FREQUENCY DEVICES™, INC.

# D72 & DP72 Series

## 1.0 Hz to 100 kHz Fixed Frequency

## 16 Pin DIP 2-Pole Filters

### Description

The D72 and DP72 Series of low-power, fixed-frequency, linear active filters are high performance, 2-pole filters in a compact package. These Butterworth and Bessel low-pass and Butterworth high-pass filters (D72 only) combine linear active filter design with the space savings of a 16-pin dual in-line package (DIP). Each model comes factory tuned to a user-specified corner frequency between 1 Hz and 100 kHz (DP72, 1 Hz to 5kHz). These fully self-contained units require no external components or adjustments and operate with dynamic input voltage range from non-critical ±5V to ±18V power supplies.


### Features/Benefits:

- Low cost solution for low frequency signal conditioning
- Compact DIP design minimizes board space requirements
- Plug-in ready-to-use, reducing engineering design and manufacturing time
- Factory tuned, no external clocks or adjustments needed saving time and labor of other discrete assembly solutions
- Low harmonic distortion and wide signal-to-noise ratio to 12 bit resolution

### Applications

- Anti-alias filtering
- Vibration & shock analysis
- Automatic test equipment
- Aerospace, navigation and sonar
- Communication systems
- Medical electronics
- Sound and vibration testing
- Noise elimination
- Process control

### Available Low-Pass Models:



### Available High-Pass Models:



### General Specifications:



1784 Chessie Lane, Ottawa, IL 61350 • Tel: 800/252-7074, 815/434-7800 • FAX: 815/434-8176
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# Fixed Frequency 2-Pole Low-Pass and High-Pass Filters

| Model | D72L2B & DP72L2B | D72L2L & DP72L2L | Model | D72H2B |
|---|---|---|---|---|
| **Product Specifications** | **Low-Pass** | **Low-Pass** | | **High-Pass** |
| **Transfer Function** | 2-Pole, Butterworth | 2-Pole, Bessel | **Transfer Function** | 2-Pole, Butterworth |
| **Size** | 0.88" x 0.46" x 0.375" | 0.88" x 0.46" x 0.375" | **Size** | 0.88" x 0.46" x 0.375" |
| **Range $f_c$**<br>**D72**<br>**DP72** | <br>1 Hz to 100 kHz<br>1 Hz to 5 kHz | <br>1 Hz to 100 kHz<br>1 Hz to 5 kHz | **Range $f_c$** | 1 Hz to 100 kHz |
| **Theoretical Transfer Characteristics** | Appendix A<br>Page 6 | Appendix A<br>Page 1 | **Theoretical Transfer Characteristics** | Appendix A<br>Page 26 |
| **Passband Ripple**<br>(theoretical) | 0.0 dB | 0.0 dB | **Passband Ripple**<br>(theoretical) | 0.0 dB |
| **DC Voltage Gain**<br>(non-inverting) | 0 ± 0.1 dB typ. | 0 ± 0.1 dB typ. | **Voltage Gain**<br>(non-inverting) | 0 ± 0.1 dB to 100 kHz |
| **Stopband Attenuation Rate** | 12 dB/octave | 12 dB/octave | **Stopband Attenuation Rate** | 12 dB/octave |
| | | | **Power Bandwidth** | 120 kHz |
| | | | **Small Signal Bandwidth** | (-6 dB) 1 MHz |
| **Cutoff Frequency** $f_c$ ± 2% max.<br>**Stability** ± 0.03% /°C<br>**Amplitude** -3 dB<br>**Phase** -90° | | **Cutoff Frequency** $f_c$ ± 2% max.<br>**Stability** ± 0.03% /°C<br>**Amplitude** -3 dB<br>**Phase** -74.3° | **Cutoff Frequency** $f_c$ ± 2% max.<br>**Stability** ± 0.03% /°C<br>**Amplitude** -3 dB<br>**Phase** -90° | |
| **Filter Attenuation**<br>(theoretical) | 1.49 dB 0.80 $f_c$<br>3.01 dB 1.00 $f_c$<br>30.0 dB 5.62 $f_c$<br>40.0 dB 10.0 $f_c$ | 1.91 dB 0.80 $f_c$<br>3.01 dB 1.00 $f_c$<br>30.0 dB 7.10 $f_c$<br>40.0 dB 12.75 $f_c$ | **Filter Attenuation**<br>(theoretical) | 40 dB 0.10 $f_c$<br>30 dB 0.18 $f_c$<br>3.01 dB 1.00 $f_c$<br>0.02 dB 4.00 $f_c$ |
| **Total Harmonic Distortion @ 1 kHz**<br>**D72**<br>**DP72** | <br><-70 dB<br><-70 dB | <br><-70 dB<br><-70 dB | **Total Harmonic Distortion @ 1 kHz**<br>**D72** | <br><-70 dB |
| **Wide Band Noise**<br>(5 Hz - 2 MHz) | 200 µVrms typ. | 200 µVrms typ. | **Wide Band Noise**<br>(5 Hz - 2 MHz) | 400 µVrms typ. |
| **Narrow Band Noise**<br>(20 Hz - 100 kHz) | 50 µVrms typ. | 50 µVrms typ. | **Narrow Band Noise**<br>(20 Hz - 100 kHz) | 100 µVrms typ. |
| **Filter Mounting Assembly** | FMA-01A | FMA-01A | **Filter Mounting Assembly** | FMA-01A |



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## Specification

(25°C and Vs ± 15 Vdc)

**Analog Input Characteristics**[1]

| | |
|---|---|
| Impedance | 10 kΩ min. |
| Voltage Range | ± 10 Vpeak |
| Max. Safe Voltage | ± Vs |

**Analog Output Characteristics**

| | |
|---|---|
| Impedance | 1 Ω |
| Linear Operating Range | ± 10 V |
| Maximum Current[2] | |
| D72 | ± 10 mA |
| DP72 | ± 5 mA |
| Offset Voltage | 10 mV max.<br>3 mV typ. |
| Offset Temp. Coeff. | 20 µV / °C |

**Power Supply (±V)**

| | |
|---|---|
| Rated Voltage | ± 15 Vdc |
| Operating Range | ± 5 to ± 18 Vdc |
| Maximum Safe Voltage | ± 18 Vdc |
| Quiescent Current **D72** | 5 mA max.<br>3 mA typ. |
| Quiescent Current **DP72** | 1.5 mA max.<br>600 µA typ. |

**Temperature**

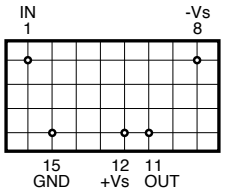
| | |
|---|---|
| Operating | 0 to + 70 °C |
| Storage | - 25 to + 85 °C |

Notes:

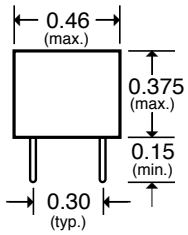
1. Input and output signal voltage referenced to supply common.
2. Output is short circuit protected to common. DO NOT CONNECT TO ±Vs.

## Pin-Out and Package Data
## Ordering Information

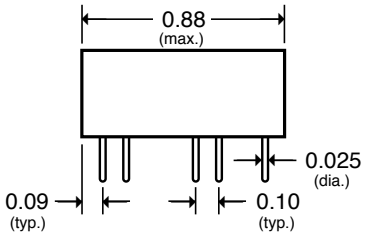
All dimensions are in inches
All case dimensions ± 0.01"
Grid Dimensions 0.1" x 0.1"




BOTTOM VIEW




FRONT VIEW




SIDE VIEW

**Filter Mounting Assembly-See FMA-01A**

## Ordering Information

**Filter Type**
**L** - Low Pass
**H** - High Pass

**Transfer Function**
**B** - Butterworth
**L** - Bessel

**D72L2B-849 Hz**

**Power Level**
**D** – Standard Power
**DP** – Low Power

**- 3 dB Corner Frequency**[3]
e.g., 849 Hz
2.50 kHz
33.3 kHz

3. How to Specify Corner Frequency:
Corner frequencies are specified by attaching a three digit frequency designator to the basic model number. Corner frequencies can range from 1 Hz to 100 kHz.





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FREQUENCY DEVICES™, INC.

# Low-Pass

**2-Pole**

**Bessel**

**Appendix A**

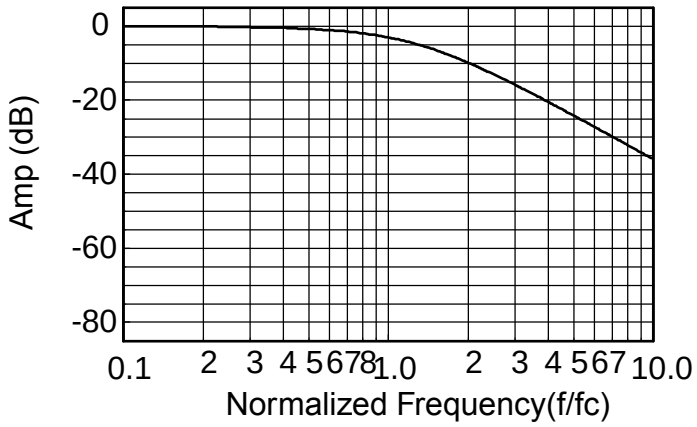
## Theoretical Transfer Characteristics

| f/fc (Hz) | Amp (dB) | Phase (deg) | Delay[1] (sec) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | .217 |
| 0.10 | -0.027 | -7.79 | .216 |
| 0.20 | -0.108 | -15.6 | .216 |
| 0.30 | -0.248 | -23.4 | .216 |
| 0.40 | -0.448 | -31.1 | .215 |
| 0.50 | -0.712 | -38.8 | .212 |
| 0.60 | -1.044 | -46.4 | .208 |
| 0.70 | -1.443 | -53.8 | .202 |
| 0.80 | -1.907 | -60.9 | .195 |
| 0.85 | -2.161 | -64.4 | .190 |
| 0.90 | -2.430 | -67.7 | .185 |
| 0.95 | -2.71 | -71.0 | .180 |
| 1.00 | -3.01 | -74.2 | .175 |
| 1.10 | -3.63 | -80.3 | .164 |
| 1.20 | -4.28 | -86.0 | .153 |
| 1.30 | -4.95 | -91.3 | .141 |
| 1.40 | -5.65 | -96.2 | .130 |
| 1.50 | -6.35 | -101 | .120 |
| 1.60 | -7.05 | -105 | .110 |
| 1.70 | -7.75 | -109 | .101 |
| 1.80 | -8.44 | -112 | .093 |
| 1.90 | -9.13 | -115 | .085 |
| 2.00 | -9.80 | -118 | .079 |
| 2.25 | -11.4 | -125 | .064 |
| 2.50 | -12.9 | -130 | .053 |
| 2.75 | -14.4 | -134 | .045 |
| 3.00 | -15.7 | -138 | .038 |
| 3.25 | -17.0 | -141 | .033 |
| 3.50 | -18.2 | -144 | .028 |
| 4.00 | -20.3 | -148 | .022 |
| 5.00 | -24.0 | -155 | .014 |
| 6.00 | -27.1 | -159 | .010 |
| 7.00 | -29.7 | -162 | .007 |
| 8.00 | -32.0 | -164 | .005 |
| 9.00 | -34.1 | -166 | .004 |
| 10.0 | -35.9 | -167 | .004 |

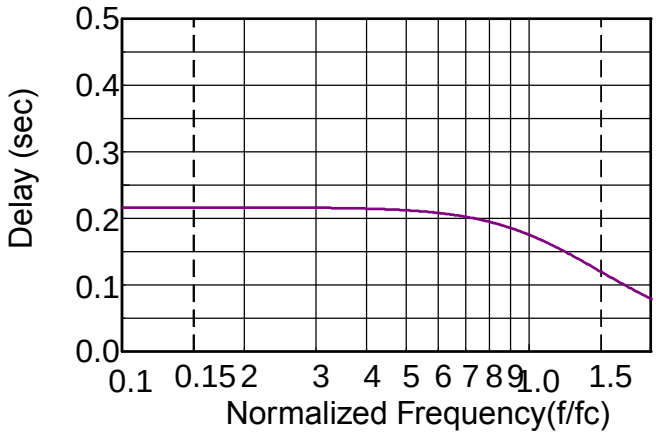
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

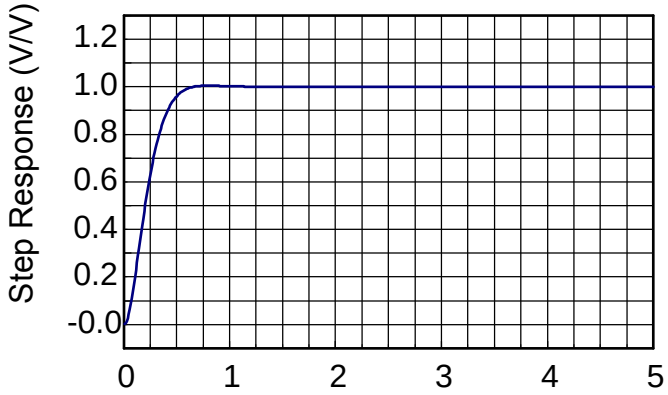
## Frequency Response




## **Delay** (Normalized)




## Step Response



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# Low-Pass

**2-Pole**

**Butterworth**

**Appendix A**

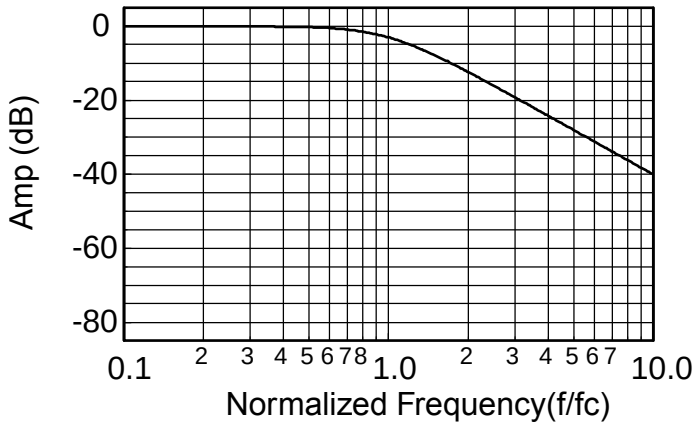
## Theoretical Transfer Characteristics

| f/fc (Hz) | Amp (dB) | Phase (deg) | Delay[1] (sec) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | .225 |
| 0.10 | 0.00 | -8.13 | .227 |
| 0.20 | -0.01 | -16.4 | .234 |
| 0.30 | -0.035 | -25.0 | .243 |
| 0.40 | -0.110 | -34.0 | .255 |
| 0.50 | -0.263 | -43.3 | .265 |
| 0.60 | -0.529 | -53.0 | .271 |
| 0.70 | -0.935 | -62.7 | .270 |
| 0.80 | -1.491 | -72.3 | .262 |
| 0.85 | -1.824 | -77.0 | .255 |
| 0.90 | -2.191 | -81.5 | .246 |
| 0.95 | -2.59 | -85.8 | .236 |
| 1.00 | -3.01 | -90.0 | .225 |
| 1.10 | -3.92 | -97.7 | .202 |
| 1.20 | -4.88 | -105 | .179 |
| 1.30 | -5.86 | -111 | .157 |
| 1.40 | -6.85 | -116 | .138 |
| 1.50 | -7.83 | -121 | .121 |
| 1.60 | -8.78 | -125 | .106 |
| 1.70 | -9.71 | -128 | .094 |
| 1.80 | -10.6 | -131 | .083 |
| 1.90 | -11.5 | -134 | .074 |
| 2.00 | -12.3 | -137 | .066 |
| 2.25 | -14.3 | -142 | .051 |
| 2.50 | -16.0 | -146 | .041 |
| 2.75 | -17.6 | -149 | .033 |
| 3.00 | -19.1 | -152 | .027 |
| 3.25 | -20.5 | -154 | .023 |
| 3.50 | -21.8 | -156 | .020 |
| 4.00 | -24.1 | -159 | .015 |
| 5.00 | -28.0 | -164 | .009 |
| 6.00 | -31.1 | -166 | .006 |
| 7.00 | -33.8 | -168 | .005 |
| 8.00 | -36.1 | -170 | .004 |
| 9.00 | -38.2 | -171 | .003 |
| 10.0 | -40.0 | -172 | .002 |

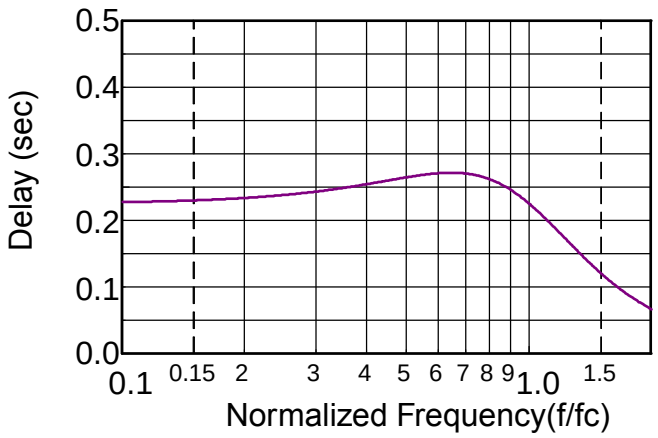
1. **Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

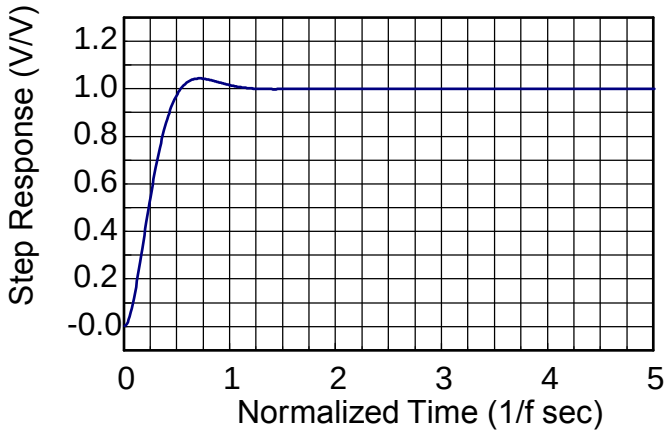
### Frequency Response




### **Delay** (Normalized)




### Step Response



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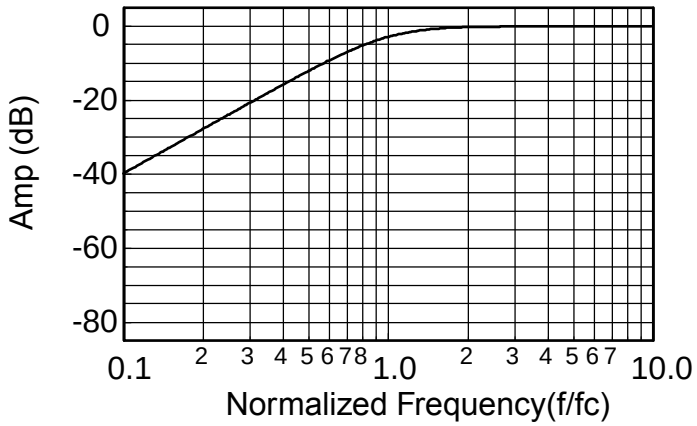
## Theoretical Transfer Characteristics

| f/fc (Hz) | Amp (dB) | Phase (deg) | Delay[1] (sec) |
|---|---|---|---|
| 0.10 | -40.00 | 172 | .227 |
| 0.20 | -27.97 | 164 | .234 |
| 0.30 | -20.95 | 155 | .243 |
| 0.40 | -16.03 | 146 | .255 |
| 0.50 | -12.31 | 137 | .265 |
| 0.60 | -9.40 | 127 | .271 |
| 0.70 | -7.13 | 117 | .270 |
| 0.80 | -5.37 | 108 | .262 |
| 0.85 | -4.65 | 103 | .255 |
| 0.90 | -4.02 | 98.5 | .246 |
| 0.95 | -3.48 | 94.2 | .236 |
| 1.00 | -3.01 | 90.0 | .225 |
| 1.20 | -1.71 | 75.5 | .179 |
| 1.40 | -1.01 | 64.1 | .138 |
| 1.60 | -0.62 | 55.4 | .106 |
| 1.80 | -0.40 | 48.7 | .083 |
| 2.00 | -0.26 | 43.3 | .066 |
| 2.50 | -0.11 | 34.0 | .041 |
| 3.00 | -0.05 | 27.9 | .027 |
| 4.00 | -0.02 | 20.7 | .015 |
| 5.00 | -0.01 | 16.4 | .009 |
| 6.00 | -0.00 | 13.6 | .006 |
| 7.00 | -0.00 | 11.7 | .005 |
| 8.00 | -0.00 | 10.2 | .004 |
| 9.00 | -0.00 | 9.04 | .003 |
| 10.0 | -0.00 | 8.13 | .002 |

## Frequency Response




1. **Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$



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