

## **Low noise relais switched 2meter mast mounted preamplifier**

This skript was translated by DL5DBM from the german skript of DK4MM, few modifikations were made to the concept and a new PCB-layout with a better RF-SHIELDING.

A low noise preamp is only of interest for the passionate 2meter enthusiast, who is interested in working via troposkatter, meteorskatter, sporadik E and EME. To do this he needs a preamp with low-noise and high gain capabilities in order to increase the performance of his station.

You get the best results in mounting the preamp as close as possible to the antenna-system, so that you can handle the Kabel-losses, or keep them as low as possible, and you increase the gain of the receiver.

Industrial manufactured transceivers have a noise-factor between 4 and 8 dB, so that the preamp would already make a great improvement being connected directly to the transceiver.

For example:

A receiver with a noise-factor of 6 dB, is connected with the Antenna through a 30 meter (RG213) coaxial cable.

30 meters of RG213 has a loss of 2,5 dB. So the noise-factor increases to  $6+2,5=8,5$  dB

A preamp mounted directly beneath the antenna-system with a gain of 16 dB and a noise-factor of 2 dB would do the following:  $8,5 \text{ dB} + 2 \text{ dB}$  (preamp-noise-factor) - 16 dB of Gain, provide a overall-gain of about 6 dB's

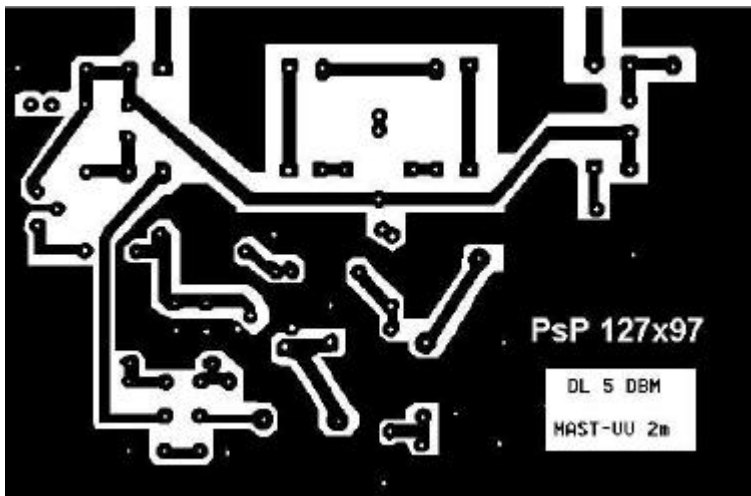
In another way, it is crazy and not efficient enough riding on the noise-factor ratings of equipment, because, the natural (temperature) radiation of (3 dB) and cosmic radiation by 100° Kelvin still gives (1,2 dB) noise, not forgetting the QRM (man made noise). So, an antenna pointing to the cold sky, receives a lot more noise than the 0,8 dB noise produced by the preamplifier.

The higher the Frequency the lower the natural noise gets, so working on high Frequencies increases the importance of using low-noise-preamps (70 cm and higher).

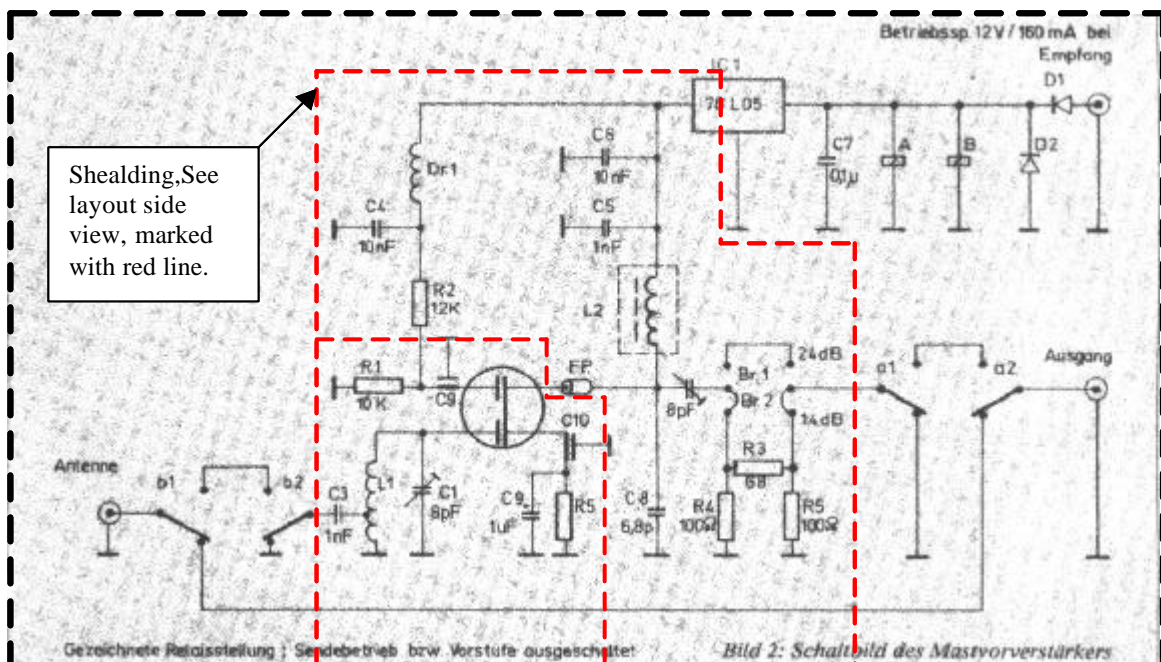
The concept used in this case, showed us a very high reliability, and it was not necessary to use expensive coaxial relays to do the switching. Relays type used here is for 250 VAC, laid out for a current of 6 Amps, and low contact resistance. The feedthrough losses are approximately 0.3 dB, the contacts in the printed-board-relays are silver plated and the connections of the N-Sockets are soldered directly to the printedboard.

When the supplyvoltage is added to the preamp the relays are activated and the preamp is in function, so in case the supplyvoltage fails during operation, the relays fall to their inactive position and bypass the in- and out-going signals so that the preamp won't be destroyed by transmitted power.

## Etchingpattern foil side (MMVBOARD.JPG)



The dimensions of the PCB are 110 X 73 millimeters and would fit perfectly into a shielded-box.



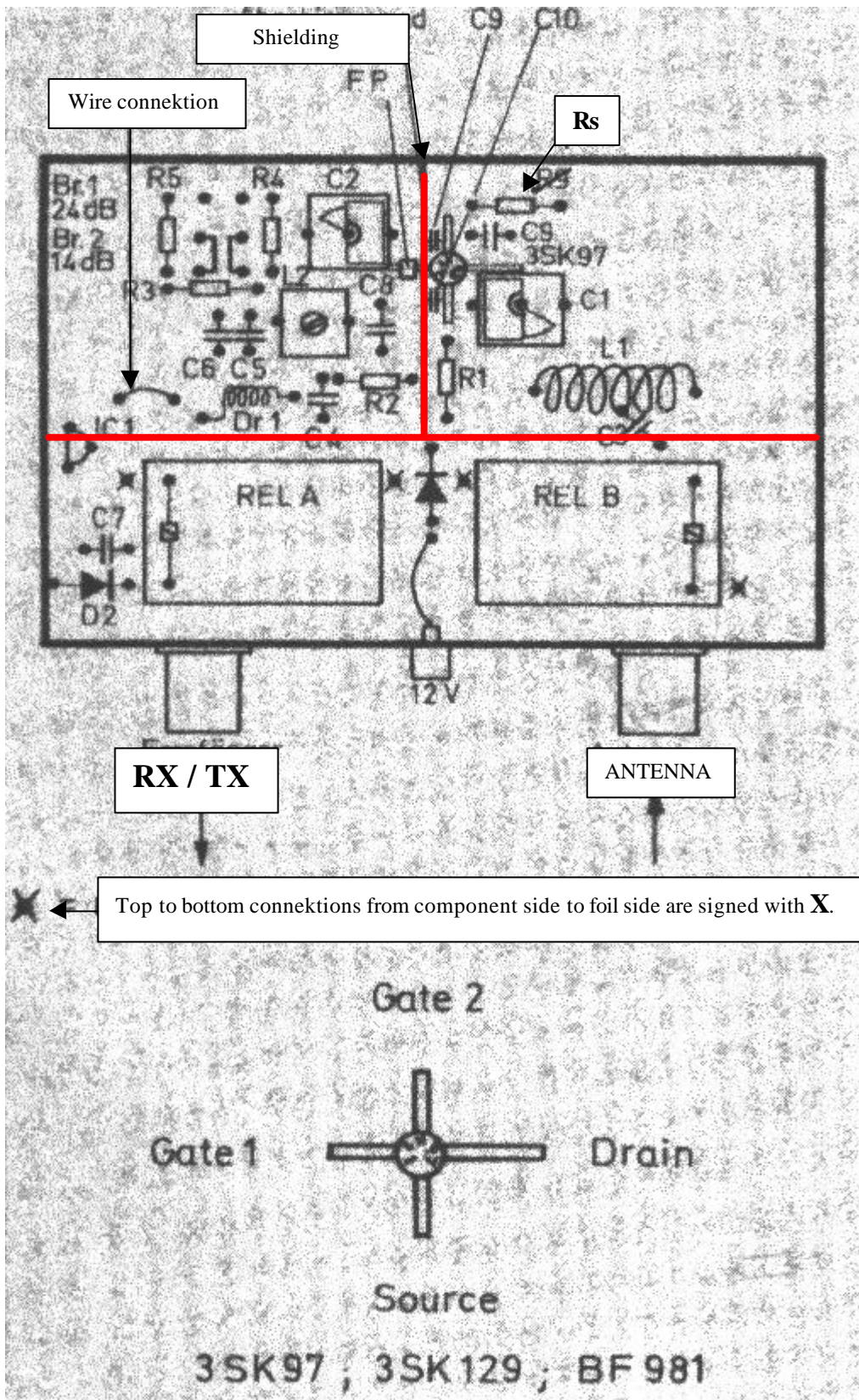
Preamp is switched in transmitting mode

### The input circuit (L1 and C1)

L1 is an air wound coil made of 7 turns of 1,5 mm silverplated copper wire, wound on a shaft with a diameter of 6mm. C1 is a 8pF print mount ceramic air capacitor.(TRONSER)

The antenna is tapered to L1 at 2,5 Windings from the cold side. The tapering point must be found by experimenting, because the noisefactor of the preamp can be tuned for lowest response by this feature.

The amplifikation can be reduced from 24 to 14 dB with a 10dB attenuator at the output of the preamp.(R3, R4 and R5), to fit to different kabel lengths or to reduce input signal strength to the resciever.



Use Transistor with it`s printed side up.

The value of the source resistor (Rs) depends on the used transistor and the drain current.



Depending on strong signal depressing and noise figure we recommend a drain current between 8 mA and 15 mA. The value of **Rs** varies between 150 Ohms for DG-GaAs-Fet (3SK-97), 27 Ohms for DG-Mos-Fet (BF981), or 61 Ohms for a 3SK-129. IC 1 is a 5V regulator and is only for use with DG-GaAs-Fet's, for the use of a DG-Mos-Fet you should replace the 5V regulator (78L-05) with a 12V type (78L-12)

D1 is only for polarity protection.

D2 is for induction voltage suppression over the relay coils as soon as the voltage is taken off.

The preamp is built on a double-sided PCB, the component side is only for screening and grounding circuit components.

### **Testing and adjusting the preamp.**

1. Connect DC voltage to the preamp, **the relay must pull.**
2. Check drain current "**I**", you must measure the voltage drop over **Rs**, and use following formula, ( **$I = U/R_s$** , **U is the measured voltage**)

**For example:** You used in your construction a resistor of 150 Ohms for **Rs**, and you measure a voltage drop of 1,8 V over the resistor. Put these values to the formula ( **$1,8V / 150 \text{ Ohms} = 0,012 \text{ A} = 12\text{mA}$** ) and you get the drain current "**I**" of **12mA**.

If not, you must change the value of **RS** to get a current between 8 and 15mA.

3. Connect the preamp to a receiver, and enable the 10dB attenuator,
4. adjust the capacitor C2, to 50% of its value,
5. put the frequency to match 145 MHz (USA 146 MHz) for band coverage, or main operating frequency (SSB or satellite section), in SSB-mode
6. Adjust L2 (helical-filter) and C1 (input capacitor) to obtain maximum signal or noise figure-readout on the S-meter of the receiver.
7. Adjust C2 and L2 for maximum reception.
8. Search for a weak signal and tune C1 carefully to higher capacitance while listening to the signal, to obtain a better signal to noise figure ratio. The signal strength might drop slightly.

This method of tuning the preamp is only a help, you should rather tune it with a noise-generator and spectrum analyzer to get best performance.

### **IMPORTANT-NOTE**

To prevent damage to the transistor through RF-POWER, you should use a switching-unit (SEQUENSER) with this preamp, manual switching is not acceptable and dangerous. Have a look at the ARRL-HANDBOOK for solutions to this problem.

I personally have made very good experiences with this preamp, and I use it for contests on 2 meters. The preamp can manage RF-OUTPUT POWER till to 1KW. That is the maximum power I have.

I recommend you, to use N-Sockets and Plugs for high power and best performance.

A good antenna is important because the preamp can only amplify signals that reach it, if it gets **rubbish**, it amplifies **rubbish!!!!**

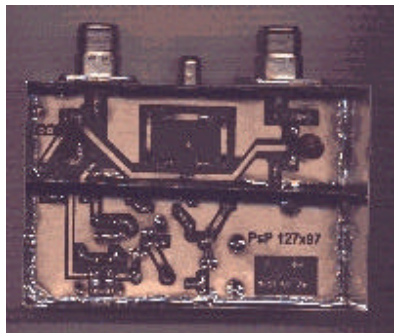
## PARTS - LISTING

<u>Amount</u>	<u>Part</u>
1	metal tinned case 74 X 111 X 50 mm
2	N-Sockets
1	Chinch-Socket (for supply voltage)
2	relais Typ. REL 37 with 2 switching contactts each, Manufakturur ERNI in Germany.
R1	10 KOhm
R2	12 Kohm
R3	68 Ohm
R4, R5	100 Ohm
<b>Rs</b>	150 Ohm for 3SK97, CF300, S3030,or 27 Ohm for BF981, or 68 Ohm for 3SK129.
T1	3SK97, BF981, 3SK129,CF300, S3030
C1 and C2	8pF cheramik air capacitor (Tronser)
C9 and C10	1nF cheramik chip capacitors
C3 and C5	1nF cheramik
C4 and C6	10nF cheramik
C8	6,8pF cheramik
C7	0,1uF bipolar
C9	1nF/35V Tantal-Elko
L1	7 turns of silvercoated copper wire, with a Diameter of 1,5 mm, wound on a 6mm rod. Taperd at 2,5 turns from cold side.
L2	TOKO 100 112 or Neosid Type...BV511830 If you use TOKO then you have to largen the space of the holes on the PCB
Ferrit bead	3mm
IC1	78L-05 or 78L-12 depending on Transistor.
D1	1N4007
D2	1N914 or 1N4148
DR1	is broudband choke (UKW Type) , six hole Ferrit with 2.5 windings.

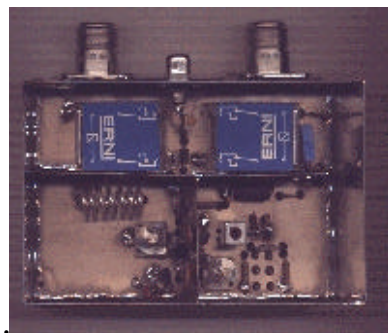
**Use only if necessary because of noise figure**

Optionally you can use antiparalell switched diodes (1N4148) at the input and output of the circuit to increase protection of the transistor. (Paralell to C1, and connecting between output side of C2 to ground on the solder side.

**solder side**



**component side**



**In case of any question to this projekt, please kontakt me via email**

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**I will try to answer your questions as fast as possible.**

**Sorry for my poor english, but I am out of praktice!**

**73 de dl5dbm, Anwar, jo32wo**