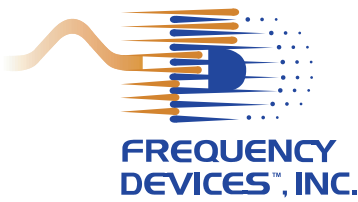


# ASC-50

## OPERATION MANUAL September 2001



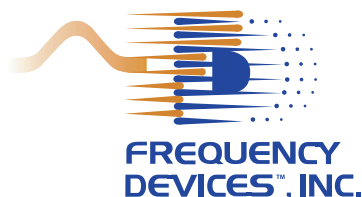


# ASC-50 Operation Manual

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# ASC-50 Operation Manual

The ASC-50 is a self-contained signal conditioning filter/amplifier instrument that combines Analog and Digital Signal Processing (DSP) capabilities while providing conventional analog signal input and output. Analog and DSP functions are available without the need for computer programming while familiar analog instrument operation is maintained. Data entry is accomplished via a “soft front panel” and a two line Liquid Crystal Display (LCD) that prompts the user to select among various menu choices.

## Features

- Wide variety of filter types, functions and frequencies
- Precise, stable filter performance
- Adjustable gain and attenuation
- DC offset control
- Choice of single or differential inputs
- Special DSP bypass
- Analog and DSP clip indicators
- Filter performance display

## Filter Types

- Low-pass (LP)
- High-pass (HP)
- Band-pass (BP)
- Band-reject (BR)

## Filter Functions

- Butterworth (Buttr)
- Chebyshev (Cheby)
- Elliptic-60dB (EII60)
- Elliptic-80dB (EII80)
- FIR-40dB (FIR40)
- FIR-60dB (FIR60)
- FIR-80dB (FIR80)

## Gain Control

- PRE** - Analog pre-gain range 0 to +36dB in 6dB steps
- POST** - Digital post-gain range -48dB to +42dB in 6dB steps

**DC Offset Control** - Input DC offset range  
±5 Volts

## Over-Range Indication

- Analog saturation, clipping detection (← **CLIP**)
- Digital saturation, clipping detection (**CLIP** →)

## Available Low-Pass, High-Pass Transfer Functions

### ANALOG

Butterworth	4,6,8,10 Pole
Chebychev (0.1dB Ripple)	4,6,8,10 Pole
Elliptic-60 dB (0.1dB Ripple)	4,6,8,10 Pole
Elliptic-80 dB (0.1dB Ripple)	4,6,8,10 Pole

### DIGITAL

FIR-40 dB  
FIR-60 dB  
FIR-80 dB

## Band-Pass, Band-Reject Transfer Functions

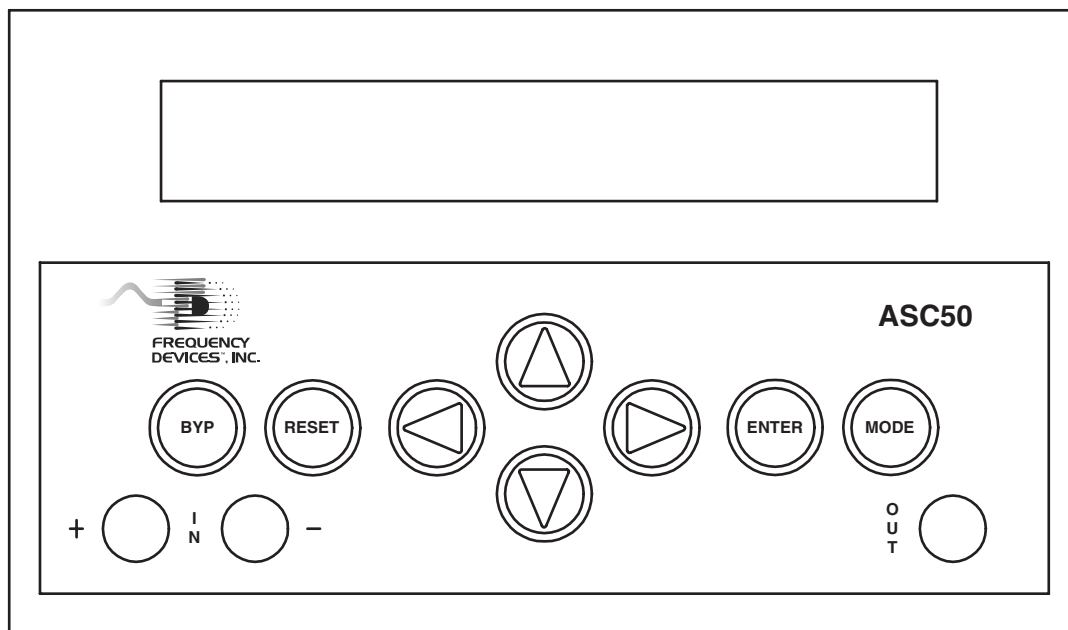
### ANALOG

Butterworth	3,4 Pole-Pair	Q = 2,5,10,20
Chebychev	3,4 Pole-Pair	Q = 2,5,10,20
Elliptic-60 dB (0.1dB Ripple)	3,4 Pole-Pair	Q = 2,5,10,20
Elliptic-80 dB (0.1dB Ripple)	3,4 Pole-Pair	Q = 2,5,10,20

### DIGITAL

FIR-40 dB	BW1,BW2,BW3,BW4
FIR-60 dB	BW1,BW2,BW3,BW4
FIR-80 dB	BW1,BW2,BW3,BW4

## LOCATION OF FRONT PANEL CONTROLS AND TERMINATIONS



## Power-On/Off

A two-position toggle switch located on the rear panel turns the AC power on and off. Upon power-on, the front panel will display **MODE 1** of the set-up present at the time power was turned off.

## A. Mode Key

Many more functions are controlled than could be displayed on one screen. Four modes of operation are utilized. Each press of the **MODE** key displays a different mode (1 through 4). Four consecutive presses of the **MODE** key will return the display to the initial mode.

## B. Enter Key

In order to load the filter chosen via the arrow keys, it is necessary to press the **Enter** key. Until this is done the present filter is still operating. This allows the operator to spool through the available choices before making a selection. When in **MODE 1**, to warn the user that a new filter selection has not yet been made operational, the **Warning: <ENT> flashes**. It is extinguished by pressing the **ENTER** key which loads the selected filter.

## C. Arrow Keys

Four **arrow (←, →, ↑, ↓) keypads** are available to highlight fields and make selections. The **left ←** and **right → arrows** allow movement within fields and are used to select the field to be modified. Continuous looping through all the fields will occur as the **left ←** or **right → arrow** key is repeatedly pressed. The **up ↑** and **down ↓ arrows** cycle between the various choices available in each field. Changes that require use of the **ENTER** key are indicated by the flashing **<ENT>** symbol (**MODE 1 only**).

## D. Reset Key

During the filter selection process and before pressing **Enter** or while the warning **<ENT>** flashes, the user can return the display to the current active filter mode by pressing **RESET**.

## E. Bypass Key

The internal DSP filter can be bypassed by pressing the **BYP** key. This will bypass the DSP filter, but not the input anti-alias (**AA**) and output reconstruction (**RC**) filters. The **BYP** key toggles between the active and bypass modes (denoted **ACT** and **BYP** on the display) and always returns the display to **MODE 1**. This permits the operator to monitor the effects of the DSP filter.

## F. Input Connectors

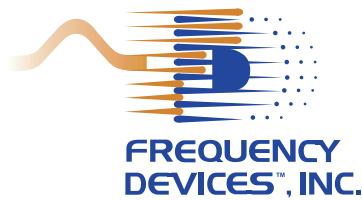
Two shielded, female BNC input (**+IN** and **-IN**) connectors are present on the front panel. An input signal connected to the **+IN** provides single-ended input. To operate in the differential input mode, differential input signals must be connected to the **+IN** and **-IN** connectors. The **-IN** connector is only used for the differential input-operating mode.

## G. Output Connector

One shielded female BNC output connector is present on the front panel.

## H. LCD Display

A two-line display indicates the setup choices available as well as providing the user selected characteristics. Fields that are controllable are presented to the display for viewing (a **flashing cursor** within a field indicates the specific parameter that can be modified by utilizing the arrow keys). Selected performance characteristics are also identified. A **Menu Options** chart is included (see **Attachment 1**) to indicate how selections are made within modes and fields. . User choices are made via the **arrow (←, →, ↑, ↓) and Enter Keys**.



# ASC-50 Operation Manual

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## USING THE ASC-50

### User Interface

User entry is accomplished by means of a “soft front panel” with the user entry prompted by the display.

**Left ← and Right → Arrows** - place the blinking cursor on the function that is to be changed.

**Up ↑ and Down ↓ Arrows** - make changes to the current setup.

**<ENT>** - In **MODE 1** a blinking **<ENT>** on the display reminds the user that new functions are not implemented until the **ENTER** button is pressed.

**MODE** - selects which menu is displayed. **MODE** makes no changes to the current setup. By repeatedly pressing **MODE** the entire setup can be reviewed without making any changes.

**ENTER** - implements the selected setup.

**BYP** - provides a special DSP bypass operation, its use is signaled on the display.

**RESET** - allows the previous setup to be restored.

### Flashing Cursor

A **Flashing Cursor** indicates which field is awaiting update.

### DISPLAY MODES

Three display modes register the complete range of operational choices; the fourth mode provides filter characteristics. Pressing the **MODE** key a maximum of three times will display the modes in succession. The fourth time **MODE** is pressed the original display is returned.

**Field 1 - Filter type**

- A. LP (Low-pass)
- B. HP (High-pass)
- C. BP (Band-pass)
- D. BR (Band-reject)

**Field 2 - Filter function**

- A. Buttr (Butterworth)
- B. Cheby (Chebyshev)
- C. Ell60 (Elliptic-60dB)
- D. Ell80 (Elliptic-80dB)
- E. FIR40 (Finite Impulse Response 40dB)
- F. FIR60 (Finite Impulse Response 60dB)
- G. FIR80 (Finite Impulse Response 80dB)

**Field 3 - Number of Poles**

(Does **not** apply for FIR filters)

- A. 4P (4 Pole)
- B. 6P (6 Pole)
- C. 8P (8 Pole)
- D. 10P (10 Pole)
- E. 3PP (3 Pole Pair)
- F. 4PP (4 Pole Pair)

**Field 1 - Analog Pre-gain Control**

- A. Pre-gain ( 0dB to +36dB)

**Field 1 - Single / Differential Input Control**

- A. SNG (Single Ended Input)
- B. DIF (Differential Mode Input)

**Field 1 - Filter Performance,**

Shape Factor/Transition Band

- A. Shape Factor - Shape Factor Ratio
- B. Trans BW-Transition Bandwidth (Hz)
- C. Pass BW-Pass-band Bandwidth (Hz)
- D. Stop BW-Stop-band bandwidth (Hz)
- E. Warning - 1, 2, 3

**Mode 1**

**Field 4 - Q/Bandwidth**

- A. Q2 (Q=2) Does **not** apply to FIR40, FIR60, FIR80
- B. Q5 (Q=5) Does **not** apply to FIR40, FIR60, FIR80
- C. Q10 (Q=10) Does **not** apply to FIR40, FIR60, FIR80
- D. Q20 (Q=20) Does **not** apply to FIR40, FIR60, FIR80
- E. BW1 (FIR BW #1) Does **not** apply to Buttr, Cheby, Ell60, Ell80
- F. BW2 (FIR BW #2) Does **not** apply to Buttr, Cheby, Ell60, Ell80
- G. BW3 (FIR BW #3) Does **not** apply to Buttr, Cheby, Ell60, Ell80
- H. BW4 (FIR BW #4) Does not apply to Buttr, Cheby, Ell60, Ell80

**Field 5 – Active/Bypass**

- A. Active mode (**ACT**)
- B. DSP Bypass mode (**BYP**)

**Field 6 – Corner Frequency**

- A. 0.10 Hz - 0.99 Hz (0.01 Hz Steps)
- B. 1 Hz - 9.9 Hz (0.1 Hz Steps)
- C. 10 Hz - 99 Hz (1 Hz Steps)
- D. 100 Hz - 990 Hz (10 Hz Steps)
- E. 1,000 Hz - 9,900 Hz (100 Hz Steps)
- F. 10,000 Hz - 30,000 Hz (1000 Hz Steps)

**Mode 2**

**Field 2 - DSP Post-gain Control**

- A. Post-gain (-48dB to +42dB)

**Mode 3**

**Field 2 - Input DC Offset Control, relative DC offset**

- A.  $\pm 5V$  range in  $\geq 0.15mV$  steps

**Mode 4**

**Field 2 – Stop-band Bandwidth**

- A. BW (Hz)

Filter performance characteristics presented to the display are not available for change but rather indicate relative performance of the various filters (See **Attachment 2** for plots of the available filter transfer functions).

### Shape Factor (SF)

Used for analog filters to indicate the ratio of corner frequency of the filter to attenuation floor frequency. In the case of Butterworth (**Buttr**) and Chebychev (**Cheby**) filters an attenuation level of 80dB is assumed. Band-pass (**BP**) and Band-reject (**BR**) filters exhibit the same attenuation slope on both the upper and lower sides of the response (symmetric).

### Transition Bandwidth (Trans BW)

Low-pass (**LP**) and high-pass (**HP**) digital filters are labeled with a bandwidth (Hz) that expresses the difference between the attenuation floor frequency and the upper (**LP**) or lower (**HP**) limit of the pass-band frequency.

### Pass-band Bandwidth (Pass BW)

Band-pass (**BP**) and Band-reject (**BR**) digital FIR filters are labeled with a bandwidth (Hz) that expresses the difference between the two pass-band frequencies. The band-pass (**BP**) passes frequencies over the range ( $F_c \pm BW/2$ ). The band-reject (**BR**) passes frequencies outside the range ( $F_c \pm BW/2$ ).

### Stop-band Bandwidth (Stop BW)

Band-pass (**BP**) and band-reject (**BR**) digital FIR filters are labeled with a bandwidth (Hz) that expresses the difference between the two stop-band frequencies. The band-pass (**BP**) filter rejects frequencies outside of the range ( $F_c \pm BW/2$ ). The band-reject (**BR**) rejects frequencies over the range ( $F_c \pm BW/2$ ).

## WARNING MESSAGES

**Warning Messages** indicate that a filter is operating outside of normal limits.

### Warning 1 - HP FIR (Attenuation @ DC)

This message is displayed when the selected FIR high-pass filter is unable to achieve the desired level of attenuation at a frequency of 0 Hz (DC).

### Warning 2 - BP FIR (Attenuation @ DC)

This message is displayed when the selected FIR band-pass filter is unable to achieve the desired level of attenuation at a frequency of 0 Hz (DC).

### Warning 3 - BR FIR (Attenuation @ DC)

This message is displayed when the selected FIR band-reject filter is unable to achieve the desired level of attenuation at a frequency of 0 Hz (DC).



## Sampling Rate Control

The maximum bandwidth of any DSP system is limited to less than one-half of the sampling frequency. In the case of the ASC-50 the maximum bandwidth is one-quarter of the sampling frequency. In order to provide the highest performance from the available bandwidth the ASC-50 provides an automatic-sampling rate selection control. A sampling frequency between 36Hz and 150kHz is chosen depending on the filter type, function and frequency (See **CHART 1** below).

<b>Filter Function</b>	<b>Filter Type</b>	<b>Corner Frequency</b>	<b>Sample Frequency</b>	<b>System BW</b>
LP,HP	Analog/Digital	$F_c < 0.735 \text{ Hz}$	36.7 Hz	9 Hz
BP,BR	Analog/Digital	$F_c < 1.47 \text{ Hz}$	36.7 Hz	9 Hz
LP,HP	Analog/Digital	$1.47 \text{ Hz} > F_c \geq 0.735 \text{ Hz}$	73.5 Hz	18 Hz
BP,BR	Analog/Digital	$2.94 \text{ Hz} > F_c \geq 1.47 \text{ Hz}$	73.5 Hz	18 Hz
LP,HP	Analog/Digital	$2.94 \text{ Hz} > F_c \geq 1.47 \text{ Hz}$	147.1 Hz	36 Hz
BP,BR	Analog/Digital	$5.88 \text{ Hz} > F_c \geq 2.94 \text{ Hz}$	147.1 Hz	36 Hz
LP,HP	Analog/Digital	$5.88 \text{ Hz} > F_c \geq 2.94 \text{ Hz}$	294.1 Hz	73.5 Hz
BP,BR	Analog/Digital	$11.76 \text{ Hz} > F_c \geq 5.88 \text{ Hz}$	294.1 Hz	73.5 Hz
LP,HP	Analog/Digital	$11.76 \text{ Hz} > F_c \geq 5.88 \text{ Hz}$	588.3 Hz	147 Hz
BP,BR	Analog/Digital	$23.53 \text{ Hz} > F_c \geq 11.76 \text{ Hz}$	588.3 Hz	147 Hz
LP,HP	Analog/Digital	$23.53 \text{ Hz} > F_c \geq 11.76 \text{ Hz}$	1.17 kHz	294 Hz
BP,BR	Analog/Digital	$47.06 \text{ Hz} > F_c \geq 23.53 \text{ Hz}$	1.17 kHz	294 Hz
LP,HP	Analog/Digital	$47.06 \text{ Hz} > F_c \geq 23.53 \text{ Hz}$	2.35 kHz	588 Hz
BP,BR	Analog/Digital	$94.12 \text{ Hz} > F_c \geq 47.06 \text{ Hz}$	2.35 kHz	588 Hz
LP,HP	Analog/Digital	$94.12 \text{ Hz} > F_c \geq 47.06 \text{ Hz}$	4.71 kHz	1.17 kHz
BP,BR	Analog/Digital	$188.25 \text{ Hz} > F_c \geq 94.12 \text{ Hz}$	4.71 kHz	1.17 kHz
LP,HP	Analog/Digital	$188.25 \text{ Hz} > F_c \geq 94.12 \text{ Hz}$	9.41 kHz	2.35 kHz
BP,BR	Analog/Digital	$376.50 \text{ Hz} > F_c \geq 188.25 \text{ Hz}$	9.41 kHz	2.35 kHz
LP,HP	Analog/Digital	$376.50 \text{ Hz} > F_c \geq 188.25 \text{ Hz}$	18.8 kHz	4.71 kHz
BP,BR	Analog/Digital	$753.00 \text{ Hz} > F_c \geq 376.50 \text{ Hz}$	18.8 kHz	4.71 kHz
LP,HP	Analog	$753.00 \text{ Hz} > F_c \geq 376.50 \text{ Hz}$	37.6 kHz	9.41 kHz
LP,HP	Digital	$1.506 \text{ kHz} > F_c \geq 376.50 \text{ Hz}$	37.6 kHz	9.41 kHz
BP,BR	Analog	$1.506 \text{ kHz} > F_c \geq 753.00 \text{ Hz}$	37.6 kHz	9.41 kHz
BP,BR	Digital	$3.012 \text{ kHz} > F_c \geq 753.00 \text{ Hz}$	37.6 kHz	9.41 kHz
LP,HP	Analog	$1.506 \text{ kHz} > F_c \geq 753.00 \text{ Hz}$	75.3 kHz	18.8 kHz
LP,HP	Digital	$6.024 \text{ kHz} > F_c \geq 1.506 \text{ kHz}$	75.3 kHz	18.8 kHz
BP,BR	Analog	$3.012 \text{ kHz} > F_c \geq 1.506 \text{ kHz}$	75.3 kHz	18.8 kHz
BP,BR	Digital	$12.048 \text{ kHz} > F_c \geq 3.012 \text{ kHz}$	75.3 kHz	18.8 kHz
LP,HP	Analog	$30.000 \text{ kHz} > F_c \geq 1.506 \text{ kHz}$	150.6 kHz	37.6 kHz
LP,HP	Digital	$30.000 \text{ kHz} > F_c \geq 6.024 \text{ kHz}$	150.6 kHz	37.6 kHz
BP,BR	Analog	$30.000 \text{ kHz} > F_c \geq 3.012 \text{ kHz}$	150.6 kHz	37.6 kHz
BP,BR	Digital	$30.000 \text{ kHz} > F_c \geq 12.048 \text{ kHz}$	150.6 kHz	37.6 kHz

**CHART 1**

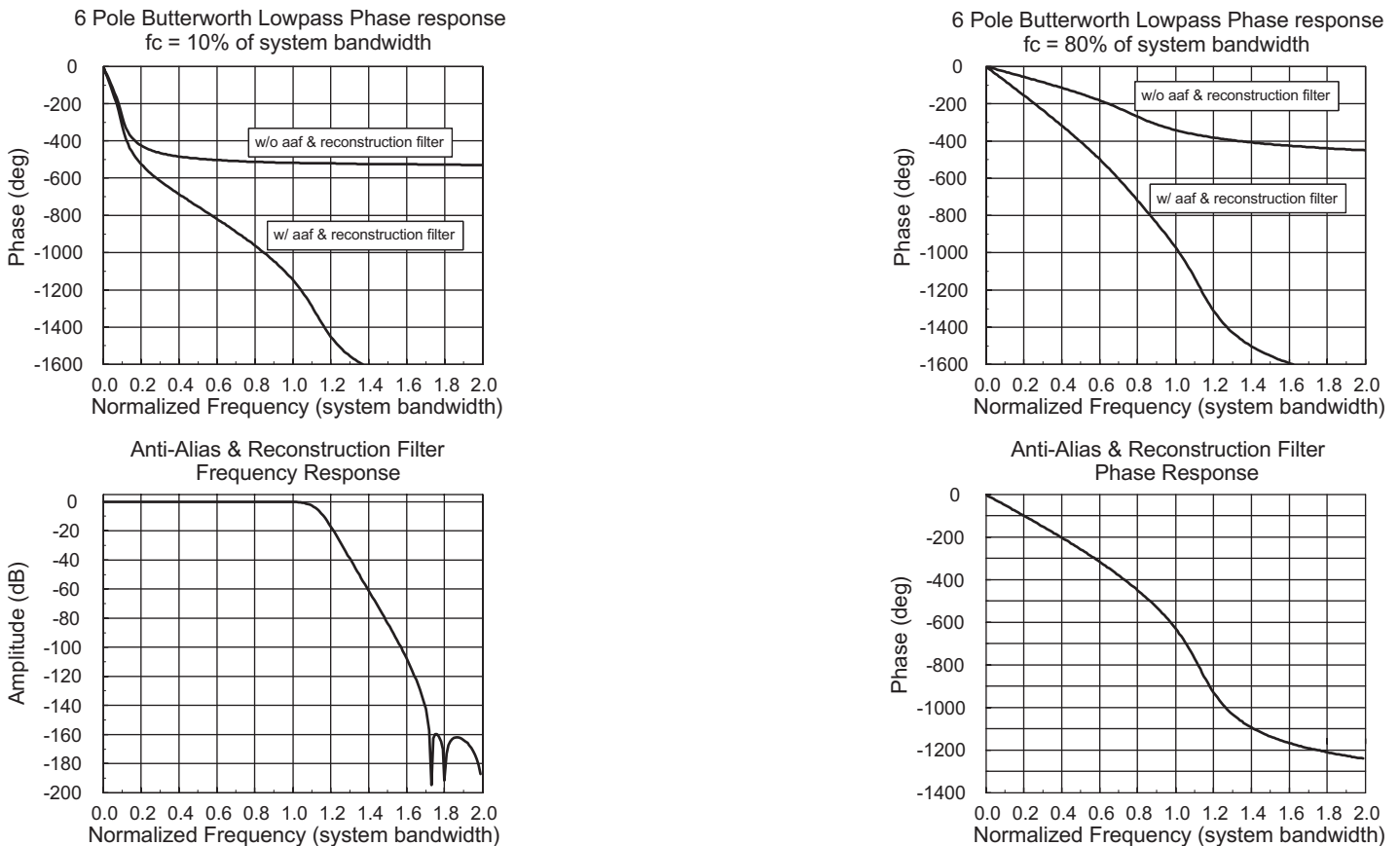
## OPERATIONAL CONSIDERATIONS

### Anti Alias and Reconstruction Filters

The automatic sample control is transparent to the user and operates the internal input anti-alias (**AA**) and output reconstruction (**RC**) filters. These filters, operating in cascade, determine the system bandwidth and phase characteristics.

The system bandwidth (amplitude response) is always limited to one-quarter of the sampling frequency in use. **CHART 1** (above) shows the sample rate and system bandwidth for the available filter configurations. For low-pass (LP) and band-pass (BP) filters this is of little consequence because the cutoff frequency is internally programmed to be within the system bandwidth. However, the high frequency amplitude response of high-pass and band-reject filters is limited to the system bandwidth.

The phase response of the AA and RC filters is always added to the filter function that is selected via the front panel. This effect is more pronounced on analog filter transfer functions than on the digital (FIR) filter transfer functions and when the filter selected is programmed to a frequency close to the sample rate. The delay, in digital (FIR) transfer functions, which appears as linear phase shift, is generally large enough that the phase contributed by the AA and RC filters is not significant. **Figure 1** illustrates the effects of this additional phase on typical Butterworth low-pass filters with corner frequencies of 10% and 80% of system bandwidth.



**FIGURE 1**

## Instrument Gain and Offset Considerations

The user is provided with wide latitude in the selection of **pre-gain (PRE)** and **post-gain (POST)**. Practical considerations should be recognized, since the linear operating range of both the input and output analog circuitry is limited to  $\pm 10V$  peaks (7.07Vrms in the case of a sine wave) hence amplitudes greater than this amount will result in saturation of the input or output. A large value of pre-gain may result in the saturation of the analog input stages and no-amount of post-gain correction will restore linear operation. Likewise very large values of post-gain may result in the saturation of the DSP output section. Very small values for post-gain may create poor signal-to-noise ratios as the DSP output is severely attenuated.

## Clip Indications

To assist the user in identifying potential saturation, (non-linear operating condition), two clip-indicators are provided.

An analog clip indicator (**← CLIP**) indicates that the input voltage after the application of pre-gain (**PRE**) exceeds the maximum linear ( $\pm 10$  Volt) range of the instrument. This is an approximate detector. Depending on the frequency and type of waveform applied to the input, non-linear operation may occur without an analog clip indication.

A digital clip indicator (**CLIP →**) is activated when the peak-to-peak level of the output DSP waveform exceeds the digital-to-analog converters maximum range after the application of post-gains (**POST**).

## Input Voltage Range

The ASC-50 has a maximum input operating voltage range of  $\pm 10$ Volts. Operation beyond this range will result in the display of one or both **CLIP** indicators. Maximum safe input range (non-operating) is noted in the specification.

## DC Offset Capability

The DC offset capability allows the ASC-50 to accept input waveforms with DC levels that would otherwise cause the instrument to saturate, especially at high gain levels. The offset value displayed represents the approximate voltage that the input stage is offset from zero (0) Volts. Some external means of measuring the effect of a DC offset change is needed, such as a voltmeter or oscilloscope. The value presented is approximate, effects of drift must be recognized. Amplified dc offset can cause internal saturation and activation of the clip indicator.

## DSP Bypass Control

The overall frequency response of the ASC-50 is the cascade of the anti-alias and reconstruction filters as well as the DSP filter chosen. DSP Bypass (**BYP**) allows the operator to remove the DSP filter from the cascade while retaining frequency sampling along with anti-alias and reconstruction filtering.

Several uses for bypass are indicated. In order to judge the effect of the channel bandwidth, the DSP filter is temporarily removed, allowing a measurement to be made. Gain and phase responses can be obtained for DSP filters alone or by "normalizing" (using a relative 0dB gain and  $0^\circ$  phase) for sampling anti-alias and reconstruction filters. It must be remembered **that Bypass does not bypass the entire ASC-50** but merely the internal DSP filter.

## SPECIFICATIONS (@25°C and Rated Power Input)

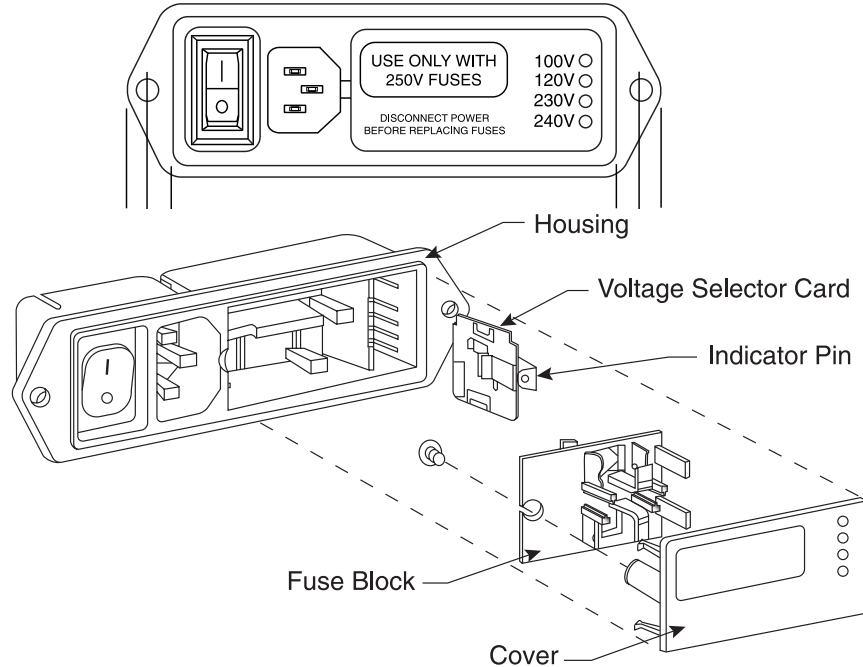
### Input Characteristics

Impedance	1M $\Omega$    47pF to Analog Ground (each input)
Input Configuration	Single Ended or Differential
Analog Clipping Indicator Threshold	$\pm 10V$
DC Offset	$\pm 5V$ DC
Analog Pre-Gain Range	0 to +36dB (6 dB steps)
CMMR	>60 dB @ 1 kHz

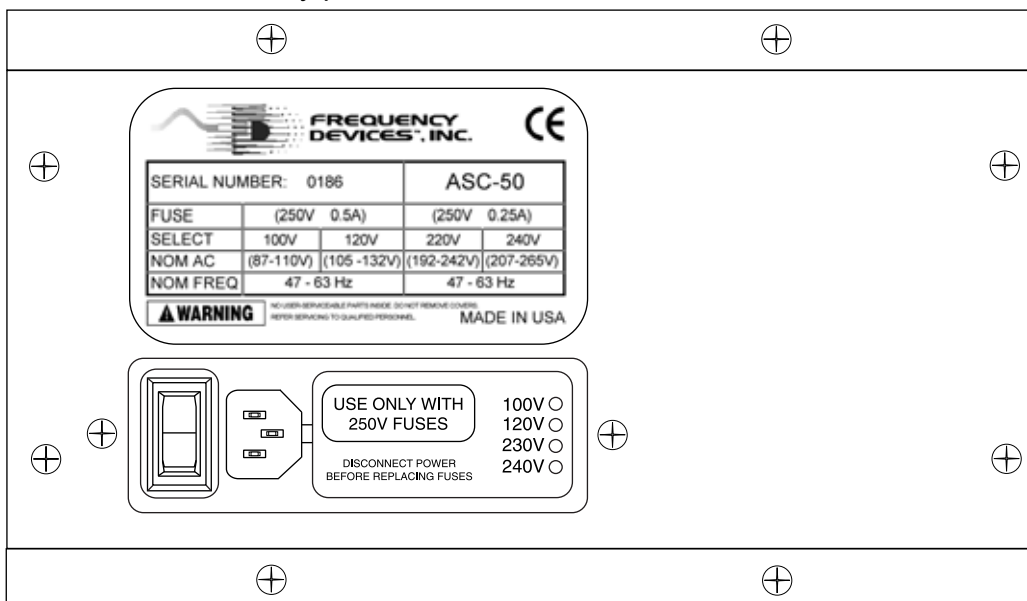
### Output Characteristics

Impedance	<1 $\Omega$
Output Configuration	Single Ended
Digital Clipping Indicator Threshold	$\pm$ Full Scale (Digital to Analog Converter)
Digital Post-Gain Range	-48dB to +42dB (6 dB steps)
Linear Signal Level	$\pm 10V$ Peak (7.07Vrms) max.
Safe Signal Level	$\pm 60V$ Peak max.
Total Harmonic Distortion	-70dBV typical @ 7.07Vrms 1kHz (Bypass Condition 30kHz BW)
Noise	-90dBV typical Input Grounded (Bypass Condition 30kHz BW)

## INSTRUCTIONS TO CHANGE VOLTAGE ASC-50 BACK PANEL POWER ENTRY MODULE

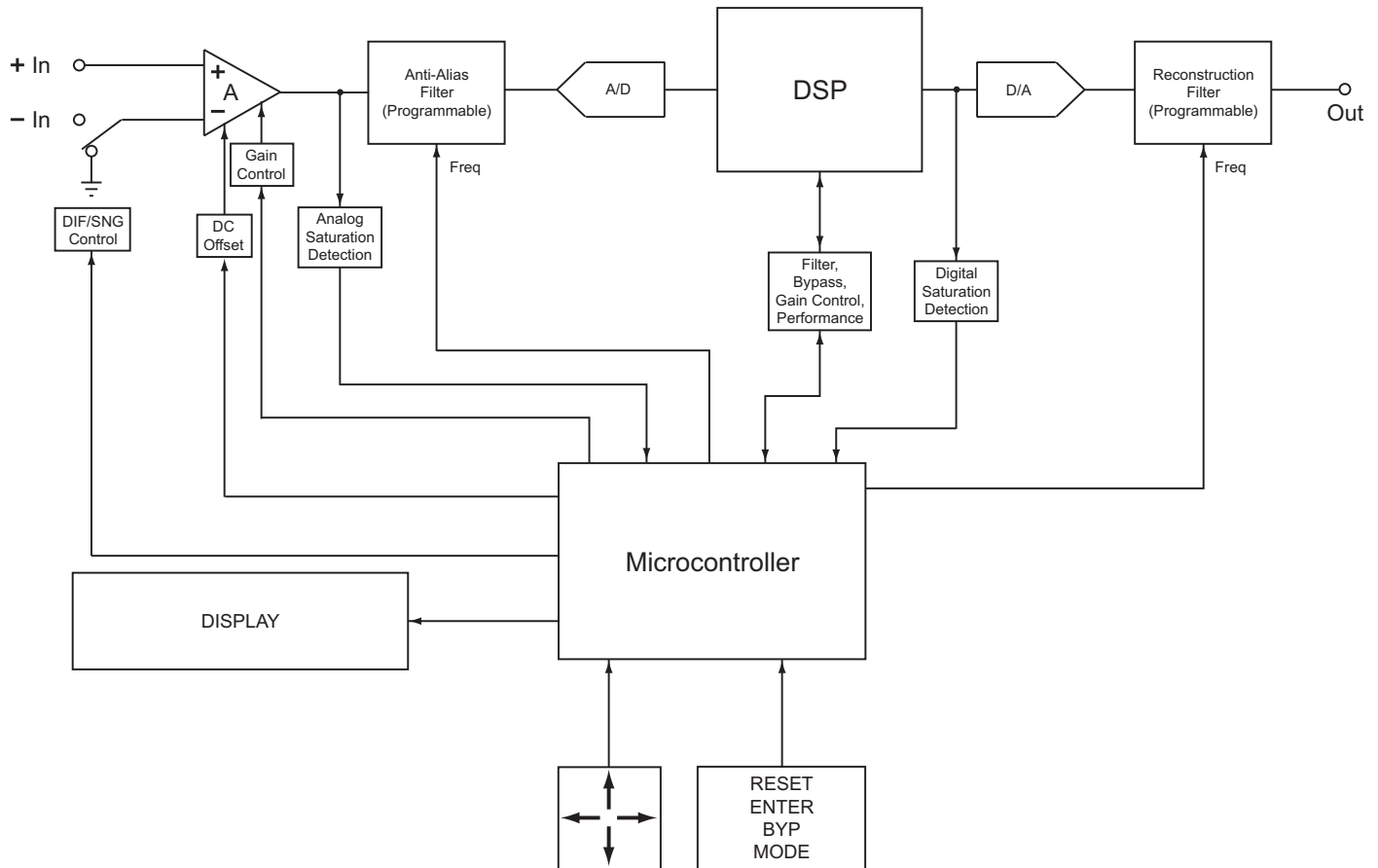


1. Disconnect power
2. Remove black plastic cover next to power cord connection.
3. Check fuses and replace blown fuse with 250V fuse.
4. Remove pc-board with white plastic tab and position pc-board and tab for 230V or 240V operating voltage. White dot will show in window when correctly positioned.
5. Replace black plastic cover that contains new fuse.
6. Plug-in to electrical outlet and verify performance.



## Theory of Operation

Referring to the block diagram (**Figure 2**), the operation of the ASC-50 can be explained in terms of the various functional blocks.



**ASC-50 Block Diagram**

**Figure 2**

### Micro-controller

The micro-controller acts as a central administrator for all functional elements. Keypad operations are transformed into a format that the Digital Signal Processor (DSP) can recognize and display characters generated by the micro-controller.

### Input Amplifier

Gain settings, single/differential input control, and DC offset level functions are incorporated within the input amplifier.

## **Saturation Detectors**

Analog and digital saturation detectors are routed from their sources to the display indicators.

## **Anti-alias Filter**

Limits the input bandwidth to one-fourth of the sampling frequency, preventing corruption from out-of-band signals.

## **Analog to Digital Converter**

The analog to digital converter (A/D) provides the Digital Signal Processor (DSP) with sampled amplitude data.

## **Digital Signal Processor (DSP)**

The Digital Signal Processor (DSP) creates filter functions based upon micro-controller command, permits transition between active (ACT) and bypass (BYP) modes, and produces filter performance characteristics for display. With the exception of filter or frequency change, the sampled data stream from/to the DSP is not interrupted by micro-controller - DSP communication. The DSP determines the sample frequencies, loads and stores the filter coefficients, begins filter operation.

## **Digital to Analog Converter**

The digital to analog converter (D/A) restores an analog waveform from the DSP output data word.

## **Reconstruction Filter**

Smooths the D/A waveform, removing sampling noise by limiting bandwidth to one-fourth the sampling frequency.

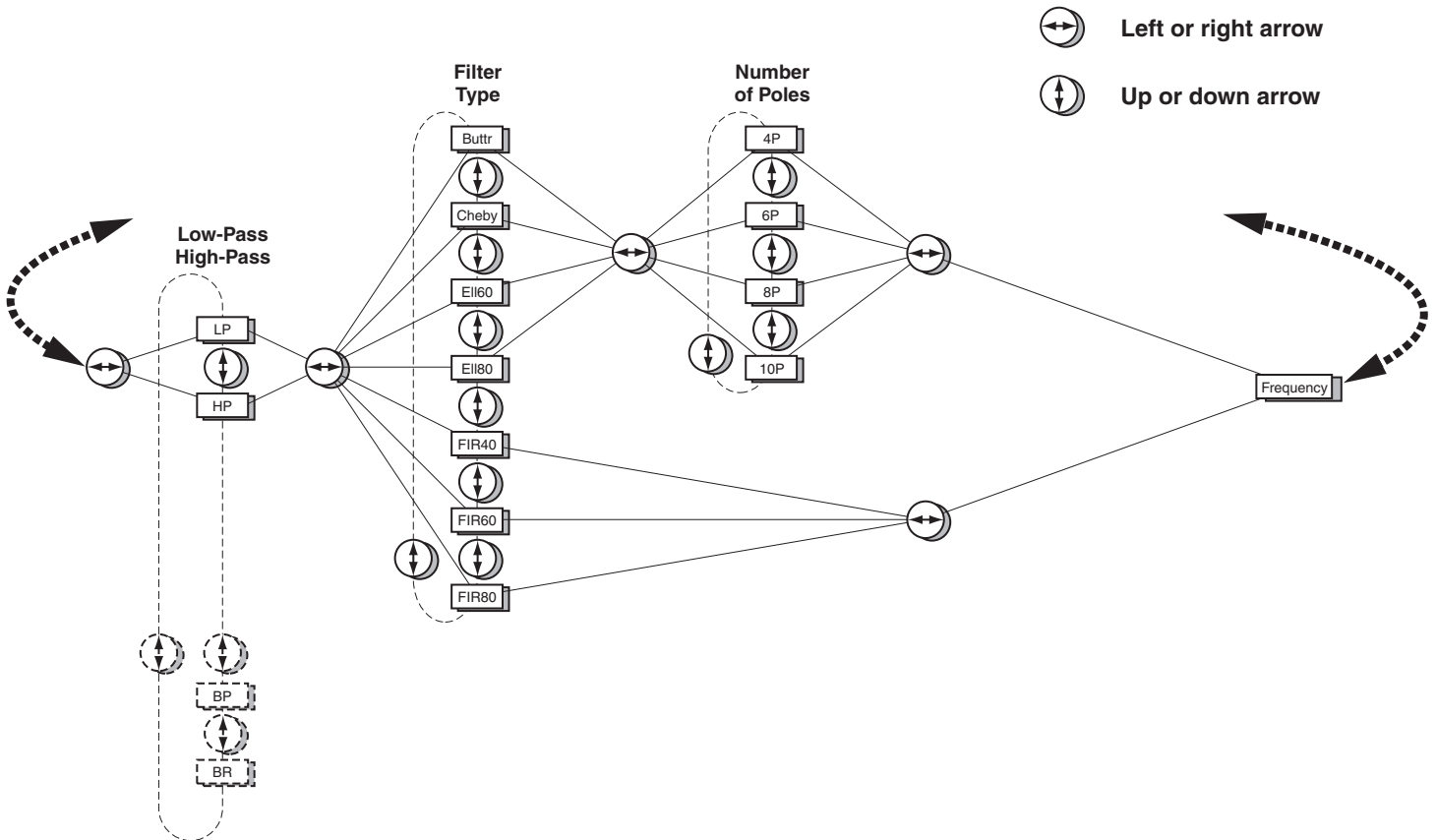
## **Keypads**

Keypads provide the user interface by means of left/right arrow parameter selection and up/down arrow choice. In addition RESET restores a filter setup that was awaiting activation via the ENTER key. Bypass (BYP) activates the special DSP bypass operation. The MODE key allows viewing of all display screens.

## **Display**

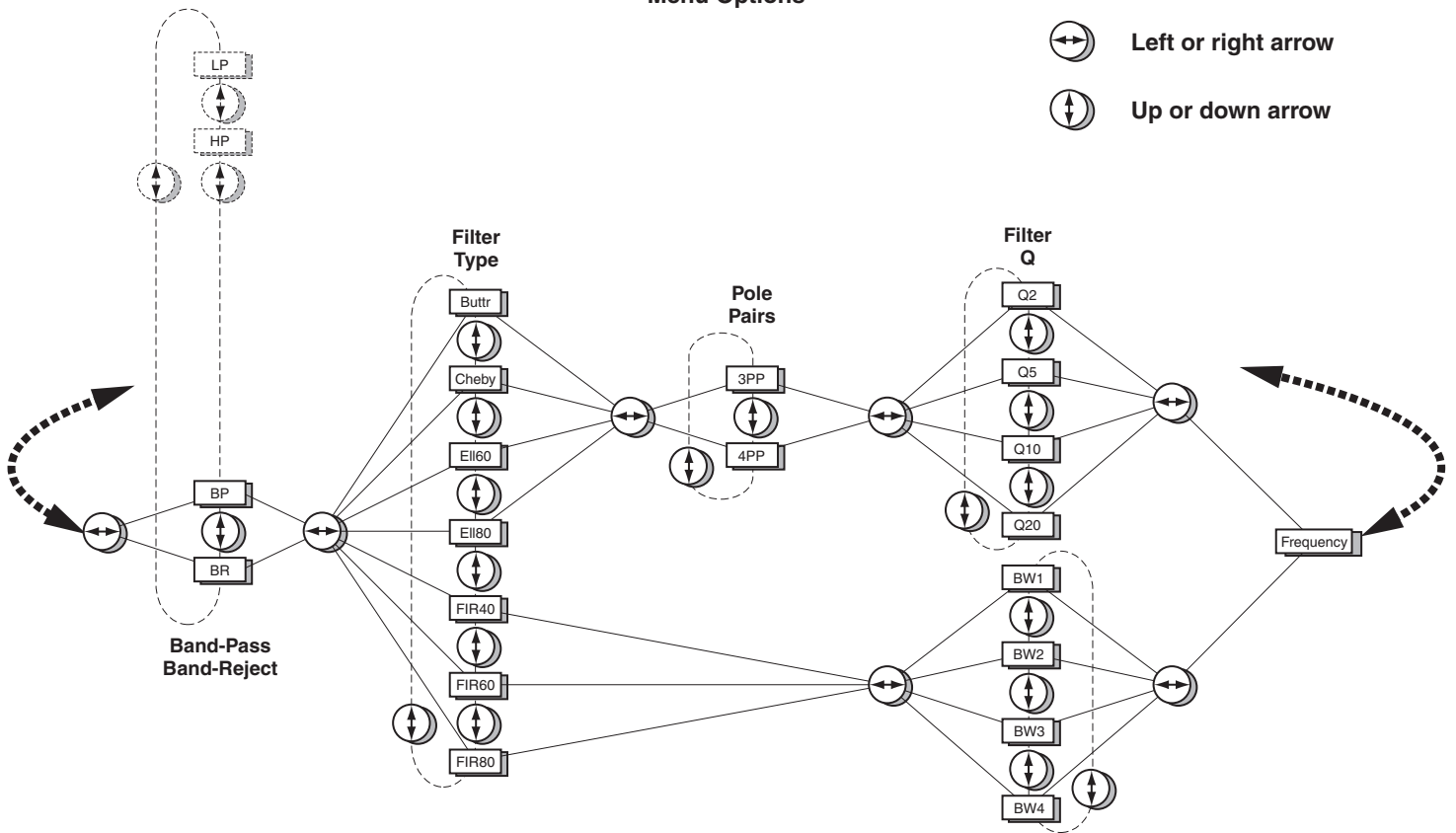
Permits viewing of filter setup choices clip indicators and performance characteristics within four modes.

## ASC50 Lowpass and Highpass Filter Menu Options

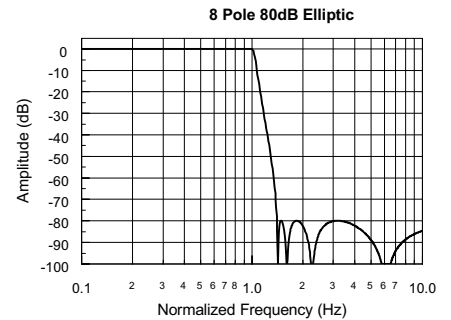
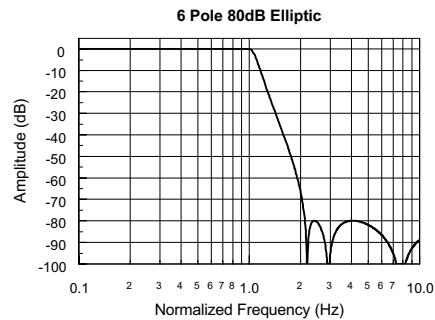
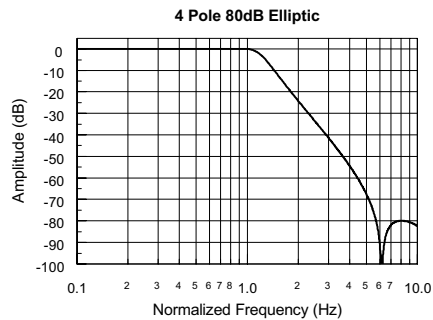
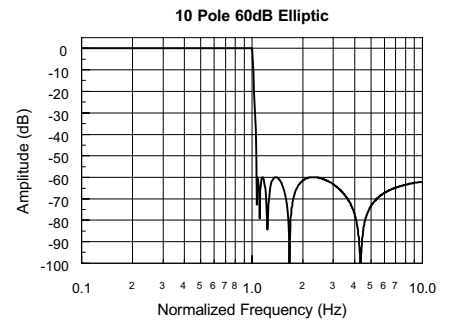
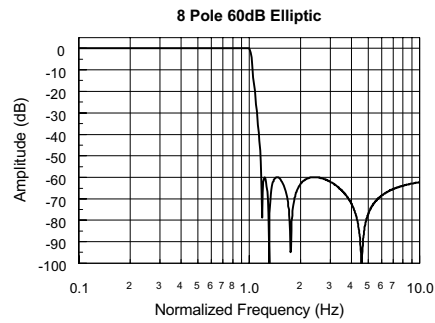
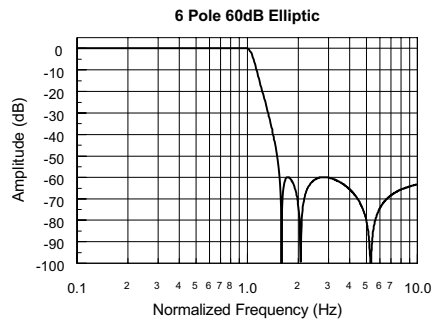
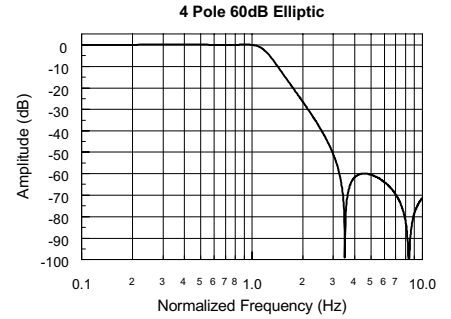
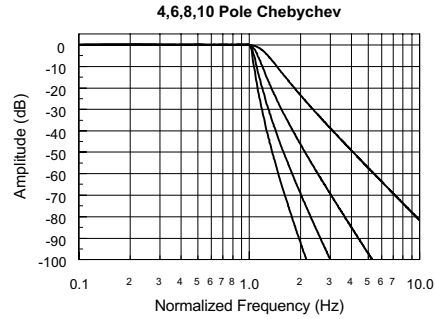
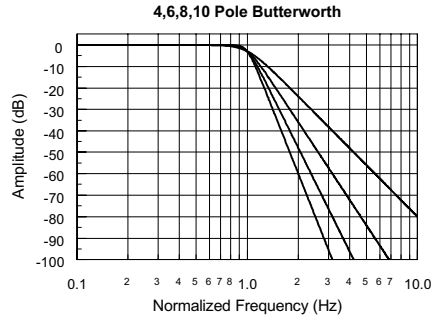




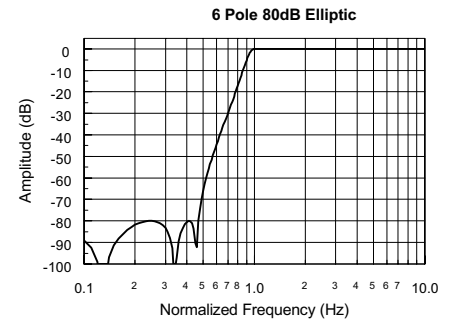
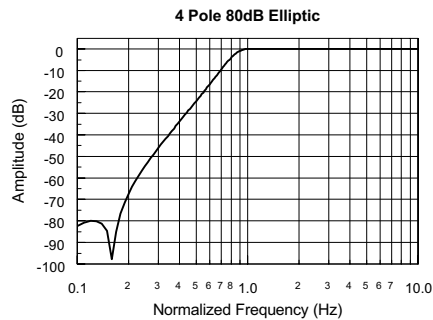
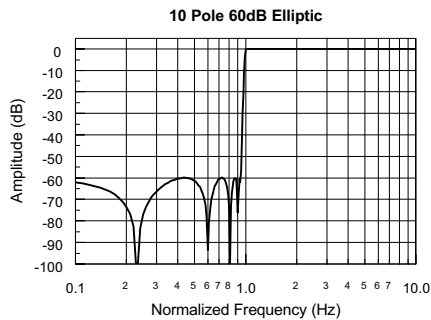
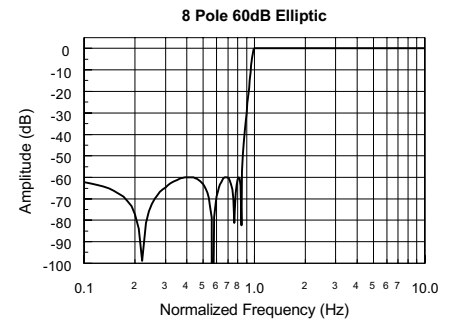
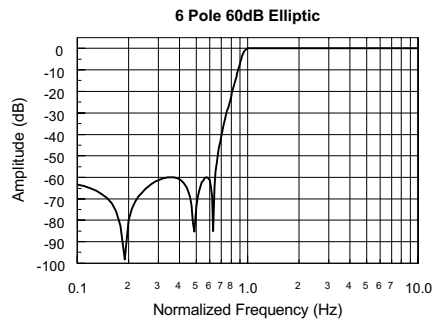
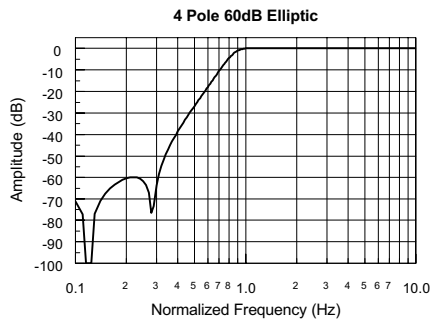
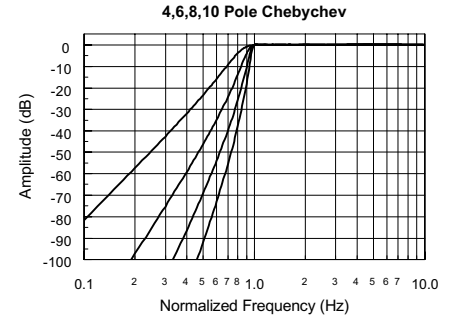
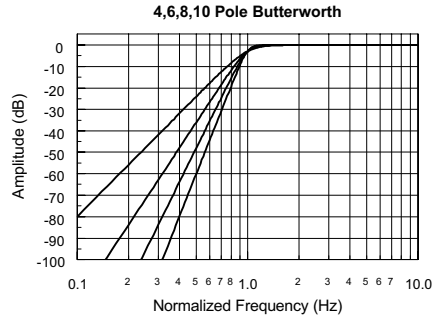
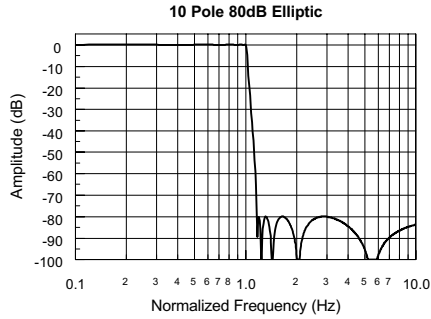
## ASC50 Bandpass and Bandreject Filter Menu Options



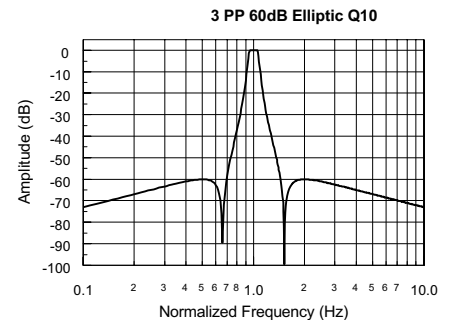
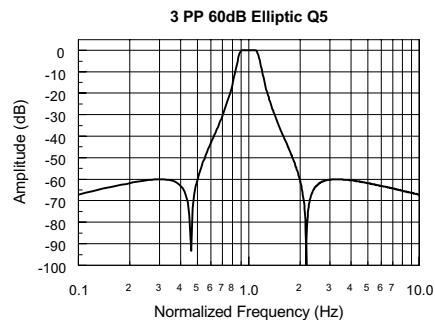
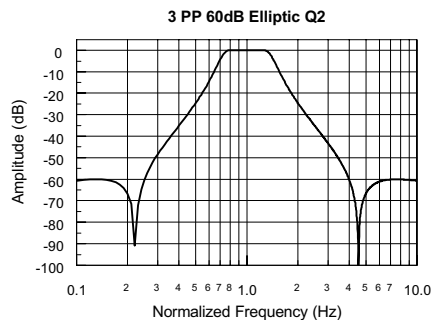
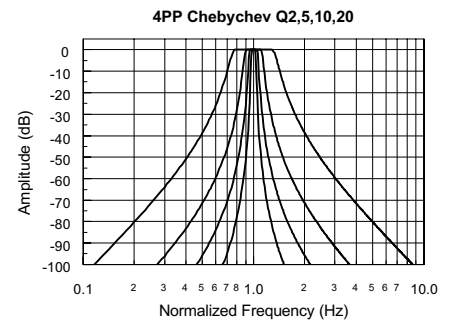
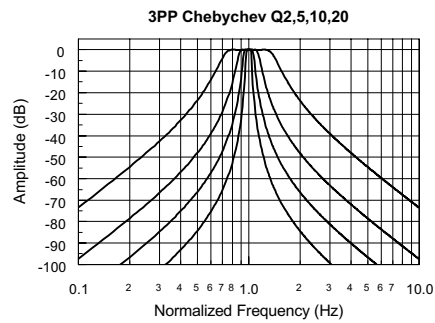
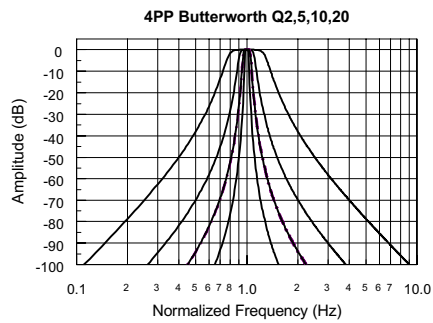
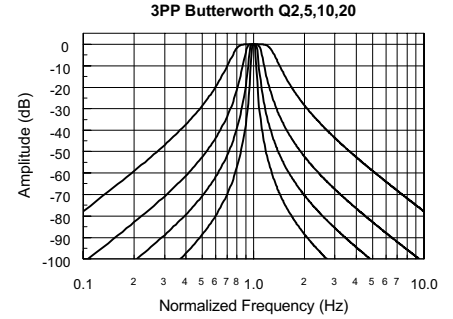
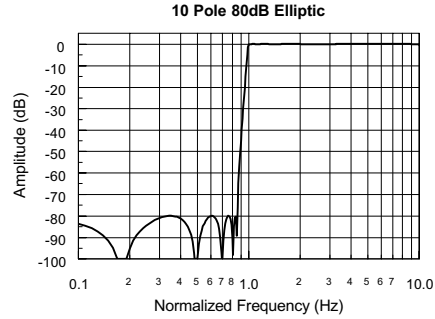
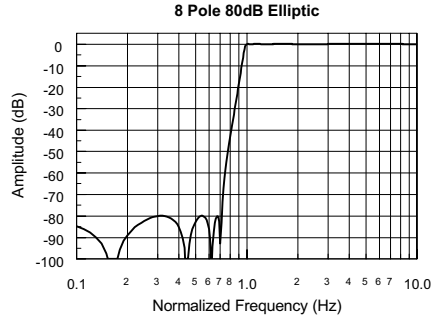
## AVAILABLE IIR TRANSFER FUNCTIONS



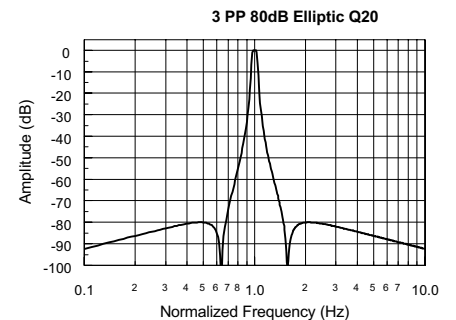
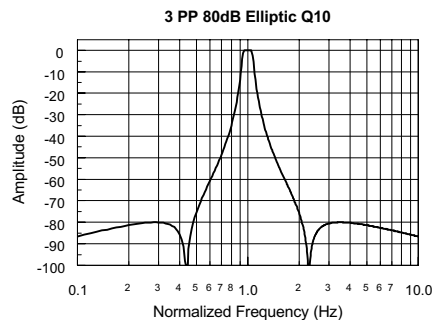
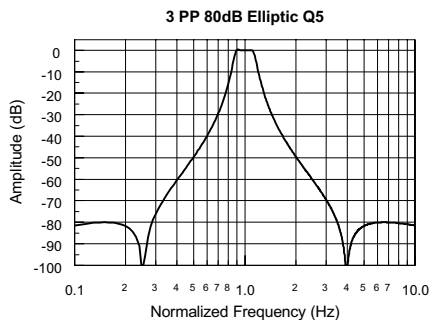
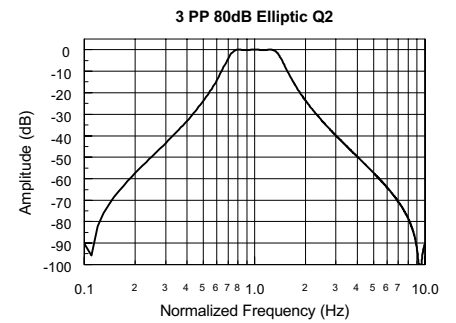
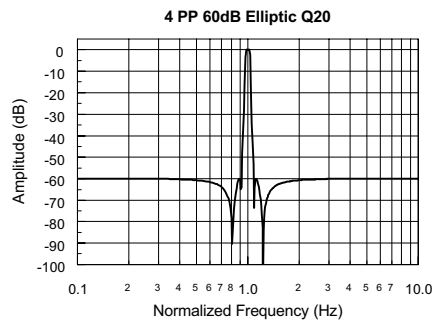
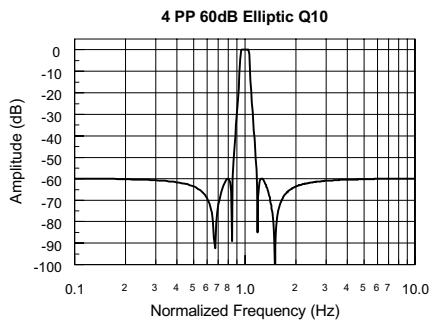
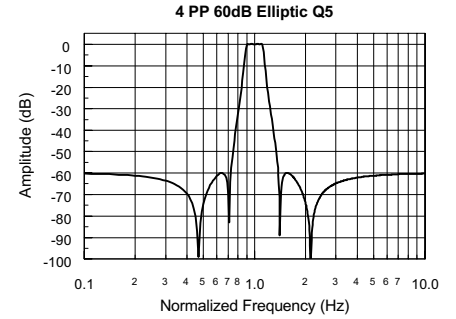
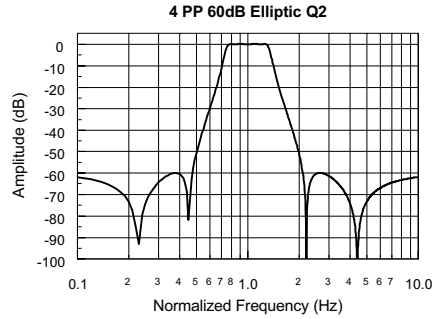
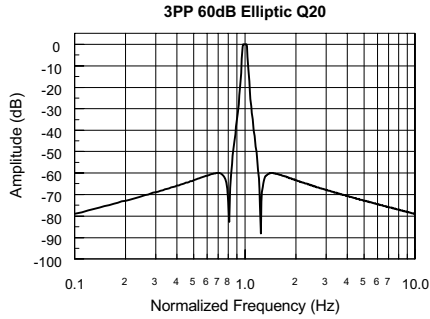
## AVAILABLE IIR TRANSFER FUNCTIONS



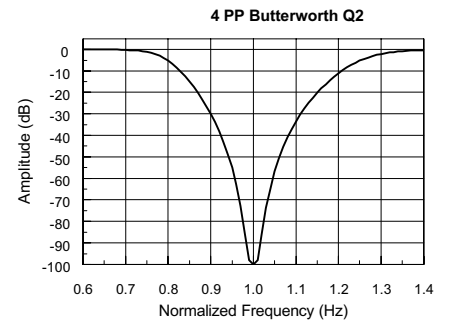
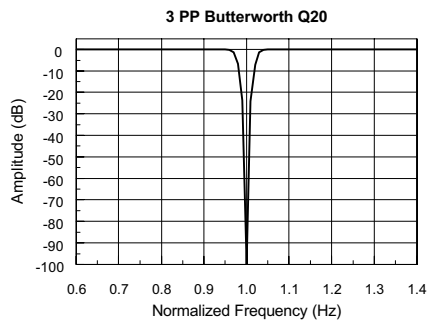
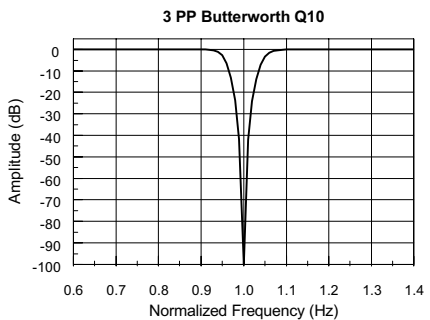
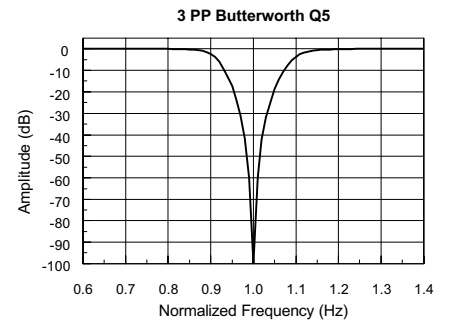
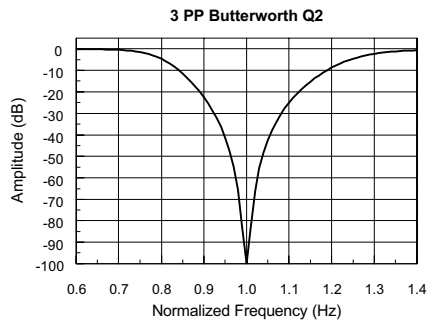
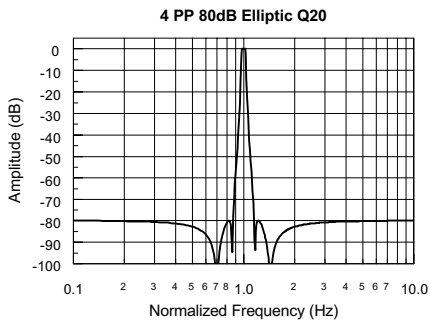
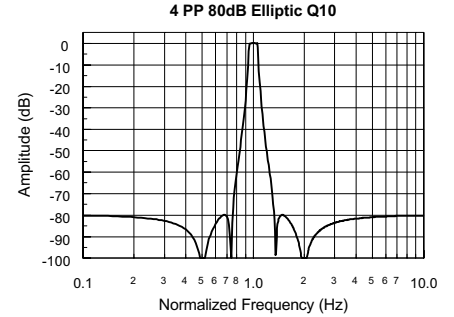
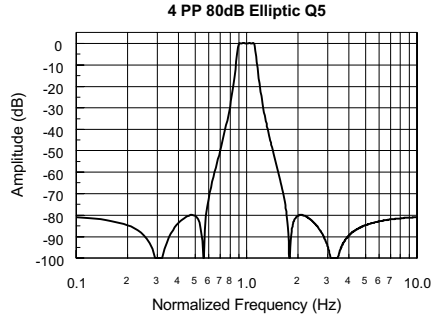
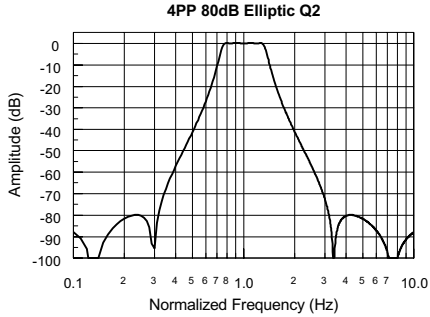
## AVAILABLE IIR TRANSFER FUNCTIONS



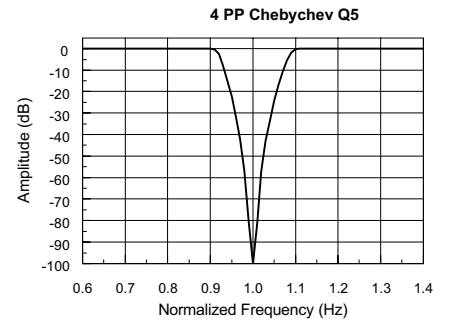
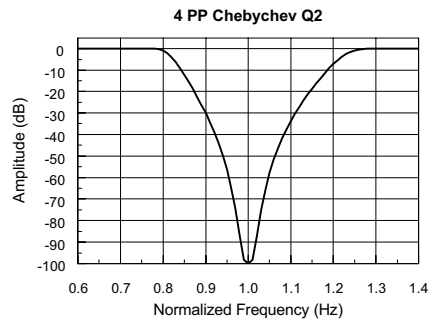
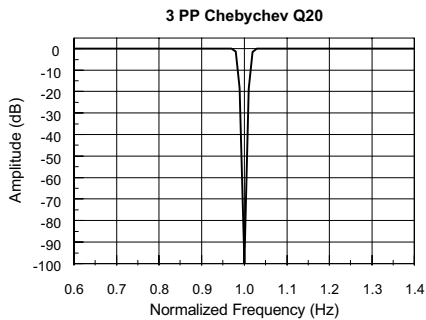
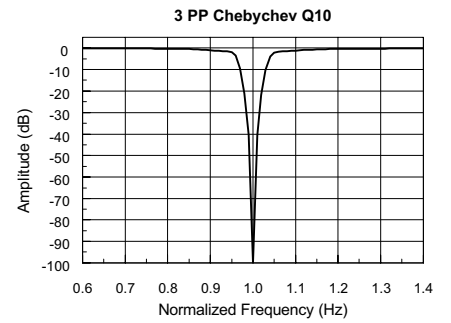
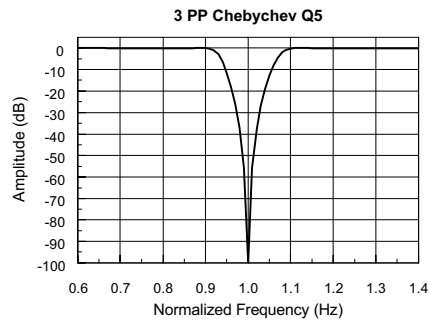
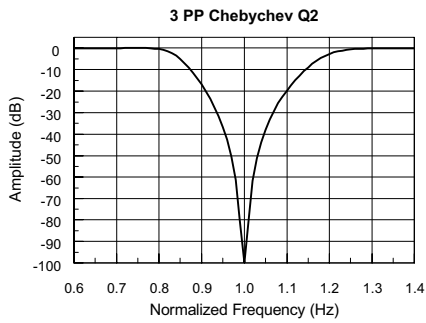
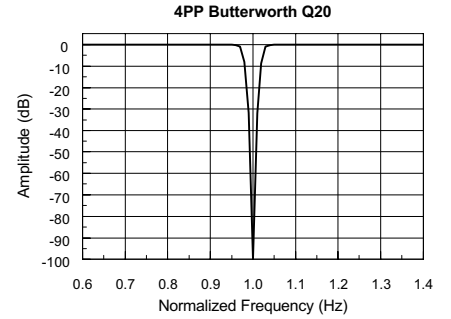
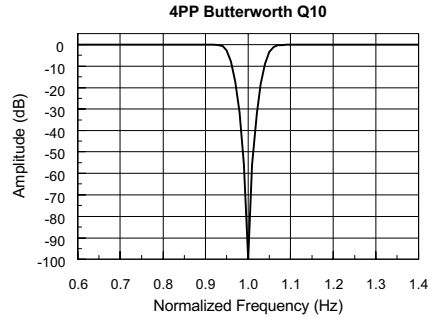
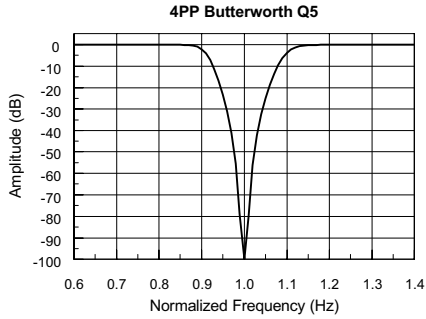
## AVAILABLE IIR TRANSFER FUNCTIONS



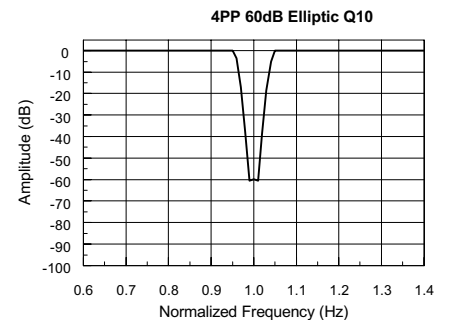
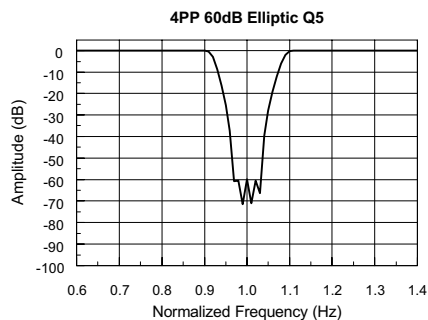
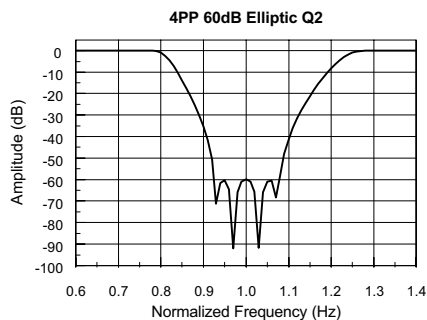
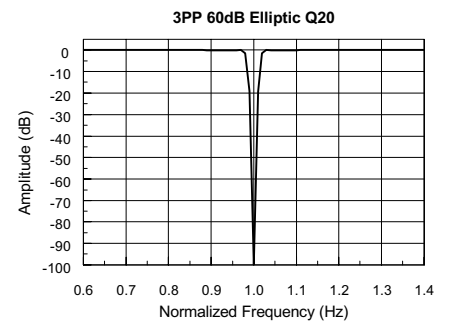
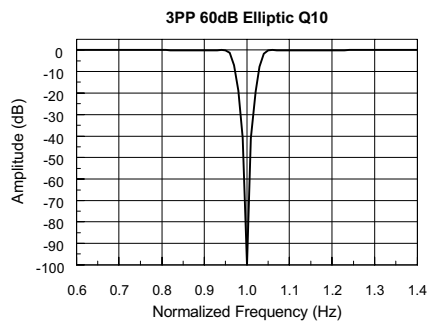
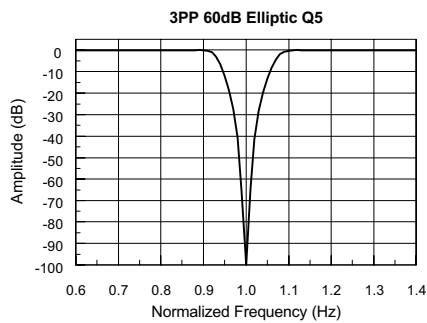
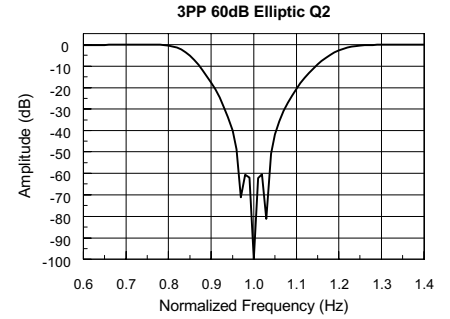
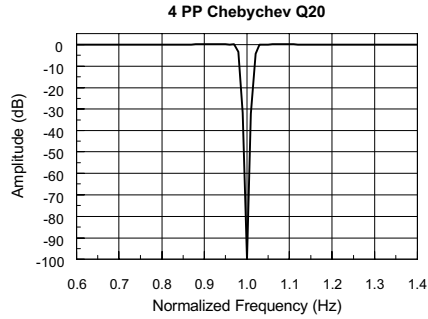
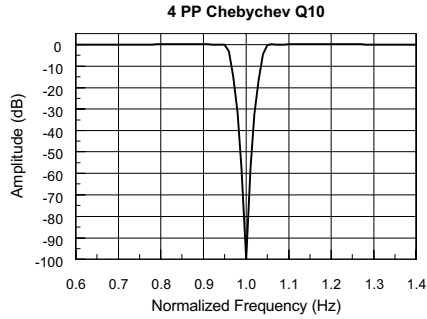
## AVAILABLE IIR TRANSFER FUNCTIONS



## AVAILABLE IIR TRANSFER FUNCTIONS

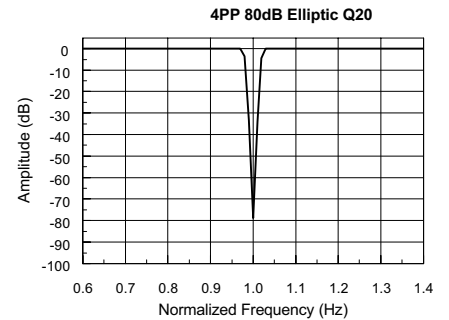
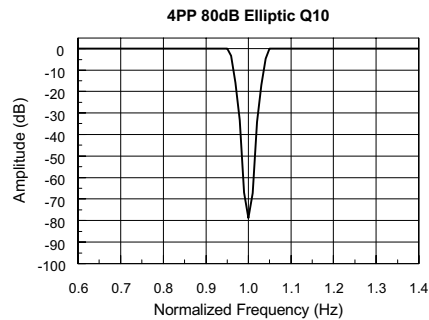
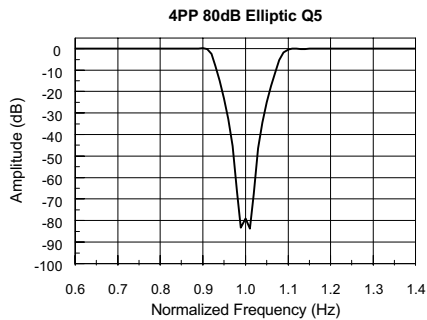
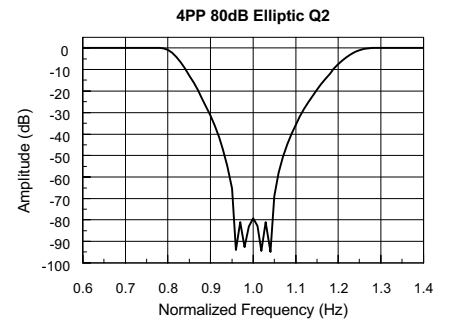
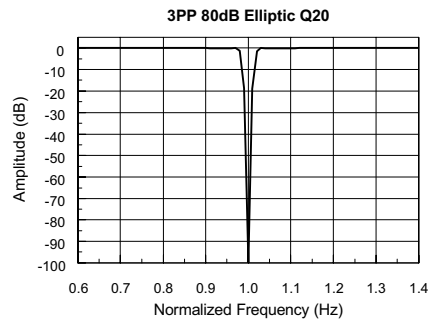
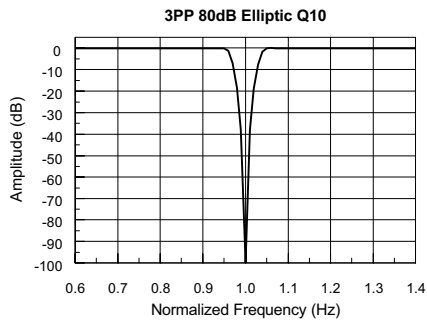
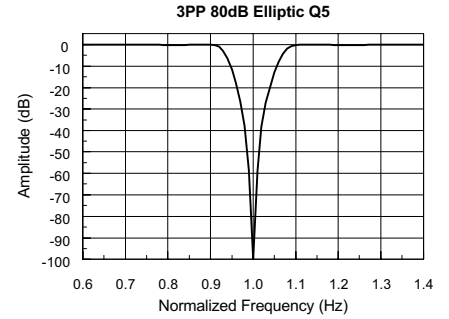
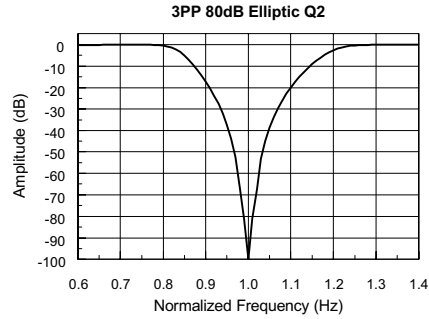
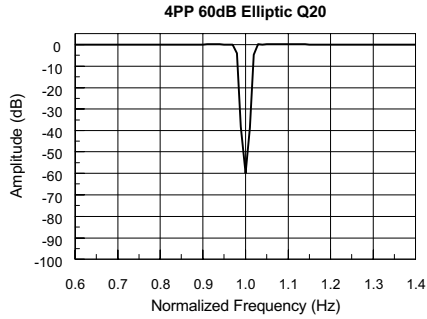


## AVAILABLE IIR TRANSFER FUNCTIONS

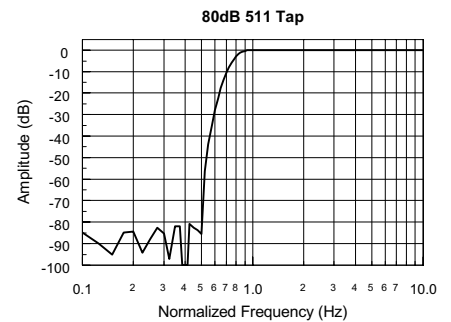
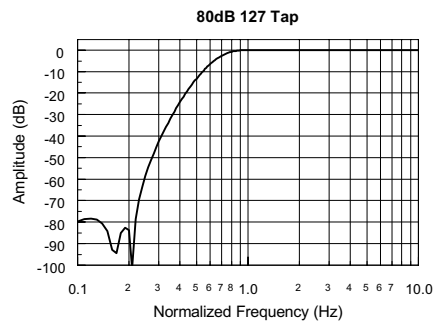
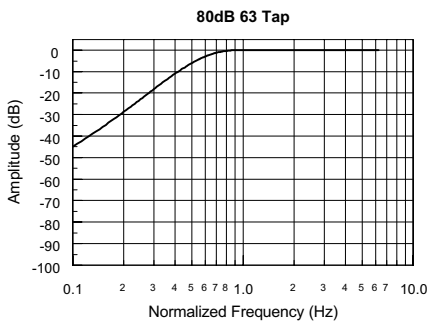
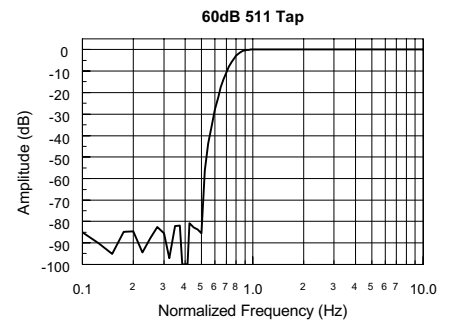
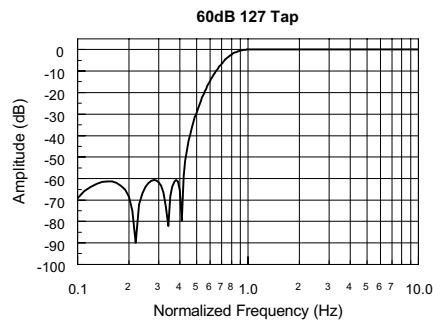
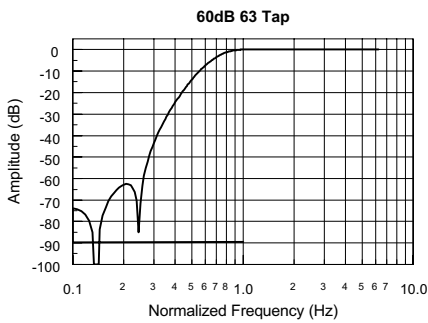
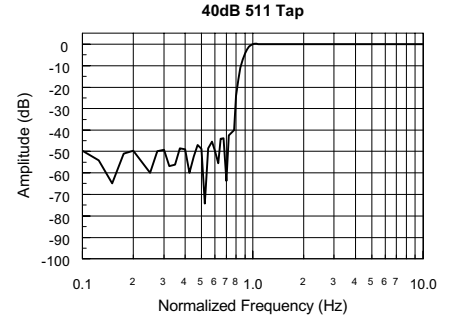
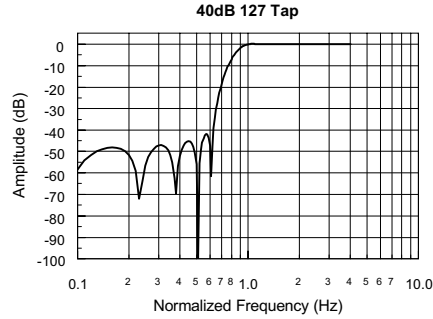
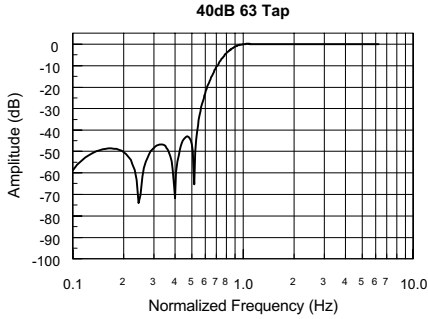




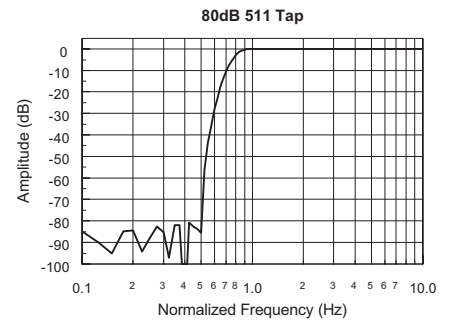
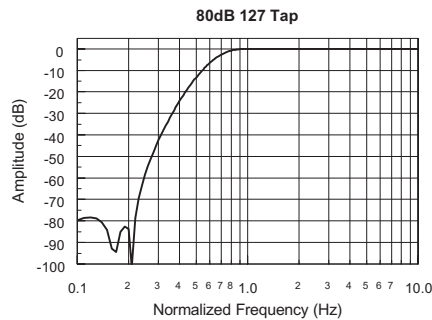
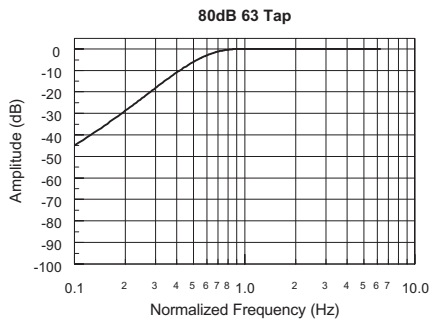
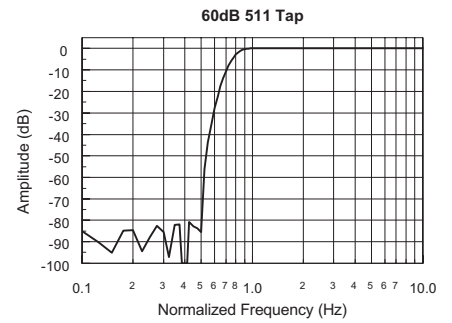
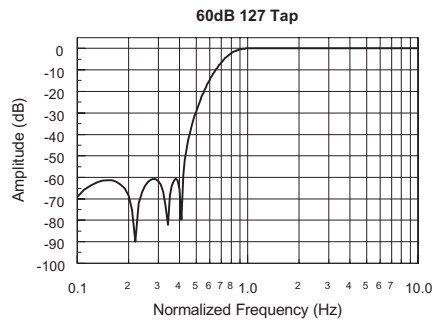
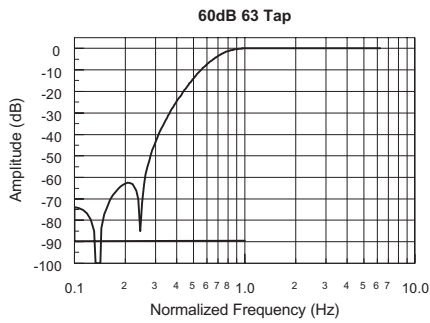
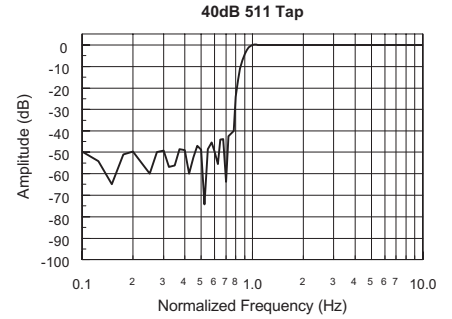
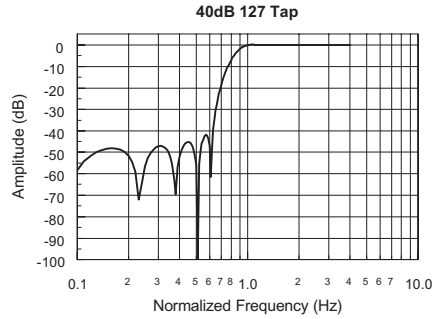
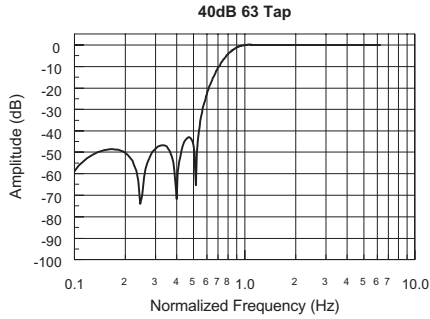
## AVAILABLE IIR TRANSFER FUNCTIONS



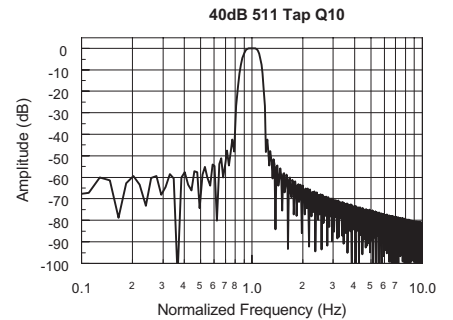
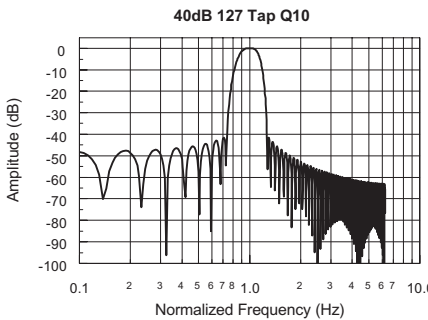
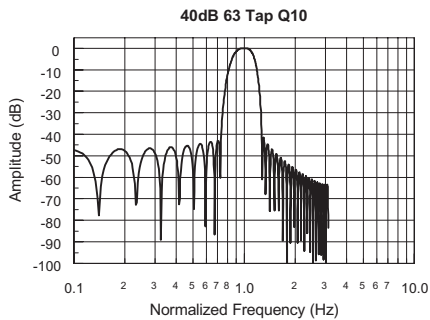
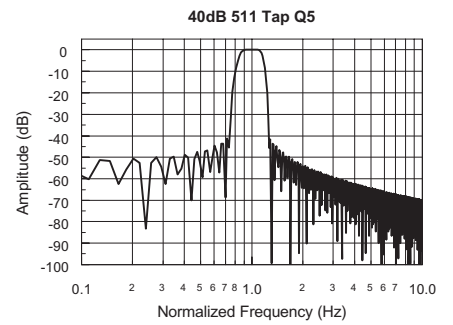
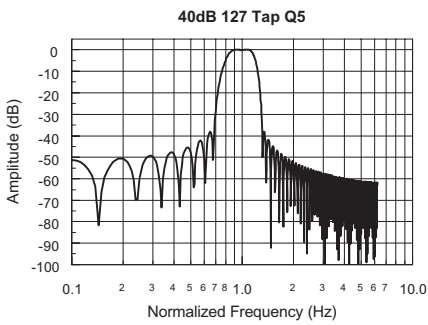
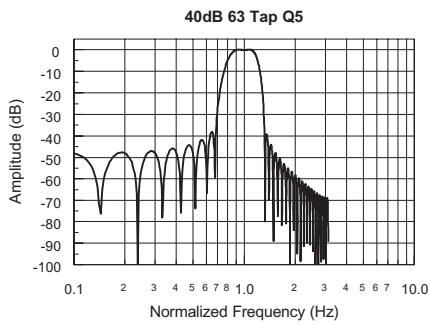
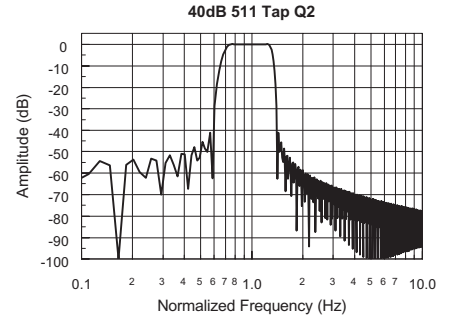
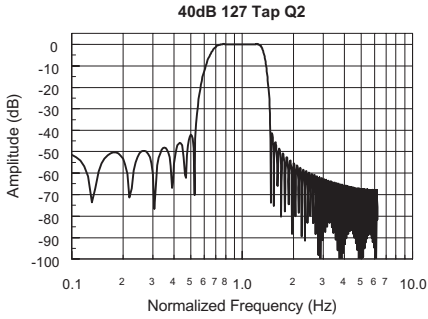
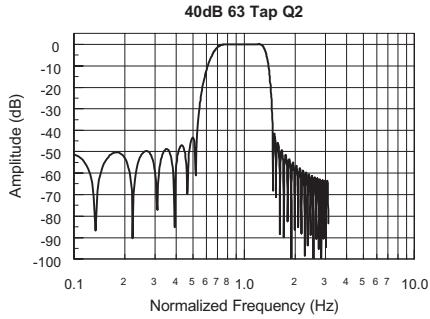
## AVAILABLE FIR TRANSFER FUNCTIONS



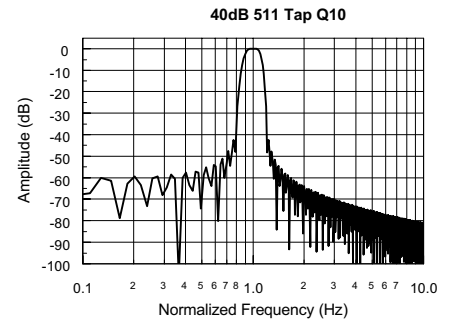
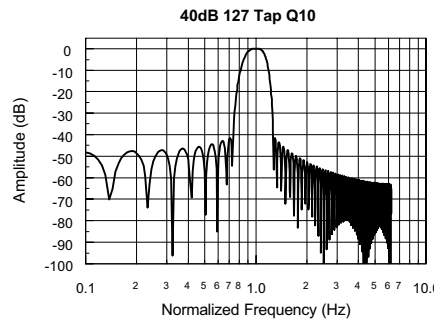
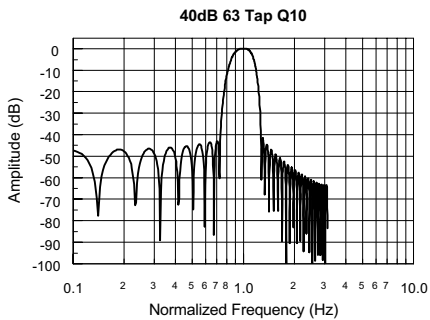
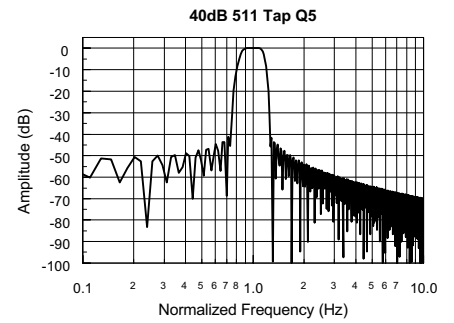
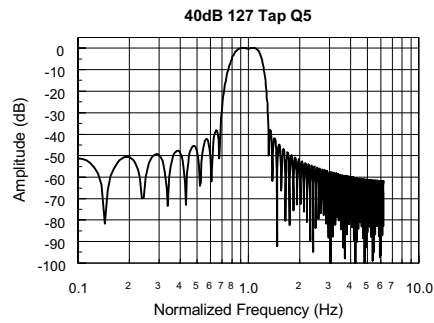
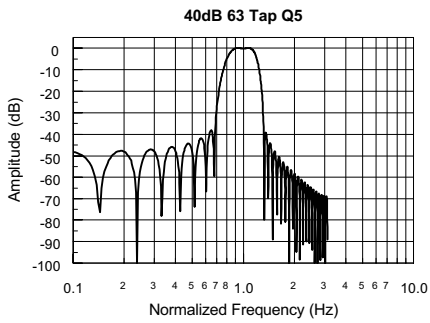
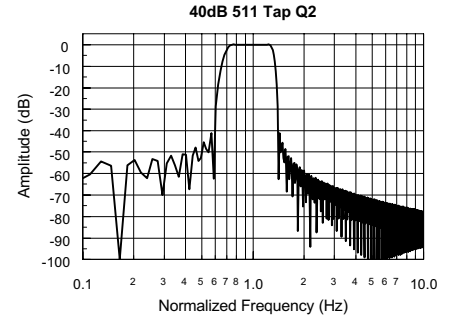
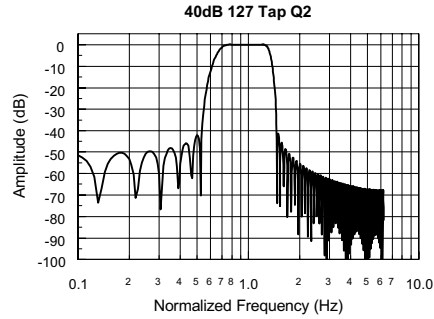
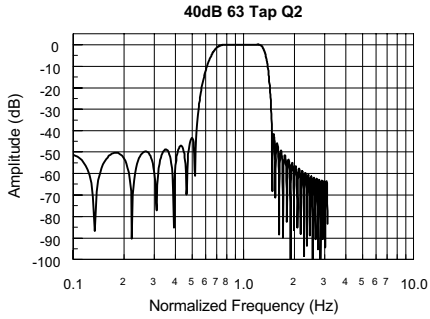
## AVAILABLE FIR TRANSFER FUNCTIONS



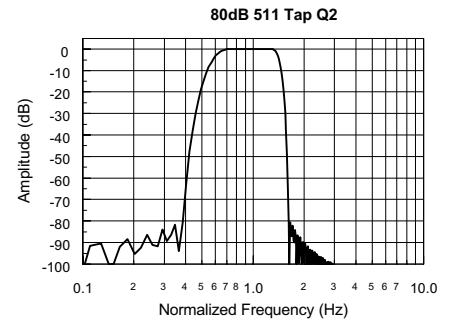
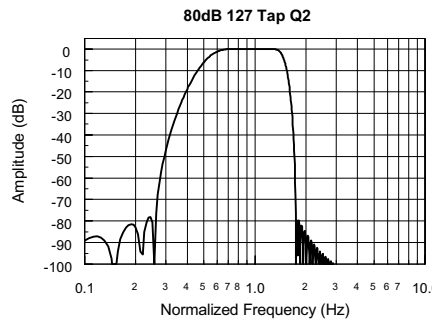
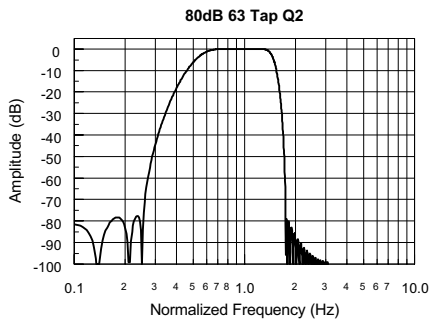
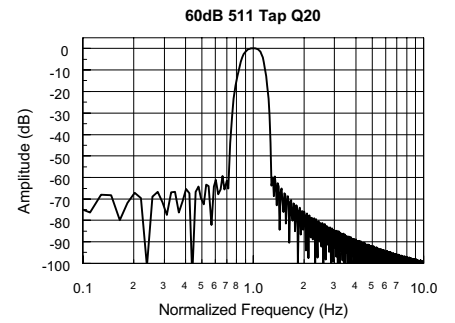
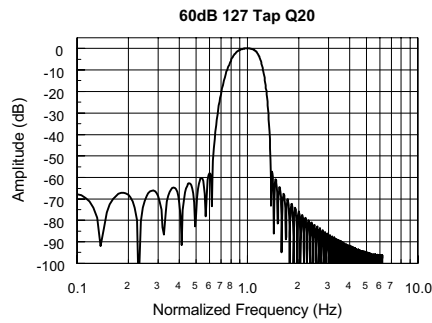
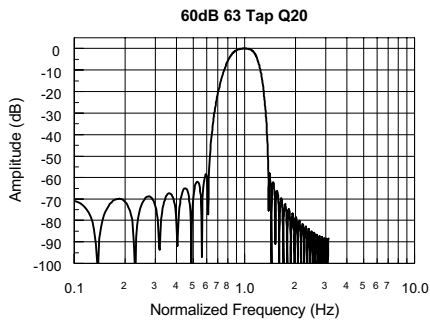
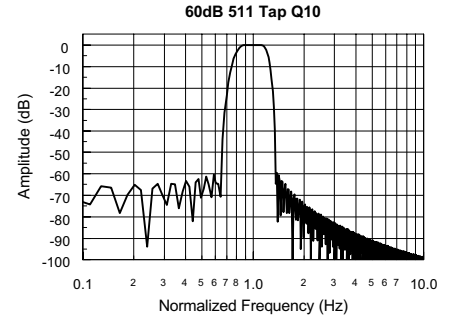
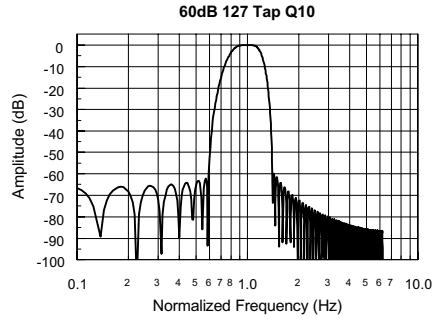
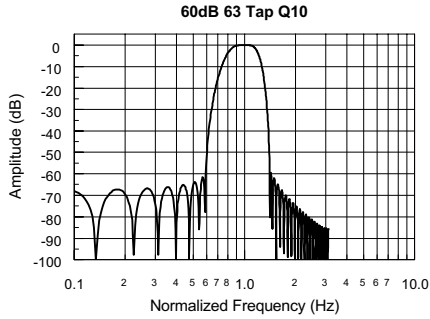
## AVAILABLE FIR TRANSFER FUNCTIONS



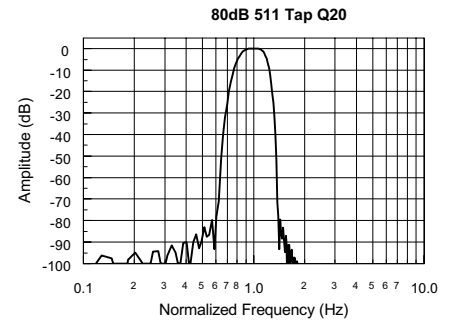
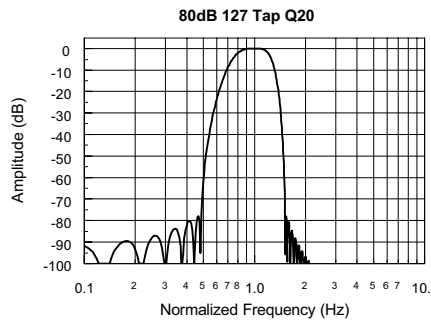
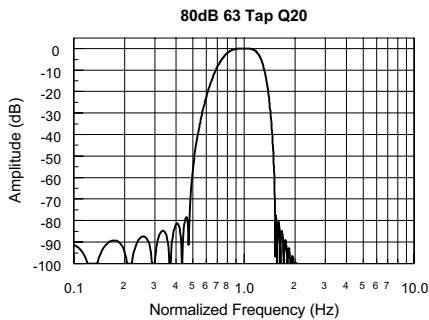
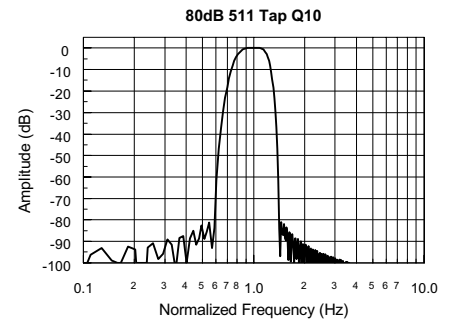
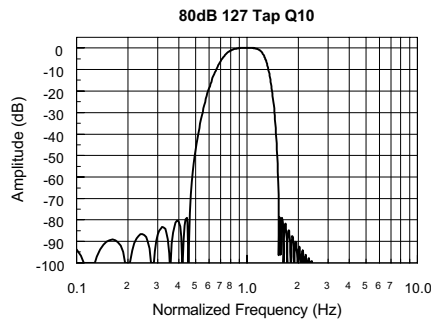
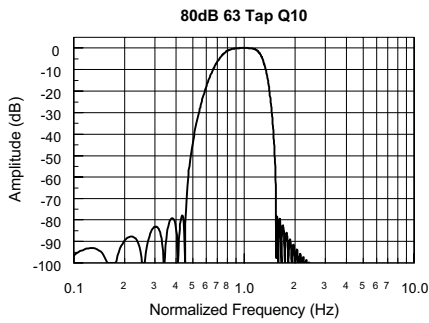
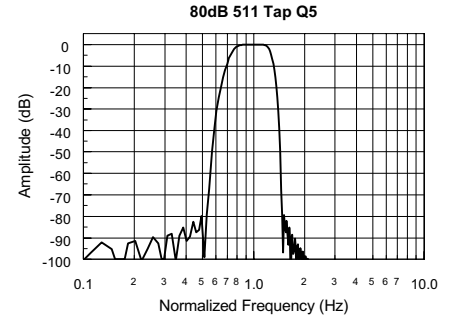
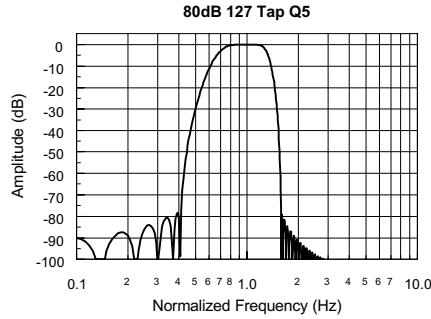
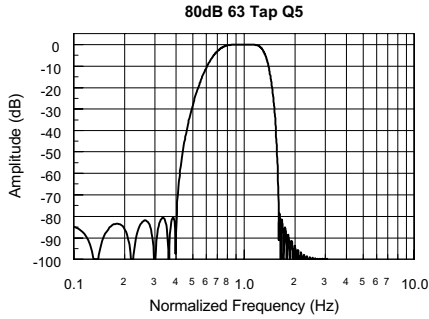
## AVAILABLE FIR TRANSFER FUNCTIONS



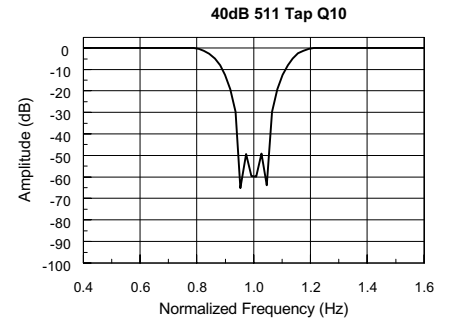
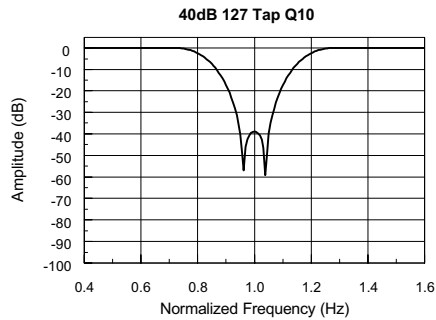
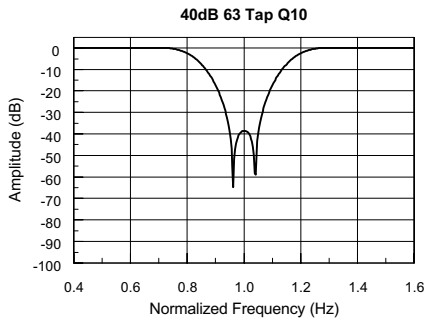
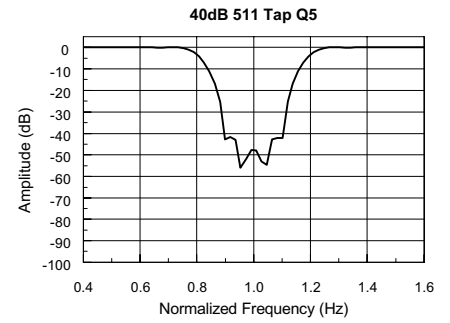
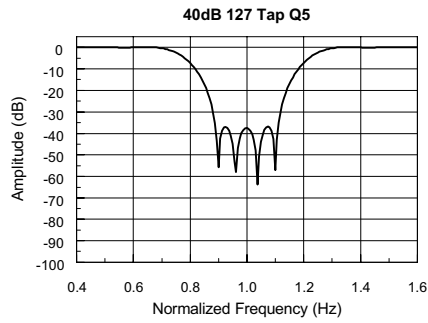
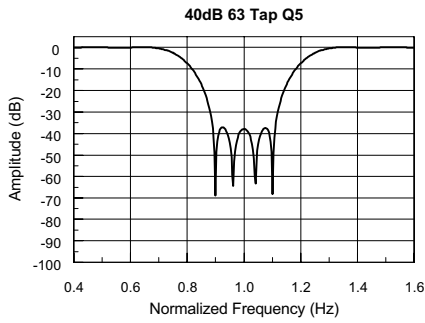
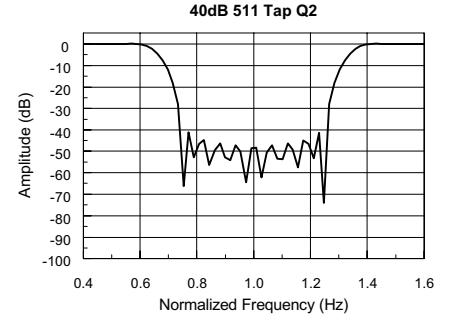
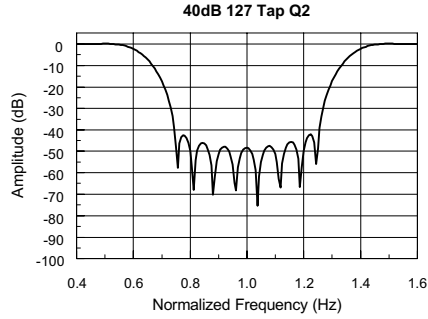
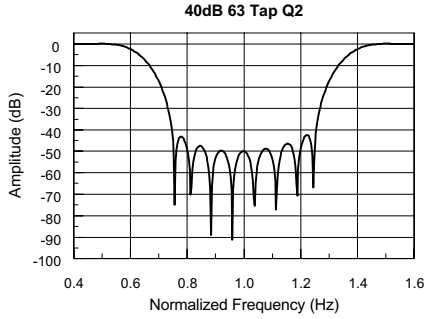
## AVAILABLE FIR TRANSFER FUNCTIONS



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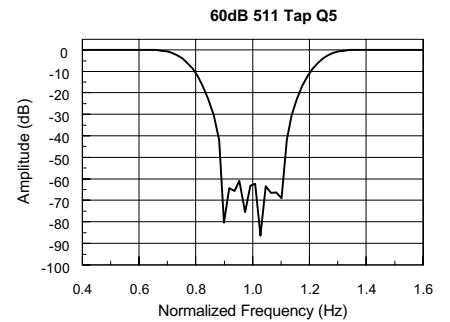
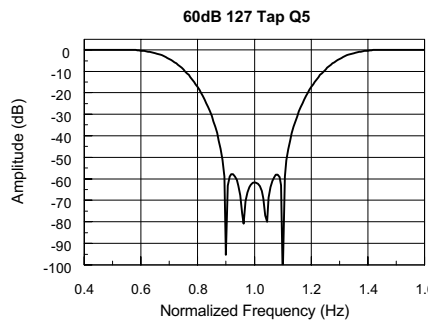
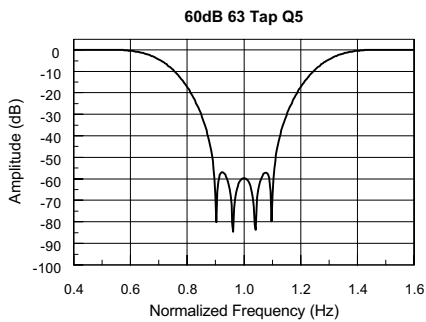
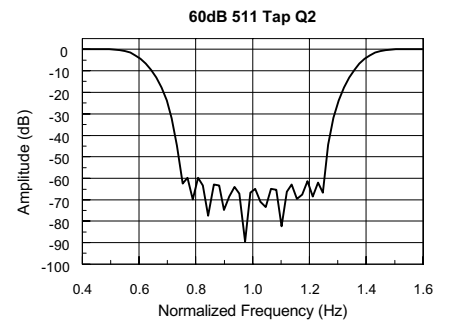
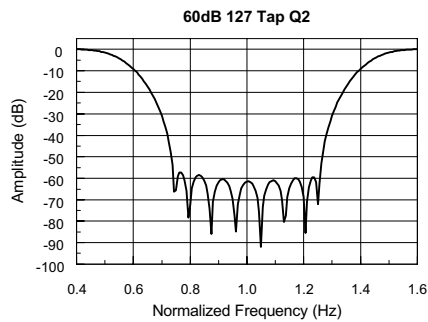
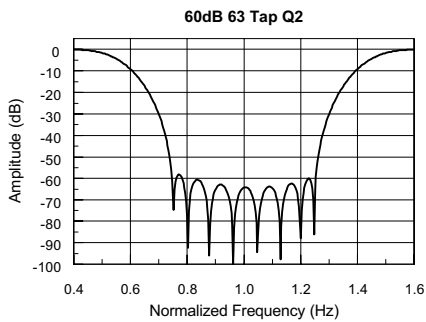
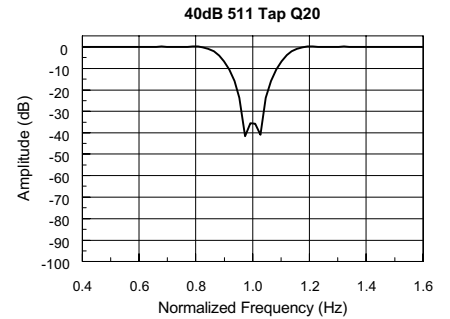
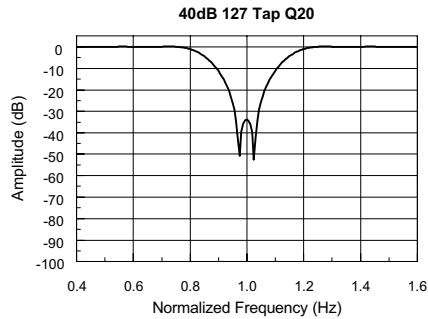
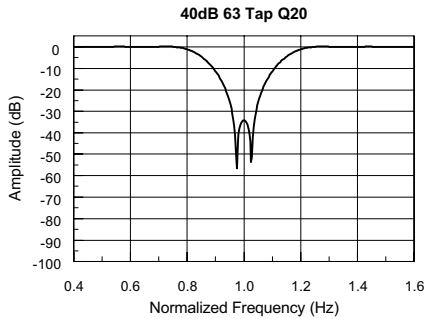


## AVAILABLE FIR TRANSFER FUNCTIONS

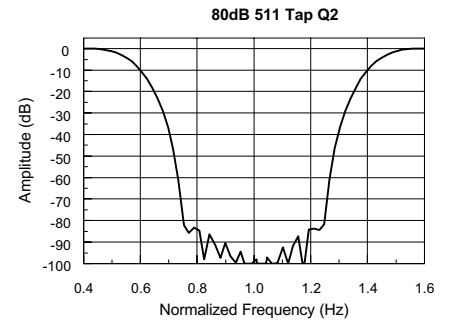
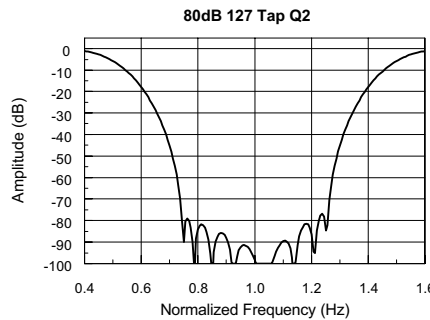
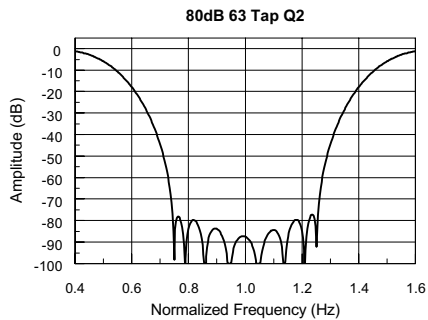
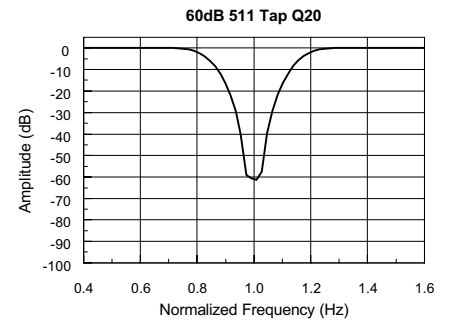
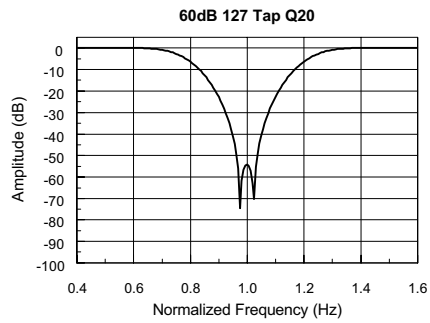
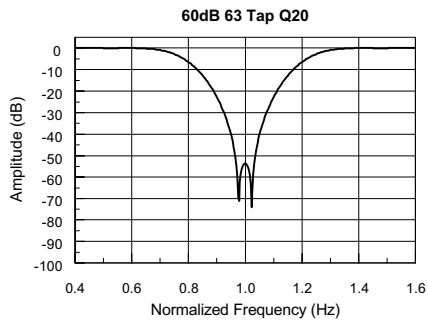
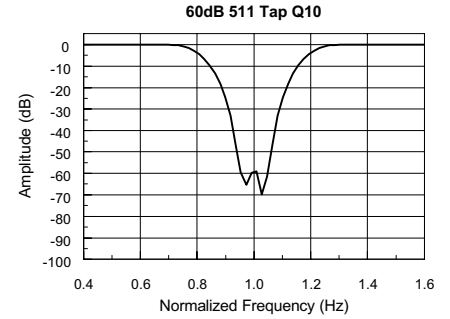
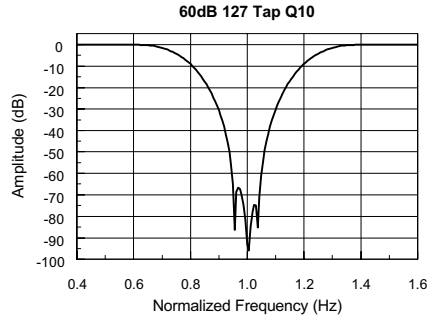
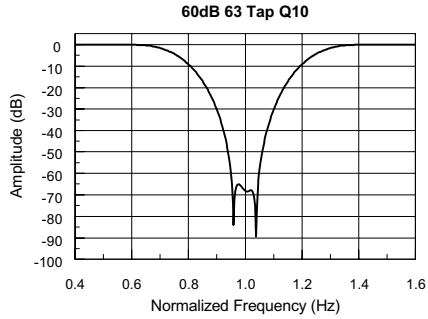




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