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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Alien Technology Model: B2450R01

FCC ID:	P65B2450R01
GRANTEE:	Alien Technology 18410 Butterfield Blvd, Ste 150 Morgan Hill, CA 95037
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	January 16, 2003
FINAL TEST DATE:	January 9 and January 10, 2003

AUTHORIZED SIGNATORY: _____

David Bare
Chief Technical Officer

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SCOPE

An electromagnetic emissions test has been performed on the Alien Technology model B2450R01 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators for a frequency hopping spread spectrum device. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 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 B2450R01 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 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 which are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of Alien Technology model B2450R01 complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Alien Technology model B2450R01. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

120V, 60Hz

Frequency MHz	Level dBuV	Power Lead	15.207 Limit	15.207 Margin	Detector QP/Ave	Comments
0.542	38.6	Neutral	46.0	-7.4	AV	

LIMITS OF POWER AND BANDWIDTH, CHANNEL NUMBER, SPACING ANDOCCUPANCY

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The maximum power output was 30 dBm on the lowest channel. The maximum 6 dB bandwidth was 483 kHz on the highest frequency channel. The total number of channels for the EUT was 79. The channel spacing was 1025 kHz. The maximum occupancy on a single channel was 0.361 seconds in any 31.6 second period. The actual test data and any correction factors are contained in an exhibit of this report.

LIMITS OF ANTENNA CONDUCTED OUT OF BAND POWER

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The highest out-of-band (Un-restricted) emission recorded in any 100 kHz band was more than 20dB below the in-band level at any frequency between 30 and 25000 MHz. The actual test data and any correction factors are contained an exhibit of this report.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247 and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Frequency MHz	Level dBuV/m	Pol v/h	15.209 Limit	15.209 Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
4804.000	53.4	v	54.0	-0.6	Avg	15	1.0	

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 NAMAS document NIS 81.

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 B2450R01 is a RFID interrogator that is designed to interrogate and read RFID tags. Normally, the EUT would be placed on a tabletop, wall or other position during operation. The EUT was therefore, placed on a table during emissions testing to simulate the end user environment. The electrical rating of the EUT is 100 to 240 V, 50/60 Hz, 2.5 Amps.

The sample was received on January 9, 2003 and tested on January 9 and January 10, 2003. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	B2450R01	RF Reader	001	P65B2450R01

OTHER EUT DETAILS

Power Supply -- PhiHong Model PSA-30V-120

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated aluminum. It measures approximately 17.8 cm wide by 24.1 cm deep by 6.7 cm high.

MODIFICATIONS

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

ANTENNAS AND CONNECTORS

The EUT is provided with two custom circularly polarized 6 dBi antennas. The RF output connectors utilize reverse threaded TNC connectors that mate to the cable provided with the antenna.

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L Latitude C600	Laptop	HQH9N01	-

No remote support equipment was used during emissions testing.

EXTERNAL I/O CABLING

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

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
Comm	Laptop	9-Pin	Unshielded	2
Ethernet	Laptop	RJ-45	Unshielded	2
I/O	Terminated	9-Pin	Unshielded	2
AC Adapter	AC Mains	Power cord	Unshielded	3
Antenna 1	Antenna	Coax cable	Shielded	1
Antenna 2	Antenna	Coax cable	Shielded	1
Power	AC Adapter	Multicore	Unshielded with ferrite	1

TEST SOFTWARE

Software was running during emissions testing which enabled the unit to transmit either on the same channel or hopping among channels as required for test purposes.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on January 9 and January 10, 2003 at the Elliott Laboratories Open Area Test Site #3 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 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 C63.4-1992. 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 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 thermister mount 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 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, 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.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of dB microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. 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 radiated results may be converted to the linear form of uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 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

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

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

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

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

Antenna Conducted Emissions, 10-Jan-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 9Hz - 40GHz), system 2	84125C	1410	12	4/2/2002	4/2/2003

Antenna Conducted Emissions, 10-Jan-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1423	12	9/6/2002	9/6/2003
Rohde & Schwarz	Power Meter	NRVS	1422	12	9/6/2002	9/6/2003

Radiated Emissions, 10-Jan-03
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Narda West	High Pass Filter 4.0 GHz,	60583 HXF370	247	12	3/14/2002	3/14/2003
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	12	3/11/2002	3/11/2003
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	1/23/2002	1/23/2003
Hewlett Packard	Spectrum Analyzer 30Hz - 40 GHz	8564E (84125C)	1148	12	4/2/2002	4/2/2003
Hewlett Packard	Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	12	11/19/2002	11/19/2003

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 49825 22 Pages

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EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Emissions Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Alien Technologies

Model

B2450R01

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Emissions Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a RFID interrogator which is designed to interrogate and read RFID tags. Normally, the EUT would be placed on a tabletop, wall or other position during operation. The EUT was, therefore, placed on a table during emissions testing to simulate the end user environment. The electrical rating of the EUT is 100 to 240 V, 50/60 Hz, 2.5 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	B2450R01	RF Reader	001	P65B2450R01

Other EUT Details

Power Supply -- PhiHong Model PSA-30V-120

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated aluminum. It measures approximately 17.8 cm wide by 24.1 cm deep by 6.7 cm high.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None

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

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EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Emissions Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L Latitude C600	Laptop	HQH9N01	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
Comm	Laptop	9-Pin	Unshielded	2
Ethernet	Laptop	RJ-45	Unshielded	2
I/O	Terminated	9-Pin	Unshielded	2
AC Adapter	AC Mains	Power cord	Unshielded	3
Antenna 1	Antenna	Coax cable	Shielded	1
Antenna 2	Antenna	Coax cable	Shielded	1
Power	AC Adapter	Multicore	Unshielded with ferrite	1

EUT Operation During Emissions

Alien test software CCITT-16 Version 1.2.19

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/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: 1/10/2003
Test Engineer: Rafael
Test Location: SVOATS #3

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: 11°C
Rel. Humidity: 96%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a-1c	RE, Spurious Emissions In Restricted Bands	FCC Part 15.209 / 15.247(c)	Pass	-.6dB @ 4804 MHz
2	Bandedges	FCC Part 15.209 / 15.247(c)	Pass	-8.6dB @ 2390 MHz

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.

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EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/A

Run #1a: Radiated Spurious Emissions. Low Channel @ 2402 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4804.000	57.7	v	74.0	-16.3	Pk	15	1.0	
4804.000	53.4	v	54.0	-0.6	Avg	15	1.0	
7206.000	53.1	v	74.0	-20.9	Pk	15	1.0	
7206.000	40.9	v	54.0	-13.1	Avg	15	1.0	
9608.000		v	74.0	-74.0	Pk			Noise Floor
9608.000		v	54.0	-54.0	Avg			Noise Floor
12010.000	61.0	v	74.0	-13.0	Pk	10	1.0	
12010.000	52.2	v	54.0	-1.8	Avg	10	1.0	
14412.000		v	74.0	-74.0	Pk			Noise Floor
14412.000		v	54.0	-54.0	Avg			Noise Floor
16814.000		v	74.0	-74.0	Pk			Noise Floor
16814.000		v	54.0	-54.0	Avg			Noise Floor
4804.000	55.0	h	74.0	-19.0	Pk	40	1.0	
4804.000	49.0	h	54.0	-5.0	Avg	40	1.0	
7206.000	52.9	h	74.0	-21.1	Pk	0	1.0	
7206.000	40.7	h	54.0	-13.3	Avg	0	1.0	
9608.000	56.4	h	74.0	-17.6	Pk	0	1.0	
9608.000	43.8	h	54.0	-10.2	Avg	0	1.0	
12010.000	60.9	h	74.0	-13.1	Pk	15	1.0	
12010.000	50.5	h	54.0	-3.5	Avg	15	1.0	
14412.000		h	74.0	-74.0	Pk			Noise Floor
14412.000		h	54.0	-54.0	Avg			Noise Floor
16814.000		h	74.0	-74.0	Pk			Noise Floor
16814.000		h	54.0	-54.0	Avg			Noise Floor

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.

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EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/A

Run #1b: Radiated Spurious Emissions. Center Channel @ 2450 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4900.000	51.4	v	74.0	-22.6	Pk	30	1.0	
4900.000	42.8	v	54.0	-11.2	Avg	30	1.0	
7350.000	54.5	v	74.0	-19.5	Pk	10	1.0	
7350.000	43.7	v	54.0	-10.3	Avg	10	1.0	
9800.000	56.6	v	74.0	-17.4	Pk	360	1.0	
9800.000	43.4	v	54.0	-10.6	Avg	360	1.0	
12250.000	59.0	v	74.0	-15.0	Pk	350	1.0	
12250.000	45.9	v	54.0	-8.1	Avg	350	1.0	
14700.000		v	74.0	-74.0	Pk			Noise Floor
14700.000		v	54.0	-54.0	Avg			Noise Floor
17150.000		v	74.0	-74.0	Pk			Noise Floor
17150.000		v	54.0	-54.0	Avg			Noise Floor
4900.000	51.7	h	74.0	-22.3	Pk	330	1.0	
4900.000	41.6	h	54.0	-12.4	Avg	330	1.0	
7350.000	54.5	h	74.0	-19.5	Pk	10	1.0	
7350.000	42.7	h	54.0	-11.3	Avg	10	1.0	
9800.000	56.2	h	74.0	-17.8	Pk	0	1.0	
9800.000	43.5	h	54.0	-10.5	Avg	0	1.0	
12250.000	59.0	h	74.0	-15.0	Pk	15	1.0	
12250.000	46.8	h	54.0	-7.2	Avg	15	1.0	
14700.000		h	74.0	-74.0	Pk			Noise Floor
14700.000		h	54.0	-54.0	Avg			Noise Floor
17150.000		h	74.0	-74.0	Pk			Noise Floor
17150.000		h	54.0	-54.0	Avg			Noise Floor

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 Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/A

Run #1c: Radiated Spurious Emissions. High Channel @ 2480 MHz

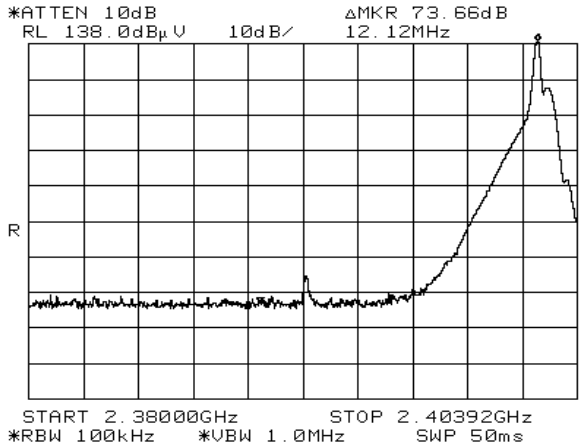
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4960.000	54.7	v	74.0	-19.3	Pk	30	1.0	
4960.000	49.4	v	54.0	-4.6	Avg	30	1.0	
7440.000	55.2	v	74.0	-18.8	Pk	350	1.0	
7440.000	44.6	v	54.0	-9.4	Avg	350	1.0	
9920.000	56.1	v	74.0	-17.9	Pk	0	1.0	
9920.000	43.5	v	54.0	-10.5	Avg	0	1.0	
12400.000	59.5	v	74.0	-14.5	Pk	20	1.0	
12400.000	46.8	v	54.0	-7.2	Avg	20	1.0	
14880.000		v	74.0	-74.0	Pk			Noise Floor
14880.000		v	54.0	-54.0	Avg			Noise Floor
17360.000	58.1	v	74.0	-15.9	Pk	35	1.0	
17360.000	46.4	v	54.0	-7.6	Avg	35	1.0	
4960.000	53.1	h	74.0	-20.9	Pk	345	1.0	
4960.000	46.5	h	54.0	-7.5	Avg	345	1.0	
7440.000	56.3	h	74.0	-17.7	Pk	10	1.0	
7440.000	46.1	h	54.0	-7.9	Avg	10	1.0	
9920.000		h	74.0	-74.0	Pk			Noise Floor
9920.000		h	54.0	-54.0	Avg			Noise Floor
12400.000	59.7	h	74.0	-14.3	Pk	20	1.0	
12400.000	46.9	h	54.0	-7.1	Avg	20	1.0	
14880.000		h	74.0	-74.0	Pk			Noise Floor
14880.000		h	54.0	-54.0	Avg			Noise Floor
17360.000	57.5	h	74.0	-16.5	Pk	0	1.0	
17360.000	46.6	h	54.0	-7.4	Avg	0	1.0	

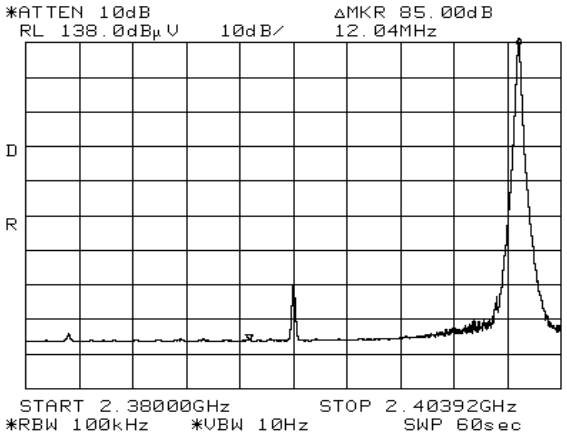
Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/A

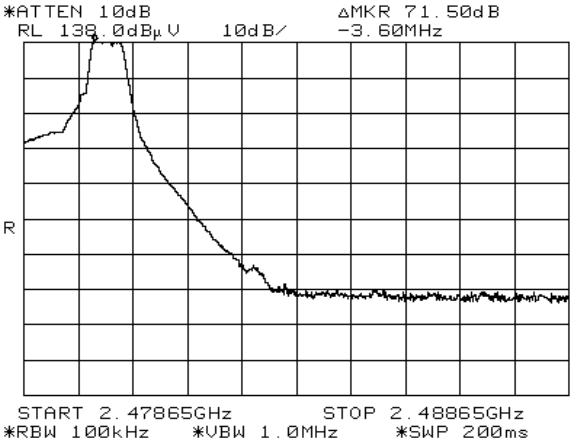
Run #2: Bandedge Plots

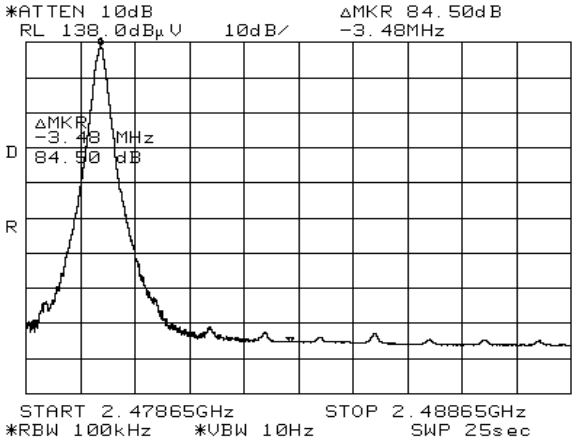
Low Channel





High Channel





Elliott

EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	N/A

Frequency	Level	Pol	Delta	Reading	15.209 / 15.247		Detector
MHz	dBµV/m	v/h	(dB)	dBµV/m	Limit	Margin	Pk/QP/Avg
2390.000	132.8	v	73.7	59.1	74.0	-14.9	Pk
2390.000	132.3	v	85.0	47.3	57.0	-9.7	Avg
2390.000	133.6	h	73.7	59.9	74.0	-14.1	Pk
2390.000	133.4	h	85.0	48.4	57.0	-8.6	Avg
2483.500	131.0	v	71.5	59.5	74.0	-14.5	Pk
2483.500	130.7	v	84.5	46.2	57.0	-10.8	Avg
2483.500	133.0	h	71.5	61.5	74.0	-12.5	Pk
2483.500	132.7	h	84.5	48.2	57.0	-8.8	Avg

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

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: 1/9/2003
Test Engineer: jmartinez
Test Location: SVOATS #3

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop 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: 13°C
Rel. Humidity: 96%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC	Pass	-7.4dB @ 0.542MHz

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.

Elliott

EMC Test Data

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

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

Frequency	Level	AC	FCC		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.542	38.6	Neutral	46.0	-7.4	AV	
0.541	38.4	Line 1	46.0	-7.6	AV	
0.168	46.1	Line 1	54.9	-8.8	AV	
0.169	56.0	Neutral	64.9	-8.9	QP	
0.168	56.0	Line 1	64.9	-8.9	QP	
0.169	45.0	Neutral	54.9	-9.9	AV	
0.542	40.0	Neutral	56.0	-16.0	QP	
0.541	40.0	Line 1	56.0	-16.0	QP	
0.293	32.1	Line 1	50.4	-18.3	AV	
0.293	32.0	Neutral	50.4	-18.4	AV	
0.293	38.9	Neutral	60.4	-21.5	QP	
0.293	38.7	Line 1	60.4	-21.7	QP	

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

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: 1/9/2003
Test Engineer: jmartinez
Test Location: SVOATS #3

Config. Used: 1
Config Change:
EUT Voltage: 120V/60Hz

General Test Configuration

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: 12°C
Rel. Humidity: 88%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	20dB Bandwidth	15.247(a)(1)	Pass	Refer to individual runs
2	Output Power	15.247(b)(1)	Pass	Refer to individual runs
3	Channel Occupancy / Separation	15.247(a)(1)& (1)(iii)	Pass	Refer to individual runs
4	Number of Channels	15.247(b)(1)	Pass	Refer to individual runs
5	Out of Band	15.247(c)	Pass	Refer to individual runs
6	Bandedge Plots	15.247(c)	Pass	Refer to individual runs

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.

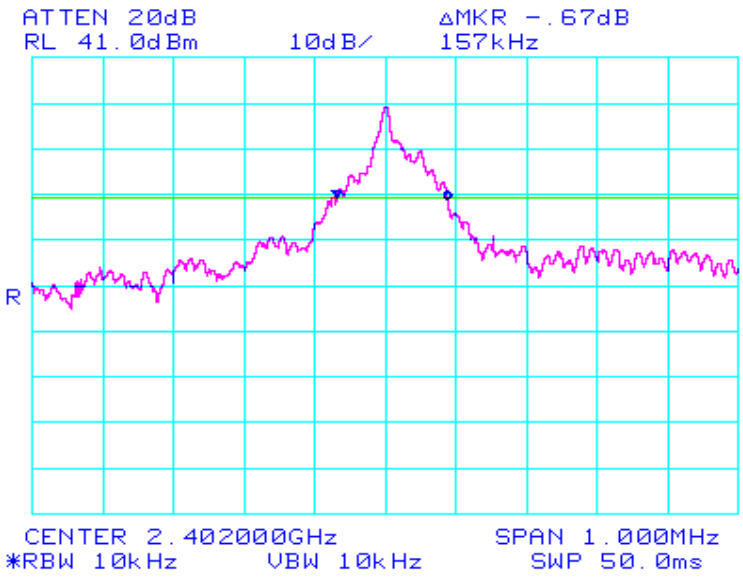
Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Run #1: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Signal Bandwidth	Graph reference #
Low	2402	10 KHz	157 kHz	Refer to plots below
Mid	2450	10 kHz	463 kHz	Refer to plots below
High	2480	10 KHz	483 kHz	Refer to plots below

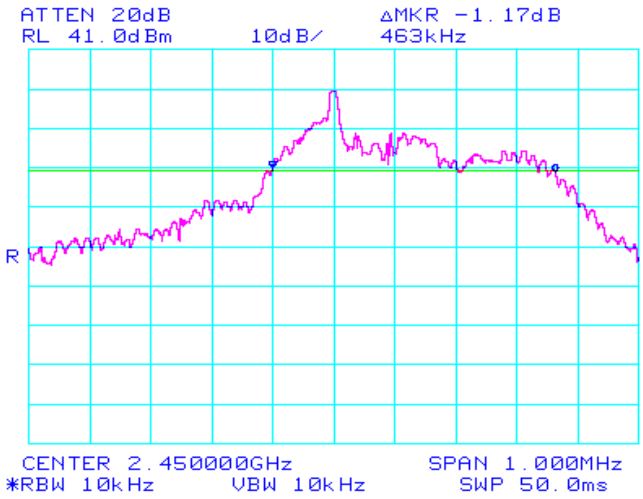
Note 1:	Add note here
Note 2:	

Low Channel

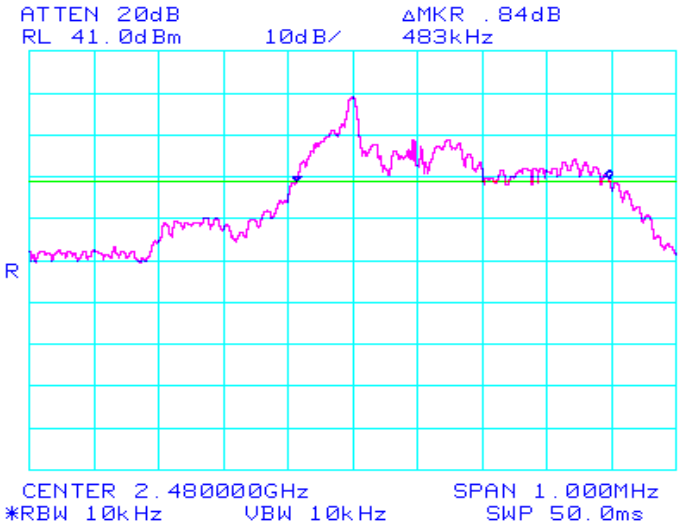


Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Middle Channel



High Channel



Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

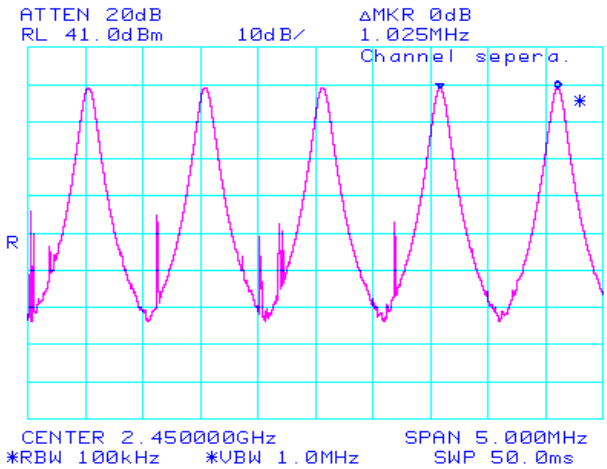
Run #2: Output Power (Peak Power Meter)

Channel	Frequency	Output Power	Setting
	(MHz)	dBm	
Low	2402	30	7A
Mid	2450	29.75	7A
High	2480	29.54	7A

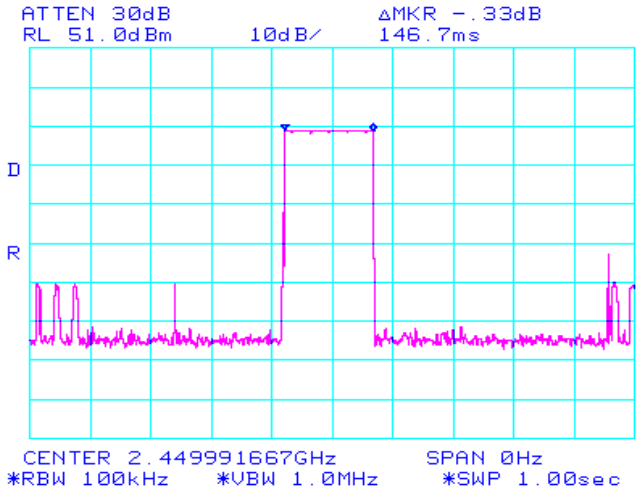
Run #3: Channel Occupancy And Spacing

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

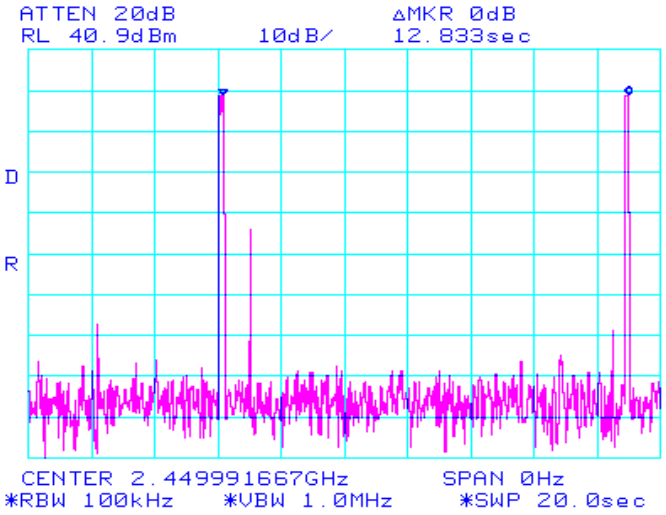
The channel spacing was:	1025	kHz	
The minimum channel separation permitted is:	483	kHz	
The total number of channels (N) was:	79	channels	
79 channels * 0.4 seconds:	31.6	Seconds	
The dwell time (Dt) on the center channel was:	0.1467	Seconds	Measured
Time between succesive occupancy of a channel (Ot):	12.833	Seconds	Measured
Time between succesive occupancy of a channel:	11.589	Seconds	Calculated (Dt * N)
Dwell time calculated :	0.1624	Seconds	Calculated (Ot /* N)
Average time per 31.6 seconds:	0.400	Seconds	Calculated (31.6 / N)
Average time per 31.6 seconds:	0.361	Seconds	Measured (31.6/Ot * Dt)
The maximum permitted dwell time in a 31.6 second period for FCC Part 15.247/RSS 210(o):	0.4	Seconds	



Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

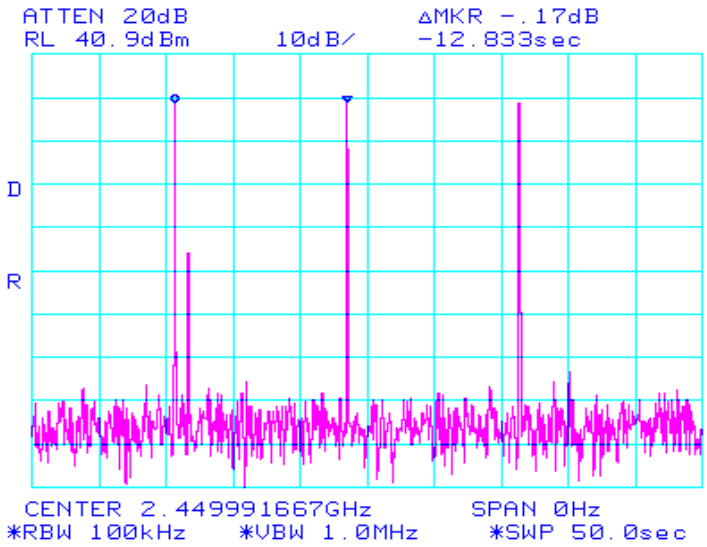


Dwell Time:
146.7 ms



Channel Occupancy:
12.833 Seconds in a 20 sec sweep time

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS



Channel Occupancy:
12.833 Seconds in a 50 sec sweep time

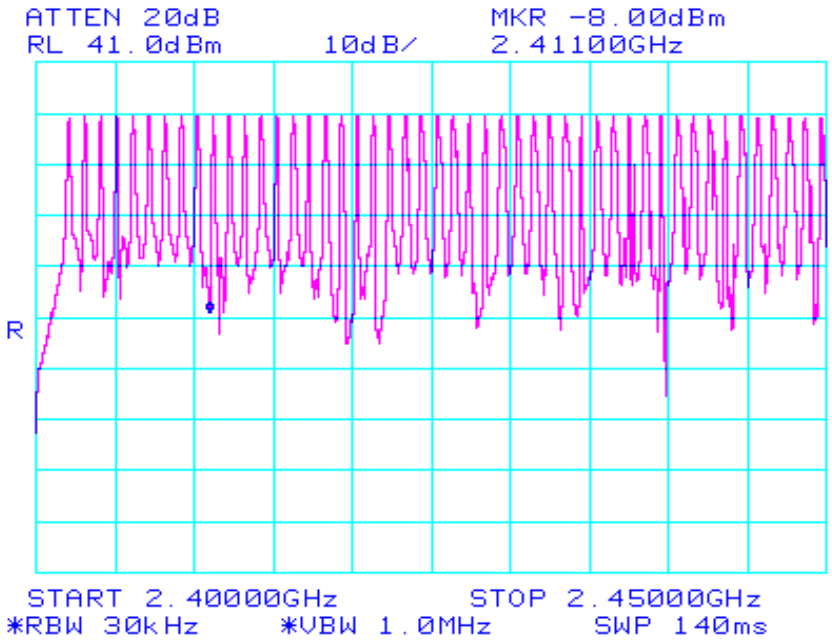
Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Run #4: Number of Channels

The number of channels was verified with the radio transmitting normally (i.e. In hopping mode)

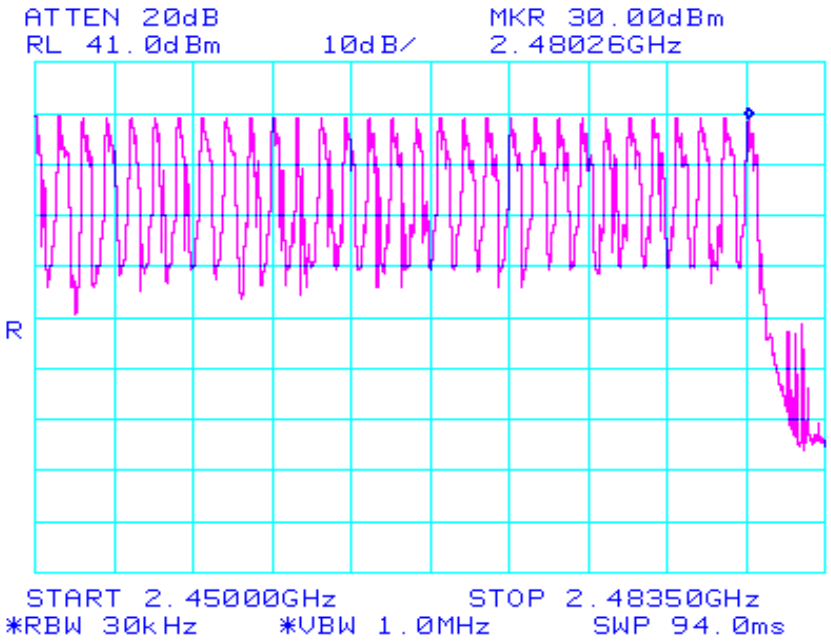
The number of channels was: 79

Refer to Plots below



48 Channels

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

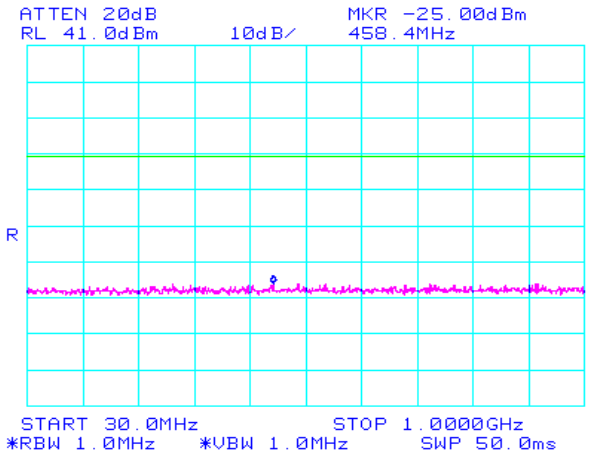


31 channels

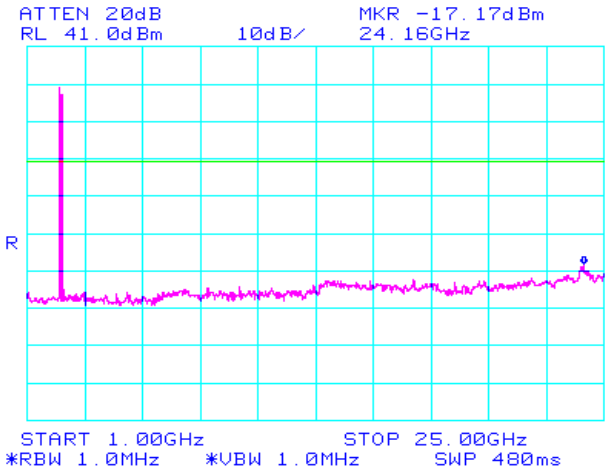
Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Run #5: Spurious/ Out-of Band Emissions

All spurious emissions were more than 20dB below the fundamental signal level when measured in a 100kHz bandwidth. Refer to the plots below.



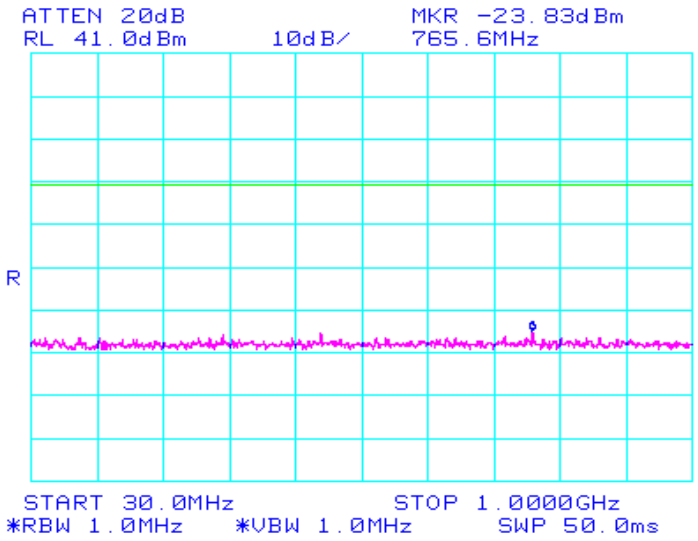
30 - 1000 MHz



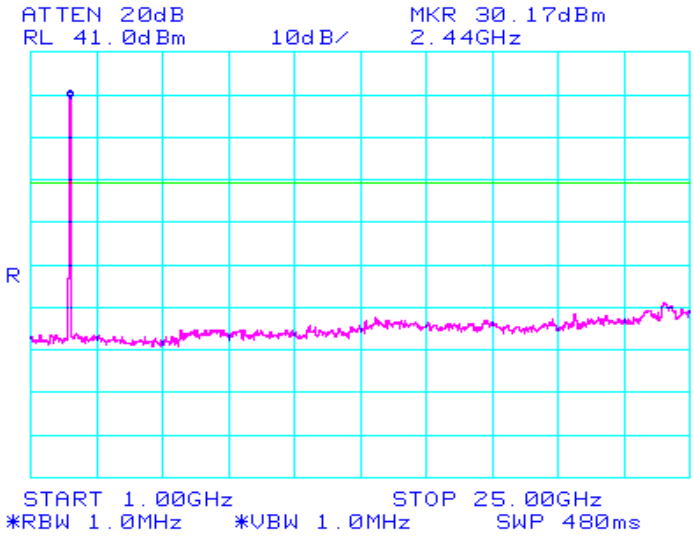
1,000 - 25,000 MHz

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Run #5: Continued - Spurious emissions, Center Channel



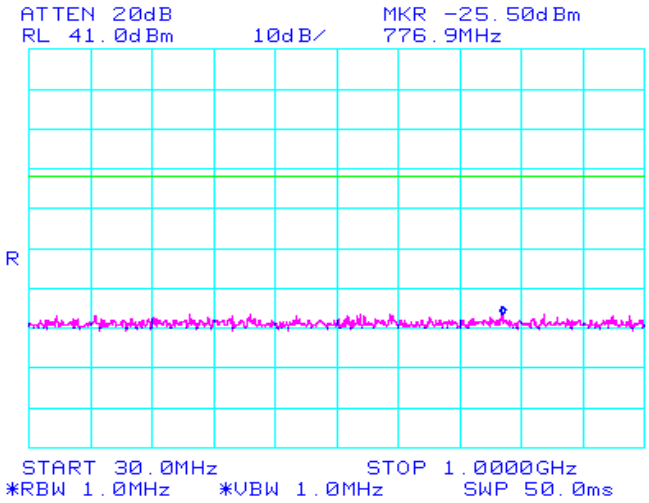
30 - 1000 MHz



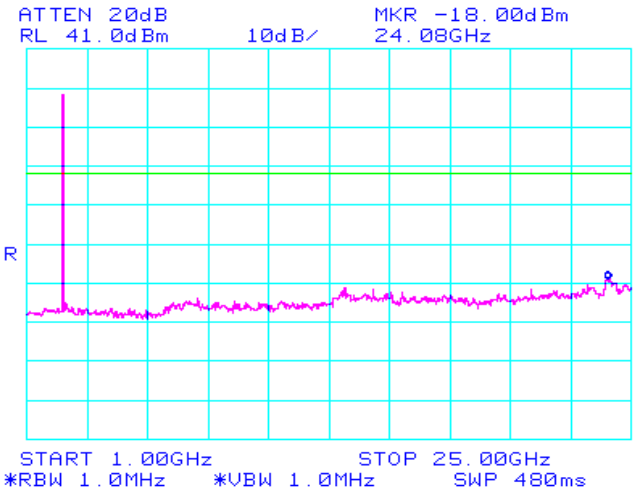
1,000 - 25,000 MHz

Client:	Alien Technologies	Job Number:	J49804
Model:	B2450R01	T-Log Number:	T49825
		Proj Eng:	Mark Briggs
Contact:	Robert Malin		
Spec:	FCC 15.247/RSS-210 issue 5	Class:	FHSS

Run #5 Continued - Spurious emissions, High Channel



30 - 1000 MHz



1,000 - 25,000 MHz