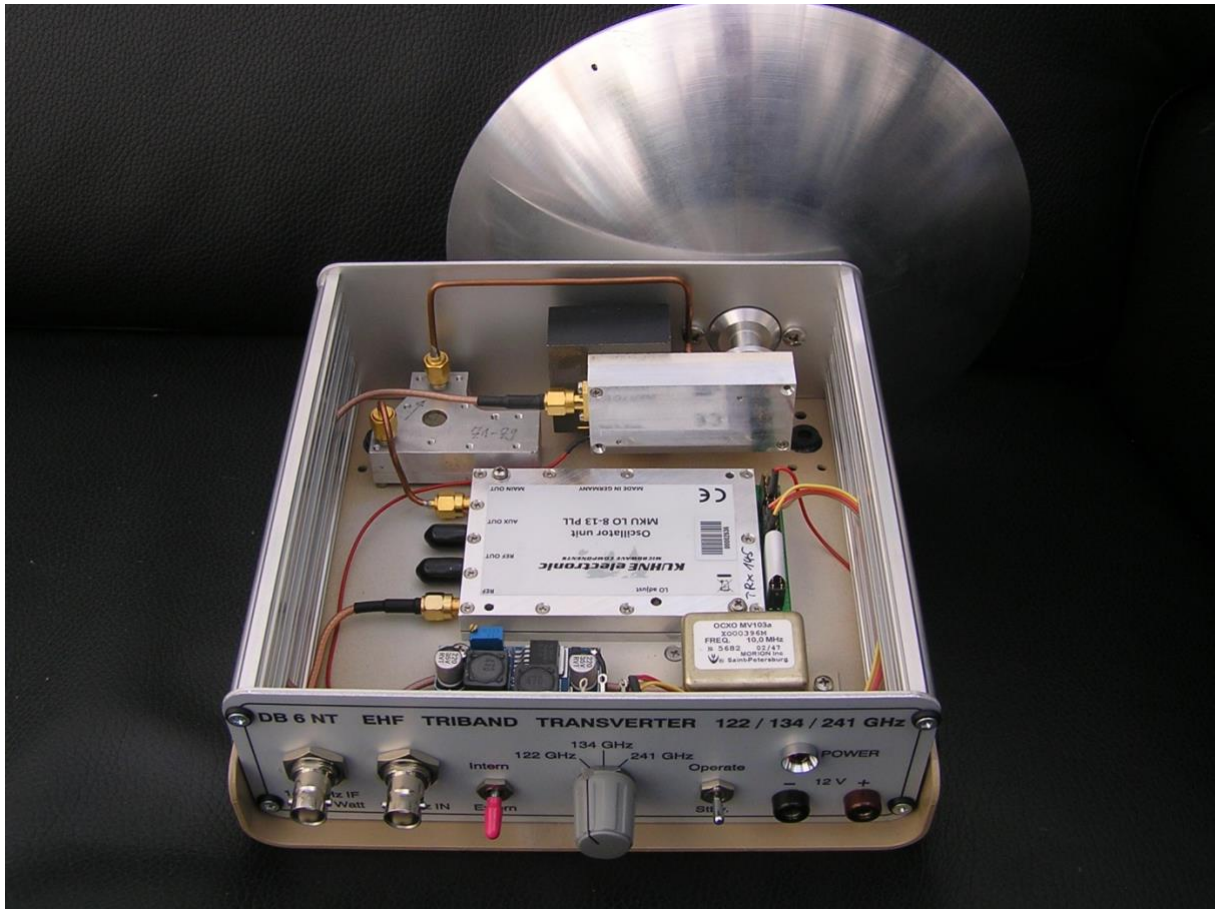


Triband Transverter for 122 – 134 – 241 GHz

DB6NT



In order to realise the idea of a triband transverter it was necessary to extend the range of the oscillator processing to the state that all needed frequencies can be generated for the supply of the mixer.

On the bands of 122 and 134 GHz this should be realised by a subharmonic mixer. This means that the half of the original LO frequency is needed.

At 241 GHz the mixer is to be run on a quarter of the frequency of the LO.

While doing this on the 122 GHz band and an IF of 144 MHz you come to a LO frequency of 61,053 GHz. At 134 GHz you get a 67,392 GHz LO and at 241 GHz it is a 60,444 GHz LO.

Therefore, the frequency editing of the LO has to work in the range of about 60 to 67,4 GHz. Since I couldn't get readymade modules on the Surplus market I looked for a multiplier chip to solve this problem.

At a LO output frequency of 8 GHz I chose the quadrupler CHX2095 followed by the doubler CHX2192 made by UMS. Next to this is the amplifier stage stocked with the Chip HMC ABH209 made by Analog Devices. These chips can cover the whole frequency range needed. There are small limitations when it comes to the higher frequency range (134 GHz). Here is the data a little worse than in the low frequency range.

Unfortunately, these semiconductors are not available in a SMD-version but they have to be built-in as a chip respectively they have to be bonded.

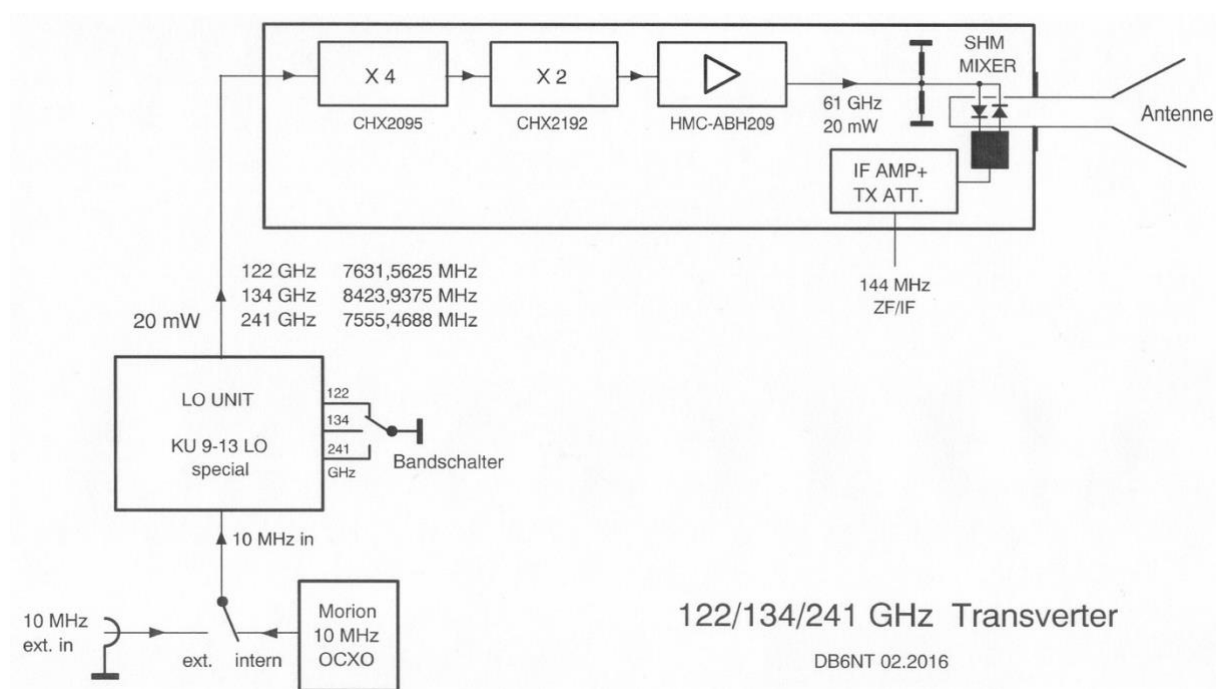
The mixer is constructed with Russian antiparallel schottky diodes. I still had some of the Russian company SALUT ELECS Ltd available. The Type 2A147A-2 (A91147-1) has a junction capacity of only 8 fF and is located in a Beam-Lead case. I also think the MACOM diode MA4E1318 (20fF) would still be suitable for this. The diodes are directly glued on the circuit board (silver conductive H20S). The position is directly above the waveguide (WR7/8) which leads through the bottom plate and is soldered. The waveguide can be reduced in its height at this point in order to provide a better adaptation to the mixer. A brass structure with short circuit slide is screwed onto the circuit board from above.

The mixer is connected to the LO side with a high pass (2 times $1 / 4\lambda$) and to the IF side with a low pass (trace Z).

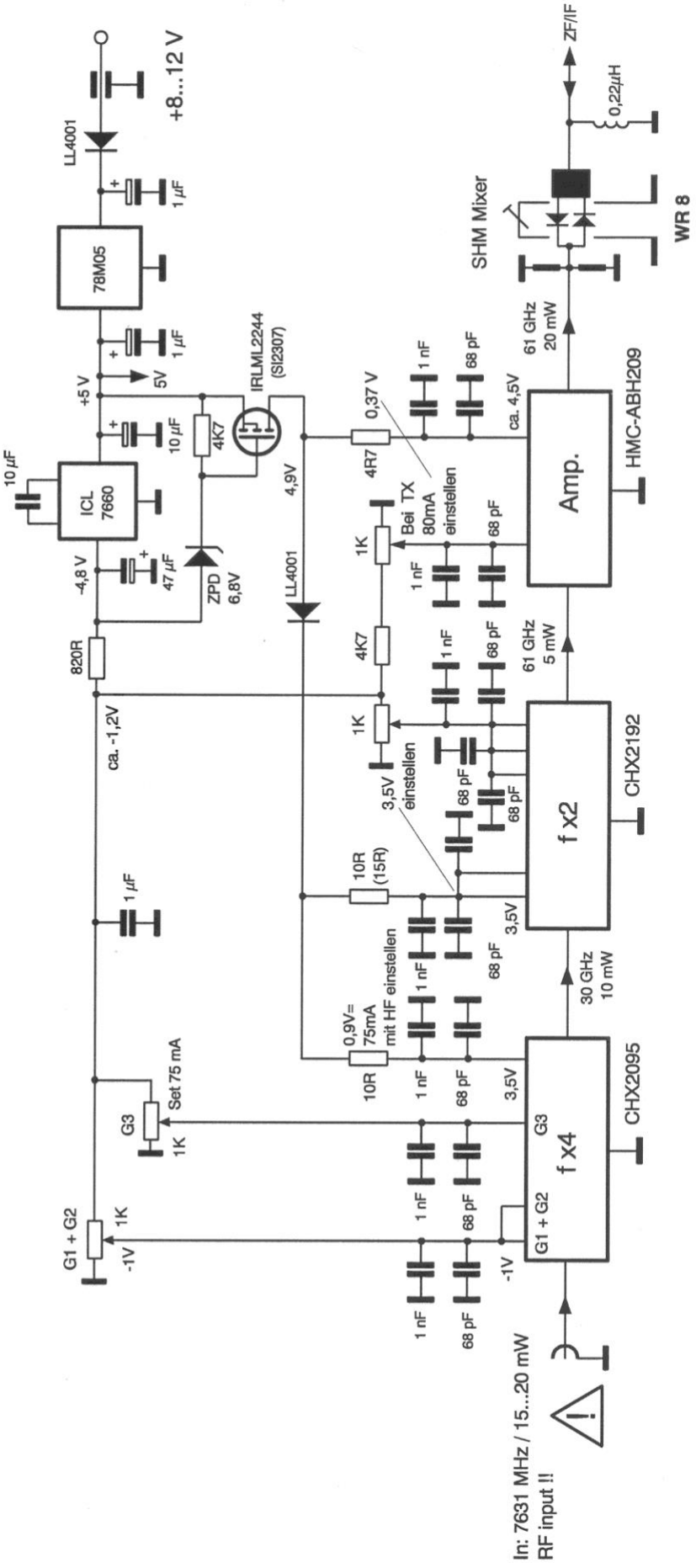
The construction is carried out with a RT 5870 / 0.12mm Teflon conductor plate, which is soldered to a 5mm brass plate.

Band switching occurs only by switching the LO frequency. A modified MKU LO 8-13 PLL is used as LO.

If the module is only equipped with a diode in the mixer, it can also be used as a CW transmitter. As a mixer / transverter it is to be used only conditionally.



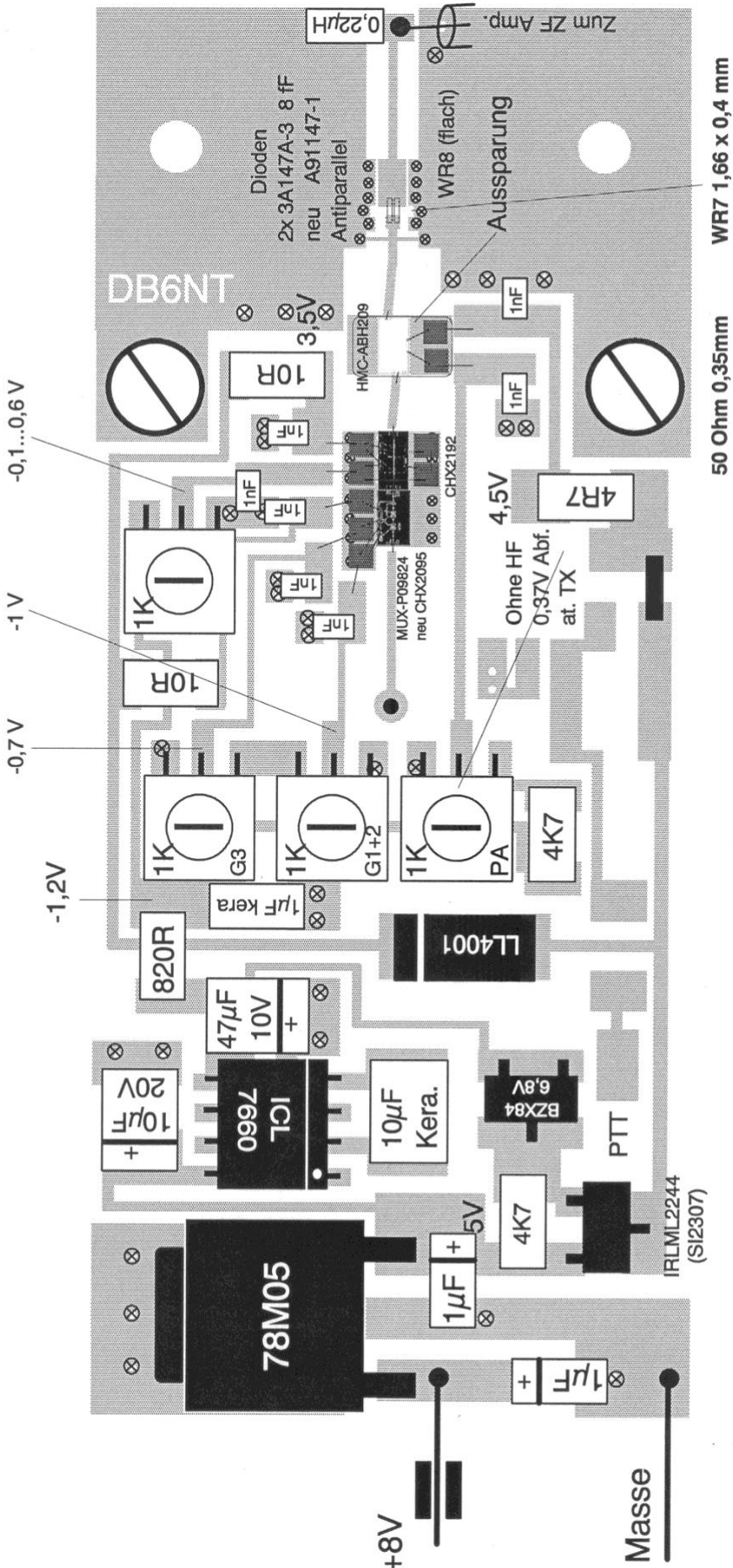
122/134/241 GHz Transverter DB6NT 02.2016

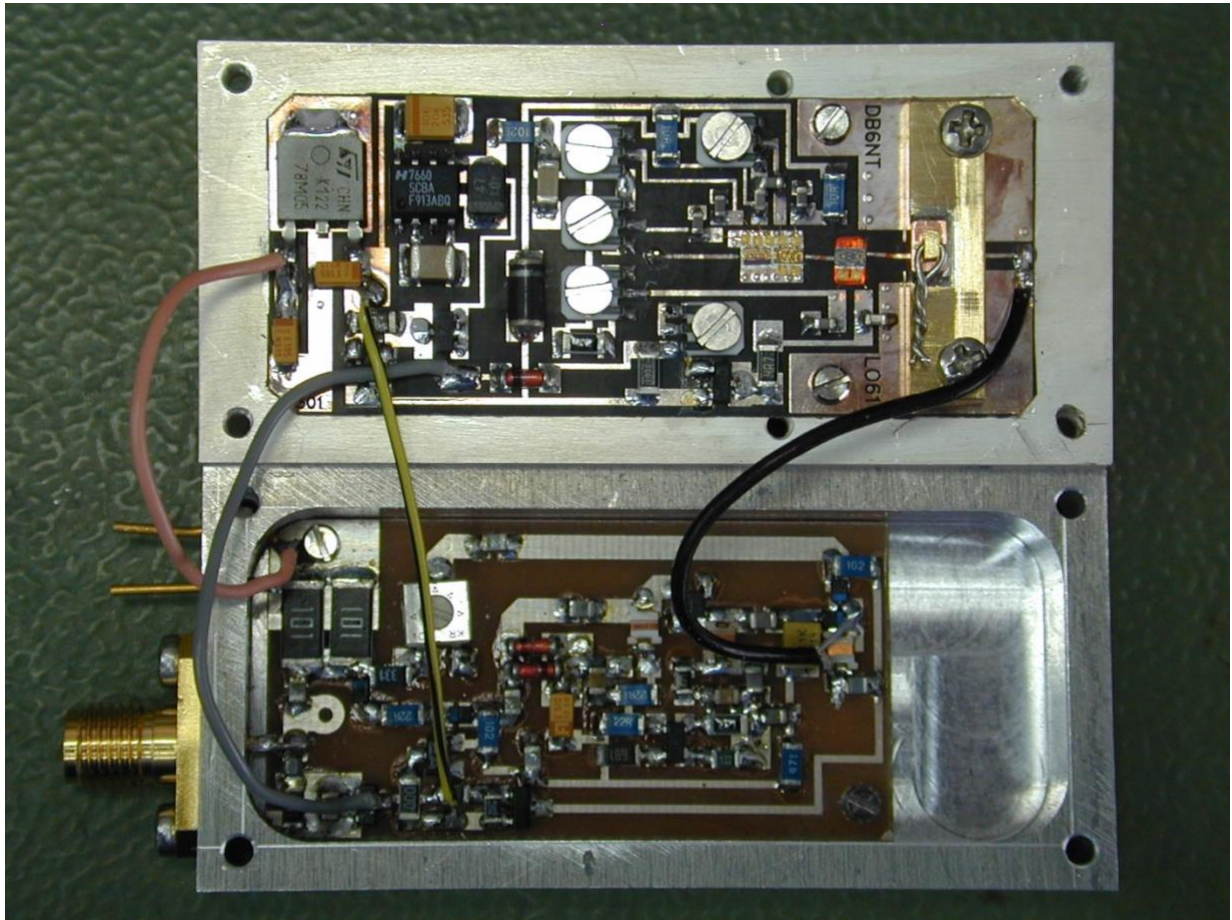


122/134/241 GHz Transverter DB6NT 02.2016

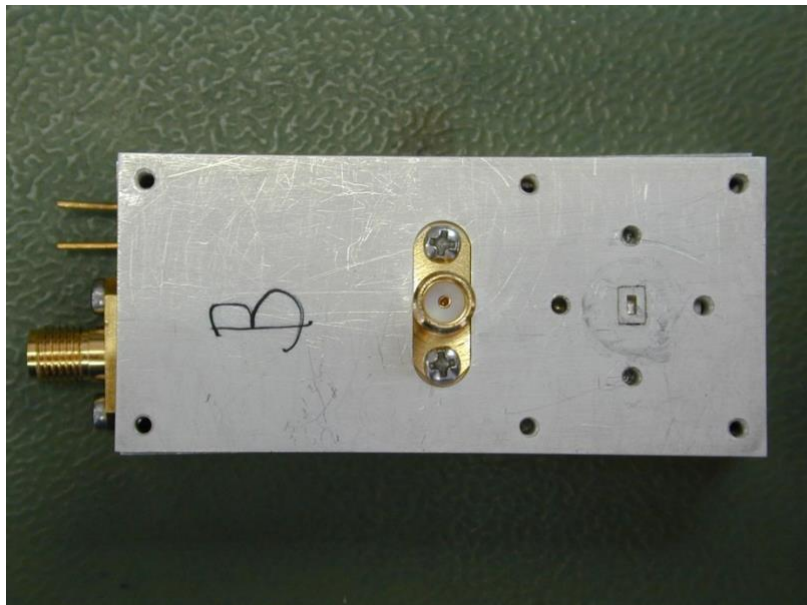
RT5870/0,12mm

Spannungen mit HF gemessen, Wenig Unterschied.

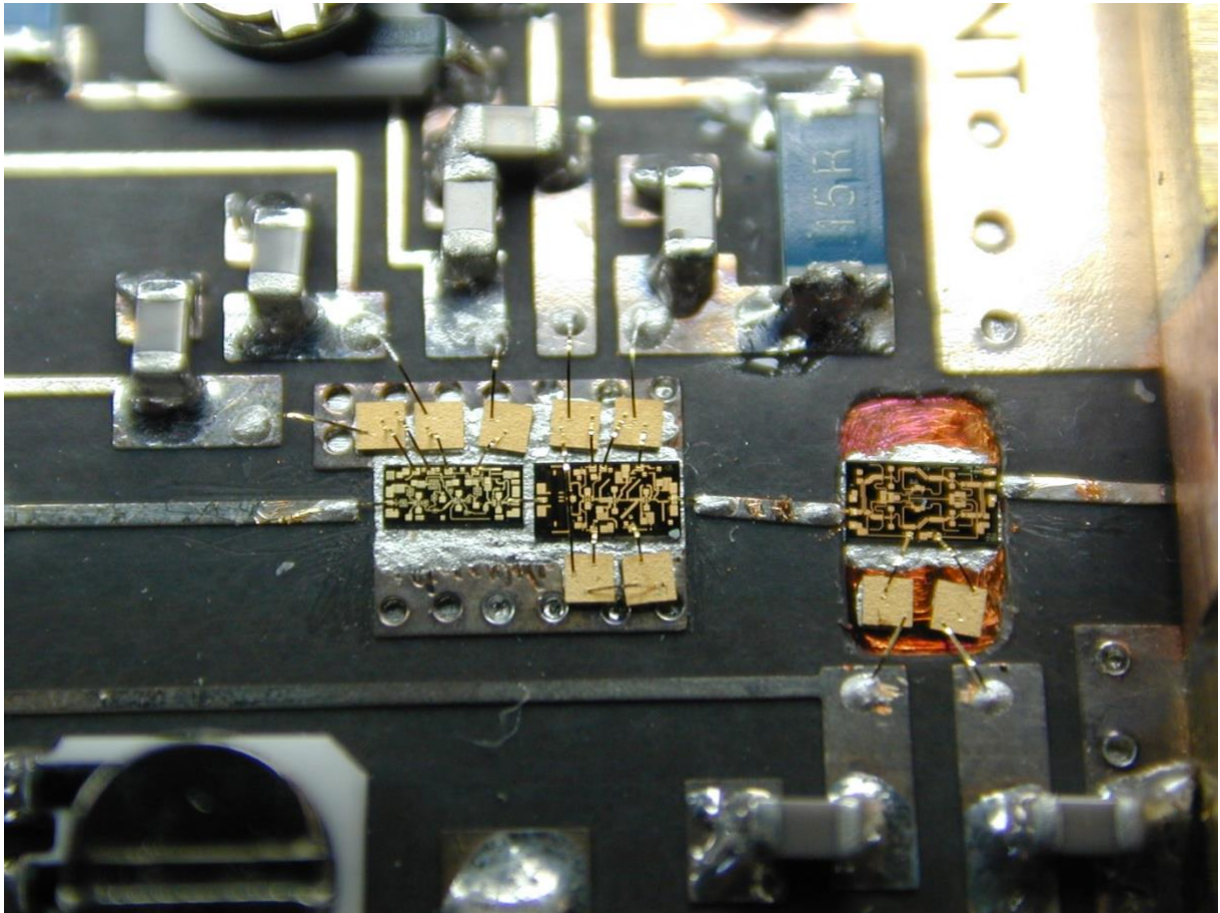




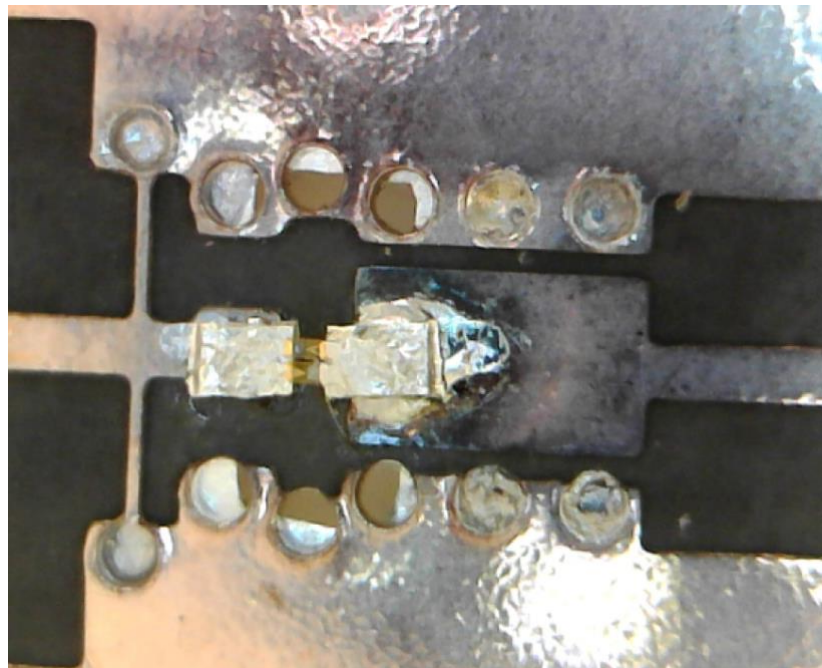
This pictures shows the open Transverter. The IF part with power supply is located in the cover.



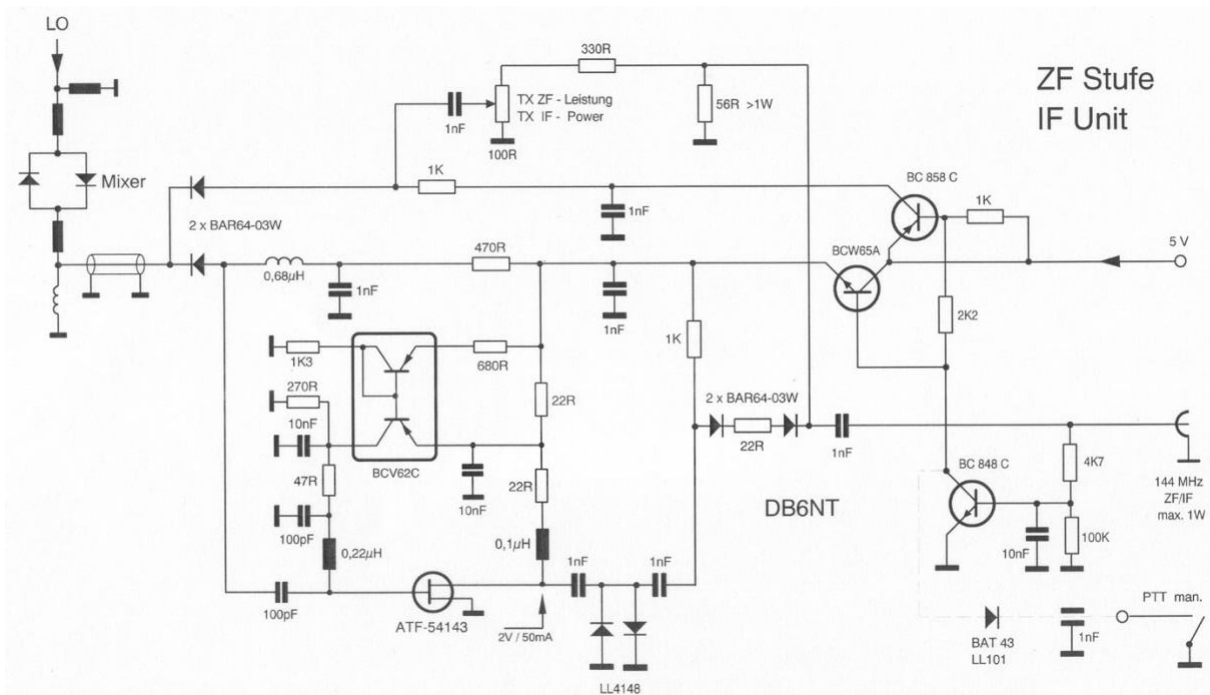
The bottom of the transverter module. To the left is the IF socket, in the middle the socket for feeding the LO frequency and on the right the RF waveguide flange with the copper cable conductor inserted and the flange holes. On this set-up, no pins were used.



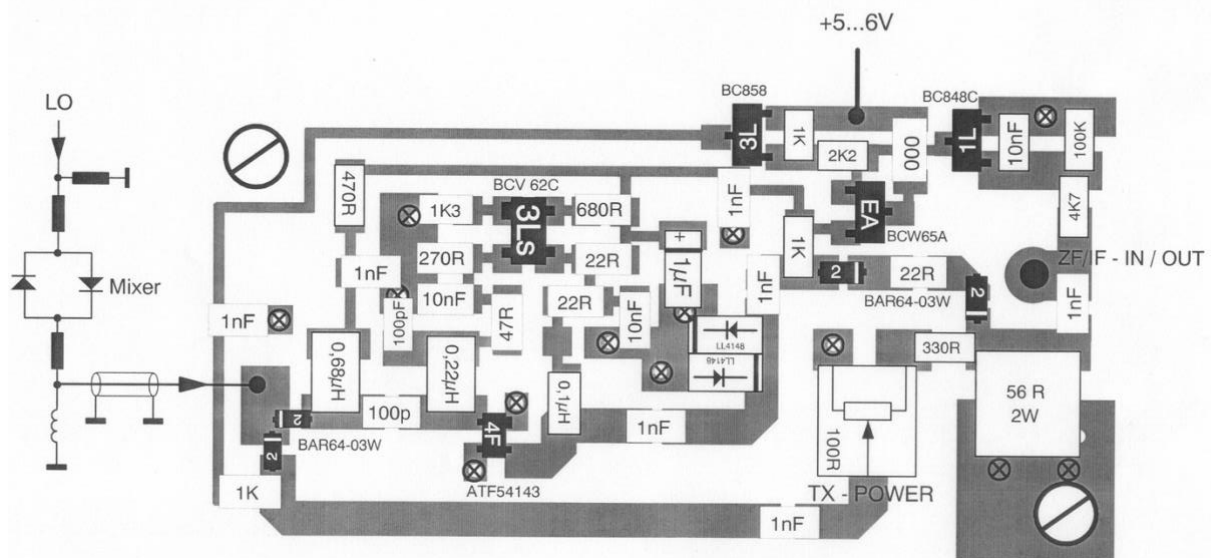
Construction of the oscillator multiplier chain as well as the amplifier stage. The amplifier is soldered directly to the base plate. For this purpose, the plate was milled at this point.



The picture shows the beam-lead diodes mounted with silver conductive adhesive above the waveguide below the printed circuit board.



ZF - Verstärker für mmWave Mixer DB6NT 06.2006



The adjustment of the multiplier stages starts with the feeding of the 8 GHz oscillator signal with approximately 10 ... 20 mW, as well as the control by the 144 MHz transmission signal. The TX signal can be observed at the transverter output. For this purpose, a second transverter or a spectrum analyzer can be used. Thereafter, the gate voltage G1 / 2 of the CHX2095 is set to -1V. Now the currents of the further stages are set. Now a signal at the output is measurable. By changing the operating currents of the stages and the 144 MHz IF control, the maximum output signal is optimized. The short-circuit valve on the mixer must also be optimized. However, the adjustment of the slider is always only optimal for one band and thus represents a compromise for the 3 band transverter.

On the receiver side, a noise change is detected by switching the 8 GHz oscillator on and off. A separate receiver adjustment is not required. Three transverters have been set up and adjusted. The noise figure achievable at 122 GHz is 12 dB NF, at 134 GHz approximately 14 dB NF. These measurements were performed with a noise tube type. TN-167 from Clare, and confirmed by a differential measurement "cold sky" to soil. The sunshine noise could also be detected. The measurements at 241 GHz are still outstanding, but should be 10 ... 20db worse. For operation in the 241 GHz band, an upstream high-pass filter must be used or a different IF frequency should be used; otherwise, you can work without notice on only half of the frequency. The SSB output power is at 122 GHz at -7 dBm (0.2 mW). At 134 GHz the power is much smaller due to the smaller LO power. The LO suppression is at -15 dB at 122 GHz.

In summer first qsos on the 122 GHz band could be made with DG8EB under normal weather conditions over 52 km in SSB.

A 30cm and a 60cm dish were used. The first QSOs on the 134 GHz band and 241 GHz band have already been done.

My special thanks go to **Gert Weinhold DG8EB**. Gert built all 3 transverters in excellent quality and designed all micromechanical parts such as short-circuit valves and waveguide components. The gluing of diodes is also his specialty.

Another thanks goes to **Gerold Henning** who did the bonding work.

References:

Data sheet CHX2095

http://www.richardsonrfpd.com/resources/RelDocuments/SYS_25/CHX2095-99F-Full-0036.pdf

Data sheet CHX2192

http://www.richardsonrfpd.com/resources/RelDocuments/SYS_26/CHX2192-99F-Full-0204.pdf

Data sheet HMC-ABH209

<http://www.analog.com/media/en/technical-documentation/data-sheets/hmc-abh209.pdf>

Further descriptions are in the download section

<http://www.db6nt.de/download-archiv.html>