WPS-343724-99

3.4 – 3.7 GHz Linear Power Amplifier
Data Sheet
June 2006

Features:

- **14.0 dB Gain**
- **36 dBm P1dB**
- **50 dBm IP3**
- **EVM < 2.0% at 29 dBm Pout**
- **Prematch for Easy Cascade**
- **Pb Free Surface Mount Pkg**
- **MTTF > 100 yrs @ T_C 150℃**

Applications:

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

Description:

The WPS-343724-99 is a 4 watt amplifier pre-matched to 50 ohm operating over frequency range 3.4 GHz to 3.7 GHz. The RF gain is 14 dB. The typical output IP3 is 50 dBm and P_{1dB} is 36 dBm. The WPS-343724-99 amplifier has excellent performance for 802.11 WLAN and 802.16 WiMax applications. At 2.0% error vector magnitude (EVM), the amplifier can achieve an average output power of 29 dBm. The WPS-343724-99 is packaged in a flange with a proprietary copper alloy for excellent thermal conductance. The package construction is environmentally 'lead free' and 'cadmium free'.

Electrical Specifications:

- ***@ 25℃, Vds = 8.0 V, Zo = 50 ohms***

SYMBOL	PARAMETERS	Min	Typical	Max	Unit
Freq.	Frequency Range	3.4		3.7	GHz
SSG	Small Signal Gain	12	14		dB
VSWR	Input/ Output VSWR		2.0:1/2.0:1		-
P1dB	Pout at 1 dB Compression Point		+36		dBm
EVM	Error Vector Magnitude (see note 1)		2.0		%
OIP3	Output Third Order Intercept (see note 2)		50		dBm
Ids	DC Current		1200		mA
Vgs	Gate Voltage		-0.7		Volt
Rth	Thermal Resistance Junction to Case		7		°C/W

Notes:

1. The output power is 29 dBm for 2.0% EVM and the test signal is 802.16, 256 carriers, 64 QAM with 3/4 coding factor. The measured EVM includes the accumulated errors (0.9%) from the modulator and driver stages.
2. The output power per tone is 25 dBm and the tone separation is 20 MHz center at 3.5 GHz.

MicroWave Technology, Inc. an IXYS Company, 4268 Solar Way, Fremont, CA 94538
510-651-6700 FAX 510-651-2208 WEB www.mwtinc.com

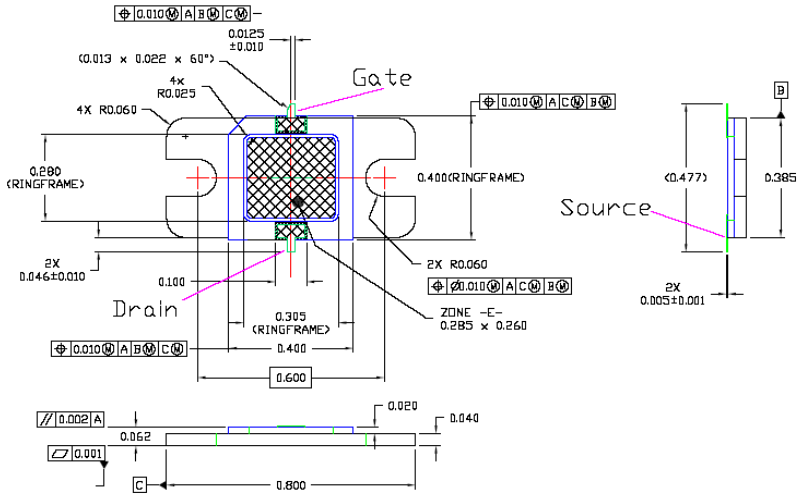
WPS-343724-99

3.4 – 3.7 GHz Linear Power Amplifier
Data Sheet
June 2006

Absolute Maximum Ratings

Maximum Bias Voltage	10.0 V
Maximum Continuous RF Input Power	+33 dBm
Maximum Peak Input Power	+36 dBm
Maximum Case Operating Temperature	+70 ℃
Maximum Storage Temperature	- 65 to + 150 ℃

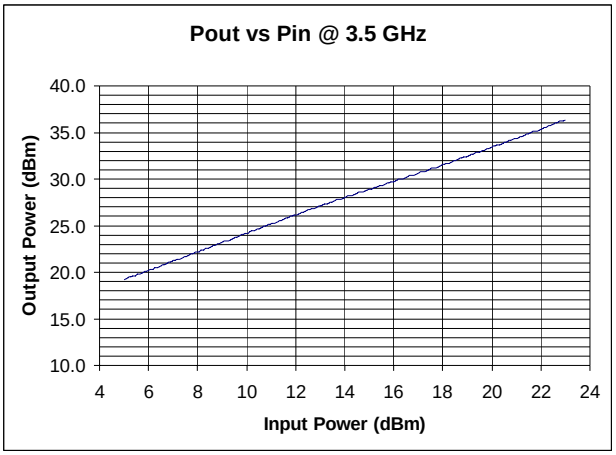
Package Outline Diagram (Package 02)

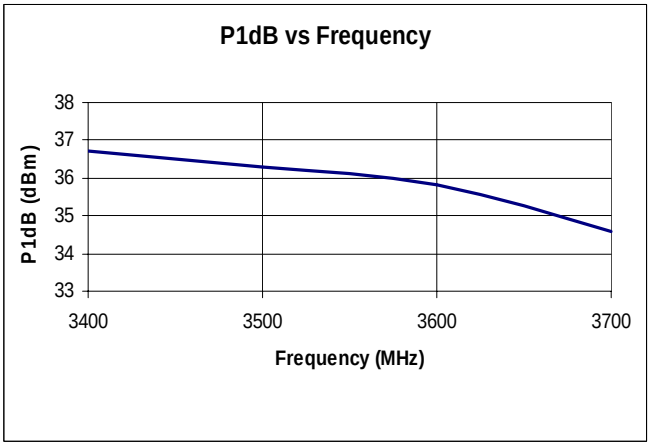


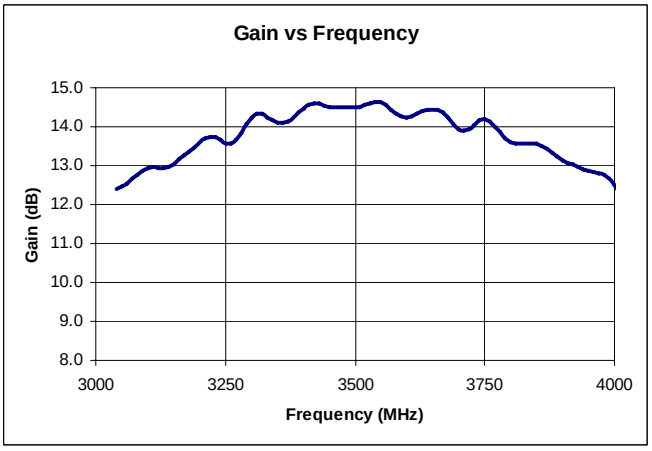
WPS-343724-99

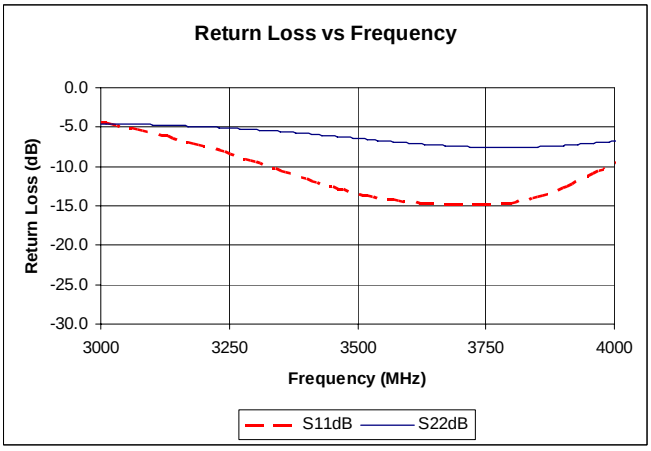
3.4 – 3.7 GHz Linear Power Amplifier
Data Sheet
June 2006

Typical Test Data @ 25°C Vdd=8.0V and Vgs=-0.8V









MicroWave Technology, Inc. an IXYS Company, 4268 Solar Way, Fremont, CA 94538
510-651-6700 FAX 510-651-2208 WEB www.mwtinc.com

S-parameters are measured in MWT's test fixture.

Vdd=8.0V Vgs=-0.7V Ids=1.3A

Freq	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
3.0	0.58	-0.22	1.45	4.21	0.03	0.01	0.33	-0.47
3.1	0.43	-0.38	2.97	3.50	0.04	-0.01	0.19	-0.51
3.2	0.23	-0.47	4.46	2.10	0.03	-0.02	0.04	-0.51
3.3	0.01	-0.46	5.01	0.13	0.03	-0.04	0.11	-0.46
3.4	0.15	-0.35	4.82	-2.06	0.01	-0.05	0.25	-0.36
3.5	0.21	-0.16	3.61	-3.96	-0.01	-0.05	0.32	-0.20
3.6	0.11	0.01	1.38	-5.10	-0.04	-0.04	0.31	-0.02
3.7	0.11	0.05	-1.15	-4.93	-0.05	-0.02	0.22	0.12
3.8	0.30	-0.09	-2.99	-3.27	-0.05	0.01	0.06	0.18
3.9	0.37	-0.34	-3.48	-1.21	-0.04	0.02	0.07	0.16
4.0	0.28	-0.57	-2.94	0.28	-0.02	0.03	0.17	0.10
4.1	0.12	-0.72	-2.04	1.09	-0.01	0.03	0.22	0.02
4.2	0.08	-0.78	-1.24	1.41	0.01	0.03	0.23	-0.06
4.3	0.26	-0.78	-0.54	1.39	0.01	0.02	0.23	-0.12
4.4	0.41	-0.74	-0.04	1.19	0.01	0.01	0.21	-0.17
4.5	0.54	-0.67	0.25	0.91	0.01	0.01	0.18	-0.22
4.6	0.65	-0.59	0.42	0.64	0.01	0.00	0.16	-0.26
4.7	0.74	-0.50	0.46	0.40	0.01	0.00	0.12	-0.30
4.8	0.80	-0.41	0.45	0.22	0.01	-0.01	0.08	-0.33
4.9	0.86	-0.32	0.40	0.08	0.01	-0.01	0.04	-0.36
5.0	0.89	-0.22	0.33	-0.02	0.00	-0.01	0.00	-0.39

WPS-343724-99

3.4 – 3.7 GHz Linear Power Amplifier
Data Sheet
June 2006

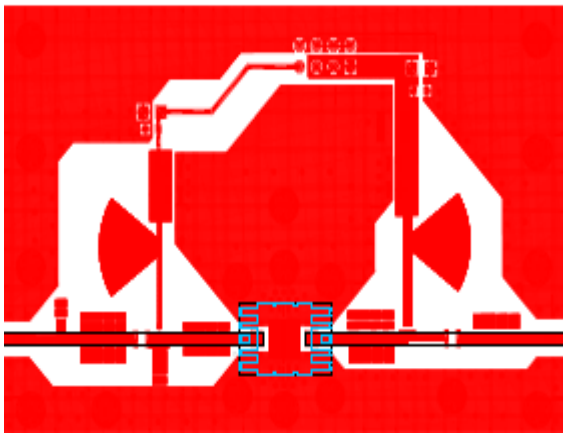


Figure 1 Evaluation board

Application Note

The evaluation board material, shown in Figure 1, is Rogers 4003 material, 20 mil thick, and 2 oz copper weight. The '02' package is used to evaluate the WPS343724-99 hardware. The 4 watt device in the '02' package has a limited temperature range of approximately 80°C. An earless flange or flange package is offered with better Tjc and can be used at much higher temperatures. Please consult the factory for your specific application. 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. The WPS343724-99 has a noise figure less 5.5 dB shown in Figure 2 and the supply current shown in Figure 3 is less than 1.3 A in small signal and increases to 1.43 A for an output power of 37 dBm. The RF drive level is increased incrementally and stopped when the gate leakage current of 11 mA is reached. Typical large signal gain response, shown in Figure 4, varies from 14 to 15 dB over the frequency range 3.4 to 3.7 GHz. The output IP3 response shown in Figure 5 uses a two tone separation of 20 MHz and 25 dBm per tone at 3.4, 3.5, 3.6 and 3.7 GHz.

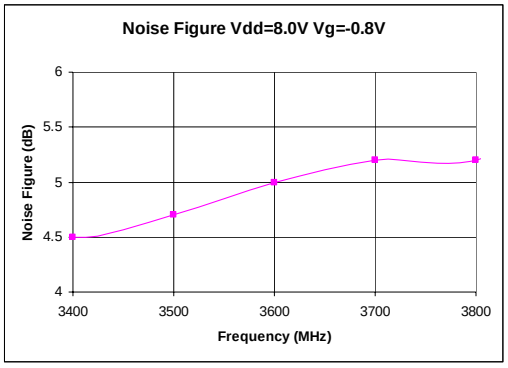


Figure 2 Noise Figure

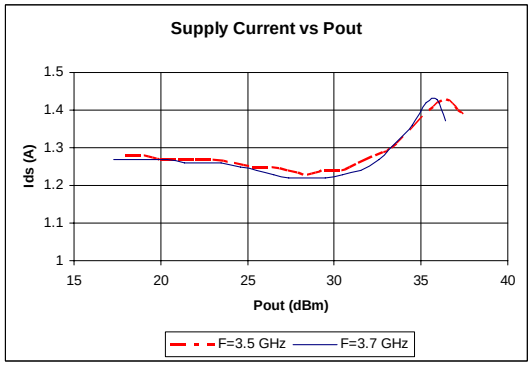


Figure 3 Supply Current

MicroWave Technology, Inc. an IXYS Company, 4268 Solar Way, Fremont, CA 94538
510-651-6700 FAX 510-651-2208 WEB www.mwtinc.com

Application Note (Con't)

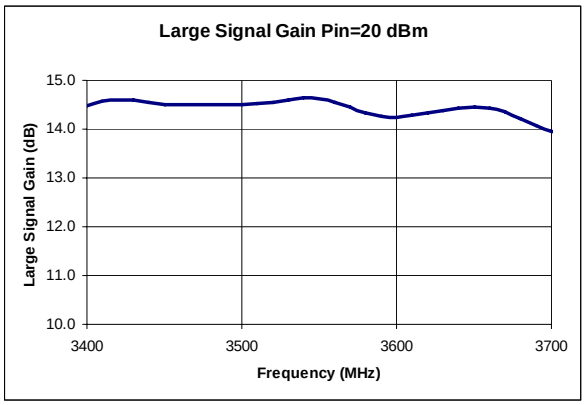


Figure 4 Gain Response

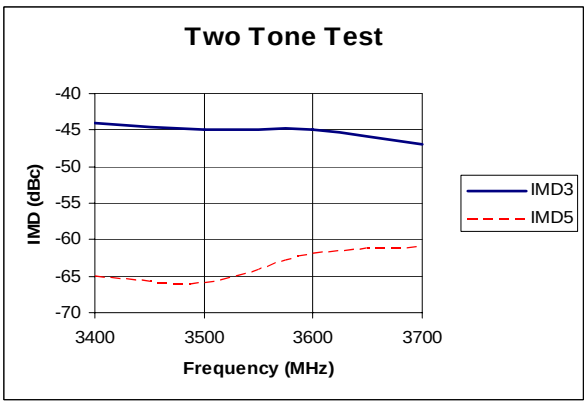


Figure 5 OIP3

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 29 dBm is achieved for an error vector magnitude of 2.0% as shown in Figures 4 thru 6. The amplifier's output power is 7.2 higher than the burst and RSSI power levels.

IEEE 802.16 - 2004					
Frequency:	3.4 GHz	Signal Level:	20 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:	1/2425

Result Summary						
No. of Bursts	2					*
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	2.12	2.12	2.82	2.12	2.82	%
EVM Data Carriers	2.12	2.12	2.82	2.13	2.82	%
EVM Pilot Carriers	2.03	2.05		2.06		%
IQ Offset	0.28	0.29		0.29		%
Gain Imbalance	0.02	0.01		0.01		%
Quadrature Error	0.012	0.017		0.022		°
Center Frequency Error	- 0.04	0.53	± 27200	1.10	± 27200	Hz
Symbol Clock Error	- 0.02	- 0.02	± 8	- 0.02	± 8	ppm
Burst Power	19.47	19.47		19.47		dBm
Crest Factor	9.28	9.29		9.29		dB
RSSI	21.81	21.81		21.81		dBm
RSSI Standard Deviation		- 2.70				dB
CINR	38.67	38.67		38.67		dB
CINR Standard Deviation		2.99				dB

Figure 6 802.16, 256 carriers, 64QAM at 3.4 GHz, EVM=2% @ Pavg=29 dBm.

Application Note (Con't)

IEEE 802.16 - 2004					
Frequency:	3.7 GHz	Signal Level:	18 dBm	External Att:	0 dB
Sweep Mode:	Continuous	Trigger Mode:	Free Run	Trigger Offset:	-10 µs
Burst Type:	OFDM DL Burst	Modulation:	64QAM3/4	No Of Data Symbols:	1/2425

Result Summary						
No. of Bursts	2					*
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	2.09	2.09	2.82	2.10	2.82	%
EVM Data Carriers	2.09	2.10	2.82	2.11	2.82	%
EVM Pilot Carriers	1.99	2.00		2.00		%
IQ Offset	0.16	0.16		0.17		%
Gain Imbalance	0.08	0.07		0.07		%
Quadrature Error	- 0.015	- 0.014		- 0.014		°
Center Frequency Error	- 2.51	4.08	± 29600	5.56	± 29600	Hz
Symbol Clock Error	- 0.04	- 0.04	± 8	- 0.04	± 8	ppm
Burst Power	18.42	18.42		18.43		dBm
Crest Factor	9.21	9.23		9.24		dB
RSSI	20.75	20.75		20.75		dBm
RSSI Standard Deviation		- 0.87				dB
CINR	38.34	38.34		38.34		dB
CINR Standard Deviation		16.75				dB

Figure 7 802.16 256 carriers, 64 QAM at 3.7 GHz, EVM = 2.0% @ Pavg=29.0 dBm

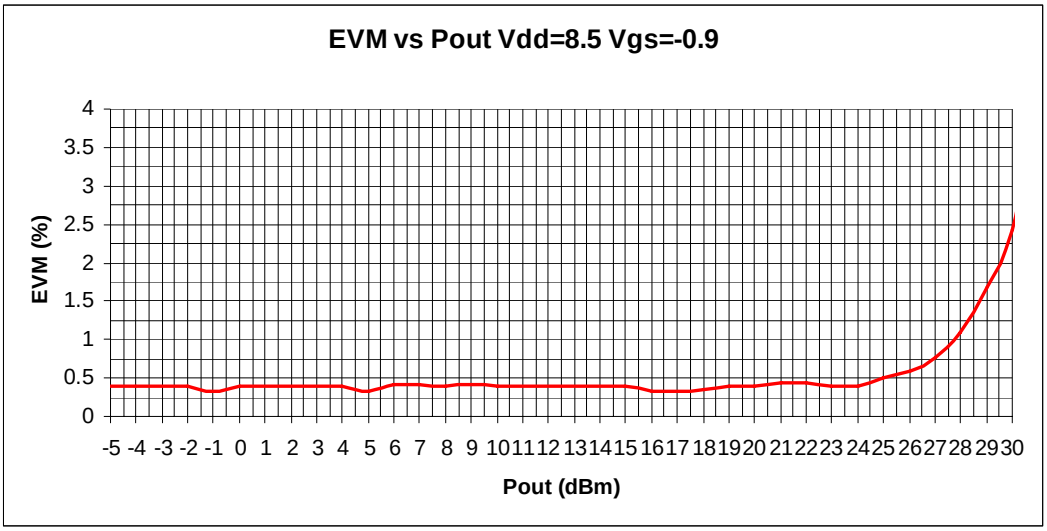


Figure 8 EVM vs Pout, 64 QAM at 3.5 GHz, EVM = 2.0% @ Pavg=29.0 dBm

Application Note (Con't)

Typical constellation response for 802.16 Pavg=29.5 dBm and 2.5% EVM

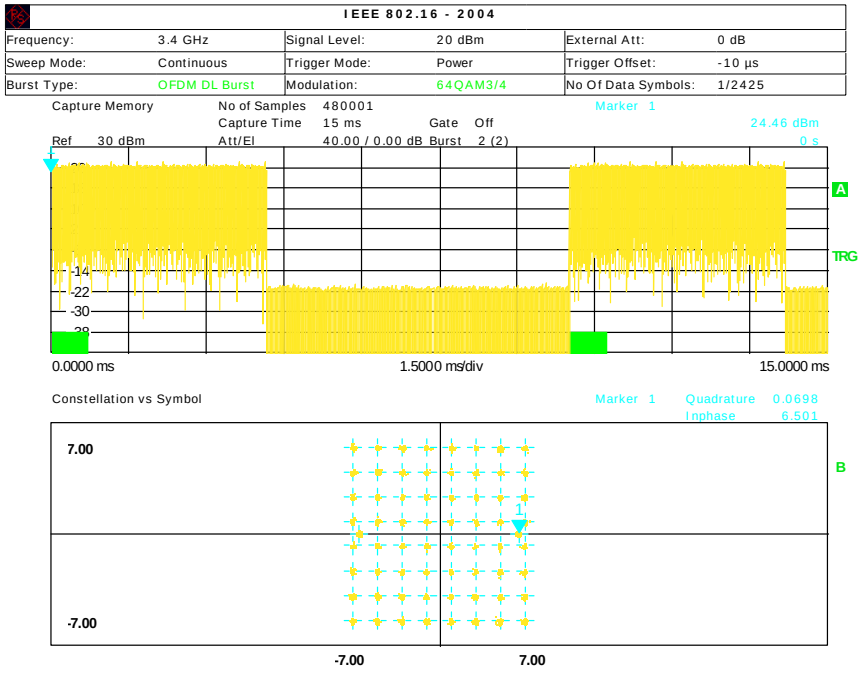


Figure 9 WiMax constellation Pavg=29.5 dBm at 3.4 GHz for 2.5% EVM for all carriers.

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.

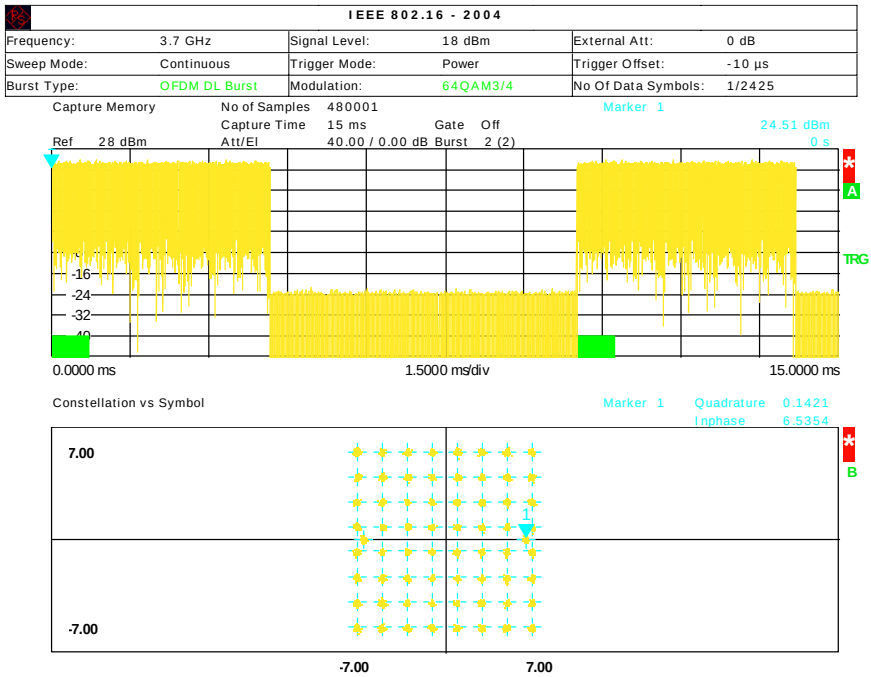


Figure 10 WiMax constellation Pavg= 27.5 dBm at 3.5 GHz. for 2.5% EVM.