Wireless Microphone Technology

Basics

- A wireless system is both a transmitter and a receiver
- Both the transmitter and the receiver must be set to the same channel or frequency to work
- Mixing systems will not work due to audio processing
- One receiver cannot pick up multiple transmitters
- But multiple receivers can cover multiple reception areas

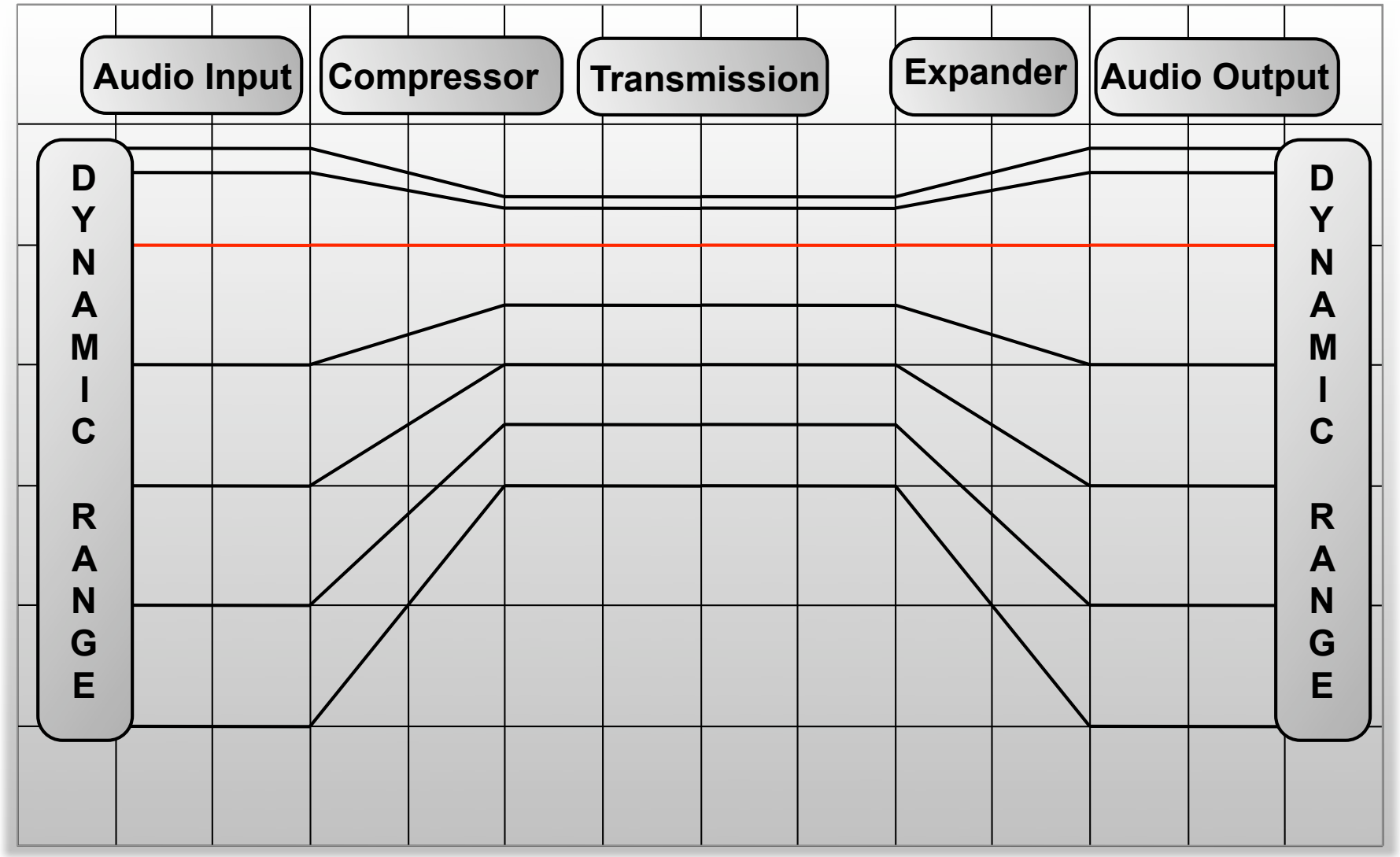
RF Signal

- Mixing two RF signals will make two additional signals
- The sum of the two signals
- The difference of the two signals
  - Mix 800MHz and 801MHz
  - 800 + 801 = 1601 MHz
  - 801 - 800 = 1 MHz
- RF signals create harmonics of the original
- A Signal at 800 MHz will creates:
  - Second order harmonic : 2 x f = 1600MHz
  - Third order harmonic : 3 x f = 2400MHz
  - Fourth order harmonic : 4 x f = 3200MHz

Compander

- A Compander is a **comp**ressor and an ex**pander**
- The audio is compressed in the transmitter and the audio is expanded in the receiver
- The algorithms are matched to stop audio artefacts
- Mixing wireless units will mismatch the algorithms
- A Compander reduces the noise floor and expands the dynamic range

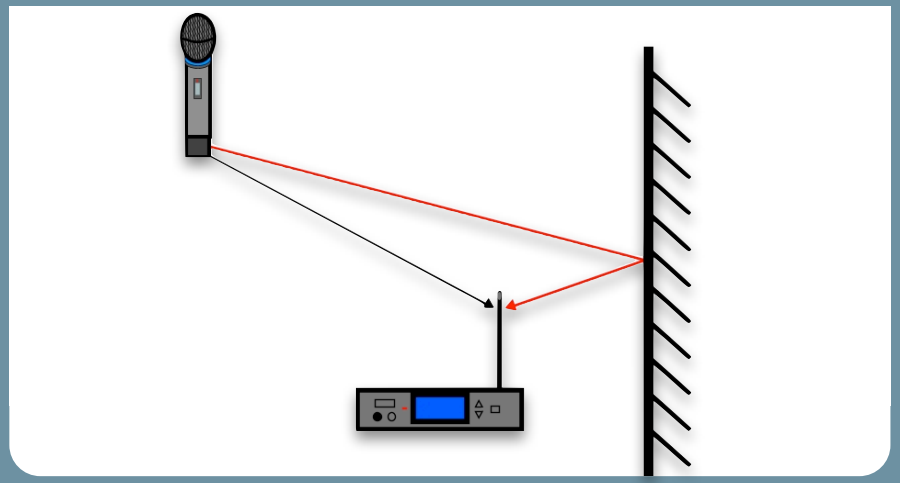
Compander

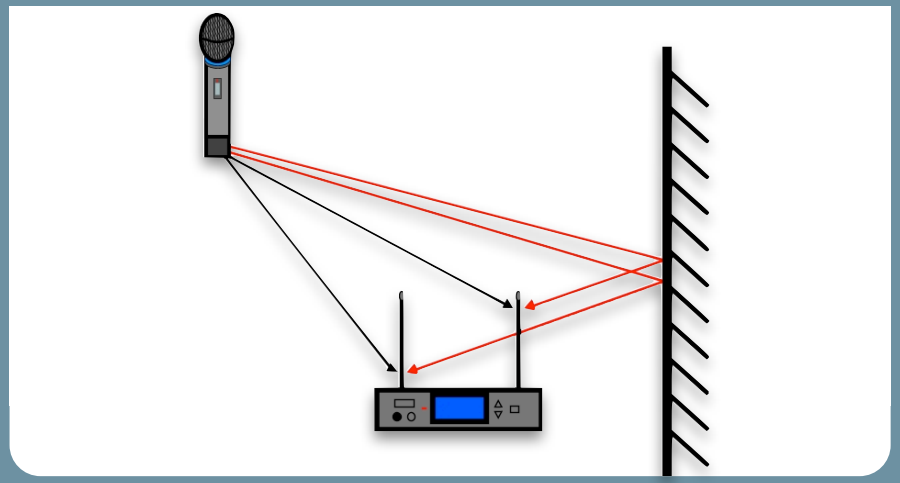

Audio Input
Compressor
Transmission
Expander
Audio Output
DYNAMIC RANGE
DYNAMIC RANGE

Dual Compander

- The audio signal is split through a crossover
- Audio above and below 500 Hz is compressed individually, then mixed and transmitted
- The receiver splits the audio again - both signals are expanded individually and then mixed back together
- This gives superb audio clarity with a superior dynamic range for the full frequency band

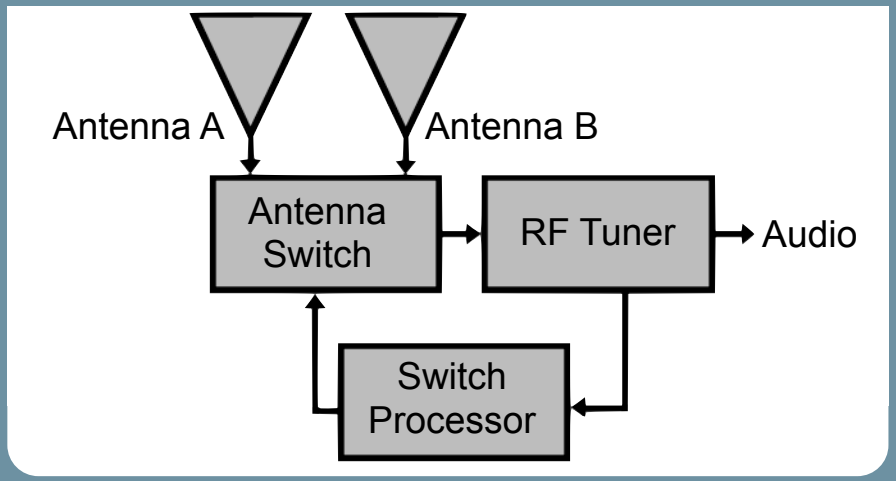
Diversity

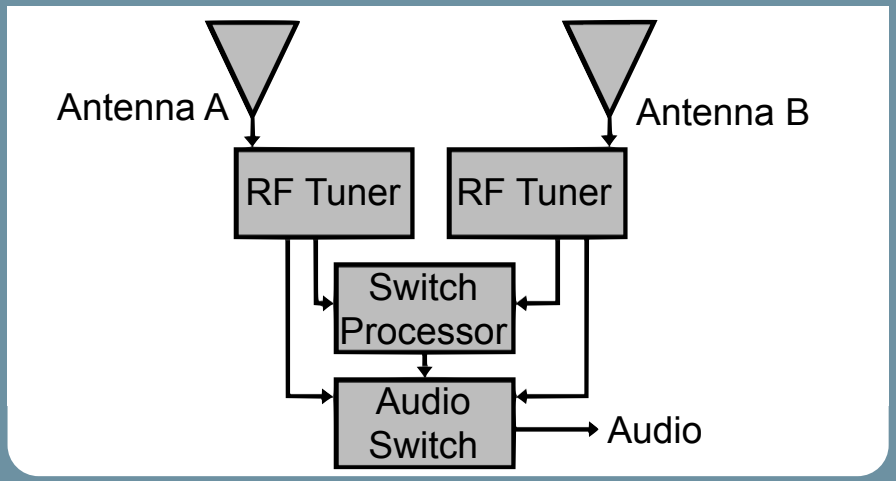




- Drop outs can occur when a direct and reflected signal are out of phase
- With two antennae the phase relationship between the direct and reflected signal is different
- If one antenna has a drop out, the other antenna will have a strong signal
- Keep the two antennae together, do not split them up

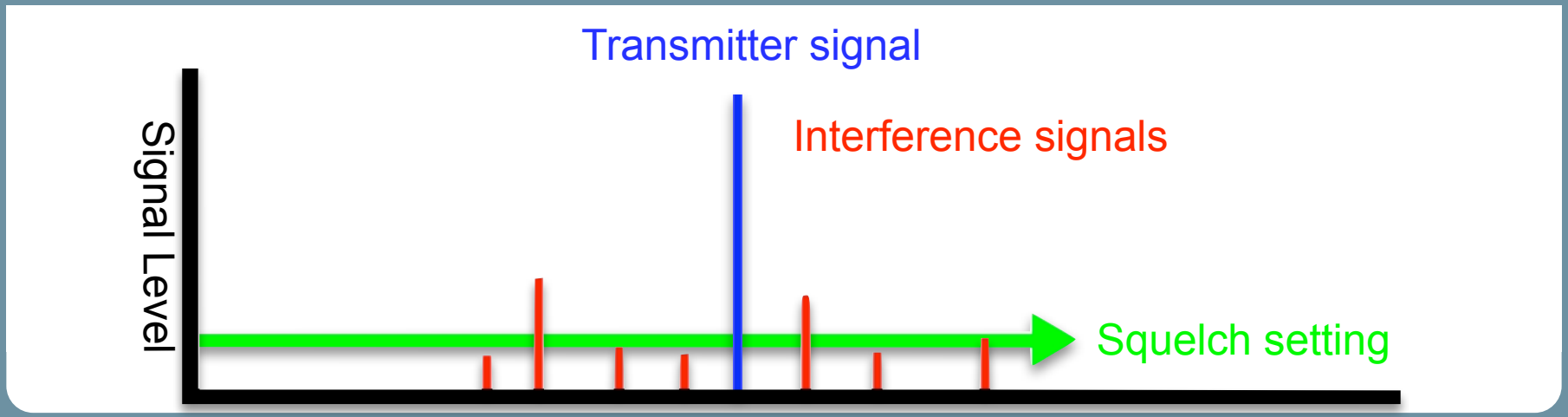
Diversity





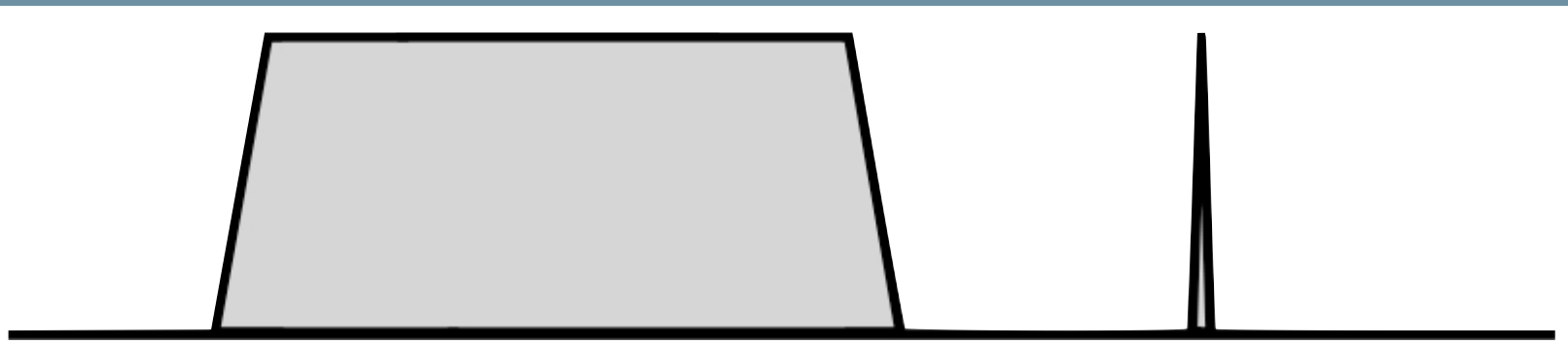
- Switching diversity is achieved with two antennae and one RF tuner
- When the antenna has a drop out, the RF tuner signals to switch antenna, this should switch slowly
- True Diversity uses two separate RF tuners. The switch processor constantly monitors and selects the best signal to use, this should switch quickly

Squelch



- Squelch is a threshold which opens the system to RF signals
- Without squelch you would hear interference when your transmitters are off, like a radio not tuned in
- Higher squelch settings reduce the transmission range
- To set up the squelch, turn all transmitters off and adjust the squelch clockwise until no interference is received

Squelch



- With Tone Lock™ Squelch the transmitter adds tone
- The receiver only works if it hears the tone
- This stops the receiver opening for other RF signals
- Digital Tone Lock™ Squelch is used to transmit information from the transmitter such as battery condition, transmitter name and type

700 Series

- The 700 Series offers 8 selectable channels
- 4 channels can run together for a “solid” system
- Rack trays are available to mount two side by side
- Tone Lock™ Squelch
- To get the best dynamic range, turn the transmitter full up and set the receiver output to about 70%

2000 Series

- 10 channels to select from
- All 10 channels will run side by side
- True diversity systems for better RF performance
- Great for musical applications
- High quality PRO41 capsule in the handheld
- 100m clear line of sight transmission

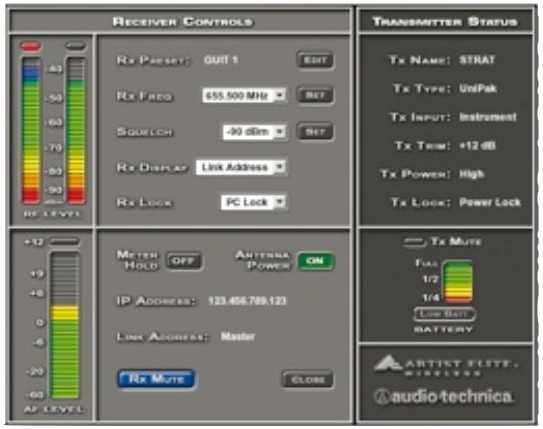
3000a Series

- 200 selectable frequencies
- 22 systems can run together side by side (per band)
- The dynamic handheld uses the flagship AE4100 capsule
- The condenser handheld houses the easy to use ATM710 capsule

4000 Series

- Dual Companding processes the bass separately from the treble for unmatched clarity and dynamic range
- Handhelds house the “top of the range” premium Artist Elite capsule
- Metal encased belt-pack transmitter

5000 Series



- Dual receiver with in-built unity gain antenna distribution
- Uses the same transmitters as the 4000 series
- Software control provides monitoring/controlling of RF power, audio level, battery status, mute status, channel frequency and naming
- An in-built spectrum analyzer and coverage test is a vital tool for installers and uses it to check RF performance

Antennas

- ATW-A49 Log Periodic Dipole Array or paddle antenna
- +6dB of gain in the direction it is facing, like a cardioid microphone (+6dB is double the transmission distance)
- -21dB reduction in gain from the back
- Place antennas at an angle of 90 degrees to each other to improve diversity, one vertical and one horizontal
- AT8459 can be used for different positioning

Antenna Distribution

ATW-DA49 AEW-DA860F

- Antenna distribution supplies an antenna signal and a power for multiple receivers
- AEW-DA860F provides 4 main outputs and a cascade output and has tuned filtering to stop interference
  - AEW-DA550C (541.500 - 566.375 MHz)
  - AEW-DA660D (655.500 - 680.375 MHz)
  - AEW-DA800E (795.500 - 820.000 MHz)
  - AEW-DA860F (840.125 - 864.875 MHz)
- ATW-DA49 provides 4 outputs over 400 - 900MHz

Cables

Link cable (RG58 quality)

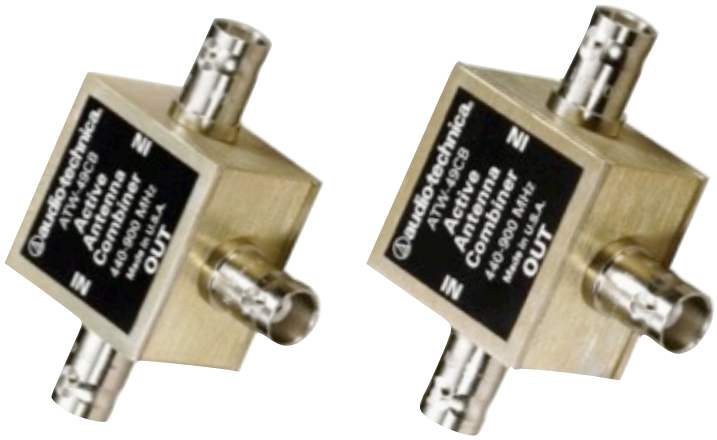
AC25 (RG8 quality)

- Cables cause most RF problems
- 50 Ohm cable provide “Power” impedance matching
- RG58 losses -7dB every 10m of cable - use for links
- RG8 losses -1.7dB every 10m - use for all cable runs
- BNC to BNC connectors lose -1dB per double connection, so keep them to a minimum

Boosters

- ATW-B80 Active boosters compensate for long cable runs with switchable +3dB or +10dB
- Require +12V DC provided by the 4000, 5000 receivers and the distribution systems
- Highly tuned with expensive filtering for specific frequency bands
- Daisy chain up to 3 booster for long cable runs

Combiners



- ATW-49CB active unity gain antenna combiners
- Set two sets of antennas to multiple areas
- Requires 5-14V DC provided by the 4000, 5000 receivers and the distribution systems
- Broadband frequency response 400-900MHz
- Be certain to keep pairs of antennae together and retain the diversity

Splitters

- ATW-49SP active unity gain antenna splitters
- Distributes one set of antennas to two receivers
- Requires 5-14V DC provided by the 4000, 5000 receivers and distribution systems
- Broadband frequency response 400-900MHz

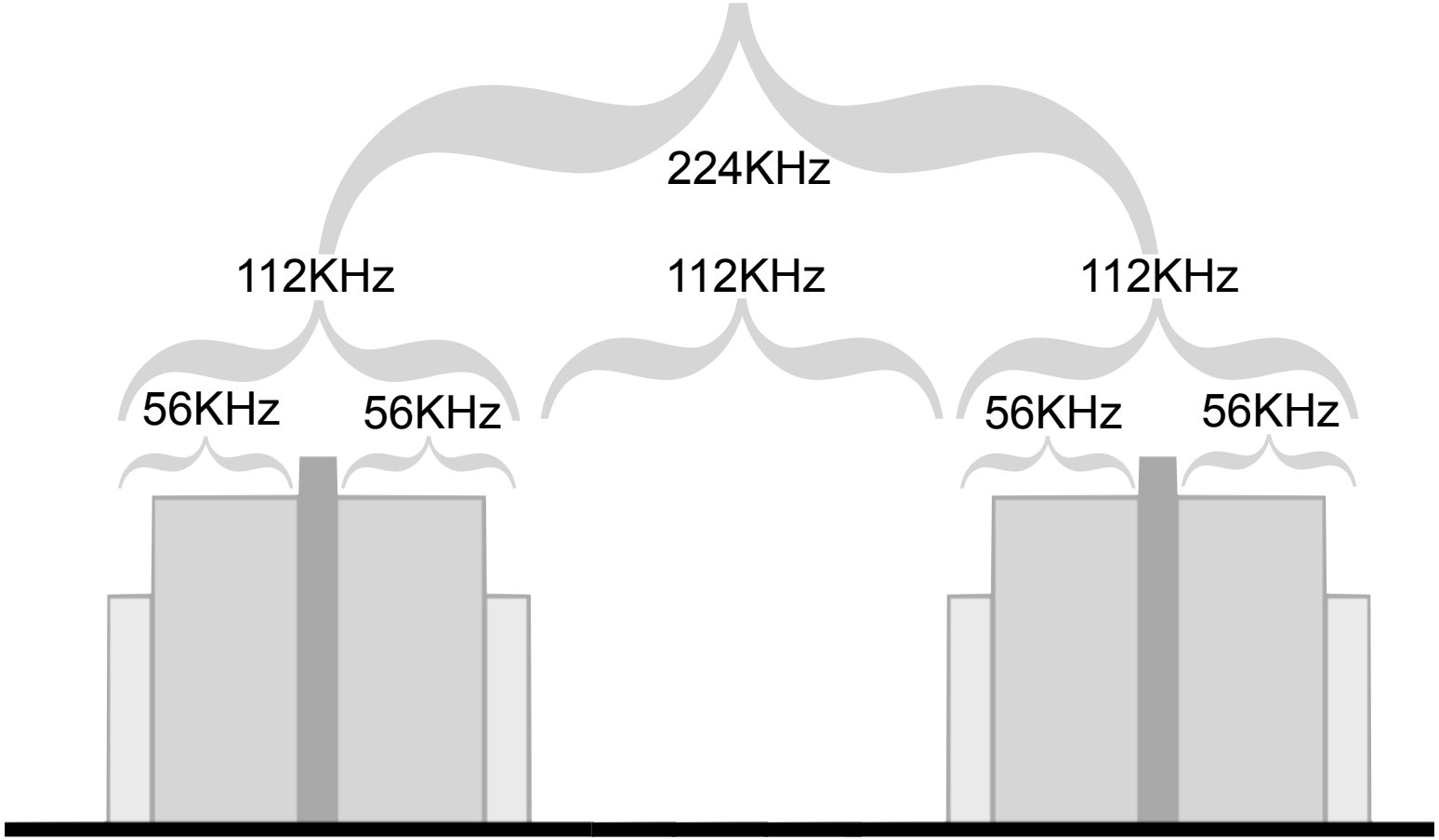
Batteries

- Alkaline battery give the best performance for price giving you 8-10 hours for a 10mW transmitter
- Lithium batteries provide up to 24 hours
- For rechargeable batteries use NiMH or nickel metal hydride for around 6 hours use
- Avoid Ni-CAD or zinc carbon batteries

Multiple Systems

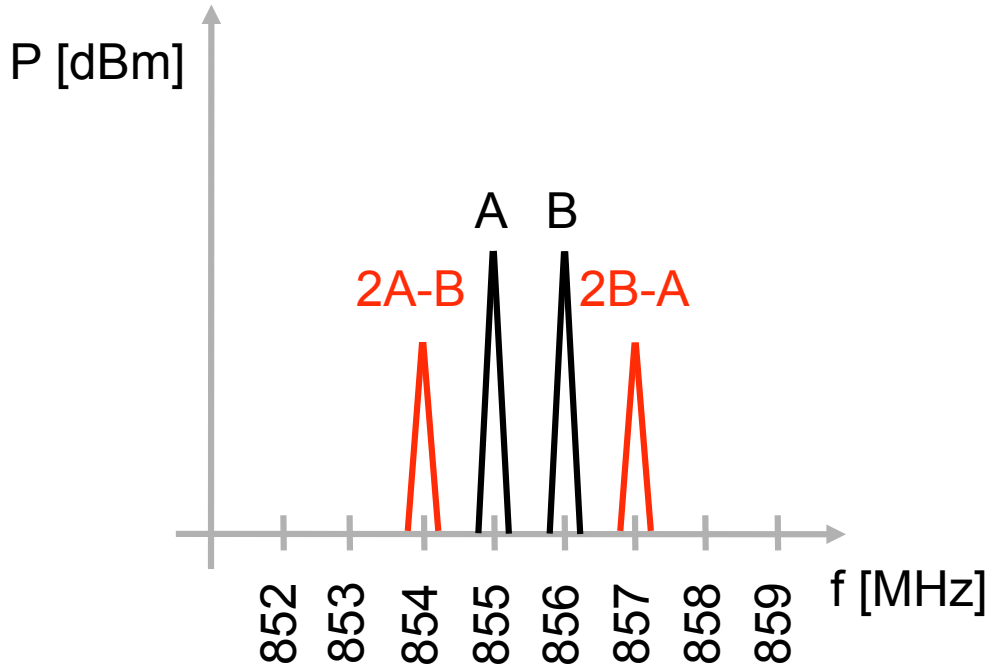
- How many systems can be used at once?
- 3000, 4000, 5000 : 22 systems (per band)
- 2000 : 10 systems
- 700 : 4 systems

Frequency Spacing



- Maximum Deviation : +-56KHz
- Bandwidth : 2 x 56 = 112KHz
- Safety margin = 112KHz
- Recommended space : 224KHz

Intermodulation



- Lets look at the following frequencies
  - A = 855 MHz B = 856 MHz
- Where are the harmonics, the sum and the difference?
  - 2xA = 710 MHz 2xB = 1712 MHz
  - A+B = 1711 MHz B-A = 1 MHz
- 3rd order intermodulations are
  - 3xA = 2565 MHz 3xB = 2568 MHz
  - 2xA+B = 2566 MHz 2xB+A = 2567 MHz
  - 2xA-B = 854 MHz 2xB-A = 857 MHz

Frequency Planning

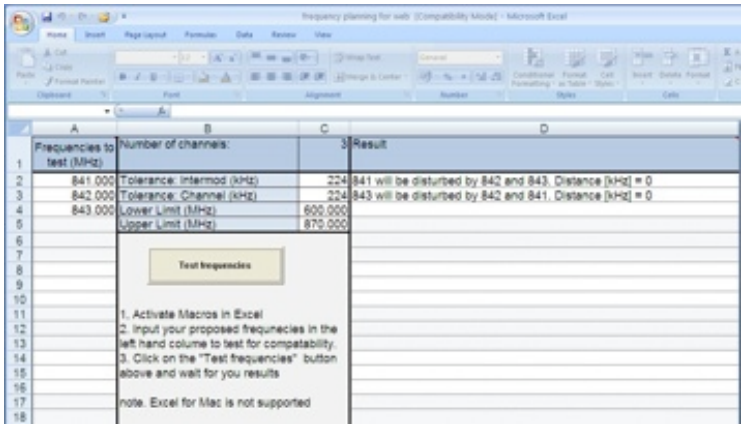
Artist Elite Series Wireless Operating Frequencies

Suggested Frequencies for Multi-channel Systems Operation

Band UK: 840.125 - 864.875 MHz (TV Ch. 67-69)

Group 1			Group 2			Group 3		
TV Ch.	Frequency - MHz	*	TV Ch.	Frequency - MHz	*	TV Ch.	Frequency - MHz	*
67	840.250		67	840.625		67	840.625	
67	840.625		67	841.250		67	840.875	
67	841.375		67	842.875		67	841.625	
67	842.750	6	67	843.125	6	67	842.875	8
67	843.375		67	843.875		67	843.875	
67	844.625		67	844.250		67	844.500	
	~			~		67	845.375	
						67	845.750	
68	847.000		68	846.250				
68	847.250		68	846.750			~	
68	848.375	4	68	847.500	6	68	846.500	3
68	850.125		68	849.000		68	848.875	
	~		68	849.875		68	849.500	
			68	850.125				
69	854.625						~	
69	854.900			~		69	855.500	
69	857.125		69	857.950		69	855.750	
69	858.250	7	69	859.375	5	69	857.625	6
69	858.625		69	860.125		69	858.650	
69	860.400		69	861.125		69	859.000	
69	861.125		69	861.750		69	860.625	
	~			~			~	
de reg	863.125		de reg	863.125		de reg	863.125	
de reg	863.375	4	de reg	863.625	4	de reg	863.375	4
de reg	864.375		de reg	863.875		de reg	863.875	
de reg	864.875		de reg	864.875		de reg	864.125	

Max. = 17 ex de reg | Max. = 17 ex de reg | Max. = 17 ex de reg

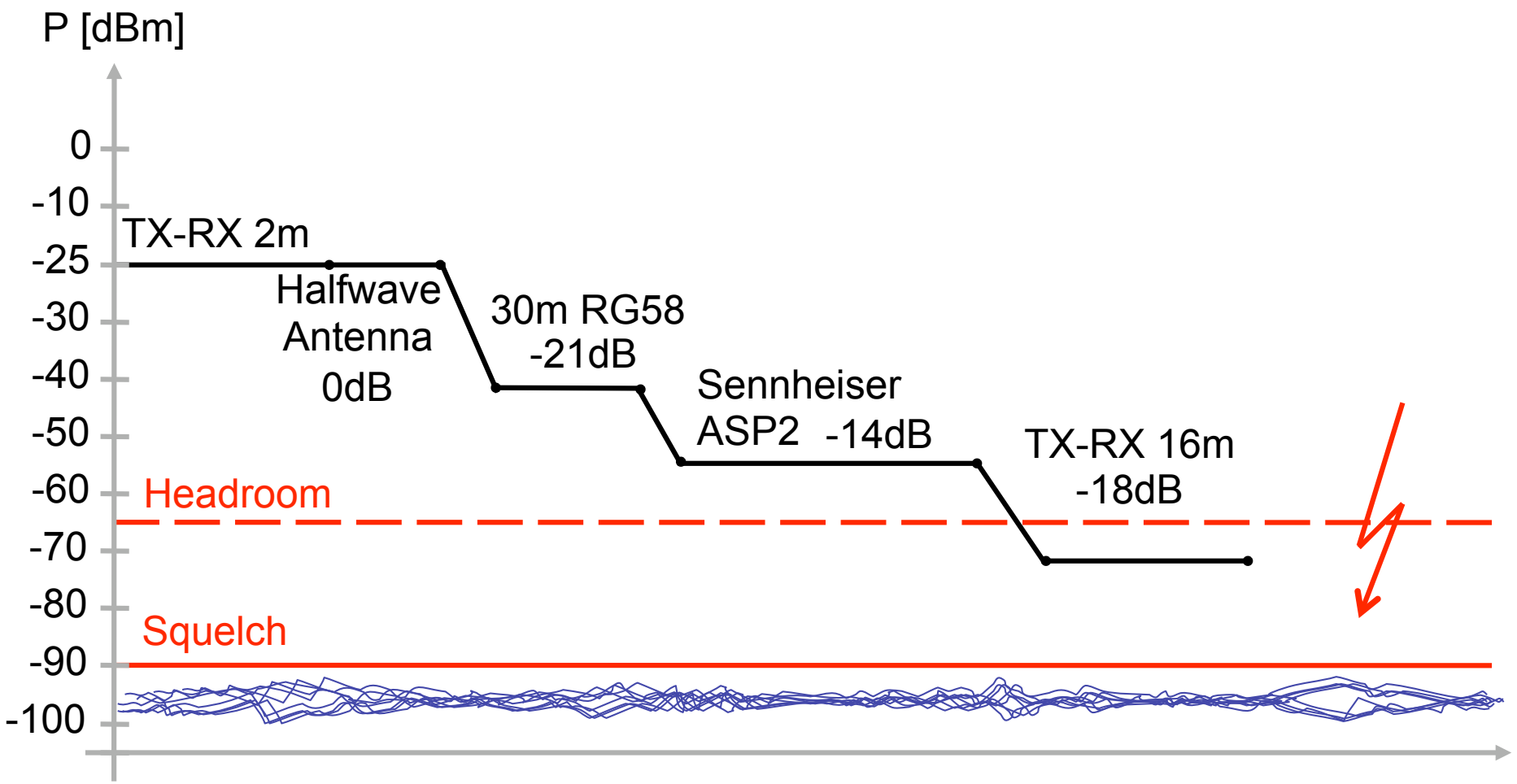


- Always use an intermodulation free frequency plan
- Use the supplied frequency plans in the manuals
- Download the Excel based Frequency Planning Tool from the support section of the website
- Call Audio-Technica, technical support

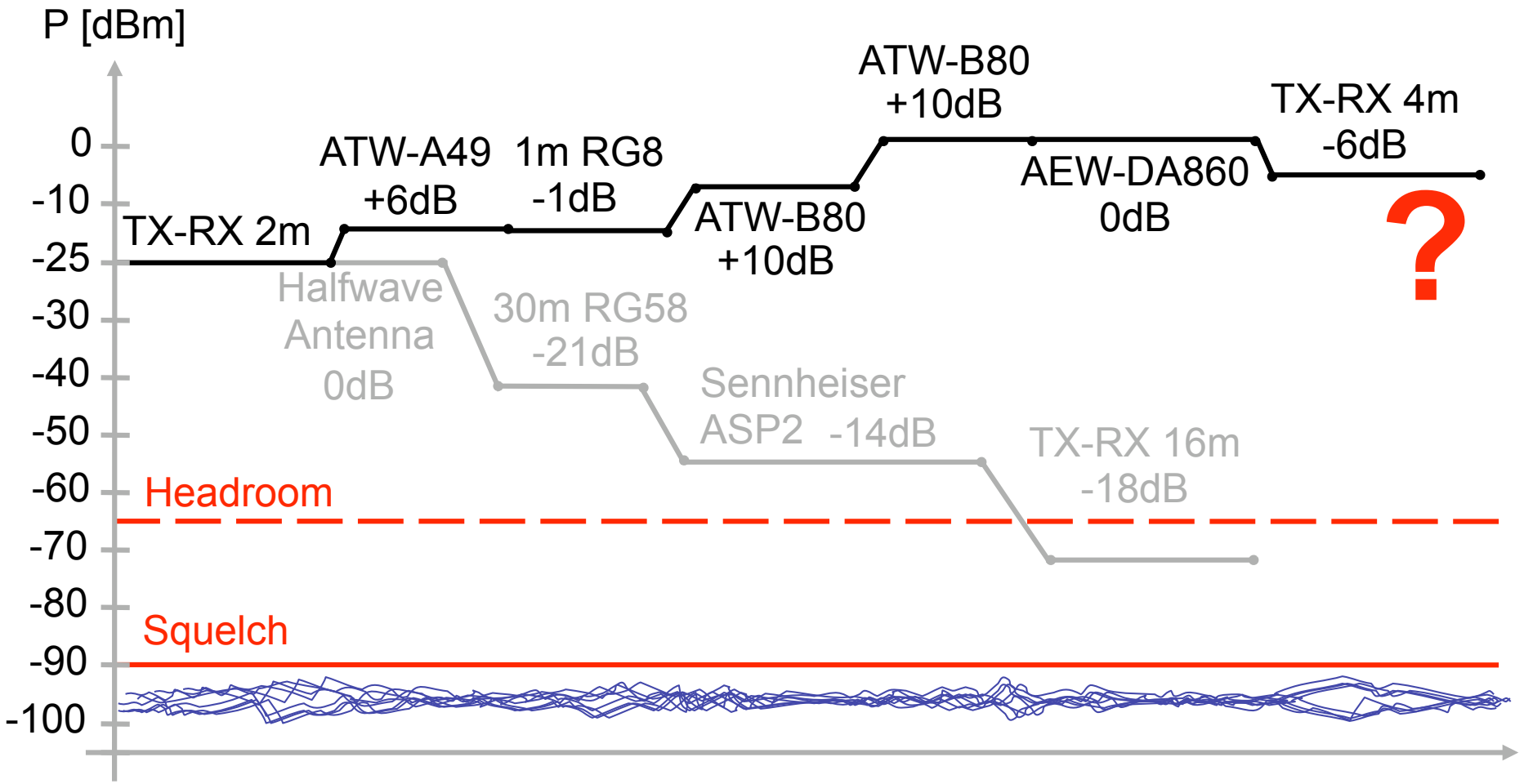
R.F. Gain

Doubling the distance	- 6dB
Half the distance	+6dB
10m RG58 cable	-7dB
10m RG8 cable	-1.7dB
BNC-BNC connection	-1dB
+10dB Booster	+10dB
Active Distribution System	0dB
Passive Distribution per Split	-3dB per split
ATW-A49 paddle antenna	+6dB (in main axis)
Blocking of the human body	-25dB

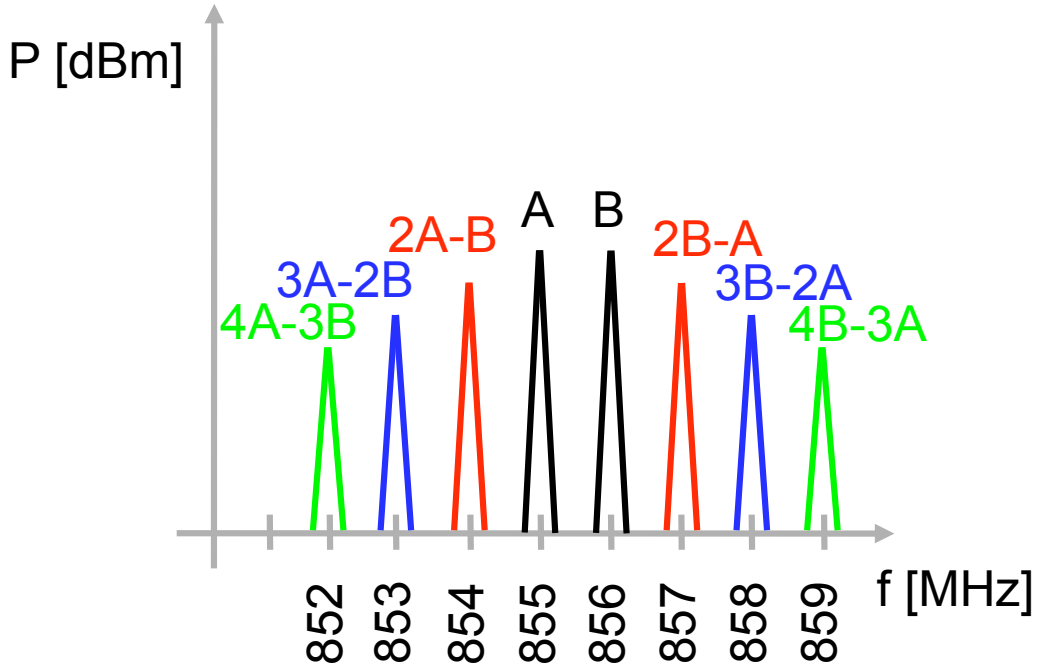
R.F. Gain


P [dBm]
0
-10
-25
-30
-40
-50
-60
-70
-80
-90
-100
TX-RX 2m
Halfwave
Antenna
0dB
30m RG58
-21dB
Sennheiser
ASP2 -14dB
TX-RX 16m
-18dB
Headroom
Squelch

R.F. Gain

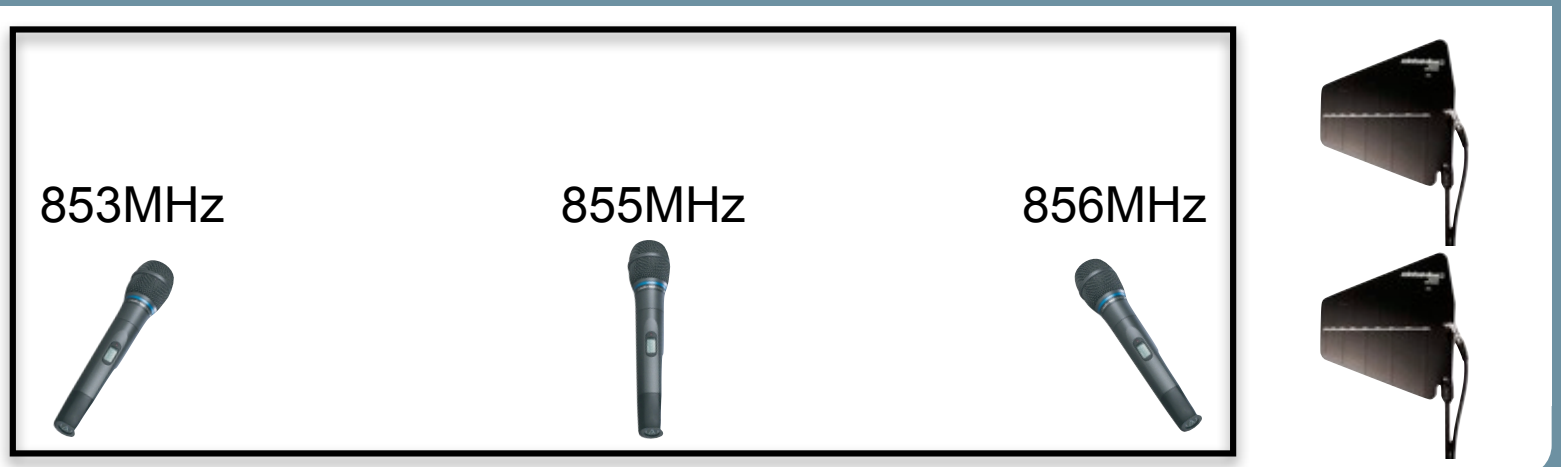

P [dBm]
0
-10
-25
-30
-40
-50
-60
-70
-80
-90
-100
TX-RX 2m
ATW-A49
+6dB
1m RG8
-1dB
ATW-B80
+10dB
ATW-B80
+10dB
AEW-DA860
0dB
TX-RX 4m
-6dB
?
Halfwave
Antenna
0dB
30m RG58
-21dB
Sennheiser
ASP2 -14dB
TX-RX 16m
-18dB
Headroom
Squelch

R.F. Gain



- For the following frequencies
  - A = 855 MHz B = 856 MHz
- 3rd order intermodulations are
  - 2xA-B = 854 MHz 2xB-A = 857 MHz
- 5th order intermodulations are
  - 3xA-2xB = 853 MHz 3xB-2xA = 858 MHz
- 7th order intermodulations are
  - 4xA-3xB = 852 MHz 4xB-3xA = 859 MHz

Near / Far Problem



- This occurs when some microphones are closer to the antennas and other microphones are far away
- The close proximity of two microphones on 855MHz and 856MHz to the antennae will make a strong 5th order intermodulation 3xA-2xB = 853MHz
- This will disturb the microphone further away