NXP Semiconductors
Technical Data

Document Number: MMRF5017HS
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RF Power GaN Transistor

MMRF5017HS

30–2200 MHz, 125 W CW, 50 V WIDEBAND RF POWER GaN TRANSISTOR

This 125 W RF power GaN transistor is capable of broadband operation from 30 to 2200 MHz and includes input matching for extended bandwidth performance. With its high gain and high ruggedness, this device is ideally suited for CW, pulse and broadband RF applications.

This part is characterized and performance is guaranteed for applications operating in the 30 to 2200 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

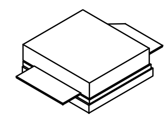
Typical Performance: V_{DD} = 50 Vdc, T_A = 25°C

Frequency (MHz)	Signal Type	P_{out} (W)	G_{ps} (dB)	η_D (%)
30–940 (1,2)	CW	90	16.0	45.0
520 (1)	CW	125	18.0	59.1
940 (1)	CW	80	18.4	44.0
2200	Pulse (100 μsec, 20% Duty Cycle)	200	17.0	57.0

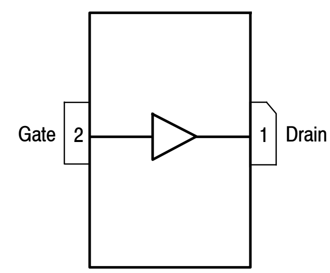
Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
520 (1)	Pulse (100 μsec, 20% Duty Cycle)	> 10:1 at All Phase Angles	3.4 (3 dB Overdrive)	50	No Device Degradation

1. Measured in 30–940 MHz wideband reference circuit (page 4).
2. The values shown are the minimum measured efficiency performance numbers across the indicated frequency range.



NI-400S-2S



(Top View)

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

Figure 1. Pin Connections

Features

- Advanced GaN on SiC, offering high power density
- Decade bandwidth performance
- Input matched for extended wideband performance
- High ruggedness: > 10:1 VSWR

Typical Applications

- Ideal for military end-use applications, including the following:
  - Narrowband and multi-octave wideband amplifiers
  - Radar
  - Jammers
  - EMC testing
- Also suitable for commercial applications, including the following:
  - Public mobile radios, including emergency service radios
  - Industrial, scientific and medical
  - Wideband laboratory amplifiers
  - Wireless cellular infrastructure

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	125	Vdc
Gate-Source Voltage	V_{GS}	–8, 0	Vdc
Operating Voltage	V_{DD}	0 to +55	Vdc
Maximum Forward Gate Current @ T_C = 25°C	I_{GMAX}	24	mA
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–55 to +150	°C
Operating Junction Temperature Range	T_J	–55 to +225	°C
Absolute Maximum Channel Temperature (1)	T_{MAX}	350	°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	154 0.77	W W/°C

Table 2. Thermal Characteristics

Characteristic (2)	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case CW: Case Temperature 81°C, 80 W CW, 50 Vdc, I_{DQ} = 200 mA, 940 MHz	$R_{\theta JC}$ (IR)	1.3 (3)	°C/W
Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 90°C, P_D = 96 W	$R_{\theta CHC}$ (FEA)	1.77 (4)	°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)	II, passes 200 V

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

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-Source Breakdown Voltage (V_{GS} = –8 Vdc, I_D = 20 mAdc)	$V_{(BR)DSS}$	150	—	—	Vdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 20 mAdc)	$V_{GS(th)}$	–3.8	–3.0	–2.3	Vdc
Gate Quiescent Voltage (V_{DD} = 48 Vdc, I_D = 200 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	–3.6	–3.1	–2.3	Vdc
Gate-Source Leakage Current (V_{DS} = 0 Vdc, V_{GS} = –5 Vdc)	I_{GSS}	–7.5	—	—	mAdc

Table 5. Ordering Information

Device	Tape and Reel Information	Package
MMRF5017HSR5	R5 Suffix = 50 Units, 32 mm Tape Width, 13-inch Reel	NI-400S-2S

1. Reliability tests were conducted at 225°C. Operation with T_{MAX} at 350°C will reduce median time to failure.
2. Characterized in 30–940 MHz reference circuit at 940 MHz and 80 W CW output power.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
4. $R_{\theta CHC}$ (FEA) must be used for purposes related to reliability and limitations on maximum channel temperature. MTTF may be estimated by the expression MTTF (hours) = $10^{[A + B/(T + 273)]}$, where *T* is the channel temperature in degrees Celsius, *A* = –10.3 and *B* = 8260.

NOTE: Correct Biasing Sequence for GaN Depletion Mode Transistors

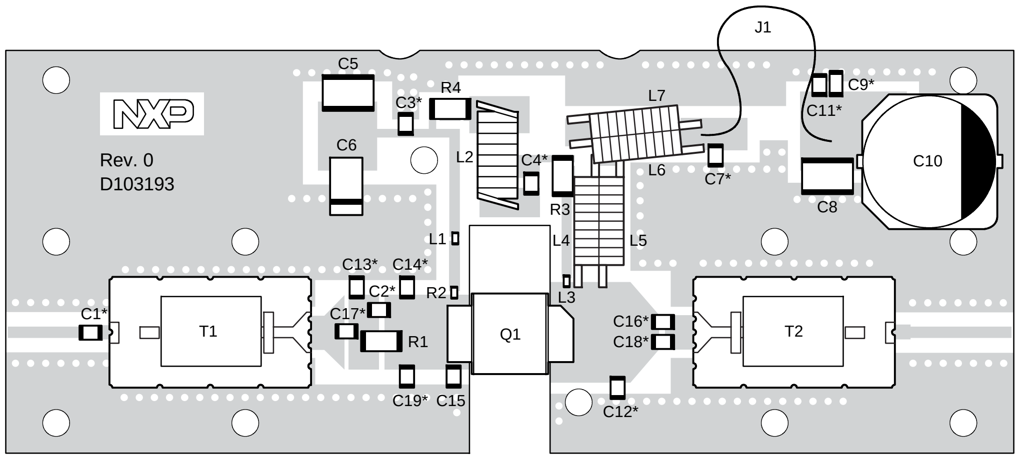
Turning the device ON

1. Set V_{GS} to –5 V
2. Turn on V_{DS} to nominal supply voltage (50 V)
3. Increase V_{GS} until I_{DS} current is attained
4. Apply RF input power to desired level

Turning the device OFF

1. Turn RF power off
2. Reduce V_{GS} down to –5 V
3. Reduce V_{DS} down to 0 V (Adequate time must be allowed for V_{DS} to reduce to 0 V to prevent severe damage to device.)
4. Turn off V_{GS}

30–940 MHz WIDEBAND REFERENCE CIRCUIT — 2.0″ × 5.0″ (5.1 cm × 12.7 cm)



*C1, C2, C3, C4, C7, C9, C11, C12, C13, C14, C16, C17, C18 and C19 are mounted vertically.

Figure 2. MMRF5017HS Wideband Reference Circuit Component Layout — 30–940 MHz

Table 6. MMRF5017HS Wideband Reference Circuit Component Designations and Values — 30–940 MHz

Part	Description	Part Number	Manufacturer
C1	1500 pF Chip Capacitor	ATC700B152JT50XT	ATC
C2	100 pF Chip Capacitor	ATC800B101JT500XT	ATC
C3, C7	39 pF Chip Capacitor	ATC800B390JT500XT	ATC
C4	680 pF Chip Capacitor	ATC800B681JT50XT	ATC
C5, C8	2.2 μF Chip Capacitor	C3225X7R2A225KT	TDK
C6	22 μF, 25 V Tantalum Capacitor	TPSD226M025R0200	AVX
C9	0.1 μF Chip Capacitor	C1206C104K1RACTU	Kemet
C10	220 μF, 100 V Electrolytic Capacitor	EEV-FK2A221M	Panasonic–ECG
C11	220 pF Chip Capacitor	ATC100B221JT200XT	ATC
C12	2.2 pF Chip Capacitor	ATC800B2R2BT500XT	ATC
C13, C14, C19	5.6 pF Chip Capacitor	ATC800B5R6CT500XT	ATC
C15	10 pF Chip Capacitor	ATC800B100JT500XT	ATC
C16, C18	470 pF Chip Capacitor	ATC800B471JT200XT	ATC
C17	330 pF Chip Capacitor	ATC800B331JT200XT	ATC
J1	#16 AWG, Magnetic Wire, Length = 2.5″	8074	Belden
L1	270 nH Inductor	0603AF-271XJRU	Coilcraft
L2	422 nH inductor	132-18SMJL	Coilcraft
L3	240 nH Inductor	0603AF-241XJRU	Coilcraft
L4, L5, L6, L7	1.3 μH Inductor	4310LC-132KE	Coilcraft
Q1	RF Power GaN Transistor	MMRF5017HS	NXP
R1	51 Ω, 1/2 W Chip Resistor	CRCW201051R0JNEF	Vishay
R2	10 Ω, 1/4 W Chip Resistor	CRCW080510R0FKEA	Vishay
R3, R4	100 Ω, 4 W Chip Resistor	CW12010T0100GBK	ATC
T1, T2	High Power Transformer, 30–1000 MHz, 50 Ω to 12.5 Ω	XMT0310B5012	Anaren
PCB	Shengyi S1000-2, 0.031″, ε_r = 4.8	D103193	MTL

TYPICAL CHARACTERISTICS — 30–940 MHz WIDEBAND REFERENCE CIRCUIT

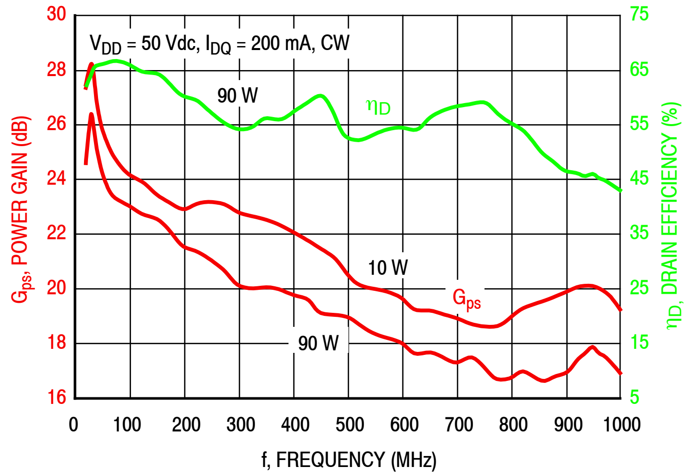


Figure 3. Power Gain and Drain Efficiency versus Output Power and Frequency

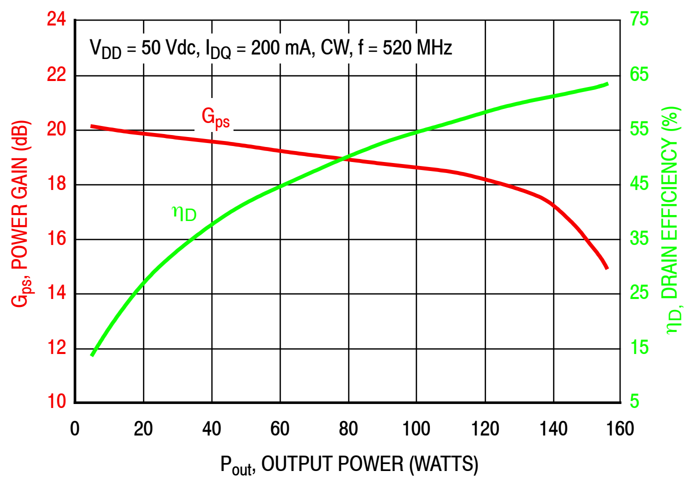


Figure 4. Power Gain and Drain Efficiency versus CW Output Power – 520 MHz

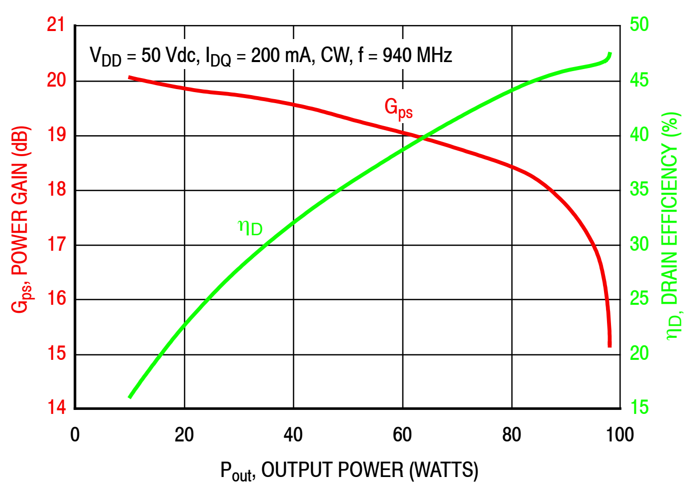


Figure 5. Power Gain and Drain Efficiency versus CW Output Power – 940 MHz

30–940 MHz WIDEBAND REFERENCE CIRCUIT

f MHz	Z_{source} Ω	Z_{load} Ω
20	39.0 + j23.1	11.3 – j5.0
30	59.6 – j3.7	11.0 – j3.1
50	28.3 – j28.7	11.1 – j1.8
70	15.5 – j22.2	11.2 – j1.3
90	11.1 – j17.3	11.3 – j1.1
136	7.9 – j11.3	10.7 – j1.4
174	7.0 – j8.9	10.0 – j0.3
360	6.2 – j5.0	11.9 – j0.2
440	6.0 – j4.6	11.9 – j0.0
520	5.5 – j4.7	12.3 – j0.1
760	2.5 – j4.0	14.4 – j1.2
850	1.7 – j2.9	16.2 – j3.5
940	1.1 – j1.8	15.9 – j7.9
1000	1.0 – j1.1	13.2 – j10.6

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

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

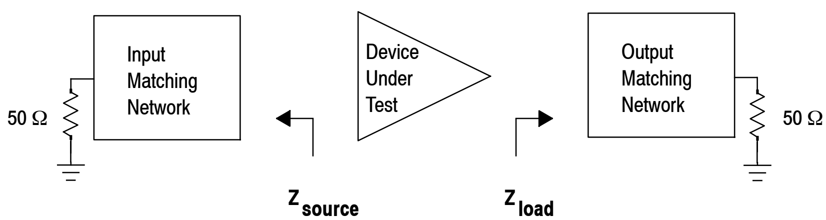
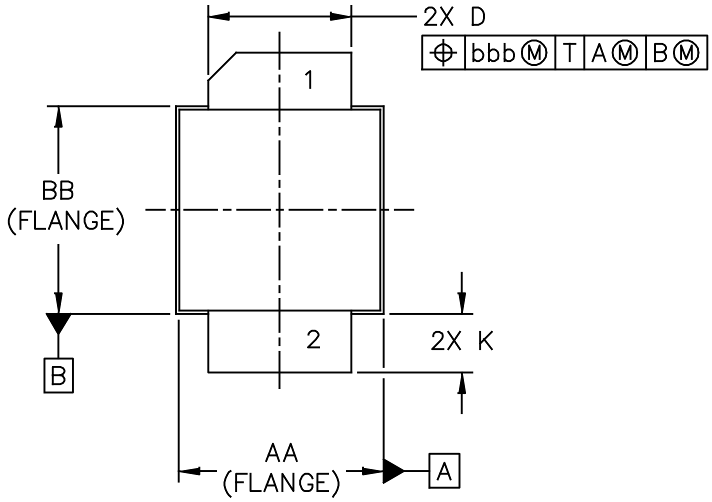
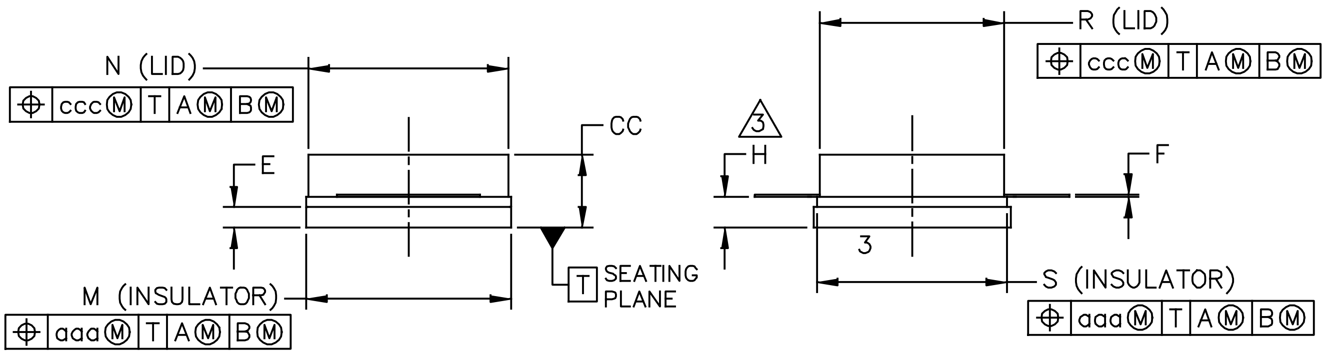


Figure 6. Wideband Series Equivalent Source and Load Impedance — 30–940 MHz

PACKAGE DIMENSIONS





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	STANDARD: NON–JEDEC	
	SOT1828–1	13 JAN 2016

NOTES:

1. CONTROLLING DIMENSION: INCH

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

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. INPUT & OUTPUT LEADS (PIN 1 & 2) MAY HAVE SMALL FEATURES SUCH AS SQUARE HOLES OR NOTCHES FOR MANUFACTURING CONVENIENCE.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	.395	.405	10.03	10.29	aaa	.005		0.13	
BB	.382	.388	9.70	9.86	bbb	.010		0.25	
CC	.125	.163	3.18	4.14	ccc	.015		0.38	
D	.275	.285	6.98	7.24					
E	.035	.045	0.89	1.14					
F	.004	.006	0.10	0.15					
H	.057	.067	1.45	1.70					
K	.0995	.1295	2.53	3.29					
M	.395	.405	10.03	10.29					
N	.385	.395	9.78	10.03					
R	.355	.365	9.02	9.27					
S	.365	.375	9.27	9.53					

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PRODUCT DOCUMENTATION 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

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	June 2018	• Initial release of data sheet

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Rev. 0, 06/2018

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ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703

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