Low noise 80VDC power supply for MEMS RF switch

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1 Introduction

The ADGM1004 MEMS RF switch is a highly versatile component widely used in precision RF applications. However, the integrated 80V DC power supply, which powers the MEMS actuation mechanism, poses a significant challenge to achieving harmonics-free RF performance. This power supply utilizes an internal Switched Mode Power Supply (SMPS) based on a 10 MHz oscillator to generate the required voltage. Unfortunately, the 10 MHz oscillator introduces harmonic noise into the RF signal chain, degrading the overall system performance.

The harmonic feedthrough from the internal oscillator and its higher-order harmonics adversely affects the signal-to-noise ratio (SNR) and the linearity of the RF system. This interference is particularly critical in applications requiring a clean RF spectrum, such as communication systems and high-precision test equipment. To mitigate these issues, the device allows the internal oscillator to be disabled, enabling the use of an external 80V DC power supply.

The ADGM1004 datasheet highlights the severity of the harmonic leakage when the internal oscillator is active. Comparisons of RF performance with and without the internal oscillator show in the figure 3 There is a significant improvements in noise floor and signal integrity when an external power supply is used.

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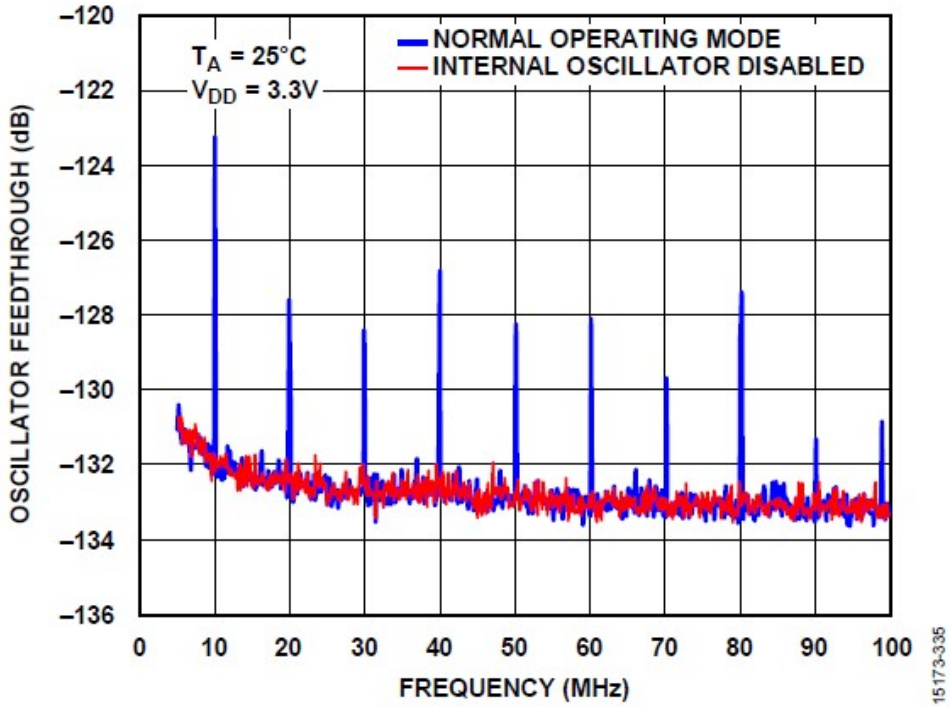

Figure 1: Comparison of spectrum through MEMS switch with internal power supply (blue) and external power supply

2 Block Diagram Explanation

The block diagram shown in Figure 2 illustrates the design of an 80V DC power supply intended to provide a clean and stable output voltage for RF applications. Each component in the diagram plays a crucial role in achieving harmonics-free DC voltage suitable for the ADGM1004 MEMS RF switch. Below is the detailed explanation of each block:

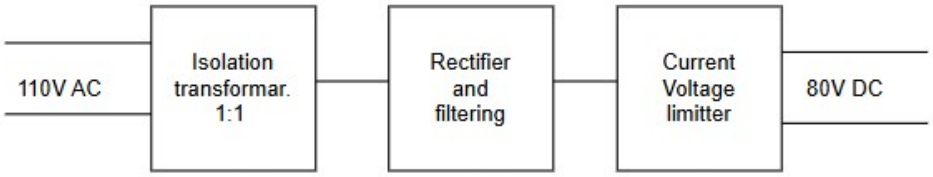

Figure 2: Block diagram of 80VDC power supply

2.1 110V AC Input

The power supply starts with a 110V AC input, which serves as the primary energy source. This is typically the standard mains voltage supplied in most regions.

2.2 Isolation Transformer (1:1)

The isolation transformer provides galvanic isolation between the AC mains and the downstream circuitry. This ensures safety by preventing direct electrical connection between the input and output circuits, reducing the risk of electric shock. The 1:1 ratio transformer maintains the same voltage level (110V AC) while providing isolation.

2.3 Rectifier and Filtering

This stage converts the isolated AC voltage to DC voltage:

- **Rectifier:** A rectifier circuit, typically a diode bridge, converts the AC voltage to a pulsating DC voltage.
- **Filtering:** A filtering network consisting of capacitors and inductors smooths the pulsating DC to produce a steady DC voltage with minimal ripple.

2.4 Current and Voltage Limiter

The current and voltage limiter ensures a clean and stable 80V DC output while protecting the circuit and connected devices. It includes:

- Voltage regulation to maintain a constant 80V output regardless of load variations.
- Current limiting to prevent damage in case of overcurrent scenarios.

2.5 80V DC Output

The final output is a clean and stable 80V DC voltage, free from harmonic noise. This external power supply eliminates the harmonic interference caused by the internal SMPS in the ADGM1004 MEMS RF switch, making it ideal for precision RF applications.

The external power supply, as detailed in the block diagram, effectively addresses the issues of harmonic feedthrough and interference, ensuring reliable and noise-free operation of the RF switch.

3 Circuit Diagram

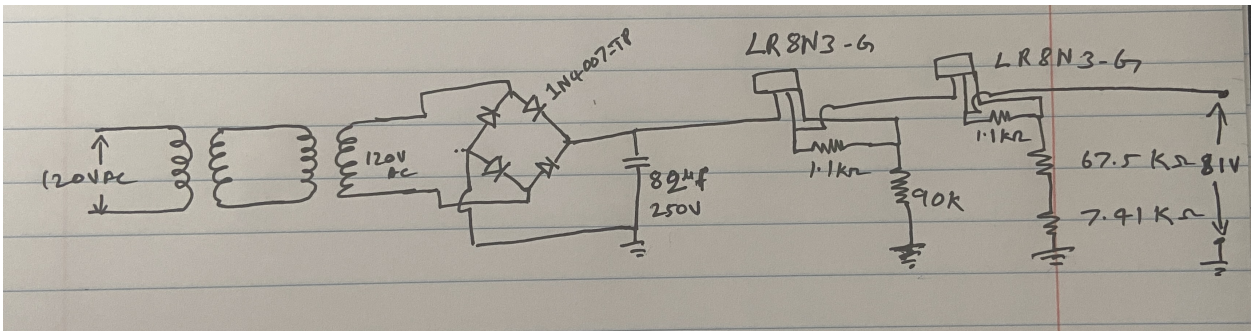

Figure 3: Circuit diagram of 110VAC to 80VDC convertor