Pacific Antenna 10 Watt HF Amplifier Kit Manual

This is Version 5.5 dated 20160505

Read This Page First

- □ If you are reading this you know the manuals are always available at QRPKITS.com.

  If you have questions contact qrpkits.com@gmail.com

- □ There is no need to print out the whole assembly manual unless you want a copy. Print the Parts List and Schematic then view the rest of the manual on a computer, laptop, or tablet. The Parts List has columns for inventory and construction.

- □ Please take time to inventory the parts before starting. Report any shortages to QRPKITS.com (In many cases it may be faster and cheaper to pull a replacement from your parts supply, but please let us know if we missed something.)

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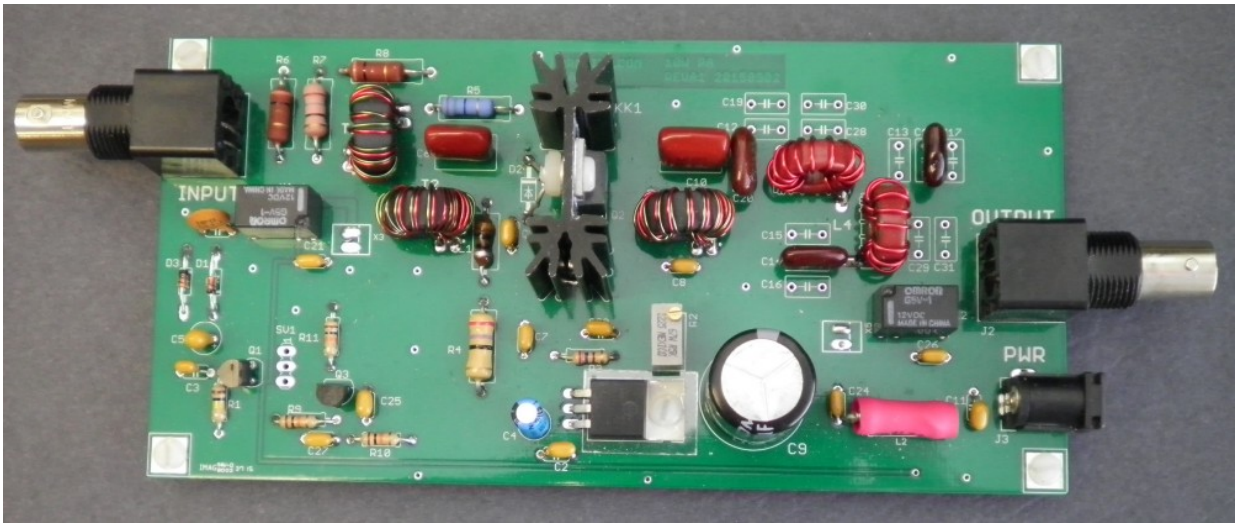
10 Watt HF Amplifier Kit



Description

Our 10 watt HF amplifier kit is designed to increase the power output of low power transmitters. It provides approximately 15dB gain and includes an input attenuator that can be configured to reduce power output of transmitters as needed.

Can be configured to work with transmitters from 100 mW to approximately 2W.

The amplifier has automatic, RF sensed, TR switching and can also be remotely keyed and locked out if needed by grounding one of two control lines.

It is designed around a MRF475/ 2SC1969 transistor along with diode controlled temperature feedback for the adjustable bias circuit to maintain the bias current at a constant level and provide for stable linear operation.

Support

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Tools Needed

- □ Temperature Controlled Soldering Station with small tip or 15-35 watt soldering iron with small tip.
- □ Solder, 60/40 or 63/37 Tin-Lead recommended
- □ Small Diagonal Cutters
- □ Small Needle Nose Pliers
- □ Pencil, Pen, and/or Highlighter
- □ BRIGHT work light
- □ Meter to measure current (typical DMM will be ok)
- □ 50 Ohm Dummy load capable of handling 10W

Optional

- □ Wattmeter to measure output of amplifier.
- □ Magnifying headpiece or lighted magnifying glass.
- □ Solder Sucker or Solder Wick
- □ Small multi-blade Screw Driver
- □ Knife or Wire Stripper
- □ Small Ruler
- □ Cookie Sheet to build in and keep parts from jumping onto the floor.

Construction Techniques

- □ There is no need to print out the whole assembly manual unless you want a copy. Print the Parts List and Schematic (last two pages) then view the rest of the manual on a computer, laptop, or tablet.
- □ The Parts List has columns for inventory and construction.
    - Use the first column to check the parts as you inventory them.
    - Use the second column to check the parts as you install them.
- □ Please take time to inventory the parts before starting. Report any shortages to QRPKITS.com (In many cases it may be faster and cheaper to pull a replacement from your parts supply, but please let us know if we missed something.)
- □ Pre-sorting components can speed up the assembly and reduce mistakes.
- □ If you are a beginner, new to soldering, there are a number of resources on the web to help you get on the right track soldering like a pro. Google Soldering Techniques.
- □ Use a Temperature Controlled Soldering Station with small tip or 15-35 watt soldering iron with small tip. Conical or very small screw driver tips are best. DO NOT use a large soldering iron or soldering gun.
- □ You can insert several parts at a time onto the board. When you insert a part bend the leads over slightly to hold the part in place, then solder all at the same time. Clip the leads flush.
- □ Most parts should be mounted as close to the board as possible. Transistors should be mounted about 1/8” above the board. Solder one lead on ICs or IC sockets and then check to make sure the component is flush before soldering the remaining leads.

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10 Watt HF Amplifier Inventory and Parts List for Manual V5.3

Inventory	Installed	Quan.	Part #	Value	Identification	Description
		1	R3	270 Ω	red-vio-brn-gold	Resistor ¼ W
		3	R9, R10, R11	10K Ω	brn-blk-org-gold	Resistor ¼ W
		1	R1	100K Ω	Brn-blk-yel-gold	Resistor ¼ W
		1	R5	15 Ω	Brn-grn-blk-gold	Resistor 1 W
		1	R4	27 Ω	Red-vio-blk-gold	Resistor 1 W
		1	C1	100pF	101	Disk Ceramic Capacitor
		12	C2, C3, C7, C8, C11, C21, C22, C23, C24, C25, C26, C27	0.1uF	104 (yellow)	Capacitor, monolythic
		2	C6, C10	0.1uF	104K (red)	Film Capacitor
		1	C5	4.7uF	4.7 uF	Tantalum Capacitor
		1	C4	10uF	10 uF	Electrolytic Capacitor
		1	C9	1000uF	1000 uF	Electrolytic Capacitor
		1	L1	10uH	Brn-blk-blk-silver	Inductor small
		1	L2	10uH	Brn-blk-blk-silver	Inductor Large
		2	D1, D3	1N4148	Glass Diode	Diode
		1	Q1	BS170	BS 170	Mosfet, TO-92
		1	Q3	2N3906		PNP Transistor, T0-92
		2	R2	5K Ω	R5K	5K Ω 10 turn trimmer, gray
		1	K1, K2	G5V1	G5V1	Relay, black, 6 pin
		1	Q2	2SC1969	2SC1969	Transistor, TO-220
		1	IC1	LM-317	LM317MABT	Voltage Reg. TO-220
		2	INS	Insulator	Mica Insulator	Insulator for TO-220
		2	Screw	4-40	4-40x 1/4" screw	Nylon 4-40 screw
		2	Nut	4-40	4-40 nut	Nylon 4-40 nut
		1	KK1	Heatsink	Black	Finned Heatsink
		1	D2	Diode	N4004, plastic dioc	Diode to mount on heatsink
		1	RT	Terminal	ilver crimp termina	Flag Ring Terminal for diode
		3	T1, T2, T3	FT50-61	Toroids, gray	4:1 bifiliar winding
		1	5 feet	#22 wire	Red magnet wire	#22 Red wire for toroids
		1	3 feet	#22 wire	Green magnet wire	#22 Green wire for toroids
		1	SV1	3 Pin	Header strip	3 pin snappable header strip
		1	J3	Power Jack	ack coax power jac	PCB MOUNT 2.1mm Jack
		2	J1, J2	BNC Jack	Black, 90 degree BN	Board mount BNC Jack
		6"	COAX	RG174	Small black coax	RG174 coax cable
		1	PCB	PCB	Circuit Board	10W AMP PCB
		1	R7	18Ω 2W	Brn-gry-blk-gold	Resistor 2 W, attenuator, 3dB
		2	R6, R8	300Ω 2W	Org-blk-brn-gold	Resistor 2 W, attenuator, 3dB
		1	R7	39Ω 2W	Org-wht-blk-gold	Resistor 2 W, attenuator, 6dB
		2	R6, R8	150Ω 2W	Brn-grn-brn-gold	Resistor 2 W, attenuator, 6dB
		1	R7	75Ω 2W	Vio-grn-blk-gold	Resistor 2 W, attenuator, 10dB
		2	R6, R8	100 Ω 2W	Brn-blk-brn-gold	Resistor 2 W, attenuator, 10dB

Note: Bandkits are included in separate packages and are listed in the table on page 10.

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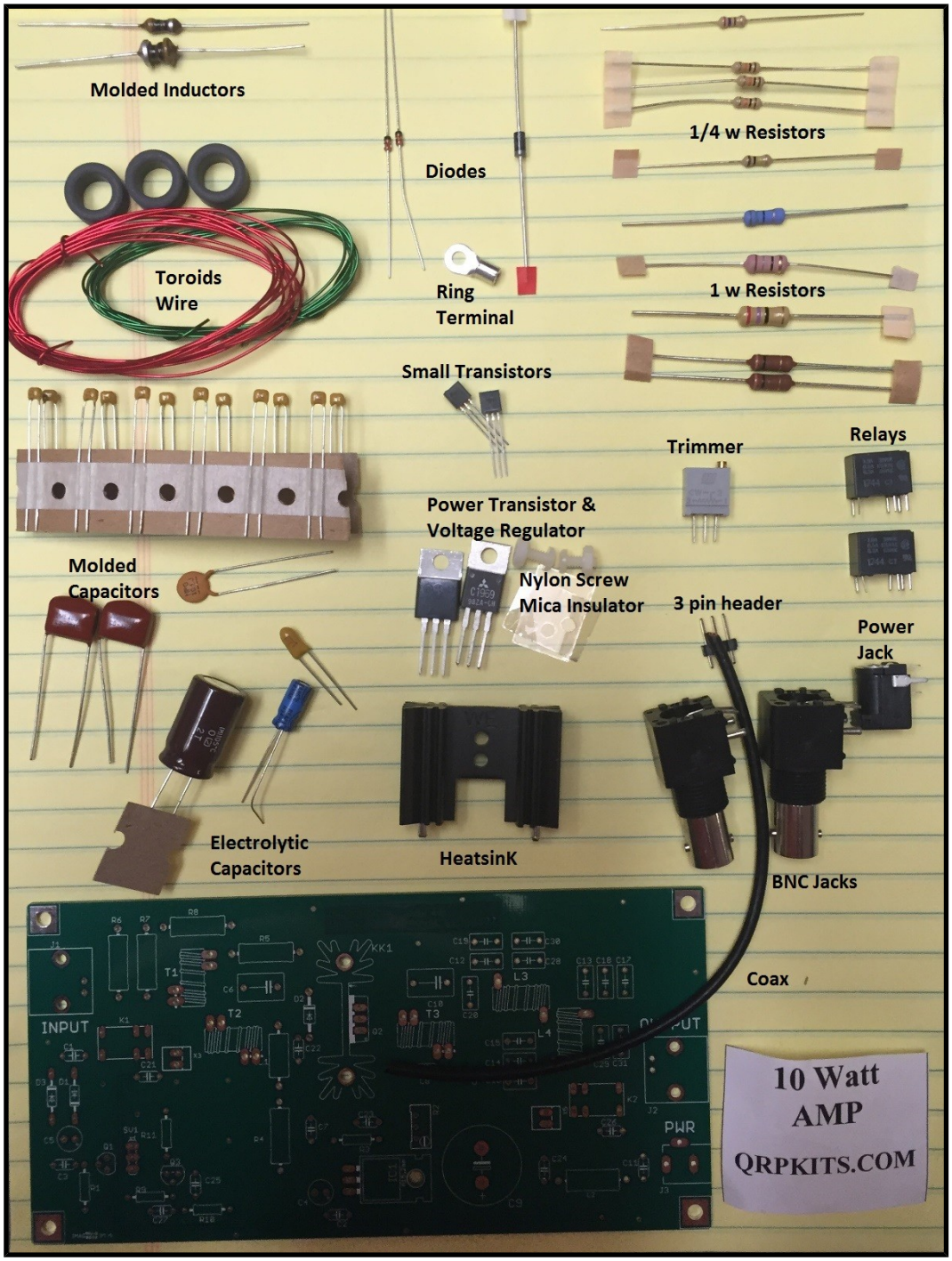
Note, the kit includes a syringe or tube of heat sink grease. This should be used on Q2 and IC1 (the TO220 parts) to provide better cooling. It should also be used on the ring terminal used to hold Diode D2.

10W HF Amplifier Parts Identification



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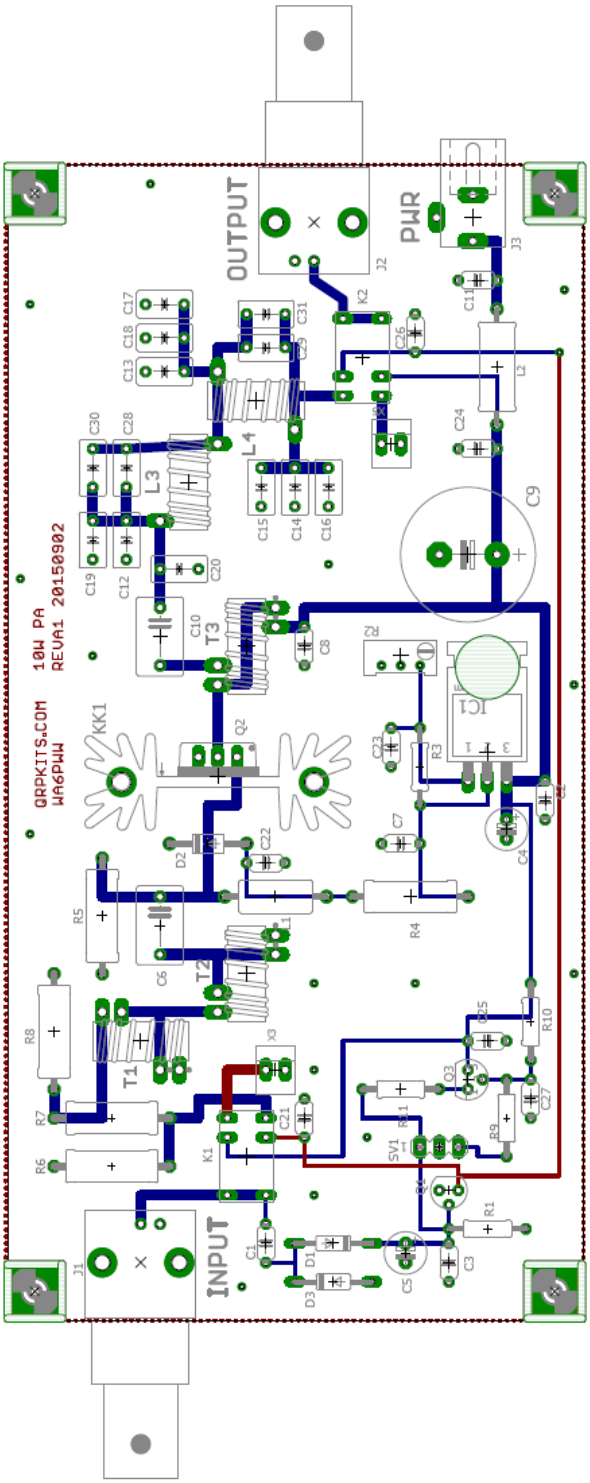
Board Layout



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Inserting the Parts

Resistors

Sort the resistors by value insert them smallest value first, largest value last. Be sure to check the color code for each resistor as you install. [Measuring with an Ohm meter is a good idea.]

□	1	R3	270 Ω	red-vio-brn-gold	Resistor, 1/4w
□	1	R9	10KΩ	brn-blk-org-gold	Resistor, 1/4w
□	1	R10	10KΩ	brn-blk-org-gold	Resistor, 1/4w
□	1	R11	10KΩ	brn-blk-org-gold	Resistor, 1/4w
□	1	R1	100KΩ	brn-blk-yel-gold	Resistor, 1/4w
□	1	R5	15 Ω	brn-grn-blk-gold	Resistor, 1W
□	1	R4	27Ω	red-vio-blk-gold	Resistor, 2W
□	1	R6	*	See Attenuator table	Resistor, 2W
□	1	R7	*	See Attenuator table	Resistor, 2W
□	1	R8"	*	See Attenuator table	Resistor, 2W
□					

Note: See input attenuator table for R6,R7 and R8 values. The kit will be supplied with resistors for 3dB, 6dB and 10dBattenuation levels. You should select the values based on your transmitter output to give approximately 100-200mW drive to the amplifier.

Capacitors

First insert the molded capacitors.

□	1	C1	100pF	101	Disk ceramic capacitor
□	1	C2	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C3	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C7	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C8	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C11	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C21	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C22	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C23	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C24	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C25	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C26	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C27	0.1uF	104 (YEL)	Capacitor, monolithic
□	1	C6	0.1uF	104K (RED)	Film Capacitor (Red)
□	1	C10	0.1uF	104K (RED)	Film Capacitor (Red)

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Electrolytics

Now insert the tantalum capacitor and electrolytic capacitors. These capacitors are polarized. The longer lead is the positive + (plus) lead. The positive hole is marked on the circuit board with a + symbol. The shorter lead is the - (minus) lead. The negative lead is also marked with a black bar on the side of the capacitor.

□	1	C5	4.7uF	4.7	Tantalum Capacitor
□	1	C4	10uF	10 uF	Electrolytic Capacitor
□	1	C9	1000uF	1000 uF	Electrolytic Capacitor

Molded Inductors

□	1	L1	10uH	brn-blk-blk-silver	Molded inductor, small
□	1	L2	10uH	brn-blk-blk-silver	Molded inductor, large

Remaining small parts

□	2	D1	1N4148	4148 (glass)	DIODE
□		D3	1N4148	4148 (glass)	DIODE
□	1	Q1	BS170	BS170	N-CHANNEL Mosfet
□	1	Q3	2N3906	2N3906	PNP Transistor
□	1	R2	5K	R5K	Trimmer gray multi turn
□	1	K1	G5V1	G5V1	RELAY
□	1	K2	G5V1	G5V1	RELAY

The LM317 regulator is mounted to the board using a mica insulator and the a Nylon Screw & Nut. Bend the leads carefully and test fit to the boards. Make sure the tab lies flat and then apply a small amount of heat sink compound to the regulator tab and to the board, place the insulator in place and attach the LM317 using the nylon screw and nut. DO NOT SOLDER the leads until the screw is tight.

□	1	IC1	LM317MABT	500 mA Voltage Regulator
□	1	INS	Mica Insulator	TO-220 Mica insulator
□	1	SCREW	Nylon Screw	#4-40 x 1/4” Nylon
□	1	NUT	Nylon Nut	#4-40 Nylon Nut

Parts on the Heatsink

First, solder the heatsink to the board using the 2 large pins. This may require a larger soldering iron or at least operating on the highest temperature setting for small irons. Solder one pin and check that the insulator is flush with the board and vertically straight before soldering the second pin.

□	1	screw	Nylon Screw	#4-40 x 1/4” #4-40 x 1/4” Nylon
□	1	nut	Nylon Nut	#4-40 #4-40 Nylon Nuts
□	1	KK1	Heatsink	Black finned with PCB pins
□	1	D2	1N4004	DIODE

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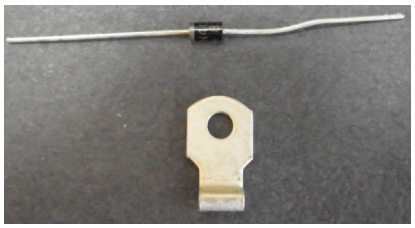
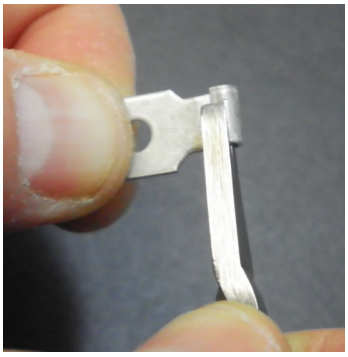
□	1	RT	Ring Terminal	Flag Ring terminal
□	1	Q2	2SC1969	NPN RF Power Transistor
□	1	INS	Mica Insulator	TO-220 Mica insulator

Preparing D2:

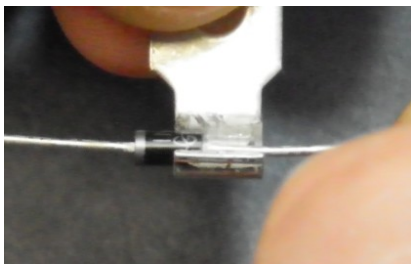
Diode D2 is used as temperature feedback for the bias current regulator to control thermal drift in the amplifier bias. D2 is mounted, using a flag ring terminal that is supplied in the kit so that it can be attached to the back side of the heatsink for Q2.



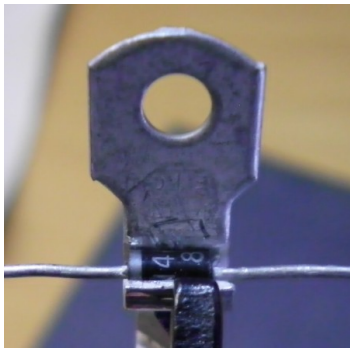
Using needle nose pliers or screwdrivers, open the wire crimp section of the ring terminal to make a u shaped space for the 1n4004 diode body to fit into the ring terminal.



The ring terminal should fit into the u shaped area formed by opening up the crimp area on the ring terminal. Before crimping down, apply a small amount of heat sink compound to the diode body.



Carefully close the u shaped opening around the diode, making sure band is on the left as shown in the picture above. Be careful not to crush the diode. Just in case, a spare diode and ring terminal are included in the kit.



Carefully bend the leads of the diode so that they will reach down to the board when the diode is attached to the heatsink. Be careful to keep the leads from shorting to the ring terminal.

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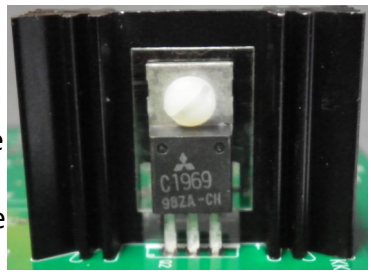
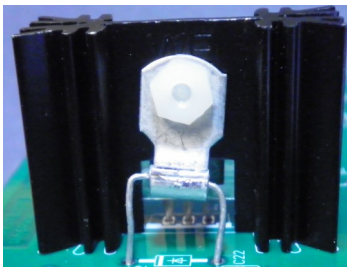
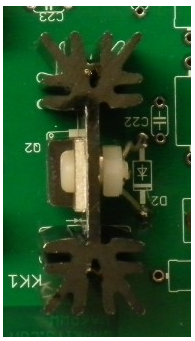
Insert their respective leads into the board and mount the ring terminal to the side of the heatsink closest to the diode drawing on the and Q2 to the opposite side using the same nylon screw and nut that hold Q2 to the other side of the heatsink.





A mica insulator is placed between Q2 and the heatsink to provide electrical isolation and a thin film of heat sink compound should be used on the tab of Q2 and the heatsink to provide good thermal contact.
When both parts are in place, tighten the screw to hold Q2 and the ring terminal holding diode D2 in contact with the heat sink. Once everything is in place and the screw is tight, solder the leads for the transistor and diode D2 to the board.



Toroids

□	1	T1	FT50-61 Toroids	14 Turns 4:1 Bifiliar on FT50-61
□	1	T2	FT50-61 Toroids	14Turns 4:1 Bifiliar on FT50-61
□	1	T3	FT50-61 Toroids	14 Turns 4:1 Bifiliar on FT50-61
□	1	L3	T50 Toroids	See Band Kit table for info
□	1	L4	T50 Toroid	See Band Kit table for info
□	5’	#22	RED Magnet Wire	Wire
□	3’	#22	GREEN Magnet Wire	Wire

T1, T2 and T3 are each wound with 14 turns of parallel red and green wire. This will produce a bifiliar transformer with 4 leads. At each end, there will be a red and a green pair of wires.

The wires should be stripped and tinned on the ends and then connected to the board by alternating the red and green wires in the board holes from one end to the other of the pads. This means that at one end if you start with the red wire, then the green it is paired with goes in the next board hole, then the red on the other end of the winding followed by the green it is paired with. This will maintain proper phase of the windings. Double check the orientation and then solder the wires to the board.

Note: When you finish the transformers, there will be extra wire remaining for the coils (L3, L4).

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Band Kits

Inventory	Installed	Part #	10M +12M	15M +17M	20M	30M	40M	80	160M
		C12, C19 or C20	TBD	TBD	150pF	180pF	270pF	TBD	TBD
		C14, C15, or C16			150pF	180pF	270pF		
		C13, C17 or C18			300pf	360pF =2x 180pF*	560pF		
		C28			22pF	27pF	22pF		
		C30			N/A	N/A	22pF		
		C29			51pf	33pF	51pF		
		C31			N/A	33pF	51pF		
		L3**	T50-6	T50-6	T50-2 11 turns	T50-2 14 turns	T50-2 16 turns	T50-2	T50-2
		L4**	T50-6	T50-6	T50-2 11 turns	T50-2 14 turns	T50-2 16 turns	T50-2	T50-2

Notes:
*In some cases, the capacitor value needed may require 2 or more smaller capacitors in parallel. Multiple positions are included on the board to accommodate capacitors in parallel.

**L3 and L4 are wound with the specified turns of #22 wire. Once wound, strip and tin the ends of the leads, then insert and solder them to the board.

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Resistive Attenuator Values

You will need to select a value of resistors that gives the desired attenuation level from the table below. You should select the attenuation level that gives in the range of approximately 100-300mW drive to the amplifier from your transmitter.
Note that the attenuator only affects the input power as it is bypassed on receive.

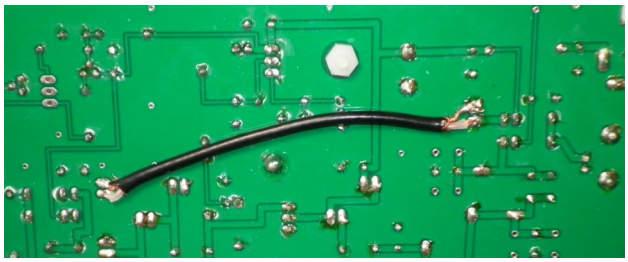
R6	R7	R8	Attenuation
300	18	300	3db
150	39	150	6db
100	75	100	10db

3db = 50% reduction: 1W in = 500mW to amplifier
6dB = 75% reduction: 1W in = 250mW to amplifier
10dB = 90% reduction: 1W in = 100mW to amplifier

These resistors for each of the 3 attenuation levels are included in kit

Final Assembly

To complete the amplifier board, install a section of coax cable between pads X3 and X5. Note the coax center goes to the upper pads when you are looking at the board from above and the shield goes to the lower pads. The pads not connected to a trace are ground (shield connection). This is recommended to be installed on the bottom of the board. This section serves to bypass the amplifier when receiving.



Setup and Testing

Once the amplifier is assembled, inspect all solder joints checking for good connections and especially, look for any solder bridges or whiskers that may short nearby pads.

When first connecting power, it is best to use a power supply with current control or if that is not available, use a 5A or less fuse in the power line to protect the circuitry in case of shorts.

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Setting Bias Current

In order for the amplifier to operate in a linear mode, bias current is applied to slightly turn on the final transistor. The bias current is set using the trim pot R2.
To set the bias, use a multimeter in current measurement mode, placed in series with the positive lead of the DC power. If you have a power supply with an internal current meter it may be used instead of the multimeter.

- Turn the 10 turn trim pot R2 fully counter clockwise. This may take several turns and there is no stop but you will hear it click as rotated when it as at the end of its range.
- Connect a dummy load or other 50 ohm load to the output
- Connect DC power to the amplifier.
- Key the amplifier using the key input on SV1 PIN 3. (connect Pin3 to ground to key)

The current should be close to zero, with only a few milliamps are drawn by the bias regulator and the TR relay.

- Note the current at this point. _____mA

- Adjust R@, the Bias pot, to increase the current drawn by the amplifier to be 100 milliamps greater than the initial current recorded above

Troubleshooting

If the Amplifier doesn't seem to be working follow the troubleshooting guide below to diagnose the problem.

1). Check that the parts are correctly installed

2). Check the soldering for missed, cold joints or shorts.

3). If the Amplifier keys when grounding pin 3 of SV1 but not from the RF input, check that C1 is the correct value for the band for which the amplifier is built.

4). Check that your exciter is outputting sufficient power to key the amplifier. IF using very low power exciters, use the keying control input on SV1 PIN3.

5). Check that you are operating on the correct band. The amplifier is single band. While it may operate on bands LOWER than the band it was built for, the harmonic content will be out of spec. It will NOT operate on a higher band that what it was built for.

6). If there is no receive signals, check that the coax jumper is installed on the back of the Amplifier PCB.

7) Check the power draw of the amplifier. Maximum should be less than 3A and typically approximately 1-2 Amps when keyed. If bias is too high, the measured current draw may exceed 2A. In this case, recheck the bias setting.

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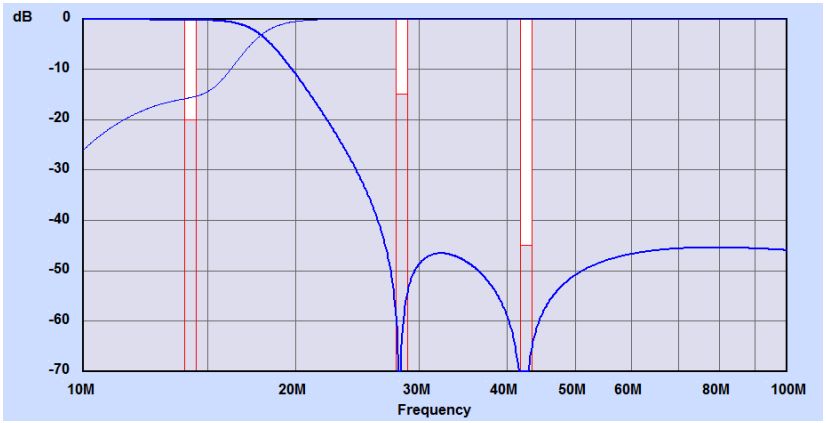
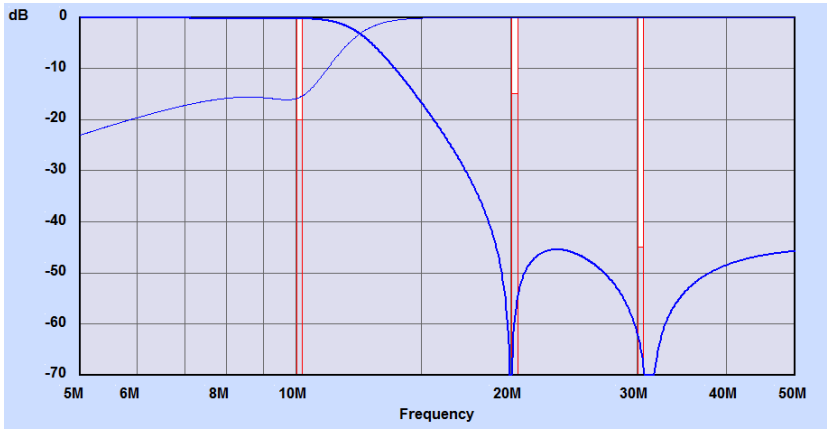
Low Pass Filter Response

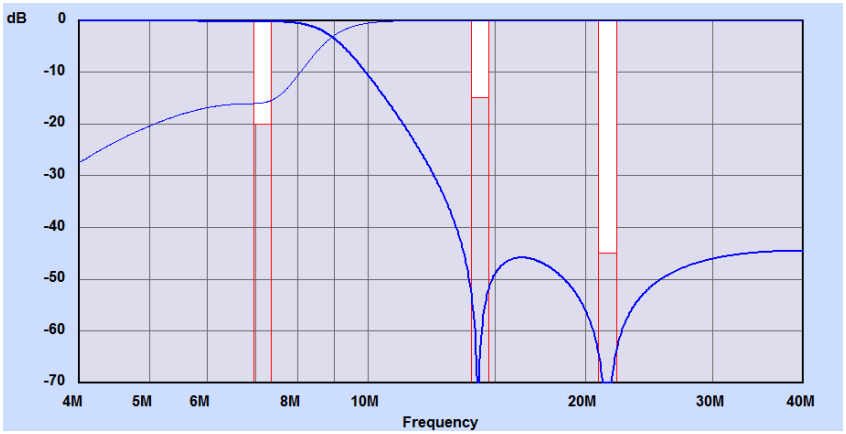
20M



30M



40M



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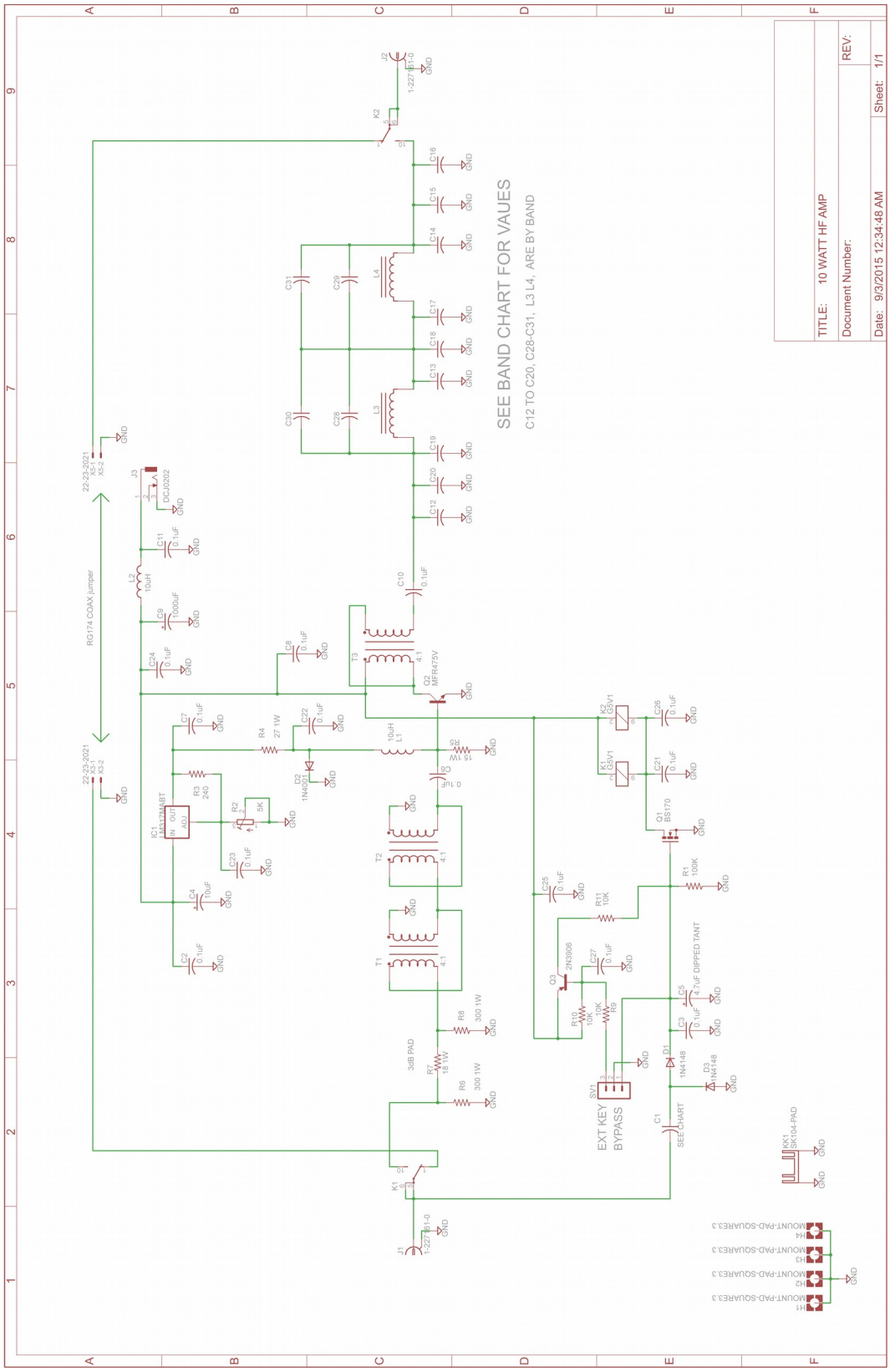
Schematic Diagram



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