



FCC CFR47 PART 22 SUBPART H CERTIFICATION

TEST REPORT FOR

CELLULAR REPEATER

MODEL: R-820

FCC ID:NTTR820

REPORT NUMBER: 99U0577

ISSUE DATE: SEPT 24, 1999

Prepared for
WATKINS JOHNSON COMPANY
3333 Hillview Ave.
Palo Alto, CA 94304

Prepared by
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LAB CODE:200065-0

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1. FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part2, Subpart J, Sections 2.1033 – 2.1055.

2.1033(c)(1) Applicant: WATKINS JOHNSON COMPANY
3333 Hillview Ave.
Palo Alto, CA 94304

Contact person: Randall Riley

Telephone number: (650) 813-2721

2.1033(c)(2) FCC ID: NTTR820

2.1033(c)(3) Instructions/Installation Manual

Refer to **Attachment:** User's Manual.

2.1033(c)(4) Type of emissions

DXW (TDMA), F9W (CDMA), F8W(AMPS)

2.1033(c)(5) Frequency Range

824-849MHz(REV), 869-894MHz(FWD)

2.1033(c)(6) Range of Operation Power

0.0000001-10Watts

2.1033(c)(7) Maximum Power Rating

FWD:10Watts REV: 0.1Watts

Section 22.913(a); Maximum ERP.

The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts.

2.1033(c)(8) Applied voltage and currents into the final transistor elements

24VDC at 4.0 AMPS on Q3 and Q4 (10.0Watts)

2.1033(c)(9) Tune-up/Optimizations Procedure

Refer to installation manual

2.1033(c)(10) Complete Circuit Diagrams and Functional Diagram

Refer to Schematics and Block Diagram . Confidentiality is requested for these items.

2.1033(c)(10a) Means for Frequency Stabilization

Not Applicable. Eut is a repeater.

2.1033(c)(10b) Means for Suppressing of Spurious radiation.

SAW filter. See Repeater description

2.1033(c)(10c) Means for Limiting Modulation.

Not Applicable. Eut is a repeater.

2.1033(c)(10d) Means for Limiting Power.

Software control

2.1033(c)(11) Equipment Identification

A drawing of the equipment identification nameplate appears in file titled: PROPOSED FCC ID LABEL FORMAT.

2.1033(c)(12) Photographs

Photographs of the equipment, internal and external views, are found in the **Attachment:** Eut Photographs.

2.1033(c)(13) Description of Digital Modulation Techniques

N/A, EUT is repeater.

2.1033(c)(14) Standard Test Condition

The power amplifier was tested under the following conditions.

AC Supply Voltage: 120Vac, 60Hz

The amplifier was aligned and tuned up according to manufacturer's alignment procedure, prior to testing. All data presented represents the worst case parameter

being measured.

2.1033 Description of Various Base Station Configuration

Not Applicable.

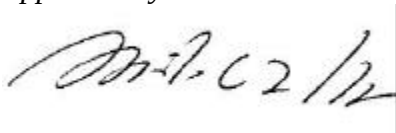
2.1033 Use of Various Power Supplies

Not Applicable.

TYPE OF EQUIPMENT:	CELLULAR REPEATER
MEASUREMENT DISTANCE:	3 METER
TECHNICAL LIMIT:	FCC 22.359, 22.917, 15.207 & 15.209
FCC RULES:	PART 22
EQUIPMENT AUTHORIZATION PROCEDURE	CERTIFICATION
MODIFICATIONS MADE ON EUT	☐ YES ☒ NO

The above equipment was tested by Compliance Certification Services for compliance with the requirements set forth in the FCC CFR 47, PART's 15 & 22. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved By



MIKE C.I. KUO / VICE - PRESIDENT
COMPLIANCE CERTIFICATION SERVICES

2. TEST FACILITY

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

3. ACCREDITATION AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code:200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT(1300F2))

4. MEASUREMENT INSTRUMENTATION

Radiated emissions were measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide liner horn. EMI receivers were used for line conducted readings, spectrum analyzers with pre-selectors and quasi-peak detectors were used to perform radiated measurements. Receiving equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and LISNs conform to CISPR specification for "Radio Interference Measuring Apparatus and Measurement Methods," Publication 16.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

5. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

6. UNITS OF MEASUREMENT

Measurements of radiated interference are reported in terms of dB(uV/m) at a specified distance. The indicated readings on the spectrum analyzer were converted to dB(uV/m) by use of appropriate conversion factors. Measurements of conducted interference are reported in terms of dB(uV).

The field strength is calculated by adding the Antenna Factor and Cable Factors, then by subtracting the Amplifier Gain from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
 RA = Receiver Amplitude
 AF = Antenna Factor
 CF = Cable Attenuation Factor
 AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4dB/m and a Cable Factor of 1.1dB is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/m. The 32 dBuV/m value was mathematically converted to its corresponding level in uV/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dBuV/m}$$

$$\text{Level in uV/m} = \text{Common Antilogarithm } [(32 \text{ dBuV/m})/20] = 39.8 \text{ uV/m}$$

Compliance Engineering Services Inc.

Project No. : 99U0577
Report No. : 990924C1
Date : 09/24/1999
Time : 14:24
Test Engr : PETE K

>> 3 M RADIATED EMISSION DATA <<

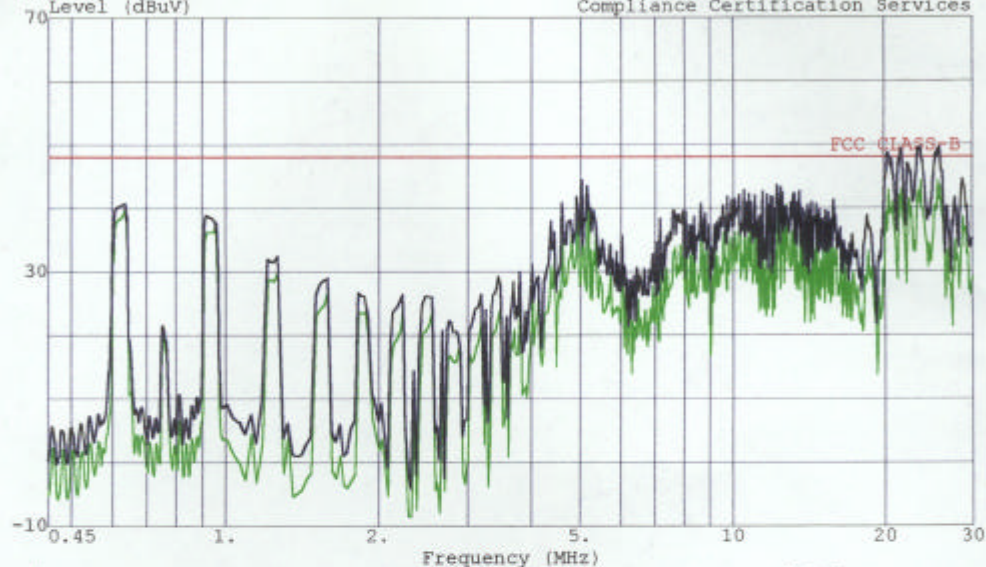
Company : WATKINS JOHNSON
Equipment Under Test : R820 REPEATER
Test Configuration : EUT ONLY
Type of Test : FCC CLASS B
Mode of Operation : IDLE

Freq.	dBuV	PreAmp	Ant	Cable	dBuV/m	Limit	Margin	Pol	Hgt (m)	Az
broad band emissions:										
Biconical 1214 ; Pre-pamp = 8447D-P5 2944A06550:										
65.36	52.30	-27.44	5.83	0.96	31.65	40.00	-8.35	V	1.0	0
66.80	54.10	-27.43	5.70	0.97	33.33	40.00	-6.67	V	1.0	0
68.66	54.10	-27.43	5.53	0.97	33.18	40.00	-6.82	V	1.0	0
75.80	49.90	-27.37	7.39	1.07	30.99	40.00	-9.01	V	1.0	0
80.16	52.80	-27.34	8.86	1.14	35.46	40.00	-4.54	V	1.0	0
81.10	52.80	-27.34	9.00	1.14	35.60	40.00	-4.40	V	1.0	0
Total # of data 6										
V. c2.2										



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Data#: 7 File#: 99U0577.EMI Date: 09-24-1999 Time: 15:14:29
Level (dBuV) Compliance Certification Services



Trace: 5
Project No. : 99U0577
Report No. : 990924LC
Test Engr : PETE KREBILL
Company : WATKINS JOHNSON
EUT : R820 REPEATER
Test Config.: EUT/PC/SIG GEN
Type of Test: FCC B
Mode of Op. : TX 40dBm 883MHz
: L1 PEAK=BLACK QP=GREEN

Ref Trace:



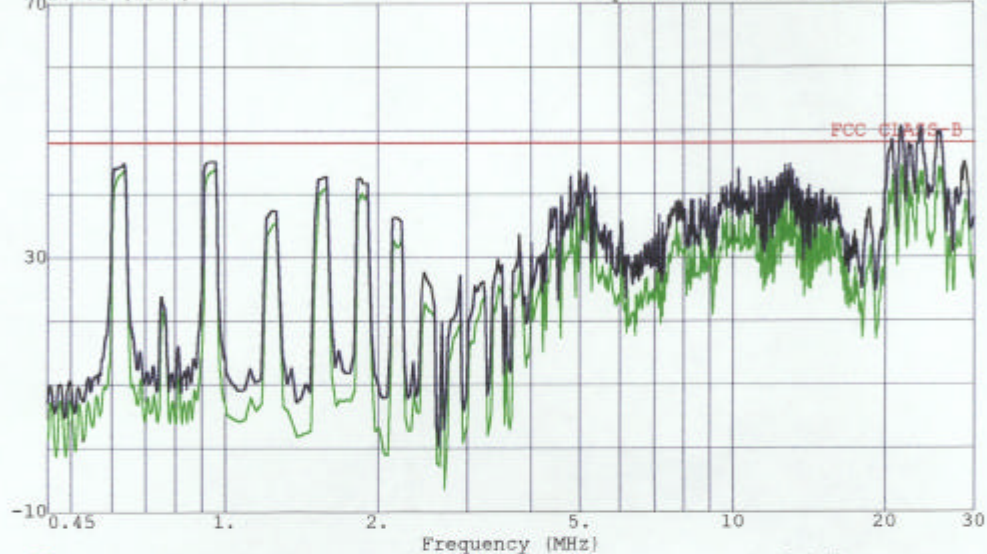
1366 Bordeaux Dr.
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Data#: 14 File#: 99U0577.EMI

Date: 09-24-1999 Time: 15:37:34

Level (dBuV)

Compliance Certification Services



Trace: 12

Ref Trace:

Project No. : 99U0577
Report No. : 990924LC
Test Engr : PETE KREBILL
Company : WATKINS JOHNSON
EUT : R820 REPEATER
Test Config.: EUT/PC/SIG GEN
Type of Test: FCC B
Mode of Op. : TX 40dBm 883MHz
: L2 PEAK=BLACK QP=GREEN

8. TEST EQUIPMENT LIST

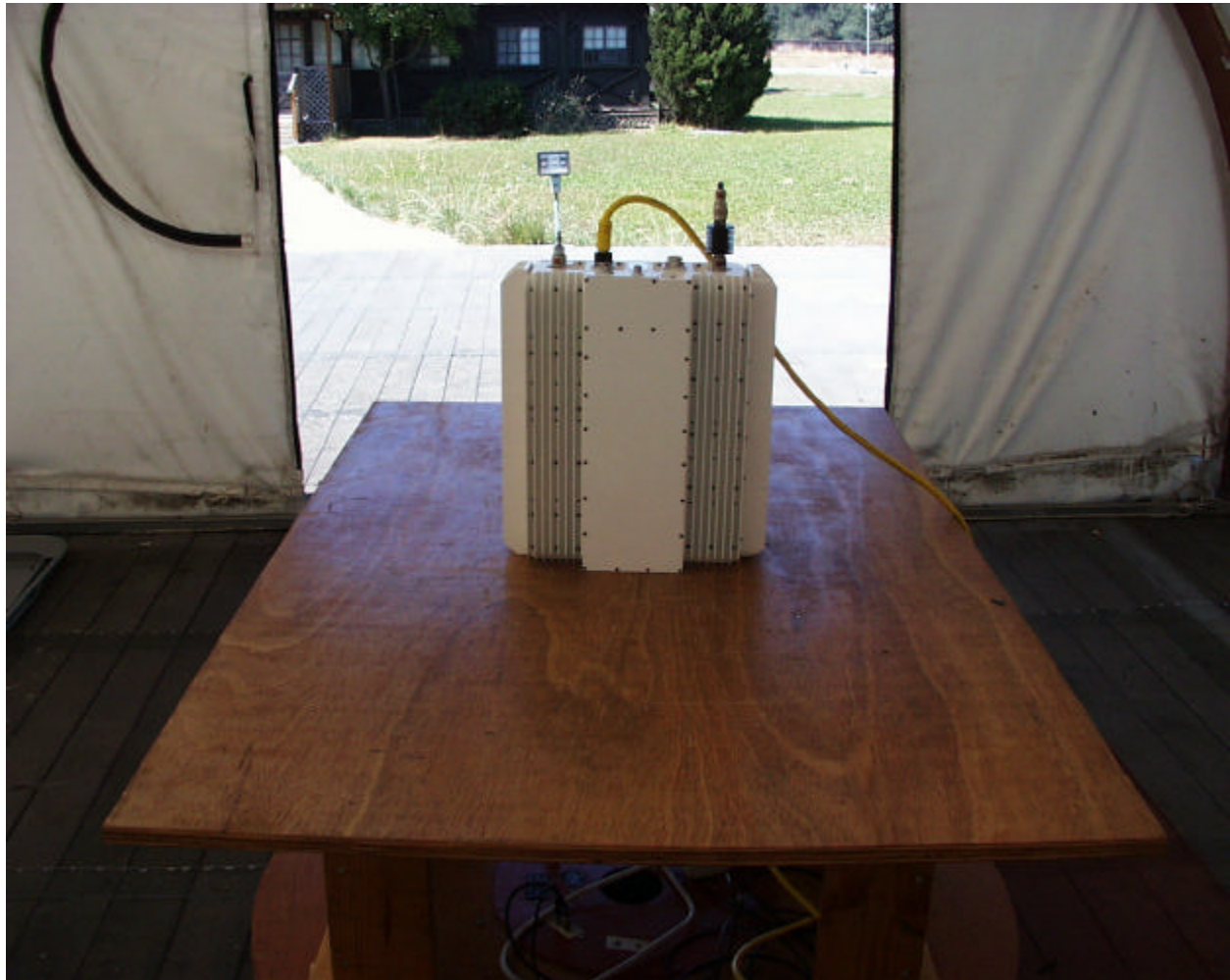
Equipment	Manufacturer	Model No.	Serial No.	Site	Cal Date	Due Date
Receiver	H.P.	8546A	3520A00259	A	03/99	03/00
Bilog Antenna	CHASE	CBL6112	2049	A	05/99	05/00
Pre-Amp	H.P.(P1_M)	8447D	2944A06833	A	09/98	10/99
Spectrum Analyzer	H.P.	8566B	3014A06685	N/A	07/99	07/00
Spectrum Analyzer	H.P.	8593EM	3710A00205	N/A	05/99	05/00
Horn Antenna	EMCO	3115	9001-3245	N/A	12/97	12/00
Pre-Amp	H.P. (1-26.5GHz)	8449B	3008A00369	N/A	04/99	04/00
Power Meter	H.P.	436A	2709A29209	N/A	02/99	02/00
Power Sensor	H.P.	8482A	2349A08568	N/A	02/99	02/00
Horn Antenna	ARA	MWH-1826/B	1013	N/A	7/28/99	7/28/00

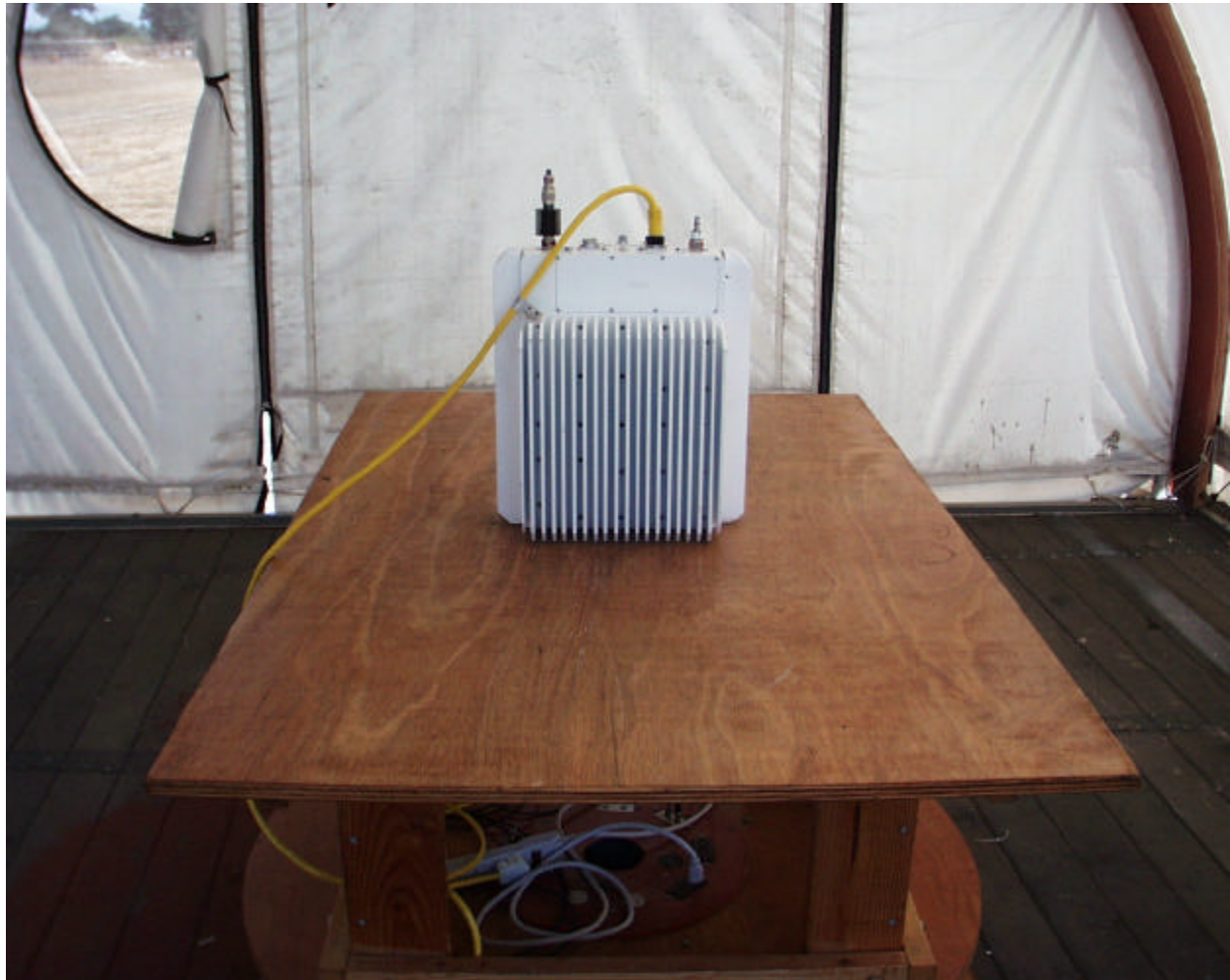
B) SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial No.
SIGNAL GENERATOR	HP	E4433B	N/A
SIGNAL GENERATOR	HP	E4433B	N/A

9. EUT SETUP PHOTOS

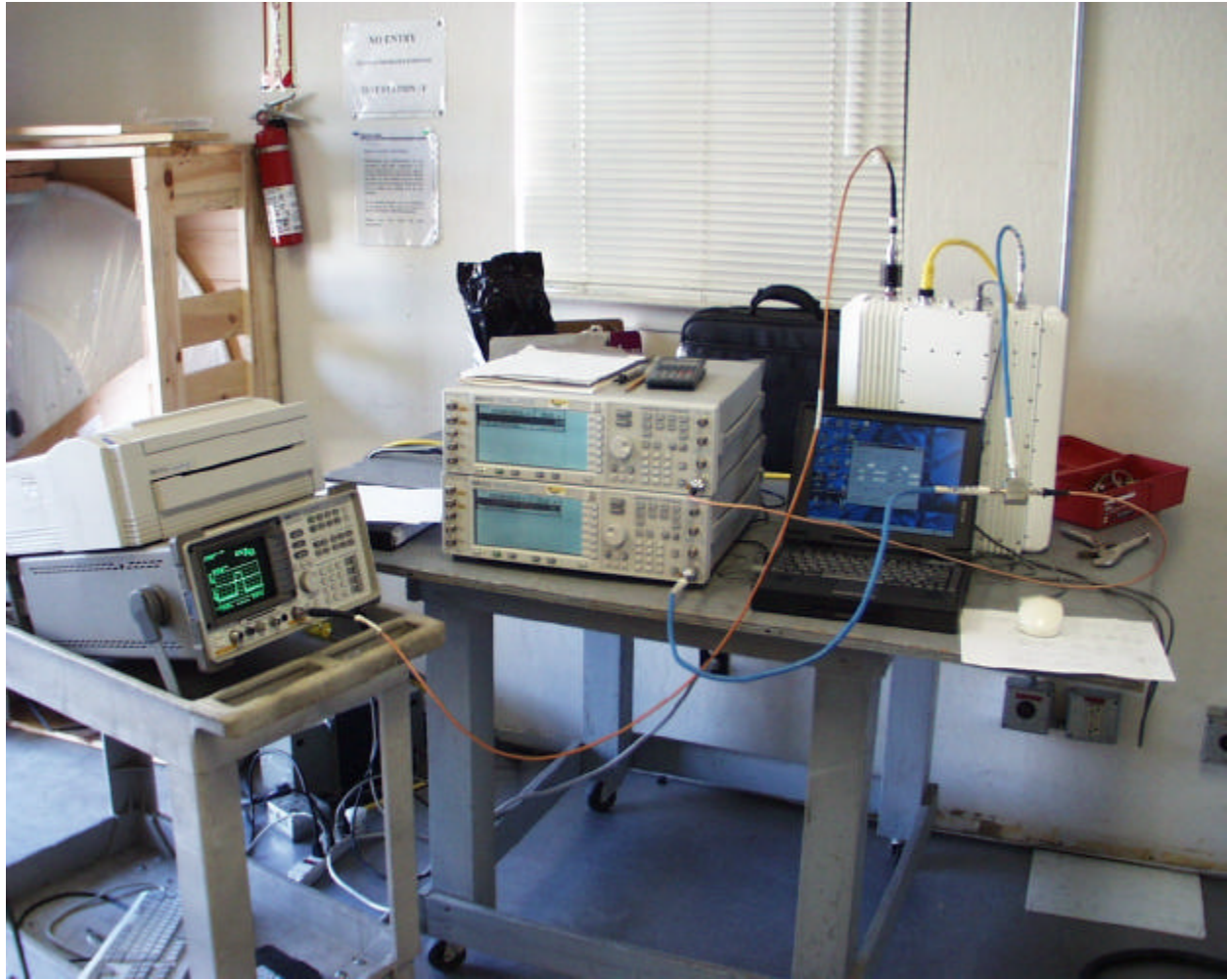


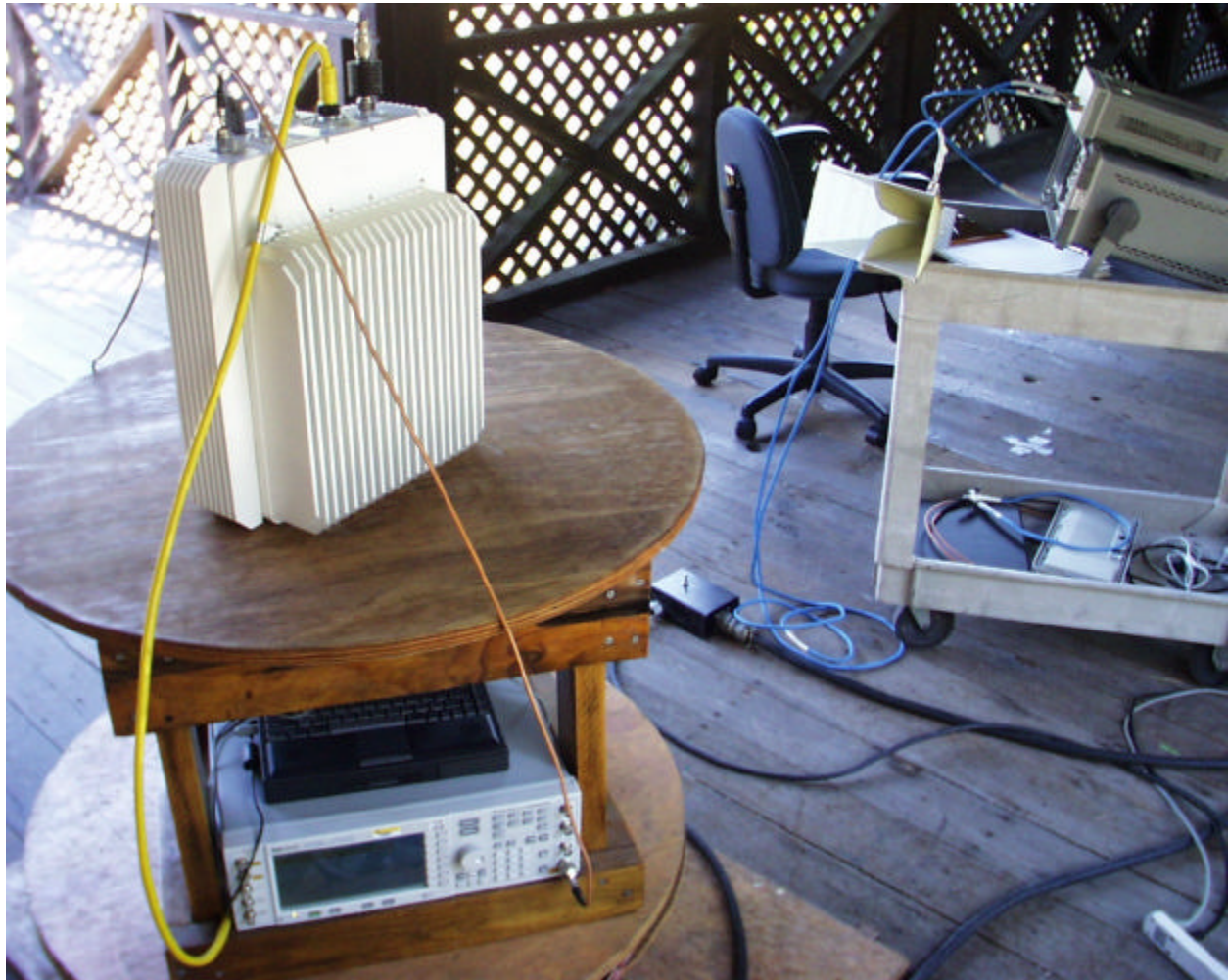












10. EXTERNAL I/O CABLE CONSTRUCTION DESCRIPTION

CABLE NO:1	
I/O Port: : ANTENNA OUT	Number of I/O ports of this type: 2
Number of Conductors: 2	Connector Type: N-TYPE
Capture Type: SCREW IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length: 1.5 M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO: 2,3	
I/O Port:: RF OUT FROM SIGNAL GENERATOR	Number of I/O ports of this type:1 EACH
Number of Conductors: 2	Connector Type: N-TYPE TO SMA
Capture Type: SCREW-IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length:1.5M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO:4	
I/O Port: : ANTENNA IN	Number of I/O ports of this type: 2
Number of Conductors: 2	Connector Type: N-TYPE TO SMA
Capture Type: SCREW IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length: 1.5 M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO: 5	
I/O Port: POWER SUPPLY	Number of I/O ports of this type: 1
Number of Conductors: 3	Connector Type: USA 110TYPE
Capture Type: PUSH IN	Type of Cable used: UNSHEILDED
Cable Connector Type: PLASTIC	Cable Length:1.6
Bundled During Tests: NO	Data Traffic Generated: NO
Remark: N/A	

CABLE NO: 6	
I/O Port: CONTROL	Number of I/O ports of this type:1
Number of Conductors: 9	Connector Type: DB9
Capture Type: SCREW-IN	Type of Cable used: UN-SHIELDED
Cable Connector Type: PLASTIC	Cable Length:2.0M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	



SECTION 2.1047: MODULATION CHARACTERISTICS

Not applicable. EUT is a repeater.

SECTION 2.1049: OCCUPIED BANDWIDTH

Test Setup: Refer to figure #1

Minimum Requirement:

Section 2.1049(i); transmitters designed for other types of modulation-when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

Test Procedure:

The Eut's occupied bandwidth is compared to the input source plot (signal generator) and output plot (power amplifier) and check that the input signal bandwidth is not greater at the output of amplifier.

Test results:

Plots were made for the output of the amplifier and another for the input from signal generator. was used for this test. Refer to chart designating plots.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINALS

Test Setup: Refer to figure #1

Minimum Requirement:

Section 22.917(e):

For transmitters the magnitude of each spurious, harmonic, and intermodulation emissions that can be detected when the equipment is operated under conditions specified in the instruction manual and/or alignment procedure, shall not be more than $43 + 10 \log (P)$ dBc below the mean power output, which is equivalent to -13 dBm.

Section 22.917(f):

Measured at REV transmit antenna with 849MHz. Input.

Test Procedure:

Scan Eut from 1MHz to the 10th harmonic of carrier and check for spurious, harmonic,

and intermodulation emissions. Set the **RES Bw**: 30kHz, offset analyzer for external attenuation and using the **DISPLAY LINE** place it at -13dBm. Use enough attenuation to prevent overload on the spectrum analyzer input, which can cause overload..

Test results:

Plots were made for the output of the amplifier and another for the input from signal generator. was used for this test. Refer to chart designating plots.

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION

Measurement Equipment Used:

HP 8593EM Spectrum Analyzer

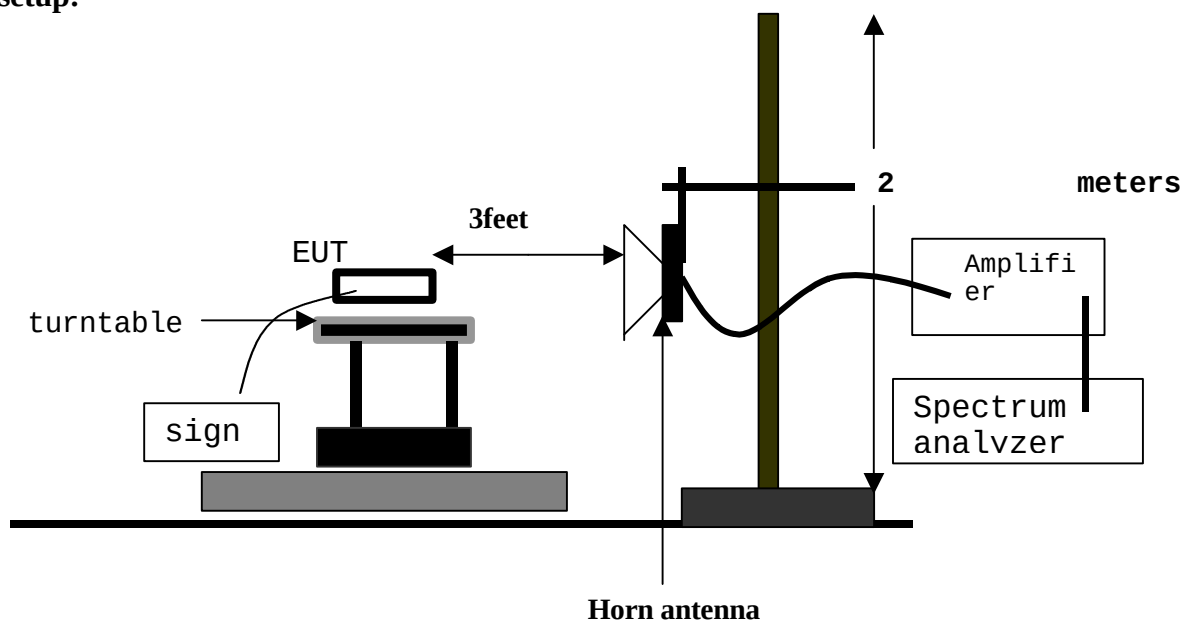
HP 8449 B Preamplifier, 1-26 GHz

ARA DRG-118/A Double Ridged Horn antenna, 1 - 18 GHz

QIM "The Workhorse" low loss cable, 9 ft (loss: 0.85 dB/ft@ 26 GHz)

ARA MWH-1826/B Horn antenna 18/26GHz

Test setup:



Radiated Emissions Configuration

Minimum Requirement:

Section 22.917(e):

The magnitude of each spurious and harmonic emissions detected as being radiated from the EUT must be at a level no more than $43 + 10 \log$ (mean output power, watts) dB below the mean power output (-13dBm).

Resultant radiated field at 3 meters from -13dBm source feeding isotropic antenna: 82 dBuV/m.

Test procedure:

3foot test

EUT antenna output was terminated with a 50-ohm load. The EUT was placed on a outdoors-wooden table. The search antenna placed 3 ft from the EUT. With the transmitter operating at full power the turntable was slowly rotated to locate the direction of maximum emission. Once maximum direction is determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

Test Result:

Please refer to attached spreadsheet.

PETE KREBILL

WJ
R820 REPEATER

ALL READINGS ARE PEAK

F(MHz)	Level (dBuV)	AF (dB)	CL (dB)	AMP (dB)	FILTER (dB)	DIST (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)
FO:838MHZ									
1676	44.98	25.2	2.34	-35.5	10	-10.5	36.52	82	-45.48
2514	42.41	29.2	2.79	-35.5	1	-10.5	29.4	82	-52.6
3352	41.18	32.8	4.1	-35.5	1	-10.5	33.08	82	-48.92
4190	40.55	32.3	5	-35.5	1	-10.5	32.85	82	-49.15
5028	40.74	34.3	5.4	-35.5	1	-10.5	35.44	82	-46.56
5866	40.78	35.2	5.7	-35.5	1	-10.5	36.68	82	-45.32
6704	44.34	36	6	-35.5	1	-10.5	41.34	82	-40.66
7542	44.16	36.9	6.4	-35.5	1	-10.5	42.46	82	-39.54
8380	45.63	37.5	6.7	-35.5	1	-10.5	44.83	82	-37.17
FO:882MHZ									
1764	46.56	25.2	2.34	-35.5	10	-10.5	38.1	82	-43.9
2646	47.41	29.2	2.79	-35.5	1	-10.5	34.4	82	-47.6
3528	41.96	32.8	4.1	-35.5	1	-10.5	33.86	82	-48.14
4410	41.46	32.3	5	-35.5	1	-10.5	33.76	82	-48.24
5292	40.86	34.3	5.4	-35.5	1	-10.5	35.56	82	-46.44
6174	41.22	35.2	5.7	-35.5	1	-10.5	37.12	82	-44.88
7056	45.3	36	6	-35.5	1	-10.5	42.3	82	-39.7
7938	44.96	36.9	6.4	-35.5	1	-10.5	43.26	82	-38.74
8820	45.83	37.5	6.7	-35.5	1	-10.5	45.03	82	-36.97

AF= ANTENNA FACTOR
CL=CABLE LOSS
AMP= AMPLIFIER GAIN

FILTER=HP FILTER INSERTION LOSS
DIST=DISTANCE CORRECTION TO 3 METERS

RES & VIDEO BW=1MHZ

SECTION 2.1055: FREQUENCY STABILITY

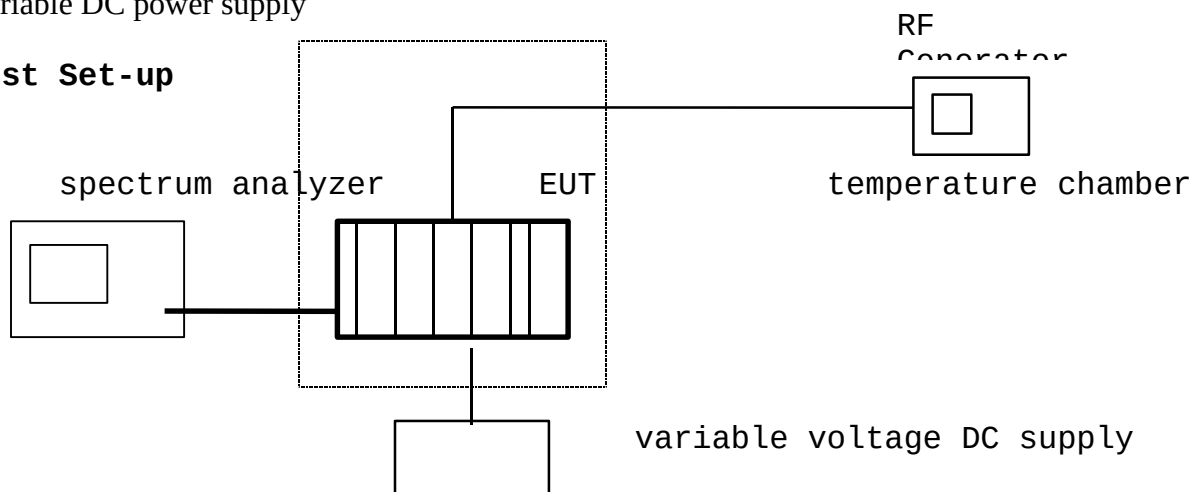
Measurement Equipment Used:

HP 8593EM Spectrum Analyzer

QIM "The Workhorse" low loss cable, 9 ft (loss: 0.85 dB/ft@ 26 GHz)

Variable DC power supply

Test Set-up



Minimum Requirement:

Section 22.355: 2.5ppm for mobile units.

Test Method

Temperature: Vary the ambient temperature from -30 to +50°C, in 10 degree increments, allowing the EUT to stabilize at each temperature.

Primary Supply Voltage: Vary the supply voltage from 85% to 115% of the nominal operating voltage with EUT at 20°C.

Test Procedure : CW signal was input to the EUT. Analyzer span and B/W was adjusted to give accuracy required. At each measurement a peak reading was taken and compared to a measurement taken at room temp(20C.) and normal voltage(120VAC).

Test Result:

Please refer to attached spreadsheet

<u>Tx Output (MHz)</u>	<u>ppm</u>	<u>limit (Hz)</u>					
881.999788	2.5	2204.999					
<u>Frequency (MHz)</u>	<u>Temp</u>	<u>Delta(MHz)</u>		<u>Frequency (MHz)</u>	<u>Percent</u>	<u>Voltage</u>	<u>Delta (Hz)</u>
881.99975	-30	-0.000038		881.999775	85	93.5	-0.000013
881.99975	-20	-0.000038		881.99938	115	138	-0.000408
881.99975	-10	-0.000038					
881.999775	0	-0.000013					
881.999775	10	-0.000013					
881.99979	20	0.000000					
881.999788	30	0.000000					
881.999838	40	0.000050					
881.999875	50	0.000087					
<u>Tx Output (MHz)</u>	<u>ppm</u>	<u>limit (Hz)</u>					
836.999800	2.5	2092.5					
<u>Frequency (MHz)</u>	<u>Temp</u>	<u>Delta(MHz)</u>		<u>Frequency (MHz)</u>	<u>Percent</u>	<u>Voltage</u>	<u>Delta (Hz)</u>
836.999800	-30	0.000000		836.999775	85	93.5	-0.000025
836.999763	-20	-0.000037		836.999800	115	138	0.000000
836.999775	-10	-0.000025					
836.999775	0	-0.000025					
836.999800	10	0.000000					
836.999800	20	0.000000					
836.999800	30	0.000000					
836.999850	40	0.000050					
836.999888	50	0.000088					

Setup Photo

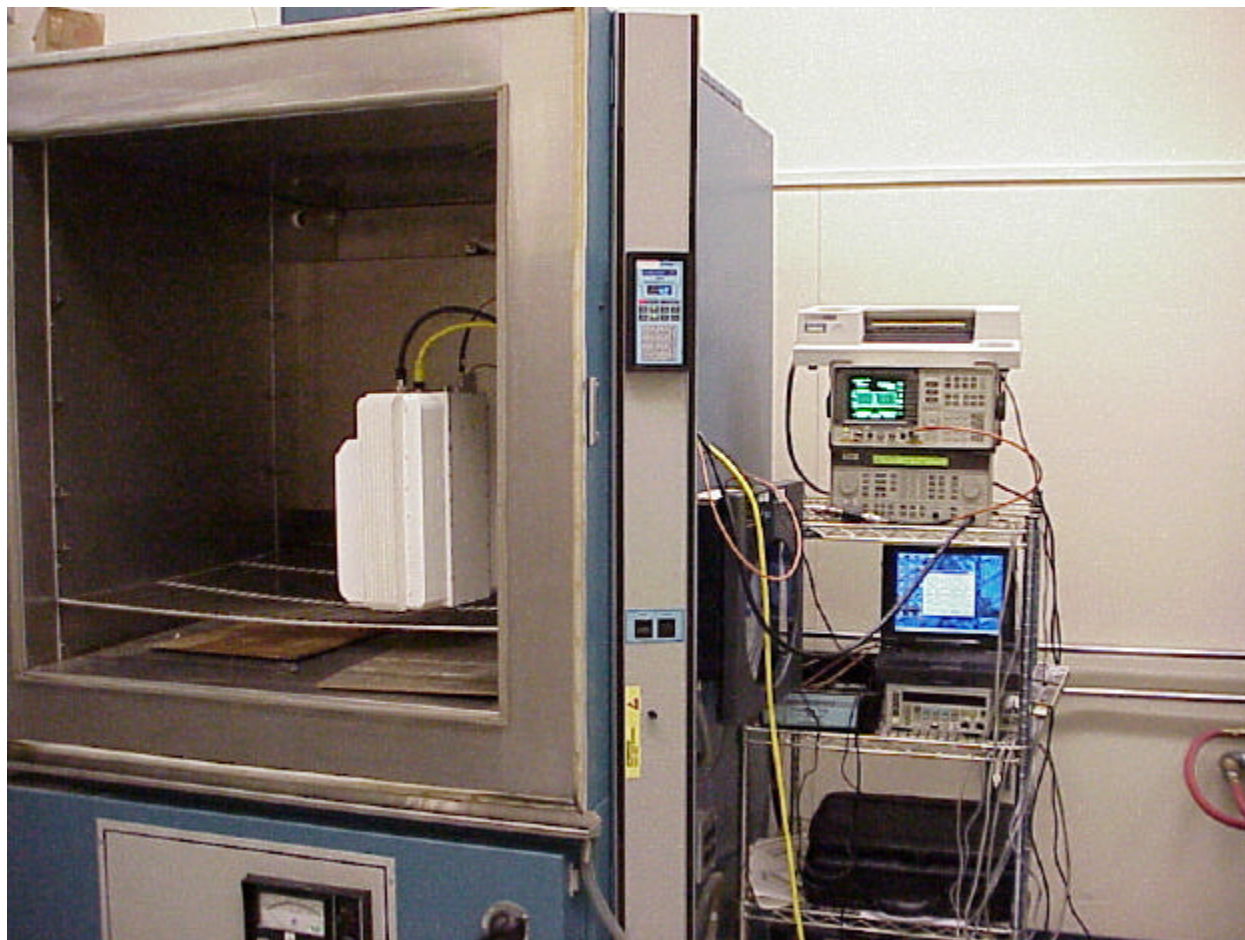


CHART OF PLOTS:

TDMA FWD INTERMODS	1
TDMA FWD OUT OF BAND	2,3
TDMA FWD INPUT	4
TDMA REV INTERMODS	5
TDMA REV OUT OF BAND	6,7
TDMA REV INPUT	8
CDMA FWD INTERMODS	9
CDMA FWD OUT OF BAND	10,11
CDMA FWD INPUT	12
CDMA REV INTERMODS	13
CDMA REV OUT OF BAND	14,15
CDMA REV INPUT	16
AMPS FWD INTERMODS	17
AMPS FWD OUT OF BAND	18,19
AMPS FWD INPUT	20
AMPS REV INTERMODS	21
AMPS REV OUT OF BAND	22,23
AMPS REV INPUT	24
MOBILE EMISSIONS IN BASE BAND	25
BANDWIDTH CDMA REV	26
BANDWIDTH CDMA REV INPUT	27
BANDWIDTH CDMA FWD	28
BANDWIDTH CDMA FWD INPUT	29
BANDWIDTH TDMA REV	30
BANDWIDTH TDMA REV INPUT	31
BANDWIDTH TDMA FWD	32
BANDWIDTH TDMA FWD INPUT	33
BANDWIDTH AMPS REV	34
BANDWIDTH AMPS REV INPUT	35
BANDWIDTH AMPS FWD	36
BANDWIDTH AMPS FWD INPUT	37