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

OF

Bluetooth CF Card

Trade Name: Abe

Model No.: CS8033 / C8249A

FCC ID: NV6-CS8033

Report No.: B30624207-RP

Issue Date: July 11, 2003

Prepared for

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

Prepared by

C&C LABORATORY, CO., LTD.
No. 81-1, Lane 210, Bade Rd. 2,
Luchu Hsiang, Taoyuan Hsien, Taiwan.
TEL: 886-3-3240332
FAX: 886-3-3245235

This report shall not be reproduced, except in full, without the written approval of C&C Laboratory, Co., Ltd.

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:	Bluetooth CF Card
Trade Name:	Abe
Model No.:	CS8033 / C8249A
Model Difference:	All the above Models are identical except the model designation
Serial Number:	Nil
File Number:	B30624207-RP
Date of Test:	July 9~10, 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:

Harris Lai

Executive Vice President

C&C Laboratory Co., Ltd.

Table of Contents

1. GENERAL INFORMATION 5
1.1 Product Description 5
1.2 Related Submittal(s) / Grant (s) 5
1.3 Test Methodology 5
1.4 Test Facility 5
1.5 Special Accessories 5
1.6 Equipment Modifications 5
2. SYSTEM TEST CONFIGURATION 6
2.1 EUT Configuration 6
2.2 EUT Exercise 6
2.3 Test Procedure 6
2.4 Configuration of Tested System 7
3. SUMMARY OF TEST RESULTS 8
4. DESCRIPTION OF TEST MODES 8
5. CONDUCTED EMISSION TEST 9
5.1 Standard Applicable 9
5.2 EUT Setup 9
5.3 Measurement Procedure 9
5.4 Measurement Equipment Used: 10
5.5 Measurement Result 10
6. PEAK OUTPUT POWER MEASUREMENT 13
6.1 Standard Applicable 13
6.2 Measurement Procedure 13
6.3 Measurement Equipment Used: 13
6.4 Measurement Result 13
7. 20dB BANDWIDTH MEASUREMENT 14
7.1 Standard Applicable 14
7.2 Measurement Procedure 14
7.3 Measurement Result 14
7.4 Measurement Equipment Used: 14
8. BAND EDGES MEASUREMENT 17
8.1 Standard Applicable 17
8.2 Measurement Procedure 17
8.3 Measurement Result 17
8.4 Measurement Equipment Used: 17

9. SPURIOUS RADIATED EMISSION TEST 19
9.1 Standard Applicable 19
9.2 EUT Setup 19
9.3 Measurement Procedure 19
9.4 Test SET-up (Block Diagram of Configuration) 20
9.5 Measurement Equipment Used: 21
9.6 Field Strength Calculation 21
9.7 Measurement Result 21
9.8 Radiated Spurious Emission Measurement Result (Below 1GHz) 25
10. FREQUENCY SEPARATION 34
10.1 Standard Applicable 34
10.2 Measurement Procedure 34
10.3 Measurement Result 34
10.4 Measurement Equipment Used: 34
11. NUMBER OF HOPPING FREQUENCY 36
11.1 Standard Applicable 36
11.2 Measurement Procedure 36
11.3 Measurement Result 36
11.4 Measurement Equipment Used: 36
12. TIME OF OCCUPANCY (DWELL TIME) 38
12.1 Standard Applicable 38
12.2 Measurement Procedure 38
12.3 Measurement Result 38
12.4 Measurement Equipment Used: 38
13. Peak Power Spectral Density 42
13.1 Standard Applicable 42
13.2 Measurement Procedure 42
13.3 Measurement Result 42
13.4 Measurement Equipment Used: 42
14. ANTENNA REQUIREMENT 45
14.1 Standard Applicable 45
14.2 Antenna Connected Construction 45
15. RF EXPOSURE 46
15.1 Standard Applicable 46
APPENDIX 1 PHOTOGRPHS OF SET UP 47
APPENDIX 2 EXTERNAL PHOTOGRPHS OF EUT 50
APPENDIX 3 INTERNAL PHOTOGRPHS OF EUT 52

1. GENERAL INFORMATION

1.1 Product Description

The In-Tech Electronics Limited Model: CS8033 / C8249A (referred to as the EUT in this report) is Bluetooth CF Card.

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 Spread Spectrum (FHSS)

D). Antenna Designation: quarter wave type PCB Antenna, 2.85dBi, Non-User Replaceable (Fixed)

E). Power Supply: CF slot of the client device

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: NV6-CS8033 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

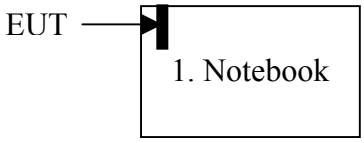


Table 2-1 Equipment Used in Tested System

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

3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§ 15.207(a)	Conducted Emission	Compliant
§ 15.247(b)(1)	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 (Bluetooth CF Card) 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 Notebook PC via PCMCIA port. The Notebook PC system was placed on the center of the back edge on the test turn table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the Notebook 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 Notebook 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

AC POWER LINE CONDUCTED EMISSION TEST

Operation Mode:	Normal Operating			Test Date :	July 9, 2003
Temperature :	32°C	Humidity :	60%	Test By:	Robin

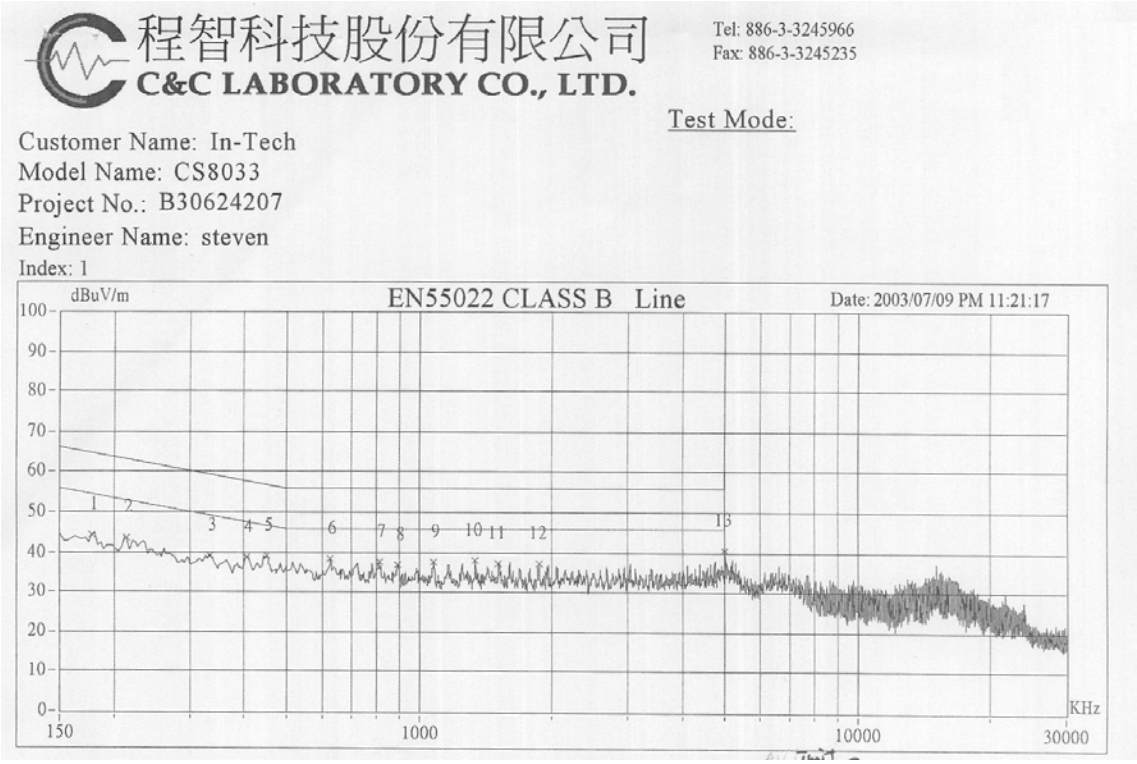
FREQ MHz	Q.P. Reading dBuV	AVG Reading dBuV	Q.P. Limit dBuV	AVG Limit dBuV	Q.P. Margin dB	AVG Margin dB	NOTE
0.449	39.17	---	56.89	46.89	-17.72	---	L1
0.627	38.34	---	56.00	46.00	-17.66	---	L1
0.809	37.51	---	56.00	46.00	-18.49	---	L1
1.078	37.51	---	56.00	46.00	-18.49	---	L1
1.343	38.01	---	56.00	46.00	-17.99	---	L1
1.515	37.34	---	56.00	46.00	-18.66	---	L1
0.162	48.05	---	65.36	55.36	-17.31	---	L2
0.717	38.67	---	56.00	46.00	-17.33	---	L2
1.343	38.17	---	56.00	46.00	-17.83	---	L2
1.522	38.50	---	56.00	46.00	-17.50	---	L2
1.608	38.34	---	56.00	46.00	-17.66	---	L2
1.700	38.67	---	56.00	46.00	-17.33	---	L2

Remark：

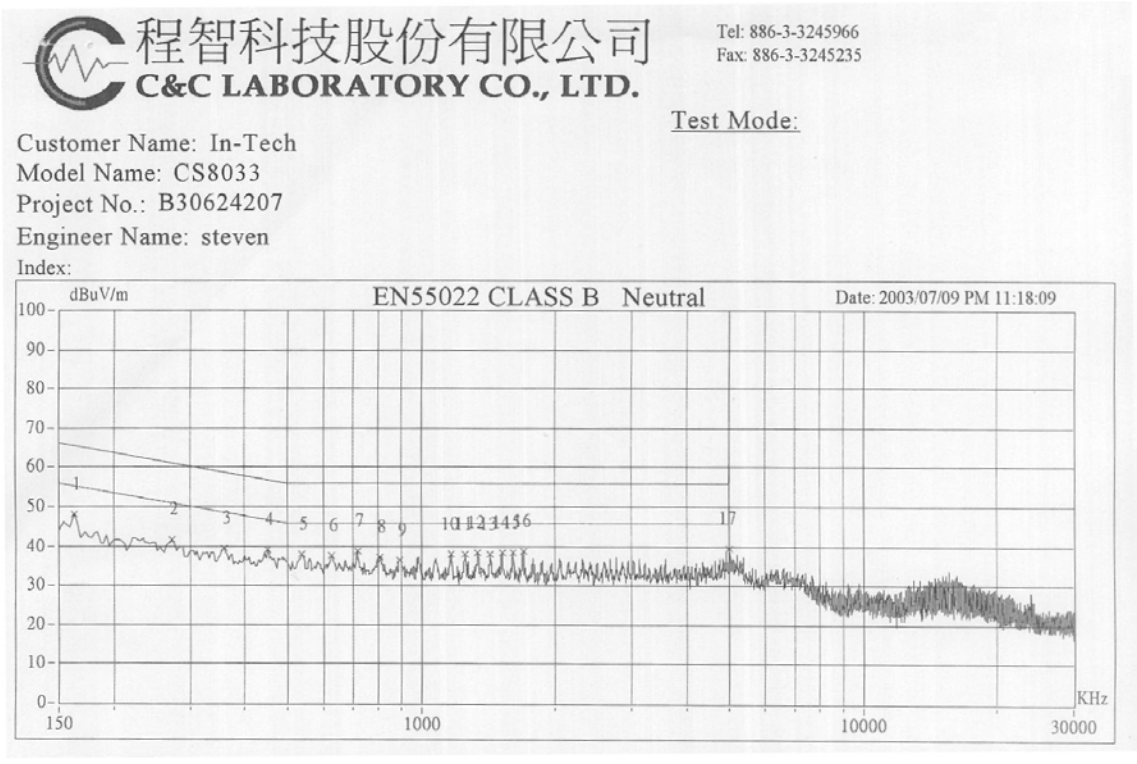
1. *Measuring frequencies from 0.15 MHz to 30MHz.*
2. *The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-Peak detector and Average detector.*
3. *"---" denotes the emission level with Quasi-Peak was or more than 2dB below the Average limit, so no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

Conducted Emission Test Plot

L1



L2



6. PEAK OUTPUT POWER MEASUREMENT

6.1 Standard Applicable

According to § 15.247(b)(1), for Frequency Hopping Spread Spectrum, 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 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	BOONTON	56218	2240	01/09/2003	01/09/2004
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

6.4 Measurement Result

Channel	Frequency (MHz)	Reading Power (dBm)	Cable Loss (dB)	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

7. 20dB BANDWIDTH MEASUREMENT

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 shall not exceeded 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 completed.

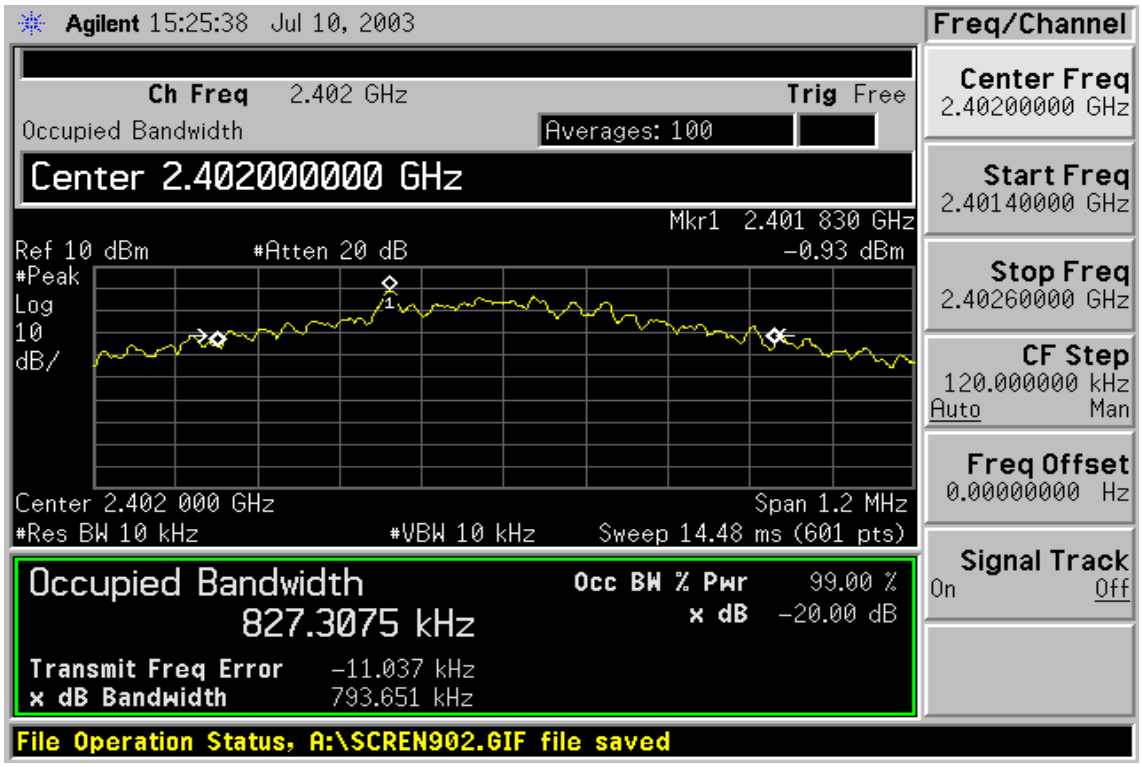
7.3 Measurement Result

CH	Bandwidth (MHz)	Bandwidth Limit (MHz)	Result
Low	0.794	1	PASS
Mid	0.791	1	PASS
High	0.790	1	PASS

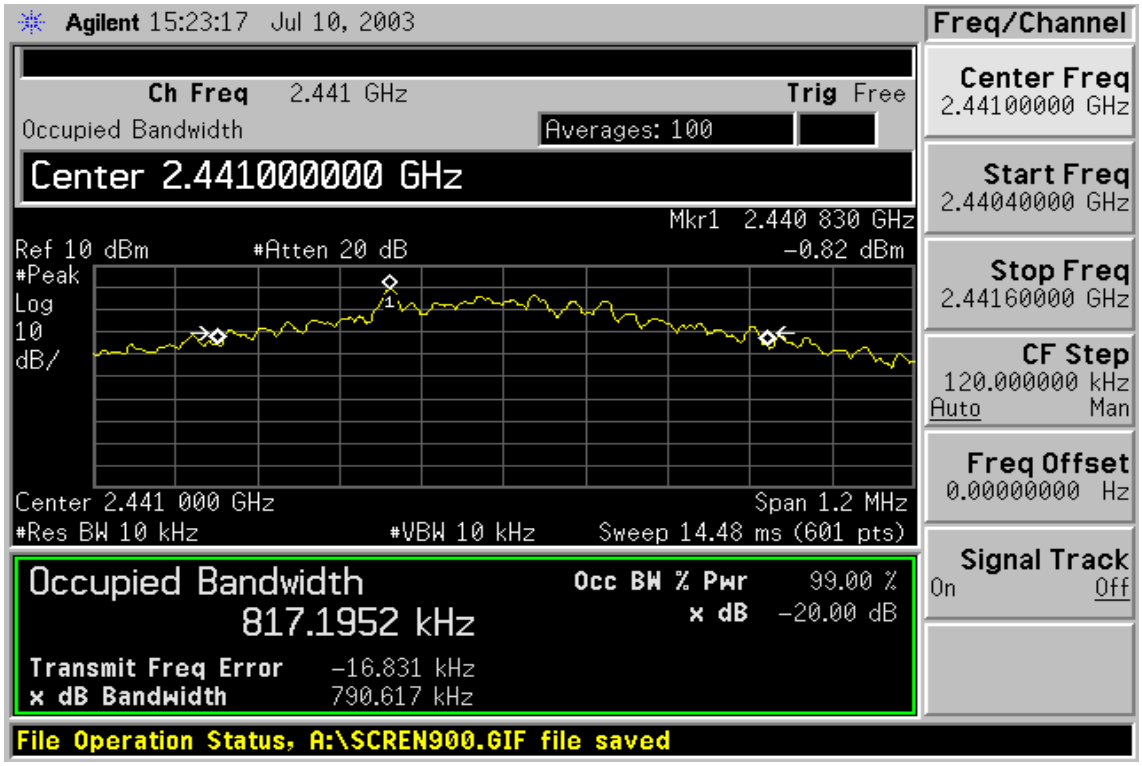
7.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

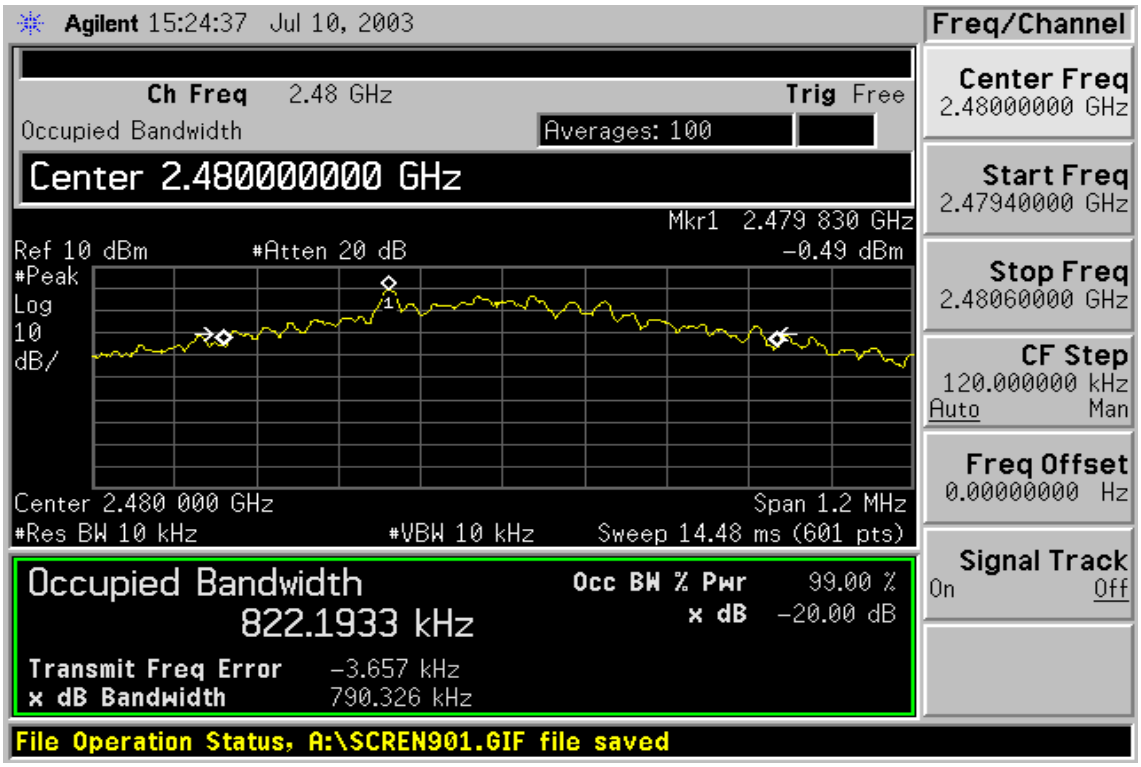
20dB Band Width Test Data CH-Low



20dB Band Width Test Data CH-Mid



20dB Band Width Test Data CH-High



8. 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 in 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 in15.209(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=50MHz, Sweep = auto
5. Mark Peak and record the max. level.
6. Repeat above procedures until all frequency measured were completed.

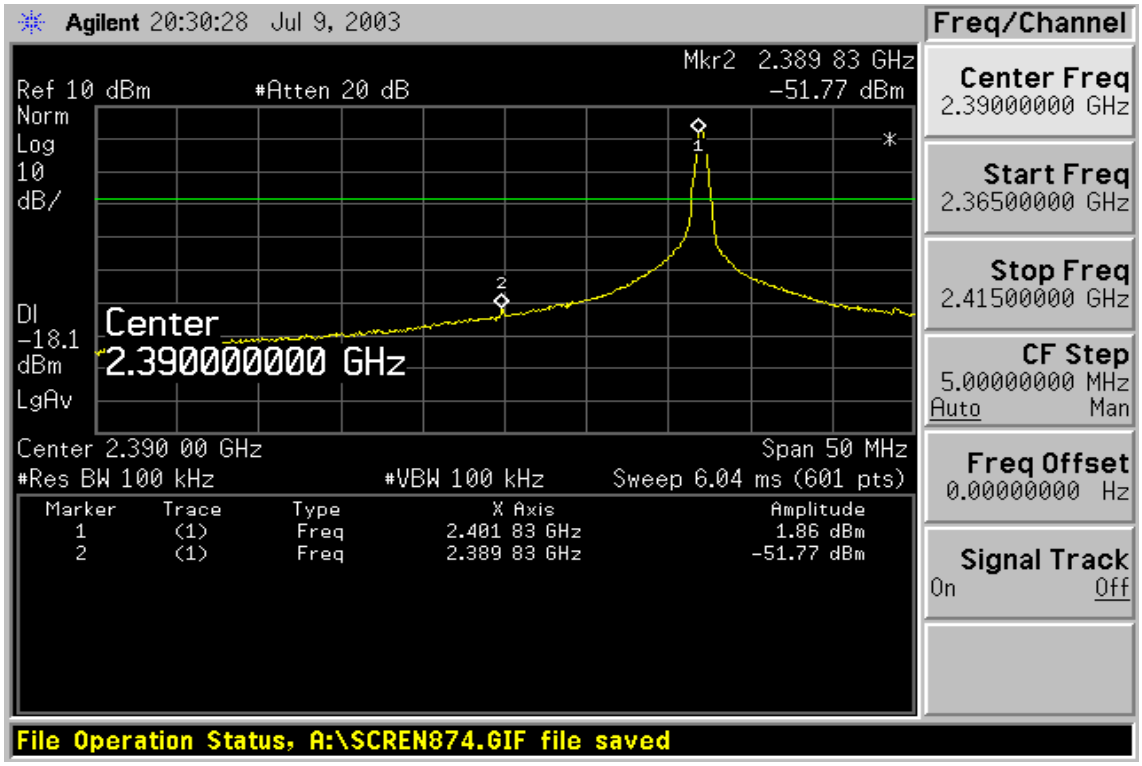
8.3 Measurement Result

Refer to attach spectrum analyzer data chart.

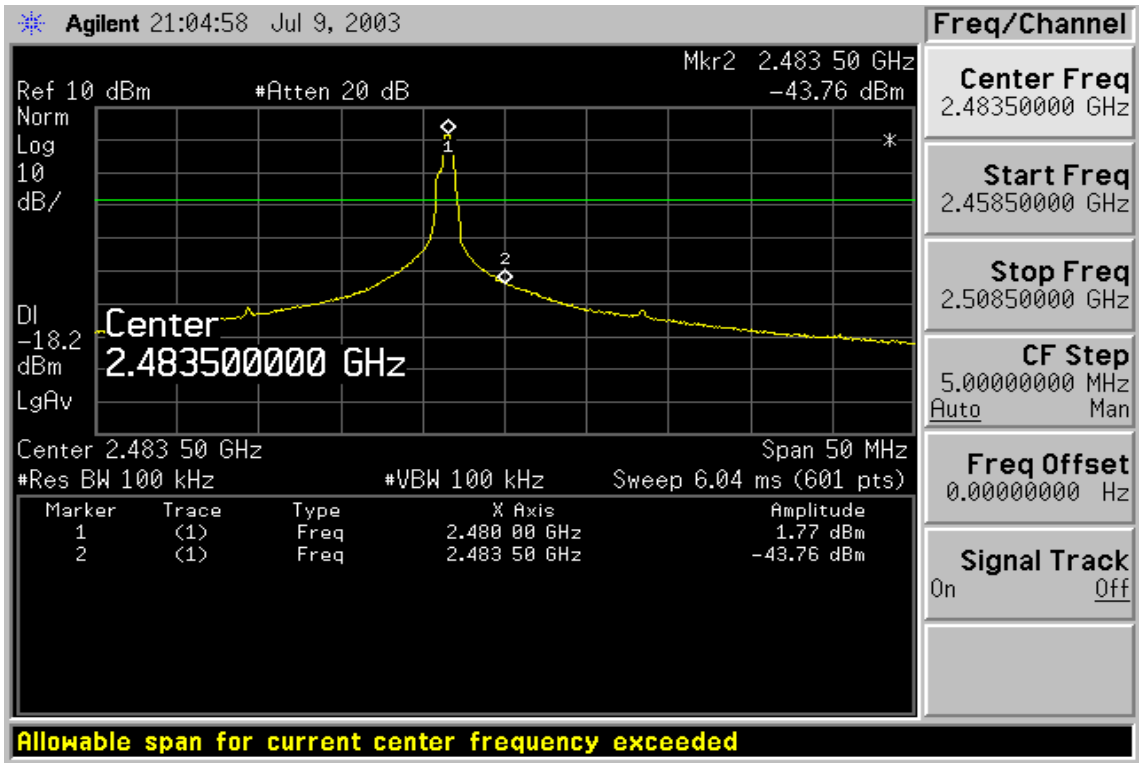
8.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Band Edges Test Data CH-Low



Band Edges Test Data CH-High



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

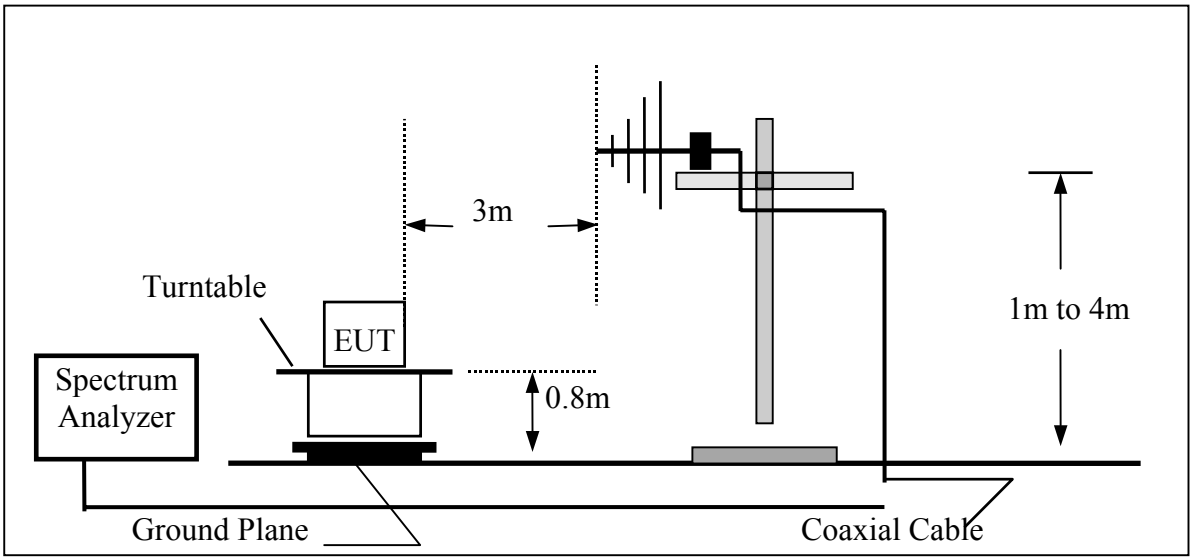
1. The radiated emission tests were performed in the 3 meters open-test site, using the setup in accordance with the ANSI C63.4-1992.
2. The EUT was put in the front of the test table. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor 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 table-top. 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 neces-sary.
6. The host PC system was connected with 110Vac/60Hz power source.

9.3 Measurement Procedure

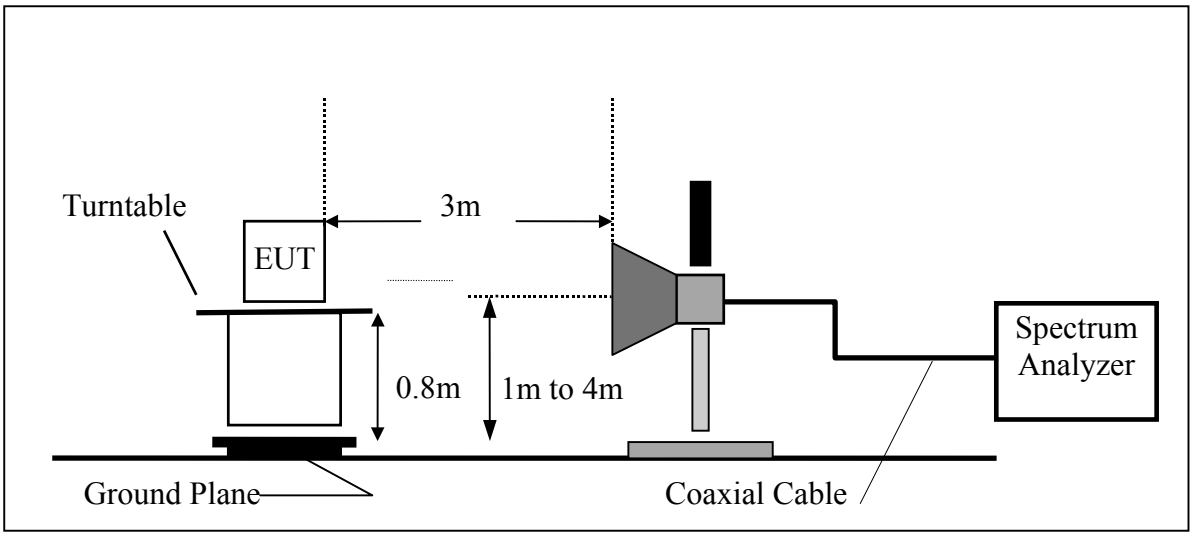
1. The EUT was placed on a turn-table which is 0.8m above ground plane.
2. The turn-table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compli-ance.
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 above 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	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
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	07/06/2003	07/05/2004
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	07/11/2003	07/10/2004
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

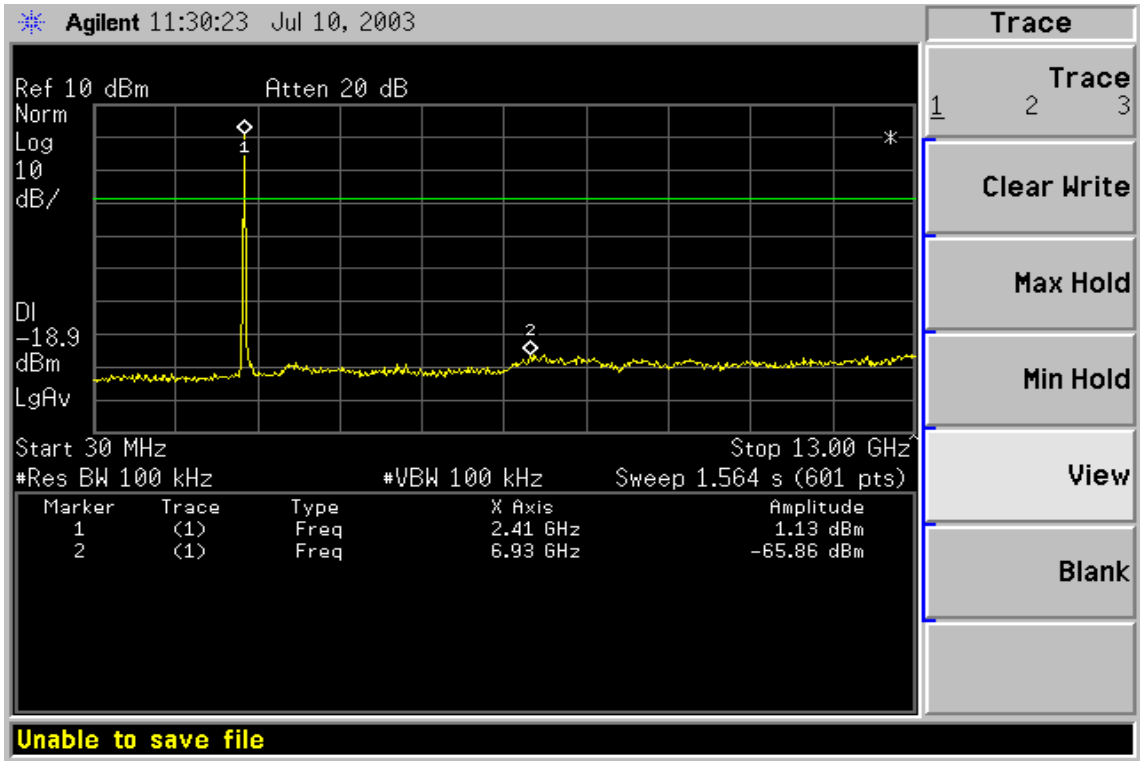
Refer to attach tabular data sheets.

NOTE:

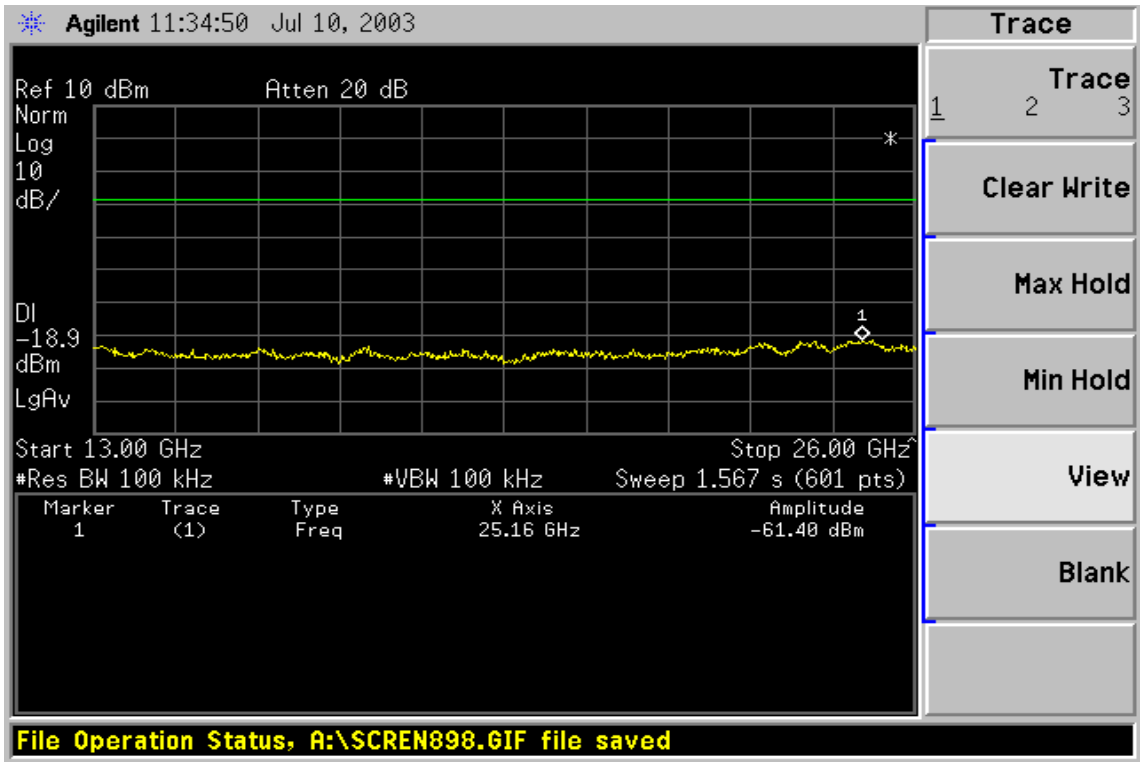
The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 100kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.

Conducted Spurious Emission Measurement Result (Ch Low)

Ch Low 30MHz~13GHz

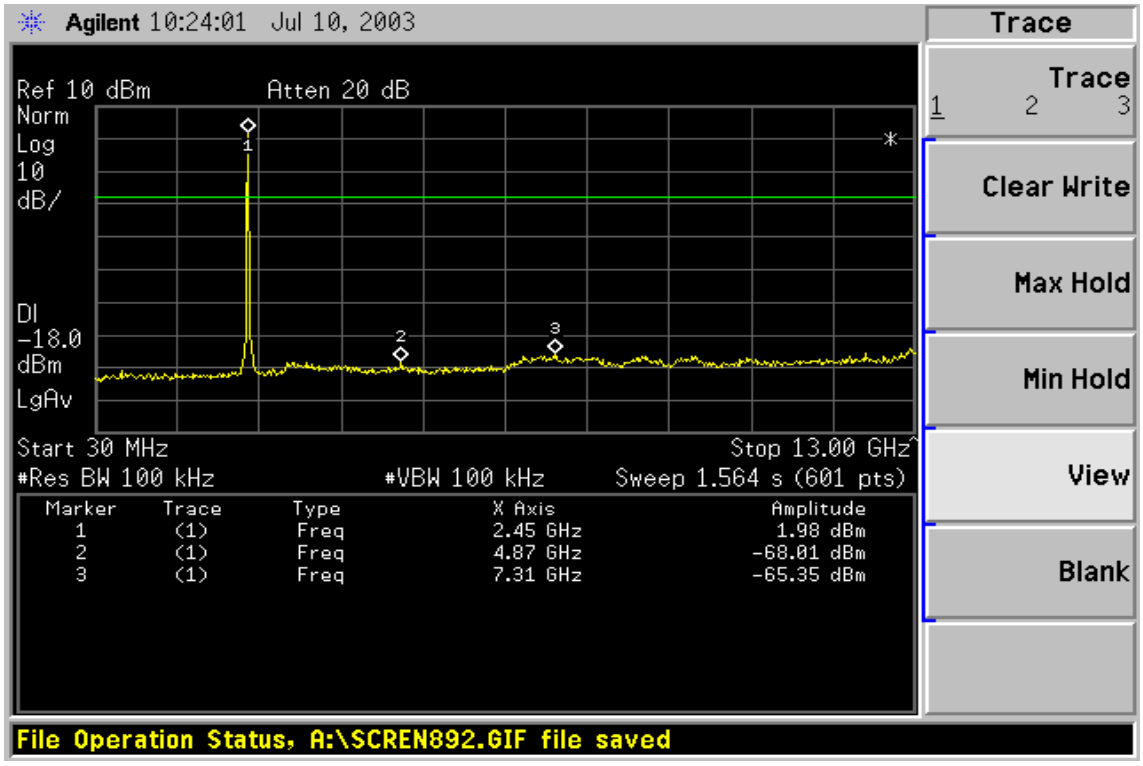


Ch Low 13GHz~26GHz

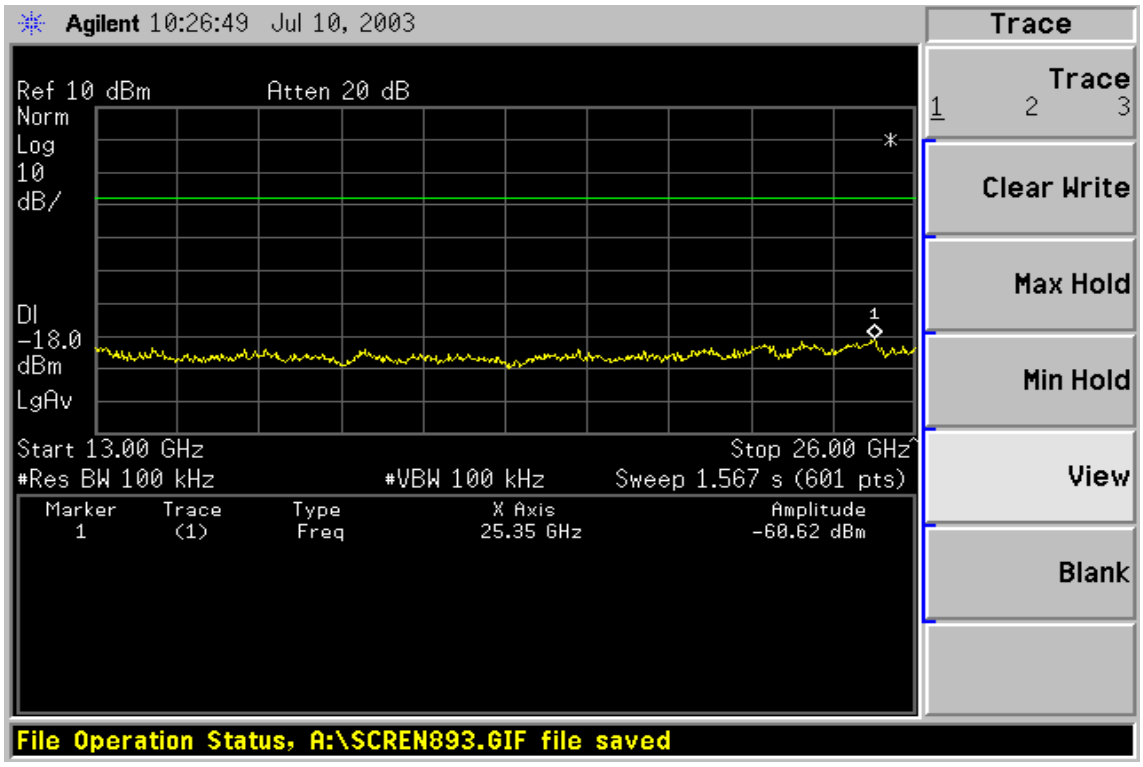


Conducted Spurious Emission Measurement Result (Ch Mid)

Ch Mid 30MHz~13GHz

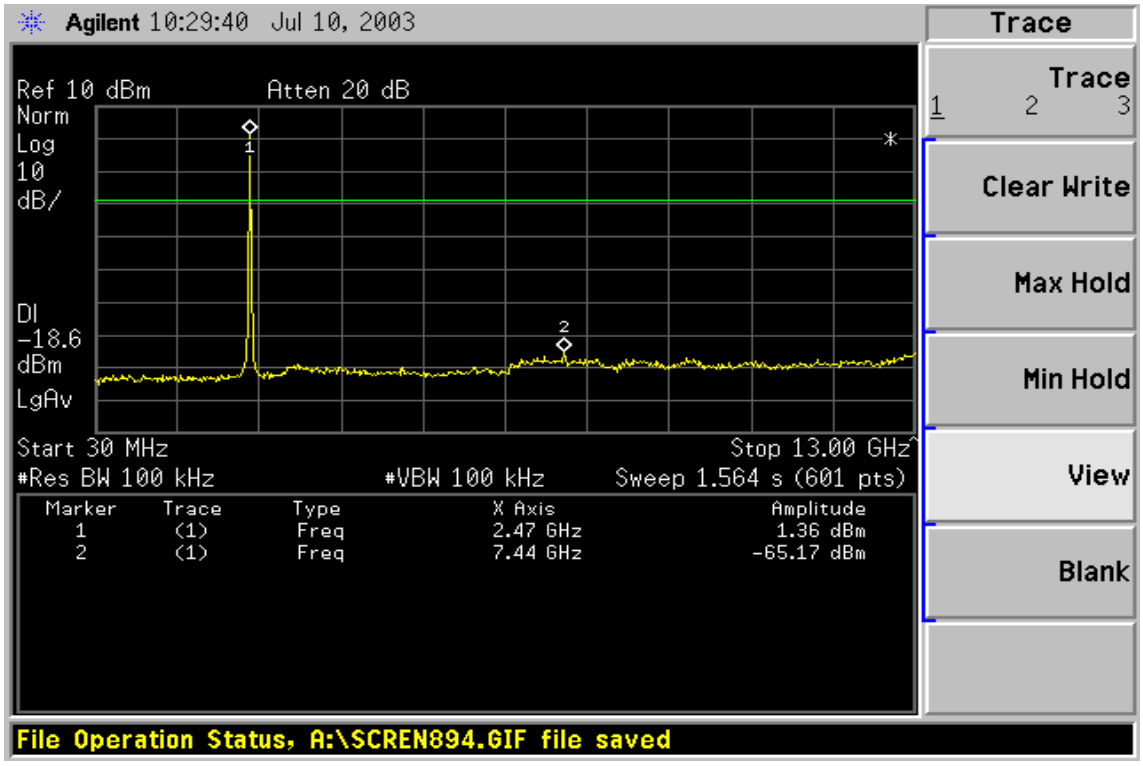


Ch Mid 13GHz~26GHz

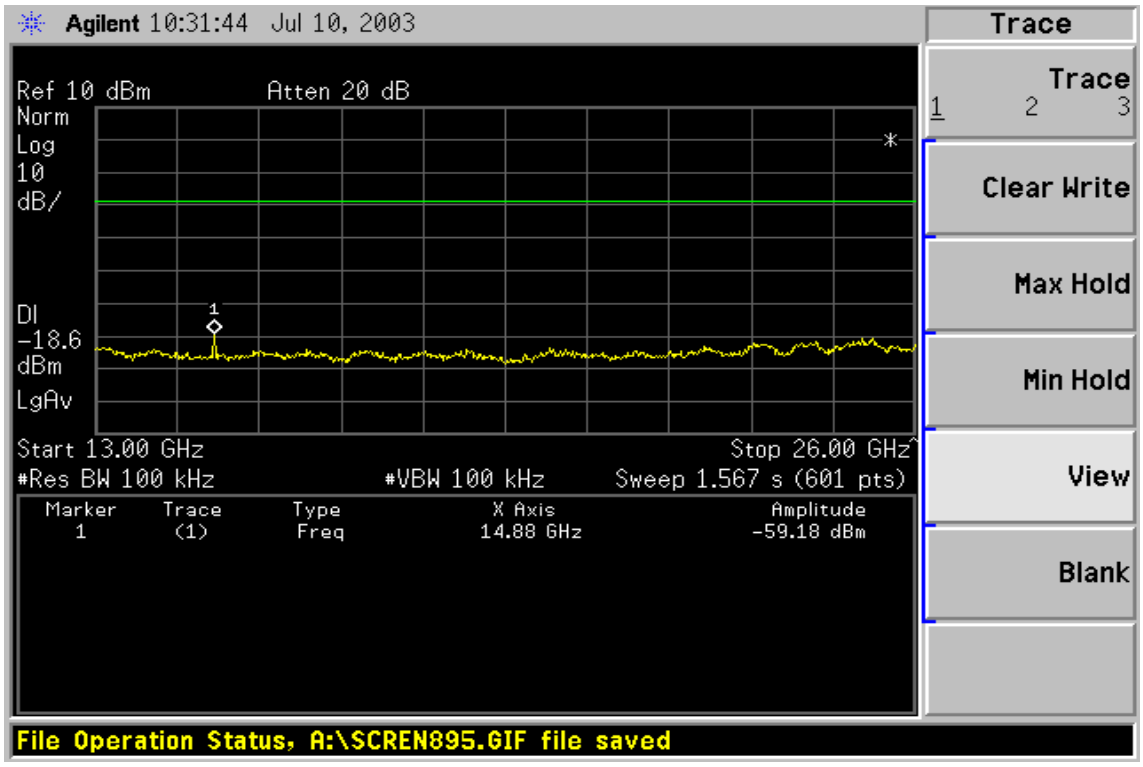


Conducted Spurious Emission Measurement Result (Ch High)

Ch High 30MHz~13GHz



Ch High 13GHz~26GHz



9.8 Radiated Spurious Emission Measurement Result (Below 1GHz)

Operation Mode	TX CH Low	Test Date:	July 9, 2003
Fundamental Frequency	2402MHz	Test By	Robin
Temperature	30°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)
283.35	V	Peak	56.34	-13.20	43.14	46.00	-2.86
400.33	V	Peak	45.17	-9.95	35.22	46.00	-10.78
479.66	V	Peak	47.17	-8.49	38.68	46.00	-7.32
512.33	V	Peak	43.67	-8.11	35.56	46.00	-10.44
527.50	V	Peak	43.67	-7.99	35.68	46.00	-10.32
872.83	V	Peak	40.34	-4.21	36.13	46.00	-9.87
283.35	H	Peak	54.84	-13.20	41.64	46.00	-4.36
288.30	H	Peak	48.67	-12.99	35.68	46.00	-10.32
512.33	H	Peak	43.17	-8.11	35.06	46.00	-10.94
571.83	H	Peak	42.00	-7.72	34.28	46.00	-11.72
672.16	H	Peak	41.50	-6.13	35.37	46.00	-10.63
872.83	H	Peak	40.50	-4.21	36.29	46.00	-9.71

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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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	July 9, 2003
Fundamental Frequency	2441MHz	Test By	Robin
Temperature	30°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)
283.80	V	Peak	56.34	-13.18	43.16	46.00	-2.84
512.33	V	Peak	43.17	-8.11	35.06	46.00	-10.94
527.50	V	Peak	45.17	-7.99	37.18	46.00	-8.82
672.16	V	Peak	40.67	-6.13	34.54	46.00	-11.46
802.83	V	Peak	42.84	-4.57	38.27	46.00	-7.73
872.83	V	Peak	41.50	-4.21	37.29	46.00	-8.71
283.35	H	Peak	53.00	-13.20	39.80	46.00	-6.20
288.30	H	Peak	48.17	-12.99	35.18	46.00	-10.82
361.83	H	Peak	45.67	-10.91	34.76	46.00	-11.24
528.66	H	Peak	42.50	-7.97	34.53	46.00	-11.47
672.16	H	Peak	41.34	-6.13	35.21	46.00	-10.79
872.83	H	Peak	41.00	-4.21	36.79	46.00	-9.21

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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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	July 9, 2003
Fundamental Frequency	2480MHz	Test By	Robin
Temperature	30°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)
283.35	V	Peak	56.84	-13.20	43.64	46.00	-2.36
512.33	V	Peak	43.67	-8.11	35.56	46.00	-10.44
528.66	V	Peak	46.84	-7.97	38.87	46.00	-7.13
623.16	V	Peak	43.67	-6.86	36.81	46.00	-9.19
655.83	V	Peak	41.84	-6.22	35.62	46.00	-10.38
872.83	V	Peak	41.00	-4.21	36.79	46.00	-9.21
283.35	H	Peak	55.17	-13.20	41.97	46.00	-4.03
288.30	H	Peak	49.17	-12.99	36.18	46.00	-9.82
512.33	H	Peak	43.00	-8.11	34.89	46.00	-11.11
528.66	H	Peak	42.50	-7.97	34.53	46.00	-11.47
624.33	H	Peak	43.17	-6.85	36.32	46.00	-9.68
872.83	H	Peak	40.00	-4.21	35.79	46.00	-10.21

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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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	July 10, 2003
Fundamental Frequency	2402MHz	Test By	Robin
Temperature	30°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
2020	44.50	---	-4.32	40.18	---	74.00	54.00	-33.82
4800	40.67	---	3.24	43.91	---	74.00	54.00	-30.09
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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	July 10, 2003
Fundamental Frequency	2402MHz	Test By	Robin
Temperature	30°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
1146	48.67	---	-9.62	39.05	---	74.00	54.00	-34.95
4791	39.50	---	3.22	42.72	---	74.00	54.00	-31.28
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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	July 10, 2003
Fundamental Frequency	2441MHz	Test By	Robin
Temperature	30°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
2030	44.34	---	-4.29	40.05	---	74.00	54.00	-33.95
4875	44.00	---	3.40	47.40	---	74.00	54.00	-26.60
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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	July 10, 2003
Fundamental Frequency	2441MHz	Test By	Robin
Temperature	30°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
2013	44.00	---	-4.35	39.65	---	74.00	54.00	-34.35
4875	40.17	---	3.40	43.57	---	74.00	54.00	-30.43
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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	July 10, 2003
Fundamental Frequency	2480MHz	Test By	Robin
Temperature	30°C	Pol	Ver.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
1083	49.50	---	-9.84	39.66	---	74.00	54.00	-34.34
2013	44.00	---	-4.35	39.65	---	74.00	54.00	-34.35
4950	43.00	---	3.56	46.56	---	74.00	54.00	-27.44
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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	July 10, 2003
Fundamental Frequency	2480MHz	Test By	Robin
Temperature	30°C	Pol	Hor.
Humidity	65%		

Freq. (MHz)	Peak Reading (dBuV)	AV Reading (dBuV)	Ant./CL CF(dB)	Actual FS Peak (dBuV/m)	Actual FS AV (dBuV/m)	Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
1140	49.84	---	-9.43	40.41	---	74.00	54.00	-33.59
2033	44.67	---	-4.28	40.39	---	74.00	54.00	-33.61
4950	41.17	---	3.56	44.73	---	74.00	54.00	-29.27
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. *Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are 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.*
5. *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 4.0 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

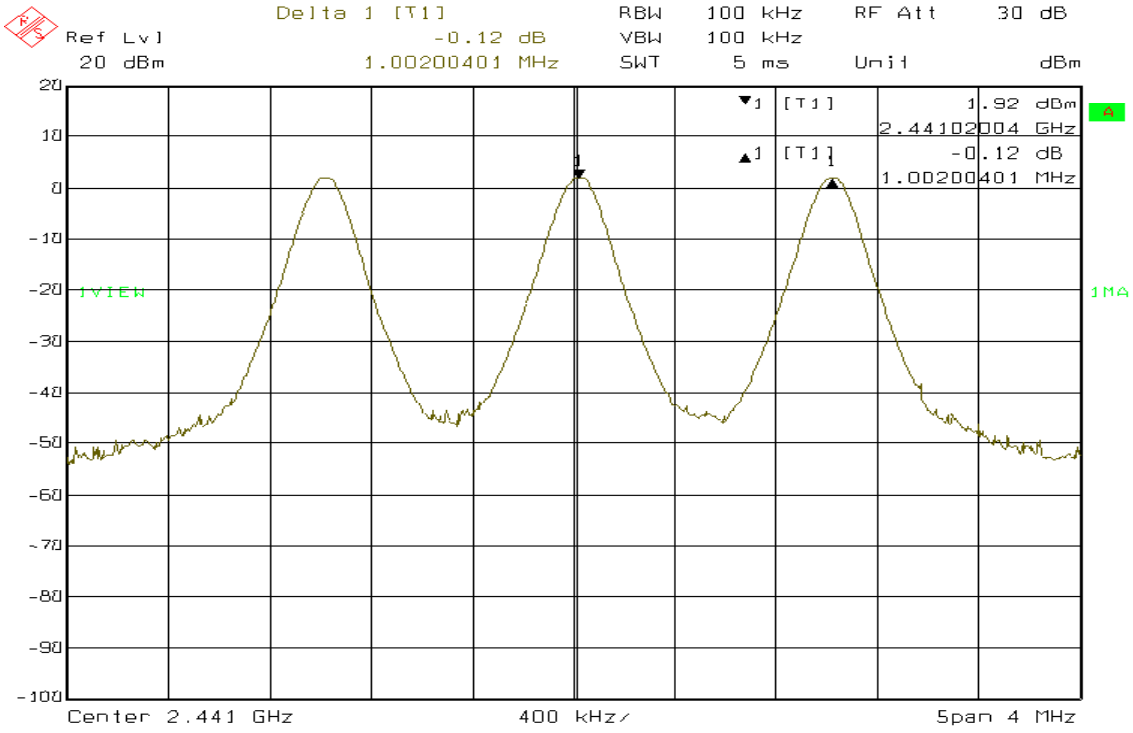
10.3 Measurement Result

Channel Separation (MHz)	Limit (kHz)	Result
1.002	601.00	PASS

10.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
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

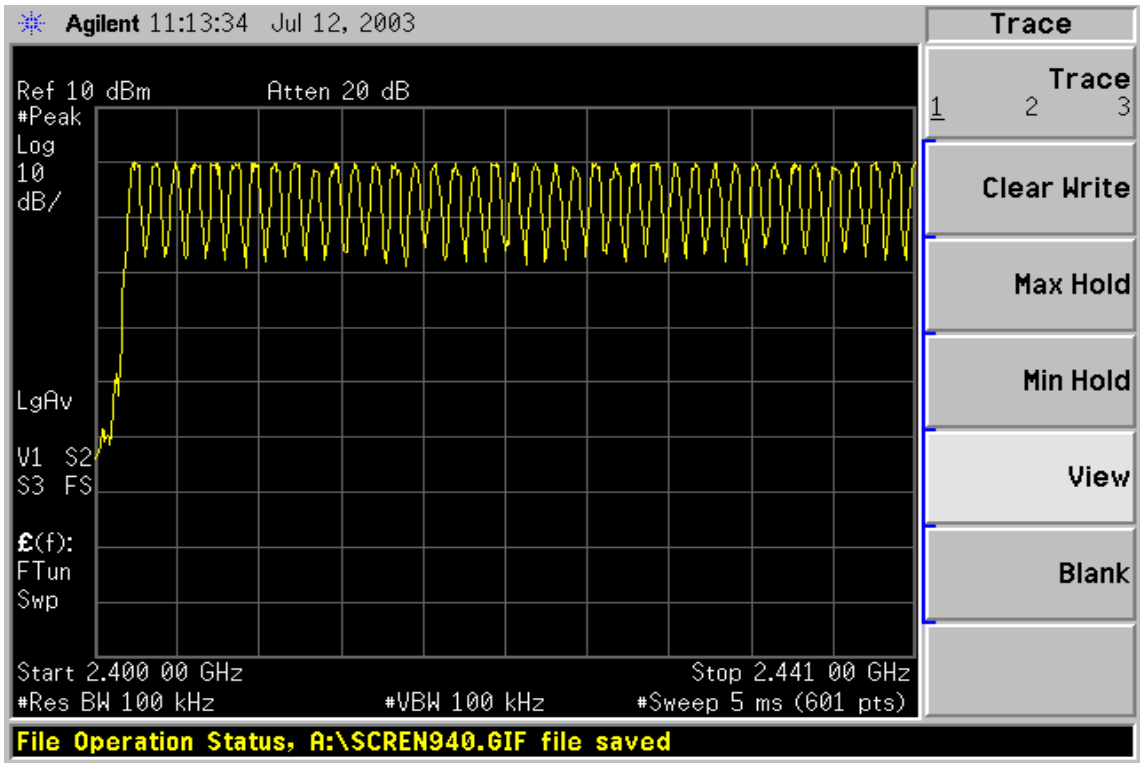
Limit (No. of CH)	Result (No. of CH)	Result
75	79	PASS

11.4 Measurement Equipment Used:

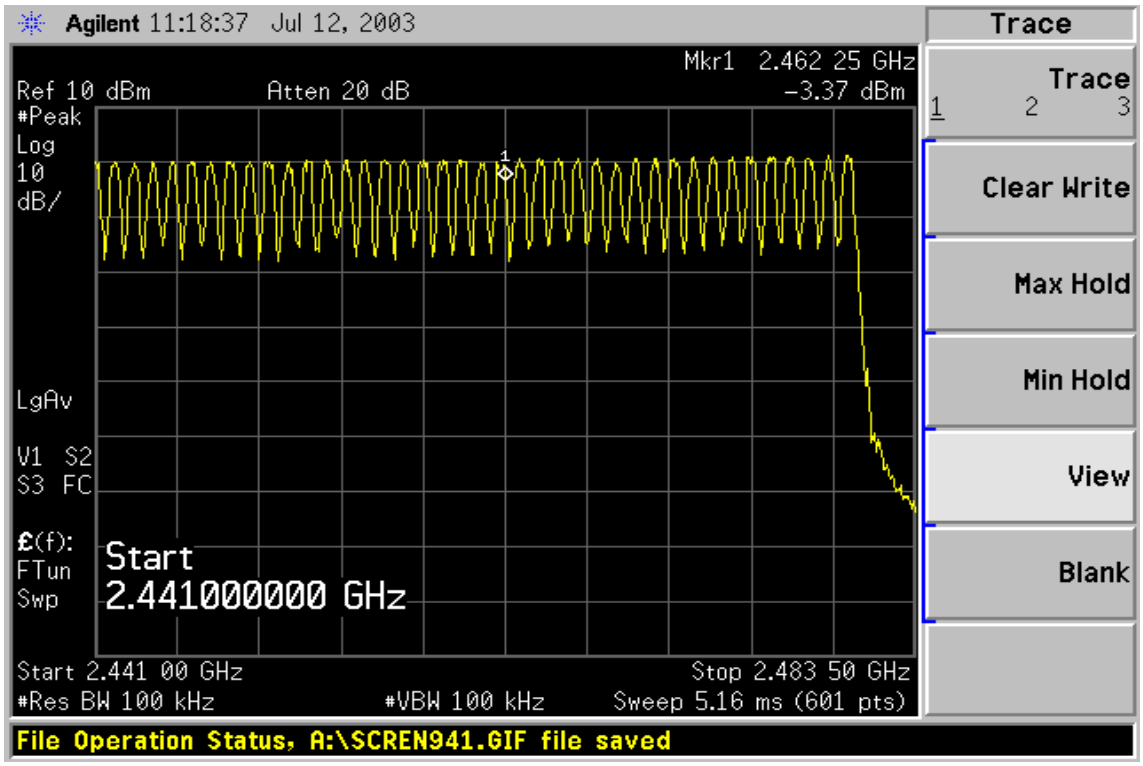
EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

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 * 79 = 31.6 (s)
CH Low: 0.42 * 1600/79 * 31.6=268.80 (ms)
CH Mid: 0.41 * 1600/79 * 31.6=262.40 (ms)
CH High: 0.41 * 1600/79 * 31.6=262.40 (ms)

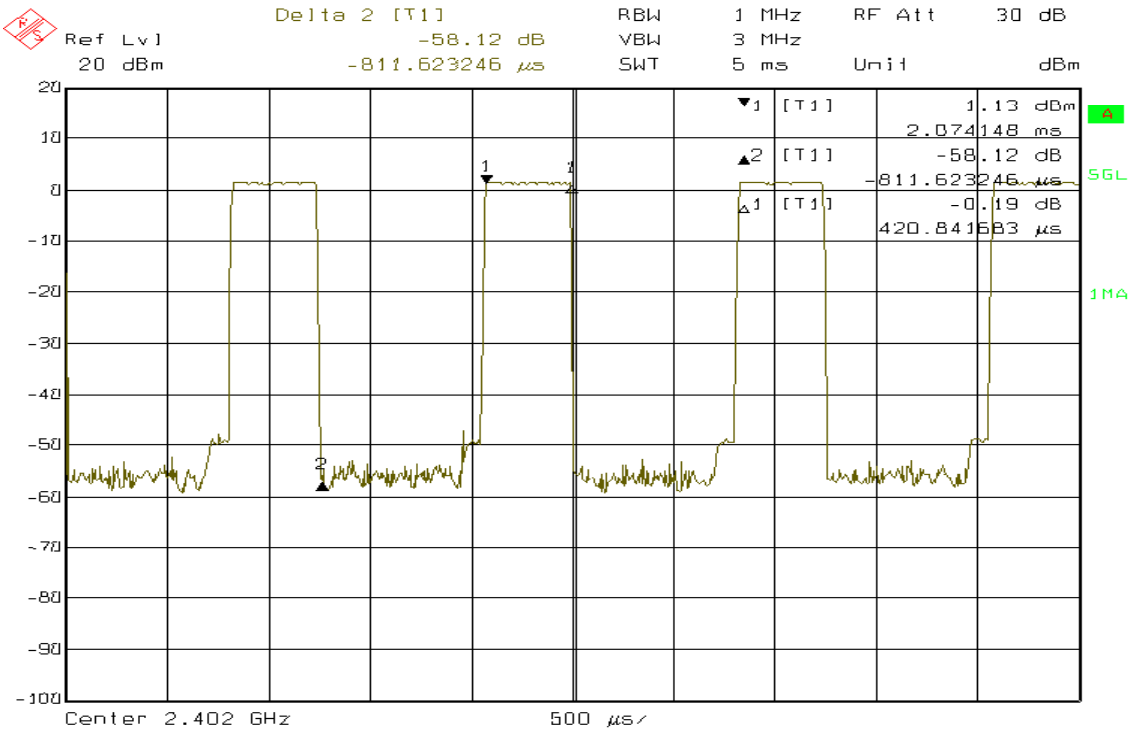
CH	Pulse Time	Total of Dwell (ms)	Period Time (ms)	Limit (ms)
Low	0.42	268.80	31.60	400.00
Mid	0.41	262.40	31.60	400.00
High	0.41	262.40	31.60	400.00

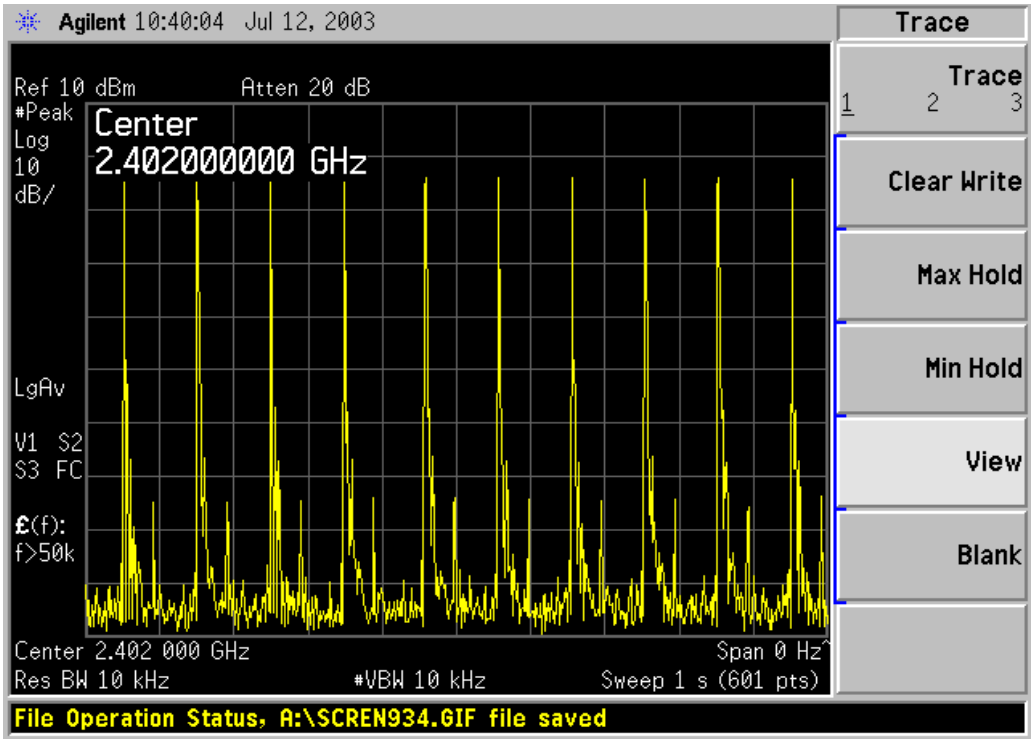
12.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal Due.
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

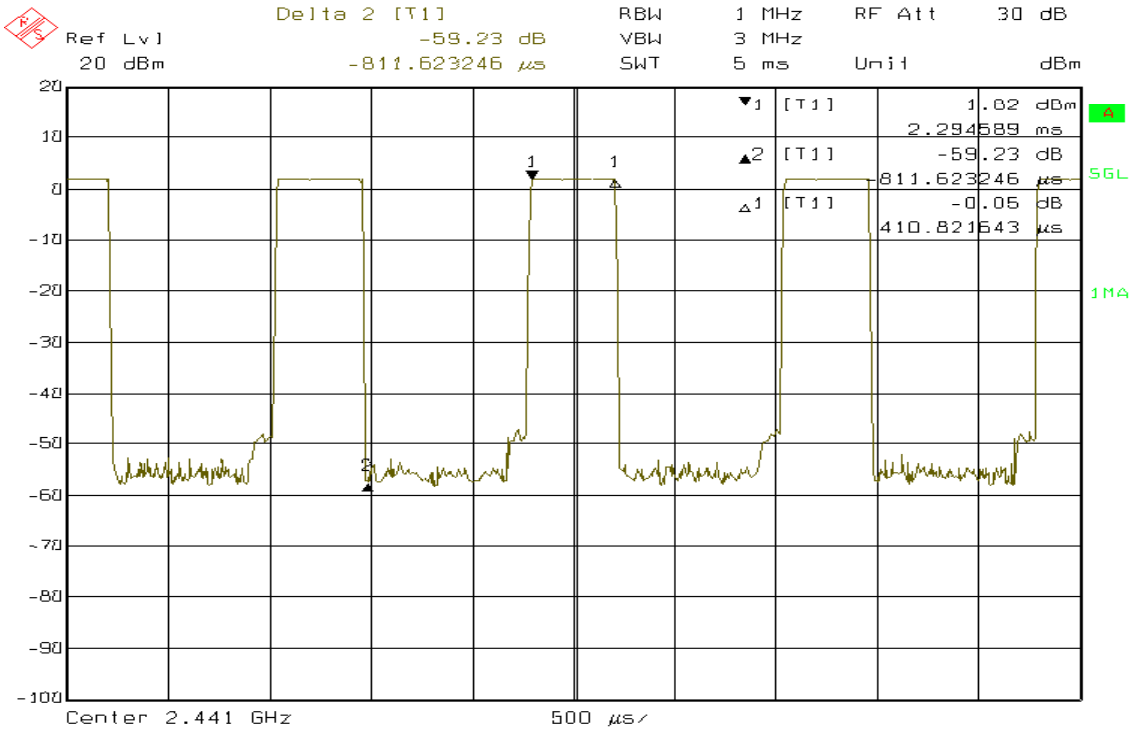
Dwell Time Test Data

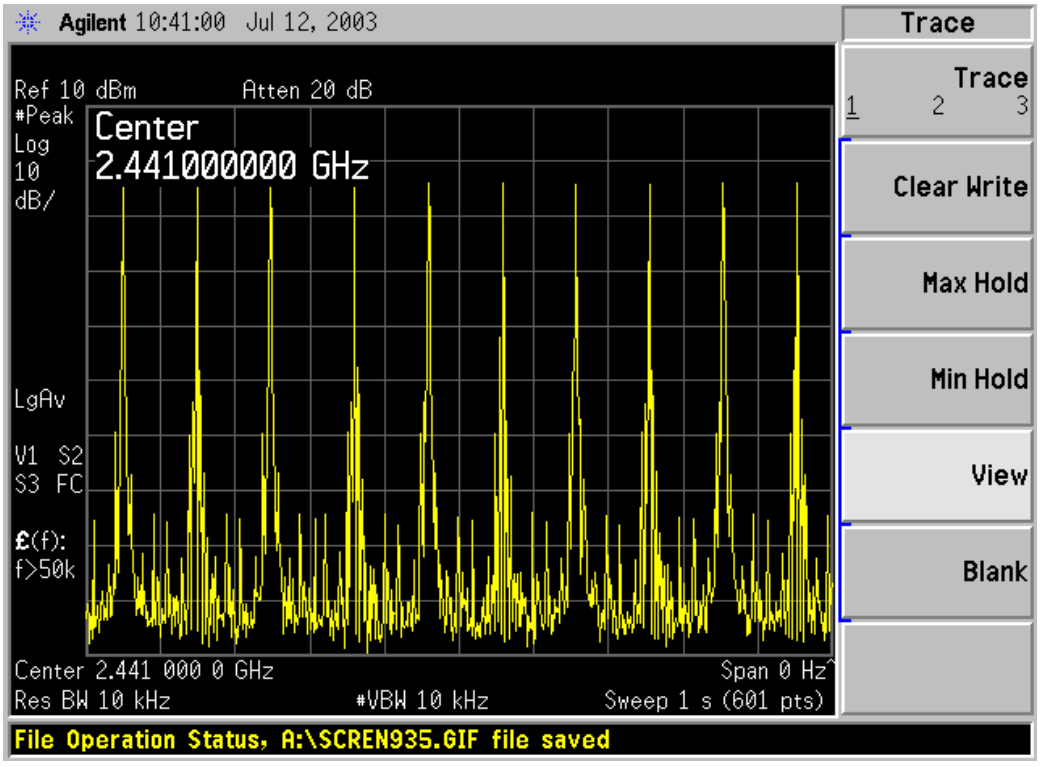
CH LOW



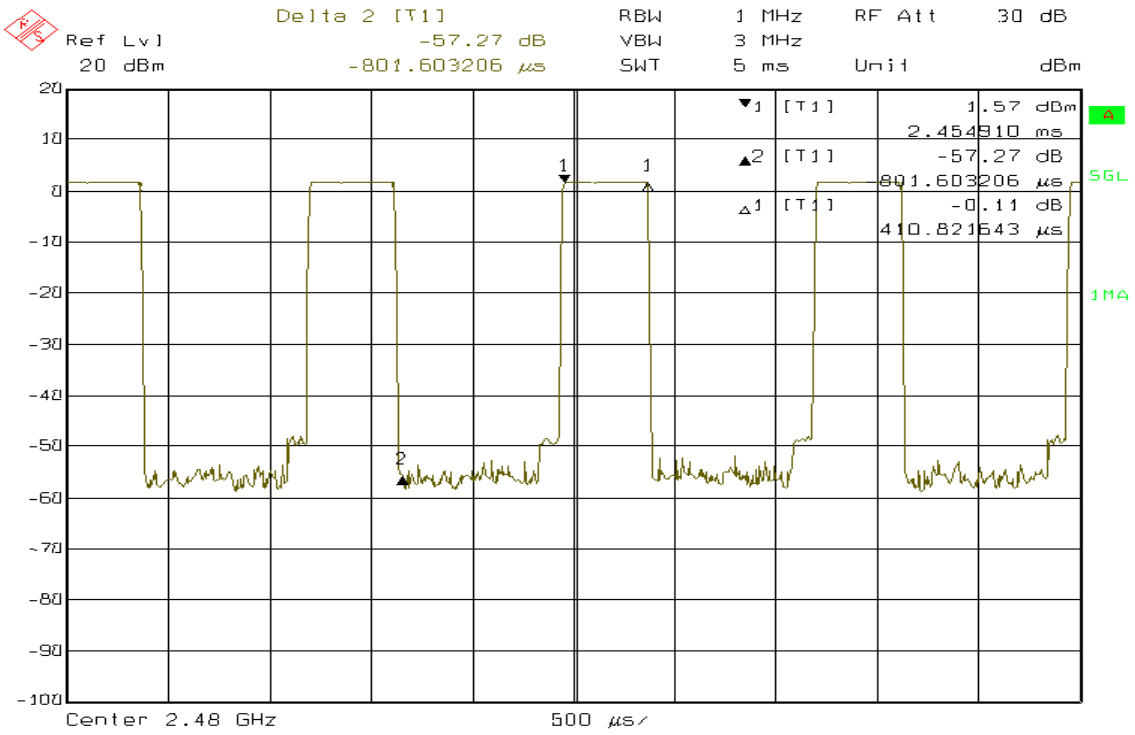


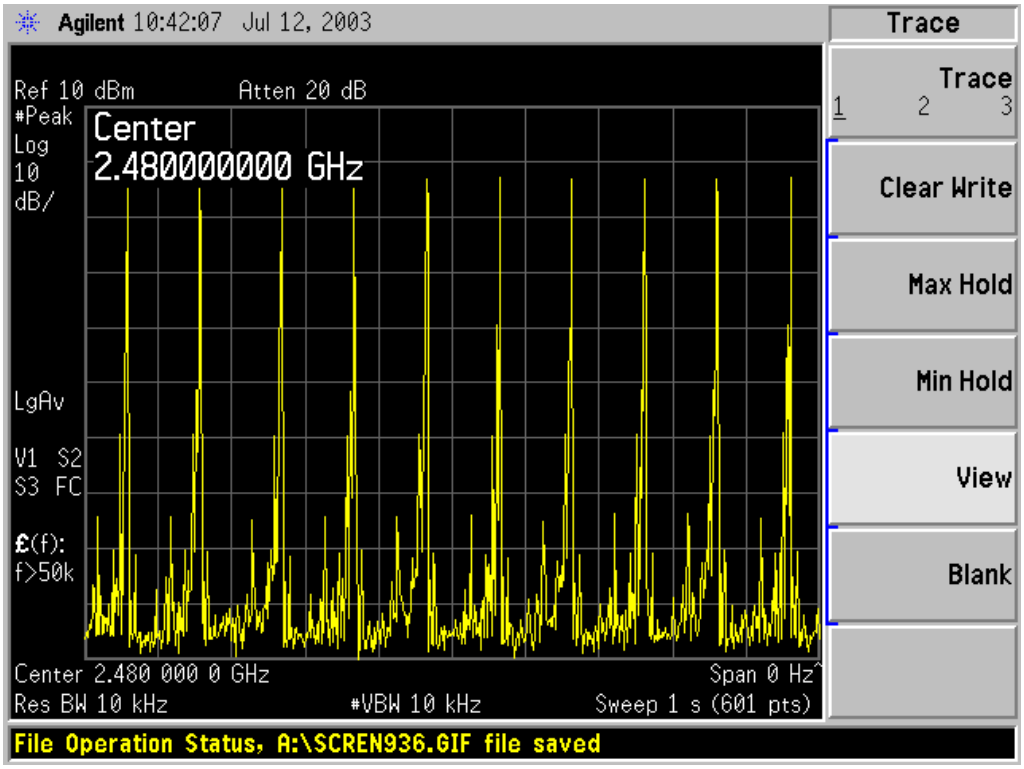
CH MID


Delta 2 [T1]
Ref Lvl
20 dBm
-59.23 dB
-811.623246 µs
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 30 dB
Unit dBm
1 [T1] 1.82 dBm
2.294589 ms
2 [T1] -59.23 dB
811.623246 µs
Δ1 [T1] -0.05 dB
410.821643 µs
SGL
1MA
Center 2.441 GHz
500 µs/


Agilent 10:41:00 Jul 12, 2003
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Center
2.441000000 GHz
LgAv
V1 S2
S3 FC
£(f):
f>50k
Center 2.441 000 0 GHz
Span 0 Hz
Res BW 10 kHz
#VBW 10 kHz
Sweep 1 s (601 pts)
File Operation Status, A:\SCREN935.GIF file saved
Trace
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank

CH HIGH


Delta 2 [T1]
Ref Lvl
20 dBm
-57.27 dB
-801.603206 µs
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 30 dB
Unit dBm
1 [T1] 1.57 dBm
2.454910 ms
2 [T1] -57.27 dB
801.603206 µs
Δ1 [T1] -0.11 dB
410.821543 µs
SGL
1MA
Center 2.48 GHz
500 µs/


Agilent 10:42:07 Jul 12, 2003
Trace
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Center
2.480000000 GHz
LgAv
V1 S2
S3 FC
£(f):
f>50k
Center 2.480 000 0 GHz
Span 0 Hz
Res BW 10 kHz
#VBW 10 kHz
Sweep 1 s (601 pts)
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
File Operation Status, A:\SCREN936.GIF file saved

13. Peak Power Spectral Density

13.1 Standard Applicable

According to § 15.247(d), 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.

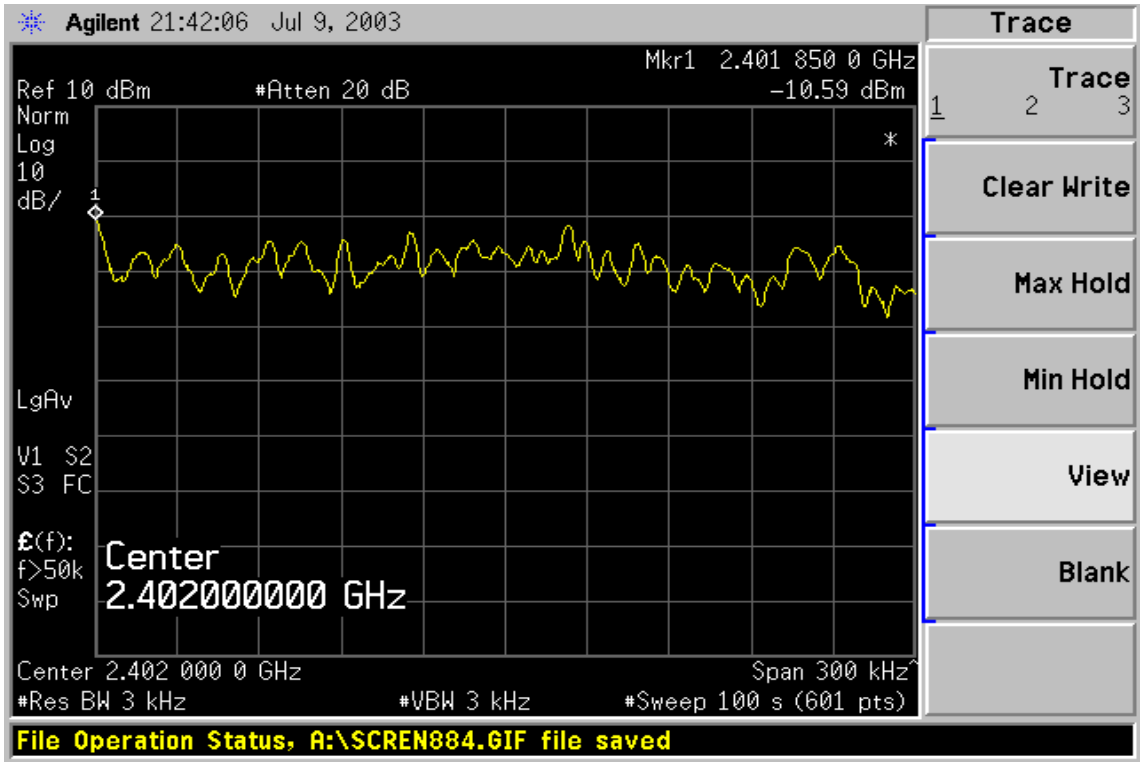
13.3 Measurement Result

CH	RF Power DensityReading (dBm)	Cable Loss (dB)	RF Power Density Level (dBm)	Maximum Limit (dBm)
Low	-10.59	1.20	-9.39	8
Mid	-10.86	1.20	-9.66	8
High	-10.35	1.20	-9.15	8

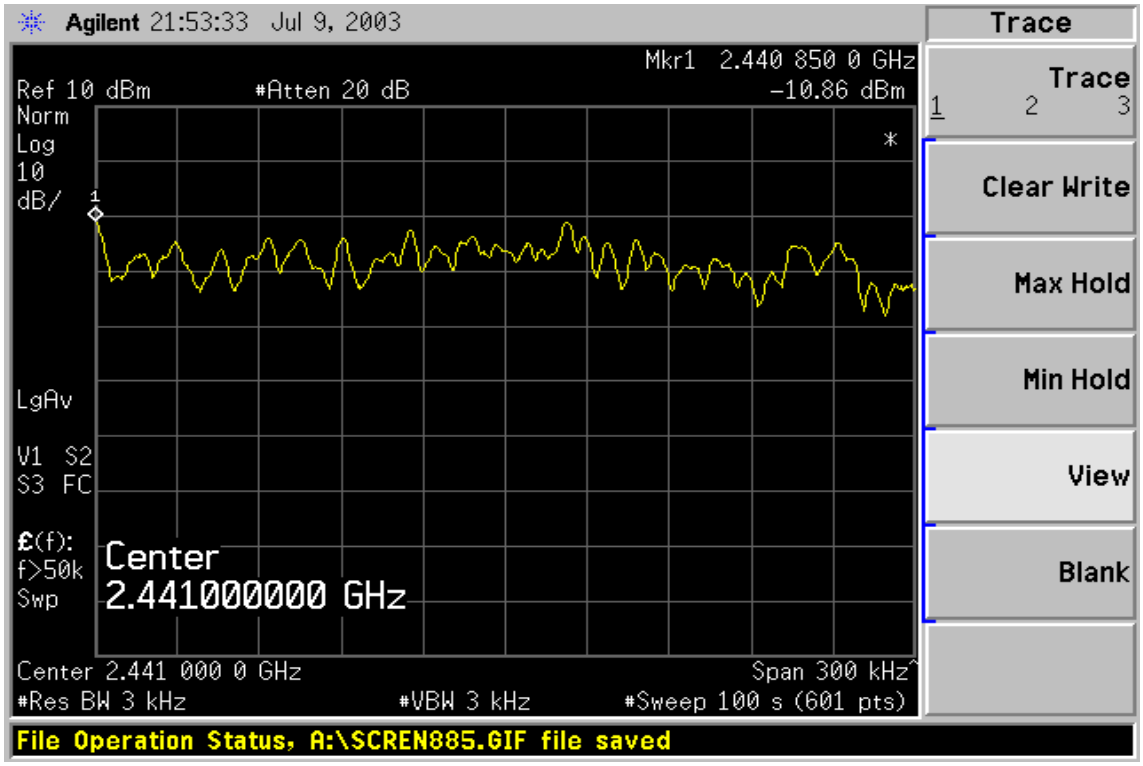
13.4 Measurement Equipment Used:

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
Spectrum Analyzer	Agilent	E4446A	US42510252	4/28/2003	4/27/2004
Low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

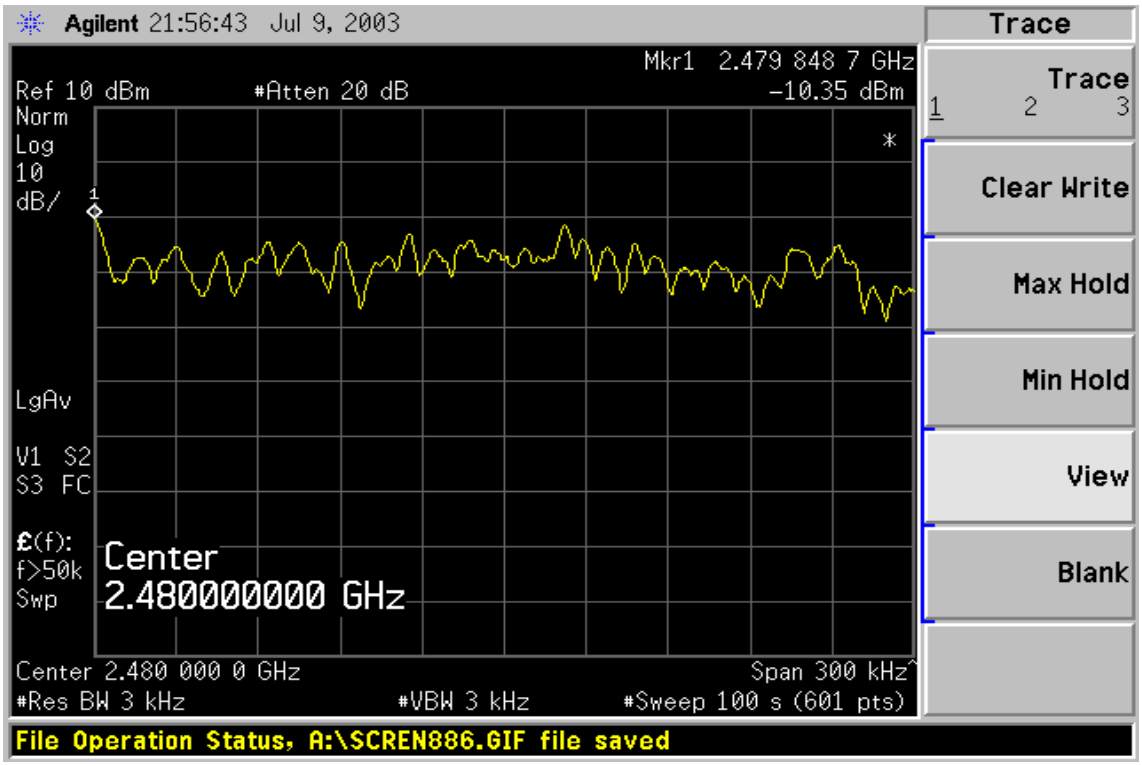
Power Spectral Density Test Plot (CH-Low)



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 2.85 dBi 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.

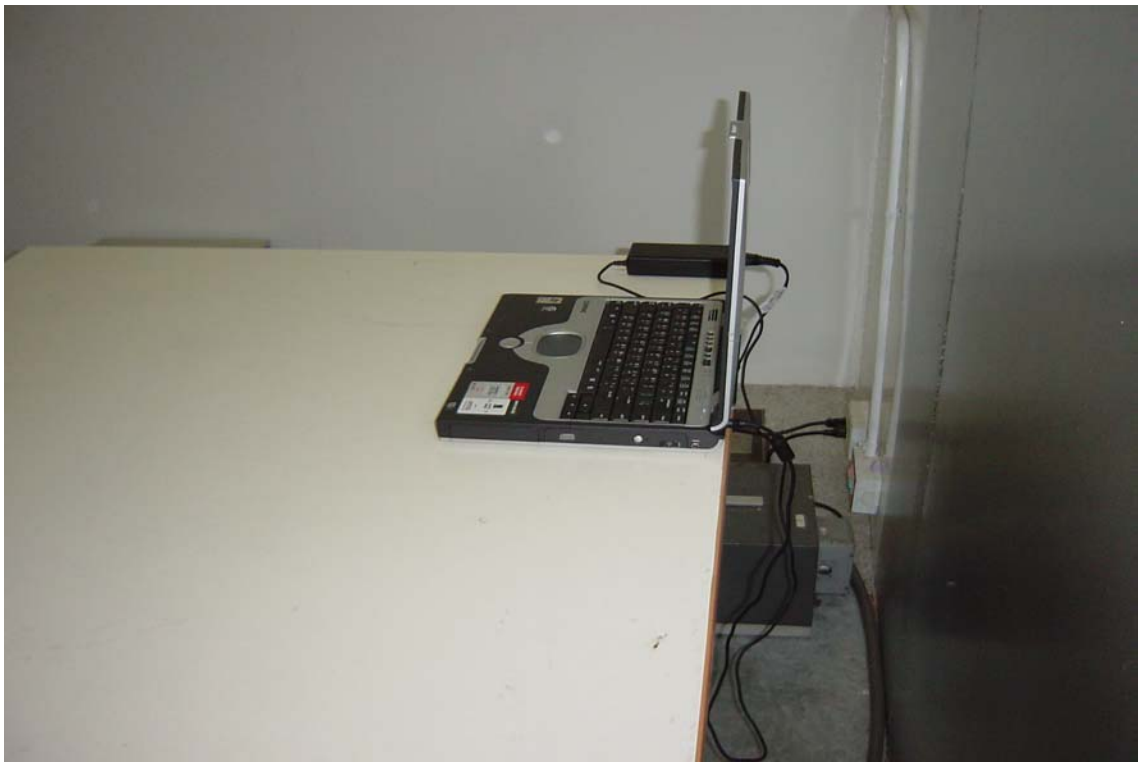
This device is classed as a portable device

The Max. output power is –2.33dBm (0.58mW) at 2441MHz, which is lower than general population low threshold 60/F(60/2.480=24.19mW), The SAR is not required.

APPENDIX 1 PHOTOGRPHS OF SET UP

Radiated Emission Set up Photos

Conducted Emission Set Up Photos



APPENDIX 2 EXTERNAL PHOTOGRPHS OF EUT

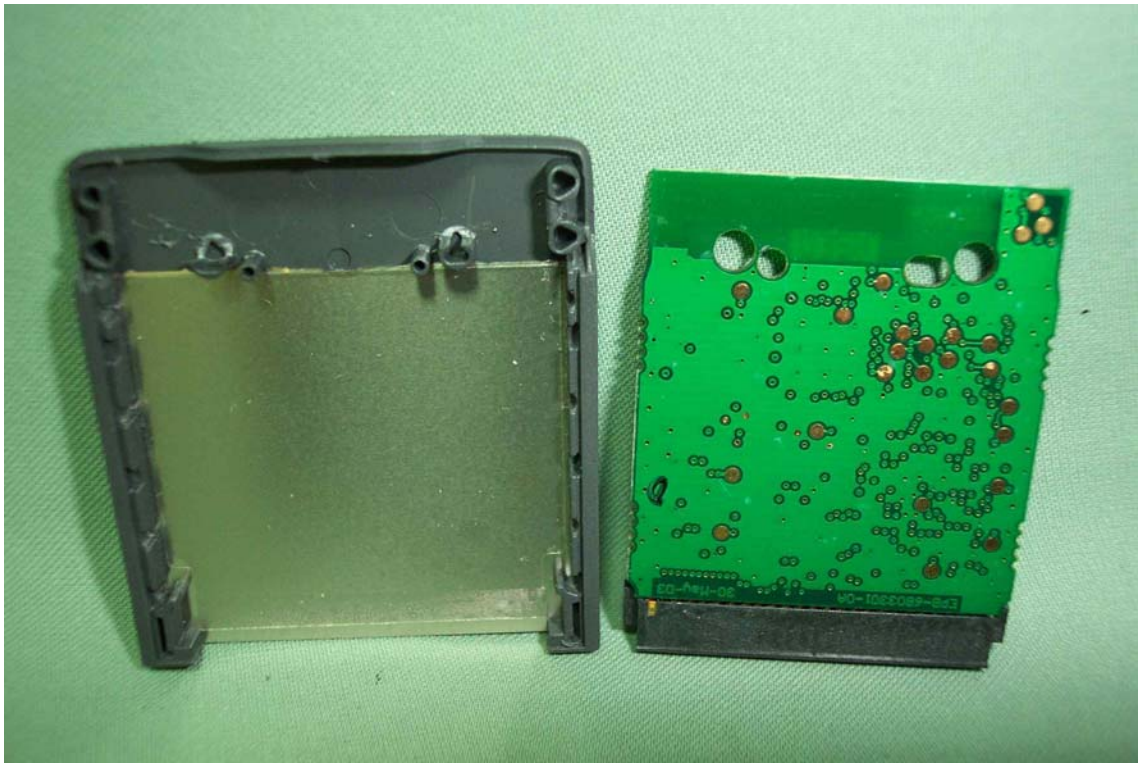
Front view of EUT

Front view of EUT

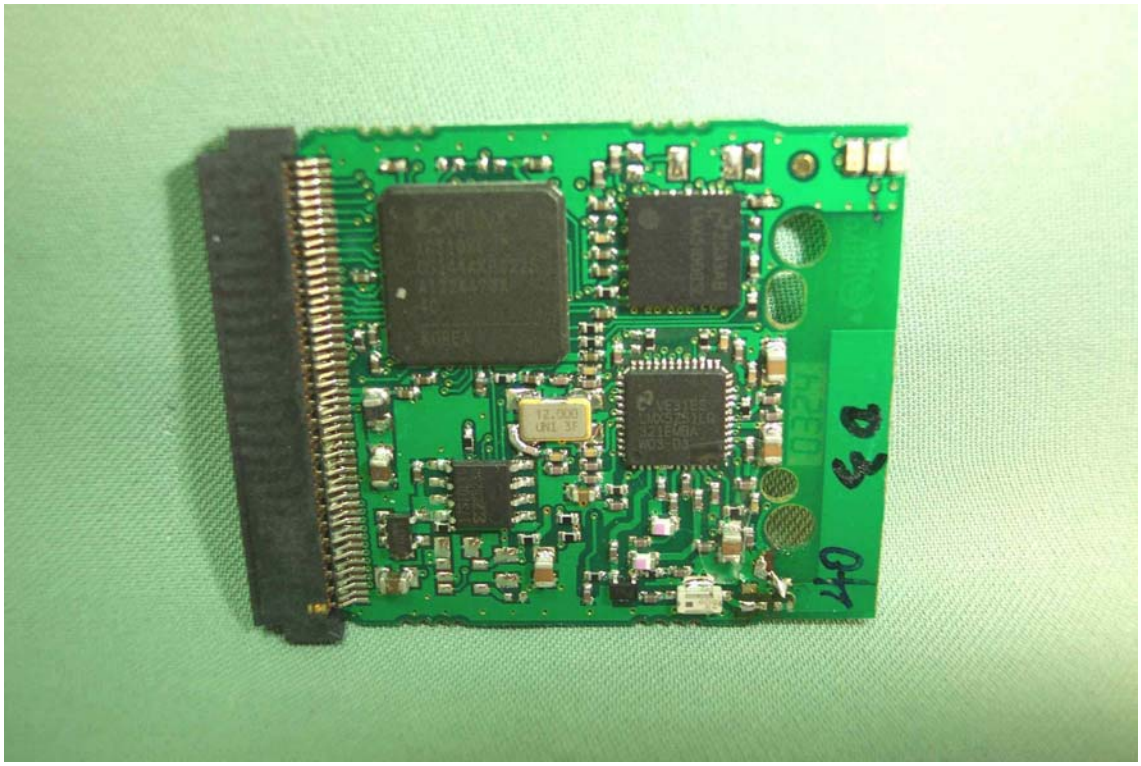
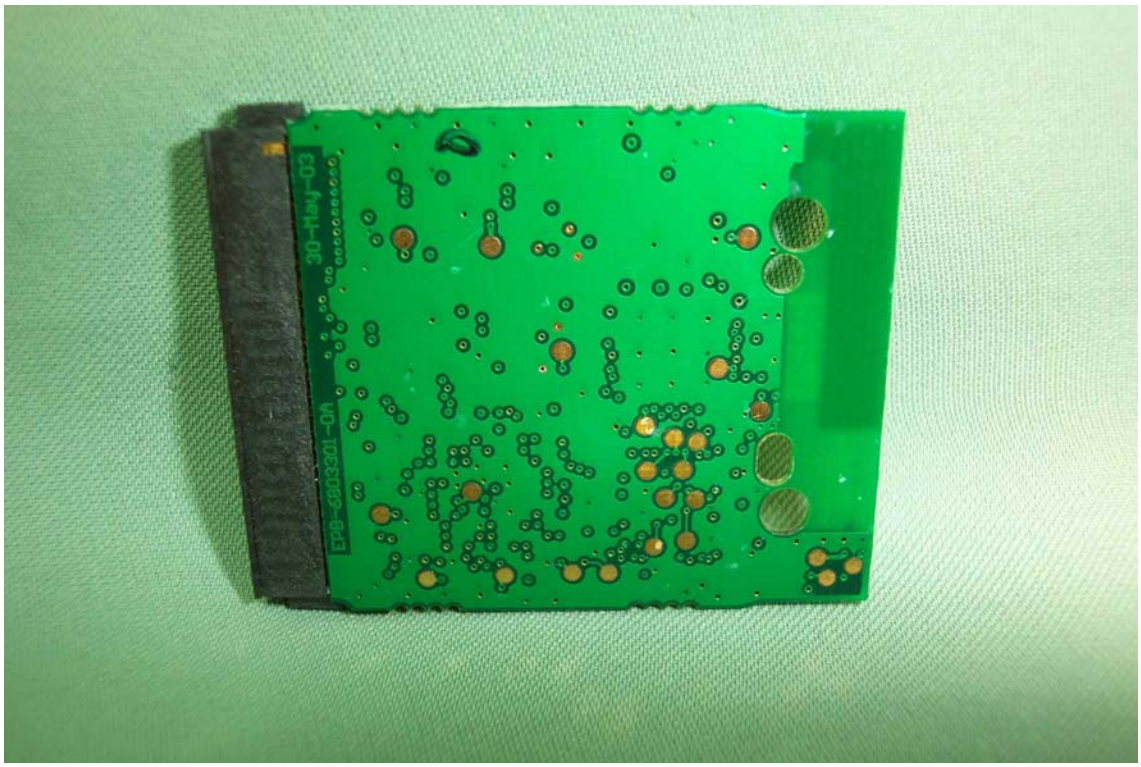
APPENDIX 3 INTERNAL PHOTOGRPHS OF EUT

Internal View of EUT – 1

Internal View of EUT – 2



Internal View of EUT - 3



Internal View of EUT – 4