

A WELL-KNOWN INTERFERENCE

By Luiz Amaral
PY1LL/AC2BR

INTRODUCTION

Any ham who has operated, especially at night, on 80m or 160m, certainly has already observed an interference (EMI) produced by TV sets on their receivers, or even people who listen the AM radios on MW or on the tropical band have observed them. They are noisy signals that occur at the multiples of the horizontal sweep frequency F_h of the TVs (close to 15.7kHz) that fade in intensity as the tuned frequency increases and that, many times, block the signal of interest and prevents the contact. Bigger TV sets normally interfere more than those of less energy consumption.

WHAT ARE THEY?

Whenever we make that question we get as answer that they are merely the harmonics of the horizontal sweep that produces radiated or conducted EMI.

The horizontal sweep current wave shape of a TV is really rich in harmonics as it is a sawtooth¹ and the intensity of the harmonics falls approximately² proportionally to the order of the harmonic, that means, the intensity of the harmonic of order N is inversely proportional to N . Besides, the separation between consecutive signals is just that separates the harmonics.

But here a difficulty, that not all people notice, arises. The wave shape and the frequency of a sawtooth signal are both *constant*, that is, invariable for a tuned channel, *independent* of the bright or the scene that is on the screen. So all its harmonics would be 'not modulated carriers' separated by F_h . But that *is not* observed when listening one of the interfered frequencies! They are not 'not modulated carriers', as they are noisy, and this modulation also *depends* on the bright and the observed scene³.

¹Any periodic not sinusoidal waveform has harmonics and, the more different it is from a sinusoid, the richer in harmonics it will be.

²It would be exactly if the falling time were zero.

³Put a radio receiver close to the TV set and vary the bright (with a tuned channel) and observe the dependence of the noise on the shown scene.

We can conclude that, the simple occurrence of the radiation/conduction of the horizontal sawtooth harmonics is not enough to explain the phenomenon. If it varies with the scene, it is something that also depends on the CRT electron beam anyhow, not the case of the sawtooth.

It is well-known the fact that accelerated charges radiate electromagnetic waves⁴. The electrons of the beam in the image tube have an acceleration component in the direction of the beam itself due the high voltage, but static, more or less constant and independent on the sweep, but they also have accelerations rather perpendicular to the beam due the sweeps themselves and just during the beam direction change of the sweep the greater electron accelerations occur. In this case, the radiation intensity is dependent on the beam intensity (bright) that is the accelerated charge and on the scene itself. As the beam, besides the horizontal acceleration, has a vertical one, the resulting modulation also contains modulation at the vertical frequency F_v , or 60Hz⁵, which is easily noted by listening to the characteristic hum that follows the interferences.

CONCLUSION

The interference at low RF frequencies produced by TV sets (it is valid for computer monitors too) has two components essentially distinct: the direct harmonics of the horizontal sweep current⁶ and the radiation from the electron beam accelerations due the sweeps, both components, in principle, being able to result in radiated and conduct EMI.

They are, in general, interferences rather difficult to be eliminated (perhaps the conducted component can be attenuated with a good line filter, as a ferrite toroid on the mains cable) because induction to the antenna conductor and because it is very complicated to block the radiation that is generated by the electron beam, as it is not possible to shield the tube entirely and to go on listening the TV program. Besides, generally the entire neighborhood has TV sets and, then, things get complicated!

In my personal experience I succeeded in attenuating the interference on a hamradio receiver produced by a 10" B&W TV used as my RTTY digital system monitor. Simply I glued aluminum paper on all the TV plastic case (inside it), having the precaution to connect it to the TV chassis and keeping all the case ventilation holes fully unblocked. The result was very fine, reducing the interferences to perfectly tolerable. In the case of

⁴The intensity of radiation is proportional to the acceleration and to the charge value.

⁵ Our system operates on 60Hz.

⁶The vertical sweep also contains the same harmonics, but its direct interference is much smaller due the high order of those harmonics in MW and above.

modern color TV sets with CRT, things may be much worse because of the higher power of those interferences. That is why the sets (TVs and computers) with LCD screens are highly advisable, as they don't have accelerated beams nor produce X-rays⁷.

⁷ **The electrons are violently decelerated (negative acceleration) when they collide with the face of the tube. As their energy is very large, the breaking radiation is not in radio bands, in the visible or UV spectra, but in the region of x-rays.**