

Five Things I wish I had  
learnt about PA years ago

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## 1. Gain Structure



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What Is It?

Levels

Why Is It Important?

How To Set Gain Structure



## 1. Gain Structure

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What Is Gain Structure?



Mic Level



Line Level



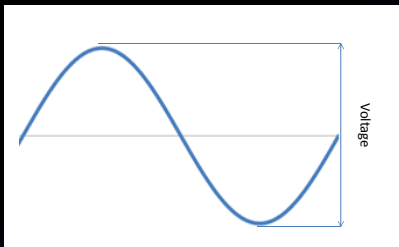
Power Level



## 1. Gain Structure

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Levels



## 1. Gain Structure

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Levels

Mic Level

Low

Typically 10-40dB below  
line level depending on  
microphone type &  
placement, and acoustic  
volume of source

Line Level

1.228 Vrms

+4dBu on a sound desk

Power Level

High

Varies depending on  
output transducer and  
required volume

Head Amp

Power Amp



## 1. Gain Structure

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### Why Is Gain Structure Important?



## 1. Gain Structure

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### Why Is Gain Structure Important?

Goals:

- Best signal-to-noise ratio
- Avoid clipping or distortion



## 1. Gain Structure

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### How To Set Gain Structure

1. Mic placement



## 1. Gain Structure

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### How To Set Gain Structure

2. Get a strong signal



## 1. Gain Structure

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### How To Set Gain Structure

3. Set pre-amp gain



## 1. Gain Structure

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### How To Set Gain Structure

Setting Power Amp Gain



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## 2. What Do All The Desk Controls Do?



## 2. What do all the desk controls do?

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### A Quick Overview of the Desk

Channel Gain & EQ

Auxiliary Outputs

Channel Fader, Mute & Groups

Master Section

Sub-Group Section



## 2. Desk Controls

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### Channel Gain & EQ

Polarity inverse

Input gain trim

High freq EQ

Low-mid EQ

EQ bypass



Phantom power

Mic / line pad

100Hz bass cut

Hi-mid EQ

Bass EQ



## 2. Desk Controls

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### Auxiliary Outputs



Pre-fade Aux

- Level sent is *not* effected by the channel fader
- Use for:
  - Stage monitor sends
  - Independent recording feeds

Post-fade Aux

- Level sent is proportional to the channel fader
- Use for:
  - Effects sends
- Do NOT use for monitor sends



## 2. Desk Controls

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### Channel Fader, Mute & Groups



Stereo pan control

Mute

Signal presence lights

PFL - Pre Fade Listen

Mix buss routing

Mute group assign

Channel fader



## 2. Desk Controls

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### Master Section



Master Output meters

Master mutes

Master AFL

Master faders



## 2. Desk Controls

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### Sub-Group Section



Group assign  
Group pan control  
Group meters  
Mutes mutes  
Group AFL

Group faders



## 3. How Do I Stop Feedback?

Five Things I wish I had learnt about PA years ago



## 3. How do I Stop Feedback?

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What Is It?

Why Does It Occur?

How Do I Stop It?



## 3. Feedback

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### What Is Feedback?

Undesirable ringing, whistling or hum through the sound system

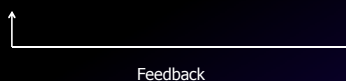


## 3. Feedback

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### Why Does Feedback Occur?

Source → Mic → Mixing Desk → Amplifier → Loudspeaker



## 3. Feedback

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### Scenario 1

Feedback level is significantly quieter than source level

Source → Mic → Mixing Desk → Amplifier → Loudspeaker



Result – Feedback loop is rapidly diminishing, no noticeable ring



### 3. Feedback

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#### Scenario 2

Feedback level is only slightly quieter than source level

Source → Mic → Mixing Desk → Amplifier → Loudspeaker



Result – Feedback loop is slowly diminishing, noticeable ring follows source



### 3. Feedback

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#### Scenario 3

Feedback level is the same as/louder than source level

Source → Mic → Mixing Desk → Amplifier → Loudspeaker



Result – Feedback loop is increasing, growing uncontrollable ringing ensues



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#### How Do I Stop Feedback?

You can't...

...but you can avoid / limit it's effects



### 3. Feedback

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#### Gain Before Feedback

- "Gain" defines the increase in acoustic energy generated by amplification through a sound system.
- "Gain before feedback" is the maximum achievable gain before the unwanted effects of feedback become noticeable.
- That is: the threshold at which the level from the sound system at the microphone position is approaching the level directly from the source.



### 3. Feedback

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#### How Do I Stop Feedback?

Staying below gain before feedback

=

No audible feedback effects



### 3. Feedback

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#### What If I Need More Level?

Increase source level at input by:

- Turning source up or positioning microphone closer to source.

Improve gain before feedback by:

- Repositioning microphone and speakers



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## 4. Radio Microphones



## 4. Radio Microphones

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An Overview  
Radio Mic Licences  
Digital Switch Over  
Quick Setup Tips



## 4. Radio Mics

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### An Overview

Transmitter



Receiver



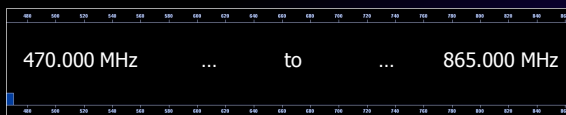
## 4. Radio Mics

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### An Overview

We need to tune the radio mic system to a unique frequency.

This can be anywhere within this range (in the UK):

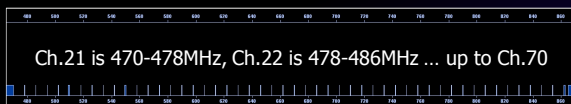


## 4. Radio Mics

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### An Overview

To make it easier to administrate, this radio-frequency (RF) spectrum is split into 8.0 MHz "channels".



The only exception is Ch.70 which is only 2MHz wide  
863.000MHz – 865.000MHz



## 4. Radio Mics

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### Do I need a Licence?

It depends!

There are three ways to do it:

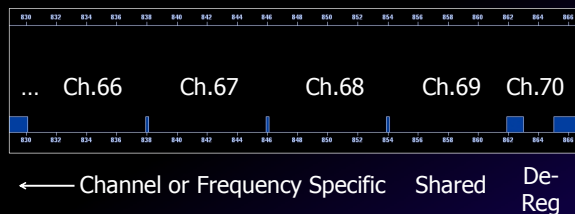
- Ch.70 "De-Regulated"
- Ch.69 Shared Licence
- Frequency Specific Licence



## 4. Radio Mics

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### Do I need a Licence?



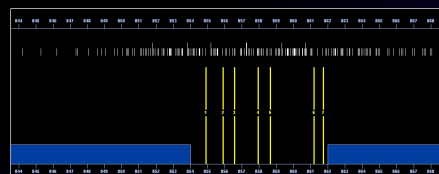
## 4. Radio Mics

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### How Many mics?

The more Radio Mics you use, the harder it gets to find free spectrum... Inter-Modulation Frequencies.

Need to use RF Plotting software to work out what works.



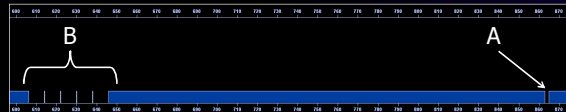
## 4. Radio Mics

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### Digital Switch Over

The DSO has changed everything...

I can either use "A" as De-Reg only, or "B" in Ch.38 Shared



Ch.38 Shared ... and beyond

Ch.70 De-Reg



## 4. Radio Mics

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### To Summarise

Radio Mics need unique freq so transmitter & receiver "sync".

If I am running up to 4-Systems I can use Ch.70:  
e.g. 863.100 / 863.500 / 864.300 / 865.900

If I need any more systems then I should look at either a Ch.38 Shared Licence or a Frequency Specific Licence.



## 4. Radio Mics

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### Quick Setup Tips

Get the frequency correct

Good line-of sight between transmitter and receiver

Gain Structure:

- Mic Sensitivity
- AF Output

Use antennae distribution with larger configurations (3≤)

Re-Chargeable Batteries?



## 5. It's Too Loud!

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## 5. It's too loud!

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### What Is "Too Loud"?

#### Measuring Sound Level

#### Sound Levels & The Law

#### Reducing Sound Levels



## 5. It's too loud!

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### What Is "Too Loud"?

What do people mean when they say "It's too loud!"?

Volume is causing physical discomfort

Volume is distracting or overbearing

Volume risks hearing damage

They dislike the musical style or ambience

There is a lack of clarity

They don't want to hear "noisy" instruments



## 5. It's too loud!

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### Measuring Sound Level

Sound Pressure Level (SPL) measured in Pascals

Usually described in decibels (dB)



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### The Decibel

- The decibel is a unit of ratio

- Useful for describing ratios between very large and widely varying numbers

- Ideal for SPL as audible sound can range from  $2 \times 10^{-5} \text{Pa}$  to  $200 \text{Pa}$



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### The Decibel

In acoustics we typically make the reference level the threshold of human hearing so...

...0dB is the threshold of hearing



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### The Decibel

Threshold of physical pain occurs at 120dB

Physical discomfort may be reported at lower levels – the threshold is subjective





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### Hearing Loss

Noise induced hearing loss is the permanent damage that occurs to the human auditory system due to exposure to sound impetus.



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### Hearing Loss

All sound exposure contributes to noise induced hearing loss over time.

*There is no "safe" level*

However, prolonged exposure to high sound levels will accelerate the rate of noise induced hearing loss and is best avoided.



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### Sound Levels & The Law

The *Control of Noise at Work Regulations 2005* require employers to prevent or reduce risks to health and safety from exposure to noise at work.

The regulations do not apply to members of the public exposed to noise from their non-work activities, or making an informed choice to go to noisy places



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### Important Measurements:

Daily exposure level ( $LA_{8eq}$ )

- Level of exposure to noise averaged over a typical 8 hour working day

Peak level ( $LA_{pk}$ )

- Maximum peak SPL to which a person is exposed at any point



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### Action Levels:

Lower exposure action values

- Daily or weekly exposure of 80dB  $LA_{8eq}$
- Peak SPL of 135dB  $LA_{pk}$

Employers must make hearing protection available to employees who's exposure exceeds these levels



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### Action Levels:

Upper exposure action values

- Daily or weekly exposure of 85dB  $LA_{8eq}$
- Peak SPL of 137dB  $LA_{pk}$

Employers must enforce the use hearing protection by employees who's exposure exceeds these levels



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### Action Levels:

Exposure limit values

- Daily or weekly exposure of 87dB LA<sub>8eq</sub>
- Peak SPL of 140dB LA<sub>pk</sub>

These are the maximum permissible exposure levels *after* taking account of any hearing protection



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### Sound Levels & The Law

Is my church service exceeding legal levels?

Very unlikely...

- A typical 1½hr service would have to deliver a continuous average of over 92dBA to exceed the upper action level



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### Reducing Sound Levels

What if it really is too loud?

- It is often not as simple as just turning it down



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### Reducing Sound Levels

Possible strategies to reduce causes of excessive volume?

- ~~Engineered~~ ~~agreed~~ ~~levels~~ loud
- ~~Meat~~ ~~on~~ ~~spillers~~
- ~~Acoustic~~ ~~isolated~~ ~~(guitar~~ ~~amps~~ ~~podiums~~ ~~kits~~ ~~etc.)~~
- ~~Building~~ ~~acoustic~~ & installation of appropriate systems



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### Reducing Sound Levels

Important considerations

- Deal with complaints humbly and sensitively
- Work with worship bands and church leaders
- This is tricky and it is not always the engineer's fault!



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