



project
Amateur Radio

DL-QRP-AG



Hohentwiel

144 MHz SSB / CW Transceiver

Content:

Preface	3
Description of the DK1HE 2m QRP SSB/CW-Transceiver, the „ Hohentwiel „	3
Preface:	3
Description of the individual sections:	4
133 MHz VCXO :	4
2 meter RF section:	7
Description of the receiver chain (RF board)	7
Functional description of the transmitter chain (RF board)	7
10,7MHz IF section:	8
Functional description of the receiver chain (IF board)	9
Functional description of the transmitter chain (IF board):	9
Control board :	10
Control board components	12
Components of the IF board	15
Components for the VCXO	18
Components for the RF board	21
Winding instructions:	24
Neosid filter kits series 7.S :	24
Neosid filter kits series 10:	24
Trimming of the individual sections:	24
133 MHz VCXO :	24
2 meter RF section:	25
10,7 MHz IF section:	25
Receiver tuning:	25
Transmitter tuning:	26
Control board:	26
Hohentwiel modifications	26

Preface

Please spend some time reading the Amateur Radio homebrew guide shipped with your kit by QRPproject. This guide contains background information, mostly for those of you, not so familiar with home brewing or kit building. Take a little time working through this material.

Should you have any problem or suggestions for improvement, please turn to Peter, DL2FI, he'll be glad to help you.

It's easiest to get to QRPeter via the email address support@qrpproject.de or by phone at +49(30)85961323.

The small print:

There is a great deal of small components in this kit. As many of us are growing older, these components can be the cause of problems. I strongly recommend a magnifying glass, to check the soldering points or component codes.

More small print

In spite of the care we took in creating this manual, errors could have slipped in. In case of doubt, the following is the prioritized list of authorities (most trustworthy first):

- the diagram
- photos and drawings
- parts list
- everything else

Please read every section completely, before you fire up your soldering iron. The important stuff isn't always in the first sentence.

Should you find any errors, please let us know! We enjoy constructive criticism. I supply correction notes as quickly as possible, as they make the product better.

Revised documentation is available on our home page at <http://www.QRPproject.de>. Please look up the proper kit.

If you don't have access to the web, you can call our support: QRPeter DL2FI +49(30)859 61 323

Description of the DK1HE 2m QRP SSB/CW-Transceiver, the „ Hohentwiel „

by Peter Solf DK1HE, dedicated to German QRP Club DL-QRP-AG and QRP-project.

translated by Peter Raabye, OZ5DW

Project coordination: Peter Zenker, DL2FI

Manual by **fi**project

Preface:

If you look through the last 20 years of QRP publications, you will notice that the maximum frequency seems to lie at a magical 28 MHz. This gives rise to some questions:

- Aren't we interested in the bands above 10 meters?
- Are the necessary techniques too difficult?
- Are the costs of home brewing too high?

The answer to question 1 is a clear NO. As a home brewer's firm, we are committed to amateur radio. Only innovative activities will secure the future of our hobby. The future lies in the VHF, UHF and SHF ranges. Peter (DL2FI) is right in his idea, the a lot of VHF/UHF licencees will rush to us for kits, if we can produce them. A percentage of the VHF/UHF licencees will necessarily supply us with know how, and bring in new constructors. The special knowledge of the individual SIGs will grow.

The answer to question 2 is also a clear NO. Through the large scale production of RF components for commercial use, a large selection of components are available. Several components are very well suited for amateur use. This makes it possible to build UHF gear with very low component counts. Thanks to mass production of these special components, their price is affordable for most of us. Which answers question three.

The author has addressed the above mentioned gap by creating a 2 meter transceiver, in which the following is stressed:

- SSB/CW modulation (enough FM yep boxes available)
- tuning with a large side band noise distance (no PLL!), important for transverter use for UHF and SHF.
- low power consumption on reception, important for portable use with built in rechargeable batteries.
- a practical, sufficient output (5 Watt), current drain of the PA only 0,6 A.

- frequency ranges in lower band (144,0-144,2MHz) as well as higher band (144,2-144,5MHz) through switchable VCXOs.
- good dynamic range and low noise RF input
- passive T/R mixer with large dynamic range
- good AGC range in receiver
- good RF selectivity, important in noisy areas
- output signal with a low harmonic content and good IM characteristics, suited for driving an external PA
- good frequency stability of the local oscillator through use of 5 ppm crystals in VCXO
- low noise IF amplifier by putting 2. crystal filter directly in front of the product detector
- extremely low noise FET product detector (Sperrschicht FET)
- RIT

The transceiver is built in four sections:

- 133 MHz VCXO
- 2 m RF section (RX/TX)
- 10,7 MHz IF section (SSB-Exciter)
- Control section (AF amplifier/Voltage stabilizers/CW-VOX/T/R switch/Side tone generator)

The break between sections chosen to reduce external wiring.

The individual sections work nearly autonomously, that is they are individually tunable directly after completion.

The concept of functional sections allows reuse of the sections in your own projects.

Thanks to reuse of parts of the Black Forest transceiver, we didn't have to reinvent the wheel, and the development time is consequently reduced significantly. In this project the reproducibility and the use of easily found, common components have been of importance too.

Description of the individual sections:

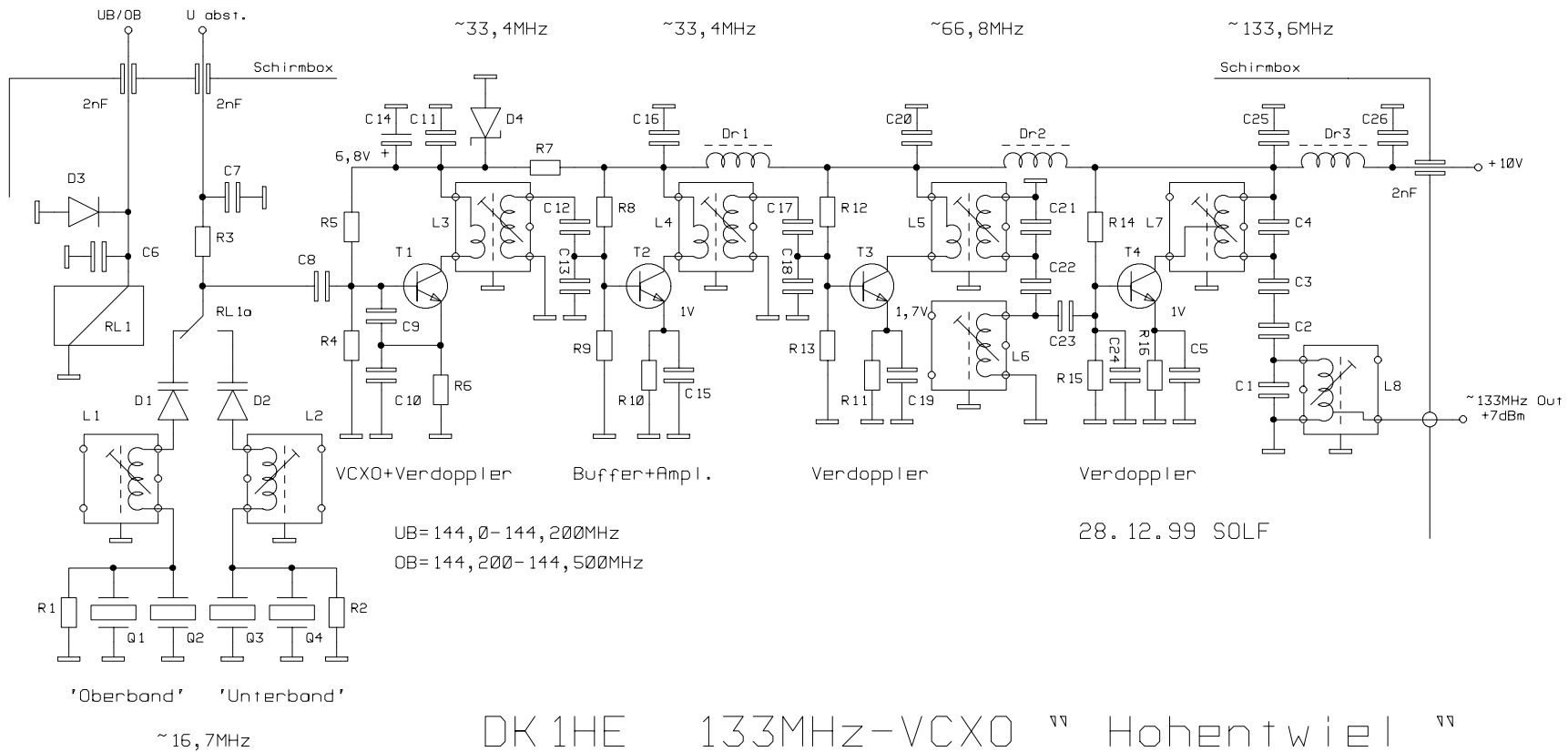
133 MHz VCXO :

This is the heart of the transceiver concept. It produces the 133 MHz local oscillator signal, and gives the frequency stability and spectral purity necessary. Further it reduces the side band noise distance and the large signal

dynamics of the receiver. Pulled VCXOs are superior to low cost PLLs on these points. If the pulling range isn't exaggerated, they give a perfectly acceptable frequency stability. In the circuit used here the total range of 133,3 - 133,8 is divided into two sub ranges (lower and higher band). This gives a band spread and a tuning comfort while reducing the pulled range of the crystal. This range division and the parallel coupling of two crystal for each range (Q1-Q2/Q3-Q4) gives a better frequency stability and reduces the change in oscillator voltage to +/- 1,5 dB in the chosen ranges. T1 oscillates in a capacitive three point coupling. C9-C10 defines the feed back. The resonant circuit comprises of L1 (L2), the blocking capacitance of D1 (D2) and the series connection of C8, C9 and C10, whose current at resonance flows through the series resonant crystals Q1-Q2 (Q3-Q4). The resonance frequency of these circuits will be tuned at the maximum tuning voltage at D1 (D2) with the help of the pulling coil L1 (L2) to the wished frequencies for the respective pair of crystals. If the tuning voltage is reduced, the resonance frequency is shifted by the increase in blocking capacity of D1 (D2), with the consequence that Q1-Q2 (Q3-Q4) now sees a detuning determined inductive resistance. The Crystal frequency and the generated VCXO frequency will shift to lower frequencies. The minimum tuning voltage should not go below 1,5 Volts. The lower band range can be set with the potentiometers P3 and P4 on the control board, respectively. R1+R2 serves to reduce crystal subharmonics. At the same time, they give the DC connection for the tuning diodes. To give well defined level at band change, the crystal change is done via a low capacity Reed relay. The resonant circuit of L3, C12 and C13 in the collector of T1 is tuned to the first harmonic (~33,4 MHz). The divider C12-C13 gives an impedance match for the following buffer stage of T2. This stage has the following jobs:

- isolation of the multiplier chain from the VCXO
- amplification of the relatively weak ~33,4 MHz oscillator signal.

To give a better suppression of the ~16,7 MHz crystal sub harmonics, the collector circuit of T2 is followed by a further resonant circuit tuned to ~33,4 MHz, L4, C17 and C18. The buffer is followed by two identical, band filter coupled frequency doubler stages, T3 and T4. Both stages works in doubler friendly class B operation. C17-C18 gives an output match for the buffer. Through measurement of the maximum voltage drop at the emitter resistances R11 and R16 respectively, the resonance of the resonant circuits is quite easily found. The coupling of the oscillator signal, now multiplied by 8, goes through the output band filter L7-C4/L8-C1. Through the series connected C2-C3 the filter is capacitatively coupled. By means of the high Q



of the individual resonant circuits the necessary double capacitor needs a very low value (about 0,5 pF), which is realised by the series connection of C2-C3. Over a tap at L8, the local oscillator signal of ~133 MHz is lead on at +7 dBm. The local oscillator level can easily be raised to +10 dBm with T4 (R16). Through the band filter coupling of the multiplier stages, the local oscillator output is very clean. To reduce the magnetic emissions from this section, it is enclosed in a 74 x 55,5 x 30 mm box. The DC signals is supplied via feed through capacitors.

Translations:

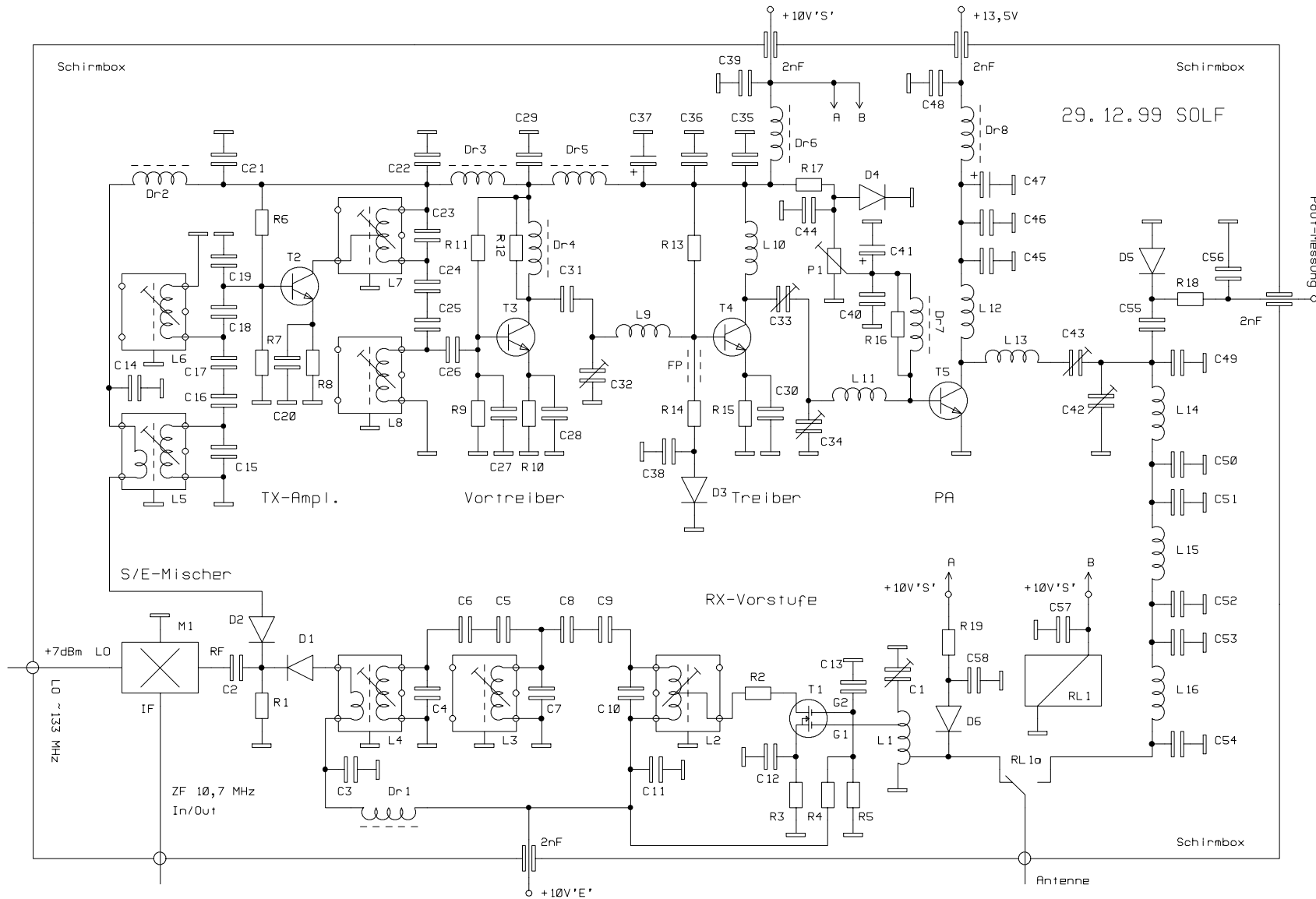
Verdoppler = doubler stage

Oberband= upper band (144,3-144,5 MHz)

Unterband= Lower band (144,0-144.3 MHz)

Schirmbox = Shielded box.

DK1HE 2m HF-Teil ▽ Hohentwiel ▽



2 meter RF section:

The 2 meter RF section contains the following functional groups:

- T/R mixer
- Receiver preamplifier
- Transmitter preamplifier, buffer and PA
- Transmitter output filter
- measuring rectifier for a relative output meter
- T/R antenna relay

Description of the receiver chain (RF board)

The antenna signal is lead via the T/R relay to L1-C1. Chosen as an air wound coil and a highQuality ceramic air trimmer, it has a very high Q and gives an optimal noise coupling to the MOSFET T1. The utilized FET is made for low cross modulation in TV cable tuners, according to the manufacturer. The stage amplification is some 27 dB and the noise figure around 1,2 dB. T1 is followed by a capacitatively coupled band filter with three resonant circuits with a high mirror suppression. The 3dB band width is some 2 MHz. Over the secondary the signal is lead out of L4 through the PIN diode D1 to the RF gate of the T/R mixer M1. In this the ~133 MHz local oscillator signal is used to produce the 10,7 MHz IF level. M1 is a +7 dBm mixer, which guarantees a good large signal response. The resulting amplification RF + IF is some 15 dB.

Functional description of the transmitter chain (RF board)

The 10,7 MHz exciter signal from the IF section is fed to the IF ports of the T/R transmitter M1 for mixing with the ~133 MHz local oscillator signal to the 144 MHz level. The PIN diode D2 leads the signal on to the transmitter amplifier T2. This stage consists of a capacitatively coupled 2 stage resonant circuit on input and output of T2 (L5-L6/L7-L8). The harmonic reduction of the transmitter is defined by these stages. It is especially necessary for harmonics in the air band (~133-10,7 MHz). This is especially important in exposed areas. T2 works in linear class A. C26-C27 gives an impedance match of the signal amplified by T2, to the following predriver at T3. This class A stage amplifies the signal to + 3 dBm. Over the transformer C31, C32 and L9 the collector impedance is matched to the 20 ohm input of T4. The quiet current of this stage (30 mA) is supplied via D3, which is mounted on

a mica disc directly on the pc board (heat coupling). L10 compensates the dynamic collector capacity of T4 at the working frequency. The stage amplification is some 18 dB, which gives a driver output of some 120 mWatt. The transformer C33-C34-L11 serves to adapt the low impedance basis of T5 (~5 Ohm) to the output of T4. The quiet current of the PA is adjusted by P1 (100mA). D4, which is heat coupled to T5 to stabilize the quiet current. The collector coil L12 serves as a compensation of the capacitive componen of the collector impedance of T5. C45-C46-C47 serves as a wide band RF decoupling of the supply voltage. The output stage amplifies the output signal to 5 Watt. Through L13-C43-C42 the collector impedance of T5 is transformed to the 50 ohm level. The measurment rectifier D5 gives a voltage proportional to the output power on through C56. The three stage low pass filter L14-L15-L16 following the PA reduces the 1. harmonic by 60 dB. The output is lead via the relay RL1 to the antenna. The PIN diode D6 protects gate 1 of T1 from too large RF voltages. To utilize the good selectivity of the RF section the pc board is enclosed in a box of 148 x 55,5 x 30 mm. The DC signals are supplied over feed through capacitors.

Translations:

Vortreiber = Predriver

Treiber= driver

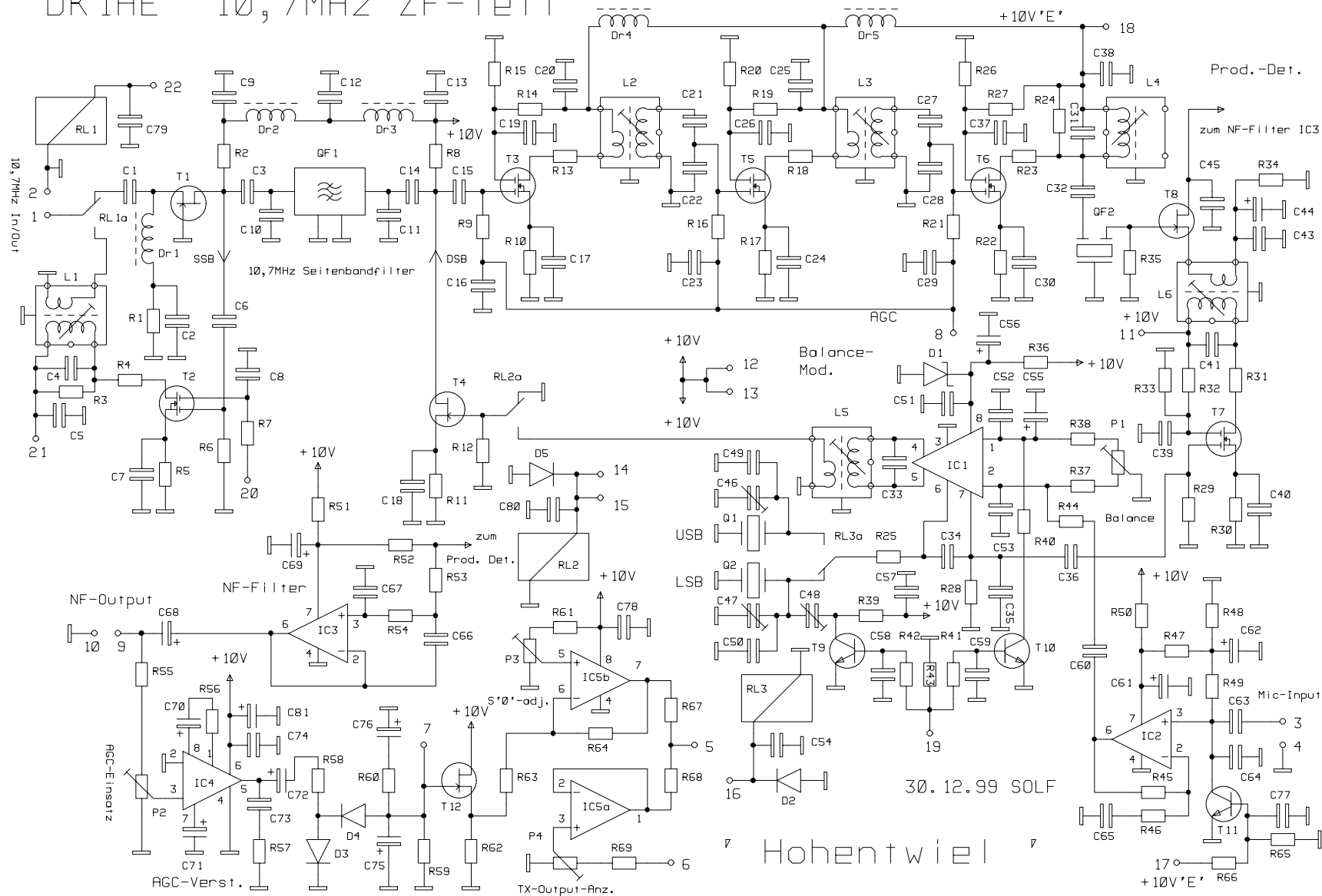
RX Vorstufe = RX Preamplifier

S/E Mischer = Transmit / Receive Mixer

10V „S“ = 10 Volt Transmit

10V „E“ = 10 Volt Receive

DK 1HE 10,7MHz ZF-Teil



10,7MHz IF section:

The 10,7 MHz IF section contains the following functional groups:

- highly selective 10,7 MHz sideband filter
- three stage AGC controlled IF amplifier

- extra crystal filter before the demodulator, to reduce noise
- low noise FET product detector
- active AF low pass filter
- fast attack AGC
- amplifier for S and output meter

- microphone preamplifier
- balanced modulator
- sideband oscillator for LSB/USB/CW
- stage for direct control of transmitter mixer
- DC regulated transmitter output power

The T/R switching of this section is done with Reed relays in DIL casings. This gives the following benefits, compared to switching diodes:

- much higher isolation
- well defined switching conditions
- no intermodulation effect, especially at lower frequencies
- only power consumption in transmitting mode
- no coupling/decoupling capacitors or current limiting resistors needed
- no greater space consumption on pc board.

Functional description of the receiver chain (IF board)

The 10,7 MHz IF signal given by the 2 meter RF section is lead into the gate coupled T1 via RL1. The low input impedance of T1 gives a broad band termination for the reception mixer. An extra splitting filter (diplexer) is thus not needed. R2 determines the working resistance for T1. At the same time it gives the input termination of the following crystal filter QF1. The output termination of this amplifier chain is set by the dividers C21-C22 and C27-C28 to some 70 dB. Through the utilization of MOSFETs and selective circuits, this setup is superior to other applications with cascaded broad band amplifier IC, regarding noise figure. The basic amplification is often too high, and the SSB demodulator is „noised out“. To reduce the noise bandwidth further, an extra crystal filter QF2 with a band width of 7,5 kHz (an FM filter for 12,5 kHz frequency spacing) is placed just prior to the product detector T8. The product detector forms an additive FET mixer, together with T8. R34 places its working point in the non linear portion of the characteristic. The buffer T7 gives an RF voltage of 0,3 Volts eff from the sideband oscillator (IC1) via L6 to the source of T8. Through the use of a FET, the mixer noise is very much better than usual NE612 designs. Intermodulation is no problem, thanks to good selectivity in preceeding stages. At the drain of T8, the demodulated AF signal is taken out to the active low pass filter at IC3. The passband is limited to 3 kHz. The resulting steepness of the filter is about 18 dB/octave. C68 couples the AF signal to the AF output amplifier, and to the AGC amplifier. To get the negative AGC regulation voltage needed for the IF amplifier,

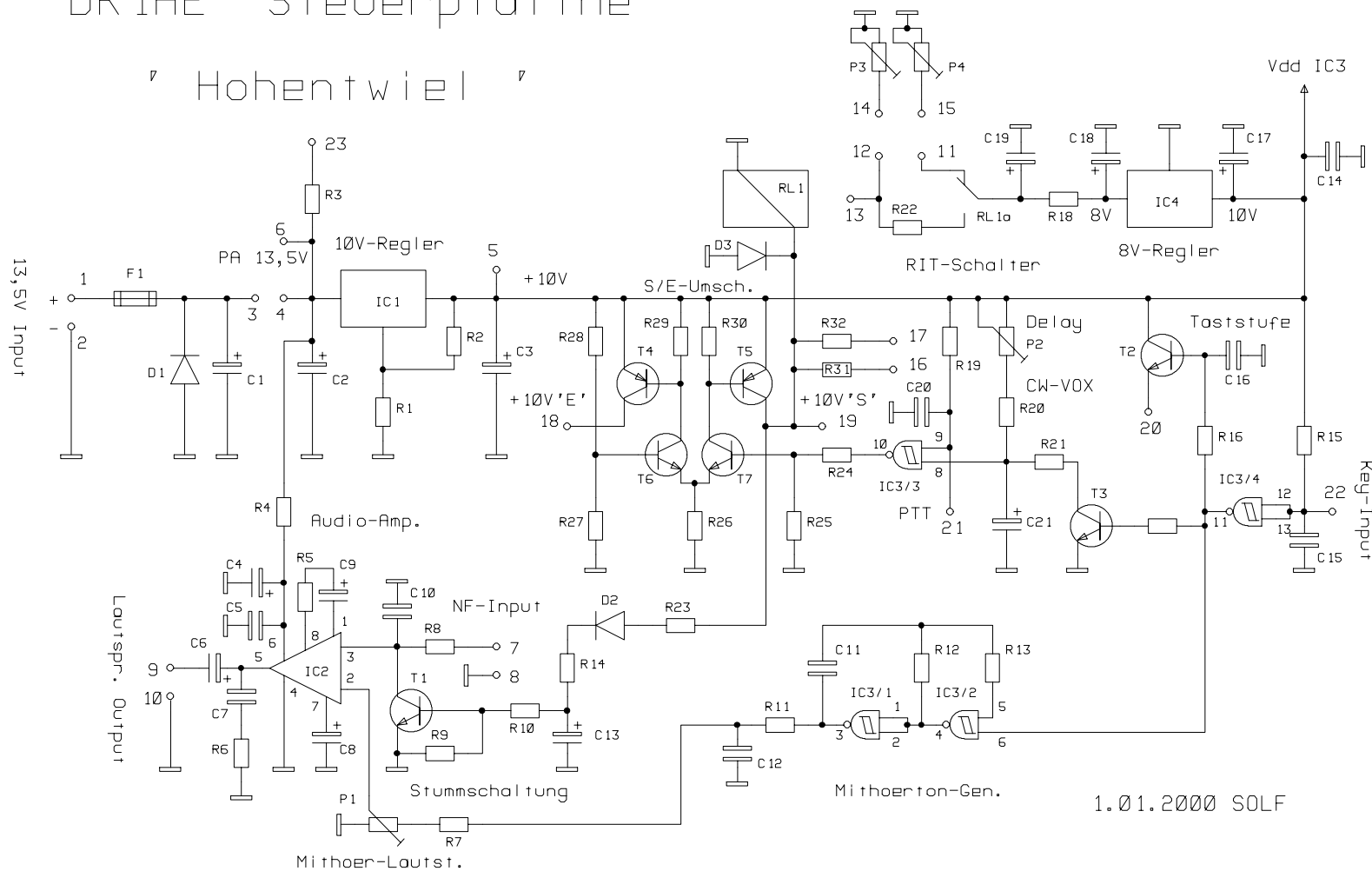
the voltage from the AF is amplified in IC4 and rectified in the peak rectifier D3-D4 to proper negative values. To get a fast AGC, we need a high charging voltage at C75. Normal op amps will not give enough current (especially on negative peaks). That is why we chose an AF amplifier (LM386). R58 dampens the regulating circuit and prohibits „over regulation“. R59 defines the time constant of the AGC decay. To regulate the IF stages, the gate 1 voltages are set to negative values, which is only possible with MOSFETs. In contrast to the usual way of reducing the gate 2 voltage, this approach gives less signal distortion at full regulation. If the gate 2 voltage of +4 Volts is reduced significantly (maybe to less than 0 Volts), the internal supply voltage of the lower cascade FET will be lowered with a consequent move of the working point into the non linear part of the characteristic. The utilized way of regulation, leaves the partial supply voltages of the cascaded FETs in peace. The working point of the lower FET will be moved to a part with lower steepness, as in the good old days of vacuum tubes. T12 works as a voltage follower with voltage control. It serves as supply for the output meter amplifier (IC5b). With P3 the meter can be zero adjusted. R67 limits the maximum output voltage. Through the use of an op amp, the most varied types of solenoid instruments can be used. IC5a works as a voltage follower for the relative output of the transmitter. R68 should be of the same value as R67. P4 regulates the maximum deviation of the meter.

Functional description of the transmitter chain (IF board):

The microphone signal is amplified in IC2 and lead on to the balanced modulator IC1 via C60-R44. T11 blocks IC2 on receive. The sideband oscillator in IC1 gives the wished carrier frequency with the crystals Q1-Q2, switched by RL3. P1 is used to adjust the carrier suppression. L5 decouples the DSB signal from IC1. In CW mode, the modulator is debalanced by T10. At the same time, the frequency of Q2 is pulled some 700 Hz lower by C48-T9, and into the filter pass band of QF1. RL3 is then forced by the control logic to LSB. RL2 switches the 10,7 MHz DSB signal to the gate of T4, which works as a transformer. R8 sets the working resistance of the stage. The DSB signal goes through the side band filter of QF1 the other way raound and comes forward as an SSB signal for gate 1 of the coupling amplifier T2. RL1 leads the amplified 10,7 MHz Ssb signal on with an amplitude of some -6 dBm (~100 mV eff) to the transmitter mixer in the 2 meter RF section. Over a variable DC voltage on gate 2 of T2 (pin 29) it is possible to adjust the transmitter output power. In CW mode, the drain voltage of T2 is keyed (pin 21).

DK 1HE Steuerplatine

Hohentwiel



Control board :

The control board couples together all of the previously described section to a complete transceiver. It contains the following functional groups:

- 10 Volts board voltage supply
- switched 10 Volt supplies for T/R
- AF amplifier for reception
- side tone oscillator for CW mode

- CW VOX
- RIT circuit

Functional description of the parts:

The external power supply of 13,8 Volts is lead through the fuse F1 to the 10 Volts, low drop regulator IC1. This voltage regulator gives the 10 Volt supply for the systems boards of the transceiver and works in a supply voltage range of 11-15 Volts. D1 serves as a polarization protector. The

unregulated voltage supplies the PA stage via pin 6, and over R4 also the receiver AF amplifier. The amplification of IC2 is regulated with R5. T1 serves for muting the AF section during transmission. This will reduce the shot noise from the T/R switch. P1 supplies the AF amplifier with a side tone signal from IC3/1-2 in CW mode. The differential amplifier T6-T7 together with the power transistors T4-T5 constitutes an electronic switch, which outputs either +10 Volts 'E' (reception) or + 10 Volts 'S' (transmission) voltages. The switch is controlled by the nand gate IC3/3. By keying the PTT input, pin 21, to ground IC3/3 goes into 'transmit', after releasing the PTT, the electronic switch returns to 'reception'. By keying the key input, pin 22, to ground, pin 11 of IC3/4 goes to high and gives a rounded voltage increase over R16-C16, which is led by the voltage follower T2, which switches T3 on. This will charge C21 over R21, giving a high state on pin 10 of IC3/3, thus activating it and the following switch into 'transmit'. Parallel to this IC3/4 will activate the side tone oscillator over pin 11. After release of the morse key, the side tone is disabled and C16 will discharge through R16 with a rounded decay voltage, releasing T2 and the transmitting voltage softly. The charging transistor T3 blocks, and C31 discharges slowly through P2-R20 (delay). When the triggering level of IC3/3 is reached, the output (pin 10) goes to low and switches the electronic switch to 'receive'. Over IC4 a highly stable 8 Volts tuning voltage is produced for the 133 MHz VCX0. The filter R18-C19 reduces the noise of this voltage. The RIT switch of RL1 puts an external potentiometer between pin 11 and 12 in series with the tuning potentiometer. In transmission mode, R22 of half the resistance of the RIT potentiometer, is series coupled to the tuning potentiometer. This way the reception frequency can be symmetrically fine tuned around the transmission frequency. The trimming potentiometers P3-P4 serves for adjustment of the lower frequency limit of upper/lower band.

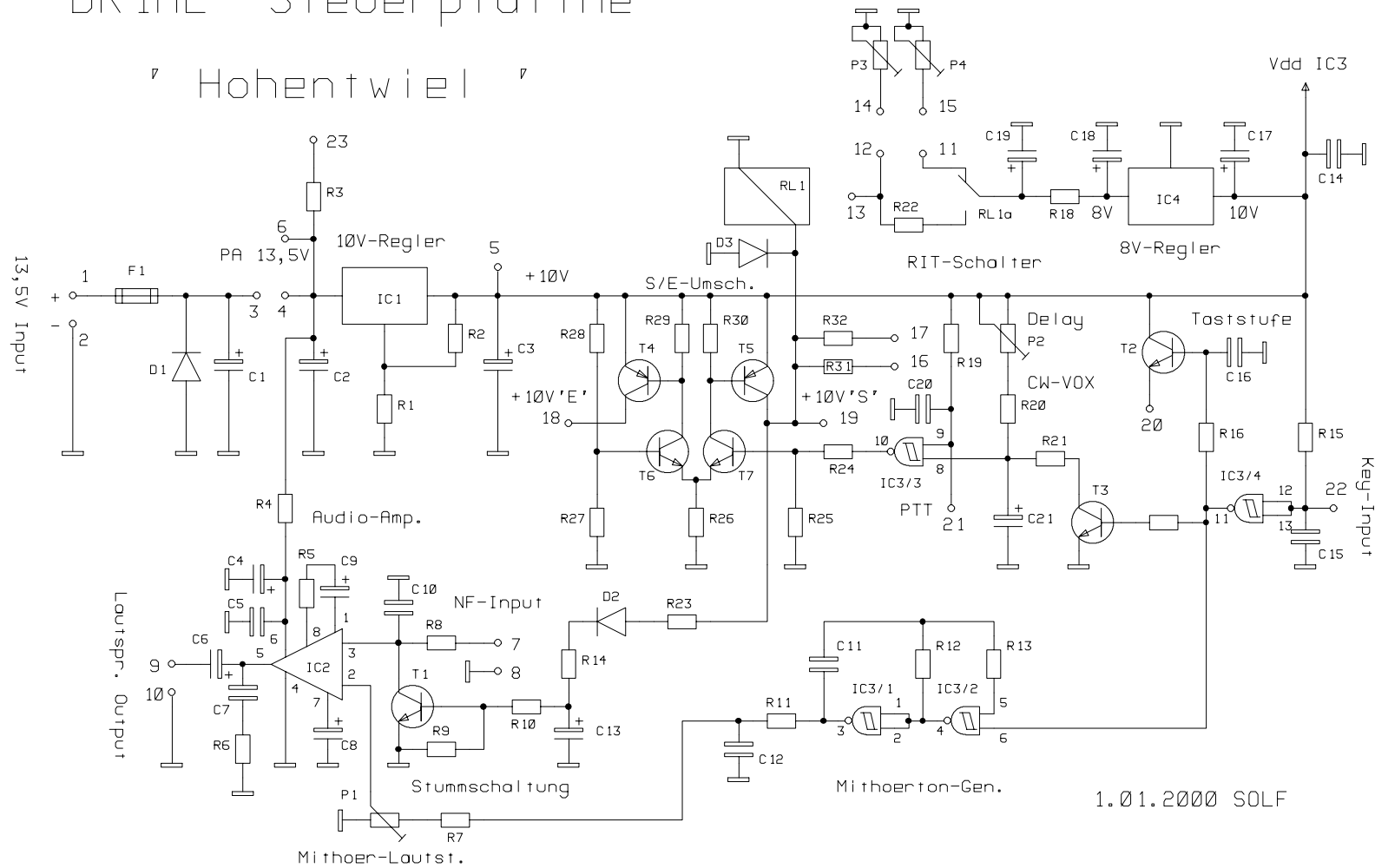
Author: Peter Solf
DK1HE
Rielasingen

In the following part you will start building your Hohentwiel 2m SSB CW Transceiver. Please follow the rules given in the little booklet FI's Workbench Tips, you got with the kit. Solder first the low profile parts, solder them step by step and mark them in the manual if soldered.

Before you start to wind any coil, please read winding instructions page 24

DK 1HE Steuerplatine

▾ Hohentwiel ▾



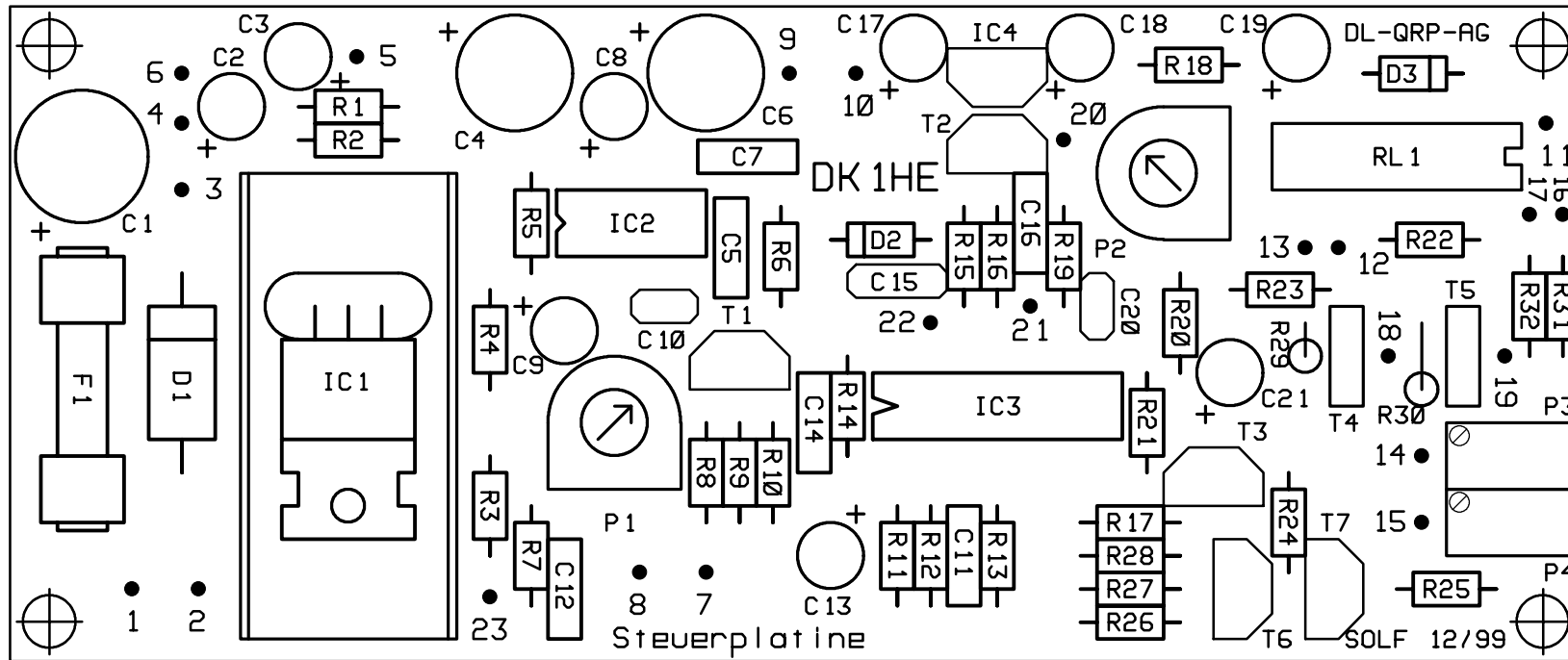
Control board components

- [] C1 470µF 16V rad.
- [] C2 6,8µF 25V tantalum
- [] C3 6,8µF 25V tantalum
- [] C4 220µF 16V rad
- [] C5 0,1µF film RM5
- [] C6 220µF 16V rad.
- [] C7 0,047µF film RM5
- [] C8 10µF 16V rad
- [] C9 10µF 16V rad.
- [] C10 1nF
- [] C11 0,022µF film RM5
- [] C12 0,033µF film RM5

- [] C13 1µF 35V rad.
- [] C14 0,1µF film RM5
- [] C15 10nF RM5
- [] C16 0,22µF film RM5
- [] C17 1µF 35V tantalum
- [] C18 1µF 35V tantalum
- [] C19 10µF 16V tantalum
- [] C20 10nF
- [] C21 6,8µF 16V tantalum
- [] P1 250R 10X5mm Piher
- [] P2 100K trimmer potentiometer horizontal
- [] P3 trimmer potentiometer 5K horizontal

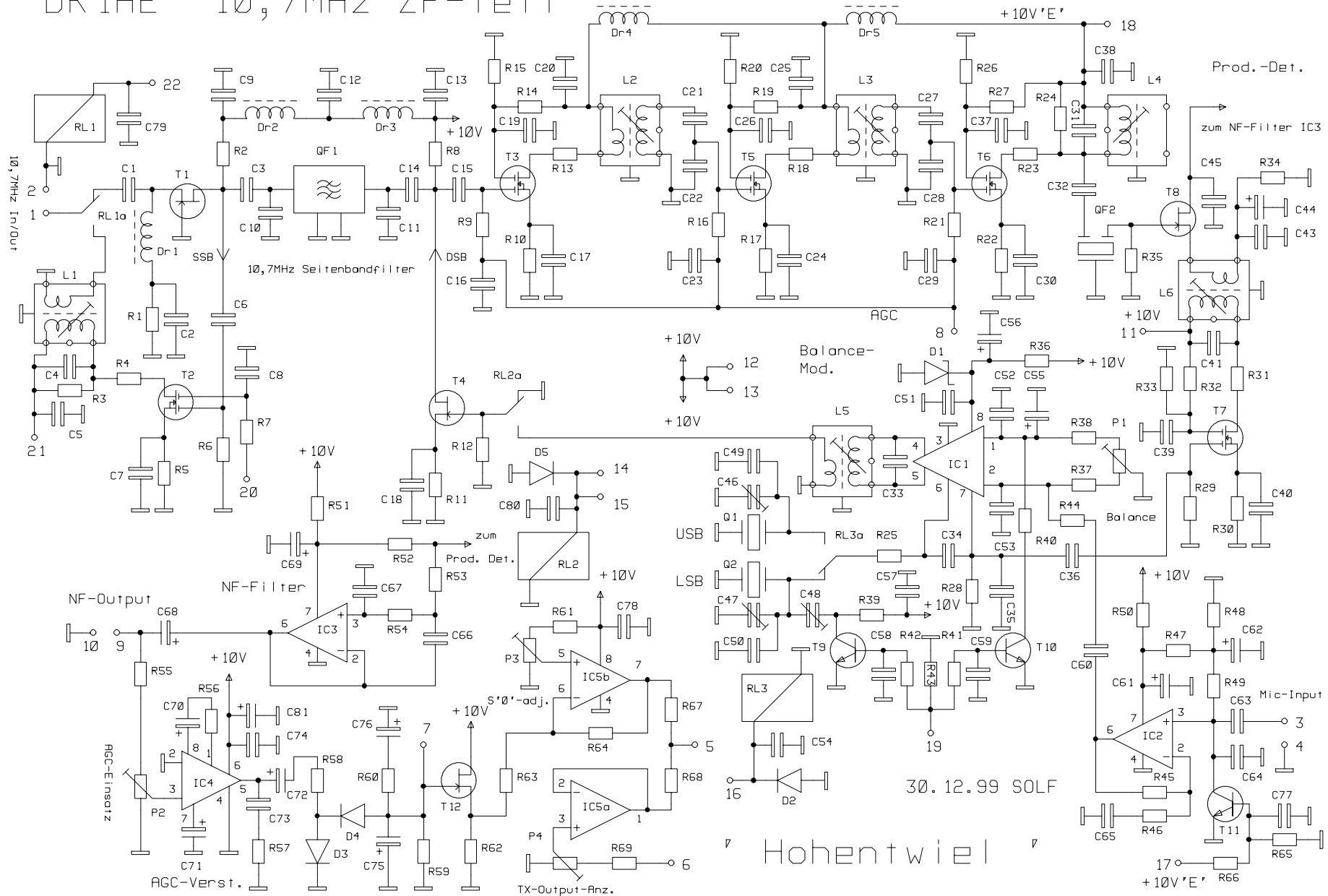
- [] C13 1µF 35V rad.
- [] C15 10nF RM5
- [] C17 1µF 35V tantalum
- [] C19 10µF 16V tantalum
- [] C21 6,8µF 16V tantalum
- [] P1 250R 10X5mm Piher
- [] P2 100K trimmer potentiometer horizontal
- [] P3 trimmer potentiometer 5K horizontal

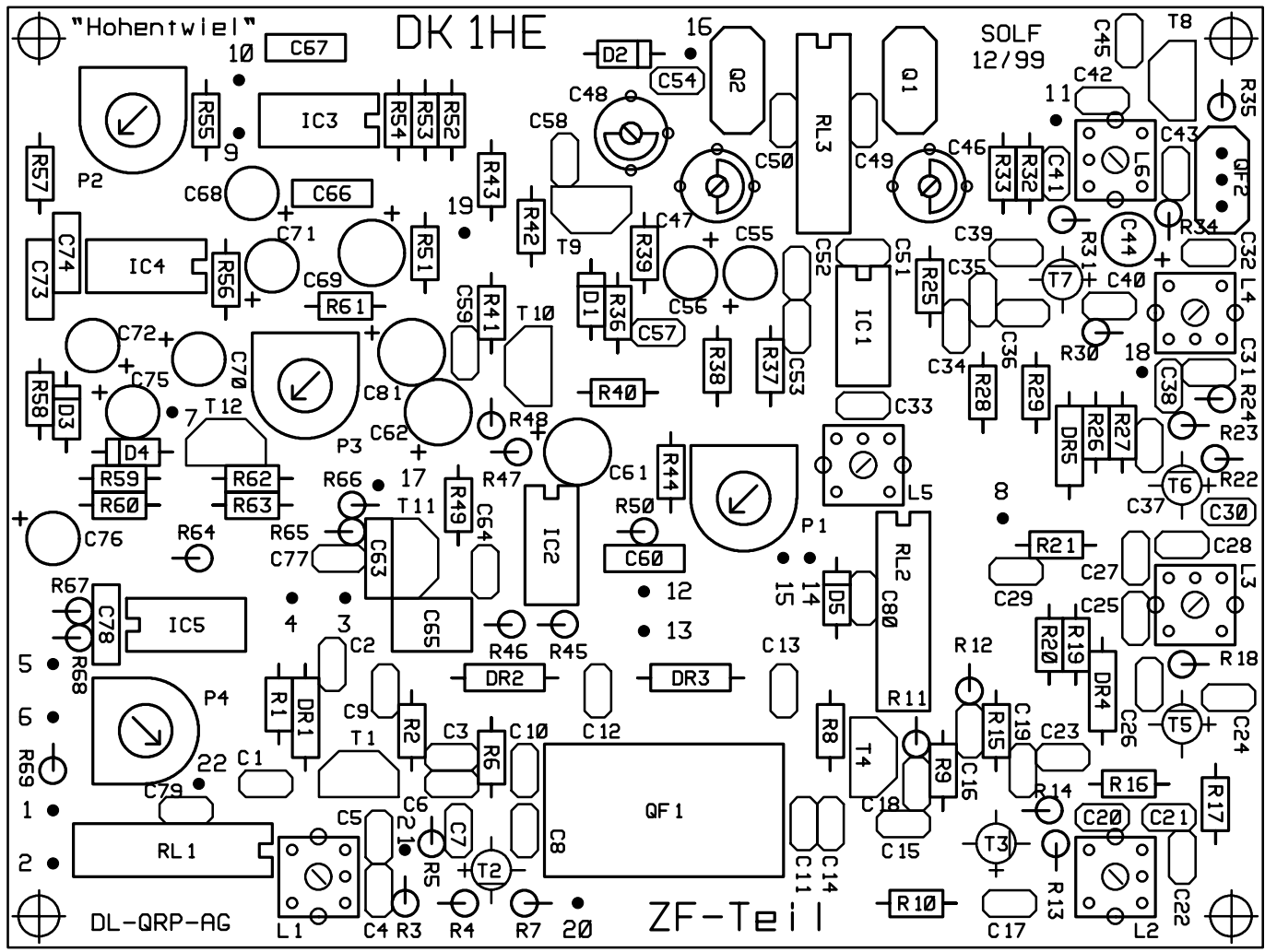
- [] C14 0,1µF film RM5
- [] C16 0,22µF film RM5
- [] C18 1µF 35V tantalum
- [] C20 10nF
- [] C21 6,8µF 16V tantalum
- [] P2 100K trimmer potentiometer horizontal
- [] P3 trimmer potentiometer 5K horizontal



- | | | | | | |
|---------|--------------------------|---------|-----------------|---------|-----------------|
| [] P4 | trimmer potentiometer 5K | [] T3 | BC337-40 | [] T4 | BD136 |
| [] R1 | 820R metal film | [] T5 | BD136 | [] T6 | BC546B |
| [] R3 | 1,5K | [] T7 | BC546B | [] F1 | Fuse 1,25A slow |
| [] R5 | 680R trimming | [] IC1 | LT1086CT | [] IC2 | LM386N-1 |
| [] R7 | 82K | [] IC3 | 4093 | [] IC4 | 78L08 |
| [] R9 | 12K | | | | |
| [] R11 | 12K | | | | |
| [] R13 | 100K | | | | |
| [] R15 | 33K | | | | |
| [] R17 | 18K | | | | |
| [] R19 | 33K | | | | |
| [] R21 | 150R | | | | |
| [] R23 | short | | | | |
| [] R25 | 10K | | | | |
| [] R27 | 10K | | | | |
| [] R29 | 12K | | | | |
| [] R31 | 1,2K | | | | |
| [] D1 | 1N5402 | | | | |
| [] D3 | 1N4148 | | | | |
| [] T1 | BC337-40 | [] R2 | 120R metal film | [] R4 | 3,3R |
| | | [] R6 | 4,7R | [] R8 | 22K |
| | | [] R10 | 27K | [] R12 | 22K |
| | | [] R14 | 56R | [] R16 | 22K |
| | | [] R18 | 390R | [] R20 | 39K |
| | | [] R22 | 120R metal film | [] R24 | 6,8K |
| | | [] R26 | 820R | [] R28 | 10K |
| | | [] R30 | 12K | [] R32 | 15K |
| | | [] D2 | 1N4148 | [] RL1 | Reed relay |
| | | [] T2 | BC337-40 | | |

DK 1HE 10,7MHz ZF-Teil

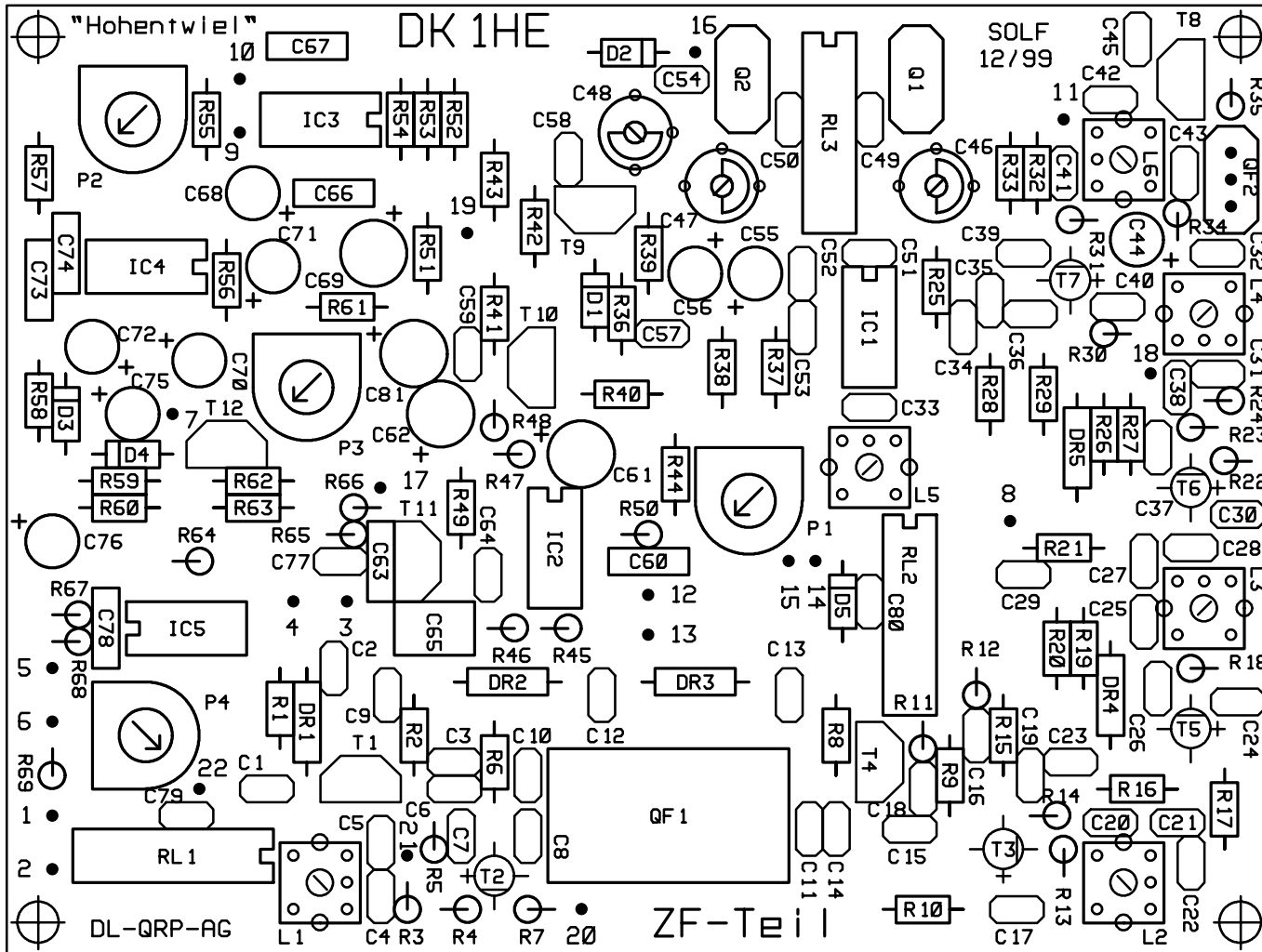




Components of the IF board

[] C1 10nF	[] C2 10nF	[] C3 10nF	[] C4 39pF	[] C5 10nF	[] C6 100pF	[] C7 10nF	[] C8 10nF	[] C9 10nF	[] C10 10pF	[] C11 12pF	[] C12 22nF	[] C13 10nF	[] C14 10nF	[] C15 100pF	[] C16 10nF	[] C17 10nF	[] C18 10nF	[] C19 10nF	[] C20 10nF	[] C21 39pF	[] C22 220pF	[] C23 10nF	[] C24 10nF	[] C25 10nF	[] C26 10nF	[] C27 39pF	[] C28 220pF	[] C29 10nF	[] C30 10nF	[] C31 39pF	[] C32 10nF	[] C33 39pF	[] C34 220pF NPO	[] C35 220pF NPO	[] C36 3,3pF	[] C37 10nF	[] C38 10nF	[] C39 10nF	[] C40 10nF	[] C41 39pF	[] C42 10nF	[] C43 10nF	[] C44 10µF 16V rad.	[] C45 4,7nF	[] C46 trimmer 30 pF 7mm red	[] C47 trimmer 30pF 7mm red	[] C48 trimmer 30 pF 7mm red	[] C49 22pF	[] C50 22pF	[] C51 22nF	[] C52 10nF	[] C53 10nF	[] C54 22nF	[] C55 10µF 16V rad.	[] C56 47µF 16V rad.	[] C57 10nF	[] C58 10nF	[] C59 10nF	[] C60 0,033µF film	[] C61 100µF 16V rad	[] C62 100µF rad.	[] C63 0,1µF film RM5	[] C64 1nF	[] C65 0,47µF Film RM5	[] C66 820pF Styroflex 63V	[] C67 220pF Styroflex	[] C68 1µF 35V rad.	[] C69 100µF 16V rad.	[] C70 left out	[] C71 10µF 25V rad.	[] C72 47µF 16V rad.	[] C73 0,047µF film RM5	[] C74 0,1µF film RM5	[] C75 33µF 16V rad.	[] C76 left out	[] C77 1nF	[] C78 0,1µF film RM5	[] C79 22nF	[] C80 22nF	[] C81 100µF 16V rad.	[] D1 ZPD6,8	[] D2 1N4148	[] D3 BAT42	[] D4 BAT42	[] DR1 47µH SMCC
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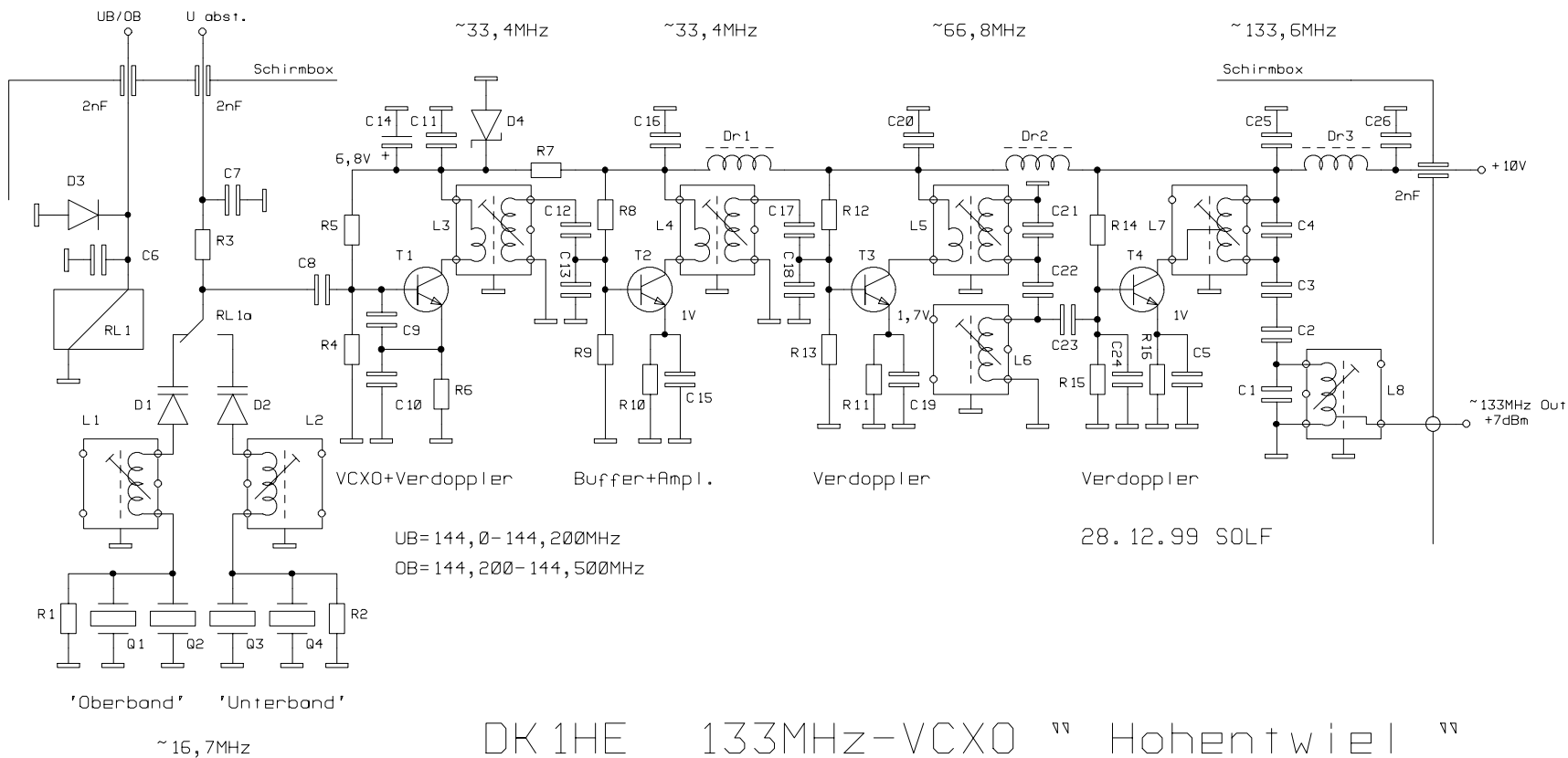
Stand: 2. Mai 03



- [] L2 Neosid filter kit 7S
32 turns 0,1mm copper wire;secondary 16 turns 0,1mm copper wire;cover core + adjustable core F10b
- [] L3 Neosid filter kit 7S
32 turns 0,1mm copper wire;secondary 16 turns 0,1mm copper wire;cover core + adjustable core F10b
- [] L4 Neosid filter kit 7S
32 turns 0,1mm copper wire;cover core+adjustable core F10b
- [] L5 Neosid-Bausatz 7S
32 turns 0,1mm copper wire;secondary 8 turns 0,1mm copper wire centered on primary;cover core+adjustable core F10b
- [] L6 Neosid filter kit 7S
32 turns 0,1mm copper wire;secondary 2 turns 0,1mm copper wire at cold end of primary;cover core+adjustable core F10b
- [] P1 10K variable Resistor
- [] P2 10K variable Resistor
- [] P3 10K variable Resistor
- [] P4 10K variable Resistor
- [] R1 470R [] R2 560R
- [] R3 3,3K [] R4 27R
- [] R5 68R [] R6 100K
- [] R7 100K [] R8 560R
- [] R9 100K [] R10 68R

- | | | | |
|---|--------------------|--------------------|--------------|
| [] DR2 100µH SMCC | [] DR3 100µH SMCC | [] R11 270R | [] R12 220R |
| [] DR4 100µH SMCC | [] DR5 100µH SMCC | [] R13 27R | [] R14 150K |
| [] IC1 NE612 | [] IC2 TL071 | [] R15 100K | [] R16 100K |
| [] IC3 TL071 | [] IC4 LM386 | [] R17 68R | [] R18 27R |
| [] IC5 LM358 | | [] R19 150K | [] R20 100K |
| | | [] R21 100K | [] R22 68R |
| [] L1 Neosid filter kit 7S | | [] R23 27R | [] R24 1,8K |
| 32 turns 0,1mm copper wire;secondary 4 turns 0,1mm copper wire at cold end of primary;cover core+adjustable core F10b | | [] R25 0R (short) | [] R26 100K |
| | | [] R27 150K | [] R28 22K |
| | | [] R29 100K | [] R30 68R |

[]	R31	27R	[]	R32	150K
[]	R33	100K	[]	R34	5,6K
[]	R35	1,5K	[]	R36	390R
[]	R37	100K	[]	R38	100K
[]	R39	100K	[]	R40	27K
[]	R41	33K	[]	R42	27K
[]	R43	12K	[]	R44	15K
[]	R45	220K	[]	R46	1K
[]	R47	10K	[]	R48	10K
[]	R49	47K	[]	R50	390R
[]	R51	560R	[]	R52	8,2K
[]	R53	120K metal film	[]	R54	120K metal film
[]	R55	4,7K	[]	R56	left out
[]	R57	4,7R	[]	R58	330R
[]	R59	33K	[]	R60	left out
[]	R61	18K	[]	R62	5,6K
[]	R63	68K	[]	R64	220K
[]	R65	12K	[]	R66	33K
[]	R67	see trimming notes	[]	R68	see trimming notes
[]	R69	33R	[]	RL1	Reed relay 1XUm
[]	RL2	Reed relay 1XUm	[]	RL3	Reed relay 1XUm
[]	T1	BF246A	[]	T10	BC546B
[]	T11	BC546B	[]	T12	BF244B
[]	T2	BF981	[]	T3	BF981
[]	T4	BF245B	[]	T5	BF981
[]	T6	BF981	[]	T7	BF981
[]	T8	BF245A	[]	T9	BF199
[]	Q1	Crystal USB 10698,5KHz	[]	Q2	Crystal LSB 10701,5KHz
[]	QF1	Crystalfilter 10M22D	[]	QF2	Crystalfilter 10M8A



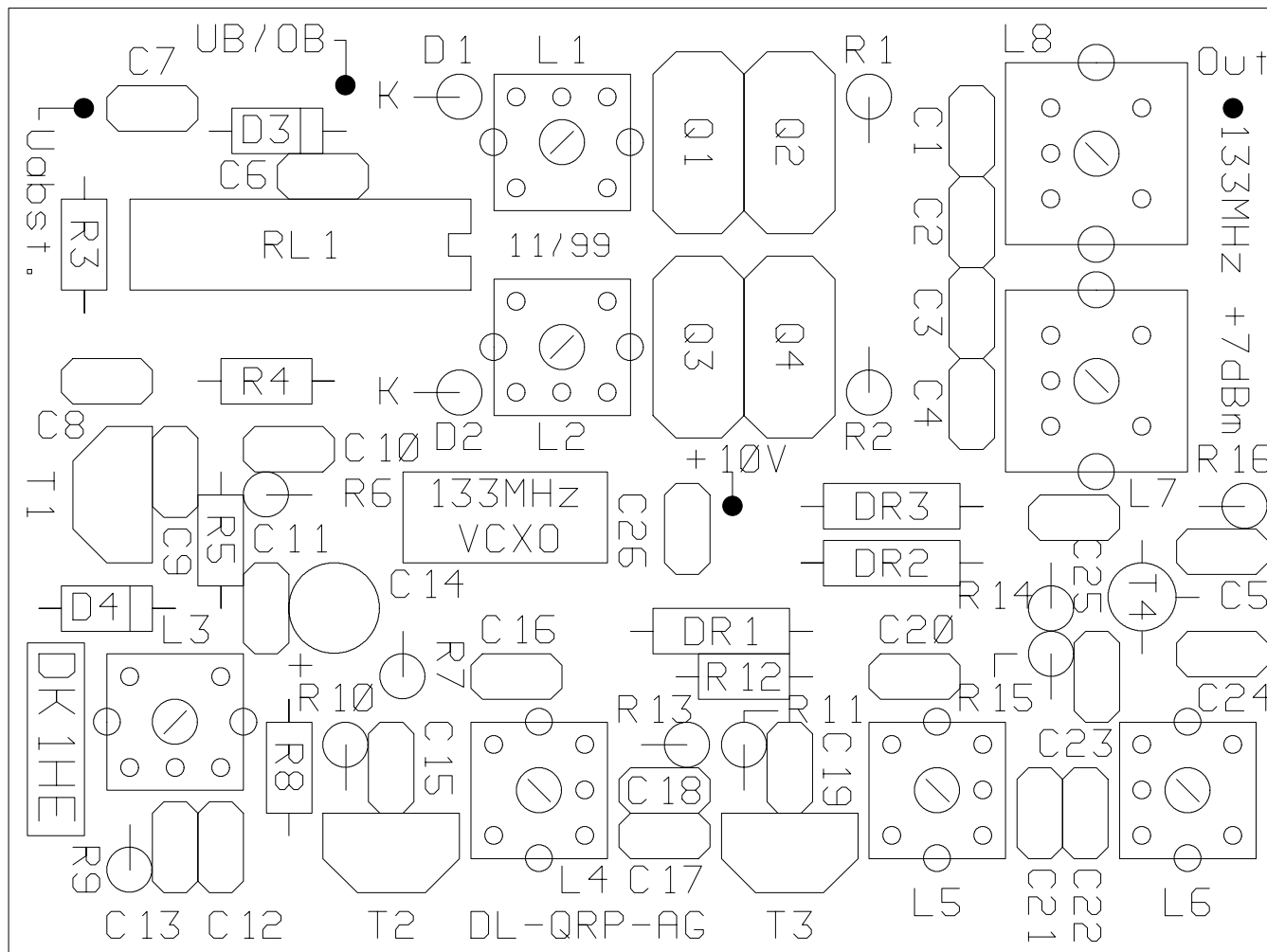
Components for the VCXO

- [] C1 15pF
- [] C3 1pF
- [] C5 4,7nF
- [] C7 10nF
- [] C9 100pF
- [] C11 10nF
- [] C13 220pF
- [] C15 10nF

- [] C2 1pF
- [] C4 15pF
- [] C6 10nF
- [] C8 1nF
- [] C10 100pF
- [] C12 39pF
- [] C14 47µF
- [] C16 10nF

- [] C17 39pF
- [] C19 10nF
- [] C21 27pF
- [] C23 39pF
- [] C25 4,7nF
- [] R1 680R
- [] R3 68K
- [] R5 47K
- [] R7 470R
- [] R9 3,3K

- [] C18 220pF
- [] C20 10nF
- [] C22 1pF
- [] C24 82pF
- [] C26 1nF
- [] R2 680R
- [] R4 47K
- [] R6 1K
- [] R8 15K
- [] R10 220R

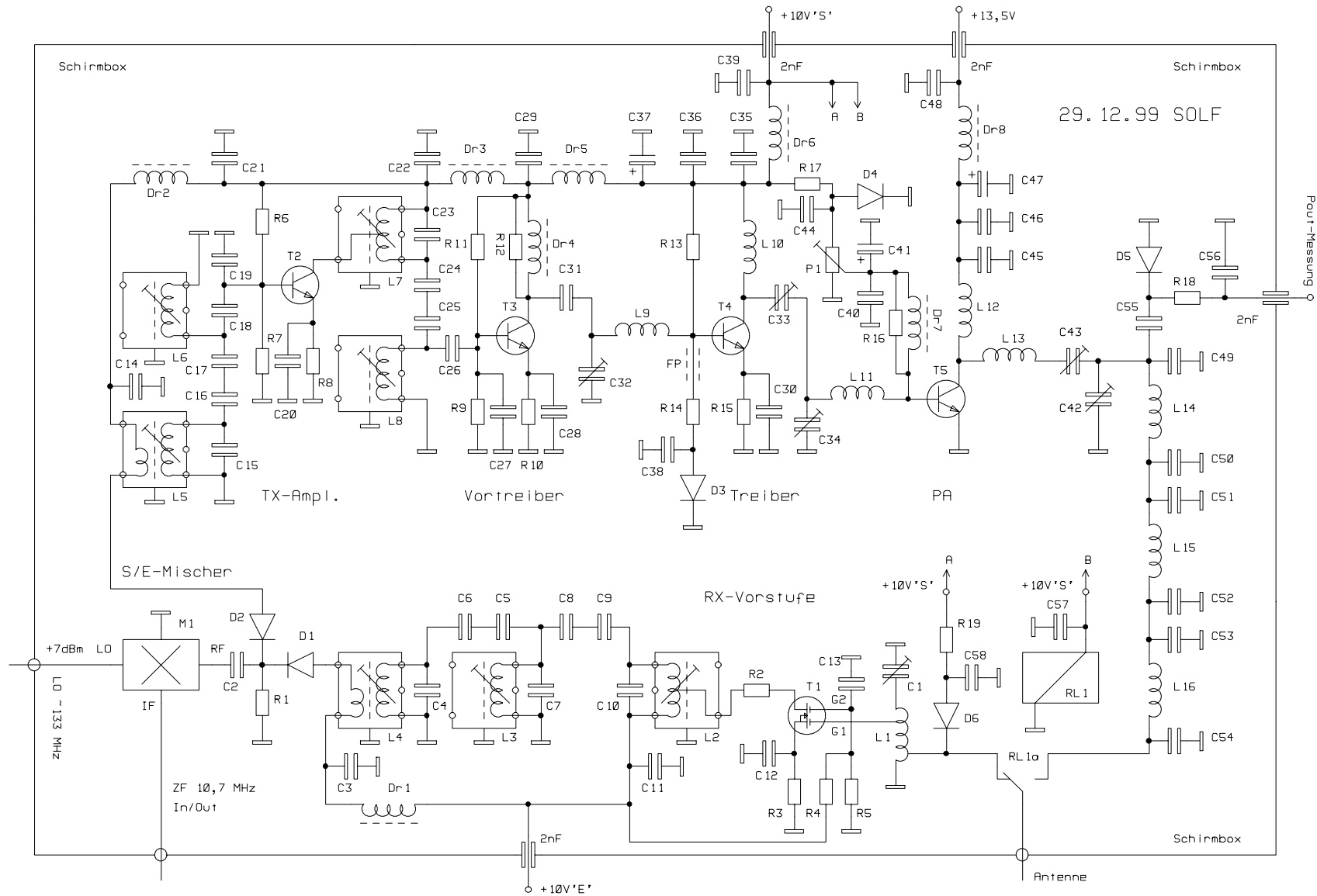


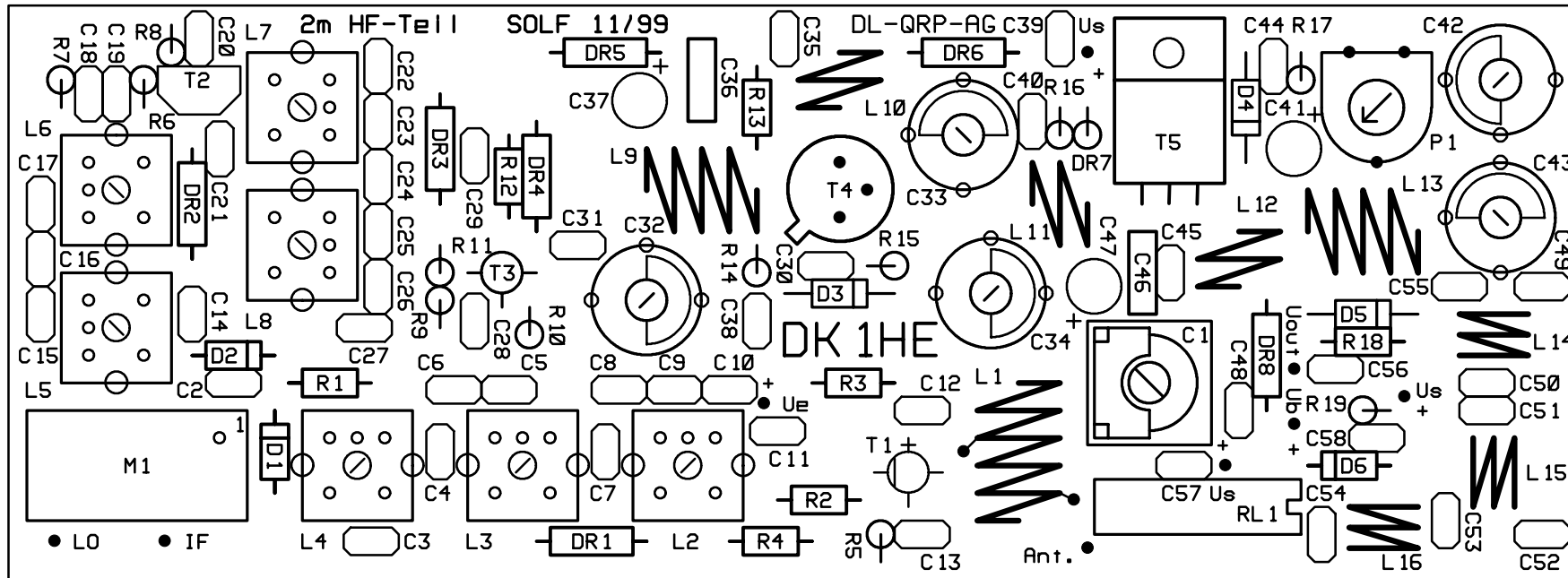
- [] L2 Neosid filter kit 7S
32 turns 0,1mm copper wire ; cover core+adjustable core F10b
- [] L3 Neosid filter kit 7S
12 turns 0,2mm copper wire;secondary 4 turns 0,2mm copper wire at cold end of primary;cover core left out;adjustable core F40
- [] L4 Neosid filter kit 7S
12 turns 0,2mm copper wire;secondary 6 turns 0,2mm copper wire at cold end of primary;cover core left out;adjustable core F40
- [] L5 Neosid filter kit 7S
6 turns 0,2mm copper wire;secondary 3 turns 0,2mm copper wire at cold end of primary;cover core left out;adjustable core F40
- [] L6 Neosid filter kit 7S
6 turns 0,2mm copper wire;cover core left out;adjustable core F40
- [] L7 Neosid filter kit 10
5 turns 0,6mm silver wire ;winding width 7mm;tap at 2 1/2 turns from cold end;(center tap) core F100b
- [] L8 Neosid filter kit 10
L8 : 5 turns 0,6mm silver wire ;winding width 7mm;tap at 3/4 turns from cold end;core F100b
- [] D1 BB109G/BB139
- [] D2 BB109G/BB139
- [] D3 1N4148
- [] D4 ZPD 6V8
- [] Q1 16,725MHz TQ31.05.18-S
- [] Q2 as Q1
- [] Q3 16,6875MH TQ31.05.18-S
- [] Q4 as Q3

- [] R11 330R
- [] R12 39K
- [] R13 2,2K
- [] R14 39K
- [] R15 2,2K
- [] R16 some 270R try it out to set Pout to +7dBm
- [] DR1 6,8µH SMCC
- [] DR2 3,3µH SMCC
- [] DR3 1µH SMCCC
- [] RL1 Reed relay 1*um
- [] T1 BF199
- [] T2 BF199
- [] T3 BF311
- [] T4 BFW92

- [] L1 Neosid filter kit 7S
32 turns 0,1mm copper wire ; cover core+adjustable core F10b

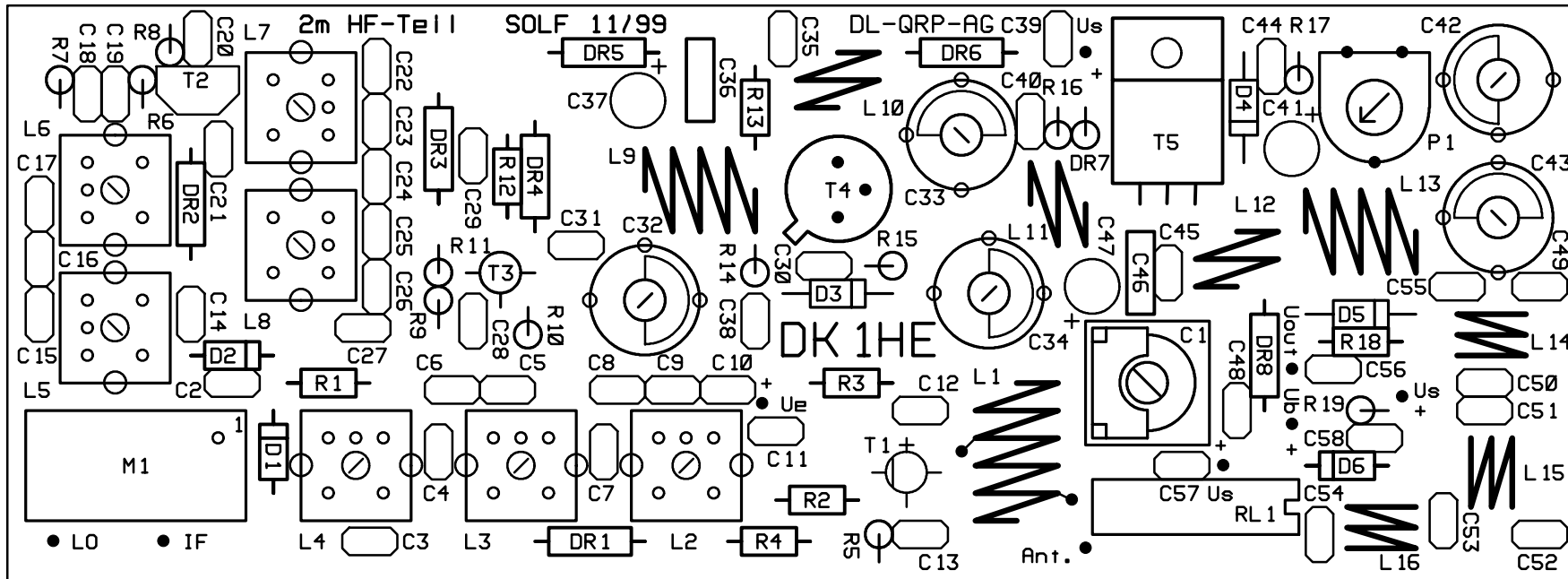
DK1HE 2m HF-Teil ▽ Hohentwiel ▽





Components for the RF board

[] C1	Trimmer 13pF	[] C2	2,2nF	[] C39	1nF	[] C40	1nF
[] C3	2,2nF	[] C4	15pF	[] C41	47μF 16V rad.	[] C42	film trimmer 40pF grey
[] C5	1pF	[] C6	1pF	[] C43	trimmer 25pF green	[] C44	1nF
[] C7	15pF	[] C8	1pF	[] C45	1nF	[] C46	0,22μF film 63V RM5
[] C9	1pF	[] C10	15pF	[] C47	10μF 25V rad.	[] C48	1nF
[] C11	1nF.i	[] C12	1nF	[] C49	22pF	[] C50	22pF
[] C13	1nF	[] C14	2,2nF	[] C51	22pF	[] C52	22pF
[] C15	15pF	[] C16	1pF	[] C53	22pF	[] C54	22pF
[] C17	1pF	[] C18	18pF	[] C55	1pF	[] C56	1nF
[] C19	82pF	[] C20	1nF	[] C57	1nF	[] C58	1nF
[] C21	1nF	[] C22	1nF	[] D1	BA479	[] D2	BA479
[] C23	15pF	[] C24	1pF	[] D3	1N4148	[] D4	1N4148
[] C25	1pF	[] C26	18pF	[] D5	1N4148	[] D6	BA479
[] C27	120pF	[] C28	1nF	[] DR1	1μH SMCC	[] DR2	1μH SMCC
[] C29	1nF	[] C30	1nF	[] DR3	1μH SMCC	[] DR4	3,3μH SMCC
[] C31	1nF	[] C32	trimmer 15pF blue	[] DR5	1μH SMCC	[] DR6	1μH SMCC
[] C33	film trimmer 15pF blue	[] C34	trimmer 25pF green	[] DR7	1μH SMCC	[] DR8	short+3 Ferrite beads
[] C35	1nF	[] C36	0,1μF film RM5	[] L1	air wound coil 6 turns 1mm silver wire inner diameter 6mm;antenna tap 3/4 turns from cold end; tap Gate 1 of T1 4 1/4 turns from cold end		
[] C37	10μF 25V rad.	[] C38	1nF				



- [] L2 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;tap at 2 1/2 turns from cold end;core F100b

- [] L3 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;tap at 2 1/2 turns from cold end;core F100b

- [] L4 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;secondary 1 turns Teflon isolated wire at cold end of primary;core F100b

- [] L5 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;secondary 1 turns Teflon isolated wire at cold end of primary;core F100b

- [] L6 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;tap at 2 1/2 turns from cold end;core F100b

- [] L7 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;tap at 2 1/2 turns from cold end;core F100b

- [] L8 Neosid filter kit 10
4 turns 0,6mm silver wire;winding width 7mm;tap at 2 1/2 turns from cold end;core F100b

- [] L9 air wound coil
5 turns 1mm silver wire inner diameter 6mm

- [] L10 air wound coil
3 turns 1mm silver wire inner diameter 7mm

- [] L11 air wound coil
2 turns 1mm silver wire inner diameter 6mm

- [] L12 air wound coil
3 turns 1mm silver wire inner diameter 7mm

- [] L13 air wound coil
5 turns 1mm silver wire inner diameter 6mm

[] L14 air wound coil
3,5 turns 1mm copper wire inner diameter 5mm;coil on coil

[] L15 air wound coil
3,5 turns 1mm copper wire inner diameter 5mm;coil on coil

[] L16 air wound coil
3,5 turns 1mm copper wire inner diameter 5mm;coil on coil

[] M1	Mixer IE500 or equal	[] P1	Potentiometer 100R ceramic
[] R1	1,5K	[] R2	27R
[] R3	56R	[] R4	150K
[] R5	100K	[] R6	10K
[] R7	2,2K	[] R8	220R
[] R9	1,5K	[] R10	33R
[] R11	8,2K	[] R12	left out
[] R13	1,8K	[] R14	82R+Ferrite bead
[] R15	10R	[] R16	100R
[] R17	470R 0,5W	[] R18	10K
[] R19	1,5K	[] RL1	Reed relay 1XUm
[] T1	BF982/BF910	[] T2	BF311
[] T3	BFR96	[] T4	2N4427
[] T5	2SC1971		

Winding instructions:

Neosid filter kits series 7.S :

The filters in the 7.S series consists of the following parts:

- coil form with 5 lead in 2,5 mm raster
- coil core for adjustment GW 3x8
- covering core (which isn't necessary for all coils)
- screen can

Important notice: By use of a covering core, this should be glued to the coil body (a drop of epoxy glue).

To avoid shorts between the screen can and the solderings leads on the component side of the pc board, every can should have an underlay disc (Neosid part number IP7 Nr. 70411300).

After winding the coil body the turns should be fixed by a littllle UHU hart glue or equal.

Neosid filter kits series 10:

For the VHF circuits it is necessary to use the somewhat larger filter kits of series 10, to have a high enough Q. They consists of the following parts:

- coil form without soldering leads, type K 313b Nr.: 70.2030.00
- tinned screen can, type B 10 Nr.: 94.4538.11
- Isolating frame, type IR 10 Nr.: 57.4117.00
- adjustment core, type GW 3X8 F100b

The winding should be done on a 4 mm drill body under tension. The turns should then be equally spaced to give a winding of some 7 mm.

Important notice: The RF-wise cold end of the coil should always be below, towards the pc board. The winding direction is always towards the cold end. You should be careful to obtain the full number of turns indicated.

The wire ends should be bent at right angles, to be parallel to the coil form, to make it possible to pass them through the holes in the base plate of the form. The necessary taps are done with mounting wire (solder cleanly). The the coil body is mounted on the coil form. The cold end should be placed below, towards the pc board!

To avoid movement of the coil, the lowest turn should be glued to the bottom of the form with very little epoxy glue. In coils with a secondary, the secondary shouldn't be put on till the epoxy glue on the primary is hardened (this is definitely easier than the other way round).

Finally the screen can is put over the coil form and then the isolating disc is put in proper position below the base plate of the form at the end of the screen can. The leads should be trimmed to some 10 mm. The adjustment core shouldn't be fitted till after the coil is soldered to the pc board (risk of ruining the core by warming).

Trimming instructions for the Hohentwiel 2 meter SSB/CW Transceiver

As told in the preface, the transciever is built in four sections, which are tested and trimmed individually. This is a great help in connection with any error corrections. Before completing the transciever, each section should be tested. After soldering each board, it should be checked against the parts list and the diagram, whether all parts are correctly placed. The solder side should be checked, using a magnifying glass, to look for solder splashes and unsoldered components. It will be clear from the wiring diagram whichs external pins have to be hooked up for testing.

For an optimal tuning, you will need the following

- an analog multimeter
- a digital multimeter
- a frequency counter
- an RF generator
- an RF millivolt meter
- an oscilloscope
- an RF power meter with a dummy load (or an SWR meter)
- a laboratory power supply with adjustable current limitation.

Trimming of the individual sections:

133 MHz VCXO :

1. set all adjustment cores flush with the coil upper borders.
2. set the tuning voltage to +7,5 Volts with the potentiometer
3. let RL1 be off (upper band)
4. connect a +10 Volt power supply.

5. hook up an analog multimeter to the emitter of T3 (R11)
6. tune L3 and L4 in turns to a voltage maximum of some 1 V.
7. connect multimeter to the emitter of T4 (R16)
8. tune L5 and L6 in turns to a voltage maximum of some 1 V.
9. terminate the local oscillator output with 50 ohms and connect an RF millivolt meter.
10. tune L7 and L8 in turns to an RF voltage maximum of some 500 mV eff.
11. connect a frequency counter (over an attenuator) to the local oscillator output
12. with L1, tune output frequency to 133,780 MHz
13. reduce the tuning voltage till the output frequency is 133,540 MHz (band center)
14. repeat steps 5 to 10 (voltage maximum at the band center)
15. once more set the tuning voltage to +7,5 Volts, and activate RL1 (lower band)
16. tune output frequency to 133,500 MHz with L2

2 meter RF section:

Tuning of the receiver. All cores flush with the upper borders of the coil forms.

1. connect the 133 MHz VCX0 with the local oscillator input (frequency set to band center)
2. terminate IF port with 50 ohms and hook up an oscilloscope to it.
3. connect the antenna input with a signal generator (f=144,24 MHz, some 10 mV eff.)
4. in turns tune L4, L3, L2 and C1 for a voltage maximum at the oscilloscope (10,7 MHz), the conversion amplification should be at least 15 dB.
5. C1 should be trimmed to the best S/N ratio.

Tuning of the transmitter. All adjustable cores should be flush with the upper border of the coil forms. All trimmer capacitors in center position. Quiet current potentiometer P1 adjusted to the ground side end.

1. connect the antenna output with a dummy load and a Watt meter.
2. activate the antenna relay RL1!!!
3. let mixer inputs be open.
4. do not power up the PA stage
5. supply +10 Volts ,S'

6. you should find some 0,3 Volts at the emitter of T4 (at an Ic of some 30 mA)
7. connect 13,5 Volts to the PA stage via an ampere meter.
8. carefully adjust the quiet current of T5 to 100 mA with P1
9. remove voltages
- 10 connect the 133 MHz VCX0 to the local oscillator input (frequency set to band center)
11. connect the IF port to a signal generator tuned to 10,7 MHz, and giving some 100 mVolts eff., unmodulated
12. supply +10 Volts ,S'
- 13 hook up an RF volt meter capacitatively to the collector of T3
14. in turns tune L5-L6 and L7-L8 to a signal maximum
15. supply 13,4 Volts to the PA stage via an ampere meter.
16. trim C43, C42, C34, C33 and C32 to maximum output
- 17 pause!!!
18. repeat stage 16.

After an optimal tuning, the transmitter should output som 5 W, the current drawn by the PA amount to some 650 mA.

10,7 MHz IF section:

Important advice: to obtain a stable device, this section must be mounted on 5 mm stand offs over a metal sheet.

Receiver tuning:

All adjustable cores must be flush with the upper borders of the coil forms. Trimmer capacitors C46, C47 and C48 should be turned half way in. The AGC potentiometer P2 should be turned to the ground end, all other potentiometers to center position. Remeber the AGC connection bridge at pin 7 and 8!

1. supply +10 Volts and +10 Volts ,E'
2. connect an RF millivolt meter to the source of T8
3. trim L6 to a maximum RF voltage of some 300 mV eff.
4. couple a frequency counter loosely to the source of T8.
5. activate RL3
6. tune the carrier frequency to 10698,5 kHz with C46
7. deactivate RL3
8. tune the carrier frequency to 10701.5 kHz with C47
9. activate T9 by putting pin 19 to +10 Volts

10. tune the carrier frequency to 10700,8 with C48 (for a 700 Hz CW offset)
11. disconnect pin 19
12. connect a monitor amplifier to the AF output at pin 9 and 10
13. hook up the IF input at pin 1 and 2 to an unmodulated signal generator on 10,7 MHz
14. adjust the generator for a 700 Hz beat tone. Reduce the signal till the AF signal is just perceptible above the noise.
15. trim L4, L3 and L2 to a maximum AF voltage. Reduce signal generator output as necessary to avoid flooding of receiver
16. after a well done tuning, it should be possible to read a 0,5 microVolt signal
17. turn signal generator off
18. set the AGC potentiometer P2 to 3/4. Connect pin 7 of IC5b with 2,2 kOhm to ground. Hook up an analog volt meter in parallel to this resistor (12 Volt DC range).
19. trim P3 till the reading is 0 Volts.
20. reconnect the 10,7 MHz signal generator and raise the RF signal voltage slowly. The measurement at the volt meter should raise approximately proportional to the RF signal. The AF monitor signal should stay about the same in loudness.
21. note the maximum voltage at the meter. Calculate the S meter series resistor R67 as $R_v = E_{Rmax} : I$ at full scale.
22. Use the same value for R68 (TX power) as for R67.
23. remove the 2,2 kOhm resistor

Transmitter tuning:

1. terminate the 10,7 MHz port, pin 1-2, with 50 ohms. Connect an RF millivolt meter in parallel to this.
2. put +4 Volts at pin 20 (transmitter power adjustment potentiometer)
3. supply +10 Volts ,S'. Put pin 19 to +10 Volts. Deactivate RL3!! Put pin 21 to +10V
4. trim L5 and L1 to a maximum RF voltage, some 100-200 mVolts eff
5. remove the voltage at pin 19. Connect pin 3-4 to a microphone. couple the 10,7 MHz port, pin 1-2, loosely to a test receiver (scanner). When you speak into the microphone, a clean SSB signal should be heard.
6. by activating RL3, you should be able to generate the opposite side band
7. trim P1 (balance) to the best carrier suppression (without modulation)

Control board:

The control board doesn't need any tuning. Test the stabilized 10 Volt supply voltage. With the key input, pin 22, put to ground, you can easily test the AF amplifier, the side tone oscillator, the T/R switch and the CW VOX. The AF volume potentiometer R5 should be mounted via soldering stand offs, as it determines the amplification of IC2.

After a successful completion of the tuning, and wiring of the transceiver, you will only need to fine tune the 133 MHz VCXO and the 2 meter RF section.

This manual needs further work. For that, I ask all of you users to join in a working community. Tell about every problem with explanations, unclear points etc. It would be nice to be able to supply measuring values as averages, to enrich the manual.

Peter, DL2FI

Hohentwiel modifications

To avoid a jump in the AGC voltage it has been necessary to make the following modification in some units:

The bridge between pin 11 and 12 has had to be changed to a 100 micro-Henry RFC.

Reason:

At pin 11 the BFO oscillator has a lot of power on the BFO frequency. At pin 12 you find the IF chain input and the in- and output of the crystal filters. Even though pin 11 is decoupled properly, you will find BFO RF on the 680 ohm resistor, when RF radiates into the IF filter with certain positions of the cores of the IF coils.

The RFC inhibits the passing on of BFO energy (it has been drawn into the diagram now).

Translations:

ZF-Teil = IF section

Steuer Platine= Control board

HF Teil = RF section

Gesamtverdrahtung = Wiring plan

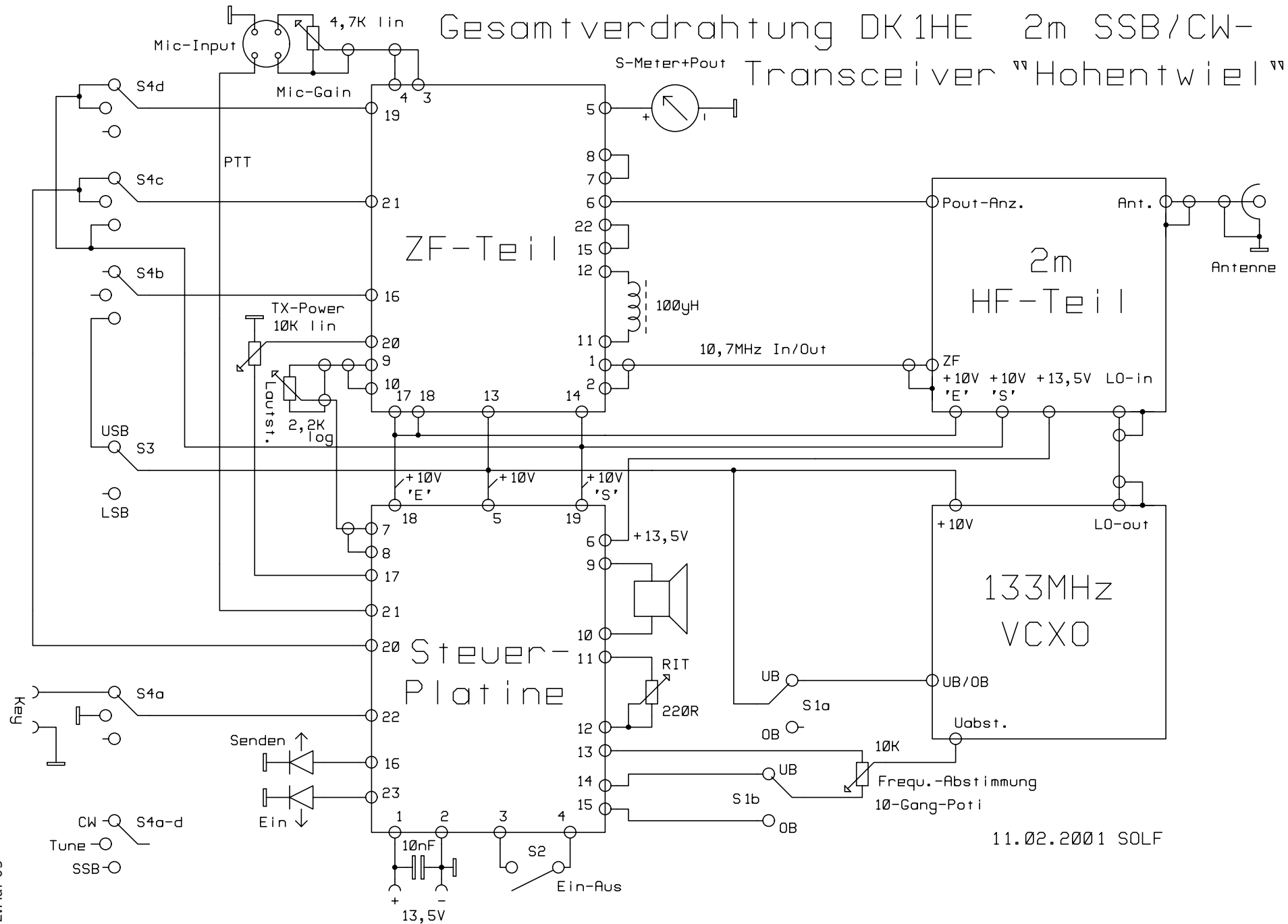
Frequ. Abstimmung = Frequency tuning Pot

Pout Anz = Power Out Display

Senden = Transmit

Ein = On

Gesamtverdrahtung DK1HE 2m SSB/CW-Transceiver "Hohentwiel"



11.02.2001 SOLF

Stand: 2. Mai 03