



10

AUDIO CHAIN SETUP

10.1 INTRODUCTION

In the previous lessons, you have studied about different audio equipment like consoles, mixers, amplifiers and recording/playback equipment etc. In this lesson, you will learn how to install and disassemble the audio chain/ setup equipment. Public address system or sound recording equipment setup is used in two ways, either permanently fixed or movable to different locations as per requirement. In both the cases, the installation of the sound equipments is very important. Right from taking the equipments out of boxes, assembling, positioning to the fixing and testing, a very precise knowledge and practice is required. In very large events, the size of speakers and other equipments is very huge hence extra practical knowledge is required to handle such large equipment. Dismantling the sound equipments, storing them along with the accessories, connectors etc. and transporting them properly is a big challenge.

10.2 OBJECTIVES

After reading this lesson, the learner will be able to :

- install and assemble a range of sound/ audio equipments
- estimate power requirement for different sound/ audio equipments
- perform appropriate placement of power fitting
- implement techniques for performing sound checks
- disassemble the sound/ audio equipment and store these properly



10.3 AUDIO CHAIN

Audio chain refers to a studio or outside setup of audio equipment arranged for the purpose of public address/recording/broadcast of the required programme. In this section we would learn about aspects to be taken care of when different audio equipment are integrated to form an audio chain. As mentioned earlier, the programme from source to listener involves the use of devices to pick up sound that may be a microphone, recording/playback and signal processing equipment. Figure 10.1 is a simplified block schematic diagram of an audio chain of a broadcast studio.

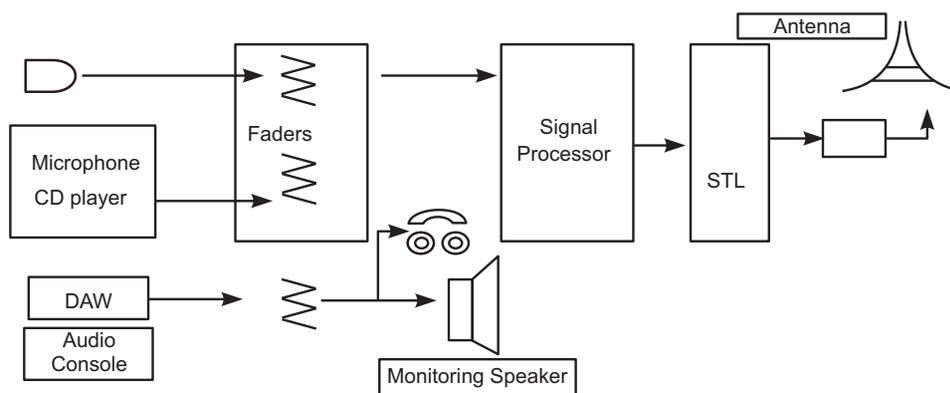


Fig. 10.1: Audio chain of broadcast studio

Audio chain of a broadcast studio is basically a linkage of various equipments, involving various sound sources, such as a microphone to pick up the announcer's voice, CD player or a digital audio workstation (DAW), mixer or audio control, signal processing equipment, monitoring speakers and a studio transmitter link.

Similar setup would be there for a PA system and recording chain, except for the STL and Transmitter, which would be replaced by PA amplifiers and recording equipment.

10.4 SETTING UP YOUR STUDIO

Once you have your equipment, you need to connect it together with cables and possibly install equipment racks and acoustic treatment to complete the setup. Let's consider the features of important components like Cables, Connectors and other equipment to install the audio chain setups.

10.4.1 Cables

Cables carry electric signals from one audio component to another. They are usually made of one or two insulated conductors (wires) surrounded by a fine-



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wire mesh shield that reduces hum. Outside the shield is a plastic or rubber insulating jacket. On both ends of the cable are connectors.

Cables are either balanced or unbalanced. A balanced line is a cable that uses two wires (conductors) to carry the signal, surrounded by a shield. Each wire has equal impedance to ground. An unbalanced line has a single conductor surrounded by a shield (see Fig. 10.3). The conductor and shield carry the signal. A balanced line rejects hum better than an unbalanced line, but an unbalanced line less than 10 feet long usually provides adequate hum rejection and costs less.

A cable carries one of these five signal levels or voltages:

- Mic level: about 2 mV (0.002 volt) to about 1 V depending on how loud the sound source is, and how sensitive the mic is
- Instrument level: typically 0.1 V to 1 V for passive pickups; up to 1.75 V for active pickups
- Semipro or consumer line level: -10 dBV (0.316 volt)
- Pro line level: $+4$ dBu (1.23 volts)
- Speaker level: about 20 volts.

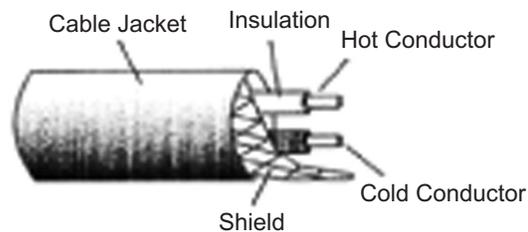


Fig. 10.2: A2 conductor shielded, balanced line.

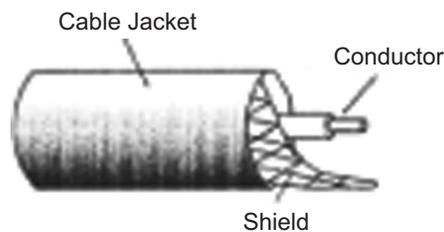


Fig. 10.3: A1 conductor shielded, unbalanced line.

10.4.2 Equipment Connectors

Recording equipment also has balanced or unbalanced connectors built into the chassis. Be sure your cable connectors match your equipment connectors.



Balanced equipment connectors:

- 3-pin (XLR-type) connector
- 1/4-inch TRS (tip-ring-sleeve) phone jack-

Unbalanced equipment connectors:

- 1/4-inch TS (tip-sleeve) phone jack-
- Phono jack (RCA connector)-Figure 10.4

A jack is a receptacle; a plug inserts into a jack.

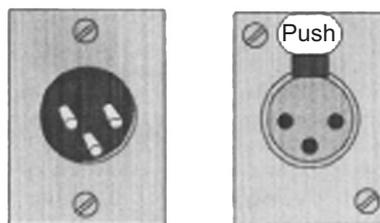


Fig. 10.4: A 3-pin XLR-type connector used in balanced equipment.

Left: male output connector. Right: female input connector.

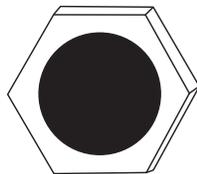


Fig. 10.5: A 1/4-inch phone jack used in balanced and unbalanced equipment.

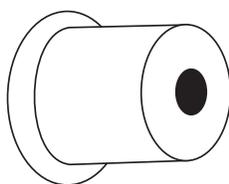


Fig. 10.6: A phone (3CA) jack used in unbalanced equipment.

Connectors are confusing because a single connector can have several functions (usually not the same time).: Here are some examples:

- **XLR:** Balanced line input at +4dBu, balanced mic input at 2 mV to 1 V, or balanced line output at +4dBu



- **TS (mono 1/4-inch phone jack):** Unbalanced mic input, unbalanced line-level input or output (+4dBu or -10 dBV), instrument input, or low-cost speaker connector
- **Combi connector:** An XLR mic input plus a TRS input (instrument level or line level)
- **RCA (phono):** Home stereo line-level input or output at -10dBV, composite video input/output, or SPDIF digital-audio input/output

Equipment connectors are labeled according to their function. If you see an XLR connector with the label “MIC,” you know it’s a balanced mic input IF it’s a 1/8-inch connector on a sound card, look at the icon near the connector. It’s either a mic input, line input, line output, or speaker output.

INTEXT QUESTIONS 10.1

Fill in the blanks :

1. DAW stands for digital work station.
2. Voltage level of a microphone is about
3. A three pin (XLR) connector is a type of equipment connector.
4. A combi connector consist of an XLR mic input plus a input.

10.4.3 Cable Types

Cables are also classified according to their function. In a studio, you’ll use several types of cables: power, mic, MIDI, speaker, USB, FireWire, S/PDIF, TASCAM TDIF, Alesis Lightpipe, guitar cords, and patch cords.

A power cable, such as an AC extension cord or a power cord on a device, is made of three heavy-gauge wires surrounded by an insulating jacket. The wires are thick to handle high current without overheating.

A mic cable is usually 2-conductor, shielded. It has two wires to carry the signal, surrounded by a fine-wire cylinder or shield that reduces hum pickup. On one end of the cable is a connector that plugs into the microphone, usually a female XLR-type. On the other end is either a 1/4-inch phone plug or a male XLR-type connector that plugs into your mixer or audio interface.

Rather than running several mic cables to your mixer or interface, you might consider using a snake, which is a box with multiple mic connectors, all wired to a thick multi-conductor cable. A snake is especially convenient if you’re running long cables to recording equipment from another room. It’s essential for most on-location recording.



A MIDI cable uses a 5-pin DIN connector on each end of a 2-conductor shielded cable. The cable connects MIDI OUT to MIDI IN, or MIDI THRU to MIDI IN.

A speaker cable connects a power amp to each loudspeaker. To avoid wasting power, speaker cables should be as short as possible and should be heavy gauge (between 12 and 16 gauge). They can even be made from lamp cord (zip cord). Number 12 gauge is thicker than 14; 14 is thicker than 16.

A USB cable or a FireWire cable connects a peripheral device.

An S/PDIF cable transfers a digital signal from one device's S/PDIF output to another device's S/PDIF input. It uses a shielded unbalanced cable (ideally a 75-ohm RG59 Video cable) with an RCA plug on each end.

10.4.4 Cable Connectors

Several types of cable connectors are used in audio. Figure 10.7 shows a 1/4-inch mono phone plug (or TS phone plug), used with cables for unbalanced microphones, synthesizers, and electric instruments. The tip terminal is soldered to the cable's center conductor; the sleeve terminal is soldered to the cable shield.

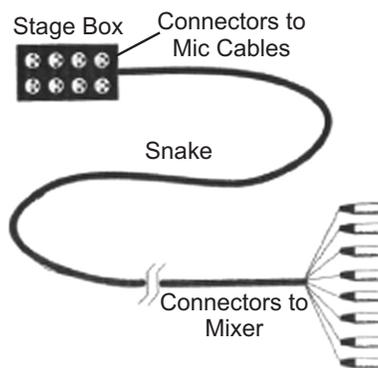


Fig. 10.7: A stage box and snake.

Figure shows an RCA or phono plug, used to connect unbalanced line-level signals. The center pin is soldered to the cable's center conductor; the cup terminal is soldered to the cable shield.

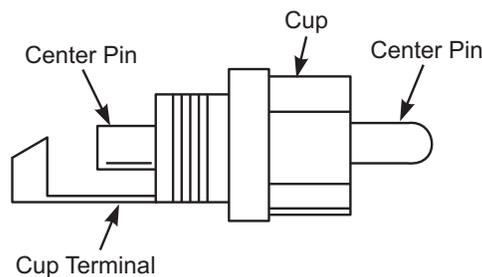


Fig. 10.8: An RCA (phono) plug



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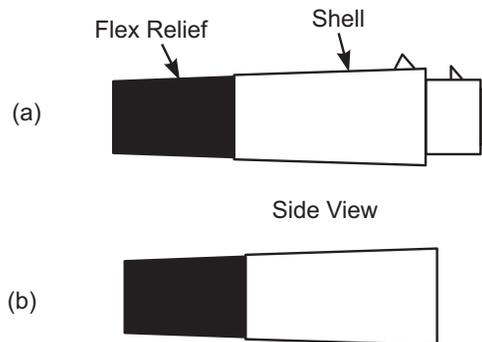


Fig. 10.9: A 3-pin pro audio connector (XLR-type) (A) female (b) male

Figure 10.9 shows a 3-pin pro audio connector (XLR-type). It is used with cables for balanced mics and balanced recording equipment. The female connector (with holes; Figure) plugs into equipment outputs. The male connector (with pins; Figure) plugs into equipment inputs. Pin 1 is soldered to the cable shield, pin 2 is soldered to the “hot” red or white lead, and pin 3 is soldered to the remaining lead. This wiring applies to both female and male connectors.

Figure shows a stereo (TRS) phone plug, used with stereo headphones and with some balanced line-level cables. For headphones, the tip terminal is soldered to the left-channel lead, the ring terminal is soldered to the right-channel lead, and the sleeve terminal is soldered to the common lead. For balanced line-level cables, the sleeve terminal is soldered to the shield, the tip terminal is soldered to the hot red or white lead, and the ring terminal is soldered to the remaining lead.

Some mixers have insert jacks that are stereo phone jacks; each jack accepts a stereo phone plug. The tip is the send signal to an audio device input, the ring is the return signal from the device output, and the sleeve is the ground.

10.4.5 Equipment Connections

The instruction manuals of your equipment tell you how to connect each component to the others. In general, use cables that are as short as possible to reduce hum, but that are long enough to let you make changes.

Be sure to label all your cables on both ends according to what they plug into—for example, MIXER CH1 MONITOR OUT or ALESIS 3630 IN. If you change connections temporarily, or the cable becomes unplugged, you’ll know where to plug it back in. A piece of masking tape folded over the end of the cable makes a stay put label.

Let’s say you have a hardware mixer in your recording setup. Here’s a typical way to hook up the gear :

Audio Chain Setup

1. Plug the AC power cords of audio equipment and electric musical instruments into AC outlet strips fed from the same circuit breaker. Make sure that the sum of the equipment current ratings does not exceed the breaker's amp rating for that outlet. Plug the power amplifier or powered speakers into their own outlet on the same breaker so that they receive plenty of current. Consider using an AC power conditioner such as made by Furman (www.furmansound.com). It provides clean, steady AC power to sensitive electronic equipment. Surge protection and noise filtering are included.
2. Connect mic cables to mics. Use mic cables with a male XLR connector on one end and a female XLR connector on the other end.
3. Connect mic cables to the female XLR connectors in either the snake junction box, or directly into mic inputs on a mixer or mic preamps. Plug the snake connectors into the mic inputs. If your mixer has phone-jack mic inputs, you may need to use an impedance-matching adapter (female XLR to phone) between the mic cable and the mic input jack.
4. Set the output volume of synthesizers and sound modules about three-quarters up. Using a guitar cord, connect their audio outputs to instrument or line inputs on your mixer. If this causes hum, use a direct box. Using a MIDI cable, connect the MIDI OUT of a MIDI controller to the MIDI IN of your audio interface or MIDI interface.
5. If you are recording a guitar direct, connect its cord either to (1) an instrument input on your mixer or audio interface (1/4-inch phone jack), or (2) a direct box. Connect the XLR output of the direct box to a mic input on your mixer or audio interface.
6. If the mixer is a standalone unit (not part of a recorder-mixer), connect the mixer's stereo line outputs to the inputs of an audio interface. Use a stereo RCA-to-RCA cable or two phone-to-phone cables. If the mixer has a USB or FireWire connector, connect that to the mating connector in your computer—you don't need an audio interface.
7. Connect the audio interface line outputs to the mixer's 2-track or tape inputs, or directly to powered speakers. Use a stereo RCA-to-RCA cable or two phone-to-phone cables. Again, if the mixer has a USB or FireWire connector, connect that to the mating computer connector and omit the audio interface.
8. Connect the mixer's monitor outputs to the power-amp inputs. Connect the power-amp outputs to loudspeakers. Or if you are using powered (active) monitors, connect the mixer monitor outputs to the monitor-speaker inputs.
9. If the mixer does not have internal effects, connect the mixer aux-send



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- connectors to effects inputs (not shown). Connect the effects outputs to the mixer aux-return or bus-in connectors. Use phone-to-phone cables.
10. If you're using a separate mixer and multitrack recorder, connect mixer bus 1 to recorder track 1 IN; connect bus 2 to track 2, and so on. Also connect the recorder's track 1 OUT to the mixer's line input 1; connect the track 2 OUT to the mixer's line input 2, and so on. Use cables with RCA or phone connectors. As an alternative, connect insert jacks to multitrack inputs and outputs. At each insert plug, connect the tip (send) terminal to a track input and connect the ring (return) terminal to the same track's output. Use a TRS-to-2-TS cable (stereo phone plug to two mono phone plugs).
 11. If you have several headphones for musicians, connect the mixer's headphone jack to a small amplifier to drive their headphones. Use a cable with a stereo phone Plug on one end and two mono phone plugs on the other end (TRS-to-2-TS cable). Or if the mixer's headphone signal is powerful enough, connect it to a box with several headphone jacks wired in parallel.

Figure 10.10 shows typical connections in a Digital Audio Workstation (DAW) recording studio with a multichannel audio interface.

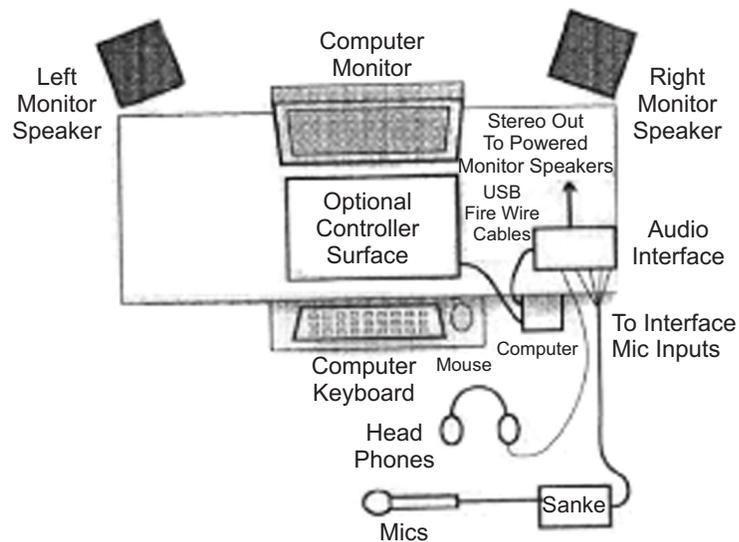


Figure 10.10: Typical layout of a DAW recording studio

As shown in Figure above, you might connect the equipment like this:

1. Using a guitar cord, connect electric instruments to instrument inputs on the audio interface. If an instrument is more than about 15 feet from the interface, connect its output to a direct box (using guitar cords), and connect the direct box XLR output to a snake or to an audio interface mic input.

Audio Chain Setup

2. Using an XLR mic cable, connect each mic to a mic input on the audio interface. If the mics are more than about 15 feet from the interface, connect each mic to a snake box, and connect the snake XLR connectors to the interface mic inputs. If you prefer to use a separate mic preamp and A/D converter, plug the mic into the preamp, and connect the preamp's line output to the A/D converter's line input using an XLR or phone-to-phone cable.
3. Using a MIDI cable, connect the MIDI OUT of a MIDI controller to the MIDI In of the audio interface.
4. Using two phone-to-phone Cables (stereo or mono), connect the stereo output of the interface to two powered monitors. If your monitor speakers are passive connect the interface stereo outputs to the line inputs of a stereo power amp. Use speaker cable to connect the power-amp outputs to the speakers.
5. Plug headphones (or a headphone amplifier or junction box) into the headphone jack of the interface.
6. Using a USB or FireWire cable, connect the USB/FireWire port in the interface to the mating port in the computer.
7. Using a USB cable, connect the USB port of an external hard drive to a mating port in the computer. That hard drive can be used for audio files or for backup.

Hooking up a recorder-mixer studio can be quite simple. Plug mics into mic inputs, plug headphones into headphone jacks, and plug powered speakers into the mixer monitor outputs.

10.5 ASSEMBLING AND INSTALLING SOUND/AUDIO EQUIPMENT AT SITE

Following points may be observed before assembling sound equipment

1. You must know and visit the place in advance where the sound equipment needs to be assembled and ascertain the following
 - (a) Contact the person who will authorize you to work at site
 - (b) Know the exact place where the sound equipment i.e. Loudspeakers, Amplifiers, Signal processing equipment, Microphones will be required to be placed.
 - (c) Know the sockets from where the power supply will be drawn. You draw power from 5A socket if the total power to be drawn is less than say 900W. If the total power to be drawn is 1KW or more it should drawn from 15 A sockets.



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- (d) Plan layout of power supply cables and power outlets to equipment. Similarly plan layout of Microphones cables (from Microphones to Amplifiers) & Loudspeaker cables (from Amplifiers to Loudspeakers).
- (e) Ascertain the movement of people during the programme. This will help you to lay power supply cable, Microphone cables & Loudspeaker cables in a manner to avoid disturbance and disruption of the programme and damage to cables. In some cases carpets may be laid on cables to avoid disruption of cables due to heavy movement of people (dancing etc).
- (f) To ascertain the requirement and arrangements for placing equipment (Microphone Stand booms, Amplifiers, Sound processing equipment etc.) on table of appropriate size. Table height of 30" is quite appropriate for operating the equipment.

10.6 TRANSFERRING THE SOUND EQUIPMENT TO THE SITE

Following points should be taken care of while moving the Equipment to site:

- (a) Fragile, delicate and costly equipment should be transferred in their own boxes which have suitable casing lined with foam to avoid any transit damage.
- (b) Other equipments should also be transported in suitable boxes made for the purpose and lined with foam cushion (e.g. Amplifiers, Loudspeakers, Tape Recorders, CD players etc.)
- (c) End connectors of Microphone cables, Loudspeaker cables should be checked for appropriate connections to avoid embarrassment at last moment.
- (d) Always carry appropriate tools (Screw drivers, soldering Iron, Solder, Flux etc) to carry out minor repairs at site if need be.
- (e) Always reach the site in advance to set up, and test the equipment. Keep sufficient margin of time for some unforeseen problems, repairs at site.
- (f) Make a list of Inventory issued from Stores. It will help you to return back all the items to Stores.

10.7 CONNECTING THE EQUIPMENTS FOR FUNCTIONING

Following points should be taken care of while connecting the equipment for actual functioning :

- (a) Place the equipment appropriately on a table to ensure ease of operation i.e.

Microphones should be placed where the singer or speakers will sit or stand. Amplifier Speech Processing Equipment should be placed where Sound Assistant is to sit. Loudspeakers should be placed to enable equitable distribution of Sound energy.

- (b) Microphones should be connected to MIC inputs. Equipment like Tape Recorders, CD Players, Gramophone Players(Record Players) etc. should be connected to LINE Inputs.
- (c) Loudspeakers should be connected to appropriate level Output Impedance terminals of Power Amplifiers.
- (d) Power supply switch of all the Equipment should be checked to have been turned to 220 Volts AC.(Some imported Equipment is designed for 110 Volts AC, its transformer setting should be changed to 220 Volts AC.) In case 110 V AC Equipment does not have a selector switch, a 220Volts-110Volts Transformer is required to be used between Power Supply of 220 Volts and 110 Volts Equipment.
- (e) Operate the Equipment for rehearsal, judging the settings of various controls of Equipment for suitable listening.
- (f) Observe the safety precautions as mentioned in the lesson on safety instructions

10.7.1 Phantom Power

Phantom power, in the context of professional audio equipment, is a method for transmitting DC electric power through microphone cables, to operate microphones that contain active electronic circuitry. It is best known as a convenient power source for condenser microphones, though many active direct boxes also use it. The technique is also used in other applications where power supply and signal communication takes place over the same wires.

Phantom power supplies are often built into mixing desks, microphone preamplifiers and similar equipment. In addition to powering the circuitry of a microphone, traditional condenser microphones also use phantom power for polarizing the microphone's transducer element. Three variants of phantom power, called P12, P24 and P48, are defined in the international standard IEC 61938.

10.8 SOUND CHECKS OF EQUIPMENTS

Before the actual operation of sound equipments a sound check is required so that any problem either minor or major can be detected and rectified. The problem of Hum is often seen. In all the modern signal audio equipments, self testing feature is in built and its users friendly. In just one click all the features of the sound equipment are self tested. Even in some of the equipments trouble shooting is also in built.





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10.8.1 Hum Prevention

You patch in a piece of audio equipment, and there is a sound - HUM! It's a low-pitched tone or buzz. This annoying sound is a tone at 60 Hz (50 Hz in Europe) and multiples of that frequency.

Hum is caused mainly by

- Cables picking up magnetic and electrostatic hum fields radiated by power wiring-especially if the cable shield connection is broken.
- Ground loops. A ground loop is a conductive loop or circuit made of a cable shield and a power-ground wire. A ground loop occurs when two or more separated pieces of audio equipment are each connected to power ground through a 3-prong power cord, and are also connected to each other through a cable shield. The ground voltage may be slightly different at each piece of equipment, so a 50- or 60-Hz hum signal flows between the components along the cable shield.

These are the most important points to remember about hum prevention:

- To prevent ground loops, plug all equipment into outlet strips powered by the same AC outlet or AC circuit.
- Do not use an AC (electrical) 3-to-2 adapter to disconnect the power ground-it causes a safety hazard.
- Some power amps create hum if they don't get enough AC current. So connect the power amp (or powered speakers) AC plug to its own wall outlet socket-the same outlet that feeds the outlet strips for the recording equipment.
- If possible, use balanced cables going into balanced equipment. Balanced inputs have XLR or hRS connectors and two conductors surrounded by a shield. At both ends of the cable, connect the shield to a screw in the chassis, not to XLR pin 1. Or use audio gear whose XLR connectors are wired with pin 1 to chassis ground, not to signal ground.
- Transformers isolate unbalanced connections. If that is not an option, use the cable assemblies..
- Don't use conventional SCR dimmers to change the studio lighting levels. Use Luxtrol® variable-transformer dimmers or multiway incandescent bulbs instead.

Even if your system is wired properly, a hum or buzz may appear when you make a connection. Follow these tips to stop the hum:

Audio Chain Setup

- If the hum is coming from a direct box, flip its ground-lift switch.
- Check cables and connectors for broken leads and shields.
- Unplug all equipment from each other. Start by listening just to the powered monitor speakers. Connect a component to the system one at a time, and see when the hum starts to identify the hum generating equipment and isolating.
- Remove audio cables from your devices and monitor each device by itself. It may be defective.
- Lower the volume on your power amp (or powered speakers), and feed them a higher-level signal.
- Use a direct box instead of a guitar cord between instrument and mixer.
- To stop a ground loop when connecting two devices, connect between them a 1:1 isolation transformer, direct box, or hum eliminator (such as the Jensen CI-2RR, Behringer HD400, Rolls HE13).
- Make sure that the snake box is not touching metal.
- To prevent accidental ground loops, do not connect XLR pin 1 to the connector shell except for permanent connections to equipment inputs and outputs.
- Try another mic.
- If you hear a hum or buzz from an electric guitar, have the player move to a different location or aim in a different direction. You might also attach a wire between the player's body and the guitar strings near the tailpiece to ground the player's body.
- Turn down the high-frequency EQ on a buzzing bass guitar track.
- To reduce buzzing between notes on an electric-guitar track, apply a noise gate.
- Route mic cables and patch cords away from power cords; separate them vertically where they cross. Also keep recording equipment and cables away from computer monitors, power amplifiers, and power transformers.

By following all these tips, you should be able to connect audio equipment without introducing any hum.

10.9 DISMANTLING THE EQUIPMENT AFTER THE PERFORMANCE

You should observe following points for dismantling the Equipment:





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Audio Chain Setup

- (a) You should seek approval or consent of the Contact Person before starting the dismantling Process.
- (b) Once permission of the Contact Person has been obtained, disconnect Power supply and then Grounding arrangement if an additional Grounding arrangement has been done.
- (c) After disconnecting Power supply, remove delicate and costly equipment and pack them in their respective packing's.
- (d) Remove the cables from site and wind them in suitable cable drums.
- (e) Check the inventory with respect to List of Inventory got issued from Stores before starting return journey from the site.
- (f) Hand over all the items which were taken on loan from stores for the purpose of the event.

10.10 WHAT HAVE YOU LEARNT

In this lesson you learnt about the components of audio chain, different types of cables and connectors, installing and assembling various equipments, phantom power etc., connecting the various equipments for functioning, performing sound checks and hum prevention and finally dismantling the equipment after the performance.

10.11 TERMINAL QUESTIONS

1. Define Audio Chain . List the various components used to connect studio equipments.
2. What are the different types of recording devices that can be put to use in a recording studio ?
3. Discuss the importance of performing sound checks.
4. What factors should be considered to prevent Hum Sound ?

10.12 ANSWERS TO INTEXT QUESTIONS

1. Audio
2. 2 MV
3. balanced
4. TRS