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)	η_D (%)	IRL (dB)
2700–3100 (1)	Pulse (300 μsec, 15% Duty Cycle)	150 Peak	17.2	49.0	–6

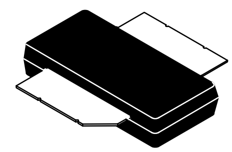
Load Mismatch/Ruggedness

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

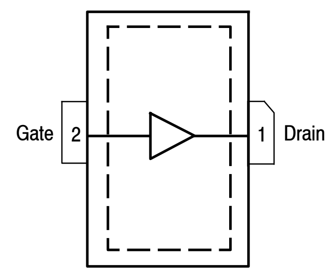
1. The values shown are the center band performance numbers across the indicated frequency range.
2. Measured in 3100 MHz narrowband production test fixture.

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

Features

- Characterized with series equivalent large-signal impedance parameters
- Internally matched for ease of use
- Qualified up to a maximum of 32 V_{DD} 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

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	741 3.7	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value [2,3]	Unit
Thermal Impedance, Junction to Case Pulse: Case Temperature 76°C, 160 W Peak, 300 μsec Pulse Width, 15% Duty Cycle, 32 Vdc, I_{DQ} = 100 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°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 10 μAdc)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 32 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 180 μAdc)	$V_{GS(th)}$	0.8	1.2	1.6	Vdc
Gate Quiescent Voltage (V_{DD} = 32 Vdc, I_D = 100 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.1	1.6	2.1	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.8 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°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (1) (In NXP Production Test Fixture, 50 ohm system) V_{DD} = 32 Vdc, I_{DQ} = 100 mA, P_{out} = 160 W Peak (24 W Avg.), f = 3100 MHz, 300 μsec Pulse Width, 15% Duty Cycle					
Power Gain	G_{ps}	15.0	17.0	19.0	dB
Drain Efficiency	η_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 mA

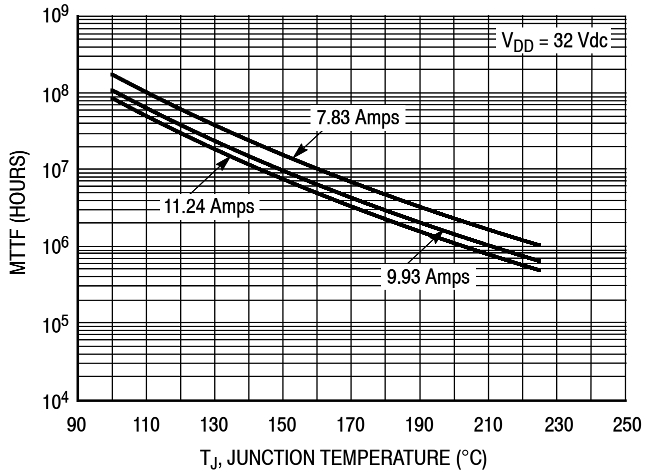
Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
3100	Pulse (300 μsec, 15% Duty Cycle)	10:1 at all Phase Angles	6.8 Peak (3 dB Overdrive)	32	No Device Degradation

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 W, V_{DD} = 32 Vdc, I_{DQ} = 100 mA

Frequency (MHz)	Signal Type	P_{in} (W)	G_{ps} (dB)	η_D (%)	IRL (dB)
2700	Pulse (300 μsec, 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)

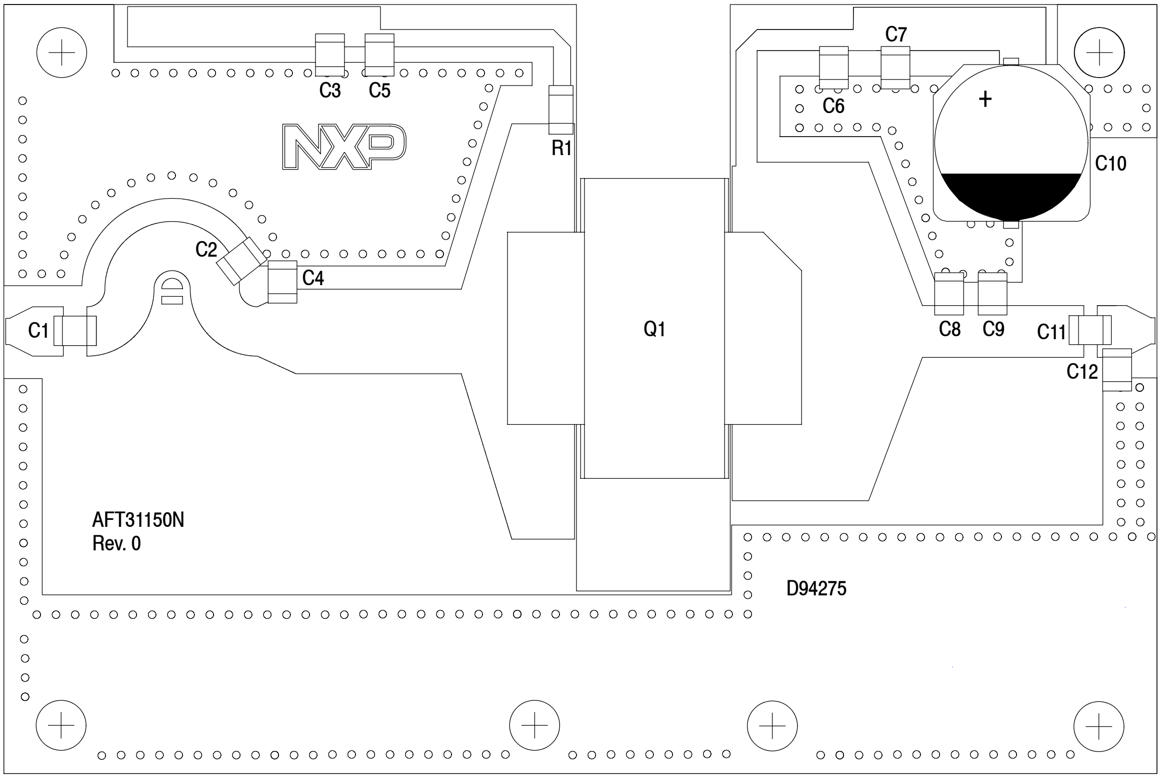


Figure 3. AFT31150N Reference Circuit Component Layout – 2700–3100 MHz

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 μF 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 μF, 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 Ω, 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
PCB	Rogers RT6035HTC, 0.030″, ε_r = 3.5	D94275	MTL

TYPICAL CHARACTERISTICS – 2700–3100 MHz REFERENCE CIRCUIT

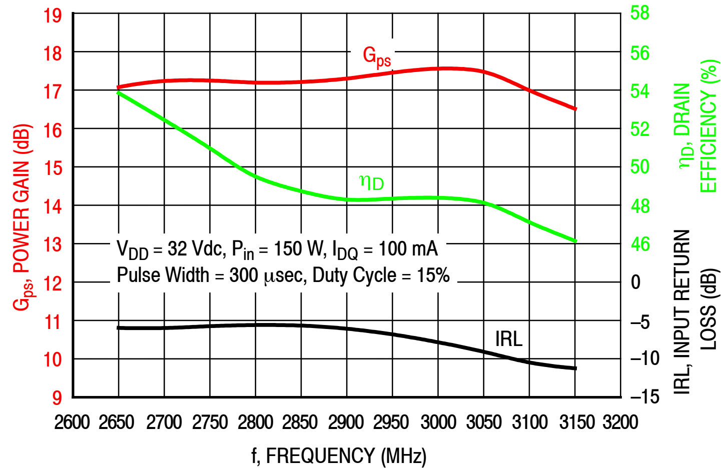


Figure 4. Power Gain, Drain Efficiency and IRL versus Frequency at a Constant Output Power

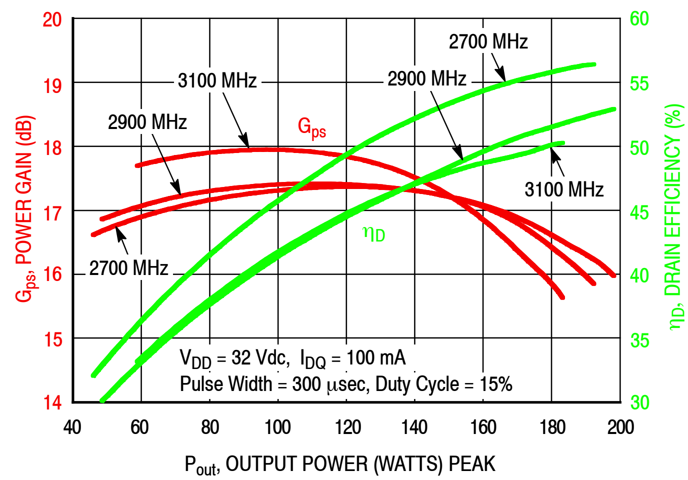


Figure 5. Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS – 2700–3100 MHz REFERENCE CIRCUIT

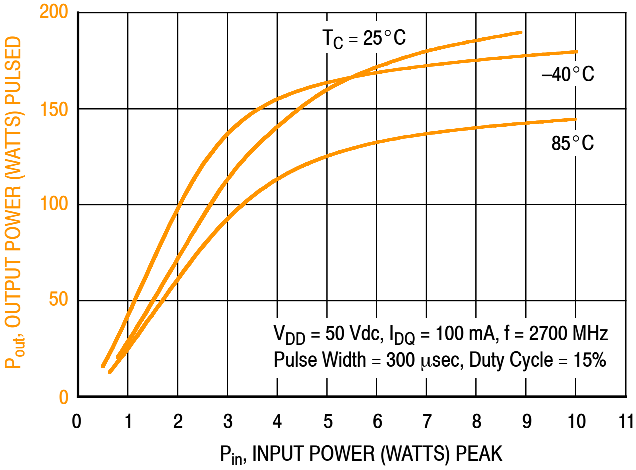


Figure 6. Output Power versus Input Power versus Temperature – 2700 MHz

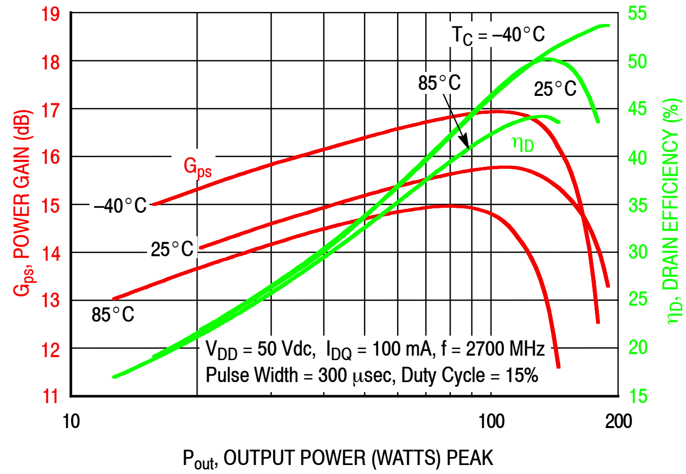


Figure 7. Power Gain and Drain Efficiency versus Output Power – 2700 MHz

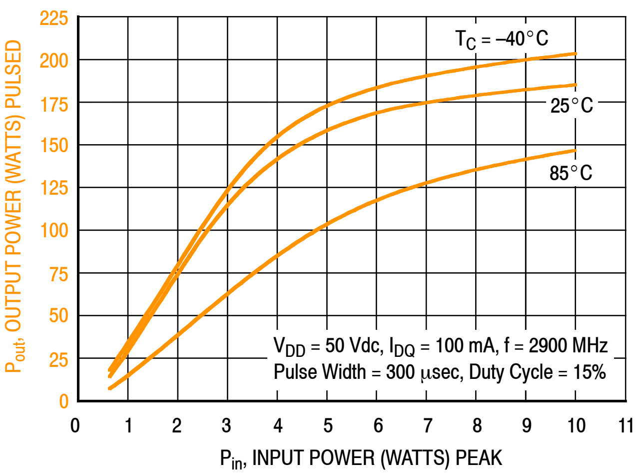


Figure 8. Output Power versus Input Power versus Temperature – 2900 MHz

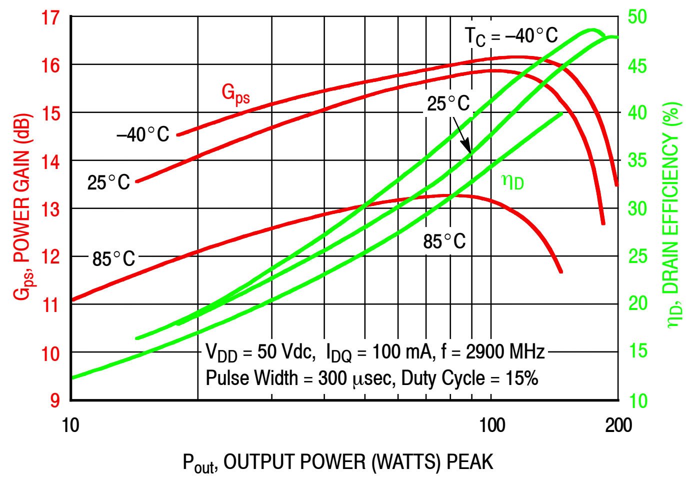


Figure 9. Power Gain and Drain Efficiency versus Output Power – 2900 MHz

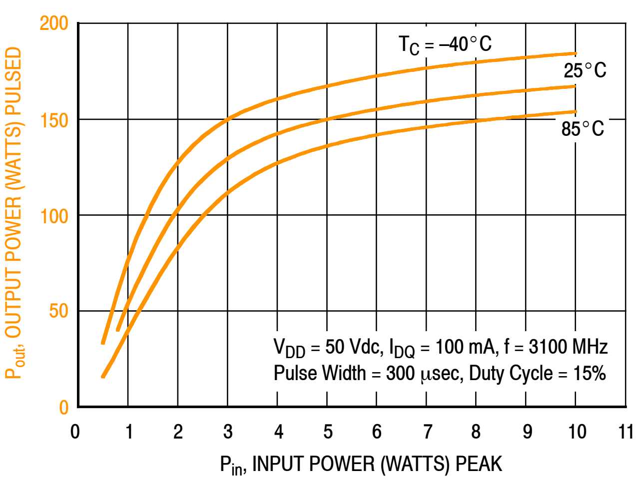


Figure 10. Output Power versus Input Power versus Temperature – 3100 MHz

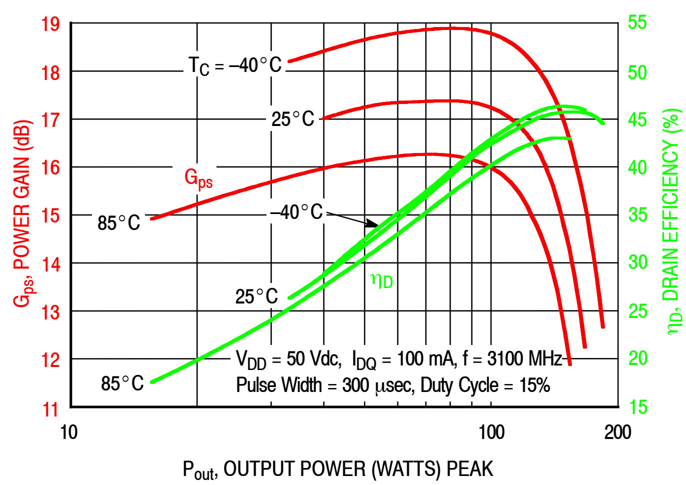
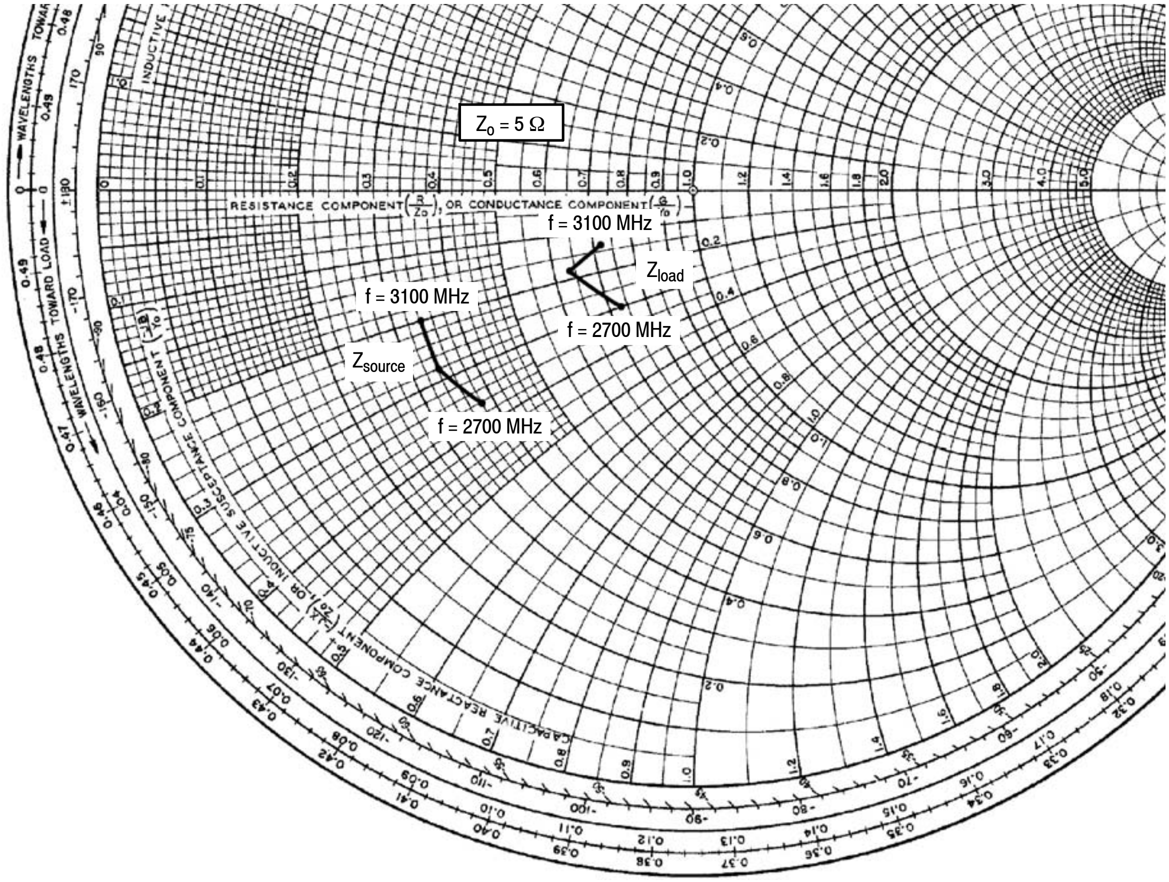


Figure 11. Power Gain and Drain Efficiency versus Output Power – 3100 MHz

2700–3100 MHz REFERENCE CIRCUIT



f MHz	Z_{source} Ω	Z_{load} Ω
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_{source} = Test circuit impedance as measured from gate to ground.

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

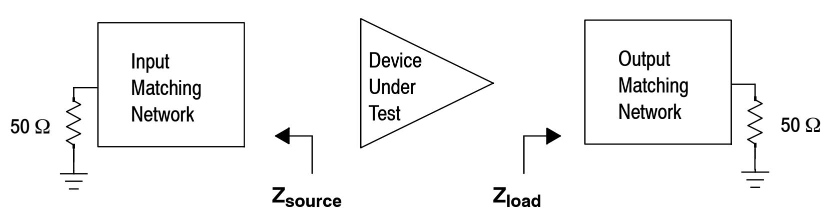


Figure 12. Series Equivalent Source and Load Impedance – 2700–3100 MHz

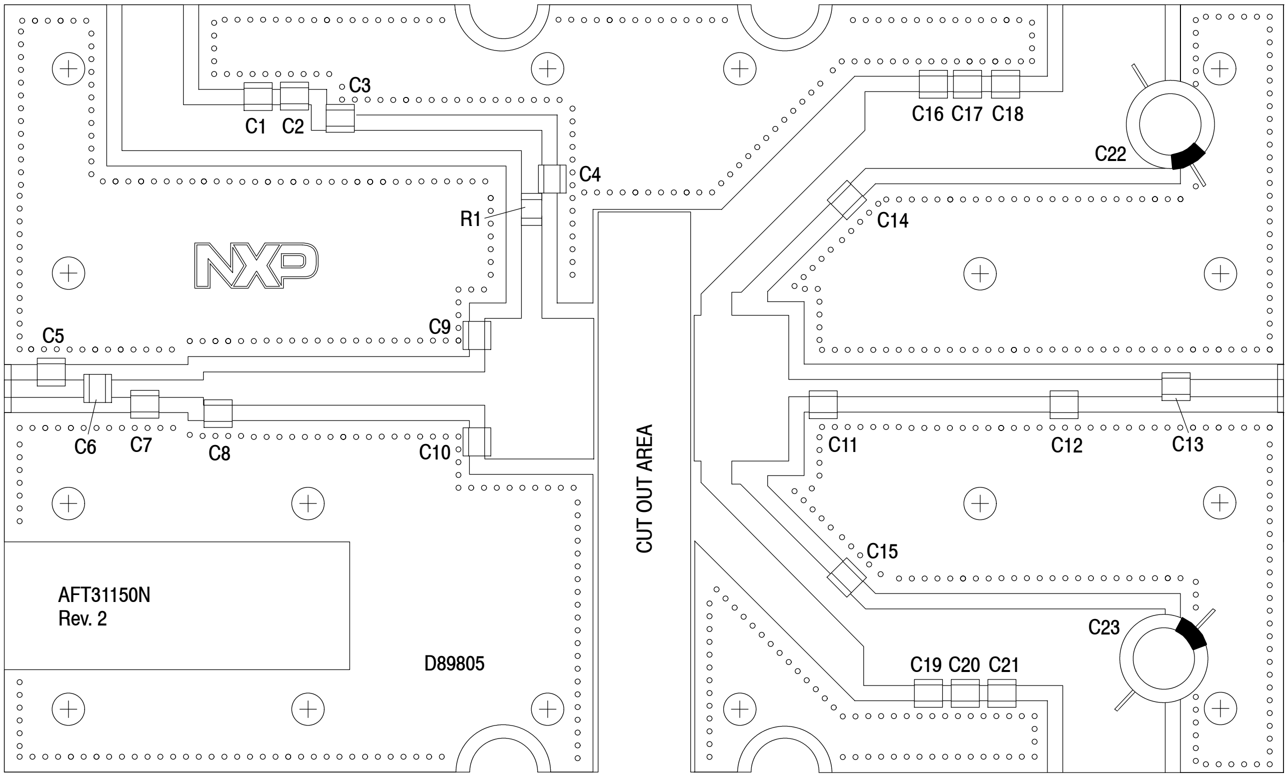


Figure 13. AFT31150N Narrowband Test Circuit Component Layout – 3100 MHz

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

Part	Description	Part Number	Manufacturer
C1, C18, C21	10 μF Chip Capacitor	C5750X7S2A106M	TDK
C2, C17, C20	1 μF Chip Capacitor	C3225JB2A105K200AA	TDK
C3, C16, C19	0.1 μF 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 μF, 100 V Electrolytic Capacitor	MCGPR100V227M16X26-RH	Multicomp
R1	20 Ω, 1/4 W Chip Resistor	CRCW120620R0FKEA	Vishay
PCB	Taconic RF35, 0.030″, ε_r = 3.5	D89805	MTL

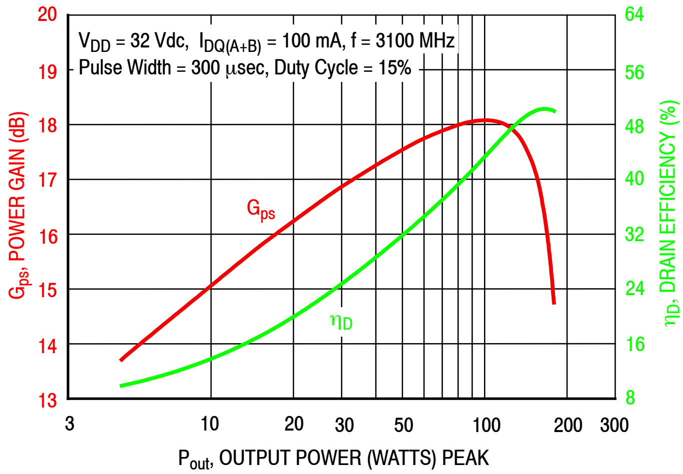


Figure 14. Power Gain and Drain Efficiency versus Output Power

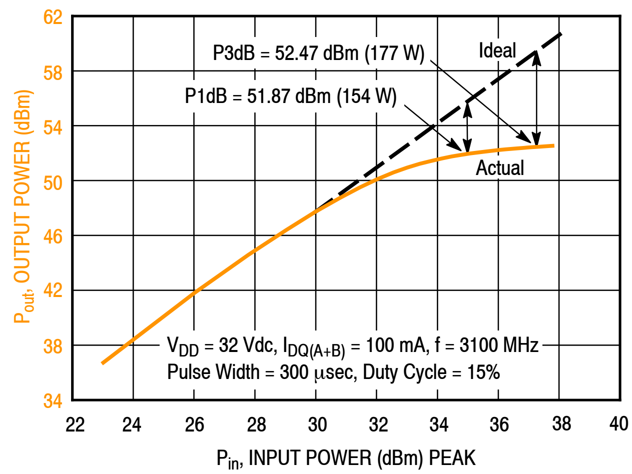


Figure 15. Output Power versus Input Power

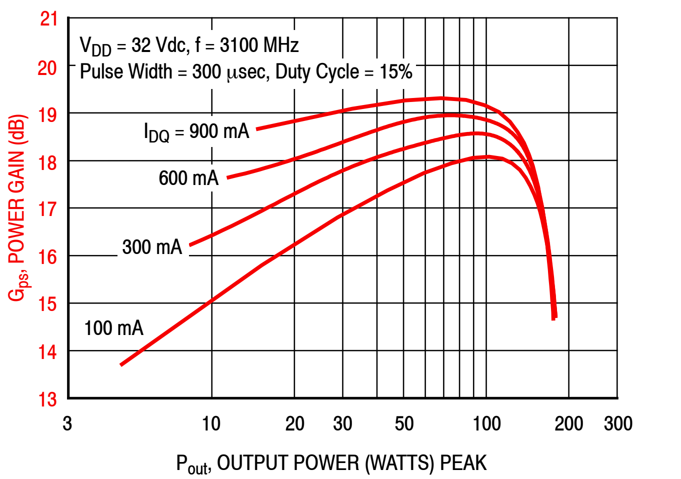


Figure 16. Power Gain versus Output Power

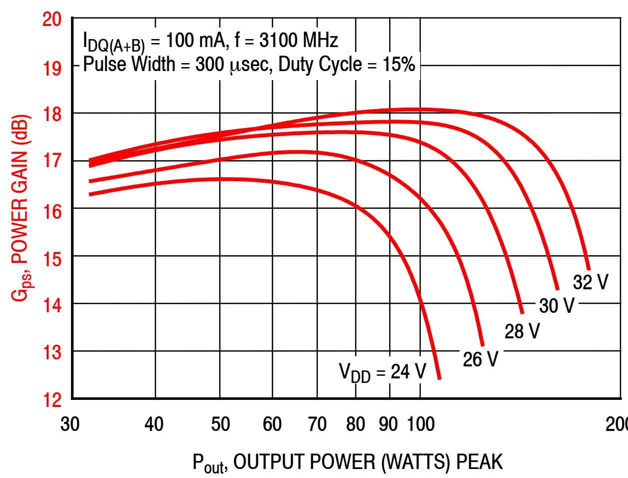


Figure 17. Power Gain versus Output Power and Drain Voltage

3100 MHz NARROWBAND PRODUCTION TEST FIXTURE

f MHz	Z_{source} Ω	Z_{load} Ω
3100	9.5 – j5.3	5.5 + j1.2

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

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

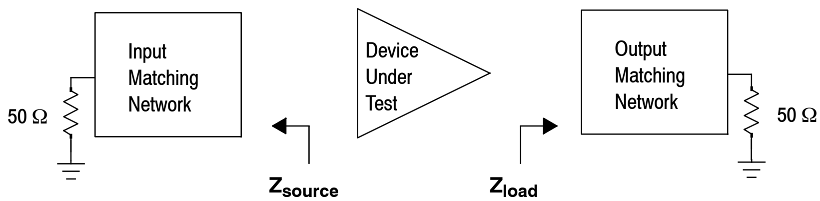
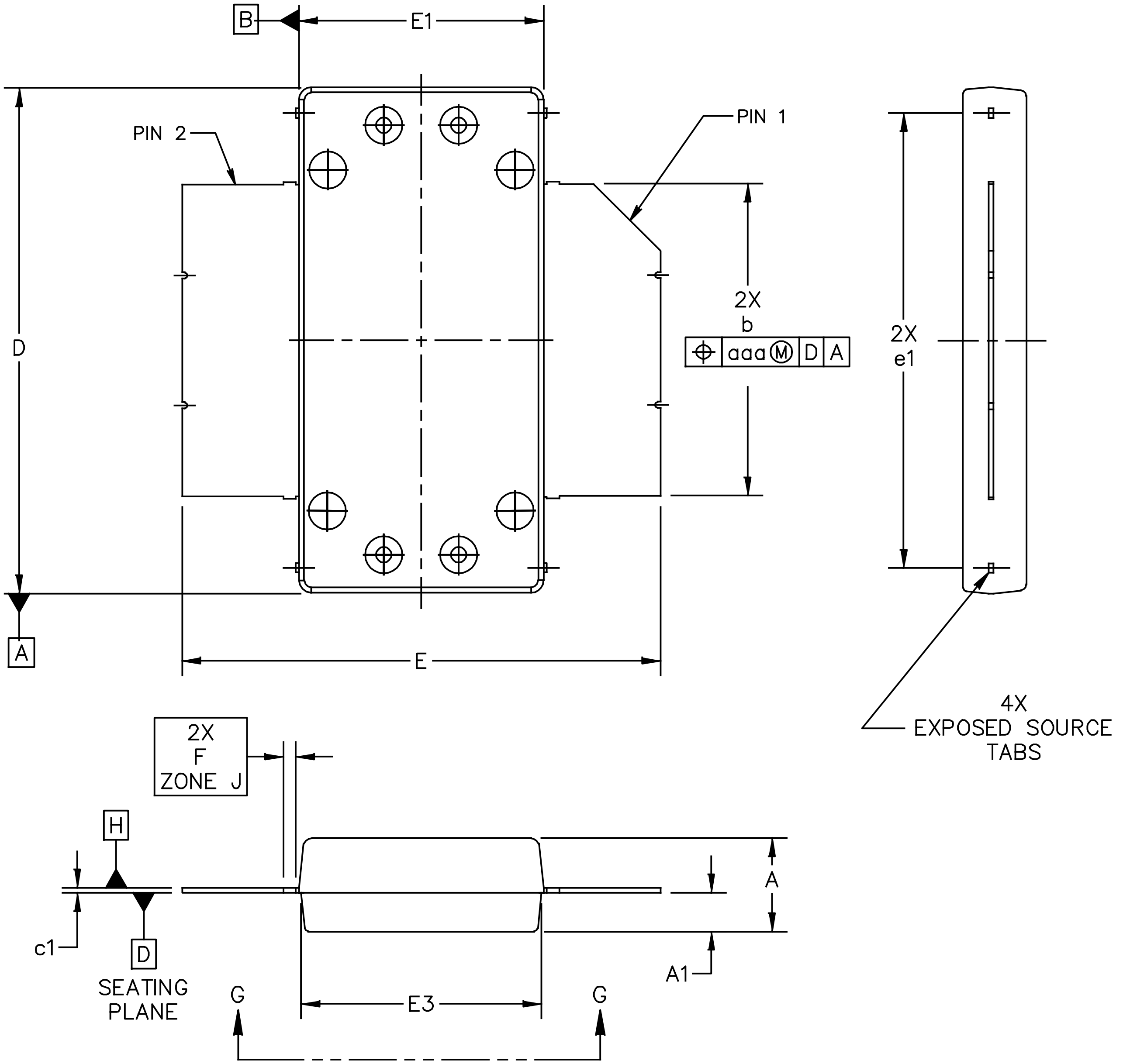


Figure 18. Series Equivalent Source and Load Impedance – 3100 MHz

PACKAGE DIMENSIONS



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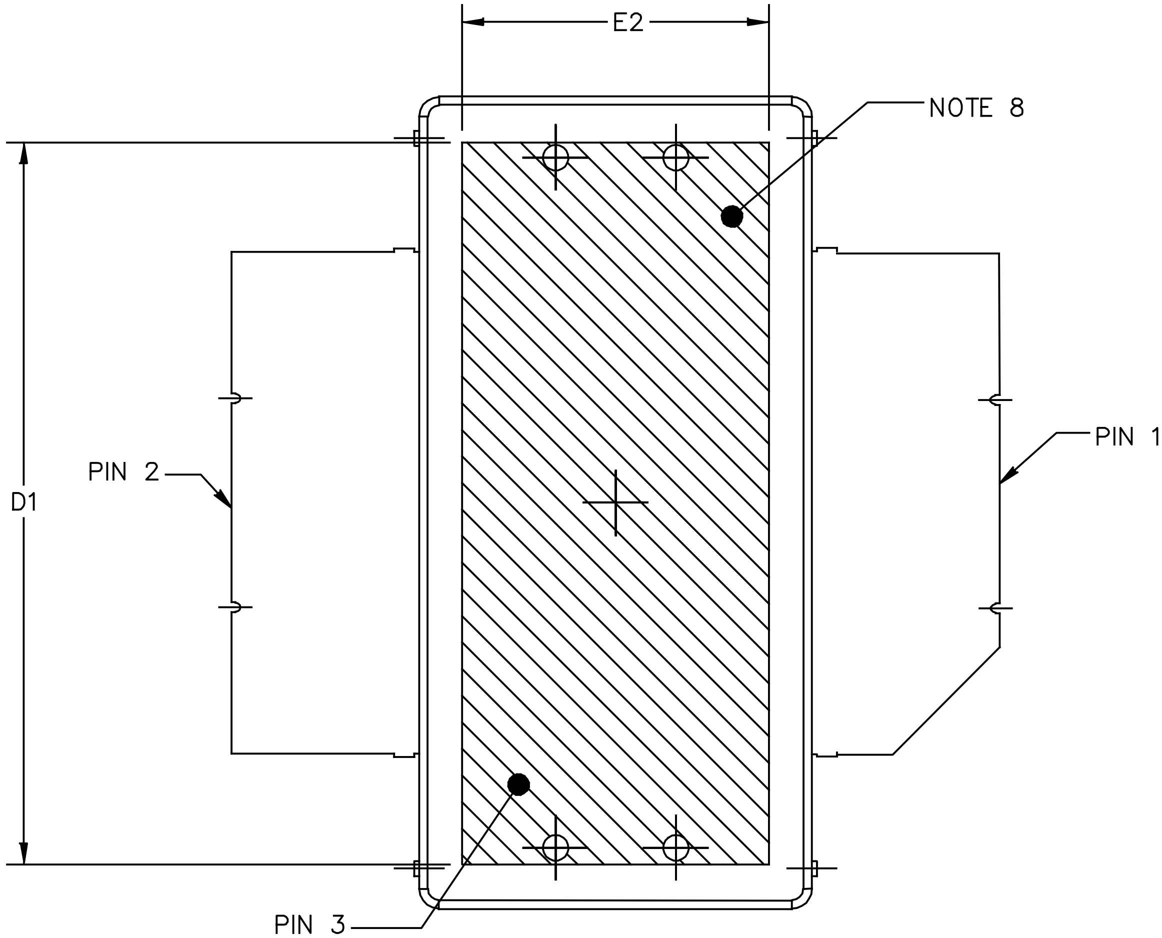
	STANDARD: NON–JEDEC	
	SOT1693–1	22 JAN 2016



BOTTOM VIEW
VIEW G–G

	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: OM780–2 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

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER 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	----					
E	.762	.770	19.36	19.56	aaa	.004		0.10	
E1	.390	.394	9.91	10.01					
E2	.306	----	7.77	----					
E3	.383	.387	9.73	9.83					
F	.025 BSC		0.635 BSC						

MECHANICAL OUTLINE

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TITLE:
OM780-2
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	• Initial release of data sheet

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Document Number: AFT31150N
Rev. 0, 05/2017