



# RF Power GaN Transistor

This 79 W asymmetrical Doherty RF power GaN transistor is designed for cellular base station applications requiring wide instantaneous bandwidth capability covering the frequency range of 1800 to 2200 MHz.

This part is characterized and performance is guaranteed for applications operating in the 1800 to 2200 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

## 2100 MHz

- Typical Doherty Single-Carrier W-CDMA Characterization Performance:  $V_{DD} = 48$  Vdc,  $I_{DQA} = 200$  mA,  $V_{GSB} = -5.4$  Vdc,  $P_{out} = 79$  W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.<sup>(1)</sup>

Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	15.4	56.6	7.1	-33.1
2140 MHz	15.4	56.6	7.1	-34.9
2170 MHz	15.4	56.6	7.1	-34.9
2200 MHz	15.3	56.5	7.0	-34.5

## 1800 MHz

- Typical Doherty Single-Carrier W-CDMA Performance:  $V_{DD} = 48$  Vdc,  $I_{DQA} = 200$  mA,  $V_{GSB} = -5.5$  Vdc,  $P_{out} = 89$  W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. <sup>(1)</sup>

Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	Output PAR (dB)	ACPR (dBc)
1805 MHz	15.1	56.0	7.0	-31.1
1840 MHz	15.6	56.5	7.1	-31.8
1880 MHz	15.1	58.7	7.0	-30.8

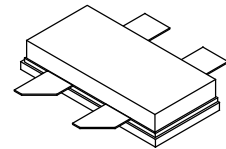
1. All data measured in fixture with device soldered to heatsink.

## Features

- High terminal impedances for optimal broadband performance
- Advanced high performance in-package Doherty
- Able to withstand extremely high output VSWR and broadband operating conditions

## A3G22H400-04SR3

1800–2200 MHz, 79 W AVG., 48 V  
AIRFAST RF POWER GaN  
TRANSISTOR



NI-780S-4L

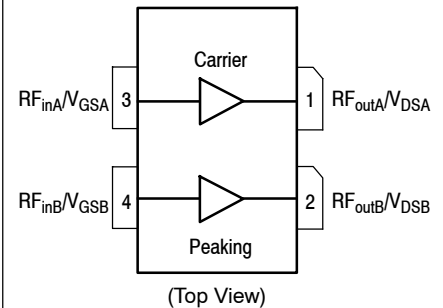


Figure 1. Pin Connections

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	125	Vdc
Gate-Source Voltage	$V_{GS}$	-8, 0	Vdc
Operating Voltage	$V_{DD}$	0 to +55	Vdc
Maximum Forward Gate Current @ $T_C = 25^\circ\text{C}$	$I_{GMAX}$	49	mA
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$
Case Operating Temperature Range	$T_C$	-55 to +150	$^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	-55 to +225	$^\circ\text{C}$
Absolute Maximum Junction Temperature (1)	$T_{MAX}$	275	$^\circ\text{C}$

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case Case Temperature $77^\circ\text{C}$ , $P_D = 64.8\text{ W}$	$R_{\theta JC}$ (IR)	0.87 (2)	$^\circ\text{C/W}$
Thermal Resistance by Finite Element Analysis, Junction-to-Case Case Temperature $77^\circ\text{C}$ , $P_D = 64.8\text{ W}$	$R_{\theta JC}$ (FEA)	1.51 (3)	$^\circ\text{C/W}$

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JS-001-2017)	2
Charge Device Model (per JS-002-2014)	C3

**Table 4. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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**Off Characteristics (4)**

Drain-Source Breakdown Voltage ( $V_{GS} = -8\text{ Vdc}$ , $I_D = 18.9\text{ mAdc}$ ) ( $V_{GS} = -8\text{ Vdc}$ , $I_D = 29.7\text{ mAdc}$ )	$V_{(BR)DSS}$	150 150	—	—	Vdc
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**On Characteristics - Side A, Carrier**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 18.9\text{ mAdc}$ )	$V_{GS(th)}$	-3.8	-3.0	-2.3	Vdc
Gate Quiescent Voltage ( $V_{DD} = 48\text{ Vdc}$ , $I_{DA} = 200\text{ mAdc}$ , Measured in Functional Test)	$V_{GSA(Q)}$	—	-3.0	—	Vdc
Gate-Source Leakage Current ( $V_{DS} = 0\text{ Vdc}$ , $V_{GS} = -5\text{ Vdc}$ )	$I_{GSS}$	-5.85	—	—	mAdc

**On Characteristics - Side B, Peaking**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 17\text{ mAdc}$ )	$V_{GS(th)}$	-3.8	-3.1	-2.3	Vdc
Gate-Source Leakage Current ( $V_{DS} = 0\text{ Vdc}$ , $V_{GS} = -5\text{ Vdc}$ )	$I_{GSS}$	-9.2	—	—	mAdc

- Functional operation above  $225^\circ\text{C}$  has not been characterized and is not implied. Operation at  $T_{MAX}$  ( $275^\circ\text{C}$ ) reduces median time to failure by an order of magnitude; operation beyond  $T_{MAX}$  could cause permanent damage.
- Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.nxp.com/RF> and search for AN1955.
- $R_{\theta JC}$  (FEA) must be used for purposes related to reliability and limitations on maximum junction temperature. MTTF may be estimated by the expression  $MTTF$  (hours) =  $10^{[A + B/(T + 273)]}$ , where  $T$  is the junction temperature in degrees Celsius,  $A = -10.3$  and  $B = 8260$ .
- Each side of device measured separately.

(continued)

**Table 4. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Functional Tests</b> <sup>(1,2)</sup> (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQA} = 200\text{ mA}$ , $V_{GSB} = -5.4\text{ Vdc}$ , $P_{out} = 79\text{ W Avg.}$ , $f = 2110\text{ MHz}$ , 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 @ $\pm 5\text{ MHz}$ Offset. <b>[See note on correct biasing sequence.]</b>					
Power Gain	$G_{ps}$	14.3	15.0	17.3	dB
Drain Efficiency	$\eta_D$	52.0	55.8	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	6.5	7.2	—	dB
Adjacent Channel Power Ratio	ACPR	—	-30.9	-27.7	dBc

**Load Mismatch** (In NXP Production Test Fixture, 50 ohm system)  $I_{DQA} = 200\text{ mA}$ ,  $V_{GSB} = -5.4\text{ Vdc}$ ,  $f = 2140\text{ MHz}$ , 12 sec(on), 10% Duty Cycle

VSWR 10:1 at 55 Vdc, 417 W Pulsed CW Output Power (3 dB Input Overdrive from 340 W Pulsed CW Rated Power)	No Device Degradation
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**Typical Performance** <sup>(2,3)</sup> (In NXP Doherty Characterization Test Fixture, 50 ohm system)  $V_{DD} = 48\text{ Vdc}$ ,  $I_{DQA} = 200\text{ mA}$ ,  $V_{GSB} = -5.4\text{ Vdc}$ , 2110–2200 MHz Bandwidth

$P_{out}$ @ 3 dB Compression Point <sup>(4)</sup>	P3dB	—	400	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 2110–2200 MHz bandwidth)	$\Phi$	—	-15	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	$VBW_{res}$	—	200	—	MHz
Gain Flatness in 90 MHz Bandwidth @ $P_{out} = 79\text{ W Avg.}$	$G_F$	—	0.05	—	dB
Gain Variation over Temperature (-30°C to +85°C)	$\Delta G$	—	0.015	—	dB/°C
Output Power Variation over Temperature (-30°C to +85°C)	$\Delta P_{1dB}$	—	0.004	—	dB/°C

**Table 5. Ordering Information**

Device	Tape and Reel Information	Package
A3G22H400-04SR3	R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel	NI-780S-4L

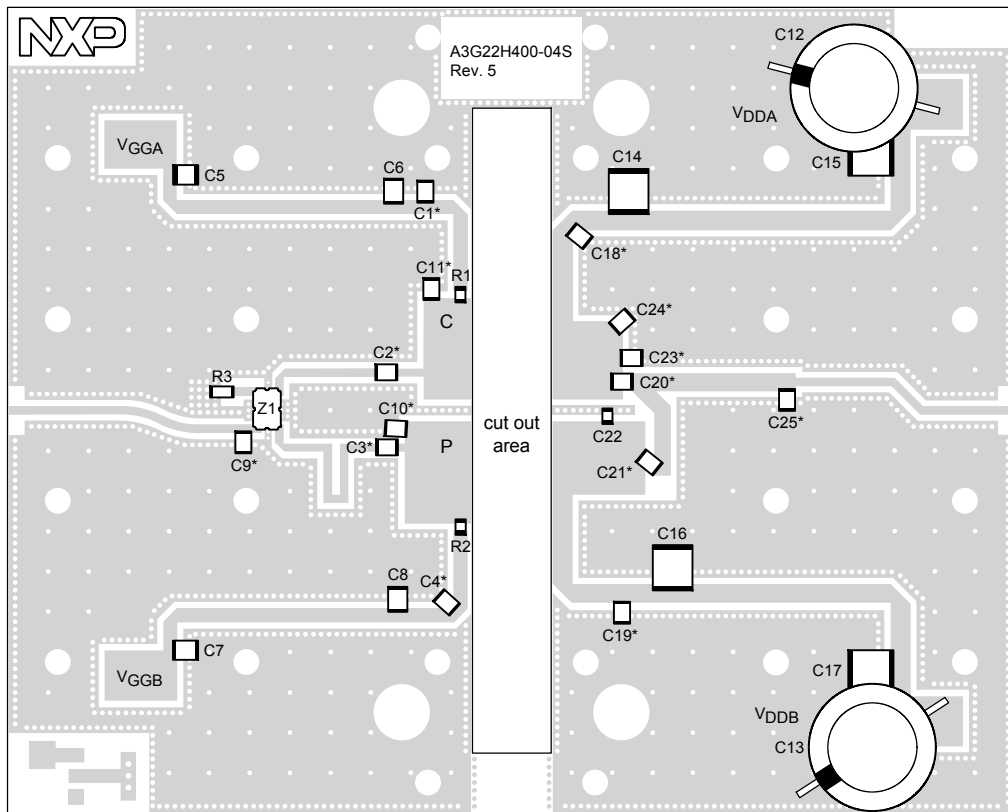
- Part internally matched both on input and output.
- Measurements made with device in an asymmetrical Doherty configuration.
- All data measured in fixture with device soldered to heatsink.
- $P_{3dB} = P_{avg} + 7.0\text{ dB}$  where  $P_{avg}$  is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.

**NOTE: Correct Biasing Sequence for GaN Depletion Mode Transistors****Turning the device ON**

- Set  $V_{GS}$  to -5 V
- Turn on  $V_{DS}$  to nominal supply voltage (48 V)
- Increase  $V_{GS}$  until  $I_{DS}$  current is attained
- Apply RF input power to desired level

**Turning the device OFF**

- Turn RF power off
- Reduce  $V_{GS}$  down to -5 V
- Reduce  $V_{DS}$  down to 0 V (Adequate time must be allowed for  $V_{DS}$  to reduce to 0 V to prevent severe damage to device.)
- Turn off  $V_{GS}$

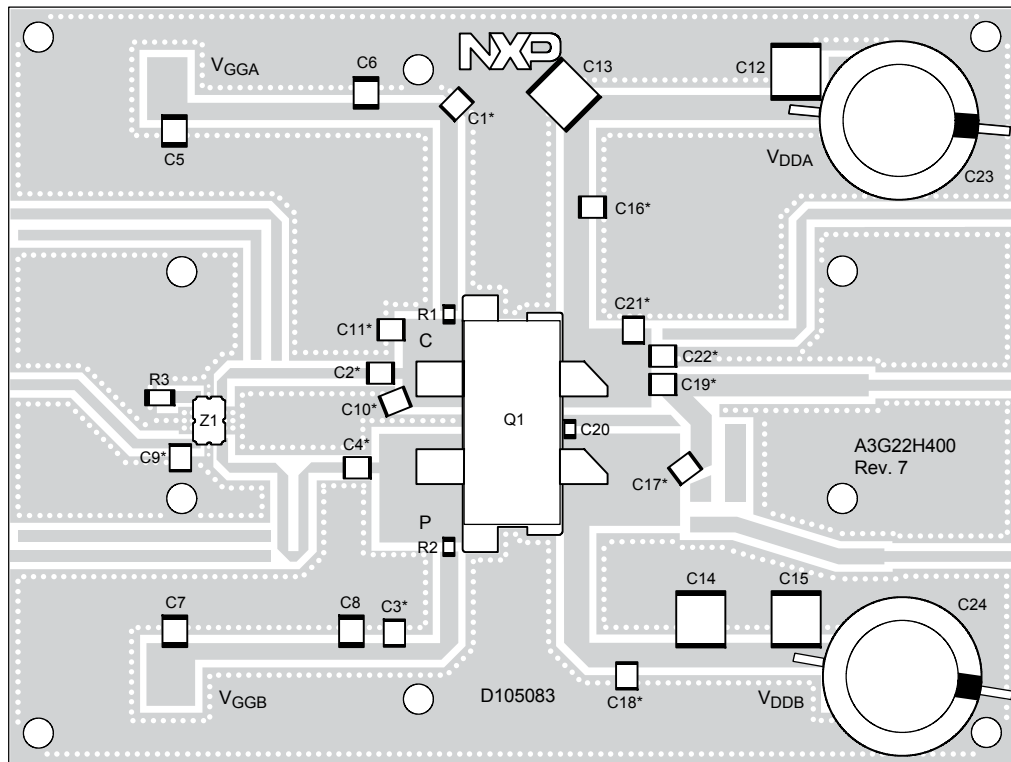


\*C1, C2, C3, C4, C9, C10, C11, C18, C19, C20, C21, C23, C24, and C25 are mounted vertically. aaa-030284

**Figure 2. A3G22H400-04SR3 Production Test Circuit Component Layout**

**Table 6. A3G22H400-04SR3 Production Test Circuit Component Designations and Values**

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C18, C19	8.2 pF Chip Capacitor	ATC100B8R2CT500XT	ATC
C5, C6, C7, C8	10 $\mu$ F Chip Capacitor	C3225X7S1H106M250AB	TDK
C9, C10	0.2 pF Chip Capacitor	ATC100B0R2BT500XT	ATC
C11	0.7 pF Chip Capacitor	ATC100B0R7BT500XT	ATC
C12, C13	470 $\mu$ F, 100 V Electrolytic Capacitor	MCGPR100V477M16X32	Multicomp
C14, C15, C16, C17	10 $\mu$ F Chip Capacitor	C5750X7S2A106M230KB	TDK
C20	3 pF Chip Capacitor	ATC100B3R0CT500XT	ATC
C21	15 pF Chip Capacitor	ATC100B150JT500XT	ATC
C22	1.0 pF Chip Capacitor	GQM2195C2E1R0BB12D	Murata
C23, C24, C25	0.5 pF Chip Capacitor	ATC100B0R5BT500XT	ATC
R1, R2	3.3 $\Omega$ , 1/8 W Chip Resistor	CRCW08053R30FKEA	Vishay
R3	50 $\Omega$ , 10 W Termination Chip Resistor	060120A25X50-2	Anaren
Z1	1800–2200 MHz Band, 90°, 2 dB Directional Coupler	X3C20F1-02S	Anaren
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	—	MTL



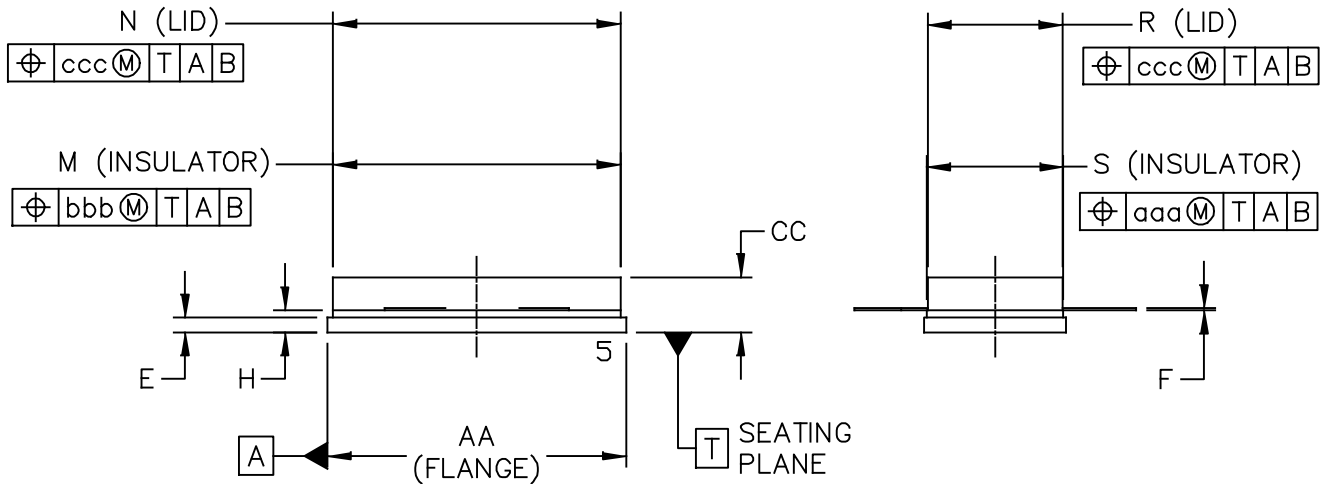
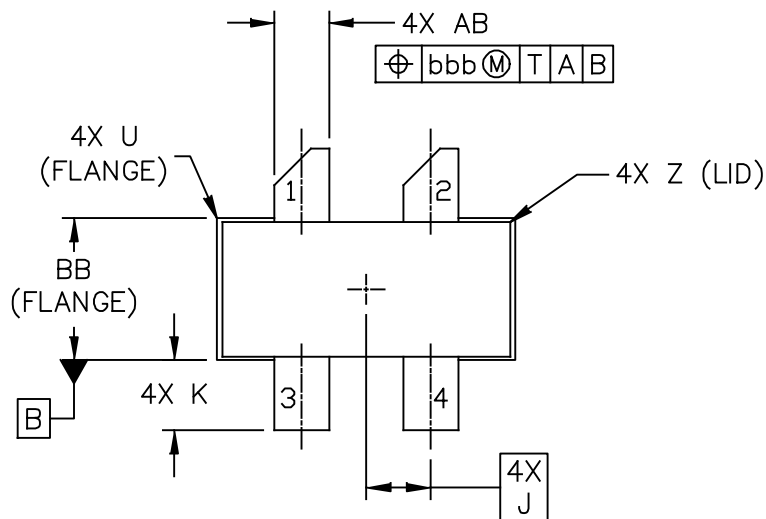
\*C1, C2, C3, C4, C9, C10, C11, C16, C17, C18, C19, C21, and C22 are mounted vertically. aaa-030312  
 Note: All data measured in fixture with device soldered to heatsink.

**Figure 3. A3G22H400-04SR3 Characterization Test Circuit Component Layout — 2110–2200 MHz**

**Table 7. A3G22H400-04SR3 Characterization Test Circuit Component Designations and Values — 2110–2200 MHz**

Part	Description	Part Number	Manufacturer
C1, C2, C3, C16, C17, C18	8.2 pF Chip Capacitor	ATC100B8R2CT500XT	ATC
C4	12 pF Chip Capacitor	ATC100B120JT500XT	ATC
C5, C6, C7, C8	10 $\mu$ F Chip Capacitor	C3225X7S1H106M250AB	TDK
C9	0.3 pF Chip Capacitor	ATC100B0R3BT500XT	ATC
C10, C11	0.8 pF Chip Capacitor	ATC100B0R8BT500XT	ATC
C12, C13, C14, C15	10 $\mu$ F Chip Capacitor	C5750X7S2A106M230KB	TDK
C19	3.6 pF Chip Capacitor	ATC100B3R6CT500XT	ATC
C20	0.9 pF Chip Capacitor	GQM2195C2ER90BB12D	Murata
C21, C22	0.6 pF Chip Capacitor	ATC100B0R6CT500XT	ATC
C23, C24	470 $\mu$ F, 100 V Electrolytic Capacitor	MCGPR100V477M16X32	Multicomp
Q1	RF Power LDMOS Transistor	A3G22H400-04S	NXP
R1, R2	3.3 $\Omega$ , 1/8 W Chip Resistor	CRCW08053R30FKEA	Vishay
R3	50 $\Omega$ , 10 W Termination Chip Resistor	060120A25X50-2	Anaren
Z1	1800–2200 MHz Band, 90°, 2 dB Directional Coupler	X3C20F1-02S	Anaren
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	D105083	MTL

### PACKAGE DIMENSIONS



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NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM FLANGE TO CLEAR EPOXY FLOW OUT PARALLEL TO DATUM B.

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
AA	.805	.815	20.45	20.70	U		.040		1.02
BB	.382	.388	9.70	9.86	Z		.030		0.76
CC	.125	.170	3.18	4.32	AB	.145	.155	3.68	– 3.94
E	.035	.045	0.89	1.14					
F	.003	.006	0.08	0.15	aaa		.005		0.127
H	.057	.067	1.45	1.70	bbb		.010		0.254
J	.175 BSC		4.44 BSC		ccc		.015		0.381
K	.170	.210	4.32	5.33					
M	.774	.786	19.61	20.02					
N	.772	.788	19.61	20.02					
R	.365	.375	9.27	9.53					
S	.365	.375	9.27	9.52					
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## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

### Application Notes

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- .s2p File

### Development Tools

- Printed Circuit Boards

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

1. Go to <http://www.nxp.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	May 2018	• Initial release of data sheet



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