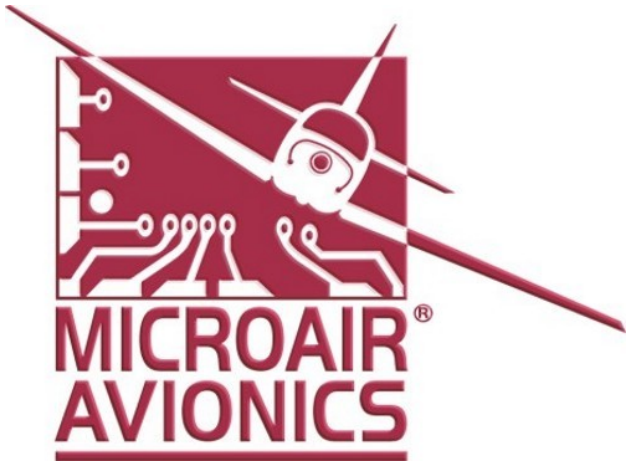
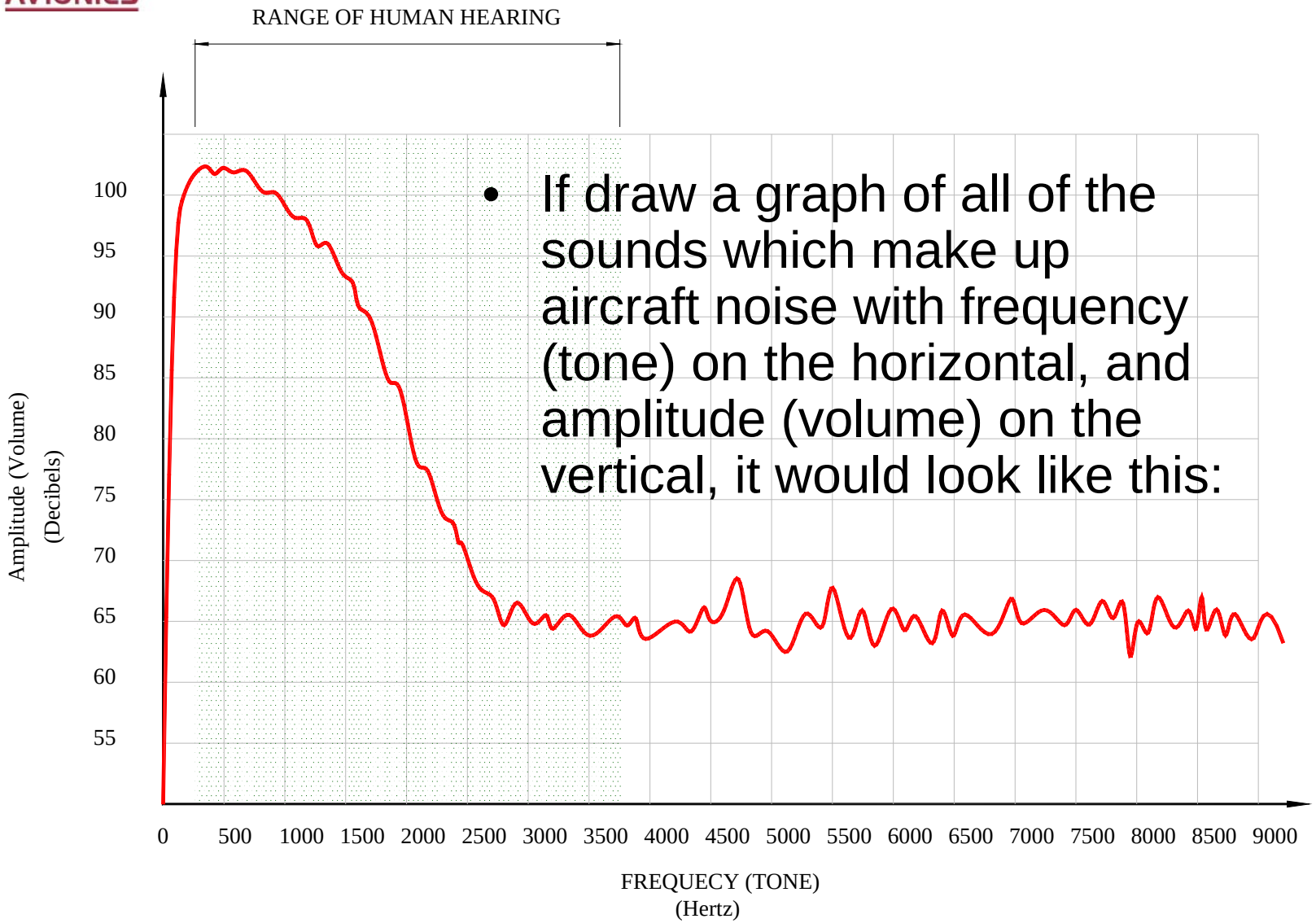


Aircraft Noise and Headsets

What is noise

- Noise is a complex array of sounds
- Each sound has a frequency (tone) and an amplitude (volume).
- When these sounds are combined they form the aircraft noise we are all familiar with.

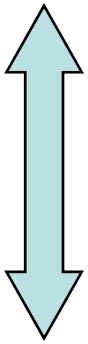
Noise Spectrum



- If draw a graph of all of the sounds which make up aircraft noise with frequency (tone) on the horizontal, and amplitude (volume) on the vertical, it would look like this:

Noise Levels

Rustling leaves	20 dB
Room in a quiet dwelling at midnight	32
Soft whispers at 5 feet	34
Window air conditioner	55
Conversational speech	60
Household department of large store	62
Busy restaurant	65
Vacuum cleaner in private residence (at 10 feet)	69
Ringing alarm clock (at 2 feet)	80
Loudly reproduced orchestral music in large room	82
Beginning of hearing damage if prolonged exposure over	**85 dB**
Printing press plant	86
Heavy city traffic	92
Heavy diesel-propelled vehicle (about 25 feet away)	92
Air grinder 95 Cut-off saw	97
Home lawn mower	98
Turbine condenser	98
150 cubic foot air compressor	100
Ultralight Aircraft @ cruise power	**105**
Banging of steel plate	104
Air hammer	107
Jet airliner (500 feet overhead)	115



Aircraft cabin noise is typically 20dB above the level where damage to earring will occur

Damaging Noise

- FAA studies have determine that prolonged exposure to noise level above 85dB will damage human hearing.
- The peak noise levels in ultralight aircraft are over 100dB!
- Without serious protection, your hearing will be damaged

Engine Noise

- *The typical ultralight engine will turn a two bladed propeller at 3000rpm.*

- The propeller blades will pass the pilot 6000 per minute, or 100 times per second (100 hertz).
- A 4 cyl engine ignition will fire 3000 times per minute, 50 times per second (50 hertz).
- A 6 cyl engine ignition will fire 4500 times per minute, 75 times per second (75 hertz).

Effect of Noise

- Noise can damage your hearing! Prolonged exposure to +85dB will damage your hearing.
- Prolonged exposure to noise will accelerate the onset of fatigue.
- Prolonged exposure to noise will reduce your ability to concentrate on a task.

Effect of Noise

- Consider an ultralight aircraft on a 3 hour flight, where the pilot is travelling to an airport he has never landed at before.

- The cabin noise level is 105dB.
- The pilot is wearing a headset which offers 20dB of noise suppression.
- The pilot will be subjected to 3 hours exposure to 85dB of noise.

Protection

- The typical hearing protection for pilots is the aviation headset

Protection

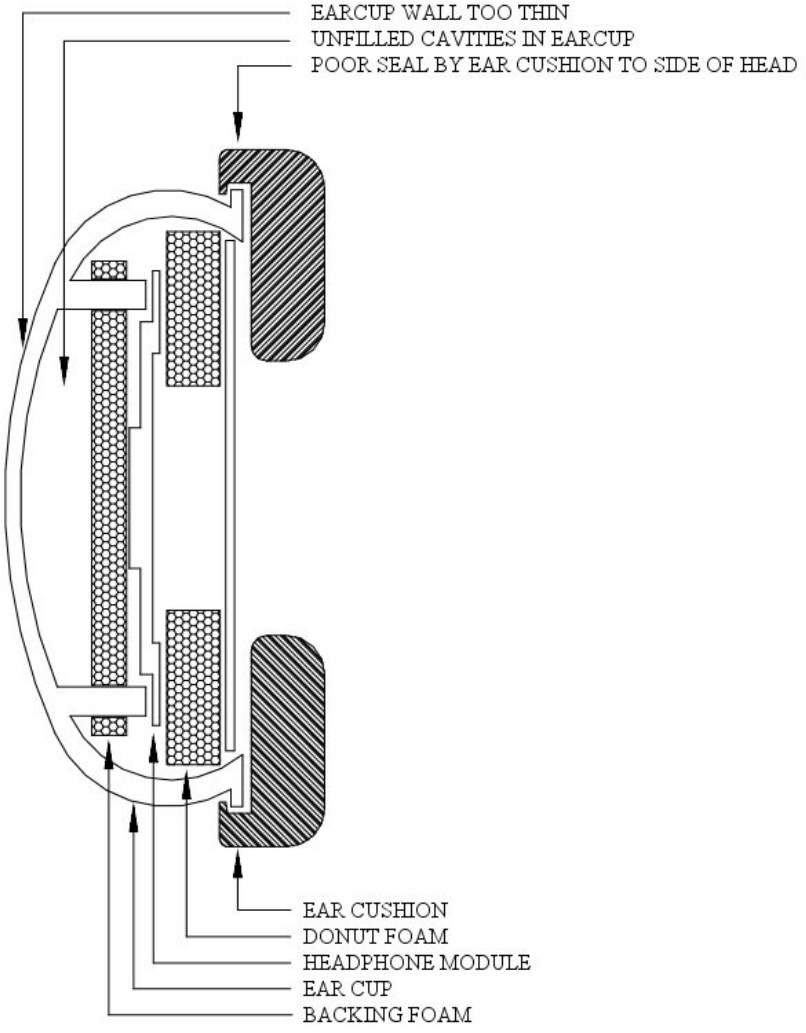
- Headset protect the pilots hearing using two methods:

- Passive ear cushions and foam
- Active electronic noise cancellation
- Passive microphone mic muffs

Passive Protection

The make up of a headset

- Ear Cup
- Backing Foam
- Headphone Module
- Doughnut Foam
- Cloth Cover
- Ear Cushion



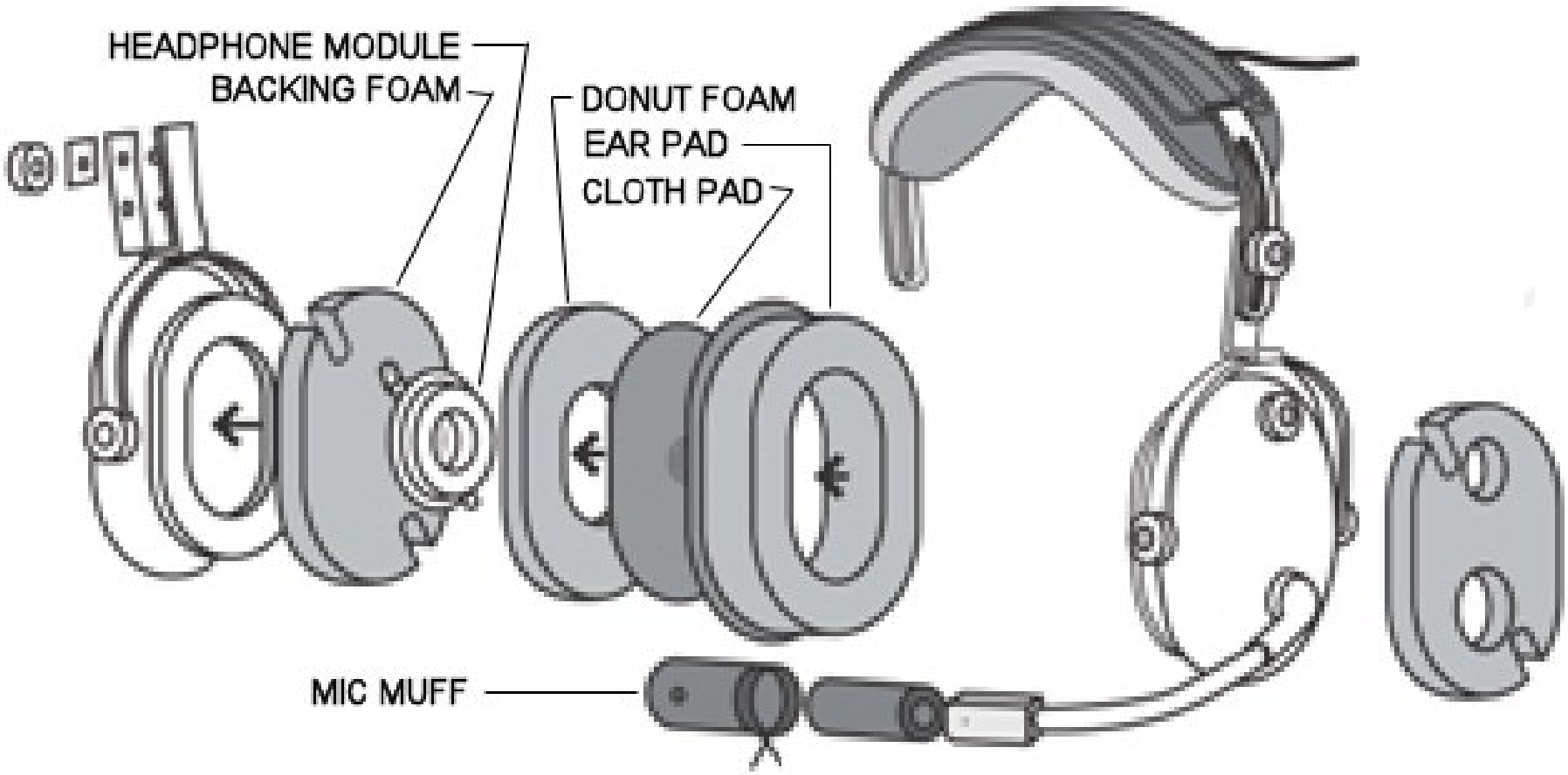
Passive Protection

- For passive protection to work the headset must achieve the following:

- A good fit against the side of the head

- Have noise suppressing foam which fills the earcup cavity.

Passive Protection



Active Protection

- “Active” protection uses electronics to remove or suppress unwanted aircraft noise. There are two methods:

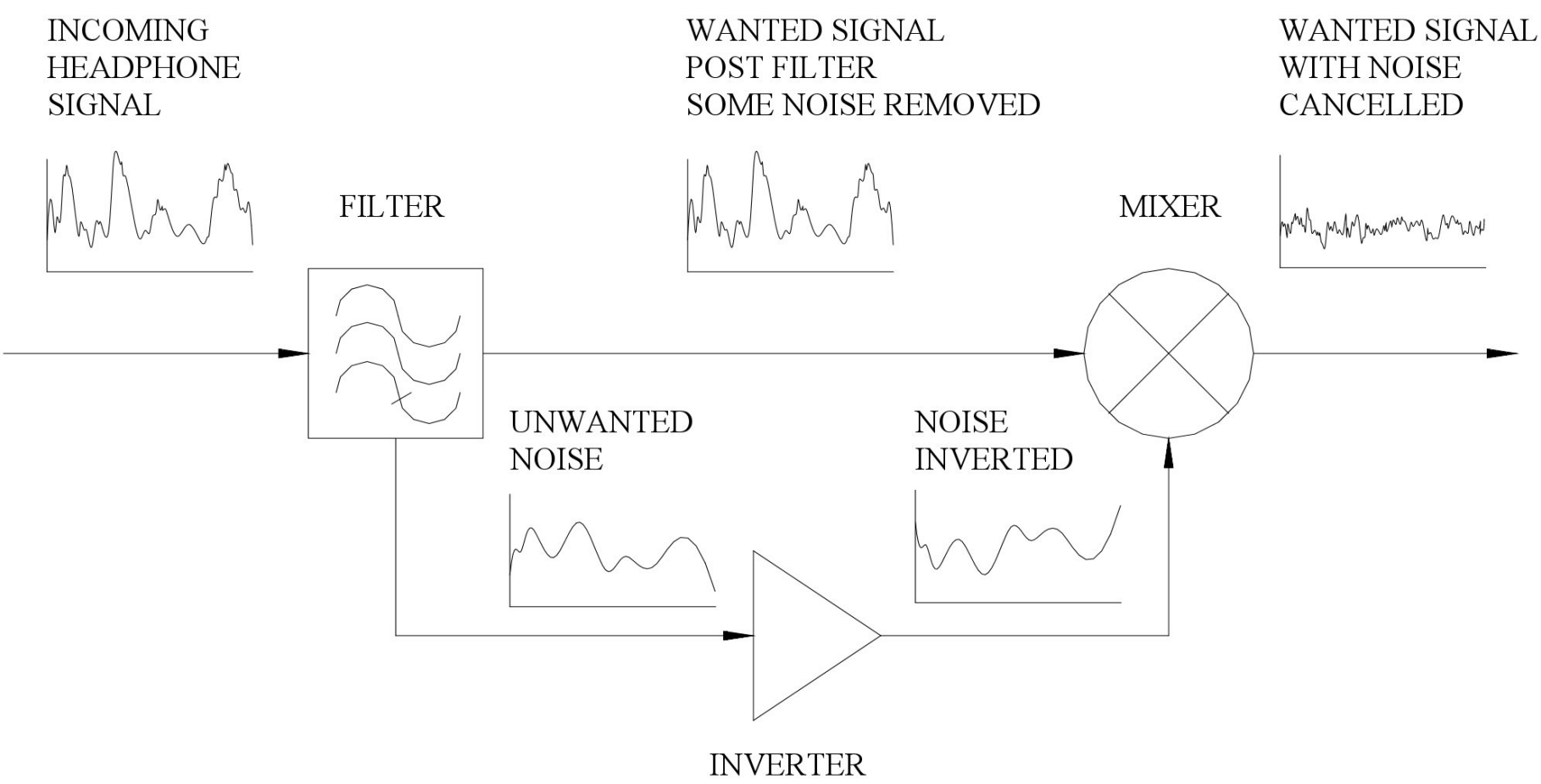
- Active Noise Reduction (ANR)

- Dynamic Noise Reduction (DNR)

ANR

- ANR systems use a filter to separate the wanted signal from the unwanted noise.
- Most of the unwanted noise is low frequency (below 300Hz).
- The separated noise is “inverted” (anti-phase), and then mixed with the original signal. The noise and “inverted” noise cancel each other.

ANR


INCOMING
HEADPHONE
SIGNAL
FILTER
WANTED SIGNAL
POST FILTER
SOME NOISE REMOVED
MIXER
WANTED SIGNAL
WITH NOISE
CANCELLED
UNWANTED
NOISE
NOISE
INVERTED
INVERTER

ANR

- ANR systems can typically achieve noise suppression of 10-20dB.
- At 20dB the noise is 1/100th of the original level.
- ANR will effectively suppress noise below 300 Hertz.
- ANR will not suppress noise above 300 hertz because it will also suppress the wanted audio signal.
- ANR systems and headsets are lower cost than their DNR counterparts.

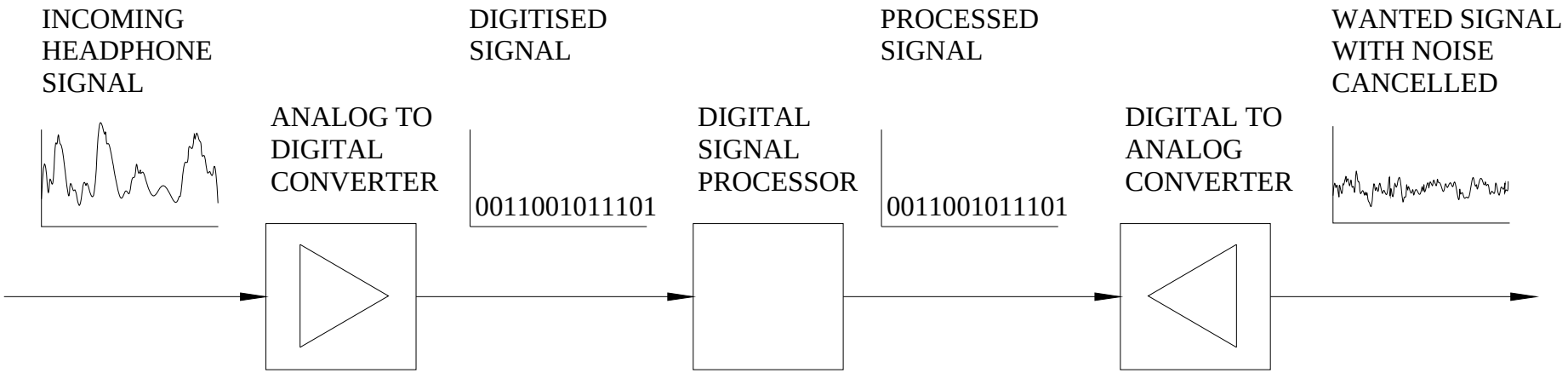
DNR

- Dynamic Noise Reduction uses digital electronic techniques to remove the noise components from the incoming headphone signal.

DNR

- The incoming signal is “digitised” into a series of numerical values.
- The digital signal processor analyses this data to “look” for repetitive noise signals.
- Noise components of the signal are then “predicted” and removed form the signal.

DNR


INCOMING HEADPHONE SIGNAL
ANALOG TO DIGITAL CONVERTER
DIGITISED SIGNAL
0011001011101
DIGITAL SIGNAL PROCESSOR
PROCESSED SIGNAL
0011001011101
DIGITAL TO ANALOG CONVERTER
WANTED SIGNAL WITH NOISE CANCELLED

DNR

- DNR systems typically suppress noise from 15dB to 25dB.
- Noise signals up to 3500 hertz can be detected and suppressed.
- DNR systems are usually more expensive than ANR systems.
- DNR technology can make headsets significantly lighter.

Headset Suppression

- Noise suppression is expressed in decibels (dB) by most headset manufacturers.

- Where the headset has “active” suppression, the noise suppression is usually spilt into passive and active dB values.

Microphones

- In most aircraft there is some form of intercom.
- If the microphone has no suppression against noise pick up, this noise can enter the audio system.

Microphones

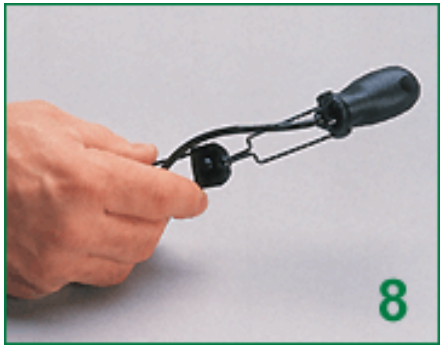
- Most microphones have a mic muff to offer some suppression to the cabin noise.

- Most are hopeless!

Microphones

- Like the earcups, microphones need a quality noise suppressing foam muff.

- In addition to this a jacket over the foam will increase the effectiveness of the foam.



Headsets: Rule 1

- You get what you paid for ! Cheap headsets will do little to protect your hearing.
- Passive headsets can range in price from $60 to $600.
- Active headsets can range in price from $250 to $1500.

Headsets: Rule 2

- Wear a new headset for at least 10 minutes before buying ! You will be wearing that headset for hours at a time…

- Passive headsets can be heavy and become uncomfortable.

- Active headsets can leave you wondering what to do with the battery box and all that extra wiring.

Headsets: Rule 3

- There are three types of microphone offered on aviation headsets !
  - Dynamic
  - Amplified Dynamic
  - Electret

- Know which one works with your radio!