Main board of transceiver “KLOPIK”

This is HF homemade multi-band transceiver. A simple generic receiver-transmitter path having the least switching of circuits in the modes of reception and transmission and to enable easy assembly with a minimum of tuning elements.

The proposed scheme of the main tract is designed for beginners in ham radio without complex and expensive instrumentation. An experienced hobbyist may, at its discretion, to add to the circuit nodes as needed and make small, light transceiver to operate in the campaign.

The scheme of the primary tract is very simple, logical and easy to "read". This is a classic super heterodyne with single frequency conversion.

Description

In receive mode (RX) the signal output from band bandpass filters (DPF) arrives at the "classical" diode mixer. The signal from VFO goes to another input of mixer. From the output of the mixer intermediate frequency signal (IF) goes to the first stage intermediate frequency amplifier (performed on the transistors VT1 and VT2). The load of this cascade is 8x quartz crystal filter ZQ1, which provides the main selectivity of the receiver adjacent channel.

The filtered signal is amplified by one more stage of the IF amplifier (transistors VT3 and VT4), which is also loaded on a “Variable” 4x quartz crystal filter (ZQ2).

Output from ZQ2 filter – the signal is supplied to the third stage of the IF amplifier (transistors VT5 and VT6), and with its output – to the second diode mixer which is also fed a signal from a reference quartz oscillator, performed by transistor VT10. From the output of the mixer the audio signal through the normally closed relay contacts K2.1 goes to the low frequency amplifier (LFA) - LM386.

The output of LFA is loaded by a variable resistor R32, which provides volume control.

Automatic gain control (AGC) assembled on C28, VD9, VD10, R26, C24 and VT9. Despite its simplicity, AGC is quite effective and allows you to very comfortably make the signal levels from terrestrial noise, up to 9 +40 dB on S-meter. AGC starts to work when power signals is 7 points or more.

In the S-meter uses a DC amplifier (transistor VT11), which is loaded on the ammeter with a current maximum deviation of 200 μA.

All three of the cascades of the IF Amplifier are reversible. In transmit mode (TX) – when you press the pedal actuate relays K1 — K2. Relay contacts K1.1 reverses the direction of signal flow in the cascades of the IF amplifier, and through the contacts of K2.1 voltage goes to a microphone amplifier (this removes the voltage low frequency amplifier of S-meter).

The signal from the microphone amplifier on transistors VT7 and VT8 goes to the diode mixer VD5-VD8, that in TX playing the role of the balanced modulator. From the output of the modulator a dual band signal with suppressed carrier (DSB) passes through all three stages of the IF amplifier in the "reverse" direction (i.e., from the balanced modulator to the diodes mixer VD1-VD4), and in the process of signal going through the quartz crystal filters ZQ1 and ZQ2 are allocated to the desired sideband, i.e. a SSB signal.

Further transport of the SSB signal at the operating frequency, located in one of the Amateur HF bands, occurs in the diodes mixer VD1-VD4, after which the signal goes to bandpass filters.

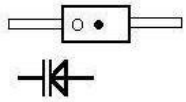
The suppression of carrier frequency of balanced modulator is regulated by a trimming resistor R20.

Elements and assembly details.

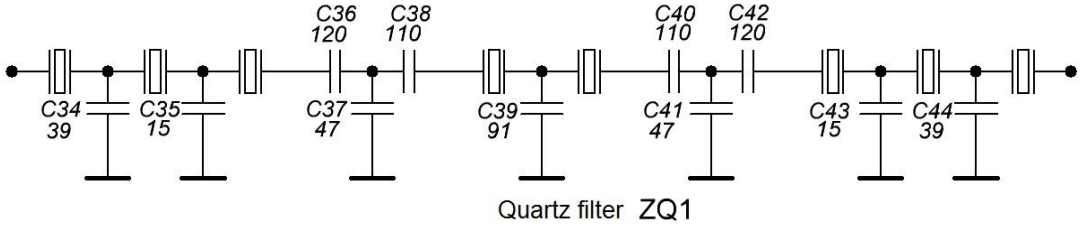
- **Reverse cascades.** The modes of the transistors are set automatically and adjusting is not need. At a supply voltage of +6 in the gain of such stage is 17-18dB; at +9V – +20dB; at 12V – +23-24dB. Due to deep feedback cascade works very stable, and the gain depends weakly on the type of the used transistors. In current scheme for RX - the n-p-n transistor **КТ368 (analog 2N3904)**. Transistors structure p-n-p operating in the transmission mode is **КТ326 (analog 2N3906)**. As can be seen from the diagram, all three stages are identical, with the exception of the cascade on the VT5 and VT6, in which there is no capacitor in the emitter circuit of the transistor VT5. This is done to reduce the gain in the transmit mode, allowing you to avoid overloading subsequent stages and the mixer.
- **“КП501”** transistor in the AGC system can be replaced by 2N7000.

- Diodes for mixers are "**КДС523**" (can be replaced by 1N4148).
- Broadband **transformers T1, T2 and T8** are wound on the coils 7x4x2. Three slightly twisted wires (2-3 twists per centimeter). Wire 0.16 mm. 15-18 turns.
- Transformer of balanced **modulator T7** must have sufficient inductance to signals of sound frequencies, so it must be wound on the coil 10x6x5. Three slightly twisted wires (2-3 twists per centimeter). Wire 0.16 mm. Turns to fill the coil. Special attention should be to the symmetry of windings of each transformer – it depends on balancing quality mixers.
- **Transformers T3-T6** are wound on the coil 7x4x2. Two twisted wires (2-3 twists per centimeter). Wire 0.16 mm. 15-18 turns included under-sequentially (beginning of one winding connects to the end of other, forming the average output – see the pictures below).
- **Coil L1** that is used to adjust the frequency of reference oscillator. Skeleton for winding 5-6mm with core and screen. Wire 0.1mm. 25 turns.
- **Relay K1-K2** compact РЭС49 (analog TR5V L-S-Z 12V).
- **VFO.** can be used any VFO or the frequency synthesizer operating at appropriate frequencies and forming the desired voltage of the output signal. You should not push to the mixer a voltage more than 1.2 — 1.5 V, because this will lead to an increase of the intrinsic noise of the system. However, if your VFO has enough power, in the first mixer can be set via the two series-connected diode in the shoulder. In this case, you can expect some increase in dynamic range (several decibels) in the receive mode, and you can also increase the level of the output signal in transmit mode — up to 200 — 250 mV instead of 100-150 mV with a mixer, which is equipped with one diode in each arm.
- **Microphone amplifier** assembled on transistors VT7 and VT8 and has two inputs for a dynamic microphone and an electret MKE-3.
- **The sensitivity** of a path to calculate:
    - the loss in BPF -6dB loss in the mixer -6 dB,
    - the gain of the IF amplifier - +20 dB,
    - the loss in the 1st quartz filter -6 dB,
    - the gain of the 2nd IF Amplifier +20 dB,
    - the loss in the 2nd quartz filter -4 dB,
    - the gain of the 3rd Amplifier +20 dB.
    - Totally, to the entrance of the detector (before the capacitor C11) the gain of the receiving path is +38 dB or 80 times the voltage. From the entrance of the detector the actual measured sensitivity (the ratio signal/noise 10 dB) is 10 μV. Thus, the maximum achievable sensitivity with the antenna input can reach of 0.125 μV. **This only the theory, but really – not worse than 0.35μV**.
- **The gain adjustment** for RF is best done on the basis of a smooth attenuator, which could be installed before BPF.
- The main tract can be supplemented Telegraph CW unit (see the diagram below).
- **Quartz Crystal Filters**: main 8x quartz filters and variable 4x quartz filter (0,7 – 2,7 kHz).
    - Quartz crystals 8,867238 MHz.
    - Squareness coefficient at the levels 6 and 60 dB ~ 1.6;
    - Attenuation over a bandwidth of more than 80 dB;
    - flatness in the passband is 1.5 - 2 dB;
    - bandwidth by level 6 dB – 2.4 ±0,15 KHz;
    - input and output impedance - 202±10 Ohms.

Varicap КВ127Б

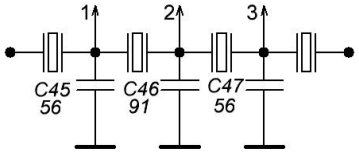


Quartz Crystal filters



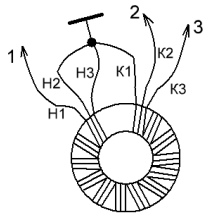
Quartz filter ZQ1

to elements of regulation of a band

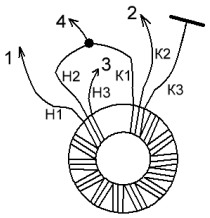


"Podchistochny" quartz filter

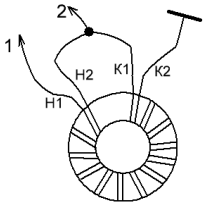
The illustration “how to make a coils T1-T8”



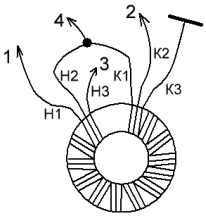
T1



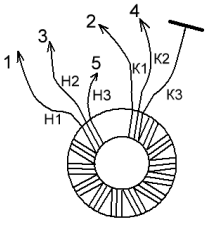
T2



T3-T4-T5-T6

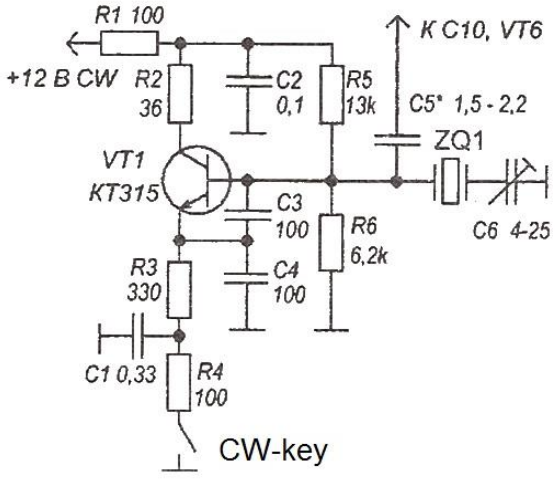


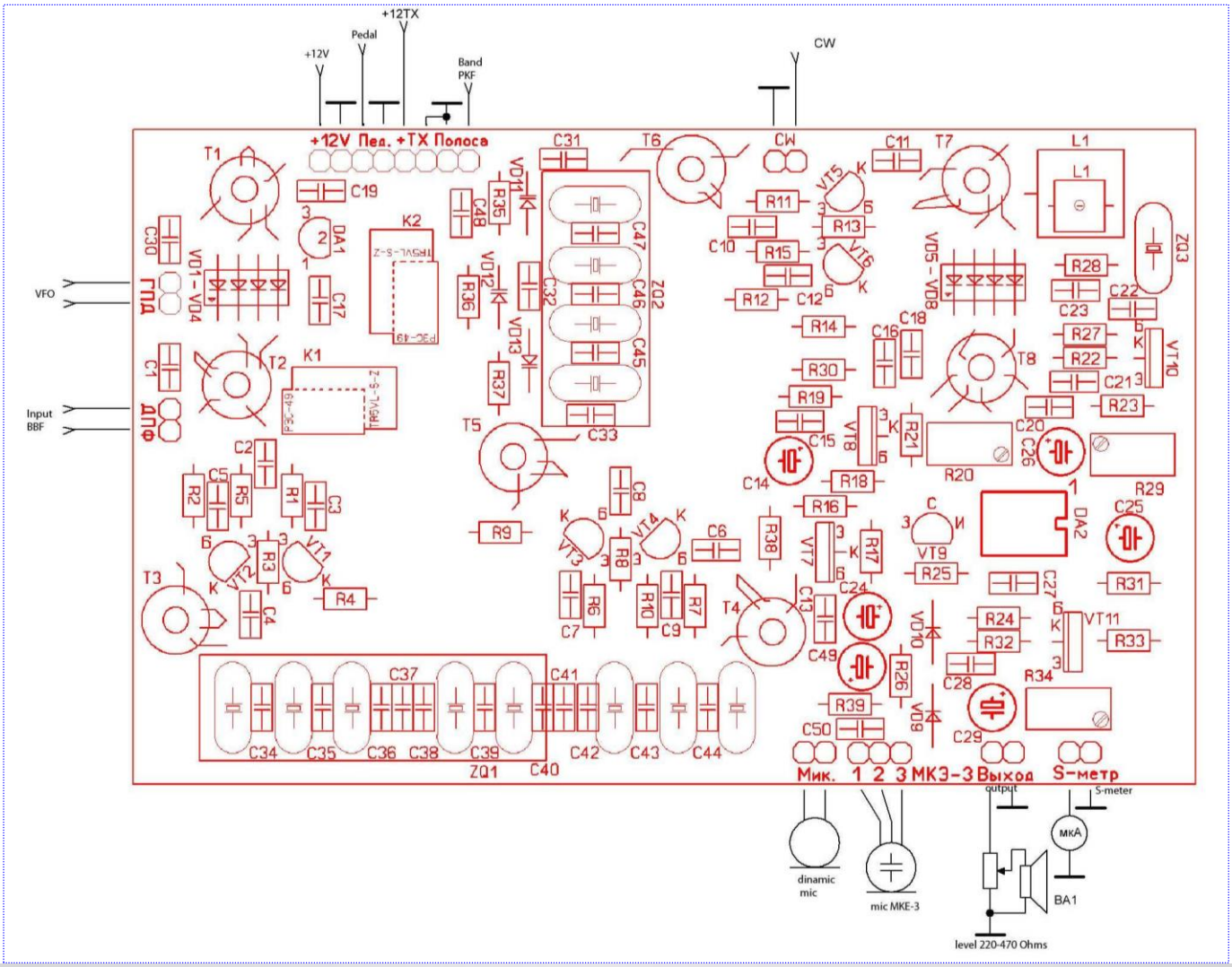
T7

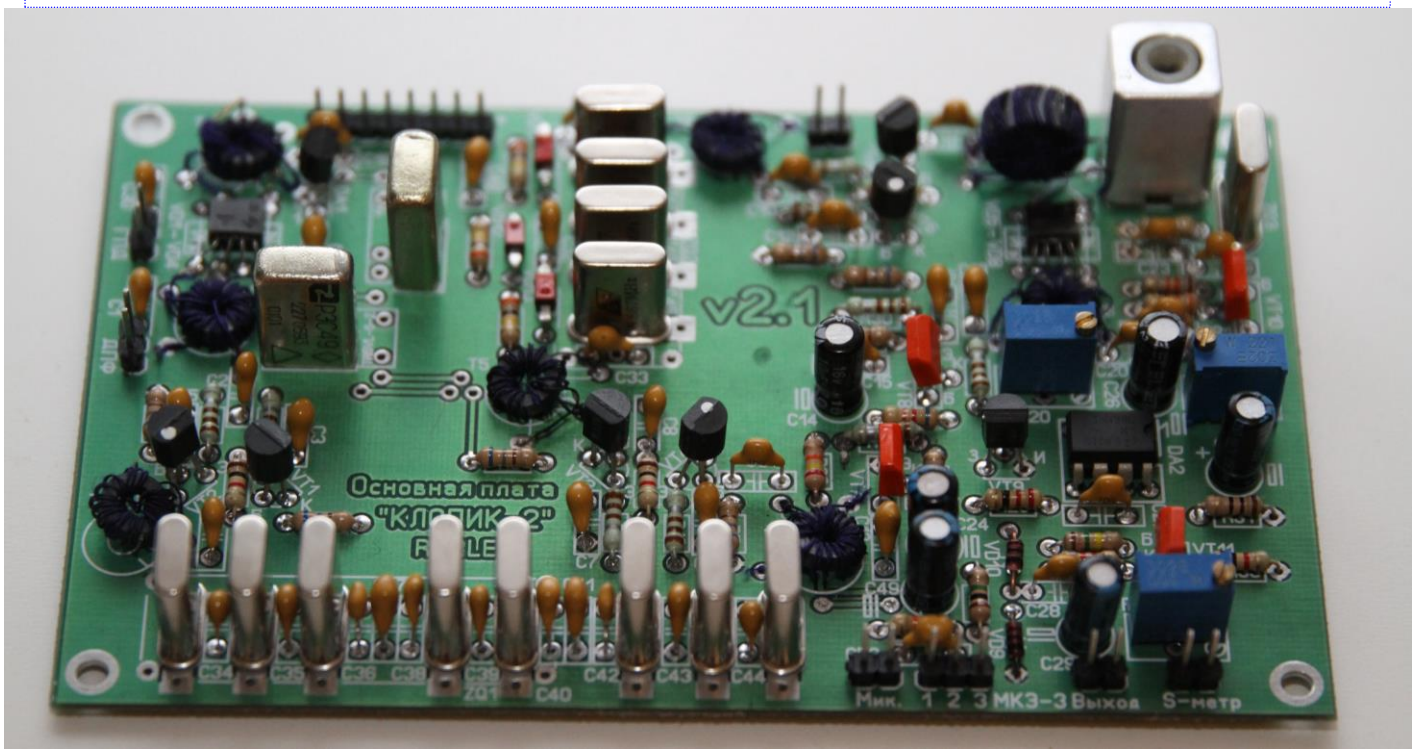


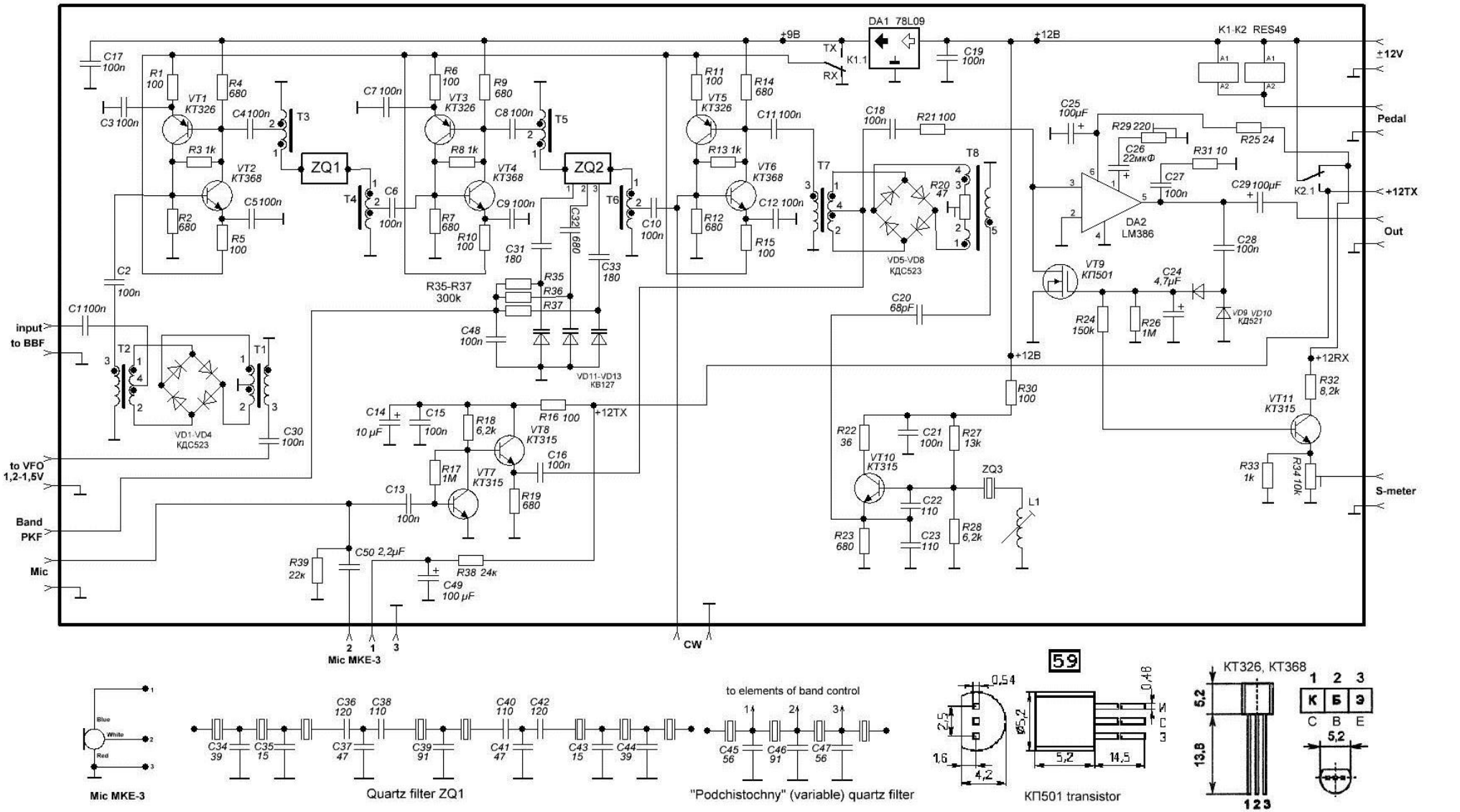
T8

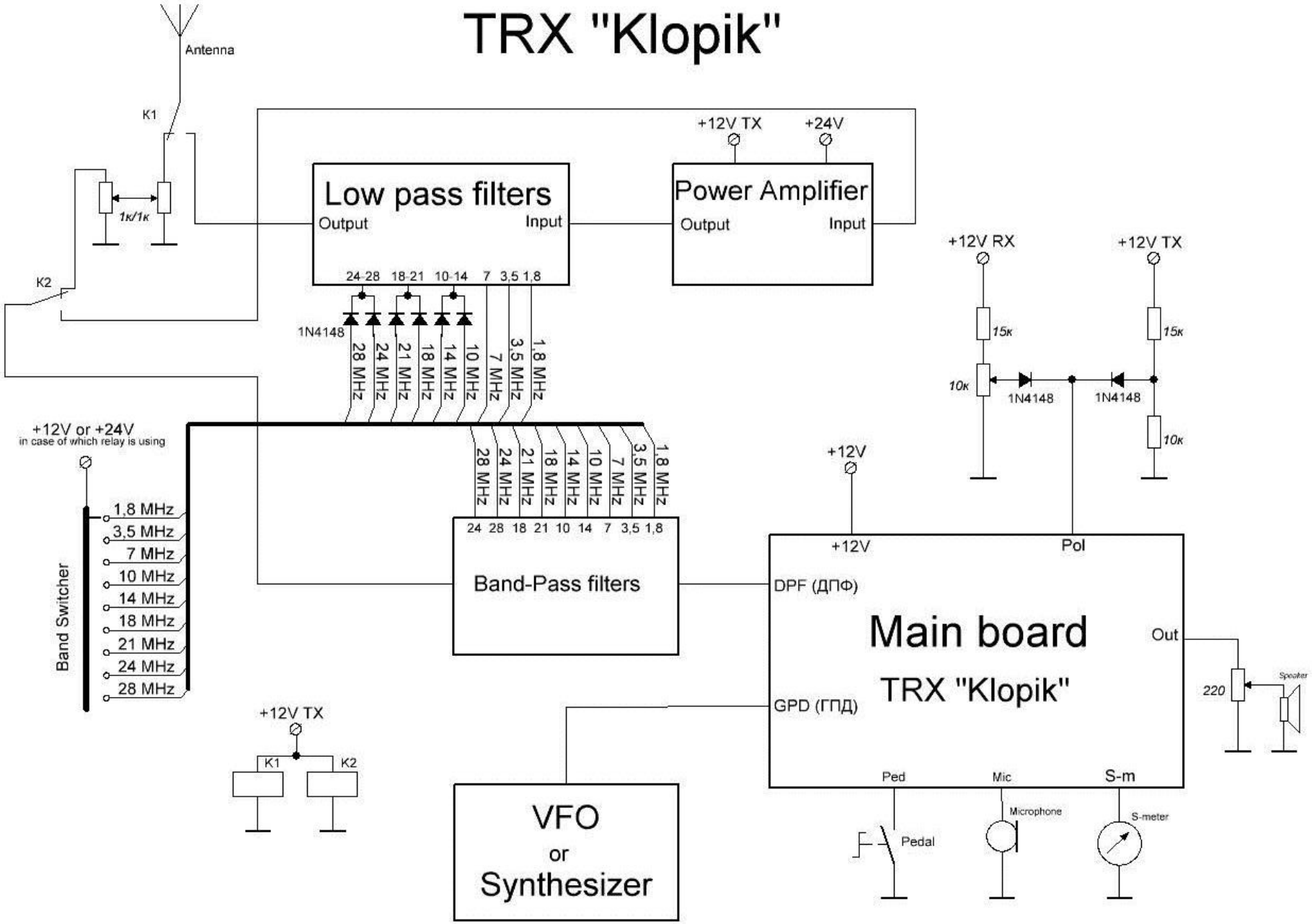
CW Key diagram




+12TX
Pedal
+12V
Band
PKF
CW
+12V Пед. +TX Полоса
VFO
ГПД
Input
BBF
ДПФ
Мик. 1 2 3 МКЭ-3 Выход S-метр
output
S-meter
dinamic
mic
mic MKE-3
BA1
level 220-470 Ohms


v2.1
Основная плата
"КЛОНИК-2"
Мик. 1 2 3 МКЭ-3 Выход S-метр


DA1 78L09
+9B
+12B
TX
RX
K1.1
K1-K2 RES49
±12V
Pedal
+12TX
Out
S-meter
K2.1
ZQ1
ZQ2
T1
T2
T3
T4
T5
T6
T7
T8
VT1 KT326
VT2 KT368
VT3 KT326
VT4 KT368
VT5 KT326
VT6 KT368
VT7 KT315
VT8 KT315
VT9 KП501
VT10 KT315
VT11 KT315
DA2 LM386
VD1-VD4 КДС523
VD5-VD8 КДС523
VD9 VD10 КД521
VD11-VD13 КВ127
R35-R37 300k
input to BBF
to VFO 1,2-1,5V
Band PKF
Mic
Mic MKE-3
CW
+12RX
+12TX
Blue
White
Red
Mic MKE-3
Quartz filter ZQ1
to elements of band control
"Podchistochny" (variable) quartz filter
59
КП501 transistor
KT326, KT368
К Б Э
C B E


TRX "Klopik"
Antenna
K1
1к/1к
K2
Low pass filters
Output
Input
+12V TX
+24V
Power Amplifier
Output
Input
24-28 18-21 10-14 7 3,5 1,8
1N4148
28 MHz
24 MHz
21 MHz
18 MHz
14 MHz
10 MHz
7 MHz
3,5 MHz
1,8 MHz
+12V RX
+12V TX
15к
10к
1N4148
1N4148
15к
10к
+12V or +24V
in case of which relay is using
Band Switcher
1,8 MHz
3,5 MHz
7 MHz
10 MHz
14 MHz
18 MHz
21 MHz
24 MHz
28 MHz
24 28 18 21 10 14 7 3,5 1,8
Band-Pass filters
+12V
+12V
Pol
DPF (ДПФ)
Main board
TRX "Klopik"
GPD (ГПД)
Out
220
Speaker
+12V TX
K1
K2
VFO
or
Synthesizer
Ped
Mic
S-m
Pedal
Microphone
S-meter

Examples of location the boards in TRX

9-band TRX with digital synthesizer Si5351 with LCD Nokia 5110

5-band TRX with analog VFO with LCD 16x2