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TVRO in the 21st Century

Antenna Requirements to Operate in
DVB S2 and DVB S2-X

"Satellite Antenna Systems Engineering Excellence"

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The early-on satellite operations for cable and broadcast television environments were relatively simple; the satellites all had minimum 3º spacing from adjacent satellites and exhibited sufficient power (EIRP) levels so that even poorly built satellite antennas could function at acceptable operating levels. Even more significant was that a typical satellite provided 24 transponders that could support just a single carrier, thus dramatically limiting the quantity of programming that the satellite provided, especially as compared with the multiple-channel operation capabilities of current satellites. That began to change in the mid 1980's when the FCC approved 2º satellite spacing operations. Very quickly, antenna size, surface tolerances and mechanical stability became important factors for an antenna to exhibit adequate Adjacent Satellite Interference (ASI) capability. These requirements began to weed out poorly built antennas and move the industry toward antennas that exhibit these characteristics in order to provide the quality of operations that new modulation schemes demanded.

The early 1990's introduced further dramatic changes in satellite operations with introduction of digital transmission and high order modulation schemes that enabled a single transponder to provide multiple channels of programming content. Classic digital signals, used for low data rates, used a two-condition transmission method. A "bit" of data was represented by one condition, the absence of a "bit" by the other condition (typically called a "state" in the industry). Because the differences between these two states were easy to distinguish, the transmission was very robust, and error-free.

But, as data rate requirements increased, the number of transmitted "states" was increased, using discrete phase shifts to indicate groups of bits, then discrete amplitude changes, then combinations of these methods to indicate still larger groups of "bits". These advances allowed dramatically faster data rates for the digital transmissions.

But, with these advances came problems. Because of the increased number of "states" in the transmission, the difference between the "states" became very small, making them difficult to distinguish from noise at the receiving end of the system. The signal-to-noise ratio became a more important factor in maintaining reliability of reception. But for most TVRO operators, their existing antennas were adequate, if just barely.

Currently new, even higher order (DVB S2 and DVB S2-X) modulation schemes are being implemented in all phases of satellite operations. These new schemes dramatically increase the number of "states" that the demodulation equipment must process, making them much more subject to data errors caused by system noise. In order for these new higher order transmission systems to maintain a high reliability factor, the system signal-to-noise ratio will need to be much better than that required for the older digital transmission systems.

There are two basic ways to improve the signal-to-noise ratio in a TVRO system. One is to increase the power of the transmitted signal. But modern satellites already employ the latest transmitter technologies, and, for the older satellites, replacing them is typically a multi-hundred million dollar process.

The other way to improve the signal-to-noise ratio is to use an improved receiving antenna.

We need to digress for a moment, and talk about "noise". "Noise" in a satellite receiving system comes essentially from two sources: the first, amplifier in the LNB, and extraneous signals picked up by the antenna. Modern LNBs employ state-of-the-art electronics, and little or no improvement can be anticipated there. But, in most TVRO operations, the antenna can be improved to reduce the extraneous signals.

Many TVRO operators installed 3.7 meter antennas years ago, and are still using them today. For the current digital transmission systems, they are adequate, but just barely. For the new proposed systems, they just will not do the job. Larger antennas (4.5M+) of good quality and tight beamwidth are needed to provide improved reception and margin.

The problem, as mentioned before, is the pickup of undesired signals by the antenna. Remember that all the TVRO satellites transmit with the same channel frequency lineup, with adjacent satellites having the polarizations of the channels reversed from each other. Thus, for any given channel on any given satellite, there may be two adjacent satellites transmitting on the same channel frequency, with reversed signal polarization.

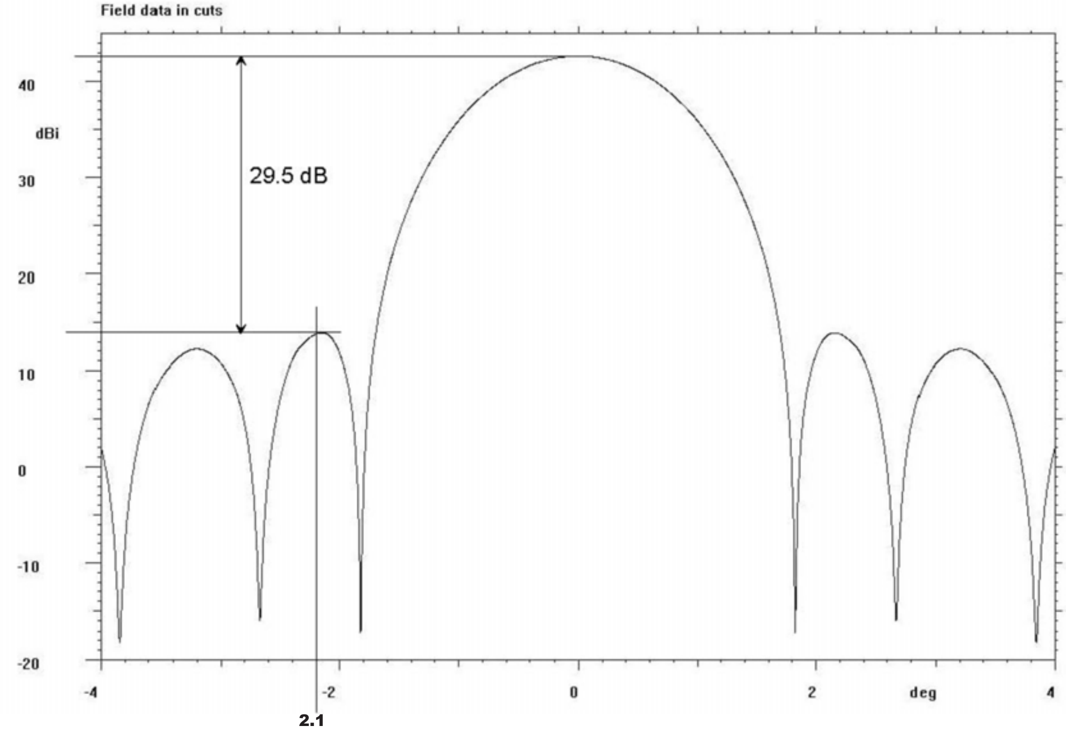
Since the satellites are spaced only two degrees apart in the geosynchronous orbit, the signals from the two adjacent satellites can easily be picked up by the sidelobe responses of the ground antenna, and can enter the receiving system as "noise". The following two diagrams will show why the selection of the antenna will be critical for new and upgraded TVRO systems.

The first plot shows a typical sidelobe response of a 3.7 meter antenna, a widely used antenna in TVRO operations. Note that the first sidelobe peaks at 2.1 degrees offset from the main lobe, and is down about 29.5 dB. This sidelobe response allows considerable energy from the adjacent satellite to enter the receiving system, and potentially interfere with reliable reception of digital signals.

(A note here: although the satellites are spaced at 2 degrees, that spacing angle is based on the center of the earth. Actual differential look angles from the surface of the earth are slightly greater. Thus the attention to the response of the antenna at 2.1 degrees. rather than at 2.0 degrees.)

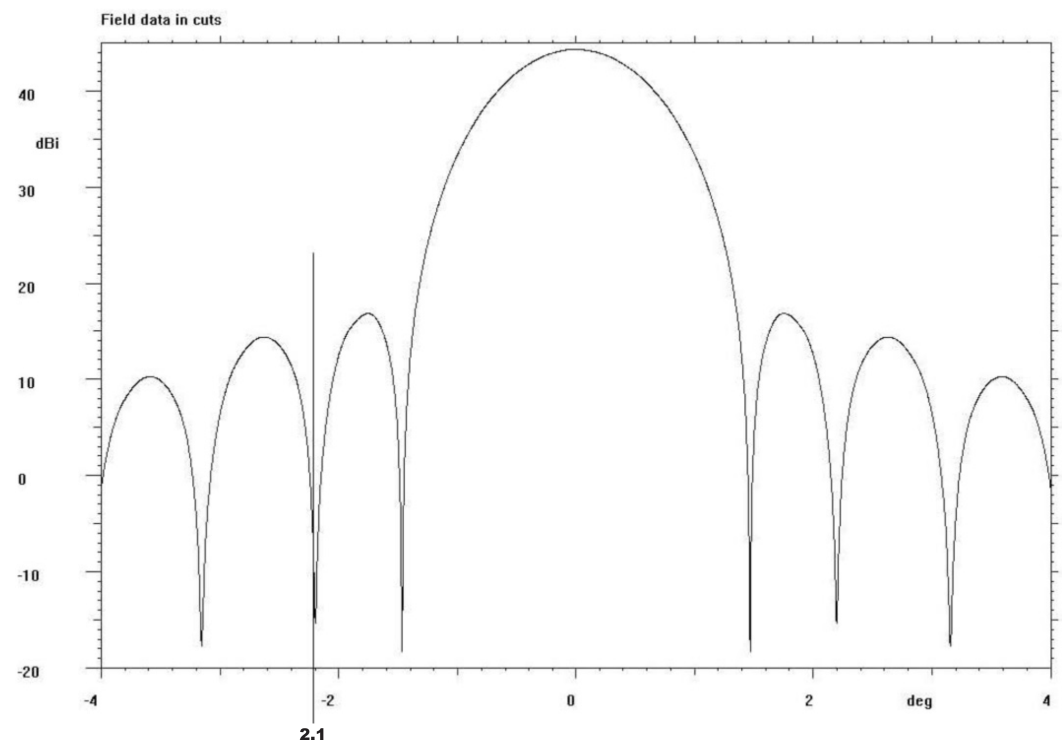
Technical and engineering contributions provided by John Kernkamp of Kernkamp Consulting

3.7 Meter Antenna Standard Illumination



The next plot will show the same type of sidelobe pattern analysis for a 4.5 meter antenna. The 4.5 is also a popular size, but was often overlooked in the past, because it is more expensive than the 3.7 meter antenna, and the 3.7 was adequate for the older transmission methods.

4.5 Meter Antenna Standard Illumination



Notice that the 4.5 meter antenna has the second null in its sidelobe response pattern at exactly 2.1 degrees. This null allows this antenna to dramatically reject the signals from the two adjacent satellites.

In conclusion, it is sure that new, higher order modulation methods for satellite transmissions will not work well with older antennas, due to adjacent satellite signals entering the system through the relatively high sidelobe responses. New antennas will be required, which must be designed to have sidelobe and beamwidth responses properly placed to effectively reject the adjacent satellite signals.

Note: Watch our website – www.superiorsatelliteusa.com – for a full discussion on why the sidelobe and beamwidth characteristics of a satellite antenna affects the ability of that reflector to operate in the new high order modulation schemes (DVB S2 and DVB S2-X) environments. We will provide visual aids that readily and easily explain these functions. Further, we will also explain how to test the capability of your existing satellite antennas to operate in the bandwidth sensitive satellite architecture.

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SSE SERIES 8345 HP 4.5 METER ANTENNA

High Performance 4.5 Meter Satellite Antenna

- **12 precision stamped steel panels and radial beam construction provides an extremely accurate reflector surface**
- **Excellent platform for multi- satellite operations (accessing up to 3 adjacent satellites with one antenna)**
- **Outstanding performance for high modulation schemes (DVB-S2 and DVB S2-X)**
- **Intelsat and FCC - approved for uplink operations. Real-world range-test documentation and patterns available**
- **Strongest in the industry Tri-pod mounting system maintains operational signal levels in extreme high wind environments**
- **2 man installation with no crane or special equipment required**
- **Steerable Options Navigator 45**

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