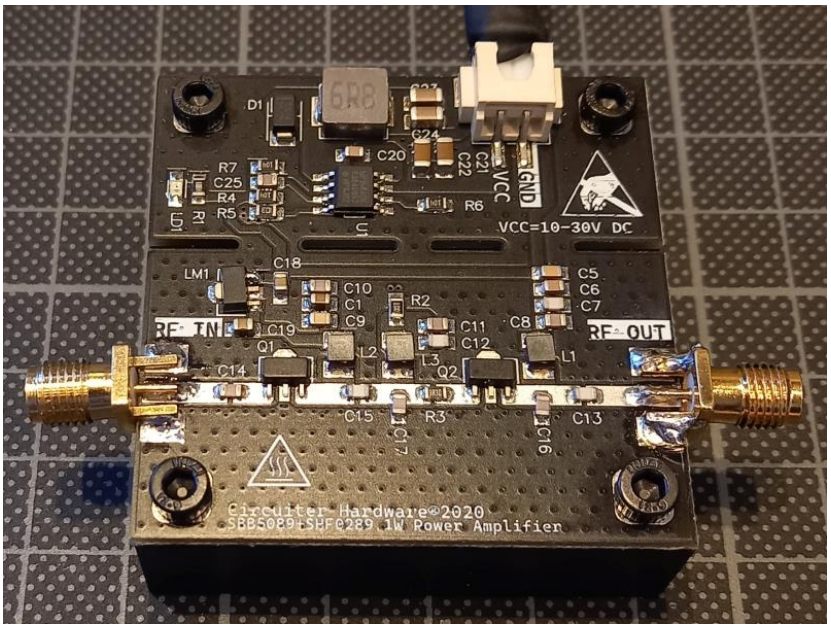
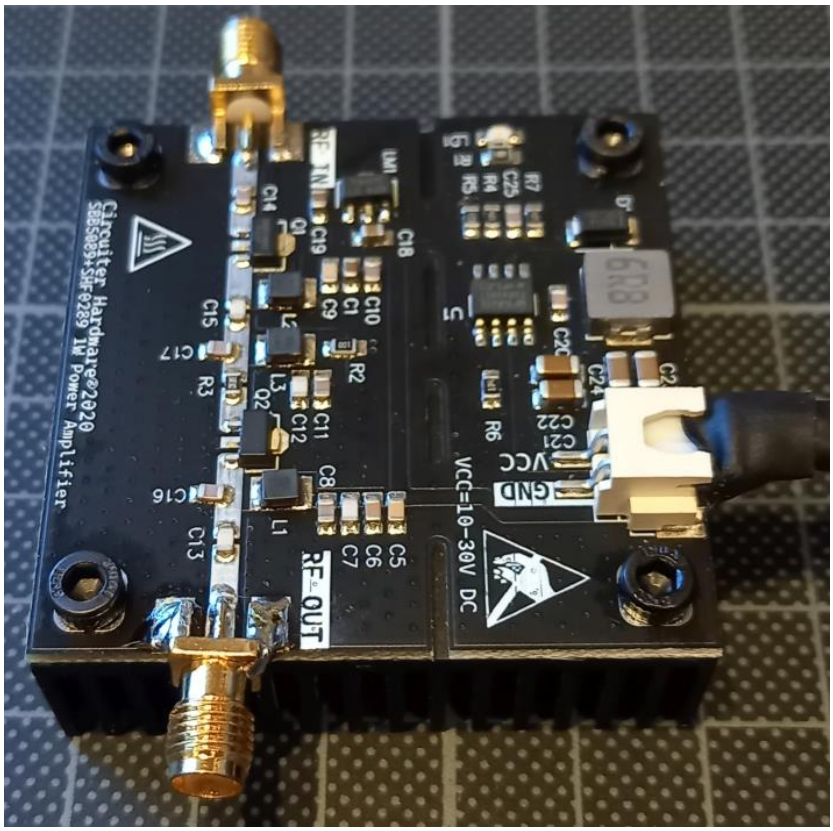
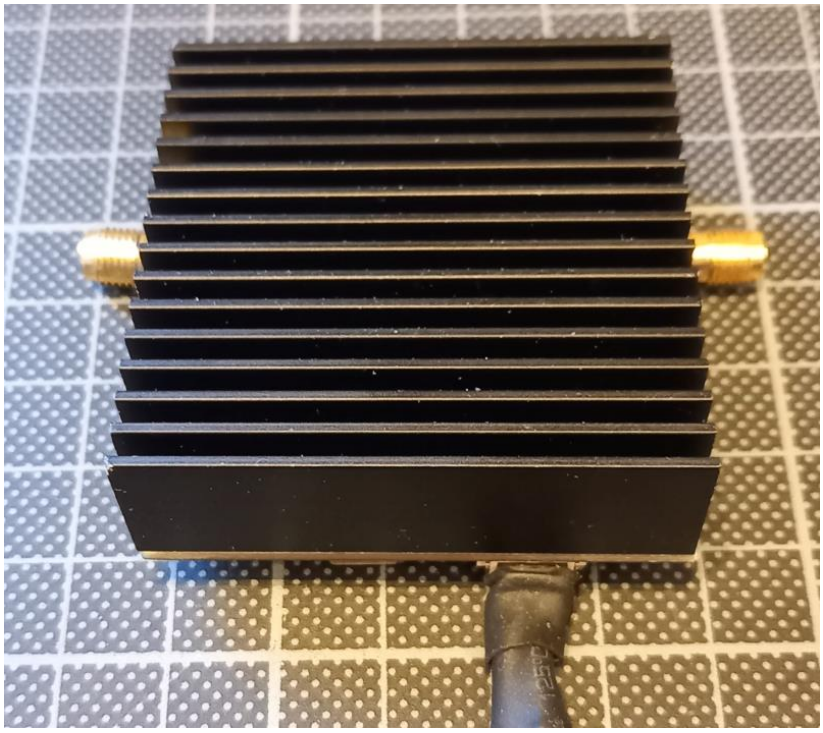
1-Watt Chinese Amplifier 100 – 1300 MHz

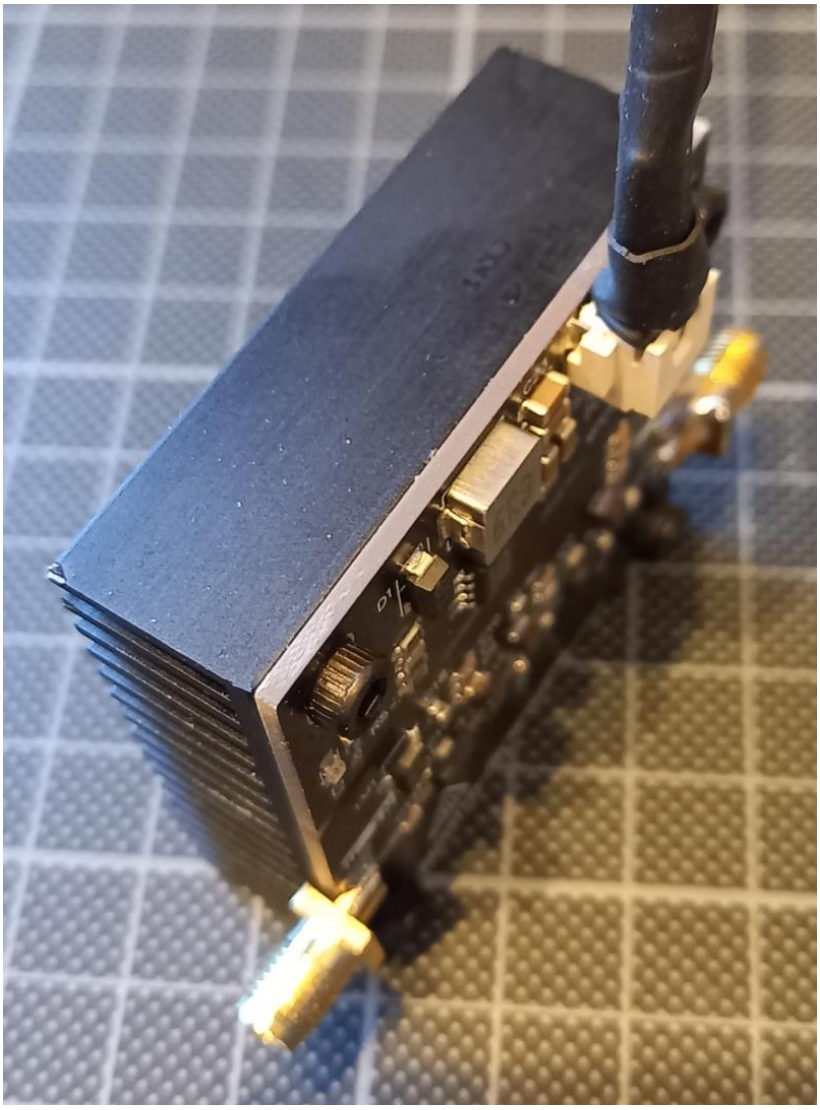
Matthias, DD1US, 24.4.2021, Rev 1.1

Recently I bought an amplifier module from China on Ebay. It is a module with a two-stage RF amplifier and a power management circuit (consisting of a DC-DC-Converter and a linear voltage regulator). The PCB is mounted on a heatsink. The two-stage design is comprised of two MMICs from Qorvo: an SBB-5089 (originally from RFMD) and an SHF-0289 (originally from Sirenza Microdevices). Here are some pictures:

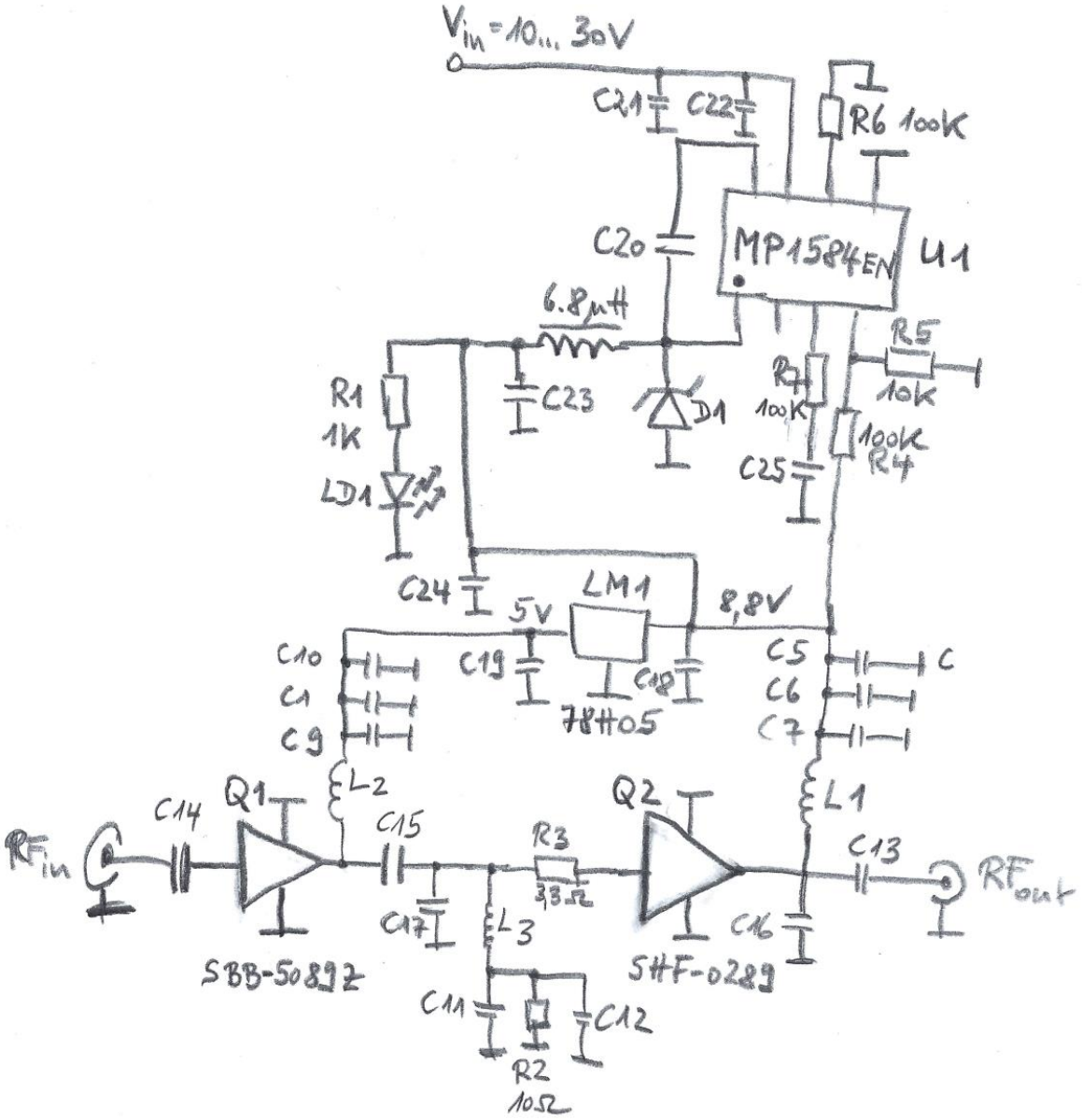








I did not find a schematic of the amplifier in the internet and therefore I created a sketch of it.



Q1 SBB5089Z
InGaP HBT
0.05 - 6 GHz
0.1 W

Q2 SHF2089
GaAs HFET
0.05 - 6 GHz
1 W

LM1 78H05
5V lin. reg.

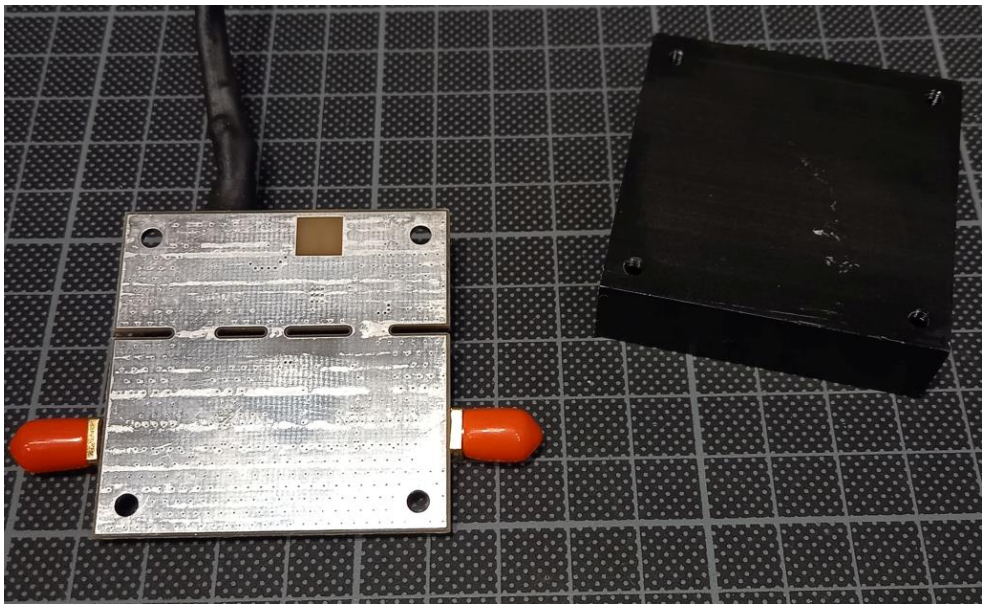
U1 MP1584EN
DC-DC-Buckconverter
5 - 28 V

The seller specified a supply voltage range of 10 … 30V, a DC input power of 5W, a frequency range of 100 … 1300 MHz and a gain of 25dB or higher. The specified RF output power is specified to be 1W or higher.

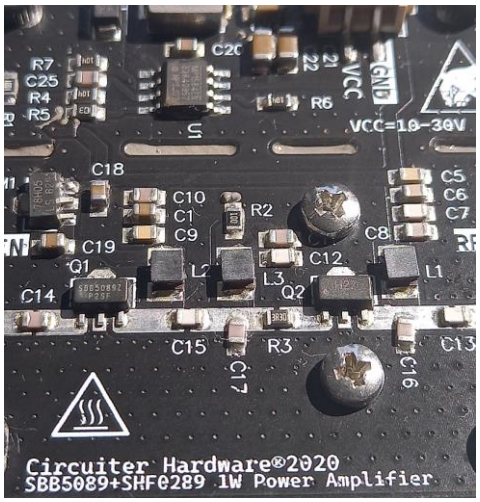
I checked the input voltage range and indeed, based on the switched mode power supply the output signal did not change with an input voltage range between 10.5 V and 30 V. The corresponding current is reduced at higher supply voltages. As the DC-DC-Buck-Converter is only specified for an input voltage up to 28V I recommend to use a supply voltage between 10.5 V and 28.

The first stage is supplied with the 5V voltage stabilized by the 78H05 linear voltage regulator. The second stage is supplied with the 8.8V voltage supplied from the DC-DC-Converter. As the absolute maximum rating of the SHF-0289 is 9V this seems to be marginal but ok.

The second amplifier gets quite hot and I checked how the PCB is mounted on the heatsink: there is not thermal grease used to minimize the thermal resistance. Also, in the datasheet of the SHF-0289 it is recommended to place screws close to the device which is not the case at the module I got. Below you can find a picture of the backside of the PCB and the heatsink:



Therefore, I added 2 M2.5 screws close to the second MMIC and mounted the PCB on the heatsink with some thermal grease (Arctic 5).



First, I measured the device first at 1300 MHz as I was considering to use it as a driver amplifier for my HPA in the 23cm ham radio band. With a supply voltage of 12V the current consumption was 386mA. Thus, the input power is 4.6 W.

Pin /dBm	Pout/dBm	Gain /dB
-20.5	+10.8	31.3
-10.5	+20.9	31.4
-0.5	+26.6	27.1
+9.5	+27.0	17.4

Thus at 1300 MHz the maximum output power is 0.5W and the associated gain is 17.4 dB. The small signal gain is 31.3dB.

Next, I measured the same amplifier at 435 MHz. The basing was the same, with a supply voltage of 12V the current consumption was 386mA.

Pin /dBm	Pout/dBm	Gain /dB
-20.3	+16.0	36.6
-0.3	+31.0	31.3
+9.7	+30.8	21.1

Thus at 435 MHz the maximum output power is 31 dBm = 1.25 W and the associated gain is 31.3 dB. The small signal gain is 36.6dB.

Finally, I measured the device at 145 MHz. The basing was the same, with a supply voltage of 12V the current consumption was 386mA.

Pin /dBm	Pout/dBm	Gain /dB
-10.1	+27.9	38.0
-5.1	+29.9	35.0
-0.1	+29.3	29.4

Thus at 145 MHz the maximum output power is 1W and the associated gain is 35 dB. The small signal gain is 38 dB.

Possibly the output power could be slightly improved by changing the output matching of the second stage. I might give this a try in the future.

Also I am planning to replace the SMA-connectors by SMA-Flange connectors with 4 holes. 2 of the holes will be screwed into the heatsink. This should make the setup mechanically much more rigid.

Given the price of only 11 Euros including shipping this module is a nice broadband amplifier to boost the output level of typical signal generators for testing power amplifiers.

If you have comments or suggestions, please send them to my Email address which you can find below.

Kind regards

Matthias

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