

# IMPROVING POWER OUTPUT OF THE IC-22

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Perhaps the most popular two metre FM transceiver in Australia at present is the ICOM IC-22, one of the products of the burgeoning Japanese amateur communications manufacturing industry. Undoubtedly it enjoys this popularity owing to its price firstly, and secondly to its features. By reputation, if not largely in fact, it has perhaps the "hottest" receiver of similar transceivers intended for 2m FM mobile operation.

The RF power output of these transceivers is nominally 10W. Most units will probably produce close to this when first purchased. However, it appears from experience, that the RF power output deteriorates with use, some dropping below 6W. The reason for this is not fully understood, but suffice to say that the phenomena exists and is certainly measurable.

Now, this situation is not all that disastrous in itself as it is only in the order of 2-3 dB, but it isn't entirely welcome either as the IC-22 is intended as a mobile transceiver where every dB counts. The capture ratio of most modern FM receivers on the amateur market is around 2 dB.

Another problem arises when a 'booster amplifier' (often incorrectly referred to as a 'linear') is added, such as those kits that have become recently available as well as commercially made units. These devices produce about 35-45 W output from a nominal 10 W drive and are simply inserted in the coax between the antenna and the transceiver antenna socket.

## SWITCHING

Automatic Tx/Rx switching using either diodes or carrier-sensed relays is employed. If the drive is not up to the nominally required amount, considerably less than specified power output is obtained and the full gain of the device is often not realised. Gnashing of teeth, cursing the kit designers, tearing of hair and cries of "why doesn't anything work for me!!!"

In the course of some development work on solid-state VHF power amplifiers, the IC-22 belonging to Phil VK2ZZQ was pressed into service as a driving source. Over a period of months the power output dropped from around 9 W or so to under 6 W when the unit was running from a

nominal 13V supply. A number of enquiries and measurements confirmed the effect, many units delivering only 6 W to 7 W. Accordingly, a replacement for the P.A. transistor was sought out.

The transistor settled on was the CTC B12-12. The gain of this device appeared to be more than adequate for the job and a power output of between 11 W and 15 W from a nominal 12.5V supply was expected. In addition, the device is rated to withstand infinite VSWR, at all phase angles, from a 16V supply.

However, the input and output impedances of the existing P.A. transistor in the IC-22 were not known. A little bit of the old amateur 'suck it and see' (otherwise known as eclectic empiricism — see reference 1) was obviously going to be necessary.

Some modification of the L-G matching networks was anticipated.

Accordingly, a B12-12 was installed in place of the original P.A. transistor. With due ceremony the power output was checked to ascertain what tuning up might be necessary. Power output measured at just on 12 W from a nominal 13V supply (reference 2). Adjustment of the stage input and output trimmer capacitors could not improve on this! Bandwidth is excellent, there being less than 0.5 W variation between 146 MHz and 147 MHz.

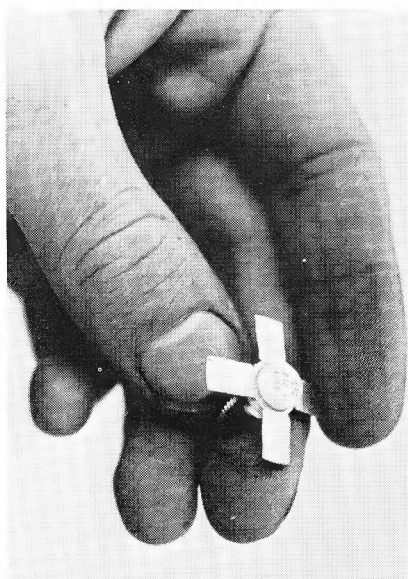


FIG. 1. THE B12-12 RF POWER TRANSISTOR

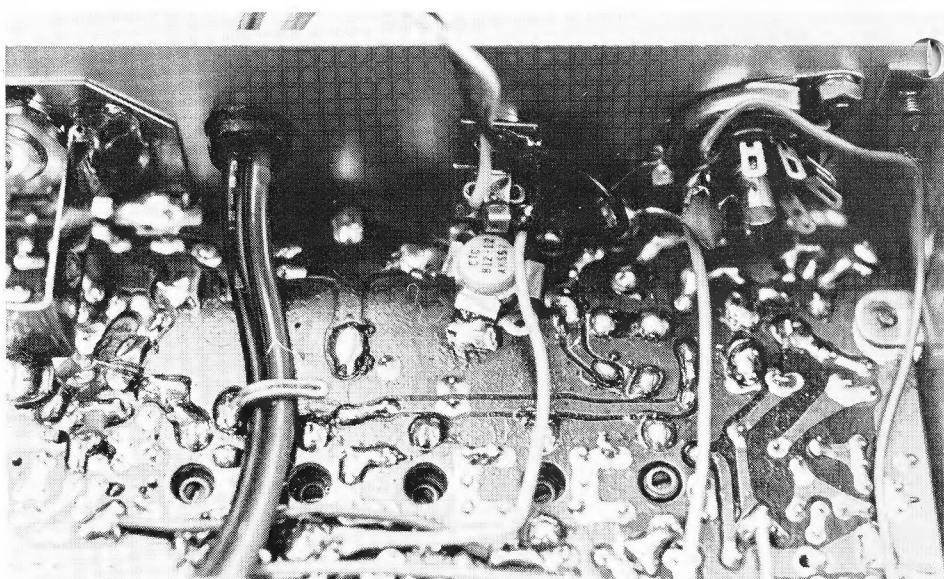
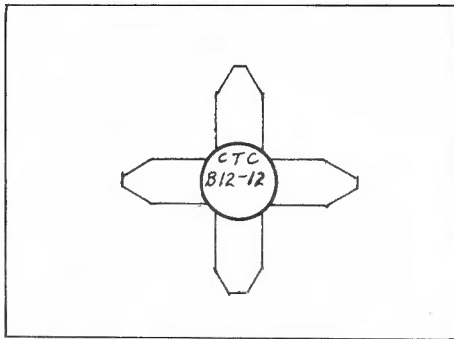


FIG. 4. THE B12-12 INSTALLED. THE COLLECTOR LEAD IS TO THE RIGHT, ADJACENT TO THE 'CTC' MARK



**FIG. 2. CAREFULLY CHAMFER THE LEADS OF THE B12-12 IN THIS FASHION**

Now for the actual conversion details. It is simplicity itself. Only the following explanation is complicated. You will need the following artisan's aids:—

- (a) One pair of household scissors,
- (b) One Phillips-head screwdriver,
- (c) One pair of long nose pliers,
- (d) One 20 W (min.) soldering iron,
- (e) 115 mm of knot-free 60/40 solder with genuine resin core,
- (f) One solder sucker,
- (g) One hand drill (of 2.6 v 10<sup>4</sup> erg capacity at rest)

OR

- one steam-driven electric drill with toothbrush, pencil and razor sharpener attachment.
- (h) One 3/16" diameter drill bit (sharp as a tack),
- (i) Thirty two minutes and 47 seconds of real time (as opposed to Greenwich mean time which is scotch anyway),
- (j) One hammer (to discourage distractions),
- (k) One centre punch (to rivet your attention).

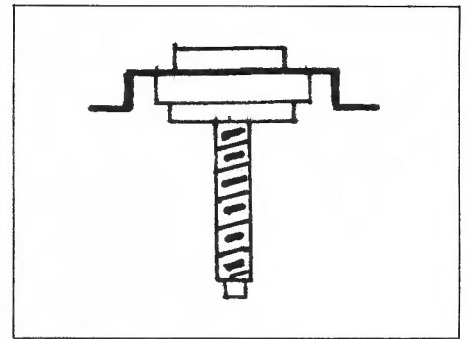
Firstly, the original P.A. transistor is removed. It is located on the under side (copper side) of the printed circuit board, towards the centre-back, immediately beneath the external speaker socket. Unbolt this socket and move it out of the way to afford easier access to the P.A. transistor.

Carefully desolder each lead of the P.A. transistor. The solder sucker ensures a neat, clean job and minimises the possibility of damage to the p.c. board. The transistor is bolted onto a flange that is attached to a flat aluminium heatsink bolted to the backdrop of the chassis/cabinet. Unbolt the transistor and carefully remove it. Don't discard it as it may be needed in the event of a catastrophe (like when junior decides that the B12-12 is a monster from Dr Who and promptly flushes it down the toilet).

Using the clearance hole in the p.c. board as a guide, put a punch mark (gently Bentley!) on the flange so that it is positioned centrally with respect to the hole. Drill a 3/16" diameter hole in this position, carefully deburring it. This is to take the bolt of the B12-12. Smear the flange with silicone grease to ensure good thermal contact between the transistor and the flange.

Now, carefully chamfer each lead of the B12-12 with a pair of sharp scissors or small tin snips. Scissors are best. See figure 2. Insert the B12-12 into position and judge how the leads need to be bent in order to make connection with the appropriate lands on the p.c. board. The collector lead is adjacent to the CTC mark on the header and this is oriented towards the antenna socket. The leads may need to be shortened somewhat, depending on their original length. Bend them approximately as shown in figure 3. Take care not to stress the leads or the lead-to-ceramic-header junction. Insert the B12-12 into position again and check that the leads match up with the lands on the p.c. board without shorting to the adjacent ground plane. Resist the temptation to solder it in place.

If all is well, bolt the transistor in place, taking care that no vertical stress is placed on the leads and that they remain in correct alignment. Now you can solder the leads to the p.c. board. Replace the external speaker socket last of all. A view of the completed conversion from the under-side of the chassis is shown in figure 4.



**FIG. 3. BEND THE LEADS APPROXIMATELY LIKE THIS (ONLY TWO LEADS SHOWN FOR CLARITY)**

Connect the antenna socket to a 50 ohm dummy load to test the converted unit. A reliable means of measuring the power output should be used. Briefly hold the transmit button down and note the power output. Some tuning may be necessary. Do not hold the transmitter on for long periods until maximum power output is achieved.

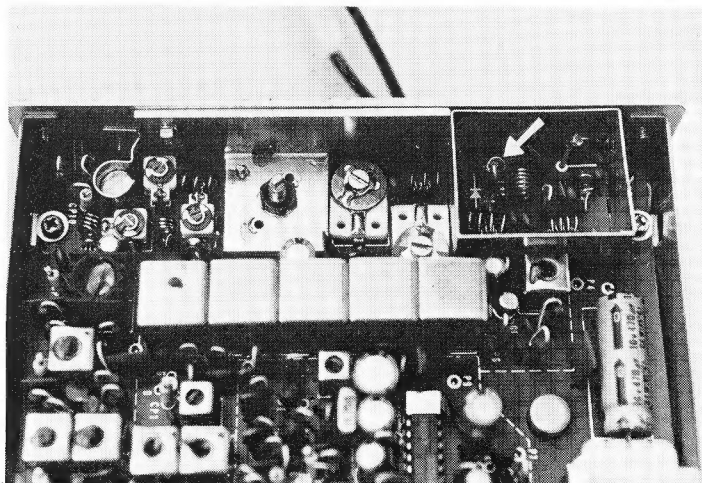
The RF output indication will now cause the meter to go full scale. This is easily adjusted. There is a diode that picks up some RF from a coil in the output network located in the shielded compartment adjacent to the antenna socket. Its location is indicated in figure 5. The diode is mounted with 1/2" leads. Simply bend it towards the back panel until the meter comes back on scale again when transmitting.

And that's about it. Double your deteriorated output power and drive your booster amp., neighbours, local repeater, etc. to distraction! The heatsink in the IC-22 gets hotter than it did previously, but the temperature rise is within the limitations of the transistor. Keep your overs short in any case — give the lower power stations a go!!

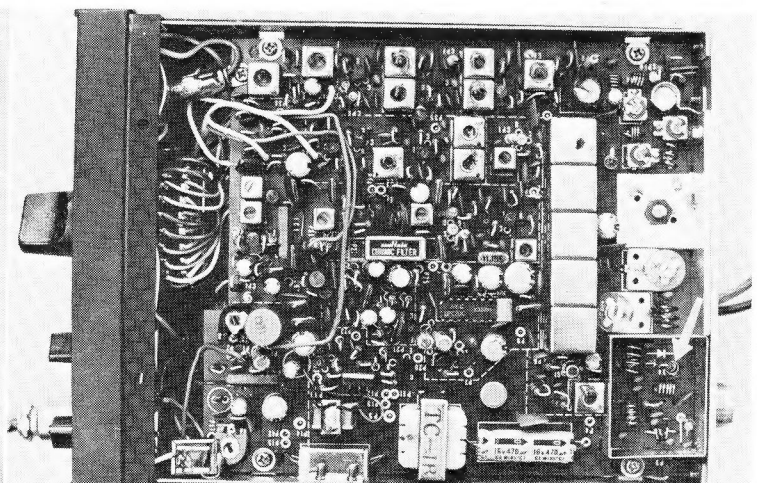
#### REFERENCES

- (1) Chambers 20th Century Dictionary, pages 334 and 346.
- (2) Bird 'Thru-line' wattmeter with 50 W, 50-250 MHz module and Delco 50 ohm dummy load.

Photos by Phil Wait WK2ZZQ



**FIG. 5. TOP VIEW OF IC-22 SHOWING THE B12-12 FIXING NUT AND THE RF OUTPUT PICKUP DIODE**



**FIG. 6. TOP VIEW OF CONVERTED IC-22. LOCATION OF THE RF OUTPUT DIODE IS INDICATED BY THE ARROW**