

***Electromagnetic Emissions Test Report
and
Application for Grant of Equipment Authorization
pursuant to
FCC Part 15, Subpart C (15.247) FHSS Specifications and
Industry Canada RSS 210 Issue 5 for an
Intentional Radiator on the
Microwave Data Systems
Model: MDS9810***

FCC ID: E5MDS-9810

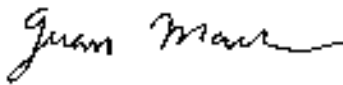
UPN: 3738A-MDS9810

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

TEST SITE: Elliott Laboratories, Inc.
684 W. Maude Avenue
Sunnyvale, CA 94086

REPORT DATE: July 19, 2004

FINAL TEST DATE: July 16 and July 17, 2004

AUTHORIZED SIGNATORY: 

Juan Martinez
Sr. EMC Engineer



Elliott Laboratories, Inc. is accredited by the A2LA, certificate number 2016-01, to perform the test(s) listed in this report. This report shall not be reproduced, except in its entirety, without the written approval of Elliott Laboratories, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS.....2

SCOPE.....3

OBJECTIVE.....3

SUMMARY OF RESULTS4

 MEASUREMENT UNCERTAINTIES 6

EQUIPMENT UNDER TEST (EUT) DETAILS7

 GENERAL..... 7

 ENCLOSURE..... 7

 MODIFICATIONS 7

 SUPPORT EQUIPMENT 7

 EUT INTERFACE PORTS..... 8

 EUT OPERATION DURING TESTING..... 8

 ANTENNA REQUIREMENTS 8

TEST SITE.....9

 GENERAL INFORMATION 9

 CONDUCTED EMISSIONS CONSIDERATIONS 9

 RADIATED EMISSIONS CONSIDERATIONS..... 9

MEASUREMENT INSTRUMENTATION10

 RECEIVER SYSTEM 10

 INSTRUMENT CONTROL COMPUTER 10

 LINE IMPEDANCE STABILIZATION NETWORK (LISN) 10

 POWER METER..... 11

 FILTERS/ATTENUATORS 11

 ANTENNAS 11

 ANTENNA MAST AND EQUIPMENT TURNTABLE 11

 INSTRUMENT CALIBRATION 11

TEST PROCEDURES12

 EUT AND CABLE PLACEMENT..... 12

 CONDUCTED EMISSIONS 12

 RADIATED EMISSIONS..... 12

 CONDUCTED EMISSIONS FROM ANTENNA PORT 13

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS14

 FCC 15.407 (A)AND RSS 210 (O) OUTPUT POWER LIMITS..... 15

 RSS 210 (O) AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS..... 15

 FCC AC POWER PORT CONDUCTED EMISSIONS LIMITS 16

 RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS..... 16

 SAMPLE CALCULATIONS - CONDUCTED EMISSIONS 17

 SAMPLE CALCULATIONS - RADIATED EMISSIONS..... 18

 EXHIBIT 1: Test Equipment Calibration Data..... 1

 EXHIBIT 2: Test Data Log Sheets 2

 EXHIBIT 3: Test Configuration Photographs 3

 EXHIBIT 4: Proposed FCC ID Label & Label Location 4

 EXHIBIT 5: Detailed Photographs..... 5

 EXHIBIT 6: Operator's Manual..... 6

 EXHIBIT 7: Block Diagram..... 7

 EXHIBIT 8: Schematic Diagrams 8

 EXHIBIT 9: Theory of Operation..... 9

 EXHIBIT 10: RF Exposure Information 10

SCOPE

An electromagnetic emissions test has been performed on the Microwave Data Systems model MDS9810 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators and RSS-210 Issue 5 for licence-exempt low power devices. 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 Microwave Data Systems model MDS9810 and therefore apply only to the tested sample. The sample was selected and prepared by Dennis McCarthy of Microwave Data Systems

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules and RSS-210 Issue 5 for license-exempt low power devices 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 that are subsequently manufactured.

SUMMARY OF RESULTS

FCC Part 15 Section	RSS 210 Section	Description	Measured Value	Comments	Result
15.247(a)(1)	6.2.2(o)(a)	20dB Bandwidth	25 kHz	The channel spacing shall be greater than the 20dB bandwidth	Complies
15.247(a)(1)	6.2.2(o)(a)	Channel Separation	25.3 kHz		Complies
15.247(a)(1)	6.2.2(o)(a)	Number of Channels	128	<p>902- 928 MHz: 50 hopping frequencies: average time of occupancy <0.4 second within a 20 second period.</p> <p><i>More than 25 but less than 50 hopping frequencies: average time of occupancy <0.4 second within a 20 second period.</i></p>	Complies
15.247(a)(1)(i)	6.2.2(o)(a)	Channel Dwell Time	.380 seconds per 20 seconds		Complies
	6.2.2(o)(a)	Channel Utilization	All channels are used equally	Refer to Theory of Operations for detailed description of the hopping algorithm	Complies
15.247 (b) (3)	6.2.2(o)(a)	Output Power, 902 - 928 MHz	29.8 dBm (At transmitter antenna port) (.955 Watts)	Multi-point applications: 902 – 928 MHz Maximum permitted is 0.25 Watts, with EIRP limited to 1 Watts for a system that uses less	Complies (Note 1)

				than 50 channels	
15.247 (b) (3)	6.2.2(o)(a)	Output Power, 902 - 928 MHz	25.6 dBm (with cable and/or attenuator) (.363 Watts) EIRP = 3.63 W	Multi-point applications: 902 – 928 MHz Maximum permitted is 1Watt, with EIRP limited to 4 Watts for a 50-channel system. Maximum permitted is 0.25 Watts, with EIRP limited to 1 Watts for a system that uses less than 50 channels	Complies (Note 2)
15.247 (b) (3)	6.2.2(o)(a)	Output Power, 902 - 928 MHz	28.4 dBm (with cable and/or attenuator) (.691 Watts) EIRP = 3.47 W	Multi-point applications: 902 – 928 MHz Maximum permitted is 1Watt, with EIRP limited to 4 Watts for a 50-channel system. Maximum permitted is 0.25 Watts, with EIRP limited to 1 Watts for a system that uses less than 50 channels	Complies (Note 3)
15.247(c)	6.2.2(o)(e1)	Spurious Emissions – 30MHz – 10GHz	All spurious emissions < -20dBc	All spurious emissions < -20dBc.	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 10GHz	45.5 dBuV/m @ 960 MHz (-0.5 dB)	Emissions in restricted bands must meet the radiated emissions limits detailed in 15.207. All others must be < -20dBc	Complies
15.207		AC Conducted Emissions	N/A	Not applicable, Unit is DC operated	Complies
	6.6	AC Conducted Emissions	N/A	Not applicable, Unit is DC operated	Complies
15.247 (b) (5)		RF Exposure Requirements	FCC /IC limits of power density not exceeded provided antenna is located a minimum of 22 cm from persons	Refer to MPE calculation Refer to User's Guide for installation instructions requiring a 22cm separation	Complies
15.203		RF Connector	Connector is an N-type	Requires Professional Installation	Complies

Note 1: Output power at transmitter antenna port is 29.8dBm, to reduced power to meet the EIRP of 36dBm EIRP, used the combination of cable loss and attenuator(s). This unit is professionally installed and installers are trained to configure the system to meet FCC's power limits.

Note 2: EIRP calculated using Yagi antenna gain of dBi (10) for the highest EIRP point-to-multipoint system.

Note 2: EIRP calculated using Omni antenna gain of dBi (7) for the highest EIRP point-to-multipoint system.

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 MDS9810 a 900 MHz FHSS radio which is designed to provide reliable long-distance communications. 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 13.8Vdc, .5 Amps.

The sample was received on July 16, 2004 and tested on July 16 and July 17, 2004. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	Proposed FCC ID #
Microwave/MS9810/FHSS radio	1270151	E5MDS_9810
Microwave/97-3194A14/Yagi	293291	N/A
Microwave/97-3194A23/Omni	297915	N/A

ENCLOSURE

The EUT enclosure is primarily constructed of Die-cast aluminum. It measures approximately 5.65 cm wide by 7.25 cm deep by 2 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/TT I EAR 2-2-TVS/Terminal	HH28353	N/A
Topward/3603D/DC Source	N/A	N/A

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)
RJ11	Terminal	Multiwire	Unshielded	1
N-Type	Antenna	Coaxial	Shielded	2
RS-232	Terminated	Multiwire	Shielded	1.2
DC Input	DC power supply	2 wire	Unshielded	1.3

EUT OPERATION DURING TESTING

EUT was set to transmit at full power low, middle, and high channel.

ANTENNA REQUIREMENTS

The antenna port is a standard, N-type connector, which is permitted as the system is intended to be professionally installed.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 16 and July 17, 2004 at the Elliott Laboratories Open Area Test Site #2 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 Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION**RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and peak power sensor 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.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in terms of Watts, milliwatts or dBm. 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.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

FCC 15.407 (a) and RSS 210 (o) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Number Of Channels	Output Power
902 – 928	≥ 50	1 W (30 dBm)
902 – 928	< 50	0.25 W (24 dBm)
2400 – 2483.5	≥ 75	1 W (30 dBm)
2400 – 2483.5	≥ 75	0.125 W (21 dBm)
5725 – 5850	≥ 75	1 W (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

RSS 210 (o) AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS

T limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands detailed in Part 15.205 and for all spurious emissions from the receiver are:

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level.

FCC AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.207.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in Industry Canada RSS-210 section 6.6.

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

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:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

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:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 12,000 MHz, 20-Jul-04**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	29-Oct-04
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12-Jan-05
Hewlett Packard	EMC Spectrum Analyzer, 9KHz-26.5GHz	8593EM	1141	23-Mar-05
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	12-May-05
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1404	17-Nov-04
EMCO	Biconical Antenna, 30-300 MHz	3110B	1498	15-Jan-05

Antenna Conducted, 20-Jul-04**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	EMC Spectrum Analyzer, 9KHz-26.5GHz	8593EM	1141	23-Mar-05

Antenna Conducted, 20-Jul-04**Engineer: Juan Martinez**

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1423	18-Mar-05
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1534	18-Mar-05

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T56403 30 Pages



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Emissions Spec:	FCC 15.247, RSS-210	Class:	Radio
Immunity Spec:		Environment:	

EMC Test Data

For The

Microwave Data Systems

Model

MDS9810

Date of Last Test: 7/31/2004



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Emissions Spec:	FCC 15.247, RSS-210	Class:	Radio
Immunity Spec:	Enter immunity spec on cover	Environment:	

EUT INFORMATION

General Description

The EUT is a 900 MHz FHSS radio which is designed to provide reliable long-distance communications. 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 13.8Vdc, .5 Amps.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Microwave Data	MS9810	900MHz Radio	1270151	E5MDS-9810
Microwave Data	97-3194A14	Yagi Antenna (10dBi)	293291	N/A
Microwave Data	97-3194A23	Omni Antenna (7dBi)	297915	N/A

Other EUT Details

EUT Enclosure

The EUT enclosure is primarily constructed of Die-cast aluminum. It measures approximately 5.65 cm wide by 7.25 cm deep by 2 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.



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Emissions Spec:	FCC 15.247, RSS-210	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	TT I EAR 2-2-TVS	Terminal	HH28353	N/A
Topward	3603D	DC Source	N/A	N/A

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)
RJ11	Terminal	Multiwire	Unshielded	1
N-Type	Antenna	Coaxial	Shielded	2
RS-232	Terminated	Multiwire	Shielded	1.2
DC input	DC power supply	2 wire	Unshielded	1.3

EUT Operation During Emissions

EUT was set to transmit at full power low, middle, and high channel.



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
		Account Manager:	Christine Vu
Contact:	Dennis McCarthy		
Spec:	FCC 15.247, RSS-210	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: 7/20/2004 & 7/31/2004
Test Engineer: Juan Martinez
Test Location: SVOATS #2
Config. Used: 2
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 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: 21 °C
Rel. Humidity: 35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	20dB Bandwidth	15.247(a)	Pass	25 kHz
2	Output Power	15.247(b)	Pass	29.8 dBm
3	Channel Occupancy / Separation	15.247(a)	Pass	0.380 Seconds
4	Number of Channels	15.247(a)	Pass	128
5	Out of band	FCC Part 15.247(c)	Pass	Refer to plots

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.



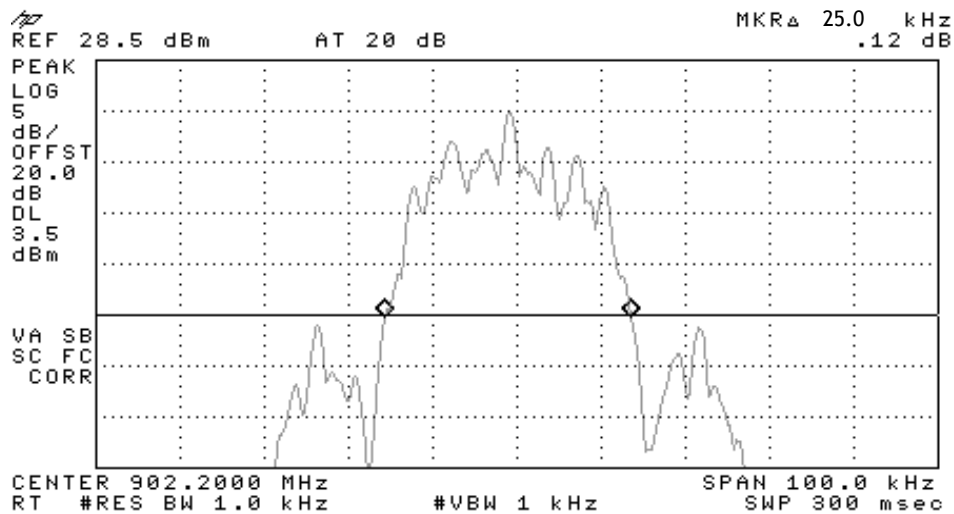
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Run #1 Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Signal Bandwidth	Graph reference #
Low	902	1kHz	25.0kHz	101
Mid	915	1kHz	24.8kHz	102
High	928	1kHz	24.9kHz	103

101

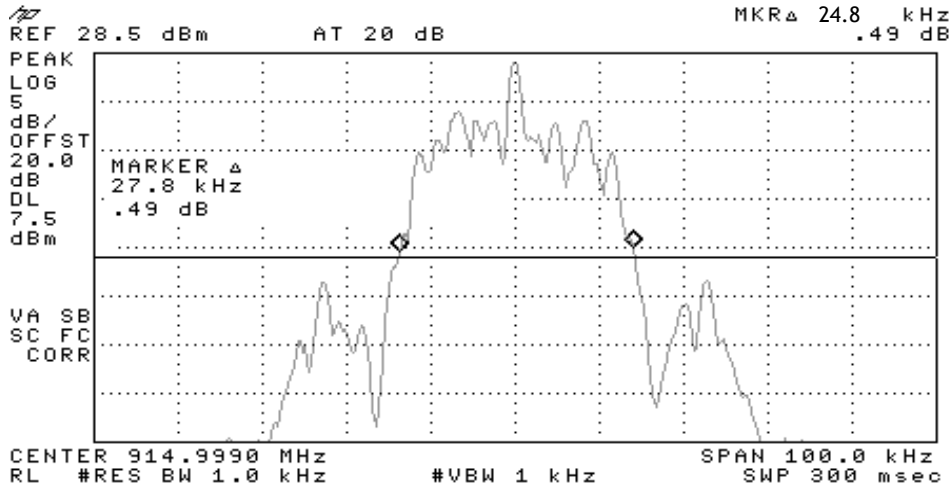




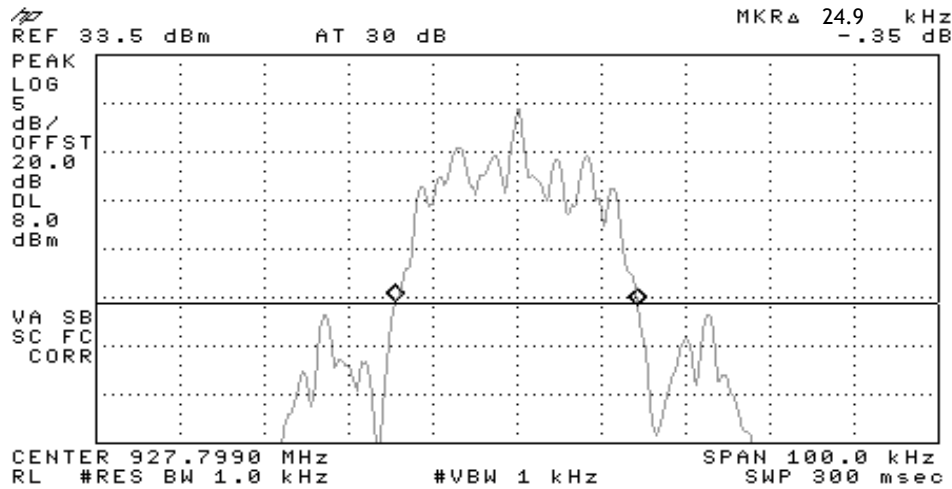
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

102



103





EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #2: Peak Meter Output Power measurement

Yagi Antenna

Channel	Frequency (MHz)	Output Power at transmitter port (dBm)	Cable loss w/ or w/o attenuator (dB)	Output Power(dBm)	Antenna Gain (dBi)	EIRP (dBm)	Notes
Low	902	26	0.4	25.6	10	35.6	1 & 4
Mid	915	28.6	3.4	25.2	10	35.2	2 & 4
High	928	29.8	4.4	25.4	10	35.4	3 & 4

Note 1: Cable installed only (cable loss was .4 dB)

Note 2: Used 3dB attenuator w/ cable loss

Note 3: Used 3dB and a 1dB attenuator w/ cable loss

Note 4: Output power at transmitter antenna port is 29.8dBm, to reduced power to meet the EIRP of 36dBm EIRP, used the combination of cable loss and attenuator. This unit is professionally installed and installers are trained to configure the system to meet FCC's power limits.

Omni Antenna

Channel	Frequency (MHz)	Output Power at transmitter port (dBm)	Cable loss w/ or w/o attenuator (dB)	Output Power(dBm)	Antenna Gain (dBi)	EIRP (dBm)	Notes
Low	902	26	0.4	25.6	7	32.6	1 & 4
Mid	915	28.6	0.4	28.2	7	35.2	2 & 4
High	928	29.8	1.4	28.4	7	35.4	3 & 4

Note 1: Cable installed only (cable loss was .4 dB)

Note 2: Cable installed only (cable loss was .4 dB)

Note 3: Used 1dB attenuator w/ cable loss

Note 4: Output power at transmitter antenna port is 29.8dBm, to reduced power to meet the EIRP of 36dBm EIRP, used the combination of cable loss and attenuator. This unit is professionally installed and installers are trained to configure the system to meet FCC's power limits.



EMC Test Data

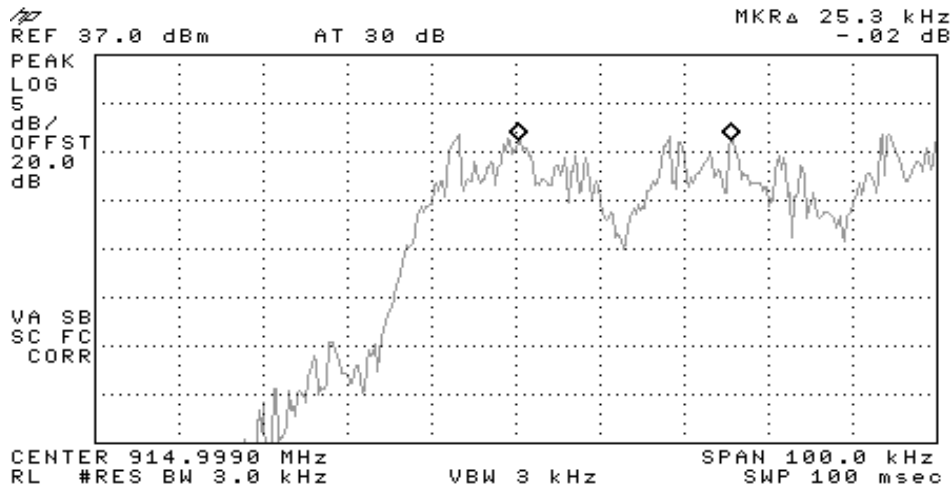
Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
	Account Manager: Christine Vu
Contact: Dennis McCarthy	
Spec: FCC 15.247, RSS-210	Class: N/A

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:	<u>25.3</u> kHz	Plot# 201
The minimum channel separation permitted is:	<u>25</u> kHz	
The total number of channels (N) was:	<u>128</u> channels	
The dwell time (Dt) on the center channel was:	<u>0.0769</u> Seconds	Plot# 202
Time between successive occupancy of a channel (Ot):	<u>4.050</u> Seconds	Plot# 203
Time between successive occupancy of a channel:	<u>9.839</u> Seconds	Calculated (Dt * N)
Dwell time calculated :	<u>0.0316</u> Seconds	Calculated (Ot / * N)
Average time per 20 seconds:	<u>0.156</u> Seconds	Calculated (20 / N)
Average time per 20 seconds:	<u>0.380</u> Seconds	Measured (20/Ot * Dt)
The maximum permitted dwell time in a 20 second period for FCC Part 15.247/RSS 210(o), based on a signal bandwidth <250kHz:	<u>0.4</u> Seconds	

#201

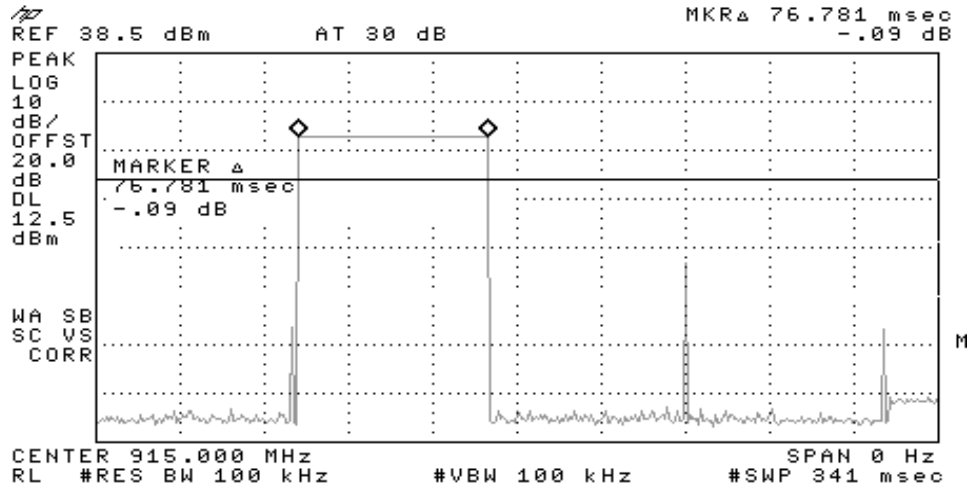




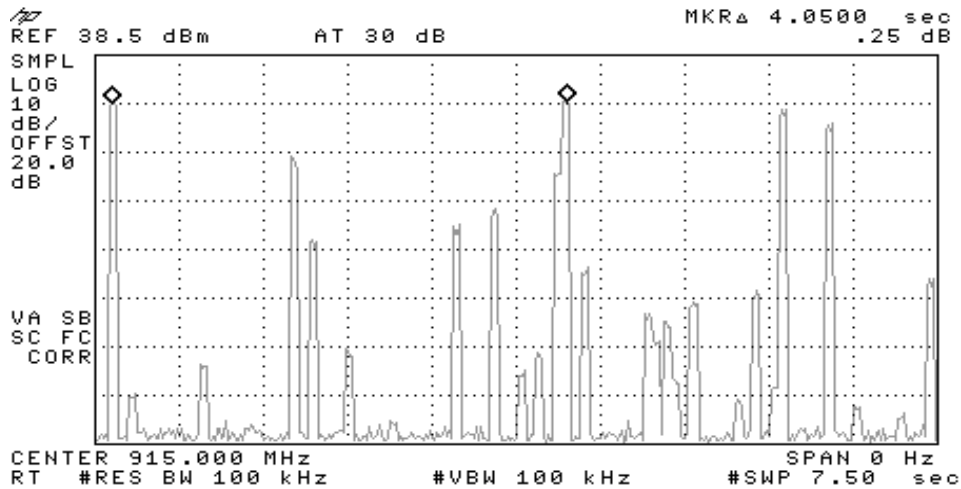
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hoptime Normal (#202)



#203





EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

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

The channel spacing was: 25.3 kHz **Plot# 201**

The minimum channel separation permitted is: 25 kHz

The total number of channels (N) was: 128 channels

The dwell time (Dt) on the center channel was: 0.1519 Seconds **Plot# 204**

Time between successive occupancy of a channel (Ot): 8.100 Seconds **Plot# 205**

Time between successive occupancy of a channel: 19.441 Seconds Calculated (Dt * N)

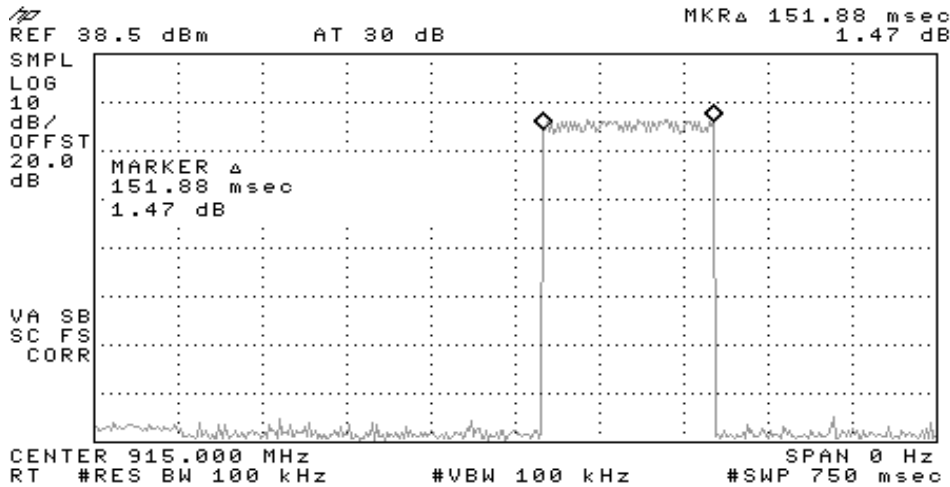
Dwell time calculated : 0.0633 Seconds Calculated (Ot / N)

Average time per 20 seconds: 0.156 Seconds Calculated (20 / N)

Average time per 20 seconds: 0.375 Seconds Measured (20/Ot * Dt)

The maximum permitted dwell time in a 20 second period for FCC Part 15.247/RSS 210(o), based on a signal bandwidth <250kHz: 0.4 Seconds

Hoptime Long (#204)

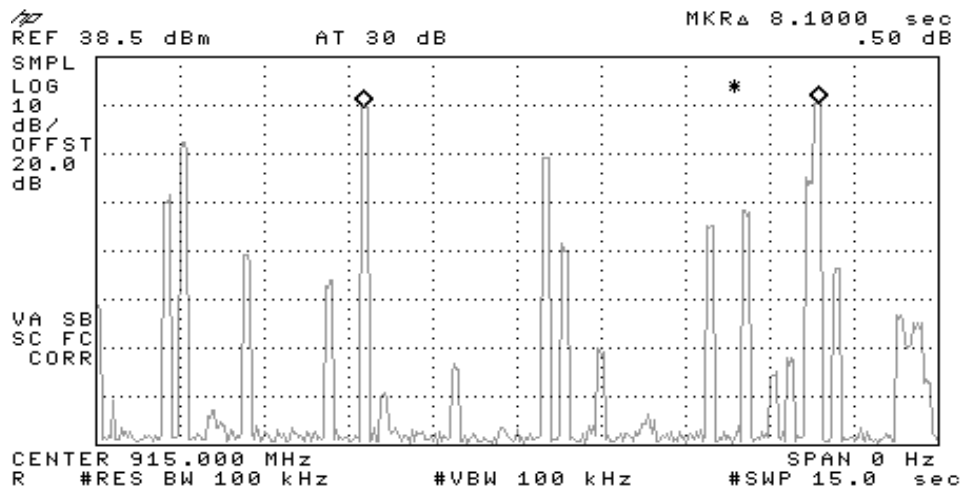




EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

#205





EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #4: Number of Channels

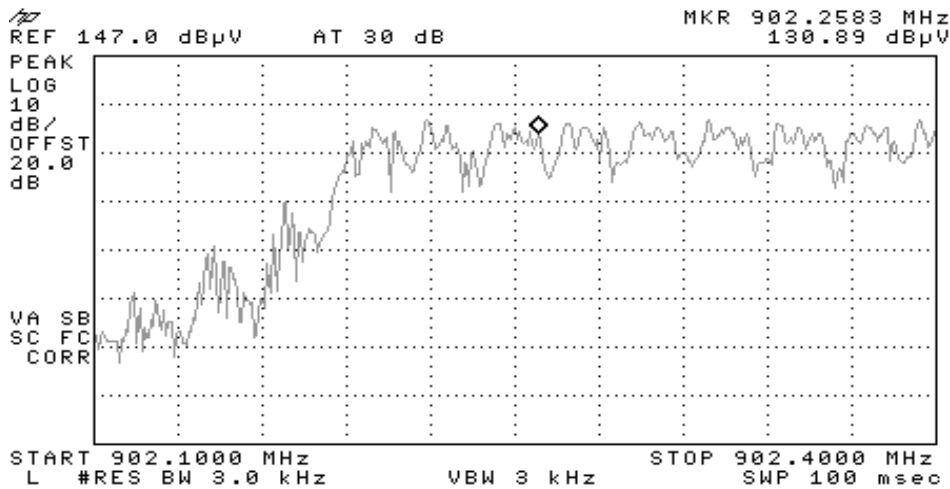
The number of channels was verified with the radio transmitting normally (i.e. In hopping mode)

The number of channels, per Zone, was: 128

Note: There are a total of 8 zones (Each zone is divided into 3.2MHz segments, Refer to Manual for more details). A total of 128 hopping channels cover each individual zone. The total hopping channels will be 1024. We plotted the 128 channels in one band, and used that as reference. There are 8 zones in each band plan "Zone 1-8". The end user can command the radio to skip zone # "s" to a maximum of 4 zones which is 64 channels. Each zone consists of 16 channels. The software command ZONE function's as a block command to not hop on channels where interference is causing undesired degradation in performance.

As a factory default all zones are enabled, this is the desired operating mode. Only if there is interference will the ZONE command be used, this is described in detail in the manual.

Hopping Channels = 9

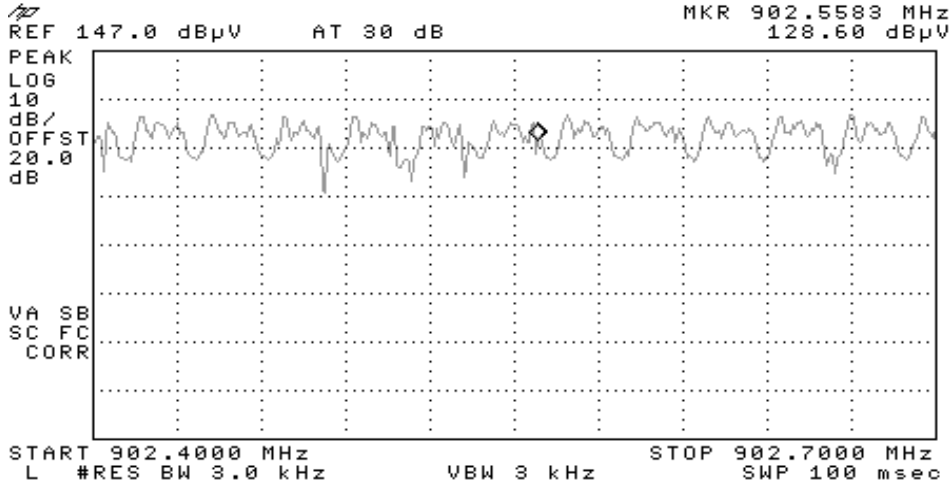




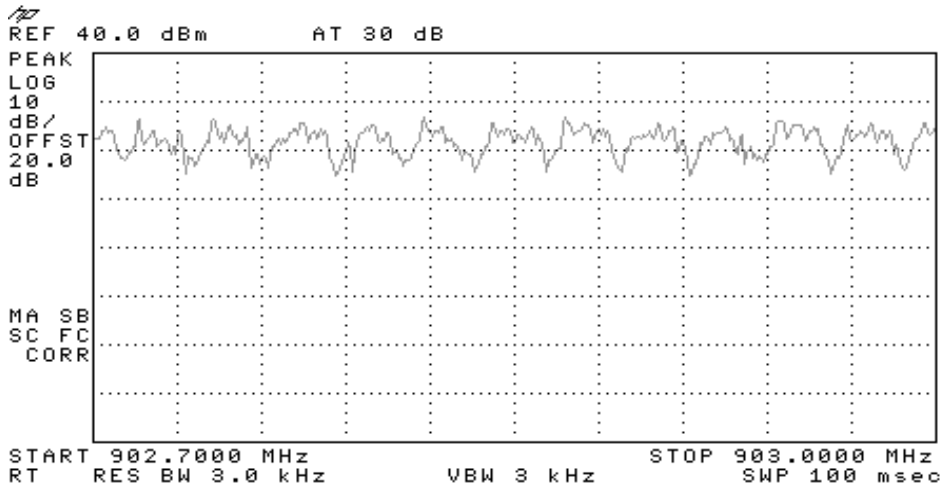
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hopping Channels = 12



Hopping Channels = 12

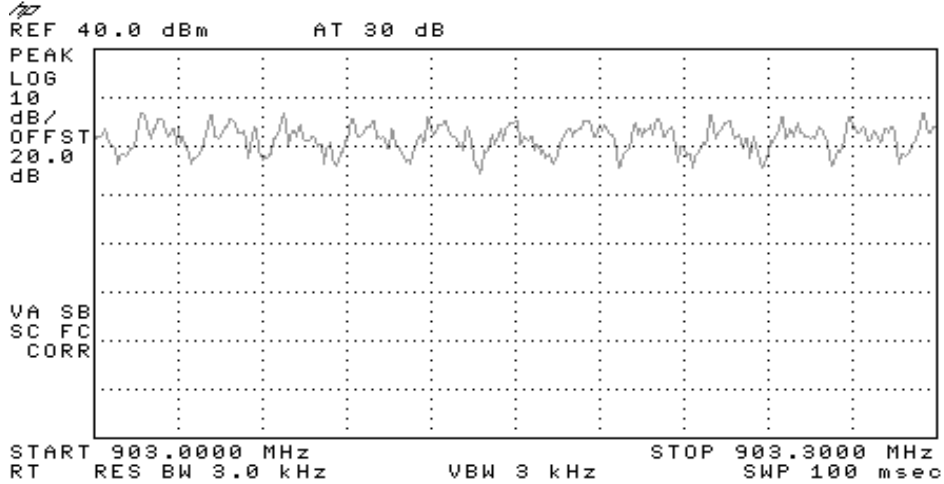




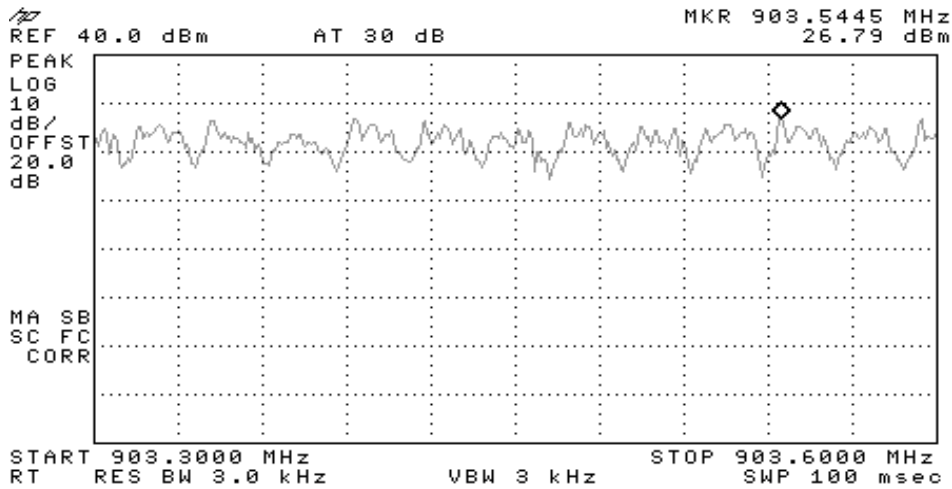
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hopping Channels = 12



Hopping Channels = 12

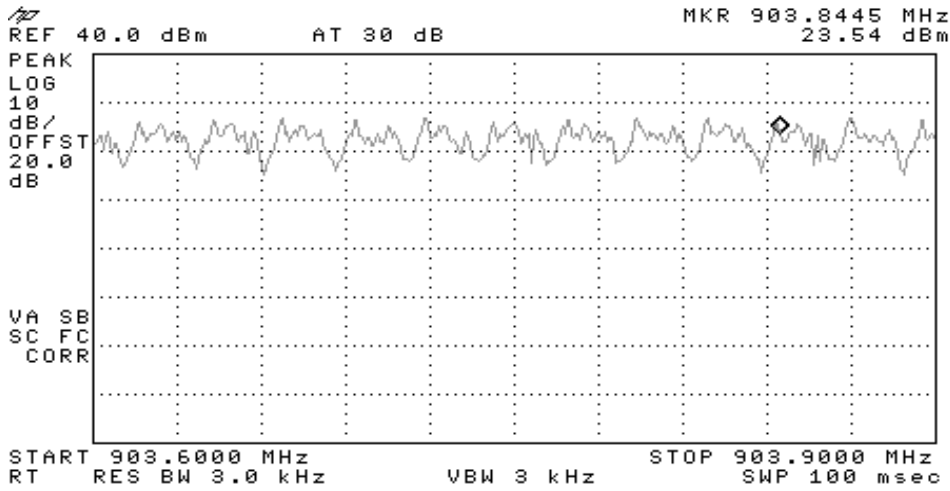




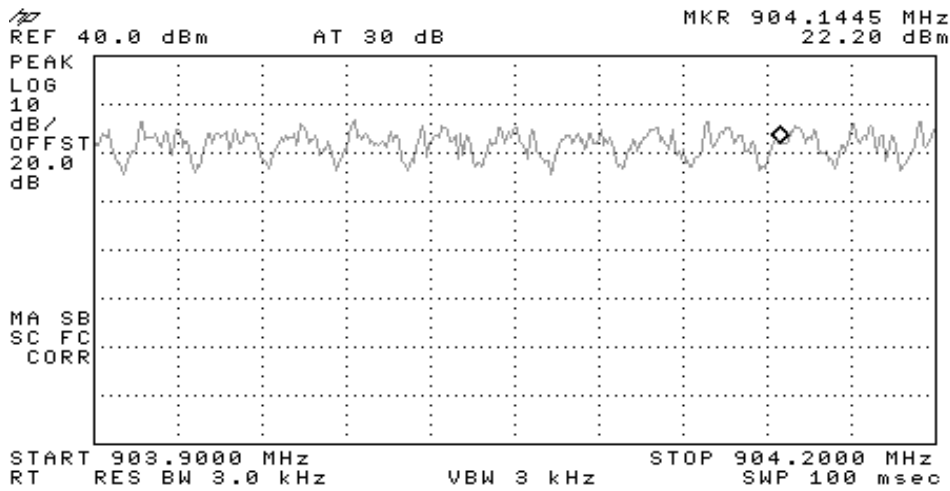
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hopping Channels = 12



Hopping Channels = 12

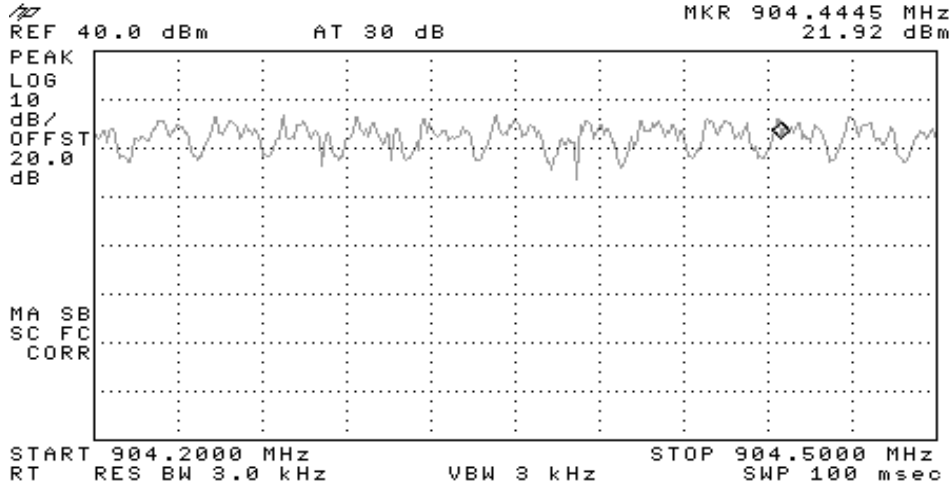




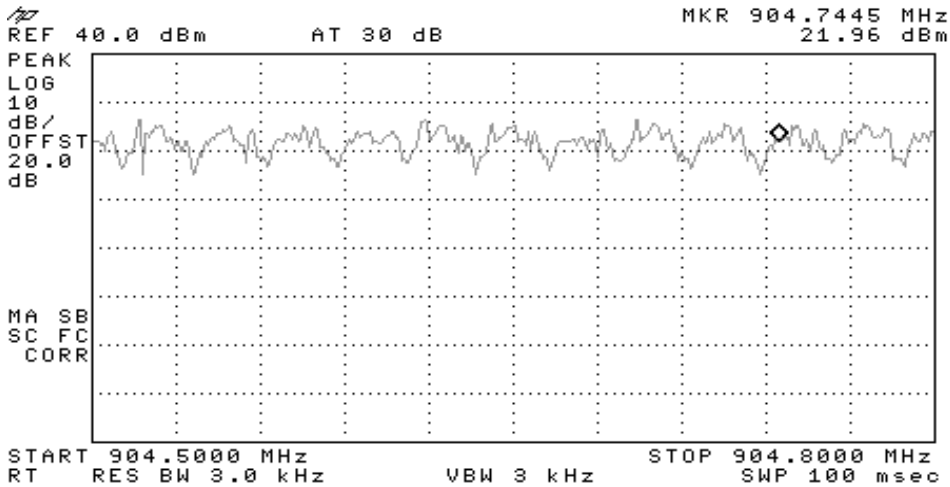
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hopping Channels = 12



Hopping Channels = 12

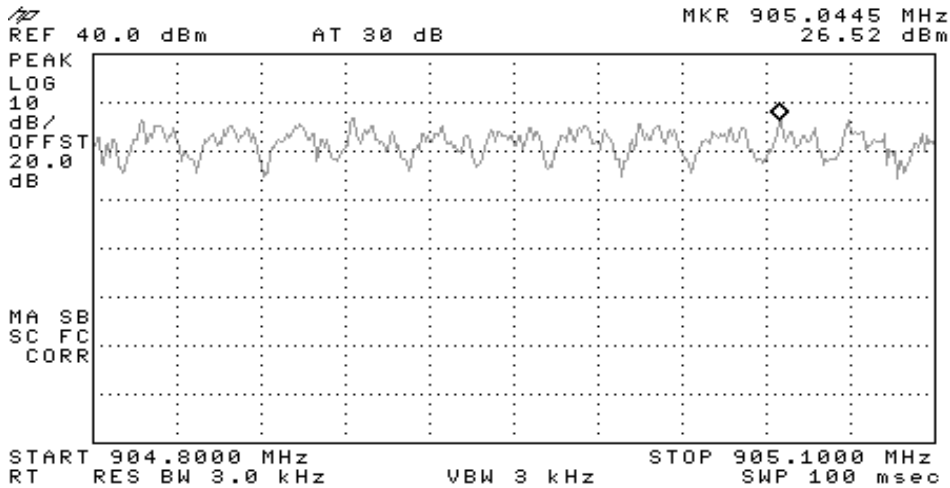




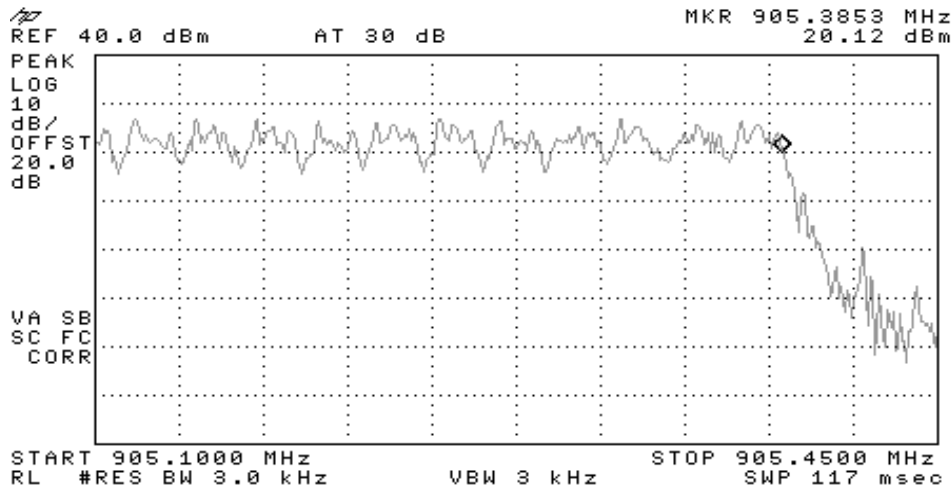
EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Hopping Channels = 12



Hopping Channels = 11



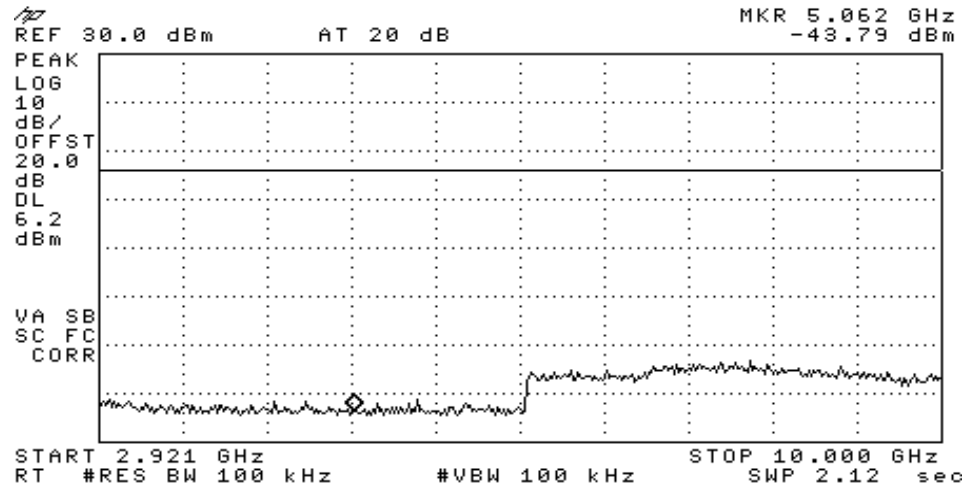
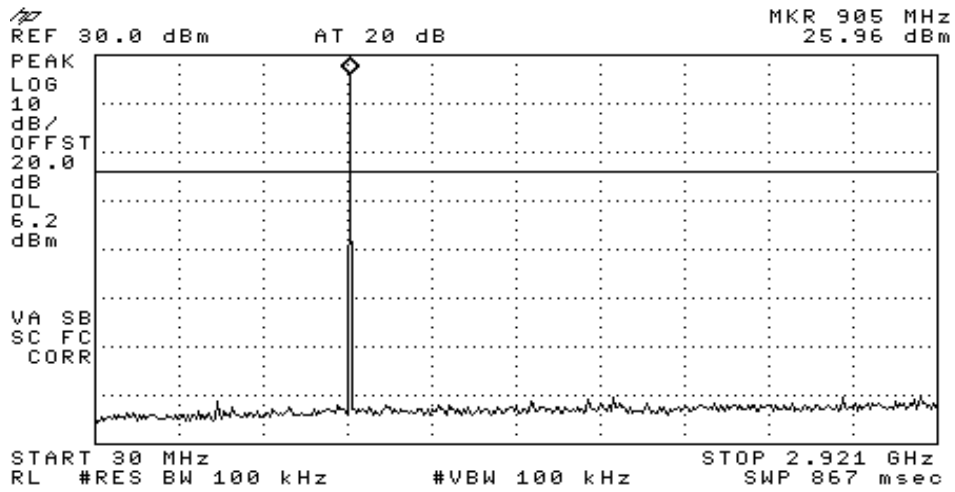


EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

Run\$ 5: Out of band

902MHz

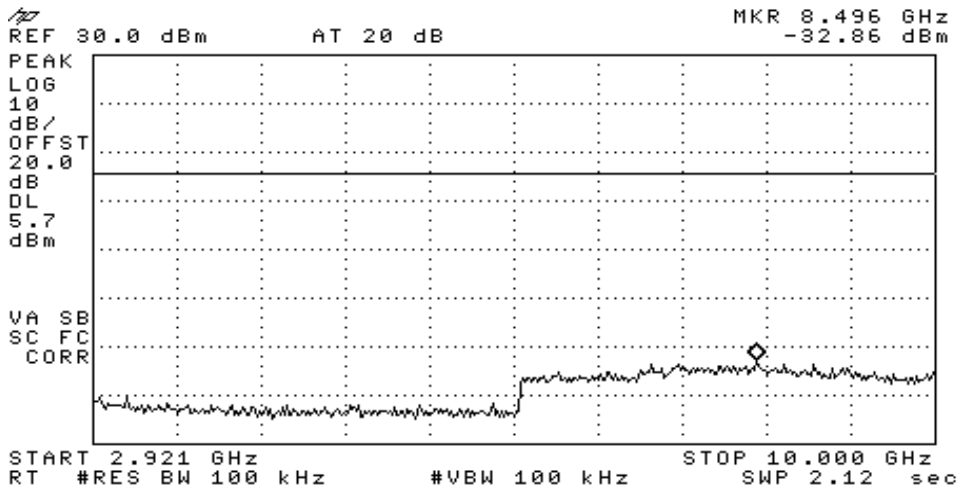
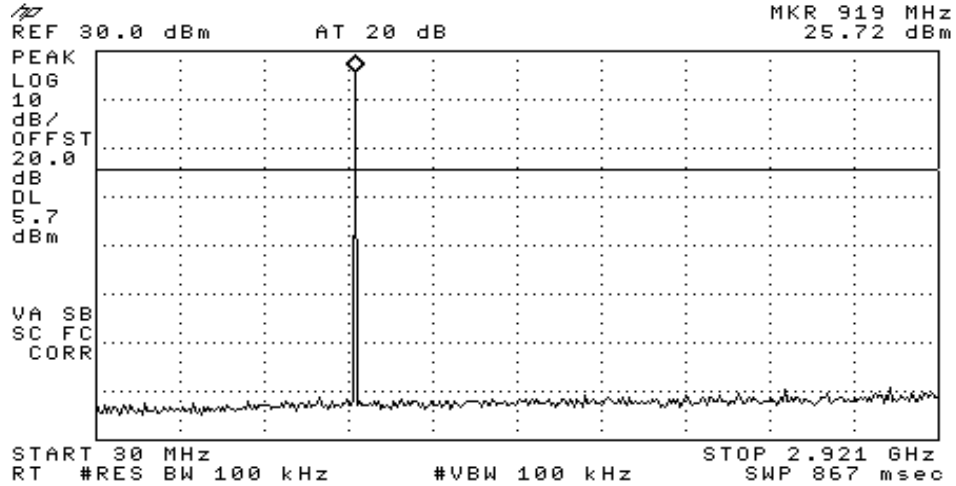




EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

915MHz

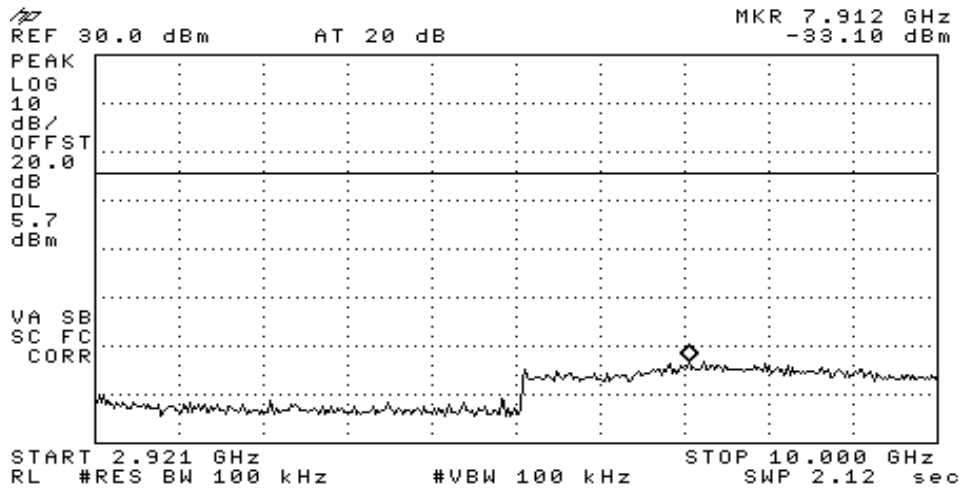
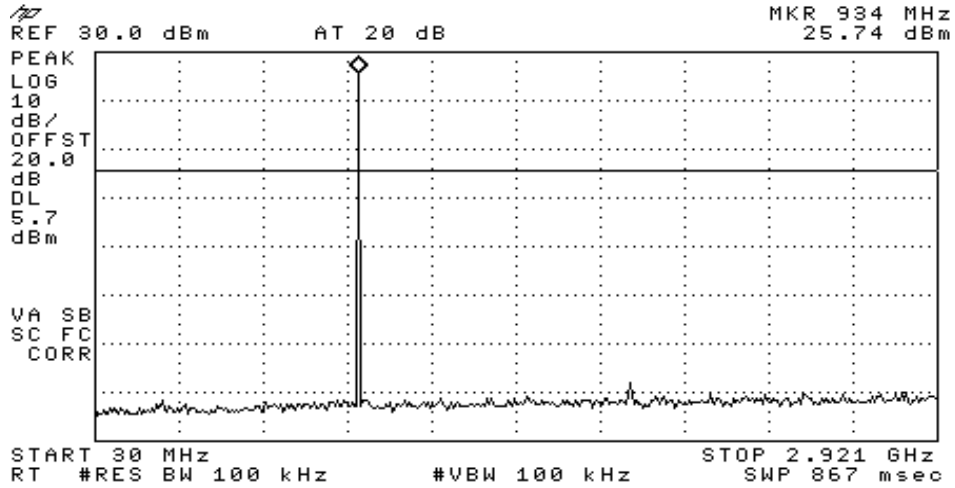




EMC Test Data

Client: Microwave Data Systems	Job Number: J56284
Model: MDS9810	T-Log Number: T56403
Contact: Dennis McCarthy	Account Manager: Christine Vu
Spec: FCC 15.247, RSS-210	Class: N/A

928MHz





EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Radiated Emissions (OMNI)

Test Specifics

Objective: The objective of this test session is to perform engineering evaluation testing of the EUT with respect to the specification listed above.

Date of Test: 7/31/2004	Config. Used: 1
Test Engineer: Juan Martinez	Config Change: None
Test Location: SVOATS #2	EUT Voltage: 13.8Vdc

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.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature:	21 °C
Rel. Humidity:	35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-3.2dB @ 1804.0MHz
1b	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-0.4dB @ 1830.0MHz
1c	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-0.8dB @ 960.000MHz

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.



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1a: Radiated Spurious Emissions, 30 - 10,000 MHz. Low Channel @ 902 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
1804.000	50.8	v	54.0	-3.2	Avg	207	1.0	Pk reading, Avg limit (Non-Rest.)
4510.000	50.8	v	54.0	-3.2	Avg	192	1.0	Pk reading, Avg limit (Restricted)
7216.000	50.4	v	54.0	-3.6	Avg	174	1.2	Pk reading, Avg limit (Restricted)
7216.000	50.2	h	54.0	-3.8	Avg	186	1.1	Pk reading, Avg limit (Restricted)
5412.000	48.1	h	54.0	-5.9	Avg	261	1.4	Pk reading, Avg limit (Restricted)
3608.000	47.8	v	54.0	-6.2	Avg	182	1.2	Pk reading, Avg limit (Restricted)
5412.000	47.8	v	54.0	-6.2	Avg	158	1.2	Pk reading, Avg limit (Restricted)
1804.000	47.1	h	54.0	-6.9	Avg	165	1.0	Pk reading, Avg limit (Non-Rest.)
4510.000	46.0	h	54.0	-8.0	Avg	261	1.0	Pk reading, Avg limit (Restricted)
3608.000	44.6	h	54.0	-9.5	Avg	133	1.0	Pk reading, Avg limit (Restricted)
9020.000	43.8	h	54.0	-10.2	Avg	180	1.2	Restricted
8118.000	42.8	v	54.0	-11.2	Avg	175	1.2	Restricted
8118.000	42.8	h	54.0	-11.2	Avg	187	1.2	Restricted
9020.000	42.8	v	54.0	-11.2	Avg	181	1.2	Restricted
2706.000	41.9	v	54.0	-12.1	Avg	235	1.0	Pk reading, Avg limit (Restricted)
2706.000	40.6	h	54.0	-13.4	Avg	192	1.1	Pk reading, Avg limit (Restricted)
9020.000	53.9	v	74.0	-20.1	Pk	181	1.2	Restricted
8118.000	53.8	v	74.0	-20.2	Pk	175	1.1	Restricted
8118.000	50.8	h	74.0	-23.2	Pk	187	1.2	Restricted
9020.000	50.0	h	74.0	-24.0	Pk	180	1.2	Restricted

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.

Note 2:



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 10,000 MHz. Center Channel @ 915 MHz

Frequency MHz	Level dBμV/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
1830.000	53.6	v	54.0	-0.4	Avg	145	1.0	Pk reading, Avg limit (Non-Rest.)
1830.000	52.6	h	54.0	-1.4	Avg	165	1.3	Pk reading, Avg limit (Non-Rest.)
5490.000	51.0	v	54.0	-3.0	Avg	147	1.1	Pk reading, Avg limit (Restricted)
4755.000	50.4	v	54.0	-3.6	Avg	175	1.1	Restricted
4755.000	50.2	h	54.0	-3.8	Avg	202	1.3	Pk reading, Avg limit (Restricted)
5490.000	48.4	h	54.0	-5.6	Avg	83	1.1	Pk reading, Avg limit (Restricted)
3660.000	47.8	v	54.0	-6.2	Avg	212	1.0	Pk reading, Avg limit (Restricted)
9150.000	45.5	h	54.0	-8.5	Avg	180	1.2	Restricted
3660.000	45.4	h	54.0	-8.6	Avg	205	1.3	Pk reading, Avg limit (Restricted)
8235.000	45.3	v	54.0	-8.7	Avg	171	1.4	Restricted
9150.000	45.2	v	54.0	-8.8	Avg	171	1.4	Restricted
8235.000	44.2	h	54.0	-9.8	Avg	170	1.3	Restricted
7320.000	44.2	h	54.0	-9.8	Avg	171	1.3	Restricted
2745.000	42.8	h	54.0	-11.2	Avg	156	1.2	Pk reading, Avg limit (Restricted)
7320.000	41.4	v	54.0	-12.6	Avg	213	1.1	Restricted
2745.000	40.0	v	54.0	-14.0	Avg	212	1.0	Pk reading, Avg limit (Restricted)
9150.000	56.7	h	74.0	-17.3	Pk	180	1.2	Restricted
8235.000	56.4	v	74.0	-17.6	Pk	171	1.4	Restricted
8235.000	55.4	h	74.0	-18.6	Pk	170	1.3	Restricted
7320.000	55.2	h	74.0	-18.8	Pk	171	1.3	Restricted
7320.000	54.9	v	74.0	-19.1	Pk	213	1.1	Restricted
4755.000	54.3	v	74.0	-19.7	Pk	175	1.1	Restricted
9150.000	45.7	v	74.0	-28.3	Pk	171	1.4	Restricted

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.

Note 2:



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 10,000 MHz. High Channel @ 928 MHz

Frequency MHz	Level dBμV/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
960.000	45.2	v	46.0	-0.8	QP	11	2.0	Restricted bands (Omni)
1855.000	51.3	v	54.0	-2.7	Avg	172	1.0	Pk reading, Avg limit (Non-Rest.)
4640.000	51.1	v	54.0	-2.9	Avg	140	1.0	Pk reading, Avg limit (Restricted)
1855.000	48.9	h	54.0	-5.1	Avg	175	1.0	Pk reading, Avg limit (Non-Rest.)
4640.000	47.0	h	54.0	-7.0	Avg	206	1.0	Pk reading, Avg limit (Restricted)
5568.000	46.7	v	54.0	-7.3	Avg	96	1.0	Pk reading, Avg limit (Restricted)
3712.000	46.4	h	54.0	-7.6	Avg	206	1.0	Pk reading, Avg limit (Restricted)
2758.000	46.2	v	54.0	-7.8	Avg	185	1.0	Pk reading, Avg limit (Restricted)
960.000	37.7	h	46.0	-8.3	QP	315	1.0	Restricted bands (Omni)
2758.000	45.4	h	54.0	-8.6	Avg	156	1.0	Pk reading, Avg limit (Restricted)
8352.000	44.5	h	54.0	-9.5	Avg	110	1.0	Restricted
3712.000	44.0	v	54.0	-10.0	Avg	196	1.0	Pk reading, Avg limit (Restricted)
5568.000	43.1	h	54.0	-10.9	Avg	332	1.2	Pk reading, Avg limit (Restricted)
7424.000	43.1	h	54.0	-10.9	Avg	265	1.2	Restricted
8352.000	43.1	v	54.0	-10.9	Avg	130	1.1	Restricted
9280.000	41.8	v	54.0	-12.2	Avg	120	1.0	Restricted
7424.000	40.8	v	54.0	-13.2	Avg	131	1.2	Restricted
8352.000	54.5	h	74.0	-19.5	Pk	110	1.0	Restricted
9280.000	53.5	h	74.0	-20.5	Pk	119	1.1	Restricted
8352.000	52.8	v	74.0	-21.2	Pk	130	1.1	Restricted
9280.000	52.4	v	74.0	-21.6	Pk	120	1.0	Restricted
7424.000	52.3	v	74.0	-21.7	Pk	131	1.2	Restricted
7424.000	51.5	h	74.0	-22.5	Pk	265	1.2	Restricted
9280.000	42.9	h	54.0	-11.1	Avg	119	1.1	Restricted

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.

Note 2:

--



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Radiated Emissions (YAGI)

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: 7/16/2004	Config. Used: 1
Test Engineer: Juan Martinez	Config Change: None
Test Location: SVOATS #2	EUT Voltage: 13.8Vdc

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.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature:	21 °C
Rel. Humidity:	35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-6.2dB @ 1804.0MHz
1b	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-2.1dB @ 1830.0MHz
1c	RE, 30 - 10,000 MHz - Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	-0.5dB @ 960.000MHz

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.



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1a: Radiated Spurious Emissions, 30 - 10,000 MHz. Low Channel @ 902 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
1804.000	47.8	v	54.0	-6.2	Avg	239	1.3	Pk reading, Avg limit (Non-Rest.)
4510.000	46.7	h	54.0	-7.3	Avg	162	1.0	Pk reading, Avg limit (Restricted)
4510.000	46.6	v	54.0	-7.4	Avg	196	1.0	Pk reading, Avg limit (Restricted)
1804.000	46.5	h	54.0	-7.5	Avg	149	1.0	Pk reading, Avg limit (Non-Rest.)
5412.000	46.5	v	54.0	-7.5	Avg	192	1.0	Pk reading, Avg limit (Restricted)
3608.000	44.4	v	54.0	-9.6	Avg	204	1.5	Pk reading, Avg limit (Restricted)
3608.000	44.2	h	54.0	-9.8	Avg	200	1.1	Pk reading, Avg limit (Restricted)
9020.000	43.5	v	54.0	-10.5	Avg	183	1.0	Restricted
9020.000	43.5	h	54.0	-10.5	Avg	174	1.0	Restricted
8118.000	42.8	v	54.0	-11.2	Avg	192	1.0	Restricted
8118.000	42.6	h	54.0	-11.4	Avg	180	1.0	Restricted
2706.000	42.3	h	54.0	-11.8	Avg	203	1.2	Pk reading, Avg limit (Restricted)
5412.000	41.5	h	54.0	-12.5	Avg	161	1.0	Pk reading, Avg limit (Restricted)
2706.000	40.8	v	54.0	-13.2	Avg	137	1.1	Pk reading, Avg limit (Restricted)
8118.000	51.4	v	74.0	-22.6	Pk	192	1.0	Restricted
9020.000	51.2	h	74.0	-22.8	Pk	174	1.0	Restricted
9020.000	51.1	v	74.0	-22.9	Pk	183	1.0	Restricted
8118.000	50.4	h	74.0	-23.6	Pk	180	1.0	Restricted

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.

Note 2:

--	--



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 10,000 MHz. Center Channel @ 915 MHz

Frequency MHz	Level dBμV/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
1830.000	51.9	v	54.0	-2.1	Avg	202	1.1	Pk reading, Avg limit (Non-Rest.)
4755.000	50.0	v	54.0	-4.0	Avg	173	1.0	Pk reading, Avg limit (Restricted)
1830.000	50.0	h	54.0	-4.0	Avg	219	1.0	Pk reading, Avg limit (Non-Rest.)
4755.000	48.8	h	54.0	-5.2	Avg	201	1.2	Pk reading, Avg limit (Restricted)
5490.000	47.1	v	54.0	-7.0	Avg	209	1.0	Pk reading, Avg limit (Restricted)
5490.000	45.6	h	54.0	-8.4	Avg	164	1.0	Pk reading, Avg limit (Restricted)
3660.000	45.2	v	54.0	-8.8	Avg	189	1.0	Pk reading, Avg limit (Restricted)
8235.000	42.9	v	54.0	-11.2	Avg	184	1.0	Restricted
8235.000	42.6	h	54.0	-11.4	Avg	180	1.0	Restricted
3660.000	42.5	h	54.0	-11.5	Avg	99	1.3	Pk reading, Avg limit (Restricted)
9150.000	42.0	v	54.0	-12.1	Avg	209	1.0	Restricted
9150.000	41.7	h	54.0	-12.3	Avg	208	1.0	Restricted
2745.000	41.0	v	54.0	-13.0	Avg	207	1.0	Pk reading, Avg limit (Restricted)
7320.000	41.0	h	54.0	-13.0	Avg	212	1.0	Restricted
2745.000	39.2	h	54.0	-14.8	Avg	213	1.3	Pk reading, Avg limit (Restricted)
7320.000	38.7	v	54.0	-15.3	Avg	207	1.0	Restricted
8235.000	53.2	h	74.0	-20.8	Pk	180	1.0	Restricted
9150.000	51.7	h	74.0	-22.3	Pk	208	1.0	Restricted
8235.000	51.4	v	74.0	-22.6	Pk	207	1.0	Restricted
9150.000	51.2	v	74.0	-22.8	Pk	209	1.0	Restricted
7320.000	50.4	h	74.0	-23.6	Pk	212	1.0	Restricted
7320.000	49.2	v	74.0	-24.8	Pk	209	1.0	Restricted

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.

Note 2:

--



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 10,000 MHz. High Channel @ 928 MHz

Frequency MHz	Level dBµV/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
960.000	45.5	h	46.0	-0.5	QP	0	1.0	Restricted
1855.000	49.7	v	54.0	-4.3	Avg	204	1.0	Pk reading, Avg limit (Non-Rest.)
5568.000	46.9	h	54.0	-7.1	Avg	283	1.0	Pk reading, Avg limit (Restricted)
6498.000	46.7	v	54.0	-7.3	Avg	214	1.0	Restricted
5568.000	46.0	v	54.0	-8.0	Avg	211	1.4	Pk reading, Avg limit (Restricted)
4640.000	45.2	v	54.0	-8.8	Avg	193	1.2	Pk reading, Avg limit (Restricted)
3712.000	44.4	v	54.0	-9.6	Avg	206	1.4	Pk reading, Avg limit (Restricted)
2758.000	44.4	v	54.0	-9.6	Avg	167	1.4	Pk reading, Avg limit (Restricted)
3712.000	44.3	h	54.0	-9.7	Avg	182	1.0	Pk reading, Avg limit (Restricted)
2758.000	43.8	h	54.0	-10.2	Avg	166	1.0	Pk reading, Avg limit (Restricted)
4640.000	43.6	h	54.0	-10.4	Avg	180	1.0	Pk reading, Avg limit (Restricted)
1855.000	43.4	h	54.0	-10.6	Avg	188	1.4	Pk reading, Avg limit (Non-Rest.)
7424.000	42.8	h	54.0	-11.2	Avg	175	1.0	Restricted
8352.000	42.8	h	54.0	-11.2	Avg	145	1.0	Restricted
9280.000	42.5	v	54.0	-11.5	Avg	160	1.0	Restricted
7424.000	41.9	v	54.0	-12.1	Avg	172	1.0	Restricted
8352.000	41.0	v	54.0	-13.0	Avg	173	1.0	Restricted
9280.000	41.0	h	54.0	-13.0	Avg	156	1.0	Restricted
6498.000	40.8	h	54.0	-13.2	Avg	180	1.0	Restricted
6498.000	55.2	h	74.0	-18.8	Pk	214	1.2	Restricted
960.000	25.6	v	46.0	-20.4	QP	295	2.2	Restricted
9280.000	52.3	v	74.0	-21.7	Pk	160	1.0	Restricted
7424.000	52.1	v	74.0	-21.9	Pk	172	1.0	Restricted
7424.000	51.9	h	74.0	-22.1	Pk	175	1.0	Restricted
8352.000	51.7	h	74.0	-22.3	Pk	145	1.0	Restricted
8352.000	51.4	v	74.0	-22.6	Pk	173	1.0	Restricted
6498.000	50.1	h	74.0	-23.9	Pk	180	1.0	Restricted
9280.000	49.8	h	74.0	-24.2	Pk	156	1.0	Restricted

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.

Note 2:



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Radiated Emissions (Rx)

Test Specifics

Objective: The objective of this test session is to perform engineering evaluation testing of the EUT with respect to the specification listed above.

Date of Test: 7/16/2004	Config. Used: 1
Test Engineer: Juan Martinez	Config Change: None
Test Location: SVOATS #2	EUT Voltage: 13.8Vdc

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.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions: Temperature: 21 °C
 Rel. Humidity: 35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 900 - 5000 MHz - Spurious Emissions	FCC B	Pass	-11.5dB @ 1660 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.



EMC Test Data

Client:	Microwave Data Systems	Job Number:	J56284
Model:	MDS9810	T-Log Number:	T56403
Contact:	Dennis McCarthy	Account Manager:	Christine Vu
Spec:	FCC 15.247, RSS-210	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 5,000 MHz.

Frequency	#VALUE!	Pol	FCC B		Detector	Azimuth	Height	Comments
MHz	#VALUE!	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
819.750	34.4	v	46.0	-11.6	QP	150	1.0	
819.750	35.1	h	46.0	-10.9	QP	147	1.2	
1639.500	44.2	v	54.0	-9.8	Avg	360	1.0	Peak Reading, Avg Limit
1639.500	45.1	h	54.0	-8.9	Avg	360	1.0	Peak Reading, Avg Limit
830.000	31.5	v	46.0	-14.5	QP	144	1.0	
830.000	33.4	h	46.0	-12.6	QP	112	1.2	
1660.000	44.0	v	54.0	-10.0	Avg	10	1.0	Peak Reading, Avg Limit
1660.000	45.5	h	54.0	-8.5	Avg	10	1.0	Peak Reading, Avg Limit
845.750	33.4	v	46.0	-12.6	QP	178	1.0	
845.750	35.4	h	46.0	-10.6	QP	178	1.2	
1691.500	42.8	v	54.0	-11.2	Avg	1	1.0	Peak Reading, Avg Limit
1691.500	44.8	h	54.0	-9.2	Avg	1	1.0	Peak Reading, Avg Limit

	3.0							
Note 1:	#VALUE!							
Note 2:	3.0							
	3.0							
	3.0							
	3.0							

EXHIBIT 3: Test Configuration Photographs

4 Pages

EXHIBIT 4: Proposed FCC ID Label & Label Location

2 Pages

***EXHIBIT 5: Detailed Photographs
of Microwave Data Systems Model MDS9810 Construction***

External Photographs 3 Pages
Internal Photographs 6 Pages

**EXHIBIT 6: Operator's Manual
for Microwave Data Systems Model MDS9810**

Manual 86 Pages

Not included in final client report, as the pdf file is protected

**EXHIBIT 7: Block Diagram
of Microwave Data Systems Model MDS9810**

1 Page

**EXHIBIT 8: Schematic Diagrams
for Microwave Data Systems Model MDS9810**

MDS9810 Schematic 7 Pages
9810_bom 9 Pages

Schematics were not included in final client report, as the pdf file is protected

**EXHIBIT 9: Theory of Operation
for Microwave Data Systems Model MDS9810**

Theory of Operations 8 Pages
Hopping sequence 20 Pages

EXHIBIT 10: RF Exposure Information

Hazard Statement Manual 6 Pages
MDS MPE 2 Pages
Antenna Info 1 of 2 3 Pages
Antenna Info 2 of 2 5 Pages