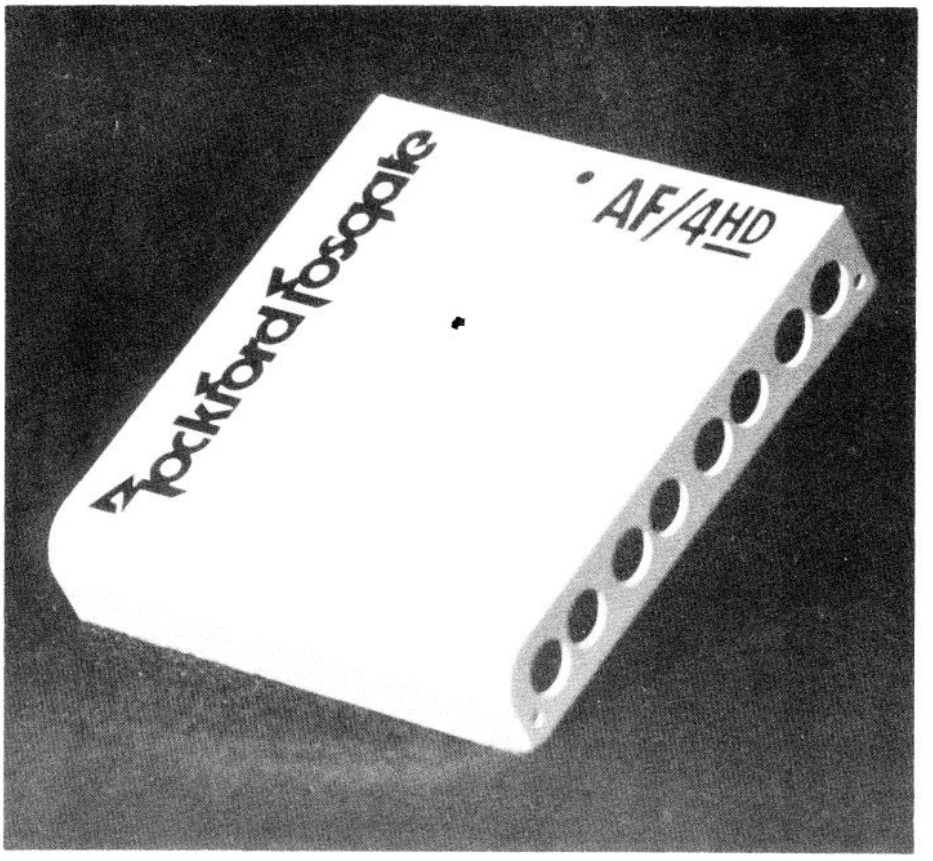
AF/4HD ACTIVE FILTER ADJUSTABLE CROSSOVER

INSTALLATION MANUAL

Rockford Fosgate

PRACTICE SAFE SOUND™

CONTINUOUS EXPOSURE TO SOUND PRESSURE LEVELS OVER 100dB MAY CAUSE PERMANENT HEARING LOSS. HIGH-POWERED AUTOSOUND SYSTEMS MAY PRODUCE SOUND PRESSURE LEVELS WELL OVER 130dB. USE COMMON SENSE AND PRACTICE SAFE SOUND.



Make your Rockford Fosgate system complete with installation accessories from Perfect Interface a division of Rockford Corporation. Ask your salesman about Perfect Power alternators power cables, speaker wire connectors cosmetic accessories and fabric.

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INTRODUCTION

The Rockford Fosgate AF/4HD is an active electronic crossover that incorporates HD (Hybrid Design) to provide state-of-the-art flexibility, performance and pleasing aesthetics. Its features include: four stereo inputs with true fading capability, infinitely adjustable frequency modules, four user definable high pass, low pass and band pass filters, single channel summing for mono applications, fully isolated high voltage power supply, low noise circuitry, low distortion, high load driving capacity 750 mV RMS input level, 750 mV RMS output level.

- FADING CAPABILITY
- ONE CHANNEL CAN BE SUMMED FOR MONO APPLICATIONS
- TWO USER SELECTABLE FILTERS (HIGH PASS OR LOW PASS)
- TWO USER ADJUSTABLE BAND PASS FILTERS THAT CAN ALSO BE SELECTED AS HIGH OR LOW PASS FILTERS
- CAPABLE OF UTILIZING ONE TO FOUR INPUTS
- GOLD PLATED RCA'S
- INTERNAL FUSE FOR PROTECTION
- CONCEALED MOUNTING
- AUDIO CIRCUIT IS HYBRID DESIGNED
- LOW DISTORTION
- WIDE RANGE OF FREQUENCY MODULES, OR FASHION YOUR OWN
- SMALL, LOW COST
- HIGH LOAD DRIVING CAPACITY: CAPABLE OF HANDLING UP TO 10 ROCKFORD FOSGATE AMPLIFIERS
- 12dB/OCTAVE CROSSOVER SLOPES
- CASCADING OF OUTPUT TO INPUT PROVIDES 24dB/OCTAVE SLOPE

INPUT AND OUTPUT LEVELS

The AF4 is designed for preamp-level (750 mVRMS) levels. Speaker-level inputs must be attenuated to under 1.0 VRMS.

Net gain in the filter passband of the AF4 is unity. (output levels are equal to input levels)

POWER WIRING INSTRUCTIONS

The Black 16-gauge wire should be grounded to the chassis. The White (or white with a red stripe) 16-gauge wire should be connected to a source of constant 12-Volt power. The Red 16-gauge wire is the remote turn-on wire. Connect it to the radio "Auto-Antenna" lead, or to some other point that goes "positive" when the system turns on. See Figure 1.

PROTECTION FUSE

The AF4 has a built-in main power fuse for over current protection. If blown, replace with AGC amp fast blow fuse. See Figure 1 for fuse location.

AF/4HD WIRING/FUSE/MODULE AND JUMPER LOCATIONS

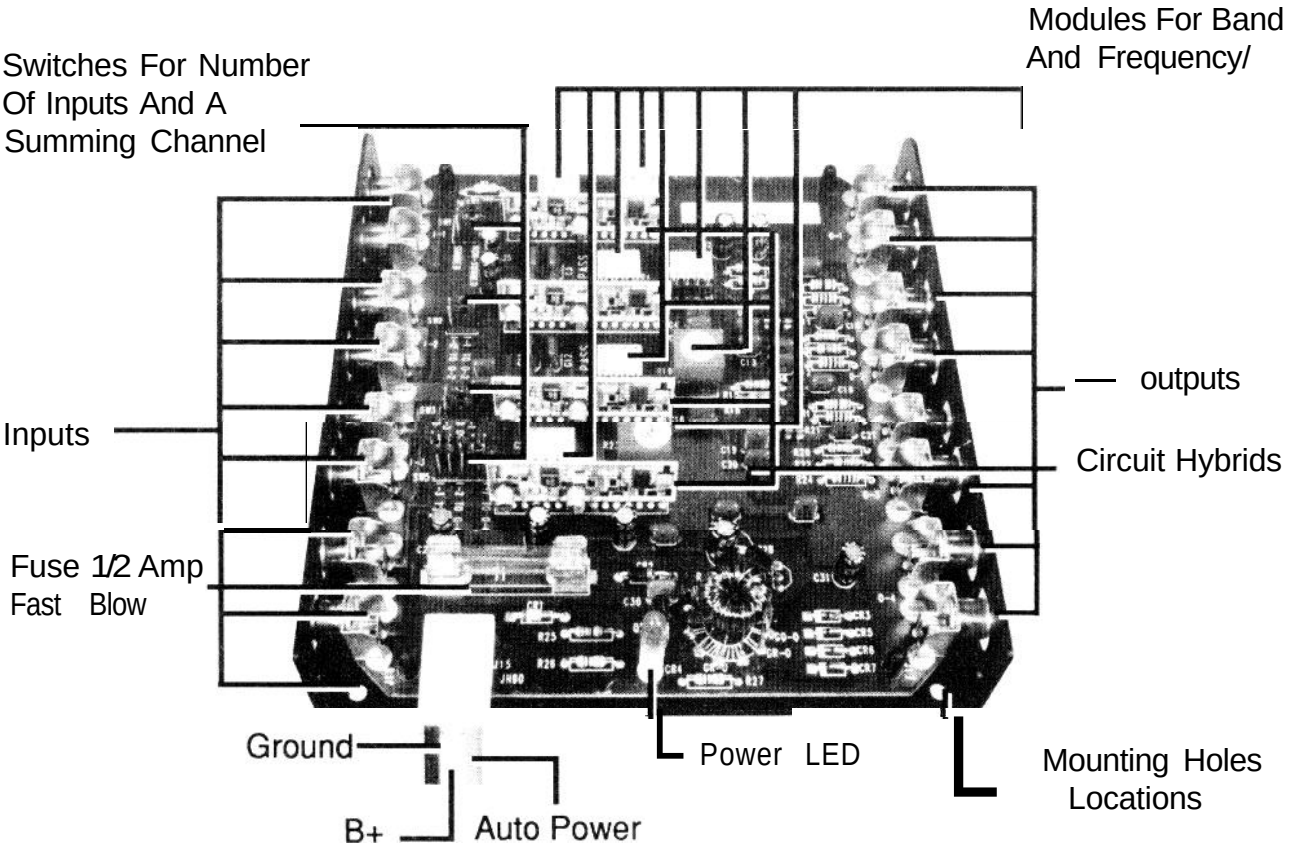


FIGURE 1

FREQUENCY SELECTION

Custom crossover frequency modules will allow you to create notch filters oroverlapfrequencies to "equalize" in or out a desired response.

High and Low crossoverfrequencies in the AF4 are selected by inserting frequency modules in sockets in the internal PC board.

In order to change a frequency module, remove the four machine screws that hold the cover and remove the cover. Remove the frequency module you wish to change, and insert the new module in its place.

See Fig. 2 for module locations.

WARNING! TURN OFF SYSTEM BEFORE REMOVING MODULES!

BUILDING A CUSTOM CROSSOVER MODULE

If you want a frequency not available in the standard Rockford modules (which are available at half-octave intervals from 50 Hertz to 9,000 Hertz), you can, in fact, build your own module.

You will need:
1. An 8-pin DIP component carrier
2. Soldering equipment
3. A source of 1/4-watt or 1/8 watt resistors. (Preferably 1% resistors)

Determine the resistance value you need for the frequency you want from the formula below.

$$R = \frac{1}{1.38\,(10^{-7})f} \text{ OHM's}$$

"f" is the frequency that you want.

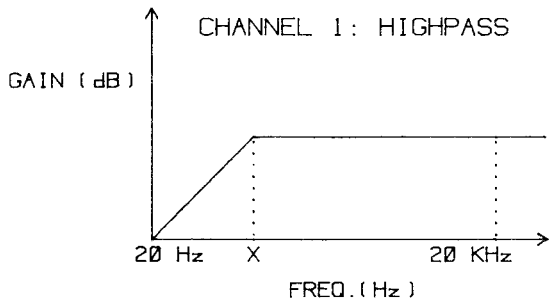
FREQUENCY RESISTOR VALUES

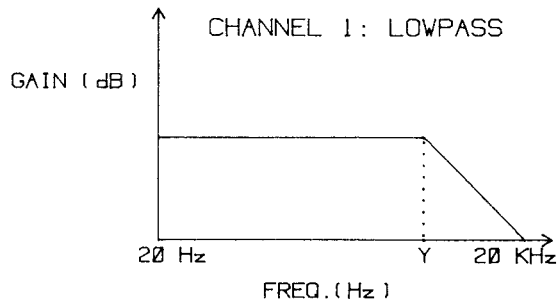
The following table was tabulated by using the formula that was given earlier.

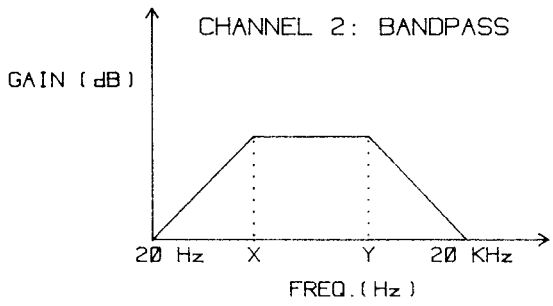
Frequency	Resistance	Frequency	Resistance
50 Hz	150k Ohms	80 Hz	9.1 k Ohms
70 Hz	100k Ohms	1k Hz	7.5k Ohms
100 Hz	75k Ohms	1.5k Hz	4.7k Ohms
150 Hz	47k Ohms	2k Hz	3.6k Ohms
200 Hz	36k Ohms	3k Hz	2.4k Ohms
275 Hz	27k Ohms	4.5k Hz	1.6k Ohms
400 Hz	18k Ohms	6.5k Hz	1.1k Ohms
550 Hz	13k Ohms	9k Hz	820 Ohms
750 Hz	9.7k Ohms	13k Hz	557 Ohms

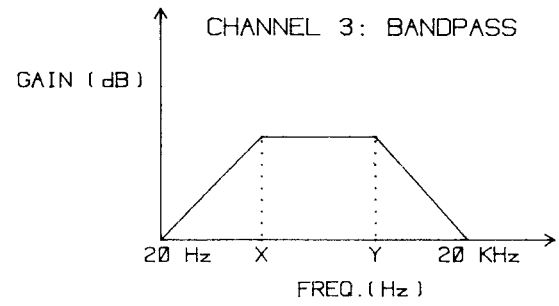
BAND SELECTION

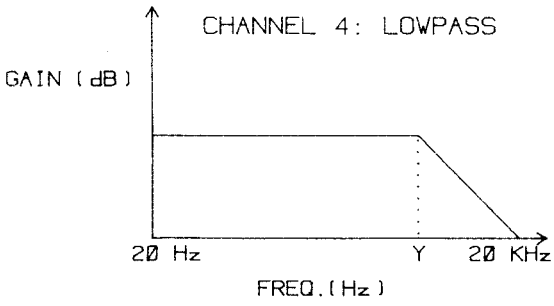
Channels one and four in the AF/4 can be defined as either high or low pass fiters. Channels two and three are adjustable band pass filters.

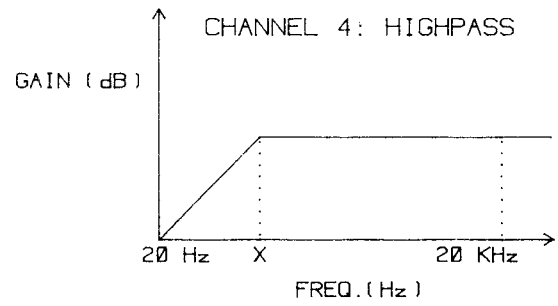








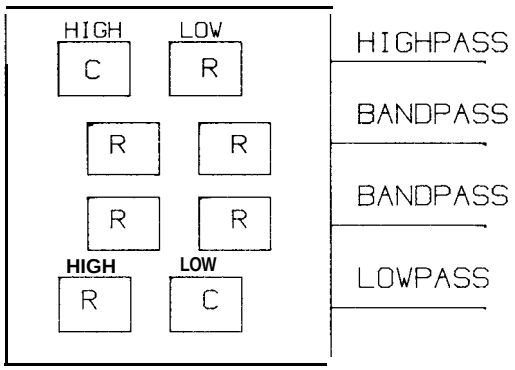


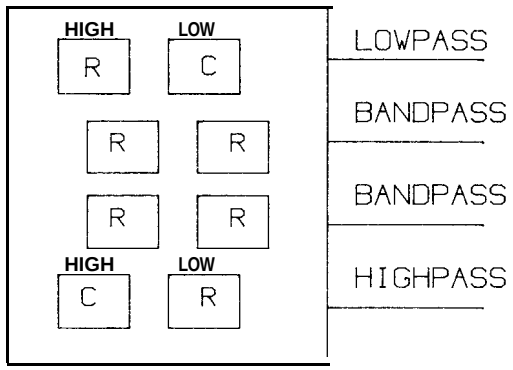


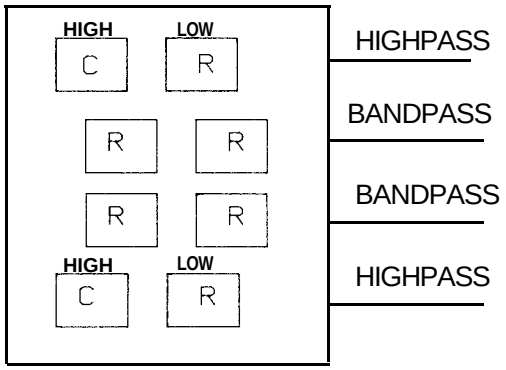
NOTE: X AND Y ARE VARIABLES.
THEY DEPEND ON THE MODULES
USED ON THE BOARD.

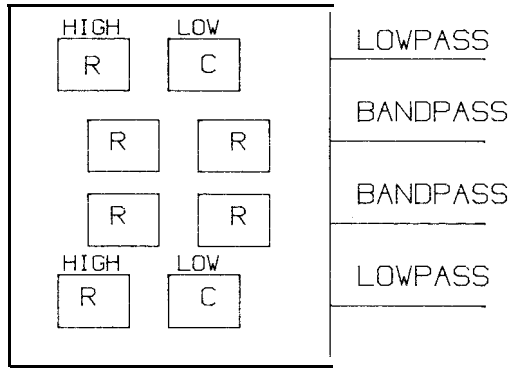
The selection is done simply by placing the capacitor module (C) in the socket location on the PC board marked "High" for high pass or "Low" for low pass. The empty location is where the resistor frequency module (R) is placed. See below.

Note: Outputs one andfourcan be defined as either a high pass or low pass depending on where the capacitor module (C) is placed. Outputs two and three are set band passes.









AF/4HD
BAND & FREQUENCY
MODULE LOCATIONS

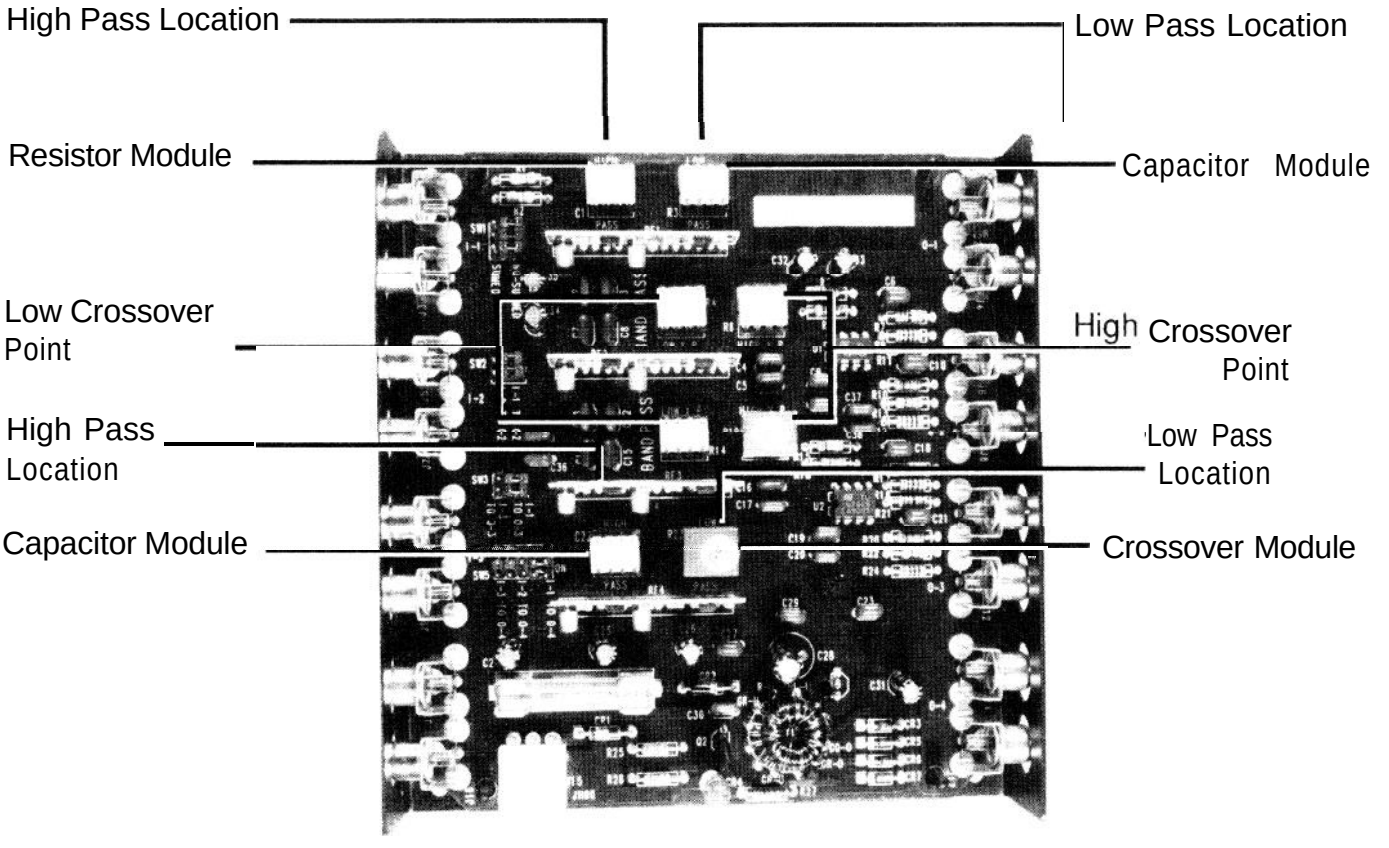
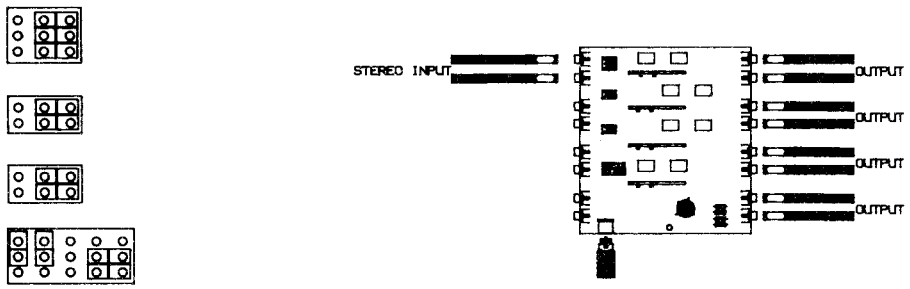


FIGURE 2

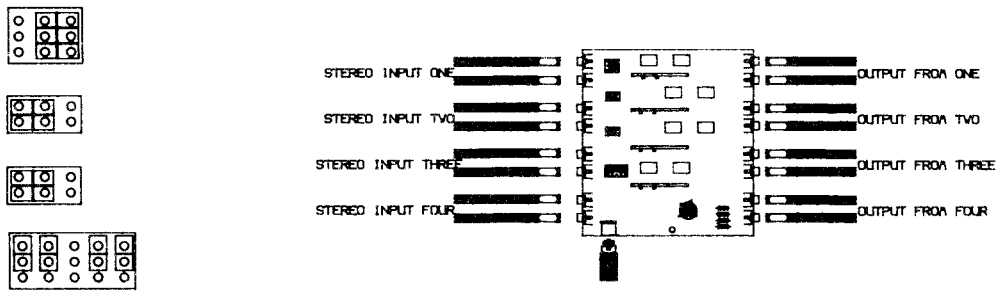
SWITCHING EXAMPLES

The AF/4HD is able to have one to four inputs. One input can be summed for Mono Applications (see Figure). Therefore, the AF/4HD can be configured for non fading or fading installations. See Switching Examples diagram.

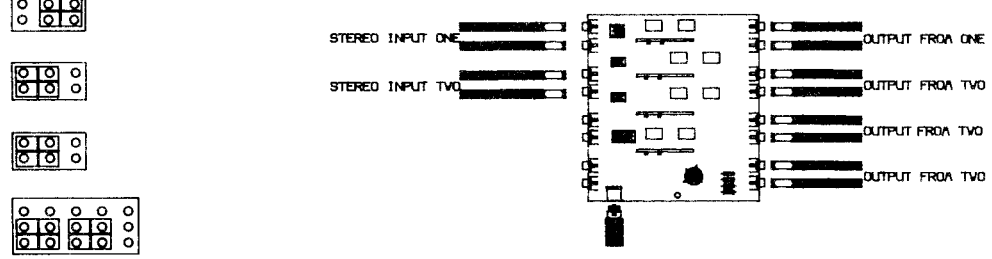
1. ONE INPUT - ONE INPUT FEEDING FOUR OUTPUTS



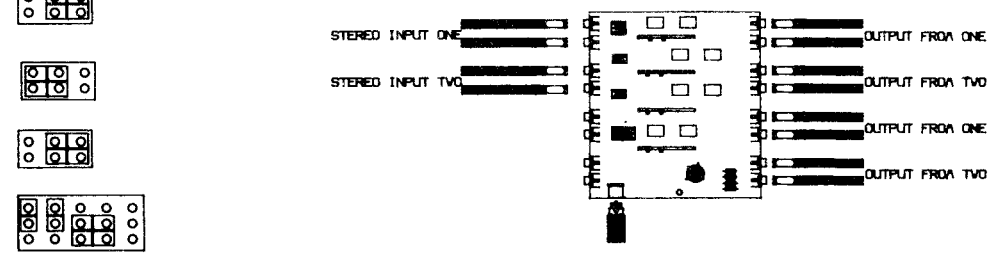
2. FOUR INPUTS - FOUR INPUTS FEEDING FOUR OUTPUTS



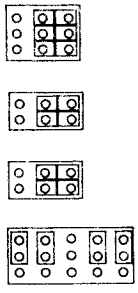
3. TWO INPUTS - ONE INPUT FEEDING ONE OUTPUT
ONE INPUT FEEDING THREE OUTPUTS

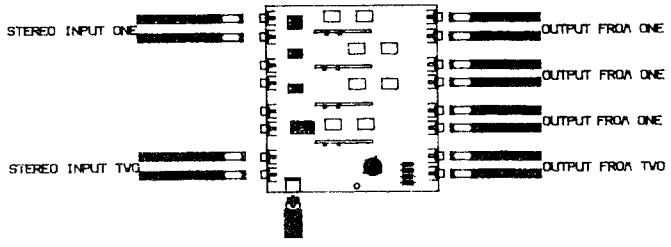


4. TWO INPUTS - ONE INPUT FEEDING TWO OUTPUTS
ONE INPUT FEEDING TWO OUTPUTS

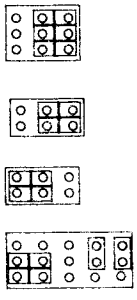


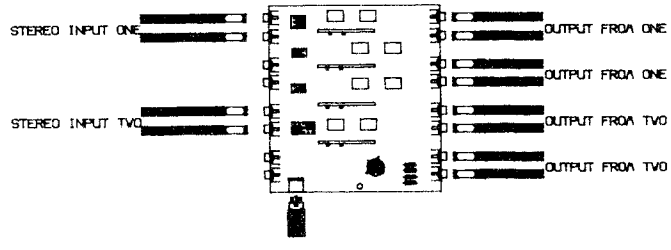
5. TWO INPUTS - ONE INPUT FEEDING THREE OUTPUTS
ONE INPUT FEEDING ONE OUTPUT



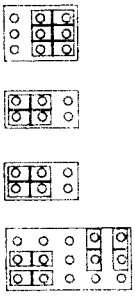


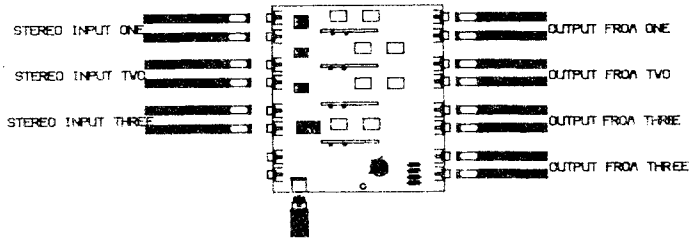
6. TWO INPUTS - ONE INPUT FEEDING TWO OUTPUTS
ONE INPUT FEEDING TWO OUTPUTS



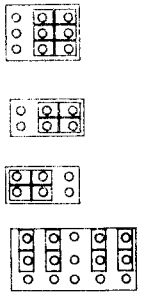


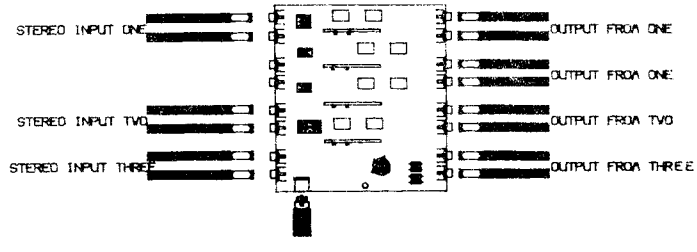
7. THREE INPUTS - ONE INPUT FEEDING ONE OUTPUT
ONE INPUT FEEDING ONE OUTPUT
ONE INPUT FEEDING TWO OUTPUTS





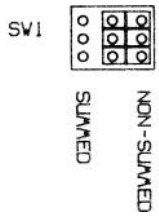
8. THREE INPUTS - ONE INPUT FEEDING ONE OUTPUT
ONE INPUT FEEDING TWO OUTPUTS
ONE INPUT FEEDING ONE OUTPUT

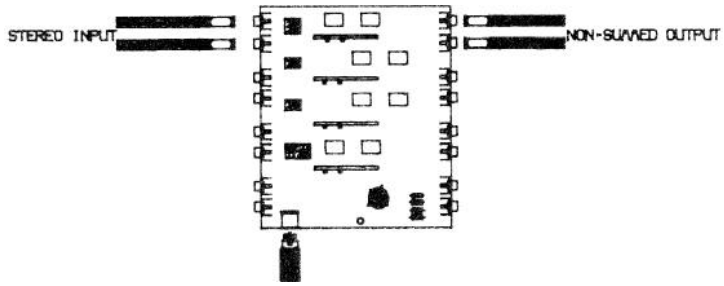


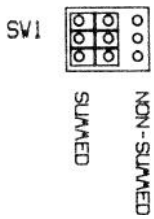


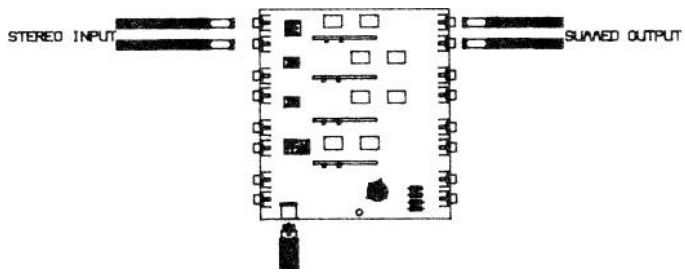
SUMMING CHANNEL

The Summing Channel can be defined as summed or non summed by moving the jumper switchers to the summed or non summed positions. (See diagram below)









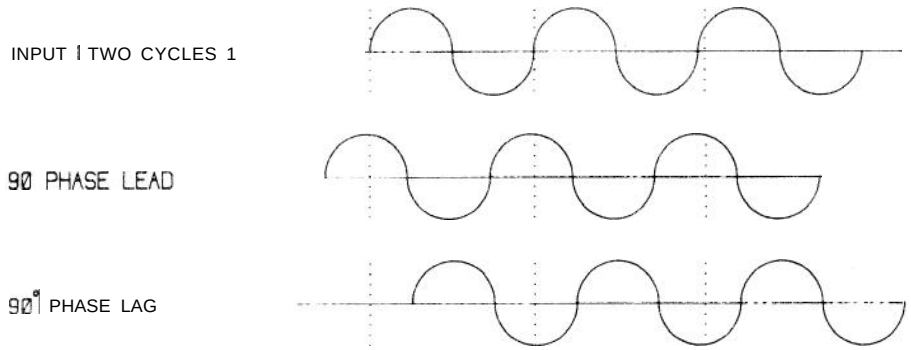
PHASE SHIFT AND CANCELLATION

The filter sections used in crossovers (both active and passive) change the phase of the input signal as well as the amplitude. In effect, phase shift moves the output forward or backward compared to the input. Phase shifting is measured in degrees. One full cycle is 360°, so if the output signal moves back 1/4 cycle, the phase shift is 1/4 of 360°, or -90°.

Cancellation is what happens when one speaker is pushing while the other is pulling. Instead of putting out sound into the environment, the speakers just swap air back and forth. (This is what happens when stereo speakers are hooked up out of phase).

The phase shift of crossover filters can cause cancellation. The drawing of the 90° leading and lagging waveforms above shows that the leading wave is negative when the lagging wave is positive. If each output went to a speaker, the speakers would be out of phase and cancellation would occur.

The Phase shift at Cutoff table shows that 12dB/Octave filters have +90° and -90° phase shifts at cutoff, and therefore they will produce cancellation unless something is done.



PHASE SHIFT AT CUTOFF

	High Pass	Low Pass
12dB/Octave	+90°	-90°
24dB/Octave	+180°	-180°

When a high and low-pass of 12dB/Octave filters is used, cancellation can be avoided by one simple step:

· Reverse the woofer phase by reversing the wiring to the + and · terminals.

Reversing the woofers has the effect of putting the woofer and midrange back in phase at the crossover frequency to compensate for the crossover's phase reversal.

On speaker systems where the woofer and midrange speakers are separated by more than a couple of feet, the travel time of sound through air can produce a phase lag leading to cancellation. For this reason:

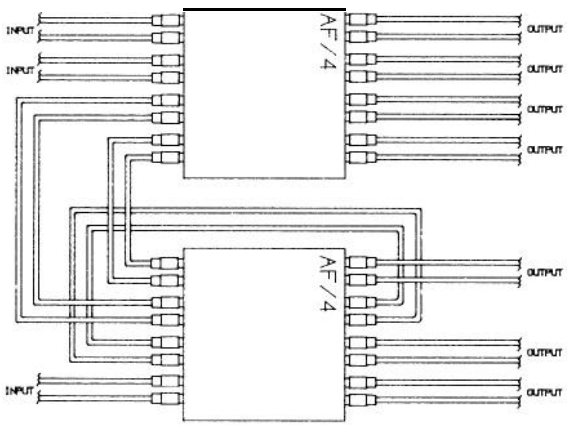
-On any installation try reversing both woofer phases. In some cases bass will be much tighter with woofers reversed.

These considerations also apply to the midrange-to-tweeter crossovers, although usually the problems introduced are less audible. The cure is the same, but applied to the tweeter:

· Reverse the tweeter phase by reversing the + and terminals.

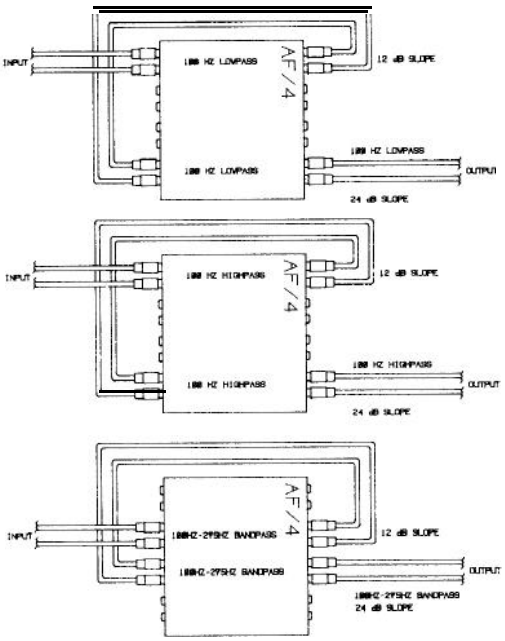
In general, the acoustics of cars and the variations of speaker placement can produce a variety of unexpected cancellations. Where possible, experiment with speaker phase by comparing the sound of the system with in-phase and reversed phase locating the smoothest-sounding connection.

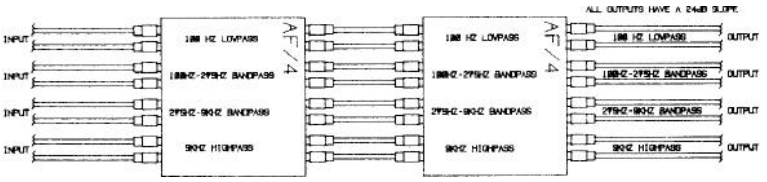
Also, unused inputs can be used as non filtered outputs.
Any combination of features can be used simultaneously. (See example below)



EXTRA FEATURES

Cascading from output to input to create 24dB per Octave slope.





ACTIVE - VS - PASSIVE CROSSOVERS

All crossovers are frequency divider networks. Both active and passive crossovers separate the audio frequencies before they arrive at the speakers, and pass to each speaker only the desired frequencies. An active crossover is an electronic "black box" (i.e. the AF/4HD) containing circuitry for frequency separation, and requires an electrical power supply. Passive crossovers go between the amplifier and the speaker, using bulky indicators and capacitors. Passive crossover components for low frequencies are particularly large and heavy. By contrast, active crossovers separate frequencies with the same high and low pass filter functions as passive crossovers, but since they are made with integrated circuits, they are much smaller and lighter.

Passive crossovers are usually much cheaper to use, since an additional amplifier isn't needed. However, there are a number of disadvantages to passive crossovers.

- FREQUENCY CONTROL: The response of a passive crossover depends strongly on the characteristics of the particular speaker.
- CROSSOVER SLOPE: Single component passive crossovers (1 cap or 1 inductor) only provide 6dB per octave rolloff. 12dB per octave passive crossover require more design time and expense.
- FREQUENCY CHANGING: Components for a wide variety of passive crossover frequencies are difficult to stock and inconvenient to change.

All these disadvantages are reduced or eliminated with the use of an active crossover/amplifier system.

CHOOSING CROSSOVER FREQUENCIES

Choosing the correct crossover frequency can be difficult. Consideration of the following items will help you make your selection easier.

OPERATING RANGE OF SELECTED DRIVERS:

Manufacturers will usually provide information about the operating range of theirdrivers so that you can choose a crossover frequency within that range to obtain maximum performance.

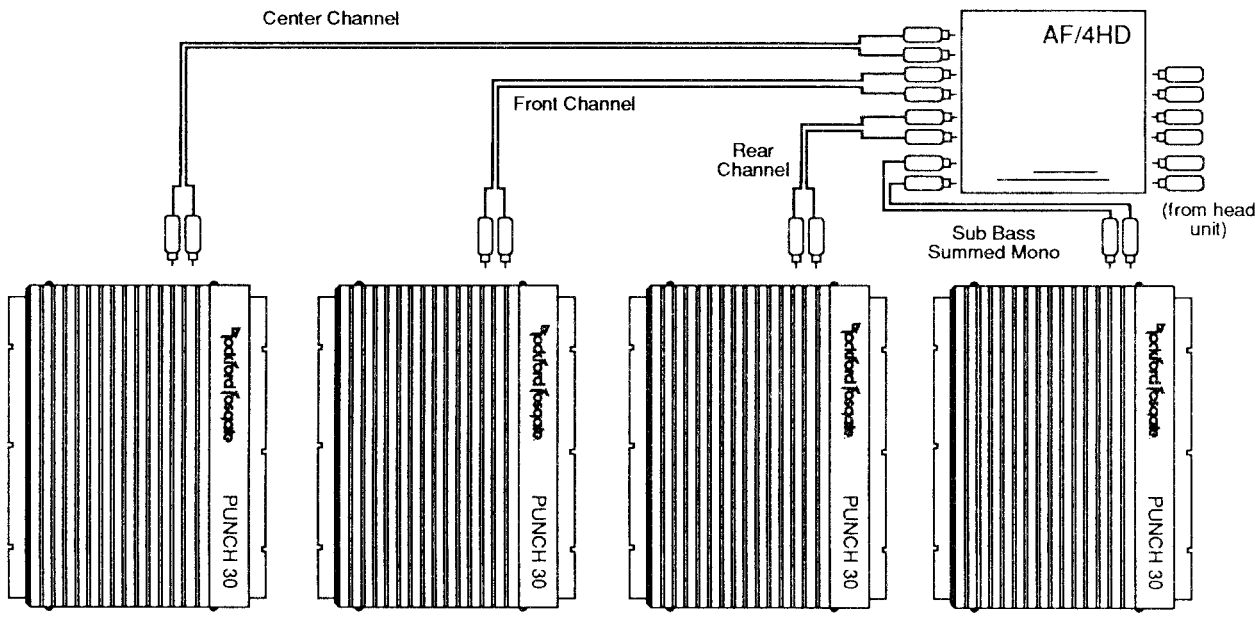
DESIRED POWER HANDLING OF DRIVERS:

Most autosound installations introduce a number of acoustical problems that can sometimes be corrected with careful attention to your crossover frequencies. The use of 1/3 octave RTA can help you determine if a problem exists and at what frequency.

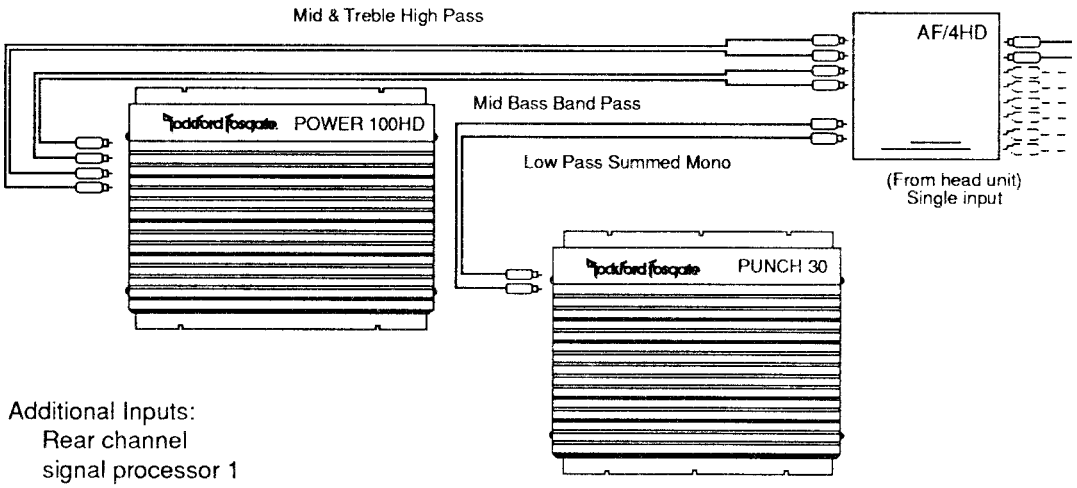
The following crossoverfrequencies work the best with Rockford Fosgate drivers, and provide a good foundation for any autosound system.

Woofer	100 Hz Low-pass
Midbass	100 Hz High-pass-275 Hz Low-pass
Midrange	275 Hz High-pass-9 kHz Low-pass
Tweeter	9 kHz High-pass

NOTE: Depending on the desired response of a given system, crossover frequencies can be varied accordingly.



This configuration allows the installer to:
Wire the system for front to rear fade, with constant bass as well as center channel. Bass and center channel are summed mono.
Any other combinations of same:
AF/4HD may be cascaded for 24dB/Octave slope with special crossover modules.



Additional Inputs:
Rear channel
signal processor 1
Signal processor 2
(OEQ-1, Epicenter, Gavotte, etc.)

This configuration allows the installer to:
Wire the system in a triamplified mode using on tweeters (four-way "System Design")
Additional inputs (shown) allow the installer to:
Wire the system front and read fade with constant bass
Wire the system front and rear fade with constant bass and center channel

AF/4HD SPECIFICATIONS

Input Level:	750 mV RMS
Input Impedance:	20,000 Ohms
Output Level:	750 mV RMS
Output Impedance:	500 Ohms
Signal-to-Noise Ratio:	Over 90dB (A-Weighted)
Distortion:	Under .01% THD + Noise
Frequency Response:	20 Hz-20,000 Hz -.5dB
Filter Response:	Butterworth
Filter Slope:	12 dB per Octave
Power Required:	Positive 12 Volts Required
Dimension:	5.5" wide x 5.75" long x 1.25" high 139.7mm x 146mm x 31.75mm
Weight:	21 oz.

LIMITED WARRANTY

ELECTRONIC WARRANTY

Rockford Fosgate warrants electronic components to the original purchaser for two years parts and one year labor providing product was purchased from and installed by an authorized Rockford Fosgate dealer. Warranty on product purchased from but not installed by an authorized dealer is one year parts. **Proof of purchase must accompany returned product.**

SPEAKER WARRANTY

Rockford Fosgate warrants all loudspeakers to the original purchaser for a period of two years providing the product was purchased from and installed by an authorized Rockford Fosgate dealer. **Proof of purchase must accompany returned product.** All warranty claims must be processed through authorized dealers. SHOULD YOU NEED TO OBTAIN SERVICE ON ELECTRONICS OR SPEAKERS, RETURN THE PRODUCT TO YOUR NEAREST ROCK-FORD FOSGATE DEALER OR CALL 602-967-3565 FOR THE DEALER NEAREST YOU. All products must be returned, freight prepaid, to an authorized Rockford Fosgate repair center where it will be repaired or replaced, at our option, and returned to you prepaid.

WHAT THE WARRANTY DOES NOT COVER

Warranty does not cover physical abuse, the cabinet or any appearance item, any accessory used in conjunction with the product, or any damage to the product resulting from alteration, accident, misuse or abuse. This warranty does not apply if the pans or labor, which would otherwise by provided without charge under this warranty, are obtained from any source other than an authorized service center. Parts not covered underwarranty will be repaired or replaced and returned C.O.D. for the pans and freight. For speaker boxes, the entire cabinet may be returned for service, but return will be freight collect. Rockford limits its obligation under any implied warranties under state laws to a period not to exceed the warranty period.

WARRANTY OUTSIDE THE U.S., PLEASE CONSULT YOUR LOCAL AGENT

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