

**Instruction Manual
For Model LPF-8
Low Pass Bessel Filter 8 Pole**



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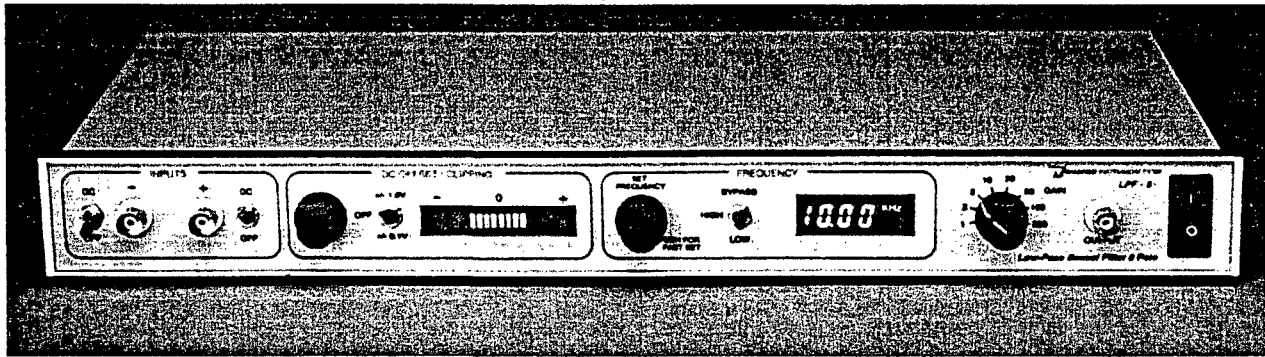
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INTRODUCTION

Overview

The LPF-8 Low-Pass Filter is used to pass lower-frequency signals while attenuating higher-frequency signals. The point at which the filter will pass or attenuate frequencies is set by a frequency control. The Frequency selected will be attenuated by 3 dB (half voltage amplitude), with frequencies below the set-frequency attenuated by less than 3 dB and frequencies above the set-frequency attenuated by more than 3 dB. The attenuation at twice the selected frequency is 14 dB (1/5), and at 10 times the frequency is 114 dB (1/500000). Note that the maximum attenuation of the filter is 60 dB (1/1000).

The LPF-8 filter passes signals with no distortion of the waveshape. A step function at the input of the filter will be a step function at the output, with no overshoot or ringing. The rise time of the step will be delayed and slowed according to the selected frequency.

The + and - inputs can be used individually (single-ended) or differentially. Input impedance is 1 Megohm to ground each input.

An Input Offset control is used to cancel offsets at the input. Two ranges are available: ± 0.1 Volt and ± 1.0 Volt. The offset control can also be turned off.

An Offset meter is provided as a convenience to display offset and signal characteristics. The meter is more sensitive in the center of the display, allowing finer resolution near zero. The meter is less sensitive at the edges to allow a ± 10 Volt range. When the outside lights are on, the filter is at or near clipping.

The frequency range is selected by a toggle switch, while the frequency is selected by one rotary control. The control is an optical encoder, which has no electrical contacts that can become unreliable. A LED display indicates the selected frequency. There are 3979 frequencies between 0.1 Hz and 19.99 KHz that can be selected.

Amplifier gain is selected from 1 to 200 with the Gain control. Gain selection is after the Offset control, so cancellations of the input offset will not be affected by the gain setting. A Gain Telegraph signal available at the rear panel provides a DC signal that indicates the gain setting selected.

A Bypass function is provided to eliminate the filter while keeping the Offset and Gain settings. This can be used for comparisons of results with and without the filter, or for using the LPF-8 as an amplifier.

SPECIFICATIONS

Inputs: + and - differential inputs

Input Selector: DC / OFF switch on each input

Input Impedance: 1 Megohm each to ground

Input CMR: 80 dB @ 60 Hz

Input Voltage Range: ± 10 Volts

Input Offset: 10 Turn Control, switch selected in 2 ranges, ± 0.1 Volts and ± 1.0 Volts or Off

Offset Indicator:

LED1 (0)	± 0 to 188 mV (-35 dB)
LED2	± 188 to 467 mV (-27 dB)
LED3	± 467 to 860 mV (-21 dB)
LED4	± 0.86 to 1.41 V (-17 dB)
LED5	± 1.41 to 2.20 V (-13 dB)
LED6	± 2.20 to 3.31 V (-10 dB)
LED7	± 3.31 to 4.88 V (- 6 dB)
LED8	± 4.88 to 7.10 V (- 3 dB)
LED9	± 7.10 to 10.0 V (0 dB)
LED10(\pm)	± 10.0 Volts (Clipping)

Overload Indication: Outside LEDs on Offset Indicator (± 10 V)

Frequency Ranges: Low: 0.1 Hz to 199.9 Hz
High: 10 Hz to 19.99 KHz

Frequency Resolution: Low: 0.1Hz, High: 10 Hz

Bypass Bandwidth: Gain = 1 BW > 200KHz

Attenuation: 14 dB per Octave (0.2 Amplitude at 2f)

Maximum Attenuation: 60 dB

SPECIFICATIONS

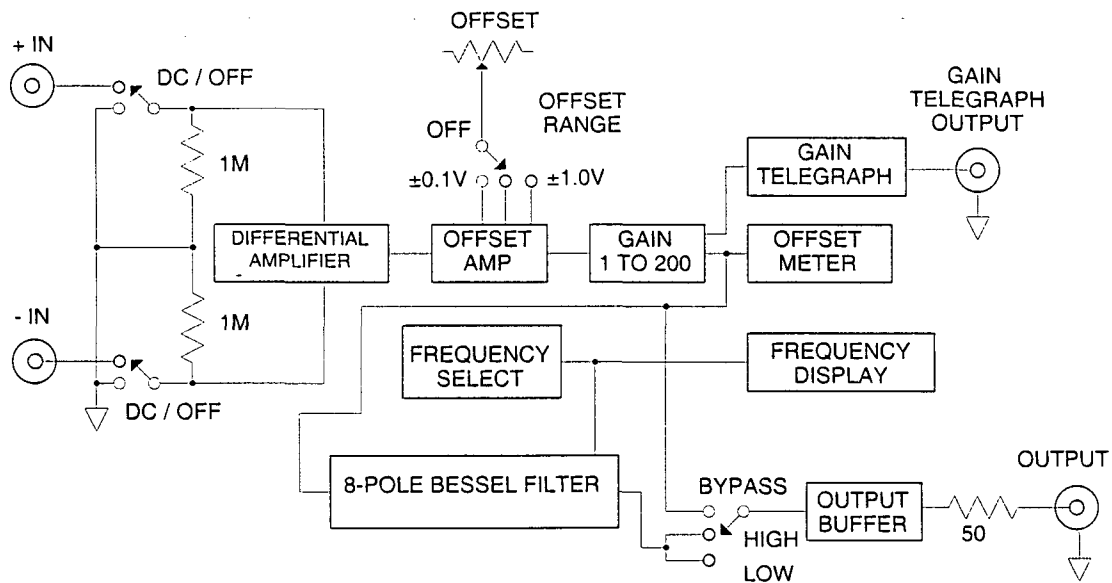
Gain/Gain Telegraph:

Gain	Telegraph	Gain	Telegraph
1	2.5 Volts	20	4.5 Volts
2	3.0 Volts	50	5.0 Volts
5	3.5 Volts	100	5.5 Volts
10	4.0 Volts	200	6.0 Volts

Output Impedance: 50 Ohms

Physical Specifications

- Power 100-130 or 200-260 VAC,
single-phase, 50/60 Hz, 20VA
- Temperature 10° C (50° F) to 40° C (104° F)
- Dimensions Height 1.73 in. (44 mm)
Width 16.2 in. (410 mm)
Depth 7.9 in. (200 mm)
- Weight 7 lb (3.2 kg)
- Shipping Weight 10 lb (4.6 kg)



LPF-8 Block Diagram

Input Signals

Two Inputs are provided on the LPF-8 front panel. The + and - Inputs can be used individually (single-ended) or differentially. When used single-ended, a positive signal on the + Input will give a positive signal at the output. Likewise, a negative signal on the - Input will give a positive signal at the output. The unused input can be turned off with a toggle switch, which ties it to the input ground.

When used differentially, the output will be (+ Input) minus (- Input). The maximum signal at the inputs is ±10 Volts. Differential signals may be within the range (as in 12 volts and 11 volts differential = 1 volt), but the actual voltages being beyond ±10 volts will cause distortion of the input signal.

For circuit protection, signals beyond ±15 Volts will be truncated to ±15 Volts.

Input Offset Controls

An Input Offset control is used to cancel offsets at the input. Two ranges are available: ±0.1 Volt and ±1.0 Volt. The offset control can also be turned off.

For a fixed offset of up to ±1.0 Volt at the input, the Input Offset control can be used to cancel the offset for a zero-offset output. The Gain setting will have no effect on a zero-offset signal. If the output is at a non-zero voltage and the Gain control is changed, the output baseline will be affected according to the gain change. For example, a 1.0 Volt DC level at a Gain of 10 will become a 2.0 Volt level at a gain of 20.

Offset Meter

An Offset meter is provided as a convenience to display offset and signal characteristics. Two LEDs in the center of the display are on for a nulled (zero) signal. As the input signal goes positive, the LEDs on the right of center will light progressively until a 10 Volt level is reached. As the input signal goes negative, the LEDs left of center will light progressively until a -10 Volt level is reached.

The Offset display is after the Gain control, so that changes in the selected gain will affect the display. The Offset display is before the filter, so that changes in the filter frequency will not affect the offset display. The Offset display follows the LPF-8 output in the Bypass mode.

The Offset display is more sensitive in the center of the display, allowing finer resolution near zero. The display is less sensitive at the edges to allow a ± 10 Volt range (see "Offset Indicator" in the specifications section for levels). When the outside lights are on, the filter is at or near clipping.

Frequency Set

The Low-pass Frequency is selected by one rotary control. Two ranges are provided for High or Low frequency ranges.

To set a frequency, first choose a range. If the frequency is below 200 Hz, select the Low range. For frequencies between 200 Hz and 19.99 KHz, select the High range.

Rotate the SET FREQUENCY control until the desired low-pass frequency is displayed on the LED numeric display. To speed up the selection, push the SET FREQUENCY control in while turning. This will move the frequency selection 10 times faster.

Increasing the Set Frequency at 1990 Hz on the High range, the display changes from 1990 Hz to 2.00 KHz. The resolution remains at 10 Hz per step throughout the entire High range. Similarly, increasing the Set Frequency at 19.90 Hz on the Low range changes the display from 19.90 Hz to 20.0 Hz, while the resolution remains 0.1 Hz.

Note that in the High range, the frequency resolution is 10 Hz, so that 125 Hz can not be selected. In the Low range, the frequency resolution is 0.1 Hz, so that 125.2 Hz can be selected.

The Bypass function on the range selection switch can bypass the filter section of the LPF-8. All other functions remain normal in the Bypass mode. This can be useful for checking the unfiltered input signal, while keeping the Gain and Offset functions intact. While in the Bypass mode, the frequency display is blanked.

The set frequency will be stored while the LPF-8 is turned off. The set frequency can be held for 10 years with the LPF-8 unit unplugged. Moving the SET FREQUENCY control while the LPF-8 is turned off or in the Bypass mode will not change the selected frequency.

Gain

The GAIN control sets the overall gain of the LPF-8 in High, Low, or Bypass mode. The gain control is located after the Offset control, and before the filter section.

The Gain control selects fixed gains between 1 and 200. Offset voltages present at the output will be affected by changes in the Gain control, but offset voltages at the input that have been nulled to zero using the Offset control will not be affected.

A Gain Telegraph output is provided on the rear panel. This output represents the selected gain as a DC Voltage, and is used by computer software to track the setting of the Gain control in a particular setup.

Minimizing Errors

In using the LPF-8, there are certain ways to get the best results. The offset error and noise inside the filter are best at higher frequency selections. Also, it is better to select the Low range for frequencies below 200 Hz.

If a selection of 20 Hz is made on the High range, the noise will be approximately 50 times higher than 20.0 Hz on the Low range. Also, DC Offset will not be as accurate or stable at this low frequency on the High range.

Another way to minimize noise is to have the input signal amplitude as high as possible without risk of clipping. As with any system, this will give a higher signal-to-noise ratio. A larger input signal also reduces the effects of offset inaccuracies, as long as the Input Offset control is adequate to cancel the offset present at the LPF-8 input.

The bandwidth of the Bypass mode is a function of the Gain selection. As the gain is increased, the bandwidth will be lowered. When Using the Bypass mode, check the specifications to be sure that the bandwidth is high enough for your application.

WARRANTY

Model LPF-8 is warranted to be free from defects in materials and workmanship for a period of two years from the date of shipment. If a failure occurs within this period, we will repair or replace the faulty component(s). This warranty does not cover failure or damage caused by physical abuse or electrical stress (exceeding specified input limits).

Shipping charges to the factory are the customer's responsibility. Collect shipments will be refused.

Return shipping of the repaired unit will be paid by WIC.