Hux Electronics

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Repair and Maintain Production Equipment

Course Reader

This document has been written specifically for those working with professional audio equipment typically used in live sound reinforcement and recording studio applications

Unit of competence : CUFGMT301A

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Contents

Definition of Hazard and Risk

A Hazard is a potential problem, a Risk is when the hazard has the potential to cause an injury to a living being.

A loose boulder on a hillside is a hazard, if that loose boulder is above a pathway used by people then it becomes a risk.

A mic cable running along the floor in a recording studio is an acceptable hazard as everyone using the studio knows to look out for cables on the floor. A mic cable running along the floor and across a doorway used by the general public is an unacceptable risk.

When working in technical areas it is everyone's responsibility to identify potential hazards and risks and to take action to prevent foreseeable accidents where possible. This action could be as simple as reporting the hazard or risk to someone who will take action, or if it is safe to do so, to actually take action yourself. Sometimes all that is needed is for the hazard or risk to be clearly marked in some way.

Some equipment is hazardous in its normal operation and so for these situations you need to know the safe work practices relevant for each particular item of equipment.

Safe practice when using typical audio cable making tools

The tools that we use for general electronics repairs, maintenance and cable making may include items such as a soldering iron, miniature side cutters, a cable sheath cutter, a Stanley knife, long nose pliers, a cable stripper, an array of screw drivers, a variety of test equipment and a broad range of other tools. All of these tools can have some risk associated with them if used improperly.

A soldering iron for electronics type work operates at 380 degrees centigrade (700 degrees F) and represents both a hazard and a risk. A soldering iron should not be left unattended while hot. Make a habit of switching soldering irons off when you are not actually using them.

If handing a soldering iron to another person the only safe way to do this is to put the soldering iron pencil (the hot part) back into its dedicated holder, this enables the other person to pick the unit up safely and at their own pace.

Miniature side-cutters are very sharp and also represent a hazard and a risk, miniature long nosed pliers are not quite as sharp but have pointed tips and can also be seen as both a hazard and a risk in some situations. Knives of any kind, most sheath cutters and cable strippers also represent both a hazard and a risk. The only safe way to pass any of these tools to another person is to place them on a table top or other surface and to allow the other person to pick them up at their own pace.

If you happen to drop your soldering iron, side-cutters or other hand tools during use do not attempt to catch them mid fall. Simply allow them to fall and then pick them up quickly once they have landed.

Care must be taken when using all hand tools and soldering equipment and it is wise to wear sensible clothing and enclosed shoes where possible.

Soldering basics

Most professional soldering irons come with a holder for the soldering pencil and a sponge holder of some kind. The sponge should be kept wet when soldering is taking place. The idea is that the hot tip of the soldering iron is wiped clean on the sponge before every series of solder joints is made or as required when the tip discolours during use.

The solder that we generally use is 60% tin and 40 % lead and it has a resin (flux) core, this is often referred to as 60/40 solder. The proper temperature for a soldering iron when using 60/40 solder is 380 degrees centigrade (700 degrees Fahrenheit), any cooler and the solder wont melt properly, any hotter and the flux will burn off too quickly.

The **resin core** (also known as the flux) in the solder is **crucial** in enabling the soldering process to work and so it is important that we don't burn off all of the flux in the joint while soldering. When solder containing flux is melted it will smoke a little. The skill in soldering comes from learning to apply the heat for long enough to do the job but not too long where all the flux has been burnt off.

The smoke from the flux is a hazard but the risk from inhaling it is relatively low. It is wise to ensure good ventilation while soldering with a cross breeze if possible or some form of fume extraction. The smoke that occurs when soldering comes entirely from the flux, the soldering iron temperature is not high enough to vaporise the tin or the lead in the solder and so there is no danger of inhaling tin or lead fumes.

There are different soldering techniques for different applications.

When soldering components into a circuit board we place the soldering iron tip on the junction of the component leg and the circuit board track and then push the solder into the place between the soldering iron tip and the work (the component leg and the circuit board track). The soldering iron is only kept in place until the solder fully melts and the joint is properly made. A good solder joint is often shiny and has a particular look.

When soldering cables and connectors we need to pre-tin the cables and pre-tin the connectors. The pre-tinning process needs to be done in a way that sufficient flux remains as we rely on this flux when we bring the tinned wire and tinned connector together and fuse one into the other.

Making XLR cables (using Neutrik XLR connectors and Canare cable)

Strip the sheath back 15mm and remove the foil or unpick the braided shield wires.

Strip the colour and white wires back 3-5mm.

Tin the colour, white and drain/shield wires.

Clamp the **female XLR** connector horizontally and fill the solder buckets with solder

Melt the solder in each solder bucket (one at a time) and push the relevant pre-tinned wire into the solder bucket, remove the heat and hold the wire still while the solder cools.

The process is almost the same for the **male XLR** connectors. Male connectors should be held and clamped vertically.

Pins outs for connectors typically found in professional audio

XLR Connector Pins

Pin-1 :	Shield (drain wire or braid wire)
Pin-2 :	Hot (colour wire) (+ve)
Pin-3 :	Cold (white wire) (-ve)

¼” TRS (stereo) Jack Connector Pins

Tip :	Hot (colour wire) (+ve)
Ring :	Cold (white wire) (-ve)
Sleave :	Shield (drain wire or braid wire)

¼” Mono Jack Connector Pins

Tip :	Hot (colour wire) (+ve)
Sleave :	Shield (drain/braid wire) (cold wire combined with shield if applicable)

Mains cables and wiring standards

The copper wires within 2-core and 3-core double insulated mains cables are covered by two layers of insulation material, an outer sheath covers all three wires (sometimes only two wires) and the inner insulation covers each individual wire. If the outer sheath is broken then the cable must be marked as an unsafe hazard and taken out of service or replaced, even if the cable is still functional.

Looking at an Australian GPO (general power outlet, also known by many as a power-point) the top left contact is the “active”, this is the contact that carries the actual 240 volts. The top right contact is the “neutral”, this is the return wire for the active. The bottom middle contact is the earth (safety) connection and this is bonded to an actual earth stake somewhere near the fuse/breaker/distribution box.

The way to remember the pin-out of an Australian GPO is the simple saying of “live left” as the live (active) connection is always the left hand top contact.

The usual colours for mains cables in Australia are as follows :

Active :	Brown
Neutral :	Blue
Earth :	Green/Yellow

Other colours that you might encounter for mains wiring are as follows, these are non standard, red/black is an outmoded Australian standard, black/white is found in some mains cables of US origin

Active :	Red	Black
Neutral :	Black	White
Earth :	Green	Green

Quad speaker cable and NL4 “Speakon” connectors

Most modern professional live sound passive speaker boxes are fitted with Neutrik NL4 “Speakon” connectors. The NL4 is a four pin connector and can be used for a single speaker circuit or for two speaker circuits (stereo, or bi-amping). The most common way to wire an NL4 connector is with a “quad” speaker cable as this ensures that the same cable can be used for any of the modes of operation.

There are many different brands and types of “quad” speaker cables. The Canare brand of “quad” speaker cable uses the colours of red, white, transparent red and transparent white.

NL4 “Speakon” connectors have a circuit 1 (pins marked as +1, -1) and a circuit 2 (pins marked as +2 and -2). The +ve pins are diagonally opposite and so once you find one you can find the other. It is common practice to use the red and white wires for circuit 1 and the transparent red and white wires for circuit 2. The screws in a modern Speakon connector are Pozidrive #1 and it is important that you use a Pozidrive #1 screwdriver when assembling NL4 cables or you risk damaging the screw heads.

Definition of Electrical Terms

Voltage :

Voltage is the "pressure" of electricity and is measured in volts (V), it can also be known as “potential difference” or as "electro motive force" (EMF). Voltage is a relative concept and is always measured between two points, these points need to be specified (i.e. “measure the voltage between battery +ve and chassis”). A voltage can be positive or negative with respect to the reference point.

A voltage can exist without current flowing (think of a 9 volt battery that is not plugged into anything, it is still producing 9 volts but is not doing any work at all)

Voltage can be seen as water pressure in a pipe connected to a water tank sitting on a tank stand. Imagine one end of the pipe being close to physical ground level. The higher the water tank relative to the bottom of the pipe the greater the water pressure becomes at the bottom of the pipe, this is true regardless of if water is flowing or not.

Voltage is measured in **volts** and can be written in formulas as E and also as EMF but by far the most common way to see it written = V

Current

Current is the flow of electricity (electrons). No current flows between the terminals of a battery or other voltage supply unless the circuit has a path and is “closed” (current cant flow in an “open circuit”). The amount of the current is determined by the available voltage and the resistance of the load. Current can be AC or DC, or positive or negative, depending upon the reference point. Electrical current can only flow in a conductor of electricity.

Using a water pipe analogy again, the current is a direct result of the water pressure (voltage) and a limiting factor can be the width of the water pipe (resistance)

Current is measured in amperes or **amps** and is written in formulas = I

Resistance

Resistance is the opposition to the flow of electricity, it can be seen both as a measure of how easily or with what difficulty electrons will flow through a device. Copper wire has a very low resistance, so a small voltage will allow a large current to flow. Plastic insulation on the other hand has a very high resistance and therefore prevents current from flowing.

Resistance is measured in **ohms**, the symbol for resistance = R or Ω (omega sign)

Other versions of resistance are called “impedance” and “reactance”, these occur in AC circuits and are complex and frequency dependant and beyond the scope of this document. The symbol for “impedance” = Z and the symbol for “reactance” = X, both are measured in ohms

<u>Power (watts)</u>

When current flows in a circuit then energy is used and heat is given off, this heat represents the actual work done by the circuit. We refer to the energy in the circuit as its power and we measure power in watts. The power dissipated by a circuit is always a direct result of both the applied voltage and the current.

We can also look at the power (in watts) of any selected part of a circuit (one speaker in a box full of speakers for example, one light bulb in a string of light bulbs, etc).

Power is measured in **watts** and is written in formulas = P

<u>DC</u>

DC stands for Direct Current, meaning that the electrons flow in one direction only. The direction of actual **electron flow** is from **negative to positive,** however it is often more convenient conceptually to think of current flow as being from **positive to negative** so it is often taught this way. When we talk of positive flowing to negative then this is referred to as **conventional current flow.**

<u>AC</u>

AC stands for Alternating Current. The electrons flow in one direction and then the opposite direction in a cyclic manner - first one way, then the other. The rate of change of current flow direction is called the frequency. AC frequency is measured in Hertz = Hz.

240 volt mains power is AC and is delivered at a frequency of 50Hz in Australia. The mains voltage in much of the US is 110 volts and it is delivered at a frequency of 60Hz.

All audio signals in electrical form (from a microphone right through to the final loudspeaker) are AC waveforms.

Ohms Law and Handy Formulas

Ohms Law

There is a predictable and proportional relationship and between voltage, current and resistance. Ohms Law is a tool that allows us to see this inter-relationship quite clearly.

If the resistance in a circuit is constant and we double the voltage then the current will also double. If the voltage in a circuit is constant and we halve the resistance then the current will double and visa versa, ect. The relationship between voltage current and resistance is always a very linear one. The basic formula variations are as follows

V (voltage) = IR

I (current) = V/R

R (resistance) = V/I

Power Law

The power is the actual energy used by a circuit and we measure this in watts. The power used is always a result of both the voltage and the current.

If the resistance in a circuit is constant and we double the voltage, the current will also double but the total power dissipated by the circuit will quadruple. The relationship between voltage and power (if the resistance is constant) is a square law one (voltage doubles then the power multiples by a factor of 4, or if the voltage halves, the power drops to ¼). The basic formula variations are as follows :

P (power in watts) = VI

V (voltage) = P/I

I (current) = P/V

Ohms Law and the Power Law in use

We can use Ohms Law and the Power Law to work out many things that are useful to know. For example if we are using a mains power board (typically with 4 to 8 outlets) that has an internal 10 amp circuit breaker we can work out the maximum practical load simply by adding up the wattage of all the items that we might plug into it.

240 volts mains voltage x 10 amps maximum current draw = 2400 watts of power is available before the circuit breaker in the power board will trip.

Resistors in series

If resistors are wired in series then the total resistance of the network of resistors will increase. We can work out the total resistance (RT) by simply adding all of the resistor values together with the following formula :

RT = R1 + R2 + R3…….etc

Resistors in parallel

If resistors are wired in parallel then the total resistance of the network of resistors will decrease. We can work out the total resistance (RT) with the following formula :

RT = 1/(1/R1 + 1/R2 + 1/R3..….etc)

If all of the resistors are of the same value (for example 2 x 8 ohm speakers in parallel) then we can simple divide the value of one of the resistors by the total number of resistors (2 x 8 ohm speakers in parallel is equal to 8 divided by 2 = 4 ohms).

One way to think of a parallel network is to think of a single light bulb running on mains power, when we switch on a second identical light bulb we have effectively added this extra bulb in parallel and are now drawing double the current, therefore our effective resistance to the power supply has halved (causing more current to flow from the same voltage source).

Resistors in Series/Parallel networks

It is possible to combine resistors in series and parallel networks at the same time, if so we simply use a combination of the rules shown above.

An example of this is a Marshall 4 x 12” quad speaker box, these contain two 16 ohm speakers wired in series plus a second pair of 16 ohm speakers also wired in series. Each of these speaker series pairs has a total impedance (a variation of resistance) of 32 ohms. These two 32 ohm speaker pairs are then wired in parallel with each other and the total resistance (RT) becomes 16 ohms again.

Another variation is an Ampeg "fridge" 8 x 10" speaker box, these use 8 ohm speakers and are wired in a series/parallel network made up of 4 pairs of series wired speakers (16 ohms each pair) which are then wired in parallel (16 ohms divided by 4) to arrive at a total impedance of 4 ohms.

Power Sources

Batteries

Technically a battery is a collection of cells, each cell may be 1.25 volts, 1.5 volts or 2 volts depending on the battery type (the correct name for an AA battery is really a cell). Electricity from a battery is created via a chemical action. Some batteries are "use once only" and these may be referred to as "primary batteries". Some batteries are "rechargeable" and these may be referred to as "secondary batteries". In general secondary batteries have a lower overall voltage than primary batteries and are not always suitable choices for some types of equipment.

Batteries are DC by default and the power delivered by a battery is exceptionally smooth and is ripple free. Battery power is suitable for portable equipment.

Battery power for studio equipment has many limitations and they are impractical on a large scale (imagine if you had to replace the batteries in every bit of equipment in a recording studio every morning before you could use it).

AC Mains Power

A coil of wire has some interesting properties, if we move a magnet near the coil then a current will be induced and the coil will output electricity, if the magnet stops moving then the electricity ceases to be created. If I spin the magnet or the coil then an alternating current (AC) is produced, this is exactly how 240 volt mains power is produced, though mains power is made on a very large scale. The total power coming out of the coil of wire can never exceed the total power (or effort) being fed into the coil of wire.

AC mains power in Australia is delivered as 240 volts RMS and at a frequency of 50 Hz.

RMS voltage

If we were able to look at the waveform of the AC mains voltage we will see that it is a sine wave (basically a graph of circular motion drawn over linear time). A sign wave is always in motion, it has a peak +ve voltage followed by a peak –ve voltage, the distance between these two peaks is called the “peak to peak voltage”, but as these peaks cannot occur at the same moment of time they are actually irrelevant.

For measurement purposes we count the +ve peak and the –ve peak as being the same (imagine them both being drawn as +ve going), the distance between zero volts and the peak is called the “peak voltage”.

The peak voltage is only at its peak for a moment and so does not represent the heating ability of the waveform (how we measure energy) and so we need some way to work out what the average voltage is (the total average of the peak and everything in between). This average will be the DC equivalent of our AC voltage and represents the actual work (heating ability) that our AC waveform can do. The formula for working an AC waveform back to its DC equivalent is as follows :

RMS voltage = the peak voltage divided by the square root of 2

We also use the RMS figure to describe the level of audio signals. 0dBu is an RMS value of 0.775 volts of audio signal level. A signal level of +4dBu is simply a signal that is 4dB higher than the 0dBu reference level and is 1.228 volts RMS (voltage to dB calculations involve the use of a 20 log law and are beyond the scope of this document).

Mains Transformers

A transformer is a device made from a coil of wire wound around a metal former (metal core), this coil is called the “primary”. Another coil of wire is also wound around the core and this coil is called the “secondary”. If AC power is fed into the primary winding it will induce an alternating magnetic field in the former (the metal core), this magnetic field will then induce an AC current into the secondary winding. The total power from the primary (less a small amount of heat loss) is then transferred to the secondary.

Mains transformers can be used to step up and step down AC voltages depending on what we are trying to achieve. The power generation company uses very high voltages to distribute power across vast distances, a higher voltage lowers the required current for the same amount of power (in watts) and this ensures that less energy is lost in the delivery system. These very high voltages are then stepped down locally (using a transformer on the street) to 240 volts for delivery into our homes and workplaces.

We can use 240 volts to power lighting and heating but require much lower voltages to power the audio equipment used in a recording studio environment. Every item of audio equipment contains a mains transformer of some kind to bring the voltage safely down to a more usable level.

Transformers can only pass AC waveforms. Transformers can have multiple primary windings and multiple secondary windings. Transformers provide total isolation between the voltage on the primary side and the voltage on the secondary side and so are essential for electrical safety.

Transformers can also be used for audio applications (mic transformers, audio isolation transformers, output transformers in valve amps, etc), these work on the same general principles as mains transformers but are built quite differently and not to be confused.

The step up or step down ability of a transformer is a product of the turns ratio. The turns ratio is literally the number of windings of wire on the primary side of the transformer verses the number of windings of wire on the secondary side of the transformer.

NP = the number of primary turns of wire, NS = the number of secondary turns of wire

Turns Ratio = NP/NS

If a transformer has 1000 turns on the primary and 100 turns on the secondary then the calculation is 1000 divided by 100 = 10, also known as a 10 to 1 ratio, and often written as 10:1 This is a step down transformer and the output voltage will always be $1/10^{th}$ of the input voltage.

1:10 indicates a step up transformer. 10:1 indicates a step down transformer, etc.

If you feed 100 volts AC into the primary of a 10:1 transformer then 10 volts AC would come out on the secondary. If you feed 240 volts AC into the same transformer then 24 volts AC would come out of the secondary.

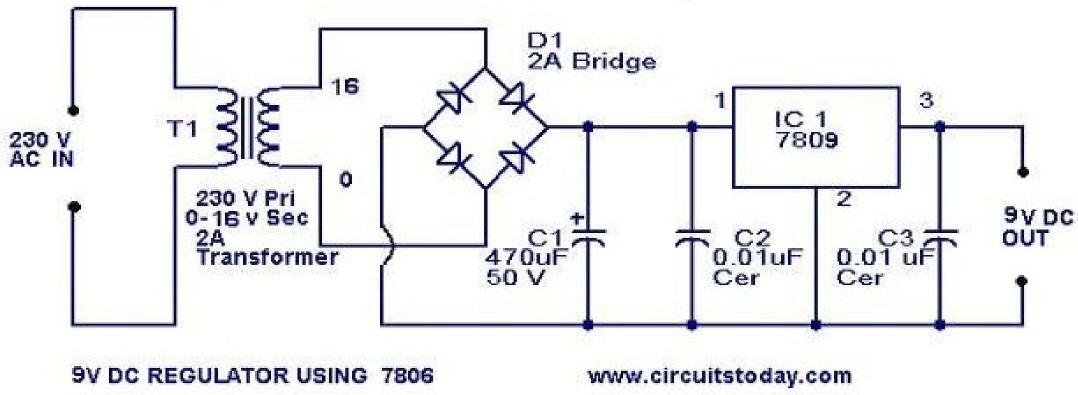
Transformers can also be used backwards and so you can use a step down transformer as a step up transformer if you wanted to or needed to.

The turns ration is rarely shown on a mains transformer, they will often show the input voltage and the output voltage and the maximum current that can be drawn. The other common specification is the total ability of the transformer in VA (volt/amps, similar to but not the same as watts). A 5VA mains transformer is quite small and light and a 1000VA mains transformer is quite large and heavy. The mains transformers in a typical audio signal processor will be between 5VA and 30VA.

An Introduction to Power Supplies

In general a linear power supply (a normal power supply) contains a step down **mains transformer**, a **bridge rectifier**, a **capacitor** and some form of **regulator**. The goal is to produce a DC output that is comparable in its smoothness and purity with a battery power source.

A real power supply might have multiple outputs, mostly DC and sometimes even some low voltage AC outputs. Typical outputs for a recording console power supply would be +15 volts and -15 volts (audio circuits), +48 volts (phantom power), +5 volts (logic), +12 volts (console lamps) and so on. For the sake of this description I will stick with just one DC output.



<u>Rectifier diode/s</u>

A diode is a semi-conductor, meaning that it acts like a conductor of current in one direction but acts like an insulator when current tries to flow in the other direction. Diodes have many uses, they are vital when we wish to turn AC into DC to power whatever it is that we wish to power.

If we feed the output of our step down mains transformer to just one diode we can have what is known as a "**half wave rectifier**", the output is now a crude form of very lumpy DC made from only the positive going section of the AC waveform. All of the negative going section of the AC waveform has been wasted and there is a complete gap for every half cycle of the input waveform.

If we use four diodes in what is called a "**bridge rectifier**" configuration then we can create a "**full wave rectifier**" which is a much better way to do things in a power supply and results in only half of the ripple of a "half wave rectifier". A "full wave rectifier" makes use of the entire AC waveform supplied from the mains transformer.

The output of a full wave rectifier will still contain a lot of ripple and so another stage is required.

Storage Capacitor

A capacitor can be used as a very fast energy storage device, it could be compared to a very fast short term battery. The output of the bridge rectifier is fed into a medium to large value capacitor, the capacitor will charge during the peak part of the original waveform and it will discharge and release energy when the peak is not present. If the AC waveform has been rectified with a “full wave rectifier” then 100 peaks charge the capacitor every second (50 Hz contains 100 peak voltages per second).

As the capacitor charges to the peak of the waveform it will charge to the RMS voltage times the square root of 2 (a quirky side effect of power supplies and how they work).

The output from the capacitor will be a mostly DC but will still contain some ripple and so one more stage is required if the output is to be as smooth as the DC obtained from a battery.

Voltage Regulator

A voltage regulator is a circuit that wastes some of the total voltage from the capacitor stage of the power supply and produces a very smooth and well controlled output.

In audio signal processors and small to medium mixing console power supplies the regulators are usually a type of IC (integrated circuit) device with a fixed output voltage (some are adjustable). Each fixed voltage regulator IC of these has three legs, (1) input voltage, (2) ground reference and (3) output voltage. All of the hard work is done by the electronic circuit inside the IC. The most common regulators used in audio signal processor power supplies are marked as LM7815 (a +15 volt regulator) and LM7915 (a -15 volt regulator), many other versions exist.

Because regulators waste some energy in the process of regulating they create heat and need to be bolted to a heat-sink (a way of extracting the heat). Anything that gets hot can melt its own solder joints and/or become unreliable if the heat is not dealt with effectively.

Are we there yet ?

Finally we have a DC output that is as good as a battery power source without the hassle of having to replace batteries. There is one more essential ingredient that is fitted to most power supplies

The Fuse

Most power supplies will have a fuse fitted on the mains power (primary) side of the transformer (some power supplies will use a circuit breaker and this serves the same purpose). A fuse is a deliberate weak link placed in series with the mains transformer and it is there to offer **protection**.

If a disastrous fault occurs in the power supply or further downstream then it is intended that the fuse should blow to protect the majority of non faulty components from overload. The fuse also acts to reduce the fire hazard that is possible with a fault condition. The fuse will also blow and protect the power supply if something has gone radically wrong with the mains power source.

Fuses come in two basic types (1) **fast blow** and (2) **slow blow**. A one amp fast blow fuse will blow reliably at one amp of current. A one amp slow blow fuse will absorb a short duration current draw of way above one amp but will still blow at one amp if this current draw is sustained.

The fuse wire in a slow blow fuse is often wound into a spiral or is fitted with several solder blobs along its length, in either case the effect is to absorb the heat from a short term overload. A slow blow fuse is sometimes marked with a “T” to indicate that it has a time delay in its action.

It is not unusual for power supplies and many other products (valve guitar amplifiers and older power amplifiers for example) to draw a higher than normal surge current on power-up before settling down to a more modest average current draw once the initial turn-on surge has past, this type of product needs to have a slow blow fuse fitted.

It is essential that you check the original fuse type and replace with the same, if you replace a slow blow fuse with a fast blow then the replacement fuse will fail even though there is no actual fault present.

It is also essential that you replace a fuse with the same or very similar value or the safety factor offered by the correct fuse is lost and you could severely damage the equipment if a real fault exists.

Fuses are sometimes used in DC sections of a power supply before or after the filter capacitor/s. In these cases dangerous voltages could be present across the fuse for quite some time after the equipment has been powered down, proceed with caution when testing or replacing fuses used in these areas.

Safe practice when checking or replacing fuses

It is important to adopt safe practices when checking or changing fuses. First unplug the equipment from the power source, then allow the equipment to stand for ten minutes or so just in case (a mains fuse will be safe straight away but a fuse in a DC section of a power supply could be dangerous for some time).

If possible remove the fuse without touching it with your fingers unless you know that it is safe to do otherwise (use the fuse holder cap if possible).

If the fuse is used in a valve amplifier then always assume that it is dangerous to touch the fuse or any exposed metal part of the fuse holder. If you have to touch the fuse with your fingers then first measure for residual voltages with a digital multi-meter (DMM).

Remember that when the correct value and type of fuse has been fitted (if the designer got it right) then the fuse will almost never blow without a reason, however fuses can fatigue over time and mains surges can weaken them.

If a fuse is fitted to an open top fuse holder (where little clips hold the fuse), then make sure that these are firm, loose contacts will arc and cause the fuse to fail prematurely.

Other power supply types

Switchmode power supplies are now very common, these are smaller and more efficient than linear power supplies but have a much shorter working life, so its all swings and roundabouts at the end of the day. Switchmode power supplies are outside the scope of this document and I will write about them in a follow up note sometime soon. Switchmode power supplies are typically used as laptop and mobile phone chargers and a huge range of modern small power supplies work in this way.

Cleaning professional audio equipment

The best policy when cleaning cables and audio equipment (or carrying out repairs) is to follow a KISS method, otherwise known as “keep it simple stupid”.

Clean dirty cables with a damp but not wet cloth or sponge, rinse often.

If you need to clean a mixing console or signal processing equipment start with a clean and unused paint brush and/or a vacuum cleaner.

If the dirt and grime is more persistent you may need to use a liquid cleaner if need be. Always disconnect the mains plug before cleaning electronic or electrical equipment with any form of liquid. Apply the liquid to a cloth or sponge, apply and then wipe clean. Never spray or pour anything directly on to a face plate or front panel as it might go somewhere that it does not belong. Avoid getting cleaning liquids into faders or jack connectors at all costs

Liquid cleaners may include (in order of preference) water, isopropyl alcohol, shellite (lighterfluid), Mr Sheen (or similar). Never use cleaners such as Jiff or methylated spirits.

Treatment of connectors, switches, faders and pots

There are only three known safe chemicals for the treatment of XLR's, jacks, switches, faders and pots, avoid most other chemical treatments where possible.

Caig Labs DeOxit Gold (G5) spray is safe to use on all switches and connectors (do not use DeOxit, only the DeOxit Gold version)

Caig labs FaderLube (F5) spray is safe to use on all faders and pots.

Electrolube EML can be used safely on all connectors, switches and on pots but is less effective than the Caig Labs options.

You can almost never treat a switch or a pot from outside the console or box (if the item to be treated is a signal processor), it is an inside job.

Nearly every push button switch has a breather hole in its side and this is where you need to squirt the spray. Pots sometimes have breather holes and sometimes they are sealed, even sealed pots usually have a pivot point where spray can be blasted in from the outside. Faders can sometimes be treated through the top panel (this works for many of the cheap mass produced faders) and sometimes it is more effective to squirt the treatment spray onto the conductive track from the rear or side of the fader (the covers come off the more serious Alps brand faders).

Avoid most other chemicals and treatments unless they are known and proven to be safe for use with professional audio equipment, some offer short term gain but can result in long term damage. **Avoid all contact cleaners** as they strip out the original lubricants and will cause long term damage.

Summary

Always take your time with any maintenance job involving electronic equipment. Think carefully about what you are about to do and double check all steps in your mind before carrying them out. Take particular care when dealing with mains powered equipment and when possible identify, eliminate or control the hazards and risks along the way.