

# ANTREX Electronics

## Electronic Components Sourcing Information

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### Product Reference Information

|                      |                           |
|----------------------|---------------------------|
| <b>Part Number:</b>  | AFT31150NR5               |
| <b>Manufacturer:</b> | NXP USA Inc.              |
| <b>Package:</b>      | Please confirm with sales |
| <b>Availability:</b> | Please confirm with sales |

**Product Page:**

<https://antrexco.com/product/details/nxp-usa-inc/aft31150nr5.html>

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**Note:**

This PDF includes an ANTREX product reference cover page.

The original manufacturer datasheet follows from the next page.

# RF Power LDMOS Transistor

## N-Channel Enhancement-Mode Lateral MOSFET

This RF power transistor is designed for applications operating at frequencies between 2700 and 3100 MHz. This device is suitable for use in pulse applications.

**Typical Performance:** In 2700–3100 MHz reference circuit,  $V_{DD} = 32$  Vdc

| Frequency (MHz) | Signal Type                           | $P_{out}$ (W) | $G_{ps}$ (dB) | $\eta_D$ (%) | IRL (dB) |
|-----------------|---------------------------------------|---------------|---------------|--------------|----------|
| 2700–3100 (1)   | Pulse (300 $\mu$ sec, 15% Duty Cycle) | 150 Peak      | 17.2          | 49.0         | –6       |

### Load Mismatch/Ruggedness

| Frequency (MHz) | Signal Type                           | VSWR                     | $P_{in}$ (W)              | Test Voltage | Result                |
|-----------------|---------------------------------------|--------------------------|---------------------------|--------------|-----------------------|
| 3100 (2)        | Pulse (300 $\mu$ sec, 15% Duty Cycle) | 10:1 at all Phase Angles | 6.8 Peak (3 dB Overdrive) | 32           | No Device Degradation |

1. The values shown are the center band performance numbers across the indicated frequency range.
2. Measured in 3100 MHz narrowband production test fixture.

### Features

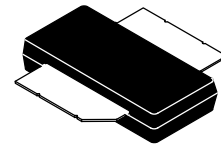
- Characterized with series equivalent large-signal impedance parameters
- Internally matched for ease of use
- Qualified up to a maximum of 32 V<sub>DD</sub> operation
- Integrated ESD protection
- Greater negative gate-source voltage range for improved Class C operation
- Recommended driver: AFIC31025N (25 W)
- Included in NXP product longevity program with assured supply for a minimum of 15 years after launch

### Typical Applications

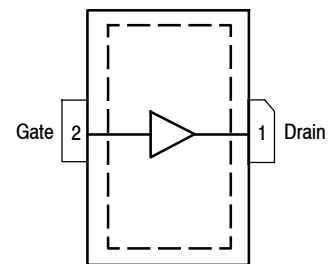
- Commercial S-Band radar systems
- Maritime radar
- Weather radar

**AFT31150N**

**2700–3100 MHz, 150 W PEAK, 32 V  
AIRFAST RF POWER LDMOS  
TRANSISTOR**



**OM-780-2L  
PLASTIC**



(Top View)

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

**Figure 1. Pin Connections**

**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        |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 741<br>3.7  | W<br>W/°C |

**Table 2. Thermal Characteristics**

| Characteristic                                                                                                                                                                                  | Symbol          | Value (2,3) | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|------|
| Thermal Impedance, Junction to Case<br>Pulse: Case Temperature $76^\circ\text{C}$ , 160 W Peak, 300 $\mu\text{sec}$ Pulse Width,<br>15% Duty Cycle, 32 Vdc, $I_{DQ} = 100\text{ mA}$ , 3100 MHz | $Z_{\theta JC}$ | 0.042       | °C/W |

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class             |
|---------------------------------------|-------------------|
| Human Body Model (per JESD22-A114)    | 2, passes 2500 V  |
| Charge Device Model (per JESD22-C101) | C3, passes 2000 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** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

**Off Characteristics**

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

**On Characteristics**

|                                                                                                               |              |     |      |     |     |
|---------------------------------------------------------------------------------------------------------------|--------------|-----|------|-----|-----|
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 180\text{ }\mu\text{Adc}$ )                     | $V_{GS(th)}$ | 0.8 | 1.2  | 1.6 | Vdc |
| Gate Quiescent Voltage<br>( $V_{DD} = 32\text{ Vdc}$ , $I_D = 100\text{ mAdc}$ , Measured in Functional Test) | $V_{GS(Q)}$  | 1.1 | 1.6  | 2.1 | Vdc |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1.8\text{ Adc}$ )                              | $V_{DS(on)}$ | 0.1 | 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.

(continued)

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

| Characteristic                                                                                                                                                                                                                                                  | Symbol   | Min  | Typ  | Max  | Unit |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------|------|------|
| <b>Functional Tests</b> <sup>(1)</sup> (In NXP Production Test Fixture, 50 ohm system) $V_{DD} = 32\text{ Vdc}$ , $I_{DQ} = 100\text{ mA}$ , $P_{out} = 160\text{ W Peak}$ (24 W Avg.), $f = 3100\text{ MHz}$ , 300 $\mu\text{sec}$ Pulse Width, 15% Duty Cycle |          |      |      |      |      |
| Power Gain                                                                                                                                                                                                                                                      | $G_{ps}$ | 15.0 | 17.0 | 19.0 | dB   |
| Drain Efficiency                                                                                                                                                                                                                                                | $\eta_D$ | 46.5 | 50.0 | —    | %    |
| Input Return Loss                                                                                                                                                                                                                                               | IRL      | —    | −19  | −9   | dB   |

**Table 6. Load Mismatch/Ruggedness** (In NXP Production Test Fixture, 50 ohm system)  $I_{DQ} = 100\text{ mA}$ 

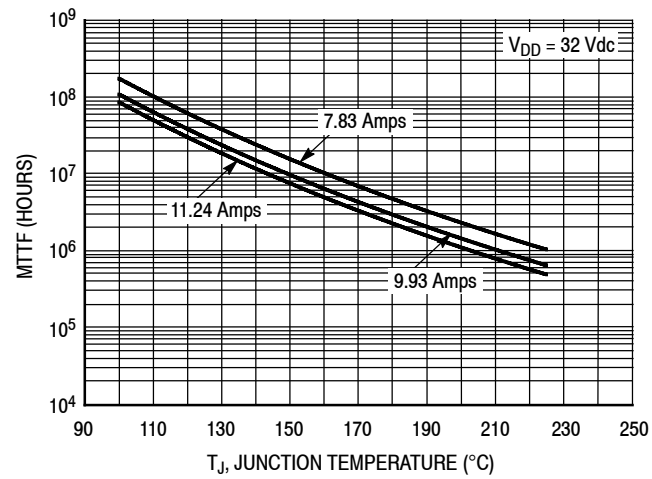
| Frequency (MHz) | Signal Type                                     | VSWR                        | $P_{in}$ (W)                 | Test Voltage, $V_{DD}$ | Result                |
|-----------------|-------------------------------------------------|-----------------------------|------------------------------|------------------------|-----------------------|
| 3100            | Pulse<br>(300 $\mu\text{sec}$ , 15% Duty Cycle) | 10:1 at all<br>Phase Angles | 6.8 Peak<br>(3 dB Overdrive) | 32                     | No Device Degradation |

**Table 7. Ordering Information**

| Device      | Tape and Reel Information                            | Package   |
|-------------|------------------------------------------------------|-----------|
| AFT31150NR5 | R5 Suffix = 50 Units, 32 mm Tape Width, 13-inch Reel | OM-780-2L |

1. Part internally matched both on input and output.

## TYPICAL CHARACTERISTICS



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

MTTF calculator available at <http://www.nxp.com/RF/calculators>.

**Figure 2. MTTF versus Junction Temperature – Pulse**

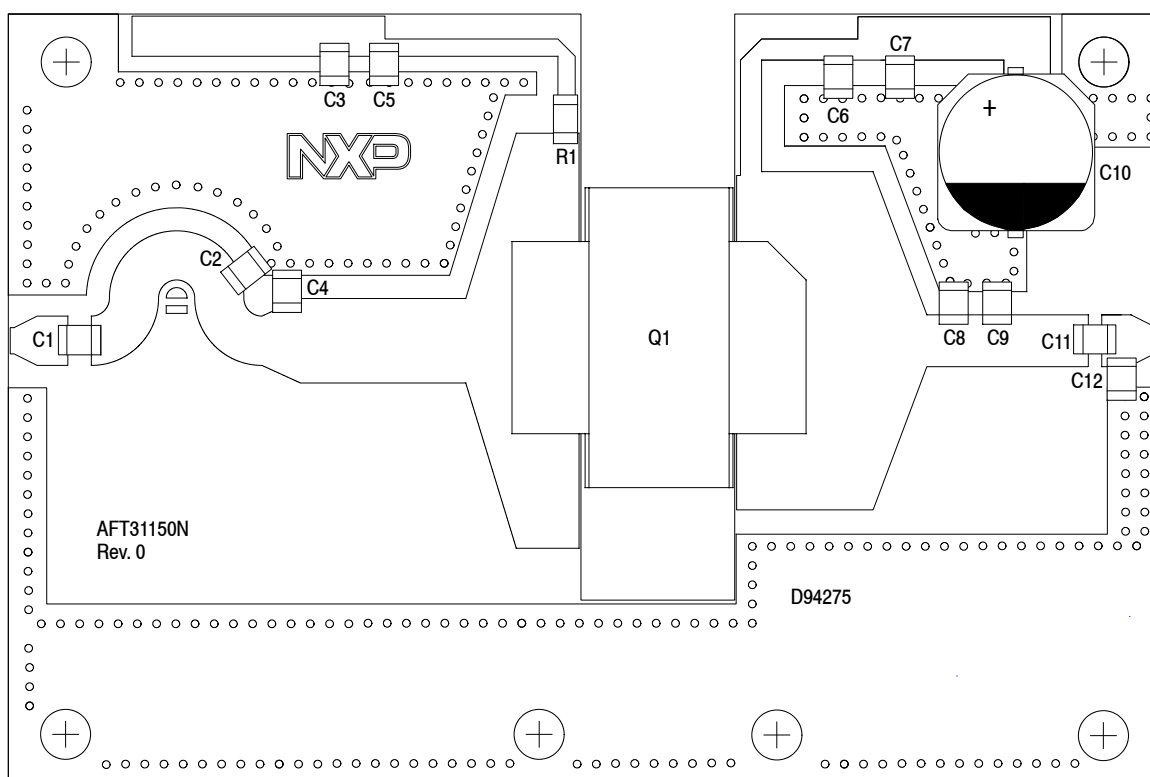
## 2700–3100 MHz REFERENCE CIRCUIT – 2.0" × 3.0" (5.1 cm × 7.6 cm)

**Table 8. 2700–3100 MHz Performance** (In NXP Reference Circuit, 50 ohm system)

$P_{out} = 150\text{ W}$ ,  $V_{DD} = 32\text{ Vdc}$ ,  $I_{DQ} = 100\text{ mA}$

| Frequency<br>(MHz) | Signal Type                              | $P_{in}$<br>(W) | $G_{ps}$<br>(dB) | $\eta_D$<br>(%) | IRL<br>(dB) |
|--------------------|------------------------------------------|-----------------|------------------|-----------------|-------------|
| 2700               | Pulse<br>(300 $\mu$ sec, 15% Duty Cycle) | 3.1             | 16.9             | 53.0            | –6          |
| 2900               |                                          | 2.9             | 17.2             | 49.0            | –6          |
| 3100               |                                          | 3.0             | 17.0             | 47.0            | –9          |

# 2700–3100 MHz REFERENCE CIRCUIT — 2.0" × 3.0" (5.1 cm × 7.6 cm)

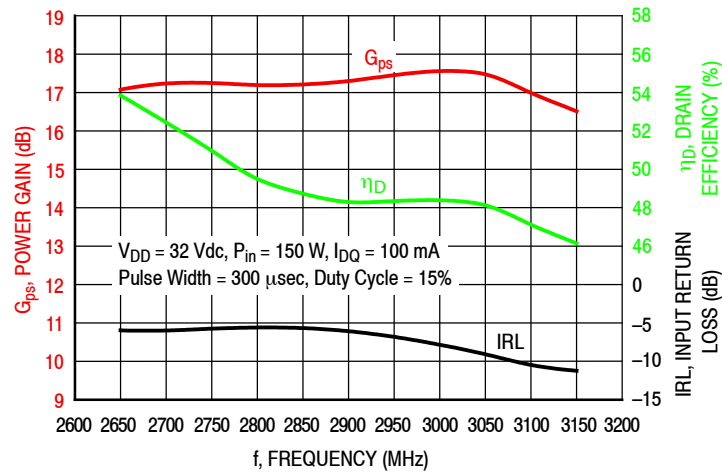


**Figure 3. AFT31150N Reference Circuit Component Layout – 2700–3100 MHz**

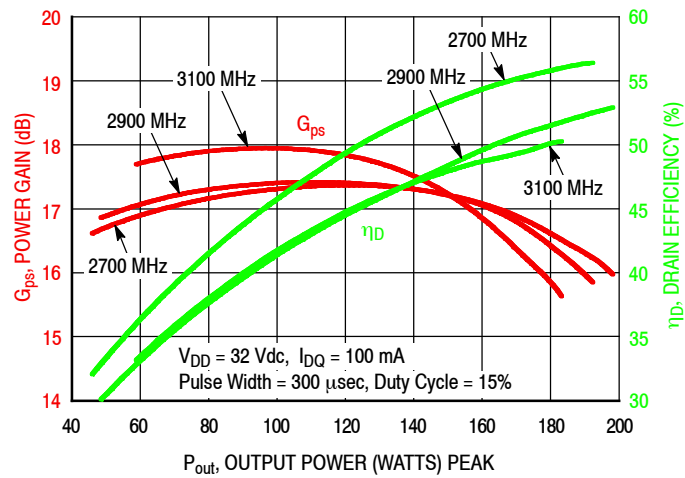
**Table 9. AFT31150N Reference Circuit Component Designations and Values – 2700–3100 MHz**

| Part   | Description                                  | Part Number         | Manufacturer |
|--------|----------------------------------------------|---------------------|--------------|
| C1     | 3.6 pF Chip Capacitor                        | ATC800B3R6CT500XT   | ATC          |
| C2     | 0.8 pF Chip Capacitor                        | ATC800B0R8BT500XT   | ATC          |
| C3, C7 | 2.2 $\mu$ F Chip Capacitor                   | C3225X7R2A225K230AB | TDK          |
| C4     | 0.6 pF Chip Capacitor                        | ATC800B0R6BT500XT   | ATC          |
| C5, C6 | 3.3 pF Chip Capacitor                        | ATC800B3R3CT500XT   | ATC          |
| C8     | 0.7 pF Chip Capacitor                        | ATC800B0R7BT500XT   | ATC          |
| C9     | 0.4 pF Chip Capacitor                        | ATC800B0R4BT500XT   | ATC          |
| C10    | 220 $\mu$ F, 50 V Electrolytic Capacitor     | MVY50V221MJ10TP     | United Chem  |
| C11    | 4.3 pF Chip Capacitor                        | ATC800B4R3CT500XT   | ATC          |
| C12    | 0.1 pF Chip Capacitor                        | ATC800B0R1BT500XT   | ATC          |
| Q1     | RF High Power LDMOS Transistor               | AFT31150N           | NXP          |
| R1     | 10 $\Omega$ , 1/4 W Chip Resistor            | CRCW120610R0JNEA    | Vishay       |
| PCB    | Rogers RT6035HTC, 0.030", $\epsilon_r = 3.5$ | D94275              | MTL          |

# **TYPICAL CHARACTERISTICS – 2700–3100 MHz REFERENCE CIRCUIT**

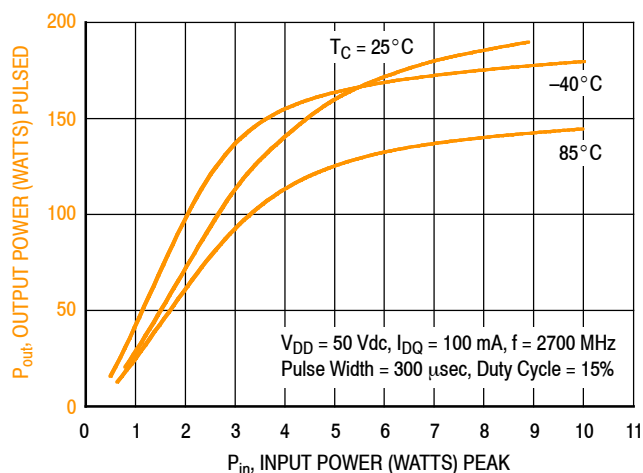


**Figure 4. Power Gain, Drain Efficiency and IRL versus Frequency at a Constant Output Power**

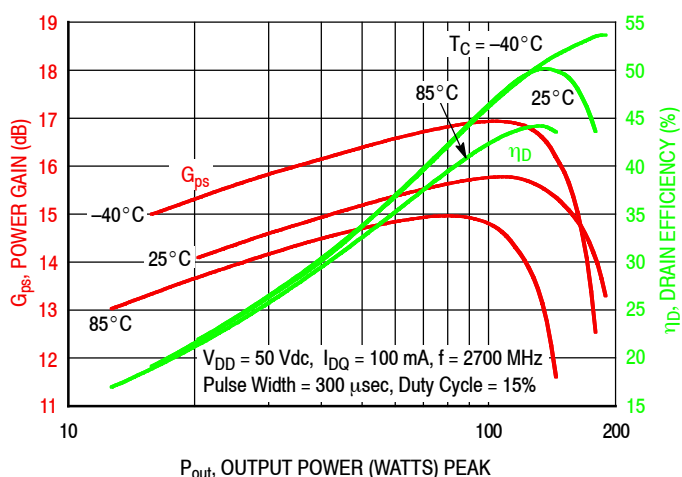


**Figure 5. Power Gain and Drain Efficiency versus Output Power**

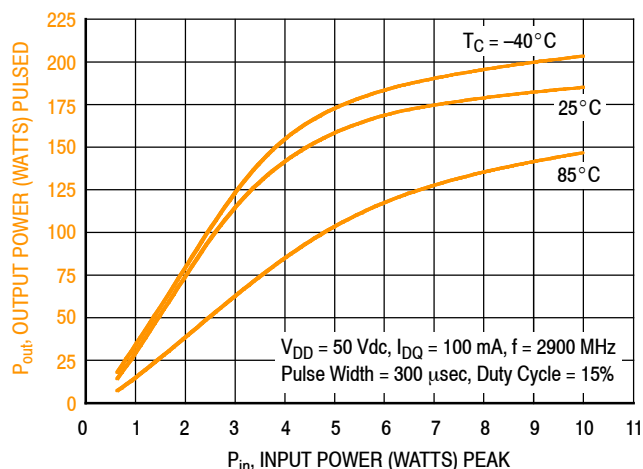
## TYPICAL CHARACTERISTICS – 2700–3100 MHz REFERENCE CIRCUIT



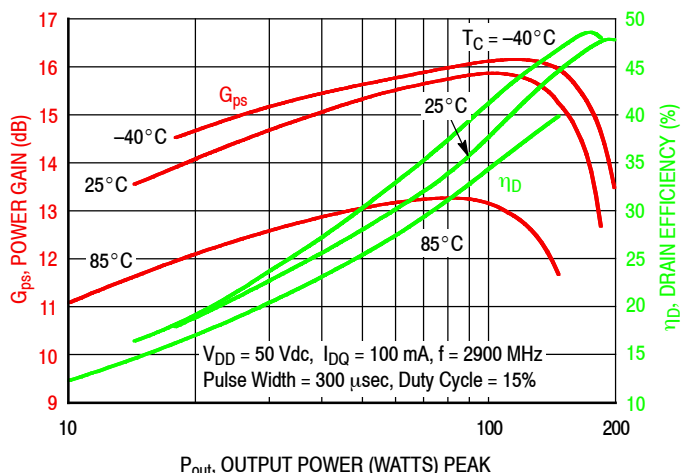
**Figure 6. Output Power versus Input Power versus Temperature – 2700 MHz**



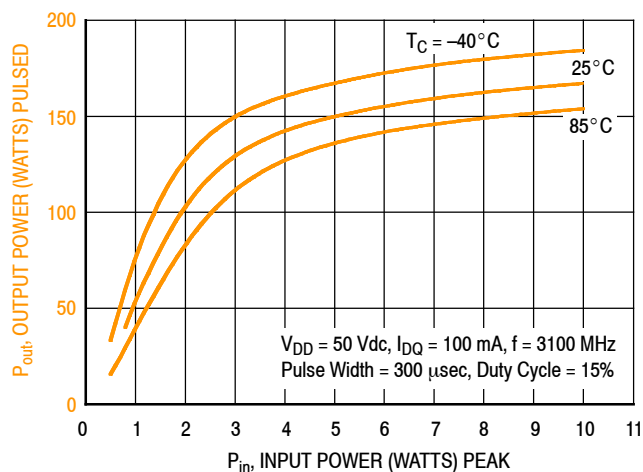
**Figure 7. Power Gain and Drain Efficiency versus Output Power – 2700 MHz**



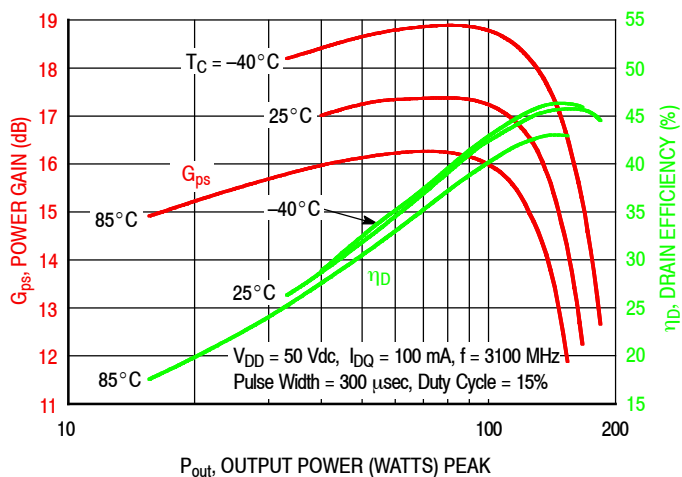
**Figure 8. Output Power versus Input Power versus Temperature – 2900 MHz**



**Figure 9. Power Gain and Drain Efficiency versus Output Power – 2900 MHz**

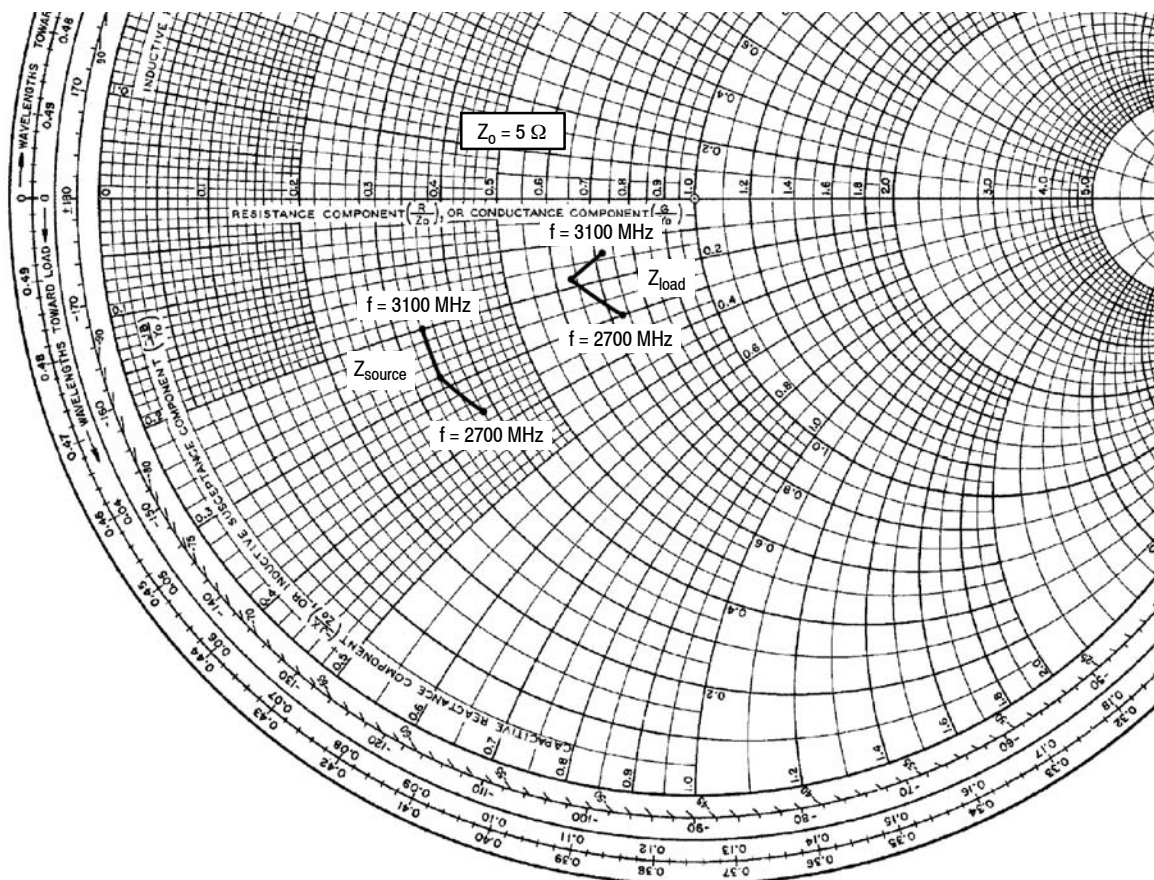


**Figure 10. Output Power versus Input Power versus Temperature – 3100 MHz**



**Figure 11. Power Gain and Drain Efficiency versus Output Power – 3100 MHz**

## 2700–3100 MHz REFERENCE CIRCUIT



| f<br>MHz | $Z_{\text{source}}$<br>$\Omega$ | $Z_{\text{load}}$<br>$\Omega$ |
|----------|---------------------------------|-------------------------------|
| 2700     | $1.9 - j1.8$                    | $3.7 - j1.5$                  |
| 2900     | $1.7 - j1.4$                    | $3.2 - j0.9$                  |
| 3100     | $1.7 - j1.0$                    | $3.6 - j0.7$                  |

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

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

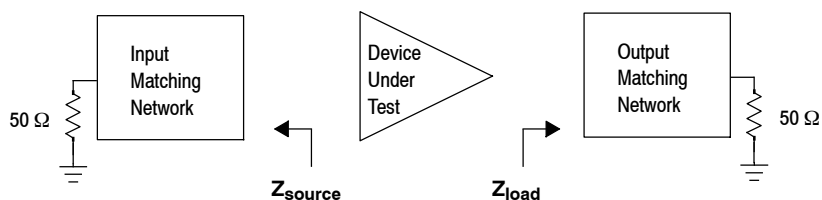
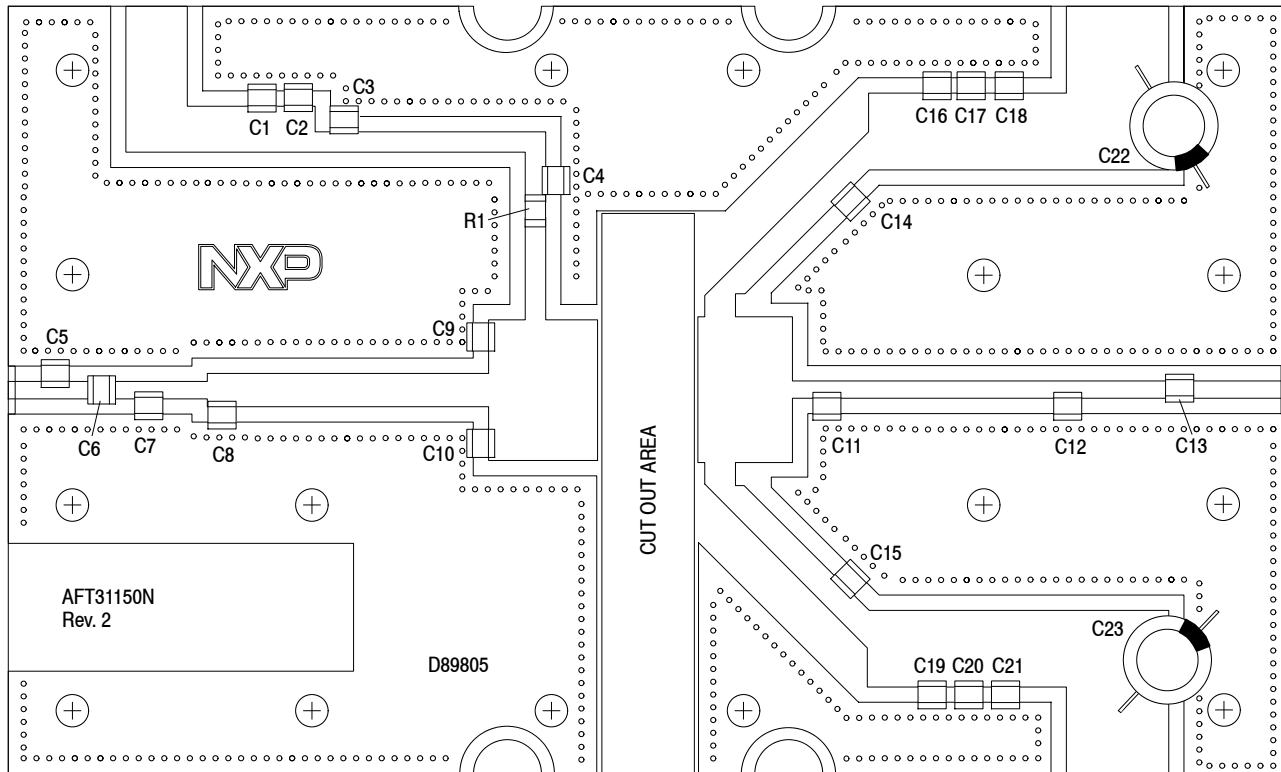


Figure 12. Series Equivalent Source and Load Impedance – 2700–3100 MHz

# 3100 MHz NARROWBAND PRODUCTION TEST FIXTURE – 3.0" x 5.0" (7.6 cm x 12.7 cm)



**Figure 13. AFT31150N Narrowband Test Circuit Component Layout – 3100 MHz**

**Table 10. AFT31150N Narrowband Test Circuit Component Designations and Values – 3100 MHz**

| Part            | Description                               | Part Number           | Manufacturer |
|-----------------|-------------------------------------------|-----------------------|--------------|
| C1, C18, C21    | 10 $\mu$ F Chip Capacitor                 | C5750X7S2A106M        | TDK          |
| C2, C17, C20    | 1 $\mu$ F Chip Capacitor                  | C3225JB2A105K200AA    | TDK          |
| C3, C16, C19    | 0.1 $\mu$ F Chip Capacitor                | C1206C104K1RACTU      | Kemet        |
| C4              | 3.3 pF Chip Capacitor                     | ATC100B3R3CT500XT     | ATC          |
| C5, C8, C9, C10 | 0.2 pF Chip Capacitor                     | ATC100B0R2BT500XT     | ATC          |
| C6, C13         | 4.3 pF Chip Capacitor                     | ATC100B4R3CT500XT     | ATC          |
| C7              | 1.0 pF Chip Capacitor                     | ATC100B1R0BT500XT     | ATC          |
| C11             | 0.3 pF Chip Capacitor                     | ATC100B0R3BT500XT     | ATC          |
| C12             | 0.8 pF Chip Capacitor                     | ATC100B0R8BT500XT     | ATC          |
| C14, C15        | 2.2 pF Chip Capacitor                     | ATC100B2R2BT500XT     | ATC          |
| C22, C23        | 220 $\mu$ F, 100 V Electrolytic Capacitor | MCGPR100V227M16X26-RH | Multicomp    |
| R1              | 20 $\Omega$ , 1/4 W Chip Resistor         | CRCW120620R0FKEA      | Vishay       |
| PCB             | Taconic RF35, 0.030", $\epsilon_r = 3.5$  | D89805                | MTL          |

## TYPICAL CHARACTERISTICS

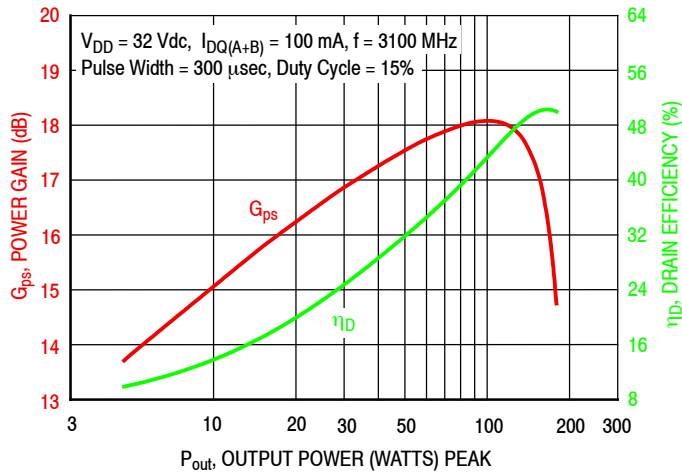


Figure 14. Power Gain and Drain Efficiency versus Output Power

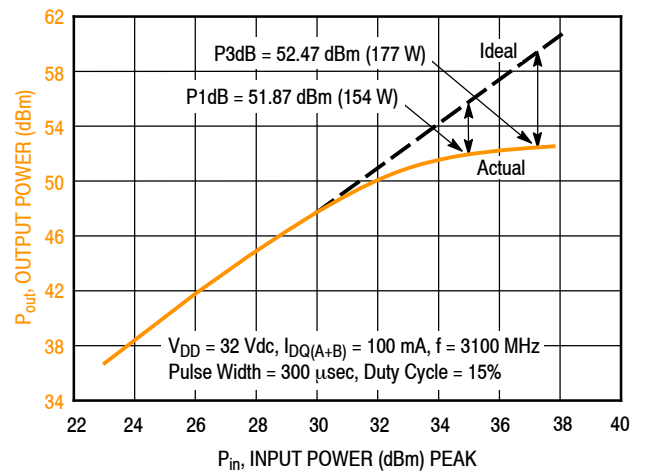


Figure 15. Output Power versus Input Power

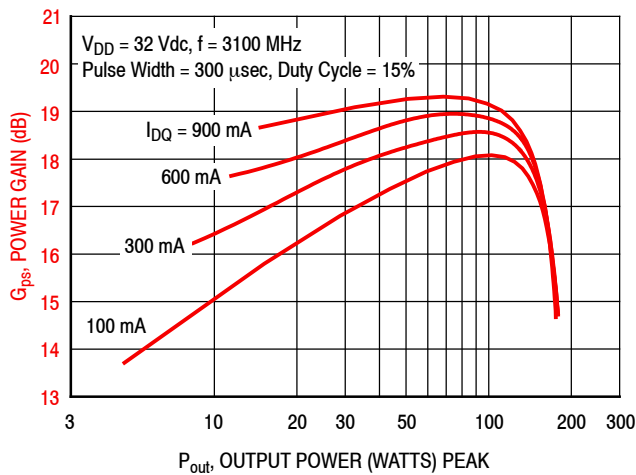


Figure 16. Power Gain versus Output Power

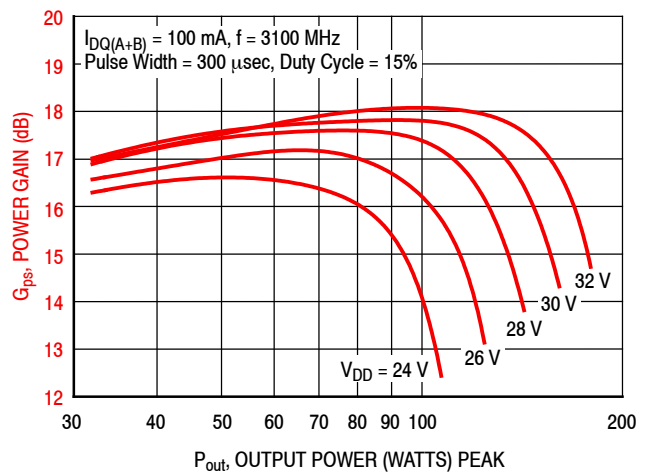


Figure 17. Power Gain versus Output Power and Drain Voltage

## 3100 MHz NARROWBAND PRODUCTION TEST FIXTURE

| f<br>MHz | $Z_{\text{source}}$<br>$\Omega$ | $Z_{\text{load}}$<br>$\Omega$ |
|----------|---------------------------------|-------------------------------|
| 3100     | $9.5 - j5.3$                    | $5.5 + j1.2$                  |

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

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

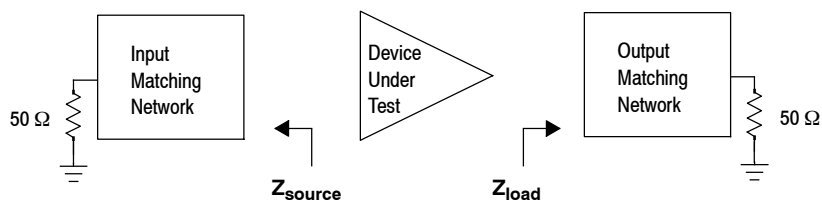
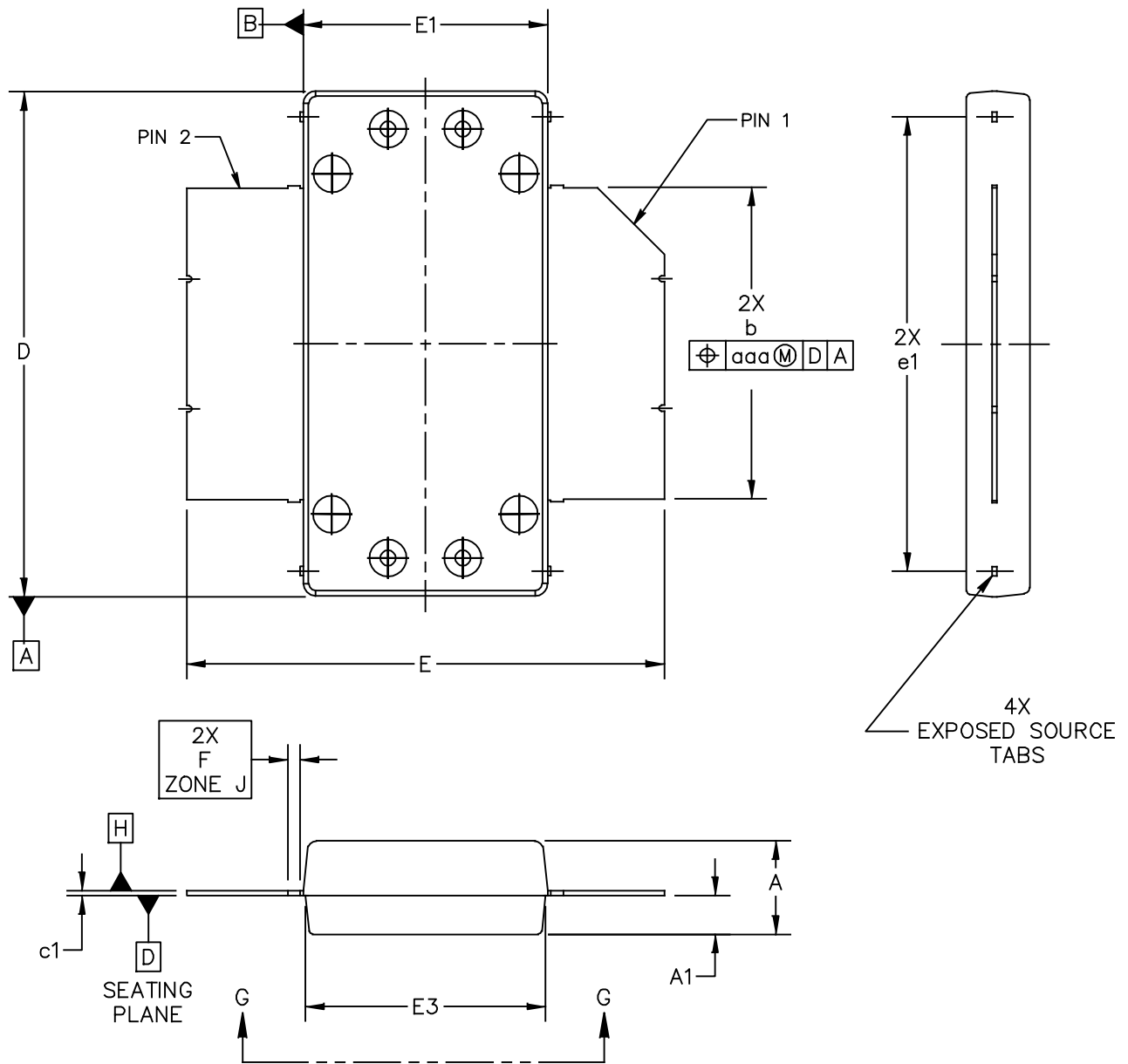
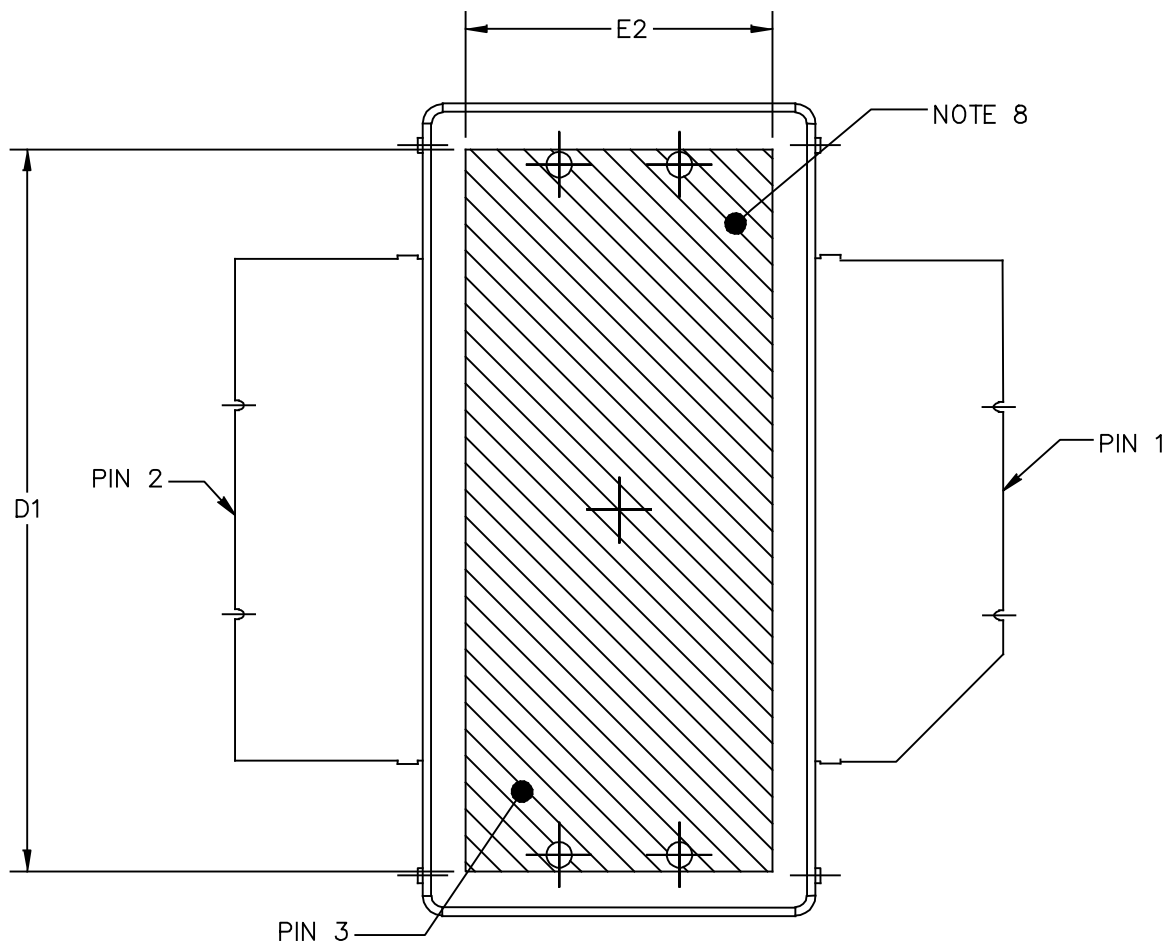


Figure 18. Series Equivalent Source and Load Impedance – 3100 MHz

# PACKAGE DIMENSIONS



|                                                  |                                 |                            |
|--------------------------------------------------|---------------------------------|----------------------------|
| © NXP SEMICONDUCTORS N.V.<br>ALL RIGHTS RESERVED | MECHANICAL OUTLINE              | PRINT VERSION NOT TO SCALE |
| TITLE:<br><br>OM780-2<br>STRAIGHT LEAD           | DOCUMENT NO: 98ASA10831D REV: C |                            |
|                                                  | STANDARD: NON-JEDEC             |                            |
|                                                  | SOT1693-1                       | 22 JAN 2016                |



BOTTOM VIEW  
VIEW G-G

|                                                  |                          |                            |
|--------------------------------------------------|--------------------------|----------------------------|
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| TITLE:<br>OM780-2<br>STRAIGHT LEAD               | DOCUMENT NO: 98ASA10831D | REV: C                     |
|                                                  | STANDARD: NON-JEDEC      |                            |
|                                                  | SOT1693-1                | 22 JAN 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 "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION A1 APPLIES WITHIN ZONE "J" ONLY
8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. THE DIMENSIONS D1 AND E2 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF HEAT SLUG.

STYLE 1:

PIN 1 - DRAIN  
PIN 2 - GATE  
PIN 3 - SOURCE

| INCH                                             |          |      | MILLIMETER |                    | INCH                                                 |      |                            | MILLIMETER |       |
|--------------------------------------------------|----------|------|------------|--------------------|------------------------------------------------------|------|----------------------------|------------|-------|
| DIM                                              | MIN      | MAX  | MIN        | MAX                | DIM                                                  | MIN  | MAX                        | MIN        | MAX   |
| A                                                | 0.148    | .152 | 3.76       | 3.86               | b                                                    | .497 | .503                       | 12.62      | 12.78 |
| A1                                               | .059     | .065 | 1.50       | 1.65               | c1                                                   | .007 | .011                       | 0.18       | 0.28  |
| D                                                | .808     | .812 | 20.52      | 20.62              | e1                                                   | .721 | .729                       | 18.31      | 18.52 |
| D1                                               | .720     | ---- | 18.29      | ----               | aaa                                                  | .004 |                            | 0.10       |       |
| E                                                | .762     | .770 | 19.36      | 19.56              |                                                      |      |                            |            |       |
| E1                                               | .390     | .394 | 9.91       | 10.01              |                                                      |      |                            |            |       |
| E2                                               | .306     | ---- | 7.77       | ----               |                                                      |      |                            |            |       |
| E3                                               | .383     | .387 | 9.73       | 9.83               |                                                      |      |                            |            |       |
| F                                                | .025 BSC |      | 0.635 BSC  |                    |                                                      |      |                            |            |       |
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| TITLE:<br><br>OM780-2<br>STRAIGHT LEAD           |          |      |            |                    | DOCUMENT NO: 98ASA10831D                      REV: C |      |                            |            |       |
|                                                  |          |      |            |                    | STANDARD: NON-JEDEC                                  |      |                            |            |       |
|                                                  |          |      |            |                    | SOT1693-1                                            |      | 22 JAN 2016                |            |       |

## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

### Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Over-Molded 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

### 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 2017 | <ul style="list-style-type: none"><li>• Initial release of data sheet</li></ul> |

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