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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 Gyration, Inc. Model: AS00258

FCC ID:	JJ4-AS00258
GRANTEE:	Gyration, Inc. 12930 Saratoga Avenue, Suite C-6 Saratoga, CA. 95070
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	May 31, 2002
FINAL TEST DATE:	May 3, 2002
AUTHORIZED SIGNATORY:	Juan Martinez Sr. EMC Engineer

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SCOPE

An electromagnetic emissions test has been performed on the Gyration, Inc. model AS00258 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 Gyration, Inc. model AS00258 and therefore apply only to the tested sample. The sample was selected and prepared by Dan DeVaul of Gyration, Inc.

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 Gyration, Inc. model AS00258 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 Gyration, Inc. model AS00258. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT was not tested to the limits detailed in FCC Rules Part 15 Section 15.207 as the unit is battery operated.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.235 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.

Fundamental

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.235 Limit	FCC 15.235 Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
49.825	70.5	v	80.0	-8.7	QP	158	1.0	

Harmonics

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.235 Limit	FCC 15.235 Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
199.300	36.1	V	43.5	-7.4	Pk	115	1.0	

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 Gyration, Inc. model AS00258 is a cordless mouse. Since the EUT is hand-held, therefore, it was tested in three orthogonal axes. The EUT operates from a dc voltage of 4.5V supplied by internal batteries. The EUT can be seated in a charging cradle when re-chargeable batteries are used, but must be taken out of the cradle in order to operate. It cannot operate (transmit) while installed in the cradle.

The sample was received on May 3, 2002 and tested on May 3, 2002. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Gyration/AS00258/Mouse	-

ENCLOSURE

The EUT enclosure is primarily constructed of non-conductive polycarbonate plastic. It measures approximately 12 cm long by 5.5 cm wide at the widest point by 4.5 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

No support equipment was used during emissions testing.

EXTERNAL I/O CABLING

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

Cable Description	Length (m)	From Unit/Port	To Unit/Port
None	-	-	-

TEST SOFTWARE

The EUT was set to continuously transmit at 49.825 MHz for Japan, US, and Canada. It was powered from alkaline batteries during testing.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on May 3, 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.

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.

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.

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:

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 - 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

Radiated Emissions, 30 - 1000 MHz, 03-May-02
Engineer: mfaustino

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
Hewlett Packard	EMC Spectrum Analyzer, Opt. 026 ¸9 KHz -26.5GHz	8593EM	1141	12	3/11/2002	3/11/2003
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1404	12	2/26/2002	2/26/2003
Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP	273	12	1/22/2002	1/22/2003

Radiated Emissions, 30 - 1000 MHz, 5-Jul-02
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	12	5/13/2002	5/13/2003
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	8/28/2001	8/28/2002
Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	1332	12	4/16/2002	4/16/2003

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T47069 6 Pages

Elliott

EMC Test Data

Client:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Emissions Spec:	FCC 15.235	Class:	-
Immunity Spec:	-	Environment:	

EMC Test Data

For The

Gyration

Model

AS00258

Client:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Emissions Spec:	FCC 15.235	Class:	-
Immunity Spec:	-	Environment:	

EUT INFORMATION

General Description

The EUT is a cordless mouse which is designed for hand-held operation. The EUT was, therefore, tested in three orthogonal axes. The EUT opertaes from a dc voltge of 4.5V supplied by inetrnal batteries. The EUT can be seated in a charging cradle when re-chargable batteries are used, but must be taken out of the cradle in order to operate. It cannot operate (transmit) while installed in the cradle.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Gyration	AS00258	Ultra Cordless Mouse	N/A	JJ4-AS00258

EUT Enclosure

The EUT enclosure is primarily constructed of non-conductive polycarbonate plastic. It measures approximately 12 cm long by 5.5 cm wide at the widest point by 4.5 cm high.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None made

Client:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Emissions Spec:	FCC 15.235	Class:	-
Immunity Spec:	-	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

EUT Interface Ports

EUT Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	The EUT is a portable, stand-alone device with no interface ports to connect to peripherals during operation.			

EUT Operation During Emissions

The EUT was set to continuously transmit at 49.825 MHz for Japan, US, and Canada. It was powered from alkaline batteries during testing.

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EMC Test Data

Client:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Spec:	FCC 15.235	Class:	-

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: 5/3 & 7/5/2002
Test Engineer: Mfaustino/jmartinez
Test Location: SVOATS #3 & #2
Config. Used: 1
Config Change: none
EUT Voltage: 4.5Vdc via 3 alkaline batteries

General Test Configuration

The EUT was located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3 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: 13°C & 21
Rel. Humidity: 66% & 45%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 49.825 MHz, Fundamental emissions	FCC 15.235	Pass	-8.7 dB @ 49.825MHz
2	RE, 30 - 1000MHz - Maximized Emissions	FCC 15.209	Pass	-7.4dB @ 199.3MHz
3	RE,Band edge Measurements	FCC 15.235	Pass	emissions >26dB below carrier

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:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Spec:	FCC 15.235	Class:	-

Run #1: Fundamental Signal Level
S/N 155 49 MHz
Initial measurements made to determine the orinetation of the EUT that produced the highest signal level.
Channel 1

Frequency	Level	Pol	FCC 15.235		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
49.825	71.3	v	80.0	-8.7	Pk	158	1.0	EUT upright
49.825	65.9	h	80.0	-14.1	Pk	82	2.8	EUT on its left side
49.825	65.4	h	80.0	-14.6	Pk	259	3.1	EUT on its back
49.825	64.9	v	80.0	-15.1	Pk	338	1.0	EUT on its left side
49.825	55.6	h	80.0	-24.4	Pk	249	2.7	EUT upright
49.825	55.6	v	80.0	-24.4	Pk	192	3.1	EUT on its back

Run #2: Maximized Radiated Emissions, 30-1000 MHz (Data re-taken on 7/5/02 by Jmartinez)
s/n155 49MHz, EUT upright (worst-case), with alkaline batteries

Frequency	Level	Pol	FCC 15.235/15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
199.300	36.1	V	43.5	-7.4	Pk	115	1.0	signal substitution
398.600	38.3	V	46.0	-7.7	Pk	118	1.0	
498.250	37.9	V	46.0	-8.1	Pk	200	1.0	
249.125	34.9	V	46.0	-11.1	Pk	22	1.0	
249.128	34.6	H	46.0	-11.4	Pk	225	3.0	
40.000	27.6	H	40.0	-12.4	Pk	222	2.4	
448.425	30.5	V	46.0	-15.5	Pk	301	1.0	
149.475	28.0	V	43.5	-15.5	Pk	258	1.0	
298.949	29.0	V	46.0	-17.0	Pk	0	2.1	
298.950	28.9	H	46.0	-17.1	Pk	320	1.8	
398.600	28.9	H	46.0	-17.1	Pk	14	1.0	
298.949	28.6	H	46.0	-17.4	Pk	15	3.1	
498.250	26.8	H	46.0	-19.2	Pk	189	2.1	
149.475	24.0	H	43.5	-19.5	Pk	22	1.3	
448.425	21.4	H	46.0	-24.6	Pk	55	1.5	
348.775	20.6	V	46.0	-25.4	Pk	180	1.0	
348.775	20.1	H	46.0	-25.9	Pk	35	2.1	

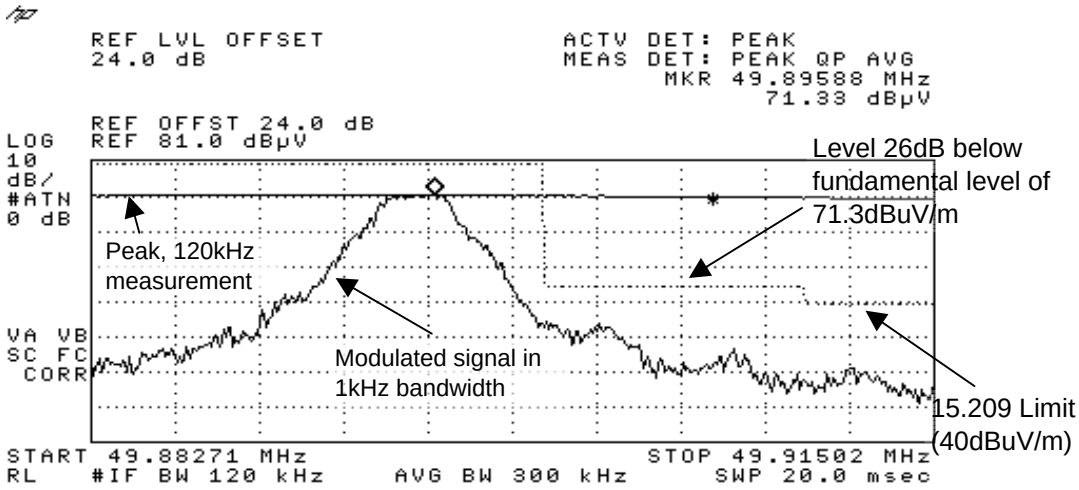
Note 1: No emission detected at 99.65 MHz.

Client:	Gyration	Job Number:	J46997
Model:	AS00258	T-Log Number:	T47069
		Proj Eng:	Mark Briggs
Contact:	Dan DeVaul		
Spec:	FCC 15.235	Class:	-

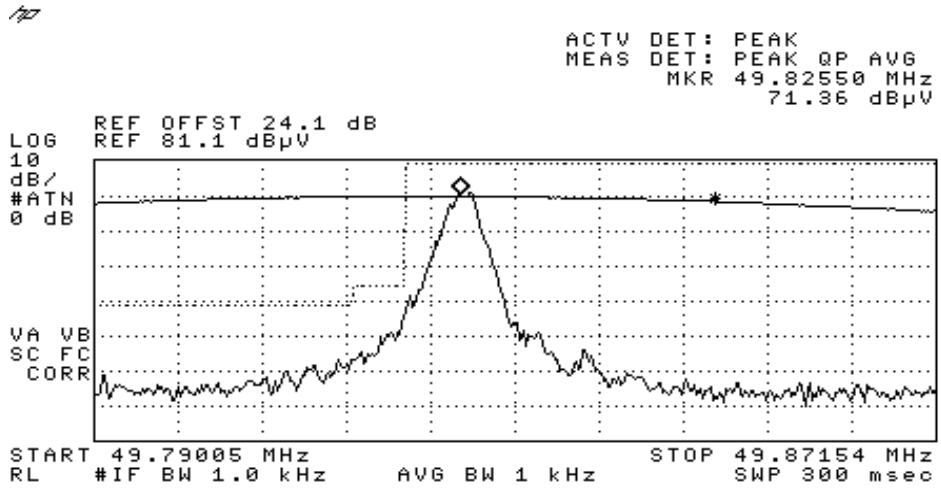
Run #3: Band edge measurements

The following plots were made with the unit operating on the highest and lowest channels. Each plot contains two traces, the first uses a resolution bandwidth of 120kHz to show that the peak level of the modulated and unmodulated signals are the same. The second trace uses a resolution bandwidth of 1kHz to demonstrate that:

- within 10kHz of the band edges, the signal level is more than 26dB below the fundamental signal level
- more than 10kHz from either band edge the signal level is below the field strength limit of 15.209



High channel, upper band edge measurement



Low Band Edge (EUT on lowest channel)