**Filtering High Frequency Amplifier Noise**

The measurement of Class-D and other PWM or Delta-Sigma digital modulator type output stage amplifiers often presents a problem due to high frequency switching noise components. These high frequency components can obstruct the measurement of typical in-band 20-20kHz measurements.

Many of these amplifiers have limited high frequency filtering of their own, and many analyzers or other measuring instrumentation have no or insufficient filtering to remove the passband effects of these strong high frequency out-of-band components. The LF280™ offers a steep 80kHz 8th order passive lowpass filter to remove these unwanted high frequency components and enable accurate in-band amplifier response measurements.

**High Performance Filters**

The LF280™ is constructed entirely of the latest high linearity ultra high permeability gapped Ferrite inductors and Polypropylene capacitors for the ultimate in stability, high frequency performance, reduction of high frequency loss, and maximum linearity. The LF280™ utilizes a unique topology of identical component values to greatly reduce component sensitivity and produce a highly stable response with maximum passband flatness and outstanding stopband attenuation.

**Precision Attenuators**

A common problem with any passive filter is loading by the external cable capacitance or analyzer/meter input circuitry which can alter the passband response.

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**Features & Capabilities**

- Dual Precision Passive 8th Order 80kHz Lowpass Filters
- Dual Precision 30dB Attenuators with 6dB Steps
- Dual Channel Single Ended or Mono Bridged Differential Mode
- High Power Capability: 90VRMS/Chan or 180VRMS/Bridged
- Very Flat Passband Response, ±0.05dB to 40kHz
- Very High Stopband Response, >70dB above 240kHz
- Very High Linearity at High Signal Levels
- Low Sensitivity to Cable/Analyzer Loading
- Constant Output Impedance, 330 Ohms/Chan
- Dual 5-Way Binding Post Amplifier Connectors
- Dual BNC and XLR Output Signal Connectors
- Short Circuit Output Protection
- Efficient High Performance Low Cost Design
- Small Size: 1.8 x 4.0 x 7.0 Inches (46 x 101 x 178 mm) 2 lbs

The LF280™ provides a precision R2R ladder attenuator which effectively removes the effects of external device loading, and provides a constant low output impedance regardless of the attenuation selected. For attenuation levels of -12dB or lower the effects of any external device loading are effectively eliminated.

An additional advantage of the precision attenuator is to reduce signal levels fed to other measuring devices which may not be capable of handling the very large signals produced from high power amplifiers.
**LF280 Magnitude & Phase Response**

- Frequency (Hz): 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M, 5M, 10M
- Phase: ±0.05 dB
- Instrumentation Limit

**LF280 Passband Response**

- Frequency (Hz): 80kHz
- Distortion: 0.0001, 0.0002, 0.0005, 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10
- 10Vrms (+22dBm), 80kHz BW
- 90Vrms (+41dBm), 80kHz BW
- Instrumentation Limit

**LF280 Stopband Response**

- Frequency (Hz): 10K, 20K
- Distortion: 0.0001, 0.0002, 0.0005, 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10
- 90Vrms (+41dBm), 80kHz BW
- Instrumentation Limit

**LF280 Group Delay Response**

- Frequency (Hz): 50, 100, 200, 500, 1K, 2K, 5K

**LF280 Distortion Response**

- Frequency (Hz): 10K, 20K
- Distortion: 0.0001, 0.0002, 0.0005, 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10
- 90Vrms (+41dBm), 80kHz BW
- Instrumentation Limit
**Amplifier Measurements**

The LF280™ provides a combination of powerful features to facilitate filtered measurements of amplifier signals spanning a wide variety of configurations and various test equipment capabilities. With any passive filter the loading imposed by connection cables and meter/analyzer inputs can potentially alter the precision frequency response of the LF280™ filters. Most meters and analyzers often have 100-500pF of input capacitance contained within their input stage circuitry. Many cables contain 100pF/Ft capacitance. This capacitance loading will affect the precise passband response of the LF280™.

To obtain maximum passband flatness the LF280™ attenuator provides a means of isolating the external equipment and cables from affecting the LF280™ filter response. Attenuation levels of -12dB or higher will effectively eliminate any external loading on the LF280™ filters by external cables and meter/analyzer circuitry.

*Note: When maximum accurate passband flatness is required, attenuation levels of -12dB or higher should be employed.*

**Ground Referenced Single Channel Measurements**

General measurements for amplifiers with single channel output modes where the Black terminal is connected to the internal Common/Ground of the amplifier. It requires only a single filter channel of the LF280™. In this case the Red/Blk terminals of the amplifier channel are connected to the Red/Blk input terminals of one channel of the LF280™. The dummy load for the amplifier is connected directly to the amplifier Red/Blk terminals as well.

The unbalanced BNC output of the LF280™ can be fed to an unbalanced or balanced input on the meter/analyzer. In most cases the Balanced XLR output can also be used. The single channel filter mode provides a maximum input signal range up to 90VRms.

**Differential Single Channel Measurements**

Some amplifiers do not have the Black terminal at Common/Ground potential, but are actually driven much like the Red terminal. In these cases the LF280™ should be used in the dual channel mode as shown here. This mode can also be used for amplifiers with very large single channel voltages.

In this mode the Red/Blk terminals of the amplifier channel are fed to both the Red/Red input terminals of the LF280™. The dummy load for the channel is connected directly to the amplifier Red/Blk terminals as well. The balanced output XLR is used and fed to the meter/analyzer. This provides a maximum input signal range up to 180VRms.

*Note: The common mode rejection capabilities of the meter/analyzer at high frequencies can be of critical importance in some cases to obtain maximum dynamic range and accuracy of the measurements. Floating the meter/analyzer and/or amplifier ground may be required to obtain sufficient CMR at the frequencies of interest.*

**Dual Channel Bridged Measurements**

Measurements for amplifiers in the bridged channel mode can be easily handled using the dual filters of the LF280™. In this case the Red/Red terminals of both amplifier channels are connected to the Red/Red input terminals of the LF280™. The dummy load for the amplifier is connected directly to the amplifier Red/Red terminals as well. The Black terminals of the amplifier and LF280™ may or may not need to be connected, depending on the equipment behavior and bench grounding characteristics involved.

The balanced XLR output of the LF280™ is fed to a balanced input on the meter/analyzer. The dual filter bridged mode provides a maximum input signal range up to 180VRms.
Typical Specifications

■ General
Configuration: Dual Single Channel
Max Input Single Ended: 90VRMS / Channel
Max Input Bridged Mode: 180VRMS / Bridged

■ Filters
Circuit Structure: 8th Order Passive Lowpass
Circuit Components: Gapped High Mu Ferrite Inductors & Polypropylene Capacitors
Filter Response: 80kHz Butterworth-6dB
Insertion Loss: -0.06dB @ 1kHz
Passband Flatness: ±0.05dB, 0Hz-40kHz
Stopband Attenuation: >70dB >240kHz
Distortion: < 0.01% @ < 10kHz < 90Vrms
Group Delay: 10uSec < 20kHz
Input Impedance: 930 Ohms / Channel (±2%)
Output Impedance: 330 Ohms / Channel (±2%)

■ Attenuators
Circuit Structure: R2R Ladder
Accuracy: ±0.02dB
Attenuation:
- 0.00dB (Full Amplitude)
- 6.02dB (1/2 Amplitude)
-12.04dB (1/4 Amplitude)
-18.06dB (1/8 Amplitude)
-24.08dB (1/16 Amplitude)
-30.10dB (1/32 Amplitude)

■ Physical
Input Connectors: Dual 5-Way Binding Posts 0.75 Inch
Output Connectors: Dual BNC and Balanced XLR
Length: 7.0 Inches (178mm)
Width: 4.0 Inches (102mm)
Height: 1.8 Inches (46mm)
Weight: 2 lbs (1kg)
Material: Steel 16ga
Finish: Textured Black Polane

WARNING!!! High power amplifiers can produce very large voltages and currents, which can be hazardous to both you and your other test equipment. Check your connections carefully, and conduct your tests first at lower voltage/power levels before increasing signal levels to full power. Check the Black terminal of the power amplifier to see if it is truly ground or driven.

Visit our web site or contact the factory for a list of International Dealers.

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