JSF Technologies Crosswalk Beacon AB500

CE Mark EMC Directive Compliance Test Report

per

EN61000-6-3:2001 Residential/Light Industrial

and

Report of Measurements

per

FCC CFR47 Part 15/C, 15.247

Revision 0.2

August 12, 2004

Approval		
Checked By:	_____ **Robert Stirling, P.Eng**	_____ **Date**

Protocol Labs, Abbotsford BC, Canada
FCC Registration Number 96437
Industry Canada Registration Number IC3384

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Section I: CE Mark EMC Directive Compliance Test Report FCC CFR47 Part 15/B Report of Measurements

Testing Details

TESTED BY: David Johanson

TEST CONDITIONS: Temperature and Humidity: 18.3°, 67%

TEST VOLTAGE: Custom Battery pack

Test Facilities

Protocol Labs
28945 McTavish Rd.
Abbotsford BC, Canada, V4X 2E7

FCC Registration Number 96437
Industry Canada Registration Number IC3384

Test Equipment List:

EMISSIONS:

Device	Model Number	Serial No.	Last Cal.	Next Cal
Antenna	EMCO 3141 Bilog	1127	27/10/03	27/10/04
Antenna	EMCO 3115 Horn	4251	15/10/03	15/10/04
LISN	Solar 8012-50-R-24-BNC	863092	22/10/03	22/10/04
Spectrum Analyzer	Hewlett Packard 8566B	2241A02102	14/11/03	14/11/04
RF-Preselector	Hewlett Packard 85685A	3107A01222	03/03/04	03/03/05
Quasi-Peak Adapter	Hewlett Packard 85650A	2043A00240	04/03/04	04/03/05
Tower	Rhientech Labs	Custom	NR	NR
Turntable	Protocol	Custom	NR	NR

Company Tested:

NAME: JSF Technologies

ADDRESS: 6771 Kirkpatrick Crescent
Saanichton, BC V8M 1Z8

CONTACT PERSON: Mr. Stan Polyakov

PHONE NUMBER: 1-250-544-1440

Equipment Under Test:

THE TEST SYSTEM:

EUT: Crosswalk Beacon

Manufacturer: JSF Technologies
Part Numbers: AB500

Test Software: Rev 4.0

TEST SETUP: The EUT was setup in its approved operating configuration as required by the manufacturer.

CABLING:

Cable	Pins	Connector	Load/Termination	Shielded	Ferrites
Program	2	Soldered	Switch	No	No

MODIFICATIONS: No modifications were required for this unit to pass.

CONCLUSION: The Crosswalk Beacon AB500 that was tested complies with the requirements of EN61000-6-3:2001 Class A and FCC CFR47 part 15/C Radiated Emissions.

Section II: CE Mark Emissions Testing

Summary of EN61000-6-3:2001 Residential/ Light Industrial Emissions Standard Testing

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with EN61000-6-3:2001 Residential/Light Industrial Emission Standard, EN55022 Information Technology Equipment, and self declaration of the CE Mark requirements under the EMC Directive.

Test Results

Testing was performed per the following standards, pursuant to EN61000-6-3:2001.

Radiated and Power Line Conducted Emission tests were performed using measurement procedure EN55022. Radiated emissions were performed on an open area 10-m test site.

Test	Standard	Description	Result
Conducted Emissions	EN55022 Class A Limits	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range	N/R
Radiated Emissions	EN55022 Class A Limits	The radiated emissions are measured in the 30-1000Mhz range	Complies
Power Line Harmonics	EN61000-3-2	Maximum 1.08, 2.3, 0.43, 1.14, 0.3, 0.77, 0.23 A… for 2^{nd} to nth Harmonic	N/R
Power Line Fluctuation/Flicker	EN61000-3-3 $P_{st} < 1$ $P_{l\,t} < 0.65$	Maximum 3% total Harmonic Distortion	N/R

Part 1: Radiated Emission Testing

DATE: June 16, 2004

TEST STANDARD: EN55022

TEST VOLTAGE: Battery Operated

MINIMUM STANDARD: Class A Limits:

Frequency (MHz)	Maximum Field Strength dBµV/m at 10 m
30 - 230	40.0
230 - 1000	47.0

METHOD OF MEASUREMENT: The equipment was set up in a 10 meter open field test site, using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. A typical application was tested.

Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

In cases where the presence of high ambient noise makes it impossible to measure an emission at the required distance, the measurement is performed at a closer distance and the limit is adjusted per EN61000-6-3: 2001

$$L2 = L1\ (d1/d2)$$

where L1 is the specified limit in uV/m at the distance d1. L2 is the new limit at the new distance d2.

MODIFICATIONS: No modifications were required for the devices to pass the test.

MEASUREMENT DATA: See Appendix B for Plots.

EMISSIONS DATA: See Table in Appendix B for corresponding frequencies.

PERFORMANCE: Complies.

Section III: FCC CFR47 Part 15 Subpart C Report of Measurements

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15 – Subpart C - Intentional Radiators. Additionally, the specific section used for compliance is 15.247 – Operation within the bands 902-928MHz – limited to frequency hopping intentional radiator. This includes the use of the FCC Public Notice DA 00-705 (Filing and Measurement Guidelines for Frequency hopping Spread Spectrum Systems) was used as a guide to the tests to be performed.

Since this is unit contains a pre-manufactured module that has already been tested and approved, not all tests have been or can be tested. The Radiated Emission tests were performed using measurement procedures outlined in the above standards.

FCC Labeling and Marking Requirements:

Markings

According to FCC Section 2,15, and ICES 003, a statement similar to the following must be included on an identification label, which also uniquely identifies the Manufactured date, either explicitly or through a Serial number etc:

> "This equipment complies with FCC Rules, Part 15 and Industry Canada's ICES 003. Operation is subject to the condition that This device may not cause harmful interference."

Additionally, If the manufacturer markets product to Quebec, the following supplemental information should be added to the label :

> "Cet Apparreil numerique de la Classe A respecte toutes les exigences du Reglement sur le material broilleur du Canada."

It is also required according to FCC Part B Section 15.21, that a caution be included such as:

> Caution: Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Part 1: Radiated Emission Testing

DATE: June16, 2004

TEST STANDARD: FCC CFR47, Part 15, Subpart C

TEST VOLTAGE: Battery Operated

TEST SETUP: The equipment was set up in a 10-meter open field test site. Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

MINIMUM STANDARD: Class A Limits:

Frequency (MHz)	Maximum Field Strength dBμV/m at 10m
30 - 88	90
88 - 216	150
216 - 960	210
960 - 1000	300

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Pins	Connector	Load/Termination	Shielded	Ferrites
Program	2	Soldered	Switch	No	No

MODIFICATIONS: No modifications were required for the devices to pass the test.

MEASUREMENT DATA: See Appendix B for Plots.

EMISSIONS DATA: See Table in Appendix B for corresponding frequencies.

PERFORMANCE: Complies.

Part 2: Antenn Requirement - 15.203

APPLICABLE REGULATIONS: 2.1

15.203 - An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RESULT: 2.2

This unit meets this requirement. The antenna is a 916.5 MHz, ¼ wave whip antenna that is attached to the top of the unit. The antenna is attached to the transmitter module through a flexible cable and a “Reversed Polarity SMA” connector. It is normally installed at the factory, but replacement Antenna’s can be ordered from the factory and only installed by qualified and trained personnel.

Part 3: Conducted Emissions Tests – 15.207

APPLICABLE REGULATIONS: 3.1

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 30MHz 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 (MHz)	Maximum Level (dBµV) Quasi-Peak	Maximum Level (dBµV) Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

RESULT: 3.2

Not applicable. The EUT is DC powered using 4 custom rechargeable batteries.

Part 4: Frequency Hopping Spread Spectrum Operation - 15.247

APPLICABLE REGULATIONS: 4.1

15.247(a) - Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions. (Please note that only the applicable regulations are listed):

(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. The system shall hop to channel frequencies that are selected at the system-hopping rate from a pseudorandomly 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.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20dB 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.

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

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt (30dBm or 137dBuV) for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

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

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

The limits used for this product under test is that for emissions that do not fall within the restricted bands of 15.205(a), the limit for the emissions is 20dB below the highest peak.

For this product, the highest peak was found on the Mid channel Fundamental of 915.5 MHz at a level of 95.6 dBuV/m for a limit line of 75.6dBuV/m.

For emissions that do fall within the restricted bands, the limit is 53.98dBuV/m at 3meters. Since all measured frequencies of concern are over 1.0Ghz, we can also use the Average measurement.

Since an average detector was not used, the Calculation of the Average Correction Factor is computed by analyzing the worst case on time in any 100msec-time period and using the formula: Correction Factor (dB) = 20*log (worst case on time/100msec).

For this product an analysis of the system transmitter worst case "ON" time in any 100mec-time period is an on time of 5.14msec. Therefore, the calculated correction factor that we could use is:

Correction Factor (dB) = 20*log (5.14/100) = -25.78dB

Additionally, the Average Correction Factor is limited to a maximum of: -20dB by . Since we are affected by this limit, therefore the Average Correction factor for this product is: –20.00dB

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

TEST PROCEDURES: 4.2

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP:

Freq. Range Measured	30Mhz – 10000MHz
Test Distance	1 to 3m
Test Instrumentation resolution	120KHz (30MHz to 1000MHz) 1MHz (1000MHz to 10000MHz)
Receive Ant. Scan Height	1m – 4m
Receive Ant. Polarization	Vertical and Horizontal.

The equipment was set up in a 3-meter open field test site. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

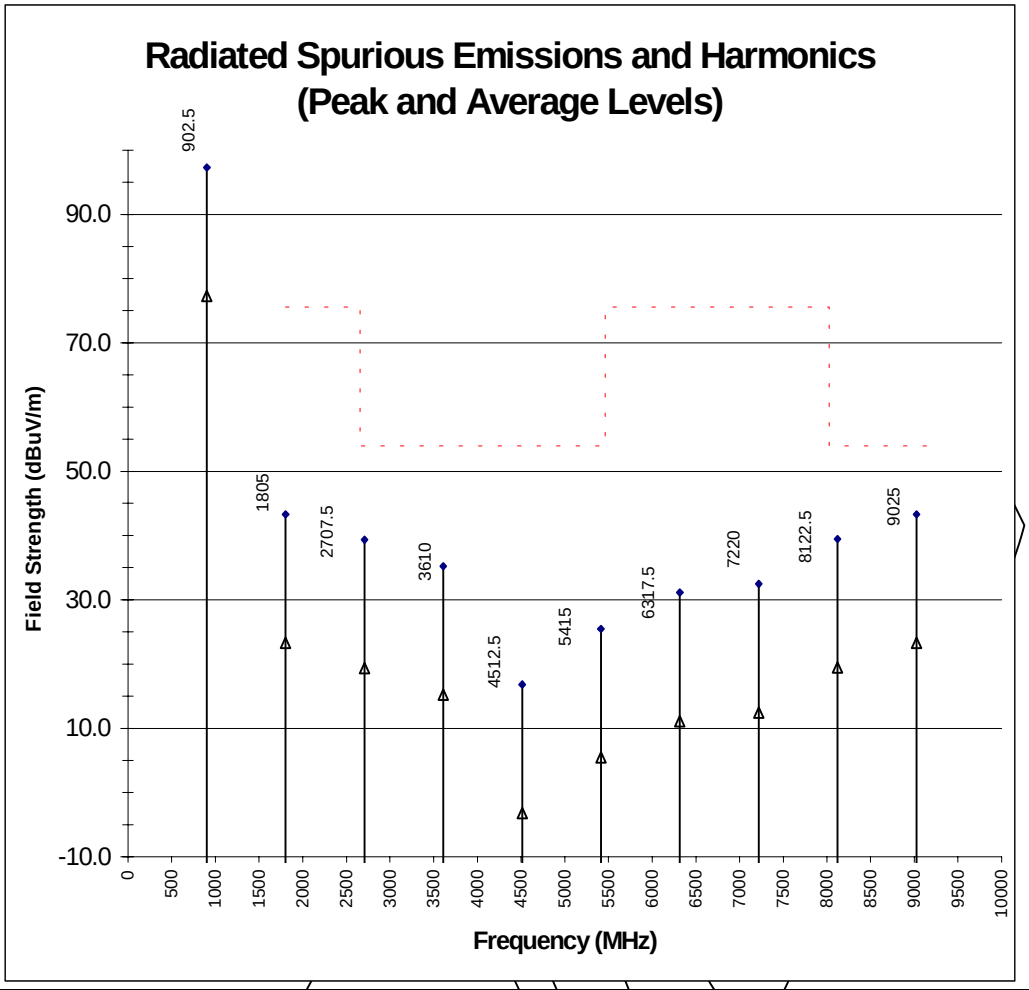
CABLING DETAILS: The EUT was set up using the supplied battery module. There are no required cables, but we did use a 1m cable with a button that is used for convenient programming of the test unit. (This programming cable is not a normal part of the unit)

RESULTS: 4.3

This transmitter was programmable to broadcast on standalone frequencies at the low (902.5), middle (915.5) and high (927.5) channels; 2 channel hopping at the end frequencies (902.5 and 927.5); 2 channel hopping in the middle peak frequencies (915 and 915.5); and full 51 channel hopping frequencies 902.5 to 927.5MHz.

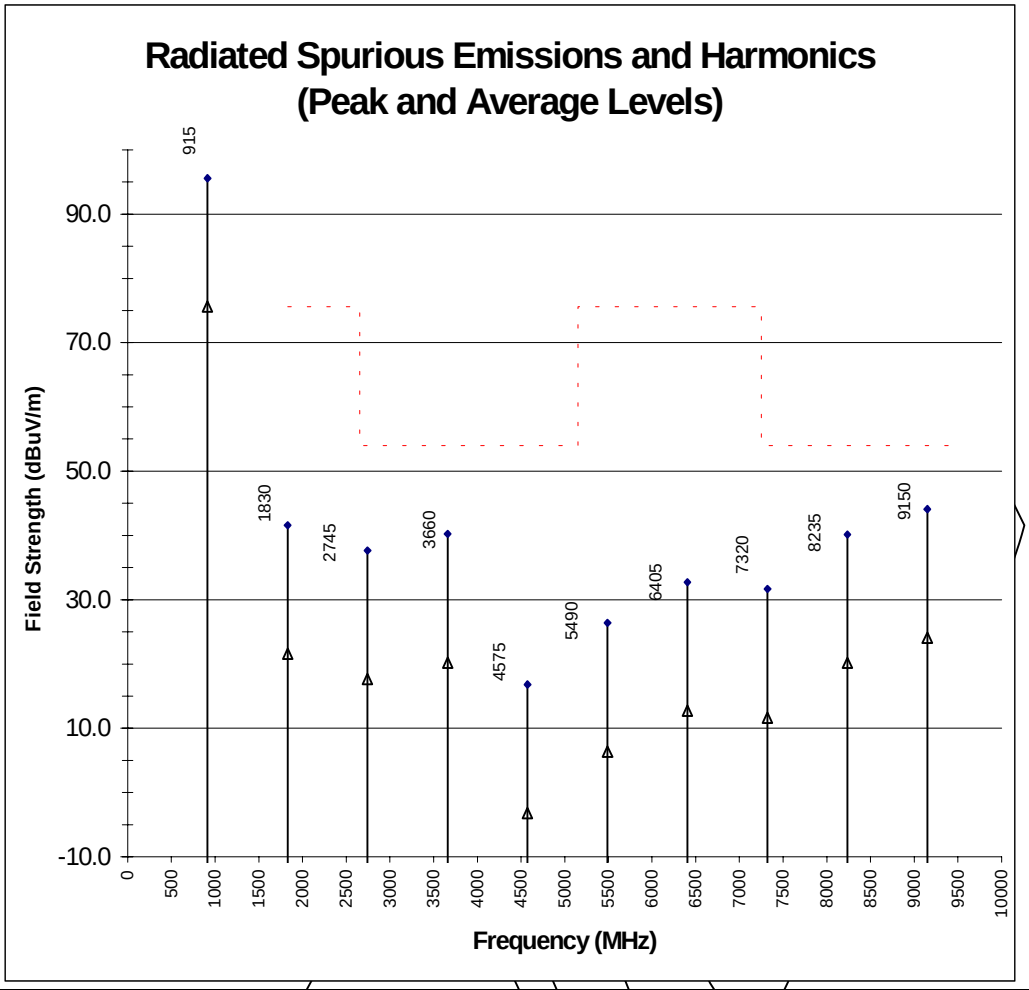
To verify compliance, the spectrum was scanned from 0.4MHz to 5000 MHz looking for all Spurious and Harmonic emissions in Receive and Transmit modes. The results are contained in the following tables and charts.

15.247(b,c): 902.5MHz, Low Channel Harmonic Emissions



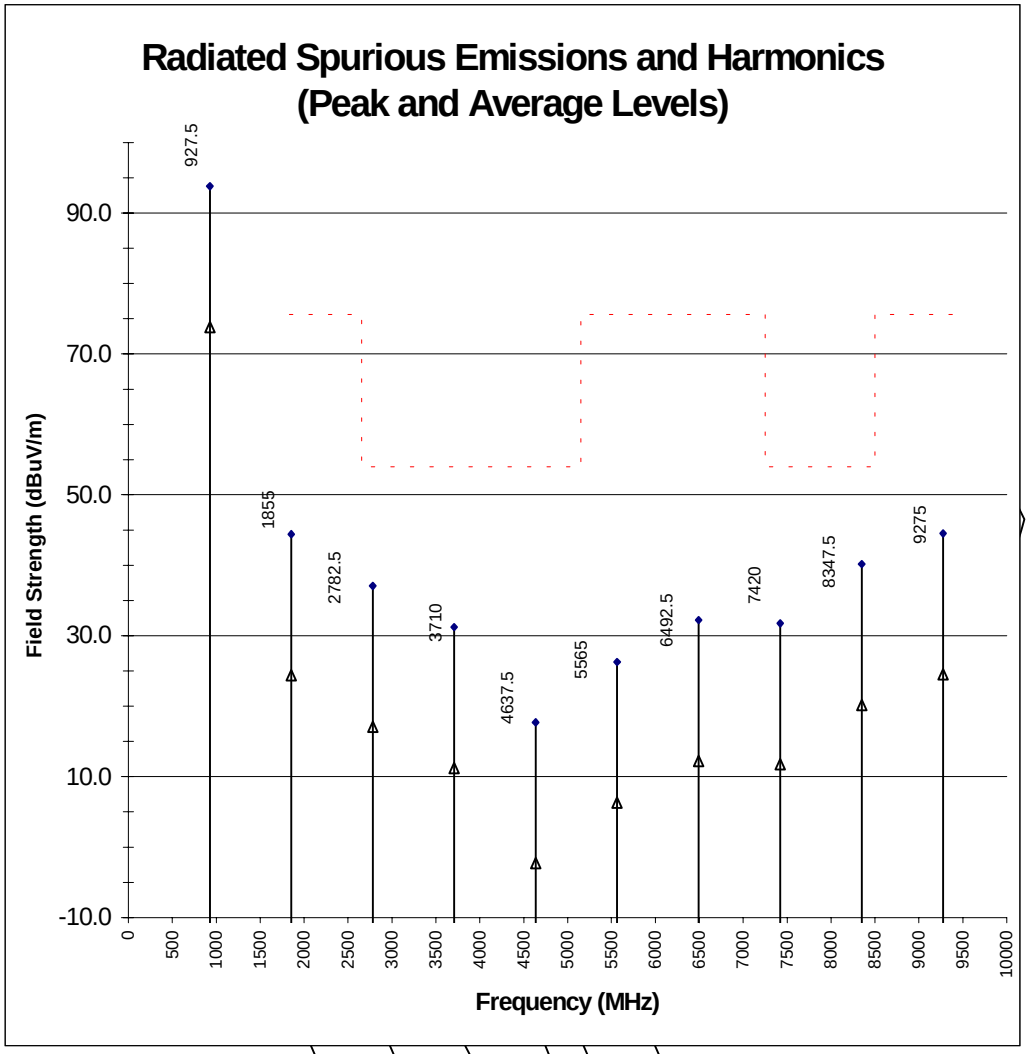
Freq. (MHz)	Harmonic	Restricted bands (15.205(a))	Measured Signal (dBµV) (note 1)	Equipment Attenuation (dB)	Corrected Peak Signal (dBµV)	Calculated Averaged Signal (dBµV) (* see 3.1)	Limit Lines (dBµV) (* see 3.1 and 4.1)	Delta Limit Peak For Freq. outside restricted bands (dB)	Delta Limit Average For Freq. inside restricted bands (dB)
902.500	1st	N/A	69.5	27.8	97.3	77.30	95.6	NA	NA
1805.000	2nd	N/A	7.9	35.4	43.3	23.30	75.6	-32.3	
2707.500	3rd	2655-2900	39	0.4	39.4	19.36	53.98		-34.62
3610.000	4th	3600-4400	27.8	7.4	35.2	15.23	53.98		-38.75
4512.500	5th	4500-5150	1.7	15.1	16.8	-3.18	53.98		-57.16
5415.000	6th	5350-5460	2.4	23.1	25.5	5.48	53.98		-48.50
6317.500	7th	N/A	5.8	25.3	31.1	11.12	75.6	-44.5	
7220.000	8th	N/A	6.7	25.8	32.5	12.46	75.6	-43.10	
8122.500	9th	8025-8500	6	33.5	39.5	19.46	53.98		-34.52
9025.000	10th	9000-9200	5.6	37.7	43.3	23.30	53.98		-30.68
Limit lines - 53.98 (Average limit) for Freq. in Restricted bands; else 75.6 dB (Peak levels; 95.6 –20db) for other Freq.									

15.247(b,c): 915.0 MHz, Mid Channel Harmonic Emissions



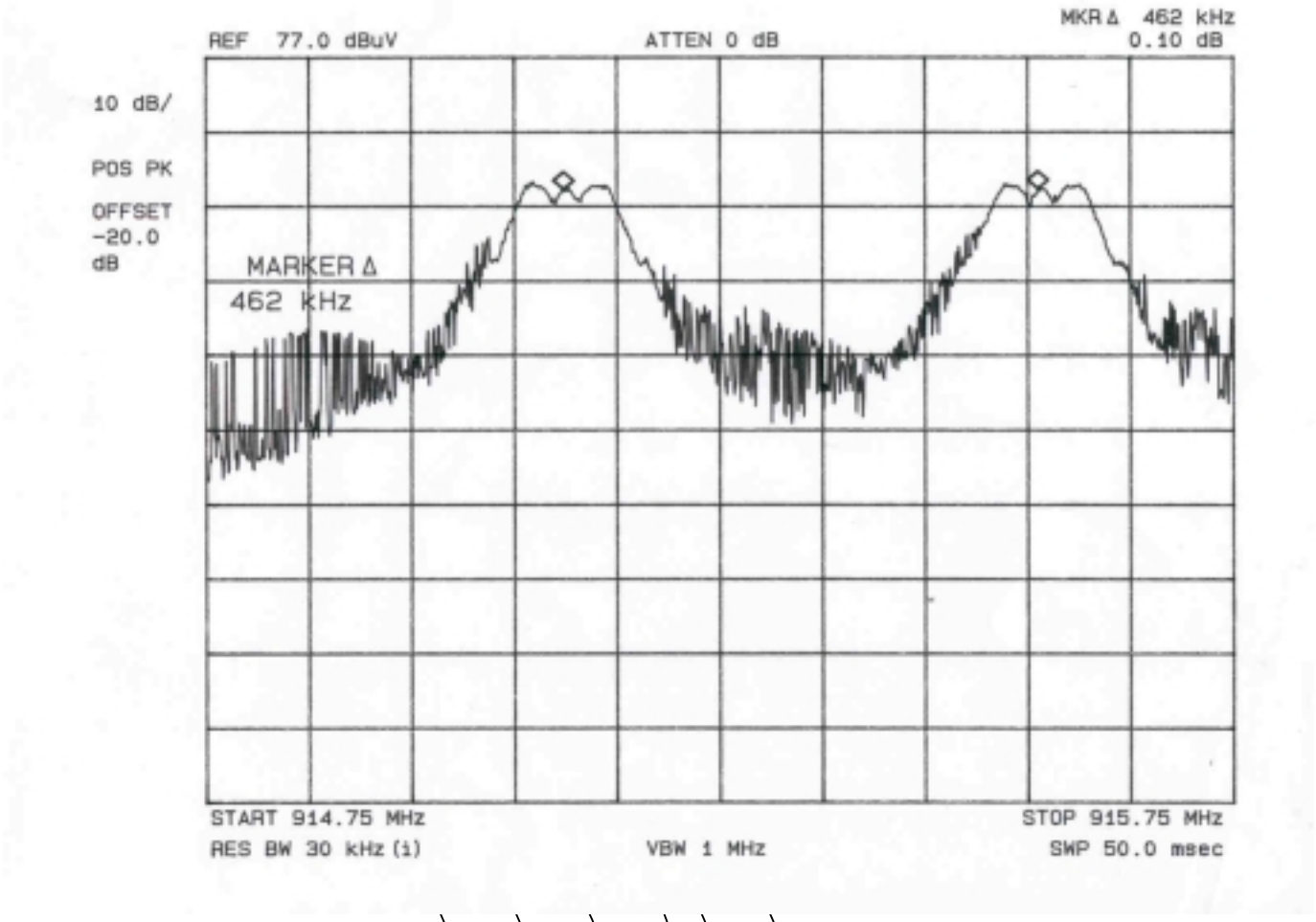
Freq. (MHz)	Harmonic	Restricted bands (15.205(a))	Measured Signal (dBµV) (note 1)	Equipment Attenuation (dB)	Corrected Peak Signal (dBµV)	Calculated Averaged Signal (dBµV) (* see 3.1)	Limit Lines (dBµV) (* see 3.1 and 4.1)	Delta Limit Peak For Freq. outside restricted bands (dB)	Delta Limit Average For Freq. inside restricted bands (dB)
915.000	1st	N/A	67.8	27.8	95.6	75.60	95.6	NA	NA
1830.000	2nd	N/A	6.2	35.4	41.6	21.60	75.6	-34.0	
2745.000	3rd	2655-2900	37.3	0.4	37.7	17.66	53.98		-36.32
3660.000	4th	3600-4400	32.8	7.4	40.2	20.23	53.98		-33.75
4575.000	5th	4500-5150	1.7	15.1	16.8	-3.18	53.98		-57.16
5490.000	6th	N/A	3.3	23.1	26.4	6.38	75.6	-49.2	
6405.000	7th	N/A	7.4	25.3	32.7	12.72	75.6	-42.9	
7320.000	8th	7250-7750	5.9	25.8	31.7	11.66	53.98		-42.32
8235.000	9th	8025-8500	6.7	33.5	40.2	20.16	53.98		-33.82
9150.000	10th	9000-9200	6.4	37.7	44.1	24.10	53.98		-29.88
Limit lines - 53.98 (Average limit) for Freq. in Restricted bands; else 75.6 dB (Peak levels; 95.6 –20db) for other Freq.									

15.247(b,c): 927.5 MHz, High Channel Harmonic Emissions



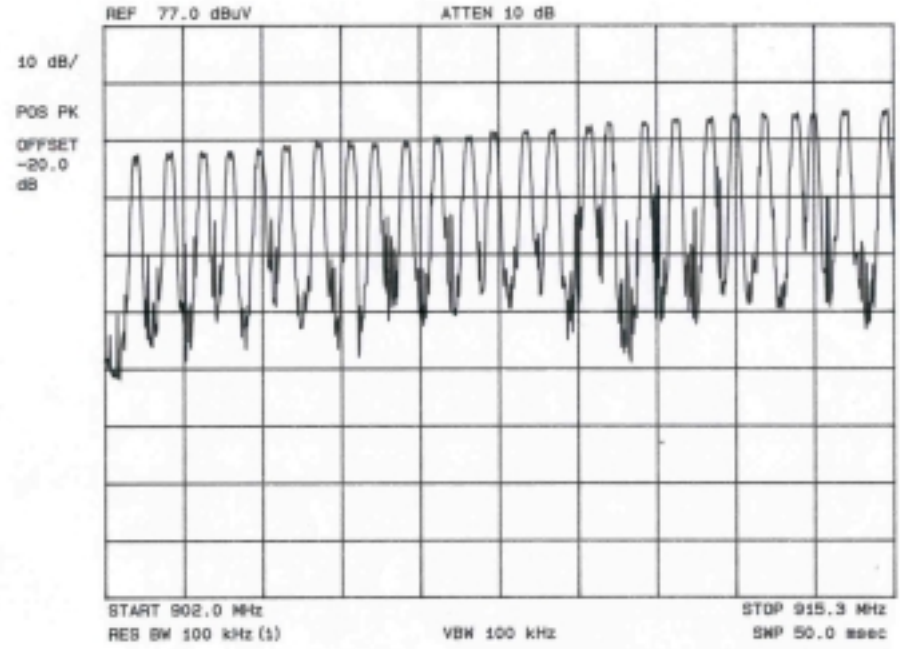
Freq. (MHz)	Harmonic	Restricted bands (15.205(a))	Measured Signal (dBµV) (note 1)	Equipment Attenuation (dB)	Corrected Peak Signal (dBµV)	Calculated Averaged Signal (dBµV) (* see 3.1)	Limit Lines (dBµV) (* see 3.1 and 4.1)	Delta Limit Peak For Freq. outside restricted bands (dB)	Delta Limit Average For Freq. inside restricted bands (dB)
927.500	1st	N/A	66.0	27.8	93.8	73.80	95.6	NA	NA
1855.000	2nd	N/A	9.0	35.4	44.4	24.40	75.6	-31.2	
2782.500	3rd	2655-2900	36.7	0.4	37.1	17.06	53.98		-36.92
3710.000	4th	3600-4400	23.8	7.4	31.2	11.23	53.98		-42.75
4637.500	5th	4500-5150	2.6	15.1	17.7	-2.28	53.98		-56.26
5565.000	6th	N/A	3.2	23.1	26.3	6.28	75.6	-49.3	
6492.500	7th	N/A	6.9	25.3	32.2	12.22	75.6	-43.4	
7420.000	8th	7250-7750	6.0	25.8	31.8	11.76	53.98		-42.22
8347.500	9th	8025-8500	6.7	33.5	40.2	20.16	53.98		-33.82
9275.000	10th	N/A	6.8	37.7	44.5	24.50	75.6	-31.1	
Limit lines - 53.98 (Average limit) for Freq. in Restricted bands; else 75.6 dB (Peak levels; 95.6 –20db) for other Freq.									

15.247(a) - Carrier Frequency Separation

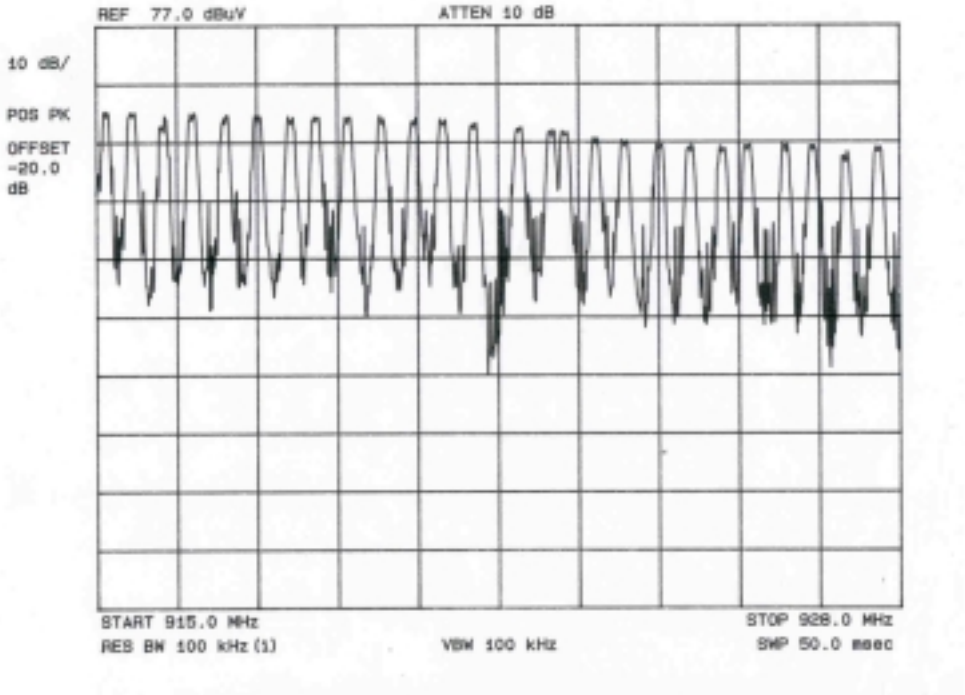


The Channel Separation exceeds both the 25KHz and 20dB bandwidth requirements.

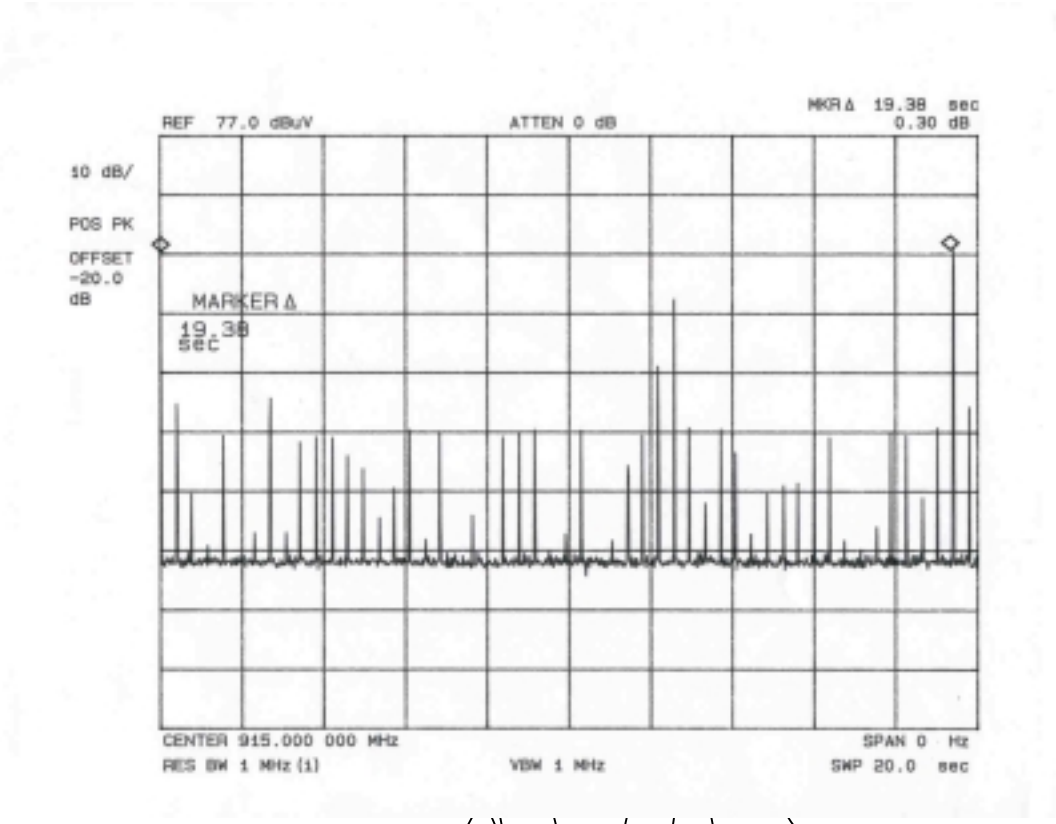
15.247(a) - Number of Hopping channels



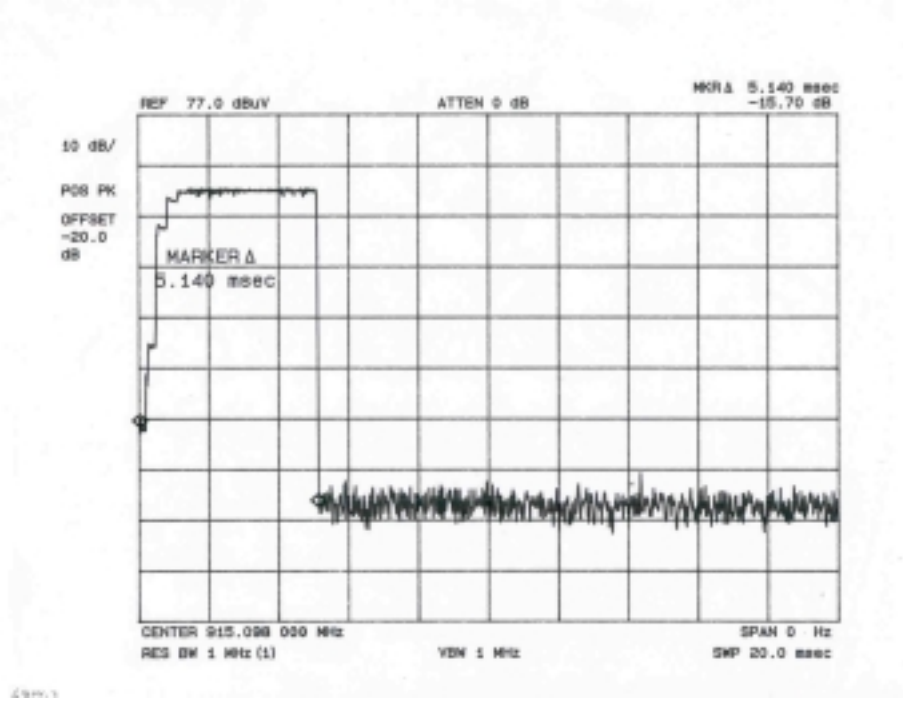
The Number of Hopping Channels in use for this product is 51.



15.247(a) - Time of Occupancy

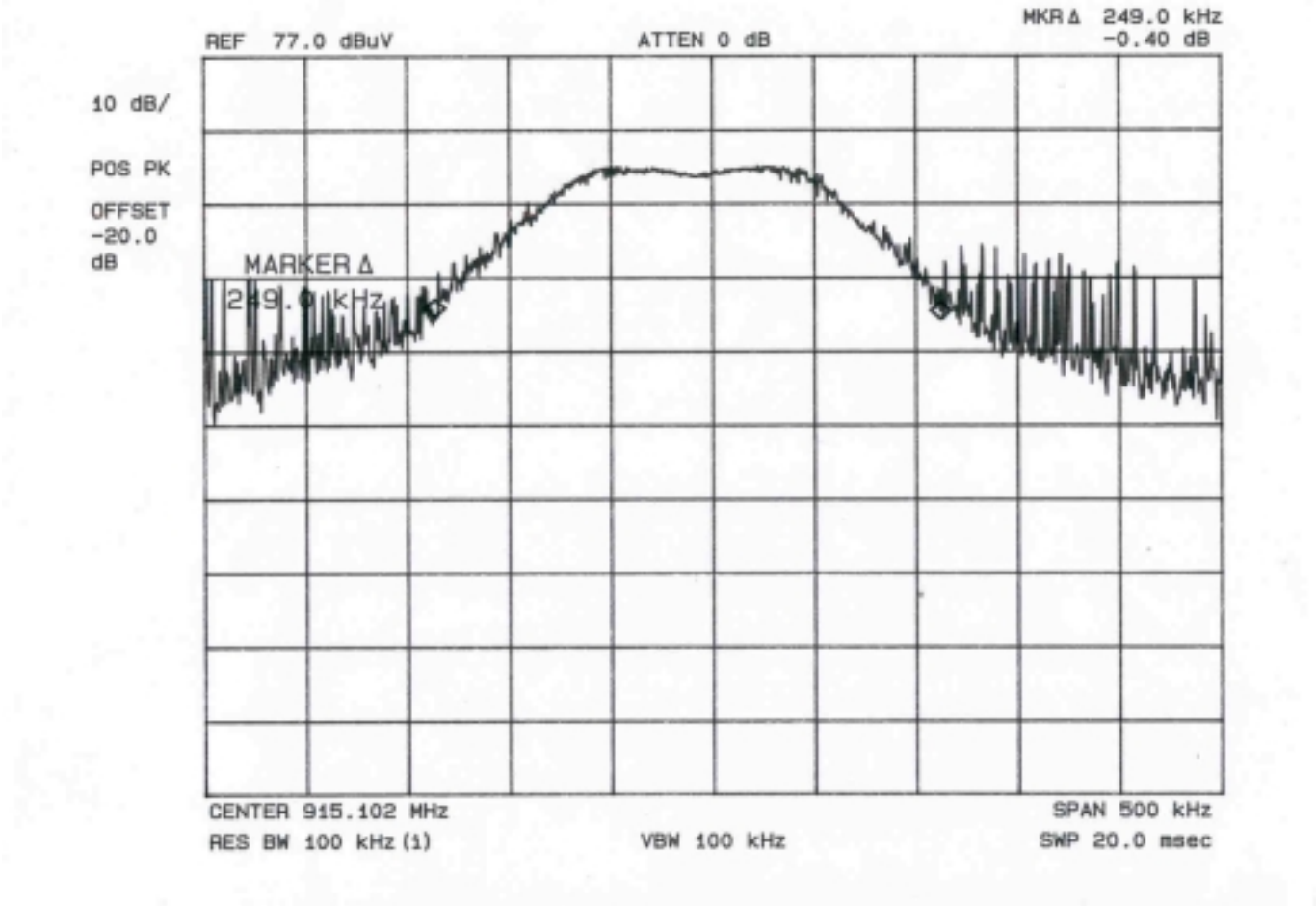


Note: the extra pulses in between the peak pulses are spurious emissions from other channels during multiple channel hopping over the 20-second period.



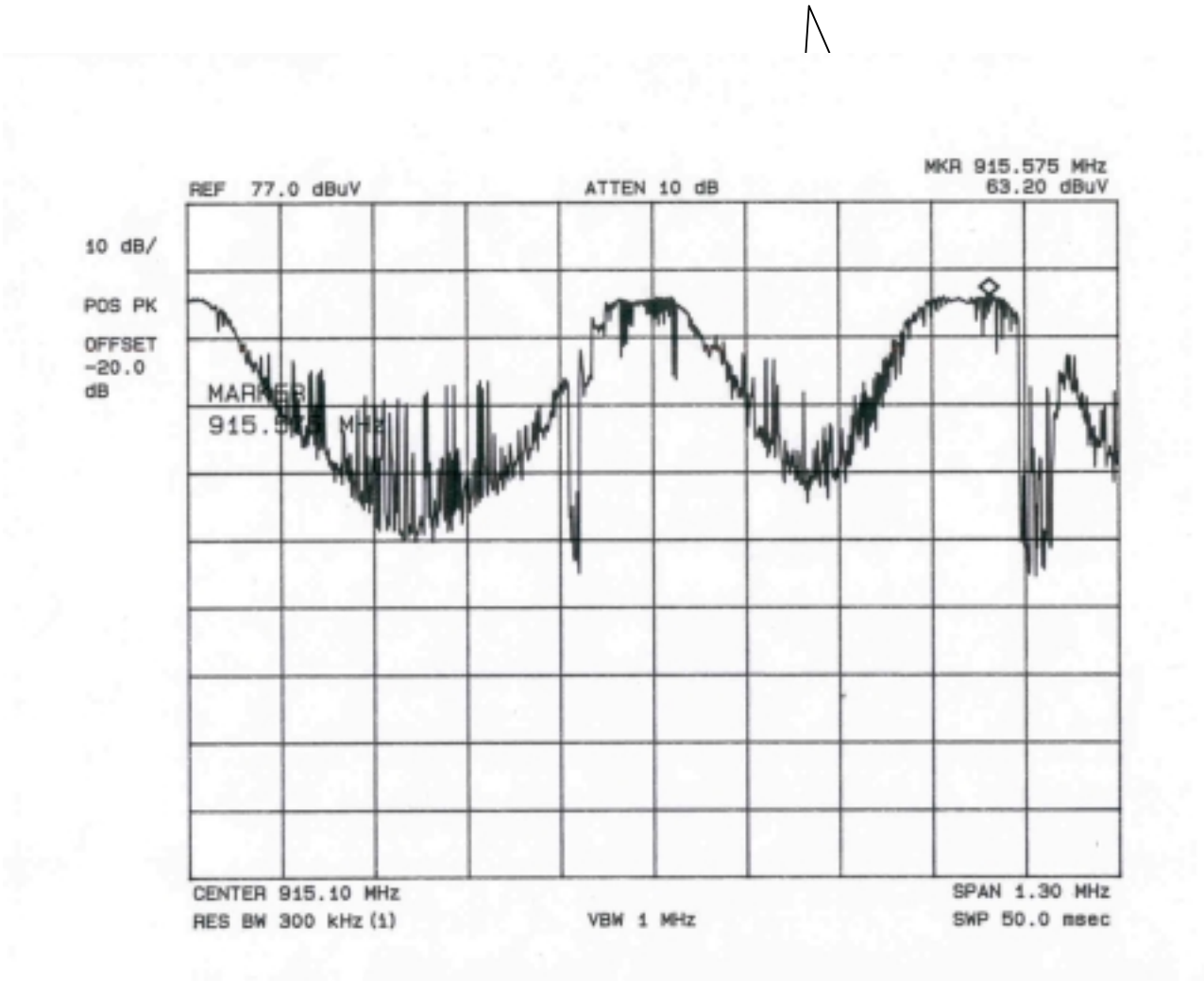
After several measurements, the worst case dwell time was measured at 5.14 mSec. This product meets the requirement of a Maximum dwell time of 400 mSec within a 20-second period.

15.247(a) - 20dB Bandwidth



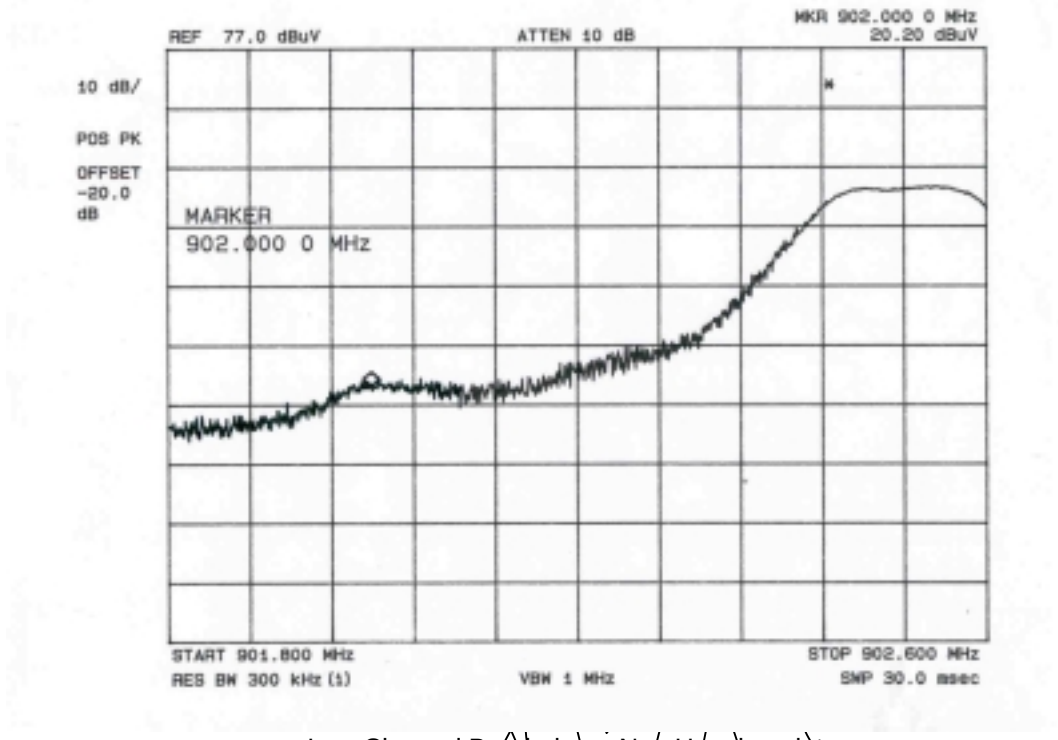
The measured 20dB Bandwidth for this product is set for 250kHz. This plot was obtained during measurements while in full channel hopping mode of operations.

15.247(b) - Peak output Power

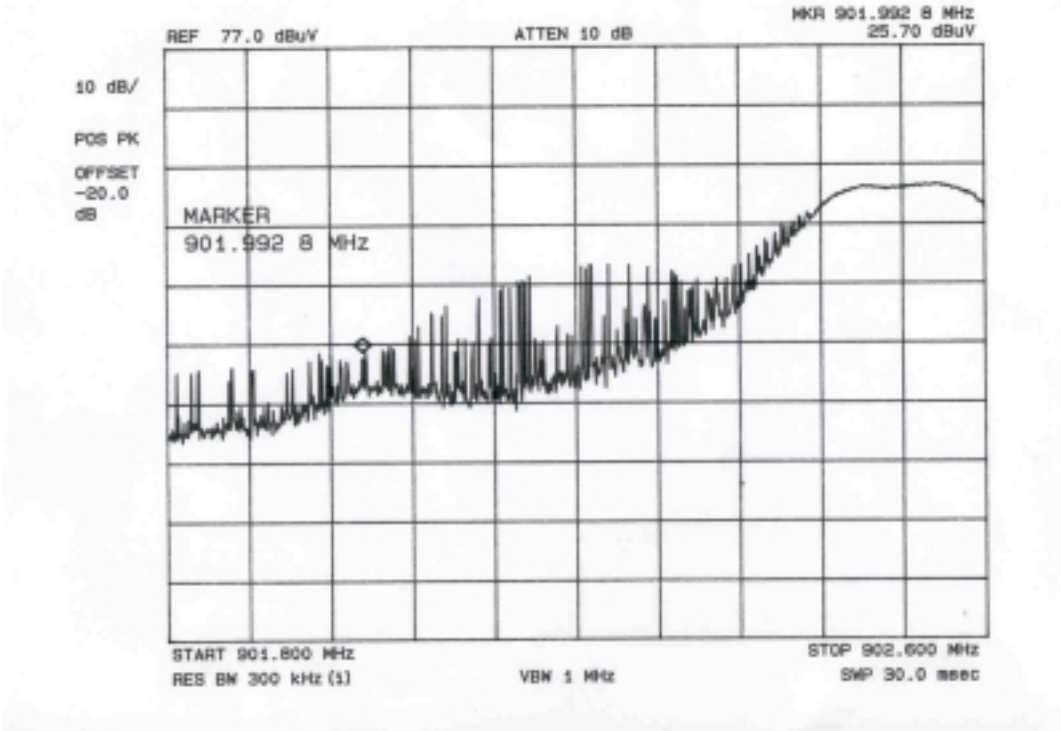


Mode of Operation	Peak Freq (MHz)	Peak Level Measured (dBµV)	Conversion to Power (dBm)	Conversion to Power (W)
Single Channel	915.0	67.800	-39.2	0.12 µW
2 Channel Hopping	915.576	63.10	-44.1	0.041 µW
51 Channel Hopping	915.575	63.20	-44.2	0.042 µW
Designed Peak Level	915.5	111.0	+4.0	2.51 mW

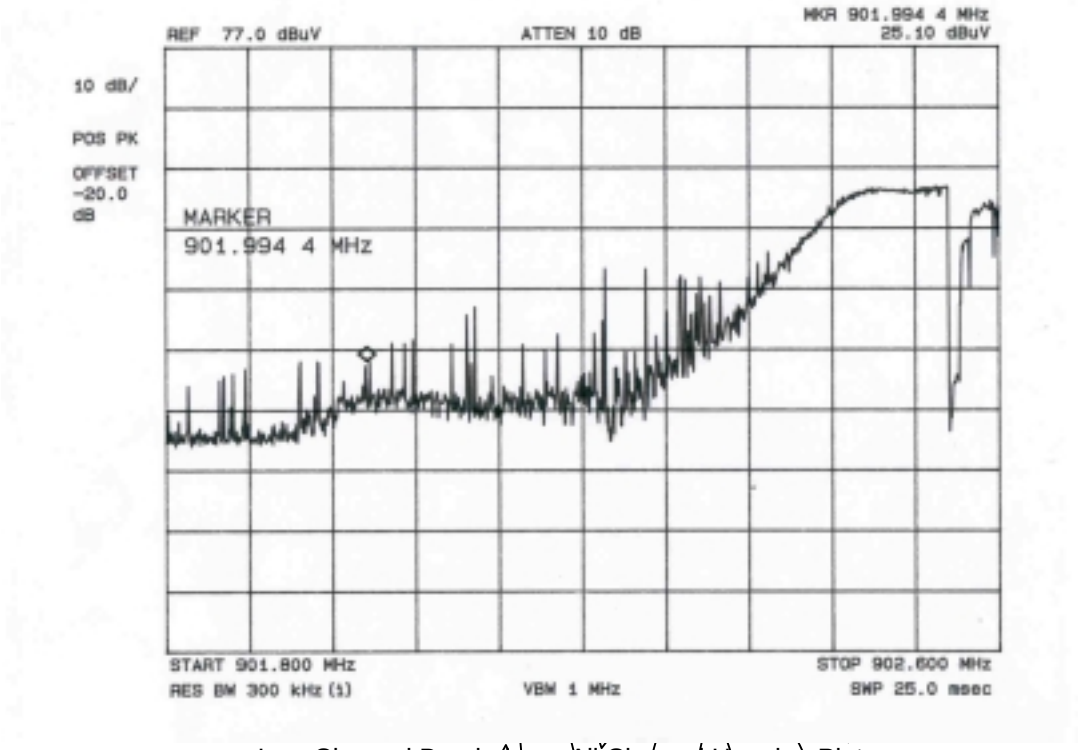
15.247(c) - Low Channel Bandedge



Low Channel Bandedge – Non Hopping plot

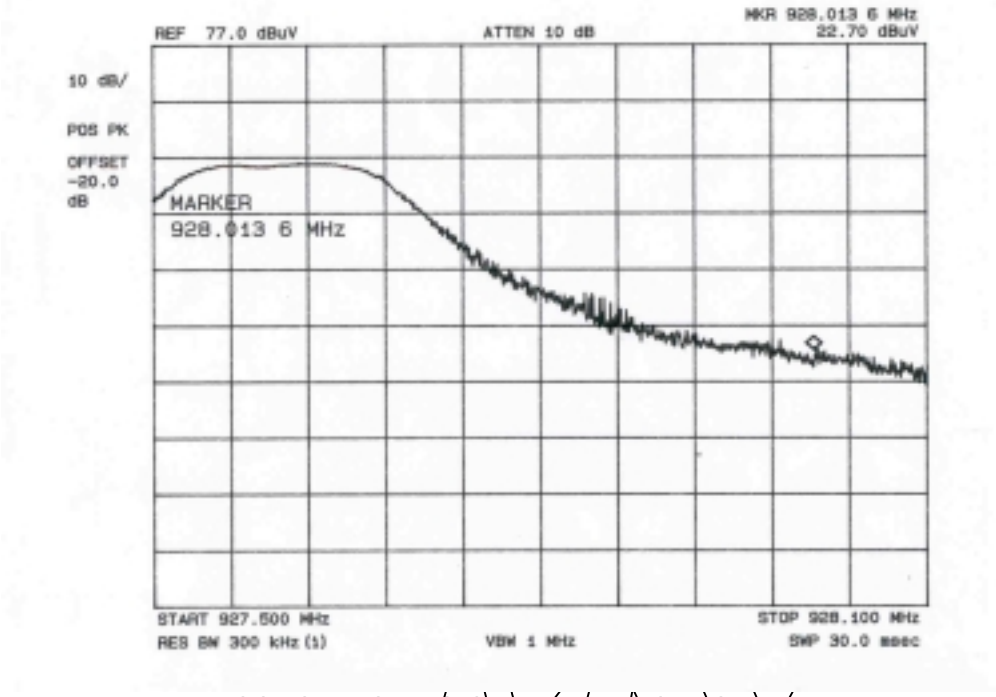


Low Channel Bandedge – 2 Channel Hopping Plot

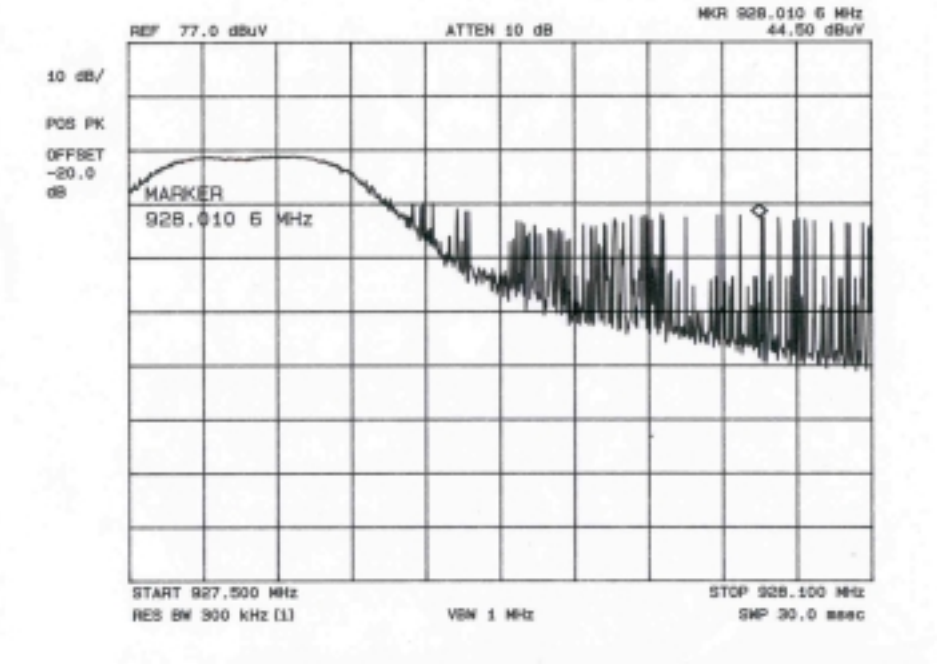


Low Channel Bandedge – All Channel Hopping Plot

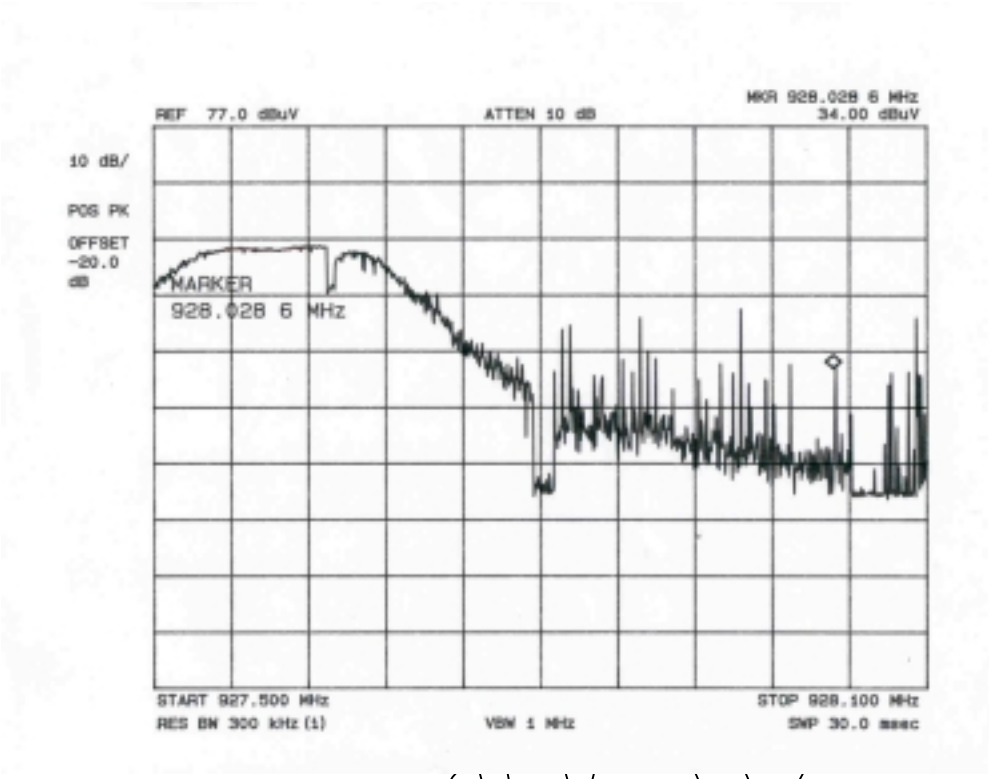
15.247(c) - High Channel Bandedge



High Channel Bandedge – Non Hopping Plot



High Channel Bandedge – 2 Channel Hopping Plot



High Channel Bandedge – All Channel Hopping Plot

Part 5: Restricted Bands Review – 15.205(b)

APPLICABLE REGULATIONS: 5.1

15.205(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.

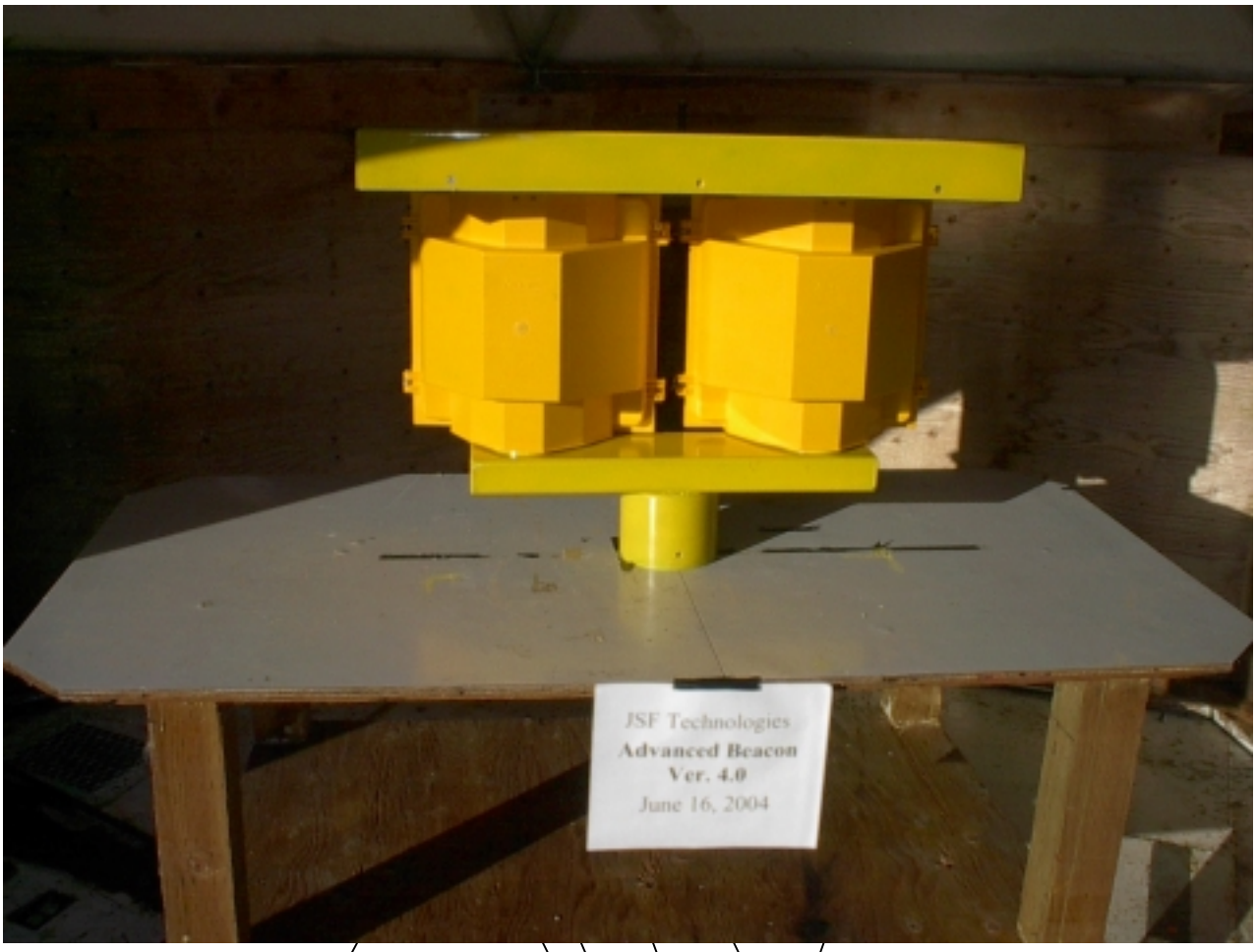
RESULT: 5.2

The spurious frequencies that have been identified to fall into restricted bands are the various harmonics of 906 and 918 MHz. The restricted bands affected are: 2655-2900MHz, 3600-4400MHz, 4500-5150MHz, 5350-5460MHz, 7250-7750MHz, 8025-8500MHz and 9000-9200MHz. Based on the perimeters of FCC Section 15.209, the Maximum Field Strength for all Frequencies above 960MHz is 500uV/m = 20Log(500uV) = 53.98 dBuV/m at 3meters using the Average Frequency Measurement or Calculation.

Referring to my tables and results in section 3.5, all frequencies in the restricted bands are below this limit.

Appendix A: Test Set-up Photos

Emissions Test Setup Front View



Emissions Test Setup Rear View

Appendix B: Measurement Data and Plot

Measurement Data: JSF Technologies – Crosswalk Beacon AB500

Conducted Emissions – Not Required Battery Powered

Radiated Emission

Table 1: FCC/CE Emissions Class A 10m

Frequency	Pol	Height	Angle	Tot Corr	Uncor-Pk	Peak	DelLim-Pk	DelLim-QP
(MHz)		(cm)	(deg)	(dB)	(dBµV)	(dBµV/m)	(dB)	(dB)
43.371620	Vert	1.0	340	5.16	17.60	22.76	-17.24	
60.321417	Vert	1.0	350	8.33	29.00	37.33	-2.67	-9.81
69.064904	Vert	1.0	350	9.62	20.80	30.42	-9.58	
133.277934	Horz	4.0	330	9.73	26.30	36.03	-3.97	-6.22
206.475237	Vert	1.0	260	12.34	15.50	27.84	-12.16	
235.944728	Horz	2.5	0	13.84	14.70	28.54	-18.46	
294.942846	Horz	3.0	340	16.56	11.00	27.56	-19.44	

Radiated Emission Plot