DL-QRP-AG

Speaky 5 Band CW SSB PSK Transceiver

Version:07.01.2004

Handbucherstellung: fiservice Peter Zenker DL2FI   email:info@qrpidee.de

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Preface to building

Please note a few basic rules, before you begin building. Even the most proficient kit builder makes errors. A few rules and experiences keeps the error count low. You will find lots of good advice in the FI Workbench Manual, contained in the kit. In the Workbench Manual, we describe parts, tell about soldering, help in winding coils on the different coil forms used in RF electronics. As our kits primarily are directed towards beginners, old hands will find lots of known material. But repetition isn‘t that bad, and even experienced builders will probably find helpful advice. We advice reading through the Workbench Manual, as well as the present manual, before beginning assembly. Reading is very important. The developers have built several kits, the last of which were original kits like the one you have bought. We have tried to avoid any tricky procedures, to simplify the job for the beginner. It will pay off to read the manual before proceeding. Read every section in its full length before soldering!

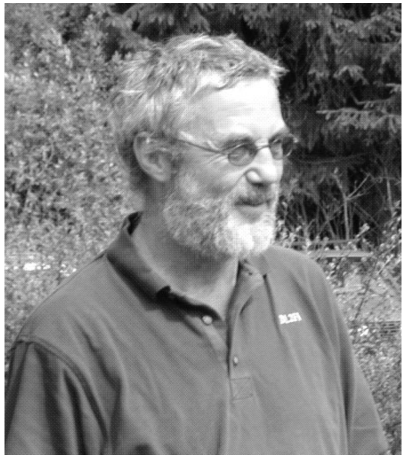
The manual

As the Speaky is quite complex, all diagrams and parts lists are put into a separate cover. This is to avoid flipping back and forth in the manual. The Speaky manual is divided in eleven sections. For every section you will find a text part with a check list, and a separate diagram and parts placement diagram. All parts belonging to the relevant section is printed in black. When needed for understanding function, parts from other sections are presented in grey. In the parts placement diagram, all parts to be mounted are in black, and already mounted parts are in grey. In the text, parts are listed in order of mounting. Please use the check boxes. This will in our experience reduce errors to a large degree. New parts are introduced in the text, when used. As the density doesn‘t allow a placement mask on the pc board, , we have introduced a coordinate grid on the board. The pc board is divided into 56 20 by 20 mm squares. Horizontally marked from A to H, and vertically 1 to 7. Every part is easy to find from this square grid.
At the end of each text section, you will find a test description. Please don‘t continue till the assembled kit passes these tests.

And when you don‘t know what to do?

Please come to me. Easiest via email to support@qrpproject.biz or by phone to +46 30 859 61 323.
To give you an impression of to whom you are speaking, I will present myself briefly.:

DL2FI, Peter, known as QRPeter. Ham operator since 1964.
I am a passionate home brewer and QRP‘er, and have been for years. It is my belief that the great chance for ham radio lies in the rediscovery of home brewing. My motto is: ham radio will be true again, when it is true to its roots. (Der Amateurfunk wird wieder wahr, wenn Amateurfunk wird, wie er war).
Based on this, I founded the DL-QRP-AG in 1997, the german QRP working group. Since then the group has grown to 2300 members, who have developed several designs helping to promote QRP world wide. Since january 2002, I also spend a lot of time on being chairman of the local Berlin chapter of the DARC (German ham radio club), as I rather prefer doing something to just quarrelling. Because of my work, I have been elected to the QRP Hall of Fame.



I wish you lots of fun on building the Speaky (Gonzales)

73 de Peter, DL2FI

DK1HE QRP SSB/ CW- Transceiver SPEAKY

Preface:
Till recently ham operators equalled QRP work to CW. QRP'ers were ridiculed or considered masochist, who made it difficult for their fellow hams with their weak signals. This changed with the marketing of the FT-817 and its rapidly increasing sales. In several QSO's, it was noted, that the FT-817 was only some 2 S degrees below a standard 100 W rig. Previously impossible SSB DX contacts were now possible. [.... EMVU .... pleas fix this: Die Scheu vor der Abgabe der EMVU- Selbsterklärung] made for a QRP renaissance. Thanks to the new licensing rules for VHF/UHF licensees, we can expect a further increase in QRP SSB activity. This couldn't be ignored by the DL-QRP- AG developers, and is was decided at the HAM- RADIO 2003 conference, to produce a SSB / CW- Transceiver in kit form for at least two switchable HF bands. Based on the Black Forest, the Tramp and the Sparrow, it was possible to develop a kit in 4 months, primarily using conventinal parts (only some 12 SMD's), for a 5 band SSB/CW transciever, leaving nothing to want for its price class. Peter, DL2FI, nicknamed it SPEAKY (Gonzales) as complement to the Miss Mosquita. The following data speaks for themselves:

Speaky technical data:

- From 1 to 5 HF bands switchable from the front of the box.
- Modulation: SSB/ CW/ PSK31 etc.
- Power input: 10W PEP
- DDS/ PLL- frequency control, with programmable frequency steps.(rotary encoder)
- choice of RIT or XIT; integrated keyer
- VFO tuning range 500KHz
- optional digital frequency readout.
- automatic bandwith selection (2,4KHz/ 600Hz) of the 4pole 8MHz-crystal filter
- tunable high Q preselector
- High current RF input circuit with dynamic feed back.
- +7dBm- Schottky- ring mixer (TUF- 1)
- High current J- FET IF amplifier
- > 90dB IF dynamic range (A244 IC)
- AGC production with peak to peak rectifier.
- AF section with power for loudspeaker
- robust PA with 2 x 2SC1969
- Transmitter output of 10W PEP
- switchable harmonics filter
- integrated speech compressor with a compression of max. 15: 1
- [please change this] Modulationsklirrfaktor of the compressor < 1% !!
- adjustable transmitter power
- CW- VOX with adjustable decay
- 10,8- 15V power supply
- stable aluminum housing (as for the Tramp)

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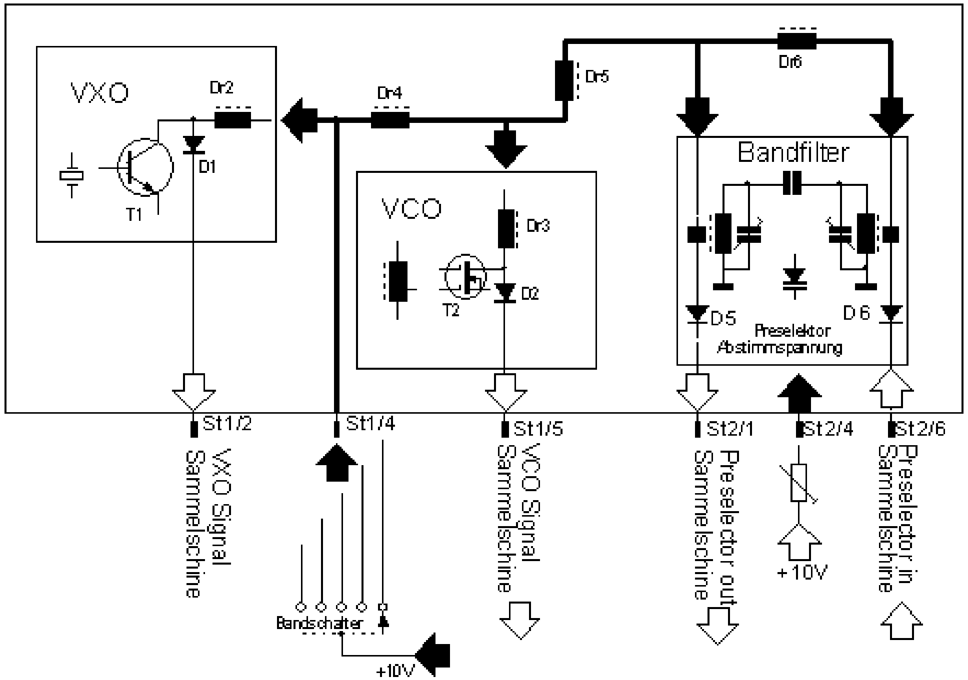
Description of the individual stages:

1. Band switching:

One of the main qualities of the transceiver is the ability to switch up to 5 HF band modules. To conserve space, only electronic switching was considered. All band specific parts are mounted in replaceable band modules. The following sections are switched when changing bands.:

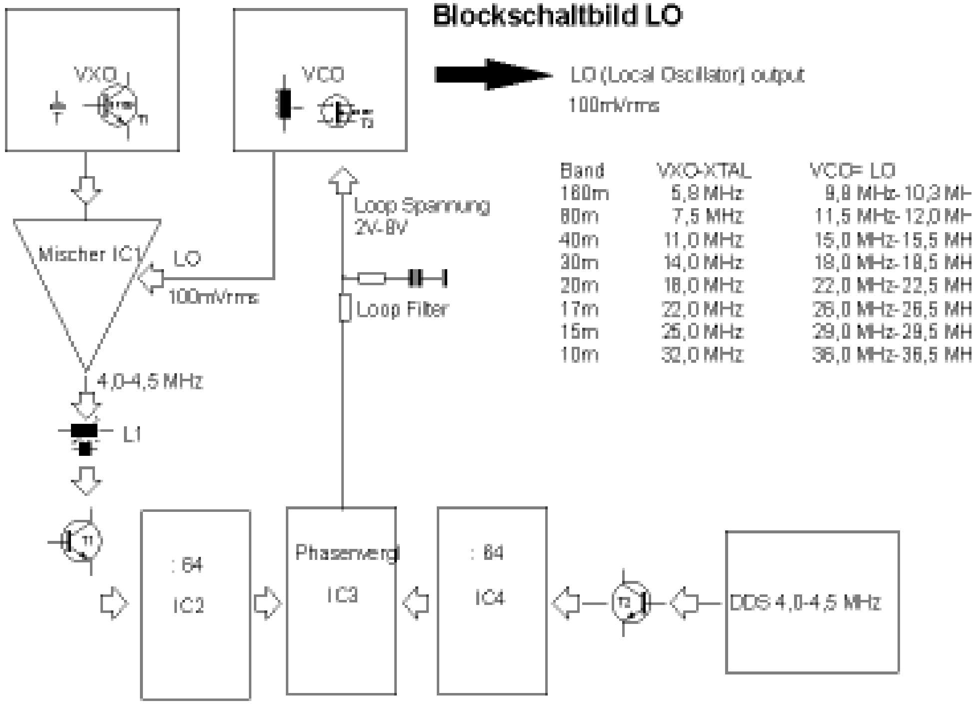
- VCO
- Band set oscillator
- RX/ TX preselector



The inputs and outputs of all band modules are connected via the PIN diodes D1- D2- D5- D6 to a common bus. The 10V switching signal activates the diodes of the corresponding HF module. The chosen module is RF-wise connected to the bus. All other diodes on the inactive modules are blocked and high impedance. The systems impedance of the RF ports is some 50-100 Ohms, so the inactive modules are effectively decoupled.

2. Local oscillator signals:

The LO signal needed for transmitting and receiving is created directly on the frequency. Via a PLL the VCO is tied to a 4,0- 4,5MHz DDS- VFO. This approach reduces the need for filtering the harmonic rich DDS output before entering the transmitter/receiver mixer.



The MOSFET (T2) VCO in the band module oscillates on a frequency 8 MHz (the IF frequency) higher than the actual working frequency. The oscillator proper works a Hartley. D4 stabilizes the amplitude. The signal from P1/Dr3 is coupled via D2 to the common VCO bus. Because of the cascode coupling of T2, the VCO is effectively decoupled from the oscillator tuned circuit. The tuning diode D3 is coupled so hard via C20 to the VCO tuned circuit of L1-C9-C11, that it gives the proper tuning steepness. This gives a good side-band noise distance. The band set oscillator of the band module swings with T1 and Q1 4 MHz lower to the band frequency of the VCO. C3-Cr1 avoids 1. harmonic function of the overtone crystals (necessary on 15, 12, 10m). The crystal signal of R4-Dr2 is coupled to the bus via D1. IC1 handles the

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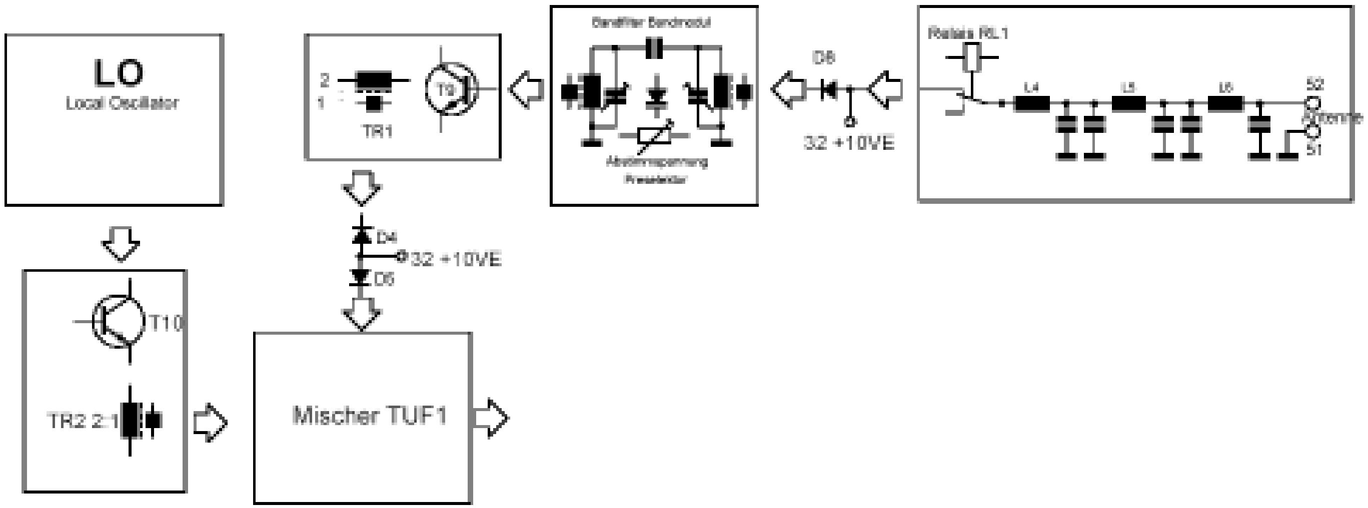
mixing of the VCO and band set XO frequencies. The mixer output circuit of L1-C5 is tuned to the difference between the two inputs; the frequency range is the range of the DDS- VFOs (4,0- 4,5MHz) . The via L1 inductively coupled amplifier T1 serves to raise the output signal of the mixer to the required input level of the following 64: 1 divider, IC2. At the output of IC2 is some 66 kHs, to feed to the frequency/phase comparator of IC3. The 2. port of IC3 gets another 66 kHz signal from the division of the DDS VFO frequency by 64 in IC4.
IC4 will give a tuning voltage, depending on the size and direction of the difference between the output frequency of IC2 and IC4. This voltage is smoothed in the loop filter of R3-R4-C1 and passed to the VCO to give equal phase of the two ~66 kHz signals. If the VFO frequency changes, the VCO follows the change. As both VCO and XO are switched in a band change, it is possible to use the same VFO range for all bands.

3. VFO
We use a direct digital synthesis (DDS) VFO. The AD9835 chip is the heart of the circuit. With a 25 MHz clock from IC8 and serial data from the CPU (IC7), the DDS signal is taken from pin 14 of the AD9835 and passed on to the PLL. The low pass filter of L2-L3 dampens the side bands and phase noise typical of the DDS. Tuning of the VFO is done by a rotary encoder, and the frequency step can be chosen with a push button. IC7 also gives the possibility to program a transmission (XIT) or reception (RIT) offset. IC7 gives a CW marking of the mode, using the keyer function of IC7. LED's show the frequency range of the VFO in 100 kHz steps. An optional 7 segment LED display is available. Transmission or reception offsets are signalled on a LED. The VFO has a tuning range of 4,000 to 4,500 MHz (+/- 5 kHz. The stability of the VFO is based on the 25 MHz clock, and thus is the crystal stability needed for PSK31.
4. RX input:
The input signal from the antenna passes through the 33 MHz transmitter low pass filter and goes via relay RL1 to the electronic switch of PIN diode D8. D8 conducts and leads the antenna signal to the band module/preselector bus via C35. This is followed by an undercritical double band filter with a out of band suppression (L2-L3). The antiserially coupled capacity diodes D7-D8-D9-D10 changes the pass band for the SSB or CW band segment. Due to this good preselector, the RF stage and the input mixer is free of large BC signals. The steep preselector filter also gives a high mirror suppression and a minimum of IF throughput. The output from the preselector is led via PIN diode D5 to the bus, and from there via C36 on to the RF input stage of T9. The amplifier works with a combined voltage and current feed back, and uses a large signal BK transistor. The working point is at Ic = 30 mA to give good large signal data in conjunction with the feed back mechanism. The broad band transformer Tr1 in the collector circuit adapts the ~200 Ohm amplifier output to some 50 Ohms. The amplification is at some 18 dB. The amplified RF signal is led via the PIN diodes D4-D5 to the RF port of the Schottky ring mixer M1, where it is mixed to an IF of 8 MHz. The broad band amplifier of T10 raises the signal level of the LO from the VCO bus to the +7 dBm necessary for M1. Setting jumper J1 to the 47 Ohm terminating resistance, you can measure this level, when adjusting it with P1 on the band module.

5. RX IF section:
The 8 MHz signal at the IF port of M1 is led on via the conduction PIN diode D13 and C81 to the input of the gate coupled IF preamplifier. By parallel coupling of JFETs T12-T13 a 50 Ohm termination is achieved for M1; the forward steepness of some 20 mS gives a stage amplification of some 15 dB. The gate coupling gives good large signal characteristics and reduces



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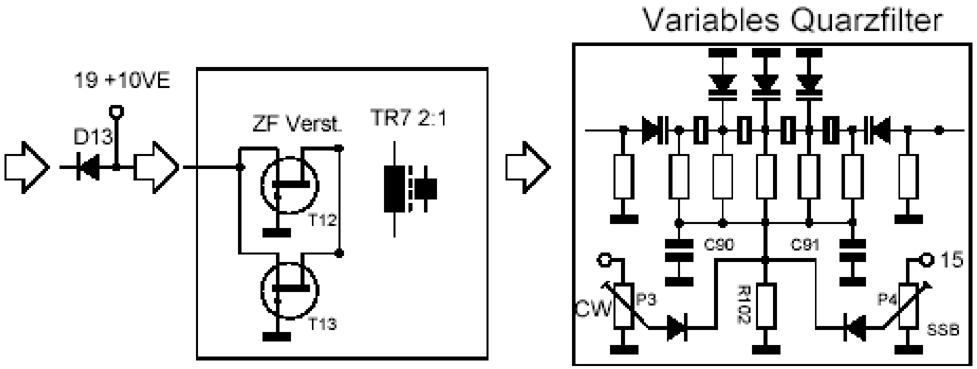
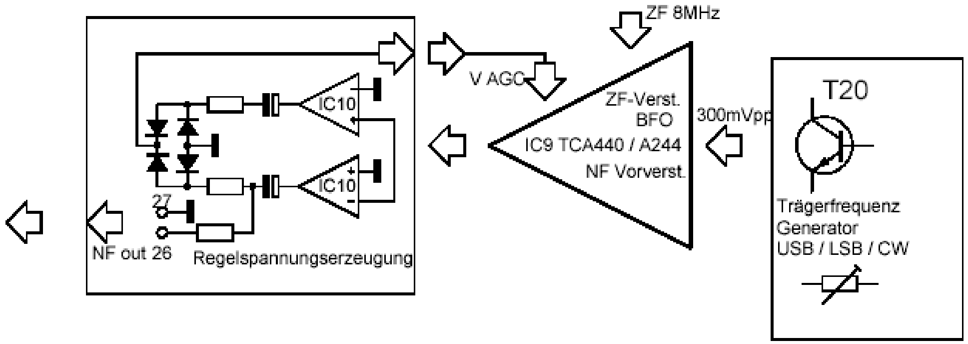
the risk of intermodulation. The 1:1 transformer Tr7 gives a potential free copuling of the IF signal to the IF filter. We use a 4 pole 8 MHz Cohn filter with electronically adjustable filter band width. The usual capacitors are replaced by capacity diodes BB112. The crystals are chosen for less than 50 Hz difference around 8 MHz. P4 and P3 adjusts the filter width for SSB or CW. At 4,5 V on R102 the band width is some 2,5 kHz, at 2 V the width is some 500 Hz (100 pF/350 pF). The filter is terminated at 330 Ohm as a



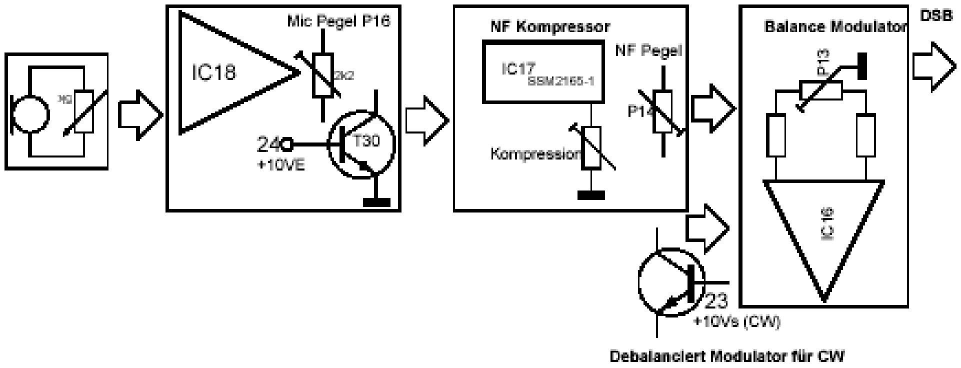
compromise for pass band dampening. C93 leads the signal from the filter to the IF IC, IC9. IC9 is a TCA440 (or its replacement A244), having excellent RF data never achieved by any successor.
The TCA440 was originally developed as an AM receiver, but isn't used as such here. The integrated, regulated input amplifier is used as an 8 MHz IF amplifier. The following mixer works as a product detector with an external BFO. The part originally used a regulated 455 kHz IF amplifier is used as a regulated AF preamplifier. The AF signal of pin 7 is limited to a band width of 0-2800 Hz by C105. The following high pass filter of C106-R75 dampens signals below 300 Hz. This is followed by the AGC amplifier of IC10. This bridge amplifier with an amplification of some 32 dB leads the signal on to the symmetrical rectifier D24-D25-D26-D27. The DC voltage at the charge capacitor C103 is proportional to the IF signal and is fed to the regulating input of IC9 (pin 9). The two way rectifier gives a frequency doubling, producing only half the AC swing on C103 compared to the classical approach. Unpleasant overloading effects from insufficient regulating voltages at low speech frequencies is thus minimized. The decay is regulated by R72. R76-R77 defines the attack. You can attach an optional 100 µA instrument at P5 to give a relative field strength indication. The combined IF/AF regulation is more than 90 dB!!! Input signals of S9+60dB are regulated distorsion free. After a further 2800 Hz low pass at R78-C110, the signal is



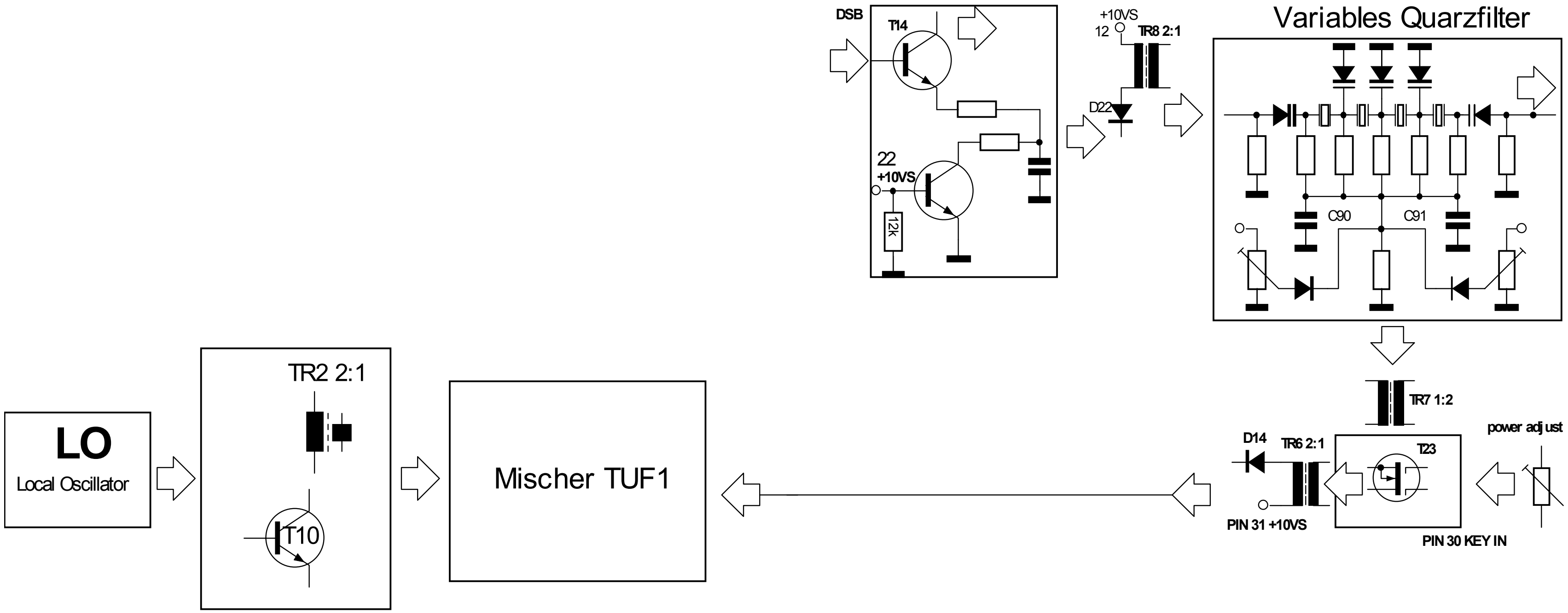
fed to an 800 mW AF PA in IC11. T16 blocks the regulating voltage during transmission. T17 blocks the AF amplifier during T/R switching to reduce switching noise.

6. Side band oscillator:
The carrier needed for modulation and demodulation is generated by the capacitative three point circuit (Colpitts) at T20. The produced frequency is determined by the parallel coupled 8 MHz crystals Q6-Q7. The tuning diodes D29-D30 in conjunction with L7 leaves a tuning range of some 6 kHz for the VXO. P7 adjust the RF signal to some 300 mVpp and leads the signal via C97-C137 to the product detector of IC9 and the balanced modulator of IC16. The tuning voltage for D29-D30 comes from potentiometers P8 and P11, switched by the analog switch in IC12. This circuit gives the necessary carrier frequencies for the different modulation types, and for the varying center frequencies, in an easy way.

7. 8MHz SSB generation:
The microphone signal is led via the mic gain potentiometer to the input of the preamplifier IC18. The circuit of C150-Dr12-C149 reduces transmitter RF in the modulation amplifier. The amplification of the stage is set to some 26 dB byt R126-R127. C148-C147 cuts speech frequencies below 300 Hz. The level of the amplified microphone signal is adjusted in P16 before going into the dynamic compresson IC17. The utilized IC SSM3165 from Analog Devices was made for studio techniques and gives a compression of max.

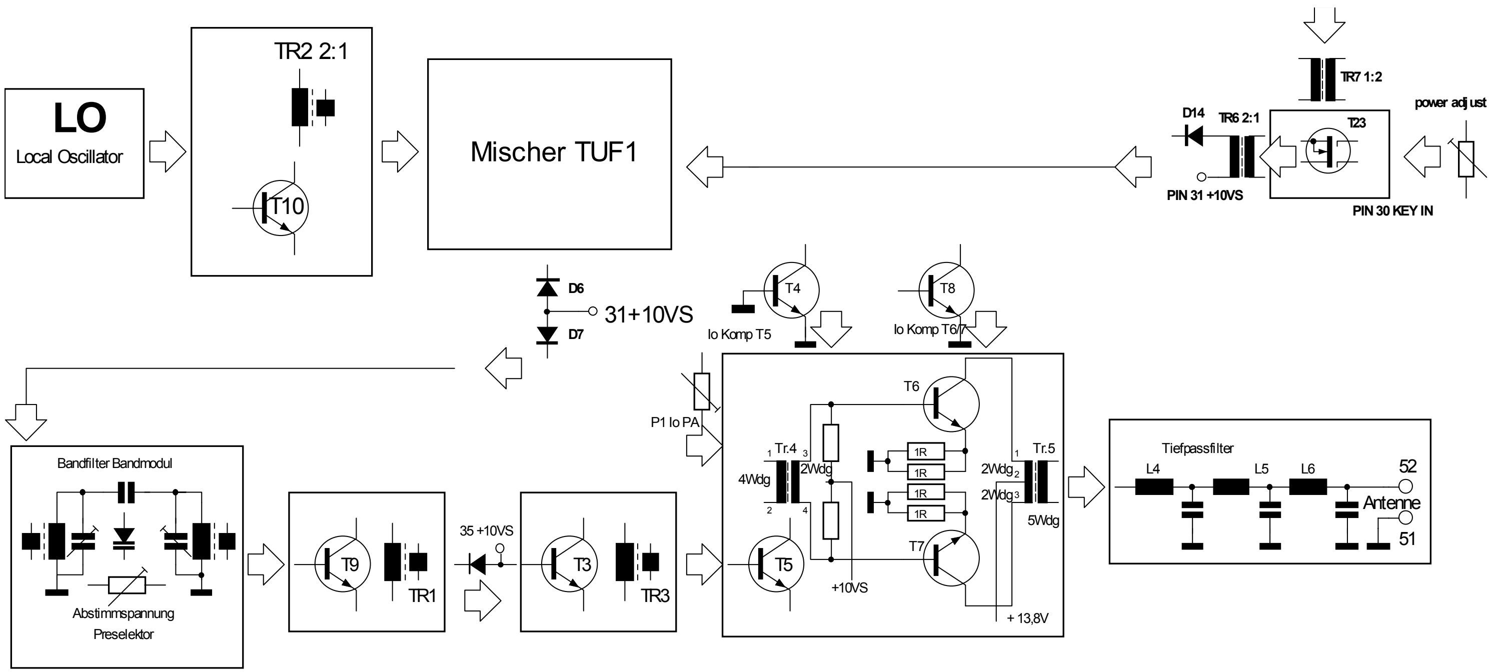


15:1, that is 15 dB input dynamic range for 1 dB og output dynamic range. The [klirrfaktor - please change!!!] of the output signal is less than 1 %. This compressor will allow the PA to swing to the QRP allowance of 10W PEP. This gives a subjective power level of some 50W uncompressed!! P15 allows individual adjustment of the compression. P14 leads the compressed signal on to the balanced modulator of IC15. C139 gives a further low pass cut off. The modulator uses the universal Gilbert cell NE612. The internal oscillator isn't used. C137 leads the appropriate signal in from T20. P13 adjust the carrier suppression. In CW mode the modulator is debalanced by T29-R116, that is the carrier signal is no longer suppressed, but led on to the modulator output. to avoid swing in problems at the modulator at T/R switching, IC16 is at permanent power. For this reason T30 blocks the modulation path during reception and disallows a DSB signal at open microphone. This guarantees against feed through to the high amplification IF. The 8 MHz DSB signal is led from pin 5 of IC15 to T14. The collector of T14 sees the transformed filter terminating resistance via the 1:1 transformer of Tr8. This gives a stage amplification of 6 dB in conjunction with R66. During reception T15 breaks the emitter circuit of T14, blocking the collector-basis voltage at R65. Pin 12 on the pc board is at ground potential at this moment, also blocking the PIN diode D22. This serves to dampen the residual carrier signal at the input of IC9. During transmission the amplified 8 MHz DSB signal is led the other way through the Cohn filer and shows up a an SSB signal with suppressed carrier at Tr7. The MOSFET T23 gives a voltage amplification of some 6 dB. Choice of side band is by the carrier frequency from T20. C85 couples the SSB signal to the amplifier at T23. A positive voltage at the source of T23 is used to adjust TX power. In CW



mode, keying is done by breaking the drain voltage at pin 30. Tr6 transforms the output impedance determined by R98 to the 50 Ohm level. PIN diode D14 leads the 8 MHz signal to the IF port of M1. D13 blocks and T12-T13 are decoupled.

8. Transmitter:
The transmission frequency is obtained by mixing the 8 MHz signal with the LO signal. M1 works as a transmitter mixer with changed siganl direction. The signal at the RF port is coupled via PIN diodes D6-D7 and C35 to the input bus of the preselector filter, now working as a transmitter prefilter. The high selectivity of the filter reduces unwanted signals from the mixer. The filtered output signal is led via the output bus over C36 to T9, the



transmitter preamplifier. The 18 dB signal at Tr1 is led via PIN diode D3 to the predriver at T3. The stage amplification is chosen to be able to drive the two stage PA fully. Tr3 serves to impedance match T3 to T5. The circuit at T5-T6-T7 is a slightly modified DL-QRP-PA:

The PA quiet current is adjustable by P1, and independent of the board voltage.

The push-pull stage uses robust 2SC1969's with a large collector current reserve, given good intermodulation characteristics.

The ferrite volume of Tr5 is enlarged to reduce distorsion due to saturation

The transmitter is followed by a 3 stage Chebychef low pass filter with a cut off frequency of 33 MHz, to reduce harmonics in the BC/TV bands by more than 60 dB. The in band variation is a maximum of 0,3 dB. The band 80 to 17 meters, this should be followed by the electronically switched output filter, developed for the “Tramp”, to reduce emissions in higher ham bands. D11 works as a measuring rectifier for the relative power output meter. To avoid uncontrolled feed back in the transmitter, the decoupling between transmitter output and the T/R switch diode should be at least 70 dB.

Experiments with electronic switching showed problems with the high RF voltage (up to 70 Vpp). As the switch carries no RF current (only active during reception), the choice was a small DIL Reed relay, which also allowed shorting the the [Übersprechsignal - please change!!], in a painless way. The attack time of the relay is only some 0.5 mSec. The life time at some 10 million cycles. Thanks to the low weight of the moveable parts, no clicks are heard.

9. CW logic, T/R switching:
Pin 2 of the CPU (IC7) is bidirectional, having the following functions:

During reception pin 2 is kept at high potentil by an internal pull up resistor. When the integrated keyer is activated, pin 2 is pulled low in the rhytm of the CW signal. Synchronously pin 15 of IC7 generates a side tone. And further an optional RIT/XIT is activated.

When the internal keyer isn't used, external keying is possible. In this mode pin 53 is grounded via R103-D31 in keying rhytm. In SSB mode the PTT keys the same pins, but T18/T19 quiets the side tone input at IC11.

In CW mode soldering pin 9 is left at +10V, that is pin 10 of IC13 shifts low to high in keying rhytm. R106-C127 rounds the attack and decay soft keying T23 via T25. T26 leads during the high phase of pin 10 (IC13), and charges C128 via R108 with at very low time constant. Below th triggering point of pin 6 of IC14, pin 4 goes high and pin 3 goes high, resulting in blocking T27 and opening T28 (both P channel MOSFETs). The transceiver is switched to transmission. After releasing the key/PTT, this status is kept as long as C128 takes to discharge over the delay potentiometer of P12 and R107 to the triggering point of pin 6 of IC13. Then T28 blocks and T27 opens. The transceiver goes back to reception mode.
During SSB pin 9 is open, that is the gate is blocked and T25-T26 are inactive. Pin 5 at IC14 is now controlled directly by the PTT button. The T/R switch now works without decay control.

10. Stabilization stages:
To make the voltage dependent characteristics of the transceiver indepen-dent of the supply voltage, all critical parts are supplied by a stabilized 10 V derived from the low drop regulator IC15. This concept limits the supply voltage for the transceiver to 10,8 to 15 Volts. The 5 Volt regulator at IC5 served to feed IC1-IC6-IC7. D2 reduces the effect loss at IC5. The R11-C12 filter reduces regulation noise at the PLL in conjunction with D1, during the short breaks in the 10 Volt supply during T/R switching (reducing chirp in the first CW character sent). The 6 Volt regulator IC14 feeds IC16-IC17 and T20.

11. Optinial circuits:
The JFET source follower T11 serves as a load free decoupling of the LO signal. 100 mVeff is found at soldering pins 16 and 17 for feeding an exter-nal frequency display. A 7 segment LED frequency display is available for this.

Author: Peter Solf DK1HE
11. 12. 2003

Building description for the Speaky

Please follow the prescribed building order for all sections. Check each part in the parts list with a pencil, to keep track. To the right of each part in the lists, you will find its coordinates on the pc board. C3 means that the component is at square C3. B/C3 means that the component is located at the border between grid squares B3 and C3.

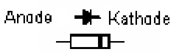
Start with the voltage regulators.

Section 1, Voltage regulators

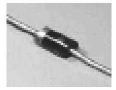
In this first section, the necessary voltages are produced. The Speaky needs +5V, +6V und +10V. In a later section theses voltages will be divided in two groups, one for the receiver and one for the transmitter. But here we will only make the raw voltages. The order of building is mainly decided by the height of the components.
First the resistors. We recommend measuring the resistors individually. The colour coding is often misinterpreted because of the body colour of the resistors. By experience we now wrong resistor values to be a common source of errors. As the Speaky is very small, yet not use SMD parts, most resistors are mounted vertically. To do this one lead must be bent back parallel to the resistor. In the placement diagram, the circle marks the position of the resistor body.
iderstand zurück gebogen. Im Bestückungsplan wird durch den Kreis angedeutet, auf welcher Seite der Widerstand stehen soll.

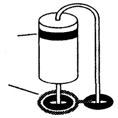
[ ]	R11	39R	B6
[ ]	R112	120R metal foil 1%	E1
[ ]	R113	820R metal foil 1%	E1

Now comes the diodes. Please check the type with a loupe. D32 is a comparatively large component, D1 and D2 looks alike, but have a printed marking. The cathode is marked by a ring. When diodes are mounted standing up, it is always the cathode lead, that is bent back parallel to the body of the diode. The ring on the placement diagram marks the place for the body.



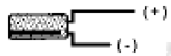
[ ]	D1	1N4148	B6
[ ]	D2	ZPD 2V7 (500mW)	A6
[ ]	D32	1N5822 o.Ä.	F1

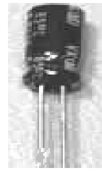




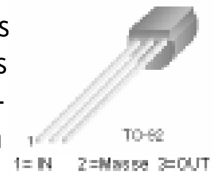
Please note the polarity of the electrolytic capacitors. The long lead is always the positive lead. Further a minus on the body marks the negative lead.

[ ]	C20	1µF/63V rad.	A6
[ ]	C21	1µF/63V rad.	A6
[ ]	C129	1µF/63V rad.	B/C 1
[ ]	C130	1µF/63V rad.	C1
[ ]	C131	10µF/35V rad.	D/E 1
[ ]	C132	10µF/35V rad.	D/E 1
[ ]	C133	470µF/25V rad.	E/F 1





The following parts are the integrated voltage regulators for 5 and 6 Volts in T092 casings. Voltage regulation with these parts look eay but is quite complicated. They contain several dozens of components. They output a constant voltage, as long as the input is at least 1 Volt higher than the output voltage. Please take care to mount the correct regulator in the correct place!! Many small signal transistors and voltage regulators are made in T092 caisngs. The placement diagram shows most parts from above. Pleas take care to mount these T092 parts with the round side oriented correctly, as shown in the placement diagram. Mount them close to the pc board, not more than 2-3 mm above the board. This is obtained with a SLIGHT pressure, - no violence! Don't mix up the two regulators. The 8 Volts regulator is marked L08, the 6 Volt one is marked L06.



[ ]	IC5	78L05	T092	A6
[ ]	IC14	78L06	T092	C1

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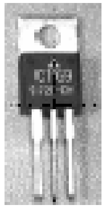
The next part is a higher effect version in a TO220 casing. This is kept at 10 Volts by an external circuit. NOTE: The casing of this regulator is at ground potential, so it must be mounted isolated. The picture shows the TO220 casing. In the placement diagram, the parts is shown from above. The fat, black line shows the metal strip, and show the mounting direction.



[ ]	IC15	LT1086CT	TO220	E1

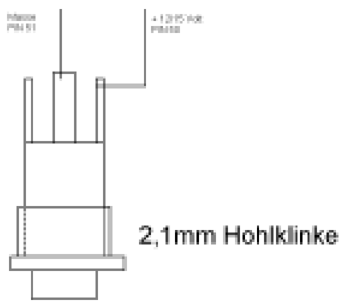
The following fuse holder consists of two parts. To make them fit later on, it makes sense to mount the fuse during soldering.

[ ]	SI-1	Fuse holder	F1
[ ]	Fuse 2,5A		F1

Finally we mount the soldering pins. Press the short end of the pin through the hole in the pc board with a pair of pliers. No violence, but some pressure is needed. Solder to the down side of the pc board.

[ ]	PIN50	+ 12V	G1
[ ]	PIN51	Ground	G/H1
[ ]	PIN46		E1
[ ]	PIN45		E/F1
[ ]	PIN47		E1
[ ]	PIN18		C5

To connect the external power, you will need a coaxial power connector and proper wires. In the bag with peripheral parts, you will find the connector . Solder two wires of about 10 cm to the connector.



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To avoid later damage, it makes sense to use a red wire for the plus, and a black wire for the minus pole.

[ ] Connect pin 47 of the pc board with pin 18 with a short piece of wire and two [Steckhülsen - please change!], to supply the upper part of the board with +10 Volts.

[ ] Connect pin 45 and 46 with a short piece of wire Verbinde and two [Steckhülsen - please change!]. Here you will mount a switch later on.

1. Visual inspection.
As a first test, inspect every section with a loupe to find shorts. Take this test seriously. Even a master solderer makes shorts with bent leads or small blobs of solder. Or even unsoldered soldering spots! Parts are overlooked more often than you think. Also check the values of all parts: Right part in right place? Electrolytic capacitors correctly polarized? Diodes?

2. Resistance test
Measure the resistance from plus to minus at the pc board (pin 50 and 51). This should be larger than 50 kOhms.

3. Smoke test
If Speaky passed the resistance test, try applying voltage to the pc board. Put between 10 and 15 Volts between pin 50 (PLUS) and pin 51 (GROUND). Use a laboratory supply with a current limiter, or put a 100 mA fuse in line. Is is good sense to use a regulated power supply with a current limiter. Reduce the current limiter to its lowest before connecting! **Allwarys turn the power supply on before turning on the device under test. ALL-WAYS! Many power supplies has an initial voltage peak, large enough to kill your apparaturs!**

Having connected the Speaky to the power supply, keep an eye on the current level and another eye on the pc board. Smoke is a definite sign of malfunction, as is a current of more than 20 mA.

4. Funkctional test:
Measure at test point, 47 = 10V
Measure at test point U2 = 6V
Measure at test point U3 = 5V

When the measurements are OK, remove the power supply and the shorts, and turn to the next section.

Section 2 T/R Switching
We begin with the trimming potentiometer P12, as mounting this is easier, when no other parts ar present. PT6 lying means a 6 mm diameter component. The value is printed sideways on the casing, and often difficult to read. The mounting position is given by the three leads, placed in an equilateral triangle.

[ ]P12 100K PT6 lying A/B5

Now the capacitors. After the electrolytic capacitors comes for the first time a multilayer capacitor. It has a marking of 104, meaning 100 nF. As examples of this type of marking, we present a few values:

101	100 pF	0,1nF	0,0001uF
102	1000 pF	1,0nF	0,001uF
103	10000 pF	10nF	0,01uF
104	100000pF	100nF	0,1uF
221	220pF	0,22nF	0,00022uF
222	2200pF	2,2nF	0,0022uF
223	22000pF	22nF	0,022uF
224	220000Pf	220nF	0,22uF

Note that the last figure marks the number of zeros. This type of capacitor, type X7R, is often used to bypass RF. There Q isn't very his, making them unusable for resonant circuits. You will find more on capacitors in the FI Workbench Book.

[ ]C126 100nF A6

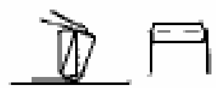
Now follows a film capacitor. WIMA film capacitors are nonpolarized, making the mounting direction unimportant. Good practice though is to mount them, so the marking can be read. They are used at AF because of their high Q. RM5 means raster measure 5 mm, most parts of the kit has a raster measure of RM2,5 equalling 2,5 mm.

[ ]C127 0,22µF Film RM 5mm B5/6

Now follows a new component, the tantalum capacitor. These are polarized as electrolytic capacitors. You will usually find their value as text on the drop shaped body, and a small plus sign at one lead. When no plus is found, the positive terminal is marked by a dash. The longer lead can also be the positive terminal. Tantalum capacitors are often use, when low leak currents are needed at high capacities.

[ ]C128 6,8µF 16V Tantalum pearl B5

Now follows an integrated circuit. TAKE CARE. The device is static sensitive. Before handling it, you must discharge your hand to ground. The soldering iron MUST be potential free, the best thing is a potential levelled soldering station.
Due to production circumstances, ICs have their leads spread a little wider than the standard raster. By careful rolling, the leads are brought to their proper position. Pin 1 is marked on the top of the IC, either by a notch or by a dot. The notch is marked in the placement diagram. Mount the IC as shown, and begin by soldering two diagonal leads. Check that the IC is flush to the pc board, and corect it, befor soldering the rest of the leads.



[ ]IC13	4093 DIL 14	A/B6

The following transistors are all in TO92 casings as the voltage regulators of section 1. Check the marking with a loupe, to avoid mixing them up. The mounting direction is shown in the placement diagram. For the MOSFETs remember to discharge your hands before handling them!

[ ]T24	BS170 MOS take care of statics	A6
[ ]T26	BS170 MOS take care of statics	B5
[ ]T25	BC546B	B5
[ ]T27	BS250 MOS take care of statics	E1/2
[ ]T28 I	RF9520 take care of statics	E1

Note the mounting direction with the following diode.

[ ]D31	1N4148	A5

The resistors should pose no problem.

[ ]R104	10K	A6
[ ]R105	39K	B6
[ ]R103	220R	A5
[ ]R107	8,2K	A5
[ ]R109	33K	A/B5
[ ]R108	39R	B5
[ ]R106	22K	B5
[ ]R110	56K	E1/2
[ ]R111	56K	D/E1

Now follows the pins for connecting the peripheral parts.

[ ]PIN 9	A/B6
[ ]PIN10	A5
[ ]PIN11	A5
[ ]PIN13	B5
[ ]PIN39	E2
[ ]PIN40	E1
[ ]PIN41	E1/2
[ ]PIN42	E1/2
[ ]PIN53	A/B5

To test this section the connection between pins 47 and 18 of section 1 is needed again. And also pin 9 should be connected to +10 Volts. A short is need between pin 11 and pin 41, and one from pin 10 to pin 42.

Test Section 2
1. Visual inspection (see Section 1)
2. Resistance test (see Section 1)

[ ] Apply supply voltage as in Section 1 test.

3. Smoke test (see Section 1)
4. Functional test

When pin 53 is grounded,
pin 13 must meauser +10 Volts

Pin 39 should be at +10 Volts, when not keyed,
and when keyed, at 0 V

Pin 40 should be at 0 Volts , when not keyed,
and at [yes: where?], when keyed.

Section 3 DDS VFO
The heart of the DDS VFO is the IC AD9835BRU, which is already mounted on delivery. most other parts are well known. As allways, take care to check the markings to avoid mixing up parts. It is often impossible to read the markings on the small ceramic capacitors. This is unfortunately impossible to change, so they will have to be measured. As most cheap multimeters today measures capacitors to below 1 pF, this should pose no problem. (Multimeters are offered by QRPProject at 29 Euro).

[ ]C13	8,2pF	8p2	C6
[ ]C14	8p2	8p2	C6
[ ]C15	220pF	221, n22	C6
[ ]C16	68pF	68p	C6
[ ]C17	470pF	471, n47	C6/7
[ ]C18	68pF	68p	C7/6
[ ]C19	220pF	221, n22	C7
[X] C22	100nF	SMD 0805	B6
[X] C23	10nF	SMD 0805	C6
[X] C24	10nF	SMD 0805	C7
[ ]C25	22pF	220,22p	B6
[ ]C26	22pF	220,22p	B6
[ ]C27	10nF	103	A6
[ ]C28	10nF	103	A6
[ ]C29	470pF	471, n470	A7
[ ]C30	100nF	104	A7
[ ]C33	10nF	103	C7
[ ]C31	10nF	103	B7
[ ]C32	10nF	103	B7
[X] C34	100nF	SMD 0805	B7

Now mount the socket for the processor. Please take care to mount it as shown in the diagram. The notch on the short side should be mounted as in the placement diagram.

[ ]IC7	socket 20 PIN	A/B7
[ ]IC7	AT90S2313 (programmed)	A/B7

The following part is an integrated 25 MHz oscillator. Pin 1 is marked on the part and in the placement diagram.

[ ]IC8	25MHz oscillator	C7

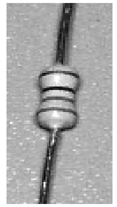
A transistor in TO92 casing

[ ]T2	BF199	C6

[X] IC6	AD9835 TSSOP16		B6/7 SMD

[ ]R9	1,5K		B6
[ ]R10	100K		C6
[ ]R12	270R		C7
[X] R13	3,9K	SMD 0805	C7
[ ]R14	680R		B7
[ ]R15	entf		B7
[ ]R16	10K		A7

Now follows two SMCC RFCs. They look like fat resistors. Measuring them with an ohmmeteres, they are close to 0 Ohm. The colour coding is as with reisistors, but due to their light bodies, they are easier to read.



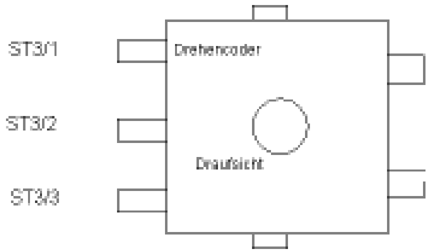
[ ]L2	4,7µH SMCC	C6
[ ]L3	4,7µH SMCC	C7

Now we mount a crystal in HC18 casing. Mounting crystals, it is necessary to avoid shorts on the pc board from the casing. To avoid this, the crystal is mounted at a short distance from the pc board, or by putting an isolating disc below the crystal. A common way to do it is to place to cut off leads from resistors temporarily under the crystal as placeholders, during soldering. Remember to remove the resistor leads again after soldering!

[ ]Q1	4,096MHz HC18	B6/7

[ ]St3	connector	A6
[ ]St4	connector	A/B7
[ ]PIN7		A/B7

To use the section, the rotary encoder sho be connected. This is done with the three core cable with connector, found in the peripheral parts bag with the rotary encoder.



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Solder the cable ends to the rotary encoder as shown in the drawing, and connect the connector to the St3 connector on the pc board.

[ ] rotary encoder at St 3
[ ] connect bridge from pin 18 to pin 47 (see Section 1)

Test Section 3
1. Visual inspection (see Section 1)
2. Resistance test (see Section 1)

[ ] Apply supply voltage as in Section 1 test.

3. Smoke test (see section 1)
4. Functional test
Method 1:
After turning on, the DDS VFO should oscillate at 4.030 MHz. This is easy to check with a short wave radio. Make a wire link from isolated wire. The free ends should be twisted. Leave a small sling at the closed side, and connect the free ends to ground and antenna input of the receiver respectively. Put the sling over T2. Turn on power. The receiver should now have a strong 4.030 signal.

Method 2:
Oscilloscope owners could inspect the signal at C13. It should be some 2-3 Vpp.

Method 3:
With an absorbtion frequency meter (or a grid dip meter in absorbtion position), you should be able to demonstrate the function of the DDS.

Remove the supply voltage and the bridges, and proceed to the next section.

Section 4 IF
The following trimming potentiometer was supposed to be standing. In practice, this has shown to be difficult to trim. Instead we mount a PT6 lying. The raster is a little too small for this, so the leads of the trimming potentiometer must be bent carefully. This is a little clumsy to do, but better clumsy now, than when trimming!

[ ]P6	2,5K PT6 lying		E2

IC 11 should be rolled gently, as we did previously.

[ ]IC11	LM386-4 DIL8		E2/3

Now the capacitors

[ ]C111	0,1µF Film RM 5mm		D3
[ ]C112	2,2nF	222	E2/3
[ ]C113	22nF	223	E2
[X] C114	10µF/6,3V (SMD)	E3/2	

Don’t forget to polarize electrolytic capacitors correctly. The long lead is plus.

[ ]C115	10µF/35V rad.		F2/3
[ ]C116	220µF/16V rad.		F2
[ ]C117	220µF/16V rad.		F2
[X] C118	47nF	SMD 0805	E2
[ ]C125	10nF	103	D2
[ ]R79	22K		E2/3
[ ]R80	1M		D3
[ ]R83	100k		D2
[ ]R84	22K		E2
[ ]R85	39K		E2
[X] R86		SMD 0805	

[ ]R87 3,3R F1
[X] R88 4,7R SMD 0805 E2

Die Diode D28 wird wieder stehend montiert. Das Kathodenseitige Bein wird parallel zurück gebogen, der Körper kommt dorthin, wo der Kreis im LayOut gezeichnet ist.

[ ]D281N4148 D3

[ ]T17 BS170 MOS ESD beachten D3
[ ]T18 BS250 MOS ESD beachten E2
[ ]T19 BS170 MOS ESD beachten E2

[ ]PIN33 E3
[ ]PIN34 E3
[ ]PIN43 E/F 1/2
[ ]PIN44 F1/2

[ ] Kopfhörer an PIN 44 und Masse anschließe

Test Baugruppe 4
1. Sichttest (siehe BG1)
2. Widerstandstest (siehe BG1)

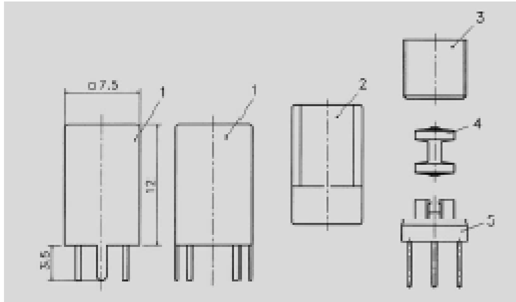
[ ] Versorgungsspannung wie in BG1 anlegen

3. Rauchwolkentest (siehe BG1)
4. Funktionstest

Mit dem Finger auf PIN 33 tippen, es muss im Kopfhöhrer deutlicher Brumm zu hören sein.
Entferne die Spannungsversorgung und den Kopfhörer und mach weiter mit der nächsten Baugruppe.

Baugruppe 5 Trägeroszillator mit Umschaltung

Die in dieser Baugruppe benutzte Neosid Spule ist völlig anders aufgebaut die bekannten Neosid Zylinderspulen. Es handelt sich um eine sogenannte BOBIN Spule. Der Wickelkörper besteht aus einem Ferritkörper, der in etwa wie eine Garn Rolle aussieht. Die Wicklung wird auf diesen Körper nicht einlagig aufgebracht, sondern einfach aufgewickelt. Wichtig ist nur, dass die Windungszahl stimmt.



1=Abschirmbecher 2= Kappenführung aus Plastik 3 Kappenkern
4= Spulenkörper 5= Sockel

Nimm den Fuß der Bobin Spule, gebe einen kleinen Tropfen Superkleber zwischen die Rasten und presse vorsichtig die Ferrit Garnrolle in die Raster. Lass den Kleber trocknen, ehe du weiter machst, du kannst ja schon einmal die anderen Bauteile auflöten.

VORSICHT, IC12 ist empfindlich gegen statische Aufladung! Rollen des IC erst nach Entladung.

[ ]IC12 4066 DIL14 D2

PT6 hatten wir schon, das sind die kleinen schwarzen Trimmpotis

[ ]P7 1K PT6 liegend B2
Spectrol 75H sind Präzisions-Trimmpotis im Metallgehäuse. VORSICHT, die drei Beinchen erst genau mit den Löchern in der Platine vergleichen. Die Trimmpotis rutschen sehr leicht in die Bohrungen, wenn sie richtig herum eingesetzt werden. Ist Druck nötig, dann sind sie verdreht.

[ ]P8 10K Spectrol 75H D2
[ ]P9 10K Spectrol 75H D1
[ ]P11 10K Spectrol 75H D2
[ ]P10 10K Spectrol 75H D1

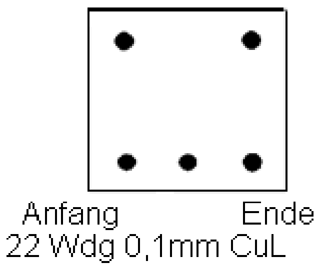
[ ]D29 BB109G / BB409 o.Ä. C1
[ ]D30 BB109G / BB409 o.Ä. C1

The following transistors are mounted according to the placement diagram.

[ ]T20	BF199	B2
[ ]T21	BS250 MOS beware of static!	E2
[ ]T22	BS250 MOS beware of static!	E2

The crystal is mounted with the help of two cut off resistor leads.

[ ]Q6	8,000MHz HC18		B1
[--]Q7	8,000MHz HC18		not used
[ ]R89	47K		B2
[ ]R90	47K		B2
[ ]R91	68k		C1
[ ]R92	39K		C/D2
[ ]R93	39K		D2
[ ]R94	39K		D/E2
[ ]R95	100K		D1/2
[ ]C97	1nF	102	B3
[ ]C119	22nF	223	A/B2
[ ]C120	330pF	331;n330	B2
[ ]C121	220pF	221;n22	B2
[ ]C122	10nF	103	C1/2
[ ]C123	100nF	104	C2



Now the coil form should be glued properly, and the coil can be wound. The picture on the left shows the coil from below. Start at pin „anfang“, by twisting the 0.1 mm wire three times around the pin, and then through the notch onto the body. Put 22 turns on the body, and then again go down through the notch at pin „ende“. Put the turns around the lead. And you're done.

Fix the coil in a vice and solder wire and pins at the same time. This is easy: Touch the wire and solder with the soldering iron at the same time (LITTLE solder!). Don't push too hard. The leads become hot, and the plastic soft! Check for contact with an ohm meter.

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All well? Then screw the core into the plastic holder till it is flush with the top. Please take care not to set it askew. Solder the coil onto the pc board, and put on the covering core. Loosely fit the can, but don't solder it yet.

[ ]L7 Neosid filter 7.1 F10b B1
22 turns 0.1mm lacquered copper wire.

We only have to put in two pins, to finish this section

[ ] pin 28	C/D2
[ ] pin 29	D2

Test Section 5

1. Visual inspection (see Section 1)
2. Resistance test (see Section 1)

[ ] Apply supply voltage as in Section 1 test.

3. Smoke test (see Section 1)

4. Functional test
Connect pin 29 to +10V
Put trimming potentiometer in center position.

Put your link wire from Section 3 close to T10 and tune the receiver to about 8.000 MHz. You should hear the BFO loud and clear. P8 should tune the BFO +/- 1 kHz.

With an oscilloscope, you should be able to see the 8 MHz signal at C97 and adjust it to some 300 mVpp.

If everything is OK, proceed to Section 6.

Section 6 BFO, IF amplifier, AGC

[ ]IC9	Socket 16 PIN		A/B3
[ ]IC9	TCA440/A244 DIL16		A/B3
[ ]IC10	TDA7050 DIL8		B/C2
[ ]D23	1N4148		B2

The following germanium diodes have quite sensitive, large glass bodies. The raster on the pc board is too small for them to be mounted horizontally. All 4 diodes should be mounted obliquely.

[ ]D24	AA143 or the like		C2
[ ]D25	AA143 or the like		C2
[ ]D26	AA143 or the like		C2
[ ]D27	AA143 or the like		C2

[ ]T16	BC337-40		B2
[ ]C93	1000pF RM 5mm		A3
[ ]C94	10nF	103	A3
[ ]C95	22nF	223	B3
[ ]C96	10nF	103	B3
[ ]C98	100µF/16V rad.		A4
[ ]C99	100nF RM 5mm		A3
[ ]C100	22nF	223	A4

Remember to polarize the tantalum capacitors correctly. The long wire is PLUS.

[ ]C101	10µF/16V Tantalum pearl	A/B4
[ ]C102	1µF/35V Tantalum pearl	B4
[ ]C104	10µF/16V Tantalum pearl	B4

Mount the electrolytic capacitors correctly. The long lead is PLUS.

[ ]C103	33µF/16V rad.	B4
[ ]C107	10µF/35V rad.	B/C2
[ ]C108	10µF/35V rad.	B2
[ ]C109	47µF/35V rad.	C2

[ ]C105	0,1µF Film RM 5mm	B3
[ ]C106	0,033µF Film RM 5mm	B3
[ ]C110	0,022µF Film RM 5mm	C1/2

[ ]R70	120R	B3
[ ]R71	2,2K	A4
[ ]R72	100k	B4
[X] R73	27R SMD 1206	B3
[ ]R74	560R	B3
[ ]R75	18K	B3
[ ]R76	470R	C2
[ ]R77	470R	C2
[ ]R78	27K	C2
[ ]R81	33K	B2
[ ]R82	12K	B2
[ ]P5	2k5 PT6 lying	B3
[ ]PIN20		B4
[ ]PIN25		B2
[ ]PIN26		B1/2
[ ]PIN27		B1

To test this section, we need the link to the AF amplifier. Prepare the volume potentiometer (2k2 log). Logarithmic potentiometers are identified either by the word log or the letter B (2,2k B or 2k2B). Solder 3 pieces of wire, each 15 cm long onto the potentiometer. To prevent hum, twist the three wires.

Test Section 6
1. Visual inspection (see Section 1)
2. Widerstandstest (see Section 1)

[ ] put pin 29 to +10 Volt (see Section 5)

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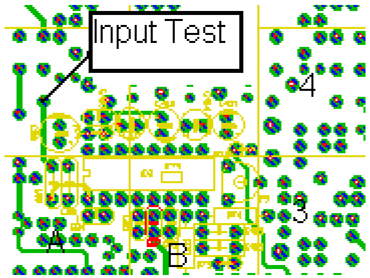
[ ] Bridge pin 47 to pin 18
[ ] Bridge pin 20 to ground
[ ] Connect head phones to pin 44 and ground
[ ] Connect potentiometer arm to pin 33, ends to pins 26 and 34
[ ] Put potentiometer in center position

[ ] Apply power as in Section 1 test.

3. Smoke test (see Section 1)

4. Functional test

After switching on, a definite noise should be audible in the phones. If the pin 20 to ground bridge is removed, the noise should decrease substantially. (instead of this bridge you can later on install an S meter. Without the bridge or S meter, the A244/TCA3440 doesn't work correctly. With the bridge in place, touch the point marked input test in the drawing with a screw driver. Now you should hear weak BC signals.

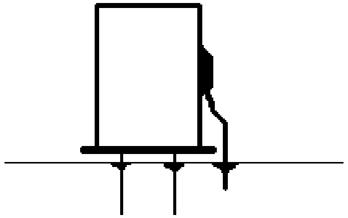


If all tests were successful, remove the bridges and proceed to section 7.

Baugruppe 7 IF amplifier, IF filter

Begin with the crystals. These are not the lowest parts, but in prototyping, we found the ground connection of the crystals difficult, when the other parts were in place. Please again note the minimum distance between the crystals and the pc board (use cut off resistor leads to help!).

[ ]Q2	8,000MHz HC18	C4/5
[ ]Q3	8,000MHz HC18	B4/5
[ ]Q4	8,000MHz HC18	B4/5
[ ]Q5	8,000MHz HC18	A4/5



In close proximity to the crystals, you will find ground soldering spots (Q5 left lower, Q4 and Q3 lower, Q2 right lower). Solder cut off resistor leads into these spots, an solder the free ends to the crystal bodies at half height of the narrow side of the respective bodies. Grind the crystals lightly with sanding paper, this eases the soldering.

[ ] Crystal ground connections, 4 pcs.

The following 5 diodes are in TO92 casings. They look like transistor, but only have to leads. Mount according to the placement diagram.

[ ]D15	BB112	C4
[ ]D16	BB112	B4
[ ]D17	BB112	B4
[ ]D18	BB112	A/B4
[ ]D19	BB112	A4

BEWARE, the BA479 should not be confused with the 1N4148. Use a loupe!.

[ ]D13	BA479	C/D
[ ]D14	BA479	C/D3
[ ]D20	1N4148	B5
[ ]D21	1N4148	C5
[ ]D22	BA479	A4
[ ]T12	BF246A	C4
[ ]T13	BF246A	C4
[ ]T14	BF199	A3
[ ]T15	BC546B	A3
[ ]R56	1,5K	D3

The following resistor is in principle an adjustment value. The regulation of the receiver can be optimized, if this resistor is chosen so that the current through it is about 10 mA.
As it is impossible at this stage to measure the current, and the resistor on the other hand is necessary, we recommend soldering in two cut off resistor leads, and provisionally mounting R57 on them. This makes it easier, later on, to exchange it for another value.

[ ]R57	220R (auf Io~ 10mA abgl.)		D4
[ ]R58	330R		C4
[ ]R59	47K		C4/5
[ ]R60	47K		B4/5
[ ]R61	47K		B4/5
[ ]R62	47K		A/B 4/5
[ ]R63	47K		A4/5
[ ]R64	330R		A4
[ ]R65	47K		A3
[ ]R66	82R		A3
[ ]R67	820R		A3
[ ]R68	12K		A/B3
[ ]R69	33K		A/B3
[ ]R102	68K		B5
[ ]C59	47nF	473	D3/4
[ ]C81	47nF	473	D3/4
[ ]C82	22nF	223	C4
[ ]C83	22nF	223	D4
[ ]C84	22nF	223	C5
[ ]C90	10nF	103	C4/5
[ ]C91	10nF	103	A5
[ ]C92	22nF	223	A4/5
[ ]C124	22nF	223	A3
[ ]Dr10	47µH	SMCC	C3/4
[ ]Dr11	47µH	SMCC	D4

The Sprectrol 75H' s are trimming potentiometers in metal casings.

[ ]P3	10K Spectrol 75H	B5
[ ]P4	10K Spectrol 75H	C5

Now we encounter two news parts: transformers on Amidon toroid ferrite cores. As this is an error prone area, we will present a little more text on them.

Little toroid coil school
As our american QRP friends, we often use high Q toroids from Amidon.

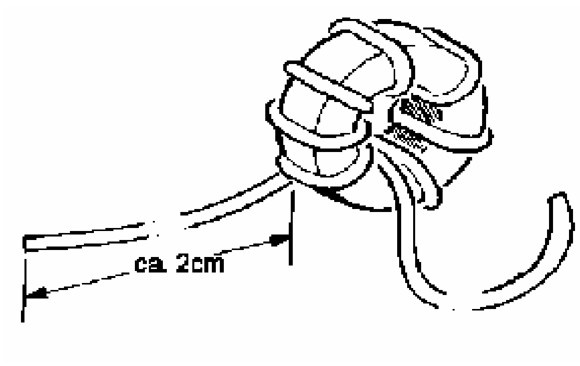
Basically iron carbonyl rings are for narrow band applications and ferrites for broad band applications. On the CD you will find the Mini RK program by Wilfried, DL5SWB. With this small, but helpful program, it is childs play to calculate the necessary turns for a given inductance, or the other way around, the inductance for a known number of turns.

Winding toroids always provokes fear in beginners. Unjust! In you start without prejudice and keep the basic rules in mind, nothing can go wrong. Important: one wire through the ring is one turn. For practice begin by making Tr7, as we will need this shortly.
Cut off some 25 cm of 0.3 mm lacquered copper wire, and take the core in one hand. Put one end of the wire through the hole. That was the first turn. But STOP!!!
Schneide Dir ca. 25cm vom 0,3mm CuL–Draht ab Nimm nun den Kern in die Hand und stecke ein Drahtende hindurch. Damit ist bereits die erste Windung fertig, aber STOP!!!!

Look at your work, and consider how you put the wire through the ring. There are two possibilities. Either back-to-front, or front-to-back. From an RF point of view, this doesn't matter. but for the later mounting, this is very important, as it decides the placement on the pc board. You should chose the direction that feels best for you.

If you started back-to-front, the next turn must be clockwise, to get the right geometry for Tr7. If you start front-to-back, you must wind counter-clockwise.
This rule is only for Tr7. Developers have their oddities too. Wayne, the constructor of the K2, always turns opposite to DK1HE. Worse: For DK1HE the optimum layout of the pc board is so important, that he changes the winding geometry for each coil in the Speaky. A quick test winding will always make it possible to see, what the developer meant to be done.

Now put on the necessary number of turns distributed well over the ring. To avoid error, count the turns on the INSIDE of the ring. The coil in the picture has 8 turns. Well distributed means that the turns are spread over som 270 degrees of the ring circumference. That is the optimal range for toroid coils. When you think of this while winding, you will never need to adjust the turns afterward, even though it is possible to some degree. Turns should never cross, but should be single layer for each coil (primary or secondary for transfor-mers).



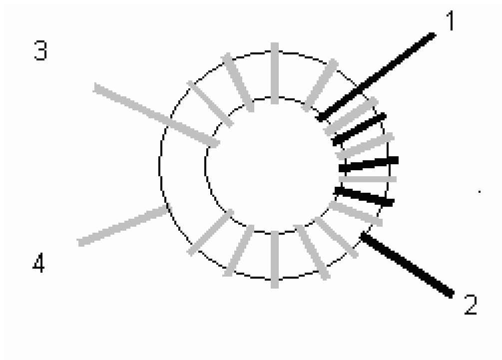
Take care on winding, to pull the wire snugly on the core. This is no problem on iron carbonyl rings as they are round and smooth. But on ferrites,the sharp edges might damage the isolation on the wire.

Cut the free ends, but not too short, and solder the ends. How this is done is a little under discussion. The lacquer on the wire used is solderable, this means that it melts at soldering temperature. Up to about 0.8 mm wire the heat capacity of a standard soldering iron suffices for this, even for burning off the lacquer. To do this, touch the wire as close to the core as possible with the soldering iron, and put on liberal amounts of solder. You should get a real drop. After a short while the lacquer should melt, and smoke should rise. Keep your nose away, as the smoke isn't exactly healthy! When smoke rises, move the solder blob slowly towards the end of the wire, till you have soldered about 1 cm of the wire. If the lacquer won't melt, it helps to add fresh solder. There melted lacquer is shoved away with this method.
When you are done, check that the wire is soldered all the way around. This is very important, as most error in home brew transceivers are from badly soldered coils made from lacquered copper wire. With thicker wires, you will have to scrape off the lacquer with a knife. Please be careful not to nick the wire, as it will break at the nicks!

Use the same technique on the other end of the wire. This completes the toroid coil.

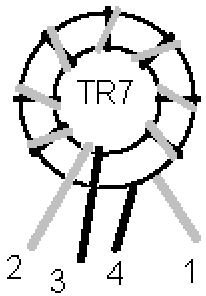
Often you will need a secondary winding, as in Tr7. This can be symmetrical or unsymmetrical. Symmetrical always means without ground connection. No coil end will reach ground or a bypass capacitor. Such symmetrical coils always ahve the secondary centered over the primary.

Now, let us focus on an example of a symmetrical winding: The primary should have 14 turns, the secondary 4. To have the secondary symmetri-cally placed, we have to count on the INSIDE of the ring.

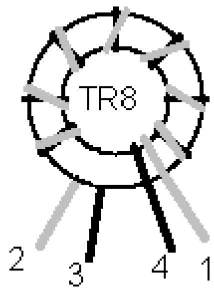


14 divided by 2 is 7. The middle is at 7 turns. The 4 secondary turns must start at the 5th turn of the primary, and end at the 9th, as shown in the drawing. In another way: The secondary is symmetrical to the center of the primary, before and after it, you will find 5 turns.
Should calculations ever result in half turns, you ignore the half turn, and accept the slight assymmetry.
With unsymmetrical secondaries, you put the seconday turns between the turns of the primary. You begin in principle at the cold end of the coil. Which end is cold? Cold in an RF sense, is close to ground. This doesn't necessarily mean galvanically connected to ground. From an RF point of view the connection can be via a capacitor of low reactance. Don't be scared by this!
Another type of transformer is made by twisting two wires and winding bifilar turns. Such transformers are found i Tr7 and Tr8 in Section 7. Bifilar technique gives a transformer of low stray capacitance.

Now for the real thing: Tr7 consists of 2 x 10 turns of 0.3 mm lacquered copper wire on an Amidon FT37-43 core. FT37-43 means ferrite, material 43, 0.37 inch diameter. No colouring, ferrites are carbon coloured.
Take two pieces of 25 cm wire of different colours (I call them red and gold), and twist the pieces at about two twists per cm. This isn't critical, but rather use more than less turns per cm. With this "double wire" put ten turns on the toroid (The drawing only shows 8, not to be too cluttered). Both end now have to be untwisted, and now the coil should look a lot lite the drawing on the left (remember the drawing has 8 turns, you should have 10!).



[ ]Tr7 Amidon FT37-43 C4/5



And now we have a case of changing the geometry of the pc board for the coil geometry. The coil 1/2 doesn't moun from lower right to upper left, but instead from lower left to upper right. You have to wind opposite to Tr7! (Only 8 turns shown!).

[ ]Tr8 Amidon FT37-43 A4/5

Not that difficult, eh?

Now the easy part, the pins, and you complete this section.

[ ] pin 12	A5
[ ] pin 14	B5
[ ] pin 15	B5
[ ] pin 22	B3
[ ] pin 9	C4

Test Section 7
1. Visual inspection (see Section 1)
2. Resistance test (see Section 1)

[ ] pin 29 to +10 Volt (see Section 5)
[ ] pin 19 to 10V
[ ] pin 15 to 10 V
[ ] Bridge pin 47 to pin 18
[ ] Bridge pin 20 to ground
[ ] Trimmer P4 to center position
[ ] Connect head phones to pin 44 and ground.
[ ] Potentiometer arm to pin 33, ends to pins 26 and 34

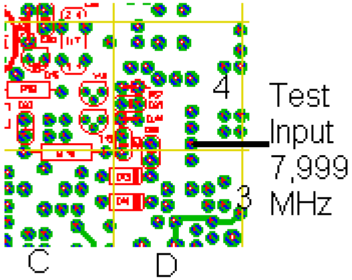
[ ] Potentiometer centered

[ ] Apply power supply as in Section 1

3. Smoke test (see Section 1)

4. Functional test

You should hear noise in the head phones. The simple test with the finger on the input, as with the BFO, won't work this time, as the crystal filter only will allow 8 MHz to be recieved (Actually rather 7.999 MHz, as the center frequency of the Cohn filter depending on band width is a little lower than the individual crystals).



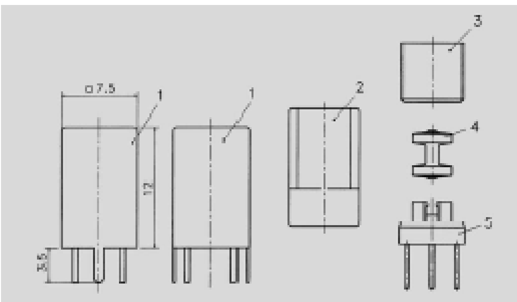
At this place, we need a signal generator. If you have a variable transmitter, you can use that. Connect it to a dummy load at low power, and tune it to 7.999 MHz. A link wire connected to point Test Input should give a beat tone in the head phone, if the transmitter frequency is changed slightly.

If you don't have a variable transmitter or a measuring transmitter, a crystal oscillator tuned to 8 MHz will be helpful. You can build on with the crystal left over. The test can be left out, though.

Remove all bridges after the test, and proceed to Section 8.

Section 8 PLL

In this section we will once more use a Neosid Bobin core. 1 = can, 2 = plastic cover 3 = covering core 4 = coil body 5 = socket.



Version:07.01.2004

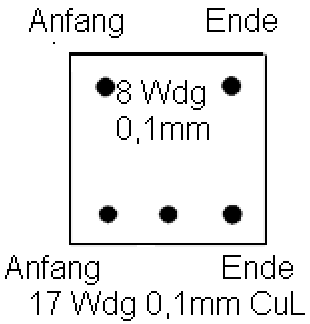
Grasp the base of the bobin core, put a small drop of super glue between the edges and push the ferrit spool into the base. Let the glue dry before proceeding. You can mount other parts while waiting.

Mounting the ICs will help in mounting the other parts. Be careful with IC2 to IC4, they are static sensitiv. Remember to discharge your hands to ground.

The ICs should be rolled gently before mounting.

[ ]IC2	4060 DIL16		D/E6
[ ]IC3	4046 DIL16		D/E6
[ ]IC4	4060 DIL16		B/C6
[ ]IC1	NE612 DIL8		D7
[ ]T1	BF199		D7
[ ]R1	1,5K		E7
[ ]R2	1,5K		E7
[ ]R3	47K		E6/7
[ ]R4	4,7K		E6/7
[ ]R6	1,5K		C/D 6/7
[ ]R7	1M		D6/7
[ ]R8	1M		C6
[ ]R5	100K		D7
[ ]C1	0,22µF	Film	E6
[ ]C2	10nF	103	D/E7
[ ]C3	22nF	223	D7
[ ]C4	47nF	473	D7
[ ]C5	220pF	221	D7
[ ]C6	1nF	102	D/E7
[ ]C7	10nF	103	C/D7
[ ]C8	1nF	102	D6/7
[ ]C9	100nF	104	C/D6
[ ]C10	100nF	104	E5/6
[ ]C11	100nF	104	B6
[ ]C12	220µF/16V	rad.	B6
[ ]L1	Neosid filter 7.1 F2		C/D7

Now the coil form should be dry, and you can wind the coil.
The picture on the left shows the base of the coil from below. Begin at pin „anfang“ by winding the 0.1 mm wire around the pin 3 times, continuing up the notch. Now put on 17 turns, and return through the proper notch to pin „ende“. Three turns around the pin, and you‘re done. For the secondary, wtih a new piece of wire, go to pin „anfang“, up through the notch, put on 8 turns, return through the proper notch, put 3 turns around pin „ende“, and DONE.



Mount the coil carefully in a vice and solder pins and wires at the same time. This is easy: touch the wire and the solder (LITTLE solder) at the same time. Don‘t push too hard: The lead will be hot, and the plastic softens. Test for shorts with an ohm meter.
Everything OK? Then put the ferrite core gently into the plastik body, be careful not to put it in at a wrong angle. Solder the coil i place and put on the covering core. The can should be mounted loosely, not yet soldered.

[ ] L1 Neosid 17 turns
Now fix the connector for the band modules.
The connector strips should be carefully mounted at a right angle to the pc board. Good practice is to start soldering on lead at the middle of the strip, an check and adjust for proper position, before soldering the rest.
Weiter geht es mit den Steckplätzen für die Bandmodule.

[ ] Connector strip	E7
[ ] Connector strip	E5
[ ] Connector strip 4A	E7
[ ] Connector strip 4B	E5
[ ] Connector strip 3A	F7
[ ] Connector strip 3B	F5
[ ] Connector strip 2A	G7
[ ] Connector strip 2B	G5
[ ] Connector strip 1A	H7
[ ] Connector strip 1B	H5

Now the corresponding pins for the band switching:

[ ] pin 5	E7
[ ] pin 4	E7
[ ] pin 3	F7
[ ] pin 2	G7
[ ] pin 1	H7

Now for the only fixed bridge on the pc board. This should be made from unisolated wire in square E4/E5, and soldered in.

This section cannot be tested yet, as the band set oscillator and the VCO of the band module are needed. Put the main pc board aside, and finish one band module. We recommend the 40 meter module.

Band module 40 Meter

[ ]P1	250R	Piher PT6 lying
[ ]C1	220pF	
[ ]C2	150pF	
[ ]C3	left out	
[ ]C5	22nF	223
[ ]C6	10nF	103
[ ]C7	22nF	223
[ ]C8	22nF	223
[ ]C9	47pF	473
[ ]C10	27pF	27p
[ ]C12	10nF	103
[ ]C15	10nF	103
[ ]C16	3,9pF	3p9
[ ]C17	3,9pF	3p9
[ ]C18	22nF	223
[ ]C19	22nF	223
[ ]C20	27pF	27p
[ ]C21	10nF	103

[ ]R1	8K
[ ]R2	27K
[ ]R3	1K
[ ]R4	10R
[ ]R5	56K
[ ]R6	68R
[ ]R7	100K
[ ]R8	150K
[ ]R9	100K
[ ]R10	68K
[ ]R11	68K
[X] Dr1	left out
[ ]Dr2	22µH SMCC
[ ]Dr3	22µH SMCC
[ ]Dr4	22µH SMCC
[ ]Dr5	22µH SMCC
[ ]Dr6	22µH SMCC
[ ]T1	BF199

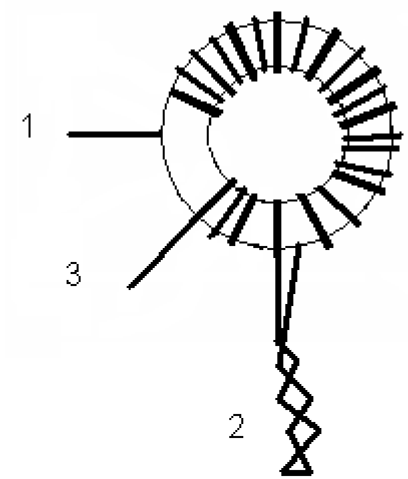
The following BF981 transistor has 4 terminals. One of the leads is definitely longer than the rest. This goes into the hole marked with a dot on the pc board. The lead are bent carefully a little away from the printed side, taken extreme care of static precautions! When the transistor is in place, the marking should be readable.

[ ]T2 BF981

BEWARE: Risk of mixing up BA479 / 1N4148. Use a loupe!!!

[ ]D1	BA479
[ ]D2	BA479
[ ]D5	BA479
[ ]D6	BA479
[ ]D4	1N4148
[ ]D3	BB109G/BB409 or the like
[ ]D7	BB109G /BB409 or the like
[ ]D8	BB109G /BB409 or the like
[ ]D9	BB109G /BB409 or the like
[ ]D10	BB109G /BB409 or the like

We have done toroids before. On the band module we use iron carbonyl rings, which are colour coded by type. L1 is wound on a 0.37 inch type 6 ring, which is yellow. (T37-6)



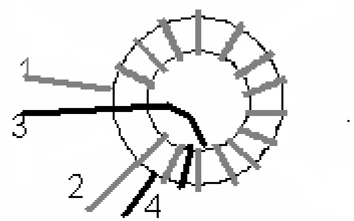
As already tried on the transformers, we will begin by noting the winding geometry. The primary of L1 has the cold end lower left (seen from the upper side of the pc board) at point 3, and ends at the upper right at point 1.

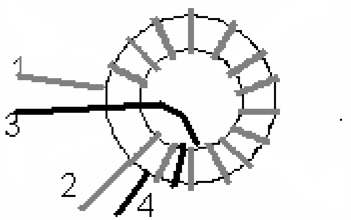
Use 0.3 mm lacquered copper wire and begin at the cold end. Twist an end after 4 turns (counted on the inside), to form the tap. Wind a futher 19 turns (giving a total of 23 turns with a tap at turn 4 from the cold end).

Mount it according to the placement diagram.

[ ] L1 Amidon T37-6

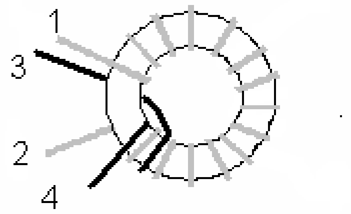
Both band filter coils have a secondary. This isn't difficult either. This time it isn't done with a tap, but with a proper secondary. Begin with the primary, 26 turns of 0.3 mm lacquered copper wire. BEWARE: the drawing only shows 8 turns for reasons of clarity! The geometry is correct, though. Now put on the secondary as shown in the drawing. The secondary is ended at point 3.





[ ]L2 Amidon T37-2

L3 is identical to L2, apart from being a mirror image, to avoid long pc board lines. That is: same number of turns, but winding the other way round.

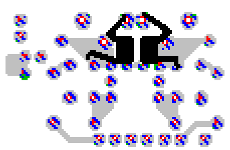


[ ]L3 Amidon T37-2

Now mount the trimming capacitors. BEWARE not to confuse C11 with the others.

[ ]C4 2,5-60pF Film trimmer 7mm D (black)
[ ]C11 2,0-45pF Film trimmer 7mm D (violet)
[ ]C13 2,5-60pF Film trimmer 7mm D (black)
[ ]C14 2,5-60pF Film trimmer 7mm D (black)

Now something unusual, but not special: 2 capacitors are to be mounted on the solder side of the board.


Je 150pF parallel zu C13/C14

[ ]C22 150pF on solder side
150p/n15
[ ]C23 150pF on solder side
150p/n15

Now we just have to put in the two connectors to finish the band module. Mount them and put all trimmers in center position.

[ ] Connector strip A
[ ] Connector strip B
[ ] Trimmers in center position

Test Section 8
1. Visual inspection (see Section 1)
2. Widerstandstest (see Section 1)

[ ] Bridge pin 47 to pin 18 legen
[ ] Put band module pin 1 to +10V
[ ] Connect rotary encoder to DDS
[ ] Apply power as in Section 1 test.

3. Smoke test (se Section 1)

4. Functional test
The complete PLL should work now. Test the band set oscillator first. With a link wire and a short wave receiver, the oscillator should be loud at 11 MHz. Hook up a digital volt meter to the connection between R3 and R4 (main board E7). If the voltage is close to 0 or 8 Volts, the PLL isn't working yet. Turn trimmer T2 slowly. At some position the PLL will "catch", and the voltage should be between 2 and 6 Volts. Trim it to some 5 Volts. With the link wire at T2, you should hear a strong signal at 15.030 MHz.
If you own an oscilloscopi, you can see the VCO signal at IC1 pin 6. With trimmer P1 set it to some 250 mVpp. If you use an RF probe, set to 100 mVeff.
L1 is so broad banded, that it doesn't demand tuning. But set it to max. signal at IC2 pin 11, anyhow.

That's that. The PLL works. Remove the bridges and go on to section 9.

Section 9 RX/TX Mixer, Low pass filter

The three leads of the BFR96 should be bent carefully down, the writing should be readable, when the transistor is in place.

[ ] T9	BFR96(S)	E4
[ ] T10	BFR96(S)	D5

[ ] T11	BF244A (optional)	C/D5

For the mixer TUF 1 you have to be careful about short to the pc board as with crystals. Mount it with the help of two pieces of cut off resistor leads as help, and remember to remove them after soldering! Remember to mount the mixer in proper direction. Seeing it from below, note that the leads aren't centered. At the component side, you can see how to orient it. (Shown as the mixer as a transparent object in the drawing).

[ ]M1	Mixer TUF1	D3/4

Now a few diodes, check their value with a loupe, not to mix them up.

[ ]D4	BA479	E/F3
[ ]D5	BA479	E3
[ ]D6	BA479	D3/4
[ ]D7	BA479	D4
[ ]D8	BA479	D/E4

Now the other type

[ ]D9	1N4148	F2/3
[ ]D10	1N4148	F2/3
[ ]D111	N4148	F2
[ ]D121	N4148	F2

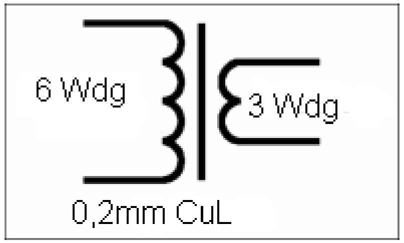
SMCC RFCs are well known by now

[ ]Dr1	10µH	SMCC	F3
[ ]Dr2	47µH	SMCC	E3
[ ]Dr3	47µH	SMCC	D/E 3/4
[ ]Dr4	47µH	SMCC	E3/4
[ ]Dr5	10µH	SMCC	C/D 4/5
[ ]Dr9	10µH	SMCC	F3
[ ]C35	47nF	473	E4
[ ]C36	47nF	473	E4
[ ]C37	100nF	104	E3/4
[ ]C38	47nF	473	E4
[ ]C39	47nF	473	E3/4
[ ]C40	47nF	473	F2/3
[ ]C41	47nF	473	F3/4
[ ]C42	47nF	473	E3
[ ]C43	47nF	473	D3
[ ]C44	47nF	473	D3
[ ]C45	47nF	473	E3
[ ]C46	47nF	473	D4
[ ]C47	100nF	104	D5
[X] C48	47nF	473	D5 left out
[ ]C49	47nF	473	D/E5
[ ]C50	15pF	15p	D5
[ ]C51	47nF	473	C5
[ ]C52	10nF	103	C5
[ ]C73	150pF	151,n15	G2
[ ]C74	120pF	121;n12	G1/2
[ ]C75	120pF	121;n12	G1
[ ]C76	120pF	121;n12	G1
[ ]C77	120pF	121;n12	G1
[ ]C78	150pF	151;n15	H1
[ ]C79	47nF	473	G2
[ ]C80	47nF	473	F2
[ ]R17	1,5K		E5
[ ]R18	1,5K		E5
[ ]R19	1,5K		D/E5

[ ]R20	2k7		E4
[ ]R21	1k2		E4
[X] R22	10R	0803 SMD	E3
[ ]R23	39R		E3/4
[ ]R24	1,5K		F3
[ ]R25	1,5K		D3
[ ]R26	47R		D4
[ ]R27	2k7R		D5
[ ]R28	1k2		D5
[ ]R29	1K		D5
[X] R30	10R	0803 SMD	D5
[ ]R31	39R		D5
[ ] R32	100K		D5
[ ]R33	1K		C5
[ ]R52	1,2K		FG/2
[ ]R53	330R		FG/2
[ ]R54	depending on instrument		F2
[ ]R55	1K		E4
[ ]P2	10K Piher PT6 lying		F2

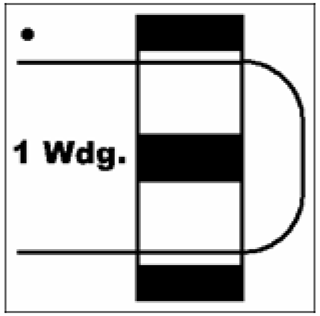
Winding instructions Transformer TR1

Now, after a pause, follows a new part. The transformer Tr1 i wound on a double hole („pig nose“) core.

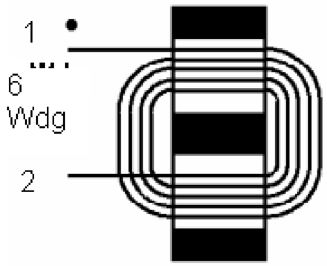


Put the pig nose core in front of you, so that the holes pass from left to right. Tr1 has a primary of 4 turns, and a secondary of 2 turns, to transform downwards.

Like the other diagrams for transformers, this drawing also contains a dot. This is always the beginning of the winding (for coils too). Cut a 20 cm piece of 0.2 mm wire, and feed it through the pig nose, as shown in the diagram. One turns is done by going through one hole and back through the other.

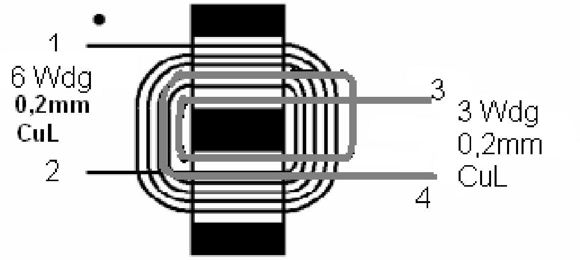


Make three turns: Through the upper hole going right (leave and end of some 2 cm outside). Back through the lower hole. One turn done.



Now go on: through the upper hole, back through the lower. End of turn two. Don't scratch the wire on the edge of the core! The lacquer is easily damaged.

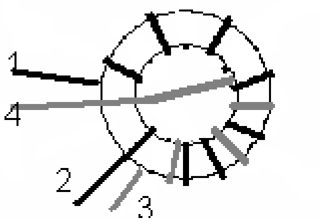
Go on with turn 2, 3, 4, 5 and 6 and the primary is done [Is this really correct for FOUR turns?] This completes the primary, and leaves us to do the secondary. To easy mounting, our developer has laid out Tr1 so that the secondary leaves the core opposite to the primary. Take a 10 cm piece of 0.2 mm wire and feed it carefully from right to left through the upper hole and back from left to right through the lower holde. End of the first secondary winding. Two more and we are finished!



Now the transformer can be mounted. The secondary goes to 3 and 4, the primary to point 1 and 2, as shown in the layout.

[ ]Tr1 QRP double hole core F3/4

Now follows another transformer, this time on an FT37-43 core. The primary has 8 turns, the secondary 4. Mounting according to the layout drawing.



[ ]Tr2 Amidon FT37-43 8 turns/4 turns D4/5

The three coils for the low pass filter is without any frills.

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Just put the proper number of turns on Amidon iron carbonyl rings, type 6, yellow. Use 0.5 mm lacquered copper wire. Note the geometry!

[ ]L4 Amidon T37-6 10 turns 0.5 mm lacquered copper wire, 270 degrees covered G2

[ ]L5 Amidon T37-6 11 turns 0.5mm lacquered copper wire, 270 degrees covered G1

[ ]L6 Amidon T37-6 10 turns 0.5mm lacquered copper wire, 270 degrees covered G/H1

[ ]	J1 Connector J1		D4
[ ]	pin 6		F5
[ ]	pin 16		C5
[ ]	pin 17		C5
[ ]	pin 32		D/E3
[ ]	pin 36		F3
[ ]	pin 37		F2
[ ]	pin 51		G/H 0/1
[ ]	pin 52		G/H 0/1
[ ]	RL1	DIL Reed relay 12V 1xUM	F/G 2/3
[ ]	J1 3 pin Connector		D4

Test Section 9
1. Visual inspection (see Section 1)
2. Resistance test (see Section 1)

[ ] Bridge pin 47 to pin 18
[ ] Put band module pin 1 to +10V
[ ] Connect rotary encoder to the DDS
[ ] Put pin 29 to +10 Volt (see section 1)
[ ] Put pin 19 to 10V
[ ] Put pin 15 to 10 V
[ ] Bridge pin 47 to pin 18
[ ] Bridge pin 20 to ground
[ ] Center trimmer potentiometer P4
[ ] Connect head phones to pin 44 and ground
[ ] Connect volume potentiometer arm to pin 33, ends to pins 26 and 34
[ ] Turn volume potentiometer to center position
[ ] Connect BNC connector to pin 52 and 53
[ ] Connect pin 6 to preselector potentiometer arm.
[ ] Connect preselektor potentiometer to +10 and via 1k8 to ground as shown in the wiring diagram.
[ ] Center preselector potentiometer
[ ] Put pin 32 to +10V
[ ] Put jumper on J1 2/3

3. Smoke test (see section 1)
[ ] Apply power as in section 1 test.

4. Functional test
Adjust P1 on the band module for 500 mVeff or 1,5 Vpp at J1/1. If you cannot measure, just peak the voltage with a diode probe.
Move jumper to J1 2/3

Put a strong signal at 7.030 MHz with at measurement transmitter via a link wire to the BNC connector. Adjust frequency. Trim C16/C17 to maximum with the weakest possible transmitter signal. Now you should be able to hear ham operators in the 40 meter band.

If you can, proceed to section 10.

Section 10 SSB Generator and SSB amplifier

[ ]	P13	22K Piher PT6 lying	A1/2
[ ]	P14	50k Piher PT6 lying	A1
[ ]	P15	220K Piher PT6 lying	B1
[ ]	P16	2,2K Piher PT6 lying	B1
[X]	IC17	SSM2165-1 SO8	A1

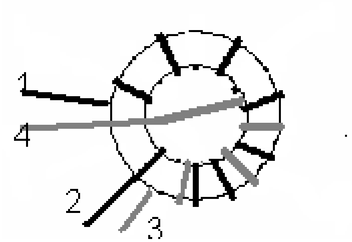
Roll the ICs before mounting! Remember static precautions!

[ ]	IC16	NE612 DIL8	A2/3
[ ]	IC18	TL071 DIL8	C/D1

Potential free soldering!

[ ]	T23	BF910 MOS beware of static!		C3
[ ]	T30	BC337-40		B1
[ ]	C85	100pF	101	C4
[ ]	C86	22nF	223	C3
[ ]	C87	22nF	223	C3
[ ]	C88	2nF	202	D3
[ ]	C89	10nF	103	C3
[ ]	C134	47nF	473	A2/3
[ ]	C135	10nF	103	A2
[ ]	C137	1000pF	103	A2/3
[ ]	C138	10nF	103	A2
[ ]	C139	0,033µF	Film RM 5mm	A2
[ ]	C149	1nF	103	D1
[ ]	C150	1nF	103	
[ ]	C136	10µF/16V	Tantalum pearl	A2
[ ]	C140	100µF/16V	rad.	A/B1
[ ]	C142	1µF/63V	rad.	A1
[ ]	C143	22µF/16V	rad.	A1
[ ]	C145	1µF/63V	rad.	C1
[ ]	C146	100µF/16V	rad.	C/D1
[ ]	C141	0,1µF	film RM 5mm	A1
[ ]	C144	0,1µF	film RM 5mm	A0/1
[ ]	C147	0,22µF	film RM 5mm	C0/1
[ ]	C148	0,01µF	film RM 5mm	D1
[ ]	R96	100K		C3
[ ]	R97	150K		C3
[ ]	R98	220R		C/D3
[ ]	R99	27R		C3
[ ]	R100	56R		C3
[ ]	R101	100K		C4
[ ]	R114	100K	metal film 1%	A2
[ ]	R115	100K	metal film 1%	A2
[ ]	R116	27K		A2
[ ]	R117	33K		A2
[ ]	R118	12K		A2

[ ]	R119	120R		B1
[ ]	R120	12K		B1
[ ]	R121	33K		B1
[ ]	R122	2k2		B/C1
[ ]	R123	390R		C1
[ ]	R124	100K		D1
[ ]	R125	100K		D1
[ ]	R126	2,7K		C1
[ ]	R127	56k		C1
[ ]	Dr12	100µH	SMCC	D0/1



Der Übertrager TR6 ist identisch mit dem Übertrager TR2 aus Baugruppe 8. 8 Wdg primär und 4 Windungen sekundär mit 0,3mm CuL

[ ]Tr6 Amidon FT37-43
C/D3

[ ]	PIN 21	C3
[ ]	PIN 23	A1/2
[ ]	PIN 24	B1
[ ]	PIN 30	D3
[ ]	PIN 31	D3
[ ]	PIN 48	D1
[ ]	PIN 49	D0/1

[NOTE: could place this right!!!] The Tr6 transformmer is identical to the Tr2 transformer from section8. 8 turns primary, 4 turns secondary, 0.3 mm lacquered copper wire.

Section 11, Transmitter driver and PA

[ ] P1 100R 0,5W Cermet lying RM 5x10mm F/G3

Bend leads of BRF96 away from the marking text.

[ ] T3	BFR96(S)		G4
[ ] C53	47nF	473	G4
[ ] C54	100nF	104	G4
[ ] C56	47nF	473	H4
[ ] C57	47nF	473	G4
[ ] C58	47nF	473	H4
[ ] C59	47nF	473	
[ ] C60	2,2nF	222	H3
[ ] C61	47nF	473	F4
[ ] C62	47nF	473	F3
[ ] C63	47nF	473	G3
[ ] C65	47nF	473	H1
[ ] C66	100nF	104	H3
[ ] C68	100nF	104	H2/3
[ ] C69	100nF	104	H2
[ ] C72	47nF	473	F1
[ ] C64	0,47µF	Film RM 5mm	G3
[ ] C55	0,1µF	Film RM 5mm	G3
[ ] C70	1µF	Film RM 5mm	H2
[ ] C67	47µF/16V	rad.	G3
[ ] C71	100µF/25V	rad.	H1
[ ] D3	BA479		F4
[ ] Dr6	47µH	SMCC	F3/4
[ ] Dr7	10µH	SMCC	G3
[ ] R34	1K		F4
[ ] R35	2k7K		G4
[ ] R36	1k2R		G4
[ ] R37	10R		G4
[ ] R38	39R		G4
[ ] R39	68R		H4
[ ]R40	820R (adjust for Irest T5~ 100mA)		H4
[ ] R41	4,7R		H4
[ ] R42	4,7R		H3
[ ] R43	1R		H3
[ ] R44	270R	1 Watt Metal film	G4
[ ] R45	5,6R		H1/2
[ ] R46	10R		G/H3
[ ] R47	10R		H3
[X] R48	1R	SMD 1206	H2
[X] R49	1R	SMD 1206	H2
[X] R50	1R	SMD 1206	H2
[X] R51	1R	SMD 1206	H2

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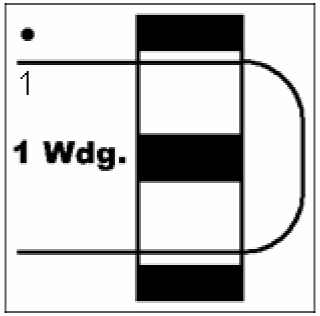
Mount the TO220 transistors, so they are flush with the pc board edge. The are to be screwed to the back of the box.

[ ] T4	BD242/ BD244	H4
[ ] T5	2SC1970 Mitsubishi!!	H3/4
[ ] T6	2SC1969 Mitsubishi!!	H2
[ ] T7	2SC1969 Mitsubishi!!	H3
[ ] T8	BD242/ BD244	H1/2

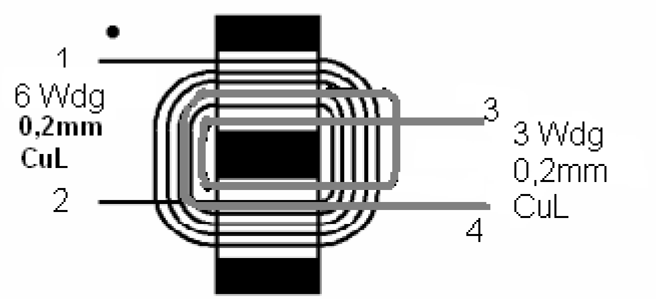
We continue with the broad band transformers Tr3 and Tr4. They are identical. These transformers are wound on pig nose cores.

First Tr3:
Put the pig nose in front of you, pointing the holes from left to right, an mark the left side with a drop of colour. Nail lacquer is godd, felt tipped pens work badly). The marking is important to avoid mixing up primary and secondary.. Tr1 [Tr3???] contains a primary of 4 turns and a secondary of 2 turns. As in most other transformer diagrams, one winding is marked with a dot. This is always the beginning of the winding.
Cut a 14 cm piece of 0.2 mm wier and feed it through the pig nose as shown in the drawing.



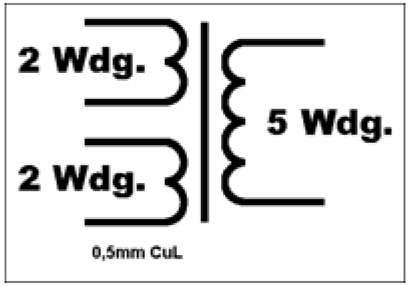
One turn is completed from one pass through each hole.
Put on two turns: left to right through the upper hole, then back right to left through the lower. Once more. Done. Leave 2 cm wire at the beginning of the wiere. Don‘t pull too hard on the wire, not to damage the lacquer.
If you have done right till now, two wire end hang out of the left side of the core, on top a short, at the bottom a longer.
(I hope you don‘t get mad at my being so detailed, describing twice and thrice. The transformers count for quite a number of mistakes!) Now repeat to put on more turn.
Now do the same from the other side for the secondary, with a 10 cm piece of wire, leaving 3 turns primary and three turns secondary.
Now take the first wire again and put on another three turns for a total of 6 on the primary. That is 6 turns on the left and 3 on the right. This way the secondary is so-so symmetrical. Now mount the transformer, respecting its orientation by looking at the number at the leads in the drawings. Solder the ends before mounting, to remove the lacquer.
It is easier if the wires ar long enough for them to be held firmly to the pc board during soldering.

[ ] Tr3 QRP double hole core G/H4

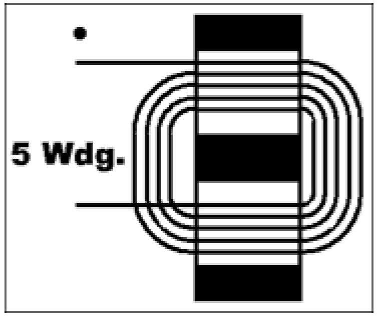


Repeat this for transformer Tr4, but remember that Tr4 has a primary of 3 turns and a secondary of 2 turns.

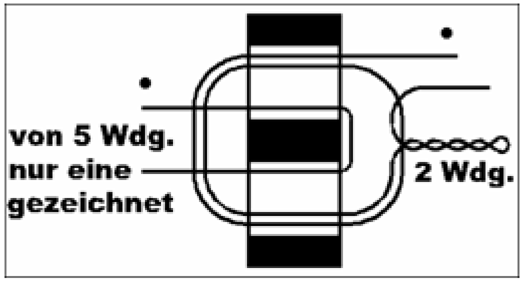
[ ] Tr4 QRP double hole core H3



Now Tr5. This isn‘t much more difficult, but the 0.5 mm wire is stiffer. The holes in the BD202-43 pig nose core are bigger, though. Please be careful not to scrape the lacquer on the wire on the core!!! Tr5 has a primary of 2 x 2 turns and a secondary of 5 turns. Cut a 25 cm piece of the 0.5 mm lacquered copper wire. Begin upper left and put on 5 turns. This means from left to right upper, then right to left lower equals one turn.



Repeat this for every turn till you have 5. The winding is done. Naturally you have to space the turns less than in the drawing! Be careful not to damage the lacquer on the wire.
Now follows the first part of the primary. Take a 15 cm piece of wire and begin opposite to the secondary, going right to left at the top, continuing left to right at the bottom. One turn. Now repeat this. Now the trick: twist a 30 mm loop back to the pig nose.This should look as in the drawing. Now continue with the free end right to left on top, left to right at the bottom. For two full turns.



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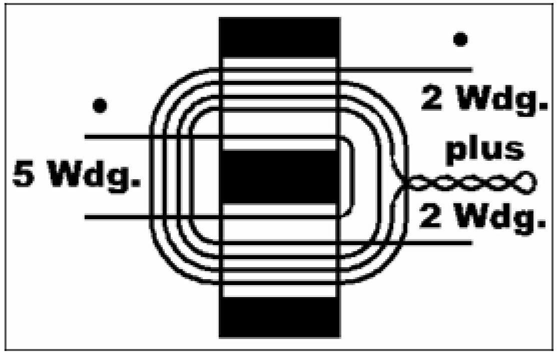
Now the transformer should look like the following drawing. To the left two wire ends, to the right three, counting the twisted part as one wire.



Solder all 5 ends and mount the transformer. Every wire end should be in its proper place for the pc board.
That's that! Now follows the rest of the transmitter output parts.

[ ] Tr5 double hole core BN43-202 G/H 2/3

[ ] pin 35 F3

Now the RFC for the PA power supply. Wind 10 turns of 0.5 mm lacquered copper wire well distributed over an Amidon FT50-43. Take note of the necessary geometry.

[ ] Dr8 Amidon FT50-43 F/G1

That should be all. The rest is just trimming. In stead of another section test, I recommend that the pc board is mounted in the box, and all peripheral parts are wired and soldered. The open construction of the box leaves access to both sides of the pc board. It found a test without box, and with live wires too risky.

If you follow our advice, then continue preparing the front and back of the box as you want them or according to our template. Mount potentiometers, switches and the pc board. Mount the pc board BELOW the frame, to leave enough room for the peripheral parts.

Pin placement Speaky, placement diagram

PIN 1	BM 1	H7
PIN 2	BM2	G7
PIN 3	BM3	F7
PIN 4	BM4	E7
PIN 5	BM5	E7
PIN 6	VPreSel	F5
PIN 7	A/B7	
PIN 8	D2/3	
PIN 9	+10V_CW	A/B6
PIN 10	an PIN 42	A5
PIN 11	an PIN 41	A5
PIN 12	A5	
PIN 13	SoftKeyOut	B5
PIN 14	B5	
PIN 15	B5	
PIN 16	Counter	C5
PIN 17	Counter	C5
PIN 18	+10V	C5
PIN 19	B3	
PIN 20	B4	
PIN 21	C3	
PIN 22	B3	
PIN 23	an T22	A1/2
PIN 24	+10VE	B1/2
PIN 25	B2	
PIN 26	B1/2	
pin 27	B1	
pin 28	C/D2	
pin 29	D2	
pin 30	D3	
pin 31	+10VS	D3
pin 32	+10VE	D/E3
pin 33	E3	
pin 34	E3	
pin 35	+10VS	F3
pin 36	+10V	F3
pin 37	POut Anz.	F2
pin 38	E2	
pin 39	+10VE	E2
pin 40	+10VS	E1
pin 41	Ue_	E1/2
pin 42	Us_	E1/2
pin 43	E/F 1/2	
pin 44	F1/2	
pin 45	PWR ON	E/F1
pin 46	PWR ON	E1
pin 47	+10V	E1
pin 48	GND	D1
pin 49	NF Pot	D0/1
pin 50	+DC Input	G1
pin 51	GND	G/H1
pin 52	ANT	G/H 0/1
pin 53	ExtKey/PTT	A/B5

Trimmer potentiometers, placement diagram

P1	F/G3	Quiet current PA
P2	F2	Output indicator
P3	B5	Band width CW filter
P4	C5	Band width SSB filter
P5	B3	S Meter indicator
P6	D/E 2	Side tone level
P7	A/B 2	Level of BFO/carrier oscillator
P8	D2	BFO USB
P9	D1	BFO LSB
P10	D1	BFO CW receiver
P11	D2	BFO CW transmitter
P12	A5	CW decay
P13	A2	Carrier suppression
P14	A1	AF level SSB TX
P15	A/B 1	SSB compression level
P16	B1	Mic level

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