SK TECH CO., LTD.

Certificate of Compliance

Test Report No.:	**SKTTRT-040525-001**		
NVLAP CODE:	**200220-0**		
Applicant:	**SEECODE Co., Ltd.**		
Applicant Address:	4th floor, Amin Bldg., 110-1, Yangjae-dong, Seocho-gu, Seoul, 137-891 Korea		
Device Under Test:	**VISOR (Bluetooth Handsfree Carkit)**		
FCC ID:	**RPRSFK404**	**Model No.:**	**SFK404**
Receipt No.:	SKTEU04-0313	**Date of receipt:**	May 14, 2004
Date of Issue:	May 25, 2004		
Location of Testing:	**SK TECH CO., LTD.** 820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea		
Test Procedure:	**ANSI C63.4 / 2001**		
Test Specification:	**47CFR, Part 15 Subpart C / December 08, 2003**		
Equipment Class:	**DSS - Part 15 Spread Spectrum Transmitter**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Jong-Soo, Yoon*

05/25/2004

Signature *Date*

Approved by: *Jae-Kyung, Bae*

05/25/2004

Signature *Date*

Other Aspects:	
Abbreviations:	**· OK, Pass = passed · Fail = failed · N/A = not applicable**

☞
- **This test report is not permitted to copy partly without our permission.**
- **This test result is dependent on only equipment to be used.**
- **This test result is based on a single evaluation of one sample of the above mentioned.**
- **This test report must not be used to claim product endorsement by NVLAP or any agency of the U.S Government.**
- **We certify that this test report has been based on the measurement standards that is traceable to the national or International standards.**

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NVLAP Lab. Code: 200220-0

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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247 for Spread Spectrum Transmitter. The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by SK Tech Co., Ltd. and were made under Chief Engineer's supervision.
We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

SK TECH Co., Ltd.

2.1 Location

820-2, Wolmoon Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.
This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200220-0 and DATech for DAR-Registration No.: TTI-P-G155/97-10

2.2 List of Test and Measurement Instruments

Equipment Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
EMI Test Receiver	Rohde&Schwarz	ESHS 10	862970/019	07, 2004
EMI Test Receiver	Rohde&Schwarz	ESHS 10	835871/002	10, 2004
Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	834549/011	08, 2004
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	836679/018	08, 2004
EMI Test Receiver	Rohde&Schwarz	ESVS 10	825120/013	10, 2004
EMI Test Receiver	Rohde&Schwarz	ESVS 10	834468/008	10, 2004
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	01, 2005
Spectrum Analyzer	Agilent	E4405B	US40520856	07, 2004
DC Power Supply	H.P	6634A	2926A-0178	06, 2004
Amplifier	H.P	8447F	3113A05153	10, 2004
Amplifier	H.P	8349B	2644A03250	08, 2004
Signal Generator	H.P	8673G	3128A00422	08, 2004
Vector Signal Generator	Agilent	E4438C	MY42080359	08, 2004
TRILOG broadband antenna	Schwarzbeck	VULB9160	3141	05, 2004
Log Periodic Antenna	Schwarzbeck	UHALP9107	1819	10, 2004
Biconical Antenna	Schwarzbeck	BBA9106	91031626	10, 2004
Horn Antenna	AH Systems	SAS-200/571	304	05, 2005
Horn Antenna	Electro Metrics	EM-6961	6298	08, 2004
Horn Antenna	Electro Metrics	EM-6961	6297	08, 2004
Horn Antenna	Electro Metrics	EM-6961	6297	08, 2004

2.3 Test Date

Date of Application : May 14, 2004

Date of Test : May 14, 2004 ~ May 22, 2004

2.4 Test Environment

See each test item's description.

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The product specification described herein was obtained from the product data sheet or user's manual.

3.1 Rating and Physical Characteristics

Type / Model No.	VISOR (Bluetooth Handsfree Carkit) / SFK404
Power source	DC 4.2V (Li-Ion battery pack), AC/DC adapter, Cigar lighter jack
Local Oscillator or X-Tal	X-Tal: 18.432 MHz, 4 MHz
Transmit Frequency	2402 ~ 2480 MHz (1MHz, 79 channels)
Antenna Type	Integral SMD chip antenna (50Ω, 0dBi)
Type of Modulation	FHSS (GFSK)
RF Output power	< 4dBm
External Ports	DATA Jack for updating: 25pin DSUB type or 5pin USB type DC Charging Jack AC/DC adapter manufactured by Wang Huei Company Limited Model No.: JYCC-074C, AC Input: 100-240V, 50-60Hz, DC output: 5.2V Cigar lighter jack Model No.: NOKIA 8210, DC input: 12V ~ 24V

3.2 Equipment Modifications

None.

3.3 Submitted Documents

Block diagram

Schematic diagram

Antenna Specification

RF Module Specification

Part List

User manual

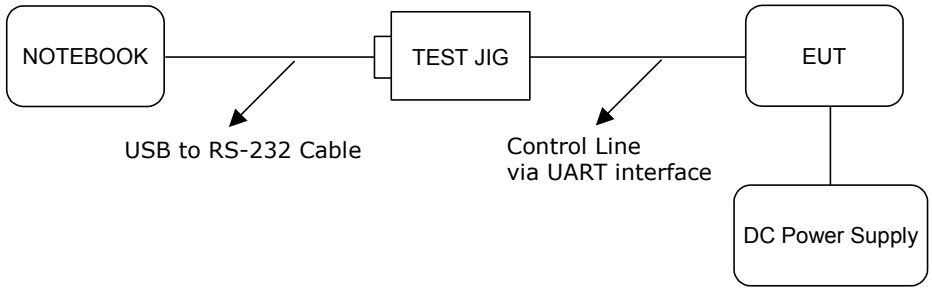
4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode using the TEST JIG provided by the applicant for controlling the EUT via UART interface so that the operating frequency of the EUT could be changed with the frequency hopping turned off.

The EUT was powered from several power sources as follows:

Measurement Item	Power Source
Conducted RF power	DC Power Supply (H.P, Model No. 6634A)
Radiated disturbance	Full charged battery (Model No. 8210LHB)
Conducted disturbance	AC/DC Adapter (Model No. JYCC-074C)



4.2 List of Peripherals

Equipment Type	Manufacture	Model	Cable Description
Notebook	Trigem	Dreambook	1.8m, Shielded, USB to RS-232 Cable
DC Power Supply	H.P	6634A	1.8m, Unshielded Power Line
TEST JIG **	SEECODE	-	0.01m, Unshielded Control Line (RS-232)
BT Transceiver	SEECODE	AIRBridge	USB Dongle, used during the measurement on the spurious conducted emissions

** For control of RF module via UART interface in the EUT.

4.3 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Conducted RF power	± 1.49 dB	±2.98dB
Radiated disturbance	± 2.37 dB	±4.74dB
Conducted disturbance	± 1.47 dB	±2.94dB

5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	CFR 47 Section	Report Section	Test Result
Antenna Requirement	15.203, 15.247(b)	5.1	PASS
Maximum Peak Output Power	15.247(b)	5.2	PASS
Carrier Frequency Separation	15.247(a)	5.3	PASS
20dB Channel Bandwidth	15.247(a)	5.4	PASS
Number of Hopping Channels	15.247(a), 15.247(b)	5.5	PASS
Time of Occupancy (Dwell Time)	15.247(a)	5.6	PASS
Spurious Emission, Band Edge, and Restricted bands	15.247(c), 15.205(a), 15.209(a), 15.109(a)	5.7	PASS
Peak Power Spectral Density	15.247(d)	5.8	PASS
Conducted Emissions	15.207(a), 15.107(a)	5.9	PASS
RF Exposure	15.247(b), 1.1307(b)(1)	5.10	PASS

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), if transmitting antennas of directional gain greater than 6dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.1.2 Result: PASS

The transmitter has an integral SMD chip antenna. The directional gain of the antenna is typically 0 dBi.

5.2 MAXIMUM PEAK OUTPUT POWER

5.2.1 Regulation

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1 watt (30 dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band, the maximum peak output power shall not exceed 0.125 watt (20.97 dBm).

According to §15.247(b)(4), if transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.2.2 Test Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer to MAX HOLD mode with RBW = 3 MHz.
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
6. Repeat above procedures until all frequencies measured were complete.

5.2.3 Test Results: PASS

Table 1: Measured values of the Maximum Peak Output Power (Conducted)

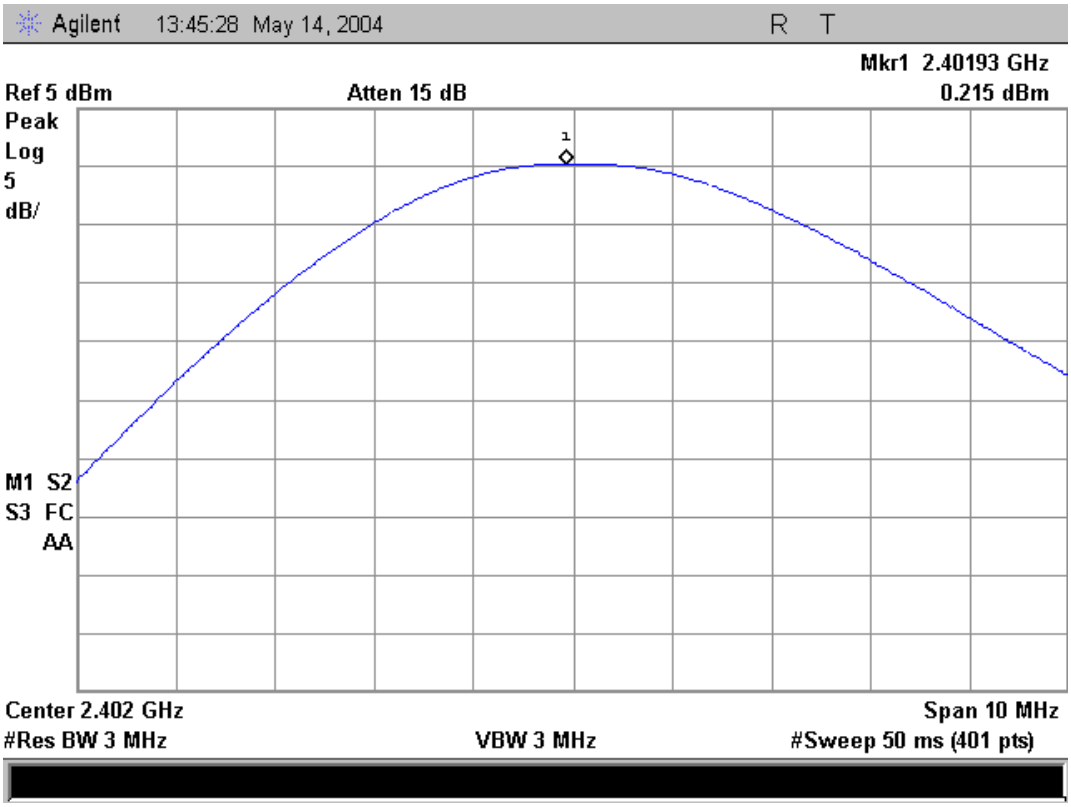
Operating Frequency	Resolution Bandwidth	Reading	Cable Loss	Actual	Limit
2402 MHz	3 MHz	0.215 dBm	0.1 dB	0.315 dBm (1.075 mW)	1 W
2441 MHz	3 MHz	0.166 dBm	0.1 dB	0.266 dBm (1.063 mW)	1 W
2480 MHz	3 MHz	-0.064 dBm	0.1 dB	0.036 dBm (1.008 mW)	1 W

Actual = Reading + Cable Loss

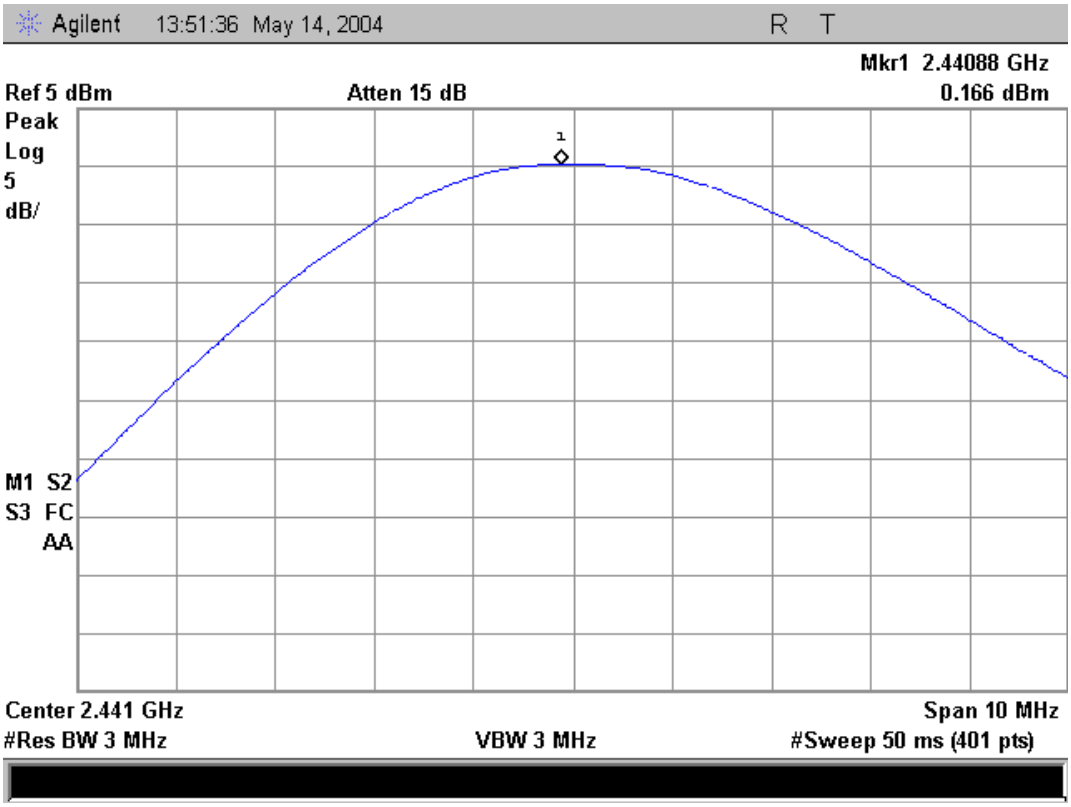
NOTE: Since the directional gain of the SMD chip antenna declared by manufacturer (G_{ANT} = 0 dBi) does not exceed 6.0 dBi, there was no need to reduce the output power.

Figure 1. Plot of the Maximum Peak Output Power (Conducted)

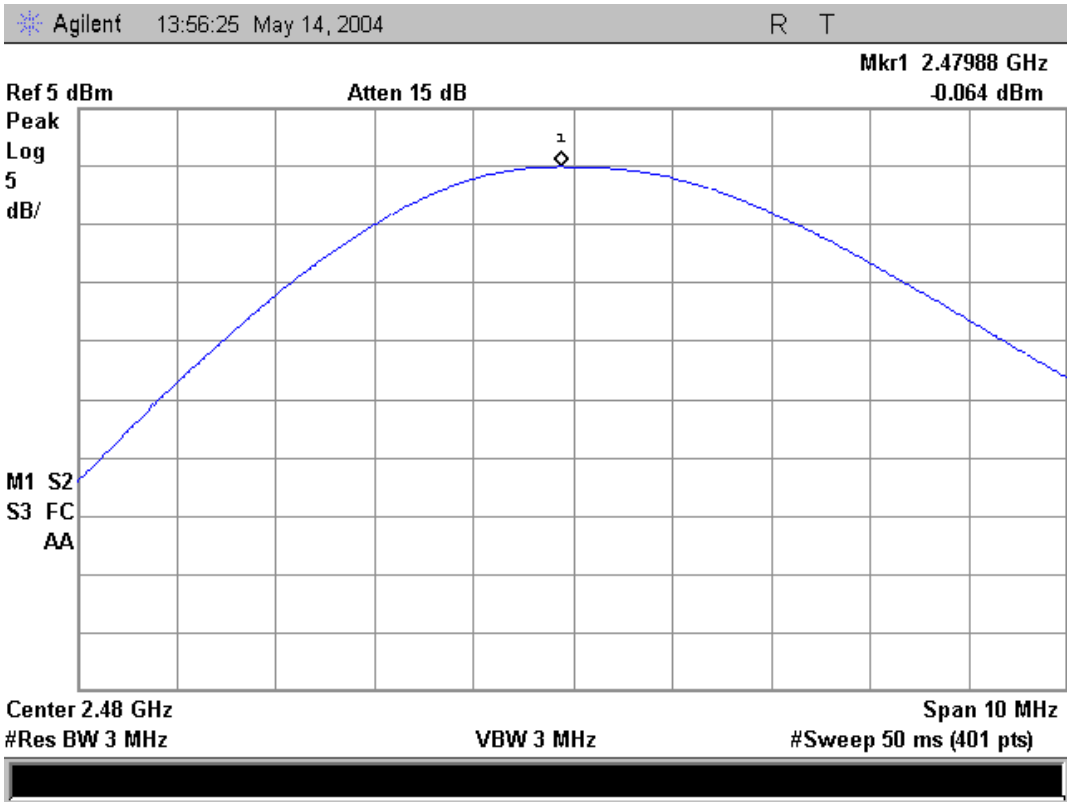
Lowest Channel (operating at 2402 MHz)



Middle Channel (operating at 2441 MHz)



Highest Channel (operating at 2480 MHz)



5.3 CARRIER FREQUENCY SEPARATION

5.3.1 Regulation

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

5.3.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface, and then set the spectrum analyzer to MAX HOLD mode.
4. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
5. Repeat above procedures until all frequencies measured were complete.

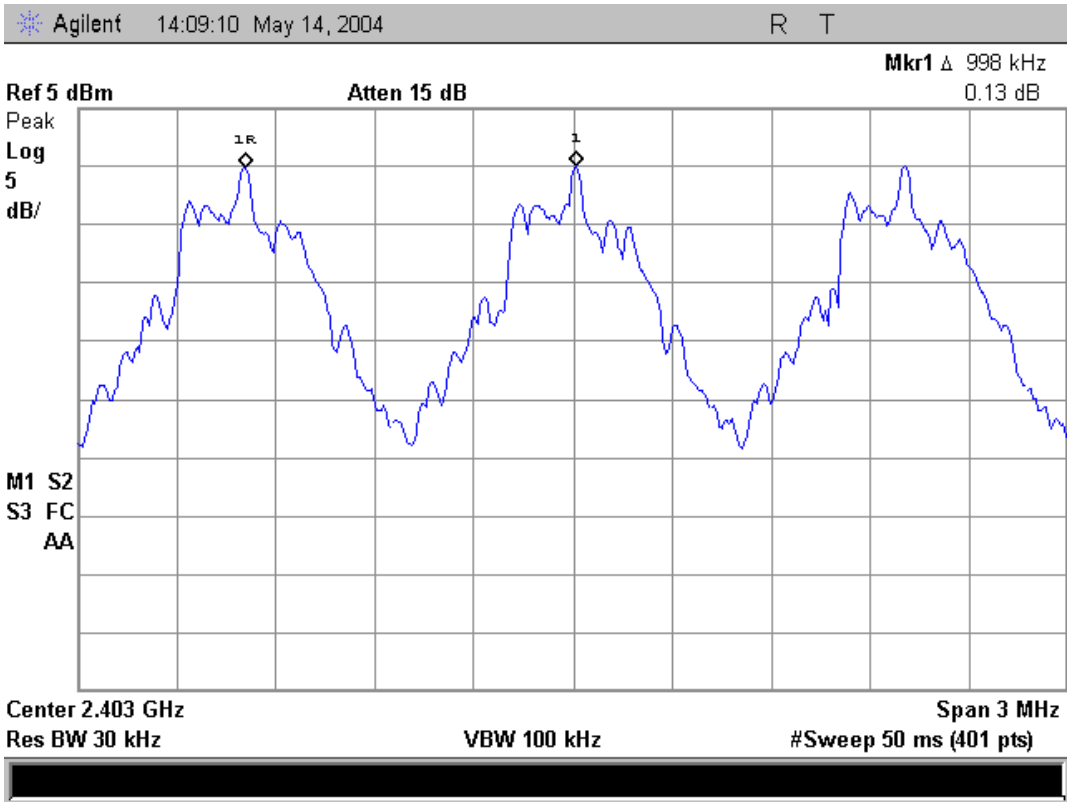
5.3.3 Test Results: PASS

Table 2: Measured values of the Carrier Frequency Separation (Conducted)

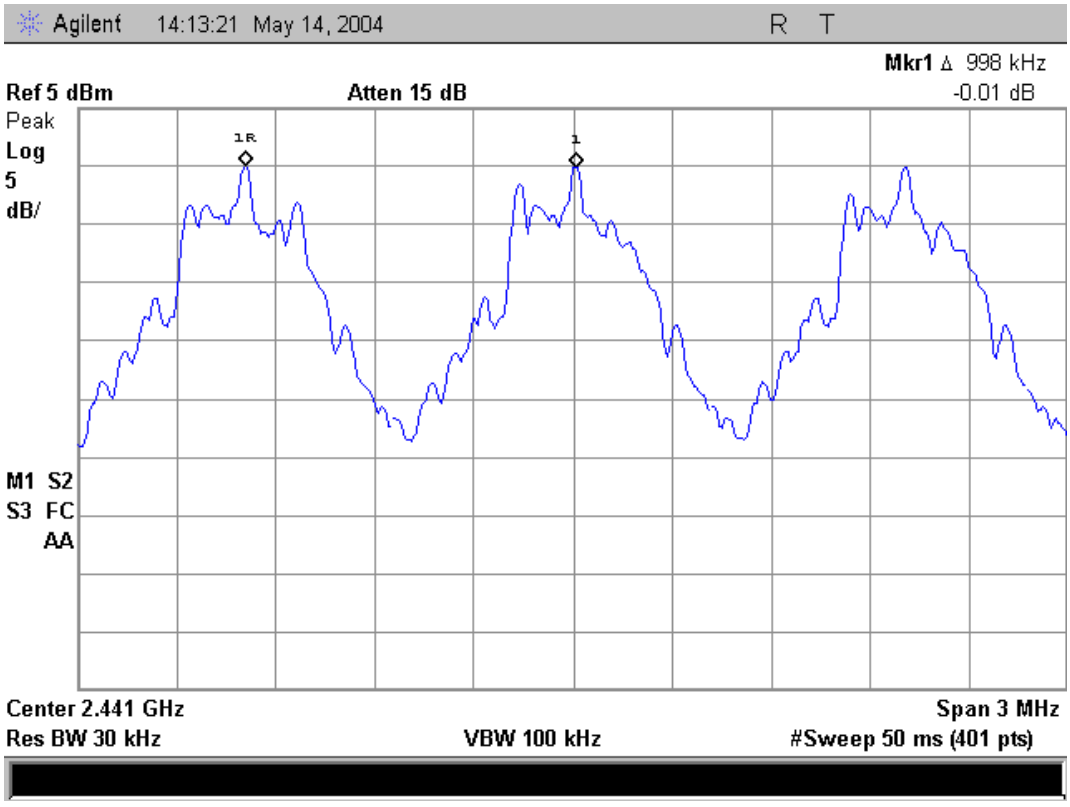
Operating frequency	Carrier frequency separation	Limit
2402 MHz	998 kHz	≥ 25 kHz or 20 dB bandwidth
2441 MHz	998 kHz	≥ 25 kHz or 20 dB bandwidth
2480 MHz	997 kHz	≥ 25 kHz or 20 dB bandwidth

Figure 2. Plot of the Carrier Frequency Separation (Conducted)

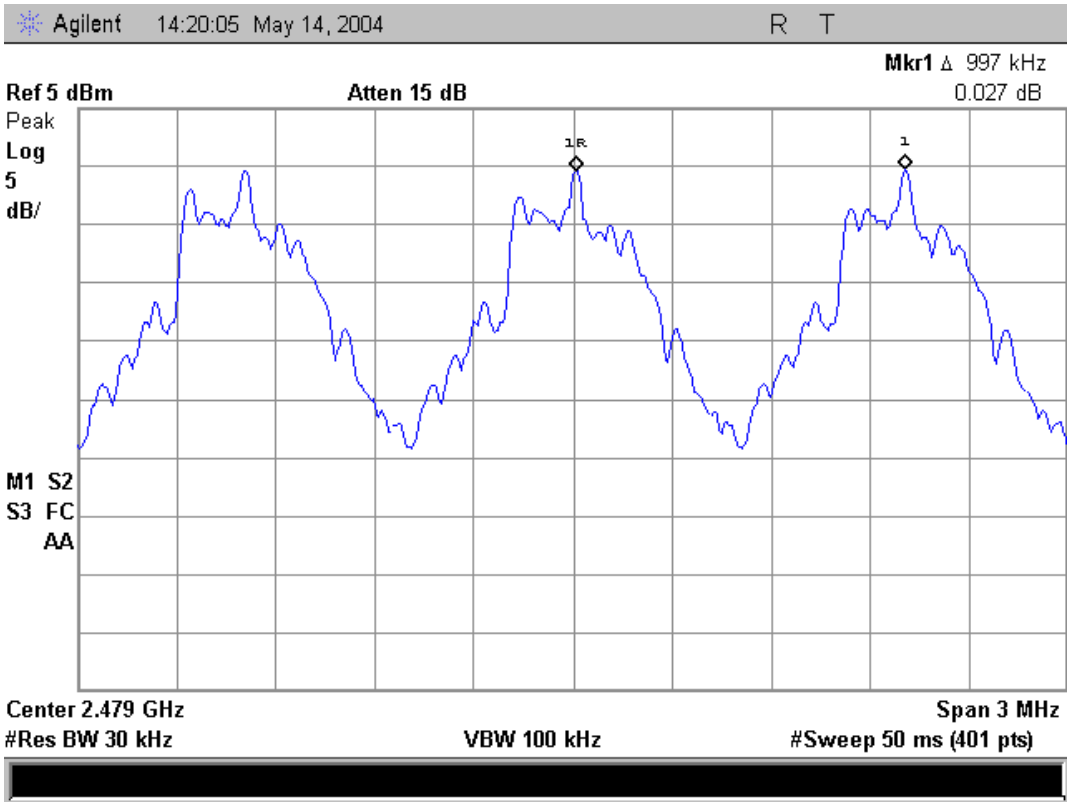
Lowest Channel (operating at 2402 MHz)



Middle Channel (operating at 2441 MHz)



Highest Channel (operating at 2480 MHz)



5.4 20dB CHANNEL BANDWIDTH

5.4.1 Regulation

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

5.4.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer to MAX HOLD mode and then set a reference level on it equal to the highest peak value.
5. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
6. Repeat above procedures until all frequencies measured were complete.

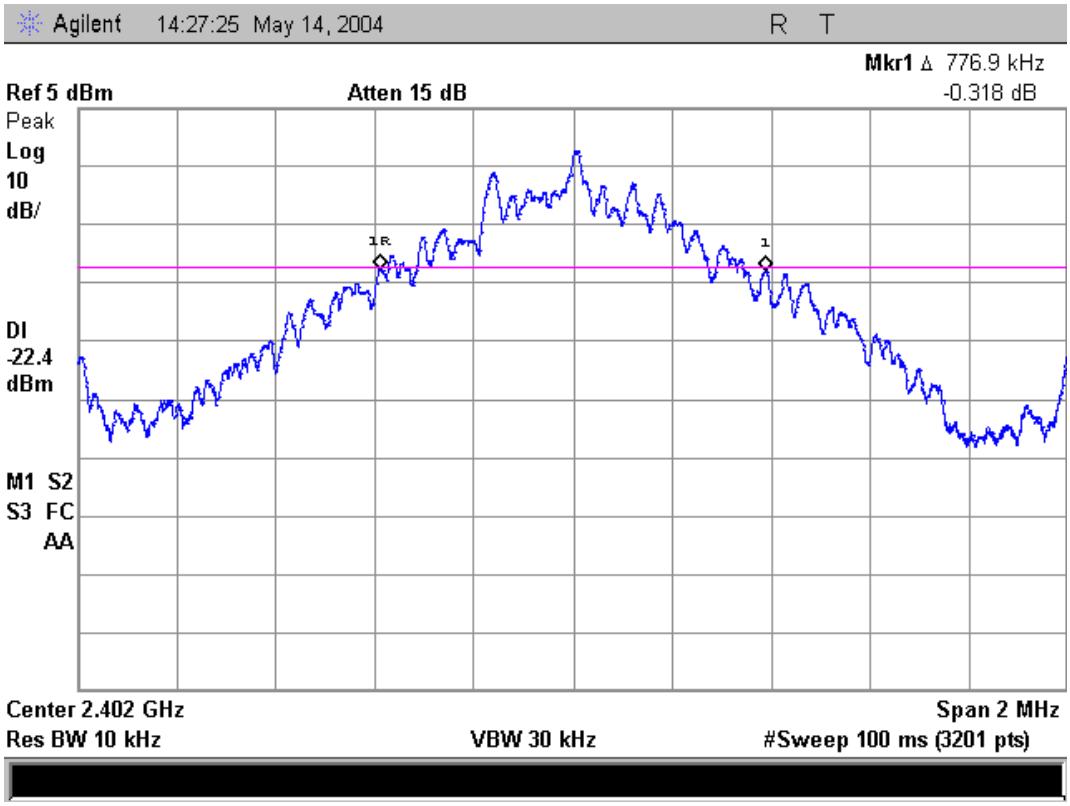
5.4.3 Test Results: PASS

Table 3: Measured values of the 20dB Channel Bandwidth (Conducted)

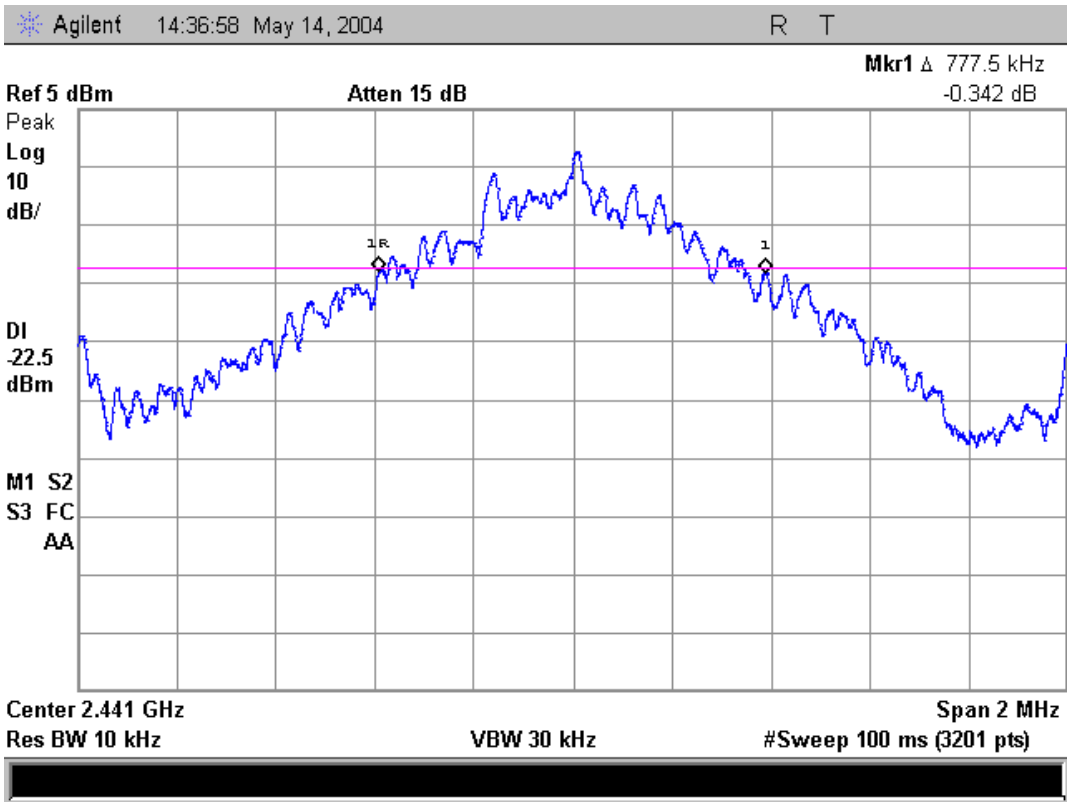
Operating frequency	20dB Channel bandwidth	Limit
2402 MHz	776.9 kHz	< 1 MHz
2441 MHz	777.5 kHz	< 1 MHz
2480 MHz	776.9 kHz	< 1 MHz

Figure 3. Plot of the 20dB Channel Bandwidth (Conducted)

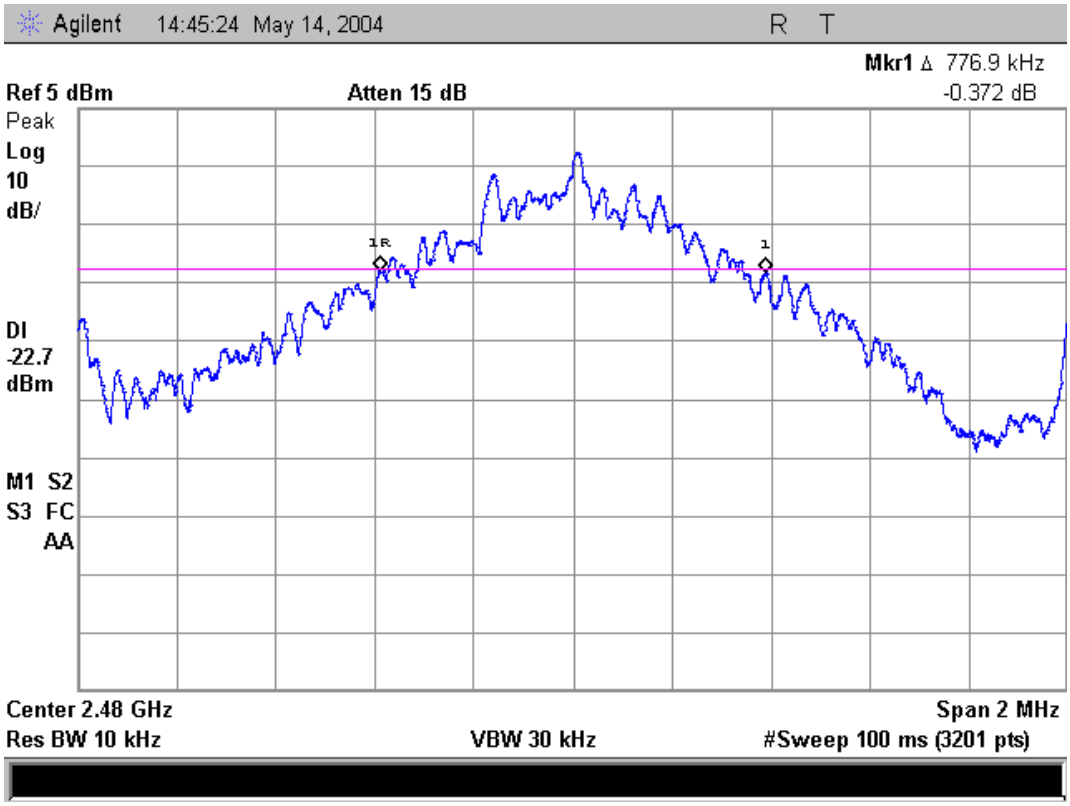
Lowest Channel (operating at 2402 MHz)



Middle Channel (operating at 2441 MHz)



Highest Channel (operating at 2480 MHz)



5.5 NUMBER OF HOPPING CHANNELS

5.5.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. Frequency hopping systems, which use fewer than 75 hopping frequencies, may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping systems may avoid or suppress transmissions on particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum peak output power shall not exceed 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band, the maximum peak output power shall not exceed 0.125 watt (20.97dBm).

5.5.2 Test Procedure

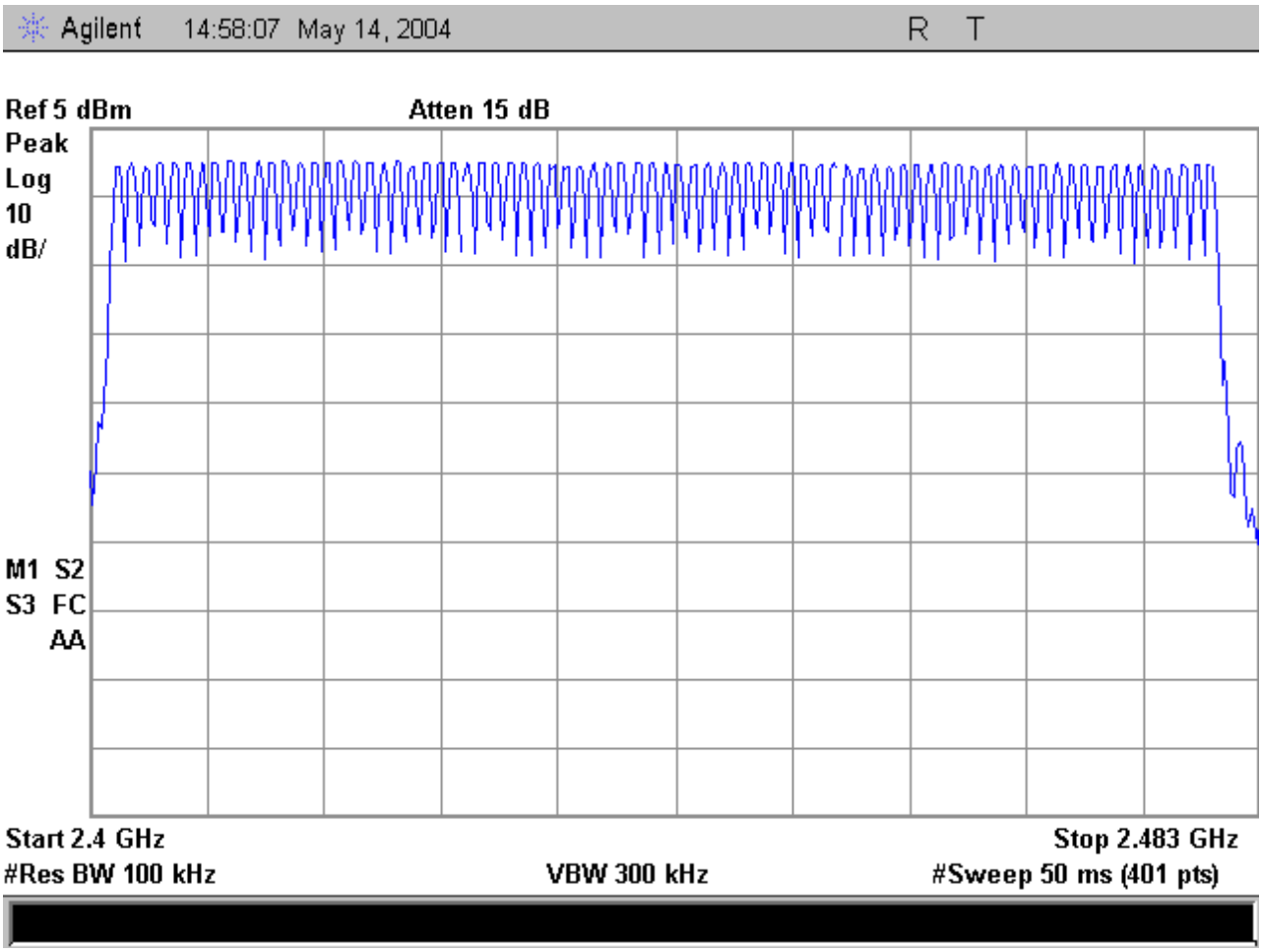
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set the hopping function enabled by controlling it via UART interface.
4. Set the spectrum analyzer MAX HOLD and record the number of hopping channels.

5.5.3 Test Results: PASS

Table 4: Measured values of the Number of Hopping Channels (Conducted)

Operating frequency	Number of hopping channels	Limit
2402 - 2480 MHz	79	≥ 15

Figure 4. Plot of the Number of Hopping Channels (Conducted)



5.6 TIME OF OCCUPANCY (DWELL TIME)

5.6.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.6.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface.
4. Set the spectrum analyzer to ZERO SAPN centered on the hopping channel with RBW = 1MHz, and then measure the dwell time using the marker-delta function.
6. Repeat above procedures until all frequencies measured were complete.
7. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

5.6.3 Test Results: PASS

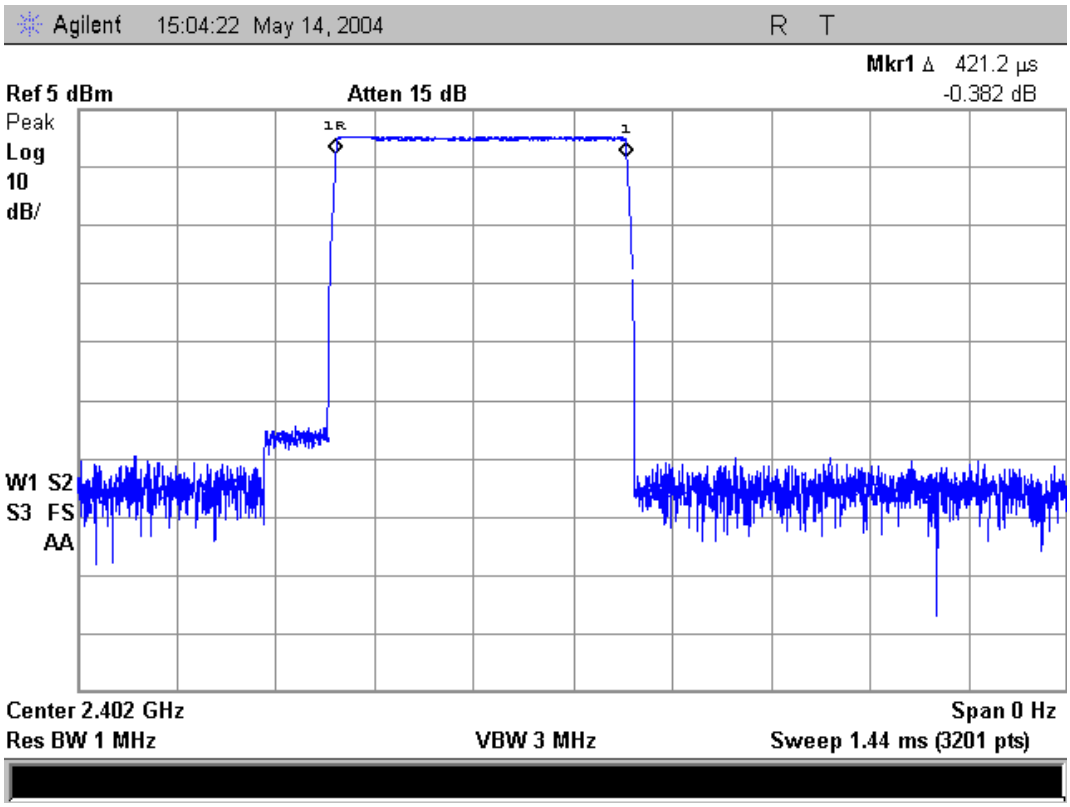
Table 5: Measured values of the Time of Occupancy (Conducted)

Operating frequency	Reading	Hopping rate	Number of Channels	Actual	Limit
2402 MHz	0.4212 ms	800 hops/s	79	134.784 ms	0.4 seconds
2441 MHz	0.4212 ms	800 hops/s	79	134.784 ms	0.4 seconds
2480 MHz	0.4217 ms	800 hops/s	79	134.944 ms	0.4 seconds

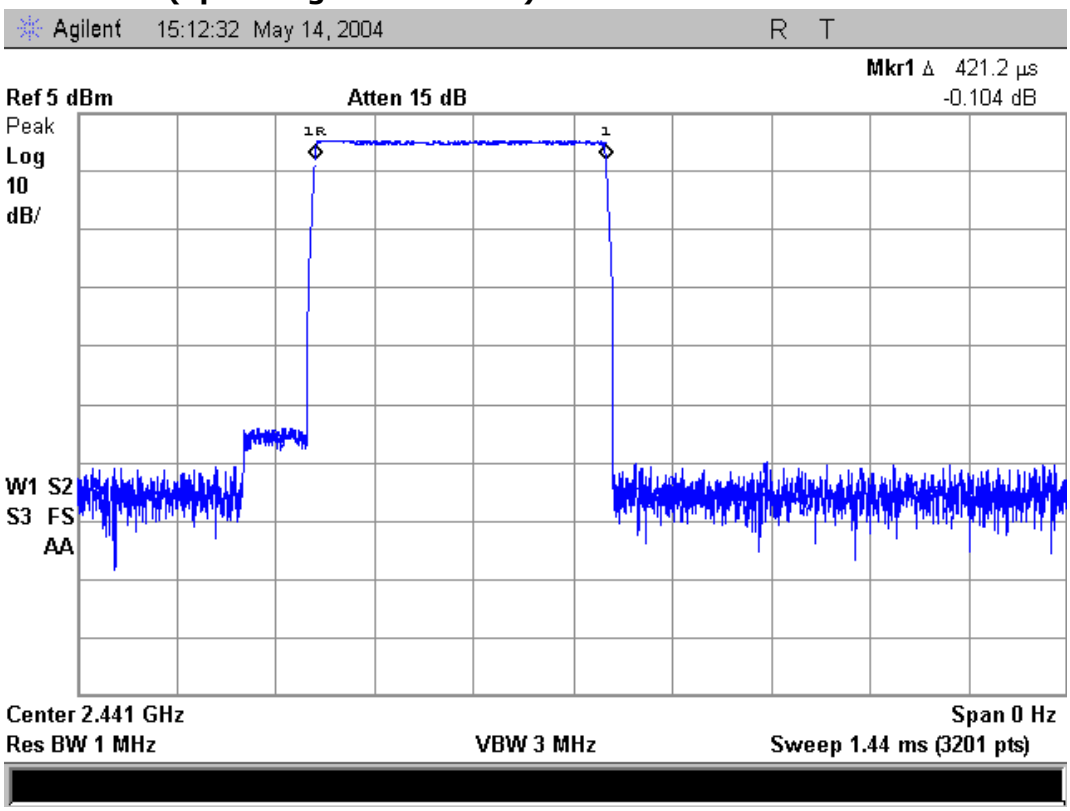
Actual = Reading × (Hopping rate / Number of channels) × Test period
Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds]
NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels. A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Figure 5. Plot of the Time of Occupancy (Conducted)

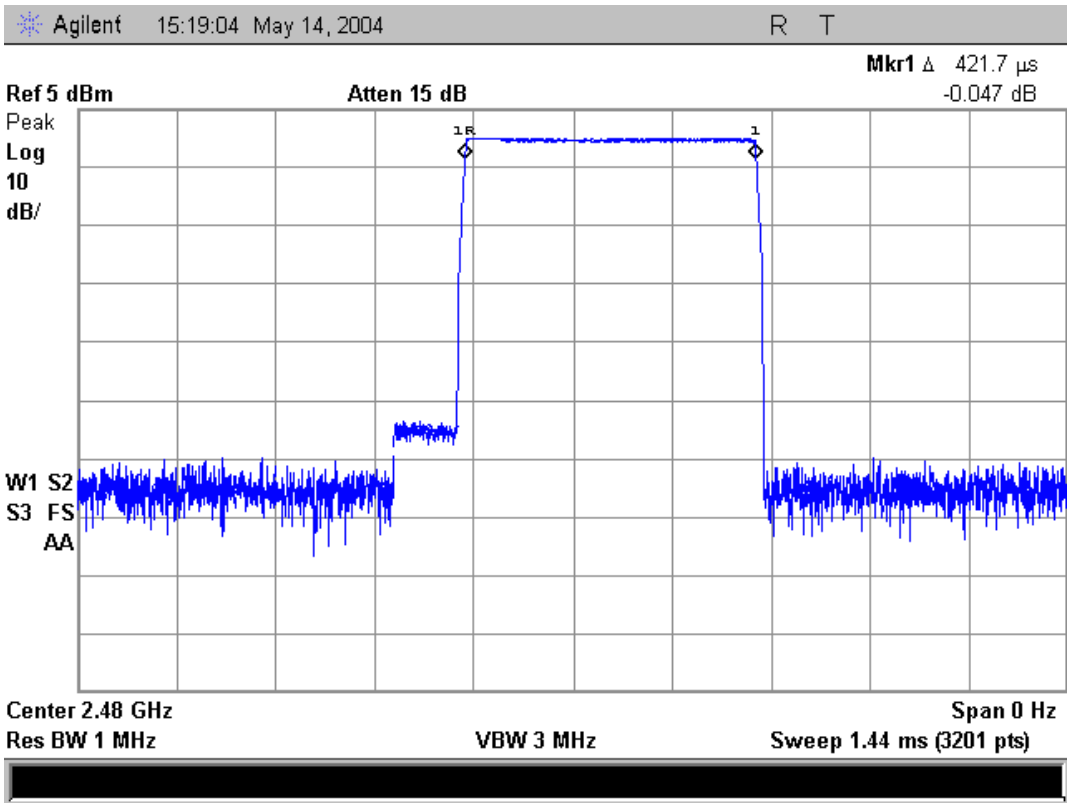
Lowest Channel (operating at 2402 MHz)



Middle Channel (operating at 2441 MHz)



Highest Channel (operating at 2480 MHz)



5.7 SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

5.7.1 Regulation

According to §15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

5.7.2 Test Procedure

1) Spurious RF Conducted Emissions:

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer to MAX HOLD mode with RBW = 100kHz, VBW = 100kHz and wide SPAN enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
5. Set the marker on the peak of any spurious emission, and then measure the peak level of the emissions marked, using the spectrum analyzer with RBW = 100kHz, VBW = 100kHz, and SPAN = 100MHz.
6. Repeat above procedures until all frequencies measured were complete.

2) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.

5.7.3 Test Results: PASS

Table 6: Measured values of the RF antenna port emissions (Conducted)

Frequency [MHz]	Reading [dBm]	Cable Loss [dB]	Actual [dBm]	Limit [dBm]	Margin [dB]
Lowest Channel (operating at 2402 MHz)					
2402.00	-0.15	0.1	-0.05	-	-
2385.97	-62.84	0.1	-62.74	-20.05	42.69
4804.00	---	0.2	---	-20.05	---
Middle Channel (operating at 2441 MHz)					
2441.00	-0.30	0.1	-0.20	-	-
4882.00	---	0.2	---	-20.20	---
Highest Channel (operating at 2480 MHz)					
2480.00	-0.56	0.1	-0.46	-	-
2483.50	-52.94	0.1	-52.84	-20.46	32.38
2484.00	-51.33	0.1	-51.23	-20.46	30.77
2484.50	-50.49	0.1	-50.39	-20.46	29.93
4960.00	---	0.2	---	-20.46	---

Actual = Reading + Cable Loss

Remark "---" means the emission level was too low to be measured or in the noise floor.

NOTE: All the Reading values were taken using Spectrum Analyzer with RBW=100 kHz, VBW=100 kHz, and SPAN=100 MHz

Table 7: Measured values of the Field strength of spurious emission (Radiated)

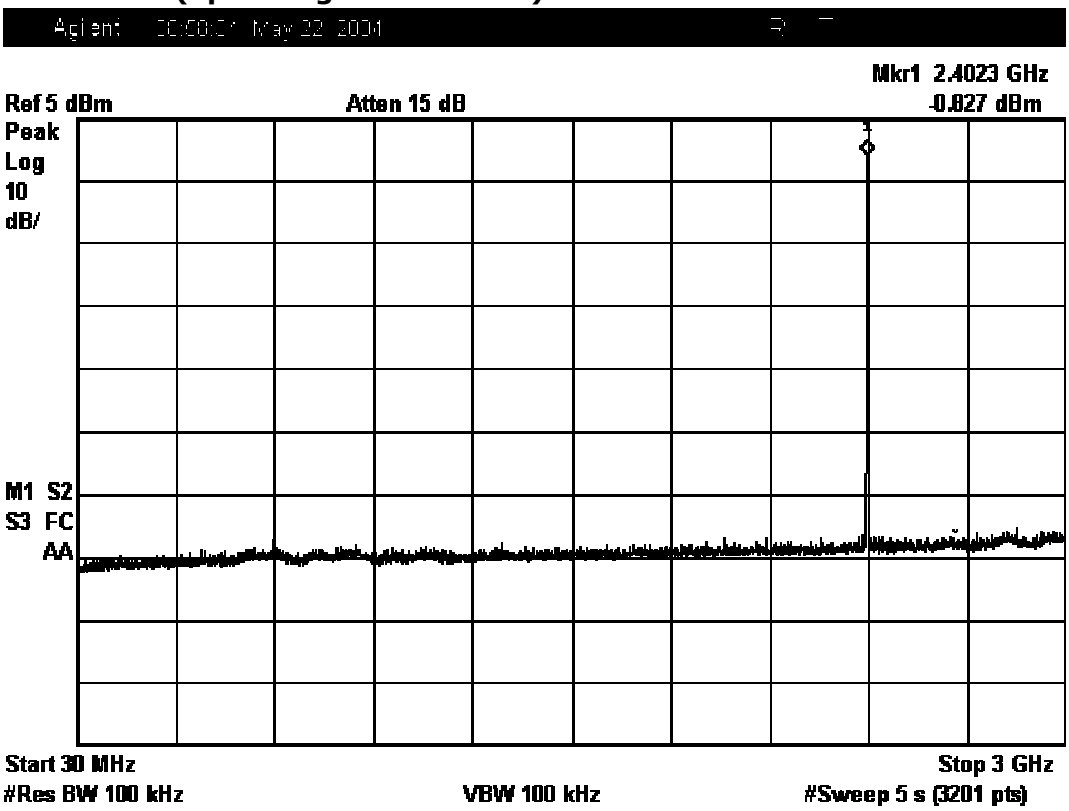
Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Table Angle [°]	Reading [dB(μV)]	Amp Gain [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz										
---	120									
					No Spurious Radiated Emissions Found					
AVERAGE data, emissions above 1000 MHz										
2390.0	1000	V	1.0	0	37.04	30.1	29.2/7.4	43.54	54.0	10.46
2483.5	1000	V	1.0	0	36.60	30.1	29.2/7.4	43.10	54.0	10.90
---	1000									
PEAK data, emissions above 1000 MHz										
2390.0	1000	V	1.0	0	51.81	30.1	29.2/7.4	58.31	74.0	15.69
2483.5	1000	V	1.0	0	50.79	30.1	29.2/7.4	57.29	74.0	16.71
---	1000									

Margin (dB) = Limit – Actual
[Actual = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

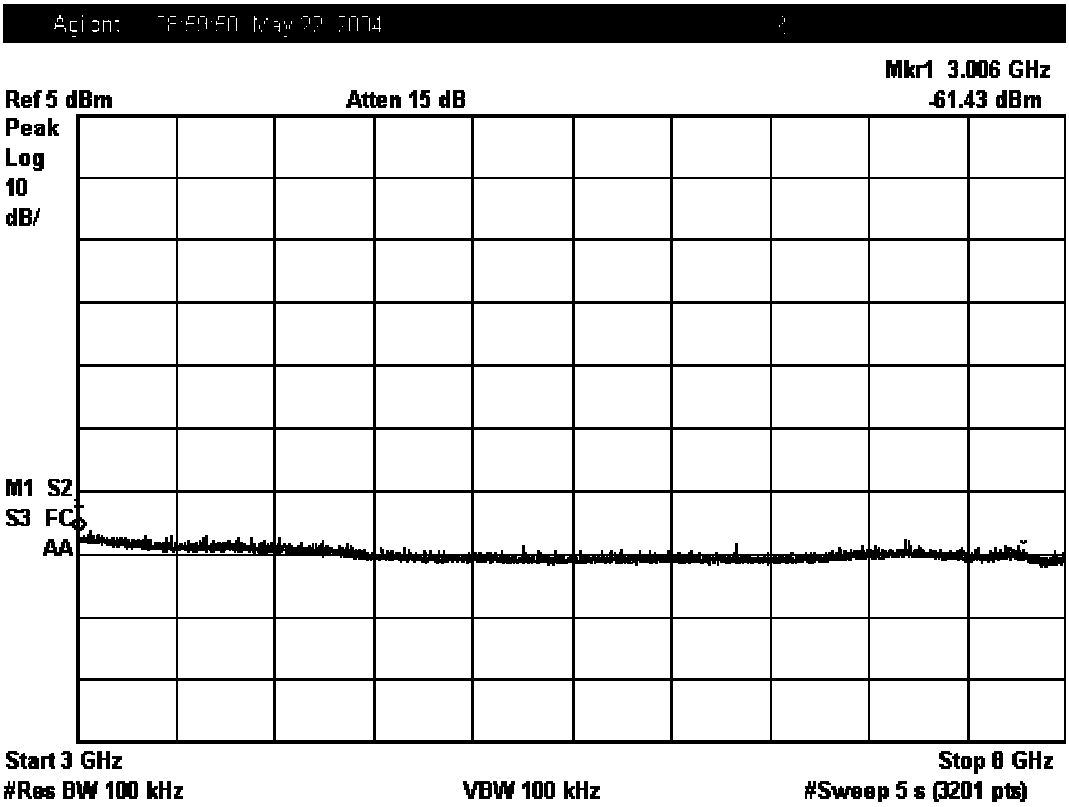
NOTE: The spectrum was scanned from 30 MHz to 18 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor. The measured data in the above table include the spurious radiated emissions that do not fall in the restricted bands.

Figure 6. Plot of the RF antenna port emissions (Conducted)

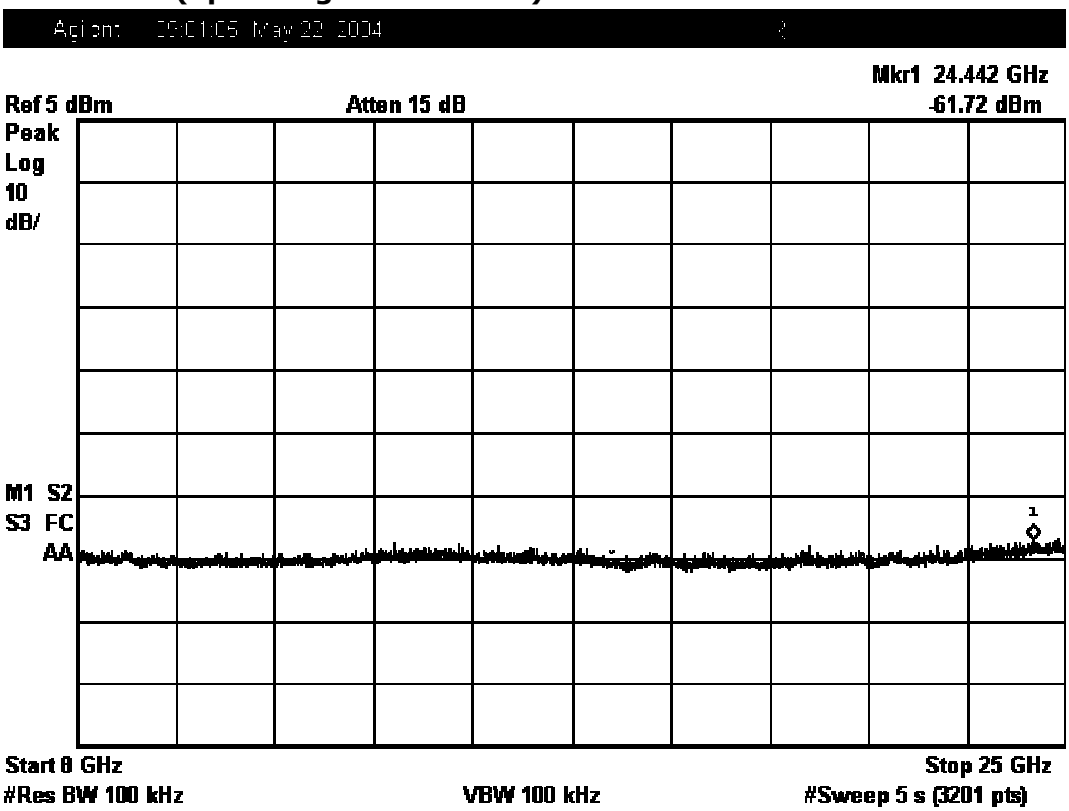
Lowest Channel (operating at 2402 MHz): 30MHz ~ 3GHz



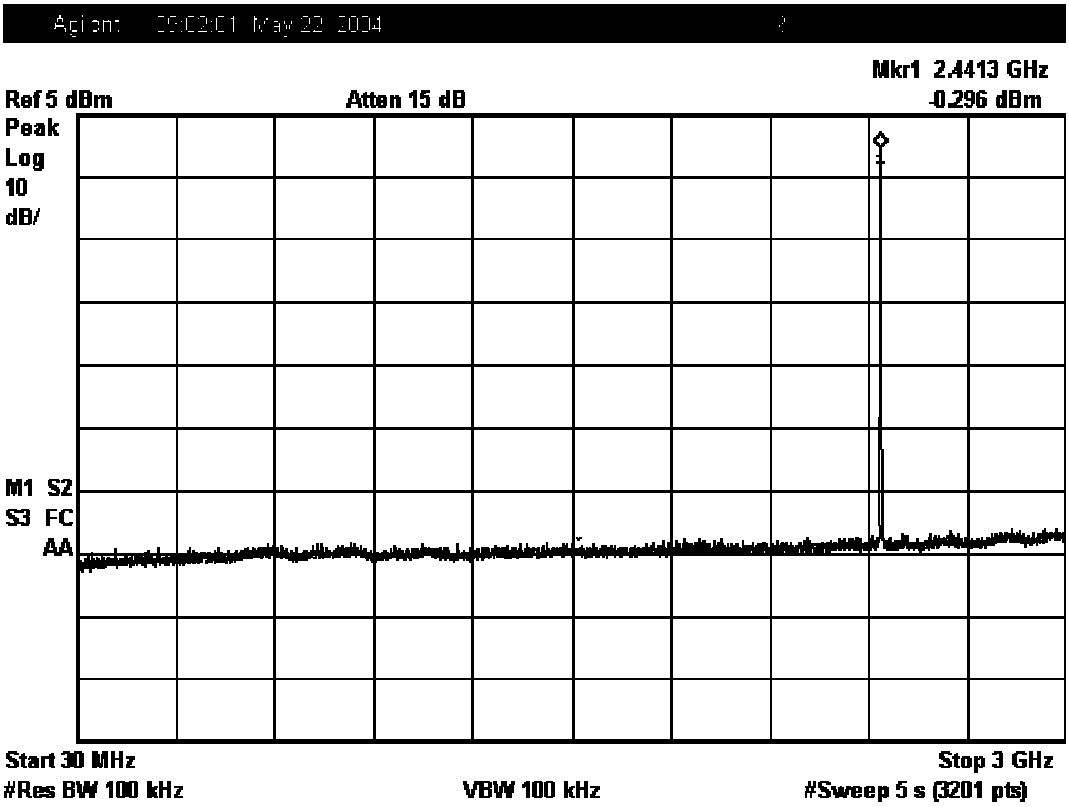
Lowest Channel (operating at 2402 MHz): 3GHz ~ 8GHz



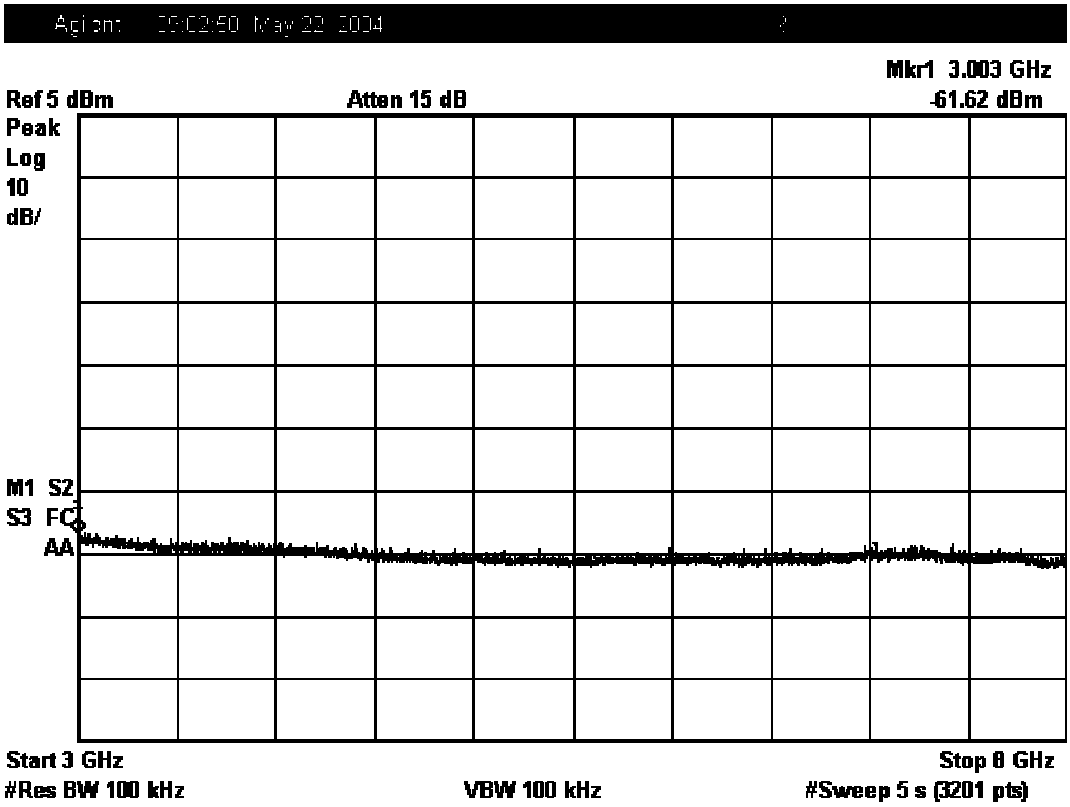
Lowest Channel (operating at 2402 MHz): 8GHz ~ 25GHz



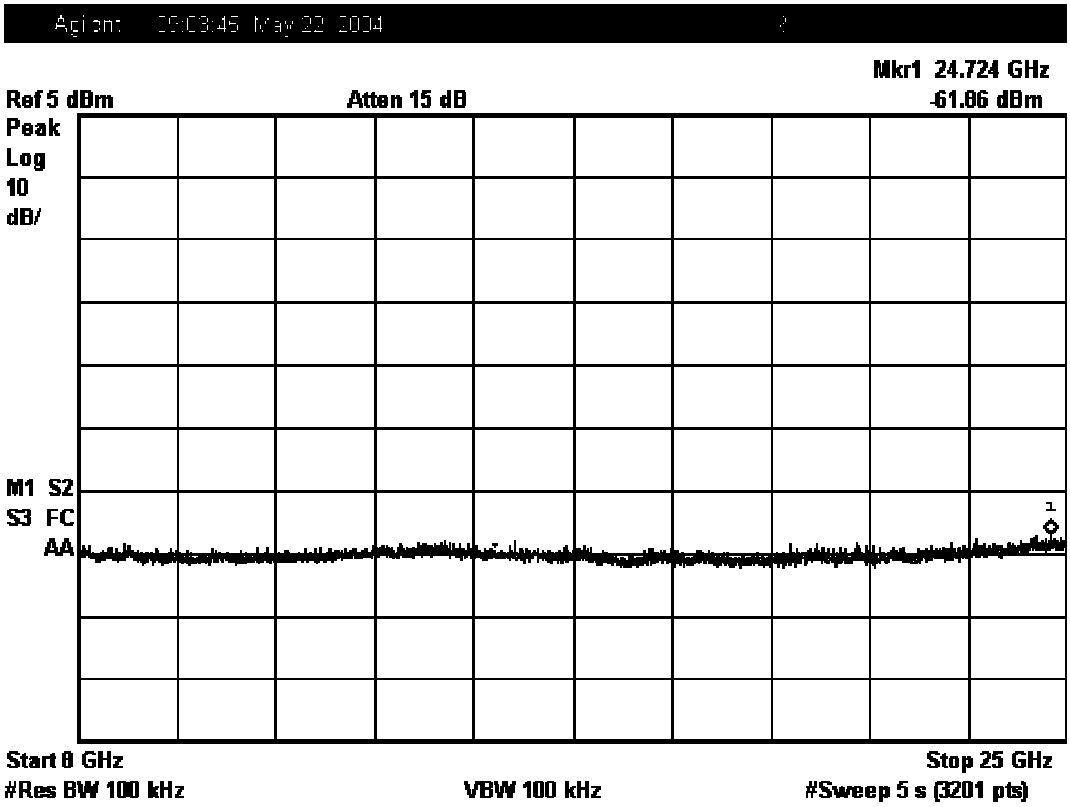
Middle Channel (operating at 2441 MHz): 30MHz ~ 3GHz



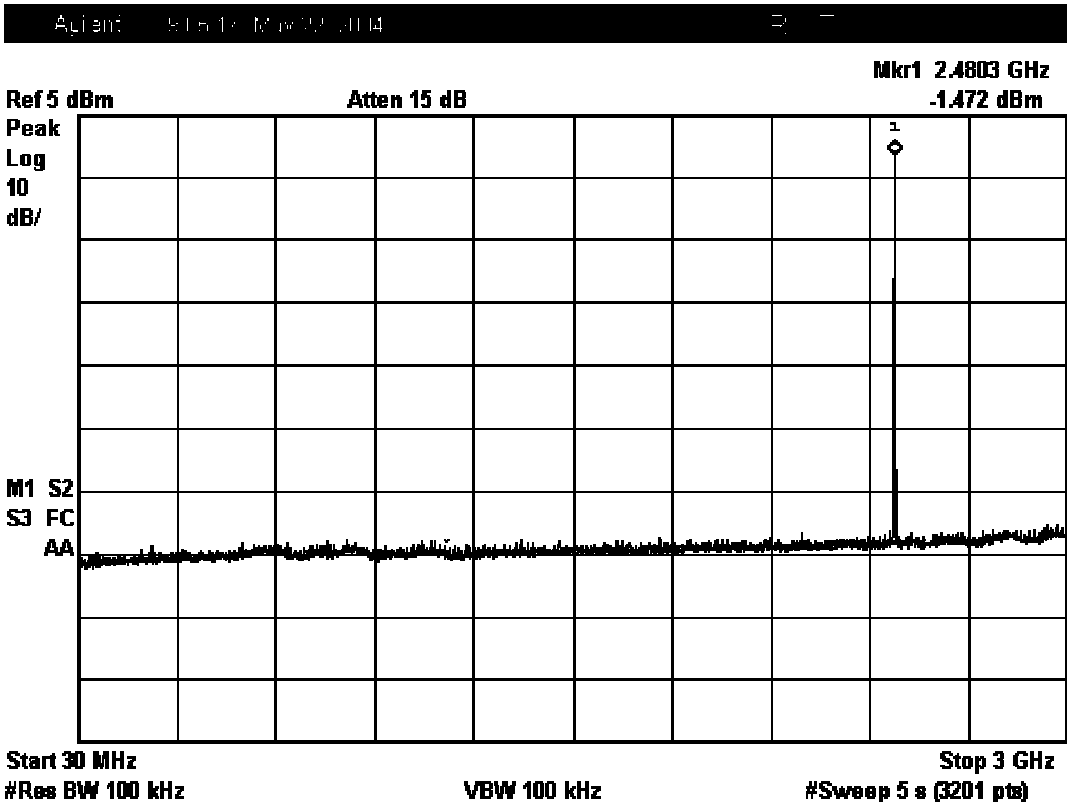
Middle Channel (operating at 2441 MHz): 3GHz ~ 8GHz



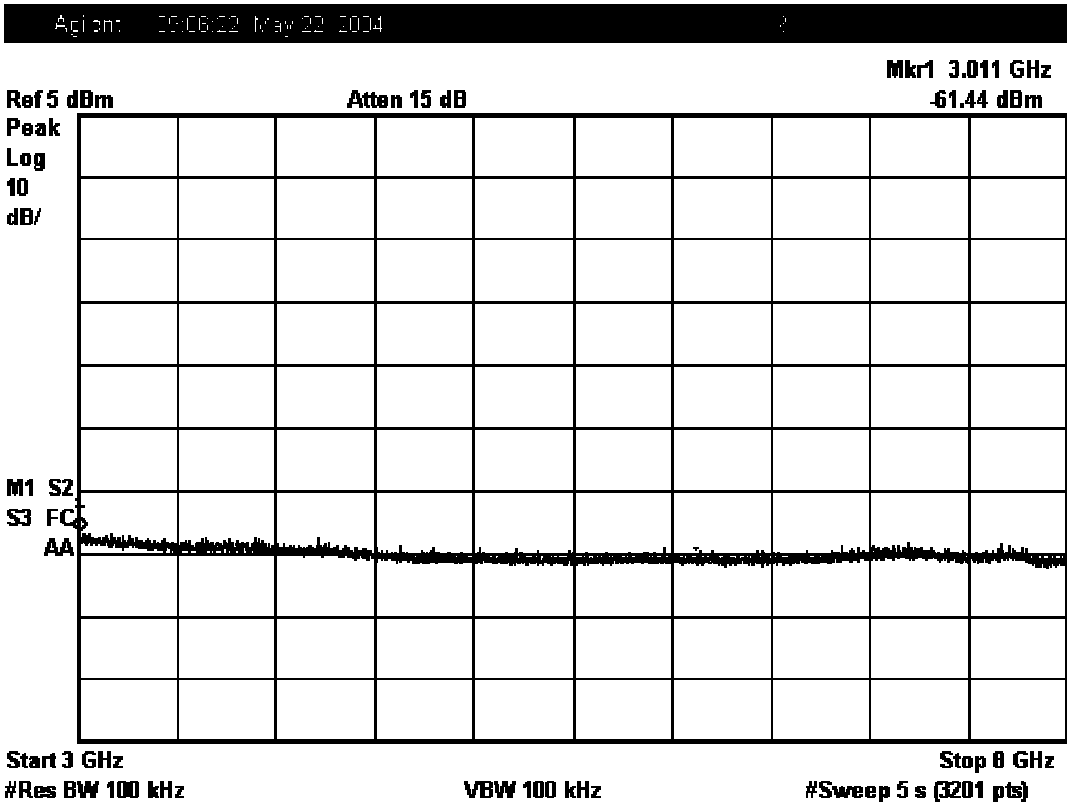
Middle Channel (operating at 2441 MHz): 8GHz ~ 25GHz



Highest Channel (operating at 2480 MHz): 30MHz ~ 3GHz



Highest Channel (operating at 2480 MHz): 3GHz ~ 8GHz



Highest Channel (operating at 2480 MHz): 8GHz ~ 25GHz

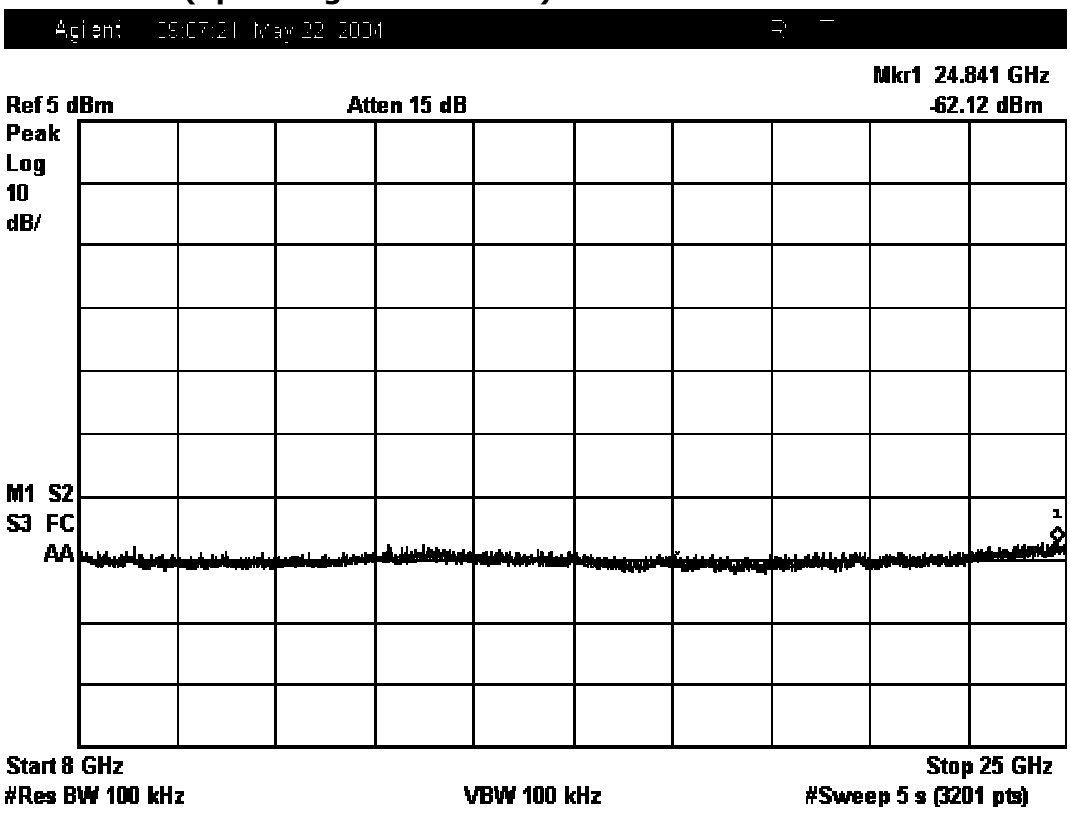
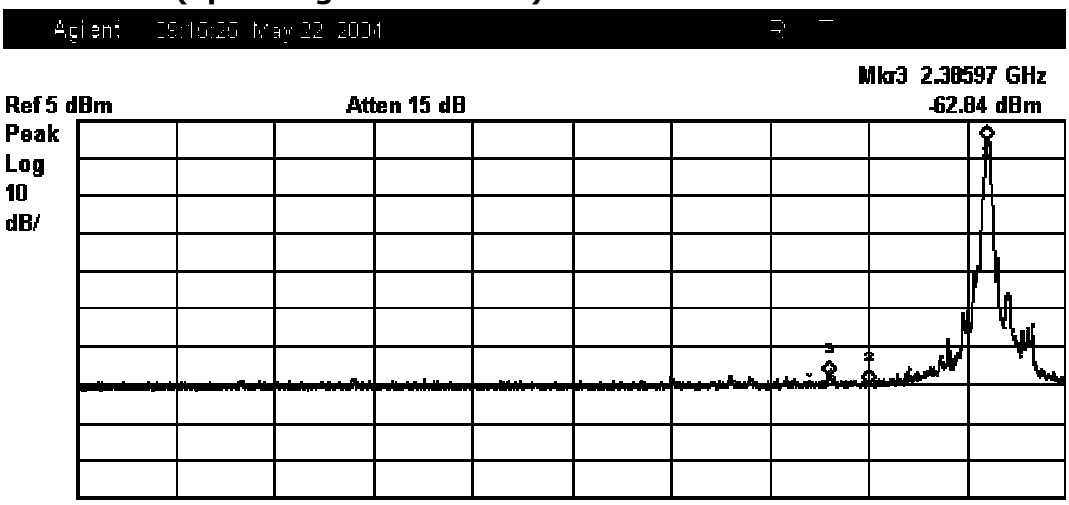


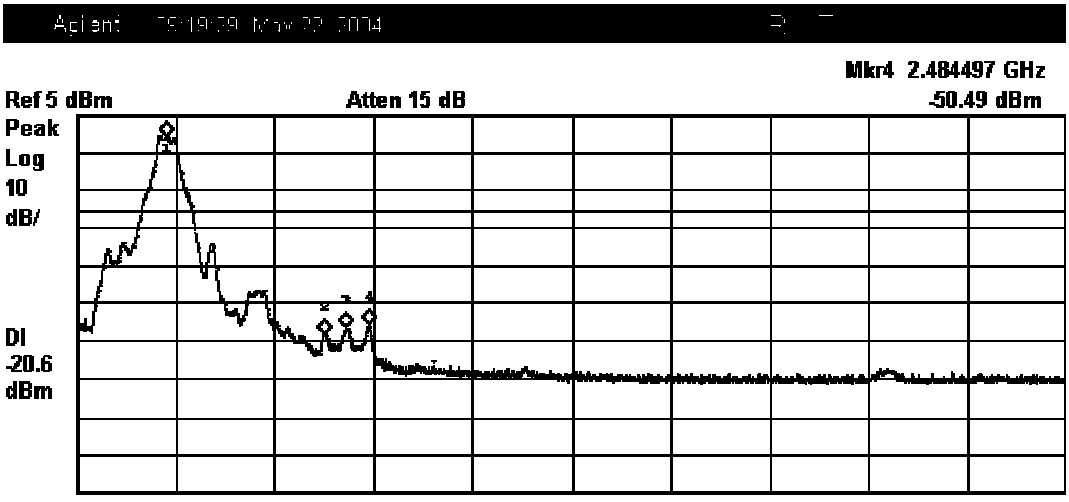
Figure 7. Plot of the Band Edge (Conducted)

Lowest Channel (operating at 2402 MHz): 2310 ~ 2390 MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.40200 GHz	-0.146 dBm
2	(1)	Freq	2.39000 GHz	-64.88 dBm
3	(1)	Freq	2.38597 GHz	-62.84 dBm

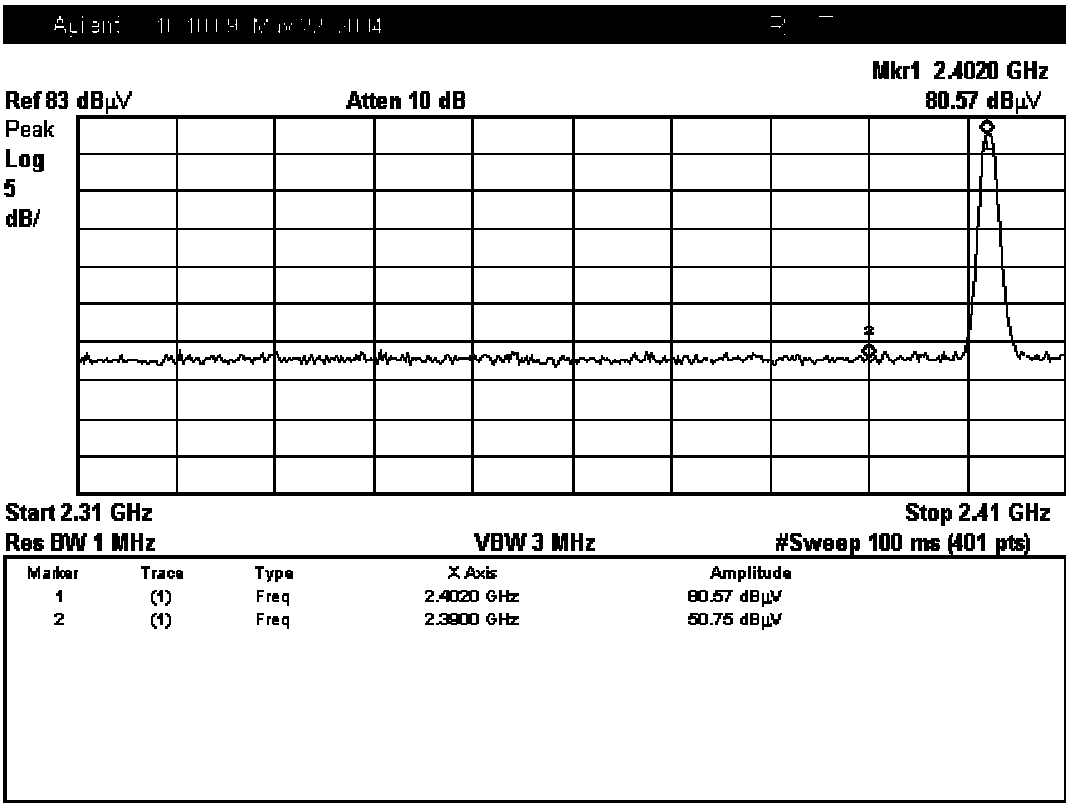
Highest Channel (operating at 2480 MHz): 2483.5 ~ 2500MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.480001 GHz	-0.555 dBm
2	(1)	Freq	2.483500 GHz	-52.94 dBm
3	(1)	Freq	2.484002 GHz	-51.33 dBm
4	(1)	Freq	2.484497 GHz	-50.49 dBm

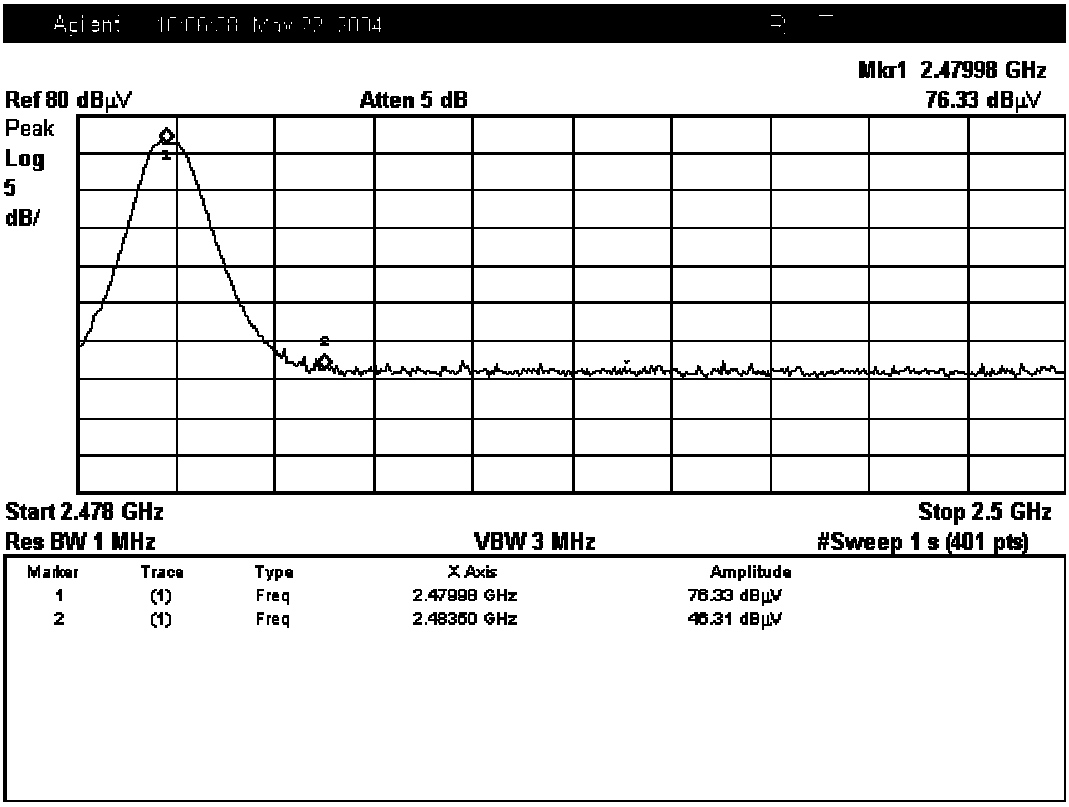
Figure 8. Plot of the Band Edge (Radiated)

Lowest Channel (operating at 2402 MHz): 2310 ~ 2390 MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4020 GHz	80.57 dBµV
2	(1)	Freq	2.3900 GHz	50.75 dBµV

Highest Channel (operating at 2480 MHz): 2483.5 ~ 2500MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.47998 GHz	76.33 dBµV
2	(1)	Freq	2.48350 GHz	46.31 dBµV

5.8 PEAK POWER SPECTRAL DENSITY

5.8.1 Regulation

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

5.8.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer to MAX HOLD mode with RBW = 3kHz.
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
6. Repeat above procedures until all frequencies measured were complete.

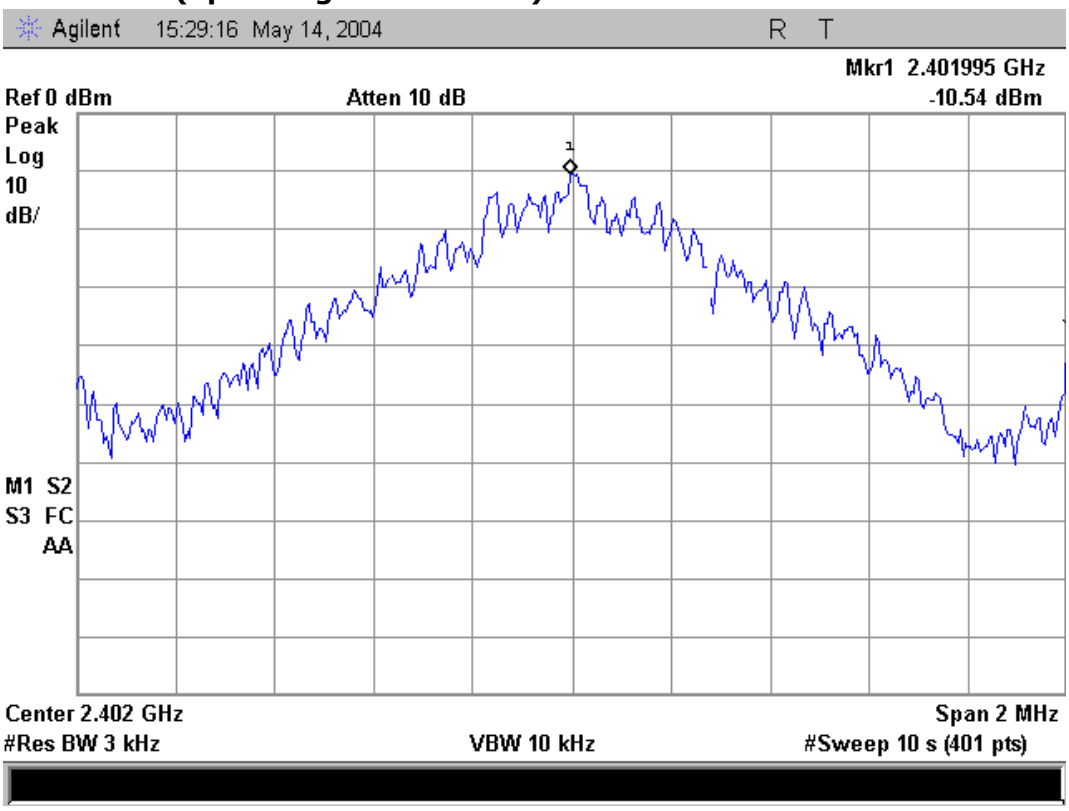
5.8.3 Test Results: PASS

Table 8: Measured values of the Peak Power Spectral Density (Conducted)

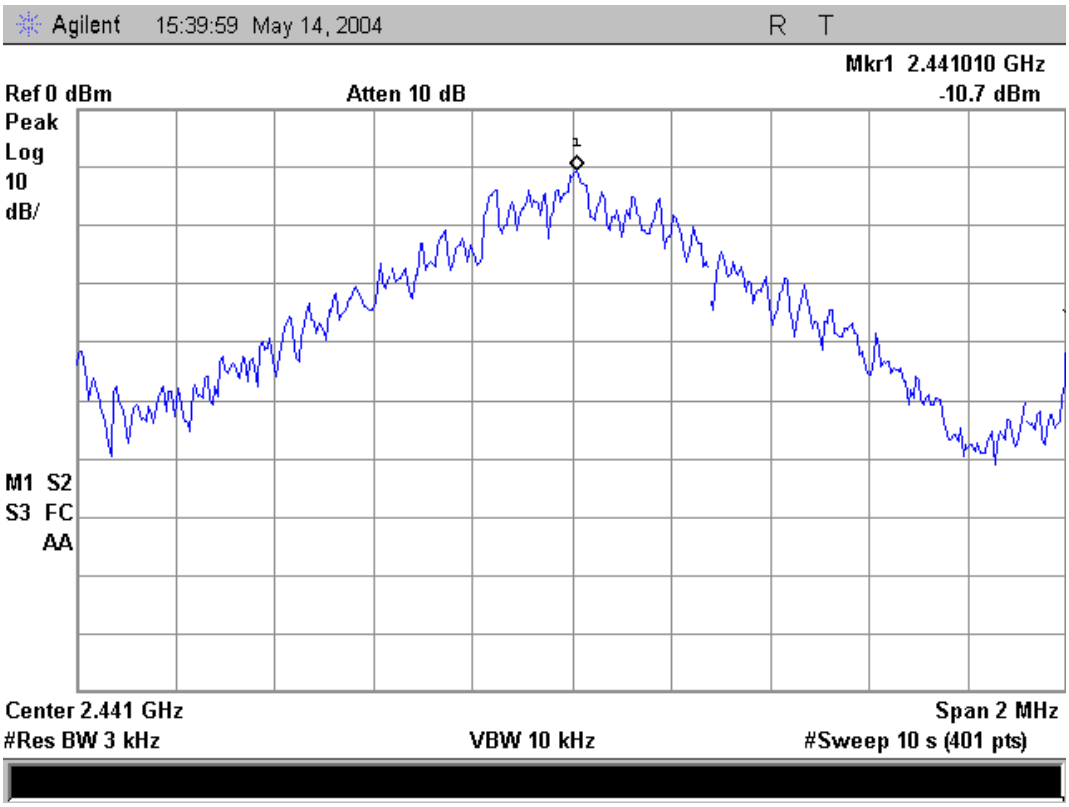
Operating frequency	Reading	Cable Loss	Actual	Limit
2402 MHz	-10.54 dBm	0.1 dB	-10.44 dBm	8.0 dBm
2441 MHz	-10.70 dBm	0.1 dB	-10.60 dBm	8.0 dBm
2480 MHz	-11.16 dBm	0.1 dB	-11.06 dBm	8.0 dBm

Figure 9. Plot of the Peak Power Spectral Density (Conducted)

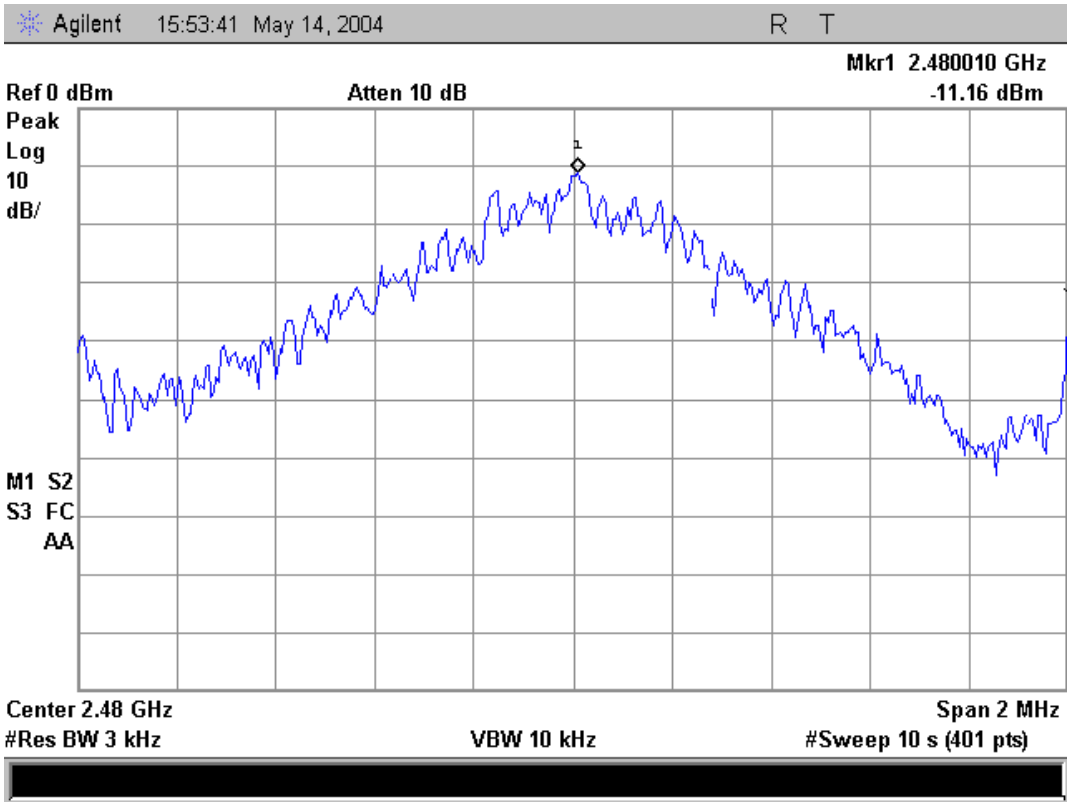
Lowest Channel (operating at 2402 MHz)



Middle Channel (operating at 2441 MHz)



Highest Channel (operating at 2480 MHz)



5.9 CONDUCTED EMISSIONS

5.9.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.9.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

5.9.3 Test Results: PASS

Table 9: Measured values of the Conducted Emissions

Frequency [MHz]	Reading [dBμV]		CF/CL [dB]	Actual [dBμV]		Limit [dBμV]		Margin [dB]	
	Qp	Ave		Qp	Ave	Qp	Ave	Qp	Ave
LINE – PE									
0.23	47.82	---	0.09/0.1	48.01	---	62.45	---	14.44	---
0.33	43.06	---	0.09/0.1	43.25	---	59.45	---	16.20	---
0.35	45.05	---	0.09/0.1	45.24	---	58.96	---	13.72	---
0.48	42.76	---	0.09/0.1	42.95	---	56.34	---	13.39	---
0.57	40.82	---	0.10/0.1	41.02	---	56.00	---	14.95	---
0.60	42.04	---	0.11/0.1	42.25	---	56.00	---	13.75	---
0.62	21.69	---	0.11/0.1	21.90	---	56.00	---	34.10	---
0.72	41.06	---	0.13/0.1	41.29	---	56.00	---	14.71	---
0.95	38.22	---	0.13/0.1	38.45	---	56.00	---	17.55	---
21.0	31.24	---	0.81/0.6	32.65	---	60.00	---	27.35	---
NEUTRAL – PE									
0.22	45.39	---	0.13/0.1	45.62	---	62.82	---	17.20	---
0.36	44.87	---	0.14/0.1	45.11	---	58.73	---	13.62	---
0.48	45.45	---	0.15/0.1	45.70	---	56.34	---	10.64	---
0.57	39.52	---	0.15/0.1	39.7	---	56.00	---	16.23	---
0.59	40.58	---	0.15/0.1	40.83	---	56.00	---	15.17	---
0.61	40.01	---	0.15/0.1	40.26	---	56.00	---	15.74	---
0.63	20.60	---	0.15/0.1	20.85	---	56.00	---	35.15	---
0.73	39.44	---	0.15/0.1	39.69	---	56.00	---	16.31	---
0.75	27.79	---	0.15/0.1	28.04	---	56.00	---	27.96	---
17.22	27.71	---	0.55/0.6	28.86	---	60.00	---	31.14	---
20.89	32.66	---	0.60/0.6	33.86	---	60.00	---	26.14	---

Margin (dB) = Limit – Actual
[Actual = Reading + CF + CL]
1. Remark "---" means the level is undetectable or the Qausi-peak value is lower than the limit of Average.
2. CF/CL = Correction Factor and Cable Loss
3. Qp = Quasi-peak, Ave = Average value

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.

Figure 10. Plot of the Conducted Emissions

Line - PE

21 May 2004 11:16

CONDUCTED DISTURBANCE

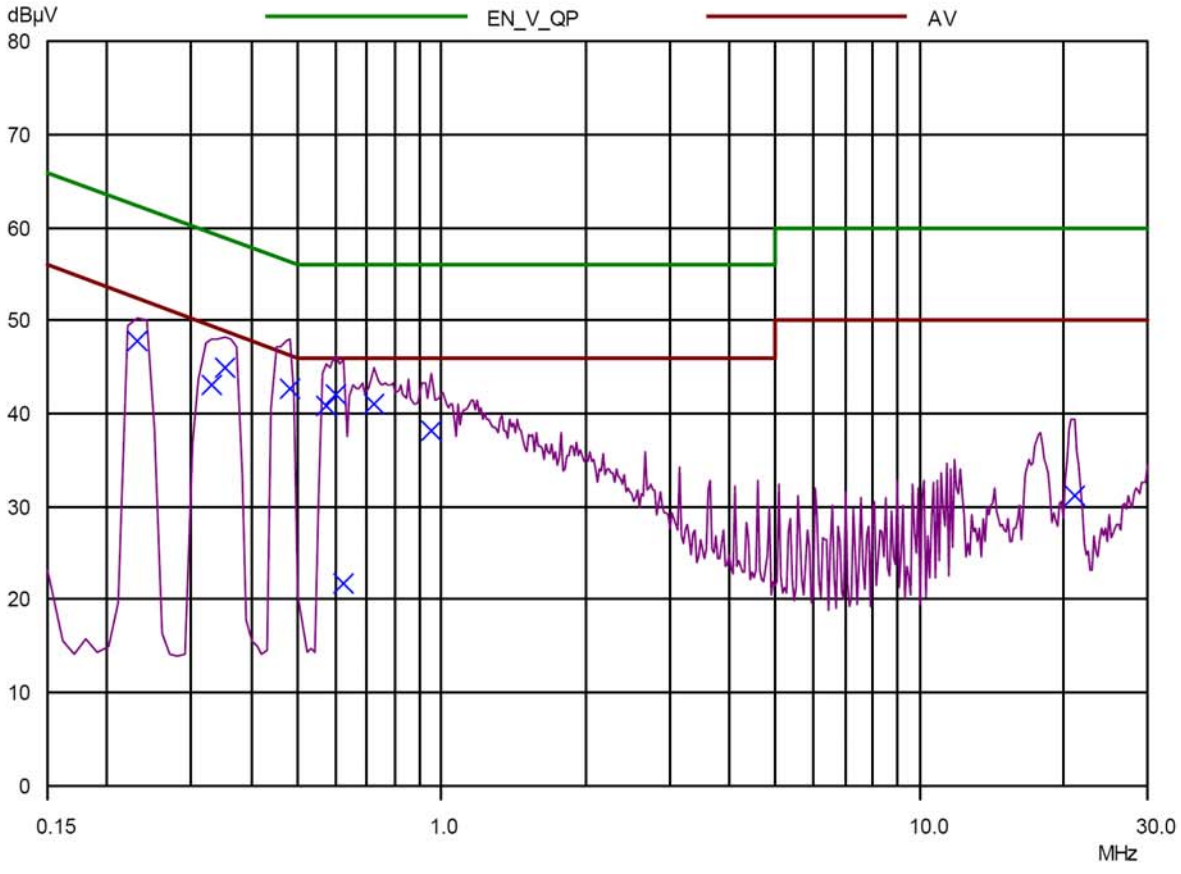
EUT: SFK404
Manuf:
Op Cond:
Operator:
Test Spec:
Comment: LINE-PE

Result File: SFK404L.dat : SFK404

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	10kHz	10kHz	PK	100msec	Auto	OFF	60dB

Final Measurement: Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 35 dB



Neutral - PE

21 May 2004 11:25

CONDUCTED DISTURBANCE

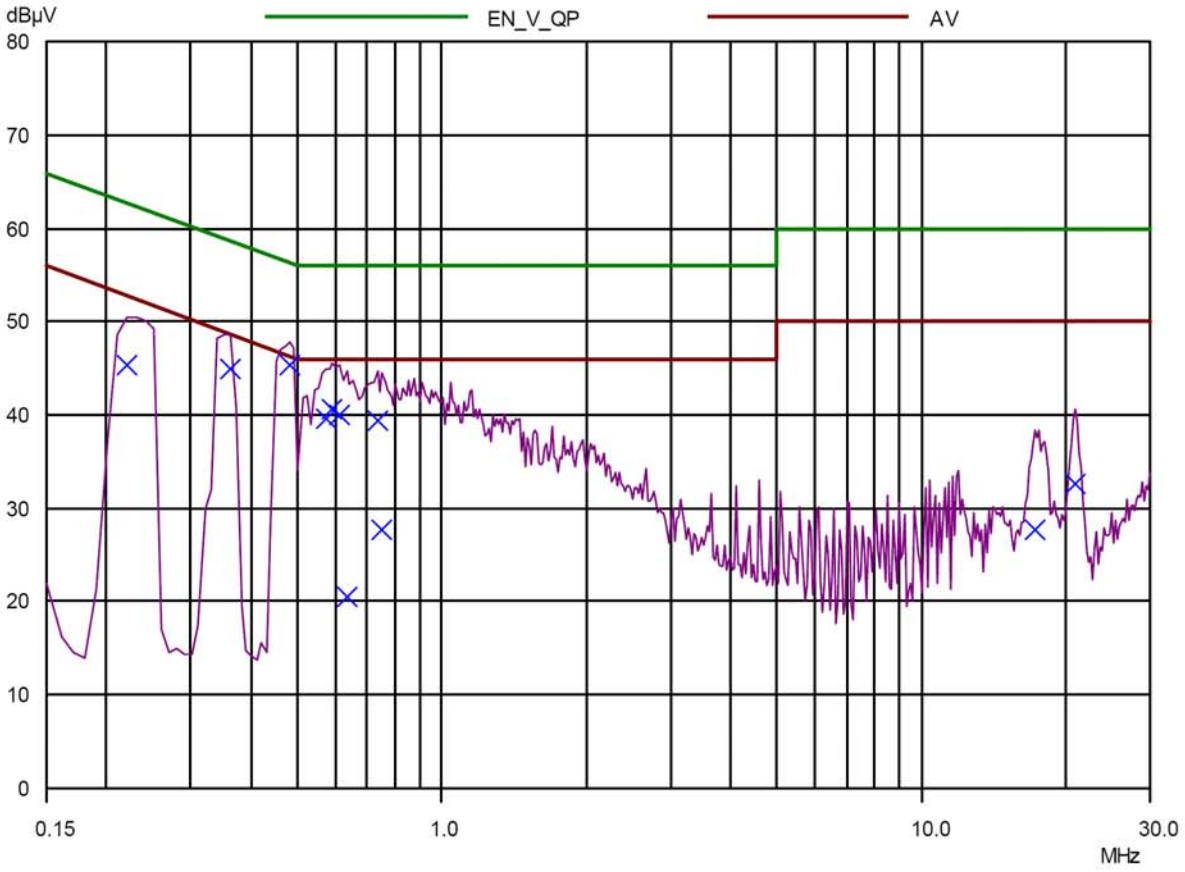
EUT: SFK404
Manuf:
Op Cond:
Operator:
Test Spec:
Comment: NEUTRAL-PE

Result File: sfk404N.dat : SFK404

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	10kHz	10kHz	PK	100msec	Auto	OFF	60dB

Final Measurement: Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 35 dB



5.10 RF Exposure

5.10.1 Regulation

According to §15.247(b)(5), systems operating under the provisions of this section (§15.247) shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines, §1.1307(b)(1).

Limits for Maximum Permissive Exposure: According to §1.1310 and §2.1093, RF exposure is calculated.

Frequency Range	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 equivalent power density

MPE (Maximum Permissive Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

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

$\left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$

S = power density [mW/cm^2]
P = power input to antenna [mW]
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 [cm]

EUT: Maximum peak output power = 0.315[dBm] (= 1.075 [mW]) & Antenna gain = 0[dBi] (= 1 numeric)	
100mW, at 20cm from an antenna 6[dBi]	S = PG/4πR² = 100 × 3.98 / (4 × π × 400) = 0.0792 [mW/cm^2] < 1.0 [mW/cm^2]
1.1mW, at 20cm from the antenna 0[dBi]	S = PG/4πR² = 0.00021884 [mW/cm^2] < 1.0 [mW/cm^2]
1.1mW, at 1cm from the antenna 0[dBi]	S = PG/4πR² = 0.0875 [mW/cm^2] < 1.0 [mW/cm^2]
1.1mW, at 0.3cm from the antenna 0[dBi]	S = PG/4πR² = 0.9726 [mW/cm^2] < 1.0 [mW/cm^2]

NOTE: The antenna used for the EUT is an integral SMD chip antenna. The calculated values of MPE for the EUT show that MPE is safe beyond 0.3 cm from the antenna.

5.10.2 RF Exposure Compliance Issue

The EUT is categorically excluded from routine environmental because it operates at very low power level. The equipment is deemed to comply with the SAR or MPE limits without testing due to this very low power level. The maximum RF EIRP power output from the EUT is less than 1.1mW. If the entire RF power was absorbed by 1 gram of tissue (not possible considering typical RF circuits), the SAR limit of 1.6mW/g would still not be exceed. Therefore no warning labels, no RF exposure warnings in the manual or other protection measures are required for the EUT.