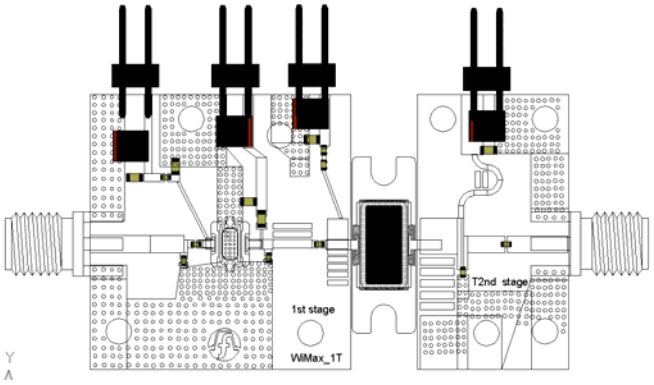
- **PERFORMANCE (3.5 GHz)**
  (802.16-2004 WiMAX Modulation)
  - 30 dBm Typical Output Power, < 2.5% EVM
  - 14 dB Typical Small-Signal Gain
  - Class B Efficiency 14% (8V / 720 mA I_{DQ})
  - > 48 dBm 3rd Order Intercept Point
  - Low total components count



DEMO BOARD SIZE: 1 x 2 in. (2.54 x 5.08 cm.)
CONNECTORIZED VERSION SHOWN

- **DESCRIPTION AND APPLICATIONS**

The FRD3500X230 is a 2-stage, connectorized Reference Design that delivers a typical linear power of 30 dBm with the 802.16-2004 modulation, while maintaining less than 2.5% EVM. The design features a FPD4000AS driver stage, followed by a FPD10000AF power output stage. Both stages are dual-biased to allow a range of bias conditions on each stage, allowing operation from Class B to Class A. Board layout and components list are included.

- **ELECTRICAL SPECIFICATIONS AT 22°C**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Operating Bandwidth	BW	Class A / AB / B		200		MHz
Small Signal Gain	SSG	Class A: V_{DS} = 10V; I_{DQ} = 1.6 A		14		dB
Gain Flatness	ΔG	Class A: V_{DS} = 10V; I_{DQ} = 1.6 A		± 1.5		dB
Center Frequency (adjustable)	f_{CEN}	Nominal bias conditions	3.4	3.5	3.6	
Power at 1dB Gain Compression Class A - CW Single Tone	P_{1dB}	V_{DS} = 10V; I_{DQ} = 1.6 A		37.5		dBm
Power Gain at dB Gain Compression Class A - CW Single Tone	G_{1dB}	V_{DS} = 10V; I_{DQ} = 1.6 A		13		dB
Channel Power with 802.16-2004 2.5% max. EVM	P_{CH}	Class AB Mode V_{DS} = 10 V; I_{DQ} = 1.25 A	31.0	31.5		dBm
Channel Power with 802.16-2004 2.5% max. EVM	P_{CH}	Class B Mode V_{DS} = 8 V; I_{DQ} = 730 mA typ.	29	30		dBm
Power-Added Efficiency 802.16-2004 modulation	Eff	Class AB Mode Class B Mode		10 14		%
Operating Current at 30 dBm P_{CH}	I_{OP}	V_{DD} = 8.0 V; V_{GG} = -1.20 / -0.89 V		0.9		A
Nominal Drain Supply	V_{DD}	All operating conditions		8		V
Nominal Gate Voltages For Class B Operation	V_{GG}	$V_{GG}1$ (1st Stage) $V_{GG}2$ (2nd Stage)		-1.2 -0.89		V V
Total DC Power (operating)	P_{TOT}	Class B at P_{CH} = 30 dBm		7.0		W

- **RECOMMENDED OPERATING BIAS CONDITIONS**

  Drain-Source Voltage: From 8V to 10V
  Quiescent Current: From 700mA (Class B) to 1.6A (Class A)

- **ABSOLUTE MAXIMUM RATINGS[1]**

Parameter	Symbol	Test Conditions	Min	Max	Units
Drain Supply Voltage	V_{DD}	$-3V < V_{GS} < +0V$		12	V
Gate Supply Voltage	V_{GG}	$0V < V_{DD} < +8V$		-3	V
Operating Current	I_{OP}	For $V_{DS} > 2V$		1.8	A
Gate Current	I_G	Forward or reverse current		+60/-15	mA
RF Input Power[2]	P_{IN}	Under any acceptable bias state		500	mW
Channel Operating Temperature	T_{CH}	Under any acceptable bias state		175	ºC
Storage Temperature	T_{STG}	Non-Operating Storage	-40	150	ºC
Total Power Dissipation	P_{TOT}	Ambient temperature to 85ºC		12	W
Gain Compression	Comp.	Under any bias conditions		5	dB
Simultaneous Combination of Limits[3]		2 or more Max. Limits		80	%

[1] $T_{Ambient}$ = 22°C unless otherwise noted [2] Max. RF Input Limit must be further limited if input VSWR > 2.5:1
[3] Users should avoid exceeding 80% of 2 or more Limits simultaneously

Notes:

- Operating conditions that exceed the Absolute Maximum Ratings could result in permanent damage to the devices.

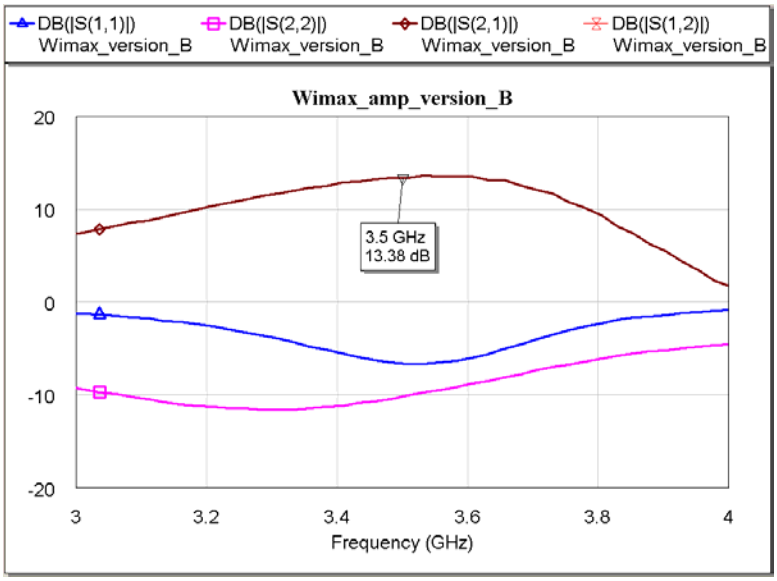
- **HANDLING PRECAUTIONS**

  To avoid damage to the devices care should be exercised during handling. Proper Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing. This product has be tested to Class 1A (> 250V but < 500V) using JESD22 A114, Human Body Model, and to Class A, (< 200V) using JESD22 A115, Machine Model..

- **APPLICATIONS NOTES & DESIGN DATA**

  Recommendations on matching circuits is available from your local Filtronic Sales Representative or directly from the factory. **User must ensure that proper bias sequencing is observed: Gate bias must be applied before Drain bias, and during power-down the Drain bias must be removed first.**

- TYPICAL SMALL-SIGNAL PERFORMANCE:



- TYPICAL CLASS AB / B CW PERFORMANCE:

Table 2 Linearity under Class AB bias condition

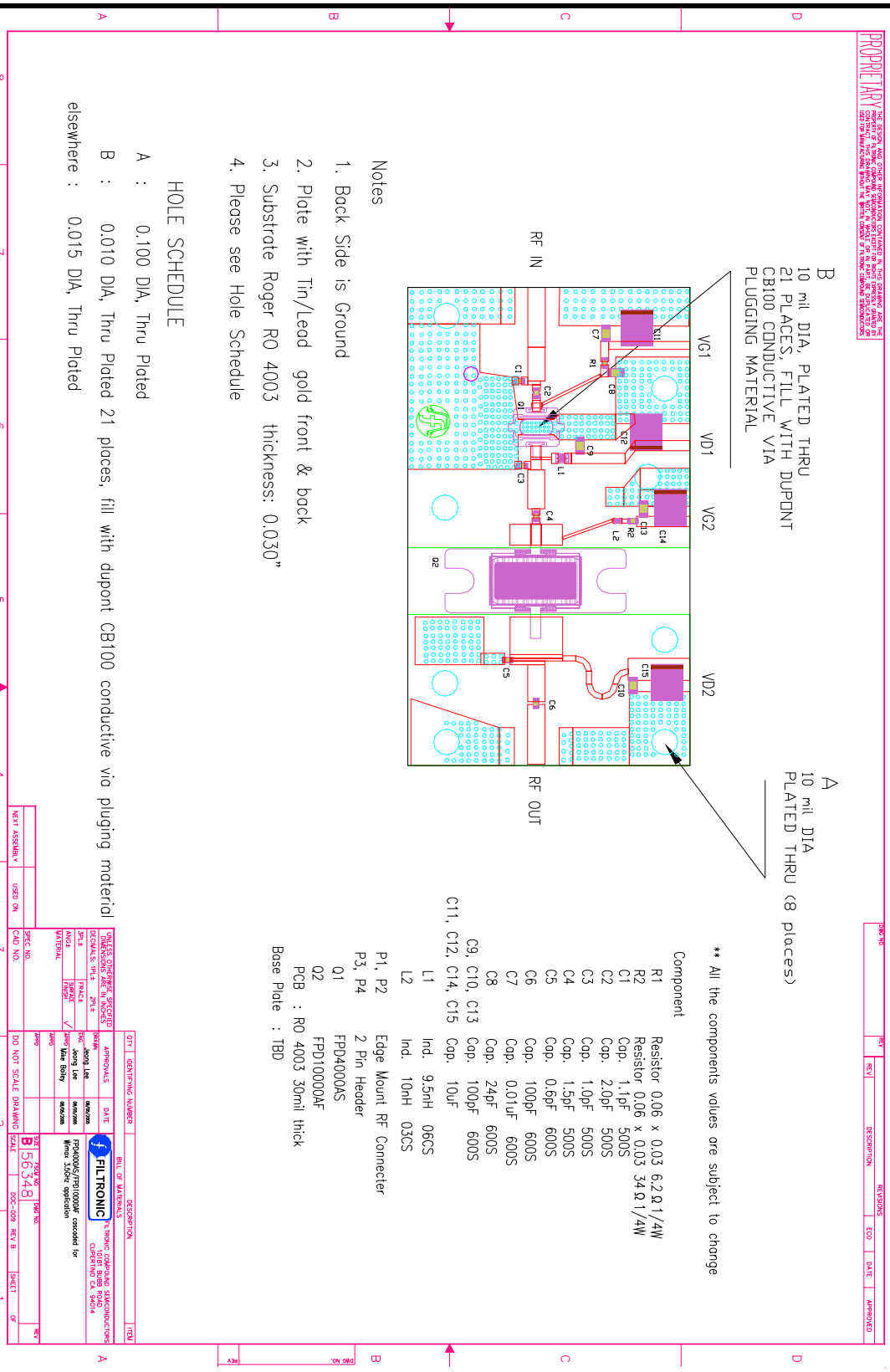
input total power	VDD1	VGG1	Ids1	VDD2	VGG2	Ids2	IM3	IM5	gain	Pout,total	Pdc
no input power	7.00	-1.24	0.09	8.50	-0.89	0.63					
17dbm	7.00	-1.24	0.26	8.50	-0.89	0.70	-41.40	-46.00	12.00	29.00	7.77
18dbm	7.00	-1.24	0.29	8.50	-0.89	0.72	-42.50	-46.00	12.00	30.00	8.15
19dbm	7.00	-1.24	0.32	8.50	-0.89	0.74	-43.50	-47.00	12.00	31.00	8.53
20dbm	7.00	-1.24	0.35	8.50	-0.89	0.80	-43.00	-43.00	12.00	32.00	9.25

TYPICAL CLASS A CW PERFORMANCE:

Table 1 Power Sweep under Class A bias condition

Power Sweep:

Pin (dBm)	Pout (dBm)	Gain (dB)	Id (mA)	Vds	Ig (uA)	Eff.	PAE	Comp Point
11	25.4	14.4	1660.00	10.00		2.1%	2.0%	0.00
12	26.3	14.3	1660.00	10.00		2.6%	2.5%	0.02
13	27.4	14.4	1660.00	10.00		3.3%	3.2%	0.00
14	28.3	14.3	1660.00	10.00		4.1%	3.9%	0.03
15	29.3	14.3	1660.00	10.00		5.2%	5.0%	0.01
16	30.3	14.3	1670.00	10.00		6.5%	6.2%	0.01
17	31.3	14.3	1670.00	10.00		8.2%	7.9%	0.01
18	32.3	14.3	1680.00	10.00		10.2%	9.8%	0.03
19	33.3	14.3	1700.00	10.00		12.5%	12.1%	0.07
20	34.2	14.2	1810.00	10.00		14.4%	13.8%	0.20
21	35.2	14.2	1900.00	10.00		17.4%	16.7%	0.16
22	36.0	14.0	1990.00	10.00		20.1%	19.3%	0.32
23	36.8	13.8	1990.00	10.00		23.9%	22.9%	0.57
24	37.4	13.4	2100.00	10.00		26.4%	25.2%	0.91



All information and specifications are subject to change without notice.