

# AGR19180EF 180 W, 1930 MHz—1990 MHz, PCS LDMOS RF Power Transistor

## Introduction

The AGR19180EF is a 180 W, 28 V N-channel laterally diffused metal oxide semiconductor (LDMOS) RF power field effect transistor (FET) suitable for personal communication service (PCS) (1930 MHz—1990 MHz), code division multiple access (CDMA), global system for mobile communication (GSM/EDGE), time division multiple access (TDMA), and single-carrier or multicarrier class AB power amplifier applications.

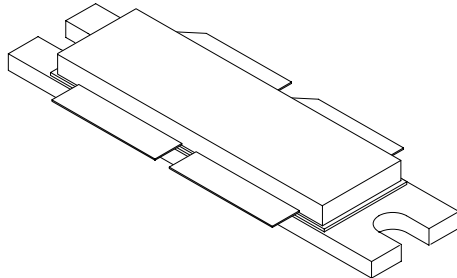


Figure 1. AGR19180EF (flanged) Package

## CDMA Features

Typical two carrier CDMA performance:  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 1600\text{ mA}$ ,  $P_{OUT} = 38\text{ W}$ ,  
 $f_1 = 1958.75\text{ MHz}$ ,  $f_2 = 1961.25\text{ MHz}$ , IS-95/97  
 CDMA pilot, sync, paging, traffic codes 8—13  
 (9 channels) 1.2288 MHz channel bandwidth (BW),  
 adjacent channel power ration (ACPR) measured  
 over a 30 kHz BW at  $f_1 - 885\text{ kHz}$ ,  $f_2 + 885\text{ kHz}$ .  
 Distortion products measured over 1.2288 MHz  
 channel BW at  $f_1 - 2.5\text{ MHz}$ ,  $f_2 + 2.5\text{ MHz}$ .  
 $\text{Peak/avg} = 9.72\text{ dB}$  @ 0.01% probability on  
 CCDF:

- Output power: 38 W.
- Power gain: 14.5 dB.
- Efficiency: 26%.
- IM3: -33 dBc.
- ACPR: -48.5 dBc
- Return loss: -12 dB.

## Device Performance Features

- High-reliability, gold-metalization process.
- Hot carrier injection (HCI) induced bias drift of <5% over 20 years.
- Internally matched.
- High gain, efficiency, and linearity.
- Integrated ESD protection.
- Device can withstand a 10:1 voltage standing wave ratio (VSWR) at 28 Vdc, 1960 MHz, 180 W output power pulsed 4  $\mu\text{s}$  at 10% duty.
- Large signal impedance parameters available.

## ESD Rating\*

AGR19180EF	Minimum (V)	Class
HBM	500	1B
MM	50	A
CDM	1000	4

\* Although electrostatic discharge (ESD) protection circuitry has been designed into this device, proper precautions must be taken to avoid exposure to ESD and electrical overstress (EOS) during all handling, assembly, and test operations. PEAK Devices employs both a human-body model (HBM) and a charged-device model (CDM) qualification requirement in order to determine ESD-susceptibility limits and protection design evaluation. ESD voltage thresholds are dependent on the circuit parameters used in each of the models, as defined by JEDEC's JESD22-A114 (HBM) and JESD22-C101 (CDM) standards.

**Caution:** MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

## Electrical Characteristics

**Table 1. Thermal Characteristics**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.35	$^{\circ}\text{C}/\text{W}$

**Table 2. Absolute Maximum Ratings\***

Parameter	Symbol	Value	Unit
Drain-source Voltage	$V_{DSS}$	65	Vdc
Gate-source Voltage	$V_{GS}$	-0.5, 15	Vdc
Total Dissipation at $T_C = 25^{\circ}\text{C}$	$P_D$	500	W
Derate Above $25^{\circ}\text{C}$	—	3	$\text{W}/^{\circ}\text{C}$
Operating Junction Temperature	$T_J$	200	$^{\circ}\text{C}$
Storage Temperature Range	$T_{STG}$	-65, 150	$^{\circ}\text{C}$

\* Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Recommended operating conditions apply unless otherwise specified:  $T_C = 30^{\circ}\text{C}$ .

**Table 3. dc Characteristics**

Parameter	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-source Breakdown Voltage ( $V_{GS} = 0$ , $I_D = 400 \mu\text{A}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Gate-source Leakage Current ( $V_{GS} = 5 \text{ V}$ , $V_{DS} = 0 \text{ V}$ )	$I_{GSS}$	—	—	6	$\mu\text{A}_{dc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28 \text{ V}$ , $V_{GS} = 0 \text{ V}$ )	$I_{DSS}$	—	—	200	$\mu\text{A}_{dc}$
<b>On Characteristics</b>					
Forward Transconductance ( $V_{DS} = 10 \text{ V}$ , $I_D = 1 \text{ A}$ )	$G_{FS}$	—	12	—	S
Gate Threshold Voltage ( $V_{DS} = 10 \text{ V}$ , $I_D = 600 \mu\text{A}$ )	$V_{GS(TH)}$	—	—	3.0	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28 \text{ V}$ , $I_D = 2 \times 800 \text{ mA}$ )	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain-source On-voltage ( $V_{GS} = 10 \text{ V}$ , $I_D = 1 \text{ A}$ )	$V_{DS(ON)}$	—	0.08	—	Vdc

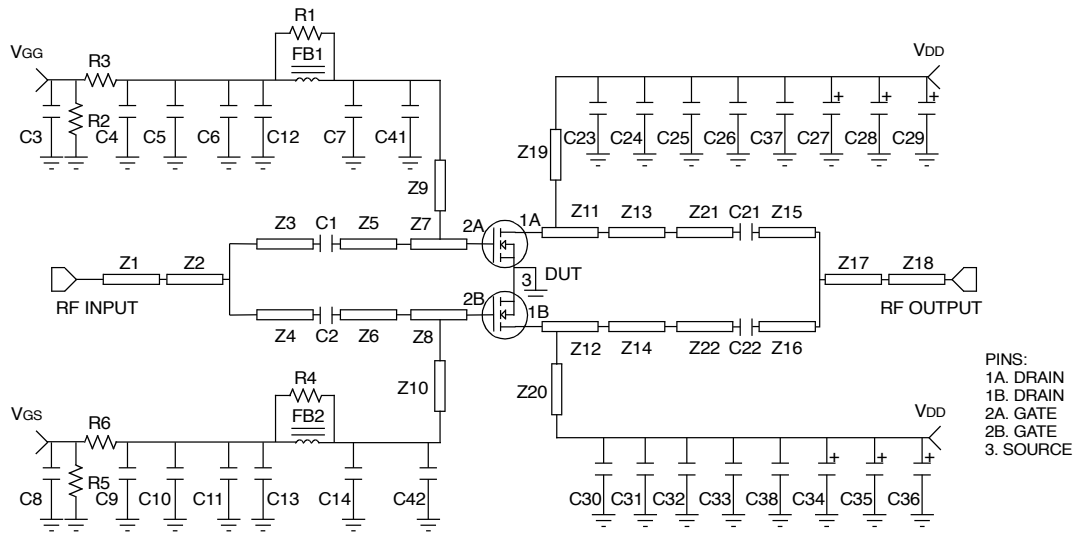
## Electrical Characteristics (continued)

**Table 4. RF Characteristics**

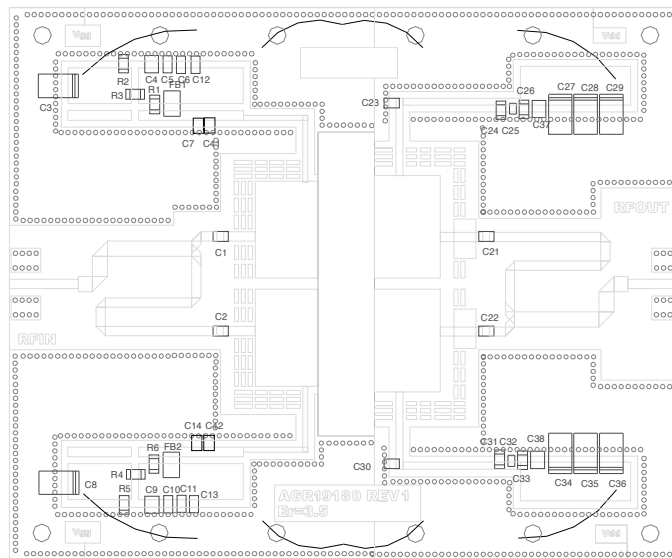
Parameter	Symbol	Min	Typ	Max	Unit
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance ( $V_{DS} = 28\text{ V}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ ) (Part is internally matched both on input and output.)	$C_{RSS}$	—	4.0	—	pF
<b>Functional Tests (in Supplied Test Fixture)</b>					
Common-source Amplifier Power Gain ( $V_{DD} = 28\text{ Vdc}$ , $P_{OUT} = 38\text{ W}$ average, two carrier N-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )	GPS	—	14.5	—	dB
Drain Efficiency ( $V_{DD} = 28\text{ Vdc}$ , $P_{OUT} = 38\text{ W}$ average, two carrier N-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )	$\eta$	—	26	—	%
Third-order Intermodulation Distortion* ( $V_{DD} = 28\text{ Vdc}$ , $P_{OUT} = 38\text{ W}$ average, two carrier N-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ ; IM3 measured in a 1.2288 MHz integration bandwidth centered at $f_1 - 2.5\text{ MHz}$ and $f_2 + 2.5\text{ MHz}$ , referenced to the carrier chan- nel power)	IM3	—	-33	—	dBc
Adjacent Channel Power Ratio* ( $V_{DD} = 28\text{ Vdc}$ , $P_{OUT} = 38\text{ W}$ average, two carrier N-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ ; ACPR measured in a 30 kHz integration bandwidth cen- tered at $f_1 - 885\text{ kHz}$ and $f_2 + 885\text{ kHz}$ , referenced to the carrier channel power)	ACPR	—	-48.5	—	dBc
Input Return Loss ( $V_{DD} = 28\text{ Vdc}$ , $P_{OUT} = 38\text{ W}$ average, two carrier N-CDMA, $I_{DQ} = 1600\text{ mA}$ , $f_1 = 1930\text{ MHz}$ , $f_2 = 1932.5\text{ MHz}$ and $f_1 = 1987.5\text{ MHz}$ , $f_2 = 1990\text{ MHz}$ )	IRL	—	-12	—	dB
Ruggedness ( $V_{DD} = 28\text{ V}$ , $P_{OUT} = 180\text{ W}$ continuous wave (CW), $I_{DQ} = 1600\text{ mA}$ , $f = 1930\text{ MHz}$ , VSWR = 10:1 [all phase angles])	$\Psi$	No degradation in output power.			

\* N-CDMA, typical peak/average ratio of 9.72 dB at 0.01% CCDF,  $f_1 = 1958.75\text{ MHz}$ , and  $f_2 = 1961.25\text{ MHz}$ .  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 2 \times 800\text{ mA}$ , and  $P_{OUT} = 38\text{ W}$  average.

**Test Circuit Illustrations**



**A. Schematic**



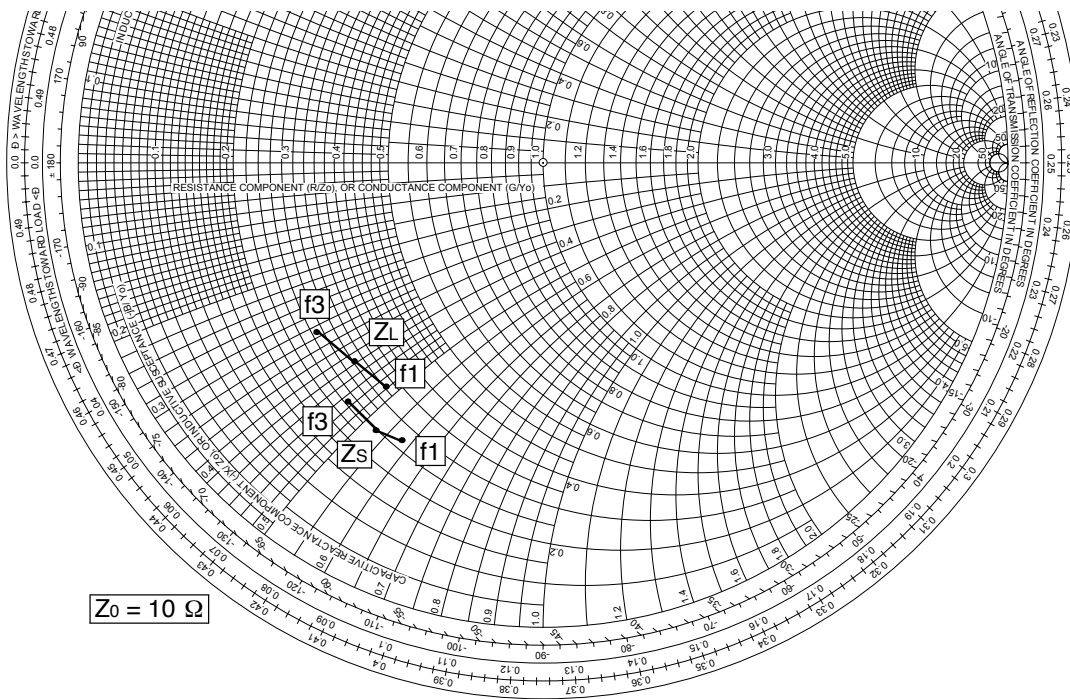
**B. Component Layout**

**Parts List:**

- Microstrip line: Z1 0.500 in. x 0.067 in.; Z2, Z17 1.080 in. x 0.110 in.; Z3, Z16 0.210 in. x 0.067 in.; Z4, Z15 2.020 in. x 0.067 in.; Z5, Z6 0.230 in. x 0.067 in.; Z7, Z8 0.455 in. x 0.700 in.; Z9, Z10 1.100 in. x 0.035 in.; Z11, Z12 0.475 in. x 0.740 in.; Z13, Z14 0.100 in. x 0.067 in.; Z18 0.230 in. x 0.067 in.; Z19, Z20 0.490 in. x 0.050 in.; Z21, Z22 0.160 in. x 0.285 in.
- ATC® chip capacitor: C1, C2, C21, C22: 10 pF; C7, C14, C23, C30, C41, C42: 8.2 pF; C12, C13: 1000 pF.
- Kemet® tantalum capacitor: C27, C34: 10  $\mu$ F, 35 V T491D; C4, C9, C37, C38: 1  $\mu$ F, 50 V T491C.
- Kemet® chip capacitor: C5, C10, C18, C26, C33: 0.1  $\mu$ F.
- Sprague® tantalum surface-mount chip capacitor: C3, C8, C28, C29, C35, C36: 22  $\mu$ F, 35 V.
- Vitramon® 1206 capacitor: C5, C12: 22000 pF.
- 1206 size chip resistor: R1, R4: 4.7 k $\Omega$ ; R2, R5 560 k $\Omega$ , R3, R6: 1.02 k $\Omega$ .
- Fair-Rite® ferrite bead: FB1, FB2: 2743019447.
- Taconic® ORCER RF-35: board material, 1 oz. copper, 30 mil thickness,  $\epsilon_r = 3.5$ .

**Figure 2. Test Circuit**

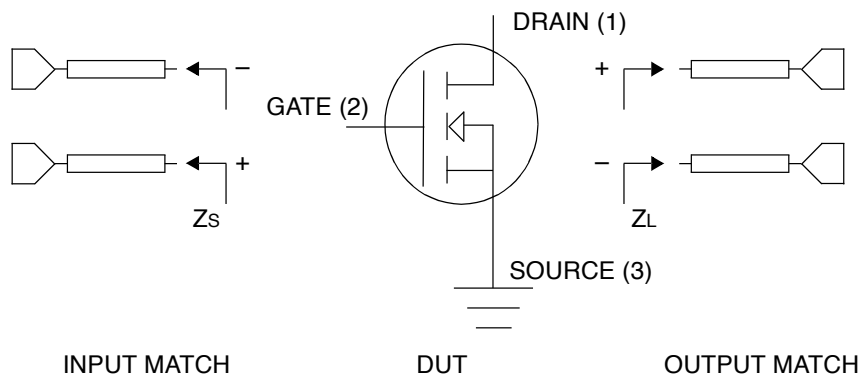
### Typical Performance Characteristics



MHz (f)	Zs Ω (Complex Source Impedance)	ZL Ω (Complex Optimum Load Impedance)
1930 (f1)	2.58 – j5.9	3.2 – j4.67
1960 (f2)	2.36 – j5.26	2.85 – j3.86
1990 (f3)	2.37 – j4.51	2.72 – j3.07

Zs = Test circuit impedance as measured from gate to gate, balanced configuration.

ZL = Test circuit impedance as measured from drain to drain, balanced configuration.



**Figure 3. Series Equivalent Input and Output Impedances**

Typical Performance Characteristics (continued)

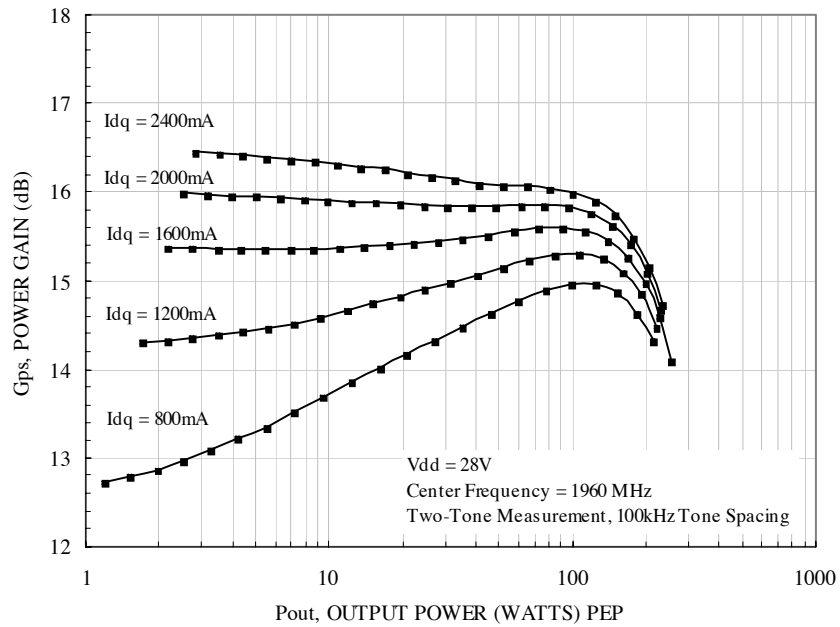


Figure 4. Two-Tone Power Gain versus Output Power

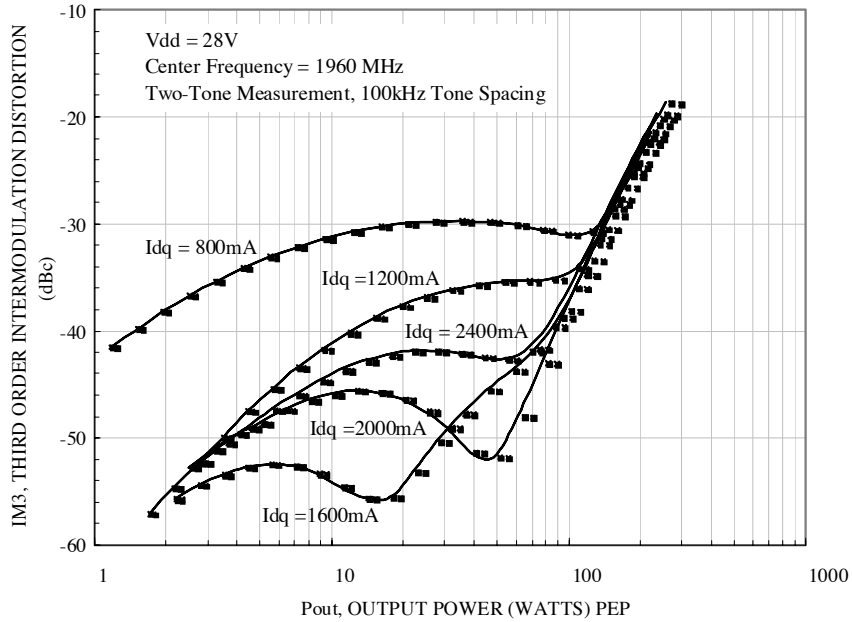


Figure 5. Third Order Intermodulation Distortion versus Output Power

Typical Performance Characteristics (continued)

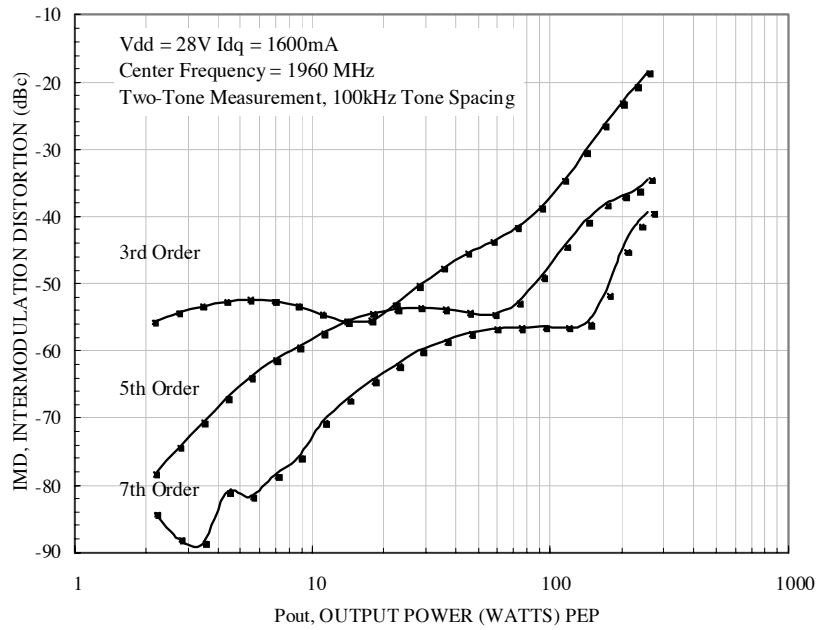


Figure 6. Intermodulation Distortion versus Output Power

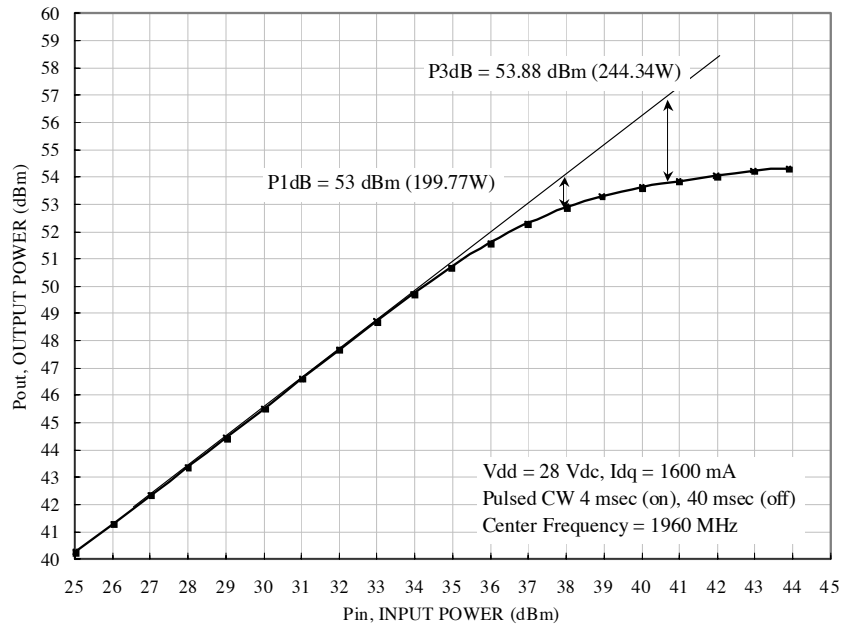
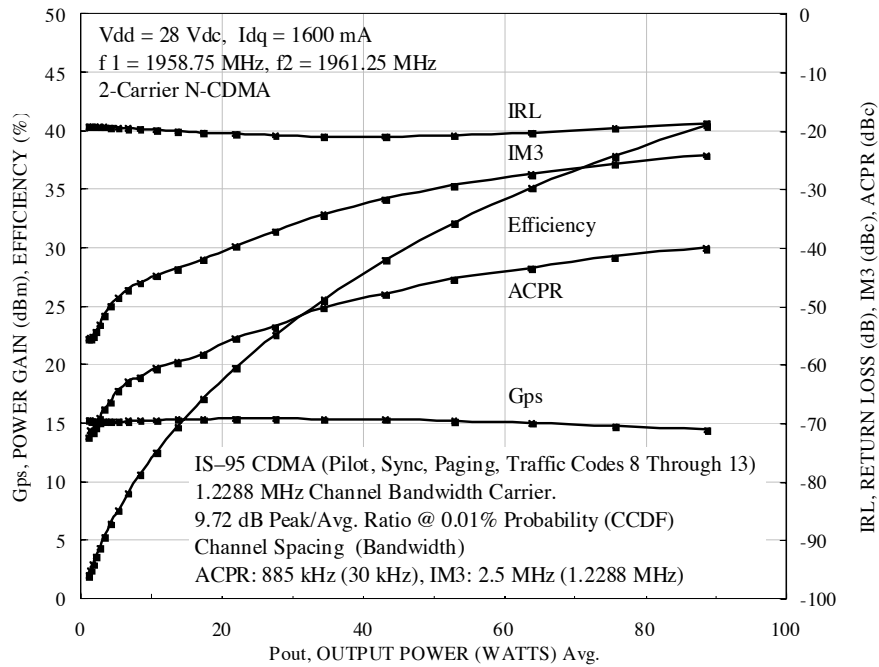
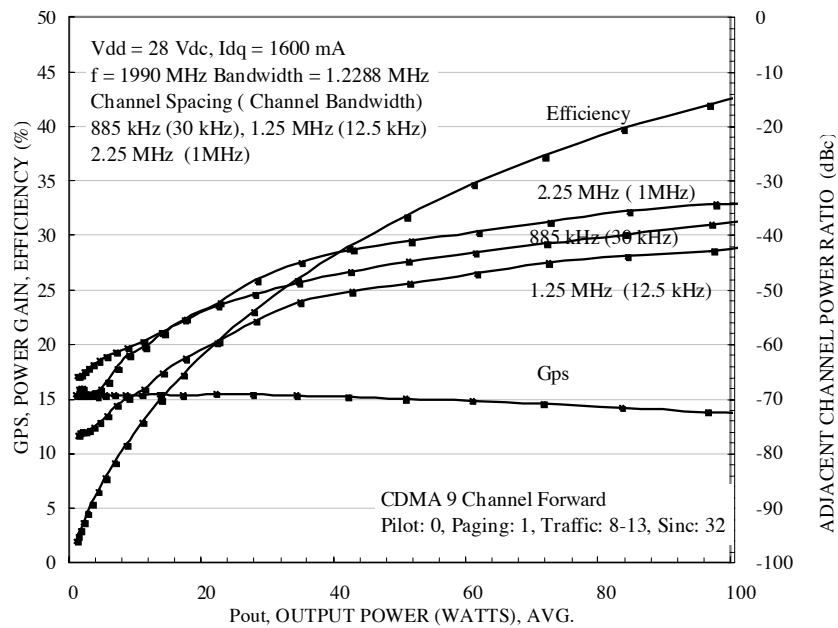


Figure 7. Pulsed CW Output Power versus Input Power

**Typical Performance Characteristics (continued)**



**Figure 8. Two-Carrier N-CDMA ACPR, IM3, Power Gain, Drain Efficiency versus Output Power**

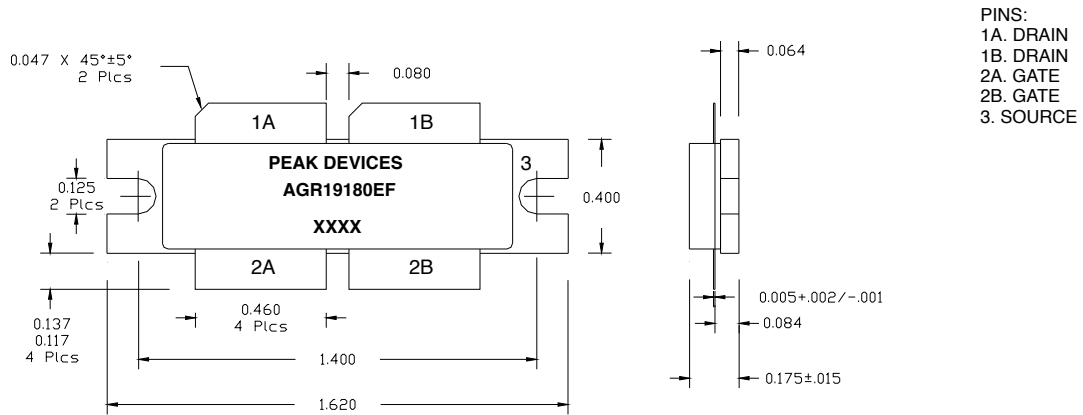


**Figure 9. N-CDMA ACPR, Power Gain, Drain Efficiency versus Output Power**



## Package Dimensions

All dimensions are in inches. Tolerances are  $\pm 0.005$  in. unless specified.



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