

4110 SERIES HIGH PASS, LOW PASS, BANDPASS FILTERS

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DESCRIPTION

The DL Instruments 4110 Series Filters are designed for multichannel applications.

This series consists of precision, active filters with frequency selectable by front panel controls in 1/10 decade steps. This provides 10 equally spaced settings per decade on a logarithmic scale, and permits bandpass operation in octave, decade, and other convenient bandwidths. Phase and amplitude tracking between filters with the same setting will be within $\pm 4^\circ$ and ± 2 dB respectively.

The 4110 Series is compatible with DL Instruments 450 Series Amplifiers.

RESOLUTION AND ACCURACY

Continuously tunable filters are inherently qualitative instruments with, at best, 5% accuracy, poor reproducibility of settings, and poor frequency and phase shift characteristics. If a filter must be set with high resolution, there is a strong implication that the user wants to know accuracy where the cutoff frequency is. This cannot be determined from the dial settings of a continuously tunable filter — and must therefore be measured, a time consuming and expensive process.

DL Instruments solves this by offering filters with switch-selectable frequency settings. These filters use the internationally accepted 1/10 decade frequency step (10 steps per decade on a logarithmic scale). This permits operation with octave, decade, and other convenient bandpass settings, and provides sufficient frequency resolution for general laboratory and data acquisition applications. These filters have the advantage of compactness, ease of use, and freedom from operator error.

Standard accuracy of the 4110 Series Filters is $\pm 1\%$ in frequency, $\pm 2^\circ$ in phase, and ± 1 dB insertion loss—all at least twice as good as the best competitive filters.

FILTERS AND AMPLIFIERS

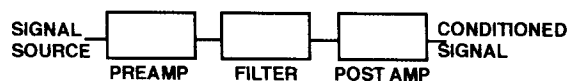
Most signal measuring systems that require filters also require amplification of the signal. DL Instruments filters make it convenient to add gain.

Compatible DL Instruments amplifiers with selectable gain of up to 90 dB are available for use with rack mount filter models.

All 4110 Series Filters have a rear mounted XLR connector (standard in some, optional in others) that provides power to and receives the signal from any DL Instruments low noise preamplifiers.

GAIN DISTRIBUTION

Generally speaking, it is desirable to place the filter in the amplification chain as close to the signal source as the self-noise of the filter will permit. This arrangement maximizes the allowable dynamic range of unwanted signals that the system will accommodate. If the noise of the signal source is larger than the self-noise of the filter, *in the passband of interest*, then no preamplifier is required. Otherwise, a fixed gain preamplifier, with its input characteristics optimized for the particular signal source, should be used ahead of the filter. The remainder of the gain should be placed either after the filter or distributed within the filter poles. The gain options described above provide near-optimum gain distribution.



BUTTERWORTH

In the majority of applications, the user wants flat, attenuation-free response in the passband, and maximum attenuation outside it. This criterion is best met by the Butterworth (maximally flat) filter. (See Figure 1)

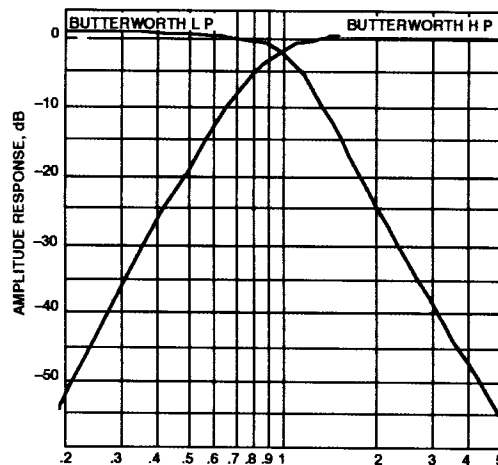


Figure 1 Normalized Frequency Response of 4 Pole Filters

4110 SERIES SPECIFICATIONS

FILTER MODES	High-Pass, Low-Pass, Bandpass. Butterworth only		
FREQUENCY SETTINGS	1.0, 1.25, 1.6, 2.0, 2.5, 3.15, 4.0, 5.0, 6.3, 8.0, 10.0		
FREQUENCY RANGES	MODEL	HIGH-PASS	LOWPASS
*Highest decade of low-pass filter section operates with reduced phase and cutoff frequency accuracy. ($\pm 5\%$ accuracy typical)	4111	.01 Hz – 1 kHz	.01 Hz – 10 kHz *
	4112	.1 Hz – 10 kHz	.1 Hz – 100 kHz *
	4113	1 Hz – 100 kHz	1 Hz – 1 MHz *
CUTOFF FREQUENCY ACCURACY	$\pm 1\%$		
FREQUENCY STABILITY	Less than 200 ppm/ $^{\circ}$ C/pole		
PHASE ACCURACY	$\pm 2^{\circ}$		
ATTENUATION SLOPE	24 dB/octave; 80 dB/decade (4 pole)		
MAXIMUM ATTENUATION	90 dB (70 dB highest decade in LP)		
INSERTION LOSS	0 dB \pm .1 dB		
DISTORTION	Less than 0.1% at 5 volts rms into 5 K Ω load at 1 kHz		
HUM AND NOISE	Less than 70 μ volts rms with 100 kHz detector bandwidth		
FILTER DRIFT	100 μ V/ $^{\circ}$ C + 250 μ V/day referred to the output (4111) 50 μ V/ $^{\circ}$ C + 250 μ V/day referred to the output (4112, 4113)		
INPUT (Single Ended)	Connectors	Rear Panels: BNC	
	Max Linear Input	± 7 V pk (diode protected) to 100 kHz decreasing to ± 1 V @ 1 MHz	
	Coupling	dc coupled in LP, ac coupled in HP and BP (ac + dc <200V)	
	Impedance	22M Ω $\pm 10\%$ // 60 pF max.	
OUTPUT (Single Ended)	Connector	Rear Panel: BNC	
	Maximum Output	± 7 volts peak ± 5 Ma peak (short circuit protected)	
	Impedance	50 Ω , $\pm 10\%$ dc coupled	
	Offset	Internally adjustable to zero with HP in "out" position	
POWER	External ± 15 V @ 100 Ma		
ENVIRONMENT	-20 $^{\circ}$ C to +55 $^{\circ}$ C Operating; -55 $^{\circ}$ C to +85 $^{\circ}$ C Storage; R.H. 95%		
DIMENSIONS AND WEIGHT	6.75" H x 2" W x 10.5" D 3 lbs		

POWER SUPPLIES				
MODEL	P11	P12	P37	P33
VOLTAGE	± 15 V	± 15 V, +28V	± 15 V	± 15 V, +28V
CURRENT	1 Amp	1 Amp (± 15 V) 200 ma (+28V)	500 ma	500 ma (± 15 V) 100 ma (+28V)
LINE REGULATION	.05%	.05%	.05%	.05%
LOAD REGULATION	.01%	.01%	.01%	.01%
ACCURACY	Adjustable	Adjustable	Adjustable	Adjustable
STABILITY	$\pm .1\%$ /day	$\pm .1\%$ /day	$\pm .1\%$ /day	$\pm .1\%$ /day
RIPPLE AND NOISE	45 μ V rms	45 μ V rms	45 μ V rms	45 μ V rms
CAL OSCILLATOR	No	No	Yes	Yes
MOUNTING CASE	S11, S21	S11, S21	S30	S30
LINE FREQUENCY	47-440 Hz	47-440 Hz	47-440 Hz	47-440 Hz
WEIGHT	9 lbs	9 lbs	1 lb	1 lb
SIZE	6.57" H x 2.75" W x 12.25" D		6.75" H x .72" W x 10" D	
USE WITH	4110 Series	4110 Series w/Option 03	4100 Series	4110 Series w/Option 03
OPTIONS	STANDARD - 105V-130V	OPT 01 - 90V-110V	OPT 02 - 180V-220V	OPT 03 - 210V-260V
FEATURES	• Short Circuit Protected • Battery power inputs terminal on rear connector of mounting case			

MOUNTING CASES	
	MODEL S11 7 CHANNEL MTG CASE
DIMENSIONS	7" H x 19" W x 14" D
WEIGHT	25 lbs including power supply
	MODEL S30 4 CHANNEL PORTABLE CASE
DIMENSIONS	7.20" H x 9.12" W x 14.35" D
WEIGHT	12 lbs including power supply

REMOTE PREAMPLIFIER OPTIONS	
OPTION 03 REMOTE PREAMPLIFIER +28 VOLT POWER	Add 5 pin XLR connector to rear panel to supply +28 volts and signal connections to remote preamplifier
OPTION 09 REMOTE PREAMPLIFIER ± 15VOLT POWER	Add 5 pin XLR connector to rear panel to supply ± 15 volts and signal connections to remote preamplifier

OTHER ACCESSORIES		
X1 Extender Module w/6 ft Cable	Y1 Blank Front Panel	Z1 Blank Plug-In Chassis