SKT

SK TECH CO., LTD.

Certificate of Compliance

Test Report No.:	**SKTTRT-031210-008**		
NVLAP CODE:	**200220-0**		
Applicant:	**Bluelogic Technology Inc.**		
Applicant Address:	B-B01, 58-7 Jamwon-dong, Seocho-Ku Seoul 137-030, Korea		
Device Under Test:	**Bluetooth Trackball Keyboard**		
FCC ID:	**ROZWingkey**	**Model No.:**	**Wingkey**
Receipt No.:	SKTEU03-0685	**Date of receipt:**	December 5, 2003
Date of Issue:	December 10, 2003		
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:	**FCC Title 47, Part 15 Subpart C / August 26, 2003**		
Equipment Class:	**Part 15 Spread Spectrum Transmitter**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Chang Min, Moon*

12/10/2003

Signature *Date*

Approved by: *Jae-Kyung, Bae*

12/10/2003

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.**

NVLAP®

NVLAP Lab. Code: 200220-0

>> Table of Contents <<

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	ESVS 10	825120/013	10, 2004
EMI Test Receiver	Rohde&Schwarz	ESVS 10	834468/008	10, 2004
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	12, 2003
Spectrum Analyzer	Agilent	E4405B	US40520856	07. 2004
Amplifier	H.P	8447F	3113A05153	10, 2004
Amplifier	H.P	8349B	2644A03250	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	03, 2004
Horn Antenna	Electro Metrics	EM-6961	6298	08, 2004
Horn Antenna	Electro Metrics	EM-6961	6297	08, 2004
Antenna Mast	TOKIN	5907	N/A	N/A
Antenna & Turntable controller	TOKIN	5906	N/A	N/A
50Ω Switcher	Anritsu	MP59B	6100214538	N/A

2.3 Test Date

Date of Application : December 5, 2003

Date of Test : December 5, 2003 ~ December 9, 2003

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.)	EUT (Transmitter)
Power source	DC 4.5V (AA Alkaline Battery x 3)
Transmit Frequency	2402 MHz ~ 2480 MHz
Antenna Type (Gain)	SMD chip antenna (50Ω, 6dBi)
Type of Modulation	FHSS (GFSK)
Rated RF Output power	< 0 dBm
Number of Channels	1 MHz, 79 channels

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 EUT was configured using the special test software so that the EUT changed Carrier Frequency. Conducted RF measurements were performed at 50Ω terminal Antenna port with Spectrum Analyzer after removing SMD chip antenna.

4.2 List of Peripherals

Equipment Type	FCC ID	Manufacture	Model	Serial Number
Notebook (COMPAQ Presario)	DoC	Compaq	CM2080	3892B474
AC Adaptor*	-	Lite-ON ElectronicsCo.,Ltd,	PA-1600-02	1517195CB
Test Jig** (for module control)	-	-	-	-
AC Adaptor**	-	-	-	-

* For use with Compaq Presario Notebook Computer

** For control of Bluetooth Module via UART interface in the EUT.

4.3 Type of Used Cables

Description	Length	Type of shield	Manufacturer	Remark

None

4.4 Uncertainty

Conducted RF power measurement

Uc (Combined standard Uncertainty) = ± 1.49 dB

Expanded uncertainty U = KUc = ±2.98dB (K = 2)

Radiated disturbance

Uc (Combined standard Uncertainty) = ± 2.37 dB

Expanded uncertainty U = KUc = ±4.74dB (K = 2)

5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
Maximum Peak Output Power	15.247(b)(1)	5.2	PASS
Carrier Frequency Separation	15.247(a)	5.3	PASS
Number of Hopping Channels	15.247(a)	5.4	PASS
Time of Occupancy (Dwell Time)	15.247(a)	5.5	PASS
Channel Bandwidth	15.247(a)	5.6	PASS
Spurious Emission, Band Edge, and Restricted bands	15.247(c), 15.209(a)	5.7	PASS
Peak Power Spectral Density	15.247(d)	5.8	PASS
RF Exposure	15.247(b)(5), 1.1307(b)(1)	5.9	PASS
Conducted Emissions*	15.207	*	*

**** Not required, the EUT only employs battery power for operation.***

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

FCC section 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.1.2 Result: PASS

The transmitter has a SMD chip antenna (Gain: 6dBi) and does meet the requirements of this section.

Please refer to the Antenna Specification of Submitted Document**.**

5.2 MAXIMUM PEAK OUTPUT POWER

5.2.1 Regulation

According to §15.247(b)(1), the maximum peak output power shall not exceed 1 watt (30dBm). If directional transmitting antennas with a gain of more than 6 dB are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dB.

5.2.2 Test Procedure

Antenna port of the EUT is connected to the spectrum analyzer RF input.

Using the special test software, the EUT was operated in hopping mode. The low, middle, and high channels were monitored.

The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

5.2.3 Test Results: PASS

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

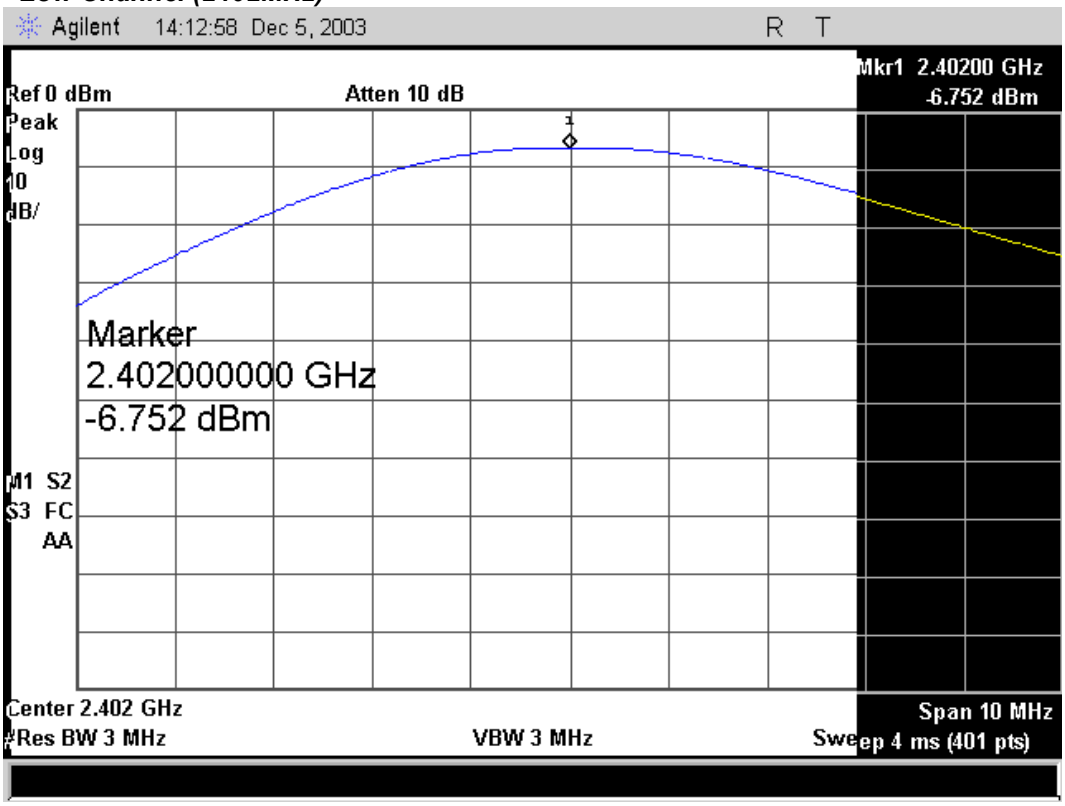
Frequency [MHz]	Resolution Bandwidth [MHz]	Reading [dBm]	Cable Loss [dB]	Actual [dBm]	Limit [dBm]
2402	3	-6.75	0.1	-6.65	30.0
2441	3	-7.90	0.1	-7.80	30.0
2480	3	-10.70	0.1	-10.6	30.0

** Actual = Reading + Cable Loss*

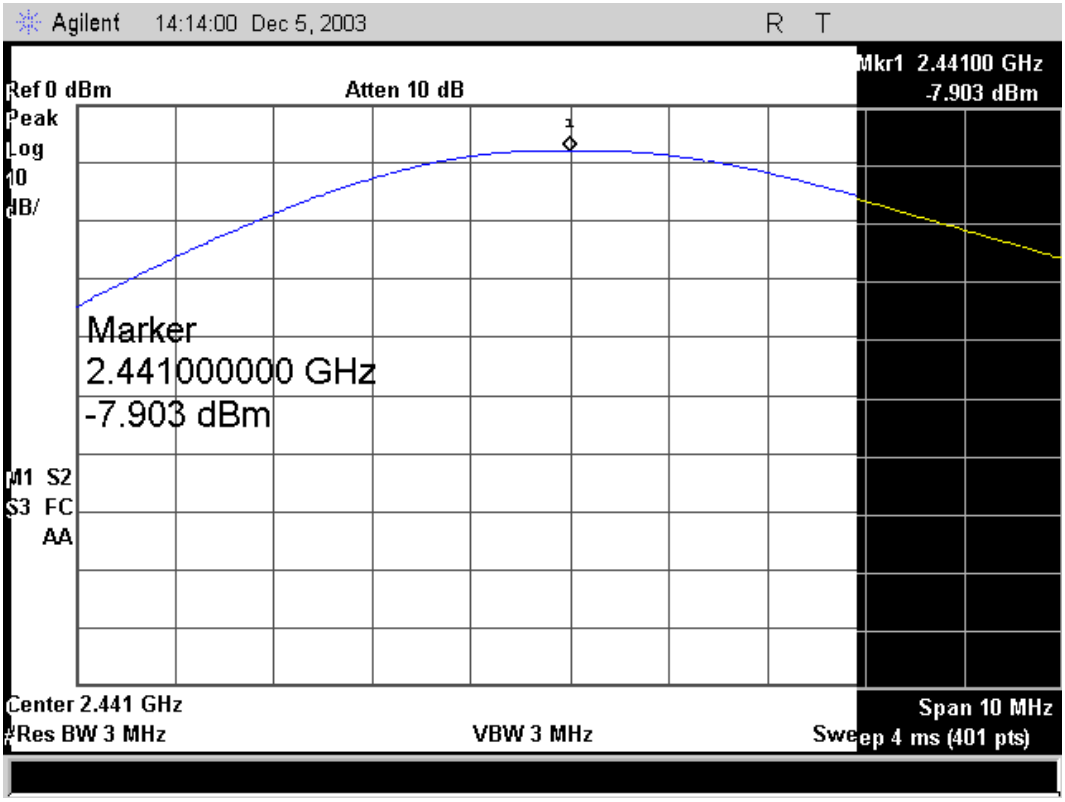
Since the gain of the built-in antenna specified by manufacturer (G_{ant} = 6.0 dBi) does not exceed 6.0 dBi there was no need to reduce the output power.

Plot of the Maximum Peak Output Power (Conducted)

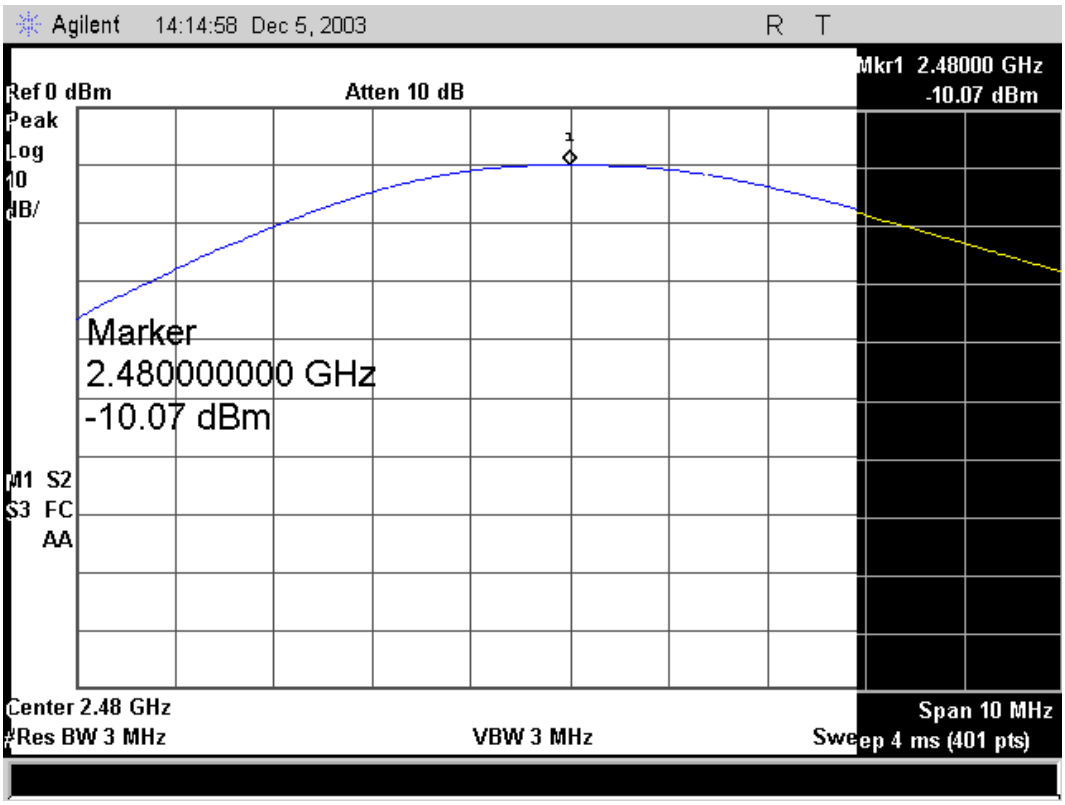
Low Channel (2402MHz)



Middle Channel (2441MHz)



High Channel (2480MHz)



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

Antenna port of the EUT is connected to the spectrum analyzer RF input.

The output of the EUT was controlled using special software and all channels were enabled.

The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

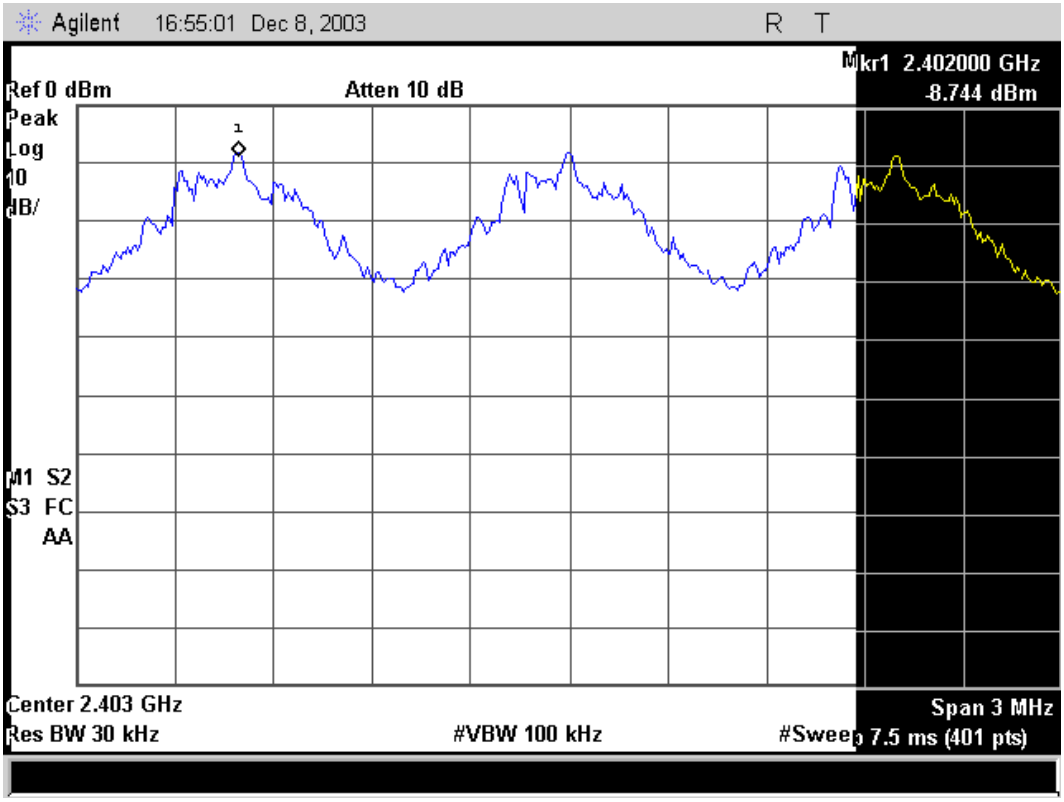
5.3.3 Test Results: PASS

The 20 dB bandwidth of the EUT is 818 kHz (See section 5.6 in this test report).

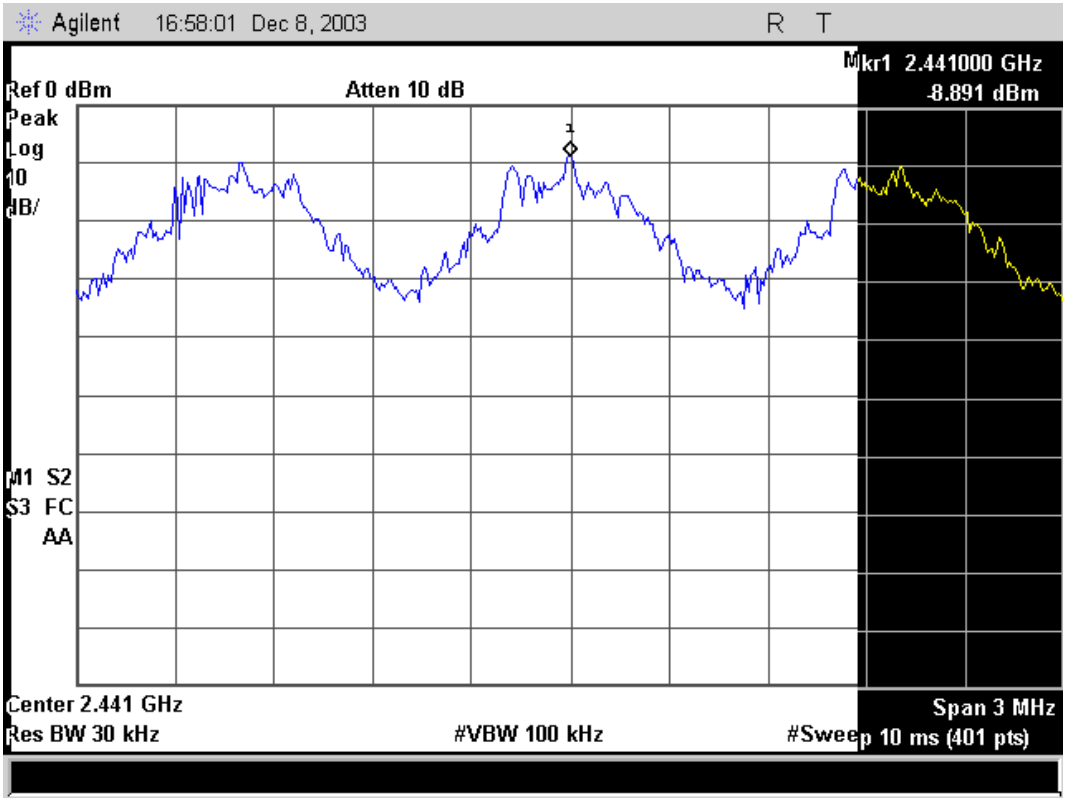
The test results of the channel separation are depicted in the plot.

Plot of the Carrier Frequency Separation (Conducted)

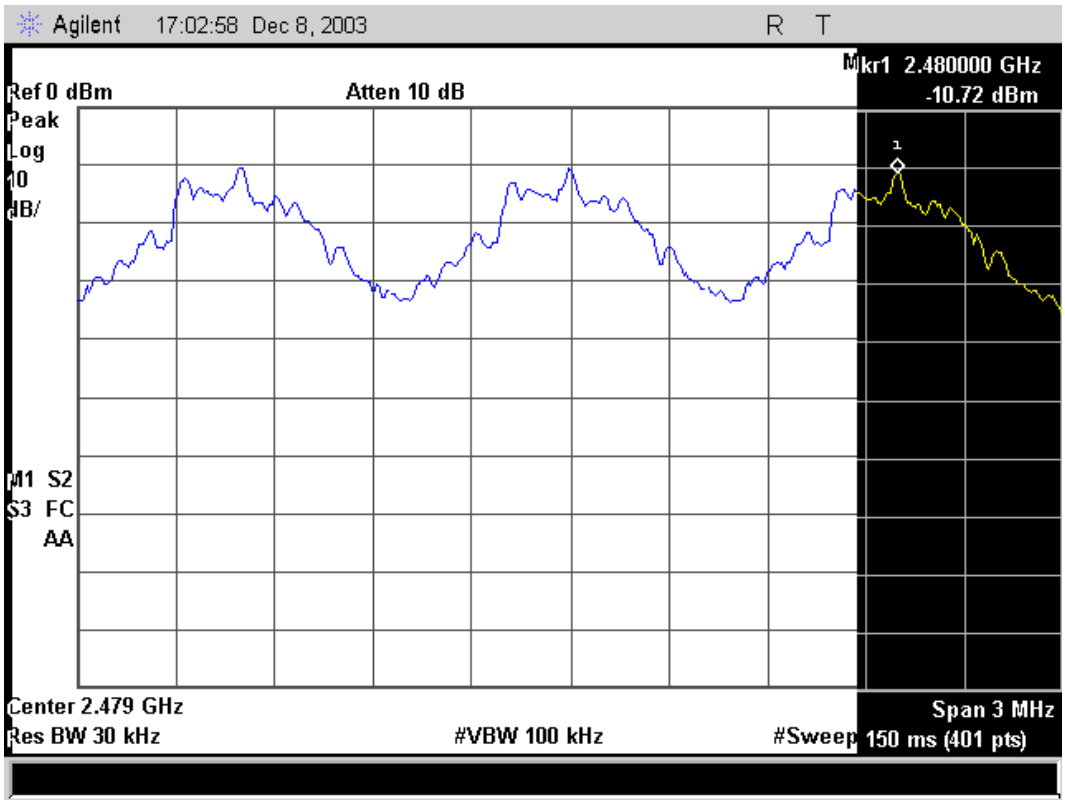
Low Channel (2402MHz)



Middle Channel (2441MHz)



High Channel (2480MHz)



5.4 Number of Hopping Channels

5.4.1 Regulation

According to §15.247(a)(1), The minimum number of Hopping frequencies is 75.

5.4.2 Test Procedure

Antenna port of the EUT is connected to the spectrum analyzer RF input.

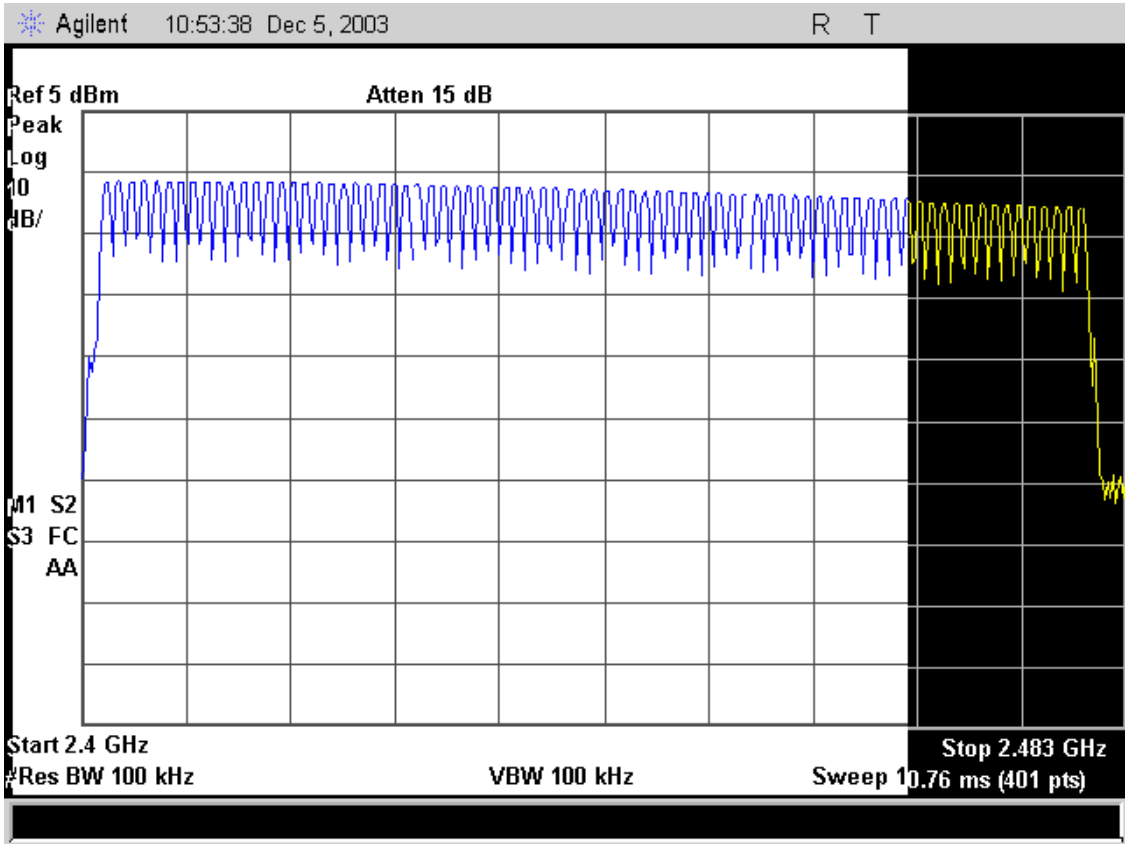
The output of the EUT was controlled using special software and all channels were enabled.

The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

5.4.3 Test Results: PASS

*Measurements were performed over 4 bands of approximately 20 MHz each. The graphical data of the 4 bands was combined and is displayed below. A total of **79** equally spaced channels were detected. The plot on the next page shows the results of the measurement of the number of hopping frequencies on the EUT.*

Plot of the Number of Hopping Frequencies(Conducted)



5.5 Time of Occupancy(Dwell Time)

5.5.1 Regulation

According to §15.247(a)(1), The maximum dwell time within any 30-second period is 0.4 Second.

5.5.2 Test Procedure

The transmitter output is connected to the spectrum analyzer RF input.

Using special test software, EUT was operated in hopping mode. The low, middle, and high channels were monitored.

The 6 dB bandwidth of the transmitter is defined as the portion of the signal, which is higher than peak signal minus 6 dB.

The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

5.5.3 Test Results: PASS

The single channel dwell time for each channel is well under the 0.4 second limit.
An explanation of how the results were arrived at is provided below.

The dwell time over a 30 second period can be calculated by measuring the pulse duration of a single hop and multiplying that measurement by the hopping rate and the 30 second period and then dividing by the number of channels. The EUT hops over 79 channels.
The maximum hopping rate is 1600 hops/second. A sample calculation is provided:

(single Hop Dwell × Hopping Rate)/(Total number of Channels)× Period = Total Dwell Time
(0.0004252 × 1600) / 79 × 30 = 0.258 Seconds

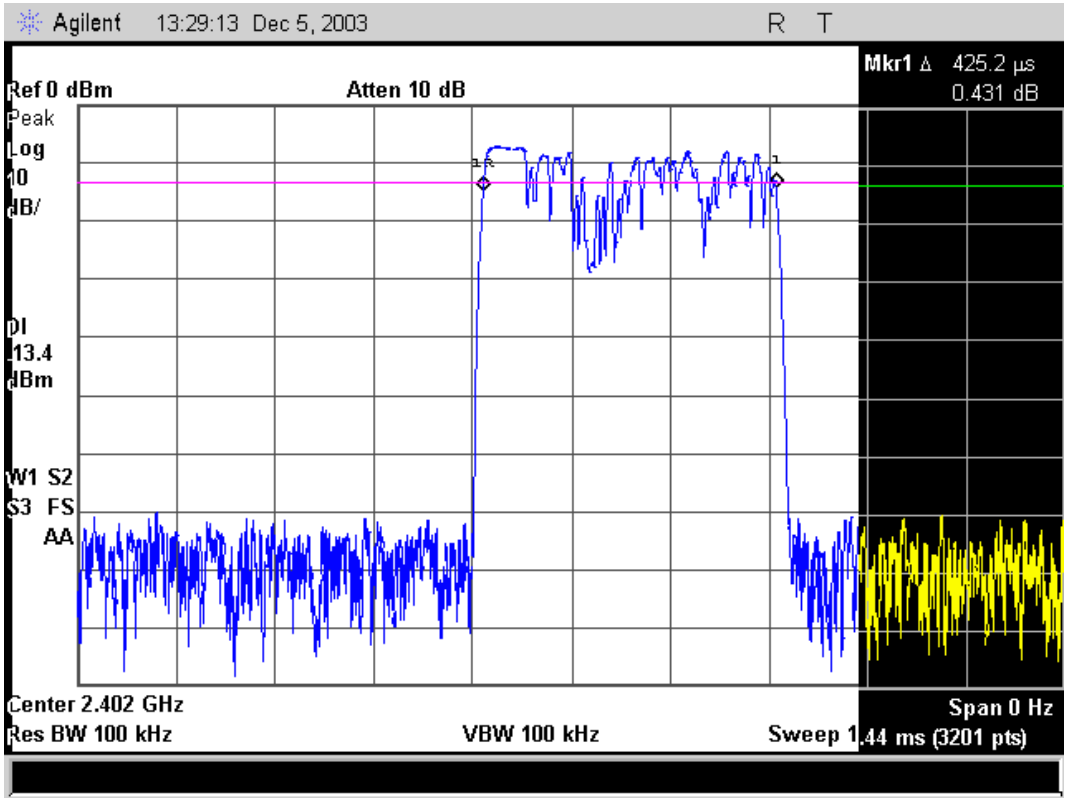
The dwell time results are summarized in the table below.

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

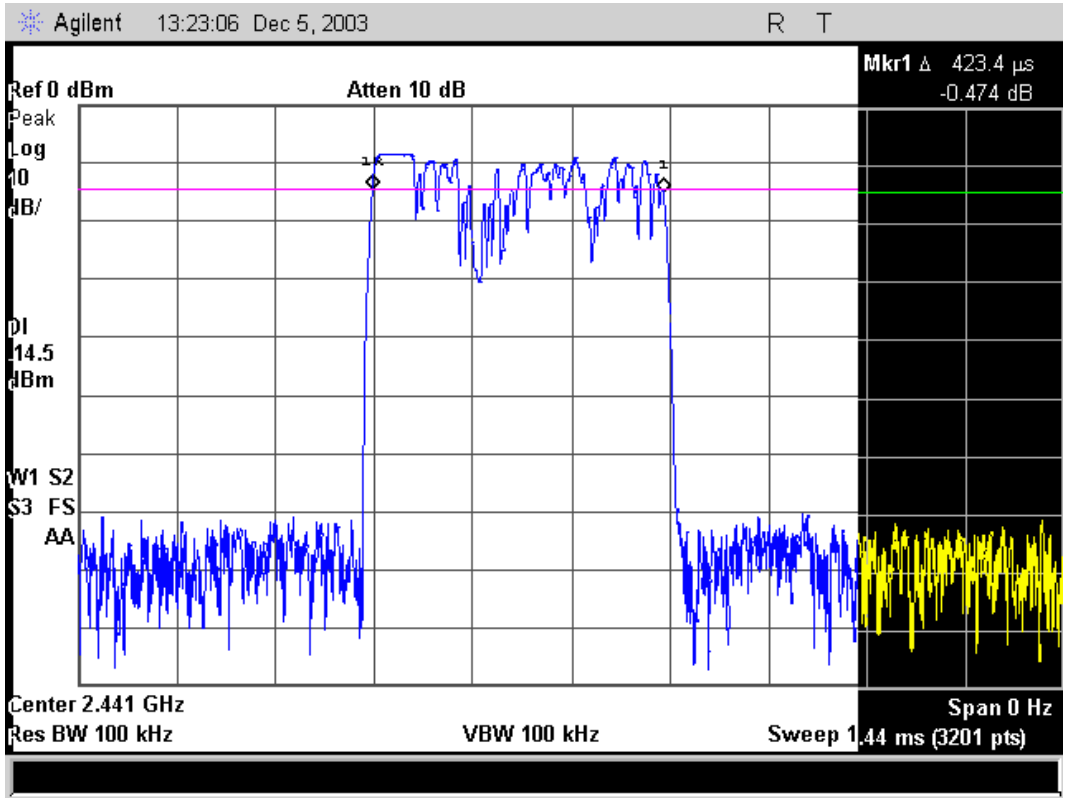
Frequency [MHz]	Single Hop Dwell [second]	Hopping Rate [hops/sec]	Total number of channels	Period [second]	Total single channel 30 Second Dwell Time [second]	Limit [second]
2402	0.0004252	1600	79	30	0.258	0.4
2441	0.0004234	1600	79	30	0.257	0.4
2480	0.0004216	1600	79	30	0.256	0.4

Plot of the Time of Occupancy (Conducted)

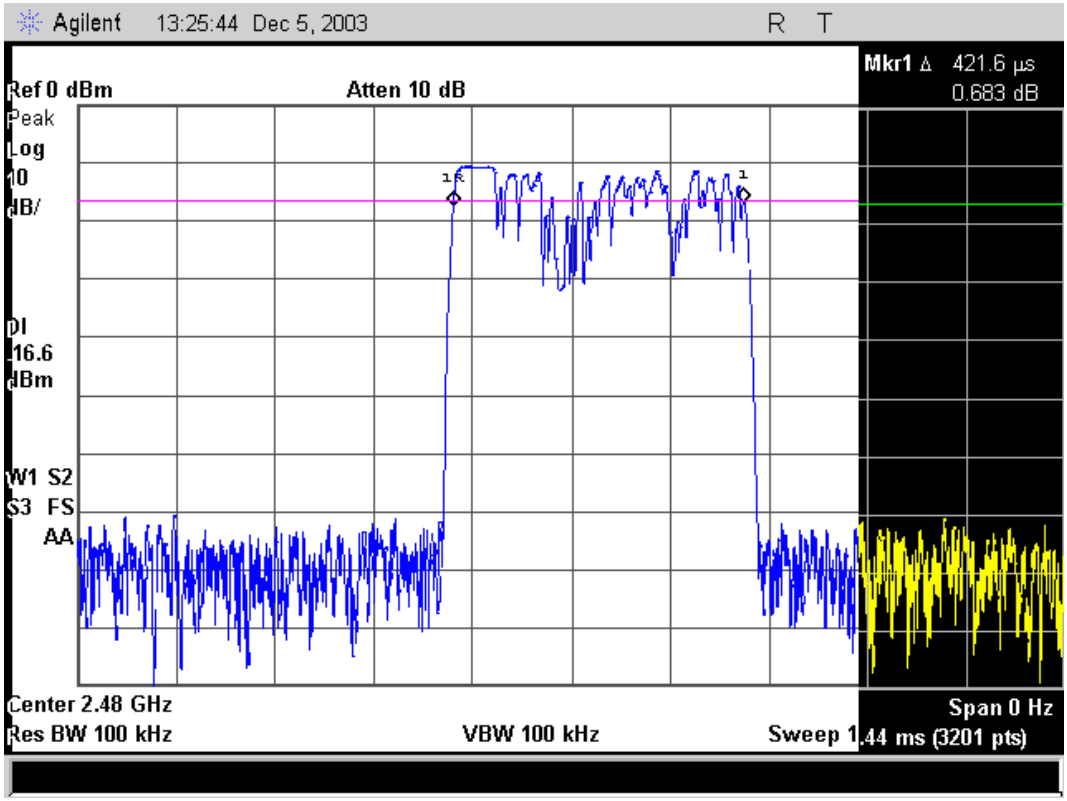
Low channel (2402MHz)



Middle channel (2441MHz)



High channel (2480MHz)



5.6 Channel Bandwidth

5.6.1 Regulation

According to §15.247(a)(1), The maximum 20 dB bandwidth of the hopping channel is 1MHz.

5.6.2 Test Procedure

20 dB channel bandwidth measurements were performed at three operating frequencies: the low, middle, and high channels.

The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

5.6.3 Test Results: PASS

Table of Measured values of the Channel Bandwidth (Conducted)		
Operating frequency	20 dB Bandwidth	Limit
2402 MHz	808 kHz	*1 MHz*
2441 MHz	818 kHz	*1 MHz*
2480 MHz	816 kHz	*1 MHz*

Plot of the Channel Bandwidth (Conducted)

Low Channel(2402MHz)

Middle Channel(2441MHz)

High Channel(2480MHz)

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 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)).

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

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) RF Antenna Conducted Test: The EUT was configured to operate at maximum power and the antenna port was connected to the spectrum analyzer. Set the spectrum analyzer as following: RBW = 100 kHz, VBW = 100 kHz, scan up through 10^{th} harmonic. Record harmonics/spurious.

2) Tests for Restricted Bands: The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters. The EUT was placed on the top of the 0.8 meter high, 1 x 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°. 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. To obtain the final test data, the EUT was arranged on a turntable situated on a 4x4 meter at the Open Area Test Site. The EUT was tested at a 3-meter test distance. 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. 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.

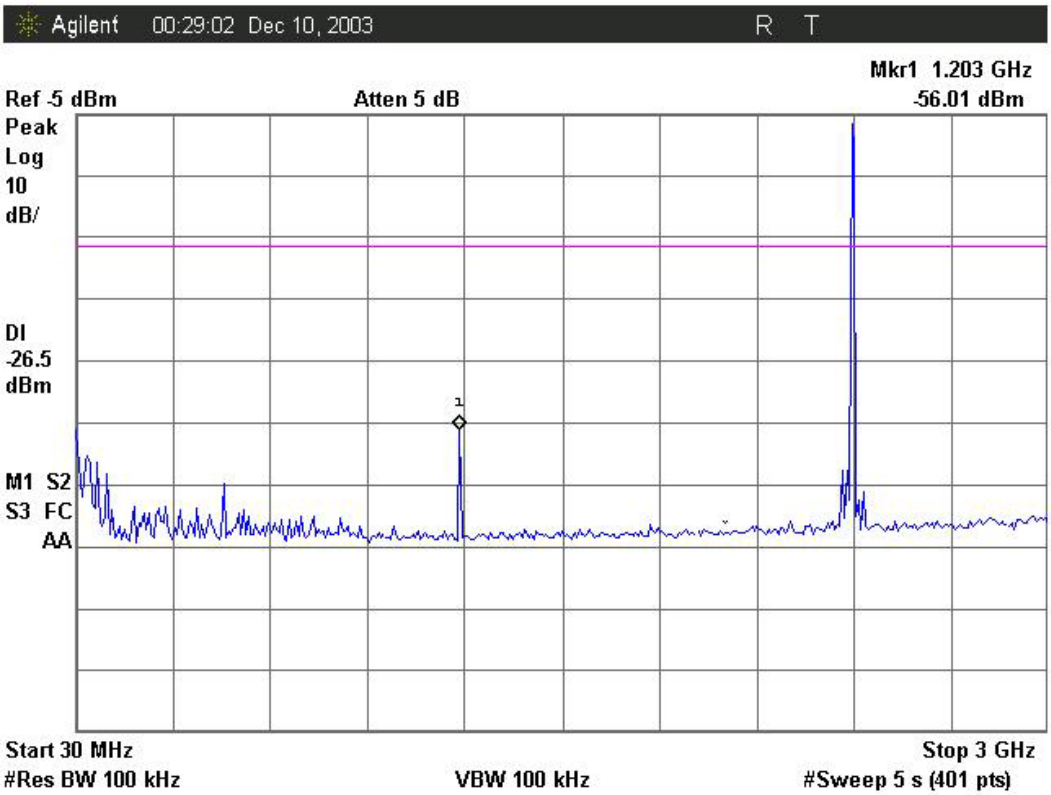
5.7.3 Test Results: PASS

Measured values of the RF antenna port emission (Conducted)_Low Channel(2402MHz)					
Frequency (MHz)	Reading (dBm)	Cable Loss (dB)	Actual (dBm)	Limit (dBm)	Margin (dB)
2402	-6.43	0.1	-6.33	-	-
1201.5	-55.97	0.1	-55.87	- 26.33	29.54
7205.5	-68.98	0.3	-68.68	- 26.33	42.35

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

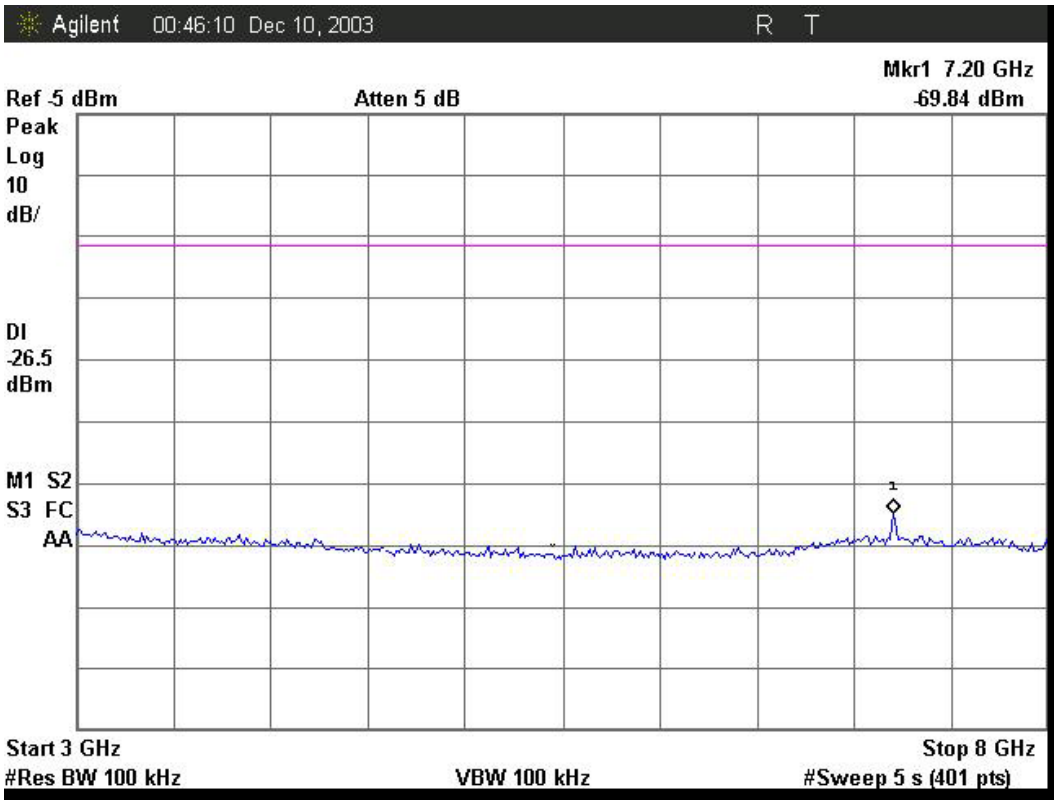
Plot of the RF antenna port emission (Conducted): 30 MHz ~ 3 GHz

Low Channel (2402MHz)



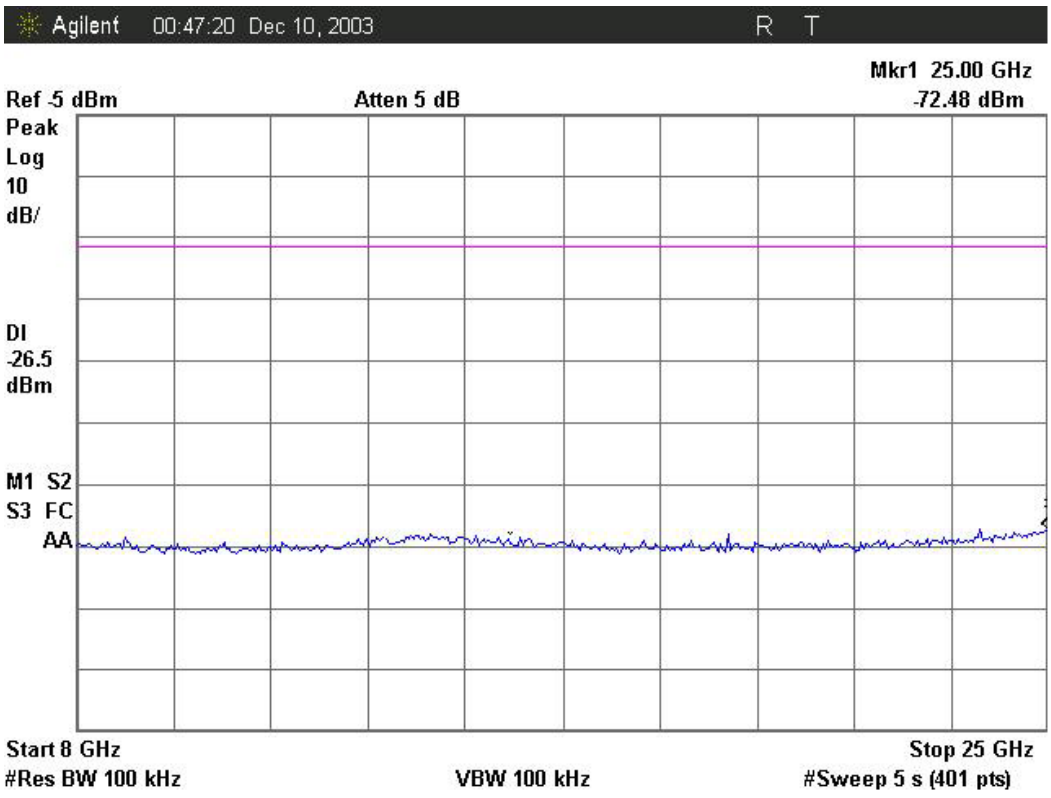
Plot of the RF antenna port emission (Conducted): 3 GHz ~ 8 GHz

Low Channel (2402MHz)



Plot of the RF antenna port emission (Conducted): 8 GHz ~ 25 GHz

Low Channel (2402MHz)

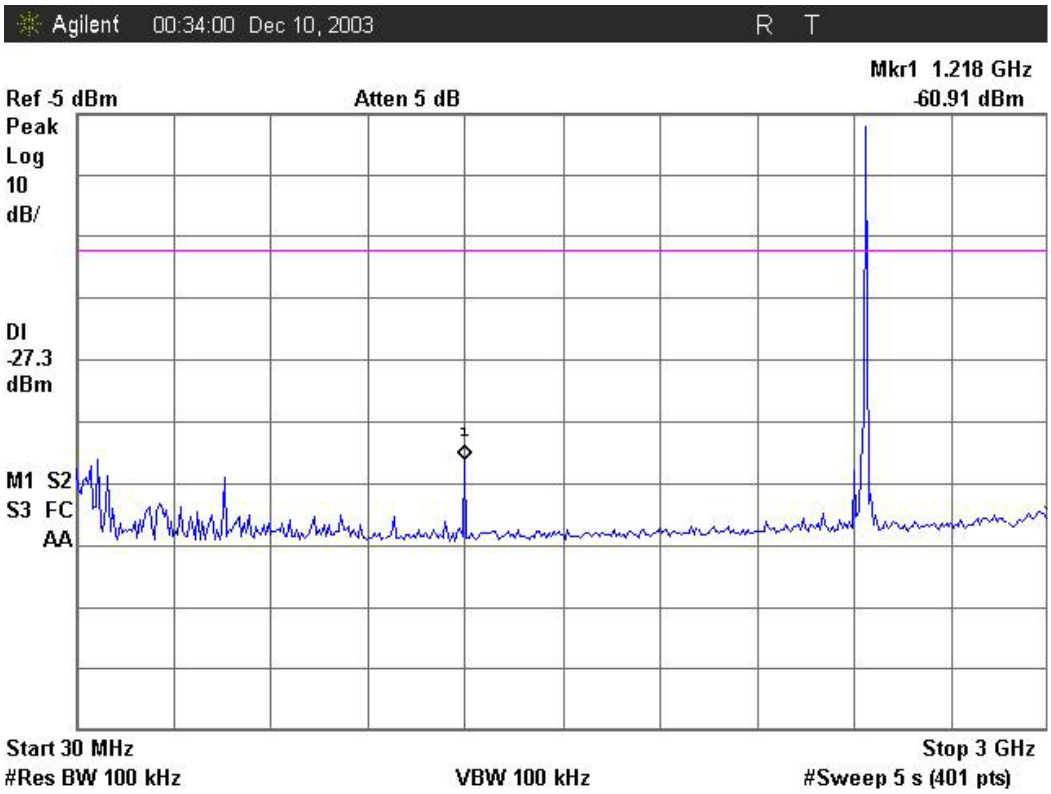


Measured values of the RF antenna port emission (Conducted)_Middle channel(2441MHz)					
Frequency (MHz)	Reading (dBm)	Cable Loss (dB)	Actual (dBm)	Limit (dBm)	Margin (dB)
2441	-7.15	0.1	-7.05	-	-
1221	-60.00	0.1	-59.90	- 27.05	32.85
3050	-72.74	0.1	-72.64	- 27.05	45.59

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

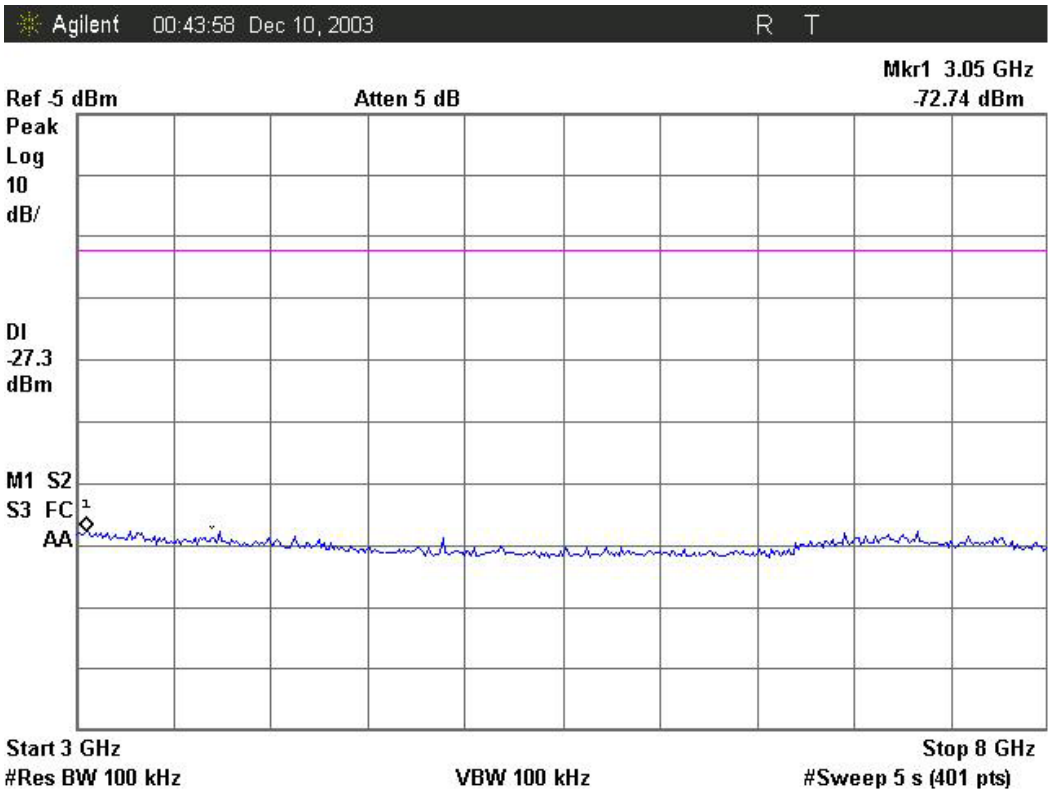
Plot of the RF antenna port emission (Conducted): 30 MHz ~ 3 GHz

Middle Channel (2441MHz)



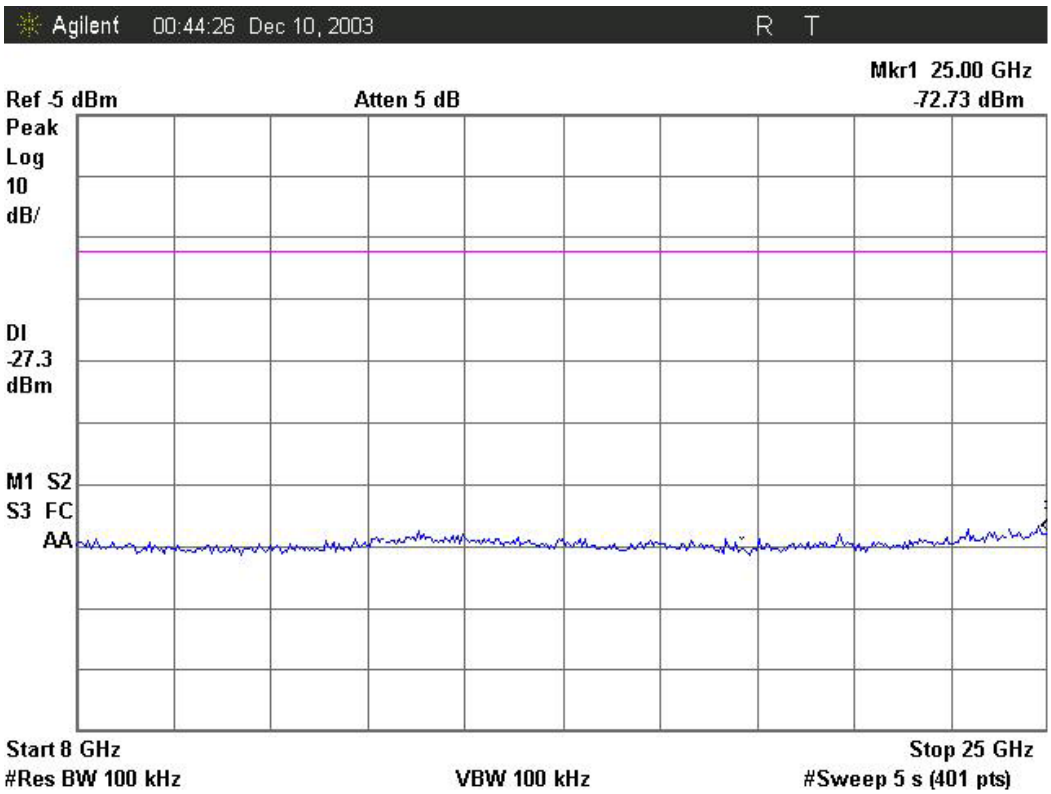
Plot of the RF antenna port emission (Conducted): 3 GHz ~ 8 GHz

Middle Channel (2441MHz)



Plot of the RF antenna port emission (Conducted): 8 GHz ~ 25 GHz

Middle Channel (2441MHz)

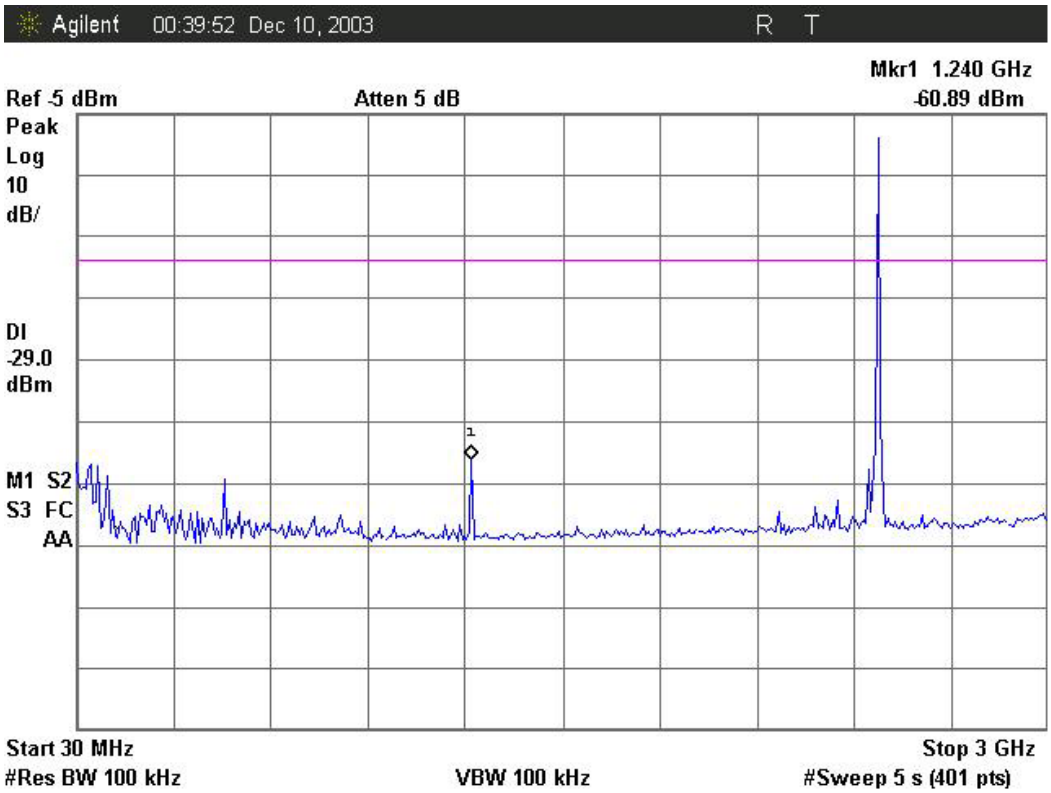


Measured values of the RF antenna port emission (Conducted)_High channel(2480MHz)					
Frequency (MHz)	Reading (dBm)	Cable Loss (dB)	Actual (dBm)	Limit (dBm)	Margin (dB)
2480	-8.96	0.1	-8.86	-	-
1240.5	-61.15	0.1	-61.05	- 28.86	32.19
4960	-66.84	0.2	-66.64	- 28.86	37.78

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

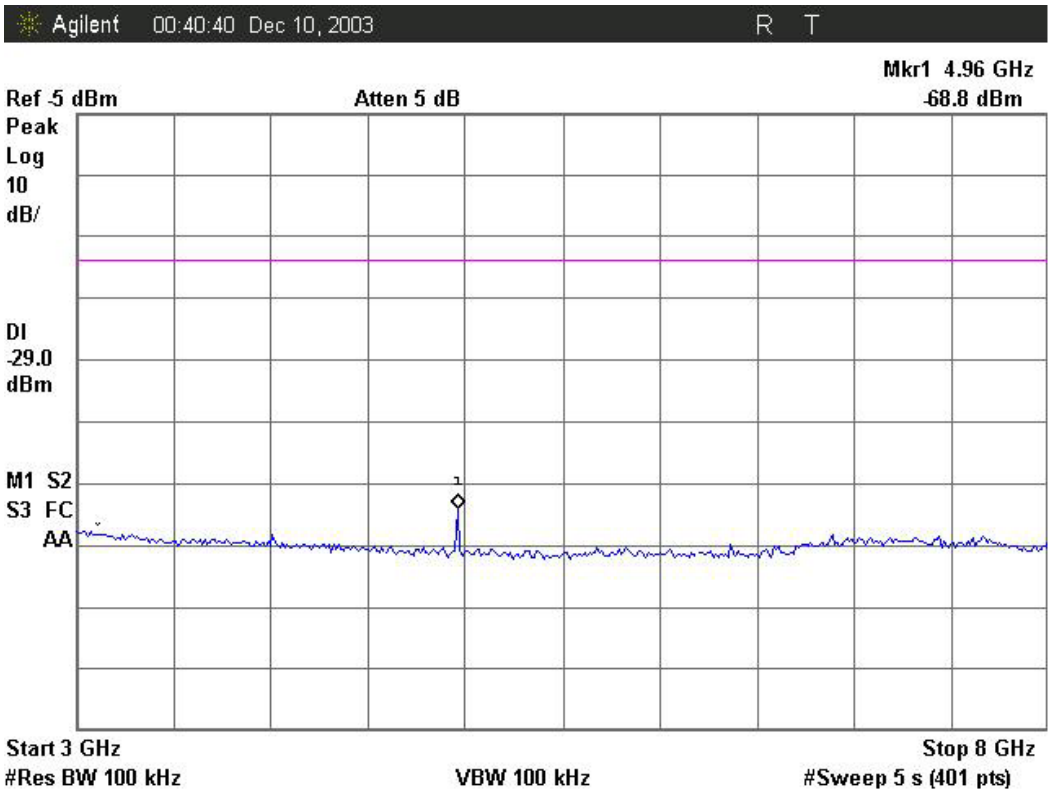
Plot of the RF antenna port emission (Conducted): 30 MHz ~ 3 GHz

High Channel (2480MHz)



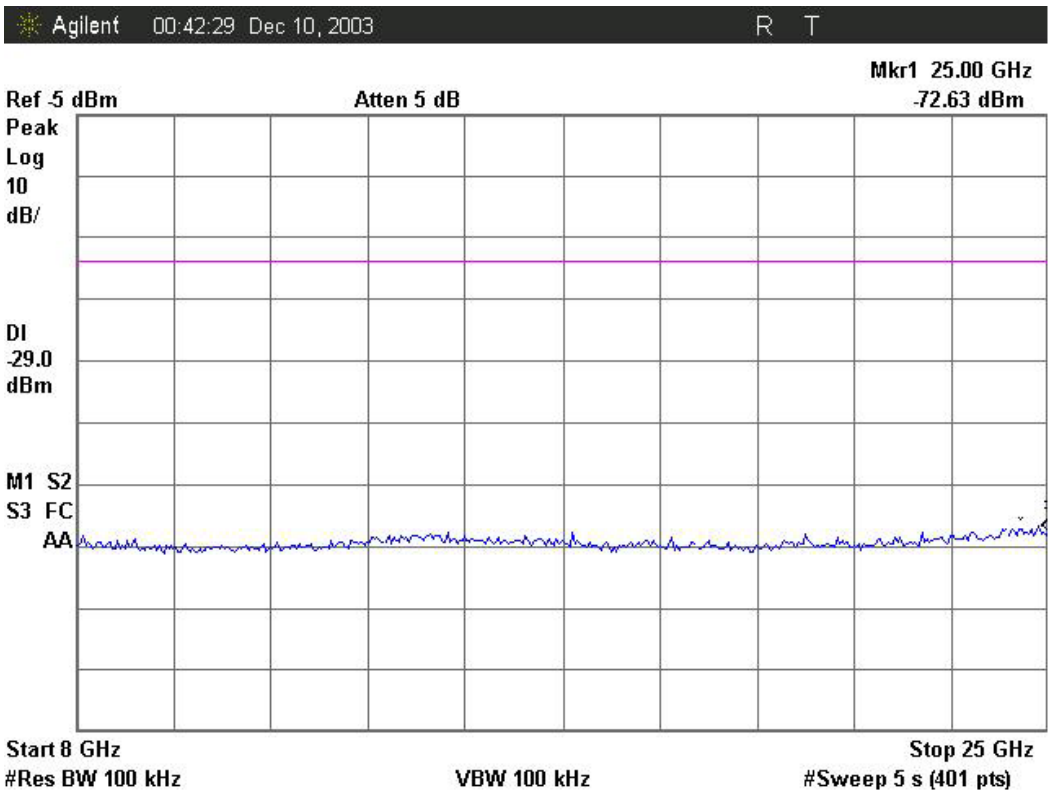
Plot of the RF antenna port emission (Conducted): 3 GHz ~ 8 GHz

High Channel (2480MHz)



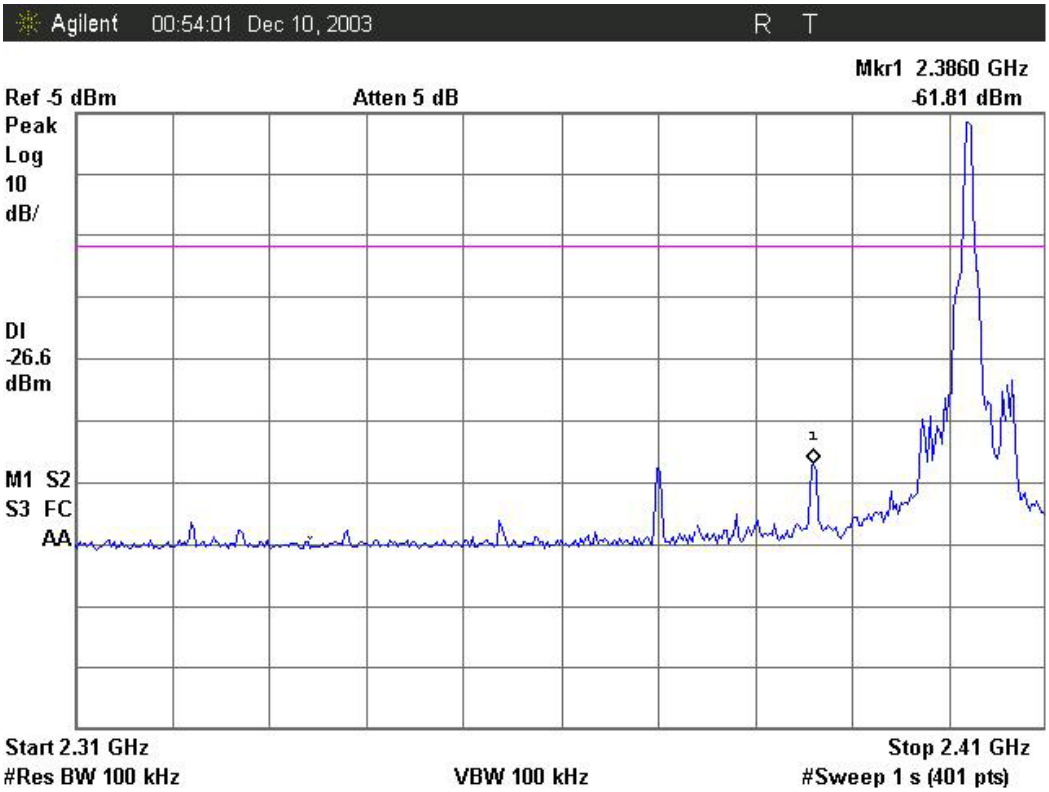
Plot of the RF antenna port emission (Conducted): 8 GHz ~ 25 GHz

High Channel (2480MHz)



Plot of the Lower Band Edge (Conducted): 2310 ~ 2390 MHz

Low Channel(2402MHz)



Plot of the Higher Band Edge (Conducted): 2483.5 ~ 2500MHz

High Channel (2480MHz)

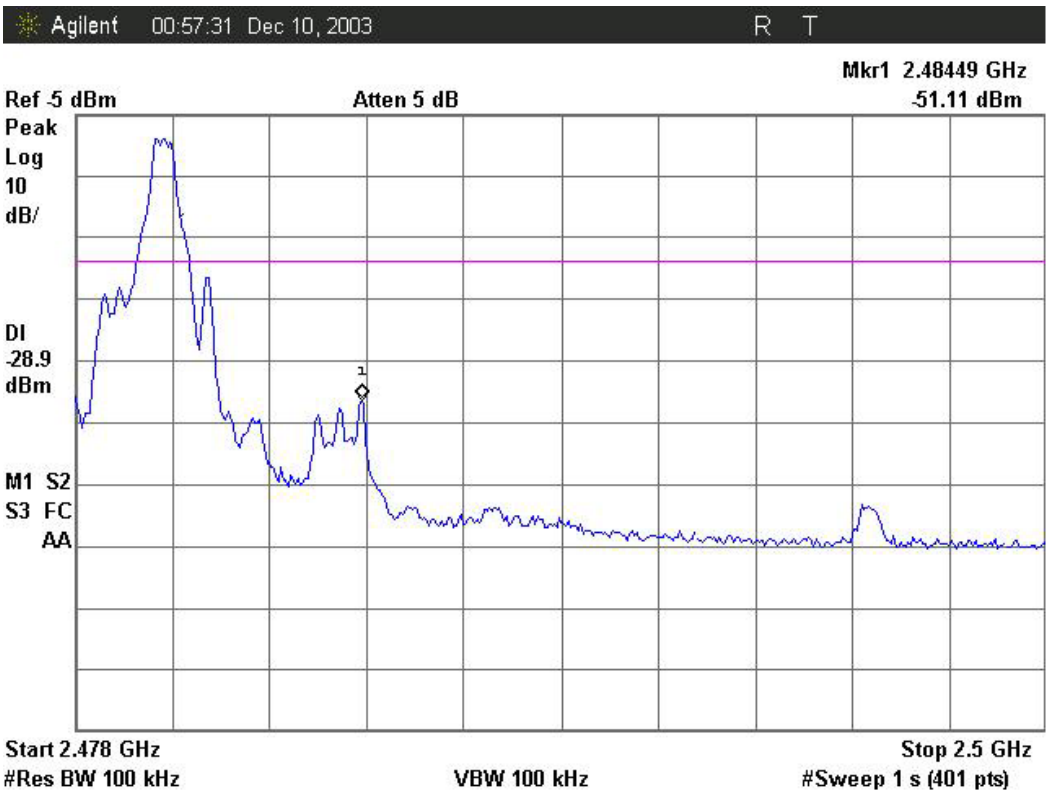


Table of Measured values of the Field strength in the Restricted bands (Radiated)										
Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. (V/H)	Antenna Height [m]	Table Angle [°]	Reading [dB(μV)]	Amp Gain [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz										
	120									
AVERAGE data, emissions above 1000 MHz										
	1000									
PEAK data, emissions above 1000 MHz										
	1000									

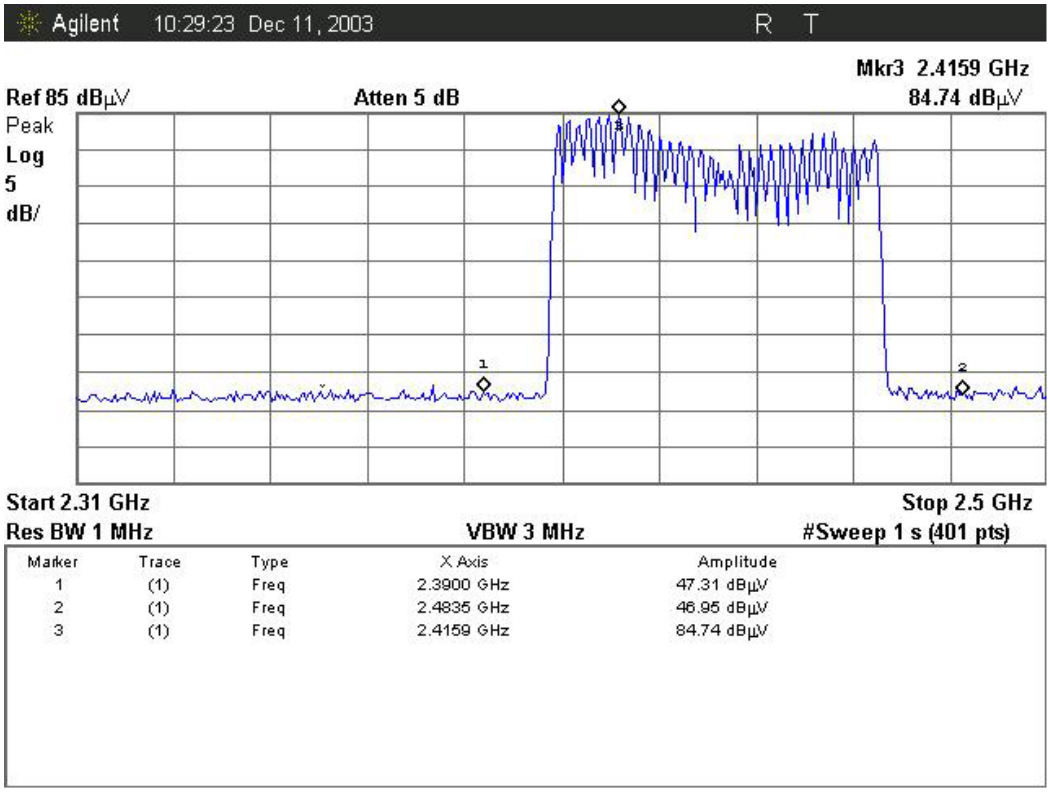
No emissions found

1. *H = Horizontal, V = Vertical Polarization*
2. *AF/CL = Antenna Factor and Cable Loss*
3. *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.*

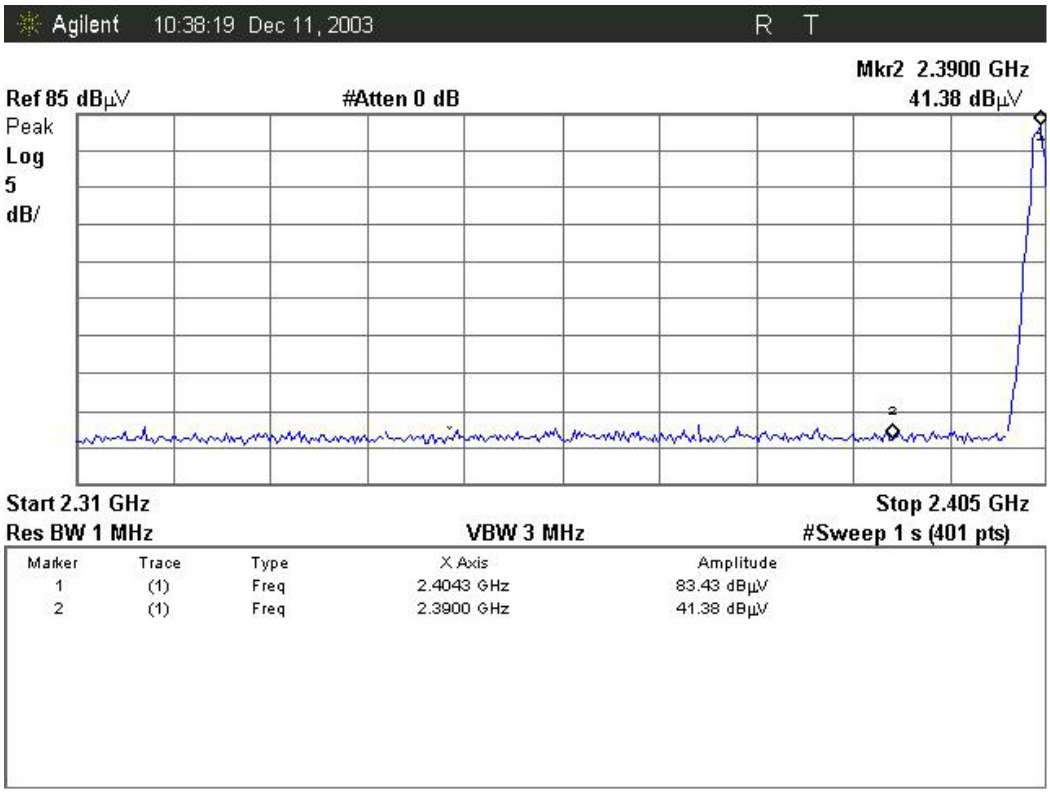
Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + AF + CL]

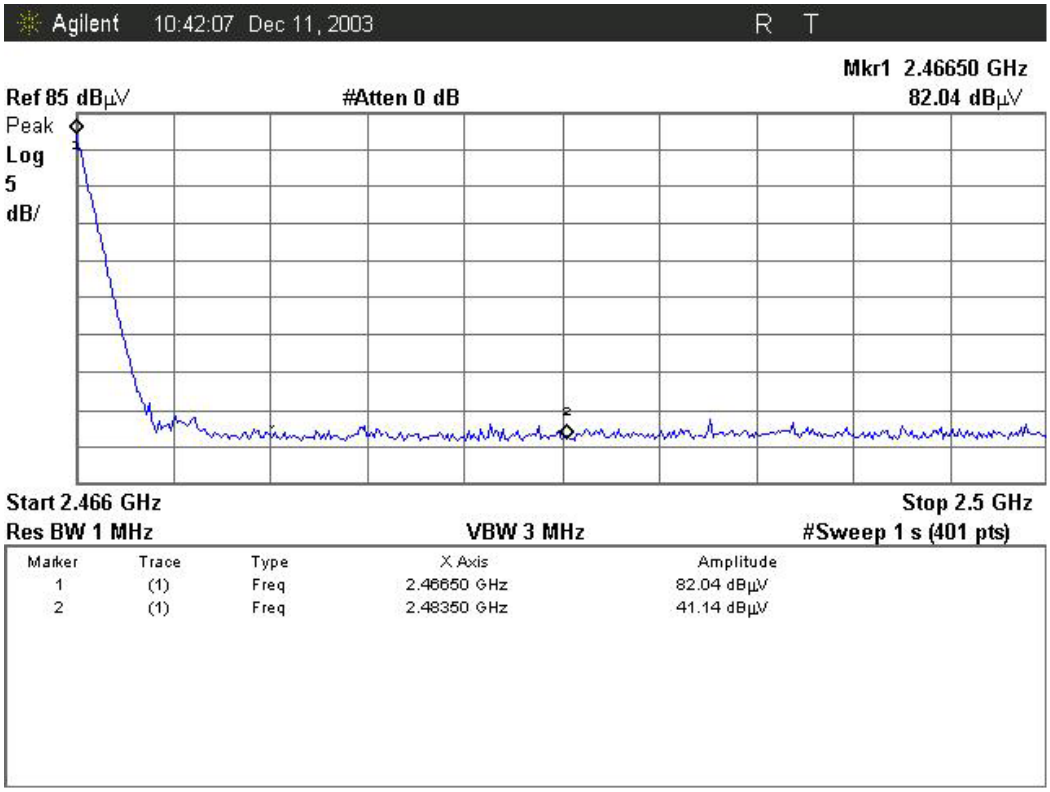
Plot of the Band Edge (Radiated) – Hopping activated: 2310 ~ 2500 MHz



Plot of the Low Band Edge (Radiated) – Hopping activated: 2310 ~ 2390MHz



Plot of the High Band Edge (Radiated) – Hopping activated: 2483.5 ~ 2500MHz



5.8 PEAK POWER SPECTRAL DENSITY

5.8.1 Regulation

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 3 kHz band during any time interval of continuous transmission.

5.8.2 Test Procedure

The Peak Power Spectral Density of the EUT was measured at the antenna port conducted from the transmitter using a spectrum analyzer.

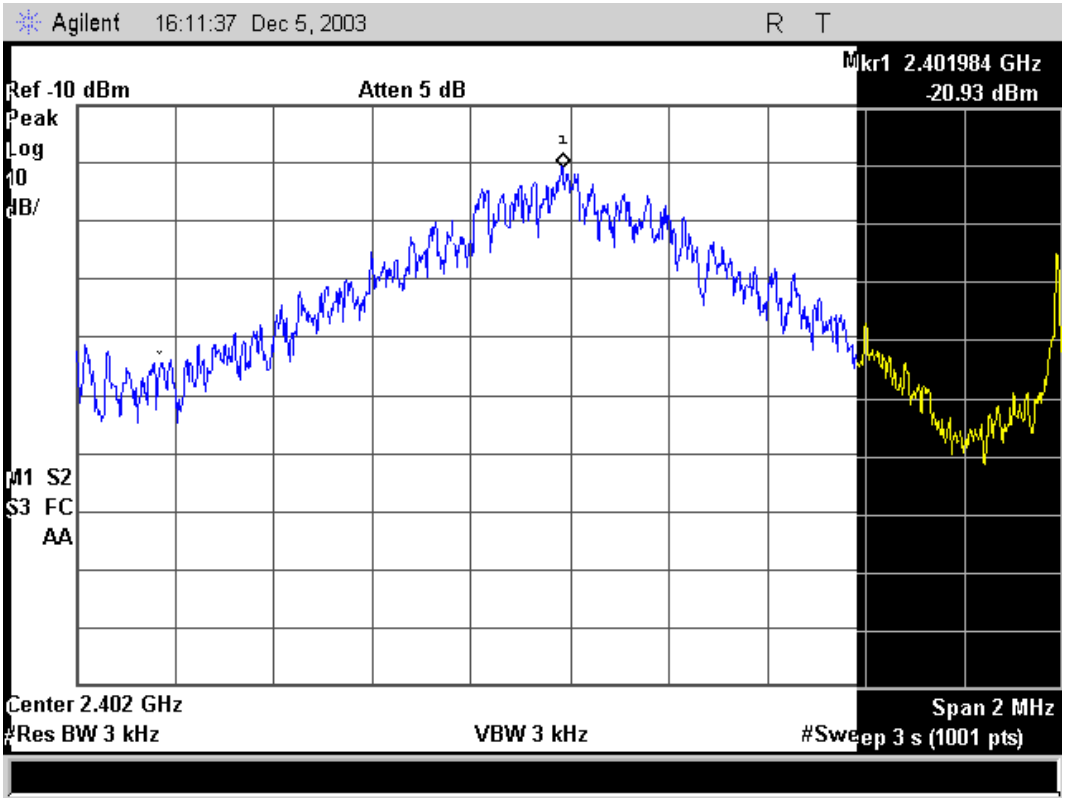
The setting of the spectrum analyzer, RBW/VBW is depicted in the plot.

5.8.3 Test Results: PASS

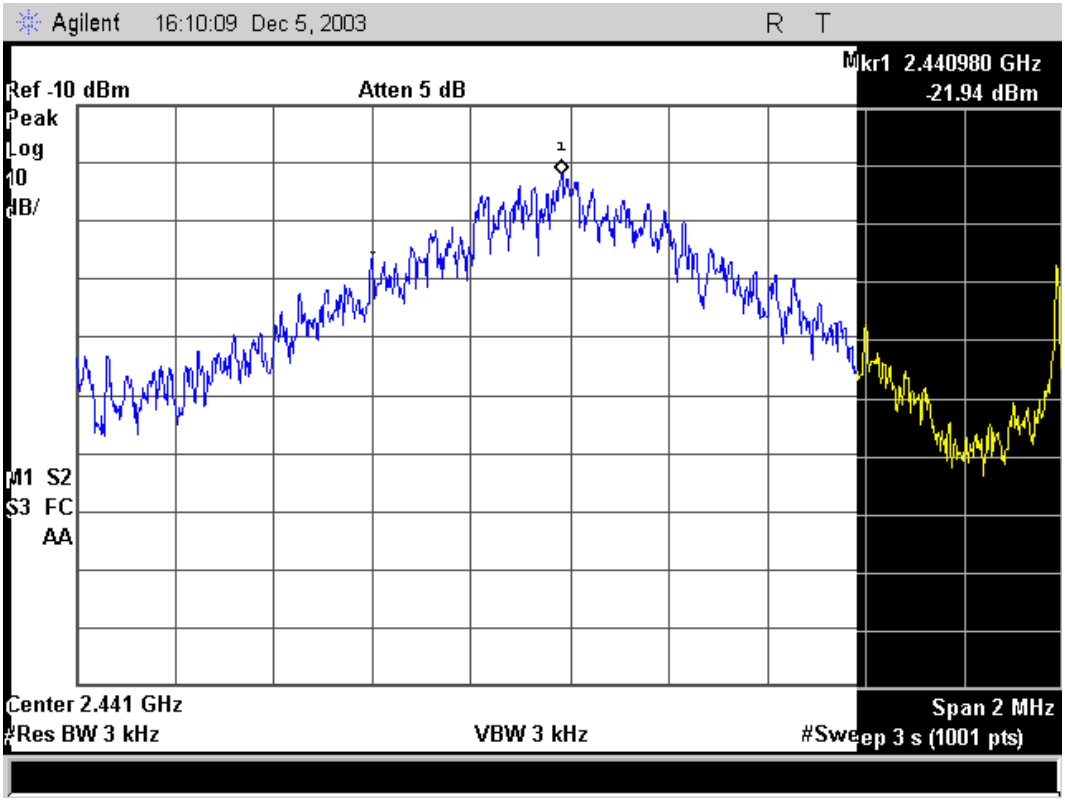
Table of Measured values of the Peak Power Spectral Density (Conducted)				
Operating frequency (MHz)	Reading (dBm/3kHz)	Cable Loss (dB)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)
2402	-20.93	0.1	-20.83	8.00
2441	-21.94	0.1	-21.84	8.00
2480	-24.07	0.1	-23.97	8.00

Plot of the Peak Power Spectral Density (Conducted)

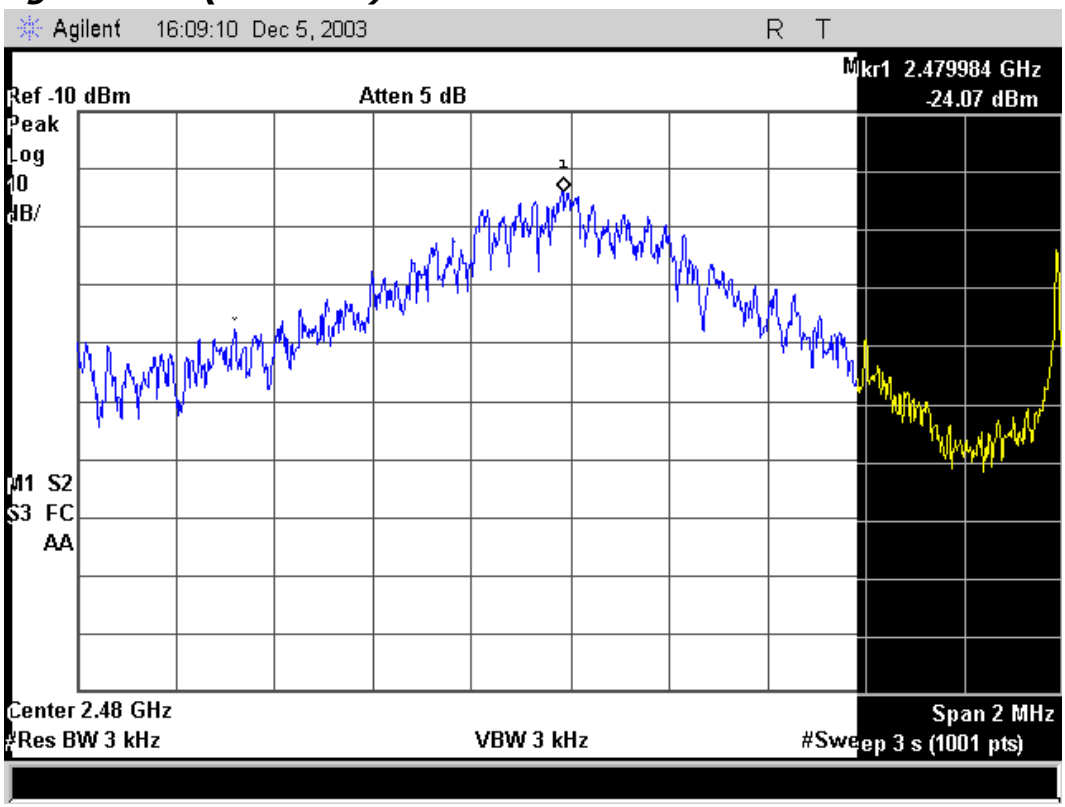
Low channel(2402MHz)



Middle channel(2441MHz)



High channel(2480MHz)



5.9 RF Exposure

5.9.1 Regulation

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

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

Limits for Maximum Permissive Exposure (MPE)

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

5.9.2 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 mW. 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.