

Harmonics and Parasitics

Harmonics

Harmonics are multiples of a transmitted frequency and are the result of a non-linear action. They are present in any signal which has a distorted sinewave. Harmonics are the even or odd multiple of the fundamental transmitted frequency. For example, a transmitter at 3.5 MHz would have harmonics at 7, 10.5, 14, etc MHz.

Harmonics are typically produced by an over-driven stage somewhere in the system. An example is over-modulation of a transmitter ("flat-topping"). Reducing the microphone gain in this case will significantly reduce the harmonic output.

Harmonic interference occurs at distinct frequencies.

Harmonics should be suspected if a transmitter on a lower frequency causes interference to a frequency which is a multiple of it. For example, a transmitter on the 10m band, at say 28 MHz, could cause interference to a television receiver receiving on TV Channel 2, which is 54 to 61 MHz. The probable cause is the second harmonic $2 \times 28 = 56$ MHz.

For TV and other frequency use, refer to charts and tables in the annual NZART CallBook for the *New Zealand Radio Spectrum Usage*. This information is also available from the Ministry of Commerce web page.

Harmonics can be produced within transmitters and receivers or outside of both.

Harmonics generated within a transmitter must be filtered out. A filter in the output lead is usually installed by manufacturers. External filters are also used.

Harmonics generated within a receiver generally cause cross-modulation or intermodulation.

Harmonics can also be generated by external causes - for example a bad connection between two metal surfaces, e.g. gutters, metal roofing, and antennas. The joint can oxidise and form a poor quality diode which when excited by an RF field produces harmonics.

Harmonics which are not exactly on the frequency being received can sometimes be removed with a selective filter - band reject, high pass or low pass.

Generally, harmonics should be suppressed at their source.

Parasitic oscillations

With parasitic signals there is no simple mathematical relationship between the operating frequency and the interfering frequency. The effects may be the same as with harmonics - a VHF receiver being interfered with by a HF transmission. The cause is an additional and undesired oscillation from an oscillator or amplifier for which it was not designed. The circuit functions normally but the parasitic oscillation occurs simultaneously.

Parasitics are suppressed by adding additional components to the circuit to suppress the undesired oscillation without affecting the primary function of the circuit. A typical solution is to add a VHF choke (an inductor) or a small-value resistor (a "stopper") somewhere close to the active component in the offending circuit.