A3T09S100N

Airfast RF Power LDMOS Transistor

Rev. 0 — March 2021

Data Sheet: Technical Data

Designed for two-way radio applications with frequencies from 136 to 941 MHz. The high gain, ruggedness and wideband performance of this device make it ideal for large-signal, common-source amplifier applications in radio equipment.

Typical Single-Carrier W–CDMA Production Fixture Performance:
V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{out} = 15 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF

Frequency (MHz)	G_{ps} (dB)	η_D (%)	Avg. P_{out} (W)
880	22.8	33.8	15

Typical Reference Circuit Performance: V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{in} = 0.125 W, CW

Frequency (MHz)	G_{ps} (dB)	η_D (%)	P_{out} (W)
136	28.5	64.0	90

Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
880	CW	> 10:1 at all Phase Angles	1.3	32	No Device Degradation
136	CW	> 5:1 at all Phase Angles	0.2	32	No Device Degradation

Features

- Characterized for operation from 136 to 941 MHz
- Unmatched input and output allowing wide frequency range utilization
- Integrated ESD protection
- Wideband — full power across each mobile radio band
- Exceptional thermal performance
- High linearity for: TETRA, SSB, LTE

Typical Applications

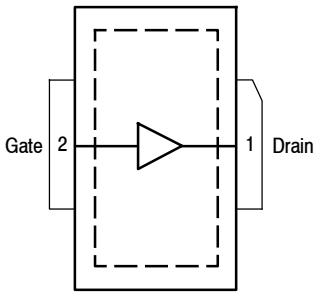
- Output stage for VHF, UHF and 900 MHz 28 V base stations
- Output stage for VHF, UHF and 900 MHz high performance mobile radios

A3T09S100N

136–941 MHz, 100 W CW, 32 V AIRFAST RF POWER LDMOS TRANSISTOR



TO-270-2 PLASTIC



(Top View)

Note: The backside of the package is the source terminal for the transistor.

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}	–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
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	222 1.11	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 80.5°C, 14 W Avg., W–CDMA, 28 Vdc, I_{DQ} = 450 mA, 880 MHz	$R_{\theta JC}$	0.90	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JS–001–2017)	Class 1C, passes 1500 V
Charge Device Model (per JS–002–2014)	Class C3, passes 1000 V

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22–A113, IPC/JEDEC J–STD–020	3	260	°C

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 32 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate–Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 100 μAdc)	$V_{GS(th)}$	1.0	1.8	3.0	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_D = 450 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2.3	2.6	2.9	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 100 mAdc)	$V_{DS(on)}$	—	0.02	—	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 7.5 Adc)	g_{fs}	—	6.2	—	S

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.nxp.com.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.

(continued)

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Dynamic Characteristics					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.4	—	pF
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	30.9	—	pF
Input Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	68.3	—	pF

Functional Tests (In NXP Production Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{out} = 15 W Avg., f = 880 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.

Power Gain	G_{ps}	22.0	22.8	25.0	dB
Drain Efficiency	η_D	32.4	33.8	—	%
Adjacent Channel Power Ratio	ACPR	—	–38.0	–33.0	dBc
Input Return Loss	IRL	—	–19	–9	dB

Load Mismatch/Ruggedness — 880 MHz (In NXP Production Test Fixture, 50 ohm system) I_{DQ} = 450 mA

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
880	CW	> 10:1 at all Phase Angles	1.3 (3 dB Overdrive)	32	No Device Degradation

Load Mismatch/Ruggedness — 136 MHz (In NXP Reference Circuit, 50 ohm system) I_{DQ} = 450 mA

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
136	CW	> 5:1 at all Phase Angles	0.2 (3 dB Overdrive)	32	No Device Degradation

Table 6. Ordering Information

Device	Tape and Reel Information	Package
A3T09S100NR1	R1 Suffix = 500 Units, 24 mm Tape Width, 13-inch Reel	TO-270-2

Typical Characteristics

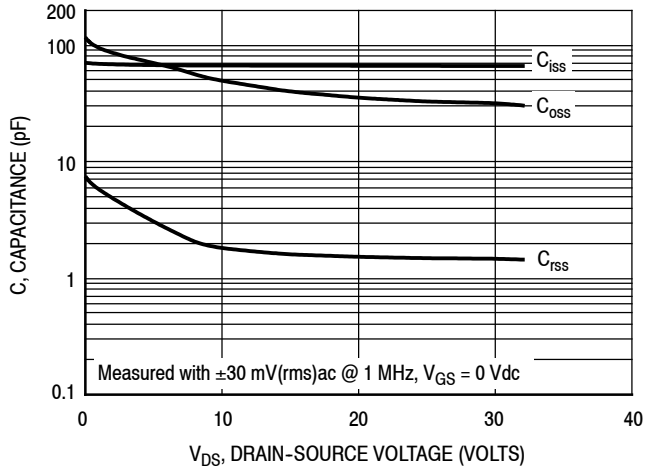


Figure 2. Capacitance versus Drain-Source Voltage

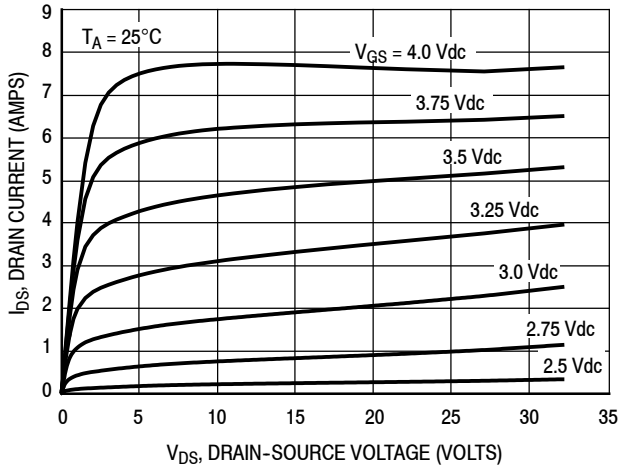
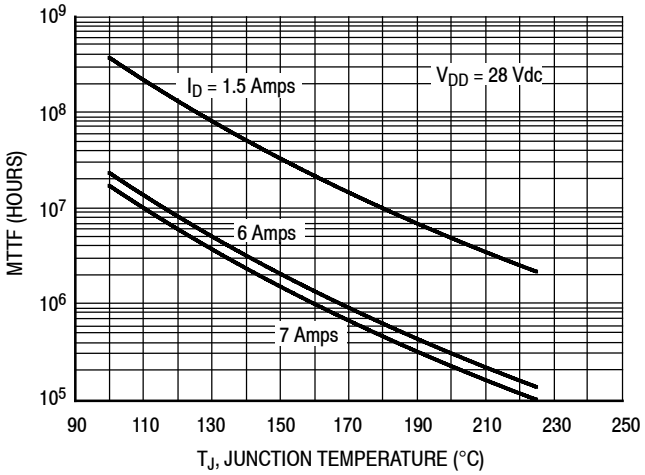


Figure 3. Drain Current Versus Drain-Source Voltage

Typical Characteristics (cont.)



Note: MTTF value represents the total cumulative operating time under indicated test conditions.

MTTF calculator available at http://www.nxp.com.

Figure 4. MTTF versus Junction Temperature — CW

880 MHz Production Fixture — 3″ × 5″ (7.6 cm × 12.7 cm)

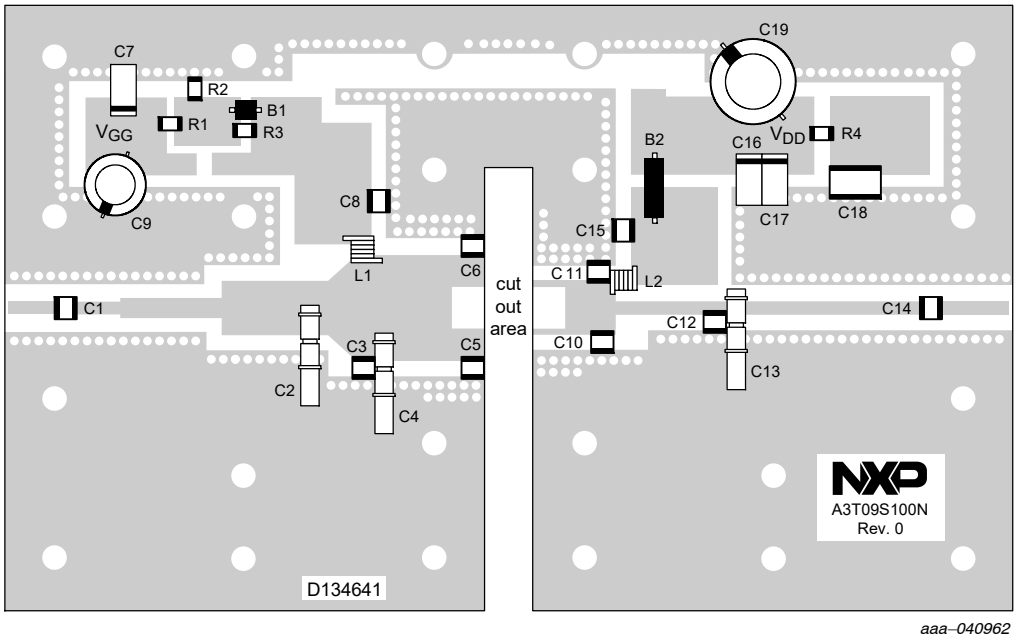


Figure 5. A3T09S100N Production Fixture Component Layout — 880 MHz

Table 7. A3T09S100N Production Fixture Component Designations and Values — 880 MHz

Part	Description	Part Number	Manufacturer
B1	Short RF Bead	2743019447	Fair-Rite
B2	Long RF Bead	2743021447	Fair-Rite
C1, C8, C14, C15	47 pF Chip Capacitor	100B470JT500XT	ATC
C2, C4, C13	0.8–8.0 pF Variable Capacitor, Gigatrim	27291SL	Johanson
C3	3.0 pF Chip Capacitor	100B3R0JT500XT	ATC
C5, C6	15 pF Chip Capacitor	100B150JT500XT	ATC
C7, C16, C17	10 μF, 35 V Tantalum Capacitor	T491D106035AT	Kemet
C9	100 μF, 50 V Electrolytic Capacitor	MCGPR50V107M8X11	Multicomp
C10, C11	12 pF Chip Capacitor	100B120JT500XT	ATC
C12	4.3 pF Chip Capacitor	100B4R3JT500XT	ATC
C18	0.56 μF Chip Capacitor	C1825C564J5RACTU	Kemet
C19	470 μF, 63 V Electrolytic Capacitor	MCGPR63V477M13X26	Multicomp
L1, L2	12.5 nH Inductor	A04TJLC	Coilcraft
R1	1 kΩ, 1/4 W Chip Resistor	CRCW12061001FKEA	Vishay
R2	560 kΩ, 1/4 W Chip Resistor	CRCW12065600FKEA	Vishay
R3	12 Ω, 1/4 W Chip Resistor	CRCW120612R0FKEA	Vishay
R4	27 Ω, 1/4 W Chip Resistor	CRCW120627R0FKEA	Vishay
PCB	Taconic RF35, 0.030”, ε_r = 3.5, 1 oz. Copper	D134641	MTL

Typical Characteristics — 880 MHz Production Test Fixture

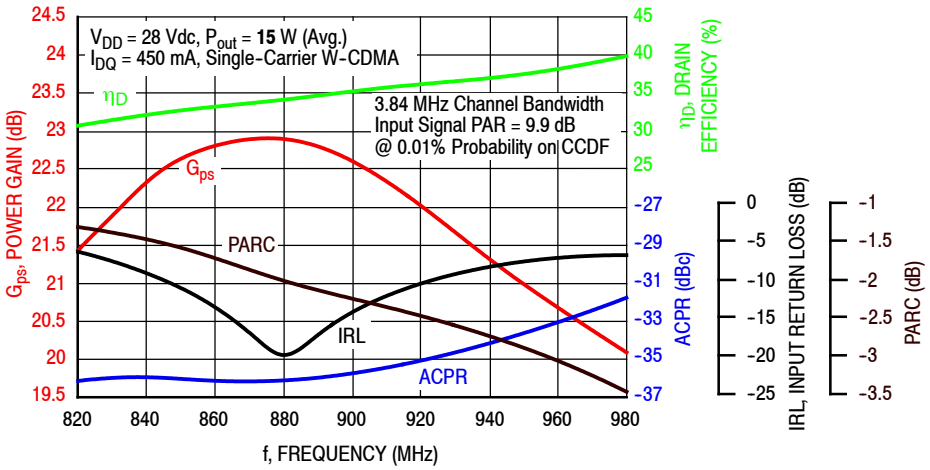


Figure 6. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 15 Watts Avg.

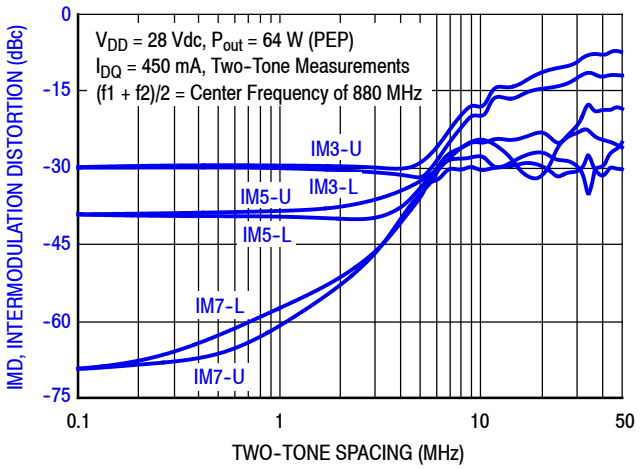


Figure 7. Intermodulation Distortion Products versus Two-Tone Spacing

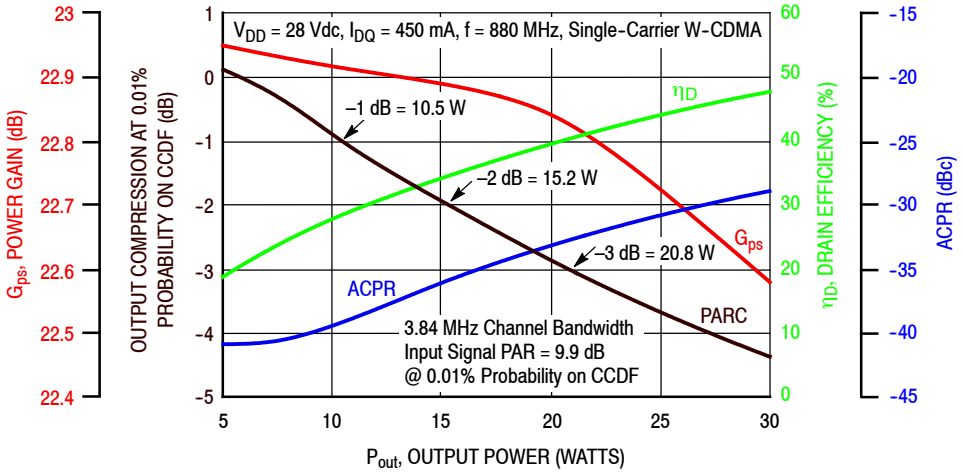


Figure 8. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

Typical Characteristics — 880 MHz Production Test Fixture (cont.)

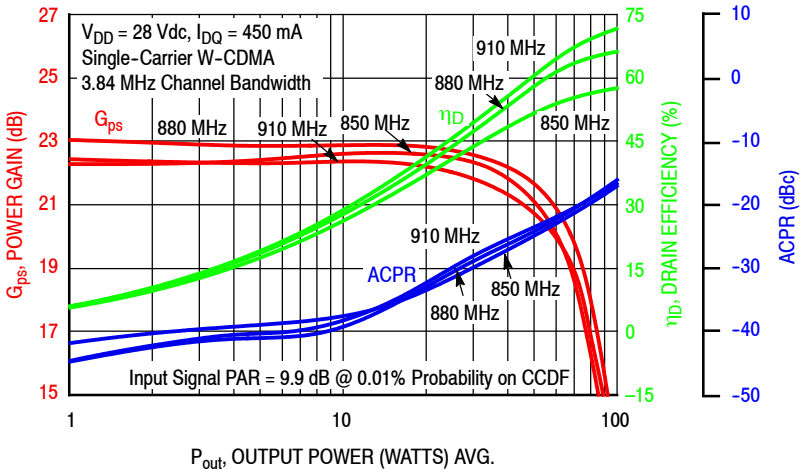


Figure 9. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power

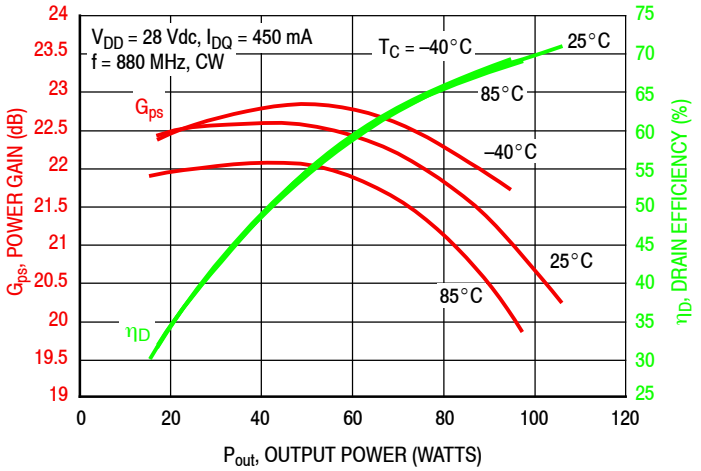


Figure 10. Power Gain and Drain Efficiency versus CW Output Power over Temperature

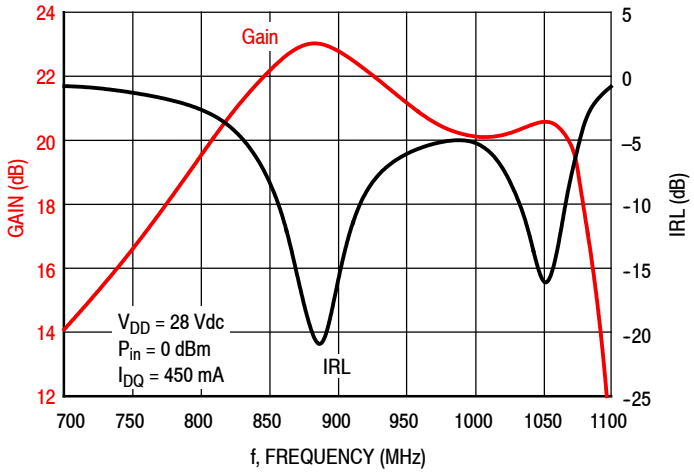


Figure 11. Broadband Frequency Response

850–910 MHz Production Fixture

f (MHz)	Z_{source} (Ω)	Z_{load} (Ω)
850	0.56 + j0.44	2.23 + j0.56
880	0.62 + j0.77	2.23 + j0.83
910	0.73 + j1.21	2.20 + j1.09

Z_{source} = Test circuit impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

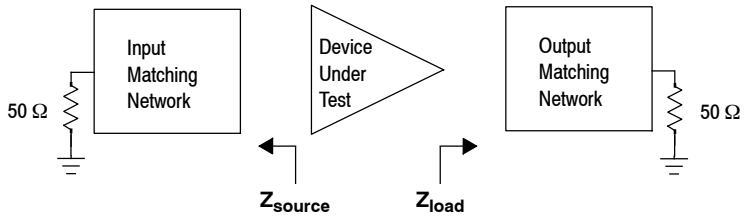


Figure 12. Series Equivalent Source and Load Impedance – 850–910 MHz

136 MHz Reference Circuit — 3″ × 5″ (7.6 cm × 12.7 cm)

Table 8. 136 MHz Performance (In NXP Reference Circuit, 50 ohm system)
V_{DD} = 28 Vdc, I_{DQ} = 450 mA, P_{in} = 0.125 W, CW

Frequency (MHz)	G_{ps} (dB)	η_D (%)	P_{out} (W)
136	28.5	64.0	90

136 MHz Reference Circuit — 3″ × 5″ (7.6 cm × 12.7 cm)

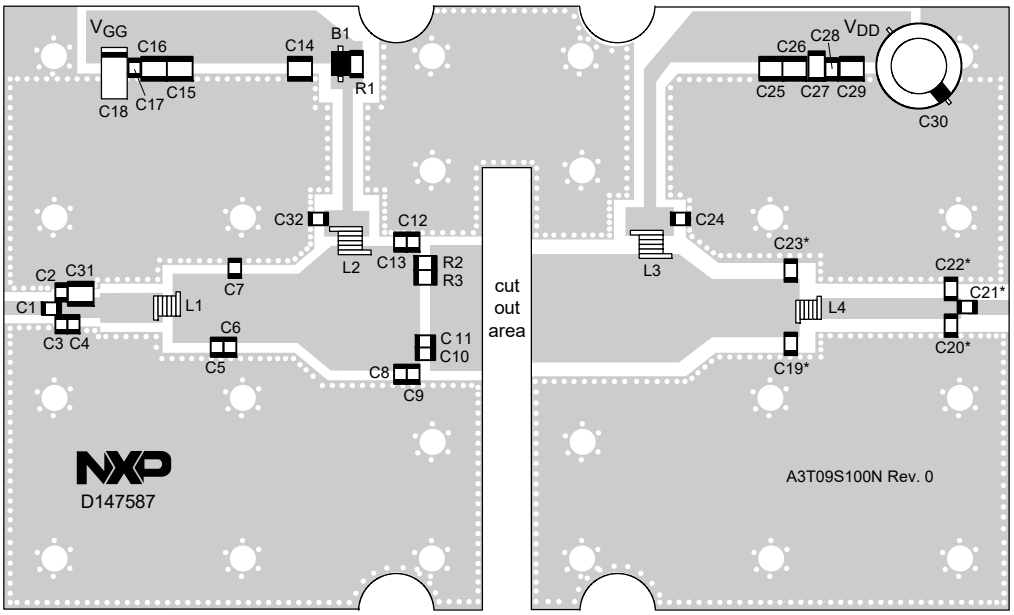


Figure 13. A3T09S100N Reference Circuit Component Layout — 136 MHz

136 MHz Reference Circuit — 3″ × 5″ (7.6 cm × 12.7 cm) (cont.)

Table 9. A3T09S100N Reference Circuit Component Designations and Values — 136 MHz

Part	Description	Part Number	Manufacturer
B1	30 Ω, 6 A Ferrite Bead	MPZ2012S300A	TDK
C1	18 pF Chip Capacitor	600F180JT250XT	ATC
C2, C20, C22	36 pF Chip Capacitor	600F360JT250XT	ATC
C3	24 pF Chip Capacitor	600F240JT250XT	ATC
C4, C9	2.0 pF Chip Capacitor	600F2R0BT250XT	ATC
C5, C6, C7	8.2 pF Chip Capacitor	600F8R2BT250XT	ATC
C8, C12	1.5 pF Chip Capacitor	600F1R5BT250XT	ATC
C10	100 pF Chip Capacitor	600F101JT250XT	ATC
C11	30 pF Chip Capacitor	600F300JT250XT	ATC
C13	1.0 pF Chip Capacitor	600F1R0BT250XT	ATC
C14, C25	510 pF Chip Capacitor	100B511JT500XT	ATC
C15, C21, C26	1000 pF Chip Capacitor	100B102JT50XT	ATC
C16, C27	10 nF Chip Capacitor	C1210C103J5GACTU	Kemet
C17, C28	0.1 μF Chip Capacitor	C1206C104K1RACTU	Kemet
C18	22 μF, 25 V Tantalum Capacitor	TPSD226M025R0200	AVX
C19, C23	51 pF Chip Capacitor	800B510GT500XT	ATC
C24	15 pF Chip Capacitor	800B150JT500XT	ATC
C29	10 μF, 100 V Electrolytic Capacitor	C5750X7S2A106M230KB	TDK
C30	330 μF, 63 V Electrolytic Capacitor	MCRH63V337M13X21	Multicomp
C31	10 pF Chip Capacitor	100B100JT500XT	ATC
C32	15 pF Chip Capacitor	600F150JT250XT	ATC
L1	27 nH Inductor	1812SMS-27NJLC	Coilcraft
L2	68 nH Inductor	1812SMS-68NJLC	Coilcraft
L3	82 nH Inductor	1812SMS-82NJLC	Coilcraft
L4	12.5 nH Inductor	A04TJLC	Coilcraft
R1	12 Ω, 1/10 W Chip Resistor	RR1220Q-120-D	Susumu
R2, R3	43 Ω, 1/4 W Chip Resistor	CRCW120643R0FKEA	Vishay
PCB	Rogers RO4350B, 0.030″, ε_r = 3.66, 1 oz. Copper	D147587	MTL

Typical Characteristics — 136 MHz Reference Circuit

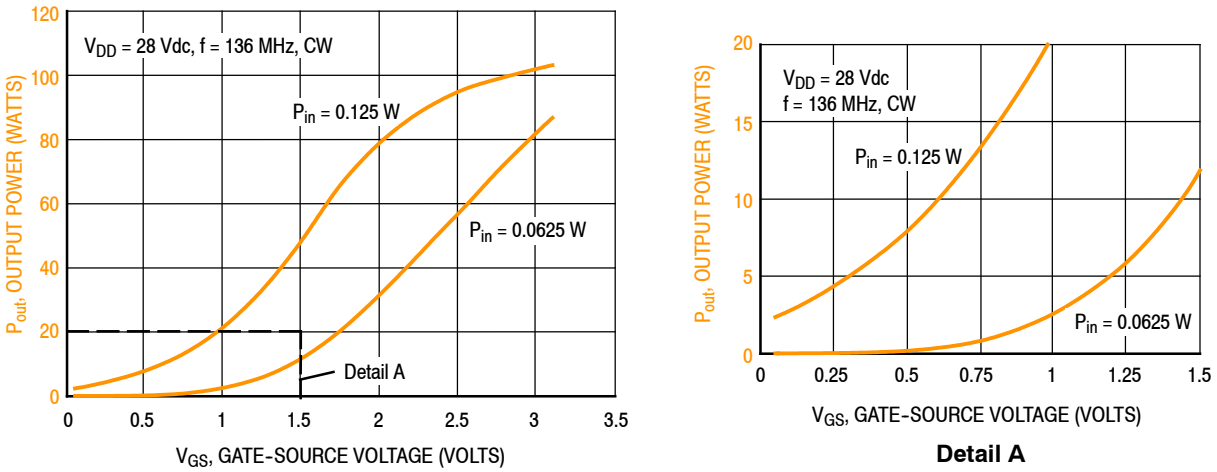


Figure 14. Output Power versus Gate-Source Voltage

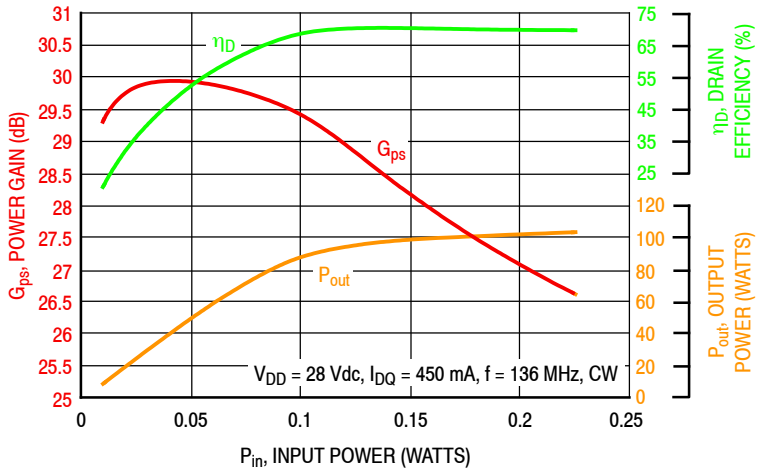


Figure 15. Power Gain, Output Power and Drain Efficiency versus Input Power

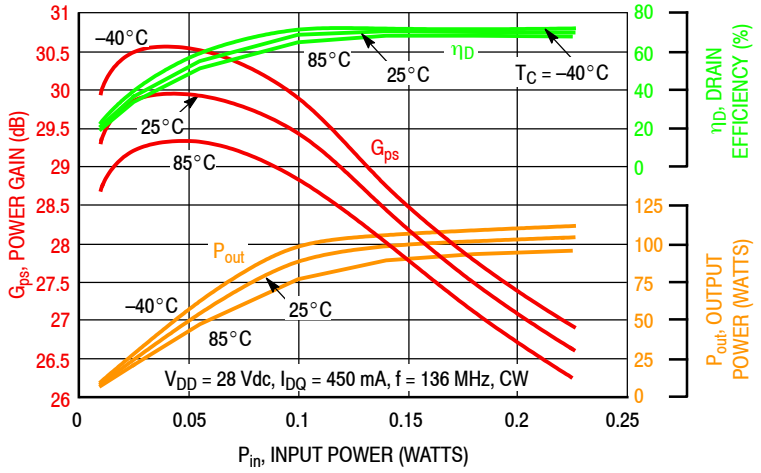


Figure 16. Power Gain, Output Power and Drain Efficiency versus Input Power over Temperature

136 MHz Reference Circuit

f (MHz)	Z_{source} (Ω)	Z_{load} (Ω)
136	7.22 + j13.0	3.87 + j0.32

Z_{source} = Test circuit impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

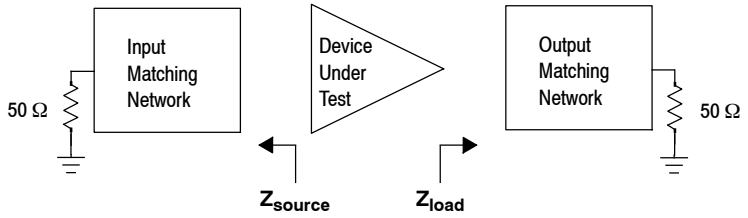
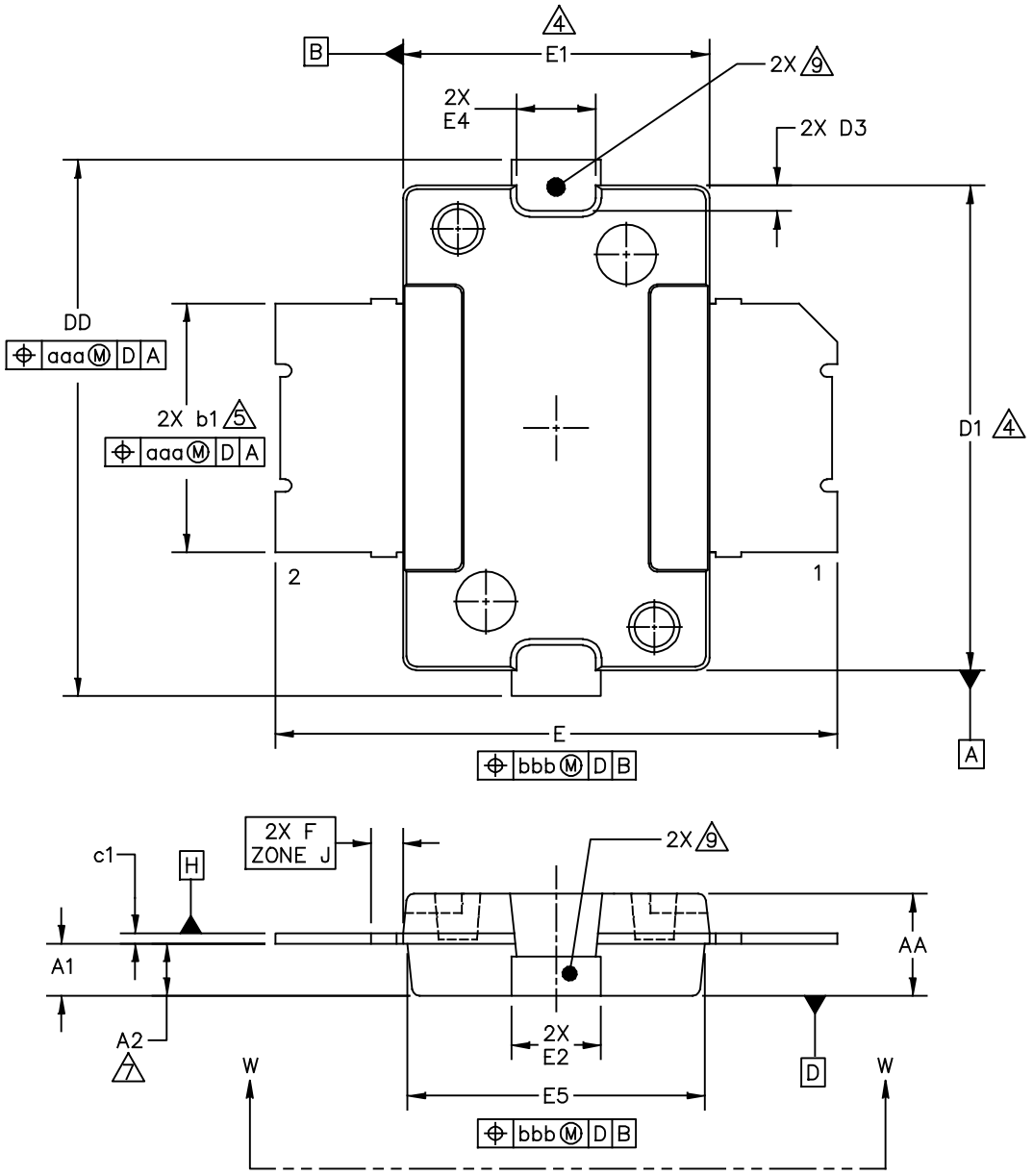


Figure 17. Series Equivalent Source and Load Impedance – 136 MHz

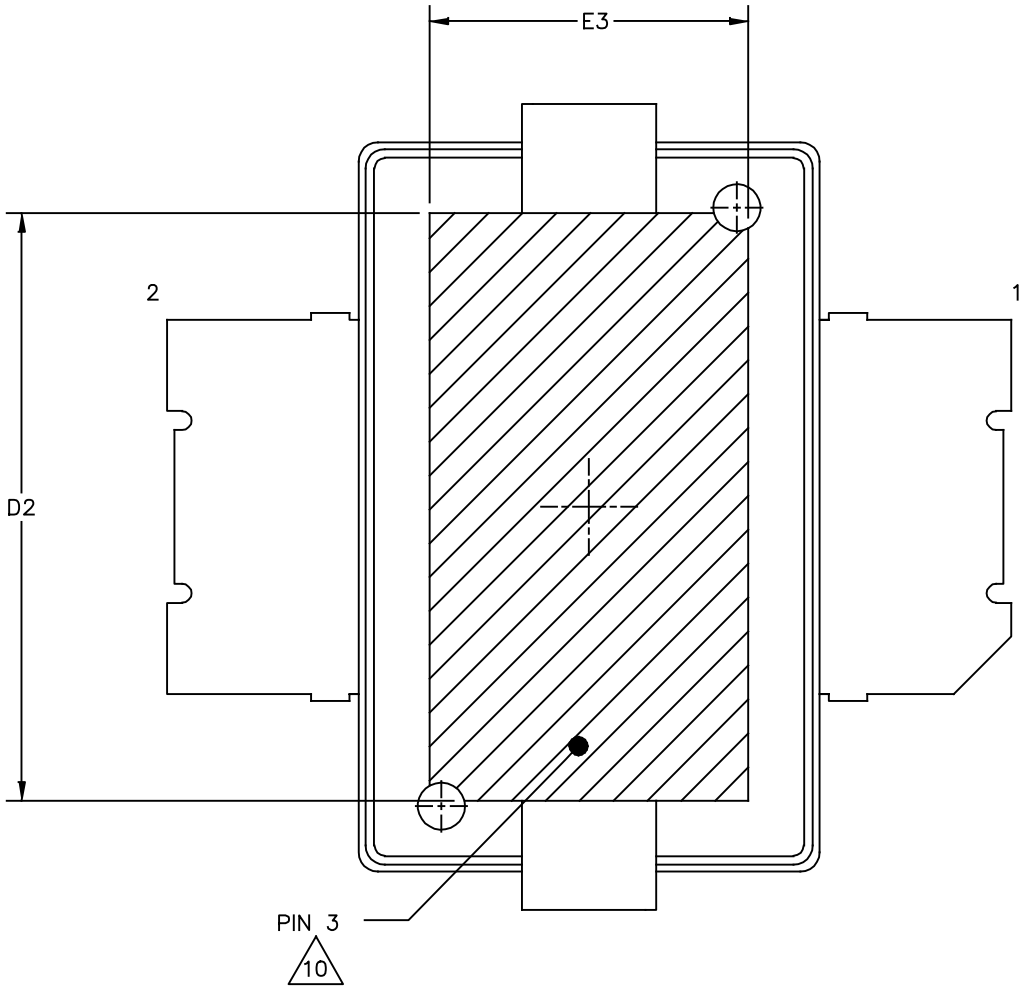


Figure 18. Product Marking

Package Information



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TITLE: TO−270−2	DOCUMENT NO: 98ASH98117A	REV: R
	STANDARD: NON−JEDEC	
	SOT1732−1	22 FEB 2016



VIEW W–W
BOTTOM VIEW

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TITLE: TO–270–2	DOCUMENT NO: 98ASH98117A	REV: R
	STANDARD: NON–JEDEC	
	SOT1732–1	22 FEB 2016

NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DATUM PLANE H IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 INCH (0.15 MM) PER SIDE. DIMENSIONS D1 AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 INCH (0.13 MM) TOTAL IN EXCESS OF THE b1 DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.
7. DIMENSION A2 APPLIES WITHIN ZONE J ONLY.
8. DIMENSIONS DD AND E2 DO NOT INCLUDE MOLD PROTRUSION. OVERALL LENGTH INCLUDING MOLD PROTRUSION SHOULD NOT EXCEED 0.430 INCH (10.92 MM) FOR DIMENSION DD AND 0.080 INCH (2.03 MM) FOR DIMENSION E2. DIMENSIONS DD AND E2 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE D.
9. THESE SURFACES OF THE HEAT SLUG ARE NOT PART OF THE SOLDERABLE SURFACES AND MAY REMAIN UNPLATED.
10. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. DIMENSIONS D2 AND E3 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF THE HEAT SLUG.

	INCH		MILLIMETER			INCH		MILLIMETER	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX
AA	.078	.082	1.98	2.08	E4	.058	.066	1.47	1.68
A1	.039	.043	0.99	1.09	E5	.231	.235	5.87	5.97
A2	.040	.042	1.02	1.07	F	.025 BSC		0.64 BSC	
DD	.416	.424	10.57	10.77	b1	.193	.199	4.90	5.06
D1	.378	.382	9.60	9.70	c1	.007	.011	0.18	0.28
D2	.290	----	7.37	----	aaa	.004		0.10	
D3	.016	.024	0.41	0.61	bbb	.008		0.20	
E	.436	.444	11.07	11.28					
E1	.238	.242	6.04	6.15					
E2	.066	.074	1.68	1.88					
E3	.150	----	3.81	----					

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DOCUMENT NO: 98ASH98117A REV: R

STANDARD: NON–JEDEC

SOT1732–1 22 FEB 2016

Product Documentation, Software and Tools

Refer to the following documents, software and tools to aid your design process.

Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator
- RF High Power Model
- .s2p File

Development Tools

- Printed Circuit Boards

Revision History

The following table summarizes revisions to this document.

Revision	Date	Description
0	Mar. 2021	• Initial release of data sheet

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Home Page:
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