An iso-frequency converter for the BC669A transceiver

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The BC669 is a good AM transceiver, but it operates only on six crystal-controlled frequencies. However, the receiver can operate also in VFO mode with a local oscillator whose frequency is 385 kHz (the IF) higher than the operating frequency. Unfortunately, the transmitter is ‘rock-bound’. The idea behind this project was to generate the transmitter frequency by subtracting 385 kHz from the receiver LO frequency and so provide true transceive operation. The author uses his BC669-C only on AM between 3600 and 3800 kHz, so the frequency converter to be described here works only in this band. Whereas this project is aimed at the BC669, the principle is applicable to other equipment where it is desired to link a transmitter and receiver in a transceiver configuration, and the unit can easily be adapted for other receive IF.

Figure 1. The author’s BC669-C transceiver

The BC669 is a crystal-controlled AM transceiver in the range 1.68–4.45 MHz with a rated output of 45 W from a pair of 807. It is housed in a two-section steel cabinet with the RF sections of the receiver and transmitter in the top unit and the modulator and receiver audio output stage below. It was designed to operate either as a field station or from a vehicle providing RT and CW communications for US antiaircraft brigades and regiments. The circuit diagram is shown in **Figure 3 [1].**

V10 and associated circuitry are the transmitter oscillator. The operating frequency is controlled by the crystals that are selected by switches S3.5 and S3.6. The receiver LO frequency is generated using V3 and this signal is available on the cathode of V3. We can withdraw a sample of this signal, convert it to the transmit frequency by subtracting the IF (385 kHz) and, after filtering and amplification, we can drive the control grid of V10 (the V10 now is working as an amplifier) in order to operate the transmitter at the same frequency as the receiver.

The circuit diagram of the converter is shown in **Figure 4.**

The 385 kHz signal is generated by the Hartley oscillator Q3 and passes to U1 mixer IF port. The LO signal is withdrawn from local oscillator valve cathode (V3, 6J5) through a 10 kΩ resistor and it is sent to U1 LO port by the emitter follower Q1. The RF voltage on the cathode is 30–40 Vpp and about –10 dBm at the LO port. The double-pole bandpass filter composed of L1, C7, C5, C8, L2 rejects all frequencies outside the band 3600–3800 kHz (**Figure 2**).

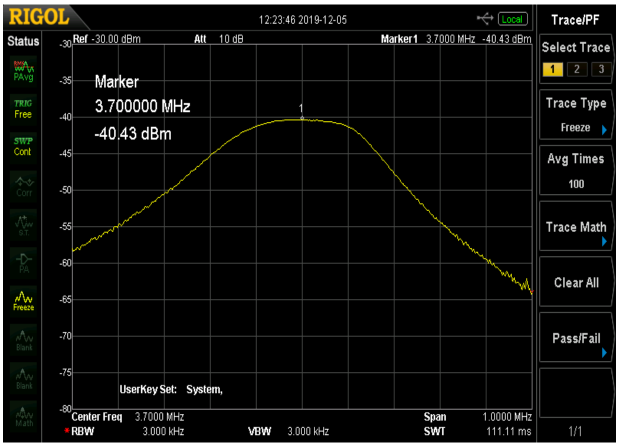

Figure 2. Bandpass characteristics of the filter

Transistor Q2 amplifies this signal to 10–20 Vpp in order to drive the grid of the 6L6 (V10) which becomes the driver for the pair of 807 because the crystals are no longer in place and the common pin of switch S3-6 is connected to the 6L6 grid. The 6L6 anode is connected to the common pin of switch S3-5 and coil L4 (21 µH) tunes the anode to the centre frequency of the band (3700 kHz).

Q4 provides the bias to oscillator Q3 only in transmit condition (PTT relays RY1 activated). If the circuit pin 1 is grounded, the oscillator is ON also when on receive and the circuit acts as an RF BFO that allows for demodulation of SSB signals and netting on AM.

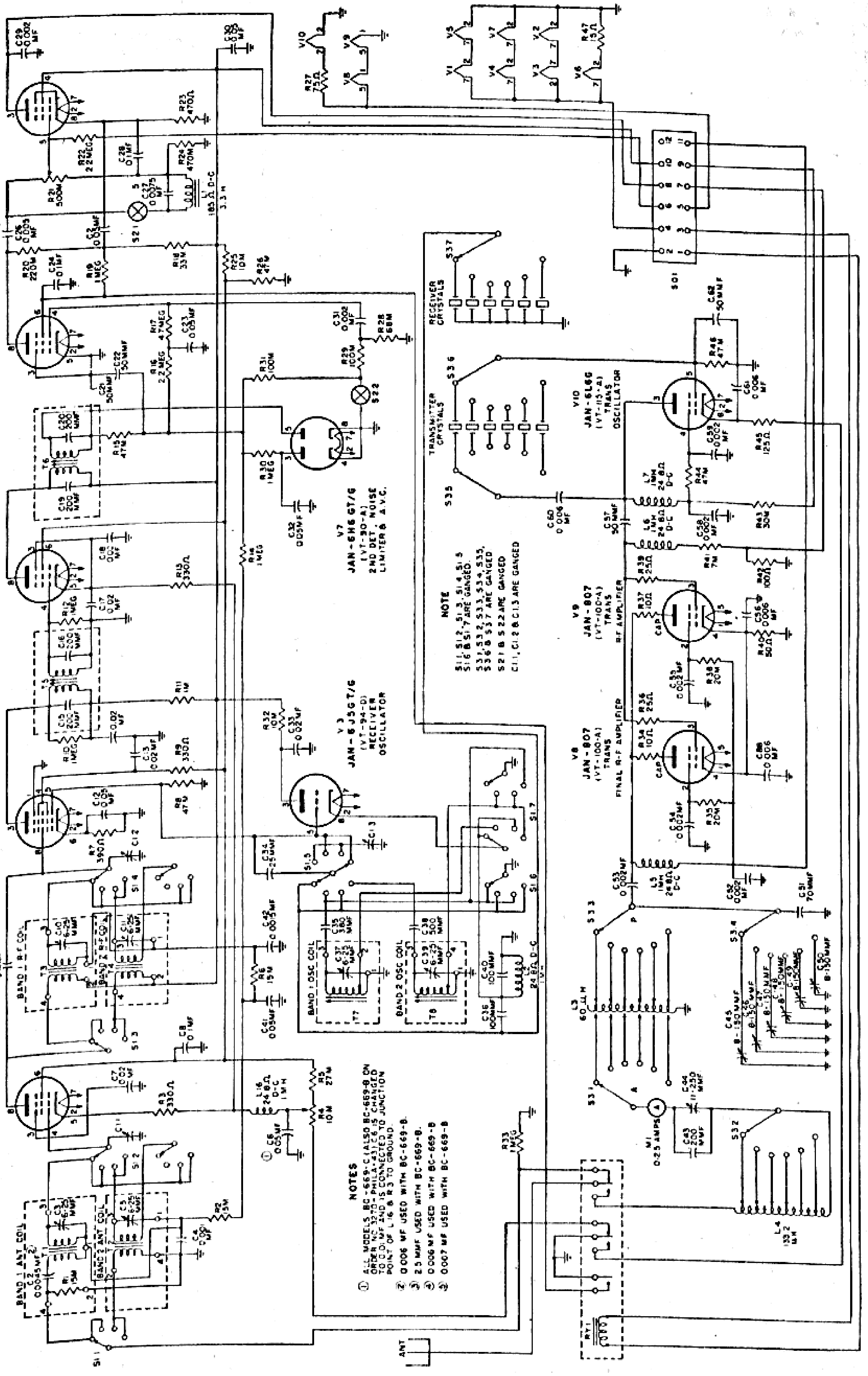

Figure 3. Circuit diagram of the BC669 in its original form

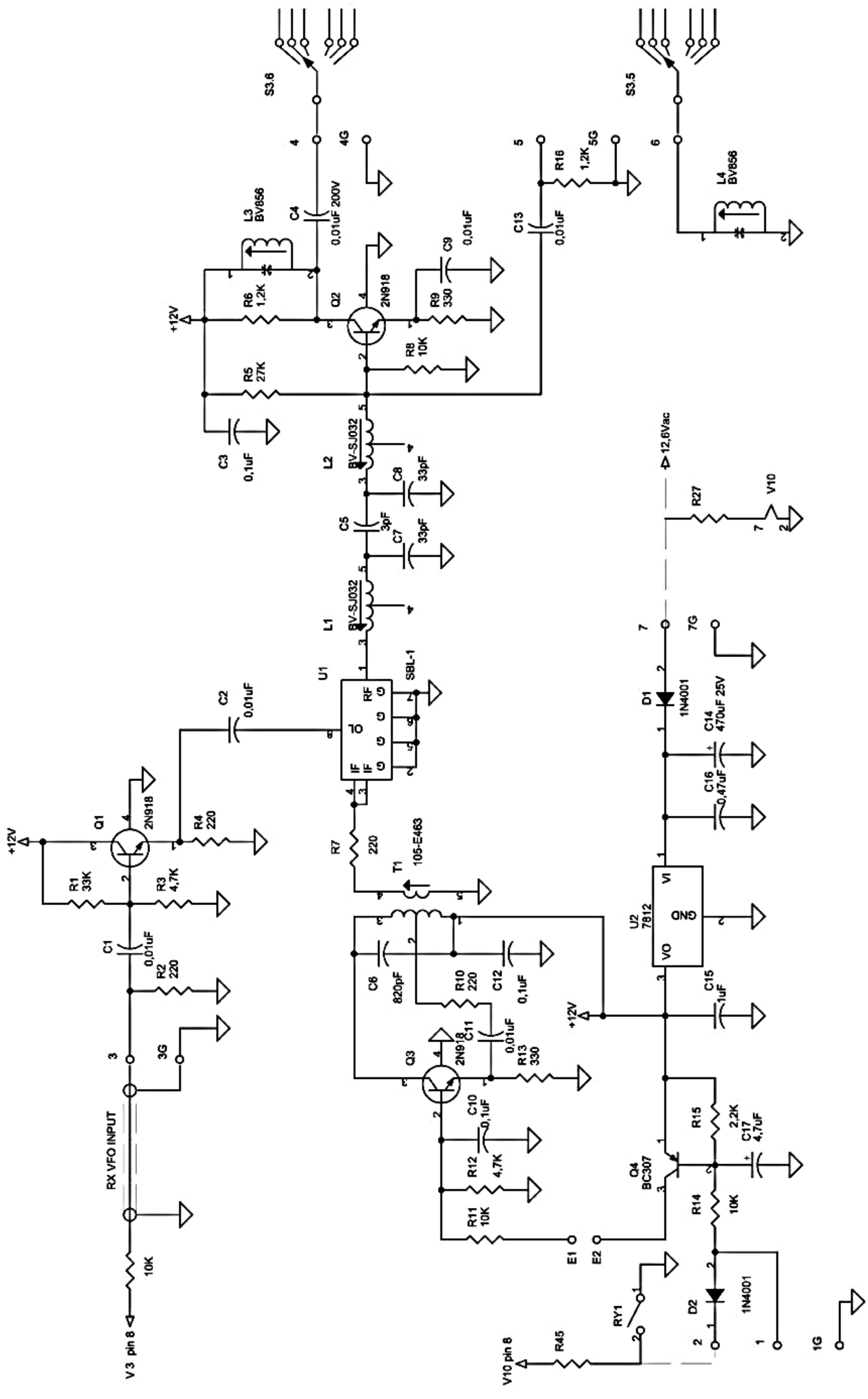

Figure 4. Circuit diagram of the frequency converter

Power is supplied from the 12.6 VAC heater supply that is rectified and stabilised at 12 VDC. The total current requirement is about 30 mA.

In principle, it is possible to build a converter that could operate across the whole frequency range of the BC669 (i.e. allowing transceiver operation on both Top Band and 80 m) but that would require a more complex circuit.

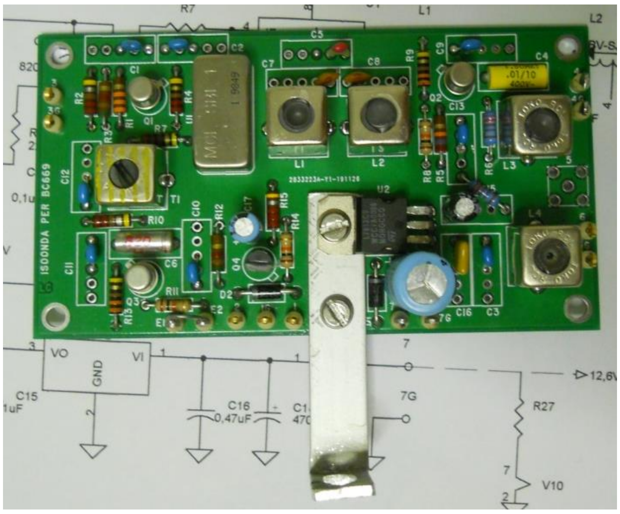

Figure 5. The finished converter PCB

The finished converter PCB is shown in **Figure 5** and the track layout in **Figure 6**.

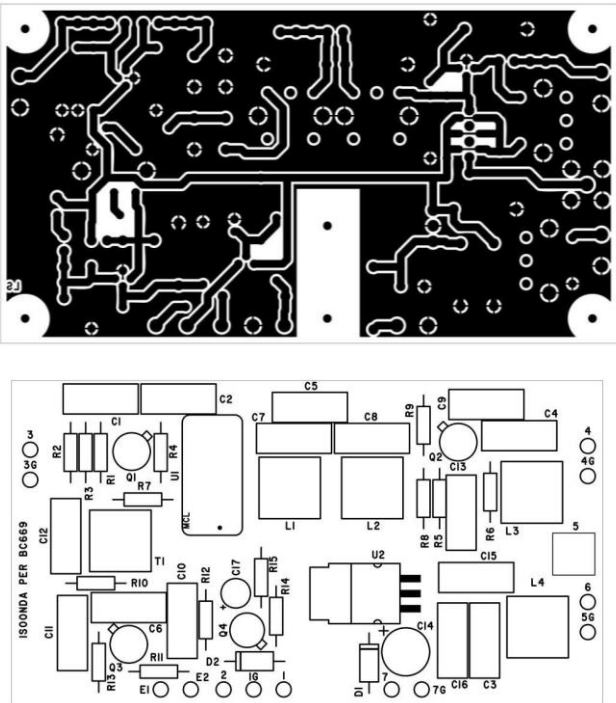

Figure 6. PCB track pattern and layout

The PCB is a two-layer epoxy copper-clad board, 55 mm x 100 mm. The top layer is a ground plane.

All resistors are rated ¼ W. All capacitors are rated at 25 V minimum except C4 which is rated at 200 V.

Capacitors C5, C6, C7 and C8 must have high stability with respect to temperature.

The transformer winding information and the values of inductors are (minimum to maximum inductance):

L1 and L2: 32–45µH
L3 and L4: 14–27µH

Transformer T1:

Pins 1–3	185–390 µH
Pins 1–2	14–26 µH
Pins 2–3	102–215 µH
Pins 4–5	4–8µH

T1 was actually a Sumida coil marked 105 E463 obtained at a flea market; together with C6, this transformer determines the 385 kHz oscillator frequency and, in the absence of the original component, should be wound by trial and error.

Transistor Q4 could be replaced with any 15-volt low power PNP transistor.

Installation of this circuit in the BC669 does not require any modification to the transceiver but just five wire connections to the points that are indicated on the drawing (**Figure 4**). The author's approach was to fix the printed circuit board under one of the transmit crystals locking screws as shown in **Figure 7**.

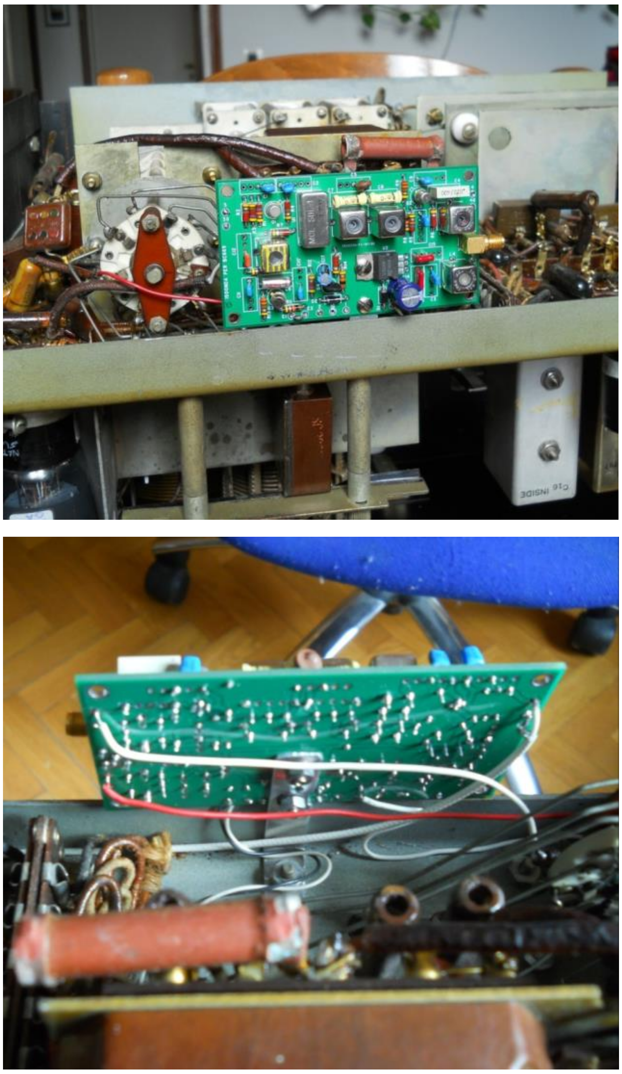

Figure 7. The PCB is secured to one of the transmit crystals locking screws, viewed from both sides

Alignment procedure:

1. Set L4 to 21 µH.
2. Connect terminal 2 to ground.
3. Supply 12.6 VAC or 15–17 VDC to terminals 7 and 7G, and check for 12 VDC at the output of U2.
4. Tune T1 for 385 kHz oscillator frequency.
5. Connect a 50 pF capacitor between terminals 4 and 4G. Connect a ‘sweeper’ or a tracking spectrum analyser to U1, pin 1, and inject a signal centred on 3700 kHz, span 1000 kHz level –20 dBm, 50 Ω impedance. Monitor the output at terminals 4 and 4G with a high impedance probe and adjust L1, L2 and L3 to tune the filter.
6. Check the RF output voltage: it must be 10 Vpp minimum.
7. Disconnect the spectrum analyser and inject a CW signal, power –10 dBm and frequency between 3985 and 4185 kHz into terminals 3 and 3G, and check the RF output voltage which must be 10 Vpp minimum in the range of frequencies.

That’s all: install the converter on the BC669.

Figures 7–11 show where the converter needs to be connected to the BC669 transceiver. The numbers in brackets refer to the connection points on the converter PCB.

Figure 8. Connecting the 12.6 VAC supply

12.6 VAC (7 and 7G): The white wire is connected to R27, the grey one to the ground (**Figure 8**).

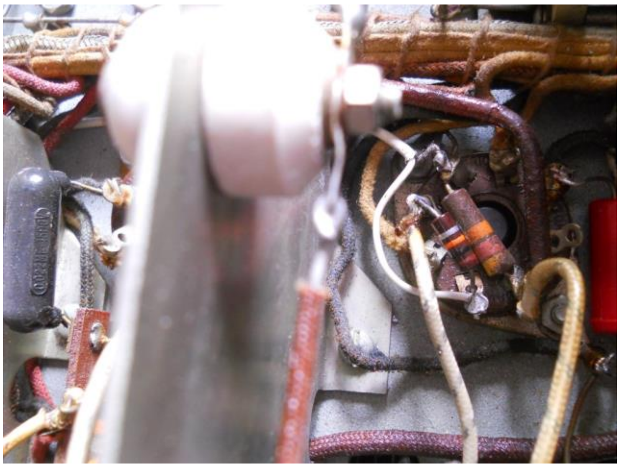

Figure 9. 10 kΩ resistor soldered across V3

LO sampling (3 and 3G). A 10 kΩ resistor is soldered between pin 8 (cathode) and pin 6 of V3. Pin 6 is used simply as a support because there is no internal connection in V3 to that pin. The screen of the coaxial cable is grounded at pin 1 of V3 (**Figure 9**).

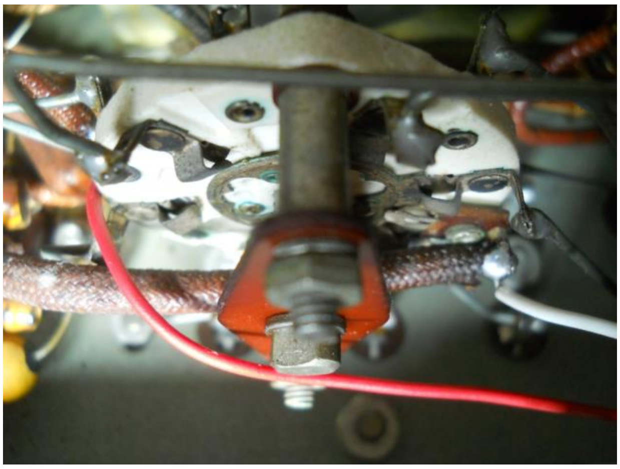

Figure10. Connections to S3.5 and S3.6

Connecting the switches. (4) The white wire connects to S3.6 common pin; (6) the red wire connects to S3.5 common pin (**Figure10**).

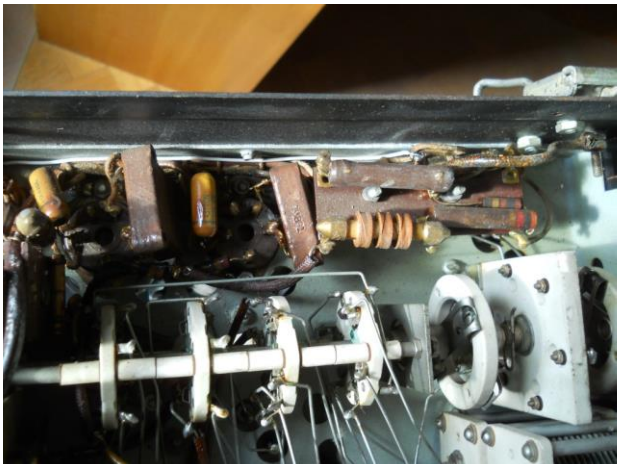

Figure11. PTT connection

PTT connection (2). The white wire that runs along the chassis side is connected to R45 (**Figure 11**).

Following installation, the BC669 transmit frequency was preset to 3625, 3675, 3725 and 3775 kHz using channels 2,3,4 and 5 in order to cover the bandwidth from 3600 to 3800 kHz in four 50 kHz sections. Hence, when there is a change in frequency, one only needs to adjust the antenna tuning capacitor.

The author has had several QSOs using the equipment in this transceive configuration and has always received favourable reports and the arrangement is easy to use.

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