## Ataptation UMTS power amplifier module for 2400 MHz amateur band

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The idea of this study is to describe the modification of the UMTS power amplifier to work in the 2400 MHz amateur band (satellite QO-100 uplink).

The amplifier can be a complement to the 432/2400 MHz transverter from SG Laboratory Ltd (Bulgarian transverter) with a solid state power amplifier, allowing to obtain 40 W of output power.

The amplifier originally worked in the 2110-2170 MHz band with 50 W power. It is a one-stage system, implemented as a Doherty amplifier, where one transistor works in the AB class and the other in the C class. More on this subject can be found on the Internet, e.g.:

https://www.electronics-notes.com/articles/radio/doherty-amplifier/basics-primer.php https://www.electronics-notes.com/articles/radio/doherty-amplifier/design.php https://www.microwaves101.com/encyclopedias/doherty-amplifiers

The modified amplifier is powered by 28 V. On the board, there is an electronic potentiometer AD5259, which has been factory-set so that the quiescent current of the amplifier is about 850 mA. This value has not been modified.

The transistors used are LDMOS type BLF7G22L-130N: http://www.seekic.com/uploadfile/member\_pdf/61890/201617174815885.pdf

The power supply is provided on two multipin connectors using small laminate plates, to which the wires can be soldered.



Figure 1. Description of the pins in the power sockets and the laminate board inserted into one of the sockets

In the modules, there were used P-SMP RF connectors. Due to the low popularity of these connectors, it is recommended to make transitions to N or SMA connectors using the cables attached to the modules.



Figure 2. Cables with P-SMP and SMA connectors

We start the adaptation of the module by removing the capacitor located in front of the input insulator. This treatment significantly improves input matching - SWR at 2400 MHz decreases from 1.9 to 1.16.



Figure 3. Capacitor that needs to be removed.

Next, we modify the matching circuits of the transistors.

In the gates circuits, 5x5 mm thin copper sheet should be soldered. In the drains circuits, cut off fragments of copper foil. The modifications in the drains are not the same for both transistors.



Figure 4. Modifications in the circuits of gates and drains.

When using cables with a right-angled P-SMP plug, cut a part of the metal cover (screen) near the input socket. This is illustrated in Figure 5.



Figure 5. Cutting in the cover

The amplifier is ready to work. Before the development of this study, six amplifiers were modified. The following results were obtained:

- Output power: 36 to 47 W, with 2 W of the input power
- Gain:12.6 to 13.7 dB
- Current consumption from 28 V power supply: 3.6 to 4.2 A
- Efficiency: 36 to 40%

Remarks:

1. For operation RF shield/cover absolutely must be used! With the high powers being used, here the radiation hazard does exist for the eyes. Beware of excessive RF exposure to your eyes and the other parts of the body.

2. The amplifier board must be bolted to a solid heat sink. With an output power of 40 W, 80 W is transformed into heat. The heatsink is also a DC and RF ground for transistors - good contact must be ensured.

3. The unmodified module enables 18 W output power with 2 W on the input.

4. At the output of the amplifier, there is a directional coupler for controlling the output power. The coupling at 2400 MHz is about 40-41 dB.

5. With 2 W input power, 50 W can be achieved by omitting the input and output isolators. The input will then be at the JP503S divider (necessary track cutting), while the output - before the output isolator. The connection method is illustrated in Figures 6 and 7.

6. With more input power, you can experiment with tuning the amplifier for even more power. The cables with the P-SMP connector attached to the module are K\_02252\_D (Teflon, with double braiding). They are able to handle about 100 W at 2400 MHz. http://www.ame-hft.de/pdf/koax/k02252d.pdf

At power over 100 W, thicker teflon cables, eg UT141/RG402 or RG142, should be used on the output.



Figure 6. Connecting the input bypassing the isolator.



Figure 7. Connecting the output before isolator.



Figure 8. A complete power amplifier on a heat sink, with the cover (screen) attached, connected power supply, RF input and output cables.