

SUBMITTAL APPLICATION REPORT

FOR GRANT OF CERTIFICATION

FOR

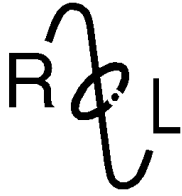
MODEL: R5H
5745-5825 MHz
Broadband Wireless Data Transmitter

FOR

MIKROTIK
Pernavas 46
Riga, Latvia LV-1009

Test Report Number: 080910

Authorized Signatory: *Scot D. Rogers*
Scot D. Rogers



ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

ENGINEERING TEST REPORT For APPLICATION of GRANT of CERTIFICATION

FOR
CFR 47, PART 15C - INTENTIONAL RADIATORS
CFR47 Paragraph 15.247
License Exempt Intentional Radiator

For

MIKROTIK

Pernavas 46
Riga, Latvia LV-1009

BROADBAND WIRELESS DATA TRANSMITTER
Model: R5H
Frequency Range 5745-5825 MHz
FCC ID#: TV7-R5H

Test Date: September 10, 2008

Certifying Engineer: *Scot D Rogers*
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Table Of Contents

TABLE OF CONTENTS.....	3
FORWARD	5
OPINION / INTERPRETATION OF RESULTS	5
ENVIRONMENTAL CONDITIONS.....	5
EQUIPMENT TESTED	5
2.1033(B) APPLICATION FOR CERTIFICATION	6
APPLICABLE STANDARDS & TEST PROCEDURES	6
EQUIPMENT FUNCTION AND TESTING PROCEDURES	7
EQUIPMENT AND CABLE CONFIGURATIONS	7
AC Line Conducted Emission Test Procedure	7
Radiated Emission Test Procedure.....	8
UNITS OF MEASUREMENTS	8
TEST SITE LOCATIONS	8
LIST OF TEST EQUIPMENT	9
SUBPART C - INTENTIONAL RADIATORS.....	10
15.203 Antenna Requirements	10
15.205 Restricted Bands of Operation.....	10
Radiated Emissions in Restricted Bands Data (worst-case) 15.205	10
Summary of Results for Radiated Emissions in Restricted Bands 15.205	10
Statement of Modifications and Deviations	11
15.207 AC line Conducted Emissions Procedure	11
Figure One AC Line Conducted Emissions Line 1	12
Figure Two AC Line Conducted Emissions Line 2.....	12
AC Line Conducted Emissions Data (7 Highest Emissions) 15.207.....	13
Summary of Results for AC Line Conducted Emissions 15.207.....	13
15.209 Radiated Emissions Procedure	14
Figure Three General Radiated Emissions taken at 1 meter in screen room	15
Figure Four General Radiated Emissions taken at 1 meter in screen room.....	15
Figure Five General Radiated Emissions taken at 1 meter in screen room	16
Figure Six General Radiated Emissions taken at 1 meter in screen room	16
Figure Seven General Radiated Emissions taken at 1 meter in screen room.....	17



Figure Eight General Radiated Emissions taken at 1 meter in screen room.....	17
Radiated Emissions from EUT Data (Highest Emissions) 15.209	18
Summary of Results for General Radiated Emissions 15.209.....	18
Statement of Modifications and Deviations	18
15.247 Operation in the Band 5725-5850 MHz	19
Figure Nine Antenna Port Conducted Emissions	19
Figure Ten Antenna Port Conducted Emissions.....	20
Figure Eleven Antenna Port Conducted Emissions.....	20
Figure Twelve Antenna Port Conducted Emissions.....	21
Figure Thirteen Antenna Port Conducted Emissions	21
Figure Fourteen Operations at three frequencies in band.....	22
Figure Fifteen 6dB Band width Requirement plot taken in screen room	22
Figure Sixteen 6dB Band width Requirement plot taken in screen room.....	23
Figure Seventeen 6dB Band width Requirement plot taken in screen room	23
Figure Eighteen Power Spectral Density plot taken in screen room	24
Figure Nineteen Power Spectral Density plot taken in screen room	24
Figure Twenty Power Spectral Density plot taken in screen room	25
Transmitter Antenna Conducted Emissions Data	25
Radiated Emissions from EUT Data (12 dBi Omni).....	26
Radiated Emissions from EUT Data (17 dBi Sector).....	26
Radiated Emissions from EUT Data (23 dBi Panel).....	27
Radiated Emissions from EUT Data (29 dBi Grid)	27
Radiated Emissions from EUT Data (32 dBi Dish).....	28
Summary of Results for Radiated Emissions of Intentional Radiator 15.247.....	28
Statement of Modifications and Deviations	28
ANNEX.....	29
Annex A Measurement Uncertainty Calculations.....	30
Annex B Test Equipment List For Rogers Labs, Inc.....	32
Annex C Rogers Qualifications.....	33
Annex D FCC Site Registration Letter	34



Forward

The following information is submitted for consideration in obtaining a Grant of Certification for a License Exempt Intentional Radiator operating under CFR47 Paragraph 15.247.

Name of Applicant:
MIKROTIK
Pernavas 46
Riga, Latvia LV-1009

Model: R5H

FCC I.D.: TV7-R5H FRN: 0014 43 1100
Frequency Range: 5745-5825 MHz

Operating Power: 1 Watt antenna port conducted power

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Emissions as per CFR47 paragraphs 2 and 15.205	Complies
Emissions as per CFR47 paragraphs 2 and 15.207	Complies
Emissions as per CFR47 paragraphs 2 and 15.209	Complies
Emissions as per CFR47 paragraphs 2 and 15.247	Complies

Environmental Conditions

Ambient Temperature 21.3° C
Relative Humidity 41%
Atmospheric Pressure 29.98 in Hg

Equipment Tested

<u>Equipment</u>	<u>Model</u>	<u>FCC I.D.#</u>
EUT	R5H	TV7-R5H
CPU	PP02x	N/A

2.1033(b) Application for Certification

- (1) Manufacturer: MIKROTIK
Pernavas 46
Riga, Latvia LV-1009
- (2) Identification: Model: R5H
FCC I.D.: TV7-R5H
- (3) Instruction Book:
Refer to Exhibit for Instruction Manual.
- (4) Description of Circuit Functions:
Refer to Exhibit of Operational Description.
- (5) Block Diagram with Frequencies:
Refer to Exhibit of Operational Description.
- (6) Report of Measurements:
Report of measurements follows in this Report.
- (7) Photographs: Construction, Component Placement, etc.:
Refer to Exhibit for photographs of equipment.
- (8) No Peripheral Equipment was Necessary for operation. A laptop computer was used for testing purposes.
- (9) Transition Provisions of 15.37 are not being requested.
- (10) Not Applicable. The unit is not a scanning receiver.
- (11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2007, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-2003 Document FCC, documents DA00-1407 and DA00-705 and/or TIA/EIA 603-1. Testing for the line-conducted emissions were performed as defined in sections

7 and 13.1.3, testing of the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4.

Equipment Function and Testing Procedures

The EUT is a 5745-5825 MHz transmitter used to transmit data in applications offering broadband wireless connectivity. The unit is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes the R5H transceiver was connected to the AC power supply and communicating to the laptop computer allowing for operational control of the transmitter and communications over the network interface between the EUT and supporting computer system. The R5H receives power from the supplied AC power adapter connected to utility power systems. No other interfacing options are provided on the design. For testing purposes the R5H and support equipment were powered from the AC power adapter supply and set to transmit in all maximum data modes available. The device is marketed for professionally installed use and the antenna connection complies with the unique antenna connection requirements.

Equipment and Cable Configurations

AC Line Conducted Emission Test Procedure

The R5H operates from DC power only and must be connected to the supplied and approved AC power adapter for operation. For testing purposes, the manufacturer supplied AC power adapter was used to power the system. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4. The test setup including the EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50 μ Hy choke. EMI was coupled to the spectrum analyzer through a 0.1 μ F capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table.

Radiated Emission Test Procedure

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Testing for the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. Refer to photographs in the test setup exhibits for EUT placement during testing.

Units of Measurements

Conducted EMI Data is in dB μ V; dB referenced to one microvolt

Radiated EMI Data is in dB μ V/m; dB/m referenced to one microvolt per meter

Test Site Locations

Conducted EMI The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS

Radiated EMI The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS

Site Approval Refer to Annex for Site Registration Letter

NVLAP Lab code 200087-0

List of Test Equipment

A Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

HP 8591 EM Analyzer Settings		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A Analyzer Settings		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Mfg.	Model	Cal. Date	Due.
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/07	10/08
LISN	Comp. Design	1762	2/08	2/09
Antenna	ARA	BCD-235-B	10/07	10/08
Antenna	EMCO	3147	10/07	10/08
Antenna	EMCO	3143	5/08	5/09
Analyzer	HP	8591EM	5/08	5/09
Analyzer	HP	8562A	5/08	5/09

Subpart C - Intentional Radiators

As per CFR47, Subpart C, paragraph 15.247 the following information is submitted.

15.203 Antenna Requirements

The product is marketed and sold for professional installation only. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled and there are no deviations or exceptions to the specification.

15.205 Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were checked at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. No other significant emission was observed which fell into the restricted bands of operation.

Sample Calculations:

$$\begin{aligned} \text{RFS (dB}\mu\text{V/m @ 3m)} &= \text{FSM(dB}\mu\text{V)} + \text{A.F.(dB)} - \text{Gain(dB)} \\ &= 24.3 + 39.9 - 30 \\ &= 34.2 \end{aligned}$$

Radiated Emissions in Restricted Bands Data (worst-case) 15.205

Frequency in MHz	FSM Horz. (dB μ V)	FSM Vert. (dB μ V)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dB μ V/m)	RFS Vert. @ 3m (dB μ V/m)	FCC Class B Limit @ 3m (dB μ V/m)
11490.0	24.3	23.1	39.9	30.0	34.2	33.0	54.0
11570.0	26.0	21.0	39.9	30.0	35.9	30.9	54.0
11650.0	24.0	23.6	39.9	30.0	16.6	33.5	54.0
22980.0	23.3	24.3	47.2	30.0	17.1	41.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions in Restricted Bands 15.205

The radiated emissions for the EUT meet the requirements for FCC Part 15C Intentional Radiators. The EUT had a 12.5 dB minimum margin below the limits. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. No other emissions were found in the restricted frequency bands. Other emissions were present with amplitudes at least 20 dB below the FCC Limits.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to meet the FCC Part 15C paragraph 15.205 emissions requirements. There were no deviations or exceptions to the specifications.

15.207 AC line Conducted Emissions Procedure

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied AC power adapter for the EUT was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μ F capacitor, internal to the LISN. Power line conducted emissions testing were carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each radio frequency emission displaying the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures one and two for plots of the AC Line conducted emissions.

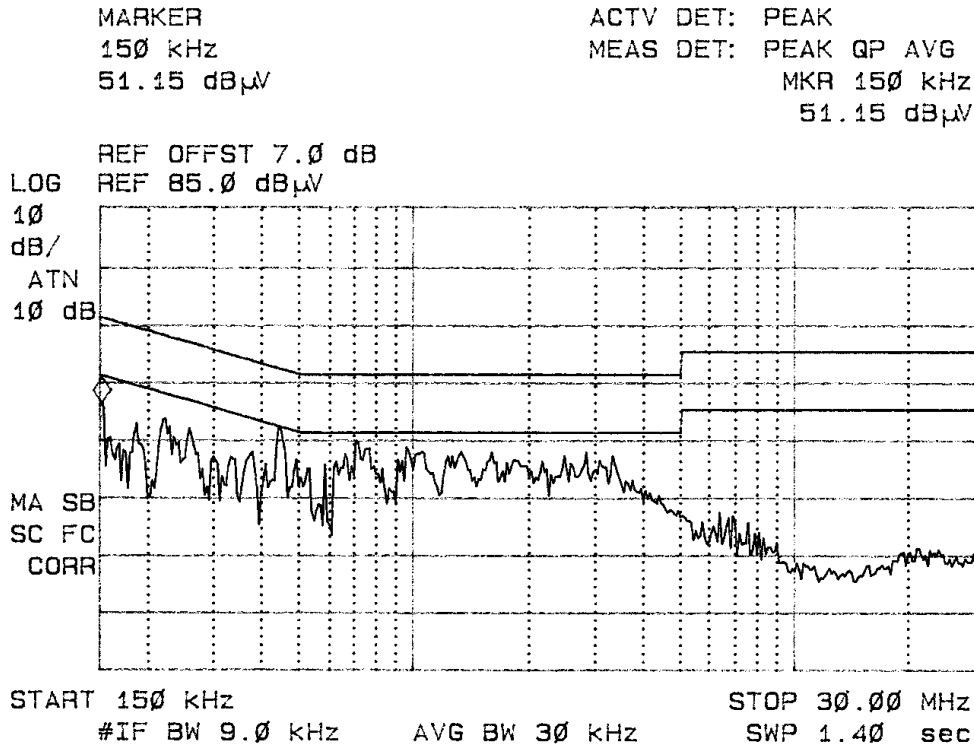


Figure One AC Line Conducted Emissions Line 1

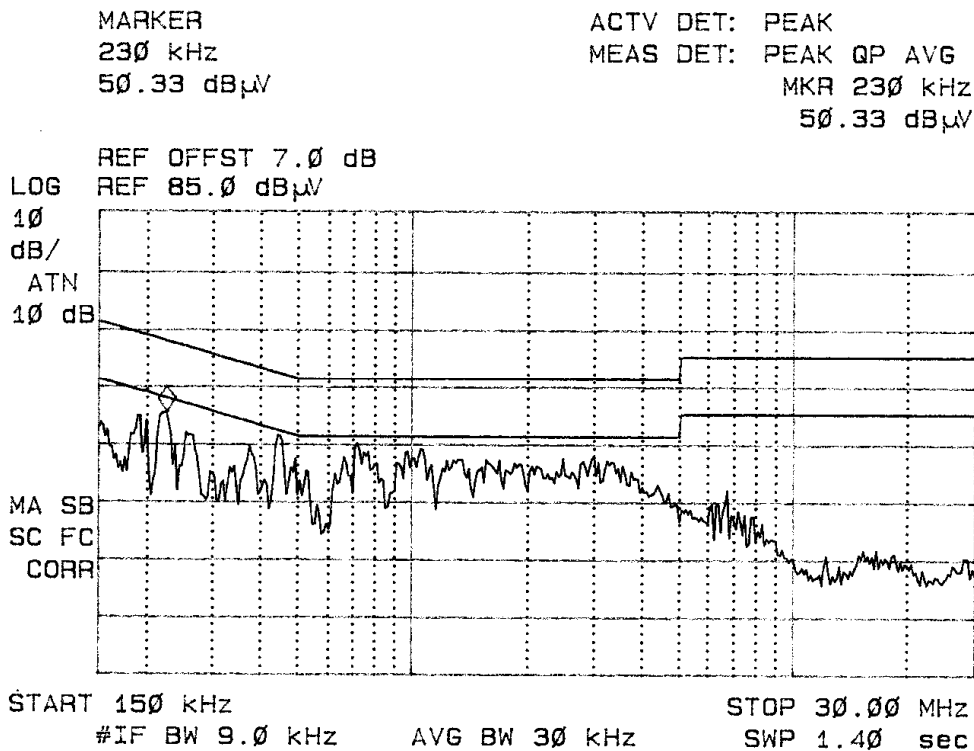


Figure Two AC Line Conducted Emissions Line 2

AC Line Conducted Emissions Data (7 Highest Emissions) 15.207

Frequency band (MHz)	L1 Level (dBμV)			L2 Level (dBμV)			CISPR 22 Limit Q.P. Ave(dBμV)
	Peak	Q.P.	AVE	Peak	Q.P.	AVE	
0.15 – 0.5	51.2	47.8	42.2	50.3	48.2	41.5	65 / 55
0.5 – 5	44.9	41.9	32.6	43.4	40.4	27.1	56 / 46
5 – 10	29.6	25.0	16.1	35.2	30.7	20.3	60 / 50
10 – 15	23.0	17.7	11.1	25.8	19.6	10.7	60 / 50
15 – 20	25.5	18.4	10.8	25.4	21.0	10.6	60 / 50
20 – 25	25.6	19.3	11.1	25.2	19.2	13.3	60 / 50
25 – 30	25.1	18.3	11.7	24.4	18.7	11.0	60 / 50

Other emissions present had amplitudes at least 10 dB below the limit.

Summary of Results for AC Line Conducted Emissions 15.207

The conducted emissions for the EUT meet the requirements for CISPR 22 and FCC Part 15B CLASS B Digital Devices. The EUT had a 14.1 dB minimum margin below the Quasi-Peak limit, and a 13.4 dB minimum margin below the CISPR average limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

15.209 Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available modes with worst-case data recorded. The antenna port was connected to a 50-ohm load and operated through all available modes for general radiated emissions testing. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Plots were made of the radiated frequency spectrum from 30 MHz to 18,000 MHz for the preliminary testing. Refer to figures three through eight for plots of the general radiated emissions spectrum taken in a screen room. The highest radiated emission was then re-maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 60,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and or, pyramidal horns and mixers from 4 GHz to 60 GHz, notch filters and appropriate amplifiers were utilized.

Sample Calculations:

$$\begin{aligned} \text{RFS} &= \text{Radiated Field Strength} \\ \text{dB}\mu\text{V/m @ 3m} &= \text{dB}\mu\text{V} + \text{A.F.} - \text{Amplifier Gain} \\ \text{dB}\mu\text{V/m @ 3m} &= 45.4 + 7.0 - 30 \\ &= 22.4 \end{aligned}$$

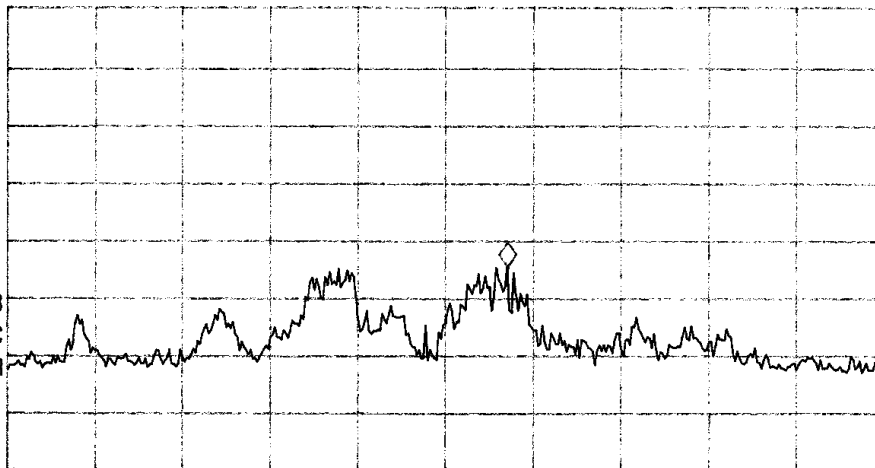
MARKER
144.0 MHz
35.20 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 144.0 MHz
35.20 dBμV

LOG REF 80.0 dBμV

10
dB/
#ATN
0 dB

MA SB
SC FC
CORR



START 30.0 MHz STOP 230.0 MHz
#IF BW 120 kHz AVG BW 300 kHz SWP 41.7 msec

Figure Three General Radiated Emissions taken at 1 meter in screen room

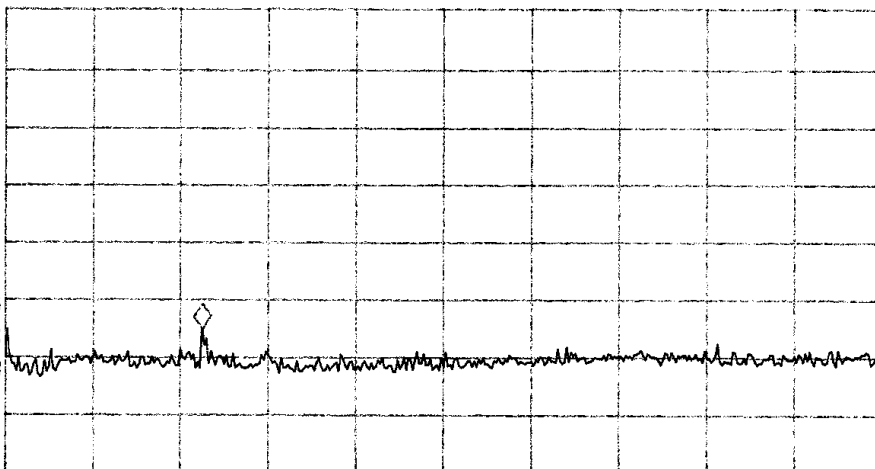
MARKER
425 MHz
24.68 dBμV

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 425 MHz
24.68 dBμV

LOG REF 80.0 dBμV

10
dB/
#ATN
0 dB

VA SB
SC FC
CORR



START 200 MHz STOP 1.200 GHz
#IF BW 120 kHz AVG BW 300 kHz SWP 208 msec

Figure Four General Radiated Emissions taken at 1 meter in screen room

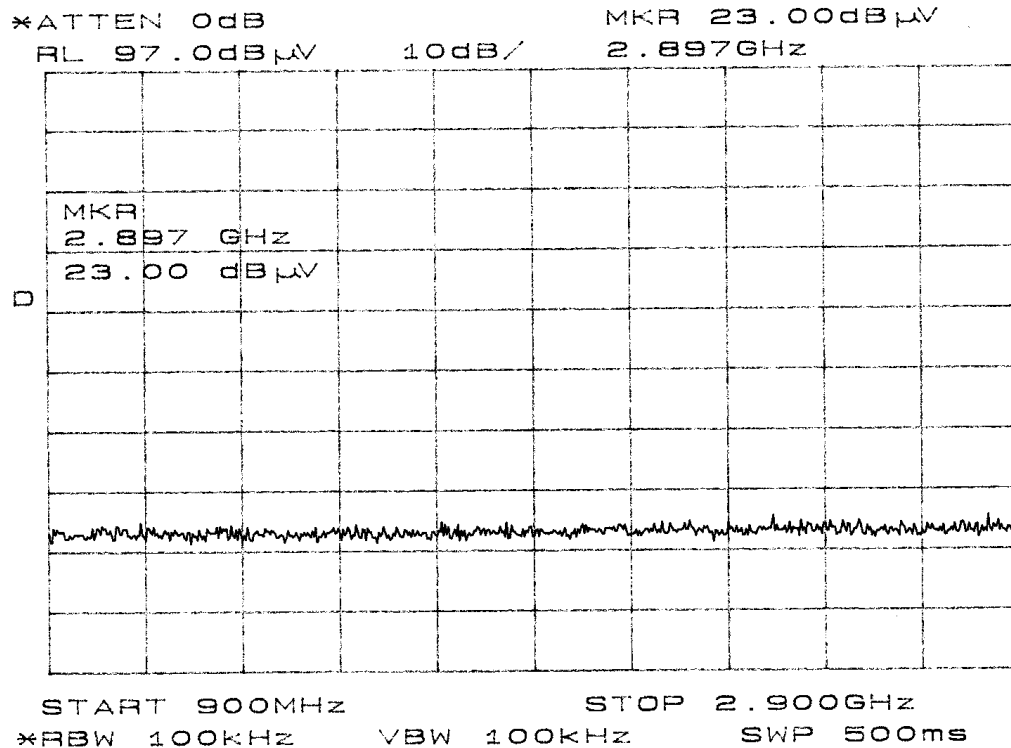


Figure Five General Radiated Emissions taken at 1 meter in screen room

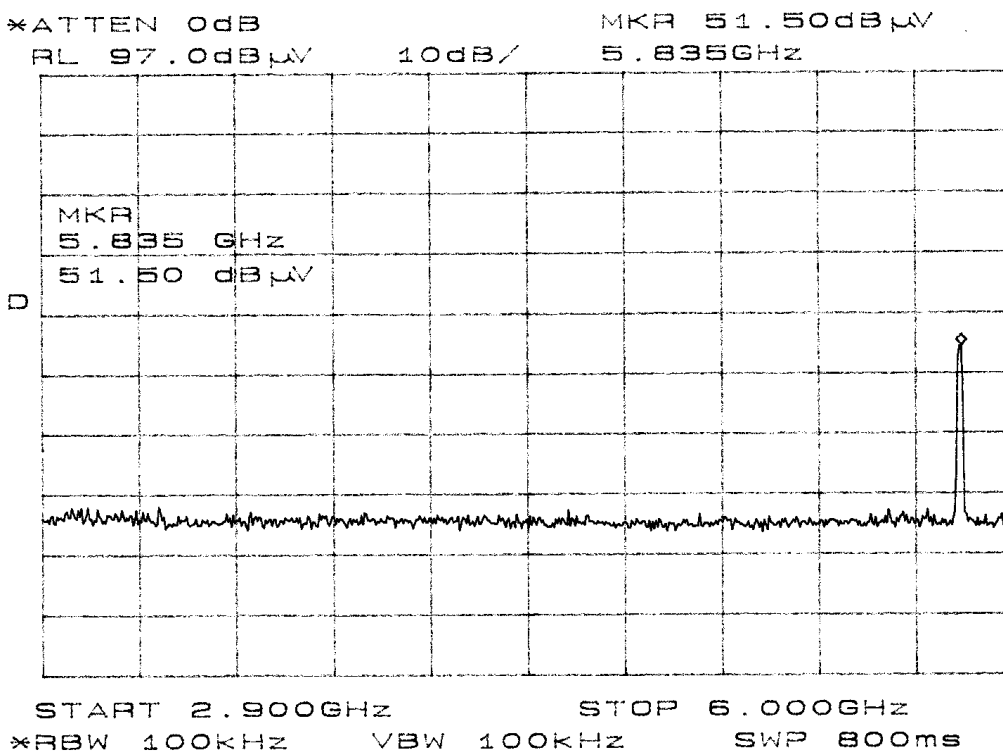


Figure Six General Radiated Emissions taken at 1 meter in screen room

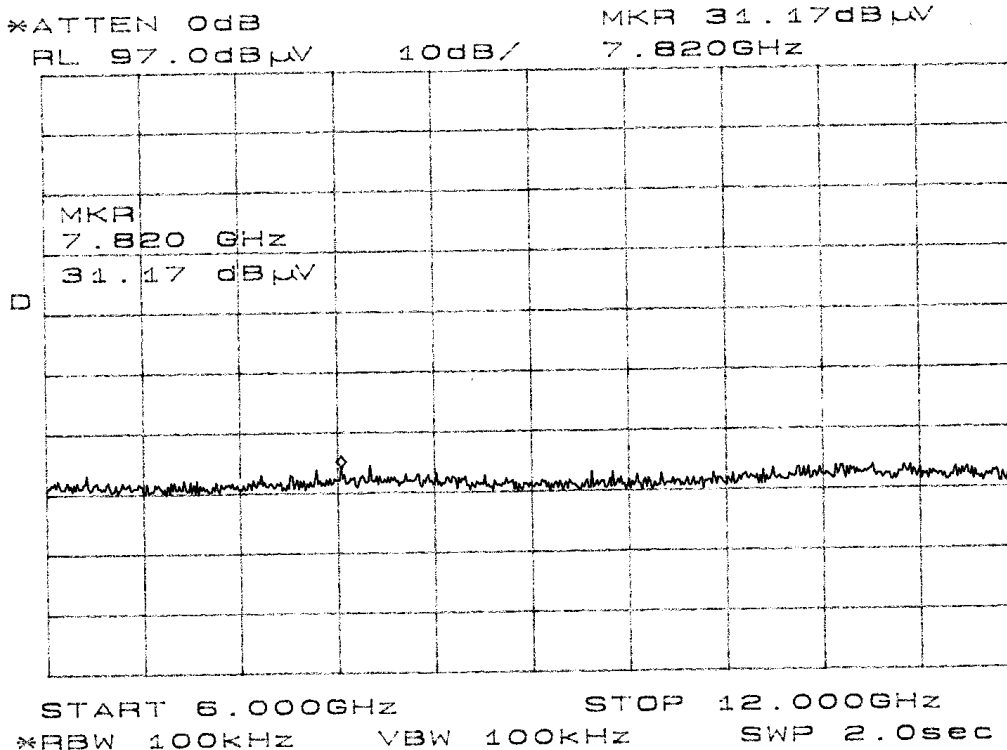


Figure Seven General Radiated Emissions taken at 1 meter in screen room

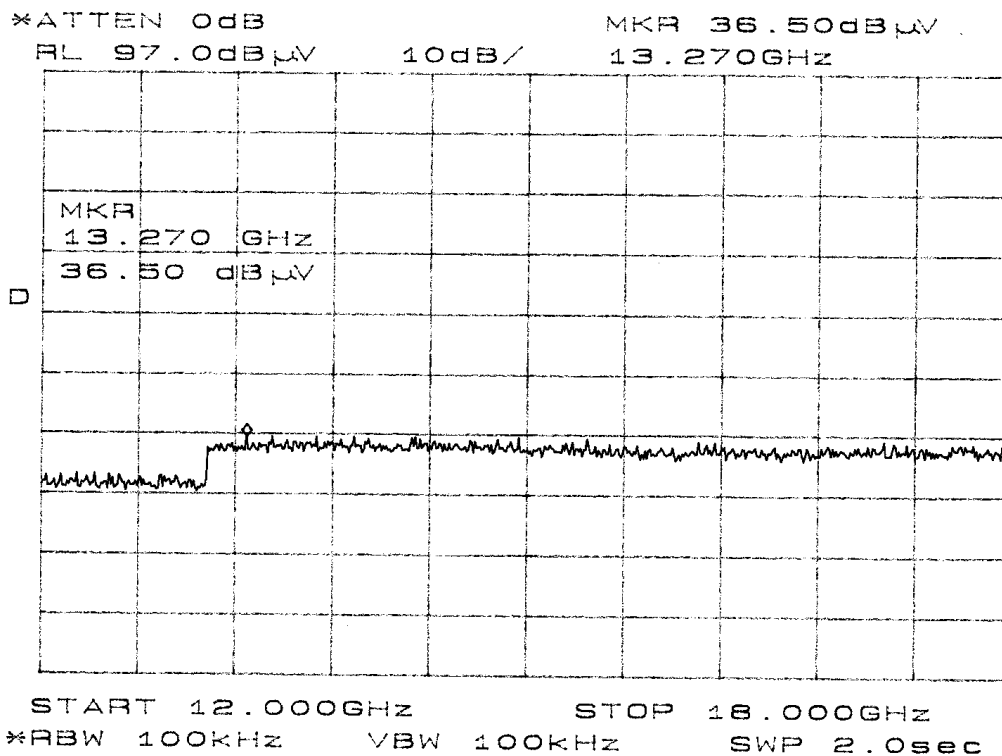


Figure Eight General Radiated Emissions taken at 1 meter in screen room

Radiated Emissions from EUT Data (Highest Emissions) 15.209

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	FCC Class B Limit @ 3m (dBμV/m)
103.4	45.4	55.3	7.0	30	22.4	32.3	43.5
107.5	46.9	54.3	6.9	30	23.8	31.2	43.5
134.4	48.7	42.5	8.5	30	27.2	21.0	43.5
135.8	47.2	50.5	8.5	30	25.7	29.0	43.5
139.3	47.8	43.4	9.7	30	27.5	23.1	43.5
141.3	44.6	48.3	9.7	30	24.3	28.0	43.5
143.3	40.8	43.7	12.5	30	23.3	26.2	43.5
145.3	38.9	41.8	12.5	30	21.4	24.3	43.5
146.7	40.8	41.2	12.5	30	23.3	23.7	43.5
148.2	48.0	45.1	12.5	30	30.5	27.6	43.5
172.8	50.2	46.7	8.8	30	29.0	25.5	43.5
422.2	45.5	41.3	16.8	30	32.3	28.1	46.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for General Radiated Emissions 15.209

The radiated emissions for the EUT meet the requirements for FCC Part 15C paragraph 15.209 Intentional Radiators. The EUT had an 11.2 dB minimum margin below the limits. Other emissions were present with amplitudes at least 20 dB below the FCC Limits.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to meet the CISPR 22 or CFR47 emissions requirements. There were no deviations or exceptions to the specifications.

15.247 Operation in the Band 5725-5850 MHz

The power output was measured both at the antenna connection and at the open area test site at a three-meter distance. Five antenna configurations were offered and tested for certification. The panel offers gain of 23 dBi, the Grid offers gain of 29 dBi, the Omni offers 12 dBi, the Sector offers 17 dBi, and the dish offers gain of 32 dBi. Data was taken per Paragraph 2.1046(a) and 15.247. Figures nine through thirteen demonstrate antenna conducted emissions and compliance with the requirements of 15.247(c) for emission limitations. Figure fourteen demonstrates compliance with maximum output power requirements of 15.247(a)(2) across the band. Figures fifteen through seventeen demonstrate compliance with the minimum 6 db bandwidth requirements of 15.247(A)(2). Figures eighteen through twenty demonstrate compliance to power spectral density per 15.247(d). Compliance to band edge requirements per 15.209 and 15.247 are demonstrated in radiated emissions tables for each antenna configuration. Antenna option configurations tested for compliance ranged in gain from 12 dBi to 32 dBi with worst case emissions presented in this document.

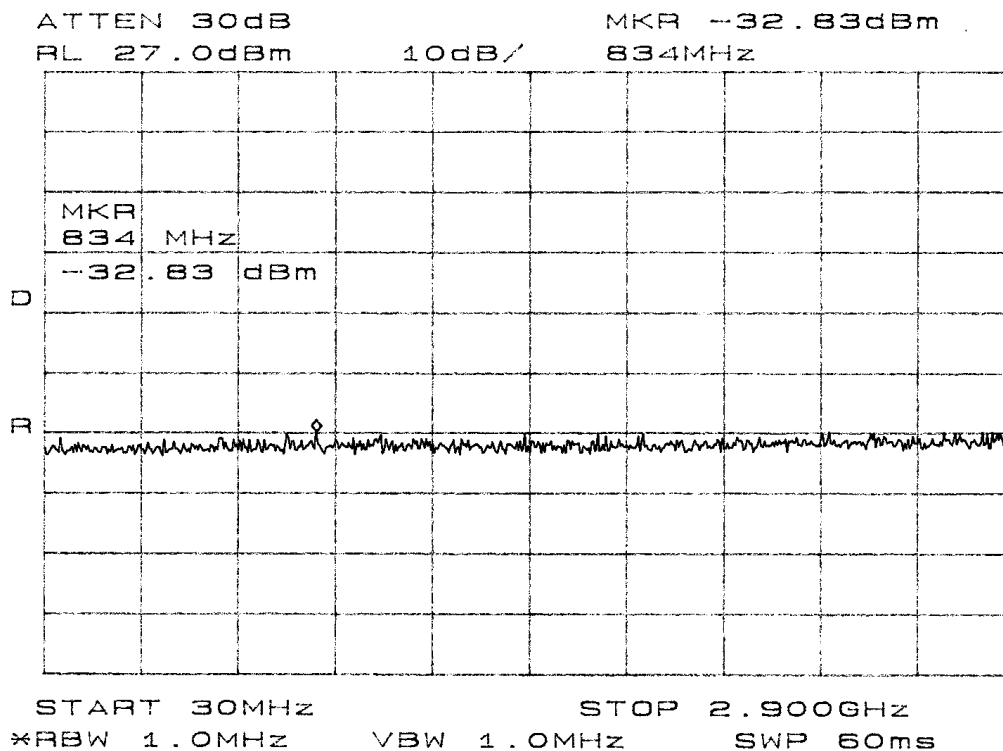


Figure Nine Antenna Port Conducted Emissions

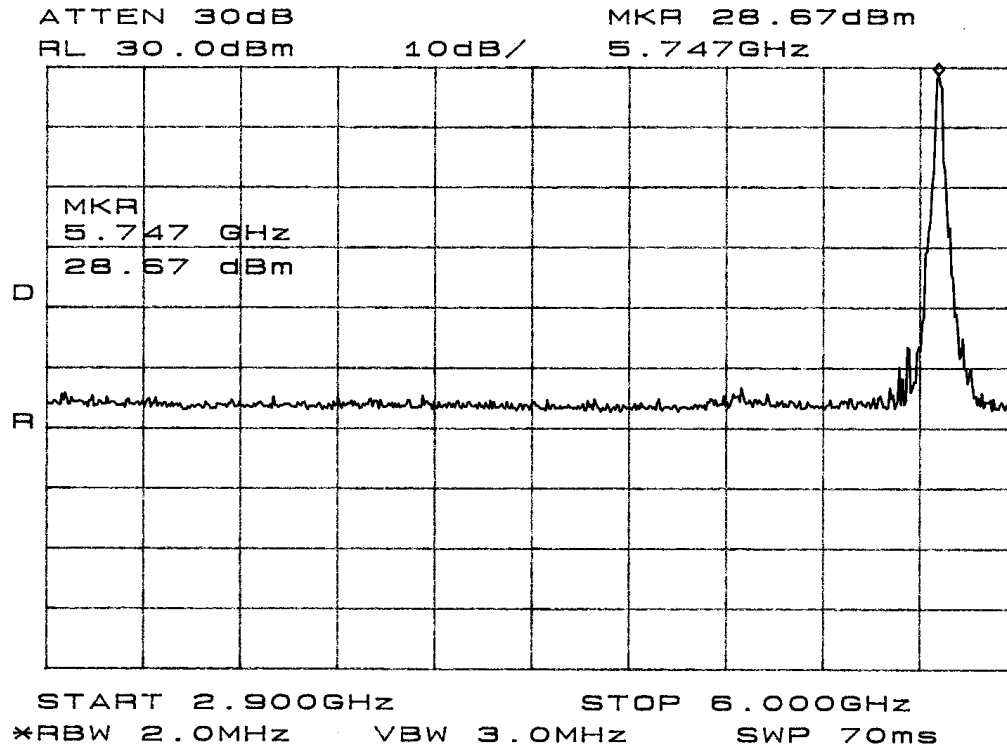


Figure Ten Antenna Port Conducted Emissions

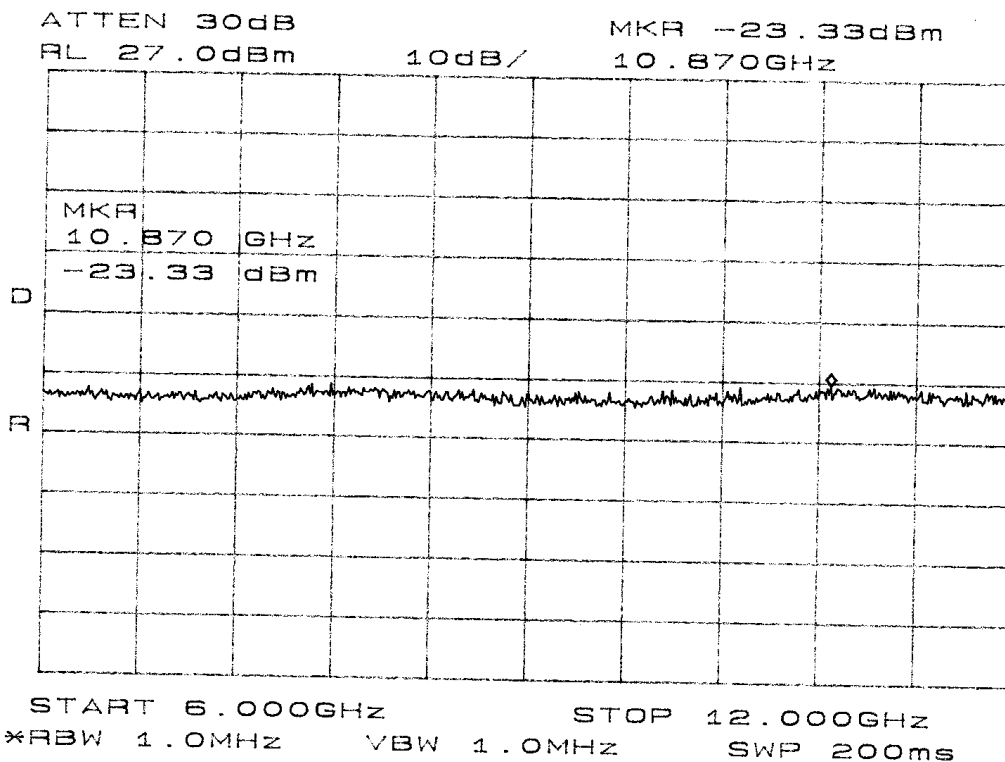


Figure Eleven Antenna Port Conducted Emissions

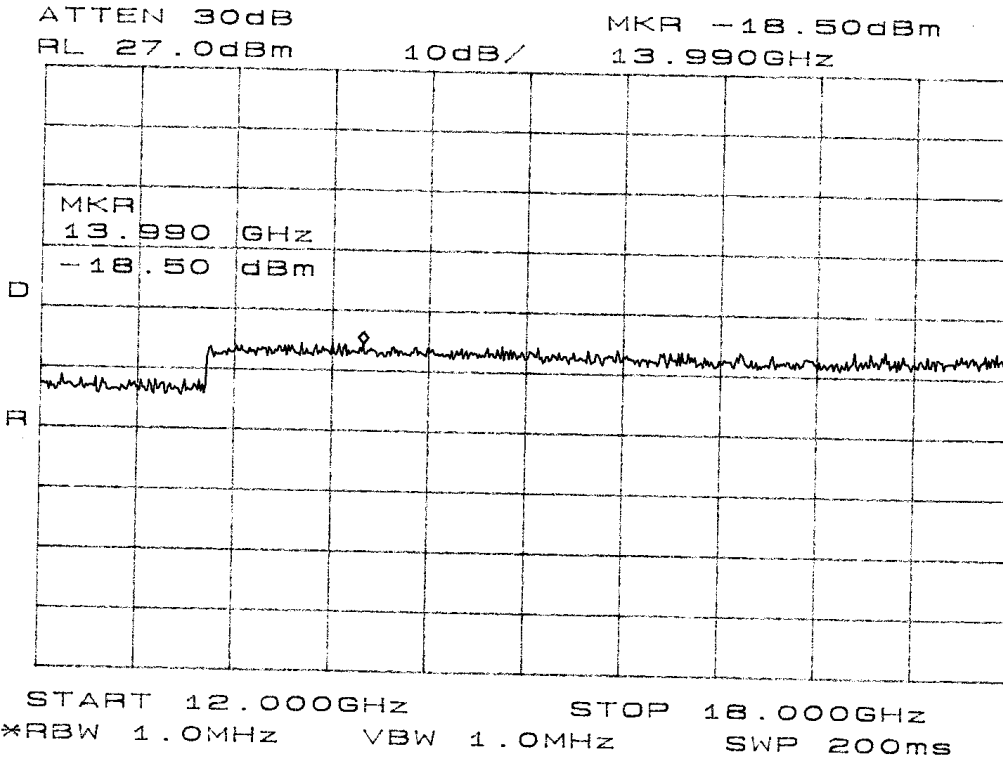


Figure Twelve Antenna Port Conducted Emissions

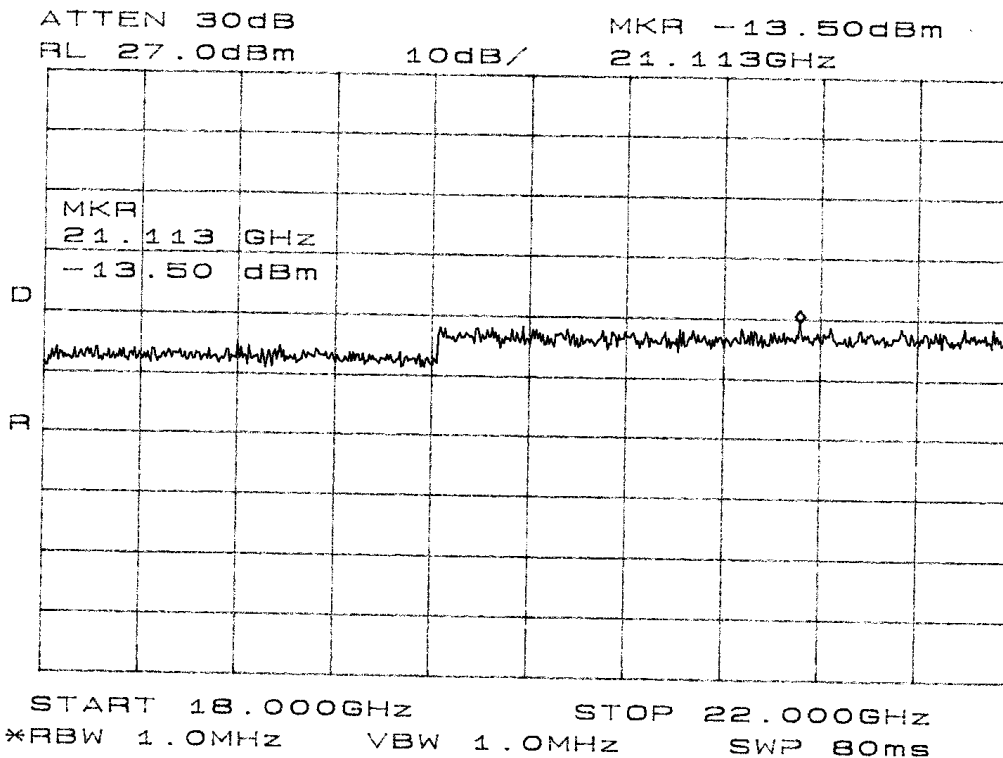


Figure Thirteen Antenna Port Conducted Emissions

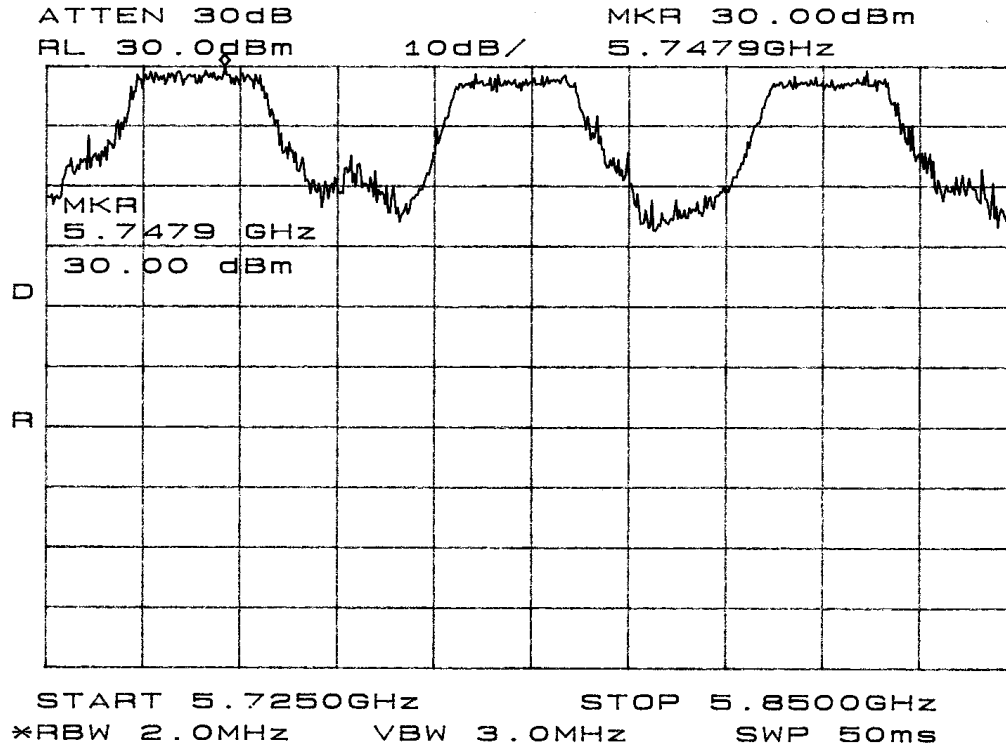


Figure Fourteen Operations at three frequencies in band

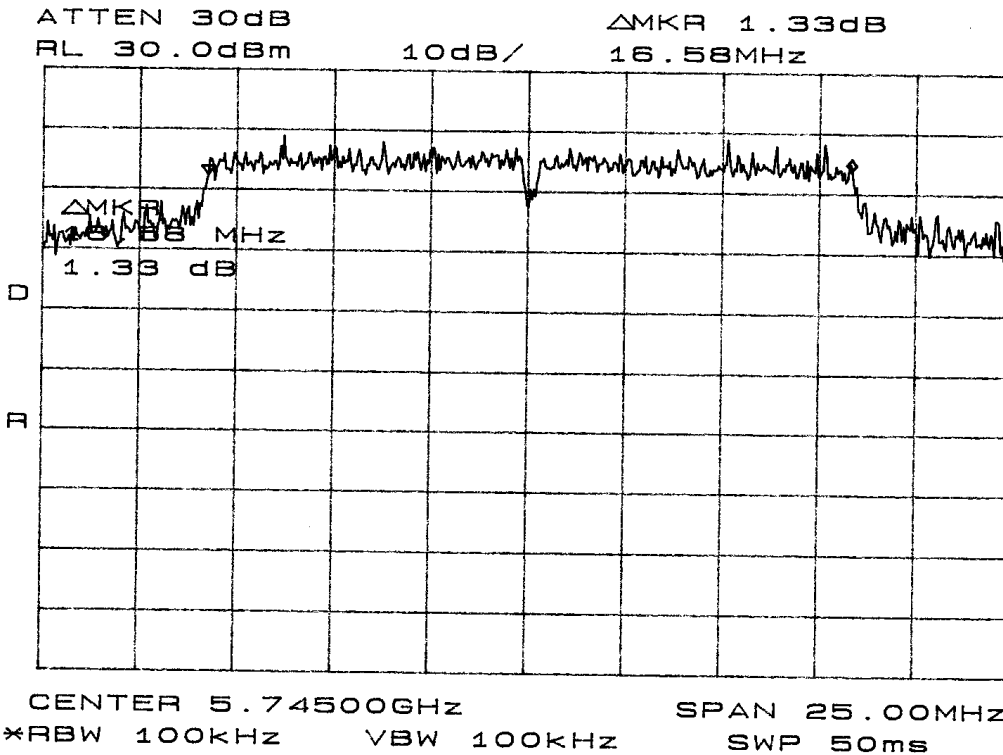


Figure Fifteen 6dB Band width Requirement plot taken in screen room

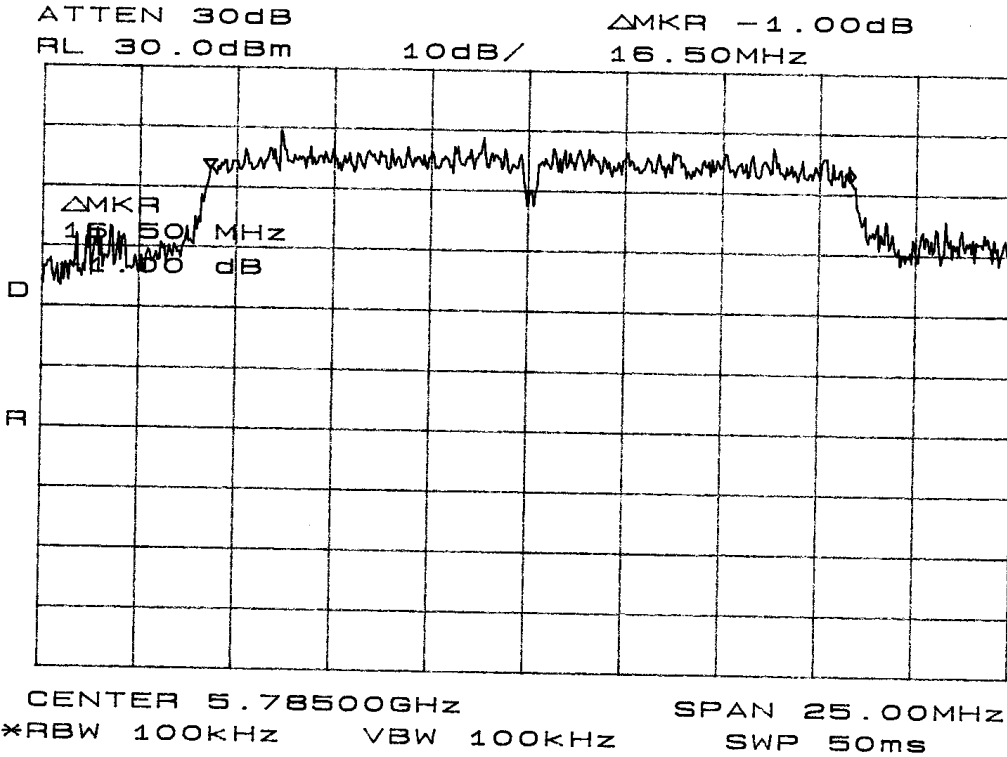


Figure Sixteen 6dB Band width Requirement plot taken in screen room

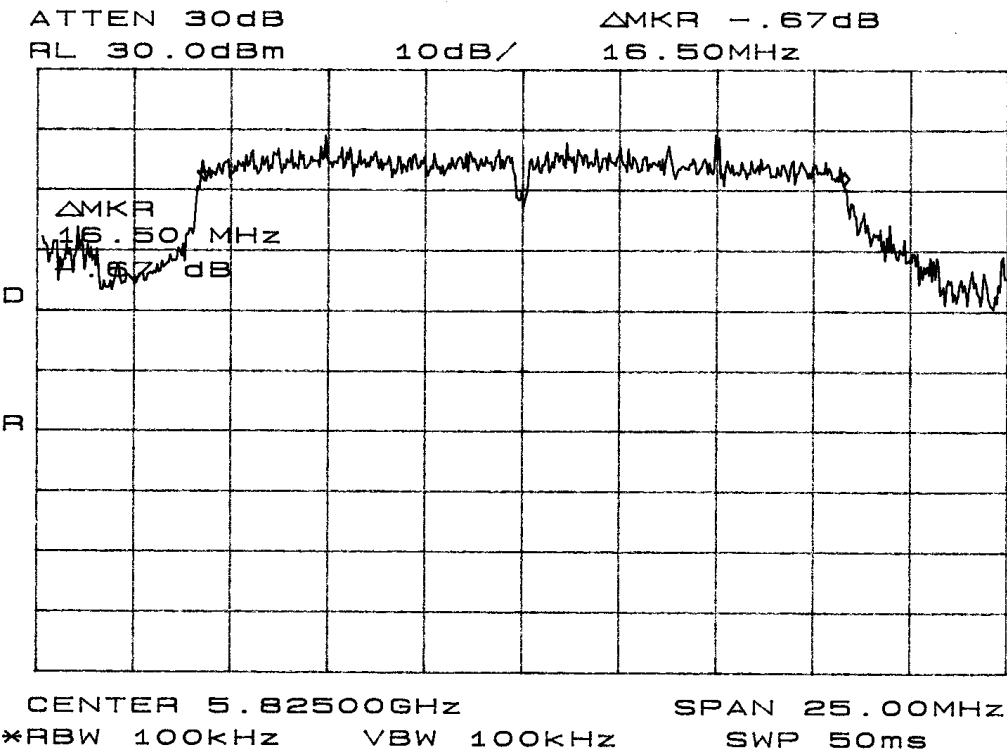


Figure Seventeen 6dB Band width Requirement plot taken in screen room

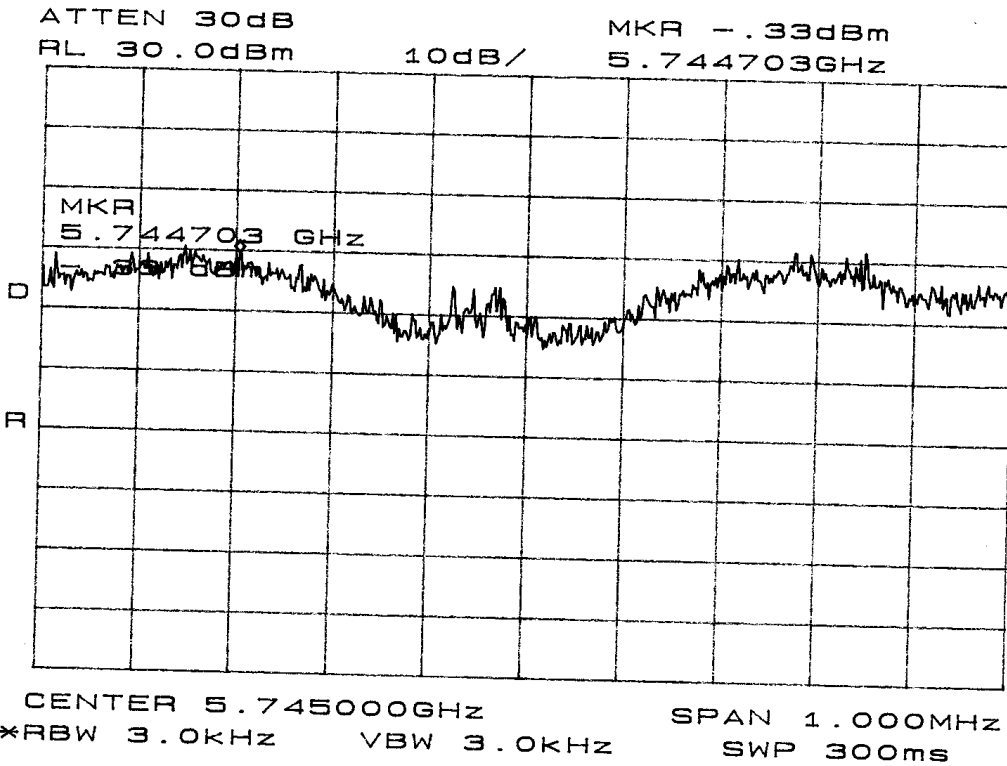


Figure Eighteen Power Spectral Density plot taken in screen room

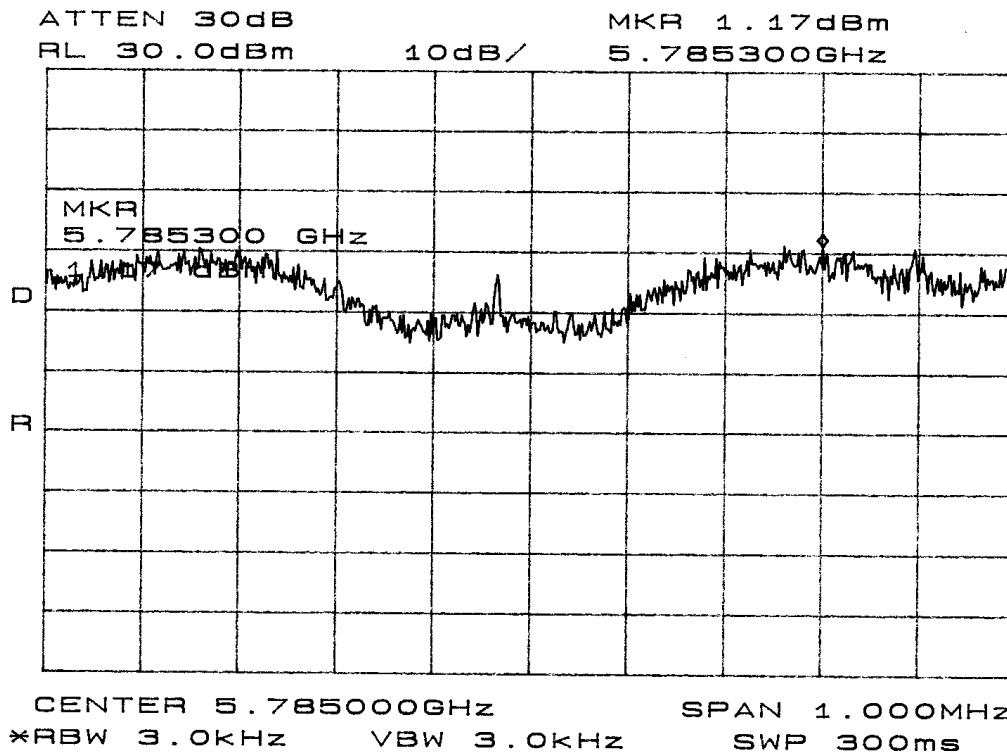


Figure Nineteen Power Spectral Density plot taken in screen room

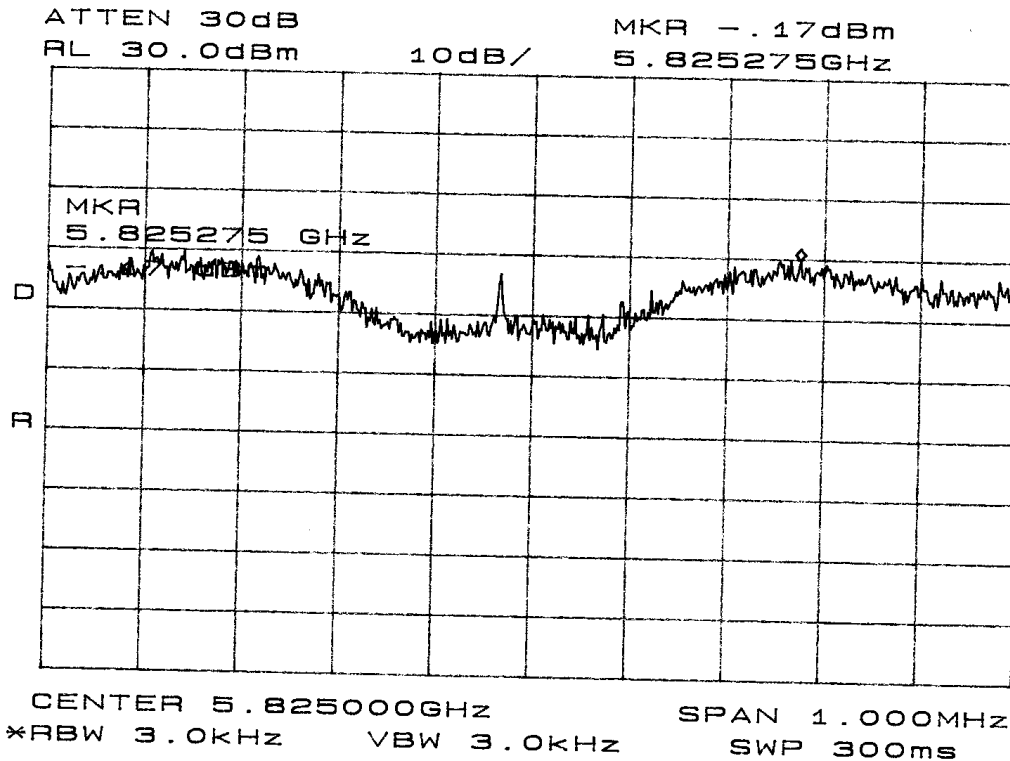


Figure Twenty Power Spectral Density plot taken in screen room

Transmitter Antenna Conducted Emissions Data

The antenna conducted output power, power spectral density, and 20-dB bandwidth were measured at three frequencies in the band of operation. The data reported below represents the worst-case operational conditions.

Frequency MHz	Antenna Conducted Output Power dBm	Modulated Output Power mW	Occupied Bandwidth MHz	Power Spectral Density dBm
5745.0	30.00	1000.0	16.58	-0.33
5785.0	29.93	984.0	16.50	1.17
5825.0	29.88	972.7	16.50	-0.17

Radiated Emissions from EUT Data (12 dBi Omni)

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
5745.0	98.5	114.8	33.4	30	101.9	118.2	--
11490.0	19.8	19.5	39.9	30	29.7	29.4	54.0
17235.0	24.3	23.8	43.6	30	37.9	37.4	54.0
22980.0	19.3	24.0	47.2	30	36.5	41.2	54.0
5785.0	99.3	114.8	33.6	30	102.9	118.4	--
11570.0	20.0	20.1	39.9	30	29.9	30.0	54.0
17355.0	22.8	22.5	44.6	30	37.4	37.1	54.0
23140.0	23.1	19.7	47.2	30	40.3	36.9	54.0
5825.0	101.0	114.0	33.8	30	104.8	117.8	--
11650.0	20.0	19.5	39.9	30	29.9	29.4	54.0
17475.0	22.3	22.1	46.4	30	38.7	38.5	54.0
23300.0	23.1	21.8	47.3	30	40.4	39.1	54.0
Band Edge Compliance							
5725.0	19.3	30.0	33.4	30	22.7	33.4	54.0
5850.0	18.5	21.7	33.8	30	22.3	25.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Radiated Emissions from EUT Data (17 dBi Sector)

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
5745.0	108.0	119.4	33.4	30	111.4	122.8	--
11490.0	19.7	25.2	39.9	30	29.6	35.1	54.0
17235.0	24.1	26.5	43.6	30	37.7	40.1	54.0
22980.0	21.8	21.3	47.2	30	39.0	38.5	54.0
5785.0	101.0	119.5	33.6	30	104.6	123.1	--
11570.0	19.0	19.5	39.9	30	28.9	29.4	54.0
17355.0	23.0	23.3	44.6	30	37.6	37.9	54.0
23140.0	20.2	22.2	47.2	30	37.4	39.4	54.0
5825.0	100.5	118.3	33.8	30	104.3	122.1	--
11650.0	20.7	22.5	39.9	30	30.6	32.4	54.0
17475.0	23.1	25.0	46.4	30	39.5	41.4	54.0
23300.0	20.3	22.5	47.3	30	37.6	39.8	54.0
Band Edge Compliance							
5725.0	23.5	48.3	33.4	30	26.9	51.7	54.0
5850.0	21.0	38.0	33.8	30	24.8	41.8	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Radiated Emissions from EUT Data (23 dBi Panel)

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
5745.0	119.0	134.8	33.4	30	122.4	138.2	--
11490.0	20.5	27.8	39.9	30	30.4	37.7	54.0
17235.0	23.1	23.8	43.6	30	36.7	37.4	54.0
22980.0	21.8	21.1	47.2	30	39.0	38.3	54.0
5785.0	119.3	130.0	33.6	30	122.9	133.6	--
11570.0	19.1	30.0	39.9	30	29.0	39.9	54.0
17355.0	23.7	23.8	44.6	30	38.3	38.4	54.0
23140.0	21.3	21.0	47.2	30	38.5	38.2	54.0
5825.0	120.8	131.8	33.8	30	124.6	135.6	--
11650.0	19.5	21.3	39.9	30	29.4	31.2	54.0
17475.0	23.0	22.3	46.4	30	39.4	38.7	54.0
23300.0	21.8	22.6	47.3	30	39.1	39.9	54.0
Band Edge Compliance							
5725.0	46.5	48.8	33.4	30	49.9	52.2	54.0
5850.0	29.5	35.3	33.8	30	33.3	39.1	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Radiated Emissions from EUT Data (29 dBi Grid)

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
5745.0	115.3	131.6	33.4	30	118.7	135.0	--
11490.0	27.6	24.7	39.9	30	37.5	34.6	54.0
17235.0	24.3	24.3	43.6	30	37.9	37.9	54.0
22980.0	21.8	22.8	47.2	30	39.0	40.0	54.0
5785.0	116.7	132.7	33.6	30	120.3	136.3	--
11570.0	20.8	27.5	39.9	30	30.7	37.4	54.0
17355.0	24.0	24.3	44.6	30	38.6	38.9	54.0
23140.0	21.5	24.5	47.2	30	38.7	41.7	54.0
5825.0	115.3	134.8	33.8	30	119.1	138.6	--
11650.0	19.7	23.0	39.9	30	29.6	32.9	54.0
17475.0	24.8	23.8	46.4	30	41.2	40.2	54.0
23300.0	19.6	23.7	47.3	30	36.9	41.0	54.0
Band Edge Compliance							
5725.0	24.3	40.1	33.4	30	27.7	43.5	54.0
5850.0	25.3	34.8	33.8	30	29.1	38.6	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Radiated Emissions from EUT Data (32 dBi Dish)

Frequency in MHz	FSM Horz. (dBμV)	FSM Vert. (dBμV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBμV/m)	RFS Vert. @ 3m (dBμV/m)	Limit @ 3m (dBμV/m)
5745.0	128.3	138.3	33.4	30	131.7	141.7	--
11490.0	24.3	23.1	39.9	30	34.2	33.0	54.0
17235.0	23.0	23.6	43.6	30	36.6	37.2	54.0
22980.0	23.3	24.3	47.2	30	40.5	41.5	54.0
5785.0	128.0	135.5	33.6	30	131.6	139.1	--
11570.0	26.0	21.0	39.9	30	35.9	30.9	54.0
17355.0	23.7	23.0	44.6	30	38.3	37.6	54.0
23140.0	20.0	22.8	47.2	30	37.2	40.0	54.0
5825.0	128.5	138.2	33.8	30	132.3	142.0	--
11650.0	24.0	23.6	39.9	30	33.9	33.5	54.0
17475.0	24.5	24.0	46.4	30	40.9	40.4	54.0
23300.0	20.8	23.1	47.3	30	38.1	40.4	54.0
Band Edge Compliance							
5725.0	26.1	39.0	33.4	30	29.5	42.4	54.0
5850.0	26.5	34.7	33.8	30	30.3	38.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions of Intentional Radiator 15.247

The EUT demonstrated antenna conducted output power of 1 watt and had the highest radiated emission of 142.0 dBμV/m at 3 meters at the fundamental frequency of operation utilizing the dish antenna. The EUT demonstrated a worst-case of 12.3 dB margin below the limit for the harmonic emissions. The radiated emissions for the EUT meet the requirements for CFR47 Part 15.247 Intentional Radiators. There are no measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the FCC Limits. The specifications of 15.247 were met; there are no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to meet the CFR47 Part 15C emissions standards. There were no deviations to the specifications.



NVLAP Lab Code 200087-0

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment List.
- Annex C Rogers Qualifications.
- Annex D FCC Site Registration Letter.

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5
Combined standard uncertainty $u_c(y)$ is		

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$$U_c(y) = \pm 1.6 \text{ dB}$$

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of $k = 2$ will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k=1}^n (q_k - \bar{q})^2}$$

$$U = 2 U_c(y) = 2 \times \pm 1.6 \text{ dB} = \pm 3.2 \text{ dB}$$

Notes:

- 1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with $k = 2$.
- 1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.
- 1.3 The antenna factor uncertainty does not take account of antenna directivity.
- 1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.
- 1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.
- 1.6 Site imperfections are difficult to quantify but may include the following contributions:
 - Unwanted reflections from adjacent objects.
 - Ground plane imperfections: reflection coefficient, flatness, and edge effects.
 - Losses or reflections from "transparent" cabins for the EUT or site coverings.
 - Earth currents in antenna cable (mainly effect biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	± 1.5
LISN coupling specification	rectangular	± 1.5
Cable and input attenuator calibration	normal (k=2)	± 0.5
Combined standard uncertainty $u_c(y)$ is		

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$$U_c(y) = \pm 1.2 \text{ dB}$$

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of $k = 2$ will suffice, therefore:

$$U = 2 U_c(y) = 2 \times \pm 1.2 \text{ dB} = \pm 2.4 \text{ dB}$$

**Annex B Test Equipment List For Rogers Labs, Inc.**

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Oscilloscope Scope: Tektronix 2230	2/08
Wattmeter: Bird 43 with Load Bird 8085	2/08
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/08
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/08
R.F. Generator: HP 606A	2/08
R.F. Generator: HP 8614A	2/08
R.F. Generator: HP 8640B	2/08
Spectrum Analyzer: HP 8562A,	5/08
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591EM	5/08
Frequency Counter: Leader LDC825	2/08
Antenna: EMCO Biconilog Model: 3143	5/08
Antenna: EMCO Log Periodic Model: 3147	10/07
Antenna: Antenna Research Biconical Model: BCD 235	10/07
Antenna: EMCO Dipole Set 3121C	2/08
Antenna: C.D. B-101	2/08
Antenna: Solar 9229-1 & 9230-1	2/08
Antenna: EMCO 6509	2/08
Audio Oscillator: H.P. 201CD	2/08
R.F. Power Amp 65W Model: 470-A-1010	2/08
R.F. Power Amp 50W M185- 10-501	2/08
R.F. PreAmp CPPA-102	2/08
LISN 50 μ Hy/50 ohm/0.1 μ f	10/07
LISN Compliance Eng. 240/20	2/08
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/08
Peavey Power Amp Model: IPS 801	2/08
Power Amp A.R. Model: 10W 1010M7	2/08
Power Amp EIN Model: A301	2/08
ELGAR Model: 1751	2/08
ELGAR Model: TG 704A-3D	2/08
ESD Test Set 2010i	2/08
Fast Transient Burst Generator Model: EFT/B-101	2/08
Current Probe: Singer CP-105	2/08
Current Probe: Solar 9108-1N	2/08
Field Intensity Meter: EFM-018	2/08
KEYTEK Ecat Surge Generator	2/08



NVLAP Lab Code 200087-0

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background

- 1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.
- 2) Bachelor of Science Degree in Business Administration Kansas State University.
- 3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D. Rogers



NVLAP Lab Code 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

**Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046**

June 18, 2008

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: June 18, 2008

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst