RECORDING AND PRODUCTION

WORKBOOK 5

CHAPTER 1
STUDIO RECORDING EQUIPMENT ⊙

CHAPTER 2
MUSIC TECHNOLOGY EQUIPMENT & SOFTWARE ⊙

E Chapters that are essential to this workbook.
⊙ Chapters that are optional to this workbook.

Please note

Any details or photographs of equipment, software, manufacturers or suppliers do not constitute a recommendation or endorsement by DWP, but are intended to provide typical reference examples only.

LIVE SOUND

WHAT IS IT?

Live sound is the term used for ensuring that performers can be heard when performing in public. This chapter is about live sound from a musician and DJ's point of view, and aims to give an introduction into the sorts of equipment and systems available, and how to set it up and get a good sound.

We will start by looking at Public Address systems (PA's) and their uses.

We will then look in detail at situations where PAs are used and what you might need, including small (pub) gigs, karaoke and permanently installed PAs.

We will then look at techniques for getting a good sound. It will help if you have read chapter one before reading this section.

We will conclude by looking at Health and Safety, from a setting up and performance point of view.

WHY DO I NEED TO KNOW ABOUT THIS?

Playing live is an important part of the music industry, and the sound of the performance is critical. Understanding what makes up a PA and how to get the best out of it will help ensure that your live audience can hear you properly and help ensure you have a good gig.

The information in this chapter applies equally to DJs, Karaoke performers, bands and electronic musicians who perform live.

The health and safety aspect of this chapter is also highly important as some venues have very strict rules about health and safety and what you can and can't bring in.

YOU MUST HAND IN YOUR WORK BY   TO

	HOW LONG should this assignment take?	Every person works at his/her own pace. As a guide, spend 2 hours reading and making notes, another 3 hours to write your answers and a further hour to discuss them with your MOLP tutor.
	HOW will I be assessed?	Your tutor will assess your work. He/she will give you feedback on how you have done. If you have not completed the work, you will be given the chance to do further work to pass this assignment.
	WHAT do I do now?	Read the TASKS section below to get an overview of this project. Then read the NOTES AND GUIDANCE section for help. Carry out the TASKS.

TASKS

1 In the box below, list 10 different situations and uses for PA equipment

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

2 The following is a list of possible PA equipment. Circle True or False for each to indicate whether it would be found in a PA.

Amplifier	True	False
DI Box	True	False
Recorder	True	False
Mixer	True	False
Control Surface	True	False
Subwoofer	True	False

3 In the box below explain what a Technical Rider is.

4 For each of the types of PA system below, list one advantage and one disadvantage.

Format	Advantage	Disadvantage
Active speakers and a mixer		
Powered mixer and passive PA speakers		
Amplifier and passive PA speakers and subwoofer		

5 For each instrument in the list below, write whether you would use a dynamic microphone, a condenser microphone or a DI box to get the best sound.

Acoustic Guitar	Dynamic / Condenser / DI Box
Electric Bass	Dynamic / Condenser / DI Box
Snare Drum	Dynamic / Condenser / DI Box
Keyboard	Dynamic / Condenser / DI Box
Vocal	Dynamic / Condenser / DI Box
Electric Guitar	Dynamic / Condenser / DI Box
Drum Overhead	Dynamic / Condenser / DI Box
DJ	Dynamic / Condenser / DI Box

6 Circle True or False for each of the statements below.

Larger woofers are better for producing lower frequencies	True	False
A crossover splits the sound into frequency bands	True	False
The power handling of a speaker shows what frequencies it can produce	True	False
Active speakers are better than passive speakers	True	False
Subwoofers are necessary when using a PA just for vocals	True	False
A wedge is an angled monitor speaker that goes on the stage	True	False

7 If you were a guitarist in a band, and were playing a gig at a pub, what instruments would you want to hear through your monitor?

8 Explain, in the box below, what feedback is and how it can be avoided.

9 For each of the PA components in the list below, write what it would connect to.

From	To
Microphone	
Powered Mixer	
Bass Guitar	
Amplifier	
DI Box	

10 On a separate sheet of paper, draw a stage plan indicating where the PA and monitors would be placed for a band playing in a pub type venue consisting of ;

2 singers, 2 keyboard players, 1 drummer, 1 bassist

11 Show on the following tick list your current experience of live sound.

☐ I have played in a band live on stage

☐ I am a DJ and have played live on stage

☐ I have helped set up a PA

☐ I have set up a PA system

☐ I have been a front of house engineer

☐ I own my own PA system

12 For the list of instruments below, write what processing and effects you could use in a live sound situation.

Instrument	Processing	Effect	Why?
Electric guitar			
Vocal			
Kick drum			
Snare drum			
DJ			
Bass guitar			

13 Circle True or False for each of the following statements.

Guitar amps should be as loud as possible on stage	True	False
PA systems should always be distorting	True	False
Graphic equalisers can be used to reduce feedback	True	False
Monitors shouldn't be louder than the front of house system	True	False
Most venues don't have much natural reverberation	True	False
The maximum vocal level should be obtained first	True	False

14 In the table below, specify what equipment you would buy for a PA for use for Pub gigs, for a band with;

1 lead vocal   4 backing vocals   2 electric guitarists   1 acoustic guitarist   1 electric bassist   1 drummer

Component	Quantity	Make	Model	Price	Why?

Now hand in this worksheet to your tutor. Go to the 'more tasks' section for extra projects.

WHAT IS A PA SYSTEM?

A PA is a **Public Address system**. There are a wide variety of PA systems in existence, from small one speaker setups to 80 speaker flown systems as used at festivals such as Glastonbury.

PA systems are in use in venues, pubs, clubs, shopping centres, shops, restaurants, railway stations, stadiums and many other places. They were originally devised to enable announcers or public speakers to be heard – hence the name public address.

For the purposes of this chapter, we will be concentrating on the sorts of systems you would expect to use for small to medium size pubs and venues, from 10 to 2000 people.

PA systems are generally used for amplifying voices, as guitarists have loud guitar amps, bassists have bass amps and drums are just loud. However, as the gigs get bigger more and more gets put through the PA system, and hence the PA system grows in size. The largest PA's and situations require that all the instruments go into the PA, and that the PA also provides different on stage sound for each performer.

For the purposes of this chapter, PA systems will be split into mobile (or touring) systems, and installed systems. Some venues have their own systems installed, and others require that you bring your own or hire one.

WHAT ARE THE COMPONENT PARTS OF A PA SYSTEM?

A basic PA system consists of a microphone or some other source of sound (CD player etc), an amplifier and a loudspeaker.

At their most extreme, PA systems consist of racks of amplifiers, huge arrays of different types of loudspeakers, mixing desks, effects, microphones and lots of cable.

When PA systems are used for gigs, they often feature two sets of PA system in one – 'Front of house' sound, and Monitors (or 'on stage' sound). This is so that the audience can hear the music, and the band can hear each other. Most of this section will be about 'front of house' systems, but monitoring will be covered.
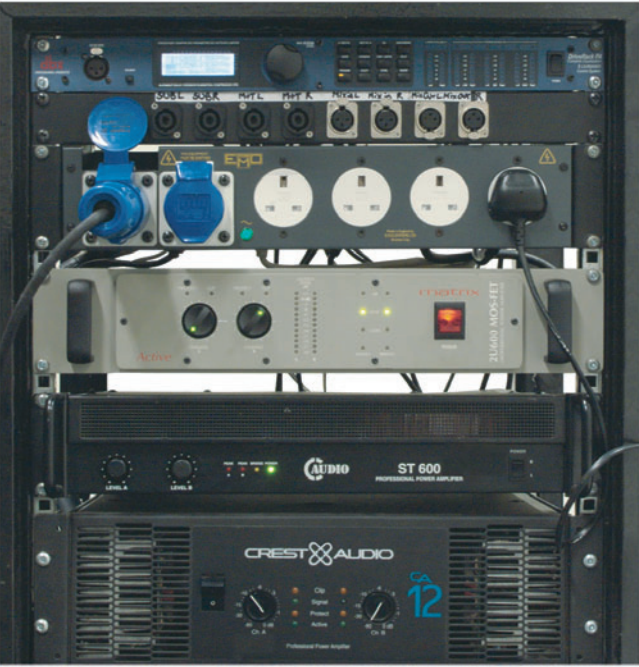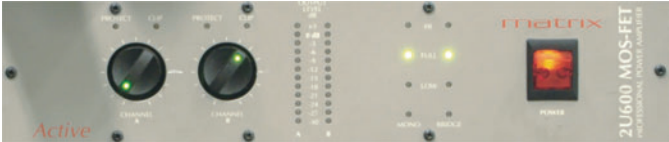
Now lets look at mobile and installed systems.

A lot of live music venues have an installed PA system with the cabling connected from the stage to the mixing desk. They often have their own engineer to operate the PA, and just require a spec sheet (specification sheet) or technical rider. This is simply a sheet of paper specifying what instruments will be played and what microphones will be required, so the engineer can sort out their connections and signal routing.
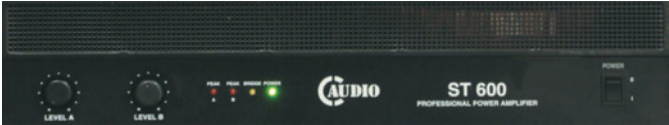
Mobile systems can be further divided into two categories – **ACTIVE** and **PASSIVE**.

ACTIVE SYSTEMS have the amplifiers built into the loudspeaker cabinets (such as the Mackie SRM450). There are good reasons for this; amplifiers are matched to the loudspeakers by the manufacturer and there is less to carry around and set up. You need to provide mains power for each loudspeaker this way, which often involves having long mains extension leads all over the place. It also can make upgrading or changing the system more difficult.

PASSIVE SYSTEMS are when the amplifier and loudspeaker are separate. You therefore have more to carry around and set up, but it gives more flexibility. They also allow for active equalisation and bi-amping which is when the signal is split into frequency bands and each band has its own amplifier and speakers. Most large systems are constructed in this way.

Passive systems can be further divided into systems that make use of a powered mixer, or systems that use a power amp and a mixer.

Passive speaker and power amplifier

Amplifier Rack

TOP: Matrix 2U600 MOS-FET professional power amplifier

MIDDLE: C-Audio stereo power amplifier

BOTTOM: CREST AUDIO CA12 power amplifier

Mackie active speaker
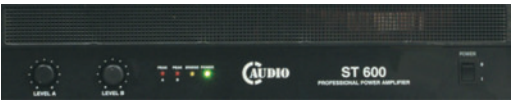
MIXING DESKS are necessary as they enable you to plug several inputs into your PA, set different levels for each, adjust the tone (equaliser) and add effects.

Mixing desks and effects units are generally positioned at the back of the venue, facing the stage, in the 'front of house' position, enabling the engineer to hear all the sound from the stage and the PA.
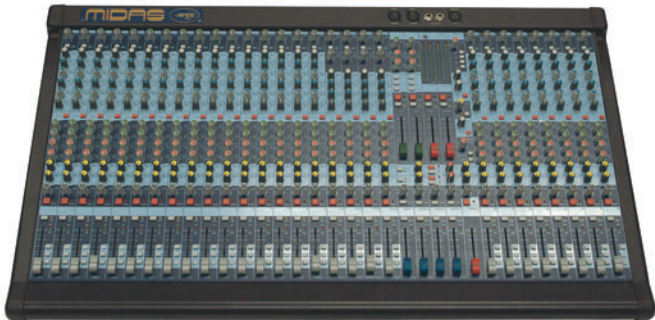
POWERED MIXERS are mixing desks with built in amplifiers to power the speakers, thereby removing the need for any other amplification. Powered mixers tend to be used at the smaller end of the PA market, as the built in amplifiers aren't particularly powerful.

Master section from MIDAS Mixiing desk

Phonic Power Pod 615 Powered Mixer

MIDAS Mixing desk

INPUT SOURCES

Once you have chosen your mixer, you need to get sound into it. This will be either from a microphone or a connection to some other source such as a DJ mixer or keyboard. Connections to sources such as this are generally made through Direct Inject boxes (DI Box), which are designed to match the level of a range of inputs to the level required by a mixing desk.

The table below outlines what sorts of connection or microphone you would expect to use for each sound source.

A large cable called a multicore is used to carry the signals to and from the stage. A multicore has a stage box at one end, with sockets to plug microphones and DI boxes into, and plugs at the other end to connect to the mixing desk.

MULTICORE

Source	Type	Example
Vocals	Dynamic microphone	Shure SM58
Electro-acoustic Guitar	DI Box	Behringer Ultra-DI DI100
Electric Guitar	Dynamic microphone	Shure SM58 or SM57
Electric Bass	DI Box	Behringer Ultra-DI DI100
Keyboard	DI Box	Behringer Ultra-DI DI100
DJ	DI Box	Behringer Ultra-DI DI100
Kick Drum	Dynamic microphone	AKG D112
Snare Drum	Dynamic microphone	Shure SM57
Tom tom	Dynamic microphone	Sennheiser MD421 or Shure SM57
Drum Overhead	Condenser microphone	AKG C451 or AKG C1000s

TYPES OF SPEAKERS

The most basic PA speakers consist of two drivers (individual speakers within a speaker cabinet are called drivers) – one for low frequencies and one for high frequencies. The low frequency drivers are called woofers, and the high frequency drivers tweeters. Typically, woofers are 10", 12", 15" or 18" diameters, with larger sizes capable of higher volumes and lower frequencies. The tweeters come in a range of styles and sizes, and are matched to the woofers. The sound entering the cabinet is split into high and low frequencies by a crossover.

The cheapest passive speakers would have a 10" woofer and 1" tweeter. The other specifications to be aware of are the power handling, which shows how powerful an amp they can accommodate, the frequency response, which shows what range of frequencies the speakers can produce (e.g. the B1020 are 55Hz to 18KHz) and the Sound Pressure Level (SPL) which shows how loud the speakers are per watt of power from the amp (e.g. the B1020 produce 95dB for 1 Watt at 1m distance).

Speakers go up in size and price from around £110, some have more drivers and some separate the frequencies into 3 bands (low, mid and high frequencies) and have a driver for each band. Active speakers are based on the same principles but have one or more built in amplifiers.

PA's that will be used in larger rooms or to amplify an entire band or DJ usually have Subwoofer speakers as well. These speakers are capable of producing lower frequencies than the speakers described above, and at a louder level. They usually have one or more 15" or 18" drivers.

Typically one subwoofer and one normal PA speaker are used for each side of the stage, with the normal speaker often positioned on a pole or directly on top of the subwoofer.

TOP : Passive PA speakers example 1
BOTTOM : Subwoofers

Passive PA speakers example 2

MONITORING
(ON STAGE SOUND)

BUYING
SECOND HAND

Once the front of house sound has been arranged, the next step is the sound on stage, or monitoring. This is essential for all music related PA applications, as the performers need to be able to hear what they are doing. For the smallest PA applications, only the vocal needs to be put into the monitors. At the other end of the scale, all the instruments need to be in the monitors, and each performer will want a different mix in their monitors.

The most common form of monitor is the wedge monitor. This is an angled speaker cabinet that is placed on the floor in front of the performer. Wedge monitors also come in active and passive varieties, so active wedges have built in amplifiers, and passive wedges need a separate amplifier.

Another common form of monitor is called a sidefill. These are stacks of speakers that are similar or the same as normal PA speakers, positioned at the sides of the stage pointing in at the performers. Another variation on this is the drumfill, which is the same as a sidefill but positioned next to the drummer so they can hear the other instruments. These are often large speakers to enable them to be heard over the noise of the drum kit.

In-ear monitors are becoming more popular now. These are basically in-ear headphones that are moulded to fit the ears of each performer. They enable much more accurate monitoring for the performer and help eliminate feedback. However, some performers don't like them as it feels more like being in the studio than being on stage.
In-ear monitoring systems are usually wireless, and a set of one transmitter, one receiver and one set of headphones costs from £340.

FEEDBACK

Feedback is when a microphone picks up the sound from the PA or monitors, and the signal goes round in a circle, amplifying each time. The end result is a howl or squeal that sounds bad and is very loud. It is avoided by careful speaker placement and equalisation, as the feedback is often at a certain frequency that can be cut.

Wedge monitor example

It is quite common to buy PA equipment second hand.

There are many places to obtain second hand music equipment, from local papers, to websites, magazines to auctions. One of the most popular places now is ebay, the online auction site. It is possible to pick up some bargains, but when buying any music equipment second hand ensure you can test it before you pay. PA equipment can get quite battered and bruised and may require some maintenance.

There are some weblinks in the Want to know more? section that lead to second hand PA equipment listings.

SETTING IT
ALL UP

SMALL (PUB) GIG

This section will describe a typical PA setup for a band in a small venue such as a pub. Let's assume a typical band line up;

Lead vocal, 2 × backing vocal, Drums, Electric guitar, Electric bass, Keyboard

The PA would normally provide amplification for the keyboards and the vocal, as the drums would be loud enough by themselves, and the guitarist and bassist's amplifiers would be loud enough on their own.
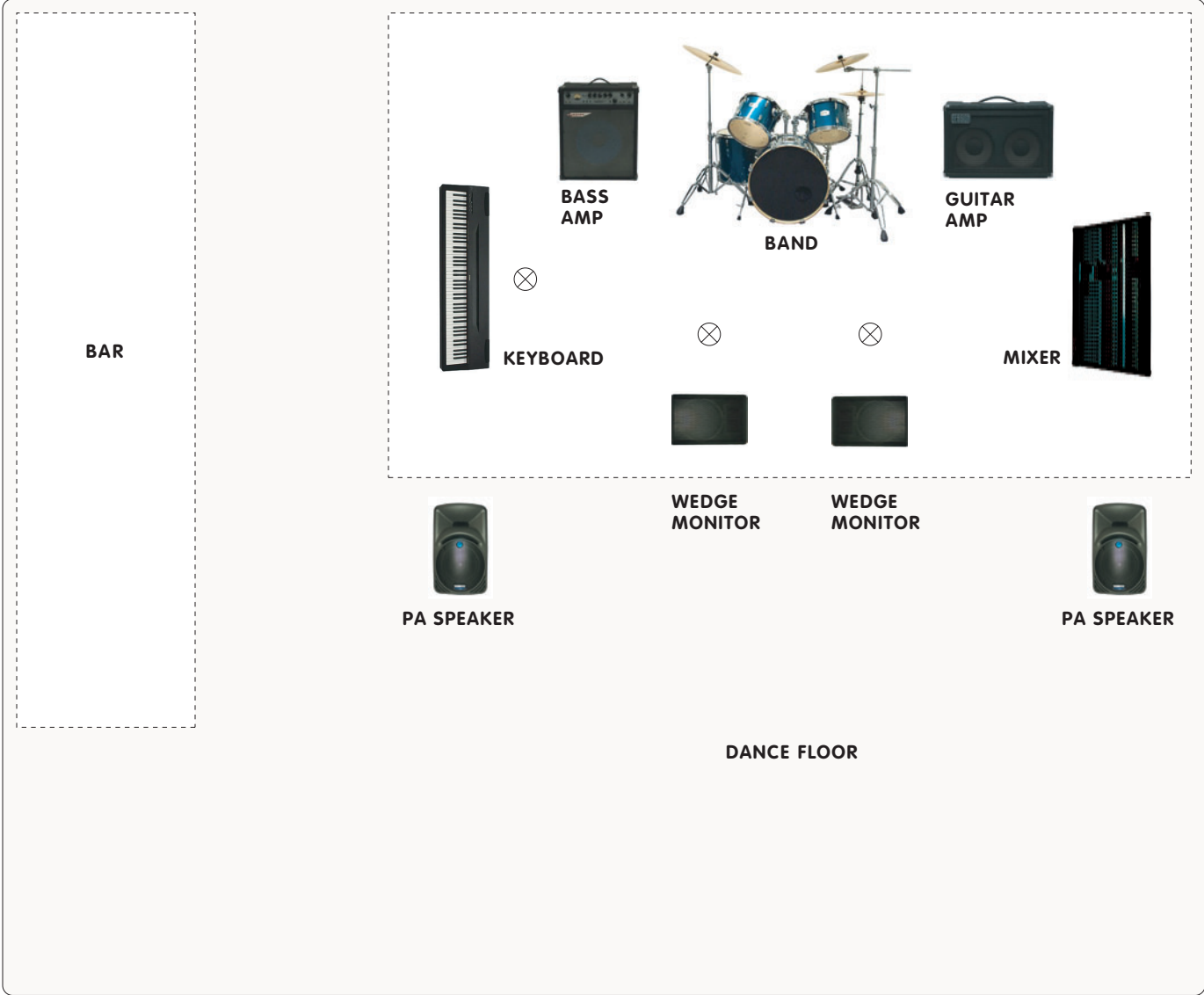
As the PA wouldn't be handling any bass or kick drum, a simple PA system consisting of 2 speakers each side, with 12" or 15" woofers and a tweeter would be sufficient. These would normally be placed on stands so that they are above the heads of people standing at the front.
Monitoring would be necessary so that the performers can hear the vocal and keyboards, but as small venues tend to have small stages there would probably only be room for 2 wedge monitors.

For a gig such as this, a powered mixer, passive speakers, and a powered wedge monitor and a passive slave wedge would be ideal. You would need a mixer with a minimum of 4 channels, and it would need to have an aux send to be used to send a mix to the monitors.

The following is a list of equipment that would be ideal for this sort of live sound situation. The price is only an indication, and if equipment was bought second hand it would be cheaper.

Component	No.	Manufacturer	Price	Why
Powered mixer	1	Behringer	£250	250w per speaker output, 10 input channels
PA speaker	2	Behringer	£140 each	12" woofer, tweeter, 200w power handling
Active monitor	1	Carlsbro	£255	12" woofer, tweeter, 100w amplifier
Passive monitor	1	Carlsbro	N/A	Comes with active wedge
Microphones	3	Shure	£69 each	Industry standard live vocal mic
DI box	1	Behringer	£39	Robust build, good quality
			£1031	

BAR

BASS AMP

BAND

GUITAR AMP

KEYBOARD

MIXER

WEDGE MONITOR

WEDGE MONITOR

PA SPEAKER

PA SPEAKER

DANCE FLOOR

NOTE : ⊗ **MICROPHONE PLACEMENTS**

KARAOKE

Karaoke or singers who perform with a backing track need a slightly different design of PA system. The PA would amplify everything, including the backing track (from a CD player or similar) and one or more microphones.

There would be a need for subwoofers, as the PA would be handling bass from the backing track.

Monitors would also be necessary as the performer would need to hear themselves and the backing track.

The ideal choice here would be an active PA – active speakers and subwoofers, an active monitor and a small mixing desk. This is because it is easier to set up and move around, and provides a good quality of sound.

The list in the table below is an indication of what you could use for this sort of situation. As before, this is not the only way that this job can be done.

Component	No.	Manufacturer	Price	Why
Mixer	1	Behringer	£120	4 mic inputs, CD player input, built in effects
Active PA speaker	2	Mackie	£1300 for 2	High quality bi-amped 400w speaker
Active monitor	1	Carlsbro	£175	12" active monitor
Microphones	1	Shure	£69	Industry standard live vocal mic
CD Player	1	Denon	£100	Rack mountable
			£3064	

CD PLAYER

MIXER

BAR

WEDGE MONITOR
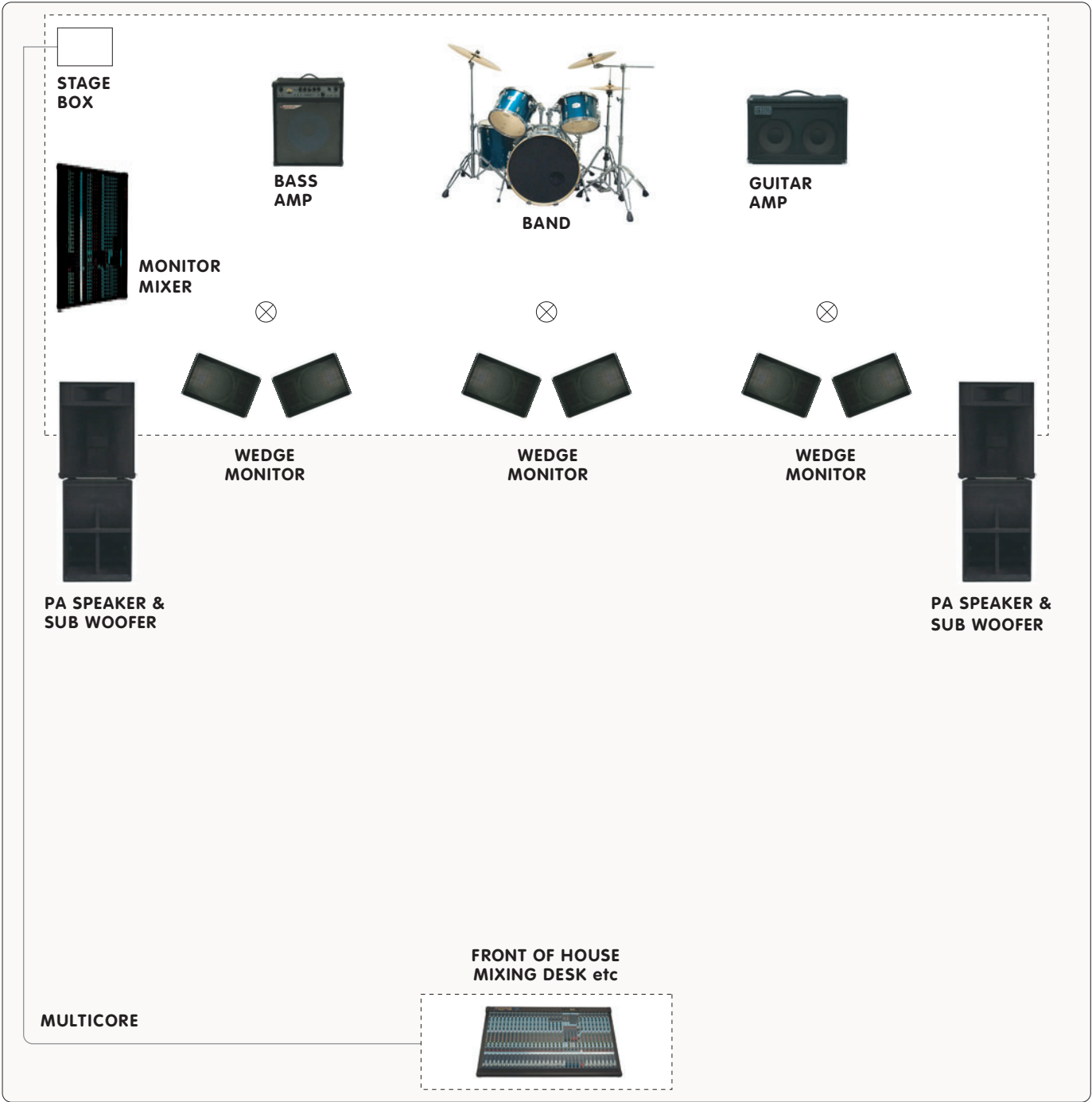
PA SPEAKER & SUB WOOFER

PA SPEAKER & SUB WOOFER
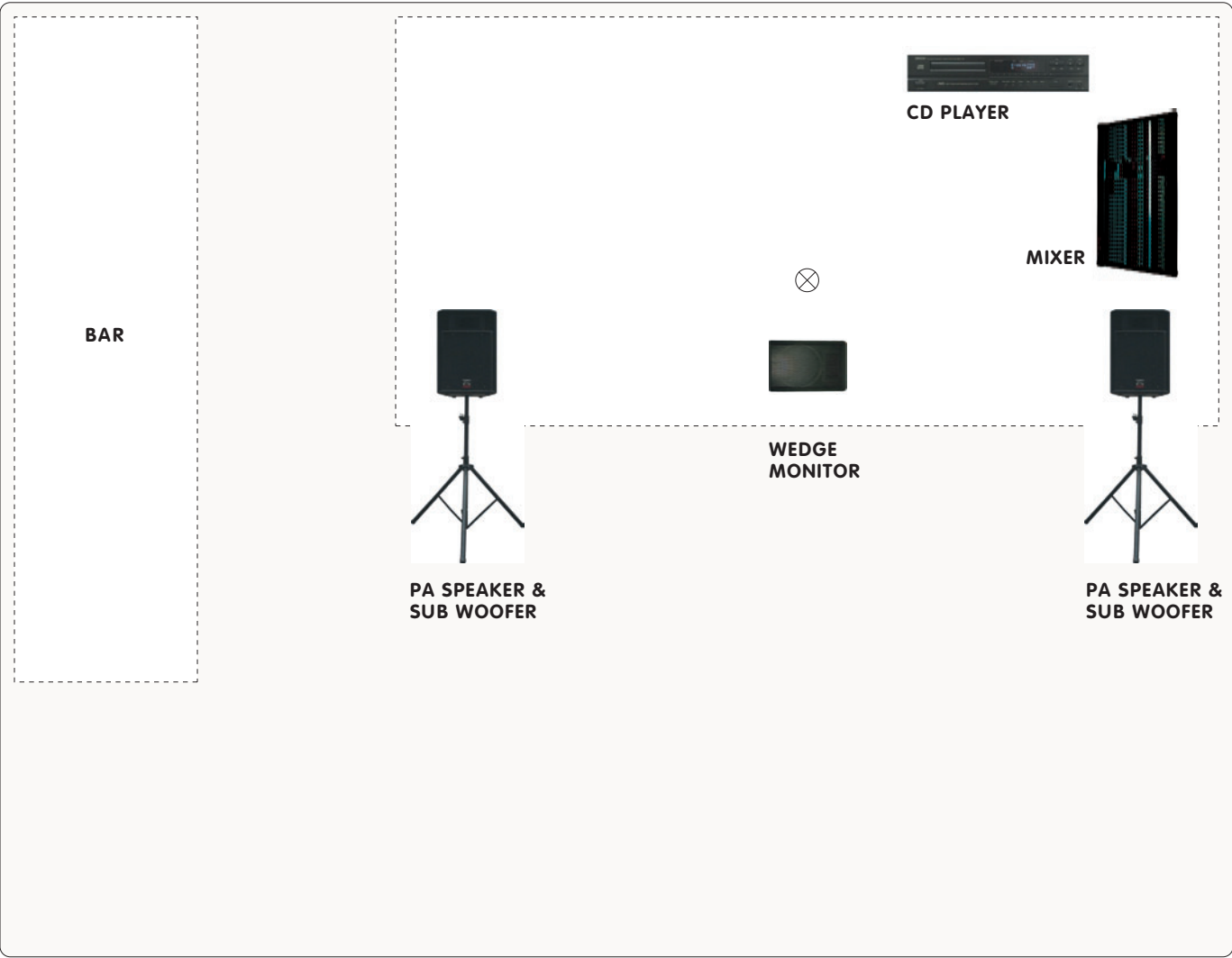
NOTE : ⊗ MICROPHONE PLACEMENTS

PERMANENT VENUE PA

The diagram represents the sort of equipment used in a permanent venue PA. In this situation, the front of house engineer would use one or more aux sends to send a feed to the monitors from each channel. In this way, different mixes for different monitors can be provided.

The front of house mixing desk would generally be set up in a convenient position, and would be accompanied by effects units, compressors, noise gates and graphic equalizers.

The stage box and multicore would normally be positioned at the back or side of the stage, ready to plug the microphones and DI boxes into.

STAGE BOX

BASS AMP

BAND

GUITAR AMP

MONITOR MIXER

WEDGE MONITOR

WEDGE MONITOR

WEDGE MONITOR

PA SPEAKER & SUB WOOFER

PA SPEAKER & SUB WOOFER

FRONT OF HOUSE MIXING DESK etc

MULTICORE

NOTE : ⊗ **MICROPHONE PLACEMENTS**

GETTING THE RIGHT MIX

There are some basic principles for getting a good live sound.

Set up the PA and get the vocal as loud as you comfortably can without feedback. Then match the other instruments to this vocal level.

If you are putting the whole band through the PA, ensure that the amps on stage are not too loud, as this will make getting the sound right through the PA difficult.

Ensure that the monitors are not too loud as this sound will interfere with the front of house sound.

Use this table to work out what types of effects or processing you need.

Instrument	Processing	Why	Effect	Why
Vocal	Compression	Keeps the level consistent and makes it easier to hear over other instruments	Reverb	Gives a sense of space to the mix, but use with care – not too long a reverb time
Bass guitar	Compression	Keeps the level consistent	None	Bass players can add their own effects on stage if they want them
Electric guitar	Maybe compression	Keeps the level consistent	None	Guitarists can add their own effects on stage if they want them
Acoustic guitar	Compression	Keeps the level consistent	Reverb	Gives a sense of space to the mix, but use with care
Keyboards	None		None	
Kick drum	Noise gate	Removes unwanted sound from the mic	None	
Snare drum	Noise gate	Removes unwanted sound from the mic	Reverb	Gives more depth to the snare, but use with care
Tom toms	Noise gate	Removes unwanted sound from the mic	Reverb	Gives more depth to the snare, but use with care
Drum overheads	None		None	
DJ	Limiting	Limiting is hard Compression which ensures that the PA isn't overloaded	None	

HEALTH & SAFETY

When performing live or running a PA in a venue there are many health and safety issues to be aware of. These include:

CROWD SAFETY
First Aid
Security
Capacity
Disabled Access
Ventilation
Slips and Trips
Fire Exits
The Door
Staff Safety

For more information on health and safety
➤ WORKBOOK 4 – PERFORMING – CHAPTER 4

ELECTRICAL SAFETY
PAT - Has equipment been tested?
RCDs - Residual Current Devices
Ventilation

FIRE SAFETY
Fire Exits
Fire Extinguishers
Fire Proofing – need to ensure any sets are fire proof

NOISE POLLUTION
Time curfew – some venues have a time limit on how late they can make noise
Volume (Decibel) limit – some venues have a maximum volume limit, and sometimes this is linked to the mains power to the stage, so that if the volume gets too loud the power is cut

WANT TO KNOW MORE?

LINKS

New Deal for Musicians has no responsibility for or control of the following sites. The inclusion of any site does not necessarily imply New Deal for Musicians approval of the site. To access any of the sites please type in the address into a browser or search using keywords from the name of the link.
www.dfes.gov.uk/ukonlinecentres Find Internet access that's close to you.

MORE INFORMATION AND LINKS

☐ **www.futuremusic.co.uk**
specialises in modern music technology, reviews, tips and techniques. Occasionally will contain competitions. Links to equipment manufacturers. Second hand gear listed.

☐ **www.soundonsound.com**
more general studio equipment and techniques. Reader's ads for second hand gear. The "Search" for articles from past issues is very useful.

☐ **www.computermusic.co.uk**
good info on the basic computer based set up for music. Tutorials on music software. Reviews of readers demos.

☐ **www.vocalist.org.uk/equipment.html**
Information on setting up and using PA systems as a vocalist

☐ **www.dv247.com**
Suppliers of recording equipment and PA systems

☐ **http://backstageshop.co.uk**
Suppliers of PA systems

☐ **www.ebay.co.uk**
Online auction site – you can find all sorts of musical equipment and PA equipment here

☐ **www.loot.com**
Second hand newspaper and online search

☐ **www.concert-systems.com**
New and second hand PA system suppliers

MAGAZINES

☐ **Future Music**
All the latest hi tech equipment is reviewed, plus studio and remixing tips.

☐ **Sound On Sound**
More general studio technology features. Good tips and techniques from professionals.

☐ **Sound On Sound Live**
Supplement magazine for live sound bundled with certain issues of Sound On Sound.

☐ **Computer Music**
Magazine specifically for making music with computers. Usually has a free CD with samples and software.

☐ **The Mix**
Professional Audio and Music Production magazine

☐ **Broadcast Now**
The magazine for the broadcast industry

☐ **Audio Media**
Professional Audio Magazine

☐ **Pro Sound News**
Magazine for the professional sound industry

☐ **Lighting & Sound International**
Magazine serving the broad range of the entertainment, presentation and events industries

BOOKS

☐ **Live Sound Reinforcement**
Hunter- Stark
Publisher : Omnibus Press
ISBN : 0918371074
Detailed information on a wide range of PA systems and setup

☐ **Basic Live Sound**
Paul White
Publisher : Sanctuary Publishing
ISBN : 1860742718
Good introductory book – applies professional live sound techniques to the working musician

☐ **The Live Sound Manual – Ben Duncan**
Publisher : Backbeat UK
ISBN : 0879306998
All aspects of live sound covered in detail

☐ **JBL Audio Engineering for Sound Reinforcement**
Publisher : Music Sales Limited
ISBN : 0634043552
Complete sound reinforcement reference book

MORE TASKS

1   Order a book on Live Sound from your local library to found out a lot more.

2   The way to get into live sound engineering is often by word of mouth. Get friendly with local bands and offer to go to rehearsals with them and set up their equipment. The next step is to accompany them to gigs and work with the in-house sound engineer as an assistant.

3   What is phantom power and what do you need to watch out for?

4   If you are regularly playing gigs, pay extra attention to how the PA system is set up.

5   Look in the yellow pages or search the Internet for local PA companies and see if you can offer yourself as unpaid work experience.

6   Where is the best place to position a microphone to amplify an acoustic guitar/flute/violin/saxophone?

7   You're on stage and your guitar sound dies. What do you check first?
a. The whole line, starting at your guitar
b. The whole line, starting at the mixer
c. Your guitar lead is still connected to the amp/DI box/stage box/Pedals or effects
d. The battery in your pedal

8   The sound is distorting on your vocals. What would you adjust on the mixing desk?
a. master fader
b. gain
c. pan
d. individual channel fader
e. mid EQ

9   There is no sound coming out of your left speaker. What is the likely cause?

10 There is no sound coming out of one channel. What do you need to check?

answers

1 Guitar : towards the neck or over the bridge, not over the sound hole
Flute : near the mouthpiece
Violin : near the bridge
Saxophone : near the bell
2 c 3 gain   4 The likely cause is that there is a poor connection of speaker cable at either end.
5 Connections; no mute on that channel; leads; active microphone switched on.

ACKNOWLEDGEMENTS