NXP Semiconductors
Technical Data

Document Number: MRF085H
Rev. 1, 10/2017

RF Power LDMOS Transistor

High Ruggedness N-Channel Enhancement-Mode Lateral MOSFET

This high ruggedness device is designed for use in high VSWR industrial, scientific and medical applications and sub-GHz aerospace and defense and mobile radio applications. Its unmatched input and output design allows for wide frequency range use from 1.8 to 1215 MHz.

Typical Performance: V_{DD} = 50 Vdc

Frequency (MHz)	Signal Type	P_{out} (W)	G_{ps} (dB)	η_D (%)
30–520 (1,2)	CW	50 CW	14.0	40.0
520 (3)	CW	85 CW	25.6	73.3

Load Mismatch/Ruggedness

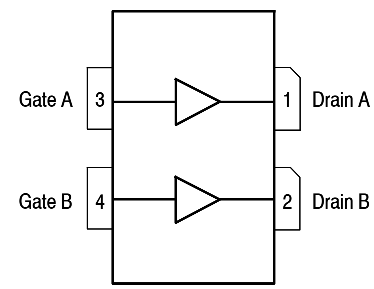
Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
520 (3)	CW	> 65:1 at all Phase Angles	0.56 (3 dB Overdrive)	50	No Device Degradation

1. Measured in 30–520 MHz broadband reference circuit.
2. The values shown are the minimum measured performance numbers across the indicated frequency range.
3. Measured in 520 MHz narrowband test circuit (page 5).

MRF085H

1.8–1215 MHz, 85 W CW, 50 V WIDEBAND RF POWER LDMOS TRANSISTOR

NI-650H-4L



(Top View)

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

Figure 1. Pin Connections

Features

- Unmatched input and output allowing wide frequency range utilization
- Device can be used single-ended or in a push-pull configuration
- Characterized from 30 to 50 V for ease of use
- 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
  - Industrial heating, welding and drying systems
- Broadcast
  - Radio broadcast
  - VHF TV broadcast
- Aerospace
  - VHF omnidirectional range (VOR)
  - HF and VHF communications
  - Weather radar
- Mobile radio
  - VHF and UHF radios

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, +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	235 1.18	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case CW: Case Temperature 85°C, 85 W CW, 50 Vdc, $I_{DQ(A+B)}$ = 100 mA, 520 MHz	$R_{\theta JC}$	0.85	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2, passes 2000 V
Charge Device Model (per JESD22-C101)	C2, passes 500 V

Table 4. Electrical Characteristics (T$_A$ = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (4)					
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	400	nAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 50 mA)	$V_{(BR)DSS}$	133	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	2	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 100 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	7	μAdc
On Characteristics					
Gate Threshold Voltage (4) (V_{DS} = 10 Vdc, I_D = 85 μAdc)	$V_{GS(th)}$	1.5	2.0	3.0	Vdc
Gate Quiescent Voltage (V_{DD} = 50 Vdc, $I_{D(A+B)}$ = 100 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2.0	2.6	3.3	Vdc
Drain-Source On-Voltage (4) (V_{GS} = 10 Vdc, I_D = 210 mAdc)	$V_{DS(on)}$	—	0.27	—	Vdc
Dynamic Characteristics (4)					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	0.17	—	pF
Output Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	14.7	—	pF
Input Capacitance (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	39.0	—	pF

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.
4. Each side of device measured separately.

(continued)

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (In NXP Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, $I_{DQ(A+B)}$ = 100 mA, P_{out} = 85 W CW, f = 520 MHz					
Power Gain	G_{ps}	24.0	25.6	28.0	dB
Drain Efficiency	η_D	70.0	73.3	—	%
Input Return Loss	IRL	—	–21	–9	dB

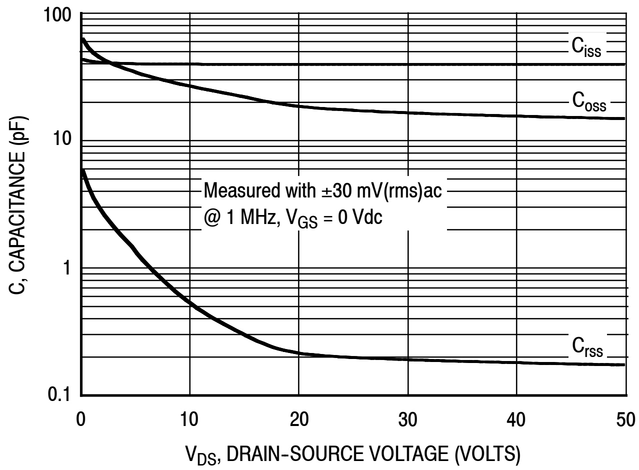
Load Mismatch/Ruggedness (In NXP Test Fixture, 50 ohm system) I_{DQ} = 150 mA

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
520	CW	> 65:1 at all Phase Angles	0.56 (3 dB Overdrive)	50	No Device Degradation

Table 5. Ordering Information

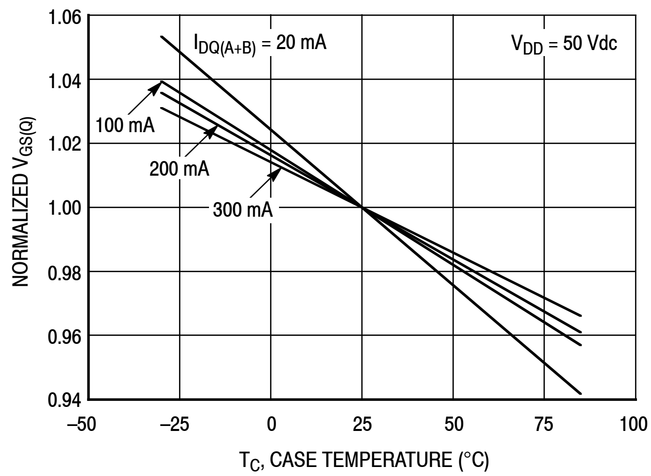
Device	Tape and Reel Information	Package
MRF085HR3	R3 Suffix = 250 Units, 44 mm Tape Width, 13-inch Reel	NI-650H-4L
MRF085HR5	R5 Suffix = 50 Units, 44 mm Tape Width, 13-inch Reel	NI-650H-4L

TYPICAL CHARACTERISTICS



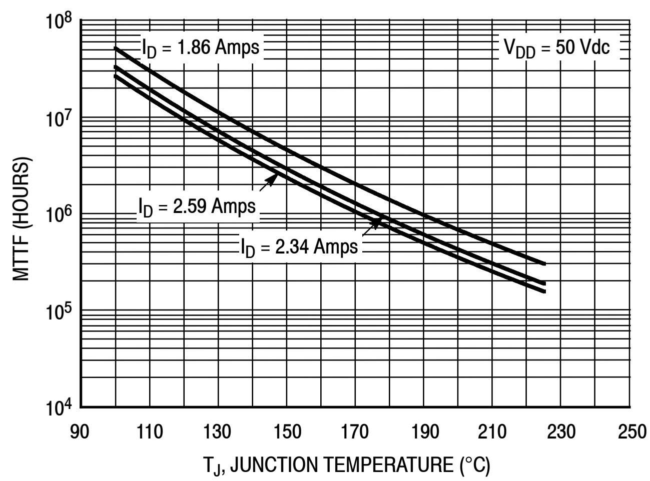
Note: Each side of device measured separately.

Figure 2. Capacitance versus Drain-Source Voltage



I_{DQ} (mA)	Slope (mV/°C)
20	–2.35
100	–1.88
200	–1.78
300	–1.59

Figure 3. Normalized V_{GS} versus Quiescent Current and Case Temperature



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

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

Figure 4. MTTF versus Junction Temperature – CW

520 MHz NARROWBAND PRODUCTION TEST FIXTURE – 4.0″ × 5.0″ (10.2 mm × 12.7 mm)

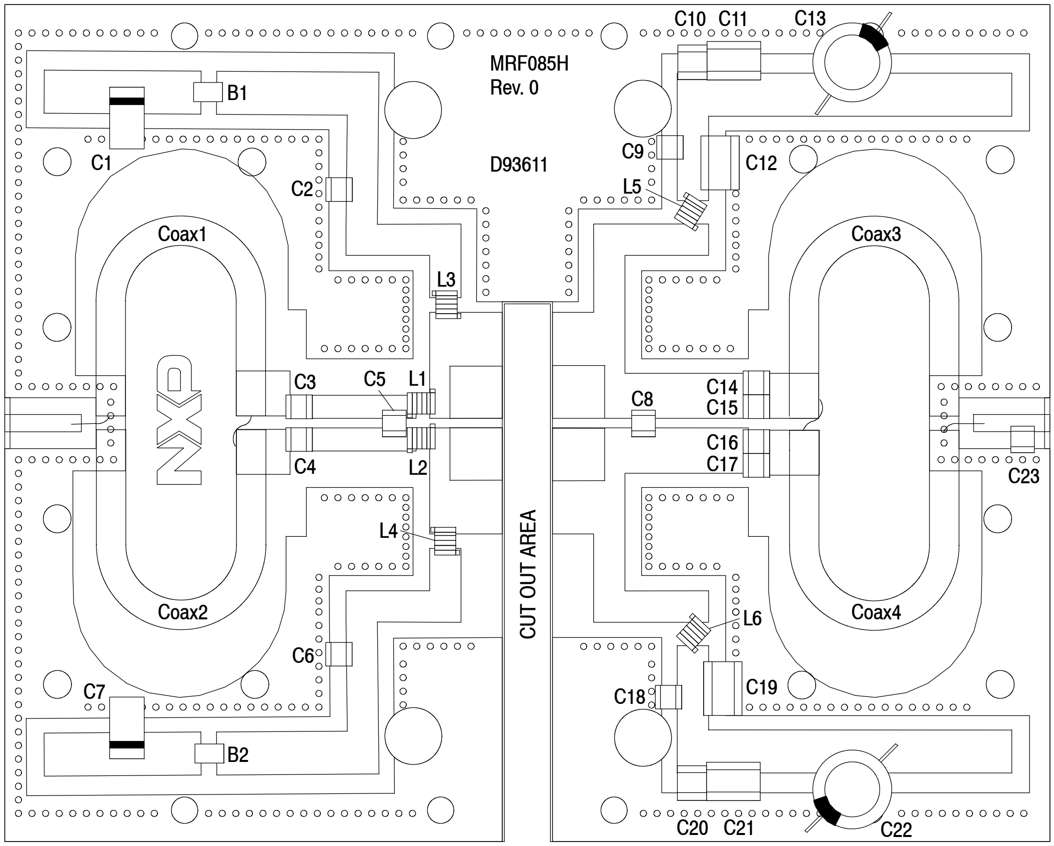
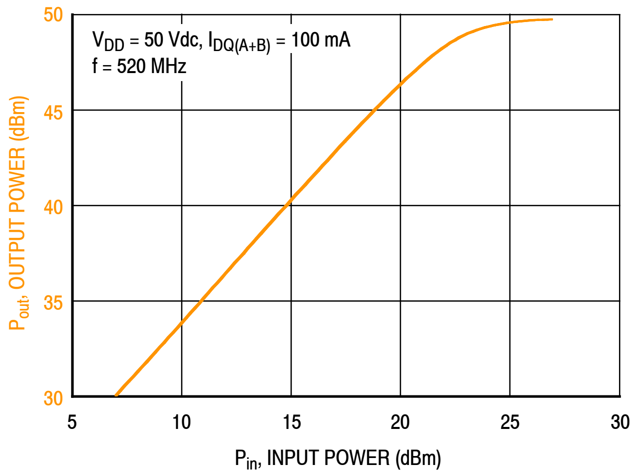


Figure 5. MRF085H Narrowband Test Circuit Component Layout – 520 MHz

Table 6. MRF085H Narrowband Test Circuit Component Designations and Values – 520 MHz

Part	Description	Part Number	Manufacturer
B1, B2	Short RF Bead	2743019447	Fair-Rite
C1, C7	22 μF, 35 V Tantalum Capacitor	T491X226K035AT	Kemet
C2, C6, C9, C18	240 pF Chip Capacitor	ATC100B241JT200XT	ATC
C3, C4	51 pF Chip Capacitor	ATC100B510GT500XT	ATC
C5	36 pF Chip Capacitor	ATC100B360JT500XT	ATC
C8	5.1 pF Chip Capacitor	ATC100B5R1CT500XT	ATC
C10, C20	10 pF Chip Capacitor	ATC200B103KT50XT	ATC
C11, C21	0.01 μF Chip Capacitor	C1825C103K1GACTU	Kemet
C12, C19	0.1 μF Chip Capacitor	C1812F104K1RACTU	Kemet
C13, C22	220 μF, 100 V Electrolytic Capacitor	MCGPR100V227M16X26-RH	Multicomp
C14, C15, C16, C17	120 pF Chip Capacitor	ATC100B121JT300XT	ATC
C23	5.6 pF Chip Capacitor	ATC100B5R6CT500XT	ATC
Coax1, 2, 3, 4	25 Ω, Semi Rigid Coax, 2.4” Shield Length	UT141-25	Precision Tube Company
L1, L2, L5, L6	2.5 nH Inductor, 1 Turn	A01TKLC	Coilcraft
L3, L4	22 nH Inductor, 7 Turns	B07TJLC	Coilcraft
PCB	Arlon AD255A, 0.030″, ε_r = 2.55	D93611	MTL



f (MHz)	P1dB (W)	P3dB (W)
520	88	94

Figure 6. CW Output Power versus Input Power

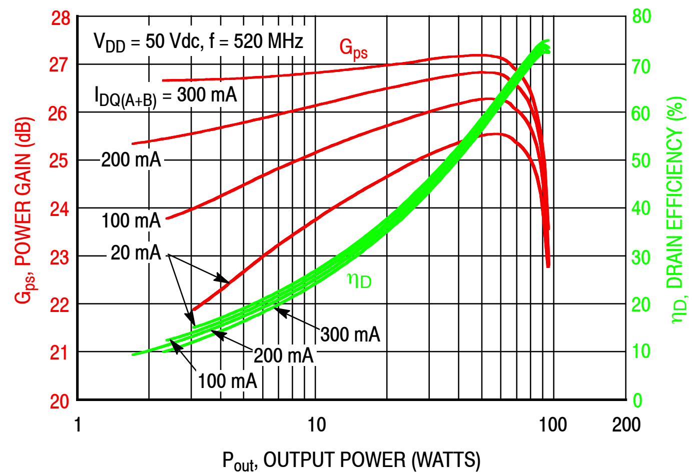


Figure 7. Power Gain and Drain Efficiency versus CW Output Power and Quiescent Current

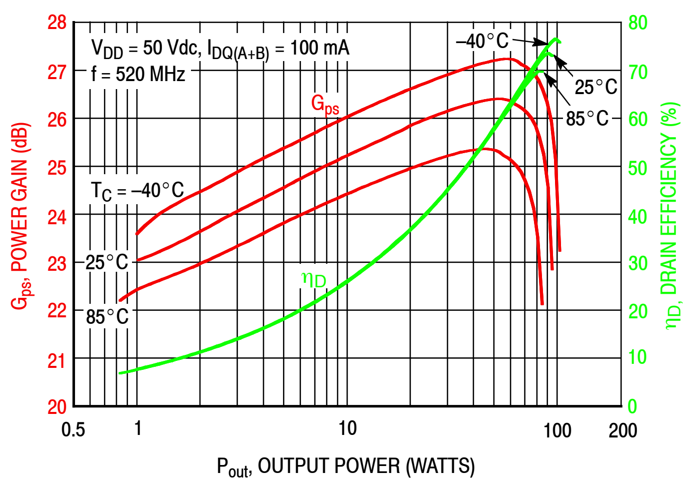


Figure 8. Power Gain and Drain Efficiency versus CW Output Power

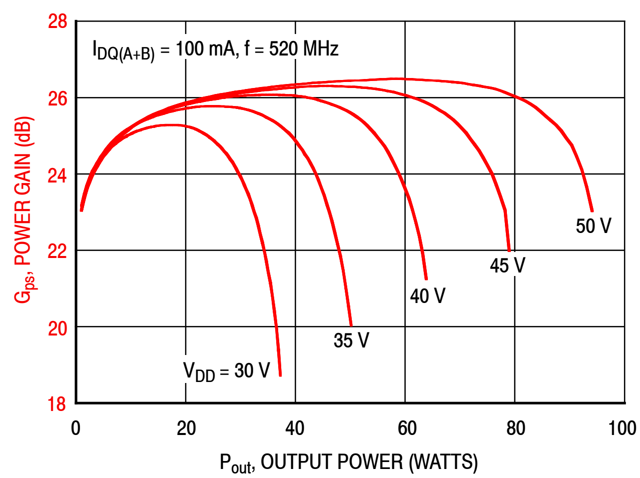


Figure 9. Power Gain versus CW Output Power and Drain-Source Voltage

520 MHz NARROWBAND PRODUCTION TEST FIXTURE

f MHz	Z_{source} Ω	Z_{load} Ω
520	1.32 + j20.2	22.6 + j18.2

Z_{source} = Test circuit impedance as measured from gate to gate, balanced configuration.

Z_{load} = Test circuit impedance as measured from drain to drain, balanced configuration.

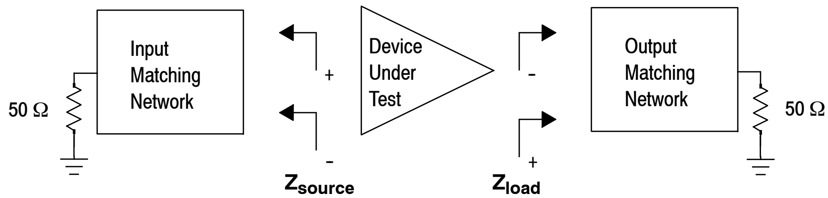
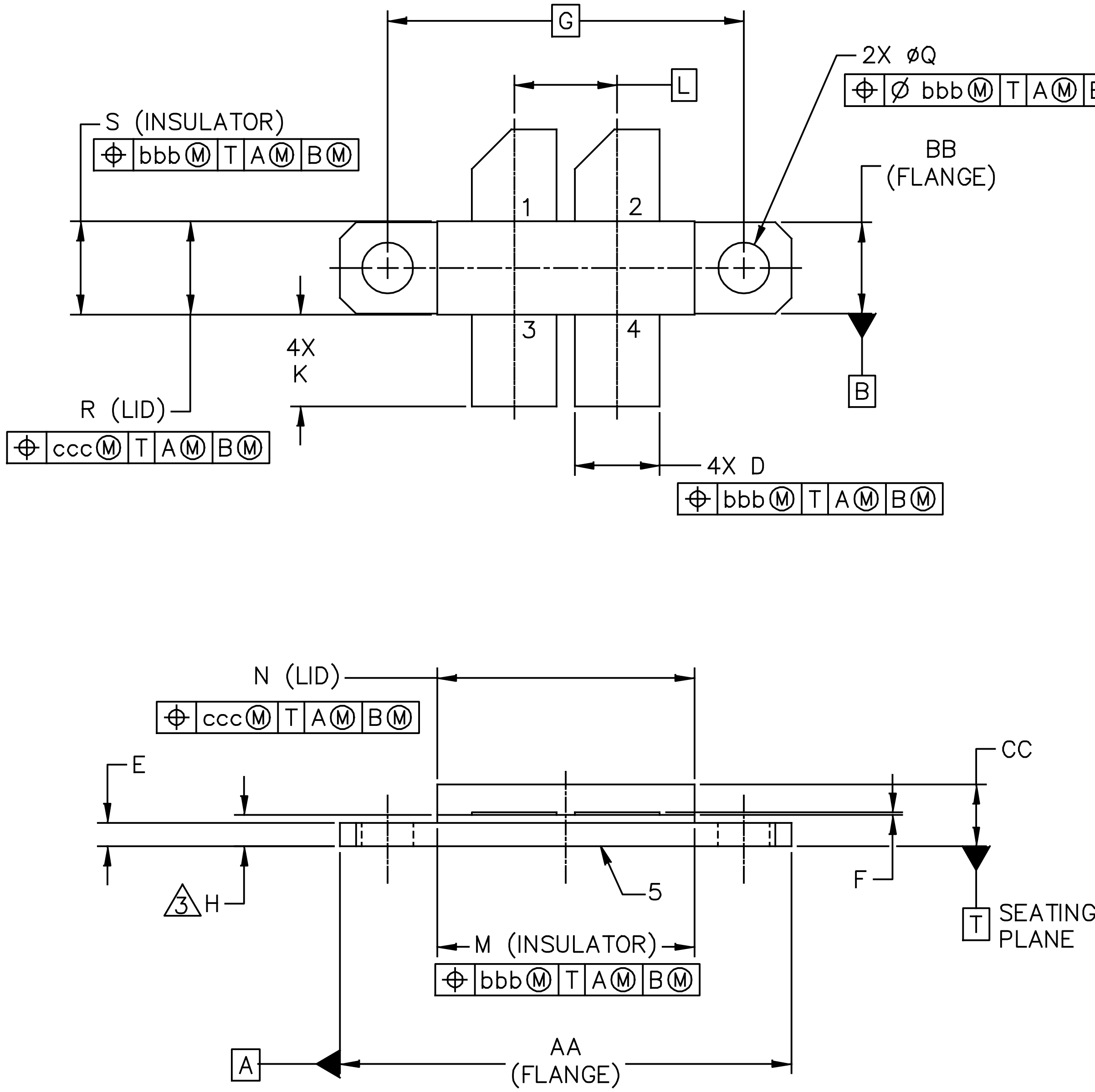


Figure 10. Narrowband Series Equivalent Source and Load Impedance — 520 MHz

PACKAGE DIMENSIONS



© NXP SEMICONDUCTORS N.V. ALL RIGHTS RESERVED	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: NI-650H-4L	DOCUMENT NO: 98ARB18494C	REV: F
	STANDARD: NON-JEDEC	
	SOT1911-1	26 JAN 2017

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. (3) DIMENSION H IS MEASURED .030 INCH (0.762 MM) AWAY FROM THE FLANGE PARALLEL TO DATUM B TO CLEAR EPOXY FLOW OUT.
4. DELETED REV. B.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	1.135	1.145	28.83	29.08	Q	ø.125	ø.135	ø3.18	ø3.43
BB	.225	.235	5.72	5.97	R	.227	.233	5.77	5.92
CC	.135	.178	3.43	4.52	S	.225	.235	5.72	5.97
D	.210	.220	5.33	5.59	bbb	.010		0.25	
E	.055	.065	1.40	1.65	ccc	.015		0.38	
F	.004	.006	0.10	0.15					
G	.900 BSC		22.86 BSC						
H	.077	.087	1.96	2.21					
K	.220	.250	5.59	6.35					
L	.260 BSC		6.60 BSC						
M	.643	.657	16.33	16.69					
N	.638	.650	16.21	16.51					

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: NI–650H–4L	DOCUMENT NO: 98ARB18494C	REV: F
	STANDARD: NON–JEDEC	
	SOT1911–1	26 JAN 2017

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

Application Notes

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity 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	July 2017	• Initial release of data sheet
1	Oct. 2017	• Table 5, Ordering Information: added MRF085HR3 to table and R3 suffix tape and reel information, p. 3

How to Reach Us:

Home Page:
nxp.com

Web Support:
nxp.com/support

Document Number: MRF085H
Rev. 1, 10/2017