

# Satellite Ground Stations

## Reliability improvements and extended lifetimes

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**Operational Expense (OpEx) is under constant pressure for further cost savings. As satellite ground stations become more automated, including many unattended facilities, the reliability and service of every part of the transmission chain becomes even more important.**

TWT Amplifiers have gained favor in teleports because of their mounting flexibility, broad bandwidth, high efficiency and very high linear power; however, historically, some TWTAs were unable to live up to reliability expectations. **Comtech Xicom** has worked hard in four areas to make certain that the customers are well served:

- *Redundancy*
- *Circuit Design/Package Design*
- *TWT Reliability and Life*
- *Serviceability*

The choice of a redundancy system involves many factors. For critical applications where an interruption of service cannot be tolerated, a higher level of redundancy can be offered such as a 2 for 1 system. Two standby amplifiers backing up a primary amplifier can also eliminate the need for emergency trips by teleport staff to site to replace a failed amplifier to re-establish redundancy as would be required for standard redundancy systems.

When more power from a single amplifier is desired, 2 amplifiers can be power combined, and a 3rd amplifier used as a back-up for either primary amplifier if one should fail. Even more power can be generated with the output of 4 amplifiers combined. In Xicom's *Continuous Power System*, redundancy is achieved by having acceptable power margin; the system is operated at a reduced power level and in the event of a failed amplifier, the remaining amplifier outputs are increased to recover to the original system operating power level. There is no transmission interruption as would be caused by a switch action and only a temporary small drop in power.

### Circuit Design

For the past 5 years the Xicom team has taken a closer look at how we design and build our products. Every circuit is analyzed for steady state and transient conditions. Every issue is addressed, no problem is 'below the radar' for finding the root cause and correcting it. Creating an environment of continuous improvement has paid off, particularly with a decline in warranty repair rates and an improvement in first pass yields. Improved quality leads to lower costs and higher overall customer satisfaction.

### TWT Reliability and Life

TWTs have a long heritage for use in satcom HPAs. They offer linear RF amplification and are the most efficient energy conversion devices for broadband RF power. Tube manufacturers design their products for high reliability and long life while manufacturing for volume production at a competitive price.

NEC Corporation has been a long-time supplier of TWTs to Xicom and the HPA industry. They have shipped more than 4,900 millimeter wave TWTs and are achieving production shipments of up to 70 pieces per month. NEC continues to increase the linear power, bandwidth, efficiency, and frequency range of TWT products, while demonstrating excellent reliability and longevity. They continuously

increase performance in Ka-band (>650W), Q-band (>200W) and are now pioneering Q/V-band with more than 250W of performance over more than 5 GHz of bandwidth.

NEC's application of continuous improvement principles, such as Kaizen, has demonstrated continuous cost improvements and excellent field reliability with fielded yield rate of more than 99 percent over the last 5 years when integrated in a Xicom HPA. The forward-thinking mindset engrained within their company culture demonstrates their long-term commitment to the SATCOM market. It will keep them at the forefront of millimeter wave SATCOM TWT industry.



Four Xicom XTD-750 amplifiers in an antenna mounted Continuous Power System

### Redundancy Systems

Teleports have always counted on 1:1 redundancy switched systems, but as power levels climb more multi-amp systems have evolved. By moving to a three- or four-amp system configuration, more amps can be making a contribution to the system output power, allowing more fade margin and better QoS.

These systems need to be easy to install, configure and tough enough to 'set and forget'. A well-designed platform includes building blocks that can be interchanged from one antenna to another with remote controllers which can be easily configured in the field for different antenna system requirements. The versatility provided by a software defined controller means new system configurations can be created and sent to customers thus making the controller future-proof.

High reliability TWTs are a principal component in the reliability of the HPA; however, proper operation of the TWT within the HPA is also important to the reliability of the HPA. For example, Xicom's Life Extension technology lengthens the useful amplifier life by automatically adjusting the anode voltage to keep the beam performance constant as a function of time. This is the same process that is used in GEO spacecraft to keep the payload meeting spec over the useful life of the satellite. Xicom's Life Extension Circuit is predicted to automatically increase tube life by 2-3 years and maintains gain and linearity throughout the amplifier's life.

### **Serviceability**

Teleport operators have a variety of equipment to operate and maintain. In addition to being reliable, equipment must be easy to operate, maintain and troubleshoot, particularly when problems occur. Xicom's intuitive and color-coded control panels help greatly in easing this burden, providing a single point to monitor and control a redundancy system and its amplifiers.

A significant advantage of the Xicom multi-amp redundancy systems is that amps can be brought out of service without a switching event. Xicom pays close attention to service by designing systems that are built around users. We use circulators and quick disconnects so amplifiers can be removed while the system is still in operation. Amplifiers can be mounted on slides for fast and easy remove and re-alignment when being replaced

Teleports once located in remote areas are being engulfed by urban expansion and the need for quiet operation becomes an area of concern for the teleport operator and the surrounding community. In these situations, liquid cooling approaches help to diminish, if not eliminate, the noise usually associated with high power air-cooled amplifier located outdoors.

This has the added benefit of the amplifiers not needing routine servicing because the blowers and fins have moved to a ground mounted liquid heat exchanger.

## **Conclusions**

To stay ahead of the competition, Xicom is aggressively developing new products to deliver more value to our customers. Building on our solid technological foundations and infrastructure, Xicom is well positioned for the next generations of teleport HPAs.

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*With a solid background in SATCOM as well as optical and wireless telecommunications, author Eric Schmidt has held management positions at NEC, Space Systems Loral, CPI (formerly Varian), and Siemens. He has more than 30 years' experience identifying market opportunities and developing strategic customer relationships. He received his Bachelor of Science degree from Cornell University with a concentration in microwave circuit design, and his master's degree from the Massachusetts Institute of Technology.*

