

RF Power LDMOS Transistor

High Ruggedness N-Channel Enhancement-Mode Lateral MOSFET

This high ruggedness device is designed for use in high VSWR industrial, medical, broadcast, aerospace and mobile radio applications. Its unmatched input and output design allows for wide frequency range use from 1.8 to 470 MHz.

Typical Performance

Frequency (MHz)	Signal Type	V _{DD} (V)	P _{out} (W)	G _{ps} (dB)	η _D (%)
27 ⁽¹⁾	CW	50	1200 CW	26.0	82.3
		57.5	1520 CW	27.0	80.1
		65	1800 CW	27.8	75.6
87.5–108 ^(2,3)	CW	60	1550 CW	21.9	82.2
144	CW	65	1800 CW	23.5	77.5
230 ⁽⁴⁾	Pulse (100 μsec, 20% Duty Cycle)	65	1800 Peak	24.0	74.0

Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P _{in} (W)	Test Voltage	Result
230	Pulse (100 μsec, 20% Duty Cycle)	> 65:1 at all Phase Angles	14 W Peak (3 dB Overdrive)	65	No Device Degradation

1. Data from 27 MHz narrowband reference circuit (page 4).
2. Data from 87.5–108 MHz broadband reference circuit (page 5).
3. The values shown are the center band performance numbers across the indicated frequency range.
4. Data from 230 MHz narrowband production test fixture (page 6).

Features

- Unmatched input and output allowing wide frequency range utilization
- Device can be used single-ended or in a push-pull configuration
- Qualified up to a maximum of 65 V_{DD} operation
- Characterized from 30 to 65 V for extended power range
- High breakdown voltage for enhanced reliability
- Suitable for linear application with appropriate biasing
- Integrated ESD protection with greater negative gate-source voltage range for improved Class C operation
- Characterized with series equivalent large-signal impedance parameters
- Lower thermal resistance part available: MRFX1K80N
- Included in NXP product longevity program with assured supply for a minimum of 15 years after launch

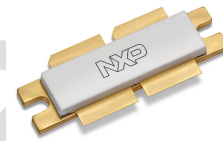
Typical Applications

- Industrial, scientific, medical (ISM)
 - Laser generation
 - Plasma etching
 - Particle accelerators
 - MRI, RF ablation and skin treatment
 - Industrial heating, welding and drying systems
- Radio and VHF TV broadcast
- Aerospace
 - VHF omnidirectional range (VOR)
 - HF communications
 - Weather radar

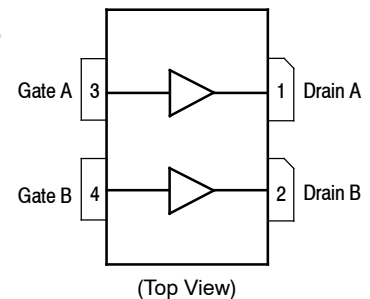
MRFX1K80H

PREPRODUCTION

**1.8–470 MHz, 1800 W CW, 65 V
WIDEBAND
RF POWER LDMOS TRANSISTOR**



NI-1230H-4S



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

Figure 1. Pin Connections

This document contains information on a preproduction product. Specifications and information herein are subject to change without notice.

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	-0.5, +182	Vdc
Gate-Source Voltage	V_{GS}	-6.0, +10	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⁾	T_J	-40 to +225	°C
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	2222 ⁽²⁾ 11.11 ⁽²⁾	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value ⁽³⁾	Unit
Thermal Resistance, Junction to Case CW: Case Temperature 95°C, 1800 W CW, 65 Vdc, $I_{DQ(A+B)} = 150\text{ mA}$, 98 MHz	$R_{\theta JC}$	0.09 ⁽²⁾	°C/W

Table 3. Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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Off Characteristics ⁽⁴⁾

Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	1	μAdc
Drain-Source Breakdown Voltage ($V_{GS} = 0\text{ Vdc}$, $I_D = 100\text{ mAdc}$)	$V_{(BR)DSS}$	182	—	—	Vdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 182\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	100	mAdc

On Characteristics

Gate Threshold Voltage ⁽⁴⁾ ($V_{DS} = 10\text{ Vdc}$, $I_D = 740\text{ }\mu\text{Adc}$)	$V_{GS(th)}$	1.7	2.4	2.7	Vdc
Gate Quiescent Voltage ($V_{DD} = 65\text{ Vdc}$, $I_{D(A+B)} = 100\text{ mAdc}$, Measured in Functional Test)	$V_{GS(Q)}$	2.3	2.8	3.3	Vdc
Drain-Source On-Voltage ⁽⁴⁾ ($V_{GS} = 10\text{ Vdc}$, $I_D = 2.76\text{ Adc}$)	$V_{DS(on)}$	—	0.15	—	Vdc
Forward Transconductance ⁽⁴⁾ ($V_{DS} = 10\text{ Vdc}$, $I_D = 43\text{ Adc}$)	g_{fs}	—	44.7	—	S

1. Continuous use at maximum temperature will affect MTTF.
2. Data is based on preliminary results and is subject to change.
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 3. Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
Dynamic Characteristics ⁽¹⁾					
Reverse Transfer Capacitance ($V_{DS} = 65\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{rss}	—	2.8	—	pF
Output Capacitance ($V_{DS} = 65\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{oss}	—	201	—	pF
Input Capacitance ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz)	C_{iss}	—	762	—	pF
Functional Tests (In NXP Production Test Fixture, 50 ohm system) $V_{DD} = 65\text{ Vdc}$, $I_{DQ(A+B)} = 100\text{ mA}$, $P_{out} = 1800\text{ W Peak}$ (360 W Avg.), $f = 230\text{ MHz}$, 100 μsec Pulse Width, 20% Duty Cycle					
Power Gain	G_{ps}	23.0	24.0	—	dB
Drain Efficiency	η_D	69.0	74.0	—	%
Input Return Loss	IRL	—	-15	-9	dB

Table 4. Load Mismatch/Ruggedness (In NXP Production Test Fixture, 50 ohm system) $I_{DQ(A+B)} = 100\text{ mA}$

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	14 W Peak (3 dB Overdrive)	65	No Device Degradation

1. Each side of device measured separately.

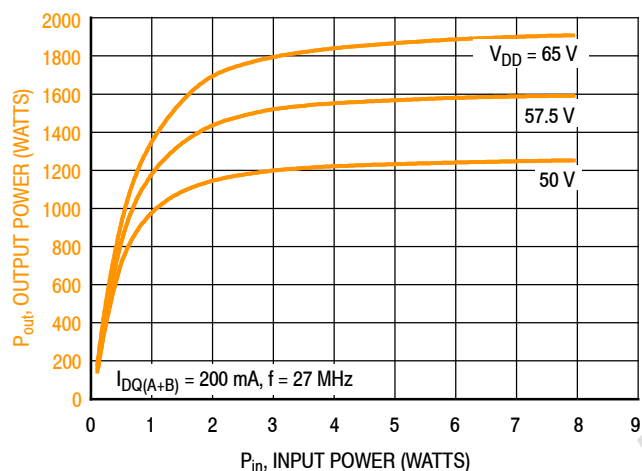
27 MHz NARROWBAND REFERENCE CIRCUIT – 2.88" × 6.91" (73 mm × 176 mm)

Table 5. 27 MHz Narrowband Performance (In NXP Reference Circuit, 50 ohm system)

$I_{DQ(A+B)} = 200 \text{ mA}$, $P_{in} = 3 \text{ W}$, CW

Frequency (MHz)	V_{DD} (V)	P_{out} (W)	G_{ps} (dB)	η_D (%)
27	50	1200	26.0	82.3
	57.5	1520	27.0	80.1
	65	1800	27.8	75.6

TYPICAL CHARACTERISTICS



f (MHz)	V_{DD} (V)	P_{1dB} (W)	P_{sat} (W)
27	50	825	1250
	57.5	1010	1600
	65	1150	1900

Figure 2. CW Output Power versus Input Power and Drain-Source Voltage

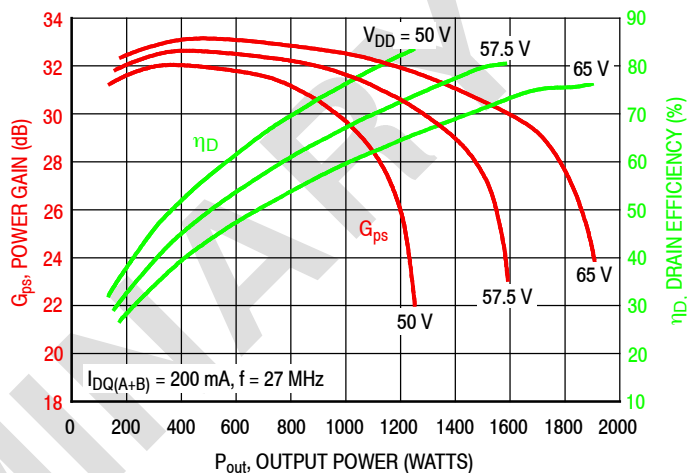


Figure 3. Power Gain and Drain Efficiency versus CW Output Power and Drain-Source Voltage

87.5–108 MHz BROADBAND REFERENCE CIRCUIT – 2.88" × 5.12" (73 mm × 130 mm)

Table 6. 87.5–108 MHz Broadband Performance (In NXP Reference Circuit, 50 ohm system)

$I_{DQ(A+B)} = 150 \text{ mA}$, $P_{in} = 10 \text{ W}$, CW

Frequency (MHz)	V_{DD} (V)	P_{out} (W)	G_{ps} (dB)	η_D (%)
87.5	60	1502	21.8	83.2
98	60	1556	21.9	82.2
108	60	1488	21.7	79.4

TYPICAL CHARACTERISTICS

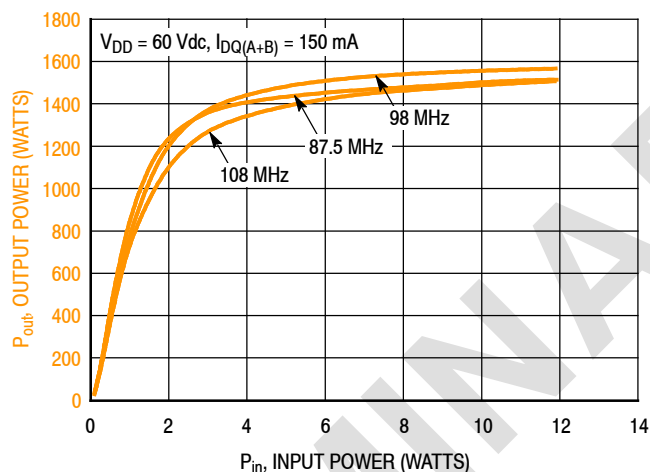


Figure 4. CW Output Power versus Input Power and Frequency

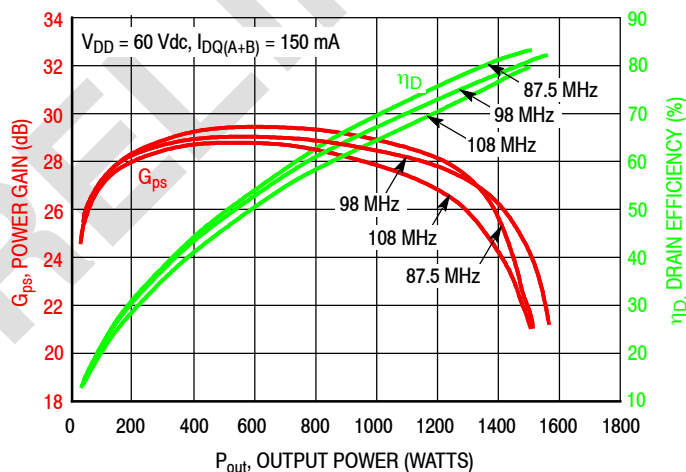
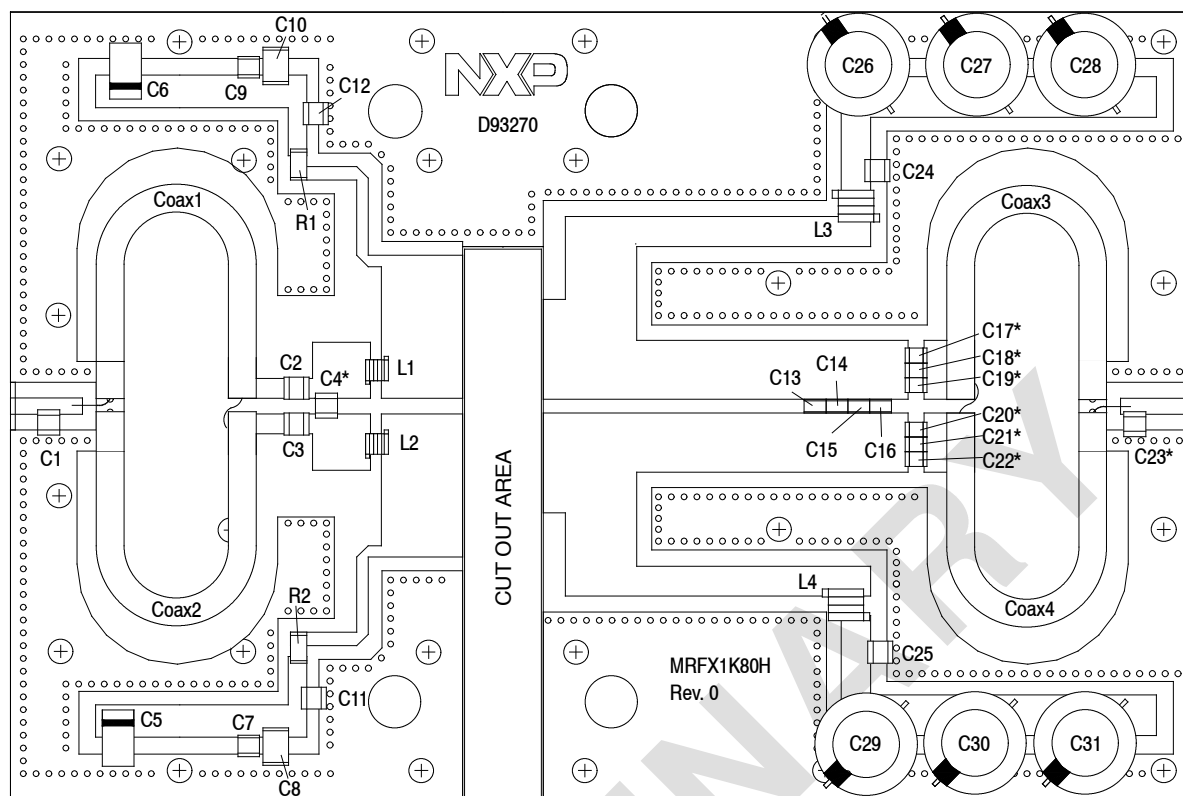


Figure 5. Power Gain and Drain Efficiency versus CW Output Power and Frequency

230 MHz NARROWBAND PRODUCTION TEST FIXTURE – 6.0" x 4.0" (152 mm x 102 mm)



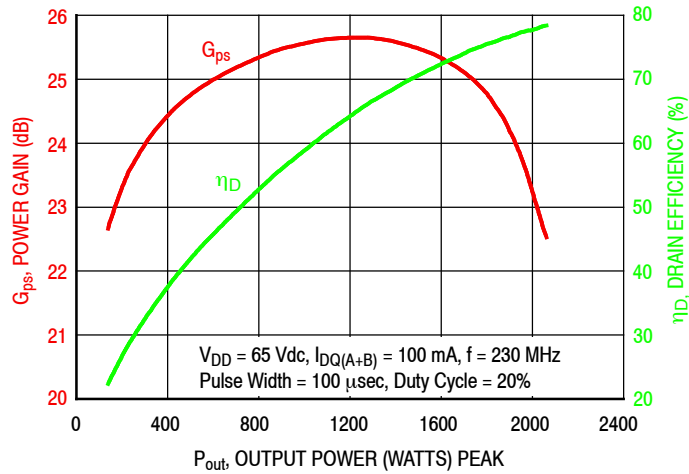
*C4, C17, C18, C19, C20, C21, C22 and C23 are mounted vertically.

Figure 6. MRFX1K80H Narrowband Test Circuit Component Layout — 230 MHz

Table 7. MRFX1K80H Narrowband Test Circuit Component Designations and Values — 230 MHz

Part	Description	Part Number	Manufacturer
C1, C2, C3	22 pF Chip Capacitor	ATC100B220JT500XT	ATC
C4	27 pF Chip Capacitor	ATC100B270JT500XT	ATC
C5, C6	22 μ F, 35 V Tantalum Capacitor	T491X226K035AT	Kemet
C7, C9	0.1 μ F Chip Capacitor	CDR33BX104AKWS	AVX
C8, C10	220 nF Chip Capacitor	C1812C224K5RACTU	Kemet
C11, C12, C24, C25	1000 pF Chip Capacitor	ATC100B102JT50XT	ATC
C13	24 pF Chip Capacitor	ATC800R240JT500XT	ATC
C14, C15, C16	20 pF Chip Capacitor	ATC800R200JT500XT	ATC
C17, C18, C19, C20, C21, C22	240 pF Chip Capacitor	ATC100B241JT200XT	ATC
C23	7.5 pF Chip Capacitor	ATC100B7R5CT500XT	ATC
C26, C27, C28, C29, C30, C31	470 μ F, 63 V Electrolytic Capacitor	MCGPR63V477M13X26-RH	Multicomp
Coax1, 2, 3, 4	25 Ω Semi Rigid Coax Cable, 2.2" Shield Length	UT-141C-25	Micro-Coax
L1, L2	5 nH Inductor	A02TKLC	Coilcraft
L3, L4	6.6 nH Inductor	GA3093-ALC	Coilcraft
R1, R2	10 Ω , 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
PCB	Arlon AD255A 0.030", $\epsilon_r = 2.55$	D93270	MTL

TYPICAL CHARACTERISTICS



f (MHz)	P1dB (W)	P3dB (W)
230	1800	2030

Figure 7. Power Gain and Drain Efficiency versus Output Power

f MHz	Z_{source} Ω	Z_{load} Ω
230	$1.1 + j2.7$	$2.2 + j2.9$

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.

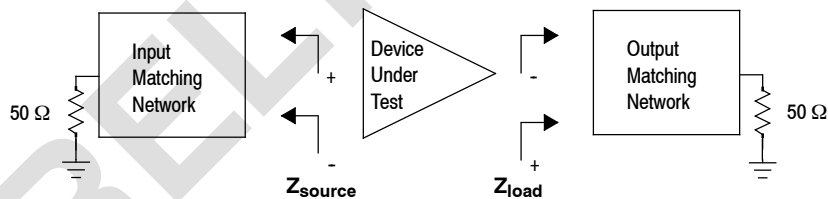
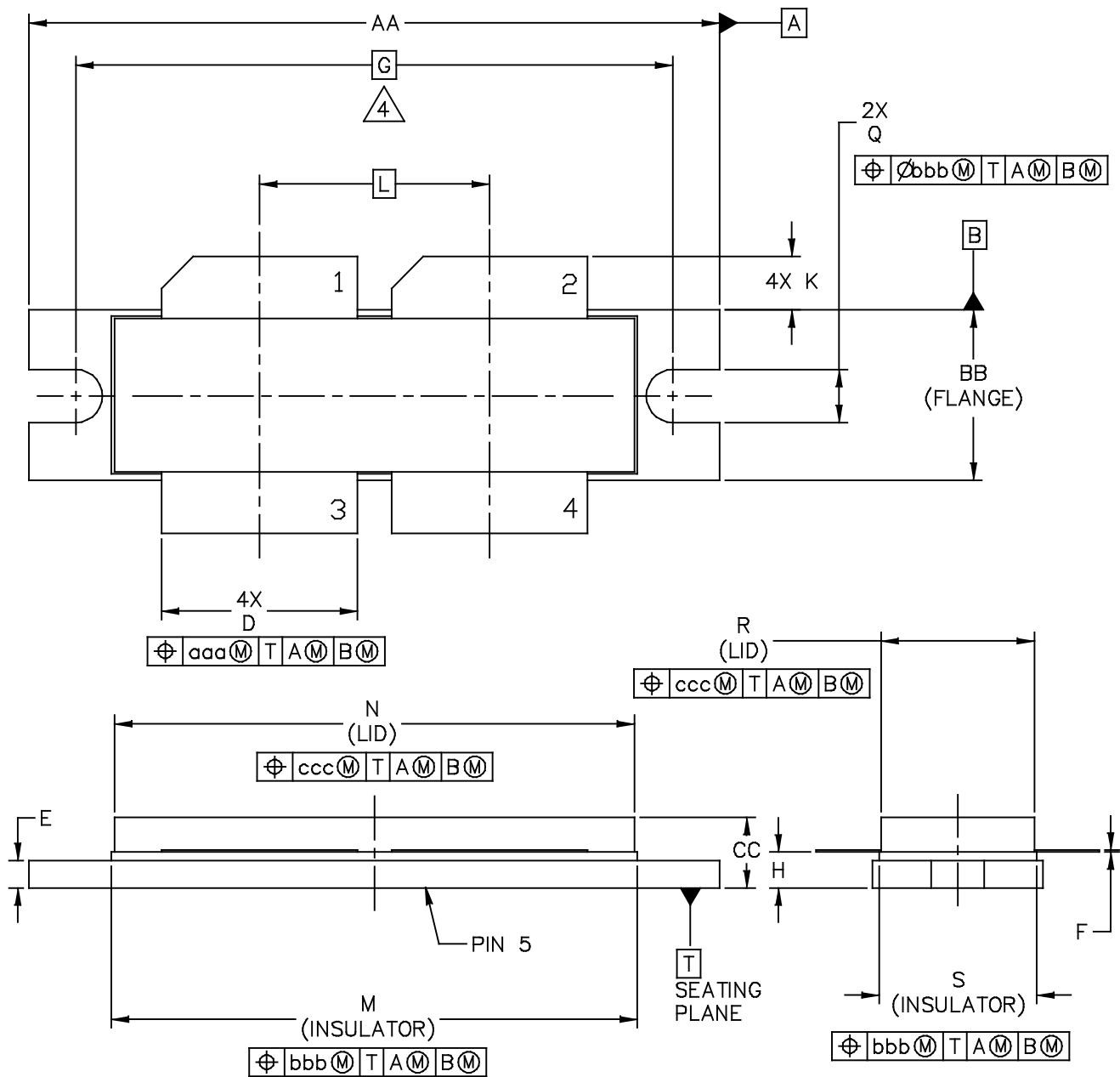


Figure 8. Narrowband Series Equivalent Source and Load Impedance — 230 MHz

PACKAGE DIMENSIONS



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TITLE: NI-1230-4H	DOCUMENT NO: 98ASB16977C REV: G	
	STANDARD: NON-JEDEC	
	SOT1787-1	03 MAR 2016

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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