PICOTEST

J2123A Data Sheet

Negative Voltage - Line Injector

Low Impedance, Low Noise, and Low Voltage-Compliance

Modulate a DC Power Source Voltage

Perform Power Supply Rejection Ratio (PSRR) Measurements

Perform Power Supply Modulation Ratio (PSMR) Measurements

Perform Audio Amplifier Common-Mode Rejection Ratio (CMRR) Measurements

Negative Voltage Line Injector

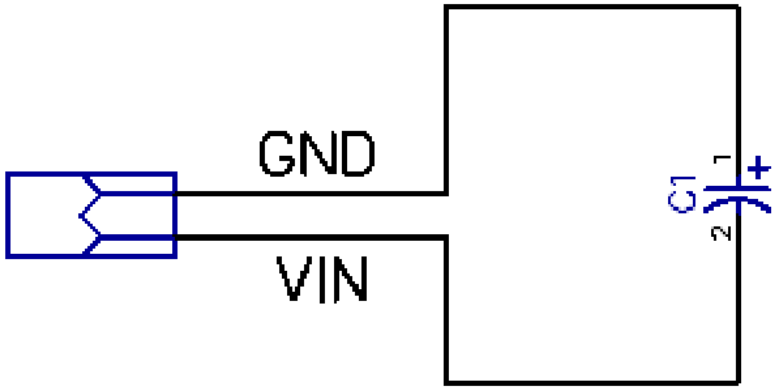
The J2123A line injector is used to superimpose an AC modulation signal on a DC source voltage for Power Supply Rejection Ratio (PSRR) and Power Supply Modulation Ratio (PSMR) testing. These applications require very low output noise, as well as a low output impedance over a wide bandwidth.

The Picotest J2123A, like the Picotest J2120A (for positive voltages), achieves these difficult requirements using a passive design to assure optimum performance.

Important Usage Note: The J2123A will be damaged if the input voltage is reversed. In a negative voltage system, the return jack (ground or 0 volts) should be more positive than the MINUS SUPPLY connection.

To clarify, there is a polarized internal capacitor connected per Figure 1.

Do not apply a reverse voltage across this capacitor.



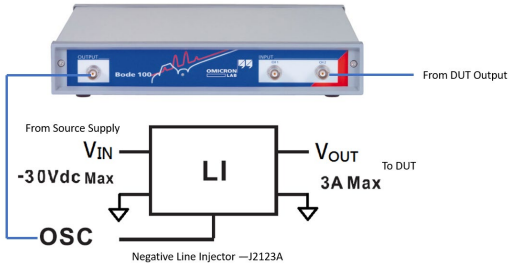
Internal Input Capacitor Polarity
Figure 1

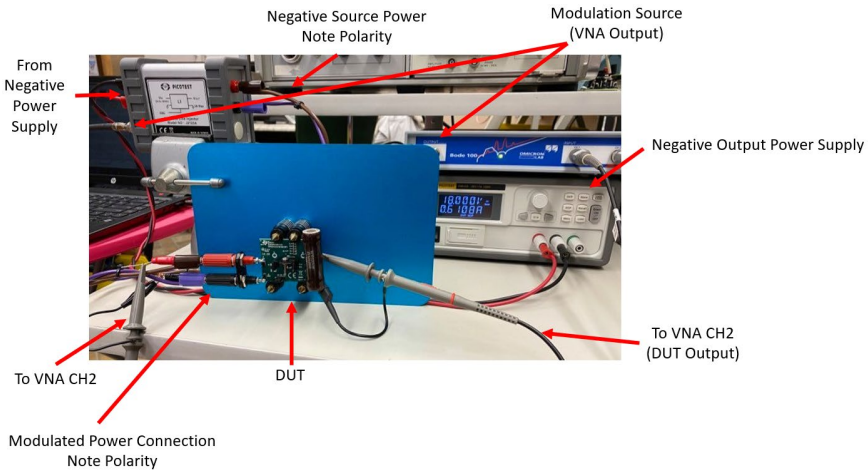
Figure 2 shows a typical test setup. A negative output power supply is connected to the J2123A. In this example, the output of an OMICRON Lab Bode 100 VNA is used for the modulation source.

Please pay attention to the polarities. In a negative voltage system, the positive connection is ground (return) and other connection is the negative voltage.

FEATURES:

- Provides low-impedance modulation of a negative output power supply.
- Supports Power Supply Rejection Ratio (PSRR) testing.
- Supports Power Supply Modulation Ratio (PSMR) testing.
- Passive, low-noise signal injection.





Typical Test Setup
Figure 2

KEY LINE INJECTOR CHARACTERISTICS

The general performance metrics of power supplies and reference sources include DC voltage accuracy, temperature coefficient, noise, output impedance, PSRR and stability. While the requirements vary greatly from application to application, the general characteristics are the same.

PSRR is a significant performance concern as even small amounts of high frequency ripple voltage at the input can significantly degrade the output precision of the device and impact downstream circuitry.

While the injection transformer used for Bode plots is a very wideband adapter, it is not useful for measuring ripple rejection (PSRR) of a power supply or even an opamp. This is because the attributes that make the injection transformer perform so well also result in a transformer that is intolerant of DC current. Even very small DC currents (5mA or less) can greatly reduce the signal capacity or even totally saturate the transformer. For this reason, the Picotest line injector (J2123A) is another essential test adapter.

The line injector allows the input DC supply voltage to be modulated by the network analyzer source signal, as in the case of a PSRR measurement. The line injector must be capable of a frequency range well below the AC line frequency and at least above the control loop bandwidth of the circuit being tested.

The line injector is only capable of sourcing current, so that the output amplitude can be significantly impacted by the operating current and the total storage capacitance at the load.

The Bode-100 network analyzer has a very high selectivity so distortion at the output of the line injector generally does not influence the measurement. Again, this is a small signal injector, so the oscillator signals should be kept as small as possible above the noise floor. As a recommendation, try to keep the input signal amplitude below 50mVpp (-20dBm). In some cases, we want to attenuate the source signal even further, and so we include attenuators in the injector kits. Some analyzers, such as the Bode-100 allow shaping the injection amplitude as a function of frequency, which helps optimize the signal level.

The line injector can also be used in conjunction with a current probe to measure the input impedance of a power supply. The input impedance of a switching power supply or regulator is negative, which creates a stability concern when combined with an EMI filter. As a result, the measurement is an important part of the design, analysis, and verification process. You can correct for the scaling by performing the THROUGH calibration with a 1 Ohm resistor.

SINGLE-SUPPLY PSRR or PSMR TEST OPERATING PROCEDURE

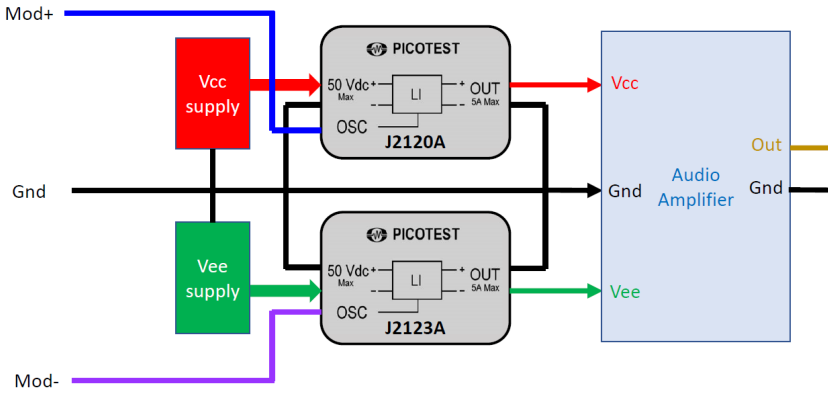
1. Run the calibration procedure for the gain/phase test being run.
2. Connect a negative output power source to the power input of the J2123A injector. Make sure the power supply polarity is connected properly. For a negative voltage system, the common is the most positive voltage. This means, if a positive voltage power source is used, the red or plus voltage is the return and the black or negative creates the supply voltage.
3. Connect the Bode 100 (or other signal source) to the OSC input.
4. Connect the J2123A output to the input of the power source Device Under Test (DUT). Make sure the negative power supply is connected properly—with the return as the most positive system voltage.
5. Run the desired test to evaluate the system PSRR or PMSR.
6. As an example, see the Picotest TI TPS7A3301EVM Negative 1A Linear Regulator Case Study.

AUDIO AMPLIFIER PSRR or CMRR TEST OPERATING PROCEDURE

1. To measure audio amplifier PSRR where both positive and negative rails are present, ground should be centered between the two power supplies. In this case, the positive supply should see positive modulation while the negative

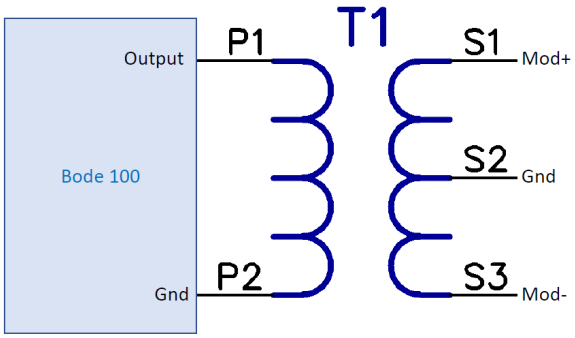
supply sees simultaneous negative modulation. In this case, the average of V+ and V- is zero and the differential voltage is modulated. To measure Audio amplifier CMRR, the power supplies are moved in the same direction. The difference between V+ and V- is fixed and the average of the two power supplies is modulated.

2. Figure 3 shows the setup for an audio amplifier PSRR or CMRR test.

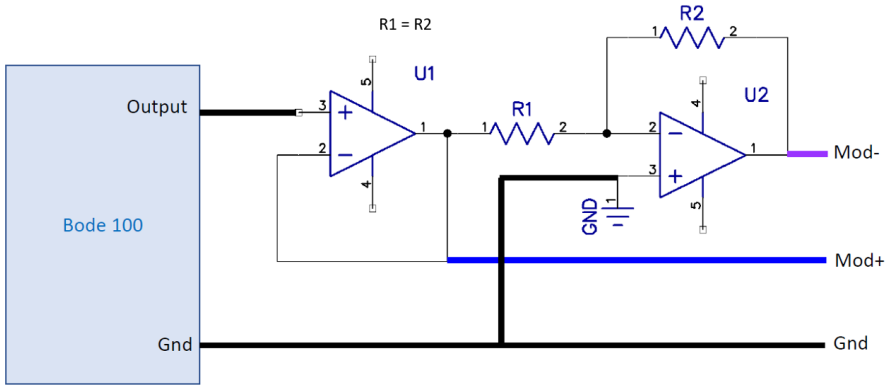


Audio Amplifier PSRR or CMRR Test Setup
Figure 3

3. Figures 4 and 5 show how the modulation source can be connected to the J2120A and J2123A to support a dual power source audio amplifier PSRR test.



Creating an Audio Amplifier PSRR Modulation Source—Option 1
Center-Tapped Injection Transformer
Figure 4



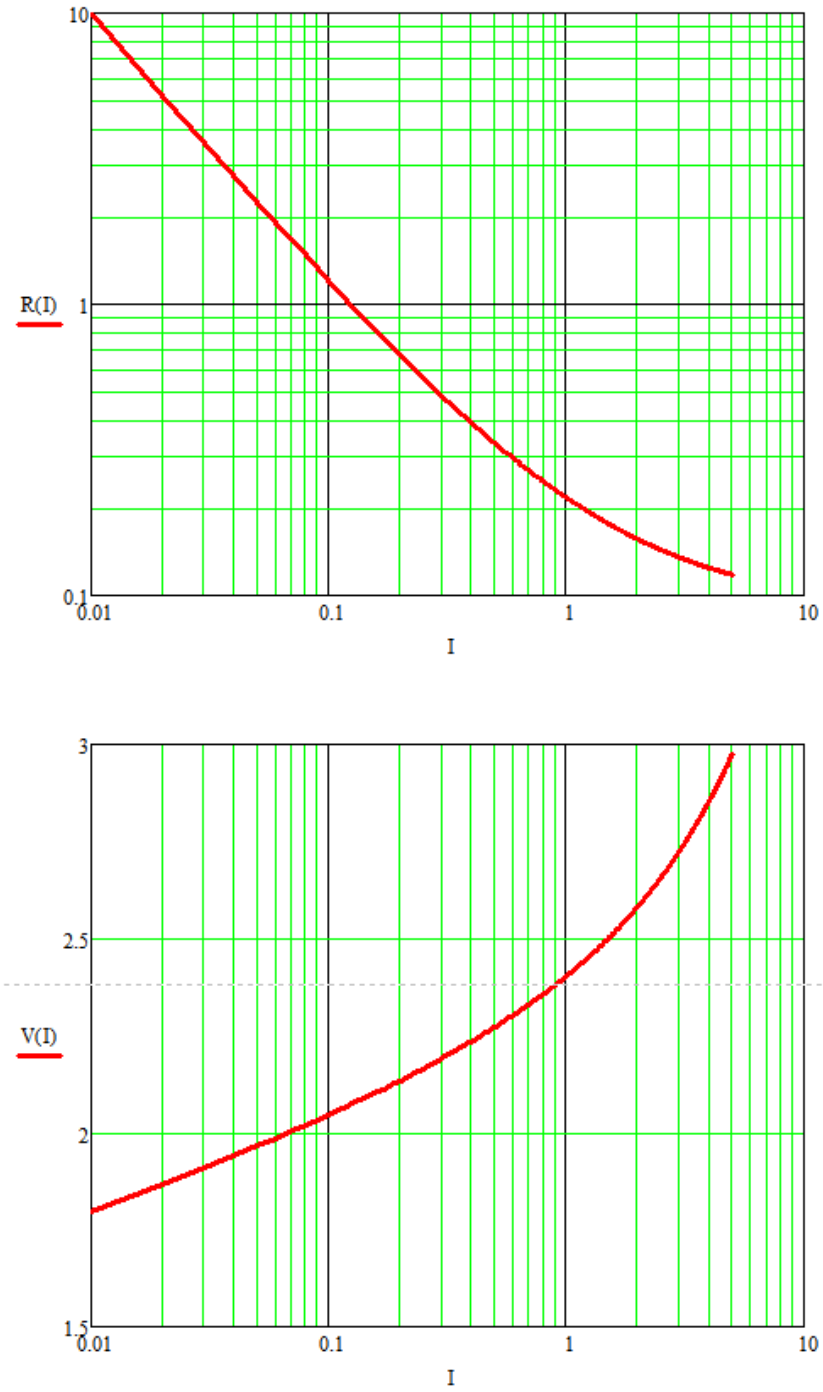
Creating an Audio Amplifier PSRR Modulation Source—Option 2
Figure 5

REMOTE SENSE FOR THE J2123A LINE INJECTOR

Internally, the Picotest J2123A uses a passive design, so there is a DC voltage drop between the input and output of the line injector. This voltage is a function of the operating current. To get a constant, known voltage at the DUT input, the engineer can adjust the lab supply output voltage for each load current operating point.

An alternate method of creating a stable and known voltage at the DUT input can be done if the lab power source has remote voltage sense with wide enough compliance to compensate for the J2123A voltage drop. Figure 6 shows the typical J2123A resistance and voltage drop and defines how much remote sense compliance is required.

Picotest provides a reference design for a remote sense circuit for the J2120A injector. That design—provided the capacitor polarities and noted and line up with the negative power source—can be used as a guide for remote sense of the J2123A Negative Voltage – Line Injector.



Typical J2123A Resistance and Voltage Drop between Input and Output
Figure 6

For an arbitrary current, the J2123A resistance and voltage drop can be calculated using Formula 1.

$$V(I) = 2.312 * I^{0.055} + 0.090I$$
$$R(I) = 0.127 * I^{-0.945} + 0.090$$

Typical J2123A Resistance and Voltage Drop Calculation
Formula 1

To learn how this solution can address your specific needs please contact Picotest:
877-914-7426
info@picotest.com
www.picotest.com

J2123A SPECIFICATIONS

Characteristic	J2123A
Maximum DC Input Voltage	30VDC
Maximum Continuous Current	3A
Maximum Voltage Drop	3VDC
3dB Frequency Response	20Hz-20MHz
Useable Frequency Response	10Hz-50MHz
Recommended Injection Signal	-20dBm-10dBm
Temperature Range	0-50°C
Maximum Altitude	6000 Ft

REFERENCE

1) Picotest TI TPS7A3301EVM Negative 1A Linear Regulator Case Study