



**THE DATASHEET OF  
AFT18S230-12NR3**



# RF Power LDMOS Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

This 50 W RF power LDMOS transistor is designed for cellular base station applications covering the frequency range of 1805 to 1880 MHz.

### 1800 MHz

- Typical Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Vdc,  $I_{DQ} = 1400$  mA,  $P_{out} = 50$  W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

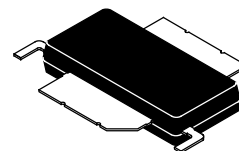
Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	Output PAR (dB)	ACPR (dBc)	IRL (dB)
1805 MHz	17.1	33.3	7.1	-33.6	-14
1840 MHz	17.5	33.3	7.1	-33.6	-16
1880 MHz	17.6	33.8	6.9	-33.7	-11

### Features

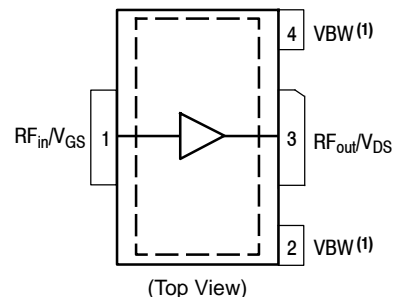
- High thermal conductivity packaging technology for reduced thermal resistance
- Greater negative gate-source voltage range for improved Class C operation
- Designed for digital predistortion error correction systems
- Optimized for Doherty applications

## AFT18S230-12NR3

**1805-1880 MHz, 50 W AVG., 28 V AIRFAST RF POWER LDMOS TRANSISTOR**



**OM-780-2L2L PLASTIC**



Note: Exposed backside of the package is the source terminal for the transistor.

**Figure 1. Pin Connections**

- Device cannot operate with the  $V_{DD}$  current supplied through pin 2 and pin 4.

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +65	Vdc
Gate-Source Voltage	$V_{GS}$	-6.0, +10	Vdc
Operating Voltage	$V_{DD}$	32, +0	Vdc
Storage Temperature Range	$T_{stg}$	-65 to +150	°C
Case Operating Temperature Range	$T_C$	-40 to +150	°C
Operating Junction Temperature Range (1,2)	$T_J$	-40 to +225	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 78°C, 50 W CW, 28 Vdc, $I_{DQ} = 1400$ mA, 1842.5 MHz	$R_{\theta JC}$	0.27	°C/W

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	2
Machine Model (per EIA/JESD22-A115)	B
Charge Device Model (per JESD22-C101)	IV

**Table 4. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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**Off Characteristics**

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65$ Vdc, $V_{GS} = 0$ Vdc)	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28$ Vdc, $V_{GS} = 0$ Vdc)	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5$ Vdc, $V_{DS} = 0$ Vdc)	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

**On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10$ Vdc, $I_D = 291$ $\mu\text{Adc}$ )	$V_{GS(th)}$	1.0	2.0	2.5	Vdc
Gate Quiescent Voltage ( $V_{DD} = 28$ Vdc, $I_D = 1400$ mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2.3	2.8	3.3	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10$ Vdc, $I_D = 2.9$ Adc)	$V_{DS(on)}$	0.1	0.24	0.3	Vdc

**Functional Tests (4)** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28$  Vdc,  $I_{DQ} = 1400$  mA,  $P_{out} = 50$  W Avg.,  $f = 1880$  MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5$  MHz Offset.

Power Gain	$G_{ps}$	16.3	17.6	19.3	dB
Drain Efficiency	$\eta_D$	29.0	33.8	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	6.0	6.9	—	dB
Adjacent Channel Power Ratio	ACPR	—	-33.7	-30.0	dBc
Input Return Loss	IRL	—	-11	-6	dB

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.freescale.com/rf/calculators>.
3. Refer to [AN1955](#), *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf> and search for AN1955.
4. Part internally matched both on input and output.

(continued)

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Load Mismatch</b> (In Freescale Test Fixture, 50 ohm system) $I_{DQ} = 1400\text{ mA}$ , $f = 1840\text{ MHz}$					
VSWR 10:1 at 32 Vdc, 309 W CW Output Power (3 dB Input Overdrive from 204 W CW Rated Power)	No Device Degradation				
<b>Typical Performance</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ} = 1400\text{ mA}$ , 1805–1880 MHz Bandwidth					
$P_{out}$ @ 1 dB Compression Point, CW	P1dB	—	204	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 1805–1880 MHz bandwidth)	$\Phi$	—	-17	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW <sub>res</sub>	—	70	—	MHz
Gain Flatness in 75 MHz Bandwidth @ $P_{out} = 50\text{ W Avg.}$	$G_F$	—	0.4	—	dB
Gain Variation over Temperature (-30°C to +85°C)	$\Delta G$	—	0.009	—	dB/°C
Output Power Variation over Temperature (-30°C to +85°C)	$\Delta P1dB$	—	0.006	—	dB/°C

**Table 6. Ordering Information**

Device	Tape and Reel Information	Package
AFT18S230-12NR3	R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel	OM-780-2L2L

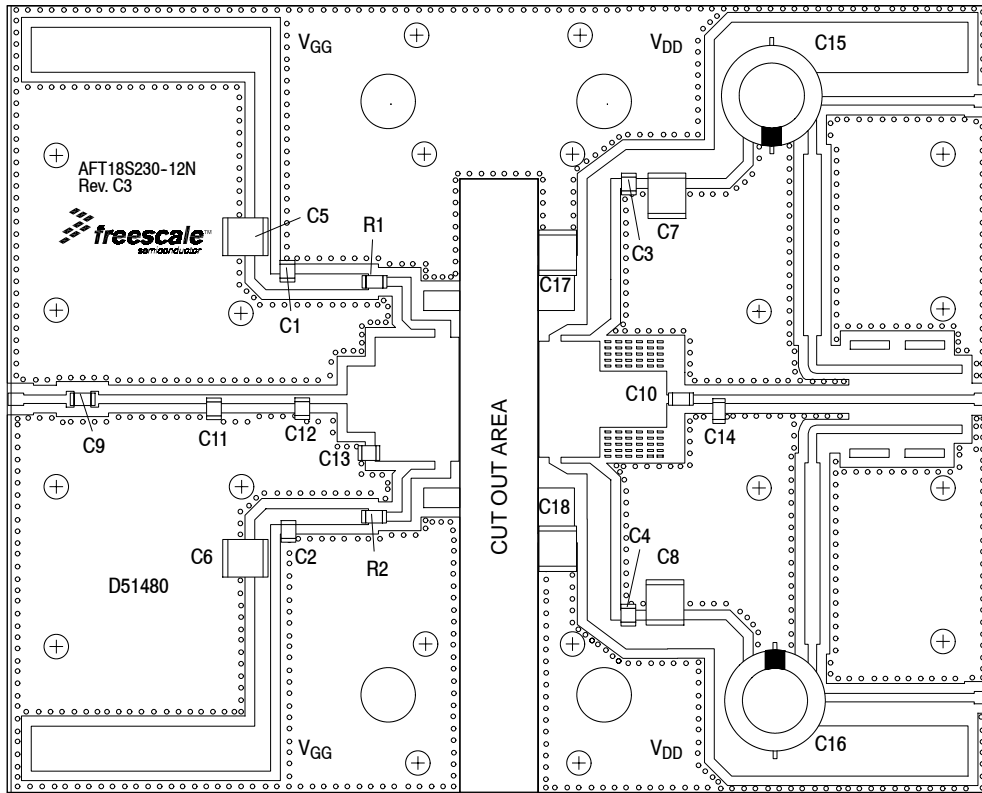
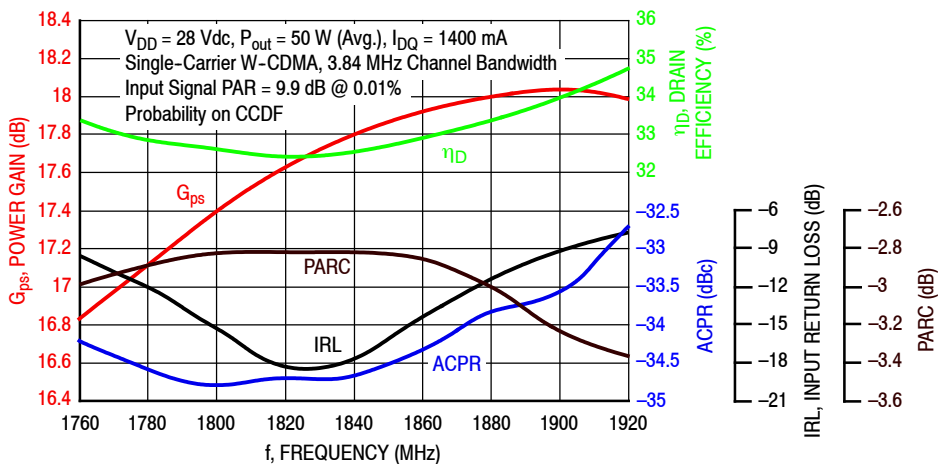


Figure 2. AFT18S230-12NR3 Test Circuit Component Layout

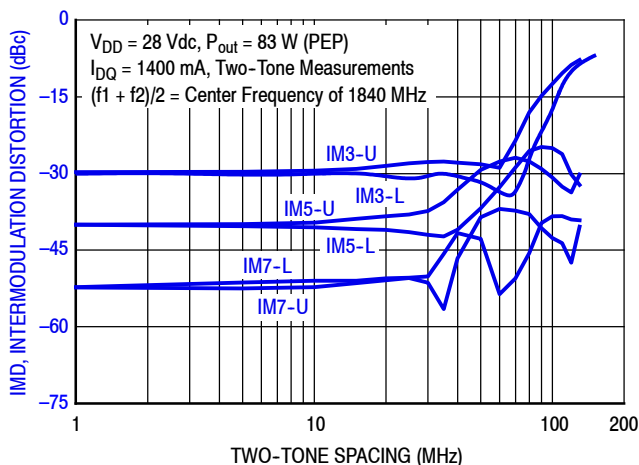
Table 7. AFT18S230-12NR3 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C9	12 pF Chip Capacitors	ATC100B120FW1500XT	ATC
C5, C6, C7, C8, C17, C18	10 $\mu$ F Chip Capacitors	C5750X7S2A106M230KB	TDK
C10	6.8 pF Chip Capacitor	ATC100B6R8BW1500XT	ATC
C11	1.1 pF Chip Capacitor	ATC100B1R1BW1500XT	ATC
C12	1.0 pF Chip Capacitor	ATC100B1R0BW1500XT	ATC
C13	0.4 pF Chip Capacitor	ATC100B0R4BW1500XT	ATC
C14	0.9 pF Chip Capacitor	ATC100B0R9BW1500XT	ATC
C15, C16	470 $\mu$ F, 50 V Electrolytic Capacitors	477CKS050M	Illinois Capacitor
R1, R2	4.02 $\Omega$ , 1/4 W Chip Resistors	CRCW12064R02FKEA	Vishay
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	D51480	MTL

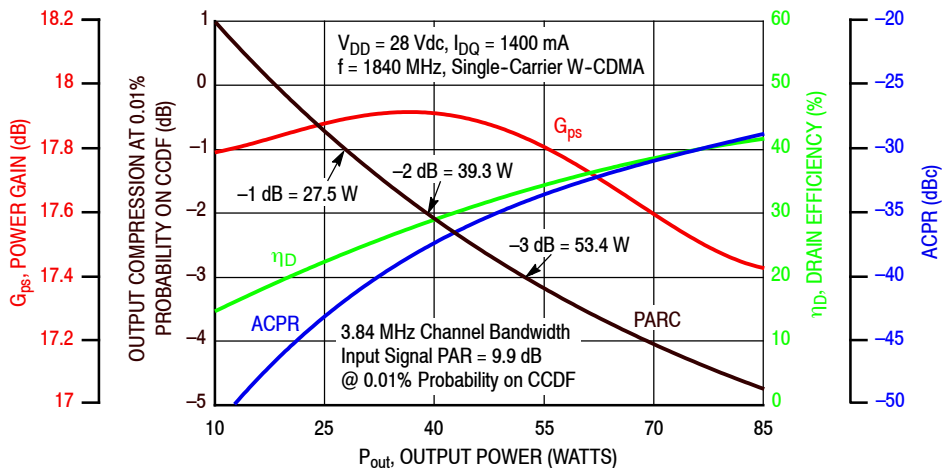
### TYPICAL CHARACTERISTICS



**Figure 3. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 50$  Watts Avg.**

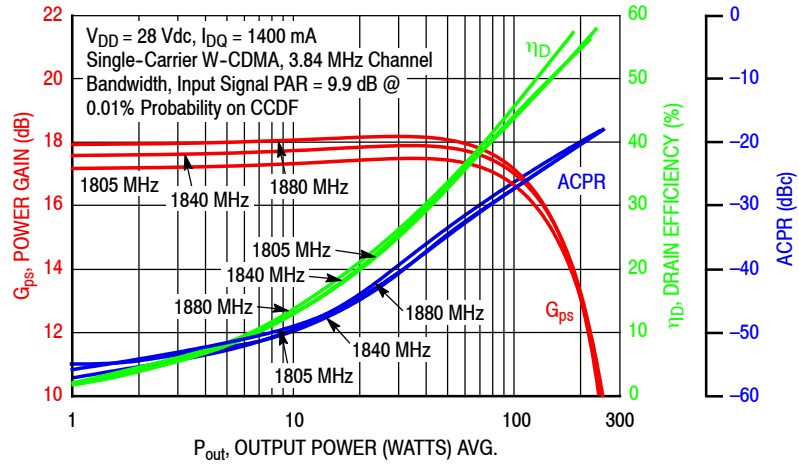


**Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing**

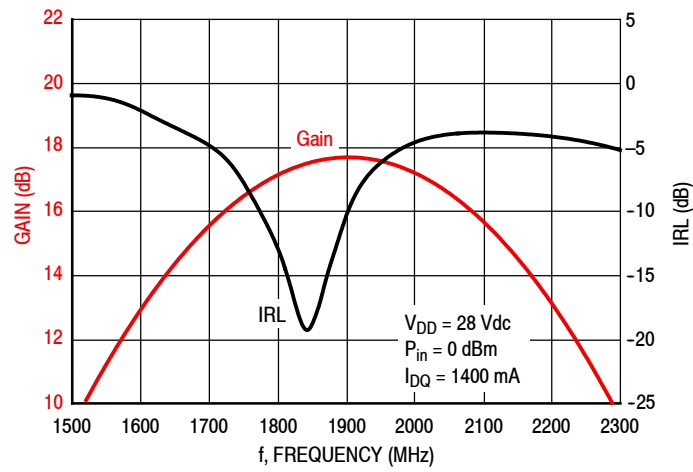


**Figure 5. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**

### TYPICAL CHARACTERISTICS



**Figure 6. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power**



**Figure 7. Broadband Frequency Response**

**Table 8. Load Pull Performance — Maximum Power Tuning**
 $V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQA} = 1400 \text{ mA}$ , Pulsed CW,  $10 \mu\text{sec(ON)}$ , 10% Duty Cycle

f (MHz)	$Z_{\text{source}} (\Omega)$	$Z_{\text{in}} (\Omega)$	Max Output Power					
			P1dB					
			$Z_{\text{load}}^{(1)} (\Omega)$	Gain (dB)	(dBm)	(W)	$\eta_D$ (%)	AM/PM (°)
1805	$1.17 - j4.25$	$1.10 + j3.92$	$1.10 - j3.55$	16.8	54.0	250	53.4	-12
1840	$1.69 - j4.78$	$1.38 + j4.25$	$1.06 - j3.65$	16.7	54.0	253	53.5	-13
1880	$3.16 - j5.35$	$2.16 + j4.57$	$1.09 - j3.92$	16.5	54.0	250	52.4	-13

f (MHz)	$Z_{\text{source}} (\Omega)$	$Z_{\text{in}} (\Omega)$	Max Output Power					
			P3dB					
			$Z_{\text{load}}^{(2)} (\Omega)$	Gain (dB)	(dBm)	(W)	$\eta_D$ (%)	AM/PM (°)
1805	$1.17 - j4.25$	$1.07 + j4.03$	$1.10 - j3.61$	14.7	54.7	298	55.8	-18
1840	$1.69 - j4.78$	$1.39 + j4.39$	$1.13 - j3.80$	14.6	54.8	299	56.1	-18
1880	$3.16 - j5.35$	$2.25 + j4.78$	$1.16 - j4.07$	14.3	54.7	296	54.3	-18

(1) Load impedance for optimum P1dB power.

(2) Load impedance for optimum P3dB power.

 $Z_{\text{source}}$  = Measured impedance presented to the input of the device at the package reference plane.

 $Z_{\text{in}}$  = Impedance as measured from gate contact to ground.

 $Z_{\text{load}}$  = Measured impedance presented to the output of the device at the package reference plane.

**Table 9. Load Pull Performance — Maximum Drain Efficiency Tuning**
 $V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQA} = 1400 \text{ mA}$ , Pulsed CW,  $10 \mu\text{sec(ON)}$ , 10% Duty Cycle

f (MHz)	$Z_{\text{source}} (\Omega)$	$Z_{\text{in}} (\Omega)$	Max Drain Efficiency					
			P1dB					
			$Z_{\text{load}}^{(1)} (\Omega)$	Gain (dB)	(dBm)	(W)	$\eta_D$ (%)	AM/PM (°)
1805	$1.17 - j4.25$	$1.12 + j4.11$	$1.95 - j2.42$	19.5	52.3	171	64.8	-19
1840	$1.69 - j4.78$	$1.48 + j4.43$	$1.88 - j2.54$	19.3	52.2	168	64.6	-20
1880	$3.16 - j5.35$	$2.41 + j4.75$	$1.77 - j2.67$	19.1	52.2	164	64.1	-20

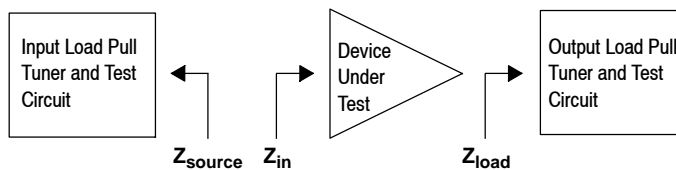
f (MHz)	$Z_{\text{source}} (\Omega)$	$Z_{\text{in}} (\Omega)$	Max Drain Efficiency					
			P3dB					
			$Z_{\text{load}}^{(2)} (\Omega)$	Gain (dB)	(dBm)	(W)	$\eta_D$ (%)	AM/PM (°)
1805	$1.17 - j4.25$	$1.08 + j4.14$	$1.80 - j2.54$	17.3	53.2	211	67.0	-26
1840	$1.69 - j4.78$	$1.42 + j4.52$	$1.69 - j2.54$	17.3	52.9	197	66.5	-28
1880	$3.16 - j5.35$	$2.40 + j4.89$	$1.73 - j2.72$	17.1	52.9	193	65.4	-26

(1) Load impedance for optimum P1dB efficiency.

(2) Load impedance for optimum P3dB efficiency.

 $Z_{\text{source}}$  = Measured impedance presented to the input of the device at the package reference plane.

 $Z_{\text{in}}$  = Impedance as measured from gate contact to ground.

 $Z_{\text{load}}$  = Measured impedance presented to the output of the device at the package reference plane.


### P1dB – TYPICAL LOAD PULL CONTOURS — 1840 MHz

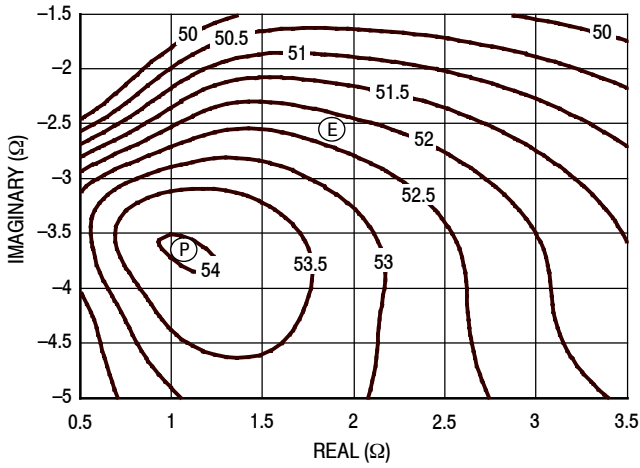


Figure 8. P1dB Load Pull Output Power Contours (dBm)

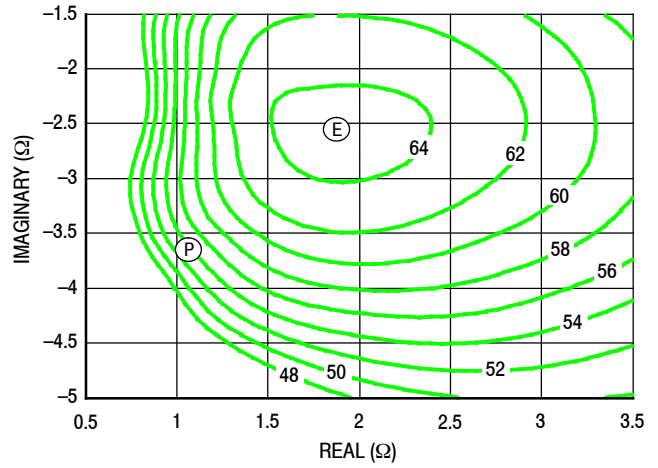


Figure 9. P1dB Load Pull Efficiency Contours (%)

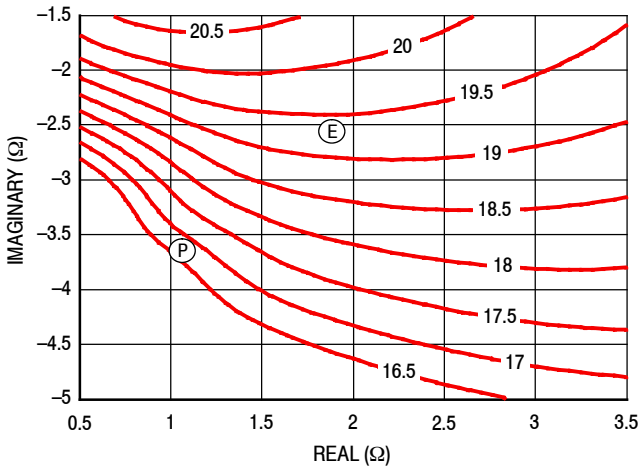


Figure 10. P1dB Load Pull Gain Contours (dB)

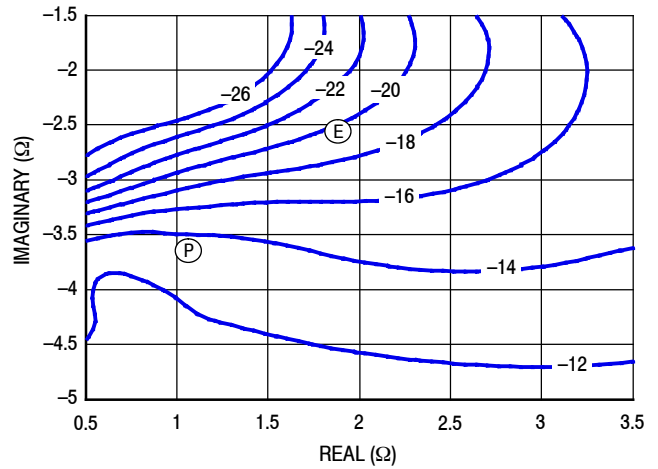


Figure 11. P1dB Load Pull AM/PM Contours (°)

**NOTE:** (P) = Maximum Output Power  
(E) = Maximum Drain Efficiency

- Gain
- Drain Efficiency
- Linearity
- Output Power

### P3dB – TYPICAL LOAD PULL CONTOURS — 1840 MHz

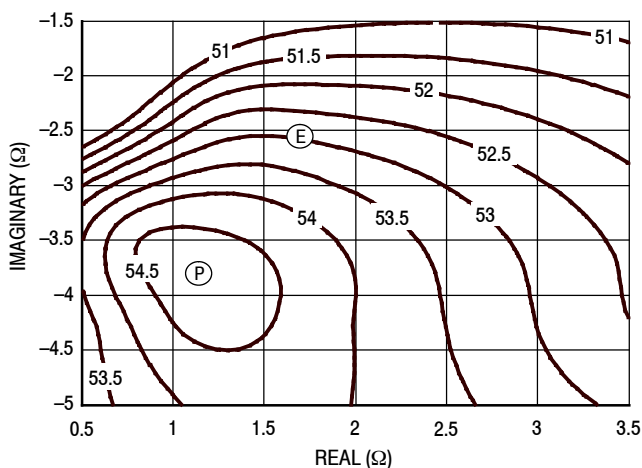


Figure 12. P3dB Load Pull Output Power Contours (dBm)

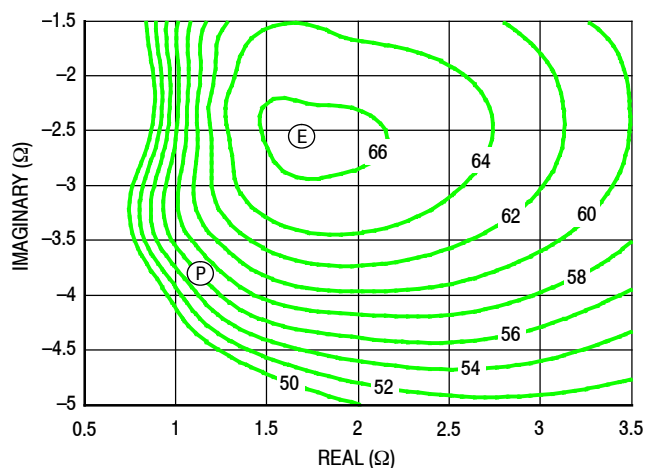


Figure 13. P3dB Load Pull Efficiency Contours (%)

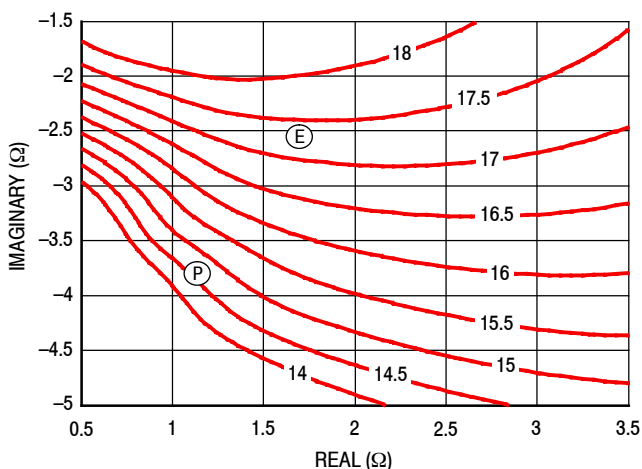


Figure 14. P3dB Load Pull Gain Contours (dB)

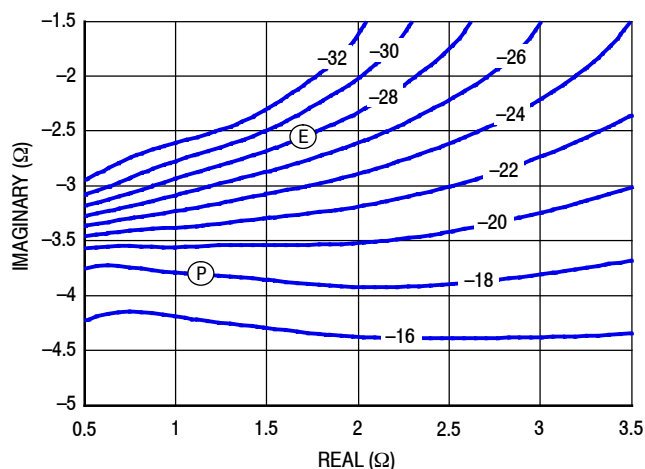
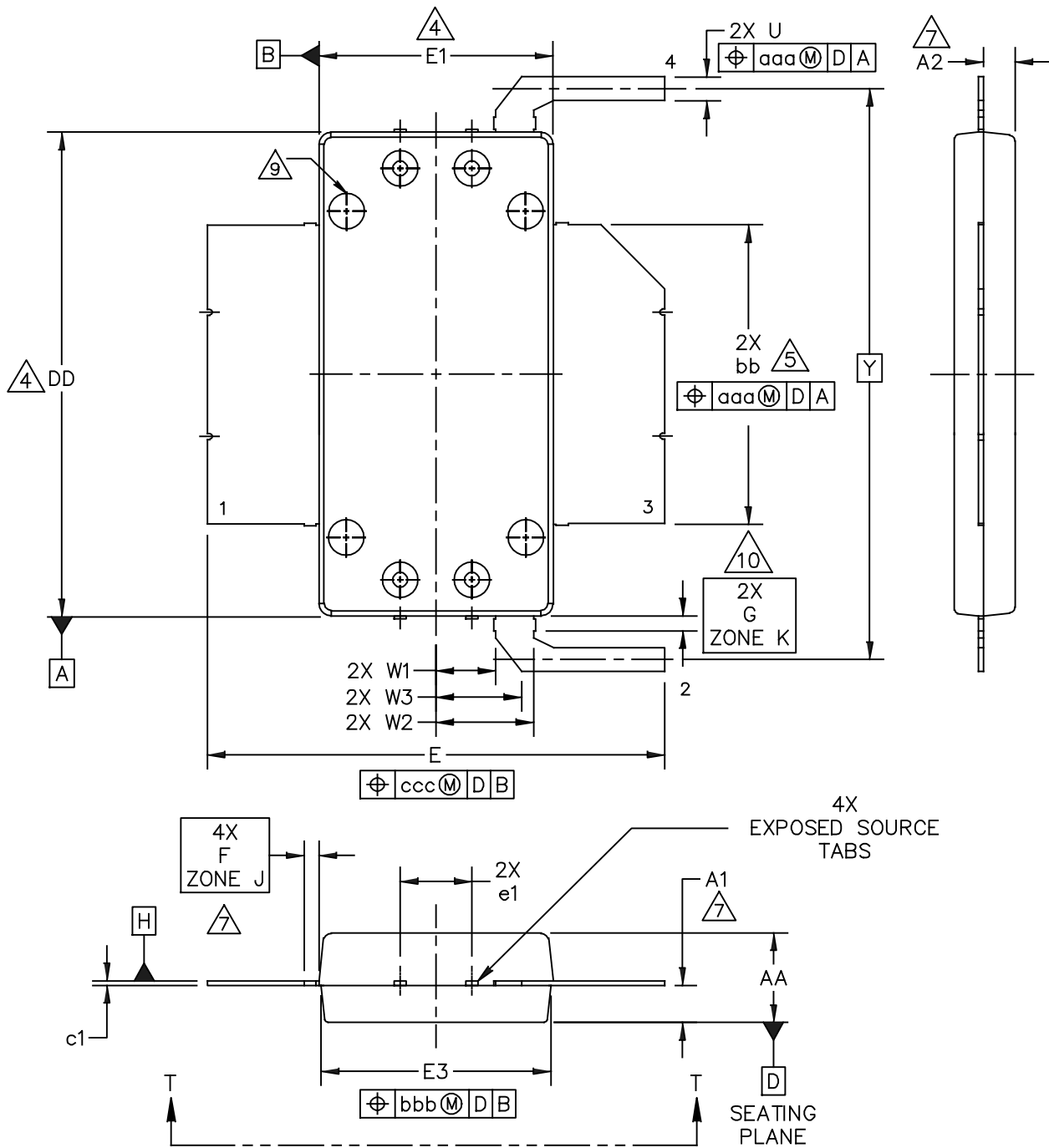


Figure 15. P3dB Load Pull AM/PM Contours (°)

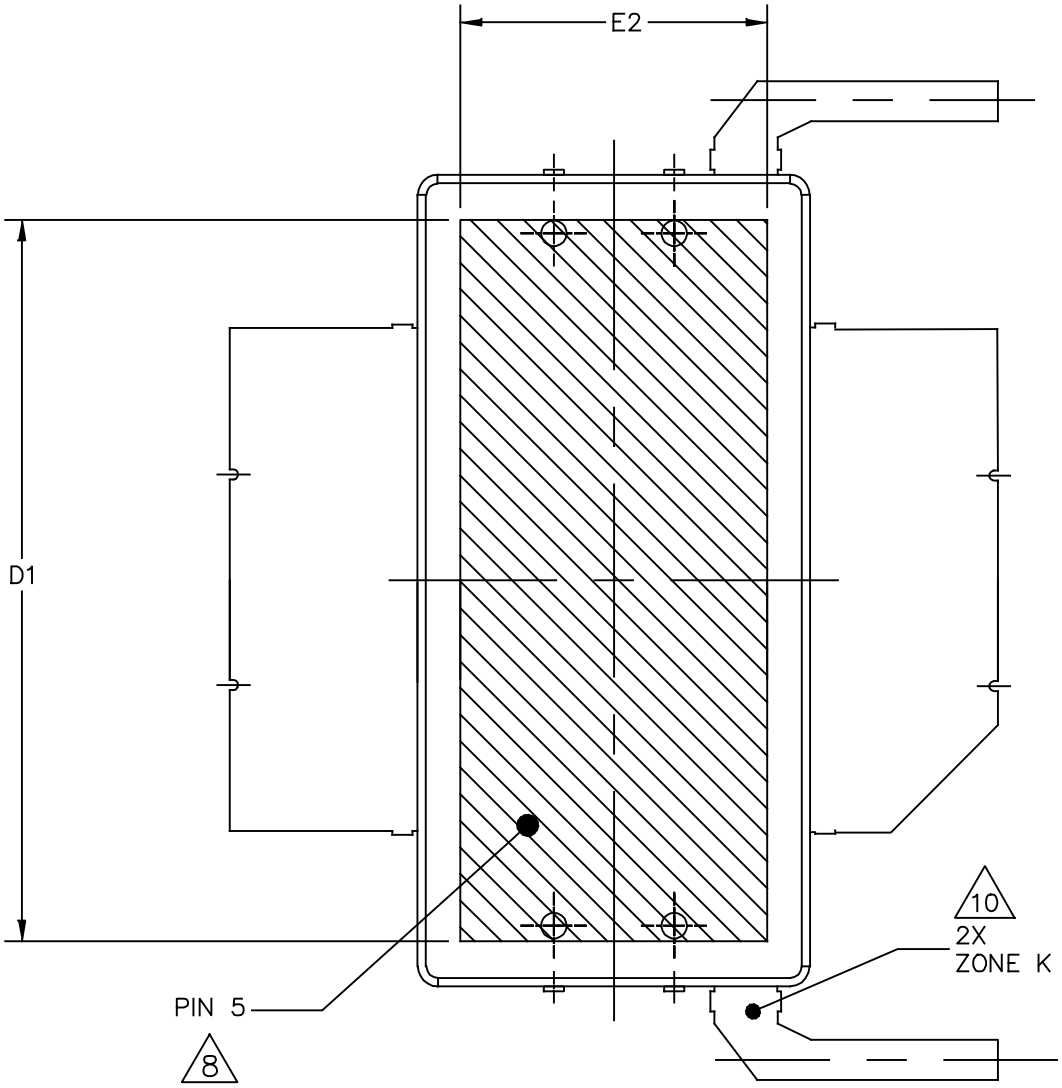
**NOTE:** (P) = Maximum Output Power  
(E) = Maximum Drain Efficiency

- Gain
- Drain Efficiency
- Linearity
- Output Power

### PACKAGE DIMENSIONS



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BOTTOM VIEW  
VIEW T-T

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NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE H IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS DD AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 INCH (0.15 MM) PER SIDE. DIMENSIONS DD AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
5. DIMENSION bb DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 INCH (0.13 MM) TOTAL IN EXCESS OF THE bb DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.
7. DIMENSIONS A1 AND A2 APPLIES WITHIN ZONE J ONLY. A1 APPLIES TO PINS 1 AND 3. A2 APPLIES TO PINS 2 AND 4. TOLERANCES OF DIMENSIONS A1 AND A2 ARE TENTATIVE.
8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. THE DIMENSIONS D1 AND E2 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF HEAT SLUG.
9. DIMPLED HOLE REPRESENTS INPUT SIDE.
10. ZONE K REPRESENTS NON-SOLDERABLE REGION WHERE MOLD FLASH AND RESIN BLEED ARE PERMITTED ON BOTH SIDES OF THE LEADS.

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
AA	.148	.152	3.76	3.86	W1	.095	.105	2.41	2.67
A1	.059	.065	1.50	1.65	W2	.158	.168	4.01	4.27
A2	.056	.068	1.42	1.73	W3	.138	.148	3.51	3.76
DD	.808	.812	20.52	20.62	U	.037	.043	0.94	1.09
D1	.720	----	18.29	----	Y	.956 BSC		24.28 BSC	
E	.762	.770	19.35	19.56	bb	.497	.503	12.62	12.78
E1	.390	.394	9.91	10.01	c1	.007	.011	0.18	0.28
E2	.306	----	7.77	----	e1	.116	.124	2.95	3.15
E3	.383	.387	9.73	9.83	aaa	.004		0.10	
F	.025 BSC		0.64 BSC		bbb	.006		0.15	
G	.030 BSC		0.76 BSC		ccc	.010		0.25	

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## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

### Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Over-Molded Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN3789: Clamping of High Power RF Transistors and RFICs in Over-Molded Plastic Packages

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- Electromigration MTTF Calculator
- RF High Power Model
- s2p File

### Development Tools

- Printed Circuit Boards

### To Download Resources Specific to a Given Part Number:

1. Go to <http://www.freescale.com/rf>
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	July 2015	• Initial Release of Data Sheet

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