

Model 3988

0.03Hz to 1MHz, Dual Channel Butterworth/Bessel Programmable Filter

- Two Channel
- Cutoff Frequency Range: 0.03Hz to 1MHz
- Attenuation Slope: 48dB/Octave
- Filter Modes: Low-Pass and High-Pass
- Responses: Butterworth and Bessel
- Pre-Filter and Post-Filter Gains
- Input Type: Differential and Single-Ended
- Amplifier (Filter By-Pass) Mode
- GPIB Programmable



DESCRIPTION

The Krohn-Hite Model 3988 Butterworth/Bessel dual channel filter is one of a family of filters carefully designed with the user in mind, providing ease of operation, reliability and price competitiveness.

The 3988 provides a tunable frequency range from 0.03Hz to 1MHz in the low-pass mode and 0.03Hz to 300kHz in the high-pass mode. Both modes are extended down to 0.003Hz with the 002 option. The frequency response characteristic is either maximally flat (Butterworth) for clean filtering in the frequency domain, or linear phase (Bessel) to provide superior pulse filtering.

Each channel of the 3988 is an 8-pole, wide range, low-pass/high-pass filter or an amplifier providing gains to 70dB in 0.1dB steps. The 3988 will accept input signals of $\approx 10V$ peak at 0dB gain and has selectable ac or dc coupling. Overload detectors are standard and assist the user in detecting input signals or incorrect gain settings. Ninety-nine groups of non-volatile memory for storage of front panel set-ups are stored in battery-backed CMOS which can be recalled with a simple command.

BAND-PASS/BAND-REJECT OPERATION

With the Model 3988, the user can simply connect two channels in series to achieve band-pass operation or two in summed parallel for band-reject operation.

APPLICATIONS

Applications for the 3988 are ultra-sound measurements, random noise testing, sound recording, suppressing interference in audio communications and related fields of medical, geological, geophysical, oceanographic, military and more. All these features and more are backed with the quality Krohn-Hite has provided in filters since 1949.

SPECIFICATIONS

Specifications apply at 25°C, $\pm 5^\circ C$.

FUNCTIONS (Each Channel)

Low-pass filter, high-pass filter, voltage gain amplifier.

FILTER MODE

Type: 8-pole, Butterworth/Bessel.

Attenuation: 48dB/octave.

Tunable Frequency Range fc: Low-pass, 0.03Hz to 1MHz; high-pass, 0.03Hz to 300kHz; (option 002, 0.003Hz).

Frequency Resolution: 3 digits, 0.1Hz to max fc; 2 digits, 0.03Hz to 0.099Hz; (option 002, 1 digit, 0.003Hz to 0.009Hz; 2 digits, 0.01Hz to 0.099Hz).

Cutoff Frequency Accuracy: $\pm 1\%$, 0.5Hz to 50kHz; $\pm 2\%$, 50.1kHz to max fc; $\pm 5\%$, 0.03Hz to 0.5Hz (option 002, $\pm 5\%$, 0.003Hz to 0.5Hz).

Relative Gain at fc: $-3dB$, Butterworth; $-12.6dB$, Bessel.

High-Pass Bandwidth (0dB Gain): $>4MHz$.

Stopband Attenuation: >80dB.

Maximum Input: $\pm 10V$ peak at 0dB gain, reduced in proportion to gain setting; $\pm 7V$ peak for LP, $f_c > 500kHz$, $f_{sig} > 500kHz$.

Pre-Filter Gain: 0dB, 10dB, 20dB, 30dB, 40dB, 50dB, $\pm 0.2dB$.

Post-Filter Gain: 0dB to 20dB in 0.1dB steps, $\pm 0.2dB$.

Wideband Noise (2MHz bandwidth detector): 0dB gain, $< 300\mu V_{rms}$ for $f_c \leq 5kHz$, $< 500\mu V_{rms}$ for $f_c \leq 50kHz$, $\leq 1mV_{rms}$ for $f_c > 50kHz$. Max. gain, $< 25\mu V_{rms}$ RTI.

Harmonic Distortion: $-80dB$ at 1kHz.

DC Stability: Typically $\pm 2mV/^\circ C$.

AMPLIFIER MODE

Bandwidth: $> 7MHz$ min. gain; $> 700kHz$ max. gain.

Response: $\pm 0.1dB$ typical, $\pm 0.5dB$ max.

Gain: 0dB to 70dB in 0.1dB steps, $\pm 0.2dB$.

Input (Differential or single-ended +(in phase), -(inverted):

CMRR: $> 60dB$ to 10kHz; $> 50dB$ to 100kHz.

Sensitivity: 3mV peak with 70dB total gain for 10V peak output.

Maximum Input: $\pm 10V$ peak at 0dB gain, reduced in proportion to gain setting.

Impedance: 1 megohm in parallel with 100pf.

Coupling: ac (0.16Hz) or dc.

Maximum DC Component: $\pm 100V$ in ac coupled mode.

Output:

Maximum Voltage (open circuit): $\pm 10V$ peak.

Maximum Current: $\pm 80mA$ peak.

Impedance: 50 ohms.

DC Offset: Adjustable to zero volts.

Harmonic Distortion (1V output): $-80dB$ (0.01%) to 10kHz; $-60dB$ (0.1%) to 100kHz.

Wideband Noise (RTI, 2MHz BW detector): $300\mu V_{rms}$ min. gain; $25\mu V_{rms}$ max. gain.

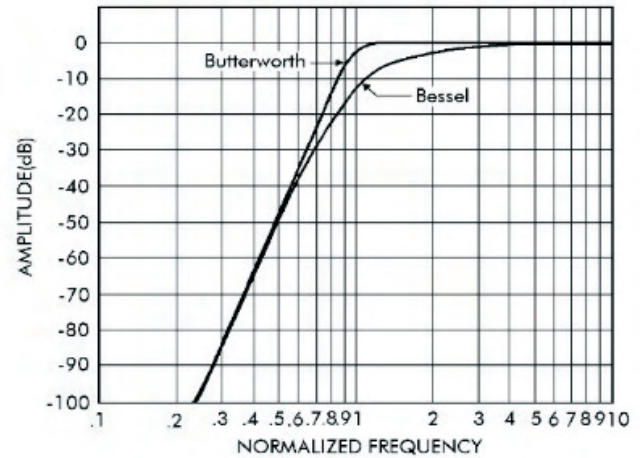
DC Stability (RTI): Typically $\pm 10mV/6C$.

GENERAL

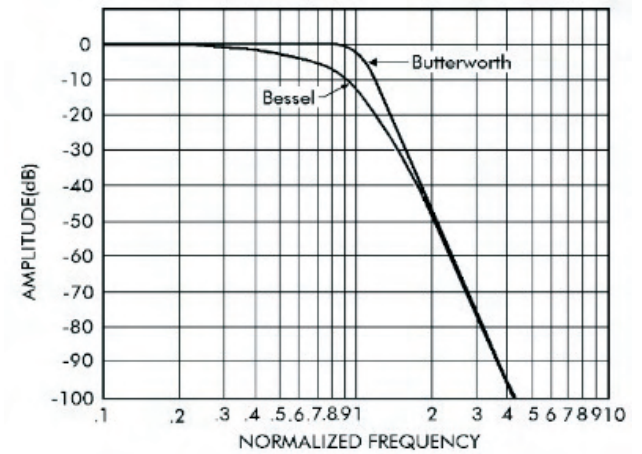
Crosstalk Between Channels: $-85dB$ below full scale with input source < 50 ohms.

Low-Pass Phase Match Between Channels: $\pm 2^\circ$ to 500kHz, $\pm 5^\circ$ to 1MHz.

High-Pass Phase Match Between Channels: For $f_c \leq 100kHz$, $\pm 2^\circ$ for $f_{sig} \leq 500kHz$, 2° times $f_{sig}/500kHz$ for



High-Pass Amplitude Response



Low-Pass Amplitude Response

f_{sig} to 2MHz; for $f_c > 100kHz$, $\pm 5^\circ$ for $f_{sig} \leq 500kHz$, 5° times $f_{sig}/500kHz$ for f_{sig} to 2MHz.

Gain Match Between Channels: $\pm 0.2dB$ max. to 100kHz.

Switch: For selection of Input, +(in phase), Differential or -(inverted).

Memory: 99 selectable groups; memory is non-volatile battery-backed CMOS.

Self-Test Diagnostics: MPU checks unit upon power-up. Display indicates failure mode.

Displays: 7 segment, green, LED; 0.3" high.

Remote Programming: IEEE-488.1 interface. Subsets: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT0, C0, E1.

Operating Temperature: $0^\circ C$ to $50^\circ C$.

Isolation to Chassis: $\pm 200V_{dc}$.

Input/Output Connectors: BNC.

Power: 50 watts.

Dimensions and Weights: 3.5" (9cm) high, 8.5" (21.8cm) wide, 18" (46.2cm) deep; 12 lbs (5.4kg) net, 14 lbs (6.3kg) shipping.

Accessories: 6 foot, 3-terminal line cord, operating manual.

OPTIONS

002: extends low end cutoff to 0.003Hz.

Rack Mount Kit: Part No. RK-37, permits installation of the Model 3988 into a standard 19" rack spacing.

Extended 1 Year Warranty: Part No. EW3988.

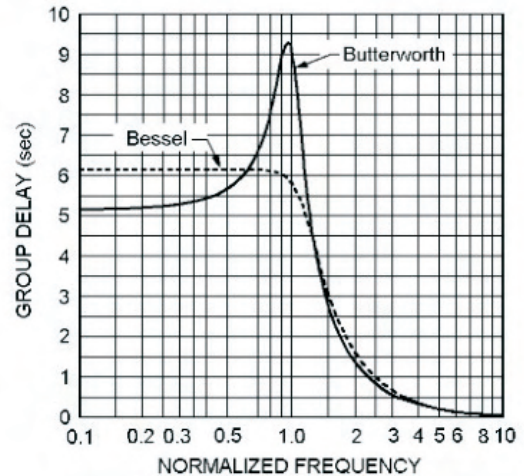
OPTIONAL ACCESSORIES

CAB-010: GPIB Cable with Connectors, 2-Meters

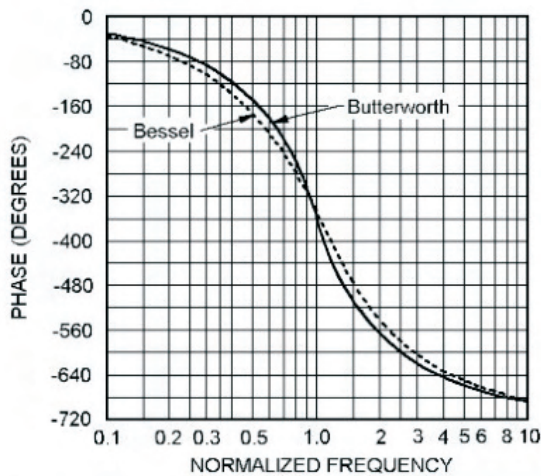
CAB-011: GPIB Cable with Connectors, 1-Meters

CAB-025: Cable, BNC, 3ft, Low Noise

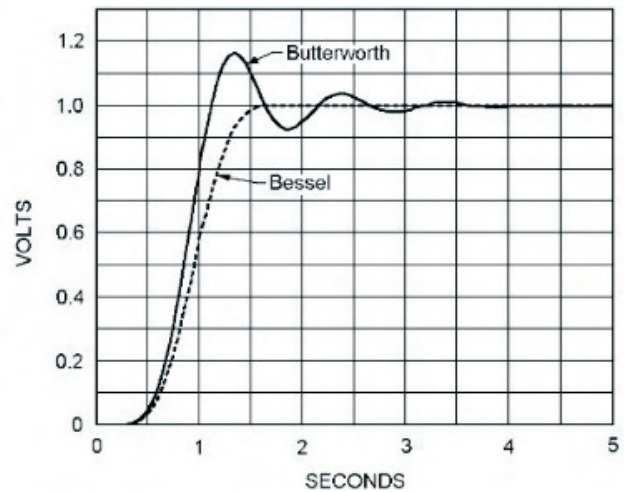
Specifications subject to change without notice.



Group Delay



Phase Response



Transient Response