FCC CFR47 PART 24 SUBPART E BROADBAND PCS
TEST REPORT

FOR

PCS LINEAR POWER AMPLIFIER

MODEL: SPA9325-30

FCC ID: E675JS0041

REPORT NUMBER: 99U0587

ISSUE DATE: SEPTEMBER 28, 1999

Prepared for
POWERWAVE TECHNOLOGIES, INC.
2026 McGAW AVENUE
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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: POWERWAVE TECHNOLOGIES, INC.
2026 McGAW AVENUE
IRVINE, CA 92614

Contact person: Robert Biedka

Telephone number: (714) 757-6605

2.1033(c)(2) FCC ID: E675JS0041

2.1033(c)(3) Instructions/Installation Manual

Refer to **Attachment**: Installation and Service manual.

2.1033(c)(4) Type of emissions

300K0GXW

2.1033(c)(5) Frequency Range

Transmit: 1930 – 1990 MHz

2.1033(c)(6) Range of Operation Power

200mW to 30 W

2.1033(c)(7) Maximum Power Rating

Section 24.232(a); Maximum ERP. The effective radiated power (ERP) of base transmitters must not exceed 100 Watts.

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

26 Vdc @ 2 amps

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

Refer to **Attachment**: Installation and Service manual.

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

Refer to **Attachment**: Schematics and Parts list. Confidentiality is requested for these items.

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

Not Applicable. Eut is a power amplifier

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

Not applicable.

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

Not Applicable. Eut is a power amplifier.

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

Compression of the RF output power transistors.

2.1033(c)(11) Equipment Identification

A drawing of the equipment identification nameplate appears under **Attachment**: 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

Not Applicable.

2.1033(c)(14) Standard Test Condition

The power amplifier was tested under the following conditions.

DC Supply Voltage: 26Vdc
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.

TYPE OF EQUIPMENT:	PCS LINEAR AMPLIFIER
MEASUREMENT DISTANCE:	(X) 3 METER ( ) 10 METER
FCC RULES:	PART 2, PART 15, PART 24 SUBPART E
EQUIPMENT AUTHORIZATION PROCEDURE	CERTIFICATION
MODIFICATIONS MADE ON EUT	☐ YES ☒ NO
DEVIATIONS FROM MEASUREMENT PROCEDURE	☐ YES ☒ NO

The above equipment was tested by Compliance Certification Services for compliance with the requirements set forth in the FCC CFR 47, PART 2, PART 15 and PART 24. 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.

Reviewed By

MIKE KUO, VICE-PRESIDENT
COMPLIANCE CERTIFICATION SERVICES

2. TEST RESULT SUMMARY FOR PART 15.

FCC PART 15 Radiated Emission Test was conducted by operating the configuration as indicated below.

OATS No: C-SITE	Data Report No. 990928C1			Date 9/28/99		Tested By: JUAN MARTINEZ	
Six Highest Radiated Emission Readings							
Frequency Range Investigated				30 MHz TO 1000 MHz			
Freq. (MHz)	Meter Reading (DbuV)	C.F. (dB/m)	Corrected Reading (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Reading Type (P/Q/A)	Polar (H/V)
46	**39.4**	**-15.24**	**24.16**	**40**	**-15.84**	**P**	**V**
126	**39.1**	**-14.03**	**25.07**	**43.5**	**-18.43**	**P**	**V**
66	**49.3**	**-20.7**	**28.6**	**40**	**-11.4**	**P**	**V**
156	**33.9**	**-7.95**	**25.95**	**43.5**	**-17.55**	**P**	**V**
244	**45.89**	**-12.12**	**33.77**	**46**	**-12.23**	**P**	**V**
220	**44.89**	**-12.94**	**31.95**	**46**	**-14.05**	**P**	**V**

C.F.(Correction Factor)=Antenna Factor + Cable Loss-Amplifier Gain
Corrected Reading = Metering Reading + C.F. Margin = Corrected Reading - Limits
P= Peak Reading H= Horizontal Polarization/Antenna
Q= Quasi-peak V= Vertical Polarization/Antenna
A= Average Reading
Comments: N/A

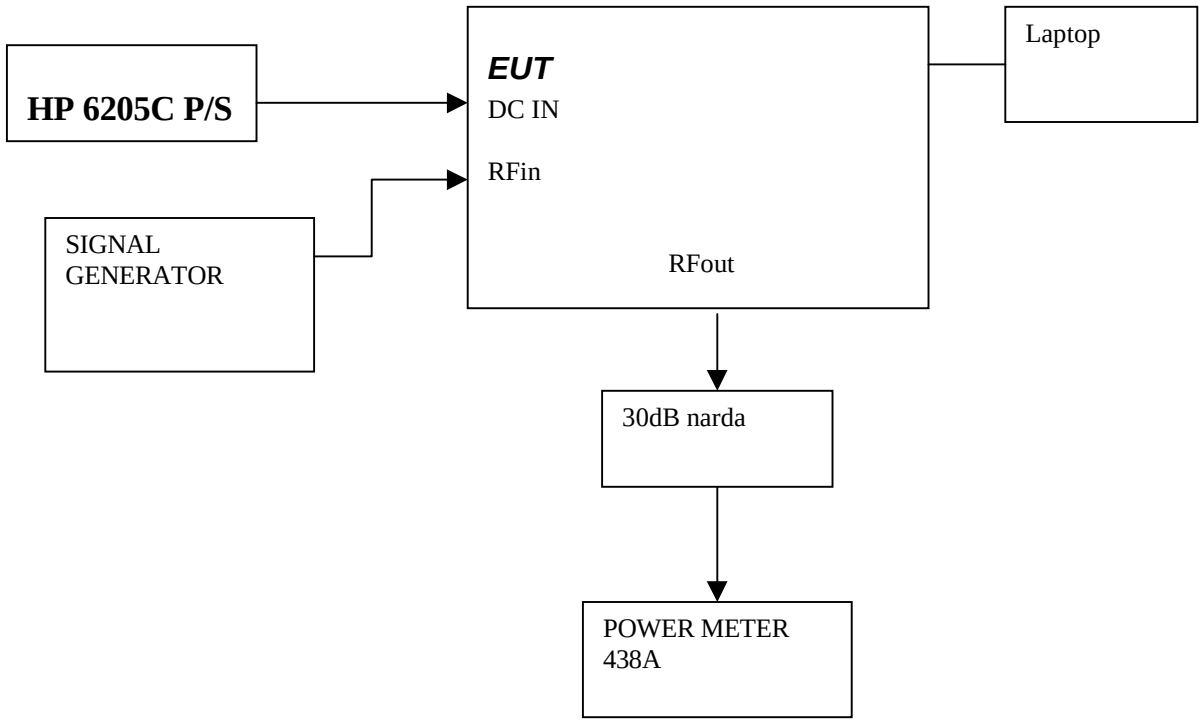
3. FCC PART 2 CERTIFICATION TEST RESULTS:

SECTION 2.1046: RF POWER OUTPUT

Equipment used.

Narda 30dB High Power Attenuator
Flexco low loss cables, 9ft. (Loss: 0.85 dB/ft @ 26GHz)
HP Power Sensor/8141
HP Power Meter/438A
HP Digital Signal Generator/ESG-D2000A
HP Power Source/6654A
HP laptop/Omni Book

Test Set-up



Minimum Requirement:
24.232(A); Maximum Peak output power for base station transmitters should not exceed 100 Watts.

24.232(B); Mobile/Portable stations are limited to 2 Watts EIRP peak power.

Test Procedure:
The EUT was set to maximum output power (maximum gain). RF output power was measured with Power Meter.

Test Result:
Measured with power meter. All outputs were adjusted between 44 and 45 dBm, during testing.

SECTION 2.1047: MODULATION CHARACTERISTICS

(NOT APPLICABLE TO AMPLIFIERS)

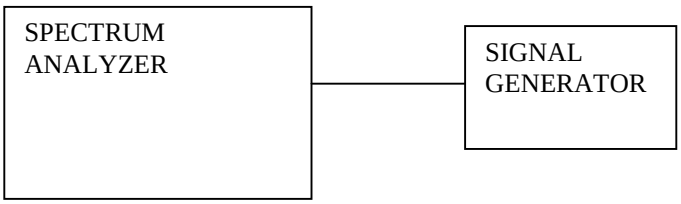
SECTION 2.1049: OCCUPIED BANDWIDTH

Test Equipment:

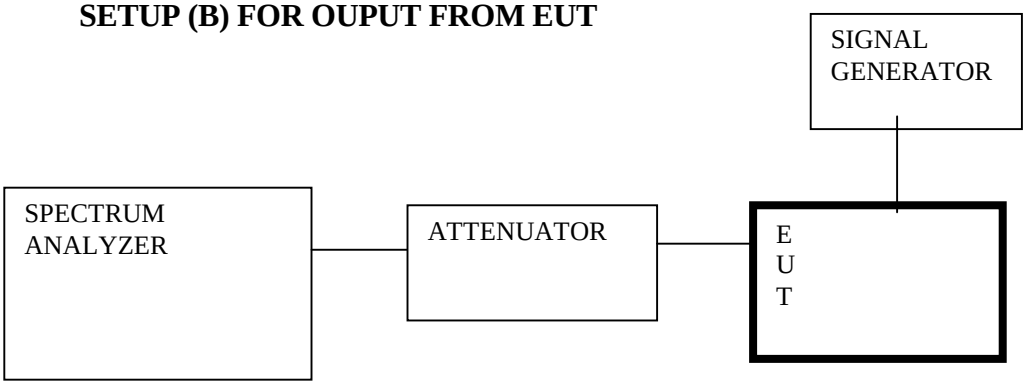
HP Spectrum Analyzer/8593EM
Low loss cable, 2ft(loss: 0.85dB/ft @ 26GHZ)

Test Setup:

SETUP (A) FOR INPUT FROM SIGNAL GENERATOR



SETUP (B) FOR OUPUT FROM EUT



Minimum:
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 no distortion is created when input signal is amplified by Eut.

Used setup **B** and connect output from Eut to spectrum analyzer, making sure that enough external attenuation is being used to protect input of spectrum analyzer. Use the **REF LVL OFF** function to correct for external attenuation and cable loss. Set the spectrum to the frequency that will be measured. Set the power amplifier to the maximum output gain. Recorded the signal generator level for future reference. Set spectrum **SWEEP TIME** to **AUTO** and set **RES BW.** to 3kHz. Use enough **SPAN** to display the whole signal on spectrum analyzer. Activate the **MAX HOLD** function and wait while the spectrum analyzer captures the envelope of the transmitted occupied bandwidth.

Used setup **A** and connect signal generator to spectrum analyzer, make sure that the input signal from signal generator is low enough, before connecting to spectrum analyzer. Keep all settings on spectrum analyzer the same and only removing the **REF LVL OFF** function, which was used to correct the external attenuation., set the spectrum to the frequency that will be measured. Set spectrum **SWEEP TIME** to **AUTO** and set **RES BW.** to 3kHz. Use enough **SPAN** to display the whole signal on spectrum analyzer. Activate the **MAX HOLD** function and wait while the spectrum analyzer captures the envelope of the transmitted occupied bandwidth

Test Result:

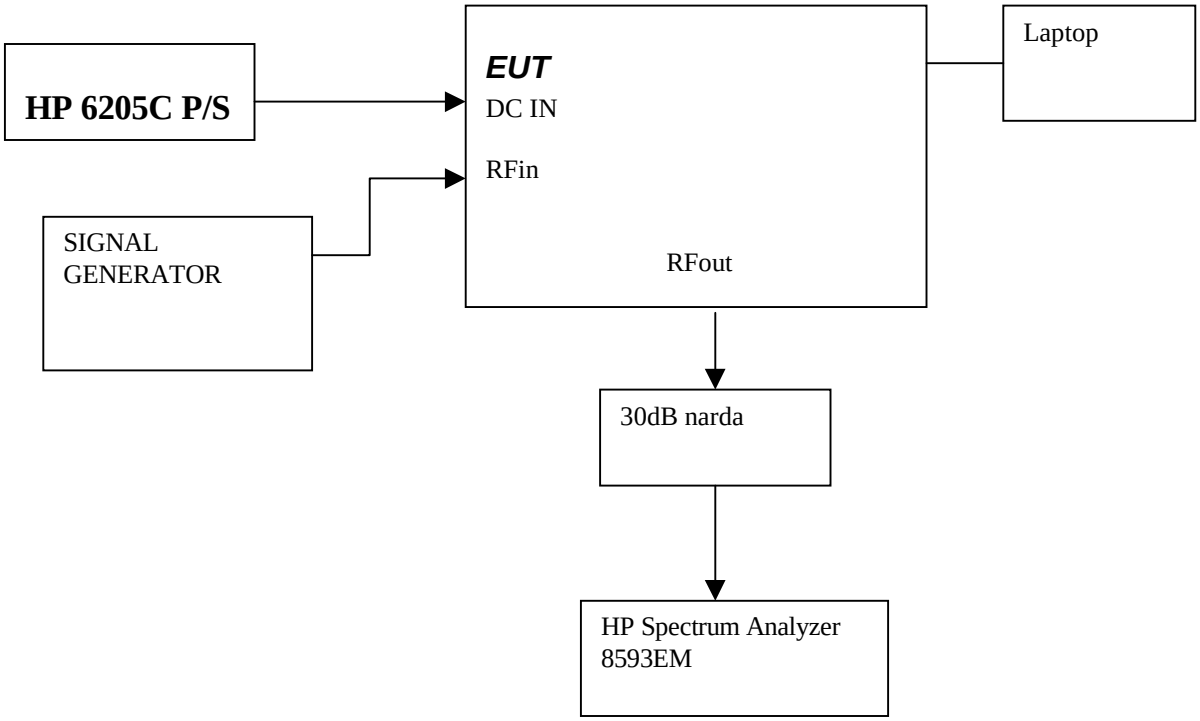
Plot included one for the input and another for the output. Please refer to spectrum plots under SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

Equipment used.

HP Spectrum Analyzer/8593EM
Narda 30dB High Power Attenuator
Flexco low loss cables, 9ft. (Loss: 0.85 dB/ft @ 26GHz)
HP Digital Signal Generator/ESG-D2000A
HP Power Source/6654A
HP laptop/Omni Book

Test Set-up



NOTE: Two amplifiers with different isolators were tested. Data on both are included.

Minimum standard:
24.238(a); The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under conditions specified in the instruction manual and/or alignment procedure, shall not be less than 43+10 log (mean output power in watts) dBc below the mean power output outside a licensee's frequency block.

Amplifier Mean Power = 30 Watts (44.77 dBm)
43 + 10 log (30 Watts) = 57.77 dB

Out-of-Band and Band-edges emissions must be attenuated by the following amount:
44.77 dBm – 57.77 dB = **-13 dBm**

24.238 (b) & (c):

(1) Compliance with the out-of-band emissions requirement is based on test being performed with **1MHz** analyzer RES BW.

(2) At block edges, **RES BW** may be adjusted to a level at least as large as **1% of emission bandwidth**. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. For the EUT this is at least:

GSM:
.01 * 300 KHz = 3 kHz. A RES BW of 3 kHz was used for measurement at the block edges.

Test Procedure:
All tests performed with the output power or gain set to maximum.

1) For the low and high block emission measurements, the signal was set as close as possible to the bandedge. Also, set the RES BW to 3 kHz, **1% of emission bandwidth,** to show compliance with –13 dBm limit. Blocks A trough F was measured.

2) For the Out-of-Band measurements used a **1 MHz RES BW** and scan from 15 MHz to 10***fo*** of the fundamental carrier for all frequency blocks. Place display line at –13 dBm.

Test Results:
The following table indicates the number associates with Low, High, 26dB Bandwidth, and out-of- band emissions plots. Included input signal source plot from the signal generator and output plots from amplifier. Two amplifiers with different isolators were tested. Data on both are included.

GSM (S/N: 6PCS)									
BLOCK A	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK A	HIGH	Out-of-band	Inputs
Forward	**1**	**2**	**3+4**	**5**	**6**	**Forward**	**7**	**8+9**	**10**
BLOCK D	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK D	HIGH	Out-of-band	Inputs
Forward	**11**	**12**	**13+14**	**15**	**16**	**Forward**	**17**	**18+19**	**20**
BLOCK B	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK B	HIGH	Out-of-band	Inputs
Forward	**21**	**22**	**23+24**	**25**	**26**	**Forward**	**27**	**28+29**	**30**
BLOCK E	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK E	HIGH	Out-of-band	Inputs
Forward	**31**	**32**	**33+34**	**35**	**36**	**Forward**	**37**	**38+39**	**40**
BLOCK F	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK F	HIGH	Out-of-band	Inputs
Forward	**41**	**42**	**43+44**	**45**	**46**	**Forward**	**47**	**48+49**	**50**
BLOCK C	LOW	26dB BW	Out-of-band	Output	Inputs	BLOCK C	HIGH	Out-of-band	Inputs
Forward	**51**	**52**	**53+54**	**55**	**56**	**Forward**	**57**	**58+59**	**60**

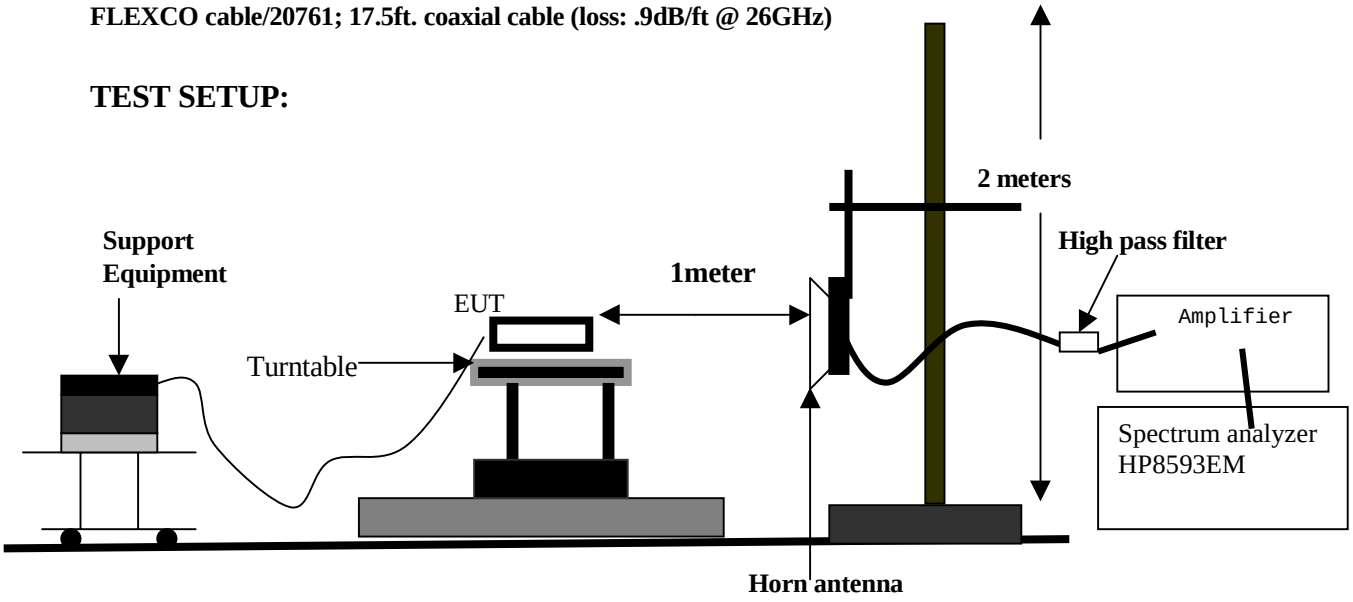
GSM (S/N: 39PCS)					
BLOCK A	LOW	Out-of-band	BLOCK A	HIGH	Out-of-band
Forward	**61**	**62+63**	**Forward**	**64**	**65+66**
BLOCK D	LOW	Out-of-band	BLOCK D	HIGH	Out-of-band
Forward	**67**	**68+69**	**Forward**	**70**	**71+72**
BLOCK B	LOW	Out-of-band	BLOCK B	HIGH	Out-of-band
Forward	**73**	**74+75**	**Forward**	**76**	**77+78**
BLOCK E	LOW	Out-of-band	BLOCK E	HIGH	Out-of-band
Forward	**79**	**80+81**	**Forward**	**82**	**83+84**
BLOCK F	LOW	Out-of-band	BLOCK F	HIGH	Out-of-band
Forward	**85**	**86+87**	**Forward**	**88**	**89+90**
BLOCK C	LOW	Out-of-band	BLOCK C	HIGH	Out-of-band
Forward	**91**	**92+93**	**Forward**	**94**	**95+96**

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION.

Equipment used.

Emco Horn Antenna/3115
HP Pre-Amp (1 – 26.5 GHz)/8449B
HP Spectrum Analyzer/8593EM
FSY High Pass Filter (4 GHz)/001
FLEXCO cable/20761; 17.5ft. coaxial cable (loss: .9dB/ft @ 26GHz)

TEST SETUP:



Minimum Requirement:

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.

Using the relationship between field strength and RF power into an isotropic transmit antenna:

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

P= Eut Maximum Power (Watts)
G= Antenna in Numeric Gain (Assume 1)
D= Distance (Meters)

$$E = \frac{\sqrt{30 \times 30\ w \times 1}}{3} = 10\ V/m$$

20 * log (10 V/m x 1,000,000) = 140 dBuV/m @ 3 meters

Emission Mask: 43 + 10 * log (P) dB

43 + 10 * Log (30 W) = 57.77 dB

140 – 57.77 = **82.2 dBuV/m @ 3 meters**

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

Test procedure:
EUT antenna output was terminated with a 50-ohm load. The EUT was placed on a wooden table on the outdoor ground plane. The search antenna was placed 1 meter 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 was determined the search antenna was raised and lowered in both vertical and horizontal polarization.

Test Result:
The maximum readings so obtained are recorded in a spreadsheet attached. Maximum levels measured at 1 meter were extrapolated to specified distance of 3 meters.

9/28/99
Radiated Emissions Juan Martinez
FCC 24.238(A) 1 meter

Powerwave Technologies
PCS linear amplifier (M/N: SPA9325-30)

F(MHz)	READING (dBuV)	AF (dB)	CL (dB)	Amp (dB)	DIST (dB)	DUTY (dB)	Other (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)
(S/N: 6PCS)										
Fo: 1950 MHz										
Block B&E Forward										
3899	61.91	32.5	4.38	-35	-9.5	0	0	54.29	82	-27.71
5849	59.72	34.5	5.43	-35	-9.5	0	1	56.15	82	-25.85
7799	56.18	36	6.13	-35	-9.5	0	1	54.81	82	-27.19
9749	47.9	37.1	7.35	-35	-9.5	0	1	48.85	82	-33.15
11,699(N.F.)	47.23	39.5	8.4	-35	-9.5	0	1	51.63	82	-30.37
13,649(N.F.)	47.21	40.4	9.63	-35	-9.5	0	1	53.74	82	-28.26
15,599(N.F.)	48.64	39.6	10.33	-35	-9.5	0	1	55.07	82	-26.93
17,549(N.F.)	49.75	45.5	11.2	-35	-9.5	0	1	62.95	82	-19.05
(S/N: 39PCS)										
Fo: 1950 MHz										
Block B&E Forward										
3899	61.91	32.5	4.38	-35	-9.5	0	0	54.29	82	-27.71
5849	59.72	34.5	5.43	-35	-9.5	0	1	56.15	82	-25.85
7799	56.18	36	6.13	-35	-9.5	0	1	54.81	82	-27.19
9749	47.9	37.1	7.35	-35	-9.5	0	1	48.85	82	-33.15
11,699(N.F.)	47.23	39.5	8.4	-35	-9.5	0	1	51.63	82	-30.37
13,649(N.F.)	47.21	40.4	9.63	-35	-9.5	0	1	53.74	82	-28.26
15,599(N.F.)	48.64	39.6	10.33	-35	-9.5	0	1	55.07	82	-26.93
17,549(N.F.)	49.75	45.5	11.2	-35	-9.5	0	1	62.95	82	-19.05

NOTE: ALL REAINGS IN PEAK MODE

DIST: Correction to extrapolate reading to 3m specification distance
1M measurement distance: **-9.5** dB
OTHER: High pass filter insertion loss (4 **GHz**)
AF: Antenna Factor **DUTY:** Duty Cycle correction factor
AMP: Pre-amp gain **CL:** CABLE LOSS

ANALYZER BANDWIDTH SETTINGS

	Res Bw:	Video Bw:
Peak:	1MHz	1MHz
Average:	1MHz	10 Hz

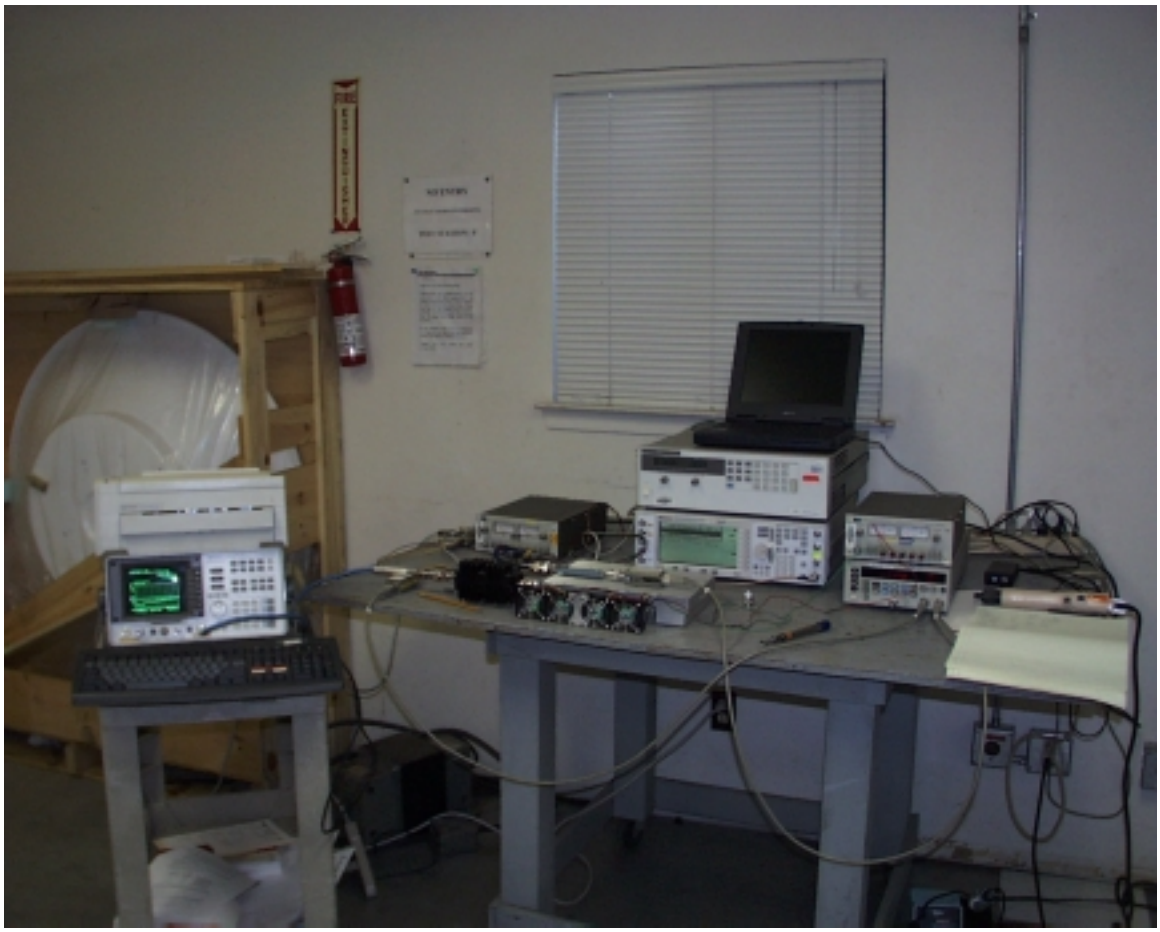
SECTION 2.1055: FREQUENCY STABILITY

(NOT APPLICABLE, EUT IS AN AMPLIFIER)

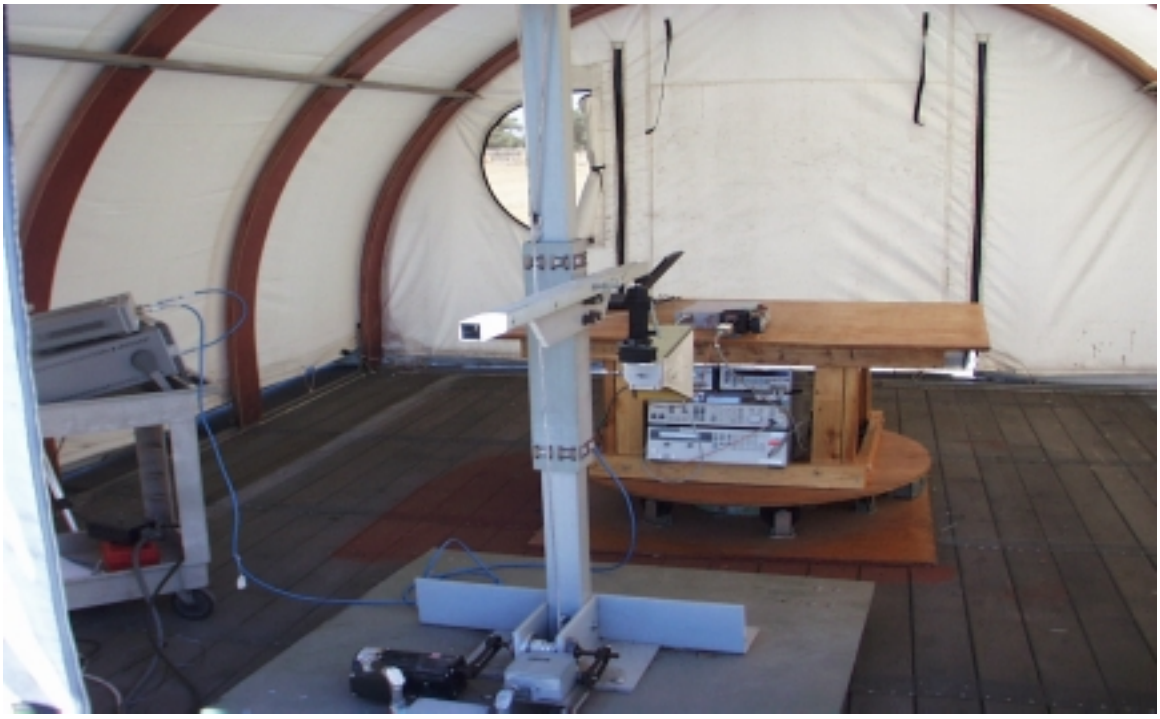
4. EUT SETUP PHOTOS

RADIATED PART 15 SETUP

ANTENNA CONDUCTED SETUP



1 METER RADIATED SETUP



ATTACHMENTS

EUT PHOTOGRAPHS

INSTALLATIONS & SERVICE MANUAL

ADDENUM 1 SCHEMATICS & PARTS LISTS

PROPOSED FCC ID LABEL FORMAT