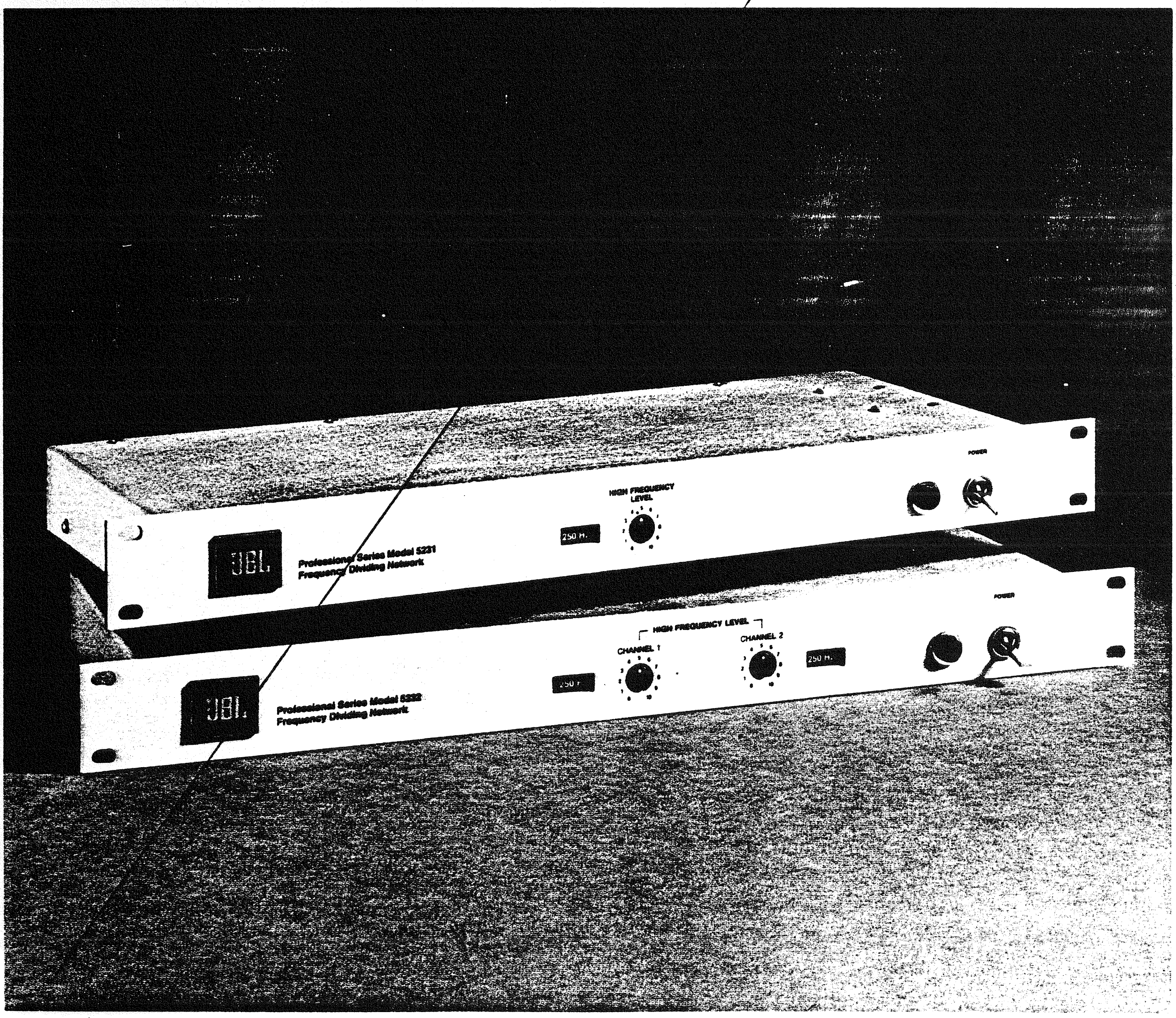
Professional Series Technical Manual

Electronic Frequency Dividing Networks

5231 Single Channel
5232 Dual Channel



Index

Professional Division Warranty

Every JBL Professional Series electronic product is guaranteed against defects in material and workmanship for a period of two years. JBL will replace defective parts and make necessary repairs under this warranty if our examination reveals evidence of faulty workmanship or material. The warranty does not cover damage caused by misuse, accident or neglect. JBL retains the exclusive right to make such determination on the basis of factory inspection.

If it is impractical to return the product to the factory, please write JBL describing the difficulty or malfunction. JBL may, at its option, establish alternative repair procedures or furnish replacement parts as appropriate. Products returned to the factory must be shipped prepaid.

The warranty on JBL products shall remain valid only if repairs are performed by JBL or under its authorized procedures, and provided that the serial number on the unit has not been defaced or removed.

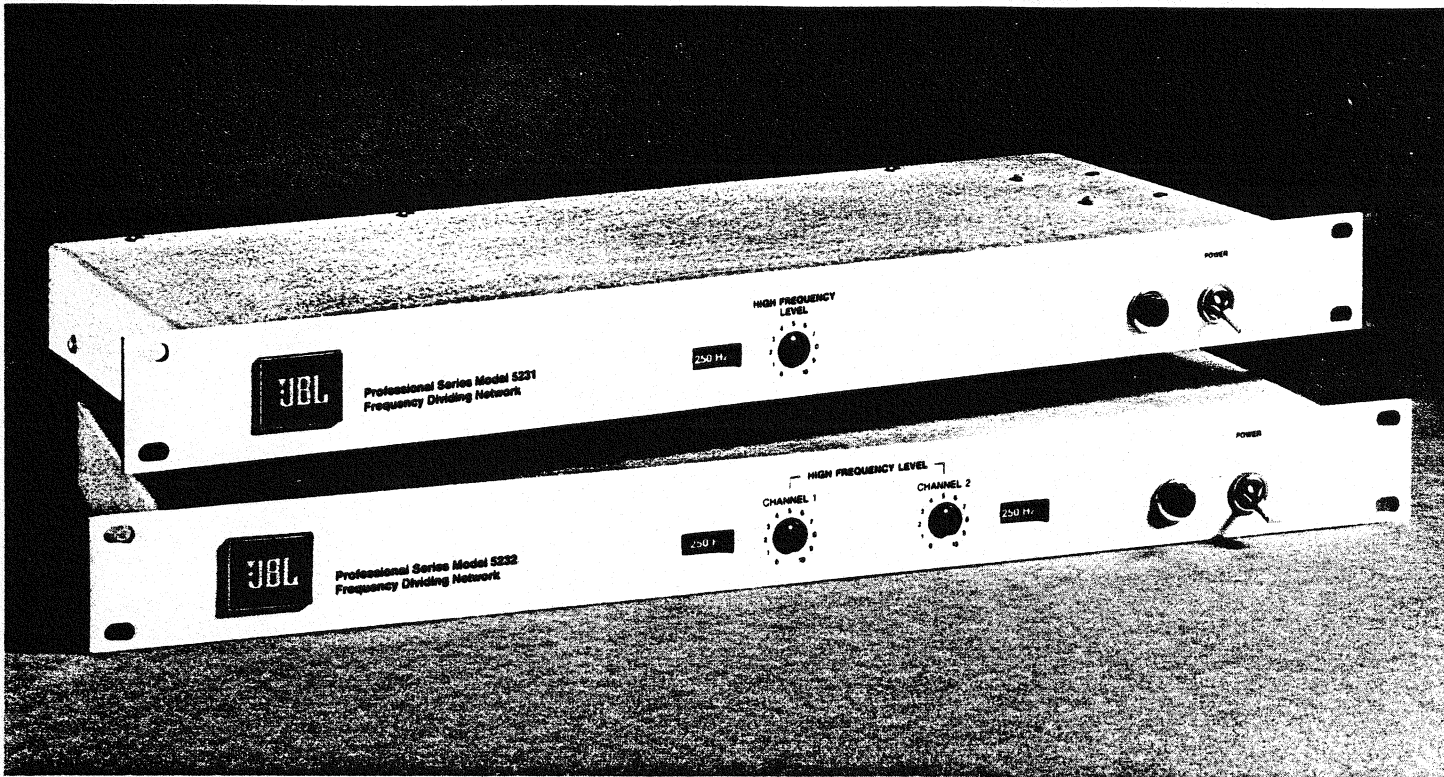
Specifications

Gain	0 dB in the pass band
Rated Output	6.2 volts (+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 output
Frequency Response	±0.5 dB, 20-20,000 Hz equivalent bandwidth
Crossover Frequency	Selectable by plug-in module, 3-dB crossover point ±10%
Filter Slope	12 dB per octave
Input Impedance	Greater than 50,000 ohms
Load Impedance	2,000 ohms minimum
Output Impedance	
L.F.	Less than 70 ohms
H.F.	70-2500 ohms (depending on setting of level control)
Channel Isolation	Greater than 60 dB
Signal/Noise Ratio	Greater than 90 dB, 20-20,000 Hz
Controls	One high frequency level per channel; one on/off switch
Power Requirement	5 Watts, 120 VAC, 50/60 Hz
Operating Temperature	Up to 132°F (55°C)
Dimensions	1¾" x 19" x 7⅝" deep 4.4 x 48.3 x 19.4 cm deep
Mounting	1 EIA standard rack space
Panel Finish	Non-glare baked enamel, light gray
Net Weight	4 lbs. (1.8 kg) either unit with accessory crossover card(s) installed
Shipping Weight	5.5 lbs. (3.0 kg) either unit
Warranty	Two years

Accessories

Crossover Cards (one required per channel)	52-5120	Blank
	52-5122	500 Hz
	52-5123	800 Hz
	52-5127	7000 Hz for the 2405 ultra-high frequency transducer
	52-5130	For the 4330 and 4332 studio monitors
	52-5140	For the 4340 studio monitor
	52-5160	For the 4350 studio monitor

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 is always warranted to equal or exceed the original design specifications unless otherwise stated.



The JBL 5231 and 5232 Electronic Frequency Dividing Networks

The 5231 and 5232 are designed for use with studio monitor or sound reinforcement loudspeaker systems where bi-amplification or tri-amplification is desirable. The 5231 (single channel) and 5232 (dual channel) feature unbalanced, high impedance inputs, unity gain in the pass band and unbalanced low impedance outputs. The 5231 will provide a single channel crossover. The 5232 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 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 the commonly used frequencies of 500 Hz and 800 Hz. 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 4330, 4332, 4340 or 4350 bi-amplified studio monitors. 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.

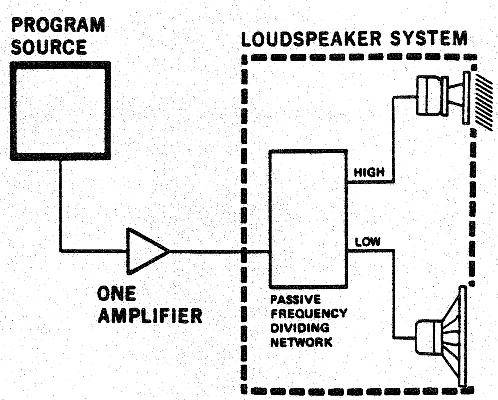
2. *Flexibility*—In sound reinforcement applications it is often desirable to combine one low frequency driver with several high frequency units to obtain a controlled dispersion pattern; thus, one may select amplifiers of the appropriate power for each group of transducers.

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.

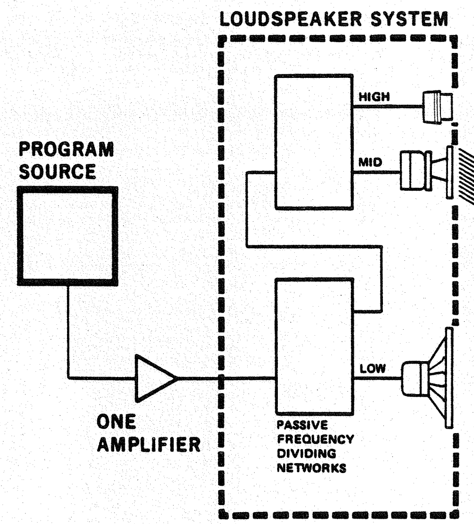
Installation

The electronic frequency dividing network receives the program signal from a line level source—an audio preamplifier, studio mixdown console or portable mixer—and separates the signal into high and low frequency bands. Outputs from the network feed the appropriate power amplifiers. Each amplifier, in turn, drives its respective loudspeaker system components. Typical installations are diagrammed in Figure 1.

Conventional Passive Networks

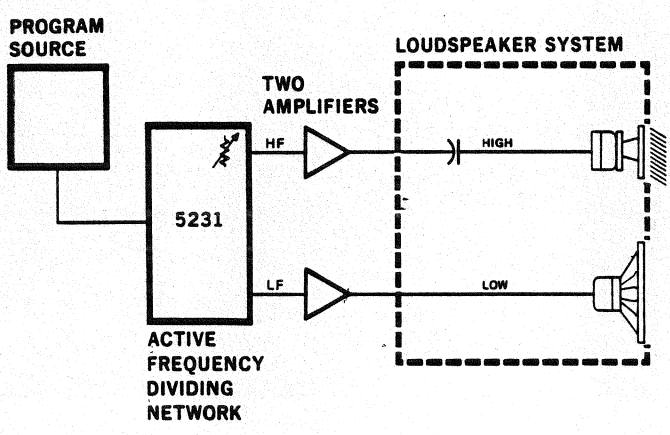


Two-Way System

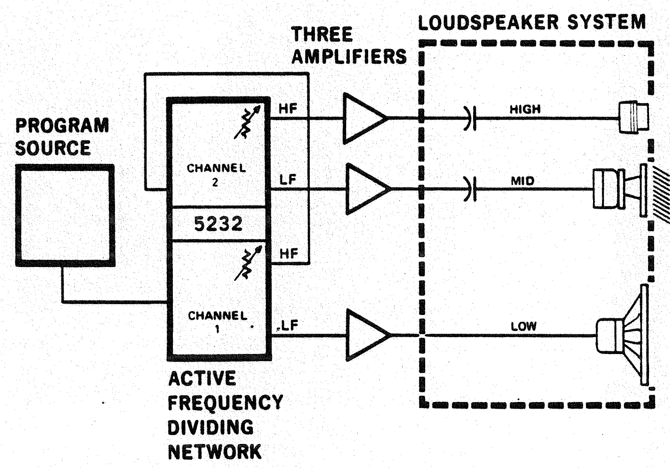


Three-Way System

Electronic Networks



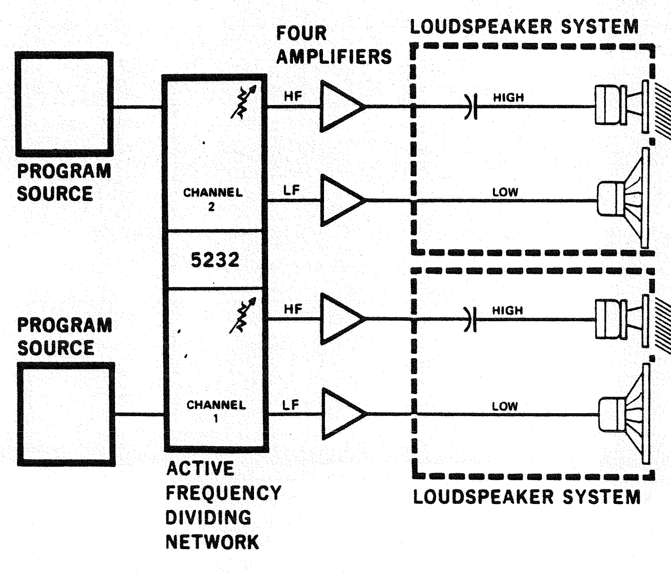
Two-Way System with Single Channel Active Crossover



Three-Way System with Dual Channel Active Crossover

Figure 1. *Typical Installations Of The 5231 And 5232 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.



Two Independent Two-Way Systems with Dual Channel Active Crossover

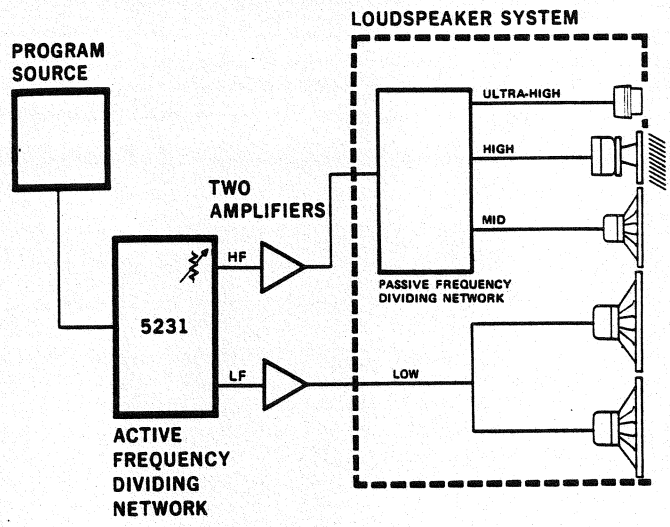


Figure 2. *Combining Electronic And Passive Frequency Dividing Networks*

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 5232 can accommodate both systems. Note that the passive, high level frequency dividing network used in the 4350 already incorporates the required attenuation capacitors to protect the midrange and high frequency drivers.

Crossover Card Insertion

Prior to installing the 5231 or 5232, a crossover card must be inserted in each channel as follows:

1. Place the 5231 or 5232 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.

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.

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"), 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.

Note: Operation of the 5231 or 5232 without a crossover card will not damage the unit.

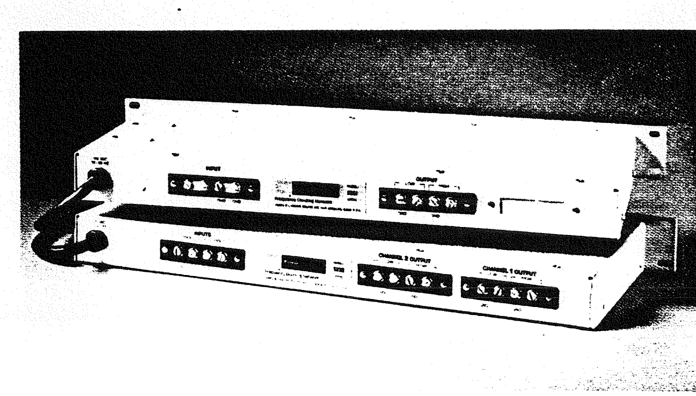
Table 1. Minimum Values For Low Frequency Attenuation Capacitors

Crossover Frequency	Driver Impedance		
	4 ohms	8 ohms	16 ohms
250 Hz to 500 Hz	200.0 µf	100.0 µf	50.0 µf
Above 500 Hz to 5 kHz	100.0 µf	50.0 µf	25.0 µf
Above 5 kHz	10.0 µf	5.0 µf	2.5 µf

The above capacitors are available from any electronics parts supplier. Capacitor breakdown voltages should be greater than 75 V. Do not use polarized electrolytic capacitors; paper or Mylar capacitors are acceptable. If voltage across the protected driver exceeds the voltage at the output of the amplifier at frequencies just below crossover, a resistor must be placed in parallel with the drivers. The resistor should have a minimum value of twice the rated impedance of the driver.

Mounting

The 5231 or 5232 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.



Input and output terminals of the 5231 and 5232.

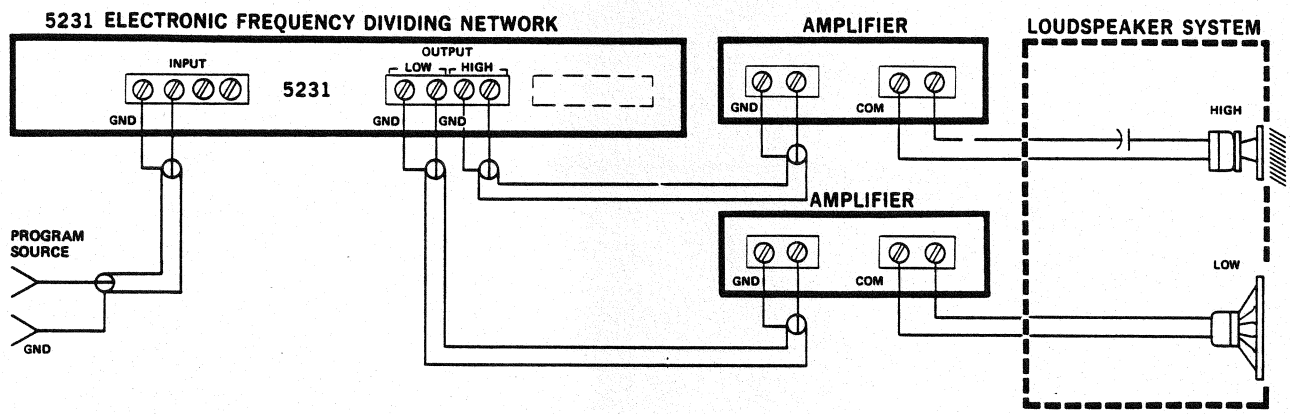
Connections

Shielded cable is required at all input and output signal connections. If cable lengths greater than 15 to 20 feet are required between the electronic crossover and the power amplifier, it is recommended that isolation transformers or isolation line amplifiers be connected to the output of the crossover to reduce the possibility of induced RF interference or hum.

Input Connections—Inputs to the 5231 and 5232 are for an unbalanced line level source. Screw terminals on the rear panel are provided for connection of each input and are clearly identified.

Output Connections—Each output channel can deliver 6.2 volts into 2000 ohms (+18 dB referenced to 0.775 volts). 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 high-impedance (bridging) line input of any conventional amplifier. Typically, the impedance of a bridging input is at least 5000 ohms (usually 10,000 ohms or more), therefore, two or more power amplifiers can be driven by a single electronic frequency dividing network.

Single Channel Bi-amplification



Dual Channel Bi-amplification

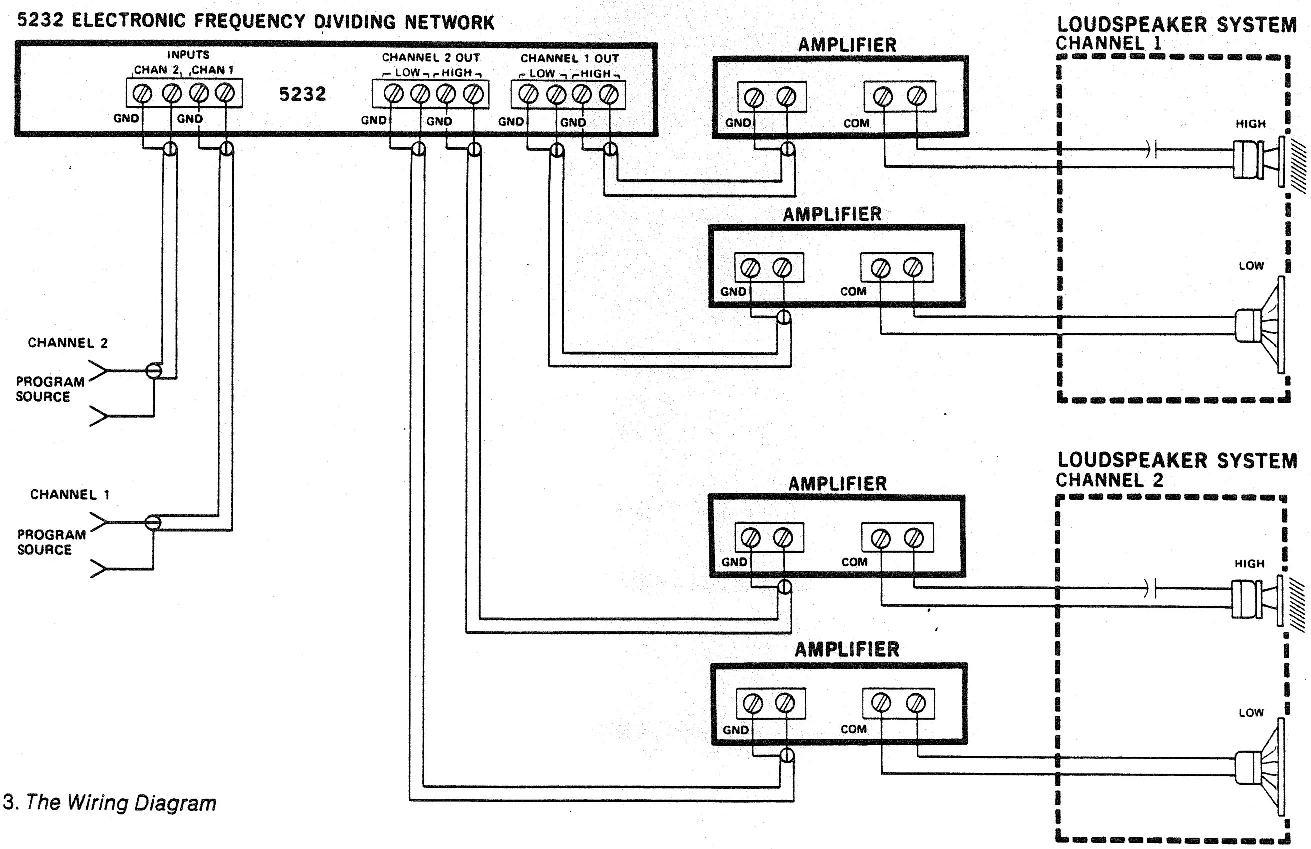


Figure 3. *The Wiring Diagram*

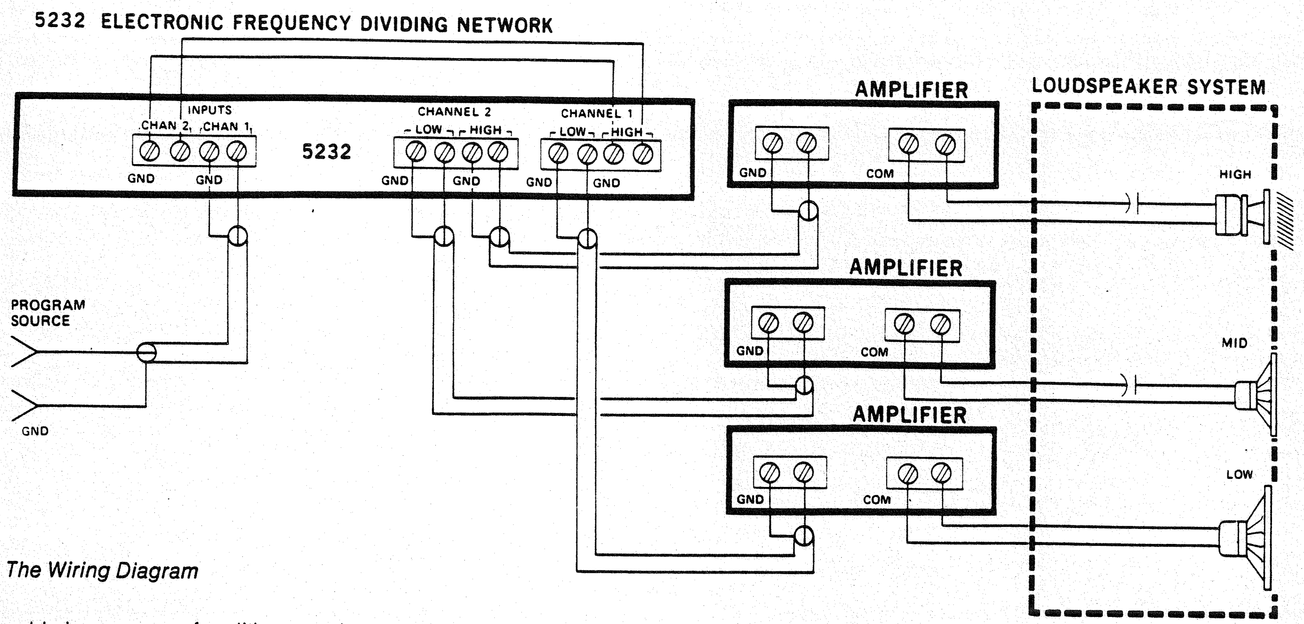


Figure 3. *The Wiring Diagram*

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 wide-band 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 2000 Hz, 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 5231 or to each channel of a 5232 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 5232 are used for a tri-amplified loudspeaker system, it is generally installed so that the Channel 1 level control simultaneously regulates output of both midrange and high frequency drivers and the Channel 2 level 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 crossover frequencies of 900 Hz, 1100 Hz, 1200 Hz, 1500 Hz, 2000 Hz, 2500 Hz, 5000 Hz, 6000 Hz, 7000 Hz and 9500 Hz may be assembled on a blank crossover card (JBL Model 52-5120) using standard components. Filter slopes (12 dB/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.

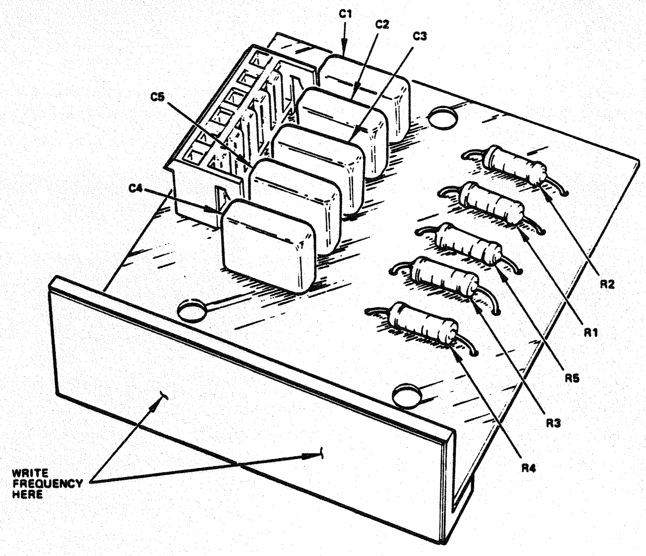


Figure 4. *Blank Crossover Card*

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

Crossover Frequency (Hertz)	Capacitors C1 - C5 (microfarads)	Resistors R1 - R5 (ohms)
900	.012000	10 k
1100	.010000	10 k
1200	.008200	11 k
1500	.008200	9.1 k
2000	.004700	12 k
2500	.001800	24 k
5000	.001500	15 k
6000	.001200	16 k
7000	.001500	11 k
9500	.001200	10 k

Note: Resistors are all 1/4-Watt, 5% tolerance. Capacitors are all 5% tolerance, SEACOR or AMPEREX metalized polyester, or equivalent.

$Cr = \frac{K}{F}$

K = .11254
C in MFD
r in KΩ
F in KHz

Parts List

Servicing should be referred to qualified personnel.
A list of major parts has been included for convenience.

Schematic Reference Number		JBL Part Number	Description
5231	5232		
TRANSFORMER			
T301	T301	51325	Power Transformer
DIODES			
CR401, 402, 403, 404	CR401, 402, 403, 404	39869	IN4003
CR405, 406	CR405, 406	52225	1N4746
TRANSISTORS			
Q401	Q401	48342	MPSU06 (NPN)[1]
Q402	Q402	48341	MPSU56 (PNP)[1]
INTEGRATED CIRCUITS			
U401, 402, 403	U401, 402, 403, 404, 405, 406	51366[2]	RC4131DN[3]
OTHER			
R407	R407, 414	51367	Pot, 10,000-ohm, 10% log taper
DS101	DS101	82515	Pilot Light
S101	S101	84733	Power Switch

[1]MPS refers to Motorola devices
[2]May be JBL P/N 53510, Motorola P/N MC1741SC P1.
[3]RC refers to Raytheon devices

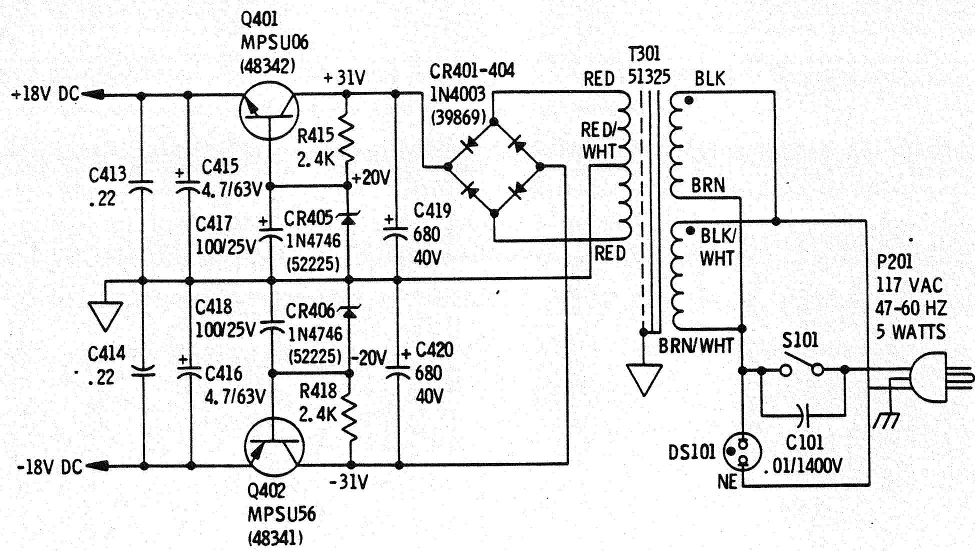
Service Notes

The 5231 and 5232 utilize integrated circuitry. Proper operation can be verified by measurement of DC output voltages for each integrated circuit which should measure 0, ± ½ VDC. If this specification is not met, the integrated circuit is defective and should be replaced.

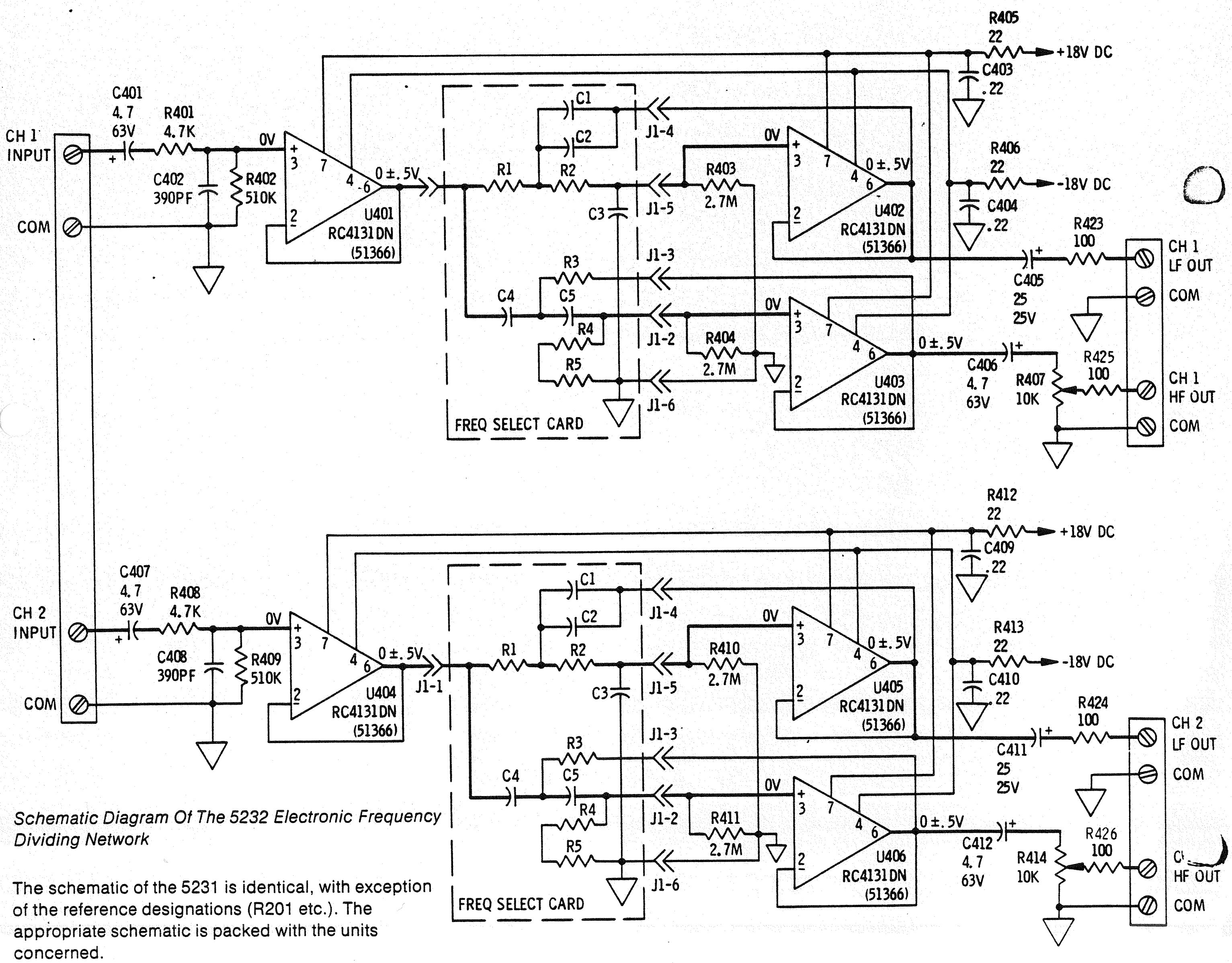
DC voltages are measured with respect to ground. It should be noted that a DC voltmeter having a high input impedance (10 megohms or greater) is recommended.

NOTE: UNLESS OTHERWISE SPECIFIED

1. JBL RESERVES THE RIGHT TO MAKE COMPONENT CHANGES WITHOUT NOTICE.
2. RESISTORS IN OHMS, 1/2W, 5%.
3. CAPACITORS IN μFD.
4. IF A 2N FAMILY OR HOUSE NUMBERED DEVICE WILL WORK IN THE CIRCUIT WITHOUT SELECTION, THE NUMBER WILL APPEAR ON THE SCHEMATIC AS THE PRIMARY NUMBER AND THE JBL PART NUMBER WILL APPEAR BELOW IN PARENTHESIS. IF THE DEVICE IS A SPECIAL SELECTION FROM A PARTICULAR FAMILY, THE JBL PART NUMBER WILL APPEAR FIRST WITH THE 2N OR HOUSE NUMBERED DEVICE IN PARENTHESIS.
5. ▽ CIRCUIT GROUND
6. CHASSIS GROUND



Power Supply



Schematic Diagram Of The 5232 Electronic Frequency Dividing Network

The schematic of the 5231 is identical, with exception of the reference designations (R201 etc.). The appropriate schematic is packed with the units concerned.