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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: NanoScanner

FCC ID:	P65BHNPR001
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:	July 2, 2002
FINAL TEST DATE:	June 11 and June 18, 2002

AUTHORIZED SIGNATORY: _____

Juan Martinez
Senior EMC Engineer

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SCOPE

An electromagnetic emissions test has been performed on the Alien Technology, Model: NanoScanner pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. 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 NanoScanner 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 NanoScanner 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 NanoScanner. 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.

0.45 - 30MHz, 120V/60Hz

Frequency MHz	Level dBuV	Power Lead	FCC 15.207 Limit	FCC 15.207 Margin	Detector QP/Ave	Comments
0.543	42.6	Line 1	48.0	-5.4	QP	

LIMITS OF ANTENNA CONDUCTED 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 22 dB below the in-band level at 1795 MHz. The actual test data and any correction factors are contained in 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	FCC Class A Limit	FCC Class A Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
387.095	44.2	h	46.4	-2.2	QP	138	2.3	

LIMITS OF POWER AND BANDWIDTH

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

The maximum power output was 29.3 dBm on channel 1. The minimum 20-dB bandwidth was 330 kHz on channel 1. For a system with 63 channels and an antenna gain of 6dB the maximum permitted output power is 30dBm.

The actual test data and any correction factors are contained in an exhibit of this report.

CHANNEL SEPARATION, CHANNEL OCCUPANCY, AND NUMBER OF CHANNLES.

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

The maximum Channel Separation is 400 kHz. The minimum Channel Occupancy was 316.7 mS. The number of Channels is 63. The Theory of Operations details how these channels are, on average, equally used.

The actual test data and any correction factors are contained in an exhibit of this report.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 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	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Alien Technology model NanoScanner is a radio, which is designed to read RF ID tags. The radio is a frequency hopping spread spectrum device that uses 63 channels between 902.6MHz and 927.4 MHz. Normally; the EUT would be mounted to a wall during operation. For testing purposes the EUT was treated as tabletop equipment during testing.

The sample was received on June 11, 2002 and tested on June 18 and June 20, 2002.

The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Alien Technology NanoScanner FHSS Radio	11

OTHER EUT DETAILS

EUT operates in the 902 -928 MHz ISM band

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel.

MODIFICATIONS

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

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number
Dell	Latitude C600	Laptop	HQH9N01
Hewlett Packard	2225C	Printer	2714540166

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)
RS-232	PC	RS-232	Shielded	1
Ethernet	PC	Cat-5	Unshielded	1
I/O	Alarms	RS-232	Shielded	1
Antenna 0	Antenna	HF141	Shielded	2
Antenna 1	Terminated 50Ohms	-	-	-
Power	AC mains	Power cable	Unshielded	1

EUT OPERATION

The EUT was in the interrogation mode (transmitting) during tests performed against 15.247. For measurements made on individual channels the unit was operating only on that channel. For channel occupancy measurements the unit was operating in hopping mode.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 11 and June 18, 2002 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 & 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 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 results are then converted to the linear forms of uV and 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 Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

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:

$$R_r - B = C$$

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, 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

Spurious Emissions, 12-Jun-02
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	High Pass filter, 1.5GHz	P/N 84300-80037	1158	12	3/4/2002	3/4/2003
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	12	3/2/2002	3/2/2003
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	12	4/23/2002	4/23/2003
Miteq	Pre-amp, 1-18GHz	AFS44	1346	12	1/7/2002	1/7/2003
Hewlett Packard	Spectrum Analyzer 9KHz - 26GHz	8563E	284	12	3/21/2002	3/21/2003

Conducted Emissions, 18-Jun-02
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Elliott Laboratories	LISN 2 x (Solar 8028 LISN + 6512 Caps)	LISN-5,Support	379	12	8/10/2001	8/10/2002
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	372	12	7/27/2001	7/27/2002
Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	1316	12	5/6/2002	5/6/2003
Solar Electronics	Support Equipment LISN, 0.150-30.0 MHz	8012-50-R-24-BNC	305	12	7/30/2001	7/30/2002

Antenna Conducted Emissions, 18-Jun-02
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/21/2002	2/21/2003

Radiated Emissions, 30 - 1000 MHz, 20-Jun-02
Engineer: bwright

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Elliott Laboratories	Biconical Antenna, 30-300 MHz	DM-105-T1	382	12	8/22/2001	8/22/2002
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1404	12	2/26/2002	2/26/2003
Rohde & Schwarz	Test Receiver, 20-1300MHz	ESVP	273	12	2/6/2002	2/6/2003

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 47291_Radio	20 Pages
T 47291_Digital	10 Pages

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EMC Test Data

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Alien Technology

Model

NanoScanner

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.20	Class:	A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a radio which is designed to read RF ID tags. The radio is a frequency hopping spread spectrum device that uses 63 channels between 902.6MHz and 927.4 MHz. Normally, the EUT would be mounted to a wall during operation. For testing purposes the EUT was treated as table-top equipment during testing.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	NanoScanner	FHSS Radio	11	-

Other EUT Details

EUT operates in the 902 -928 MHz ISM band

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel.

Modification History

Mod. #	Test	Date	Modification
1			

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.20	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	Latitude C600	Laptop	HQH9N01	-
Hewlett Packard	2225C	Printer	2714540166	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
RS-232	PC	RS-232	Shielded	1
Ethernet	PC	Cat-5	Unshielded	1
I/O	Alarms	RS-232	Shielded	1
Antenna 0	Antenna	HF141	Shielded	2
Antenna 1	Teminated 50Ohms	-	-	-
Power	AC mains	Power cable	Unshileded	1

EUT Operation During Emissions

The EUT was in the interrogation mode (transmitting) during tests performed against 15.247. For measurements made on individual channels the unit was operating only on that channel. For channel occupancy measurements the unit was operating in hopping mode.

For digital device emissions measurements, the unit was operating with the transmitter off, the receiver enabled and the EUT communicating to the PC.

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	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: 6/11/2002
Test Engineer: Rafael
Test Location: SVOATS #4

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: 14°C
Rel. Humidity: 94%

408-578-5532

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, Spurious Emissions In Restricted Bands	FCC Part 15.209 / 15.247(c)	Pass	-.1dB @ 5489.925

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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1a: Radiated Spurious Emissions, Low Channel @ 902.6 MHz
Circular Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	132.1	128
Limit for emissions outside of restricted bands:	112.1 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5415.563	48.0	V	54.0	-6.0	Avg	200	1.1	
2707.763	44.5	H	54.0	-9.5	Avg	150	1.0	
5415.509	43.1	H	54.0	-10.9	Avg	185	1.0	
7220.710	41.9	V	54.0	-12.1	Avg	190	1.0	
2707.736	41.6	V	54.0	-12.4	Avg	170	1.0	
7220.808	40.4	H	54.0	-13.6	Avg	225	1.0	
9025.887	40.3	V	54.0	-13.7	Avg	190	1.0	
9025.891	40.2	H	54.0	-13.8	Avg	0	0.0	
8123.366	38.5	V	54.0	-15.5	Avg	215	1.1	
8123.376	37.4	H	54.0	-16.6	Avg	215	1.2	
3610.320	35.4	V	54.0	-18.6	Avg	210	1.2	
4512.864	34.6	V	54.0	-19.4	Avg	200	1.0	
3610.343	34.1	H	54.0	-19.9	Avg	240	1.0	
4512.990	33.2	H	54.0	-20.8	Avg	185	1.1	
9026.022	52.8	V	74.0	-21.2	Pk	190	1.0	
9026.149	52.3	H	74.0	-21.7	Pk	0	0.0	
5415.637	52.1	V	74.0	-21.9	Pk	200	1.1	
7221.002	51.2	V	74.0	-22.8	Pk	190	1.0	
7220.797	50.5	H	74.0	-23.5	Pk	225	1.0	
2707.985	50.4	H	74.0	-23.6	Pk	150	1.0	
8123.640	49.9	V	74.0	-24.1	Pk	215	1.1	
5415.540	48.9	H	74.0	-25.1	Pk	185	1.0	
8122.944	48.6	H	74.0	-25.4	Pk	215	1.2	
2707.917	48.5	V	74.0	-25.5	Pk	170	1.0	
3610.500	44.3	H	74.0	-29.7	Pk	240	1.0	
3610.462	44.1	V	74.0	-29.9	Pk	210	1.2	
4512.910	43.9	H	74.0	-30.1	Pk	185	1.1	
4513.077	43.5	V	74.0	-30.5	Pk	200	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.

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EMC Test Data

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1b: Radiated Spurious Emissions, Center Channel @ 915 MHz
Circular Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	131.7	127.6
Limit for emissions outside of restricted bands:	111.7 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5489.920	53.9	V	54.0	-0.1	Avg	315	1.0	
5489.878	48.3	H	54.0	-5.7	Avg	345	1.0	
2745.185	65.9	V	74.0	-8.1	Pk	300	1.0	Partial ambient
2744.893	42.8	V	54.0	-11.2	Avg	300	1.0	Partial ambient
7319.916	41.2	H	54.0	-12.8	Avg	330	1.0	
7319.899	40.9	V	54.0	-13.1	Avg	295	1.0	
9149.889	40.9	H	54.0	-13.1	Avg	335	1.0	
9149.884	40.6	V	54.0	-13.4	Avg	345	1.6	
8234.945	38.9	V	54.0	-15.1	Avg	325	1.1	
3659.938	38.5	V	54.0	-15.5	Avg	300	1.3	
2744.893	57.3	H	74.0	-16.7	Pk	345	1.0	Partial ambient
8234.900	37.0	H	54.0	-17.0	Avg	310	1.0	
5489.663	56.6	V	74.0	-17.4	Pk	315	1.0	
2744.953	36.4	H	54.0	-17.6	Avg	345	1.0	Partial ambient
3659.887	35.9	H	54.0	-18.1	Avg	30	1.0	
4574.913	32.5	V	54.0	-21.5	Avg	300	1.0	
5489.987	52.3	H	74.0	-21.7	Pk	345	1.0	
9149.968	52.3	H	74.0	-21.7	Pk	335	1.0	
9149.668	52.1	V	74.0	-21.9	Pk	345	1.6	
4574.904	31.9	H	54.0	-22.1	Avg	300	1.1	
7319.377	51.2	V	74.0	-22.8	Pk	295	1.0	
7320.103	51.0	H	74.0	-23.0	Pk	330	1.0	
8235.037	50.4	V	74.0	-23.6	Pk	325	1.1	
8234.923	49.3	H	74.0	-24.7	Pk	310	1.0	
3659.800	45.6	V	74.0	-28.4	Pk	300	1.3	
3660.445	45.0	H	74.0	-29.0	Pk	30	1.0	
4574.788	43.7	V	74.0	-30.3	Pk	300	1.0	
4574.715	43.6	H	74.0	-30.4	Pk	300	1.1	

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:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1c: Radiated Spurious Emissions, High Channel @ 927.4 MHz
Circular Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	130.8	127
Limit for emissions outside of restricted bands:	110.8 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7419.187	44.8	V	54.0	-9.2	Avg	280	1.0	
2782.173	44.2	V	54.0	-9.8	Avg	285	1.0	
7419.137	43.8	H	54.0	-10.2	Avg	230	1.0	
5564.382	42.1	V	54.0	-11.9	Avg	270	1.0	
5564.385	41.6	H	54.0	-12.4	Avg	260	1.0	
2782.150	41.1	H	54.0	-12.9	Avg	275	2.1	
9273.888	39.1	H	54.0	-14.9	Avg	245	1.0	
8346.565	38.9	H	54.0	-15.1	Avg	240	1.3	
9273.998	38.7	V	54.0	-15.3	Avg	250	1.0	
8346.524	37.9	V	54.0	-16.1	Avg	295	1.0	
7419.127	53.5	V	74.0	-20.5	Pk	280	1.0	
7419.251	52.9	H	74.0	-21.1	Pk	230	1.0	
3709.591	32.6	H	54.0	-21.4	Avg	285	1.5	
3709.512	32.6	V	54.0	-21.4	Avg	260	1.0	
4636.876	32.1	V	54.0	-21.9	Avg	255	1.0	
9274.010	51.3	V	74.0	-22.7	Pk	250	1.0	
9273.477	50.9	H	74.0	-23.1	Pk	245	1.0	
4636.125	30.8	H	54.0	-23.2	Avg	245	1.0	Noise Floor
8346.494	49.9	H	74.0	-24.1	Pk	240	1.3	
8346.572	49.6	V	74.0	-24.4	Pk	295	1.0	
5564.455	48.7	H	74.0	-25.3	Pk	260	1.0	
5564.493	48.4	V	74.0	-25.6	Pk	270	1.0	
2782.157	48.1	V	74.0	-25.9	Pk	285	1.0	
2782.327	46.2	H	74.0	-27.8	Pk	275	2.1	
4636.447	43.7	H	74.0	-30.3	Pk	245	1.0	Noise Floor
3709.545	43.6	H	74.0	-30.4	Pk	285	1.5	
4636.435	43.6	V	74.0	-30.4	Pk	255	1.0	
3709.478	43.0	V	74.0	-31.0	Pk	260	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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	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: 6/11/2002
Test Engineer: Rafael
Test Location: SVOATS #4

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: 14°C
Rel. Humidity: 94%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, Spurious Emissions In Restricted Bands	FCC Part 15.209 / 15.247(c)	Pass	-1.7dB @ 2752.166

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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1a: Radiated Spurious Emissions, 30-10000 MHz. Low Channel @ 902.6 MHz
Linear Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	121.1	135.3
Limit for emissions outside of restricted bands:	115.3 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5415.521	49.5	H	54.0	-4.5	Avg	100	1.0	
5415.553	48.1	V	54.0	-5.9	Avg	75	1.2	
7220.710	46.9	V	54.0	-7.1	Avg	50	1.1	
3610.331	44.6	H	54.0	-9.4	Avg	115	1.5	
2707.740	42.2	H	54.0	-11.8	Avg	25	1.0	
3610.375	41.2	V	54.0	-12.8	Avg	60	1.2	
7220.765	41.0	H	54.0	-13.0	Avg	75	1.0	
9025.936	39.8	V	54.0	-14.2	Avg	80	1.0	
9025.846	39.7	H	54.0	-14.3	Avg	90	1.0	
2707.758	36.9	V	54.0	-17.1	Avg	40	1.2	
8123.340	36.9	H	54.0	-17.1	Avg	80	1.0	
8123.259	36.5	V	54.0	-17.5	Avg	15	1.0	
4512.934	36.0	V	54.0	-18.0	Avg	60	1.1	
7220.703	53.1	V	74.0	-20.9	Pk	50	1.1	
5415.471	52.9	H	74.0	-21.1	Pk	100	1.0	
9026.091	52.6	V	74.0	-21.4	Pk	80	1.0	
9025.326	52.2	H	74.0	-21.8	Pk	90	1.0	
5415.576	52.0	V	74.0	-22.0	Pk	75	1.2	
7220.601	51.5	H	74.0	-22.5	Pk	75	1.0	
4512.938	31.2	H	54.0	-22.8	Avg	55	1.0	
3610.276	51.1	H	74.0	-22.9	Pk	115	1.5	
2707.886	49.8	H	74.0	-24.2	Pk	25	1.0	
8123.933	49.3	H	74.0	-24.7	Pk	80	1.0	
8122.661	48.9	V	74.0	-25.1	Pk	15	1.0	
3610.188	47.6	V	74.0	-26.4	Pk	60	1.2	
2707.730	45.0	V	74.0	-29.0	Pk	40	1.2	
4513.025	45.0	V	74.0	-29.0	Pk	60	1.1	
4513.323	42.9	H	74.0	-31.1	Pk	55	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.

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1b: Radiated Spurious Emissions, Center Channel @ 917.4 MHz
The middle channel was changed from 915MHz to 917.4MHz, since there was an ambient in the 3rd harmonic.
Linear Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	123.8	134.9
Limit for emissions outside of restricted bands:	114.9 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2752.166	52.3	V	54.0	-1.7	Avg	335	1.3	
5504.362	51.6	V	54.0	-2.4	Avg	30	1.1	
2752.160	49.0	H	54.0	-5.0	Avg	85	1.3	
5504.354	46.4	H	54.0	-7.6	Avg	50	1.5	
7339.143	43.3	V	54.0	-10.7	Avg	350	1.1	
3669.546	42.6	V	54.0	-11.4	Avg	0	1.3	
3669.555	41.9	H	54.0	-12.1	Avg	35	1.3	
7339.098	39.4	H	54.0	-14.6	Avg	340	1.4	
9174.100	39.3	H	54.0	-14.7	Avg	360	1.3	
9173.747	38.9	V	54.0	-15.1	Avg	360	1.3	
8256.504	37.0	H	54.0	-17.0	Avg	50	1.4	
8256.491	36.9	V	54.0	-17.1	Avg	10	1.3	
5504.527	54.9	V	74.0	-19.1	Pk	30	1.1	
2752.190	54.2	V	74.0	-19.8	Pk	335	1.3	
7338.993	52.2	V	74.0	-21.8	Pk	350	1.1	
9174.452	52.1	V	74.0	-21.9	Pk	360	1.3	
9173.923	51.9	H	74.0	-22.1	Pk	360	1.3	
2752.050	51.8	H	74.0	-22.2	Pk	85	1.3	
5504.042	51.3	H	74.0	-22.7	Pk	50	1.5	
7338.960	51.3	H	74.0	-22.7	Pk	340	1.4	
4586.913	30.8	H	54.0	-23.2	Avg	350	1.0	
4587.091	30.7	V	54.0	-23.3	Avg	340	1.1	
8256.277	49.6	H	74.0	-24.4	Pk	50	1.4	
8256.202	49.4	V	74.0	-24.6	Pk	10	1.3	
3669.450	48.7	V	74.0	-25.3	Pk	0	1.3	
3669.505	48.5	H	74.0	-25.5	Pk	35	1.3	
4586.775	45.9	V	74.0	-28.1	Pk	340	1.1	
4586.310	42.7	H	74.0	-31.3	Pk	350	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.

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1c: Radiated Spurious Emissions, High Channel @ 927.4 MHz
Linear Antenna

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	123.2	134.2
Limit for emissions outside of restricted bands:	114.2 dBµV/m	

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3709.565	41.2	H	54.0	-12.8	Avg	140	1.0	
7419.124	40.7	H	54.0	-13.3	Avg	135	1.1	
7419.063	40.5	V	54.0	-13.5	Avg	160	1.1	
5564.370	39.3	V	54.0	-14.7	Avg	180	1.1	
9273.969	38.6	V	54.0	-15.4	Avg	100	1.0	
5564.355	38.5	H	54.0	-15.5	Avg	145	1.1	
3709.520	38.4	V	54.0	-15.6	Avg	140	1.0	
9273.969	38.3	H	54.0	-15.7	Avg	0	1.0	
8346.563	37.2	H	54.0	-16.8	Avg	135	1.4	
8346.548	37.2	V	54.0	-16.8	Avg	145	1.0	
2782.167	35.8	H	54.0	-18.2	Avg	155	1.0	
2782.170	35.4	V	54.0	-18.6	Avg	115	1.0	
4636.965	33.8	V	54.0	-20.2	Avg	165	1.0	
7419.519	51.7	V	74.0	-22.3	Pk	160	1.1	
4636.877	31.6	H	54.0	-22.4	Avg	145	1.0	
9273.908	51.4	V	74.0	-22.6	Pk	100	1.0	
7418.861	51.1	H	74.0	-22.9	Pk	135	1.1	
9274.658	51.1	H	74.0	-22.9	Pk	0	1.0	
8346.756	50.2	H	74.0	-23.8	Pk	135	1.4	
8346.208	49.3	V	74.0	-24.7	Pk	145	1.0	
5564.233	47.8	V	74.0	-26.2	Pk	180	1.1	
5564.613	47.4	H	74.0	-26.6	Pk	145	1.1	
3709.441	47.0	H	74.0	-27.0	Pk	140	1.0	
3709.576	45.9	V	74.0	-28.1	Pk	140	1.0	
4637.053	45.3	V	74.0	-28.7	Pk	165	1.0	
2782.418	44.7	V	74.0	-29.3	Pk	115	1.0	
2782.018	44.3	H	74.0	-29.7	Pk	155	1.0	
4636.956	43.8	H	74.0	-30.2	Pk	145	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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	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: 6/18/2002
Test Engineer: Rafael
Test Location: Chamber #2

Config. Used: 1
Config Change: None
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 via a suitable attenuator (30dB) 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: 20°C
Rel. Humidity: 47%

Summary of Results

Run #	Test Performed	Limit	Result	Comment
1	20dB Bandwidth	15.247(a)	Pass	330kHz
1	99% Bandwidth	15.247(a)	-	500kHz
2	Output Power	15.247(b)	Pass	29.3 dBm / 0.85 W
3	Channel Separation	15.247(a)	Pass	400kHz
3	Channel Occupancy	15.247(a)	Pass	< 400mS per 10 second period
4	Number of Channels	15.247(a)	Pass	63 Channels
5	Spurious/ Out-of Band Emissions	15.247(a)	Pass	All out of band emissions > -20dBc

Modifications Made During Testing:

No modifications were made to the EUT during testing

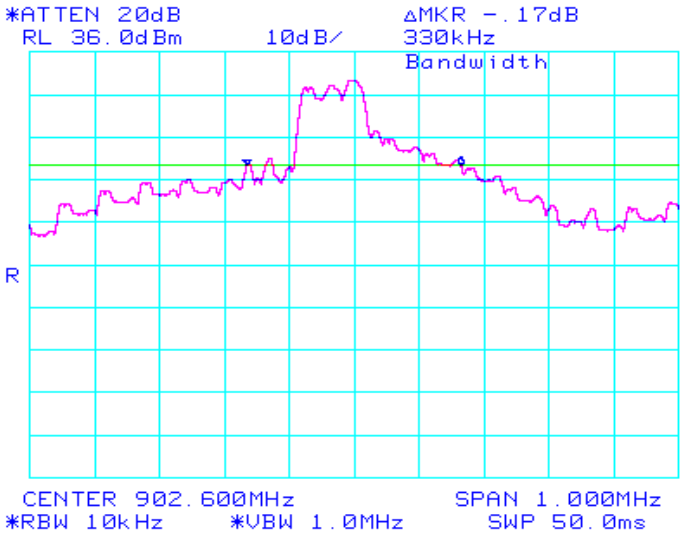
Deviations From The Standard

No deviations were made from the requirements of the standard.

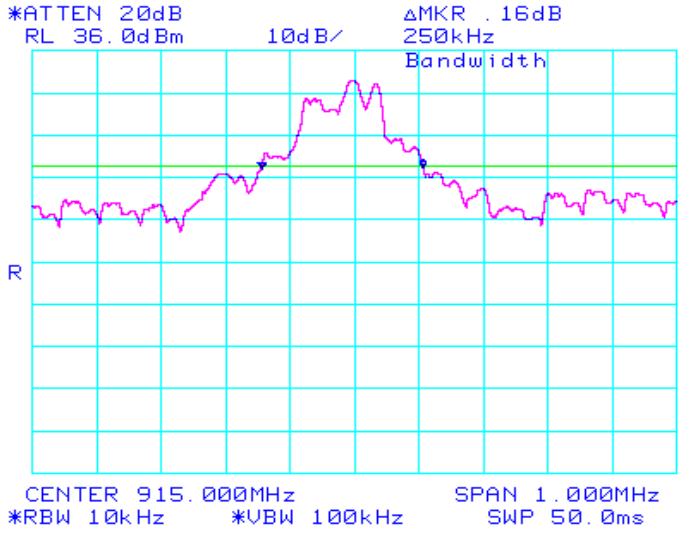
Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1: Bandwidth

Channel	Frequency (MHz)	Res BW	20dB Bandwith	99% Bandwidth
Low	902.6	10KHz	330KHz	500KHz
Mid	915	10KHz	250KHz	500KHz
High	927.4	10KHz	252KHz	500KHz

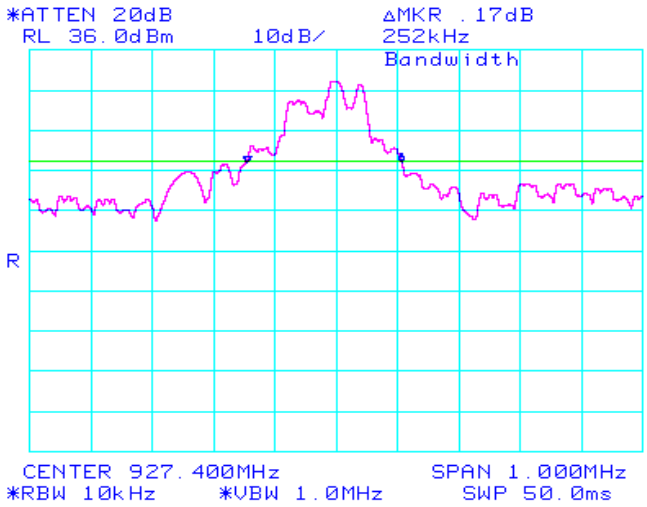


Note: signal level at 902 MHz is >20dB below the fundamental signal level



Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #1: 20dB Bandiwdth Continued



Note: signal level at 928 MHz is >20dB below the fundamental signal level

Run #2: Output Power

Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	Comment
Low	902.6	1 MHz	29.3	0.85	VBW=1 MHz
Mid	915	1 MHz	28.8	0.76	VBW=1 MHz
High	927.4	1 MHz	28	0.63	VBW=1 MHz

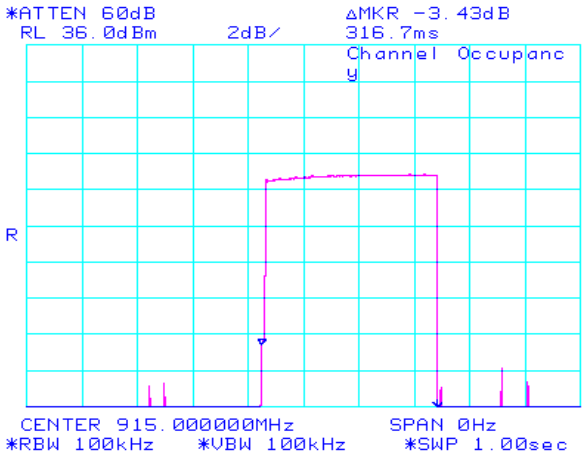
Note 1:	Maximum antenna gain used for this antenna is 6dBi, therefore, maximum permitted power for a system utilizing more than 50 channels is 30dBm (1 Watt)

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

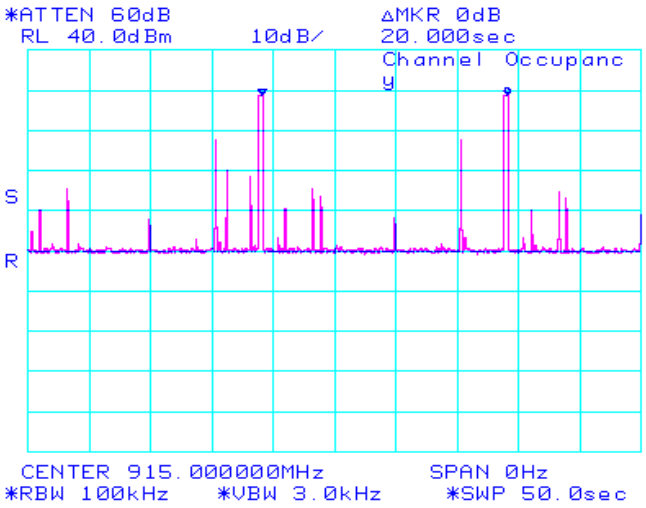
Run #3: Channel Occupancy And Spacing

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

The channel spacing was:	400 kHz
The minimum channel separation permitted is:	340 kHz
The dwell time on the center channel in a 20 second period was:	317 mS
The maximum permitted dwell time in a 10 second period for FCC Part 15.247/RSS 210(o), based on a signal bandwidth >250kHz:	400 mS



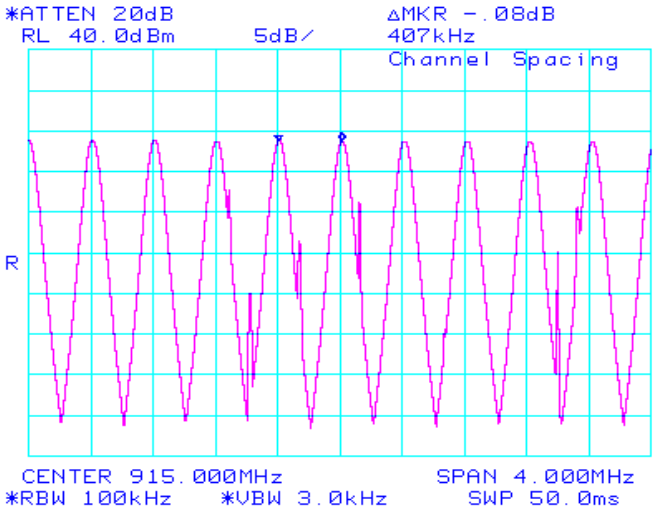
Dwell time on a single channel
316.7mS



Time between repeating the use of a channel
20 seconds

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #3: Channel Occupancy And Spacing (continued)

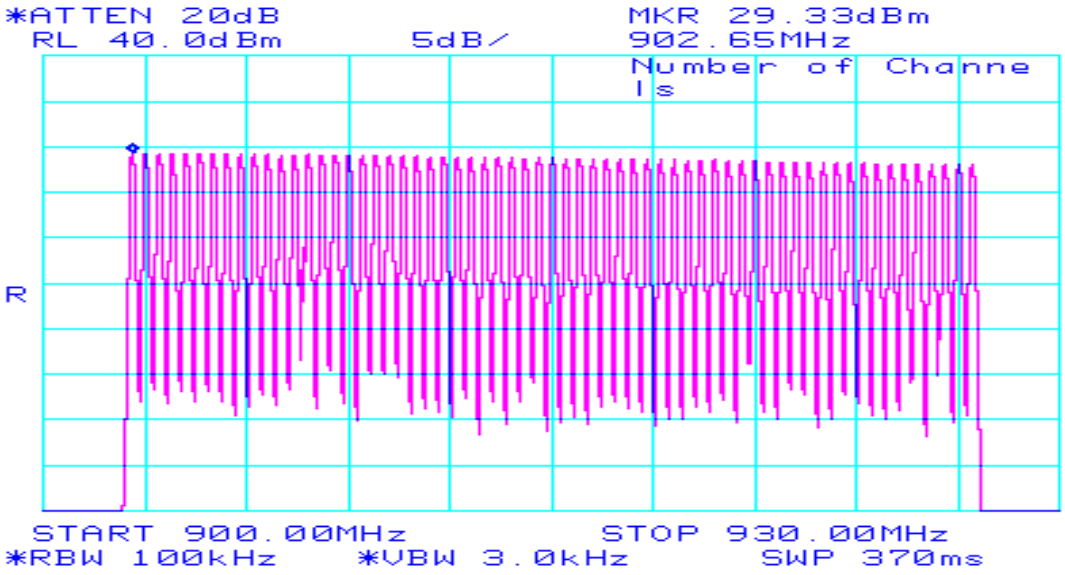


Run #4: Number of Channels

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

The number of channels was: 63 between 902.6MHz and 927.4 MHz

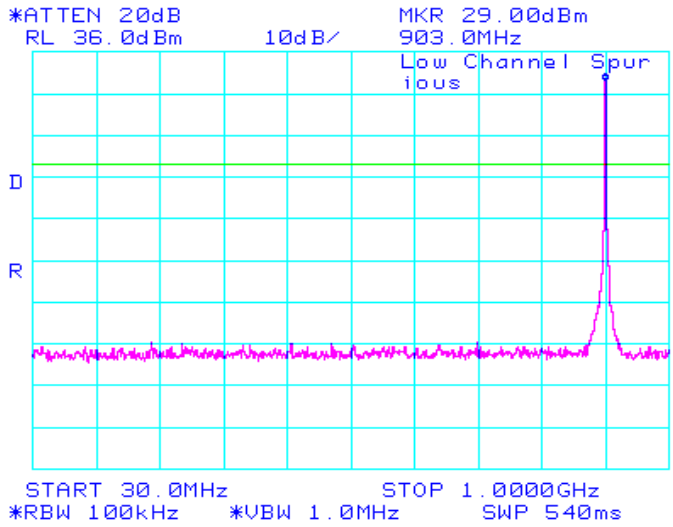
15.247 and RSS 210 require a minimum of 50 channels.



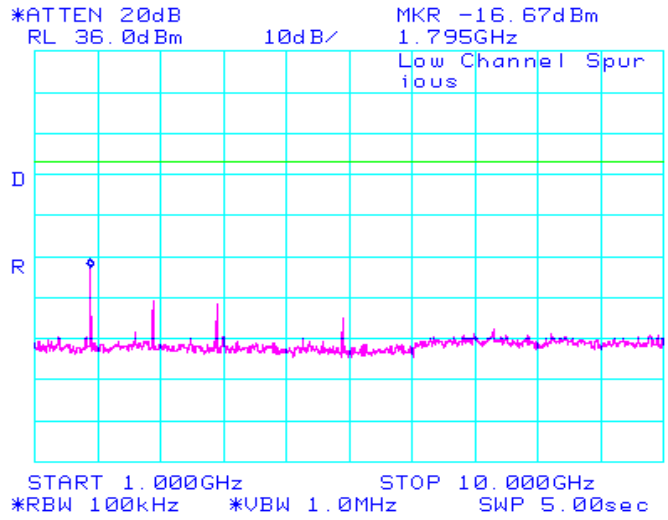
Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

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. A plot showing the restricted band that starts at 960 MHz has also been included to demonstarte compliance in that band.



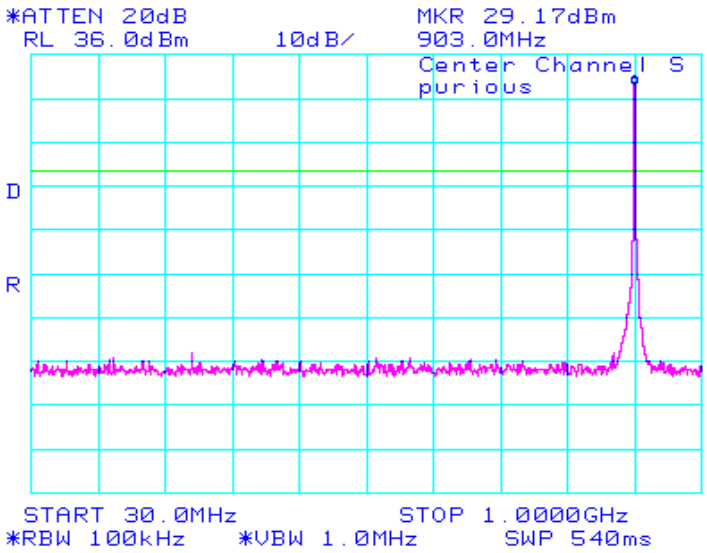
30 - 1000 MHz



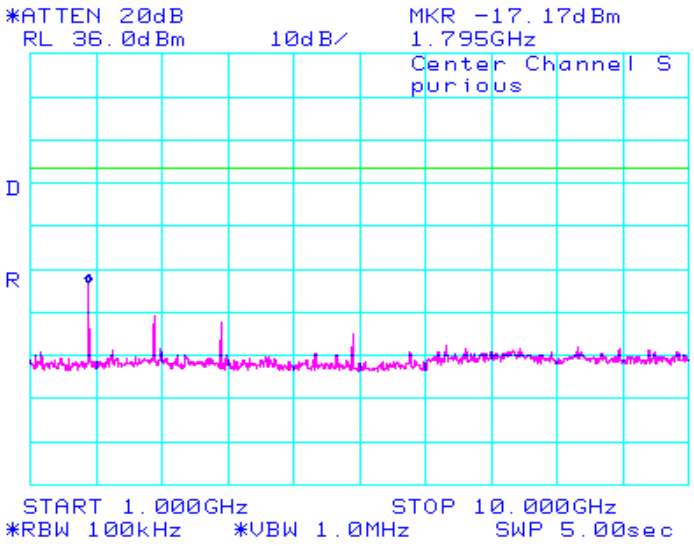
1,000 - 10,000 MHz

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #5: Continued - Spurious emissions, Center Channel



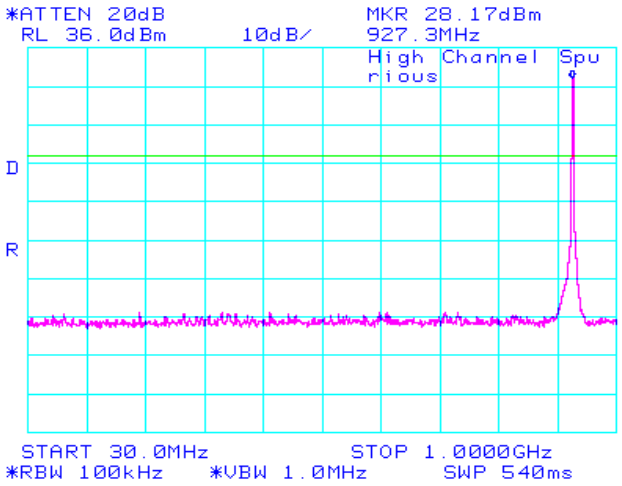
30 - 1000 MHz



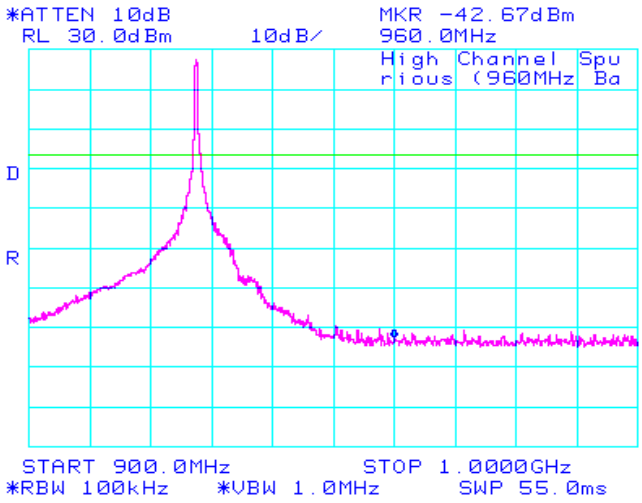
1,000 - 10,000 MHz

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #5: Continued - Spurious emissions, High Channel



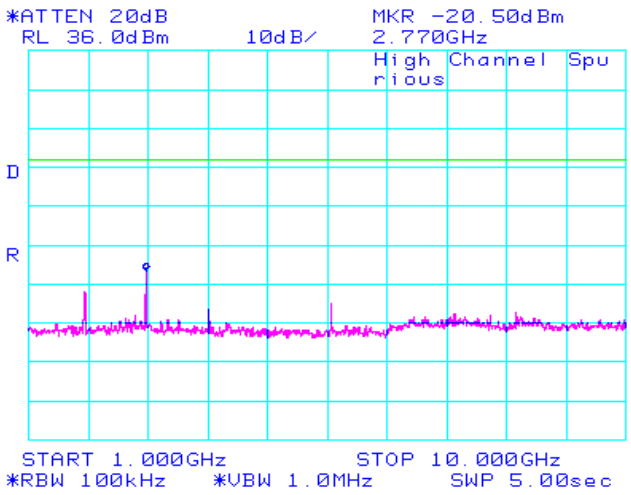
30 - 1000 MHz



960 MHz Restricted Band

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	N/A

Run #5: Continued - Spurious emissions, High Channel



1,000 - 10,000 MHz

Elliott

EMC Test Data

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Alien Technology

Model

NanoScanner

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.20	Class:	A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a radio which is designed to read RF ID tags. The radio is a frequency hopping spread spectrum device that uses 63 channels between 902.6MHz and 927.4 MHz. Normally, the EUT would be mounted to a wall during operation. For testing purposes the EUT was treated as table-top equipment during testing.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Alien Technology	NanoScanner	FHSS Radio	11	-

Other EUT Details

EUT operates in the 902 -928 MHz ISM band

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel.

Modification History

Mod. #	Test	Date	Modification
1			

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Emissions Spec:	FCC15.247(FHSS), 15.109, 15.20	Class:	A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	Latitude C600	Laptop	HQH9N01	-
Hewlett Packard	2225C	Printer	2714540166	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
RS-232	PC	RS-232	Shielded	1
Ethernet	PC	Cat-5	Unshielded	1
I/O	Alarms	RS-232	Shielded	1
Antenna 0	Antenna	HF141	Shielded	2
Antenna 1	Teminated 50Ohms	-	-	-
Power	AC mains	Power cable	Unshileded	1

EUT Operation During Emissions

The EUT was in the interrogation mode (transmitting) during tests performed against 15.247. For measurements made on individual channels the unit was operating only on that channel. For channel occupancy measurements the unit was operating in hopping mode.

For digital device emissions measurements, the unit was operating with the transmitter off, the receiver enabled and the EUT communicating to the PC.

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A

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: 6/18/2002
Test Engineer: Rafael
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: 14.6°C
Rel. Humidity: 81%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC 15.207/Class B	Pass	-5.4dB @ .543MHz

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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A

Run #1: AC Power Port Conducted Emissions, 0.45 - 30MHz, 120V/60Hz

Frequency	Level	AC	FCC 15.207 / Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.543	42.6	Line 1	48.0	-5.4	QP	
0.543	42.5	Neutral	48.0	-5.5	QP	
0.505	41.1	Neutral	48.0	-6.9	QP	
0.504	40.9	Line 1	48.0	-7.1	QP	
1.552	33.3	Neutral	48.0	-14.7	QP	
2.171	33.0	Line 1	48.0	-15.0	QP	

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	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: 6/20/2002
Test Engineer: Blair Wright
Test Location: Ch#2 and Oats#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 emissions testing.
Preliminary scans in an anechoic chamber were made at a test distance of 4m and the data was extrapolated to 10m. On the OATS, the measurement antenna was located 10 meters from the EUT for the measurement range 30 - 1000 MHz.
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: 14.4°C
Rel. Humidity: 77%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, 30 - 1000MHz - Maximized Emissions	FCC Class A Digital Device	Pass	-2.2dB @ 387.095MHz

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 Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A

Run #1: Preliminary Radiated Emissions, 30-1000 MHz, OATS scan based on run #1

Measurements made at 10m

Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
387.095	44.2	h	46.4	-2.2	QP	138	2.3	
265.420	43.3	h	46.4	-3.1	QP	123	3.5	
453.430	43.3	h	46.4	-3.1	QP	150	1.6	
265.420	42.7	v	46.4	-3.7	QP	91	1.0	
586.138	42.7	h	46.4	-3.7	QP	85	1.5	
453.430	41.6	v	46.4	-4.8	QP	210	1.0	2nd reading note 1
254.362	40.8	h	46.4	-5.6	QP	87	2.7	
464.486	40.6	h	46.4	-5.8	QP	138	1.5	
464.486	40.5	v	46.4	-5.9	QP	269	1.0	
475.546	40.2	h	46.4	-6.2	QP	202	1.6	
387.095	39.8	v	46.4	-6.6	QP	228	1.0	
243.290	39.7	h	46.4	-6.7	QP	100	2.6	
475.546	39.6	v	46.4	-6.8	QP	290	1.4	
519.780	39.6	v	46.4	-6.8	QP	359	1.0	
132.710	36.2	v	43.5	-7.3	QP	110	1.0	
309.657	39.1	v	46.4	-7.3	QP	249	1.0	
342.835	39.1	h	46.4	-7.3	QP	126	2.7	
243.280	39.0	v	46.4	-7.4	QP	95	2.6	
309.657	39.0	h	46.4	-7.4	QP	116	3.3	
276.470	38.9	v	46.4	-7.5	QP	95	1.0	
342.835	38.8	v	46.4	-7.6	QP	235	1.0	
254.340	38.3	v	46.4	-8.1	QP	127	1.0	
608.255	38.3	h	46.4	-8.1	QP	157	1.3	
597.242	38.0	h	46.4	-8.4	QP	169	1.8	
276.470	37.6	h	46.4	-8.8	QP	109	3.6	
331.777	37.5	h	46.4	-8.9	QP	126	2.7	
586.138	37.2	v	46.4	-9.2	QP	343	1.0	
331.777	37.0	v	46.4	-9.4	QP	268	1.0	
176.930	33.6	v	43.5	-9.9	QP	194	1.0	
442.405	36.4	h	46.4	-10.0	QP	152	1.9	
574.986	36.0	h	46.4	-10.4	QP	154	1.5	
442.405	34.2	v	46.4	-12.2	QP	256	1.0	
597.242	34.1	v	46.4	-12.3	QP	274	1.7	
519.780	34.0	h	46.4	-12.4	QP	162	1.9	
132.710	29.5	h	43.5	-14.0	QP	192	1.5	
300.015	32.2	v	46.4	-14.2	QP	274	1.0	

Client:	Alien Technology	Job Number:	J47256
Model:	NanoScanner	T-Log Number:	T47291
		Proj Eng:	David Bare
Contact:	Rob Martin		
Spec:	FCC15.247(FHSS), 15.109, 15.207	Class:	A

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

Measurements made at 10m

Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
574.986	31.6	v	46.4	-14.8	QP	209	1.1	
608.255	29.5	v	46.4	-16.9	QP	270	2.0	
263.600	29.3	h	46.4	-17.1	QP	102	3.5	
319.800	20.2	v	46.4	-26.2	QP	244	1.0	
374.000	19.1	v	46.4	-27.3	QP	0	1.0	

Note 1:	Ethernet Board Reseated. Prior reading was 46.6dB
Note 2:	Ambiant is to strong can not distinguish EUT from Ambiant.

Run #2: Maximized Radiated Emissions From Run #1

Measurements made at 10m

Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
387.095	44.2	h	46.4	-2.2	QP	138	2.3	
265.420	43.3	h	46.4	-3.1	QP	123	3.5	
453.430	43.3	h	46.4	-3.1	QP	150	1.6	
265.420	42.7	v	46.4	-3.7	QP	91	1.0	
586.138	42.7	h	46.4	-3.7	QP	85	1.5	
453.430	41.6	v	46.4	-4.8	QP	210	1.0	

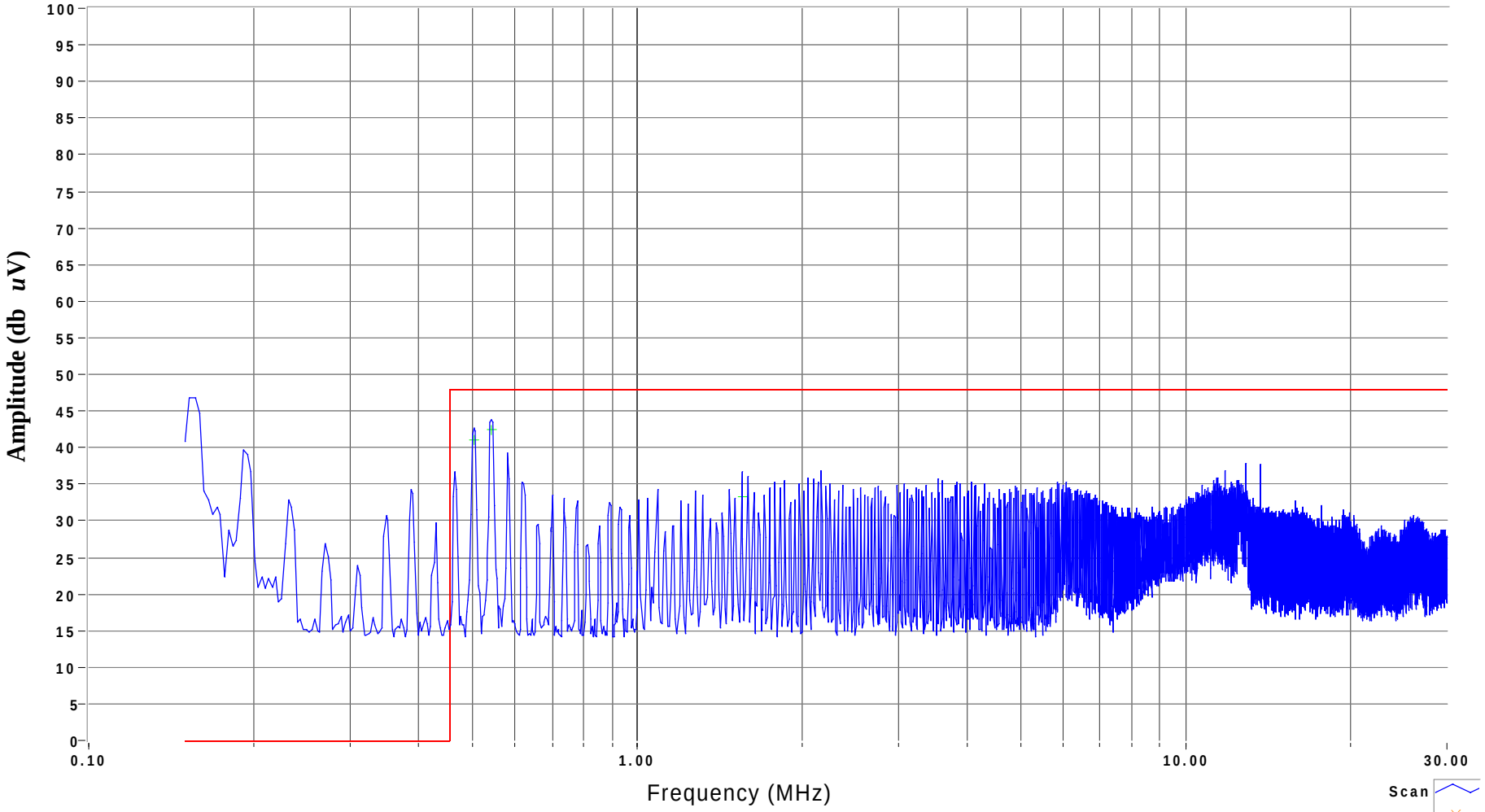
Elliott

SVOATS #3: Alien Technology Nannoscanner Run 1

Spec: FCC-B

Mains Lead Neutral

T47291



6/18/02

Rafael Varela

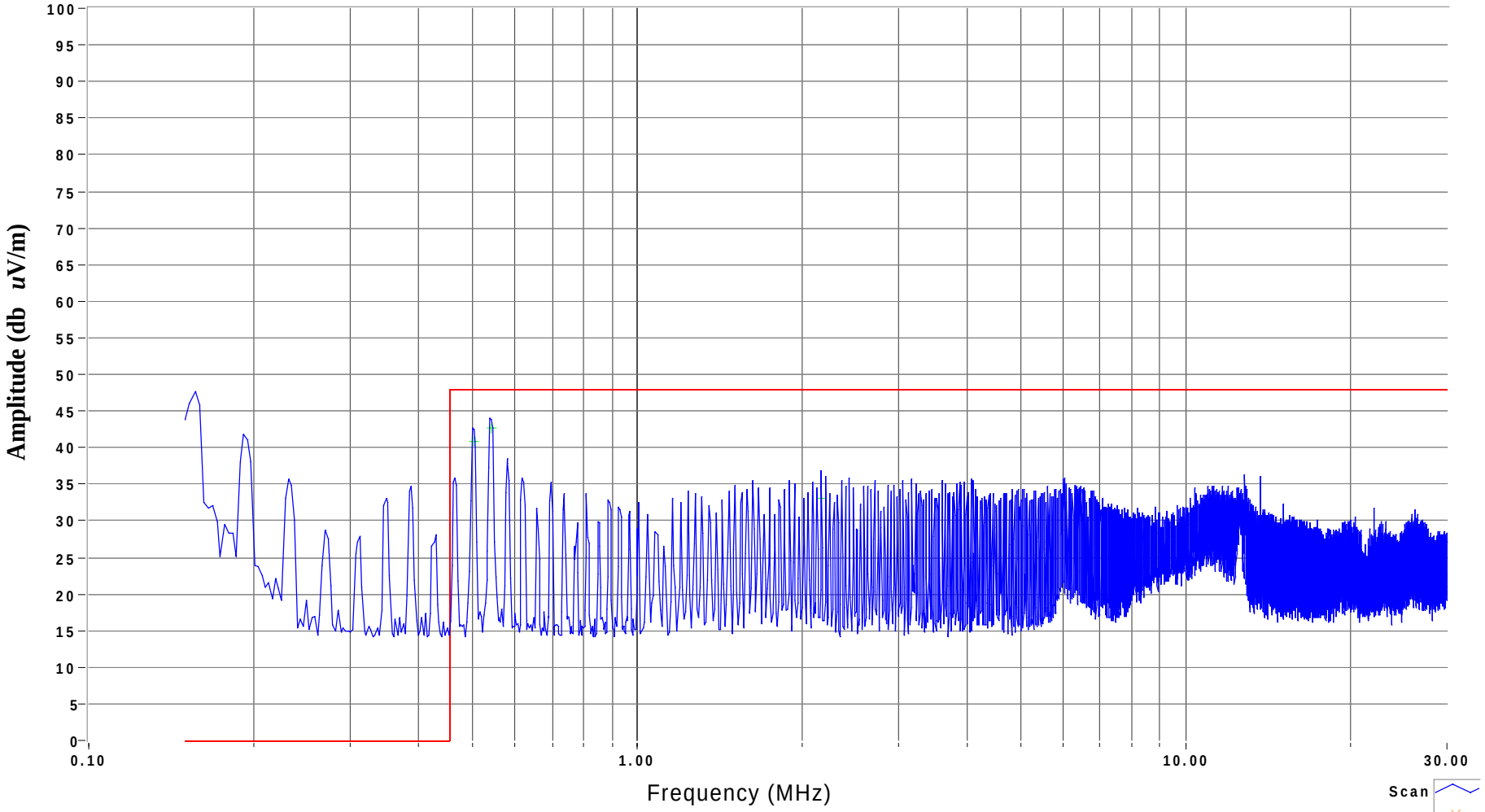
Elliott

SVOATS #3: Alien Technology Nannoscanner Run 1

Spec:
FCC-B

Mains Lead
Line 1

T47291



6/18/02

Rafael Varela