MRFX1K80H VHF TV DOHERTY (174-230 MHz) REFERENCE CIRCUIT WITH VERTICAL TRANSFORMER

ORDERABLE PART NUMBER: **MRFX1K80H-VHFDHY**

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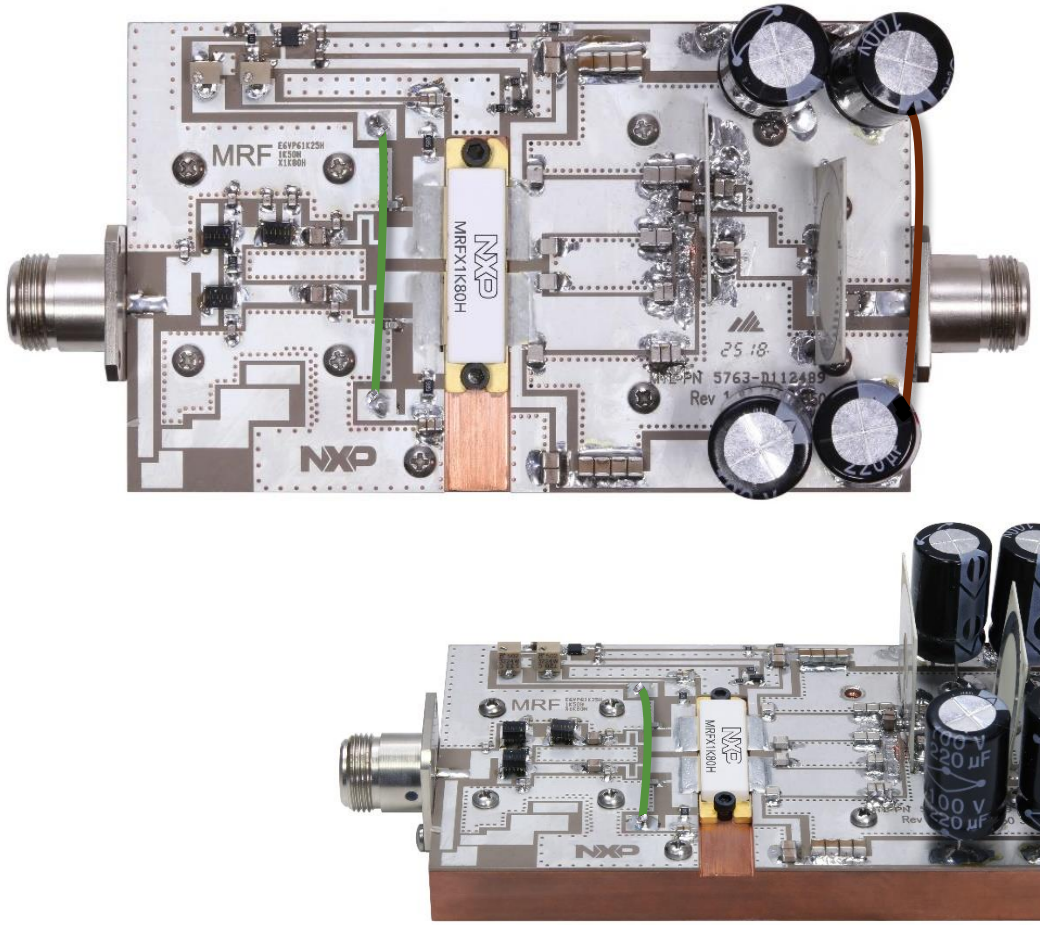
Introduction

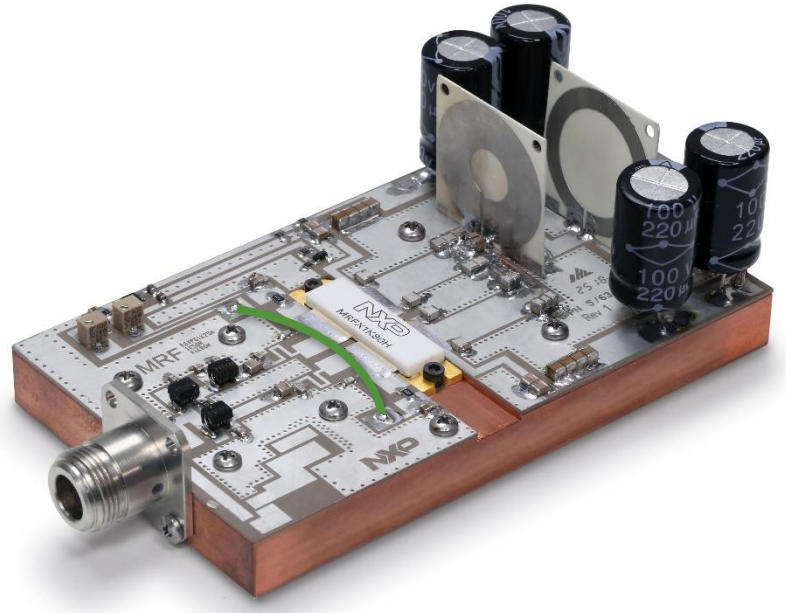
- The NXP MRFX1K80H is a 1.8-400 MHz, 1800 W RF power LDMOS transistor housed in an NI-1230 air-cavity ceramic package. Its unmatched input and output allows wide frequency range utilization.
  - Further details about the device, including its data sheet, are available on www.nxp.com/MRFX1K80H.

- The following pages describe the 174-230 MHz 125 W Doherty reference circuit implemented with a vertical planar transformer.
  Its typical application is VHF TV transmitters.

- The reference circuit can be ordered through NXP's distribution partners and etailers using part number MRFX1K80H-VHFDHY.

Circuit Overview – 7.62 cm × 12.70 cm (3.0″ × 5.0″)





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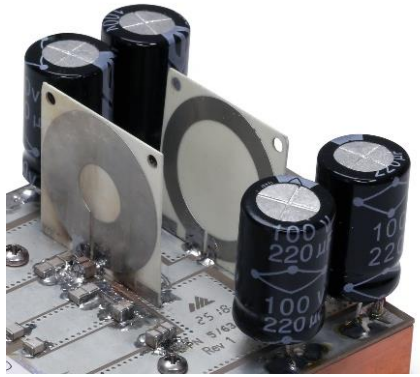


Vertical planar transformer

Wire connecting $V_{peaking}$.

Wire connecting drain voltages for both sides of the transistor.

Typical Performance

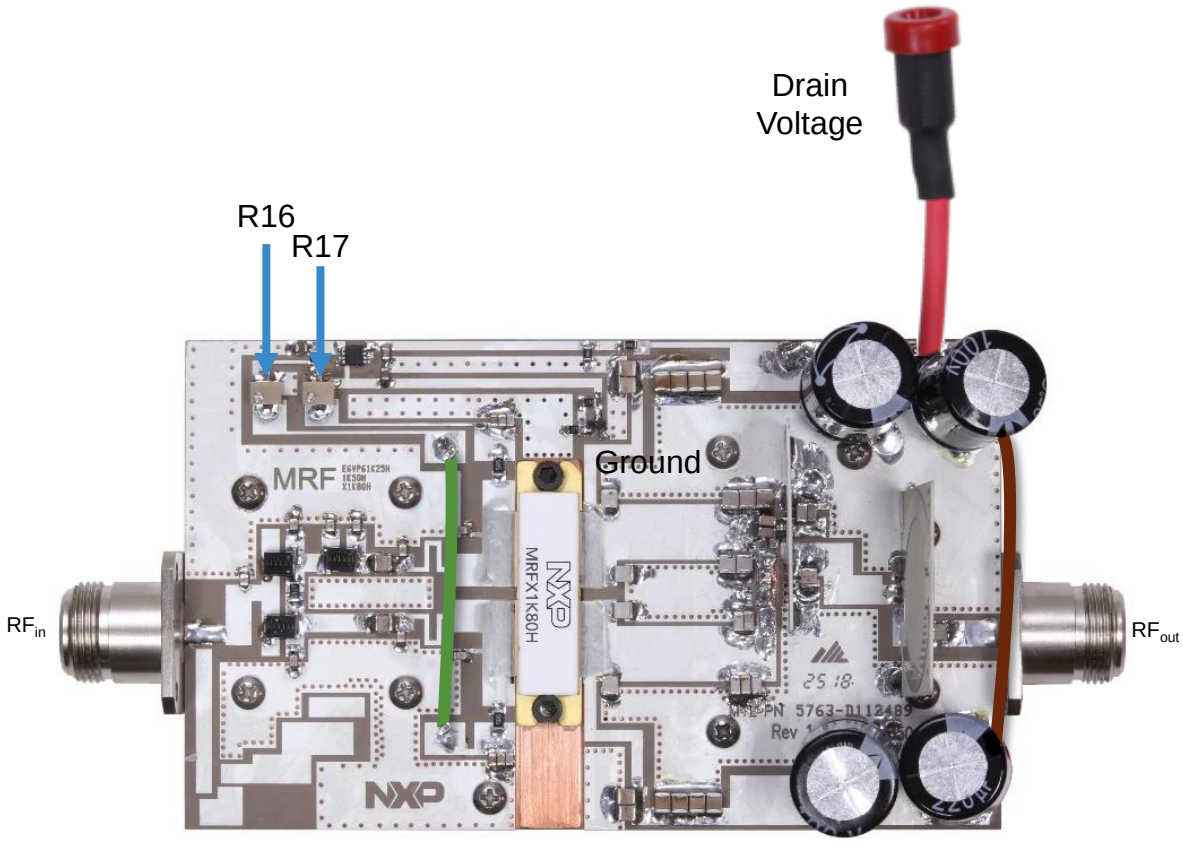
V_{DD} = 63 Vdc, $I_{carrier}$ = 200 mA, $V_{peaking}$ = 1.8 Vdc, DVB-T signal, no pre-distortion correction.

Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Output Power (W)	Power Gain (dB)	IRL (dB)	Delta -4 (dB)	Delta +4 (dB)	PAR (dB)	Drain Efficiency (%)	I_D (A)
174	32.4	54.0	250	21.6	-13.2	-23.2	-24.1	7.6	45.7	8.7
200	32.7	54.0	250	21.3	-17.3	-26.2	-24.3	8.2	43.3	9.2
230	32.0	54.0	250	22.0	-22.1	-26.6	-26.4	7.7	43.4	9.2

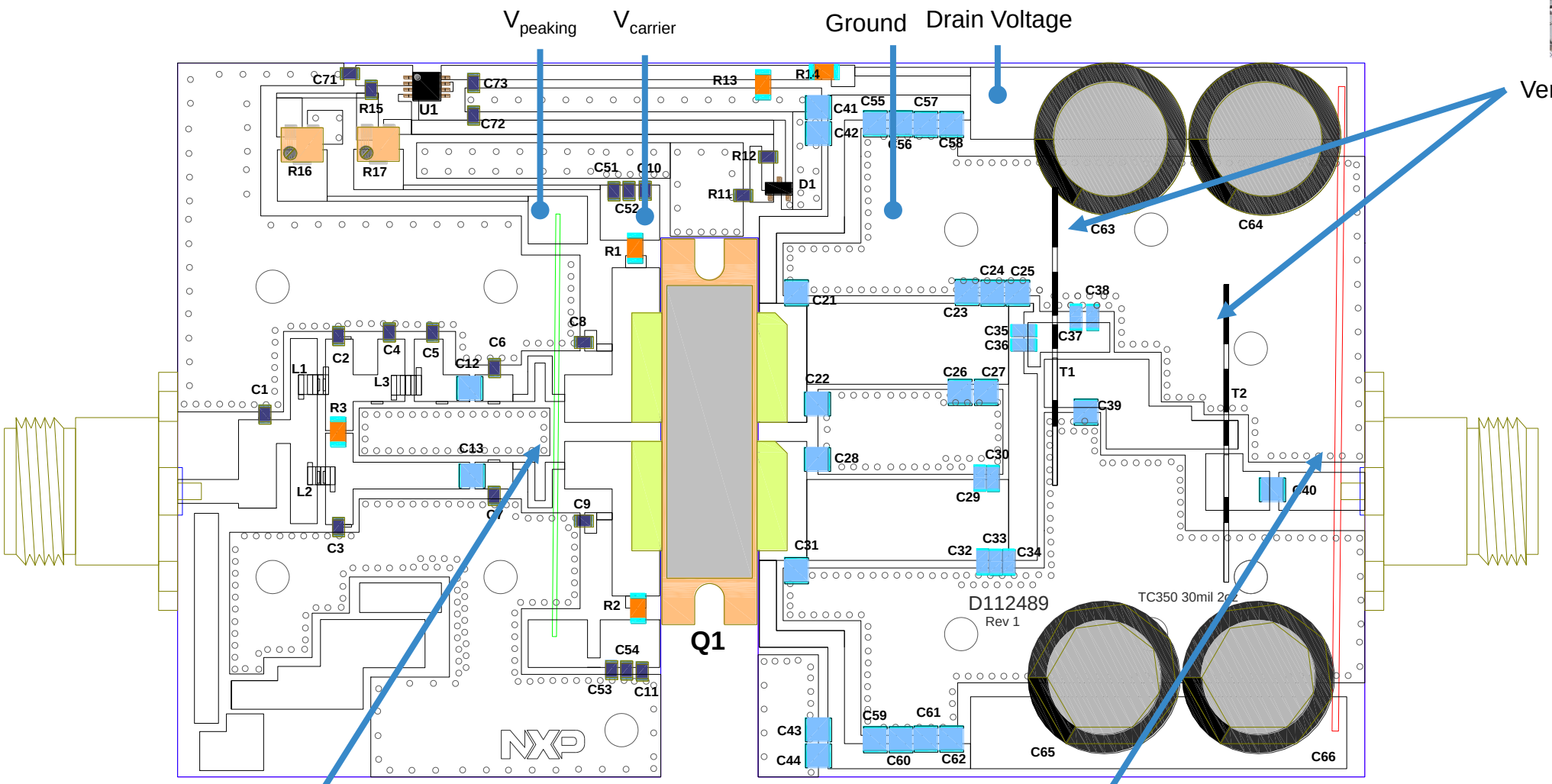
Parts tested clamped with thermal grease. It is strongly recommended to use solder in final PA.

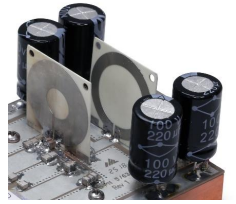
Quick Start

1. Mount the reference circuit onto a heatsink capable of dissipating more than 350 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 peak.
4. Connect the RF input to a 50 ohm source with the RF off.
5. Connect the drain voltage (V_{DD}) and raise it slowly to 63 V while ensuring that the drain current remains below or equal to the typical drain quiescent current of $I_{carrier}$ = 200 mA.
6. If needed, adjust the R17 potentiometer to modify the carrier gate voltage to adjust the carrier drain quiescent current
7. Adjust the R16 potentiometer for $V_{peaking}$ = 1.8 V.
8. Raise the RF input slowly to 1.9 W (32.7 dBm)
9. Check the RF output power (typically 250 W average), the drain current (around 9 A for this power level) and the temperature of the board.



Component Placement Reference





Bill of Materials

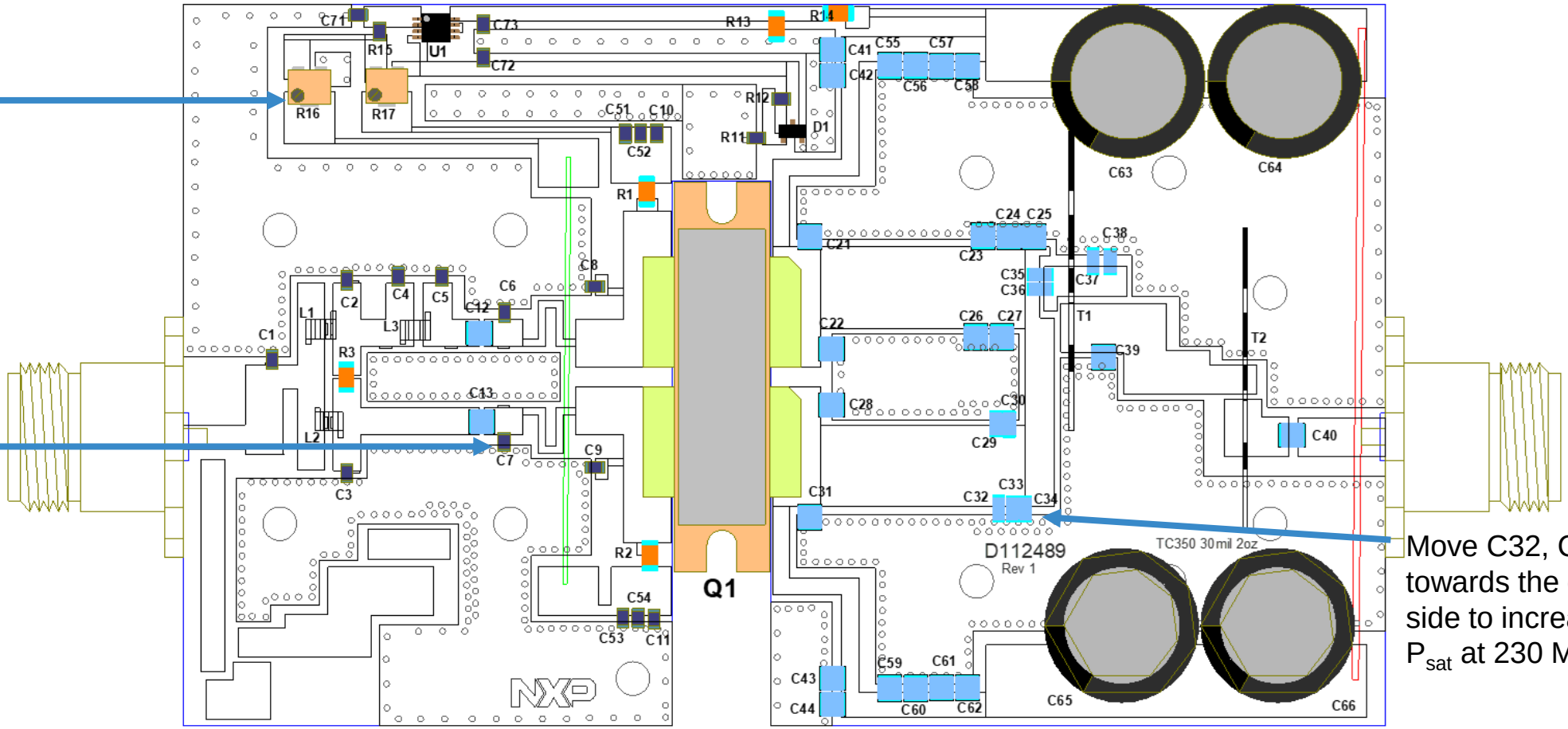
Designator	Description	Part Number	Manufacturer
C1	18pF Chip Capacitor	600F180JT250XT	ATC
C2,C3	10pF Chip Capacitor	600F100JT250XT	ATC
C4,C5	15pF Chip Capacitor	600F150JT250XT	ATC
C6,C7	82pF Chip Capacitor	600F820JT250XT	ATC
C8,C9,C10,C11	1000pF Chip Capacitor	GRM2165C2A102JA01D	Murata
C12,C13,C35,C36,C41,C42,C43,C44	910pF Chip Capacitor	800B911JT50XT	ATC
C21 to C23, C25 to C32, C34	75pF Chip Capacitor	800R750JT500XT	ATC
C24,C33	91pF Chip Capacitor	800R910JT500XT	ATC
C37,C38	82pF Chip Capacitor	800R820JT500XT	ATC
C39	39pF Chip Capacitor	800R390JT500XT	ATC
C40	100pF Chip Capacitor	800R101KT500XT	ATC
C51,C53,C71,C72,C73	1 µF Chip Capacitor	GRM21BR71H105KA12L	Murata
C52,C54	0.01 µF Chip Capacitor	GRM21BR72A103KA01B	Murata
C55 to C62	10uF Chip Capacitor	GRM32EC72A106KE05L	Murata
C63 to C66	220 µf 100 V Electrolytic capacitors	MCGPR100V227M16X26	Multicomp
L1,L2	47nH Inductor	1812SMS-47NJLC	Coilcraft
L3	39nH Inductor	1812SMS-39NJLC	Coilcraft
Q1	LDMOS transistor	MRFX1K80H	NXP
R1,R2	5.6 ohm 1206 Chip Resister	CRCW12065R60JNEA	Vishay
R3	82 ohm 1206 Chip Resister	CRCW120682R0FKEA	Vishay
R11,R15	2.2 KΩ 0805 Chip Resistor	CRCW08052K20JNEA	Vishay
R12	1.2 KΩ 0805 Chip Resistor	CRCW08051K20FKEA	Vishay
R13,R14	10 KΩ 0805 Chip Resistor	CRCW080510K0FKEA	Vishay
R16,R17	SMT Trim Pot 5KΩ, (12 turn)	3224W-1-502E	Bourns
D1	Discrete Semi's Transistors, NPN	BC847ALT1G	On-Semi
U1	IC 5V Regulator (micro8)	LP2951ACDMR2G	On-Semi
PCB	TC350 30 mil 2 oz	D112489	MTL
T1,T2 (Vertical transformer)	RO4350B 20mil 2 oz	D113265	MTL
Heatsink	Copper Heatsink	C224X276T490D42	Machine Shop

* C14-C20, C45-C50, C67-C70, R4-R10 Not Used

Tuning Tips

Change $V_{peaking}$ value through R16 to adjust the trade-off between efficiency and linearity

Move C6, C7 to bring IRL at 174 MHz below -10 dB



Move C32, C33, C34 towards the drain side to increase the P_{sat} at 230 MHz.

Revision History

- The following table summarizes revisions to the content of the MRFX1K80H Doherty with Vertical Planar Transformer MHz Reference Circuit zip file.

Revision	Date	Description
0	September 2019	• Initial Release

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