Document Number: MRF300AN
Rev. 0, 05/2018

√RoHS

RF Power LDMOS Transistors

High Ruggedness N-Channel Enhancement-Mode Lateral MOSFETs

MRF300AN
MRF300BN

1.8–250 MHz, 300 W CW, 50 V WIDEBAND RF POWER LDMOS TRANSISTORS

These high ruggedness devices are designed for use in high VSWR industrial, scientific and medical applications and HF and VHF communications as well as radio and VHF TV broadcast, sub-GHz aerospace and mobile radio applications. Their unmatched input and output design allows for wide frequency range use from 1.8 to 250 MHz.

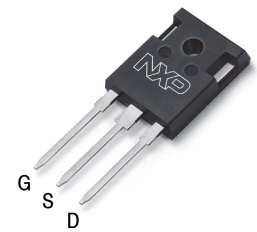
Typical Performance: V_{DD} = 50 Vdc

Frequency (MHz)	Signal Type	P_{out} (W)	G_{ps} (dB)	η_D (%)
27	CW	340 CW	27.3	80.6
40.68 (1)	CW	330 CW	28.2	79.0
81.36	CW	310 CW	26.0	76.5
230 (2)	Pulse (100 μsec, 20% Duty Cycle)	330 Peak	20.4	75.5

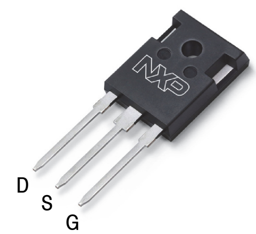
Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
40.68	Pulse (100 μsec, 20% Duty Cycle)	> 65:1 at all Phase Angles	2 Peak (3 dB Overdrive)	50	No Device Degradation
230	Pulse (100 μsec, 20% Duty Cycle)	> 65:1 at all Phase Angles	6 Peak (3 dB Overdrive)	50	No Device Degradation

1. Measured in 40.68 MHz narrowband reference circuit (page 5).
2. Measured in 230 MHz typical narrowband fixture (page 10).



TO-247-3L
MRF300AN

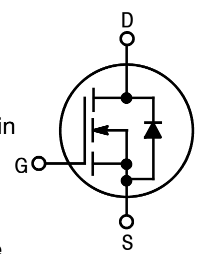


TO-247-3L
MRF300BN

Note: Exposed backside of the package also serves as a source terminal for the transistor.

Features

- Unmatched input and output allowing wide frequency range utilization
- Two opposite pin-connection versions (A and B) to be used in a push-pull, two-up configuration for wideband performance
- Characterized from 30 to 50 V
- Suitable for linear application
- Integrated ESD protection with greater negative gate-source voltage range for improved Class C operation



Typical Applications

- Industrial, scientific, medical (ISM)
  – Laser generation
  – Plasma etching
  – Particle accelerators
  – MRI and other medical applications
  – Industrial heating, welding and drying systems
- Broadcast
  – Radio broadcast
  – VHF TV broadcast
- Mobile radio
  – VHF base stations
- HF and VHF communications
- Switch mode power supplies

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +133	Vdc
Gate-Source Voltage	V_{GS}	–6.0, +10	Vdc
Operating Voltage	V_{DD}	50	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 +175	°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	272 1.82	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value [2,3]	Unit
Thermal Resistance, Junction to Case CW: Case Temperature 76°C, 300 W CW, 50 Vdc, I_{DQ} = 50 mA, 40.68 MHz	$R_{\theta JC}$	0.55	°C/W
Thermal Impedance, Junction to Case Pulse: Case Temperature 74°C, 300 W Peak, 100 μsec Pulse Width, 20% Duty Cycle, 50 Vdc, I_{DQ} = 100 mA, 230 MHz	$Z_{\theta JC}$	0.13	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JS-001-2017)	2, passes 2500 V
Charge Device Model (per JS-002-2014)	C3, passes 1200 V

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	0	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 = 50 mAdc)	$V_{(BR)DSS}$	133	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 100 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 840 μAdc)	$V_{GS(th)}$	1.7	2.2	2.7	Vdc
Gate Quiescent Voltage (V_{DS} = 50 Vdc, I_D = 100 mAdc)	$V_{GS(Q)}$	—	2.5	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1 Adc)	$V_{DS(on)}$	—	0.16	—	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 30 Adc)	g_{fs}	—	28	—	S

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
Dynamic Characteristics					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.31	—	pF
Output Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	104	—	pF
Input Capacitance (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	403	—	pF
Typical Narrowband Performance – 230 MHz (In NXP Narrowband 230 MHz Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 100 mA, P_{in} = 3 W, f = 230 MHz, 100 μsec Pulse Width, 20% Duty Cycle					
Common-Source Amplifier Output Power	P_{out}	—	330	—	W
Drain Efficiency	η_D	—	75.5	—	%
Input Return Loss	IRL	—	–21	—	dB

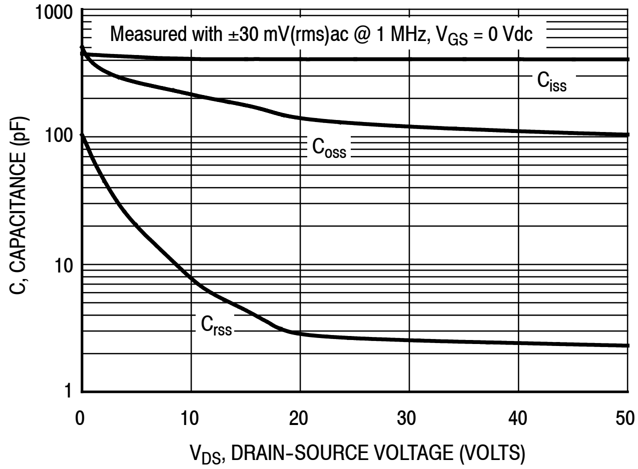
Table 6. Load Mismatch/Ruggedness (In NXP Narrowband 230 MHz Fixture, 50 ohm system) I_{DQ} = 100 mA

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
230	Pulse (100 μsec, 20% Duty Cycle)	> 65:1 at all Phase Angles	6 Peak (3 dB Overdrive)	50	No Device Degradation

Table 7. Ordering Information

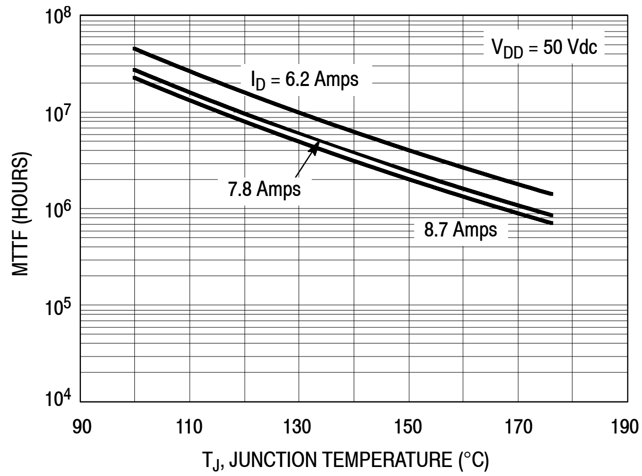
Device	Shipping Information	Package
MRF300AN	MPQ = 240 devices (30 devices per tube, 8 tubes per box)	TO-247-3L (Pin 1: Gate, Pin 2: Source, Pin 3: Drain)
MRF300BN		TO-247-3L (Pin 1: Drain, Pin 2: Source, Pin 3: Gate)

TYPICAL CHARACTERISTICS



Note: Each side of device measured separately.

Figure 1. Capacitance versus Drain-Source Voltage



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

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

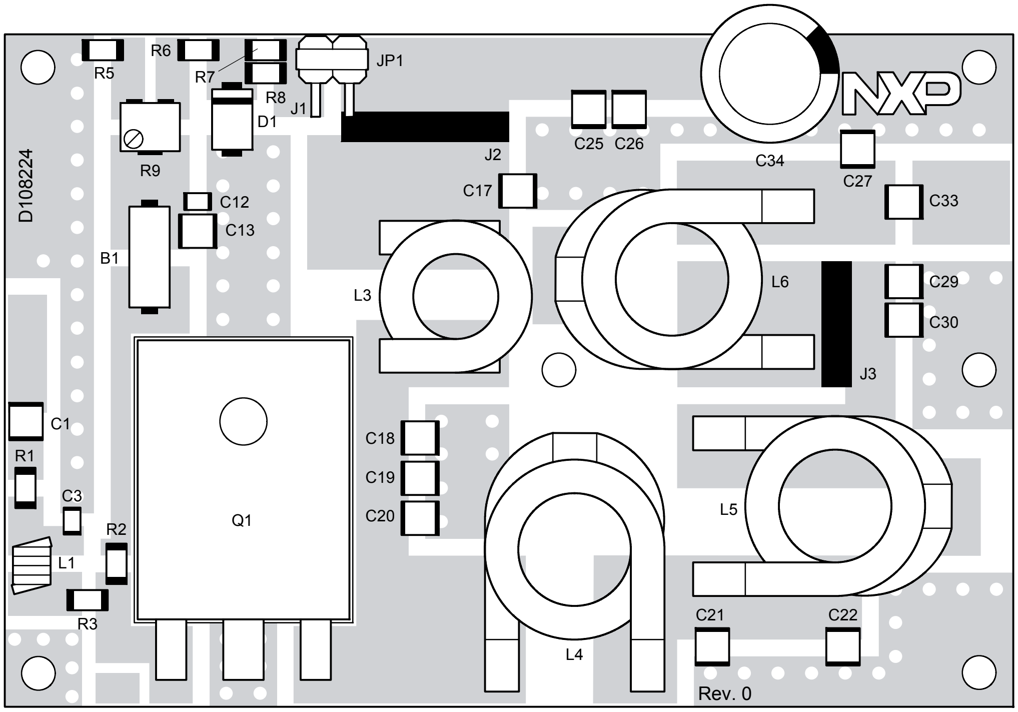
Figure 2. MTTF versus Junction Temperature — CW

40.68 MHz NARROWBAND REFERENCE CIRCUIT (MRF300AN)

Table 8. 40.68 MHz Narrowband Performance (In NXP Reference Circuit, 50 ohm system)

V_{DD} = 50 Vdc, I_{DQ} = 50 mA, P_{in} = 0.5 W, CW

Frequency (MHz)	G_{ps} (dB)	η_D (%)	P_{out} (W)
40.68	28.2	79.0	330



Note: Component numbers C2, C4–C11, C14–C16, C23, C24, C28, C31, C32, R4 and L2 are not used.

aaa-030512

Figure 3. MRF300AN 40.68 MHz Narrowband Reference Circuit Component Layout

40.68 MHz NARROWBAND REFERENCE CIRCUIT (MRF300AN)

Table 9. MRF300AN Narrowband Reference Circuit Component Designations and Values — 40.68 MHz

Part	Description	Part Number	Manufacturer
B1	Long Ferrite Bead	2743021447	Fair-Rite
C1, C13, C17	22,000 pF Chip Capacitor	ATC200B223KT50XT	ATC
C3	200 pF Chip Capacitor	GQM2195C2A201GB12D	Murata
C12	1 μF Chip Capacitor	GRM31CR72A105KA01L	Murata
C18, C19, C20	68 pF Chip Capacitor	ATC100B680JT500XT	ATC
C21	200 pF Chip Capacitor	ATC100B201JT300XT	ATC
C22	220 pF Chip Capacitor	ATC100B221JT200XT	ATC
C25	0.1 μF Chip Capacitor	GRM32NR72A104KA01B	Murata
C26	10 μF Chip Capacitor	GRM32ER61H106KA12L	Murata
C27	56 pF Chip Capacitor	ATC100B560CT500XT	ATC
C29	75 pF Chip Capacitor	ATC100B750JT500XT	ATC
C30	91 pF Chip Capacitor	ATC100B910JT500XT	ATC
C33	5100 pF Chip Capacitor	ATC700B512KT50XT	ATC
C34	220 μF, 63 V Electrolytic Capacitor	EEU-FC1J221	Panasonic
D1	8.2 V Zener Diode	SMAJ4738A-TP	Micro Commercial Components
J1	Right Angle Breakaway Headers (2 Pins)	9-146305-0	TE Connectivity
J2, J3	Jumper	Copper Foil	
JP1	Shunt (J1)	382811-8	TE Connectivity
L1	120 nH Chip Inductor	1008CS-121XJLB	Coilcraft
L3	117 nH Chip Inductor	1212VS-111MEB	Coilcraft
L4	33 nH Chip Inductor	2014VS-33NMEB	Coilcraft
L5	108 nH Chip Inductor	2014VS-111MEB	Coilcraft
L6	155 nH Chip Inductor	2014VS-151MEB	Coilcraft
Q1	RF Power LDMOS Transistor	MRF300AN	NXP
R1, R3	0 Ω, 1/4 W Chip Resistor	CRCW12060000Z0EA	Vishay
R2	100 Ω, 1/4 W Chip Resistor	CRCW1206100RFKEA	Vishay
R5	12 kΩ, 1/4 W Chip Resistor	CRCW120612K0FKEA	Vishay
R6	27 kΩ, 1/4 W Chip Resistor	CRCW120627K0FKEA	Vishay
R7, R8	20 kΩ, 1/4 W Chip Resistor	CRCW120620K0FKEA	Vishay
R9	5.0 kΩ Multi-turn Cermet Trimmer Potentiometer	3224W-1-502E	Bourns
PCB	FR4 0.087″, ε_r = 4.8, 2 oz. Copper	D108224	MTL

TYPICAL CHARACTERISTICS — 40.68 MHz NARROWBAND REFERENCE CIRCUIT (MRF300AN)

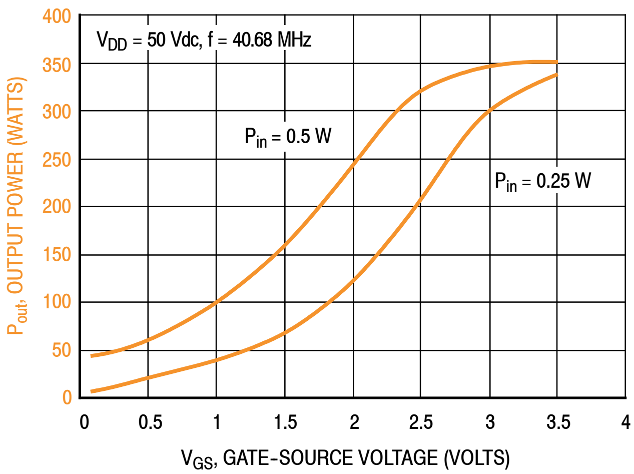
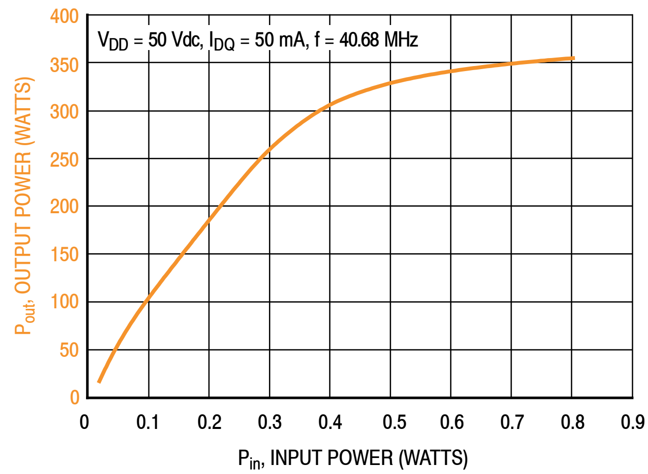


Figure 4. CW Output Power versus Gate-Source Voltage at a Constant Input Power



f (MHz)	P1dB (W)	P3dB (W)
40.68	250	340

Figure 5. CW Output Power versus Input Power

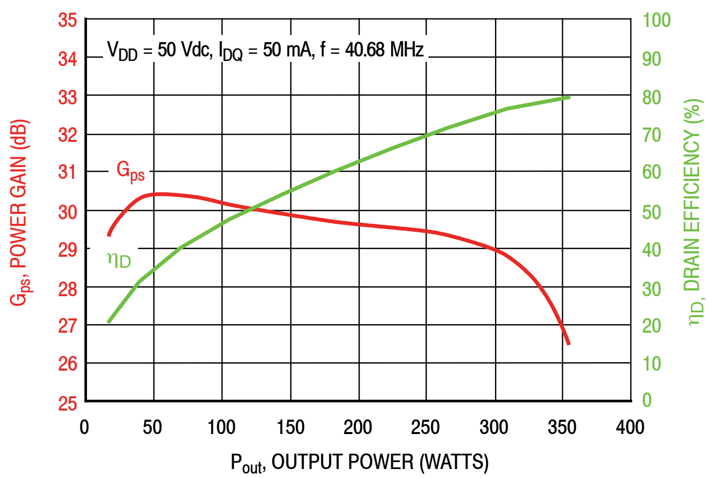


Figure 6. Power Gain and Drain Efficiency versus CW Output Power

40.68 MHz NARROWBAND REFERENCE CIRCUIT (MRF300AN)

f MHz	Z_{source} Ω	Z_{load} Ω
40.68	7.83 + j13.51	5.34 + j1.03

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

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

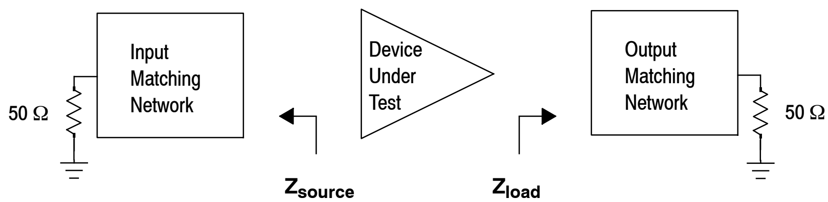


Figure 7. Narrowband Series Equivalent Source and Load Impedance — 40.68 MHz

230 MHz NARROWBAND FIXTURE (MRF300AN) — 4.0″ × 5.0″ (10.2 cm × 12.7 cm)

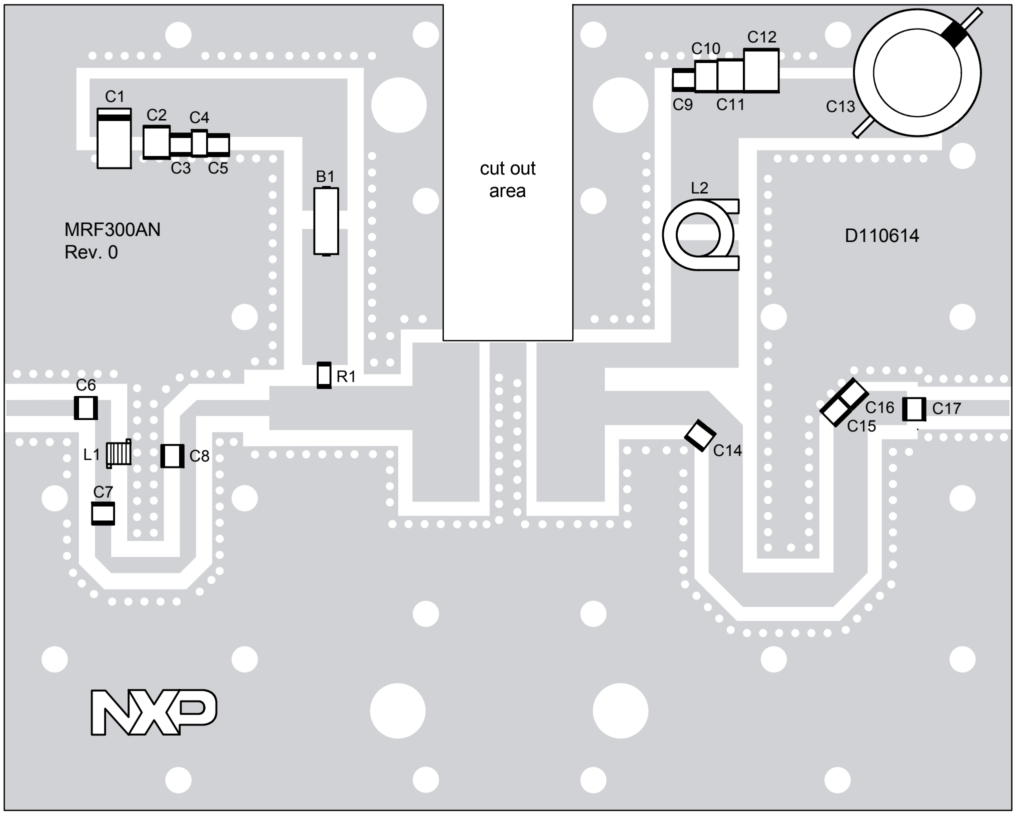


Figure 8. MRF300AN Narrowband Fixture Component Layout — 230 MHz

Table 10. MRF300AN Narrowband Fixture Component Designations and Values — 230 MHz

Part	Description	Part Number	Manufacturer
B1	Long Ferrite Bead	2743021447	Fair-Rite
C1	47 μF, 16 V Tantalum Capacitor	T491D476K016AT	Kemet
C2	2.2 μF Chip Capacitor	C3225X7R1H225K250AB	TDK
C3	10 nF Chip Capacitor	C1210C103J5GACTU	Kemet
C4	0.1 μF Chip Capacitor	GRM319R72A104KA01D	Murata
C5, C9	1000 pF Chip Capacitor	ATC800B102JT50XT	ATC
C6, C7	18 pF Chip Capacitor	ATC100B180JT500XT	ATC
C8, C14	56 pF Chip Capacitor	ATC100B560CT500XT	ATC
C10	0.1 μF Chip Capacitor	C1812104K1RACTU	Kemet
C11	2.2 μF Chip Capacitor	C3225X7R2A225K230AB	TDK
C12	2.2 μF Chip Capacitor	HMK432B7225KM-T	Taiyo Yuden
C13	220 μF, 100 V Electrolytic Capacitor	MCGPR100V227M16X26	Multicomp
C15	1.2 pF Chip Capacitor	ATC100B1R2BT500XT	ATC
C16	24 pF Chip Capacitor	ATC100B240JT500XT	ATC
C17	470 pF Chip Capacitor	ATC800B471JT200XT	ATC
L1	47 nH Chip Inductor	1812SMS-47NJLC	Coilcraft
L2	146 nH Chip Inductor	1010VS-141NME	Coilcraft
R1	470 Ω, 1/4 W Chip Resistor	CRCW1206470RFKEA	Vishay
PCB	Rogers AD255C 0.030″, ε_r = 2.55, 2 oz. Copper	D110614	MTL

TYPICAL CHARACTERISTICS — 230 MHz, T_C = 25°C NARROWBAND FIXTURE (MRF300AN)

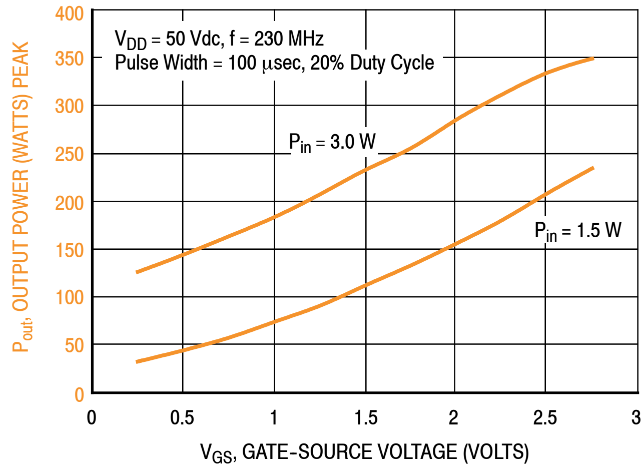
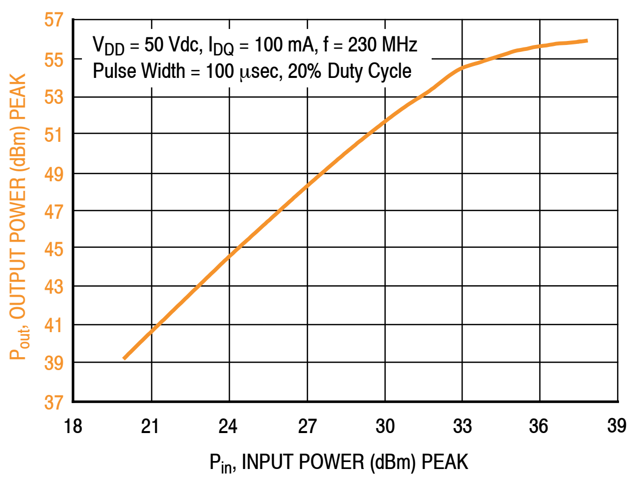


Figure 9. Output Power versus Gate-Source Voltage at a Constant Input Power



f (MHz)	P1dB (W)	P3dB (W)
230	334	382

Figure 10. Output Power versus Input Power

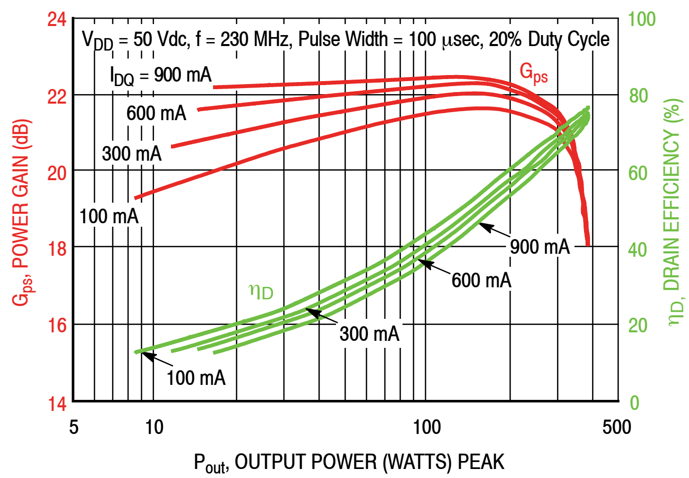


Figure 11. Power Gain and Drain Efficiency versus Output Power and Quiescent Current

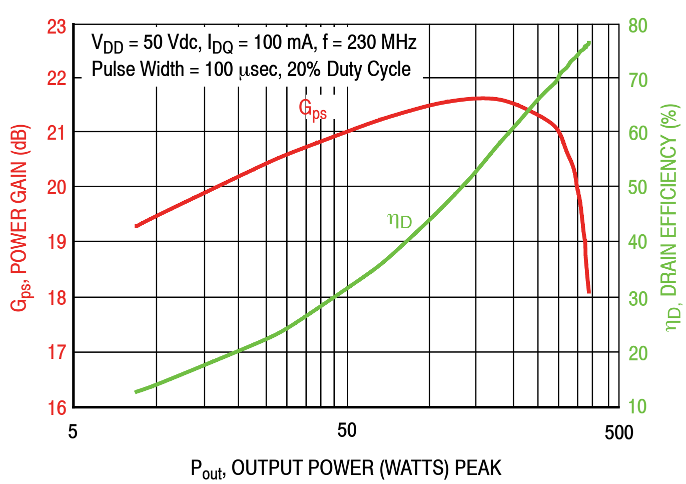


Figure 12. Power Gain and Drain Efficiency versus Output Power

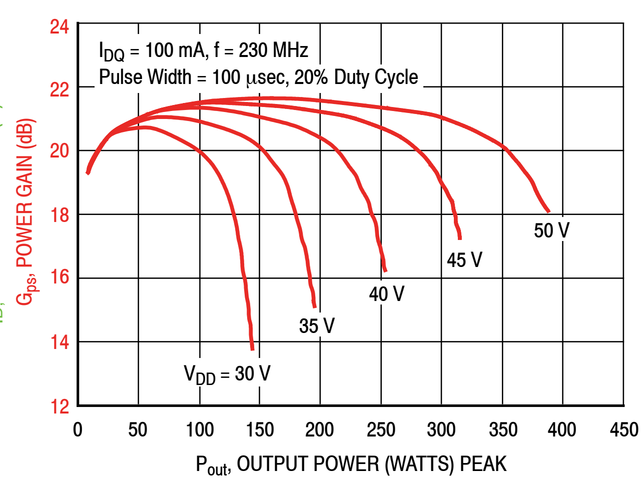


Figure 13. Power Gain versus Output Power and Drain-Source Voltage

230 MHz NARROWBAND FIXTURE (MRF300AN)

f MHz	Z_{source} Ω	Z_{load} Ω
230	1.77 + j1.90	2.50 + j0.78

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

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

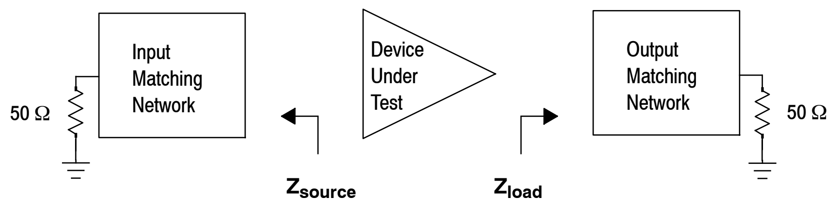
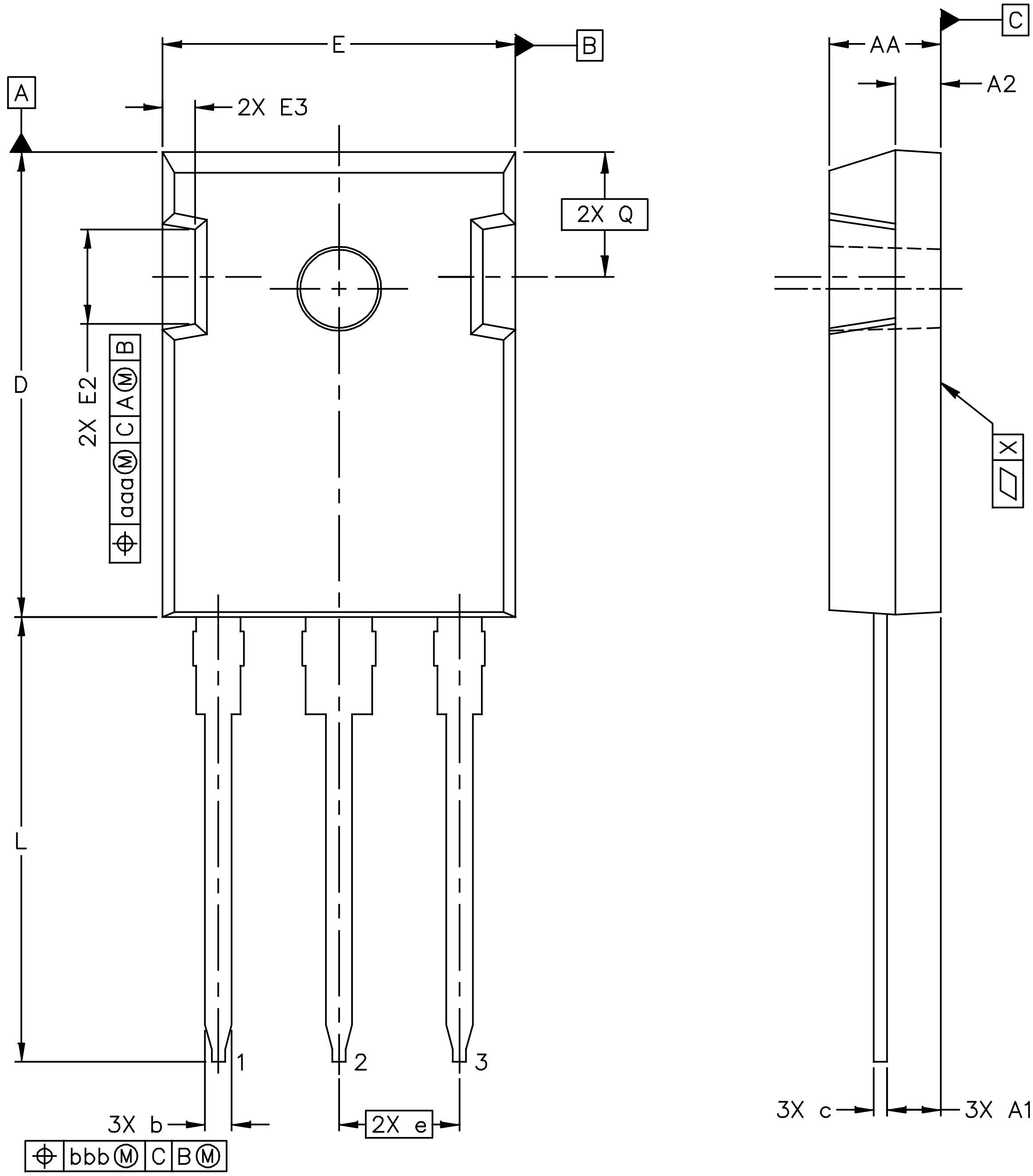


Figure 14. Narrowband Series Equivalent Source and Load Impedance — 230 MHz

PACKAGE DIMENSIONS



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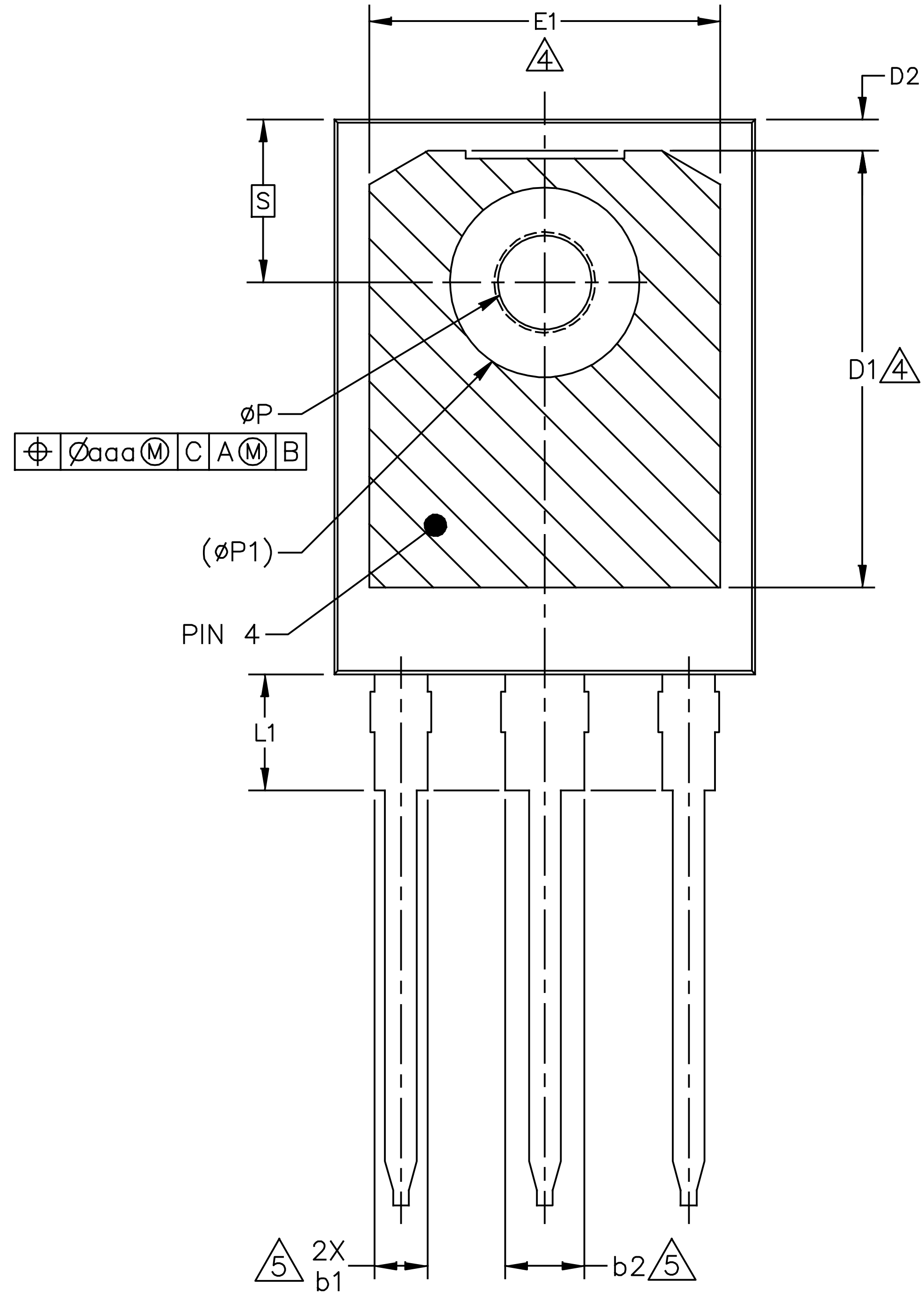

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	STANDARD: NON–JEDEC	
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NOTES:

1. CONTROLLING DIMENSION: MILLIMETER, ANGLES ARE IN DEGREES.

2. INTERPRET DIMENSIONS AND TOLERANCES AS PER ASME Y14.5M–1994.

3. DIMENSION D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 MM (.005 INCH) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.

4. HATCHING REPRESENTS THE EXPOSED AREA OF THE THERMAL PAD (PIN 4). DIMENSIONS D1 AND E1 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF THE EXPOSED AREA OF THE THERMAL PAD. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION D1 AND E1.

5. DIMENSIONS b1 & b2 DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.15 MM (.006 INCH) PER SIDE IN EXCESS OF THE DIMENSIONS b1 & b2 AT MAXIMUM MATERIAL CONDITION.

6. EJECTOR MARKS ON TOP SURFACE ARE PERMITTED AND IT IS SUPPLIER OPTION. THE MAXIMUM DEPTH OF EJECTOR MARK IS 0.25 MM (.010 INCH)

7. ø P TO HAVE MAXIMUM DRAFT ANGLE 1.5°.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.90	2.16
b	.042	.052	1.07	1.33
b1	.075	.095	1.91	2.41
b2	.113	.133	2.87	3.38
c	.022	.027	0.55	0.69
D	.819	.831	20.80	21.11
D1	.515	---	13.08	---
D2	.020	---	0.51	---
E	.618	.635	15.70	16.13
E1	.487	---	12.37	---
E2	.145	.201	3.68	5.11

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
E3	.039	.102	0.99	2.60
e	.214 BSC		5.44 BSC	
L	.780	.800	19.80	20.32
L1	---	.173	---	4.40
P	.138	.146	3.50	3.71
P1	---	.291	---	7.40
Q	.228 BSC		5.79 BSC	
S	.242 BSC		6.15 BSC	
X	---	.004	---	0.01
aaa	.025		0.64	
bbb	.010		0.25	

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DOCUMENT NO: 98ASA01082D REV: 0

STANDARD: 18 OCT 2017

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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 2018	• Initial release of data sheet

How to Reach Us:

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Document Number: MRF300AN
Rev. 0, 05/2018