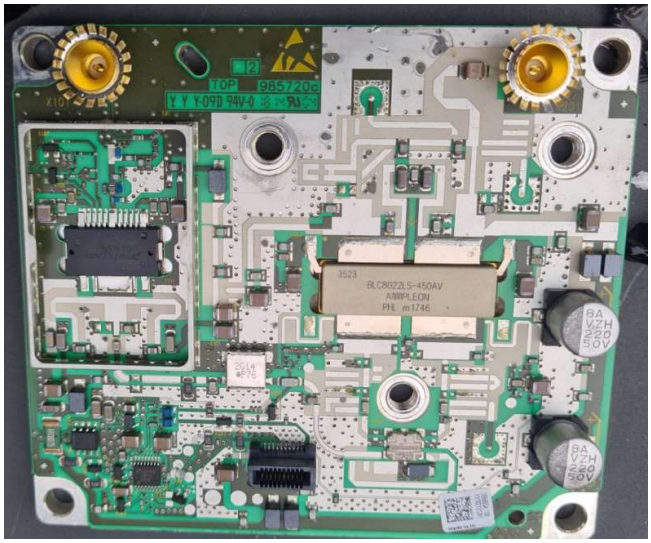
Modification of SSPA UMTS power amplifier module for 2320 MHz amateur band



This manual concerns retuning of the UMTS power amplifier module based on a double LDMOS transistor type BLC8G22LS-450AV to the 2320 MHz amateur band. It should be treated as a starting point for possible more precise tuning.

Warning: Be especially careful not to expose your eyes to RF power - working amplifier must always have the cover screwed on.

Start the modification of the module by removing the RF sockets and soldering the coaxial cables in their place (Figure 1). Any type of 50 ohm cable with SMA connector can be used at the input. If a cable with p-smp plugs is available, the input jack may not be removed.

The output cable must withstand a power of at least 150 W at 2320 MHz. Teflon cables such as UT141, RG142 or RG400 may be used.

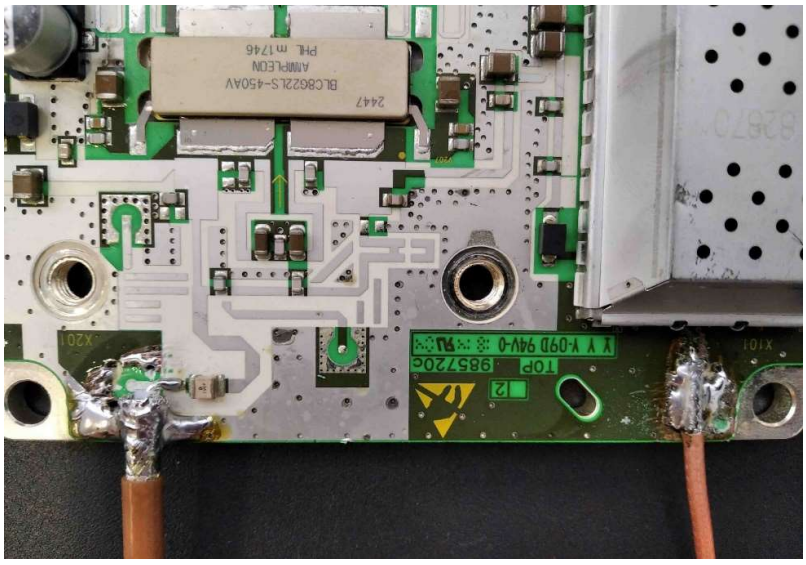


Figure 1. Cables soldered in place of sockets

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The efficiency of the retuned amplifier is about 30 %, so a sufficiently large heat sink should used. The heat sink used during the tests was 30 x 30 x 4 cm.

The module is powered with 28V through a dedicated board. Supply is connected to the thick tracks. The first thin track is a PTT signal for the final LDMOS (Figure 2). Without supplying voltage on this track, a current of about 600 mA flows through the driver stage. After applying PTT voltage, current increase to about 1.4 A. The remaining tracks are unused. The PTT pin should be connected to +28 V and external supply switch (relay or PMOS transistor) must be provided.

In case of lack of power board, the supply wires are soldered directly to the amplifier board (Figure 3).

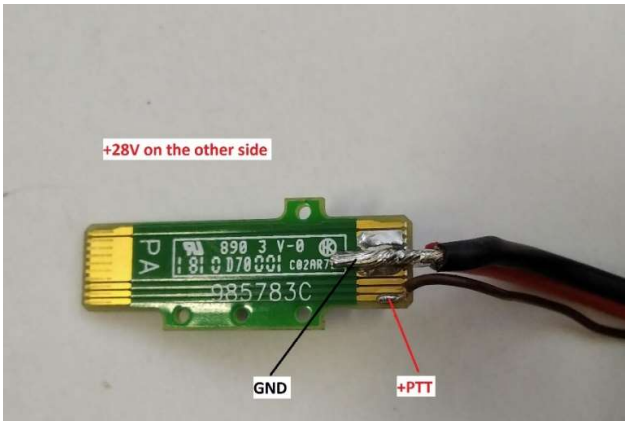

Figure 2. Board for connecting the module power supply

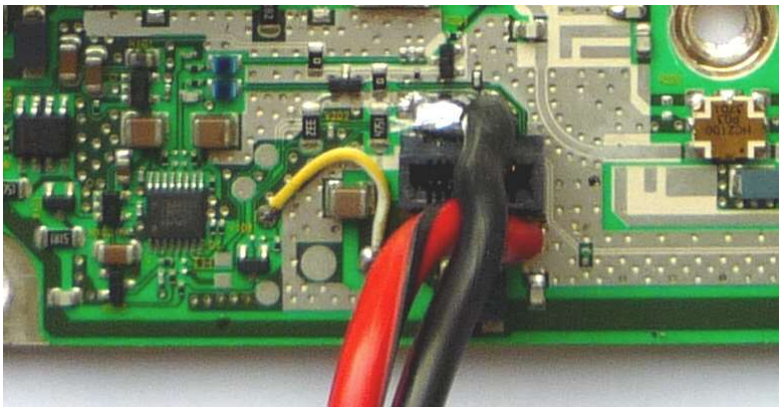

Figure 3. In case of lack of the power board, wires are soldered to the module

The proper modification of the power amplifier start with removing two capacitors from the driver circuit (Figure 4). This procedure increases gain at 2320 MHz.

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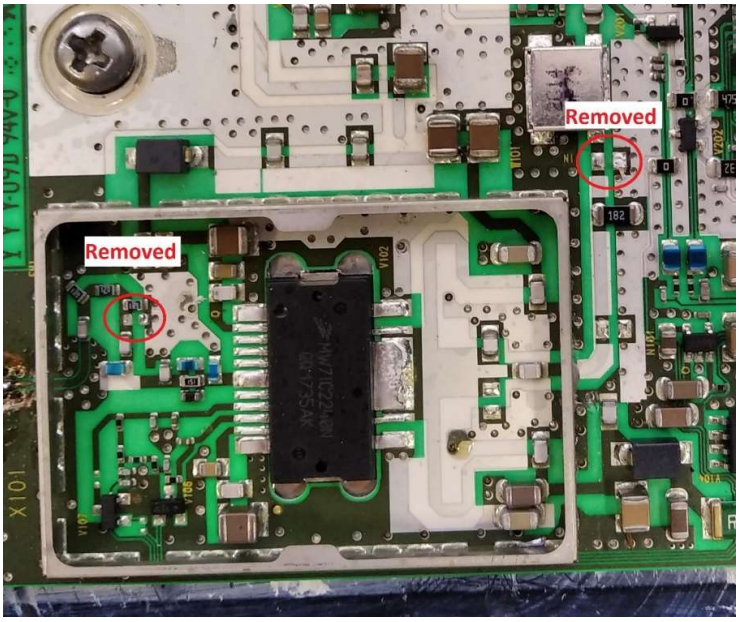

Figure 4. Capacitors from the driver to be removed

The final stage includes a transistor dedicated to the Doherty amplifiers (BLC8G22LS-450AV), which actually contains two LDMOS transistors in its structure: main and peak (Figure 5).

Figure 5. Double LDMOS used in final stage

The method of modifying the input (gates) circuits was obtained by measuring with a VNA matching at the main and peak inputs and empirically - striving to obtain the maximum gain of the module. It is a coarse method and it is probably possible to obtain even better parameters. It turned out that it was only necessary to modify the input circuit of the main transistor (Figure 6).

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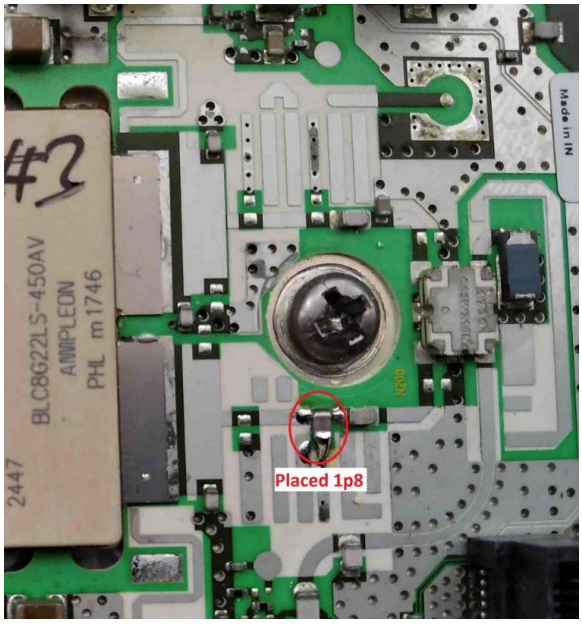

Figure 6. Tuning of the input

In turn, in the output circuit of the main transistor, the marked capacitors are removed and the farthest capacitor is resoldered so that, it is next to the closer one. This is shown at Figure 7. As in the case of the peak transistor input circuit, the satisfactory results were obtained without changing anything in the output circuit of this transistor.

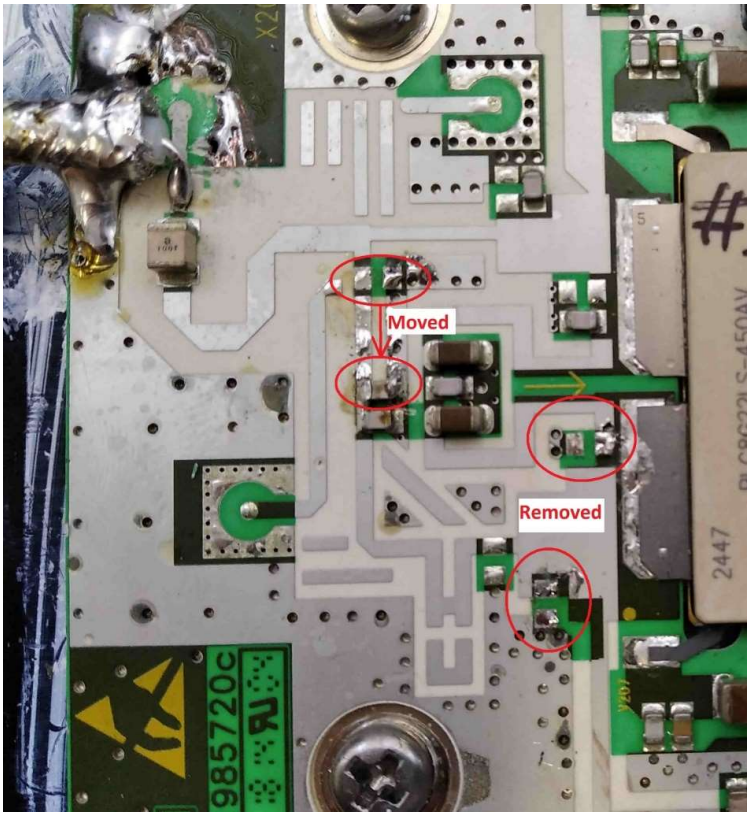

Figure 7. Tuning of the output

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The complement of the PA module is a top cover. It is available in two versions: fully shielded and open on one side. For the second case, the open side must be sealed with aluminum adhesive tape.

Due to the fact, that the edge of the cover is not in perfect contact with the heat sink and the RF leaks through the slot, it is advisable to seal the remaining sides with aluminum tape (Figure 8). This applies to both types of covers.

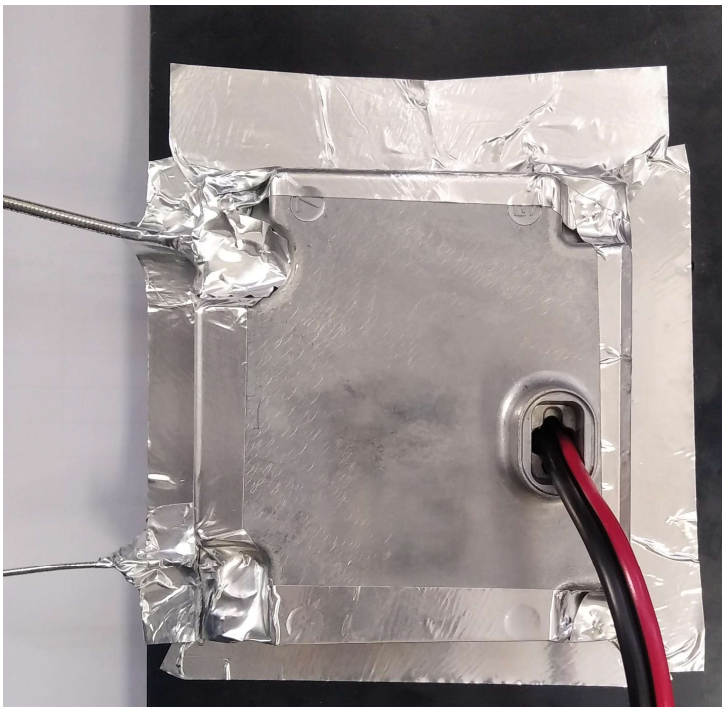

Figure 8. PA module with the cover sealed with aluminum adhesive tape

The modification described above makes possible to obtain a power of about 150-170W at 2320 MHz. Also, with finer tuning of the module it is possible to get more power output.

According to the procedure described above, a few modules were retuned. The following results were obtained:

- Input power 25 mW (+14 dBm)
- Output power 150 to 170 W
- Quiescent current ca 1.4 A
- Current at maximum output power 18 to 22 A
- Efficiency 28 to 30 %

The retuned modules were also measured at 2400 MHz, but the results were not satisfactory. With the input power of +15 dBm, the maximum output power was only 40 W, with low efficiency (10 to 14%) and poor linearity.

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