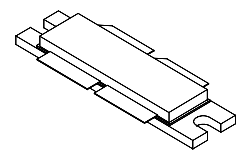
Document Number: MMRF1050H
Rev. 0, 02/2021

RF Power LDMOS Transistor

High Ruggedness N-Channel Enhancement-Mode Lateral MOSFET

MMRF1050H

850–950 MHz, 1050 W PEAK, 50 V RF POWER LDMOS TRANSISTOR



NI-1230H-4S

This RF power transistor is designed for short pulse applications operating at frequencies from 850 to 950 MHz.

Typical Performance: V_{DD} = 50 Vdc, $I_{DQ(A+B)}$ = 100 mA

Frequency (MHz)	Signal Type	P_{out} (W)	G_{ps} (dB)	η_D (%)
950	Pulse (100 μsec, 20% Duty Cycle)	1050 Peak	21.3	63.7

Load Mismatch/Ruggedness

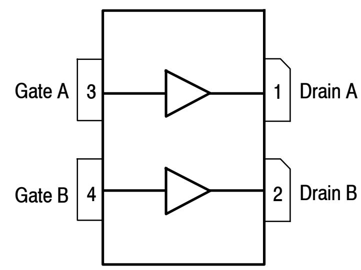
Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
950	Pulse (100 μsec, 20% Duty Cycle)	> 20:1 at all Phase Angles	15 W Peak (3 dB Overdrive)	50	No Device Degradation

Features

- Internally input and output matched for broadband operation and ease of use
- Device can be used in a single-ended, push-pull or quadrature configuration
- Qualified up to 50 V
- High ruggedness, handles > 20:1 VSWR
- Integrated ESD protection with greater negative voltage range for improved Class C operation and gate voltage pulsing
- Characterized with series equivalent large-signal impedance parameters

Typical Applications

- Land- or sea-based UHF radar



(Top View)

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

Figure 1. Pin Connections

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +105	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	–55 to 150	°C
Operating Junction Temperature Range (1,2)	T_J	–55 to 225	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Impedance, Junction to Case Pulse: Case Temperature 87°C, 1050 W Peak, 100 μsec Pulse Width, 20% Duty Cycle, 50 Vdc, $I_{DQ(A+B)}$ = 100 mA, 950 MHz	$Z_{\theta JC}$	0.034	°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 1000 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}	—	—	1	μAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 10 μA)	$V_{(BR)DSS}$	105	—	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 105 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
On Characteristics					
Gate Threshold Voltage (4) (V_{DS} = 10 Vdc, I_D = 396 μAdc)	$V_{GS(th)}$	1.3	1.7	2.3	Vdc
Gate Quiescent Voltage (5) (V_{DD} = 50 Vdc, $I_{DQ(A+B)}$ = 100 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.7	2.0	2.3	Vdc
Drain-Source On-Voltage (4) (V_{GS} = 10 Vdc, I_D = 1.98 Adc)	$V_{DS(on)}$	0.05	0.14	0.35	Vdc
Dynamic Characteristics (4)					
Reverse Transfer Capacitance (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.85	—	pF

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.nxp.com.
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.
5. Measurement made with device in push-pull configuration.

(continued)

Table 4. 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} = 50 Vdc, $I_{DQ(A+B)}$ = 100 mA, P_{out} = 1050 W Peak (210 W Avg.), f = 950 MHz, 100 μsec Pulse Width, 20% Duty Cycle					
Power Gain	G_{ps}	19.0	21.3	23.5	dB
Drain Efficiency	η_D	57.0	63.7	—	%
Input Return Loss	IRL	—	–18.5	–9.0	dB

Table 5. Load Mismatch/Ruggedness (In NXP Production Test Fixture, 50 ohm system) $I_{DQ(A+B)}$ = 100 mA

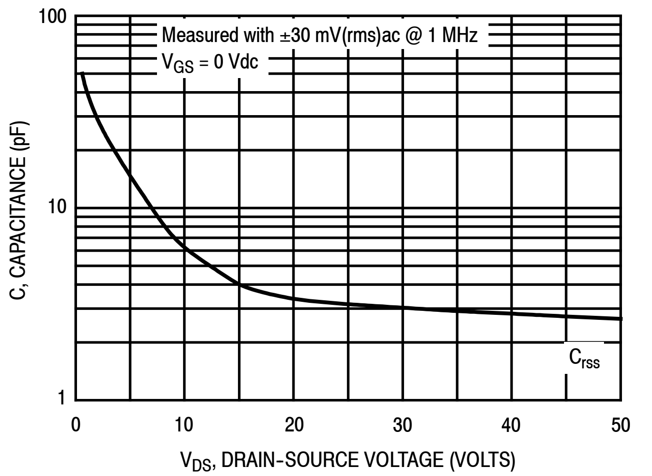
Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
950	Pulse (100 μsec, 20% Duty Cycle)	> 20:1 at all Phase Angles	15 W Peak (3 dB Overdrive)	50	No Device Degradation

Table 6. Ordering Information

Device	Tape and Reel Information	Package
MMRF1050HR6	R6 Suffix = 150 Units, 56 mm Tape Width, 13-inch Reel	NI-1230H-4S

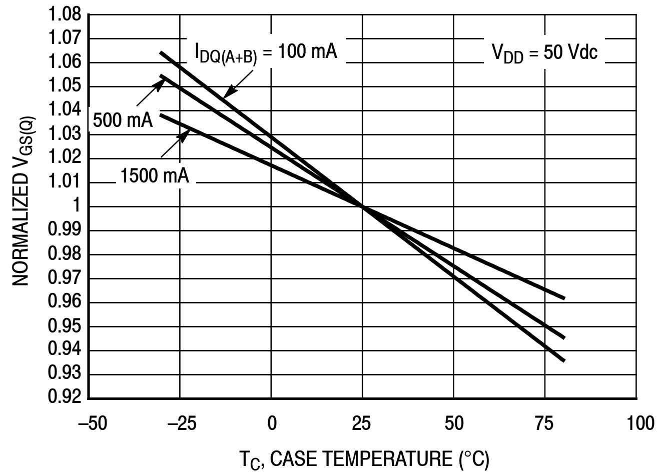
1. Measurement made with device in push-pull configuration.

TYPICAL CHARACTERISTICS



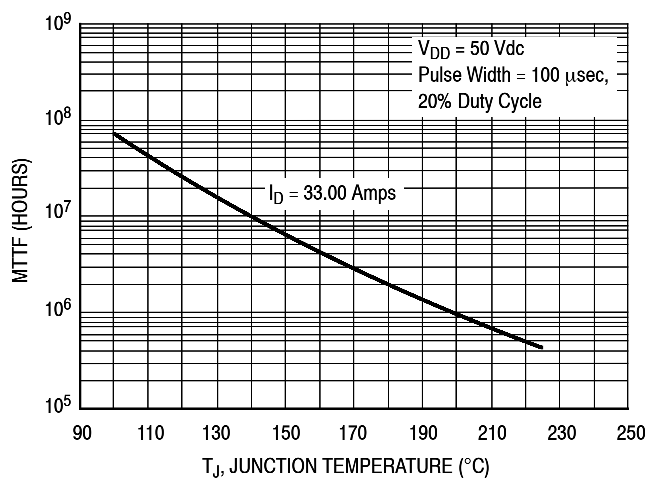
Note: Each side of device measured separately.

Figure 2. Capacitance versus Drain-Source Voltage



I_{DQ} (mA)	Slope (mV/°C)
100	–2.36
500	–2.26
1500	–1.84

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

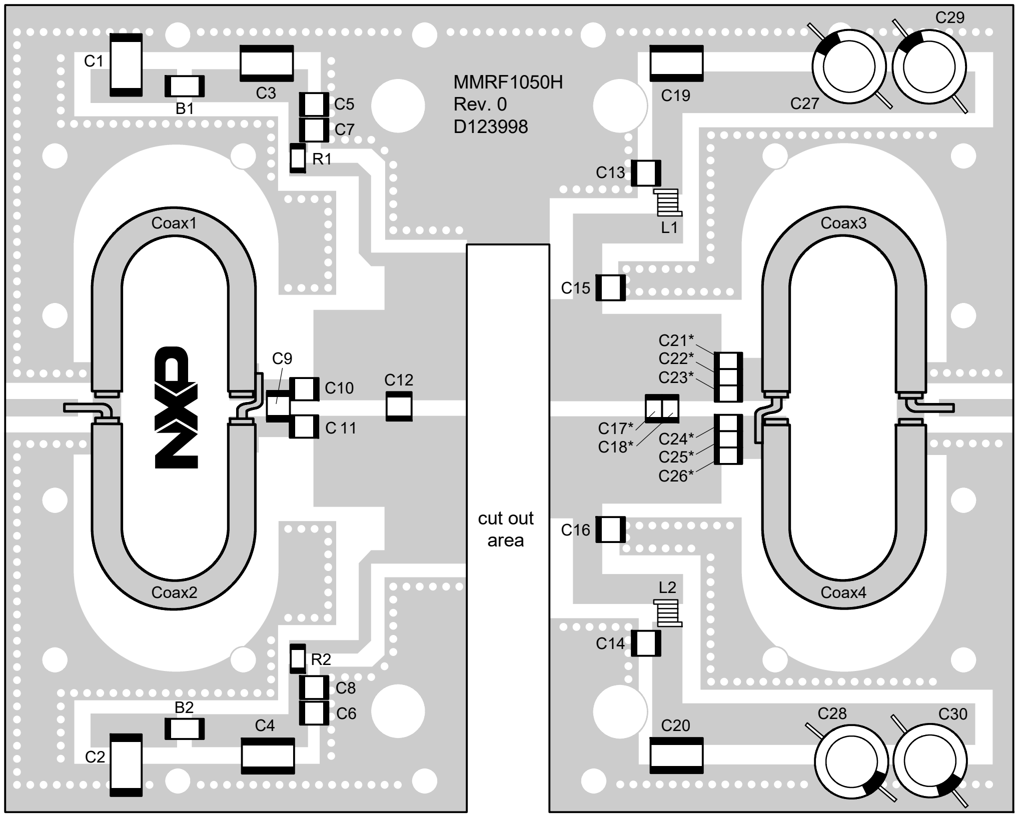


Note: MTTF value represents the total cumulative operating time under indicated test conditions.

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

Figure 4. MTTF versus Junction Temperature — Pulse

950 MHz PRODUCTION FIXTURE — 4″ × 5″ (10.2 cm × 12.7 cm)



* C17, C18, C21, C22, C23, C24, C25 and C26 are mounted vertically.

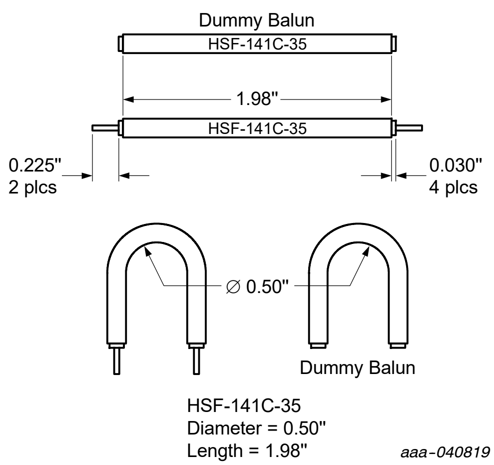


Figure 5. MMRF1050H Production Fixture Component Layout — 950 MHz

Table 7. MMRF1050H Production Fixture Component Designations and Values — 950 MHz

Part	Description	Part Number	Manufacturer
B1, B2	Short RF Bead	2743019447	Fair-Rite
C1, C2	22 μF, 35 V Tantalum Capacitor	T491X226K035AS	Kemet
C3, C4	2.2 μF Chip Capacitor	C1825C225J5RACTU	Kemet
C5, C6	0.1 μF Chip Capacitor	CDR33BX104AKWS	AVX
C7, C8, C13, C14	36 pF Chip Capacitor	100B360JT500XT	ATC
C9	2.7 pF Chip Capacitor	100B2R7BT500XT	ATC
C10, C11	30 pF Chip Capacitor	100B300JT500XT	ATC
C12	6.2 pF Chip Capacitor	100B6R2BT500XT	ATC
C15, C16	8.2 pF Chip Capacitor	100B8R2CT500XT	ATC
C17, C18	4.7 pF Chip Capacitor	100B4R7CT500XT	ATC
C19, C20	0.01 μF Chip Capacitor	C1825C103K1GAC-TU	Kemet
C21, C22, C23, C24, C25, C26	43 pF Chip Capacitor	100B430JT500XT	ATC
C27, C28, C29, C30	470 μF, 63 V Electrolytic Capacitor	MCGPR63V477M13X26	Multicomp
Coax1, 2, 3, 4	35 Ω Semirigid Coax Cable, 1.98″ Shield Length	HSF-141C-35	Hangzhou Hongsen
L1, L2	12 nH, 3 Turn Inductor	GA3094-ALC	Coilcraft
Q1	RF Power LDMOS Transistor	MMRF1050H	NXP
R1, R2	1000 Ω, 1/4 W Chip Resistor	CRCW12061K00FKEA	Vishay
PCB	Arlon 450 0.030″, ε_r = 2.55, 2 oz. Copper	D123998	MTL

TYPICAL CHARACTERISTICS — 950 MHz, T_C = 25°C
PRODUCTION TEST FIXTURE

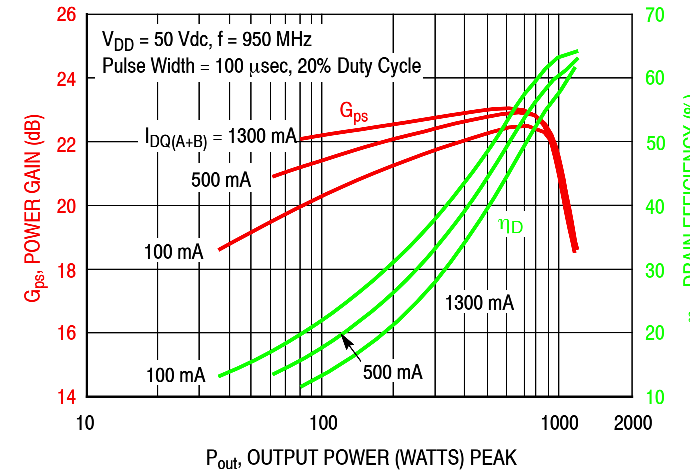


Figure 6. Power Gain and Drain Efficiency versus Output Power and Quiescent Current

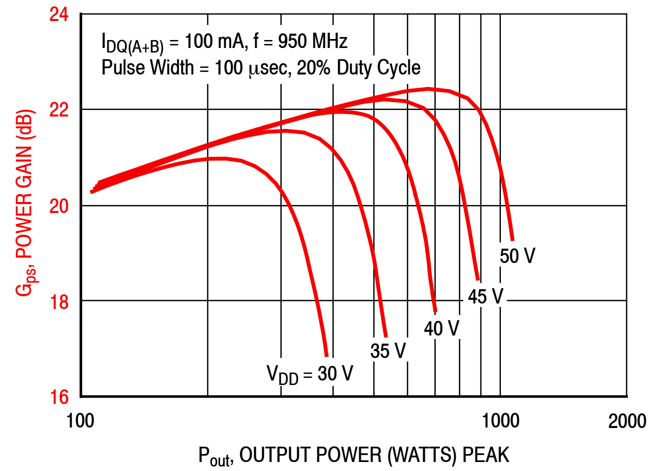


Figure 7. Power Gain versus Output Power and Drain-Source Voltage

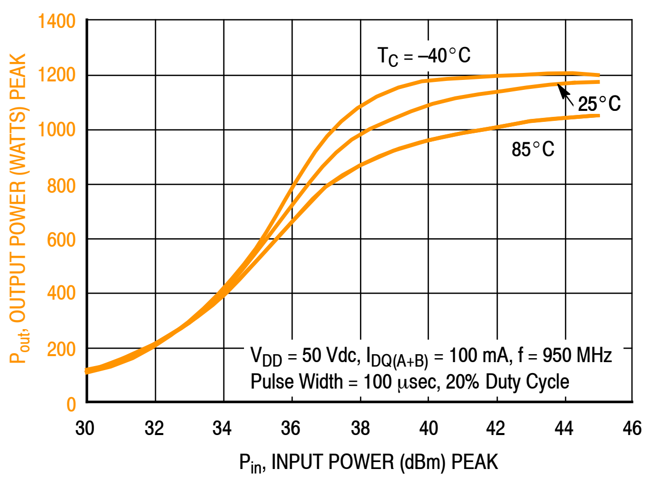


Figure 8. Output Power versus Input Power over Temperature

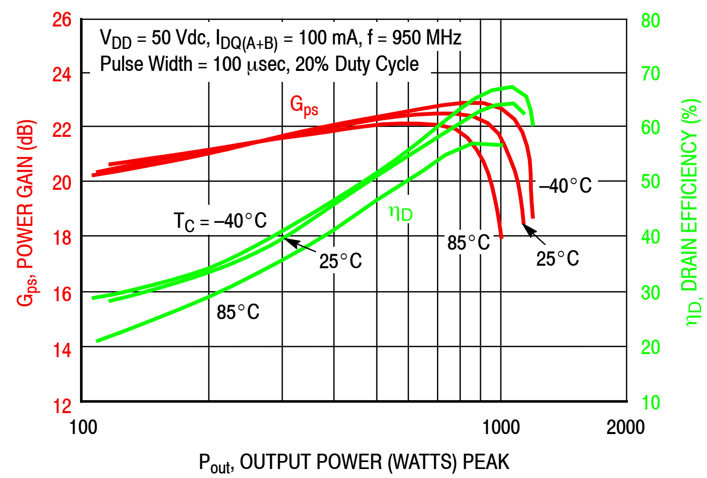


Figure 9. Power Gain and Drain Efficiency versus Output Power over Temperature

PRODUCTION FIXTURE

Band-Specific Optimized Performance and Impedance Information (T_C = 25°C)

The measured input and output impedances are presented to the input of the device at the package reference plane. Measurements are performed in NXP optimally tuned fixtures in the frequency ranges of 850 and 950 MHz.

f (MHz)	Z_{source} (Ω)	Z_{load} (Ω)
850	3.0 – j3.1	4.3 – j2.0
950	6.2 – j2.9	4.0 – j1.1

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

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

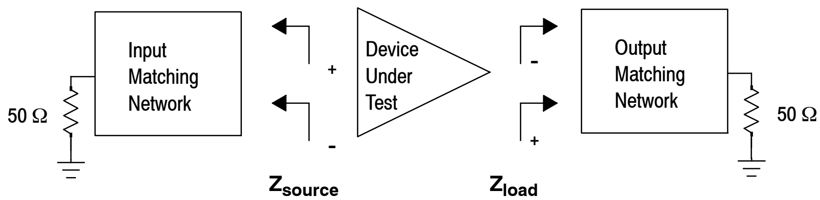
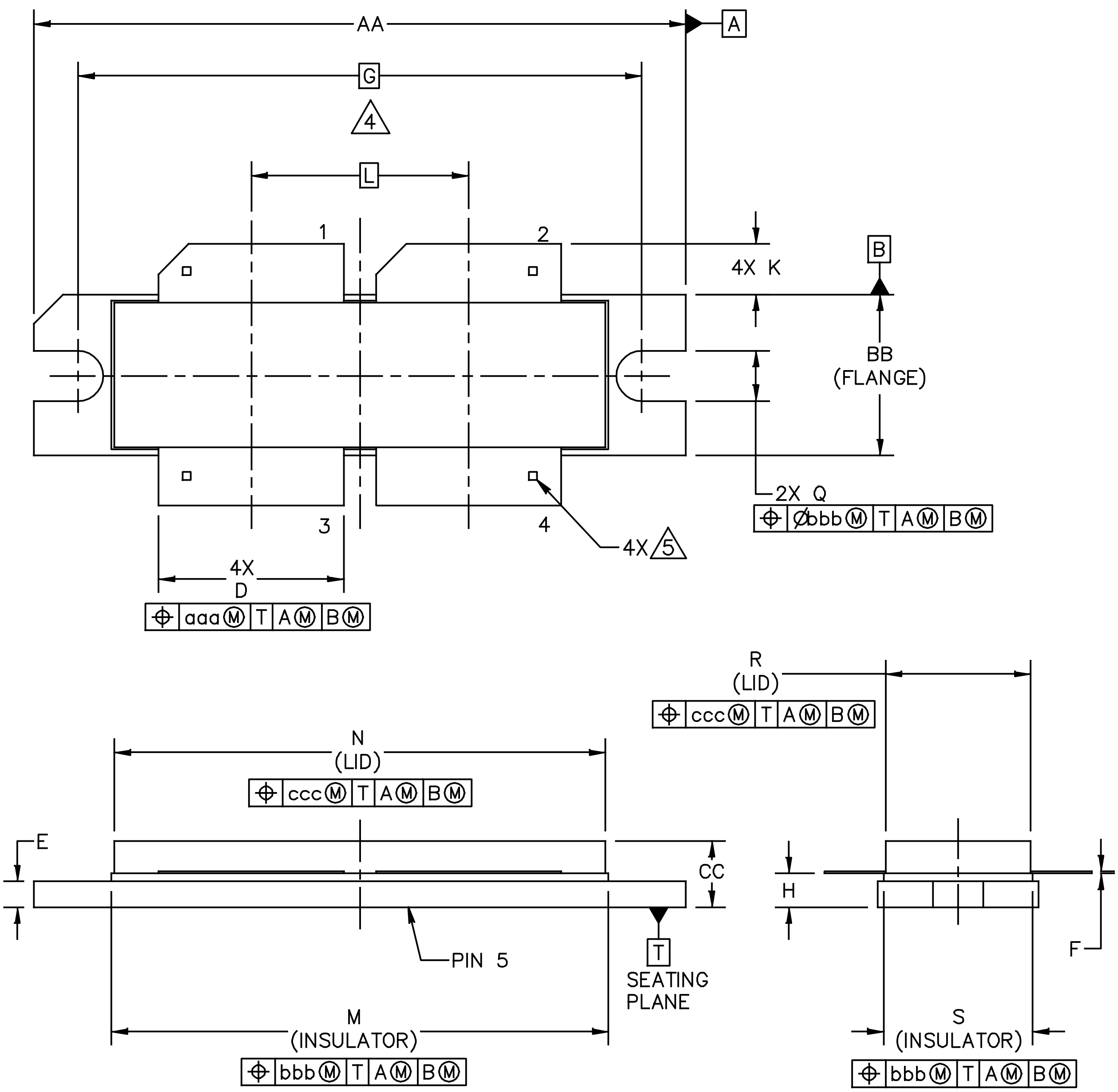


Figure 10. Series Equivalent Source and Load Impedance

H–CFM–F–5 I/O 41.15 X 10.16 X 4.575 PKG, 13.72 PITCH – 4S NI–1230H–4S

SOT1787–1



DATE: 25 OCT 2019

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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 THE FLANGE TO CLEAR THE EPOXY FLOW OUT REGION PARALLEL TO DATUM B.
4. RECOMMENDED BOLT CENTER DIMENSION OF 1.52 INCH (38.61 MM) BASED ON M3 SCREW.
5. FIDUCIALS ARE OPTIONAL ON PINS 3 & 4.

	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, 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
- .s2p File

Development Tools

- Printed Circuit Boards

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Feb. 2021	• Initial release of data sheet

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