Advantages of Paradise Datacom Product Technologies in Theatre as Compared With Alternative Technologies

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Abstract

On the battlefield, decision makers require situational awareness to effectively command missions with minimal risk. Dependable and flexible communications technologies provide commanding officers with the reliable reach back they desire thereby ensuring a greater probability of mission success. The aim of this paper is to outline the technological advantages of Paradise Datacom's Solid-State Power Amplifiers (SSPAs) and integrated Multiplexer/Router/Satellite Modems (VMUX Modems) in applications where satellite communications dependability and flexibility are of paramount importance.

Paradise Datacom SSPA Reliability, Performance & Flexibility

Paradise Datacom is a world-recognized leader in the development and manufacture of Solid-State Power Amplifiers (SSPAs) that generate the satellite communications industry's highest output power levels utilizing the industry's smallest volumetric package sizes. However, being the leading manufacturer of small lightweight amplifier products is not the sole focus of the engineering staff at Paradise Datacom. To be measured as the satellite communications industry's premier Radio Frequency (RF) product manufacturer, technology advantages must be sought in concert with reliability advantages.

Since Solid-State Power Amplifiers are intrinsically transistor-based amplification products, users benefit from a non-gaseous and non-disposable base amplification technology. Beyond the widely known reality that solid-state Gallium Arsenide (GaAs) Field Effect Transistor (FET) based amplifiers have a useful lifetime that is at least three times that of an equivalent tube based amplifier, SSPAs also benefit from being a more robust technology when it is considered that SSPA RF modules – the equivalent components of the actual Traveling Wave Tubes in Traveling Wave Tube Amplifiers or TWTAs – are factory repairable. In the event of an RF amplifier module failure, the user need not dispose of the RF module for an equivalent replacement but rather repair the basic solid-state RF module at a much lower repair cost than the replacement of its throw-away alternative.

In addition to basic reliability advantages, Solid-State Power Amplifiers are inherently more ruggedized than TWTAs for adverse transport and communications conditions. While being traversed over arduous terrain, SSPAs can withstand shocks and vibrations better than their TWTA counterparts. SSPAs exceed typical Traveling Wave Tube Amplifier shock and vibration capabilities by a factor of five. SSPAs also provide power instantly at the flip of a switch while Traveling Wave Tube Amplifiers must first undergo a warm up process that can take between three and thirty minutes to complete prior to providing actual RF power to the waveguide flange. It is recommended that the TWTA warm up process be completed by an experienced TWTA technician to prevent self-inflicted damage to the equipment. Solid-State Power Amplifier products do not require a technician of advanced skill to prevent accidental damage to the

amplifier at power-up. Finally, when discussing amplifier product reliability Solid-State Power Amplifiers benefit from wider operating temperature ranges than TWTA products allowing worry-free operation in the harshest climatic environments. Paradise Datacom's outdoor packaged SSPA products utilize enclosures that completely separate all electronics from the cooling section of the amplifier making water and debris intrusion an unlikely event.

It is often suggested that TWTA products are more functional than SSPA products in single carrier environments in terms of providing raw power per dollar cost. While it is true that TWTAs can provide more raw, non-linear or saturated power per dollar cost in single carrier environments, it should be clearly considered that SSPAs provide more usable power per dollar cost in those same single carrier environments. Illustration 1. shows a 4Mbps, QPSK modulated signal being transmitted at a 400-watt SSPAs 1dB compression point. At 5dB per division, one can see that the sidelobe suppression performance of the Solid-State Power Amplifier (23dBc) is almost enough at P1dB compression to meet most satellite operator performance requirements (25dBc). Illustration 2. shows the same single signal 1dB attenuated from the amplifiers P1dB compression point. At this level of backoff from P1dB (1dB), the SSPA more than meets the sidelobe suppression requirements of most satellite operators.

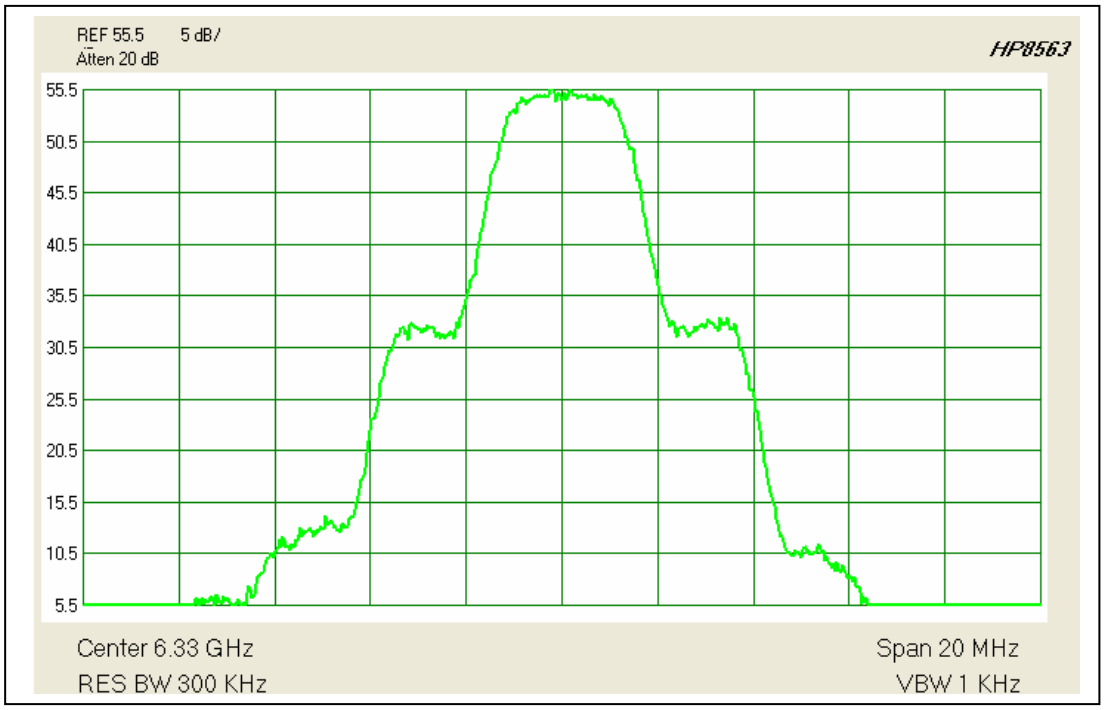


Illustration 1: A 4Mbps QPSK modulated signal being transmitted at the 1dB gain compression point of a 400-watt SSPA.

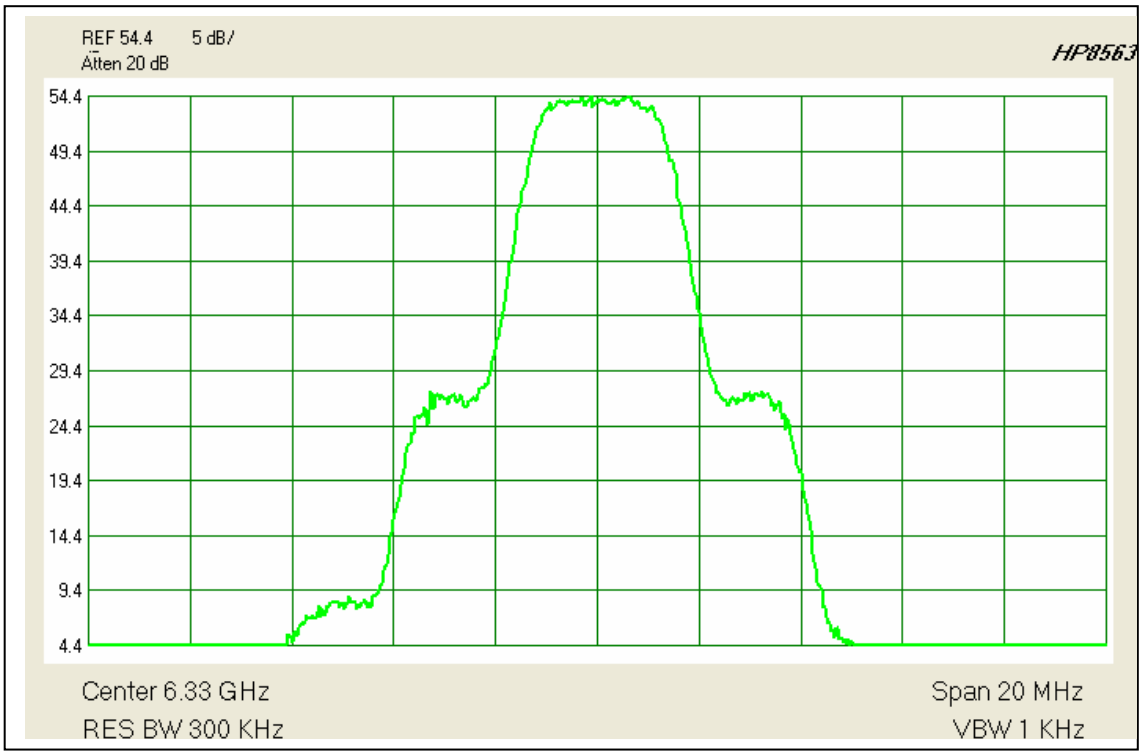


Illustration 2: The same 4Mbps QPSK modulated signal being transmitted at 1.0dB backed off from the P1dB compression point of a 400-watt SSPA.

Typically, SSPAs need only be backed of 0.5dB from P1dB compression for single carrier applications using QPSK modulation techniques. Higher order forms of modulation require greater levels of backoff, however these backoff requirements are significantly less for SSPAs than for TWTAs. Illustration 3. shows a comparison between a TWTA that provides 80-watts of power at the flange and an SSPA that provides 50-watts of power at P1dB compression each transmitting a QPSK modulated signal in a single carrier environment. This chart shows that the SSPA can operate very near its P1dB compression point (within 0.5dB) while the TWTA must be backed of by 5dB to meet the sidelobe suppression requirements of most satellite operators. This means that the SSPA would have a useable output power level of close to 50-watts while the TWTA would have a useful output power level of 27-watts (roughly half the output of the SSPA). Add to this, the Voltage Standing Wave Ratio (VSWR) performance advantages of SSPAs that allow them to provide better power transfer characteristics from amplifier to antenna due to less impedance mismatch and the user gains another 0.5dB of useable power from an SSPA. Thus in single carrier environments, SSPAs can typically replace TWTAs of twice the SSPAs rated power. In multi-carrier environments, naturally more linear SSPAs can typically replace TWTAs of three or more times the SSPAs rated power depending upon the number of carriers being transmitted.

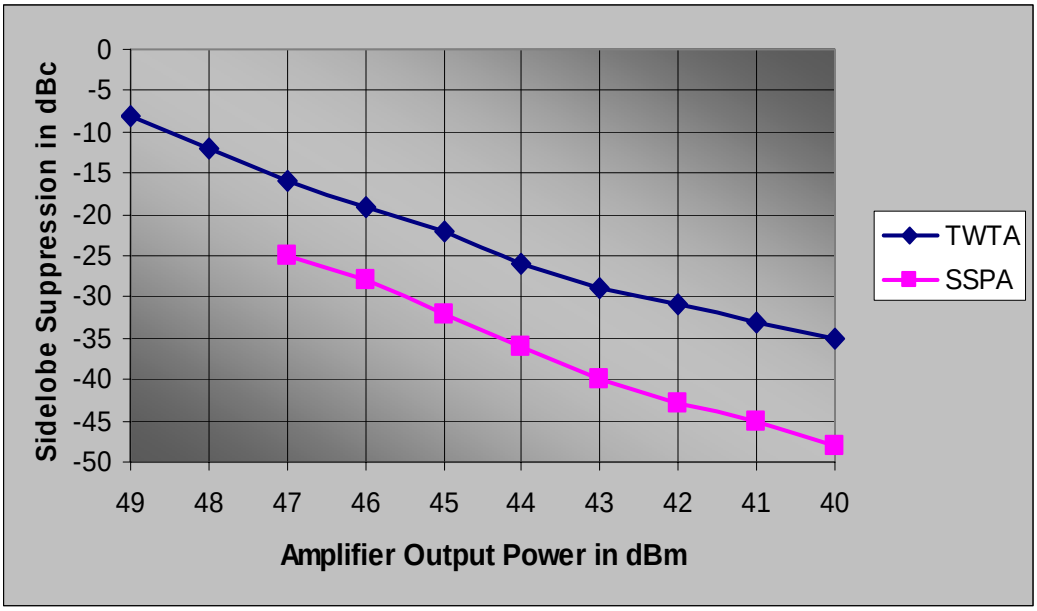


Illustration 3: A single carrier QPSK modulated signal comparison of usable power vs. raw power.

When it comes to flexibility from an amplifier product, Paradise Datacom delivers a variety of solutions. In the same indoor or outdoor amplifier enclosure, a systems integrator or user can select from creating a satellite telecommunications system using SSPA or Solid-State Power Block Upconverter (SSPB) technologies – an SSPA with an L-Band input frequency or fiber-optic input as opposed to a RF input frequency thereby eliminating one stage of frequency conversion and increasing overall satellite system reliability. If L-Band Input SSPBs are preferred, the integrator or user can then choose from in internal 10MHz reference or an external 10MHz reference. In the near future, Paradise Datacom amplifiers will be capable of an auto-detect reference designed in such a way that if a reference signal (any reference frequency from 5MHz to 100MHz in 5MHz steps, but typically 10MHz or 50MHz) is applied to the amplifier it is utilized, but in the absence of an external reference signal the amplifier will produce it's own extremely stable internal 10MHz reference providing the user with some soft fail functionality.

Once the amplification power level and conversion selections (if any) are made, the user can choose from a multitude of monitor and control (M&C) interfaces including the usual compliment of serial buses being the typical RS-232 and RS-485 interfaces. New and unique to Paradise Datacom's line of amplifier products are Ethernet, Bluetooth wireless and Frequency Shift Key (FSK) M&C connectivity, a treble of monitor and control interfaces that are unmatched by any other amplifier manufacturer. Offered as optional interfaces today, in the near future Ethernet, Bluetooth wireless and FSK will be provided as standard connectivity options. Illustration 4. shows an example of the flexibility of Paradise Datacom amplifier products in meeting a variety of system level applications. As new system requirements evolve, Paradise Datacom will continue to offer solutions to these challenges.

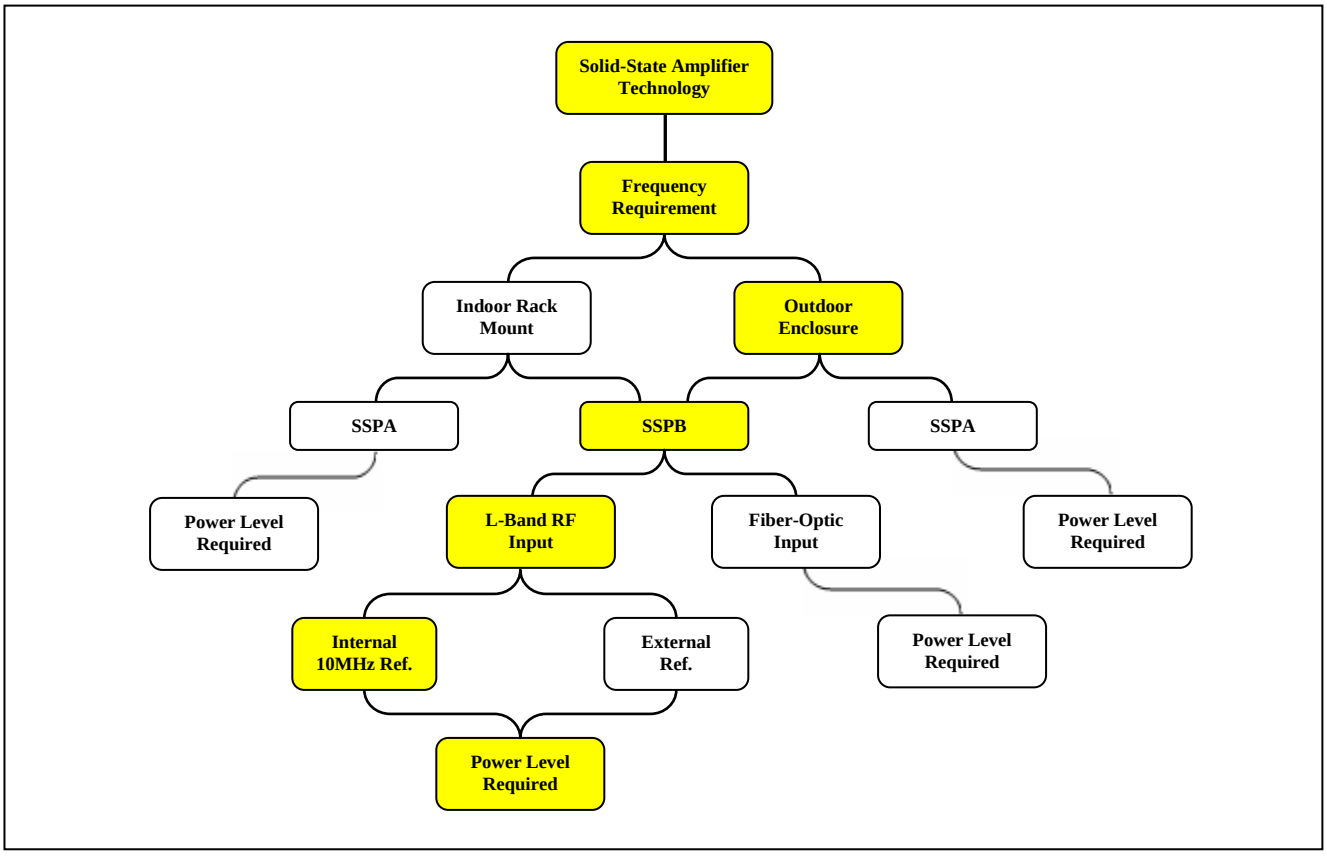


Illustration 4: Example of Paradise Datacom Solid-State Amplifier product line flexibility.

Paradise Datacom VMUX Modem Reliability, Performance & Flexibility

Paradise Datacom offers a wide array of Single Channel Per Carrier (SCPC) satellite modem products including standard and time proven 70/140MHz modems, reliable L-Band modems, hybrid 70MHz transmit/L-Band receive modems, accelerated IP modems and the latest entrant the Versatile Multiplexer (VMUX) Modem. All modems offer the typical compliment of Modulation, Forward Error Correction (FEC) and Baseband Interface options that satellite users are familiar with including BSPK, QPSK, OQPSK & 8PSK modulation orders, Viterbi, Sequential (with or without Reed-Solomon) and Turbo FEC techniques, and RS-232/485, X.21, V.35, G.703 (balanced or unbalanced) and 10/100 Base T Ethernet data interface options.

The newest VMUX modem combines all of the terrestrial interfaces with the exception of G.703 into a single neat chassis (see Picture 1.) that provides the maximum functionality possible from a satellite modem available on the market today. Having partnered with the world's premier versatile multiplexer company Vocality International, Paradise Datacom offers a unique solution to remote Very Small Aperture Terminal (VSAT) requirements.

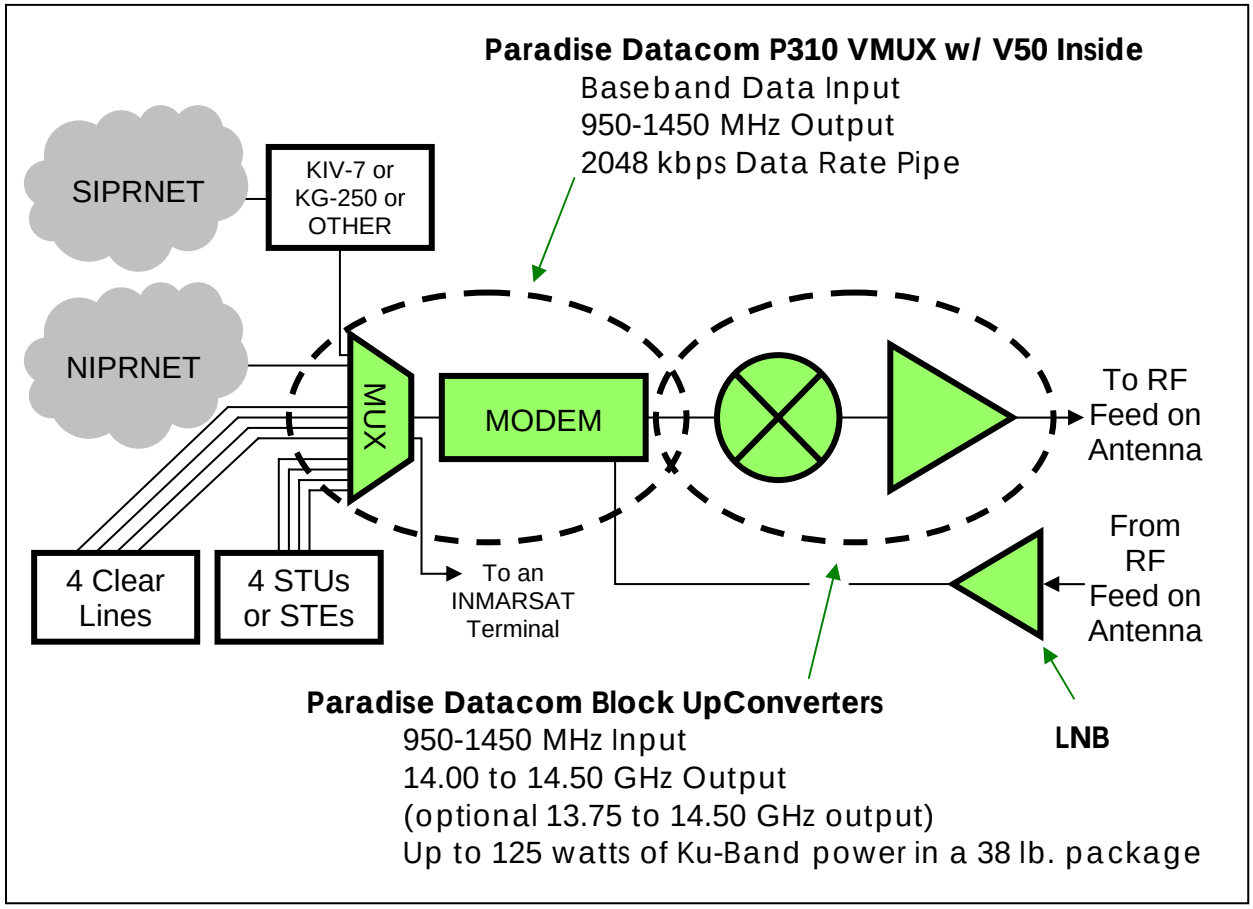
Picture 1.: Rear panel view of the P310VMUX modem product offered by Paradise Datacom.

Using the same technology that is embedded in Vocality's V50 multiplexer, Paradise Datacom's latest modem provides up to eight analog voice ports, four of which can be configured for Secure Telephone Unit (STU) or Secure Terminal Equipment (STE) use. In addition to its voice ports, this newest modem product also offers accelerated IP connectivity and static routing via its Ethernet port as well as a serial port for bulk data transfer. What makes this product special is its dynamic bandwidth allocation capability. A user can for example configure the VMUX modem to maximize the available data bandwidth (up to 2048kbps) for IP connectivity, and in the event of a phone call a portion of the data (typically less than 9.6kbps) is removed from the IP pipeline and temporarily handed off to the voice circuit. This is known as Voice and Internet Protocol (V&IP) as opposed to the alternate Voice Over Internet Protocol (VOIP). V&IP removes the security concerns associated with VOIP traffic, as it completely separates voice traffic from all other IP data and routes it to its destination independently. When the call is completed, the voice circuit bandwidth is dynamically handed back for IP connectivity usage.

A worst case scenario would be the use of 8 Adaptive Differential Pulse Code Modulation (ADPCM) voice circuits configured to utilize 32kbps of bandwidth each. The cumulative voice bandwidth when all lines are in use would be 256kbps, leaving more than a T1 data rate capacity for IP connectivity – more than enough data capability for most small posts, companies or troop squadrons.

From an RF transport perspective, these versatile multiplexer modems can be fitted with 70MHz, L-Band or hybrid 70MHz transmit and L-Band receive RF interfaces. Recently, users have been trending toward L-Band Inter-Facility Links (IFLs) for use with SSPBs in order to save costs and reduce overall component count thereby increasing reliability. The VMUX modem product, based upon Vocality International's technologies and testing, provides the best solution to secure calls over double satellite transmission hops. It has been calculated and reported that more than 80 percent of secure voice calls over double satellite transmission hops have been successfully connected on the first attempt as opposed to less than 20 percent of calls using alternative technologies.

Illustration 5. shows a sample VSAT node using a variety of products manufactured by Paradise Datacom. In that example, an L-Band VMUX modem is being used with a reliable high power SSPB and a Phase Locked Loop (PLL) LNB. This is a common terminal package for 2Mbps IP and eight voice circuit applications.



Ilustration 5: Example of a SCPC VSAT node using a family of Paradise Datacom product technologies.

Summary

Paradise Datacom offers a wide variety of satellite telecommunications products that are dependable and flexible. These products benefit from being on the right side of the technology treadmill and are further nourished by the staff of Paradise Datacom ensure the greatest reliability, performance, and flexibility advantages for their customers both today and into the future.

Paradise Datacom is a leading manufacturer of S, C, X, Ku and Ka-Band Solid-State Power Amplifiers, Solid-State Power Block-Upconverters, Transceivers, Satellite Modems, Low Noise Amplifiers and a variety of system related products including 1:1 and 1:2 redundancy systems, Phase Combined Amplifier Systems, 1:8 Redundant Satellite Modem Systems as well as other custom systems. Contact the factory for more information or a quotation at +1.814.466.6275 or e-mail sales@paradisedata.com.

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