Antenna Gain

Antennas are frequency-dependent devices. The aperture of an antenna is set, but the aperture size in terms of wavelength is a function of frequency. The electrical size and therefore the electrical parameters of a television antenna will change with frequency. This also includes the gain of the antenna. Careful design will minimize the gain change to be less than about 0.1 dB over a channel.

Radiation Pattern

The signal amplitude received by the viewer depends on the antenna gain and the relative pattern amplitude radiated toward the receiving site. Change of the pattern amplitude as frequency changes will cause a corresponding amplitude modification; in effect superimposing an amplitude modulation on the received signal. The amplitude amplitude relationship among the frequencies contained within the transmission will be modified. The originally transmitted picture now has been modified to some degree.

There has been some concern over the stability of antenna patterns for some time. The signal from most antennas will be stable and not dependent on frequency when viewed from small depression angles (20 to 100 miles away). Close to the antenna, at large depression angles, the antenna pattern may be very cyclic. This may cause the signal to be greatly dependent on frequency.

Center-fed antennas are vulnerable to angular shifts of the side lobe positions. The side-lobe amplitudes are also fequency-dependent. These changes may introduce a signal variation of as much as 10 to 12 dB in the angular range where the side lobes dominate. End-fed antennas will exhibit some movement in the angular position of the peak of beam. However, an end-fed antenna will produce less amplitude variation at low elevation angles. Although the total signal variation from an end-fed antenna may be 5 to 8 dB, careful design will limit this to about 2 dB.

How much of this is tolerable? That depends on the kind of transmission scheme employed, and on the correction circuits that may be used. The correction may be reasonably simple, provided that the amplitude variation is fairly small and linear or nearly linear with frequency. The NTSC television system uses amplitude modulation for conveying video information. The secondary amplitude modulation, superimposed on the signal by the antenna, may degrade the picture quality. This degradation may affect any system, including HDTV, which relies on amplitude modulation.

Wind Deflection

Antennas are specified to withstand -- that is, survive -- wind velocities in excess of 100 mph, depending on their location. The generally accepted wind velocity specification for operational wind velocity is 50 mph. Top-mounted units are not supported by the tower, and so will bend or deflect in wind. They bend to a parabolic shape. The displacement of the antenna from the vertical varies exponentially with height. The "bending" of the antenna changes the apparent phase relationship among the radiating elements.

The result is that the main beam of the antenna will be displaced; the antenna pattern is modified and the gain is effected. All of these cause the amplitude of the signal to vary as the antenna sways in the wind. Careful design will minimize this problem (stiff antenna, smooth pattern, etc.)

Multi-Antenna Environment

When there are two or more antennas in proximity at the same height, there will be some interaction. The signal radiated by one will be reflected by the others. The reflected signal, travelling a long route, arrives at the receiver delayed in time. This of course is the same as an echo in the transmission system; the same problems result. The magnitude of the reflected signal depends on the distance between the antennas and the electrical cross section of the reflecting antenna. The time delay caused by the extra distance is a function of the physical layout of the installation and the location of the viewer in relation to it.

Calculating Amplitude, Phase Distortion

The worksheet presented in Figure 15 will help in assessing the amplitude and phase distortion one may expect to be caused by the transmission line/antenna system. The prediction of visible ghosting is left solely to the RF pulse test method.

SUMMARY

Attenuation and velocity of propagation are parameters that change slowly with frequency. Even in dispersive transmission lines, the changes caused by these attributes are not considered to be significant.

Transmission lines cause nonlinear distortions mainly due to reflections (echoes). A typical transmission line system having a VSWR of 1.05 will produce a phase variation of about 2.8 degrees, and an amplitude change of about 0.45 dB.