Analysis of a 2.4 GHz 1.3W amplifier from Phillip Prinz DL2AM

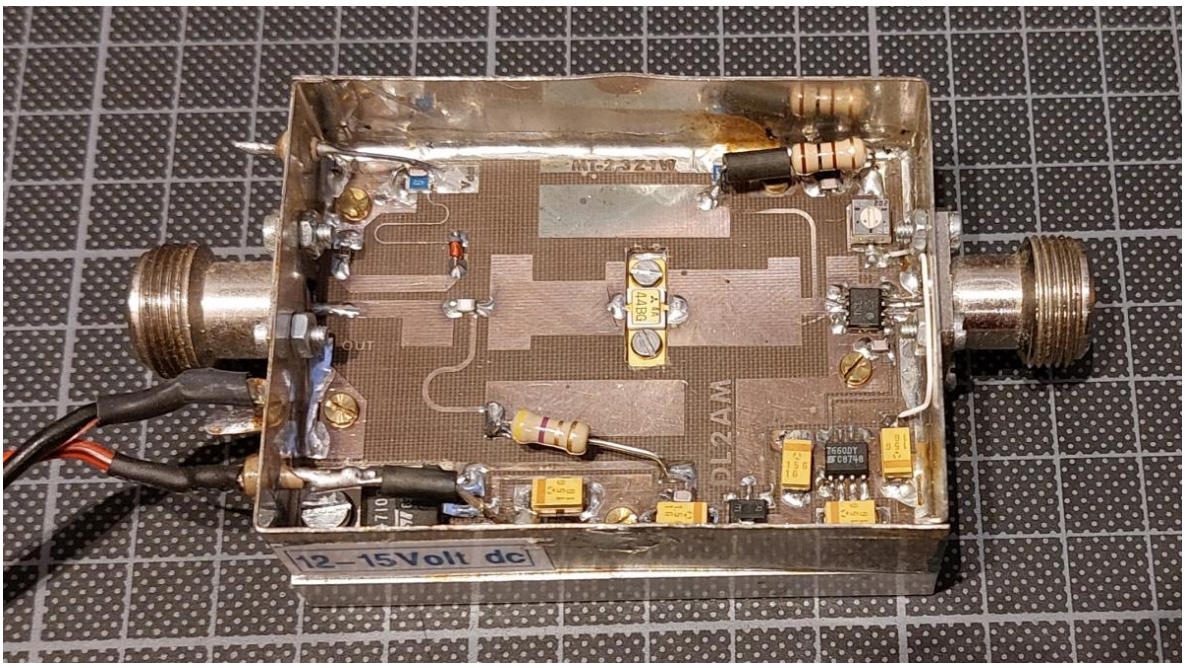
Matthias, DD1US, April 4th 2024, rev 1.0

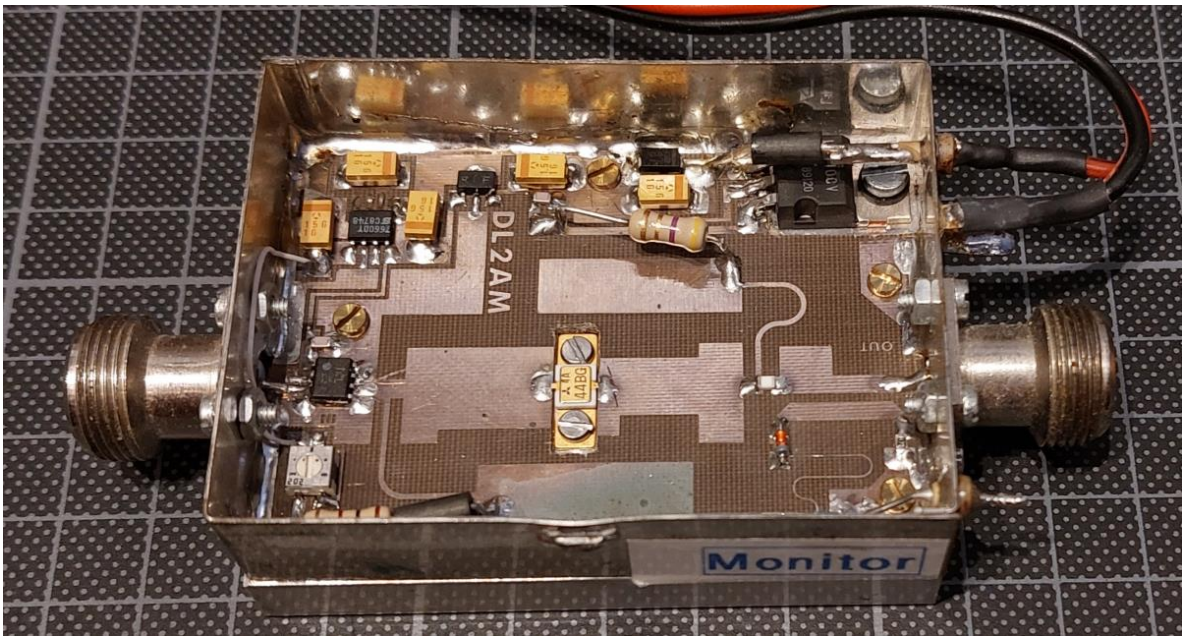
Some time ago I acquired a defective 13cm power amplifier which was originally sold by Phillip Prinz DL2AM. On the PCB there is a marking MT2,3Z1W which seems to be the model number. The two-stage amplifier is housed in a tin-plated cabinet. The PCB looks like RT-Duroid and it is properly attached to a solid metal heat spreader.

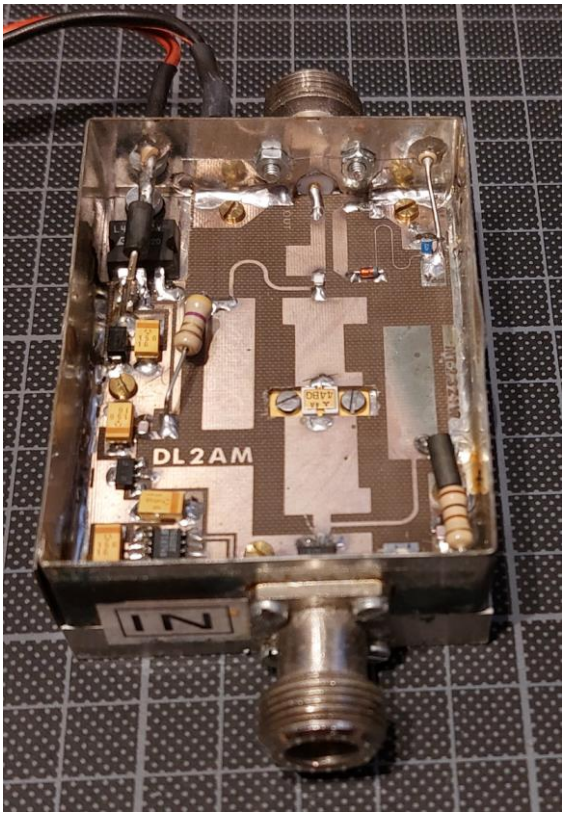
The supply voltage range is 12-15V and the amplifier features a directional coupler with diode detector measuring the forward output power.

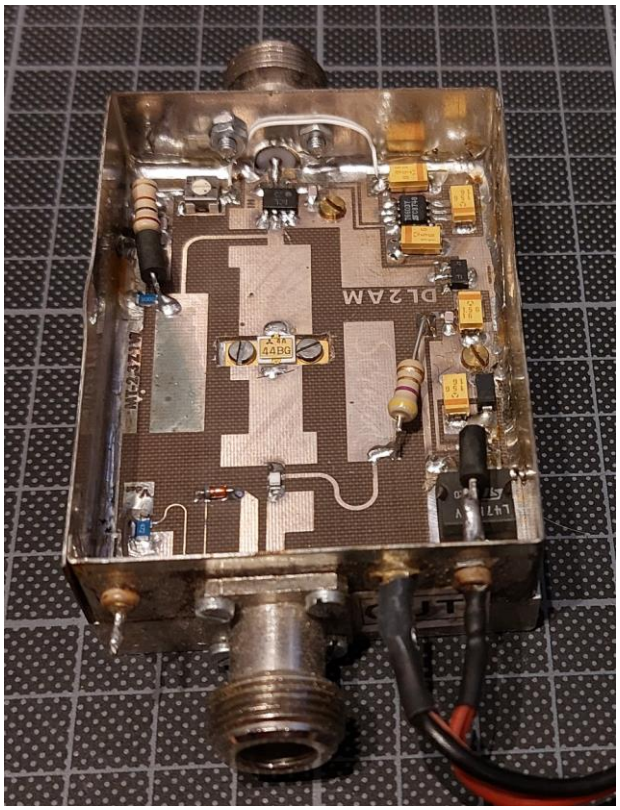
The amplifier was broken and during inspection I found out that the driver amplifier in the first stage was defective. I replaced it with a Mini Circuits VNA25+. The second stage is using a Mitsubishi MGF0904 GaAsFET. After replacement of the defective part the PA now works fine again.

Here are some pictures of the device:





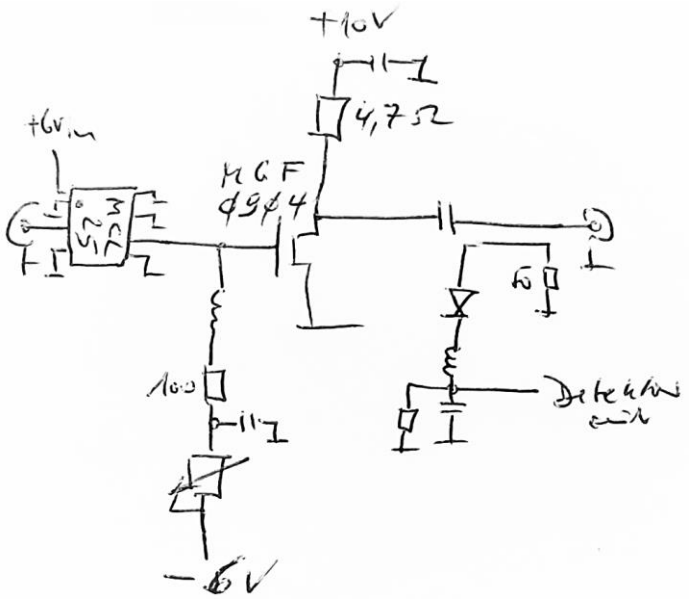

DL2AM
IN


DL2AM


12–15Volt dc


Monitor

Here is a sketch of the simple RF part of the schematic:



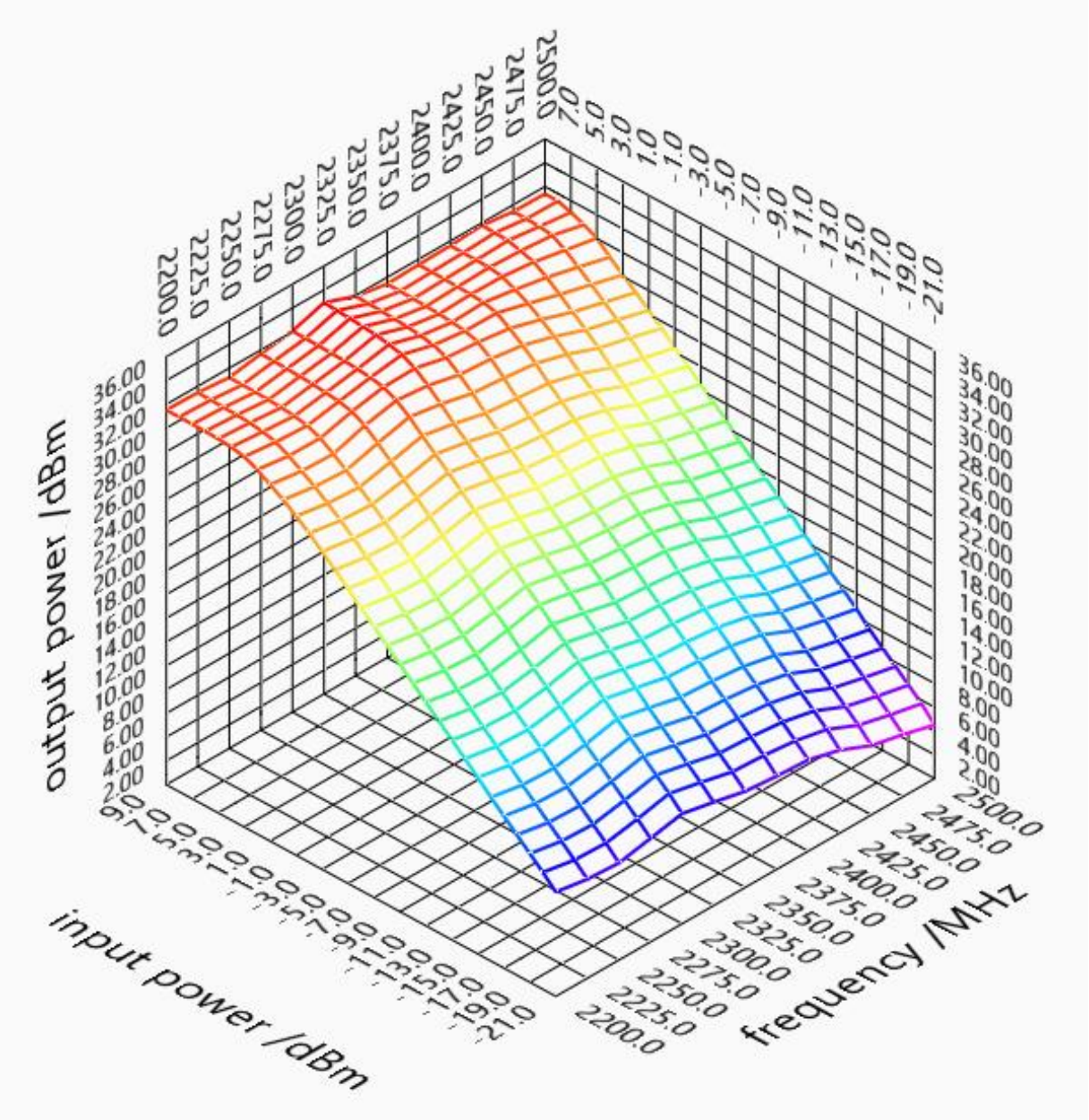
The supply voltage is stabilized to 10V by an L4710CV low drop voltage regulator from ST Microelectronic. This is also the drain voltage of the second stage. The negative gate voltage for the GaAs FET is generated by a 6V voltage regulator followed by an ICL7660 voltage inverter and a potentiometer to adjust the gate voltage.

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

Small signal gain is about 28dB. Maximum output power is 1.15W at an input power of 8.6dBm. P1dB is 1W.

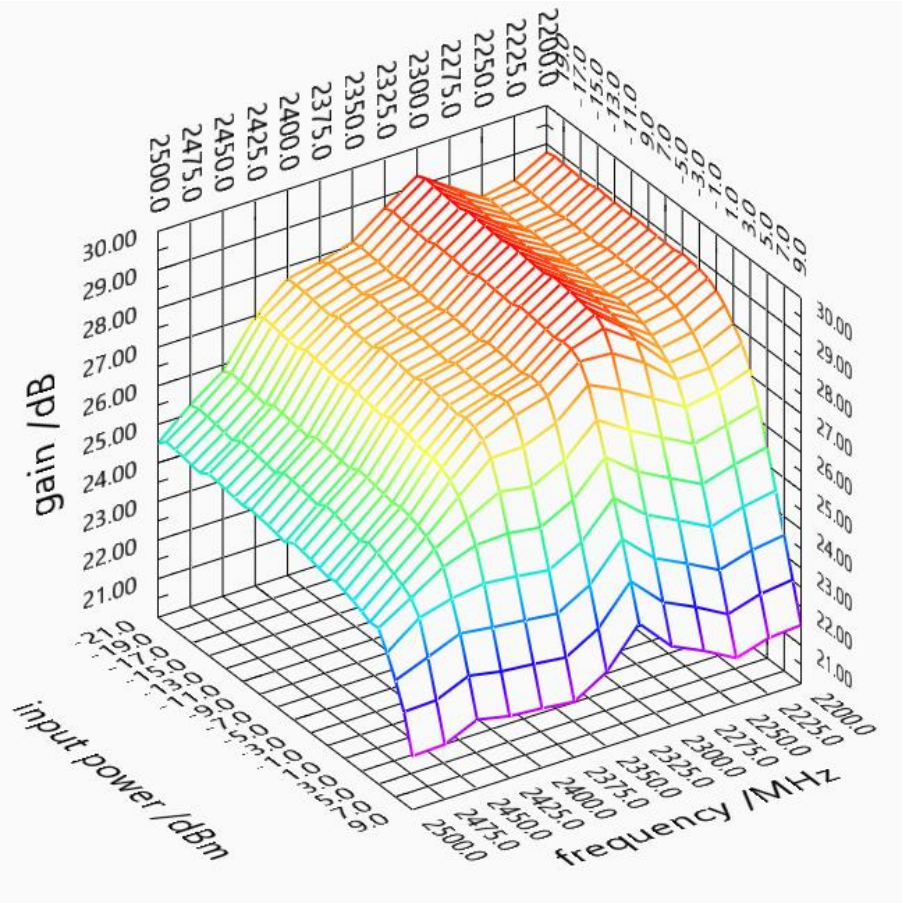
The amplifier is operated in Class A mode. The quiescent current consumption of the amplifier is 410mA rising to a total current of 444mA at 1.15W RF output power. The maximum efficiency of the total amplifier is 21.5%.

In addition, I measured output power as a function of frequency and input power:

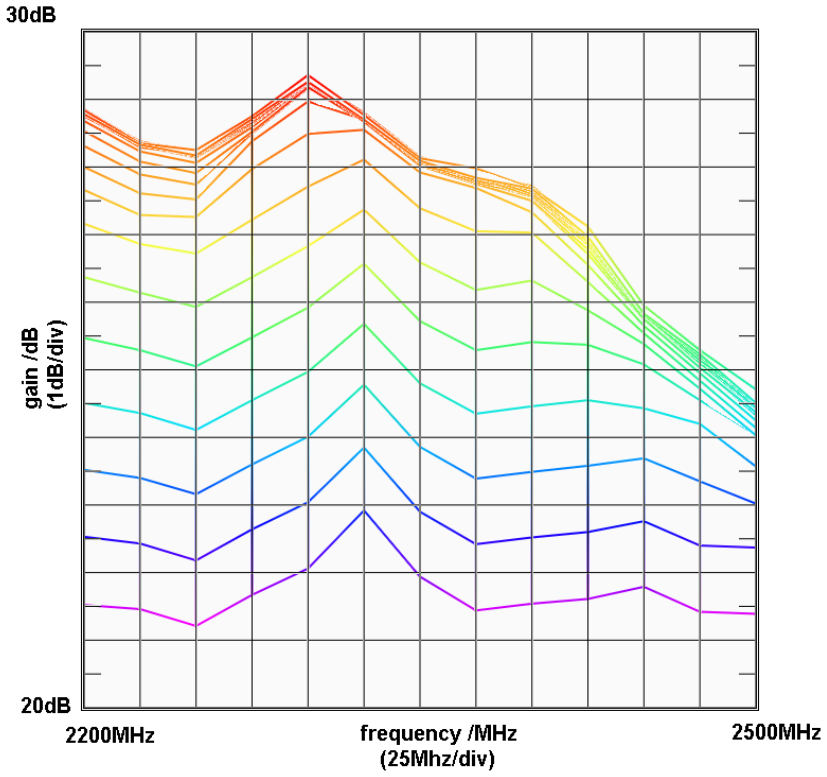


Maximum (saturated) output power is quite constant in the frequency range from 2200 to 2500MHz with a slight peak at 2325MHz.

Next, I measured gain versus frequency and input power. Gain peaks at about 2.3GHz with about 29.3dB.

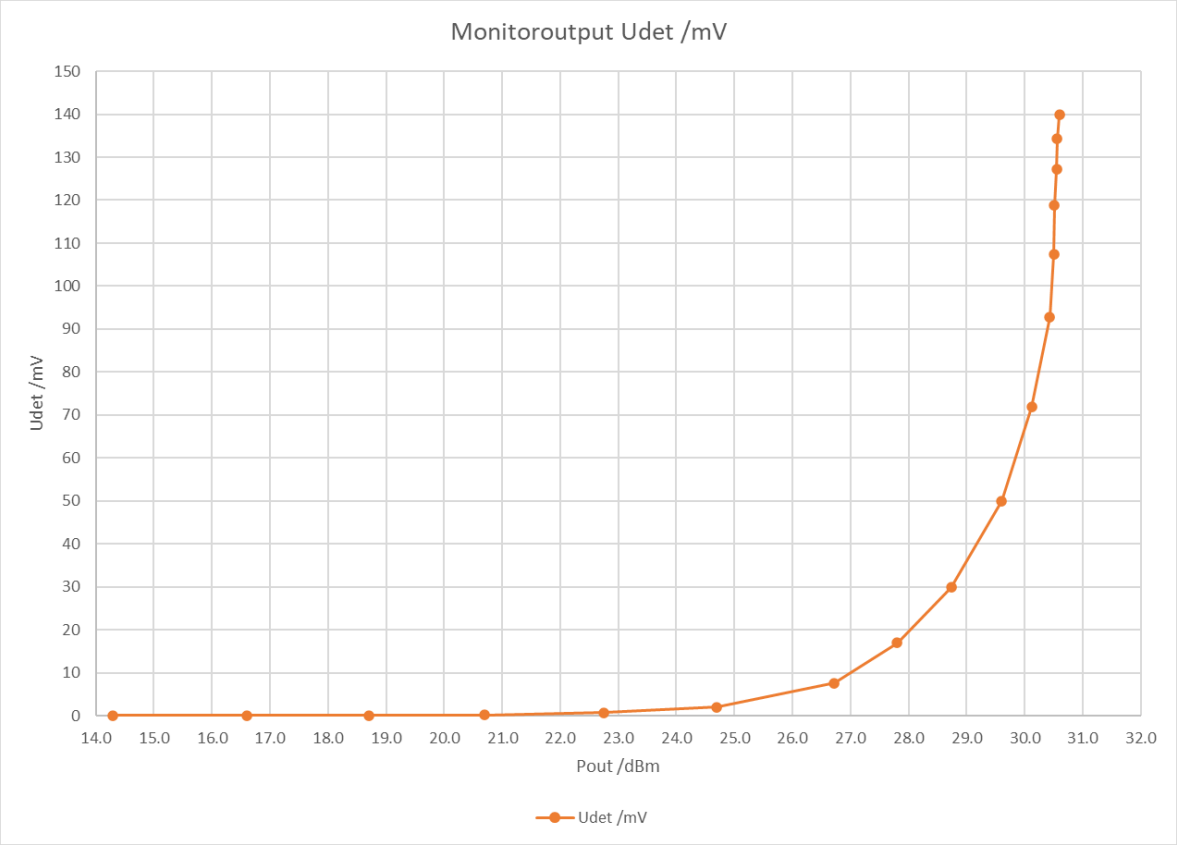


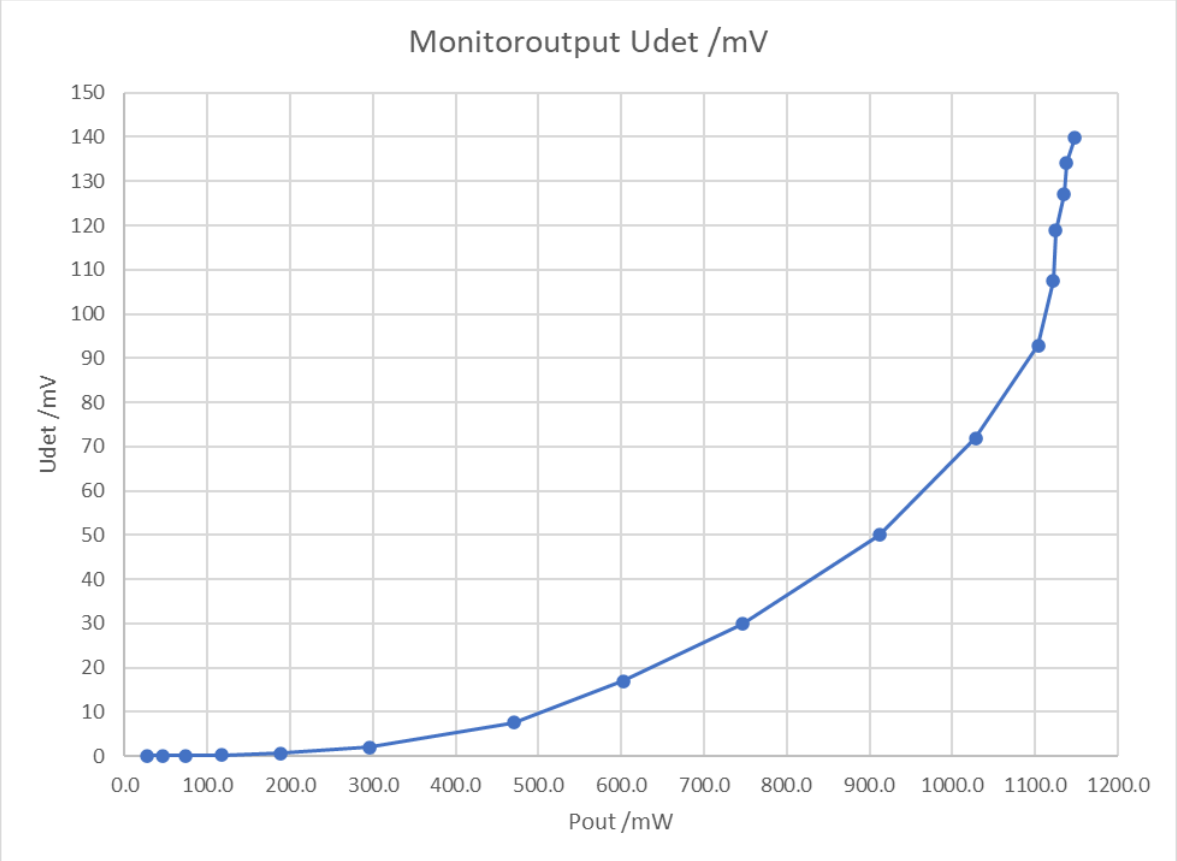
This is the same measurement as a 2D graphic showing grain versus frequency.



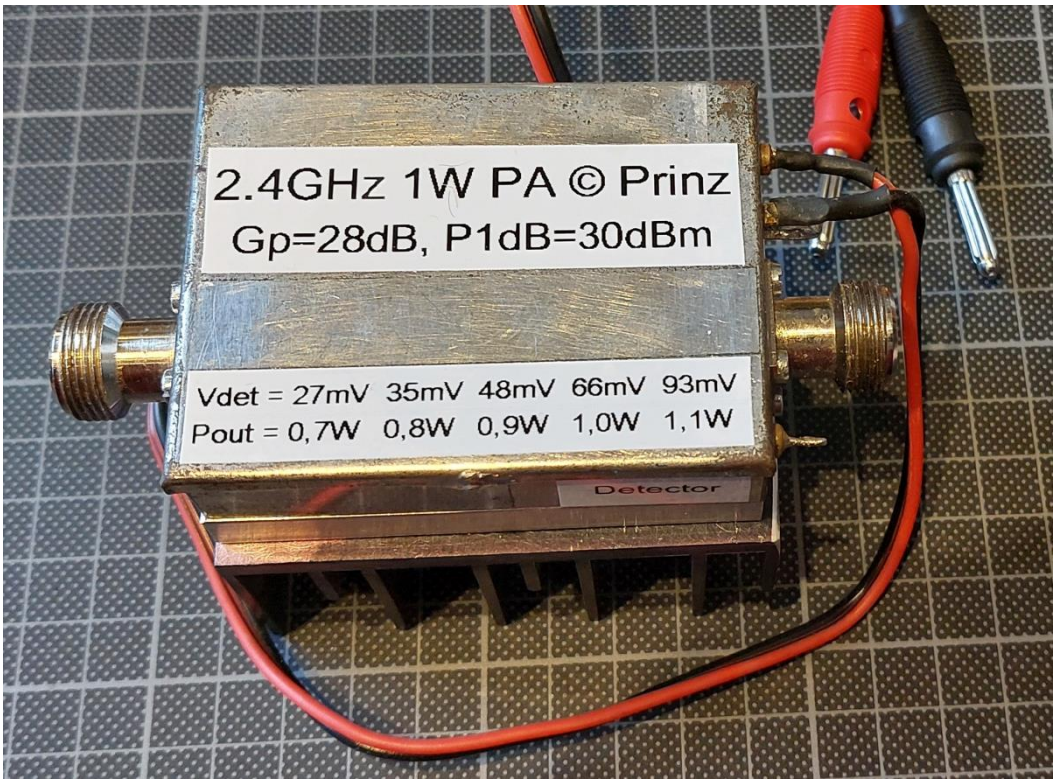
Input power was increased in 2dB steps from -21dBm (lowest curve) up to +9dBm (uppermost curve).

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

Matthias DD1US

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