FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

GPS Tracking System

Model: TomTom ONE Cork

Trade Name: TomTom

Issued to

TomTom BV
Rembrandtplein 35, 1017 CT Amsterdam,
The Netherlands

Issued by

Compliance Certification Services Inc.
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ACCREDITED
No. 0824-01

TAF
Testing Laboratory
0363

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1. TEST RESULT CERTIFICATION

Applicant: TomTom BV
Rembrandtplein 35, 1017 CT Amsterdam,
The Netherlands

Equipment Under Test: GPS Tracking System

Trade Name: TomTom

Model: TomTom ONE Cork

Date of Test: December 12 ~ 13, 2006

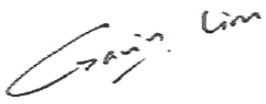
APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

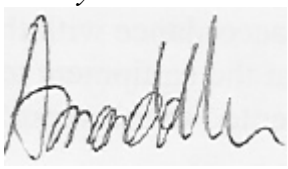
The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:



Gavin Lim
Section Manager
Compliance Certification Services Inc.

Reviewed by:



Amanda Wu
Section Manager
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	GPS Tracking System
Trade Name	TomTom
Model Number	TomTom ONE Cork
Model Discrepancy	N/A
Power Supply	1. Power Adapter: Model: PSB05R-050Q I/P: AC 100-240V, 0.2A, 50-60Hz O/P: DC 5V, 1.0A MAX., 12-17VA 2. Battery: Model: IAC Edinburgh SPEC: MaxeII 653443 1100mAh 3. Powered from host device
Frequency Range	2402 ~ 2480 MHz
Transmit Power	0.28 dBm
Modulation Technique	FHSS (GFSK)
Transmit Data Rate	1Mbps
Number of Channels	79 Channels
Antenna Specification	Gain: -4.5 dBi
Antenna Designation	Chip Antenna

Remark:

1. *The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*
2. *This submittal(s) (test report) is intended for FCC ID: S4LONE-CK filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.*

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, 15.207, 15.209 and 15.247.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.

3.4 FCC PART 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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	([2])
13.36 - 13.41	322 - 335.4		

[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.

3.5 DESCRIPTION OF TEST MODES

The EUT (model: TomTom ONE Cork) had been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting mode was programmed.

Software used to control the EUT for staying in continuous transmitting mode was programmed. The worst case data rate is determined as the data rate with highest output power.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

Channel Low (2402MHz), Mid (2441MHz) and High (2480MHz) were chosen for full testing.

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

4. INSTRUMENT CALIBRATION

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: *Each piece of equipment is scheduled for calibration once a year.*

Conducted Emissions Test Site				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	E4446A	MY43360131	01/18/2007
Power Meter	Agilent	E4416A	GB41291611	05/24/2007
Power Sensor	Agilent	E9327A	US40441097	05/24/2007

3M Semi Anechoic Chamber				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	E4446A	US42510252	08/02/2007
Test Receiver	Rohde&Schwarz	ESCI	100064	11/13/2007
Switch Controller	TRC	Switch Controller	SC94050010	05/05/2007
4 Port Switch	TRC	4 Port Switch	SC94050020	05/05/2007
Horn-Antenna	TRC	HA-0502	06	06/06/2007
Horn-Antenna	TRC	HA-0801	04	05/05/2007
Horn-Antenna	TRC	HA-1201A	01	07/10/2007
Horn-Antenna	TRC	HA-1301A	01	07/18/2007
Bilog- Antenna	Sunol Sciences	JB3	A030205	03/09/2007
Turn Table	Max-Full	MFT-120S	T120S940302	N.C.R.
Antenna Tower	Max-Full	MFA-430	A440940302	N.C.R.
Controller	Max-Full	MF-CM886	CC-C-1F-13	N.C.R.
Site NSA	CCS	N/A	FCC: 965860 IC: IC 6106	09/25/2008
Test S/W	LABVIEW (V 6.1)			

Remark: *The measurement uncertainty is less than +/-2.0065dB (30MHz ~ 1GHz), +/-3.0958dB (Above 1GHz) which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.*

Powerline Conducted Emissions Test Site				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
EMI TEST RECEIVER 9kHz-30MHz	ROHDE & SCHWARZ	ESHS30	828144/003	10/31/2007
TWO-LINE V-NETWORK 9kHz-30MHz	SCHAFFNER	NNB41	03/10013	06/14/2007
LISN 10kHz-100MHz	EMCO	3825/2	9106-1809	03/20/2007
Test S/W	LABVIEW (V 6.1)			

Remark: *The measurement uncertainty is less than +/- 2.81dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.*

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☒ No.81-1, Lane 210, Bade 2nd Rd., Luchu Hsiang, Taoyuan Hsien 338, Taiwan
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

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

5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	EN 55011, EN 55014-1/2, CISPR 11, CISPR 14-1/2, EN 55022, EN 55015, CISPR 22, CISPR 15, AS/NZS 3548, VCCI V3 (2001), CFR 47, FCC Part 15/18, CNS 13783-1, CNS 13439, CNS 13438, CNS 13803, CNS 14115, EN 55024, IEC 801-2, IEC 801-3, IEC 801-4, IEC/EN 61000-3-2, EIC/EN 61000-3-3, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 50081-1/ EN 61000-6-3, EN 50081-2/EN 61000-6-4, EN 50081-2/EN 61000-6-1: 2001	ACCREDITED 0824-01
USA	FCC	3/10 meter Open Area Test Sites (93105, 90471) / 3M Semi Anechoic Chamber (965860) to perform FCC Part 15/18 measurements	93105, 90471 965860
Japan	VCCI	3/10 meter Open Area Test Sites to perform conducted/radiated measurements	R-393/1066/725/879 C-402/747/912
Norway	NEMKO	EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2	ELA 124a ELA 124b ELA 124c
Taiwan	TAF	EN 300 328, EN 300 220-1, EN 300 220-2, EN 300 220-3, 47 CFR FCC Part 15 Subpart C, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 14115, CNS 13438, AS/NZS CISPR 22, CNS 13022-1, IEC 61000-4-2/3/4/5/6/8/11, CNS 13022-2/3	Testing Laboratory 0363
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	SL2-IS-E-0014 SL2-IN-E-0014 SL2-A1-E-0014 SL2-R1-E-0014 SL2-R2-E-0014 SL2-L1-E-0014
Canada	Industry Canada	3/10 meter Open Area Test Sites (IC 3991-3, IC 3991-4) / 3M Semi Anechoic Chamber (IC 6106) to perform RSS 212 Issue 1	IC 3991-3 IC 3991-4 IC 6106

** No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.*

6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC (Remote)	SONY	VGN-S44TP	28198080 8100339	WLAN: ETC094LPD0155 Bluetooth: ETC094LPD0156	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
2.	GPS Simulator (Remote)	HWAJEAT	GPS-101	EN001	N/A	N/A	N/A

Remark:

1. *All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2. *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

7. FCC PART 15.247 REQUIREMENTS

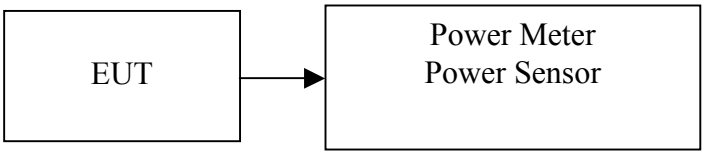
7.1 PEAK POWER

LIMIT

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

1. According to §15.247(a)(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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
2. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
3. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted 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.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the peak power detection.

TEST RESULTS

No non-compliance noted

Test Data

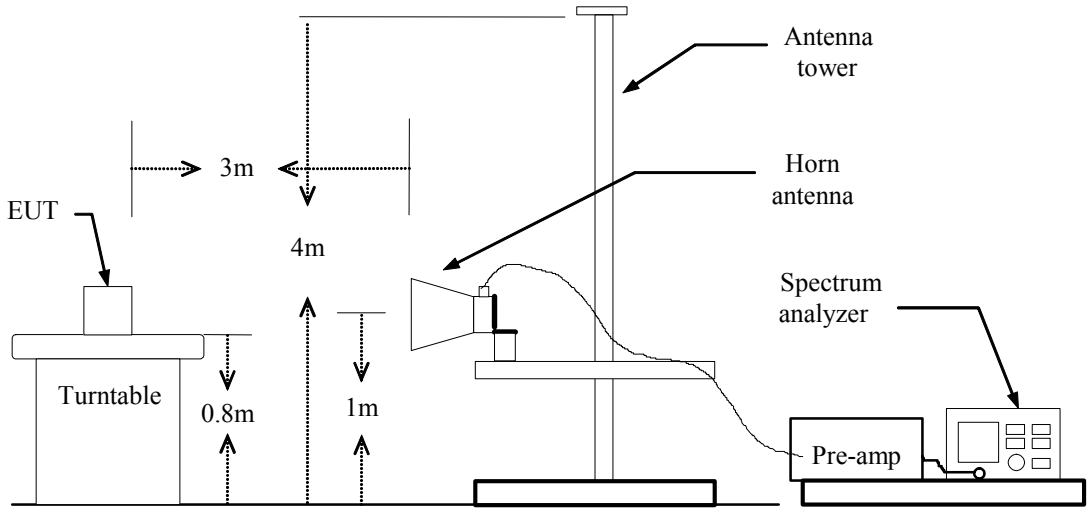
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	0.28	0.00107	1	PASS
Mid	2441	-0.10	0.00098		PASS
High	2480	-0.10	0.00098		PASS

7.2 BAND EDGES MEASUREMENT

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.205(c)).

Test Configuration



TEST PROCEDURE

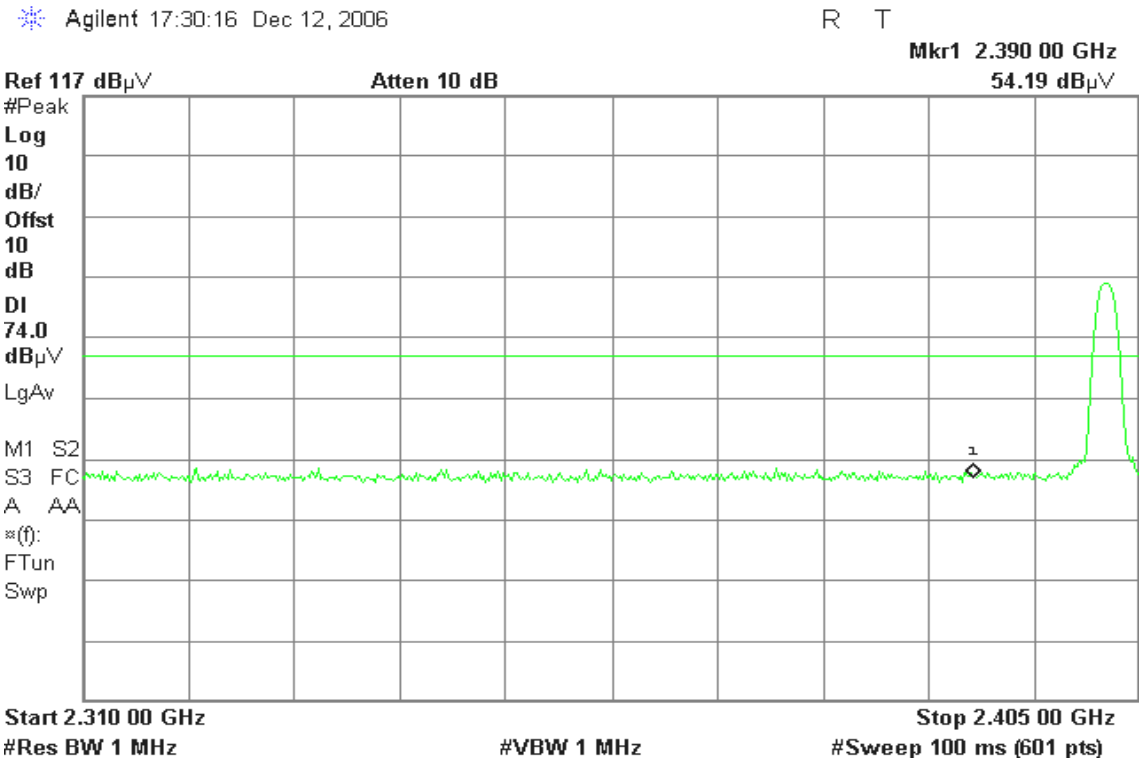
1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
   (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

TEST RESULTS

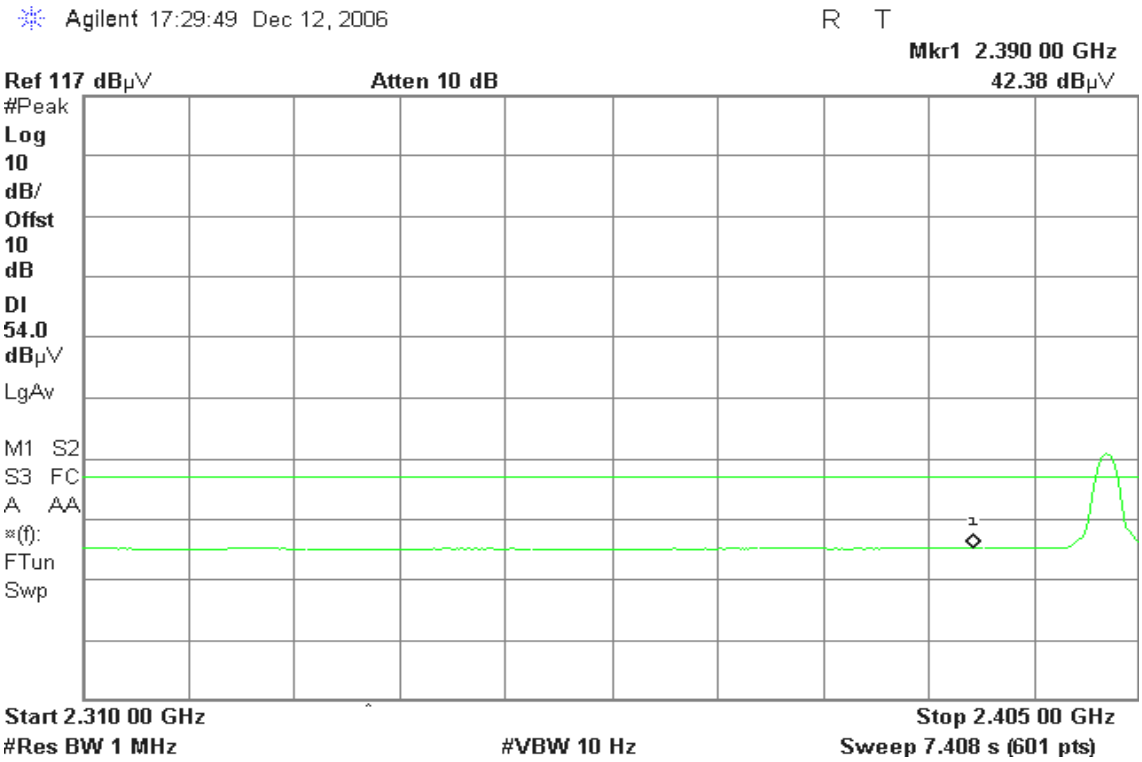
Refer to attach spectrum analyzer data chart.

Band Edges (CH Low)

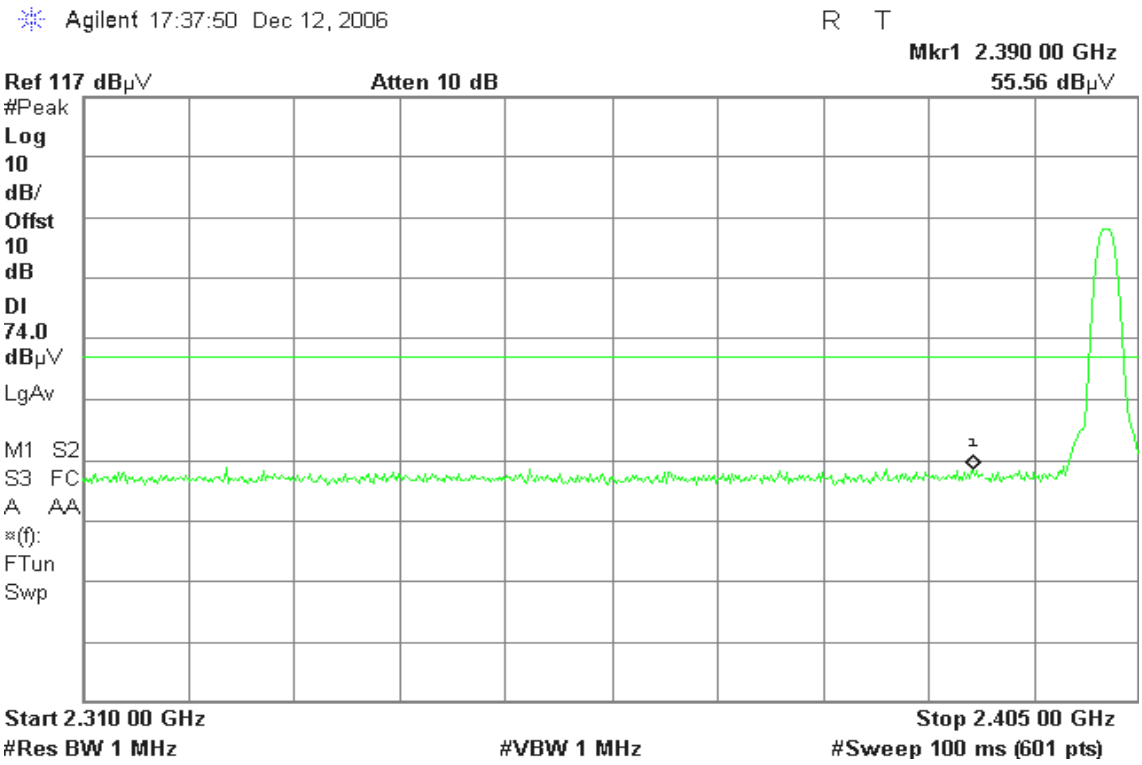
Detector mode: Peak Polarity: Vertical



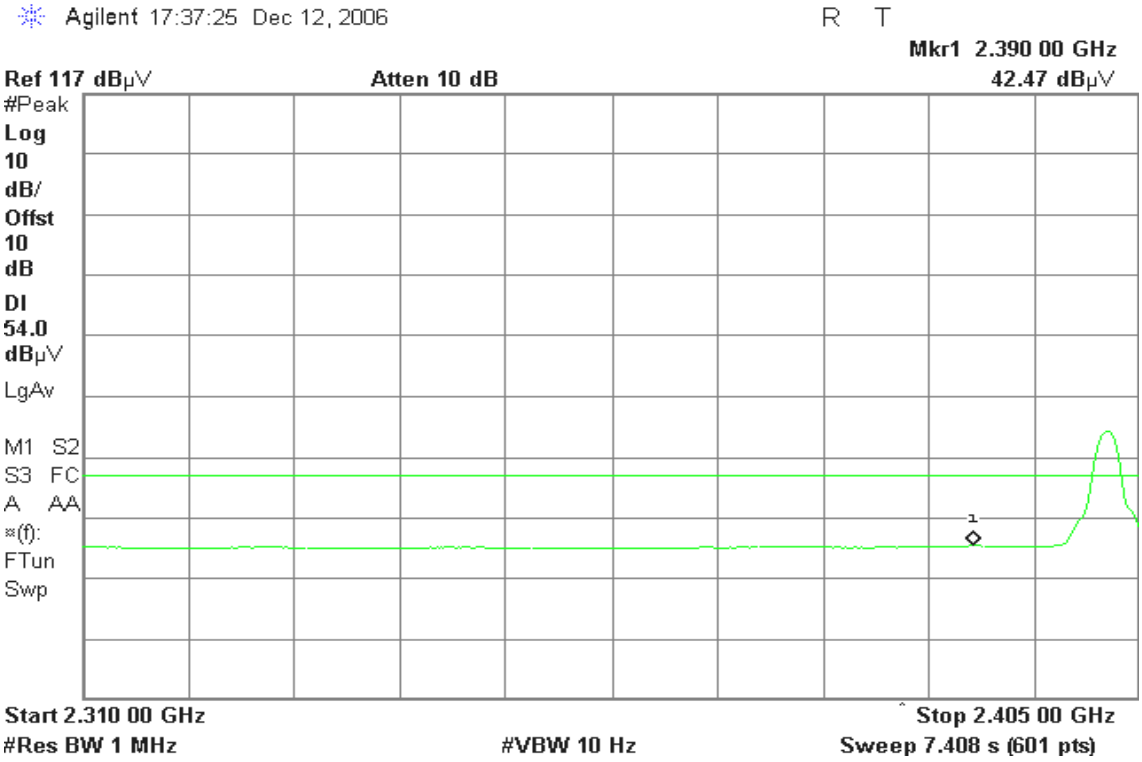
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

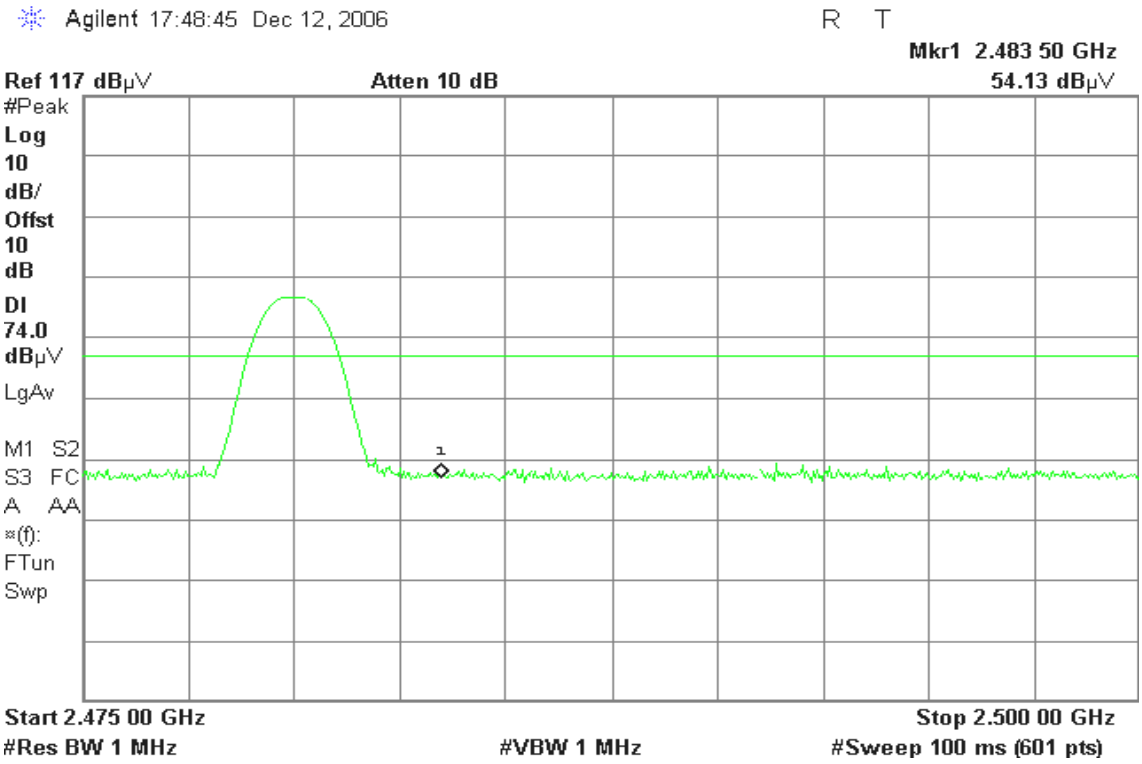


Detector mode: Average **Polarity: Horizontal**

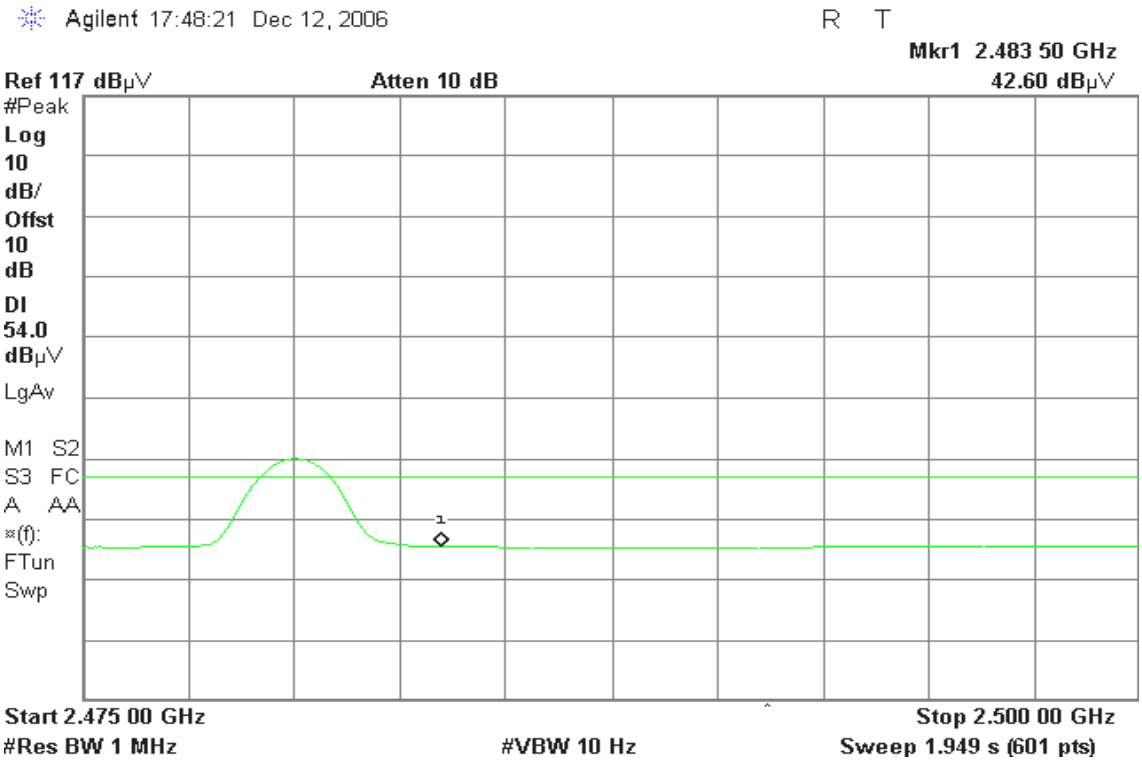


Band Edges (CH High)

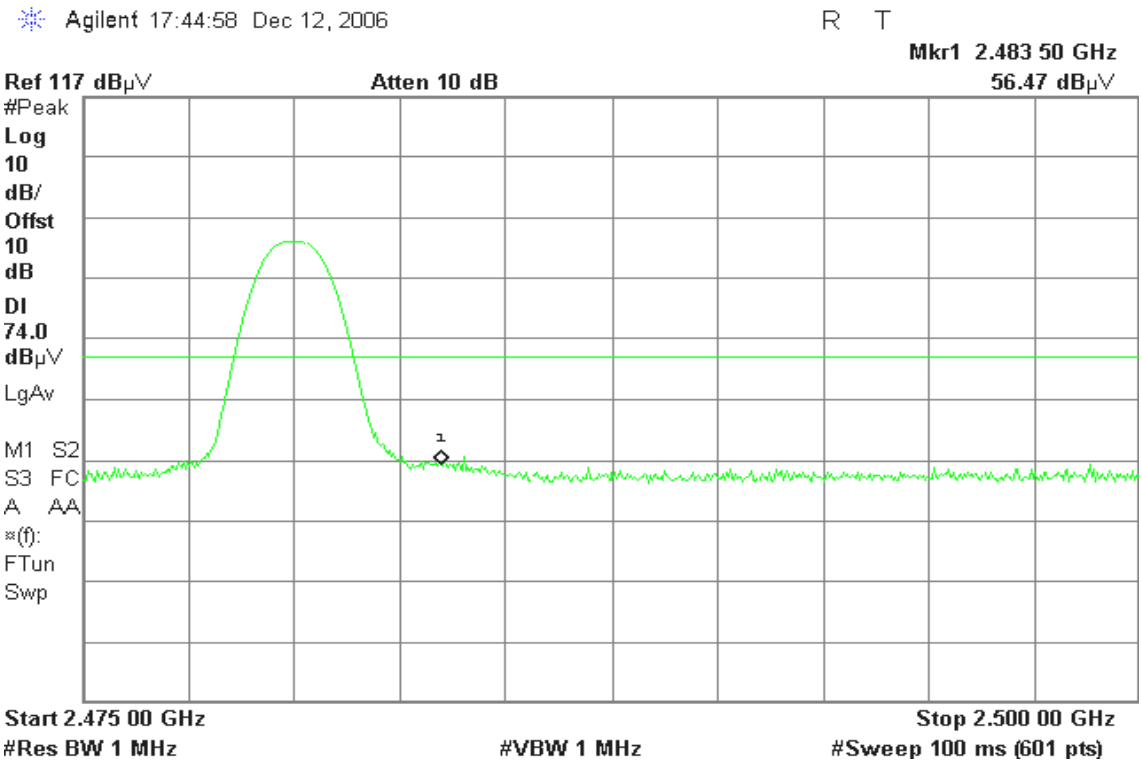
Detector mode: Peak Polarity: Vertical



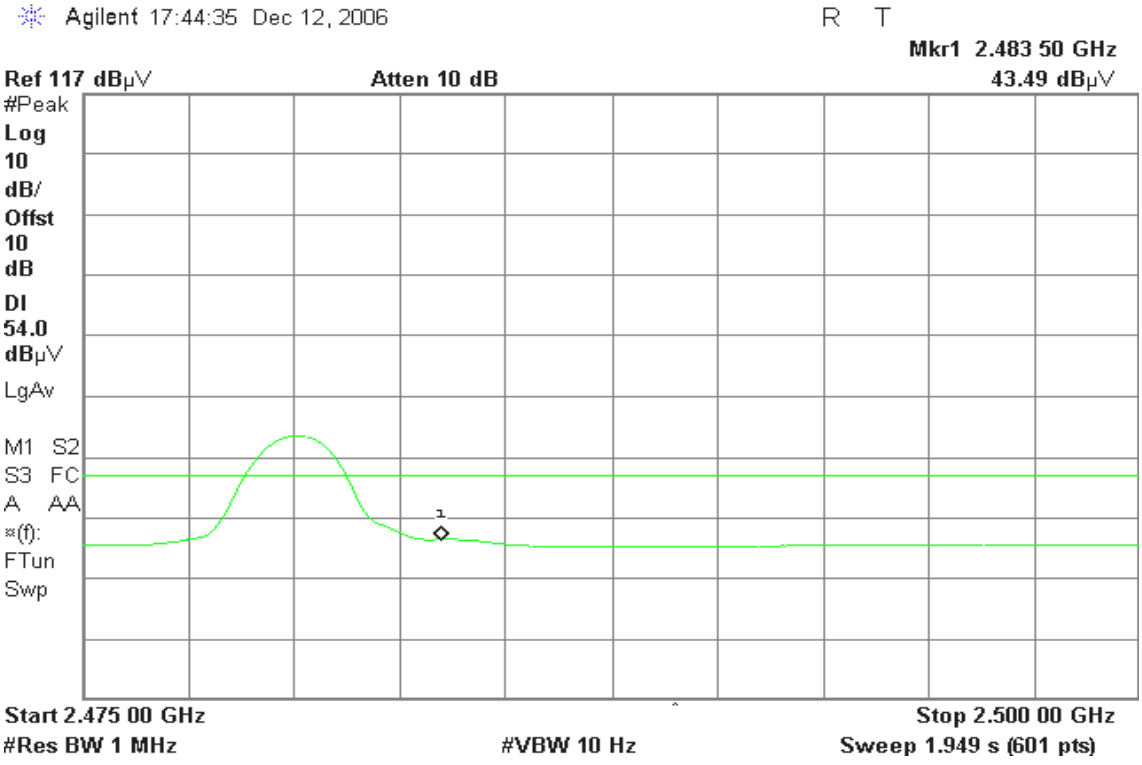
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**

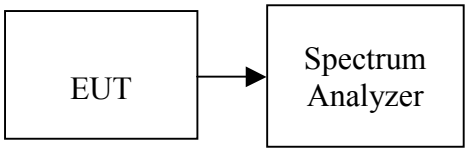


7.3 PEAK POWER SPECTRAL DENSITY

LIMIT

1. According to §15.247(e), for digitally modulated systems, the 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.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s
4. Record the max. reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

TEST RESULTS

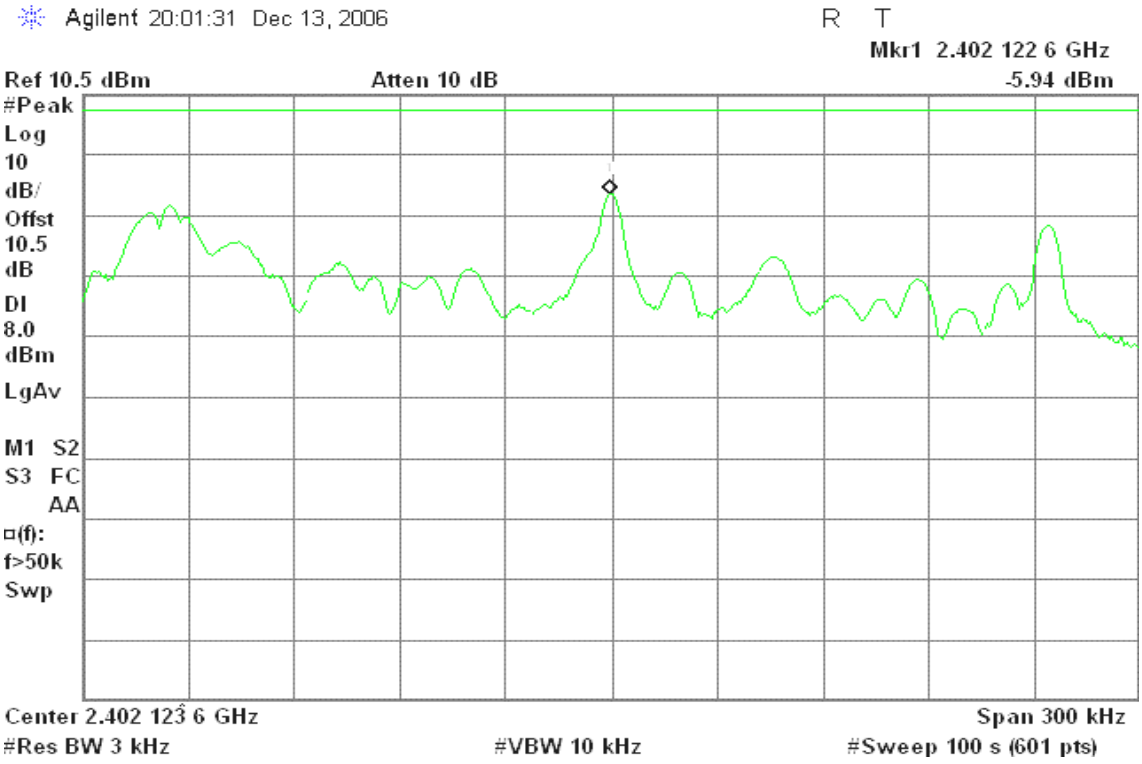
No non-compliance noted

Test Data

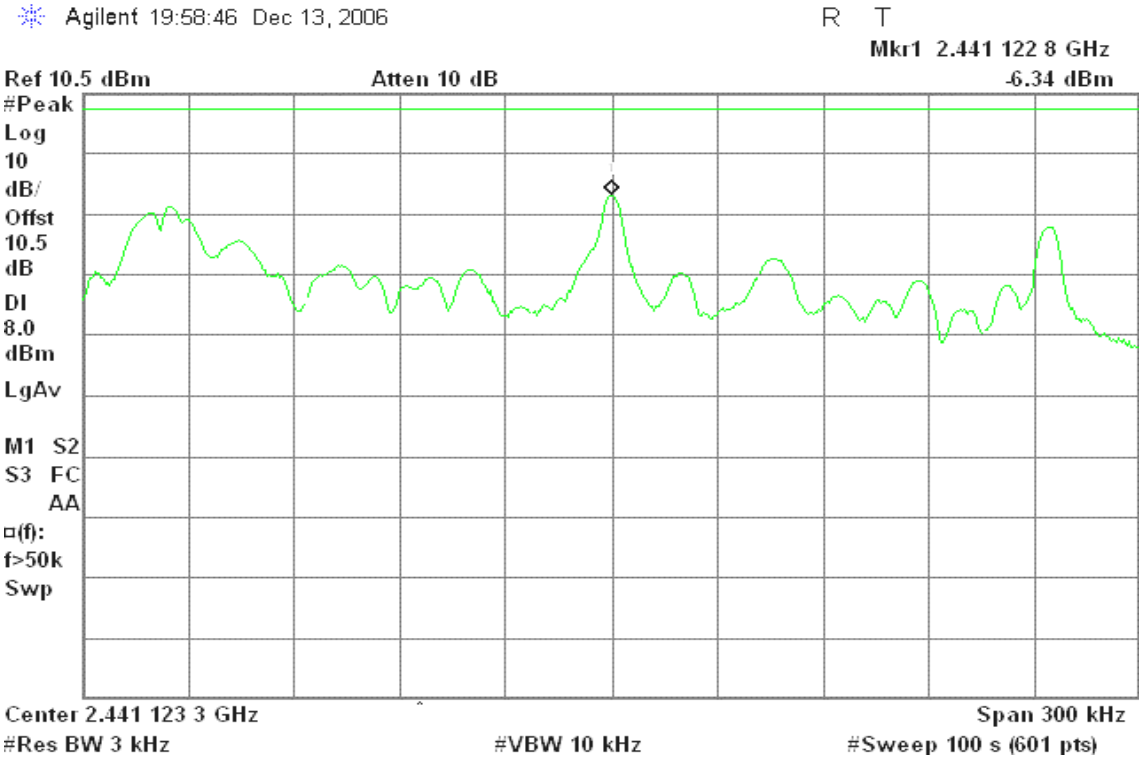
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2402	-5.94	8.00	PASS
Mid	2441	-6.34		PASS
High	2480	-6.18		PASS

Test Plot

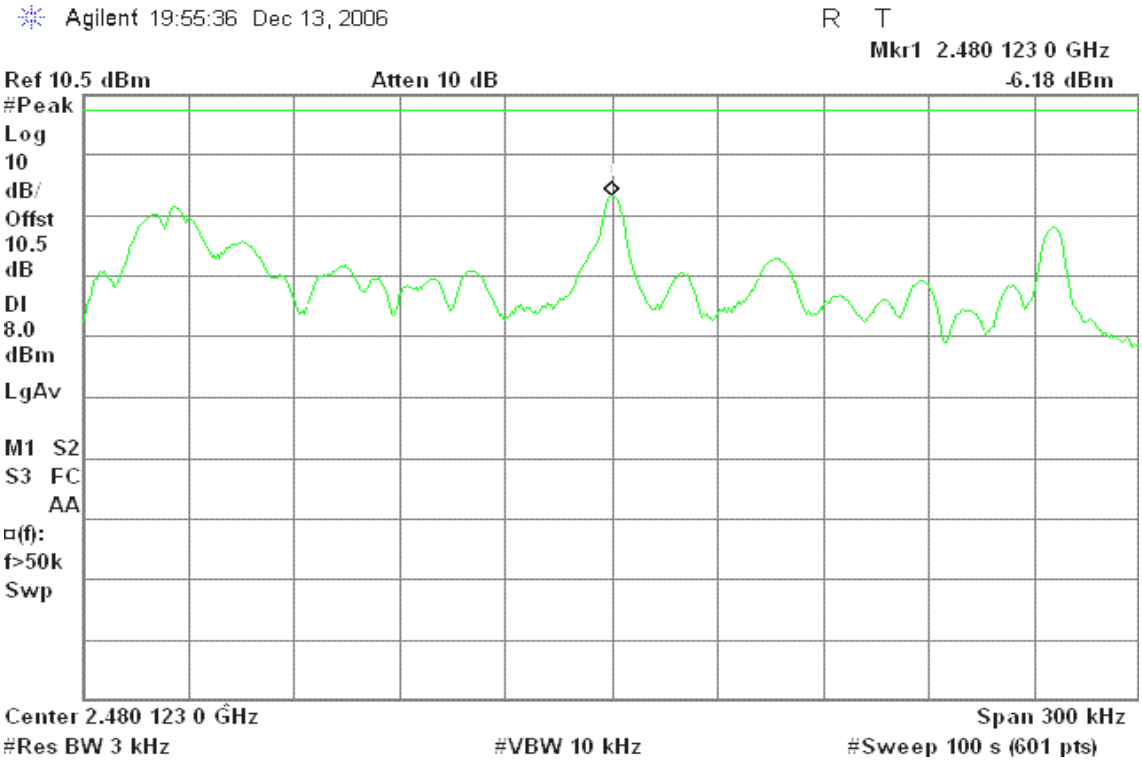
PPSD (CH Low)



PPSD (CH Mid)



PPSD (CH High)

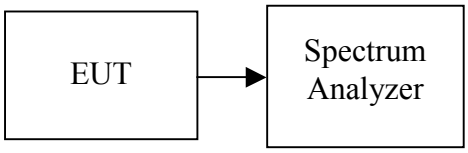

Agilent 19:55:36 Dec 13, 2006
R T
Mkr1 2.480 123 0 GHz
-6.18 dBm
Ref 10.5 dBm
Atten 10 dB
#Peak
Log
10
dB/
Offst
10.5
dB
Dl
8.0
dBm
LgAv
M1 S2
S3 FC
AA
¤(f):
f>50k
Swp
Center 2.480 123 0 GHz
Span 300 kHz
#Res BW 3 kHz
#VBW 10 kHz
#Sweep 100 s (601 pts)

7.4 FREQUENCY SEPARATION

LIMIT

According to §15.247(a)(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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW = 30kHz, VBW = 100kHz, Span = 2MHz, Sweep = auto.
5. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency.

TEST RESULTS

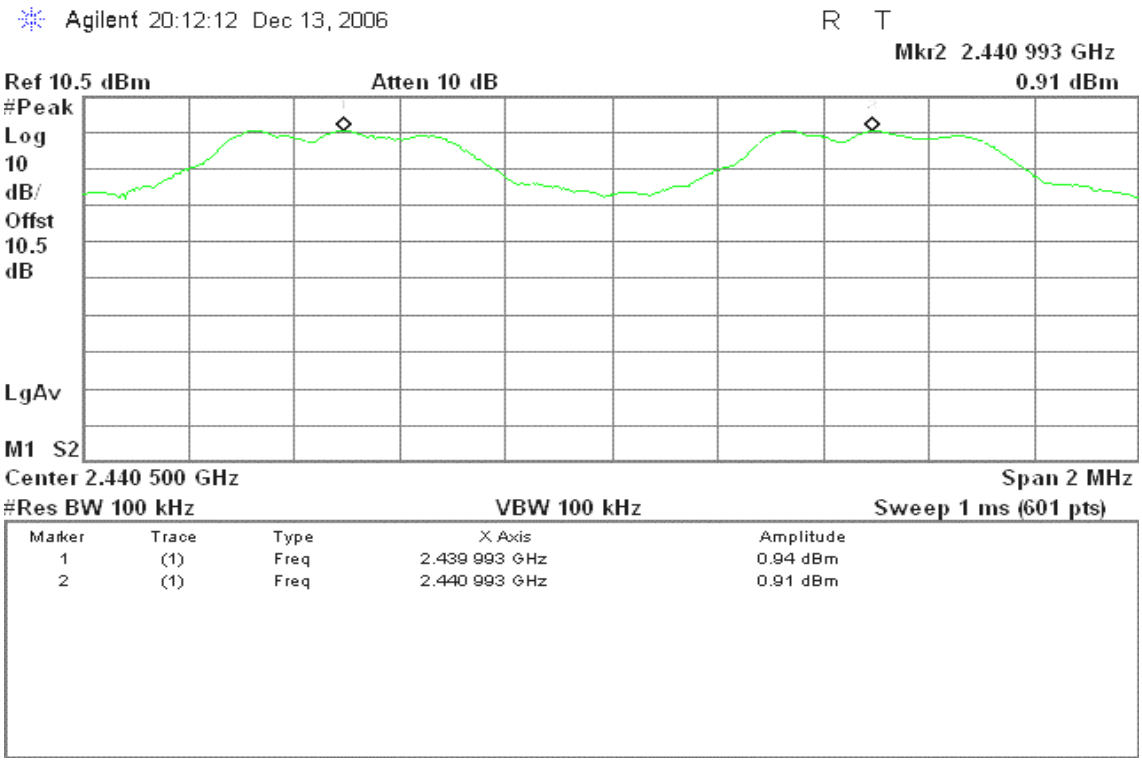
No non-compliance noted

Test Data

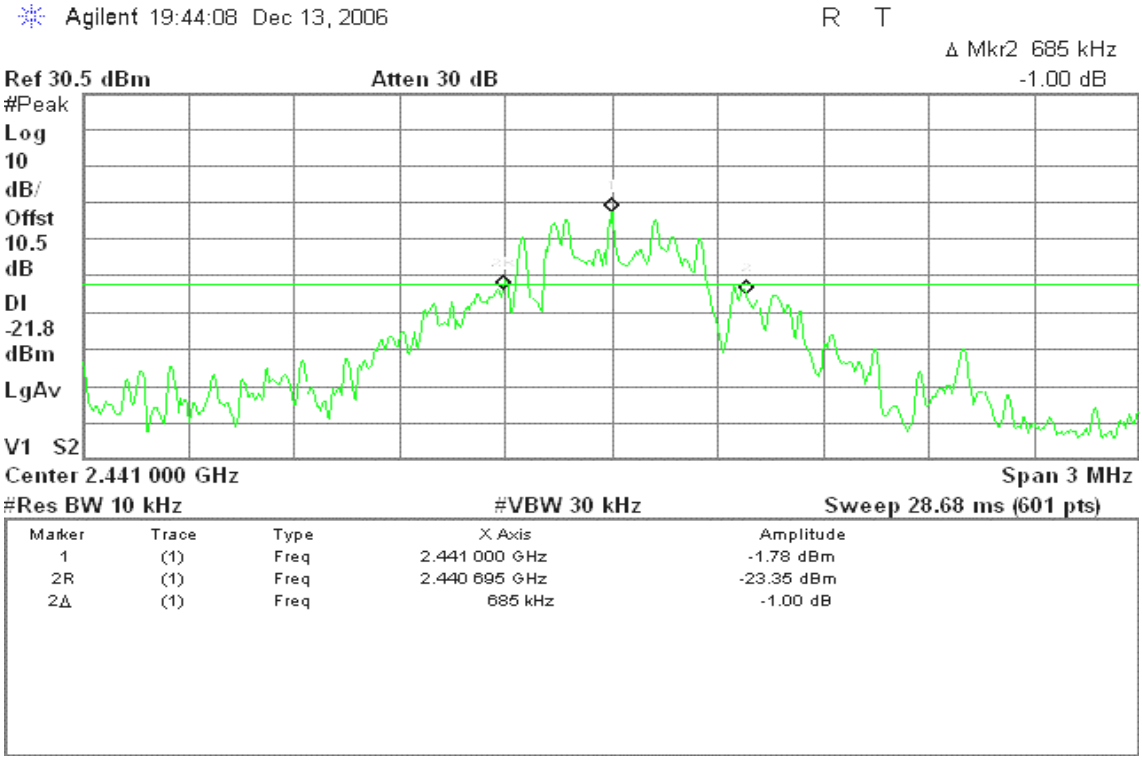
Channel Separation (MHz)	20dB Bandwidth (kHz)	Channel Separation Limit	Result
1.00	685	> 20dB Bandwidth	Pass

Test Plot

Measurement of Channel Separation



Measurement of 20dB Bandwidth

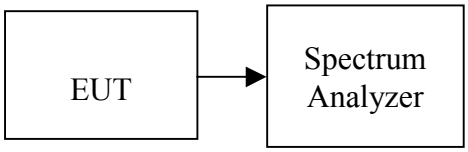


7.5 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz, Sweep = auto and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=510kHz.
5. Max hold, view and count how many channel in the band.

TEST RESULTS

No non-compliance noted

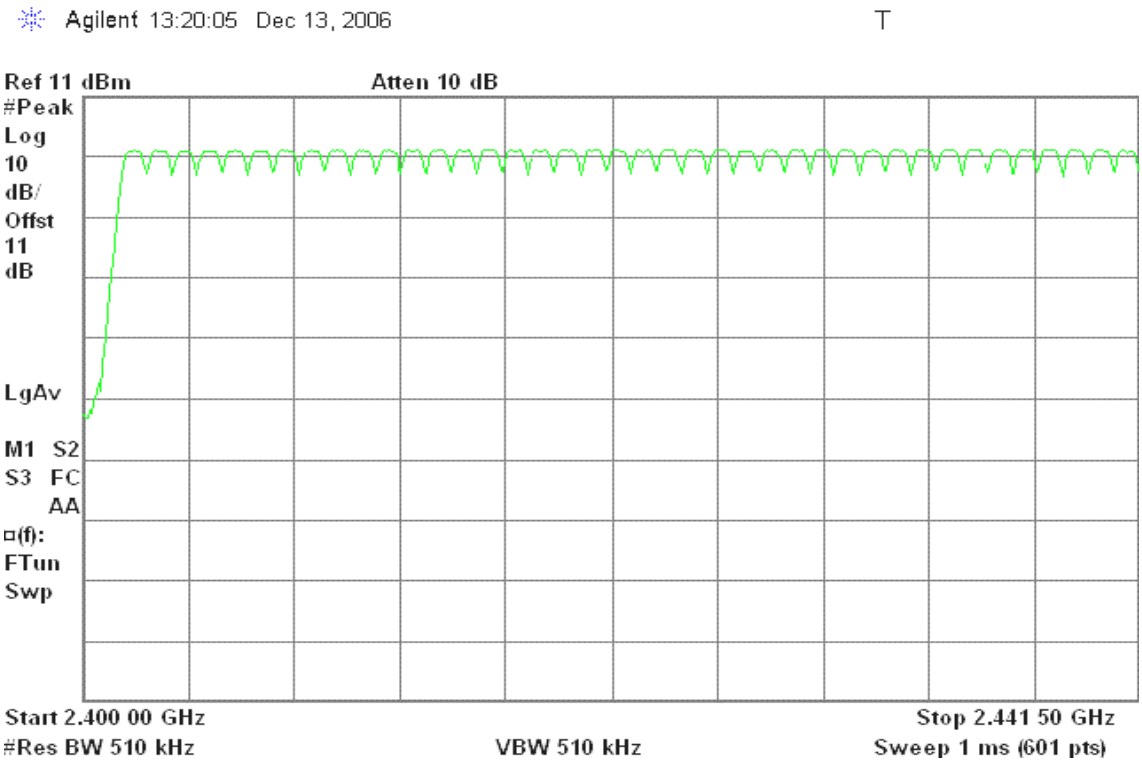
Test Data

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

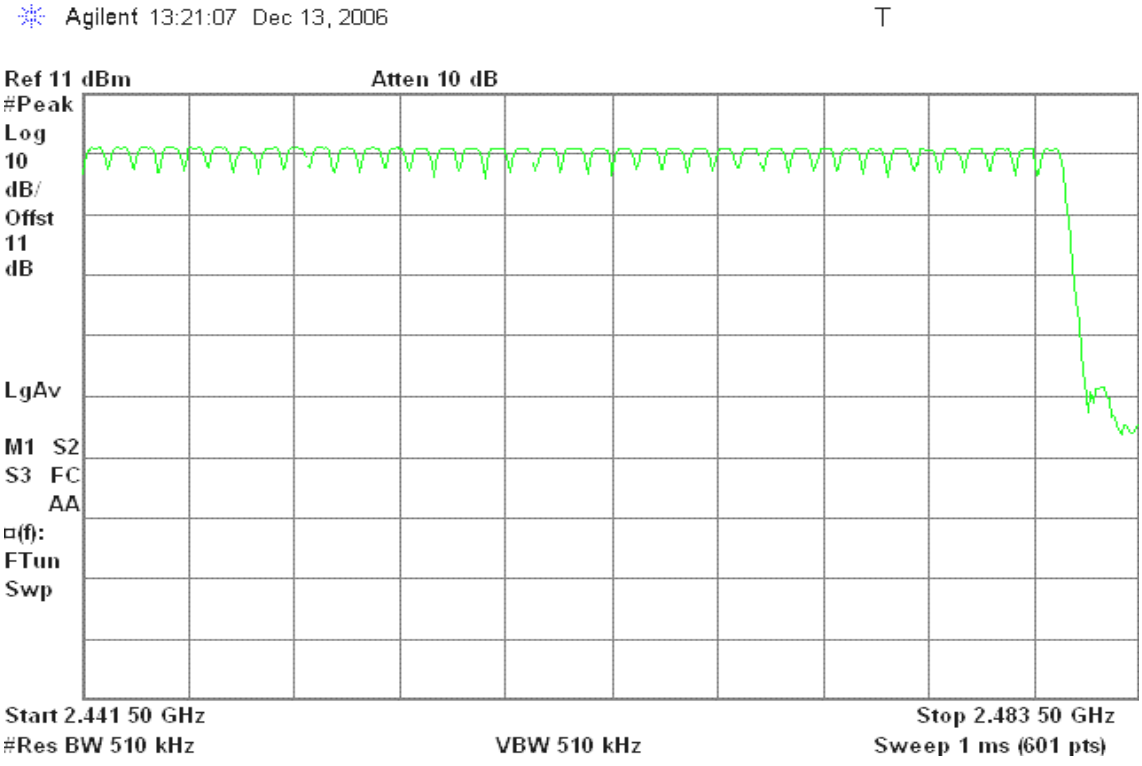
Test Plot

Channel Number

2.4 GHz – 2.4415 GHz



2.4415 GHz – 2.4835 GHz

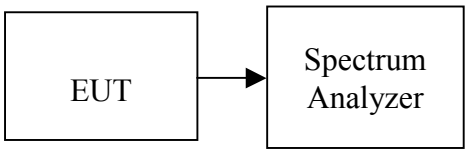


7.6 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = auto.
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted

Test Data

DH 1

CH Low: 0.42 * (1600/2)/79 * 31.6 = 134.40 (ms)
CH Mid: 0.42 * (1600/2)/79 * 31.6 = 134.40 (ms)
CH High: 0.43 * (1600/2)/79 * 31.6 = 137.60 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.42	134.40	31.60	400.00	PASS
Mid	0.42	134.40	31.60		PASS
High	0.43	137.60	31.60		PASS

DH 3

CH Low: 1.68 * (1600/4)/79 * 31.6 = 268.8 (ms)
CH Mid: 1.68 * (1600/4)/79 * 31.6 = 268.8 (ms)
CH High: 1.68 * (1600/4)/79 * 31.6 = 268.8 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.68	268.80	31.60	400.00	PASS
Mid	1.68	268.80	31.60		PASS
High	1.68	268.80	31.60		PASS

DH 5

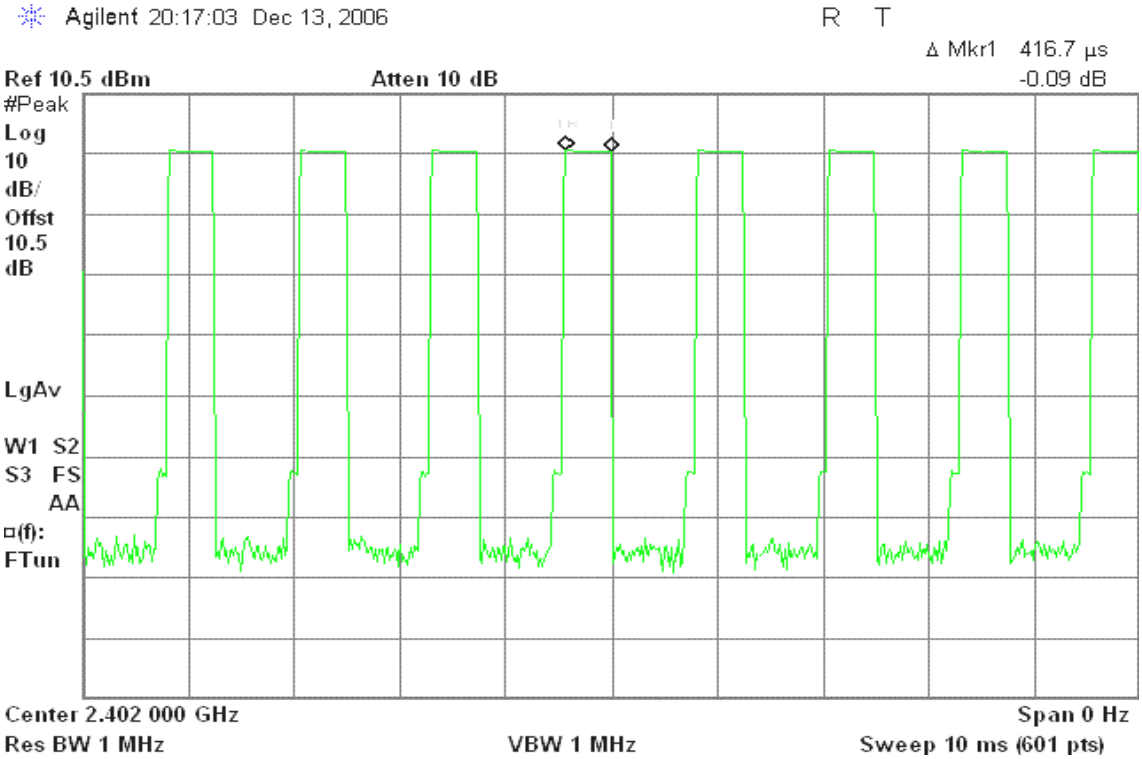
CH Low: 2.93 * (1600/6)/79 * 31.6 = 312.53 (ms)
CH Mid: 2.93 * (1600/6)/79 * 31.6 = 312.53 (ms)
CH High: 2.93 * (1600/6)/79 * 31.6 = 312.53 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.93	312.53	31.60	400.00	PASS
Mid	2.93	312.53	31.60		PASS
High	2.93	312.53	31.60		PASS

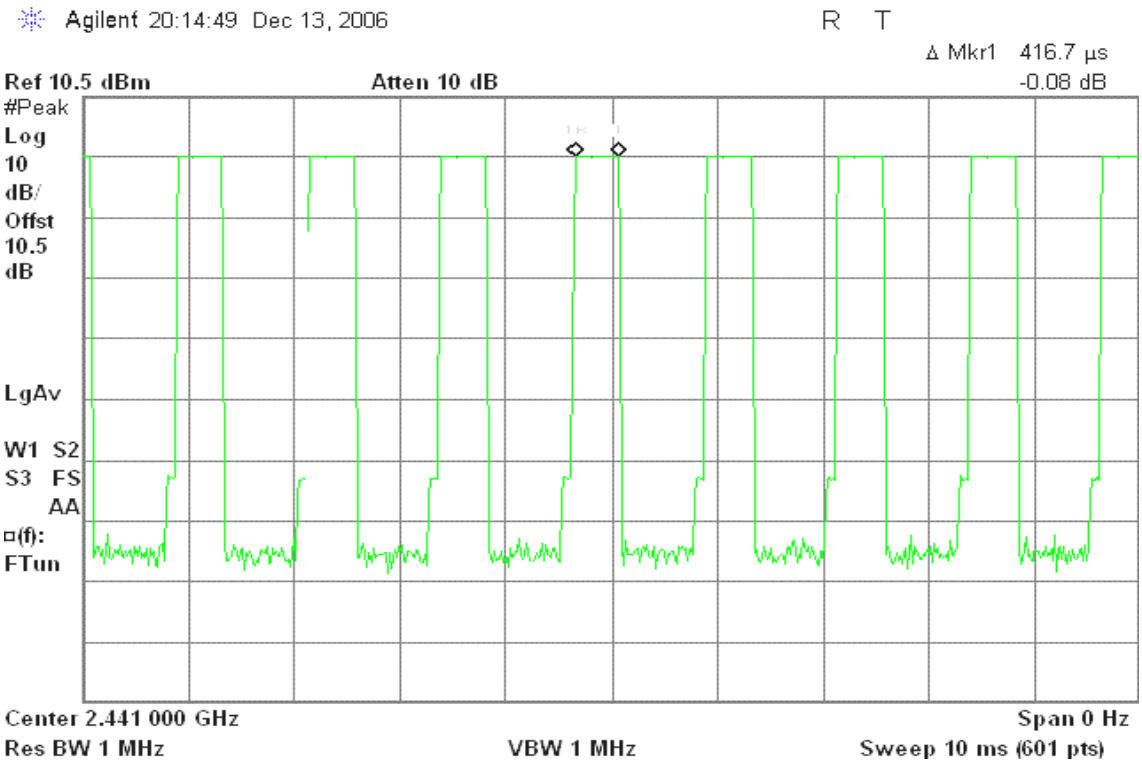
Test Plot

DH 1

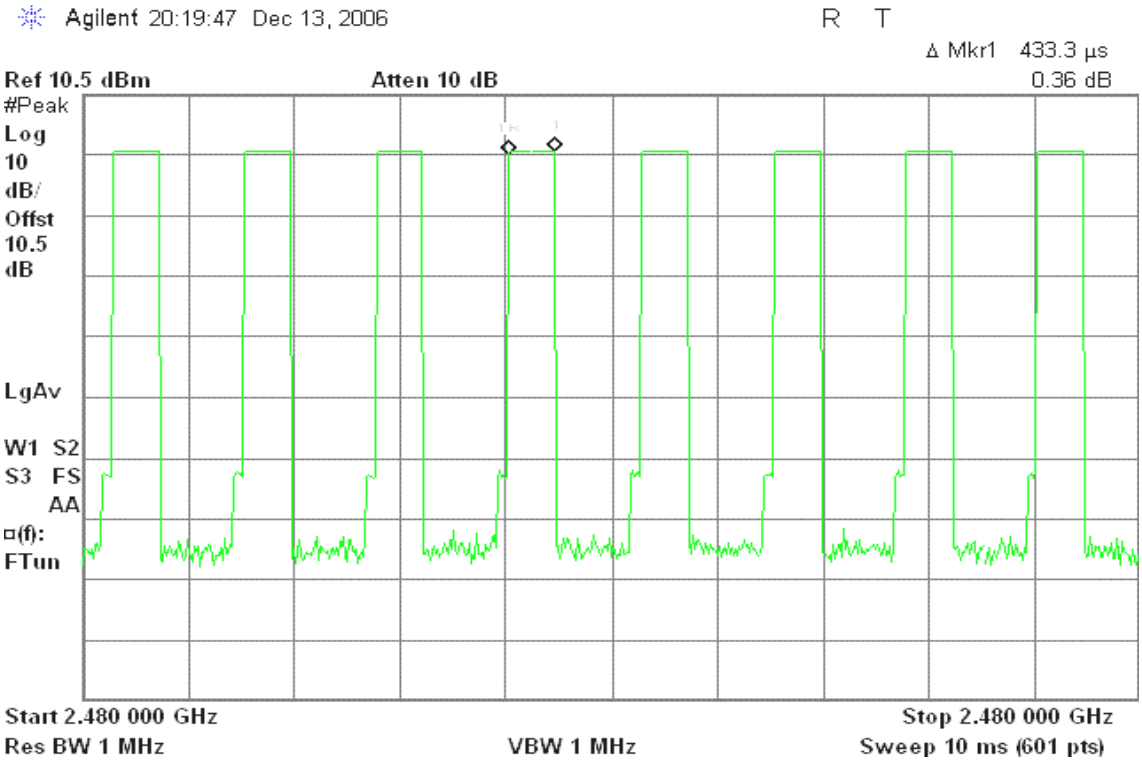
(CH Low)



(CH Mid)

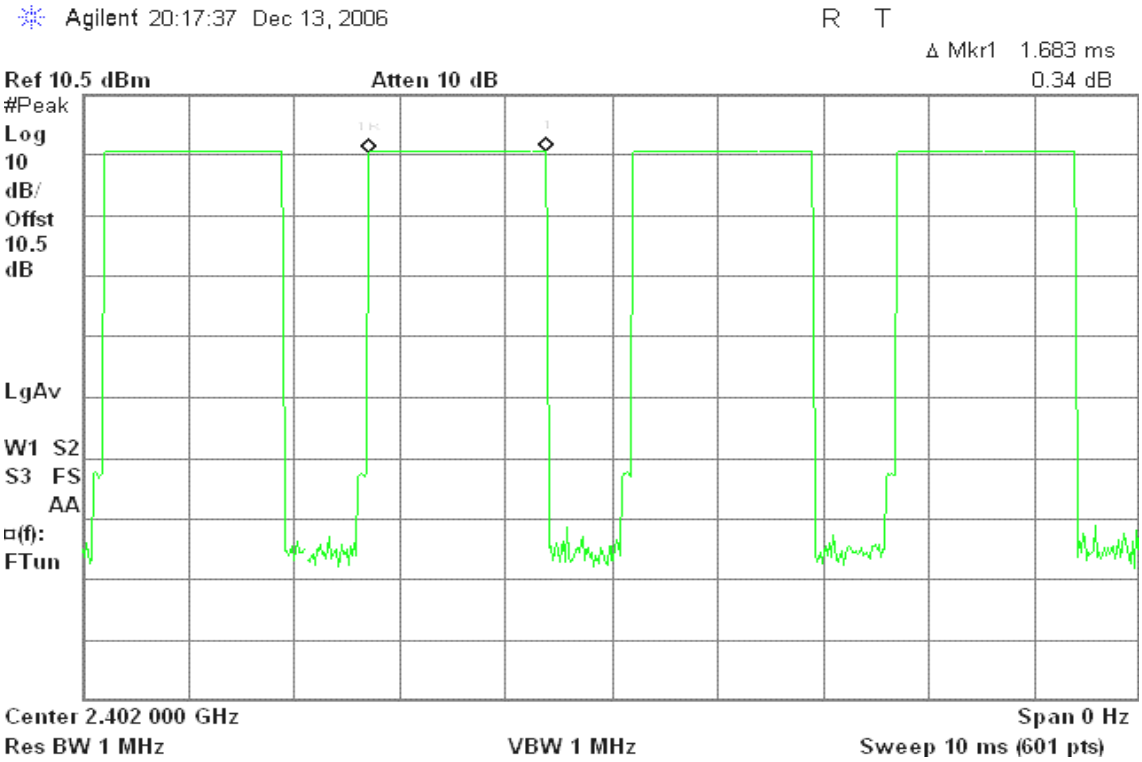


(CH High)

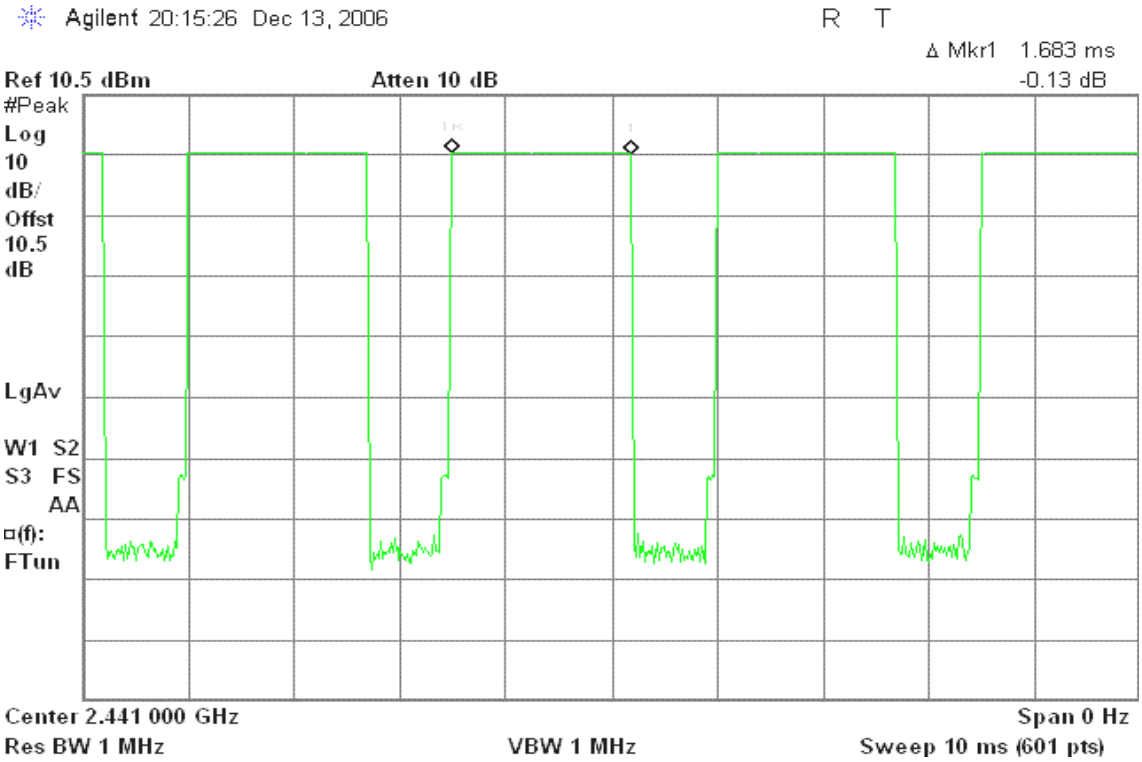


DH 3

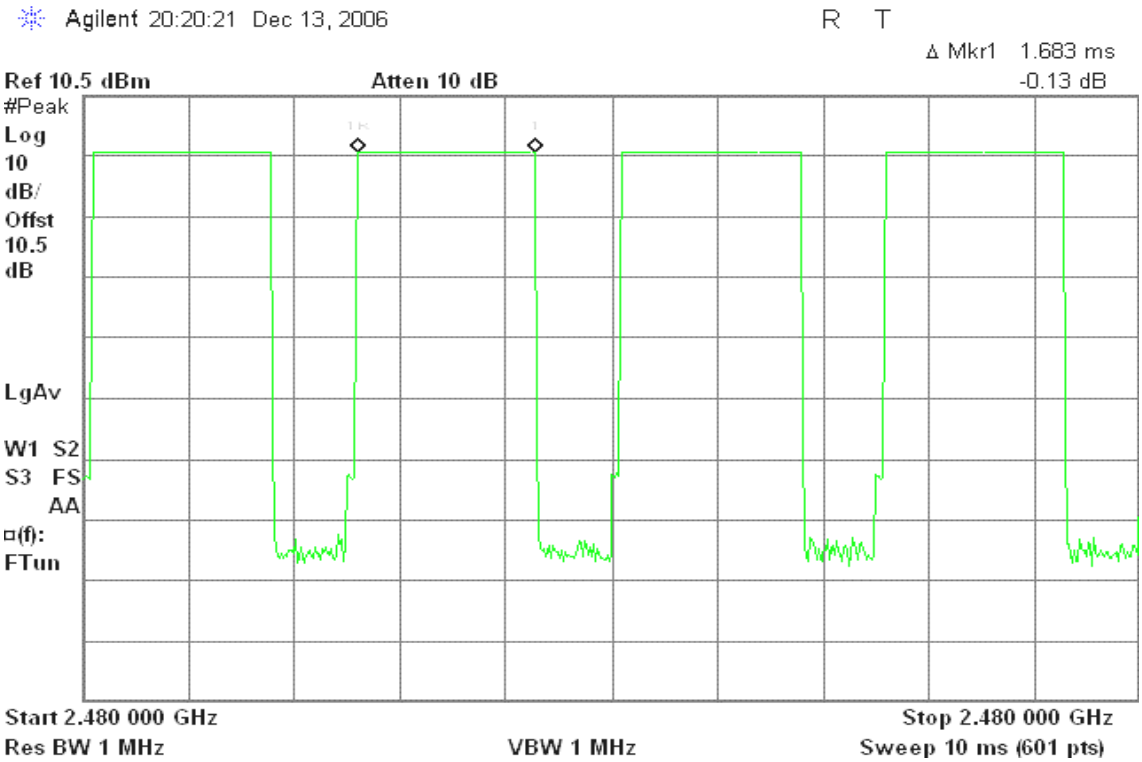
(CH Low)



(CH Mid)

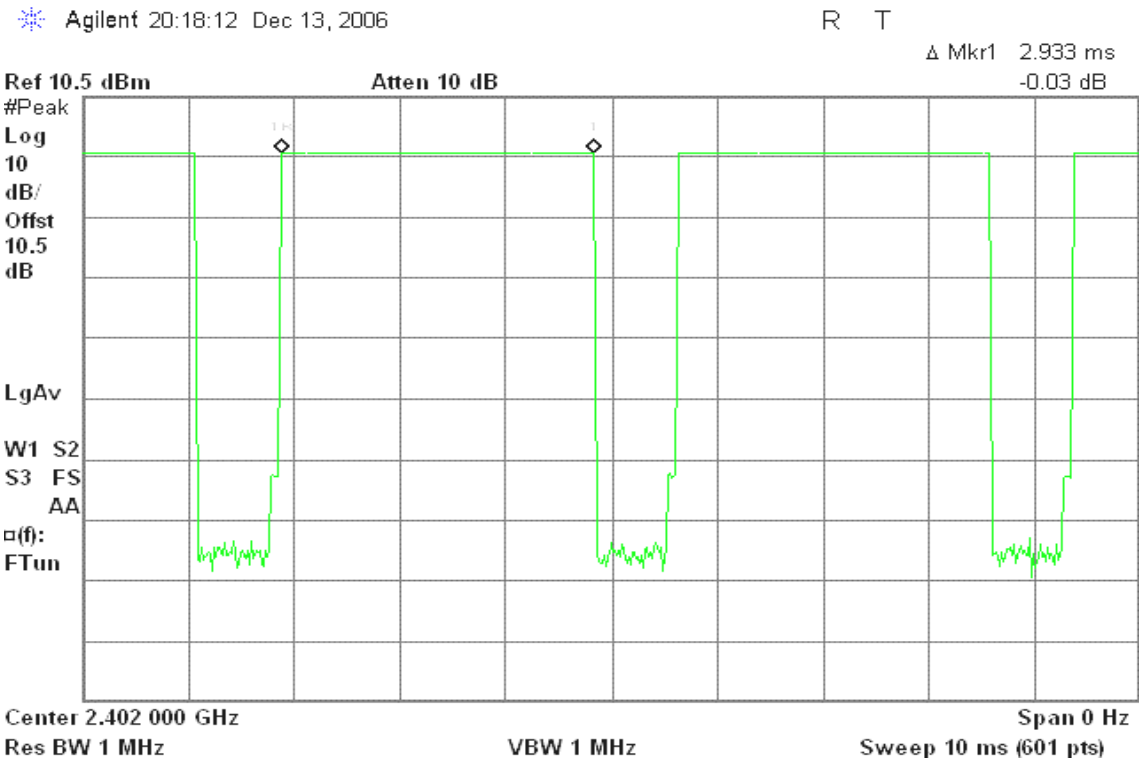


(CH High)

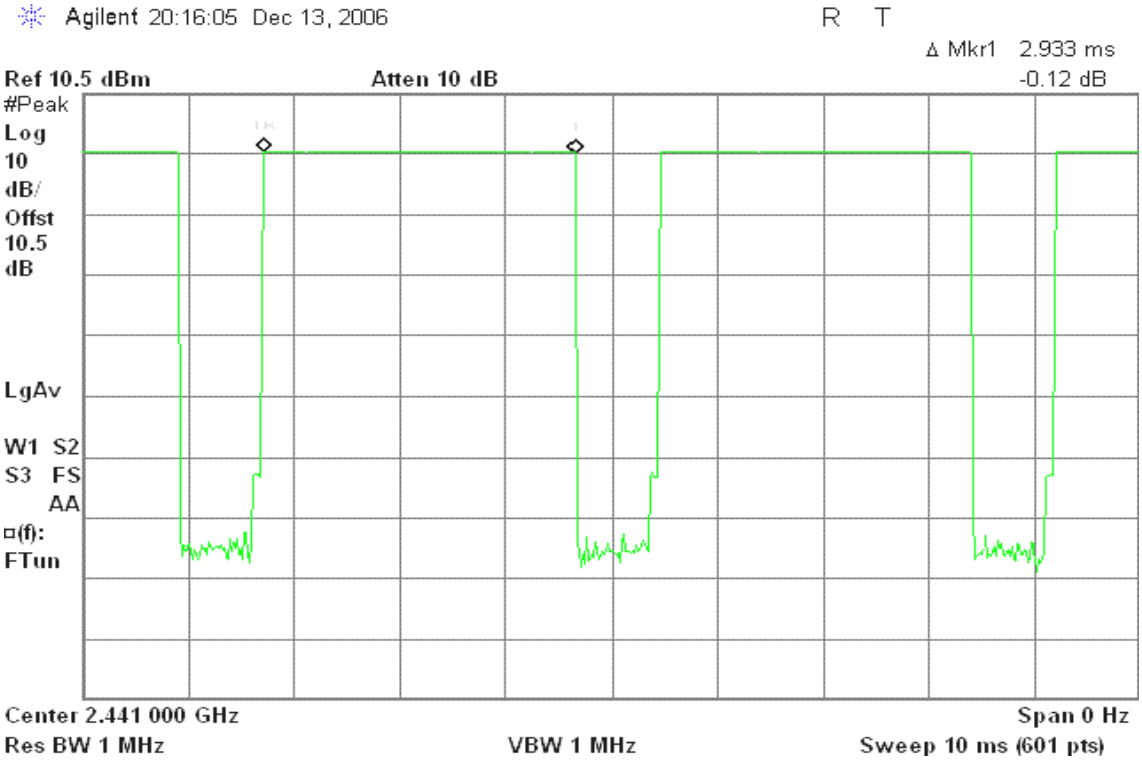


DH 5

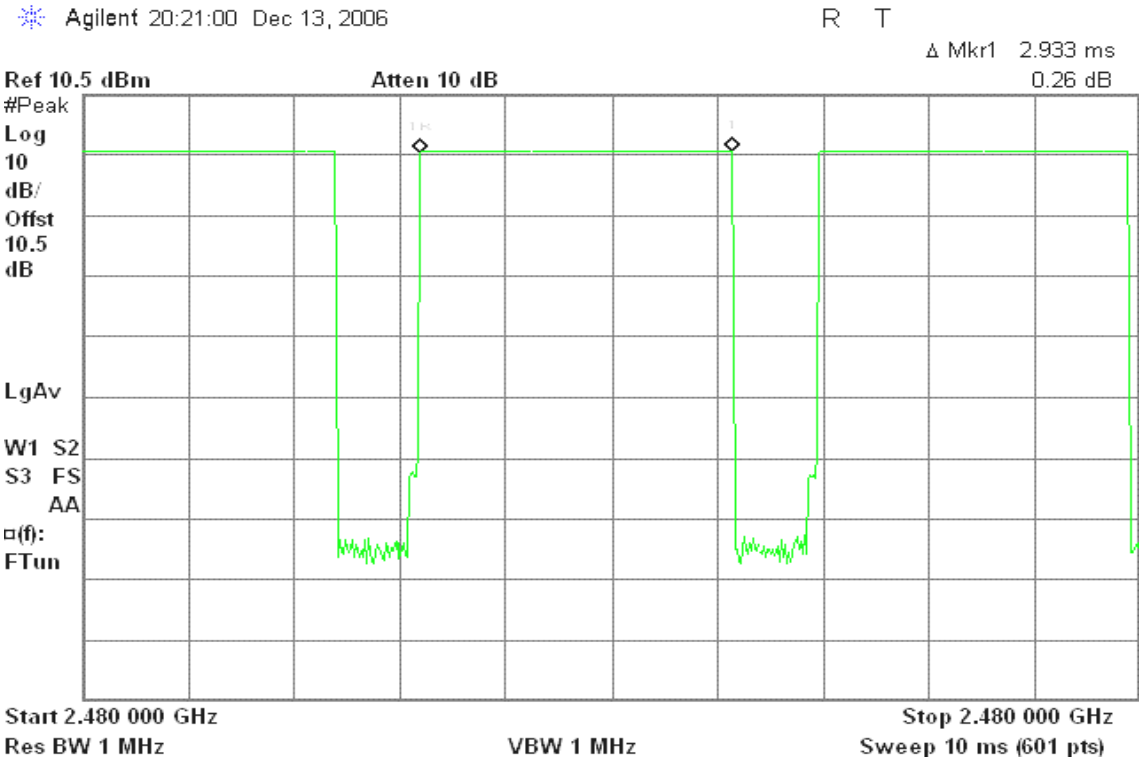
(CH Low)



(CH Mid)



(CH High)


Agilent 20:21:00 Dec 13, 2006
R T
Δ Mkr1 2.933 ms
0.26 dB
Ref 10.5 dBm
Atten 10 dB
#Peak
Log
10
dB/
Offst
10.5
dB
LgAv
W1 S2
S3 FS
AA
¤(f):
FTun
Start 2.480 000 GHz
Res BW 1 MHz
VBW 1 MHz
Stop 2.480 000 GHz
Sweep 10 ms (601 pts)

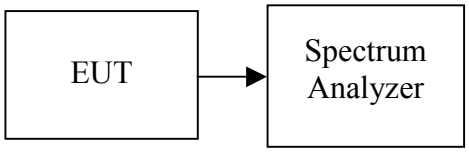
7.7 SPURIOUS EMISSIONS

7.7.1 Conducted Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.205(c)).

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

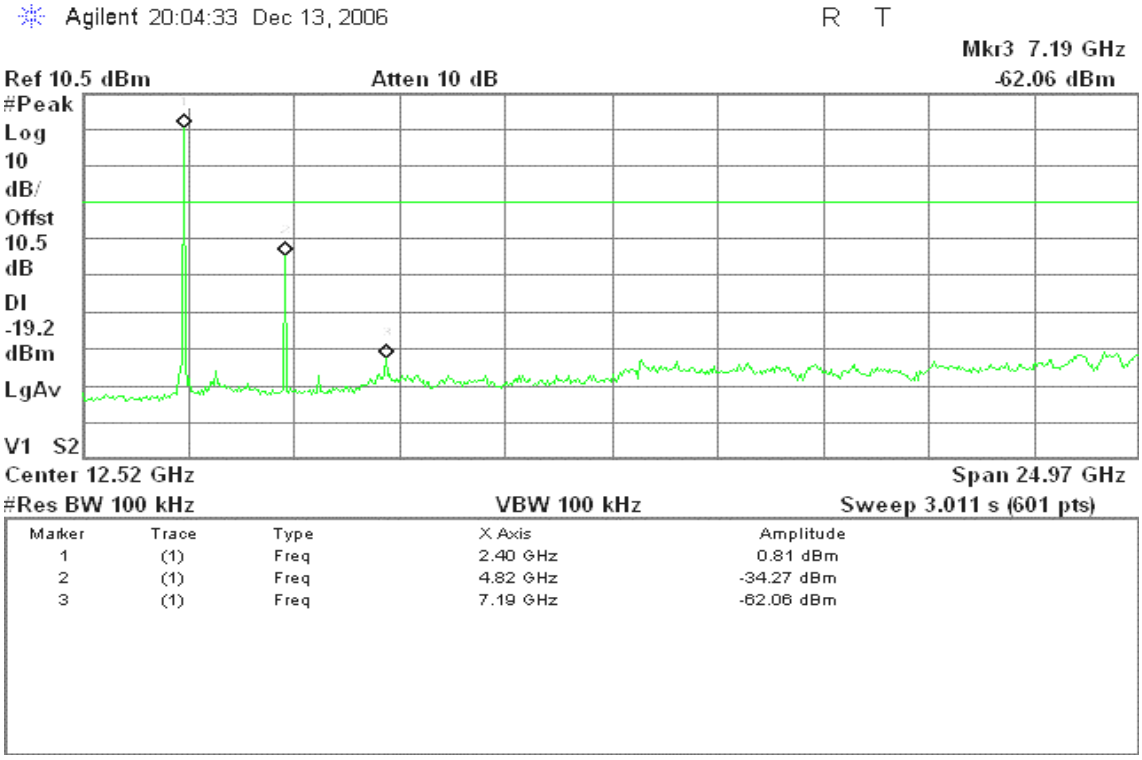
Measurements are made over the 30MHz to 25GHz range with the transmitter set to the lowest, middle, and highest channels.

TEST RESULTS

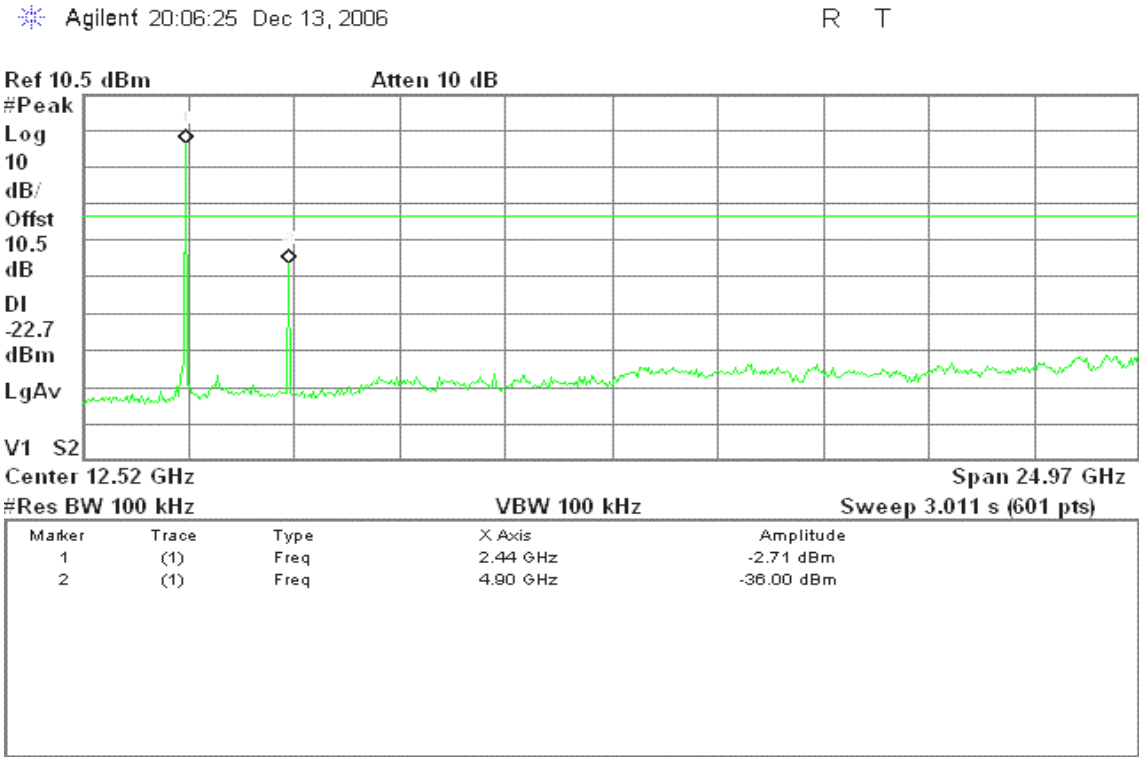
No non-compliance noted

Test Plot

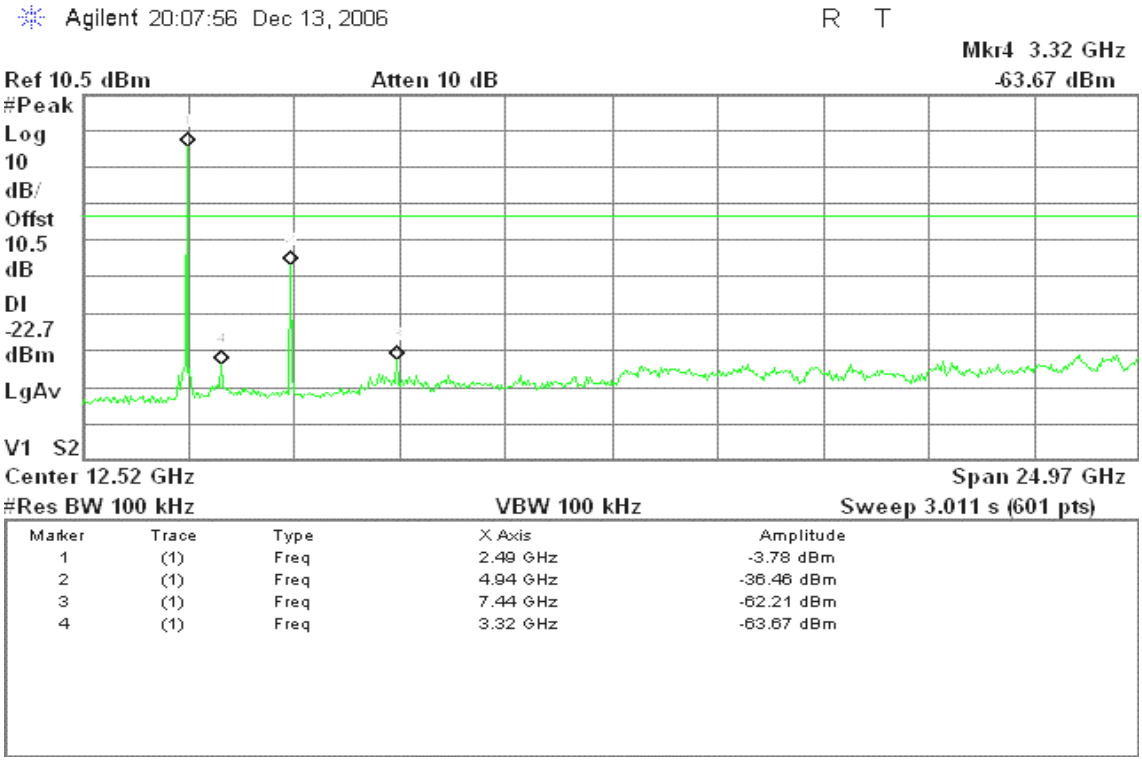
CH Low



CH Mid



CH High


Agilent 20:07:56 Dec 13, 2006
R T
Mkr4 3.32 GHz
Ref 10.5 dBm
Atten 10 dB
-63.67 dBm
#Peak
Log
10
dB/
Offst
10.5
dB
Dl
-22.7
dBm
LgAv
V1 S2
Center 12.52 GHz
Span 24.97 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 3.011 s (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.49 GHz -3.78 dBm
2 (1) Freq 4.94 GHz -36.46 dBm
3 (1) Freq 7.44 GHz -62.21 dBm
4 (1) Freq 3.32 GHz -63.67 dBm

7.7.2 Radiated Emissions

LIMIT

1. According to §15.209(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 (µV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

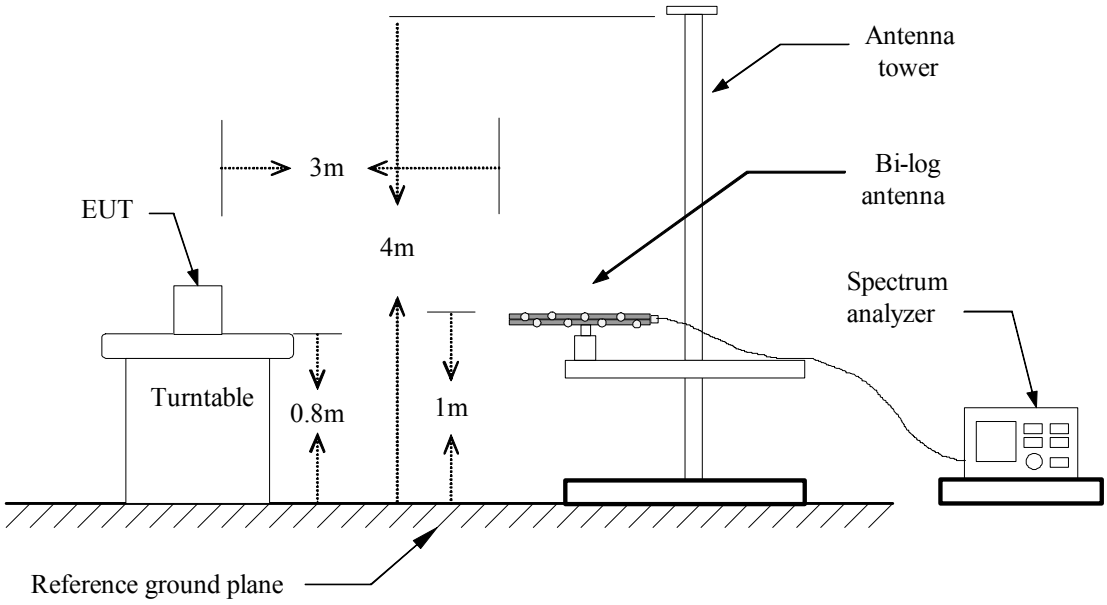
Remark: *Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of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

2. In the emission table above, the tighter limit applies at the band edges.

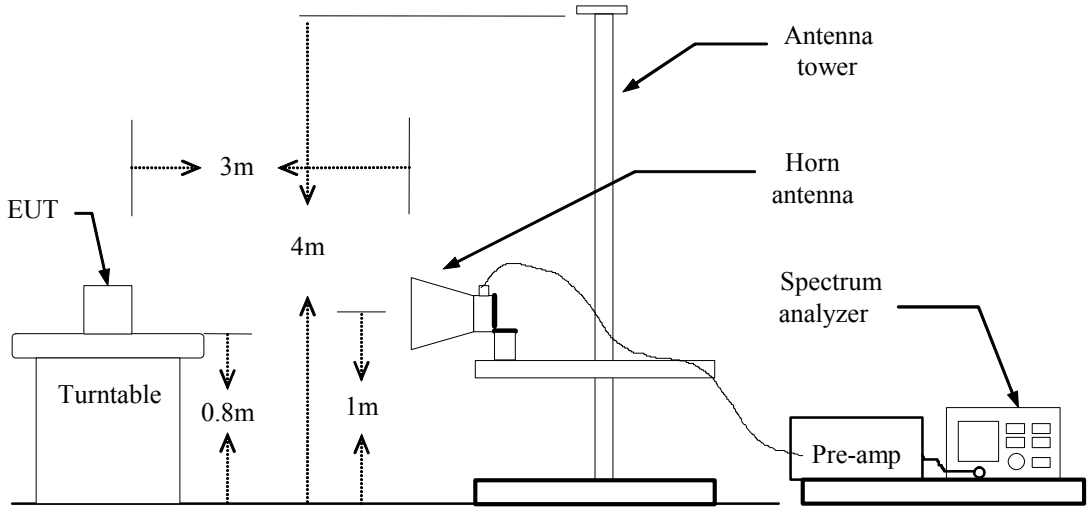
Frequency (MHz)	Field Strength (µV/m at 3-meter)	Field Strength (dBµV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Test Configuration

Below 1 GHz



Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

   Below 1GHz:

   RBW=100kHz / VBW=300kHz / Sweep=AUTO

   Above 1GHz:

   (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO

   (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Link **Test Date:** December 12, 2006

Temperature: 23°C **Tested by:** Skyman Tsai

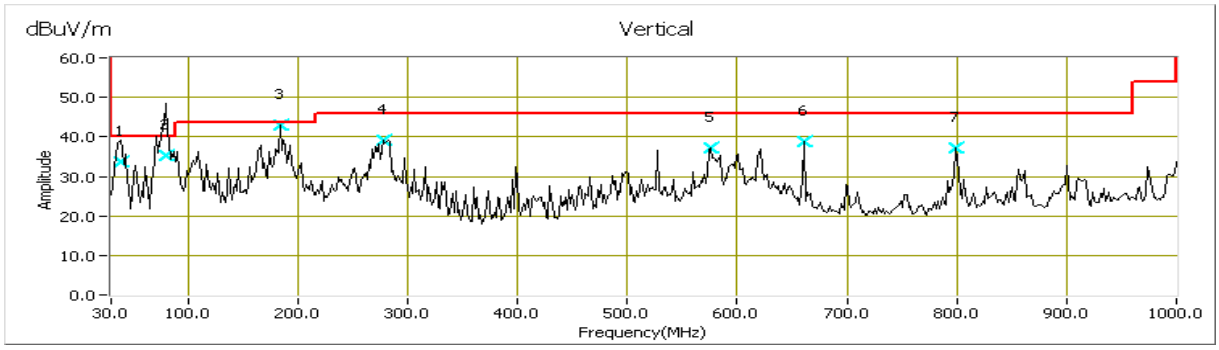
Humidity: 52 % RH **Polarity:** Ver. / Hor.

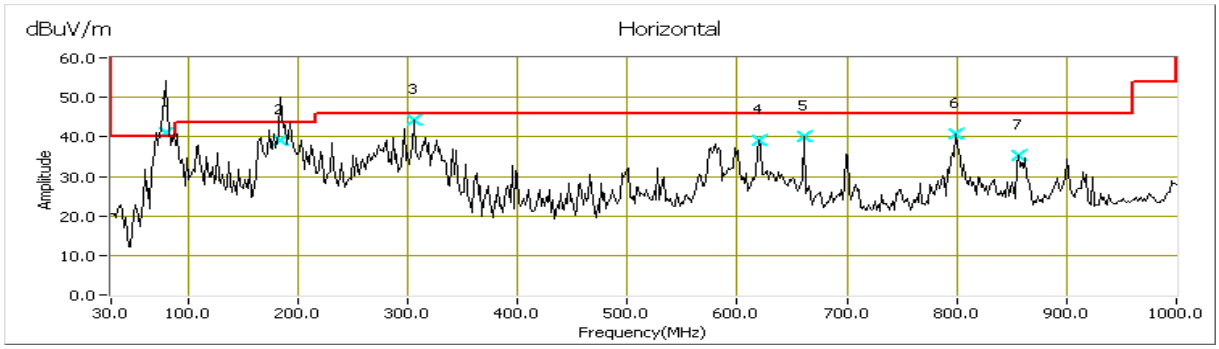
Frequency (MHz)	Ant.Pol. (H/V)	Reading (dBuV/m)	Correction Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
38.08	V	59.02	-25.17	33.85	40.00	-6.15	QP
80.12	V	67.85	-32.41	35.44	40.00	-4.56	QP
183.58	V	70.72	-27.85	42.87	43.50	-0.63	Peak
277.35	V	64.88	-25.58	39.30	46.00	-6.70	Peak
660.50	V	56.32	-17.36	38.96	46.00	-7.04	Peak
799.53	V	52.30	-15.13	37.17	46.00	-8.83	Peak
183.58	H	67.14	-27.85	39.29	43.50	-4.21	QP
306.45	H	69.41	-25.15	44.26	46.00	-1.74	Peak
620.08	H	57.38	-18.14	39.24	46.00	-6.76	Peak
660.50	H	57.52	-17.36	40.16	46.00	-5.84	Peak
799.53	H	56.04	-15.13	40.91	46.00	-5.09	Peak
856.12	H	49.74	-14.33	35.41	46.00	-10.59	Peak

Remark:

1. *Measuring frequencies from 30 MHz to the 1GHz.*
2. *Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.*
3. *Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.*
4. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
5. *Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).*

Test Plot


dBuV/m
Vertical
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Amplitude
1
2
3
4
5
6
7
30.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
Frequency(MHz)


dBuV/m
Horizontal
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Amplitude
2
3
4
5
6
7
30.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
Frequency(MHz)

Above 1 GHz

Operation Mode: TX / CH Low **Test Date:** December 12, 2006

Temperature: 22°C **Tested by:** Skyman Tsai

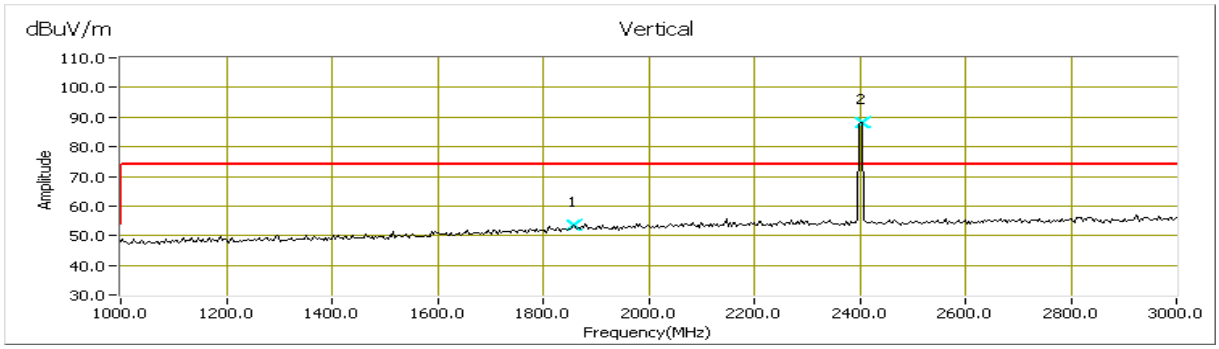
Humidity: 50 % RH **Polarity:** Ver. / Hor.

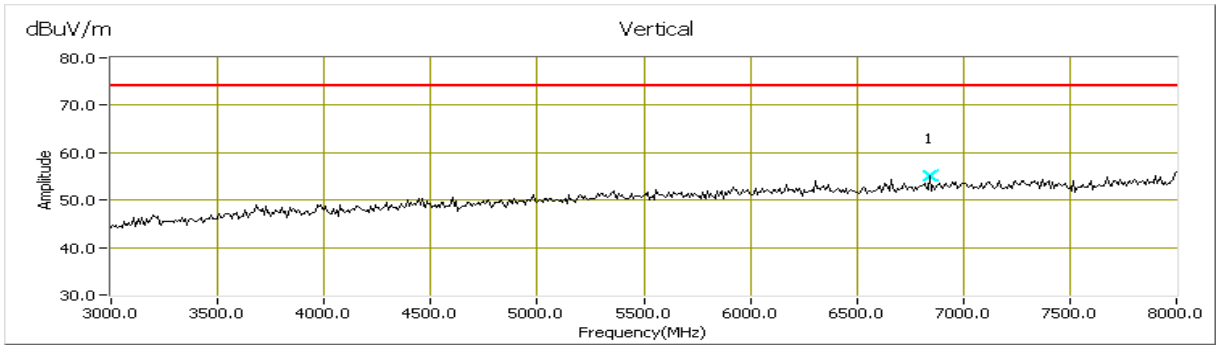
Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1856.67	V	51.83	38.36	1.79	53.62	40.15	74.00	54.00	-13.85	AVG
6841.67	V	40.82	26.79	14.37	55.19	41.16	74.00	54.00	-12.84	AVG
N/A										
1950.00	H	51.57	38.41	2.51	54.08	40.92	74.00	54.00	-13.08	AVG
6558.33	H	39.78	26.70	13.90	53.68	40.60	74.00	54.00	-13.40	AVG
N/A										

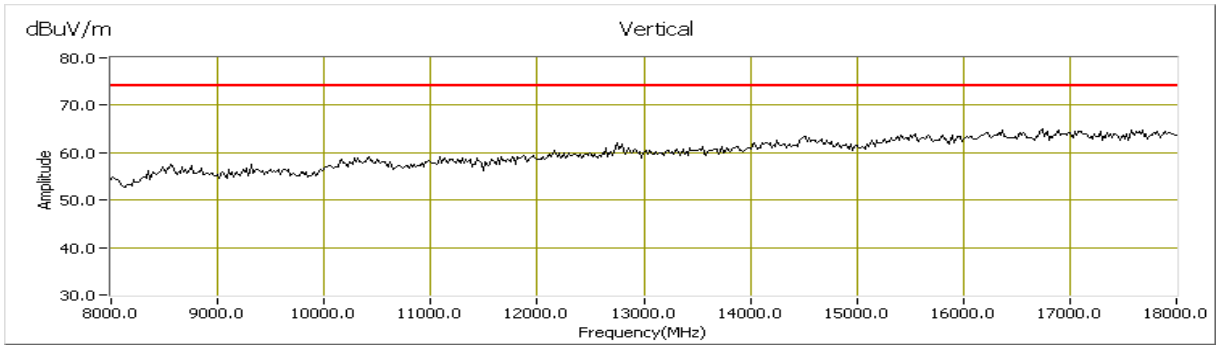
Remark:

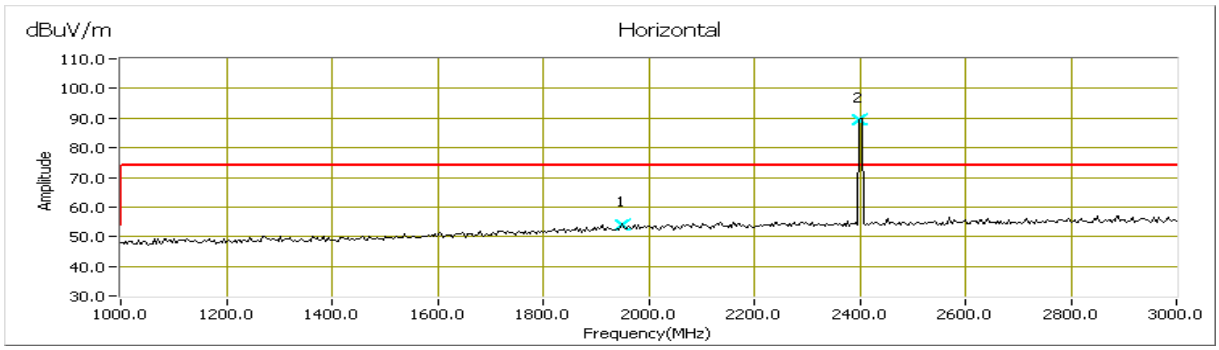
1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

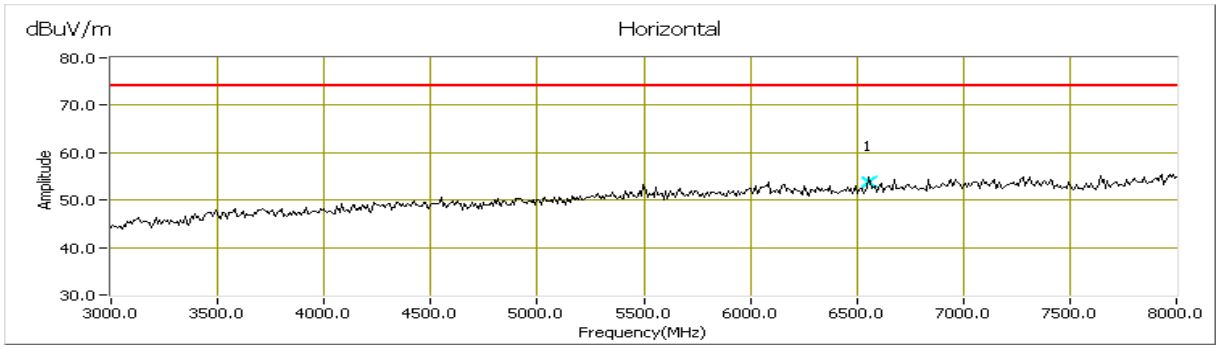
Test Plot

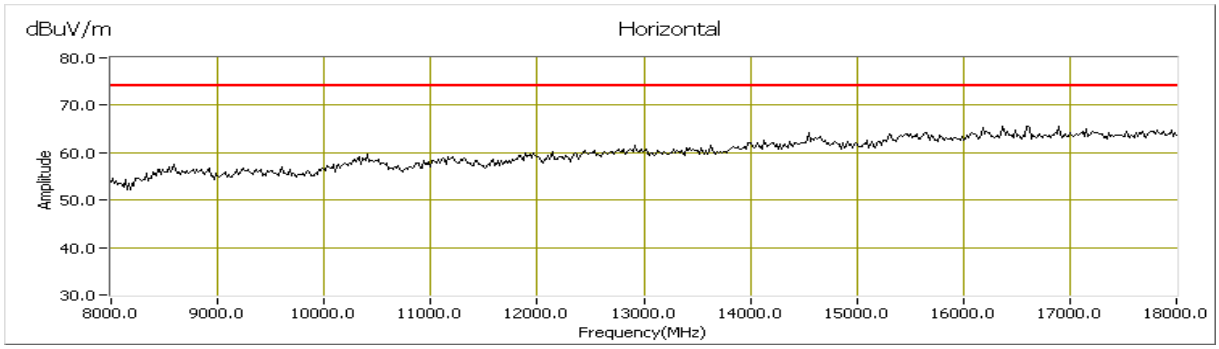

dBuV/m
Vertical
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Vertical
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Vertical
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)

Operation Mode: TX / CH Mid **Test Date:** December 12, 2006

Temperature: 22°C **Tested by:** Skyman Tsai

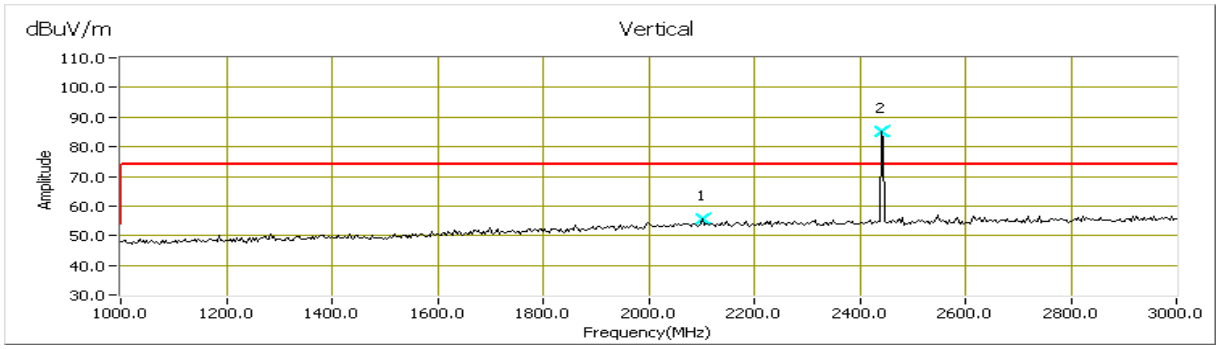
Humidity: 50 % RH **Polarity:** Ver. / Hor.

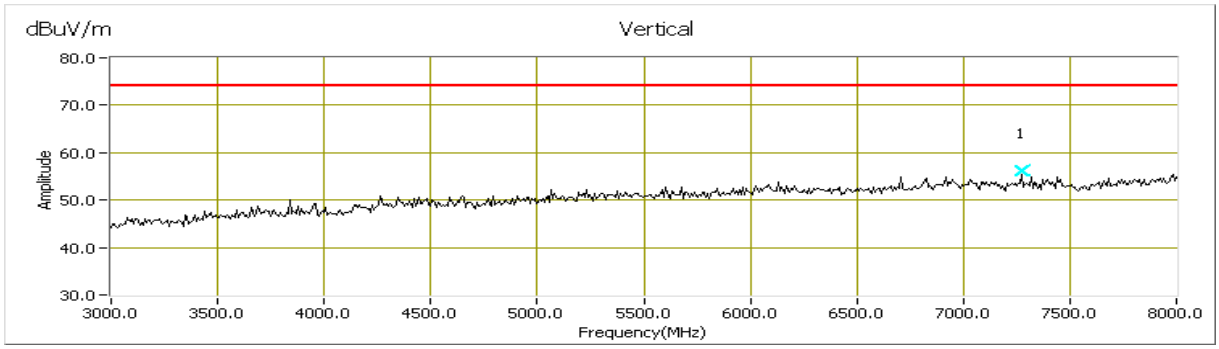
Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
2103.33	V	52.57	38.36	3.21	55.78	41.57	74.00	54.00	-12.43	AVG
7275.00	V	41.08	27.34	15.10	56.18	42.44	74.00	54.00	-11.56	AVG
N/A										
1696.67	H	52.45	38.48	0.57	53.02	39.05	74.00	54.00	-14.95	AVG
7025.00	H	40.98	27.29	14.67	55.65	41.96	74.00	54.00	-12.04	AVG
N/A										

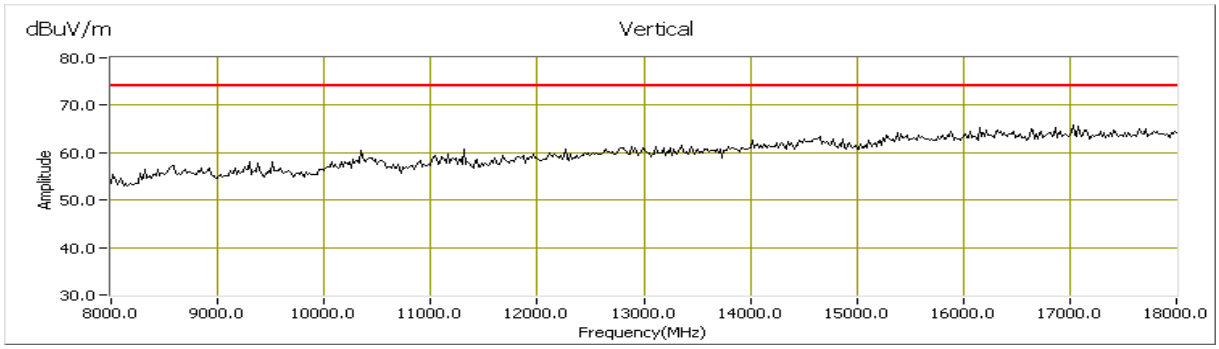
Remark:

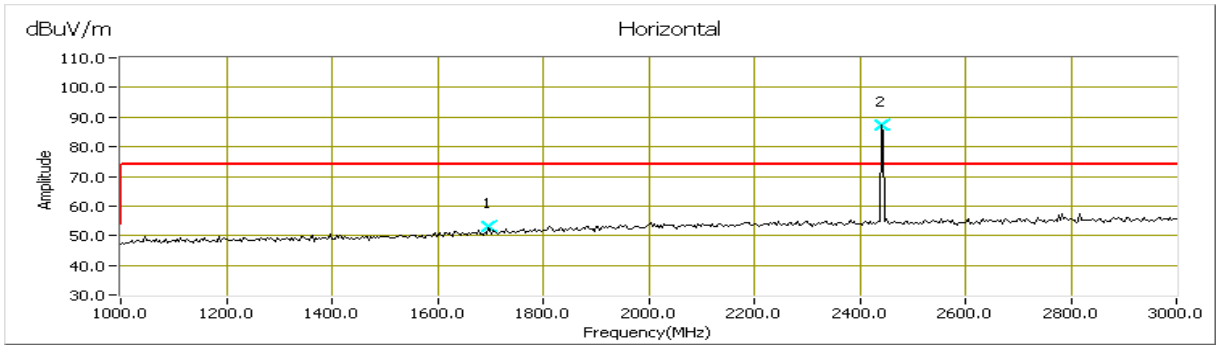
1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

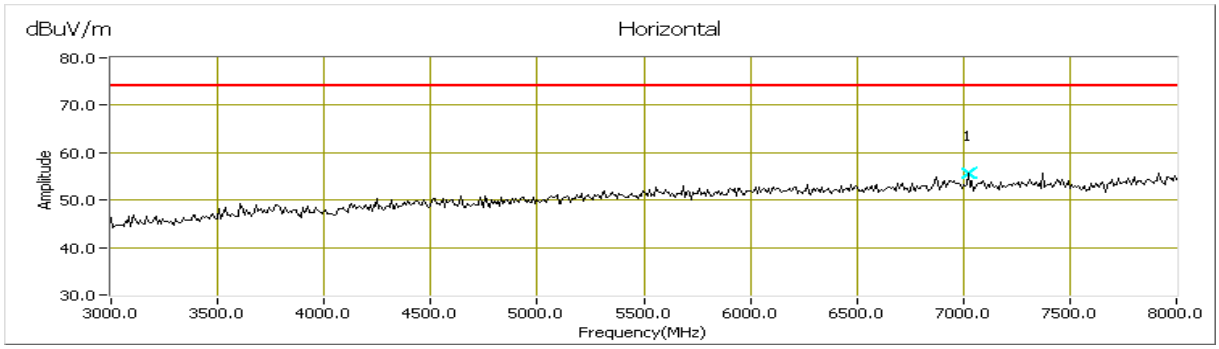
Test Plot

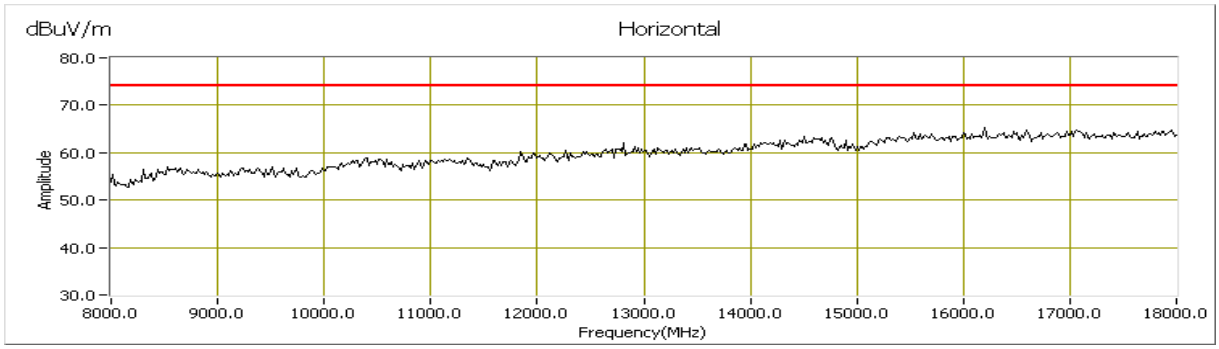

dBuV/m
Vertical
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Vertical
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Vertical
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)


dBuV/m
Horizontal
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Horizontal
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Horizontal
80.0
70.0
60.0
50.0
40.0
30.0
Amplitude
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)

Operation Mode: TX / CH High **Test Date:** December 12, 2006

Temperature: 22°C **Tested by:** Skyman Tsai

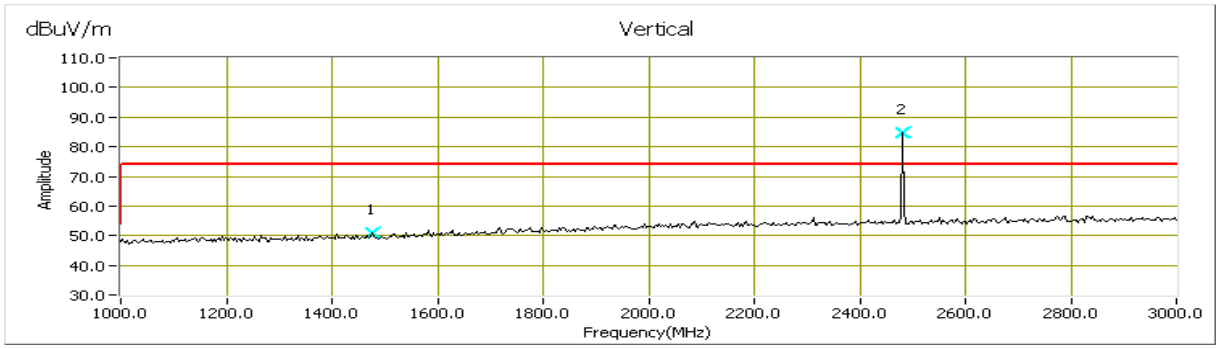
Humidity: 50 % RH **Polarity:** Ver. / Hor.

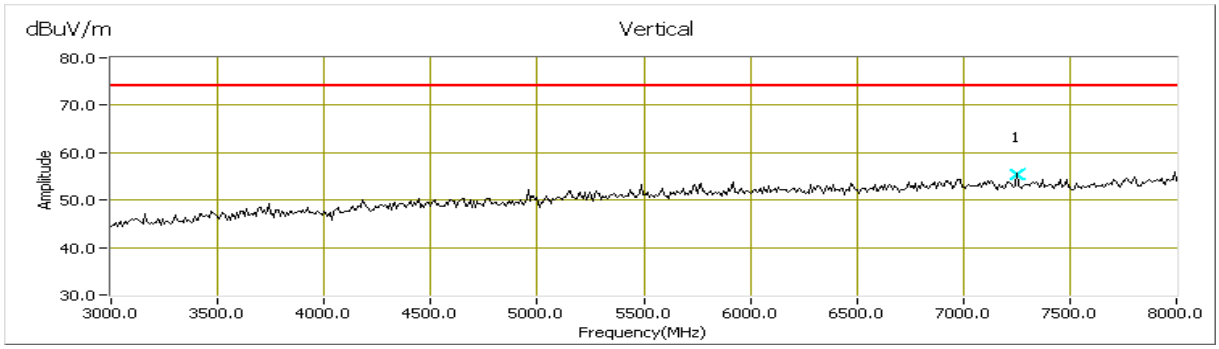
Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1476.67	V	52.11	---	-1.01	51.10	---	74.00	54.00	-2.90	Peak
7250.00	V	40.28	27.43	15.06	55.34	42.49	74.00	54.00	-11.51	AVG
N/A										
1476.67	H	51.75	---	-1.01	50.74	---	74.00	54.00	-3.26	Peak
6925.00	H	41.37	27.57	14.50	55.87	42.07	74.00	54.00	-11.93	AVG
N/A										

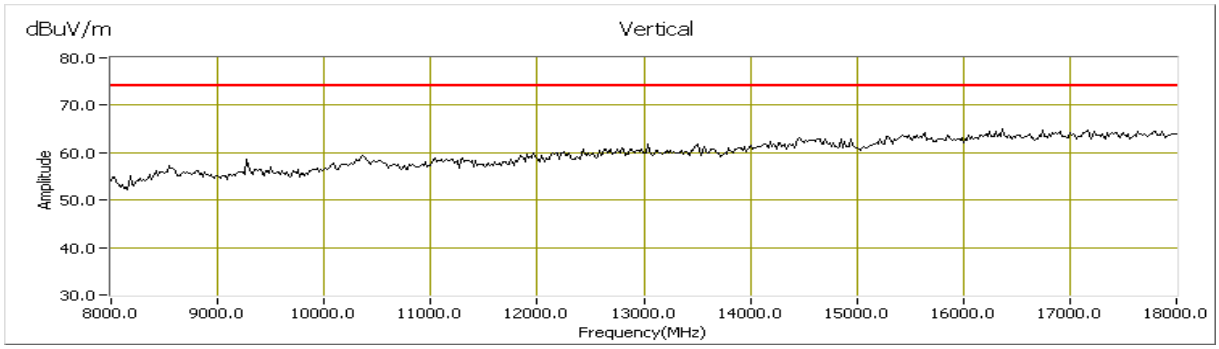
Remark:

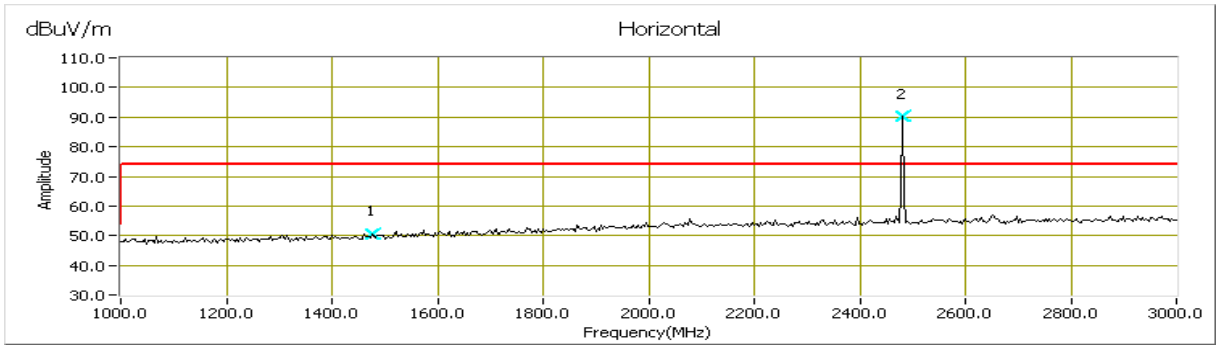
1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

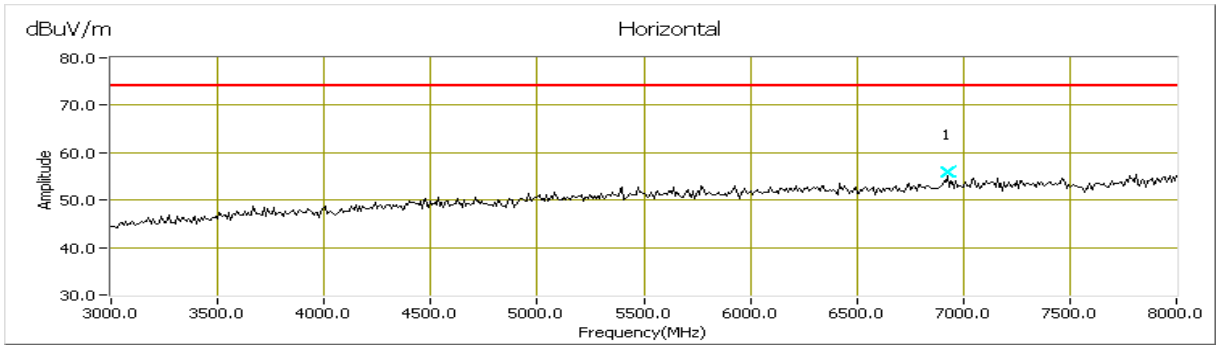
Test Plot

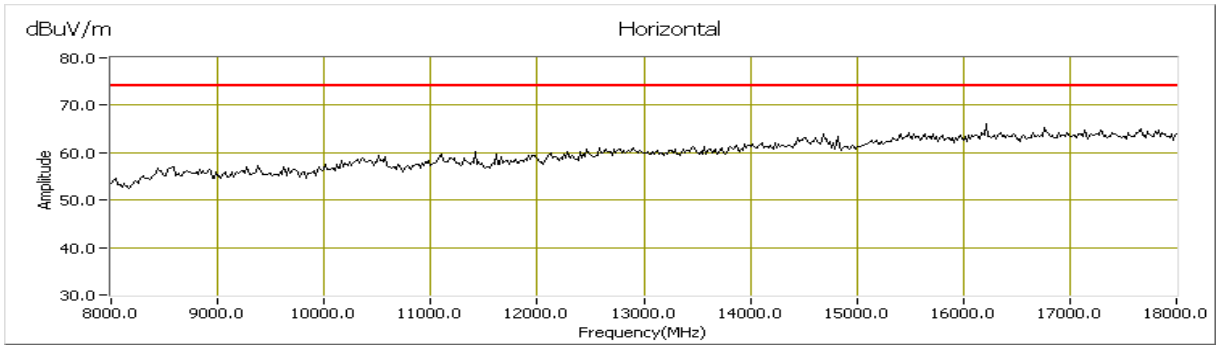

dBuV/m
Vertical
Amplitude
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Vertical
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Vertical
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
1
2
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
2400.0
2600.0
2800.0
3000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
1
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
6500.0
7000.0
7500.0
8000.0
Frequency(MHz)


dBuV/m
Horizontal
Amplitude
80.0
70.0
60.0
50.0
40.0
30.0
8000.0
9000.0
10000.0
11000.0
12000.0
13000.0
14000.0
15000.0
16000.0
17000.0
18000.0
Frequency(MHz)

7.8 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(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 Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

***** *Decreases with the logarithm of the frequency.*

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Test Data

Operation Mode:	Normal Link	**Test Date:**	December 12, 2006
Temperature:	25°C	**Tested by:**	Skyman Tsai
Humidity:	55% RH		

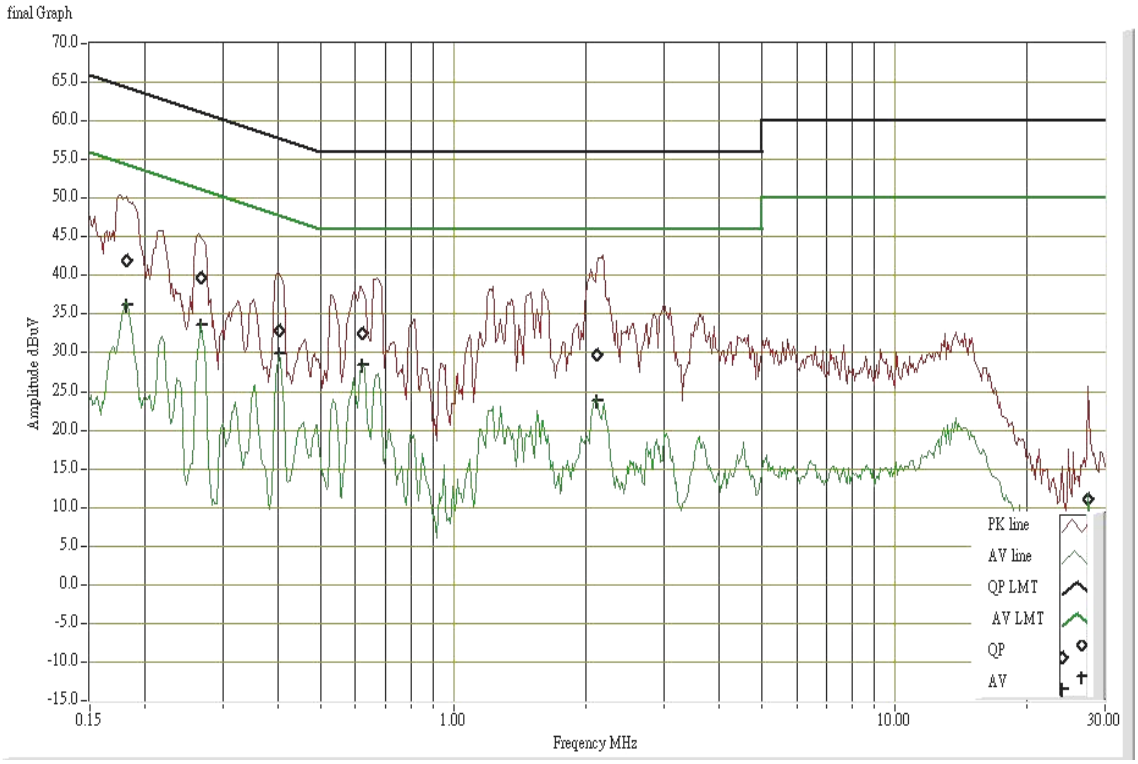
Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB)	QP Result (dBuV)	AV Result (dBuV)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.182	41.960	36.140	0.136	42.096	36.276	64.394	54.394	-22.298	-18.118	L1
0.268	39.680	33.680	0.100	39.780	33.780	61.180	51.180	-21.400	-17.400	L1
0.403	32.870	29.870	0.100	32.970	29.970	57.791	47.791	-24.821	-17.821	L1
0.620	32.580	28.350	0.100	32.680	28.450	56.000	46.000	-23.320	-17.550	L1
2.113	29.700	23.730	0.100	29.800	23.830	56.000	46.000	-26.200	-22.170	L1
27.497	11.000	7.970	1.300	12.300	9.270	60.000	50.000	-47.700	-40.730	L1
0.182	41.760	35.520	0.136	41.896	35.656	64.394	54.394	-22.498	-18.738	L2
0.268	39.640	32.480	0.100	39.740	32.580	61.180	51.180	-21.440	-18.600	L2
0.403	32.730	28.560	0.100	32.830	28.660	57.791	47.791	-24.961	-19.131	L2
0.620	32.240	27.740	0.100	32.340	27.840	56.000	46.000	-23.660	-18.160	L2
0.671	32.080	25.970	0.100	32.180	26.070	56.000	46.000	-23.820	-19.930	L2
2.113	28.450	21.700	0.100	28.550	21.800	56.000	46.000	-27.450	-24.200	L2

Remark:

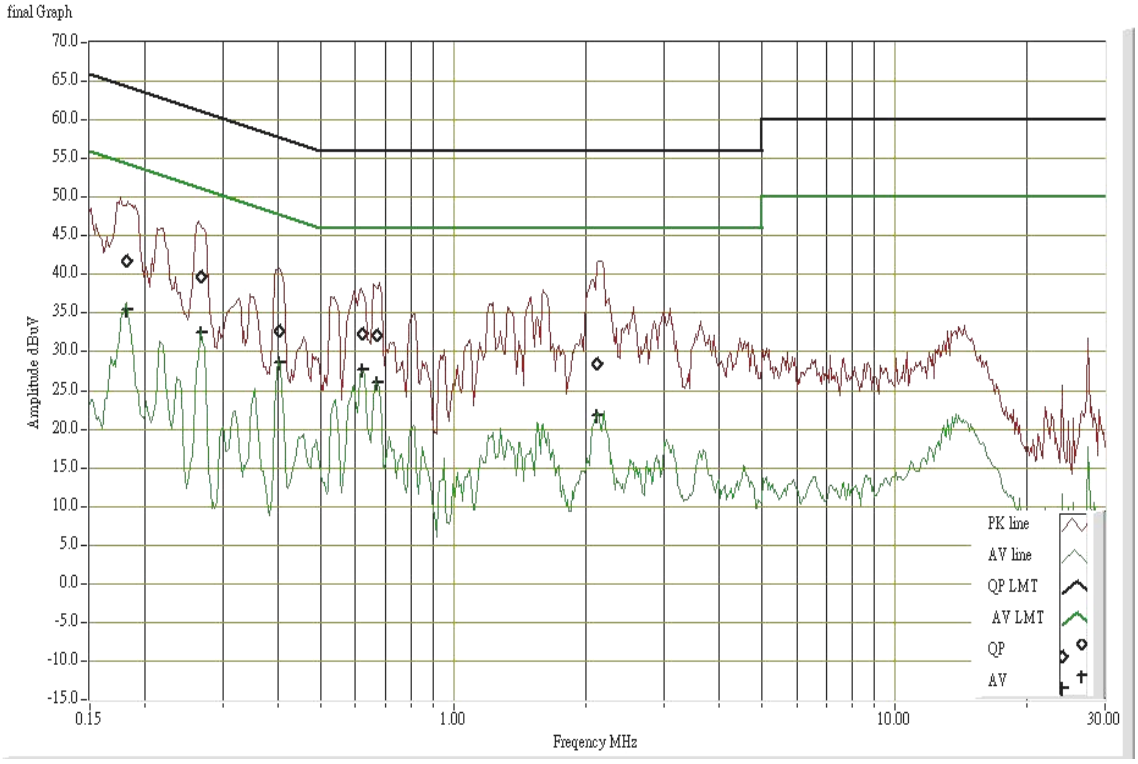
1. *Measuring frequencies from 0.15 MHz to 30MHz.*
2. *The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.*
3. *The IF bandwidth of SPA between 0.15MHz and 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz;*
4. *L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)*

Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)



APPENDIX I
RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.247(i), 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.

EUT Specification

EUT	GPS Tracking System
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☒ Others: Bluetooth: 2.402GHz ~ 2.480GHz
Device category	☒ Portable (<20cm separation) ☐ Mobile (>20cm separation) ☐ Others _____
Exposure classification	☐ Occupational/Controlled exposure *(S = 5mW/cm^2)* ☒ General Population/Uncontrolled exposure *(S=1mW/cm^2)*
Antenna diversity	☒ Single antenna ☐ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☐ Tx/Rx diversity
Max. output power	0.28dBm (1.07mW)
Antenna gain (Max)	-4.5 dBi (Numeric gain: 0.35)
Evaluation applied	☐ MPE Evaluation ☐ SAR Evaluation ☒ N/A*
Remark: *1. The maximum output power is 0.28dBm (1.07mW) at 2402MHz (with 0.35 numeric antenna gain.)* *2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.* *3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm^2 even if the calculation indicates that the power density would be larger.*	

Test Results

No non-compliance noted.

(SAR evaluation is not required for the PORTABLE device while its maximum output power is lower than the general population low threshold: $60/f_{(GHz)}=60/2.441=24.58$mW)