# 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) | $\eta_D$ (%) | 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) | $\eta_D$ (%) | $P_{out}$ (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

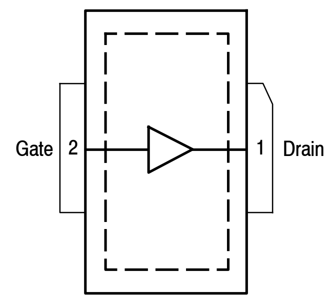
**Typical Applications**

- 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<br>Derate above 25°C | $P_D$ | 222<br>1.11 | W<br>W/°C |

### Table 2. Thermal Characteristics

| Characteristic | Symbol | Value (2,3) | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case<br>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<br>($V_{DS}$ = 65 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 10 | μAdc |
| Zero Gate Voltage Drain Leakage Current<br>($V_{DS}$ = 32 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 1 | μAdc |
| Gate-Source Leakage Current<br>($V_{GS}$ = 5 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | — | — | 1 | μAdc |
| **On Characteristics** | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 100 μAdc) | $V_{GS(th)}$ | 1.0 | 1.8 | 3.0 | Vdc |
| Gate Quiescent Voltage<br>($V_{DD}$ = 28 Vdc, $I_D$ = 450 mAdc, Measured in Functional Test) | $V_{GS(Q)}$ | 2.3 | 2.6 | 2.9 | Vdc |
| Drain-Source On-Voltage<br>($V_{GS}$ = 10 Vdc, $I_D$ = 100 mAdc) | $V_{DS(on)}$ | — | 0.02 | — | Vdc |
| Forward Transconductance<br>($V_{DS}$ = 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 | $\eta_D$ | 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

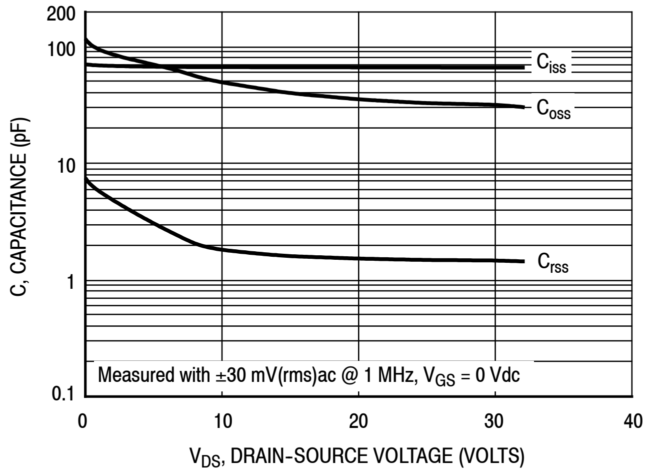



**Figure 2. Capacitance versus Drain-Source Voltage**

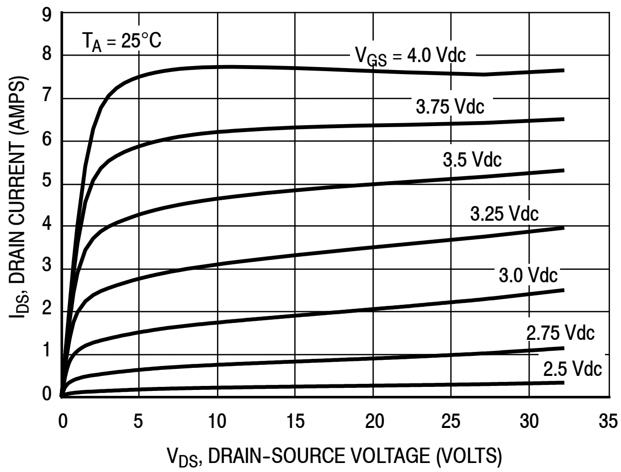
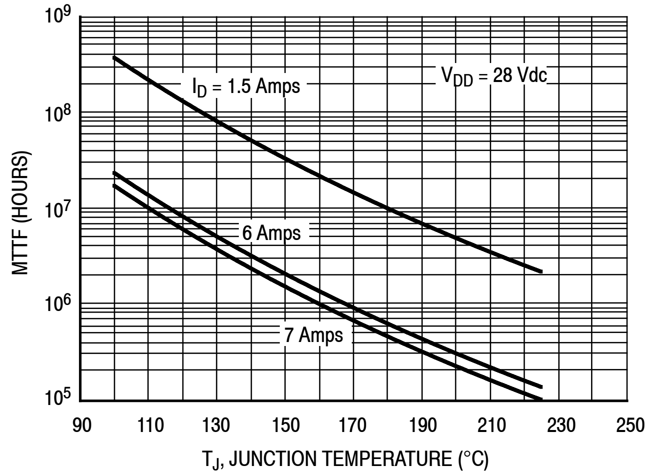



**Figure 3. Drain Current Versus Drain-Source Voltage**

# 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)

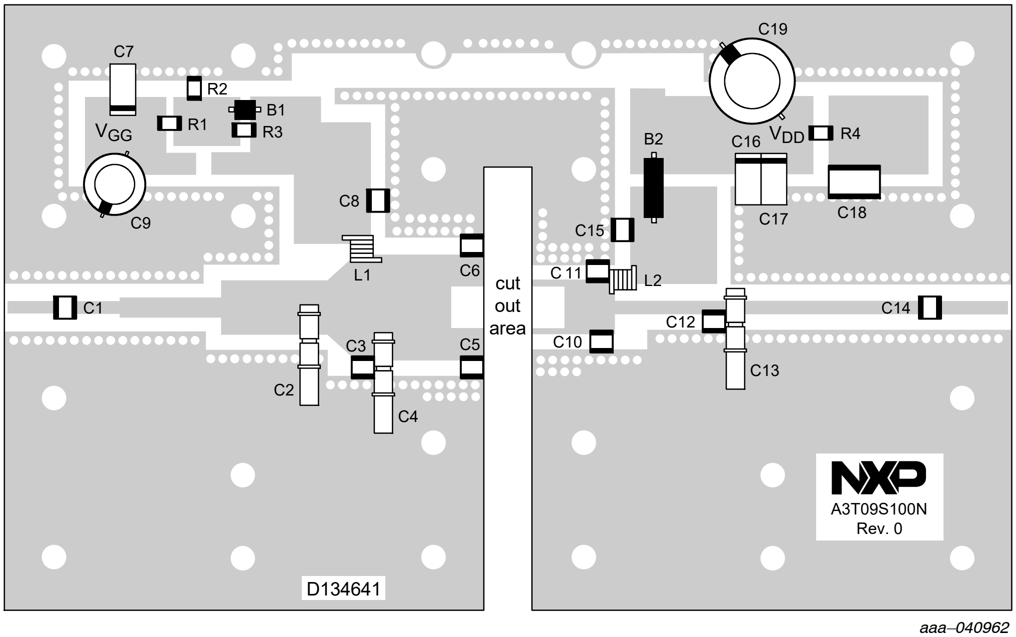



**Figure 5. A3T09S100N Production Fixture Component Layout — 880 MHz**

**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”, $\varepsilon_r$ = 3.5, 1 oz. Copper | D134641 | MTL |

# Typical Characteristics — 880 MHz Production Test Fixture

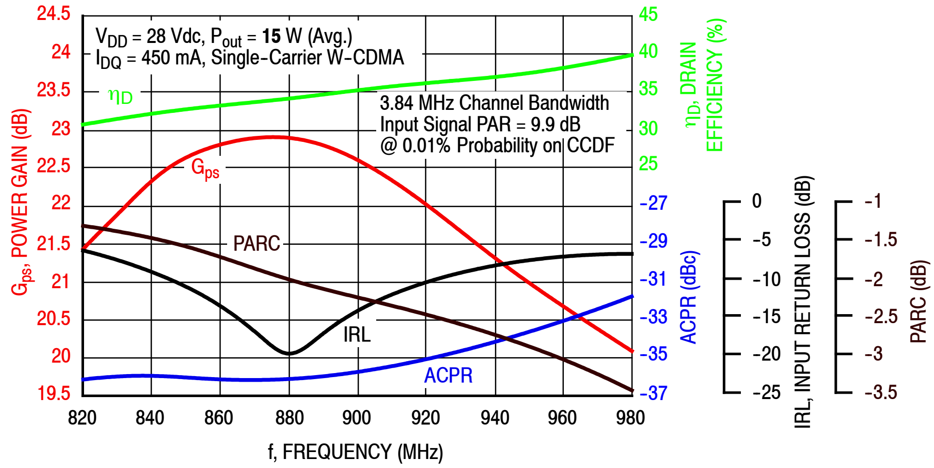



**Figure 6. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ $P_{out}$ = 15 Watts Avg.**

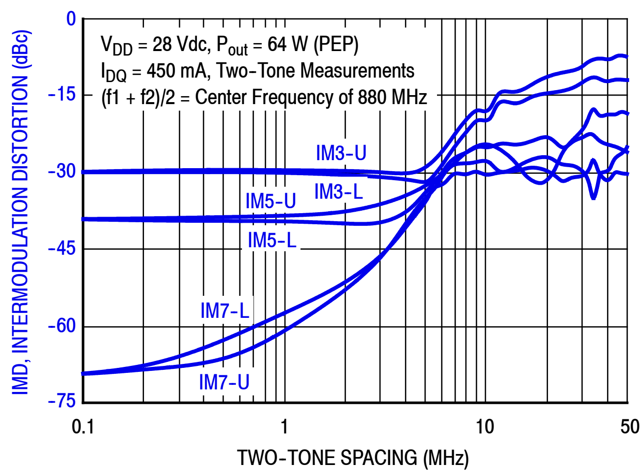



**Figure 7. Intermodulation Distortion Products versus Two-Tone Spacing**

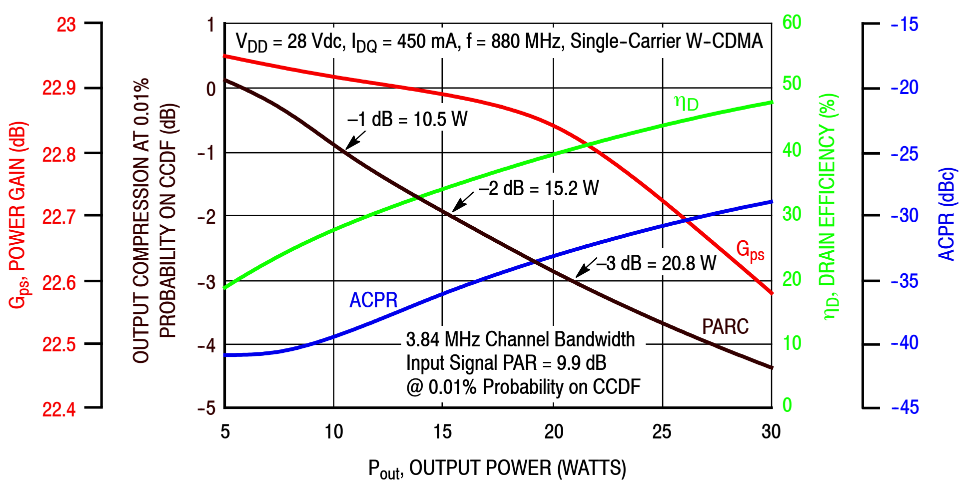



**Figure 8. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**

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

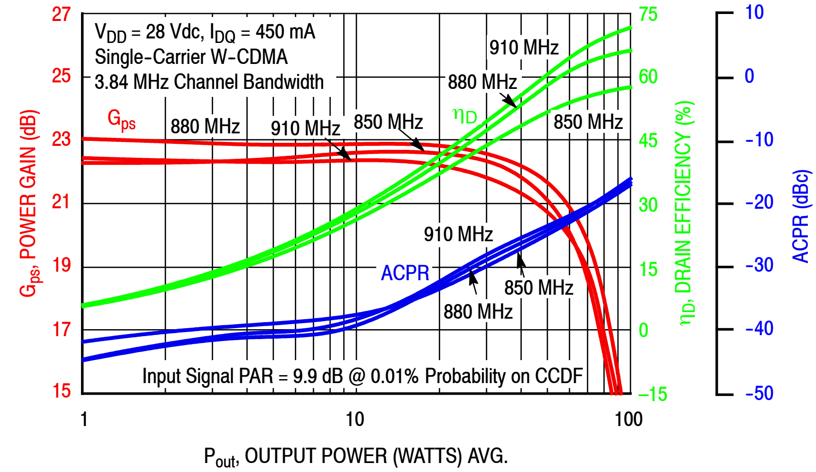



**Figure 9. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power**

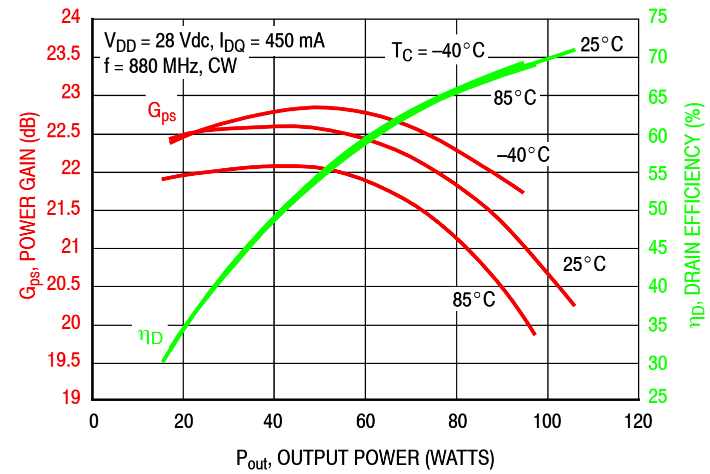



**Figure 10. Power Gain and Drain Efficiency versus CW Output Power over Temperature**

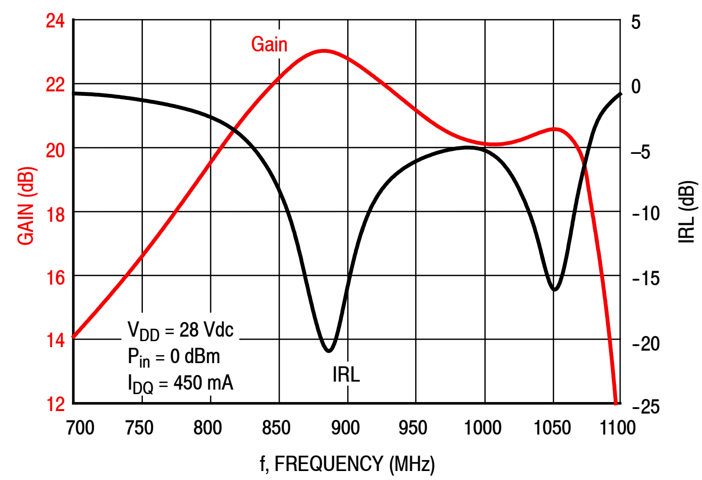



**Figure 11. Broadband Frequency Response**

# 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.

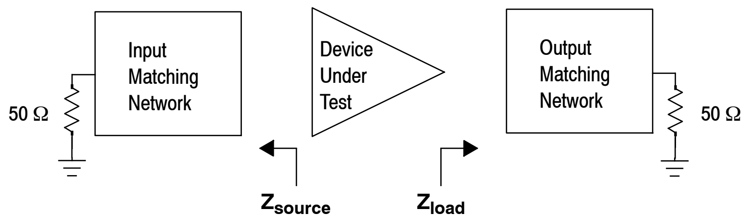


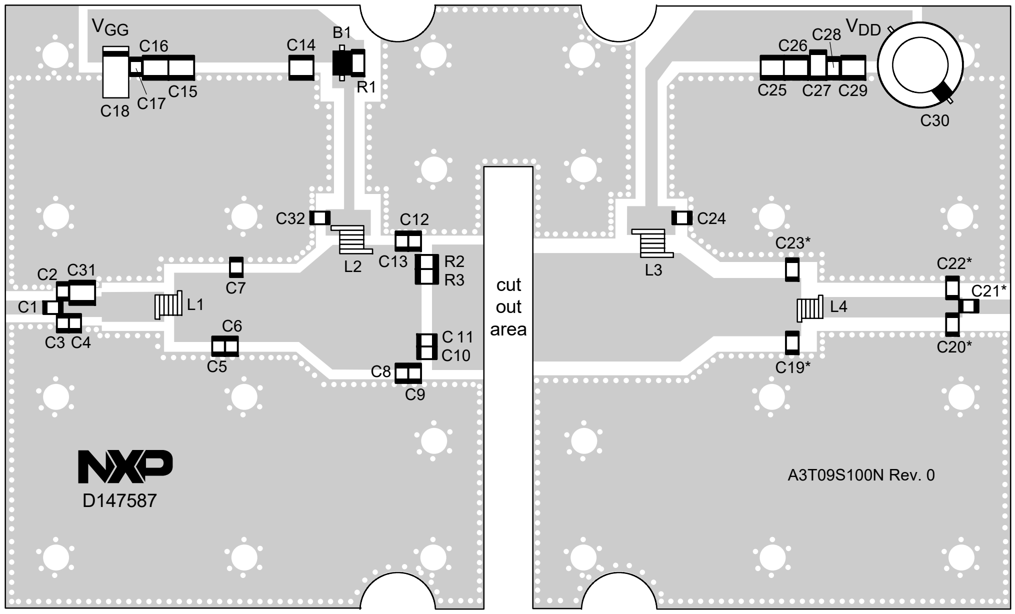

**Figure 12. Series Equivalent Source and Load Impedance – 850–910 MHz**

# 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) | $\eta_D$ (%) | $P_{out}$ (W) |
|---|---|---|---|
| 136 | 28.5 | 64.0 | 90 |

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




*C19, C20, C21, C22 and C23 are mounted vertically.

aaa–040963

**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″, $\varepsilon_r$ = 3.66, 1 oz. Copper | D147587 | MTL |

# Typical Characteristics — 136 MHz Reference Circuit

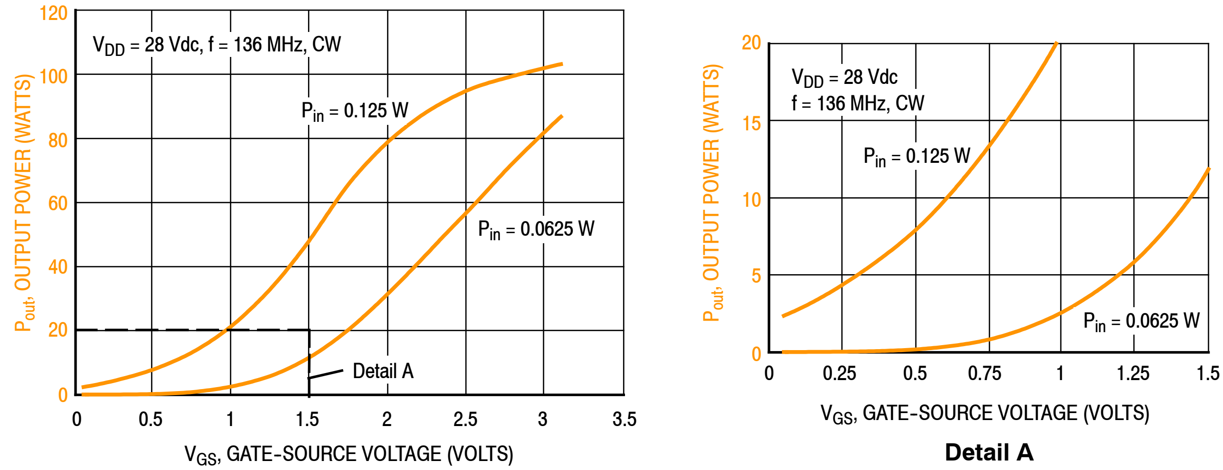



**Figure 14. Output Power versus Gate-Source Voltage**

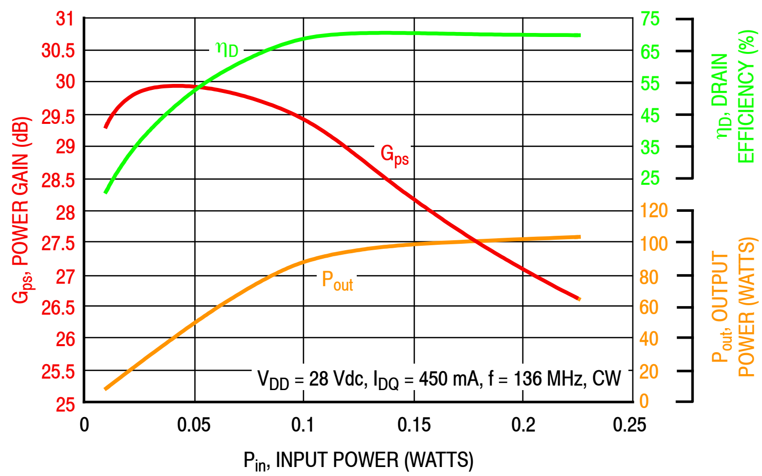



**Figure 15. Power Gain, Output Power and Drain Efficiency versus Input Power**

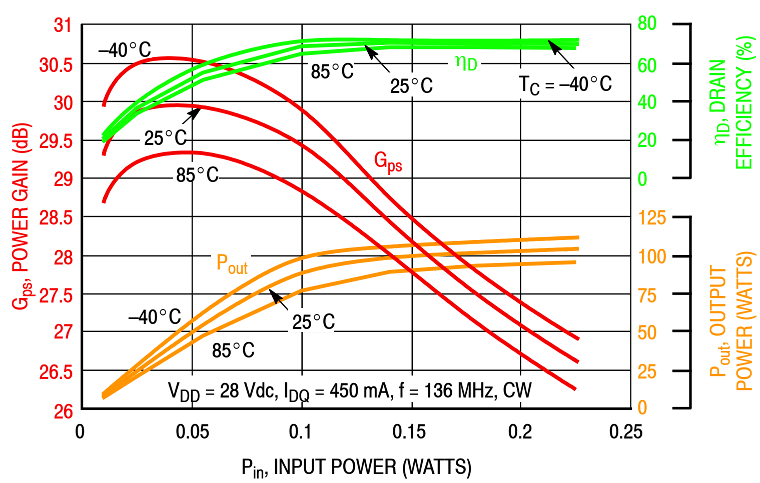



**Figure 16. Power Gain, Output Power and Drain Efficiency versus Input Power over Temperature**

# 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.

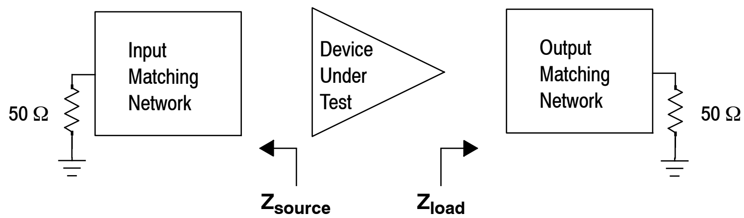



**Figure 17. Series Equivalent Source and Load Impedance – 136 MHz**

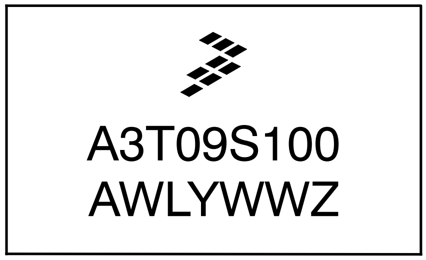
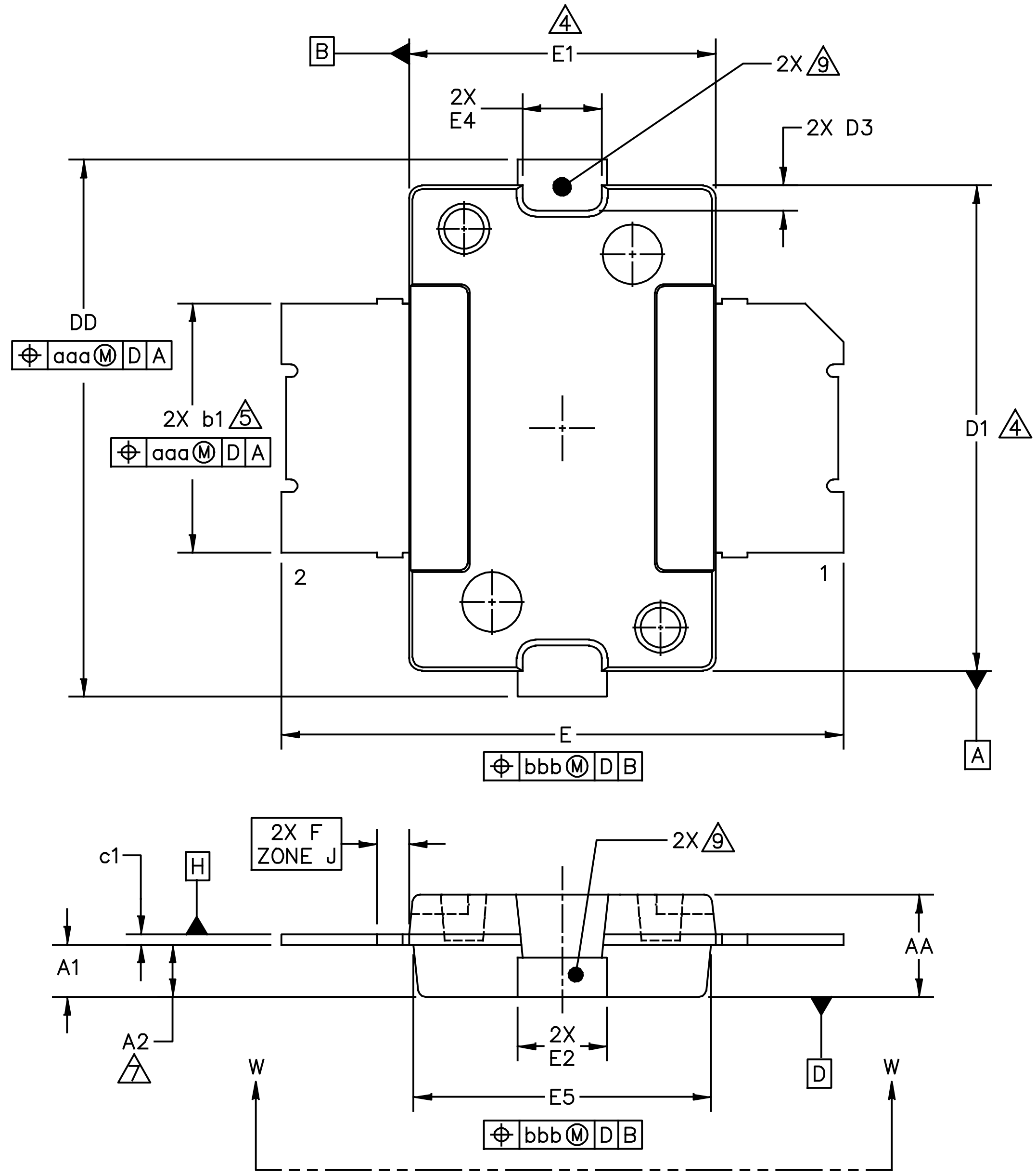



**Figure 18. Product Marking**

# Package Information

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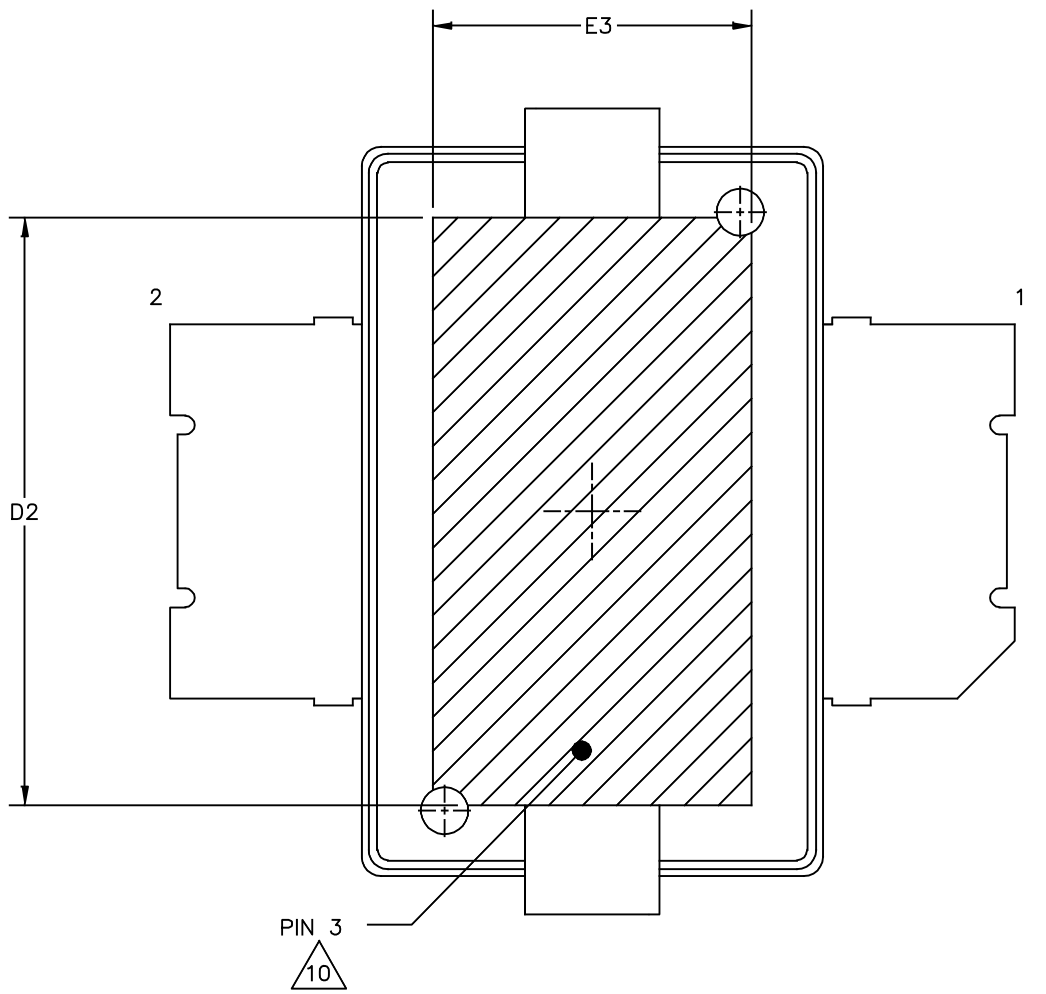
|---|---|---|
| TITLE: TO–270–2 | | DOCUMENT NO: 98ASH98117A REV: R |
| | | STANDARD: NON–JEDEC |
| | | SOT1732–1 22 FEB 2016 |




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.

| DIM | INCH | | MILLIMETER | | DIM | INCH | | MILLIMETER | |
|---|---|---|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | | 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 | ---- | | | | | |

| | | |
|---|---|---|
|  | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE |
| TITLE: TO–270–2 | 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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