

# **EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER**

## **I. GENERAL INFORMATION**

Requirement: Federal Communications Commissions

Test Requirements: 15.205, 15.207, 15.209, 15.247

Applicant: Alvarion Ltd.  
Atidim Technological Park, Bldg. #1  
P.O, Box 13139  
Tel Aviv 61131 Israel

Product ID: **FCC ID: LKT-DS58**

## **II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)**

The Breezenet DS.5800 is a direct sequence spread spectrum transceiver, operating in the 5725 - 5850 MHz Part 15 ISM band

Operation is per IEEE 802.11b.

Output power : 12 dBm, 15 dBm, 18 dBm, 21 dBm, or 24 dBm (software controlled).

Lowest channel: Channel 1 ( 5740 MHz )

Highest channel: Channel 14 ( 5812 MHz )

Four modulation rates are available:

1 Mbps: DBPSK

2 Mbps: DQPSK

5.5 and 11 Mbps: CCK

## **III. TEST LOCATION**

All emissions tests were performed at:

Compliance Certification Services  
571F Monterey Road  
Morgan Hill, CA 95037

T.N. Cokenias  
EMC Consultant/Agent for Alvarion

10 March 2002

## TEST PROCEDURES

### Radiated Emissions

Test Requirement: 15.109, 15.205, 15.209, 15.247

### Measurement Equipment Used:

Type of Equipment	Manufacture	Model
Spectrum Analyzer	HP	8566B
Spectrum Display	HP	85662A
Quasi-Peak Detector	HP	85650A
Pre-Amplifier (10k-1.3GHz)	HP	8447D
Pre-Amplifier (1-26.5GHz)	MITEQ	NSP2600-44
Bilog Antenna 30 - 1000 MHz	CHASE	CBL6112
Horn Antenna (1-18GHz)	EMCO	3115
Horn Antenna (18-26.5GHz)	ARA	MWH-1826/B
Horn Antenna (26.5-40GHz)	DICO	1149
Harmonic Mixer (18-26.5GHz)	HP	11970K
Harmonic Mixer (26.5-40GHz)	HP	11970A
HPF (1.8GHz)	FSY	HP 1800-9SS
HPF (7.6GHz)	FSY	HP 7600-9SS

### Test Procedures, 1- 22 GHz:

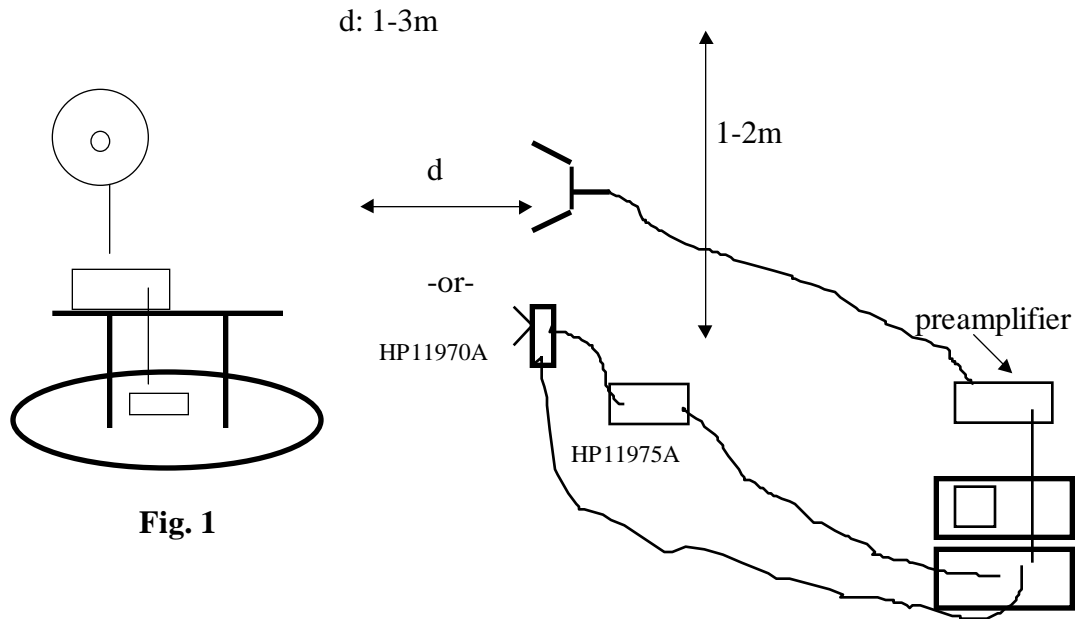
1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.
2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.
3. Radiated emissions were investigated for a LOW channel, a MID channel, and HIGH channel. Emissions were investigated to the 10<sup>th</sup> harmonic.

- Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Procedures, 22 - 40 GHz:**

- The EUT was moved to within 1 m of the appropriate external mixer antenna used for the frequency band being investigated.
- The external mixer antenna was raised and lowered in horizontal and vertical polarity along each face of the EUT and the EUT antenna.
- Maximum reading obtained in (5) and (6) was recorded on the spread sheet

**Radiated Test Set-up, 1-40 GHz**



**Fig. 1**

Testing was performed at 3 different frequencies

Channel	Frequency, MHz
Low	5740
Mid	5780
High	5812

Radiated emissions were performed at each frequency 4 different transmitter antennas at maximum input power to antenna.

Antennas tested:

Antenna Type	Gain	Antenna Manufacturer	Model Number
Integral panel (P2P)	21 dBi	Mars Antenna	MA575820V
Omnidirectional(P2MP)	7.5 dBi	RadioWaves	MFB58008
Sector antenna(P2P &(P2MP)	17 dBi	RadioWaves	SEC-5V-90-17
2 ft.Dish (P2P)	29 dBi	RadioWaves	SP2-58NS
	28.5 dBi typ		

**Test Results:** Worst case results are presented. Refer to separate Excel spread sheet files.

NOTE: For radiated emissions that fall on restricted bands per 15.205, emissions limit is 54 dBuV/m at 3 m for emissions above 960 MHz.

Per 15.247(c) all other undesired emissions must be 20 dB below the highest in-band emission when measured in a 100 kHz bandwidth. Conducted measurements are presented for emissions up to 26.5 GHz.

For emissions above 26.5 GHz only radiated emissions were possible due to the operating frequency limitation of the spectrum analyzer. The equivalent field strength for a radiated emission 20 dB below peak emission is calculated below:

24.2 dBm - 20 dB = 4.2 dBm conducted emission maximum.

Assume 0 dBi = 1 numeric (worst case for radiated emission limit) antenna gain , out of band.

Relationship between E, V/m and TX power at 3m separation:

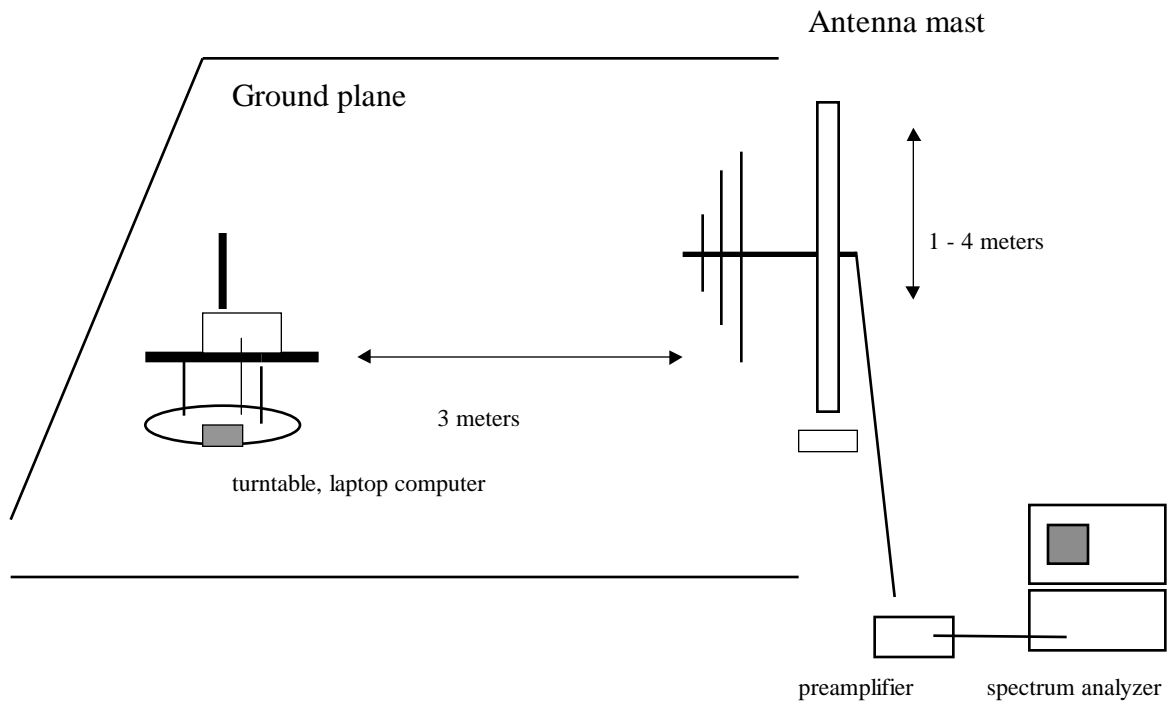
$$E\text{V/m} = (\sqrt{30 \cdot P\text{W} \cdot G})/d \text{ meters}$$

$$4 \text{ dBm} = 2.51 \text{ mW} = .00251 \text{ watts}$$

$$E \text{ V/m at 3 m} = (\sqrt{30 \cdot .00251 \cdot 1})/3 \text{ meters} = .009146 \text{ V/m} = 91,469 \text{ uV/m} = 99,2 \text{ dBuV/m}$$

Radiated emissions test results indicate emissions more than 30 dB below limit for 15.247(c) 20dB out of band requirement.

### **Radiated Test Set-up, 30 - 1000 MHz**



### Test Procedures, 30 -1000 MHz

The EUT was set to RECEIVE/TRANSMIT mode. Radiation emissions from the digital portion of the EUT were measured according to the dictates of ANSI C63.4.

### Test Results

Refer to tabulated data sheet.

**Minimum 6 dB Bandwidth**

**Test Requirement: 15.247(a)2**

**Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer  
6' length low loss coaxial cable

**Test Procedures**

The EUT was configured on a test bench. The EUT was set for continuous operation (TDD function turned OFF) . Frequency was set to 5.740 GHz (LOW channel). While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission occupied bandwidth.

The test was repeated at 5.780 GHz (MID channel) and at 5.812 GHz (HIGH channel).

**Test Results:** Refer to attached spectrum analyzer charts. Data taken with RES BW of 100 kHz shows minimum 6 dB BW of 10.5 MHz. Minimum requirement: 500 kHz

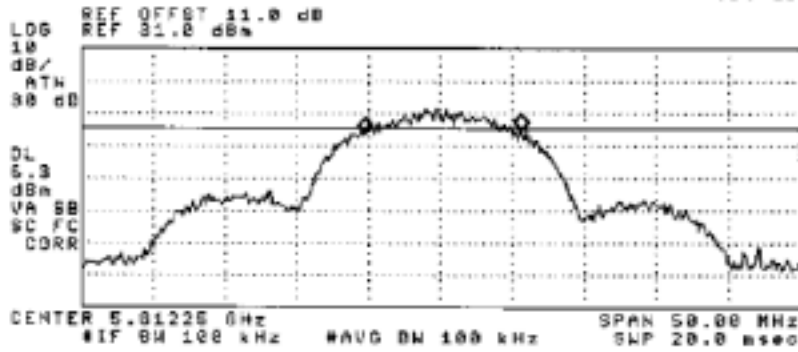
<b>Channel</b>	<b>Frequency, MHz</b>
Low	5740
Mid	5780
High	5812

**NOTE:** 6 dB bandwidth was measured at each modulation, with essentially the same bandwidth resulting. Data is presented for the 11 Mbps modulation setting.

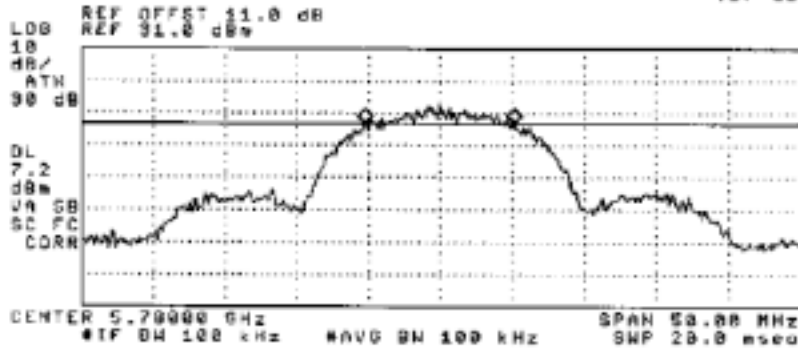
**15.247(a)2: Minimum 6 dB Bandwidth**



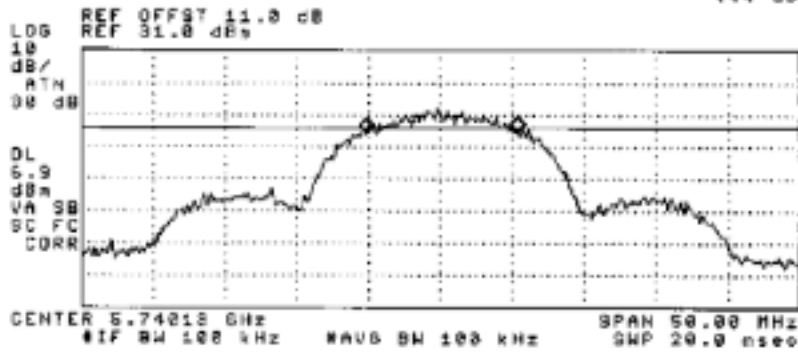
14:35:19 FEB 20, 2002  
 15.247(a)(2) ALUARIOM 5.86Hz DSSS, CH14  
 ACTV DET: PEAK  
 MEAS DET: PEAK OP AVG  
 MKR<sub>1</sub> -10.38 MHz  
 -1.84 dB



14:42:55 FEB 20, 2002  
 15.247(a)(2) ALUARIOM 5.86Hz DSSS, CH9  
 ACTV DET: PEAK  
 MEAS DET: PEAK OP AVG  
 MKR<sub>1</sub> 10.38 MHz  
 -1.17 dB



14:44:35 FEB 20, 2002  
 15.247(a)(2) ALUARIOM 5.86Hz DSSS, CH1  
 ACTV DET: PEAK  
 MEAS DET: PEAK OP AVG  
 MKR<sub>1</sub> 10.58 MHz  
 .44 dB



## **RF Power Output**

**Test Requirement:** 15.247(b)

### **Measurement Equipment Used:**

Gigatronics Peak Power Meter model 8651A cal 01/02/2002

Gigatronics Peak Power Sensor model 80701A cal 01/02/2002

### **Test Procedures**

1. The EUT was configured on a test bench. The power meter was zeroed and calibrated.

The control software was activated and power was set to produce highest output level.

2. The process in (1) was repeated for MID channel and HIGH channel.

### **Test Results**

Power level readings converted to dBm are shown below. Refer also to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

<b>Channel</b>	<b>Frequency, MHz</b>	<b>Output Power, dBm</b>	<b>Limit, dBm</b>
1 LOW	5740	24.2	30.0
9 MID	5780	24.0	30.0
14 HIGH	5812	24.2	30.0

Maximum output power output variation within 0.2 dBm of design maximum 24 dBm output.

**NOTE:** Data is presented for the 11 Mbps modulation setting. Maximum power output is independent of modulation type

**Spurious Emissions, Conducted**  
**Test Requirement: 15.247(c)**

**Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer  
2 ft length low loss A coaxial RF cable

**Test Procedure**

1. The EUT was configured on a test bench. The cable was connected between the EUT antenna port and the spectrum analyzer input port.

Spectrum analyzer RES BW was set to 100 kHz. The EUT's TDD function was stopped, transmission was continuous at the LOW channel. While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission.

Readings were taken out to 10fo.

2. The process in (1) was repeated for MID channel and HIGH channel.

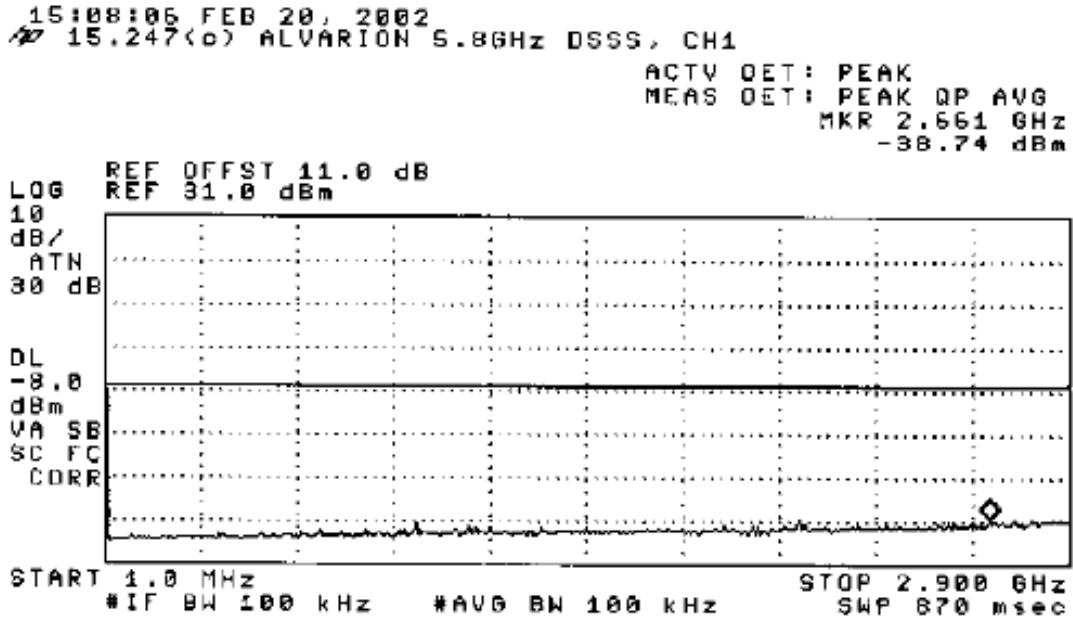
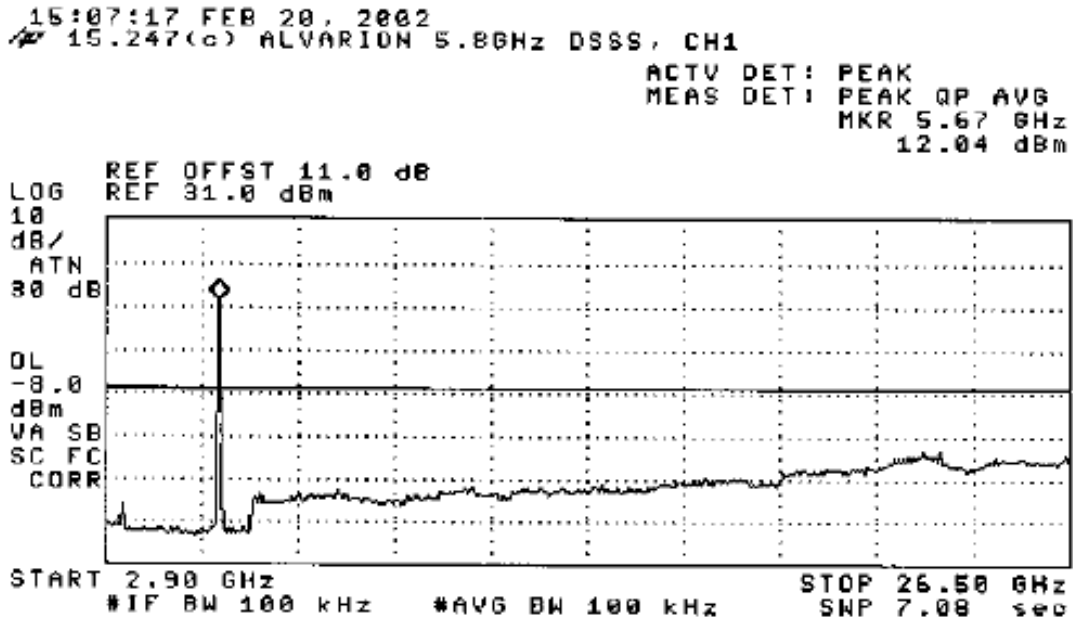
**Test Results**

Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

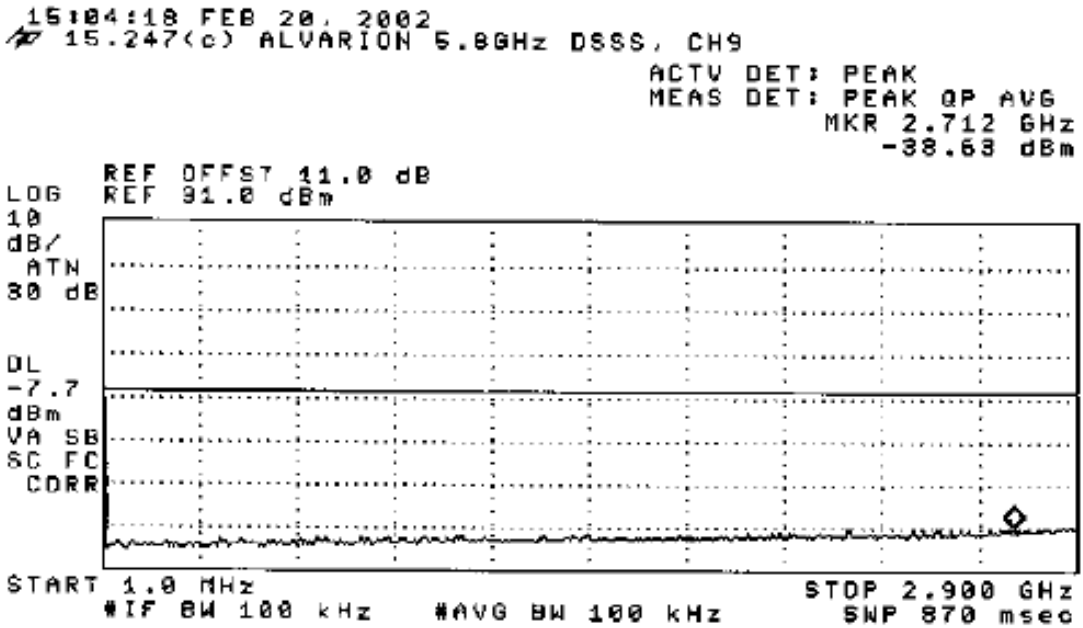
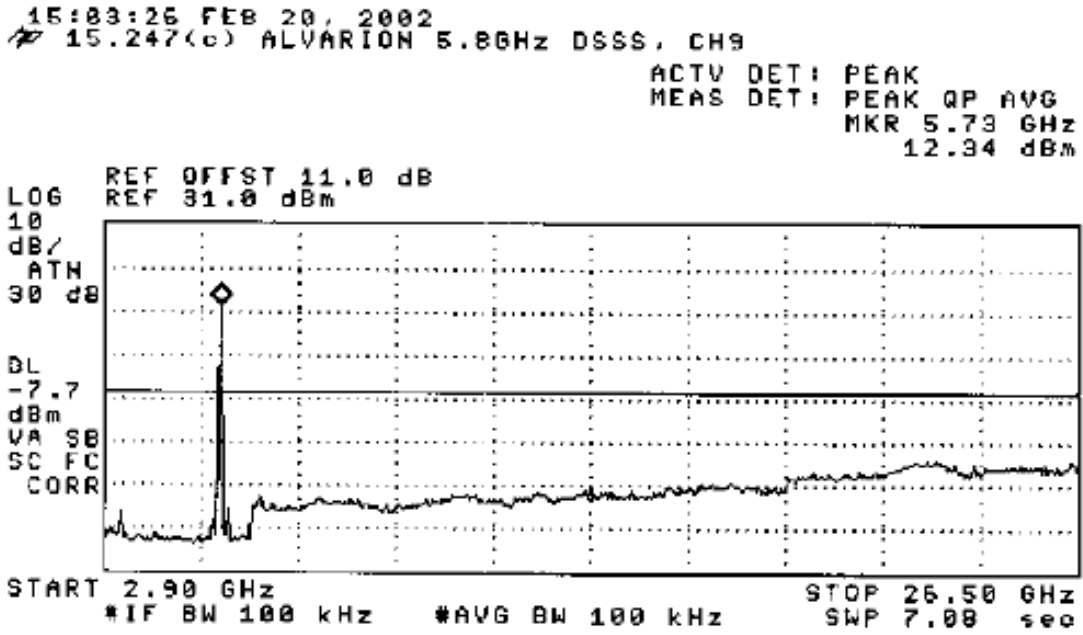
<b>Channel</b>	<b>Frequency, MHz</b>
1 LOW	5740
9 MID	5780
14 HIGH	5812

**NOTE:** Data is presented for the 11 Mbps modulation setting.

15.247(c): Spurious Emissions, Conducted, LOW Channel



15.247(c): Spurious Emissions, Conducted, MID Channel

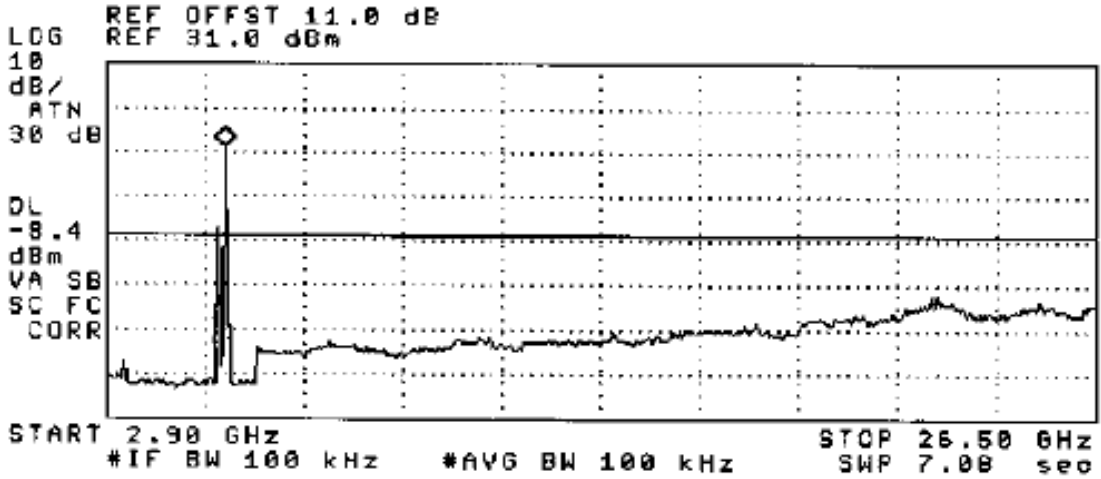


15.247(c): Spurious Emissions, Conducted, HIGH Channel

14:59:23 FEB 20, 2002

15.247(c) ALVARION 5.8GHz DSSS, CH14

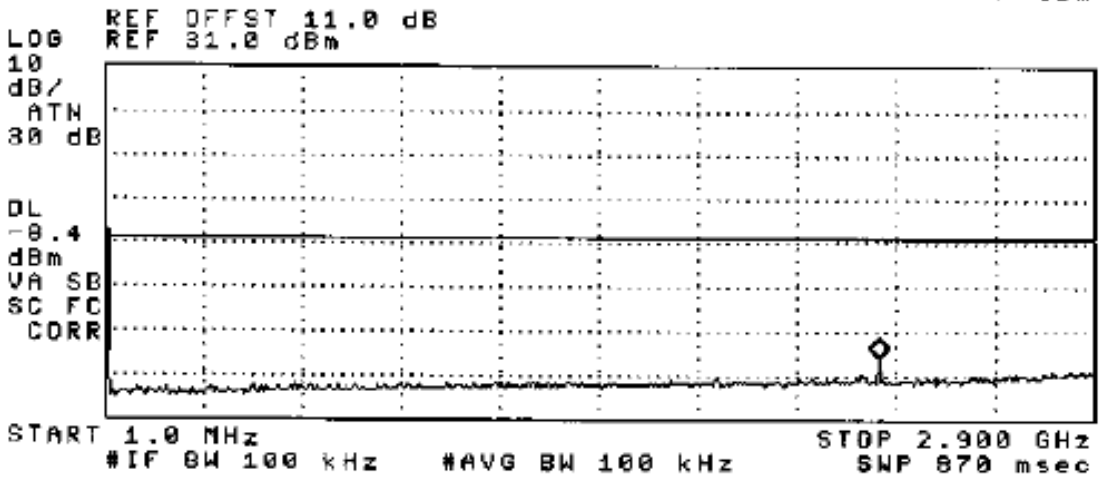
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 5.73 GHz  
11.59 dBm



15:00:28 FEB 20, 2002

15.247(c) ALVARION 5.8GHz DSSS, CH14

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.259 GHz  
-35.12 dBm



## **Power Spectral Density**

**Test Requirement: 15.247(d)**

### **Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer  
2 ft length low loss A coaxial RF cable

### **Test Procedure**

For the LOW channel, the emission peak was set to the center of the display. The SPAN was set to 300 kHz, the RES BW and VID BW were set to 3 kHz, and SWEEP TIME was set to 100 seconds. The maximum trace was recorded and compared to the 8 dBm limit.

The test was repeated for MID and HIGH channel.

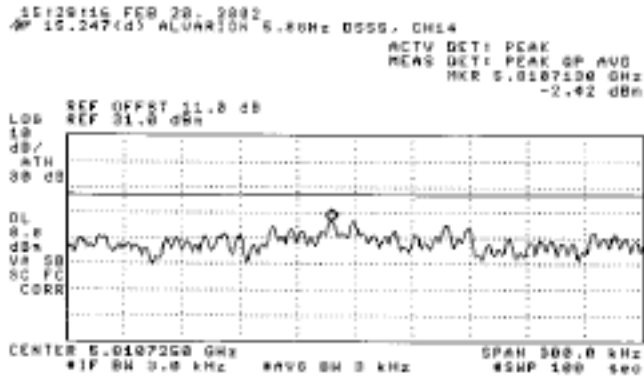
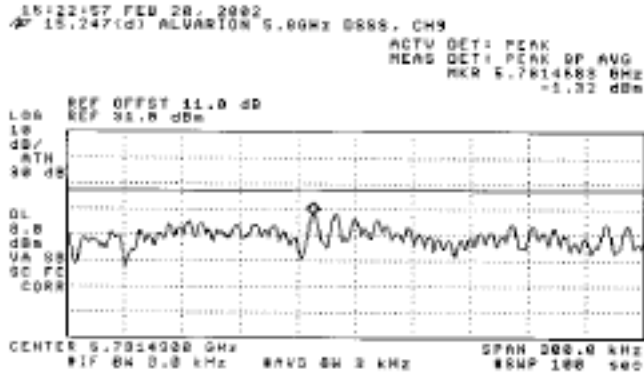
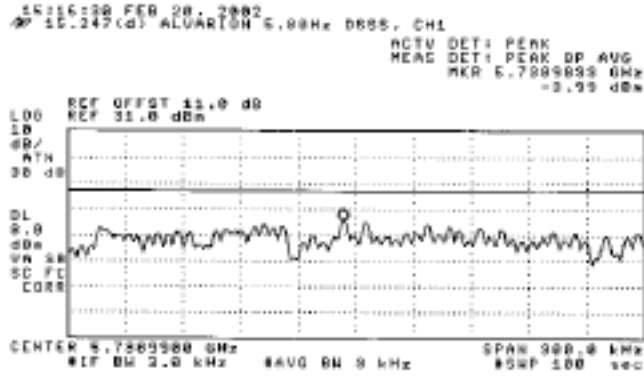
### **Test Results**

Maximum measured PSD was approximately -1.3 dBm. Refer to attached spectrum analyzer charts.

<b>Channel</b>	<b>Frequency, MHz</b>
1 (Low)	5740
9 (Mid)	5780
14 (High)	5812

**NOTE:** Data is presented for the 11 Mbps modulation setting. Readings essentially identical for all four modulation types, 11 Mbps appearing to be worst case.

### 15.247(d): Power Spectral Density





**Processing Gain**

**Test Requirement: 15.247(e)**

Processing gain test set-up, method, and final results are attached. Data is submitted in a separate Excel spreadsheet document.