



# RF Power GaN Transistor

This 14 W asymmetrical Doherty RF power GaN transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 3400 to 3600 MHz.

This part is characterized and performance is guaranteed for applications operating in the 3400 to 3600 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

### 3500 MHz

- Typical Doherty Single-Carrier W-CDMA Performance:  $V_{DD} = 48$  Vdc,  $I_{DQA} = 80$  mA,  $V_{GSB} = -5.0$  Vdc,  $P_{out} = 14$  W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

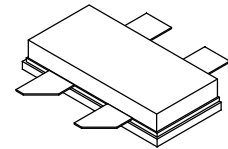
Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	Output PAR (dB)	ACPR (dBc)
3400 MHz	14.0	43.8	9.6	-34.0
3500 MHz	14.0	41.4	9.7	-34.5
3600 MHz	14.0	42.5	9.6	-32.2

### Features

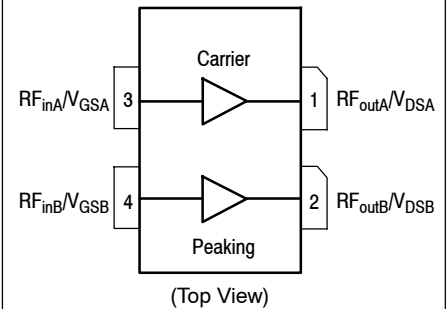
- High terminal impedances for optimal broadband performance
- Advanced high performance in-package Doherty
- Able to withstand extremely high output VSWR and broadband operating conditions

**A3G35H100-04SR3**

**3400–3600 MHz, 14 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 @ $T_C = 25^\circ\text{C}$	$I_{GMAX}$	13.4	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 $71^\circ\text{C}$ , $P_D = 24.3\text{ W}$	$R_{\theta JC}$ (IR)	2.3 (2)	$^\circ\text{C}/\text{W}$
Thermal Resistance by Finite Element Analysis, Junction-to-Case Case Temperature $90^\circ\text{C}$ , $P_D = 24\text{ W}$	$R_{\theta JC}$ (FEA)	3.88 (3)	$^\circ\text{C}/\text{W}$

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JS-001-2017)	1C
Charge Device Model (per JS-002-2014)	C2

**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 ( $V_{GS} = -8\text{ Vdc}$ , $I_D = 5.4\text{ mAdc}$ ) ( $V_{GS} = -8\text{ Vdc}$ , $I_D = 8.04\text{ mAdc}$ )	$V_{(BR)DSS}$	150 150	—	—	Vdc
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**On Characteristics - Side A, Carrier**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 5.4\text{ mAdc}$ )	$V_{GS(th)}$	-3.8	-3.1	-2.3	Vdc
Gate Quiescent Voltage ( $V_{DD} = 48\text{ Vdc}$ , $I_{DA} = 80\text{ mAdc}$ , Measured in Functional Test)	$V_{GSA(Q)}$	-3.6	-2.9	-2.6	Vdc
Gate-Source Leakage Current ( $V_{DS} = 0\text{ Vdc}$ , $V_{GS} = -5\text{ Vdc}$ )	$I_{GSS}$	-1.7	—	—	mAdc

**On Characteristics - Side B, Peaking**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 8.04\text{ mAdc}$ )	$V_{GS(th)}$	-3.8	-3.2	-2.3	Vdc
Gate-Source Leakage Current ( $V_{DS} = 0\text{ Vdc}$ , $V_{GS} = -5\text{ Vdc}$ )	$I_{GSS}$	-2.5	—	—	mAdc

1. 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.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.nxp.com/RF> and search for AN1955.
3.  $R_{\theta JC}$  (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  $B = 8260$ .
4. 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 Test Fixture, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQA} = 80\text{ mA}$ , $V_{GSB} = -5.0\text{ Vdc}$ , $P_{out} = 14\text{ W Avg.}$ , $f = 3600\text{ MHz}$ , 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	$G_{ps}$	13.0	14.0	15.0	dB
Drain Efficiency	$\eta_D$	37.7	42.5	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	8.8	9.6	—	dB
Adjacent Channel Power Ratio	ACPR	—	-32.2	-29.5	dBc

**Load Mismatch** <sup>(2)</sup> (In NXP Doherty Test Fixture, 50 ohm system)  $I_{DQA} = 80\text{ mA}$ ,  $V_{GSB} = -5.1\text{ Vdc}$ ,  $f = 3500\text{ MHz}$ , 12  $\mu\text{sec(ON)}$ , 10% Duty Cycle

VSWR 10:1 at 55 Vdc, 158 W Pulsed CW Output Power (3 dB Input Overdrive from 91 W Pulsed CW Rated Power)	No Device Degradation
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**Typical Performance** <sup>(2)</sup> (In NXP Doherty Test Fixture, 50 ohm system)  $V_{DD} = 48\text{ Vdc}$ ,  $I_{DQA} = 80\text{ mA}$ ,  $V_{GSB} = -5.1\text{ Vdc}$ , 3400–3600 MHz Bandwidth

$P_{out}$ @ 3 dB Compression Point <sup>(3)</sup>	P3dB	—	100	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 3400–3600 MHz bandwidth)	$\Phi$	—	-32	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	$VBW_{res}$	—	260	—	MHz
Gain Flatness in 200 MHz Bandwidth @ $P_{out} = 14\text{ W Avg.}$	$G_F$	—	0.31	—	dB
Gain Variation over Temperature (-30°C to +85°C)	$\Delta G$	—	0.011	—	dB/°C
Output Power Variation over Temperature (-30°C to +85°C)	$\Delta P_{1dB}$	—	0.006	—	dB/°C

**Table 5. Ordering Information**

Device	Tape and Reel Information	Package
A3G35H100-04SR3	R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel	NI-780S-4L

- Part internally input matched.
- Measurements made with device in an asymmetrical Doherty configuration.
- P3dB =  $P_{avg} + 7.0\text{ dB}$  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  $V_{GS}$

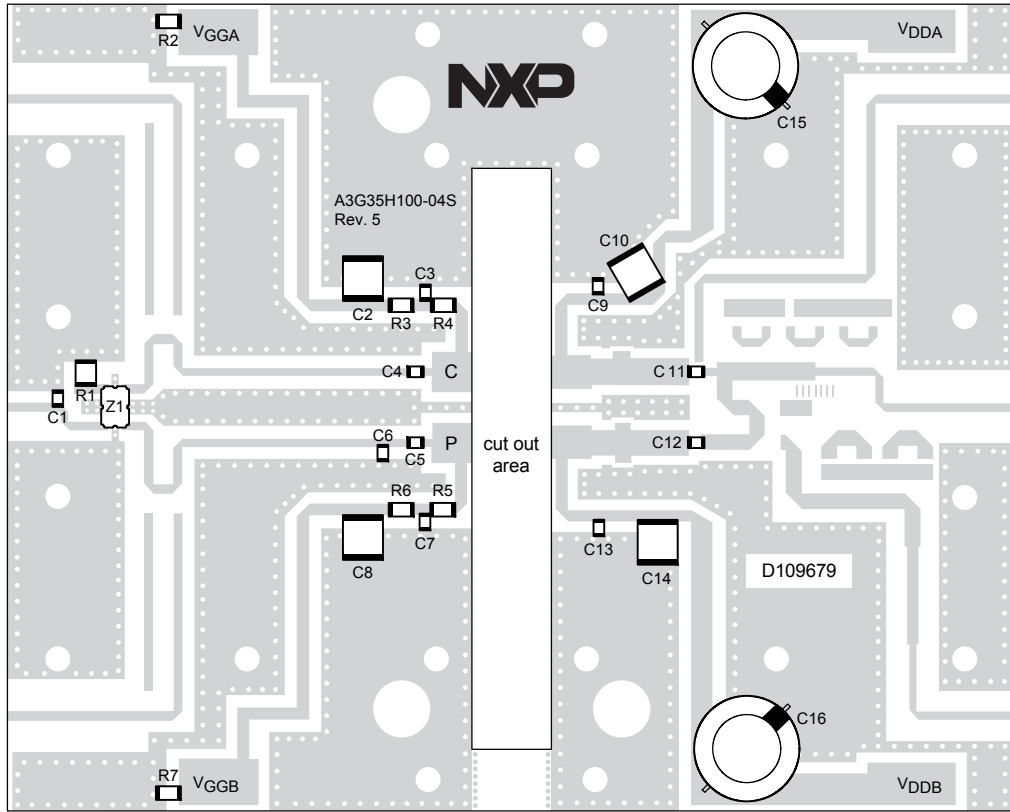


Figure 2. A3G35H100-04SR3 Test Circuit Component Layout

aaa-030282

Table 6. A3G35H100-04SR3 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C6	0.1 pF Chip Capacitor	ATC600F0R1BT250XT	ATC
C2, C8, C10, C14	10 $\mu$ F Chip Capacitor	C5750X7S2A106M230KB	TDK
C3, C4, C5, C7, C9, C11, C13	5.1 pF Chip Capacitor	ATC600F5R1BT250XT	ATC
C12	4.3 pF Chip Capacitor	ATC600F4R3BT250XT	ATC
C15, C16	220 $\mu$ F, 100 V Electrolytic Capacitor	MCGPR100V227M16X26	Multicomp
R1	50 $\Omega$ , 10 W Chip Resistor	C10A50Z4	Anaren
R2, R7	51 k $\Omega$ , 1/4 W Chip Resistor	CRCW120651K0FKEA	Vishay
R3, R6	3 $\Omega$ , 1/4 W Chip Resistor	CRCW12063R00JNEA	Vishay
R4	1.5 $\Omega$ , 1/4 W Chip Resistor	RC1206FR-071R5L	Yageo
R5	1 $\Omega$ , 1/4 W Chip Resistor	CRCW12061R00FKEA	Vishay
Z1	3300–3800 MHz Band, 90°, 2 dB Hybrid Coupler	X3C35F1-02S	Anaren
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	D109679	MTL

### TYPICAL CHARACTERISTICS — 3400–3600 MHz

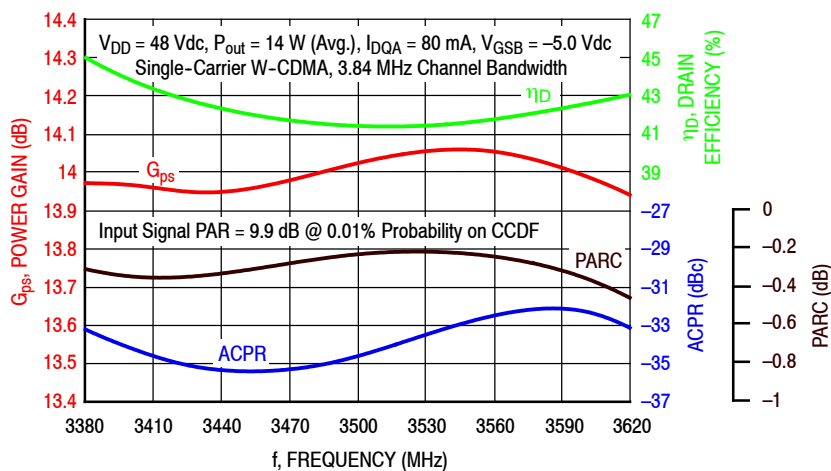


Figure 3. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 14$  Watts Avg.

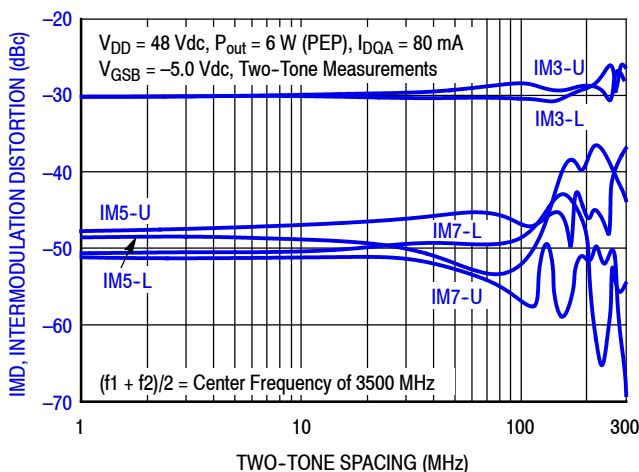


Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing

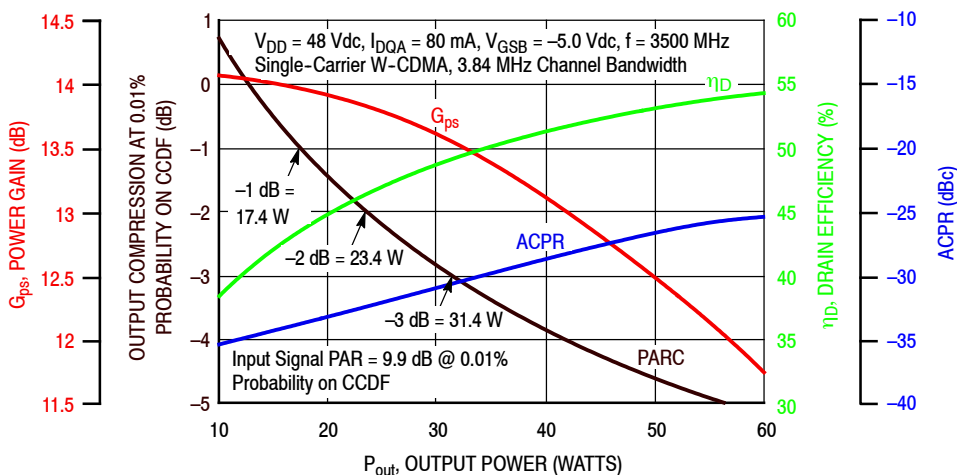
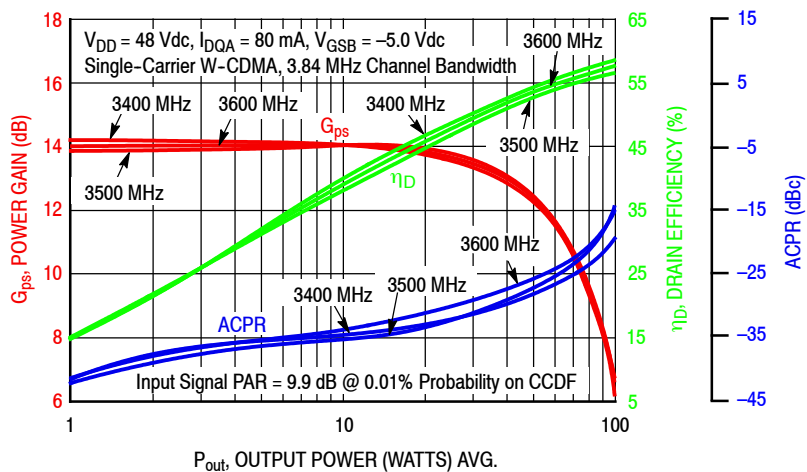
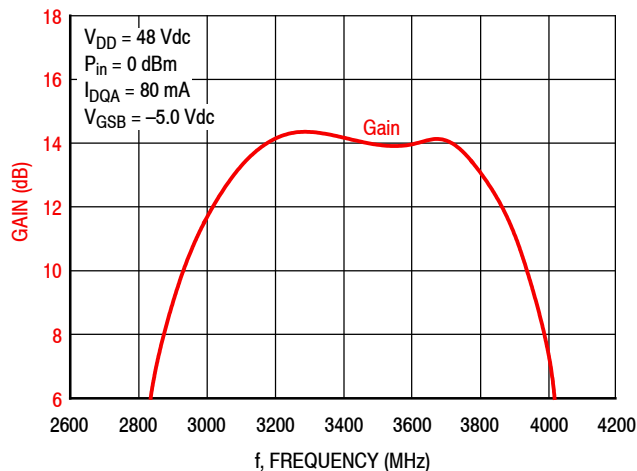


Figure 5. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

### TYPICAL CHARACTERISTICS — 3400–3600 MHz

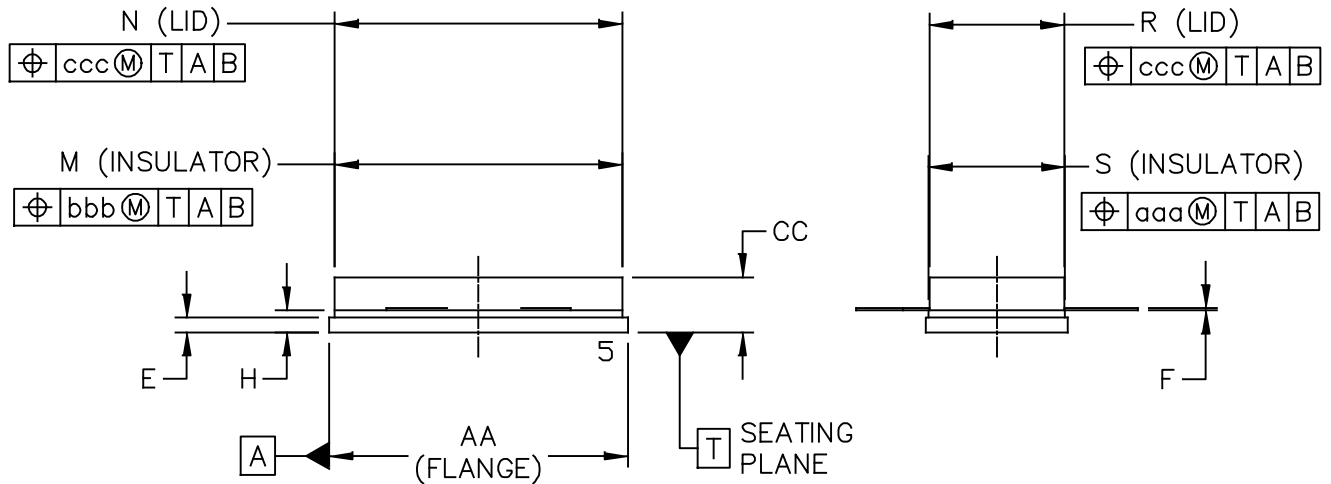
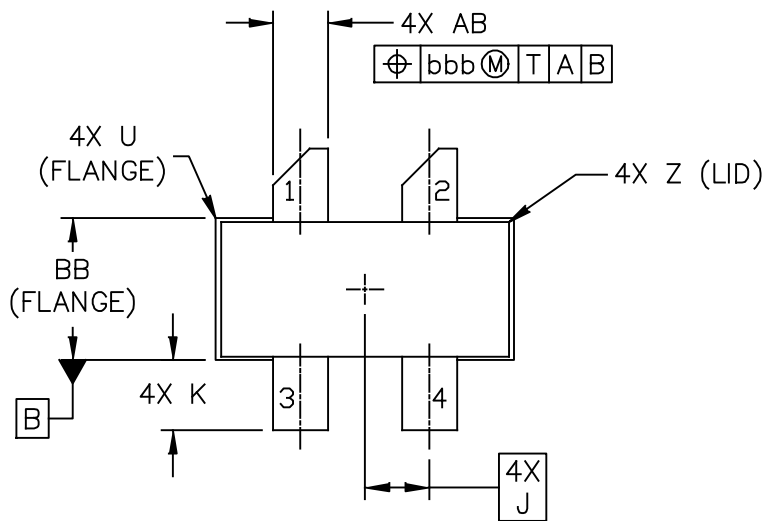


**Figure 6. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power**



**Figure 7. Broadband Frequency Response**

### PACKAGE DIMENSIONS



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	STANDARD: NON-JEDEC	
	SOT1826-1	01 AUG 2016

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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					STANDARD: NON-JEDEC				
					SOT1826-1			01 AUG 2016	



## 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

### 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	<ul style="list-style-type: none"><li>• Initial release of data sheet</li></ul>

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