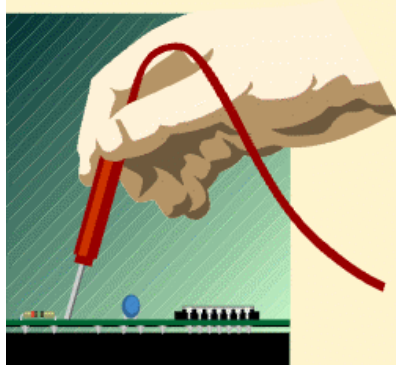


HELP!

50 Tips From The Ham Shack

By Martin Butler M1MRB / W9ICQ



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Foreword

A famous philosopher, Michael Polanyi, stated that much knowledge is tacit: it is deeply personal, practical, and difficult to articulate. This “know-how” is acquired through experience. It is essential for perception, scientific discovery, and skilled performance. Such is the case for a surprising amount of what is known in amateur radio. We have handbooks that attempt to articulate a broad and, at times, deep formal understanding of the hobby at a given time.

No, this is not a philosophy book! However, I introduce this volume in this framework because it is often the small things that become major roadblocks, and even off-ramps, to the beginning ham. They have not yet become aware of many things like those the author covers in these pages. This is because they are either difficult for many to articulate, or they are so practical that formal handbooks and texts do not bother to include them. While perhaps necessary, as a former Editor-in-Chief myself, this is unfortunate because it requires almost an artisan-like Elmering of new and seasoned amateur operators alike to overcome many of them.

Because of broader societal change, the craft of Elmering no longer operates like the artisan craft villages of old. It is fragmented between in-person teaching and online segments of topics that do little to resemble a coherent flow of key insights to the student. Many just give up on making sense of the things that are preventing them from maturing as amateur radio practitioners.

In this volume, my colleague Martin Butler, M1MRB, formalises significant aspects of such ham radio Knowledge. This lifts these ideas up from being fugitive bits of knowledge and can make all the difference to beginners in the hobby. Many veteran hams will no doubt also benefit because they may not have come cross these practical suggestions for solving so many things that we struggle with daily.

It is my honour to offer you what is about to become evident to your better understanding of the hobby. I learned a lot by reading a draft.

Frank M. Howell, PhD K4FMH
Ridgeland, MS, USA

Introduction

This book lists a few tips and tricks I have used to help me achieve many repairs. Most of these are generic tips, and I claim no credit for their content, only for sharing them. I hope you find them useful.

DO NOT try or use any of the high-voltage tips if you do not understand them, or if you are not comfortable with your ability.

Tool safety is important. Please read the manual or leaflet that came with the device before use.

While you may already know some of these tips, I hope others will help you when working in the workshop.

1) Testing a fuse with a mobile phone

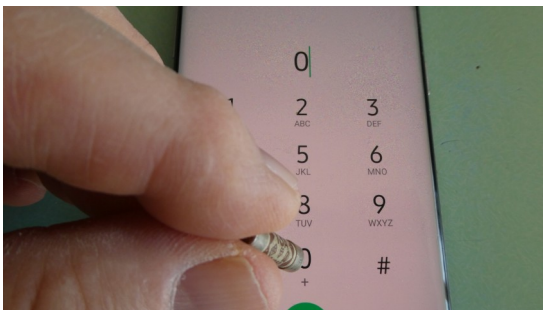
I cannot claim the credit for this tip. I spotted it on Facebook and suddenly realised it was such a good idea that I had to tell my friends about it.

Nowadays most of us walk around with a mobile phone in our pocket. If we come across a situation where we need to test a fuse to see if it is blown, we probably do not have a multimeter with us.

This is where the mobile smartphone comes into use. Open the phone and go to the dial pad. Hold the fuse between the fingers of one hand and touch the other end of the fuse to the smartphone screen above a number. If the smartphone starts to dial and the number is displayed on the screen, you have a good fuse. If no number is displayed, your fuse is dead. This works because a good fuse has a wire connection between the metal end caps, allowing contact from your finger through the fuse to the smartphone screen.

Items required:

- A mobile smartphone
- The fuse under test



Testing a fuse with a Smartphone

2) Checking an infrared remote control is working

There is a very simple way of testing an infrared remote control to see if it is transmitting. We humans cannot see infrared light, so our naked eyes are not much use. Once again, our smartphone comes to our aid. On your smartphone, select the camera.

Point the infrared remote control at the camera and press a button on the remote. You will not see a red light with your eyes; however, the smartphone should show a flashing white light that is not visible to the naked eye.

At this stage, you can test all of the buttons to ensure they are working.

This test only proves the infrared remote control is transmitting. It may not prove that it is transmitting the correct information. However, if you see a flashing light, in most cases your infrared remote control is working.



A picture from a Smartphone showing the remote control handset is working

3) Checking that capacitors are installed correctly

I am not talking about electrolytic or tantalum capacitors, which are polarised. If you get an electrolytic capacitor connected with the wrong polarity, it can explode. I was repairing a radio for a friend, and he had fitted one the wrong way around. There was a hole in my kitchen ceiling after the capacitor exploded.

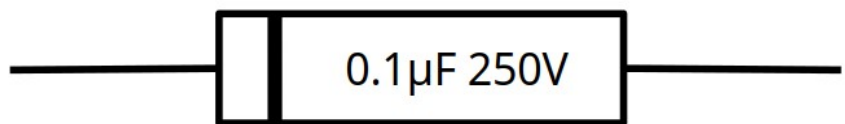
Tantalum capacitors will often fail short-circuit, and if they are fitted across a power rail, they may burn up with lots of smoke if they go faulty. They also have to be fitted the correct way around due to their polarity.

Most people think that non-polarised capacitors can be fitted either way around. This is partly true because they are not polarised. However, on old equipment you may be renovating, if they are not fitted correctly, the device may not have optimum performance.

These capacitors are made by rolling the two capacitor plates and the dielectric into a tube. This means one wire is connected to the inner of the capacitor and the other to the outer. Therefore, the outer lead could pick up stray interference within the device. The lead connected to the outside of the capacitor should be connected to ground or to the low-impedance part of the circuit.

In the old days, the end of the capacitor connected to the outside lead was marked with a band. Today, manufacturers do not always do this.

So how do we find the outside connector on modern capacitors? You will need an oscilloscope. Connect the capacitor to the oscilloscope and then hold the capacitor between your fingers. You will see a hum signal from you on the oscilloscope. Reverse the capacitor and check again. The orientation that gives the lower hum pickup normally indicates the outer foil lead is connected to ground side of the circuit.



A image of an old style paper and foil capacitor with a making showing which lead is connected to the outer foil.

4) How to check a loudspeaker

When testing an audio amplifier for distorted output, you need to know whether it is a faulty audio amplifier or a faulty loudspeaker. There are a number of ways to approach this problem, depending on what equipment you own.

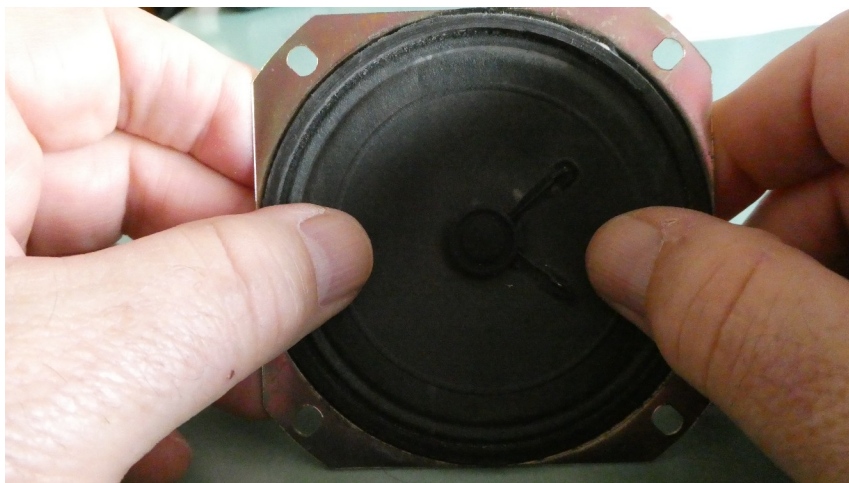
If you own an audio signal generator and an oscilloscope, you can feed an audio frequency into the input of the amplifier and look at the output on the oscilloscope. This will show you if the amplifier is working correctly. If you do not have an audio signal generator and an oscilloscope, you could check the loudspeaker in the following manner.

Remove the loudspeaker from its case and, with it facing you, carefully press down on the loudspeaker cone near the middle. A good loudspeaker cone should move freely with no rubbing. On a distorted loudspeaker, you will hear the rubbing of the voice coil and magnet. At this stage, the loudspeaker is unrepairable for most of us. If you need it repaired, it will need to go to a specialist repairer.

What has happened is that the voice coil has become hot and has physically distorted. This is often due to running too much power through a low-power loudspeaker.

Side note: An 8-ohm loudspeaker will not measure 8 ohms on a multimeter. The 8 ohms quoted is the impedance value of the loudspeaker. If you want to check a loudspeaker voice coil to make sure it is not open circuit, this can be done by quickly connecting the multimeter on ohms across the loudspeaker. Do not leave the multimeter

connected for more than a couple of seconds, or you may overheat the voice coil.



An image of how to test a loudspeaker for a rubbing coil

5) How to hold a screw on a screwdriver

I'm sure that most of you are thinking, "Just use a magnetic screwdriver." Yes, this will work in most cases.

However, if you do not have a magnetic screwdriver, or the screw is not made of ferrous metal, what are you going to do?

This idea came about when trying to fit screws deep into cabinets. This can be done very easily with the following method. All you need is a piece of sticky tape. Insulating tape, Sellotape or masking tape will do; it is not critical.

Push the screw through the tape from the sticky side. Fit the screw onto the screwdriver head and attach the two sticky ends to the shaft of the screwdriver. Once the screw has started into the hole, pull the screwdriver out and remove the tape with a set of pliers. Then tighten the screw in the normal manner.

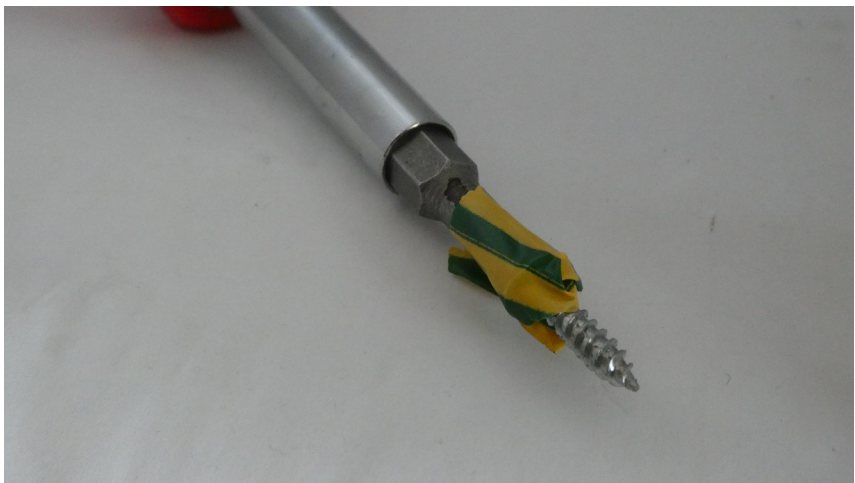
Another way to do this is to dig the screwdriver head into some wax. Then press the screw onto the screwdriver, and the wax should hold the screw in place while fitting.

Items required:

Insulating tape, Sellotape, masking tape or candle wax



Parts needed to hold a screw onto a screwdriver



An image of a screw attached to a screwdriver

6) Refitting self-tapping screws

You are probably wondering why I am telling you how to refit a self-tapping screw. Surely you put it in the hole and tighten it up with a screwdriver.

While this will work once or twice, you will soon find that the screw will no longer tighten down after a few times. What happens is that every time you refit the screw, it cuts a new thread into the plastic, and eventually there is nothing for the screw to cut into.

So how do we solve this problem?

Put the self-tapping screw on top of the hole it is going into and fit the screwdriver head onto the top of the screw. Now turn the screw anti-clockwise as if you are undoing it. Listen carefully, and you will hear the screw drop into the original cut thread. You should also be able to feel the screw drop into the original thread.

Now screw the screw back in. It should screw down easily and eventually go tight.

7) The many uses of a screwdriver

There is a saying that when a bad job is done by a workman, the workman always blames his tools.

However, if you are trying to use poor-quality tools that may have been abused, this makes your job more difficult.

I visited a member of the family who needed a job done. I asked for a screwdriver and was given one that his wife had been using to dig concrete from between paving slabs. The blade was so deformed I was unable to use it.

I'm sure you will be able to think of many more misuses of a screwdriver. Here are a few examples:

- Using a screwdriver as a chisel
- Using a screwdriver as a scraper
- Using a screwdriver to make holes
- Using a screwdriver to open paint tins
- Using a screwdriver to short out capacitors
- Using the handle of a screwdriver to tap things
- And many more

I do not lend tools, and I use them for the task they are intended for. If family members want to do something, they either have their own tools or I give them an old tool. This way, my tools are kept in good working condition and ready for when I need them.

8) Different types of cross-head screwdrivers

Until a few years ago, I was under the impression there were two types of cross-head screws and screwdrivers. The two types in common use are Phillips and Pozidriv.

Phillips screws are mainly used on items of equipment, cars or things with metal bodies. There are also different sizes of Phillips screws and screwdrivers. Therefore, I'm sure you will have more than one Phillips screwdriver.

Pozidriv screws are mainly used with woodwork. You will find this type of screw fitted in furniture and flat-pack furniture. You can identify a Pozidriv screw or screwdriver by the extra points between the major cross-head elements.

I have, and I'm sure most of us have, used the wrong screwdriver at times. This leads to damage to the screw head, which may make it difficult to remove at a later date.

I could never understand why, when working on radios, I sometimes damaged the screw head when removing screws. This seemed to happen when working on some of our most popular brands. The radios in question were manufactured in Japan.

I have since found out that there is another cross-head screw standard called JIS (Japanese Industrial Standard). These look like Phillips screws; however, the pitch angle of a JIS screw is different from a Phillips screw.

The simple solution, now you know the answer, is to purchase a set of JIS screwdrivers. They are not expensive and will stop you from damaging radios from Japan, Japanese cars and similar equipment.



Three cross head screwdrivers. The left screwdriver is a Phillips, the middle screwdriver is a JIS and the right screwdriver is a Pozidriv

9) Take photos

This is almost too obvious to mention, but recording how something comes apart, which screws need undoing and where wires go is important when dismantling devices.

In the old days, we used to make notes with a pen and paper. This was the process we used to dismantle a device. The information was only as good as your notes. If you missed something, you would have to work out later where a wire or part went.

This is where the modern smartphone with a camera comes to our aid. Take as many pictures as you need.

Most smartphones have a lot of memory to store pictures while working on the device.

10) Set screws into the order you took them out

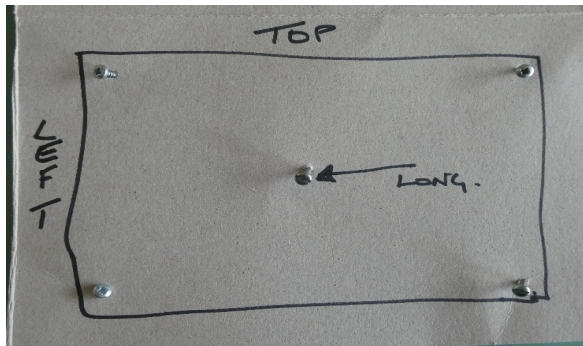
When you are repairing a device and taking lots of screws out of it, sometimes they are different lengths.

Also, if there are lots of screws from various parts, knowing which screw goes where saves a lot of time when putting the item back together.

My favourite method when dismantling an item with lots of screws is to start with a piece of scrap cardboard.

I then draw a plan view of the area I am dismantling. When you remove a screw, press it into its position on the cardboard plan. Do the same when moving to the next part you are dismantling.

Some items, such as nuts and washers, cannot be pushed into the cardboard. These items can be stuck to the cardboard with Sellotape and labelled with a pen on your plan.



An image on cardboard of where the screws came out

11) Shortening a Bolt

Sometimes you may need to shorten bolts for several reasons. This could be so you do not have to tighten a nut a long way down the thread of the bolt. You may also be trying to use bolts from your recovered junk box to save a few pennies.

If you put the bolt into a vice and cut it to the length you require with a hacksaw or angle grinder, this will shorten your bolt. However, you may then have trouble putting a nut onto the bolt thread due to damaged thread or swarf where you cut the bolt.

One solution is to fit the nut onto the bolt first. This also helps hold the bolt better in the vice. Cut your bolt with a hacksaw or angle grinder. Now undo the nut on the bolt, and as the nut comes off the bolt, it will clean and remove any swarf left over from cutting.

The nut should now mate with the thread of the bolt when used.

12) The hole is too big for the screw

Sometimes, when a self-tapping screw has been fitted too many times the wrong way, as I mentioned in a previous tip, there is nothing left for the screw to bite into.

A simple way to solve this problem, although not very technical, is to push a used matchstick into the hole.

Push it all the way in and then break it off flush. Now refit the screw into the hole. The screw should tighten down.

This is not pretty, but it works.

Another method, which takes more effort and works with larger holes and screws, is to drill out the hole in the plastic box and fit a wall plug into the hole. Then refit your screw.

Items required:

- Used matchstick or small wooden splinter
- Wall plug for larger holes
- Screwdriver

13) Checking a multimeter current on ohms

This is something that may save you from chasing yourself round and round in circles. With some modern equipment that only draws a low current, we may fit low-amperage fuses.

The problem is that some multimeters pass a surprising amount of current when set to measure resistance.

If that current is higher than the rating of the fuse you are testing, the meter itself may blow the fuse.

You will need a second multimeter for this test. Set the multimeter you want to check to the resistance range.

Connect the second multimeter, set to measure current, in series with the first multimeter's test leads.

Read how much current is flowing, then write the value on a small label and attach it to the first meter.

If your meter passes 250 mA on the resistance range, it is no use trying to test fuses below that value because the multimeter may blow them.

Items required:

- Two multimeters
- A small sticky label
- Pen or marker

14) Why is there a mirror on my multimeter display?

There is a misconception these days that analogue multimeters are bad and digital multimeters are good. I could argue at length in favour of either, although anyone starting in electronics should probably start with a digital multimeter.

Analogue multimeters can be as accurate as digital multimeters if you understand how they work and how to use them. You will not find a mirror on a digital display; the reason becomes obvious with an analogue meter.

On a good-quality analogue multimeter, you will see a small mirror in the shape of an arc behind the pointer.

To increase the accuracy of your measurement, look straight down at the multimeter pointer. If you are not looking straight down, you will see a reflection of the pointer. Move your head until there is no reflection, then read the result from the scale.

This mirror is used to remove parallax errors. Cheaper or poor-quality multimeters often do not have this mirror aid.



Multimeter with a mirror

15) Analogue Multimeters Measuring Ohms and Transistors

If you are new to electronics, or have only ever used a digital multimeter, you may not be aware of this design issue.

An analogue multimeter, when making measurements on the ohms ranges, is effectively showing the current passing through the device under test. When you short the two probes together, there is very little resistance and the meter movement moves all the way to the right. This is because the resistance is very low.

When you measure a resistance, the meter falls back towards the left-hand side. The larger the resistance, the closer the meter pointer moves to the left. This is because, with a higher resistance, less current flows through the device under test.

Now we need to move our attention to semiconductors.

This is where it can catch you out if you are not aware of the following fact. On many analogue multimeters, when using the ohms ranges, the black lead is positive, and the red lead is negative. If you did not know this and you measured a transistor base, collector, and emitter, you could think you were measuring a PNP transistor when it was actually an NPN transistor.

If you have to purchase a special transistor, you need to understand which type it is. One last point: on a digital multimeter, when measuring ohms, the red lead is positive, and the black lead is negative.

16) Static Build-Up on a Multimeter

When using an analogue multimeter, you may sometimes find that the pointer will not return to zero, or that the pointer moves when you touch the meter. This is frustrating when you are trying to make measurements.

The problem is usually found when the meter movement is covered with a plastic cover. The plastic can develop a static charge, which affects the meter movement.

This can be fixed quickly and cheaply without taking the multimeter apart.

Take a dry cloth and put a couple of drops of washing-up liquid on it. Wipe the plastic multimeter movement cover with the cloth and polish it clean. That is it; you do not need water or anything else.

17) Killer Oscilloscope

SAFETY NOTE: Oscilloscopes can be connected to equipment containing dangerous voltages. Do not probe live equipment unless you understand the circuit, the test equipment, and the safety risks involved.

Yes, the title was there to attract your attention.

As with any test equipment, a good mechanical inspection should be done before use. If you are unhappy with the condition of the device or its leads, do not use it until it has been repaired. This should be normal practice before using any equipment.

However, this tip applies to a good-condition, working oscilloscope, because many people these days are not trained in its operation.

All an oscilloscope does is display voltage against time on a screen. The display has a graticule – the squares on the screen - and, with the controls, this is how you measure the voltage and timing of a waveform.

When using a scope probe, you can set the probe input for DC or AC. DC shows how much DC the signal is sitting on, often called the offset. It is sometimes useful to know how much DC voltage is present in the waveform you are looking at. When the input is set to AC, the DC offset is not displayed, and only the AC signal is shown. On more modern digital oscilloscopes, the AC/DC switch may be a menu option.

Now, the killer part of this tip. If you are using your oscilloscope in AC mode, there is a capacitor connected in series to block the DC. This capacitor gets charged up to the DC offset voltage. If you are probing around high-voltage areas and then probe a low-voltage device, such as an IC, you may discharge the internal oscilloscope capacitor through that device. This could kill a perfectly working component, and now you have two faults.

In just a few minutes, you could damage several devices.

To solve this problem, when your oscilloscope is set to AC, ground the tip of the oscilloscope probe before each measurement.

18) Soldering

Soldering is a subject I could probably write a whole chapter on, but here I'm going to give you a few tips to make great joints every time.

Soldering iron

Over the years, PCBs (Printed Circuit Boards) and components have become smaller. Today I have many soldering irons, compared with the two I used to use fifty years ago. They are all basically the same, with a heating element that heats a soldering tip to melt solder.

One of the most basic rules is to let the soldering iron fully heat up to temperature and build a heat reservoir.

Just because a soldering iron can melt solder within a minute and a half, it is not ready for use. If you try to use it at this stage, the soldering iron tip will cool down too quickly and you will almost definitely have a bad solder joint.

Choosing the correct soldering iron and iron tip for the job creates better-finished results.



Solder

There are different types of solder you can buy, and choosing the correct one is essential. Never use plumber's solder and flux on electronic equipment because the flux is

very acid-based and can eat through component leads and PCB tracks.

There are many types of solder available to the home constructor or repairer. When I first started, we used 60/40 solder, which has some flux included in the solder wire.



60/40 solder is 60% tin and 40% lead. Today, in manufacturing, lead is now banned and lead-free solder is used. Lead-free solder melts at a much higher temperature.

The choice is yours. If you use lead-free solder, you may require a higher-powered soldering iron that can heat to a higher temperature.

Cleanliness

Having the right solder and soldering iron at the right temperature for the job is only part of it. While flux is there to aid soldering by partially cleaning the joint when soldering, if we start with a clean PCB and clean components, the solder joint will be much better. You will also make the joint more quickly, exposing components to heat for a shorter time.

A piece of fine wet-and-dry paper or emery cloth is good for cleaning component leads and PCBs, but do not rub too hard. You can get PCB rubbers, but once again do not rub too hard and be careful with gold edge connectors. Gold is a soft metal, and care should be taken.

Soldering

After all of the above, you are now ready to solder. Soldering is not done like many people who produce YouTube videos do. They put solder onto the soldering iron tip and just dab it onto the joint.

To solder properly, you heat the whole joint with the soldering iron, including the component and PCB or connector, and then apply the solder. Remove the solder and then remove the soldering iron. This whole process should take less than five seconds.

19) De-soldering

When fault-finding and repairing equipment, there comes a time when you will need to remove a component.

Depending on what type of solder has been used, this will determine how easy it is to de-solder a faulty component.

The first tip is that if you are replacing a through-hole component such as an integrated circuit, it is easier to cut the leads off the integrated circuit and then remove the leads one by one. Then unblock the holes. This will put less stress on the PCB (Printed Circuit Board) solder pads.

Solder pumps

These work well with solder that has a lower melting temperature, such as 60/40. Activate the solder pump, heat the joint, then push the solder pump button and the solder will be sucked into the solder pump. You may have to do this more than once to clear all the solder.



Solder braid

This is a method that I do not find works well for me. Make sure you put plenty of flux onto the solder braid before starting. Put the braid onto the joint and then place your soldering iron onto the braid. The solder in the joint will wick up into the braid. For me, solder braid works best for cleaning up solder pads on PCBs.



De-soldering gun

If you are likely to do a lot of repair work, a de-soldering gun is worth the money. These heat up like a soldering iron and have a hollow tip. They are connected to a vacuum pump. You place the hollow tip over the component lead. The solder will melt. Wiggle the tip on the joint and press the button to activate the vacuum pump and remove the solder.



Gravity

Often, when lead-free solder has been used, it is difficult to unblock holes on PCBs. Cut the faulty component off the PCB and remove the leads from the PCB one at a time by heating the joint and pulling the lead out with a pair of pliers.

At this point, the component is removed, but the through-holes are blocked. Lead-free solder has a high melting temperature and will solidify almost as soon as you remove the soldering iron. This tip worked for me when repairing radios and I needed to unblock PCB holes. Put the soldering iron onto the blocked solder pad. When the solder is melted, quickly tap the PCB onto the bench and let gravity do its work.

20) Cleaning a PCB After Soldering

After repairing a piece of equipment or making an electronic kit, I like to clean the Printed Circuit Board (PCB). After soldering with multicore solder, you are often left with brown flux residue.

I like to lightly scrape this and break it up into a brown powder. Next, I pour some isopropyl alcohol onto the PCB and, with an old toothbrush, wash the flux away. Dab the PCB dry with a tissue or cloth and you should end up with a clean-looking board.

After doing this, it is easier to carry out a visual inspection of the joints for dry joints or solder shorting out tracks on the PCB.

Items required:

- A tissue or cloth
- Some isopropyl alcohol
- An old toothbrush
- Rubber gloves

IMPORTANT: Isopropyl alcohol can enter the body through the skin and may affect the liver. If you are going to use isopropyl alcohol regularly, use rubber gloves to protect your health.

21) Cleaning a Soldering Iron Tip with a Scouring Pad

When you are soldering, it is important to keep your soldering iron tip clean. One way to do this is to use an old sponge that has been made wet with water. Most soldering iron stands include a sponge for this purpose.

While this will clean the tip by wiping it across the sponge, it will also cool the tip quickly. Repeated use of this method may delaminate the coating on the soldering iron bit from its body, reducing its life.

A better way of cleaning a soldering iron bit is to use what looks like a pot scourer. Pushing the tip in and out quickly cleans it without reducing the heat too much. These are sold commercially both online and in electronics stores, or you can make your own for a few pennies.

To make your own, start with a container. I find a used tuna tin to be about the right size once it has been washed out.

Make sure there are no sharp edges that could cut you. Most local supermarkets sell scouring pads in multipacks, often for less than a pound.

Take one of the scouring pads and place it in your clean tuna tin. Keep this handy on the work surface when soldering so you can clean the soldering iron tip when needed.

Items required:

- A clean small tin or suitable container
- A scouring pad

22) Soldering with a Coin

OK, I sound like a cowboy telling you this. However, needs must. This tip came about because I was out with a friend and we had a solder joint that had come apart. He had several tools in his camper van but no soldering iron or solder.

Fortunately, the connector we needed to reconnect a wire to had a big blob of solder. The person who had repaired the joint before obviously did not know how to solder.

A copper coin would have worked better, but we did not have one. I did have a small key in my wallet, which became my soldering tip.

Hold the key with a pair of pliers over a gas ring until the key is hot enough to melt the solder. Then put the wire onto the blob of solder and melt it with the key.

While it was not the best solder joint, it saved the day and worked until my friend could do the job properly.

23) Weller Soldering Gun Soldering Bits

I have owned a Weller soldering gun since the mid-1970s, and it still has its uses. The soldering tip gets very hot very quickly, which is useful when working outside the house.

However, the disadvantage is that the small soldering tip cools down quickly.

The soldering tips for the soldering gun are available to buy, and in essence they are just pieces of thick copper wire. By using a short piece of thick copper wire from an offcut of electrical cable, you can make another soldering tip at no cost.

Remember to remove the insulation from any wire first.

If you do not have offcuts of electrical wire, ask an electrician if you can have one. Tell them what you are doing; they may use a Weller soldering gun themselves and may not know this tip.

24) PCB Rubber Cleaning an Untinned Tip

When you fit a new soldering iron tip to your soldering iron, you must be ready to melt some solder onto the tip as soon as it can melt solder. This is called tinning the tip and will allow you to use the soldering iron properly.

Unfortunately, sometimes you may get distracted during this process and the soldering iron may come up to its normal operating temperature. If this happens, the soldering iron tip will tarnish and stop the solder from melting onto the tip.

Solder will just drip off.

The soldering iron tip needs to be cleaned without damaging the coating on the soldering iron bit.

The best way I have found to do this is to turn the soldering iron off and let the tip totally cool down. Then take a PCB (Printed Circuit Board) rubber and rub it lightly over the tip.

Then restart the initial process of tinning the soldering iron tip.

A PCB rubber is abrasive, so do not rub too hard or you may remove the surface of the tip.

25) Cleaning plastic with WD-40

I'm sure you are thinking, "WD-40 is a lubricant, so what's this cleaning thing?" Well, you are right; most people use WD-40 as a lubricant, and it works well doing its job.

When I worked for a radio company, we used to rent out walkie-talkie radios to building sites. Most times the radios came back looking as if they had been through the concrete mixer. The plastic cases had to be scrubbed clean, often with a wire brush. Although not perfect, we used to wipe them over with a thin coat of WD-40, which put a shine back on the plastic.

While most of you will not have to do such a drastic clean on devices, the same trick of wiping plastic items with a cloth and a little WD-40 will improve the look of a tired item.

26) Removing sticky labels off boxes

If we purchase a new device and it is delivered by a courier, we will often find address labels and information stuck on the box. If you are disposing of the box, it is your choice whether to remove your details or not.

In this modern world, I would suggest you remove your identity details because there are people who will try to use your identity for ill-gotten purposes.

If you are keeping the box with the device, it is nice to keep the packing box clean of shipping labels.

The quick and easy way to remove shipping labels is with a hot-air heat gun or a hair dryer on high heat. Do not worry if the label goes black while you are doing this. Once warm, the label will usually peel off easily in one piece.

Safety note: Use care with heat guns and hair dryers. Keep heat away from flammable materials and do not overheat cardboard, plastics or packaging.

27) Removing sticky glue from devices

How often have you removed a label from a device and found sticky residue still left behind? This tip should help you solve that problem.

Most modern glues are solvent-based, so they can often be softened and removed with a suitable cleaner.

Petrol may work, but it is highly flammable and should not be stored or used casually in a workshop.

A safer option is to visit a chemist or hardware shop and buy some isopropyl alcohol. A small bottle is usually inexpensive and will last a long time if you keep the lid on after use. To use it, pour a small amount onto a tissue or cloth, then wipe the sticky area until the residue is removed.

IMPORTANT: Isopropyl alcohol can be absorbed through the skin and can affect your health if used carelessly.

If you are going to use it for more than a quick wipe, wear rubber gloves and work in a well-ventilated area. Keep it away from flames, sparks and hot soldering irons.

Items required:

- Tissue or cloth
- Isopropyl alcohol
- Rubber gloves

Other commercial products may work as well.

28) Protecting paper labels

Often, when you make something and put it in a box, you need a label or two. There are two methods I have found that work, depending on what is available to you.

I start with a graphics package on the computer, preferably one that lets you specify the exact size of your layout. I make the label a little smaller than the project box, cut it out and check the size. Once I am happy, I take a coloured sheet of A4 paper, normally blue or green, and print the final label.

Cut out your final label and use a laminator to seal the image in a plastic covering. Normally, control knobs or plugs will hold the label in place. If your project has a screen or display, use the same method but cut a window out of your label to accommodate the display. The display will still work fine and will be clearly visible.

If you do not own a laminator, create your label as above and then paint on two or three coats of clear nail varnish over the label. This will help protect your paper label when the device is in use.

Items required:

- Computer graphics package
- Coloured A4 paper
- Laminator or clear nail varnish
- Scissors or craft knife

29) AC Current Limiter

When working on high-voltage or mains-powered equipment, it is often useful to limit the current supplied to the device under test. This is very useful when powering up a device that has not been switched on for years, or when you suspect the device is faulty.

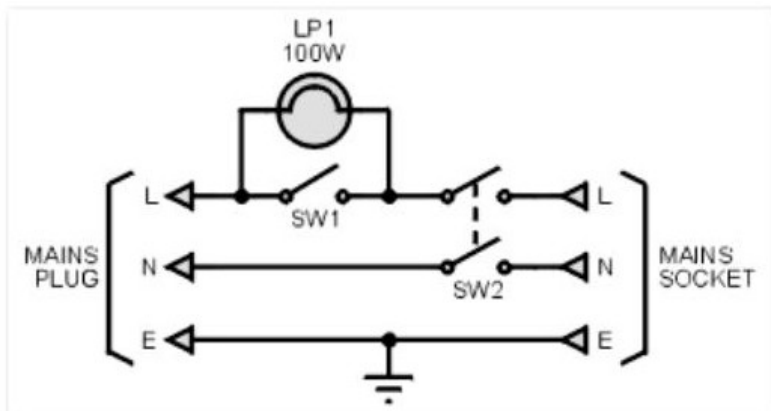
You require an old-fashioned incandescent light bulb, which needs to be placed in series with the device under test.

Newer LED light bulbs, while good for the environment, are no use for this situation.

When applying power to the device under test, the incandescent light bulb should light dimly as long as the device does not have a short circuit. Some voltage will be dropped across the incandescent light bulb, and this is normal. I would leave the device under test in this configuration for a good few minutes in case a short circuit develops after a few minutes.

If the incandescent light bulb glows brightly, you have a problem. Switch off, remove the mains power and look for a short circuit.

Safety note: DO NOT try or use any of the high-voltage tips if you do not understand them, or if you are not comfortable with your ability. Tool safety is important. Please read the manual or leaflet that came with the device before use.



Circuit Diagram of an easy to make AC Current Limiter

30) Mating BNC and N-type connectors

I have told this tip to a number of Amateur Radio operators and friends who work in the radio industry. Most do not believe me at first, while others check to make sure it is not the first of April.

While I would not recommend this type of connection for long-term use, it can be useful while testing a piece of equipment.

A male N-type plug will mate with a female BNC socket in a push-together manner. They will hold together as long as they are not moved. This method should only be used in an emergency if you do not have the correct connector.



An image of an N-type plug on the left and two BNC sockets on the right



An image showing an N-type plug connected to a BNC socket

31) Where to find a 12-volt radio supply in a car

If you read most Amateur/Ham Radio books, as well as the radio manual, they all suggest connecting your power leads directly to the battery. Electrically, this would be the best option, but there are some very good reasons why you may not wish to do this.

Modern cars come with a multi-year warranty, and drilling holes through the car firewall may void this. If a hole in the car firewall is not sealed correctly, you could get fumes from the engine bay into your car. Both of these are valid reasons for not drilling a hole in the car firewall.

If you do decide to drill a hole anywhere in a new car, you need to check that you are not going to drill through a wiring loom or a piece of electronic equipment.

Most Amateur/Ham Radio books tell you that you should never use the cigarette lighter socket, which today is marketed as an accessory socket. These sockets are usually able to supply 12 volts at 10 amps, but the plug-and-socket connections are very poor.

I have found that removing the accessory socket and connecting your radio feed wires in parallel with the accessory socket leads is a good option. Because this is done inside the car, your wires can be kept short and tidy.

Also, if you sell the car, these wires can be removed easily without doing any damage.

The method above has worked for me on several cars for years. You should be able to run 25 watts with no problems and, most times, up to 50 watts. However, car manufacturers do not recommend running high power while driving, as this could interfere with the engine management system.

32) Ladder Safety

There are times when we have to work above ground level to complete a task. This usually involves the use of a ladder, and without following a few rules, you may be putting yourself in danger.

There are many different types of ladders designed for various jobs. Using the correct type reduces your chances of an accident and will make your job much easier. At the time of writing, I have five different ladders.

You should always inspect the ladder to ensure it is in good working order. This is doubly important if you have a ladder stored outside. Once you are happy with the condition of your ladder and have chosen the correct one, you are ready to erect it.

With stepladders, make sure they are fully opened and that any locking mechanism is used. On a large ladder, it is worth putting a cloth over the top bars of the ladder to ensure it will not mark the wall. Erect the ladder at a ratio of 4 to 1; that is, four units up for every one unit away from the wall.

If the ladder is going to be in the same place for a long period, find a suitable point to tie the ladder and make it secure.

Climb the ladder slowly and carefully, testing the stability of the ladder on the lower rungs. If the ladder has not been securely tied, get someone to stand on the bottom rung to ensure the ladder is secure with some weight at the bottom.

When working at height, do not overreach to complete a job. Move the ladder into a new position. This may take an extra five minutes, but it is much better than spending weeks in hospital.

When doing this type of work, you should use PPE (Personal Protective Equipment). Hard hats and high-visibility vests are a good start. When working at height, another useful item is a tool belt. This allows both hands to remain free while climbing and gives you a place to keep tools while working at height.



**Always
Face Ladder
Use Both
Hands
Climb Slowly**

33) Using a Bulldog clip to hold cables

This is a straightforward tip to stop cables falling to the floor when unplugged. All you need is a Bulldog paper clip.

There are various designs of these clips, and you can use what you have available.

The type that works best is the one with a black body and shiny metal levers. These are available in many sizes, so you should be able to find one that will fit your desk or table.

With this type of Bulldog clip, you clip it onto your desk or table. Then squeeze one of the levers in and detach it from the Bulldog clip. Put your cable through the gap and refit the lever to the Bulldog clip.

This will stop cables falling to the floor and make it easy to find cables that are not in use all the time.

The other type of Bulldog clip does not come apart like the ones mentioned above. However, if this is all you have at the time, they have a hole in the lever and, with the aid of a cable tie done up loosely, you can achieve the same result.

34) Bagging up programming leads

If you are like me, you probably have more radios than you can use at any one time. One thing I always recommend when purchasing a new radio is to buy a programming lead for it.

Often, the new radio software for programming can be found online and, in most cases, for free. If you do not have a programming cable, your only option is to try to program the radio memories from the radio keypad. This is both time-consuming and likely to lead to mistakes, which then gives you even more problems to rectify.

A lot of these programming leads look the same, although they are wired differently. If they are stored in a box, the wires always seem to tangle together, which is also a pain.

The way I solve this problem is to purchase some small plastic bags that can be sealed. Place the programming lead into the bag and, with a permanent marker, write on the bag which programming lead is included.

This tip works for me and makes finding and using the correct programming lead easy.



Radio
programming leads
in separate bags

35) Tantalum capacitors

Tantalum capacitors are very useful electrolytic capacitors because they have several advantages over standard electrolytic capacitors.

Firstly, they are relatively small for their capacitance value. This makes them useful in compact devices.

They are also often used in RF (Radio Frequency) areas of electronic circuits. However, when they fail, they can create more problems than they solve.

Tantalum capacitors often fail by going short circuit, so it is worth measuring each one with an ohmmeter if you suspect a fault. Because of their construction and the chemicals used, if they are fitted across a supply rail and go short circuit, they can catch fire and give off a lot of smoke.

I have had tantalum capacitors fail and produce a lot of smoke several times. It is always worrying when this happens.



A few Tantalum capacitors

36) How to test light emitting diodes

This can be very useful if you want to test an LED. The first thing that comes to mind for most people is to grab a digital multimeter and select the diode test option. This sounds like a good idea until you realise that many meters supply only around 1 volt at the terminals.

All LEDs require a higher voltage to turn on and light. Red LEDs light at around 1.7 volts, with other colours having a higher turn-on voltage, often up to about 3 volts.

You may be lucky and have a meter that puts a higher voltage across the terminals on the diode test range, although this is not common. I have an old meter that will do this, but many will not.

So, if you have several LEDs in your parts bin, how do you know if they work? If they are made from clear plastic, how do you know what colour they are?

A simple and cheap way to test LEDs is with a 9-volt battery, a 2,200-ohm resistor and a battery connector.

Connect the red battery wire to one end of the 2,200-ohm resistor. Now connect the LED between the black battery lead and the free end of the resistor. Reverse the connection to the LED if the first attempt does not work.

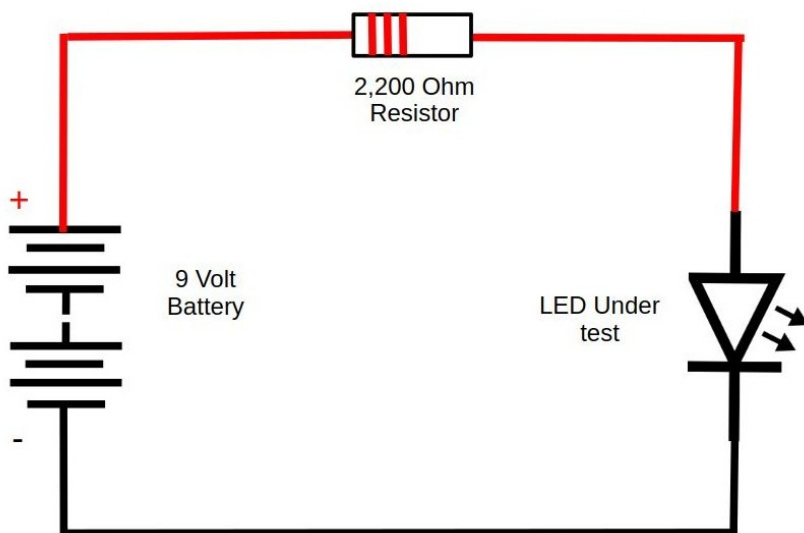
The 2,200-ohm resistor is sufficient to work with standard LEDs and will limit the current through the LED while dropping the remaining voltage across it.

Items required:

- A 2,200-ohm resistor
- A 9-volt battery
- A battery clip with red and black leads
- The LED under test



Parts required: A 9 volt battery, a battery connector and a 2,200 ohm resistor.



The simple LED test circuit

37) Using pliers as a third hand

This is a tip that I use regularly while working on repairs. Sometimes two hands are not enough. This can be used in your workshop or when you are working remotely. A third hand is very useful when you need to hold something still, usually when soldering.

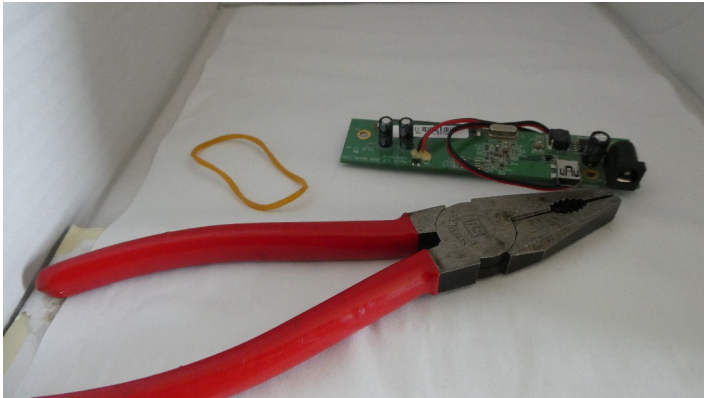
Any pair of pliers will do, depending on the job you are doing. With the pliers closed, wrap an elastic band around the base of the handles. Then open the pliers enough to hold your item and let the elastic band close the jaws onto the device.

Doing this over the years has helped me many times when working away from the bench and I did not have a vice available.

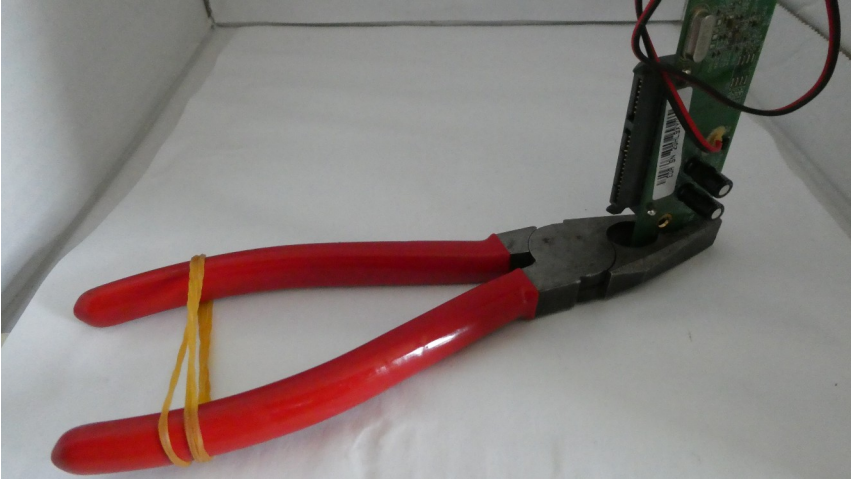
Items required:

A pair of pliers

A rubber band



An image of the basic parts needed to make a third hand



Home made third hand in use

38) Identifying the end of a cable

When we run several cables between two places, it is often difficult to find which two wires are a pair, especially if a lot of the wire colours are the same.

You are probably thinking: I only need to short two wires together at the far end, then at the local end look for a pair with a short circuit. While this will work in most cases, if you have damaged the cables while pulling them through various obstructions, there may be more than one pair of wires that measure as a short circuit.

Another solution is to connect a resistor across the remote pair. Use a fairly high resistance value because, with low resistance values, you will also measure the cable resistance as well as the resistor. This may confuse you with a different value from the one you were expecting.

My preferred method is to connect a diode across the remote pair at the far end. At the local end, measure a pair of wires. One way the diode will conduct and show resistance; the other way it will appear as an open circuit.

Items required:

- A diode with crocodile clips on each end
- A multimeter

39) Injecting hum into an audio amplifier

This is a quick and dirty tip that helps you split your fault-finding on a radio or audio amplifier. While the tip can work on both high- and low-voltage items, please be very careful when working on high-voltage equipment.

If you hold the blade of a screwdriver and touch the centre of the volume control, you should hear mains hum generated by your body being fed into the audio amplifier. This gives you an indication that the amplifier is working.

On an audio amplifier, you can inject the hum in the same way, but this time into the input socket.

Your audio amplifier may not be working perfectly, but if you can hear the hum, it is working well enough to suggest that the fault is unlikely to be in the audio output stage.

Do not use this method on equipment where dangerous voltages may be present unless you are trained and confident to do so.

40) Drain Pipe Loudspeaker

You are probably thinking I have lost the plot with this one. However, if you stick with me, you may be surprised.

Most communications radios and other electronic devices have their loudspeakers mounted on the top of the case.

While you may think this is fine, for a few pennies you can improve the audio.

The first thing you need is a drain pipe connector with an angle of about 60 degrees. Your local hardware store will stock these in various sizes and colours. Choose one a little larger than the loudspeaker opening on your device case, and in a colour you are happy with.

Place the drain pipe connector over the loudspeaker opening and it will channel the audio in your direction.

You may be surprised at the improvement.

To hold the drain pipe connector on your device, use some craft putty. In the UK, this is commonly called Blu Tack.

Items required:

- A 60-degree drain pipe connector
- Some craft putty, such as Blu Tack



A basic plumbing part



The basic plumbing part sitting over the radios loudspeaker and focusing the sound forward

41) Extending the Range of a Walkie-Talkie (Ground Plane)

Walkie-talkie radios, which our American cousins call handy-talkies, are designed to be low-power, short-range devices. They often have power levels up to 5 watts, although there are the odd models rated at 10 watts.

The higher the power, the quicker the battery runs out. Running a radio on high power can also make some batteries get hot, which will keep your hand warm in winter but is a pain in the summer.

So, how do you increase the range of your walkie-talkie without costing a fortune? Your first option is to fit a better antenna. However, there is another simple way to increase the range of a walkie-talkie.

You need to add a ground plane to your walkie-talkie. Try to find a screw that is connected to the chassis.

If one cannot be found, unscrew the antenna and find a loop crimp connector that will fit over the earth part of the antenna socket.

Now cut two pieces of wire: one for two metres and another for seventy centimetres. Start with 50 centimetres for two metres and 16 centimetres for the 70 cm band.

Once connected, you may be able to access repeaters that were just out of range before. This tip may make the walkie-talkie look strange, but it works well.

You could always make the ground plane with a plug and socket so that it can be removed when you only need local contacts. In the USA, these are sometimes called Rats Tails.



42) How to Roll Up Coax Cable Correctly

While you may think it is strange for me to say you need to roll up coax cable correctly, after all, it is only a piece of wire, I am sure you have seen people wind all sorts of wire in a loop between their hand and elbow. If you do this to coax cable, it can shorten its life and may change its impedance.

A change in impedance cannot be found with a multimeter.

This could lead to you chasing a strange SWR (Standing Wave Ratio) fault. Coax cable is also expensive to buy, and looking after it will give it a longer service life.

If you damage your coax cable, the chances of a break in the inner wire being close to the end are remote.

There are ways of finding how far along a break in the cable is, but this is outside the scope of this tip because it requires non-standard test equipment, which often costs more than replacing a suspect length of coax cable.

So how do we roll up coax cable correctly? When you purchase coax cable, it will initially have come off a reel.

Because of the time it has been stored, the coax cable seems to develop a memory effect.

When rolling up your cable, start by creating a circular loop of cable. Either hold the first loop in your hand or put a piece of tape around the first loop. Do not make this loop too small. Then wind the coax cable through your hands so that it emulates going back onto a reel. Let the coax

cable go the way it wants to go. You may have to turn the loops of cable in your hand to remove any kinks while winding it up.

Doing this will give you longer use of your coax cable for portable or temporary operation.

43) Marking Guy Wires and Wires on the Ground

This is a safety tip, and it is even more useful today because many people walk around with their heads buried in a mobile phone.

When we are out playing radio portable, we often erect antennas that need masts with guy wires, or antennas that need a wire ground plane. To highlight guy wires or ground-plane wires, I use strips of plastic tied to the cables.

These can be made from old carrier bags that have passed their useful life as bags. Just cut the carrier bag into strips and tie the strips around the wires.

Keep another bag with you to put the removed plastic strips in, ready for use the next time you go out.

This is a great way to keep your temporary operating area safe.

44) Turning a Hammer into a Rubber Hammer

This is a straightforward tip that can help when bending metal and you do not have a rubber hammer.

Often, when you need to straighten something or remove a dent without marking the item, you can turn an ordinary hammer into a rubber hammer for very little cost.

Take a rubber chair-foot cover or walking-stick foot cover and place it over the hammer head. These rubber foot covers only cost a few pennies and can be removed quickly to return the hammer to normal use.

45) How to Find Hidden Circuit Diagrams on the Internet

The internet is a great source of information, but with so much online, it can sometimes be hard to find what you are looking for. Search engines often display items to purchase and are full of advertisements.

Depending on the manufacturer, you may sometimes find service manuals to download.

Many devices are generic products that have been badge-engineered by sticking a company logo on the device.

If, after a generic search for a circuit diagram, you are unable to find what you are looking for, try the following.

On the printed circuit board, there will often be a part number. This may tell you who else uses this PCB in their products, which can narrow down the search.

In Google, after you have searched, you are given the option to view images. Clicking on images and scrolling through the results will often reveal the circuit diagram, service information, or PCB layout you are looking for.

46) Parting Coax Braid

This is another tip that I wish I had known about years ago. When working with coax cable, the outer conductor, which acts as both a shield and a ground connection, is often made of wire woven together.

I used to separate the woven wire with a small screwdriver. Then I discovered this tip.

First, remove the outer waterproof jacket from the coax cable. Take care not to cut into the woven braid when doing this, or you will have loose whiskers of wire falling out.

Now take an old toothbrush and start from the end, brushing outwards as you go around the coax cable. In a few minutes, and with a little patience, you will have separated all the exposed woven braid.

47) Broken Light Bulb Remover

SAFETY NOTE: This procedure involves mains voltage. Isolate the power at the fuse box or consumer unit and verify the circuit is dead before touching anything.

First of all, this tip involves working with mains voltage: 230 volts AC in Europe or 120 volts AC in the USA. These voltages can kill you, so if you are not comfortable doing this, ask an electrician.

Most light bulbs, when they fail, remain intact. Sometimes, when you try to remove them from the socket, the glass parts from the base. This can leave exposed wires, which may be live. You are then left with the metal connector still in the lamp socket.

First things first: do not rely on the wall switch to remove the power. It may have turned the power off, but someone else entering the room may try to turn the light on. Find your house fuse box and turn off your lighting circuit. I still check with a voltage pen, mains tester screwdriver, or meter to ensure there is no voltage at the bulb socket.

While you may think I am overdoing it, you do not know if someone has modified the house wiring.

Remember, there are old electricians, and there are bold electricians, but there are not many old, bold electricians.

Now for the tip, after covering the safety issues. Cut the end off a plastic drink bottle. This also helps protect you from getting cut if the glass is broken. Slide the modified bottle over the connector; the plastic bottle also gives you

some isolation. Untwist as normal to remove the broken bulb connector.

Sometimes, using a hot-air tool, you can shrink the plastic bottle to make a better fit.

Once again, safety is paramount. Only do this if you are confident in your skills and ability.

48) Discharging Capacitors

SAFETY NOTE: Capacitors in power supplies and valve/tube equipment can retain dangerous voltages after the equipment has been switched off. Do not work on high-voltage equipment unless you are competent to do so.

This tip is to save you from getting an electrical shock from a charged capacitor. When fault-finding equipment, we apply power to locate the fault. We then disconnect the power to make measurements.

Electrolytic capacitors can store voltage much like a battery.

When the circuit is working properly, these voltages are discharged when the device is switched off. This is not always the case.

Therefore, it is worth checking that electrolytic capacitors have discharged.

This is especially true when working on high-voltage equipment.

The quick and dirty way to discharge electrolytic capacitors is to short them out with a metal device such as a screwdriver. This is not good for the capacitors and can shorten their life. It also creates a flash and a bang.

The correct way to discharge an electrolytic capacitor is to discharge it through a load. You can make a simple device to do this. All you need is a resistance to drain the voltage in a controlled manner.

I started with some wire-wound resistors, the type you can bolt to a metal heat sink. The total value of resistance is not critical, as long as it is above 4,000 ohms. These resistors need to be of high enough wattage to dissipate the heat within them.

To make this device, start with a plastic box big enough to take the components. Cut a piece of metal to fit in the box.

Drill the metal plate and fit the wire-wound resistors. Wire all of the resistors in series to give you the total resistance from end to end. Fit four banana sockets, wiring the two black sockets to one end of the resistors and the two red sockets to the other end.

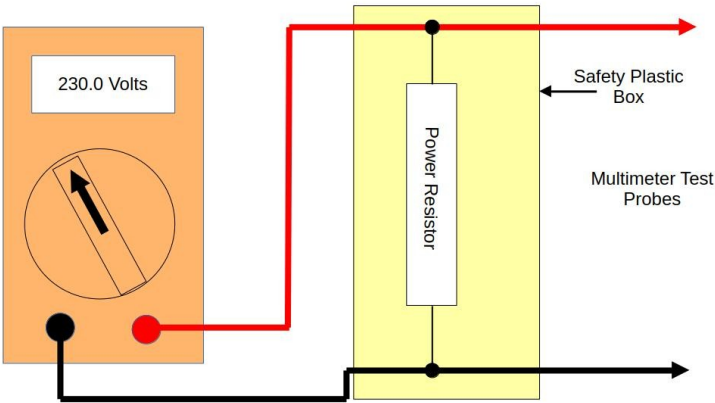
To use it, connect a digital voltmeter to one set of red and black sockets and a set of multimeter probes to the other sockets. Set the multimeter to a high enough DC voltage range. If you get the test leads connected with the wrong polarity, the digital multimeter will display a minus sign while discharging.

Once the multimeter voltage has dropped to zero, your electrolytic capacitor is fully discharged.

The above describes using a digital voltmeter. An analogue multimeter would work, but you need to pay extra attention to the voltage polarity. If an analogue multimeter is connected with the wrong polarity, the meter movement is driven back past zero volts and could burn out the meter movement.

Caution: On completion of discharging the capacitors, you must remove the discharge box before making any measurements. If not, all measurement readings will be

wrong and the resistors will get very hot. It may even melt your plastic box.



Discharging Capacitors

How to make a simple Capacitor Discharging Unit

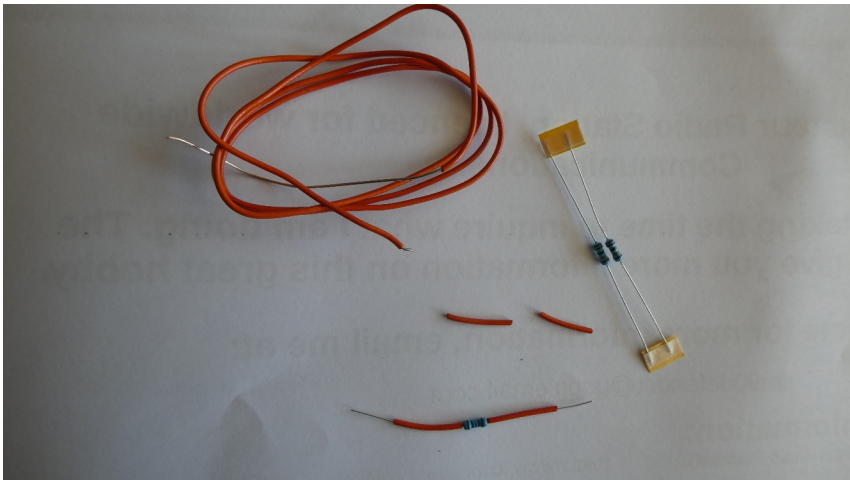
49) Sleeving Component Leads

This is a very simple tip and should not cost you any money. When doing point-to-point wiring, the component leads are the interconnecting wires. You do not want these wires to touch each other, as this will cause problems.

The solution is to sleeve the component leads, leaving enough wire at the end of the sleeving to make the solder joint.

So where are we going to find sleeving? I keep offcuts of wire in a tub. When I need sleeving, I just use my wire strippers and remove some insulation. I then slide the insulation over the component lead and solder it in place.

Because we are using odd offcuts of wire, this is good recycling and costs us nothing.



50) Is a Thermal Imaging Camera Useful for Electronics?

SAFETY NOTE: A thermal imaging camera does not remove the electrical shock risk. Keep safe distances from live equipment and only work on circuits within your competence.

This is a question I have asked myself ever since thermal imaging cameras became available. Today, there are many models on the market across a variety of price ranges. I know a lot of people like to use their smartphones for many things. Recently, thermal imaging camera modules have become available for smartphones.

I have two major concerns about these modules.

Firstly, they seem to be no cheaper than a dedicated thermal imaging camera, and when phones change in a few years, the software may no longer work, or the connector may have changed.

The second concern is that, with a smartphone device, you may get too close to the electronics and get an electrical shock.

Therefore, for safety, I prefer the stand-alone handheld version, which normally has a rubber case. This will not protect you from doing something very stupid, but it will give you better isolation from electric shocks.

So, what would you use a thermal imaging camera for in electronics? Today's modern electronics often use multiple integrated circuits. Tracing signals through a printed circuit board is still a good skill, but a quick look at a faulty printed circuit board with power applied may show one integrated circuit running very hot or very cold.

This would be a good place to start your investigation.

When constructing home-brew items, it is also very useful to see if a component is getting too hot and whether you need to increase the heat sink size.

You could spend a lot of money on a thermal imaging camera, but my approach was to look for a device at the cheaper end of the market and see how much I used it. If this device proves useful to you, you can always upgrade, and you should be able to sell your original device to recover some of the cost.



Thermal Imaging Cameras for a Smartphone and a stand alone unit

An Extra One :-)

I hope you enjoyed these tips, which have helped me repair many items over the years. I am sure some you already knew, and others you may not have known.

My last suggestion is to purchase a notebook. When you come across similar tips or technical information that you need to remember, write it down. I know this is old school, but I believe it is far easier than trying, in a few years, to remember which device you stored the information on.

Please stay safe and do not undertake jobs outside your skill set or comfort zone.

Stay safe.

After more than fifty years of working in the Radio and Computer industries, I have come across many useful tips. While I cannot claim the credit for all of these tips, they have all saved me time and money.

A few of these tips you may already know; however, when producing this book, I shared some of the tips with my friends. They found them very useful and informative.

I'm sure you will learn something from this book.