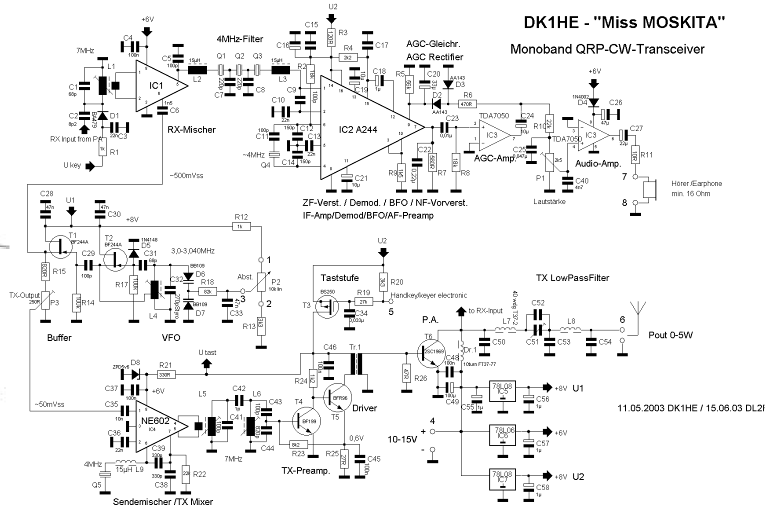
DL-QRP-AG



Miss Mosquita, Monoband CW Superhet Transceiver 40m Version

Version: June 14. 2006

Manual by: fiservice Peter Zenker DL2FI email:info@qrpidee.de

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Version: June 14. 2006

Monoband QRP- CW Transceiver „MOSKITA“

By Peter Solf DK1HE

Preface

Since the publication of the RockMite in FUNKAMATEUR 11/02, I have been planning a low cost small foot print transceiver. The goal was

- no technical limitations like the original
- a good price/value relation
- use of commonly available components

Out of this rose the first female CW transceiver of the DL-QRP-AG, the Moskita.

Technical data

- bands 40 m
- single conversion superhet with a 6 pole Cohn filter
- filter bandwith of some 500 Hz (40 m version)
- VFO tunable over the entire CW segment
- Sensitivity about 0.4 µV
- AGC on the IF, more than 90 dB of dynamic range
- Adjustable transmitter output of more than 2 W (up to 5 W) on 40 meters
- Efficiency of PA of more than 70%
- Soft keying of the transmitter
- Monitor side tone facility
- Working voltage of 10-14 Volts
- Working current, RX 30 mA, TX+RX some 380 mA. Pout= 2W at E=12.5 Volts.

To be manageable the level of integration has to be high, to fit in a pill box. For the receiver, a modified „Spatz/Sparrow“-design was chosen. This combines good reception data with low component count. The output is limited to 5 Watts (due to stability issues not in every enclosure.)

Circuit desciption of the individual stages (40 m version):

VFO:

The heart of the circuit is the voltage controlled 3.0-3.040 MHz VFO, which supplies the necessary LO signals for transmission and reception. The JFET T2 in conjunction with L4/C32 works in a Hartley configuration. D5 serves to stabilize the amplitude and to better the spectral purity of the oscillator. The tuning is achieved via the varactors D6 and D7. R12/ R13 defines the frequency limits. The RF output voltage of T2 is coupled via C29 to the following JFET buffer of T1. The low feed back source coupling here is fed to the input mixer at IC1 through C6 and to the transceiver mixer (SA602) through the voltage divider of R15/ P3. P3 manages the stageless adjustment of the transmitter output up to 5 Watts.

Receiver:

The reception signal goes through the transmitter output filter. The series circuit of L7/ C51/ C52 works as a preselector. C2 couples to the input circuit of L1/ C1. As the PA transistor T6 is blocked on reception, is constitutes no load on the reception signal (class C operation). The PIN diode of D1 serves to short circuit the high RF voltages of the input during transmission, and thus protects the input mixer. IC1 (SA602) mixes the inductively coupled 7 MHz reception signal with the 3 MHz VFO signal to the 4 MHz IF level. The selectivity of the receiver is mainly governed by the 6 pole Cohn filter following IC1. In the present configuration this results in a 6 dB band width of som 500 Hz. L2/ C5 and L3/ C9 serves to transform the impedance of the filter input and the filter output. The band limited 4 MHz IF signal is fed to the receiver IC, IC2 the venerable TCA440/a244d. This IC contains

- a regulated IF input amplifier
- a product detector
- a BFO (working in conjunction to Q4)
- a regulated AF amplifier
- an AGC stage

The demodulated output signal of IC2 is fed via C23 to the input (pin 2) of the first of two AF amplifiers in IC3 (TDA7050). The amplification is fixed at 26 dB. The low impedance output (pin 7) feeds the regulating rectifier of D2 and D3 via C24 and R6. The charging capacitor of C20 together with R5 govern the time constant of decay for the AGC, and R6 governs the attack time and blocks to high a level of regulation. Pin 9 of IC2 accepts the AGC regulating voltage. By regulating the IF and AF in parallel, a total regulation of more than 90 dB is achieved. This means that antenna signals of more than 500 mV eff. are regulated free of distorsion. The volume potentiometer is made unnecessary. Pin 7 of IC3 feeds the second amplifier via

R10/P1, which works as a head phone amplifier. R10 serves to protect the amplifier output against shorts and too low head phone impedance. To improve the noise bandwidth of the entire IF section to the CW segment, 3 low pass filters are utilized: (R4/ C17- R7/ C22- P1/ C25). The resulting frequency limit is some 800 Hz. The filter steepnes is some 20dB/ Oktave.

Transmitter:
The transmission signal is produced by mixing the ~3MHz VFO signal with the 4 MHz carrier from Q5 in the transmitter mixer of IC4. L10 shifts the crystal frequency so low as to achieve the TX shift. The output of IC4(SA602) follows an under critically coupled band pass filter of C42 and L5/ L6, which leaves the 7 MHz sum frequency unchanged. P3 serves to adjust the transmitter output continuously up to 5 Watts. C43/ C44 serves to impedance transform the high resonance impedance of the secondary of L6 to the input impedande of the broad band amplifier of T4 and T5. These are galvanically coupled. The collector quiet current is stabilized at som 25 mA by DC feed back. The microwave transistor T5 (BFR96) can feed some 150mW to the PA. TR1 serves a transformer from T5 to the low impedance basis (~5 Ohm) of the PA transistor T6 (2SC1969). In prototypes a 3 stage output low pass filter didn't adapt the output impedance of T6 to 50 Ohms at the antenna. The PA was very unstable at reactive loads (bad SWR), and showed parasitic on half the working frequency, leaving unacceptable subharmonics. The efficiency was untolerably low. This f/ 2 effect is described by Hajo (DJ1ZB) in several publications, and showed a solution with a serially coupled circuit. Peter (DL2FI) optimised this for the Mosquita with the help of a simulation program and several measurements. Jürgen (DL1JGS) built several parallel versions to ensure the ability to build copies. A real team work, Thanks! – to Hajo, Peter, Jürgen. The result of this work is the present output filter. The ~40 Ohm output impedandce (at 2 Watts) is transformed from T6 byt L7 to a much higher value, and then through C51 (+C52)/C53 to a 50 Ohm level. Through resonance, you will experience very high RF voltages, and the voltage limits of C51/ C52 must be considered. The serial circuit has a high impedance at f/2, and serves to reduce subharmonic parasitics quite well. Through the low pass filter of C53 /L8/ C54 you will achieve a total dampening of harmonics of at least 45dBc. The collector efficiency of the stage is more than > 70%; A high value for class C operation.

Transmitter keying:
The P-channel MOSFET T3 (BS250) works as a switch and supplies the early transmitter stages with 8V during keying. During reception C34 is charged via R19/C20 to working voltage, thus blocking T3. By keying the transmitter C34 is charged over R19 with a time constant of some 5 mS. While the voltage of C34 is lower than the gate opening voltage, T3 will increasingly conduct resulting in a „soft" attack of the transmitter power. When releasing the key, C34 is recharged over R19/C20. When the charging voltage at C34 is lower than the gate opening voltage, T3 will conduct decreasingly, resulting in a „soft" decay of the transmitter power. Key clicks is safely suppressed this way.

Voltage stabilizers:
To allow the very varying voltages of portable use, the construction contains IC5 / IC6 / IC7 to stabilize the supply voltage. They allow working from 10 to 14 volts.

Constructor:
Peter Solf DK1HE
English translation: Peter Raabye OZ5DW

Preface to building
We would like to present a few basic rules before building the kit.
Even the most experienced kit builder make mistakes, that is unavoidable.
A few rules and a little knowledge will reduce these mistakes to a minimum.
In the FI Workbench Manual, you will find several good tips. In it you will find details on components, on soldering and on winding coils.
As our kits are constructed to be beginner friendly, old hands will recognize a lot, but repetition isn't all that bad, and even experienced kit builders will find something good.
In kit building, reading is very important, and we recommend reading the entire documentation before starting to build the kit. The developers at QRPProject have built several prototypes, the last of which were with the original kit. We have tried to reduce pitfalls and to give a good description

in this manual, to lead kit builders around the pitfalls left. Please also read the corresponding *entire* section once more before starting each new section.

The manual:

The manual is divided in seven sections. In each section you will find the complete diagram on your left. All components to be mounted in this section will be in black, components already mounted in dark grey, and those to be mounted later in light grey. On your right, you will find the component placement diagram, this will use the same colour code, except that components to be mounted later are left out.

In the text part, you will find every component, please use the check boxes! From experience we know this to help a lot to reduce errors. New parts will be presented briefly in the text. After each section, you will find a test suite for the section. Please do the tests before skipping on to the next section.

And when you don't know how to proceed?

Then you turn to me! Easiest via email to support@qrpproject.biz on by telephone to (+46)/(0) 30 859 61 323.

For you to have an idea of whom you are working with, I will present myself briefly: DL2FI, Peter, called QRPeter. Ham operator since 1964.

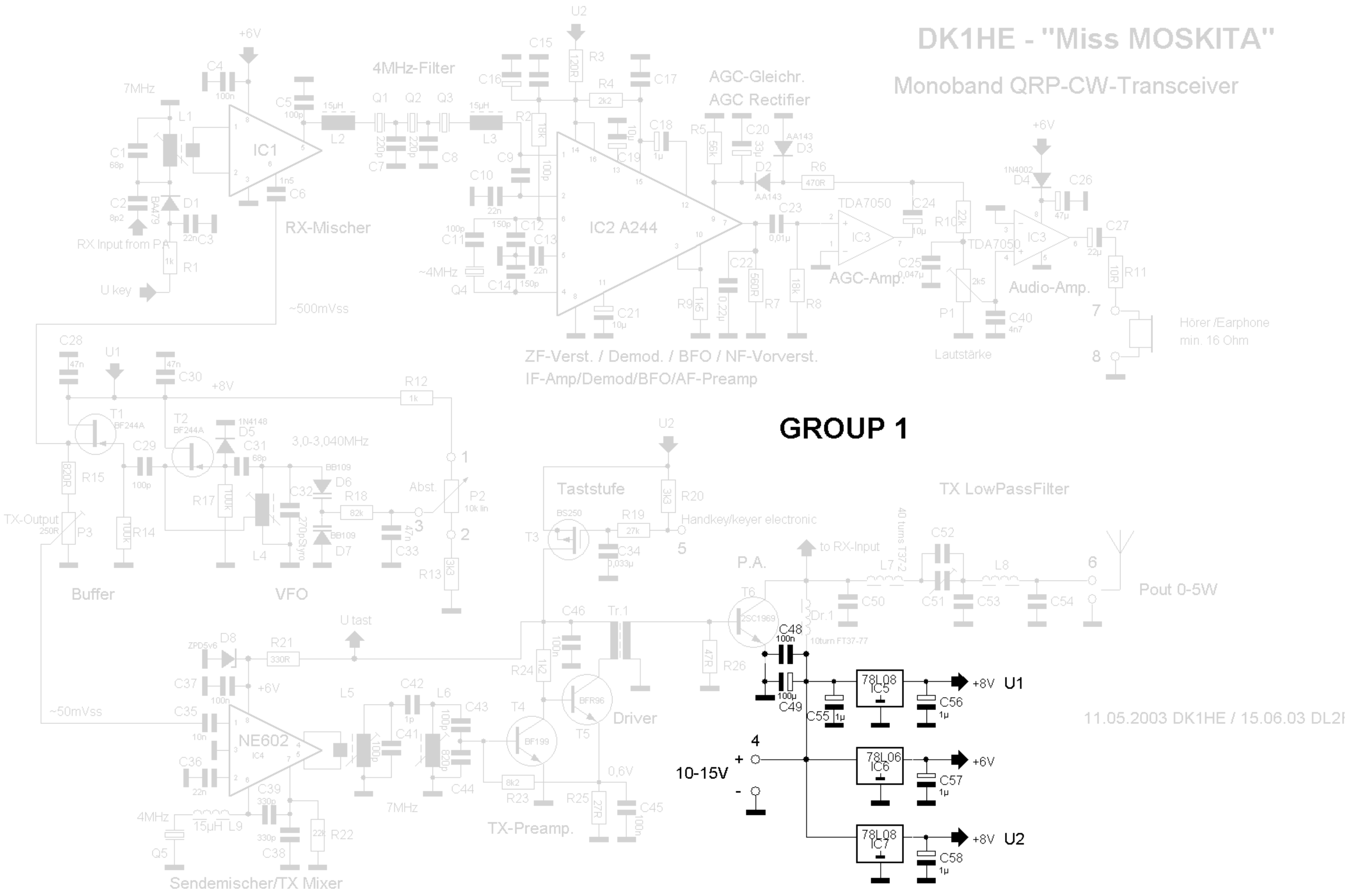
I have been a passionate home brewer and QRP operator for a long time, and it is my belief, that the best chance of ham radio is the rediscovery of home brewing. My motto: True ham radio comes from doing ham radio as it was. („Der Amateurfunk wird wieder wahr, wenn amateurfunk wird, wie er war.“).

Based on this belief, I was one of those starting the DL-QRP-AG, the german QRP work group, in 1997. This work group has grown to som 2300 members, who have developed several good devices to push the international success of QRP and home brewing. Since january 2002 I also spend much time as a local chapter head of the Berlin DARC Ham Radio Club, as I find it better to do something yourself than just complain. The international QRP movement have included me in their Hall of Fame.

I wish you much fun in the building of the Miss Mosquita

73 de Peter, DL2FI

PS: Why Miss Mosquita? Simple! So easy, so small and so much power and dynamics, that it had to be a girl!



GROUP 1

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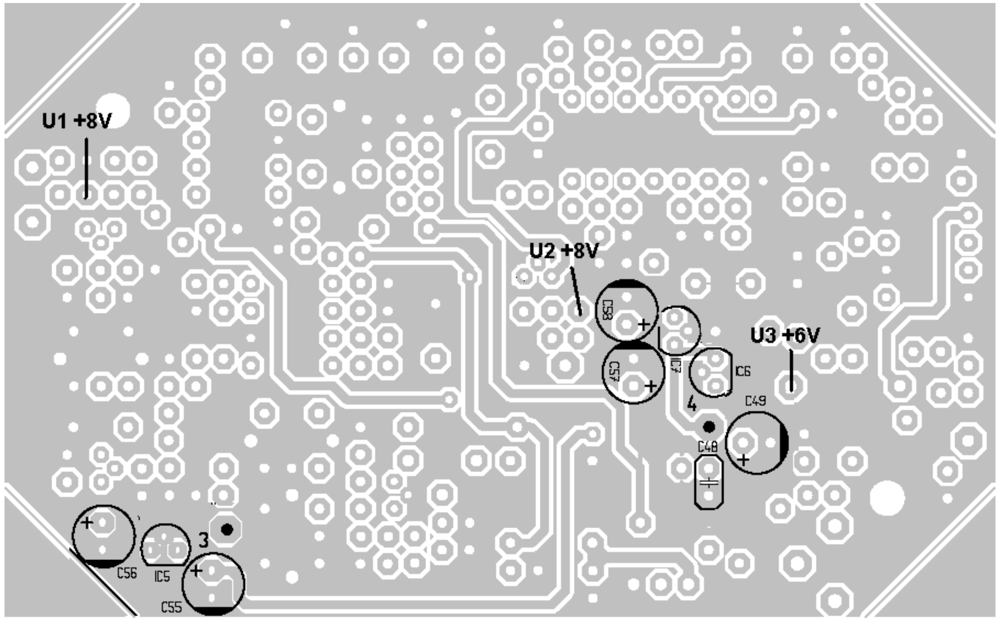


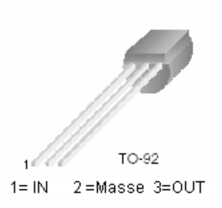
Section 1 Voltage Regulation:

Begin with the voltage regulation part.

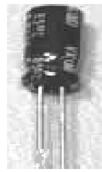
In the first section, we will mount the voltage controllers for the necessary voltages. Start with the small capacitors marked 104 for 100 nF. These capacitors of the X7R are usually only used to bypass high frequencies. The Q is not very high, so they are unusable for resonant circuits. You will find more on capacitors in FI's Workbench Book.

[ ] C48 100nF X7R Bypass capacitor, marked 104

The following three components are integrated voltage controllers for 6V (1) and 8V (2) int TO92 plastic casing. Voltage controllers of this type looks simple, but are quite complicated inside. They contain several dozen of components each. They will deliver a constant voltage output, as long as the input voltage is at least 1 Volt higher than the output voltage. Please be sure to mount the proper regulator in the proper place! Several small signal transistors and voltage controllers are made in TO92 casings. The placement diagram shows most components face up, that is from the top side of the printed circuit board. Please mount the components with the rounded side pointing as in the diagram. Please don't mix up the regulators (printed L08 for the 8V regulators, and L06 for the 6V type).



[ ] IC5 78L08 8V regulator TO92 (positive)
[ ] IC6 78L06 6V Regulator TO92 (positive)
[ ] IC7 78L08 8V Regulator TO92 (positive)



Now follow the electrolytic capacitors. Please note the polarity. The long lead is the positive, the negative side is marked with a minus sign.

[ ] C49 100uF electrolytic capacitor
[ ] C55 1uF electrolytic capacitor
[ ] C56 1uF electrolytic capacitor
[ ] C57 1uF electrolytic capacitor
[ ] C58 1uF electrolytic capacitor

Finally the soldering pins. Push the short end of the pins into the printed circuit board hole with a pair of pliers. No violence, but some force. Solder to the back side of the pc board.

[ ] Pin 4 soldering pin

Test of section 1:

1. Visual inspection.

The first test is to check the pc board with a loupe for possible shorts. Please take this test seriously. Even soldering masters makes shorts with bent leads or sprinkles of solder. None less annoying are unsoldered soldering spots. This is more common, than you may think. Check also for correct parts in correct places. Electrolytics correctly polarized? Diodes?

2. Resistance test

Measure the resistance from plus to to minus on the pc board with and ohm meter. The value is OK, as long as it isn't a short. You should read at least 50 kOhm

3. Smoke test

If Miss Mosquita passes the resistance test, you can apply the supply voltage to the pc board. It is a good idea to use a supply with a current limiter. Adjust the limit to minimum before connecting. Please remember to turn the supply on first, and THEN the device. This is always the proper sequence, as many power supplies delivers brief transients, that can be large enough to destroy your devices. With the Mosquita hooked up, have one eye on the current consumption and one on the pc board. If you see smoke, it is an obvious sign of malfunction. Current consumption above some 20 mA will also indicate malfunction

Voltage Test:

Measure the resistance between pin 4 and ground with an ohm meter. The resistance should be several kOhm. If not, check the pc board for solder bridges and check the polarity of the electrolytic capacitors. Hook up a supply voltage of 10 to 15 V between pin 4 (plus) and ground. If possible, use a laboratory supply with a current limitation of some 100 mA.
Measure at test point U1 = 8V.
Measure at test point U2 = 8V.
Measure at test point U3 = 6V.

If everything checks OK, continue to section 2.

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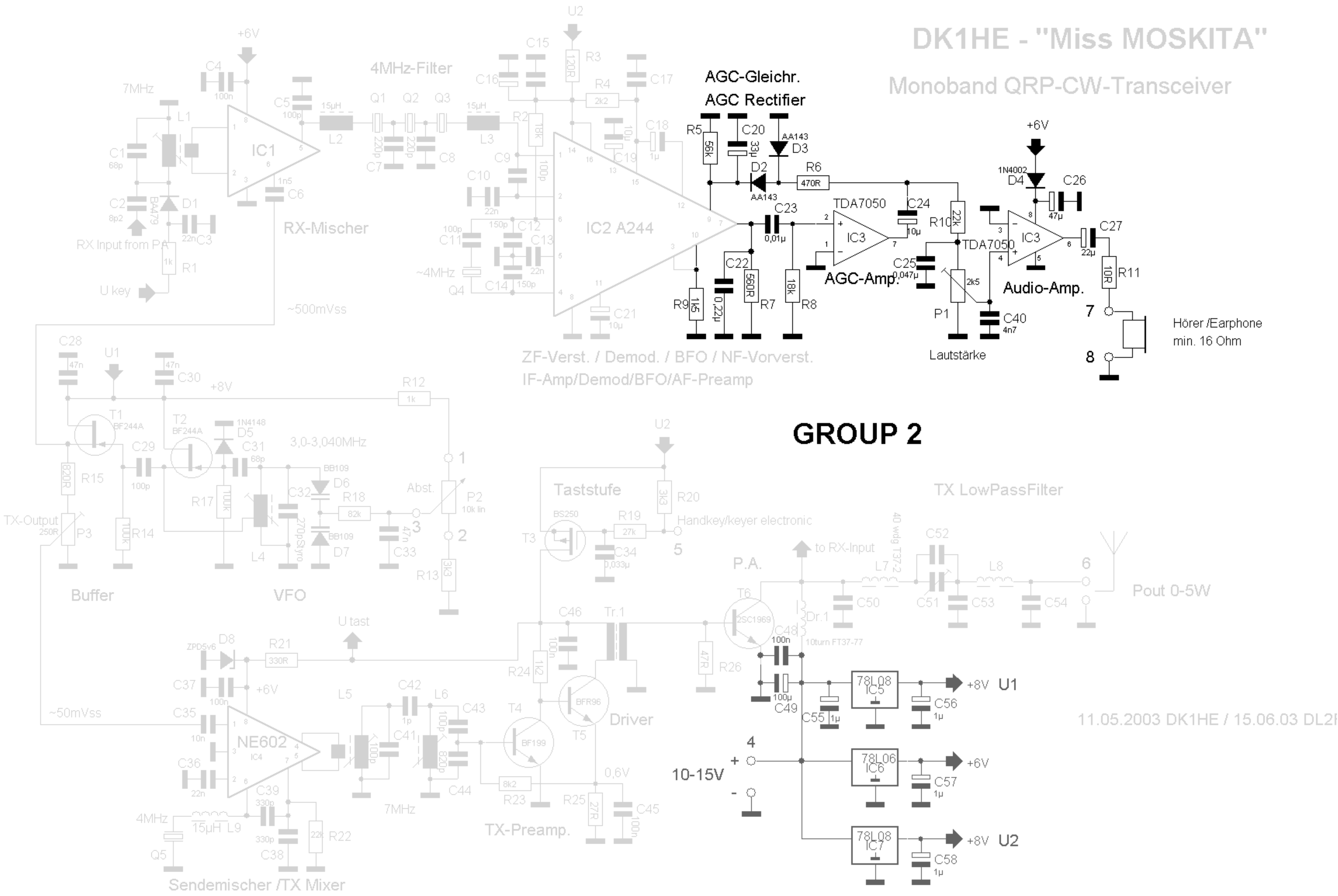

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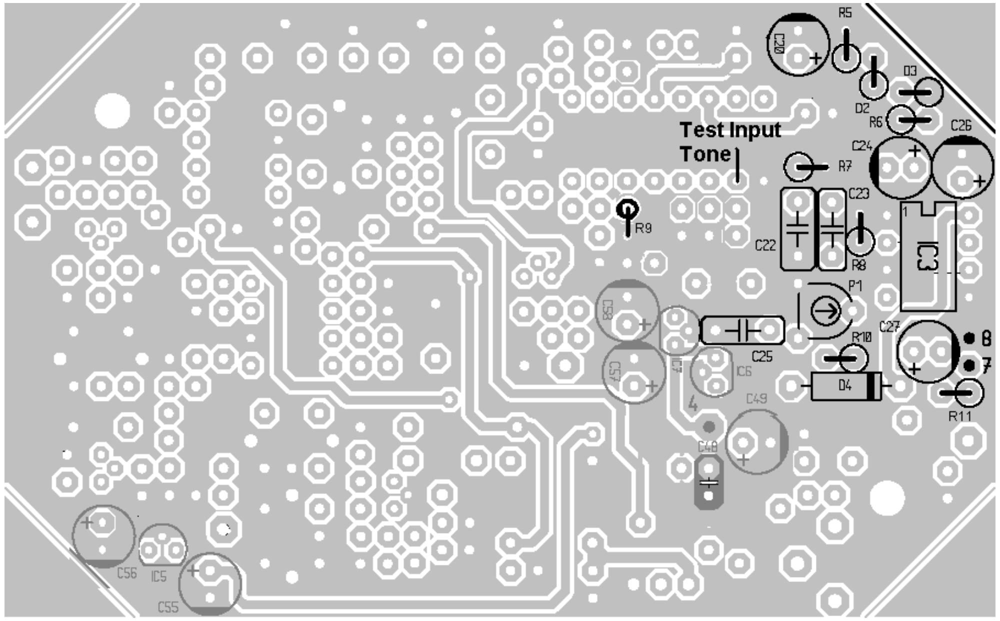


Section 2

AF amplifier and AGC rectifier

As room is sparse, we have chosen Piher trimming potentiometers. You will find 2 in the kit: 1 horizontal and 1 vertical. The horizontal is identified by the fact, that you can adjust it with a screw driver vertically from above.

[ ] P1 2,5K Piher Trim Pot PT6 horizontal

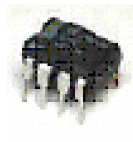
Now the resistors. As Miss Mosquita has to be small, without using SMD parts, most resistors are mounted standing. To do this one lead is bent back over the body of the resistor. In the placement diagram, a circle identifies the place for the reistor body. If you aren't sure about resistor values, please measure each before mounting.

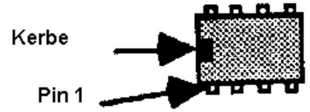
[ ] R5 56K [ ] R6 470R [ ] R7 560R
[ ] R8 18K [ ] R9 1k5 [ ] R10 22K
[ ] R11 10R

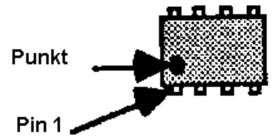
Now follows the film capacitors. The WIMA film capacitors are non polarized, the mounting directions is in principle unimportant. It is good practice, though, to mount them, so it is possible to read the printed values.

[ ] C22 0,22µF 63V film RM 5 [ ] C23 0,01µF 63V film RM 5
[ ] C25 0,047µF 63V film RM 5

Now follows a new part, an integrated circuit. The drawing shows this IC. Our AF amplifier is a TDA7050 in a DIP casing. From production reasons, the leads of such Ics are bent a little outward. To fit the IC into the pc board, you will have to bend the leads inward. You do that by „rolling“ the IC on a flat surface as shown in the drawing, till the leads are at 90 degrees with the casing.







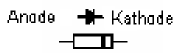
Pin 1 of an IC is know by the marking on the top side. That will be either a notch or a printed point. In the placement diagram, the marking is a notch. The IC is placed as shown in the drawing, and soldered on two diagonally spaced leads. Then you check whether the IC is flush with the pc board, followed by soldering the rest of the leads.

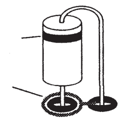
[ ] IC3 TDA7050

Now for the electrolytic capacitors. Note the polarity and correct placement.

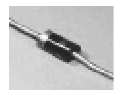
[ ] C24 10µF 16V rad. [ ] C26 47µF 16V rad.
[ ] C27 22µF 16V rad. [ ] C20 33µF 16V rad.

The ring on the following diodes mark the cathode. When mounting diode vertically, we always bend the cathode lead back, parallel to the body of the diode, and mount the body where the ring marking is on the pc board.





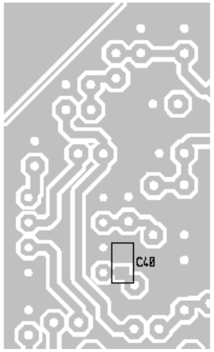
[ ] D2 AA143 [ ] D3 AA143
[ ] D4 1N4002



Now mount the two soldering pins for the head phone jack.

[ ] Pin 7 soldering pin [ ] Pin 8 soldering pin

and – oh, my! – a single SMD capacitor. You may have heard, maybe at DL-QRP-AG meetings or at my lectures, that SMD soldering really isn't a problem. In the FI Workbench Book, you will find a complete description of



working with SMD parts. We do sell, though, pc boards for Miss Mosquita with the SMD parts already mounted (there is one more SMD part in a later section). Please check the bottom side of the pc board, whether the SMD parts are mounted already. Else look at this as a small practice. Don't worry. It isn't difficult at all.

[ ] C40 4,7nF SMD!! 0805 (solder to bottom side of the pc board, - see the drawing lefthand.)

This concludes section 2, and you may proceed to the test.

Test of section 2

Visual inspection.
Resistance test
Smoke test
as decribed before

Voltage test:
Measure the voltage from pin 8 of IC3 to ground. This should be some 5,4 V. If not, check the supply voltage and the polarity of diode D4.

The hum test:
Hook up the head phones to pin 7 and 8. It is best to do this by soldering the head phone jack provisorically to the soldering pins.

Turn the P1 trimming potentiometer for volume fully clockwise. When you touches the middle contact of P1 with a screw driver, you should hear a loud hum, maybe even some broadcast. The latter depends on your distance to your nearest broadcast transmitter and how many antenna wires are close to where you sit. The more RF in the room, the more you will hear.
The same applies to touching pin 2 of IC3 with the screw driver. When P1 is fully turned up, the hum is louder. If you hear a hum, you may continue to section 3. If not, repeat the visual inspection, as you probably have a bad soldering or a misplaced part.

AF Test
If you have access to an AF generator, you can replace the hum test with feeding an AF signal into the Miss Mosquita. The feeding points are the same as used for the hum test. PC software exists to emulate an AF generator. Such a program is found on the QRPProject CD.

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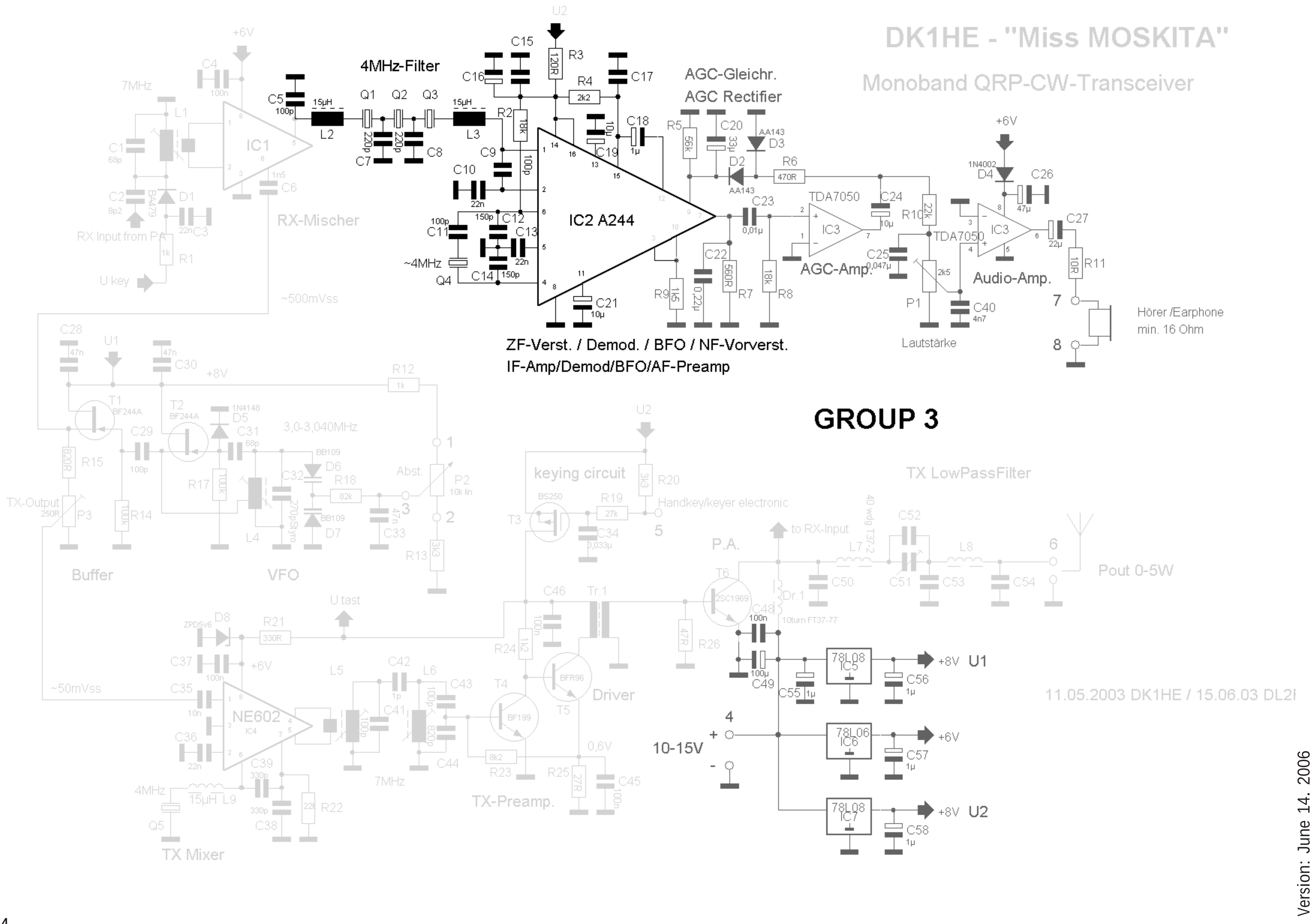
DK1HE - "Miss MOSKITA"
Monoband QRP-CW-Transceiver
GROUP 3
4MHz-Filter
IC2 A244
ZF-Verst. / Demod. / BFO / NF-Vorverst.
IF-Amp/Demod/BFO/AF-Preamp
AGC-Gleichr.
AGC Rectifier
TDA7050
IC3
AGC-Amp.
Audio-Amp.
Lautstärke
Hörer /Earphone
min. 16 Ohm
RX-Mischer
RX Input from PA
U key
~500mVss
~4MHz
7MHz
Buffer
VFO
3,0-3,040MHz
keying circuit
Handkey/keyer electronic
TX LowPassFilter
P.A.
to RX-Input
Pout 0-5W
TX-Output
~50mVss
NE602
TX Mixer
TX-Preamp.
Driver
10-15V
78L08 IC5
78L06 IC6
78L08 IC7
+8V U1
+6V
+8V U2
11.05.2003 DK1HE / 15.06.03 DL2I
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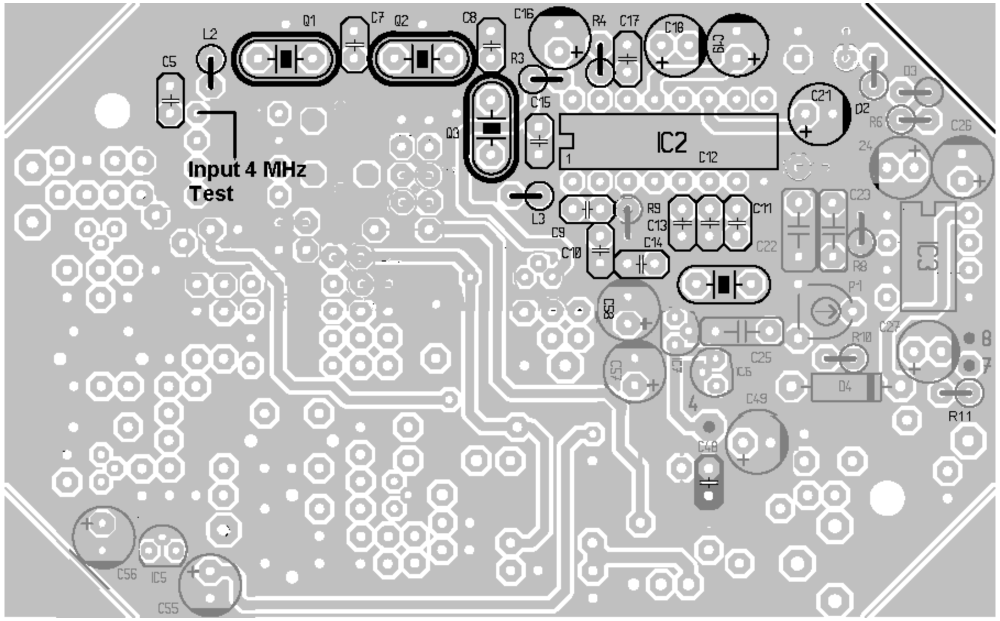
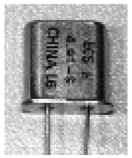


Section 3, IF amplifier

Now we mount the socket for the special IC A244D / TCA440 IC. It has 16 pins, remember to align the notch, with the notch marking on the pc board, to avoid misplacing pin 1.

[ ] IC socket 18 pin

Even though we usually start with the lower parts, please continue with the crystals. The reason is that Miss Mosquita is very small and the mounting of the crystals needs some room. Section 3 contains 4 crystals with a 4 MHz marking, These Xtals must in no case be mixed up with other 4 MHz crystals. The reason: To have a good, steep and narrow crystal filter, the crystals have to be paired. The filter crystals in the extra bag are individually measured at QRPProject and belong together.



NOTE: When soldering the crystals, the capillary effect of the pc board through plating can heap up solder under the crystals and create a short. When found in the kit (supply problems!), please use the underlay discs. If no discs are found, please mount the crystals with a small distance to the pc board. A good trick is to lay a cut of resistance lead temporarily under the crystal as a placekeeper. Remember to remove the resistor lead, when you have soldered in the crystal.

[ ] Q1 4MHz 32pF HC18/U [ ] Q2 4MHz 32pF HC18/U

[ ] Q3 4MHz 32pF HC18/U

Along Q1, Q2 and Q3 you will find some holes in the pc board. Mount cut off resistor leads in these and solder them to the crystals about half way up at a right angle. Solder for only a short time, as the crystals can be damaged.

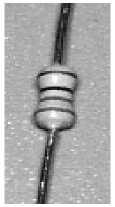
[ ] 3 crystal casings soldered to ground

With the other parts, you will find another 4 MHz crystal, Q4. Solder it in as you did Q1-Q3.

[ ] Q4 4MHz 32pF HC18/U

Now follow a few high Q bypass capacitors for the crystal filters. Here we use either ceramic capacitors or multilayer NPO capacitors. Here we're not interested in temperature coefficients, only in Q.

[ ] C5 100pF [ ] C7 220pF [ ] C8 220pF
[ ] C9 100pF



L2 and L3 are needed for impedance matching of the filters. In this case we use industrially made RFC's of SMCC type. These look like „fat" resistors. The colour code is found in the FI Workbench Book.

[ ] L2 Choke 15µH SMCC [ ] L3 Choke 15µH SMCC

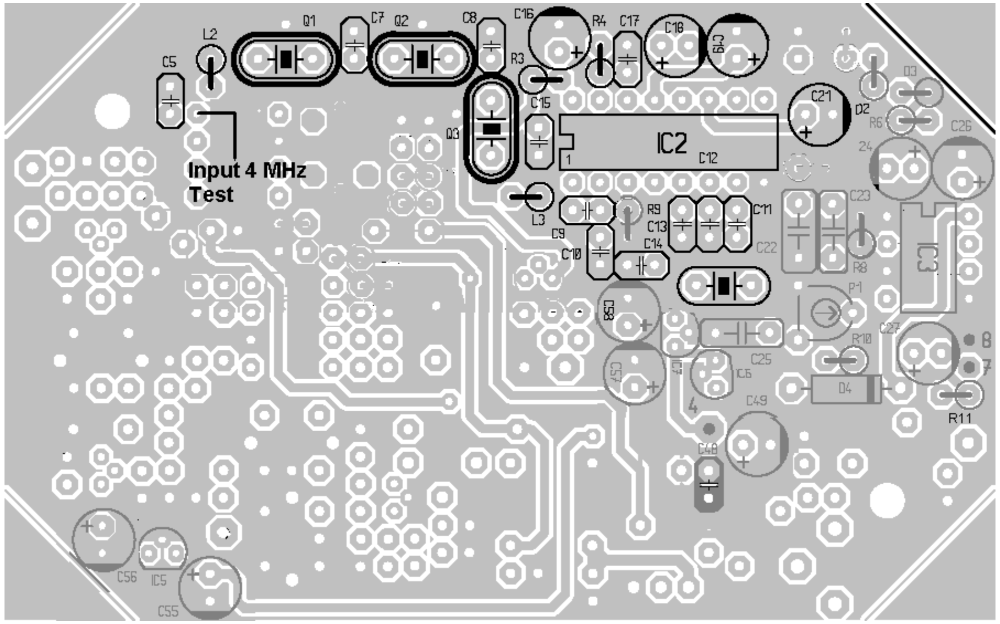
The next components are standard capacitors.

[ ] C10 22nF [ ] C11 100pF [ ] C12 150pF
[ ] C13 22nF [ ] C14 150pF [ ] C15 100nF
[ ] C17 100nF

Now follows some tantalum capacitors. These are also polarized, you will find the value printed on the drop shaped body, and a plus sign at one lead. Tantalum capacitors are often used by developers, when low loss at high capacitance is needed.

[ ] C18 1µF tantalum pearl [ ] C19 10µF tantalum pearl
[ ] C21 10µF tantalum pearl

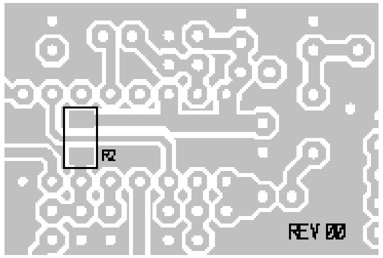
The two resistors pose no problems



[ ] R3 120R

[ ] R4 2,2K

Please note the polarity with the electrolytic capacitor.
[ ] C16 100µF 16V rad.



Now you're nearly through with section 3. You only need to mount the second SMD part of the kit. Please refer to the notes in section 2. R2 18K SMD!! 1206 (solder to the bottom side of the pc board!)

Put IC2 in ist socket and test the section.
[ ] IC2 A244D/TCA440 mount carefully, mind the notch and pin 1!

Test of section 3

Visual inspection.
Resistance test.
Check if IC2 is put correctly into the socket!
Smoke test.

Function test

Test 1

Make a link line from a piece of wire. Take a piece of wire, double it up and twist it. At the closed side, leave a small eyelet. Connect the free ends to a receiver input and ground. Hold the eyelet loop over Q4. Connect the voltage supply. Now you should hear a strong 4 MHz signal in the receiver, coming from the oscillator.

Test 2

Touch pin 1 of IC2 with a screw driver, if the volume is turned fully up, you should hear some mumbling short wave signals. In RF weak areas, you could need a piece of wire. This test shows that the IF amplifier, BFO and AF amplifier works, - they are all found in IC2. If nothing is heard, please start over from the visual inspection.

Test 3

When testing the crystal filters, the hand test doesn't suffice. For this, you will need a 4 MHz signal. I explicitly write 4 MHz and not 4.000 MHz, even though the crystals are measured to within 50 Hz, as the actual frequency is influenced by the circuit.

Test 3, Methode 1

If you have a tunable transmitter, you can turn down the output at 4 MHz with a dummy load. Hook it up to the pc board holes, where you later on will mount pin 5 of IC1 with a piece of wire as antenna. Don't solder it in, it will be a mess to clear up the hole afterwards!!! Just put in a bit of cut of resistor lead, and solder the wire to this. The resistor lead will lie ob-liquely to contact the pc board.

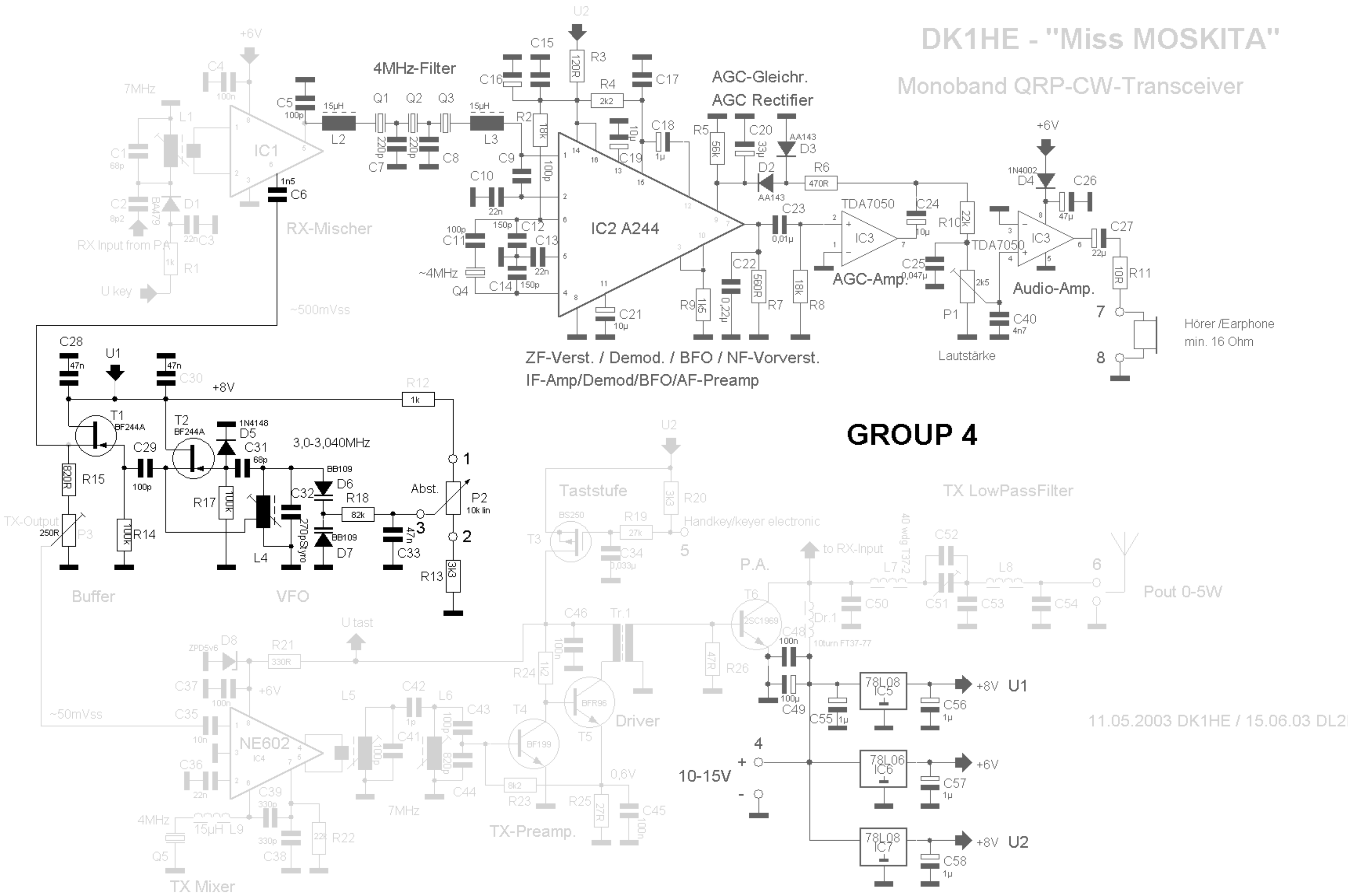
Test 3, Methode 2

If you don't have access to a 4 MHz transmitter, build a small test oscillator and use the remaining 4 MHz crystal for that. The signal from this will do. You can also buy a small RF generator kit from QRPProject (order code SignGen). The diagram for this test oscillator and for the signal generator are found on the CD.

Test 3, Methode 3

This method not only test the function of the IF, but also tells about the filter quality. Hook up a noise generator at the help antenna point. The noise generator can be easily put together, if you don't have access to one.

You will find a diagram on the CD, or you could buy a kit from QRPProject (order code RauschGen).
Connect the sound card of a pc with a stereo cable (2 x 3,5 mm jack), and start the analyser software on the PC. The GRAM freeware program is found on the CD).
The noise generator makes wide band noise from 1 to more than 30 MHz.
Our IF filter only lets part of this spectrum through. As the BFO changes the IF signal to an AF signal, the AF analyser will show the band pass curve of the filter and IF.



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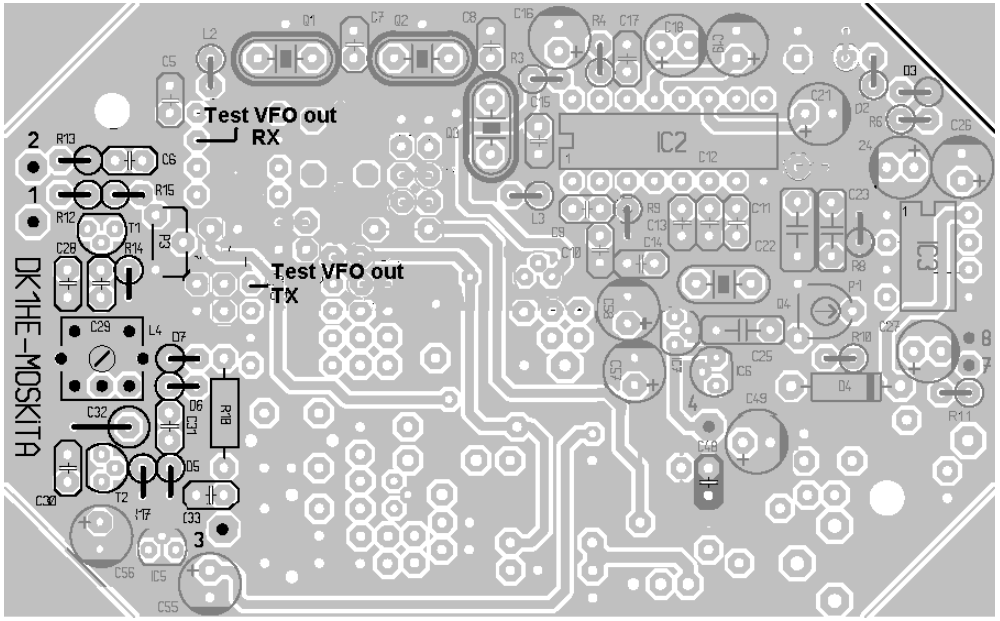


Section 4, VFO: IF You are Building a Mosquita with UniDDS VFO dont use this Installation Procedure but refere to the UniDDS Manual page 21! after you have built the DDS VFO.

The trimming potentiometer P3 is a bit awkward to mount with the rest of the parts in place, so we will begin with this.

[ ] P3 250R Piher PT6 trimming potentiometer, vertical.

The rest are old friends. Remember to mount the diode correctly!

[ ] R18 82K	[ ] D6 BB109G or BB139 or BB40p
[ ] D7 BB109G or similar	[ ] R12 1K
[ ] R13 3,3K	[ ] R14 100K
[ ] R15 820R	[ ] R17 100K
[ ] D5 1N4148	[ ] C28 47nF
[ ] C29 100pF	[ ] C30 47nF
[ ] C31 68pF	[ ] C33 47nF
[ ] C6 1,5nF	

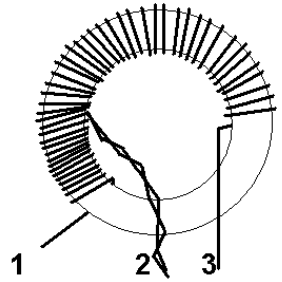
Now follows two FET transistors in TO92 plastic casings. The should be mounted according to the printed mask. The bottom of the casings should be a few mm above the pc board.

[ ] T1 BF244A TO92 [ ] T2 BF246A TO92 (changed from BF244A)

The coil needs a little more attention.

When we started the Mosquita kit, we designed the PCB to use a Neosid standard coil as the VFO coil. In praxis we found, that this type of coile caused frequency instability. Some experiment showed, that using an amidon torroid gave much better results. We decided from now on to ship the mosquita kit with an Amidon Torroid as a replacement.

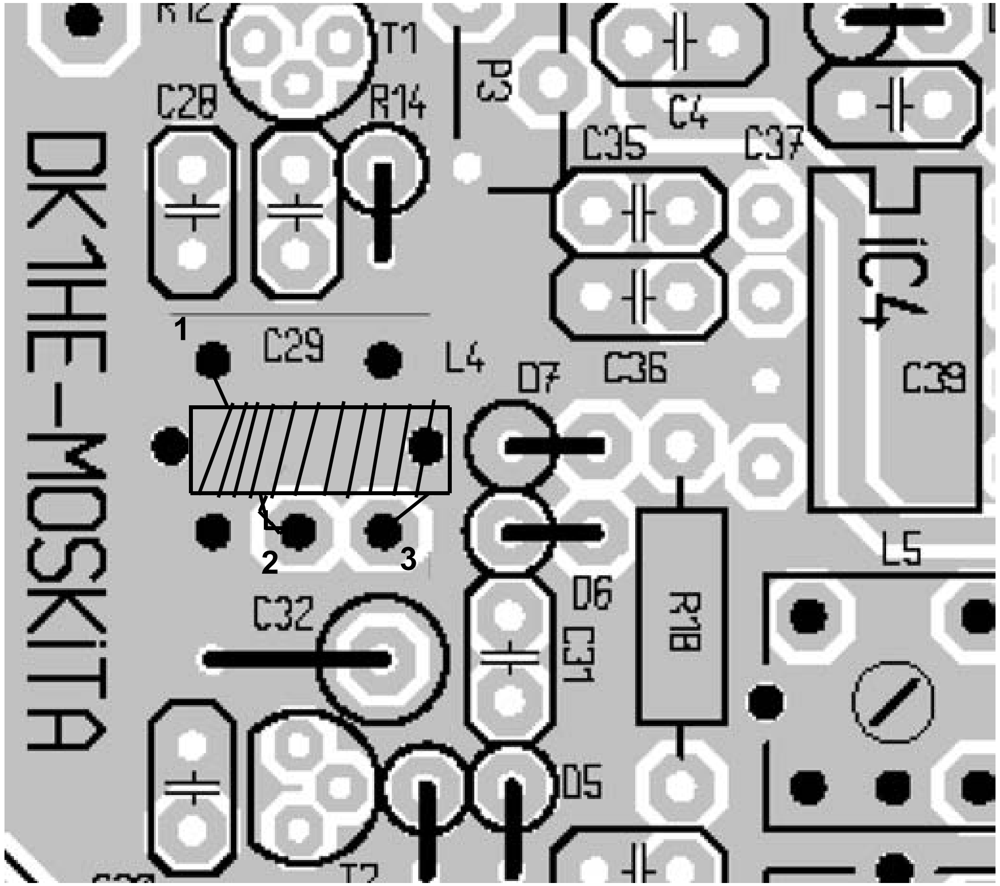
The VFO coil will be wound on a T50-6 torroid (yellow). It consists of 45 turns 0,3mm enameled copper wire, tapped at 14 turns. Hold the torroid between your fingers as you see it in the drawing. Feed the wire from the backside through the torroid leaving about 2cm wire at the back side, that is the first turn (Torroid based coils alway count inside the ring). Now add the next turns clockwise up to turn No. 14. Twist the wire back as seen in the drawing and form the remaining 32 turns. The result should look similar as the drawing. The spreading of the turns around the torroid is insignificantly in this moment, we will come back to this issue later. Now carefully tin 1cm of the 3 wires starting about 1mm next to the torroid. The best way to do is using the “BLOB” method. This means; apply a big amount of tin to the tip of your solder iron, this is the “BLOB” and hold the blob to the wire. Start just at the border of the torroid. If you see smoke, move the tip slowly to the outer end of the wire. (The smoke is not very healthy, try to avoid getting it into your nose.



It is a very common failure that the wire is not properly tinned, so do this carefully and check the result with an Ohm-Meter.

If it is ok, solder the coil to its place as shown in the next picture. While soldering pull the torroid toward the PCB to give it a stable place.

Take care to use the rigt wires. 1 is the short end seen from the tap, it is soldered to ground, the tap itself is number 2, 3 is the long end.



[ ] L4 VFO coil 46 turns at Amidon T50-6 (yellow) tapped at 14 turns.

Now the three soldering pins for for the tuning potientiometer.
[ ] PIN 1 [ ] PIN 2 [ ] PIN 3

[ ] Attach the 3 connectors of the 10k lin Potentiometer to this PINs by short wires. (Wiper at PIN 3)
The last part is the
[ ] C32 270pF Styroflex axial

Now you can test this section.
Test section 4
Visual inspection
Resistance test
Smoke test
Functional test

Hook up the supply voltage. Put the previously made link wire over L4 and couple it to the a reciever. If you have access to a frequency counter, you can connect it directly to pin 6 of IC1 instead (that is, at the hole in the pc board, where you will later mount pin 6 of IC1).
Find the VFO signal with the reciever. It should be somewhere around 3 MHz +/- a few hundred kHz. When you have found the signal, turn the tuning potentiometer to the lowest possible frequency. Now tune the frequency by spreading the turns on the torroid until you find the signul just at or below 3.000 MHz. Now the potentiometer ought to tune from about 3.000 to 3.040 MHz ore more.

You may fix the VFO coil now by using some 2 component glue. Leave 1 quarter unglued for now to have a chance to do some fine tuning after you have built your mosquita ino its enclosure. During hardening of the glue, you may readjust the spreading by use of a needle.

If you use a frequency counter, do the same adjustments with that.

Go on to section 5.

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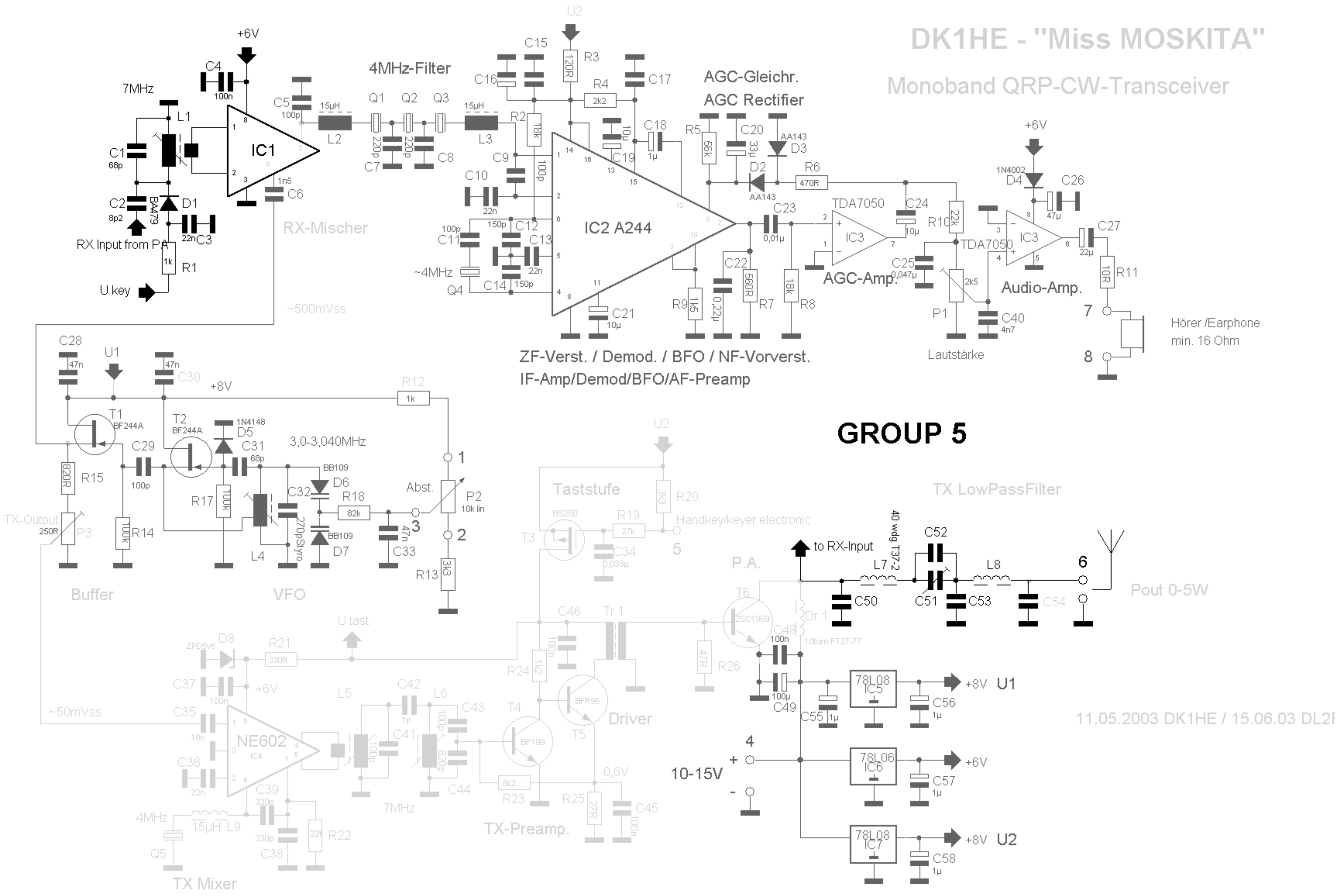

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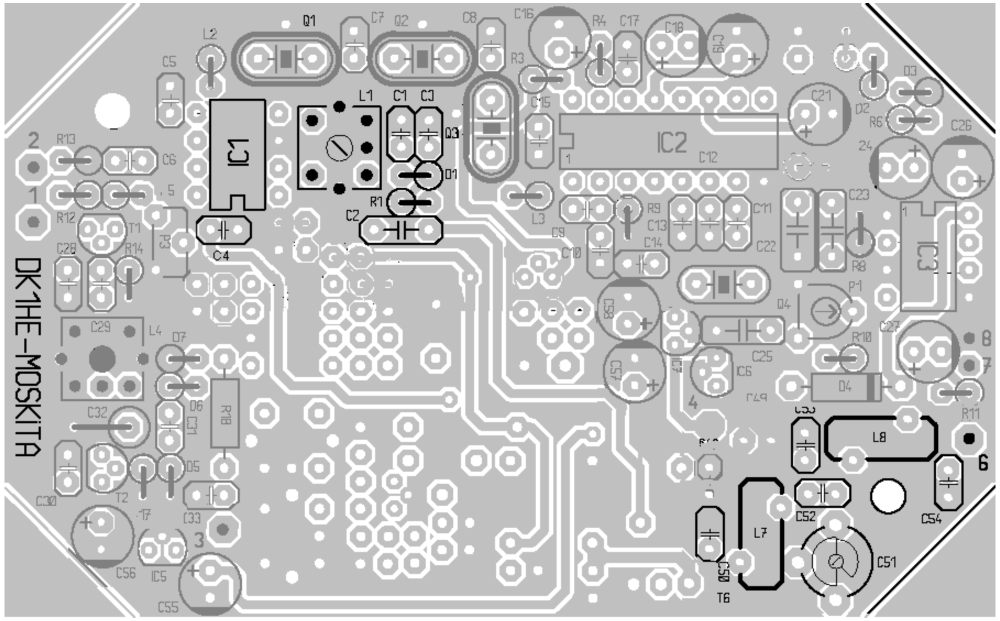
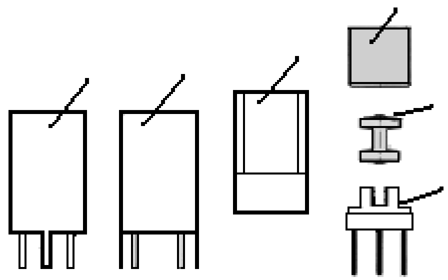


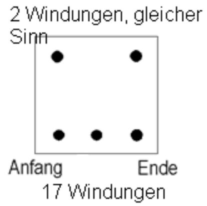
Section 5 RX mixer and low pass filter.



The Neosid coil used in thes section is different from the VFO coil. It is a BOBIN coil. It consists of a ferrite body, looking a bit like a spool of yarn. The turns are not put in one layer on this, but just put on. The number of turns are important, though. Take the foot of the bobin coil, put on a drop of super glue in the notches and press the ferrite yarn spool gently into it. Let the glue dry before proceeding. You may solder in the remaining parts while you wait.

[ ] R1 1K [ ] D1 BA479
[ ] C1 68pF [ ] C2 8,2pF
[ ] C3 22nF [ ] C4 100nF
[ ] C50 150pF [ ] C52 390pF
[ ] C53 820pF COG [ ] C54 330pF COG
[ ] C51 film trimmer 2,5- 60pF 7mm black
[ ] IC1 NE612 DIL8 (mind correct placement of pin 1!)

Now the coil form should be fixed, and you can start winding the coil. The picture on your leeft shows the coil from below. Begin at the pin marked Start („Anfang“) and loop the wire three times around the pin. Put it through the notch and onto the roll. Now wind on 17 turns onto the roll, and back through the proper notch to pin End. Three turns around the pin, and you are done.

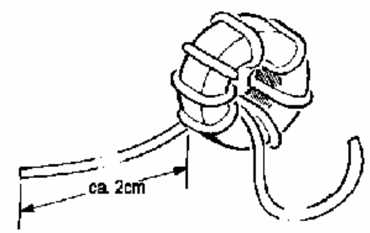


Now from the opposite pin put on a further two turns, go through the notch to the other pin, put three turns around the pin close to the coil form, to complete the secondary.
Fix the coil carefully in a vice and solder pins and wire, as you did the VFO coil. Test with the ohm meter, if the the coils is conducting, and that the two windings aren't shorted.
Worked out so far? Now put the plastic body on the socket and put the large screw core gently in. Please be careful, that the ferrite doesn't tip. Solder the coil in, and put on the screen can.

[ ] L1 Neosid coil kit 7.1 ferrite F10b. Primary 17 turns 0.1 mm lacquered copper wire. Secondary 2 turns 0.1 mm lacquered copper wire.

Now you only need to make the two coils for the low pass filter. For these we use Amidon toroid cores. They aren't ferrite but iron carbonyl, and have smaller stray fields and very good Q. The winding of these toroids is very easy. The only thing to note is, that you count the turns on the INSIDE of the ring, and that the wire ends must be deisolated very carefully. If toroids are new to you, you will need to read about them in the FI Workbench Book.

L7 is a simple, one layer coils consisting of 0.3 mm lacquered copper wire. Be careful that the wire ends are where the holes are in the pc board. If you feed the wire forward through the ring, you should wind clockwise, if you feed the wire backwards, you should wind counter clockwise. The drawing shows a toroid with 8 turns.



L7 consists of 23 turns (counted on the inside) of 0.3 mm lacquer isolated copper wire on the **RED** ring. The turns should be tight and spaced on 2/3 of the core.

Both ends are deisolated with the „blob“ method. The lacquer melts at soldering temperature. With the blob method, a thick drop of solder is put onto the soldering iron tip, and this drop is held to the wire. Starting close to the ring, keep contact between soldering iron and wire. Slightly pressing the wire helps, move as little as possible. You will note the melting by the smoke rising. Now move the soldering iron slowly towards the end of the wire. Shove the lacquer slowly against the end of the wire. Meanwhile the wire is covered in solder. Having done this at both leads, solder in the coil. Pull the wire tightly so the coil is close to the pc board to be stable.

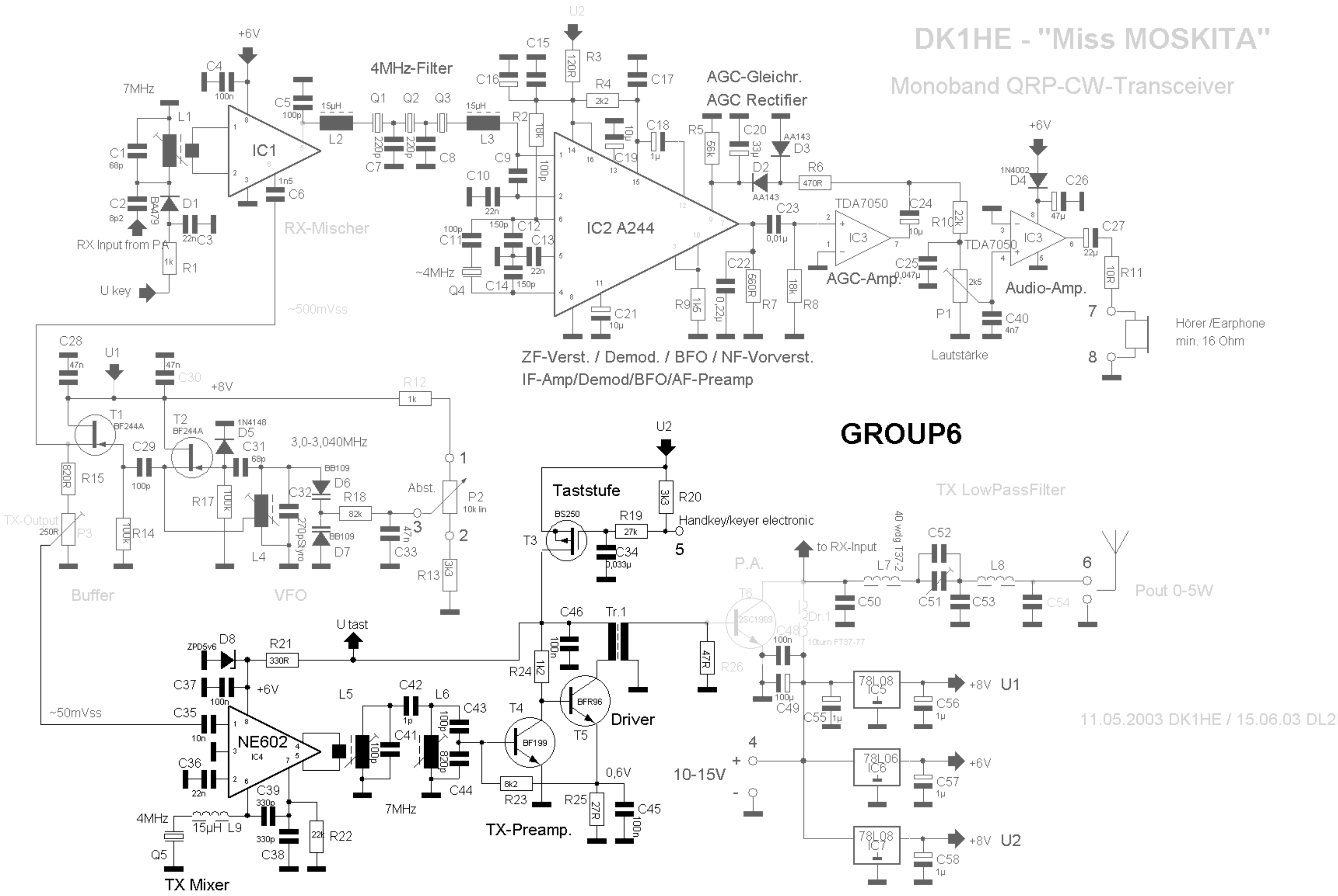
[ ] L7 23 turns 0.3mm lacquer isolated copper wire on T37-2(red)

L8 has 22 turns of 0.5 mm lacquer isolated copper wire. NOTE: the pc board holes are placed differently from L7. That is you have to wind L8 the opposite way of L7.
[ ] L8 22 turns 0.5mm lacquer isolated copper wire on T37-6 (yellow)

Having come this far, you can test the section and thus the test of the receiver, which will be completed in section 6.

Test section 5
Visual inspection
Resistance test
Smoke test
Functional test.
Section 5 completes our reciever. If everything works out OK, you will be able to hear your first signal. Hook up the head phones and the power supply. Use two short pieces of wire to hook up the antenna connector temporarily to pin 6 and ground. Now connect either a signal generator or a low power transmitter with a dummy load to the antenna connector. A small, cheap signal generator is available as a kit from QRPProject. You could use an antenna instead as Miss Mosquita is very sensitive, and strong signals should be readable even with a detuned reciever front end.

Turn in L1 so that the top of the core is some 1 mm below the screen can, and put C51 in center position. Tune the signal generator a little to an fro, till you hear a signal in the head phones. If you work on an antenna, tune the VFO to a loud signal. In both cases, all you need tils to tune L1 and C51 to a maximum.
Now Miss Mosquita is a fully functional receiver. SWL jump past section 6 and 7 of the handbook and continues to the fitting in an enclosure, all others continues with the transmitter in section 6 and 7



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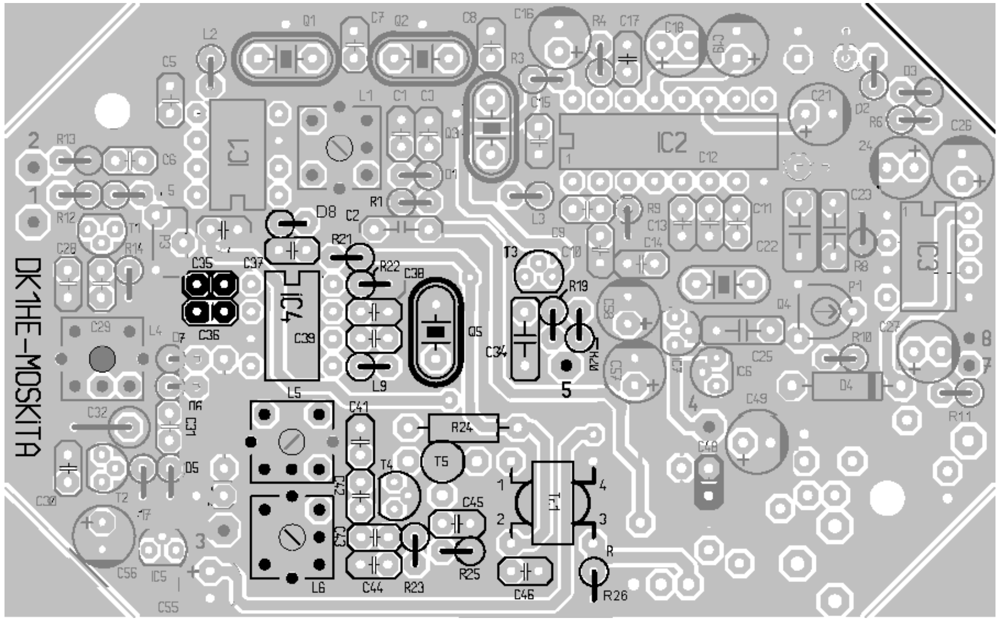
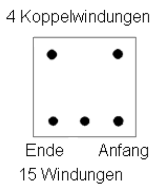


Section 6 TX mixer and driver

Please once more note the polarity of the diodes and the notch of IC4

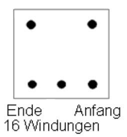
[ ] IC4 NE612

[ ] C35 10nF	[ ] C36 22nF
[ ] C37 100nF	[ ] C38 330pF COG
[ ] C39 330pF COG	[ ] D8 ZPD 5V6
[ ] Q5 4MHz 32pF HC18/U	[ ] L9 15µH SMCC
[ ] R21 330R	[ ] R22 22K
[ ] C41 100pF	[ ] C42 1pF
[ ] C43 100pF	[ ] C44 820pF NOO



L5 and L6 are also bobin coils. Do as you did with L1 in the receiver.

[ ] L5 Neosid coil kit 7.1 ferrite F10b (BOBIN). Primary 15 turns 0.1 mm lacquer isolated copper wire, secondary 4 turns 0.1 mm lacquer isolated copper wire.



[ ] L6 Neosid coil kit 7.1 ferrite F10b (BOBIN). 16 turns 0.1 mm lacquer isolated copper wire.

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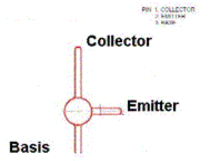
[ ] R23 8,2K	[ ] R24 1,2K
[ ] R25 27R	[ ] R26 47R
[ ] C45 100nF	[ ] C46 100nF
[ ] C34 0,033µF 63V film RM 5mm	[ ] R19 27K
[ ] R20 3,3K	

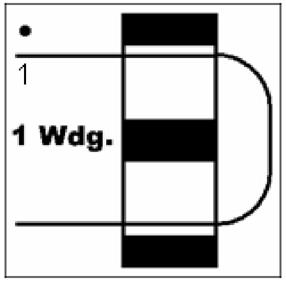


Mount the transistors according to the printed layout.

[ ] T3 BS250 TO92 [ ] T4 BF199 TO92

The BFR 96 is a special transistor for broadband amplifiers. The drawing lefthand shows how the wiring goes. Bend the leads 90 degrees down, so that you still can read the printed marking. Solder the transistor in.

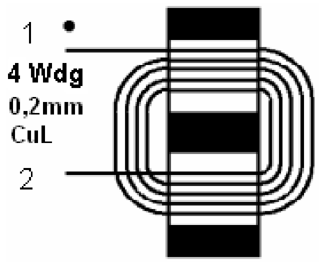
[ ] T5 BFR96(S)



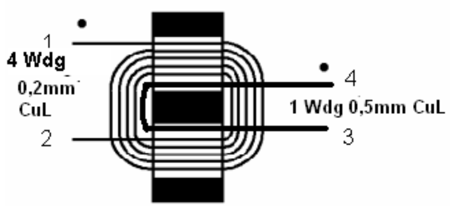
Winding instructions, transformer TR1

The TR1 transformer is wound on a double hole core, known with us as a pignose core.

Lay the pignose in front of you, holding the holes from left to right. The primary is 4 turns, and the secondary 1 turn. Like in other applications, you will se one winding marked with a point. The point always marks the beginning of the winding.



Cut two 20 cm pieces of 0.2 mm wire and feed it through the pignose as shown in the picture. One turn is complete, when you have run the wire through one hole on top and the other at the bottom. Thus, begin with 2 turns: through the upper hole to the right (leave about 2 cm hanging out to the left), and then back through the lower hole. That was one turn. Now once more through the upper, and once more through the lower. Don't pull the wire too hard over the edges of the core, as the lacquer is fragile.



Continue with turn three, four and the primary is done.
Now to the secondary. We have to transform down to the low impedance input of the output transistor. We will only need one turn of 0.5 mm lacquer isolated copper wire.
To simplify the mounting, our developer laid out TR1 so that the secondary leaves the core opposite to the primary.
Take a 6-7 cm piece of 0.5 mm wire, and feed it carefully from right to left through the upper hole and left to right through the lower hole. That concludes the secondary. The transformer can be mounted. The secondary goes to 4/3, the primary to 2/1 as shown on the printed layout and the placement diagram.
[ ] Tr.1 double hole core DL-QRP-PA. Primary 4 turns 0.2 mm lacquered copper wire. Secondary 1 turn 0.5 mm lacquered copper wire.
Now we only need two more parts to conclude this section:
[ ] C44 820pF COG [ ] IC4 NE612 DIL8
Done! Proceed to testing this section.

Test section 6

Visual inspection
Resistance test
Smoke test

Functional test.
Set the covering cores of L5 an L6 so that the upper edges are about 1 mm below the screen can. Turn trimming potentiometer P3 clockwise up to 2/3. Put the link loop close to R26 and adjust the control reciever to some 7000 kHz, or put a probe on R26. (The construction of a probe is shown in the FI Workbench Book).
If you do not have an Analyser whic will be true for most of you, use a receiver to tune the Bandpassfilter to the correct frequency.
Connect the voltage supply and key the transmitter pulling pin 5 to ground. Find the transmitter signal on your receiver. If it is too week, again use a link wire as you did in the RX section before. Adjust L5 and L6 to maximum on the S meter. If you work with a probe or scope, you may tune to a wron mixing products maximuml. Tuning and testing this section is done. Now we only have to build the PA.

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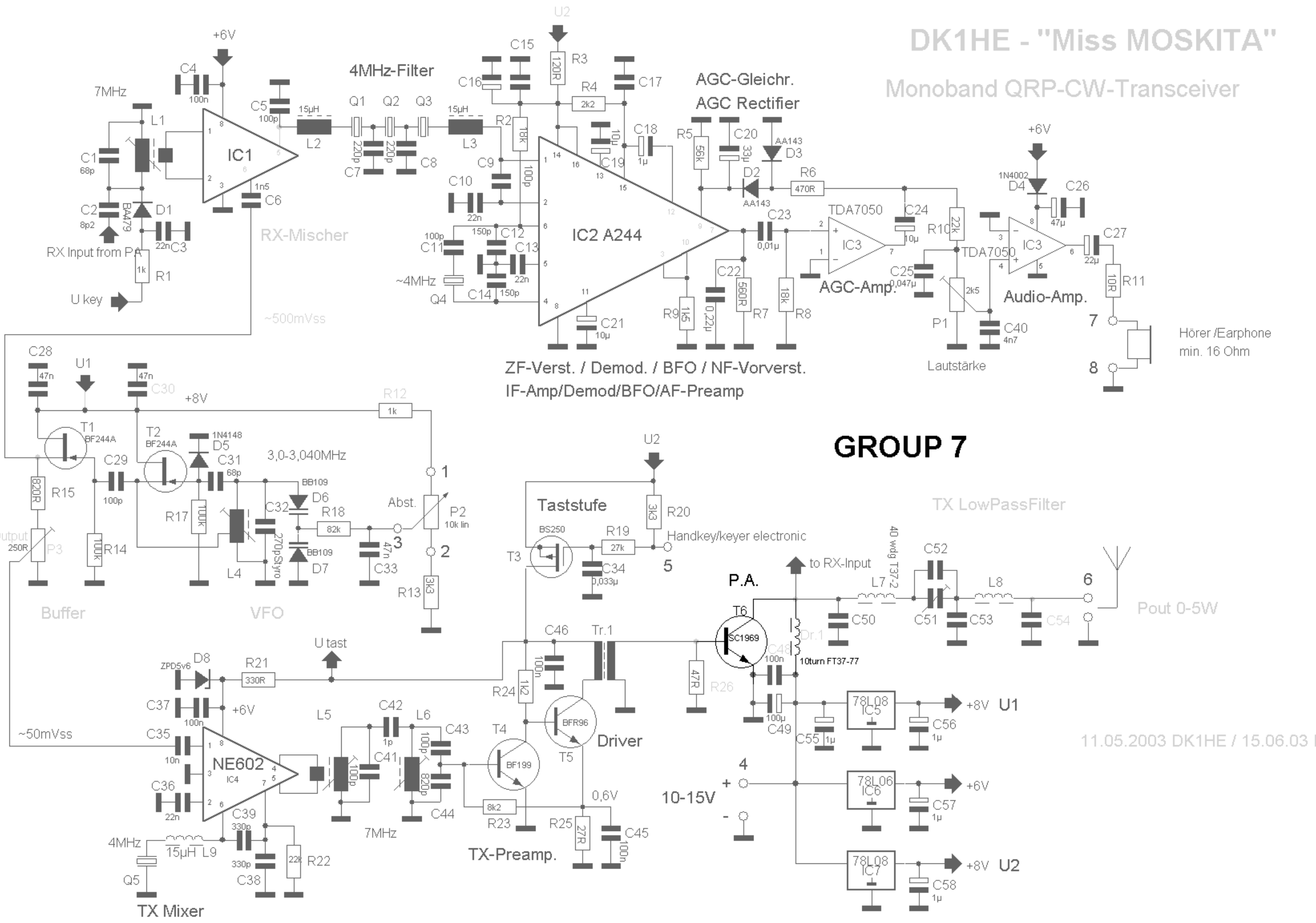

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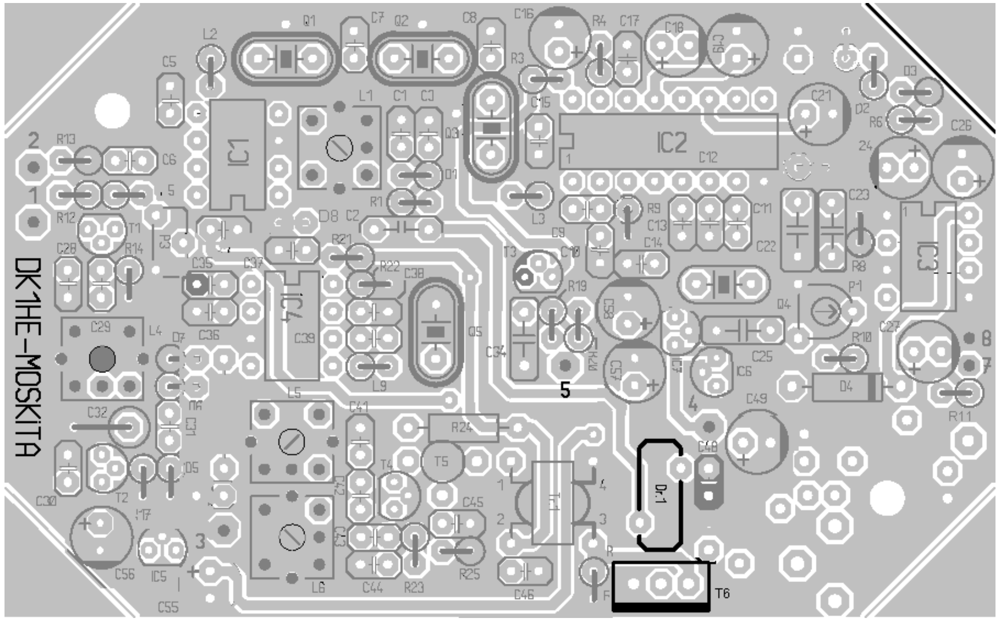
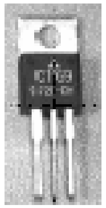


Section 7 PA

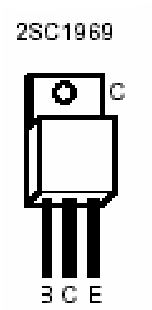
The PA isn’t very special. The RFC DR1 is made as the coils of the low pass filter, though using a special FT37 ferrite ring of 77 materil instead of the iron carbonyl rings, as we need higher inductance. This will be the grey ring. Wind 10 turns loosely spaced over 2/3 of the ring.

[ ] Dr.1 10 turns on an FT37-77, 0,5mm lacquer isolated copper wire.



The 2SC1969 power transistor is very conservatively chosen for the QRP Mosquita, which makes is very robust. Please be careful when measuring, as the casing is connected to the collector. For this reason, it must be mounted isolated. It is mounted on the pc board, so that it is flush with the back edge of the pc board. The back of the enclosure is used as a heat sink. If built into a pill box, you will have to reduce power to 2 W. If you use an encloser with a heat sink, you can go up to 5 W. Between enclosure and transistor, you will mount a grey silicone rubber disk, threading the screw through the isolator.

[ ] T6 2SC1969



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Test setion 7

Visual inspection
Resistance test
Smoke test
Functional test

This is the last section. No more tuning, just measurement. Please don’t transmit for more than a few seconds, till Miss Mosquita is in an enclosure. Hook up a dummy load to the antenna connector. If available, use a watt meter. Commercial watt meters ony have an accuracy of 10-15 % of full scale. More precise measurements are done with a dummy load and an RF volt meter or a scope (calculate effektive power from peak-to-peak values). You could use a calibrated watt meter like the OHR WM2.
Key briefly to measure the output. Tune C51, L5 and L6 tot maximum.
Mount Miss Mosquita in an enclosure and repeat all tuning.

Miss Mosquita and its enclosure

Miss Mosquita works with a free running oscillator. In spite of all temperature compensation and a super efficiency of the PA: In a pill box, it will run too hot, and will drift, if run at more than 2 W. This doesn’t mean too much, as that is the standard power of this class of transceivers. In every other aspect, Miss Mosquita is superior to the competition.

If you leave Miss Mosquita a little more room in the enclosure, and gives her a heat sink, she will deliver 5 W with no problems. At the first test you might experience a little positive or negative drift. Remember the styroflex capacitor in the VFO? With this the drift can be compensated with a little effort, - that was why it was left with long leads. You will have to find a point where the capacitor compensates the drift in the coil. In the prototypes, the compensation was close to 100%, when the styroflex capacitor was about half way behind the coil form. In practice: hook up a morse key, transmit dots and watch if the frequency drifts. This is easiest to check with a stable receiver. If the frequency do drift,

change the level of the capacitor, pause for a moment and then measure again. We could easily do this compensation on the prototypes.

If you want to make a high class device of Miss Mosquita, you can build in the DDS VFO, to obtain the smallest transciever with a DDS, a superhet RX, more than 90 dB of AGC and 5 W output. The photo at the top of this page shows a prototype with a built in PK3 keyer, a 10 turn potentiometer for finer frequency adjustment and a Micro SWR meter with a red and green LED.

If you build Miss Mosquita in a larger enclosure, you will have room for extras. I have built in the PK3 keyer and the Micro SWR meter in my version.

Parts lists for Miss Mosquita:

Section 1 Voltage regulation

C48	100nF
C49	100µF 16V rad.
C55	1µF 35V rad.
C56	1µF 35V rad.
C57	1µF 35V rad.
C58	1µF 35V rad.
IC5	78L08 TO92
IC6	78L06 TO92
IC7	78L08 TO92
Pin 4	Soldering Pin

Section 2 AF and AGC rectifier

P1 2,5K trimming potentiometer, Piher PT6 horizontal

IC3	TDA7050 DIL8
R5	56K
R6	470R
R7	560R
R8	18K
R9	1,5K
R10	22K
R11	10R
C22	0,22µF 63V Film
C23	0,01µF 63V Film
C25	0,047µF 63V Film
C24	10µF 16V rad.
C26	47µF 16V rad.
C27	22µF 16V rad.
C20	33µF 16V rad.
D2	AA143
D3	AA143
D4	1N4002
Pin 7	Lötnagel
Pin 8	Lötnagel
C40	4,7nF SMD!! 0805 (auf Unterseite bestücken!)

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Section 3 IF section

IC-Socket	16 PIN
Q1	4MHz 32pF HC18/U
Q2	4MHz 32pF HC18/U
Q3	4MHz 32pF HC18/U
Q4	4MHz 32pF HC18/U
C5	100pF
C7	220pF
C8	220pF
C9	100pF
C10	22nF
C11	100pF (adjust for CW offset frequency)
C12	150pF
C13	22nF
C14	150pF
C15	100nF
C17	100nF
C18	1µF 25V Tantalum
C19	10µF 10V Tantalum
C21	10µF 10V Tantalum
R3	120R
R4	2,2K
L2	Choke15µH SMCC
L3	choke 15µH SMCC
C16	100µF 16V rad.
R2	18K SMD!! 1206 (mount on back side of pc board!)
IC2	A244D/TCA440

Section 4 VFO

P3 250R Piher PT6 trimming potentiometer, vertical

R18	82K
D6	BB109G or similar
D7	BB109G or similar
R12	1K
R13	3,3K
R14	100K
R15	820R

R17	100K
D5	1N4148
C28	47nF
C29	100pF
C30	47nF
C31	68pF
C33	47nF
C6	1,5nF
T1	BF244A TO92
T2	BF246A TO92 (changed from BF244A)
L4	Amidon T50-6 (yellow)
C32	270pF Styroflex axial

Section 5 RX mixer and low pass filter

R1	1K
D1	BA479
C1	68pF
C2	8,2pF
C3	22nF
C4	100nF
C50	150pF
C52	390pF
C53	820pF
C54	330pF
C51	Film trimmer 2,5- 60pF 7mm black

L1 Neosid coil kit 7.1 Ferrite F10b primary 17 turns of 0,1mm lacquer isolated copper wire, secondary 2 turns of 0,1mm lacquer isolated copper wire.

L7	T37-2, 23 turns 0,3mm
L8	T37-6 22 turns 0,5mm
IC1	NE612 DIL8

Section 6 Transmitter mixer and driver

C35	10nF
C36	22nF
C37	100nF
C38	330pF COG
C39	330pF COG
D8	ZPD 5V6
Q5	4MHz 32pF HC18/U

L9 15µH SMCC (trim to equalize RX/TX frequency)

R21	330R
R22	22K
C41	100pF
C42	1pF
C43	100pF

L5 Neosid coil kit 7.1 ferrite F10b primary 15 turns of 0,1mm lacquer isolated copper wire, secondary 4 turns of 0,1 mm lacquer isolated copper wire.

L6 Neosid coil kit 7.1 ferrite F10b 16 turns of 0.1mm lacquer isolated copper wire

R23	8,2K
R24	1,2K
R25	27R
R26	47R
C45	100nF
C46	100nF
C34	0,033µF 63V film
R19	27K
R20	3,3K
T3	BS250 TO92
T4	BF199 TO92
T5	BFR96(S)

Tr.1 double hole core DL-QRP-PA primary 4 turns 0,2mm lacquer isolated copper wire, secondary 1 turn of 0,5mm lacquer isolated copper wire.

C44	820pF COG
IC4	NE612 DIL8

Baugruppe 7 PA

Section 7 PA

Dr.1 10 turns of 0,5mm lacquer isolated copper wire on an FT37-77 core

T6	2SC1969

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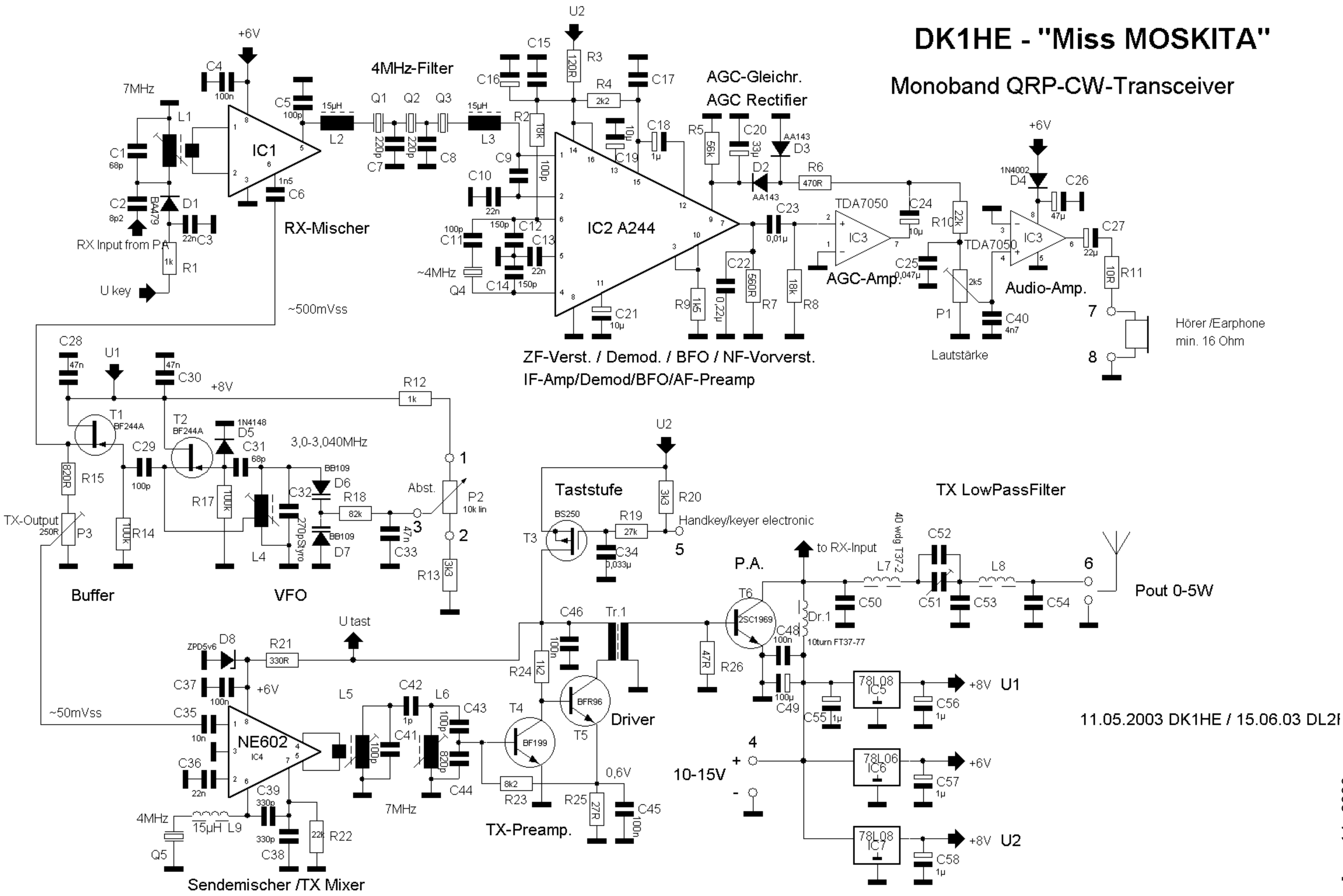
R16	entfällt
C47	entfällt
D9	entfällt



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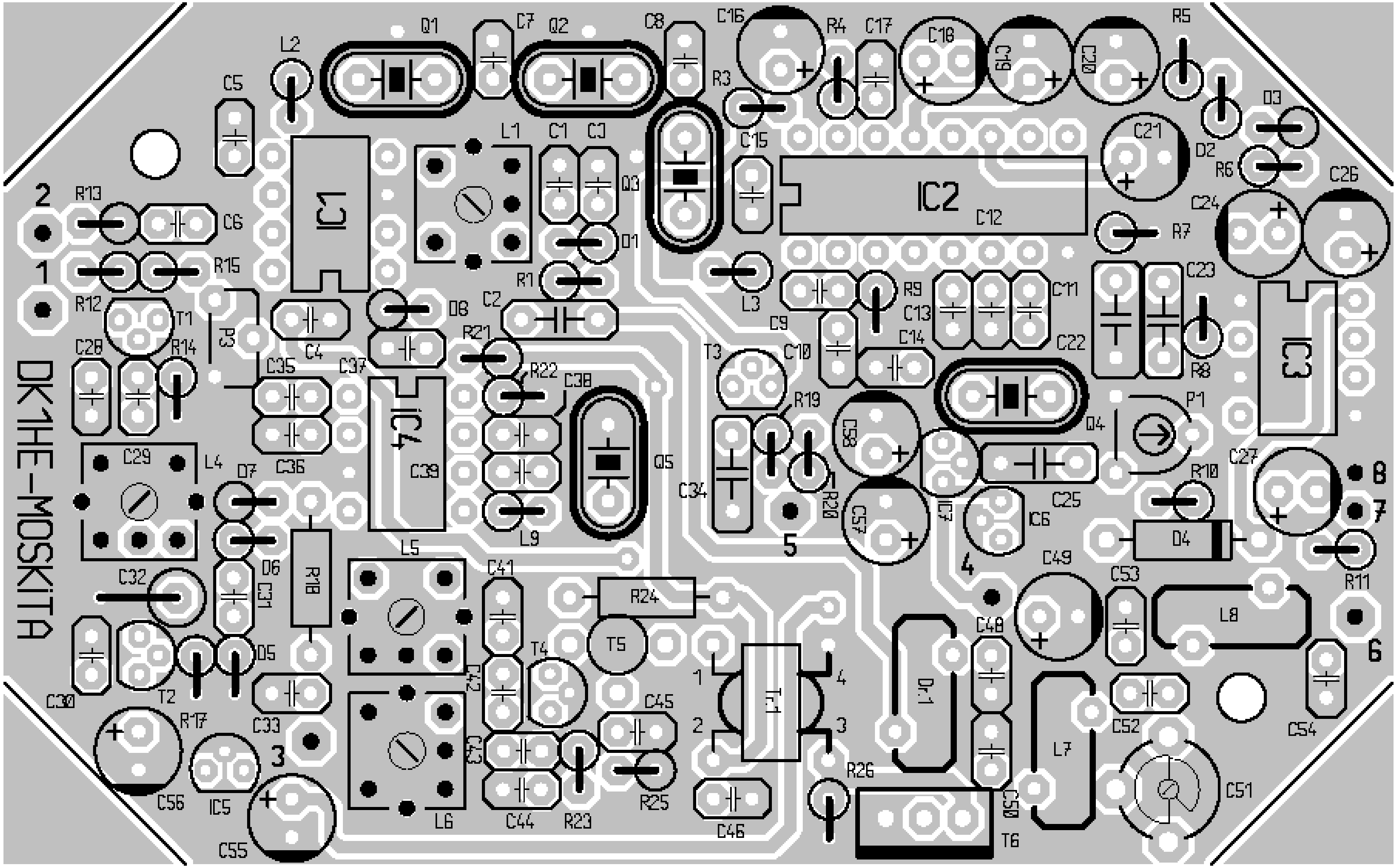

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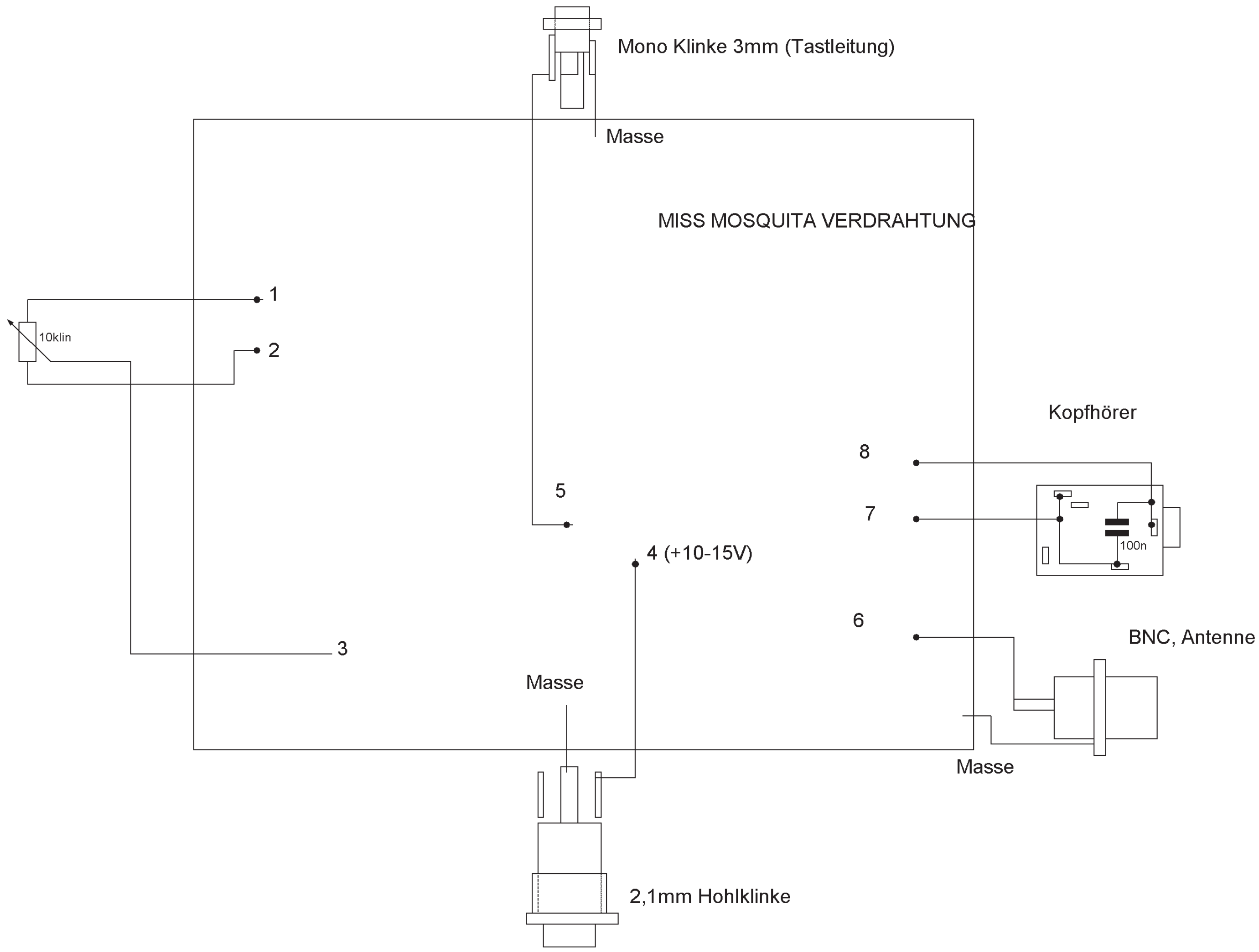

Verdrahtungsplan Miss Mosquita.
Alle hier verwendeten Bauteile gehören zum Peripheriekit.

Version: June 14. 2006