FCC CFR47 PART 15 SUBPART C
CERTIFICATION
TEST REPORT

FOR

BLUETOOTH MODULE

MODEL NUMBER: 3e-250

BRAND NAME: 3e-250 BLUETOOTH TO RS232 CORDLESS ADAPTER

FCC ID: QVT250-01

REPORT NUMBER: 03U1756-1

ISSUE DATE: JANUARY 30, 2003

Prepared for
3E TECHNOLOGIES INTERNATIONAL INC.
700 KING FARM BLVD, SUITE 600
ROCKVILLE, MD 20850, USA.

Prepared by
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1. TEST RESULT CERTIFICATION

COMPANY NAME: 3E TECHNOLOGIES INTERNARIONAL INC.
700 KING FARM BLVD., SUITE 600
ROCKVILLE, MD 20850

EUT DESCRIPTION: BLUETOOTH TO RS232 CORDLESS ADAPTER

MODEL NAME: 3e-250

DATE TESTED: JANUARY 20 – JANUARY 30, 2003

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

MIKE HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

CHIN PANG
EMC TECHNICIAN
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The 3e-250 Bluetooth to RS232 Cordless Adapter is a Plug and Play adapter that allows you to use your RS232 (Serial) Port to communicate wirelessly between multiple pieces of equipment.

In itself, the 3e-250 required no installation of software or drivers on the host machine. It doesn't initiate communications, but simply direct communication between equipment such as data recorders, computers, handheld devoices, test electronics equipment devices and the like.

It enables users to connect measurement device wirelessly to a central analysis and recording area, eliminating the need to download information from an unconnected measurement device.

The adapter incorporates a Bluetooth solution containing a BT 1.1 complaint transceiver operating in the 2.4GHz range using frequency hopping at 1600 times/sec among the available frequency ranges.

The operating rang of the 3e-250 is up to 30m or 100feet. It provides link control functionality and supports operation within a Bluetooth piconet in a slave mode. It supports all Bluetooth data rates of up to 723 Kbits/sec.

The following technical description details apply to the EUT project

Modulation: Frequency Hopping Spread Spectrum
Operating Frequency Range: 2402 MHz – 2480 MHz
EUT has a peak output power 6.8dBm and a max antenna gain of 2dBi.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, and 15.247.

4. FACILITIES AND ACCREDITATION

4.1. FACILITIES AND EQUIPMENT

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

4.2. LABORATORY ACCREDITATIONS AND LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT (1300F2)).

4.3. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP*	FCC Part 15, CISPR 22, AS/NZS 3548,IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, CNS 13438	200065-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	1300
Japan	VCCI	CISPR 22 Two OATS and one conducted Site	R-1014, R-619, C-640
Norway	NEMKO	EN50081-1, EN50081-2, EN50082-1, EN50082-2, IEC61000-6-1, IEC61000-6-2, EN50083-2, EN50091-2, EN50130-4, EN55011, EN55013, EN55014-1, EN55104, EN55015, EN61547, EN55022, EN55024, EN61000-3-2, EN61000-3-3, EN60945, EN61326-1	ELA 117
Norway	NEMKO	EN60601-1-2 and IEC 60601-1-2, the Collateral Standards for Electro-Medical Products. MDD, 93/42/EEC, AIMD 90/385/EEC	ELA-171
Taiwan	BSMI	CNS 13438	SL2-IN-E-1012
Canada	Industry Canada	RSS210 Low Power Transmitter and Receiver	IC2324 A,B,C, and F

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

CALIBRATION AND UNCERTAINTY

4.4. MEASURING INSTRUMENT CALIBRATION

The measurement instruments utilized to perform the tests documented in this report have been calibrated in accordance with the manufacturer's recommendations, and are traceable to national standards.

4.5. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Radiated Emission	
30MHz – 200 MHz	+/- 3.3dB
200MHz – 1000MHz	+4.5/-2.9dB
1000MHz – 2000MHz	+4.6/-2.2dB
Power Line Conducted Emission	
150kHz – 30MHz	+/-2.9

Any results falling within the above values are deemed to be marginal.

4.6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Name of Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Due Date**
Quasi-Peak Detector	HP9K - 1GHz	85650A	3145A01654	6/1/03
Spectrum Display	HP	85662A	2152A03066	6/1/03
Spectrum Analyzer	HP100Hz - 22GHz	8566B	3014A06685	6/1/03
Pre-Amplifier, 25 dB	HP 0.1 - 1300MHz	8447D (P_1M)	2944A06833	8/22/03
Antenna, Bicon	Eaton30 - 200MHz	94455-1	1197	3/30/03
Antenna, LP	EMCO200 - 2000MHz	3146	2120	3/30/03
EMI Test Receiver	Rohde & Schwarz	ESHS 20	827129/006	4/17/03
LISN	Fischer 9k - 100MHz	C-LISN-50/250-2	114	9/6/03
LISN	Solar Elec. Co.	012-50-R-24-BN	837990	9/6/03
Line Filter	Lindgren 10k - 10GHz	LMF-3489	497	N.C.R.
Pre-amplifier,35.5 dB (1 - 26.5GHz)	HP	8449B	3008A00369	6/30/03
Horn (1-18GHz)	EMCO	3115	6717	1/31/03
Spectrum Analyzer	Agilent	E4440A	US42221737	9/24/03
Horn (18-26.5GHz)	ARA	3115	1264	11/1/03
High Pass Filter (4.57GHz)	FSY Microwave	FM-4570-9SS	3	N.C.R.
Spectrum Analyzer	HP	8593EM	3710A00205	6/11/03

5. SETUP OF EQUIPMENT UNDER TEST

SETUP INFORMATION FOR TRANSMITTER TESTS

SUPPORT EQUIPMENT

TEST PERIPHERALS				
Device Type	Manufacturer	Model Number	Serial Number	FCC ID
PRINTER	HP	2225C	2930S52614	DSI6XU2225
Laptop	China	N34058	PB3445811902382	DoC
AC Adapter	CUI Inc	DSA-0151A-06	DPS060200-PS	NA
USB Mouse	Microsoft	X03-46340	0070536-0000	DoC
AC Adapter	Li Shin	LSE9802A206	10810241	NA

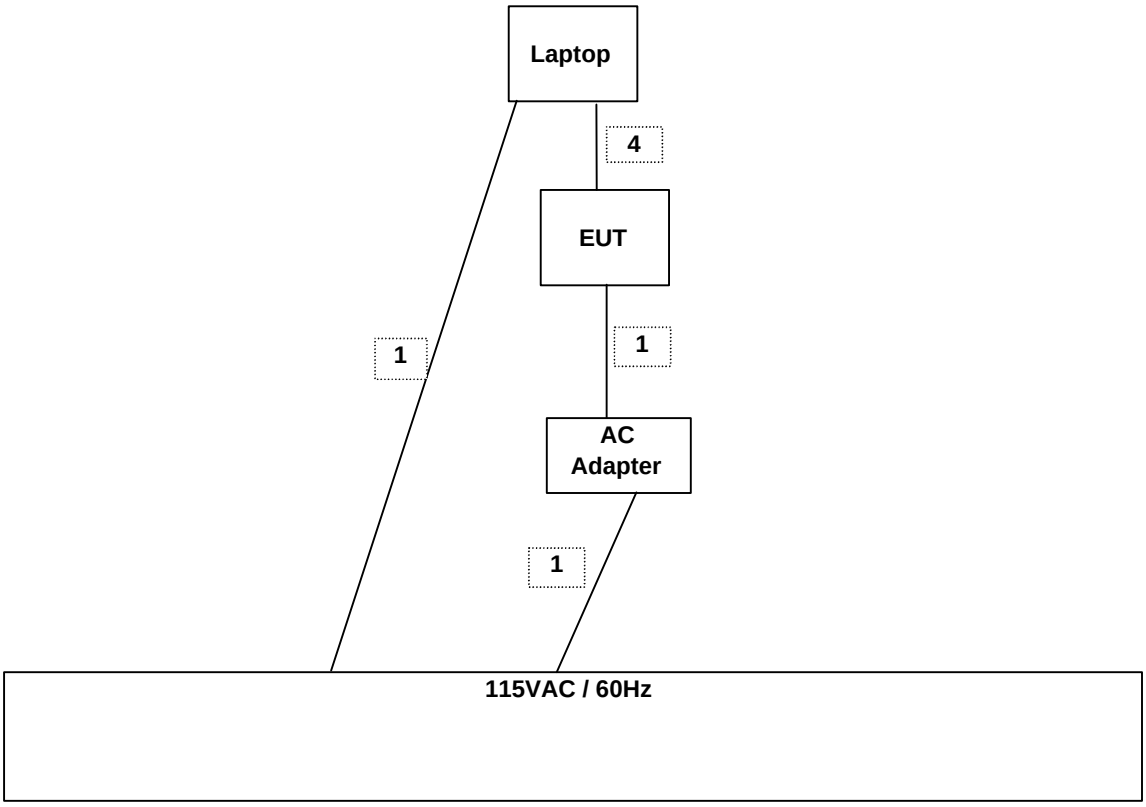
I/O CABLES

TEST I / O CABLES								
Cable No	I/O Port	# of I/O Port	Connector Type	Type of Cable	Cable Length	Data Traffic	Bundled	Remark
1	AC	3	US 115V	Un-shielded	2m	No	No	Bundle AC Cable for LC Test
2	Mouse	1	USB	Un-shielded	2m	Yes	No	N/A
3	Parallel	1	DB25	Shielded	2m	Yes	Yes	N/A
4	DB9		RS232	Un-shielded	2m	Yes	Yes	NA

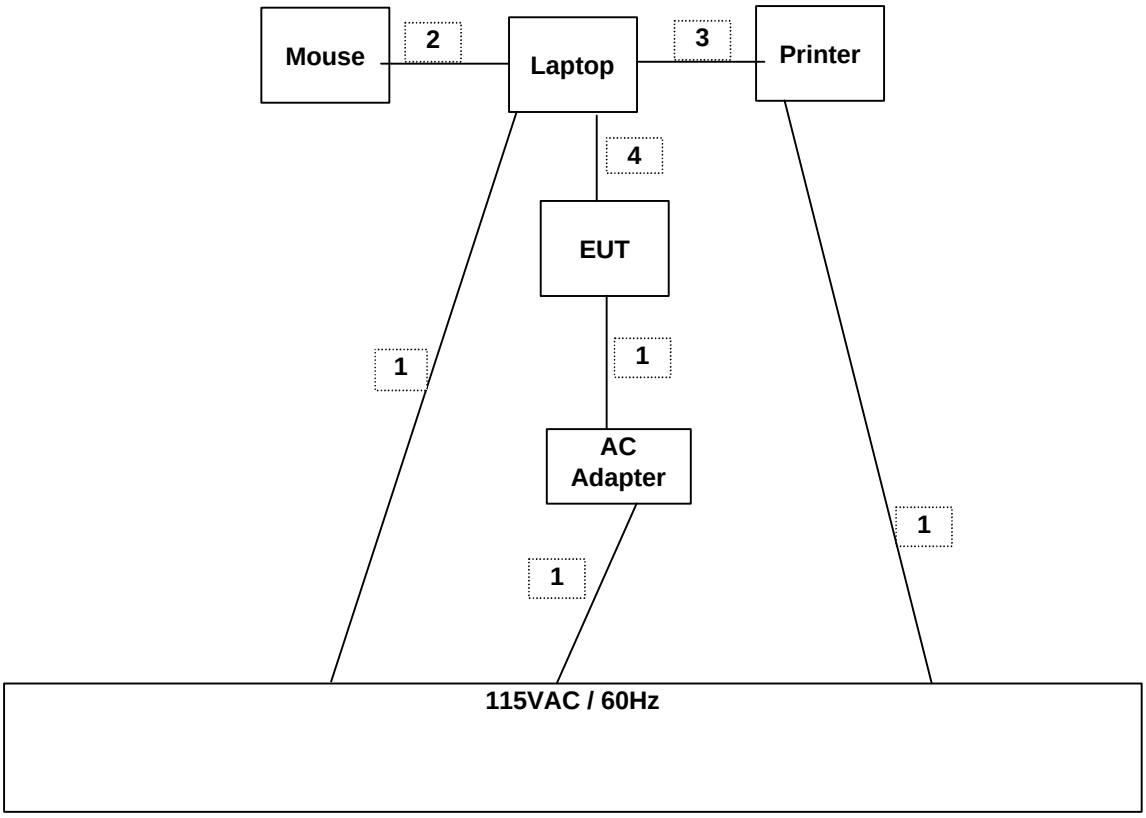
TEST SETUP

The EUT was connected to the laptop via an RS232 Cable.

SETUP DIAGRAM FOR TRANSMITTER TESTS



SETUP DIAGRAM FOR DIGITAL DEVICE TESTS



6. APPLICABLE RULES

§15.247 (a) – HOPPING FREQUENCY SEPARATION

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

§15.247 (a) (1) (iii) – NUMBER OF HOPPING FREQUENCIES

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

§15.247 (a) (1) (iii) – TIME OF OCCUPANCY

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. 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 a particular hopping frequency provided that a minimum of 15 non overlapping channels are used.

§15.247 (b)- POWER OUTPUT

The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and b(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.247 (b)- RADIO FREQUENCY EXPOSURE

(5) 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 levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

§15.247 (c)- SPURIOUS EMISSIONS

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)).

§15.247 (d) and§15.247 (f) - PEAK POWER SPECTRAL DENSITY

(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.

(f) The digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

§15.205- RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.207- CONDUCTED LIMITS

(a) Except as shown in paragraphs (b) and (c) of this section, 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 50 µH/50 ohms 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 (dBuV)	
	Quasi-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.

§15.209- RADIATED EMISSION LIMITS

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

7. TEST SETUP, PROCEDURE AND RESULT

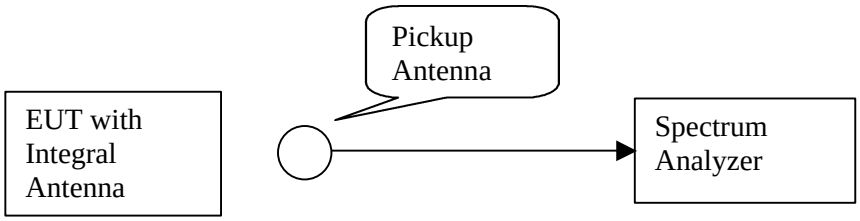
7.1. TEST SETUPS FOR ANTENNA PORT MEASUREMENTS

The EUT utilizes an integral antenna therefore it does not have a means of making a direct coaxial connection to the transmitter output antenna port. The antenna port measurements were made using the following test setups.

7.1.1. Relative Amplitude Measurements

In-band measurements such as timing and bandwidth that require relative amplitudes are measured as follows.

TEST SETUP



TEST PROCEDURE

The transmitter output is coupled to the spectrum analyzer via a near-field pickup antenna. The spectrum analyzer is adjusted as required for the particular measurement.

7.1.2. Absolute Amplitude Measurements

In-band measurements such as power and power density that require absolute amplitudes are measured as follows.

TEST SETUP

The EUT is set up on an open area test site and radiated measurements are made as described in Section 7.9, Spurious Emissions Radiated Measurements.

TEST PROCEDURE

All spectrum analyzer settings except for reference level offset are set as required for the particular measurement. The reference level offset is set as follows.

DERIVATION OF REFERENCE LEVEL OFFSET

The calculation of power is derived from the following equation:

$E = (\sqrt{(30 * P * G)}) / d$

Where:
E is the measured maximum fundamental field strength in V/m.
P is the power in watts.
G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
d is the distance in meters from which the field strength was measured.

Rearranging the equation to express power in terms of the remaining variables:
P = ((E * d)^2) / (30 * G)

In logarithmic form, at a measuring distance of 3 meters:
Power (dBm) = E (dBuV/m at 3 meters) - G (dBi) - 95.2 Equation 1

Field strength is calculated by:
E (dBuV/m) = Measured Voltage (dBuV) + Measuring Antenna Factor (dBuV/m) - Amplifier Gain (dB) + Cable Loss (dB)

Converting amplitude units from dBuV to dBm,
E (dBuV/m) = Measured Voltage (dBm) + 107 + Measuring Antenna Factor (dBuV/m) - Amplifier Gain (dB) + Cable Loss (dB) Equation 2

Combining equations 1 and 2 yields:
Power (dBm) = Measured Voltage (dBm) + 107 + Measuring Antenna Factor (dBuV/m) - Amplifier Gain (dB) + Cable Loss (dB) - EUT Antenna Gain (dBi) - 95.2

Rearranging terms yields:
Power (dBm) - Measured Voltage (dBm) = 107 + Measuring Antenna Factor (dBuV/m) - Amplifier Gain (dB) + Cable Loss (dB) - EUT Antenna Gain (dBi) - 95.2 Equation 3

Power (dBm) is the transmitter power, and Measured Voltage (dBm) is the spectrum analyzer reading with the Measuring Antenna located 3 meters from the EUT, therefore the difference between these two parameters is the spectrum analyzer reference level offset required to read transmit power directly Power (dBm) - Measured Voltage (dBm).

Equation 3 is used to calculate the Spectrum Analyzer Reference Level Offset.

7.2. 20 dB BANDWIDTH

TEST SETUP

See 7.1.1.

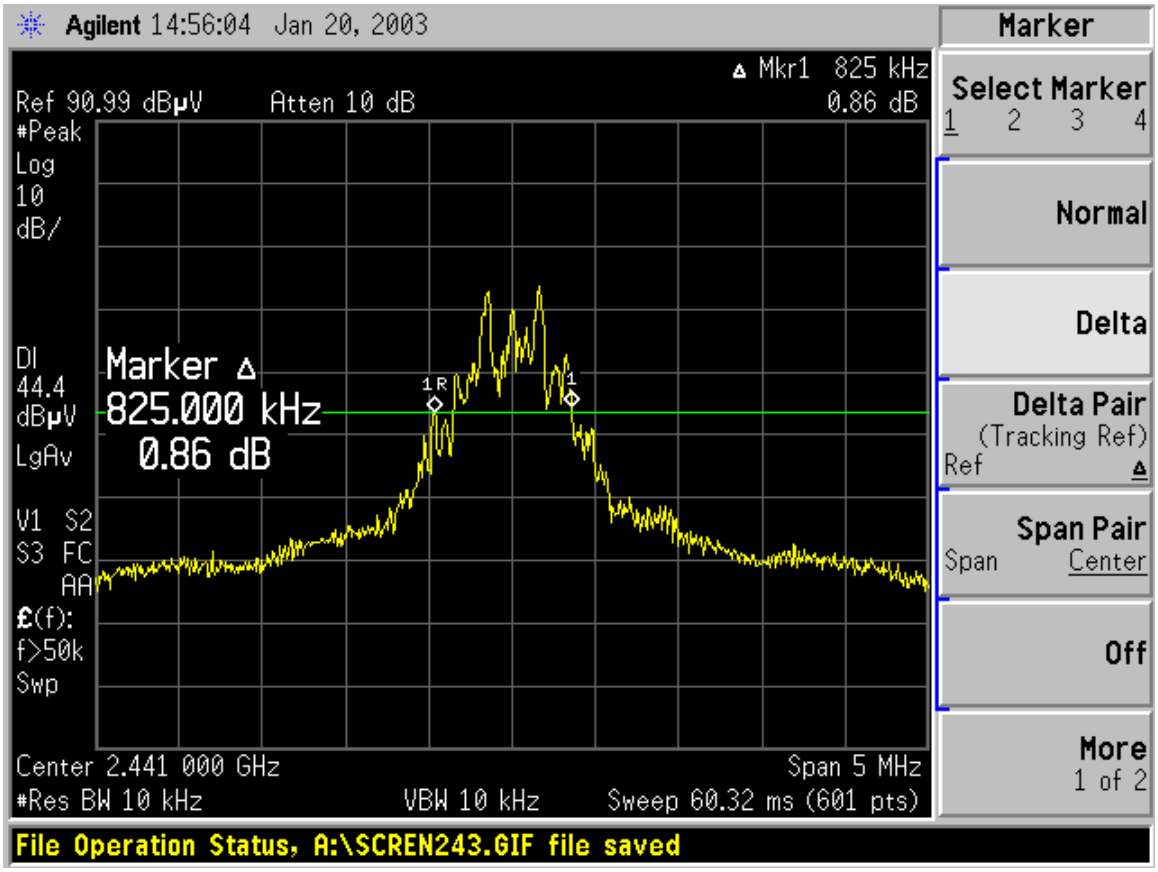
TEST PROCEDURE

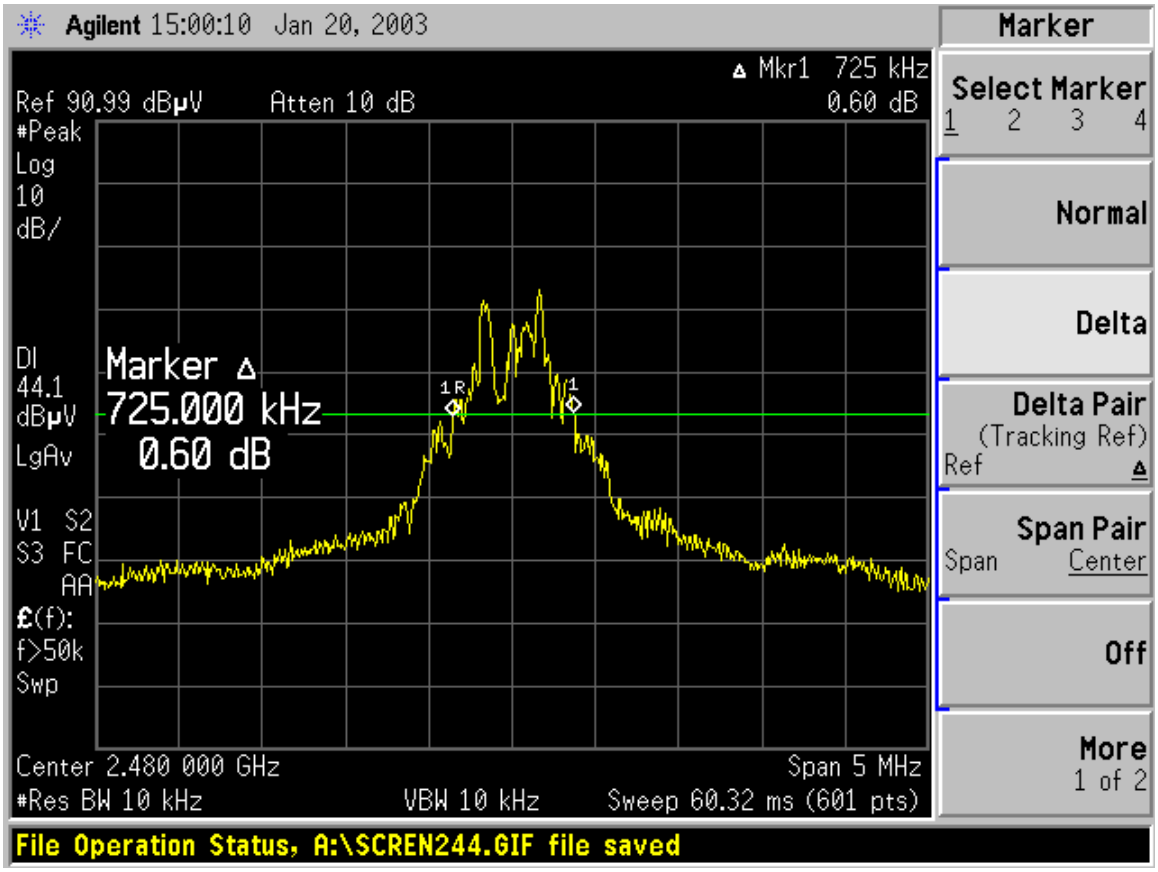
The transmitter output is coupled to the spectrum analyzer via a pickup antenna. The hopping function is turned off and the transmitter is set to a fixed frequency. The spectrum analyzer center frequency is set to the transmitter frequency. The RBW and VBW are set to 10 kHz.

RESULTS

Reporting requirement only; No non-compliance noted:

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2402	958
Middle	2441	825
High	2480	725





7.3. HOPPING FREQUENCY SEPARATION

TEST SETUP

See 7.1.1.

TEST PROCEDURE

The transmitter output is coupled to the spectrum analyzer via a pickup antenna. The RBW and VBW are set to 100 kHz, the frequency span is set to 10 MHz and the trace function to max hold. The EUT is allowed to complete the pseudorandom hopping sequence, then the separation between two adjacent hopping frequencies is measured.

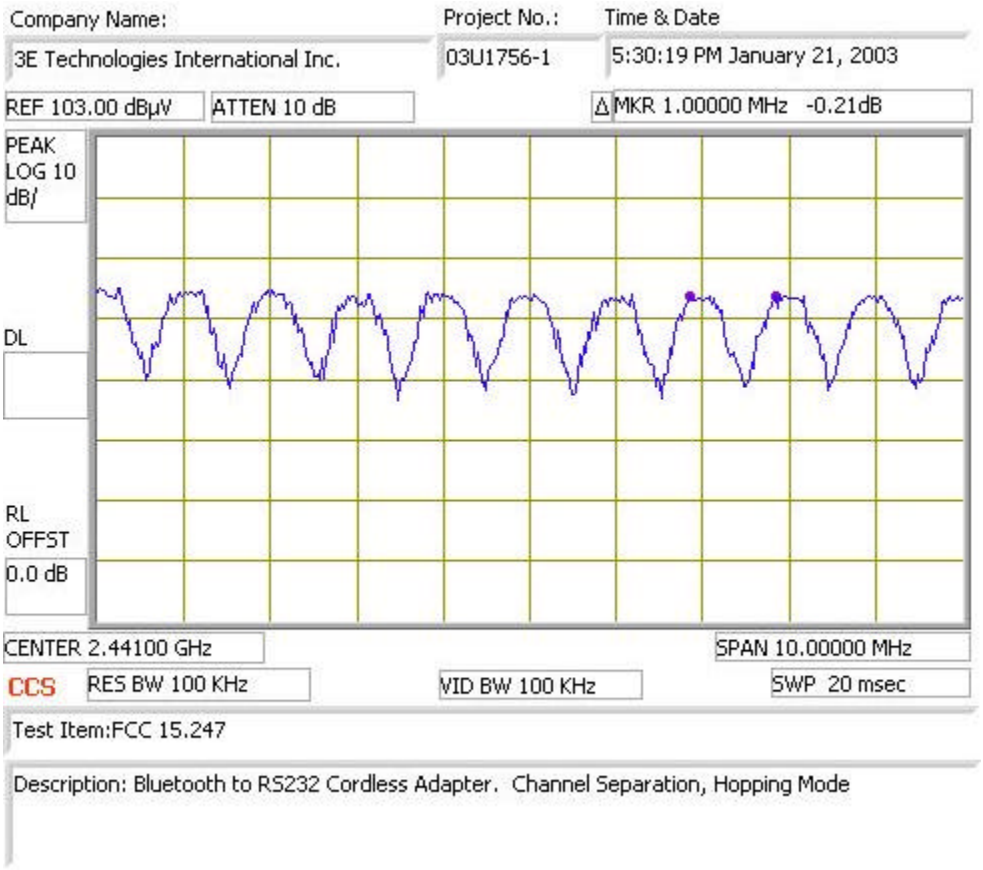
LIMIT

The 20 dB bandwidth is 958 kHz, therefore the limit is 1 MHz.

RESULTS

No non-compliance noted:

HOPPING MODE



7.4. NUMBER OF HOPPING FREQUENCIES

TEST SETUP

See 7.1.1.

TEST PROCEDURE

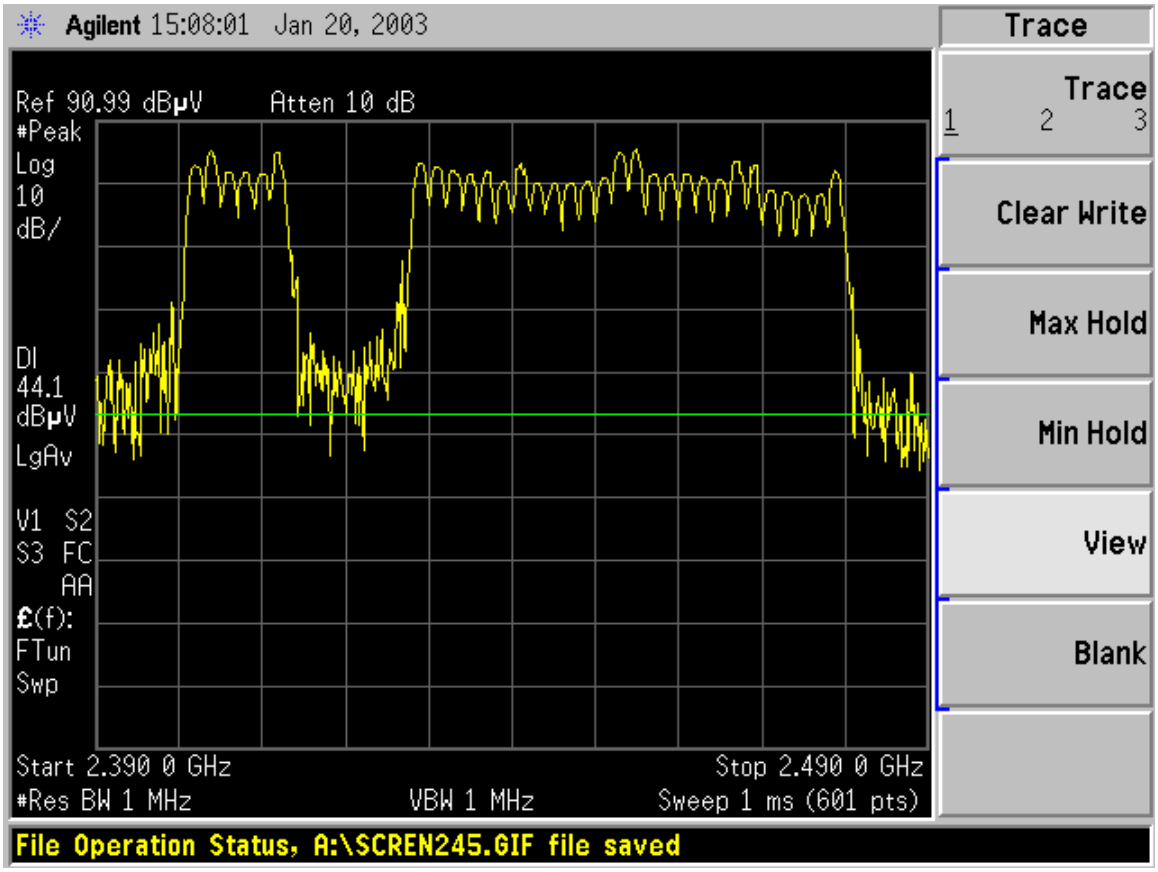
The transmitter output is coupled to the spectrum analyzer via a pickup antenna. The RBW and VBW are set to 1 MHz, the frequency span is set to 100 MHz and the trace function to max hold. The EUT is allowed to complete the pseudorandom hopping sequence, then the number of hopping frequencies is counted.

RESULTS

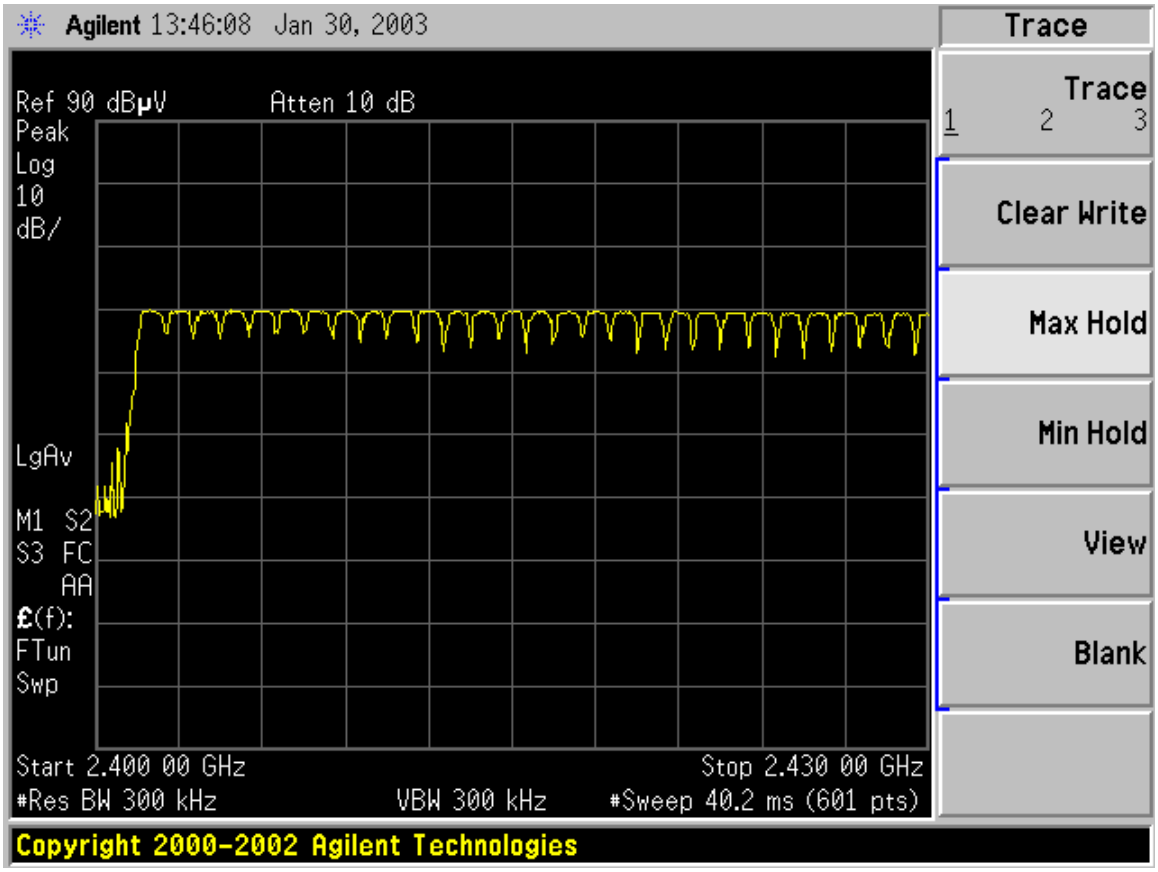
No non-compliance noted:

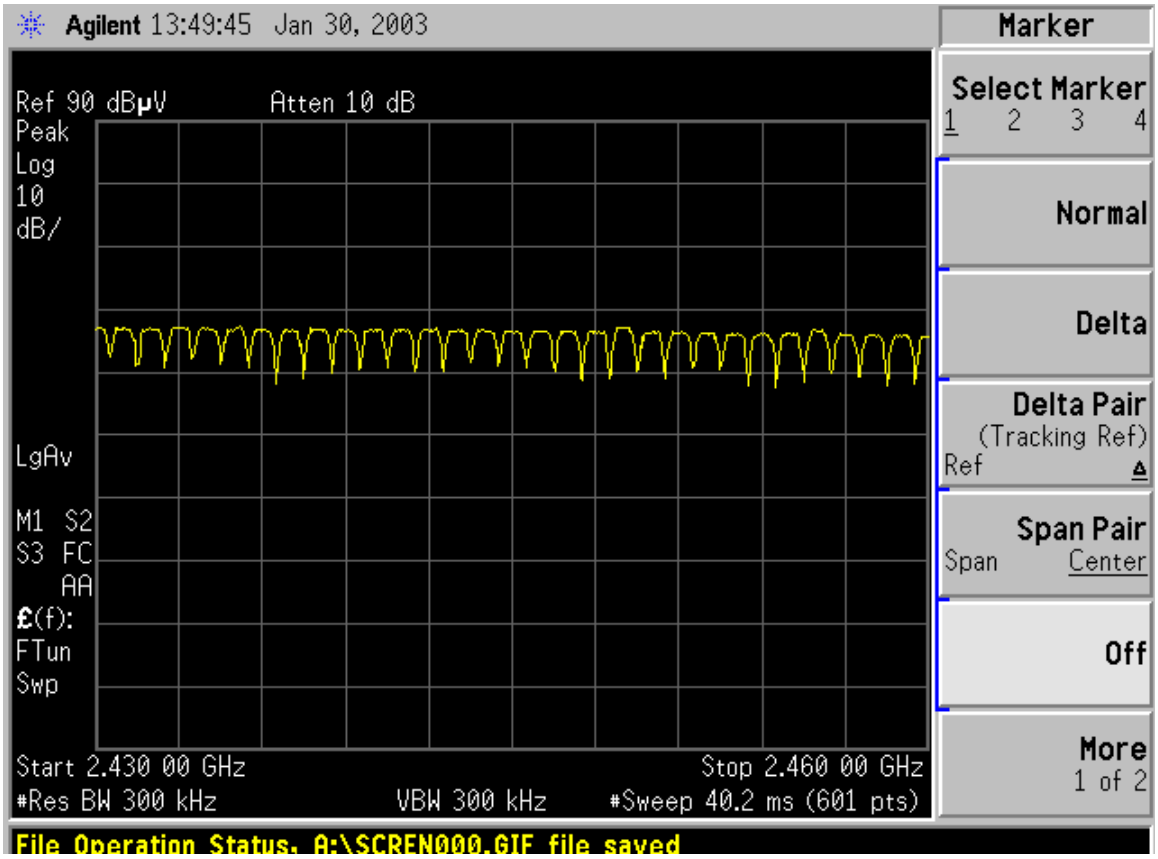
Mode	Number of Frequencies	Limit
Inquiry	32	Reporting Requirement Only
Data	79	75 Minimum

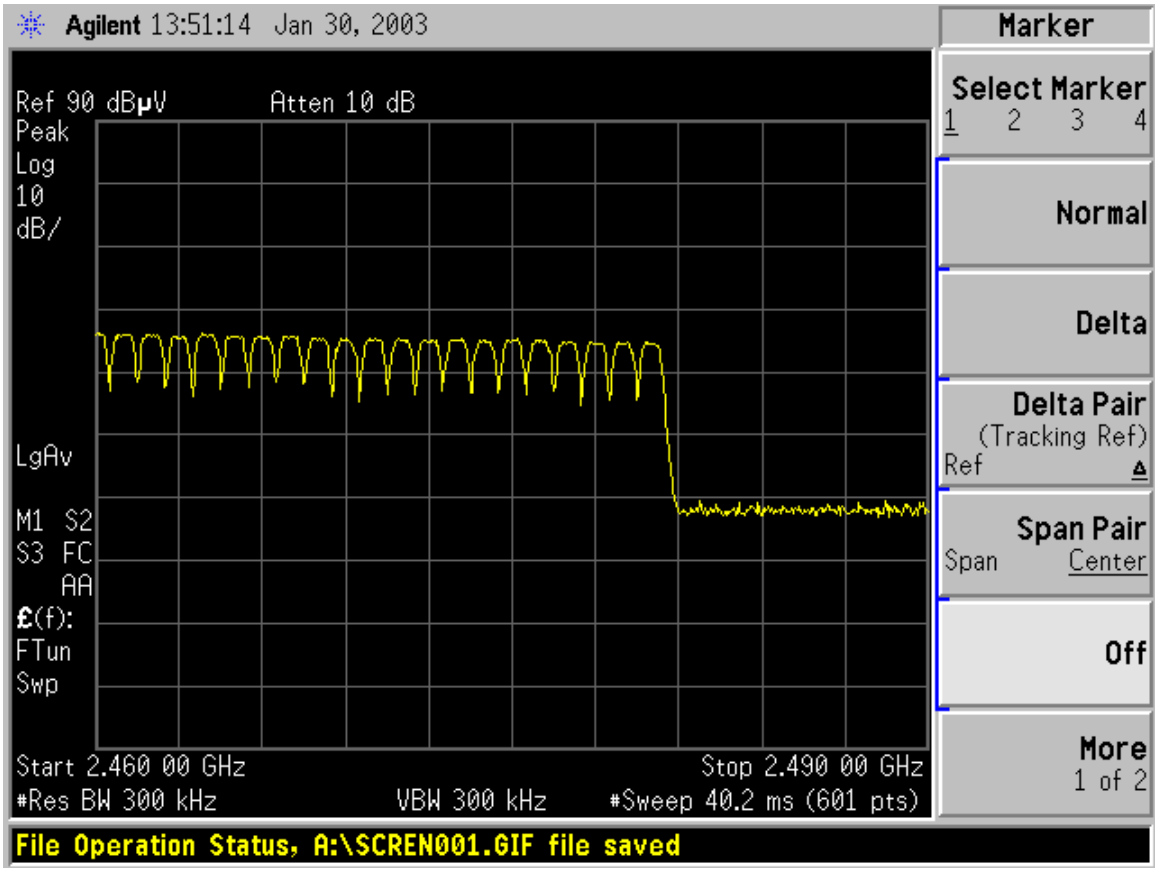
INQUIRY MODE



DATA MODE







7.5. TIME OF OCCUPANCY

TEST SETUP

See 7.1.1.

TEST PROCEDURE

The transmitter output is coupled to the spectrum analyzer via a pickup antenna. The EUT is set to the normal hopping mode. The spectrum analyzer is tuned to 2.441 GHz and zero span. The sweep time is adjusted to accurately measure the width of a single pulse. Then the sweep time is changed to the required period and the occupancy is recorded.

The time of occupancy in the data mode is independent of the packet type (packet length). The calculation is a follows:

Time of Occupancy = Time Slot Length * Hop Rate / Number Of Hopping Channels * Period

For multi-slot packets the hopping rate is reduced by the length of the packet.

LIMIT

79 hopping frequencies are used, therefore the Period is 31.6 s and the limit is 0.4 s in 31.6 s.

RESULTS

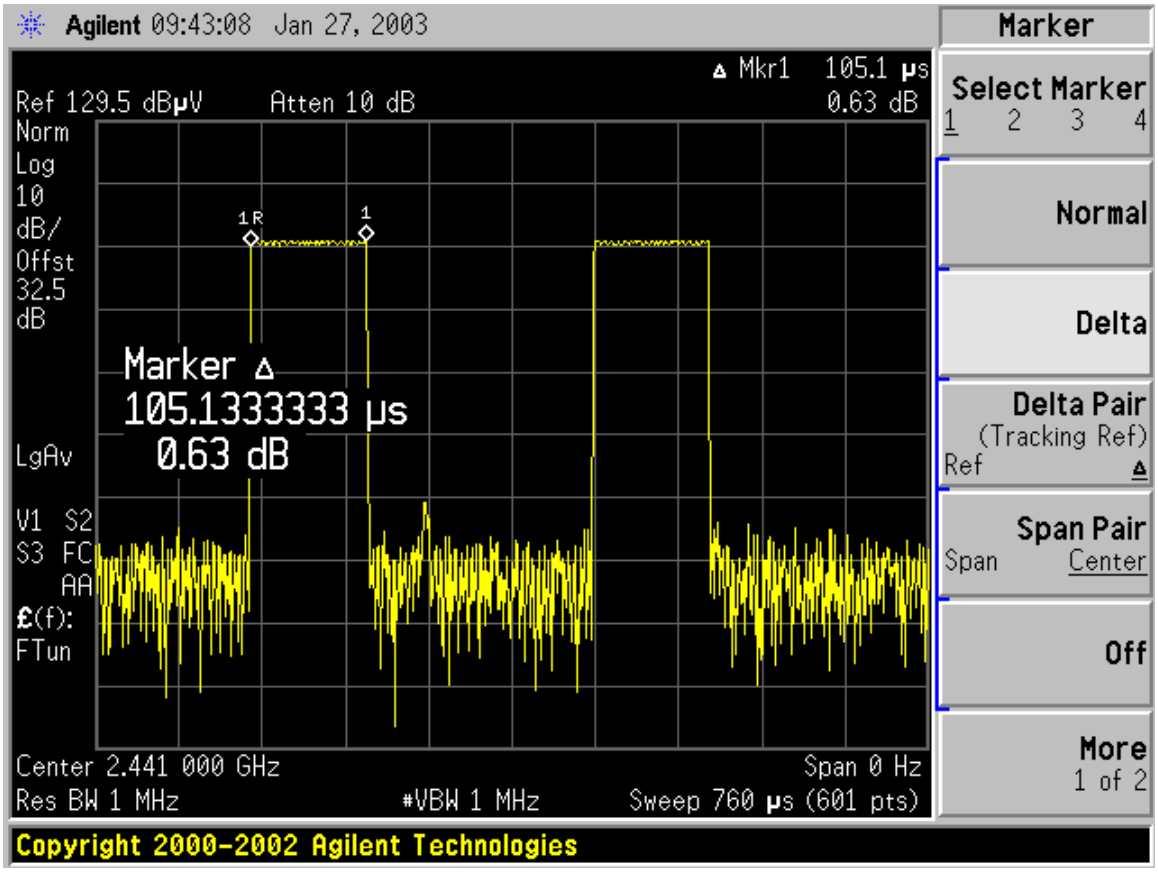
No non-compliance noted:

The Bluetooth Hop Rate is 1600 / s.

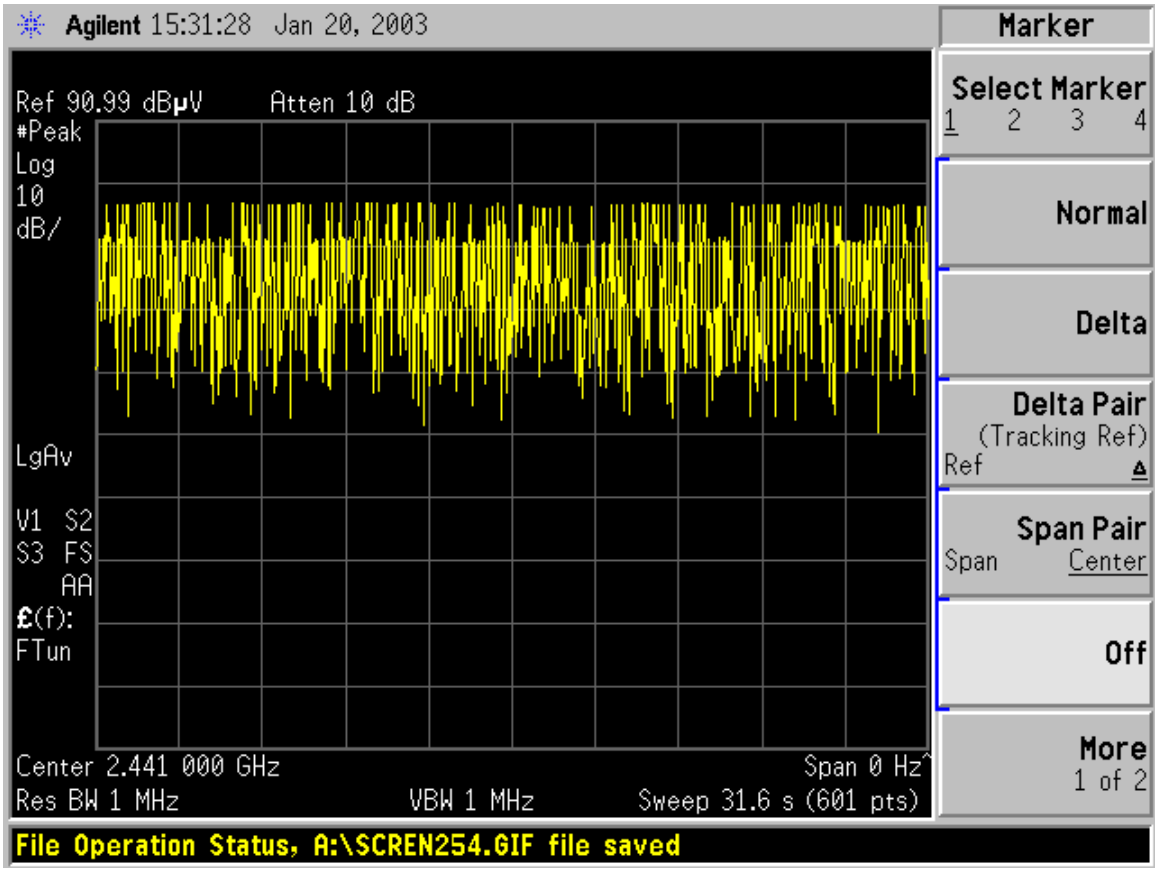
For a DH1 packet (with a maximum length of one time slot):
Time of Occupancy = 105 µs * 1600 / s / 79 * 31.6 s = 0.067 s

For a DH5 packet (with a maximum length of five time slots):
Time of Occupancy = 105 µs * 1600 / s * 1/5 / 79 * 31.6 s = 0.067 s

PULSE WIDTH



OCCUPANCY IN 31.6 SECOND PERIOD



7.6. PEAK POWER

TEST SETUP

See 7.1.2.

TEST PROCEDURE

The spectrum analyzer reference level offset is set as described in Section 7.1.2. RBW is set > EBW, RBW is set > VBW, and peak detection is used.

The hopping function is turned off.

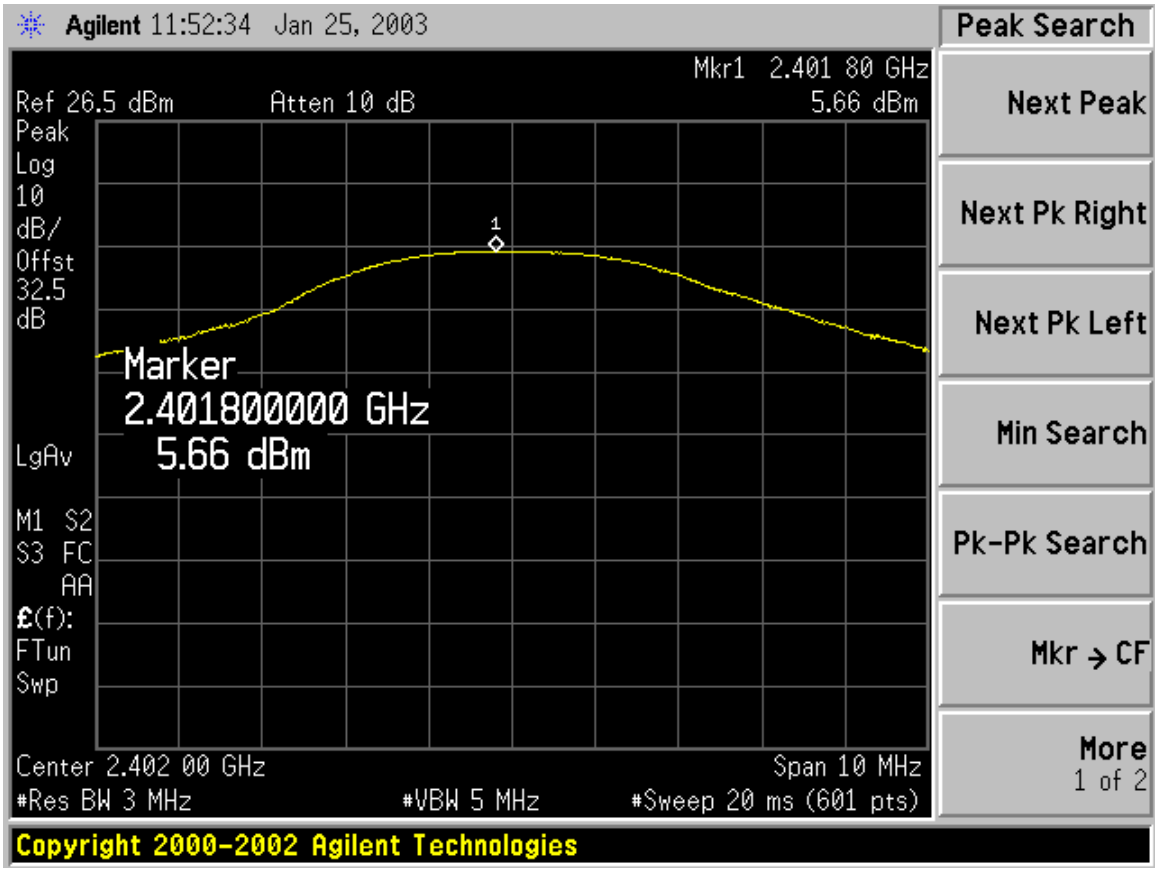
LIMIT

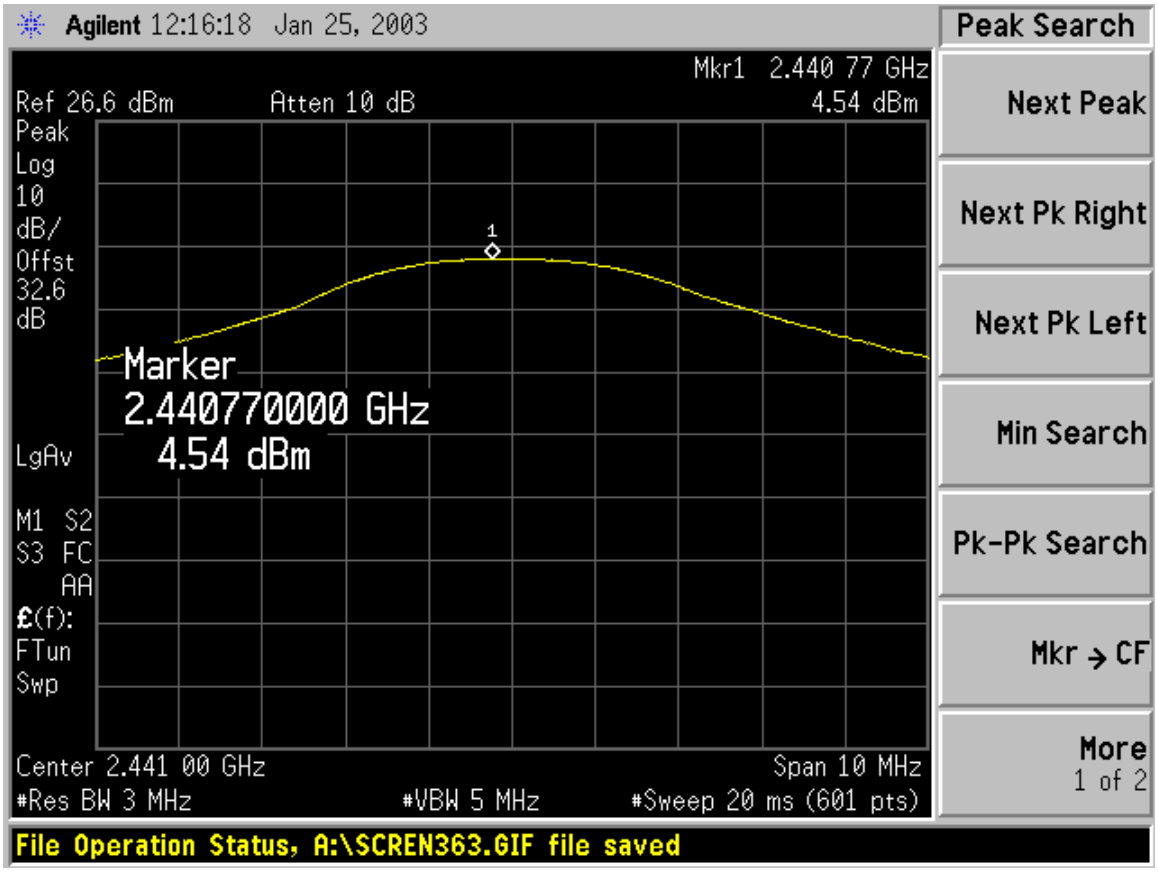
At least 75 hopping frequencies are used and the maximum antenna gain = 2.0 dBi, therefore the limit is 30 dBm.

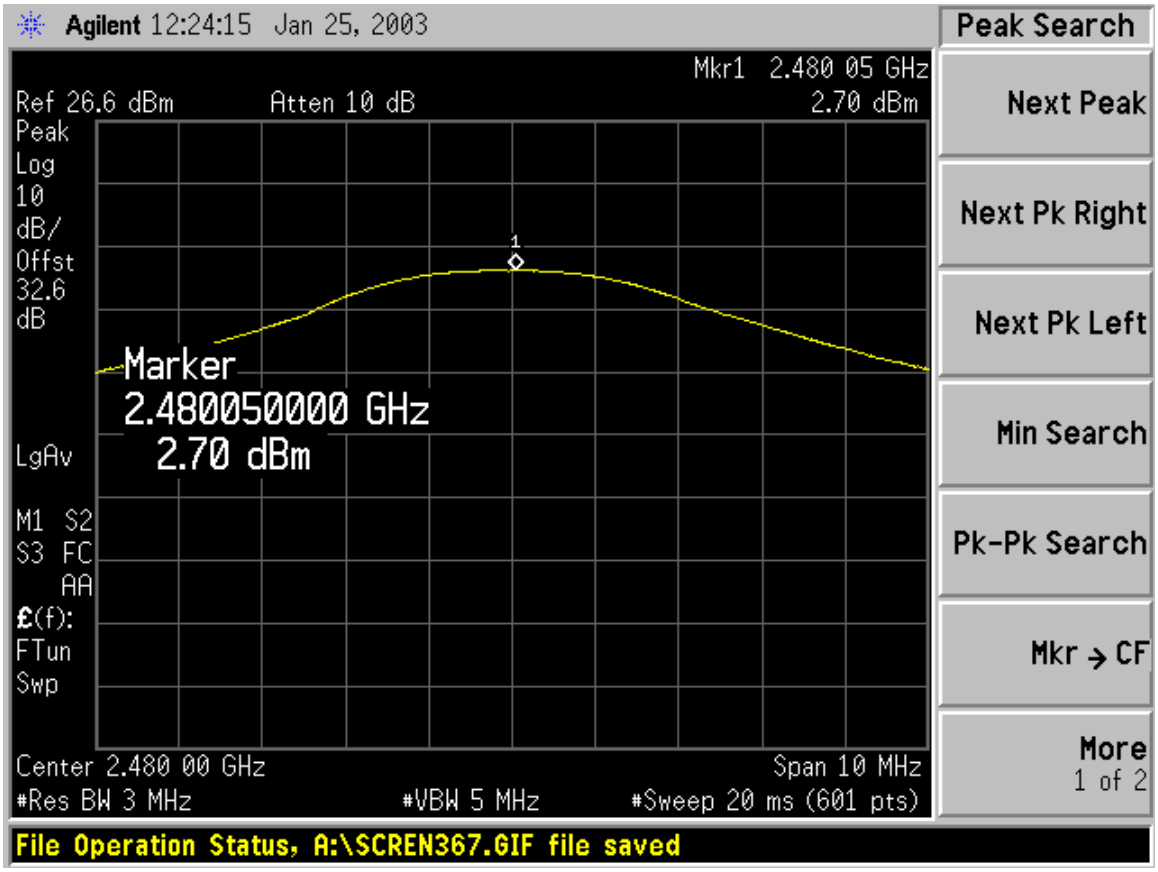
RESULTS

No non-compliance noted:

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.66	30	-24.34
Middle	2441	4.54	30	-25.46
High	2480	2.7	30	-27.3







7.7. PEAK POWER SPECTRAL DENSITY

TEST SETUP

See 7.1.2.

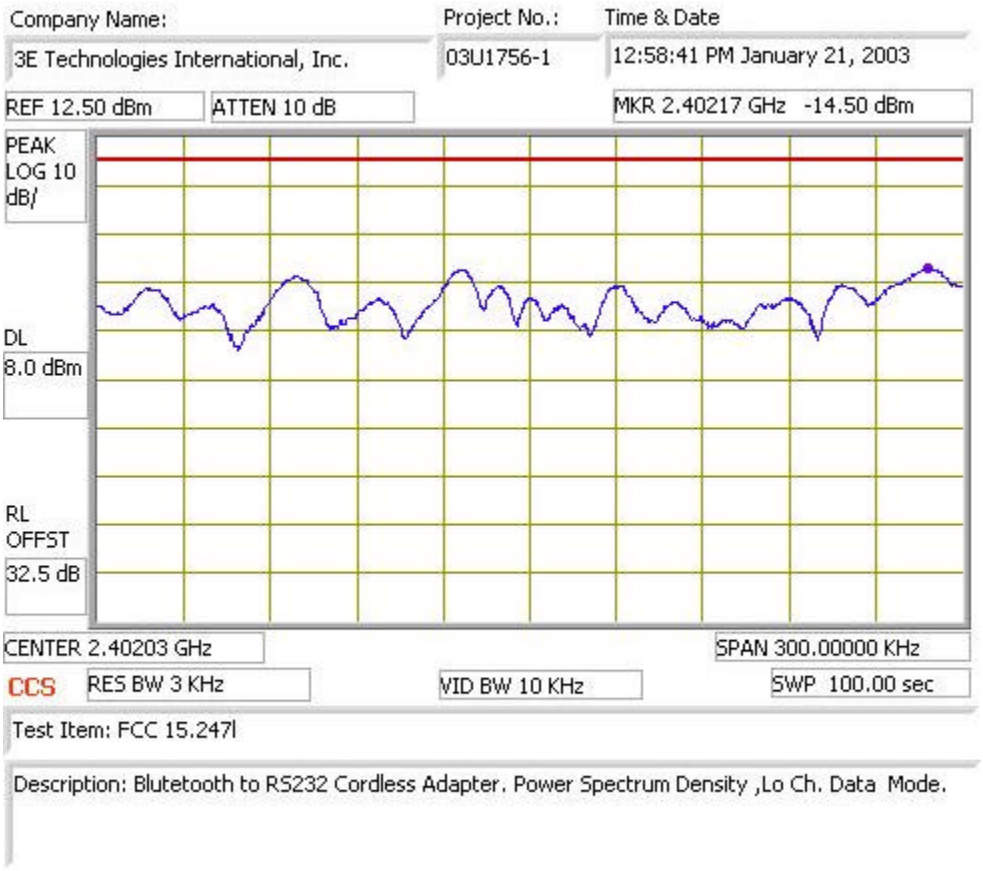
TEST PROCEDURE

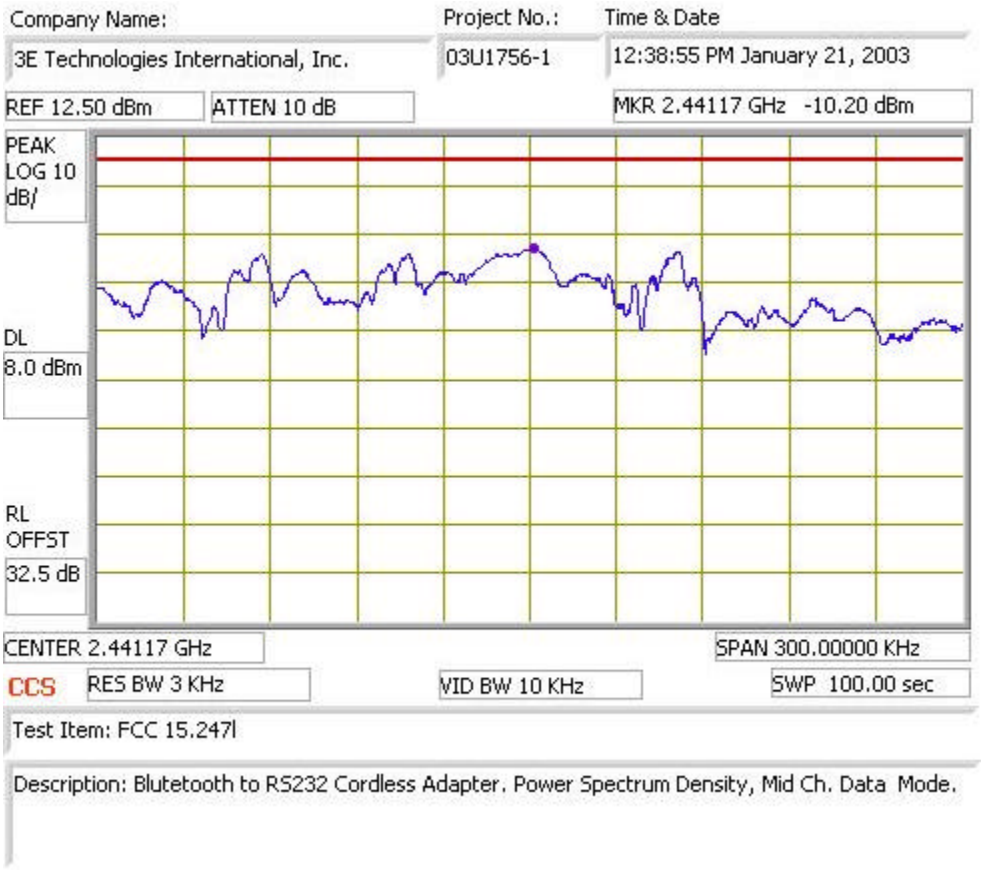
The spectrum analyzer reference level offset is set as described in Section 7.1.2. The hopping function is turned off. The spectrum analyzer RBW = 3 kHz, VBW = 10 kHz, the sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

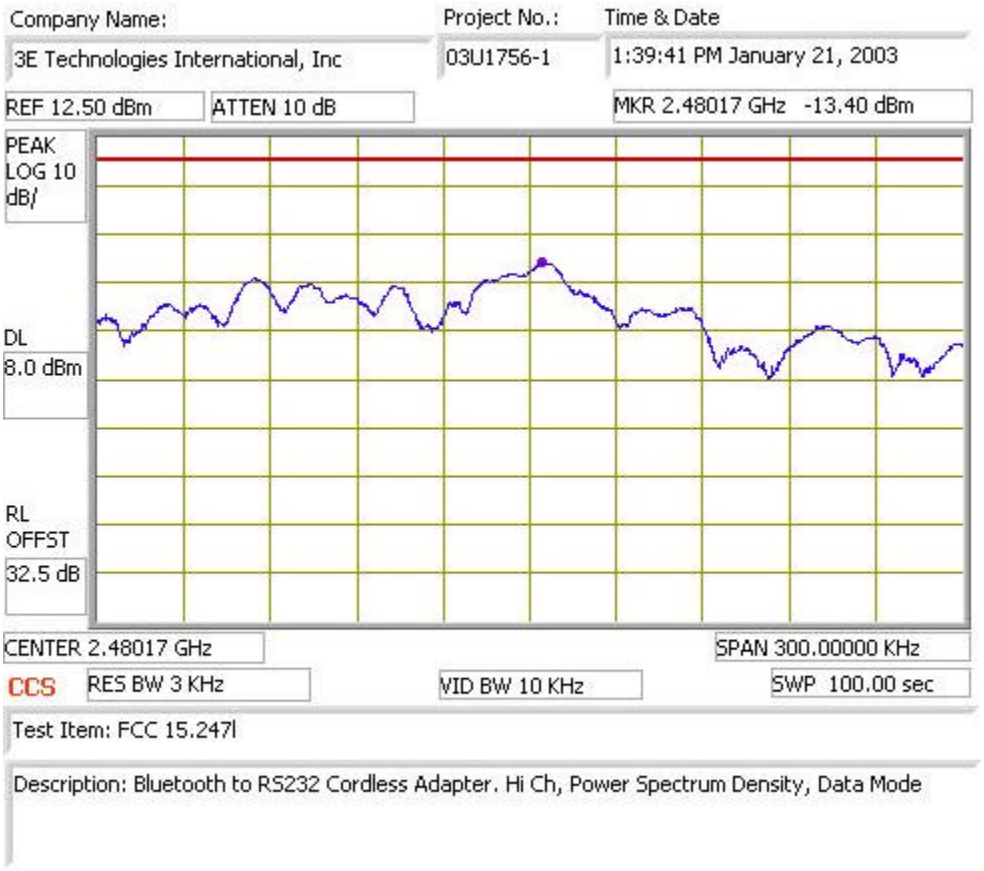
RESULTS

No non-compliance noted:

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-14.5	8	-22.5
Middle	2441	-10.2	8	-18.2
High	2480	-13.4	8	-21.4







7.8. MAXIMUM PERMISSIBLE EXPOSURE

CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts / meter
P = Power in Watts
G = Numeric antenna gain
d = distance in meters
S = Power Density in milliwatts / square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$

$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW / cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and

G (numeric) = 10 ^ (G (dBi) / 10)

yields

$$d = 0.282 * 10 ^ ((P + G) / 20) / \sqrt{S}$$ Equation (1)

where

d = MPE safe distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / cm^2

RESULTS

No non-compliance noted:

EUT output power = +5.66 dBm
Antenna Gain = 2 dBi
S = 1.0 mW / cm^2 from 1.1310 Table 1

Substituting these parameters into Equation (1) above:

MPE Safe Distance = 0.68 cm

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

7.9. SPURIOUS EMISSIONS

RF measurements of the transmitter output were made to confirm that the EUT spurious emissions meet the specified limit.

TEST PROTOCOL: SEMI-ANECHOIC CHAMBER

The EUT is set up in a semi-anechoic chamber and radiated measurements are made as described in Section 7.10. Measurements are made over the 30 MHz to 26.5 GHz range with the transmitter set to the low, middle, and high channels, and with the transmitter set to the hopping mode.

Plots of the in-band fundamental level and the out-of-band spurious level are made. Since these chamber measurements are made using the worst case antenna factor, amplifier gain, and cable loss over the selected span (thus the calculated field strength will be greater than or equal to the actual field strength) these plots constitute a frequency list and are used to determine those emissions that require fully calibrated measurements at an Open Area Test Site.

TEST PROTOCOL: OPEN AREA TEST SITE

The EUT is set up on an open area test site and radiated measurements are made as described in Section 7.10.

Spurious emissions that are outside restricted bands, and the most significant spurious emissions measured in the chamber below 1 GHz, are documented in section 7.9.2. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

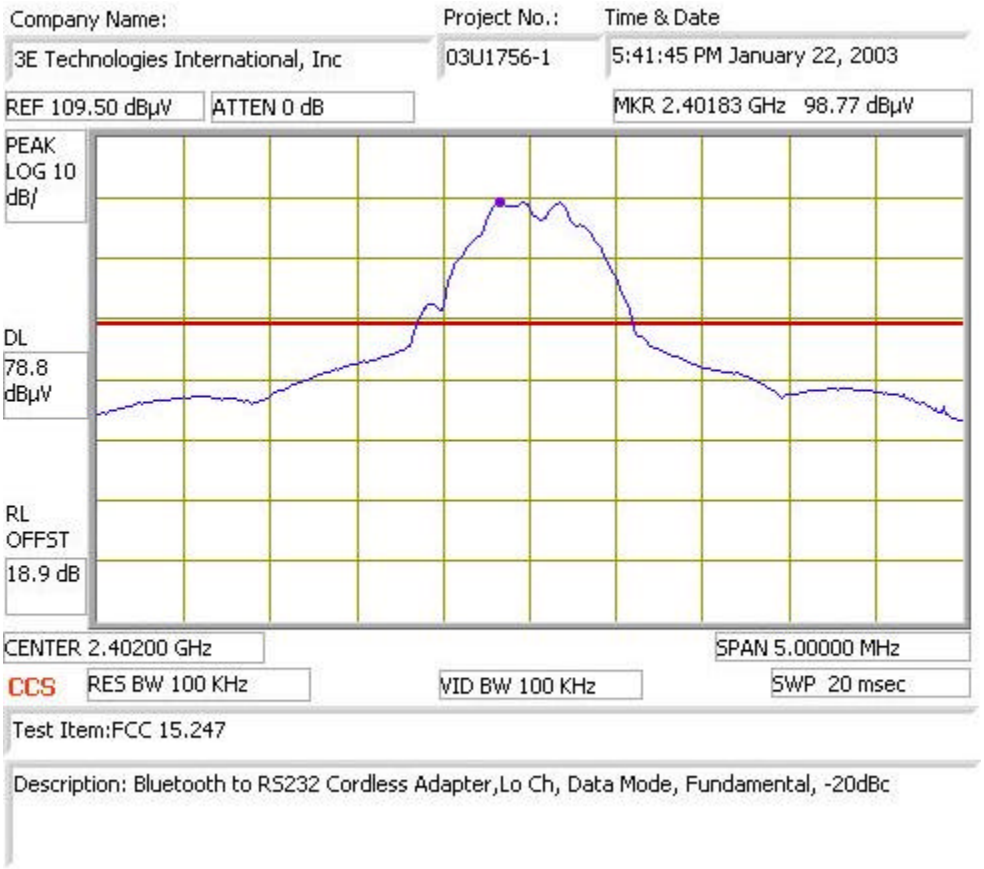
Undesirable emissions that are within restricted bands are documented in section 7.10.

RESULTS

No non-compliance noted:

7.9.1. Semi-Anechoic Chamber Measurements

LOW CHANNEL IN-BAND REFERENCE



LOW CHANNEL SPURIOUS