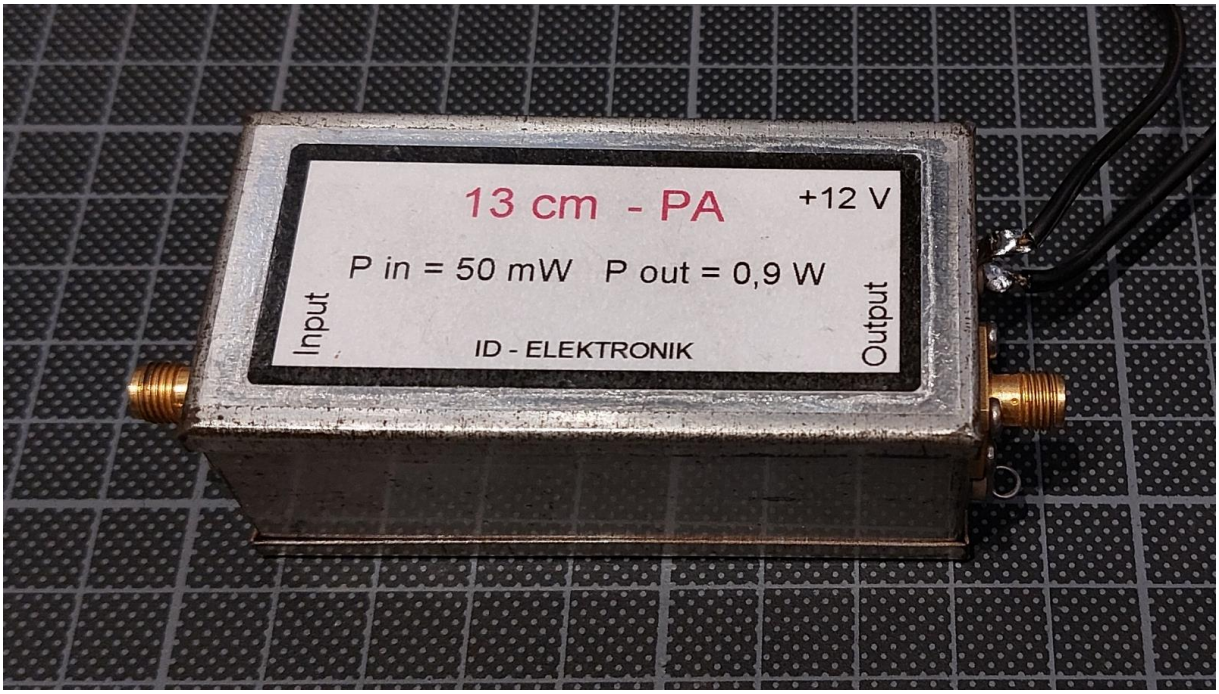
Analysis of a 2.4 GHz 900mW amplifier from ID-Elektronik

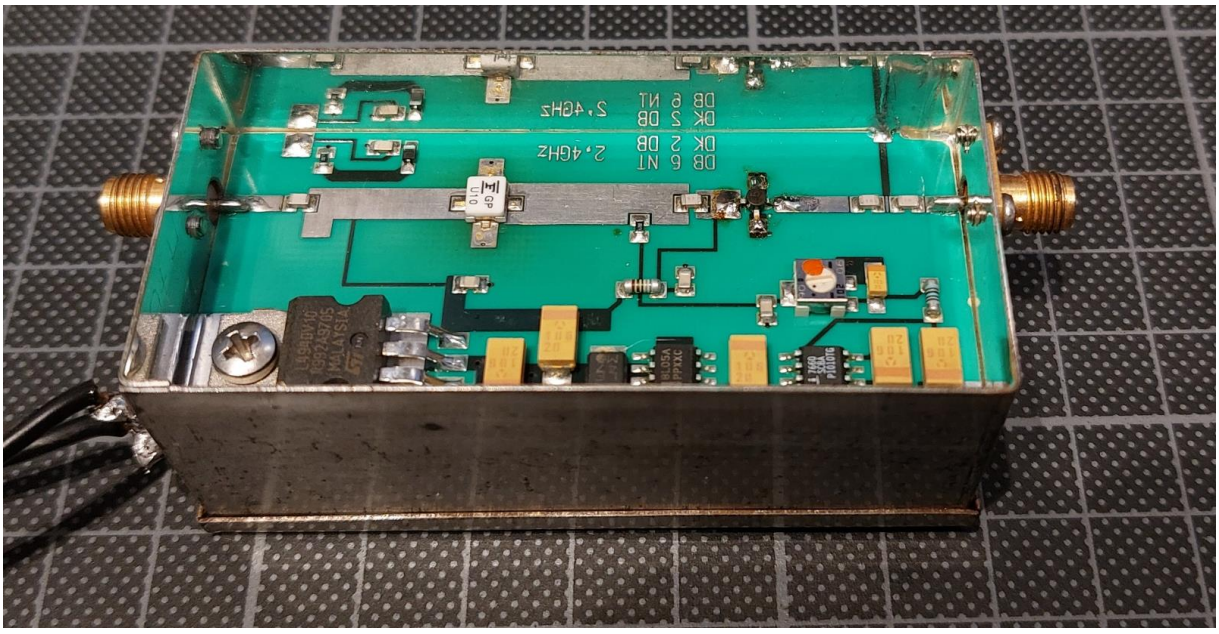
Matthias, DD1US, April 3rd 2024, rev 1.0

Some time ago I acquired a 13cm power amplifier which was originally sold by ID-Elektronik. The PCB shows the callsigns DB2DB (Ewald Goebel) and DB6NT (Michael Kuhne) who probably designed this amplifier. As I did not find much data other than its nominal output power of 900mW and a supply voltage of 12V I did some analysis and measurements at the device.

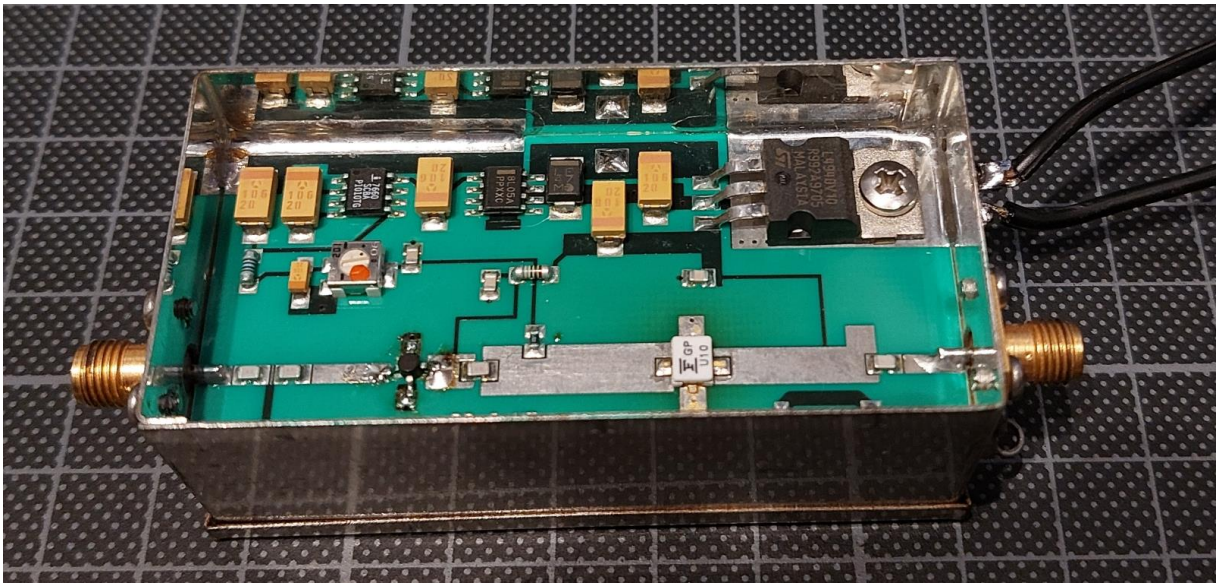
Here are some pictures of the amplifier which his encased in a tin-plated cabinet with SMA jacks at the input and output.



The amplifier is comprised of a high pass filter followed by a two-stage amplifier and a directional coupler with a diode detector (please not the in the picture below the input is right, the output is left).



The supply voltage is stabilized to 10V by a L4940V10 low drop voltage regulator from ST Microelectronic. This is also the drain voltage of the second stage. The negative gate voltage for the GaAs FET is generated by a 5V voltage regulator followed by an ICL7660 voltage inverter and a potentiometer to adjust the gate voltage.



The first stage is based on a MMIC with the marking “E5”; thus, it is most likely an ERA5 from Mini Circuits. The ERA5 MMIC needs a supply voltage of 5V which is generated by dropping the 10V supply voltage by a 68Ohm resistor. This assumes a current of 74mA which is a bit higher than the typical operating current of 65mA but well within the operating range limits of maximum 85mA. At 2.4GHz the ERA5 should give a typical gain of 18dB at 2.4GHz.

The second stage is using a Fujitsu GaAs-Fet FLU10 which should provide a typical gain of 12dB at 2.4GHz.

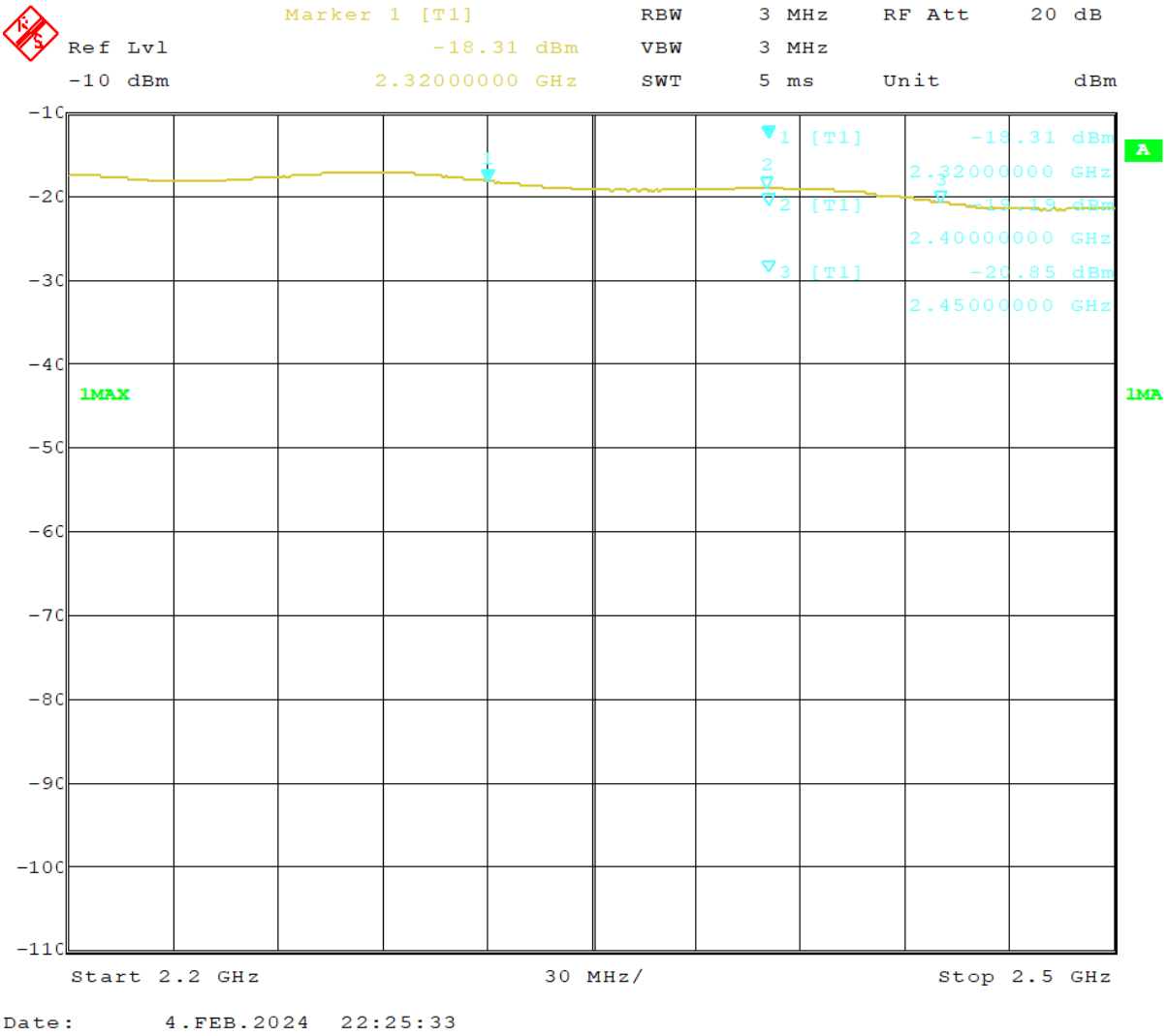
First, I measured output power and gain of the amplifier versus input power at 2.4GHz.

My signal generator is limited to provide 13.8dBm (24mW) to the amplifier and the measured output power was 29.5dBm (890mW). Probably a maximum output power of 1W is possibly when driving the amplifier a bit further in compression. The P1dB is about 25.5dBm (350mW).

The small signal gain is about 18.5dB and quite a bit lower than I had expected based on the data of the MMIC and the GaAs-FET.

The quiescent current consumption of the amplifier is 200mA rising to a total current of 272mA at 890mW RF output power. The maximum efficiency of the total amplifier is 27%.

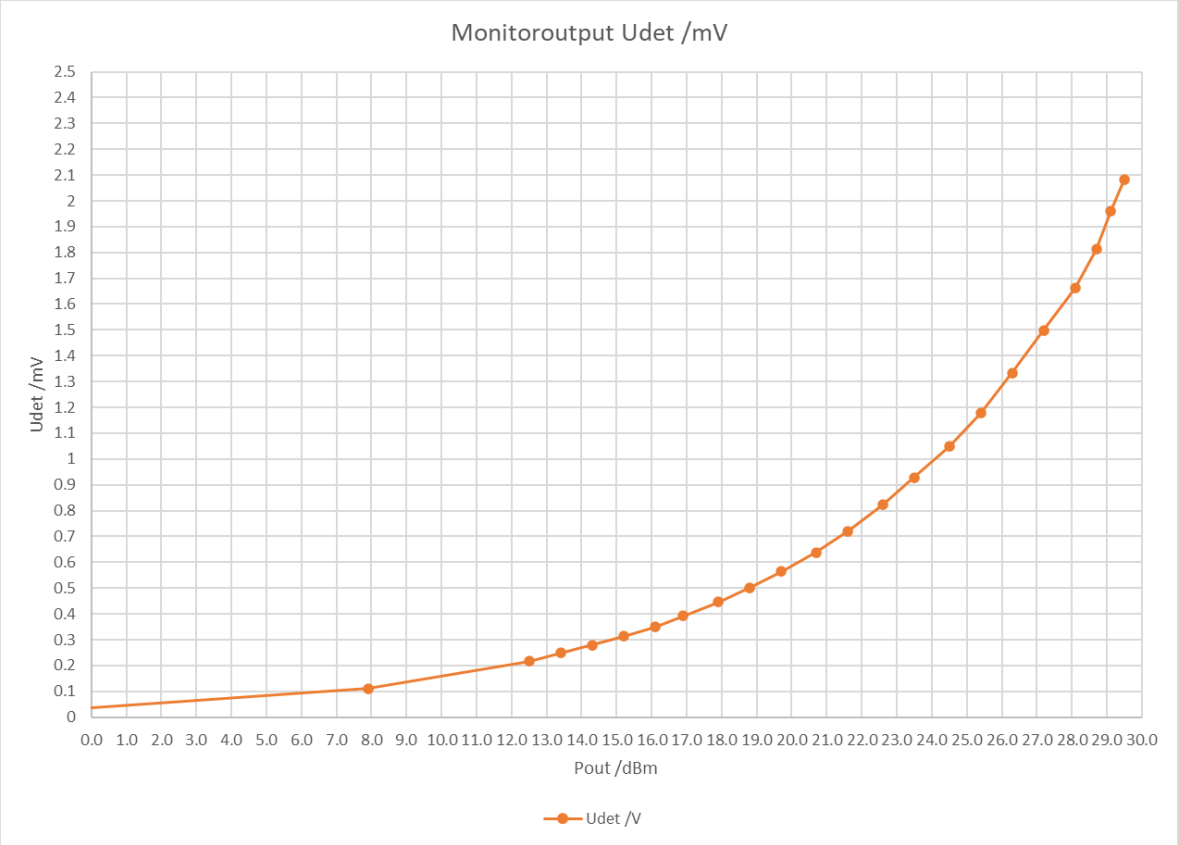
Second, I measured the frequency response of the amplifier:

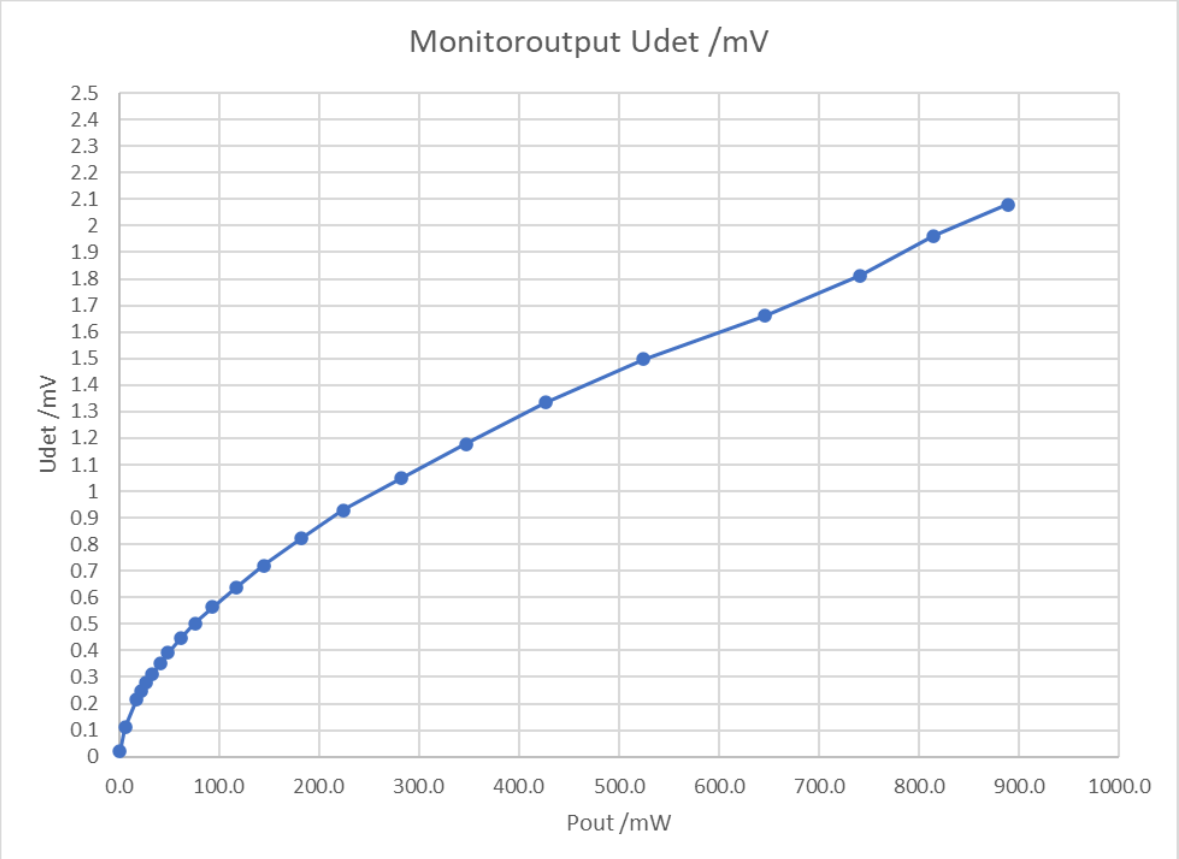


The small signal gain of the amplifier is about 0.9dB higher at 2.32GHz compared to 2.4GHz.

Yet I double checked and the maximum output power is the same at both frequencies.

This amplifier module features a directional coupler at its output. The coupler is printed on the PCB and the forward power is measured by a diode detector. Below please find the measured detector voltage versus output power at 2.4GHz. In the first diagram the x-axis is logarithmic (dBm), in the second it is linear (mW).





In summary this is a nice driver amplifier for bigger power amplifiers such as for QO-100 and the monitor output is very useful.

I am always grateful to get feedback and will be happy to answer questions.

Please direct them to the Email address, which you find below.

Best regards

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