

# AGELESS PRECISION FREQUENCY CONTROL FOR DIGITAL TV TRANSMISSION SYSTEMS

## THE TRANSITION TO DIGITAL TELEVISION

The television industry is in the process of rolling out digital television (DTV) globally. In the U.S., deployment of DTV began with initial system tests by some TV stations in the spring of 1998. The FCC has required all TV stations in the U.S. must be on the air with their digital transmissions by 2003.

Each existing TV station has been assigned a second channel for DTV use. At first, both NTSC (conventional analog television) and DTV stations will coexist, with DTV gradually taking over the market. After the year 2006 only digital stations will be allowed to transmit in the U.S. Conventional TV sets will be able to receive the new DTV signals with addition of a converter box between the antenna and the TV set, but this arrangement will not provide the new "high-definition" picture.

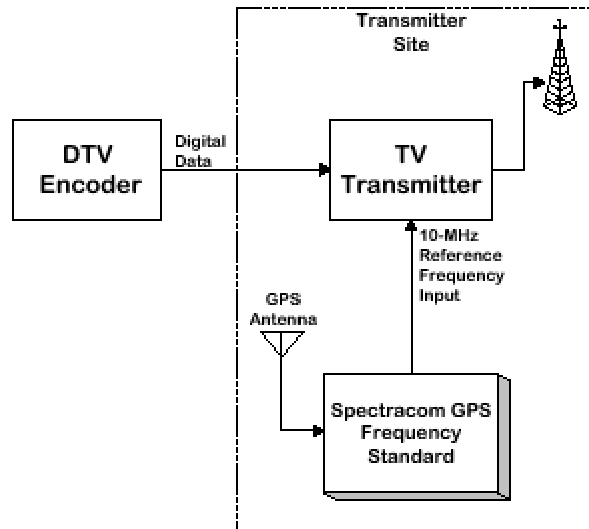
## PRECISE CHANNEL FREQUENCY CONTROL REQUIREMENT

There is a need for precision frequency control of some new DTV transmitters, and of some nearby conventional TV transmitters.

This requirement arises because of an adjacent channel interference problem that occurs when a DTV station operates on a channel immediately above a nearby NTSC channel. In these situations, the DTV station is required by the FCC to maintain its pilot carrier frequency within 3HZ of 5.082138 MHz above the visual carrier of the station in the lower adjacent channel in order to minimize interference.

To maintain this required spacing between adjacent channels, most digital stations with this problem must lock their channel frequency and that of the nearby NTSC station to signals from the Global Positioning System (GPS) satellites. This is a cost-effective solution, and the accuracy provided by this arrangement is more than adequate to meet the FCC requirement. This frequency control is provided by locking each transmitter channel frequency to the high-precision 10-MHz output of a Spectracom Ageless GPS Master Oscillator, Model 8195A. The outputs of this economically priced unit are locked to the timing signals received from the Global Positioning System satellites.

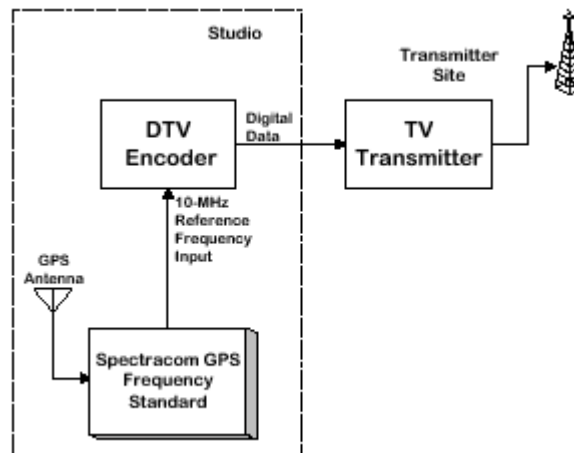
A block diagram of an installation is shown here, with the interfering stations both locked to GPS. This arrangement controls the channel spacing of the two TV signals with an accuracy of better than 0.01 Hz. If the GPS antenna is damaged or the signal is otherwise lost, the high-stability oven-controlled oscillator in the Model 8195A goes into "holdover", which keeps the frequency sufficiently accurate for at least one week on the higher channels, and up to 20 weeks on the lower channels. When the GPS signal is reacquired, the self-calibrating Ageless(TM) Oscillator readjusts its frequency to remove any accumulated error. If the longer holdover periods are required, the rubidium version of the unit (Model 8197) may be used.



*The Spectracom Model 8195A GPS Frequency Standard locks the transmitter channel frequency to the GPS satellite signals, holding it precisely on its assigned frequency. Any other nearby transmitters that are also locked to GPS will be precisely separated in frequency from this transmitter.*

### DIGITAL ENCODER CLOCKING

The digital encoder, usually located at the studio, needs a reference frequency of sufficient accuracy and stability to meet the SMPTE 310 specifications. The internal clock oscillator in some encoders is not sufficiently accurate, and an external frequency reference is required. Some set-top converters have a narrow pulling range and will not lock to the received data stream unless it is clocked by the station's encoder at a highly precise rate. Both of these factors are reasons to provide a very accurate clock source at the encoder. If the viewers receive a poor picture, they are likely to blame the station, whether or not the station is at fault, especially if they get satisfactory reception of competing stations.



*The Spectracom Model 8195A Ageless GPS Master Oscillator provides the reference frequency for the digital encoder.*

The Spectracom Ageless(TM) Oscillator provides more than adequate accuracy for this application, and it avoids the need to periodically calibrate the encoder clock source to insure that it meets the SMPTE 310 specification. If the encoder happens to be located near the transmitter, the same Ageless Oscillator can be used for controlling both the transmitter channel frequency and the encoder output data rate. Whether at the studio or the transmitter site, the Ageless Oscillator may also be used for synchronizing any other equipment that requires accurate square- or sinewave frequencies.

### **CONCLUSION**

The Spectracom Ageless GPS Master Oscillator improves the quality of TV station operations and offers these benefits:

- Minimizes interference with adjacent-channel NTSC stations.
- Automates the control of channel frequency with GPS accuracy.
- Ensures that encoder data output clock rate accuracy exceeds SMPTE 310 specs.
- Provides a master frequency standard for test equipment such as frequency counters.
- Synchronizes other station equipment.