WPS-495922-02

4.9 – 5.9 GHz Linear Power Amplifier
Data Sheet
June 2006

Features:

- **11.0 dB Gain**
- **32 dBm P1dB**
- **47 dBm IP3**
- **EVM < 2.5% at 26 dBm Pout**
- **Pre-match for Easy Cascade**
- **Pb Free Surface Mount Pkg**
- **MTTF > 100 yrs @ T_C 150°C**

Applications:

- **802.16 WiMax**
- **802.11 WLAN**
- **Wireless Communications**
- **Telecomm Infrastructure**

Description:

The WPS-495922-02 is a 1.5 watt amplifier pre-matched to 50 ohm operating over frequency range 4.9 GHz to 5.9 GHz. The RF gain is 11 dB. The typical output IP3 is 47 dBm and P_{1dB} is 32 dBm. The WPS-495922 amplifier has excellent performance for 802.11 WLAN and 802.16 WiMax applications. At 2.5% error vector magnitude (EVM), the amplifier can achieve an average output power of 26 dBm. The WPS-495922-02 is packaged in a leadless chip carrier with a proprietary copper alloy for excellent thermal conductance. The package construction is environmentally 'lead free' and 'cadmium free'.

Electrical Specifications:

- ***@ 25°C, Vds = 7.5 V, Zo = 50 ohms***

SYMBOL	PARAMETERS	Min	Typical	Max	Unit
Freq.	Frequency Range	4.9		5.9	GHz
SSG	Small Signal Gain	9	11		dB
VSWR	Input/ Output VSWR		3.0:1/2.0:1		-
P1dB	Pout at 1 dB Compression Point		+32		dBm
EVM	Error Vector Magnitude (see note 1)		2.5		%
OIP3	Output Third Order Intercept (see note 2)		47		dBm
Ids	DC Current		600		mA
Vgs	Gate Voltage		-0.7		Volt
Rth	Thermal Resistance Junction to Case		18		°C/W

Notes:

1. The output power is 25 dBm for 2.5% EVM and the test signal is 802.16, 256 carriers, 64 QAM with 2/3 coding factor. The measured EVM includes the accumulated errors (1.6%) from the modulator and driver stages.
2. The output power per tone is 22 dBm and the tone separation is 20 MHz center at 5.5 GHz.

Absolute Maximum Ratings

Max Bias Voltage	8.5 V
Max Continuous RF Input Power	+30 dBm
Max Peak Input Power	+33 dBm
Case Operating Temp	+70 °C
Max Storage Temp	*65 to +150 °C

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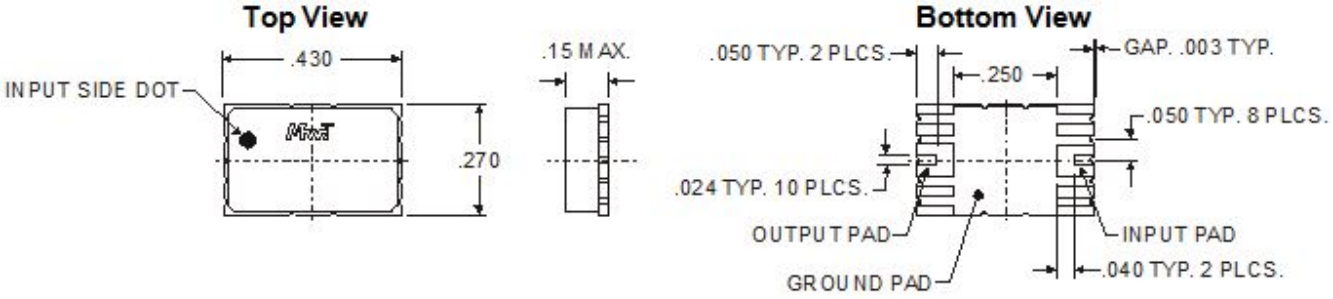
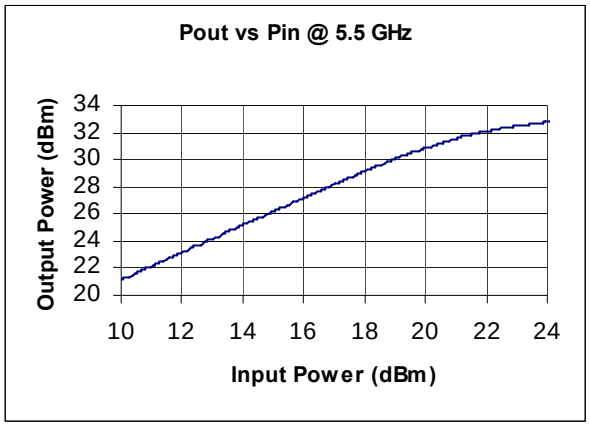
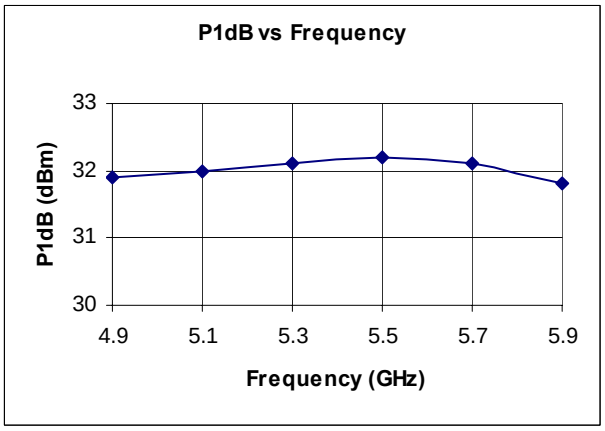
Package Outline Diagram (Package 02)

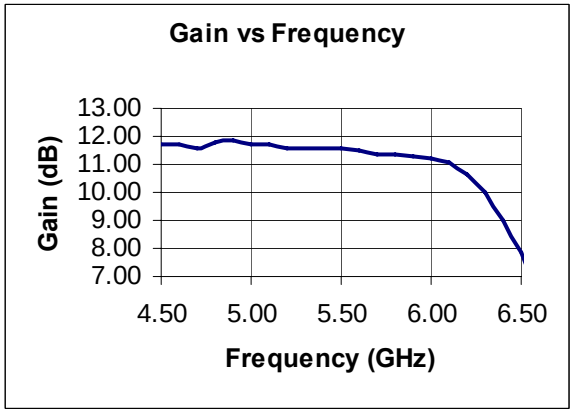


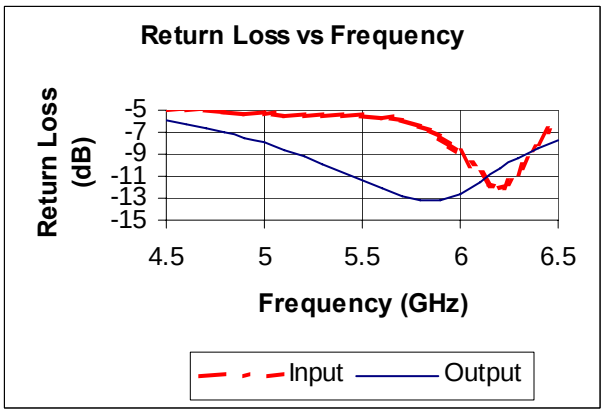
All dimensions are in inches

Pin Designation (Top View)			
Pin 1 (DOT Top Left)	GND	Pin 10	GND
Pin 2	GND	Pin 9	GND
Pin 3	RF In/Vg	Pin 8	RF Out/Vdd
Pin 4	GND	Pin 7	GND
Pin 5	GND	Pin 6	GND









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S-parameters measured at Vdd=7.5V and Vg=-0.7V 25°C

Freq	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
4.50	0.56	-84.22	4.02	-175.51	0.05	125.37	0.50	58.97
4.60	0.56	-99.93	4.02	172.22	0.05	116.31	0.48	52.86
4.70	0.56	-115.24	3.95	162.93	0.05	108.11	0.46	46.11
4.80	0.55	-130.63	4.05	153.52	0.06	100.09	0.44	39.62
4.90	0.54	-146.05	4.06	144.25	0.06	89.06	0.42	32.74
5.00	0.54	-161.60	4.01	134.37	0.06	76.23	0.40	25.76
5.10	0.53	-177.34	4.02	124.21	0.06	66.27	0.37	18.00
5.20	0.53	166.08	3.96	111.82	0.06	56.41	0.35	9.75
5.30	0.53	149.64	3.94	99.89	0.06	47.94	0.32	0.52
5.40	0.53	133.22	3.90	88.24	0.06	37.93	0.29	-9.67
5.50	0.53	117.33	3.91	76.71	0.06	27.25	0.27	-20.85
5.60	0.52	101.70	3.83	65.80	0.06	15.30	0.25	-33.30
5.70	0.50	85.80	3.78	54.29	0.07	3.57	0.23	-47.72
5.80	0.47	69.30	3.72	42.41	0.07	-9.28	0.22	-64.15
5.90	0.43	51.20	3.70	29.21	0.07	-21.23	0.22	-82.37
6.00	0.36	28.61	3.66	15.20	0.07	-34.21	0.23	-101.50
6.10	0.29	-2.41	3.57	-0.23	0.07	-49.22	0.26	-120.18
6.20	0.25	-47.53	3.39	-16.27	0.07	-64.77	0.30	-137.91
6.30	0.29	-95.77	3.12	-32.21	0.07	-81.04	0.34	-153.30
6.40	0.40	-130.47	2.80	-48.06	0.06	-97.23	0.38	-166.87
6.50	0.52	-154.23	2.47	-63.21	0.06	-112.68	0.41	-178.29

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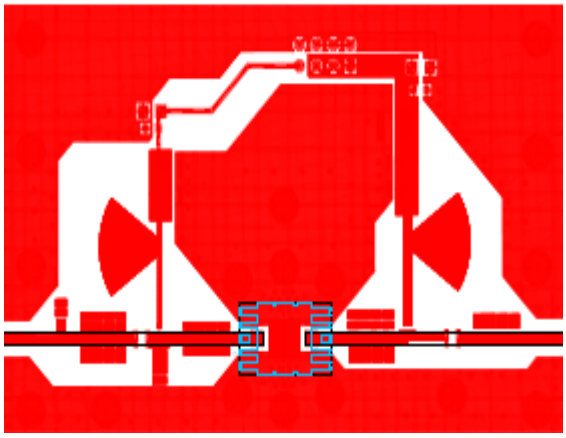

Figure 1 Evaluation board

Application Note

The evaluation board material, shown in Figure 1, is Rogers 4003 material, 20 mil thick, and 2 oz copper weight. Through holes with a diameter of 20 mils are spread uniformly over the center pad for thermal relief and RF ground. It is recommended that via holes be placed nearby the DC bias connector to maintain ground continuity between the top layer and bottom ground planes. Mounting holes near the unit will help secure the board to the chassis, minimize ground current loops and improve thermal conductivity in the absence of sweat soldering the board to the chassis.

Biasing with quarter-wave stubs at the gate and drain are shown in Figure 1. The impedance of the quarter wave structures is cyclical with frequency. A RF short is observed at frequencies that are even multiples of quarter-wavelength and open impedance is observed at frequencies that are odd multiples of a quarter-wavelength. A 56 ohm resistor is added in series to the gate bias. The effective impedance is increased which reduces the risk of oscillations. The 56 ohm resistor is not shown in Figure 1. Through holes underneath the package is required to connect the top and bottom grounds and to improve thermal conductivity. Typical large signal gain response, shown in Figure 2, varies from 10 to 11 dB over the frequency range 4.9 to 5.9 GHz. The output IP3 response shown in Figure 3 uses a two tone separation of 20 MHz at 5.1 and 5.9 GHz.

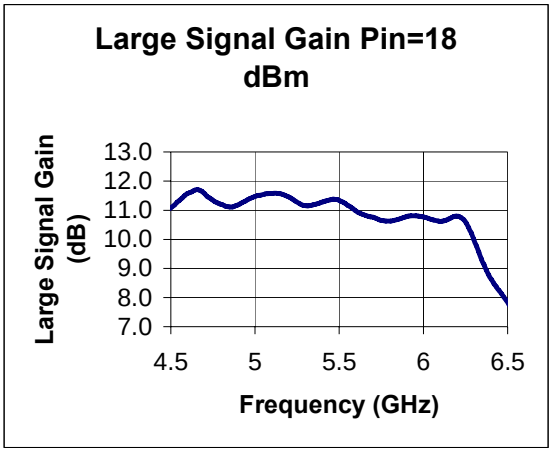

Figure 2 Gain Response

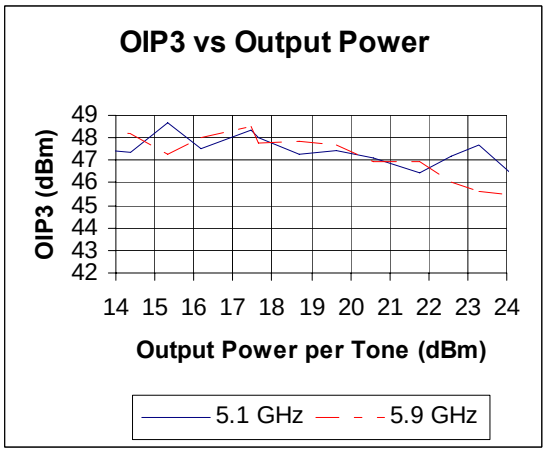

Figure 3 OIP3

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Application Note (Con't)

One of most stringent modulations for a linear amplifier is WiMAX 256 carriers, 64 QAM. The WiMAX test signals were generated using the Rhode & Schwarz SMU200A modulator and the FSQ26 is used to analyze signal integrity. An output power of 26 dBm is achieved for an error vector magnitude of 2.5% as shown in Figures 4 thru 6.

Frequency:	5.1 GHz	Signal Level:	3 dBm	External Att:	0 dB
Sweep Mode:	Continuous	Trigger Mode:	Free Run	Trigger Offset:	-10 µs
Burst Type:	OFDM DL Burst	Modulation:	64QAM2/3	No Of Data Symbols:	1/1366

Result Summary							
No. of Bursts	66						
	Min	Mean	Limit		Max	Limit	Unit
EVM All Carriers	2.28	2.49	3.76		2.77	3.76	%
EVM Data Carriers	2.28	2.49	3.76		2.76	3.76	%
EVM Pilot Carriers	1.86	2.36			2.82		%
IQ Offset	2.85	3.24			3.57		%
Gain Imbalance	1.06	0.82			0.50		%
Quadrature Error	- 0.024	0.177			0.392		°
Center Frequency Error	40.68	132.26	± 40800		185.86	± 40800	Hz
Symbol Clock Error	1.26	7.69	± 8	*	18.58	± 8	ppm
Burst Power	3.10	3.27			3.43		dBm
Crest Factor	6.37	6.61			6.83		dB
SS Timing	0.00	0.00			0.00		%
RSSI	...	...			...		dBm

Figure 4 802.16, 256 carriers, 64QAM at 5.1 GHz, Pavg=26.3 dBm

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Application Note (Con't)

Frequency:	5.9 GHz	Signal Level:	16.5 dBm	External Att:	0 dB
Sweep Mode:	Continuous	Trigger Mode:	Power	Trigger Offset:	-10 µs
Burst Type:	OFDM DL Burst	Modulation:	64QAM3/4	No Of Data Symbols:	4/2425

Result Summary						
No. of Bursts	2					*
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	2.06	2.07	2.82	2.08	2.82	%
EVM Data Carriers	2.07	2.08	2.82	2.09	2.82	%
EVM Pilot Carriers	1.90	1.91		1.92		%
IQ Offset	0.07	0.10		0.13		%
Gain Imbalance	0.18	0.08		- 0.02		%
Quadrature Error	0.218	0.238		0.257		°
Center Frequency Error	10.71	10.96	± 47200	11.21	± 47200	Hz
Symbol Clock Error	- 0.00	0.00	± 8	0.00	± 8	ppm
Burst Power	15.32	15.34		15.36		dBm
Crest Factor	8.53	8.54		8.54		dB
RSSI	17.72	17.72		17.72		dBm
RSSI Standard Deviation		- 3.87				dB
CINR	41.70	41.70		41.74		dB
CINR Standard Deviation		31.71				dB

Figure 5 802.16 256 carriers, 64 QAM at 5.9 GHz, Pavg=25.2 dBm @ EVM=2%

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Application Note (Con't)

Typical constellation response for 802.16 Pavg=26 dBm and 2.5% EVM

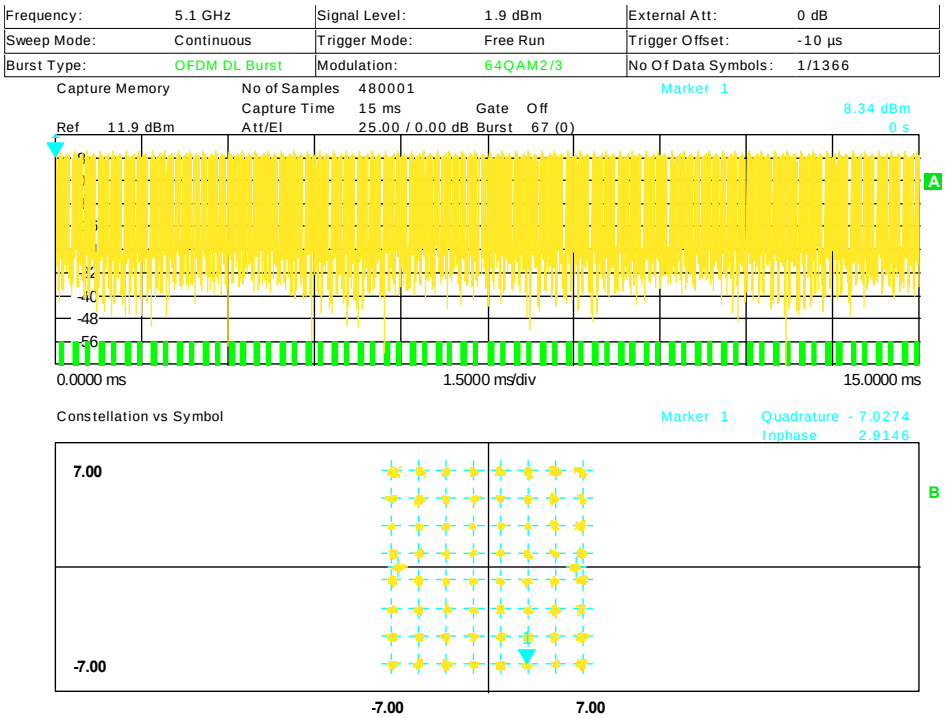

Figure 6 WiMax constellation Pavg=26 dBm at 5.1 GHz for 2.5% EVM for all carriers.

The test signal is 256 carriers, 64 QAM with 2/3 coding factor.

The signal power versus time is shown in yellow.

The constellation shown in represents 64 QAM.

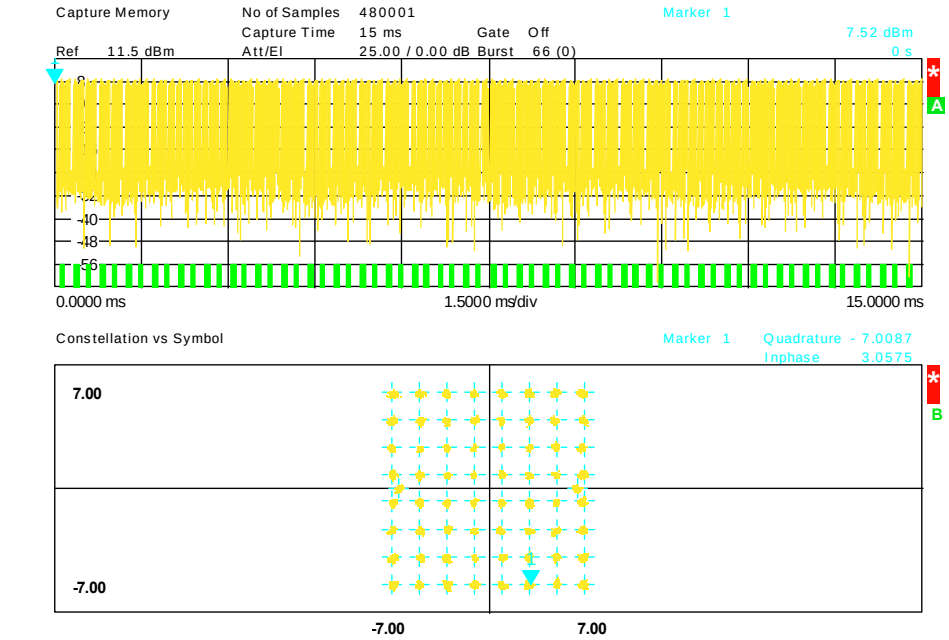

Figure 7 WiMax constellation Pavg= 25.8 dBm at 5.9 GHz. for 2.5% EVM.

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