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# RECONNECTING THE WORLD



# Handbook on Radio Frequency Spectrum Requirements for Civil Aviation

Volume II - Frequency assignment planning criteria for  
aeronautical radio communication and navigation systems (ICAO Doc 9718, Volume II)

**Sidetrack:**                    **Interference due to Intermodulation  
between Transmitters on-site**

**Workshop/Training on  
“Frequency Finder 2024” application**

**Nairobi, Kenya | 12 – 16 August 2024**

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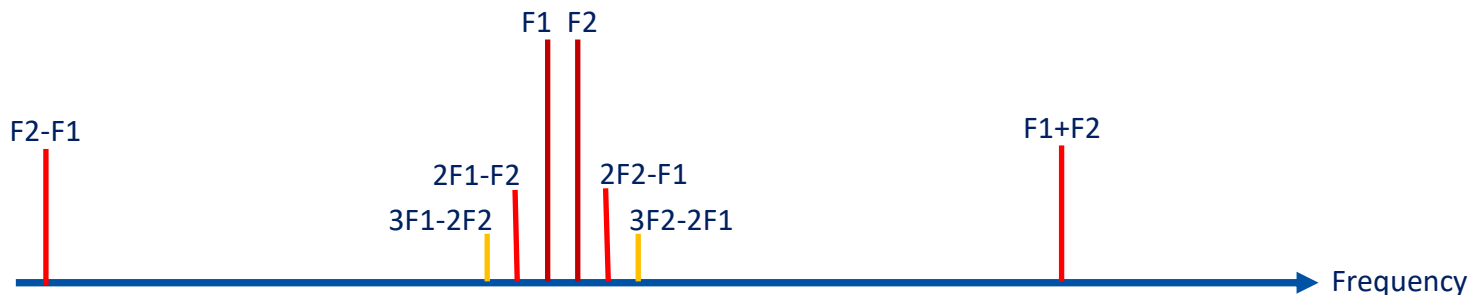


## A typical Aeronautical Transmitter Site may include a number of VHF Radios

- Antennas will be relatively close to each other, therefore:
  - an on-site antenna will receive strong signals from any close adjacent transmitting antennas
- No transmitter is completely linear and distortion free, hence:
  - there will be overtones and intermodulation created by signals being mixed together within the transmitter

## Symptoms and causes of on-site intermodulation:

- A local receiver at the VHF Radio site receives a garbled transmission, a combination of signals from other transmitters on site
- Any filter at the receiver input will not avoid the interference
- The interference is caused in a transmitter which receives a strong external signal from another nearby transmitter
- The transmitter mixes the received signal within its final amplifier stage with its own intended transmission
- The new resulting intermodulation product is transmitted together with the intentional transmission



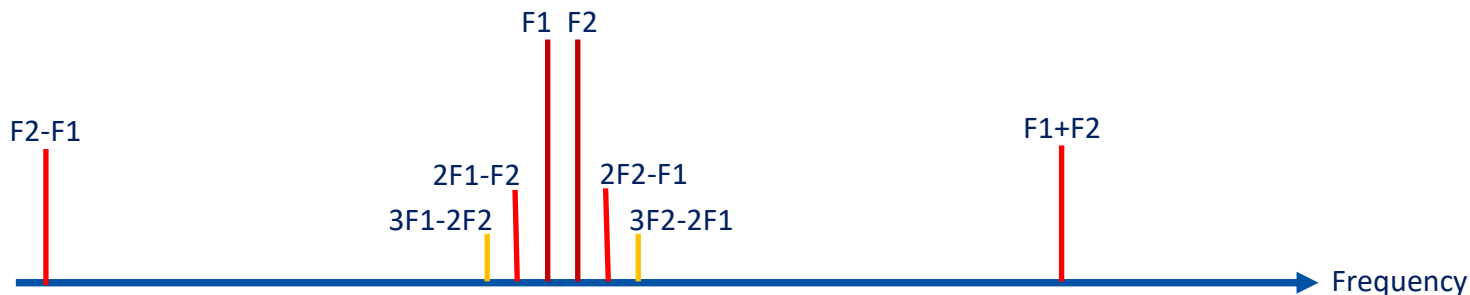


## Intermodulation Products Examples

- In this example: F1 and F2 set as 120 MHz and 121 MHz
- 3<sup>rd</sup> Order intermodulation Products 2F1-F2 (119 MHz) and 2F2-F1 (122 MHz)
- 5<sup>th</sup> Order Intermodulation Products 3F1-2F2 (118 MHz) and 3F2-2F1 (123 MHz)
- 2<sup>nd</sup> Order Intermodulation (1 MHz and 241 MHz in this example) – of no consequence

## 3rd and 5th Order Intermodulation Products

- Typically fall close to the original transmitter frequencies
- Typically within the aeronautical band, may overlap other frequencies used on site





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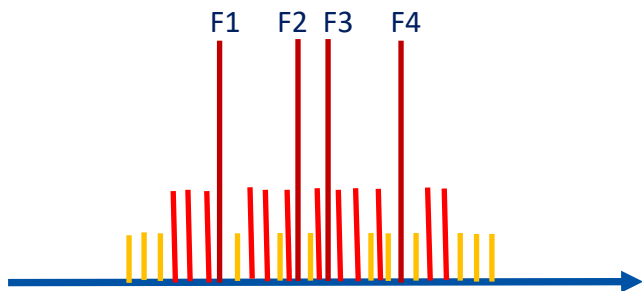
- exponential increase of potential intermodulation products
- example, four frequencies:

**3rd Order IMD:**  $2F1-F2$ ,  $2F1-F3$ ,  $2F1-F4$

$2F2-F1$ ,  $2F2-F3$ ,  $2F2-F4$

$2F3-F1$ ,  $2F3-F2$ ,  $2F3-F4$

$2F4-F1$ ,  $2F4-F2$ ,  $2F4-F3$



**5th Order IMD:**  $3F1-2F2$ ,  $3F1-2F3$ ,  $3F1-2F4$

$3F2-2F1$ ,  $3F2-2F3$ ,  $3F2-2F4$

$3F3-2F1$ ,  $3F3-2F2$ ,  $3F3-2F4$

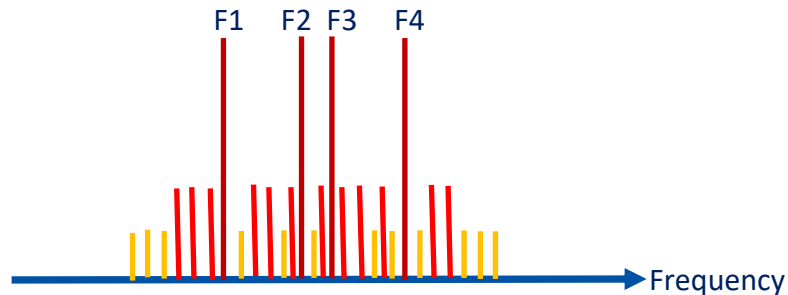
$3F4-2F1$ ,  $3F4-2F2$ ,  $3F4-2F3$



## In addition to the Analysis done by Frequency Finder

- When several transmitters share a site, it may be a good idea to perform an IMD analysis
  - Careful siting of antennas (isolation / distance) may be sufficient to avoid IMD
  - Narrowband cavity filters on transmitter outputs may be used to avoid IMD
  - Careful planning of frequencies can be used to avoid IMD

## Potential future addition to Frequency Finder





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*Questions* ?



Thank You!



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