0513
ILAC MRA

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product name:	**UMA Wireless GPS Receiver**
Brand Name:	**N/A**
Model Name:	**BS1100**
FCC ID:	**SHBBS1100**
REPORT NO:	**EF/2004/90004**
ISSUE DATE:	**Sep. 15, 2004**
FCC Rule Part:	**§15.247**
Prepared for	**ROYALDIGITAL INC.** **1F, No. 120, Xinhu 3rd Rd., Neihu District, Taipi City, 114 Taiwan**
Prepared by	**SGS Taiwan Ltd.** **No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei County, Taiwan.**

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VERIFICATION OF COMPLIANCE

Applicant:	ROYALDIGITAL INC.
	1F, No. 120, Xinhu 3rd Rd., Neihu District, Taipi City, 114 Taiwan
Equipment Under Test:	UMA Wireless GPS Receiver
Brand Name:	N/A
FCC ID Number:	SHBBS1100
Model No.:	BS1100
Model Difference:	N/A
File Number:	EF/2004/90004
Date of test:	Sep. 01, 2004 ~ Sep. 07, 2004
EUT Receive:	Aug. 31, 2004

We hereby certify that:

The above equipment was tested by SGS Taiwan 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 (2001) 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.

Test By:	Sky Wang	***Date***	Sep. 15, 2004
	Sky Wang		
Approved By	Vincent Su	***Date***	Sep. 15, 2004
	Vincent Su		

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1. GENERAL INFORMATION

1.1 Product Description

The Polstar Technologies Inc., Model: BS1100 (referred to as the EUT in this report) is UMA Wireless GPS Receiver.

A major technical descriptions of EUT is described as following:

A). Operation Frequency: 2402 – 2480MHz, 79 channels

B). Rated output power: -1 dBm

C). Modulation type: Frequency Hopping Spread Spectrum (FHSS)

D). Antenna Designation: Chip Antenna, 1.5dBi, Non-User Replaceable (Fixed)

E). Power Supply: Input: 5V dc from AC/DC Power Adapter

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **SHBBS1100** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (receiver) is compliance with Subpart B is authorized under a Doc procedure.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2001). 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 SGS Taiwan Ltd. No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan. The Open Area Test Sites and the Line Conducted labs are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2001 and CISPR 22/EN 55022 requirements. Site No. 1(3 &10 meters) Registration Number: 94644, Anechoic chamber (3 meters) Registration Number: 573967

1.5 Special Accessories

Not available for this EUT intended for grant.

1.6 Equipment Modifications

Not available for this EUT intended for grant.

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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 that was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-2001.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 a placed on as 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 C63.4-2001.

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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.	N/A						

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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)	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, §15.247(b)(4)(i)	Antenna Requirement	Compliant
§1.1310	RF Exposure	Compliant

4. DESCRIPTION OF TEST MODES

The EUT 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 741k highest data rate are chosen for full testing with AC/DC power adaptor, which was the worse condition.

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5. CONDUCTED EMISSION TEST

5.1 Standard Applicable

According to §15.207. frequency within 150KHz to 30MHz shall not exceed the limit table as below.

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 C63.4-2001.
2. The EUT was plug-in the AC/DC power adaptor. The EUT was placed on the center of the back edge on the test table. The rear of the EUTwas placed flushed with the rear of the table-top.
3. The spacing between the peripherals was 10 centimeters.
4. External I/O cables were draped along the edge of the test table and bundle when necessary.

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.

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5.4 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMC Analyzer	HP	8594EM	3624A00203	12/31/2003	12/30/2004
EMI Test Receiver	R&S	ESCS30	828985/004	01/15/2004	01/14/2005
LISN	Rolf-Heine	NNB-2/16Z	99012	12/30/2003	12/29/2004
LISN	Rolf-Heine	NNB-2/16Z	99013	11/06/2003	11/05/2004

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.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Normal Operating			Test Date :	Sep. 03, 2004
Temperature:	24 ℃	Humidity:	65%	Test By:	Sky

FREQ MHz	Q.P. Raw dBuV	AVG Raw dBuV	Q.P. Limit dBuV	AVG Limit dBuV	Q.P. Margin dB	AVG Margin dB	NOTE
0.190	56.30	42.65	64.02	54.02	-7.72	-11.37	L1
0.313	47.85	41.29	59.88	49.88	-12.03	-8.59	L1
0.385	45.74	---	58.17	48.17	-12.43	---	L1
0.469	44.93	---	56.54	46.54	-11.61	---	L1
0.637	43.31	39.82	56.00	46.00	-12.69	-6.18	L1
1.654	46.07	38.27	56.00	46.00	-9.93	-7.73	L1
0.191	55.56	48.59	63.98	53.98	-8.42	-5.39	L2
0.313	48.85	42.65	59.88	49.88	-11.03	-7.23	L2
0.383	46.97	40.19	58.21	48.21	-11.24	-8.02	L2
0.469	45.23	38.56	56.54	46.54	-11.31	-7.98	L2
0.637	44.48	37.46	56.00	46.00	-11.52	-8.54	L2
1.654	46.54	42.16	56.00	46.00	-9.46	-3.84	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)

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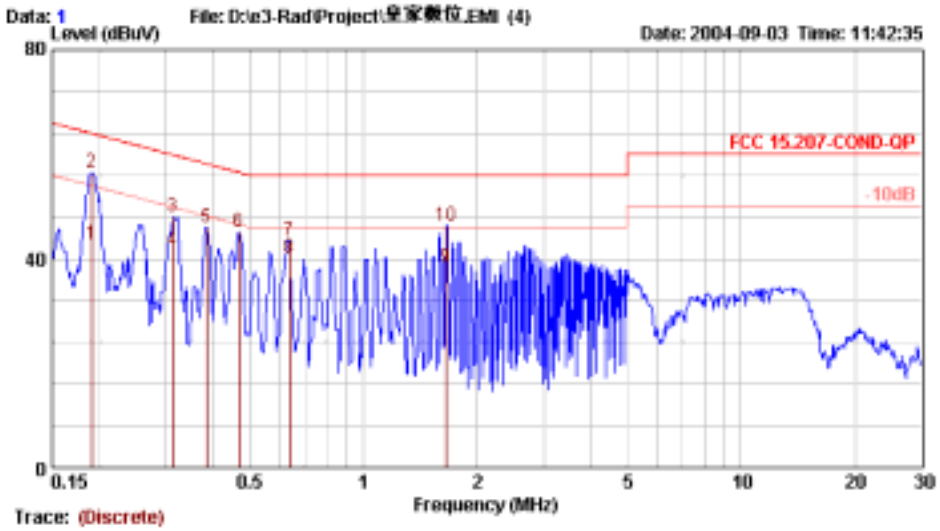
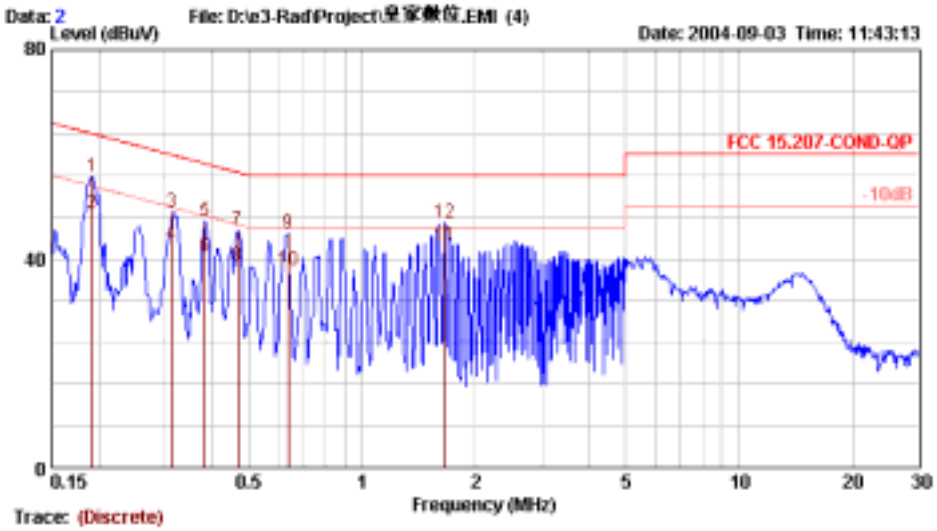
Conducted Emission Test Plot




```
Site              :966 Chamber
Condition         :FCC 15.207-COND-QP NNB-2/16Z(99012) LINE
Applicant:        :
Project No.:      :
EUT Description::
EUT Model:        :
Test Mode:        :110V
Temp./Humid.      :
Operator:         :
```




```
Site              :966 Chamber
Condition         :FCC 15.207-COND-QP NNB-2/16Z(99012) NEUTRAL
Applicant:        :
Project No.:      :
EUT Description::
EUT Model:        :
Test Mode:        :110V
Temp./Humid.      :
Operator:         :
```

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6. PEAK OUTPUT POWER MEASUREMENT

6.1 Standard Applicable

For frequency hopping systems operating in the band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: 0.125 Watts.

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	-5.13	4.00	-1.13	0.00077	1
MID	2441.00	-6.49	4.00	-2.49	0.00056	1
HIGH	2480.00	-8.63	4.00	-4.63	0.00034	1

6.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

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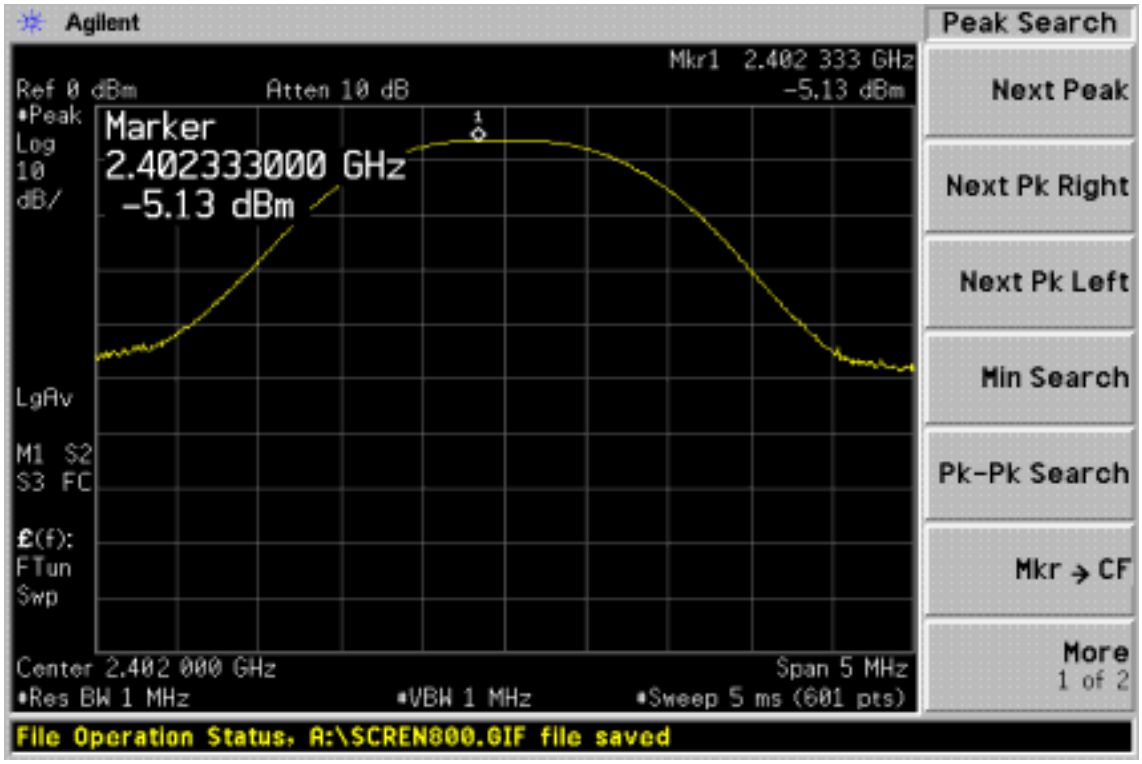
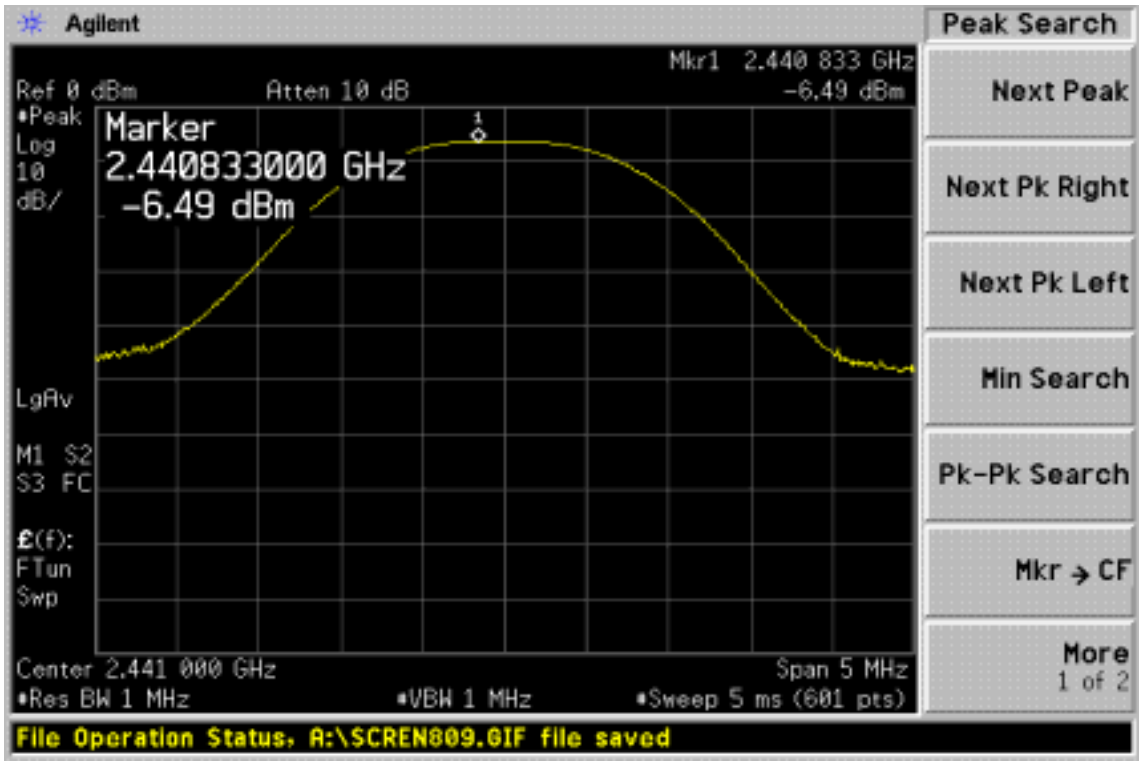
Peak Power Output Data Plot (CH Low)



Peak Power Output Data Plot (CH Mid)



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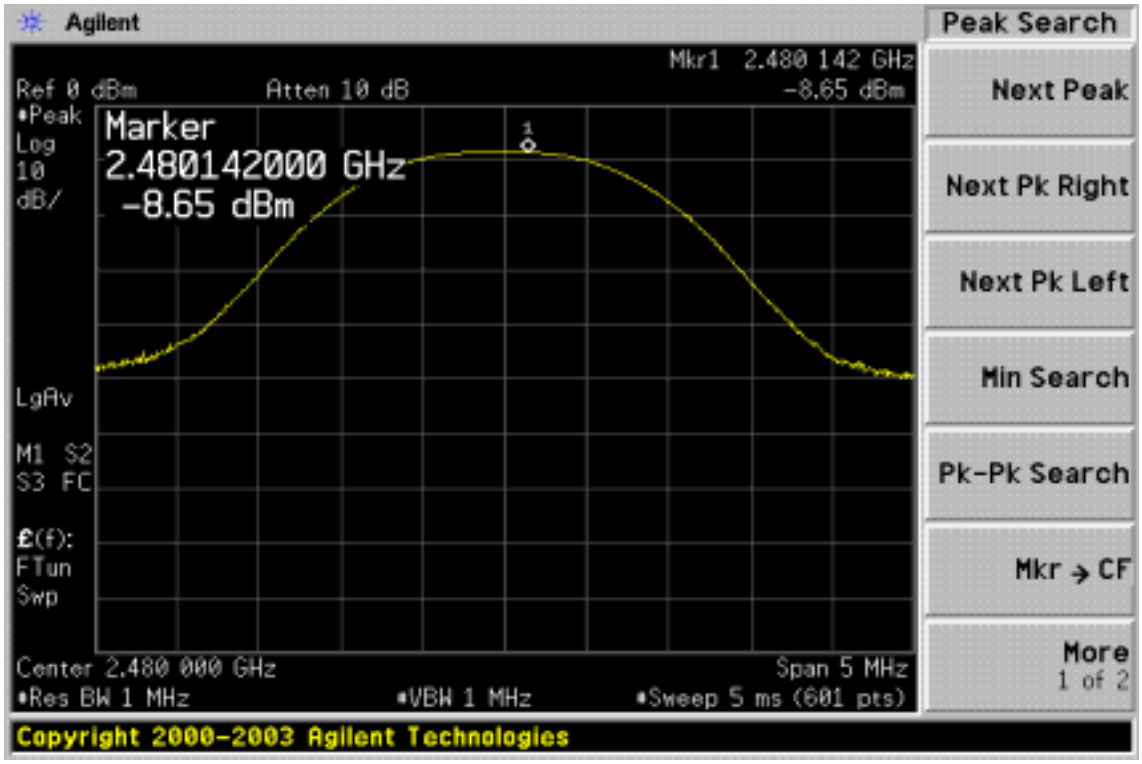
Peak Power Output Data Plot (CH High)



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7. 20dB BAND WIDTH

7.1 Standard Applicable

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz and 5725MHz – 5850MHz 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= 2.5MHz, 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

CH	Bandwidth (MHz)
Lower	0.785
Mid	0.785
Higher	0.790

7.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	05/27/2004	05/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

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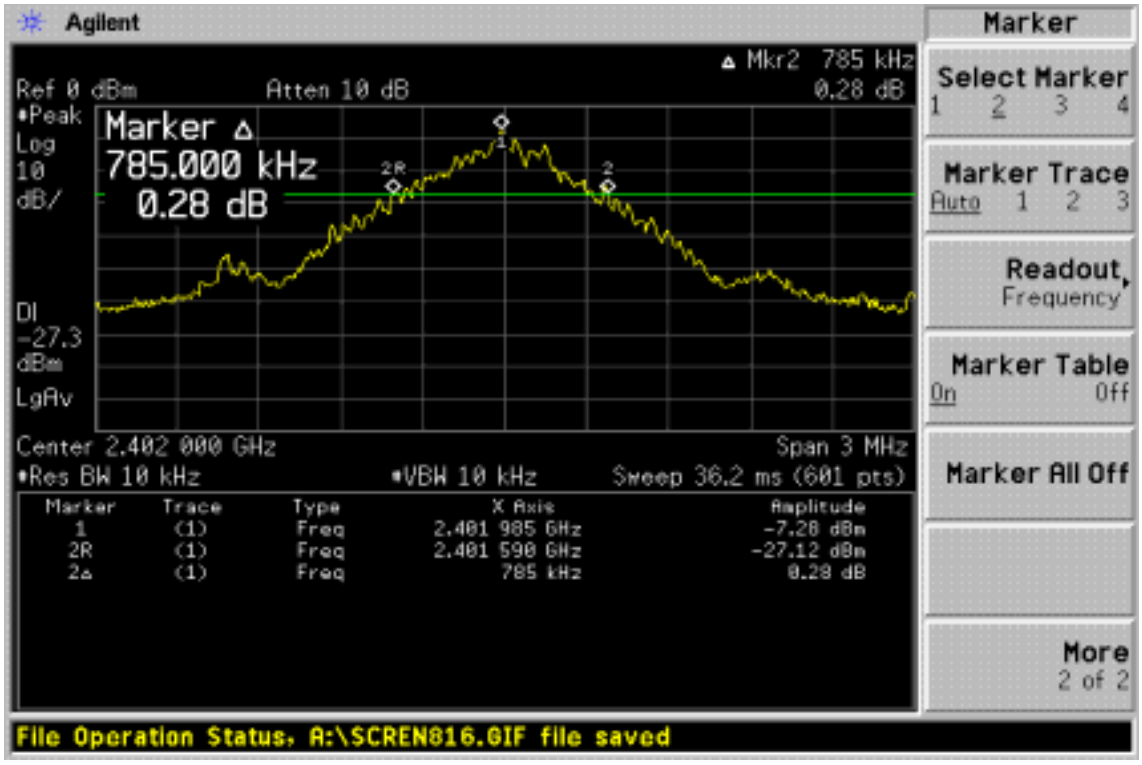
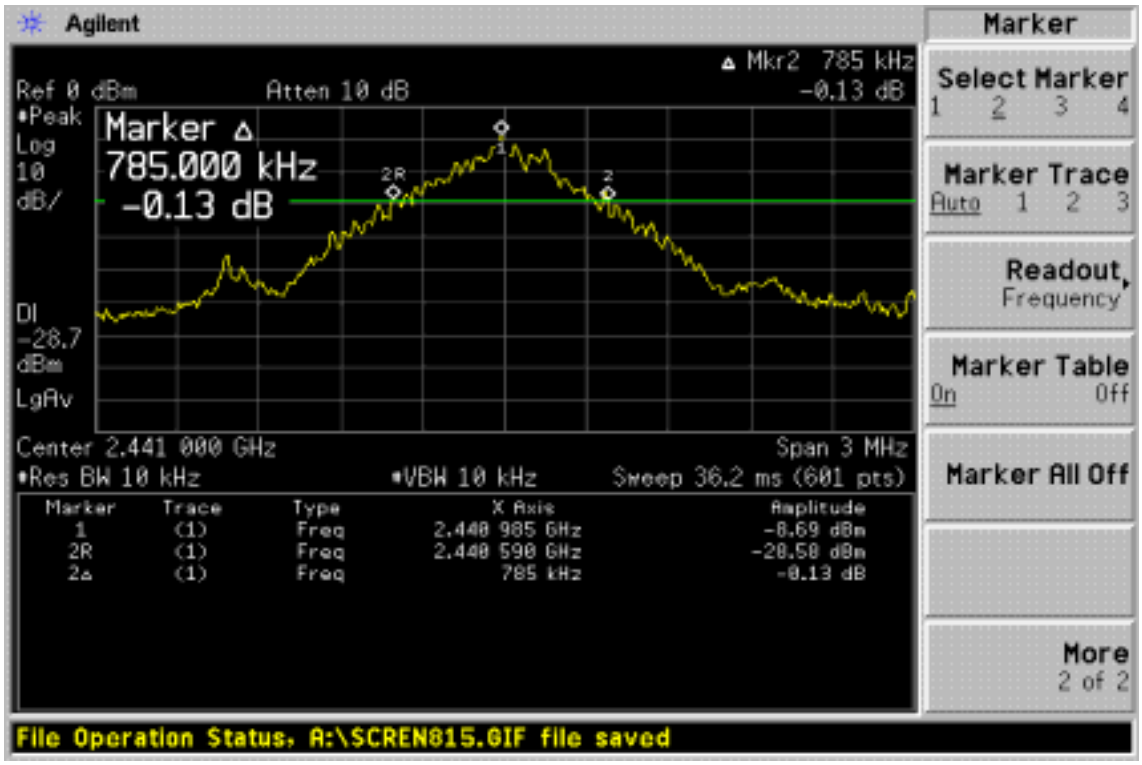
20dB Band Width Test Data CH-Low



20dB Band Width Test Data CH-Mid



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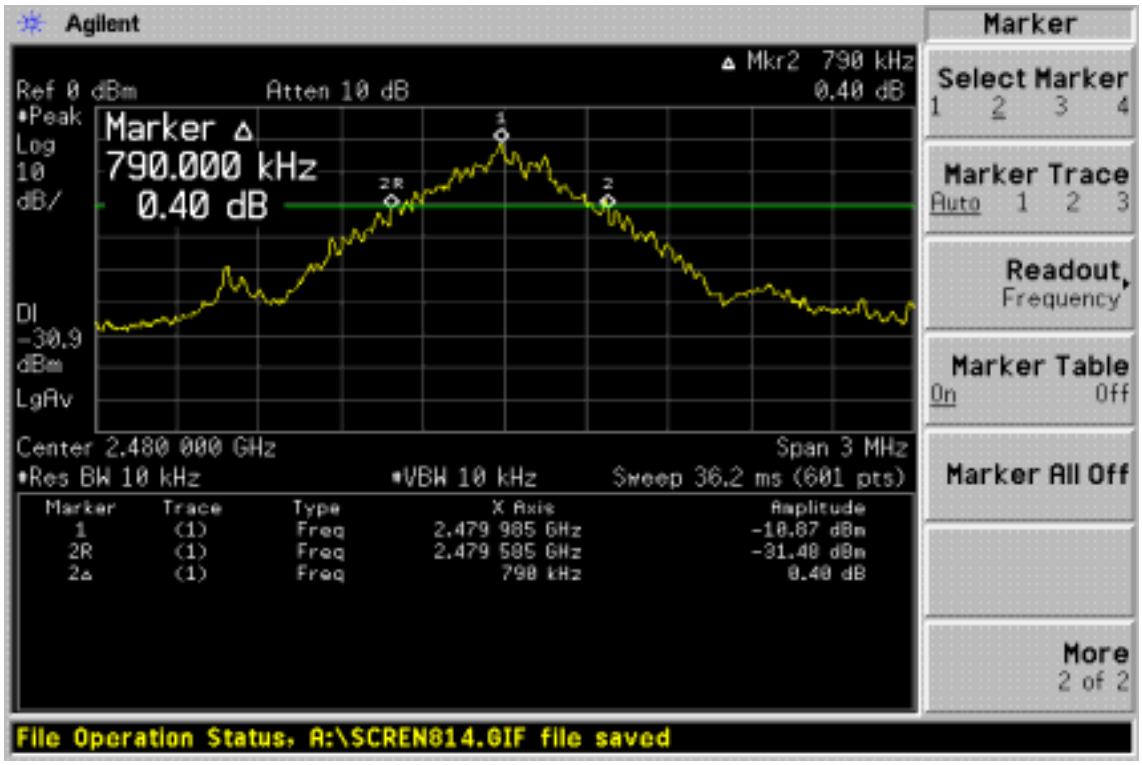
20dB Band Width Test Data CH-High



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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 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=30MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.488GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.
7. Radiated Emission refer to section 9.

8.3 Measurement Result

Refer to attach spectrum analyzer data chart.

8.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	05/27/2004	05/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

Note: Measurement Equipment for radiated emission refer to section 9.

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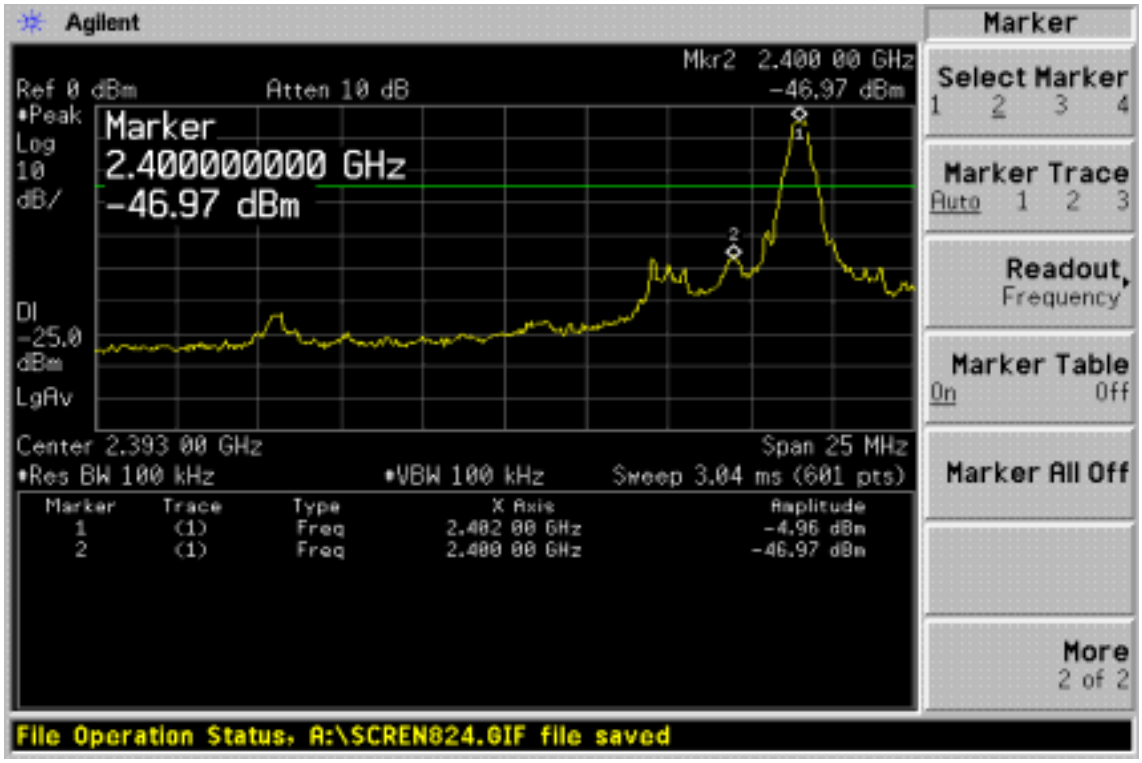
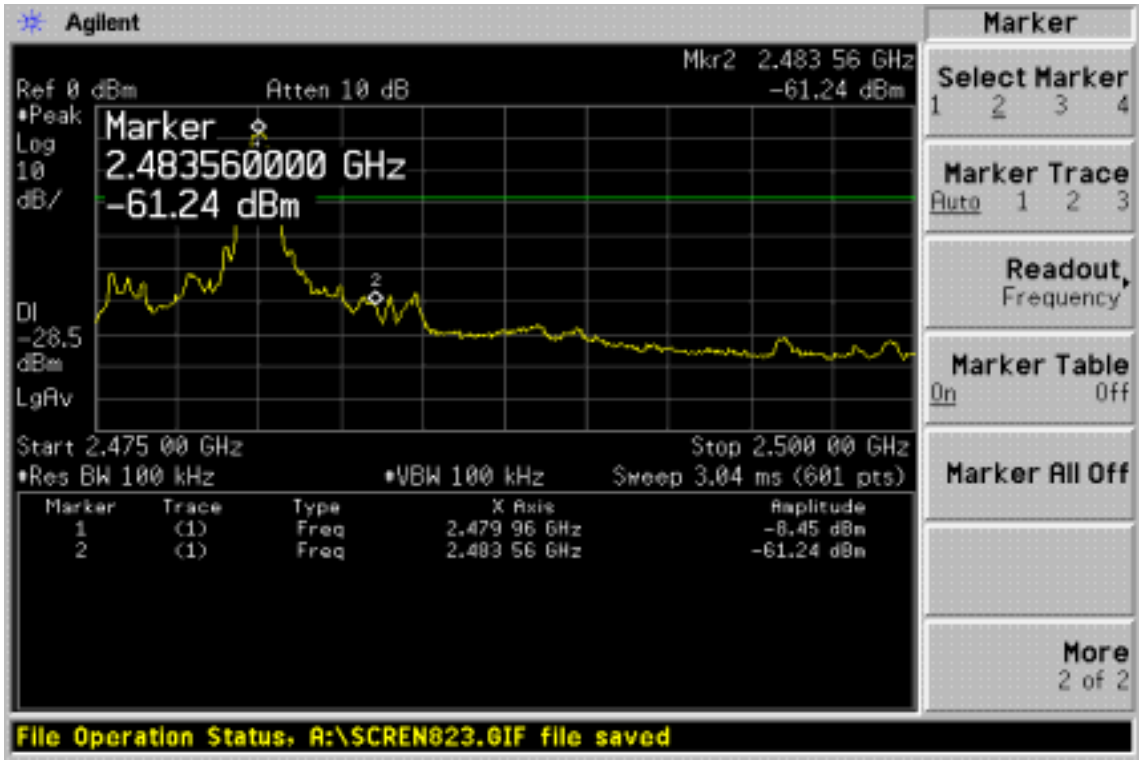
Conducted Emission: Test Data CH-Low



Conducted Emission: Test Data CH-High



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Radiated Emission:

Operation Mode	TX CH Low	Test Date	Sep. 01, 2004
Fundamental Frequency	2402 MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver.
Humidity	60 %		

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)	Remark
2393.5	---		---	---		74.00	54.00	---	Peak

Operation Mode	TX CH Low	Test Date	Sep. 01, 2004
Fundamental Frequency	2402 MHz	Test By	Sky
Temperature	25 ℃	Pol	Hor.
Humidity	60 %		

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)	Remark
2393.5	---		---	---		74.00	54.00	---	Peak

Remark：

(1) 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.

(2) 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。

(3) Spectrum Peak Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.

(4) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Emission:

Operation Mode	TX CH High	Test Date	Sep. 01, 2004
Fundamental Frequency	2480 MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver.
Humidity	60 %		

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)	Remark
2483.5	---		---	---		74.00	54.00	---	Peak

Operation Mode	TX CH High	Test Date	Sep. 01, 2004
Fundamental Frequency	2480 MHz	Test By	Sky
Temperature	25 ℃	Pol	Hor.
Humidity	60 %		

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)	Remark
2483.5	---		---	---		74.00	54.00	---	Peak

Remark：

(1) 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.

(2) 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。

(3) Spectrum Peak Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.

(4) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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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). 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 conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-2001.
2. The EUT was plug-in the AC/DC power adaptor. The EUT was placed on the center of the back edge on the test table. The rear of the EUTwas placed flushed with the rear of the table-top.
3. The spacing between the peripherals was 10 centimeters.
4. External I/O cables were draped along the edge of the test table and bundle when necessary.

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.

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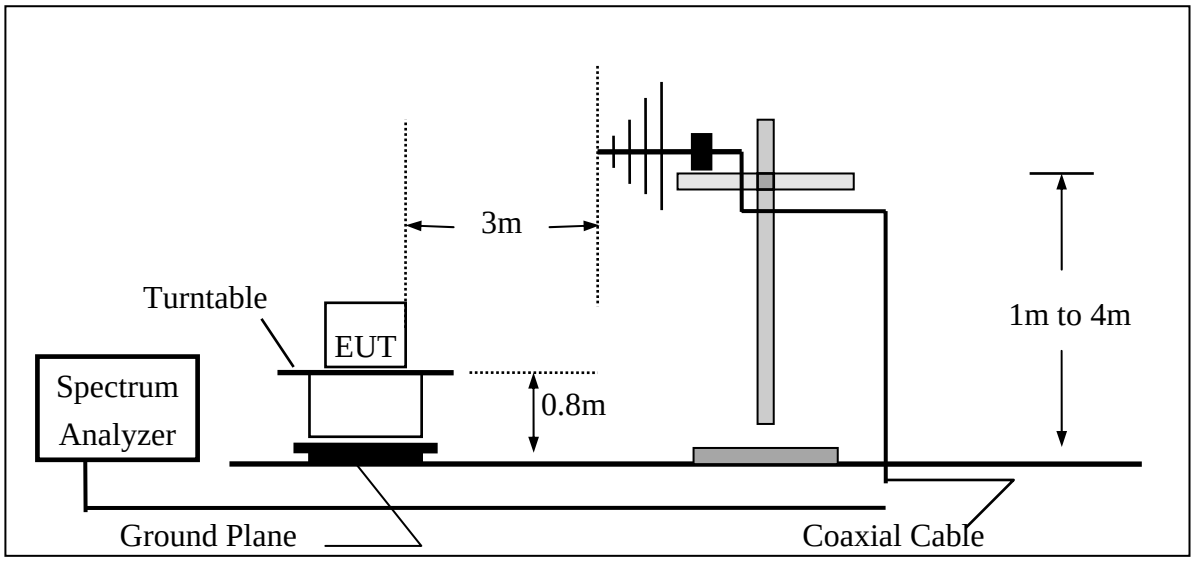
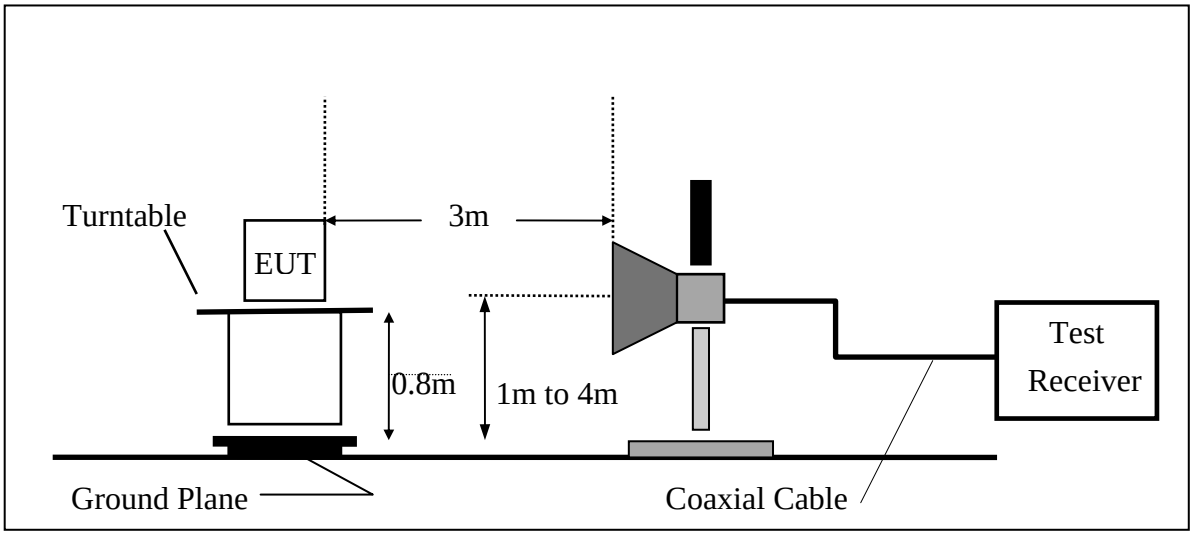
9.4 Test SET-UP (Block Diagram of Configuration)

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



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



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9.5 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	08/27/2004	08/27/2005
Bilog Antenna	SCHWAZBECK	VULB9163	152	06/03/2004	06/02/2005
Horn antenna	Schwarzbeck	BBHA 9120D	309/320	08/16/2004	08/15/2005
Horn antenna	Schwarzbeck	BBHA 9170	184/185	07/04/2004	07/03/2005
Pre-Amplifier	HP	8447D	2944A09469	07/19/2003	07/18/2005
Pre-Amplifier	HP	8494B	3008A00578	02/26/2004	02/25/2005
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	10/09/2003	10/08/2004
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	10/09/2003	10/08/2004
Site NSA	SGS	966 chamber	N/A	11/17/2003	11/16/2004

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.

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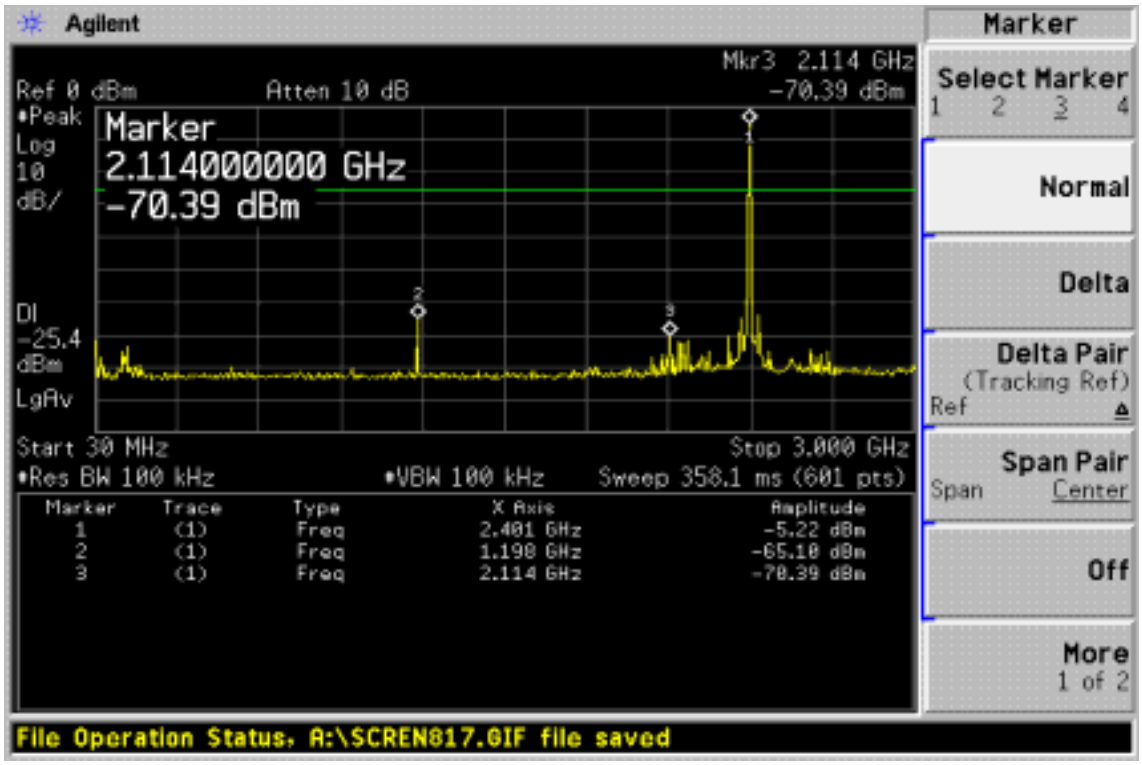
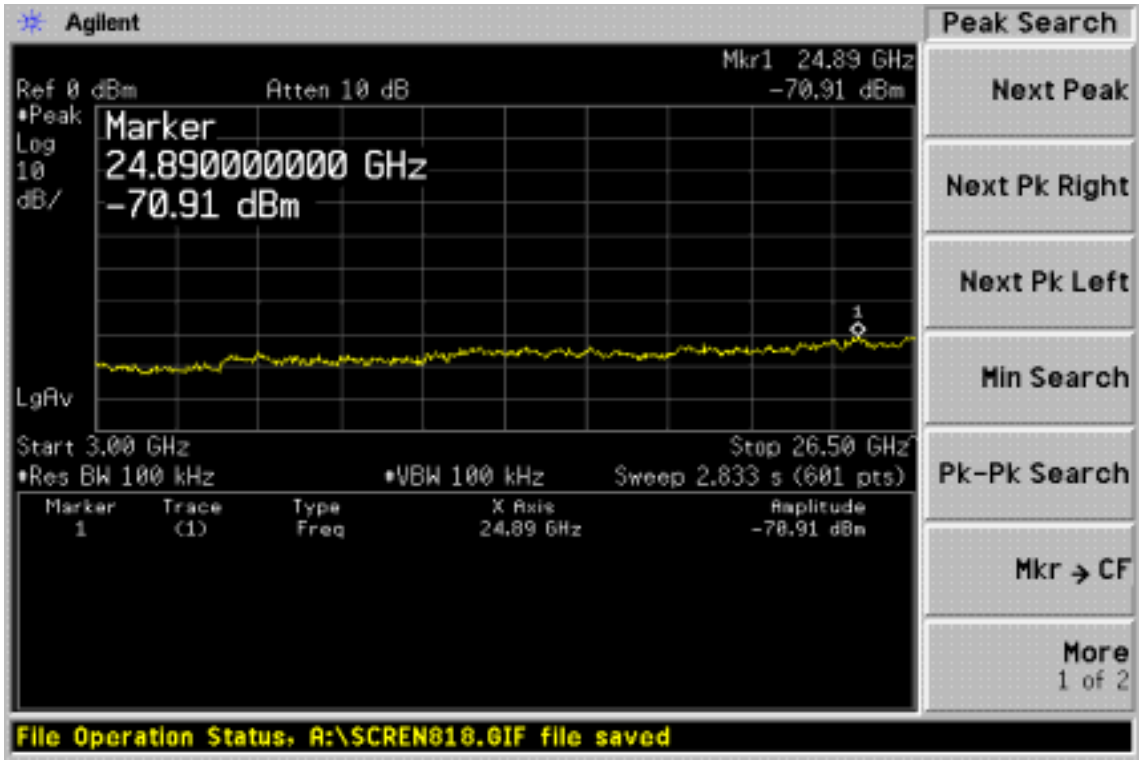
Conducted Spurious Emission Measurement Result

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz



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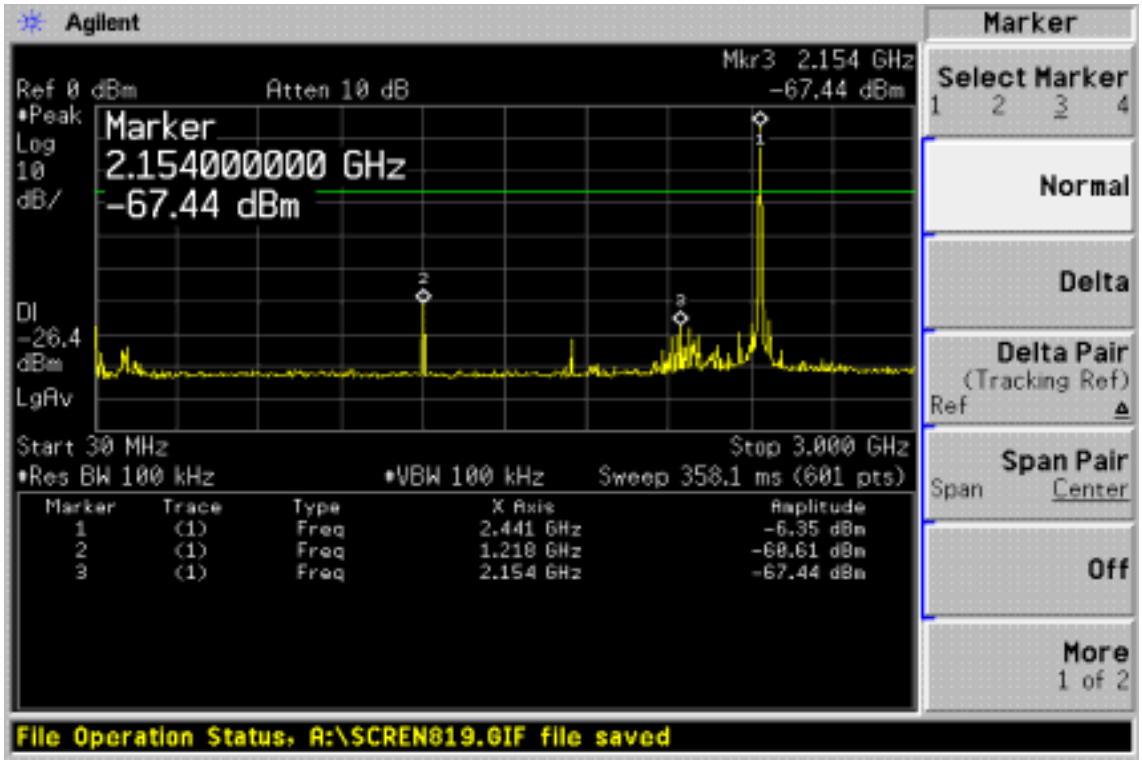
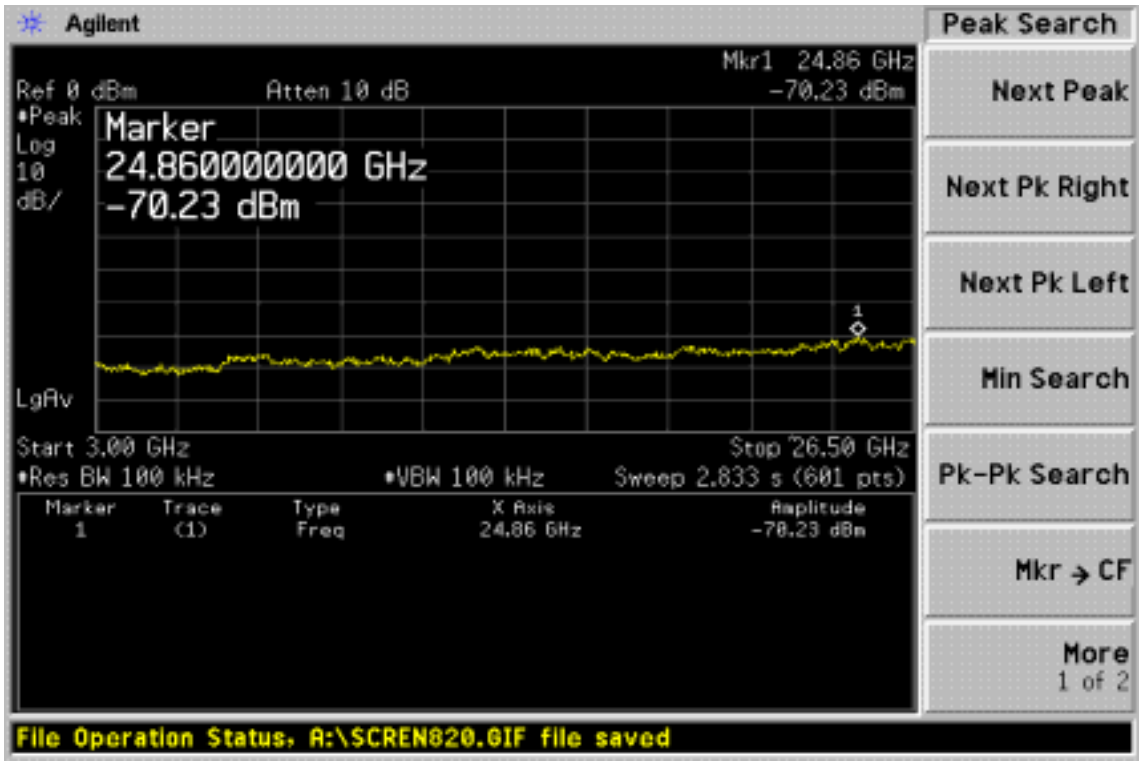
Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz



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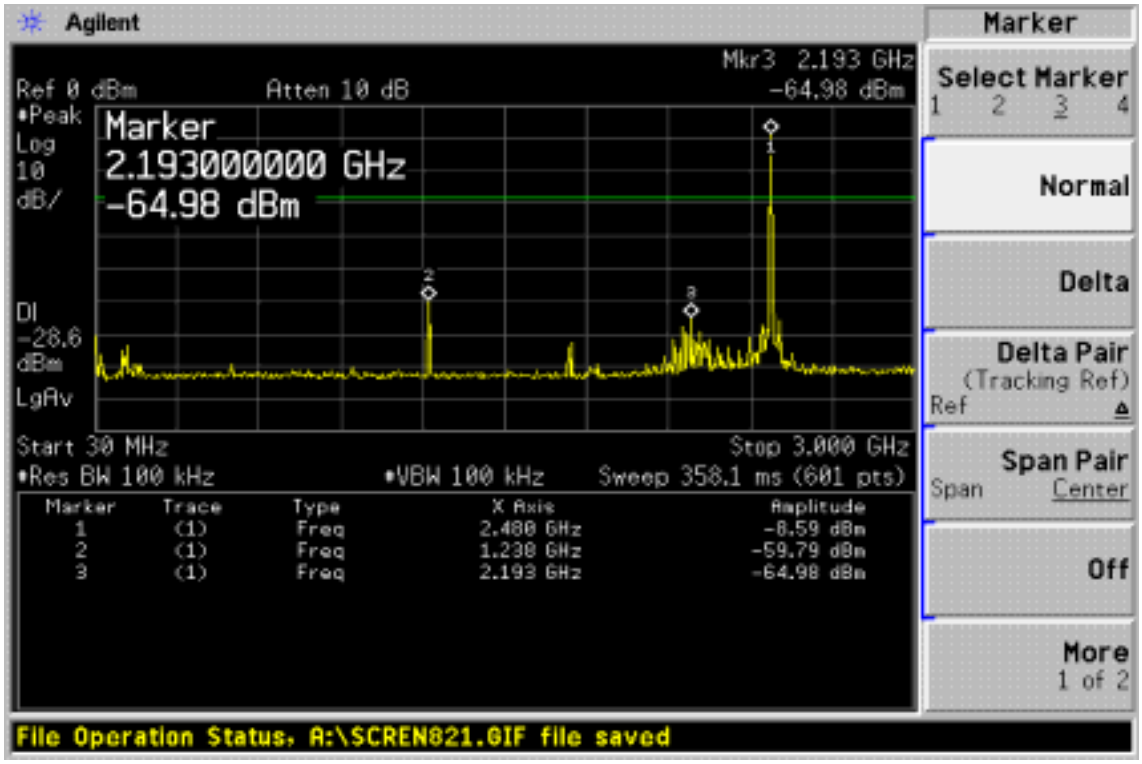
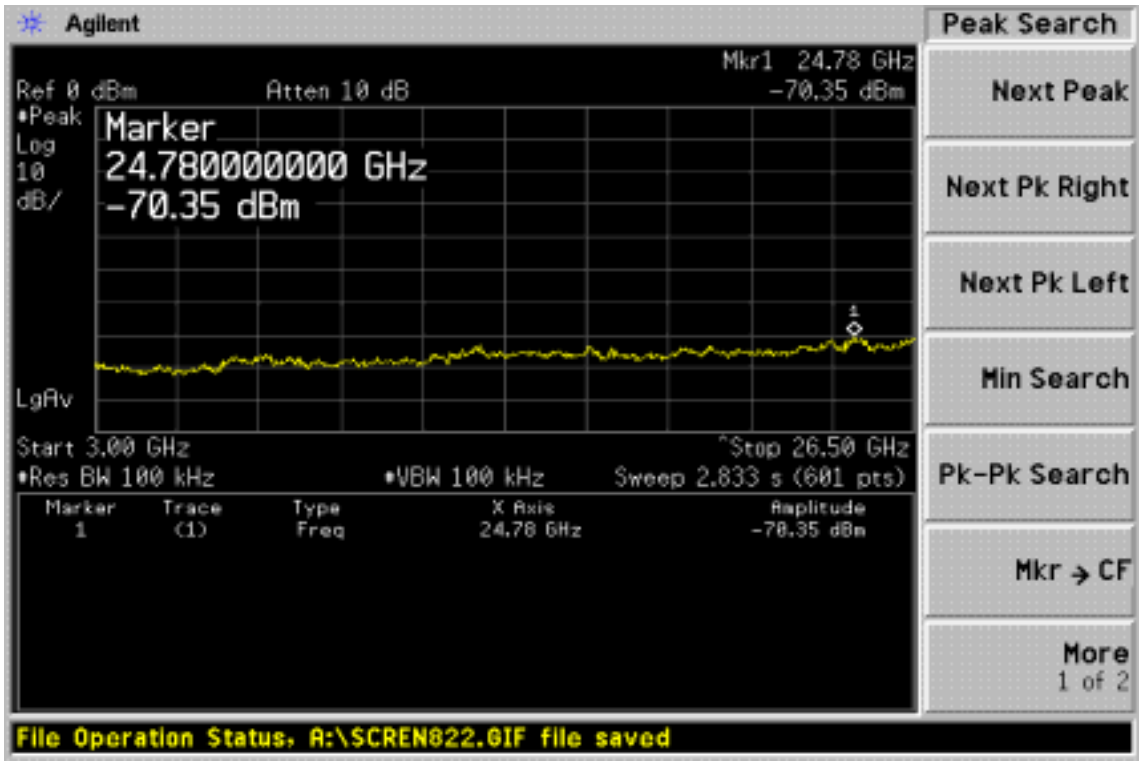
Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Low	Test Date	Sep. 01, 2004
Fundamental Frequency	2402MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver./Hor
Humidity	63 %		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
43.58	V	Peak	42.91	-14.64	28.27	40.00	-11.73
67.83	V	Peak	46.6	-15.88	30.72	40.00	-9.28
143.49	V	Peak	38.05	-13.68	24.37	43.50	-19.13
159.98	V	Peak	38.09	-14.28	23.81	43.50	-19.69
191.99	V	Peak	36.13	-16.08	20.05	43.50	-23.45
201.69	V	Peak	36.36	-16.63	19.73	43.50	-23.77
65.89	H	Peak	41.93	-15.35	26.58	40.00	-13.42
75.59	H	Peak	45.43	-17.66	27.77	40.00	-12.23
143.49	H	Peak	43.93	-13.68	30.25	43.50	-13.25
159.98	H	Peak	44.47	-14.28	30.19	43.50	-13.31
177.44	H	Peak	38.66	-15.06	23.6	43.50	-19.90
191.99	H	Peak	35.75	-16.08	19.67	43.50	-23.83

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/QP 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.

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Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Mid	Test Date	Sep. 01, 2004
Fundamental Frequency	2441MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver./Hor
Humidity	63 %		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
41.64	V	Peak	41.73	-14.67	27.06	40.00	-12.94
67.83	V	Peak	45.41	-15.88	29.53	40.00	-10.47
143.49	V	Peak	43.27	-13.68	29.59	43.50	-13.91
159.98	V	Peak	41.09	-14.28	26.81	43.50	-16.69
191.99	V	Peak	36.46	-16.08	20.38	43.50	-23.12
235.64	V	Peak	31.75	-15.68	16.07	46.00	-29.93
65.89	H	Peak	39.74	-15.35	24.39	40.00	-15.61
75.59	H	Peak	42.39	-17.66	24.73	40.00	-15.27
143.49	H	Peak	43.55	-13.68	29.87	43.50	-13.63
159.98	H	Peak	44.30	-14.28	30.02	43.50	-13.48
177.44	H	Peak	38.78	-15.06	23.72	43.50	-19.78
191.99	H	Peak	35.81	-16.08	19.73	43.50	-23.77

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/QP 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.

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Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH High	Test Date	Sep. 01, 2004
Fundamental Frequency	2480MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver./Hor
Humidity	63 %		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
41.64	V	Peak	41.51	-14.67	26.84	40.00	-13.16
67.83	V	Peak	46.10	-15.88	30.22	40.00	-9.78
143.49	V	Peak	39.33	-13.68	25.65	43.50	-17.85
159.98	V	Peak	37.80	-14.28	23.52	43.50	-19.98
191.99	V	Peak	36.42	-16.08	20.34	43.50	-23.16
201.69	V	Peak	35.19	-16.63	18.56	43.50	-24.94
67.83	H	Peak	40.64	-15.88	24.76	40.00	-15.24
75.59	H	Peak	42.83	-17.66	25.17	40.00	-14.83
143.49	H	Peak	43.12	-13.68	29.44	43.50	-14.06
159.98	H	Peak	44.69	-14.28	30.41	43.50	-13.09
167.74	H	Peak	37.93	-14.63	23.3	43.50	-20.20
177.44	H	Peak	38.70	-15.06	23.64	43.50	-19.86

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/QP 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.

(5) X Mode means the EUT in stand-up position; Y Mode means the EUT in lie-on position

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Low	Test Date	Sep. 01, 2004
Fundamental Frequency	2402 MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver.
Humidity	63 %		

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)
4796.0	40.29	--	2.95	43.24	--	74.00	54.00	-10.76
4804.0	----							
7206.0	----							
9608.0	----							
12010.0	----							
14412.0	----							
16814.0	----							
19216.0	----							
21618.0	----							
24020.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Low	Test Date	Sep. 01, 2004
Fundamental Frequency	2402 MHz	Test By	Sky
Temperature	25 ℃	Pol	Hor
Humidity	63 %		

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)
1188.5	49.43	--	-8.65	40.78	--	74.00	54.00	-13.22
4796.0	39.76	--	2.95	42.71	--	74.00	54.00	-11.29
4804.0	----							
7206.0	----							
9608.0	----							
12010.0	----							
14412.0	----							
16814.0	----							
19216.0	----							
21618.0	----							
24020.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	Sep. 01, 2004
Fundamental Frequency	2441 MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver
Humidity	63 %		

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)
4880.5	38.06	--	3.18	41.24	--	74.00	54.00	-12.76
4882.0	----							
7323.0	----							
9764.0	----							
12205.0	----							
14646.0	----							
17087.0	----							
19528.0	----							
21969.0	----							
24410.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	Sep. 01, 2004
Fundamental Frequency	2441 MHz	Test By	Sky
Temperature	25 ℃	Pol	Hor
Humidity	63 %		

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)
1221.0	49.39	--	-8.44	40.95	--	74.00	54.00	-13.05
4882.0	----							
7323.0	----							
9764.0	----							
12205.0	----							
14646.0	----							
17087.0	----							
19528.0	----							
21969.0	----							
24410.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	Sep. 01, 2004
Fundamental Frequency	2480 MHz	Test By	Sky
Temperature	25 ℃	Pol	Ver
Humidity	63 %		

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)
---	---	---	---	---	---	---	---	---
4960.0	----							
7440.0	----							
9920.0	----							
12400.0	----							
14880.0	----							
17360.0	----							
19840.0	----							
22320.0	----							
24800.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	Sep. 01, 2004
Fundamental Frequency	2480 MHz	Test By	Sky
Temperature	25 ℃	Pol	Hor
Humidity	63 %		

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)
1240.5	49.28	--	-8.42	40.86	--	74.00	54.00	-13.14
4958.5	36.76	--	3.40	40.16	--	74.00	54.00	-13.84
4960.0	----							
7440.0	----							
9920.0	----							
12400.0	----							
14880.0	----							
17360.0	----							
19840.0	----							
22320.0	----							
24800.0	----							

Remark：

(1) Measuring frequencies from 1GHz 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.

(5) Spectrum AV Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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10. FREQUENCY SEPARATION

10.1 Standard Applicable

According to §15.247(a), 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=100KHz, Adjust Span to 5 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

10.3 Measurement Result

Channel separation	Limit	Result
MHz	kHz	
1.013	>=25KHz/ 20 dB bandwidth	PASS

10.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	05/27/2004	05/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

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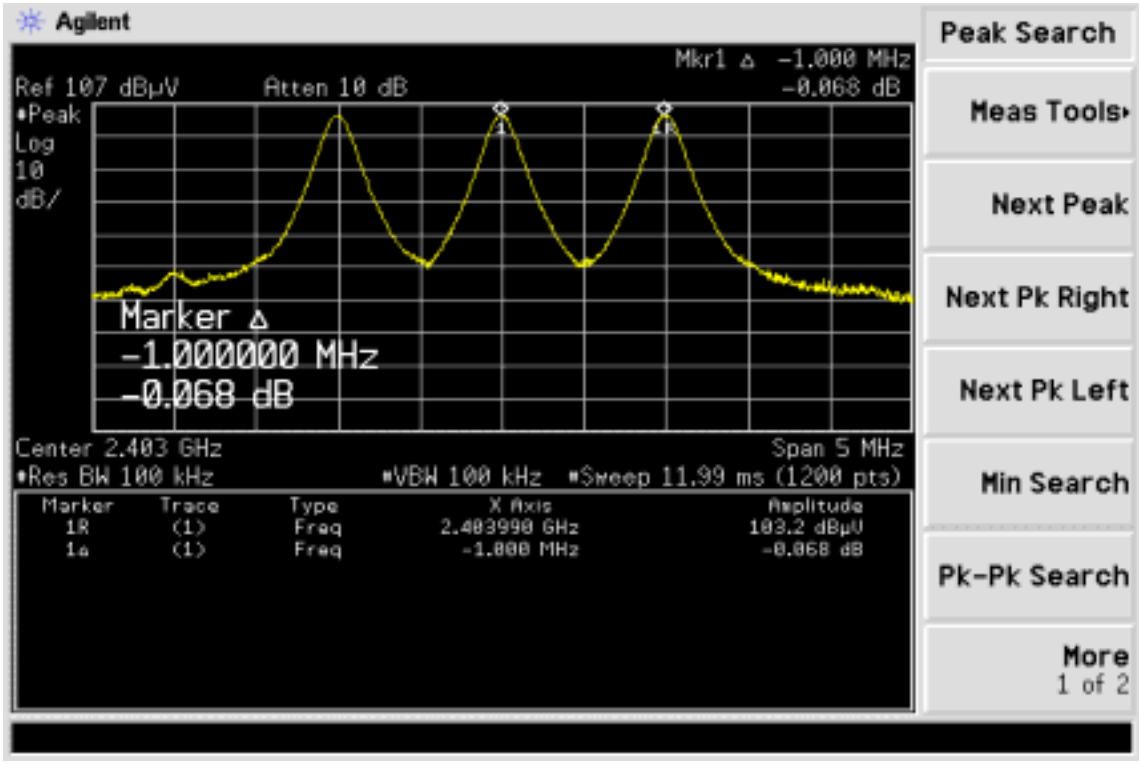
Frequency Separation Test Data



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11. NUMBER OF HOPPING FREQUENCY

11.1. Standard Applicable

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz and 5725MHz – 5850MHz bands shall use at least 15 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
	15	79	Pass

11.4. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	08/27/2004	08/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

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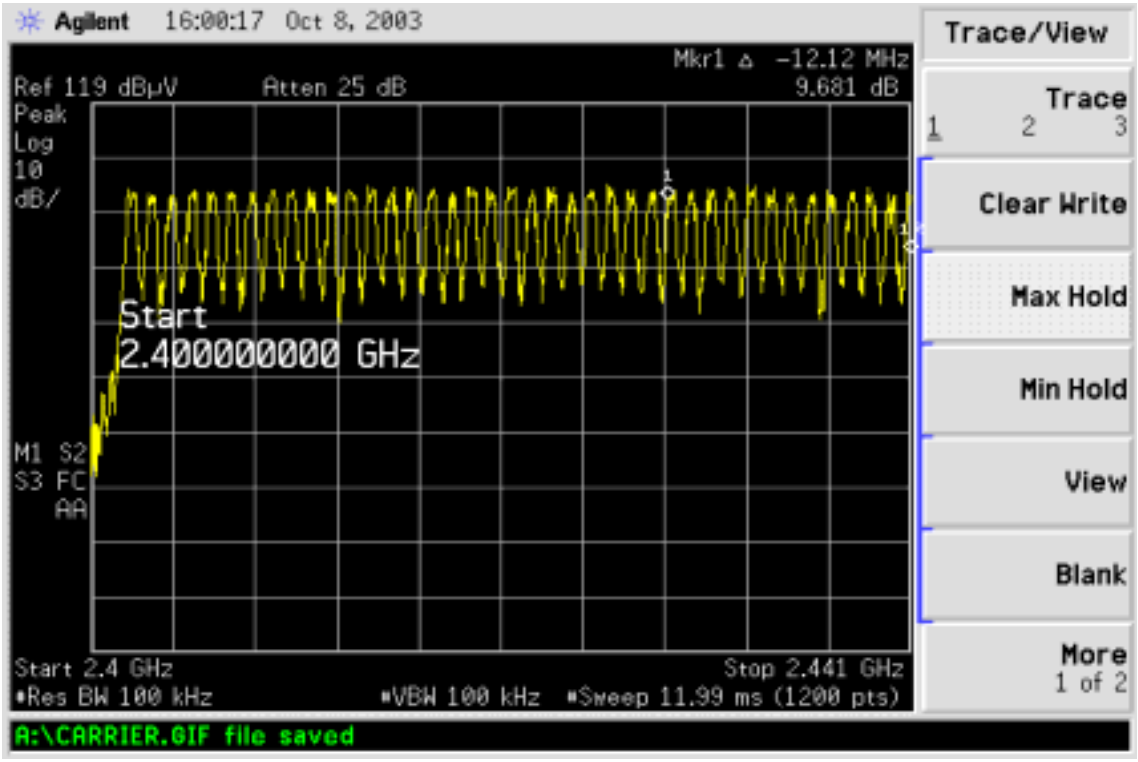
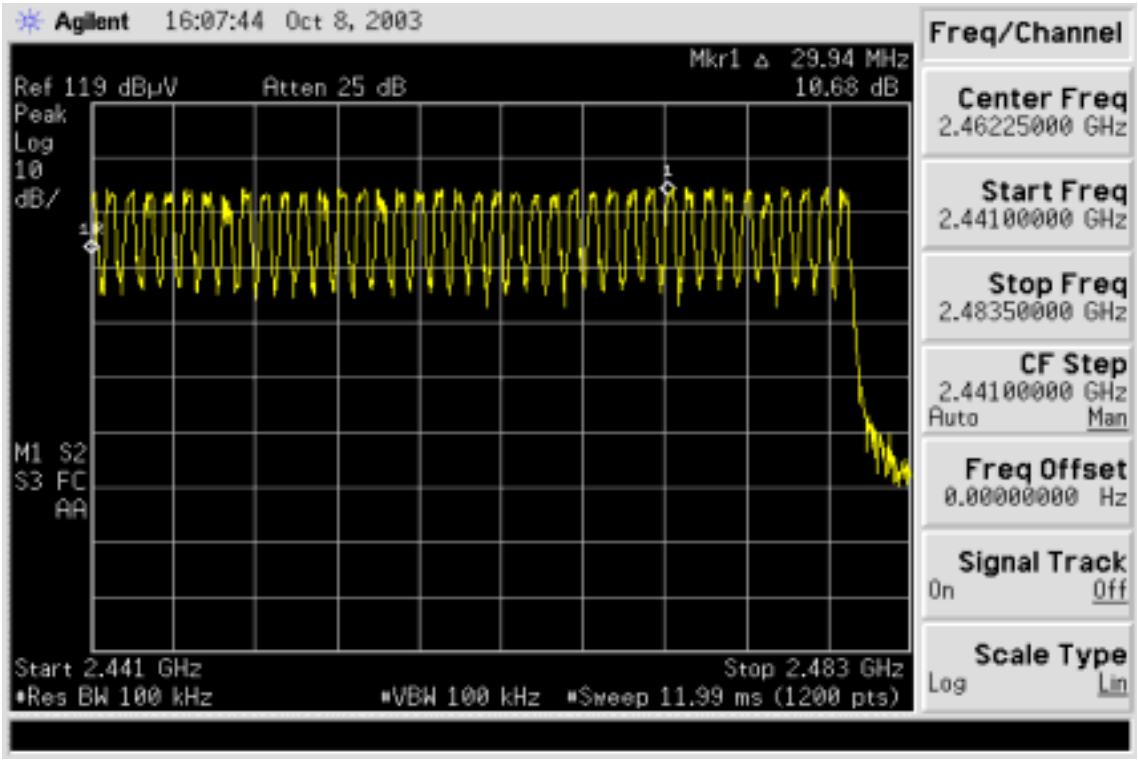
Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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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. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel 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 (ms) * 79 = 31.6 (s)

CH Low: DH1 time slot = 0.405 (ms) * (1600/(2*79)) * 31.6 = 129.6 (ms)

DH3 time slot = 1.675 (ms) * (1600/(4*79)) * 31.6 = 268 (ms)

DH5 time slot = 2.295 (ms) * (1600/(6*79)) * 31.6 = 312 (ms)

CH Mid: DH1 time slot = 0.405 (ms) * (1600/(2*79)) * 31.6 = 129.6 (ms)

DH3 time slot = 1.675 (ms) * (1600/(4*79)) * 31.6 = 268 (ms)

DH5 time slot = 2.906 (ms) * (1600/(6*79)) * 31.6 = 309.97 (ms)

CH High: DH1 time slot = 0.416 (ms) * (1600/(2*79)) * 31.6 = 129.6 (ms)

DH3 time slot = 1.662 (ms) * (1600/(4*79)) * 31.6 = 265.92 (ms)

DH5 time slot = 2.906 (ms) * (1600/(6*79)) * 31.6 = 309.97 (ms)

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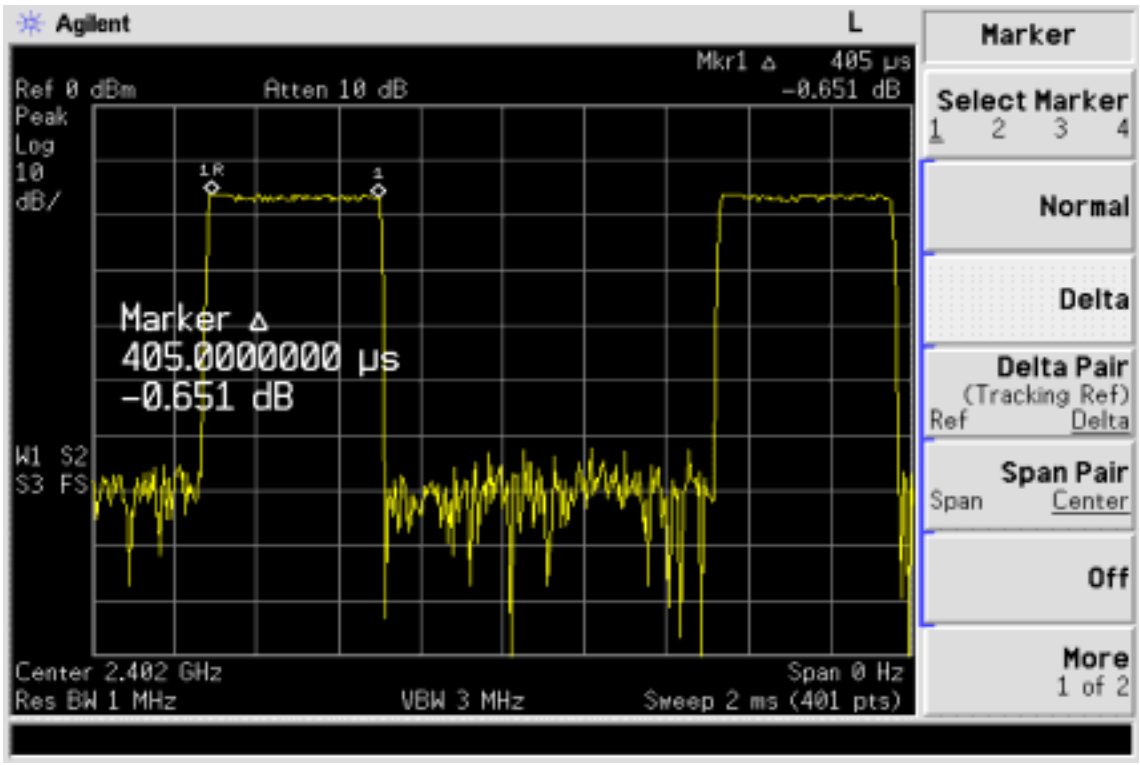
12.4. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	08/27/2004	08/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

Dwell Time Test Data

CH-Low

DH1



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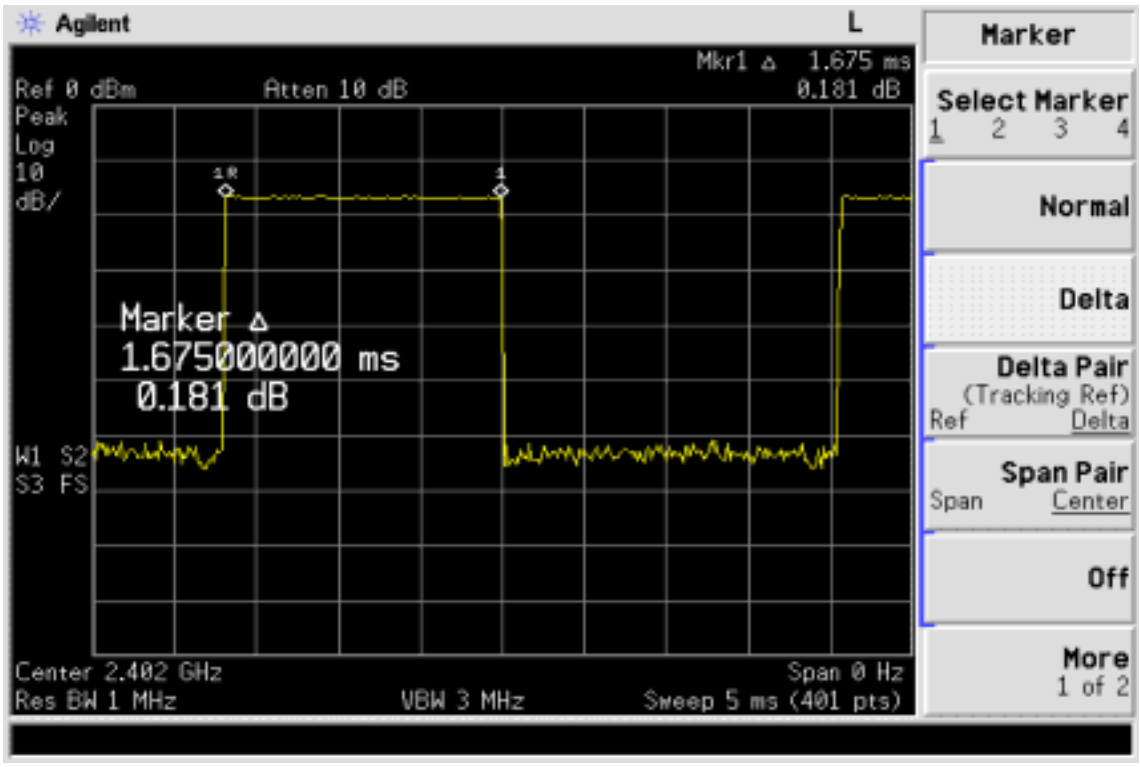
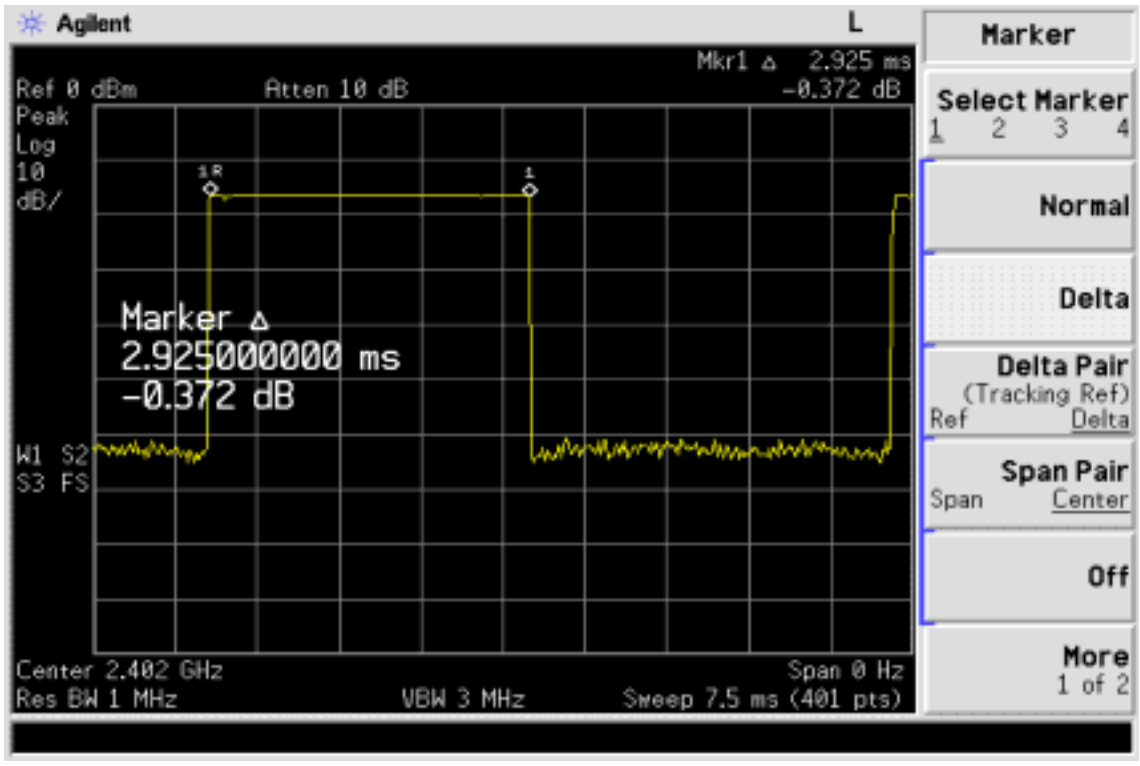
DH3



DH5



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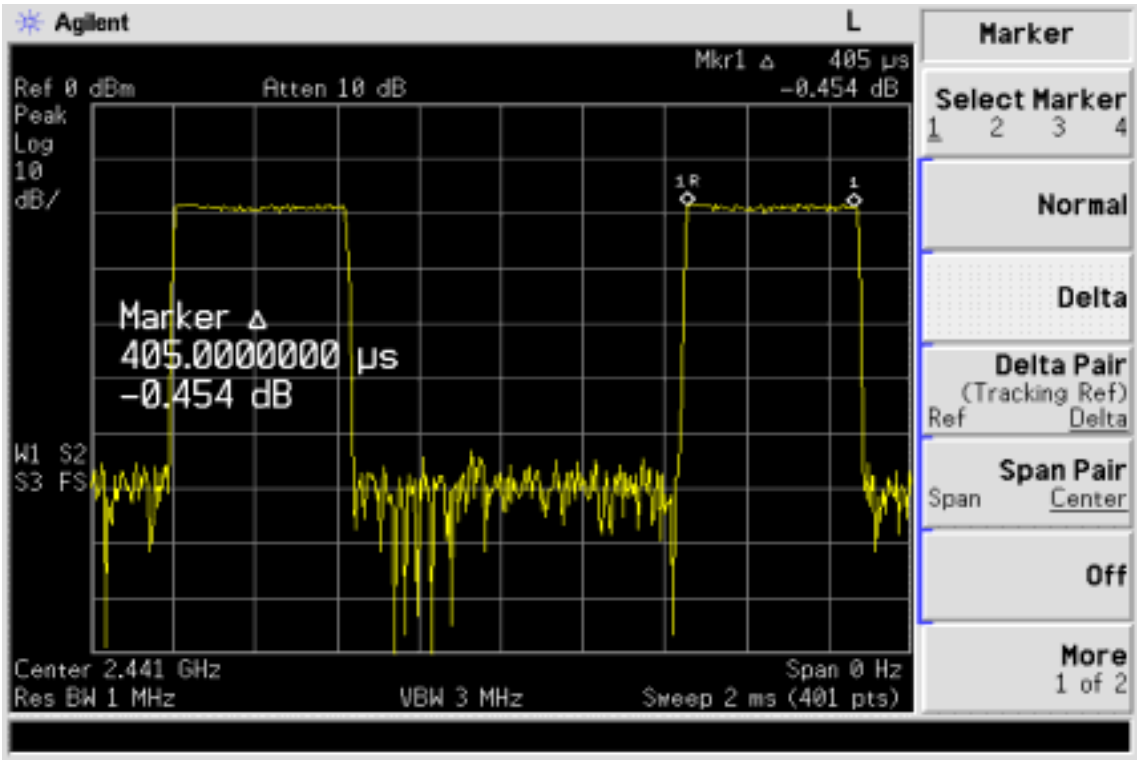
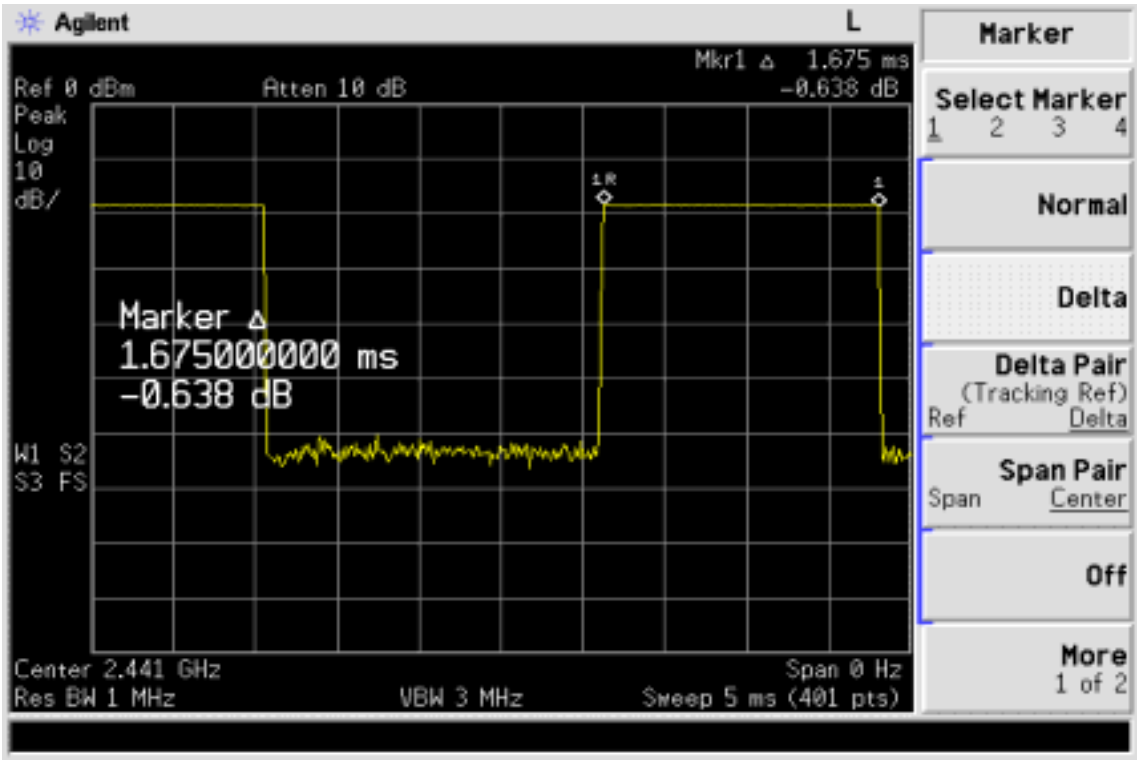
CH-Mid

DH1



DH3



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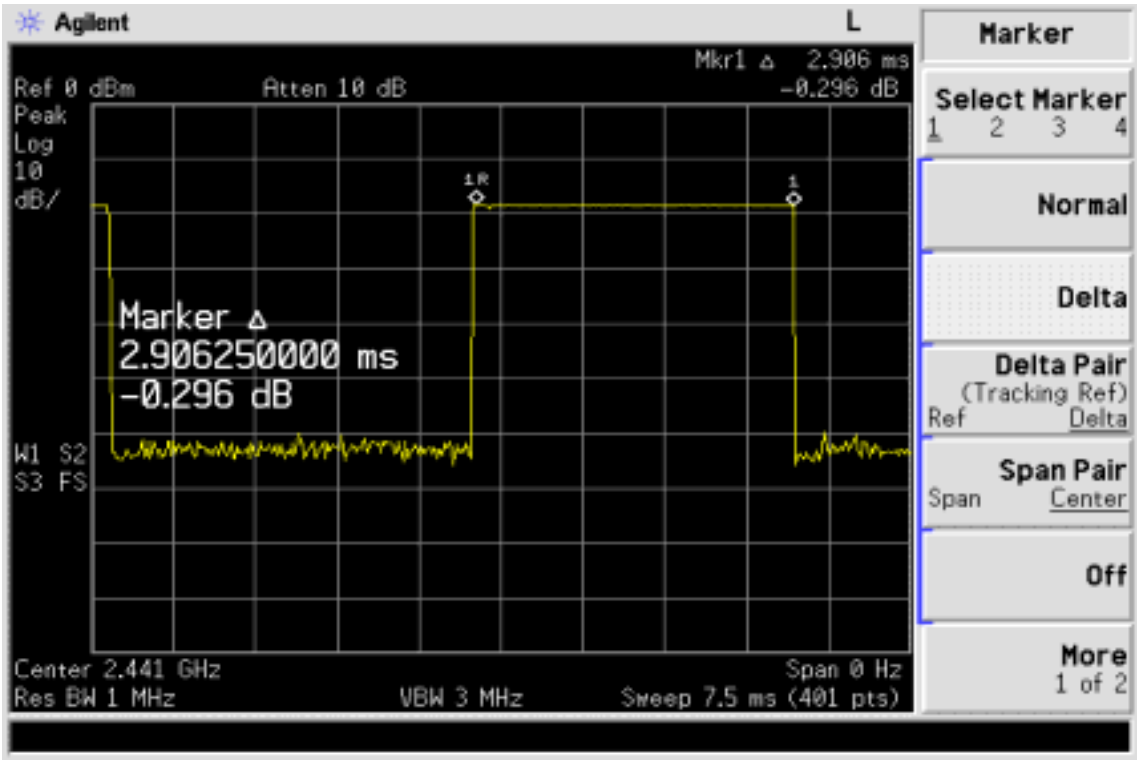
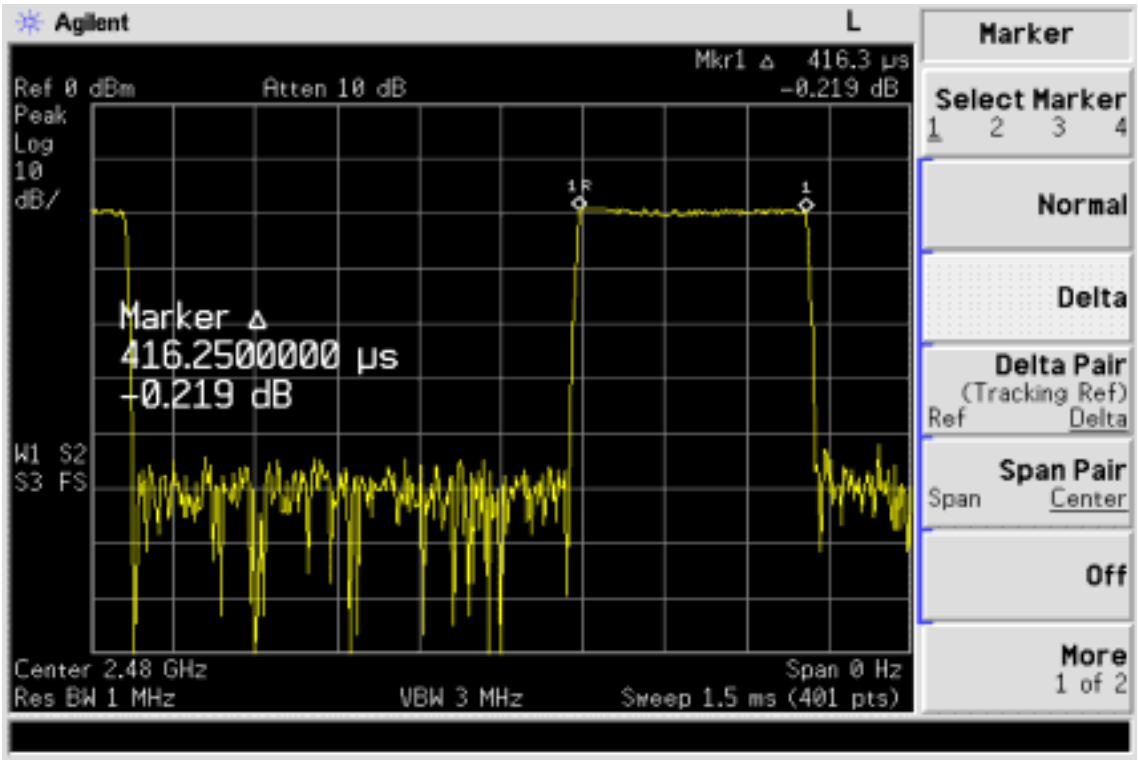
DH5



CH-High

DH1



DH3

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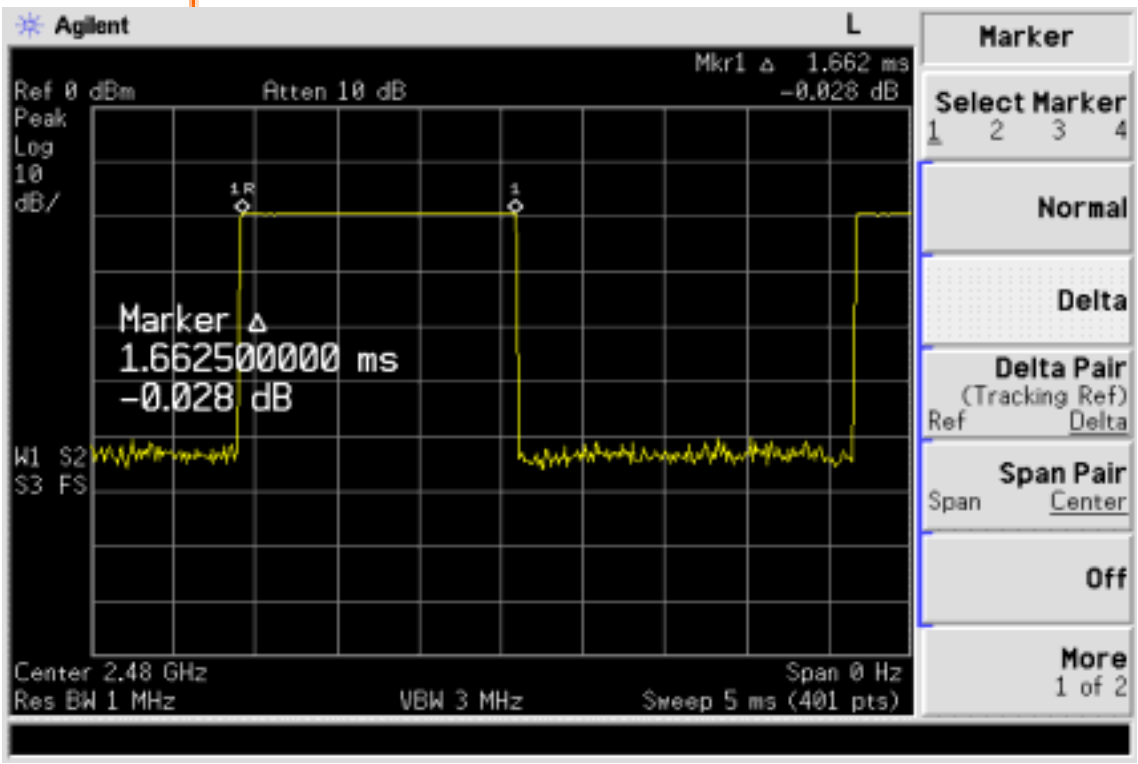
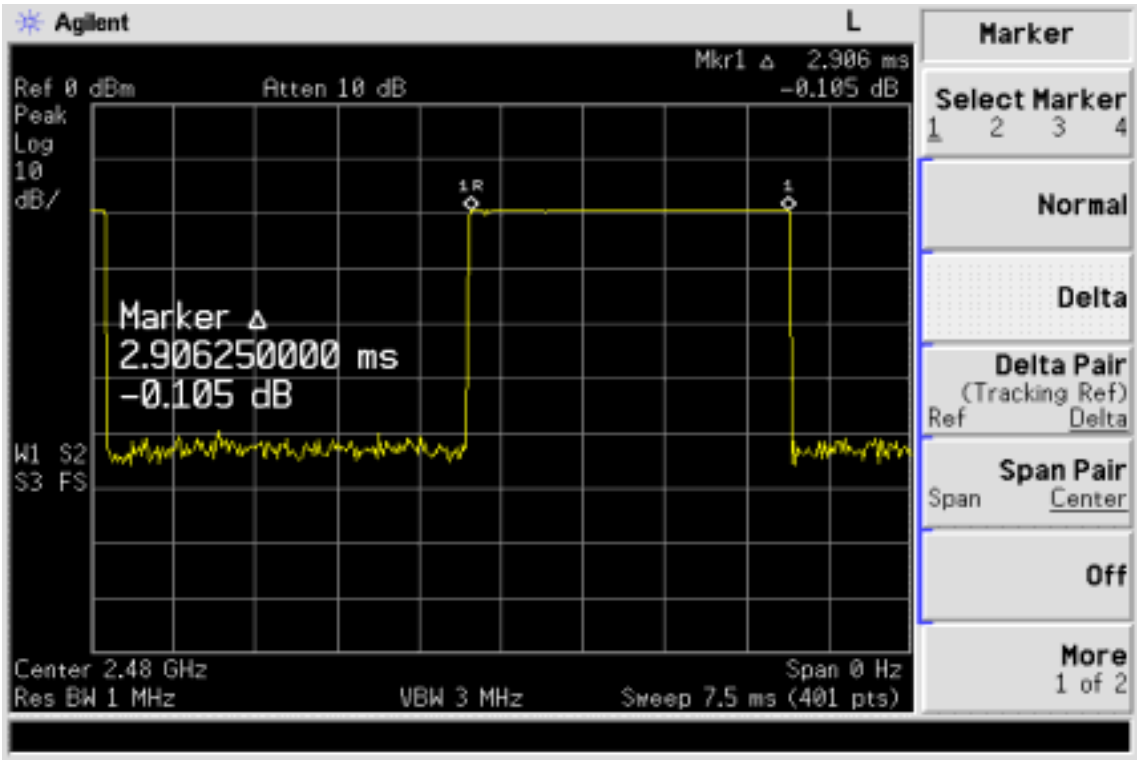


DH5



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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	-14.13	4.00	-10.13	8
Mid	-15.51	4.00	-11.51	8
High	-17.43	4.00	-13.43	8

13.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	05/27/2004	05/26/2005
Spectrum Analyzer	Agilent	E7405A	US41160416	05/27/2004	05/26/2005
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	N/A	N/A
Attenuator	Mini-Circult	BW-S6W5	N/A	10/07/2003	10/06/2004

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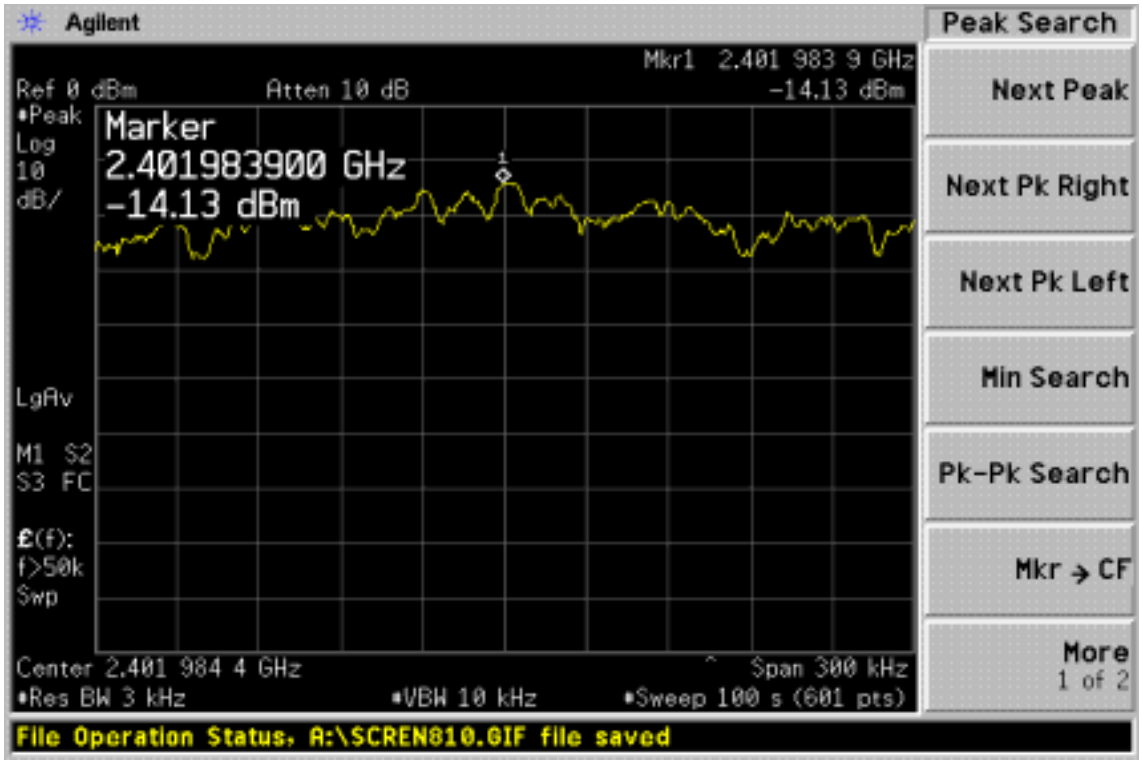
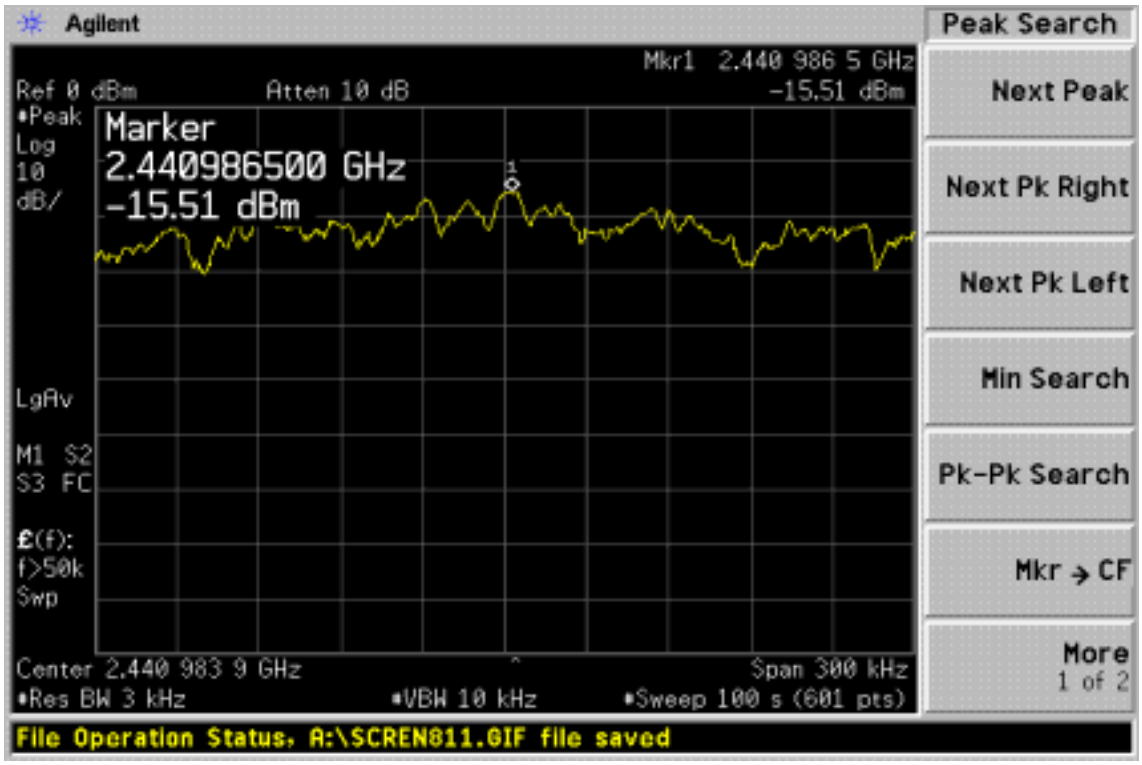
Power Spectral Density Test Plot (CH-Low)



Power Spectral Density Test Plot (CH-Mid)



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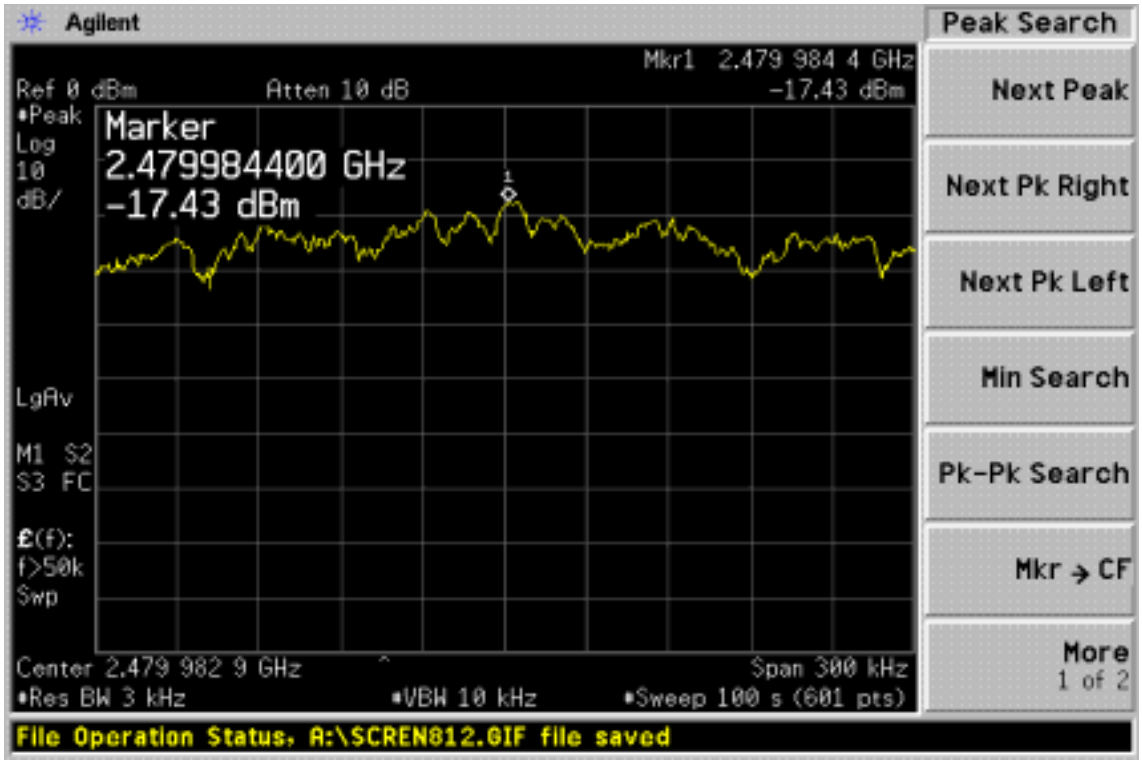
Power Spectral Density Test Plot (CH-High)



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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 gins of antenna used for transmitting is 1.5 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

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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 is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

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MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	-1.13	(dBm)
Maximum peak output power at antenna input terminal:	0.770903	(mW)
Antenna gain (typical):	1.5	(dBi)
Maximum antenna gain:	1.412538	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.00022	(mW/cm^2)
Measurement Result:		
The predicted power density level at 20 cm is	0.000217	(mW/cm^2)
This is below the uncontrolled exposure limit of 1 mW/cm	2402	MHz

15.2 Measurement Result

The predicted power density level at 20 cm is 0.000217 mW/cm^2. This is below the uncontrolled exposure limit of 1 mW/cm^2 at 2402MHz.

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