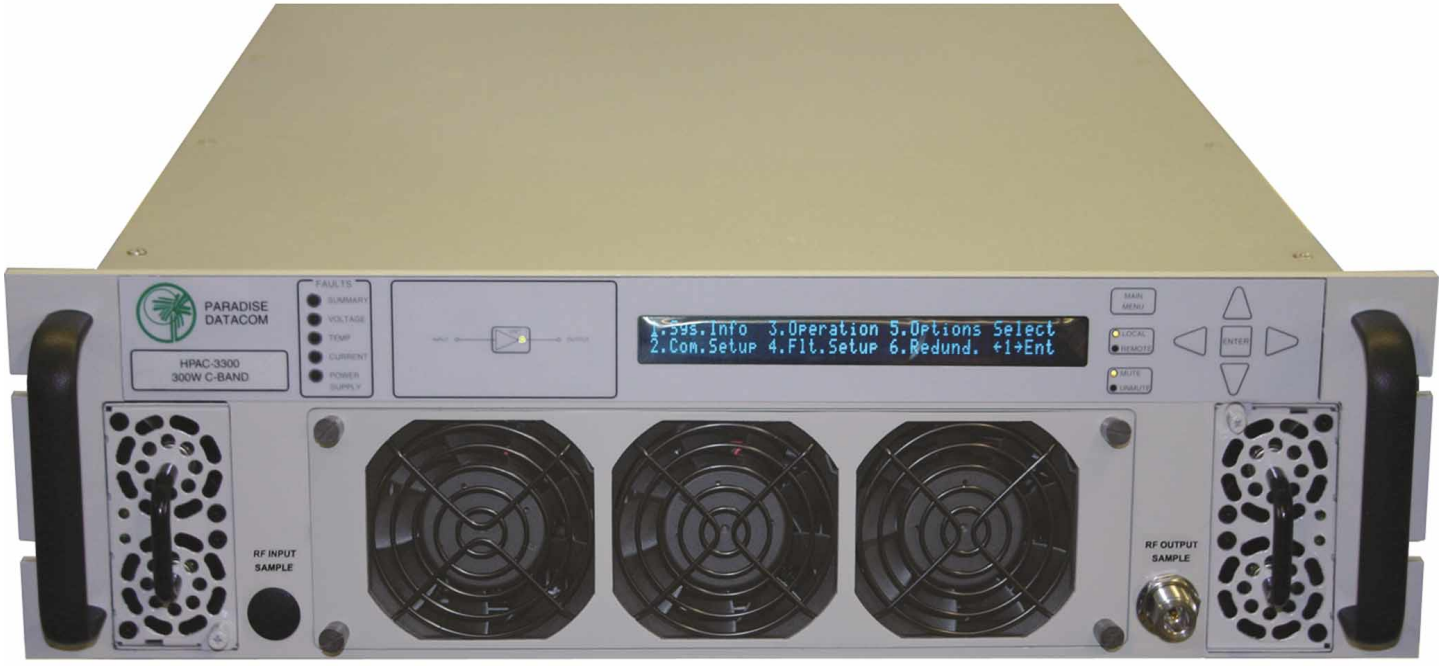


3RU Rack Mount SSPA. Photo courtesy of Paradise Datacom.

The crucial role of amplifiers

Amplifiers will long continue to play an important role in satellite communications as well as terrestrial applications. Stephen Turner, VP of Engineering, Paradise Datacom explains.

Stephen Turner, VP of Engineering, Paradise Datacom.

Question: Many thanks for your time Mr. Turner. Firstly, may I ask you to tell us why amplifiers are so crucial in satellite communications and what different types are available?

Stephen Turner: Amplifiers will long continue to play an important role in satellite communications as well as terrestrial applications. As demand for services such as data, video, communications, and control increase, the modulation schemes must evolve to compress large amounts of information in a given bandwidth. These modulation schemes impose greater constraints on amplifier performance. Higher power amplifiers and linearization techniques will be required to ensure distortion free signals.

Question: How has the design of amplifiers changed over the years?

Stephen Turner: Over the past 20 years, the design of Solid State Power Amplifiers (SSPAs) has changed significantly. Semiconductor package density continuously evolves to provide higher output power levels for a given transistor package size. The microwave circuit engineering aspects have also changed significantly.

High efficiency power combining networks have been designed that allow significant size reductions in SSPA module size. Paradise Datacom has devoted a tremendous amount of research into thermal design improvements to further reduce the size and weight of SSPAs.

Question: In terms of the SSPA / TWTA argument, which amplifier do you believe yields most benefits?

Stephen Turner: In the past, the TWTA has traditionally had a size and weight advantage over SSPAs. The thermal and power combining techniques mentioned earlier have pretty much eliminated this advantage up through 15 GHz. The TWTA still has a package density and cost advantage above 15 GHz but this will be changing over the next 10 years.

The SSPA is much more rugged and robust for extreme environmental operating conditions. There is also much less maintenance involved with SSPAs.

There has long been a debate over which type of amplifier is more efficient. If you look at the available power density, a given physical size of a TWTA can produce more raw power than an SSPA. However in communication systems, such as satellite systems,

much of this power must be wasted. The TWTA cannot be operated close to its maximum output power and still maintain distortion free communications.

While an SSPA of the same given physical size cannot produce the same amount of raw output power, it can be operated very close to its maximum output power level. Thus the net result is that, presently, there is very little difference in the efficiency between an SSPA and TWTA in a communication system. In radar and industrial heating applications the TWTA can be operated close to its maximum output power. Therefore in these applications the TWTA is more efficient than the SSPA.

Question: Do you believe that the SSPA will be the amplifier of choice for satellite earth stations in the future?
Stephen Turner: I do. It has long been accepted that semiconductor devices have much longer lifetimes (MTBFs) than vacuum tube devices. In fact we are beginning to see a move toward SSPAs not only on the ground segment but in the spacecraft as well. This will continue to be true but there are many more advantages of SSPAs over TWTAs than just the active device lifetime.

Most notably is the concept of modular reliability. An SSPA is typically designed as a parallel reliability system. This means that there are many lower power devices that operate in parallel to achieve a given amount of output power. A failure in any one of the transistors will not cause a failure of the overall amplifier.

In most systems the power requirement is sized such that the amplifier can continue to provide mission critical communications in the presence of a failed device. The TWT is a single device that is typically placed in cascade with a lower power SSPA as a driver amplifier. Thus there is no fault tolerance in this type of design. A failure of the TWT will cause a loss of signal.

There are also many advantages in the manufacture of the SSPAs. Companies that manufacture SSPAs tend to have total control of the design and test of all of the internal microwave circuitry. Many companies that manufacture TWTAs tend to be system integrators in that a travelling wave tube (TWT) is cascaded with a driver SSPA, linearizer, converters, etc. Many times the TWT manufacture does not have control over all of the components that make up the overall TWTA. This often results in a compromise in many specifications including amplifier gain, gain flatness over frequency, and output noise power density. A careful examination of TWTA and SSPA specification sheets will reveal many other performance advantages afforded by the SSPA.

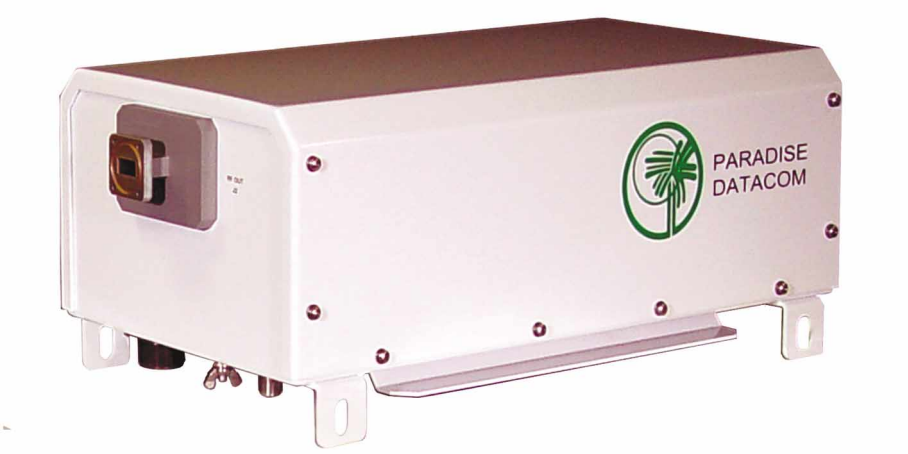
Question: What developments are being made within the amplifier industry? How will amplifiers change in the coming years?
Stephen Turner: There are many exciting changes coming to the amplifier community over the next 5 to 10 years, both at the semiconductor and amplifier design levels.

The first change is at the semiconductor device level. Over the next few years, the industry will see the introduction of Gallium Nitride (GaN) devices in the microwave amplifiers above 2 GHz. Gallium Nitride based transistors offer tremendous advantages over existing device technologies. Higher power devices will be available that will further increase the available output power levels from SSPAs.

Higher operating temperatures will be tolerable which will reduce cooling requirements and further reduce the physical size and weight of SSPAs for a given output power level.

At the amplifier design level, the same parallel device reliability mentioned previously will be implemented. This means that modular construction techniques will be employed that make these amplifiers easier to service in the field. Modular n+1 redundancy techniques will be used to lower the cost of building redundant systems.

Modules will be easily removed from a chassis without having to remove a chassis from a cabinet. In many cases module replacement can be hot-swap meaning that the equipment does not have to be taken off line for service.



Compact Outdoor SSPA. Photo courtesy of Paradise Datacom.

Question: In terms of the Asian market, what is demand like for amplifiers? Is this a key market for Paradise Datacom?
Stephen Turner: Until approximately two and a half years ago, we did not have a clear focus on the Asian market. In 2005, we created a sales office dedicated to this market. The result is an increase in our Asian business of over 400 percent. Our amplifier products are being used extensively throughout the region. We are completing our service centres in India and China and launching two sales offices in the region. We see a great future in Asia for the Paradise brand and anticipate serious growth in the near term.

Question: Congratulations on the opening of your modem manufacturing facility in Duluth, GA. Is this expansion a sign of things to come for Paradise Datacom?
Stephen Turner: This has been quite a success story. After many months of intense effort, we are now producing Evolution modems and redundancy systems at the rates necessary to meet market demand in a reasonable timeframe.

Our Atlanta team has been instrumental in growing our production capacity and establishing the procedures and processes necessary to support volume manufacturing at the levels we need and with solid quality. We have plans in place to expand the facility to support some of our RF product manufacturing. We will also be launching a host of new modem products that will be entering the market in early '08.

Question: What will 2008 hold for Paradise Datacom? In terms of engineering, what will you be hoping to achieve?
Stephen Turner: Paradise Datacom will continue to push the state-of-the-art with many new product entries in 2008. Many new SSPA systems using the previously mentioned features will be introduced. We are already beginning to ship our first SatCom SSPAs using GaN device technology.

SSPA systems in the Ka band will be introduced. In addition to the SSPA product line, our LNA and Frequency Converter product lines will also continue to grow and evolve. We will be tightly integrating fibre optic interface solutions with our SSPA and Converter products. ■