Do-it-yourself manual

VHF Retro Radio

FRANZIS

Dear Customers,

This product was developed in compliance with the applicable European directives and therefore carries the CE mark. Its authorized use is described in the instructions enclosed with it. In the event of non-conforming use or modification of the product, you will be solely responsible for complying with the applicable regulations. You should therefore take care to assemble the circuits as described in the instructions. The product may only be passed on along with the instruction and this note.

Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

Translation and DTP: G&U Language & Publishing Services GmbH
Author: Burkhard Kainka
Art & Design Cover: www.ideehoch2.de

ISBN 978-3-645-65228-5

The VHF Retro Radio

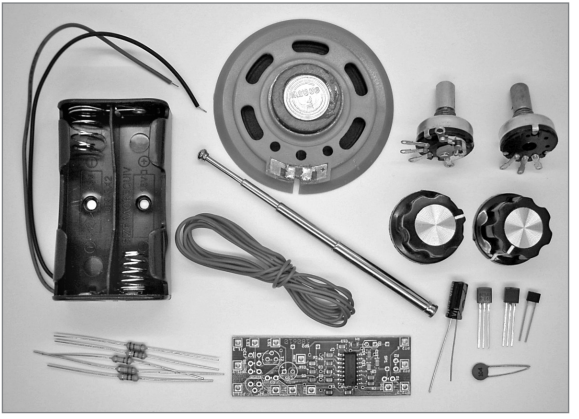
This modern VHF radio in vintage style receives FM stations in the 87.5 MHz to 108 MHz band with good reception performance. You will mainly hear the powerful local stations in high sound quality. However, the sensitivity of the receiver also allows you to listen to remote stations at times.

Large-scale introduction of VHF broadcasting began only after 1945. Initially there were still many radios that were able to receive only the AM ranges – long wave, medium wave and short wave. Many devices, however, could be upgraded with VHF retrofit kits. During the 1950s the tube superhet with VHF range became widely accepted.

This radio looks very much like a typical portable radio of the 1960s. The invention of the transistor allowed the construction of radios that consumed less power than valve receivers and therefore could be operated with batteries. Apart from this, they technically still resembled the older tube radios.

Thanks to the highly integrated receiver IC TDA7088 building your own VHF radio has become so easy that anybody will be successful in soldering this radio together. The single-ended low frequency amplifier functions pretty much like the historical tube radio. Your nostalgic radio works with a dual-stage transistor amplifier with medium volume at low battery voltage. Now you only need two 1.5-V alkaline batteries for up to 100 hours of radio reception. With your DIY-radio listening to the radio will become even more fun. Enjoy the diversity of the VHF stations.

Components



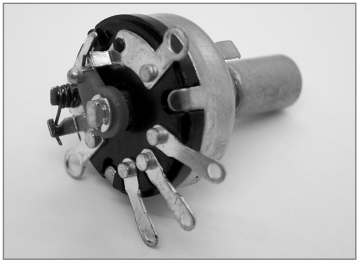
- pre-assembled PCB with TDA7088
- rod antenna
- speakers 8 Ω, 0.5 W
- volume control 22 kΩ with switch
- tuning control 22 kΩ
- insulated wire
- battery compartment with connection wires
- T1 PNP transistor BC557B
- T2 NPN transistor BC547B

- D1 varactor diode 1SV101
- R1 4.7 kΩ (yellow, violet, red)
- R2 220 kΩ (red, red, yellow)
- R3 1 kΩ (brown, black, red)
- R5 330 kΩ (orange, orange, yellow)
- R6 33 Ω (orange, orange, black)
- C15 electrolytic capacitor 100 µF
- C17 100 µF ceramic (104)

Assembly of the control elements

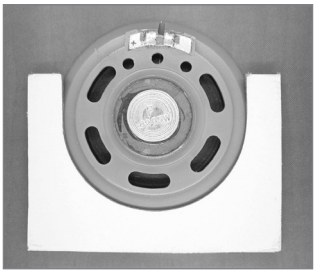
The radio has two rotary controls – one for frequency and one for volume. The three-port volume controller is equipped additionally with the two-port on/off switch. If you turn the axis all the way to the left, the switch opens. Insert the volume controller into the left mounting hole. A small tab secures correct insertion. Fix the controller with the ring nut and do not forget the washer.

The second potentiometer with 22 kΩ is used for frequency tuning and is mounted on the right. The connections of both potentiometers should face inwards so that the board can be installed between them later. Then screw both rotary knobs onto the axes so that the end stops are aligned with the printed scales.



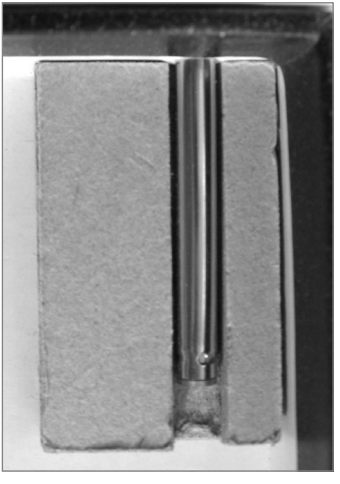
Volume control (potentiometer) with switch

Insert the speaker by pushing it into the corresponding slot. The connectors should face upwards to make sure that the connections to the board will be short. The speaker sits securely in its slot. You can, however, also add a drop of adhesive or hot glue.



Loudspeaker

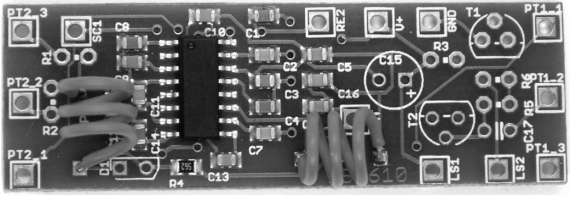
Screw the solder lug to the base of the telescopic antenna. Then slide the antenna from the inside through the housing opening and push the end into the flat holder which you have to secure correctly in the housing with the enclosed adhesive tape. Now the antenna is mounted sufficiently firmly but can still be fixed with some additional adhesive tape later.



The antenna

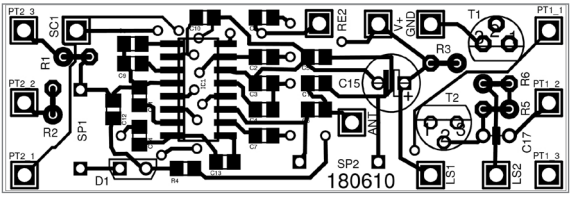
Soldering

The board contains a large number of SMD components (surface-mounted device, wireless components) already soldered on: the receiver IC TDA7088, 15 condensers and one resistor. You will only need to solder in some components with connecting wires. This includes all components of the AF amplifier, the coils and all components needed for the diode tuning of the radio.



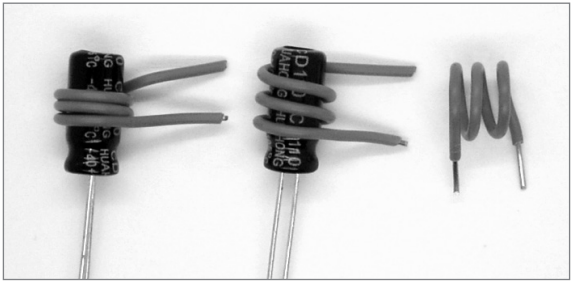
The SMD components

Now the PCB is to be assembled, please refer to the circuit diagram on the last page of the manual for orientation.

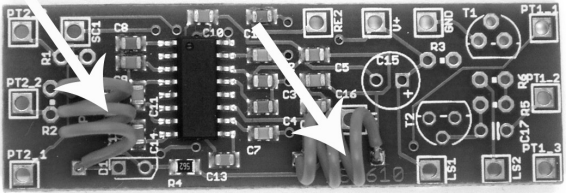


Components on the circuit board

Equip the PCB with the electronic components according to the layout diagram. First install the coils SP1 and SP2. Both coils have to be built of the included connecting wire. They each have three turns with an inner diameter of 5 mm and a length of approximately 7 mm. Use the electrolytic capacitor 100-µF as winding mandrel. First wind three turns closely adjacent to one another. Then pull the turns apart to reach a total length of approximately 7 mm. Absolute accuracy is not crucial here because the coil can still be slightly modified after installation. Remove the insulation from the wire ends. Only then pull off the coil from the winding mandrel. Now solder on the two wires at the bottom. Then cut off the protruding wires with sharp pliers approximately 2 mm above the circuit board.



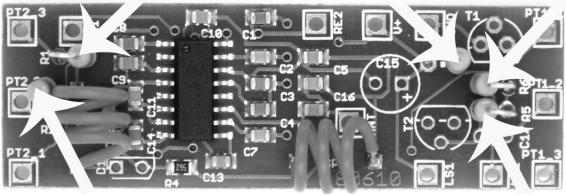
Winding the coils



Installation of the coils

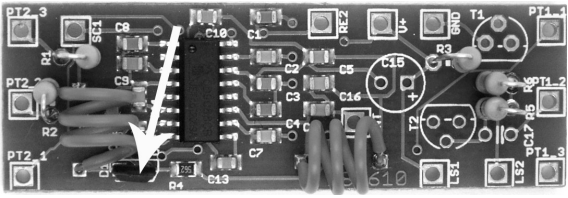
Insert the resistors R1 (4.7 kΩ, yellow, violet, red), R2 (220 kΩ, red, red, yellow) close to the connections to potentiometer PT2. The resistors R3 (1 kΩ, brown, black, red), R5 (330 kΩ, orange, orange, yellow) and R6 (33 Ω, orange, orange, black) belong to

the AF amplifier on the other side of the board. The resistor R4 (5.6 kΩ) is already soldered as an SMD component. Now bend the connecting wires so that they are suited for vertical assembly.



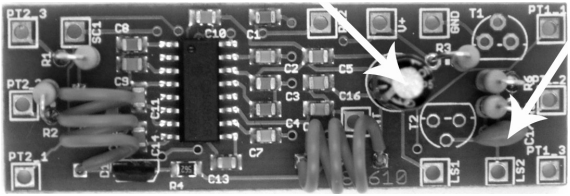
The resistors

Solder the D1 varactor diode (1SV101 in the flat transistor housing with two connections, imprint V101), following the direction shown on the PCB marking. The flat, printed side points towards the coil.



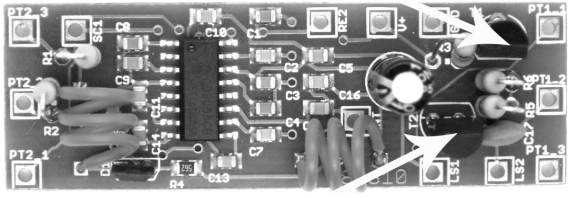
The D1 varactor diode

Now solder in the electrolytic capacitor C15 (100 µF). Observe the mounting direction. The positive terminal is marked on the board. The negative terminal – which is marked with a white line – points towards the IC. Afterwards install the ceramic disk capacitor C17 with 100 nF (print 104). The mounting direction is not important.



The capacitors

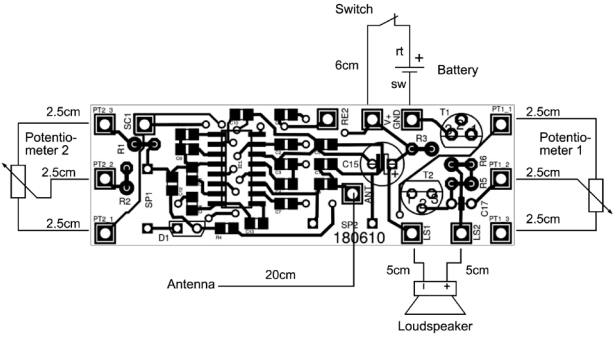
Finally you have to build in the transistors. Take care not to mix the types up. T1 is a PNP transistor BC557B, and T2 is an NPN transistor BC547B.



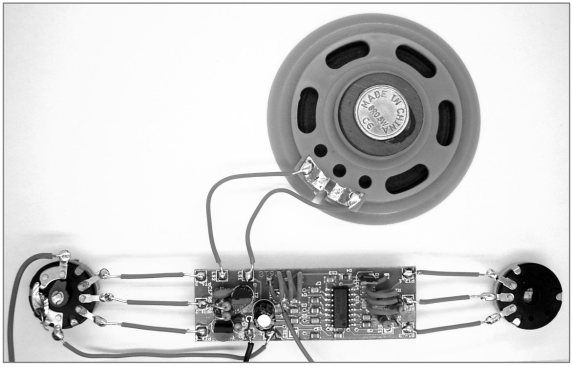
The fully equipped PCB

Next, solder on the appropriate wire pieces to the two potentiometers. For length refer to the wiring diagram. Now you can either pass the wire ends through the holes and solder them like the other components or, alternatively, you can solder them flat on the solder pad. The PCB has to be mounted in a suspended position between the two potentiometers; it is held in place by six wires. In addition, there is one wire leading to the switch of the volume potentiometer, while two more wires go to the speaker. The black wire of the battery compartment has to be connected to the GND connection. The red connector goes to the volume control switch. The remaining wire is to be soldered to the antenna connection. If this connecting wire is longer than is necessary it can still be used to increase the effective length of the antenna and thus contribute to a good reception.

Now the radio is fully assembled and waits to be tested. Sign off the assembly with your name and date in the wiring diagram on the last page of your instruction manual. Then you should copy or tear out the page and glue it into the radio case. In this way you will be able to understand everything even after years and carry out repairs if necessary. This is also the case with old radios: You can repair them even after many years because you will always find the wiring diagram inside.



The wiring diagram



The complete wiring

Initial testing and settings

Insert two 1.5V mignon alkaline batteries. Turn on the radio and set the volume control to maximum. Turn the frequency knob, and you will quickly find a station coming loud and clear from the speaker.

Now you have to adjust the frequency. Use a radio at hand for comparison. The station at the very bottom of the FM frequency range should appear at the left stop. You can shift the reception range by modifying the SP1 coil. Push the turns tighter together to receive lower frequencies. If there is still a large empty area at the left to the bottommost station, pull the turns apart a little again. For fine-tuning insert a screwdriver between two turns to slightly bend them apart.

Once the lower band edge is adjusted correctly, you can also adjust the upper 108 MHz edge. However, the frequency is dependent on the battery voltage. If you realise during operation that you cannot adjust the topmost station any more, just replace the batteries.

Reception practice

When fine-tuning a station, the receiver's AFC (Automatic Frequency Control) will lock on to the exact frequency. Then the station can be heard in a certain range of the frequency controller. Position the controller as exact as possible in the middle of this range. If battery voltage drops sharply during operation, the frequency may change and you will have to re-tune into the radio station. Depending on the modulation of the transmitter there may be sound distortions due to over-modulation of the power amplifier. If this happens, turn down the volume control a little. With its moderate volume level the FM retro radio is ideally suited for a relaxed listening experience in the evening.

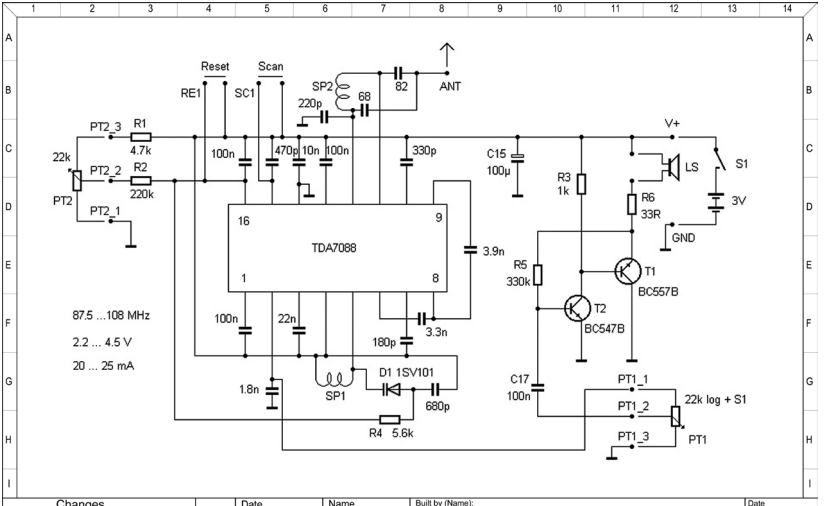
If you extend the telescopic antenna to its full length, the radio can receive every strong local station. Connecting a longer antenna wire will allow you to receive also weaker stations (for instance the local stations of the neighbouring towns). To achieve an even more powerful reception performance you can connect a second, additional antenna wire to the GND connection. Thus you will have a dipole antenna. The optimum length is 75 cm per wire. You can improve the reception of a weak station by carefully aligning both wires.

Explanations on the wiring diagram

Most VHF superhet receivers use an intermediate frequency of 10.7 MHz. The receiving frequency is first converted to the intermediate frequency and then filtered, amplified and demodulated. The VHF retro radio is a superhet, too, which converts the received signal to an intermediate frequency. But its intermediate frequency is much lower, at 70 kHz. For this reason the intermediate frequency filters are able to function without balanced coils. The FM demodulator becomes simpler and better protected against distortion. All essential stages fit into a single SMD-IC, the TDA7088 with 16 pins. Instead of a variable capacitor, as used in older receivers, the radio works with the D1 varactor diode. The higher the voltage at the diode, the lower is its capacity and the higher the receiving frequency. The only balance point is the L1 coil which can be used to adjust the lower edge of the oscillator frequency.

The low frequency power amplifier is a simple class-A amplifier with the two T1 and T2 transistors. The quiescent current is approximately 20 mA. The circuit will deliver a good sound quality at an operating voltage as of 2.2V.

The board is designed in a way that its components are all assembled in SMD technique around the actual TDA7088 receiver. That makes construction easy. You can exchange some of the wired components you have soldered yourself to modify certain properties of the radio. R1 defines the tunable frequency range. A smaller resistor will enlarge the tuning range. This makes sense, for instance, if you want to operate the radio with NiMH batteries at 2.4V. R2 determines the width of the AFC catch range. If you want, for instance, to receive weak stations in the vicinity of stronger stations it may be useful to decrease R2 down to 100 kΩ or less to get a smaller capture range. The two RE1 and SC1 connections on the board remain initially free. They are intended for subsequent extensions. The TDA7088 was originally designed for button tuning. You can find the reset and scan buttons in the wiring diagram. If you want to adapt the receiver accordingly, you have to separate the PT2_2 connection to the slider of the frequency control. You can also insert a switch here so the receiver can be tuned optionally with the buttons or the potentiometer.



Changes			Date	Name	Built by (Name):	Date
Date	Name	signed:				
		appr.:			Tested by (Name):	Date