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Electromagnetic Emissions Test Report In Accordance With Industry Canada Radio Standards Specification 119 Issue 6, FCC Part 90 on the Microwave Data Systems Transmitter Model: ROR220 PA

FCC ID NUMBER:	E5MDS-ENETL2W
UPN:	3738A-ENETL2W
GRANTEE:	Microwave Data Systems 175 Science Parkway Rochester, NY 14620
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	May 25, 2004
FINAL TEST DATE:	May 14 and May 22, 2004
AUTHORIZED SIGNATORY:	Juan Martinez Senior EMC Engineer

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FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, Section 2.1033(C) & to Industry Canada RSP-100.

2.1033(c)(1) Applicant:

Microwave Data Systems
175 Science Parkway
Rochester, NY 14620

2.1033(c)(2) & RSP-100 (4) FCC ID: E5MDS-ENETL2W
UPN: 3738A-ENETL2W

2.1033(c)(3) & RSP-100 (7.2(a)) Instructions/Installation Manual

Please refer to Exhibit 7: User Manual, Theory of Operation, and Tune-up Procedure

2.1033(c)(4) & RSP-100 (7.2(b)(iii)) Type of emissions

FCC 90 & RSS-119**: 6K8F1D**

2.1033(c)(5) & RSP-100 (7.2(a)) Frequency Range

FCC 90 & RSS-119**: 217 – 222 MHz**

2.1033(c)(6) & RSP-100 (7.2(a)) Range of Operation Power

FCC 90 & RSS-119**: 10 – 20 Watts**

2.1033(c)(7) & RSP-100 (7.2(a)) Maximum FCC & IC Allowed Power Level

FCC 90 & RSS-119**: 50 Watts Maximum**

2.1033(c)(8) & RSP-100 (7.2(a)) Applied voltage and currents into the final transistor elements

14Vdc, 3.2 Amps

2.1033(c)(9) & RSP-100 (7.2(a)) Tune-up Procedure

Please refer to Exhibit 7: User Manual and Theory of Operation

2.1033(c)(10) & RSP 100 (7.2(a)) Schematic Diagram of the Transmitter

Refer to Exhibit 6: Schematic diagram

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Frequency Stabilization

Not applicable EUT is an amplifier

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Suppression of Spurious radiation

Please refer to Exhibit 6: Schematic diagram.

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Modulation

Not applicable EUT is an amplifier.

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Power

A variable resistor that can only be varied between 10 and 20 watts controls the power limitation.

2.1033(c)(11) & RSP-100 (7.2(g)) Photographs or Drawing of the Equipment Identification Plate or Label

Refer to Exhibit 4

2.1033(c)(12) & RSP-100 (7.2(c)) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) & RSP-100 (7.2(a)) Equipment Employing Digital Modulation & 90.203 (Certification Requirements)

Not applicable EUT is an amplifier

2.1033(c)(14) & RSP-100 (7.2(b)(ii)) Data taken per Section 2.1046 to 2.1057 and RSS-133 issue 2, Rev. 1.

Refer to Exhibit 2

DECLARATIONS OF COMPLIANCE

Equipment Name and Model:
ROR220 PA

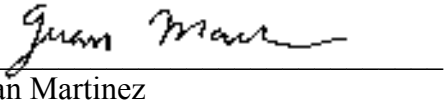
Manufacturer:
Microwave Data Systems
175 Science Parkway
Rochester, NY 14620

Tested to applicable standards:
RSS-119, Issue 6 (Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 MHz).
FCC Part 90 (Private Land Mobile Radio Service)

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC2845-**2** Dated August 8, 2001

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of TIA/EIA-603 and the specific RSS standards applicable to this device); and that the equipment performed in accordance with the data submitted in this report.

Signature	
Name	Juan Martinez
Title	Senior EMC Engineer
	Elliott Laboratories Inc.
Address	684 W. Maude Ave
	Sunnyvale, CA 94086
	USA
Date:	May 25, 2004

Maintenance of compliance with the above standards 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.).

SCOPE

FCC Part 90 & IC RSS-119 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 & IC RSS-119. TIA-603 was also used as a test procedure guideline to perform some of the required tests.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC & RSS 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 the FCC Part 90 & IC RSS-119. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033 & RSP-100.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC & Industry Canada. FCC & Industry Canada 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.).

SUMMARY OF TEST RESULTS

Part 90 and RSS-119 Test Summary

Measurement Required	FCC Part 2 & 90 Sections	RSS-119 Section	Test Performed	Measured Value	Test Procedure Used	Result
Modulation Tested	GMSK	GMSK	-	-	-	-
Modulation characteristics	2.1047/	5.7	Modulated with appropriated signal	-	H	-
Radiated RF power output (ERP/EIRP)	2.1046 / 90.279 & 90.205(g)	6.2	Radiated Output Power Test	-	-	-
Conducted RF power output	2.1046 / 90.279 & 90.205(g)	6.2	Conducted Output Power Test	43.1 dBm (20.4 Watts)	B	Complies
Spurious emissions at antenna Port	2.1051/ 90.210(d)	6.3 & 6.4(d)	Emission Limits and/or Unwanted Emission 30MHz – 5GHz (**Antenna Conducted**)	All spurious emissions < -25 dBm	J	Complies
Occupied Bandwidth	2.1049/ 90.210(c) & (d)	6.4(c) & 6.4(d)	Emission Mask and 99% Bandwidth	Refer to Plots	C & D	Complies
Field strength of spurious radiation	2.1053 / 90.210(d)	6.3 & 6.4(d)	Radiated Spurious Emissions 30MHz – 5GHz	49.8 dBuV/m @ 160 MHz (-20.5 dB)	N	Complies
Frequency stability	2.1055 / 90.213	7	Frequency Vs. Temperature	-	K	Unit is an Amplifier
Frequency stability	2.1055 / 90.213	7	Frequency Vs. Voltage	-	L & M	Unit is an Amplifier
Transient Frequency Behavior	90.214	6.5	Transient Behavior	-	I	-
Exposure to Mobile devices	2.1091	9	Exposure of Humans to RF Fields	-	-	-
Receiver	15.109	8	Receiver Spurious Emissions	-	N/A	-

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

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

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Microwave Data Systems model ROR220 PA is a 200 MHz Land Mobile amplifier, which is designed to increase the transmitter power in low coverage areas. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 14 Vdc, 4 Amps.

The sample was received on May 14, 2004 and tested on May 14 and May 22, 2004. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Microwave Data Systems ROR220 PA 200 MHz Amplifier	-

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 10 cm wide by 10 cm deep by 4 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

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

Manufacturer/Model/Description	Serial Number	FCC ID Number
Microwave Data Systems 200 MHz Radio	N/A	N/A
Topward 3603D DC Source	N/A	N/A
Xantrex XDC 80-75 DC Source	N/A	N/A
IBM 2647 Laptop	78-7PX8M	DoC

No remote support equipment was used during emissions 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)
RF Out	Spectrum Analyzer	Coaxial	Shielded	0.5
RF In	200 MHz Radio	Coaxial	Shielded	0.5
DC in	Xantrex	2 wire	Unshielded	0.6

EUT OPERATION DURING TESTING

Operating on low, middle, and high channel at full power continuously.

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TEST SITE

GENERAL INFORMATION

Final test measurements were taken on May 14 and May 22, 2004 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to Section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the Commission.

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 or Anechoic Chamber. 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.

PEAK POWER METER

A peak 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

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 appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

General: For Transmitters with 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. The attenuators and/or filters are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

Procedure B – Power Measurement (Conducted Method): The following procedure was used for transmitters that do use external antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) Either a power meter or a spectrum analyzer was used to measure the power output.
3) If a spectrum analyzer was used a resolution and video bandwidth 10kHz was used to measure the power output. Corrected for any external attenuation used for the protection of the input of analyzer. In addition, For CDMA or TDMA modulations set spectrum analyzer resolution to 1MHz and video to 30 kHz. Use video averaging with a 100-sample rate.
4) If 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.
5) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure C - Occupied Bandwidth (Conducted Method): Either for analog, digital, or data modulations, occupied bandwidth was performed. The EUT was set to transmit the appropriate modulation at maximum power. The bandwidth was measured using following methods:

1) The built-in 99% function of the spectrum analyzer was used.
2) If the built-in 99% is not available then the following method is used:

   26-dB or 20-dB was subtracted to the maximum peak of the emission. Then the display line function was used, in conjunction with the marker delta function, to measure the emissions bandwidth.

3) For the above two methods a resolution and video bandwidth of 100 or 300 Hz was used to measure the emission's bandwidth.

Procedure D – 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 and Video Bandwidth to 300 Hz, 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 H - Other Types of Equipment: Either digital or data modulated signals were simulated, by software or external sources, to performed the required tests. The EUT was set to transmit the appropriate digital modulation.

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

1) Set the transmitting signal at the middle of the operating range of the transmitter, as specified in the standard. Power is set to maximum and then to minimum.
2) Set the spectrum analyzer display line function to –25dBm.
3) Set the spectrum analyzer bandwidth to 10kHz <1GHz and 1 MHz >1GHz.
4) For the spectrum analyzer, the start frequency was set to 30 MHz and the stop frequency set to the 10^{th} harmonic of the fundamental. All spurious or intermodulation emission must not exceed the –25dBm limit.
5) Steps 1 to 4 were repeated for all modulations and output ports that will be used for transmission.

Procedure K - Frequency Stability: The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The spectrum analyzer is configured to give a 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. The Temperature chamber was varied from –30 to +50° C (or +60° C) for some IC RSS standards, if applicable) in 10 degrees increment. The EUT was allowed enough time to stabilize for each temperature variation.

Procedure L - Frequency Stability: For AC or DC operated devices the nominal voltage is varied to 85% and to 115% at either room temperature or at a controlled +20°C temperature.

Procedure M - Frequency Stability: For battery-powered devices the voltage battery end-point is determined by reducing the dc voltage until the unit ceases to function. This is performed at either room temperature or at a controlled +20°C temperature.

Procedure N - Field Strength Measurement: The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the low and high of the frequency band and set at maximum output power.

For the first scan, a pre-liminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One or more of these is with the antenna polarized vertically while the one or more of these are 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.

For the final measurement, Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a horn antenna and a signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level was adjusted until a similar level, which was measured on the first scan, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected value.

Procedure I – Transient Frequency Behavior: The TIA/EIA 603 procedure was used to determine compliance to radio being keyed on and off.

1) Connected the Test Receiver DOP or Video Output to Channel 1 of the oscilloscope. The output of the RF crystal detector was connected to Auxiliary channel 1, which served as a trigger input. The output of the combiner was connected to the Test Receiver.

2) Set the EUT to maximum power and connected as illustrated above. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at 6.25kHz, 12.5 kHz, or 25 kHz deviation and set its output to –100 dBm, then turn on the EUT.

3) The Combiner output side was connected to the Test Receiver, which was used to measure the Power. Used enough external attenuation so that the output at the combiner was set to 40 dB below the maximum input of the Test Receiver, then turn off the EUT.

4) Set the signal generator output to the same level in step 3. This level was maintained for the remainder of the test.

5) Set the horizontal sweep rate on the storage oscilloscope to 10 milliseconds per division and adjusted the display to continuously view the 1 kHz tone from the DOP or Video Output. Adjusted the vertical amplitude control to display the 1 kHz at +/- 4 divisions vertically centered on the display.

6) Set the oscilloscope to trigger at the AUX channel 1 input port.

7) Removed enough external attenuation so that the input to the RF detector and combiner is increased by 30 dB.

8) Turn on the transmitter and plotted the result for **Ton**, **T1**, and **T2**.

9) Set the oscilloscope to trigger in decreasing magnitude from the RF crystal detector.

10) Turn off the transmitter and plotted the result for **T3**.

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.

Below is a formula example used to calculate the attenuation requirement, relative to the transmitters power output, in dBuV/m. For this example an operating power range 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

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

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

FCC Rules request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

Note: Substitution Method is performed for spurious emission not being 20-dB below the calculated field strength.

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 4,000 MHz & Antenna Conducted Emissions, 26-May-04
Engineer: Juan Martinez

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz), Sunnyvale	84125C	1149	02-Jun-04
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1534	18-Mar-05
Rohde & Schwarz	Power Sensor 100uW - 10 Watts	NRV-Z53	1555	28-Aug-04
Narda	30-dB attenuator (500Watts)	757C	34490	31-Jul-04

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T55612 14 Pages

Elliott

EMC Test Data

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Emissions Spec:	FCC 90, RSS-119	Class:	Radio
Immunity Spec:		Environment:	

EMC Test Data

For The

Microwave Data Systems

Model

ROR220 PA

Date of Last Test: 5/22/2004

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Emissions Spec:	FCC 90, RSS-119	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

EUT INFORMATION

General Description

The EUT is a 200 MHz Land Mobile amplifier which is designed to increase the transmitter power in low coverage areas. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 14 Vdc, 4 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Microwave Data System	ROR220 PA	200MHz amplifier	N/A	E5MDS-ENETL2W

Other EUT Details

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 10 cm wide by 10 cm deep by 4 cm high.

Modification History

Mod. #	Test	Date	Modification
1			
2			
3			

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

Elliott

EMC Test Data

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Emissions Spec:	FCC 90, RSS-119	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Microwave Data System	200MHz	Radio	N/A	N/A
Topward	3603D	DC Source	N/A	N/A
Xantrex	XDC 80-75	DC Source	N/A	N/A
IBM	2647	Lapotp	78-7PX8M	DoC

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
RF Out	Spectrum Analyzer	Coaxial	Shielded	0.5
RF In	200 MHz Radio	Coaxial	Shielded	0.5
DC in	Xantrex	2 wire	Unshielded	0.6

EUT Operation During Emissions

Operating on low, middle, and high channel at full power continuously.

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Antenna Conducted 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: 5/22/2004
Test Engineer: Juan Martinez
Test Location: SVOATS #2
Config. Used: 1
Config Change: None
EUT Voltage: 14Vdc

General Test Configuration

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

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 44 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	99% Bandwidth; In and out	Part 90.210 & RSS-119	Pass	Refer to Plots
2	Output Power	Part 90.210 & RSS-119	Pass	43.1 dBm
3	Out of Band; 30 - 18,000MHz	Part 90.210 & RSS-119	Pass	-0.3dB @ 188.38 MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

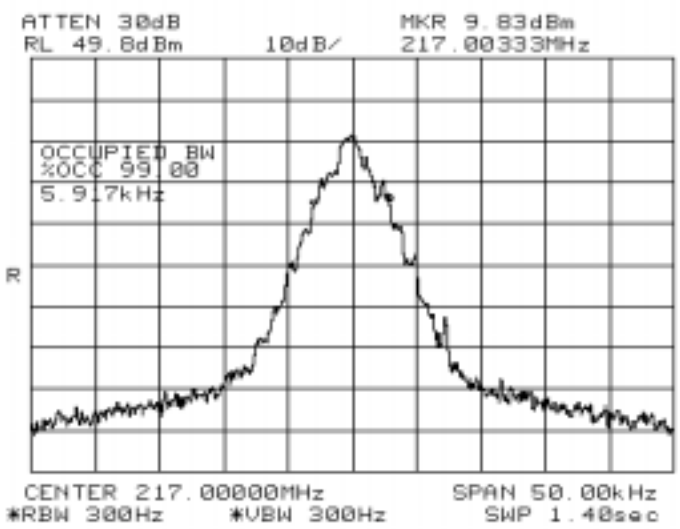
Deviations From The Standard

No deviations were made from the requirements of the standard.

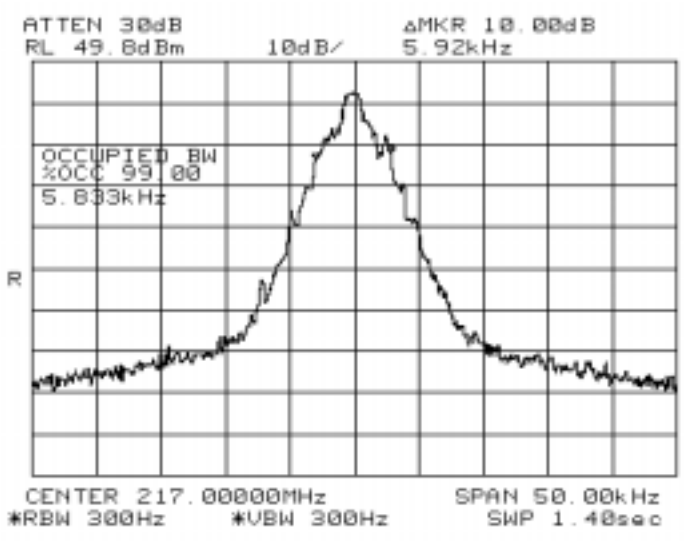
Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Run #1: 99% bandwidth; In and Out

Input Plot (217MHz)

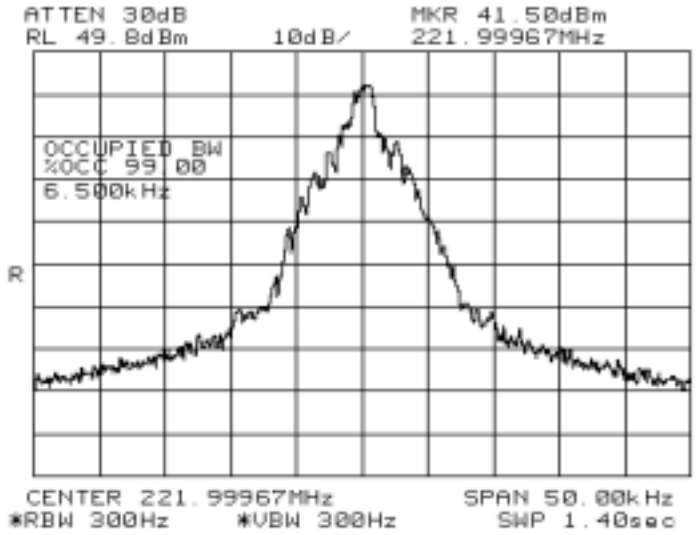


Amplifier Output Plot (217 MHz)

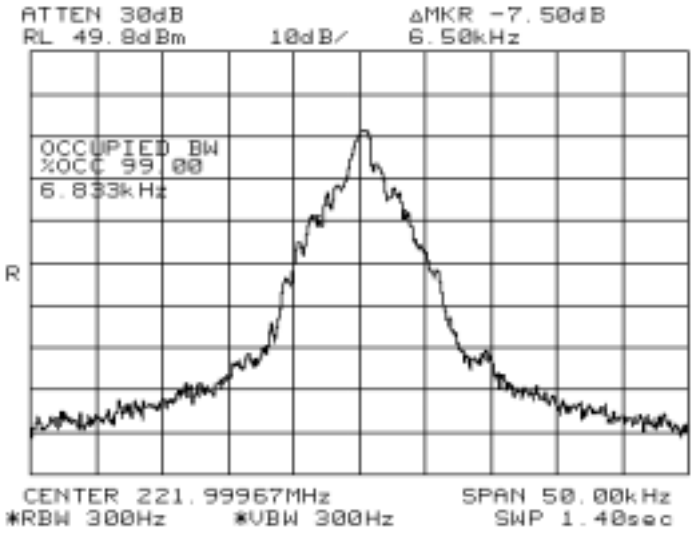


Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Amplifier Output Plot (222 MHz)

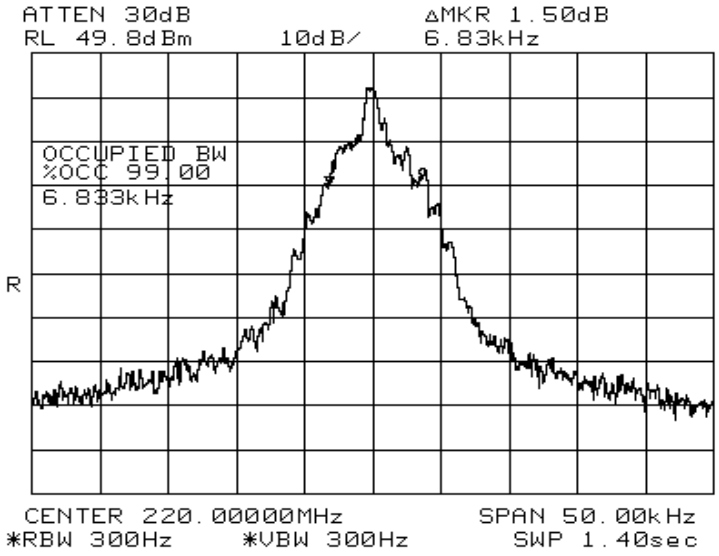


Input Plot (222 MHz)

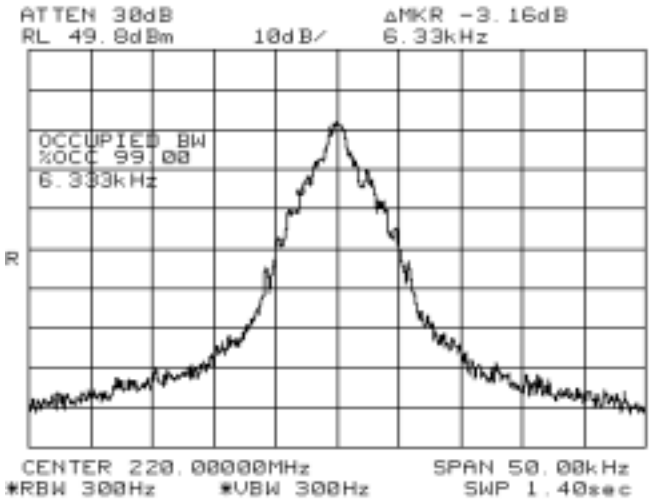


Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Amplifier Output Plot (220 MHz)



Input Plot (220 MHz)



Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

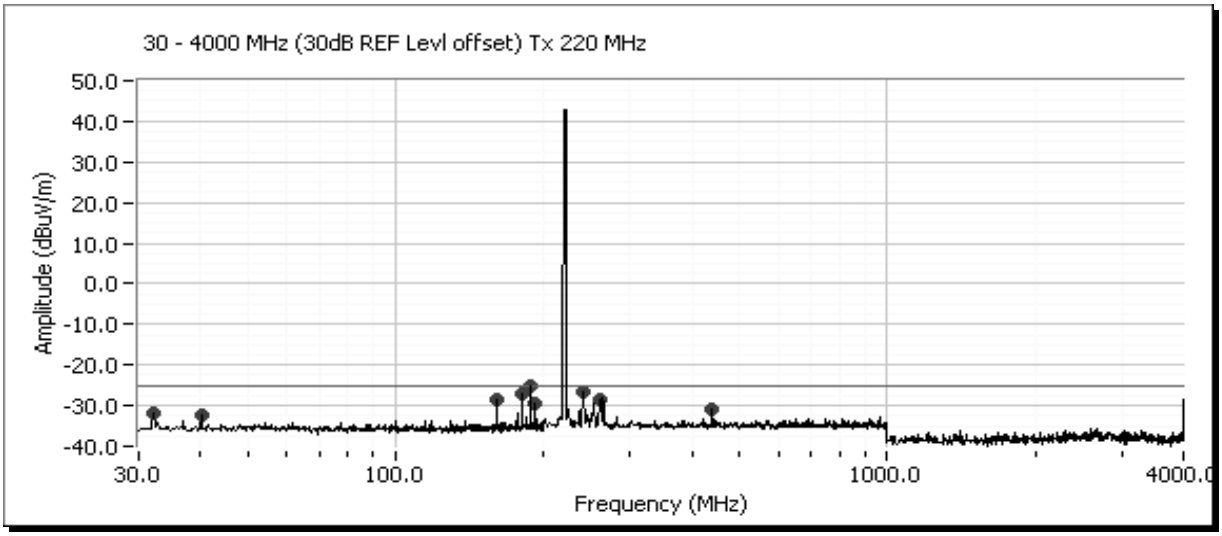
Run #2: Output Power w/ Power meter.

Channel	Frequency (MHz)	Output Power
Low	217	43.0
Middle	220	43.0
High	222	43.1

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Run #3: Out of Band Emission; 30 - 4,000 MHz

Out of band (220 MHz)

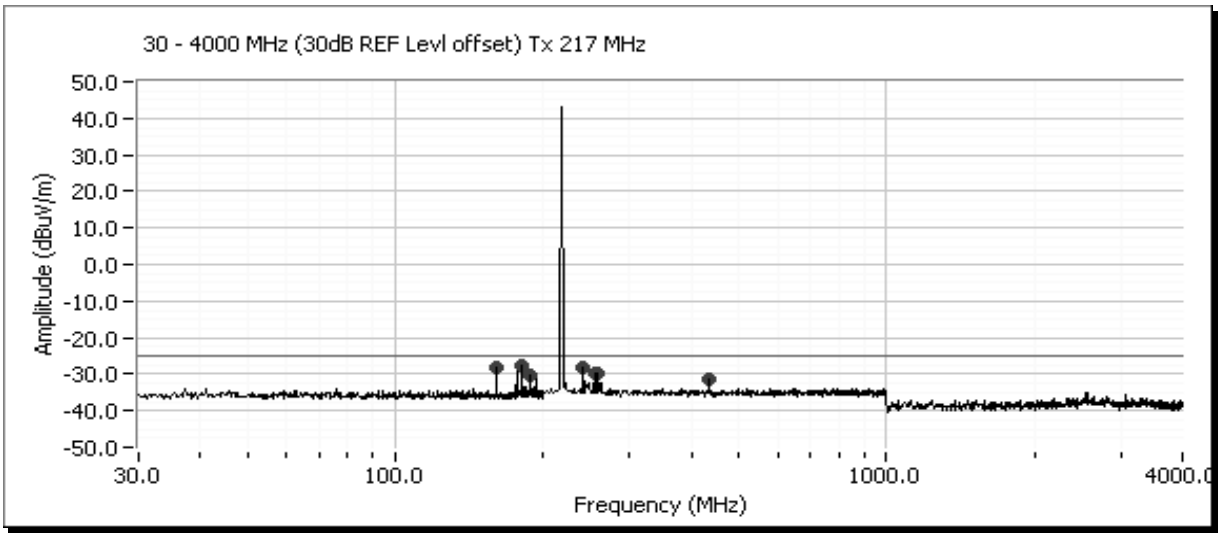


Frequency	Level	Port	Part 90		Detector	Azimuth	Height	Comments
MHz	dBm		Limit	Margin	Pk/QP/Avg	degrees	meters	
160.617	-28.7	RF Port	-25.0	-3.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
180.450	-27.2	RF Port	-25.0	-2.2	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
188.383	-25.3	RF Port	-25.0	-0.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
192.350	-29.3	RF Port	-25.0	-4.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
32.267	-31.7	RF Port	-25.0	-6.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
40.200	-32.3	RF Port	-25.0	-7.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
240.000	-26.7	RF Port	-25.0	-1.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
260.000	-28.7	RF Port	-25.0	-3.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
440.000	-30.8	RF Port	-25.0	-5.8	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
Above 1GHz RBW=VBW= 1MHz (10dB internal attenuation)								

EMC Test Data

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

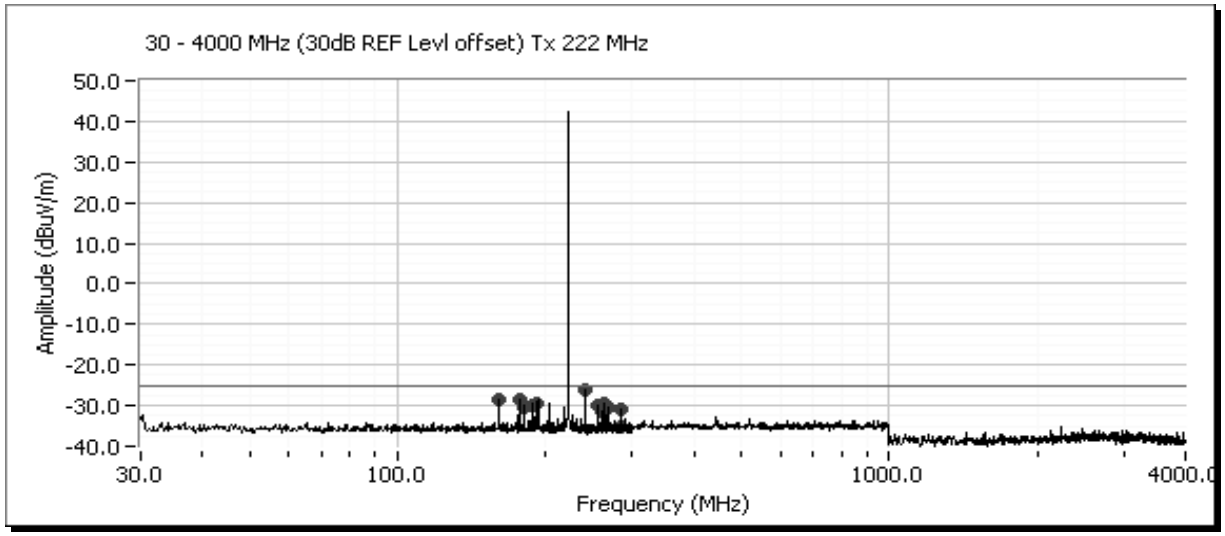
Out of band (217 MHz)



Frequency	Level	Port	Part 90		Detector	Azimuth	Height	Comments
MHz	dBm		Limit	Margin	Pk/QP/Avg	degrees	meters	
160.617	-28.3	RF Port	-25.0	-3.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
180.450	-27.7	RF Port	-25.0	-2.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
188.383	-30.2	RF Port	-25.0	-5.2	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
241.333	-28.3	RF Port	-25.0	-3.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
254.667	-29.7	RF Port	-25.0	-4.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
258.667	-29.7	RF Port	-25.0	-4.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
434.667	-31.2	RF Port	-25.0	-6.2	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
Above 1GHz RBW=VBW= 1MHz (10dB internal attenuation)								

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Out of band (222 MHz)



Frequency	Level	Port	Part 90		Detector	Azimuth	Height	Comments
MHz	dBm		Limit	Margin	Pk/QP/Avg	degrees	meters	
160.617	-28.7	RF Port	-25.0	-3.7	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
176.767	-28.3	RF Port	-25.0	-3.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
180.450	-30.5	RF Port	-25.0	-5.5	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
188.383	-30.0	RF Port	-25.0	-5.0	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
192.350	-29.5	RF Port	-25.0	-4.5	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
240.017	-26.2	RF Port	-25.0	-1.2	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
255.978	-30.2	RF Port	-25.0	-5.2	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
260.045	-31.3	RF Port	-25.0	-6.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
264.010	-29.3	RF Port	-25.0	-4.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
267.975	-30.3	RF Port	-25.0	-5.3	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
283.937	-30.8	RF Port	-25.0	-5.8	Peak	-	-	RBW=VBW= 10kHz (30dB int. att.)
Above 1GHz RBW=VBW= 1MHz (10dB internal attenuation)								

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Radiated Emissions Part 90

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: 5/14/2004
Test Engineer: Juan Martinez
Test Location: SVOATS #2
Config. Used: 1
Config Change: None
EUT Voltage: 14Vdc

General Test Configuration

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

Unless otherwise specified, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 4000 MHz.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 44 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a-1b	RE, 30 -4000 MHz, Preliminary Scan	Part 90.210 & RSS-119	Pass	-20.5dB @ 160.000MHz
2	RE, 30 -4000 MHz, Subsitution Method	Part 90.210 & RSS-119	N/A	Readings are < 20dB below the limit no substitution performed

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:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Run #1a: Radiated Spurious Emissions, Transmit Mode, 30 - 4000 MHz. EUT @ 222 MHz

Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
160.000	49.8	v	70.3	-20.5	Pk	-	-	
188.100	46.5	v	70.3	-23.8	Pk	-	-	
444.000	46.1	v	70.3	-24.2	Pk	-	-	
888.000	45.2	v	70.3	-25.1	Pk	-	-	
1110.000	45.2	v	70.3	-25.1	Pk	-	-	
1332.000	44.2	v	70.3	-26.1	Pk	-	-	
1110.000	43.1	h	70.3	-27.2	Pk	-	-	
1332.000	42.1	h	70.3	-28.2	Pk	-	-	
444.000	41.2	h	70.3	-29.1	Pk	-	-	
666.000	40.2	v	70.3	-30.1	Pk	-	-	
888.000	35.1	h	70.3	-35.2	Pk	-	-	
260.000	32.0	v	70.3	-38.3	Pk	-	-	
666.000	31.2	h	70.3	-39.1	Pk	-	-	
254.000	21.1	v	70.3	-49.2	Pk	-	-	
260.000	20.9	h	70.3	-49.4	Pk	-	-	
254.000	20.3	h	70.3	-50.0	Pk	-	-	
240.000	20.1	v	70.3	-50.2	Pk	-	-	
240.000	19.3	h	70.3	-51.0	Pk	-	-	
188.100	17.8	h	70.3	-52.5	Pk	-	-	
160.000	15.5	h	70.3	-54.8	Pk	-	-	

Note 1:	The limit in the table above is an approximate field strength limit. It has been calculated form the erp or eirp limit detailed in the EN standard using Friis' equation for free space propagation: E = 30PG/d . This limit is a conservative limit because it does not consider the presence of the ground plane. The actual signal level, in terms of erp or eirp, is determined from a substitution measurement for all signals with less than 20dB of margin relative to the calculated field strength limit.

Elliott

EMC Test Data

Client:	Microwave Data Systems	Job Number:	J55577
Model:	ROR220 PA	T-Log Number:	T55612
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 90, RSS-119	Class:	Radio

Run #1b: Radiated Spurious Emissions, Transmit Mode, 30 - 4000 MHz. EUT @ 217 MHz

Frequency	Level	Pol	Part 90		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
188.100	46.5	v	70.3	-23.8	Pk	-	-	
1100.000	44.2	v	70.3	-26.1	Pk	-	-	
160.000	42.5	v	70.3	-27.8	Pk	-	-	
434.000	42.5	v	70.3	-27.8	Pk	-	-	
1100.000	42.5	h	70.3	-27.8	Pk	-	-	
656.000	42.2	v	70.3	-28.1	Pk	-	-	
878.000	41.2	v	70.3	-29.1	Pk	-	-	
1322.000	41.2	h	70.3	-29.1	Pk	-	-	
434.000	40.1	h	70.3	-30.2	Pk	-	-	
1322.000	39.5	v	70.3	-30.8	Pk	-	-	
656.000	35.2	h	70.3	-35.1	Pk	-	-	
260.000	32.0	v	70.3	-38.3	Pk	-	-	
878.000	31.2	h	70.3	-39.1	Pk	-	-	
240.000	24.1	v	70.3	-46.2	Pk	-	-	
254.000	22.2	v	70.3	-48.1	Pk	-	-	
260.000	20.1	h	70.3	-50.2	Pk	-	-	
254.000	19.5	h	70.3	-50.8	Pk	-	-	
240.000	18.2	h	70.3	-52.1	Pk	-	-	
160.000	17.5	h	70.3	-52.8	Pk	-	-	
188.100	16.5	h	70.3	-53.8	Pk	-	-	

Note 1:	The limit in the table above is an approximate field strength limit. It has been calculated form the erp or eirp limit detailed in the EN standard using Friis' equation for free space propagation: E = 30PG/d . This limit is a conservative limit because it does not consider the presence of the ground plane. The actual signal level, in terms of erp or eirp, is determined from a substitution measurement for all signals with less than 20dB of margin relative to the calculated field strength limit.

EXHIBIT 3: Test Configuration Photographs

Uploaded as A Separate Attachment

EXHIBIT 4: Theory of Operation Microwave Data Systems Model ROR220 PA

Uploaded as A Separate Attachment

EXHIBIT 5: Proposed FCC ID Label & Label Location

Uploaded as A Separate Attachment

EXHIBIT 6: Detailed Photographs Microwave Data Systems Model ROR220 PA

Uploaded as A Separate Attachment

EXHIBIT 7: Installation Guide Microwave Data Systems Model ROR220 PA

Uploaded as A Separate Attachment

EXHIBIT 8: Block Diagram Microwave Data Systems Model ROR220 PA

Uploaded as A Separate Attachment

EXHIBIT 9: Schematic Diagrams Microwave Data Systems Model ROR220 PA

Uploaded as A Separate Attachment

EXHIBIT 10: Advertising Literature

Uploaded as A Separate Attachment