FCC PART 15.247

EMI MEASUREMENT AND TEST REPORT

For

Dust Networks, Inc.

30695 Huntwood Ave.
Hayward, CA 94544

FCC ID: SJC-D1120

This Report Concerns:	**Equipment Type:**
☒ Original Report	900 MHz Hopping System

Test Engineer:	Snell Leong
Report No.:	R0504081
Report Date:	2005-04-20
Reviewed By:	Richard Lee
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *Dust Networks, Inc.* product, FCC ID: *SJC-D1120,* or the "EUT" as referred to in this report is the base part of a 900 MHz Hopping System, which measures approximately 120mmL x 105mm W x 31mm H. The EUT operates at the frequency range of 902.4914 – 927.4823 MHz, with the maximum conducted output power of 4.24mW.

** The test data gathered are from a production sample, S/N: 181, provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *Dust Networks, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B, C.

Related Submittal(s)/Grant(s)

No Related Submittals

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003& TIA/EIA-603.

Test Facility

The Open Area Test site used by BACL to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing according to ANSI C63.4-2003.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

Special Accessories

As shown in following test block diagram, all interface cables used for compliance testing are shielded.

Schematics / Block Diagram

Please refer to Appendix A.

Equipment Modifications

No modifications were made to the EUT.

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Compaq	Laptop	Presario 2100	CNF43403FB	None

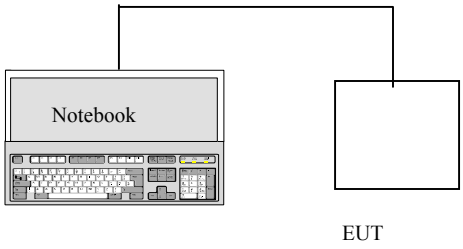
External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Serial Cable	1.5	Laptop Serial Port	EUT Serial Port

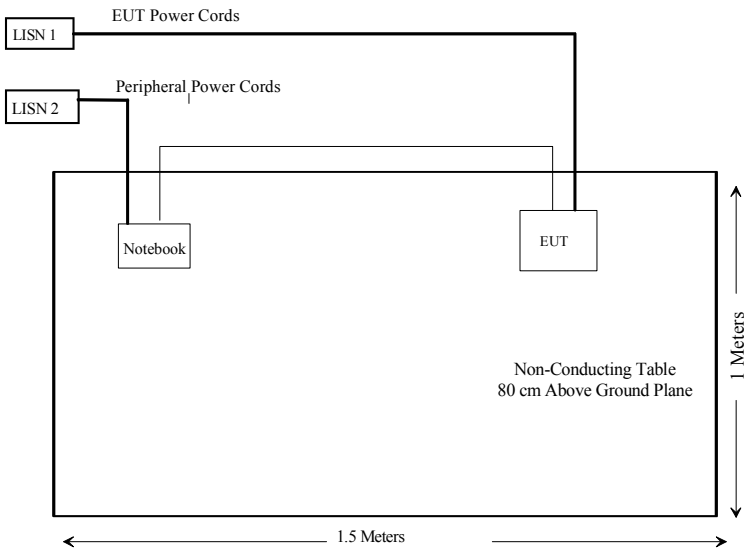
Power Supply Information

Manufacturer	Description	Model	Serial Number	FCC ID
DVE	AC Adaptor	DSA-0151A-05 A	N/A	None

Configuration of Test System



Test Setup Block Diagram



SUMMARY OF TEST RESULTS FOR FCC PART 15

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.203	Antenna Requirement	Compliant
§ 15.205	Restricted Bands	Compliant
§15.207 (a)	Conducted Emission	Within the Measurement Uncertainty
§15.209	Radiated Emission	Within the Measurement Uncertainty
§15.247 (a) (1)	Hopping Channel Separation	Compliant
§15.247 (a) (1)	Channel Bandwidth	Compliant
§15.247 (a) (1) (i)	Number of Hopping Frequencies Used	Compliant
§15.247 (a) (1) (i)	Dwell Time of Each Frequency within a 10 Second Period of time	Compliant
§15.247 (b) (2)	Maximum Peak Output Power	Compliant
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edge	Compliant
	Spurious Emission at Antenna Port	Compliant

ANTENNA REQUIREMENT

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The gain of antenna used for transmitting is 2 dBi by default, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

§15.207(a) - CONDUCTED EMISSION

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are receiver, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is $\pm$2.4 dB.

Test Setup

The measurement was performed at shield room, using the same setup per ANSI C63.4 – 2003 measurement procedure. The specification used was FCC Class B limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with LISN-1.

Receiver Setup

The receiver was set to investigate the frequency from 150 kHz to 30MHz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
Rohde & Schwarz	Receiver, EMI Test	ESCS30	100176	9/15/2004
Rohde & Schwarz	LISN, Artificial Mains	ESH2-Z5	871884/039	8/16/2004

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Test Procedure

During the conducted emission test, the power cord of the host system was connected to the mains outlet of the LISN-1.

Maximizing procedure were performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Qusi-Peak readings are distinguished with an "QP". Average readings are distinguished with an "Ave".

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

**The testing was performed by Snell Leong on 2005-04-11.*

Summary of Test Results

According to the recorded data in following table, the EUT measured –1.1dB within the measurement uncertainty of ±2.4 dB, and had the worst margin reading of:

-1.1 dB at **0.26 MHz** in the **Neutral** conductor,

Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency MHz	Amplitude dBμV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBμV	Margin dB
0.26	50.3	Ave	Neutral	51.43	-1.1
0.27	48.2	Ave	Line	51.12	-2.9
0.40	40.3	Ave	Line	47.85	-7.6
0.26	52.0	QP	Neutral	61.43	-9.4
0.27	50.2	QP	Line	61.12	-10.9
0.39	37.1	Ave	Neutral	48.06	-11.0
0.800	31.8	Ave	Line	46.00	-14.2
0.40	41.4	QP	Line	57.85	-16.5
0.78	27.7	Ave	Neutral	46.00	-18.3
0.80	37.2	QP	Line	56.00	-18.8
0.39	39.0	QP	Neutral	58.06	-19.1
0.78	34.4	QP	Neutral	56.00	-21.6

Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented in the following page as reference.

Bay Area Compliance Laboratory Corp
Class B

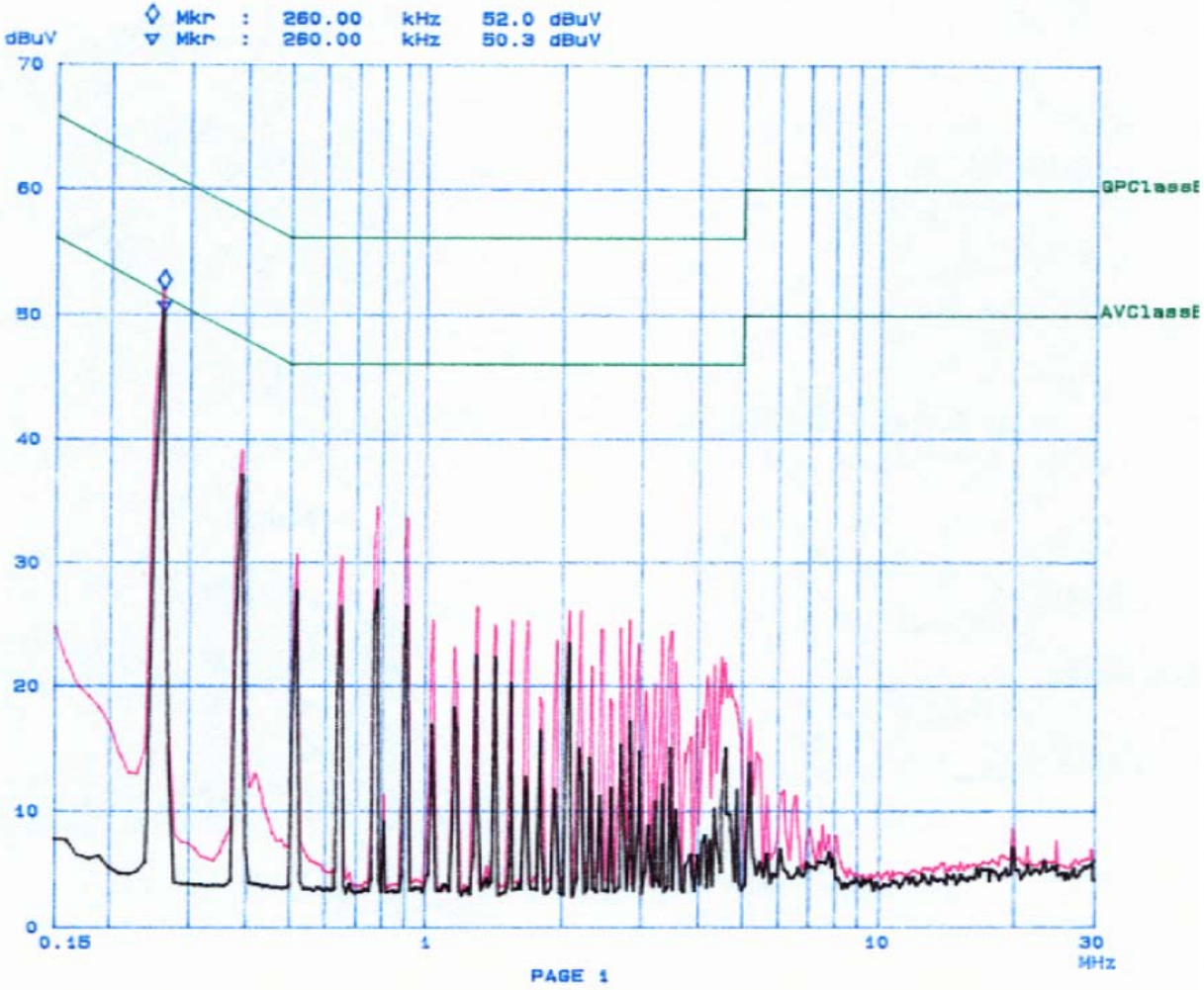
11. Apr 05 18:20

11/April/05
Snell

EUT: 900 MHz SmartMesh (Manager)
Manuf: DUST
Op Cond: Normal
Operator: SNELL
Comment: N
120C

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	10k	9k	QP+AV	20ms	15dBLN	OFF
1M	5M	10k	9k	QP+AV	1ms	15dBLN	OFF
5M	30M	100k	9k	QP+AV	1ms	15dBLN	OFF



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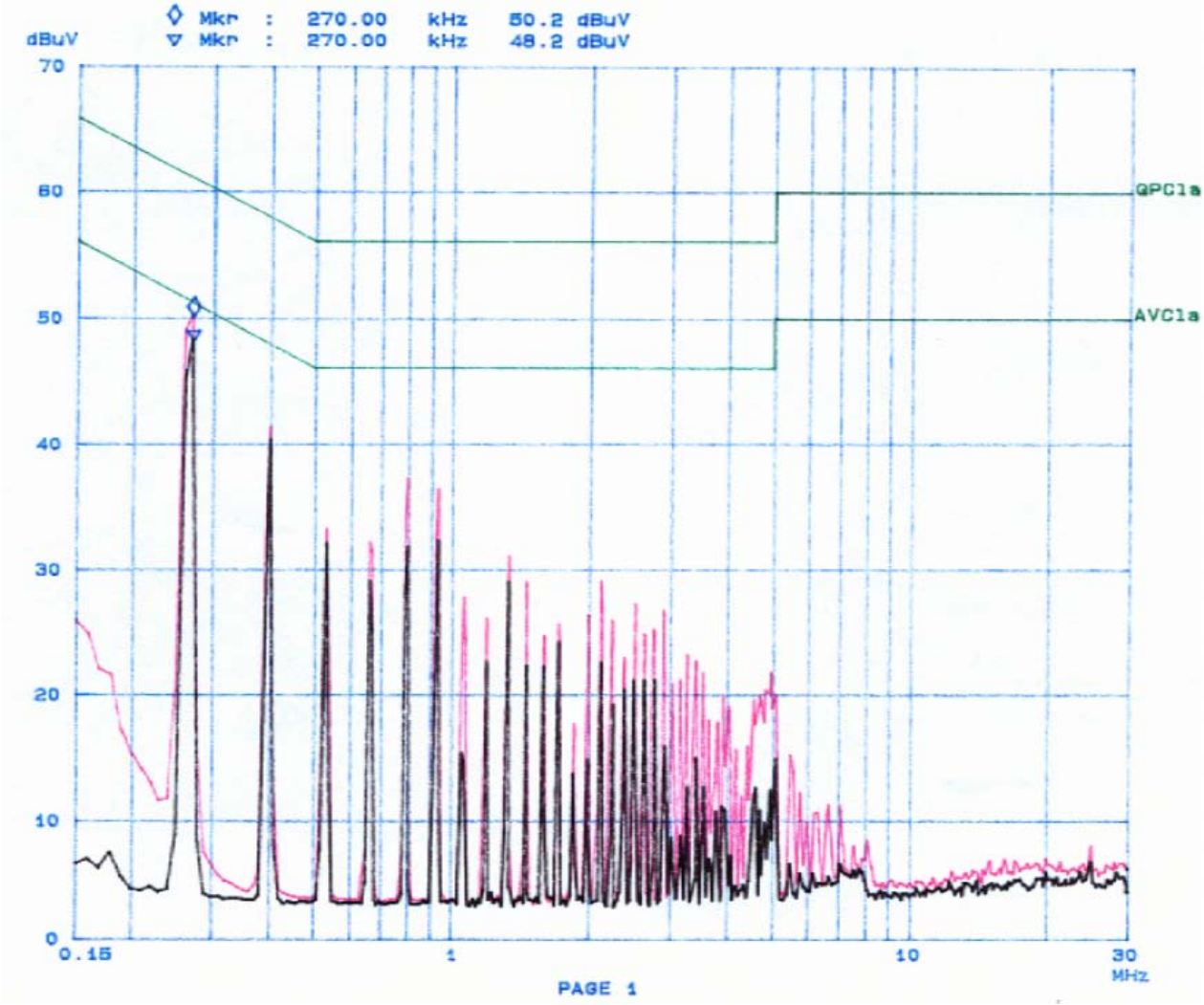
Bay Area Compliance Laboratory Corp
Class B

11. Apr 05 17:24
11/April/05
Snell

EUT: 900 MHz SmartMesh (Manager)
Manuf: DUST
Op Cond: Normal
Operator: SNELL
Comment: L
120C

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	10k	9k	QP+AV	20ms	15dBLN	OFF
1M	5M	10k	9k	QP+AV	1ms	15dBLN	OFF
5M	30M	100k	9k	QP+AV	1ms	15dBLN	OFF



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§15.205 & §15.209 - RADIATED EMISSION

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

Test Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with 120Vac/60Hz power source.

The test was conducted at both hopping enable and disable mode, only the worst test data were presented.

Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 10GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Range	***RBW***	***Video B/W***
Below 30MHz	10kHz	10kHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
EMCO	Antenna, Biconical	3110B	9603-2315	2004-12-14
HP	Amplifier, Pre	8447D	2944A10198	2004-08-20
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10
EMCO	Antenna, Log-Periodic	3148	4-1155	2004-12-14
Wisewave	Antenna, Horn, Std	ARH-2823-02	10555-02	2004-12-13

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

**The testing was performed by Snell Leong on 2005-04-13.*

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**Qp**" in the data table.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Class B Limit

Summary of Test Results

According to the recorded data in following table, the EUT measured -1.7dB margin at Middle Channel and -0.2 at Unintentional Emission within the measurement uncertainty of ±4.0dB, and had the worst margin of:

-14.8 dB at 2707.4742 MHz in the Vertical polarization, Low Channel, 3 meters

-1.7 dB at 1829.9976 MHz in the Vertical polarization, Middle Channel, 3 meters

-6.1 dB at 1854.9646 MHz in the Vertical polarization, High Channel, 3 meters

-0.2 dB at 248.8500 MHz in the Vertical polarization, Unintentional Emission, 3 meters

3 Meters Radiated Emission Test Data

Indicated			Antenna	Antenna		Correction Factor			FCC 15.247		
Freqency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Comments
MHz	dBμV/m	Degree	Meter	H/V	dB	dB	dB	dBμV/m	dBμV/m	dB	
Low Channel											
902.4914		90	1.0	V	23.6	3.8	28.4	-1.0			Fund/Peak
902.4914		0	1.2	H	23.6	3.8	28.4	-1.0			Fund/Peak
902.4914		180	1.2	V	23.6	3.8	28.4	-1.0			Ave
902.4914		0	1.2	H	23.6	3.8	28.4	-1.0			Ave
2707.4742	63.3	90	2.1	V	29.0	2.4	35.5	59.2	74	-14.8	Peak
2851.0500	62.4	90	2.1	H	29.0	2.4	35.5	58.3	74	-15.7	Peak
1804.9828	45.6	90	2.1	V	25.3	1.9	36.3	36.5	54	-17.5	Ave
2851.0500	40.1	90	2.1	H	29.0	2.4	35.5	36.0	54	-18.0	Ave
1129.8300	45.7	90	2.1	V	24.5	1.3	36.8	34.7	54	-19.3	Ave
1804.9828	63.4	180	2.3	H	25.3	1.9	36.3	54.3	74	-19.7	Peak
1129.8300	65.0	90	2.1	V	24.5	1.3	36.8	54.0	74	-20.0	Peak
2707.4742	37.8	180	2.3	H	29.0	2.4	35.5	33.7	54	-20.3	Ave
2707.4742	35.7	90	2.1	V	29.0	2.4	35.5	31.6	54	-22.4	Ave
1201.9000	42.1	90	2.1	H	24.5	1.3	36.8	31.1	54	-23.0	Ave
1804.9828	39.4	180	2.3	H	25.3	1.9	36.3	30.3	54	-23.7	Ave
2707.4742	53.7	180	2.3	H	29.0	2.4	35.5	49.6	74	-24.4	Peak
2851.0500	32.3	180	2.3	V	29.0	2.4	35.5	28.2	54	-25.8	Ave
1201.9000	57.4	90	2.1	H	24.5	1.3	36.8	46.4	74	-27.6	Peak
1129.8300	35.3	180	2.3	H	24.5	1.3	36.8	24.3	54	-29.7	Ave
1201.9000	35.0	180	2.3	V	24.5	1.3	36.8	24.0	54	-30.0	Ave
1804.9828	51.0	90	2.1	V	25.3	1.9	36.3	41.9	74	-32.1	Peak
2851.0500	45.4	180	2.3	V	29.0	2.4	35.5	41.3	74	-32.7	Peak
1129.8300	48.4	180	2.3	H	24.5	1.3	36.8	37.4	74	-36.6	Peak
1201.9000	47.2	180	2.3	V	24.5	1.3	36.8	36.2	74	-37.8	Peak

3 Meters Radiated Emission Test Data (Cont.)

Indicated			Antenna	Antenna		Correction Factor			FCC 15.247		
Freqency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Comments
MHz	dBμV/m	Degree	Meter	H/V	dB	dB	dB	dBμV/m	dBμV/m	dB	
Middle Channel											
914.9988				V	23.2	3.9	28.4	-1.2			Fund/Peak
914.9988				H	23.2	3.9	28.4	-1.2			Fund/Peak
914.9988				V	23.2	3.9	28.4	-1.2			Ave
914.9988				H	23.2	3.9	28.4	-1.2			Ave
1829.9976	25.1	90	2.1	V	25.3	1.9	0.0	52.3	54	-1.7	Ave
1829.9976	37.5	180	1.8	V	25.3	1.9	0.0	64.7	74	-9.3	Peak
2744.9964	40.4	180	2.3	H	29.0	2.4	35.5	36.3	54	-17.7	Ave
1064.5000	46.6	90	2.1	V	24.5	1.3	36.8	35.6	54	-18.4	Ave
1327.8000	46.0	90	2.1	V	24.5	1.3	36.8	35.0	54	-19.0	Ave
1829.9976	41.8	180	2.3	H	25.3	1.9	36.3	32.7	54	-21.3	Ave
2744.9964	54.8	180	2.3	H	29.0	2.4	35.5	50.7	74	-23.3	Peak
1829.9976	57.8	180	2.3	H	25.3	1.9	36.3	48.7	74	-25.3	Peak
1064.5000	38.8	180	2.3	H	24.5	1.3	36.8	27.8	54	-26.2	Ave
1327.8000	37.5	180	2.3	H	24.5	1.3	36.8	26.5	54	-27.5	Ave
1327.8000	55.0	90	2.1	V	24.5	1.3	36.8	44.0	74	-30.0	Peak
1064.5000	54.3	90	2.1	V	24.5	1.3	36.8	43.3	74	-30.7	Peak
1064.5000	53.0	180	2.3	H	24.5	1.3	36.8	42.0	74	-32.0	Peak
2744.9964	24.6	90	2.1	V	29.0	2.4	35.5	20.5	54	-33.5	Ave
1327.8000	50.9	180	2.3	H	24.5	1.3	36.8	39.9	74	-34.1	Peak
2744.9964	36.1	180	2.0	V	29.0	2.4	35.5	32.0	74	-42.0	Peak
High Channel											
927.4823				V	23.4	4.0	28.3	-0.9			Fund/Peak
927.4823				H	23.4	4.0	28.3	-0.9			Fund/Peak
927.4823				V	23.4	4.0	28.3	-0.9			Ave
927.4823				H	23.4	4.0	28.3	-0.9			Ave
1854.9646	77.1	90	2.1	V	25.3	1.9	36.3	68.0	74	-6.1	Peak
1854.9646	54.9	90	2.1	V	25.3	1.9	36.3	45.8	54	-8.3	Ave
2782.4469	43.9	90	2.1	V	29.0	2.4	35.5	39.8	54	-14.2	Ave
2782.4469	63.0	90	2.1	V	29.0	2.4	35.5	58.9	74	-15.1	Peak
1854.9646	45.9	180	2.3	H	25.3	1.9	36.3	36.8	54	-17.2	Ave
1602.8000	43.9	180	2.3	H	25.3	1.9	36.3	34.8	54	-19.3	Ave
1639.0000	42.6	90	2.1	V	25.3	1.9	36.3	33.5	54	-20.5	Ave
1602.8000	62.5	180	2.3	H	25.3	1.9	36.3	53.4	74	-20.6	Peak
1602.8000	42.5	90	2.1	V	25.3	1.9	36.3	33.4	54	-20.6	Ave
1639.0000	42.2	180	2.3	H	25.3	1.9	36.3	33.1	54	-20.9	Ave
1602.8000	61.6	90	2.1	V	25.3	1.9	36.3	52.5	74	-21.5	Peak
1639.0000	61.2	90	2.1	V	25.3	1.9	36.3	52.1	74	-21.9	Peak
1854.9646	61.0	180	2.3	H	25.3	1.9	36.3	51.9	74	-22.1	Peak
1639.0000	59.8	180	2.3	H	25.3	1.9	36.3	50.7	74	-23.4	Peak
2782.4469	32.1	180	2.3	H	29.0	2.4	35.5	28.0	54	-26.0	Ave
2782.4469	47.0	180	2.3	H	29.0	2.4	35.5	42.9	74	-31.1	Peak

Note:

FUND: Fundemental
AVG: Average

Unintentional Emission

Indicated			Antenna	Antenna		Correction Factor			FCC 15.209	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBμV/m	Degree	Meter	H/V	dB	dB	dB	dBμV/m	dBμV/m	dB
248.85	57.89	180	2.6	V	13.8	2.2	28.0	45.8	46	-0.2
298.60	56.38	180	1.5	V	13.7	2.3	27.8	44.5	46	-1.5
298.60	55.64	180	1.5	V	13.7	2.3	27.8	43.8	46	-2.2
248.85	55.38	0	2.0	H	13.8	2.2	28.0	43.3	46	-2.7
149.30	53.98	180	1.5	V	12.6	1.7	28.4	39.7	43.5	-3.8
180.00	52.53	180	2.0	H	13.2	2.0	28.3	39.4	43.5	-4.1
140.00	53.58	180	1.5	V	12.4	1.6	28.5	39.1	43.5	-4.4
140.00	51.78	180	1.5	V	12.4	1.6	28.5	37.3	43.5	-6.2
180.00	49.18	180	1.5	V	13.2	2.0	28.3	36.1	43.5	-7.4
149.30	47.18	180	1.5	V	12.6	1.7	28.4	32.9	43.5	-10.6

§15.247 (a) (1) - HOPPING CHANNEL SEPARATION

Standard Applicable

According to §15.247(a)(1), frequency hopping system 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies.

Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

**The testing was performed by Snell Leong on 2005-04-13.*

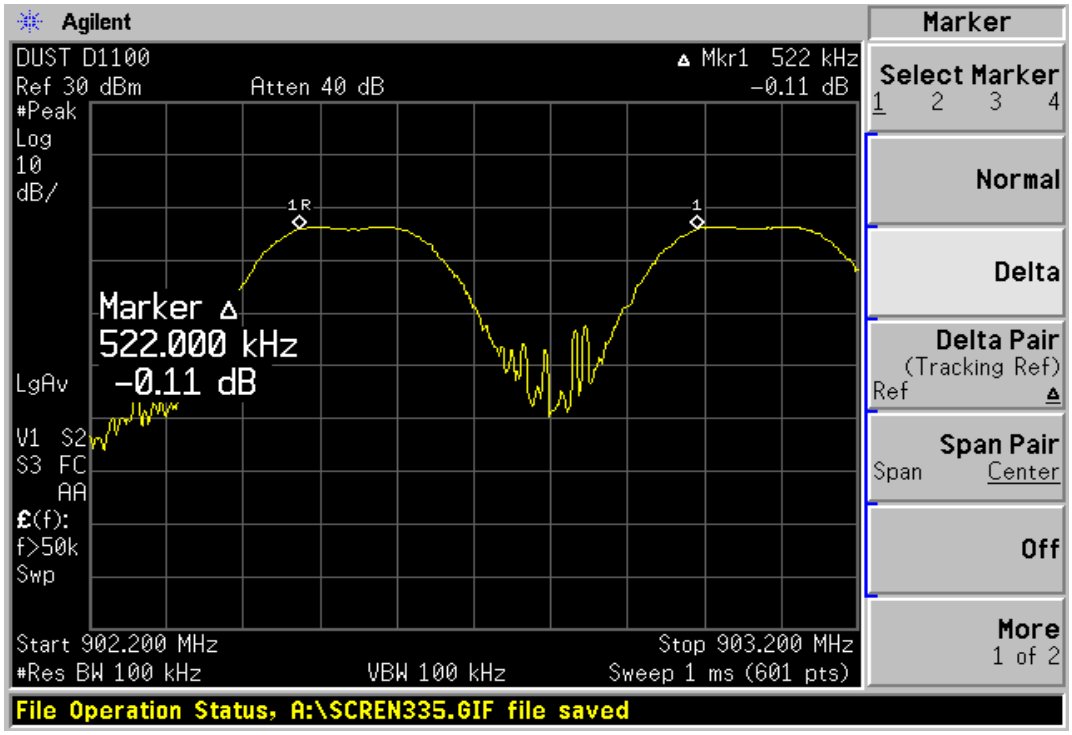
Measurement Results

Channel	Frequency MHz	Channel Separation (KHz)
Low	902.491	522
Mid	914.999	552
High	927.482	504

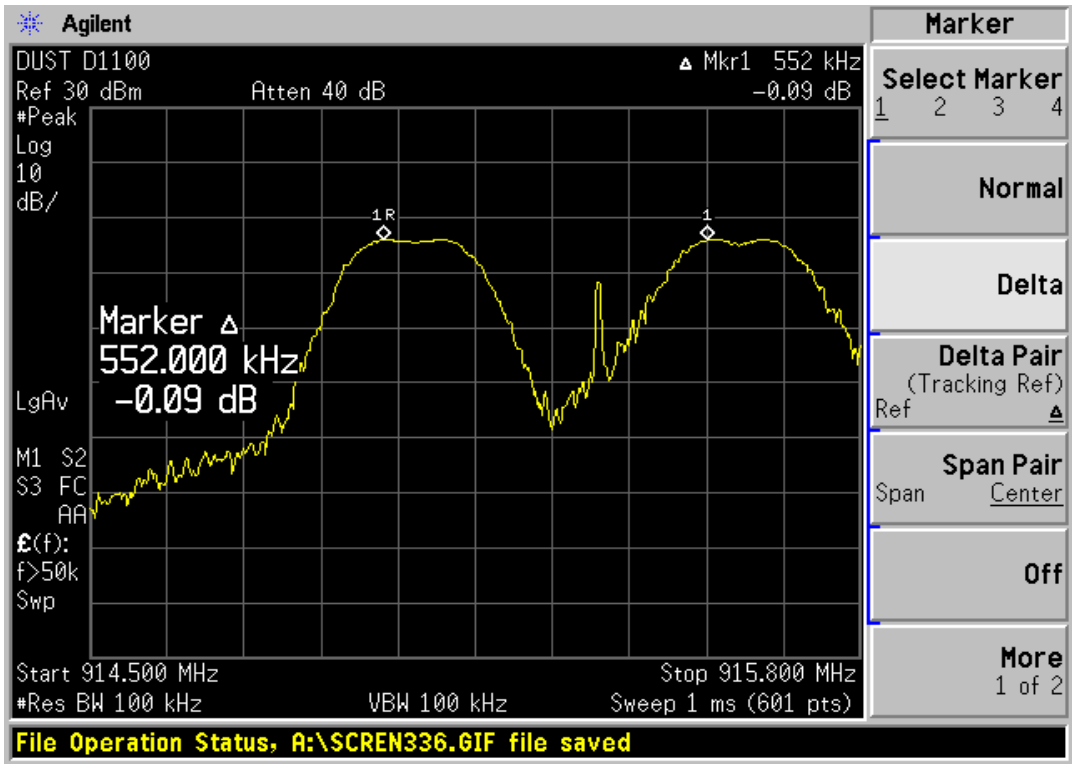
Plots of Hopping Channel Separation

Please see the following plots

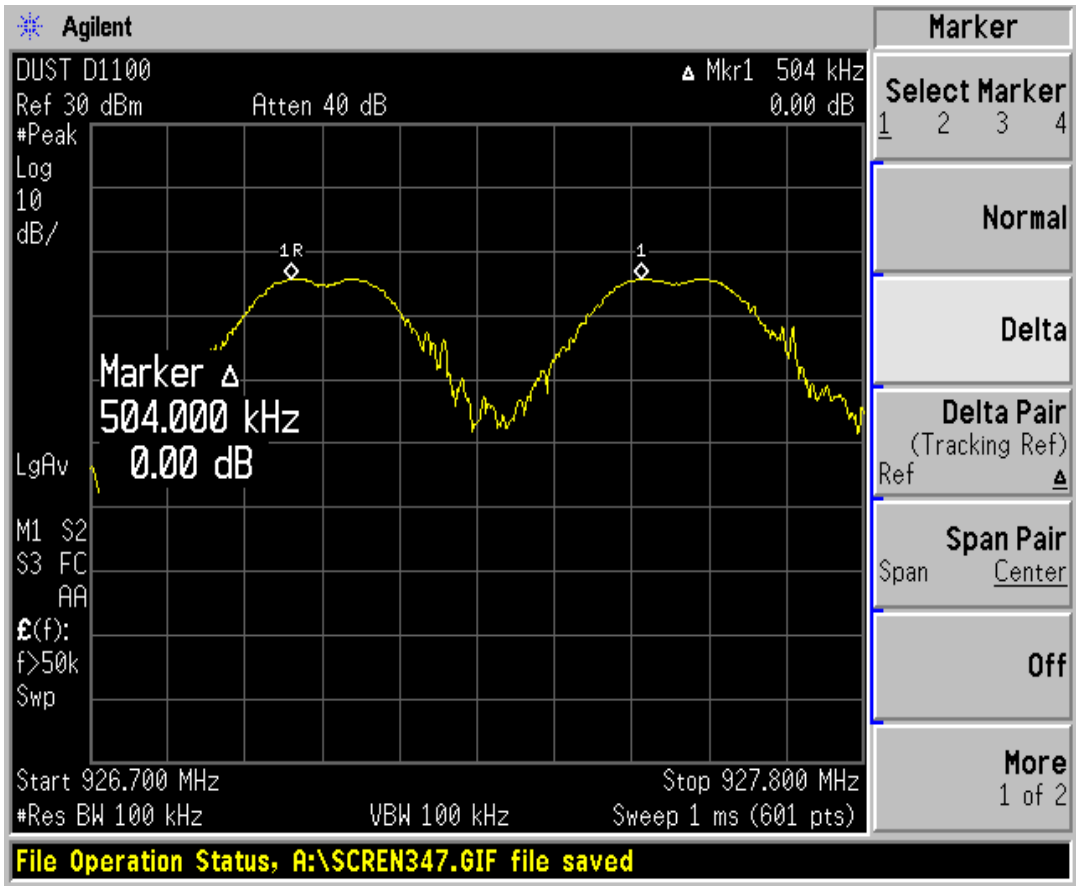
Low Channel



Middle Channel



High Channel



§15.247 (a) (1) - CHANNEL BANDWIDTH

Standard Applicable

According to §15.247(a)(l), 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.

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

**The testing was performed by Snell Leong on 2005-04-13.*

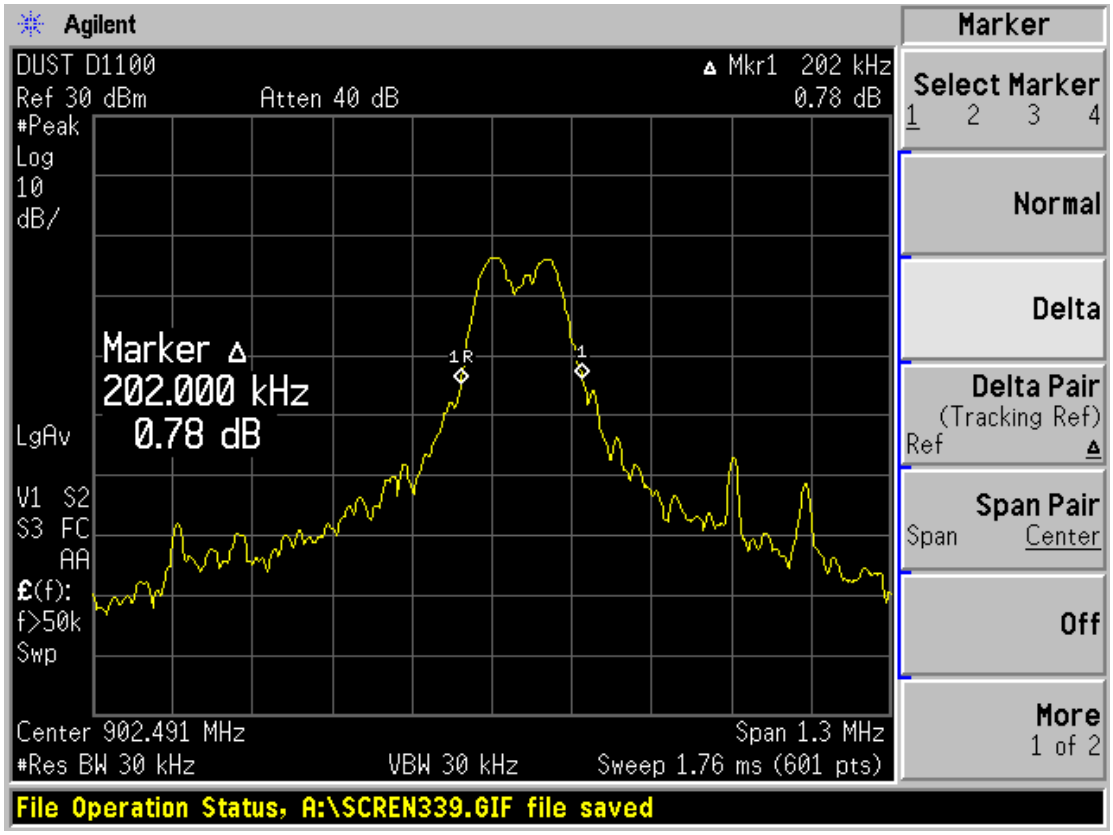
Measurement Result

Channel	Frequency MHz	Channel Bandwidth (KHz)
Low	902.491	202
Mid	914.999	204
High	927.482	357

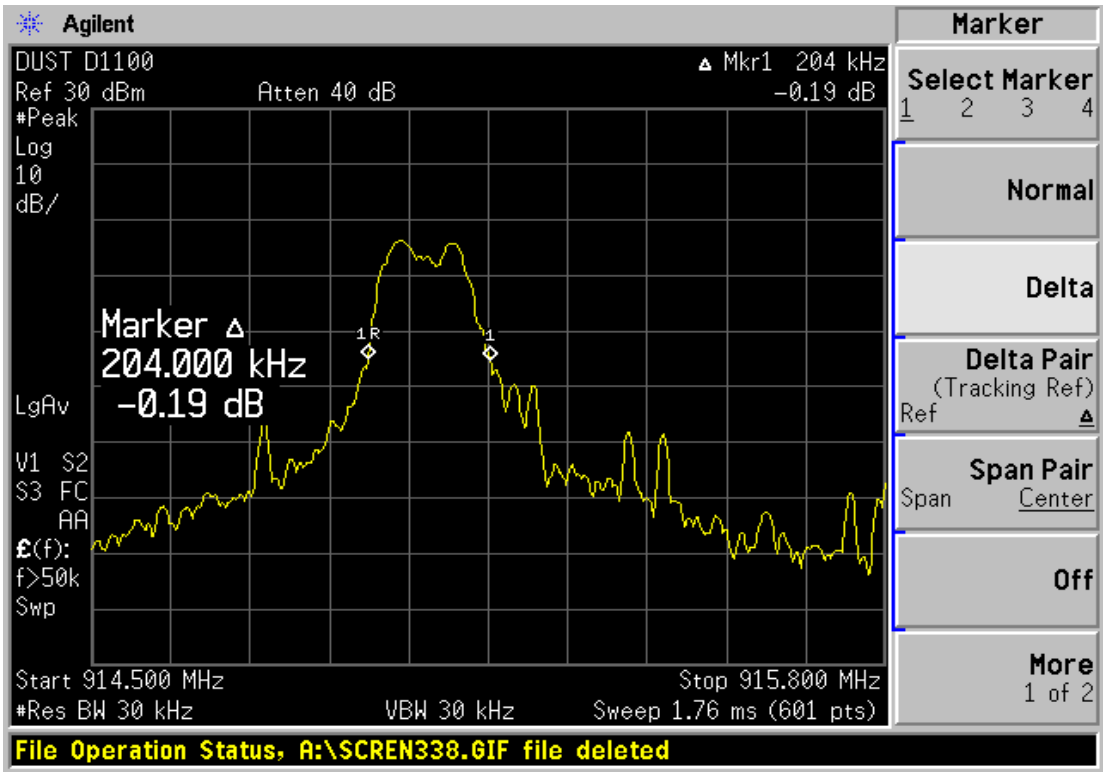
Plot of Channel Bandwidth

Please see the following plots

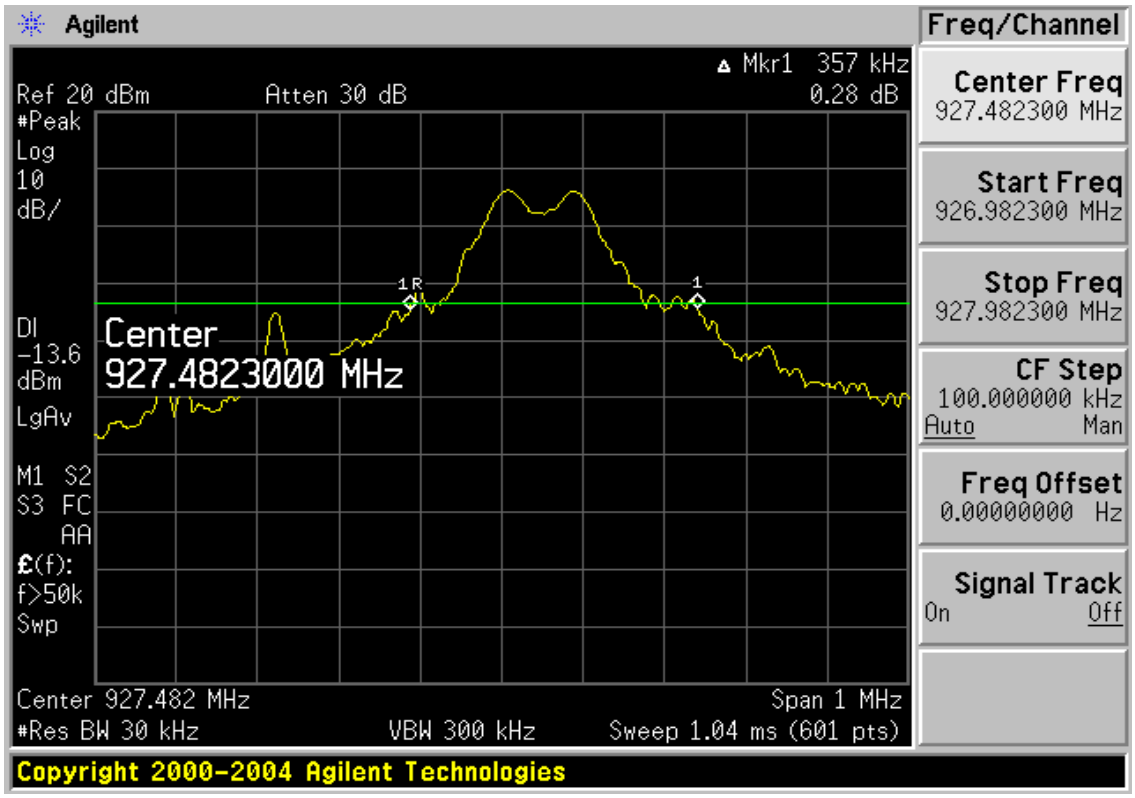
Low Channel



Middle Channel



High Channel



§15.247 (a) (1) (i) - NUMBER OF HOPPING FREQUENCY USED

Standard Applicable

Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

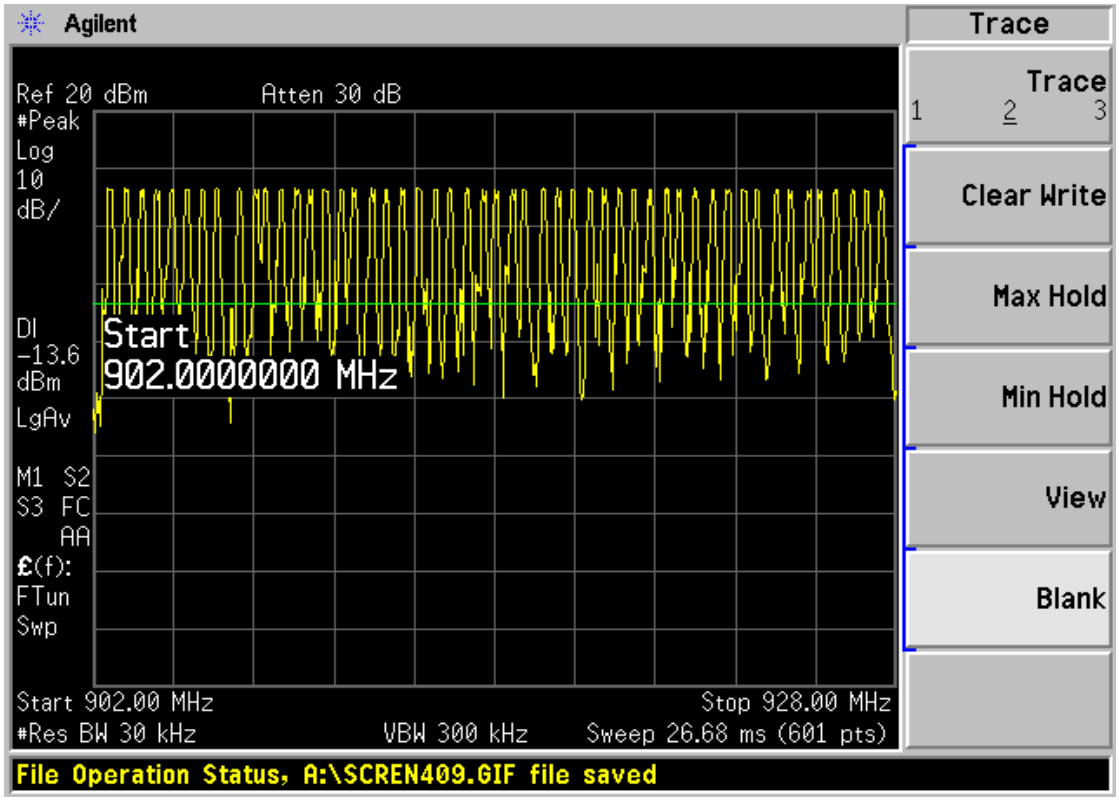
**The testing was performed by Snell Leong on 2005-04-13.*

Measurement Results

Measurement	Standard	Result
51	≥25	Compliant

Plots of Number of Hopping Frequency

Please refer to the following plots.



§15.247 (a) (1) (i) - DWELL TIME

Standard Applicable

According to §15.247 (a)(1)(i), the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 10 seconds.

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
HP	Spectrum Analyzer	8565EC	3946A00131	2004-08-06

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

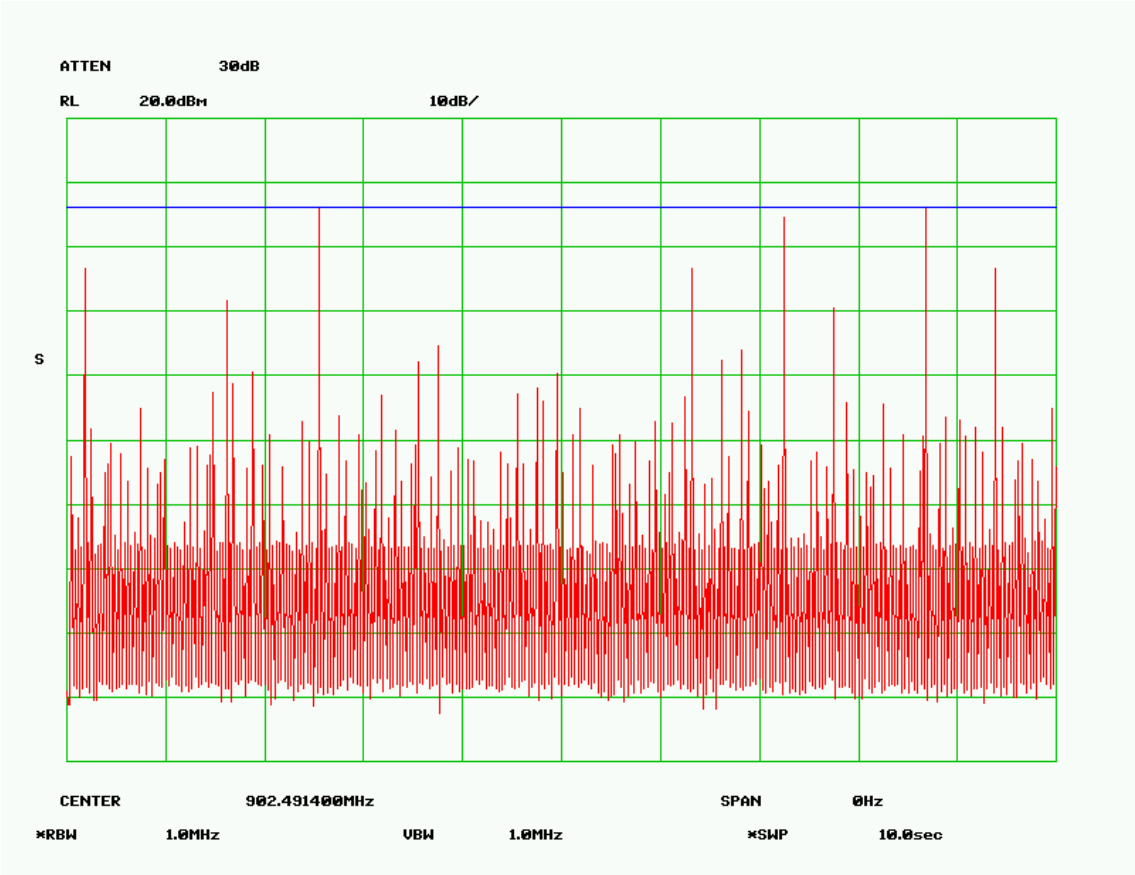
**The testing was performed by Snell Leong on 2005-04-13.*

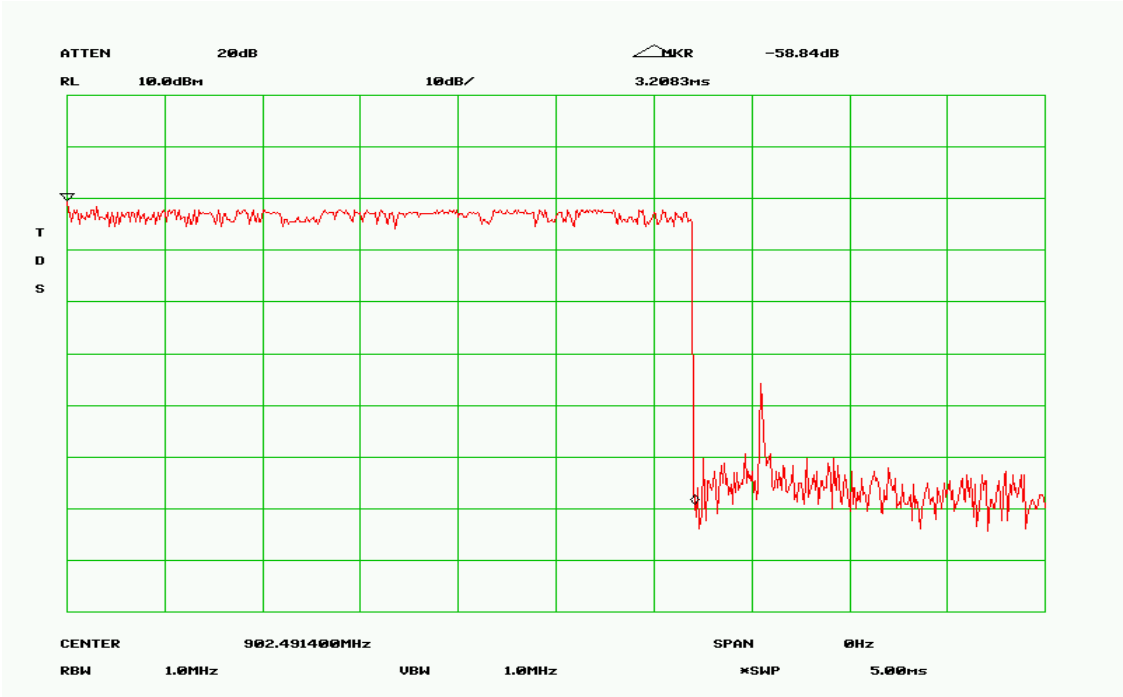
Measurement Results

Channel	Frequency MHz	Pulse Wide uSec	Occupied time per Sec	Dwell Time Sec	Limit Sec
Low	902.491	3208.3	3	0.010	0.4
Mid	914.999	3208.3	7	0.022	0.4
High	927.482	3208.3	3	0.010	0.4

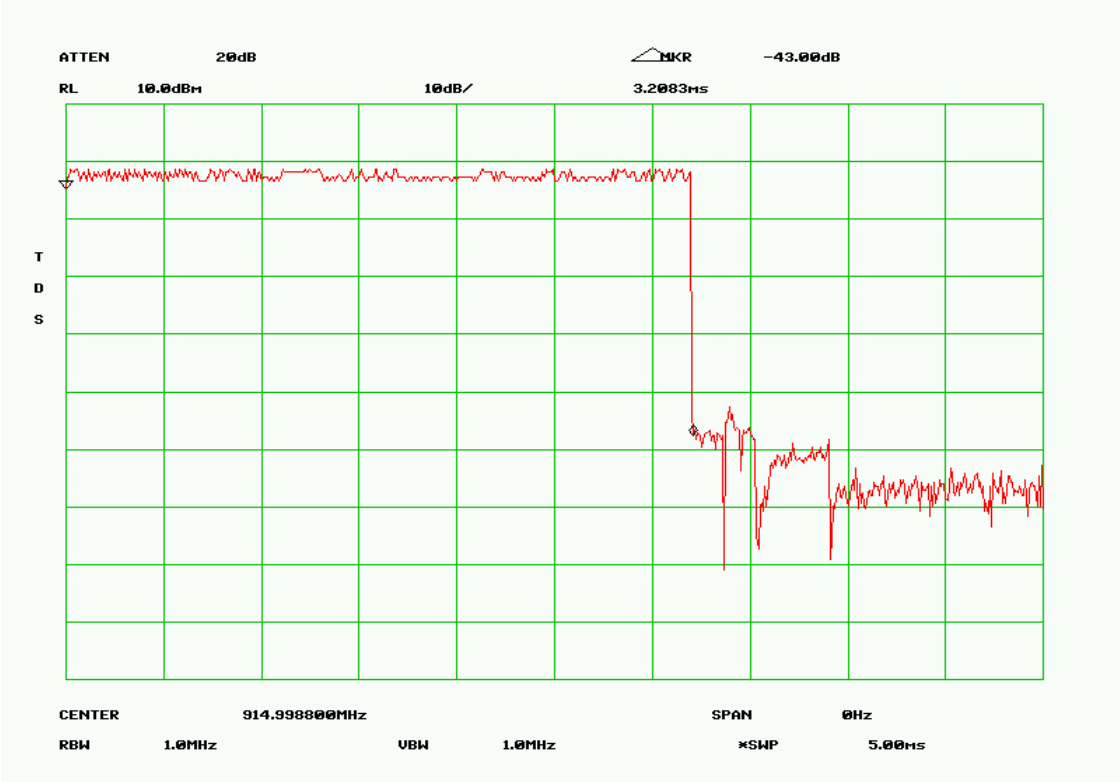
Plots of Dwell Time
Please refer the following plots.

Low Channel


ATTEN 30dB
RL 20.0dBm 10dB/
S
CENTER 902.491400MHz SPAN 0Hz
*RBW 1.0MHz VBW 1.0MHz *SWP 10.0sec


ATTEN 20dB MKR -58.84dB
RL 10.0dBm 10dB/ 3.2083ms
T
D
S
CENTER 902.491400MHz SPAN 0Hz
RBW 1.0MHz VBW 1.0MHz *SWP 5.00ms

Middle Channel



High Channel

§15.247 (b) (2) - MAXIMUM PEAK OUTPUT POWER

Standard Applicable

According to §15.247(b) (2), for frequency hopping systems employ at least 50 hopping channels in the 902-928 MHz band, the maximum peak output power of the transmitter shall not exceed 1 Watt.

Measurement Procedure

1. Place the EUT on the turntable 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.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

**The testing was performed by Snell Leong on 2005-04-13.*

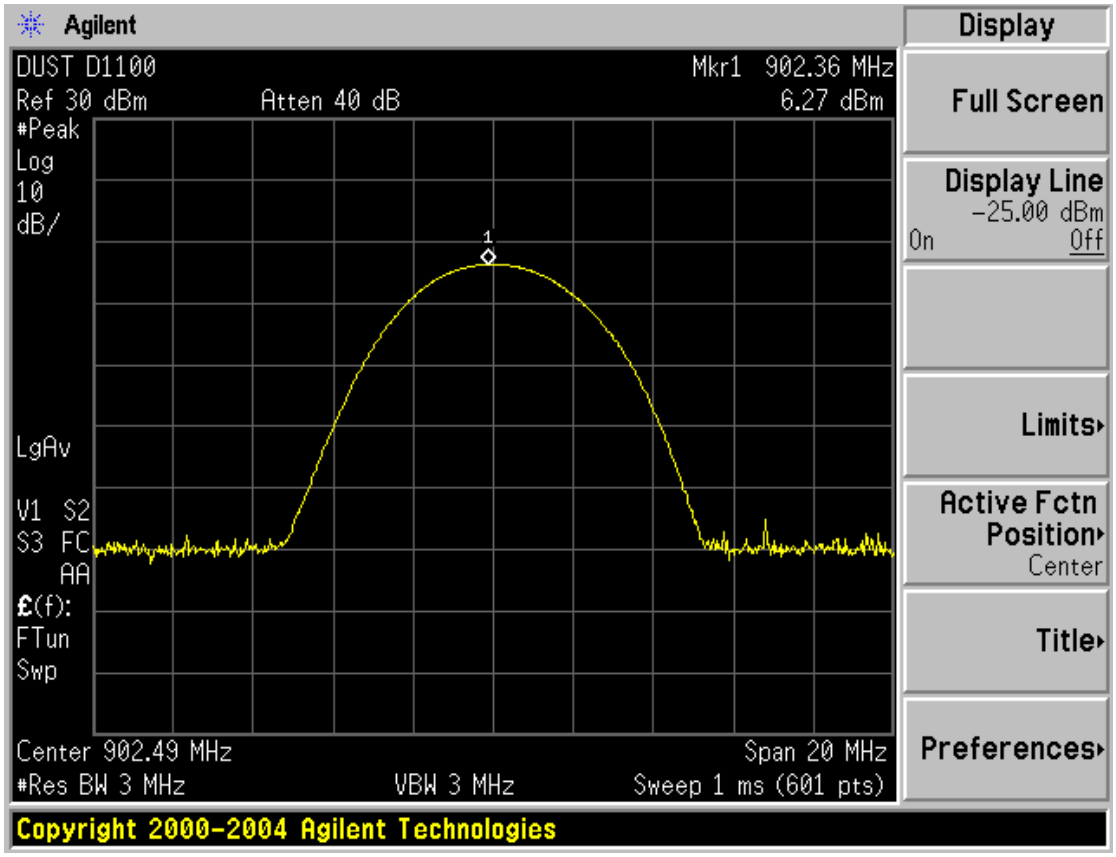
Measurement Result

Channel	Frequency	Max Peak Output Power		Limit	Result
	MHz	(dBm)	(m Watt)	(m Watt)	
Low	902.491	6.27	4.24	1000	pass
Mid	914.999	5.98	3.96	1000	pass
High	927.482	5.61	3.64	1000	pass

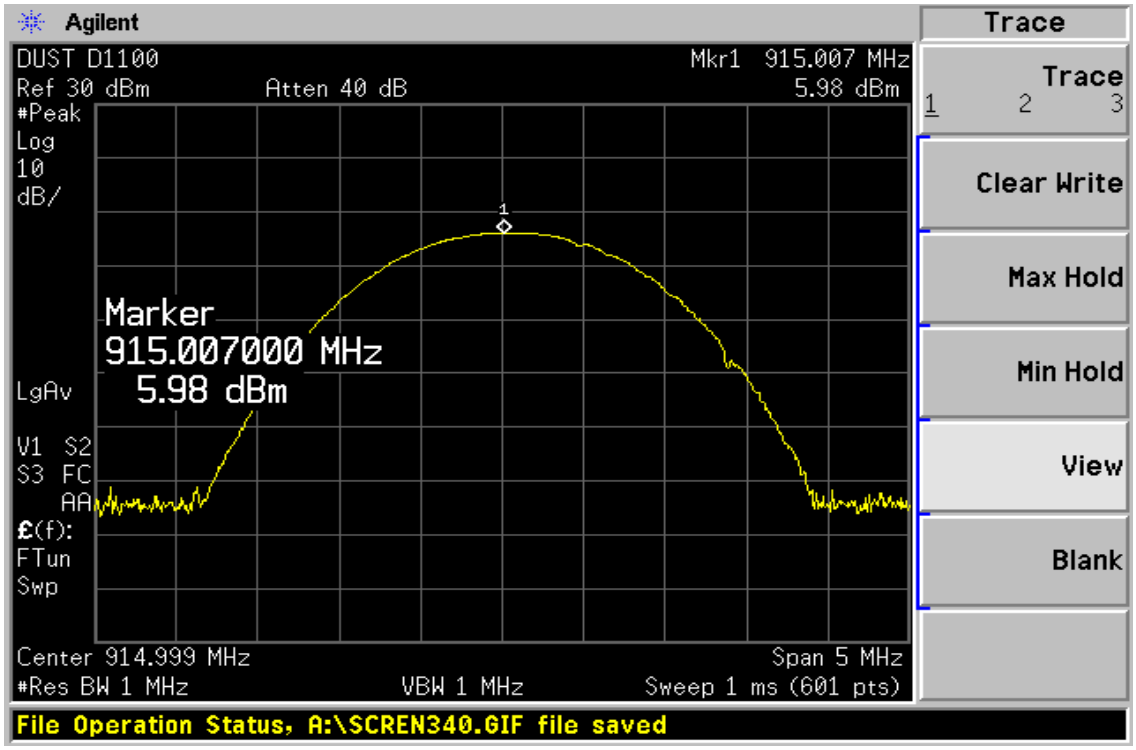
Plots of Maximum Peak Output Power

Please refer to following plots.

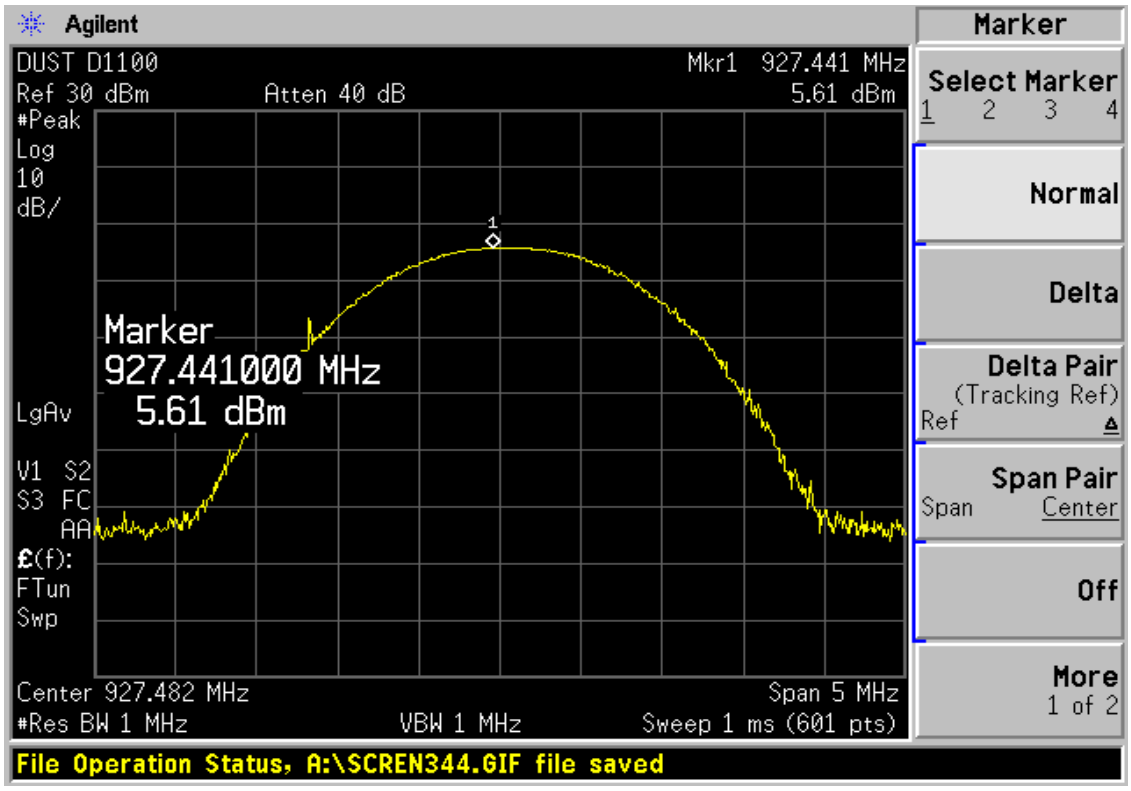
Low Channel



Middle Channel



High Channel



§15.247 (c) - 100 KHZ BANDWIDTH OF BAND EDGES

Standard Applicable

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.

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Enable the hopping mode, position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

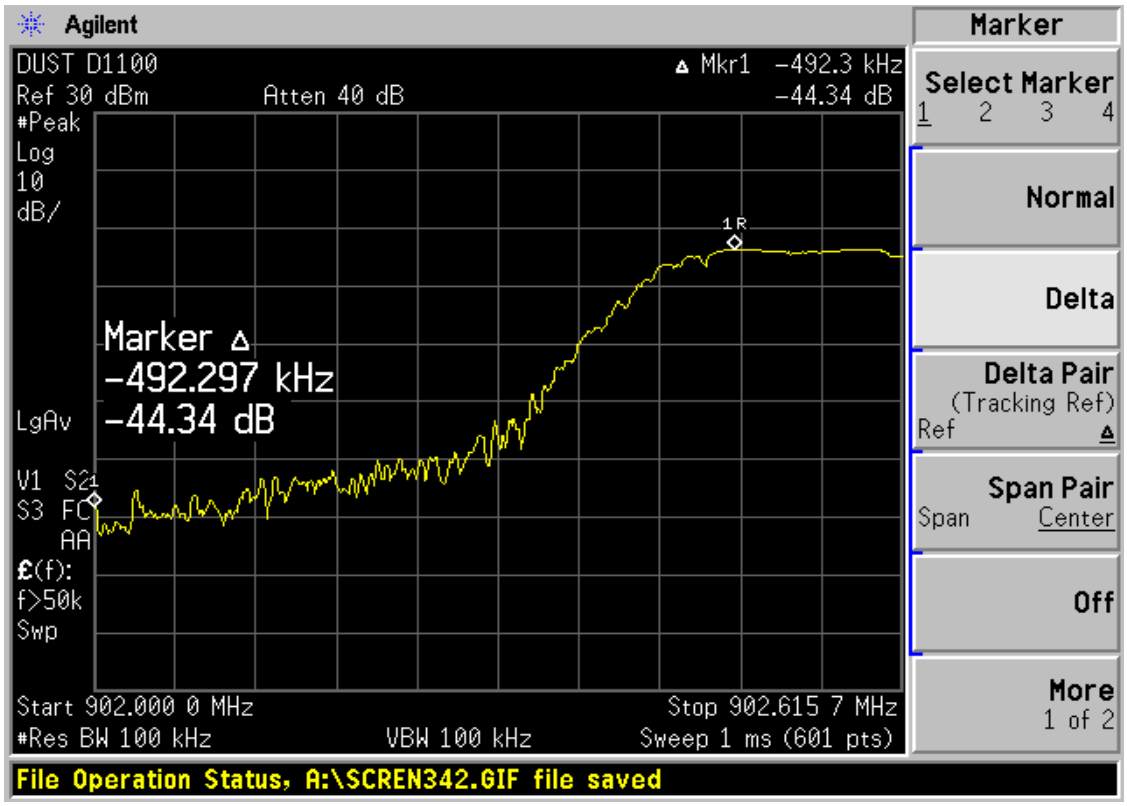
Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

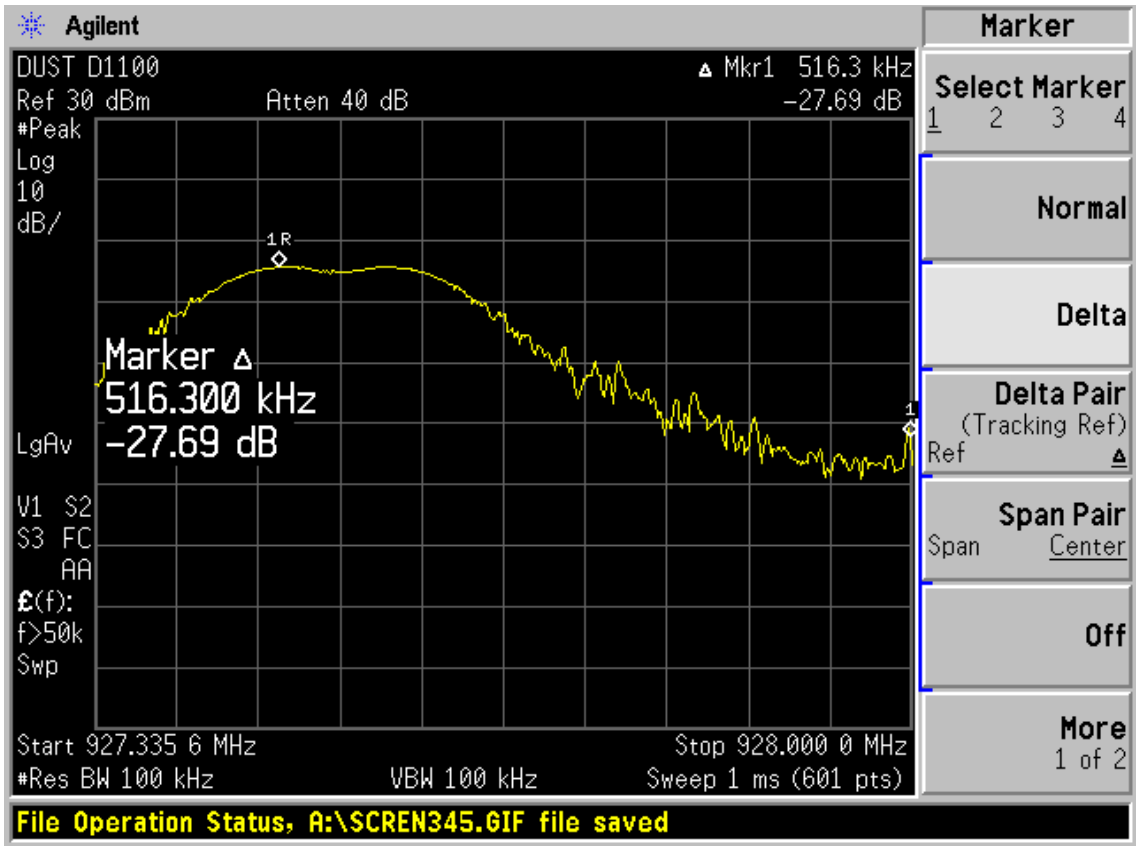
**The testing was performed by Snell Leong on 2005-04-13.*

Plots of 100kHz Bandwidth of Band Edge

Please refer the following plots.

Note: The test was conducted at both hopping enable and disable mode, only the worst test data were presented.


Agilent
DUST D1100
Ref 30 dBm
Atten 40 dB
Mkr1 -492.3 kHz
-44.34 dB
#Peak
Log
10
dB/
1R
Marker Δ
-492.297 kHz
-44.34 dB
LgAv
V1 S2
S3 FC
AA
£(f):
f>50k
Swp
Start 902.000 0 MHz
#Res BW 100 kHz
VBW 100 kHz
Stop 902.615 7 MHz
Sweep 1 ms (601 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
File Operation Status, A:\SCREN342.GIF file saved


Agilent
DUST D1100
Ref 30 dBm
Atten 40 dB
Mkr1 516.3 kHz
-27.69 dB
#Peak
Log
10
dB/
1R
Marker Δ
516.300 kHz
-27.69 dB
LgAv
V1 S2
S3 FC
AA
£(f):
f>50k
Swp
Start 927.335 6 MHz
#Res BW 100 kHz
VBW 100 kHz
Stop 928.000 0 MHz
Sweep 1 ms (601 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
File Operation Status, A:\SCREN345.GIF file saved

SPURIOUS EMISSION AT ANTENNA PORT

Standard Applicable

According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Enable the hopping mode, position the EUT on a bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.

3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.

4. Set the SA on View mode and then plot the result on SA screen.

5. Repeat above procedures until all frequencies measured were complete.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2004-11-10

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	48%
ATM Pressure:	1024 mbar

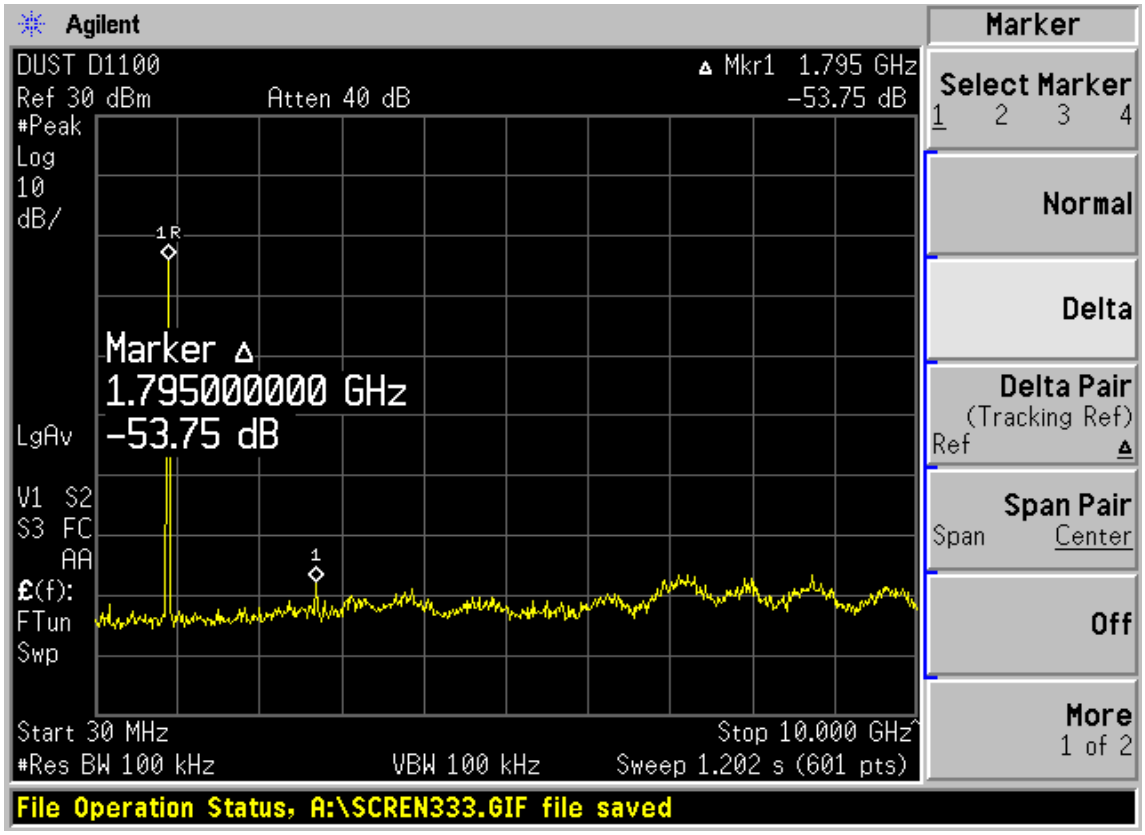
**The testing was performed by Snell Leong on 2005-04-13.*

Measurement Results

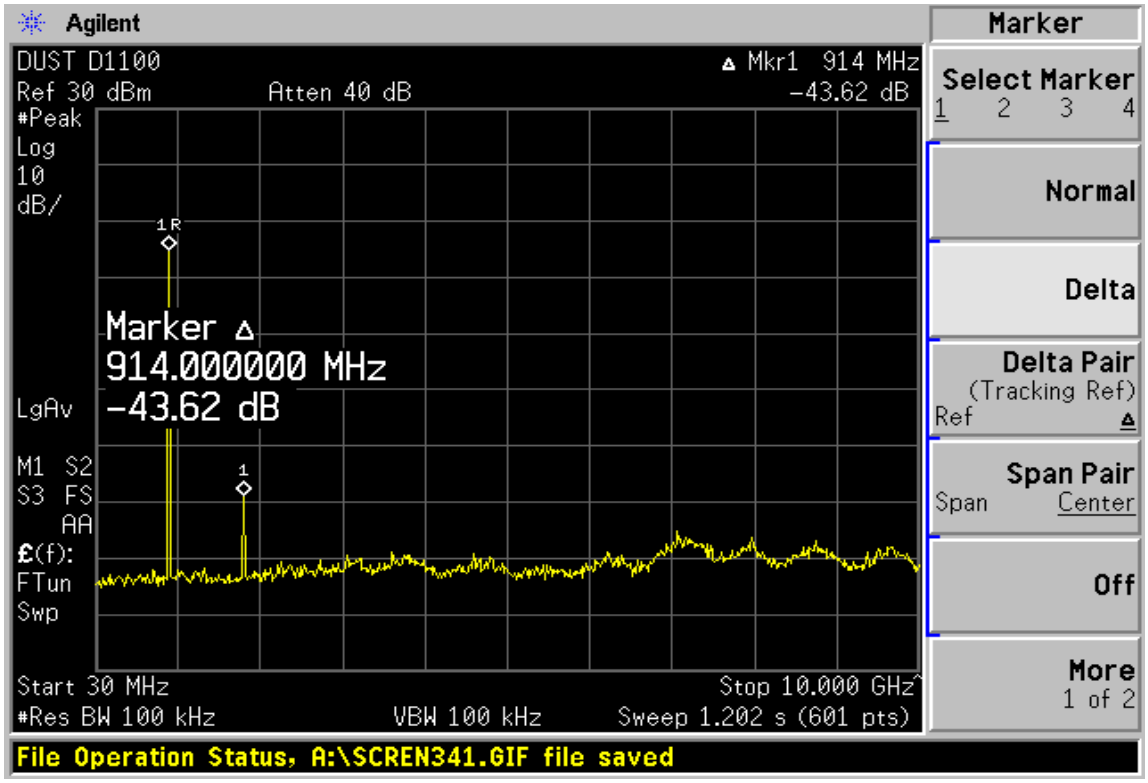
Please refer to the following plots.

Note: The test was conducted at both hopping enable and disable mode, only the worst test data were presented.

Low Channel



Middle Channel



High Channel