# Adding Bluetooth to a Vintage Radio



## By Ray Heffer

## The Radio Workshop

www.radio-workshop.co.uk

# Introduction

There's some controversy about fitting Bluetooth technology to vintage radios. This is understandable because of a popular misconception… the insides of a lovely old radio have to be ripped out in order to add Bluetooth. This is a myth, it's fake news… there is no need to destroy a vintage radio in order to add Bluetooth circuitry.

There's usually plenty of room inside the cabinet to house the Bluetooth electronics. The beauty of this is that the Bluetooth addition can be removed easily and at any time, returning the radio to its original state. I fit Bluetooth technology to vintage radios, but I don't destroy vintage radios in the process.

I believe that a vintage radio should look like a vintage radio and sound like a vintage radio. When adding Bluetooth technology, I aim to retain authenticity. In order to achieve this, I use the radio's original loud speaker and a mono amplifier. I don't fit a stereo amplifier with two speakers because, firstly, early radios were mono and, secondly, there is no room for a second speaker. Fixing a second speaker to the back panel of a radio will not produce proper stereo sound, especially if the back of the radio is against a wall.

I won't make a hole in the back panel and fit a cheap Bluetooth module. The appearance of the back panel is as important as the front of the radio. When looking at the radio, from any angle, it should appear original. Apart from the USB lead.

# Adding Bluetooth to a Vintage Radio
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Most vintage radios can be restored. However, a few have decent wood or Bakelite cabinets but the insides are too far gone. With the passing of time, many vintage valve radios have suffered from rust and corrosion. They may have been robbed for spare parts, or perhaps they are just beyond restoration. What are the options? Use your radio as an extension loud speaker? Keep your radio as an ornament? Dump your radio… No, don't dump it! There is another option. Give your radio a new lease of life by adding Bluetooth technology.

Bluetooth is a method of sending and receiving data wirelessly over short distances. We are all aware of the mass of cables found behind computers. A Bluetooth keyboard and mouse reduces the need for some wiring, but what about audio? Plugging a lead into your iPhone to play music through an external amplifier is restricting and messy. Bluetooth to the rescue! Transmit your audio wirelessly over Bluetooth to a special speaker and, success! No wires!

When adding Bluetooth to a vintage radio, a rather nice touch is to illuminate the radio dial to show the original station names. This can be done with warm white LEDs. The dial light also indicates that the unit is powered on. It's also nice to utilise the original volume control knob to adjust the Bluetooth volume and switch the unit on or off. I prefer to retain not only the original sound of the radio, by utilising the original speaker, but the appearance.

Throughout this article, I'm assuming that you have at least some knowledge of the basics, such as soldering and competent use of small tools. All the parts I've used in the article are available from eBay. There is a parts list on the last page. Just be aware that some parts may vary as items become unavailable and are replaced by similar parts. If you use a different type of Bluetooth board, the principal is the same: power in to the board and audio out. Just bear in mind that the connections and layout might be different. The same applies to the amplifier: power in, audio in and speaker out. If you are using different parts, beware of the voltage. All the items I describe here run from 5 volts. If you use 12 volt parts, for example, you will have to use a different power supply. See suggestions at the end of this article.

The reason for using separate Bluetooth and amplifier boards is to facilitate the use of a volume control. Bluetooth boards with built in audio amplifiers do not have connections for an outboard volume control. You will need to have an outboard volume control to replace the one in the radio. You can then use the original volume control knob. Also, most of these boards are stereo, which isn't suitable for a vintage radio.

The first thing to do is familiarise yourself with the various parts. So, let's get started!

## The Power Supply

The Bluetooth board, the audio amplifier and LEDs, if fitted, are powered by a standard 5 Volt iPhone charger type power supply, as shown here. These are easily obtainable and most people own at least one or two already. As with any charger or power supply, switch it off at the mains when not in use. If you use other parts, 12 volt parts for example, you will have to use a different power supply. See suggestions at the end of this article.

## The Power Lead

I use an iPhone charging lead around two metres in length, this is usually long enough to go from the radio to the charger in the wall socket. The USB connector plugs into the charger. Remove the smaller phone plug and use the red and black wires for your 5 volt supply. Red is positive and black is negative.

## The DC to DC Isolator

The isolator prevents so-called Bluetooth noise from leaving the board and entering the 5 volt supply line to the audio amplifier. It is wired in series with the Bluetooth board power supply wires. Below is the pinout photo for the B0505S-1W isolator. Five volts in from the on-off switch and five volts out to the Bluetooth board. Do not supply the audio amplifier or LEDs from the output of the isolator. The isolator can only supply 1 Watt of power, which is ideal for the Bluetooth board.

Be careful when soldering to the pins. Don't allow molten solder to run and link the pins together. Use rubber sleeving over each of the four wires and the soldered joints.



Pinouts, looking at the isolator from the writing side. The 5 volt supply will come from the connecting block, red and black wires, soldered to the pos and neg **IN** pins. The red and black leads from the Bluetooth board USB plug are soldered to the pos and neg **OUT** pins. See '*assembling the components*' on page 15.

## The RF Choke

The RF choke is a further precaution against Bluetooth noise entering the amplifier via the 5 volt supply line. Wire the RF choke in the positive (red) wire to the audio amplifier. The choke is 4.7mH 250mA 5 ohms. There is no polarity, the choke can be wired either way round.
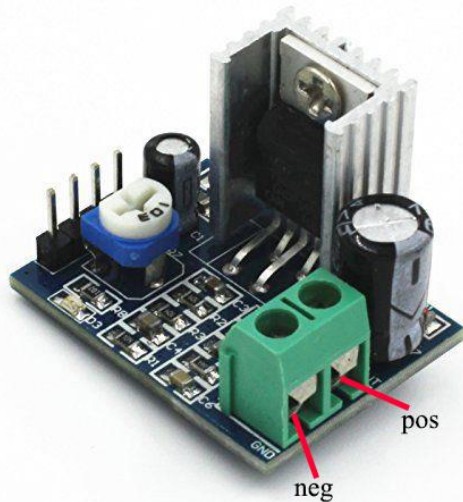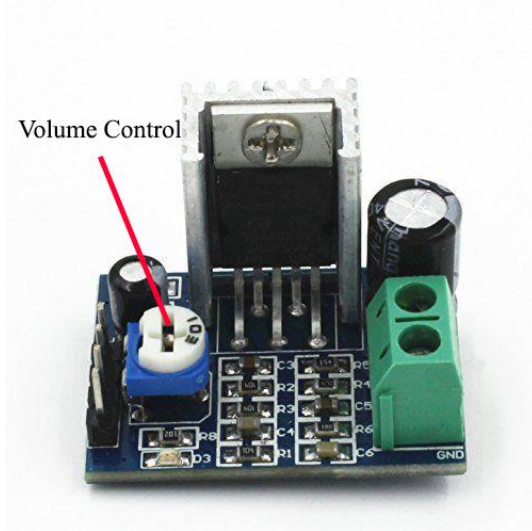
# The audio amplifier

The audio amplifier pinouts are shown here. The audio connection from the volume control should be a single screened lead. The braid goes to the **ground** pin and the inner to the **audio in** pin.

The audio amplifier loud speaker connections are shown here. Be careful when connecting the speaker leads. Try not to apply too much force to the green terminal block when tightening the screws. If your speaker is marked pos and neg, then connect the correct way to the terminal block.

# The audio amplifier pre-set volume control

The audio amplifier pre-set volume control is shown here. This control operates independently from the main volume control. Turn the main volume control up to full volume and then adjust the pre-set control to bring the level down so as not to cause distortion in the loud speaker. Bear in mind that your iPhone or other device will also have a volume setting. Adjust this to suit.

# The Bluetooth Board
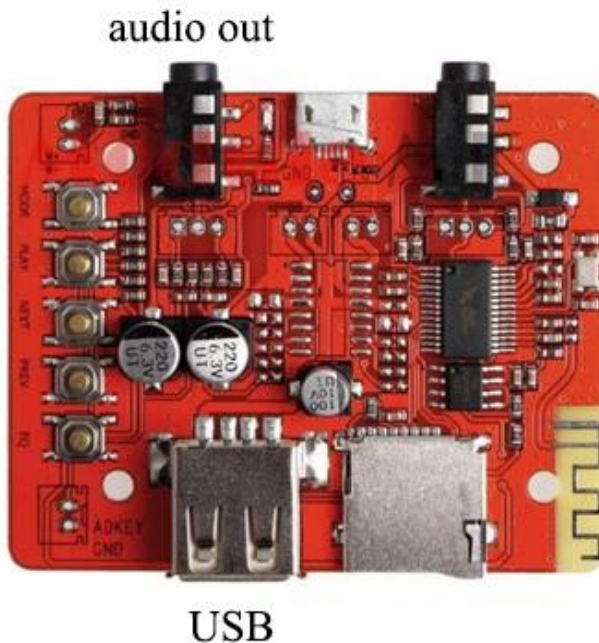
This is the business part of the setup. Shown here is the Bluetooth Receiver Board I use in vintage radios. The short USB lead, with red and black wires, plugs into the USB socket on the board. Take the red lead to the isolator OUT positive pin. Take the black lead to the isolator OUT negative pin. This supplies the board with 5 volts. The 3.5mm jack plugs into the audio out socket. That's it, there's nothing else to connect to the board.

# The on/off switch

Here are the on/off switch connections. The red and black USB lead wires from your phone charger power supply connect to '*volts in*'. Take another red and black lead from '*volts out*' to the connecting block. The tags might vary on different switches so check with a continuity meter. If your control only has two tags, then solder the red wires to these tags. Permanently join the two black wires together and use sleeving or tape over the joint.  Also see wiring diagram, on page 13.
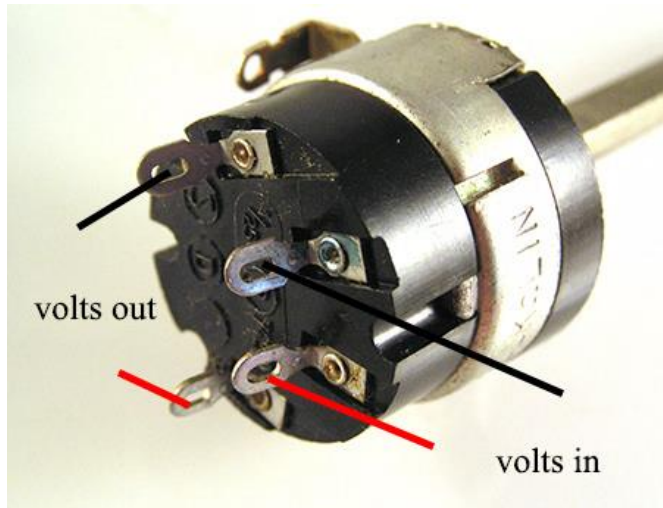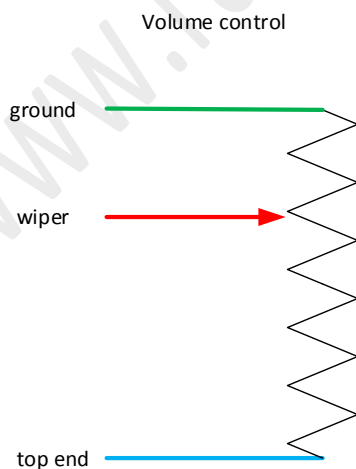
# The Volume control

This should be a 10k ohm log pot with switch. Here are the volume control connections. The ground tag is where the screened-lead braids are soldered. Connect the resistors to the centre tag. The other tag is where the single inner wire from the amplifier input connects. See '*assembling the components*' on page 15. Also see volume control diagram below.
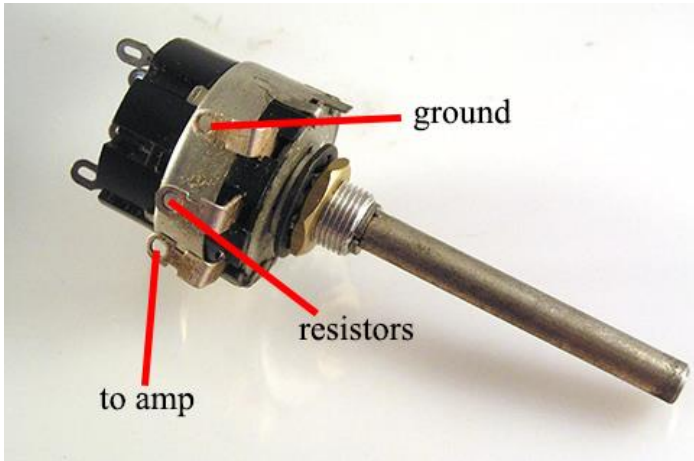


# Volume control circuit diagram

For your interest, here is the circuit diagram of the volume control. The ground tag is where the screened-lead braids are soldered. Connect the resistors to the centre tag, the wiper. The top end tag is where the single inner wire from the amplifier input goes to. See '*assembling the components*' on page 15.

## The audio connecting leads

You will need to cut a 3.5mm jack plug stereo lead to suit the length from your volume control to the audio amplifier board. Strip the insulation and twist the two braids together. Solder one inner wire to the end of a 1k resistor. Solder the other inner wire to another 1k resistor. It's best to use rubber sleeving over the soldered joins and the resistors. Now, solder the free ends of the resistors together. This mixes the two stereo channels to give a mono signal.

Solder the twisted braids to the ground end of the volume control. Solder the two resistors to the centre tag on the volume control.  Take a single length of screened lead and solder the braid to the ground of the volume control (along with the other braids). Take the inner wire to the top tag on the volume control. The 3.5mm jack plugs into the Bluetooth board audio out socket. See '*assembling the components*' on page 15 for full instructions.
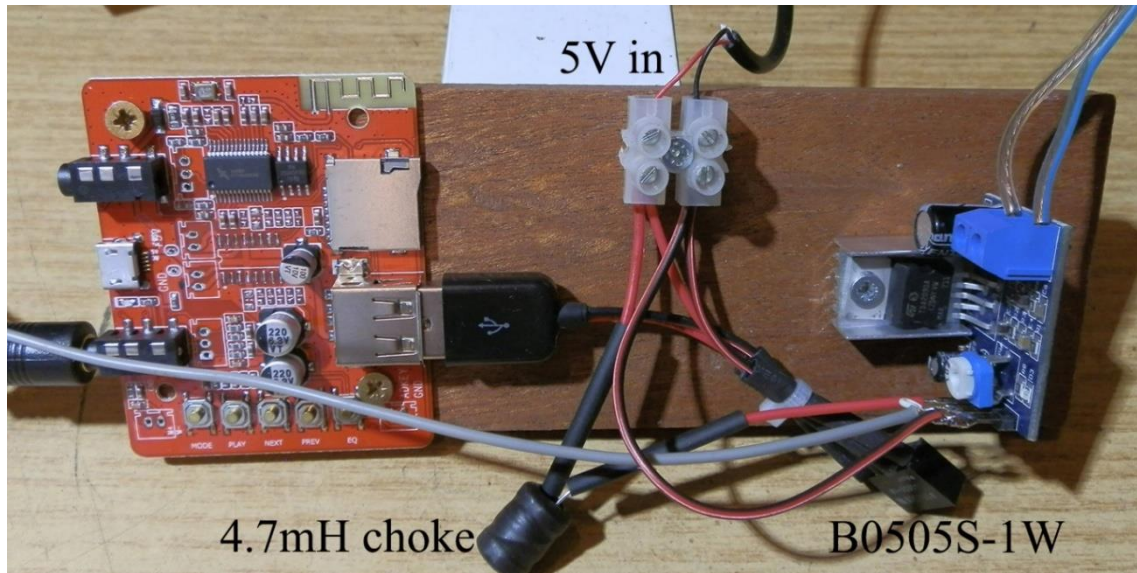
## The Bluetooth board connecting leads

The USB connector, shown here, plugs into the Bluetooth board USB socket. These leads are available on the internet, just cut the croc clips off and solder the red and black leads to the correct Isolator output pins. See '*assembling the components*' on page 15.

# The completed assembly.

I've mounted the parts on a wooden base. This can be secured inside the radio cabinet, at the top or on either side, using wood screws. The assembly can also be mounted inside an extension speaker cabinet.
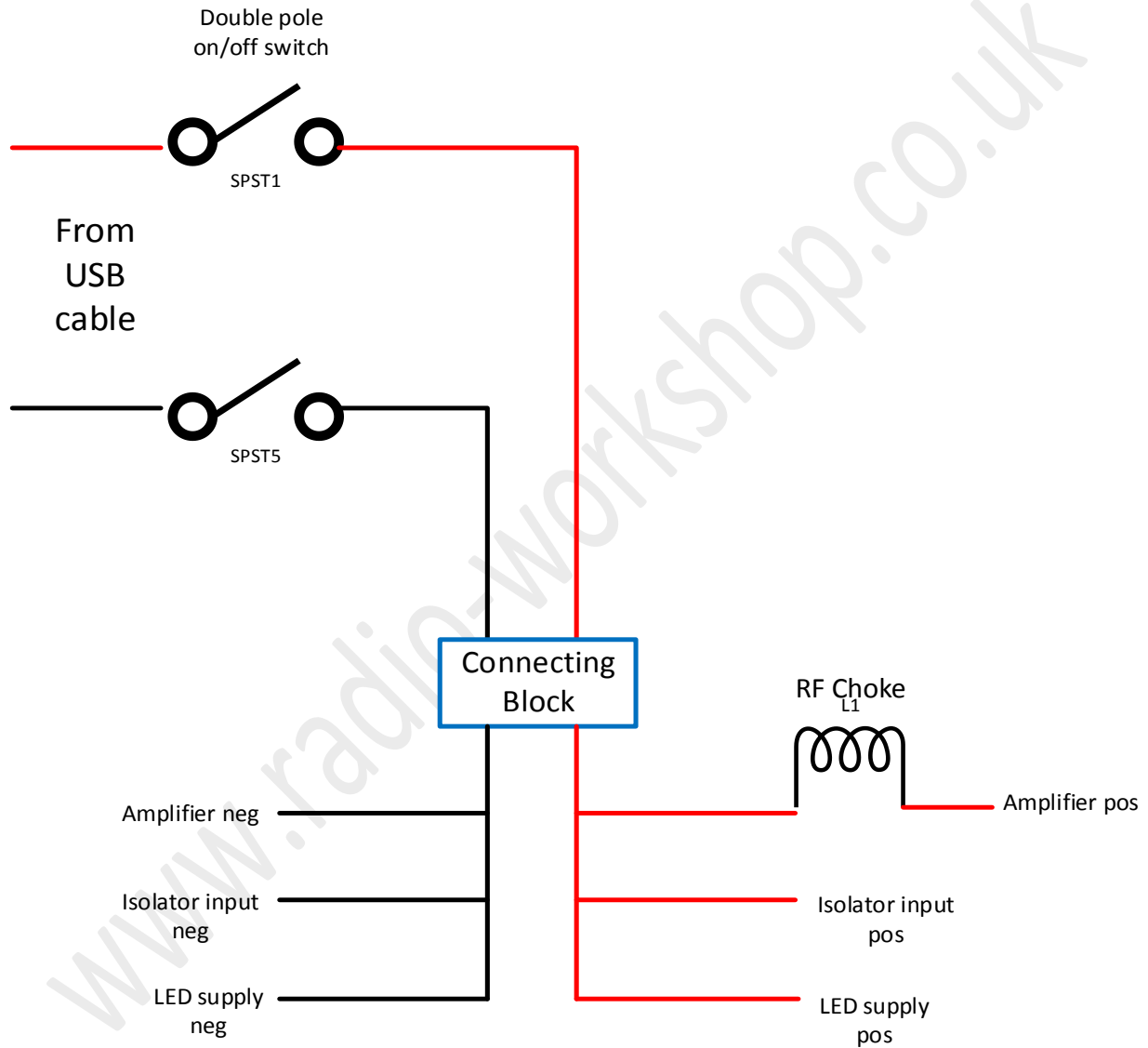


The 5 volt lead from the on/off switch goes to the connecting block. The block then supplies the Bluetooth board, via the isolator, and the amplifier, via the RF choke. The 5 volt supply for LEDs, if used, can be taken directly from the connecting block.

The 3.5mm jack plug takes the stereo audio output from the Bluetooth board to the volume control. The two outer braids join together and the two inner wires each connect to a 1k resistor. The other ends of the resistors join together and connect to the centre tag on the volume control.

# Wiring diagram – 5 volt supply

The diagram below shows the red and black wires from the USB cable supplying 5 volts via the on/off switch to the connecting block. Take the supply to the RF choke, isolator and LEDs from the other side of the block, as shown. Remember that the positive supply to each LED will need a 100 ohm series resistor. See '*assembling the components*' on page 15.

Double pole
on/off switch

SPST1

From
USB
cable

SPST5

Connecting
Block

RF Choke
L1

Amplifier neg

Amplifier pos

Isolator input
neg

Isolator input
pos

LED supply
neg

LED supply
pos

# Using LEDs

If you are to illuminate the radio dial, you will need to use LEDs. I use 10mm 20mA warm white LEDs, wired as shown below. For a 5 volt supply, which we are using, wire a 100 ohm resistor in the positive lead. Please note: the wires from the LED are of different lengths. The longer lead is positive, the shorter lead is negative. You can use up to four LEDs but each must have its own 100 ohm resistor. The negative and positive wires go directly to the connecting block, red to red, black to black.
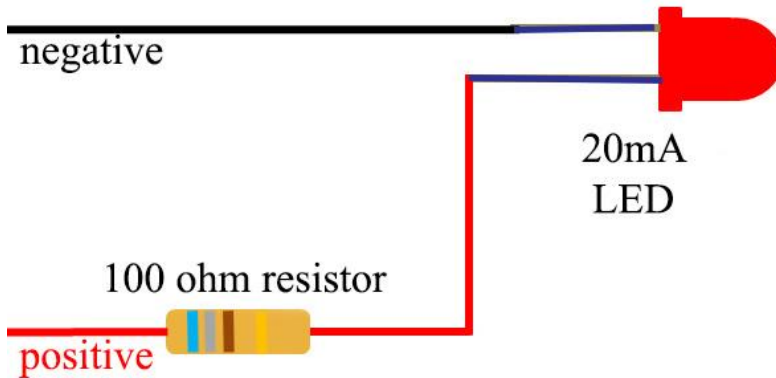


Here is an example of the warm white LEDs used as dial lights.

# Assembling the components

Wire up all the component parts before placing everything inside your radio. There are three components to mount on the wooden base, as per the photo on page 12.

**1/** When mounting the Bluetooth board on the wooden base, don't over tighten the small wood screws as this might crack the board. In fact, leave the screws loose enough to allow the board to move slightly. Position the jack sockets just over the edge of the wooden base to allow free access for the 3.5mm plug.

**2/** Remove the heatsink screw from the amplifier and replace it with a suitable wood screw. Secure the amplifier to the wooden base with the wood screw.

**3/** Screw the connecting block to the wooden base.

**4/** Take the USB plug and solder the ends of the red and black wires to the neg and pos OUT pins on the isolator. Solder another pair of red and black wires to the pos and neg IN pins on the isolator, as shown here.

Use heat-shrink sleeving over the soldered joints to prevent shorting. The USB plug feeds 5 volts to the Bluetooth board. The free red and black wires will go to the connecting block, pos and neg.

This is a fiddly job so be careful with the solder. Don't over heat the isolator and make sure that solder doesn't run and short out the pins.

**5/** Take a length of twin wire, cut the red in the centre, and solder the ends to the RF choke, as shown here. The choke can be connected either way round.

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**6/** Take the screened lead with the jack plug one end and strip the insulation from the free end. Solder the two inner wires to the two 1k ohm resistors, as shown here. Keep the braid separate. Some leads have two braided wires but you might find that there is only one, as in this case. Some cheap leads have no braid, just two plain wires for the ground. These leads are best avoided.

**7/** Once the solder joints to the resistors have been made, slide a length of sleeving over each resistor to prevent shorting. Solder the ends of the resistors together, as show. The braid, or braids, should be twisted ready to be sleeved and soldered.
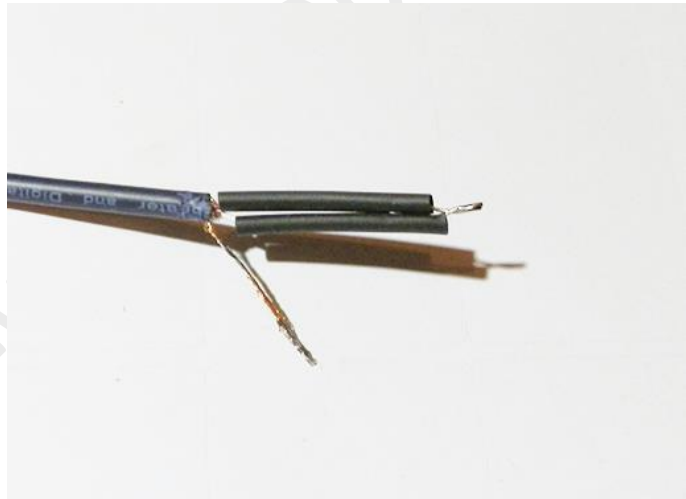
**8/** Solder the screened audio lead wires, complete with resistors, to the volume control tags. The braid, shown here with yellow sleeving, to the top tag. The two resistors joined, shown here with black sleeving, to the centre tag.
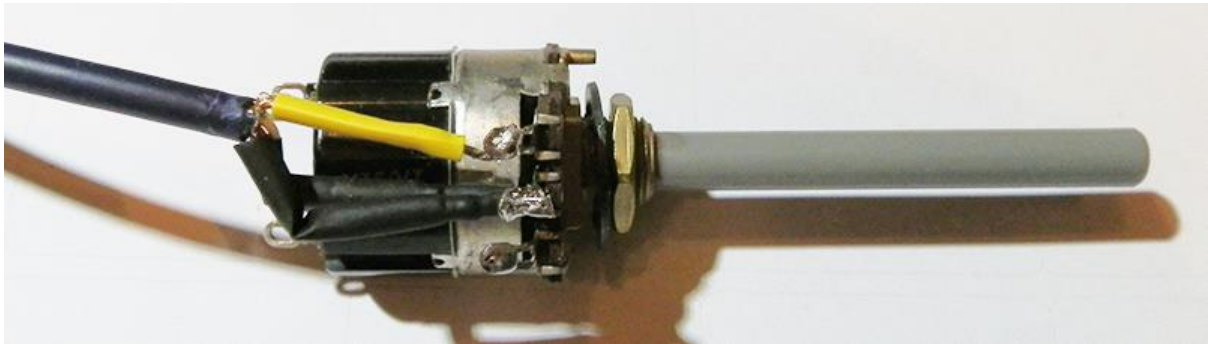


Now take a length of single screened lead and solder the braid, shown here with blue sleeving, to the top tag, along with the other braid. Take the inner to the bottom tag.
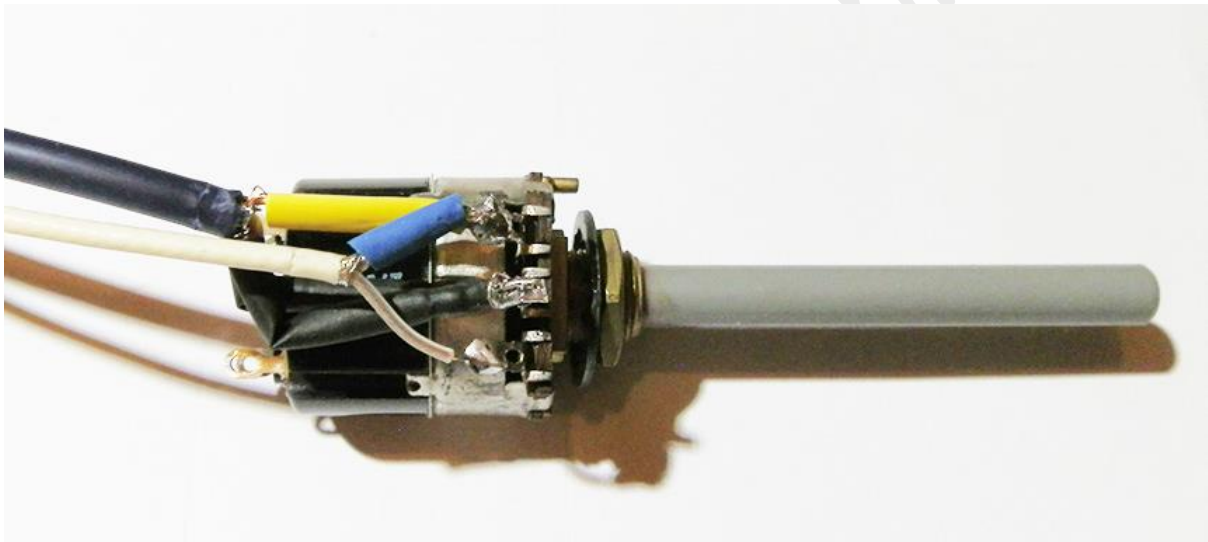


If possible, earth the metal body of the pot by soldering a wire from the body to the tag with the screened lead braid. This will prevent hum pick up.

**9/** Solder the red and black wires from the USB charger cable to the on/off switch tags shown here as '*volts in*'. Take a length of twin red and black lead and solder to the on/off switch tags shown here as '*volts out*'. Wire the volts out lead to the connecting block on the wooden base board. If your control only has two tags, then solder the red wires to these tags. Permanently join the two black wires together and use sleeving or tape over the joint.
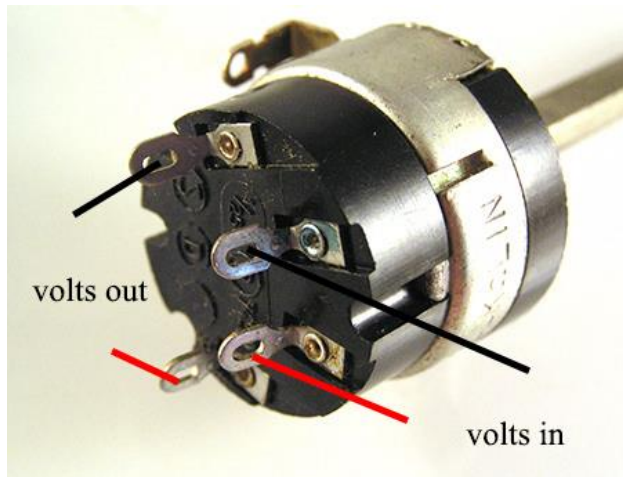


Ensure that all wires from the volume control and switch, once mounted on the chassis, will be long enough to reach the wooden base board when in its final position inside the radio cabinet.

**10/** Take the RF choke and solder one pair of red and black wires from the choke to the amplifier pins, black to -5v in and red to +5v in. Take the other pair of red and black wires from the choke and connect to the connecting block, pos and neg, on the wooden base board.

**11/** Take the pair of red and black wires from the isolator input and connect them to the connecting block, pos and neg, along with the choke wires. In the block, keep the reds together and the blacks together.  Take the USB plug and plug into the USB socket on the Bluetooth board.

**12/** Take the single screened lead from the volume control and solder the braid to the ground pin on the amplifier board. Solder the inner wire to the audio in pin.

**12/** Plug the 3,5mm jack plug into the audio out socket on the Bluetooth board. Make sure you use the correct socket on the board.

**13/** Connect a length of twin wire from the loudspeaker to the speaker terminals on the amplifier board. If your speaker is marked neg and pos, then wire to the corresponding terminals on the board. Ground is negative.

**14/** Check all wiring and connections. Plug the USB lead into your 5 volt iPhone charger and turn the volume control clockwise to switch the unit on.

You should hear beeping or a voice announcing Bluetooth, depending on the board you are using. The amplifier red LED indicator should be on. The blue LED by the jack plug should flash fast. On your iPhone or other device, look for BT2-10 under your Bluetooth heading. Once you connect to the Bluetooth board from your iPhone or other device, the blue light will be solid. Once you play music, the blue LED will flash slowly. Bear in mind that Bluetooth boards vary. Different flashing LEDs will mean different things.
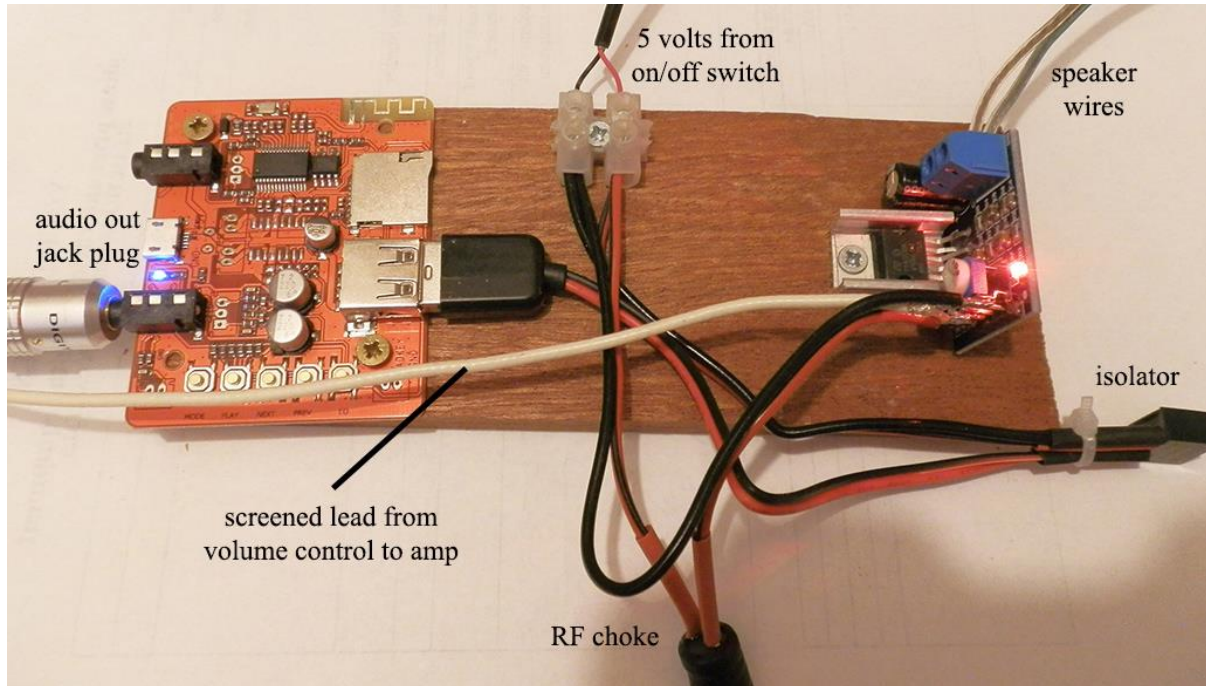


You can now mount the parts into your radio cabinet. The volume control will replace the original control in the radio. Hopefully, you'll be able to use the original speaker in the radio. The base board can be mounted anywhere by drilling a couple of holes in the board and using wood screws to mount inside the wooden radio cabinet or nuts and bolts if mounting on the chassis.

Once installed, check that everything is still working and then adjust the pre-set volume control as per instructions on page 8.

If your radio uses a small speaker and the audio quality sounds tinny, you might need to fit a tone correction capacitor, see page 20.

# Adding a tone control

You may wish to add a tone control to your Bluetooth set-up. If your radio doesn't have a tone control, this can always be added this as a pre-set control. You will need a 25k to 50k linear pot, as shown here. The pot will replace the original tone control in your radio.
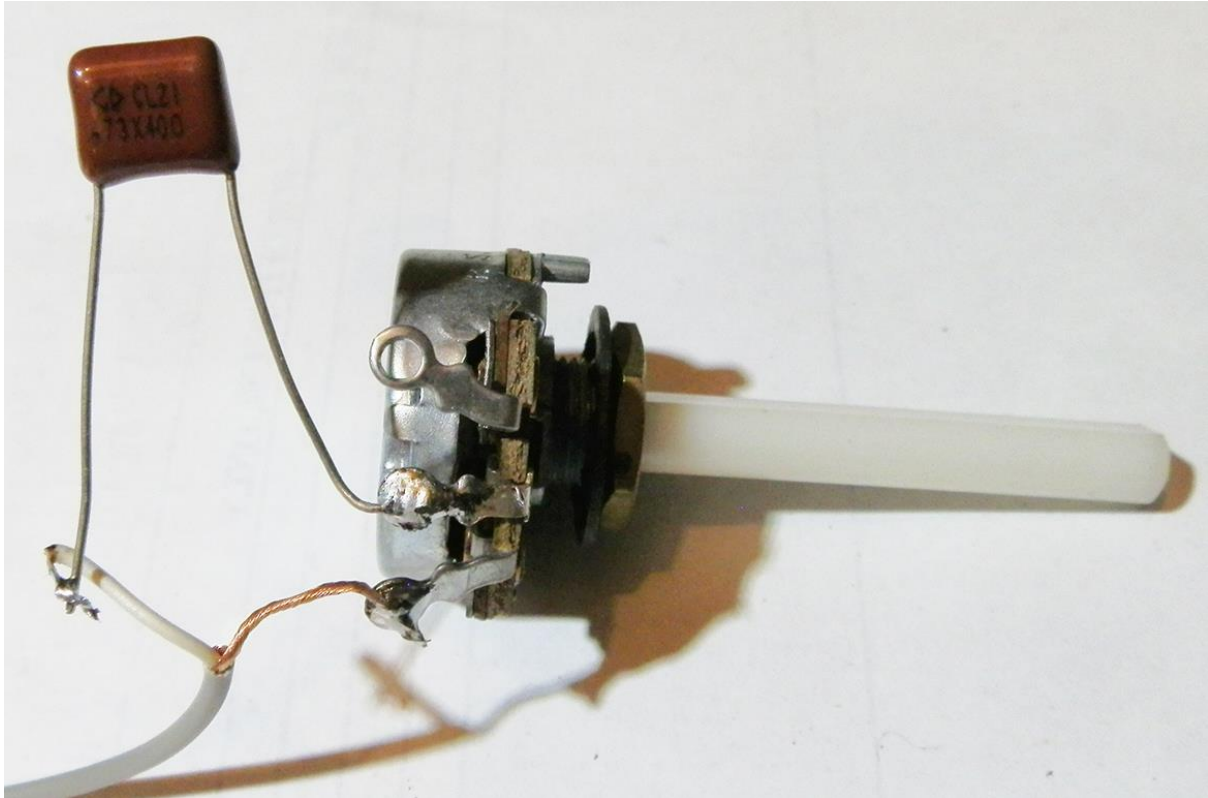


Using a length of screened lead, solder the outer braid to one end of the pot. Take the inner wire, via a 0.047uF capacitor, to the centre tag of the pot. I've deliberately shown this as a lash up so you can see the arrangement clearly. Obviously, this should be tidied up with shorter leads and sleeving before mounting in the radio.

Take the other end of the screened lead and solder the outer braid to the tag with the other braids on the volume control. Take the inner wire to the other outer tag on the volume control. If possible, earth the metal body of the pot by soldering a wire from the body to the tag with the screened lead braid. This will prevent hum pick up.

# Fitting a tone correction capacitor

If you have no need or room for a tone control, you might need a tone correction capacitor. I have found that, on a radio with a large speaker, the treble and bass is pretty good. However, on a smaller radio using a five-inch speaker, the audio might sound a little tinny. It might be necessary to fit a tone correction capacitor. This can be a 0.01uF or a 0.047uF wired across the two outer tags of the volume control. You may need to experiment with the values.

# Problems with hum

There may be a slight background hum once the unit has been assembled on a metal chassis, If you detect hum, take a wire from the two braided wires on the volume control to a ground point the chassis. This effectively grounds the chassis to prevent audio hum.

# Using the assembly on a 12 Volt supply

I've designed the Bluetooth assembly to run from a 5 Volt power supply. However, if you wish to use your vintage speaker or radio on a 12 Volt supply, there are plenty of 12 to 5 Volt adaptors available. You can use a cigarette lighter plug with a 5 Volt USB socket if you wish to use your vintage radio in a car. There are also small 12 to 5 Volt printed circuit board converters available if you wish to build the unit into the vintage radio along with the other components.

I like to listen to my Bluetooth vintage radio in the garden so I've used the adaptor shown here. I've mounted it in the centre hole in the patio table where the parasol pole usually fits. The patio has a roof so I don't need the parasol. This double USB socket is ideal for running my vintage radio or charging phones or tablets.

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**PARTS LIST**

I have listed links here where the various parts are obtainable. Bear in mind that the list might go out of date fairly quickly as suppliers run out of stock. Also, you might look for better deals on some of the parts. You'll have to source the audio jack lead, the10k log switched pot, the tone control pot and connector block etc.

Bluetooth Board

https://www.ebay.co.uk/itm/5V-WIFI-Wireless-Receiver-Board-Module-Bluetooth-Audio-For-Amplifier-Stereo-XJ/142841479940?epid=24005917930&hash=item2142040304:g:k6wAAOSwWdZZY15A

Amplifier

https://www.ebay.co.uk/itm/161927683769?ssPageName=STRK:MEWAX:IT&_trksid=p3984.m1423.l2648

RF Choke 4.7mH

https://www.ebay.co.uk/itm/Radial-Ferrite-Choke-Inductor-10uH-to-100mH-1st-Class/281770277470?hash=item419ad13a5e:m:mZw7v4jncR4N-5am4cSTkKQ:rk:1:pf:0

Isolator

https://www.ebay.co.uk/itm/222523235755?ssPageName=STRK:MEWAX:IT&_trksid=p3984.m1423.l2648

Short USB lead

https://www.ebay.co.uk/itm/USB-to-Crocodile-Alligator-Clips-Power-Cable-Test-Wire-5v-50cm-75cm/232485141085?ssPageName=STRK%3AMEBIDX%3AIT&var=531789719362&_trksid=p2057872.m2749.l2648

Long USB lead

https://www.ebay.co.uk/itm/2M-extra-long-USB-charging-charger-play-cable-lead-PS4-XBOX-ONE-Controller/172271961135?ssPageName=STRK%3AMEBIDX%3AIT&_trksid=p2057872.m2749.l2648