TEGAM Power Amplifiers Simplify PSRR Measurements

Introduction

As electronics become more complex, often with multiple modules drawing different current waveforms from a single source, the opportunity for undesired interactions through induced ripple on the supply continues to increase. Power Supply Ripple Rejection (PSRR)[1] testing is therefore an essential step in the validation of integrated circuits and electronic assemblies. Ascertaining the PSRR specifications of a component or circuit provides engineers with an understanding of how the unit will perform when subjected to adverse conditions such as external RF interference or noise on a line voltage source, as shown in Figure 1.

Figure 1

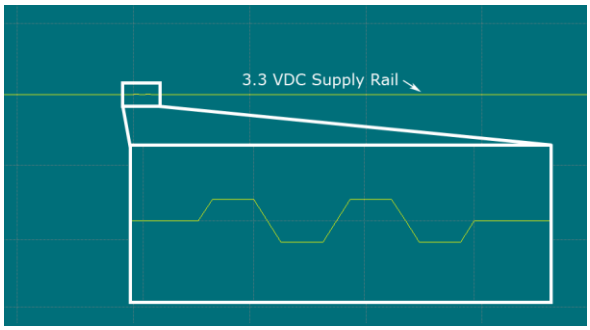


Figure 1 - Example PSRR test signal, used to test ripple rejection of discrete components. TEGAM's line of power amplifiers allows engineers to produce this or virtually any other PSRR test signal cost-effectively and with very high fidelity.

The TEGAM 23XX series of amplifiers, shown in Figure 2, can help engineers make PSRR measurements cost-effectively while simplifying the measurement process and reducing the time needed to set up the required test equipment. The TEGAM 2348 Power Amplifier is a high-current, low distortion voltage amplifier that is ideal for PSRR measurements. For lower current, high voltage applications, the TEGAM 2340 Single Channel and 2350 Dual Channel High Voltage Precision Amplifiers are well-suited. TEGAM's amplifiers are designed to faithfully amplify the source signal with little distortion, are current-limited to protect sensitive test equipment, and

[1] Power Supply Ripple Rejection is sometimes also called Power Supply Rejection Ratio. Although the terms are often used interchangeably, they embody two closely related but distinct concepts. Rejection ratio refers to items with measurable analog outputs, and expresses the ratio of undesirable signal components, e.g. noise or RF interference, to the source signal. It is one type of ripple rejection, which is a more generic term that also includes other types of rejection measurements, such as the threshold voltage for a display.

have independent voltage monitor outputs allowing technicians to monitor the amplifier output voltage without compromising the test signal. These features make TEGAM's amplifiers the perfect addition for laboratories making PSRR measurements.

Figure 2

TEGAM 2348 Power Amplifier

TEGAM 2350 Dual Channel High Voltage Precision Power Amplifier

PSRR Measurements

PSRR is typically defined as the ratio of a circuit's or component's output noise to input noise characteristics. It is expressed in dB and derived by the following equation:

$$\boldsymbol{PSRR\ (dB) = 20\ log\ \frac{Noise_{In}}{Noise_{Out}}}$$

While the principle is clear enough to understand and calculate, making accurate PSRR measurements is considerably more challenging. Not only must an engineer determine the appropriate noise profiles for the component or device under test (DUT), but the test itself can require significant design and set-up time. Figures 3a and 3b below show two typical PSRR measurement test setups. Often, multiple types of test equipment are required, along with discrete components such as capacitors and inductors to isolate the DC voltage from the injected noise. A typical setup will include a DC voltage source with sufficient current to drive the component or circuit under test, a separate AC voltage source that simulates noise or interference, a measuring device, and a series of inductors and capacitors between the sources. These LC networks are necessary to isolate the DC bias voltage and AC noise signal, summing the two signals to create the desired noise profile. Finally, by applying this summed signal with a known noise component to the DUT, and measuring the resultant noise output, the circuit's PSRR can be calculated.

Figure 3a

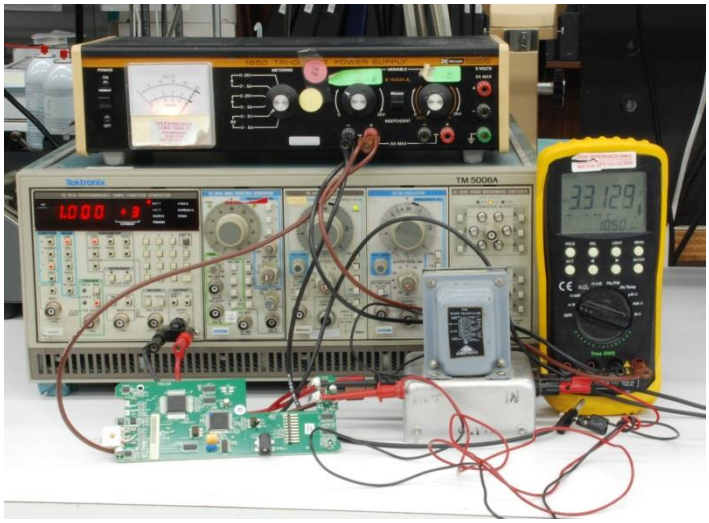
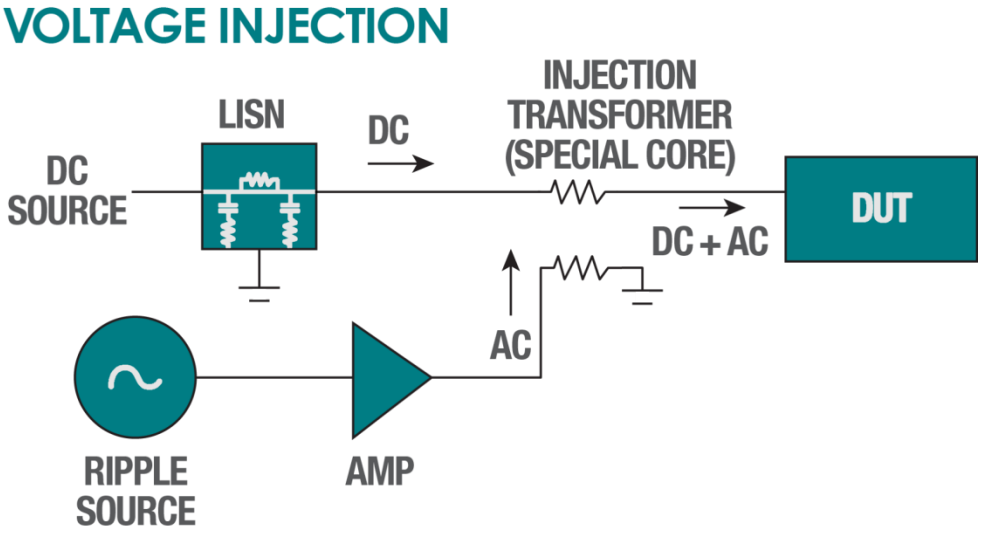
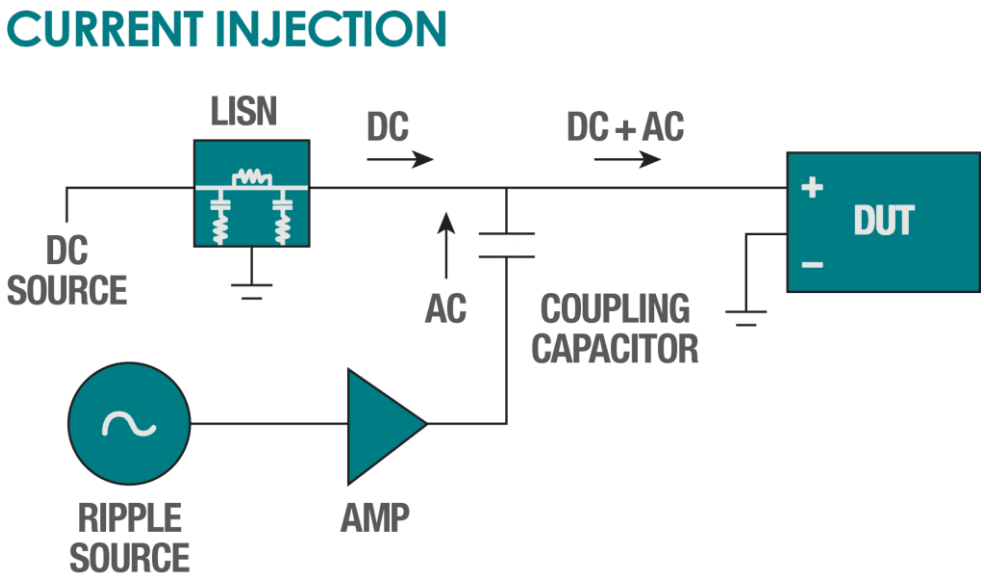


Figure 3a - Typical voltage injection PSRR measurement test setup, utilizing a high current DC power supply. Using a DC power supply without an amplifier necessitates the use of additional equipment such as isolating components and external monitoring equipment.

Figure 3b





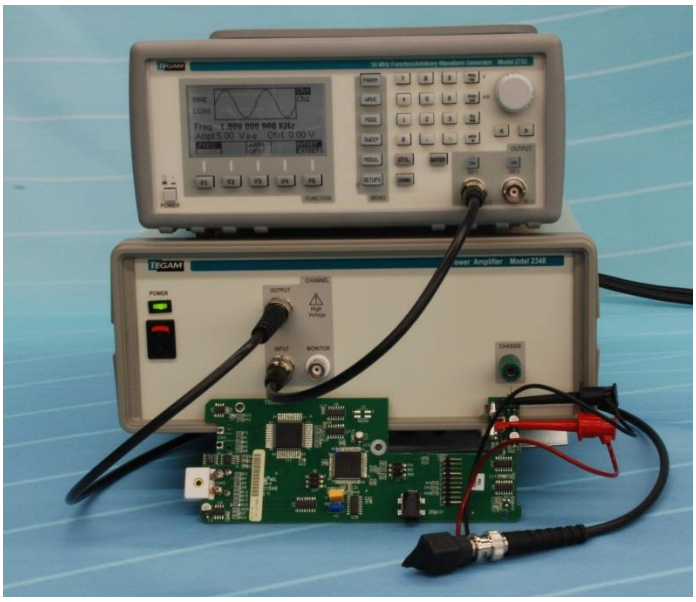
Further complicating the measurement of PSRR is the fact that different categories of components and circuits are more susceptible to different types of noise. For instance, data communications equipment may be more susceptible to clock and data-dependent jitter, while communications devices must be tested against RF interference and spurious transmitter signals. These distinct PSRR concerns mean that designers have to develop multiple noise profiles with different frequency and amplitude parameters, recalculate test circuit component values, and substitute those components accordingly. This process can be tedious, and without proper controls, difficult to achieve the accurate and repeatable results necessary.

Test equipment designed specifically for PSRR testing can be prohibitively expensive and is typically single-purpose, making it difficult to cross-utilize or repurpose to meet other laboratory needs. Further, designing and applying PSRR test parameters with standard DC and AC voltage sources is time-consuming for technicians, and it can make it difficult to develop effective testing procedures that yield reproducible measurement results. Fortunately, TEGAM's line of power amplifiers can help engineers cost-effectively realize accurate and efficient PSRR measurements that meet the rigorous testing standards required for today's electronics.

Better PSRR Measurements with the TEGAM 2348 Power Amplifier

The TEGAM 2348 Power Amplifier is the perfect unit to simplify complex PSRR tests. The 2348 is a stable and precise DC coupled amplifier with a +10 gain across its voltage range. Its full power output of 18.75 watts up to 500 kHz, and -3 dB bandwidth of 2 MHz, is capable of driving current-hungry components and circuits. These features, combined with its low distortion specifications, allow the 2348 to accurately reproduce and amplify a source signal, making it an ideal amplifier for PSRR measurements. The TEGAM 2340 and 2350 amplifiers are similarly well suited for PSRR measurements. With a 400 V p-p maximum output voltage at 40 mA, the 2340 / 2350 amplifiers provide all the same advantages as the 2348 when used in low current, high voltage applications.

Figure 4



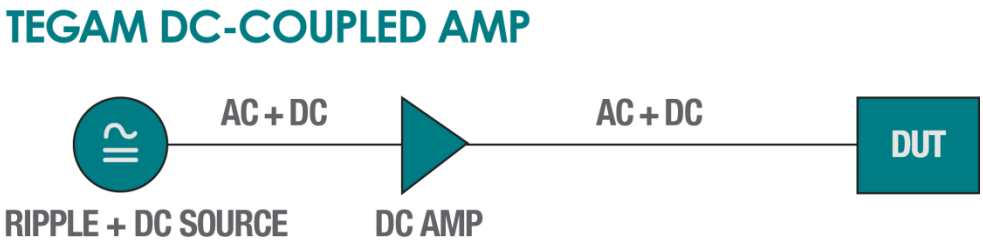


Figure 4 - Using the TEGAM 2348 Power Amplifier with an arbitrary waveform generator can greatly simplify the test setup for PSRR measurements.

In contrast to traditional PSRR test setups, the use of an amplifier to step up the current or voltage provides much more flexibility in the selection of DC and AC signal sources. Our PSRR tests typically utilize an arbitrary waveform generator (AWG) as the input signal to the amplifier. Most AWGs can mix DC voltages with various AC signals, noise patterns, and switched DC voltages, to create many of the PSRR test profiles required by test engineers. A second AWG can be utilized to provide a summing or modulation signal to the first where more sophisticated test profiles are needed, giving technicians virtually unlimited measurement options. AWGs are also programmable, have noise profiles pre-loaded, and have user-accessible memory locations that can be used to save and recall particular noise profiles. These features not only save engineer's time and frustration, they also allow for more accurate documenting of test parameters and improved repeatability and reproducibility of test results.

Using a TEGAM amplifier for PSRR measurements provides other benefits as well, such as eliminating the need for discrete components required in the measurement setup. The DC coupled output of the amplifier effectively isolates the DUT from the source signals, eliminating the need for LC isolation networks. The 2348 and 2340 / 2350 amplifiers also have independent voltage monitor outputs which provide the user with a low-level representation of the amplified output signal. This allows for real-time observations of the applied noise signal without disrupting the operative test connections.

PSRR tests are an important part of the component and circuit engineering process, but can be problematic to design and execute with traditional testing methods. Purpose-built PSRR test equipment is often costly and unable to meet other laboratory needs. TEGAM's power amplifiers are a cost-effective solution that not only help reduce initial procurement costs but can also be utilized in other measurement applications. Coupled with an AWG, the TEGAM 2348, 2340, and 2350 Power Amplifiers simplify the testing process and allow engineers to achieve accurate and reproducible PSRR measurements for most any application.