

Emissions Testing  
Performed  
on the  
**Saar Associates**  
**Frequency Hopping Spread Spectrum Transceiver**  
**Model: FHT100**

**To**

**FCC Part 15 Subpart C, 15.247**

Date of Test: March 1, 2, 4, 8, April 25, 2002

Report Date: June 11, 2002

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Report Number: 3020061

Contact: David Saar

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**I – Introduction and Summary**

TO: Mr. David Saar  
FROM: Nicholas Abbondante, Compliance Engineer  
DATE: March 1, 2, 4, 8, April 25, 2002  
PROJECT #: 3020061  
RE: Emissions testing of the Frequency Hopping Spread Spectrum Transceiver, Model: FHT100

On March 1, 2, 4, 8, and April 25, 2002 we tested the Frequency Hopping Spread Spectrum Transceiver, Model: FHT100 to determine if it was in compliance with the FCC Part 15, Subpart C, 15.247, “Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz” requirements.

A prototype version of the sample was received on 2/26/2002 in good condition.

In summary, this report confirms that the Frequency Hopping Spread Spectrum Transceiver, Model: FHT100 is compliant with the FCC Part 15, Subpart C, 15.247 requirements when production units conform to the initial sample. Please address all questions and comments concerning this report to Nicholas Abbondante, Compliance Engineer.

## **II – Technical Requirements**

### **15.1 Scope**

The EUT is a frequency hopping transceiver used to relay information such as water temperature and flow rate. A prototype version of the sample was received on 2/26/2002 in good condition.

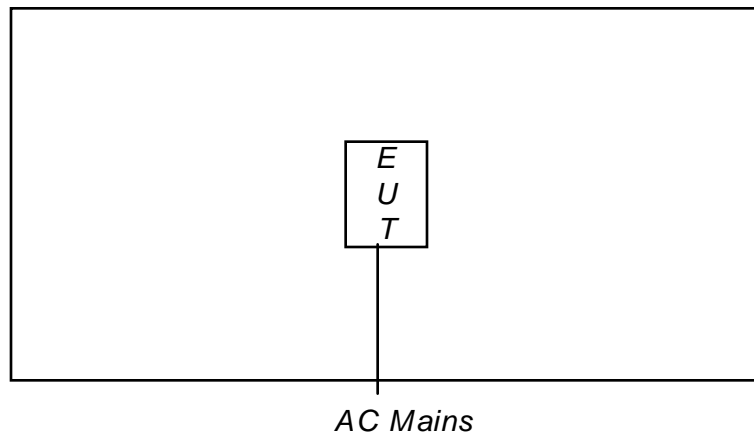
### **15.27 Special Accessories**

It was observed that several emissions fall within the restricted bands of 15.205, and must therefore meet the requirements of 15.209. In order for these emissions to meet the requirements of 15.209, the following modifications were made: 3 Fair-Rite Brand ferrites of type 0444164281 were placed on the AC mains cable at the EUT in single pass configurations, and Mini Circuits High Pass Filter HP-250 was placed on the antenna port closest to the serial input.

### **15.31 Measurement Standards**

The measurement procedures as specified by ANSI C63.4:1992 were used to test this device. See Section IV of the test report for a detailed description of the test site and the measurement equipment.

#### **System Block Diagram**



#### **Description of how the EUT was exercised during test**

The EUT was activated from nominal power. The transmitter was set to transmit a modulated

signal continuously for measurement purposes at the low and high ends of the passband. For some tests the transmitter was operating in hopping mode.

### **Justification**

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (1992).

For maximizing emissions, the system was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported.

To demonstrate compliance across the entire passband, a low and high channel were chosen.

### **15.33 Frequency range of measurement**

The device was scanned for spurious and harmonic emissions from 30 MHz to the 10<sup>th</sup> harmonic of the fundamental emission. The 10<sup>th</sup> harmonic for this device is 9240 MHz.

### **15.35 Measurement detector functions and bandwidth**

The following table illustrates the detector functions and bandwidth used to test the device.

<b>Frequency Range</b>	<b>Measurement Detector</b>	<b>Measurement Bandwidth</b>
450 kHz to 30 MHz	Quasi-Peak	9 kHz
30 MHz to 1000 MHz	Quasi-Peak	120 kHz
	Average	120 kHz
1000 MHz to 10 <sup>th</sup> harmonic	Average	1 MHz

The quasi-peak detector meets the requirements of CISPR 16.

**15.201 Certification**

The device is required to be certified in accordance with Part 2 of the FCC rules, Subpart J.

**15.203 Antenna Requirements**

The antennas are external to the EUT and attach directly via an SMA port. The EUT is intended to be professionally installed however, and therefore meets the requirement. The antenna used is a Radiall/Larsen 2.14 dB gain Center-Fed Half-wave Dipole, model: SPDA20918.

**15.205 Restricted bands of operation**

Section 15.247 requires that all spurious emissions excepting harmonics be compared to the general limits set forth in 15.209, or be attenuated by 20 dB below the fundamental, whichever is the lesser attenuation. The requirement of 15.205 is that any emissions falling within a restricted band be attenuated below the general emissions limits of 15.209. Therefore, the stricter limits of 15.209 were used when examining the spurious emissions levels, as it meets both requirements simultaneously. See section 15.35 for explanation of how detector bandwidth functions were used during testing.

**15.207 Conducted limits**

- (a) For an intentional radiator designed to be connected to the AC mains network, the radio frequency voltage that is conducted back onto the AC power line between the frequencies 450 kHz and 30 MHz shall not exceed 250  $\mu$ V, or 48 dBuV.
- (b) If the proper measuring techniques are used, and the quasi-peak value of an emission exceeds its average value by 6 dB or more, that emission is broadband and the quasi-peak value may be reduced by 13 dB and compared to the limits.
- (c) The limit shown in paragraph (a) shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz.
- (d) Devices powered from a battery are not subject to these limits unless there are provisions for connecting to a charger while the device is operating. Devices that obtain power through an AC adapter or through another device which is connected to the AC mains network are subject to these limits.

**15.209 Radiated emission limits; general requirements**

(a) Field Strength Requirements

<b>Frequency Range (MHz)</b>	<b>Field Strength (<math>\mu</math>V/m)</b>	<b>Measurement Distance (m)</b>
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

- (b) In the emission table above, the tighter limit applies at the band edges.
- (c) The level of any spurious emissions must be lower than that of the fundamental emission of the intentional radiator. The limits in the above table are based on the frequency of the spurious emission, not the frequency of the fundamental frequency.
- (d) See 15.35 for a description of measurement detector functions and bandwidth.
- (e) See 15.33 for a description of the frequency range of measurement.
- (f) If the frequency range of measurement must extend beyond the 10<sup>th</sup> harmonic because of a digital device in the intentional radiator, the emissions found above the 10<sup>th</sup> harmonic are to be compared with the general limits for radiated emissions from unintentional radiators set forth in 15.109.

**15.247 Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz**

- (a) Operation under the provisions of this section is limited to frequency hopping and direct sequence spread spectrum intentional radiators that comply with the following provisions:
- (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 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.
- (ii) Not applicable (iii) Not applicable (2) Not applicable
- (b) The maximum peak output power of the intentional radiator shall not exceed the following: (1) Not applicable
- (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt 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.
- (3) Except as shown in paragraphs (b)(3)(i), (ii), (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
- (i) Not applicable (ii) Not applicable (iii) Not applicable
- (4) 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 in 1.1307(b)(1).
- (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated



measurement. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

- (d) Not applicable (e) Not applicable (1) Not applicable (2) Not applicable (f) Not applicable
- (g) Frequency hopping spread spectrum systems aren't required to employ all available channels during each transmission. However, the system, consisting of both the transmitter and receiver, must be designed to comply with all of the regulations in this section if the transmitter is presented with a continuous data 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 # of hopping channels specified in this section.
- (h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

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**III - Attestation**

**LABORATORY MEASUREMENTS**

**Pursuant To  
Part 15, Subpart C  
For  
Intentional Radiators**

**Company Name:** Saar Associates, Inc.  
**Address:** 37 Todd Ridge Road  
Titusville, NJ, 08560

**Model:** FHT100

**Date of Test(s):** March 1, 2, 4, 8, April 25, 2002

**Test Site Location:** INTERTEK TESTING SERVICES NA INC.  
70 Codman Hill Road  
Boxborough, MA 01719

**Site:** 3

I attest to the accuracy of this report:

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Signature

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Nicholas Abbondante  
Testing Performed By

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Engineer  
Title

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Signature

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Michael F. Murphy  
Reviewer

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Staff Engineer/EMC  
Title

#### **IV - Site Description and Measurement Equipment**

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

- A. **Test Set-Up:** The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).
1. The test site is a Plastic/Fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule 2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.
  2. Power to the site is nominal line voltage of 117 V<sub>AC</sub> and 230 V<sub>AC</sub>, 60 Hz.
  3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. During the radiated emissions test, the turntable is rotated 360 degrees and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters. Body-worn, hand-held and small portable devices are mounted on a non-conductive box and emissions are investigated on three orthogonal axis.
  4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:  
$$\text{Averaging Factor in dB} = 20 \text{ LOG (duty cycle)}$$

The time period over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 465 Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities. Alternately an average detector can be employed when required.
  5. Antennas used below 1000 MHz were EMCO Model 3142 Biconolog Antennas and Compliance Design Inc. Model A100 tuned Dipole Antennas. For measurements between 1000 MHz and 18000 MHz above 1 GHz, an EMCO Model: 3115 Horn Antenna is used. The Antennas used are listed in the Test Equipment Summary in Section 6.

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6. The field strength measuring equipment used included:

Description	Manufacturer	Model	Serial #	Cal Due
Spectrum Analyzer	Agilent	E7405A	US40240205	11/02/2002
Super High Frequency Cable	Sucoflex	104PE	0555/4PEA	03/29/2003
Attenuator, 20 dB	Mini Circuits	20dB, 50 ohm	DS22A	08/14/2002
LISN 50uH .01-50MHz 24A	Solar Electronics	9252-50-R-24-BNC	955107	03/26/2002
Cable, BNC/BNC	Alpha	RG58B/U	CBL10MS3	08/24/2002
RF Filter	Hewlett Packard	85420E	3427A00177	01/24/2003
Receiver Set w/RF Filter	Hewlett Packard	85422E	3520A00188	01/24/2003
Horn Antenna	EMCO	3115	9602-4675	5/29/2002
Horn Antenna	EMCO	3115	9512-4632	10/09/2002
Preamplifier	MITEQ	NSP4000-NF	507145	9/22/2002
Antenna	EMCO	3142	9711-1224	11/14/2002

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 450 kHz to 30 MHz.
8. The EUT is warmed up for 15 minutes prior to the test. If battery powered, a new battery is used.
9. Conducted measurements were made as described in ANSI C63.4 (1992). An IF bandwidth of 9 kHz is used, and peak or quasi-peak detection is employed.
10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. Above 1000 MHz, a bandwidth of 1 MHz is generally used.
11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.
12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

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### V – Summary of Equipment Under Test

- |    |   |  |
|----|---|--|
| 1  | <b>Manufacturer:</b>  | Pro Circuits, Inc.<br>2059 Springdale Road Suite B<br>Cherry Hill, NJ, 08003           |
|    |   |  |
| 2  | <b>Grantee:</b>   | Saar Associates, Inc.<br>37 Todd Ridge Road<br>Titusville, NJ, 08560<br>(609) 818-0860 |
|    |   |  |
| 3  | <b>Trade Name:</b>  | Contact: David Saar<br>Frequency Hopping Spread<br>Spectrum Transceiver                |
| 4  | <b>Model No.:</b>   | FHT100   |
| 5  | <b>Serial No.:</b>  | Proto1   |
| 6  | <b>Intended FCC ID</b> (with preceding 3-character grantee code): | OV6FHT100  |
| 7  | <b>Date of Test:</b>  | March 1, 2, 4, 8, April 25, 2002   |
| 8  | <b>Frequencies to which device can be tuned:</b>                  | 920 – 924 MHz  |
| 9  | <b>Can customer tune device?</b>                                  | No   |
| 10 | <b>Applicable emissions limits:</b>                               | 15.205, 15.207, 15.209, 15.247   |
| 11 | <b>Antenna Information:</b>                                       | Radiall/Larsen 2.14 dB gain<br>Center-Fed Half-wave Dipole<br>Model: SPDA20918         |

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### VI - Configuration Information

**Equipment Under Test:** Frequency Hopping Spread Spectrum Transceiver  
**Model:** FHT100  
**Serial No.:** Proto1  
**FCC Identifier:** None assigned as of this report; intended FCC ID is OV6FHT100

### Support Equipment:

None, the EUT was operated in a standalone configuration.

### Cables:

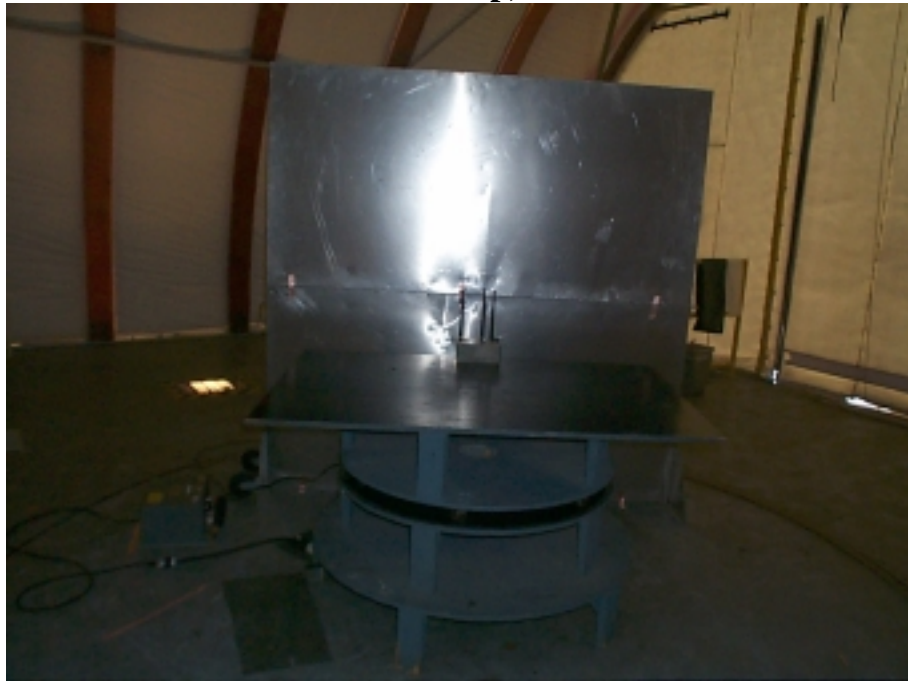
QTY	Description	Shield Description	Hood Description	Length (m)
1	AC Mains	None	Plastic	1

**VII - Configuration Photographs**

**Radiated Emissions Test Setup, Front and Back**



**Line Conducted Emissions Test Setup, Front and Back**





### **VIII - Sample Calculation**

The following is how net field strength readings were determined:

$$NF = RF + AF + CF + PF + DF$$

Where,

NF = Net Reading in dB $\mu$ V/m

RF = Reading from receiver in dB $\mu$ V

AF = Antenna Correction Factor in dB(1/m)

CF = Cable Correction Factor in dB

AVF = Duty Cycle Correction Factor in dB

DF = Distance Factor in dB (using 20 dB/decade), from 3 to 1 meters 10.5 dB was added for measurements performed at 1 meter

To convert from dB $\mu$ V/m to  $\mu$ V/m or mV/m the following was used:

$$UF = 10^{(NF / 20)}$$

Where,

UF = Net Reading in  $\mu$ V/m

#### **Example:**

For the fundamental field strength measurement at 8.4 (distance = 3 meters) see table [1].

$$NF = NF = RF + AF + CF + AVF + DF = 62.9 + 13.7 + 2.1 + (-10.0) + 0.0 = 68.7 \text{ dB}\mu\text{V/m}$$

$$UF = 10^{(68.7 \text{ dB}\mu\text{V} / 20)} = 2722.7 \mu\text{V/m}$$

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## IX - Data Tables

### Radiated Emissions/ Interference

Table: 1

Company: Saar Associates, Inc.	Tested by: Nicholas Abbondante	
Model #: FHT100	Serial #: Proto1	Location: EMI Site 3
Project #: 3020061	Pressure: N/A	Detector: HP 8542E
Date: 03/02/02 04/25/02	Temp: 17.1-17.6C	Antenna: LOG3, HORN2, HORN1
Standard: FCC Part 15.247	Humidity: 28-45%	PreAmp: None
Class: None	Group: None	Cable(s): 3C, 3M Prime
Notes: Unmodified	Distance: 3	meters

OBLSHF103, 201, 203

Abbreviations: rb - narrowband, bb - broadband, pk - peak measurement

Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
V	118.100	11.5	6.8	0.8	0.0	0.0	19.1	43.5	-24.4 *
V	238.600	47.9	12.0	2.1	0.0	0.0	62.0	96.0	-34.0
H	287.500	48.8	13.3	2.4	0.0	0.0	64.5	96.0	-31.5
H	293.600	37.4	13.4	2.4	0.0	0.0	53.2	96.0	-42.8
H	345.000	42.1	15.8	2.7	0.0	0.0	60.6	96.0	-35.4
H	358.500	33.9	16.4	2.8	0.0	0.0	53.1	96.0	-42.9
V	476.700	16.0	18.1	3.3	0.0	0.0	37.4	96.0	-58.6
V	631.300	30.0	21.3	3.7	0.0	0.0	55.0	96.0	-41.0
V	681.300	43.1	22.0	3.9	0.0	0.0	69.0	96.0	-27.0
V	800.800	56.6	22.7	4.2	0.0	0.0	83.5	96.0	-12.5
V	867.900	20.7	24.1	4.5	0.0	0.0	49.4	96.0	-46.6
V	895.900	29.1	24.5	4.6	0.0	0.0	58.2	96.0	-37.8
High Frequency									
V	1039.000	24.5	26.6	2.7	0.0	0.0	53.8	54.0	-0.2 *
V	1044.000	19.0	26.6	2.7	0.0	0.0	48.3	54.0	-5.7 *
V	1840.000	15.6	28.5	3.7	0.0	0.0	47.8	54.0	-6.2 *
V	1848.000	19.7	28.6	3.7	0.0	0.0	52.0	54.0	-2.0 *
V	2760.000	15.7	31.1	4.6	0.0	0.0	51.4	54.0	-2.6 *
V	2772.000	15.6	31.2	4.6	0.0	0.0	51.4	54.0	-2.6 *
V	3680.000	13.6	33.9	5.1	0.0	0.0	52.5	54.0	-1.5 *
V	3696.000	13.7	33.9	5.1	0.0	0.0	52.7	54.0	-1.3 *
Fundamental Field Strength									
V	920.500	86.6	24.7	4.7	0.0	0.0	116.0	N/A	N/A
V	924.000	86.6	24.7	4.7	0.0	0.0	116.0	N/A	N/A

\* - Data taken after modification

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## Intertek Testing Services NA, Inc.

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### Conducted Emissions / Interference

Table: 2

Company: Saar Associates, Inc.      Tested by: Nicholas Abbondante  
Model #: FHT100      Serial #:      Proto1      Location: EMI Site 3  
Project #: 3020061      Pressure: N/A      Detector: HP 8542E  
Date: 03/04/02      Temp: 16.3C      Cable: CBL10MS3\_AUG01.cab  
Standard: FCC Part 15.207      Humidity: 20%      LISN 1, 2: LISN13[1] ; LISN13[2] 3-26-01.lsn  
Class: None      Group: None      LISN 3, N: None      None  
Preamp: None      Attenuator: 20 dB  
Net: LISN+Cable+Attenuation+Reading-Preamp

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Quasi-Peak		
					Net dB(uV)	Limit dB(uV)	Margin dB
0.450	7.9	7.2			28.9	48.0	-19.1
0.678	6.9	7.3			28.3	48.0	-19.7
1.060	7.3	7.1			27.8	48.0	-20.2
9.370	6.7	6.7			27.3	48.0	-20.7
21.460	3.6	-2.9			24.5	48.0	-23.5
27.130	-3.6	-7.0			20.7	48.0	-27.3

**X - Duty Cycle (Average Factor)**

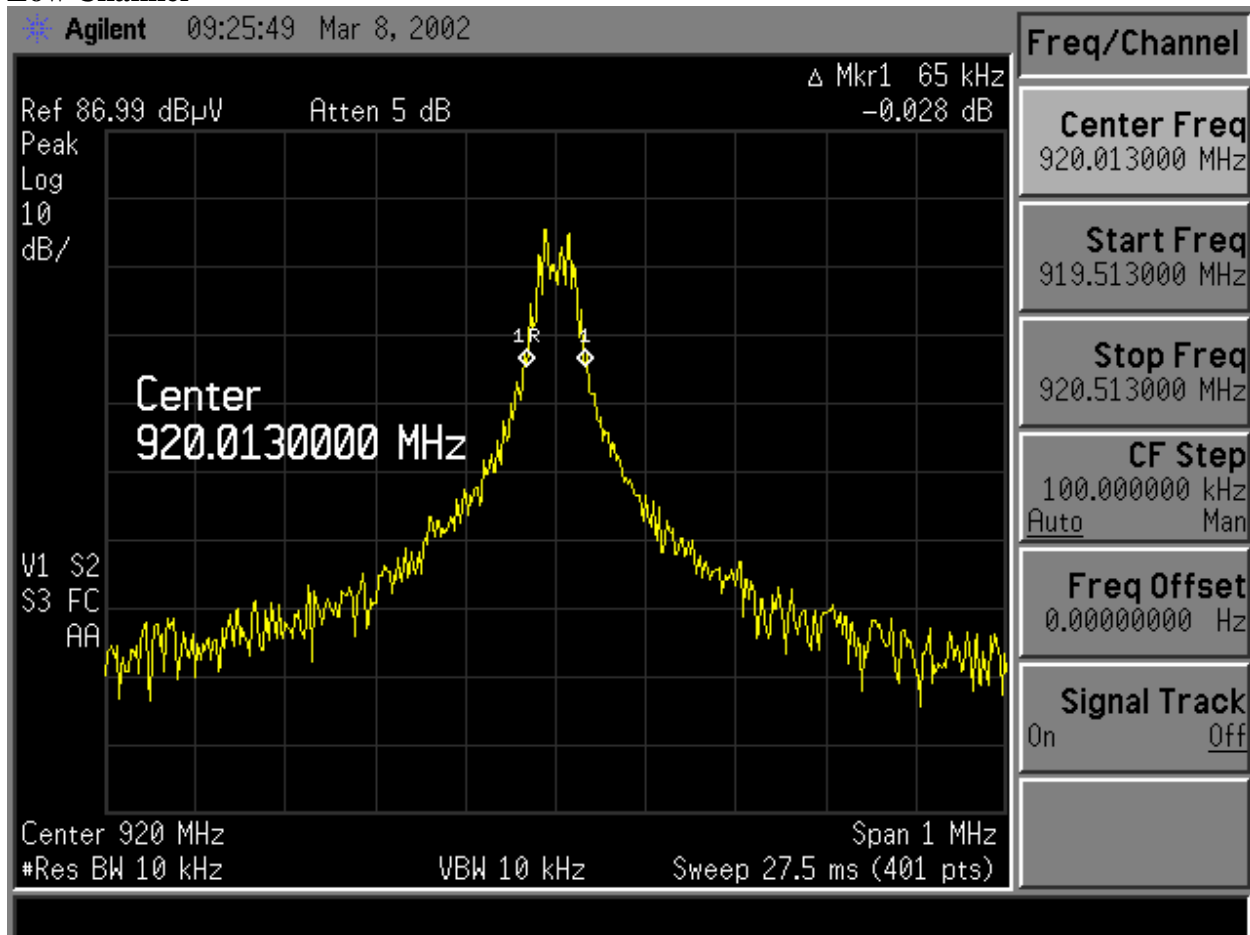
The average factor is subtracted from peak readings to compare emissions readings to average limits. The average factor is calculated from duty cycle measurements from the following plots. The average factor is  $20 \log (\text{ON-TIME} / \text{PERIOD})$  of the emission. If the period is longer than 100 milliseconds then 100 milliseconds is used for the period. Average factor is determined using the worst-case duty cycle. Note that a duty cycle was not determined for this device.

**XI – RF Output Power, Channel Bandwidth, Channel Separation, Number of Hopping Frequencies, Average Channel Dwell Time**

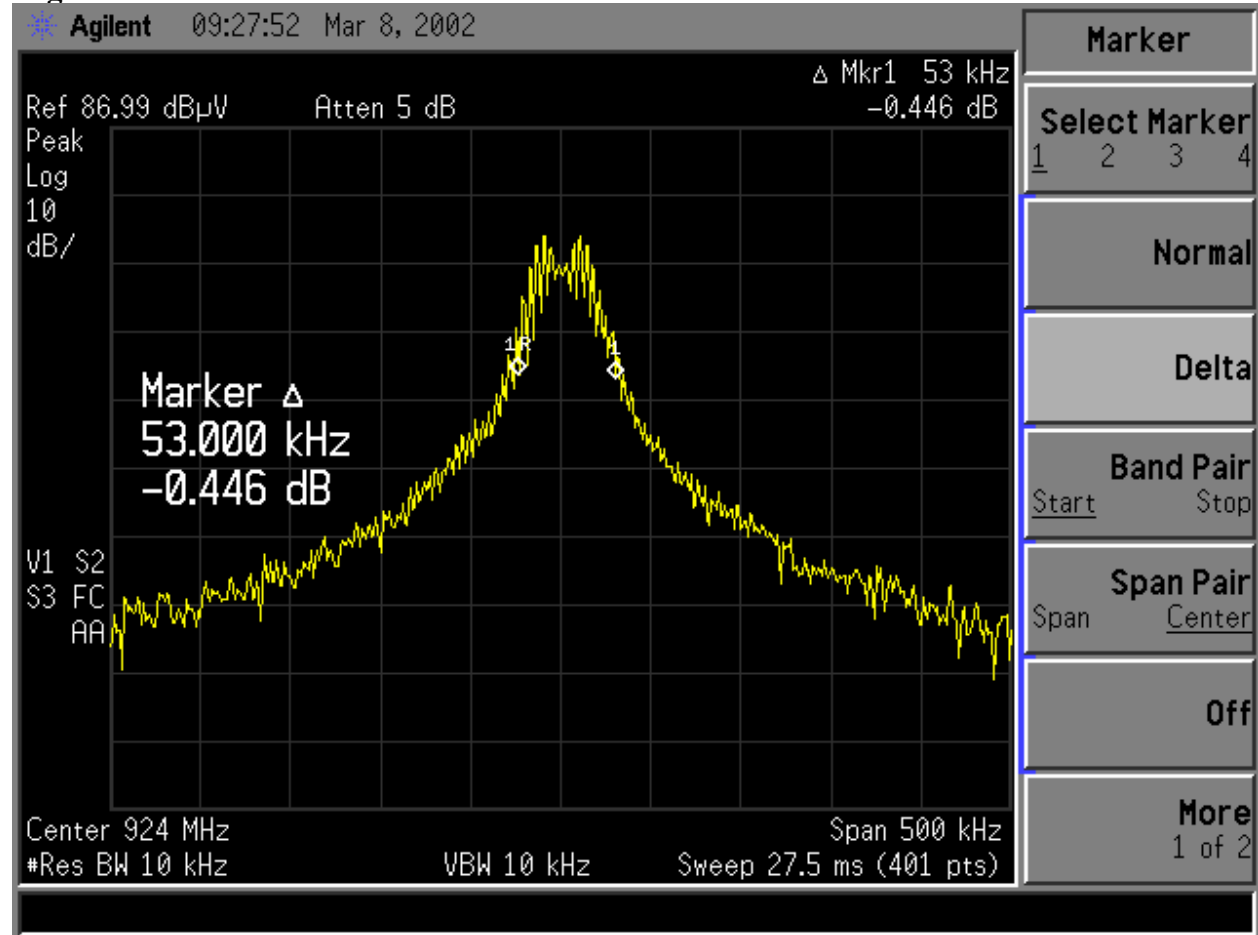
**Bandwidth**

15.247 requires that the bandwidth, measured at points 20 dB down from the carrier peak, does not exceed 500 kHz. The EUT was set to transmit continuously at the low and high end of its passband, and the bandwidth was measured 20 dB down from the peak using the marker delta function. The following results were obtained.

**Low Channel**



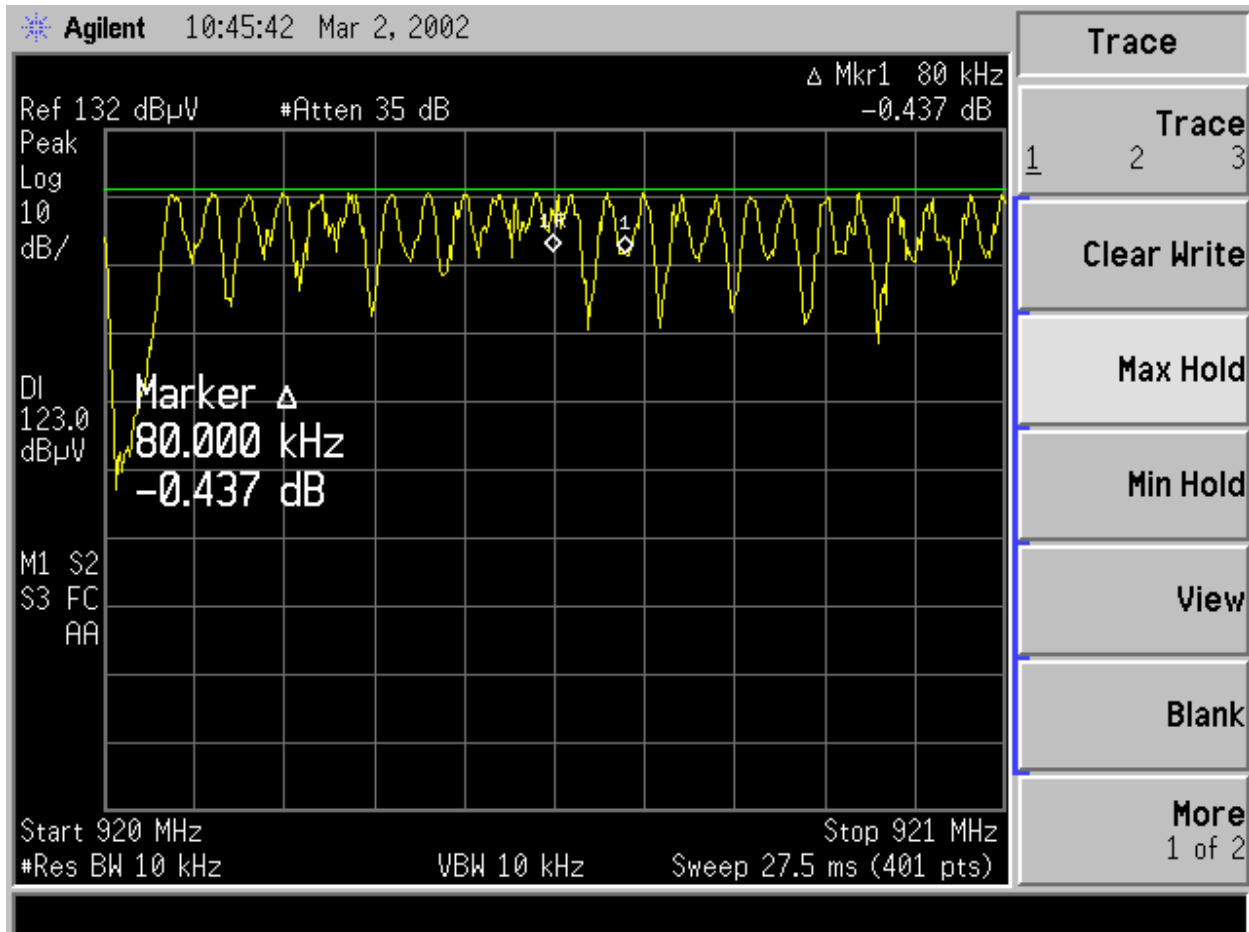
# High Channel



Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)
Low	920	65	500
High	924	53	500

### Channel Separation

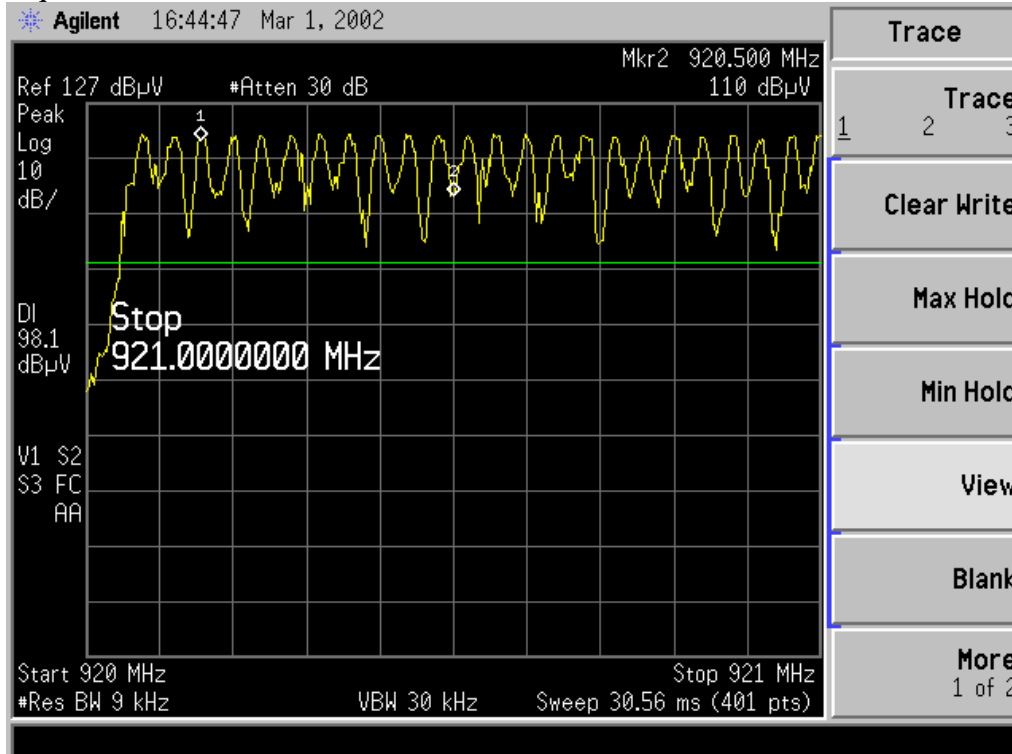
15.247 requires that the channels of a frequency hopping system be separated by at least 25 kHz, or the 20 dB bandwidth, whichever is greater. The largest 20 dB bandwidth is 65 kHz, there the channels must be separated by at least 65 kHz. A measurement was made directly from the antenna port using a max hold function on the analyzer while the EUT was set to hop. The following results were obtained.



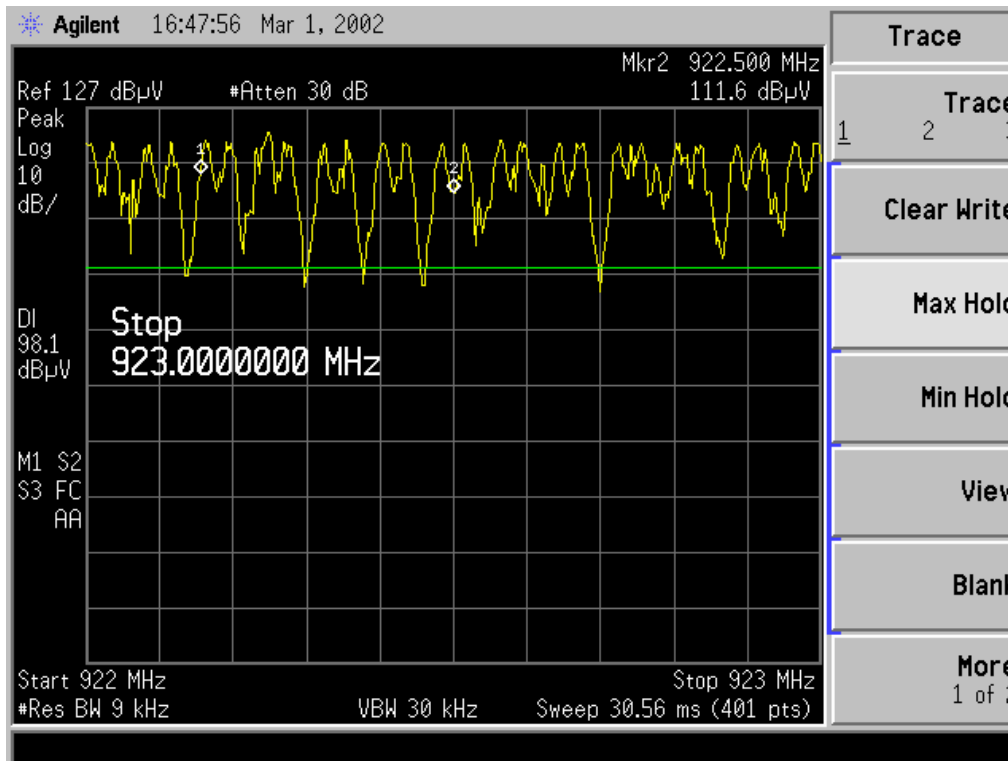
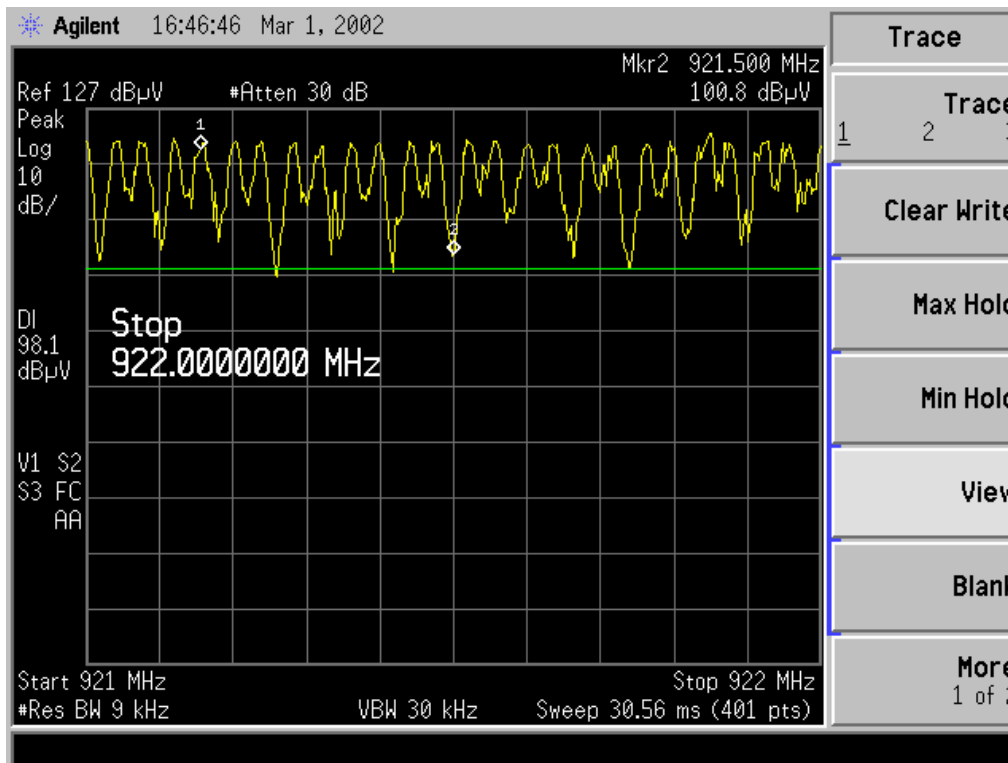
The channel separation was 80 kHz, which is larger than 65 kHz. The EUT meets the requirements.

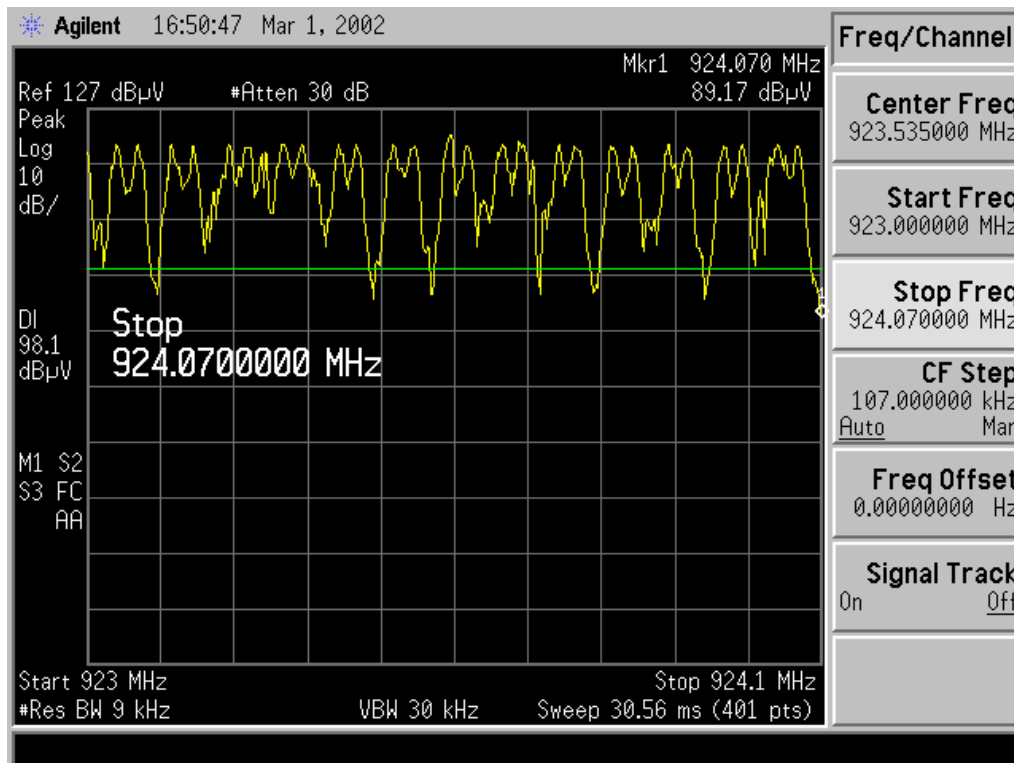
## Number of Hopping Channels

The requirements of 15.247 state that any frequency hopping system that has 20 dB bandwidth less than 250 kHz must employ at least 50 hopping channels. The EUT was set to hop and radiated measurements were made of the number of hopping channels by using a max hold function and counting the channels. 50 channels were found, therefore the EUT meets the requirements.





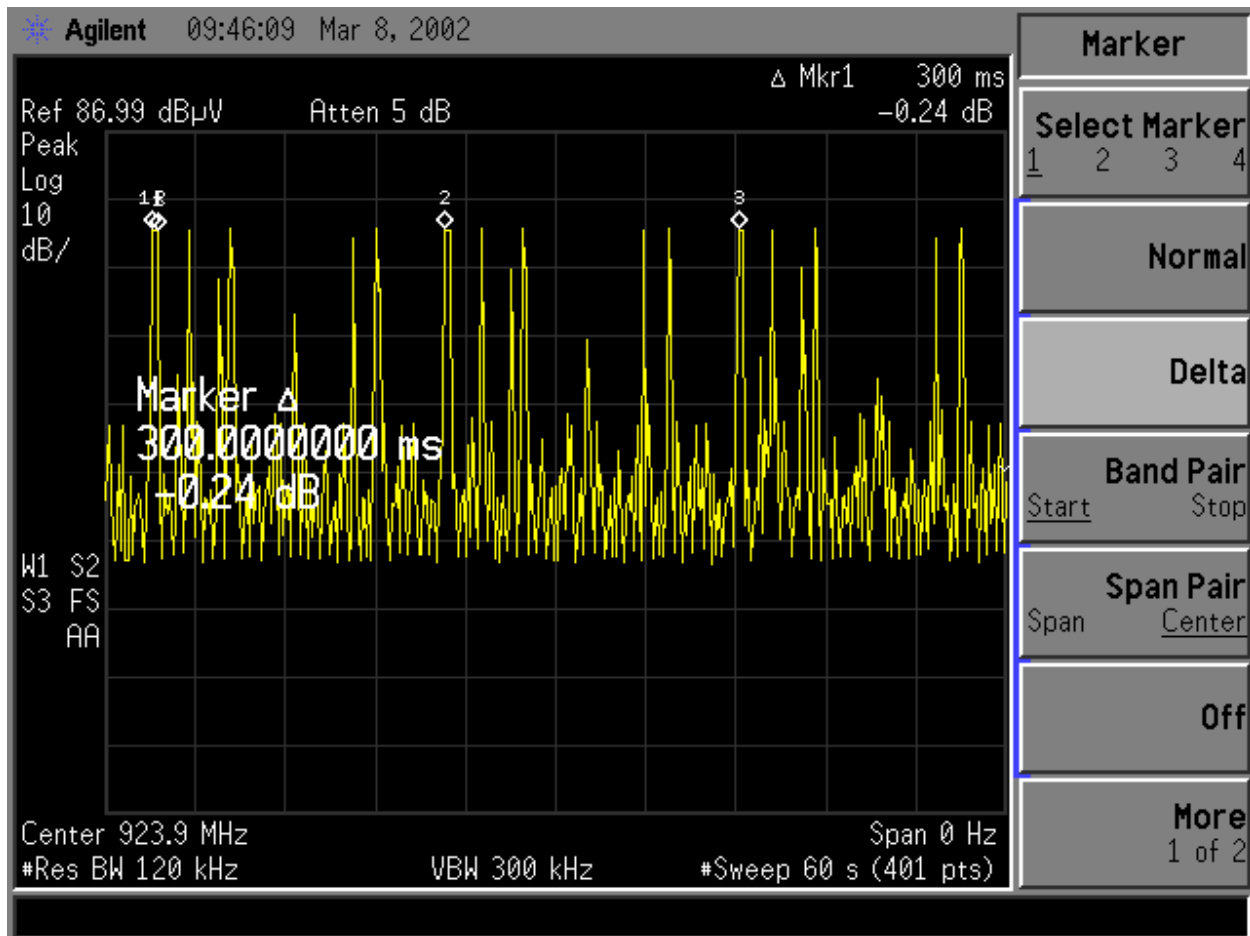




## Dwell Time

15.247 requires that frequency hopping systems that have a 20 dB bandwidth of less than 250 kHz have an average time of occupancy not exceeding 0.4 seconds in any 20 second time frame.

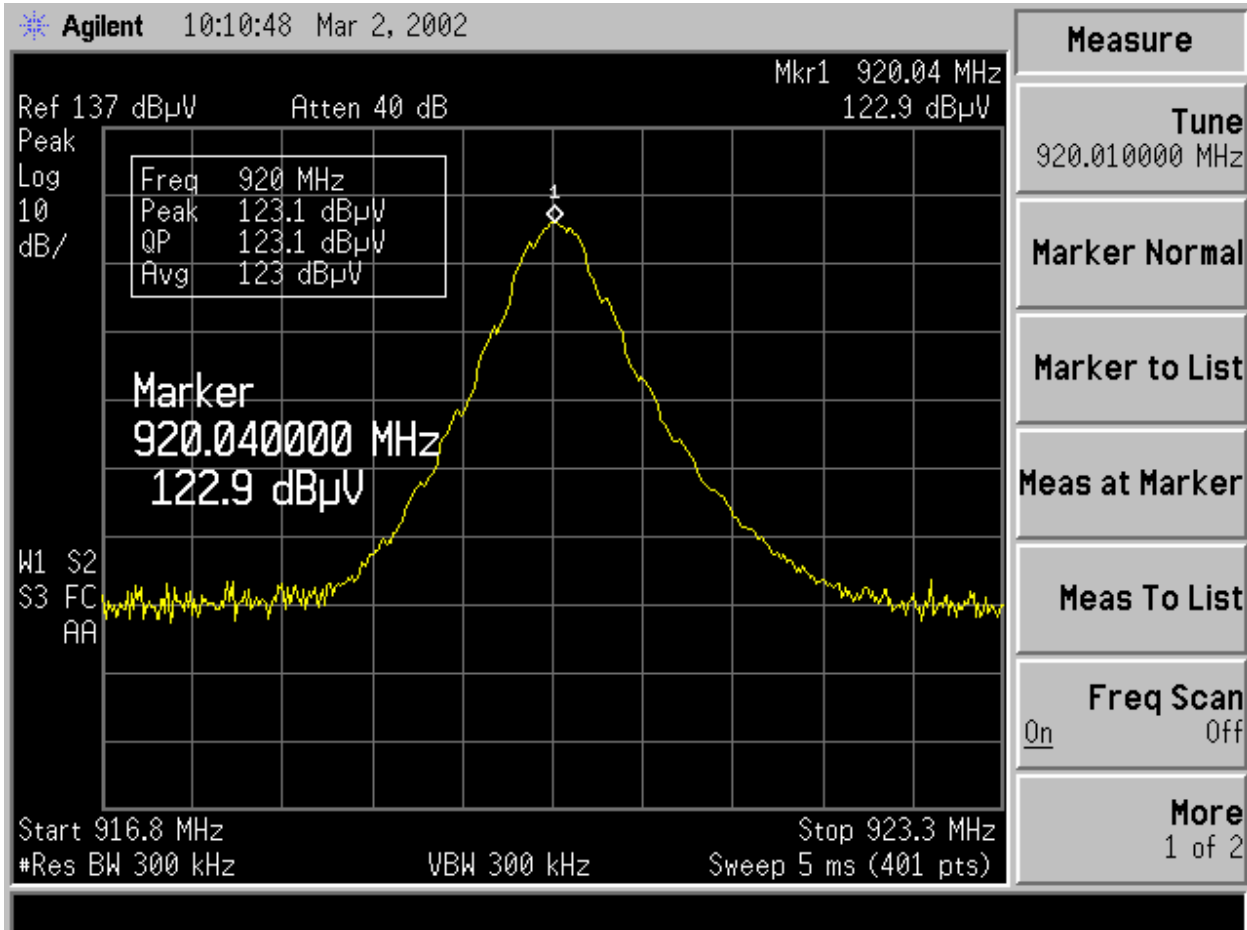
A hopping channel was selected at random, the EUT was set into normal hopping mode, and a zero span time domain plot was made of the activity in that channel. Adjacent channels hops were evident, but only 3 actual hops in the channel were observed over a 60 second time frame. Each hop was 300 ms in duration. This works out to 900 ms over 60 seconds, or 300 ms over 20 seconds, which is within the limits.



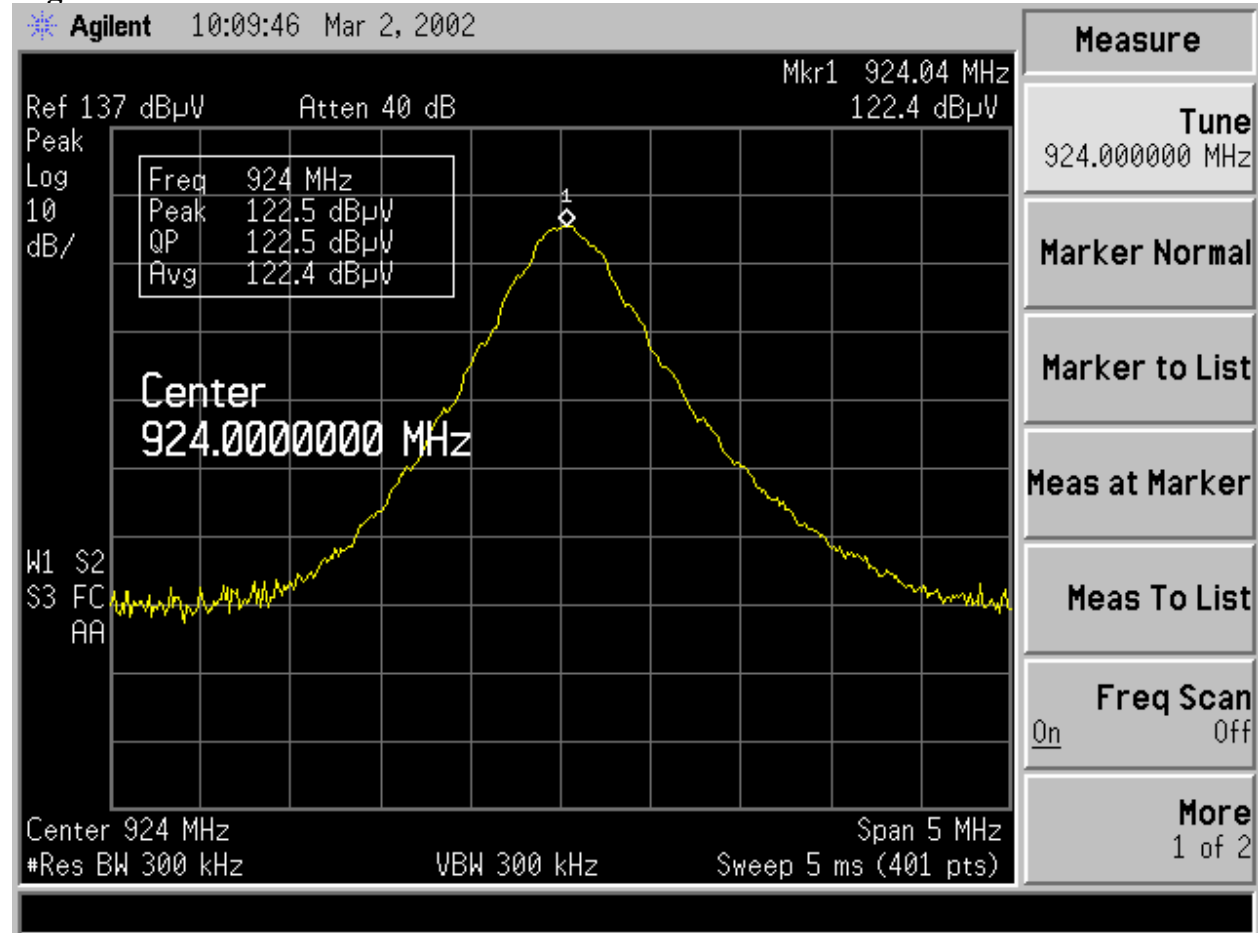
## RF Output Power

15.247 says that frequency hopping transmitters in the 902-928 MHz band employing 50 or more hopping channels must not exceed an RF output power at the antenna port of 1 watt (30 dBm). The EUT was connected directly to a spectrum analyzer and plots were made of the RF output power at the low and high ends of the passband. The EUT met the requirements.

### Low Channel



**High Channel**



Channel	Frequency (MHz)	Power (dBuV)	Power (dBm)	Limit (dBm)
Low	920	123.1	16.1	30
High	924	122.5	15.5	30