MRF1K50H 13.56 MHz REFERENCE CIRCUIT

ORDERABLE PART NUMBER: **MRF1K50H-TF5**

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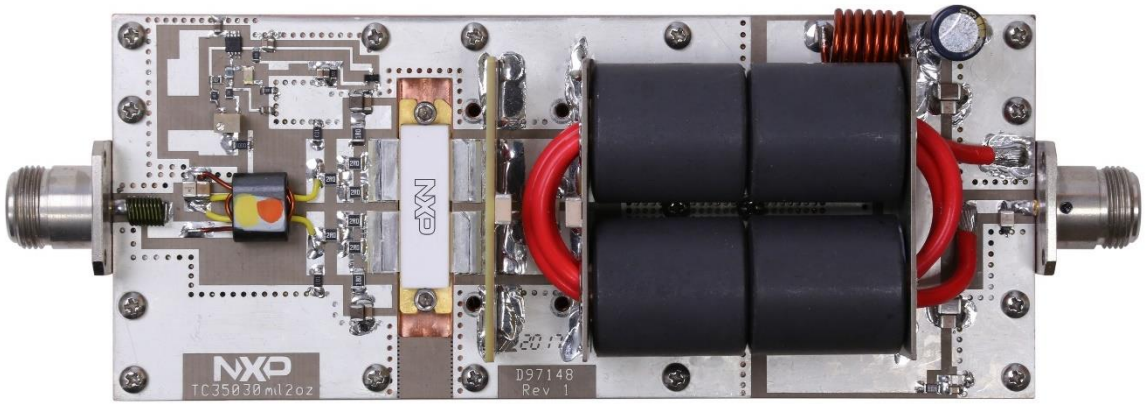
Introduction

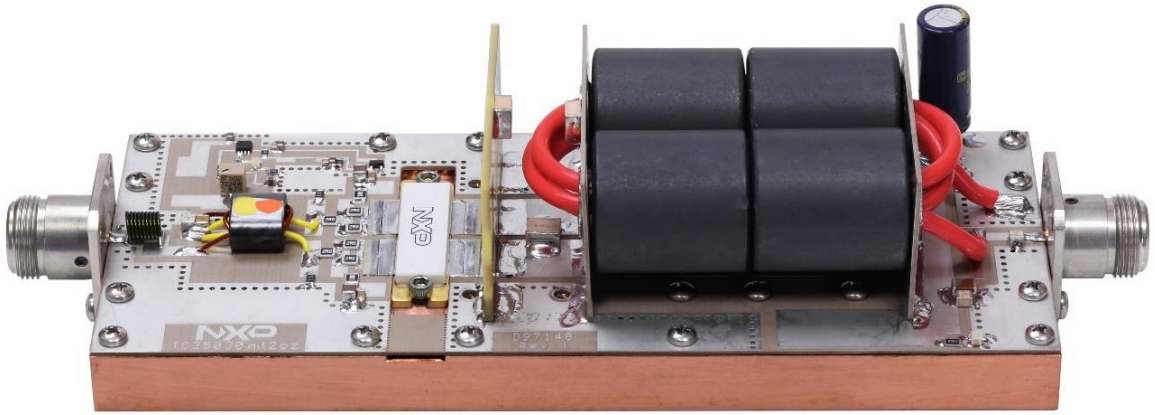
- The NXP MRF1K50H is a 1.8-500 MHz, 1500 W CW RF power LDMOS transistor housed in an NI-1230 air-cavity ceramic package. Its unmatched input and output allows wide frequency range utilization.
  - Further details about the device, including its data sheet, are available here.

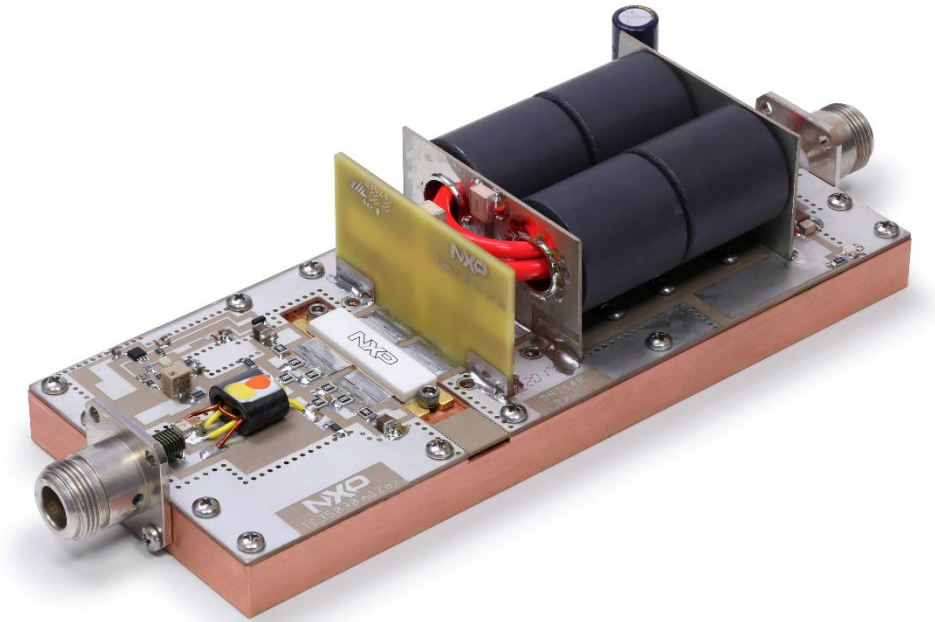
- The following pages describe the 13.56 MHz reference circuit (evaluation board).
  Its typical applications are industrial, scientific, medical (ISM), RF energy and plasma generation.

- The reference circuit can be ordered through NXP's distribution partners and etailers using part number MRF1K50H-TF5.

Circuit Overview – 7.3 cm x 17.5 cm (2.88″ x 6.90″)







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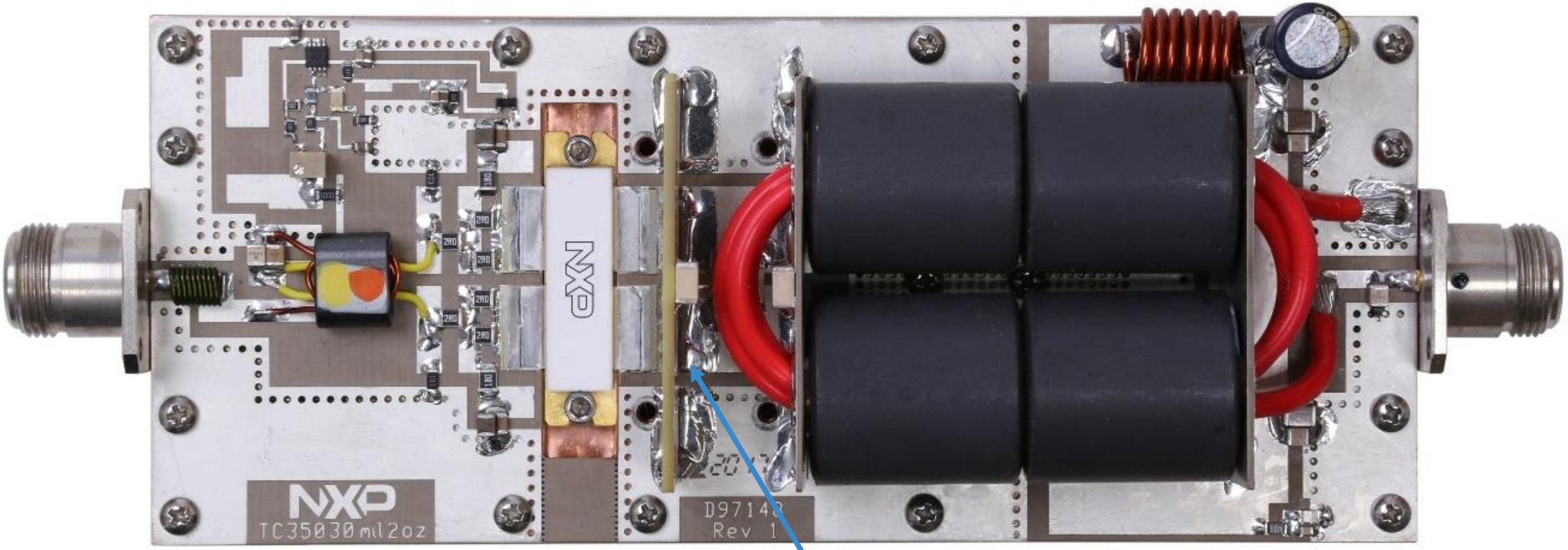
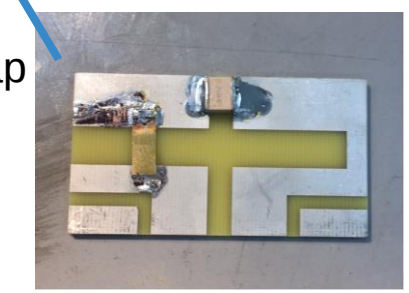
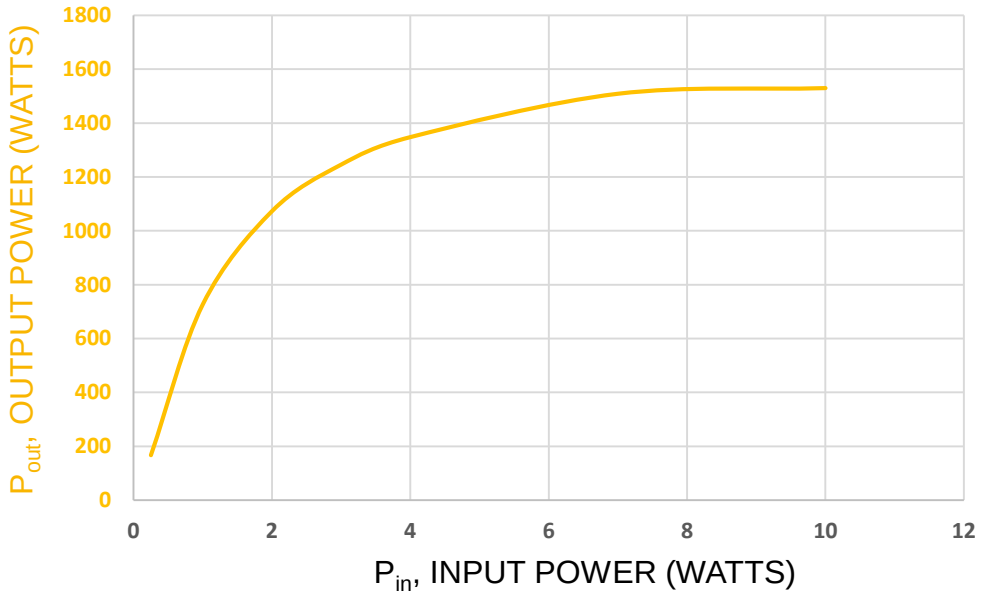
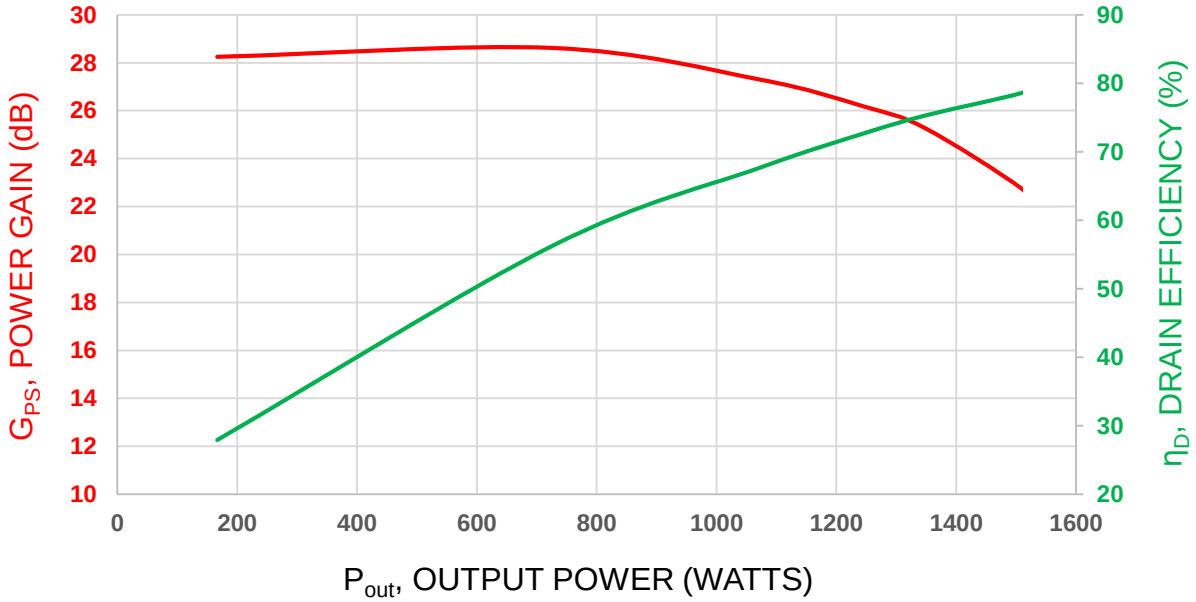


Vertical trap



Typical CW Performance



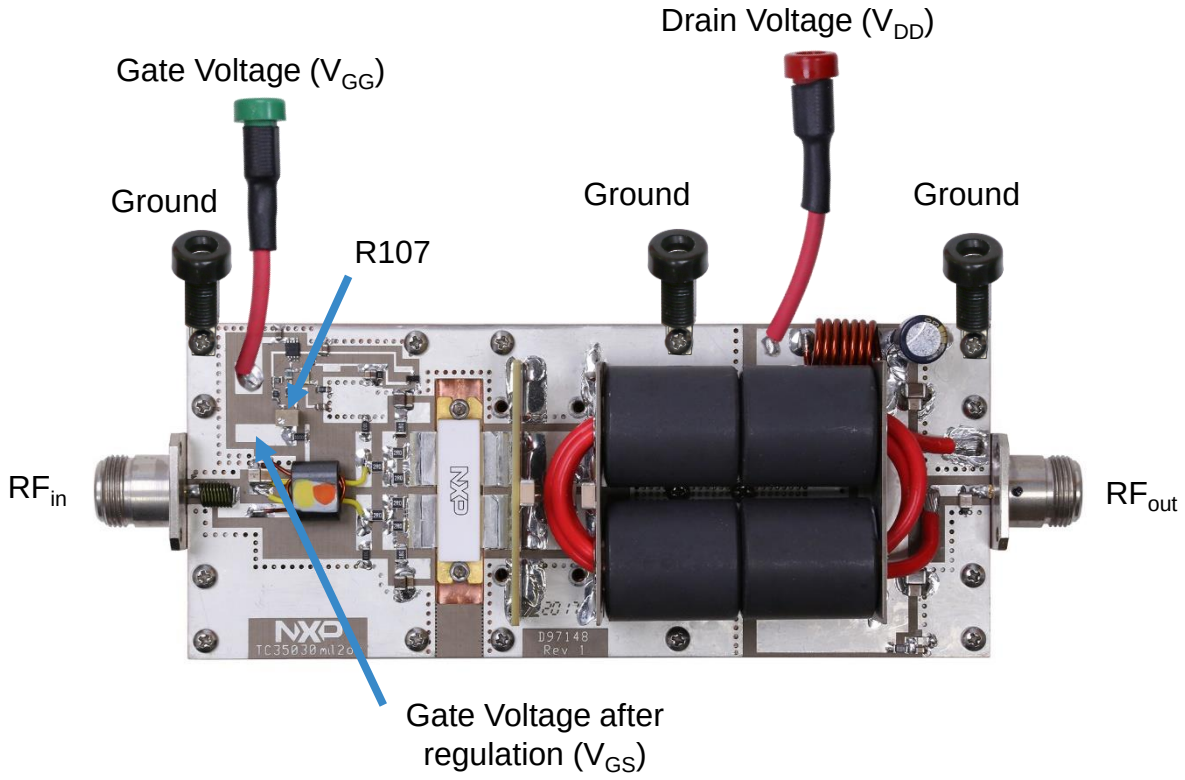


Typical Performance: V_{DD} = 48 Vdc, $I_{DQ(A+B)}$ = 400 mA, P_{in} = 8.2 W (39.2 dBm), CW

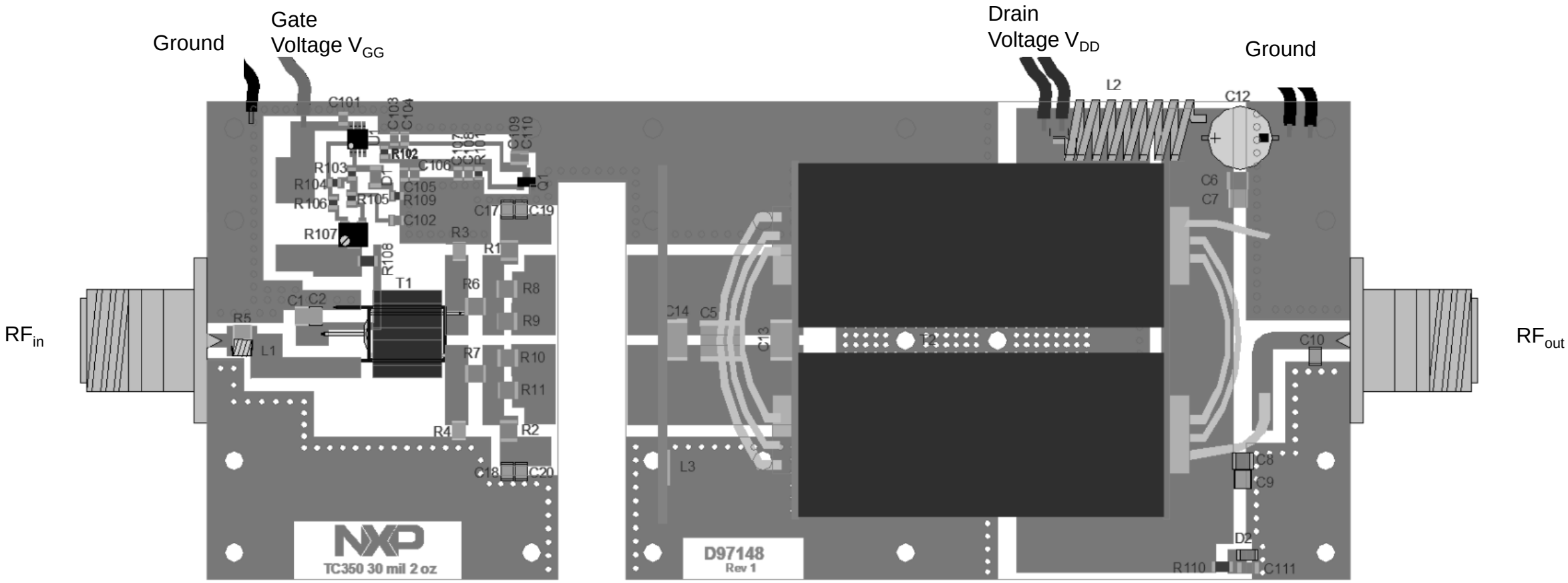
Frequency (MHz)	Output Power (W)	Power Gain (dB)	Drain Efficiency (%)
13.56	1500	22.6	78.5

Quick Start

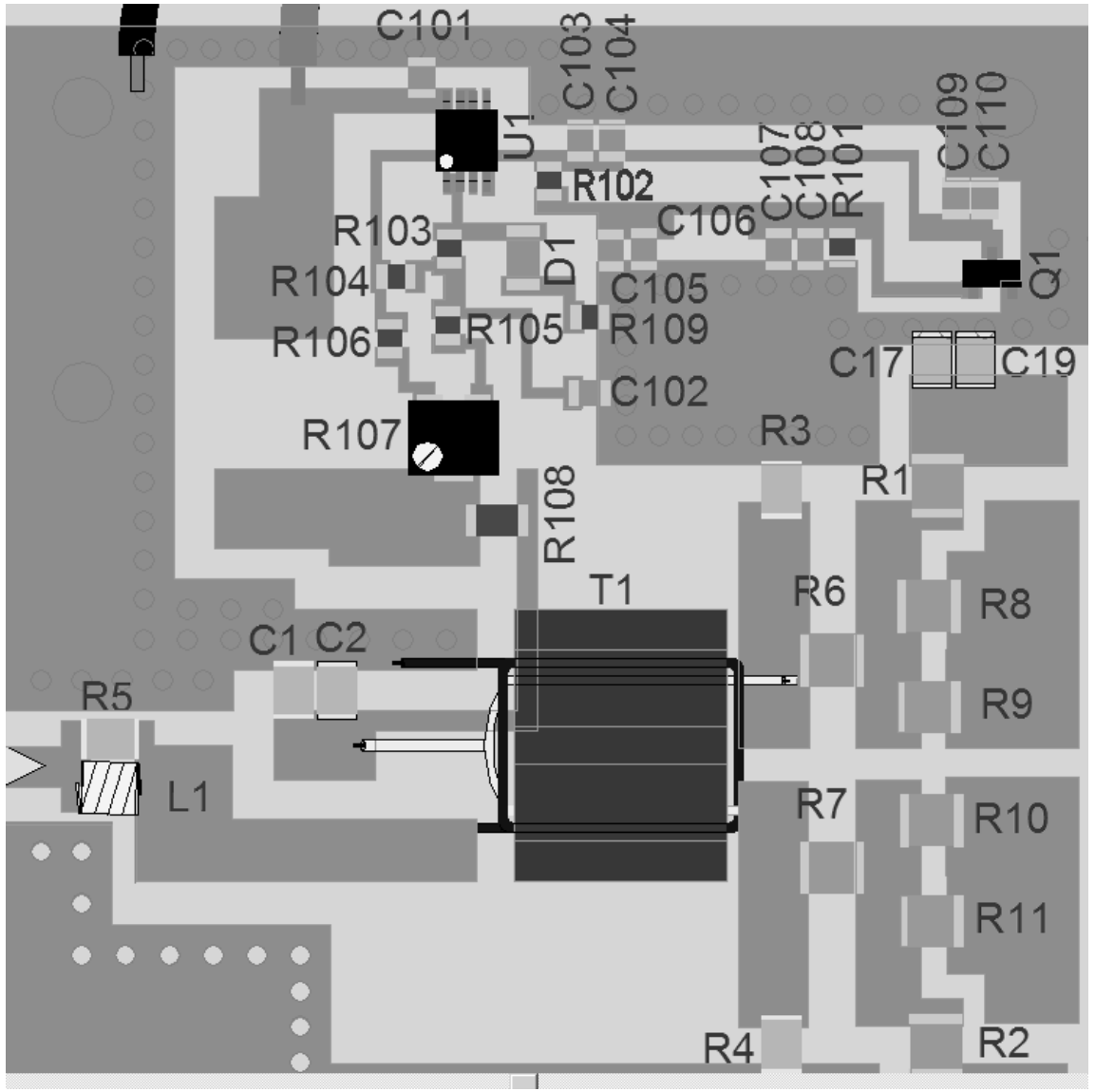
1. Mount the reference circuit onto a heatsink capable of dissipating more than 600 W in order to provide enough thermal dissipation (the baseplate included in this reference circuit is not sufficient to serve as a standalone heatsink).
2. Connect the ground.
3. Terminate the RF output with a 50 ohm load capable of handling more than 1500 W.
4. Connect the RF input to a 50 ohm source with the RF off.
5. Connect the gate voltage, set to 0 V.
6. Connect the drain voltage (V_{DD}) and raise it slowly to 48 V. Current should be 0 A.
7. Raise the gate voltage V_{GG} slowly to 12 V ensuring the drain current remains below or equal to typical quiescent current $I_{DQ(A+B)}$ = 400 mA. The gate voltage at the transistor level (V_{GS}) should be around 2.4 V.
8. If needed, adjust the R107 potentiometer to modify the gate voltage of the transistor V_{GS} to adjust the drain quiescent current $I_{DQ(A+B)}$.
9. Raise the RF input slowly to 8.2 W (39.2 dBm).
10. Check the RF output power (typically 1500 W), the drain current (around 35 A for this power level) and the temperature of the board.



Component Placement Reference



Component Placement Reference (Zoom)



Bill of Materials 1/2

Part	Description	Part Number	Manufacturer
R1,R2	18Ω 1210 chip resistor	ERJ-14YJ1804U	Panasonic
R3, R4	10K ohm	CRCW120610K0JNEA	Vishay/Dale
R5	150 ohm, 1206	CRCW1206150RFKEA	Vishay/Dale
R6,R7,R8,R9,R10,R11	2.0 Ohm, 1210	ERJ-14YJ2R0U	Panasonic
R101	2.2k ohms 0805 chip resistor 1/8W	CRCW08052K20JNEA	Vishay/Dale
R102, R109	1.2k ohms 0805 chip resistors 1/8W	CRCW08051K20FKEA	Vishay/Dale
R103	10 ohms 0805 chip resistor 1/8W	RK73H2ATTD10R0F	KOA Speer
R104	1k ohms 0805 chip resistor 1/8W	RR1220P-102-D	Susumu
R105	3.9k ohms 0805 chip resistor 1/8W	CRCW08053K90JNEA	Vishay/Dale
R106	200 ohms 0805 chip resistor 1/8W	CRCW0805200RJNEA	Vishay/Dale
R107	SMT Trim Pot 5K, (11 turn)	3224W-1-502E	Bourns
R108	100 ohms 1206 chip resistor 1/8W	CRCW1206100RFKEA	Dale/Vishay
R110	9.1k ohms 1206 chip resistor 1/4W	CRCW12069K10FKEA	Dale/Vishay
C1	1000 pF chip capacitors	100B102JT50XT	ATC
C2	39nF chip capacitors	200B393KT50XT	ATC
C6, C8	2.2 µF 100V chip capacitors	HMK432B7225KM-T	Taiyo Yuden
C7, C9	470 pF chip capacitors	100B471JT200XT	ATC
C10	18 pF chip capacitor	100B180JT500XT	ATC
C12	220 µF 63V electrolytic capacitor	EEU-FC1J221	Panasonic
C5,C13*	390 pF chip capacitor	100C391JT2500XT	ATC
C14**	470 pF chip capacitor	100C471JT2500XT	ATC
C19,C20	33 nF 1206	GRM31MR72A333KA01L	Murata
C17,C18	10 µF 1210	GRM32ER61H106KA12L	Murata
C101,C102,C104,C108	1 µF 0805 chip capacitors	GRM21BR71H105KA12L	Murata
C103,C107,C111	1000 pF chip capacitors	C2012X7R2E102M	TDK

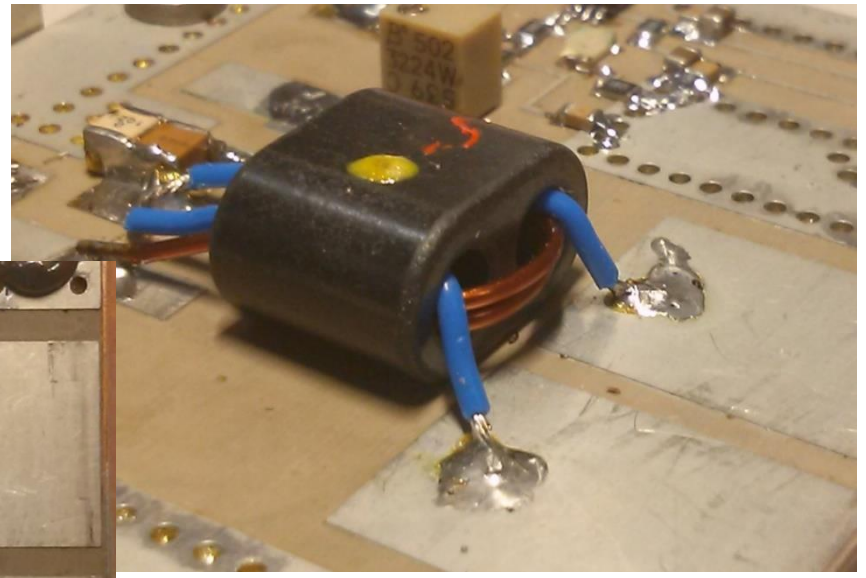
Bill of Materials 2/2

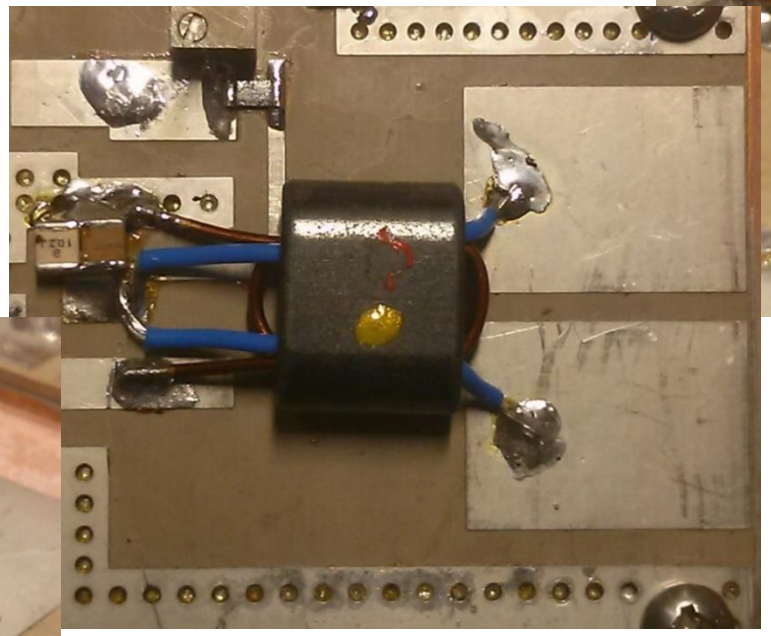
Part	Description	Part Number	Manufacturer
L1	160 nH inductor	2222SQ-161JECX	CoilCraft
L2	7T / AWG 14 Enamel, ID=0.375"/ L=0.5", Handwound	8073	Beldon
T1 Core	Multi Aperture Core, 43 material	2843000302	Fair-Rite
T1 Primary	#20 magnetic wire, Primary 2 Turns	8076	Beldon
T1 Secondary	#24 Teflon wire, Secondary 1 Turn	5854/7 BL005	Alpha Wire
T2 Core	Ferrite Cylindrical Core 61 material (X4)	2661102002	Fair-Rite
PCB, T2	Arlon TC350, 30mils 2/2oz, 2 piece construction	D50876	MTL
T2 Primary	Copper pipes, type L, ID 3/8”, OD 1/2", cut to 2.4"	LH03010	Mueller
T2 Secondary	10 AWG PTFE wire, 3 Turns (approx 27.25")	E10-37	Wesbell
U1	5V Voltage Regulator Micro8	LP2951ACDMR2G	On-Semi
Q1	Bipolar NPN transistor SOT23	BC847ALT1G	On-Semi
D2, Low Voltage	Green Led 1206	LG N971	OSRAM
D1, 50V	Red Led 1206	LH N974	OSRAM
PCB, Main	TC350 30 mils, 2/2 oz	D97148	MTL
PCB, Trap	FR4 0.059in 1oz	D96241	MTL
C105,C106,C109,C110	DNP		

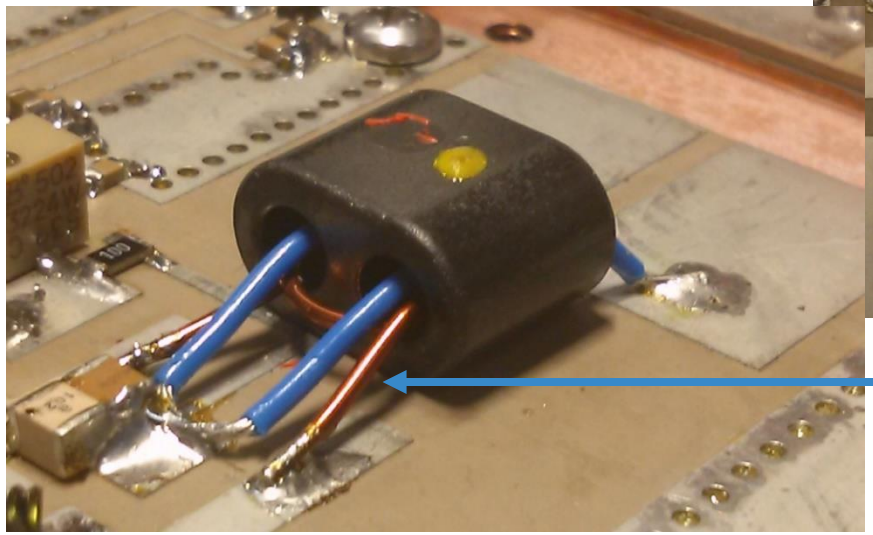
* mounted on T2 PCB

** mounted on Trap PCB

T1 Input – Balun Details



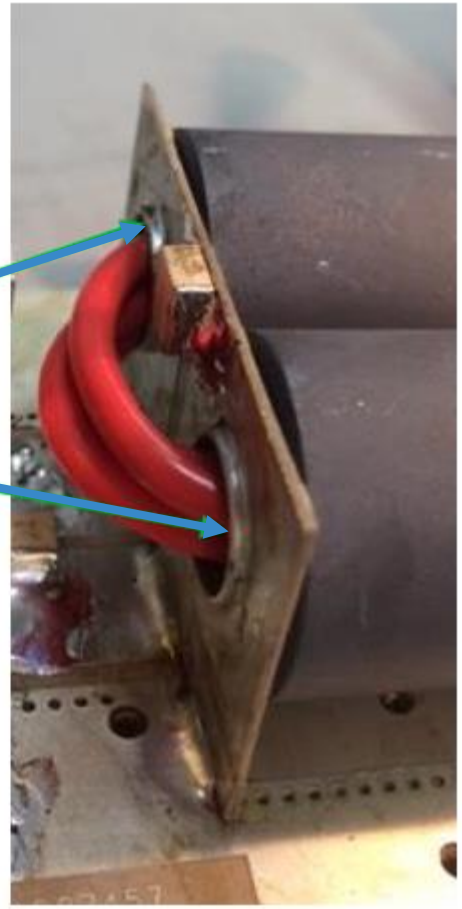




The primary cable (brown) makes 2 turns within the transformer.
The secondary cable (blue) makes 1 turn within the transformer.
At half its length, the secondary cable has a connection to the decoupling capacitors.

T2 Output – Balun Details

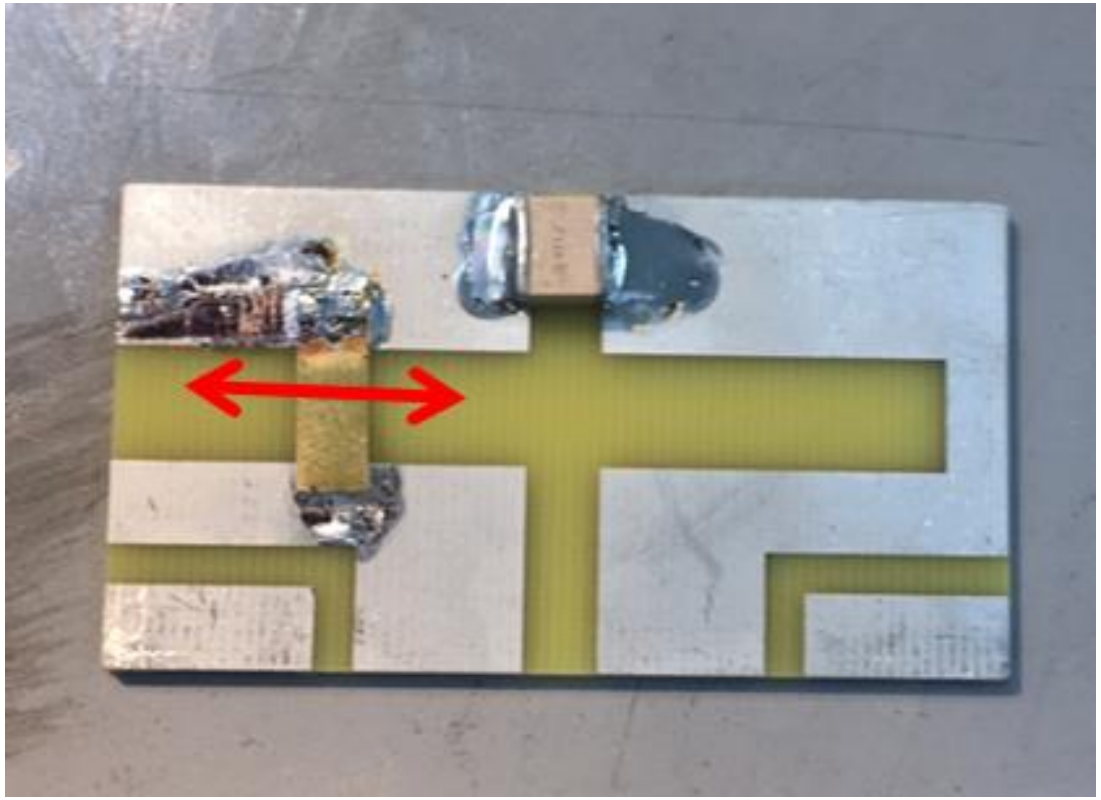
The wire makes 3 turns within the transformer.



The vertical PCBs for the T2 output transformer are cut from the D50876 board (MRF1K50H 13.56 MHz Balun.dxf).

Tuning Tip

- The shim position is sensitive for maximum efficiency.
- It shortens the third harmonic impedance for class F^{-1} tuning.
- Move shim in small increments if required



Revision History

- The following table summarizes revisions to the content of the MRF1K50H 13.56 MHz Reference Circuit zip file.

Revision	Date	Description
0	September 2019	• Initial Release

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