

◇ Tunable Active Filters

KH3321/3323

0.01Hz to 99.9kHz
HP/LP/BP/BR
DIGITALLY TUNED FILTER

- Frequency Range: 0.01Hz to 99.9kHz
- Frequency Accuracy: $\pm 2\%$
- Passband Gain: 0dB or 20dB
- Attenuation Slope: 24dB/octave (each channel)
- Battery Operation
- Maximum Attenuation: 80dB
- Floating (Ungrounded) Operation

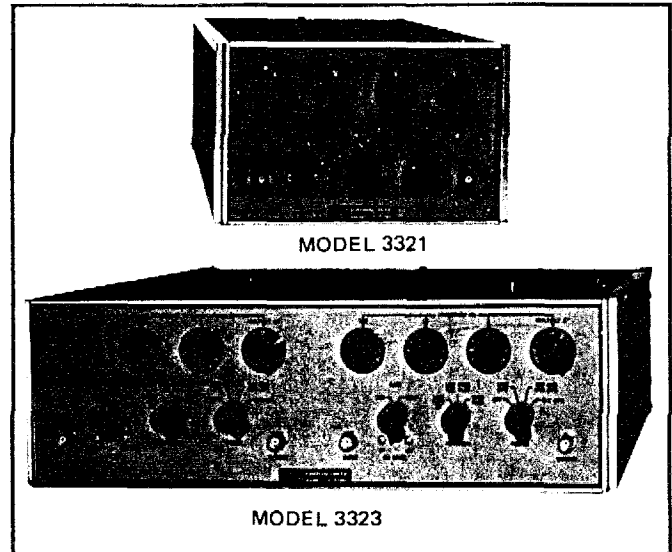
DESCRIPTION

The Krohn-Hite Model 3321 and 3323 are variable electronic filters that are digitally tuned over the range from 0.01Hz to 99.9kHz. The Model 3321 (single channel) and 3323 (dual channel) have slopes of 24dB/octave. Each channel can either be operated in high-pass or low-pass mode. When the two channels in the Model 3323 are operated in the same mode, set at the same cutoff frequency, and cascaded, an attenuation slope of 48dB/octave is obtained.

CHARACTERISTICS

The frequency response characteristics of the Model 3321 and 3323 is a fourth-order Butterworth with maximal flatness for cleanest filtering in the frequency domain. For pulse or transient signal filtering, a front panel switch is provided to change the frequency response to a modified RC, optimum for transient-free filtering (see photo). Digital tuning permits cutoff frequency calibration accuracy of $\pm 2\%$ and excellent resettability, enabling good repeatability of filter characteristics.

Front panel switch selects either 0dB or 20dB of passband gain for each channel. The 20dB gain position is extremely useful for



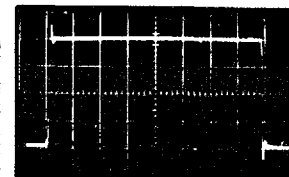
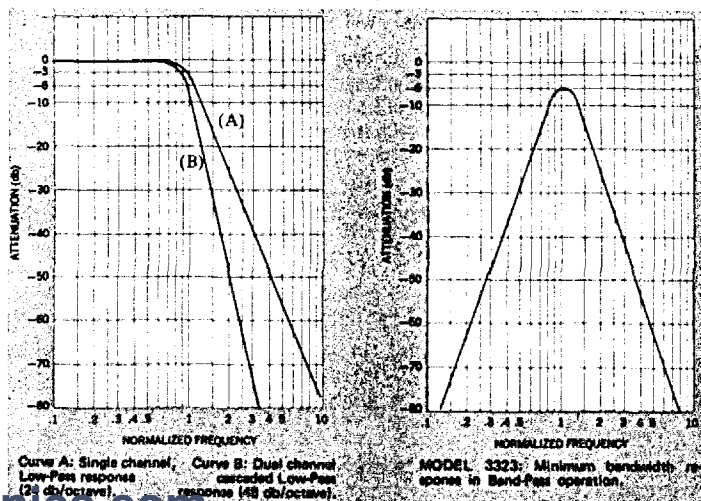
improving the signal-to-noise ratio of low level signals. The 10M ohm input impedance minimizes loading, and the 50 ohm output impedance improves high frequency performance.

BATTERY OPERATION

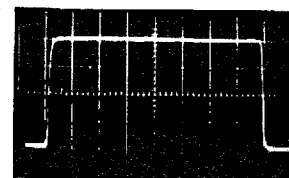
All filters are designed to operate from either ac line or from rechargeable, nickel cadmium batteries. The battery operation in the Model 3321 and 3323 is ideal for either remote applications, or when isolation from the ac line is required. Filters initially ordered without batteries may be easily converted to battery operation at any later date, by purchasing a battery kit from Krohn-Hite.

These filters are designed primarily for applications in the ultra-low frequency range. Their excellent cutoff frequency accuracy and resettability, coupled with stable output dc level and low distortion, results in a significant contribution to filter technology.

The 3300 Filter Series also include the Models 3320, 3322, 3340, 3341, 3342 and 3343. Refer to separate bulletins for detailed specifications.



Response (in Low-Pass mode) to 1 Hz square wave, with cut-off at 1 kHz in Butterworth position.



Response to same square wave in Low Q position

FILTER CHARACTERISTICS

Function:

Model 3321 (Single Channel): High-pass, 24dB/octave, low-pass, 24dB/octave.

Model 3323 (Dual Channel): Channels cascaded, high-pass, 48dB/octave, low-pass, 48dB/octave, band-pass, 24dB/octave. Channels connected in parallel; Band-reject, 24dB/octave.

Cutoff Frequency Range: 0.01Hz to 99.9kHz.

Band	Multiplier	Frequency	Resolution (Hz)
1	0.01	0.01Hz-9.99Hz	0.01
2	0.1	10.0Hz-99.9Hz	0.1
3	1	100Hz-999Hz	1
4	10	1.00kHz-9.99kHz	10
5	100	10.0kHz-99.9kHz	100

Frequency Control (Each Channel): Three rotary decade switches for frequency digits and a five position rotary multiplier switch.

Cutoff Frequency Calibration Accuracy: $\pm 2\%$ from 0.05Hz to 9.99kHz, rising to $\pm 10\%$ at 0.01Hz (less accurate in high-pass mode at 0.01Hz), $\pm 10\%$ from 10kHz to 99.9kHz (band 5). Relative to passband level, the filter output is down 3dB at cutoff in the Butterworth (maximally flat) position and approximately 15dB down when operated in a low-pass filter in the RC (transient free) position.

BANDWIDTH

Low-Pass Mode: DC to cutoff frequency setting within the range from 0.01Hz to 99.9kHz.

High-Pass Mode: Cutoff frequency setting between the range of 0.01Hz to 99.9kHz to the upper 3dB point of approximately 1MHz.

Band-Pass Operation (Model 3323): Variable within the cutoff frequency limits of 0.01Hz to 99.9kHz. For minimum bandwidth, the high-pass and low-pass cutoff frequencies are set equal. This produces an insertion loss of 6dB, with the -3dB points at 0.8 and 1.25 times the mid-band frequency.

Band-Reject Operation (Model 3323): Variable within the cutoff frequency limits of 0.01Hz to 99.9kHz. The low-pass band extends to dc. The high-pass band has its upper 3dB point at approximately 1MHz.

RESPONSE CHARACTERISTICS

Butterworth: Maximally flat, four-pole Butterworth response for optimum performance in the frequency domain.

RC: Four-pole damped response for transient-free time domain performance.

Attenuation Slope: Nominal 24dB/octave per channel in high-pass or low-pass modes.

Maximum Attenuation: > 80 dB for input frequencies to 1MHz.

Passband Gain (selected by front panel controls): 0dB, ± 0.5 dB or 20dB, ± 0.5 dB for bands 1-4; 0dB, ± 1 dB or 20dB, ± 1 dB for band 5.

INPUT CHARACTERISTICS

Maximum Voltage: ± 7 V peak in the 0dB gain position, ± 0.7 V peak in the 20dB gain position to 500kHz, decreasing to ± 3 V peak (± 0.3 V peak in the 20dB gain position) at 1MHz.

Maximum DC Component:

Low-Pass Mode: Combined ac plus dc should not exceed 7V peak in the 0dB gain position and 0.7V peak in the 20dB gain position.

High-Pass Mode: ± 100 V.

Impedance: 10M ohms in parallel with 100pF.

OUTPUT CHARACTERISTICS

Maximum Voltage: ± 7 V peak to 500kHz, decreasing to ± 3 V peak at 1MHz, open circuit.

Maximum Current: ± 70 mA peak to 500kHz, decreasing to ± 30 mA peak at 1MHz.

Impedance: 50 ohms.

Distortion: Typically $< 0.1\%$ over most of the range.

Hum and Noise (0dB or 20dB gain position): $< 500\mu$ V rms for a detector bandwidth of 100kHz, rising to 2mV rms for a detector bandwidth of 10MHz. Band 5, high-pass mode only, 2mV rms for a detector bandwidth of 100kHz, rising to 5mV rms for a detector bandwidth of 10MHz.

Output DC Level Stability: ± 1 mV/hour, ± 1 mV/ $^{\circ}$ C.

GENERAL

Operating Temperature Range: -10° C to 45° C.

Floating (ungrounded) Operation: A switch is provided on rear of chassis to disconnect signal ground from chassis ground.

Terminals: Front panel and rear panel of chassis, one BNC connector for input, one for Output, each channel. One rear terminal for chassis ground.

Power Requirements: 105-125 or 210-250 volts, single phase, 50-400Hz; 5 watts for Model 3321, 10 watts for 3323.

Dimensions And Weights:

Model 3321: $5\frac{1}{4}$ " (13.3cm) high, $8\frac{5}{8}$ " (21.9cm) wide, $13\frac{1}{2}$ " (34.3cm) deep; 12 lbs (5.5kg) net, 14 lbs (6.4kg) shipping.

Model 3323: $5\frac{1}{4}$ " (13.3cm) high, $16\frac{5}{8}$ " (42.2cm) wide, $13\frac{1}{2}$ " (34.3cm) deep; 24 lbs (10.9) net, 31 lbs (14.1 kg) shipping.

Accessories: 3-terminal line cord; operating and maintenance manual.

OPTIONS

Battery Kit:

Model 3321: Part no. BK-332.

Model 3323: Part no. BK-334.

Battery will operate approximately 10 hours without recharging.

Rack Mounting Kit:

Model 3321: Part no. RK-58.

Model 3323: Part no. RK-519.

Permits the Model 3321 or 3323 to be installed into a standard 19" rack spacing.

Band-Reject Kit: Part No. BR-30, connectors and cables to adapt two channels for series or parallel operation.

Specifications subject to change without notice.