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Electromagnetic Emissions Test Report
For a Class II Permissive change
FCC Part 22 Subpart H
on the
350W Multicarrier Amplifier
Model: MPCS2350

GRANTEE:	Spectrian 350 W. Java Dr. Sunnyvale, CA 94089
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	October 1, 2002
FINAL TEST DATE:	September 27, 2002
AUTHORIZED SIGNATORY:	Juan Martinez Sr. EMC Engineer

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FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part2, Subpart J, Section 2.1033(C).

2.1033(c)(1) Applicant:

Spectrian
350 W. Java Dr.
Sunnyvale, CA 94089

2.1033(c)(2) FCC ID: **I2OMCPS2000**

2.1033(c)(4) Type of emissions

GSM modulation: 300KGXW
EDGE modulation: 300KG7W

2.1033(c)(5) Frequency Range

Transmit: 869 – 894 MHz

2.1033(c)(6) Range of Operation Power

Maximum 55.4 dBm

2.1033(c)(7) Maximum Power Rating

Section 22.913(a): Maximum ERP: The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts.

2.1033(c)(12) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) Equipment Employing Digital Modulation

Not applicable EUT is an amplifier

2.1033(c)(14) Data taken per Section 2.1046 to 2.1057

Refer to Exhibit 2

SCOPE

FCC Part 22, Subpart H testing was performed for the equipment mentioned in this report. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules. TIA-603 may also be used as a test procedure guideline to perform the some of the required tests.

The intentional radiator above was 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.

OBJECTIVE

The primary objective of the manufacturer is compliance with FCC part 22 Subpart H. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC. FCC issues a grant of equipment authorization and a certification number 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 subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that 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.).

PERMISSIVE CLASS II CHANGES

1) Adding new emission modulation transmissions to the original granted submission.

No other changes were made to the unit other then as mention above.

EMISSION TEST RESULTS

Section 2.1046: RF Power Output

The RF Power Output was tested to Section 22.913(a)

The following modulations were tested: GSM & EDGE

Procedure used: **B**

Result: 55.4 dBm (using Power meter)

Refer to Setup Photo# 1 & 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

Section 2.1049: Occupied Bandwidth

The RF Power Output was tested to Section

The following modulations were tested: GSM & EDGE

Procedure used: **C**

Result: 247.3 kHz (GSM); 243 kHz (EDGE)

Refer to Setup Photo# 1 & 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

The Spurious Emission at the Antenna terminal was tested to Section 22.917(e).

The following modulations were tested: GSM & EDGE

Procedure used: **D & J**

Result: -14.9 dBm F3 intermod (GSM Modulation)

Refer to Setup Photo# 1 and 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Spectrian model MCPS2350 is a Multicarrier Cellular Amplifier that is designed to provide amplification for cellular base stations signals. Normally, the EUT would be placed on a table during operation. During emissions testing the EUT was placed on a table such that it was at a height of 0.8 m above the ground plane.

The sample was received on September 27, 2002 and tested on September 27, 2002. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Spectrian/MCPS2350/Amplifier	N/A

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 21.56 in wide by 17.72 in deep by 13.97 in high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number	FCC ID
Agilent	E4433B	Signal Generator	US40051573	N/A
Agilent	E4433B	Signal Generator	U37231291	N/A
Narda	3001-10	Directional Coupler	33832	N/A
Narda	41620	Combiner	N/A	N/A
Weinschel	82-30-34	30-dB Attenuator	MK969	N/A

EUT INTERFACE PORTS

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

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
Input	Signal Generators	Coaxial	Shielded	1.5
Output	Attenuator	Coaxial	Shielded	1.5
DC input	DC power	2-wire	Unshielded	1.5

EUT OPERATION

The EUT was set to transmit continuously at maximum power.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 27 , 2002 at Spectrian Facility, for the Antenna Conducted Emission measurements, located at 350 W. Java Dr., Sunnyvale, California.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing are performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring 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 particular 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. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

INSTRUMENT CONTROL COMPUTER

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

POWER METER

A power meter and thermister mount may be used for 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 EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and 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 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.

The requirements of ANSI C63.4 were used for configuration of the equipment turntable. It 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

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

TEST PROCEDURES

GENERAL: For transmitters with a detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

For transmitters with non-detachable antennas, field strength measurements are performed. The substitution method is also performed for the appropriate test requirement.

Procedure B – Power Measurement (Power Meter Method): The following procedure was used for transmitters that have removable antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) A power meter was used to measure the power output.
3) A power meter was used. Corrected for any external attenuation used for the protection of the input of the sensor head. Also set the power sensor correction by setting up the frequency range that will be measured.
4) Repeat this for the middle and high channel and all modulations that will be used and all output ports used for transmission

Procedure C – Amplifier Bandwidth (Conducted Method): If the EUT is an amplification device the following procedure was performed:

1) Set the EUT to maximum power and to the lowest channel. Set the Resolution to 3 kHz and Video Bandwidth to 30 kHz, with no averaging. These settings were used to show the true representation of the signal bandwidth.
2) Made a plot of the EUT output port and label it "Output"
3) With the same setting on the spectrum analyzer connect the cable that was connected to the input port of the amplifier to the analyzer. Made a plot and label it "Input"
   Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure D – Intermodulation (Two-Tone Method): If the EUT is an amplification device the following procedure was performed:

1) Set the EUT to maximum power. Set the Resolution and Video Bandwidth to 30 kHz, with no averaging for constant envelope modulation and 100 samples averaging for non-constant envelope modulation.
2) Set 1st signal generator to F1 = 876 MHz and 2nd signal generator to F2 = 884 MHz. Used the following formula to determine the F3 and F4 intermods:

$$F3 = 2(F1) – F2$$
$$F4 = 2(F2) – F1$$

3) Set the spectrum analyzer display line function to –13-dBm.
4) The span of the spectrum analyzer was set to display the two-tone, intermods, and anything other spurious emissions.

5) All spurious or intermodulation emission must not exceed the –13-dBm limit. Steps 1 to 4 were repeated for all modulations and output ports that will be used for transmission.

Procedure J – Antenna Conducted Emissions: For spurious emission measurements at the antenna terminal the following procedure was performed:

1) Set the transmitting two-tone signals to maximum power.
2) Set the spectrum analyzer display line function to –13-dBm.
3) Set the spectrum analyzer bandwidth to 30 kHz.
4) For the spectrum analyzer, the start frequency was set to 9 kHz and the stop frequency set to 9000 MHz. All spurious or intermodulation emission must not exceed the –13-dBm limit.
   Steps 1 to 3 were repeated for all modulations and output ports that will be used for transmission.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

RADIATED EMISSIONS SPECIFICATION LIMITS

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver or spectrum analyzer.

Below is the formula used to calculate the attenuation requirement, relative to the transmitters power output when the field strength in dBuV/m is measured. For this example an operating power of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64}}{3 \text{ meters}} = 4.05 \text{ V/m}$$

20 * log (4.05 V/m * 1,000,000) = 132.15 dBuV/m @ 3 meters

FCC Rules require an attenuation of 43 + 10 log (3) or 47.77 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.15 dBuV/m – 47.77 dB = 84.38 dBuV/m @ 3 meter.

Note: For EIRP the calculation yields a value of 82.2 dBuV/m @ 3 meters. The substitution method is used for spurious emission not being 20 dB below the calculated field strength.

EXHIBIT 1: Test Equipment Calibration Data

Antenna Conducted Emissions, 01-Oct-02
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Spectrum Analyzer 9KHz - 26GHz	8563E	284	12	3/21/2002	3/21/2003

Power Output Measurement, 01-Oct-02
Engineer: jmartinez

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

EXHIBIT 2: Test Measurement Data

The following data includes the Antenna conducted emission measurements of the Spectrian model: MCPS2350.

T48815, 11 pages

Elliott

EMC Test Data

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Emissions Spec:	FCC 22 H	Class:	Cellular
Immunity Spec:		Environment:	

EMC Test Data

For The

Spectrian

Model

MCPS2350

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Emissions Spec:	FCC 22 H	Class:	Cellular
Immunity Spec:	Enter immunity spec on cover	Environment:	

EUT INFORMATION

General Description

The EUT is an cellular amplifier which is designed to be used with Cellular station and towers. Normally, the EUT would be placed on a rack during operation. The EUT was instead treated as table-top equipment during testing to simulate the end user environment. The electrical rating of the EUT is 26Vdc, 175 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Spectrian	MCPS2350	amplifier	N/A	I2OMCPS2000

EUT Enclosure

he EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 21.56 in wide by 17.72 in deep by 13.97 in high.

Modification History

Mod. #	Test	Date	Modification
1			
2			
3			

Elliott

EMC Test Data

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Emissions Spec:	FCC 22 H	Class:	Cellular
Immunity Spec:	Enter immunity spec on cover	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Agilent	E4433B	Signal Generator	US40051573	N/A
Agilent	E4433B	Signal Generator	U37231291	N/A
Narda	3001-10	Directional Coupler	33832	N/A
Narda	41620	Combiner	N/A	N/A
Weinschel	82-30-34	30-dB Attenuator	MK969	N/A

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

EUT Interface Ports

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
Input	Signal Generators	Coaxial	Shielded	1.5
Ouput	Attenuator	Coaxial	Shielded	1.5
DC input	DC Power Supply	2 wire	Unshielded	1.5

EUT Operation During Emissions

EUT was set to continously transmitt at maximum power.

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Section 2.1046: RF Power

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: 9/27/2002
Test Engineer: jmartinez
Test Location: Off-site
Config. Used: 1
Config Change: None
EUT Voltage: 26Vdc

General Test Configuration

The EUT was located on the turntable for radiated field strength measurements and the local support equipment was located underneath the table.
A power meter was used to the measure the RF power of the EUT. An attenuator was used to protect the front end of the power sensor head. Also, the attenuator value was programmed into the power meter.

Ambient Conditions:

Temperature: 16° C
Rel. Humidity: 49%

Summary of Results

Run #	Test Performed	Limit	Result	Comment
1	Output Power	22.913(a)	Pass	

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:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Run #1: Conducted Output Power

Output power measured with a Peak Power Sensor (NRV-232, Asset# 1423), Power Meter (NRVS, Asset# 1422)

	Freq (MHz)	Measured Value (dBm)	Correction factor (dB)	Power Output (dBm)	Comments
	876.00	-4.20	59.6	55.40	Power Meter

Attenuator value enter into power meter.

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Section 2.1049: Occupied Bandwidth

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: 9/27/2002
Test Engineer: jmartinez
Test Location: Off-site

Config. Used: 1
Config Change: None
EUT Voltage: 26Vdc

General Test Configuration

When performing conducted measurements 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. Modulation must not exceed manufactures stated bandwidth.

For this specific test the occupied bandwidth was measured to provide the correct Resolution bandwidth that will be used. This requirement is specified in 22.917(h).

Because the EUT is an amplifer, input and output plots were made to show that the bandwidth was not altered. By altered we refer to the bandwidth increasing in width.

Ambient Conditions:

Temperature: 16°C
Rel. Humidity: 49%

Summary of Results

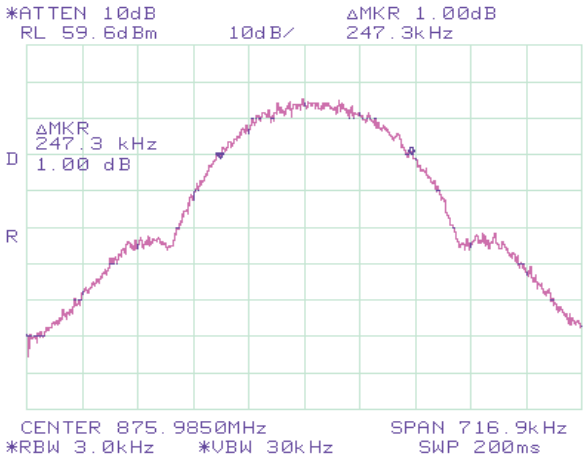
Run	Test Performed	Limit	Result	Comment
1	Occupied Bandwidth & Input - output plots	Per FCC requirement	Pass	GSM modulation
2	Occupied Bandwidth & Input - output plots	Per FCC requirement	Pass	EDGE Modulation

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Run #1: Occupied Bandwidth (GSM modulation)

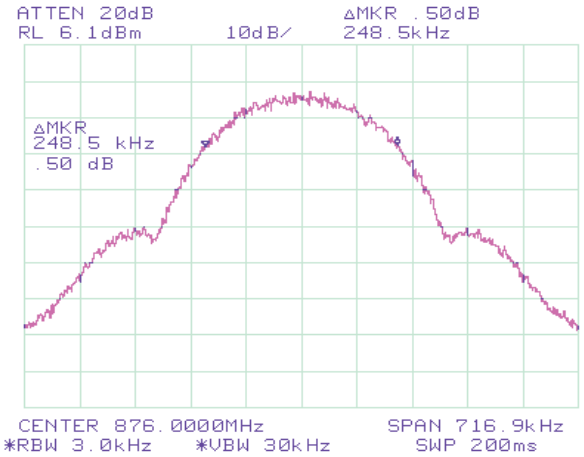
Measured Value	Specified Bandwidth	Resolution	Comments
(MHz)	(MHz)	(kHz)	
247.3	300	3	

Output Plot



GSM modulation
Output Plot

Input Plot



GSM modulation

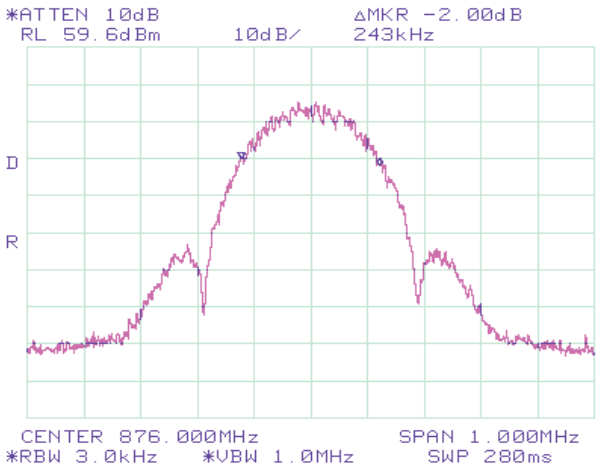
Input Plot

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Run #2: Occupied Bandwidth (EDGE Modulation)

Measured Value	Specified Bandwidth	Resolution	Comments
(MHz)	(MHz)	(kHz)	
243	300	3	

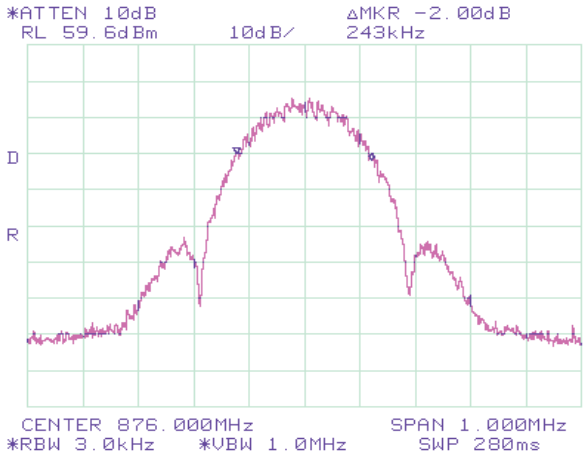
Output Plot



Edge Modulation

Output Plot

Input Plot



Edge Modulation

Output Plot

Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Section 2.1051: Spurious emission at the Antenna Terminal

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: 9/27/2002
Test Engineer: jmartinez
Test Location: Off-site
Config. Used: 1
Config Change: None
EUT Voltage: 26Vdc

General Test Configuration

The EUT and all local support equipment were located on the table for testing. The Eut was connected directly to Test Receiver. A 50-dB attenuator was used between the EUT and Test Receiver.

Ambient Conditions:

Temperature: 16°C
Rel. Humidity: 49%

Summary of Results

Run	Test Performed	Limit	Result	Comment
1	Intermodulation & Out-of-Band Emissions	22.917 (e)	Pass	GSM Modulation
2	Intermodulation & Out-of-Band Emissions	22.917 (e)	Pass	EDGE Modulation

Modifications Made During Testing:

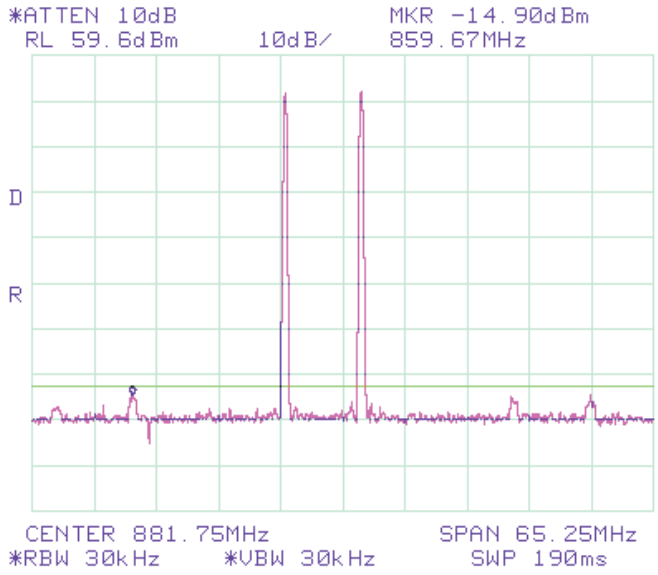
No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

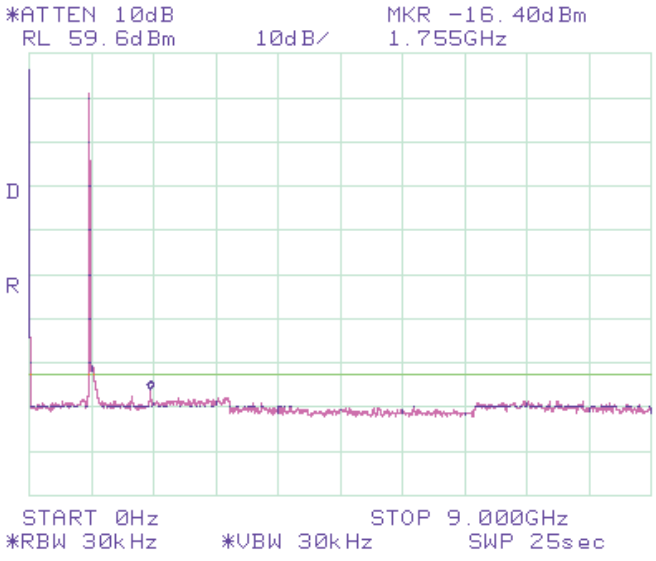
Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Run #1: Intermodulation & Out-Of-Band emissions (GSM Modulation)



GSM Modulation

Intermodulation (Two-Tone)

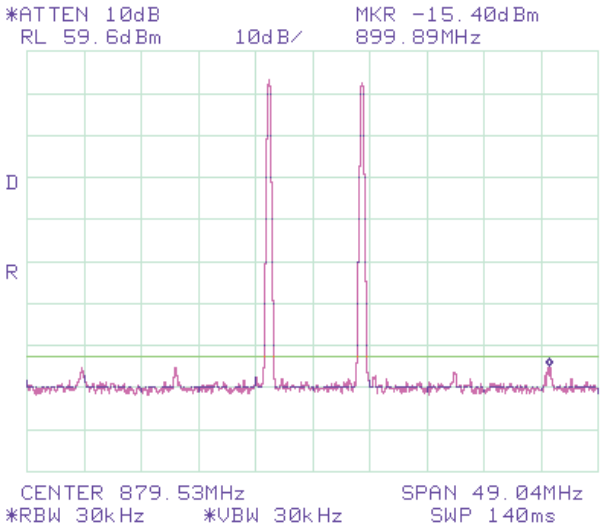


GSM Modulation

Conducted Out-of-Band Emissions

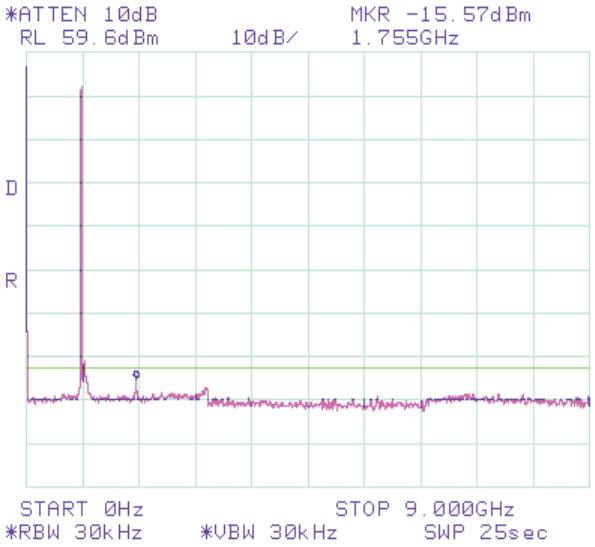
Client:	Spectrian	Job Number:	J48808
Model:	MCPS2350	T-Log Number:	T48815
		Proj Eng:	Juan Martinez
Contact:	Gary Glaze		
Spec:	FCC 22 H	Class:	N/A

Run #2: Intermodulation & Out-Of-Band emissions (EDGE modulation)



Edge Modulation

Intermodulation emission



Edge Modulation

Conducted Out-of-Band Emissions