

Features:

- 30 dB Gain
- 33 dBm P_{-1dB}
- OIP3 45 dBm
- 26.0 dBm Linear Pout @ 2.5% EVM (802.11 64QAM)
- Fully Matched Input and Output for Easy Cascade
- Internal Bias Tee
- Surface Mount Package with RoHS Compliance
- MTTF > 100 years @ 85°C ambient temperature

Applications:

- 802.16d/e WiMax
- 802.11a WLAN
- Point-To-Point Radio Applications

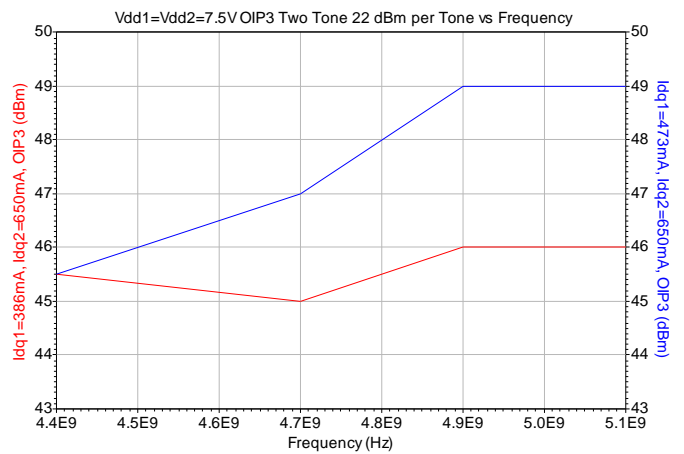
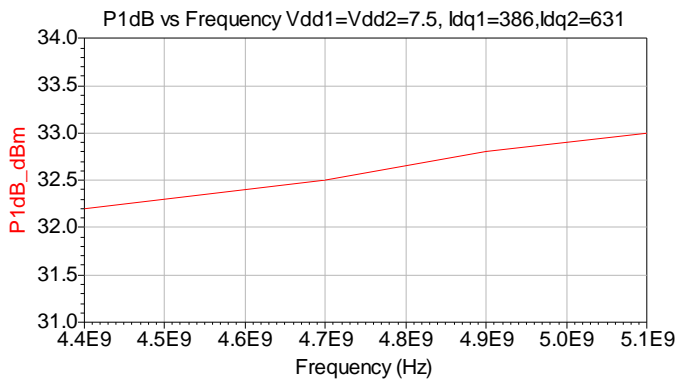
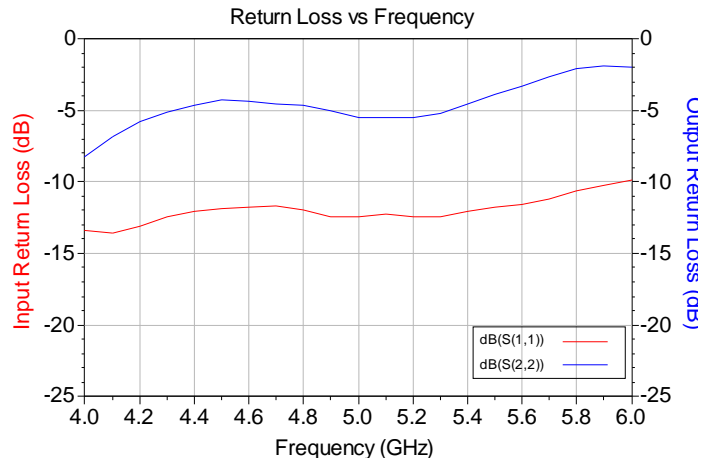
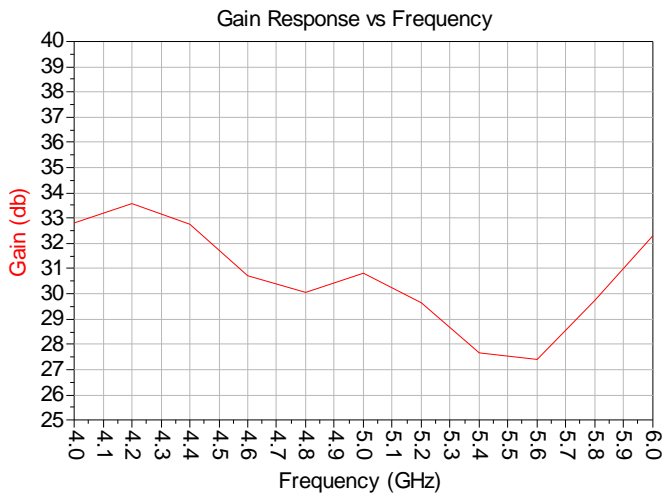
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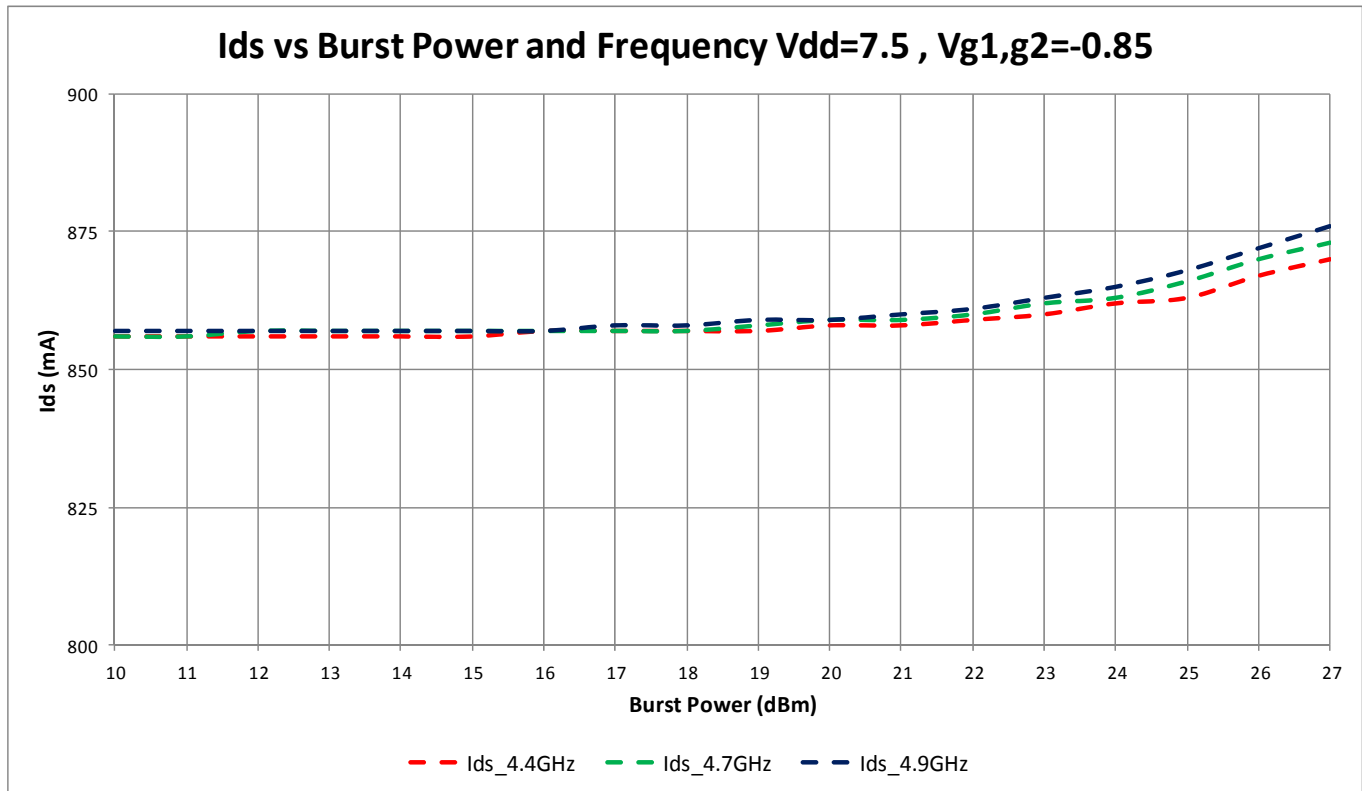
The WPS-445333H-02 is a power amplifier with the State-of-the-Art linear power-added-efficiency between 4.4 GHz and 5.9 GHz frequency band. Based on advanced robust HFET device technology, the linearity of this power amplifier at 26 dBm linear burst power with 2.0% EVM and ACPR better than -38 dBc. The modulation test pattern is 802.16x 64QAM. This linear power amplifier also has high gain. Ideal applications include the driver and the output power stage of WiMax and WLAN infrastructures and access points. It also can be used for PTP (Point-To-Point) radio applications for this band.

Typical RF Performance: $V_{dd1}=V_{dd2}=7.5V, V_{g1}=-1.9V, V_{g2}=-1.0, I_{dq1}=350mA, I_{dq2}=650mA$ $T_a=25\text{ }^\circ\text{C}, Z_0=50\text{ ohm}$

Parameter	Units	Typical Data
Frequency Range	MHz	4400-5900
Gain (Typ / Min)	dB	29 / 33
Gain Flatness (Typ / Max)	+/-dB	2.5 / 4.5
Input Return Loss	dB	10
Output Return Loss	dB	7
Output P1dB	dBm	33
OIP3	dBm	45
Pout @ 2.5% EVM	dBm	26.0
Operating Current Range	mA	1050
Thermal Resistance (Driver Stage)	°C /W	20
Thermal Resistance (Output Stage)	°C /W	16

Typical RF Performance: $V_{dd1}=7.5V, V_{dd2}=7.5V, V_{gs1}=-1.8V, V_{gs2}=-0.6V, I_{dq1}=386mA, I_{dq2}=630mA, Z_0=50\text{ ohm}, T_a=25\text{ }^\circ\text{C}$





Maximum Ratings: (Ta= 25 °C)*

SYMBOL	PARAMETERS	UNITS	ABSOLUTE MAXIMUM
Vdd1	Drain-Source Voltage Driver Stage	V	10
Vdd2	Drain-Source Voltage Output Stage	V	10
Vgs1	Gate-Source Voltage Driver Stage	V	-5
Vgs2	Gate-Source Voltage Output Stage	V	-5
Idq1	Drain Current Driver Stage	mA	500
Idq2	Drain Current Output Stage	mA	750
Ig1 and Ig2	Gate Current	mA	10
Ip	Pinch-Off Current	mA	10
Pdiss	DC Power Dissipation	W	9.0
Pin max	RF Input Power	dBm	+10
Tch	Channel Temperature	°C	175
Tstg	Storage Temperature	°C	-55 to 150

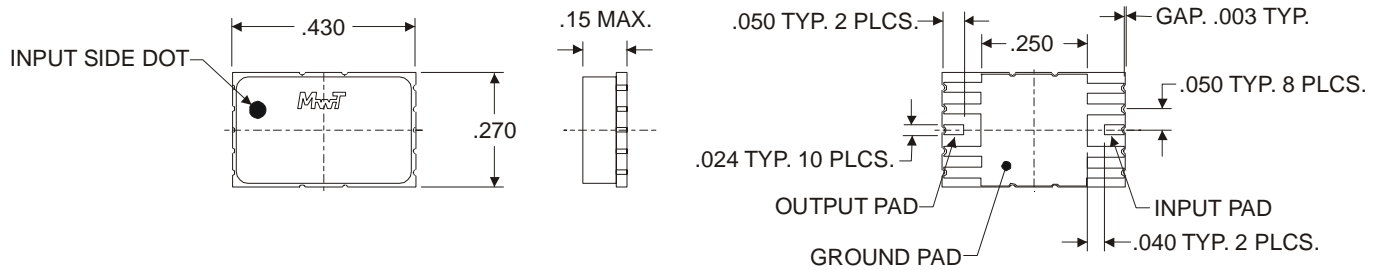
*Operation of this device above any one of these parameters may cause permanent damage.

Typical Scattering Parameters: $V_{dd1}=V_{dd2}=7.5V$, $V_{gs1}=-1.8V$, $V_{gs2}=-0.6V$, $I_{dq1}=386mA$, $I_{dq2}=630mA$, $Z_0=50\text{ ohm}$, $T_a=25\text{ }^\circ\text{C}$

S-parameters $V_{dd1}=V_{dd2}=7.5V$, $V_{g1}=-1.8V$, $V_{g2}=-0.6$, $I_{dq1}=386mA$, $I_{dq2}=630mA$

freq	magS11	AngS11	dBS21	AngS21	magS12	AngS12	magS22	AngS22
4.00 GHz	0.21	25.56	33.41	-19.38	9.46E-4	151.92	0.39	151.57
4.10 GHz	0.21	1.41	33.36	-54.39	1.06E-3	162.56	0.46	144.46
4.20 GHz	0.22	-21.73	33.95	-90.02	1.10E-3	164.58	0.52	136.11
4.30 GHz	0.24	-44.59	32.36	-101.87	1.07E-3	163.27	0.55	128.16
4.40 GHz	0.25	-65.95	33.11	-145.58	1.23E-3	-178.18	0.59	120.75
4.50 GHz	0.25	-84.98	31.98	-156.30	1.68E-3	-178.26	0.61	112.73
4.60 GHz	0.26	-100.82	31.20	179.69	2.03E-3	175.14	0.60	105.34
4.70 GHz	0.26	-116.65	31.72	149.61	2.00E-3	178.41	0.60	100.54
4.80 GHz	0.25	-132.90	30.66	140.22	2.25E-3	-176.43	0.59	95.48
4.90 GHz	0.24	-146.24	29.65	113.61	3.02E-3	176.82	0.56	91.21
5.00 GHz	0.24	-158.17	31.43	96.87	3.34E-3	173.84	0.53	90.64
5.10 GHz	0.24	-173.45	28.60	77.83	3.36E-3	159.09	0.53	90.52
5.20 GHz	0.24	171.92	30.36	58.34	3.66E-3	165.86	0.53	89.93
5.30 GHz	0.24	158.36	30.32	41.80	4.10E-3	160.26	0.55	90.62
5.40 GHz	0.25	142.64	28.62	20.21	4.18E-3	148.91	0.59	90.40
5.50 GHz	0.26	124.27	31.70	0.80	4.79E-3	148.06	0.64	88.12
5.60 GHz	0.26	106.28	28.54	-12.75	3.88E-3	139.38	0.69	84.54
5.70 GHz	0.28	89.38	31.76	-43.69	4.76E-3	133.72	0.74	79.96
5.80 GHz	0.29	70.90	30.80	-58.58	4.71E-3	129.59	0.79	73.18
5.90 GHz	0.31	50.72	30.07	-75.74	4.04E-3	119.31	0.81	64.13
6.00 GHz	0.32	29.76	33.43	-115.60	3.41E-3	115.37	0.80	57.67

Mechanical Information: *This Package is RoHS compliant*



Package Outline

Pin Designation (Top View)			
Pin Number	Signal Name	Pin Number	Signal Name
1 Dot Top Left	Vdd1	10	Vdd2
2	GND	9	GND
3	RF In	8	RF Out
4	GND	7	GND
5	Vgate1	6	Vgate2

All dimensions are in inches

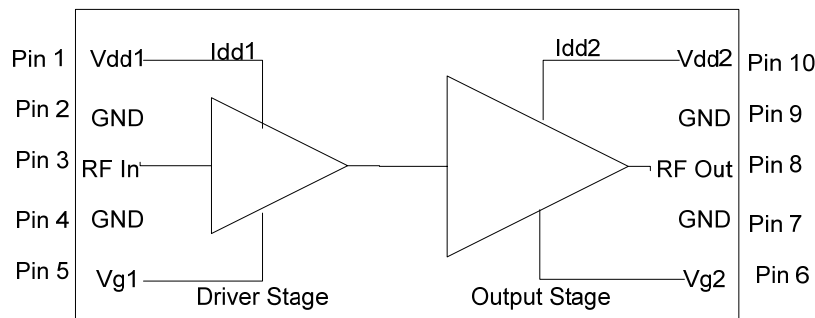


Figure 1 Functional Diagram

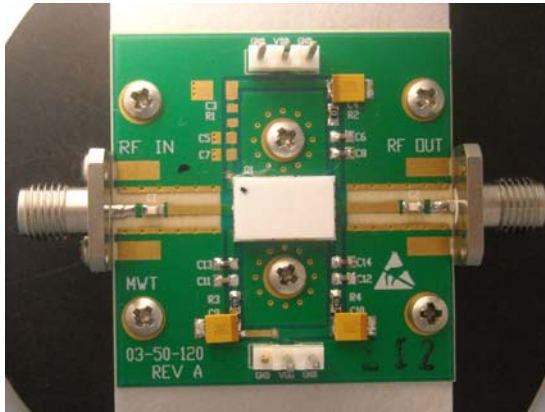


Figure 1 Evaluation board

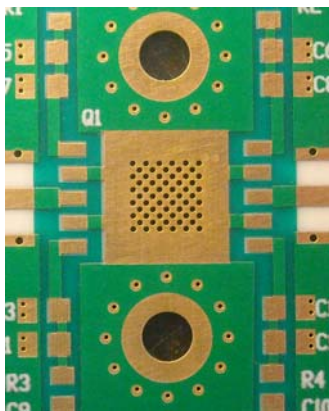


Figure 2 Hole Layout

Application Note

The evaluation board, shown in Figure 1, is fabricated with Rogers's 4003 material, 20 mil thick, 2 oz copper weight and includes four DC input connections and two RF lines. The WPS445133H-02 shown in the center of board is a 2 watt high gain and high linearity amplifier. The WPS445133H-02 is a 3 stage amplifier assembly die attach to the modified '02' package which includes four bias entries and two RF connections. The bias tees are built-in to the package. Small value bypassing capacitors are included with assembly. Proper bypassing is still required on the DC lines. The amplifier performance over a temperature range of approximately 85°C.

The PCB requires via holes with a diameter of 20 mils placed uniformly over the center pad for thermal relief and RF ground as shown in Figure 2. The via holes can be back filled with conductive epoxy for best thermal performance. The choice of capacitor bypassing near the amplifier should have a short circuit resonance at the frequency of operation. A small capacitor 3.9pf 0603 from AVX has a series resonance at 5.5 GHz and will make a good choice for the first bypass capacitor.

Followed up with larger value capacitors, 100pf or 1000pf and 2.2uF can be used to maintain voltage stability under peak current conditions. The DC ground via holes should be laid out to minimized inductive returns associated with ground loops. Use of stitch ground via holes can help control the return current and also maintain ground continuity between the top and bottom ground layers. Two mounting holes are used near the PA assembly to secure the board to the chassis; this also minimizes ground current loops and improves thermal conductivity in the absence of sweat soldering the board to the chassis. The internal bias tees inside the PA are quarter-wave stubs at the gate and drain inputs. A 56 ohm resistor is inserted in series to the gate increasing the effective impedance seen from the Vgs power supply and reducing the risk of video oscillations. DC blocks are included with assembly;

two zero ohm resistors are used at the input and output 50 ohms traces. The WPS445133H-02 has a noise figure less than 9.0 dB. A plot of noise figure versus frequency at Idq is shown in Figure 3. The amplifier behaves like a class 'A' amplifier. At small signal levels the amplifier operates at Idq. A plot of P1dB versus frequency shown in Figure 4 is plotted from 4.4 to 5.1 GHz. The drain current Idd increases to 1050 mA to 1100 mA from Idq = 1050 mA. The gain versus temperature has a negative slope of -0.07 dB/°C.

The two tone linearity shown in Figure 4 is swept across a power range from 15 to 25 dBm per tone at the output of the amplifier from 4.4 to 4.9 GHz. At 22 dBm per tone the IMD3 is 50 dBc and OIP3 is 47 dBm. The Burst power shown in Figure 5 is measured across the frequency range from 4.4 to 4.9 GHz at error vector magnitudes equal to 2% and 2.5%. The modulation is 802.16x and each frame cycle has a 10 msec duration and runs continuously. Equalization is enabled when measuring EVM performance. The WPS amplifier bias condition is Vdd=8V and the gate voltage is -0.85V and voltage power control 4.5V for an Idq=850 mA. A diagram of test setup is shown in Figure 7 and includes the frame information about the test pattern.

The gain stability over temperature is shown in Figure 6 and 7. The temperature range was taken at 10 C to 85 C deg and varies 3 dB at a fix frequency.

The EVM versus burst power, shown in Figures 8 and 9 is better than 25.5 dBm for an EVM =2% over temperature and is plotted at two spot frequencies points 4.4 GHz and 4.9 GHz from 10C to 85C degrees.

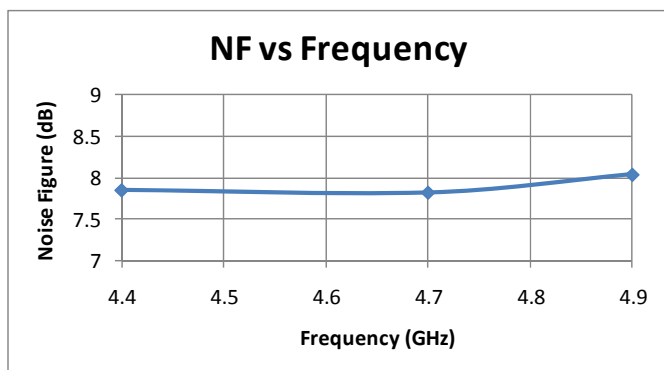


Figure 2 Noise Figure

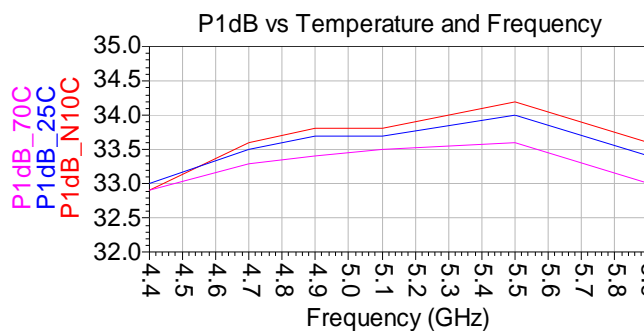


Figure 3 P1dB and Ids

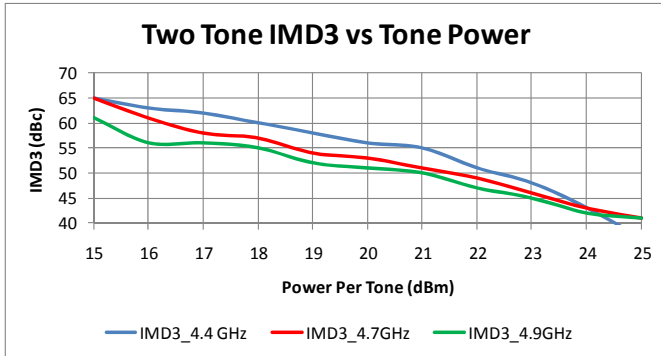


Figure 4 Two Tone

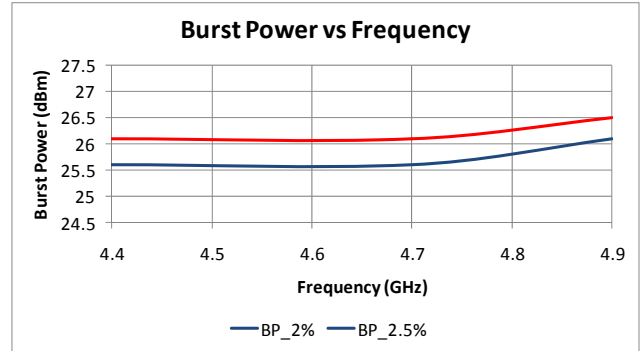


Figure 5 Burst Power

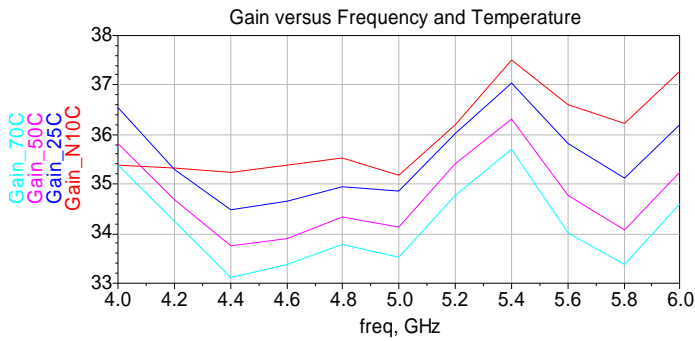


Figure 6 Gain vs Temperature

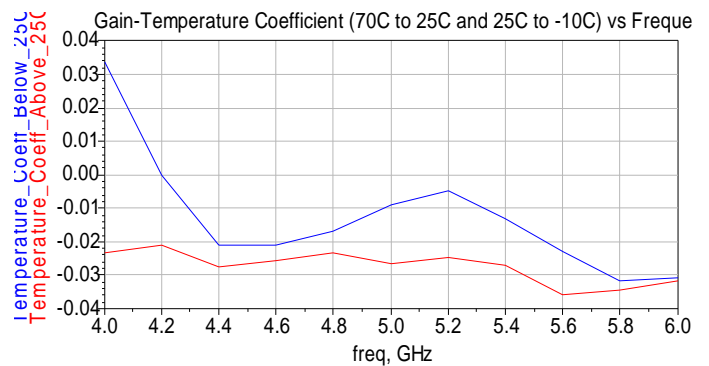


Figure 7 Gain-Temperature Coefficient

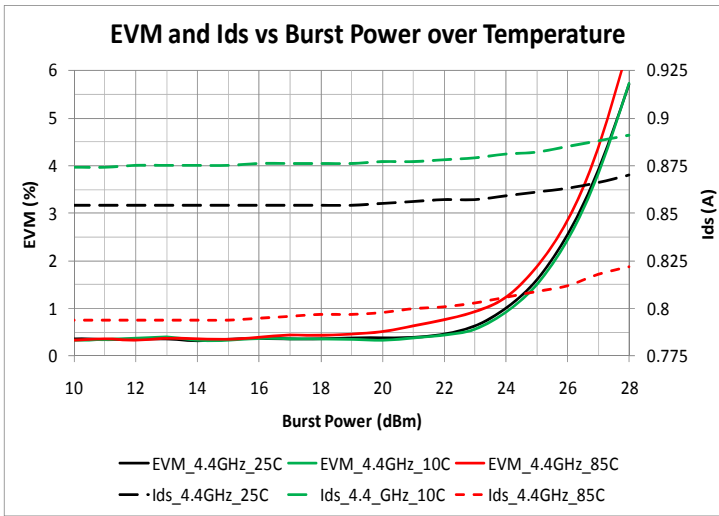


Figure 8 EVM vs Burst Power and Temperature

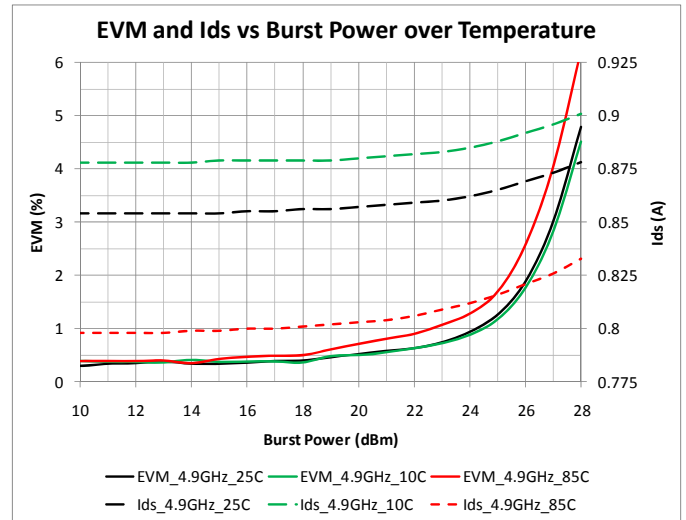


Figure 9 EVM vs Burst Power and Temperature



WPS-445333H-02

**4.4 – 5.3 GHz 2W High Efficiency
Linear Power Amplifier
June 2011**
