DC Injector (Bias Tee)

kit

Technical Manual

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Unit Specifications

Model Ref DC Injector VHF DCI-VS

Serial No

Input Frequency	50 - 144	MHz
RF - DC isolation	>58 typ 75	dB from 50MHz, dB at 144MHz
Through loss	<0.2	dB 50 MHz to 432MHz
Forward RF Power	1000 750 <500	W @ 50MHz W @ 144MHz W @ 432MHz
Supply Voltage[1]	10 – 20	V
Supply Current[2]	1	A @ 13.8vdc

Notes

1 Higher voltages may be used, subject to the rating of the capacitors esp C8, and depending on remote equipment requirements.

2 Maximum permissible current determined by RFC windings. Check requirements of remote equipment.

Scope of Document

This document is intended to provide all necessary information to guide users in the construction and installation of the hupRF High Power RF DC Injector (or Bias Tee) in normal operation.

Units are supplied as kits, with N-type connector sockets. Installation of UHF (SO239) panel mounting sockets is possible as an alternative, but some modification of the PCB outline will be required, and is not covered in this manual. Only the N-type connectors will be supplied with the kits.

These Bias Tee's are primarily intended for use with the DG8 Masthead pre-amplifiers by GM3SEK, but are not covered by his original information. However, there may be useful information contained in GM3SEK's article at http://www.ifwtech.co.uk/g3sek/

Reference data can be found on the DCI pages of the hupRF web-site, including any identified issues or problems – http://huprf.com/huprf/bias-tee-dc-injector-for-vhf/

DCI Versions

There is a single version of the DCI DC Injector kit available, intended for VHF/UHF applications, and supplied with N type sockets as standard. It is not possible to fit 7/16 connectors, due to case size limitations.

The DCI version now supplied includes switching of the DC voltage according to the PTT line of the station, to give +ve DC on the coax centre on Receive, and 0V on Transmit. Thus any relays or other devices controlled by the Bias Tee must be operated on Rx and normal on Tx. Current PCB versions are marked as V2.01 – component ID's have been re-numbered in moving to this version, but the component functions and values remain as for V2.0 versions. The key difference is that the radial 10uF electrolytic capacitor (formerly C8 and now C14) has a location on the PCB.

The main use of this product is to enable a control voltage to be supplied to a masthead system via the coax cable, removing the need for other control cables to be run up the mast. Provided that only a single switching voltage is needed, this will meet all system requirements.

DC Injector Description

The DC Injector presents a low impedance RF path between the RF Input and Antenna sockets, and a low resistance DC path between the DC input and the Antenna socket. High voltage RF rated ceramic capacitors are used to isolate the DC from the RF Input socket, and an inductor is used to provide the RF rejection on the DC path. This is

further improved by appropriately rated ceramic decoupling capacitors and a ferrite bead choke on the DC side of the inductor.

Component values are given in Table 1. It is recommended that for 50 and 70MHz operation, the full 20 turns are used for RFC1, and further advantage may be gained by adding some larger value ceramic capacitors (up to 10nF) in locations C1 or C6 on the PCB. Values supplied are fine for 144MHz use.

The switching circuit uses a high current MOSFET switch (Q2) controlled from the PTT input via an inverter formed from Q1. The PTT input is a PCB mounting Phono socket, and a PCB mounted LED indicates when the +ve DC voltage is present – ie the system is in the Receive state.

The DC Injector may still be assembled as an un-switched version. To do this, omit all the parts of the switching circuit, and bridge across from the centre connection of the DC jack to the large pad of Q1. When drilling the rear case panel, drill only the centre hole for the DC jack.

A drilling template is supplied to assist with marking out the case ready for final assembly. Check the scale of your print-out before using it as a template!

DC Injector Assembly

1 Prepare the case. Using the template mark out and drill the two panels of the case.

2 With a small file adjust the gap in the PCB for each centre pin of the N type connectors – it is deliberately supplied undersize. The gap should be a good sliding fit over the pin when you have finished, with no free sideways movement.

3 Test assemble the PCB, case panel and N type connectors, to ensure that they fit together properly and align with the case. It is worth spending time at this stage to get a good fit. If adjustment is needed, make changes to the holes in the panel, as this will all be hidden once the unit is assembled. Do not enlarge the slots in the PCB. The connectors, panel and PCB should make a good 'dry' fit as in Fig 1.

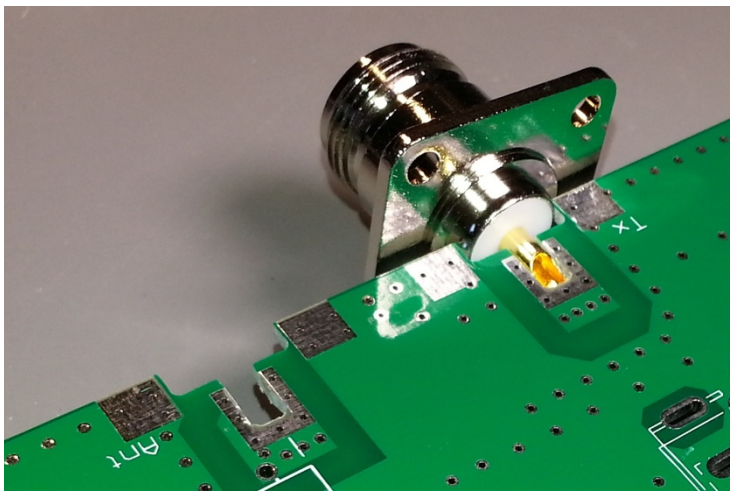
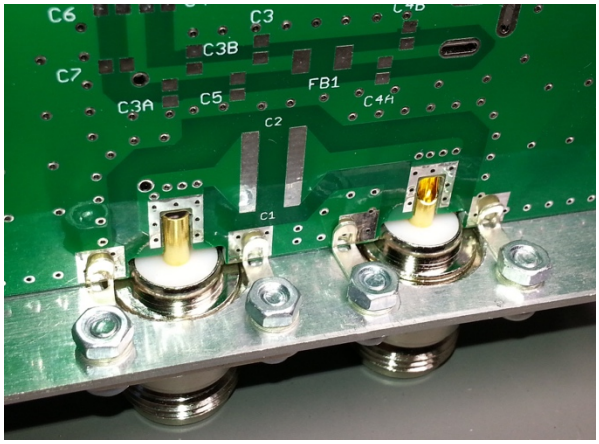


Fig 1 – slots filed to size in PCB

4 On final mounting of the N type connectors, make sure that the solder bucket part of the pin faces either the top or bottom of the case – not the side. This is to maximize the available contact area for the RF connection.



5 Prepare the eight solder tags by bending the last 4 to 5 mm at right angles to the body of the tag. On the back of each mounting bolt, now place a long solder tag, with the ends as shown in Fig 2, so that it can be soldered to the ground plane of the PCB - it is important to use all four tags on each connector to get a good low impedance ground path.

Fig 2 – N types, panel and PCB with solder tags

6 This is a good time to assemble the SMD components on the PCB – Fig 3. It is recommended that all the bypass capacitors are 1nF, apart from C3A and C3B which are 100nF (supplied). For lower frequency use, it may be advantageous to increase some values to 10nF. Do not fit the RFC inductor or the DC power socket at this stage.

Note that although R3 and R5 are the same value, they are different sizes – the larger 1206 size resistor must be installed as R5.

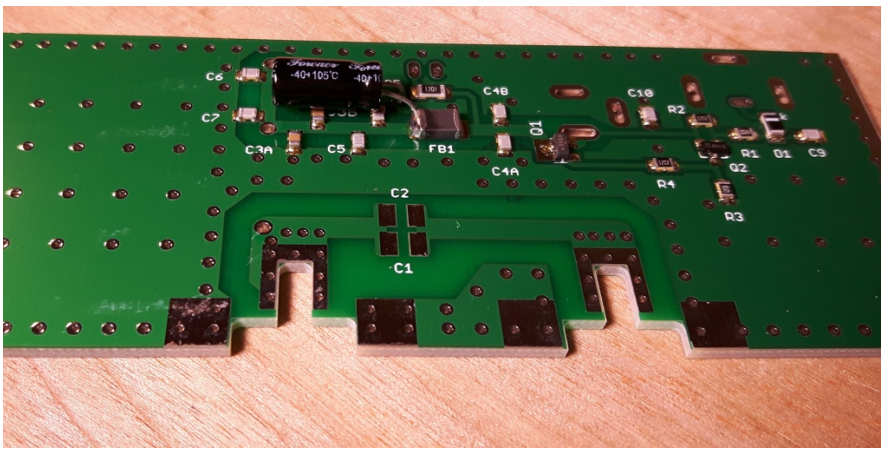


Fig 3 – SMD parts assembled on PCB

7 Place the PCB into the solder tags, as in Fig 2, so that the centre pins of the connectors sit neatly in the slots of the PCB. Offer the whole assembly into the case, to

make sure that the positioning is correct, and all solder tags will make good contact with the ground plane. Make any adjustments necessary to achieve this.

8 Once you are sure it is correct, solder the four ground tags on each side of the PCB. Check that the assembly fits the case, and the panel screw holes align correctly.

9 Now the centre pins of the connectors can be soldered. First, fill the solder bucket of each pin with solder. Use 5mm lengths of the supplied braid to bridge across the pin, ensuring that solder takes to the pin itself.

10 Lay a piece of braid across the PCB and pin, so that it forms a bridge between the two sides of the U in the PCB. Solder one side of the braid to the PCB, then solder the other end to the other side of the U. Finally solder the centre area to the pin. Repeat this with another piece of braid behind the first one, so that the pin of the N connector is completely soldered on the one side. Fig 4 shows the assembly sequence. Then do this for each connector on the other side of the PCB.

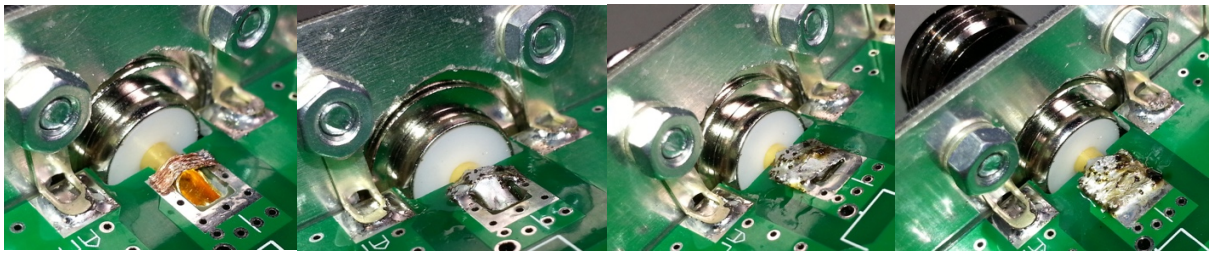
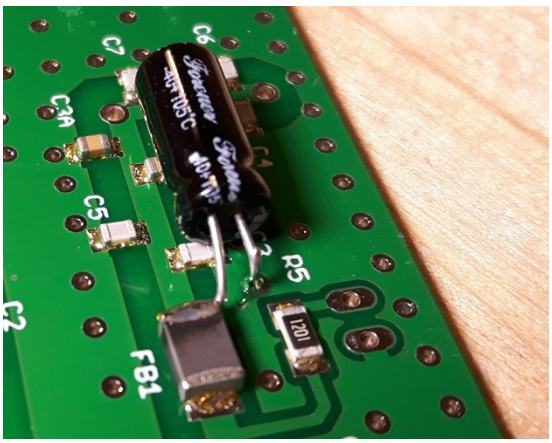


Fig 4 – sequence of soldering connector pin – must be done on both side of PCB

11 Wind the inductor as described in the parts list. Note that two sets of winding information are given. For 144MHz and 432MHz use, the shorter winding is adequate, but for use at 50MHz and 70MHz, the longer winding is recommended. Solder it in place, leaving a gap of between 1 and 2mm above the PCB surface.

12 Now fit the DC power socket, Phono socket and LED.



13 For older PCB versions, C8, the 10uF radial electrolytic, should be fitted between the 'hot' end of the Ferrite bead FB1, and ground - there is a convenient via close to R5. It can be laid flat on the underside of the PCB, as shown to left.

For later version PCB's mount this capacitor as C14, in the place shown on the PCB.

14 Check with a multi-meter that you have a very low resistance path from 'DC in' to the Antenna socket, and a very high insulation from Antenna to ground and from Antenna to RF sockets.

15 You can now slide the completed DC Injector into the case and hold it in place with the 8 fixing screws. The adhesive decal can be applied to the top of the case, and the adhesive feet can be put on the bottom - your DC Injector is now complete.

Change History

Date	Iss No	Comment	Author
14 Feb 2016	0.A	First Draft version	G4HUP
12 May 2016	1.0	First release version	G4HUP
5 Jun 2016	1.1	Web links updated	G4HUP
7 Jan 2017	2.0	DCI-VS Switched version update	G4HUP
2 Feb 2017	2.1	Update to V2.01 PCB details	G4HUP

End of text – Diagrams follow

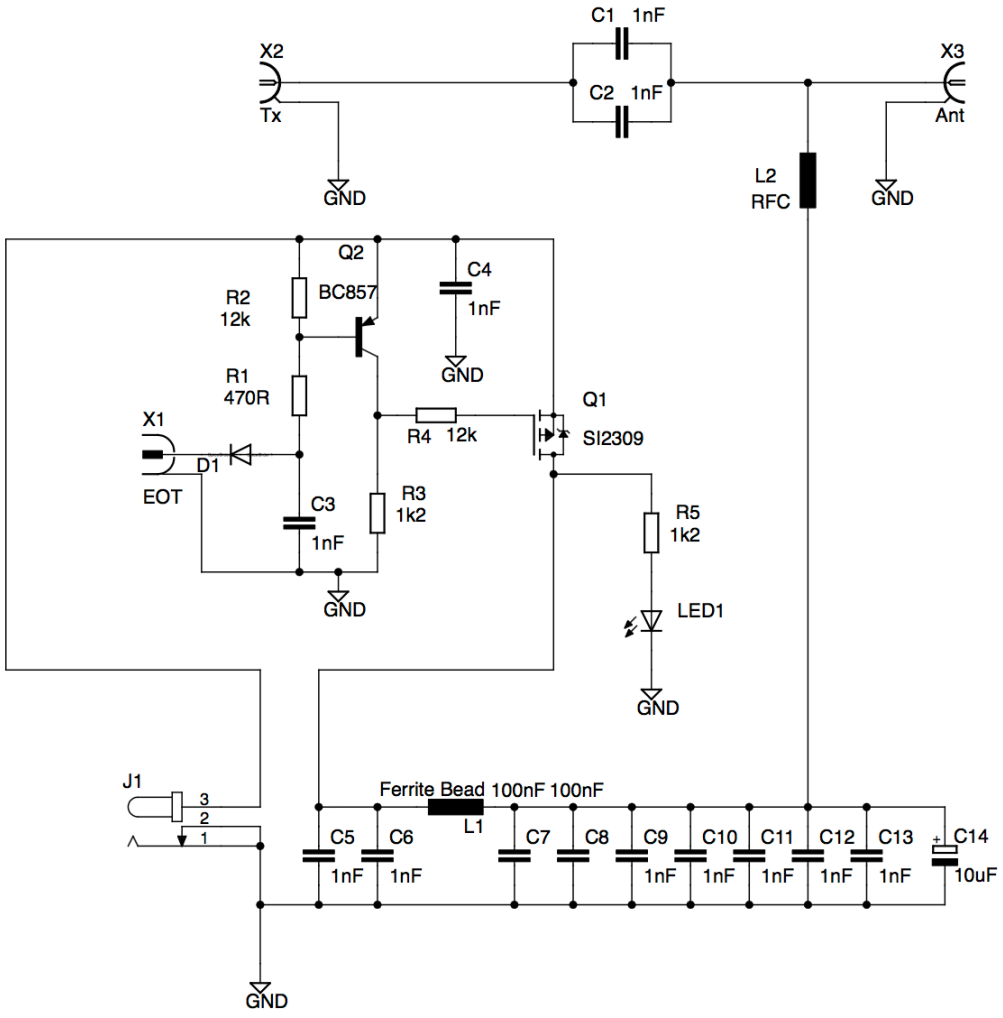


Fig 5 – Bias Tee Circuit Schematic

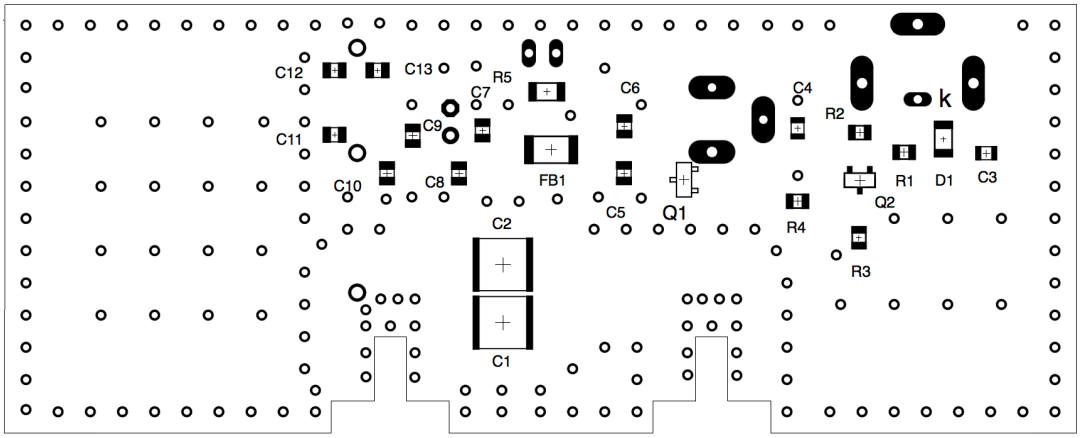


Fig 6 – Bias Tee Bottom Side PCB Layout

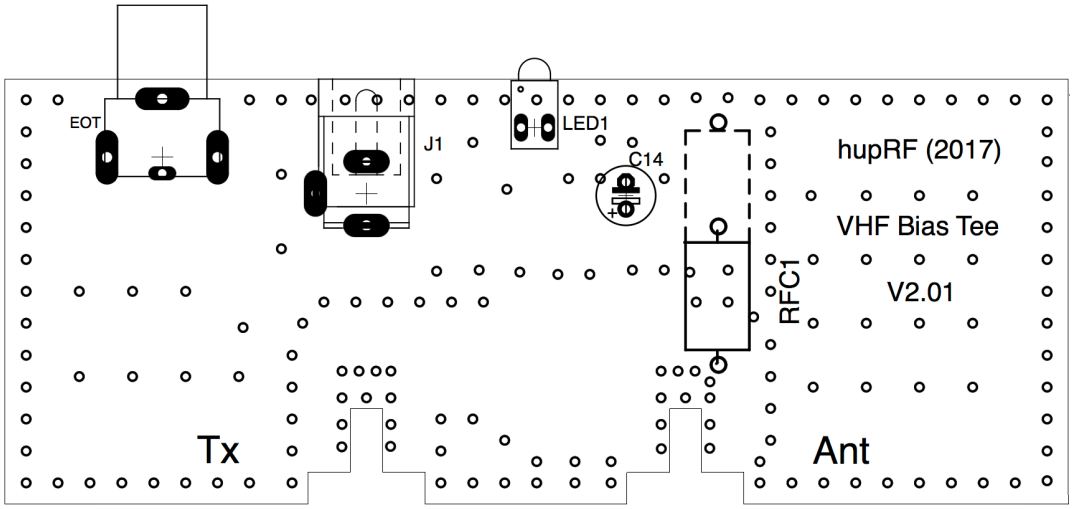


Fig 7 – Bias Tee Top Side PCB Layout

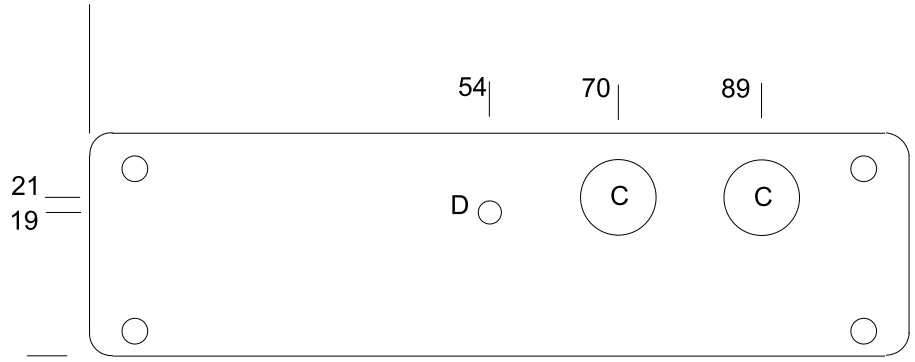
Note that C8 (C14) is not on initial PCBs – mount C8 below the assembled PCB

Component ID	Value	Detail		Comment
PCB	VHF Bias Tee	V2.0		
Tx	N Connector	Amphenol		
Ant	N Connector	Amphenol		
J1	2.1mm DC			PCB Mount
EOT	RCA Jack			PCB Mount
C1, 2	1nF 1kV	Mica	CDE	Hi Q
C7, 8	100nF 0805	Ceramic		
C3-6, C9-13	1nF 0805	COG		See text
C14	10uF 35V	Radial		
FB1	SMD Ferrite			
L2*	10t 5.5mm dia	1mm ecw		144MHz upwards
L2*	15-20t 5.5mm dia	1mm ecw		50/70MHz use
D1	TS4148	1206		
R1	470R	0805		
R2, 4	12k	0805		
R3	1k2	0805		
R5	1k2	**1206**		
Q1	SI2309			
Q2	BC857			
LED1	Green	3mm		R/A PCB mount
Bolts	M3x6mm	posidrive	X8	
Nuts	M3 full nut		X8	
Solder Tag	Long tag		X8	
Copper braid			5cm	
Lead	2.1mm plug	DC power lead	Note:	**White stripe is +ve!!**
Case	extruded			
Panels			X2	
Decal			X1	

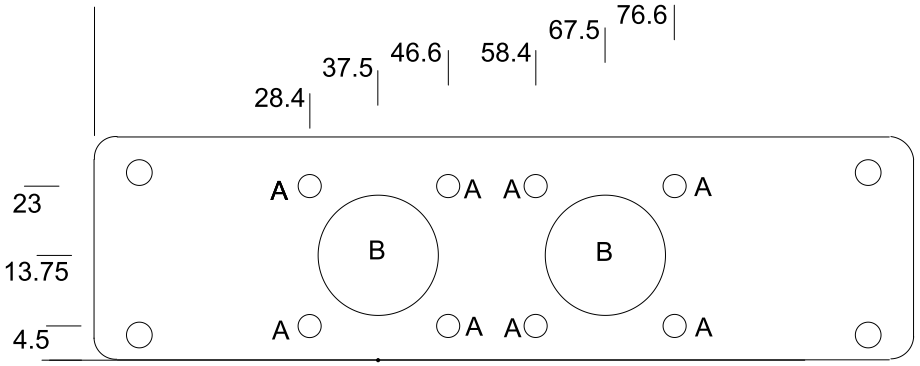
Table 1 – Parts list numbering for V2.01 PCB

*Note that L2 is marked as RFC1 on the PCB legend

This line to be 50mm long when printed



Rear panel



Front panel

Caution!! blank panel is NOT symmetrical
- ensure screw holes are offset as shown

all dimensions in mm
hole A - 3.5mm dia
hole B - 16mm dia
hole C - 10mm dia
hole D - 3mm dia

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