



**POWERWAVE TECHNOLOGIES, INC. TEST REPORT**

**FOR THE**

**POWER AMPLIFIER FRAME, PAF-1930-EX-XXX**

**FCC PART 24**

**TESTING**

**DATE OF ISSUE: NOVEMBER 16, 2007**

**PREPARED FOR:**

Powerwave Technologies, Inc.  
1801 E. St. Andrew Place  
Santa Ana, CA 92705

P.O. No.: 115894  
W.O. No.: 87159

**PREPARED BY:**

Mary Ellen Clayton  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Date of test: October 9 – November 13, 2007

**Report No.: FC07-099**

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**ADMINISTRATIVE INFORMATION**

**DATE OF TEST:** October 9 – November 13, 2007

**DATE OF RECEIPT:** October 9, 2007

**REPRESENTATIVE:** Jeffrey Dale

**MANUFACTURER:**  
Powerwave Technologies, Inc.  
1801 E. St. Andrew Place  
Santa Ana, CA 92705

**TEST LOCATION:**  
CKC Laboratories, Inc.  
110 Olinda Place  
Brea, CA 92823

**FREQUENCY RANGE TESTED:** 9 kHz-20 GHz

**TEST METHOD:** FCC Part 24

**PURPOSE OF TEST:** To perform the testing of the Power Amplifier Frame, PAF-1930-EX-XXX with the requirements for FCC Part 24 devices.

**APPROVALS**

**QUALITY ASSURANCE:**

**TEST PERSONNEL:**

Steve Behm, Director of Engineering Services

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Septimiu Apahidean, EMC Engineer

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Eddie Wong, EMC Engineer

**CONDITIONS DURING TESTING**

Ferrite Steward 28A2026\_0A2 added to data line in all amplifier modules.



## EQUIPMENT UNDER TEST (EUT) DESCRIPTION

The customer declares the EUT tested by CKC Laboratories was representative of a production unit.

## EQUIPMENT UNDER TEST

### Power Amplifier Frame

Manuf: Powerwave Technologies  
Model: PAF-1930-EX-XXX  
Serial: NA

## PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

### Power Supply

Manuf: Power Ten  
Model: P63C00330  
Serial: 9917C0030

### ESG

Manuf: Agilent  
Model: 4433B  
Serial: US40051692

### ESG

Manuf: Agilent  
Model: 4433B  
Serial: US40051840

### ESG

Manuf: Agilent  
Model: 4433B  
Serial: US40051852

### Power Meter

Manuf: Agilent  
Model: E4419B  
Serial: MY40510694

**TEMPERATURE AND HUMIDITY DURING TESTING**

The temperature during testing was within +15°C and + 35°C.  
The relative humidity was between 20% and 75%.

**FCC 2.1033(c)(3) USER'S MANUAL**

The necessary information is contained in a separate document.

**FCC 2.1033 (c)(4) TYPE OF EMISSIONS**

F9W

**FCC 2.1033 (c)(5) FREQUENCY RANGE**

1930-1990 MHz.

**FCC 2.1033 (c)(6) OPERATING POWER**

500 Watts

**FCC 2.1033 (c)(8) DC VOLTAGES**

The necessary information is contained in a separate document.

**FCC 2.1033 (c)(9) TUNE-UP PROCEDURE**

The necessary information is contained in a separate document.

**FCC 2.1033(c)(10) SCHEMATICS AND CIRCUITRY DESCRIPTION**

The necessary information is contained in a separate document.

**FCC 2.1033(c)(11) LABEL AND PLACEMENT**

The necessary information is contained in a separate document.

**FCC 2.1033(c)(12) SUBMITTAL PHOTOS**

The necessary information is contained in a separate document.

**FCC 2.1033 (c)(13) MODULATION INFORMATION**

1X EVDO

**FCC 2.1033(c)(14)/2.1046/24.232(b) - RF POWER OUTPUT**

**Test Equipment**

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
RF Power meter	02778	HP	EPM-441A	GB37170458	012706	012708
Power Sensor	02777	HP	E4412A	MY41499662	012706	012708

**Test Setup Photos**



**Test Data**

**§24.232 Power and antenna height limits.**

(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. See 24.53 for HAAT calculation method. Base station antenna heights may exceed 300 meters with a corresponding reduction in power; see Table 1 of this section. The service area boundary limit and microwave protection criteria specified in §§24.236 and 24.237 apply.

*Table 1: Reduced Power for Base Station Antenna Heights Over 300 Meters*

<i>HAAT in meters</i>	<i>Maximum E.I.R.P. (watts)</i>
<i>6300</i>	<i>1640</i>
<i>6500</i>	<i>1070</i>
<i>61000</i>	<i>490</i>
<i>61500</i>	<i>270</i>
<i>62000</i>	<i>160</i>

The EUT is a RF amplifier. The manufacturer does not provide an antenna for sale with the product, hence EIRP is not measured nor calculated. The RF power of the EUT was measured at the antenna port. The measurement matches the rate output power of the product.

**Test Setup:** The floor standing EUT comprising of three Amplifier sub-frames ( MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules(PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz. RF emission profile measured at the antenna port of each sub frame.

Modulation	Frequency	Measured power
1X EVDO	1933MHz	500W
	1960MHz	500W
	1990MHz	500W

**FCC 2.1033(c)(14)/2.1049(i)- INPUT AND OUTPUT PLOTS**

**Test Equipment**

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Spectrum Analyzer	02672	Agilent	E4446A	US44300438	010307	010309
High Freq Cable (big blue)	05421	Huber Suhner	NA	12237/4A	112805	112807
3.0 GHz HPF	02744	K&L	11SH10-3000	1	030806	030808

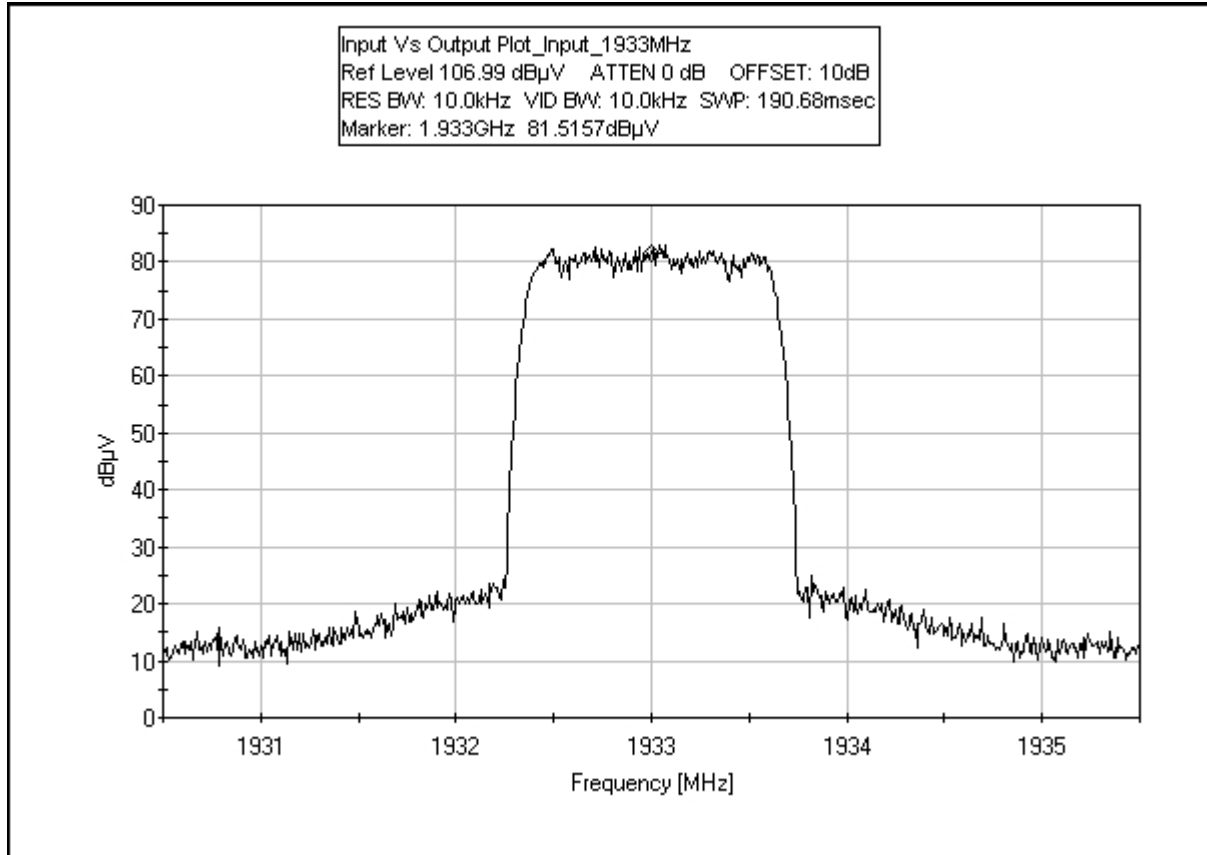
**Test Conditions:** The floor standing EUT comprising of three Amplifier sub-frames (MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules (PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz. Modulation: 1X-EVDO. Each amplifier sub frame is capable of operating in the range of 1930 – 1990 MHz. Modulation: 1X-EVDO. Top section: 1933 MHz, 500W; Middle section: 1960 MHz, 500W; Bottom section: 1987 MHz, 500W. The RF output profile is measured at the antenna port of each sub frame. The RF input profile is measured at the antenna port of each sub frame.

**Test Setup Photos**

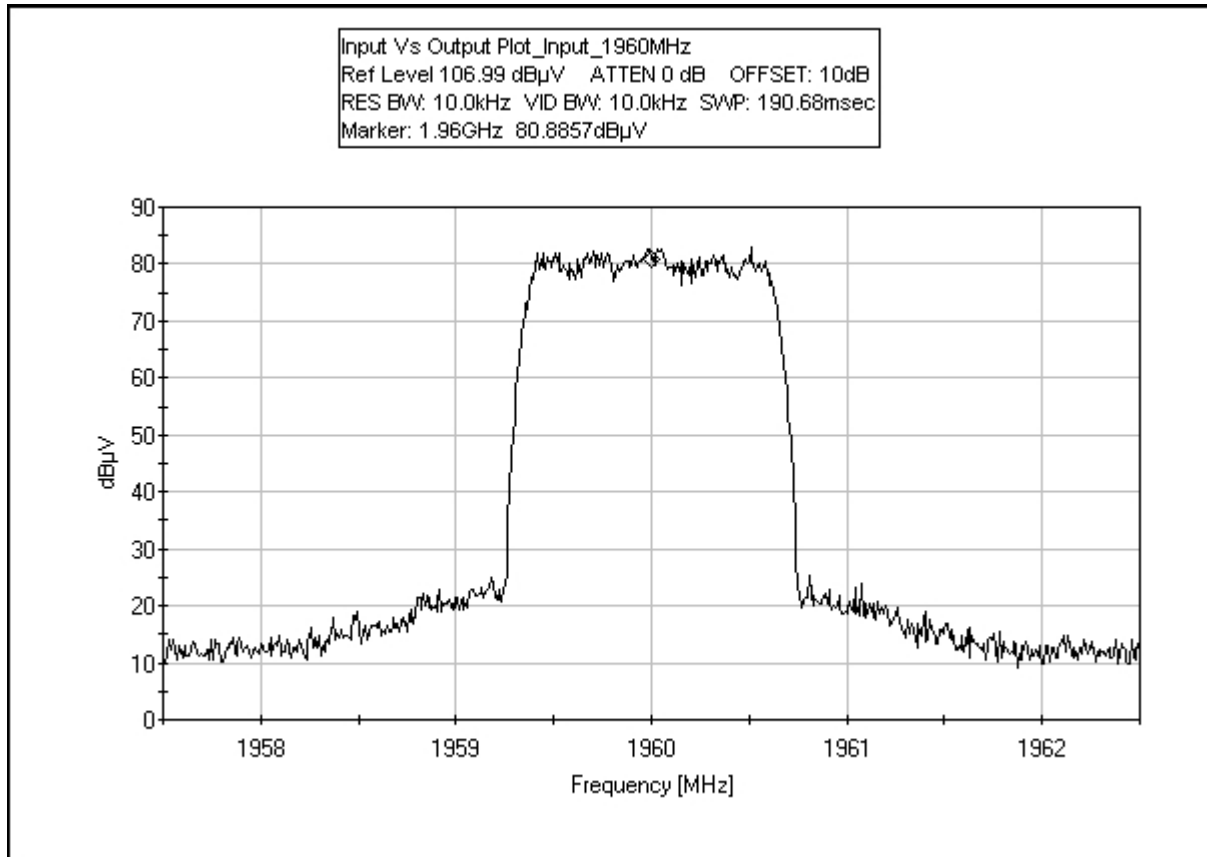




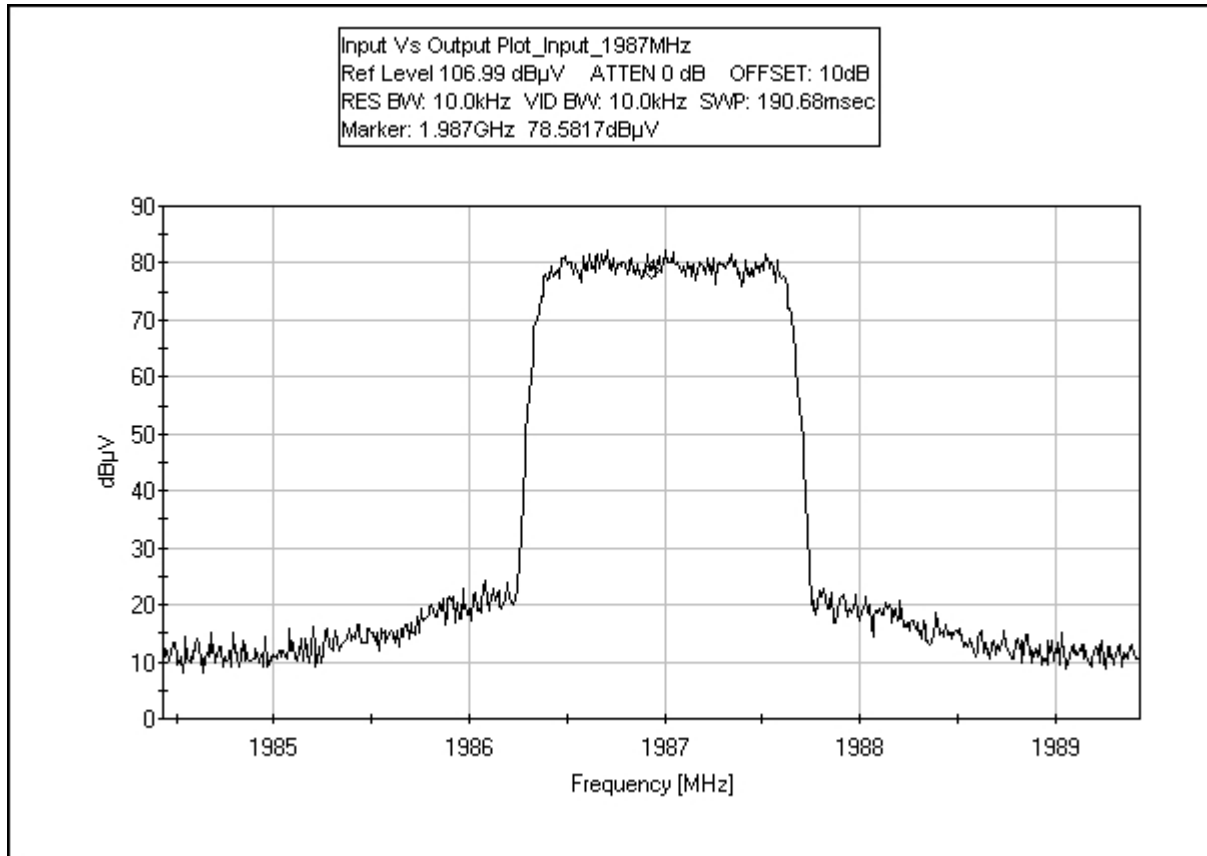
### INPUT PLOT - 1933 MHz



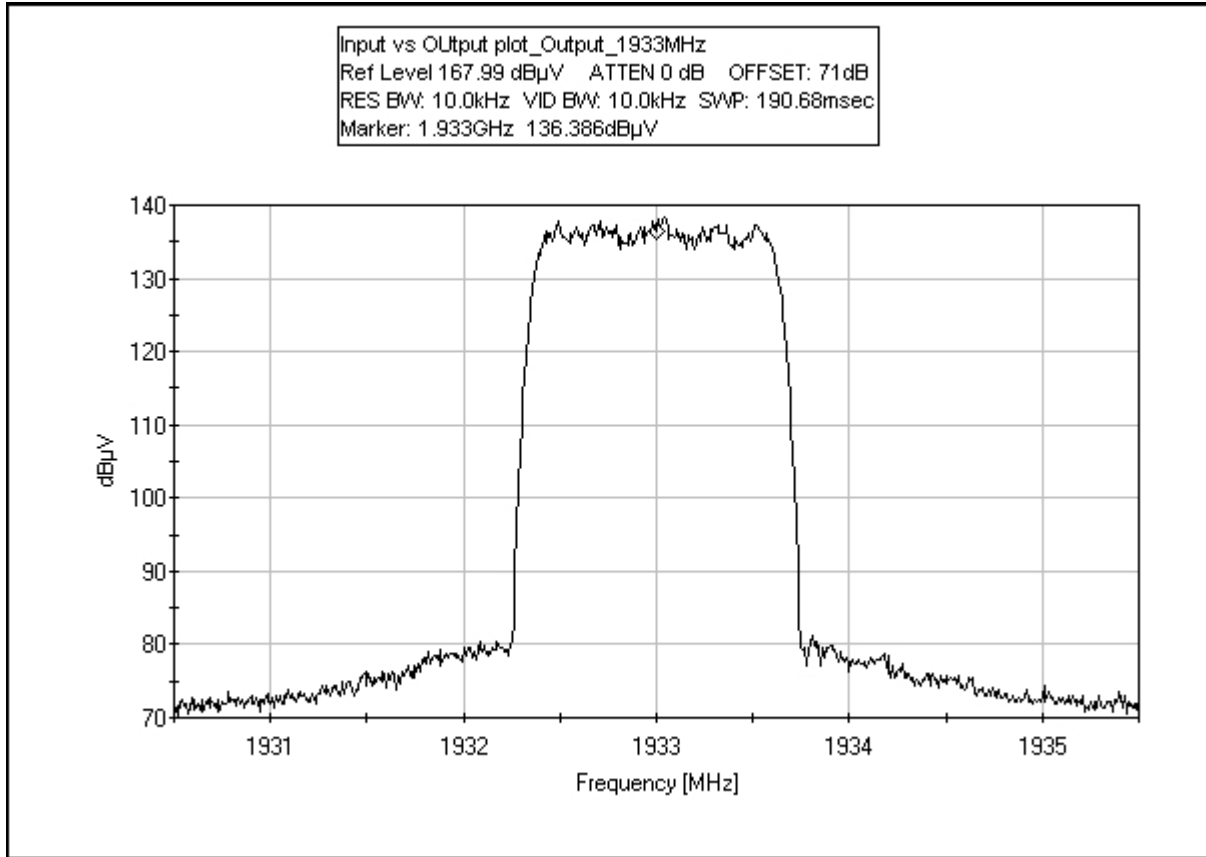
### INPUT PLOT - 1960 MHz



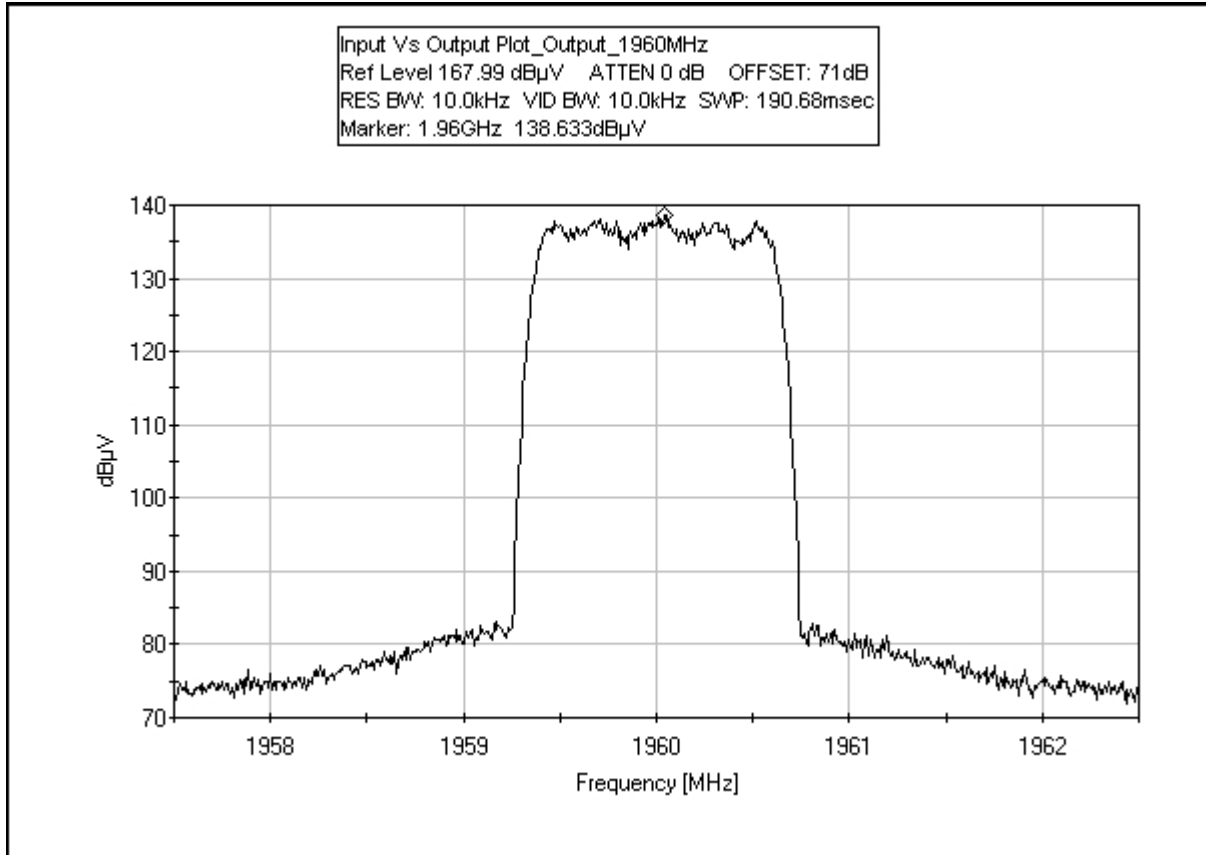
**INPUT PLOT - 1987 MHz**



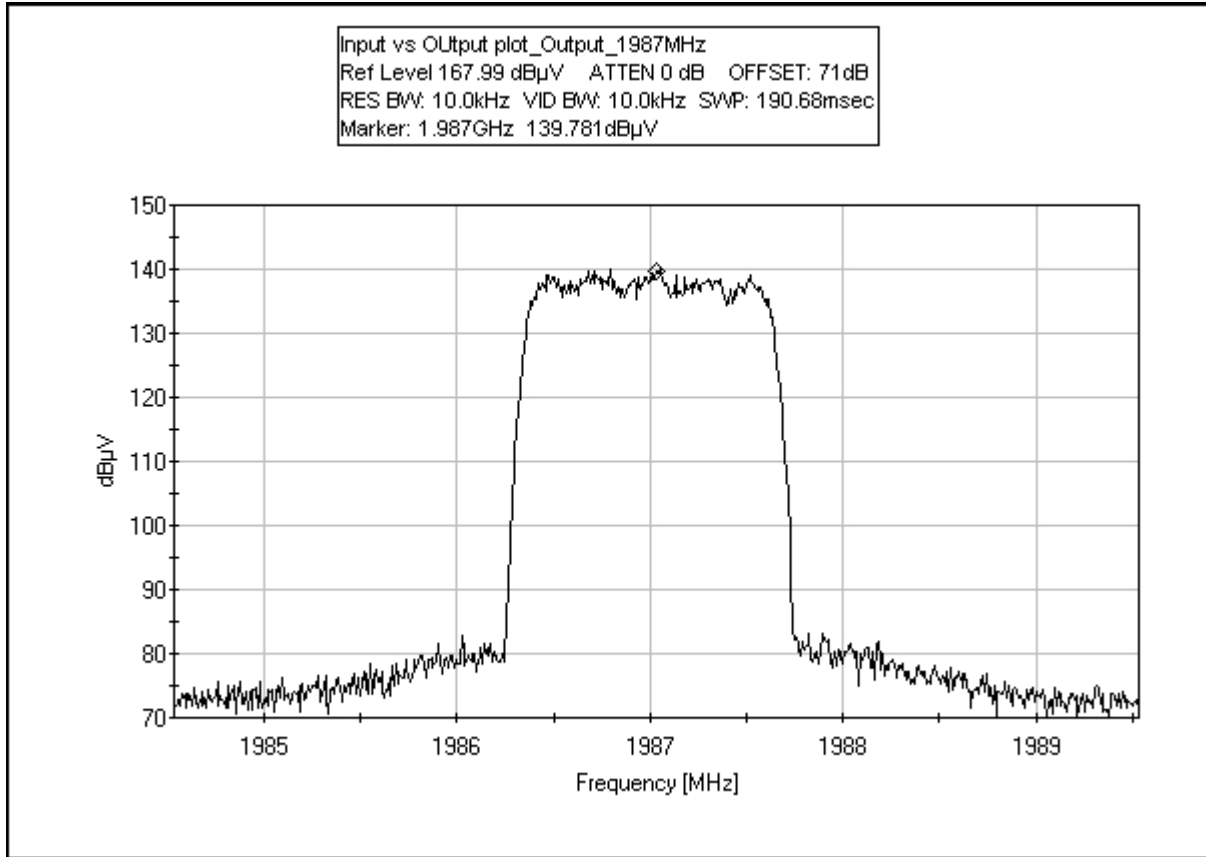
### OUTPUT PLOT - 1933 MHz



### OUTPUT PLOT - 1960 MHz



**OUTPUT PLOT - 1987 MHz**



**FCC 2.1033(c)(14)/2.1051/24.238(a) - SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

**Test Setup Photos**



## Test Data

### Limit line for Spurious Conducted Emission

$$\text{Required Attenuation} = 43 + 10 \text{ Log } P \text{ dB}$$

$$\text{Limit line (dBuV)} = V_{\text{dBuV}} - \text{Attenuation}$$

$$\begin{aligned} V_{\text{dBuV}} &= 20 \text{ Log } \frac{V}{1 \times 10^{-6}} \\ &= 20 (\text{Log } V - \text{Log } 1 \times 10^{-6}) \\ &= 20 \text{ Log } V - 20 \text{ Log } 1 \times 10^{-6} \\ &= 20 \text{ Log } V - 20 (-6) \\ &= 20 \text{ Log } V + 120 \end{aligned}$$

$$\begin{aligned} \text{Attenuation} &= 43 + 10 \text{ Log } P \\ &= 43 + 10 \text{ Log } \frac{V^2}{R} \\ &= 43 + 10 (\text{Log } V^2 - \text{Log } R) \\ &= 43 + 10 (2 \text{ Log } V - \text{Log } R) \\ &= 43 + 20 \text{ Log } V - 10 \text{ Log } R \end{aligned}$$

$$\begin{aligned} \text{Limit line} &= V_{\text{dBuV}} - \text{Attenuation} \\ &= 20 \text{ Log } V + 120 - (43 + 20 \text{ Log } V - 10 \text{ Log } R) \\ &= 20 \text{ Log } V + 120 - 43 - 20 \text{ Log } V + 10 \text{ Log } R \\ &= 20 \text{ Log } V + 120 - 43 - 20 \text{ Log } V + 10 \text{ Log } R \\ &= 120 - 43 + 10 \text{ Log } 50 \quad \text{Note : } R = 50 \Omega \\ &= 120 - 43 + 16.897 \\ &= 94 \text{ dBuV at any power level} \end{aligned}$$





Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer: **Powerwave Technologies, Inc.**  
 Specification: **FCC 24.238 (a) Conducted Spurious Emission**  
 Work Order #: **87159** Date: 11/13/2007  
 Test Type: **Conducted Emissions** Time: 14:52:38  
 Equipment: **Power Amplifier Frame** Sequence#: 7  
 Manufacturer: Powerwave Technologies Tested By: E. Wong  
 Model: PAF-1930-EX-XXX 27V dc  
 S/N: NA

**Test Equipment:**

Function	S/N	Calibration Date	Cal Due Date	Asset #
Spectrum Analyzer	US44300438	01/03/2007	01/03/2009	02672
3.0 GHz HPF	1	03/08/2006	03/08/2008	02744
Cable Big Blue	12237/4A	11/28/2005	11/28/2007	P05421

**Equipment Under Test (\* = EUT):**

Function	Manufacturer	Model #	S/N
Power Amplifier Frame*	Powerwave Technologies	PAF-1930-EX-XXX	NA

**Support Devices:**

Function	Manufacturer	Model #	S/N
Power Supply	Power Ten	P63C00330	9917C0030
ESG	Agilent	4433B	US40051692
ESG	Agilent	4433B	US40051840
ESG	Agilent	4433B	US40051852
Power Meter	Agilent	E4419B	MY40510694

**Test Conditions / Notes:**

The floor standing EUT comprising of three Amplifier sub-frames (MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules(PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz. Modulation: 1X-EVDO RF emission profile measured at the antenna port of each sub frame. Top section 1933 MHz, 500W; Middle section: 1960 MHz, 500W; Bottom section : 1987 MHz, 500W. Frequency range of measurement = 9 kHz - 20 GHz. Frequency 9 kHz - 150 kHz RBW=200 Hz, VBW=200 Hz; 150 kHz - 30 MHz RBW=9 kHz, VBW=9 kHz; 30 MHz - 1000 MHz RBW=120 kHz, VBW=120 kHz; 1000 MHz - 20,000 MHz RBW=1 MHz, VBW=1 MHz. 27 Vdc, 12 Amp from a support power supply (3 phase). 20°C, 48% relative humidity. Ferrite Steward 28A2026\_0A2 added to data line in all amplifier modules.

**Transducer Legend:**

T1=CABLE bigblue_ANP5421 112807	T2=Filter 3GHz HPF AN02744
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<b>Measurement Data:</b>		Reading listed by margin.					Test Lead: Antenna Terminal				
#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	dB	dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	5960.950M	80.3	+2.2	+0.4			+0.0	82.9	94.0	-11.1	Anten
	Ave								H		
^	5960.950M	99.6	+2.2	+0.4			+0.0	102.2	94.0	+8.2	Anten
									H		
3	9934.866M	74.6	+2.7	+0.2			+0.0	77.5	94.0	-16.5	Anten
									H		
4	7948.367M	73.8	+2.7	+0.2			+0.0	76.7	94.0	-17.3	Anten
									H		
5	5880.000M	72.8	+2.2	+0.3			+0.0	75.3	94.0	-18.7	Anten
									M		
6	3865.817M	70.9	+1.8	+0.3			+0.0	73.0	94.0	-21.0	Anten
	Ave								L		
^	3865.817M	89.1	+1.8	+0.3			+0.0	91.2	94.0	-2.8	Anten
									L		
8	3920.020M	69.2	+1.8	+0.3			+0.0	71.3	94.0	-22.7	Anten
									M		
9	5799.067M	67.5	+2.2	+0.2			+0.0	69.9	94.0	-24.1	Anten
	Ave								L		
^	5799.067M	88.8	+2.2	+0.2			+0.0	91.2	94.0	-2.8	Anten
									L		
11	3973.967M	64.6	+1.8	+0.3			+0.0	66.7	94.0	-27.3	Anten
	Ave								H		
^	3973.967M	80.6	+1.8	+0.3			+0.0	82.7	94.0	-11.3	Anten
									H		



**FCC 2.1033(c)(14)/2.1053/24.238(a) - FIELD STRENGTH OF SPURIOUS RADIATION**

Test Location: CKC Laboratories, Inc. •110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer: **Powerwave Technologies, Inc.**  
 Specification: **FCC 24.238 Radiated Spurious Emission**  
 Work Order #: **87159** Date: 11/13/2007  
 Test Type: **Radiated Scan** Time: 16:38:11  
 Equipment: **Power Amplifier Frame** Sequence#: 6  
 Manufacturer: Powerwave Technologies Tested By: E. Wong  
 Model: PAF-1930-EX-XXX  
 S/N: NA

***Test Equipment:***

Function	S/N	Calibration Date	Cal Due Date	Asset #
Bilog Antenna	2451	02/02/2006	02/02/2008	01995
Spectrum Analyzer	US44300438	01/03/2007	01/03/2009	02672
Cable	Cable15	01/05/2007	01/05/2009	P05198
Pre Amp	1937A02548	06/01/2006	06/01/2008	00309
Pre amp to SA Cable	Cable #10	05/16/2007	05/16/2009	P05050
Horn Antenna	6246	06/29/2006	06/29/2008	00849
Microwave Pre-amp	3123A00281	07/19/2006	07/19/2008	00786
2'-40GHz cable	NA	09/18/2007	09/18/2009	P2948
HeliAx Antenna Cable	P5565	09/18/2006	09/18/2008	P05565
18-26GHz Horn	3643A00027	11/27/2006	11/27/2008	02112
3.0 GHz HPF	1	03/08/2006	03/08/2008	02744

***Equipment Under Test (\* = EUT):***

Function	Manufacturer	Model #	S/N
Power Amplifier Frame*	Powerwave Technologies	PAF-1930-EX-XXX	NA

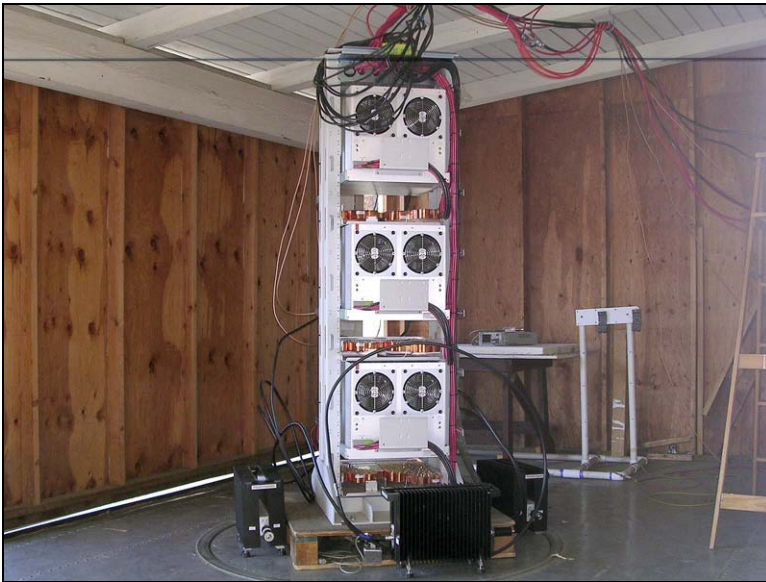
***Support Devices:***

Function	Manufacturer	Model #	S/N
Power Supply	Power Ten	P63C00330	9917C0030
ESG	Agilent	4433B	US40051692
ESG	Agilent	4433B	US40051840
ESG	Agilent	4433B	US40051852
Power Meter	Agilent	E4419B	MY40510694

***Test Conditions / Notes:***

The floor standing EUT comprising of three Amplifier sub-frames (MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules(PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz Modulation: 1X-EVDO, Top section: 1933MHz, 500W; Middle section: 1960MHz, 500W; Bottom section: 1987MHz, 500W. Frequency range of measurement = 9 kHz - 20 GHz. Frequency 9 kHz - 150 kHz RBW=200 Hz, VBW=200 Hz; 150 kHz - 30 MHz RBW=9 kHz, VBW=9 kHz; 30 MHz- 1000 MHz RBW=120 kHz, VBW=120 kHz; 1000 MHz - 20,000 MHz RBW=1 MHz, VBW=1 MHz. 27 Vdc, 12 Amp from a support power supply (3 phase). 20°C, 48% relative humidity. Ferrite Steward 28A2026\_0A2 added to data line in all amplifier modules.

**Test Setup Photos**



**Test Data**

Operating Frequency: 1930 MHz -1990 MHz  
 Channels: Low, Mid and High  
 Highest Measured Output Power: 50.00 EIRP(dBm)= 100 EIRP(Watts)  
 Distance: 3 meters  
 Limit:  $43+10\text{Log}(P)$  63.00 dBc

Freq. (MHz)	Reference Level (dBm)	Antenna Polarity (H/V)	dBc
7,839.86	-13.4	Horiz	63.40
7,731.95	-16.2	Vert	66.20
7,948.29	-19.5	Vert	69.50
5,879.97	-20.1	Horiz	70.10
7,732.02	-20.4	Horiz	70.40
9,935.33	-20.6	Vert	70.60
7,839.32	-21.5	Vert	71.50
5,960.88	-21.6	Horiz	71.60
3,973.99	-21.9	Vert	71.90
5,960.95	-22	Vert	72.00
5,880.33	-22.4	Vert	72.40
7,947.81	-22.9	Horiz	72.90
3,919.69	-23	Vert	73.00
5,799.02	-23.2	Horiz	73.20
3,920.53	-24.2	Horiz	74.20
5,798.95	-24.4	Vert	74.40
9,799.96	-25.7	Horiz	75.70
9,799.00	-26.1	Vert	76.10
3,865.85	-27.6	Vert	77.60
9,935.26	-27.9	Horiz	77.90
3,865.90	-29	Horiz	79.00
11,598.45	-33.9	Vert	83.90
11,597.33	-37.9	Horiz	87.90
9,664.95	-41.7	Vert	91.70
3,974.00	-41.8	Horiz	91.80
3,974.00	-21.6	Horiz	71.60



**BLOCKEDGE**

**Test Equipment**

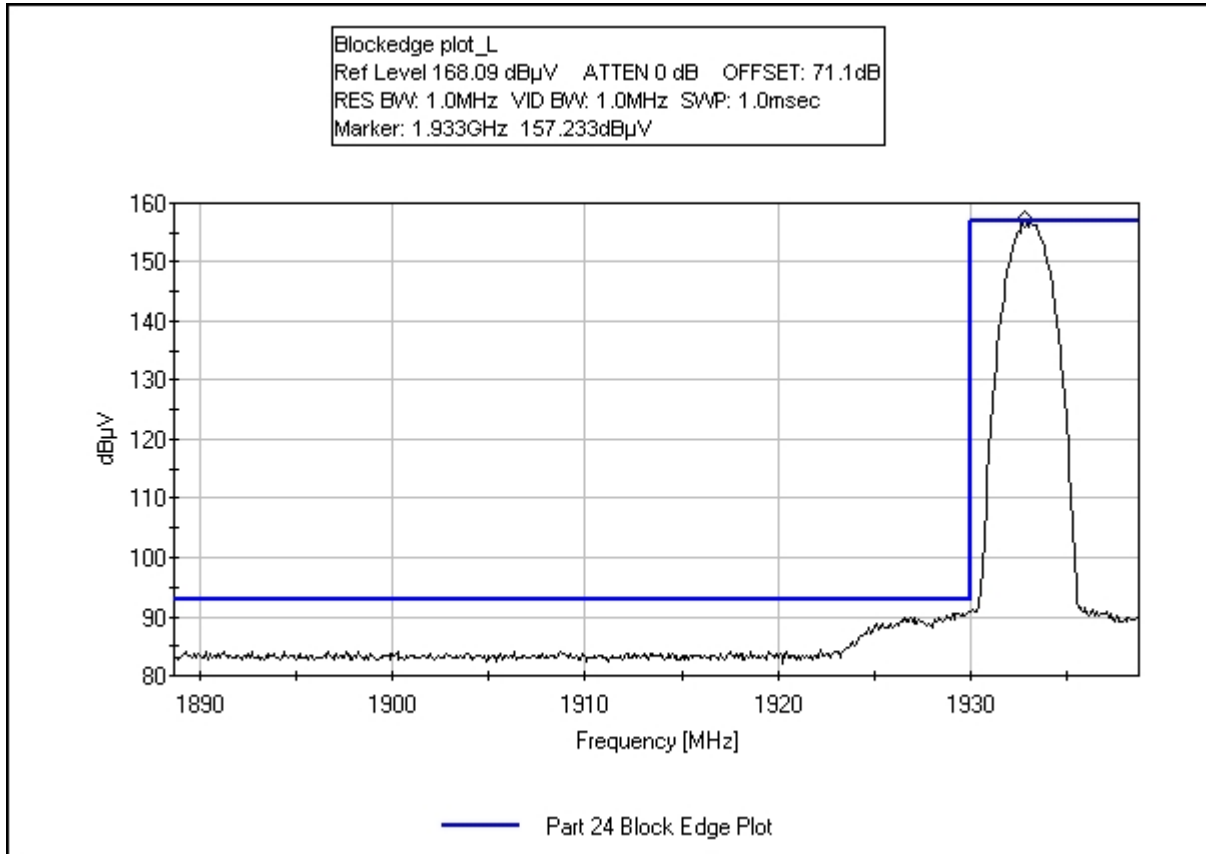
Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Spectrum Analyzer	02672	Agilent	E4446A	US44300438	010307	010309
High Freq Cable (big blue)	05421	Huber Suhner	NA	12237/4A	112805	112807
3.0 GHz HPF	02744	K&L	11SH10-3000	1	030806	030808

**Test Conditions:** The floor standing EUT comprising of three Amplifier sub-frames (MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules (PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz. Modulation: 1X-EVDO. Each amplifier sub frame is capable of operating in the range of 1930 – 1990 MHz. The bandedge compliance profile is measured at the antenna port of bottom and top amplifier sub frame.

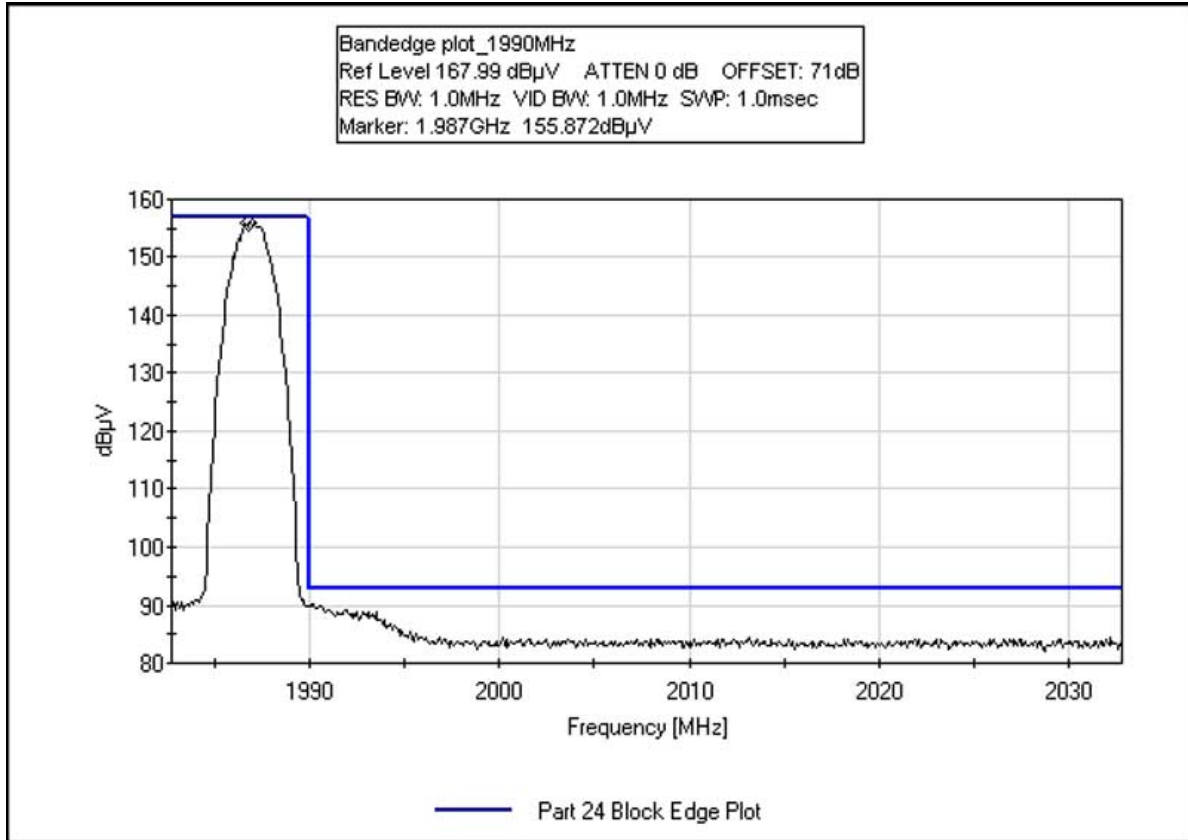
**Test Setup Photos**



### BLOCKEDGE PLOT - LOW CHANNEL



### BANDEDGE PLOT - 1990 MHz





**INTERMODULATION**

**Test Equipment**

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Spectrum Analyzer	02672	Agilent	E4446A	US44300438	010307	010309
High Freq Cable (big blue)	05421	Huber Suhner	NA	12237/4A	112805	112807
3.0 GHz HPF	02744	K&L	11SH10-3000	1	030806	030808

**Test Conditions:** The floor standing EUT comprising of three Amplifier sub-frames (MCR41930-1-4-XX) is placed on the turntable. Each amplifier sub frame contains four amplifier modules (PMCPA KS24722L2 1:1). For each amplifier sub-frame: J7 RF is connected to J8, J10-Filter I/O is connected to J7 via shielded cable and connector, J42 is connected to DC, J6 is connected to RF In and J1 is connected to a RF load string. All other ports are maintenance ports, hence are not populated. Remote ESGs supply modulated signal to the EUT, the output power of each amplifier sub-frame is monitored, with the RF input signal adjusted to maintain the rated RF output power. Operating Frequency range: 1930 - 1990 MHz. Modulation: 1X-EVDO. Each amplifier sub frame is capable of operating in the range of 1930 – 1990 MHz. Modulation: 1X-EVDO. Top section: 1933 MHz, 500W; Middle section: 1960 MHz, 500W; Bottom section: 1987 MHz, 500W. Frequency range of measurement = 9 kHz - 20 GHz. Frequency 9 kHz - 150 kHz RBW=200 Hz, VBW=200 Hz; 150 kHz - 30 MHz RBW=9 kHz, VBW=9 kHz; 30 MHz - 1000 MHz RBW=120 kHz, VBW=120 kHz; 1000 MHz - 20,000 MHz RBW=1 MHz, VBW=1 MHz. 27 Vdc, 12 Amp from a support power supply (3 phase ) 20°C, 48% relative humidity. Ferrite Steward 28A2026\_0A2 added to data line in all amplifier modules.

**Test Setup Photos**



### Test Plots

