

**ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC PART 15 SUBPART C REQUIREMENT**

OF

Abe Bluetooth USB Dongle

System Trade Name: Abe

System Model No.: UB20

Module Trade Name: National Semiconductor

Module Model No.: LMX9814

FCC ID: NV6-UB20

Report No.: 030071-R-ID

Issue Date: May 27, 2003

Prepared for

In-Tech Electronics Limited

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Prepared by

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VERIFICATION OF COMPLIANCE

Applicant: In-Tech Electronics Limited
Unit 7-10, 2/F, Century Centre, 44-46 Hung To Road,
Kwun Tong, Kowloon, H.K.

Equipment Under Test: Abe Bluetooth USB Dongle

System Trade Name: Abe

System Model No.: UB20

Module Trade Name: National Semiconductor

Module Model No.: LMX9814

Serial Number: N/A

File Number: 030071-R-ID

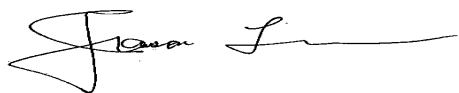
Date of Test: Apr. 30 ~ May 26, 2003

We hereby certify that:

The above equipment was tested by C&C Laboratory Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (1992) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15. 247.

The test results of this report relate only to the tested sample identified in this report.

Approved By



Jonson Lee / Director
C&C Laboratory Co., Ltd.

Review By



Susan Su / Section Manager
C&C Laboratory Co., Ltd.

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1. GENERAL INFORMATION

1.1 Product Description

The In-Tech Electronics Limited Model: UB20 (referred to as the EUT in this report) is Abe Bluetooth USB Dongle.

The EUT is compliance with Bluetooth Standard.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402 – 2480MHz, 79 channels
- B). Rated Output Power: 0dBm
- C). Modulation Type: Frequency Hopping Sequence Spread Spectrum (FHSS), GFSK
- D). Antenna Designation: Ceramic Antenna, 3.0dBi, Non-User Replaceable (Fixed)
- E). Power Supply: 4.75 – 5.25Vdc from USB Port of Notebook PC
- F). Receiver Type: Super Heterodyne

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: NV6-UB20 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (Digital Device) is compliance with Subpart B is authorized under a DoC procedure.

1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the address of C&C Laboratory, Co., Ltd. No. 81-1, 210 Lane, Pa-de 2nd Road, Lu-Chu Hsiang, Taoyuan, Taiwan, R.O.C.. The Open Area Test Sites and the Line Conducted labs are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 1992 and CISPR 22/EN 55022 requirements.

1.5 Special Accessories

Not available for this EUT intended for grant.

1.6 Equipment Modifications

Not available for this EUT intended for grant.

2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner, which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency, which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-1992. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turn-table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4-1992.

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

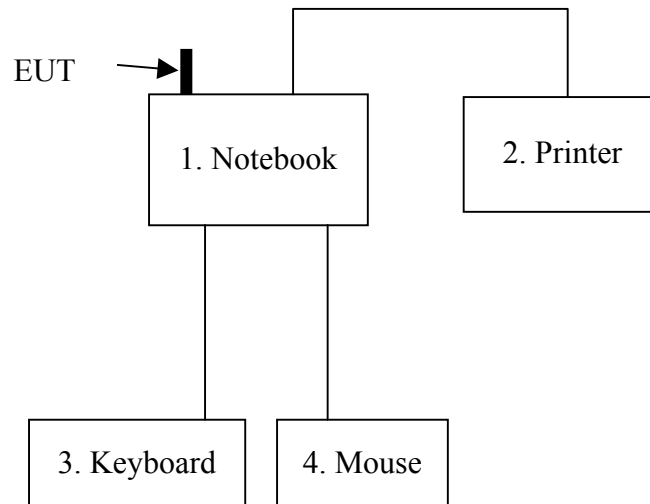


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	FCC ID	Series No.	Data Cable	Power Cord
1.	Notebook	Compaq	1525AP	FCC DoC	1V31LDLZ20PG	N/A	Unshielded,1.8m
2.	Printer	EPSON	C20SX	FCC DoC	DW4E126664	Shielded,1.8m	Unshielded,1.8m
3.	PS2 Keyboard	COMPAQ	M-S34	DZL211029	113907-068	Shielded,1.8m	N/A
4.	USB Mouse	Logitech	M-BB48	FCC DoC	LZE01360732	Shielded,1.8m	N/A

3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§ 15.207(a)	Conducted Emission	Compliant
§ 15.247(b)	Peak Output Power	Compliant
§ 15.247(a)(1)	20dB Bandwidth	Compliant
§ 15.247(c)	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§ 15.209(a) (f)	Spurious Emission	Compliant
§ 15.247(a)(1)	Frequency Separation	Compliant
§ 15.247(a)(1)(iii)	Number of hopping frequency	Compliant
§ 15.247(a)(1)(iii)	Time of Occupancy	Compliant
§ 15.247	Peak Power Density	Compliant
§ 15.203	Antenna Requirement	Compliant
§ 1.1307(b)(1)	RF Exposure	Compliant

4. DESCRIPTION OF TEST MODES

The EUT (Abe Bluetooth USB Dongle) has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low (2402MHz) 、mid (2441MHz) and high (2480MHz) with highest data rate are chosen for full testing.

5. CONDUCTED EMISSION TEST

5.1 Standard Applicable

According to § 15.207. frequency within 150KHz to 30MHz shall not exceed.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

5.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-1992.
2. The EUT was plug-in the host PC via USB port. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The keyboard was placed directly in the front of the monitor, flushed with the front tabletop. The mouse was placed next to the Keyboard, flushed with the back of keyboard.
4. The spacing between the peripherals was 10 centimeters.
5. External I/O cables were draped along the edge of the test table and bundle when necessary.
6. The host PC system was connected with 110Vac/60Hz power source.

5.3 Measurement Procedure

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

5.4 Measurement Equipment Used:

Conducted Emission Test Site # 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCS30	847793/012	12/21/2002	12/20/2003
LISN	R&S	ESH2-Z5	843285/010	12/16/2002	12/15/2003
LISN	EMCO	3825/2	9003-1628	07/26/2002	07/25/2003

5.5 Measurement Result

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

LINE CONDUCTED TEST

Model Number: UB20

Tested by: Jim

Test Mode: normal operating

Detector Function: Quasi-Peak

Temperature: 28⁰C

Humidity: 63%RH

(The chart below shows the highest readings taken from the final data)

Freq.	Q.P. Raw dBuV	AVG Raw dBuV	Q.P. Limit dBuV	AVG Limit dBuV	Q.P. Margin dB	AVG Margin dB	NOTE
0.150	49.60	---	66.00	56.00	-16.40	---	L1
2.020	33.80	---	56.00	46.00	-22.20	---	L1
2.820	36.30	---	56.00	46.00	-19.70	---	L1
4.460	35.70	---	56.00	46.00	-20.30	---	L1
5.460	31.50	---	60.00	50.00	-28.50	---	L1
8.120	31.60	---	60.00	50.00	-28.40	---	L1
0.150	47.10	---	66.00	56.00	-18.90	---	L2
2.330	34.40	---	56.00	46.00	-21.60	---	L2
2.680	37.10	---	56.00	46.00	-18.90	---	L2
4.330	36.00	---	56.00	46.00	-20.00	---	L2
5.400	31.80	---	60.00	50.00	-28.20	---	L2
8.360	30.80	---	60.00	50.00	-29.20	---	L2

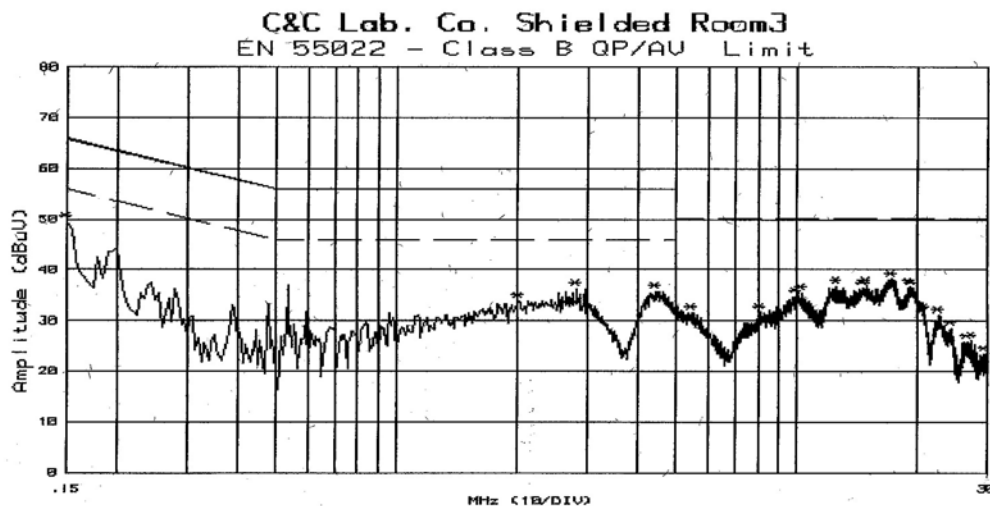
Remark:

- (1) Measuring frequencies from 0.15 MHz to 30MHz.
- (2) The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Qusia-Peak detector and Average detector.
- (3) “---” denotes the emission level was or more than 2dB below the Average limit, so no re-check anymore.
- (4) The IF bandwidth of SPA between 0.15MHz to 30MHz was 10KHz;
The IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9KHz;
- (5) L1 = Line One (Hot side) / L2 = Line Two (Neutral side)



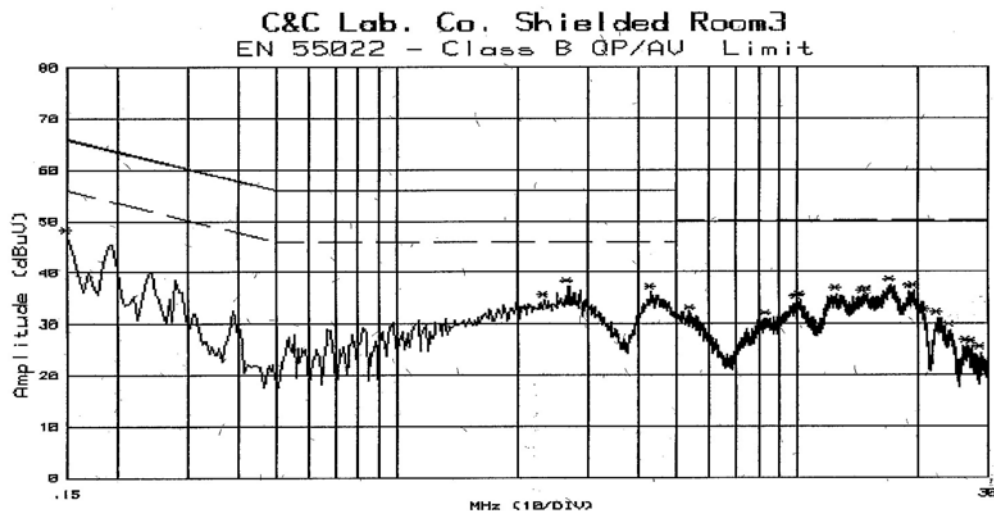
Conducted Emission Test Plot

L1



Customer:1	File#: 3491	Date :26 May 2003 19:35:15
Model :1	Humd.:63 (%)	Temp. :28 (C)
Mode :	Port :L1	Tested by:JIM
Reading :Peak(R&S Receiver)		
Remark :110V		

L2



Customer:1	File#: 3492	Date :26 May 2003 19:45:00
Model :1	Humd.:63 (%)	Temp. :28 (C)
Mode :	Port :L2	Tested by:JIM
Reading :Peak(R&S Receiver)		
Remark :110V		

6. PEAK OUTPUT POWER MEASUREMENT

6.1 Standard Applicable

According to § 15.247(b)(2), for direct sequence systems, the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

6.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Channel power function, RBW, VBW = 1MHz)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

6.3 Measurement Result

CH	Frequency (MHz)	Reading Power dBm	Cable Loss	Output Power dBm	Output Power W	Limit (W)
LOW	2402.00	-1.32	0.60	-0.72	0.00085	1
MID	2441.00	-1.31	0.60	-0.71	0.00085	1
HIGH	2480.00	-1.30	0.60	-0.70	0.00085	1

6.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
RF Power Meter	BOONTON	4531	130601	01/11/2003	01/10/2004
Power Sensor	HP	8481A	2702A61366	03/16/2003	03/15/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

7. 20dB BAND WIDTH

7.1 Standard Applicable

According to § 15.247(a)(1), Frequency hopping systems operating in the 2400MHz-2483.5MHz bands. The Maximum 20dB bandwidth of the hopping channel is 1MHz.

7.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10KHz (1 % of Bandwidth.), Span= 2MHz, Sweep=auto
4. Mark the peak frequency and -20dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

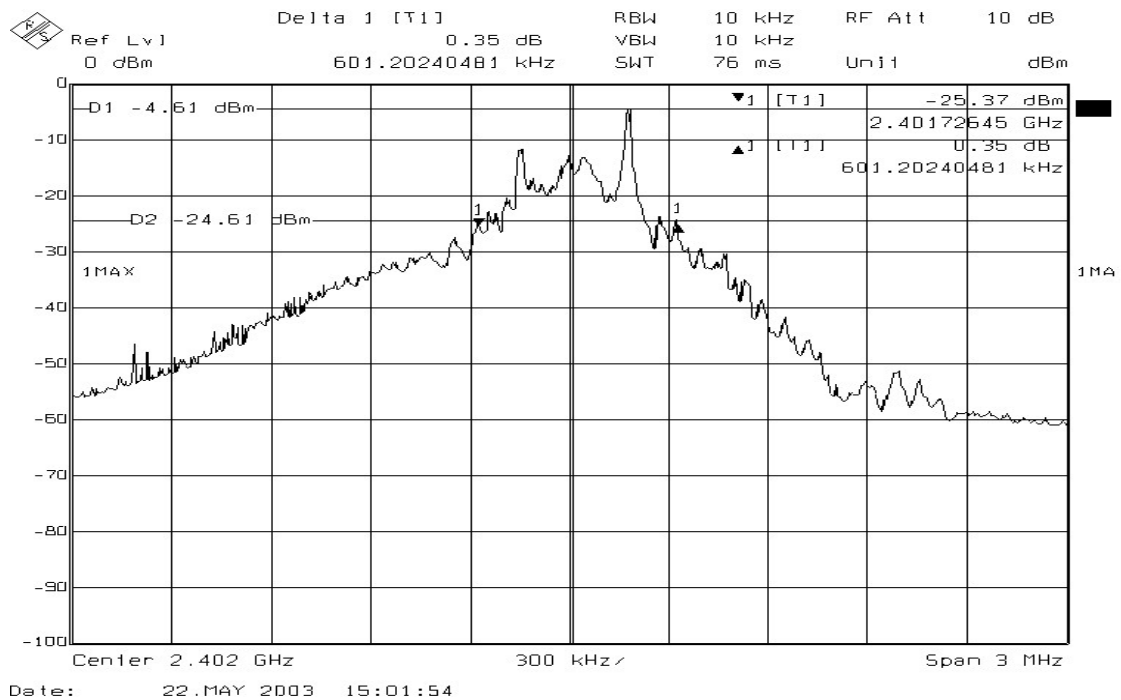
7.3 Measurement Result

C H	B a n d w i d t h (M H z)	B a n d w i d t h L i m i t (M H z)	R e s u l t
L o w e r	0 . 6 0 1	1	P A S S
M i d	0 . 5 1 7	1	P A S S
H i g h e r	0 . 5 2 9	1	P A S S

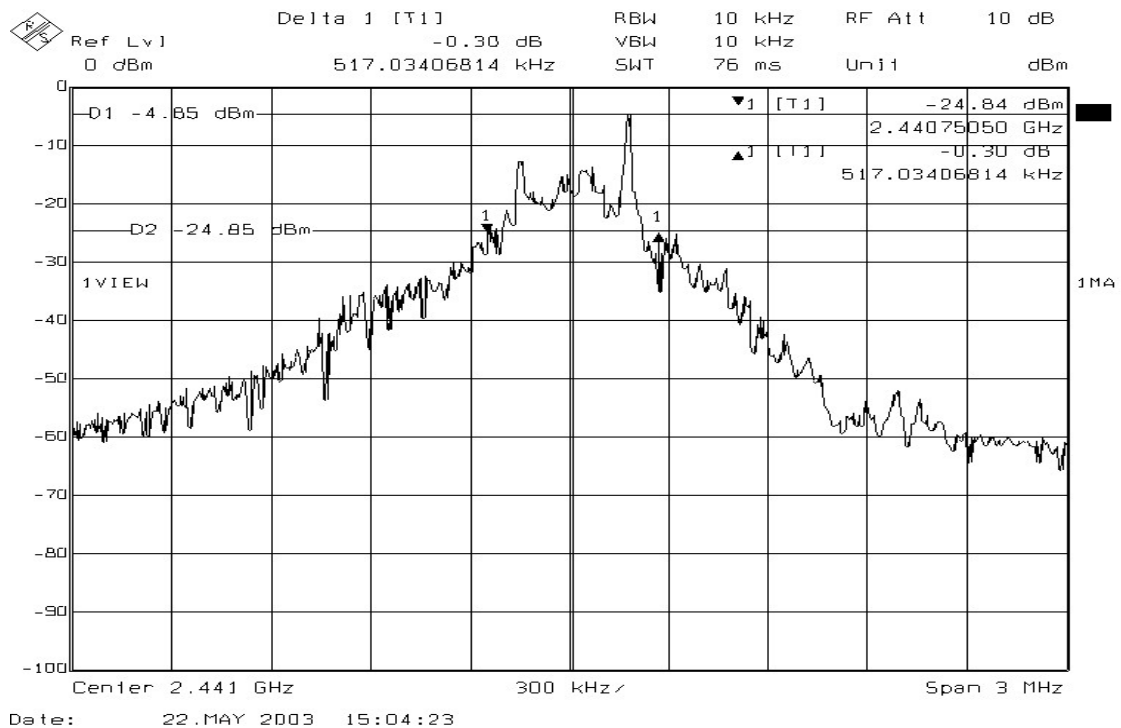
7.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

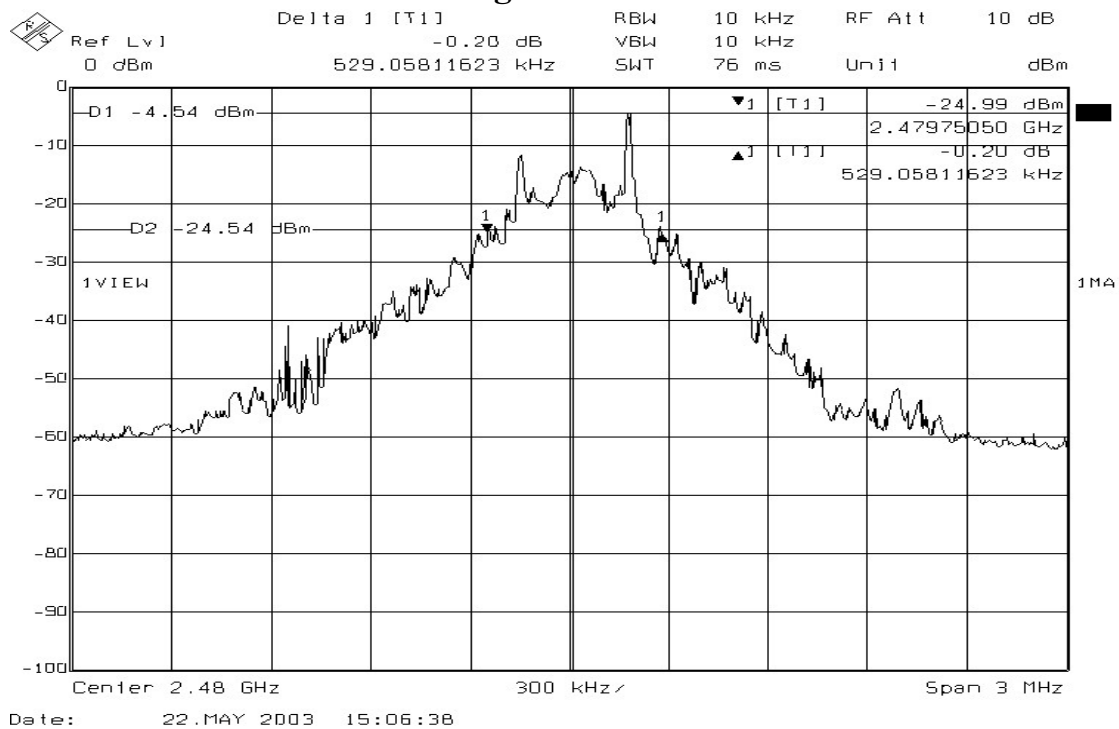
20dB Band Width Test Data CH-Low



20dB Band Width Test Data CH-Mid



20dB Band Width Test Data CH-High



8. 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable

According to § 15.247(c), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

8.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=30MHz, Sweep = auto
5. Mark Peak, 2400MHz-2483.5MHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

8.3 Measurement Result

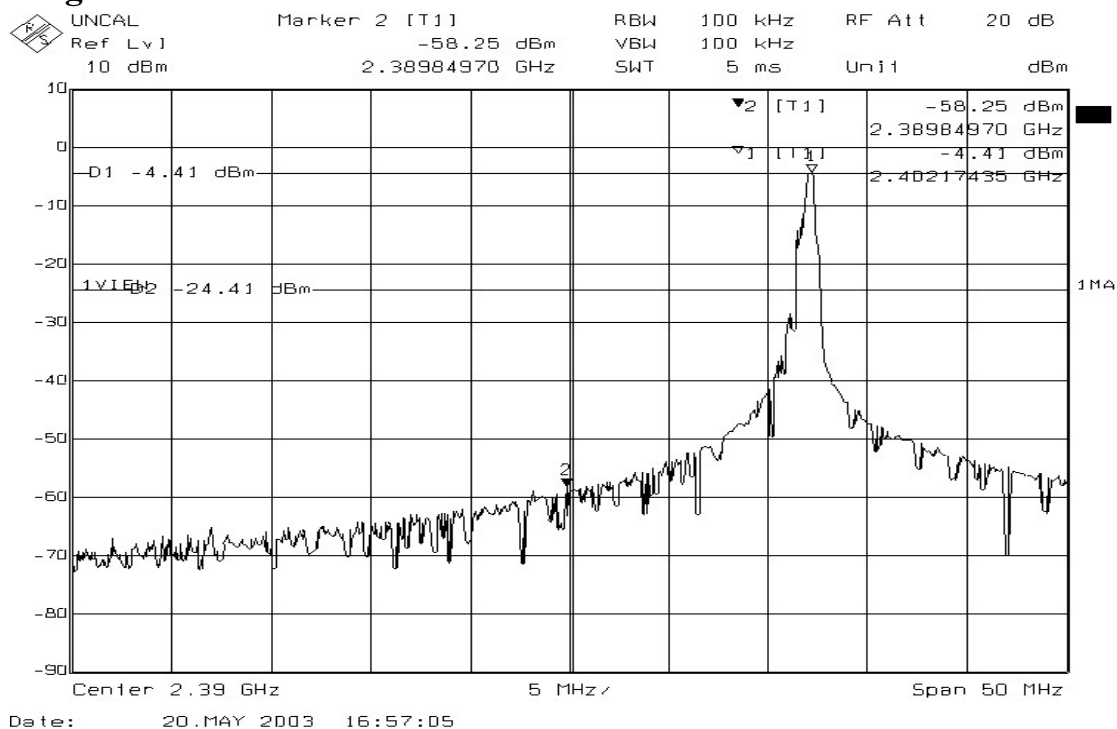
Refer to attach spectrum analyzer data chart.

8.4 Measurement Equipment Used:

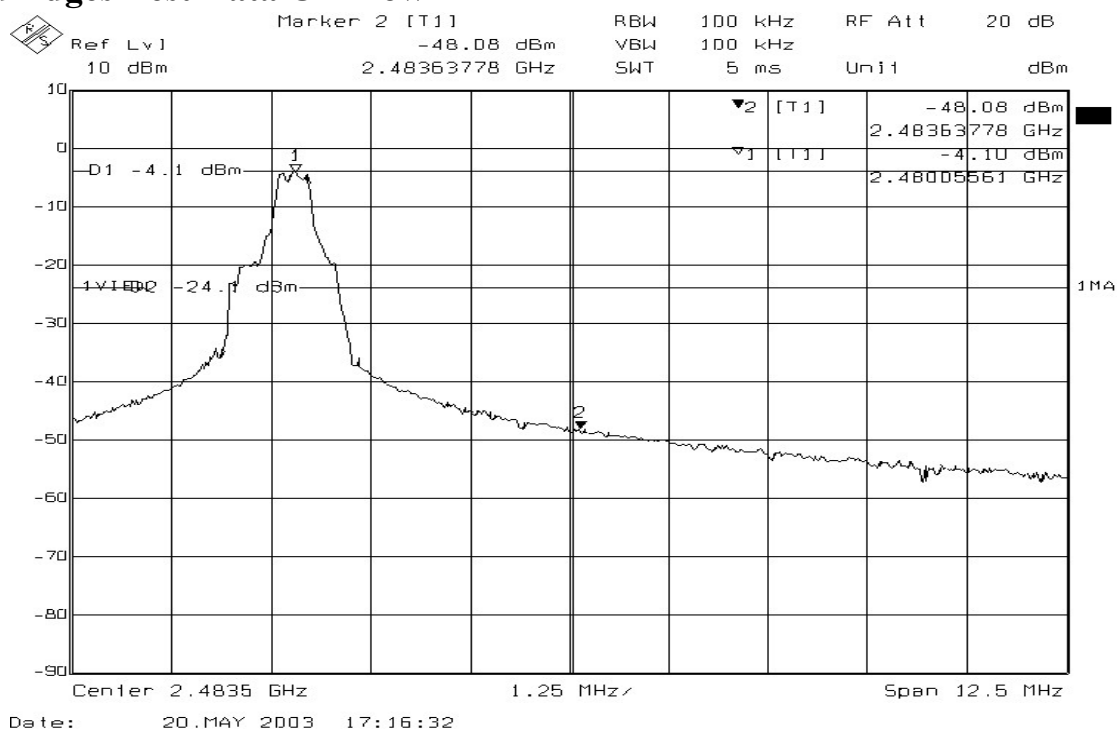
EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

0363
ILAC MRA

Band Edges Test Data CH-Low



Band Edges Test Data CH-Low



9. SPURIOUS RADIATED EMISSION TEST

9.1 Standard Applicable

According to § 15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in § 15.209(a)(f). And according to § 15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

9.2 EUT Setup

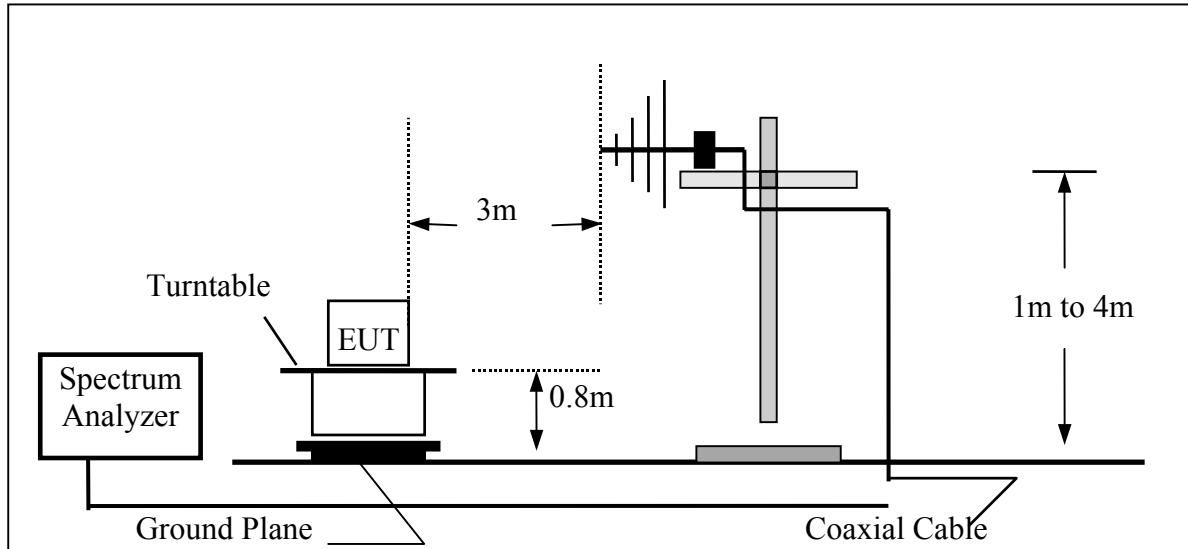
1. The radiated emission tests were performed in the 3 meters open-test site, using the setup in accordance with the ANSI C63.4-1992.
2. The EUT was put in the front of the test table. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The keyboard was placed directly in the front of the monitor, flushed with the front tabletop. The mouse was placed next to the Keyboard, flushed with the back of keyboard.
4. The spacing between the peripherals was 10 centimeters.
5. External I/O cables were draped along the edge of the test table and bundle when necessary.
6. The host PC system was connected with 110Vac/60Hz power source.

9.3 Measurement Procedure

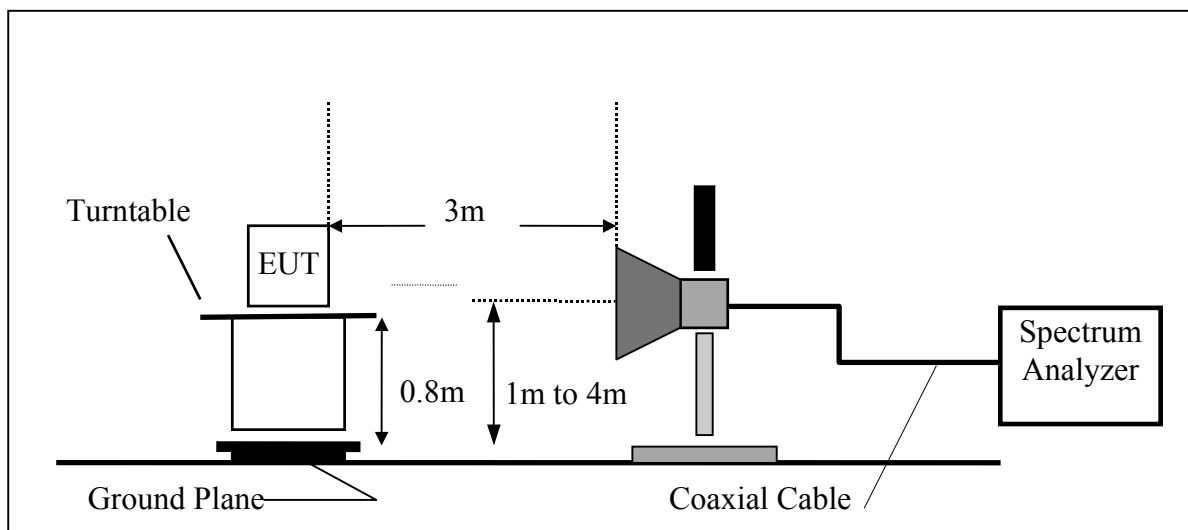
1. The EUT was placed on a turn-table which is 0.8m above ground plane.
2. The turn-table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until all frequency measured were complete.

9.4 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up Frequency Over 1 GHz



9.5 Measurement Equipment Used:

Open Area Test Site # 3					
EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	ADVANTEST	R3261A	N/A	03/19/2003	03/18/2004
EMI Test Receiver	R&S	ESVS20	838804/004	01/05/2003	01/04/2004
Pre-Amplifier	HP	8447D	2944A09173	03/04/2003	03/03/2004
Bilog Antenna	SCHWAZBECK	VULB9163	145	07/06/2002	07/05/2003
Turn Table	EMCO	2081-1.21	9709-1885	N.C.R	N.C.R
Antenna Tower	EMCO	2075-2	9707-2060	N.C.R	N.C.R
Controller	EMCO	2090	9709-1256	N.C.R	N.C.R
RF Switch	ANRITSU	MP59B	M53867	N.C.R	N.C.R
Site NSA	C&C	N/A	N/A	09/07/2002	09/06/2003
Horn antenna	Schwarzbeck	BBHA 9120	D210	02/24/2003	02/23/2004
Loop Antenna	EMCO	6502	2356	07/11/2002	07/10/2003
Pre-Amplifier	HP	8449B	3008B00965	10/01/2002	10/02/2003

9.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting. The Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.7 Measurement Result

Refer to attach tabular data sheets.

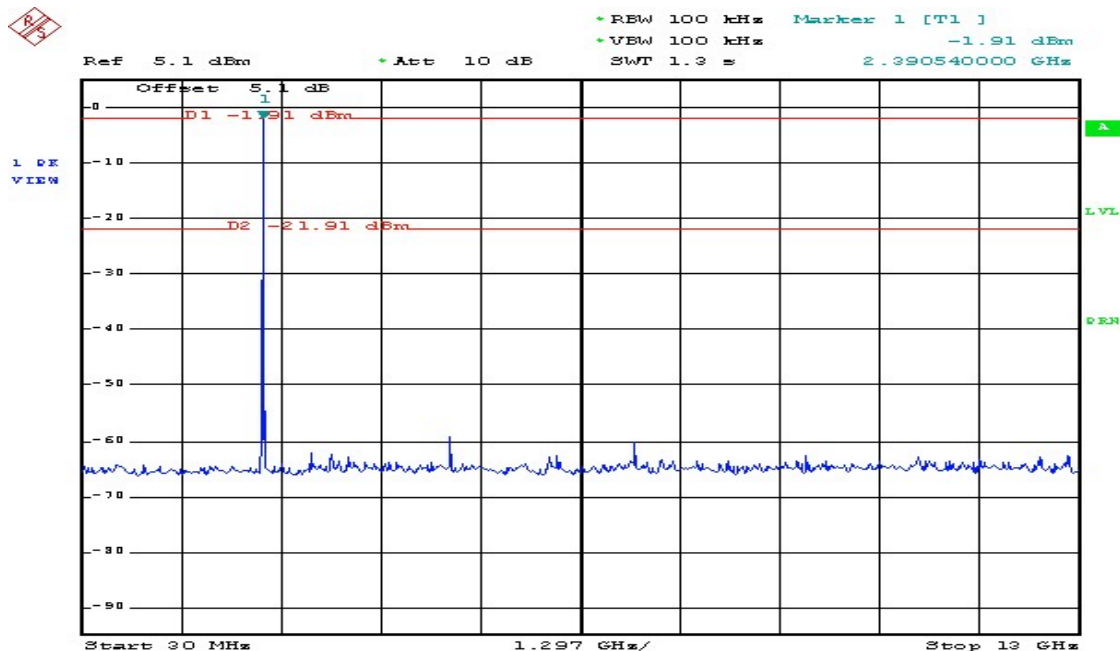
NOTE:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 100kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.



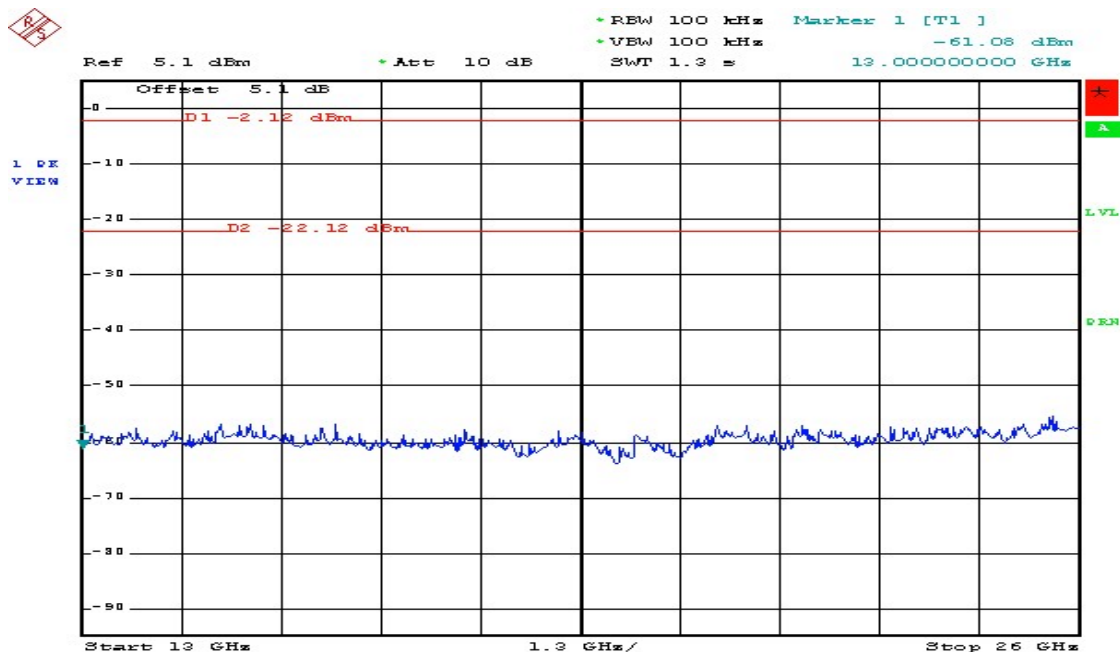
Conducted Spurious Emission Measurement Result (Ch Low)

Ch Low 30MHz~13GHz



Date: 21.MAY.2003 19:31:48

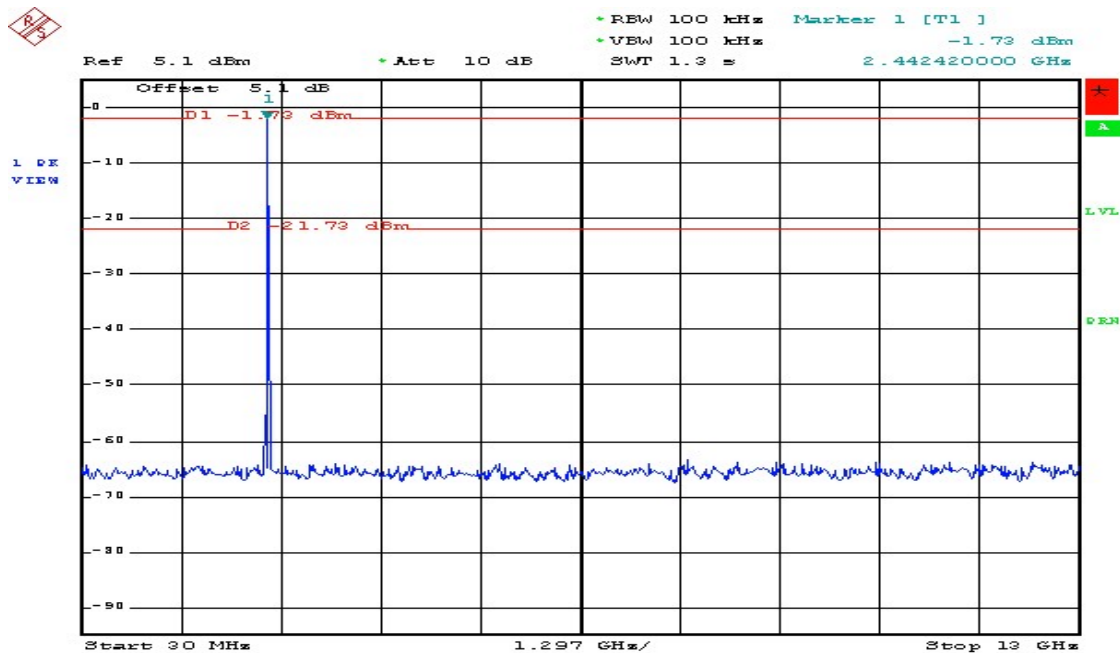
Ch Low 13GHz~26GHz



Date: 21.MAY.2003 18:57:52

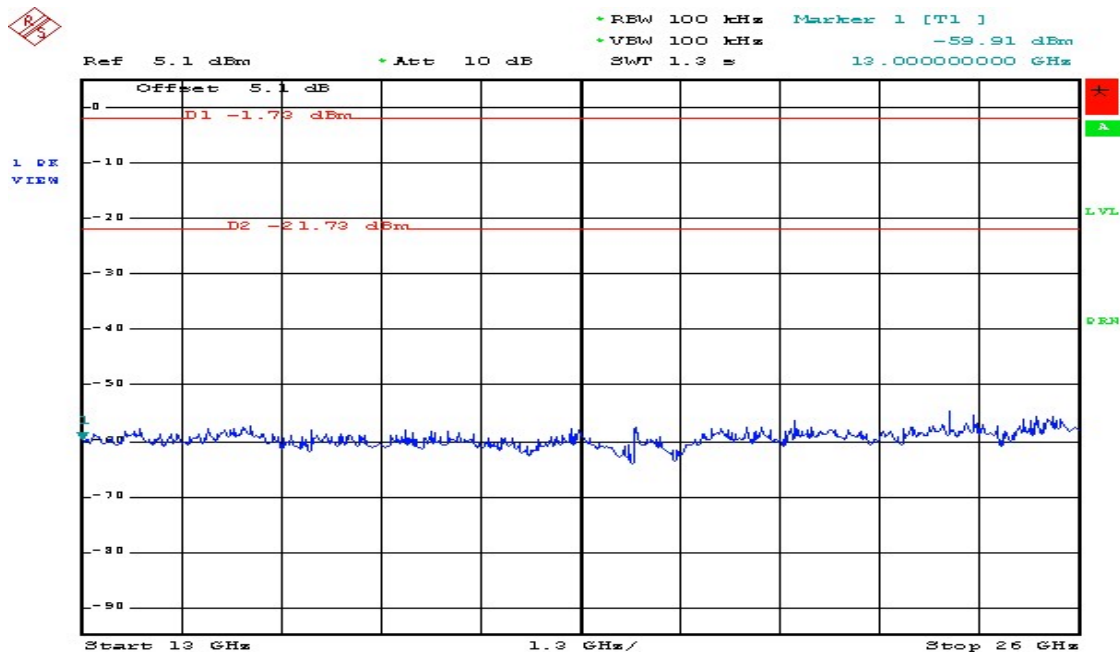
Conducted Spurious Emission Measurement Result (Ch Mid)

Ch Low 30MHz~13GHz



Date: 21.MAY.2003 18:59:20

Ch Low 13GHz~26GHz

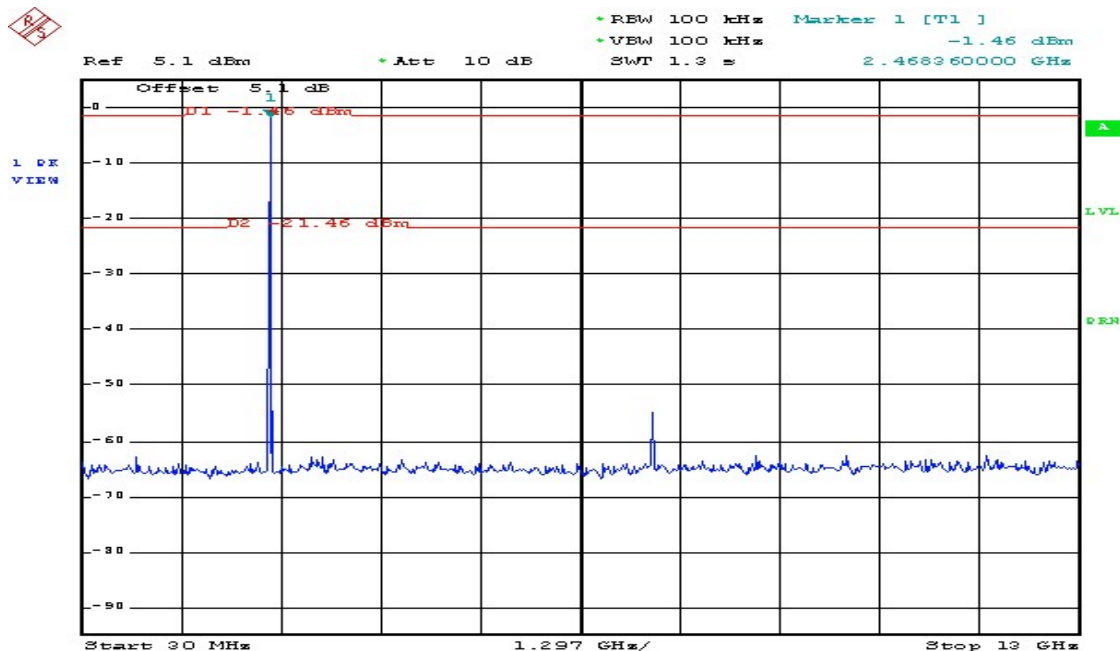


Date: 21.MAY.2003 19:24:22

0363
ILAC MRA

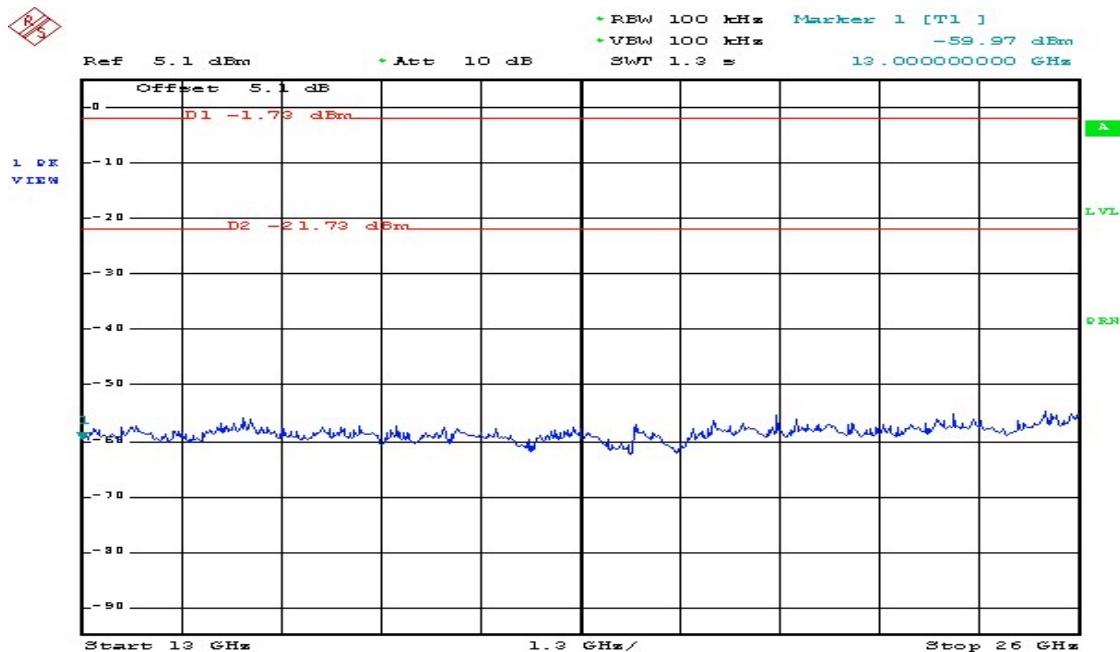
Conducted Spurious Emission Measurement Result (Ch High)

Ch Low 30MHz~13GHz



Date: 21.MAY.2003 19:28:17

Ch Low 13GHz~26GHz



Date: 21.MAY.2003 19:26:05

9.8 Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Low	Test Date:	Apr 30, 2003
Fundamental Frequency	2402MHz	Test By	Jim
Temperature	20°C	Pol	Ver./Hor
Humidity	65%		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit @3m (dBuV/m)	Safe Margin (dB)
110.46	V	Peak	21.06	12.79	33.85	43.50	-9.65
265.44	V	Peak	19.48	15.94	35.42	46.00	-10.58
344.80	V	Peak	19.95	17.89	37.84	46.00	-8.16
398.00	V	Peak	14.64	20.61	35.25	46.00	-10.75
512.80	V	Peak	13.42	22.96	36.38	46.00	-9.62
795.60	V	Peak	9.64	26.12	35.76	46.00	-10.24
110.46	H	Peak	20.46	12.79	33.25	43.50	-10.25
344.80	H	Peak	20.72	17.89	38.61	46.00	-7.39
421.80	H	Peak	12.32	20.48	32.80	46.00	-13.20
455.40	H	Peak	19.91	20.42	40.33	46.00	-5.67
573.00	H	Peak	7.76	24.78	32.54	46.00	-13.46
798.40	H	Peak	8.83	26.13	34.96	46.00	-11.04

Remark:

- (1) Measuring frequencies from 30 MHz to the 1GHz.
- (2) Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak/AV detector mode.
- (3) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (4) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Mid	Test Date	May 01, 2003
Fundamental Frequency	2441MHz	Test By	Jim
Temperature	22°C	Pol	Ver./Hor
Humidity	63%		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit @3m (dBuV/m)	Safe Margin (dB)
264.90	V	Peak	18.87	15.95	34.82	46.00	-11.18
344.80	V	Peak	21.63	17.89	39.52	46.00	-6.48
433.00	V	Peak	14.24	20.36	34.60	46.00	-11.40
455.40	V	Peak	17.36	20.42	37.78	46.00	-8.22
745.20	V	Peak	8.98	25.87	34.85	46.00	-11.15
788.60	V	Peak	13.85	26.08	39.93	46.00	-6.07
344.80	H	Peak	24.51	17.89	42.40	46.00	-3.60
398.00	H	Peak	13.53	20.61	34.14	46.00	-11.86
433.00	H	Peak	13.06	20.36	33.42	46.00	-12.58
442.80	H	Peak	13.35	20.25	33.60	46.00	-12.40
455.40	H	Peak	18.87	20.42	39.29	46.00	-6.71
543.60	H	Peak	9.94	24.05	33.99	46.00	-12.01

Remark:

- (1) Measuring frequencies from 30 MHz to the 1GHz.
- (2) Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak/AV detector mode.
- (3) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (4) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH High	Test Date	May 01, 2003
Fundamental Frequency	2480MHz	Test By	Jim
Temperature	20°C	Pol	Ver./Hor
Humidity	65%		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit @3m (dBuV/m)	Safe Margin (dB)
240.60	V	Peak	17.04	15.94	32.98	46.00	-13.02
246.00	V	Peak	15.76	16.15	31.91	46.00	-14.09
344.00	V	Peak	19.45	17.89	37.34	46.00	-8.66
455.40	V	Peak	17.85	20.42	38.27	46.00	-7.73
519.80	V	Peak	8.64	23.21	31.85	46.00	-14.15
795.60	V	Peak	10.83	26.12	36.95	46.00	-9.05
344.80	H	Peak	22.30	17.89	40.19	46.00	-5.81
389.60	H	Peak	11.88	20.16	32.04	46.00	-13.96
433.00	H	Peak	12.21	20.36	32.57	46.00	-13.43
442.80	H	Peak	13.30	20.25	33.55	46.00	-12.45
455.40	H	Peak	19.39	20.42	39.81	46.00	-6.19
661.20	H	Peak	8.56	25.08	33.64	46.00	-12.36

Remark:

- (1) Measuring frequencies from 30 MHz to the 1GHz.
- (2) Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak/AV detector mode.
- (3) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (4) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH Low	Test Date	May 15, 2003
Fundamental Frequency	2402MHz	Test By	Jim
Temperature	20°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak Reading	AV Reading	Ant./CL CF(dB)	Actual FS		Peak Limit	AV Limit	Margin (dB)
	(dBuV)	(dBuV)		Peak (dBuV/m)	AV (dBuV/m)	(dBuV/m)	(dBuV/m)	
1344	53.61	---	-8.48	45.13	---	74.00	54.00	-8.87
1596	51.09	---	-6.82	44.27	---	74.00	54.00	-9.73
1684	54.51	---	-6.34	48.17	---	74.00	54.00	-5.83
1732	50.99	---	-6.08	44.91	---	74.00	54.00	-9.09
4804	--					74.00	54.00	
7206	--					74.00	54.00	
9608	--					74.00	54.00	
12010	--					74.00	54.00	
14412	--					74.00	54.00	
16814	--					74.00	54.00	
19216	--					74.00	54.00	
21618	--					74.00	54.00	
24020	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH Low	Test Date	May 15, 2003
Fundamental Frequency	2402MHz	Test By	Jim
Temperature	20°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak Reading	AV Reading	Ant./CL CF(dB)	Actual FS		Peak Limit	AV Limit	Margin (dB)
	(dBuV)	(dBuV)		Peak (dBuV/m)	AV (dBuV/m)	(dBuV/m)	(dBuV/m)	
1348	53.24	---	-8.47	44.77	---	74.00	54.00	-9.23
1680	54.94	---	-6.36	48.58	---	74.00	54.00	-5.42
4804	--					74.00	54.00	
7206	--					74.00	54.00	
9608	--					74.00	54.00	
12010	--					74.00	54.00	
14412	--					74.00	54.00	
16814	--					74.00	54.00	
19216	--					74.00	54.00	
21618	--					74.00	54.00	
24020	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH Mid	Test Date	May 15, 2003
Fundamental Frequency	2441MHz	Test By	Jim
Temperature	20°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak Reading	AV Reading	Ant./CL CF(dB)	Actual FS		Peak Limit	AV Limit	Margin (dB)
	(dBuV)	(dBuV)		Peak (dBuV/m)	AV (dBuV/m)	(dBuV/m)	(dBuV/m)	
1344	52.44	---	-8.48	43.96	---	74.00	54.00	-10.04
1596	51.16	---	-6.82	44.34	---	74.00	54.00	-9.66
1680	51.34	---	-6.36	44.98	---	74.00	54.00	-9.02
2796	48.55	---	-1.97	46.58	---	74.00	54.00	-7.42
4882	--					74.00	54.00	
7323	--					74.00	54.00	
9764	--					74.00	54.00	
12205	--					74.00	54.00	
14646	--					74.00	54.00	
17087	--					74.00	54.00	
19528	--					74.00	54.00	
21969	--					74.00	54.00	
24410	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH Mid	Test Date	May 15, 2003
Fundamental Frequency	2441MHz	Test By	Jim
Temperature	20°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak Reading	AV Reading	Ant./CL CF(dB)	Actual FS		Peak Limit	AV Limit	Margin (dB)
	(dBuV)	(dBuV)		Peak (dBuV/m)	AV (dBuV/m)	(dBuV/m)	(dBuV/m)	
1344	52.53	---	-8.48	44.05	---	74.00	54.00	-9.95
1676	53.96	---	-6.38	47.58	---	74.00	54.00	-6.42
1692	53.52	---	-6.29	47.23	---	74.00	54.00	-6.77
2272	50.31	---	-3.47	46.84	---	74.00	54.00	-7.16
4882	--					74.00	54.00	
7323	--					74.00	54.00	
9764	--					74.00	54.00	
12205	--					74.00	54.00	
14646	--					74.00	54.00	
17087	--					74.00	54.00	
19528	--					74.00	54.00	
21969	--					74.00	54.00	
24410	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH High	Test Date	May 15, 2003
Fundamental Frequency	2480MHz	Test By	Jim
Temperature	20°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak	AV	Ant./CL CF(dB)	Actual FS		Peak	AV	Margin (dB)
	Reading (dBuV)	Reading (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Limit (dBuV/m)	Limit (dBuV/m)	
1672	52.64	---	-6.40	46.24	---	74.00	54.00	-7.76
1680	53.76	---	-6.36	47.40	---	74.00	54.00	-6.60
1704	51.26	---	-6.23	45.03	---	74.00	54.00	-8.97
4960	--					74.00	54.00	
7440	--					74.00	54.00	
9920	--					74.00	54.00	
12400	--					74.00	54.00	
14880	--					74.00	54.00	
17360	--					74.00	54.00	
19840	--					74.00	54.00	
22320	--					74.00	54.00	
24800	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Mode	TX CH High	Test Date	May 15, 2003
Fundamental Frequency	2480MHz	Test By	Jim
Temperature	20°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak	AV	Ant./CL CF(dB)	Actual FS		Peak	AV	Margin (dB)
	Reading (dBuV)	Reading (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Limit (dBuV/m)	Limit (dBuV/m)	
1084	51.52	---	-9.83	41.69	---	74.00	54.00	-12.31
1360	53.15	---	-8.42	44.73	---	74.00	54.00	-9.27
1708	51.48	---	-6.21	45.27	---	74.00	54.00	-8.73
4960	--					74.00	54.00	
7440	--					74.00	54.00	
9920	--					74.00	54.00	
12400	--					74.00	54.00	
14880	--					74.00	54.00	
17360	--					74.00	54.00	
19840	--					74.00	54.00	
22320	--					74.00	54.00	
24800	--					74.00	54.00	

Remark:

- (1) Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- (2) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- (4) Spectrum Peak Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
Spectrum AV Setting 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

10. FREQUENCY SEPARATION

10.1 Standard Applicable

According to § 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 20dB bandwidth of the hopping channel, whichever is greater.

10.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW, VBW=3KHz, Adjust Span to 3.0 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

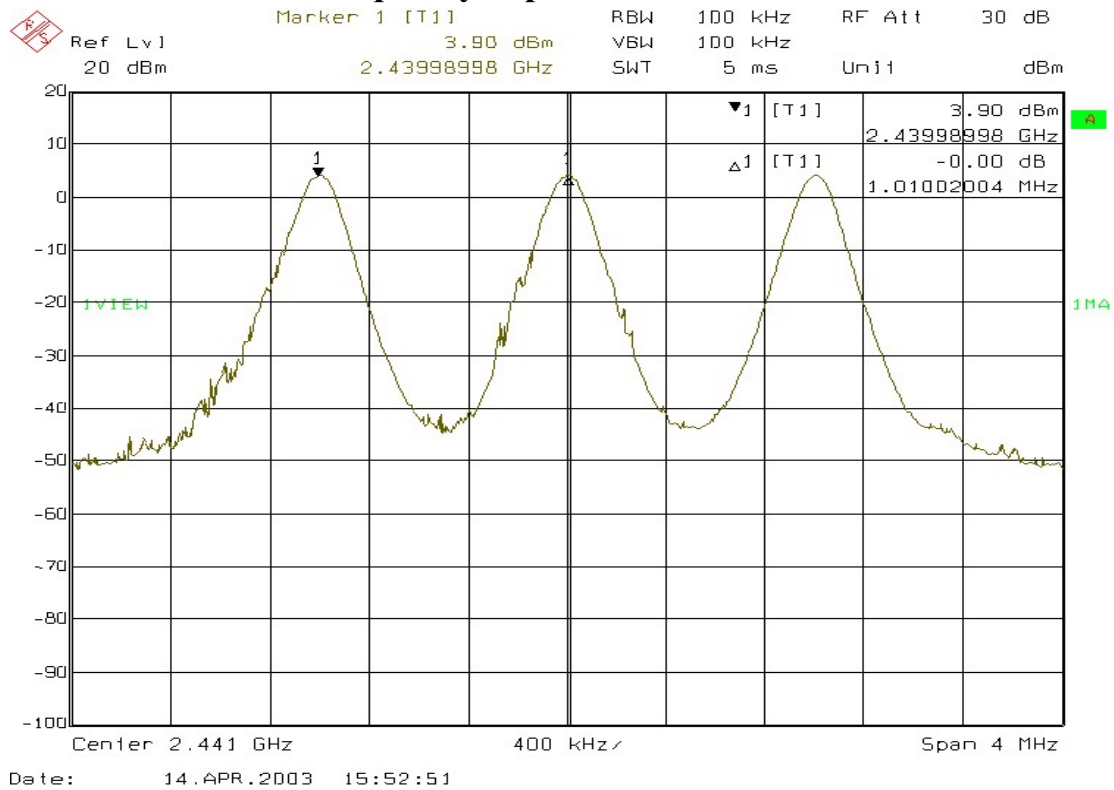
10.3 Measurement Result

Channel Separation M H z	Lim it k H z	Result
1.002	601.00	P A S S

10.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Frequency Separation Test Data



11. NUMBER OF HOPPING FREQUENCY

11.1 Standard Applicable

According to § 15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

11.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=100KHz,
5. Max hold, view and count how many channel in the band.

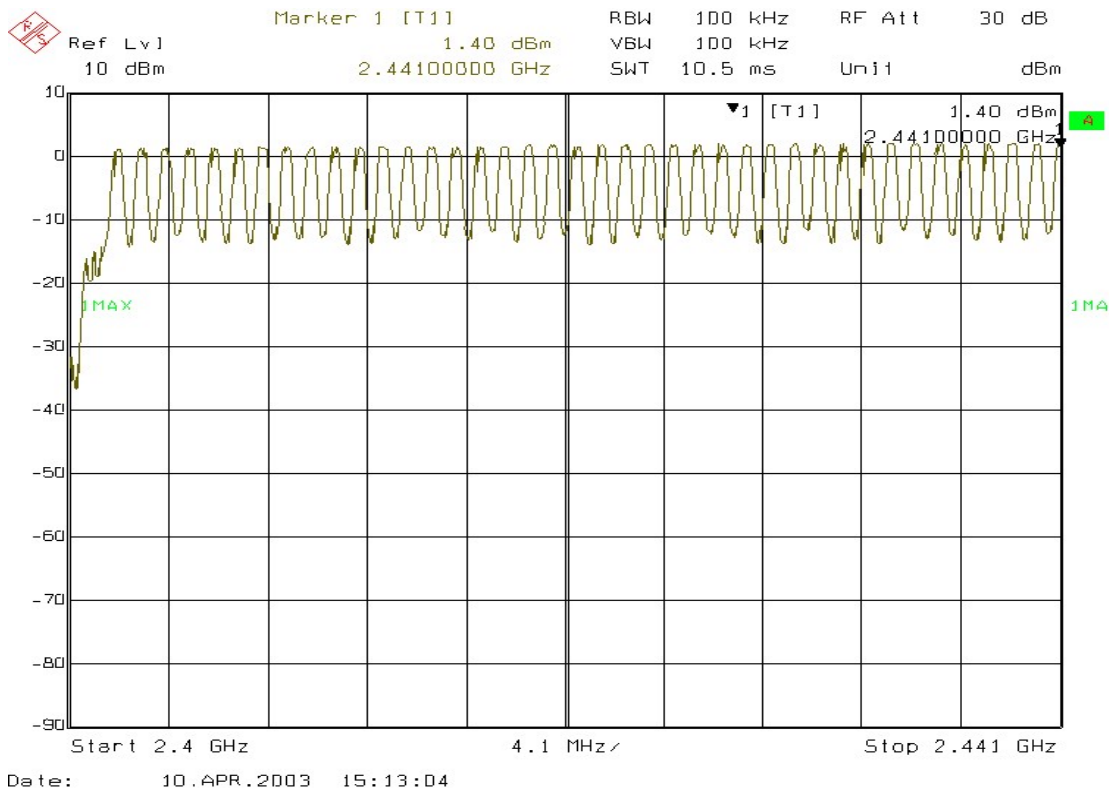
11.3 Measurement Result

Total no of hopping channel	Limit (CH)	Measurement result (CH)	Result
	75	79	PASS

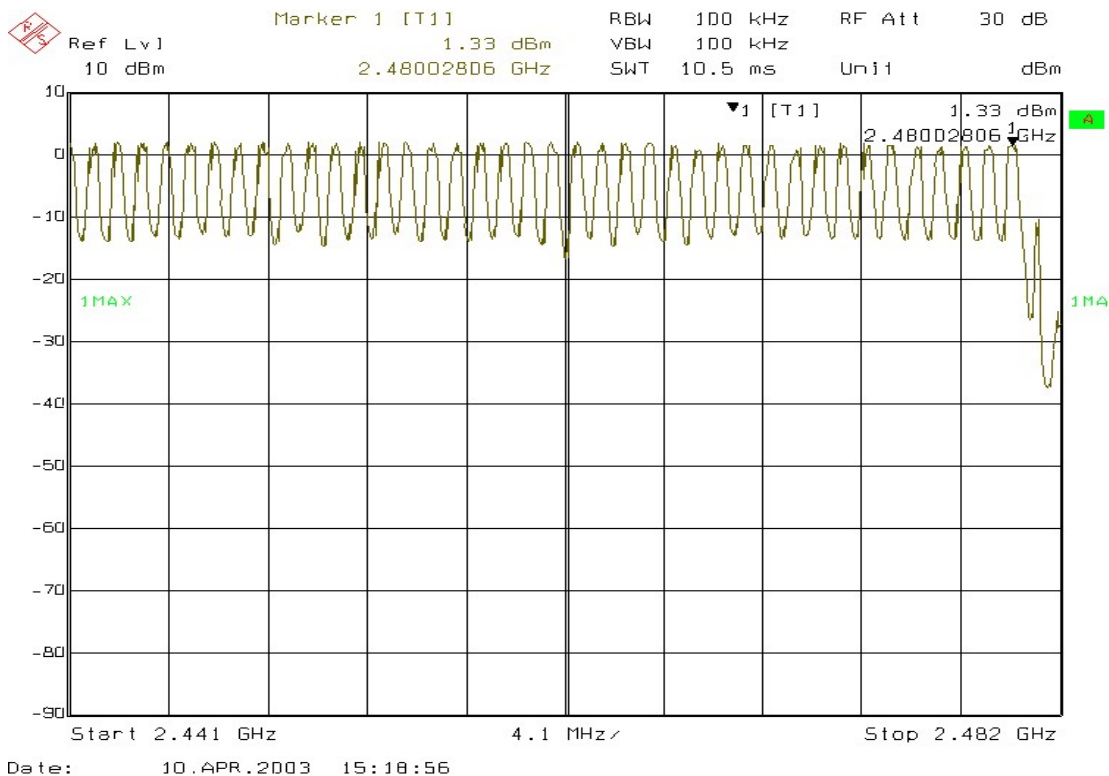
11.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Channel Number
2.4 GHz – 2.442GHz



2.442 GHz – 2.4835GHz



12. TIME OF OCCUPANCY (DWELL TIME)

12.1 Standard Applicable

According to § 15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

12.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span = 0Hz, Adjust Sweep = 30s.
5. Repeat above procedures until all frequency measured were complete.

12.3 Measurement Result

A period time = $0.4 \text{ (ms)} * 79 = 31.6 \text{ (s)}$

CH Low: $0.42 \text{ (ms)} * 1600/79 * 31.6 = 268.8 \text{ (ms)}$

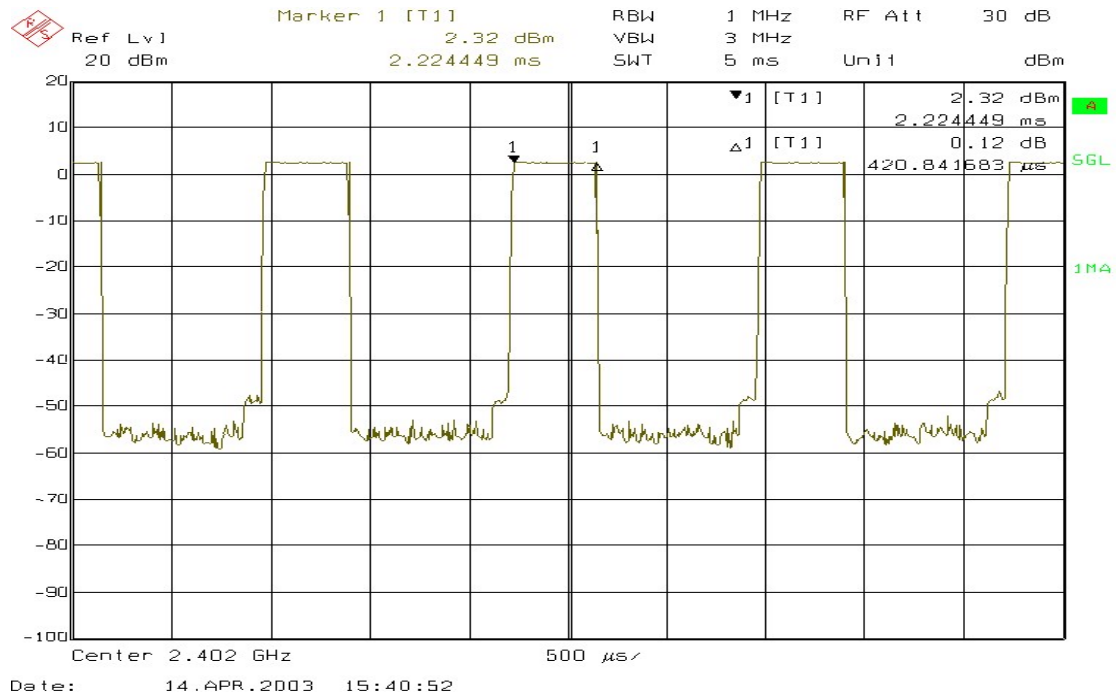
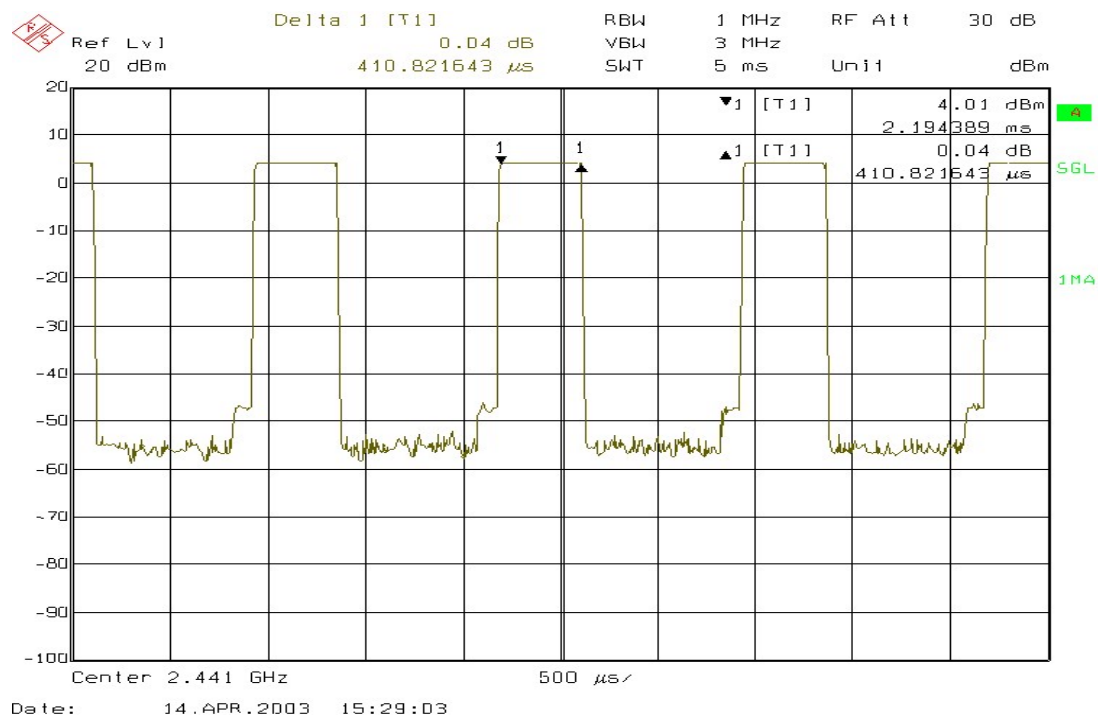
CH Mid: $0.41 \text{ (ms)} * 1600/79 * 31.6 = 262.4 \text{ (ms)}$

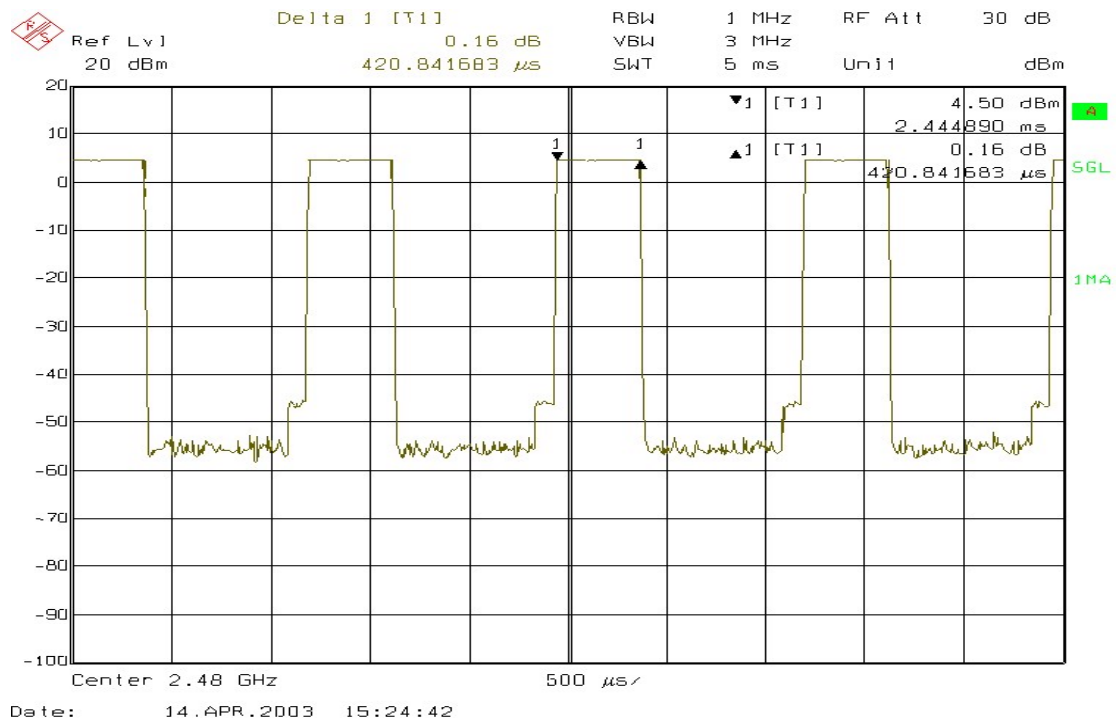
CH High: $0.42 \text{ (ms)} * 1600/79 * 31.6 = 268.8 \text{ (ms)}$

CH	Pulse Time (m s)	Total of Dwell Time (m s)	Period time (m s)	Limit (m s)
LOW	0.42	268.80	31.60	400.00
MID	0.41	262.40	31.60	400.00
HIGH	0.42	268.80	31.60	400.00

12.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Dwell Time Test Data**CH LOW****CH MID**

CH HIGH

13. Peak Power Spectral Density

13.1 Standard Applicable

According to § 15.247(d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission.

13.2 Measurement Procedure

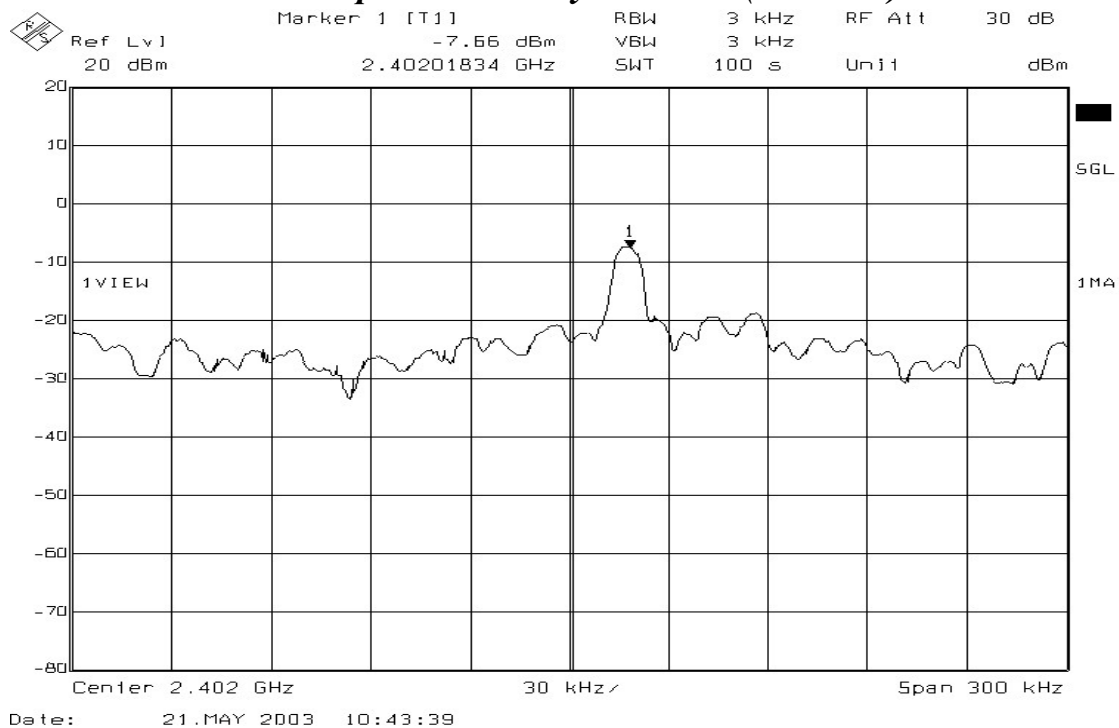
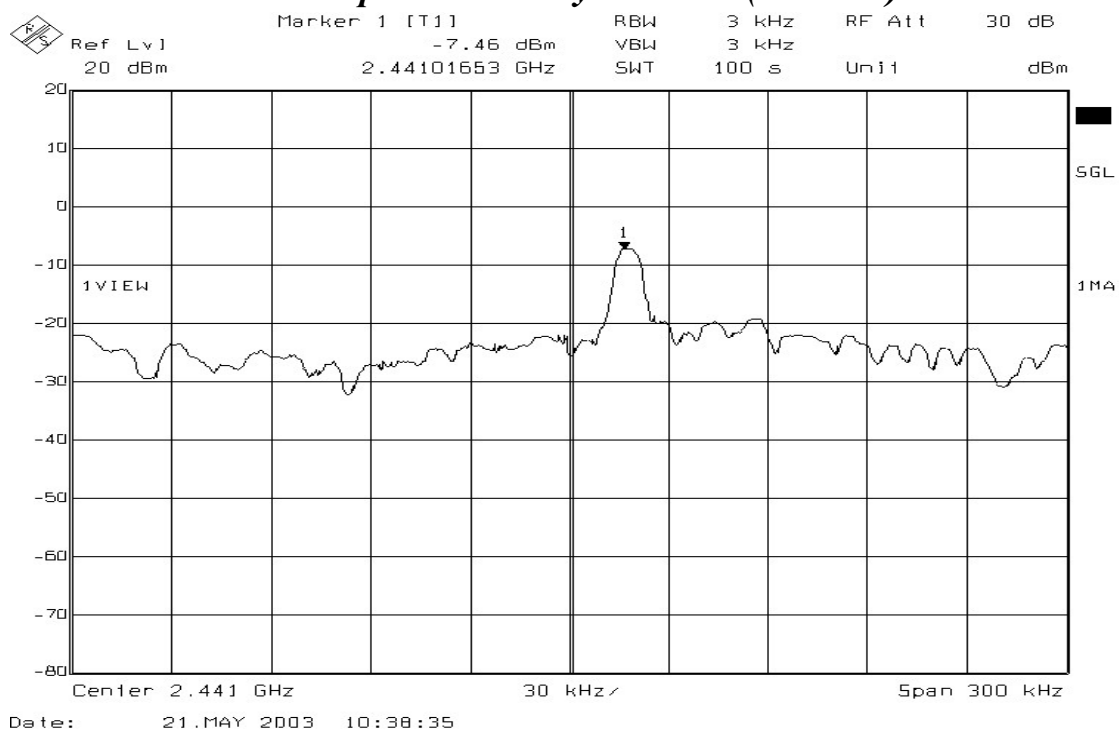
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3KHz, VBW = 3KHz, Span = 300KHz, Sweep=100s
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

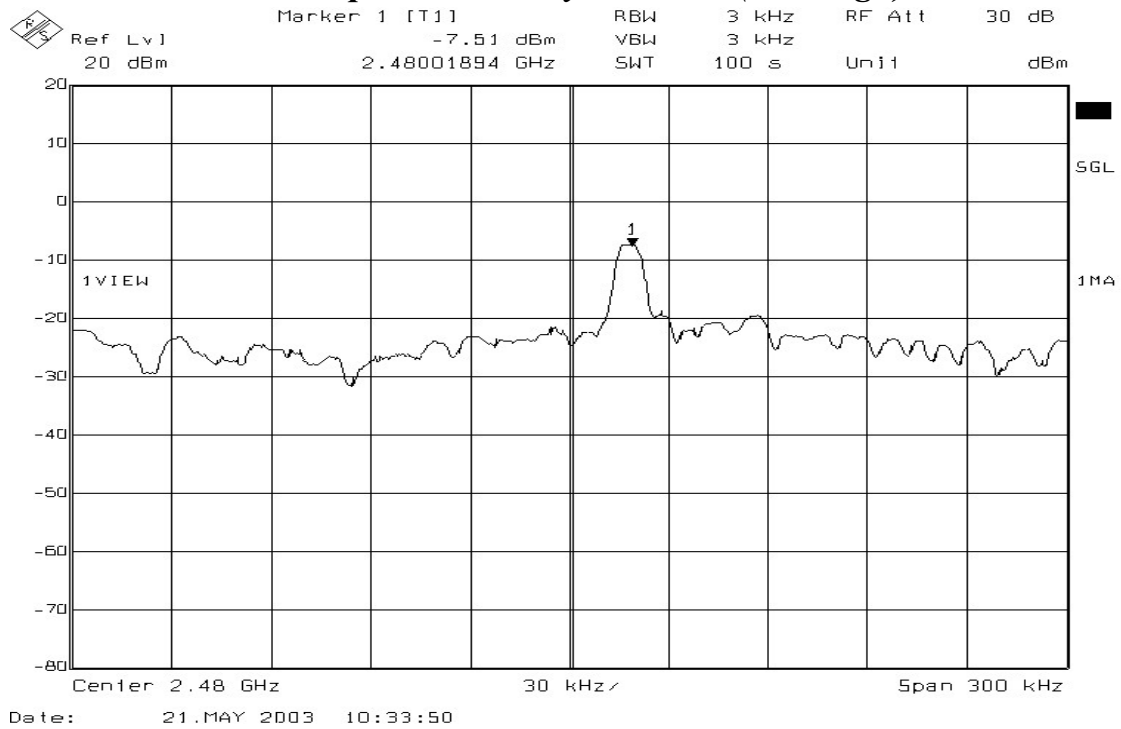
13.3 Measurement Result

CH	RF Power Density Reading (dBm)	Cable Loss (dB)	RF Power Density Level (dBm)	Maximum Limit (dBm)
Low	-7.66	0.60	-7.06	8
Mid	-7.46	0.60	-6.86	8
High	-7.51	0.60	-6.91	8

13.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/23/2002	07/22/2003
Plotter	HP	7475A	2938A29027	N/A	N/A
Low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Power Spectral Density Test Plot (CH-Low)**Power Spectral Density Test Plot (CH-Mid)**

Power Spectral Density Test Plot (CH-High)

14. ANTENNA REQUIREMENT

14.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

And according to § 15.246(1), if transmitting antennas of directional gain greater than 6dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

14.2 Antenna Connected Construction

The directional gains of antenna used for transmitting is 3 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

15. RF EXPOSURE

15.1 Standard Applicable

According to § 15.247(b)(4) and § 1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This device is classed as a portable device

The Max. output power is -0.7dBm (0.85mW) at 2480MHz, which is lower than general population low threshold $60/F(60/2.480=24.19\text{mW})$, The SAR is not required.