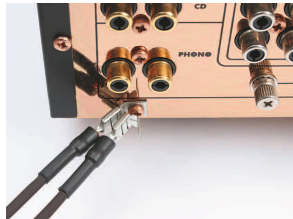




GROUNDING GUIDE



Russ Andrews explains his tried and tested technique for optimising grounding in a Hi-Fi or Home Cinema system.

Optimising your Grounding

What is Earthing and Grounding?

It is clearly crucial in any guide to improving your grounding that the basic practical difference is explained between earthing and grounding. The two are often confused and it helps to understand what each does.

Earthing

These two terms sound like they are describing the same thing and so get confused. Earthing is the term we use to talk about a connection that involves the electrical safety wiring in a mains powered (230V AC) house supply installation or mains powered equipment. It is the wire that provides the safe path to ground of a fault current, to prevent electrocution of the operator in the event of a live fault to exposed metal parts. In other words, if a fault occurs within a component causing a live part of the internal circuit to touch the external casework, the earth wire safely carries this current away from the component to ground. In theory, you shouldn't get a shock (or worse) when you touch the casework in the event of a fault.

The earth wire is a yellow/ green cable of sufficient size to carry the likely fault current. It requires a low resistance direct path to ground; the final connection to earth somewhere outside your house is usually provided by your electricity supply company. The resistance of this earth may be reduced by fitting your own earth spike in the ground outside your house in addition to the one the supplier provides.

Not all mains powered HiFi equipment has this connection to earth, however. Much of the equipment manufactured in the last 25 or 30 years has been 'double insulated' where the outer case you see is not connected to any mains-connected part. The case is 'floating' and may be plastic or metal. The mains power supply is within its own

insulated shield and the mains inlet is probably a two-pin IEC, figure 8, or three pin IEC or 'cloverleaf' type socket with the earth pin not connected internally. Source equipment and preamps are now usually double insulated like this.

Power amps or integrated amps usually have conventional three pin sockets with the earth connected.

Earthing is for safety! Earthed equipment should always be connected to your earthed ring main (I will discuss the quality of that earth some other time!).

Grounding

Grounding is the term we use to talk about connections to ground of the RFI signals picked up by the various exposed metal parts of your HiFi system. These connections are not safety related and are best connected with wires which you will need to fit to the casework, through our RF Router which is specifically tuned to these high frequency signals. The output of the RF Router is then connected to a low resistance and low inductance path to an earth spike which has a good low resistance to earth. Alternatively, the use of our plug-in RF Router provides a path to ground via your normal mains earth.

I have known for very many years that grounding casework has a

generally beneficial effect on dynamic range and bass depth etc... and we have fitted grounding terminals on our PowerBlock and wall sockets for much of that time. For a short while, the requirements of the then new 17th wiring regulations in 2008 forced us to rethink the technique of directly connecting earth spikes to the house ring

"I have known for very many years that grounding casework has a generally beneficial effect on dynamic range & bass depth"



RF Router MK II

“The benefits of grounding the signal this way are profound”

earth, as this was outlawed. They quickly abandoned this however and made it legal again. In the meantime, talking to audio designer Ben Duncan about the problem I learned that he could see a way to connect to an earth spike effectively but (then) legally and also see a second benefit in incorporating a more effective RFI dumping circuit in the design. Ben's circuit is frequency-optimised to provide an easy route for RFI to exit equipment chassis down to ground..... hence the name RF Router for the product.

Tests proved the efficacy of the device and we proceeded to experiment with ways to get the most benefit from it in any system. We began with my own big system and that of my old friend Chris. He is a retired gentleman of means, time and with an insatiable curiosity... plus, of course his great love and knowledge of music. Chris experimented with every possible combination of connecting everything together with ground wires and routers over many months and we finally came to some very important conclusions.

First, getting it right was absolutely essential. Small differences in exactly what was connected to what, in what order, were very important.

Second, the effects were stable, repeatable and predictable.

Third, although his first priority was the musical effects, Chris could see the effects in the picture quality projected on his Home Cinema screen.

Fourth, he had turned years of grounding 'black arts' insecurity into a relaxed certainty that his grounding was 'good'.

I took that knowledge and tested it on very simple modest systems to prove that it was a general solution to correct grounding rather than just specific to a very special complex system. And it was! Fortunately, the correct grounding path is very simple: follow the signal path.

The preamp or integrated amp is the 'hub' and all source equipment grounding cables connect directly to it. The preamp grounding cables connect directly to the power amp which is then linked directly to the input of the Router. If you have speakers with driver chassis ground connections, connect them both directly to the Router. The output of the Router then connects to the ring main earth or ground spike outside.

So why do we recommend grounding the metal equipment casework independently like this to earth? It's important to understand how the music signal passing through the circuits in your source components and amplifiers relate to the metal equipment casework that surrounds them.

In a single-ended system (i.e. one where the connections are made with RCA (phono) interconnects), the signal consists of the music signal and the ground: both are needed for the signal to flow as a circuit. The outer part of the phono plug is the ground connection and the centre pin is for the signal. Now, this signal ground is usually (but not always) connected inside equipment to an earth point... an earth point that is also connected to the mains earth and the equipment casework.

If you have a balanced circuit (with XLRs connectors), the signal itself is split into positive and negative but the third pin is essentially the same as the signal ground in single ended circuit. Like that circuit the signal ground is connected via the earth point to the equipment casework.

So you can see that equipment casework is linked to the signal ground: high frequency RF noise in the signal ground appears in the casework.

Because the casework is linked to the signal ground, this also means it's relatively easy to connect the signal ground (via the casework) and dump the noise in it to earth.



Use ground wire such as our Technical Ground Weave, left, to connect your equipment casework together.

Sound Benefits

The benefits of grounding the signal this way are profound. At first listen, you will be struck by how much lower the bass goes, how much tighter and cleaner it is. Then by how much more articulate, how you can hear more easily the notes being played. Next you realise that the instrument has a defined character, tone and presence as a separate instrument. Next, you

may be aware of the musician playing that instrument, his technique and musical skill.

What is true of bass instruments is true of every instrument and voice. Everyone seems to be playing better than you heard before.

After hearing all those changes you may realise that the whole performance is so much more real, so much like being there. Wow... don't you want some of that?

We found the upgrading effects of grounding on all levels of system to be so great that we have pushed Grounding up the hierarchy of upgrading steps right to the top alongside the other mains upgrades. It also prompted a reassessment of mains cable earthing itself. Starting with our woven mains cables we have completely redesigned their construction. In the light of these RFI grounding issues we realised that there was an improvement to be gained by stopping the cable weave inducing RFI noise in the earth wire: many prototypes, listening tests and RFI measurements later we are ready to launch a new range that take performance to new levels of musicality, resolution and clarity.

We have also looked at the wires and cables we use to implement the grounding process, finding that the wire material's quality was clearly audible. The improvements brought by using KIMBER TC wire and Kimber silver wire turned out to be just as audible as when they are used as signal or speaker cables! And boy was Super Burn In worthwhile! I wouldn't be without it. Speaking of SuperBurn In, we have a new machine (under development for the last five years!) to take the process to a whole new level.

Symphony

Many of you will be familiar with our long-time range of electromagnetic field stabilisers for the mains and area round the system. We have recently changed supplier to have access to the latest designs for this useful technology. The new product is the Symphony Pro, and is proving noticeably superior to our previous products in reducing the audible effects of the electromagnetic fog we live with. As the noise and hash is reduced we notice that, along with the system, WE feel more relaxed and less stressed. We think this technology is a welcome addition to our system grounding efforts.



Why grounding is especially important now

Dumping RFI out of your system has never been more important than now. The RFI fog we endure in the name of 'staying connected' is a serious issue for the Hi-Fi enthusiast, and it can only get worse exponentially into the future. As we progress through 3G, 4G and into 5G the mast density in the environment increases and the broadcast power and frequencies go up to achieve the area coverage and data density we all demand. We now expect Superfast broadband speeds of Internet access on our mobile phones anywhere we want to use the web or social media sites. Emergency Services are ramping up their communication networks to give Police, Ambulance and Fire Service personnel better live voice and video computer-driven control. There are concerns about the public health aspects of these powerful digital networks in towns and cities where the mast density must be very high to eliminate blind spots.

You may be sensibly not using Ethernet-over-mains devices, but your neighbours probably are because they don't want to use cables to connect all their audio visual kit. Our need to protect our musical enjoyment from the degrading effects of 21st century lifestyle is urgent and increasingly important. We are working increasingly hard to find effective solutions for us all.

What to do

Grounding casework is very simple to achieve. The basic components are some grounding wires, some means of connecting the wires to the casework, an RF Router, and a way of connecting your RF Router to earth - either by using the plug-in version or connecting it to either a wall socket with earth terminal or an external earth spike. Consult the diagrams on page 7 to get an idea of the connections you need to make and consult the *Choosing Your RF Router* box on page 10 to identify which is best for you.

To make wiring everything up easier, we have ready-made grounding wires and tags. To connect a ground wire to your casework, simply remove one of the casework screws (figure 1), fit a casework tag (figure 2) and refit the casework screw, securing the tag tight to the metal case.

In our example, our casework is bare copper, but if the casework is painted, strip a little of the paint off before

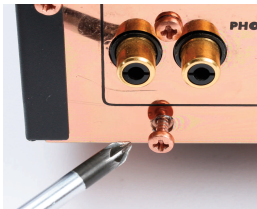


Figure 1

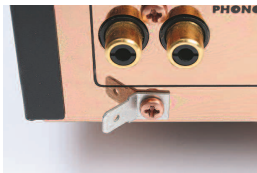


Figure 2

tightening the tag to ensure you are getting a good connection. Do this on each source, and fit a grounding tag to the preamp, or to your integrated amp.

The grounding wires (which are fitted with the appropriate spades) simply push on to the tags (figure 3) and connect everything together; they are easily removed if you need to move or rearrange anything.

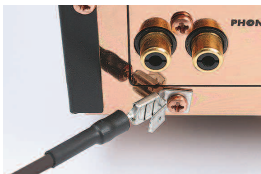


Figure 3

You'll see that the grounding wires have a stackable spade (figure 4) which makes it easy to connect multiple wires to a single chassis tag at the preamp / integrated amp (figure 5).



Figure 4

If you have a preamp and power amp combination, fit more chassis tags to them and connect a ground wire between them. Finally, connect a wire from your amplifier to the RF Router, and connect your RF Router to earth. The way you do this depends on which RF Router you have chosen.

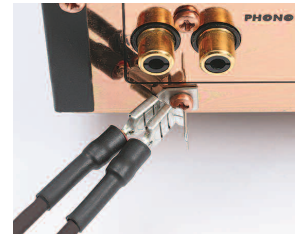


Figure 5, Showing two grounding wires connected to the chassis tag

While the basic wires and tags give a good connection, for ultimate performance you can opt to fit our Technical Ground Weave and matching tags.

These tags offer a banana socket to match the banana fitted to the Technical Ground Weave (figure 6).

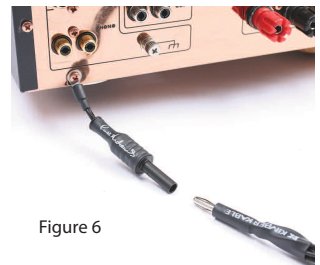


Figure 6

It's particularly worthwhile opting for this bigger weave on the final link from your power amp/integrated amp and the RF Router, and, if using the RF Router MK II, from the RF Router to the grounding point on your wall socket (or outside to your external grounding spike). I must stress the importance of using the RF Router; the sound is so much better with it inline than without it.


Grounding your speakers

You can even ground metal speaker drive units in the same way as equipment casework (and it is worth doing so). Some speakers have ground terminals, or you can fit your own – see the appendix for more information on how to do this.

Grounding double-insulated equipment

The chassis (equipment case) is the most important part to ground, but if a component is double-insulated (or the mains input is a 2-pin, figure-8 type) you will need to ground the signal earth by connecting to one of the unused phono sockets. We have a ready-made woven RCA grounding lead made with Kimber Kable for this purpose, with a phono plug on one end, and a stackable spade on the other (as shown in Figure 4 on page 4). We can also terminate them phono to M5 spade (for connecting to your RF Router), and phono to banana if you are using chassis ground banana adaptors (see Figure 6).

What is double-insulated?

Double insulated equipment – usually denoted by this symbol  – has metal casework that is not linked electrically to your component's internal circuit. Double insulated equipment often (but not always) has a figure-8 mains input socket or a 2-pin IEC socket. Because it's electrically isolated from your component's circuit, grounding the casework is less successful but we have a way to ground components which are double insulated.

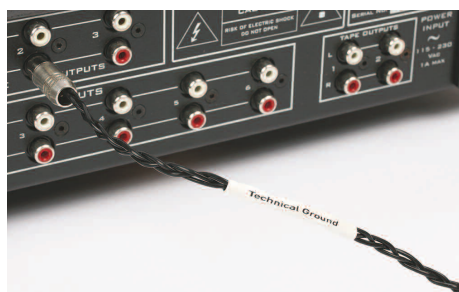


Figure 7. If your equipment is double insulated, connect the RCA grounding wire to an unused phono socket instead of attaching to the chassis. The other end connects to the next component in the conventional way.

Using the RCA Technical Ground Weave cable with standard (non double-insulated) equipment

You may get further benefits by using the RCA Technical Ground Weave cable on standard, earthed equipment. We say may because the only way to find out if there are further benefits is to try it! Listening is your best bet – if it sounds better with the additional ground in place, it is better.

The benefits of using an earth rod

All this is about dumping RFI/EMI out of the system and into a good, low resistance earth. How do I get a good low resistance earth you may well ask? I know that many of you are connecting your RF Router to the mains earth. This works well and is simple to achieve, but for very best performance you should connect the RF Router to an external earth spike or rod, buried in the ground outside.

This answer isn't simple, I'm afraid, because the quality of your earth depends on the soil resistivity which varies with type and situation. If you are lucky, a simple four foot earth spike will do a good job but you may find it more difficult in dry urban situations.

It is worth doing properly, so get a good electrician involved at the beginning who has the measuring equipment to ensure that, whatever lengths you have to go to, you get a reliable low resistance earth.

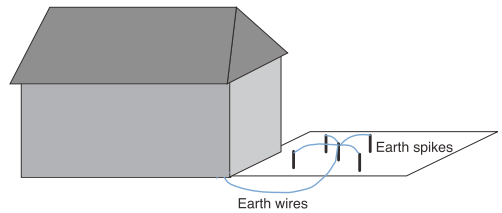
Earth rod installation – some practical considerations

Where soil conditions are good (very moist, farming, loamy and clay soils) a single earth spike may well prove sufficient to get a good low resistance earth connection. Select a suitable place away from the house (the soil is usually driest near the house) and drive in the earth spike with a lump hammer or sledge hammer - avoid buried pipes and cables! If you have found a good spot, it will drive in easily. If not, then the soil is probably full of rocks or stones that will not make a good earth. If this is the case, search for a spot without rocks. If you can find no soft and easy place, you will need to consider putting in a star network of rods linked together. Each rod should be further apart than they are deep. Another alternative is to bury a long copper plumbing pipe horizontally about 1m down in a trench. This could be under a lawn, but make the end you connect the earth cable to easily accessible so that you can check the connection regularly.

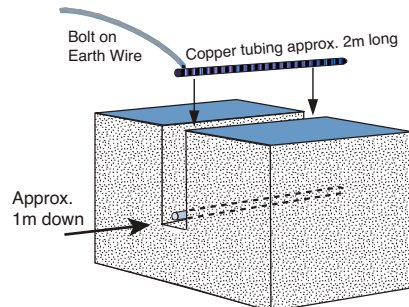
Whatever technique you apply, consider treating the soil round each rod or pipe with a chemical treatment like Magnesium sulfate, copper sulfate or ordinary rock salt. The best technique for a pipe is to dig a circular trench round the rod, fill it with the soil-treating material and cover with soil.

Your electrician can solve these problems for you and guarantee the result. Connection to the earth rod should be with a thick copper earth wire (10mm or 16mm²) or with our own Russ Andrews woven grounding wire. Remember to protect the wire in some way to prevent accidental damage that might go unnoticed (gardeners use spades and other sharp tools!).

It might also be wise to fit a plastic pipe through the wall to feed the earth wire through. It is easy then to seal it with mastic.



External Star Grounding: earth spikes in a star pattern



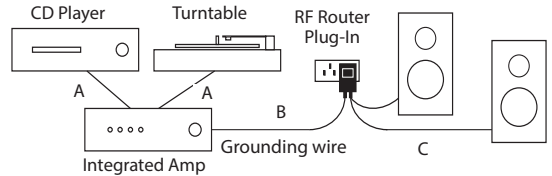
Alternative to using an earth rod: bury a piece of copper tubing.

Connecting it all together

Example 1: How to connect the casework grounds to an integrated amp.

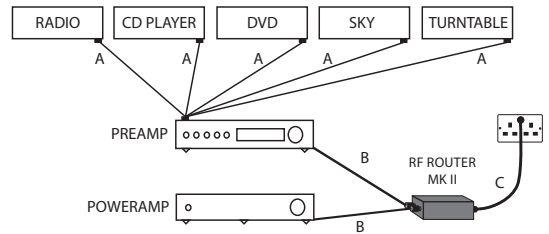
If using the Grounding Wire, use type 'A' cables between the sources and amp and type 'B' between the amp and router. In this example we are using the RF Router Plug-In which simply plugs into the wall socket, and we've even grounded our speaker drive units and connected them to the RF Router.

If you are using Technical Ground Weave, use the chassis ground banana adaptors on your sources and amplifier and Connect the technical Ground Weave to them. You can use more than one chassis screw and Chassis Ground Banana Adaptor.



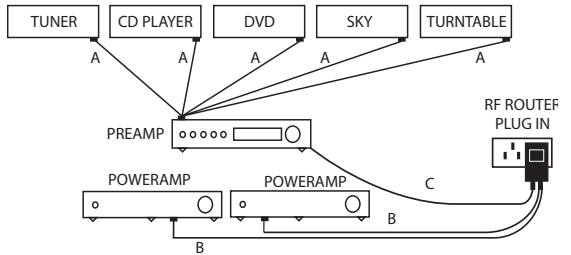
Example 2: Connecting the casework grounds to a preamp and power amp.

If you are using a separate preamp and power amp, the principle is the same – but use the preamp as the grounding 'hub' for your sources. Then link the preamp to the RF Router and the power amp to the RF Router. In this example, we are using the RF Router MK II to link to the earth terminal on a SuperSocket or UltraSocket. Use a type C cable between the router and the earth terminal.



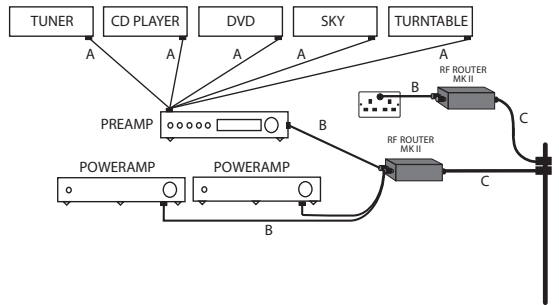
Example 3: Connecting the casework grounds to a preamp and two (or more) power amps.

If your system comprises a preamp and more than one power amp (or active loudspeakers), alternatively try grounding the system via the power amps as shown.



Example 4: Connecting Mains Earth

In this example we've also connected the ring main earth to a second RF Router MkII. It won't provide a safety earth, but it gives an effective RFI/EMI ground and is a worthwhile and noticeable improvement. Use a cable fitted with bananas at both ends to make the connection.



What you will need

Choosing your RF Router

We have two different types of RF Router, and you need to choose the correct one depending on how you are going to connect it. The RF Router MK II is in the form of a compact box which has two inputs to connect your amplifier (and speakers if you ground those or mains earth), and a single binding post output. You would use this single binding post output to connect to a SuperSocket or UltraSocket binding post with technical ground wire, or use it to connect to an external grounding spike. If you are fitting an external earth rod, you must choose this RF Router.



RF Router Mk II Code: 1898
[View online here](#)

The RF Router Plug In is in the form of a plug-in 'wall wart'. It has two input terminals to connect your amplifier and speakers, but rather than having a binding post output you simply plug it into a wall socket. It uses the earth pin of the wall wart to connect RF to ground. You cannot use the RF Router Plug In if you are fitting an additional external earth rod.



RF Router Plug-In Code: 1915
[View online here](#)

Choosing your wire

If grounding your system with **Grounding Wire**, choose a pack of tags and as many Grounding Wires as you need. The Grounding wires have different terminations depending on where you are using them; consult our diagrams on page 7 to ensure you choose the correct termination type.

Grounding Wire *Code: 1092*



[View online here](#)



[View online here](#)



[View online here](#)

Chassis Tags *Code: 3196*

[View online here](#)



If grounding your system with **Technical Ground Weave**, choose as many Chassis Ground Banana Adaptors as you need. The Technical Ground Weave is terminated with bananas to fit into the Chassis Ground Banana Adaptors or the earth terminal of our Super/Ultra Sockets.

Technical Ground Weave *Code: 1090*

Technical Ground Weave can be terminated with bananas or spades; the cost is £15 for both ends plus the cost of the cable: ie 3m terminated would be £15 + £30 = £45



[View online here](#)



Chassis Ground Banana Adaptor *Code: 3197*

[View online here](#)

More useful products...



Earth rod and clamp
Code: 1201

[View online here](#)

RCA Technical Ground Weave Code: 1096
Phono to Piggy-back Connector/M5 Spade/Banana

[View online here](#)



Phono to Piggy-back Connector



Phono to M5 Spade



Phono to Banana



DCT SuperSocket with earth terminal Code: 1803

[View online here](#)



UltraSocket Code: 1901
with earth terminal

[View online here](#)

Appendix:

Grounding your speakers

Some loudspeaker manufacturers - for example, Tannoy, in some of their higher-end and us (in the Russ Andrews Quave LS1 speakers) - helpfully provide an extra binding post that lets you ground the speaker drive units. This binding post is connected internally to the metal chassis of the drive units, allowing you to ground them in the same way as you have done with your metal-cased amplifiers and sources.

If your speakers don't have grounding terminals, you can test the principle fairly easily for yourself without having to modify the drive unit. When you remove the speaker grille, you will find the tweeter(s) and one or more drive units held in with screws. Tackle only the drivers and tweeters with metal bodies... drivers and tweeters that have a plastic chassis do not need grounding, of course.

Remove one screw from each driver and clean the metal around the screw hole to remove any paint. Strip the end of a piece of wire that is long enough to reach your RF Router, make a small loop in the stripped end and refit the driver screw through it so that it makes a good tight connection with the chassis. If there is more than one driver on each speaker, you can link them together or run two lengths of wire. Typically you would connect ground wires from both speakers to the second input terminal on your RF Router, as we have shown in Example 1, on page 7.

If you like what you hear, you can make the connection permanent, but it will involve making modifications inside the speaker. Make a connection at the back of the driver (inside the cabinet) and run ground wire to an extra binding post on the back plate, next to the usual speaker terminals. Then use this to connect to your RF router permanently with ground wire or weave from the new ground binding post. We can do this modification for you if you aren't comfortable doing it yourself - contact us for more information.