



# RF Power LDMOS Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

This 87 W asymmetrical Doherty RF power LDMOS transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 2110 to 2200 MHz.

### 2100 MHz

- Typical Doherty Single-Carrier W-CDMA Performance:  $V_{DD} = 30$  Vdc,  $I_{DQA} = 800$  mA,  $V_{GSB} = 0.35$  Vdc,  $P_{out} = 87$  W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

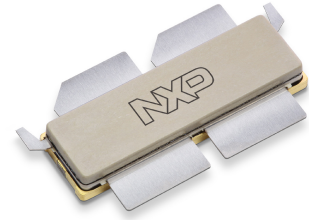
Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	14.8	49.5	8.0	-30.3
2140 MHz	15.3	48.9	8.0	-31.1
2170 MHz	15.5	48.6	7.8	-31.3
2200 MHz	15.5	47.9	7.7	-32.0

### Features

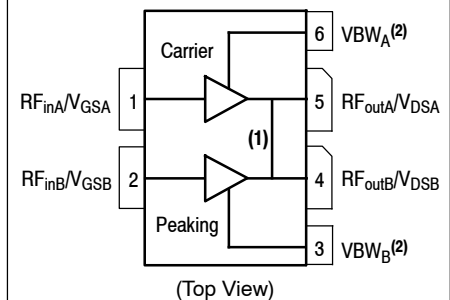
- Advanced high performance in-package Doherty
- Designed for wide instantaneous bandwidth applications
- Greater negative gate-source voltage range for improved Class C operation
- Able to withstand extremely high output VSWR and broadband operating conditions
- Designed for digital predistortion error correction systems

**A3T21H456W23SR6**

**2110–2200 MHz, 87 W AVG., 30 V  
AIRFAST RF POWER LDMOS  
TRANSISTOR**



ACP-1230S-4L2S



**Figure 1. Pin Connections**

- Pin connections 4 and 5 are DC coupled and RF independent.
- Device can operate with  $V_{DD}$  current supplied through pin 3 and pin 6.

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	-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
CW Operation @ $T_C = 25^\circ\text{C}$ when DC current is fed through pin 3 and pin 6 Derate above $25^\circ\text{C}$	CW	131 0.8	W W/°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature $79^\circ\text{C}$ , 87 W Avg., W-CDMA, 30 Vdc, $I_{DQA} = 800\text{ mA}$ , $V_{GSB} = 0.35\text{ Vdc}$ , 2155 MHz	$R_{\theta JC}$	0.14	°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)**

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 32\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	5	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

**On Characteristics - Side A, Carrier**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 160\text{ }\mu\text{Adc}$ )	$V_{GS(th)}$	1.4	1.8	2.2	Vdc
Gate Quiescent Voltage ( $V_{DD} = 30\text{ Vdc}$ , $I_{DA} = 800\text{ mAdc}$ , Measured in Functional Test)	$V_{GSA(Q)}$	2.2	2.6	3.0	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1.6\text{ Adc}$ )	$V_{DS(on)}$	0.0	0.15	0.3	Vdc

**On Characteristics - Side B, Peaking**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 360\text{ }\mu\text{Adc}$ )	$V_{GS(th)}$	0.8	1.2	1.6	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 3.6\text{ Adc}$ )	$V_{DS(on)}$	0.0	0.15	0.3	Vdc

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.nxp.com/RF/calculators>.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.nxp.com/RF> and search for AN1955.
4. Side A and Side B are tied together for these measurements.

(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>(1,2,3)</sup> (In NXP Doherty Test Fixture, 50 ohm system) $V_{DD} = 30\text{ Vdc}$ , $I_{DQA} = 800\text{ mA}$ , $V_{GSB} = 0.35\text{ Vdc}$ , $P_{out} = 87\text{ W Avg.}$ , $f = 2110\text{ MHz}$ , 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.					
Power Gain	$G_{ps}$	13.8	14.8	16.8	dB
Drain Efficiency	$\eta_D$	46.0	49.5	—	%
$P_{out}$ @ 3 dB Compression Point, CW	P3dB	55.9	56.8	—	dBm
Adjacent Channel Power Ratio	ACPR	—	-30.3	-27.5	dBc

**Load Mismatch** <sup>(3)</sup> (In NXP Doherty Test Fixture, 50 ohm system)  $I_{DQA} = 800\text{ mA}$ ,  $V_{GSB} = 0.35\text{ Vdc}$ ,  $f = 2140\text{ MHz}$ , 12  $\mu\text{sec}(\text{on})$ , 10% Duty Cycle

VSWR 10:1 at 32 Vdc, 550 W Pulsed CW Output Power (3 dB Input Overdrive from 389 W Pulsed CW Rated Power)	No Device Degradation
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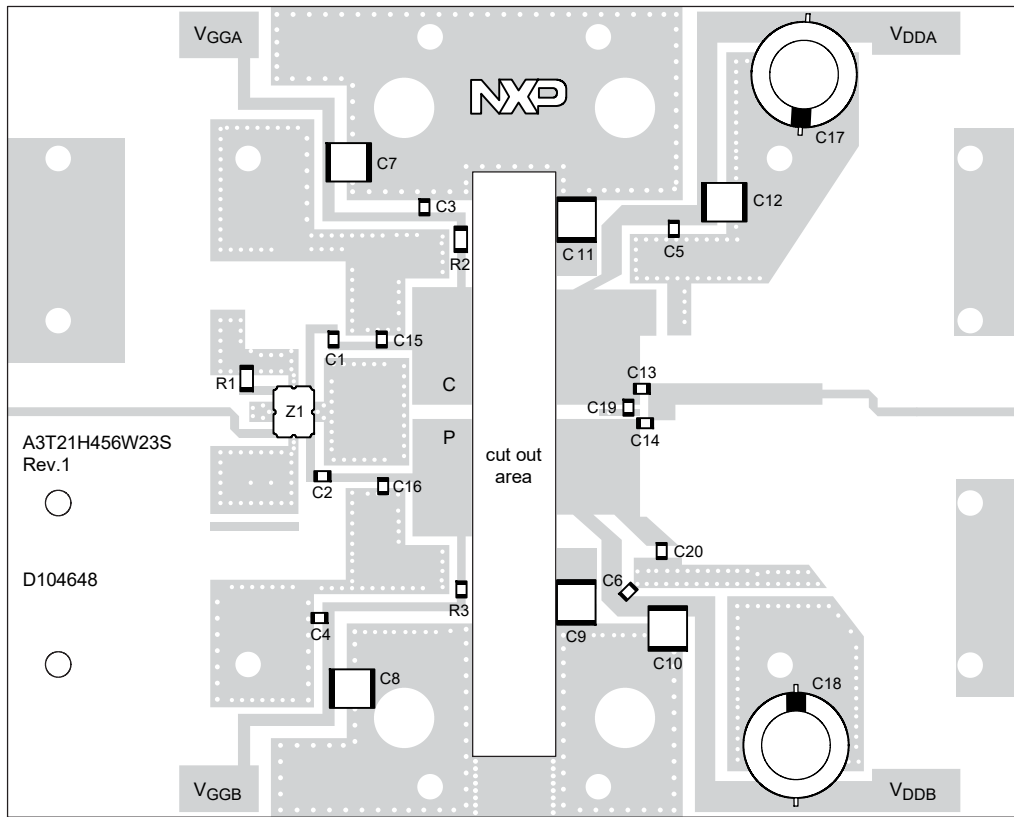
**Typical Performance** <sup>(3)</sup> (In NXP Doherty Test Fixture, 50 ohm system)  $V_{DD} = 30\text{ Vdc}$ ,  $I_{DQA} = 800\text{ mA}$ ,  $V_{GSB} = 0.35\text{ Vdc}$ , 2110–2200 MHz Bandwidth

$P_{out}$ @ 3 dB Compression Point <sup>(4)</sup>	P3dB	—	562	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 2110–2200 MHz bandwidth)	$\Phi$	—	-20	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	$VBW_{res}$	—	210	—	MHz
Gain Flatness in 90 MHz Bandwidth @ $P_{out} = 87\text{ W Avg.}$	$G_F$	—	0.2	—	dB
Gain Variation over Temperature (-30°C to +85°C)	$\Delta G$	—	0.005	—	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
A3T21H456W23SR6	R6 Suffix = 150 Units, 56 mm Tape Width, 13-inch Reel	ACP-1230S-4L2S

- $V_{DDA}$  and  $V_{ddb}$  must be tied together and powered by a single DC power supply.
- Part internally matched both on input and output.
- 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:  $V_{DDA}$  and  $V_{DDB}$  must be tied together and powered by a single DC power supply.

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**Figure 2. A3T21H456W23SR6 Test Circuit Component Layout**

**Table 6. A3T21H456W23SR6 Test Circuit Component Designations and Values**

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6, C14	15 pF Chip Capacitor	ATC600F150FW250XT	ATC
C7, C8, C9, C10, C11, C12	10 $\mu$ F Chip Capacitor	C5750X7S2A106M230KB	TDK
C13	5.1 pF Chip Capacitor	ATC600F5R1BW250XT	ATC
C15	0.6 pF Chip Capacitor	ATC600F0R6BW250XT	ATC
C16	1.0 pF Chip Capacitor	ATC600F1R0BW250XT	ATC
C17, C18	220 $\mu$ F, 50 V Electrolytic Capacitor	227CKS050M	Illinois Capacitor
C19	2.2 pF Chip Capacitor	ATC600F2R2BW250XT	ATC
C20	0.3 pF Chip Capacitor	ATC600F0R4BW250XT	ATC
R1	50 $\Omega$ , 8 W Termination Chip Resistor	S1206N	RN2 Technologies
R2, R3	6.8 $\Omega$ , 1/4 W Chip Resistor	CRCW12066R80FKEA	Vishay
Z1	2000–2300 MHz Band, 90°, 2 dB Asymmetric Coupler	CMX21Q02	RN2 Technologies
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	D104848	MTL

Figure 1 is a mechanical drawing of a package, showing top, side, and detail views. The top view includes dimensions AA, BB, and CC, and features 1, 2, 3, 4, 5, and 6. The side view includes dimensions DD, EE, FF, GG, HH, and II, and features 1, 2, 3, 4, 5, and 6. The detail view includes dimensions JJ, KK, LL, MM, NN, and OO, and features 1, 2, 3, 4, 5, and 6. The drawing includes various symbols and labels for dimensions and features.

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	STANDARD: NON-JEDEC	
	SOT1800-4	21 JUN 2017

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

2. CONTROLLING DIMENSION: INCH

3. DIMENSIONS H1 AND H2 ARE MEASURED .030 INCH (0.762 MM) AWAY FROM FLANGE PARALLEL TO DATUM B. H1 APPLIES TO PINS 1, 2, 4 & 5. H2 APPLIES TO PINS 3 & 6.

4. TOLERANCE OF DIMENSION H2 IS TENTATIVE.

5. THESE SURFACES OF THE HEAT SLUG ARE NOT PART OF THE SOLDERABLE SURFACES AND MAY REMAIN UNPLATED.

6. DATUM H IS LOCATED AT THE BOTTOM OF THE LEAD FRAME AND IS COINCIDENT WITH THE LEAD WHERE THE LEADS EXIT THE PLASTIC BODY.

7. DIMENSIONS M AND S DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .012 INCH (0.30 MM) PER SIDE. DIMENSIONS M AND S DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.

8. DIMENSIONS D, U AND K DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .010 INCH (0.25 MM) TOTAL IN EXCESS OF THE D, U AND K DIMENSION AT MAXIMUM MATERIAL CONDITION.

9. DATUM A AND B TO BE DETERMINED AT DATUM T.

DIM	INCHES		MILLIMETERS		DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
AA	1.265	1.275	32.13	32.39	S	.365	.375	9.27	9.53
BB	.395	.405	10.03	10.29	U	.035	.045	0.89	1.14
CC	.160	.190	4.06	4.83	V1	.640	.655	16.26	16.64
D	.455	.465	11.56	11.81	W1	.105	.115	2.67	2.92
E	.062	.069	1.57	1.75	W2	.135	.145	3.43	3.68
F	.004	.007	0.10	0.18	W3	.245	.255	6.22	6.48
H1	.082	.090	2.08	2.29	W4	.265	.281	6.73	7.14
H2	.078	.094	1.98	2.39	Y	0.695 BSC		17.65 BSC	
K	.175	.195	4.45	4.95	Z1	R.000	R.040	R0.00	R1.02
L	0.270 BSC		6.86 BSC		Z2	.060	.100	1.52	2.54
M	1.219	1.241	30.96	31.52	aaa	.015		0.38	
N	1.218	1.242	30.94	31.55	bbb	.010		0.25	
R	.365	.375	9.27	9.53	ccc	.020		0.51	
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TITLE:  ACP-1230S-4L2S					DOCUMENT NO: 98ASA00974D                      REV: A				
					STANDARD: NON-JEDEC				
					SOT1800-4				

## 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

- Electromigration MTTF Calculator
- .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
1	Aug. 2018	• Functional Tests table: changed P3dB min value from 55.5 dBm to 55.9 dBm to reflect current production data, p. 3

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