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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C (15.247) FHSS Specifications and Industry Canada RSS 210 Issue 5 for an Intentional Radiator on the Alien Technology Model: ALR9800

FCC ID:	P65ALR9800
UPN:	4370A-ALR9800
GRANTEE:	Alien Technology 18220 Butterfield Blvd. Morgan Hill, CA 95037
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	July 27, 2005
FINAL TEST DATE:	July 22, 2005

AUTHORIZED SIGNATORY: _____

Juan Martinez
Senior EMC Engineer

ACCREDITED
2016-01

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SCOPE

An electromagnetic emissions test has been performed on the Alien Technology model ALR9800 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators and RSS-210 Issue 5 for licence-exempt low power devices. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4:2003 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Alien Technology model ALR9800 and therefore apply only to the tested sample. The sample was selected and prepared by Robert Martin of Alien Technology

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules and RSS-210 Issue 5 for license-exempt low power devices for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units that are subsequently manufactured.

SUMMARY OF RESULTS

Note – remove references in the table below that do not apply to the radio tested

FCC Part 15 Section	RSS 210 Section	Description	Measured Value	Comments	Result
	6.2.2(o)(a)	20dB Bandwidth	205 kHz	The channel spacing shall be greater than the 20dB bandwidth	Complies
	6.2.2(o)(a)	Channel Separation	505kHz		Complies
	6.2.2(o)(a)	Number of Channels	50	**902- 928 MHz**: 50 hopping frequencies: average time of occupancy <0.4 second within a 20 second period.	Complies
	6.2.2(o)(a)	Channel Dwell Time	0.4 seconds per 20 seconds		Complies
	6.2.2(o)(a)	Channel Utilization	All channels are used equally	Refer to Theory of Operations for detailed description of the hopping algorithm	Complies
15.247 (b) (3)	6.2.2(o)(a)	Output Power, 902 – 928 MHz	29.51dBm (**Note 1)** (.893 Watts) EIRP = 3.55 W	Multi-point applications: **902 – 928 MHz** Maximum permitted is 1Watt, with EIRP limited to 4 Watts for a 50-channel system.	Complies
15.247(c)	6.2.2(o)(e1)	Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	All spurious emissions < -20dBc.	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25GHz	52.7 dBuV/m @ 2745.72 MHz (-1.3 dB)	Emissions in restricted bands must meet the radiated emissions limits detailed in 15.207. All others must be < -20dBc	Complies
15.207		AC Conducted Emissions	48.9dBuV @ 0.163 MHz (-6.4dB)		Complies
	6.6	AC Conducted Emissions	37.5dBuV @ 10 MHz (-10.7dB)		Complies
15.247 (b) (5)		RF Exposure Requirements	FCC /IC limits of power density not exceeded provided antenna is located a minimum of 23 cm from persons	Refer to MPE calculation for 23 cm derivation. Refer to User's Guide for installation instructions requiring a 23cm separation	Complies
15.203		RF Connector	Connector is N-Type	Device will be professionally installed	Complies

EIRP calculated using antenna gain of 6dBi for the highest EIRP point-to-multipoint system.

Note 1: Time Microwave LMR 195 cable will be used, which is specified to have 11 dB of attenuation per 100 feet at 900 MHz. For the applicants application they will have 2.2 dB of cable loss. Please refer to data sheet of the cable.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Alien Technology model ALR9800 is a RFID (Radio Frequency Identification) which is designed to read RFID tags. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 120/, 60 Hz, .5 Amps.

The sample was received on July 22, 2005 and tested on July 22, 2005. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	ALR9800	RFID	Prototype	
XPiQ	HUP45-30	Power Adapter	100-45-01	

ENCLOSURE

The EUT enclosure is primarily constructed of aluminum fabricated sheet metal. It measures approximately 20 cm wide by 28 cm deep by 5 cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L	Laptop	74FCDA02	n/a
Dell	AA20031	AC Adapter	9364U	n/a

No remote support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ant 1	Patch antenna	Coax	Shielded	6.1
Ant 2	Patch antenna	Coax	Shielded	6.1
Ethernet	Laptop	CAT 5	Unshielded	3
DC in	AC Adapter	3 wire	Unshielded	1.5

EUT OPERATION DURING TESTING

Program to maximum output power and tested at low, middle, and high channels.

ANTENNA REQUIREMENTS

The EUT antennas are linear polarized patch antennas.
The antennas are not integral to the EUT
The antennas connect to the EUT with non standard reverse polarity TNC connectors, thereby meeting the requirements of FCC 15.203.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 22, 2005 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and peak power sensor are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003 , and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in temrs of Watts, milliwatts or dBm. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30 \text{ P}}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

FCC 15.407 (a)and RSS 210 (o) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Number Of Channels	Output Power
902 – 928	>=50	1 W (30 dBm)
902 – 928	< 50	0.25 W (24 dBm)
2400 – 2483.5	>= 75	1 W (30 dBm)
2400 – 2483.5	>= 75	0.125 W (21 dBm)
5725 – 5850	>=75	1 W (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

RSS 210 (o) AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS

T limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands detailed in Part 15.205 and for all spurious emissions from the receiver are:

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level.

FCC AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.207.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in Industry Canada RSS-210 section 6.6.

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4:2003 , 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 1,000 MHz, 22-Jul-05
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06

Radiated Emissions, 1000 - 12,000 MHz, 22-Jul-05
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	13-Jan-06
Hewlett Packard	High Pass filter, 1.5GHz	P/N 84300-80037 (84125C)	1154	09-Jun-06
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	1242	19-Oct-06
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06

Antenna conducted Emissions, 22-Jul-05
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06

Radiated Emissions, 30 - 1,000 MHz, 26-Jul-05
Engineer: Chris Groat

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	1320	25-Aug-05
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	487	13-May-06
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	780	26-May-06
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	13-Jan-06
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	955	31-Mar-06

Conducted Emissions - AC Power Ports, 26-Jul-05
Engineer: Chris Groat

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	08-Jul-06
Solar Electronics	LISN	8028-50-TS-24-BNC support	904	08-Jul-06
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	11-Feb-06

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T60513 22 Pages

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Emissions Spec:	FCC & 15.247	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Alien Technology

Model

ALR9800

Date of Last Test: 9/12/2005

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Emissions Spec:	FCC & 15.247	Class:	A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a RFID (Radio Frequency Identification) Tag reader which is designed to read RFID tags. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 120/, 60 Hz, .5 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	ALR9800	RFID	prototype	
XPiQ	HUP45-30	Power Adapter	100-45-01	

EUT Antenna

The EUT antennas are linear polarized patch antennas.
The antennas are not integral to the EUT
The antennas connect to the EUT with non standard reverse polarity TNC connectors, thereby meeting the requirements of FCC 15.203.

EUT Enclosure

The EUT enclosure is primarily constructed of aluminum fabricated sheet metal. It measures approximately 20 cm wide by 28 cm deep by 5 cm high.

Modification History

Mod. #	Test	Date	Modification
1	Radiated Emissions	7/26/2005	Cut TP1 & TP3

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Emissions Spec:	FCC & 15.247	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L	Laptop	74FCDA02	n/a
Dell	AA20031	AC Adpater	9364U	n/a

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ant 1	Patch antenna	Coax	Shielded	6.1
Ant 2	Patch antenna	Coax	Shielded	6.1
Ethernet	Laptop	CAT 5	Unshielded	3
DC in	AC Adpater	3 wire	Unshielded	1.5

EUT Radio Operation During Emissions Tests

Program to maximum output power and tested at low, middle, and high channels.

EUT Digital Operation During Emissions Tests

EUT was set to receive mode during Radiated Emissions and set to Transmitt during AC conducted emissions.

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	A

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/26/2005
Test Engineer: Chris Groat
Test Location: SVOATS #2
Config. Used: 1
Config Change: none
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

The test distance and extrapolation factor (if used) are detailed under each run description.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, 30 - 1000MHz, Maximized Emissions	EN55022 A	Pass	37.0dBµV/m (70.8µV/m) @ 199.993MHz (-3.0dB)
3	RE, 1000 - 2000 MHz, Maximized Emissions	FCC A	Pass	No emissions visible above the noise floor

Modifications Made During Testing:

Cut TP1 & TP3 for 400 MHz Reading.

Deviations From The Standard

No deviations were made from the requirements of the standard.

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	A

Run #1: Preliminary Radiated Emissions, 30-1000 MHz

Frequency	Level	Pol	EN55022 A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
199.993	37.0	V	40.0	-3.0	QP	238	1.1	
199.993	36.4	H	40.0	-3.6	QP	238	1.7	
599.999	42.0	V	47.0	-5.0	QP	290	1.0	
599.990	41.0	H	47.0	-6.0	QP	280	3.5	
400.011	34.6	V	47.0	-12.4	QP	150	1.0	
400.011	34.5	H	47.0	-12.5	QP	292	3.5	Note 1:
30.640	26.4	V	40.0	-13.6	QP	157	1.0	
111.618	25.1	V	40.0	-14.9	QP	300	1.5	
30.584	24.0	V	40.0	-16.0	QP	266	1.0	
111.618	21.0	H	40.0	-19.0	QP	149	4.0	
30.584	20.5	H	40.0	-19.5	QP	178	4.0	
30.640	20.1	H	40.0	-19.9	QP	157	3.2	
Note 1:	Cut TP1 & TP3 for 400MHz Reading							
Note 2:	Receive Mode							

Run #2: Maximized Readings From Run #1

Frequency	Level	Pol	EN55022 A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
199.993	37.0	V	40.0	-3.0	QP	238	1.1	
199.993	36.4	H	40.0	-3.6	QP	238	1.7	
599.999	42.0	V	47.0	-5.0	QP	290	1.0	
599.990	41.0	H	47.0	-6.0	QP	280	3.5	
400.011	34.6	V	47.0	-12.4	QP	150	1.0	
400.011	34.5	H	47.0	-12.5	QP	292	3.5	Note 1:
30.640	26.4	V	40.0	-13.6	QP	157	1.0	
111.618	25.1	V	40.0	-14.9	QP	300	1.5	
30.584	24.0	V	40.0	-16.0	QP	266	1.0	
111.618	21.0	H	40.0	-19.0	QP	149	4.0	
30.584	20.5	H	40.0	-19.5	QP	178	4.0	
30.640	20.1	H	40.0	-19.9	QP	157	3.2	
Note 1:	Cut TP 1 & TP 3 for 400 MHz Reading							
Note 2:	Receive Mode							

Run #3: Maximized readings, 1000 - 2000 MHz

No digital emissions visible above the noise floor

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	B

Conducted Emissions - Power Ports

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/26/2005
Test Engineer: Chris Groat
Test Location: SVOATS #2
Config. Used: 1
Config Change: none
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was located above a ground plane, 80 cm from the LISN. A second LISN was used for any local support equipment.

The EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment.

Ambient Conditions:

Temperature: 27 °C
Rel. Humidity: 41 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	EN55022 B	Pass	48.9dBµV @ 0.163MHz (-6.4dB)
2	CE, AC Power,120V/60Hz	RSS-210	Pass	37.5dBuV @ 10 MHz (-10.7dB)

Modifications Made During Testing:

No modifications were made to the EUT during testing

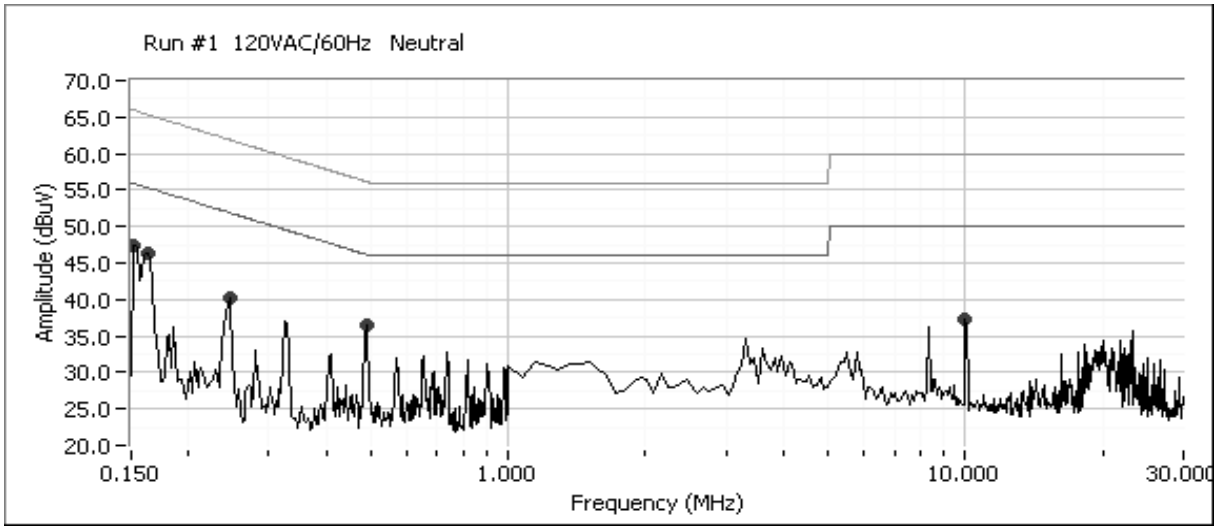
Deviations From The Standard

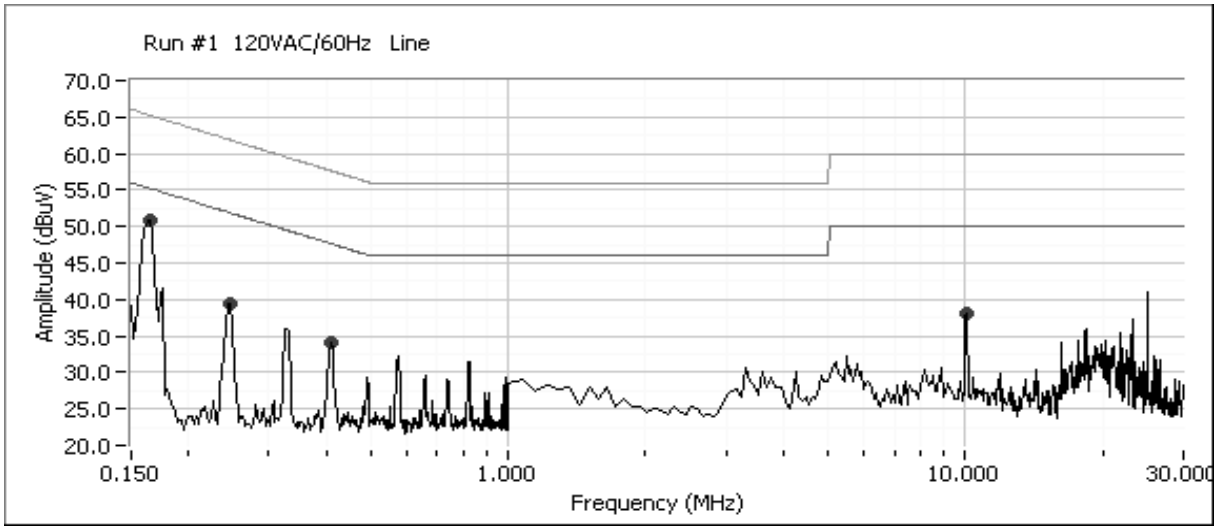
No deviations were made from the requirements of the standard.

EMC Test Data

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

Frequency	Level	AC	EN55022 B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.163	48.9	Line	55.3	-6.4	AVE	
0.163	47.0	Neutral	55.3	-8.3	AVE	
0.244	38.9	Neutral	52.0	-13.1	AVE	
0.488	31.8	Neutral	46.2	-14.4	AVE	
0.244	37.5	Line	52.0	-14.5	AVE	
0.411	32.9	Line	47.6	-14.7	AVE	
0.163	50.1	Line	65.3	-15.2	QP	
10.001	33.8	Neutral	50.0	-16.2	AVE	
10.001	33.3	Line	50.0	-16.7	AVE	
0.163	48.5	Neutral	65.3	-16.8	QP	
0.245	40.2	Neutral	61.9	-21.7	QP	
0.488	33.5	Neutral	56.2	-22.7	QP	
10.001	37.3	Neutral	60.0	-22.7	QP	
10.001	37.2	Line	60.0	-22.8	QP	
0.244	38.1	Line	62.0	-23.9	QP	
0.411	31.6	Line	57.6	-26.0	QP	

Run #2: AC Power Port Conducted Emissions, 0.45 - 30MHz, 120V/60Hz

Frequency	Level	AC	RSS-210		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.488	33.5	Neutral	48.0	-14.5	QP	
10.001	37.3	Neutral	48.0	-10.7	QP	
10.001	37.2	Line	48.0	-10.8	QP	

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

FCC 15.247 FHSS - Power, Bandwidth and Spurious Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/22/2005
Test Engineer: Juan Martinez
Test Location: SVOATS #2
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 24 °C
Rel. Humidity: 54 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1a-1c	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	52.7dBµV/m (433.0µV/m) @ 2745.7MHz (-1.3dB)
1d	Conducted Emissions	FCC 15.247(c)	Pass	All emissions < 20dBc
2	20dB Bandwidth	15.247(a)	Pass	205 kHz
3	Output Power	15.247(b)	Pass	29.5dBm
4	Channel Occupancy / Separation	15.247(a)	Pass	Refer to run
4	Number of Channels	15.247(a)	Pass	50

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1a: Radiated Spurious Emissions, 30 - 10,000 MHz. Low Channel @ 903 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2709.720	46.0	V	54.0	-8.0	AVG	331	1.0	Restricted
3613.085	46.0	V	54.0	-8.0	AVG	333	1.4	Restricted
8129.112	45.6	H	54.0	-8.4	AVG	16	1.0	Restricted
3613.122	43.8	H	54.0	-10.2	AVG	144	1.4	Restricted
8129.100	43.2	V	54.0	-10.8	AVG	308	1.0	Restricted
5419.460	41.3	H	54.0	-12.8	AVG	291	1.7	Restricted
2709.688	40.8	H	54.0	-13.2	AVG	230	0.0	Restricted
4516.210	40.5	H	54.0	-13.5	AVG	241	1.0	Restricted
9032.378	39.7	H	54.0	-14.3	AVG	348	1.1	Restricted
9032.443	39.1	V	54.0	-14.9	AVG	4	1.0	Restricted
4516.193	35.7	V	54.0	-18.3	AVG	154	1.5	Restricted
8129.112	50.0	H	74.0	-24.0	PK	16	1.0	Restricted
8129.100	49.1	V	74.0	-24.9	PK	308	1.0	Restricted
5419.460	49.1	H	74.0	-25.0	PK	291	1.7	Restricted
2709.720	48.7	V	74.0	-25.3	PK	331	1.0	Restricted
3613.085	48.2	V	74.0	-25.8	PK	333	1.4	Restricted
9032.443	47.8	V	74.0	-26.2	PK	4	1.0	Restricted
9032.378	47.7	H	74.0	-26.3	PK	348	1.1	Restricted
3613.122	46.8	H	74.0	-27.2	PK	144	1.4	Restricted
4516.210	44.5	H	74.0	-29.5	PK	241	1.0	Restricted
2709.688	44.1	H	74.0	-29.9	PK	230	0.0	Restricted
4516.193	42.5	V	74.0	-31.5	PK	154	1.5	Restricted

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 10,000 MHz. Center Channel @ 915 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2745.720	52.7	H	54.0	-1.3	AVG	47	1.8	Restricted
2745.702	49.4	V	54.0	-4.6	AVG	12	1.5	Restricted
8237.160	48.2	V	54.0	-5.8	AVG	36	1.0	Restricted
8238.892	46.2	H	54.0	-7.8	AVG	17	1.1	Restricted
5491.440	44.8	V	54.0	-9.3	AVG	350	1.1	Restricted
4576.215	42.8	V	54.0	-11.2	AVG	27	1.0	Restricted
7321.905	41.0	H	54.0	-13.0	AVG	35	1.1	Restricted
4576.200	40.1	H	54.0	-13.9	AVG	172	1.1	Restricted
5491.435	39.9	H	54.0	-14.1	AVG	188	1.0	Restricted
9152.392	39.8	V	54.0	-14.2	AVG	299	1.0	Restricted
9152.399	39.8	H	54.0	-14.2	AVG	37	1.0	Restricted
7321.920	39.4	V	54.0	-14.6	AVG	194	1.0	Restricted
3660.990	39.3	V	54.0	-14.7	AVG	324	1.4	Restricted
3660.920	37.5	H	54.0	-16.5	AVG	144	1.0	Restricted
2745.720	53.6	H	74.0	-20.4	PK	47	1.8	Restricted
2745.702	52.0	V	74.0	-22.0	PK	12	1.5	Restricted
8237.160	51.0	V	74.0	-23.0	PK	36	1.0	Restricted
8238.892	49.7	H	74.0	-24.4	PK	17	1.1	Restricted
5491.440	49.0	V	74.0	-25.0	PK	350	1.1	Restricted
9152.392	47.7	V	74.0	-26.3	PK	299	1.0	Restricted
9152.399	47.4	H	74.0	-26.6	PK	37	1.0	Restricted
7321.920	45.9	V	74.0	-28.1	PK	194	1.0	Restricted
4576.215	45.9	V	74.0	-28.1	PK	27	1.0	Restricted
7321.905	45.8	H	74.0	-28.2	PK	35	1.1	Restricted
5491.435	45.1	H	74.0	-28.9	PK	188	1.0	Restricted
4576.200	44.8	H	74.0	-29.2	PK	172	1.1	Restricted
3660.990	43.0	V	74.0	-31.0	PK	324	1.4	Restricted
3660.920	41.8	H	74.0	-32.2	PK	144	1.0	Restricted

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 10,000 MHz. High Channel @ 927 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
987.000	51.3	v	54.0	-2.7	QP	178	1.0	Restricted
8345.100	47.8	V	54.0	-6.2	AVG	188	1.1	Restricted
2781.720	47.4	H	54.0	-6.6	AVG	308	1.9	Restricted
2781.705	47.4	V	54.0	-6.6	AVG	348	1.2	Restricted
960.000	38.2	h	46.0	-7.8	QP	0	1.0	Restricted
7417.915	45.9	V	54.0	-8.1	AVG	178	1.2	Restricted
3708.957	43.6	V	54.0	-10.4	AVG	172	1.0	Restricted
4636.195	43.5	V	54.0	-10.6	AVG	17	1.0	Restricted
8345.145	42.9	H	54.0	-11.1	AVG	177	1.0	Restricted
3708.965	42.4	H	54.0	-11.6	AVG	121	1.0	Restricted
960.000	33.8	v	46.0	-12.2	QP	207	1.0	Restricted
7417.922	41.7	H	54.0	-12.3	AVG	48	1.0	Restricted
9272.405	40.4	H	54.0	-13.6	AVG	32	1.0	Restricted
4636.195	38.4	H	54.0	-15.6	AVG	229	1.5	Restricted
9272.375	37.7	V	54.0	-16.3	AVG	186	1.7	Restricted
8345.100	51.8	V	74.0	-22.2	PK	188	1.1	Restricted
7417.915	49.2	V	74.0	-24.8	PK	178	1.2	Restricted
2781.720	48.9	H	74.0	-25.1	PK	308	1.9	Restricted
2781.705	48.6	V	74.0	-25.4	PK	348	1.2	Restricted
9272.405	47.9	H	74.0	-26.1	PK	32	1.0	Restricted
8345.145	47.7	H	74.0	-26.3	PK	177	1.0	Restricted
7417.922	47.3	H	74.0	-26.7	PK	48	1.0	Restricted
9272.375	46.5	V	74.0	-27.5	PK	186	1.7	Restricted
4636.195	46.4	V	74.0	-27.6	PK	17	1.0	Restricted
3708.957	45.8	V	74.0	-28.3	PK	172	1.0	Restricted
3708.965	44.8	H	74.0	-29.2	PK	121	1.0	Restricted
4636.195	43.5	H	74.0	-30.5	PK	229	1.5	Restricted

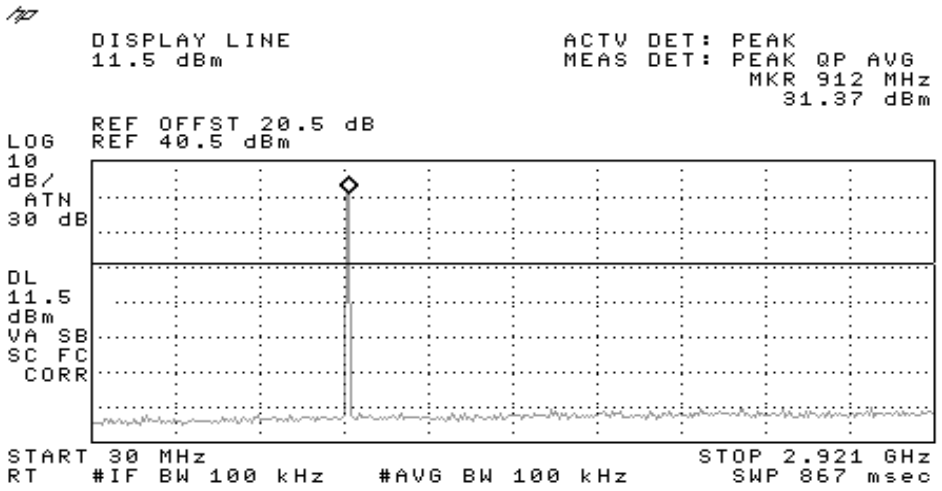
Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

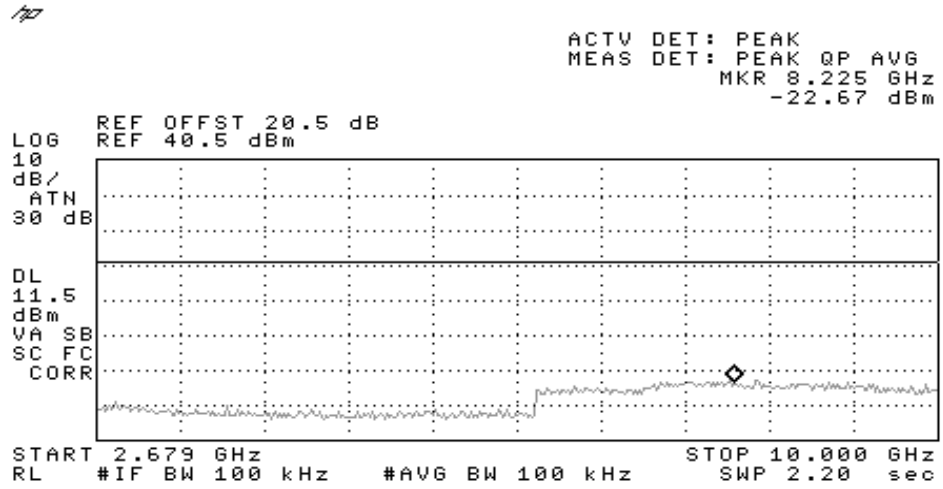
Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Run #1d: Antenna Conducted Spurious Emissions, 30 - 10,000 MHz.

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level.

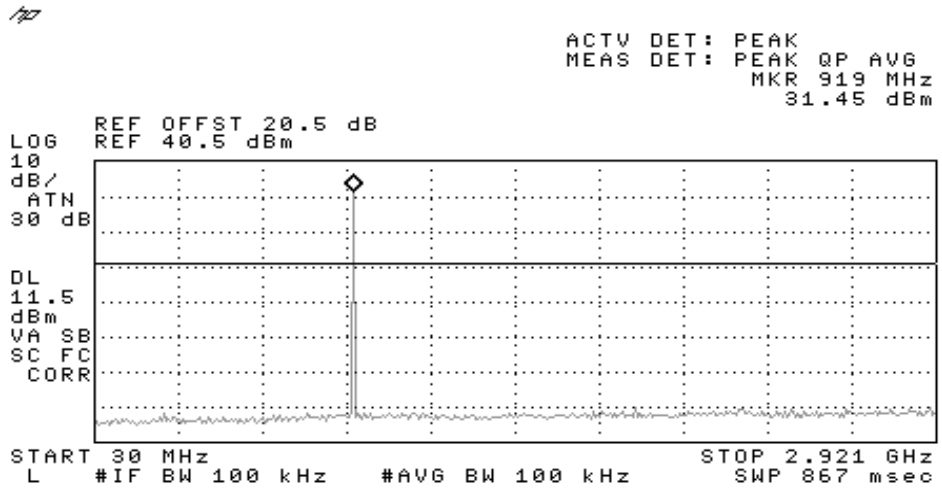
Low Channel

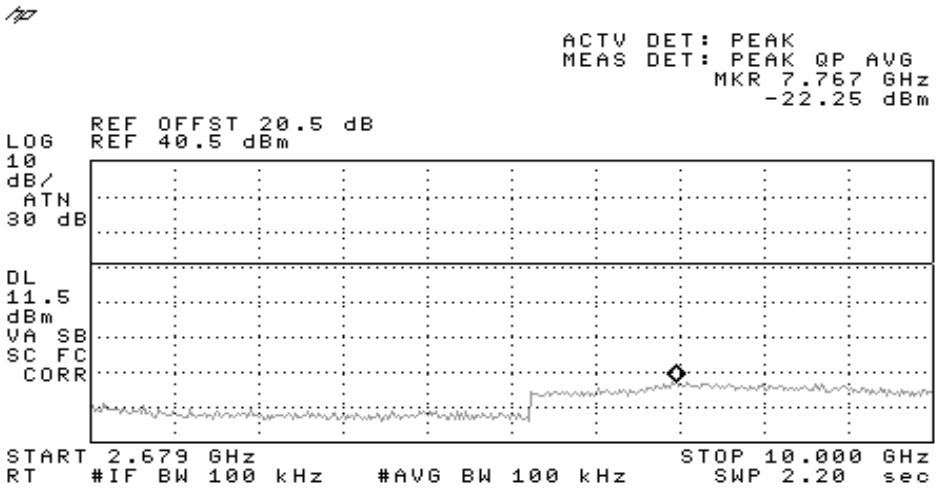




Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

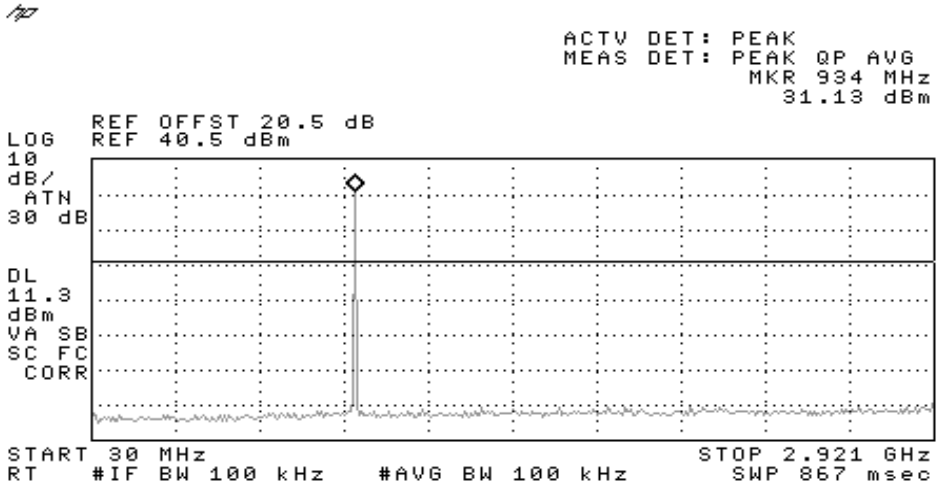
Middle Channel

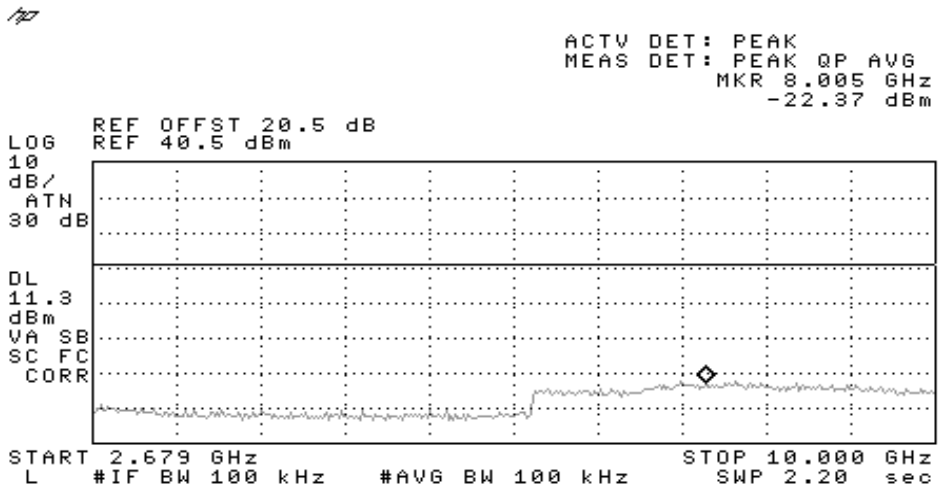




Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

High Channel



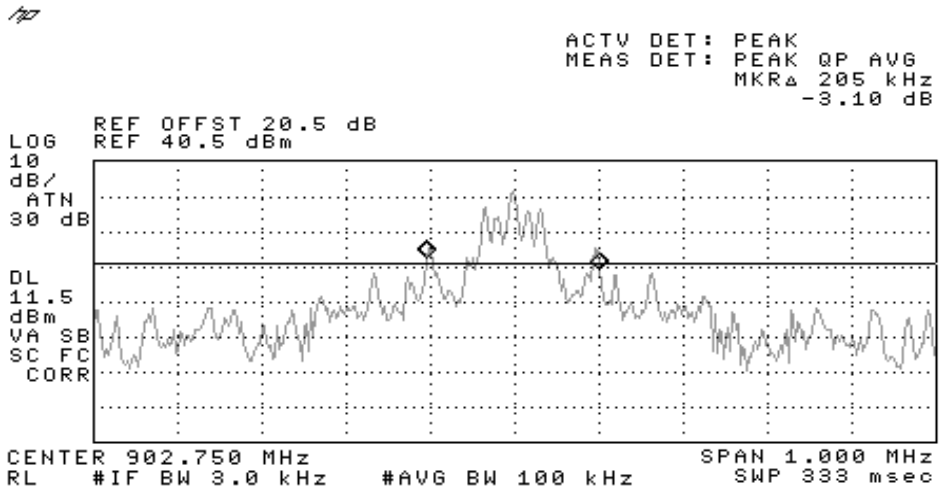


Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Run #2: Signal Bandwidth

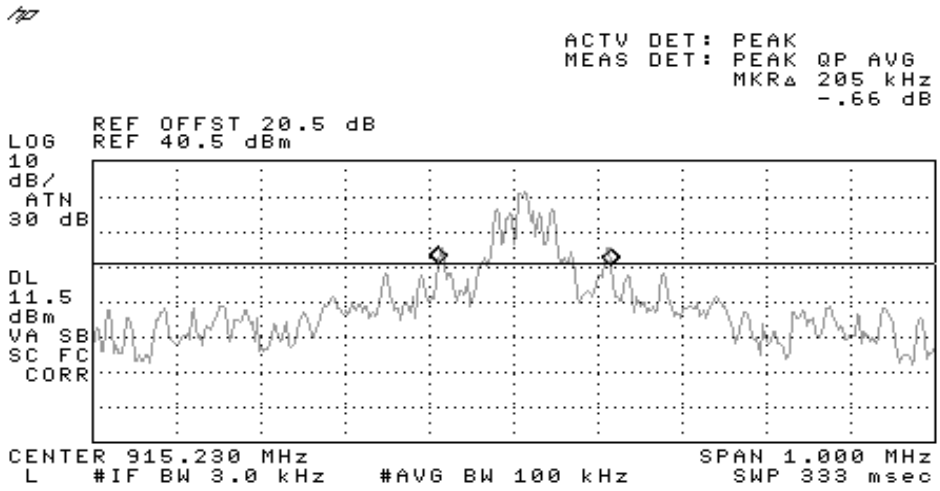
Channel	Frequency (MHz)	Resolution Bandwidth	20dB Signal Bandwidth
Low	902	3kHz	205 kHz
Mid	915	3kHz	205 kHz
High	927	3kHz	205 kHz

Low Channel

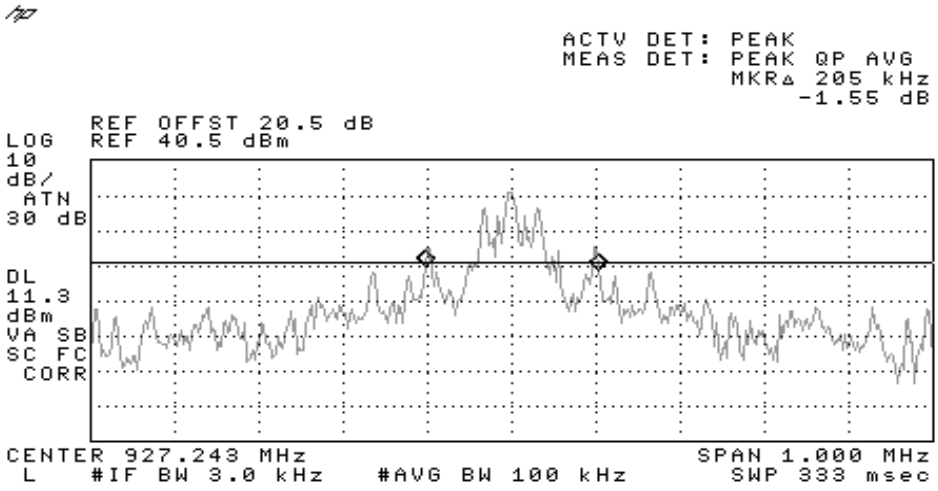


Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

MIddle Channel



High Channel



Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

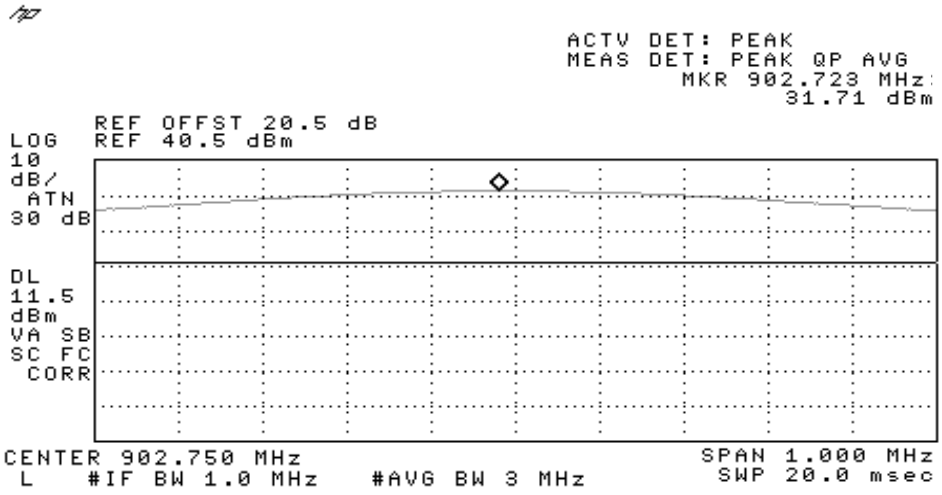
Run #3: Output Power

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.

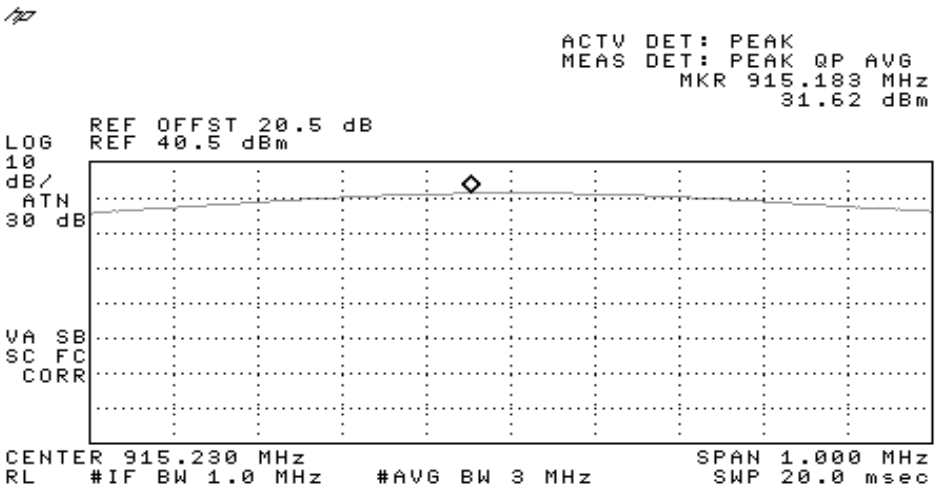
Maximum antenna gain: 6 dBi

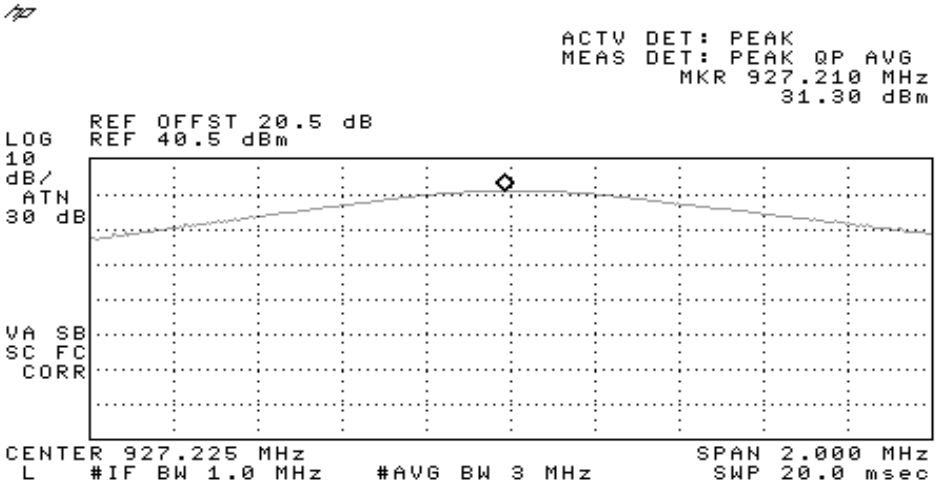
Channel	Frequency (MHz)	Res BW	Output Power	Cable loss	Output Power	EIRP
	(MHz)	(MHz)	(dBm)	(dB)	(W)	(W)
Low	902	1	31.7	2.2	0.893	3.556
Mid	915	1	31.6	2.2	0.875	3.483
High	927	1	31.3	2.2	0.813	3.236

Note:	Times Microwave LMR 195 cable will be used, which is specified to have 11 dB of antenuation per 100 feet at 900 MHz. This radio will be supplied with 20 feet of this cable when installed which gives 2.2 dB of cable loss so that the power at the antenna is 2.2 dB below of that measured at the radio. Please refer to data sheet of the cable.



Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A



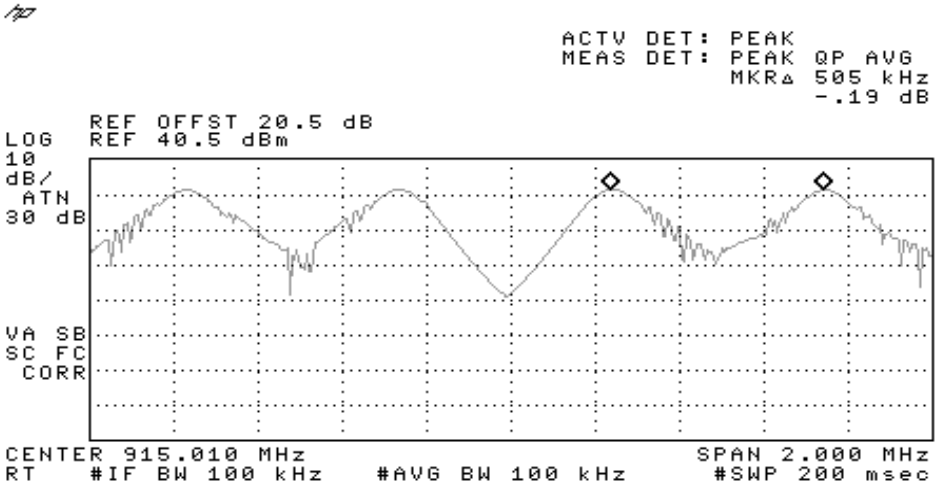


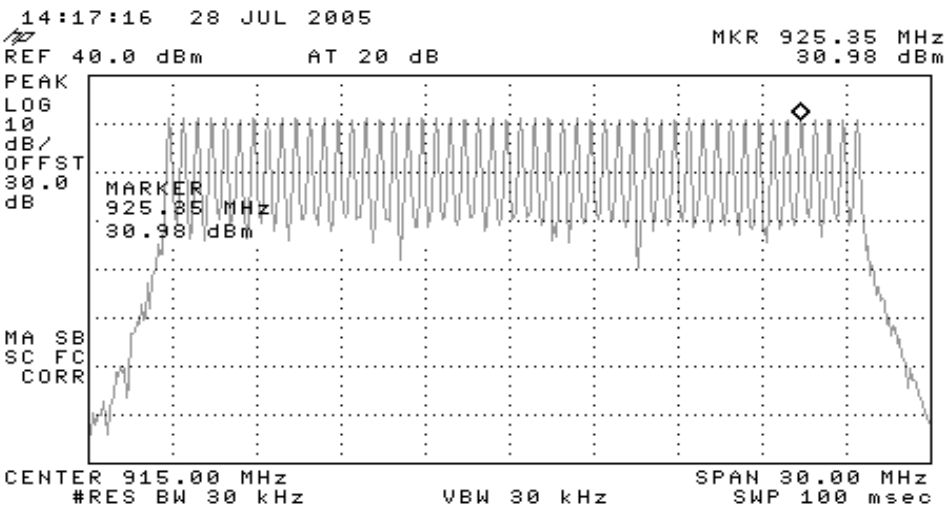
Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

Run #4: Channel Occupancy, Spacing and Number of Channels

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.

Channel spacing



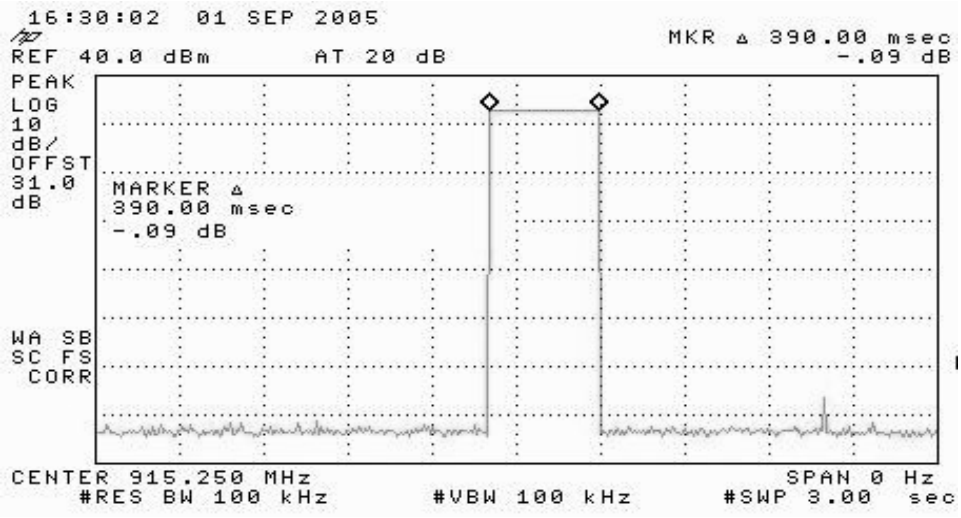


Client:	Alien Technology	Job Number:	J60418
Model:	ALR9800	T-Log Number:	T60513
		Account Manager:	-
Contact:	Robert Martin		
Spec:	FCC & 15.247	Class:	N/A

The channel occupancy was measured with the radio transmitting normally (i.e. In hopping mode)

The channel spacing was:	505	kHz
The transmit time on a single channel per transmission:	390	ms
The time between successive hops on a channel was:	19575	ms
The number of channels was:	50	
Channel dwell time in 20 seconds is:	0.400	s
Channel dwell time in 0.4 seconds mutliplied by the number of channels (50) is:	0.4	s

Dwell Time



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Time between succesive occupancy of a channel