Online Radio & Electronics Course

Reading 33

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INTERFERENCE

As a radio amateur you are expected to be able to identify interference, particularly to television and radio. Most of the time when interference occurs it is due to some fault in the receiver. Though as a licensed radio operator **you will no doubt get the blame for everything**, because if you were not there with your radio then the problem would not exist. I have also heard: "we didn't have the problem until you moved in". Your neighbour, being non-technical, will not appreciate being told by you that the problem is theirs even if it really is. **A better approach is to help them fix up 'the problem'**. If worse comes to worse, then they can contact the Australian Communications Authority and 'report' the problem. Let them, just make sure your house is in order first.

TELEVISION AND OTHER INTERFERENCE

Listed below are the terms you should understand. Some are an interference type, while others are the results that interference produces.

- Cross hatching
- Sound bars
- Herringbone pattern
- Ghosting
- Power line interference
- Receiver overload
- IF Interference
- Harmonic interference
- Audio rectification
- Co-Channel
- Alternator Whine

Lets discuss each type and what, if anything, can be done about them.

CROSS HATCHING

Cross Hatching is an unwanted pattern of interference produced on the screen of a television receiver. **Cross-hatching occurs when the interfering signal beats (mixes, heterodynes) with the vision carrier of the TV signal**. It is the **least severe form of interference**, producing diagonal bars or lines across the screen. The number of lines and their thickness depends on the beat or mix frequency. A low beat frequency produces thick lines spaced widely apart. A high beat frequency produces many fine lines close together. Cross-hatching is only caused by an unmodulated transmitter.

The cause of cross-hatching is nearly always overload of the TV's receiver, and the best approach is to apply some type of filtering at the TV receiver to reduce the overloading signal.

SOUNDS BARS

Sound bars are an unwanted pattern of interference produced on the screen of a television receiver. Sound bars are thick horizontal bars on the screen. They are produced when the interfering signal varies in amplitude or intensity, such as is the case with **amplitude modulation** (which includes single sideband).

Figure 1 – Sound Bars.

Overload to the TV receiver is again the most likely culprit. TV receiver overload is usually considered a TV problem. **The vast majority of receiver overload problems can be overcome by fitting a filter to the TV**, which by rights the TV viewer must purchase and have installed. I will explain transmission line stubs in a later reading, which is a cheap and efficient fix for receiver overload **most** of the time.

SOME ADVICE

However, let's be reasonable about this. If you have an amateur station and are running something of the order of +50dBm to +56dBm of output power (100-400 watts) and you place your transmitting antenna on the same property boundary and pointing at, or a few metres away from, your neighbours TV antenna. Then, even if your neighbours TV antenna is correctly installed and has filters connected, there is still going to be a overload problem, and morally it is your problem, though technically the problem lies with the TV receiver being unable to reject such a strong nearby off-channel transmission. An inspector under the Radiocommunications Act faced with such a dilemma would ask for cooperation. One solution would be to suggest that the TV viewer and amateur station both relocate their respective antennas.

If cooperation was not forthcoming, particularly from the amateur station, then the inspector can change the license conditions of the amateur on the spot so that the station cannot be used above a certain power level. If your antenna is rotatable and interference only occurs when the antenna is pointed at the TV antenna, then the inspector could give you instructions not to transmit in this direction. In extreme cases, the inspector could direct you to transmit during particular hours of the day.

Usually sensible placement of antennas, consideration for neighbours, and good communications skills eliminates all problems even if the help of an inspector is required. Keep in mind also that if your neighbour does call an inspector to investigate the problem, and the problem is found to be the neighbours TV antenna, feedline, or TV itself, then they will be paying for the inspectors advice.

HERRINGBONE PATTERN

Figure 2 – Herringbone Pattern.

When the interfering signal is unmodulated (either AM or FM), in other words just a carrier, cross hatching occurs. Cross hatching is diagonal lines on the screen. When modulation is added to an FM signal the diagonal lines 'wiggle' back and forth with the modulation producing a herringbone pattern'. Cross-hatching is only produced by an unmodulated carrier. This can be from AM or FM transmitters before the operator speaks into the microphone or applies some other modulating signal. Once modulation is applied, an FM transmitter creates a herringbone pattern while an AM transmitter will produce sound bars. The word ‘herringbone’ literally means ‘fish-bone’ pattern.

Figure 2 shows a TV picture with a herringbone pattern caused by overload from a modulated FM transmitter.

GHOSTING

When a secondary image can be seen on the screen displaced from the primary image, the TV is experiencing ghosting. The usual cause for ghosting is when the signal from the TV transmitter is received at the TV receiver by two or more paths. Since the distance of each path is different there is a propagation time delay causing displaced images on the screen.

Figure 3 - Ghosting.

A faulty TV antenna or its feedline, which produces a high standing wave ratio in the TV antenna system, can also cause ghosting. A high VSWR produces multiple reflections back and forth on the feedline producing a ghost image on the screen.

When ghosting is due to multiple path reception, re-orientation of the antenna should be tried first. Altering the height and changing the azimuth may eliminate the ghost. If not, it may be necessary to change to an antenna with a better front to back ratio, and improved side rejection.

POWER LINE INTERFERENCE

High voltage power lines can cause interference to the low TV channels of VHF in particular. This type of interference is always identified by two distinct bands of interference on the screen as shown in Figure 4.

Figure 4 – Power Line Interference.

This type of interference is most common on 11kV power lines which are badly maintained, or in conditions where the insulators become dusty. It will most often occur on a dry day. You should report this problem to your energy supplier - it is their responsibility to find the faulty insulator(s) or other power line components.

The reason for the two distinct bands is that the insulator or other component is arcing across when the sinewave of voltage reaches its peak. Of course, there are two peaks each cycle hence two bands of interference.

HARMONIC INTERFERENCE

Every radio transmitter emits some energy on multiples of its operating frequency. These unwanted frequencies on multiples of the operating frequency are called **Harmonics**. It is not a matter of if and when harmonics occur, it's a matter of what level the harmonics are. It is no accident that most of the amateur radio bands are harmonically related to each other. This is so that harmonics generated by amateur operators will most possibly fall on other amateur bands. An interesting experiment is to deliberately search for harmonics with a receiver, whether they are yours or that of another amateur or CB station or even a commercial broadcaster.

Harmonic interference is a transmitter problem and should be cured at the transmitter with filtering - usually a low-pass filter.

An example of harmonic interference:

An amateur transmitter is operating on 28 MHz and only causes interference to a TV receiver when it is tuned to Channel 9 (196.25 MHz Vision). What is the most likely cause of this interference? What cure would you suggest?

Since the interference is to Channel 9 only, the most likely cause is in-band interference. That is, energy is being radiated from the amateur transmitter within the band of frequencies used by Channel 9. Channel 9's vision carrier is 196.25 MHz, the seventh harmonic of an amateur transmitter operating in the 28 MHz band of frequencies will fall within the channel allocation for Channel 9. Since harmonic radiation is the problem, the only solution is to install a low-pass filter at the transmitter.

The clue given in the question was that interference was to *one* Channel only. If fundamental overload, intermediate frequency (IF), or audio rectification were the cause, then interference would generally occur to *all* channels (including unoccupied channels). Let's have a look at these types of interference now.

FUNDAMENTAL OVERLOAD

Fundamental overload is not a transmitter problem. When a transmitter is producing fundamental frequency overload, that is, receiver overload on another receiver not tuned to the transmitters frequency, then it is a receiver problem. However, when speaking about the problem from the transmitting stations point of view, we call it fundamental overload. Provided you are operating within the prescribed power levels you are not at fault, though do read the advice given on this matter earlier in this reading. The majority of interference, particularly to TV, is from fundamental overload. Fortunately fitting a high pass filter to the TV receiver usually cures this problem easily.

IF INTERFERENCE

When a transmitter causes interference to an IF stage of a radio or TV receiver the interference will occur without change no matter what channel or frequency the affected receiver is tuned to. The Interference is to an IF stage. One typical IF frequency is 10.7 MHz. Generally again this is a receiver problem and is normally due to lack of receiver shielding. Don't laugh! To prove IF overload I have had to wrap receivers and TV sets in aluminium foil to prove to the owner or their TV technician that the IF is insufficiently shielded.

AUDIO RECTIFICATION

Many household appliances contain audio amplifiers. TV's, radios, sound systems and intercoms to name just a few. Bedside clock radios send a tremor down my spine! Now, audio amplifiers are not supposed to pick up radio signals are they? Well, if enough RF energy does get into any audio amplifier, the AF amplifier will become overloaded, become non-linear, and start acting like a demodulator for radio frequency signals.

The problem is with the audio equipment for sure. Sound systems often use cheap figure eight cable for the speaker wires and there are usually bundles of it shoved behind the system. Fortunately, the fix is usually very easy for sound systems. Winding the excess speaker cable around a ferrite rod, say 10mm diameter and 250mm long, will usually get rid of the problem. You are just adding inductive reactance to the audio line, which hardly effects the audio performance at all, but offers a high reactance to high RF currents.

TV, radios, and the like require a technician to install internal RF bypassing onto the audio amplifiers input. This is usually fairly simple. Clock radios are not worth the trouble, bin them. Of course, you should eliminate mains interference first.

TELEPHONE INTERFERENCE

Telephones are not supposed to pick up radio signals, but sometimes they do. Usually a a capacitor of about 0.047μF across the line will fix the problem - the line is usually a blue/white and/or red/black cable - better still, call Telstra and complain to them.

CO-CHANNEL INTERFERENCE

TV stations do not cover a large area. However, during freak propagation conditions like tropospheric ducting, two TV signals on the one station can reach a single receiver.

Either one of the patterns in figures 5(a) and 5(b) are caused by this type of co-reception interference. It will happen to everyone at some time. The solution is to wait until the propagation conditions change.

Figure 5(a)

Figure 5(b)

Figure 5 – Examples of Co-Channel Interference

Figure 6 – Industrial Machine Interference

INDUSTRIAL HEATING

Industrial machines, of which there are many, can cause severe interference. The interference shown in figure 6 is from a dielectric heating device. Such interference is non-selective, and can happen to anyone. Either report it to the ACA or track it down and advise the owner of the machine about the problem.

This can be extremely costly interference to fix, and the only way is to advise the ACA who investigate large numbers of interference problems for the public, for free.

ALTERNATOR WHINE

This question pops up in amateur exams from time to time. A mobile amateur station experiences a variable pitch whining noise in the receiver. What is the likely source?

Of course I can hear you say, the alternator (AC generator) in the car. The diodes in the alternator can cause this interference. The diodes are needed to convert the AC to DC to charge the car battery. The varying pitch is due to the changing RPM of the car engine.

This interference is usually eliminated by installing a 1uF or larger coaxial capacitor at the alternator output terminal.

Alternator whine can also be transmitted and not heard. If other amateur stations report a variable pitch whining noise, do something about it - it is most irritating to listen to.

SUMMARY

I have covered more than you will need for exam purposes here. **There is a booklet in PDF format on the Amateur Radio and Electronics Study WEB site in the download area, called Solutions to Interference**. I suggest it for further reading. The images in the reading were 'borrowed' from Industry Canada - which is the equivalent of the Australian Communications Authority. I suggest you spend some time at the WEB site as well, as it has some interesting information on radio sounds and interference.

http://spectrum.ic.gc.ca/~emi/htmlen/index.html

Radio Interference is a very large topic, but more than well covered here for practical and exam purposes. The greatest problem with resolving radio interference is the **unknown human factor**. Problems often arise because neighbours get interference, **which they believe is your fault,** but do nothing about because they want to get along with you too. Until the day comes and it's their favourite footy show, 35^{o}C in the shade, you're CQ DX'ing or whatever, and the neigbour comes visiting with an axe in one hand. Inform your neighbours if you establish a radio station, and invite them to let you know if there are any problems. It might seem like inviting problems. However, if there is interference then the problem will not fester to boiling point provided you communicate with your neighbours. Explain to them that you have a radio transmitter and a license for it. It is possible for problems to occur that may or may not be caused by you. Ask them to speak to you if they think they may have an interference problem.

As a last comment, many pirate radio stations are done over by someone reporting interference to the ACA, although that interference may not be the pirates problem. The pirate is in the very uncomfortable position of not being able to ask the ACA for any help.
The penalties for operating unlicensed radio transmitters in Australia are huge and can carry a goal term or a simple on the spot fine and confiscation of equipment. If you are going to be a pirate or already are one, I suggest you read The Radiocommunications Act. It's your best defense!

End of Reading 33
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