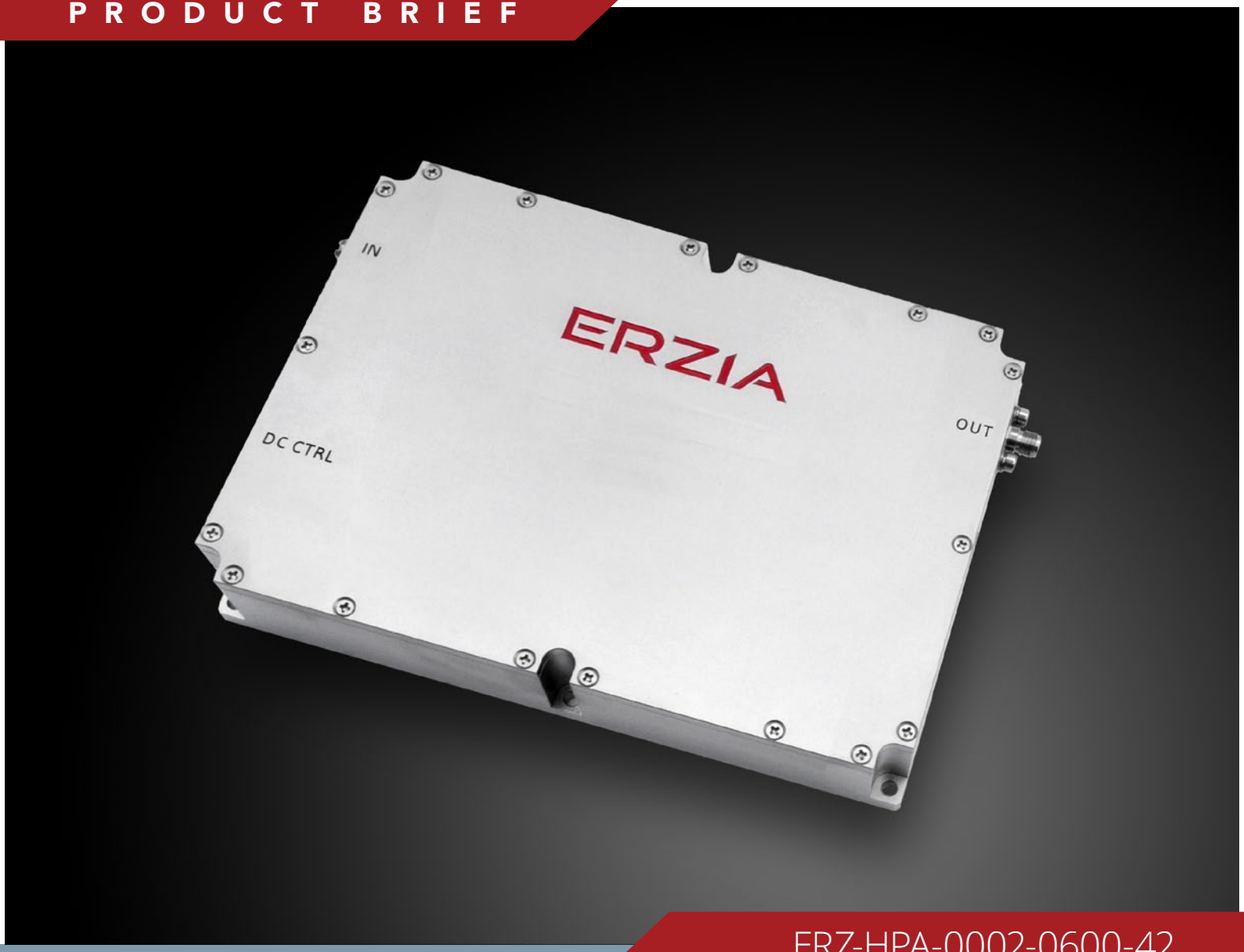
PRODUCT BRIEF



ERZ-HPA-0002-0600-42

Wideband 20W High Power Amplifier

ERZIA

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Introduction

In modern RF and microwave applications, the demand for wideband high-power amplification continues to grow. Systems operating across multiple frequency bands require amplifiers capable of delivering consistent performance over a broad spectrum. The ERZ-HPA-0002-0600-42 meets this demand by covering 20 MHz to 6 GHz, providing seamless operation across L, S, and C Bands. Designed for Electronic Warfare (EW) and aerospace applications, this high-power amplifier is a key enabler for radar, jamming, and secure communication systems.

In EW, high-power amplifiers play a crucial role in both offensive and defensive operations. Jamming systems rely on wideband amplification to disrupt enemy radar and communication links, while electronic support measures (ESM) require sensitive amplification for signal detection and threat analysis. Additionally, modern radar systems depend on high-power amplification to achieve long-range target detection and tracking, supporting critical aerospace and defense missions. The ability to operate across such a wide frequency range ensures adaptability against evolving threats and multi-band operational requirements.

Given the specialized nature of this amplifier, a full characterization was undertaken to validate its performance across the entire operating range. Comprehensive testing ensures that critical parameters, including gain, output power, efficiency, and linearity, meet the stringent requirements of demanding EW and aerospace applications. This detailed analysis provides valuable insight into the amplifier's capabilities, demonstrating its suitability for high-performance RF systems.

By presenting this characterization, we offer a thorough understanding of the amplifier's strengths and operational parameters, allowing engineers and system designers to make informed decisions. The results underscore the amplifier's reliability, efficiency, and suitability for next-generation EW and aerospace platforms.

GENERAL FEATURES

The ERZ-HPA-0002-0600-42 is a compact and efficient high-power amplifier designed for broadband applications across the 20 MHz to 6 GHz range. It delivers a saturated output power (Psat) of 42 dBm, with a gain of 38 dB and a gain flatness of ±4 dB, ensuring consistent performance over its entire frequency span. The amplifier features a 1.5:1 input VSWR and a 2.0:1 output VSWR, optimizing impedance matching for seamless system integration. Operating with a 24V DC supply, it maintains a power consumption of 90W, balancing power efficiency with high RF output.

The following table provides a detailed summary of the key electrical and operational characteristics of the ERZ-HPA-0002-0600-42.

Parameter	Typical Value
Psat	42 dBm
Gain	38 dB
Gain Flatness	±4 db
VSWR In	1.5:1
VSWR Out	2.0:1
DC Voltage	24 V
Power Consumption	90 W

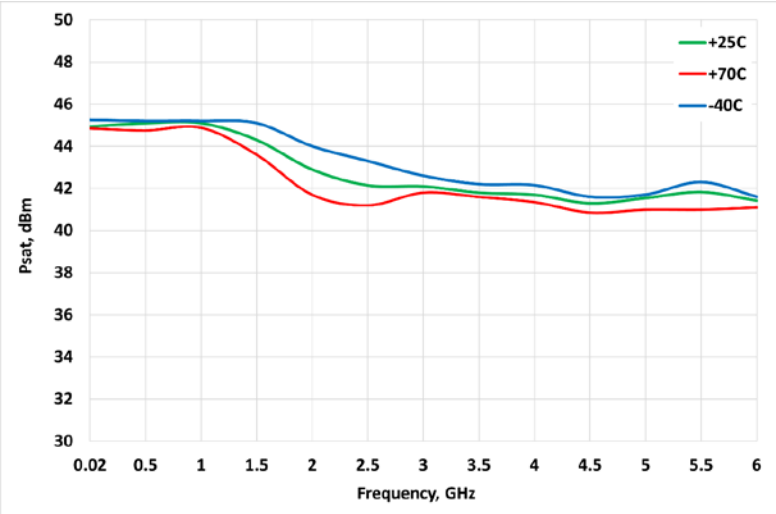
The ERZ-HPA-0002-0600-42 features SMA female connectors for both RF input and output, ensuring reliable and low-loss connections. For DC power and control, it is equipped with a D-Sub 9 connector, which includes an enable function, as well as temperature and current sensing capabilities for system monitoring and protection.

Designed for harsh environments, this amplifier meets MIL-STD-810F standards for temperature extremes, vibration, shock, and acceleration. It operates reliably from -40 to +70 °C and withstands demanding mechanical conditions, making it suitable for aerospace, defense, and field-deployed EW systems.

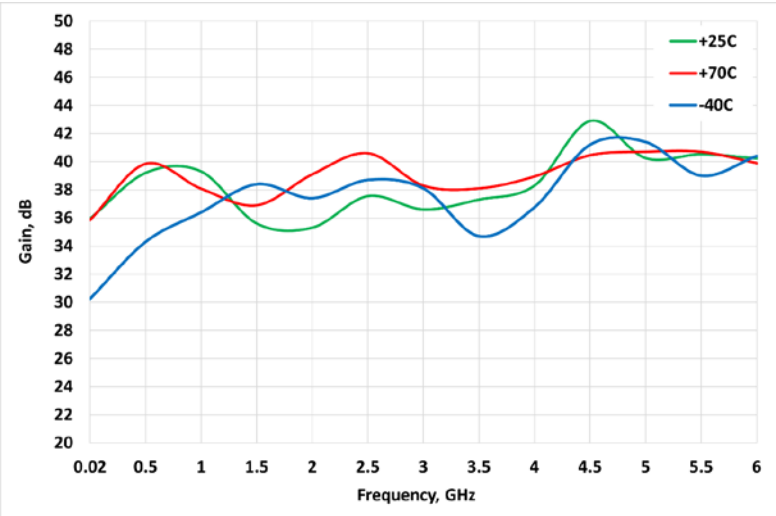
MEASUREMENTS

The following measurements were conducted in our ISO 7-certified clean room, ensuring a controlled environment free from contaminants. This facility allows for high-precision testing, guaranteeing accurate and repeatable performance validation of the SSPA (Solid-State Power Amplifier). All the measurements were performed at -40°C, +25°C and +70°C. Measurements were performed at -40°C, +25°C, and +70°C to fully characterize the ERZ-HPA-0002-0600-42 and evaluate its performance across different environmental conditions.

PSAT AND GAIN



The SSPA delivers up to 45 dBm of saturated output power (Psat) for frequencies up to 1 GHz, after which it stabilizes at 42 dBm across the remaining operating range. The most significant temperature influence occurs between 1.5 and 2.5 GHz, where lower temperatures positively impact Psat, resulting in improved output power performance.

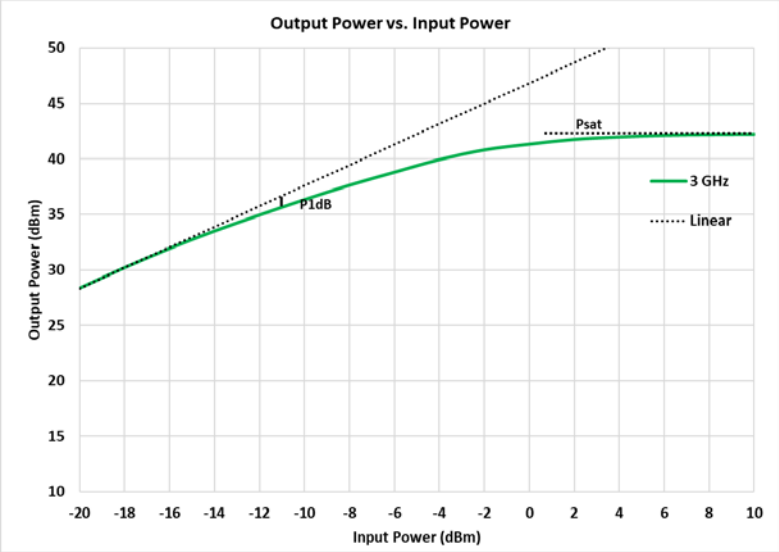


Gain is more influenced by temperature and exhibits less linearity, which is expected in wideband solutions. At 25°C, it presents a typical gain of 38 dB, with variations observed across the frequency range due to temperature effects.

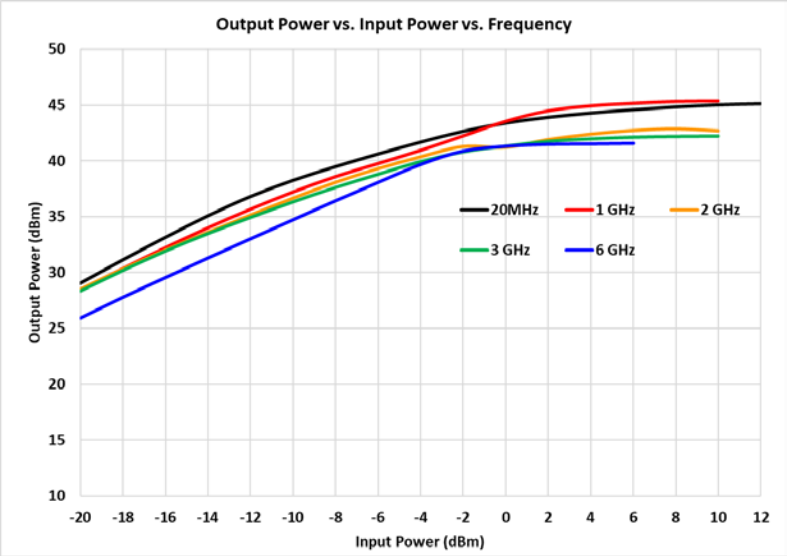
LINEARITY

The output power, linearity, and efficiency of a power amplifier are critical variables in system design, particularly when GaN technology is employed. These factors directly influence the performance and reliability of the final system, making their accurate characterization essential. GaN-based amplifiers offer significant advantages in power density and efficiency, but their nonlinear behavior at high power levels must be carefully understood to ensure optimal system performance.

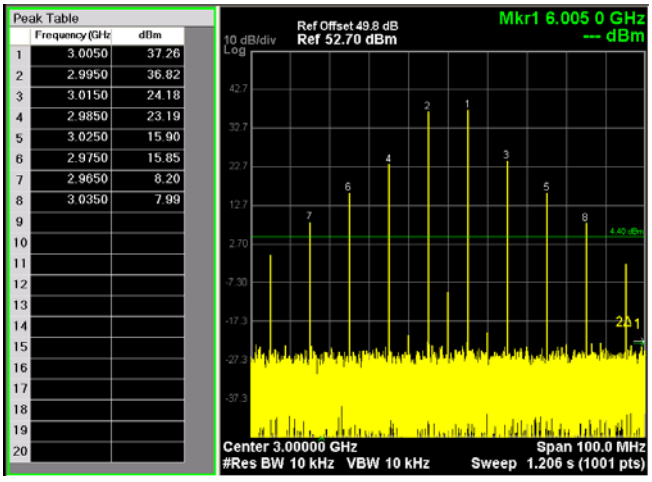
As presented in the ERZIA tech brief "Comparing Linearity Measurements in a GaN Ka-Band Satcom Power Amplifier," linearity can be analyzed in multiple ways, with each method providing crucial information for system design. In this Tech Brief, we aim to present similar linearity measurements for the ERZ-HPA-0002-0600-42. The focus will be on key performance indicators such as P1dB (1 dB compression point), IMD3 (Third-Order Intermodulation Distortion), and ACPR (Adjacent Channel Power Ratio), which will provide insights into the amplifier's linearity and its impact on signal quality across its operational frequency range.



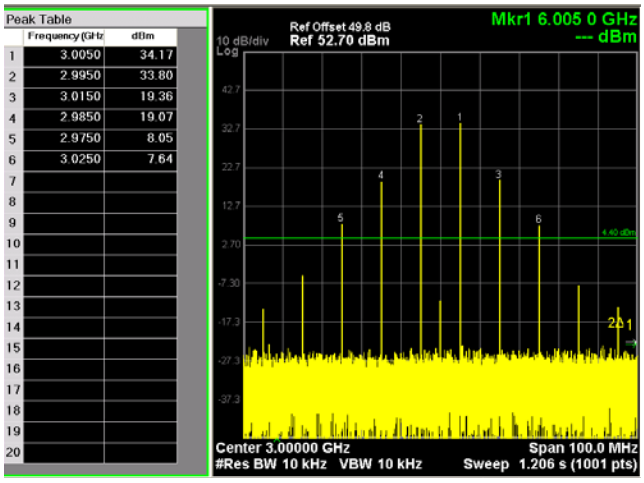
The ERZ-HPA-0002-0600-42 delivers a Psat of 42 dBm with a P1dB of 35.6 dBm at 3 GHz. The significant difference between P1dB and Psat is typical of GaN amplifiers, indicating nonlinearity at high power levels. In comparison, GaAs amplifiers generally show a much smaller difference, usually under 1 dB. While these values reflect the amplifier's maximum power output, they are not sufficient to fully assess linearity, as they only consider signal amplitude and do not account for phase variations and overall distortion.



The same measurement was replicated across different frequency bands, with the following P1dB values: 40.1 dBm at 20 MHz, 39.2 dBm at 1 GHz, 35.9 dBm at 2 GHz, and 38.9 dBm at 6 GHz. These values further illustrate the variation in linearity across the frequency range, emphasizing the need for careful characterization at each specific frequency band. However, as mentioned before, P1dB is a limited way to understand distortion. The following figures illustrate the IMD3 values, providing further insight.



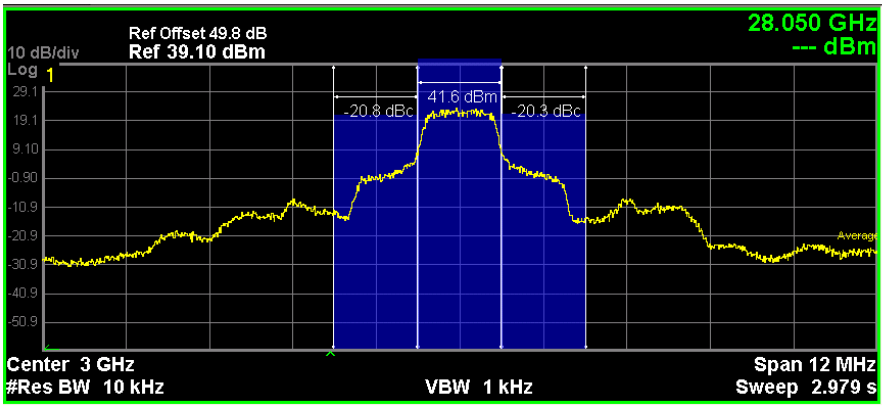
IMD3 at 3GHz, 40dBm



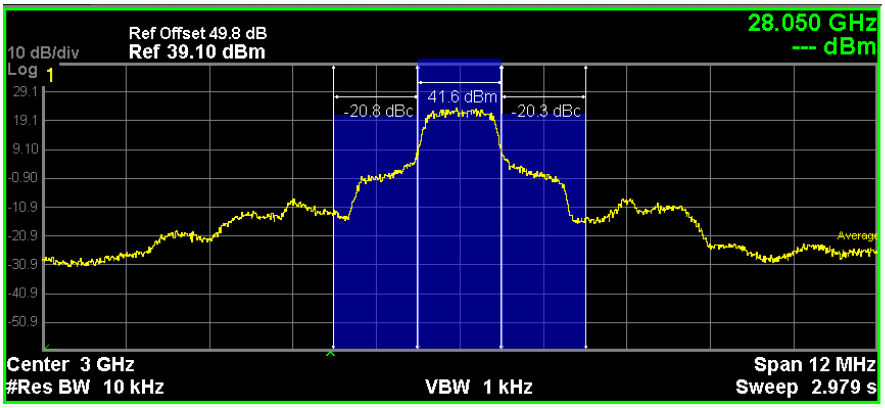
IMD3 at 3GHz, 37dBm

A two-tone test was conducted at a 3 GHz center frequency with output power levels of 40 dBm to evaluate the IMD3. The results showed an IMD3 of 13.6 dBc on the right side and 13.1 dBc on the left side, providing insight into the amplifier's third-order intermodulation distortion.

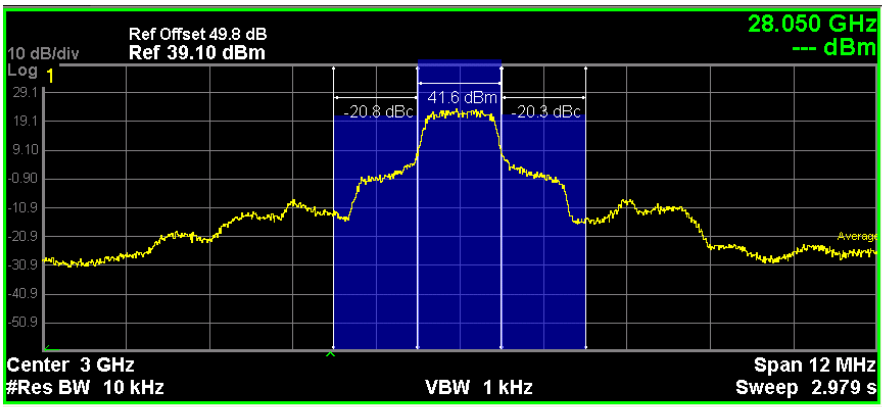
The same two-tone test was performed at 37 dBm output power, yielding an IMD3 of approximately 15 dBc, compared to the 13.4 dBc distortion measured at 40 dBm output power. Beyond IMD3, another approach to analyzing distortion is ACPR, which employs a real modulation scheme signal, providing a more reliable model of expected performance in real operations.



ACPR at 3GHz, PSat



ACPR at 3GHz, 40 dBm



ACPR at 3GHz, 37 dBm

The previous figures show the ACPR at 3GHz for different output powers, PSat, 40 dBm and 37 dBm.

With a BPSK signal, a good response of 29.7 dBc is observed at the boarder of linear region (36.4 dBm output) while a deterioration down to 28,4 dBc measured for 39.6 dBm output. As expected, the worst case scenario happen at the Psat (41.6 dBm) with near 20 dBc.

Pout (dBm)	IMD3 (dBc)	ACPR (dBc)
40	13,4	28,4
37	19	29,7

When compared to P1dB, it can be observed that IMD3 is a valuable indicator of the distortion generated by non-linearities. However, it may still offer overly pessimistic indications when evaluating higher output powers, which is the area of greatest interest. This is demonstrated by the significant differences observed between IMD3 and ACPR in the saturation zone.

Conclusion

In conclusion, this tech brief has detailed ERZIA's wideband amplifier family specifically designed for EW and aerospace applications. These amplifiers capitalize on the potential of GaN devices, focusing on their inherent benefits and integrating them into a coherent and effective product lineup.

The foremost advantage of these amplifiers is their high power density, derived from the inherent properties of GaN. This enables them to provide significant power outputs while maintaining compact sizes, ensuring efficient use of space in system design. In terms of linearity, it can be observed that relying solely on P1dB and IMD3 does not provide a complete and reliable assessment. For instance, if a system sets a 25 dBc threshold, the IMD3 at 40 dBm Pout would not recommend this SSPA. However, when considering real transmission scenarios with BPSK modulation, measurements confirm that the amplifier can be used with a considerable margin.

These amplifiers also uphold ERZIA's commitment to efficiency, leveraging GaN's natural advantages to deliver high power while minimizing energy waste. Furthermore, their compact design ensures an excellent power-to-size ratio, making them ideal for applications where space is limited. Being ITAR-free, they simplify international operations by eliminating regulatory hurdles, broadening their global applicability.

Above all, ERZIA's wideband amplifiers maintain the robustness and reliability that define ERZIA products, ensuring consistent performance even in demanding environments.

NEXT STEPS

ERZIA designs and manufactures advanced Integrated Microwave Assemblies (IMA) and specifically up/down converters for applications like Radar, EW and Satellite communications. Our equipment is focused on high performance and high reliability.

For more information about the ERZ-HPA-0002-0600-42:
erzia.com/products/hpa/867

We are ready to talk about your next project, please contact us at sales@erzia.com.