



A Guide To The Russ Andrews Grounding System

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

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Section 1

Understanding the Grounding System

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What's the difference between Earthing and Grounding?

(If you simply want to know how to set up your grounding system, skip to Section 2, [here](#))

It is crucial in any guide to improving your grounding that a clear distinction is made between grounding and earthing. The two are often confused and it helps to understand what each does.

Earthing

Earthing is the term we use to talk about a connection that involves the electrical safety wiring in a mains powered house supply installation (230V AC here in the UK), or mains powered equipment. It is the wire that provides the safe path to ground of a fault current, preventing electrocution in the event of a live fault making contact with 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, usually provided by your electricity supply company.

Not all mains powered HiFi equipment has this connection to earth, however; more about this later.

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 providing an efficient path to 'drain away' degrading RFI (Radio Frequency Interference) signals picked up by the various exposed metal parts of your Hi-Fi system.

These connections are not safety related and are best connected with wires which you fit between the casework - or spare signal sockets in some cases - and our [RF Router](#) or [SuperRouters](#), which are specifically tuned to these high frequency signals. The output of the Router is then connected via a low resistance and low inductance cable to a grounding spike. Alternatively, you can use the ground terminal on one of our dedicated wall sockets, or our [plug-in RF Router](#), which provides a path to ground via your normal mains earth.

I have known for very many years that system grounding has a beneficial effect on dynamic range and bass depth, and we have fitted grounding terminals on our [Signature PowerBlocks](#) and [wall sockets](#) for much of that time.

Why Ground the casework?

So why do we recommend grounding the metal equipment casework?

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), a minimum of two wires is required, one for the music signal and one for 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.



Image shows grounding cables connected to the chassis of a Rotel amp via a 3-way Chassis Ground Banana Adaptor.

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.

You can now see that the equipment casework is linked to the signal ground: therefore, any high frequency RF noise in the signal ground also 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 Router) and dump the noise in it to earth

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

What is true of bass instruments is also 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?

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 exponentially worse 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 super-fast broadband speeds. Emergency Services are ramping up their communication networks to give Police, Ambulance and Fire Service personnel better live voice and video computer-driven control.

You may be sensibly not using Ethernet-over-mains devices (see John Armer's article about this [here](#)), 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. Rest assured; we will continue to work increasingly hard to find effective solutions for us all!

When to Introduce Grounding

We have found the effects of grounding to be so great, on all levels of system, that we have pushed Grounding up the hierarchy of our [Upgrade Steps](#) right to the top alongside the other mains upgrades. It also prompted a reassessment of mains cable earthing itself.

Grounding and cables

Starting with our woven mains cables, our research into Grounding led us to completely redesign their construction. In the light of RFI Grounding issues, we realised that there was an improvement to be gained by stopping the cable weave inducing RFI noise into the earth wire: many prototypes, listening tests and RFI measurements later we launched our Evolution PowerKord range that takes performance to new levels of musicality, resolution and clarity.

The very latest iteration of these cables - the EVO-S - takes the principle to the next level, integrating the mains cable with our Grounding System via connection to the SuperRouters.

We have also looked at the wires and cables we use to implement the grounding process itself, finding that the wire's geometry and material quality was clearly audible. The improvements brought by using KIMBER KABLE turned out to be just as audible as when they are used as signal or speaker cables!

Development of the RF Router™

An essential part of the Grounding System are the Router products - the RF Router and the SuperRouters.

The Routers originally came about following a conversation with audio designer Ben Duncan. A change in the wiring regulations in 2008 meant it was no longer possible to directly connect additional ground spikes to the house ring earth - a technique that can improve system performance. Fortunately, Ben could still see a way to connect to a ground spike effectively whilst still complying with the latest regulations. This would also see a second benefit in incorporating a more effective RFI dumping circuit in the design.

The product Ben designed to allow this has a circuit that is frequency-optimised to provide an easy route for RFI to exit the equipment chassis down to ground.... hence the name 'RF Router' for the product. Please note that the Router must not be used in any safety earth circuit.

Tests proved the efficacy of the device and we proceeded to experiment in other ways with it to get the most benefit from it in any system.



We began with my own complex system and experimented with every possible combination, connecting the casework of everything together with ground wires and routers over many months. We finally came to some very important conclusions...

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

2. The effects were stable, repeatable and predictable.

3. Although our first priority was the musical effects, we could also see the effects in the picture quality projected on Home Cinema screens.

I took that knowledge and tested it on very 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 used as the 'hub' and the casework of all source equipment connect directly to it with grounding cables. The preamp or integrated amp then connects to the RF Router/SuperRouter.

In systems with a separate power amp or amps, the power amps then also connect directly to the Router. If you have speakers with driver chassis ground connections, connect them both directly to the Router too. The output of the Router then connects to the ring main earth via a wall socket or (preferably) a ground spike outside.

Section 2

How to set up your Russ Andrews Grounding System

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What you'll need

Grounding casework is very simple to achieve. The basic components are some grounding cables, some means of connecting the cables to the casework, an RF Router or SuperRouter, and a way of connecting your Router to Ground.

Choosing your RF Router

We have four different types of RF Router, and you will need to choose the most suitable one depending on how you are going to connect it, and the level of performance you want to enjoy.



RF Router Plug-In

The simplest type is the RF Router Plug-In, which is in the form of a 'wall-wart'. It has two ground input terminals, 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 RFI to ground. You must not use the RF Router Plug-In if you are fitting an additional external ground rod.



RF Router MKII

The RF Router MK II is the same specification as the RF Router Plug-In but is in the form of a compact box which has two ground inputs to connect your casework, and a single output binding post. You use this output to connect to the ground terminal on the front of our SuperSocket, UltraSocket or Signature socket, or use it to connect to an external ground rod.



SuperRouter

The SuperRouter is our best type of Router, using a more complex design, higher quality components and intelligent circuitry. It has 12 input binding posts and a single output binding post for connecting to the ground terminal on your wall socket, or to an external ground rod.

There are two versions of the SuperRouter – one with high performance nickel-plated binding posts and the Signature edition with WBT's gold-plated pure copper binding posts for ultimate performance.

The SuperRouters should be used in the same way as the standard RF Routers – the additional binding posts are useful for more complex, multi-box systems and allow the connection to our screened EVO-S PowerKords.

Choosing your Grounding Wires

How your equipment is electrically wired will determine how best to integrate it into the grounding ecosystem and which ground cable to use – whether you attach to the metal casework or through the ground of an unused signal socket.

We have two primary ground cables available:

1. Technical Ground Weave – available in Basic or Premium varieties for components that are earthed
2. Technical Ground Tri-braid for double insulated components wired without an earth

1. Technical Ground Weave



Technical Ground Weave, and Premium Technical Ground Weave, are both available fitted with Kimber bananas for use with all grounding devices and grounding adaptor terminations.

Due to their robust design (thickness), we recommend they are best used in conjunction with one of the various chassis ground adaptors we produce, as they put less stress on the connection, which can often be to a small chassis screw.

2. Technical Ground Tri-braid



The second type of ground wire is for double insulated (Class II) components (see [here](#)) where you will need to ground via an unused signal socket. This is called Technical Ground Tri-braid and is available with a wide variety of connectors at the component end, such as RCA, USB, HDMI, BNC and RJ45, and a choice of connections at the destination end. See [here](#) for the full range.

All the Technical Ground Weave cables have the advantage of providing a lower resistance path to ground and also – like our Kimber speaker cables and interconnects – reduce the likelihood of the cable acting as an aerial for RFI.

All Technical Ground cables have a direction arrow to indicate best performance - when connecting your component to the Router, the arrow should always indicate the path *towards* the Router. Likewise, if the cable is being used to connect the Router to a Grounding point, such as a Ground Rod or wall socket with Ground terminal, the arrow should point *towards* the Ground.

DIY Option

We sell two 'off-the-reel' cables for a do-it-yourself option – Technical Ground Weave and 4mm Ground Wire. You'll need some good quality wire strippers (see [here](#)) and connectors for a successful termination!



Section 2.1

Connecting Components that are Earthed

Click [here](#) to open a printable pdf of this page

The easiest way to establish whether or not your equipment is earthed, is to look at the IEC socket - if it has 3 pins then it is highly likely to be electrically earthed and you should attach your ground wire/s to the casework. If the power lead is captive (i.e. wired directly into the back of your component), then look to see if there is the symbol for 'double insulated' printed on the back panel. If there is no symbol then it's safe to say it has an earth.

You will need:



Technical Ground Weave



Earth pin on IEC socket



Double insulated symbol

Ways to attach

Your Technical Ground wire/s should be attached directly to the metal casework or chassis of the component. We offer a number of simple ways to do this.

1. Chassis Ground Adaptor

Available as a single or triple version, these are made to connect to any available chassis screw.

They are terminated with a 4mm eyelet for a secure fit to the equipment and a high quality 4mm Banana socket for your ground wire.

The Chassis Ground Adaptor needs to be touching bare metal, so you may need to scratch a tiny bit of paint off from around the hole in the casework that you're attaching to. The end of a scapel or screwdriver should do the trick - just mind you don't slip!

Once you have some bare metal, screw on the adaptor and then connect your Technical Ground Weave (TGW) via the banana plug.

You will need:



Single or Triple Chassis Ground Adaptor



Remove the screw and scratch a small area of paint off with a screwdriver



Attach the Chassis Ground Adaptor and screw back in



Connect the TGW

2. Casework Ground Magnet

The Casework Ground Magnet offers a simple, effective solution for steel-cased equipment. The magnet uses a strong 30mm diameter magnet to attach securely to casework, reducing the need to loosen or remove chassis screws.

Available with either one or three 4mm nickel-plated banana sockets - and wired with Kimber TCX - to connect your ground wire/s. It does not need to be touching bare metal, as our tests show it's effective even when attached to coated surfaces.

You will need:



**Single or Triple
Casework Ground Magnets**

3. Chassis Tags

The chassis tag is ideal where you have an available screw to remove and fit the tag onto as it gives a nice secure fit. However, due to the size, we can only fit the corresponding connector (called a Piggy-Back spade) to the smaller gauge Technical Ground Tri-braid.

Alternatively, this a good DIY option using the basic ground wire and our Crimping kit. The Piggy-Back connector (the part that slides onto the tag) is also stackable, so more than one wire can be connected at a time, although we recommend no more than two wires are connected to one tag.



You will need:



Chassis Tags

4mm DIY Ground Wire

Crimping Kit

Piggy-Back Connectors

4. Direct

The final DIY option is to connect the ground wire directly to the casework. Our ground wires are available with either bananas, spades or eyelets and in a variety of sizes. The most common of these is an M5 (5mm), which refers to the distance between the prongs of a spade or the diameter of the hole in an eyelet. To check what size you need, remove the screw that you've chosen to use and measure the diameter of the thread and the head.

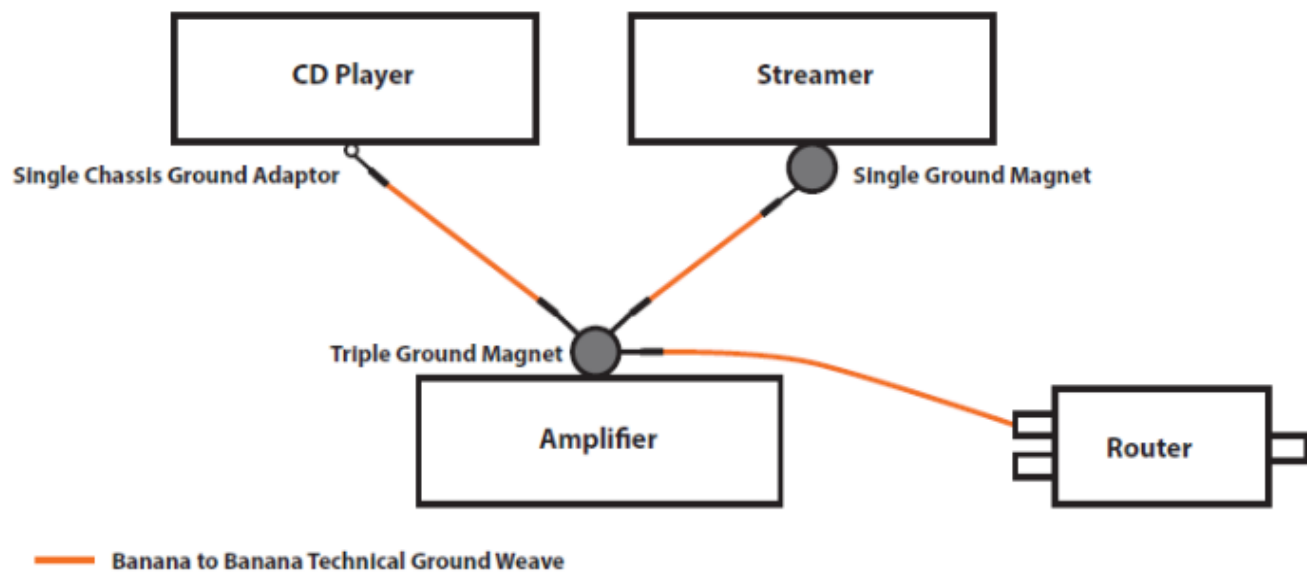


You will need:



Example of an M5 Spade and Eyelet

Example Connections - all components electrically earthed



Section 2.2

Connecting Components that are Double Insulated

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A double insulated component is wired with only Live and Neutral connected and has no connection to earth. This type of design is extremely common, but because the internals are completely insulated from the casework, attaching a ground wire to the casework is less successful in grounding RFI. The solution is to use the ground connection of an unused signal socket.



Double insulated symbol 2 pin socket



Figure 8 socket



What to look for...

Double insulated equipment – usually denoted by the symbol shown below right – has ‘floating’ metal or plastic casework that is not linked electrically to your component's internal circuit. 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.

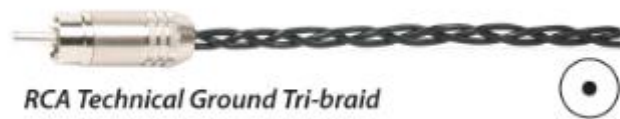


Double insulated symbol

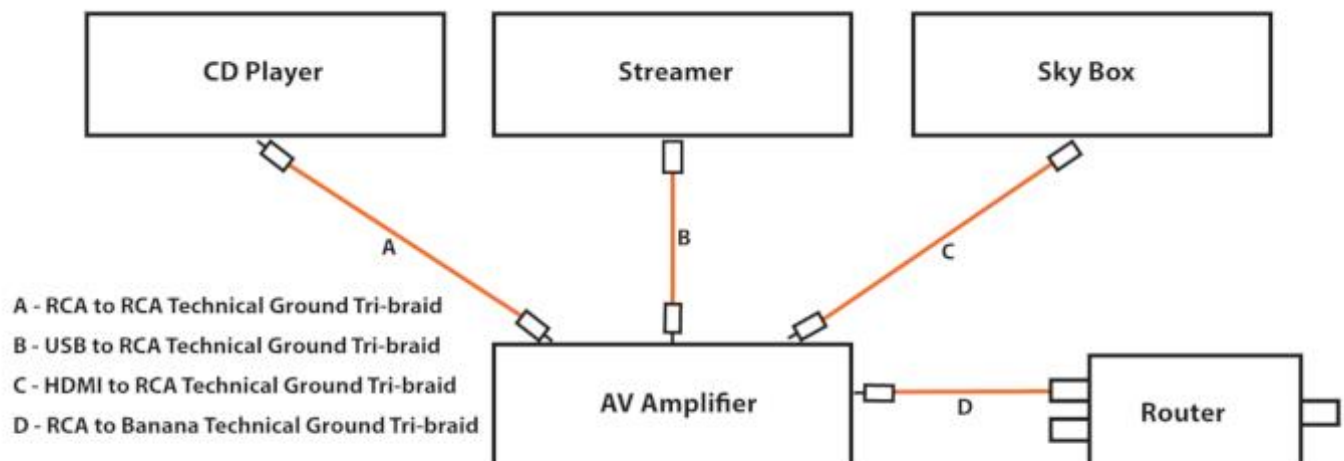
Equipment powered by an external power supply should also be considered double insulated. Occasionally the internal circuit board may be attached to the casework but it's not guaranteed.

Ways to connect double insulated equipment

We've developed a range of woven Technical Ground Tri-braid cables with the following plug options - RCA, USB (Type A and B), HDMI, RJ45, DIN, BNC and XLR.

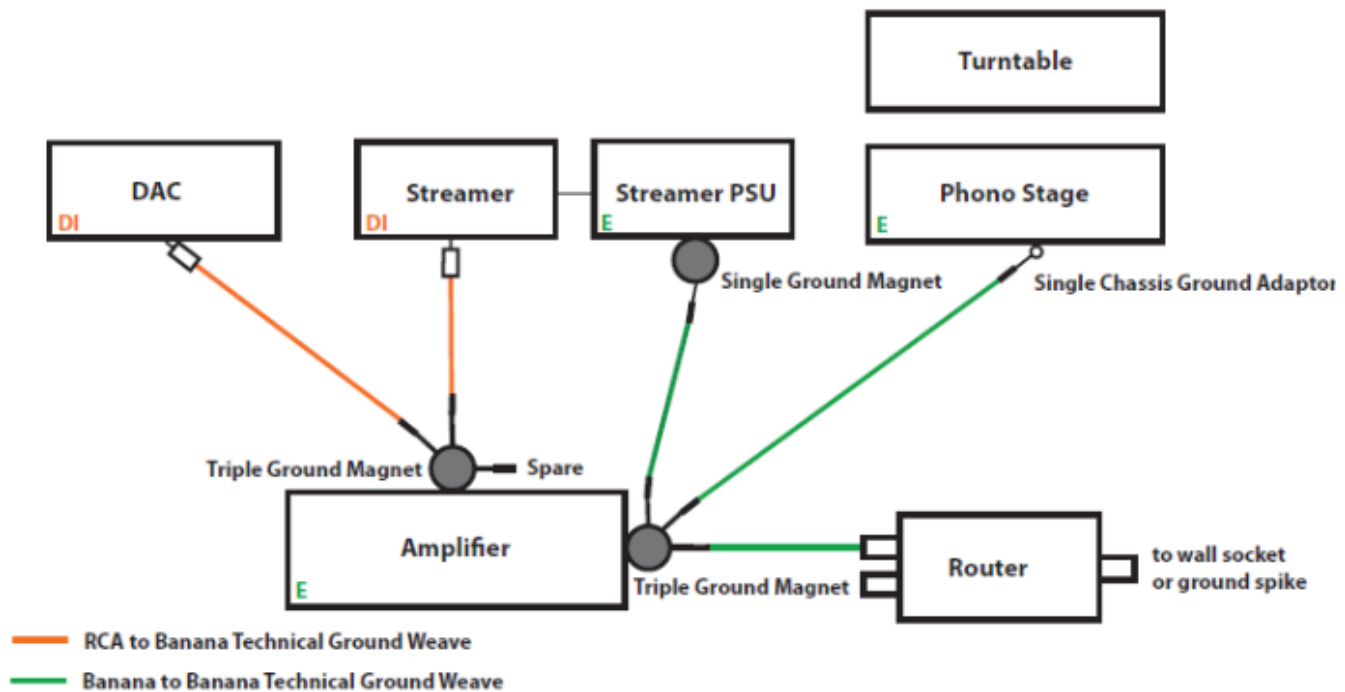


Example Connection - all components are double insulated



Example Connection - system with both earthed and double insulated components

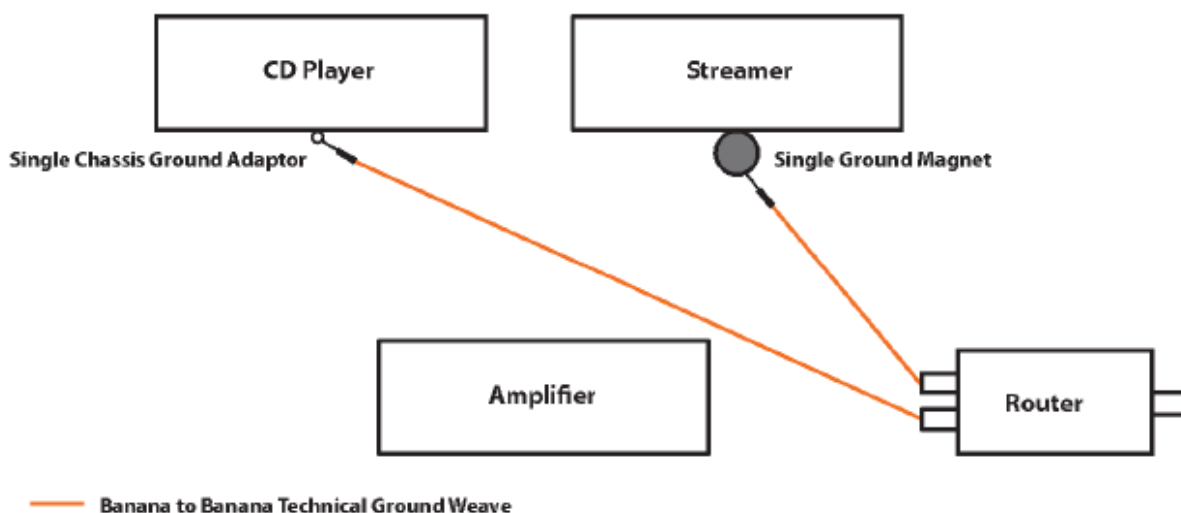
In the following example, a mix of components are Earthed (E) and Double Insulated (DI). Because the streamer has its own standalone psu which is earthed, the streamer is classed as double insulated. The turntable is automatically grounded to the phono stage through ground wire which is part of the Tone arm cable.



What if there are no screws or spare sockets?

In some circumstances, you may find your component simply has no way to attach a ground cable. Some older Naim equipment, for example, has an aluminium sleeve (non-magnetic) with no obvious screws. If this is the case then either leave it out of the grounding system or, if you're feeling confident and have the required skill, add a ground terminal.

If the component is an amplifier (which under normal circumstances we'd recommend as the hub), simply choose another component, preferably one that has an earth, to act as the hub. If your system consists of just a couple of components, connect them directly to the RF Router.



Section 2.3

Grounding Speakers and Subwoofers

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Speakers

You can 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. *Do not attach a ground wire to either the positive or negative terminals.*

A number of loudspeaker manufacturers - for example, some Tannoy models and our own legacy *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.

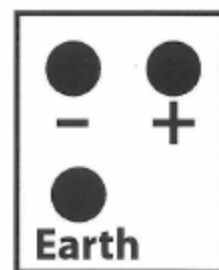


Diagram of connection plate

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 probably find the drive units are 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.

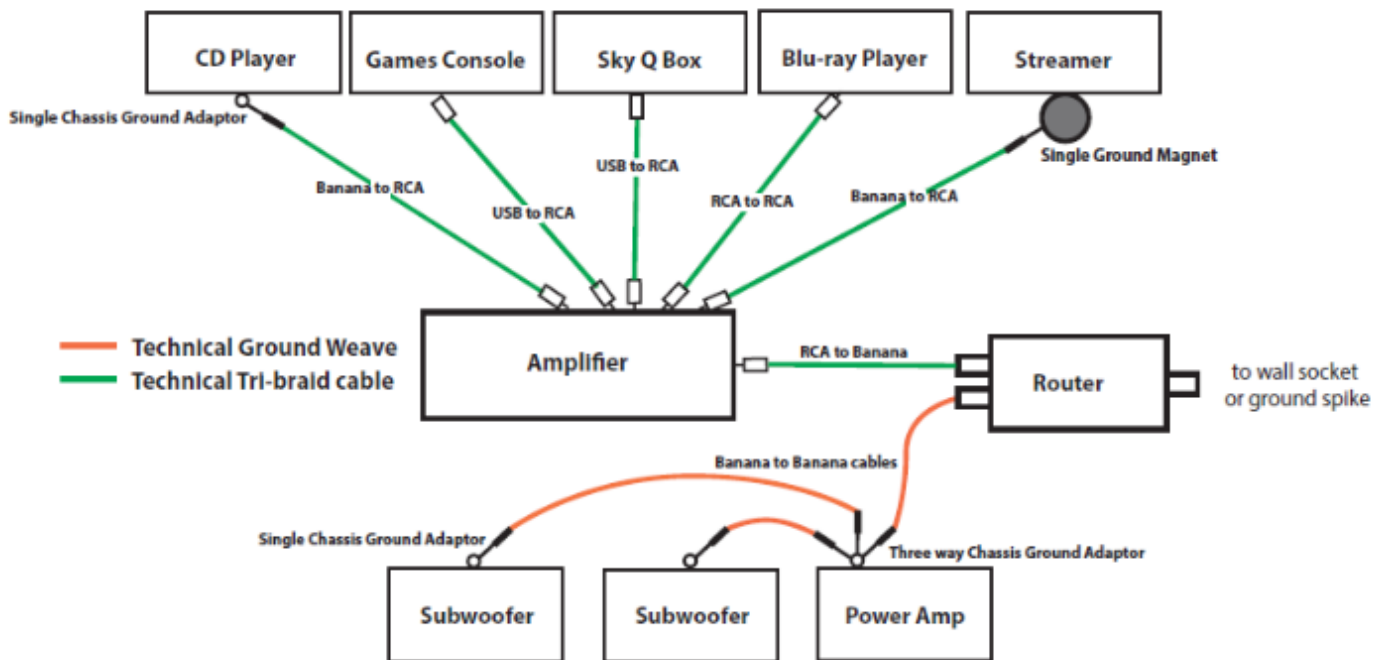
Remove one screw from each driver and clean the metal around the screw hole to remove any paint. Strip the end of a piece of wire that is long enough to reach your RF Router, make a small loop in the stripped end and refit the driver screw through it so that it makes a good tight connection with the 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, or onto one of the many terminals on your SuperRouter. 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 Router permanently with Technical Ground Weave from the new ground binding post. We can do this modification for you if you aren't comfortable doing it yourself but you'll need to organise getting your speakers to us.

Subwoofers

It can be hugely beneficial to incorporate subs into the mix. A deeper, tighter more realistic bass can be achieved. Subwoofers should be connected directly to the RF Router. Here's an example of a complex system with subwoofers and multiple amps.



Section 2.4

The benefits of using a Ground Rod

The whole point of grounding is to dump RFI/EMI out of the system and into a good, low resistance earth. How do you get a good low resistance earth? I know that many of you are connecting your Router to the mains earth: this works well and is simple to achieve, but for very best performance you should connect the Router to an external ground 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 ground 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.

Ground rod installation – some practical considerations

Where soil conditions are good (very moist, farming, loamy and clay soils) a single ground rod may well prove sufficient to get a good low resistance grounding connection.

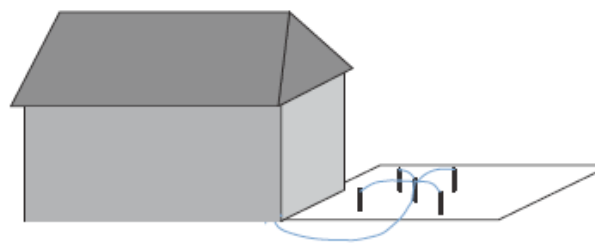
Select a suitable place away from the house (the soil is usually driest near the house) and drive in the ground rod with a lump or sledge hammer - avoid buried pipes and cables! If you have found a good spot, it will drive in easily. If not, then the soil is probably full of rocks or stones that will 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.

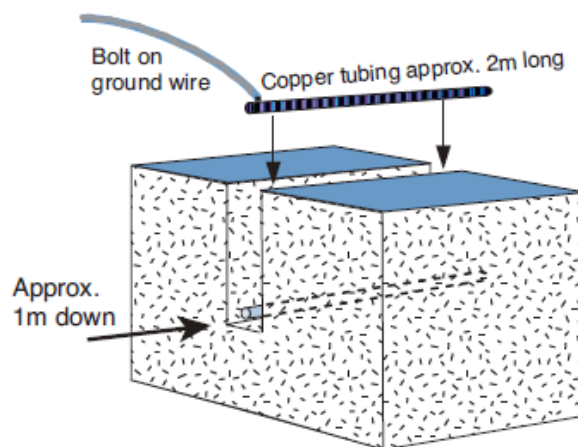
Whichever technique you apply, consider treating the soil round each rod or pipe with a treatment like magnesium sulphate, copper sulphate, ordinary rock salt or a proprietary conductive concrete such as Marconite®. The best technique is to dig a circular trench round the rod, fill it with the soil-treating material and cover with soil.

Your electrician can solve these problems for you and guarantee the result. Connection to the ground rod should be with a thick copper earth wire (10mm² or 16mm²) or with our own Technical Ground Weave. 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 cable through. It is then easy to seal it with mastic.



External Star Grounding: ground rods in a star pattern



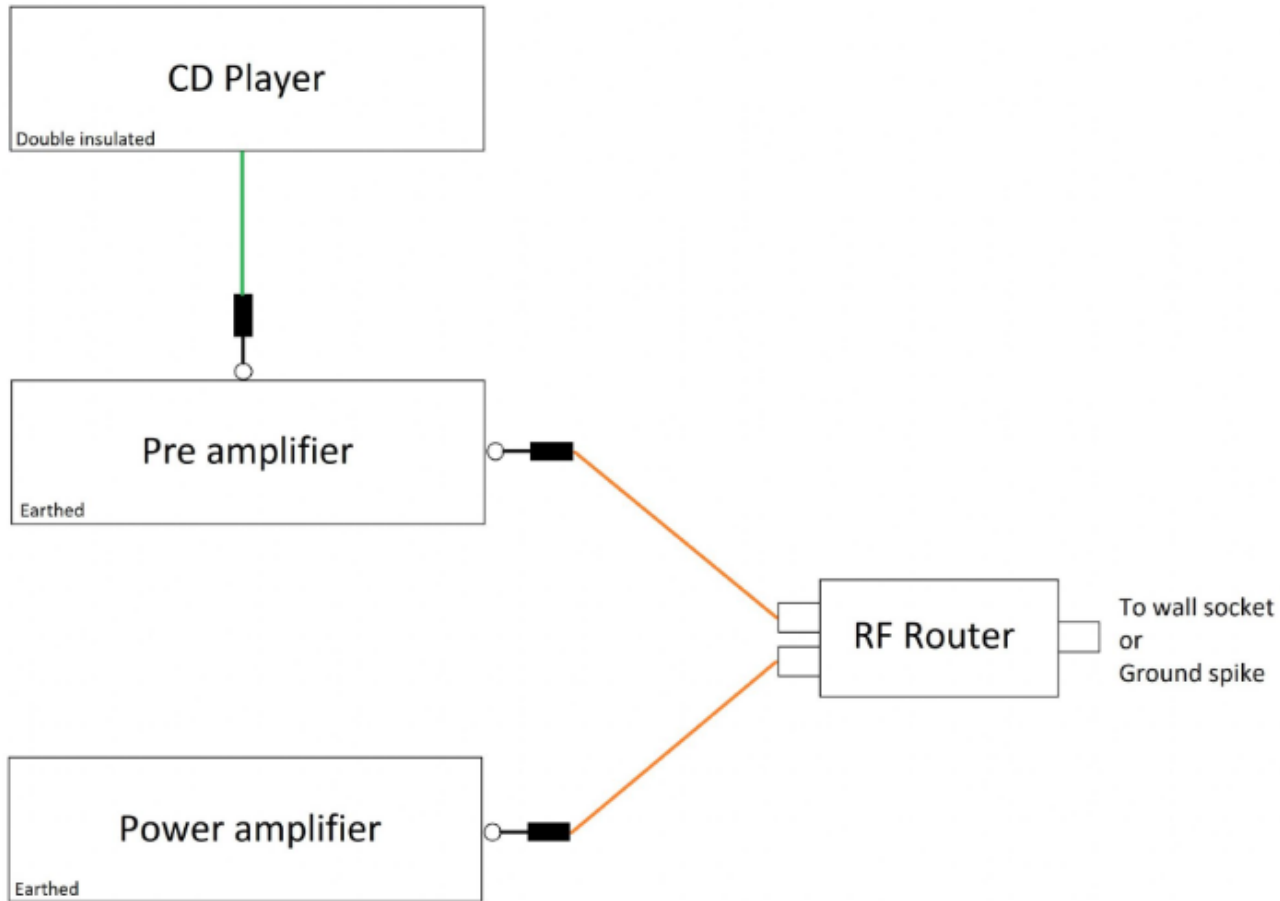
Alternative to using a ground rod: bury a piece of copper tubing.

Section 2.5

Some More Example Connections

Click [here](#) to open a printable pdf of this page

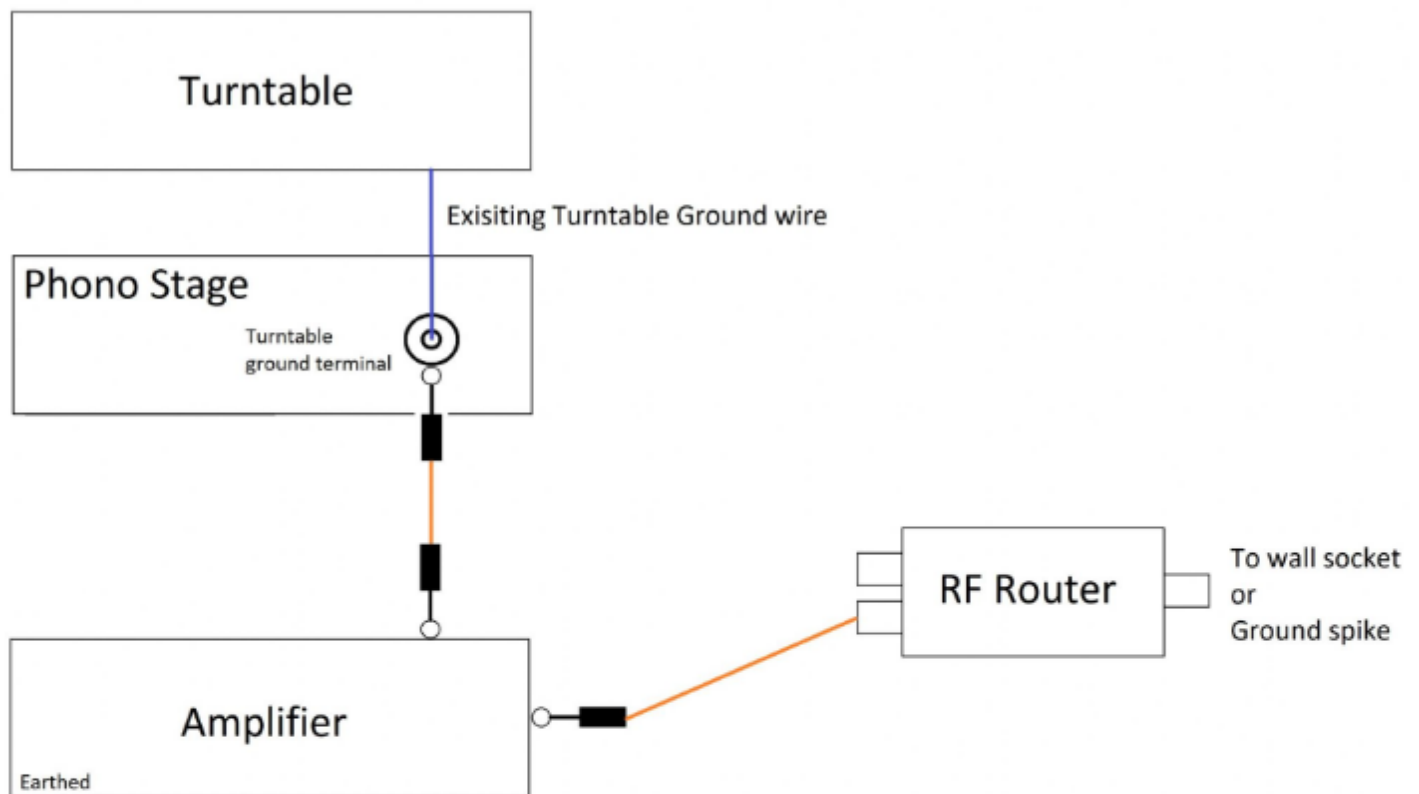
System containing separate pre and power amp



Power amplifiers should be grounded independently and direct to the Router as shown above. Additional power amps should be grounded directly to the Router with their own cable. The preamp becomes the 'hub' for your sources.

Choose the appropriate ground wire and connection depending on whether your equipment is earthed or double insulated.

System containing a Turntable and separate Phono stage



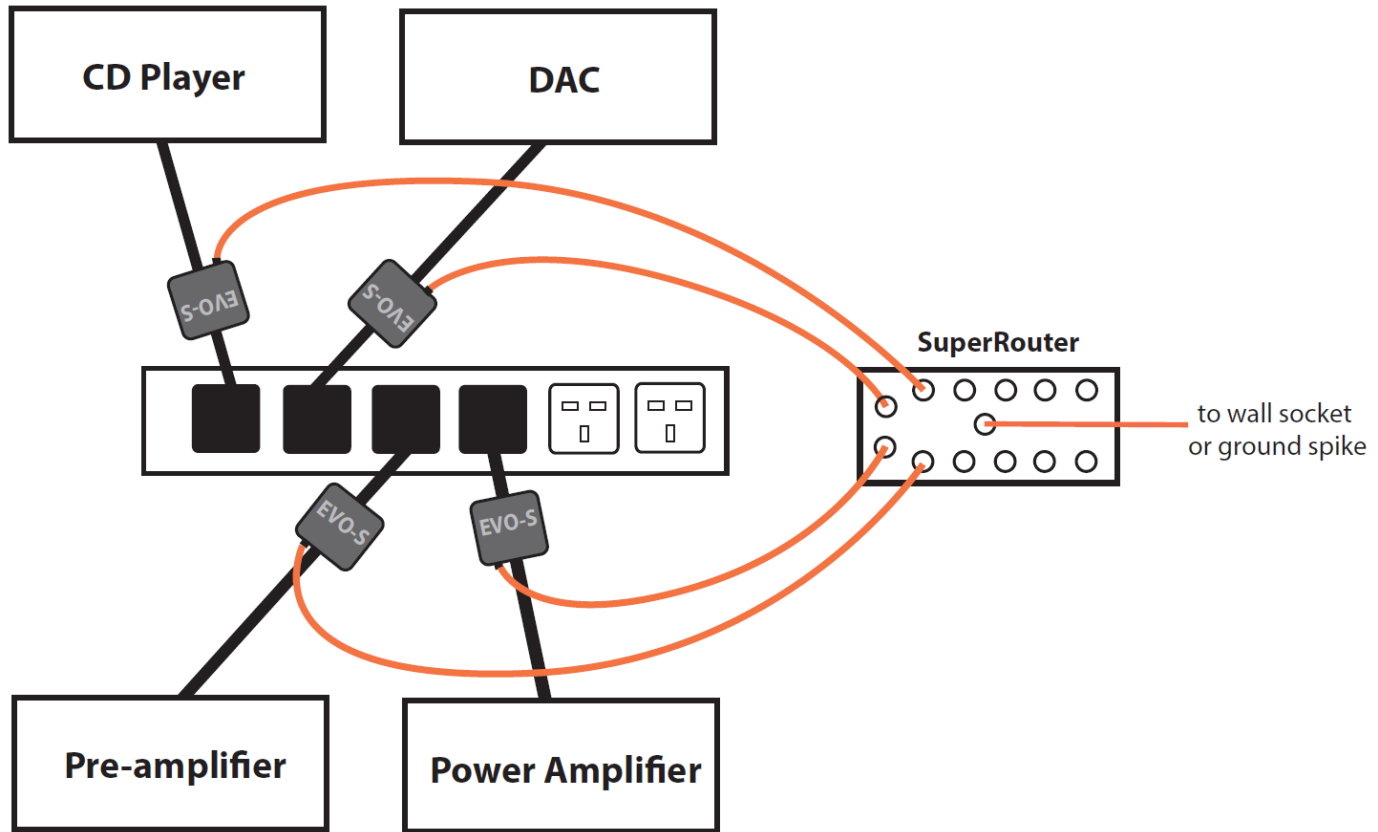
It's often very difficult to ground a turntable separately due to the lack of connection points and the material it's made from i.e. no metal parts. The good news is that it will already have its own ground wire to the phono stage, so there is no need to add a further wire - though, if it's detachable, you could upgrade this to Technical Ground Weave.

Simply ground the phono stage by connecting to the ground terminal with Technical Ground weave and the other end to your amp.

Choose the appropriate ground wire and connection depending on whether your equipment is earthed or double insulated.

Integrating Russ Andrews EVO-S PowerKords

Building on our extensive knowledge of power conditioning and system grounding, the new EVO-S PowerKords allow mains cabling to benefit from intergration with our Grounding System. By designing a unique floating screen system, we are now able to supplement the natural RFI-rejecting properties of Kimber's renowned cable geometry.



NB – Individual grounding leads from components omitted for clarity

EVO-S PowerKord utilises a Screen Interface Pod at the mains plug end of the cable which allows easy connection of the cable to one of our Routers. In this way, residual inteference can be drained away from the cable and diverted to ground via the sophisticated internal circuitry in the routers.

Each individual EVO-S PowerKord must be grounded individually to the Router as shown above. We recommend Premium Technical Ground Weave to get the best from your EVO-S PowerKord.

For best results we strongly recommend EVO-S PowerKords are used with the SuperRouter. This is the primary reason why the SuperRouter has the additional terminals.

