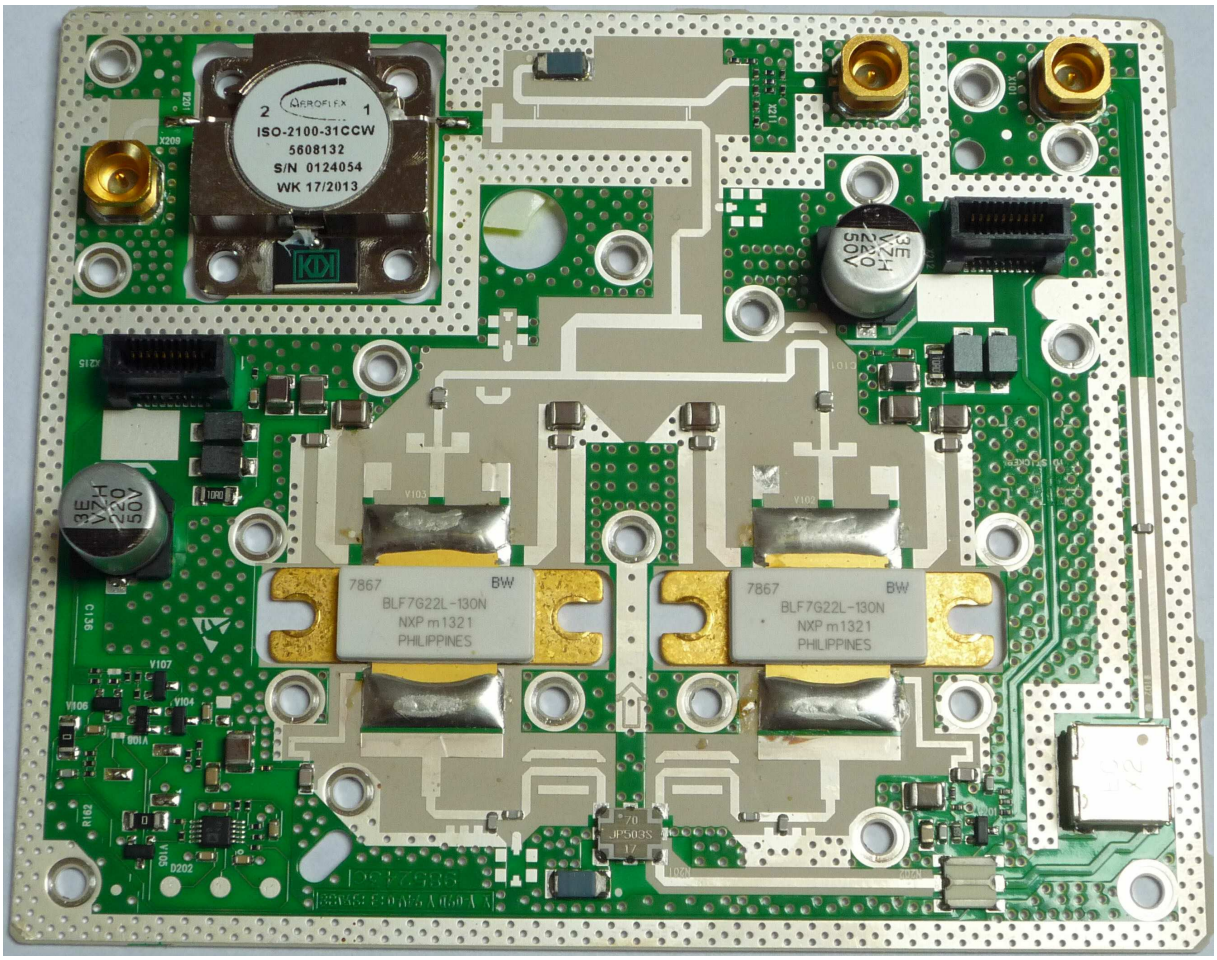
Additional notes about the 2400 MHz power amplifier (v 3.0)



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This publication describes the problems encountered during assembly, together with suggestions for solutions.

The main problem encountered by the users of the amplifier is the deterioration of parameters in relation to those obtained during tuning. The reason for this is primarily bad ground contact.

In extreme cases, this leads the amplifier to getting oscillated. This manifests itself in high current consumption (in the absence of an input signal), significantly exceeding the nominal value of the quiescent current (0.8 A). In addition, this is manifested by too low gain (about 8 dB), output power (about 10-12 W, with 2 W at input) and efficiency (about 10%) or even oscillations.

LDMOS transistors have a source on the flange, which must be connected to the bottom layer of the board (board ground) the shortest way. The heat sink, in addition to dissipating heat, provides this connection. The problem is that the flanges of the transistors are not in the same plane as the PCB - they protrude by 0.7mm. Originally, the amplifier board was placed on a heat sink that had milled areas so that the transistors would enter these places. In amateur conditions, it is not always possible to make milled areas, so often the board is placed on a flat heat sink. In this case, there is a significant reduction in gain and output power and sometimes oscillations occur. The reason is the formation of gaps between the bottom layer of PCB and the heat sink near the gates and drains. The ground of the board in these places is no longer in contact with the heat sink, which causes the formation of parasitic inductances and detuning of the matching circuits.

In other words, the transistors and the board must be mechanically perfectly fitted to the heat sink.

This can be easily done by resoldering transistors and is described in the following procedure:

1. Completely desolder both LDMOS transistors. Before this, mark them (not to swap them later).
2. Tight screw the board and transistors to the previously prepared heat sink (preparation consists of drilling and tapping holes: 20 for PCB, 4 for transistors and 4 for output isolator, if not removed).
3. Now solder the terminals of the transistors one by one, as much as possible bending them (pressing) to the board (Fig. 3). This should be done carefully so as not to mechanically damage the transistors.

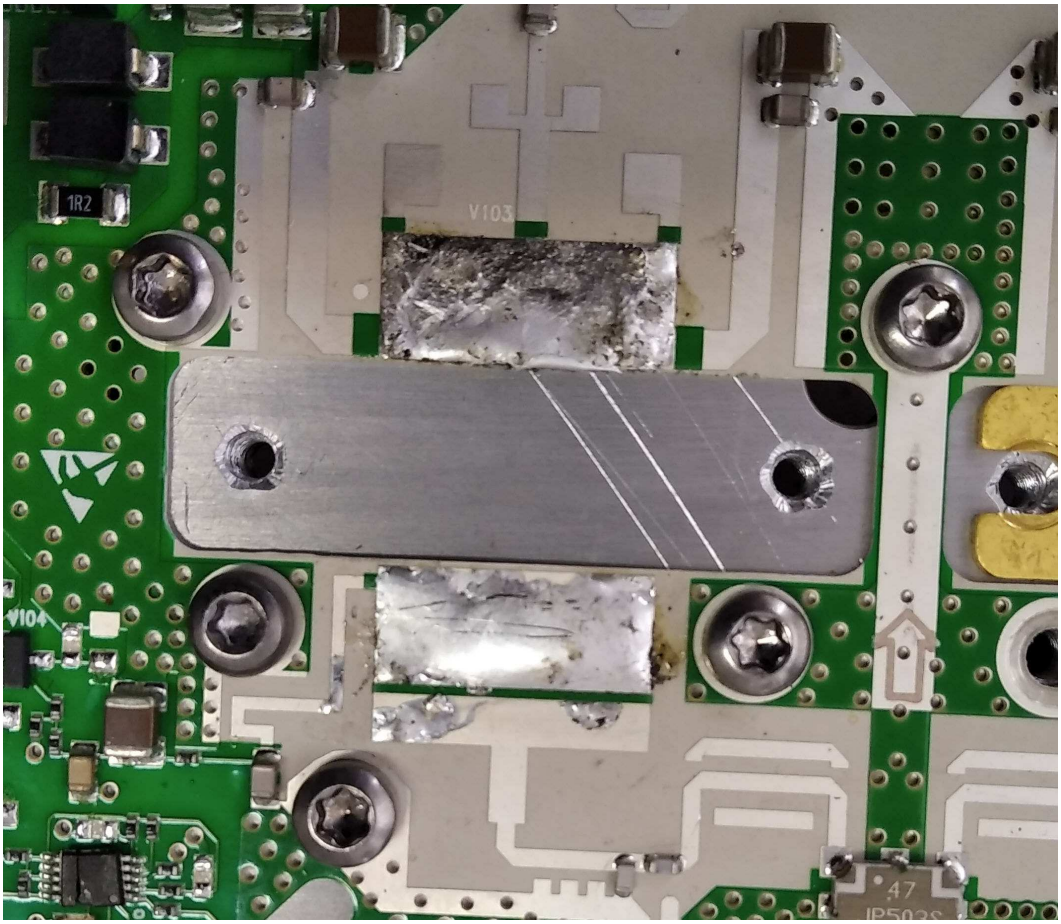

Figure 1. Board and heat sink ready to place LDMOS

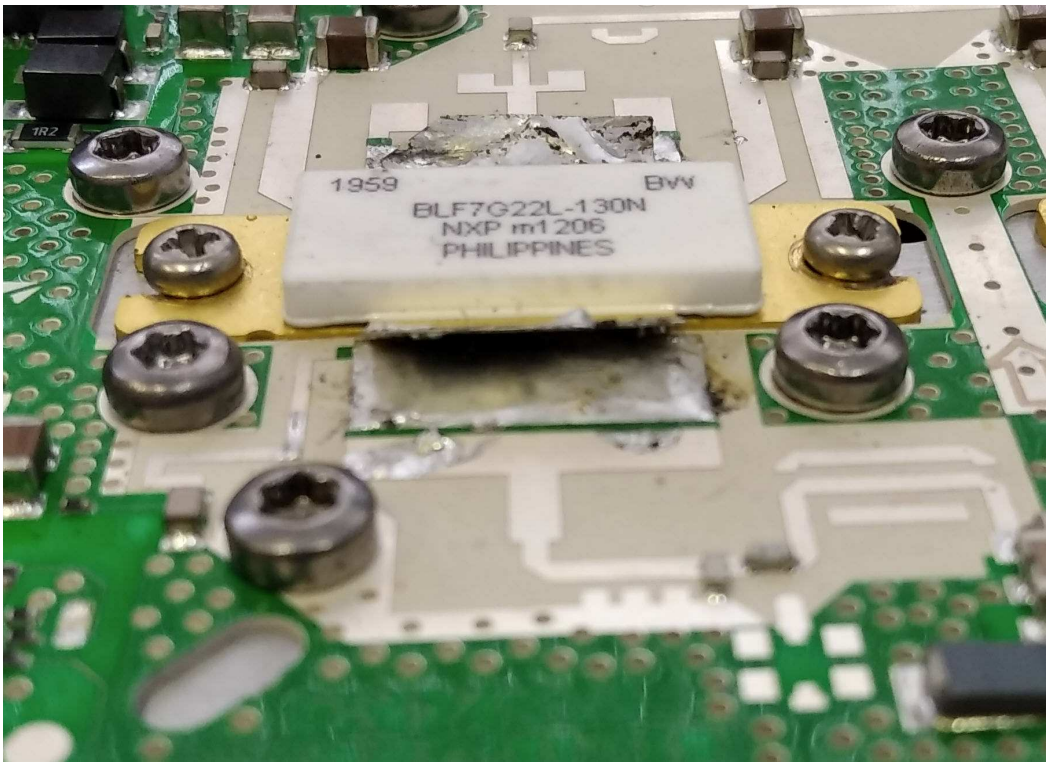

Figure 2. Screwed LDMOS ready for soldering

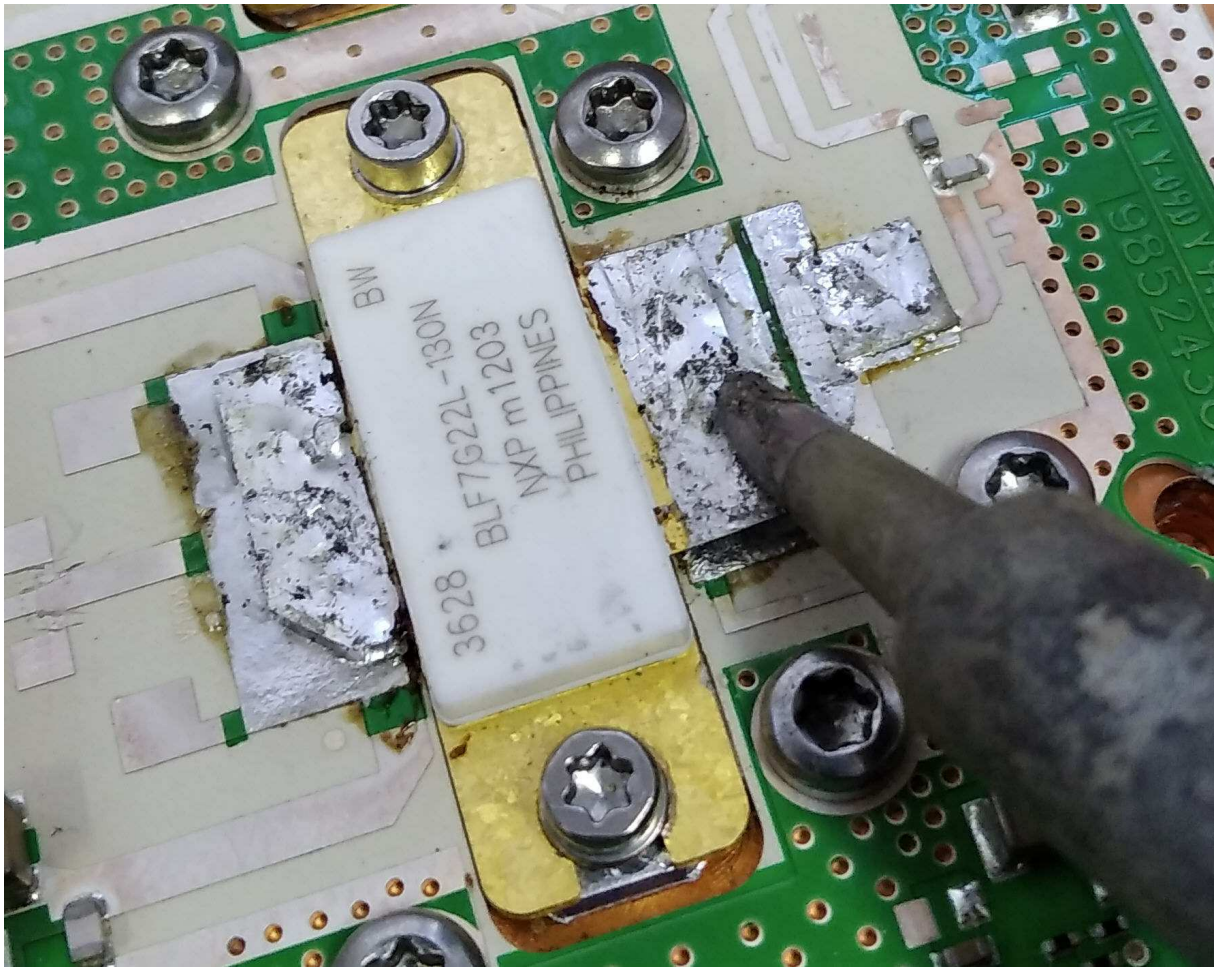

Figure 3. Soldering and bending terminals of LDMOS

Measurements of the amplifier converted this way showed a slight deterioration - the output power dropped from 45 to 40 W, which is about 10%. This is due to a slight detuning of the matching circuits of the transistors. If terminals transistors will be bent too mild (Fig. 4), degradation of parameters may be greater. Using a power meter, the amplifier may be additionally tuned, which will improve the performance. Usually, higher gain was obtained by cutting off fragments of copper foil (Fig. 5)

It is important to screw tight the board and transistors to the heat sink, using all holes in the board (20 pieces). Do not use any thermally conductive pastes as they impair contact. It applies to both transistors and board. At 40 W output power, for adequate cooling of transistors it is enough for the flange and heat sink surfaces to be clean and smooth (polished).

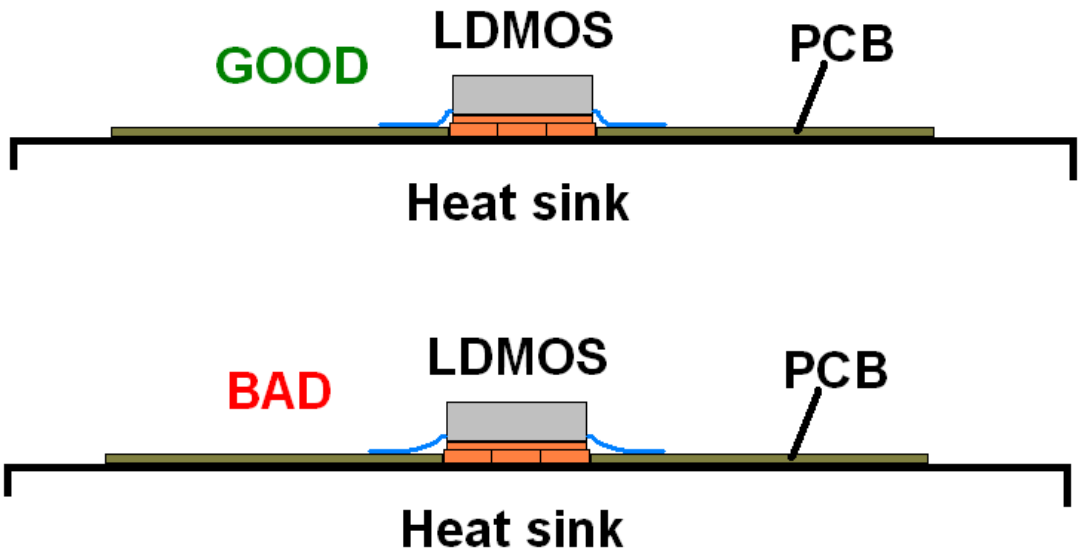

Figure 4. Good and bad way of soldering transistors

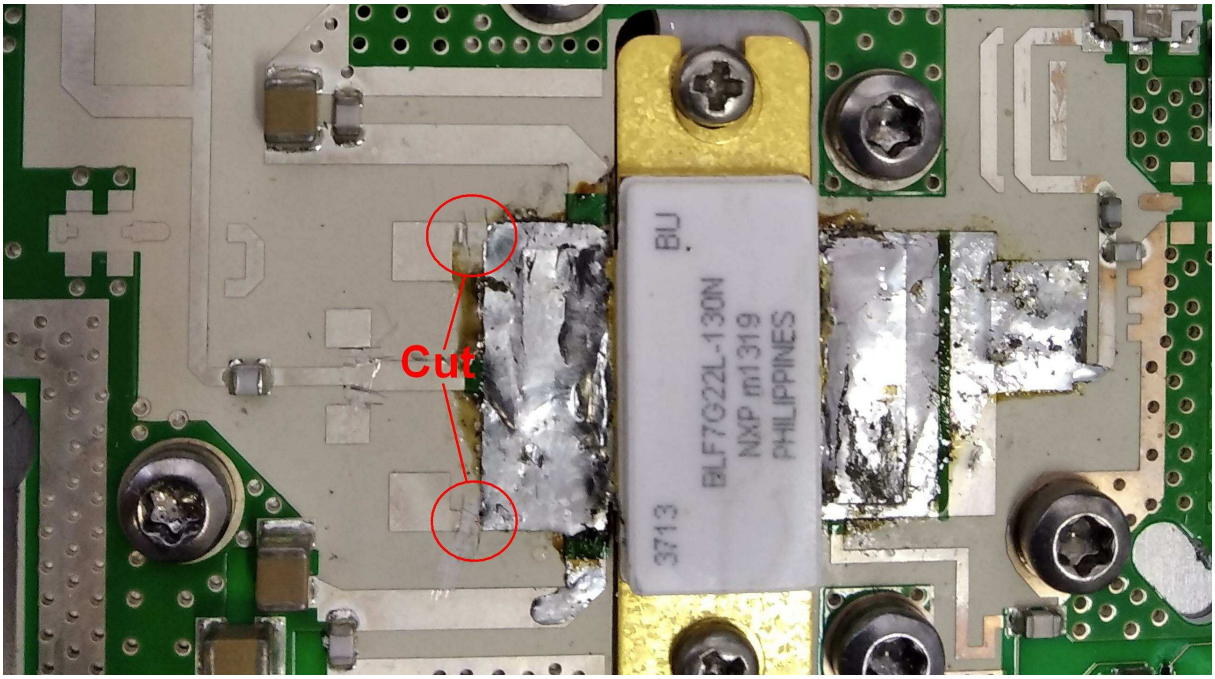

Figure 5. Improvement in drain circuit of LDMOS V103

The output isolator, if it has not previously been replaced by a 50 ohm semi rigid cable, can be screwed to flat heat sink without any modifications. It should be paid attention, whether the isolator terminals are not in contact with its housing (ground). See Figure 6.

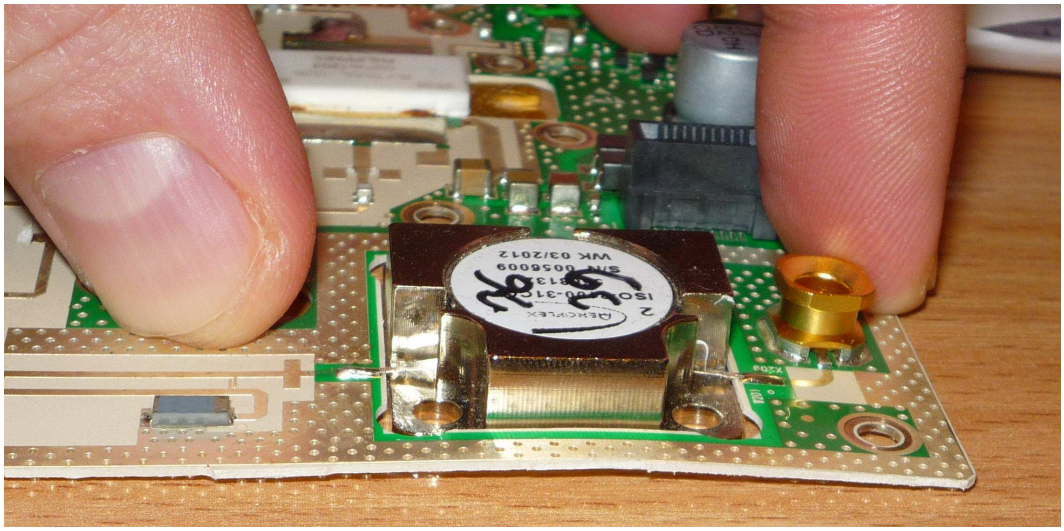

Figure 6. Output isolator on a flat surface

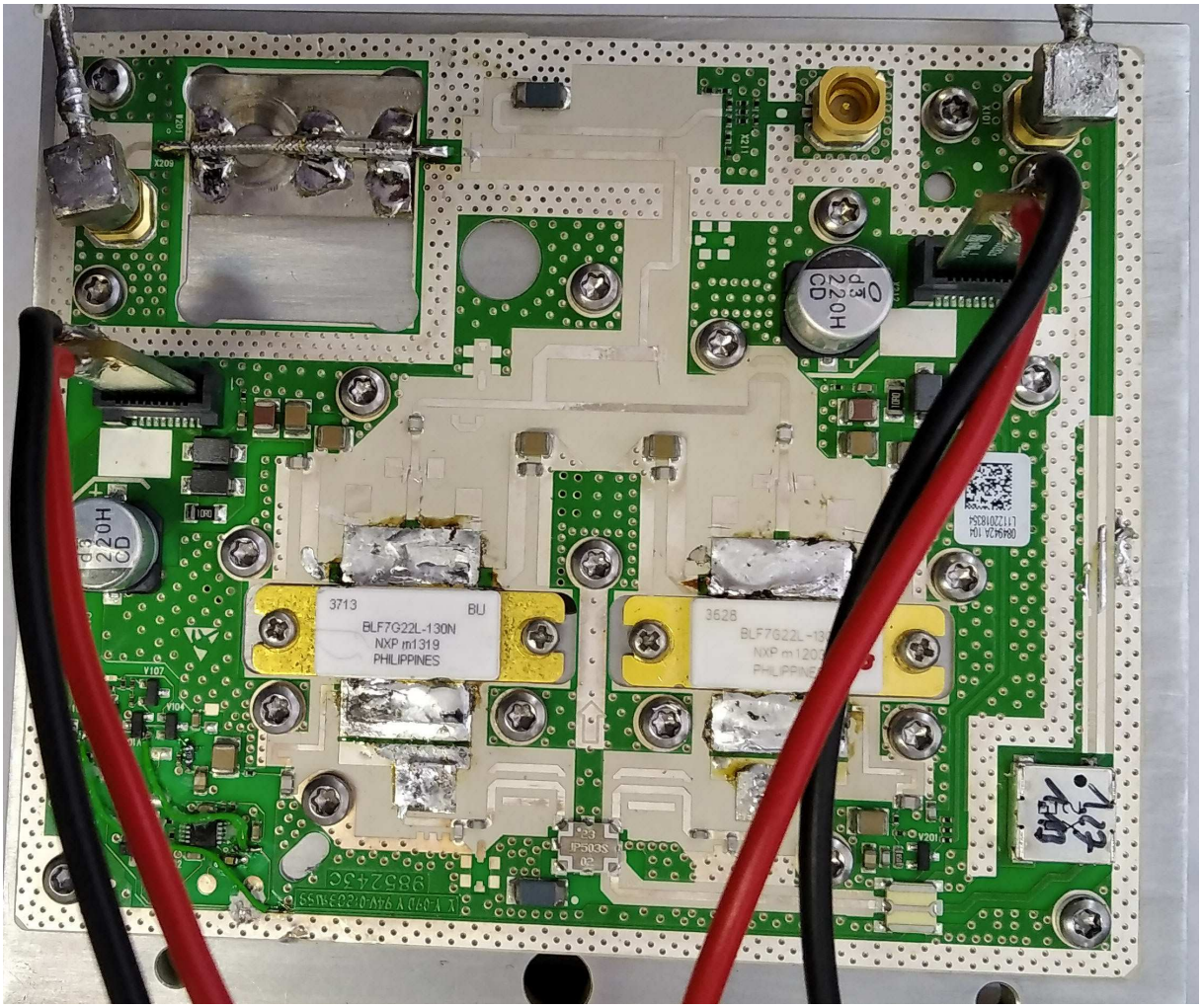

Figure 7. PA module on flat (not original) heat sink with output isolator replaced by piece of 50 ohm coax cable