

The Xicom SSPA—A Cool Alternative

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Evolving next generation satellite communication systems increasingly utilize digital transmission that require linearity over a wide dynamic range, simply put “higher data rates require higher power.” Xicom Technology has coined this phrase to capture essential system performance parameters for transmitter power levels that can only be met by high power amplifiers. Traditionally, the highest power levels have been synonymous with Traveling Wave Tube amplifiers (TWTAs) and Klystron Power Amplifiers (KPAs), but with today’s technological advancements, Solid State Power Amplifiers (SSPAs) are providing system engineers a new platform to complement their system designs. As part of its expanded

product offering, Xicom Technology has introduced a highly compact, 50W antenna-mount SSPA for use in Ku-Band satellite communications systems. Linearity of this basic building block SSPA is better than a comparable TWTA with 125W output power. Utilizing an advanced cooling system, the amplifier has a small physical footprint allowing application of the Xicom SSPA to both new and upgrade systems. By incorporating Xicom’s proven monitor and control interface, the SSPA easily configures into a redundantly combined subsystem to achieve 100W of output power.

Modular Design for Ease of Use

The Xicom SSPA incorporates several innovative design features that enhance system performance and provide cost effective maintenance. Among these features is an innovative wide-band power combining technique, capable of operation from 12.75 to 14.5 GHz, offering a combining loss of around 0.4db, as illustrated in **Figure 1**. The comparison with conventional multiport combiners shows that the Xicom architecture has both lower loss and far greater bandwidth. The modular architecture, both in the RF subsystem and the removable power supply, allows

easy component upgrading and maintenance. The block diagram for the outdoor unit is shown in **Figure 2**. The unit contains a Monitor & Control (M&C) system that is fully compatible with Xicom proven control protocol and is enhanced by an

embedded microcontroller that supports full system monitoring, built-in redundant switching and scalability functions. Also, integrated into the Xicom SSPA is a thermal management system that provides optimum cooling of the power supplies and

Frequency:	13.75 - 14.5 GHz (extended Ku-band)
Saturated Power:	47 dbm
Rated Power (P1 db):	46 dbm
Intermodulation Products:	-26 dbc (Two-tone IMD 3 db back off from rated power)
Size:	8.66 x 9.2 x 16.25 inches
Power Supply:	90-260 VAC, 47-63 Hz, Single Phase

Table 1: Xicom SSPA Performance Parameters

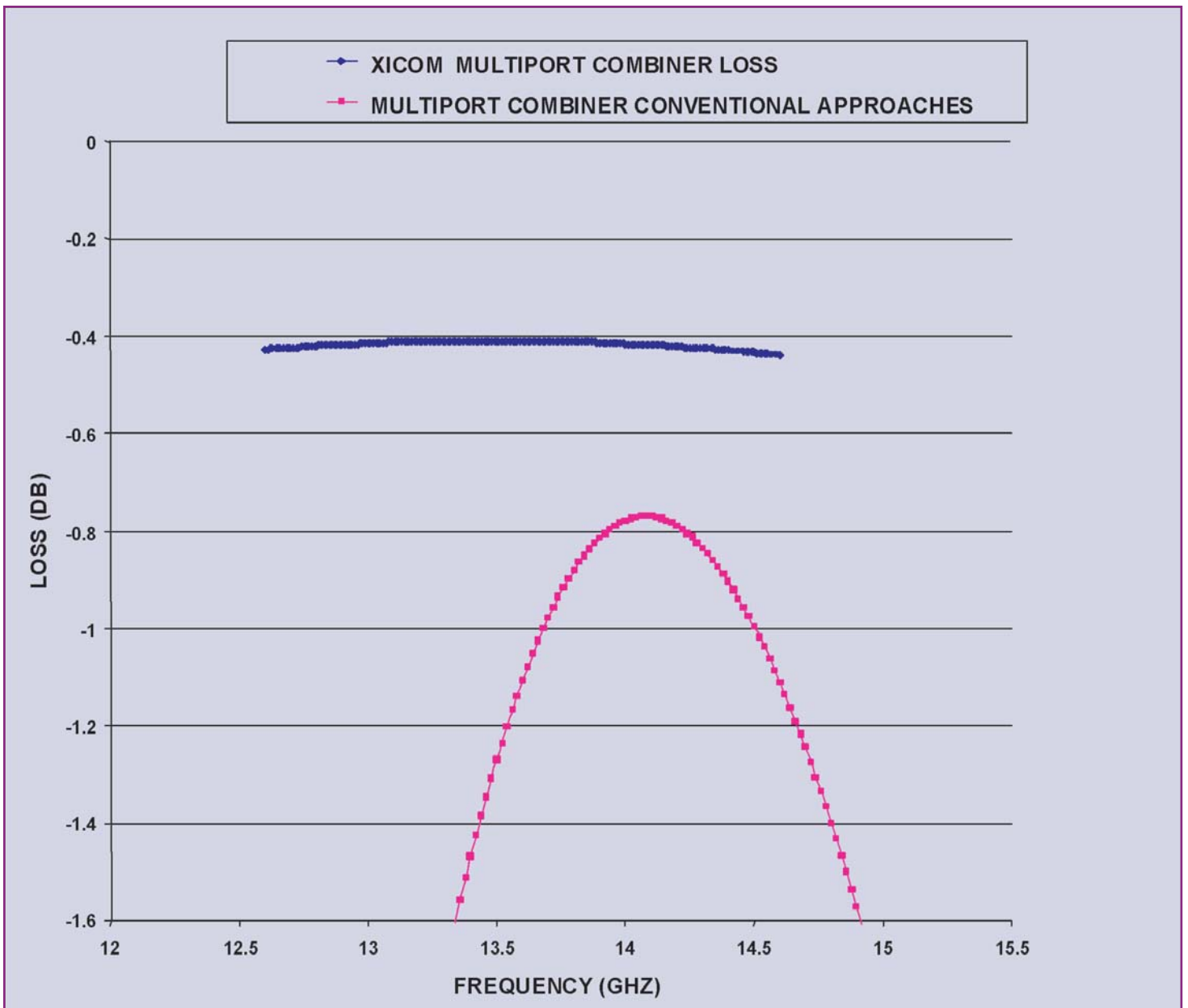


Figure 1: The Xicom Power Combining Technique

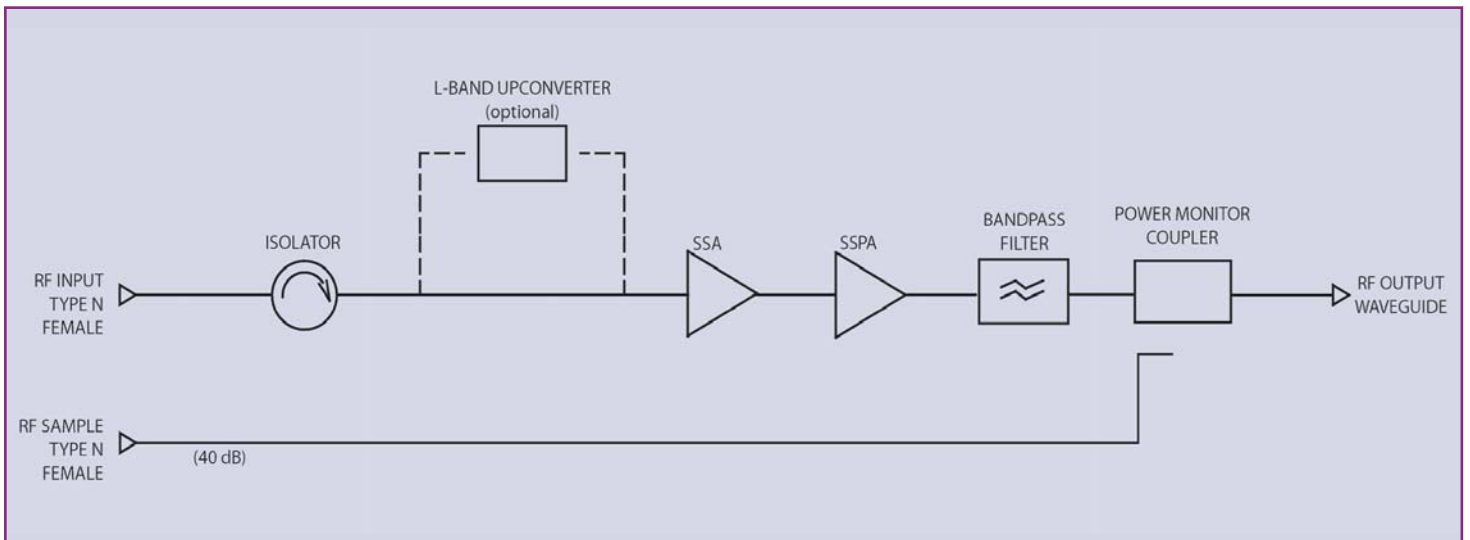


Figure 2: Block Diagram for the Xicom Antenna-Mount SSPA

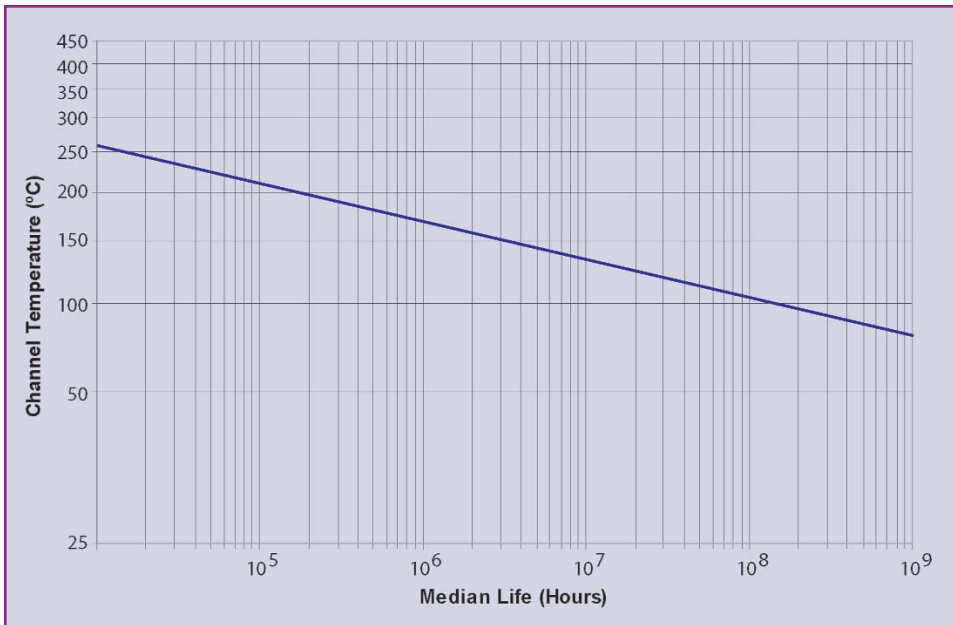


Figure 3: Typical Behavior of Solid State Device Reliability with Channel Temperature

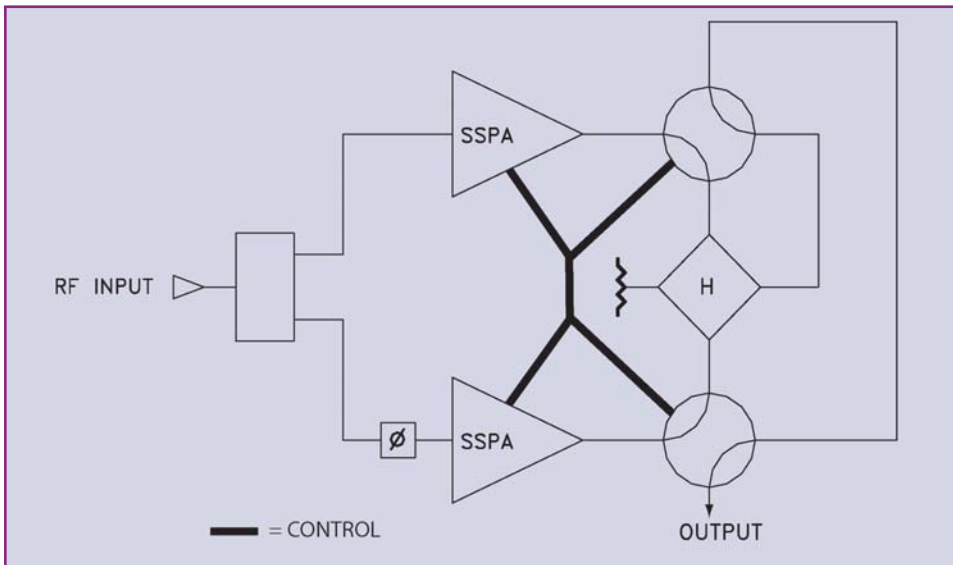


Figure 4: Xicom 1+1 Combined System

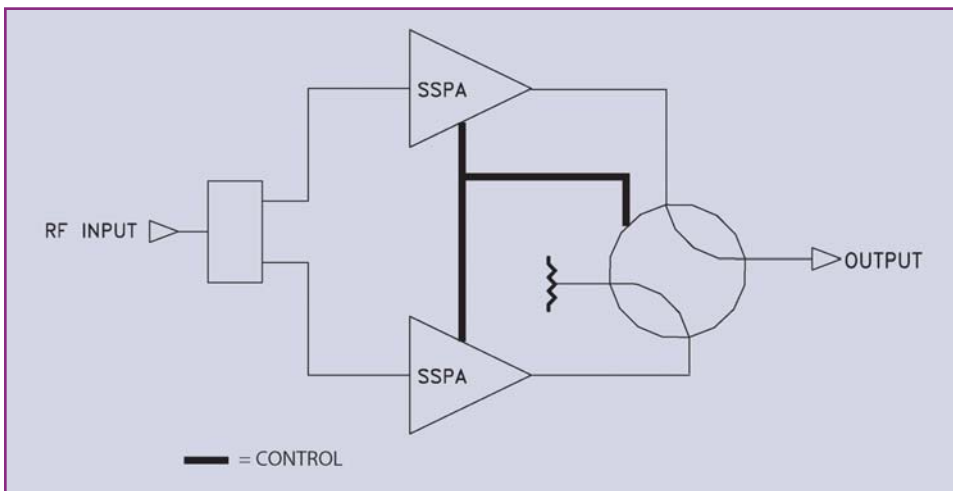


Figure 5: Xicom 1:1 Redundant System

critical system RF components, maximizing long term amplifier reliability.

The Importance of Thermal Management

It is well known that solid state systems offer outstanding long-term reliability with proper control of channel temperature (T_c). The channel temperature must generally be held below 150 degrees Centigrade. As a rule of thumb, a 10-degree reduction in channel temperature increases the device Mean-Time-To-Failure (MTTF) by a factor of 2. An Arrhenius plot, shown in **Figure 3**, illustrates typical device MTTF behavior with increasing channel temperature. Consequently, achieving the inherent benefits of microwave solid state technology requires addressing thermal management, because temperature rise is a critical design parameter, in much the same way that it is in modern advanced high-speed microprocessors. Xicom has implemented a novel cooling system to further extend solid state reliability advantages, both in the power supply and RF subsystems. These features, coupled with the SSPA's modular design, result in longer operating life, and reduced maintenance and spares costs.

Performance Parameters and Applications

A summary of the performance parameters and schematic diagram for the building block SSPA are shown in **Table 1**. An internal waveguide system provides receive band noise rejection, harmonic filtering, and also forward/reverse power monitoring that is a standard interface to the M & C system.

Examples of system application for 1+1 and 1:1 redundant operation are described in **Figures 4 and 5** respectively. Redundant configurations provide higher output power and further improvement in system availability. In the 1+1 arrangement, the amplifiers can either be phased combined to produce 100W output or be separately switched to provide system back up.

Switching control is fully integrated into the M&C unit. The combining scheme is tolerant of amplitude and

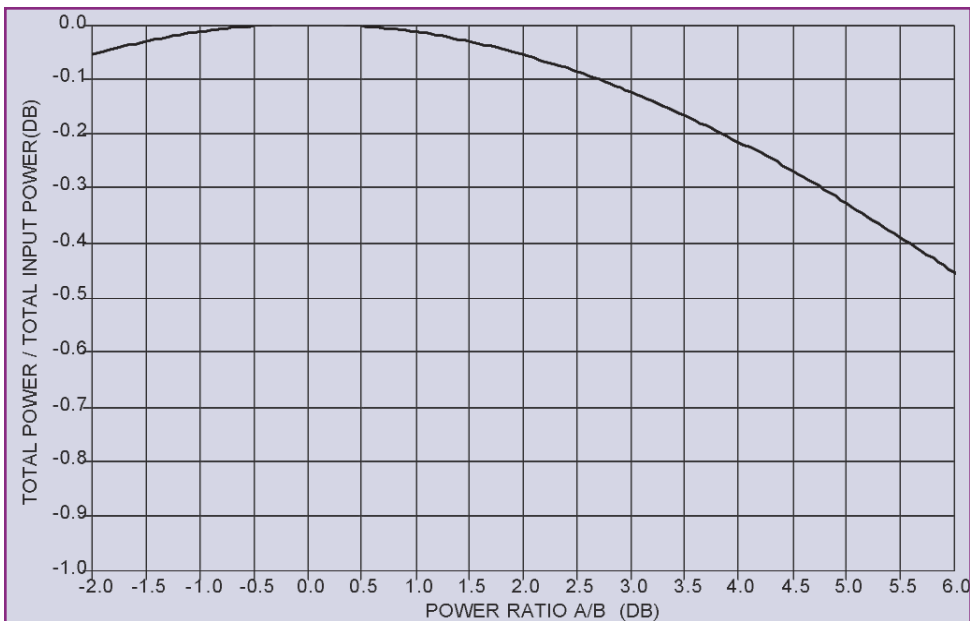


Figure 6: Model for 1+1 combining, demonstrating the effect of amplitude mismatch between the two amplifiers.

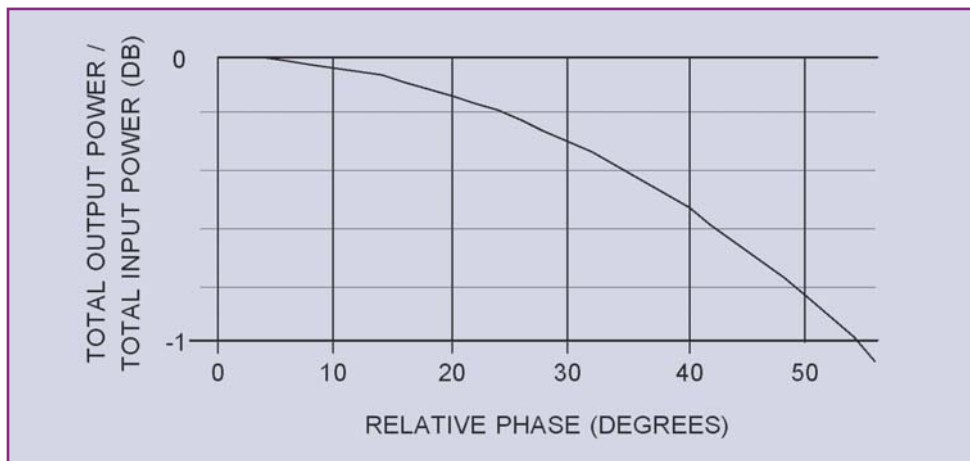


Figure 7: Model for 1+1 combining, demonstrating the effect of phase mismatch between the two amplifiers

phase mismatch between amplifiers and follows the models shown in **Figures 6 and 7.**

Optional Features

The Xicom SSPA also includes the option of an integrated upconverter that accepts 950MHz to 1700MHz L-Band input and meets IESS 309 (Rev 2) specifications. This block upconverter allows direct interface to most advanced modems. The SSPA also has a provision for adding internal linearizers, in applications requiring further IMD improvement. For simpler maintenance & monitoring an infrared remote access to the outdoor unit that is IrDA compatible is also part of the M&C system

Summary

The Xicom SSPA is highly suitable for mobile and fixed service transmitter applications requiring a robust, cost effective solution. Built-in redundancy and power combining control enables a 50W SSPA to be easily combined with a similar unit to achieve 100W of output power. Endowed with Xicom's traditional compact footprint, the Xicom SSPA is small in size and agile by design. A removable power supply allows easy maintenance. The Xicom SSPA architecture offers both system enhancements and improved reliability.

**THERMAL MANAGEMENT +
SOLID STATE RELIABILITY =
SYSTEM RELIABILITY**



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