Surround Sound Decoder

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Surround sound is the reproduction of the spacious acoustics of a live performance in a small listening room. Rear speakers and a decoder are required for surround sound.

Surround sound in residential environments is possible because of the recent introduction of the stereo television and stereo video cassette recorder. Most households have a stereo system where the left front speaker reproduces the left side of the performance and the right front speaker reproduces the right side of the performance. There are no rear speakers in a stereo system.

Dolby laboratories invented a system of encoding the rear channel information on the existing stereo channels. A decoder is required to decode the rear channel signal and to feed it to the rear channel amplifier.

The Decoder

The surround-sound decoder consists of a bass boost circuit (one for each front channel), an L-R decoder, a 7kHz low pass filter, and a rear channel gain control, as shown in the block diagram in figure 1.

Sound effects such as explosions or thunder contain a lot of information at frequencies below 50Hz. Most stereo systems roll-off frequencies below 30Hz; therefore, very low frequencies must be amplified which requires a subwoofer simulator to be incorporated into each front channel. This enables the existing stereo equipment to reproduce the information at low frequencies.

A 7kHz low pass filter is used to roll off the high frequency response of the rear channels. The surround sound system is cheap to build and it can bring exciting, three dimensional surround sound into the home.

Circuit Operation

A schematic of the surround-sound decoder is shown in figure 2. IC1A, IC1B, and IC1C form the left channel subwoofer simulator while IC2A, IC2B, and IC2C form the right channel subwoofer simulator. The subwoofer simulator provides unity gain at frequencies above 1kHz and it provides up to 28dB of gain at 10 Hz. The bass boost is adjustable via potentiometer RP1.
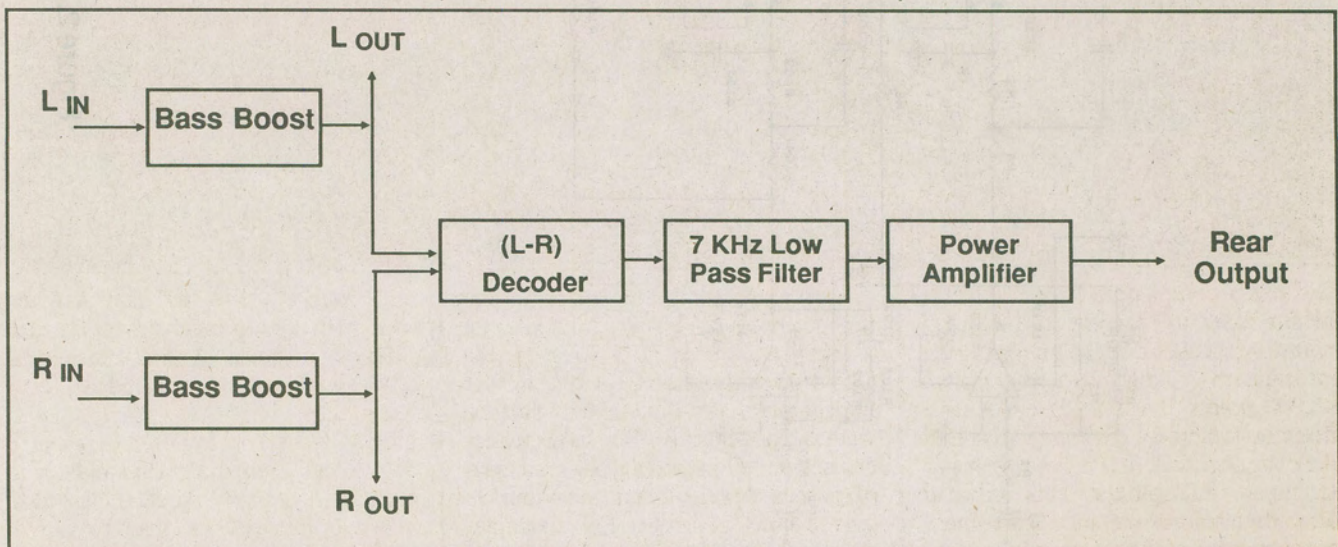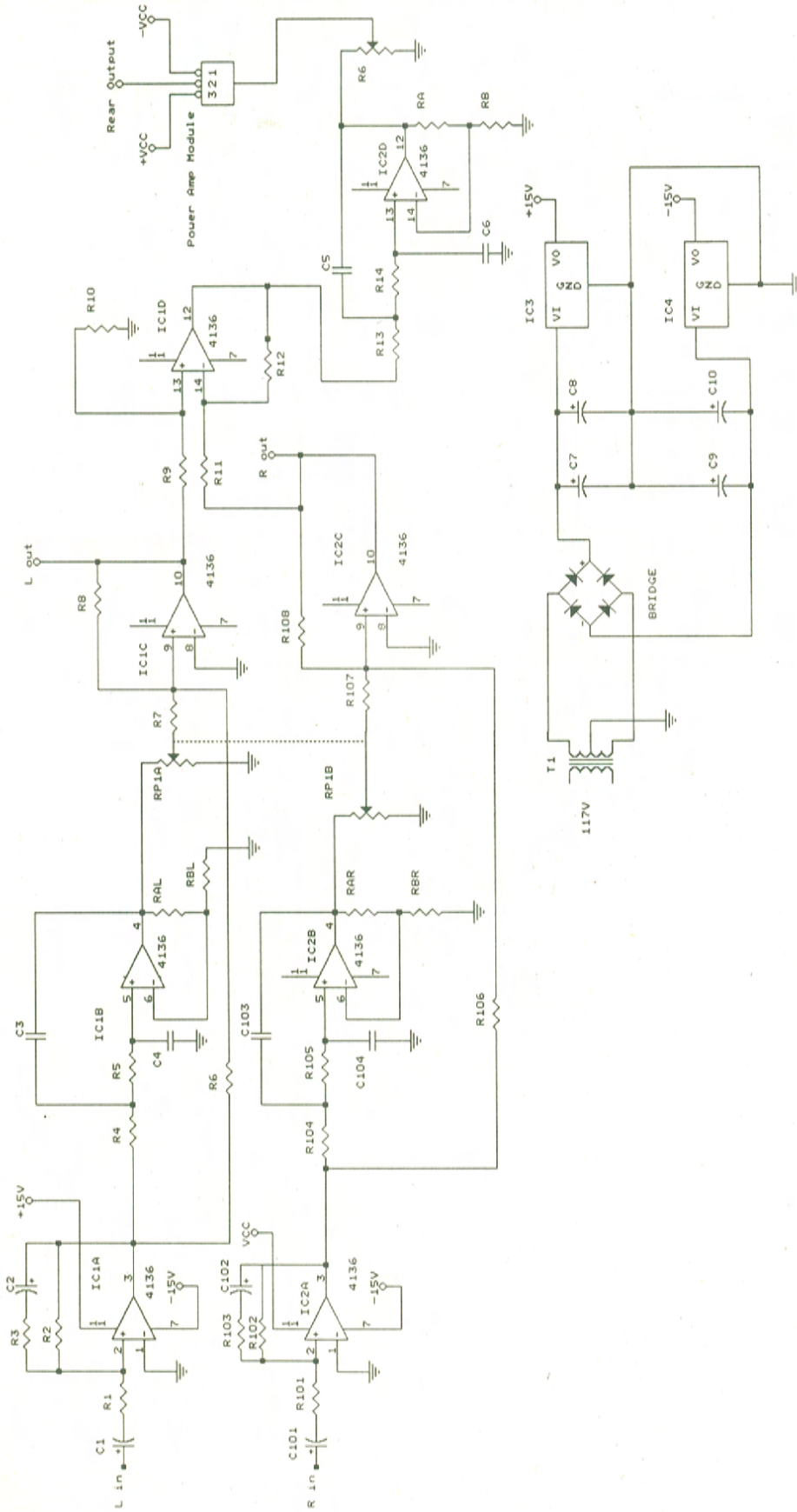

Fig. 1. Block Diagram of Surround Sound Decoder

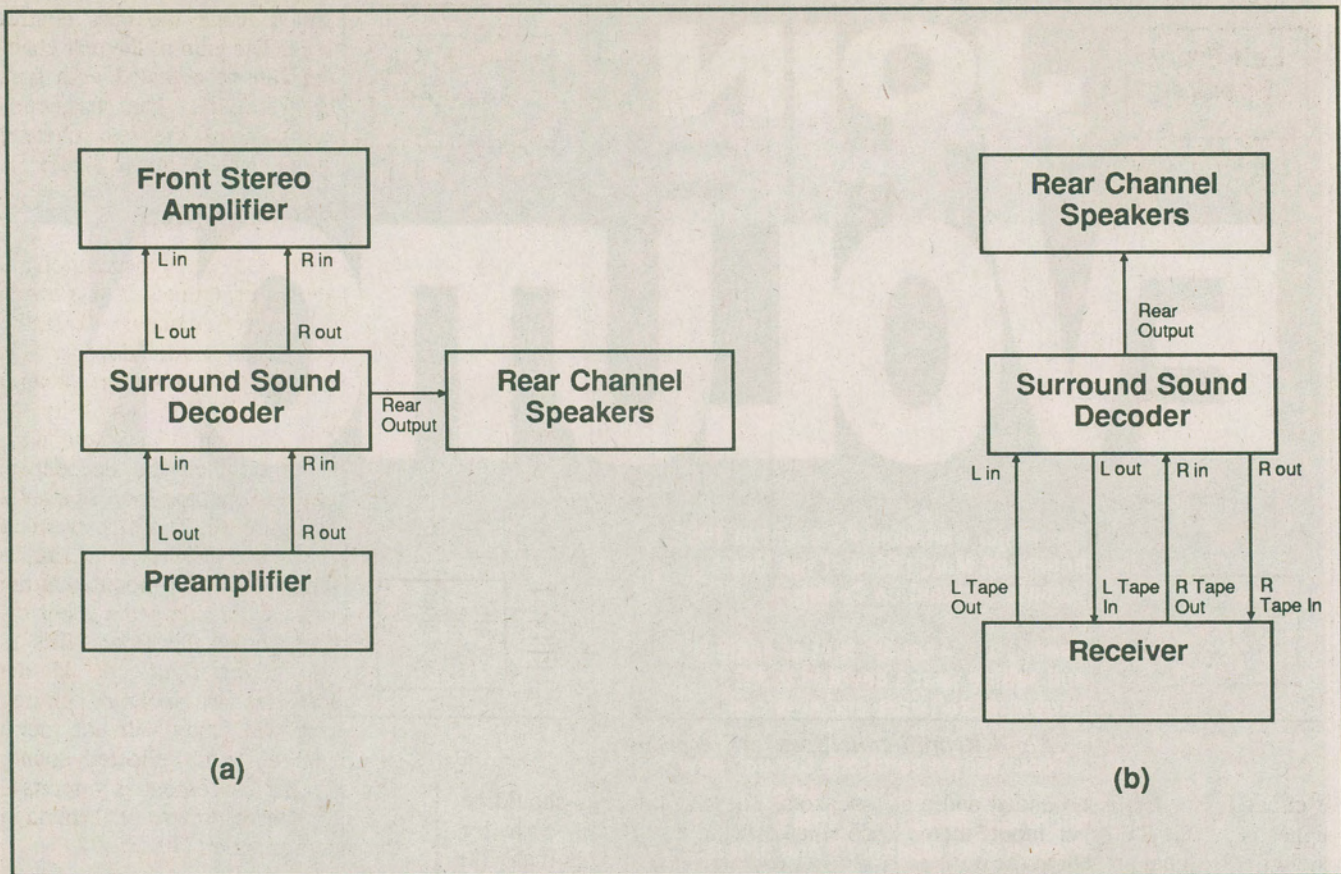Figure 2. Schematic Diagram of Surround Sound Decoder

Fig. 3. Installation of Decoder Into Stereo System

IC1D is the L-R decoder which is essentially a differential amplifier where the left channel signal is fed to the non-inverting input of the operational amplifier and the right channel is fed into the inverting input of the operational amplifier. IC2D is configured as a 7kHz low pass filter. The power amplifier can be any amplifier module capable of driving two eight ohm speakers in parallel. The remaining components make up a dual power supply required to power the system.

Construction

The surround-sound decoder may be built on a piece of perf board using point to point wiring or on a printed circuit board. Each RC4136 operational amplifier contains four separate op-amps. Alternately, eight LM741 op-amps may be used as long as the proper pins are used for the inputs, output and power supply leads. Care should be taken to orient the capacitors properly

and to avoid solder bridges. The power amplifier module may be any power amplifier that can drive two eight ohm speakers in parallel. A good choice is the ILP-HY60 available from Plitron Manufacturing Inc. at (416) 667-9914. Active Components also carrys this amplifier module. Active can be reached at 1-800-363-6592.

Parts List

all resistors are 1/4 watt @ 5%

R1,R101: 47k

R2,R102: 270k

R3,R103: 56k

R4,R5,R104,R105: 33k

R6,R8-R12,R106,R108: 10k

R7,R107,RA,RAL,RAR: 1.8k

RB,RBL,RBR: 3k

RP1: 100k dual potentiometer

R13,R14: 22k

RG: 5k potentiometer

C1,C101: 1.0 µF

C2,C102: 0.047 µF

C3,C4,C103,C104: 0.1 µF

C5,C6: 0.001 µF

IC1,IC2: RC4136 (ECG 997)

IC3: LM7815

IC4: LM7915

D1-D4: 1N5408

C7-C10: 2500 µF @ 25V

T1: 25.2 V.C.T. @ 2A transformer

Power Amp Module: see text

Testing

Testing of the decoder is straight forward. Connect the same signal to L_{in} and R_{in}. There should be a signal at the output of IC1C and IC2C. There should be no signal at the output of IC1D and hence no sound from the rear speakers.
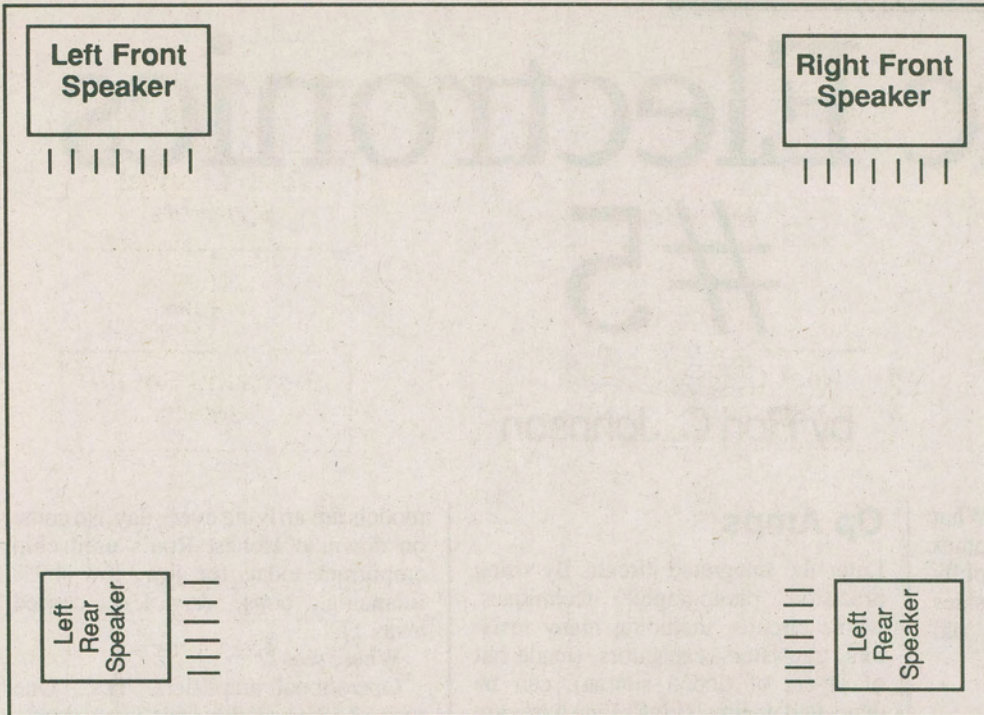
Left Front Speaker		Right Front Speaker
‖‖‖‖‖		‖‖‖‖‖
Left Rear Speaker ‖‖‖		Left Rear Speaker ‖‖‖

Fig. 4. Rear Channel Speaker Placement

justed using the bass control RP1. The gain of the rear channel can be adjusted with gain control RG. The frequency response of the rear channel should roll-off above 7kHz.

Installation

Two methods of installation are shown in figure 3. If you own a separate component system, the surround-sound decoder is placed in between the preamp and the power amplifier as shown in figure 3a. If you own a receiver, then the decoder is placed in a tape loop as shown in figure 3b. The placement of the rear speakers is important. They should be mounted at the rear of the side walls about six feet above the floor. This is shown in figure 4. If the speakers are mounted on the rear wall, they will not sound like ambient reflected sound. Proper placement is important for exciting three-dimensional sound in your listening room. ☐

If either L_{in} or R_{in} is grounded and a signal is fed to the other input, there should be a signal present at the output of IC1D and hence from the rear speakers. These initial tests should be conducted using a 1kHz sinewave for the test signal. Signals lower than 100 Hz will be amplified and can be ad-