CRYSTAL OSCILLATORS FOR SATELLITE APPLICATIONS

Martin B. Bloch
Frequency Electronics, Inc.
55 Charles Lindbergh Boulevard
Uniondale, Long Island, N.Y. 11553

ABSTRACT

Quartz crystals have achieved stabilities of 1 x 10^{-11}/day and have been and still are the key building block for use in satellite communication and timing systems. Even with introduction of rubidium, cesium and hydrogen standards for satellites, the crystal oscillator is still an important element in acheiving the stability and low noise requirement.

The crystal oscillator consumes little power (1 watt), is lightweight (less than a lb.) and achieves a MTBF of better than two million hours. The above characteristics make it ideally suitable for satellite applications and it has had an excellent track record in space. This paper summarizes quartz clocks presently employed in satellite systems with stabilities of 1 x 10^{-9}/day to 5 x 10^{-12}/day and will compare their performance on earth with what has been achieved in orbital environments with respect to life, stability, power consumption, temperature stability and radiation effects.

QUESTIONS AND ANSWERS

VOICE FROM AUDIENCE:
How many ovenized space oscillators are there?

MR. BLOCH:
If you look at the total number of ovenized oscillators in space, there are over 300 in space at this moment. Many of the systems are doubly and some are triply redundant. The GPS, as a matter of fact, is four way redundant. You have quite a few crystal oscillators per bird. In many of the early spacecraft, before we relied on multi-channel synthesizers, there was a separate TCXO for each channel, with as many as forty channels. There were lots of TCXO's per bird. The performance of crystal oscillators in space has been very, very good. There have been a few anomalies, but I think only one failure in about two thousand pieces of hardware.