For the lowest musical octave you need a

Super-Bass Filter

for the Bass you can feel!

A most effective method of extending the bass response of a stereo system is to add a super-woofer. Although the associated loudspeaker system may be somewhat bulky it can be disguised as a piece of furniture, such as a coffee table. This article presents a design for a Super Bass Filter, a necessary part of a super-woofer system.

by RON DE JONG

Most run-of-the-mill loudspeaker systems provide a useable bass response down to around 50Hz or so. This is adequate for satisfactory reproduction of most music, including most so-called "heavy rock". Those enclosures that are smaller than average will generally provide a higher "cut-off" frequency or, if they do have an extended bass response, are inefficient, in the sense that they require significantly more drive power.

Even those loudspeaker systems which are larger than average or which purport to have really extended bass rarely provide much in the way of useable response below about 40Hz.

This simply means that the majority of hifi enthusiasts have to make do with loudspeaker systems which lack at least the lowest octave of the audible spectrum. For most music, this is a satisfactory compromise. Most people just do not have the resources necessary to obtain and accommodate loudspeaker systems which cover the whole audio spectrum.

So most people never enjoy the rich sound of a truly wide range loudspeaker system — one which can really come into its own when playing classical organ music or music produced on electronic synthesizers. Sad.

Well there is a way to recover those lost octaves and this is within the reach of even those people with compact bookshelf loudspeakers: Use a separate "super-woofer" which can be housed in an enclosure with does double duty as a coffee table or end table. Powered by a separate amplifier, the super-woofer takes over where the stereo speakers leave off.

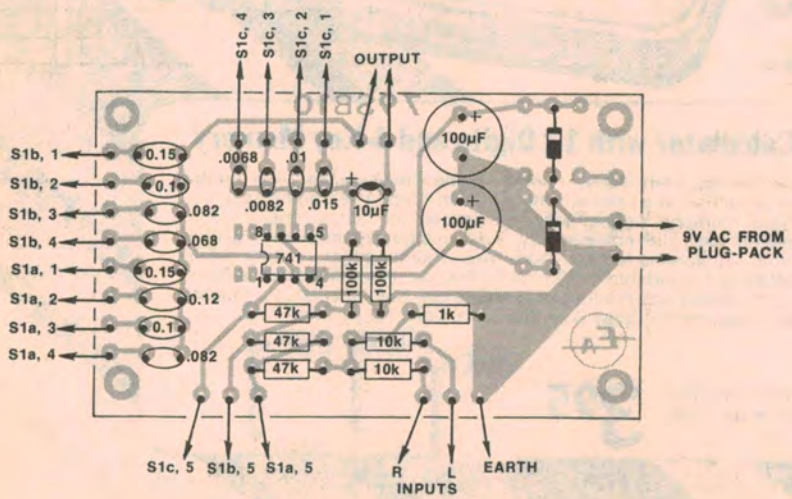
By disguising the necessary bulk of a super-woofer system in a useful piece of furniture, the hifi enthusiast can employ smaller enclosures for the main stereo speakers and yet still obtain very deep bass.

Only one super-woofer is required for a stereo system. This is because there is no directional information provided at signal frequencies below 100Hz. This also means that the super-woofer can be positioned almost anywhere within the listening room.

What is needed to drive the super-woofer is a separate power amplifier with at least as much power as the total of the existing stereo amplifier. This is to take into account that, for a super-woofer to have tolerable enclosure size, it must necessarily be relatively low in efficiency.

The signal for the super-woofer amplifier is derived from the outputs of the existing stereo amplifier. The circuit presented here is designed for this purpose. We call it a Super Bass Filter.

Our Super Bass Filter mixes and



All the components except for the frequency range selector switch are mounted on a small PC board.

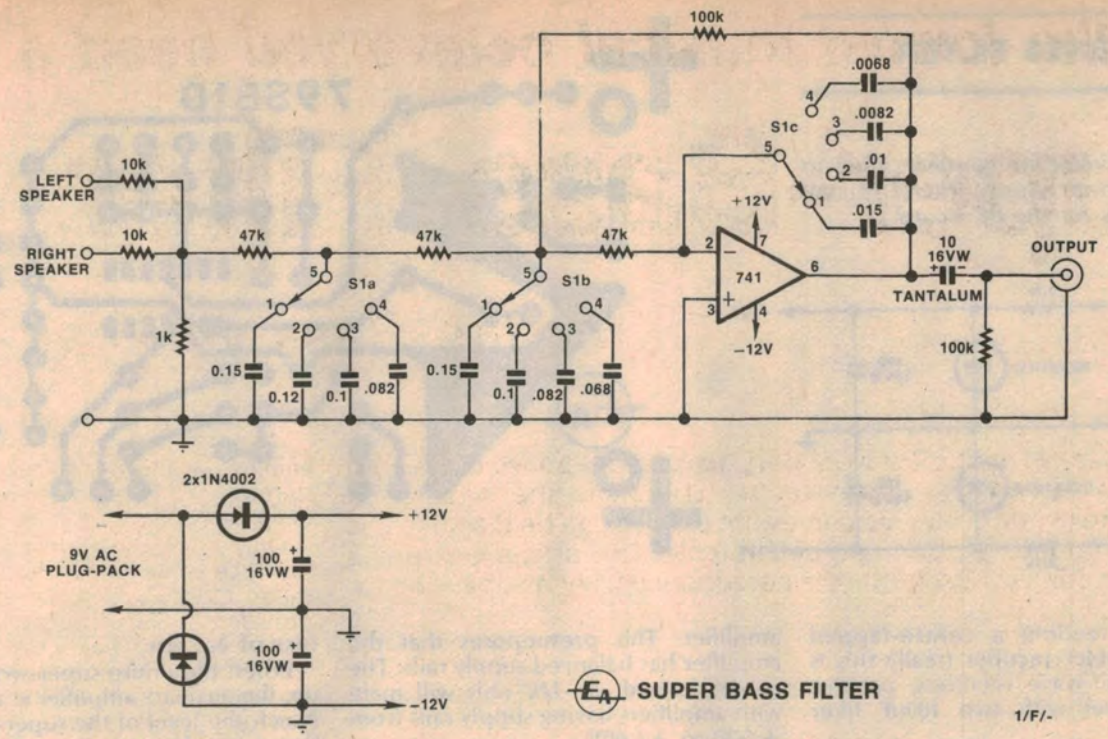
PARTS LIST

1 PC board coded 79SB10, 97mm x 57mm
1 3-pole 4-position rotary switch
1 9 volt plug pack transformer, Ferguson model PPA 9/500
½ Metre of rainbow cable

SEMICONDUCTORS
2 1N4002 diodes
1 741 op amp

CAPACITORS
2 100uF 16VW electrolytics
1 10uF 16VW tantalum
2 0.15uF metallised polyester (greencap)
1 0.12uF metallised polyester
2 0.1uF metallised polyester
2 0.082uF metallised polyester
2 .068uF metallised polyester
1 .015uF metallised polyester
1 .01uF metallised polyester
1 0.0082uF metallised polyester
1 .0068uF metallised polyester

RESISTORS
all ¼ watt: 2 x 100k, 3 x 47k, 2 x 10k, 1 x 1k



Circuit of the super bass filter. It uses only one IC — an inexpensive 741.

attenuates the signals from both channels of the existing stereo amplifier. Frequencies above the cut-off frequency are rolled off at the rate of 18dB/octave. Frequencies below the cut-off point are fed to the super-woofer amplifier. There is a switch to select the cut-off frequencies: nominally 50, 70, 80 and 100Hz.

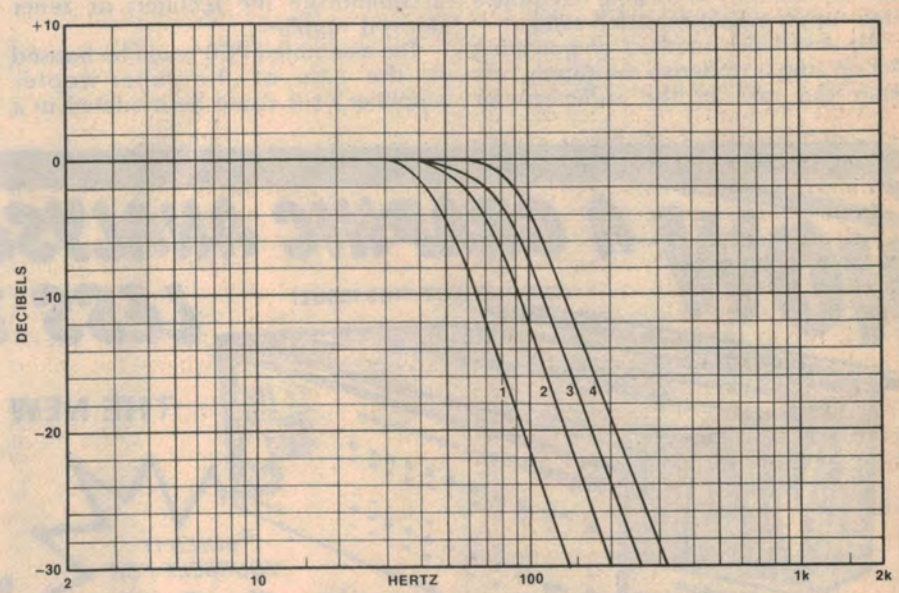
Now refer to the complete circuit of the Super Bass Filter. It uses just one operational amplifier IC, the readily available 741. This op amp is connected in a conventional low-pass filter network which has three RC networks. It is known as a third-order Butterworth filter.

A three-pole, four-position switch is used to switch the capacitors to obtain the four cut-off frequencies.

Apart from the attenuation provided by the input voltage divider, the filter circuit has a gain of unity, below the cut-off frequency. The input voltage divider has been designed to suit the output of most amplifiers. If the filter is fed from the line outputs of the stereo amplifier (or preamplifier), the input network should be changed.

This would involve omitting the 1k resistor, increasing the two 10k resistors to 47k each and substituting a link (on the PCB) for the first 47k resistor following the input mixing resistors. This modification assumes that the source impedance of the line outputs of the amplifier is low, ie, less than about 5k.

Power requirements for the op amp circuit are +/-12V DC at about 3 milliamps or less. This can be provided in two ways. The first involves the use of plugpack transformer, Ferguson



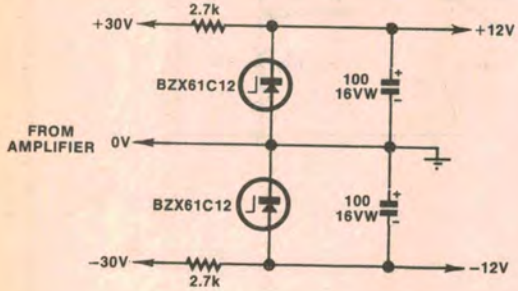
Response curves of our prototype unit for the four different frequency ranges.

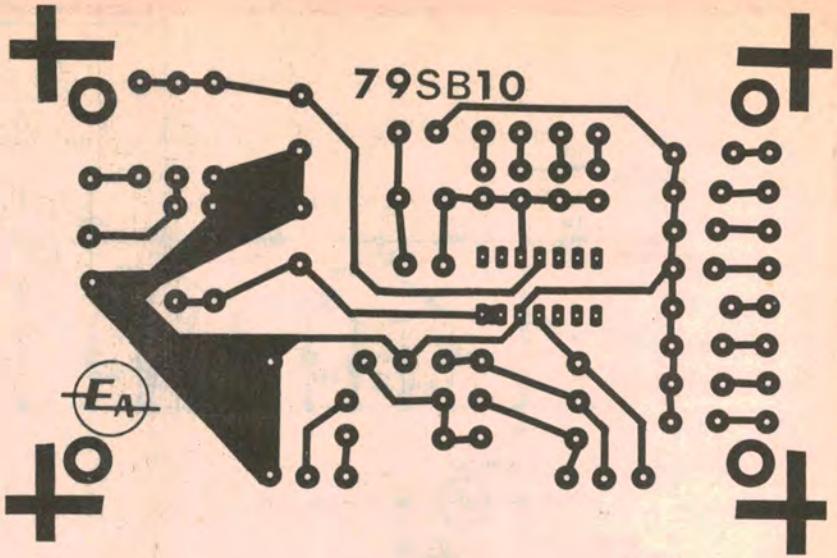
SPECIFICATIONS

HARMONIC DISTORTION:	*Typically .012% at 60Hz with respect to 100mV RMS*
SIGNAL-TO-NOISE RATIO:	*88dB unweighted with respect to 100mV RMS*
MAXIMUM OUTPUT VOLTAGE:	*5V RMS*
INPUT IMPEDANCE:	*10k*
OUTPUT IMPEDANCE:	*less than 1k*
CUT-OFF FREQUENCIES:	*50, 70, 80, 100Hz*
FILTER SLOPE:	*18dB per octave*

SUPER BASS FILTER

BELOW: Circuit to connect filter to amplifier power supply. RIGHT: Actual size artwork for the PC board.





PPA9/500, feeding a centre-tapped voltage doubler rectifier (really this is just two half-wave rectifiers, positive and negative) with two 100uF filter capacitors.

This modest degree of power supply filtering is adequate for the circuit because of the low current drain and the fact that the 741 op amp has quite a high supply ripple rejection ratio.

An alternative method of powering the op amp is to derive the supply rails from the rails of the super-woofer amplifier. This presupposes that the amplifier has balanced supply rails. The zener derived +/-12V rails will mate with amplifiers having supply rails from +/-30 to +/-60V.

All the components for the circuit are mounted on a PCB measuring 57 x 97mm (code 79sb10). This has space to accommodate the rectifiers or zener derived supplies.

The assembled PCB could be housed in the case of the super-woofer amplifier or it could be mounted in a case of its own.

When the entire super-woofer is set up, the auxiliary amplifier is adjusted to match the level of the super-woofer to the stereo loudspeakers. Once this is done, the stereo amplifier volume control is used and the auxiliary amplifier requires no further adjustment.

Just a final point: do not rotate the rotary switch for the filter while the system is powered up otherwise a loud thump will be delivered by the super-woofer.