
CARVIN

FET Series Power Amplifiers User's Guide

Models:

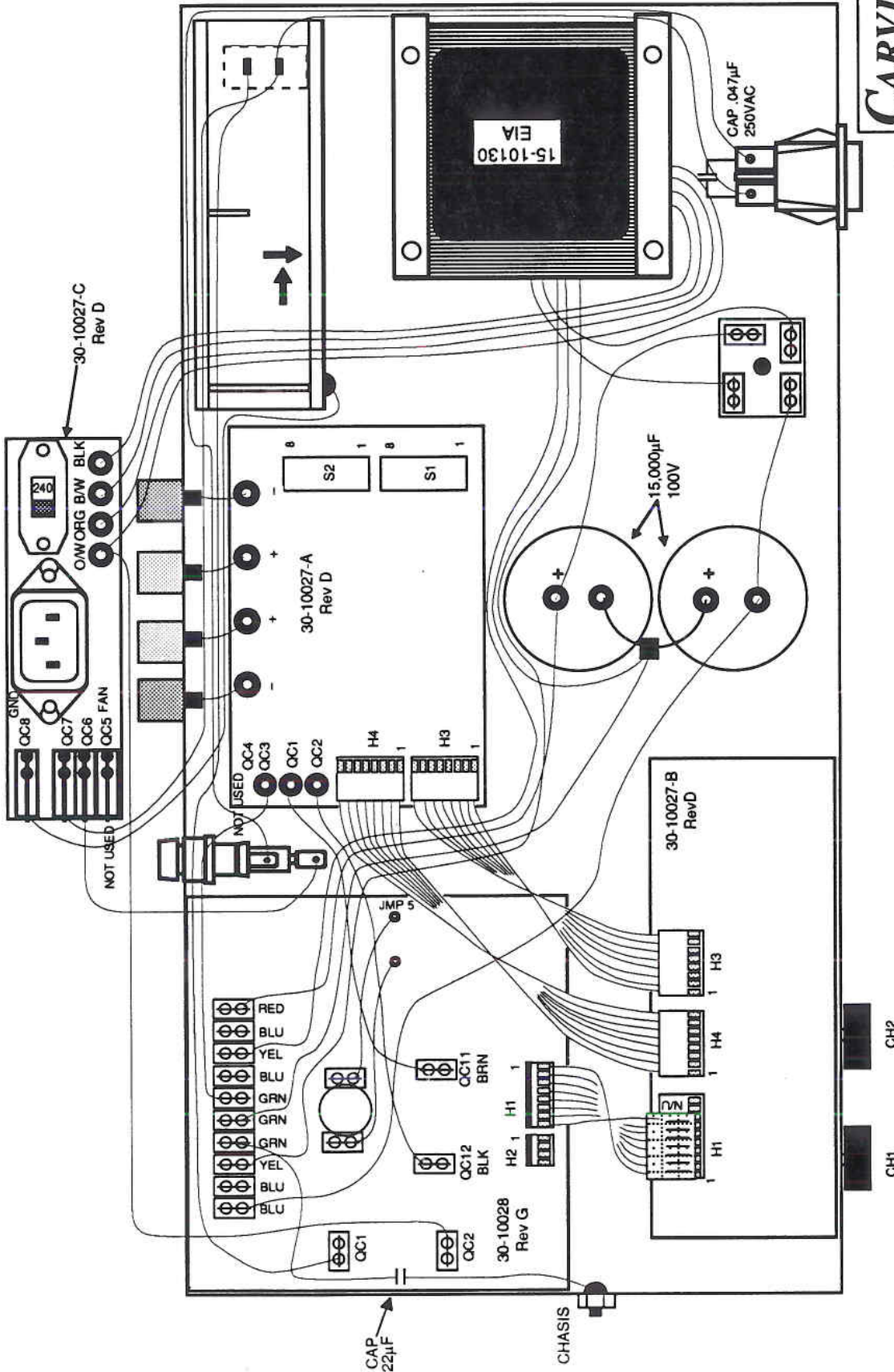
FET 450 and FET 1000

Manual No. 5009C, Revised 30APR92

1155 Industrial Ave., Escondido, CA 92029
800-854-2235

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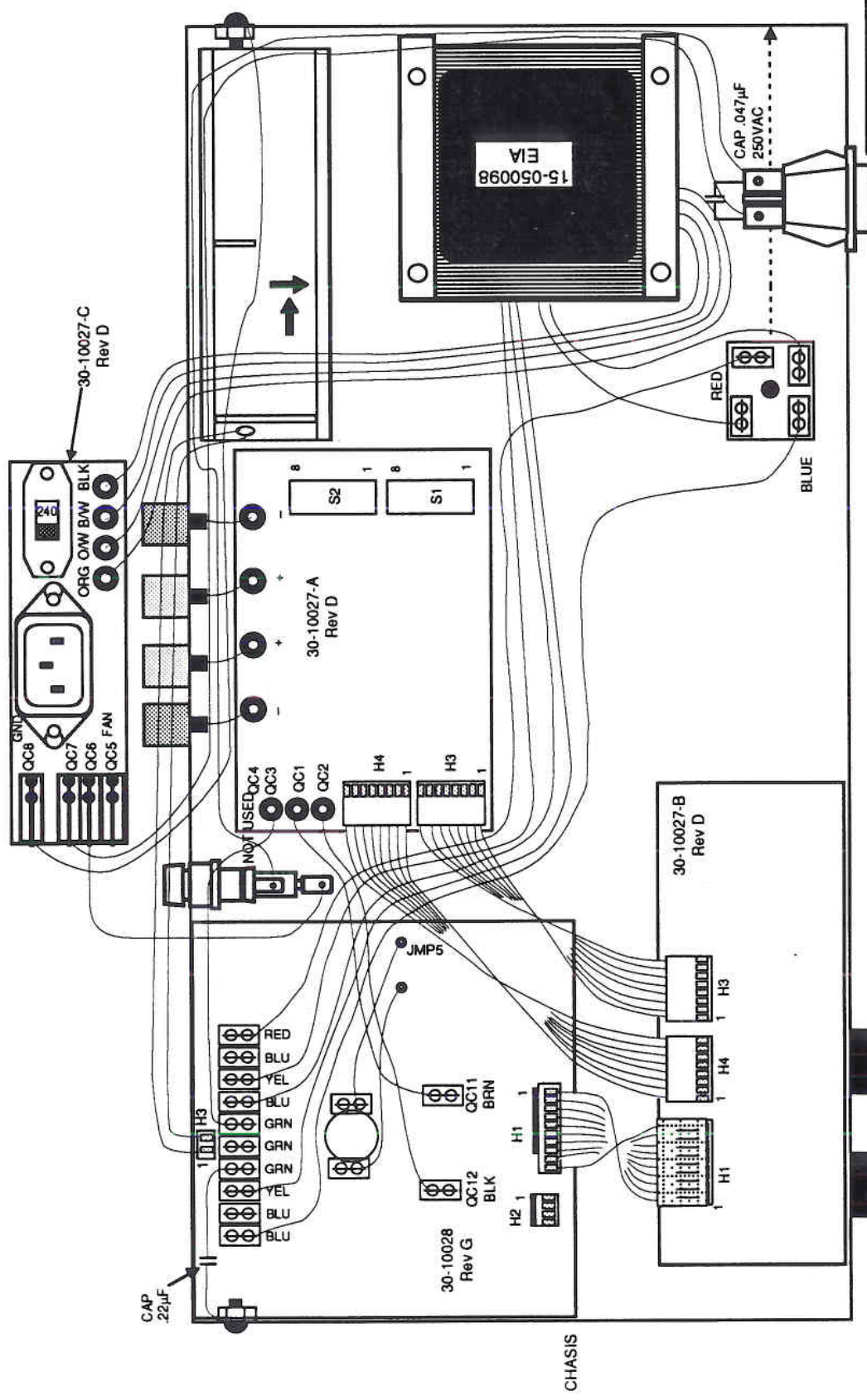


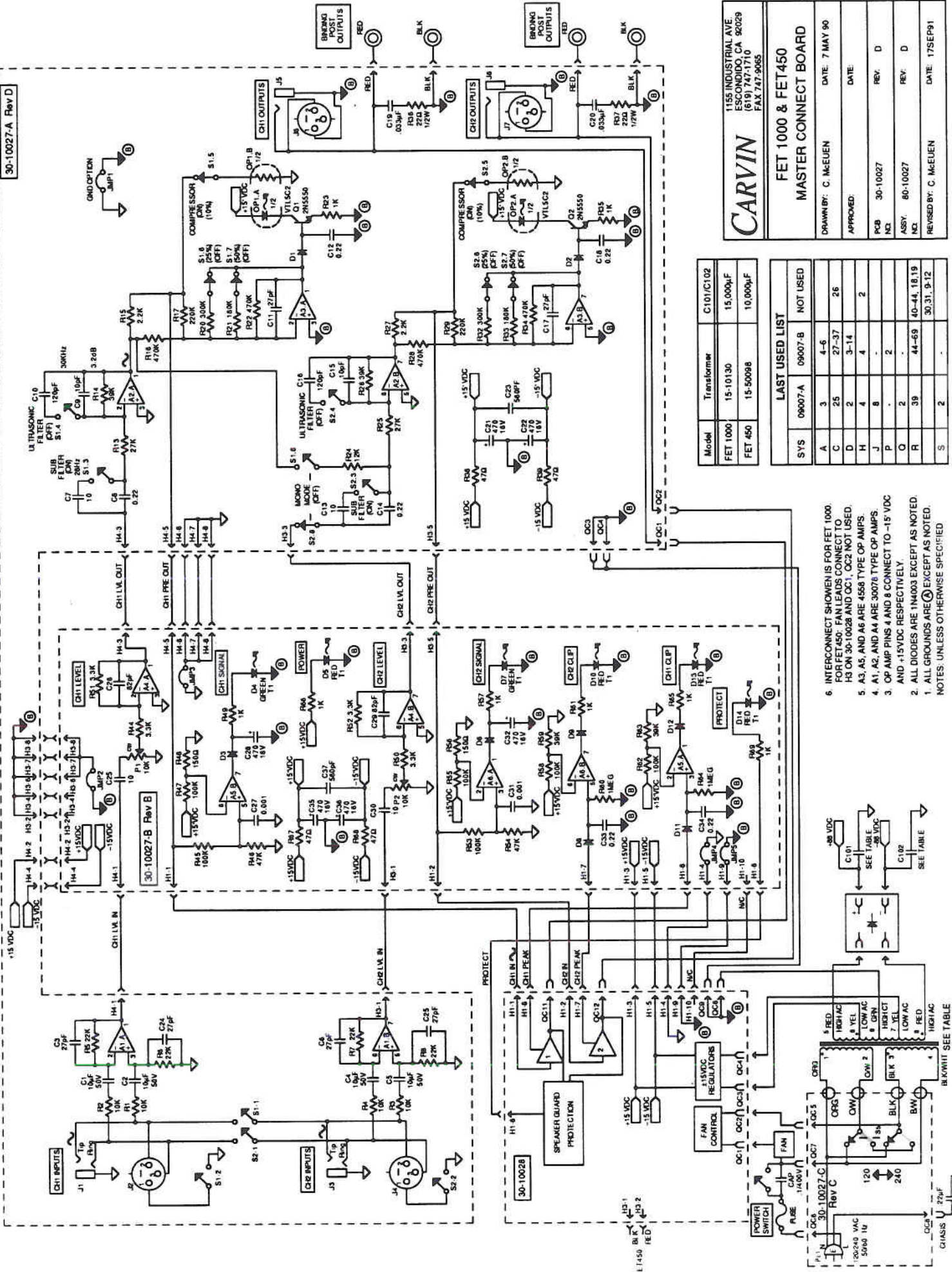
CARVIN	1155 Industrial Ave. Escondido, CA 92029 619-747-1710 FAX 619 747-9065	
	FET1000 Wiring Diagram Rev (D)	
Part No.	Date Revised	30APR92
85-10000 (Rev D)	Date Approved	
Approved By:		
Drawn By:	CFM	
	Date Drawn	4OCT90

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FET450
Wiring Diagram
Rev (B)

Part No. 85-00450 (Rev B) Date Revised 1 MAY 92
Approved By: Date Approved
Drawn By: D.RAWLINSON Date Drawn 21 NOV 91





CARVIN

FET 1000 & FET 450
MASTER CONNECT BOARD

1155 INDUSTRIAL AVE
ESCONDIDO, CA 92029
(619) 747-1710
FAX 747-9085

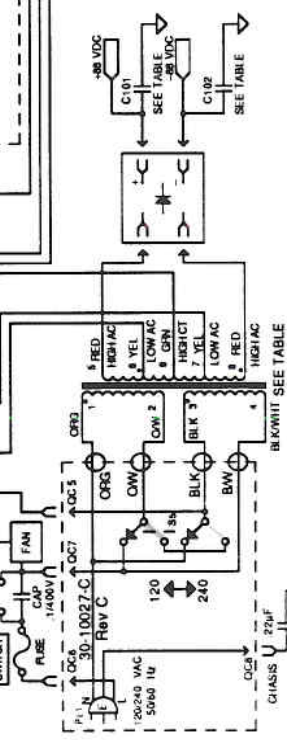
DATE: 7 MAY 90
DRAWN BY: C. McEUEEN
REVISED BY: C. McEUEEN

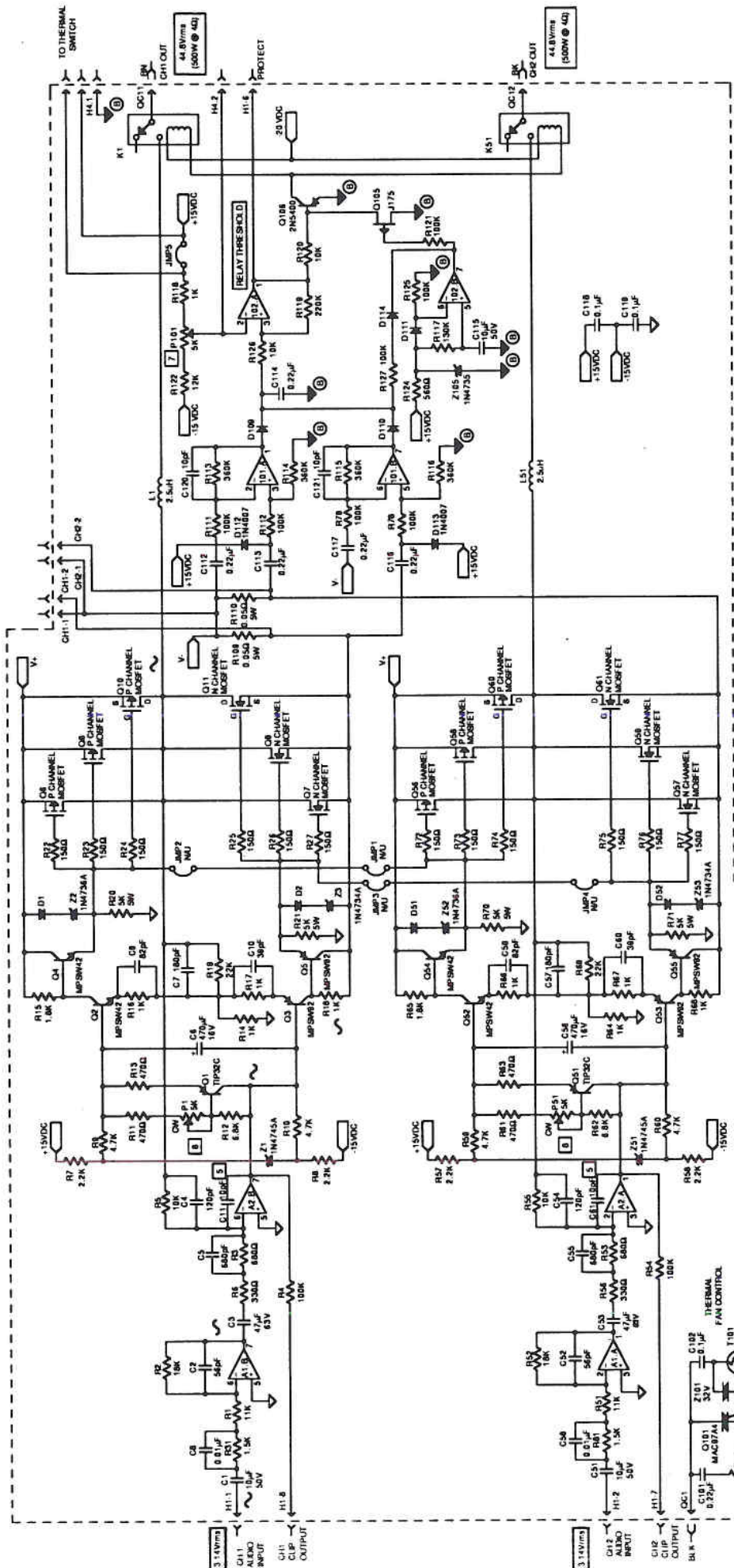
DATE: _____
APPROVED: _____
REV: D
REV: D
REV: D
REV: D

Model	Transformer	C101/C102
FET 1000	15-10130	15,000µF
FET 450	15-50098	10,000µF

LAST USED LIST			
SYS	09007-A	09007-B	NOT USED
A	3	4-6	
C	25	27-37	26
D	2	3-14	
H	4	4	2
J	8	2	
P	2		
O	2		
R	39	44-69	40-44, 18, 19
S	2		30, 31, 9, 12

- INTERCONNECT SHOWN IS FOR FET 1000. FOR FET 450, FAN LEADS CONNECT TO HQ ON 30-10028 AND OC1, OC2 NOT USED.
- A1, A2, AND A6 ARE 4568 TYPE OP AMPS.
- A1, A2, AND A4 ARE 30078 TYPE OP AMPS.
- OP AMP PINS 4 AND 8 CONNECT TO -15 VDC AND +15VDC RESPECTIVELY.
- ALL DIODES ARE 1N4003 EXCEPT AS NOTED.
- ALL GROUNDS ARE G EXCEPT AS NOTED. NOTES: UNLESS OTHERWISE SPECIFIED





CARVIN
 1155 INDUSTRIAL AVE
 ESCONCIDO, CA 92029
 (819) 747-1710
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**1000W STEREO
 POWER MODULE**

DRAWN BY: C. MCEUEN
 APPROVED: DATE: 19/JUN/90

PCB NO: 30-10028
 REV: G

ASSY NO: 80-10028
 REV: 0

REVISED BY: C. MCEUEN
 DATE: 27/MAR/92

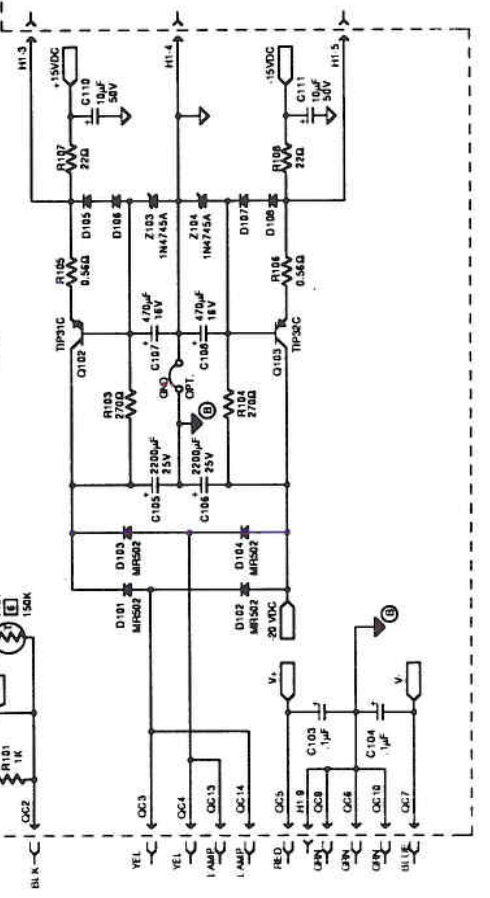
- ① ADJUST P1/P51 FOR 6mV (to 2mV) DROP ACROSS R109/R110 RESPECTIVELY UNIT WARM, 120 VAC LINE.
 - ② ADJUST P101 FOR 8.0 Vdc (to 1 Vdc) AT A102 PIN 2.
 - ③ THERMISTOR MUST BE IN CONTACT WITH HEATSINK.
 - ④ ADDED AS SECONDARY OPERATION.
 - ⑤ A101 AND A102 ARE 4558 TYPE OP AMPS.
 - ⑥ A1 AND A2 ARE MC33078 OP AMPS.
 - ⑦ ALL DIODES ARE 1N4003 (EXCEPT AS NOTED).
 - ⑧ ALL CAPACITORS IN MICROFARADS (EXCEPT AS NOTED).
- NOTES: UNLESS OTHERWISE SPECIFIED

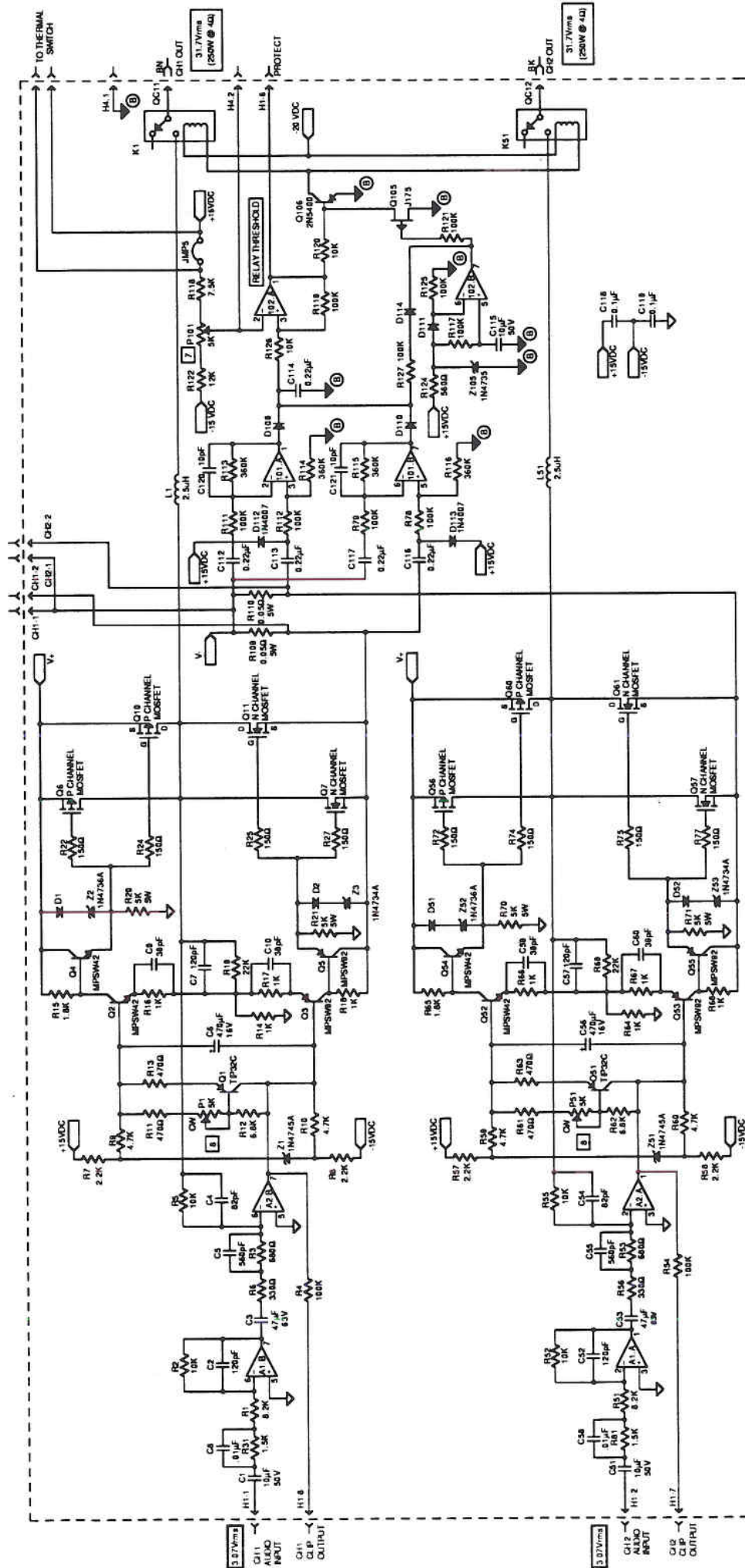
LAST USED LIST

Design	Ch. 1	Ch. 2	51-104	Sys. 101-200
A	2	-	-	102
C	11	51	122	-
D	2	52	114	-
H	-	-	-	4
JMP	2	4	5	-
K	1	51	-	-
L	1	51	-	101
P	1	51	-	106
O	11	81	-	14
R	31	81	-	127
T	-	-	-	101
Z	3	53	-	105

LABELS NOT USED

C
D
O
R
Z





CARVIN
 1155 INDUSTRIAL AVE.
 ESCONDIDO, CA 92029
 (619) 747-1710
 FAX 747-9685

**500W STEREO
 POWER MODULE** (M2M42)

DRAWN BY: C. MCEUEN DATE: 15JAN90
 APPROVED: DATE:
 PCB NO. 30 10028 REV: G
 ASST. NO. 80-05028 REV: K
 REVISION BY: C. MCEUEN DATE: 30APR92

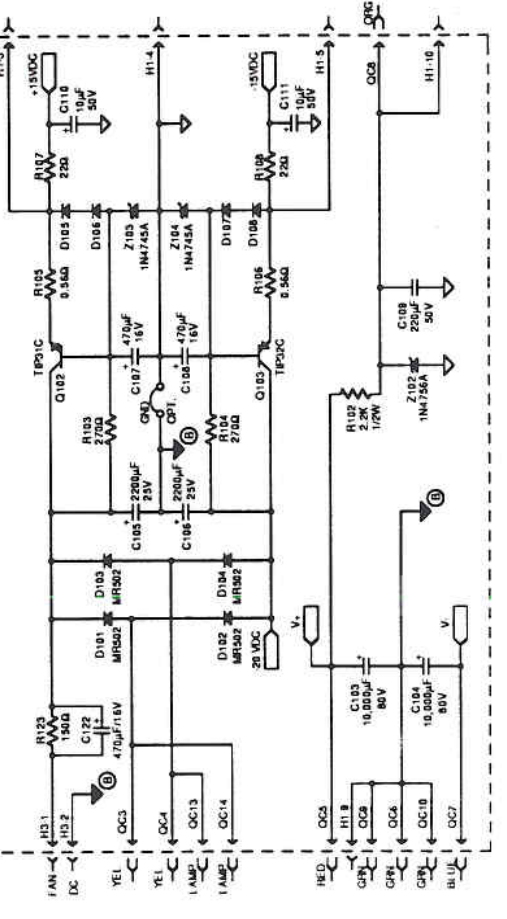
- 1. ADJUST P1/P51 FOR 6mV (±0.2mV) DROP ACROSS R109/R110 RESPECTIVELY UNIT WARM, 120 VAC LINE.
 - 2. ADJUST P101 FOR XXX Vdc (±0.1 Vdc) AT A102 PIN 2.
 - 3. ADDED AS SECONDARY OPERATION.
 - 4. A101 AND A102 ARE 4558 TYPE OP AMPS.
 - 5. A1 AND A2 ARE MC33078 OP AMPS.
 - 6. ALL DIODES ARE 1N4003 (EXCEPT AS NOTED).
 - 7. ALL CAPACITORS IN MICROFARADS (EXCEPT AS NOTED).
- NOTES: UNLESS OTHERWISE SPECIFIED

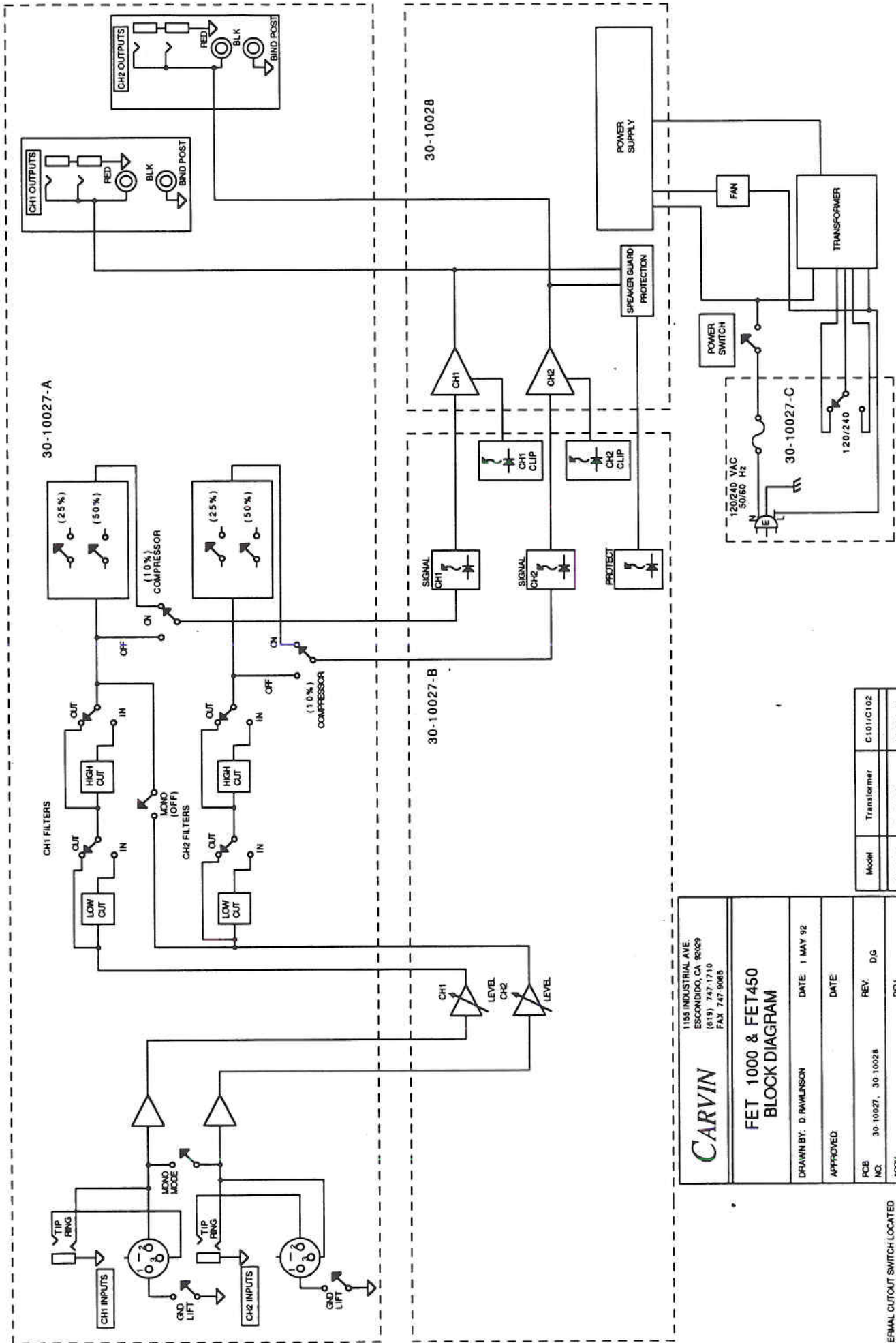
LAST USED LIST

Design	Ch. 1	1 50	Ch. 2	51-100	Syn.	101-200
A	2	-	-	-	-	102
C	10	68	-	-	-	122
D	2	52	-	-	-	114
H	-	-	-	-	-	4
JMP	2	4	4	3	-	5
K	1	51	-	-	-	-
L	1	51	-	-	-	101
P	1	51	51	106	-	104
O	11	81	104	16	-	106
OC	-	-	-	-	-	127
R	31	81	101	101	-	101
T	3	33	-	-	-	105
Z	-	-	-	-	-	-

LABELS NOT USED

C	-
D	-
O	104
R	26, 29, 80
Z	-





CARVIN		1133 INDUSTRIAL AVE. ESCONDIDO, CA 92029 (619) 747-1710 FAX 747-9068	
FET 1000 & FET450 BLOCK DIAGRAM			
DRAWN BY: D. RAWLINSON		DATE: 1 MAY 92	
APPROVED:		DATE:	
PCB NO.	30-10027, 30-10028	REV.	D.G.
ASSY. NO.		REV.	
REVISED BY:	D. RAWLINSON	DATE:	1 MAY 92

Model	Transformer	C101/C102
FET 1000	15-10130	15,000µF
FET 450	15-50098	NOTUSED

2 THE THERMAL CUTOFF SWITCH LOCATED ON THE HEAT SINK (85° C CUTOFF).
1 ALL GROUNDINGS ARE AS EXCEPT AS NOTED.
NOTES UNLESS OTHERWISE SPECIFIED.

Technical Specifications of the FET450 and FET1000

Model	FET450	FET1000
Power (in Continuous Watts) Mono Bridged Mode 8 Ω , Bridged (20-20k Hz, < .1 % THD)	450 Watts	1000 Watts
Both Channels Driven 8 Ω , (20-20k Hz, < .1 % THD) 4 Ω , (20-20k Hz, < .1 % THD)	125/125 Watts 225/225 Watts	300/300 Watts 500/500 Watts
One Channel Driven 8 Ω , (20-20k Hz, < .1 % THD) 4 Ω , (20-20k Hz, < .1 % THD)	150 Watts 250 Watts	350Watts 550 Watts
Distortion (THD) 20 to 20 kHz, any power level up to clipping: 8 Ω , 1 kHz, 50% rated power (typical): 4 Ω , 1 kHz, 50% rated power (typical):	<.05 % <.01 % <.01 %	<.05 % <.01 % <.01 %
Slew Rate (Volts per microsecond)	50	55
Damping Factor (1 kHz, 8 Ω):	>500	>500
Input Sensitivity: (for full power into 4Ω)	1.0 Vrms	1.0 Vrms
Signal To Noise Ratio:	100 dB	103 dB
Shipping Weight:	32 lbs	37 lbs
Frequency Response: (both models, 8Ω)	\pm 0.5 dB, 20 Hz to 20 kHz (-3 dB at 5 Hz and 80 kHz)	
Input Impedance: (both models)	>20 k Ω , balanced, unbalanced	
Protection Circuits:	<ul style="list-style-type: none"> • SpeakerGuard™ Speaker Protection • Short Circuit Current Limiting • Thermal Shut-Off Switch (Heatsink Temp. above 95°C) 	
Controls and Indicators:	<p>Front: Power switch 41 detent attenuators Indicators: Signal Present LED, Clip LED, Protect LED, Power LED</p> <p>Rear: Professional Accessory Group (remove plastic cover for access):</p> <ul style="list-style-type: none"> • Power Compressor Switches: off, -3dB, -6dB and -10dB settings • Subsonic filter switch: -3 dB at 30 Hz • Ultrasonic filter switch: -3 dB at 25 kHz • Mono Bridge Mode switch • Input "Y" switch • XLR Ground Lift switches (one for each channel) 	
Power Requirements:	120/240 VAC, 50/60 Hz	

Warranty and Service Information

You can use our specialized service department to repair your FET amp should service ever be required. Call us Toll-Free at 800-854-2235 for an RMA number so we can anticipate your shipment. Put the RMA number on the carton and be sure to include a full description of all problems with the unit. Pack the amp in its original carton using all the original packing material and return it by UPS pre-paid. Units with severe physical damage, missing parts, or damage from improper repair are not serviceable.

• Call Before Returning

If you are in doubt about a malfunction, please call our service department (toll-free) and we will help you determine if your unit is defective and avoid costly shipping.

• Repairs Under Warranty (1 Year)

1. There is no charge for service under warranty. However, shipping both ways is to be paid by the customer.
2. Include a copy of the original invoice to verify your warranty, along with a full description of the problems.
3. Allow approximately 10 days for servicing.
4. Include a check for \$15 to cover the return shipping charges or we can ship the items back COD for \$20 (the cost of shipping) plus the current COD fee.
5. To avoid damage, ship only in the original carton (save your cartons—a replacement is \$5 plus \$5 shipping)

• Repairs Out of Warranty

1. After your warranty has expired, the service charges for all FET amps except the FET1000 is \$70. The FET1000 is \$90. This includes all parts, labor and testing to bring your unit up to factory specifications. Return shipping is an additional \$15 (shipping is lower than the original catalog shipping cost because we reuse the carton). Include payment with your return (personal checks are accepted).
2. If there is no problem with the unit, a flat fee of 50% (\$35 or \$45) will be charged for checking the amp.
3. Allow approximately 10 days for repair and testing, plus shipping time.
4. To avoid damage, ship only in the original carton (save your carton).

• Service In Your Area

You may select your own service center or have your own qualified technician work on the unit at your own expense. This will not void the warranty unless damage was done because of improper servicing. Under the ONE YEAR WARRANTY, Carvin will ship parts pre-paid to you or your technician providing that the defective part(s) are first returned for our inspection. If you do not have a qualified service person, we ask that you do not involve yourself in servicing the unit.

LIMITED WARRANTY

Your Carvin Professional Series Product is guaranteed against failure for ONE YEAR from the date of purchase. Carvin will service the unit and supply all parts at no charge to the customer, providing the unit is under warranty. CARVIN WILL NOT PAY FOR PARTS OR SERVICING OTHER THAN OUR OWN.

This warranty is extended to the original purchaser only and is not transferable. THIS WARRANTY DOES NOT INCLUDE FAILURES CAUSED BY INCORRECT USE, INADEQUATE CARE OF THE UNIT, OR NATURAL DISASTERS.

A COPY OF THE ORIGINAL INVOICE IS REQUIRED TO VERIFY YOUR WARRANTY.

Carvin assumes no responsibility for any horn driver or speaker damaged by this unit. This warranty is in lieu of all other warranties, express or implied. No representative or person is authorized to represent or assume for Carvin any liability in connection with the sale or servicing of Carvin products. No liability is assumed for damage due to accident, abuse, lack of reasonable care, loss of parts, or failure to follow Carvin's directions.

CARVIN SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

In the interest of creating new products and improving existing ones, Carvin is continually researching the latest state of the art audio design methods, and modern packaging and production techniques. Thus, Carvin reserves the right to make changes in its products and specifications without prior notice or obligation.

Factory Direct Sales

1155 Industrial Ave.
Escondido, CA 92029
(619) 747-1710 M-F 8:30 to 4:30
Toll Free: 800-854-2235

Santa Ana Retail Sales

1907 N. Main St.
Santa Ana, CA 92706
(714) 558-0655 M-F 10:30-7; Sat 10-6

Hollywood Retail Sales

7414 Sunset Blvd.
Hollywood, CA 90046
(213) 851-4200 M-F 10:30-7; Sat 10-6

Maintain a Good Tool Kit

Put together a good tool kit and add it to your equipment list. Make sure your tool kit includes a generous assortment of connector adapters. Stock enough spare connectors to repair each different type of interconnect cable you use in your system. Preventive maintenance is always the best way to assure the least amount of equipment related problems. Keep your cables clean and in good repair at all times. And, be sure to clean any dirt or dust off all your mixers, cables, and speakers. Such preventive maintenance will provide you with a much more reliable system. A good basic tool kit might carry the following items:

- Screwdrivers appropriate for any need
 Straight and Phillips (small and large points)
- Pliers, Wire Cutters, and an Adjustable Wrench
- Soldering iron, Solder, and Solderwick
- Spare Cables
- Spare Connectors (1/4", XLR, RCA Phono, Line Cord)
- Assorted Adapters
- An Extra Line Cord (detachable type)

Of course, your tool kit can be as elaborate as you desire, according to your budget and technical ability. It is also a good idea to carry a flashlight or accessory lamp for those occasions where the house lights go down and you are left in total darkness, groping for the faders!

Power Up Sequence

There is really just one rule for good practice regarding the sequence in which to power up and down the system. The rule is:

Turn the power amplifiers on last, and off first.

Turning on all the other gear before you turn on the power amps will prevent any excessive transient signals from getting to your loudspeakers and possibly damaging the horn drivers. Likewise, at the end of the show, if you kill the power amps first there is no chance that a turn off thump from some signal processor will go through the system and take out your super tweeters.

Besides the concern over damaging the loudspeakers, it is not a good idea to expose your audience to obnoxious pops, squeals or thumps if you want them to come back again. Make sure your audience hears only high quality sound from your sound system!

Sound Check

After the sound system is connected and powered up, you will want to check every microphone and instrument connection one line at a time. To check lines to your console, have an assistant speak into each microphone and send a signal through every instrument. You need to confirm that every microphone and line properly feeds its assigned channel on the mixer. Make sure that every channel used is properly identified on the writing strip. If your audience is seated at this time you can spare them from listening to this testing by switching off the main speaker amps, (or unplugging the speaker outputs on the mixers) and monitoring the sound check, using the PFL switches, over headphones. At the same time, you can verify the stage monitor system by raising the monitor sends at each channel and then carefully raising level on the monitor send knobs. Your assistant can verify the stage monitor sound as he checks each mic and instrument. Finally, check the main system sound by using one of the mics on the stage. This completes the basic system check out.

Section

6

Efficient Set Up and Quality Sound

At this point we would like to make some general comments on setting up and operating a sound reinforcement system. The most important point to emphasize is that a little planning before the day of the performance, can prevent serious problems the night of the performance, especially if you are new to sound reinforcement work.

Preview the Concert Hall

Try to check out the concert hall before hand to determine where you can obtain power and how far you will have to run any extension cords. Check if there enough current capacity to power ALL the equipment you may need. This will ensure that you do not blow all the circuit breakers on the opening note. To check this, you need to know approximately what the total power line (AC) current requirement for your sound system will be. You can easily determine the total AC current requirement of the system (that is, the total number of "Amps" required from the AC line). To do this you need to add up the total current requirements of each piece of equipment (in amps) that you plan on using in your performance. Or, you can add the total 'watts' (power capability) of each piece of equipment in the system and divide by the number 120 (the AC line voltage). This will give you the total current needed (in amps) for your system. The current capability of the AC power circuits you use should exceed your total sound equipment's use by a healthy margin. As an example, let's say you have determined your total current requirement to be 15 Amps. Then you should make sure that the house circuits can supply at least about 20 amps (the 15 Amp minimum plus a 5 Amp safety margin). In any event, make sure you power up the complete system well in advance of show time. Now, if there are any problems you can correct them before, and not during, the show.

One of the greatest problems of circuit overloading is flood or spot lights plugged into the same circuit you use for the sound system. Try not to use the same circuit to power both the lighting and the sound system. Finally, don't forget to check that the circuit chosen can handle the current (Amps) demand of your lighting system in addition to delivering the current required for the sound system.

Make an Equipment List

A good way to prepare for the show is to write out a list of ALL the equipment that you will be using. Later you can use this list as a check list when it comes time to load up before, and after, the performance. Using a check list will help ensure that you do not forget or lose pieces of your valuable gear. Your list should include everything from the mixer down to the last interconnect cable. If you start with a block sketch of the sound system showing the mixer, snake, main amps, main speakers, monitor amps, and monitor speakers you can then draw in each interconnect cable. On every cable drawn in label each end as to the type of connector it will need. This diagram will help you to quickly set up the system because you will not have to stop and think what connects to what. It's no fun scrambling to assemble interconnect cables when show time is a few minutes away! A complete equipment list and system diagram can help prevent equipment loss and should allow quick and efficient sound system setup.

How to Use an Active Crossover in Bi/Triamped Systems

Understanding the optimum operating frequency ranges and power handling capacities of the loudspeaker drivers in your system is essential to properly setting up the active crossover in a multi-amplified sound system. This information will help the system operator to select the best crossover points and optimize the response of the system.

For example, a high frequency driver may have an optimum response range from 1500 Hz to 20 kHz. Its power handling capacity within that range might be 60 watts. The best choice for a crossover frequency would then be 1500 Hz or higher. To choose a lower crossover frequency could cause excessive voicecoil excursion and would reduce the power handling capability of the driver. Note: For every octave a driver's frequency range is lowered its power handling capacity is divided by four. So, dropping the crossover frequency from 1500 Hz to 750 Hz would reduce the above driver's power handling capacity from 60 Watts to approximately 15 Watts. However, a higher crossover point could allow for increased power handling capacity and less distortion. If a higher crossover frequency was desired (for example, 2 k or 2.5 kHz) then you would want to choose a woofer (or mid-range) speaker to compliment this crossover frequency. So, you would look for a low or mid-frequency driver that maintained a response out to the desired crossover frequency.

The Carvin XC-1000 electronic crossover is an excellent example of a high quality active crossover. It features 18 dB/octave Butterworth filters which provide maximum protection for high frequency drivers and have accurate summing characteristics. It offers sweepable parametric selection of crossover frequencies. As with any professional audio product, its inputs and outputs are balanced. Carvin highly recommends the use of this crossover with any of our professional biamp or triamp systems.

Some recommended settings for biamping and triamping Carvin's speakers are as follows:

<u>Carvin Loudspeaker Systems</u>	<u>Recommended Crossover Frequency</u>
3018 Folded Horn Woofer	150 Hz
1210 Horn Midrange	150 Hz and 2 kHz
560 Radial Horn Tweeter	2 kHz
1331 Horn Woofer	2 kHz
992 Three Way Direct Radiator	500 Hz (woofer to midrange)
973 Three Way Direct Radiator	500 Hz (woofer to midrange)
962 Two Way Direct Radiator	2 kHz
852 Two Way Direct Radiator	2 kHz
802 Two Way Direct Radiator	2 kHz
792 Two Way Direct Radiator	2 kHz
752 Two Way Direct Radiator	2 kHz

Benefits of Biamping

Multi-amplification offers significant advantages over speaker systems employing passive crossovers. In professional sound applications multi-amplification is often employed in order to achieve very high sound pressure levels. Passive crossovers waste some of the energy from the power amp and can generate distortion when driven at high levels. Removing the passive crossover and connecting the speaker drivers directly to the power amp completely eliminates these power losses and distortion.

Most passive crossovers are designed as if they were going to be loaded by perfect 8Ω resistors. When they are actually loaded by woofers and tweeters the crossover response that results can be quite different from what was intended. This is because real loudspeakers have complex impedance characteristics which interact with the passive crossover and degrade the intended crossover frequency characteristics. Active crossovers have none of these problems and provide exactly the intended frequency response regardless of the impedance of the speaker drivers.

Because high frequency drivers are almost always more efficient than woofers it is possible to operate the high frequency amp below clipping well beyond the level where the low frequency amp clips. Often it is even possible to use a lower power amp on the tweeter than on the woofer and still maintain a high frequency headroom advantage. When a sound system is being pressed to its limits for volume a multi-amplified system can be driven to higher sound pressure levels than a comparable passive crossover system before distortion becomes apparent. This advantage in sound pressure level is probably the main reason to multi-amplify a speaker system.

When to Biamp

Biamped or triamped sound systems are best targeted toward high level sound reinforcement. The increased efficiency and headroom of these types of systems allows for higher volume levels, greater speaker protection and less overall cost in multiple speaker/amplifier systems. Because of the greater efficiency and protection of these types of systems, a biamped or triamped system will provide a higher degree of reliability for demanding "high volume" sound reinforcement. Biamping or triamping is the choice among professionals and sound companies where continuous high level sound reinforcement is required. It provides simplicity in setup and allows more control over the response of the sound system.

If high level sound reinforcement is not needed, the best choice may be a passive crossover system. In small to medium sized rooms, clubs or auditoriums you may not require the output of a biamped or triamped sound system. Speaker systems using passive crossovers are less expensive overall and sound excellent for these types of applications.

Active Crossovers

The alternative to a passive crossover is multi-amplification using an active crossover. For a two-way system it is called bi-amplification, or tri-amplification for a three-way system. In a multi-amplified speaker system there is one power amplifier per driver and the crossover filtering is performed before the power amplifiers rather than after them. One power amplifier (or rather, one channel of a stereo amp) is connected directly to each driver in the speaker system. The active crossover consists of a set of active filters that operate on the line level signal from the mixer or preamp. The full spectrum signal is processed through a high pass (low cut) filter to create the "high out" signal for the tweeter's power amplifier. The signal that feeds the woofer's power amp is processed through a low pass (high cut) filter. In addition, the active crossover usually provides separate level controls for the high and low outputs so that you can match the output levels of the woofer and tweeter to one another. A multi-amplified speaker system with an active crossover has many advantages over a speaker system using a passive crossover. See Figure 5-2 below.

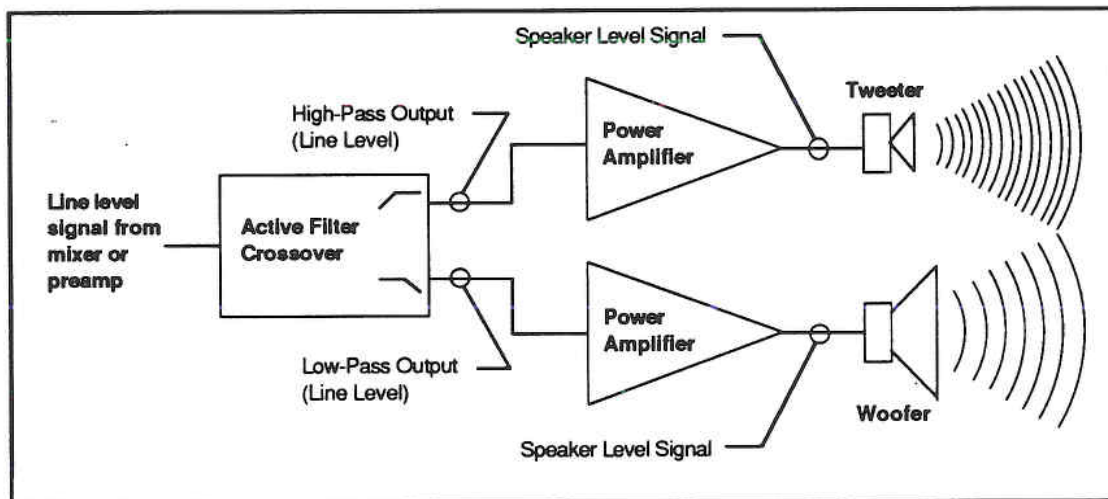


Figure 5-2: Two-Way Bi-Amped Loudspeaker with an Active Crossover

A bi-amplified speaker system requires two amplifiers to drive the system but results in some definite sonic improvements. In addition to the extra amplifier an active crossover is also required. The full range signal from the mixer or preamp is fed into the active crossover where it is split into high and low signals. The high range signal is fed to one power amp and the output of that amp fed to the tweeter. The low output of the crossover is fed to the second amp and the output of that amp fed to the woofer. This way each driver (woofer and tweeter) has its own power amp connected directly to it without a crossover between the amp and the driver.

A tri-amplified speaker system is the same as a bi-amplified system except that it is a three-way system (woofer, midrange, and tweeter) and requires three power amplifiers along with an active three-way crossover.

It is not uncommon to even see mixes of active crossovers with passive crossovers in hybrid arrangements. An example would be a three way speaker system that employed an active crossover between woofer and midrange and then a passive crossover between midrange and tweeter. In such a system two amplifiers would be used along with one two-way active crossover and one two-way passive crossover.

The simplest type of multiple driver loudspeaker system employs two drivers: a high frequency driver (a "tweeter") and a low frequency driver (a "woofer"). Our first inclination might be to apply the full frequency range signal from the amplifier to both drivers by wiring them in parallel, but this approach would have some serious problems. First, most tweeters would be destroyed by the low frequency energy of the full range signal because it would drive the tweeters diaphragm through very wide excursions and tear up the suspension. Then, in the range where the frequency response of the two drivers overlaps, there would be too much output from the combined system. That is, the system would have a "peak" in the midrange region where the drivers have overlapping frequency response. To make matters worse, the tweeter would typically be louder than the woofer. The solution to these problems is to use a crossover network to block the low frequency energy from the tweeter and combine the woofer and tweeter into a full range speaker system.

There are two general types of loudspeaker crossovers, active and passive.

Passive Crossovers

The passive type is the simplest, and is the type used most often. For example, home Hi-Fi speakers almost always use passive crossovers. A passive crossover is located in the signal path between the power amp and the speaker components. It is usually located inside the speaker enclosure along with the drivers. A passive crossover consists of passive components (resistors, capacitors and inductors) with a high power rating and acts directly on the speaker level signal from the power amplifier. It's main advantage is that it allows one power amplifier to drive a complete full range loudspeaker system. See Figure 5-1 below.

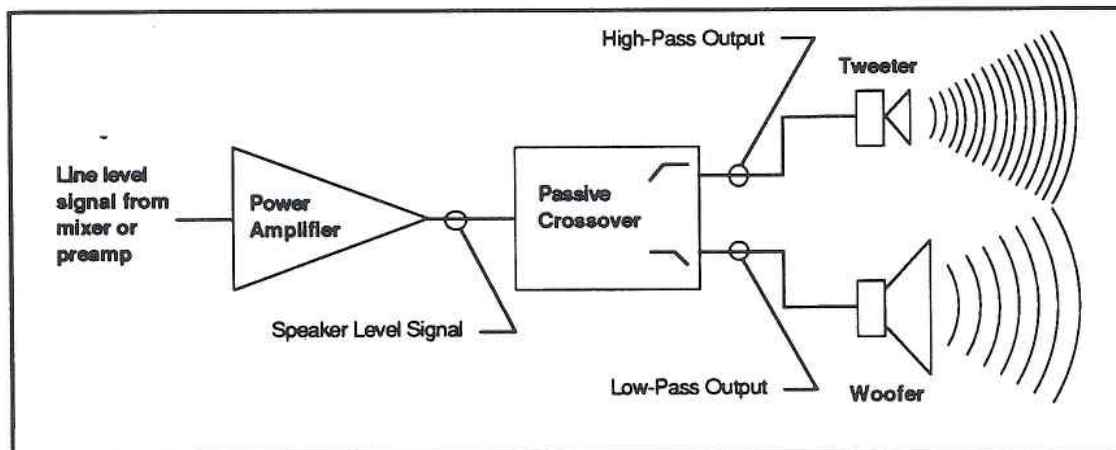


Figure 5-1: Two-Way Loudspeaker with a Passive Crossover

Section
5

Biamping and Triamping Speaker Systems

This section of the manual is intended to provide the user with an overview of loudspeaker crossovers and the advantages that can be obtained by biamping or triamping the loudspeaker systems. We will start with some loudspeaker basics and then discuss the details of active crossovers and multi-amplification.

Loudspeaker Basics

The frequency range of human hearing spans from about 20 Hz to 20,000 Hz (20 kHz); likewise the music we create contains audio information over approximately that same frequency range. In order for a sound reproduction system to accurately reproduce musical information it is necessary for the loudspeakers (as well as all other components in the audio signal path) to reproduce the full frequency spectrum. Covering the full audio spectrum from 20 Hz to 20 kHz is no problem for the electronic components but it presents a difficult challenge for loudspeakers.

Most loudspeaker component drivers are incapable of reproducing the entire audible spectrum. This is because the characteristics that make a driver good for reproducing one frequency extreme make it unsuitable at the other extreme. For example, good low frequency drivers need to be rather large in order to move a lot of air and reproduce the bass frequencies; but high frequency drivers need to be small to maintain a wide angle of coverage. This means that good low frequency transducers tend to perform poorly on the highs and that good high frequency reproducers tend to perform poorly on the lows. For high quality audio reproduction the solution to this problem is to use separate driver components to handle the high frequency range (tweeters) and the low frequency range (woofers). In order to combine the separate driver components into a full range loudspeaker system we use a crossover network. The crossover splits the full spectrum input signal into separate high and low frequency outputs to feed the separate high frequency and low frequency drivers of the loudspeaker.

In combining several loudspeaker components into a loudspeaker "system" the goal is to obtain an accurate (that is, "flat") frequency response across the complete audio spectrum. In practice it is found that woofers can only go so low, and tweeters can only go so high. This means that, in practice, the extremes of the audio spectrum are not reproduced with great accuracy by most loudspeaker systems.

Although it is possible to divide the frequency spectrum up into any number of parts for reproduction by a corresponding number of component drivers, the most popular designs use only two or three (sometimes four or more) drivers to make what are called two-way, three-way, or even four-way loudspeaker systems. Now let's look closer at how two drivers can be combined to make a full range two-way loudspeaker system. Once you understand how to combine two drivers to cover a broader frequency range than a single driver, it is easy to see how to combine these two drivers with a third driver to provide broader (or better) coverage.

Bridging the Amp

FET Amplifier bridging recommended when you need a very high power mono (single channel) amplifier. The main benefit of bridging is the increased voltage output of the amplifier. Note that the minimum load impedances double when the amp is operated in the bridged mode. When the FET450 or the FET1000 is operated in mono bridge mode it should not be loaded at less than 8Ω or it may tend to trip the protect system if it is driven at full power.

Locate the "Accessory Switches" on the rear panel of your unit. Remove the plastic cover plate with a screw driver. On the top group of switches, set switch S1-8 to the right. On the lower group of switches, set switch S2-8 to the left. This will put the unit into the bridged mode.

Use CH 1 input only. CH 2 inputs will not be used when the amplifier is in the bridged mode. Remember, the amplifier will be operating in a monaural mode, so only one input is required.

Connect your speaker load to both of the "red" banana jack binding posts. The CH 1 red post will carry the positive amplified signal; the CH 2 red post will carry the negative signal. The black terminals are NOT used.

Connect the input signal to the amplifier. Use the CH 1 input (either XLR or 1/4").

Switch on the amplifier and raise CH 1 gain control to achieve the desired volume.

Note: CH 2 volume control will have no effect on the input signal when the amp is in the bridged mode.

Output Connections

1/4" Phone Plug and Binding Post Speaker Connections: There are two 1/4" phone plugs and one pair of binding post speaker connectors per channel. These two jacks are wired in parallel along with the binding posts. All speaker cables connected to the amp should be unshielded type wire. The binding posts can be used to connect speakers using banana plugs, spade lugs, or stripped (and preferably tinned) wire.

To determine the appropriate gauge of unshielded speaker wire to use for the cable distance use the following chart:

WIRE GAUGE	LENGTH
16 Gauge	Up to 50'
14 Gauge	Up to 100'

The FET Amps can drive almost any speaker load: 32, 16, 8, 4, 2, or even 1Ω! However, you should be aware that below 4Ω the amps are subject to go into protect mode if driven to full power. With loads of 4Ω or higher the amps can be driven to full power continuously without tripping the protect mode.

When you connect two speakers of the same impedance to one channel of the amplifier they will be connected in parallel. In this case the net load on that channel of the amp is half the impedance of either speaker alone. For example, connecting two 8Ω speakers in parallel results in a 4Ω load. Likewise, two 4Ω speakers in parallel gives a 2Ω load.

In general when you are paralleling speakers of different impedances you can utilize the following procedure to determine the net load on the amp:

Procedure for Finding Parallel Impedance: Take the rated impedance of each of the speakers you are using in parallel, whether it is 8, 4, 3, 16 ohms or whatever. Invert these numbers (i.e. make a fraction out of them). For instance, 8 ohms would become 1/8, 4 ohms would become 1/4, etc. Next, add these fractions together. Finally, invert the resulting fraction and divide it out. The result will be the net load impedance for the combination of speakers. The following example is for two 8 ohm speakers connected in parallel:

$$1/8 + 1/8 = 2/8$$

$$\text{Inverted} = 8/2 = 4 \text{ ohms Total Load Impedance}$$

If you have any questions regarding how many speakers you can drive with your amplifier, please feel free to call Carvin.

Speaker Cable

For loudspeaker connections we recommend using cable no lighter than 16 Gauge. The speaker cable must be a non-shielded type as shown below in figure 4-2.

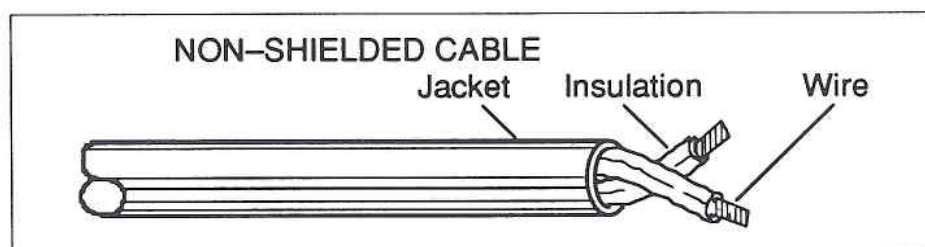


Figure 4-2 Unshielded Speaker Cable

Section
4

Connections to the Amplifier

Input Connections

A.C. Line Connector: The AC line voltage must match the line voltage selected at the rear of the unit (120 or 220 VAC at 50 or 60 Hz). A detachable 3 pin grounded AC line cord is standard equipment on all units shipped within the United States. The color code of the cord is as follows:

- Hot (Switched Leg).....Black
- Neutral.....White
- EARTH (Chassis Ground).....Green w/Yellow Tracer

Balanced XLR Inputs: XLR inputs for each channel are provided on the rear panel of the amplifier. These are balanced differential inputs which will provide a very high degree a common mode noise rejection. If you use input cables that are longer than 30 feet it is recommended that you utilize balanced sends with the balanced inputs on your amp to obtain the best noise performance from your system.

1/4" Phone Jack Inputs: These inputs are "stereo phone plug" or "tip, ring, sleeve" type balanced inputs. They may be used as either balanced or single ended type inputs. If you wish to use them as a 1/4" balanced inputs then use a stereo 1/4" phone plug wired as follows:

- Tip.....Positive Balanced (XLR pin 2)
- Ring.....Negative Balanced (XLR pin 3)
- Sleeve.....Ground (XLR pin 1)

Although the 1/4" inputs are balanced you can also use a standard (single ended, or "two wire") 1/4" phone plug with this input. Any shielded cable (a guitar cord for example) will work fine. Using a single ended input connection will tie pin 3 and pin 1 to ground. This leaves the 1/4" Tip (XLR pin 2) as the positive input signal connection. It is alright to use the XLR input of one channel and the 1/4" input of the other channel. Note that the ground connection of the 1/4" input is not affected by the XLR Ground Lift feature in the accessory group. (see section 3)

Input Connection Cable

For input signal connections we recommend you use shielded type cable as shown in figure 4-1 below.

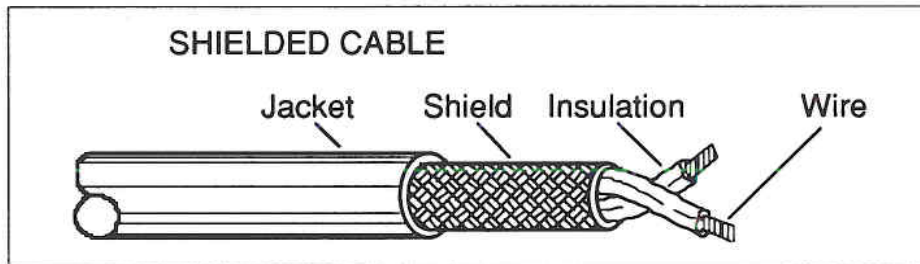


Figure 4-1 Shielded Input Cable

A condensed accessory group switch chart appears on the back panel of the FET1000 and FET450 amplifiers and is reproduced here for reference.

Accessory Group (S1 & S2)

S1 & S2	Function / Mode	Switch Position	
		Left	Right
(-1)	Stereo / Mono Input [S1-1 & S2-1 Left for Stereo Input] [S1-1 & S2-1 Right for Mono Input]		
(-2)	Ground Lift	Lifted	Ground
(-3)	Subsonic Filter	On	Off
(-4)	Ultrasonic Filter	Off	On
(-5)	Compressor On [10%]	Off	On
(-6)	With (-5) On, 25% Power	Off	On
(-7)	With (-5) On, 50% Power	Off	On
(-8)	Stereo / Mono Bridge Mode [S1-8 Left & S2-8 Right for Stereo Output] [S1-8 Right & S2-8 Left for Mono Output]		

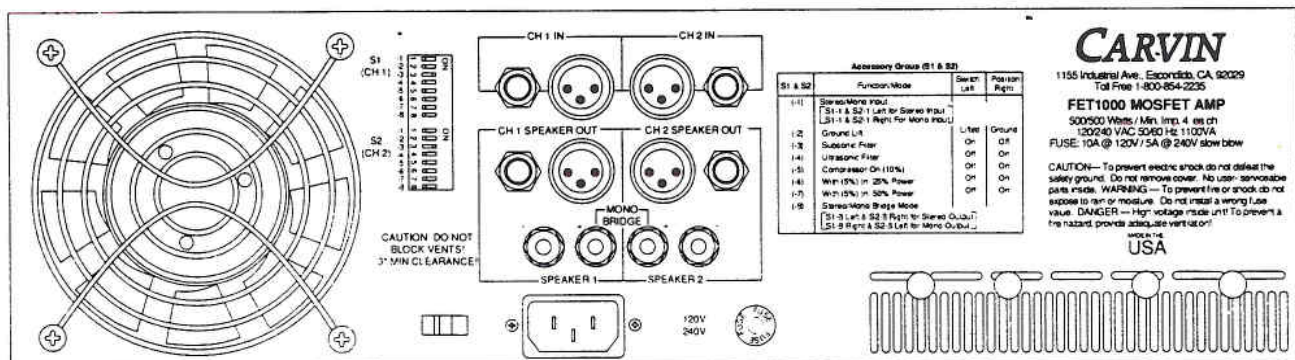


Figure 3-1 FET 1000 Rear Panel

Switch Setting Table

The following table describes the action of the accessory group switches. The switch positions (left or right) are as viewed from the rear of the amp. Where the action of the switch is the same for both channels (-2 through -7) the Channel 1 switch is listed with the channel 2 switch shown in parenthesis beside it.

Switch No.	Position	Function
S1-1 & S2-1	Left	Configures the amp inputs for normal stereo input.
S1-1 & S2-1	Right	Configures the amp inputs for mono "Y" input operation. (CH 1 and CH2 inputs are "Y"ed together) Both switches must be set either left or right.
S1-2 (S2-2)	Left	The CH 1 (CH 2) XLR input ground (pin 1) is lifted (floated).
S1-2 (S2-2)	Right	The CH 1 (CH 2) XLR input ground (pin 1) is grounded.
S1-3 (S2-3)	Left	Turns on the low cut filter for the channel. This switch cuts the bass below 30 Hz.
S1-3 (S2-3)	Right	Turns off the low cut filter for the corresponding channel allowing extended low frequency response.
S1-4 (S2-4)	Left	Turns off the high cut filter for the channel.
S1-4 (S2-4)	Right	Turns on the high cut filter for the channel. The high cut filter attenuates high frequency material above 25k Hz.
S1-5 (S2-5)	Right	This switch activates the compressor circuit for the channel. Setting this switch set to the "ON" position with switches -6, and -7 off provides the maximum level of compression and will limit the average output of the amp to about 10% of rated power by providing up to 10 dB of gain reduction. (ALL OTHER COMPRESSOR SWITCHES OFF)
S1-6 (S2-6)	Right	Switch S1-5 turns the compressor on and switch S1-6 sets the compression threshold to allow about 6 dB of gain reduction. Output power is limited to about 25% of rated power. (S1-7/S2-7 off)
S1-7 (S2-7)	Right	Switch S1-5 turns the compressor on and switch S1-7 sets the compression threshold to allow about 3 dB of gain reduction. Output power is limited to about 50% of rated power. (S1-6/S2-6 off)
S1-8& S2-8	S1-8 LEFT S2-8 RIGHT	This switch configuration provides normal "stereo" operation of the FET amplifier.
S1-8& S2-8	S1-8 RIGHT S2-8 LEFT	This switch configuration will place the amplifier in "mono bridged" mode. (Connect input to CH 1 input and connect speakers between the two red binding post terminals. Use CH 1 Level Control)

**The normal switch settings (as shipped from the factory) are:
S1-3: Right, S2-3: Right and S2-8: Right. All other switches are set Left.**

Professional Accessory Group

The signal processors built into the FET450 and FET1000 amps are controlled by a group of DIP (Dual In-line Package) switches located on the rear panel. In order to access the DIP switches you must first remove the plastic cover. Under the cover are sixteen gold contact switches. The switches are grouped according to the channel that they control. The "S1" group of switches (switches S1-1 through S1-8) controls the functions for CH 1 and the "S2" group (switches S2-1 through S2-8) select the functions for CH 2. Switches -1 and -8 in both the "S1" and "S2" groups must be switched as a pair. Switches S1-1 and S2-1 select the input "Y" connection option while switches S1-8 and S2-8 select either the "Stereo" or "Mono bridged" mode of the amplifier. The remaining switches control the various accessories for each channel and can be operated independently of one another. Always replace the plastic cover over the switch group to assure maximum air cooling.

- S1-1&S2-1 Input "Y" Configuration:** This feature allows the two channels of the amp to be driven from one input. The channels are driven with similar polarity i.e. "in phase".
- S1-2&S2-2 XLR Ground Lift:** Use this switch to float the ground on the XLR input connector when you need to break a ground loop between the mixer and the power amp. This switch does not affect the 1/4" input grounding.
- S1-3&S2-3 The Low Cut Filter:** This switch cuts the bass below 30 Hz. Use it to eliminate subsonic noise during live performances. By attenuating power wasting subsonic energy the low cut filter also helps to conserve amplifier power and reduces woofer cone excursion. We recommend that this switch always be set "ON" for concert/live performances. For studio monitoring applications, you will probably not want to use the low cut filter in order to take advantage of the wide bandwidth of the amplifier.
- S1-4&S2-4 The High Cut Filter:** The high cut filter attenuates high frequency material above 25k Hz. Because of the wide bandwidth of the FET series amplifiers (5 Hz to 80k Hz), it may be prudent to eliminate ultra-sonic frequencies above 25k Hz in live sound situations. This helps protect horn drivers, in particular, from any ultrasonic oscillations that may be generated by gear ahead of the power amps due to "rats nest" cable connections or from less than ideal grounding. In the studio (as a control room monitor amplifier) you may wish to utilize the full bandwidth of the amplifier for the most accurate response possible. For studio monitoring we recommend that you leave both the "low cut" and "high cut" filters in the OFF position.
- S1-5&S2-5 The Compressor:** The action of the compressor is virtually inaudible in normal operation. However, by reducing the volume of peak program levels, the compressor allows increased overall loudness before the onset of audible distortion. Setting the compressor switch (-5) set to the "ON" position with switches -6, and -7 off provides the maximum level of compression and will limit the average output of the amp to about 10% of rated power by providing up to 10 dB of gain reduction. Switching on -6 raises the compressor threshold to allow only about 6 dB of gain reduction. Switching on -7 (with -6 off) raises the compressor threshold even further and allows only about 3 dB of gain reduction. Use of the compressor is recommended for live sound reinforcement.
- S1-8&S2-8 Mono Bridge Mode:** The FET450 and FET1000 can be switched to Mono Bridge mode to allow the two channels to operate as one power amplifier. When switched to the mono mode the FET Amps can deliver the full rated power of both channels into a single load. (see section 4 for more detail on bridging)

Rear Panel Features

A.C. Line Cord Connector: The FET series amplifiers are supplied with a detachable three conductor line cord. This arrangement (line with safety ground) greatly reduce the possibility of electrical shock when used with three conductor outlets.

NEVER ATTEMPT TO DEFEAT THE GROUND PIN OF THE A.C. LINE CORD!

A.C. Line Fuse: The FET series amplifiers utilize standard fuses with the following values:

FET 450	5 Amp Slow Blow, Type 3 AGC
FET 1000	10 Amp Slow Blow, Type 3 AGC

These are standard fuses and may be purchased from a local vendor. Never attempt to bypass or defeat the fuse. If you are consistently blowing A.C. main fuses you should consult the warranty service section of this manual.

120/240 VAC Line Switch: This switch is located beside the A.C. line cord. BE SURE THIS SWITCH IS SET TO CORRESPOND TO YOUR LOCAL LINE VOLTAGE BEFORE YOU APPLY POWER TO THE AMPLIFIER. Should you need to change the line voltage setting then slide the switch to the opposite setting. The line voltage selected is indicated by the number (120 or 240) on the switch slider.

Output Connectors: CH 1 and CH 2 speaker outputs feature two 1/4" phone plugs (wired in parallel). This allows you to connect two speaker systems to each channel of the amplifier. In addition to the two 1/4" phone jack outputs, each channel also has gold-plated binding post banana jacks. (We recommend using the binding post/banana jacks whenever possible due to the very high reliability of this connector in high current applications.) The red terminal is the positive terminal and black terminal is ground. (See "Bridging the Amp" for additional discussion of the Banana jacks.")

Input Connectors: The amplifier will accept a balanced line input at either the XLR connector or the 1/4" phone jack. The XLR connector wiring is as follows:

- Pin 1: Ground
- Pin 2: Positive Bal.
- Pin 3: Negative Bal.

The balanced input stage of the FET amps use a transformerless differential amplifier designed to accept balanced or unbalanced input signals from low impedance sources. This "transformerless" design offers superior THD and frequency response over conventional inputs. The balanced inputs offer better than 90 dB rejection of common mode noise. Even very long cable runs with balanced lines will result in excellent low noise performance.

The 1/4" phone jack input located to the side of the XLR connector is a "stereo 1/4" phone jack." This allows for balanced 1/4" phone plug inputs. The wiring of this connector is as follows:

- Shield: Ground
- Tip: Pin 2 Positive Bal.
- Ring: Pin 3 Negative Bal.

The Protect LED: The protect light illuminates whenever the FET Amp's internal SpeakerGuard™ protection circuitry is engaged. There are three conditions that will activate the SpeakerGuard™ protection circuits:

Reasons for the Protect LED to be on:

1. A Short at the Output

Shorted speaker cables are the most common cause of this problem. Even a momentary short will trip the protect circuit. Check the speaker cables at both ends and repair or replace any questionable cables. Then reset the amp by turning it off for about 3 seconds and then back on. If the light does not go out when you cycle the power off and on then the amp is in thermal shutdown.

2. Excessive Current Draw from the Amplifier

This could be the result of operating the amp at very high levels into a speaker load less than 4Ω . Reset the amp by turning it off and then back on. If the light does not go out when you cycle the power off and on then the amp is in thermal shutdown.

3. Thermal Shutdown

This could be the result of blocked intake vents for the fan cooling system or could result from operating the amp at very high levels into a speaker load less than 4Ω . Clear any vent obstructions and wait for the amp to cool down (leave the power on to keep the fan running). After a few minutes reset the amp by turning it off and then back on.

If the protect light remains on after allowing the amp to cool and powering the amp off and on, then shut the amplifier down, unplug the speakers, and turn the amp back on to see if the fault has cleared. If the protect light remains on then disconnect the input signal and check for the protect light again. If the protect light still comes on even after allowing the amp to cool down, and with no speakers connected and no input connected, then the amp needs servicing.

Rack Mounting: The FET series amplifiers are packaged in a standard three space 5 1/4" rack mount chassis. When rack mounting the amplifier be sure to allow for adequate ventilation at the rear of the amp. Each FET amplifier features contoured handles for carrying and mounting the amplifier. The rack handles are used to mount the front panel of the amplifier to the sub-chassis and therefore should not be removed.

Front Panel Features

Power Switch: Rocking the power switch "Up" will apply power to the FET amp. The red LED power "PWR" indicator light will illuminate to indicate that the amplifier is powered. The turn on "mute" circuitry will engage immediately upon applying power to your unit. This will delay the connection to the speakers by approximately three seconds. The turn on delay allows the amp and any associated gear time to stabilize before the amp is connected to the speakers. This professional feature protects the speakers from any high level transients that might appear at the amp's input due to "turn on" transients in equipment feeding the amp.

CH 1 and CH 2 Input Level Controls: These precision (41 step) input level attenuators are carefully calibrated to allow the operator to adjust the sensitivity of the power amp to match the output level of nearly any mixer or pre-amp . These controls do not limit the amp's output power, and maximum output levels can be achieved at any setting above -10dB (12 O'clock). You can find the best gain control setting as follows:

- A. For normal operation set the FET amplifier level controls at -10dB (knob marker straight up).
- B. Adjust the mixer or pre-amp output gain controls to set the desired sound level.
- C. If you wish to operate the mixer/pre-amp at a higher output level, then reduce the settings of the input attenuators a few dB and check the mixer/pre-amp sound level again.
- D. If you wish to operate the mixer/pre-amp at a lower output level, then increase the settings of the input attenuators a few dB and check the mixer/pre-amp sound level again.

Note: If distortion should occur before the red peak indicators light, then try reducing the gain of the mixer/pre-amp and increasing the input level setting of the FET amplifier to -10 dB or higher.

The maximum input level on all FET models is:

Balanced+15 dBV
Unbalanced.....+15 dBV

LED Status Indicators: At the left of the Input Level Attenuator for each channel are a pair of LED's that indicate the signal status of the channel. The green "Signal" LED indicates when a -30 dB signal is present at the output (post level). The red "Clip" LED indicates precisely when clipping (distortion) starts to occur. These indicators monitor the circuits of the amplifier and provide an accurate indication of signal presence and any overloading. If the red clip indicators are lighting, you should turn down either the mixer/pre-amp output level, or the input level at the amplifier until the light just stops flashing (occasional flashing is OK as low level clipping distortion is rarely audible). The clipping indicators feature a special peak hold circuit that will provide a bright indication for even momentary clipping. **NOTE:** Continual flashing of the red clip indicators will not damage the amp but may be harmful to the speakers because of the excess high frequency energy generated at clipping.

Carvin utilizes only premium grade components in the construction of the FET amplifiers. All components are screened by quality control checks during assembly, bench testing, and final testing.

Carvin uses a special computer test system (ATE) to perform over 100 diagnostic tests on every FET amp before it leaves production. This includes output power, protection systems, THD, slew rate, and a host of other performance tests. In addition to this computerized testing, each unit is stress tested and undergoes an 8 hour burn-in period. Carvin's goal is to ensure you of quality without compromise.

Although the FET series amplifiers are designed to handle loads and endure conditions that home high fidelity amplifiers are not designed for, the FET amplifier's specifications and sonic performance typically exceed even the best hi-fi amps. Consequently the FET Series amps are an excellent choice for critical listening requirements such as recording studio control room monitor amplifiers or very high quality home stereo systems. Many of Carvin's artist endorsers have switched to FET Series amps for use on stage after hearing the amps auditioned in their rack systems. These amps excel at reproducing the fine musical nuances of all program material but especially the rich dynamics of live sound.

The extremely rugged construction of the FET amplifiers allows them to tolerate the severe demands of road use with touring sound systems. The chassis is constructed with heavy 14 gauge steel side panels and with a standard 19" x 5 1/4" front rack panel milled from .187" thick aluminum. It is finished in a durable brushed black anodize process. All circuit boards are the highest quality epoxy fiberglass with moisture-proof epoxy overplating. Only the highest quality (factory inspected) electronic components are used. These amps are rugged and are built to last!

As you read through the front and rear panel features you will find even more examples of Carvin's uncompromising approach to designing the FET series amplifiers. The superior sonic quality and reliability of the Carvin FET series amplifiers coupled with *Factory Direct* sales enables Carvin to offer the FET series amplifiers at a competitive price.....while providing superior performance.

Speaker protection by the virtue of the MOSFET's negative temperature coefficient becomes a built in safety feature. However, Carvin has taken the FET Amp series one step further by incorporating our exclusive SpeakerGuard™ protection circuit that automatically removes any potentially damaging voltages from the speaker. Special high speed circuitry assures immediate disconnection of the load when a fault is detected. SpeakerGuard™ represents the best possible protection against speaker damage.

Notable Advantages of the FET Series Amps

We have discussed how MOSFET devices offer many significant advantages over conventional bipolar transistors. However, in addition to the advantages provided by the MOSFET devices themselves, the FET Series amps include innovations that further distinguish them as truly innovative even when compared to other high quality MOSFET amplifiers. Following are some of the engineering features that are incorporated into each FET series amplifier. They further ensure that you will receive performance without compromise from your new Carvin amplifier.

Each FET amp is designed to perform well beyond the requirements of FTC power ratings. The FTC ratings specify very harsh operating conditions for home Hi-Fi amplifiers, but in our opinion are not tough enough to guarantee long term reliability for pro-sound applications. So we established more stringent test conditions for specifying output power ratings. We push the amps harder, and insist that they maintain adequate safety margins even when operated at extreme temperatures (such as might be encountered in a hot amp rack at a summer daytime concert). We also insist that the amplifiers operate continuously under heavy loads without reduced performance with respect to distortion.

The FET series amplifiers feature heavy-duty linear power supplies with high current transformers and filters. The combination of these heavy duty power supplies with an extremely high current output amplifier allows these amps to drive low impedance loads without thermal stress. Carvin elected to use a linear power supply with massive iron core transformers instead of a "lighter" switching power supply because of the simplicity and reliability that a linear supply provides. These power supplies provide plenty of reserve energy for massive power bursts on low frequency transients. The output current capability of the FET amps is exceptional. Normally the FET 1000 amplifiers will deliver a continuous current of 23 amps when both channels are driven at full power into 4 ohm loads. However, the MOSFET devices used in the FET 1000 can safely deliver as much as 138 amps continuously.

The FET series amplifiers are also short circuit protected. Shorted speaker cables (or intermittent shorts in cables) can kill some amplifiers but the FET series amplifiers will simply disconnect themselves from the load if a short exists. In order to resume operation just correct the cause of the short and turn the amp off for a few seconds and then back on.

All FET amplifiers feature "turn on muting." This circuit mutes the output of the amplifier for approximately three seconds after the power is applied to the unit. This allows the amplifier (as well as gear feeding the amp) to stabilize before the output is connected to the speakers.

FET amplifiers feature a thermally controlled fan. This circuit is unique in that it provides a continuously variable fan speed which responds according to the temperature of the unit. This means that as the amp is used, the fan speed will change smoothly to provide just the air flow required for the load, level and temperature conditions. This eliminates any thermal shock (as with fans that "switch on") and maintains the lowest fan setting that will meet cooling requirements. **CAUTION: NEVER BLOCK INTAKE OR EXHAUST VENTS--KEEP A 3" MINIMUM CLEARANCE!** Note: The advanced electronic fan speed control may not start the fan until the unit is warm. It is normal to hear a low level mechanical hum before the fan starts.

Section
3

About the FET Series Amps

The primary considerations in the design of our new FET series amplifier were performance and reliability. The FET series amplifiers are designed using the latest generation MOSFET's (Metal Oxide Silicon Field Effects Transistor). These devices have a wide degree of thermal protection and inherent stability. They offer significant advantages in performance and reliability compared to conventional bipolar transistor technology. These devices coupled with Carvin's advanced computer aided design and test systems have allowed us to incorporate unique new circuits that exploit the MOSFET's advantages. The combination of intelligent engineering and manufacturing have allowed the FET series amplifiers to achieve a competitive edge in performance when compared to other amplifiers. The following information will help you become more familiar with the advantages of MOSFET technology and your new FET series Carvin amplifier.

Why MOSFETs?

Carvin's MOSFET amps use a third generation MOSFET device quite different from transistors. These devices have a very high input impedance and, because of their high speed, cover an exceptionally wide frequency range. The net result of the MOSFET's extended frequency range is an amplifier with more transparent sound. The device's high speed also translates into improved "slew rate" performance. In many ways these MOSFETs resemble high impedance tubes but without the drawbacks of tubes. Don't be surprised if you hear a definite sonic improvement in your system when you switch to the Carvin FET series amps.

MOSFET's exhibit properties of "self protection" from thermal stress. They offer high current capacity for increased reliability and quick response to high level transients. They are inherently more reliable than bipolar transistors for several reasons.

Conventional bipolar transistors have a positive temperature coefficient. This means that as the device heats up its internal impedance decreases and the device tends to conduct more current...which heats the device more...etc. The result of this cycle of increasing temperature followed by increasing current is "thermal runaway". When transistors are used in parallel (as in most high power amps) this can lead to "current hogging" where the one hottest transistor tries to carry the entire load of the amplifier. Because of this characteristic amplifiers using bipolar transistors must be carefully compensated to control thermal runaway. This can result in compromised audio performance at best. At worst it can result in amp failure.

MOSFET's have a negative temperature coefficient. This means that as a device heats up its internal impedance increases and the device becomes more resistive to current flow. MOSFETs effectively distribute the current demand among all the output devices. The result is an even temperature distribution among the devices and the elimination of problems associated with "thermal runaway" and "current hogging".

Section

2

Introduction

This manual is designed to give an overview of the features and performance of Carvin's professional MOSFET amplifier line. Each of the "FET" series amplifiers (the FET450 and FET1000) has the same front and rear panel features. They differ from each other only in output power and technical specifications. This manual describes the features common to each amplifier, as well as the differences in power and specifications.

This manual will deal with features, set-up, connections (input & output), special uses and full service (technical) information about the FET series amps. There are several user oriented illustrations that should help you understand the capabilities and applications of the amps.

We hope that the information presented here will help you become acquainted with the capabilities and features of the Carvin FET series amps. A careful reading of the manual will ensure the best possible performance and enjoyment. If you have any questions regarding the operation of your new amplifier that are not covered in this manual, please call our toll-free number and our sales and engineering staff will be happy to assist you.

Questions? Call Toll Free: 800-854-2235

FEATURES of the FET Series Amps

- Professional Reliability
- Superior Sonic Performance
- Fully Complementary Output Stages
- Heavy-Duty Linear Power Supplies
- Variable Speed Electronic Fan Controller for Quiet Operation (FET 1000)
- Professional Accessory Group:
 - * Limiters with Three Adjustable Levels (each channel)
 - * Hi Cut and Lo Cut Filters (each channel)
 - * Input "Y" Switching
 - * Input Ground Lifting (each channel)
 - * Mono Bridge Mode Switching
- LED Status Indicators for Signal, Clipping, Power and Protect
- Advanced Protection Systems with *SpeakerGuard™*
- Balanced and Unbalanced Inputs
- 41 Step (1/2 dB) Input Level Attenuators
- Sound Reinforcement, Recording, and Hi-Fi Applications
- The Carvin Commitment to Excellence

About the CLIP LED Indicator

The "CLIP" LED indicates when the amp is starting to distort. Occasional flashing of this LED is alright. However, long frequent flashing should be avoided because speakers and horn drivers may be damaged by the "square wave" power associated with clipping.

About SpeakerGuard™

The SpeakerGuard™ system has three protection functions. It's important that these functions be understood should the "PROTECT" LED come on and the amp go into "Protect Mode". When the Protect Mode is triggered it causes the output relay to disconnect the amp from the load until the amp is reset. The SpeakerGuard™ system protects both the speakers and the amp from fault conditions.

1. The first protection mode is against shorted speaker cables. If the speaker outputs should ever short while a signal is present at the output, the SpeakerGuard™ "Protect" relay will disconnect the speakers from the output of the power amp protecting the speakers and the amp from any damage.
2. The second protection mode is for excess load current drawn from the speaker outputs. The FET Amp is designed to deliver its full rated power into 4Ω loads without the Protect Relay engaging. However, SpeakerGuard™ may engage if the amp is driven to full power when loaded below 4Ω. The FET Amps can be used to drive 2Ω, or even 1Ω loads, but only at output levels less than full power.
3. The third protection mode is temperature related. The "Protect" LED will come on if the amp approaches its maximum operating temperature. This SpeakerGuard™ protection mode may be triggered by blocked fan vents, excessively warm air going into the fan vents (if rack mounting, be sure the rack is well ventilated), or the amp is driven hard into a load below 4Ω.

Resetting the SpeakerGuard™ System

If the FET Amp does go into the protect mode because of an excessive load (current), simply turn the amp off, wait for 3 seconds, and then turn the amp on. The Protect LED will go off and the amp will be ready to function. If the amp does not come on then it has tripped due to thermal shutdown.

If the amp "protects" due to thermal shutdown, then leave the amp on and wait for the fan to cool the amp down. This generally takes about 3 to 5 minutes. After the amp cools down, turn the amp off for about 3 seconds and turn it back on. The amp should now be ready to function.

It's important to know that if your amp should ever go into "Protect Mode" it does not harm the amp in any way. In fact, the amp was cycled through the "Protect Mode" several times at the factory as part of Carvin's quality assurance program.

CAUTION: To prevent electric shock, do not attempt to defeat the line cord safety ground!

WARNING: To prevent fire or shock hazards, never expose the unit to rain, moisture, or explosive atmosphere! Do not use an incorrect fuse or the wrong value fuse!

Caution!
Do not allow the rear fan vents to become blocked!
Always Allow a 3" Minimum Clearance!!

Section

1

Getting Started Quickly

If you're like most new owners, you're probably in a hurry to plug in your FET Amp and use it. Here are some brief instructions to get you going quickly. However, we recommend that you read the complete manual as soon as you can in order to get the most benefit from the professional features of the FET Amp.

Connecting AC Power to the FET Amp

- ◆ Check to see that the setting of the AC Line Voltage Switch on the rear panel matches your local line voltage. If your local line voltage is not 120 VAC it will be necessary to change the switch setting as well as the line fuse.
- ◆ Use only a grounded (3 prong) power outlet to avoid any shock hazard.

Connecting the Loudspeakers

- ◆ Use either the 1/4" speaker jacks or the Red and Black speaker binding posts to connect the speakers. Make sure all your speakers are wired "in phase" with each other (positive and negative speaker terminals connected the same for all speakers). The Red binding post is the positive connection. Use only Heavy-Duty speaker cables (16 ga for 50', 14 ga for 100').

NOTE: Never run your speakers through microphone wire or multi-conductor microphone junction boxes or "snakes". This wire is normally a very light (20 gauge) and causes a substantial loss of power through the cable for less power to your speakers. All speaker wires must be non-shielded.

Input Connections to the FET Amp

- ◆ Connect the output from line level balanced sources into the balanced XLR inputs at the rear of the FET Amp. Use a 3 conductor shielded cable.
- ◆ For line level non-balanced sources, plug into the 1/4" input jacks on the rear panel. Use a 2 conductor shielded cable.

NOTE: The 1/4" input jacks on the FET 1000 and FET450 take either balanced (tip, ring, sleeve) or unbalanced inputs. The electronically balanced input stage will accept either signal.

Turn On Sequence

- ◆ Power up all gear feeding the power amp (mixer, signal processors, etc.)
- ◆ Set the level controls on the FET Amp all the way down (∞).
- ◆ Turn the amp on and slowly raise the level controls to the desired setting.

For the New Owner

Congratulations on your selection of a Carvin FET Series power amplifier. Your new FET Series amp is an example of Carvin's commitment to quality and to producing the most sophisticated audio products available today. The wide acceptance and use of our products by audio professionals and professional musicians illustrates the basis for Carvin's recognition as "The Professional's Choice."

Professionalism is measured by the results people achieve through their knowledge and efforts. It is not something that automatically happens when buying a new or more sophisticated product. Rather, it's what you do with the equipment and how well you do it that ultimately makes the point. We are certain your new Carvin amp will deliver the performance necessary for you to achieve solid results, and ultimately enjoy a high degree of professional achievement and enjoyment.

We have included this manual to help you acquire the knowledge you need to make full use of the product. All of the information you need to be up and running is right here! You'll find using this manual easy and convenient. We've attempted to present the technical aspects of the amplifier accurately and in "plain english". But, if you have any questions that are not answered here, please call us at our toll free number. Our sales staff is well versed in the technical aspects of our products and will be pleased to assist you with any questions you may have. We sincerely wish to ensure your complete satisfaction with your new product.

If you would like to comment on features or performance of your new amp, please feel free to contact us. Comments and criticism from our customers help us improve our products and our service. We sincerely welcome any comments or ideas you may have.

Please, send in the warranty card. It will insure that your purchase is recorded in our files and will allow us to know how you are using the equipment. Sending in the warranty card also helps us to mail out literature that may be of interest to you as a musician or audio professional. Let us know where you are so we can keep in touch!

May you enjoy many years of success, and creative fun with your new Carvin amplifier!

Carvin's national toll free number: 800-854-2235

Receiving Inspection

Inspect the Amp for any damage which may have occurred during shipping. If any damage is found, notify the shipping company and call CARVIN immediately.

Save the carton and all packaging materials. In the event you have to reship your amp, always use the original carton and packing material. This will provide the best possible protection for your unit during shipment. CARVIN and the shipping company are not liable for any damage caused by improper packing. A replacement carton is available for \$5 plus \$5 shipping.

Save the invoice. It will be required for warranty servicing of your unit. Always check your invoice against the items you have received.

Shipment Shortage: If you find items missing, it may be that they were shipped separately. Please allow several days for the rest of your order to arrive before inquiring. If you determine (after allowing an appropriate amount of time) you have not received all the items you ordered, please call CARVIN.