

## The Retro-Radio

This radio is a direct conversion receiver for the US AM band. The transmitted bandwidth is limited to the usual amplitude modulation at 4.5 kHz on medium wave and therefore achieves no FM quality. But it has, especially in the evening and at night, a much greater range and can receive stations from all over America.



Medium-wave transmitters were at the beginning of the history of broadcasting. Therefore, historical radios are also still in operation, and this radio could receive the stations of the time. The technique is similar to that of the first radio receiver. This is a direct conversion receiver with no intermediate frequency as opposed to later conventional superheterodyne receivers. A typical radio from great-grandfather's time had two tubes: one tube for the receiver and one for the amplifier. This radio has correspondingly two semiconductors. The single-ended audio amplifier is similar in function exactly the tube output stage. The improvement is in the much lower energy requirements: all that is needed is a single 1.5 volt cell for up to 200 hours of receipt.

To the historical model had to be a long wire antenna connected and operate an additional feedback control to optimal to achieve catch.



At the end of the day we heard the radio speakers say: "Please do not forget to ground your antenna!" This was an important protection against lightning. This radio has a modern ferrite rod antenna.

The first radios were not as loud as today's devices. Also, your radio uses a single stage audio amplifier with medium volume at low battery voltage.

Take your time and rest for a trip to as in olden times. This radio silence needs to be stressed and all your senses. Enjoy the variety of stations, especially in the evening. Listen to according to the most distant stations, adjust the frequencies, razor-sharp, with the Pointer tool.

More Retro Radio on the Internet: [www.franzis.de/elo-das-maga-zin](http://www.franzis.de/elo-das-maga-zin) is a website for interested hobbyists. This online magazine has a theme page on nostalgia radio. If you encounter any problems or carry out further experiments with this radio, visits us on the web.

## Components

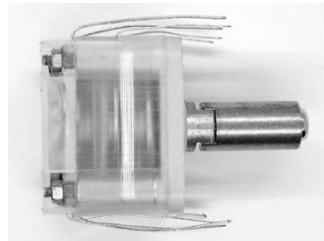
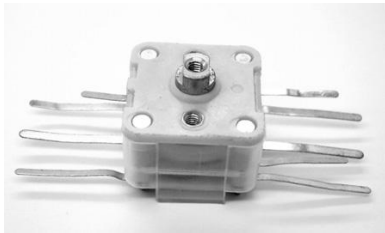


- rotary capacitor 265 pF
- Ferrite
- coil with 80 turns and 20 turns to tap
- speaker 32, 0.5 W
- moving-coil meter 0.5mA
- Volume control with switch 10k
- Board
- 0.6 m wire stranded
- Battery compartment with connecting wires 15 cm
- IC1 medium wave straight receiver TA7642

- T1 NPN transistor BC547B
- R1 100 (brown, black, brown)
- R2 680 (blue, gray, brown)
- R3 100 (brown, black, brown)
- R4 100 k (brown, black, yellow)
- R5 33 (orange, orange, black)
- C1 100 nF ceramic (104)
- C2 47 uF electrolytic capacitor
- C3 100 nF ceramic (104)
- C4 100 nF ceramic (104)
- C5 100 nF ceramic (104)
- C6 1000 uF electrolytic capacitor

### Installation of controls

The variable capacitor is used to set the desired frequency. Attach the extension shaft to the variable capacitor (tuning cap), and secure it with the long 2.5-mm screw. Use pliers to hold the shaft to avoid turning the capacitor against the stop. The variable capacitor is later mounted with two small screws and matching washers into the case.



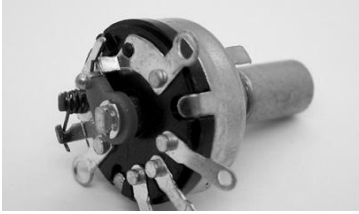
The variable capacitor

Attach the speaker, by sliding it into the appropriate slot in the case. The connections should point downward, so that later result in short connections to the board. The speaker sits firmly enough in the slot provided. However, you can use a drop of glue or hot glue to fix it further.



Speakers

The volume control has three connections and a two-port power switch. If the axle is completely turned to the left, the switch opens. Set the volume control in the left mounting hole. A small tab prevents twisted insertion. Attach the control with the nut and do not forget the washer.



The volume control (potentiometer) with switch

Finally put the meter in the designated circle opening. Usually it holds without any further aid, if necessary you can use two drops of glue on the flat side.



The measuring system

## Soldering

To build the radio eight wires are needed. Cut the wire lengths as follows:

- 1 wire at 11 cm      All these lengths are 1 cm longer than the original instructions.
- 3 wires at 9 cm      The original lengths were a little short for several connections.
- 4 wires at 6 cm

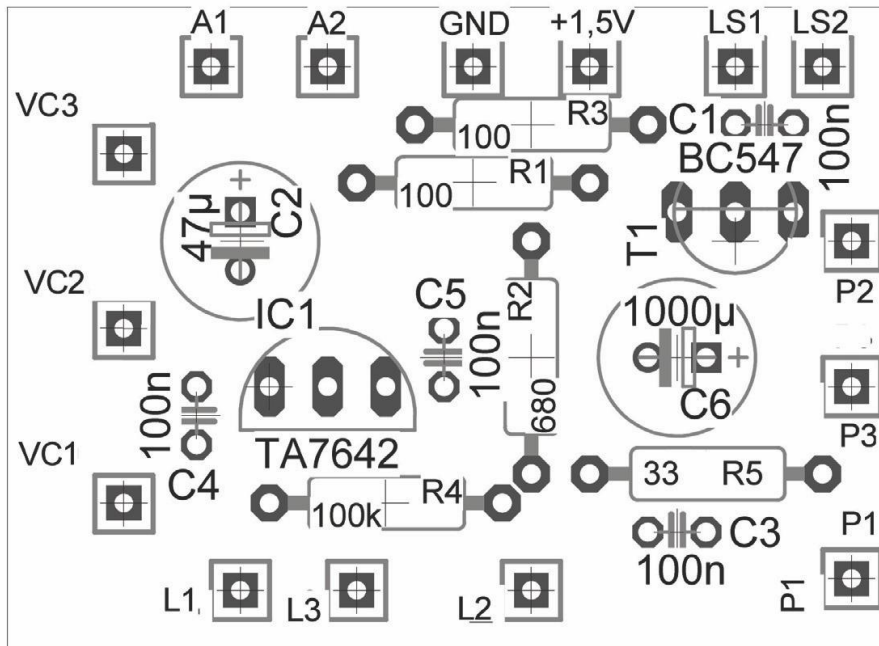
Remove 5mm of insulation at the end of a length of wire. The plastic insulation is relatively soft and can be removed with fingernails with some force. Twist the fine wires with your fingers. Tin the stripped cable ends carefully so the delicate strands do not fray. Hold the hot tip of the soldering iron simultaneously with the solder to the leads. The solder must flow around the wire completely.



Prepared wires

If you have little experience with soldering, tinning the wire ends is a good exercise where you can not do much wrong.

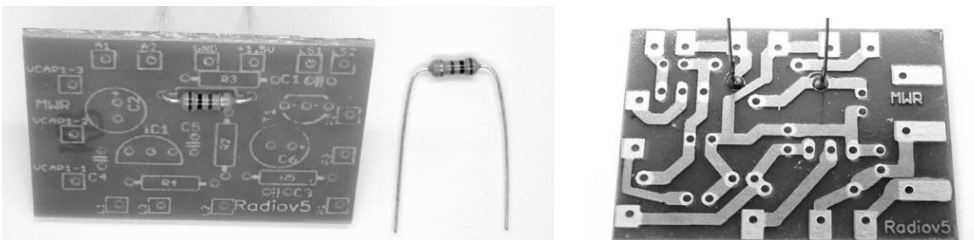
Now the board is ready for soldering together. The circuit diagram of the complete radio is on the last page of the manual for guidance.



### Components on the board

Populate the board with the electronic components in accordance with the assembly plan. Start with the resistors R1 (100, brown, black, brown), R2 (680, blue, gray, brown), R3 (100, brown, black, brown), R4 (100 k, brown, black, yellow) and R5 (33, orange, orange, black). Bend the wires to fit, and plug them into the holes of the board. Bend the leads slightly to hold the resistors in position. Solder the two wires on the underside of. Then cut off the protruding wire with a sharp wire cutter about 2 mm over the board.

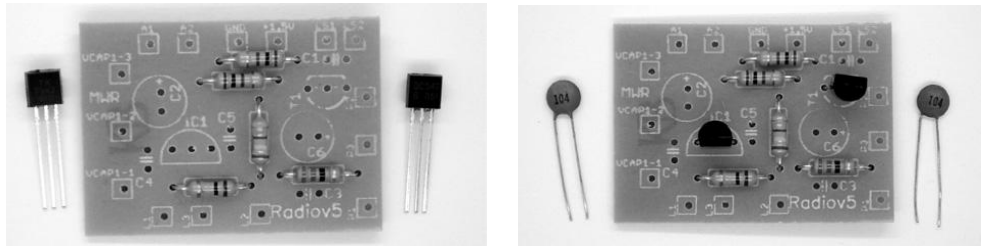
Note: Do not cut the wires too close to the board, because this may cause mechanical stress, which can damage the copper traces.



### Solder a resistor

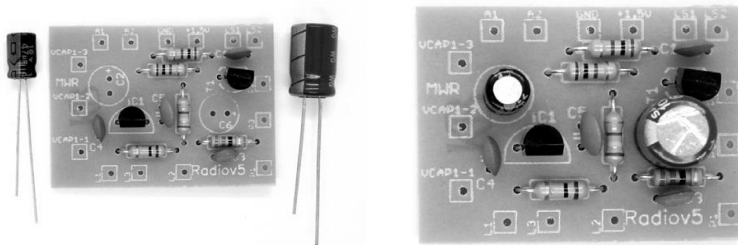
After all the resistors are soldered, insert the two semiconductors. Caution: Both are the same package type with three connections, but should not be confused. IC1 is the package with the lettering TA7642 and, the transistor gate T1 is BC547B. Be sure to position the flat side of the case. The insertion direction is indicated by the label of the

board. Let both semiconductors stand off the board by a few mm. Bend the leads slightly. Solder both semiconductors to the board.



IC1, T1 and capacitors used

Now insert and solder the ceramic disc capacitors C1, C3, C4 and C5. All four are the same types of 100 nF (104). Next, insert the electrolytic capacitors C2 (47 uF) and C6 (1.000 uF). Be sure to observe the installation direction. On the board the positive terminal is marked. This is the long wire. The negative terminal is the short wire and is also indicated by a white bar on the plastic insulation.

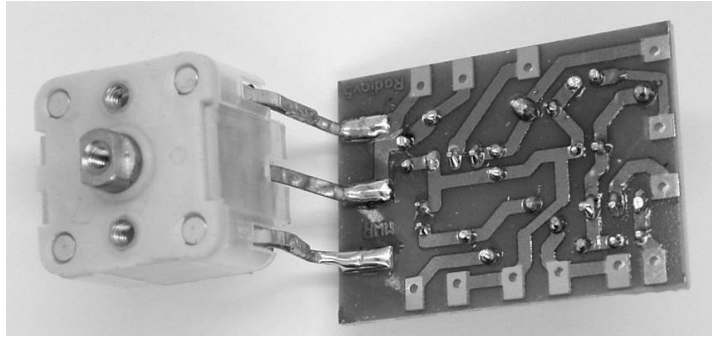
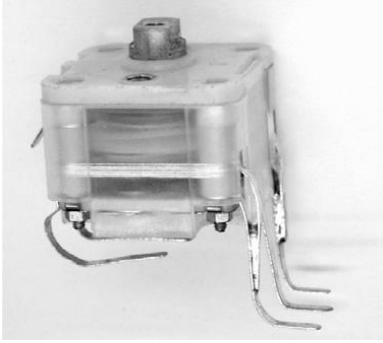


Electrolytic capacitors use - the completely assembled board.

Now look over the variable capacitor. There are more connections than are needed for this project. The extra connections can be used for additional experiments described in ELO – The magazine. Look carefully at the pictures below. Bend the flat conductors into the shape shown. Then solder the two conductors on each side together. The bent ends of the flat conductors will be soldered to the circuit board in three places. The variable capacitor also forms the mechanical support for the board. The board must be about 2.5 cm from the front panel to ensure separation from the ferrite antenna and good performance, so be sure to bend the leads correctly.

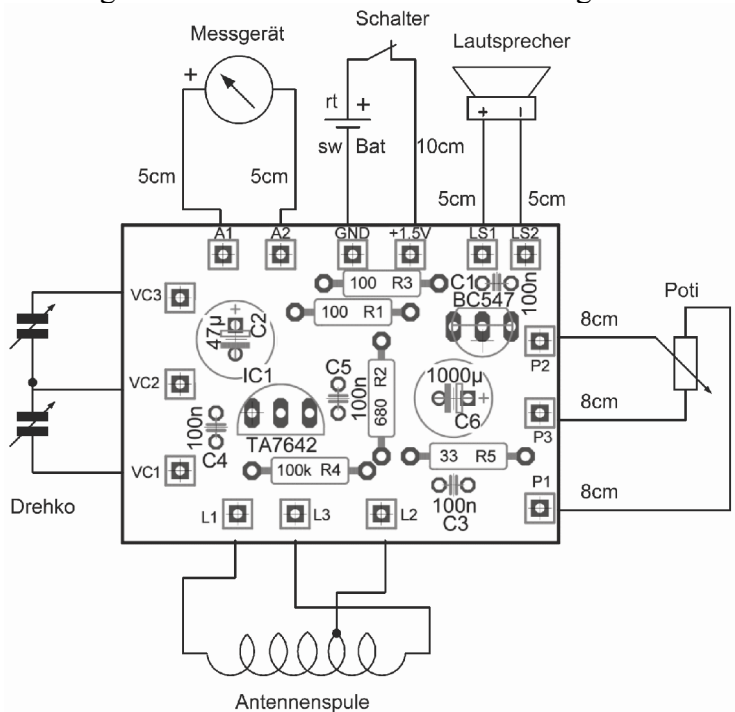
Once you are sure of the orientation, solder the variable capacitor to the board.

Additional information: On the capacitor cover are the labels C1, C2, C3, C4. The segments C1 and C2 each have 265 pF, but only C2 is actually used. The central connections are electrically continuous with the axis and form the mating connection to all parts of the capacitor. In addition, there are trimmer capacitors above C1 and C2.



### The variable capacitor and its connection to the board

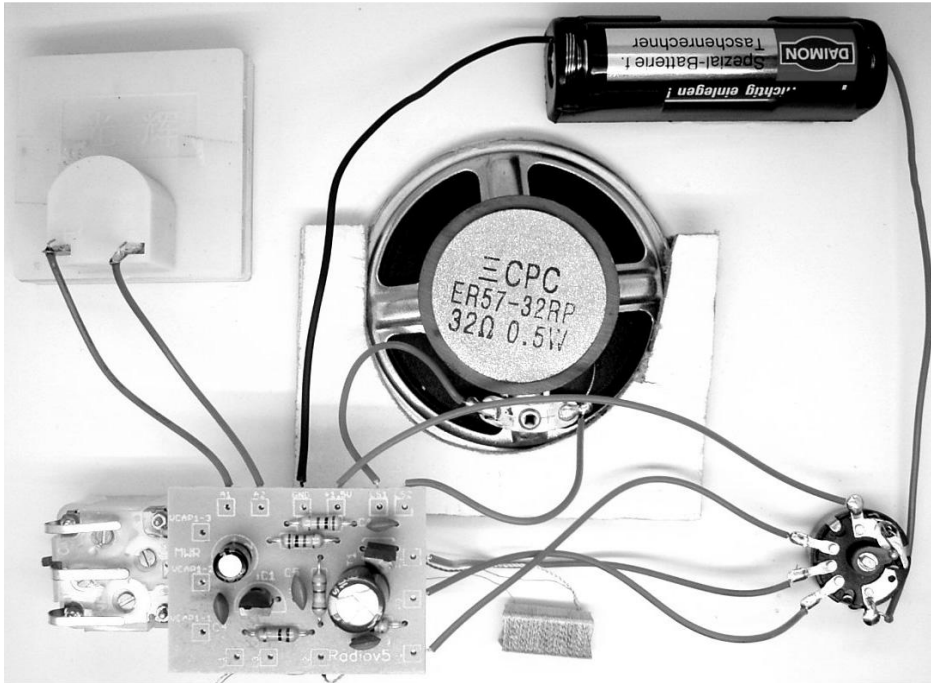
Insert and solder the eight wires previously cut and tinned into the terminal pads on the board. The lengths shown in the diagram below are 1 cm shorter than the wires you prepared. The wires can be inserted from either side of the board, but the bottom is neater. Connect and solder the black wire from the battery holder to the GND pad on the board. Remove the ferrite rod from the antenna coil. Paying special attention to the orientation of the coil, insert and solder the three wires from the coil to the board terminals (note the position of the coil tap and which end the tap is nearer). Take care in handling the antenna coil as the wires are fragile.



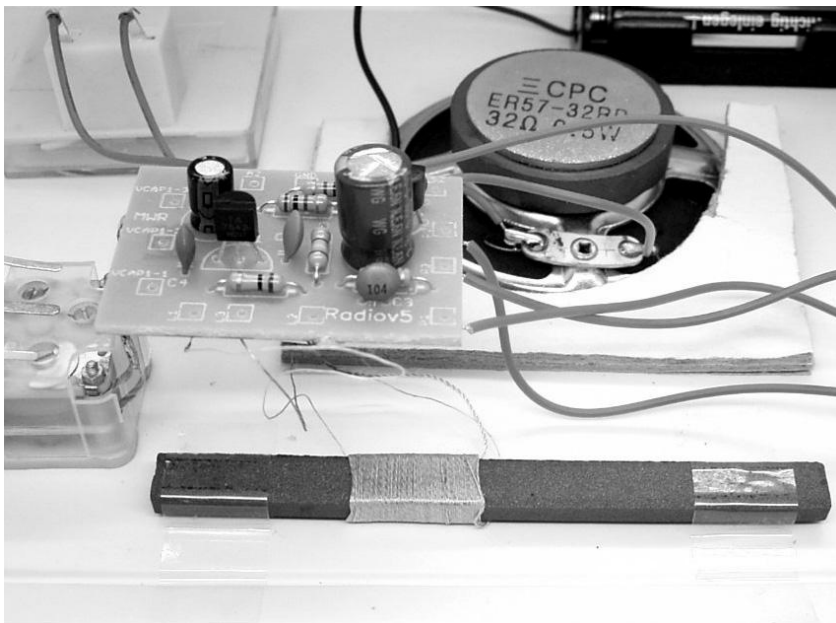
### The wiring diagram

Attach the variable capacitor to the front panel. Use the sub-washers on the 2.5-mm screws. Do not over tighten the screws or they may extend too deeply into the variable capacitor where they may touch the plates.

Refer to the pictures below for the wiring layout. Connect and solder the wires from the board to the meter, speaker, volume control and battery as shown. Look carefully at the routing of the wires from the board to the volume control.



The complete wiring



Attachment of the ferrite rod

Slide the ferrite rod in the receiver coil and secure it with some adhesive tape or hot glue



to the front panel. The orientation is important for proper function of the radio. The extended (longer) coil section is positioned in the direction of variable capacitor. If later a loud whistling (feedback) occurs, the coil was probably installed the wrong way. This may cause an inductive coupling between the board and receiving coil.

Now the radio has been completed and only needs testing. Write your name and the date on the schematic on the last page of the instruction booklet. Attach a copy of the schematic inside the radio case. This way you can follow the development even after years and perform any repairs. This was done even with the old tube radios. Even after many years a repair is possible because the circuit is always related to the radio.

### **The first test**

The radio requires a single 1.5V AA-size alkaline cell. One AA battery with only 1.2 V is not suitable because with the reduced voltage a reduced receiving performance is achieved. Insert a new 1.5-V battery. Turn on the radio and turn up the volume full on. Turning the frequency knob, you will quickly find a station that is heard loud and clear from the speaker. By day you are likely to receive only stations in the vicinity. So look for your local station. About two hours after sunset, the radio is really "perky". You can then receive numerous remote stations.

Set the lowest frequency (tuning capacitor to the left), on the pre-receive channel is not clear. The pointer of the meter now has between 8 and 10. This is an indication that the Battery in order.

Now turn the volume knob to the left (soft). This also decreases the pointer deflection. The meter shows the power of the loudspeaker amplifier. You can see that the current consumption drops when you turn down the radio volume.

### **Receiving practice**

Tune in a station. The deflection of the meter pointer goes down and gives an indication of the precise frequency setting. The meter thus also serves the function of a tuning indicator, which in old tube radios was often implemented with a display tube. If a station is very strong, it can lead to overload on the radio. You will hear clear distortion. In this case, you have to turn the volume back a little and possibly tune to another station until the sound is clear.

### **The scale calibrate**

A frequency scale is printed on the radio. To ensure the tuning is accurate, you may need to make some adjustments. You will need two radio stations with a known frequency on the lower and upper edge of the range or a second radio to compare.

First adjust the upper station. Then adjust the trim capacitor C2 that is above the variable capacitor with a screwdriver until the transmitter is at the correct place of the scale. Next, set a channel in the lower range. Now move the antenna coil on the ferrite rod out of the

center position until the station is at the correct place on the frequency scale .Repeat these two adjustments until both the upper and lower frequency stations are at the correct position on the scale.

#### Directions are aiming

The ferrite antenna of the radio is sensitive to the direction. The largest signal strength is received when it is perpendicular to the direction of reception. Conversely, you can determine the direction of the transmitter very accurate when you turn the radio until the station almost completely disappears. This method can also be used when a very strong transmitter overpowers a weaker station on an adjacent frequency. Sometimes you can hear a weak station better if you turn the radio appropriately.

#### Remote reception

Watch even the medium wave band in the evening. About two hours after sunset, the reception is always better. You will hear numerous rich stations from all over America. Often you have a choice between 30 stations or more. Sometimes, the frequencies of the stations are close to each other. Make sure to use the deflection of the pointer on the meter to get as close to the frequency of a station as possible.

At the reception on medium wave, there is still much more to discover. Further attempts, tips and tricks, and enhancements can be found in ELO - The magazine described here: ([www.franzis.de / elo-the-magazine](http://www.franzis.de/elo-the-magazine)).

#### **Notes on the diagram**

The high-frequency element in the historical model consisted of a tuned circuit and the audio tube. This radio also uses a resonant circuit comprising coil and capacitor. But the small integrated receiving circuit with three ports in fact contains several transistors with a large gain. Therefore, no wire antenna needs to be connected, because the ferrite is also sufficient for long-distance reception.

The electric circuit of a ferrite core coil and variable capacitor is also the beginning of aerial recommendations. The RF signal is coupled to a tap of the coil and the input of the receiver IC (pin 1) is supplied. At the output (Pin 3) are both the de-modulated low-frequency signal and a control voltage for the automatic locking gain control. The voltage drop of 1.2 V with no signal to below 1 V at high signal strength. The control voltage is fed back through R4 to the input and be-influences the gain of the receiver. In this way, strong and weak stations seem almost identical.

The control voltage between about 1 and 1.2 V T1 passes through the volume control on the base of the transistor amplifier. The operating point of about 20 mA is thus largely independent of the battery voltage and scattering of the current gain of the transistor changes, but the reception field strength. The meter shows the emitter voltage, and thus also the emitter current of T1. The current is, if you set a small volume, reduced to about 5 mA, because then reduced base resistance, an additional 10 k to the base current. The tool shows all the changes of the emitter current and thus also the condition of the

battery, the volume level and the signal strength of a selected station.

The circuit is very economical and requires only a battery of 1.5 V. An Alka-Lizelle with a typical capacity of 2,000 mAh at a high enough volume for 100 Hours of operation. At reduced power, the battery lasts far longer.

## Imprint

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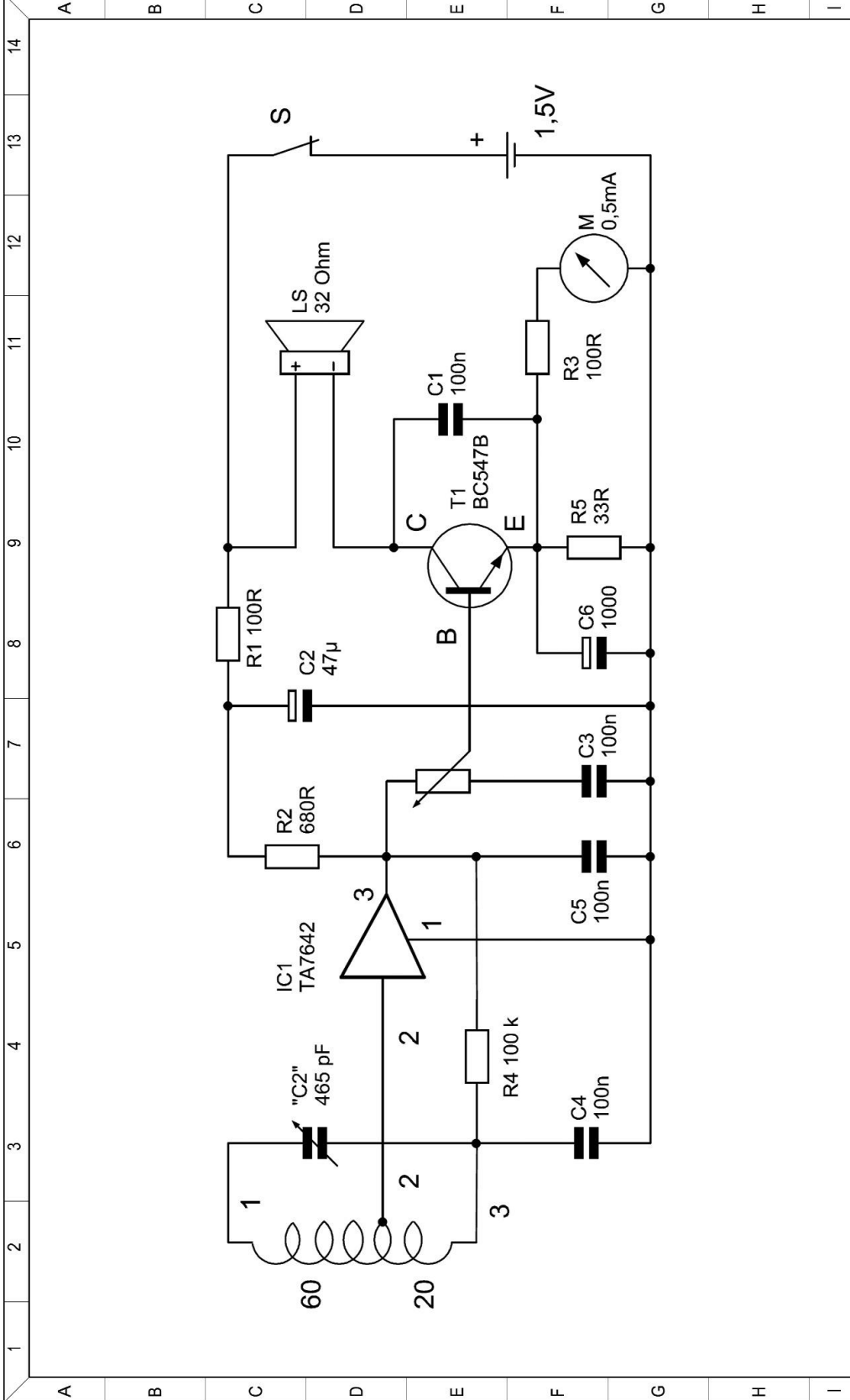
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