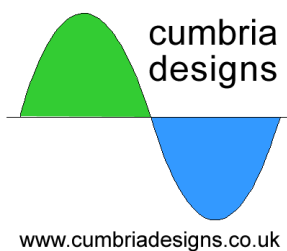


Cumbria Designs T-1
SSB/CW Filter kit (4.9152MHz)
User Manual

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1 Introduction

This document describes the assembly and installation method of the T-1 SSB/CW filter kit. Please refer to the T-1 User Manual for general information regarding component identification, placement and soldering technique.

2 Circuit Description

The T-1 Filter kit comprises of two filter assemblies; the dual filter board and the tail end filter board. Each board is designed to be plugged onto headers on the T-1 main board allowing different filter or IF schemes to be easily implemented by the user. The filter crystals supplied with this kit have been matched to within +/-10Hz to provide reproducible filter performance results. Three crystals have been marked with self adhesive paper "spots". These crystals are for use with the T-1 carrier oscillators and should not be used in the filters.

2.1 Dual Filter Board

The Dual Filter board accommodates two 6 pole ladder filters each of which is selectable by diode switching under control of the T-1 Control interface. The filter components supplied in this kit provide two filters, a Cohn SSB filter approximately 2.5kHz bandwidth and a Butterworth CW filter of approximately 480Hz bandwidth. Each of these filters defines the IF bandwidth of the T-1. The filters are matched to the 50 Ohm impedance of

the T-1 filter ports by ferrite transformers. The transformers also form part of the diode switches used to select either filter. To offer good IMD performance PIN diodes are used on the wideband port (mixer side) of the filters whereas fast switching diodes are used on the IF side of the filters. **The Dual Filter PCB has been designed to allow different types of filter to be used, for the filters described in this kit, some of the capacitor positions are not used or a fitted with shorting links. Please follow the assembly instructions carefully.**

2.2 Tail End Filter

The wideband IF of the T-1 is designed to be low noise, however due to the gain of the IF stages the noise component of the IF is noticeable particularly during weak signal reception. A simple two pole "Tail End" filter greatly reduces the demodulated noise level by attenuating the unwanted sideband immediately before the IF signal is presented to the demodulator. This filter has a nominal bandwidth of about 2.5kHz.

3 Assembly

The following assembly sequence is recommended.

3.1 Dual Filter Board

3.1.1 Crystals

Carefully fit and solder each of the filter crystals into the positions marked on the PCB. Exposed pads have been provided on the top side of the PCB to allow the crystal cans to be soldered to ground. This reduces the effect of stray capacitance on the filter performance. Take great care when soldering the cans not to overheat the crystals. An alternative grounding technique which will probably place less stress on the crystals is to use short lengths of tinned wire to connect the pad to the top of the crystal can.

3.1.2 Decoupling Capacitors

Insert leads into PCB such that the capacitor body is flush with the board surface. Bend the leads outwards slightly to hold the capacitor in place during soldering. Trim off excess leads.

3.1.3 Resistors

All resistors are mounted horizontally. Insert leads into the board and ensure that resistor body is flush with PCB. Solder and trim off excess leads.

3.1.4 Filter Capacitors

- a.) SSB Filter (Position A)



All of the filter capacitors are 39pF. **Note the positions!!**

- b.) CW Filter (Position B)



Capacitor values vary with position in filter circuit. **Take care to match value to silk screen marking on PCB!**

3.1.5 Diodes

- a.) PIN Diodes



Fit the two PIN diodes (clear glass body) in positions D1 and D2. Note orientation, cathode (band) goes towards centre.

- b.) Switching Diodes

Fit the two BAV21 switching diodes in positions D3 and D4. Note orientation, cathode (band) goes towards centre.

3.1.6 Links

Use discarded component leads to make links for positions C1, C2, C8 and C9.

3.1.7 Transformers



Wind matching transformers for each filter as described in the table below. Be sure to observe the correct orientation when installing!

	Primary (50 Ohm Port)	Secondary (Filter side)
T1, T2	5 turns	16 turns
T3, T4	4 turns	16 turns

3.2 Tail End Filter

The Tail End filter board is very simple to assemble.

3.2.1 Crystals

Fit the two crystals in the positions marked on the PCB in the same manner as described in 3.1.1

3.2.2 Capacitor

Fit the single 33pF filter capacitor in position C1.

3.2.3 Resistor

Fit R1 in the marked position ensuring that the body is flush with the PCB surface.

R1 1K Brown, Black, Black, Brown, (BROWN)

3.3 Connectors



To ensure alignment, the filter boards are mounted onto the T-1 main board before soldering.

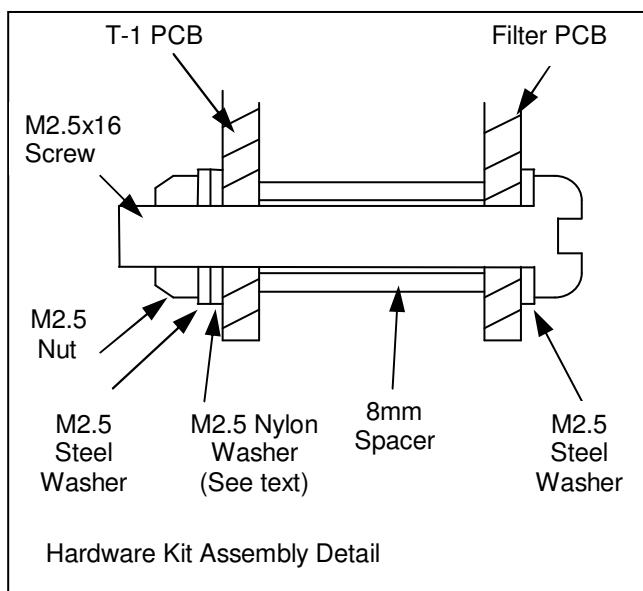
3.3.1 Main Filter Board Connectors

With a fine bladed sharp modelling knife, cut the SIL socket and pin strips to make a four way pin and socket for JP1 and a two way pin and socket for JP2.

3.3.2 Tail End Filter Board Connector

Cut the SIL socket and pin strips to make a 4 way pin and socket for PL1

Insert the broad ends of the pin strips into filter connector positions on the T-1 main board and carefully push the matching socket strip onto the thin ends of the pin strips. Using the hardware pack supplied, mount each filter board onto the T-1 main board. The assembly order for each mounting point is shown in the diagram. Some of the mounting holes are close to live pads on the main PCB in the areas the post mixer amplifier and the IF stage diode chain. 6 nylon washers are supplied to be applied where isolation is required. The filter



board ground connections are already made via the connectors. The boards should sit square with the sandwiched pin and socket connectors pushed fully home. Check alignment of the connectors and solder into place on the top side of the filter board and the underside of the main T-1 board.

4 Testing

Perform the initial testing of the T-1 described in the user manual. It should be possible to switch filters by taking the Filter A and Filter B controls on the T-1 interface high. Doing this forward biases the respective diodes connecting the associated filter into the signal path.

4.1 Filter Shape and Passband

Both filters should display bandwidths close to the design values of 2.5kHz (Filter A) and 450Hz (Filter B). A characteristic of the ladder filter is that it has a slight asymmetry of the passband with the steepest skirt being on the HF side. This implies that LSB operation provides the best unwanted sideband performance, this asymmetry may be noticeable as a slight difference in the “sound” of the receive

noise spectrum when switching between LSB and USB. However, with 6 crystals the asymmetry whilst noticeable is not too marked and good performance on both LSB and USB should be seen.

The filters may be fine tune by padding out the capacitor values with small value capacitors. Also the termination resistance will affect the filter response. Generally, reducing the termination impedance or increasing the capacitor values reduces bandwidth, increasing the termination impedance and reducing capacitor values increases bandwidth. There are a number of excellent resources on the internet and articles in ARRL and RSGB publications describing crystal filter design. The T-1 provides an excellent test bed for experimentation.

4.2 Troubleshooting

4.2.1 Filter Selection Doesn't Work

- Check that the filter selection voltage on the T-1 interface is greater than 2V.
- Check that the DC switch on the T-1 board associated with

the filter is switching on +12V to the filter board select pin.

- Check that the diodes are biased on – is the orientation correct?
- Check that there is a complete circuit from the select pin, through the diode switch to ground for the control current.

4.2.2 Filter Response is Wrong

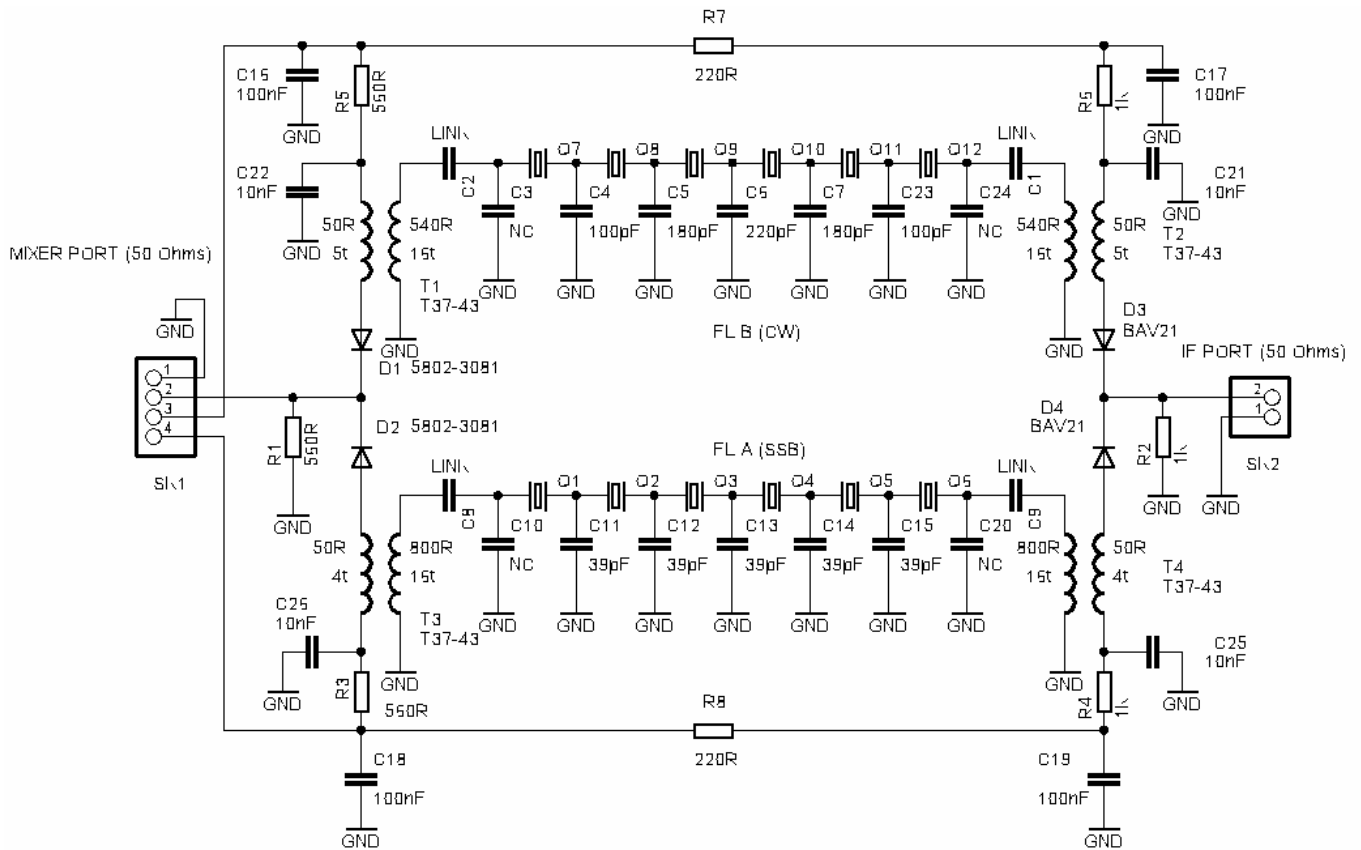
- Have you adjusted carrier oscillators for optimum USB/LSB operation?
- Check that the impedance matching transformers are correctly wound and installed the right way round.
- Check the capacitor values and the positions, remember not all of the available positions are used for the filters described.

4.2.3 H E L P!

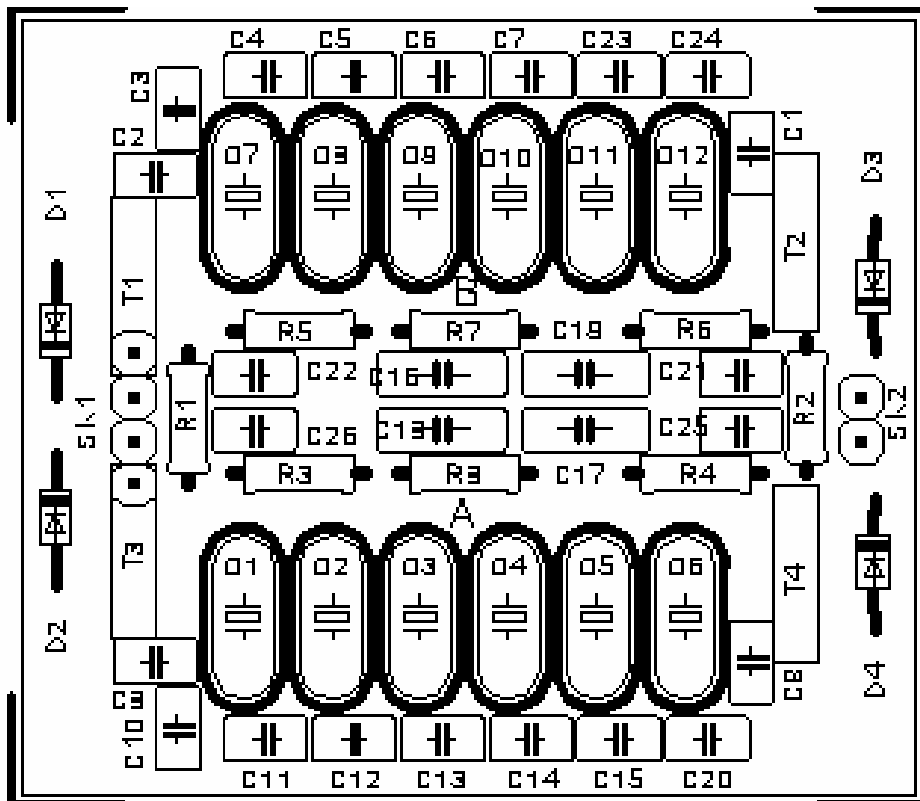
Still have a problem that you can't resolve? Don't worry contact us by letter or email at support@cumbriadesigns.co.uk for assistance.

Appendix A

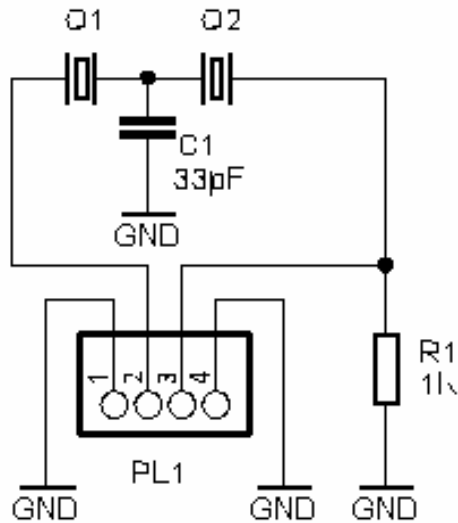
T1-2FL v1.0 Schematic



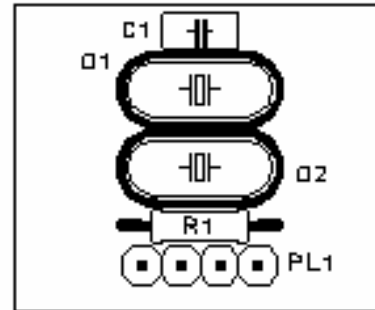
T1-2FL v1.0 Component Overlay



T-1 FL2 Schematic



T-1 FL2 Component Overlay



Appendix B

PARTS LIST

Main Filter T-1 2FL v1.0 PCB

Crystals

HC49U	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12
HC49U	Carrier Crystals X1, X2, X3 (Identified by spot)

Resistors

220R	R7, R8
560R	R1, R3, R5
1K	R2, R4, R6

Capacitors

39pF	C11, C12, C13, C14, C15
100pF	C4, C23
180pF	C5, C7
220pF	C6
10nF	C21, C22, C25, C26
100nF	C16, C17, C18, C19

Semiconductors

5802-3081	D1, D2	Pin Diodes
BAV21	D3, D4	Si Diodes

Inductors

T37-43 T1, T2, T3, T4

Tail End Filter Board T1-FL2 v1.0

Crystals

HC49U-V Q1, Q2

Resistor

1K R1

Capacitor

33pF C1

Hardware

Pin Strip and Socket Strip to make;

1	Socket Strip	1X2	SK2
1	Socket Strip	1X4	SK1
1	Pin Strip	1x2	for T-1
1	Pin Strip	1x4	for T-1
1	Socket Strip	1x4	PL1
1	Pin Strip	1x4	for T-1

0.315mm Copper Wire for Inductors
T-1 2FL PCB v1.0
T-1 FL2 PCB v1.0

Fixing Kit

6	M2.5 Screws
6	M2.5 Nuts
12	M2.5 Washers
6	8mm Nylon Spacers
6	Nylon Washers

NOTES