GPS Use in Agriculture

As described, radio noise from an AC transmission line would not be expected to directly affect GPS receivers used for farming or other operations from receiving GPS signals or the satellite- or antenna-based correction signals.

Since real-time kinematic correction signals are transmitted from antennas that are typically only a few metres high, AC transmission line towers are not expected to produce much blocking of the line of sight signals from these sources either. Repositioning of the real-time kinematic base station antenna should resolve any issues if they occur.

Signal degradation can occur due to reflections from a nearby flat-topped building or other reflecting surfaces (such as lakes). The overall performance of a GPS guidance system in agriculture depends upon a high-quality receiver and good positional correction from an independent source.

Studies of the performance of vehicle mounted receivers using GPS and Russian Global Navigation Satellite signals around AC transmission lines in Manitoba have not reported any problems in obtaining positional signals with centimetre accuracy with satellite or real-time kinematic error corrections signals [14].

For more information on AC lines and electronic devices, please consult the refrences listed on the next panel.

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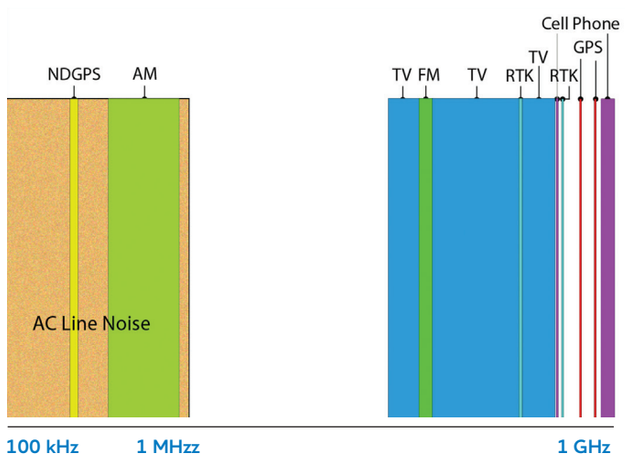
AC Lines and Electronic Devices

Manitoba Hydro distributes electricity throughout the province using alternating current (AC) transmission lines operating at voltages between 66-kilovolts (kV) and 500-kV. This brochure outlines information about electronic devices including global positioning system (GPS) receivers, radios, TVs, wireless internet and cell phones in the presence of AC transmission lines.

GPS receivers, radios, TVs, wireless internet, and cell phones all receive radio frequency signals. While radio and TV transmitters produce relatively strong radio frequency signals, GPS satellites, computers and transmission lines produce weaker radio frequency signals.

Radio and TV Receivers

Radio and TV interference may be noticeable when near an AC transmission line. Many people have heard interference while listening to amplitude-modulated (AM) radio stations and driving under power lines, particularly high voltage transmission lines. Interference to AM signals is caused by corona discharge around the transmission line conductors. This corona discharge generates broadband radio noise over a range of radio frequencies. If the signals from AM and non-digital TV sources are weak, the radio noise from nearby power lines can overlap and cause poor reception very close to the lines (Figure 2).



The illustration above represents the frequency band of radio signals from electronic devices such as TVs, cell phones, and GPS superimposed with the primary frequency range of radio noise from an AC transmission line.

TVs receiving digital television signals are not susceptible to this source of interference.

Manitoba Hydro has decades of experience designing transmission lines that minimize radio noise and has worked with customers to solve interference problems that sometimes arise near AC transmission lines

Cell Phones

Cell phones receive and transmit radio frequency signals at frequencies ranging from 850 megahertz (MHz) to 2,150 MHz. Radio noise from an AC transmission line does not overlap with the signals from a cell phone and, therefore, does not interfere with a phone's functioning near an AC transmission line.

Wireless Internet

Wireless internet operates at a frequency of 2,400 MHz. Radio noise from an AC transmission line does not overlap with wireless internet signals and, therefore, does not affect wireless internet function near an AC transmission line.

Global Positioning System Receivers

GPS is a space-based navigation system that relies on orbiting satellites circling Earth to establish the position of a GPS receiver. The receiver uses the radio frequency signals sent from three or more of these satellites to determine its exact location.

Naturally-occurring sources of radio frequency such as geomagnetic storms and man-made sources of radio frequency such as TV transmitters are sometimes reported to interfere with GPS signals because these sources produce interference in the same frequency range as the GPS satellite's signals.

Since GPS signals are of far higher frequency than the radio noise from an AC transmission line, it is very unlikely that an AC transmission line will interfere with GPS functioning.

Systems to Improve GPS Accuracy

Modern GPS receivers can receive corrections from a number of satellite-based systems with frequencies above 1 gigahertz to improve the accuracy of positional location; this is called differential GPS (DGPS). [1-3, 5-12] Nationwide Differential GPS (NDGPS) is a GPS system used in the United States and along the southern border of Canada that was developed to improve GPS accuracy when GPS first became available.[1] This system, as well as the Canadian System GPS-C (now decommissioned) make use of land-based antennas to transmit correction signals to GPS receivers at lower frequencies, but are no longer used, particularly for high-precision applications.

Some GPS systems also make use of real-time kinematic (RTK) systems to improve the accuracy of the GPS system by making use of the ultra-high frequency radio communication range.[1, 12] Since the frequency bands of these systems are far higher than the radio noise frequencies produced by an AC transmission line, signal interference is unlikely to occur. [3,13] It is possible, however, that some receiver designs may be susceptible to minor interference to the receiver, not the GPS signal due to certain related factors. Conceptually, an AC transmission line might affect GPS performance by signal blocking and reflection.

Signal Blocking and Reflection

RF signals can be blocked by physical objects such as mountains or dregraded by reflections off large solid objects. Reflections of GPS signals by buildings, lakes, and ponds can affect the accuracy of GPS positions. The towers of an AC transmission line, while relatively large compared to the size of a person for example, do not have a large footprint and they are not solid structures. So while the towers can result in some reflections and blocking of radio frequency signals, their impact is generally momentary and insignificant. Transmission line conductors also are too thin to block or cause large reflections of radio frequency signals. [3, 4]

GPS and related receivers are typically configured to reduce the effects of blocked and reflected signals, resulting in a very small and temporary blockage area if it occurs. Further, the reception of signals from multiple satellites means that the loss of a signal from one satellite is not consequential since signals from other satellites are still available to accurately determine the position of the GPS receiver.