



Interference

Presented to

LARC Basic Ham License Course
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by:

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London Amateur Radio Club (LARC)
with a little help from my friends

Interference - Overview

- Housekeeping
- Definitions and Documents
- Words to the Wise
- Is it me?
- Filters
- Mixing Products
- Interference in the Future

Housekeeping

- Introduction of Mike Watts VE3ACW, ...
- Only one person speaks at a time
- Questions when instructor invites them
- 5 minute break every hour

INTERFERENCE

There are 2 classes of interference, hereafter INT.

1. INT caused by you to other hams, the public, or other services.
2. INT caused to you; man-made QRM, natural QRN.

There are no questions on the exam on class 2. This course does not cover it. However most times you are working on INT issues it is class 2 maybe even from yourself.

Definitions

| | |
|----------------|--|
| RFI/TVI | Undesired signal entering apparatus designed for the reception of Hertzian waves eg receivers, tuners, STB's |
| EMI | Electromagnetic emissions entering apparatus NOT designed for their reception. eg porch lights, dimmers, POTS (telephone), VCR's DVD players, audio amps etc. |

Electromagnetic Compatibility Bulletin (EMCAB-2) defines 3 classes of apparatus.

- 1. Receivers for Broadcast sound, TV, and other services:
aeronautical, marine, land**
- 2. Associated Equipment**
 - a. Audio/video recorders and playback devices.**
 - b. Amplifiers**
- 3. Radio Sensitive Equipment: any device with some non linear element, diode, transistor, chip.**

Excerpts from EMCAB-2 PART 1

".... the Minister may, ...**make determinations** as to the existence **of harmful interference** and **issue orders** to persons in possession or control of radio apparatus, interference-causing equipment or radio-sensitive equipment that the Minister determines to be responsible for the harmful interference **to cease or modify the operation of the apparatus** or equipment until such time as it can be operated without causing or being affected by harmful interference"

Words to the Wise: Diplomacy and Documentation

Put on your diplomatic hat before you start any discussion on RFI/TVI with neighbours, and have copies of EMCAB-2 available. Why ??

1. Because people don't like being told:
 - a) their box is a piece of junk
 - b) their box was cheaped down so they could afford to buy it, by leaving out the RFI prevention bits.
2. Because people don't like admitting that you know more about electronics than they do.
3. Because people also don't want to admit that you have a Federal license, and they don't.

Words to the Wise: Don't Work on Their Box

Never offer to do, or perform any kind of work on their box itself. Why ??

1. Because for ever after, anything that goes wrong with their box will be deemed to be a result of your work, and they will expect you to fix it.
2. Because modern boxes are full of tiny surface mounter components which are beyond the abilities (and maybe even the vision) of most of us.
3. Because you might accidentally break it. Then what?

Words to the Wise: Make External Fixes Only

Such as:

- A/C filters
- High-pass filters
- Chokes
- Traps
- Coiling up leads, etc.
- Clip-on toroids

(samples of the above to be passed around)

Excerpts from EMCAB-2 PART 2

The Minister's determination of cause will be based upon the values of field strength shown in the table below....

| TYPE OF EQUIPMENT | FIELD STRENGTH CRITERION | |
|---------------------------|--------------------------|------|
| | dB μ V/m | V/m |
| Broadcasting Receivers | 125 | 1.83 |
| Associated Equipment | 125 | 1.83 |
| Radio-Sensitive Equipment | 130 | 3.16 |

- 1) If the level of the transmitted signal exceeds the applicable field strength value... the transmission is the cause of the problem.
- 2) If the field strength is less than the applicable value, the affected equipment's lack of immunity will be judged to be the cause.

Is It Me ?

Case A) I can hear you plainly talking about XYZ

I only work SSB, PSK31 and FT8 on HF from home

Outcome: Not me. Key words “Plainly”. (likely a CB)

The modes above don’t transmit “plain” voice.

**Case B) I heard/saw your interference at 6 PM,
on Oct 4 on TV Chan 3**

Outcome: Not me - my truck log shows I was in Toronto
then

Is It Me ?

**Case C) I heard/saw your interference at 6 PM,
on Oct 4 on TV Chan 3**

Outcome: likely me. Station log shows me working 15M
= 21 MHz, and 3rd harmonic = 63 MHz = chan 3

**Case D) I could receive chan x before you put up
a ham tower.**

Fix: Trying to get US TV station 75 Km South, getting
light & snowy picture. Good picture needs 45-50 S/N
Ratio. Replace 300 Ohm line with 75 Ohm coax, High-
pass filter, aim antenna at U.S., single channel pre-amp
at antenna

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More Definitions

| | |
|--|---|
| Desense | reduction of Rx gain caused by strong signal or noise overloading the front end or tripping AGC. (Check class) |
| Birdies | signals generated by LO that get into front end. They tune at twice the rate of a real signal. |
| Spurs | out of band signals that end up in the IF passband by mixing with internally generated signals. |
| Intermod | “Inter-modulation” Multiple frequencies mixing in complex spectrum. Your signal or a harmonic mixes with one or more other signals and produces an output on the desired frequency. It's tunable. |
| Front End Overload or Cross Modulation | Your signal is heard with the desired signal. Not tunable, heard across the dial |
| Harmonic Rectification | A fundamental frequency encountering a non-linear junction that emits harmonics |

Interference Symptoms

- **Cross Modulation.** Your signal is heard with the desired signal, or a harmonic of your signal mixes with other signals and produces an output on the desired frequency. It's tunable
- **Front End Overload.** Heard on all frequencies, i.e. not tunable

More Symptoms

| What to Listen For | What to Watch For (TV) |
|--------------------------------------|------------------------|
| Donald Duck - SSB | Visible Bars |
| Muffled Audio - AM | Loss of Vertical Hold |
| Clicks or hums or audio pumping - CW | Pixelation |

NOTES: Check their gear when you are off the air.

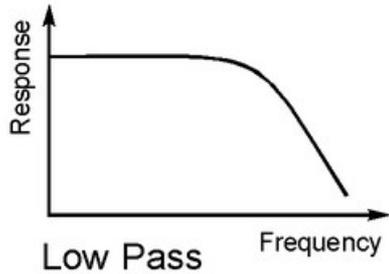
Keep a log book of your on air times

You can't fix poor reception

More Definitions

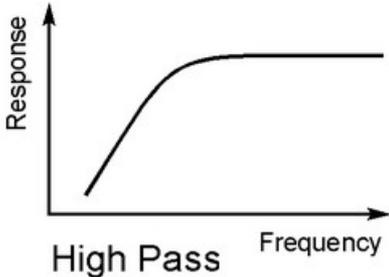
| | |
|--|--|
| Audio Rectification | Distorted Audio (SSB) Example: Church organs |
| Spurious Emissions | Mixing of internal oscillations defined by law to be -46 dB below output |
| Parasitics | Out of band frequencies produced by mixing of internal oscillators |
| Splatter, OverDriving Flattopping | Audio input exceeds 100% |
| Front End Overload or Cross Modulation | Your signal is heard with the desired signal. Not tunable, heard across the dial |
| Harmonic Rectification | A fundamental frequency encountering a non-linear junction that emits harmonics |

Filters



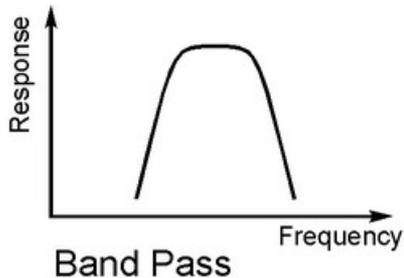
Low Pass - allow lower frequencies to pass through

(pass everything BELOW a frequency)



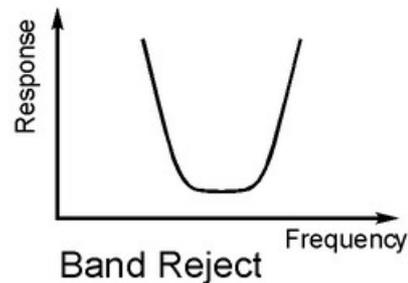
High Pass - allow higher frequencies to pass through

(pass everything ABOVE a frequency)



Band Pass - allow frequencies in a particular band to pass through

(pass signals BETWEEN 2 frequencies)



Band Reject or Notch - allow everything EXCEPT a band to pass through

(block signals BETWEEN 2 frequencies)

Filters

A Notch Filter is a highly selective band reject filter which can be used to reject a single, or a very small band of frequencies rather than a wider band.

An antenna preselector filter is essentially a narrow Band Pass filter that eliminates unwanted frequencies that could cause trouble in the mixing process.

Mixing Products

If two signals A and B are mixed together, you will get mixing products at frequencies that are:

some multiple of A plus or minus some multiple of B

For the mathematicians, the mixing products M are:

$$M = n * A + m * B$$

where n and m are positive or negative multiples

Mixing Products - Example

CKEY = 580 Khz (“B”)

Intermediate Frequency = 455 = desired mixer output

Local Oscillator = 1035 (“A”)

$$M = 1 * A - 1 * B = (1035 - 580 = 455)$$

However, for 80 Meter net on 3.685 MHz, we have:

$$A = 3685 \text{ Khz} = 3.685 \text{ MHz}$$

B = 1035 Khz = local oscillator to tune CKEY

$$M = A - 3 * B$$

$$= 3685 - 3 * 1035$$

$$= 580 \text{ Khz} = \text{CKEY! Oops!!}$$

RAFTER

Radio Moscow = 6.275 MHz

Known that Rx had 10.7 and 455 IF, and 40 MHz 1st LO

Therefore:

$$6.275 + 40 \quad 1^{\text{st}} \text{ Osc} = 46.275 - 56.975$$

$$2^{\text{nd}} \text{ Osc} = 10.7$$

$$1^{\text{st}} \text{ IF} = 11.155$$

$$3^{\text{rd}} \text{ Osc} = 455 \text{ Khz } 2^{\text{nd}} \text{ IF}$$

Listen on 56.957 to know who tuned Radio Moscow

Do same for Numbers station & look for matches

Rafter blown to Russians by Kim Philby, but used in UK
to detect unlicensed TV's

Mixing Products Demo

A = 146.52 Simplex Calling Frequency

B = 146.34 input to local repeater

C = 146.61 chat channel

D = 147.70 chat channel

Explain: $2A - 1B = D$

$$2A - 1D = B$$

$$2C - 1A = D$$

$$(A + D)/2 = C \quad A + D = 2C$$

Explain: Multi-coupled repeater site: 16 repeaters all on a single antenna, all operating 24 / 7 / 365 !!

Interference Outlook from ARRL

ARRL Handbook, Chapter 13:

"As our lives become filled with technology the likelihood of electronic interference increases.

Every lamp dimmer, garage door opener or other new toy contributes to the noise around us.

Many of these devices also listen to that growing noise and may react unpredictably to their electronic neighbors.

Sooner or later nearly every Amateur will have a problem with interference.

Most can be cured."

Practical Knowledge

The Horror Household

Flipboard Diagram

The End

QUESTIONS?

EXAM REVIEW