Professional Series Technical Manual

Electronic Frequency Dividing Networks

5233 Single Channel
5234 Dual Channel

This manual contains technical information, installation and operating procedures for qualified service personnel.

Contents

Specifications

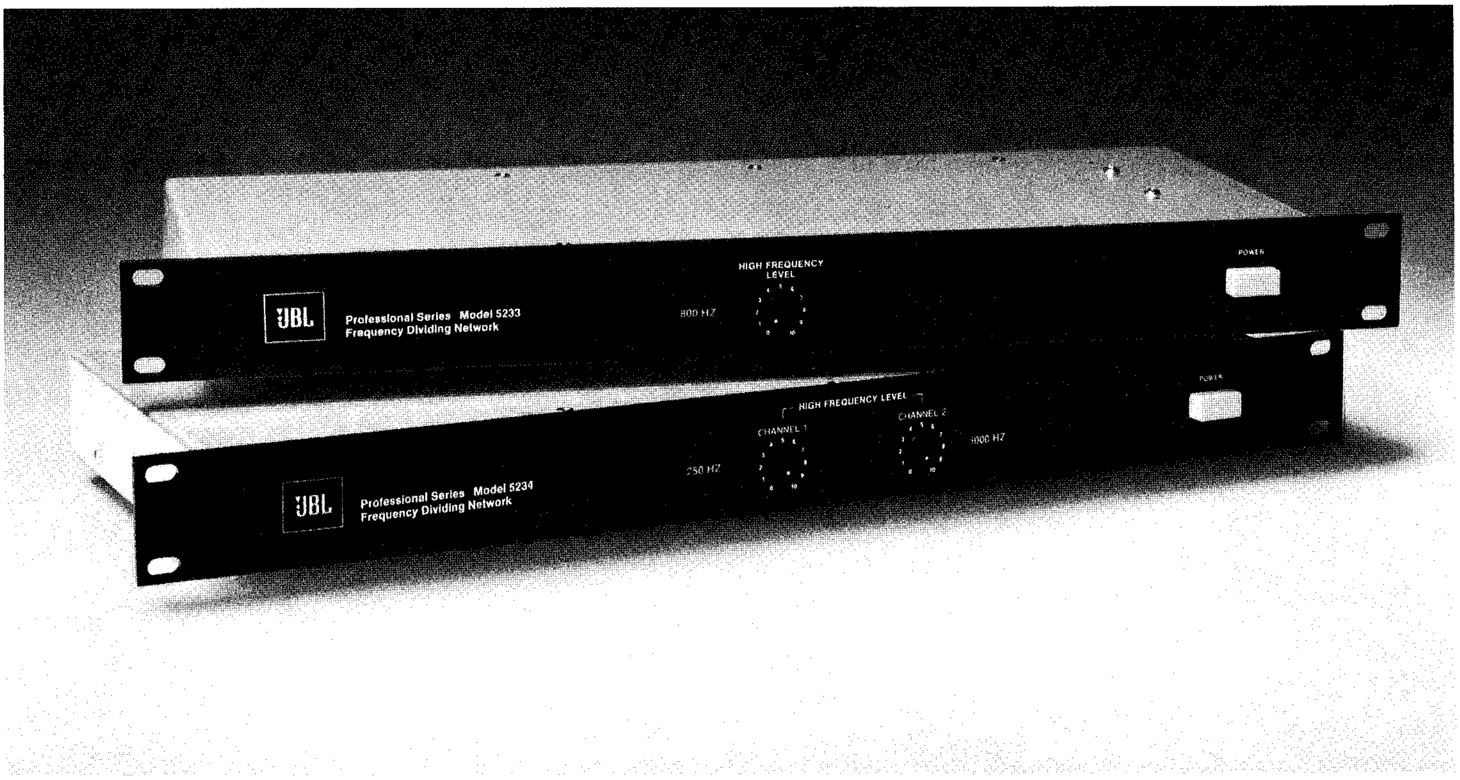
Gain	0 dB in the passband
Rated Output	6.2 V (+18 dB ref. 0.775 V)
Distortion	Less than 0.5% THD, 20-20,000 Hz at rated output Less than 0.2% THD, 20-20,000 Hz at +10 dB ref. 0.775 V
Frequency Response	±0.5 dB, 20-20,000 Hz
Crossover Frequency	Selectable by plug-in module, 3-dB crossover point ± 10%
Filter Slope	12 dB per octave
Input Impedance	Greater than 50kΩ
Load Impedance	600 Ω or greater
Output Impedance	47 Ω
Channel Isolation	Greater than 60 dB, 20-20,000 Hz
Signal/Noise Ratio	Greater than 90 dB, 20-20,000 Hz equivalent bandwidth
Controls	High Frequency Level (each channel) Power Supply Voltage Select
Power Requirement	5 Watts, 120/240 V AC, 50/60 Hz
Operating Temperature	Up to 132°F (55°C)
Dimensions	1¾ x 19 x 7⅝ in deep 44 mm x 483 mm x 194 mm deep
Mounting	1 EIA standard rack space
Panel Finish	Semi-gloss non-glare baked enamel, dark gray
Net Weight	4 lb (1.8 kg) either unit with accessory crossover card(s) installed.
Shipping Weight	6.5 lb (3.0 kg) either unit
Warranty	Two years

Accessories

Crossover Cards (one required per channel)	52-5120	Blank
	52-5121	250 Hz
	52-5122	500 Hz
	52-5123	800 Hz
	52-5124	1200 Hz
	52-5125	5000 Hz
	52-5127	7000 Hz
	52-5140	For the 4343 Studio Monitor

Note: The information contained herein and the performance specifications listed above also apply to 5231 and 5232 Electronic Frequency Dividing Networks identified by serial numbers having the suffix A.

JBL continually engages in research related to product improvement. New materials, production methods and design refinements are introduced into existing products without notice as a routine expression of that philosophy. For this reason, any current JBL product may differ in some respect from its published description but will always equal or exceed the original design specifications unless otherwise stated.



The JBL 5233 and 5234 Electronic Frequency Dividing Networks

The 5233 and 5234 are designed for use with studio monitor or sound reinforcement loudspeaker systems where bi-amplification or tri-amplification is desirable. The 5233 (single channel) and 5234 (dual channel) feature differential high impedance inputs, unity gain in the passband and unbalanced low impedance outputs. The 5233 will provide a single channel crossover. The 5234 provides two separate channels with independent crossover action (as in a stereo installation).

The power switch and pilot light for the unit and a high frequency level control for each channel are located on the front panel for easy access. The crossover frequency at which each channel is operating is indicated through a front panel window. Either model can be mounted in one EIA standard rack space.

The desired crossover frequency is obtained by inserting the corresponding printed circuit card into each channel's circuitry. Crossover cards are available for most commonly used frequencies. Filter slopes are 12 dB per octave with high and low frequency output attenuated 3 dB at the crossover point. Cards are also available with the specific crossover characteristics required for the JBL 4343 bi-amplified studio monitor. In addition, blank cards can be obtained for construction of crossover networks for other frequencies (details provided in the appendix).

Advantages

1. *Lower Distortion*—The use of electronic frequency dividing networks and multiple amplifiers permits delivery of optimum power over the desired audio spectrum with minimum distortion. By dividing the audio spectrum prior to amplification, the individual low frequency and high frequency amplifiers can perform their functions with greater effectiveness.

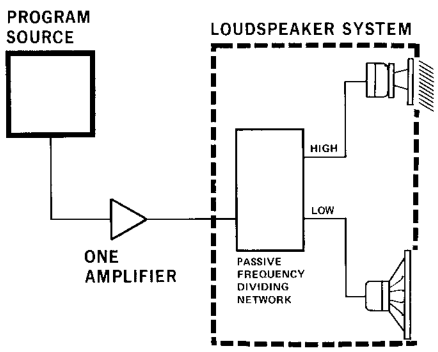
2. *Flexibility*—In sound reinforcement applications it is often desirable to combine one low frequency driver with several high frequency units to obtain a controlled dispersion pattern; thus, one may select amplifiers of the appropriate power for each group of transducers.

3. *Cost Savings*—When several loudspeaker systems are to be connected to a single channel, significant cost savings can be realized since only one electronic frequency dividing network need be used, thereby eliminating the high level passive crossover networks normally required for each of the loudspeaker systems. Moreover, since no power is dissipated in resistive attenuators, the amplifier requirements for high power sound systems may be substantially less than when high level dividing networks are used.

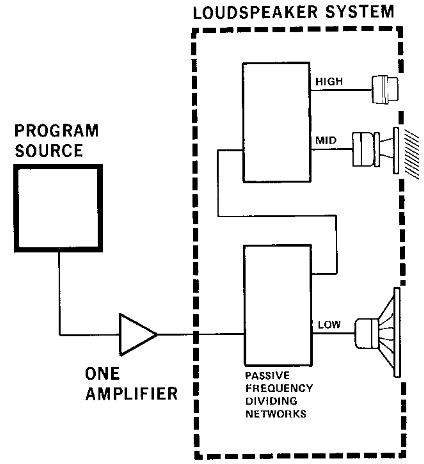
Installation

The electronic frequency dividing network receives the program signal from a line level source—preamplifier, studio console or portable mixer—and separates the signal into high and low frequency bands. Outputs from the network feed the appropriate power amplifiers, which in turn drive their respective loudspeaker system components. Input connections may be balanced or unbalanced, output connections are unbalanced; shielded cable is required. If output cable lengths are greater than 15 to 20 feet (4.5 m to 6 m), isolation transformers (600 Ω:600 Ω) are recommended at each output to reduce the possibility of radio frequency interference or hum. The outputs can deliver + 18 dB (6.2 V into 600 Ω) and

Conventional Passive Networks

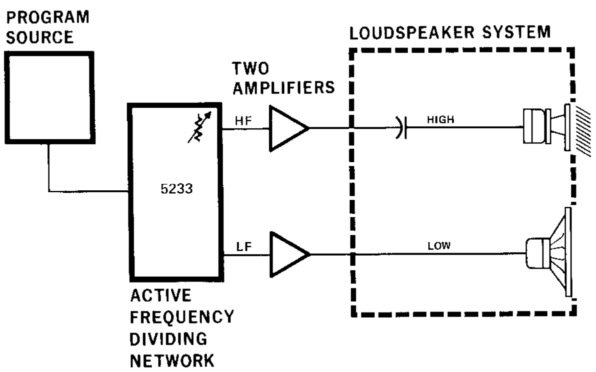


Two-Way System

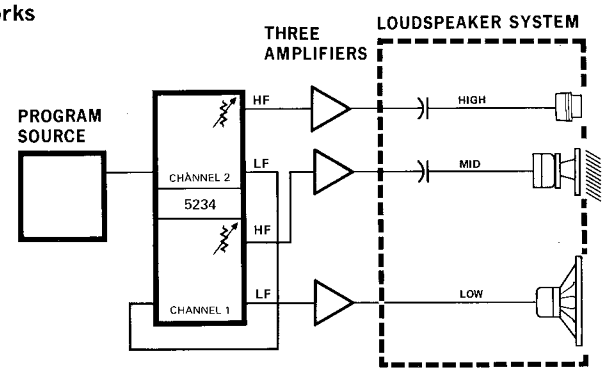


Three-Way System

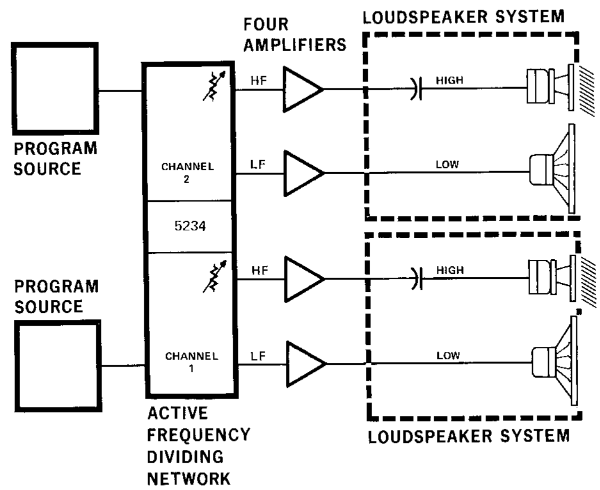
Electronic Networks



Two-Way System with Single Channel Active Crossover



Three-Way System with Dual Channel Active Crossover



Two Independent Two-Way Systems with Dual Channel Active Crossover

will drive the line inputs of conventional amplifiers. Two or more power amplifiers can be driven from each output.

The 5234 dual channel network can be used to tri-amplify a loudspeaker system by connecting the low frequency output of channel 2 to the input of channel 1. (Twist two unshielded wires together or use shielded cable for this connection.) The channel 1 outputs can then be used to drive the midrange and low frequency amplifiers. Typical installations are diagrammed in Figure 1.

Figure 1. *Typical Installations Of The 5233 And 5234 Compared To Conventional Passive Networks*

Whenever a midrange or high frequency driver is connected directly to a power amplifier, a series capacitor is recommended to attenuate unwanted low frequency "on-off" switching transient signals which can damage the driver. Specific capacitor values are given in Table 1.

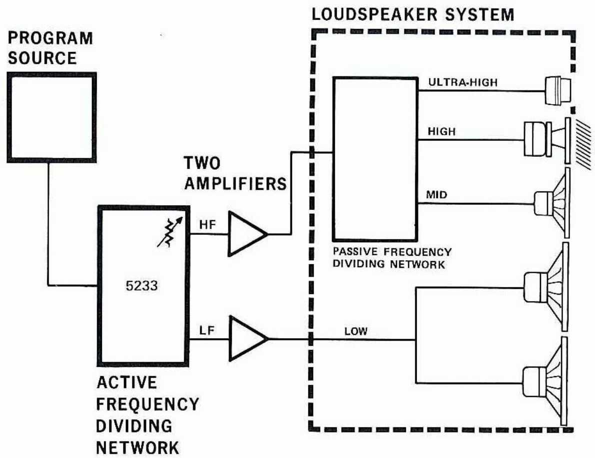


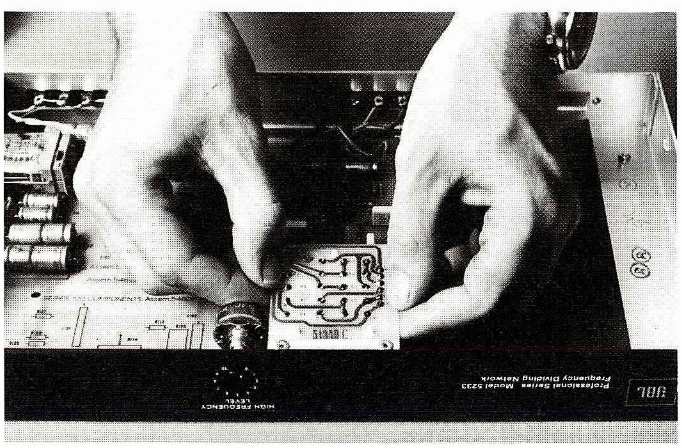
Figure 2. *Combining Electronic And Passive Frequency Dividing Networks*

It is possible to construct a system using an electronic low frequency transition and a conventional passive network for the midrange or high frequency crossover. The JBL 4350 Studio Monitor, diagrammed above, is such a system. If a pair of 4350's are to be used, a single 5234 can accommodate both systems. Note that the passive, high level frequency dividing networks used in all JBL studio monitors designed for bi-amplification already incorporate the required attenuation capacitors to protect the midrange and high frequency drivers.

Crossover Card Insertion

Prior to installing the 5233 or 5234, a crossover card must be inserted in each channel as follows:

1. Place the 5233 or 5234 upside down on a soft surface, remove the two Phillips-head screws from either side of the case and lift the bottom cover from the chassis.
2. Align the three holes in each crossover card with the corresponding mounting pins on the main printed circuit board. The components on the card should face toward the chassis with the frequency designation label oriented toward the front panel.
3. As the card is gently pressed against the mounting pin stops (approximately ¼ in, 6 mm), electrical connection will be made between the card connector and six pins on the printed circuit board.
4. Replace the bottom cover and secure it with the four screws. The unit is now ready for mounting and connection of the various inputs and outputs.



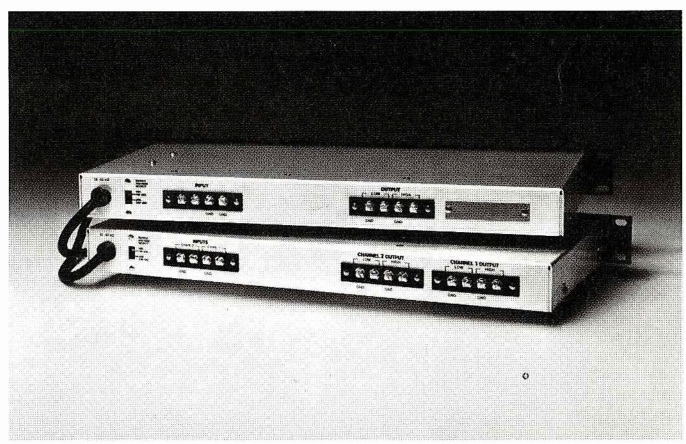
The crossover card is pressed on to mounting pins as shown. Note the use of two hands to maintain proper alignment for installation or removal of the card.

Note: Operation of the 5233 or 5234 without a crossover card will not damage the unit.

Table 1. Maximum Values For Low Frequency Attenuation Capacitors

Crossover Frequency	Driver Impedance 4 Ω	8 Ω	16 Ω
250 Hz to 500 Hz	150 μF	80 μF	40 μF
500 Hz to 5 kHz	80 μF	40 μF	20 μF
5 kHz and above	8 μF	5 μF	2 μF

Capacitor working voltages should be at least 50 V. Do not use polarized electrolytic capacitors; paper or Mylar capacitors are acceptable. A 50 W resistor having a value of two to three times the rated impedance of the driver should also be connected across the driver terminals. These capacitors are available from electronic parts suppliers. A listing of capacitors that may be obtained from JBL and the formula for determining capacitor values are provided in Table 4, located in the appendix. Note: Below the cutoff frequency of the capacitor, the power amplifier will be unterminated. If the power amplifier has an output transformer, a 20 W resistor equal to ten times the driver impedance should be installed across the amplifier output terminals.



Input and output terminals of the 5233 and 5234.

Mounting

The 5233 or 5234 can be mounted in a single EIA standard rack space without additional bracing or ventilation. All external connections are made on the rear panel. Mounting hardware is supplied with each unit.

Connections

Shielded cable is necessary for all input and output connections. Make certain that the shield is properly connected, as shown in Figures 3 and 4.

Input Connections—Inputs to the 5233 and 5234 are for a line level source, balanced or unbalanced. Screw terminals on the rear panel are provided for connection of each input and are clearly identified. Balanced connections are shown in green; exchanging hi and lo conductors will result in phase reversal.

Output Connections—Each output channel can deliver 6.2 V into 600 Ω or greater (+18 dB referenced to 0.775 V). A separate pair of screw terminals, located on the rear panel, is provided for the low and high frequency output of each channel. Outputs will drive the line input of any conventional amplifier. Typically, the impedance of a bridging input is at least 5 kΩ (usually 10 kΩ or more); therefore, two or more power amplifiers can be driven by a single electronic frequency dividing network.

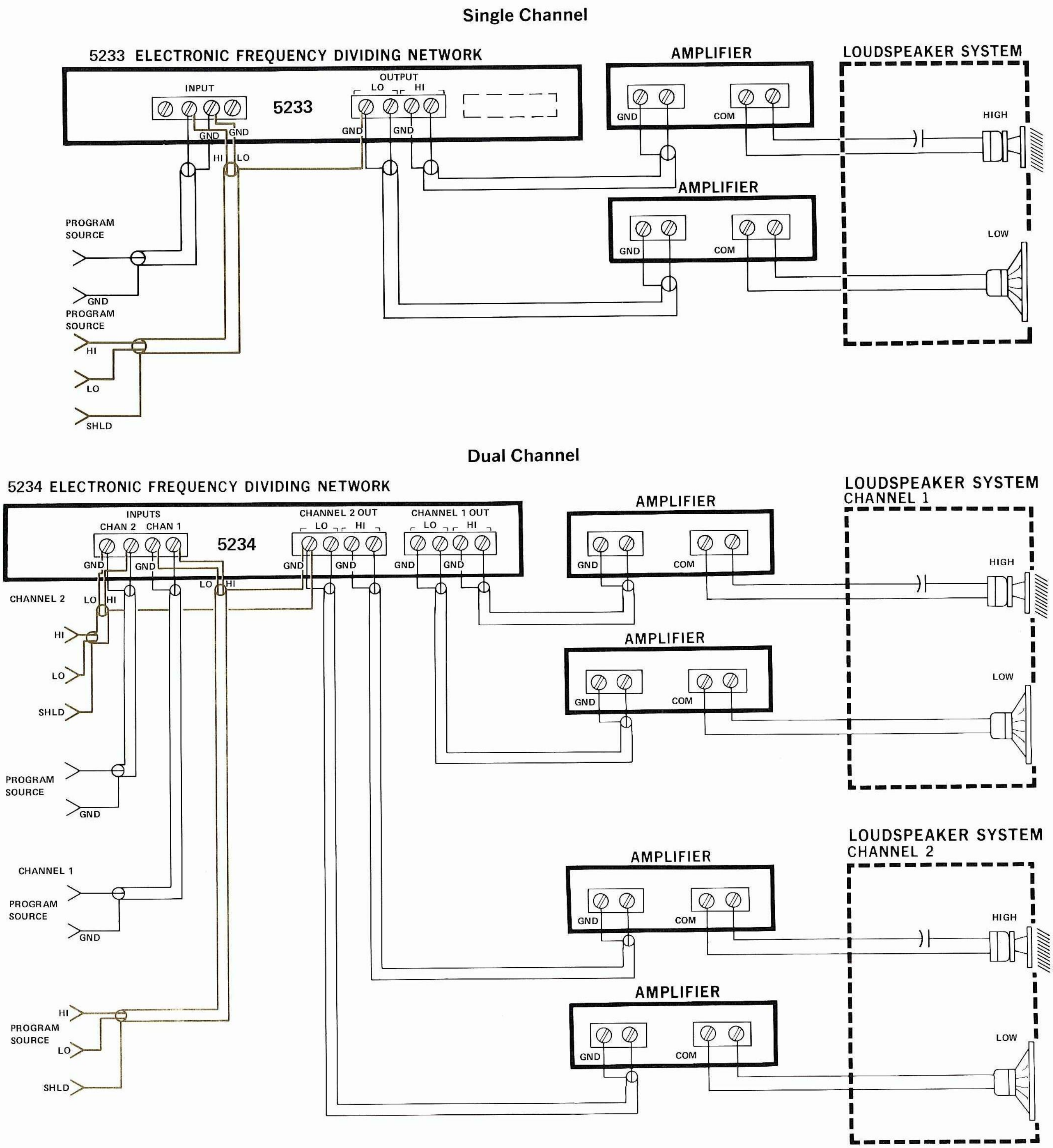


Figure 3. *Wiring Diagram For Bi-Amplification.*

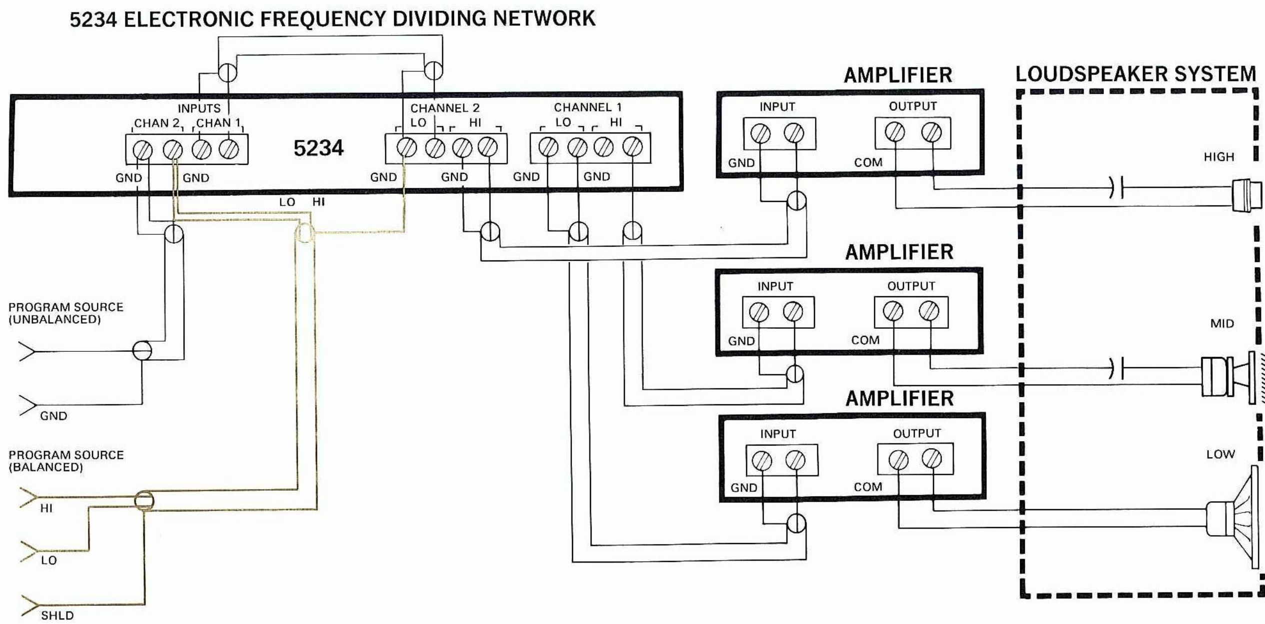


Figure 4. *Wiring Diagram For Tri-Amplification*

Shielded cable is necessary for all input and output connections, as shown. Make certain that the shield is properly connected to the ground terminal.

Operation

Verification Of System Wiring

It is imperative that each output of the electronic frequency dividing network be properly connected. Inadvertent exchange of low and high frequency output connections—at the network, power amplifiers or transducers—may result in severe damage to midrange or high frequency loudspeaker system components.

The following procedure should be followed for each program channel prior to operation.

1. With all power off, set the High Frequency Level control at "2" and adjust the program source level to minimum. (The source material may be wideband noise or music.) If the power amplifiers are equipped with level controls, adjust them to approximately one-quarter power.
2. Turn on the program source, network and amplifiers for the channel under test.
3. Gradually increase the program source volume level until audible.

   If the sound comes predominately from the midrange or high frequency drivers, immediately shut power off and check all wiring.
4. If the low frequency loudspeaker produces bass, gradually advance the High Frequency Level control.

Correct system wiring will be verified if the treble component of the program material simultaneously increases in level while coming from the midrange and high frequency drivers.

Transducer Phasing

One important factor contributing to the natural sound character of a loudspeaker system is the phase relationship of the transducers for an octave below and above each crossover frequency. Two suitable methods for establishing proper phase of the components in a two-way loudspeaker system are described in the following paragraphs. Either one may be used, depending on the availability of test equipment. A three- or four-way system should be treated in a similar manner by first establishing the proper phase for the transducers of the low frequency transition and then progressing to the midrange, high frequency or ultra-high frequency transducers, as applicable.

Objective Method—A real time third octave analyzer, condenser microphone and a pink noise source can be used to establish proper phase of the loudspeaker system components as follows:

1. Using pink noise as program material, adjust system volume for comfortable listening and set the levels of the individual transducers to display flattest overall frequency response on the real time analyzer.
2. Reverse polarity of the high frequency driver and observe the effect on frequency response through the crossover region.

Proper phasing of the transducers will have been achieved when the flattest frequency response has been obtained through the crossover region, as shown on the real time analyzer.

Subjective Method—If test instrumentation is not available, proper results can be obtained based on program material as follows:

1. Adjust volume level for comfortable listening and set approximate system balance using pink noise or the noise heard between stations of an FM tuner.
2. Listen to a recording of a male voice long enough to become accustomed to the performance of the loudspeaker system.
3. Reverse polarity of the high frequency loudspeaker, which will produce a change in voice character.

When the transducers are properly phased, a recorded male voice should sound natural and exhibit presence (or an "up front" quality), as contrasted to an undesirable "hollow" sound that can be heard when transducers are out of phase.

Note: If the crossover frequency lies above 2 kHz, reversing polarity of the high frequency component will create very little, if any, perceptible difference in system performance. The "correct" polarity will be that which yields the most natural quality with a variety of program material.

Once proper phase among the transducers of a loudspeaker system has been determined, other loudspeaker systems in the installation (assuming they are the same) may be phased accordingly. If different loudspeaker systems are used, establish common phase among the low frequency drivers and follow the above procedures for each system.

Level Control Adjustment

In most instances, manufacturers of multi-amplified loudspeaker systems provide instructions for balancing levels of the individual drivers of the system. In the absence of formal instructions, or in the case of custom loudspeaker systems, balance can be established by adjusting levels to achieve flattest response on a real time analyzer, as described in the transducer phasing instructions beginning on the previous page, or on the basis of subjective evaluation of familiar program material (or, more accurately, by using pink noise or the noise between FM stations) as described in the following paragraphs.

Each program channel should be adjusted individually; subjective evaluation should be made while seated in the normal listening location. If subjective analysis is to be used, and the power amplifiers are equipped with level controls, initially adjust the controls to one-half of their full rotation and then regulate as necessary.

Subjective Adjustment Of Bi-Amplified Systems—The following applies to a 5233 or to each channel of a 5234 used in dual channel bi-amplification.

1. With the High Frequency Level control at "0," adjust program source level for comfortable listening.
2. Rotate the network control clockwise until a satisfactory high frequency balance has been obtained in the program material. If necessary, trim source or amplifier levels.

Subjective Adjustment Of Tri-Amplified Systems—When both channels of a 5234 are used for a tri-amplified loudspeaker system, it is generally installed so that the Channel 1 level control regulates the output of the midrange driver and the Channel 2 level control governs the high frequency driver. control governs only the high frequency driver.

1. With both High Frequency Level controls at "0," adjust the source level for comfortable listening.
2. Rotate the Channel 1 level control clockwise until a satisfactory midrange level has been obtained in the program material. If necessary, adjust source or amplifier levels as appropriate.
3. Increase the Channel 2 level until a satisfactory high frequency balance has been obtained. It may be necessary to readjust midrange, source or amplifier levels to achieve the most desirable overall balance of the loudspeaker system.

Once high frequency and amplifier output levels have been established, readjustment is not generally needed. Some method of marking or locking the power amplifier level controls is recommended.

Appendix

Blank Crossover Card Assembly

In addition to the standard crossover cards, circuits for other crossover frequencies may be assembled on a blank crossover card (JBL Model 52-5120) using standard components. Filter slopes (12 dB per octave) are identical to those of the standard crossover cards. The circuits are designed to use five identical resistors and five identical capacitors. The crossover frequency can be written on the card bracket and will appear through the front panel window of the network.

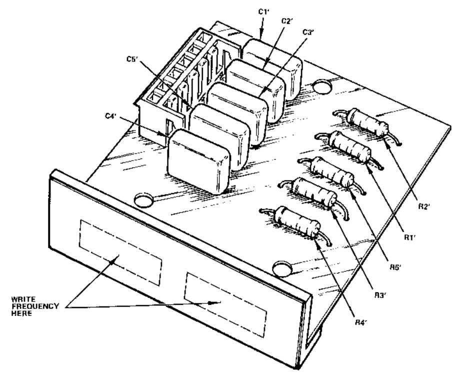


Figure 5. *Blank Crossover Card*

Component values for the various frequencies are listed in Table 2. Components should rest against the printed circuit board. Leads should be soldered and cut flush.

Table 2. Blank Crossover Card Component Values

Resistors are all ¼-Watt, 5% tolerance. Capacitors are all 5% tolerance, metalized polyester.

Crossover Frequency (Hertz)	Capacitors C1'-C5' (microfarads)	Resistors R1'-R5' (kilohms)
900	.012	10
1100	.010	10
1200	.0082	11
1500	.0082	9.1
2000	.0047	12
2500	.0018	24
5000	.0015	15
6000	.0012	16
7000	.0015	11
9500	.0012	10

The component values for other crossover frequencies can be calculated using the formula $RC = \frac{0.1125}{F}$ where R is the resistance in kilohms, C is capacitance in microfarads, and F is frequency in kilohertz. The recommended minimum value for R is 4.7 kilohms.

Table 3. JBL Crossover Card Component Values

Model Number	Crossover Frequency (Hertz)	Capacitors C1'-C5' (microfarads)	JBL Part Number	Resistors R1'-R5' (kilohms)	JBL Part Number
52-5121	250	.018	48481	24	35757
52-5122	500	.015	48480	15	35752
52-5123	800	.022	48482	6.2	35743
52-5124	1200	.0082	48947	11	35749
52-5125	5000	.0015	48927	15	35752
52-5127	7000	.0015	48927	11	35749
52-5140[1]		.018	48481	27[2]	10255

1. Crossover characteristics of the 51-5140 are tailored specifically for the 4340 Studio Monitor.
2. R1' and R2' only. The value for R3', R4' and R5' is 22 kilohms, part number 10944.

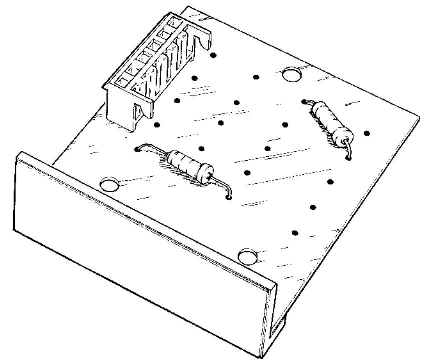


Figure 6. *Direct Amplifier Modification.*

Using two 1kΩ, ½W, 10% resistors on a 52-5120 blank crossover card as shown, and installing the card, will convert a crossover channel to a unity gain amplifier having one input and two outputs.

Audio Distribution Amplifier

A blank crossover card can be used to convert a crossover channel to a unity gain audio distribution amplifier having one input and two outputs. Two of these specially loaded cards will convert the 5234 to two independent direct amplifiers, each having one input and two outputs, or the network inputs can be paralleled to provide four outputs from a single source. The "high frequency" channel will be at unity gain when the level control is set a maximum. The control can be turned down if loss is desired.

Table 4. Capacitors Available From JBL

The following 10% tolerance, non-polarized electrolytic capacitors are suitable for driver protection and may be ordered from a JBL Professional Products dealer or directly from JBL.

JBL Part Number	Value (microfarads)	Crossover Frequency vs Driver Impedance		
		4 ohms	8 ohms	16 ohms
52938	72	1100 Hz	550 Hz	275 Hz
52939	52	1500 Hz	750 Hz	400 Hz
50341	20	4000 Hz	2000 Hz	1000 Hz
10358	16.5	5000 Hz	2500 Hz	1200 Hz
10359	13.5	6000 Hz	3000 Hz	1500 Hz
10434	12	7000 Hz	3500 Hz	1700 Hz
10391	8	10000 Hz	5000 Hz	2500 Hz
10296	6	13000 Hz	7000 Hz	3500 Hz
41040	4	20000 Hz	10000 Hz	5000 Hz
11937	3	26000 Hz	13000 Hz	7000 Hz

Capacitor size for other frequencies can be determined using the formula $C = \frac{159{,}000}{ZF}$ where C is capacitance in microfarads, Z is impedance in ohms, and F is one-half the crossover frequency in Hertz.

Service Notes

The 5233 and 5234 utilize integrated circuitry. Proper operation can be verified by measurement of DC output voltages for each integrated circuit which should measure 0, ±½ V DC. If this specification is not met, the integrated circuit is defective and should be replaced.

DC voltages are measured with respect to ground. It should be noted that a DC voltmeter having a high input impedance (10 MΩ or greater) is recommended.

Circuit layout has been designed to facilitate servicing. All components are accessible and easily replaced. Parts not normally available through supply houses can be ordered from a JBL Professional Products dealer or from:

JBL Customer Service
8500 Balboa Boulevard
Northridge, California 91329

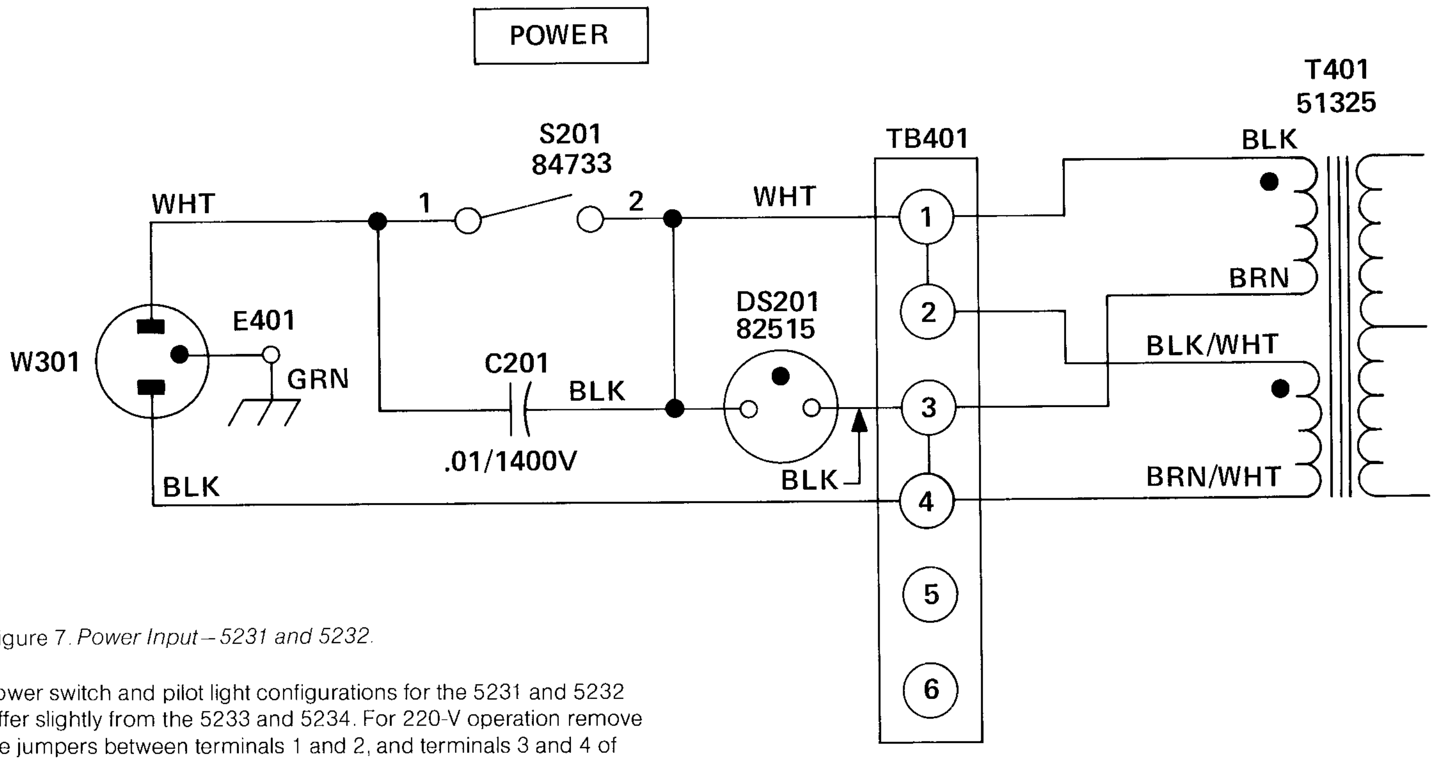


Figure 7. *Power Input—5231 and 5232.*

Power switch and pilot light configurations for the 5231 and 5232 differ slightly from the 5233 and 5234. For 220-V operation remove the jumpers between terminals 1 and 2, and terminals 3 and 4 of TB401, then connect a jumper between terminals 2 and 3.

Professional Division

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