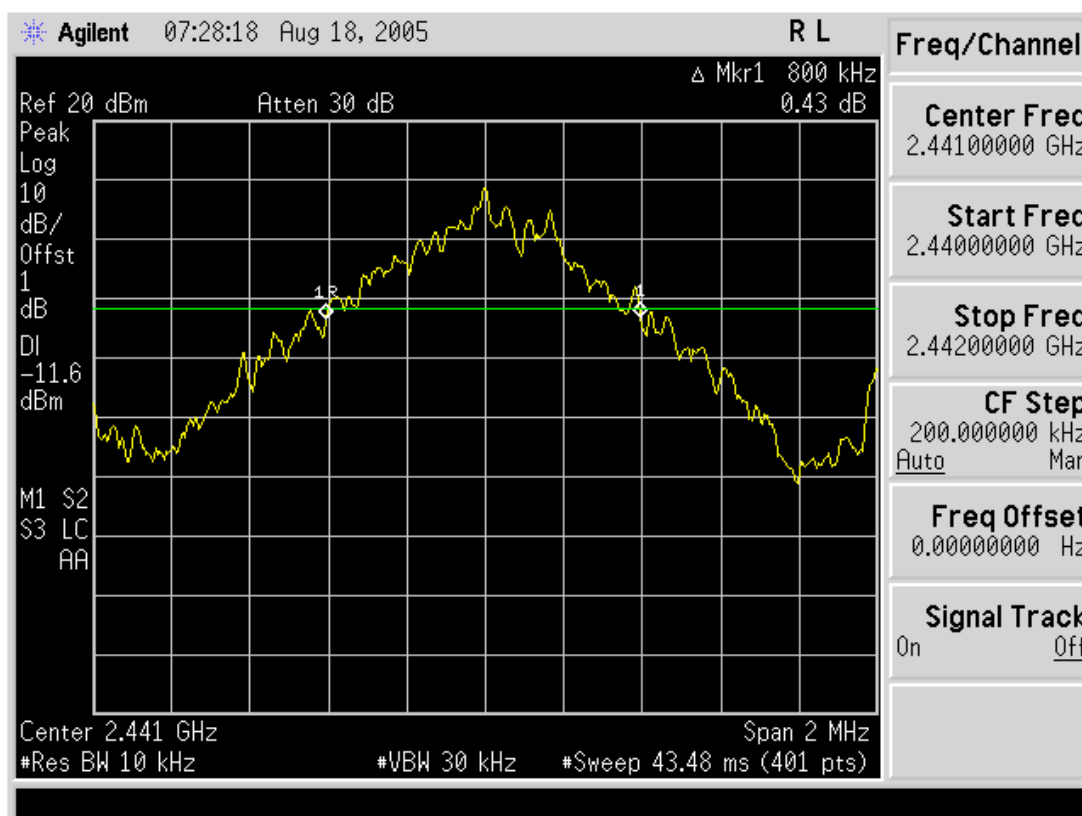
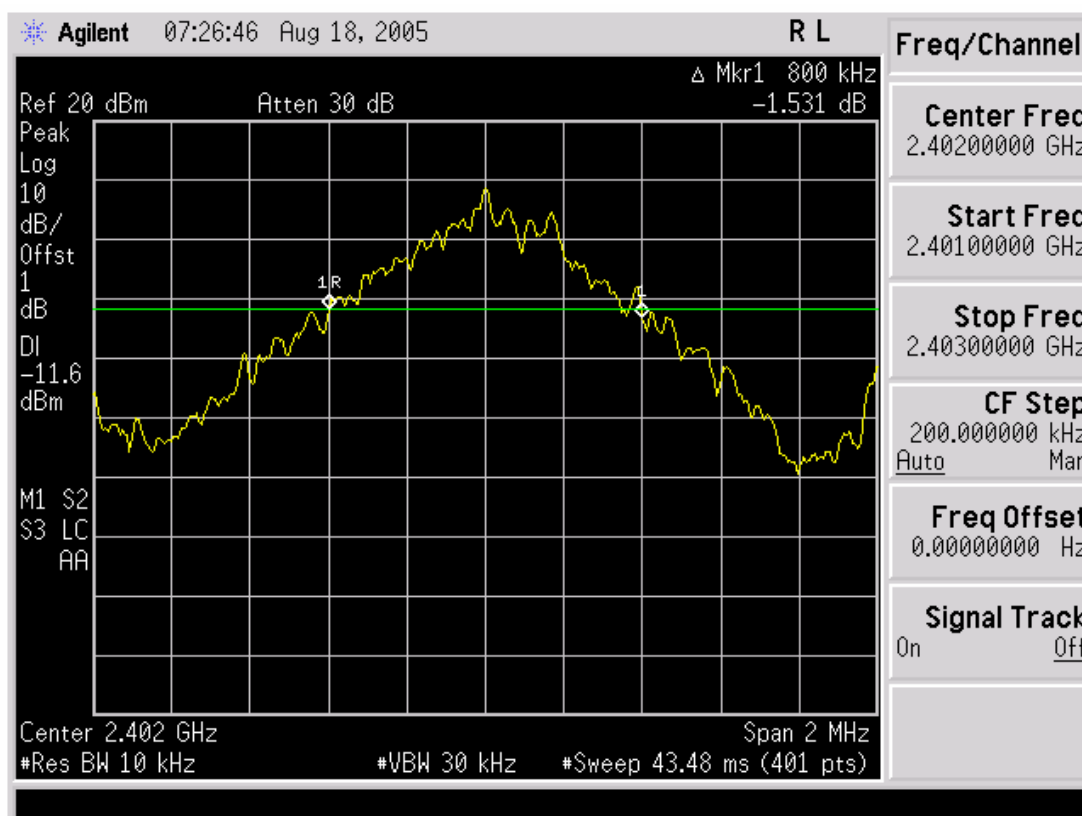
The transmitter shall have a maximum 20dB bandwidth of 1 MHz.

Measurement Setup

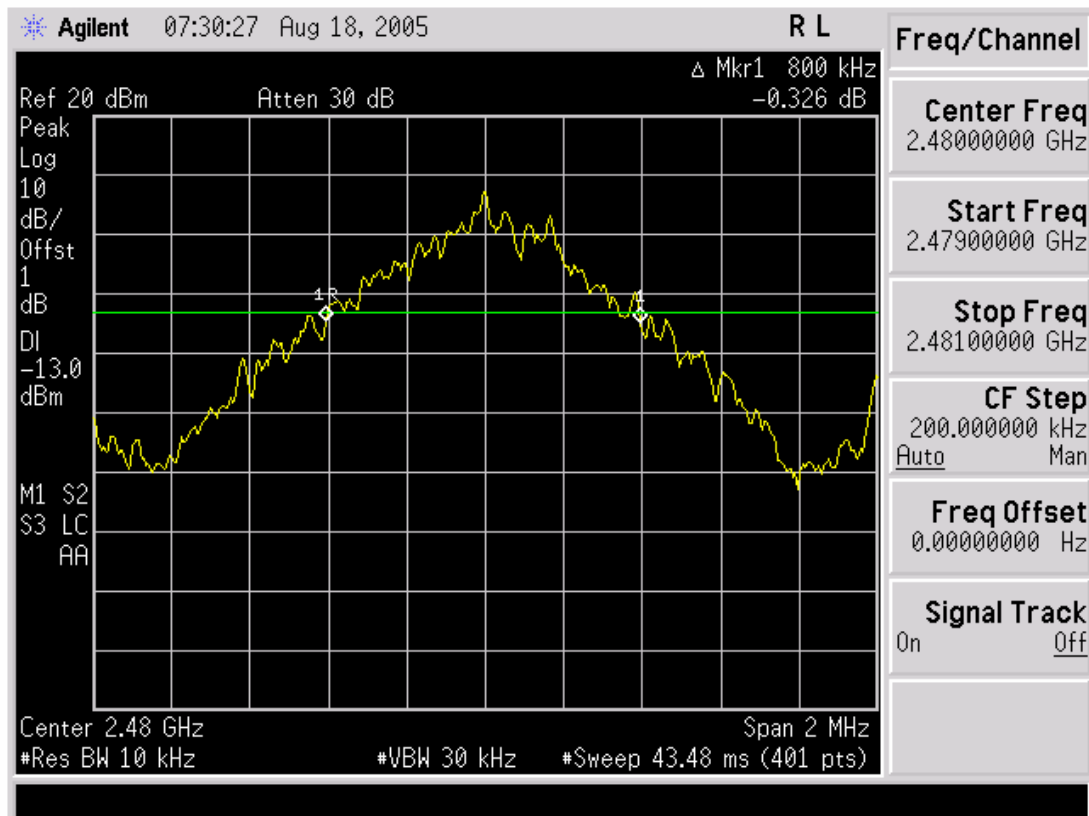
Same as the Chapter 3.2.1 (Figure 1)

TEST EQUIPMENT USED: 01, 17, 49

20 dB Bandwidth



20 dB Bandwidth



3.2.4 Time of Occupancy (Dwell Time)

Procedure:

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2441 MHz

Span = zero

RBW = 1 MHz

VBW = 1 MHz (VBW $\geq$ RBW)

Trace = max hold

Detector function = peak

Measurement Data: **Comply**

Packet Type	Burst duration in one hop (us)	Test Results	
		Dwell Time (ms)	Result
DH 1	420	134.446	Comply
DH 3	1669	268.976	Comply
DH 5	2833	301.686	Comply

- See next pages for actual measured spectrum plots.

Minimum Standard:

0.4 seconds within a 30 second period per any frequency

Measurement Setup

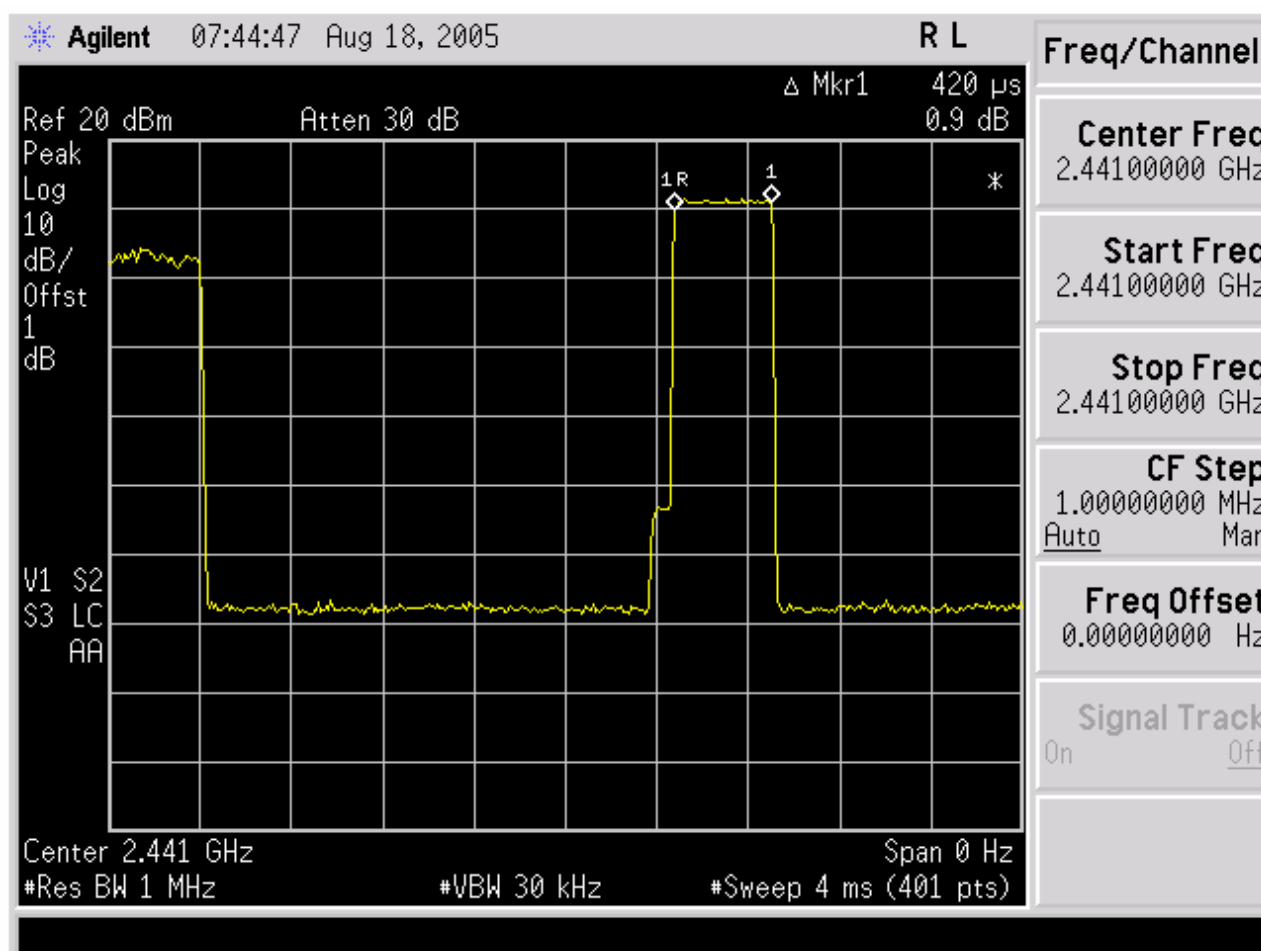
Same as the Chapter 3.2.1 (Figure 1)

TEST EQUIPMENT USED: 01, 17, 49

Time of Occupancy for PACKET Type DH 1

Each Tx-time per appearance is 420 us

So we have $320.11 \times 420 \text{ us} = 134.446 \text{ ms}$ per 31.6 seconds.

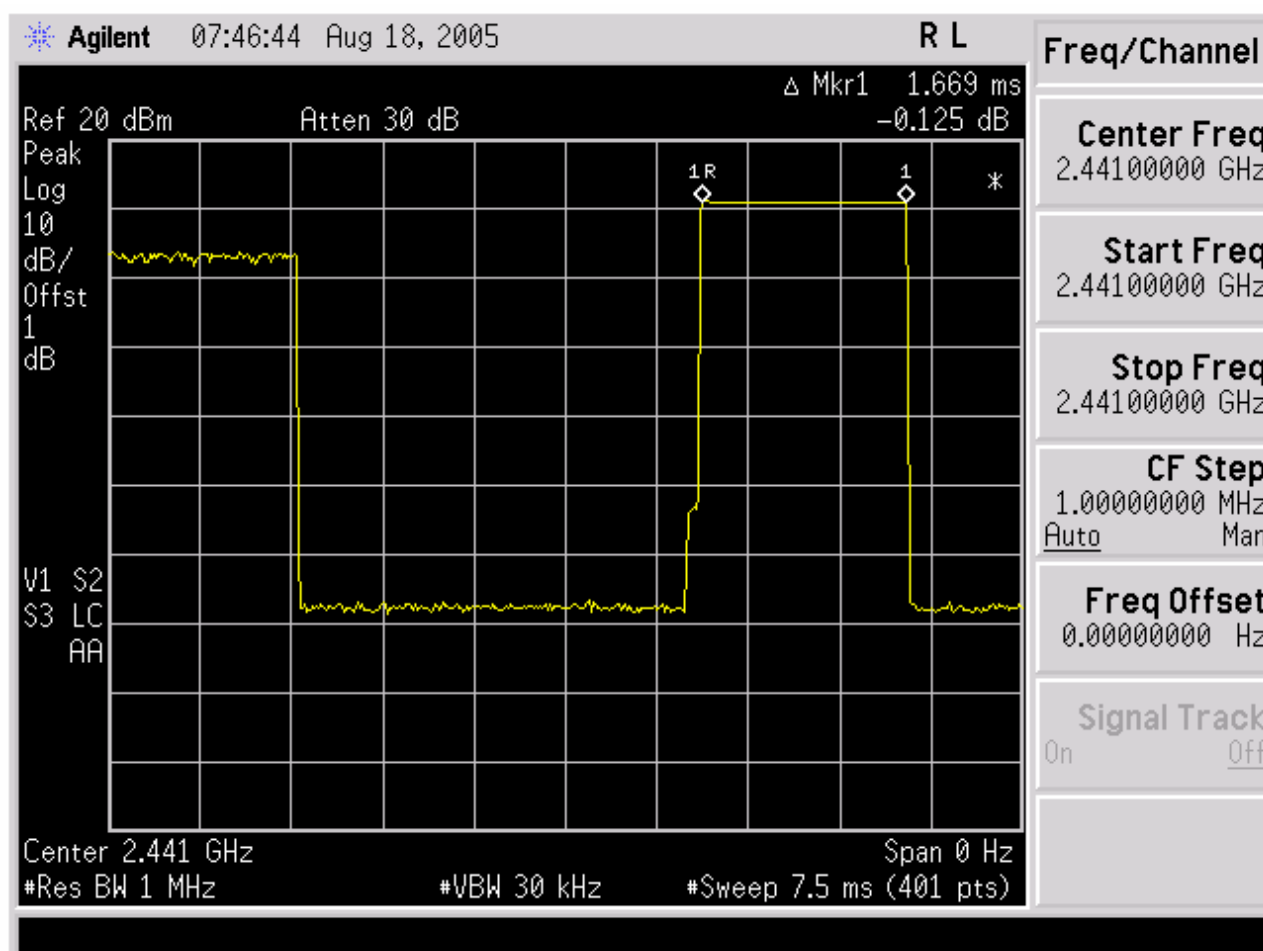


Time of Occupancy for PACKET Type DH 3

The system makes worst case 1600 hops per second or 1 time slot has a length of 625 us with 79 channels. A DH 3 Packet need 3 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case $1600/4 = 400$ hops per second with 79 channels. So you have each channel $400/79 = 5.1$ times per second and so for a period of $0.4 \times 79 = 31.6$ seconds you have $5.1 \times 31.6 = 161.16$ times of appearance.

Each Tx-time per appearance is 1.669 ms

So we have $161.16 \times 1.669 \text{ ms} = 268.976 \text{ ms}$ per 31.6 seconds.

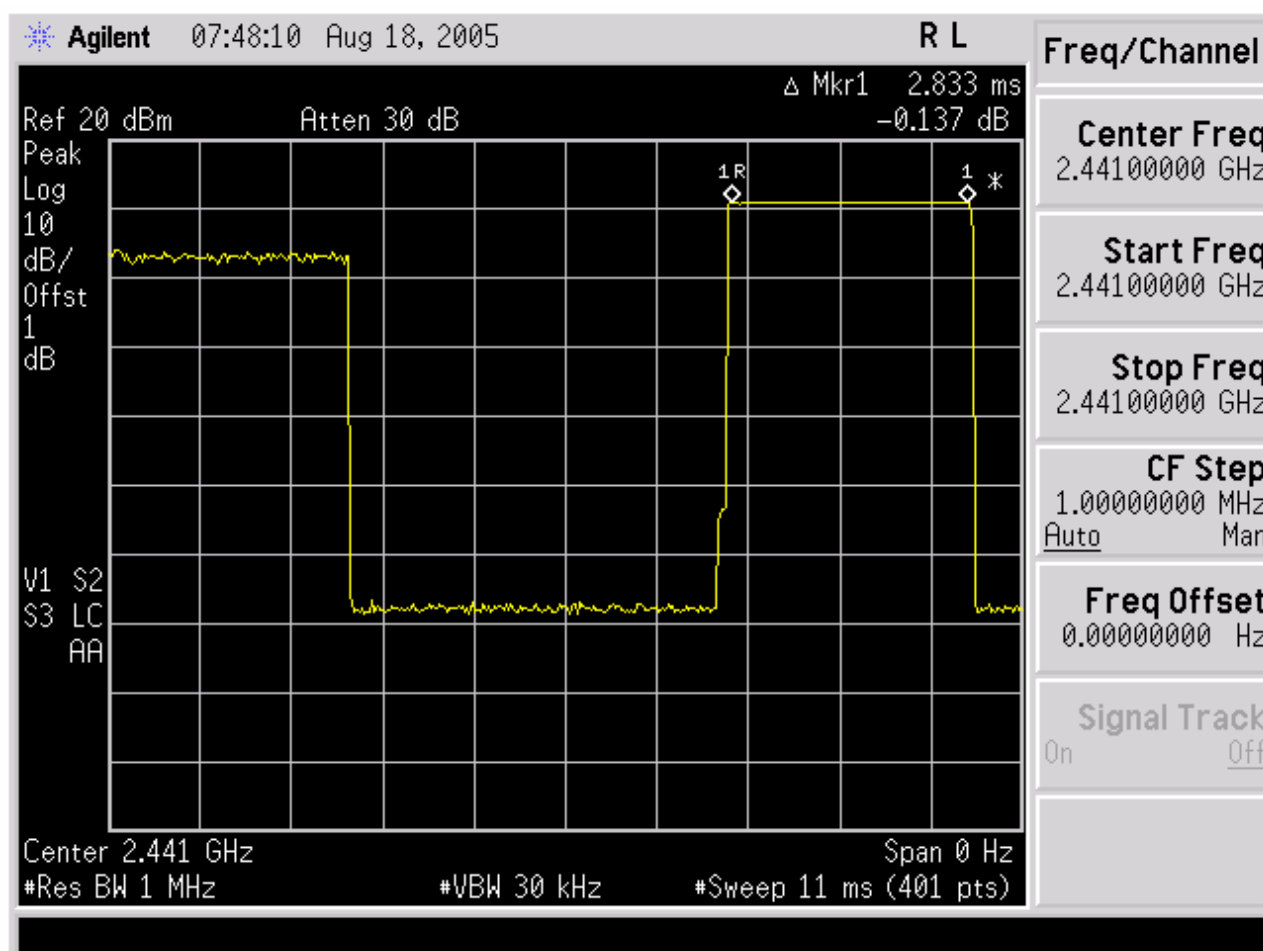


Time of Occupancy for PACKET Type DH 5

The system makes worst case 1600 hops per second or 1 time slot has a length of 625 us with 79 channels. A DH 5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case $1600/6 = 266.67$ hops per second with 79 channels. So you have each channel $266.67/79 = 3.37$ times per second and so for a period of $0.4 \times 79 = 31.6$ seconds you have $3.37 \times 31.6 = 106.49$ times of appearance.

Each Tx-time per appearance is 2.833 ms

So we have $106.49 \times 2.833 \text{ ms} = 301.686 \text{ ms}$ per 31.6 seconds.



3.2.5 Peak Output Power

Procedure:

The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 5 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 1 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 1 MHz (VBW $\geq$ RBW)

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data: **Comply**

Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	1	11.76	14.99	Comply
2441	40	12.12	16.29	Comply
2480	79	10.82	12.07	Comply

- See next pages for actual measured spectrum plots.

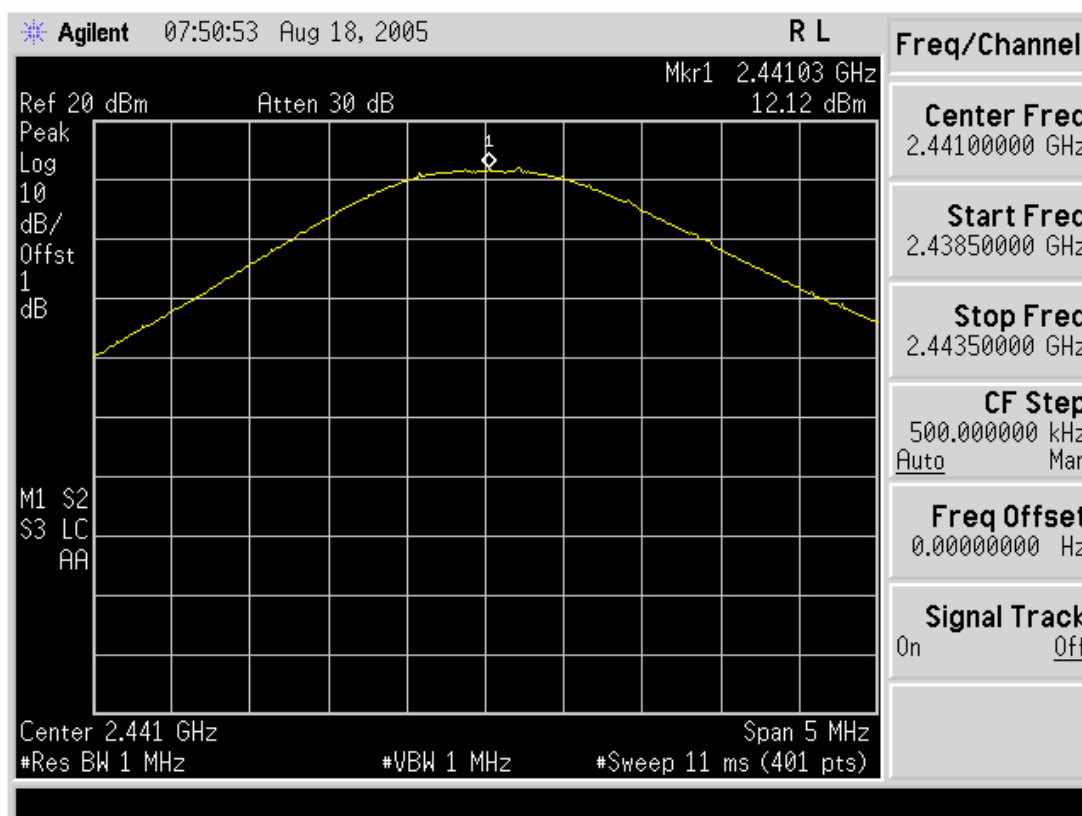
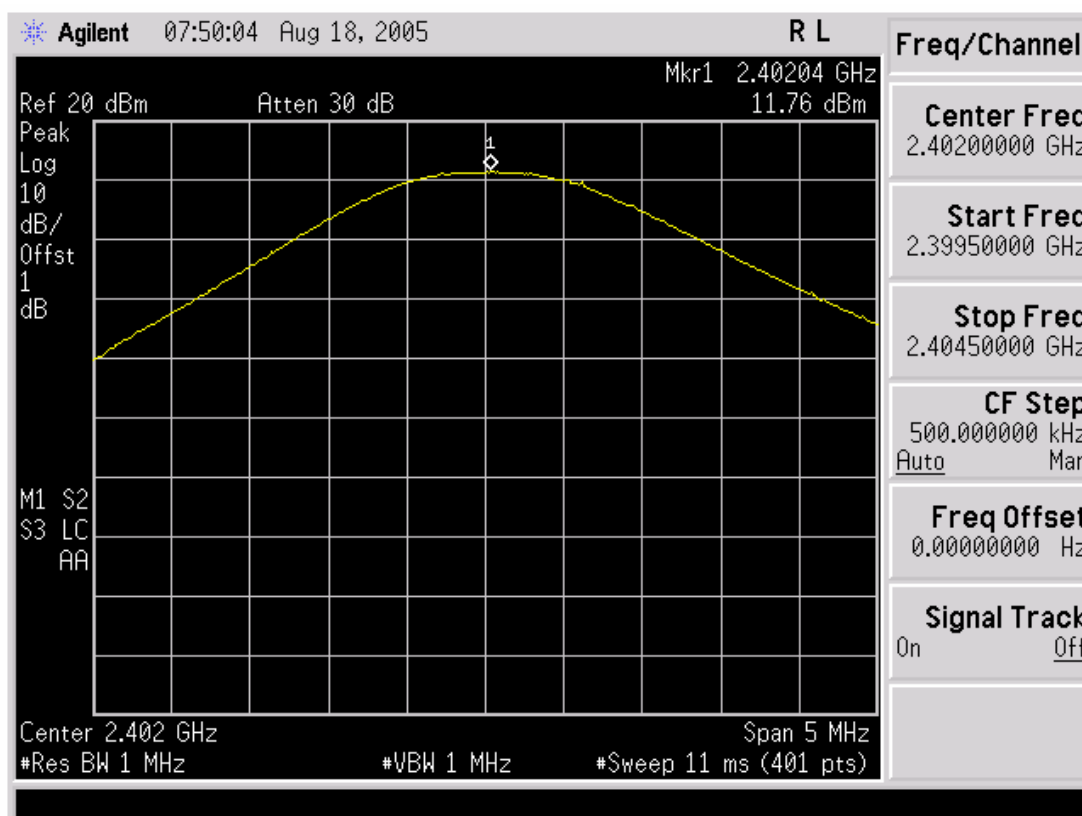
Minimum Standard:	< 1W
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Measurement Setup

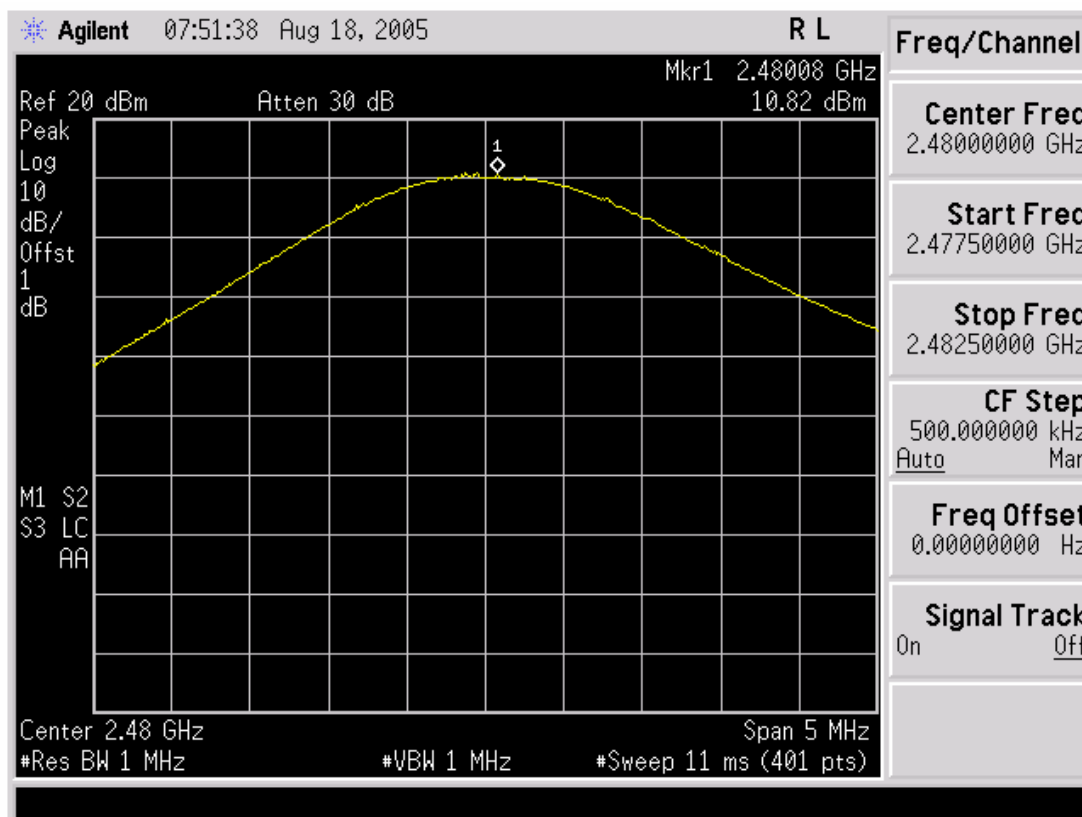
Same as the Chapter 3.2.1 (Figure 1)

TEST EQUIPMENT USED: 01, 17, 49

Peak Output Power



Peak Output Power



3.2.6 Conducted Spurious Emissions

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels	
RBW = 100 kHz	VBW = 100 kHz
Span = 100 MHz	Detector function = peak
Trace = max hold	Sweep = auto

Measurement Data: Comply

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

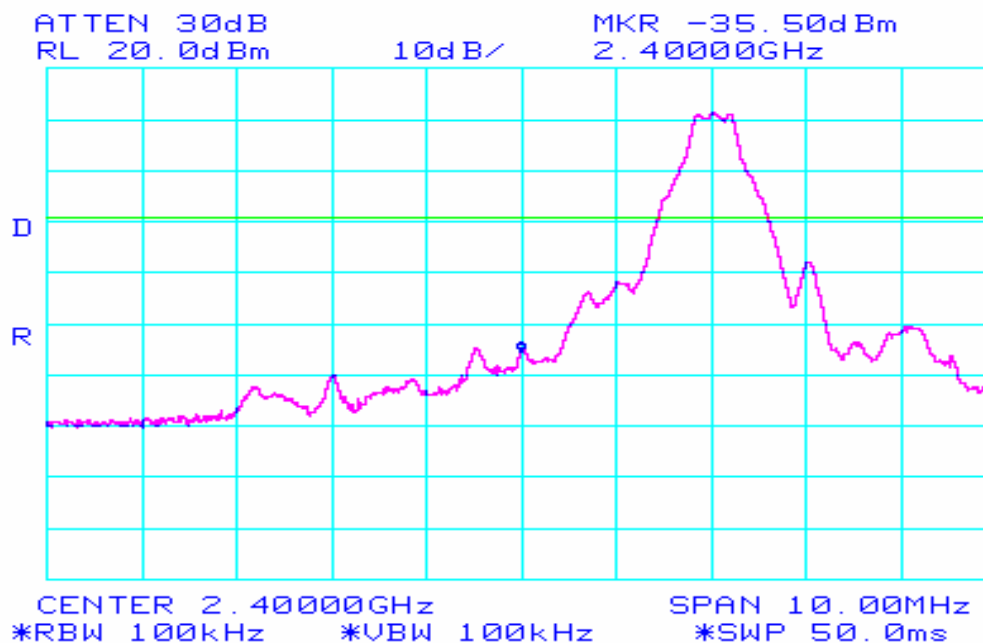
Minimum Standard:	> 20 dBc
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Measurement Setup

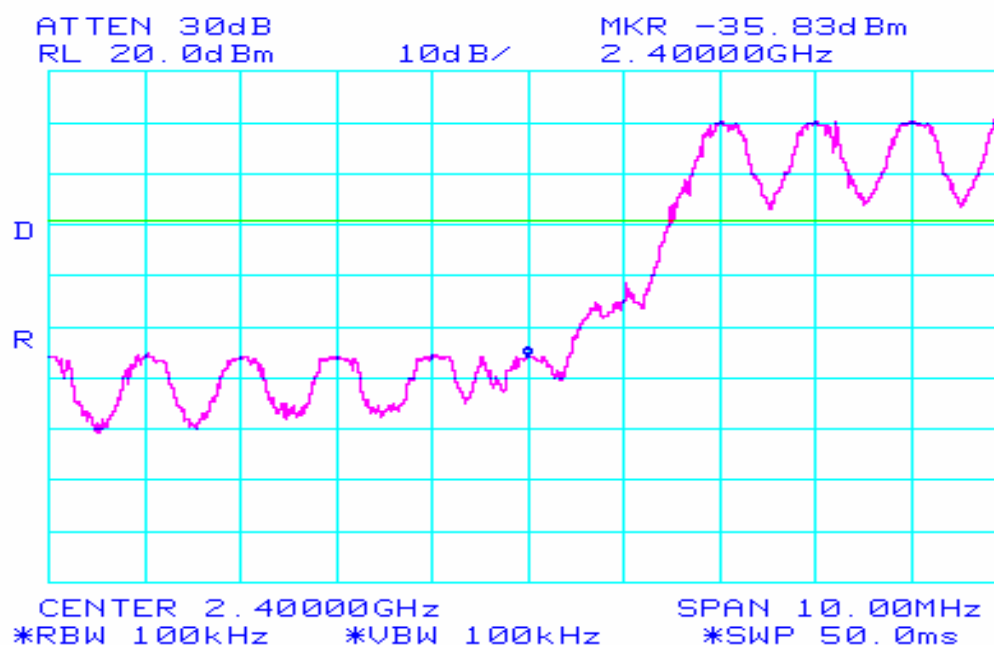
Same as the Chapter 3.2.1 (Figure 1)

TEST EQUIPMENT USED: 02, 17, 49.....

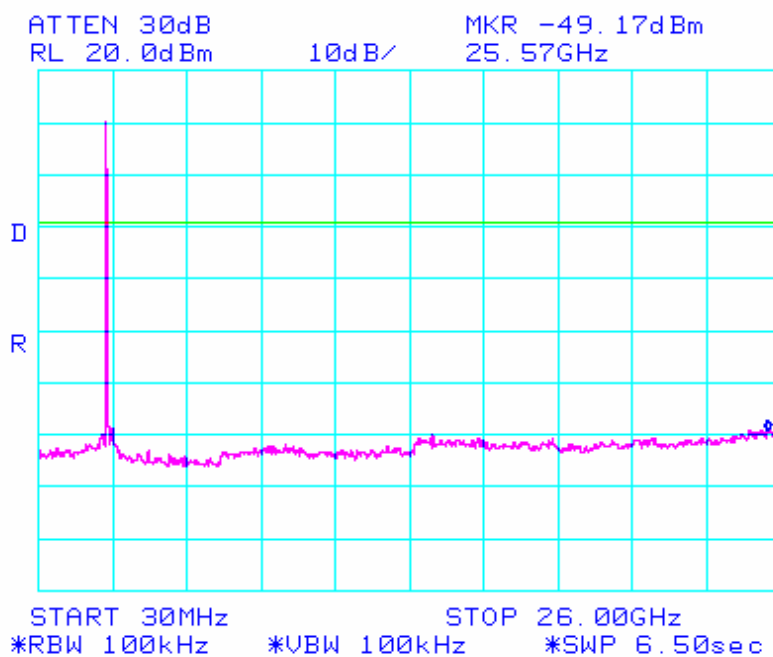
Low band with hopping disabled



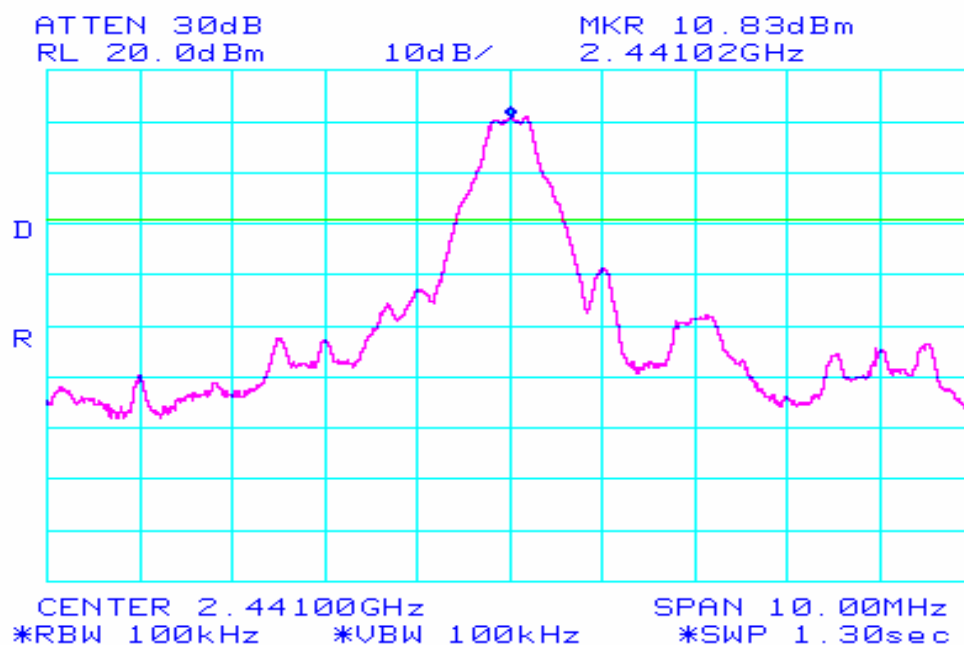
Low band with hopping enabled



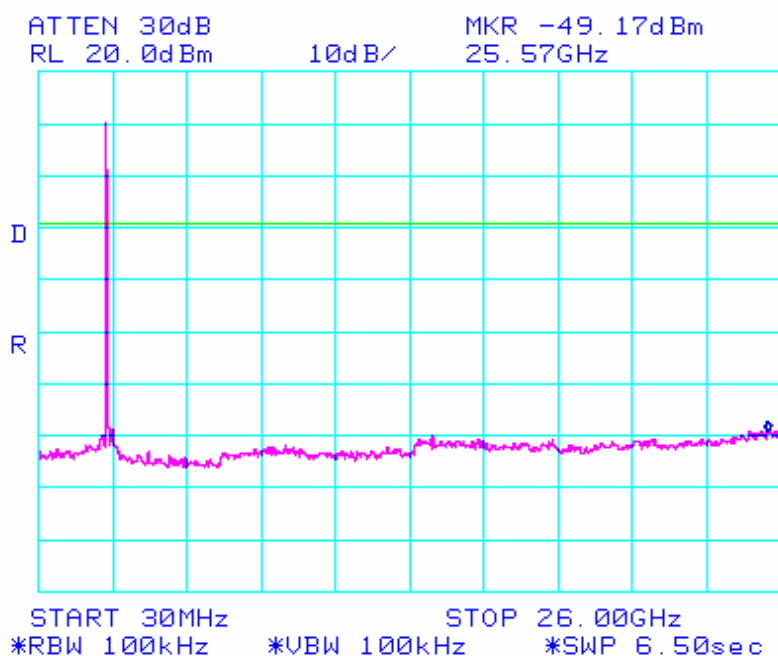
Low channel spurious



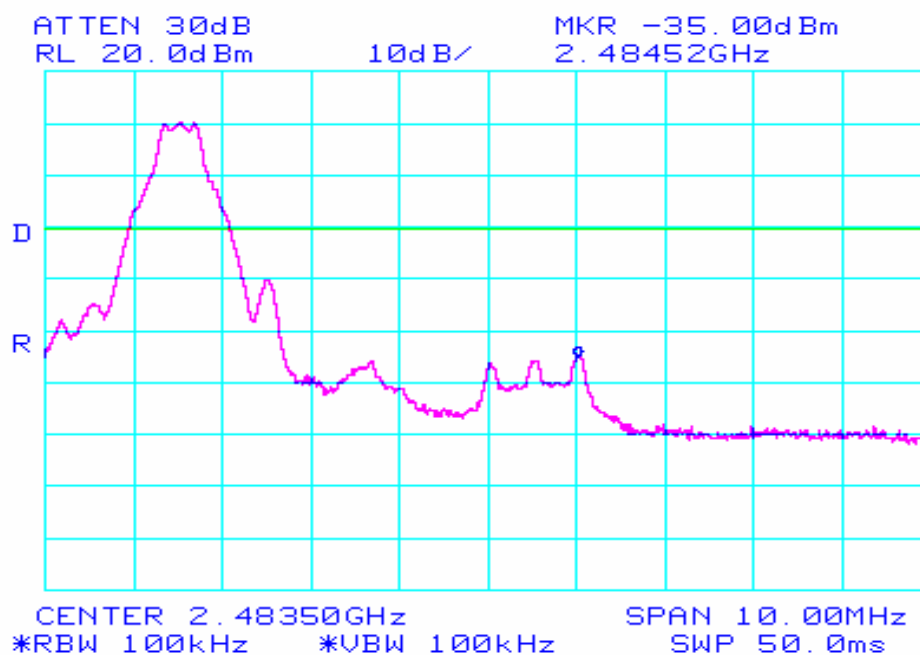
Mid channel ref



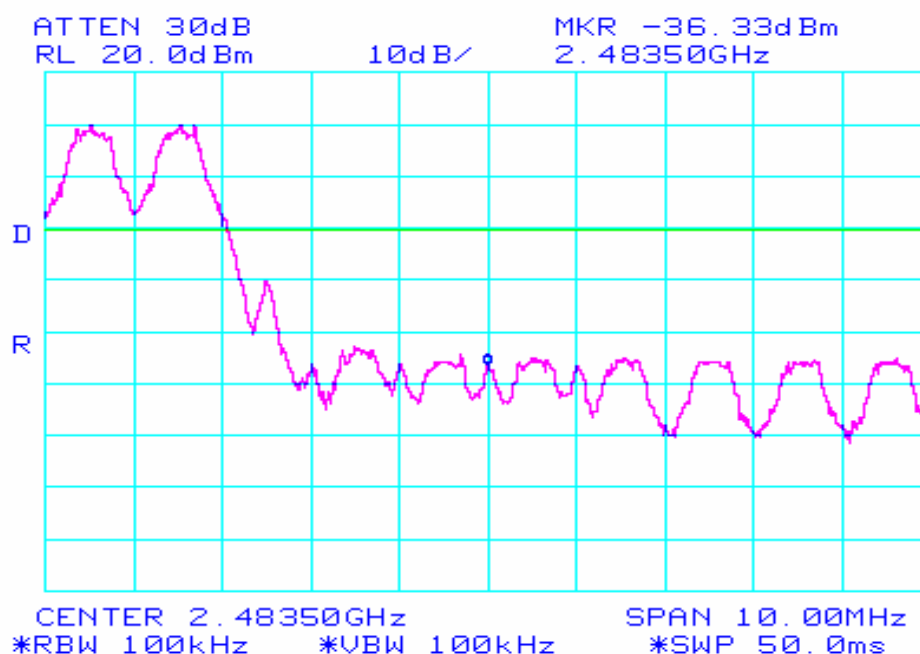
Mid channel spurious



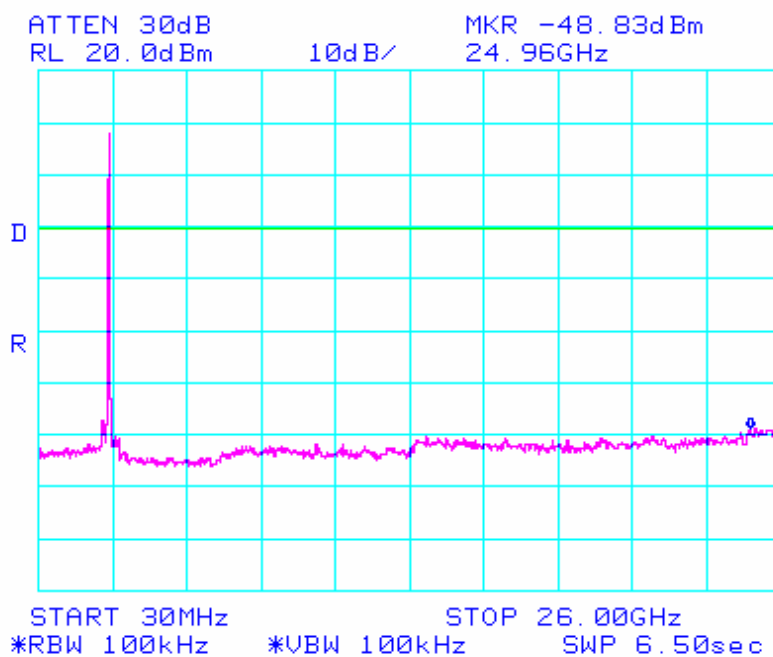
High band with hopping disabled



High band with hopping enabled



High channel spurious



3.2.7 Radiated Emissions

Procedure:

The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10th harmonic.

RBW = 120 kHz (30MHz ~ 1 GHz)

= 1 MHz (1 GHz ~ 10th harmonic)

Trace = max hold

VBW ≥ RBW (Peak)

VBW = 10Hz (Average)

Sweep = auto

Measurement Data: **Comply**

- No emissions were detected at a level greater than 10dB below limit.
- Refer to the next page.

Minimum Standard: FCC Part 15.205 (a), 15.205(b), 15.209(a) and (b)

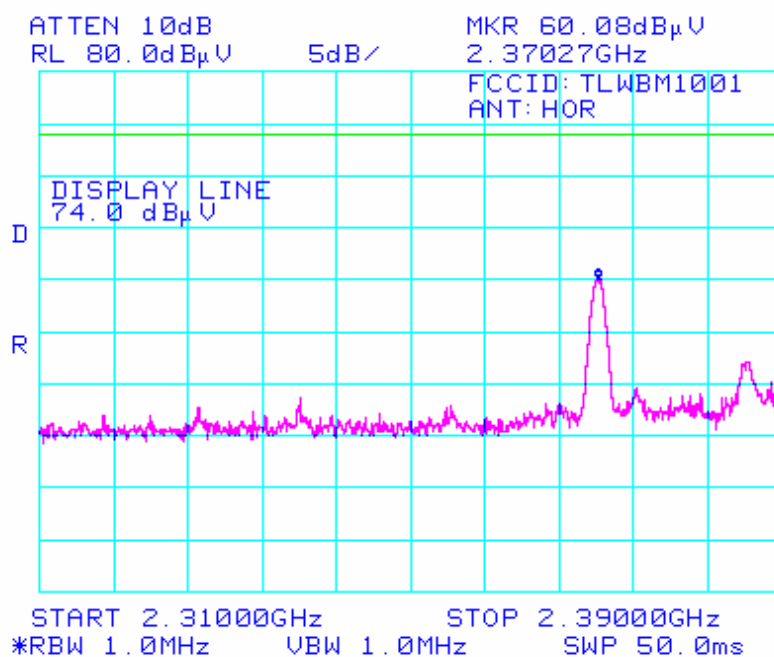
Limit : FCC P15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

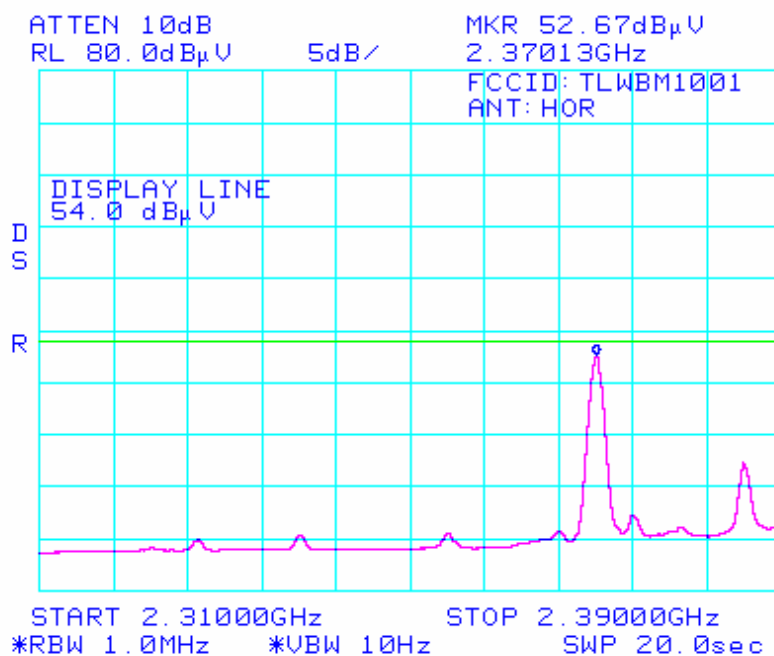
** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

TEST EQUIPMENT USED: : 02, 20, 29, 31, 32, 37, 39, 40, 46, 48

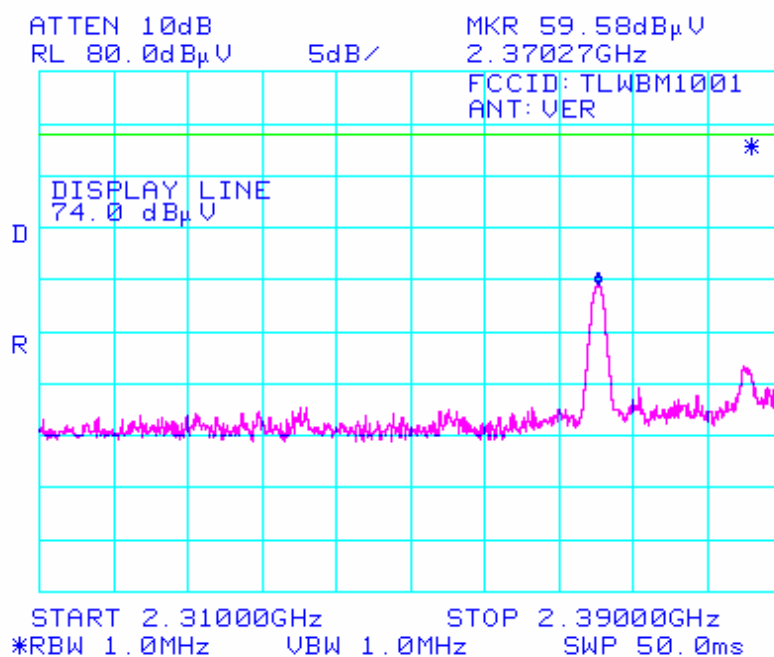
Restricted Band Edge: Low Channel (Peak, Horizontal)



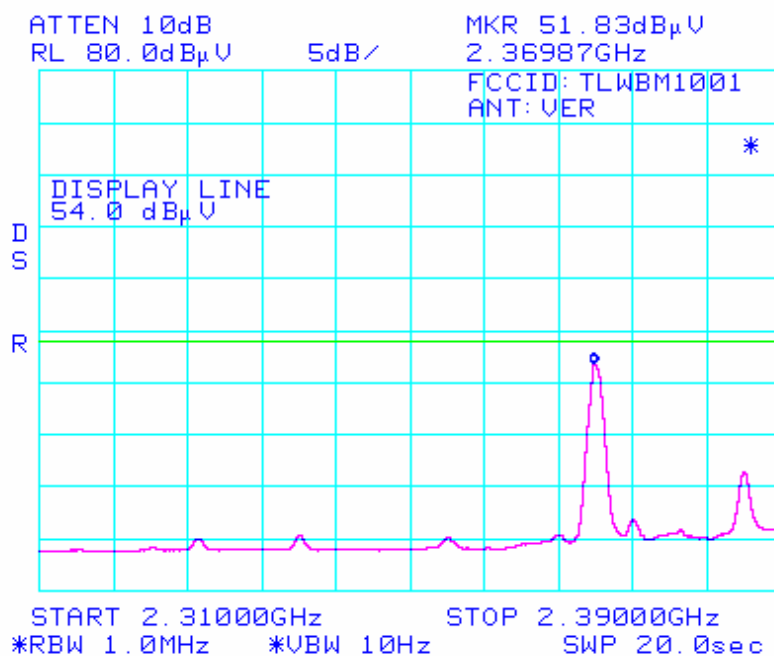
Restricted Band Edge: Low Channel (Average, Horizontal)



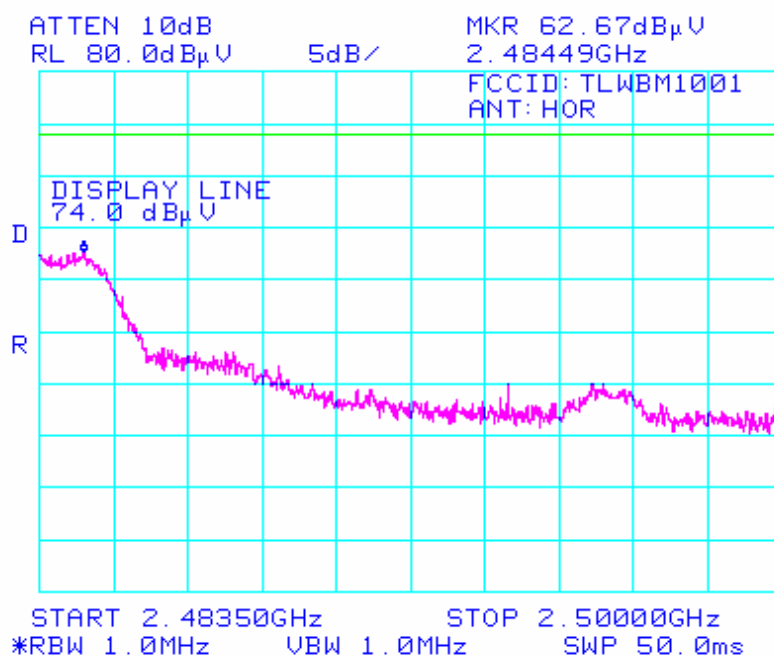
Restricted Band Edge: Low Channel (Peak, Vertical)



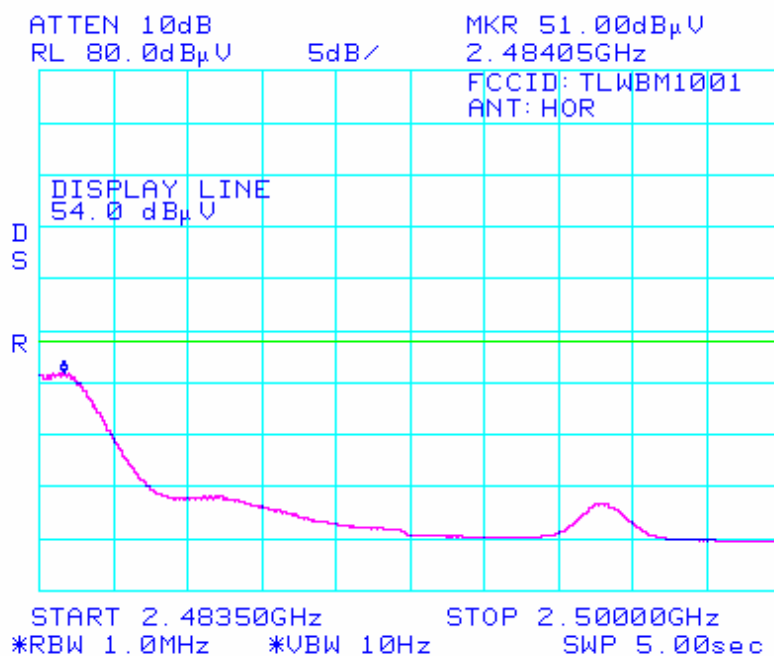
Restricted Band Edge: Low Channel (Average, Vertical)



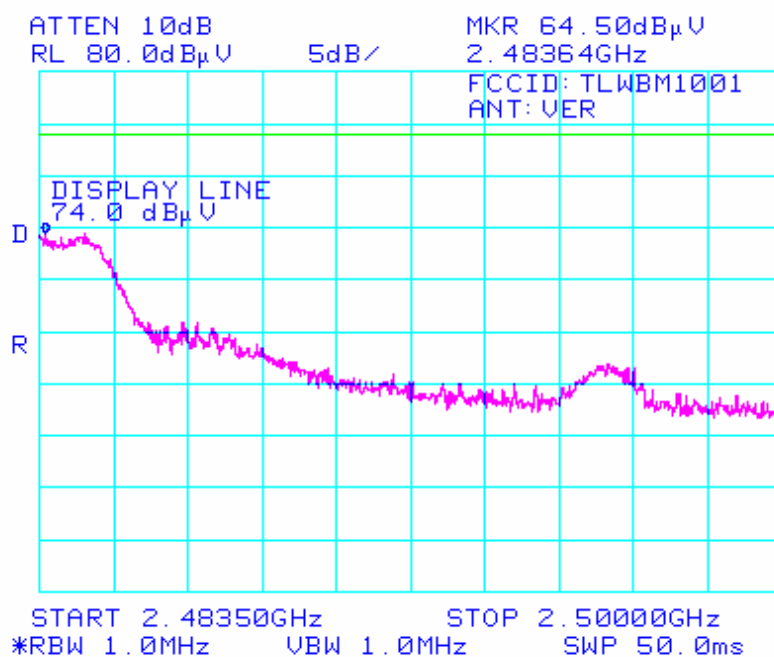
Restricted Band Edge: High Channel (Peak, Horizontal)



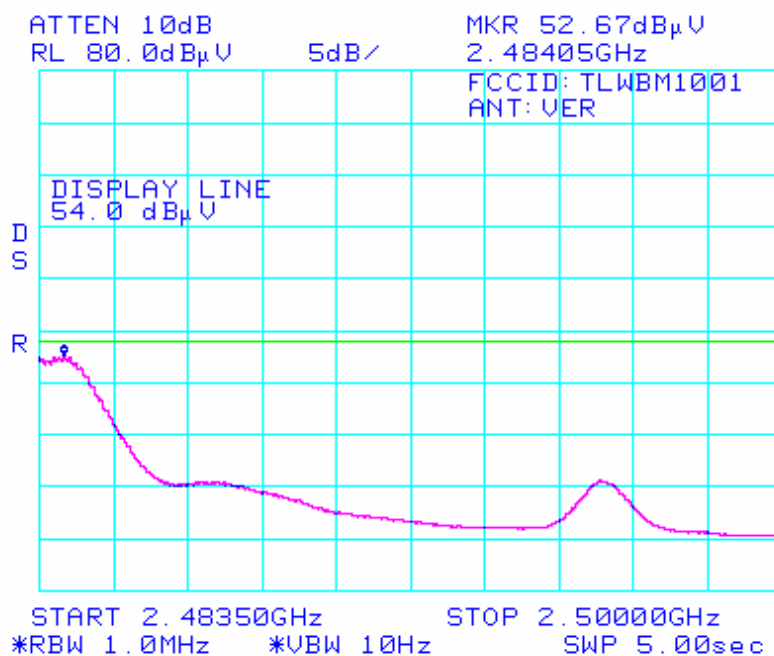
Restricted Band Edge: High Channel (Peak, Horizontal)



Restricted Band Edge: High Channel (Peak, Vertical)



Restricted Band Edge: High Channel (Peak, Vertical)



Radiated Spurious Emission Data

<u>Low Channel(2402MHz)</u>										
Frequency (MHz)	ANT Pol. (H/V)	Reading Value (dBuV)		T.F (dB)	Result (dBuV)		Limit (dBuV)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
4804	V	46.67	36.72	9.28	55.95	46.00	74	54	18.05	8.00
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

<u>Middle Channel(2441MHz)</u>										
Frequency (MHz)	ANT Pol. (H/V)	Reading Value (dBuV)		T.F (dB)	Result (dBuV)		Limit (dBuV)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
4882	V	44.33	35.28	9.78	54.11	45.06	74	54	19.89	8.94
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

<u>High Channel(2480MHz)</u>										
Frequency (MHz)	ANT Pol. (H/V)	Reading Value (dBuV)		T.F (dB)	Result (dBuV)		Limit (dBuV)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
4960	V	44.50	34.22	10.28	54.78	44.50	74	54	19.22	9.50
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

Not. 1. “ ** “ : No other emissions were detected at a level greater than 30dB below limit.

2. T.F(Total Factor) = Cable Loss + Ant Factor –AMP Gain

3. Margin = Limit - Result

-

3.2.8 AC Line Conducted Emissions

Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

Measurement Data: Not Apply

Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Measurement Setup

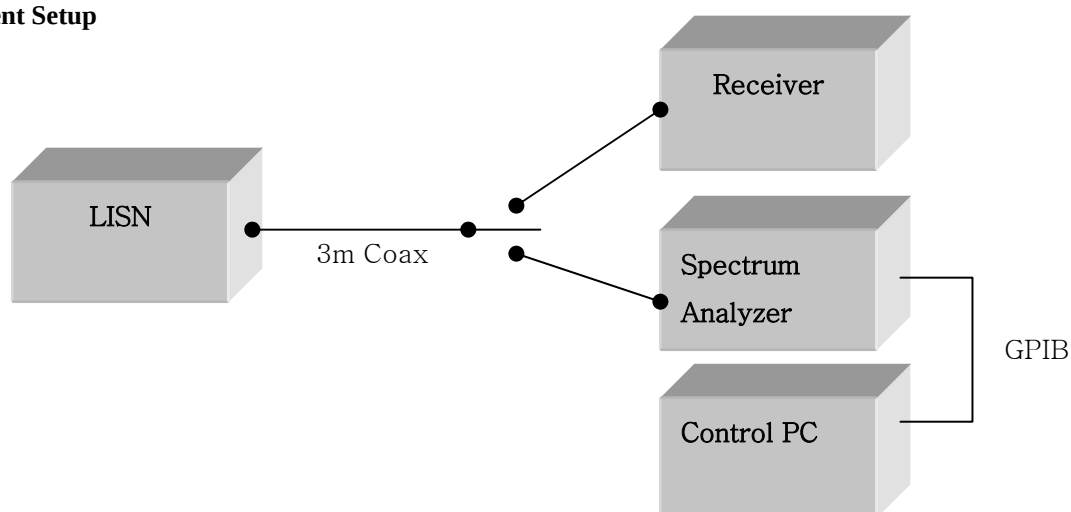
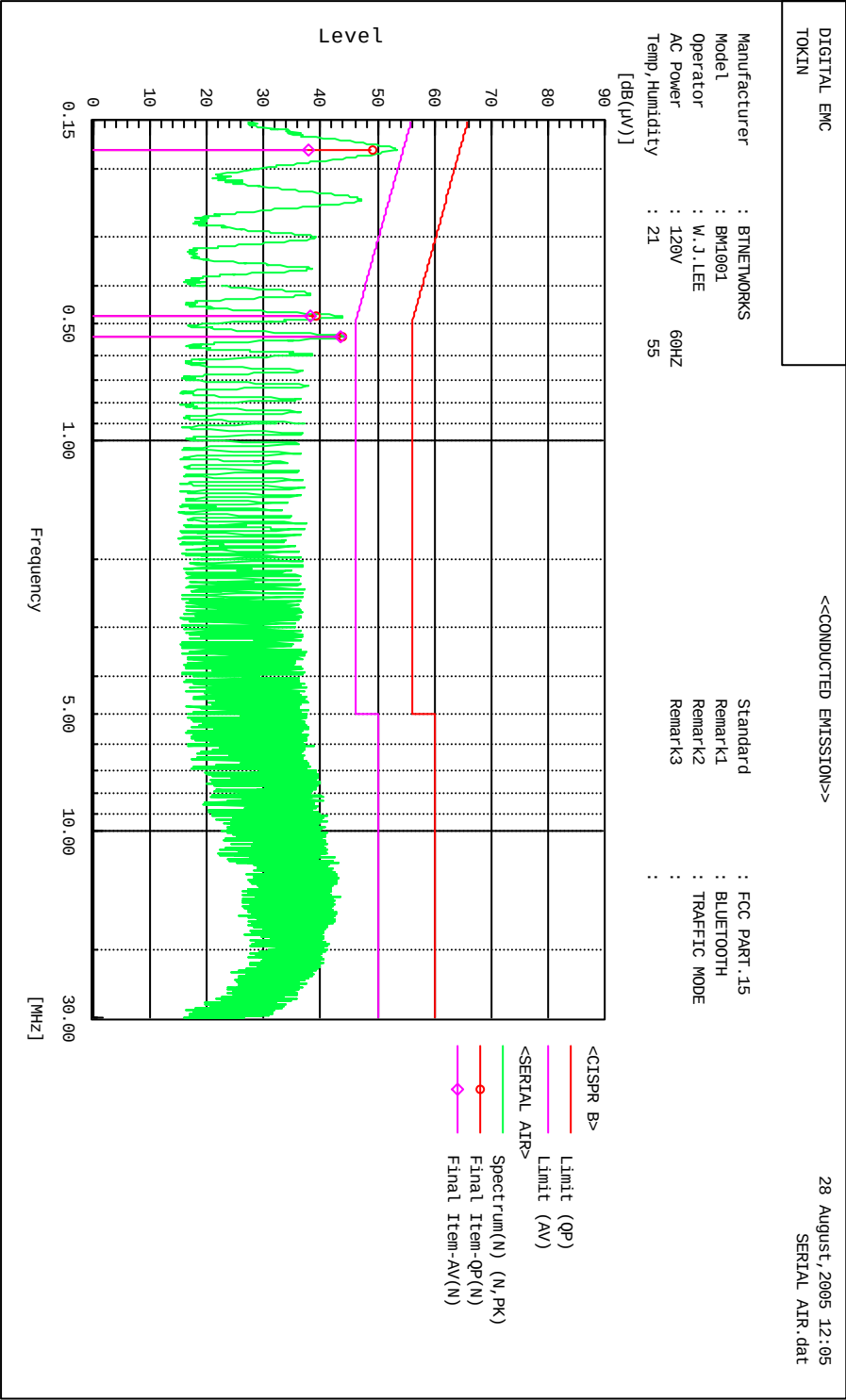


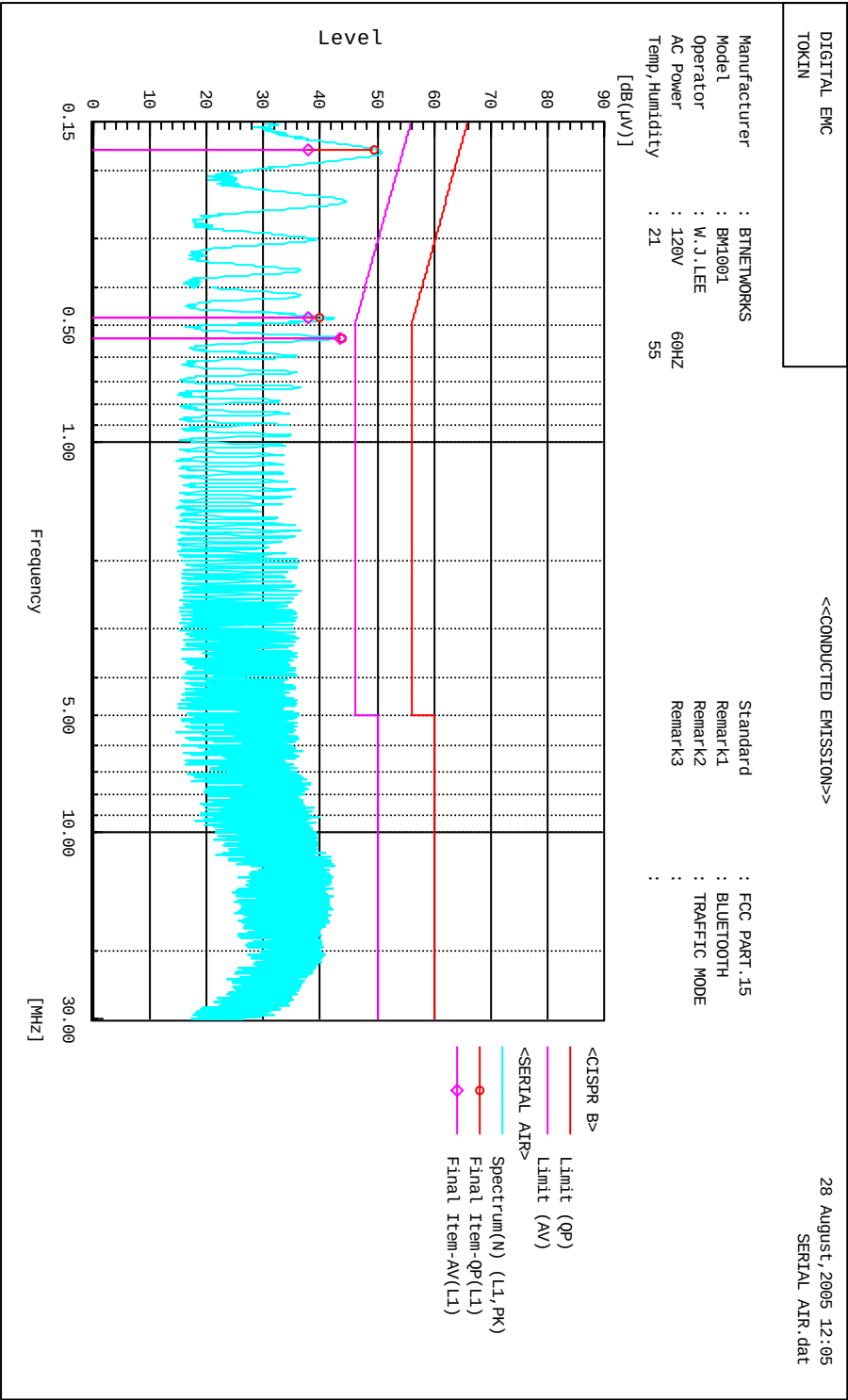
Figure 2: Measurement setup for AC Conducted Emission

TEST EQUIPMENT USED: 41, 42, 43, 44, 45, 47

AC Conducted Emissions (Line)



AC Conducted Emissions (Neutral)



AC Conducted Emissions (DATA)

```

*****
<<CONDUCTED EMISSION>>
*****
Standard      : FCC PART 15
Manufacturer   : BTNETWORKS
Model          : BM1001
Operator       : W. J. LEE
AC Power       : 120V      60HZ
Temp./Humidity : 21        55
Remark1        : BLUETOOTH
Remark2        : TRAFFIC MODE
Remark3        :
:
*****

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28 August, 2005 12:05
SERIAL AIR.dat

Final Result

--- N Phase ---													
No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV	Remark		
	[MHz]	[dB(µV)]	[dB(µV)]	[dB]	[dB(µV)]	[dB(µV)]	[dB(µV)]	[dB(µV)]	[dB]	[dB]			
1	0.179	48.6	37.4	0.6	49.2	38.0	64.5	54.5	15.3	16.5			
2	0.478	38.6	37.7	0.5	39.1	38.2	56.4	46.4	17.3	8.2			
3	0.537	43.2	43.0	0.5	43.7	43.5	56.0	46.0	12.3	2.5			
--- L1 Phase ---													
No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV	Remark		
	[MHz]	[dB(µV)]	[dB(µV)]	[dB]	[dB(µV)]	[dB(µV)]	[dB(µV)]	[dB(µV)]	[dB]	[dB]			
1	0.178	48.8	37.4	0.6	49.4	38.0	64.6	54.6	15.2	16.6			
2	0.479	39.2	37.4	0.5	39.7	37.9	56.4	46.4	16.7	8.5			
3	0.537	43.2	43.1	0.5	43.7	43.6	56.0	46.0	12.3	2.4			

APPENDIX

TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

	Type	Manufacturer	Model	Cal.Due.Date (dd/mm/yy)	S/N
01	Spectrum Analyzer	Agilent	E4404B	19/11/05	30601-01-6025569
02	Spectrum Analyzer	H.P	8563E	25/09/05	3551A04634
03	Power Meter	H.P	EPM-442A	04/07/06	GB37170413
04	Power Sensor	H.P	8481A	05/07/06	3318A96332
05	Frequency Counter	H.P	5342A	07/10/05	2119A04450
06	Multifunction Synthesizer	H.P	8904A	07/10/05	3633A08404
07	Signal Generator	Rohde Schwarz	SMR20	17/05/06	101251
08	Signal Generator	H.P	E4421A	05/07/06	US37230529
09	Audio Analyzer	H.P	8903B	07/07/06	3011A0944B
10	Modulation Analyzer	H.P	8901B	05/07/06	3028A03029
11	Oscilloscope	LeCroy	9314A	10/10/05	93144390
12	CDMA Mobile Station Test Set	H.P	8924C	07/10/05	US35360688
13	Power Splitter	WEINSCHTEL	1593	07/10/05	332
14	BAND Reject Filter	Wainwright	WRCG824	07/10/05	SN1
15	BAND Reject Filter	Wainwright	WRCG1750	07/10/05	SN2
16	AC Power supply	DAEKWANG	5KVA	18/04/06	N/A
17	DC Power Supply	H.P	6622A	18/04/06	465487
18	Attenuator (30dB)	H.P	8498A	07/10/05	50101
19	Attenuator (10dB)	WEINSCHTEL	23-10-34	07/10/05	BP4387
20	HORN ANT	EMCO	3115	06/03/07	6419
21	HORN ANT	EMCO	3115	04/25/07	21097
22	HORN ANT	A.H.Systems	SAS-574	09/11/06	154
23	HORN ANT	A.H.Systems	SAS-574	09/11/06	155
24	Dipole Antenna	Schwarzbeck	VHA9103	29/10/05	2116
25	Dipole Antenna	Schwarzbeck	VHA9103	29/10/05	2117
26	Dipole Antenna	Schwarzbeck	UHA9105	29/10/05	2261

	Type	Manufacturer	Model	Cal.Due.Date (dd/mm/yy)	S/N
27	Dipole Antenna	Schwarzbeck	UHA9105	29/10/05	2262
28	RFI/FIELD Intensity Meter	Kyorits	KNM-504D	07/07/06	SN-161-4
29	Frequency Converter	Kyorits	KCV-604C	07/07/06	4-230-3
30	TEMP & HUMIDITY Chamber	JISCO	J-RHC2	14/09/05	021031
31	Log Periodic Antenna	Schwarzbeck	UHALP9108A1	29/10/05	1098
32	Biconical Antenna	Schwarzbeck	VHA9103	29/10/05	VHA91031946
33	Digital Multimeter	H.P	34401A	18/04/06	3146A13475
34	Attenuator (10dB)	WEINSCHEL	23-10-34	07/10/05	BP4386
35	High-Pass Filter	ANRITSU	MP526	12/05/06	M27756
36	Attenuator (3dB)	Agilent	8491B	15/09/05	58177
37	Amplifier (25dB)	Agilent	8447D	18/04/06	2944A10144
38	Amplifier (30dB)	Agilent	8449b	11/10/05	3008A01590
39	Position Controller	TOKIN	5901T	N/A	14173
40	Driver	TOKIN	5902T2	N/A	14174
41	Spectrum Analyzer	H.P	8591E	18/04/06	3649A05889
42	RFI/FIELD Intensity Meter	Kyorits	KNW-2402	04/07/06	4N-170-3
43	LISN	Kyorits	KNW-407	11/08/06	8-317-8
44	LISN	Kyorits	KNW-242	11/08/06	8-654-15
45	CVCF	NF Electronic	4400	N/A	344536 4420064
46	Software	ToYo EMI	EP5/RE	N/A	Ver 2.0.800
47	Software	ToYo EMI	EP5/CE	N/A	Ver 2.0.801
48	Software	AUDIX	e3	N/A	Ver 3.0
49	Software	Agilent	Benchlink	N/A	A.01.09 021211