MMRF5014H 200-2500 MHz
REFERENCE CIRCUIT

ORDERABLE PART NUMBER: MMRF5014H-200MHZ

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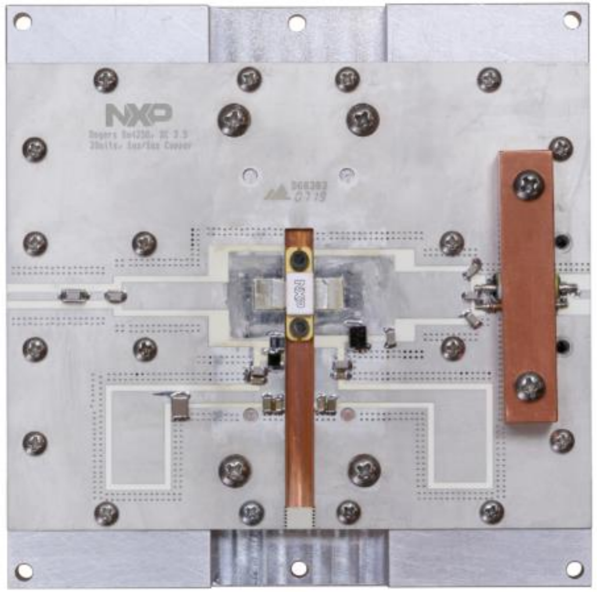
Introduction

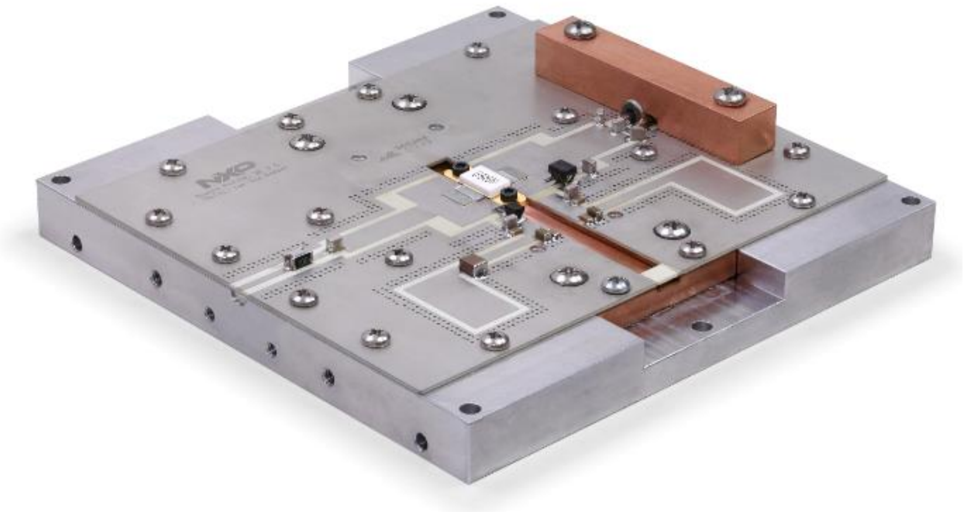
- The NXP MMRF5014H is a 1-2700 MHz, 125 W CW RF power GaN transistor housed in an NI-360 air-cavity ceramic package. Its input pre-match and no output matching enable the design of very wideband power amplifiers.
  - Further details about the device, including its data sheet, are available on www.nxp.com/MMRF5014H.

- The following pages describe the 200-2500 MHz reference circuit (evaluation board).
  Its typical applications are wideband tactical radio transmitters and EMC amplifiers.

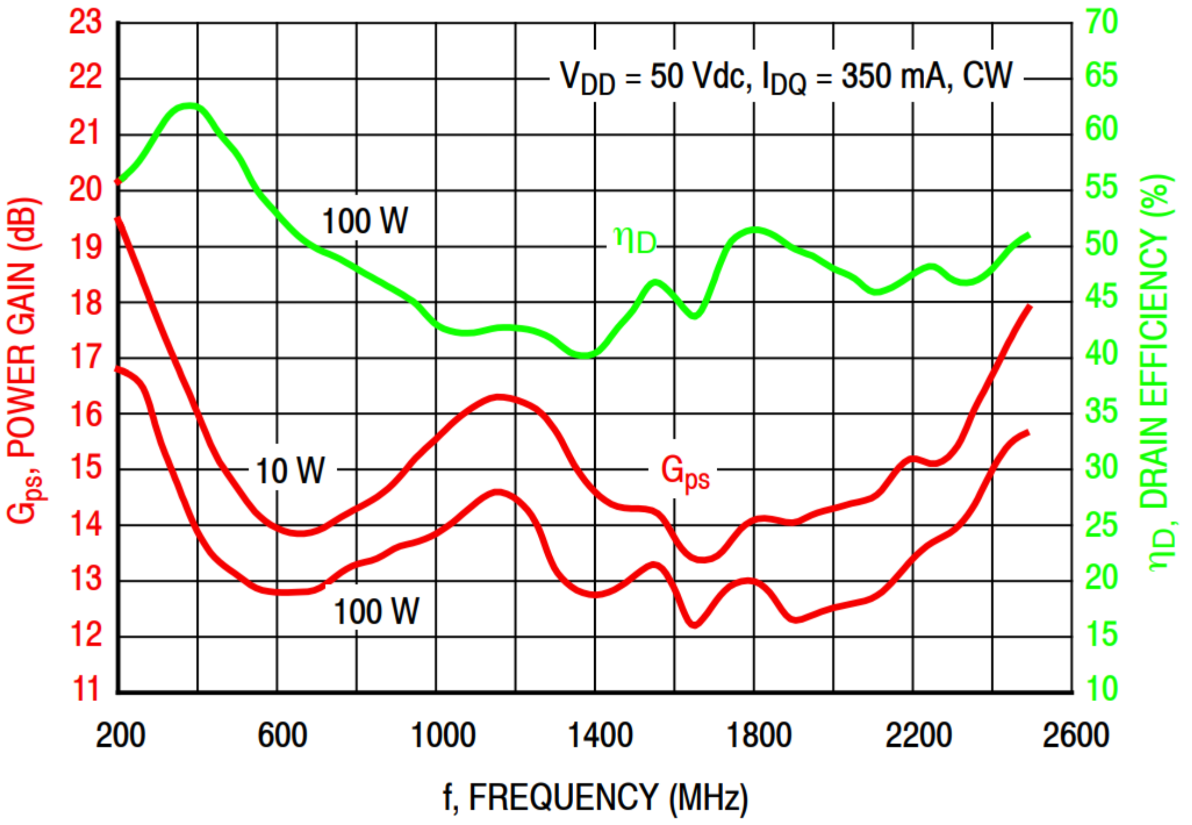
- The reference circuit can be ordered through NXP's distribution partners and etailers using part number MMRF5014H-200MHZ.

Circuit Overview – 10.16 cm × 12.70 cm (4.0″ × 5.0″)





Typical CW Performance



Typical Performance: V_{DD} = 50 Vdc, I_{DQ} = 350 mA, CW

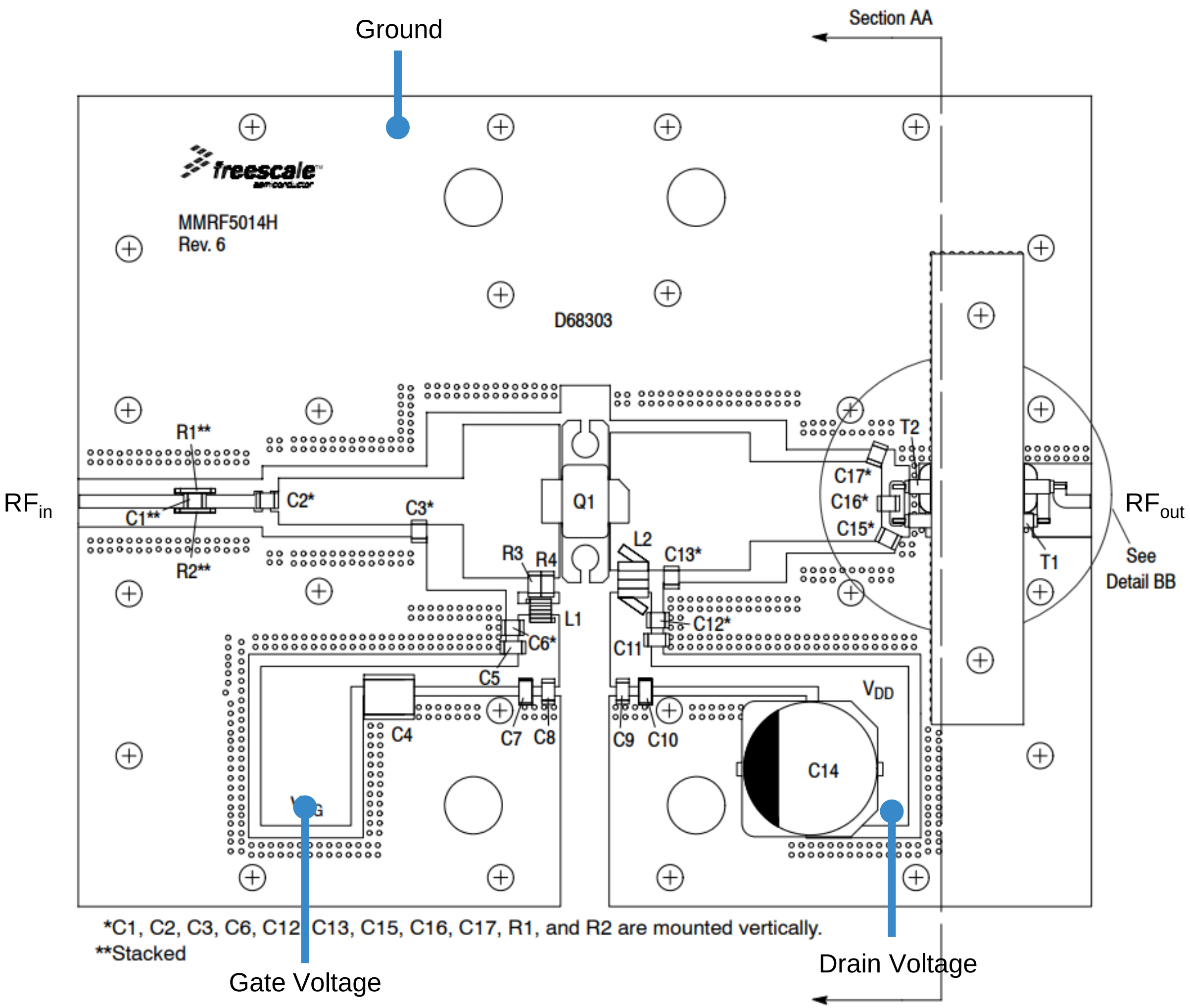
Frequency (MHz)	Output Power (W)	Power Gain (dB)	Drain Efficiency (%)
200-2500	100	12.0 (minimum across the band)	40.0 (minimum across the band)

Quick Start

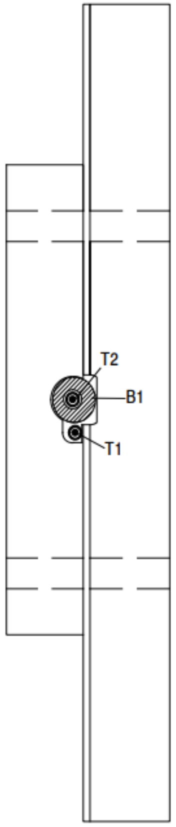
1. Mount the reference circuit onto a heatsink capable of dissipating more than 200 W in order to provide enough thermal dissipation (the baseplate included in this reference circuit is not sufficient to serve as a standalone heatsink).
2. Connect the ground.
3. Terminate the RF output with a 50 ohm load capable of handling more than 125 W.
4. Connect the RF input to a 50 ohm source with the RF off.
5. Connect the gate voltage and set it to -5 V.
6. Connect the drain voltage (V_{DD}) and raise it slowly to 48 V.
7. Increase the gate voltage slowly until the drain current reaches the desired level (drain quiescent current I_{DQ} = 350 mA typically). The gate voltage should be around -2.7 V.
8. Raise the RF input slowly to 6.3 W (38 dBm). Note: the performance charts on the previous page were made with a fixed output power, variable input power.
9. Check the RF output power (typically 100 W), the drain current (around 5 A for this power level) and the temperature of the board.

For GaN devices you must always first set the gate voltage before you connect the drain voltage.
GaN is a depletion mode device.

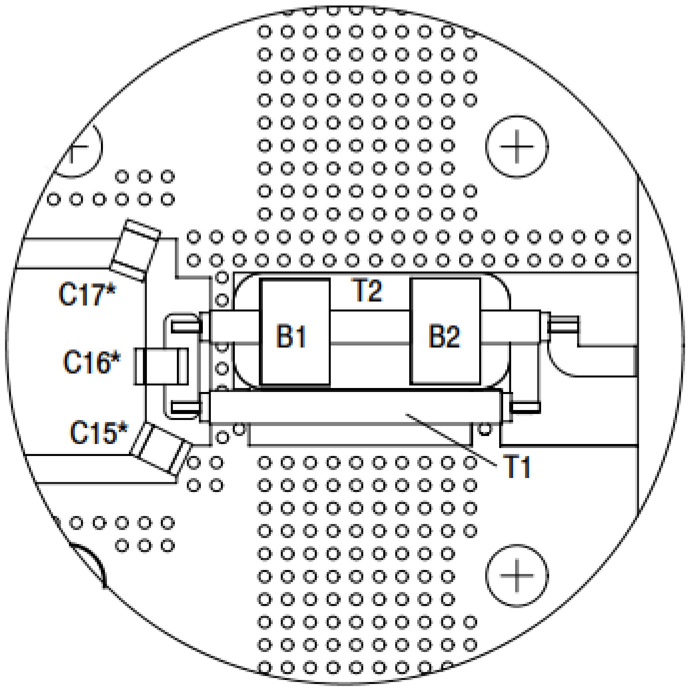
Component Placement Reference



*C1, C2, C3, C6, C12, C13, C15, C16, C17, R1, and R2 are mounted vertically.
**Stacked



Section AA



Detail BB 2X

Note: PCBs may have either NXP or Freescale markings. Existing Freescale boards will not migrate to NXP markings unless a board is revised.

Bill of Materials

Part	Description	Part Number	Manufacturer
B1, B2	Ferrite Beads	T22-6	Micro Metals
C1	56 pF Chip Capacitor	ATC800B560JT500XT	ATC
C2	75 pF Chip Capacitor	ATC800B750JT500XT	ATC
C3	1.6 pF Chip Capacitor	ATC800B1R6BT500XT	ATC
C4	6.8 μF Chip Capacitor	C4532X7R1H685K	TDK
C5, C8, C9, C11	0.015 μF Chip Capacitors	GRM319R72A153KA01D	Murata
C6, C12	5.6 pF Chip Capacitors	ATC800B5R6BT500XT	ATC
C7, C10	1 μF Chip Capacitors	GRM31CR72A105KAO1L	Murata
C13	1.4 pF Chip Capacitor	ATC800B1R4BT500XT	ATC
C14	220 μF, 100 V Electrolytic Capacitor	EEV-FK2A221M	Panasonic-ECG
C15, C17	0.9 pF Chip Capacitors	ATC800B0R9BT500XT	ATC
C16	47 pF Chip Capacitor	ATC800B470JT500XT	ATC
L1	12.5 nH Inductor, 4 Turns	A04TJLC	Coilcraft
L2	22 nH Inductor	1812SMS-22NJLC	Coilcraft
Q1	RF Power GaN Transistor	MMRF5014H	NXP
R1, R2	10 Ω, 3/4 W Chip Resistors	CRCW201010R0FKEF	Vishay
R3, R4	39 Ω, 1/4 W Chip Resistors	CRCW120639R0FKEA	Vishay
T1	25 Ω Semi Rigid Coax, 0.770″ Shield Length	UT-070-25	Micro-Coax
T2	25 Ω Semi Rigid Coax, 0.850″ Shield Length	UT-070-25	Micro-Coax
PCB	Rogers RO4350B, 0.030″, ε_r = 3.66	D68303	MTL

Tuning Tips

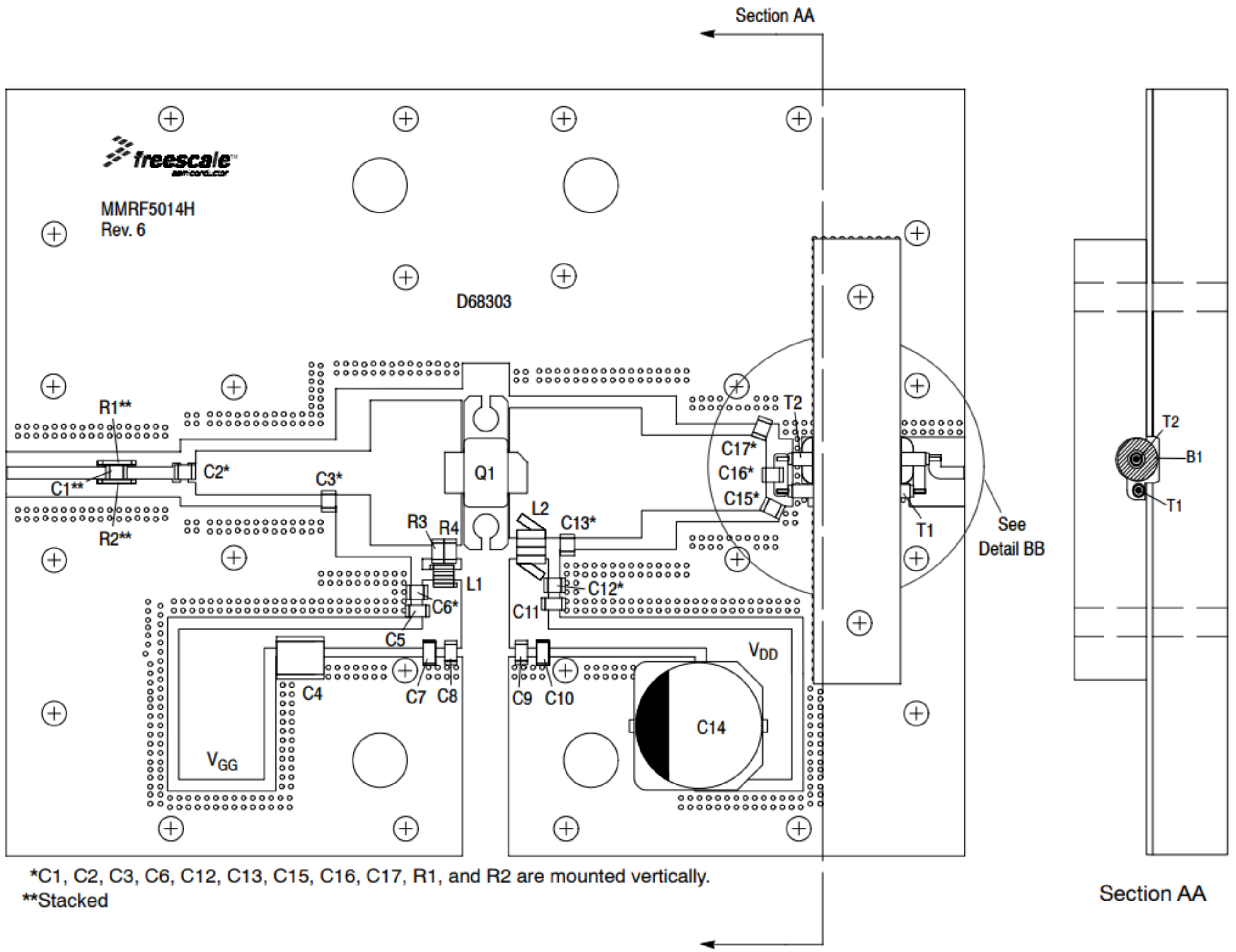
- Increasing **C13** or moving it toward the drain improves gain at 1500 MHz, high-end band gain and high-end band efficiency, but results in gain drops at 1300 MHz and 1650 MHz.

- Decreasing **C13** or moving it away from the drain improves gain at 1300 MHz and 1650 MHz, and efficiency at 1100 MHz, but causes gain drops at 1450 MHz and 2000 MHz and reduces high-end band efficiency and gain.

- Decreasing **C13** or moving it away from the drain slightly improves gain flatness.

- Moving **C16** toward T1 improves high-end band gain**.** Moving **C4** toward T2 improves gain around 1300 MHz.

- Increasing **C16** raises low-end band gain and efficiency and decreases mid- to high-band gain (1400-2500 MHz).



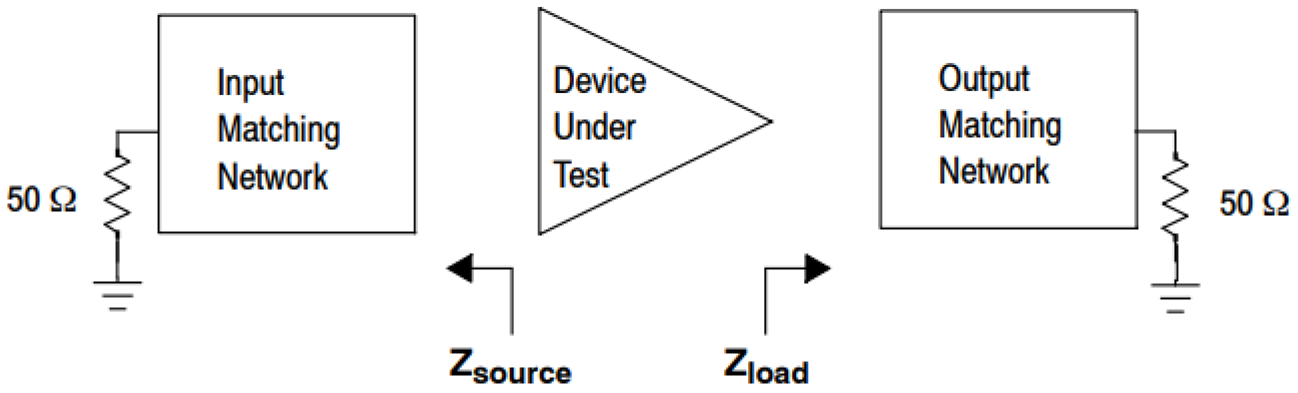
*C1, C2, C3, C6, C12, C13, C15, C16, C17, R1, and R2 are mounted vertically.
**Stacked

Impedances

f MHz	Z_{source} Ω	Z_{load} Ω
500	1.3 + j3.9	5.9 + j3.5
1000	1.0 + j0.3	5.5 + j2.9
1500	0.8 – j0.5	3.4 + j2.0
2000	1.2 – j2.0	4.7 + j0.3
2500	2.7 – j3.8	3.7 + j1.4

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

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



Revision History

- The following table summarizes revisions to the content of the MMRF5014H 200-2500 MHz Reference Circuit zip file.

Revision	Date	Description
0	September 2019	• Initial Release

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