RF Power GaN Transistor

This 56 W symmetrical Doherty RF power GaN transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 1805 to 2200 MHz.

This part is characterized and performance is guaranteed for applications operating in the 1805 to 2200 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

2000 MHz

- Typical Doherty Single-Carrier W-CDMA Performance: V_{DD} = 48 Vdc, I_{DQA} = 250 mA, V_{GSB} = –5.0 Vdc, P_{out} = 56 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

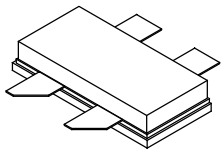
Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
1805 MHz	16.0	54.3	8.0	–26.4
1995 MHz	16.8	52.2	7.8	–31.9
2170 MHz	15.4	53.9	7.6	–33.8

Features

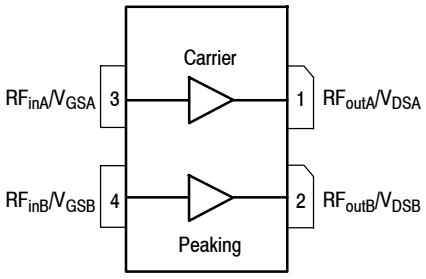
- High terminal impedances for optimal broadband performance
- Advanced high performance in-package Doherty
- Improved linearized error vector magnitude with next generation signal
- Able to withstand extremely high output VSWR and broadband operating conditions

A3G18D510-04S

1805–2200 MHz, 56 W Avg., 48 V AIRFAST RF POWER GaN TRANSISTOR



NI-780S-4L



(Top View)

Figure 1. Pin Connections

NXP reserves the right to change the detail specifications as may be required to permit improvements in the design of its products.

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, $I_{G\ (A+B)}$, @ T_C = 25°C	I_{GMAX}	25	mA
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–55 to +150	°C
Operating Active Die Surface Temperature Range	T_J	–55 to +225	°C
Maximum Channel Temperature (1)	T_{CH}	275	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case Case Temperature 72°C, P_D = 68 W	$R_{\theta JC}$ (IR)	0.83 (2)	°C/W
Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 72°C, P_D = 68 W	$R_{\theta CHC}$ (FEA)	1.1 (3)	°C/W

Table 3. ESD Protection Characteristics

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

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
Off Characteristics (4)						
Off-State Drain Leakage		$I_{D(BR)}$				
(V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)	Carrier		—	—	24.3	mAdc
(V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)	Peaking		—	—	24.3	mAdc
On Characteristics — Side A, Carrier						
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 24.3 mAdc)		$V_{GS(th)}$	–3.8	–3.0	–2.3	Vdc
Gate Quiescent Voltage (V_{DD} = 48 Vdc, I_D = 250 mAdc, Measured in Functional Test)		$V_{GSA(Q)}$	–3.7	–3.2	–2.7	Vdc
Gate-Source Leakage Current (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)		I_{GSS}	–12.2	—	—	mAdc
On Characteristics — Side B, Peaking						
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 24.3 mAdc)		$V_{GS(th)}$	–3.8	–3.3	–2.3	Vdc
Gate-Source Leakage Current (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)		I_{GSS}	–12.2	—	—	mAdc

1. Reliability tests were conducted at 225°C. Operations with T_{CH} at 275°C will reduce median time to failure.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
3. $R_{\theta CHC}$ (FEA) must be used for purposes related to reliability and limitations on maximum channel temperature. MTTF may be estimated by the expression MTTF (hours) = $10^{[A + B/(T + 273)]}$, where *T* is the channel temperature in degrees Celsius, *A* = –10.3 and *B* = 8263.
4. Each side of device measured separately.

(continued)

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (1,2) (In NXP Doherty Production Test Fixture, 50 ohm system) V_{DD} = 48 Vdc, I_{DQA} = 250 mA, V_{GSB} = –5.0 Vdc, P_{out} = 56 W Avg., f = 1805 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 @ ±5 MHz Offset. **[See note on correct biasing sequence.]**					
Power Gain	G_{ps}	15.0	16.0	18.0	dB
Drain Efficiency	η_D	44.3	54.3	—	%
P_{out} @ 3 dB Compression Point, CW	P3dB	53.6	55.1	—	dBm
Adjacent Channel Power Ratio	ACPR	—	–26.4	–21.9	dBc
Wideband Ruggedness (In NXP Doherty Production Test Fixture, 50 ohm system) I_{DQA} = 250 mA, V_{GSB} = –5.0 Vdc, f = 1995 MHz, Additive White Gaussian Noise (AWGN) with 10 dB PAR					
ISBW of 400 MHz at 55 Vdc, 228 W Avg. Modulated Output Power (8.5 dB Input Overdrive from 228 W Avg. Modulated Output Power)	No Device Degradation				
Typical Performance (In NXP Doherty Production Test Fixture, 50 ohm system) V_{DD} = 48 Vdc, I_{DQA} = 250 mA, V_{GSB} = –5.0 Vdc, 1805–2170 MHz Bandwidth					
P_{out} @ 3 dB Compression Point (2)	P3dB	—	355	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 1805–2170 MHz bandwidth)	Φ	—	–25	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	260	—	MHz
Gain Flatness in 365 MHz Bandwidth @ P_{out} = 56 W Avg.	G_F	—	1.7	—	dB
Gain Variation over Temperature (–40°C to +85°C)	ΔG	—	0.013	—	dB/°C
Output Power Variation over Temperature (–40°C to +85°C)	ΔP1dB	—	0.013	—	dB/°C

Table 5. Ordering Information

Device	Tape and Reel Information	Package
A3G18D510-04SR3	R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel	NI-780S-4L

1. Part internally input matched.
2. P3dB = P_{avg} + 7.0 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 in a Doherty Configuration

Bias ON the device

1. Set gate voltage V_{GSA} and V_{GSB} to –5 V.
2. Set drain voltage V_{DSA} and V_{DSB} to nominal supply voltage (+48 V).
3. Increase V_{GSA} (carrier side) until I_{DQA} current is attained.
4. Increase V_{GSB} (peaking side) to target bias voltage.
5. Apply RF input power to desired level.

Bias OFF the device

1. Disable RF input power.
2. Adjust gate voltage V_{GSA} and V_{GSB} to –5 V.
3. Adjust drain voltage V_{DSA} and V_{DSB} to 0 V. Allow adequate time for drain voltage to reduce to 0 V from external drain capacitors.
4. Disable V_{GSA} and V_{GSB}.

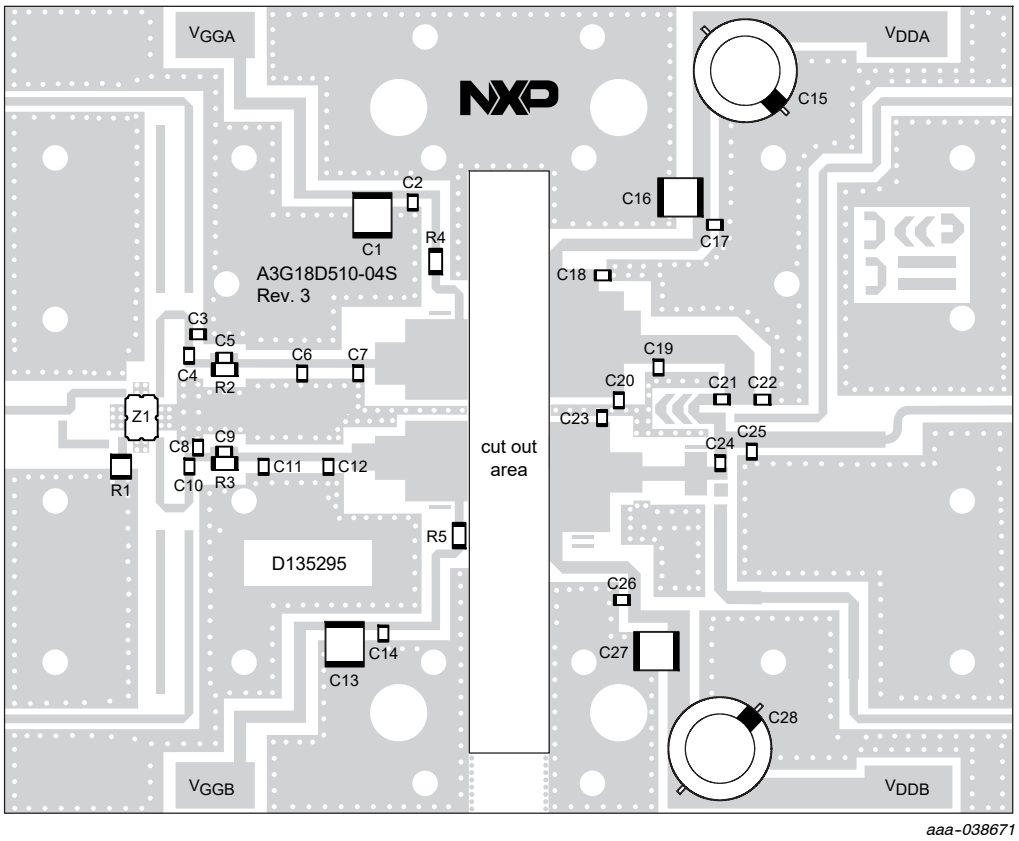
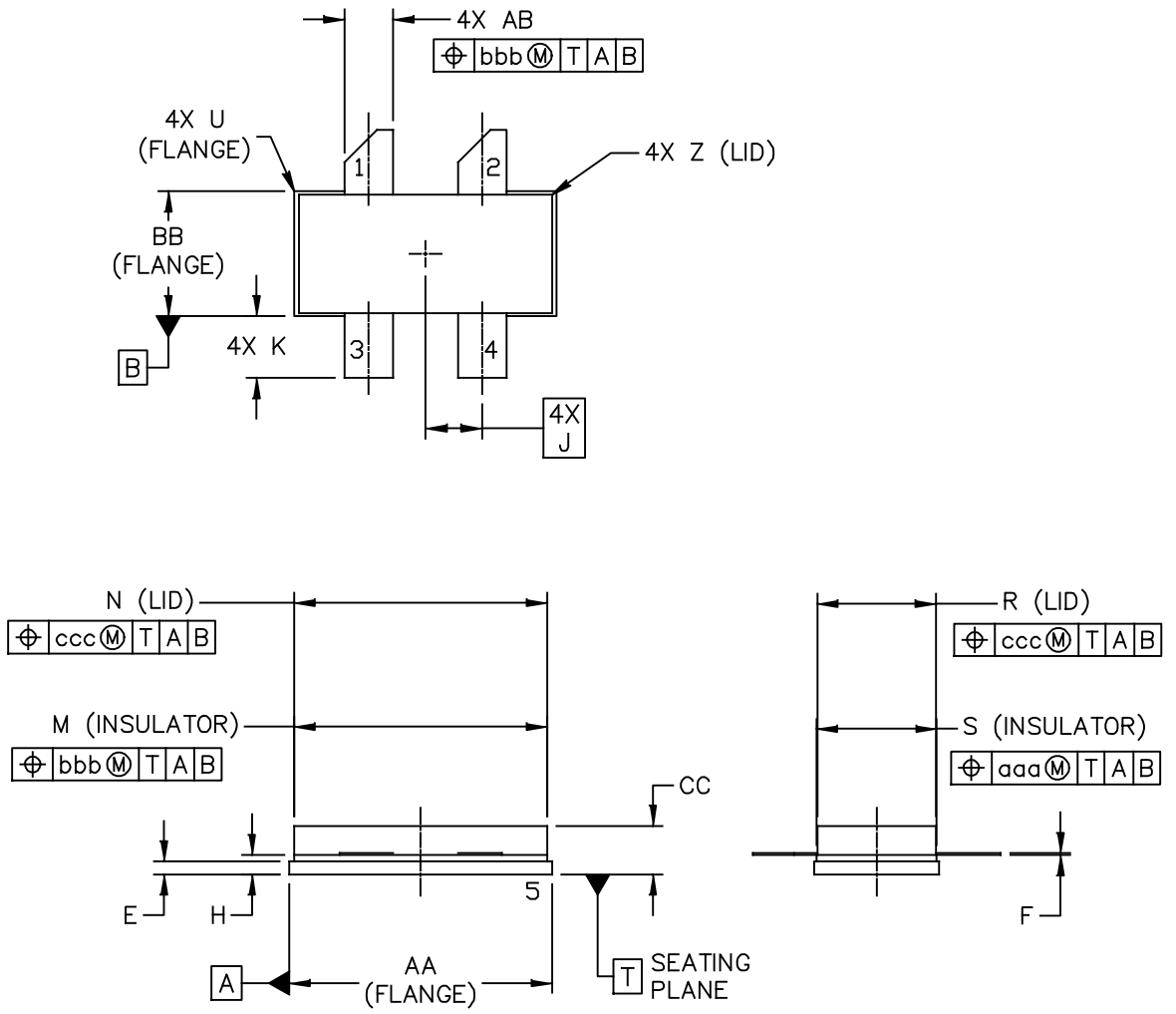


Figure 2. A3G18D510-04S Production Test Circuit Component Layout

Table 6. A3G18D510-04S Production Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C13, C16, C27	10 μF Chip Capacitor	C5750X7S2A106M230KB	TDK
C2, C14, C17, C21, C24, C26	15 pF Chip Capacitor	600F150JT250XT	ATC
C3	0.4 pF Chip Capacitor	600F0R4BT250XT	ATC
C4, C5, C9, C10	11 pF Chip Capacitor	600F110JT250XT	ATC
C6	1.6 pF Chip Capacitor	600F1R6BT250XT	ATC
C7, C22	1 pF Chip Capacitor	600F1R0BT250XT	ATC
C8, C18	0.8 pF Chip Capacitor	600F0R8BT250XT	ATC
C11, C20	1.5 pF Chip Capacitor	600F1R5BT250XT	ATC
C12	2 pF Chip Capacitor	600F2R0BT250XT	ATC
C15, C28	220 μF, 100 V Electrolytic Capacitor	MCGPR100V227M16X26	Multicomp
C19, C23	1.2 pF Chip Capacitor	600F1R2BT250XT	ATC
C25	0.2 pF Chip Capacitor	600F0R2BT250XT	ATC
R1	50 Ω, 10 W Termination Chip Resistor	C10A50Z4	Anaren
R2	9.1 Ω, 1/4 W Chip Resistor	CRCW12069R10FKEA	Vishay
R3	7.5 Ω, 1/4 W Chip Resistor	CRCW12067R50FKEA	Vishay
R4	3.9 Ω, 1/4 W Chip Resistor	CRCW12063R90FKEA	Vishay
R5	4.3 Ω, 1/4 W Chip Resistor	CRCW12064R30FKEA	Vishay
Z1	1700–2000 MHz, 90°, 3 dB Hybrid Coupler	X3C19P1-03S	Anaren
PCB	RO4350B, 0.020″, ε_r = 3.66	D135295	MTL

Package Information



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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 MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER 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

Software

- .s2p File

Development Tools

- Printed Circuit Boards

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Aug. 2020	• Initial release of data sheet

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