Freescale Semiconductor
Technical Data

Document Number: MHT1001H
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RoHS

RF Power LDMOS Transistor

N-Channel Enhancement-Mode Lateral MOSFET

RF power transistor suitable for industrial heating applications operating at 2450 MHz. Device is capable of both CW and pulse operation.

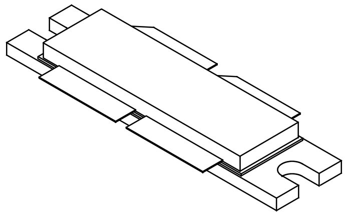
- Typical CW Performance at 2450 MHz, V_{DD} = 28 Vdc, I_{DQ} = 1900 mA, P_{out} = 190 W
  Power Gain — 13.2 dB
  Drain Efficiency — 46.2%
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2340 MHz, 190 W CW Output Power

Features

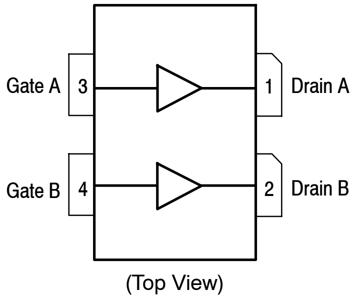
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- In Tape and Reel. R5 Suffix = 50 Units, 56 mm Tape Width, 13-inch Reel.

MHT1001HR5

2450 MHz, 190 W CW, 28 V
INDUSTRIAL HEATING, RUGGED
RF POWER LDMOS TRANSISTOR



NI-1230H-4S



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

Figure 1. Pin Connections

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5, +68	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +12	Vdc
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature (1,2)	T_J	225	°C
CW Operation @ T_C = 25°C Derate above 25°C	CW	110 1.34	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 100°C, 190 W CW (4)	$R_{\theta JC}$	0.22	°C/W

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.
4. Exceeds recommended operating conditions. See CW operation data in Maximum Ratings table.

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C
Machine Model (per EIA/JESD22-A115)	A
Charge Device Model (per JESD22-C101)	III

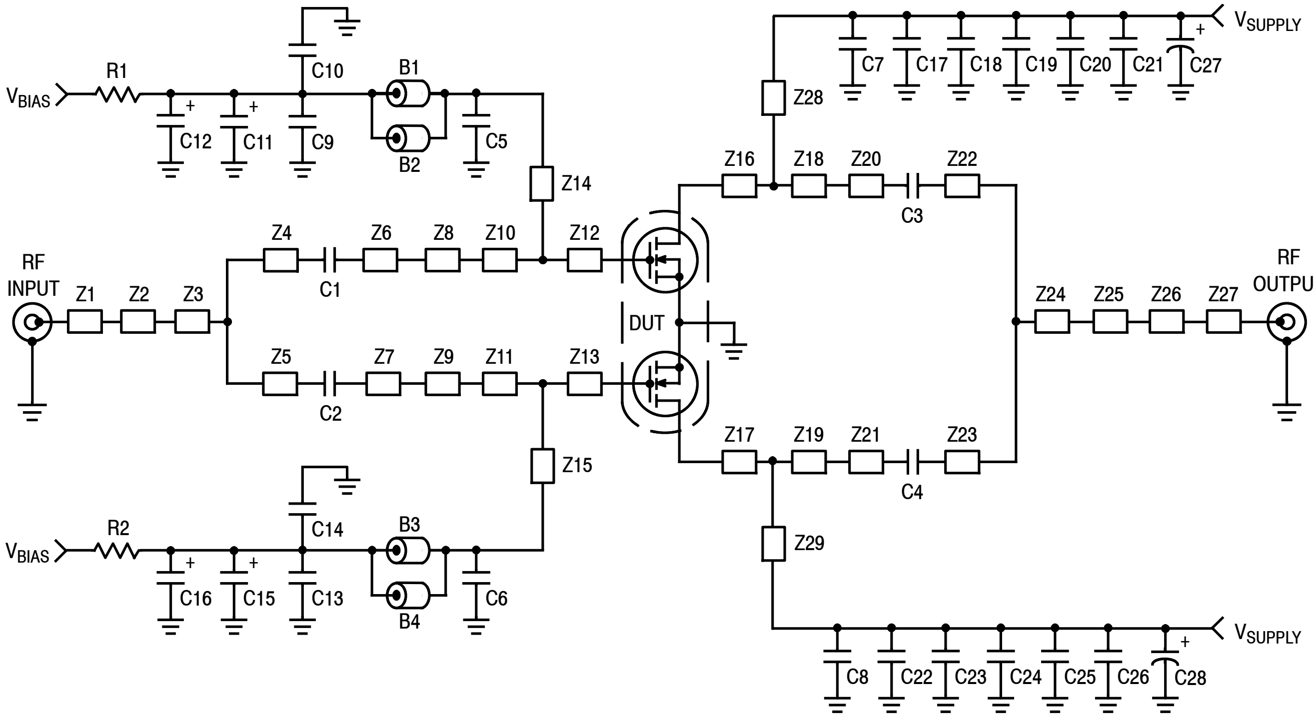
Table 4. Electrical Characteristics (T$_C$ = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (1)					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (1) (V_{DS} = 10 Vdc, I_D = 200 μAdc)	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage (3) (V_{DD} = 28 Vdc, I_D = 1900 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage (1) (V_{GS} = 10 Vdc, I_D = 2.2 Adc)	$V_{DS(on)}$	0.1	0.21	0.3	Vdc
Dynamic Characteristics (1,2)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.5	—	pF

Functional Tests (3) (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 1900 mA, P_{out} = 40 W Avg., f = 2390 MHz, 2-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. IM3 measured in 3.84 MHz Bandwidth @ ±10 MHz Offset. Input Signal PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	G_{ps}	13	14	16	dB
Drain Efficiency	η_D	22	23.5	—	%
Intermodulation Distortion	IM3	—	-37.5	-35	dBc
Adjacent Channel Power Ratio	ACPR	—	-41	-38	dBc
Input Return Loss	IRL	—	-13	—	dB

1. Each side of device measured separately.
2. Part internally matched both on input and output.
3. Measurement made with device in push-pull configuration.

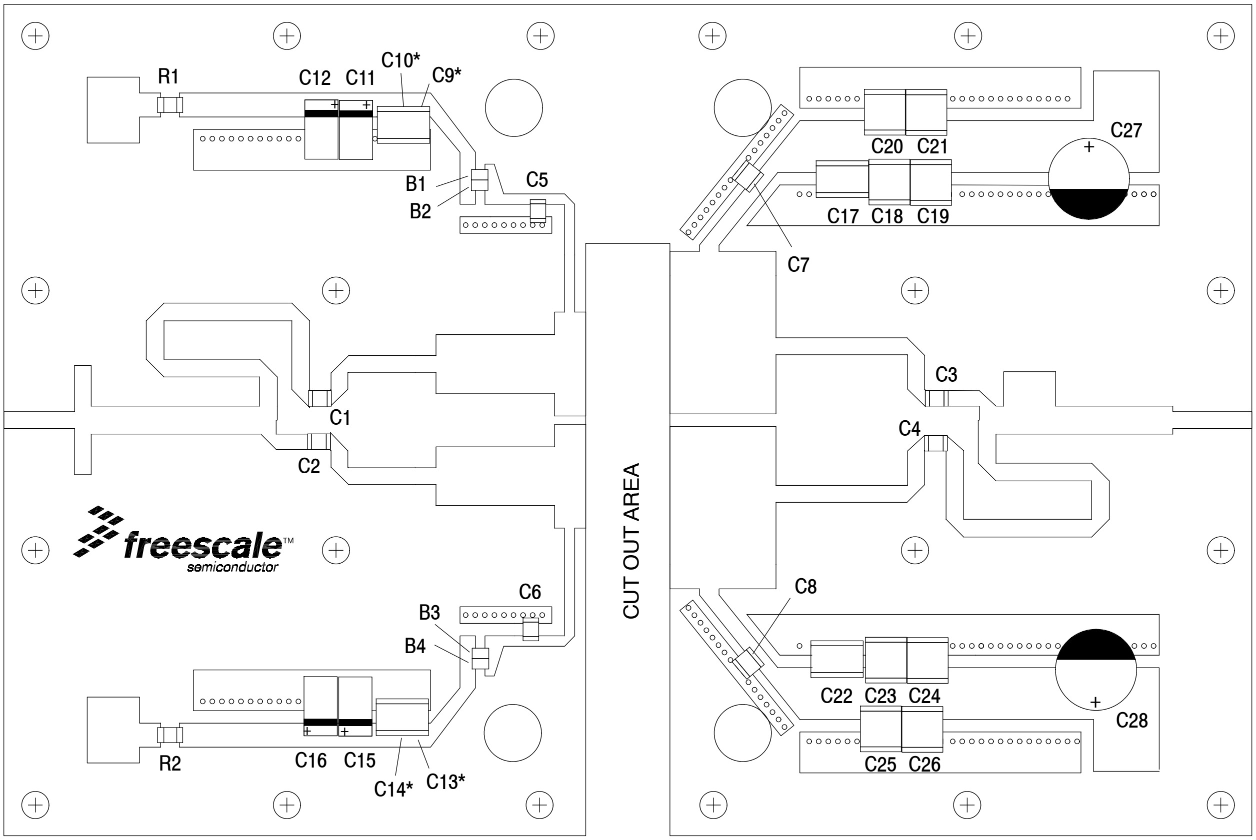


Z1	0.340″ x 0.081″ Microstrip	Z16, Z17	0.189″ x 0.782″ Microstrip
Z2	0.080″ x 0.526″ Microstrip	Z18, Z19	0.321″ x 0.782″ Microstrip
Z3	0.895″ x 0.135″ Microstrip	Z20, Z21	0.630″ x 0.081″ Microstrip
Z4	1.736″ x 0.074″ Microstrip	Z22	0.150″ x 0.081″ Microstrip
Z5	0.151″ x 0.074″ Microstrip	Z23	1.728″ x 0.085″ Microstrip
Z6, Z7	0.505″ x 0.081″ Microstrip	Z24	0.122″ x 0.135″ Microstrip
Z8, Z9	0.570″ x 0.282″ Microstrip	Z25	0.250″ x 0.300″ Microstrip
Z10, Z11	0.072″ x 0.500″ Microstrip	Z26	0.563″ x 0.135″ Microstrip
Z12, Z13	0.078″ x 0.500″ Microstrip	Z27	0.380″ x 0.081″ Microstrip
Z14	0.664″ x 0.050″ Microstrip	Z28, Z29	0.305″ x 0.057″ Microstrip
Z15	0.680″ x 0.050″ Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030″, ε_r = 2.55

Figure 1. MHT1001HR5 Test Circuit Schematic — 2450 MHz

Table 5. MHT1001HR5 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2, B3, B4	Ferrite Beads	2508051107Y0	Fair-Rite
C1, C2, C3, C4	5.1 pF, Chip Capacitors	ATC100B5R1CT500XT	ATC
C5, C6, C7, C8	5.6 pF, Chip Capacitors	ATC100B5R6CT500XT	ATC
C9, C13	0.01 μF, 100 V Chip Capacitors	C1825C103J1RAC	Kemet
C10, C14, C17, C22	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC	Kemet
C11, C15	22 μF, 25 V Tantalum Capacitors	T491D226K025AT	Kemet
C12, C16	47 μF, 16 V Tantalum Capacitors	T491D476K016AT	Kemet
C18, C19, C20, C21, C23, C24, C25, C26	10 μF, 50 V Chip Capacitors	GRM55DR61H106KA88B	Murata
C27, C28	330 μF, 63 V Electrolytic Capacitors	NACZF331M63V	Nippon
R1, R2	240 Ω, 1/4 W Chip Resistors	CRCW12062400FKEA	Vishay



*Stacked

Figure 2. MHT1001HR5 Test Circuit Component Layout

TYPICAL CHARACTERISTICS — 2450 MHz

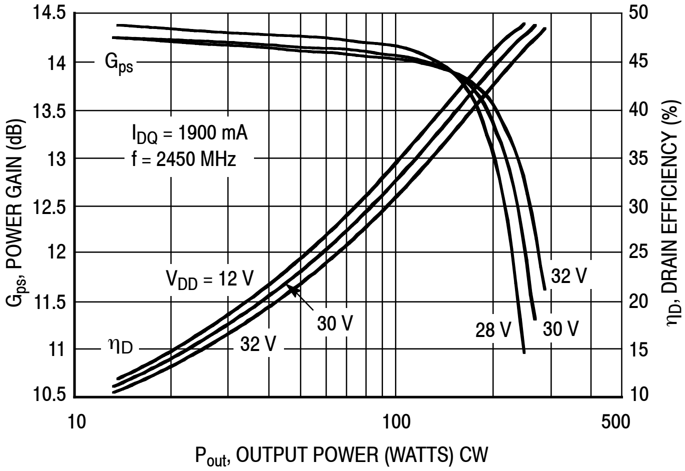


Figure 3. Power Gain and Drain Efficiency versus CW Output Power

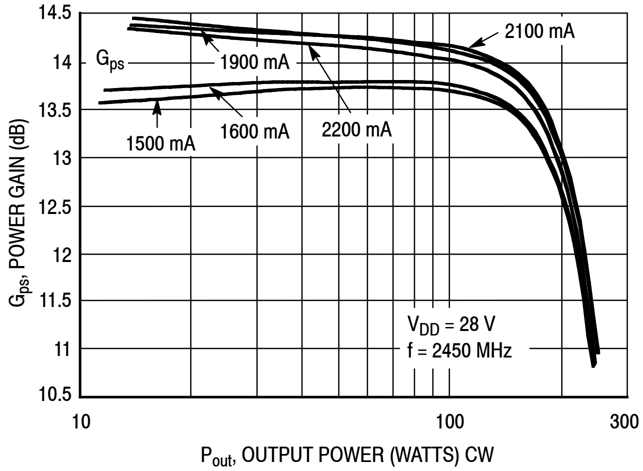


Figure 4. Power Gain and Drain Efficiency versus CW Output Power

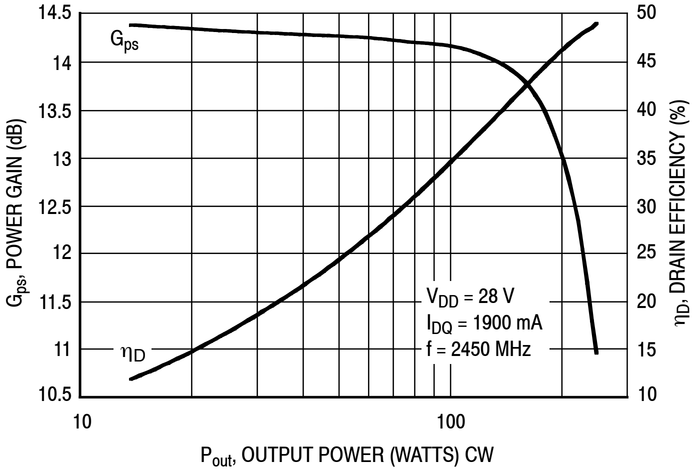
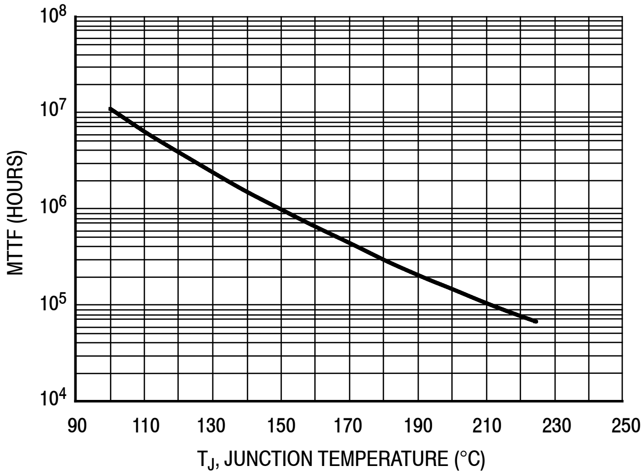


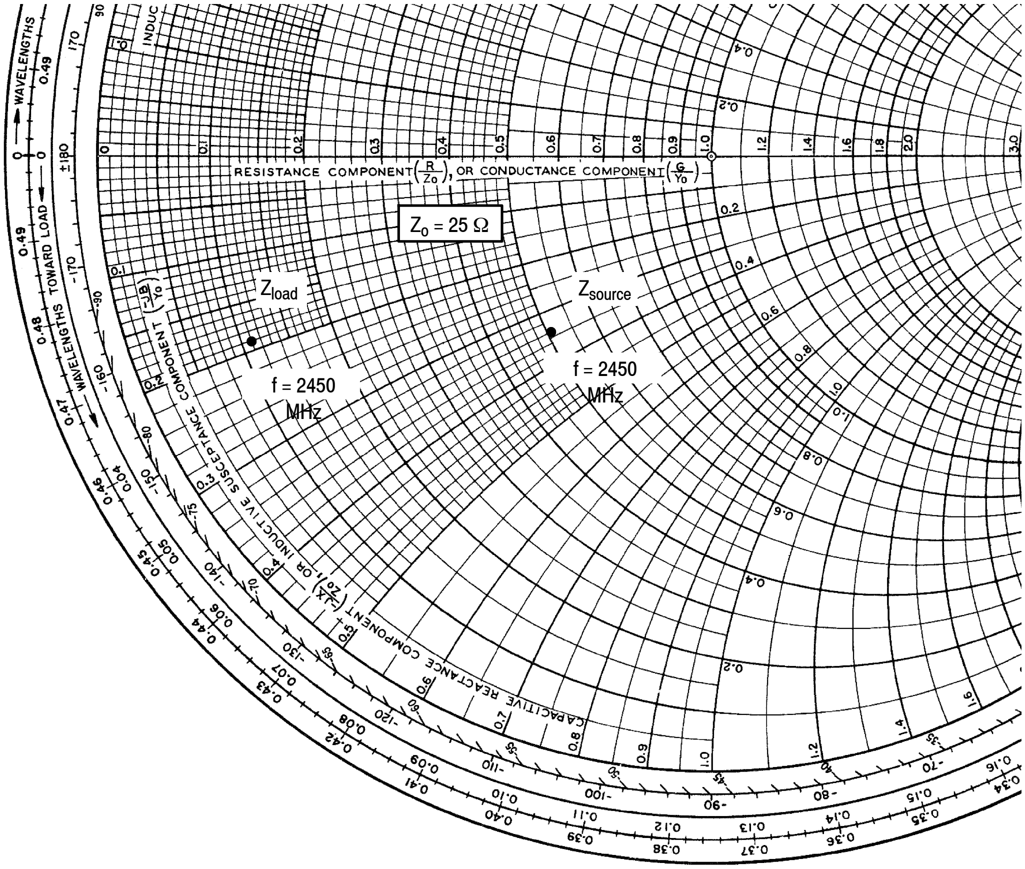
Figure 5. Power Gain and Drain Efficiency versus CW Output Power



This above graph displays calculated MTTF in hours when the device is operated at V_{DD} = 28 Vdc, P_{out} = 190 W CW, and η_D = 46.2%.

MTTF calculator available at http://www.freescale.com/rf. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

Figure 6. MTTF versus Junction Temperature



V_{DD} = 28 Vdc, I_{DQ} = 1900 mA, P_{out} = 190 W CW

f MHz	Z_{source} Ω	Z_{load} Ω
2450	12.72 - j8.48	2.75 - j4.85

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

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

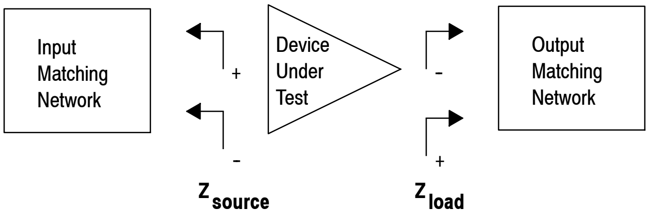
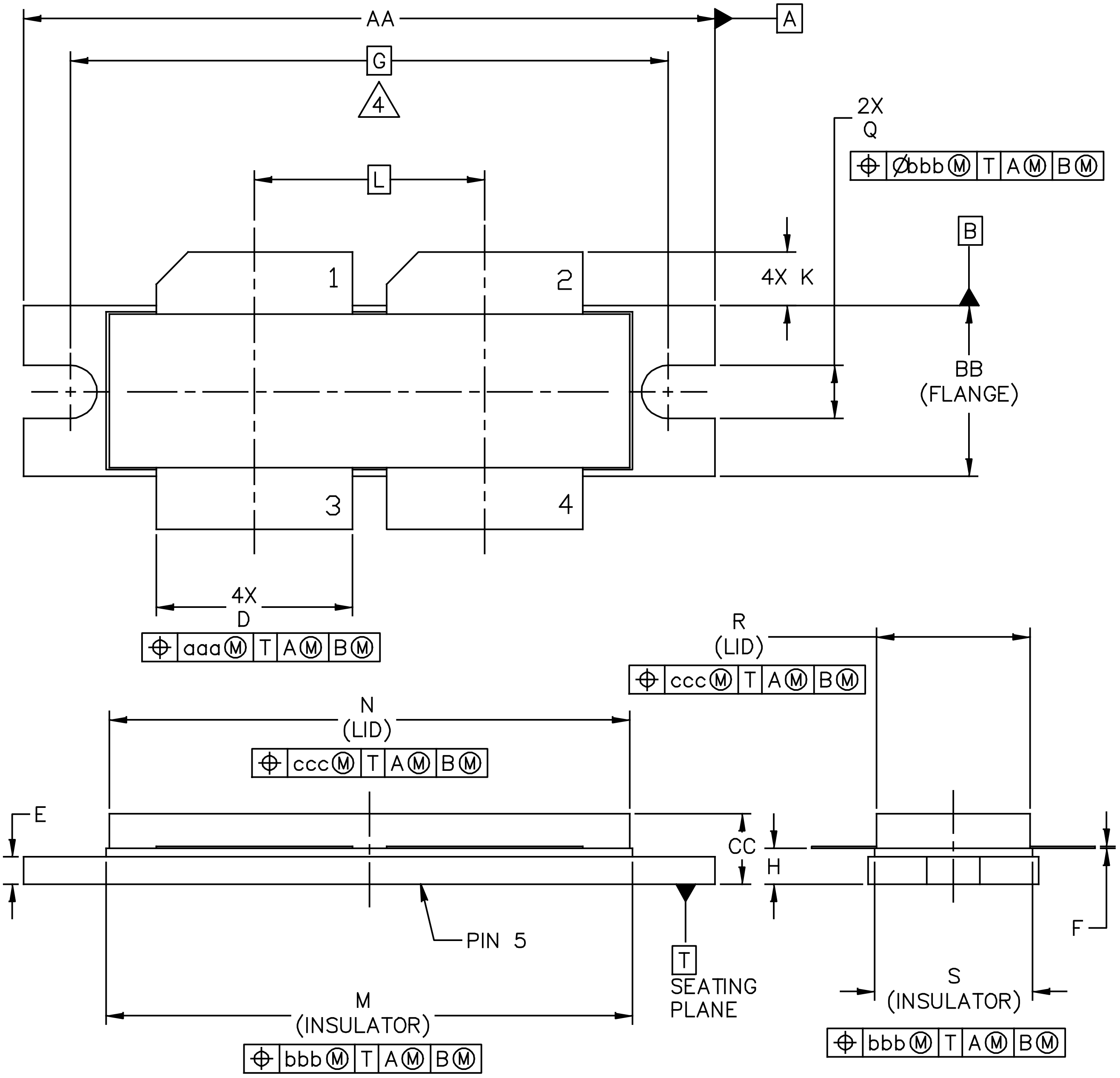


Figure 7. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



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	STANDARD: NON–JEDEC	
	28 FEB 2013	

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH
3. DIMENSION H IS MEASURED .030 INCH (0.762 MM) AWAY FROM PACKAGE BODY.
4. RECOMMENDED BOLT CENTER DIMENSION OF 1.52 INCH (38.61 MM) BASED ON M3 SCREW.

	INCH		MILLIMETER			INCH		MILLIMETER	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX
AA	1.615	1.625	41.02	41.28	N	1.218	1.242	30.94	31.55
BB	.395	.405	10.03	10.29	Q	.120	.130	3.05	3.30
CC	.170	.190	4.32	4.83	R	.355	.365	9.02	9.27
D	.455	.465	11.56	11.81	S	.365	.375	9.27	9.53
E	.062	.066	1.57	1.68					
F	.004	.007	0.10	0.18					
G	1.400 BSC		35.56 BSC		aaa	.013		0.33	
H	.082	.090	2.08	2.29	bbb	.010		0.25	
K	.117	.137	2.97	3.48	ccc	.020		0.51	
L	.540 BSC		13.72 BSC						
M	1.219	1.241	30.96	31.52					

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PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following resources to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator

For Software, do a Part Number search at http://www.freescale.com, and select the “Part Number” link. Go to the Software & Tools tab on the part’s Product Summary page to download the respective tool.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	May 2014	• Initial Release of Data Sheet

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