THE PROFESSIONAL AUDIO DIVISION OF CROWN INTERNATIONAL, INC.

Exported to select countries as Amcron.

MACRO REFERENCE

STUDIO REFERENCE AMPLIFIER

OWNER'S MANUAL

P.O. Box 1000, Elkhart, IN 46515
Telephone: 219-294-8000

Printed on recycled paper.

K80570-3
2/94

WORLDWIDE THREE YEAR FULL WARRANTY

SUMMARY OF WARRANTY

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown[1] product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship, and we further warrant the new Crown product regardless of the reason for failure, except as excluded in this Crown Warranty.

[1] *Note: If your unit bears the name "Amcron," please substitute it for the name "Crown" in this warranty.*

ITEMS EXCLUDED FROM THIS CROWN WARRANTY

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

WHAT THE WARRANTOR WILL DO

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers. We will remedy the defect and ship the product from the service center within a reasonable time after receipt of the defective product at our authorized service center. All expenses in remedying the defect, including surface shipping costs to the nearest authorized service center, will be borne by us. (You must bear the expense of all taxes, duties and other customs fees when transporting the product.)

HOW TO OBTAIN WARRANTY SERVICE

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by our authorized service center. If the repairs made by our authorized service center are not satisfactory, notify our authorized service center immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.

9/90

Telephone: 219-294-8200. Facsimile: 219-294-8301

NORTH AMERICAN SIX YEAR FULL WARRANTY

SUMMARY OF WARRANTY

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown product, for a period of six (6) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship. We further warrant the new Crown product regardless of the reason for failure, except as excluded in this Warranty.

ITEMS EXCLUDED FROM THIS CROWN WARRANTY

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

WHAT THE WARRANTOR WILL DO

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at the factory. We will remedy the defect and ship the product from the service center or our factory within a reasonable time after receipt of the defective product at our authorized service center or our factory. All expenses in remedying the defect, including surface shipping costs in the United States, will be borne by us. (You must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack, which, if needed, may be obtained from us free of charge. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by us or our authorized service center. If the repairs made by us or our authorized service center are not satisfactory, notify us or our authorized service center immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT. **SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.**

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

THIS CROWN WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.

9/90

Telephone: 219-294-8200. Facsimile: 219-294-8301

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If your unit bears the name "Amcron," please substitute it for the name "Crown" in this manual. If you need special assistance beyond the scope of this manual, please contact our Technical Support Group.

Crown Audio Division Technical Support Group
57620 C.R. 105, Elkhart, Indiana 46517 U.S.A.
Phone: **800-342-6939** (U.S.A.) or 219-294-8200 Fax: 219-294-8301

IMPORTANT

THE MACRO REFERENCE REQUIRES CLASS 1 OUTPUT WIRING.

CAUTION
RISK OF ELECTRIC SHOCK
DO NOT OPEN

TO PREVENT ELECTRIC SHOCK DO NOT REMOVE TOP OR BOTTOM COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. DISCONNECT POWER CORD BEFORE REMOVING REAR INPUT MODULE TO ACCESS GAIN SWITCH.

AVIS
RISQUE DE CHOC ÉLECTRIQUE
N'OUVREZ PAS

À PRÉVENIR LE CHOC ÉLECTRIQUE N'ENLEVEZ PAS LES COUVERTURES. RIEN DES PARTIES UTILES À L'INTÉRIEUR. DÉBRANCHER LA BORNE AVANT D'OUVRIR LA MODULE EN ARRIÈRE.

WARNING

TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE!

Magnetic Field

CAUTION! Do not locate sensitive high-gain equipment such as preamplifiers or tape decks directly above or below the unit. Because this amplifier has a high power density, it has a strong magnetic field which can induce hum into unshielded devices that are located nearby. The field is strongest just above and below the unit.

If an equipment rack is used, we recommend locating the amplifier(s) in the bottom of the rack and the preamplifier or other sensitive equipment at the top.

WATCH FOR THESE SYMBOLS:

The lightning bolt triangle is used to alert the user to the risk of electric shock.

The exclamation point triangle is used to alert the user to important operating or maintenance instructions.

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ILLUSTRATIONS

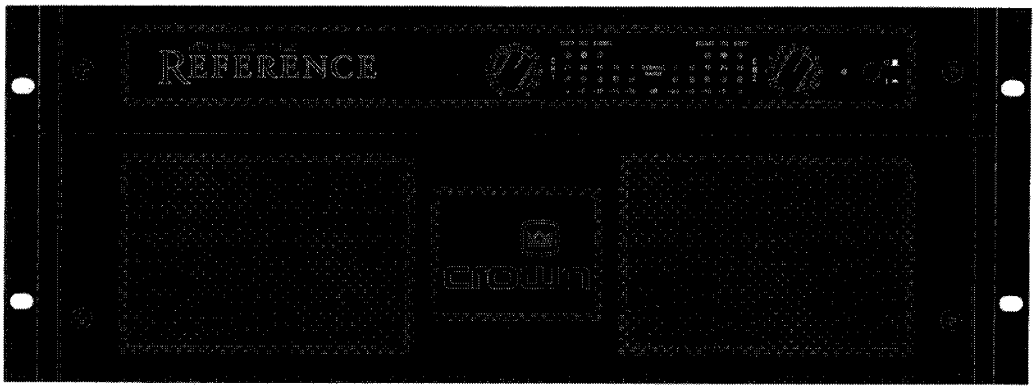


Fig. 1.1 Macro Reference Amplifier with Engraved Electroluminescent Front Panel

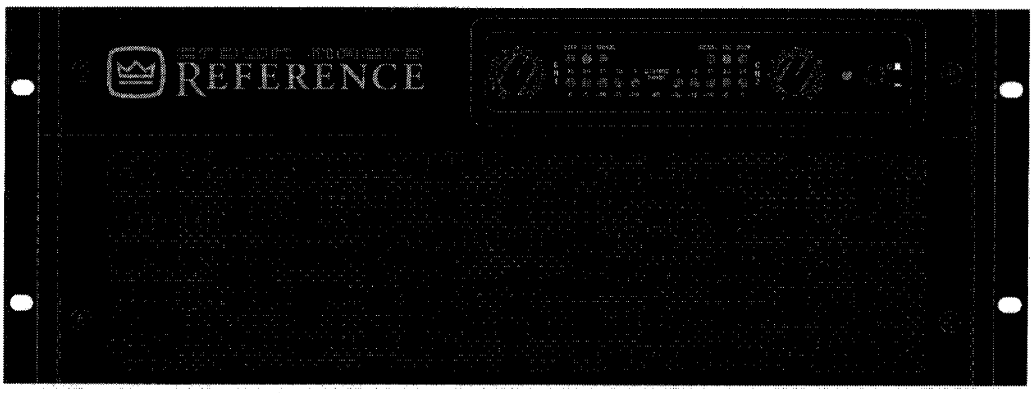


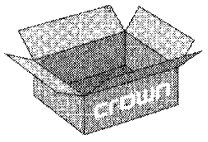
Fig. 1.2 Macro Reference Amplifier with Steel Front Panel

1 Welcome

The stunning realism of the *Macro Reference*™ attests to its technical excellence. It has a dynamic range in excess of 120 dB!—more than enough dynamic range to faithfully reproduce a 20-bit digitally recorded audio signal.

At the heart of the *Macro Reference* is a tightly damped, high-excursion circuit design so advanced it can adapt to match the instantaneous demands of any audio signal. It has the highest dynamic transfer function available, making it the closest thing to a "straight wire with gain" ever created. Superior motion control of loudspeakers is achieved with the ultra-high damping control of its outputs, producing deeper, tighter bass. Low-frequency transient response must be heard to be fully appreciated. Great care has been taken with the routing of each wire, the layout of each circuit board, and the selection of each component. As a result, its sonic integrity is without peer.

This manual will help you successfully install and use your new amplifier. Please read all the instructions, warnings and cautions contained within—especially Sections 3.3.2 and 3.3.3 if you plan to use one of the two mono modes. For your protection, please send in your warranty registration card today and save your bill of sale since it is your **official proof of purchase**.



1.1 Unpacking

Please unpack and inspect the amplifier for any damage that may have occurred during transit. If damage is found, notify the transportation company immediately. Only you, the consignee, may initiate a claim for shipping damage. Crown will be happy to cooperate as needed. Save the shipping carton as evidence of damage for the shipper's inspection.

Important: Please save all packing materials in case you need to transport the unit. **NEVER SHIP THE UNIT WITHOUT THE FACTORY PACK.**

1.2 Features

This amplifier uses advanced technology to provide the most accurate reference amplifier available. Its patented *grounded bridge*™ circuitry offers many advantages over conventional designs. In Stereo mode each channel can be treated as a separate amplifier because of its separate high voltage power supply and ultra-low crosstalk specifications. Features:

- ❑ Crown's patented *grounded bridge* circuitry generates incredible voltage swings while avoiding the stressful output configurations common to conventional amplifiers. The result: lower distortion and superior reliability.
- ❑ Patented *ODEP* (Output Device Emulation Protection) circuitry compensates for overheating and overload to keep the amplifier working long after others would fail.
- ❑ *IOC*® (Input/Output Comparator) circuitry immediately alerts of any distortion exceeding 0.05%, providing dynamic *proof of performance.*
- ❑ *P.I.P.* (Programmable Input Processor) connector accepts accessories that tailor your amplifier to suit individual applications.
- ❑ Super low harmonic and intermodulation distortion give best *dynamic transfer function* in the industry.
- ❑ Extremely wide dynamic range capable of reproducing the dynamic range of a 20-bit digitally recorded audio signal.
- ❑ Ultra-high damping factor provides superior low-frequency motion control of loudspeakers for accurate, tight bass response.
- ❑ High voltage and high current headroom provide high energy reserves to easily drive even low impedance or highly reactive loads to full power.
- ❑ Two mono modes (Bridge-Mono and Parallel-Mono) for driving a wide range of load impedances.
- ❑ Full protection against shorted outputs, open circuits, mismatched loads, general overheating, and high frequency overloads; loudspeaker protection against low frequency and DC output; full fault protection and overvoltage protection.
- ❑ Two front panels are available: A deluxe engraved front panel with electroluminescent backlighting (Figure 1.1) or a standard steel front panel (Figure 1.2) for rugged applications. Both include an *ODEP*, *IOC* and Signal Presence indicator and a Dynamic Range/Level meter for each channel as well as an Enable Indicator.
- ❑ Efficient heat sinks and a self-contained, on-demand, infinitely-variable forced air cooling system prevents overheating and prolongs component life.
- ❑ Balanced inputs with internal 3-position sensitivity switch and adjustable front-panel level controls.
- ❑ Ground lift switch to isolate chassis and audio grounds.
- ❑ Two pair of 5-way binding posts for each channel provide versatile output connection.
- ❑ Custom designed, tape-wound, low-noise toroidal supply with extremely high power density.
- ❑ Rack mountable in a standard 19 inch (48.3 cm) equipment rack (the rear must be supported). Multiple units can be stacked on top of each other.

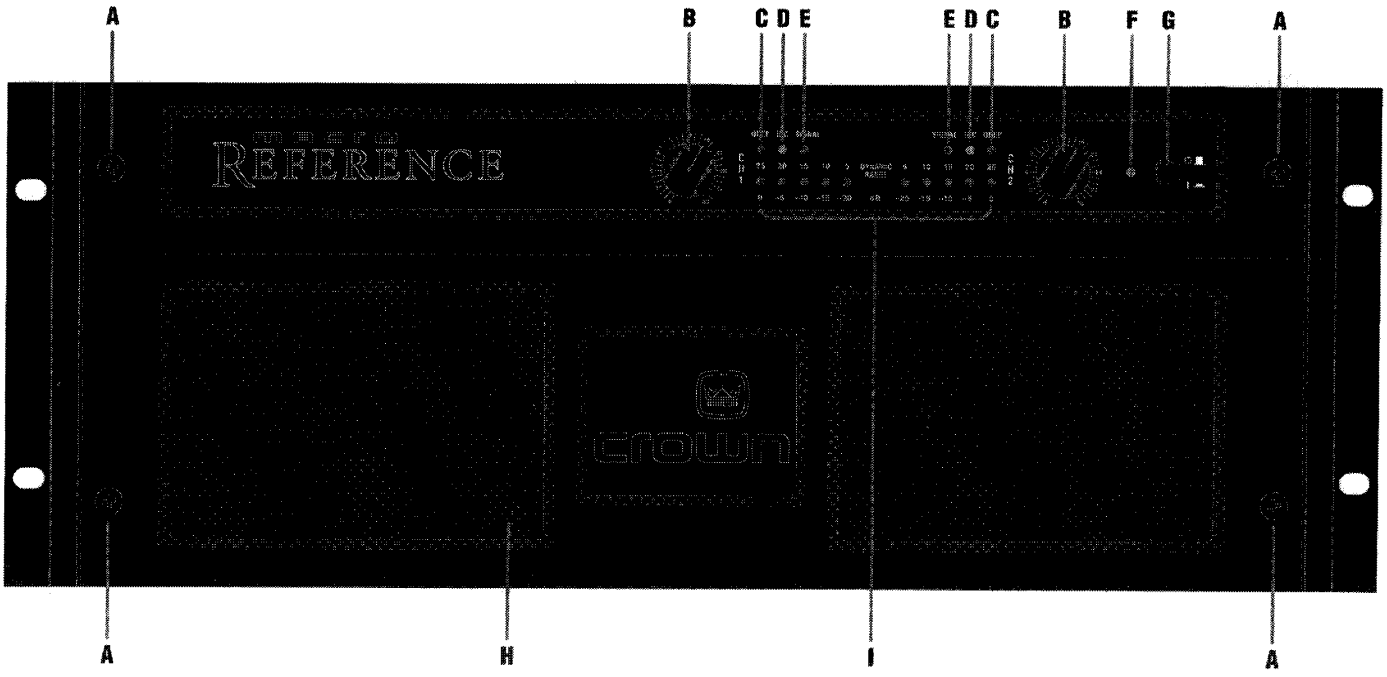


Fig. 2.1 Front Facilities

2 Facilities

A. Front Panel Access Screws

Remove these four screws to remove the front panel to clean the dust filter(s) or adjust the meter mode switch. See Sections 4.4 and 4.5.

B. Level Controls

The level of each channel is set with these convenient level controls. Each one has 31 detents for precise adjustment. See Section 4.4.

C. *ODEP* Indicators

The *ODEP* indicators glow brightly to confirm the normal operation of the Output Device Emulation Protection circuitry and the presence of reserve thermal-dynamic energy. They proportionally dim as the energy reserve decreases. In the rare event there is no reserve, the indicators will turn off and *ODEP* will proportionally limit the drive level of the output stages so the amplifier can continue to operate safely even when the operating conditions are severe. The indicators also turn off if the high voltage power supplies are in "standby" mode. See Section 4.2.

D. *IOC* Indicators

The total distortion level of each channel is monitored by the Input/Output Comparators. They compare the waveform of the input signal to that of the output and they flash brightly with a 0.1 second hold delay if there is a difference of 0.05% or more. This function is provided as proof of performance. Another *IOC* function is to indicate input overload. If the input signal is too large the indicators will flash brightly with a 0.5 second hold delay to indicate input clipping distortion. *Note: The Channel 2 IOC indicator stays on in Parallel-Mono mode.* See Section 4.2.

E. Signal Presence Indicators

The presence of an audio signal is confirmed by these indicators which flash synchronously with it. *Note: They may not flash if the level is low.* See Section 4.2.

F. Enable Indicator

This indicator lights when the amplifier is turned on ("enabled") and AC power is present. See Section 4.2.

G. Enable Switch

Depress this push-button to turn the amplifier on or off. When turned on, the output is muted for approximately four seconds to protect your system from start-up transients. (This delay can be changed. Contact the Crown Technical Support Group for details.)

H. Dust Filter

The air drawn inside the amplifier is filtered by the dust filter(s) mounted behind the front panel. Because the fan rarely needs to run, they seldom become dirty. They can be cleaned with mild detergent if they do.

I. Dynamic Range / Level Meter

A five-segment output meter is provided for each channel. It is set as a dynamic range meter at the factory and shows the dynamic range in dB. (It computes dynamic range as the ratio of the peak to average power level.) The meter can also be switched to an output level meter. As a level meter it displays the output power rela-

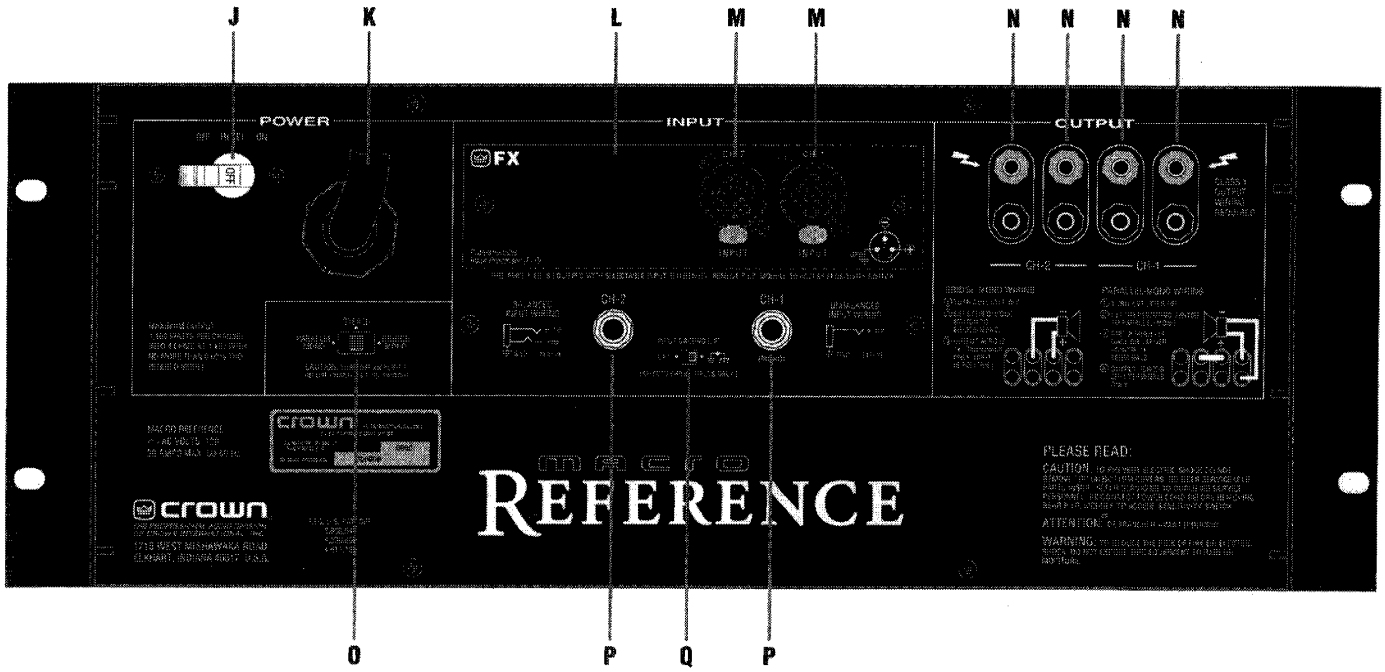


Fig. 2.2 Rear Facilities

tive to full power. For example, at 0 dB the output power would be 760 watts per channel while driving 8 ohm loads. See Section 4.2.

J. Reset Switch

A circuit breaker, located on the rear panel, serves as a reset switch to protect the power supplies.

K. Power Cord

An appropriate power cord and grounded AC plug are provided for the AC system for which your unit is rated.

L. *P.I.P.* Module

A variety of versatile Programmable Input Processor modules are available for your amplifier. They add features that can customize the amplifier for different applications. A standard P.I.P.-FX is included to provide balanced XLR inputs. *P.I.P.* input connectors are connected in parallel with the input phone jacks (P). Because the P.I.P.-FX has no circuitry, its XLR connectors can be used along with the phone jacks to "daisy chain" a single source. See Section 9.

M. Balanced XLR Inputs

A balanced 3-pin female XLR connector is provided at the input of each channel of the P.I.P.-FX which comes as a standard feature of your amplifier. The P.I.P.-FX places the XLR inputs in parallel with the phone jacks.

Do NOT use the Ch. 2 inputs in either mono mode.

N. Output Jacks

Two pair of versatile 5-way binding posts are provided for each channel for easy connection of multiple loudspeakers to each output. They accept banana plugs (the preferred connector), bare wire or spade lugs.

O. Stereo-Mono Switch

The three operating modes of this amplifier are controlled by this switch. Stereo mode is used for normal two-channel operation. Bridge-Mono mode is used to drive a mono load with an impedance of 4 ohms or more. Parallel-Mono mode is used to drive a mono load with an impedance less then 4 ohms.

Important: Do NOT change this switch unless the amplifier is first turned off. See Section 3.3.

P. Balanced Phone Jack Inputs

A balanced 1/4-inch phone jack is provided at the input of each channel. They may be used with balanced (tip, ring and sleeve) or unbalanced (tip and sleeve) input wiring. Because they are parallel to the *P.I.P.* connector, they should not be used as inputs when certain *P.I.P.* modules are installed. See Section 3.3.

Do NOT use the Ch. 2 inputs in either mono mode.

Q. Ground Lift Switch

The input signal ground may be isolated from the AC ground with this switch to help prevent the hum created by unwanted ground loops. It affects only the phone input jacks (P). It has no affect upon the *P.I.P.* module's XLR input connectors. Activating the switch inserts an impedance between the sleeve of each phone input jack and the circuit ground.

3 Installation

3.1 Mounting

The *Macro Reference* is designed for standard 19 inch (48.3 cm) rack mounting and "stack" mounting without a cabinet. In a rack cabinet it is best to mount them one on top of the other. This provides efficient air flow and enables each unit to support the one above.

Important: Due to the weight of the unit, it should be securely fastened at the back of the cabinet.

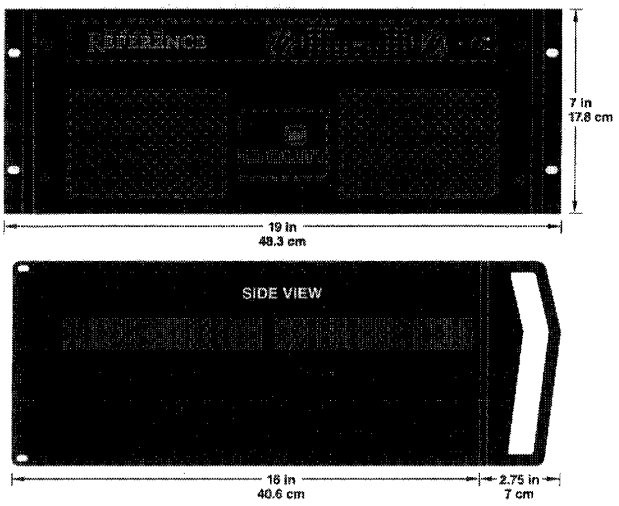


Fig. 3.1 Mounting Dimensions

3.2 Cooling

NEVER block the amplifier's side vents and front air intake. Allow at least 45 cubic feet (1.3 cubic meters) per minute of air flow. All empty spaces in the rack cabinet should be covered with blank panels to prevent improper air flow. The amplifier's air flow should be augmented with a rack cooling system if its load is less than 4 ohms and it must operate at consistently high output levels (see Section 8).

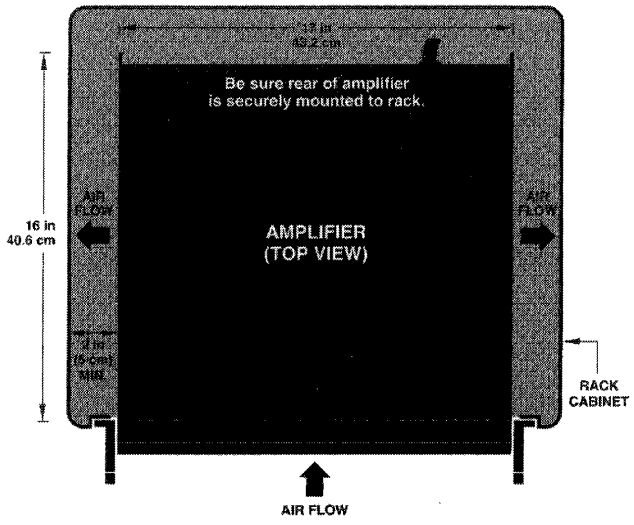


Fig. 3.2 Top View of a Rack-Mounted Unit

When mounting the unit in a rack cabinet, the rack side walls must be at least 2 inches (5 cm) away from the chassis as shown in Figure 3.2.

Tip: An easy way to verify adequate cooling is to observe the *ODEP* indicators while the amplifier is operating under worst-case conditions. If the indicators dim, additional cooling is recommended.

If your rack cabinet has a front door that could block air flow to the amplifier's air intakes, you must provide adequate air flow either with a grille in the door or by pressurizing the air behind the door. Wire grilles are recommended as opposed to perforated panels because they tend to create less turbulence.

A good choice for pressurizing the air behind a rack cabinet door is to mount a "squirrel cage" blower inside the rack (Option 1 below). At the bottom of the rack, mount the blower so it blows outside air into the space between the door and the front of the amplifiers, pressurizing the "chimney" behind the door. This blower should not blow air into or take air out of the space behind the amplifiers. For racks without a door, you can evacuate the rack by mounting the blower at the top of the rack, so that air inside the cabinet is drawn out the back (Option 2 below).

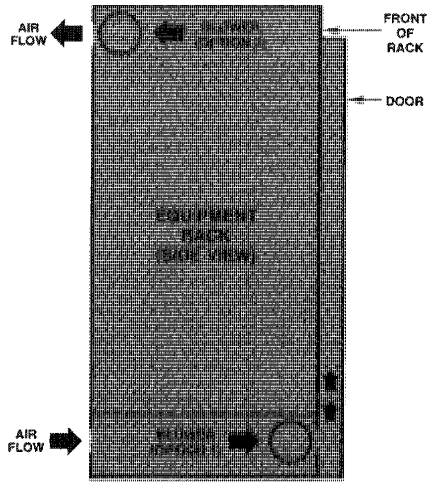


Fig. 3.3 Proper Air Flow in a Rack Cabinet

If the air supply is unusually dusty, it may be necessary to pre-filter it using commercial furnace filters, etc., to prevent rapid loading of the unit's own air filter. When needed, the unit's filter can be cleaned with mild dish detergent and water (see Section 4.5).

3.3 Wiring

This section describes the most common ways to install your amplifier into a sound system. The input and output terminals are located on the rear panel. Please use care in making connections, selecting signal sources and controlling the output level. The load you save may be your own! Crown assumes no liability for damaged loads resulting from careless amplifier use and/or deliberate overpowering.

CAUTION: Always remove power from the unit and turn the input level controls off while making or changing connections—especially if the load is a loudspeaker system. This will eliminate any chance of loud blasts or damage to the loudspeakers.

The *Macro Reference* may be operated in one of three modes (Stereo, Bridge-Mono, and Parallel-Mono) by switching the Stereo-Mono switch on the rear panel. There are VERY IMPORTANT wiring differences between these three modes which are discussed next.

3.3.1 Stereo (Two-Channel) Operation

The installation is very intuitive in Stereo mode. The input of Channel 1 feeds the output of the same channel as does the input of Channel 2. To put the amplifier into Stereo mode, first turn the amplifier off, then slide the Stereo-Mono switch to the center position, and properly connect the output wiring as shown in Figure 3.4. Two sets of binding posts are provided for each channel to facilitate easy connection of multiple loudspeaker wires to each channel. Observe correct loudspeaker polarity and be very careful not to short the outputs of one channel to that of the other channel while in Stereo mode.

CAUTION: In Stereo mode never parallel the two outputs by directly tying them together or parallel them with the output of any other amplifier. Such connection does not result in increased power output and can cause premature activation of the protection circuitry to prevent overheating.

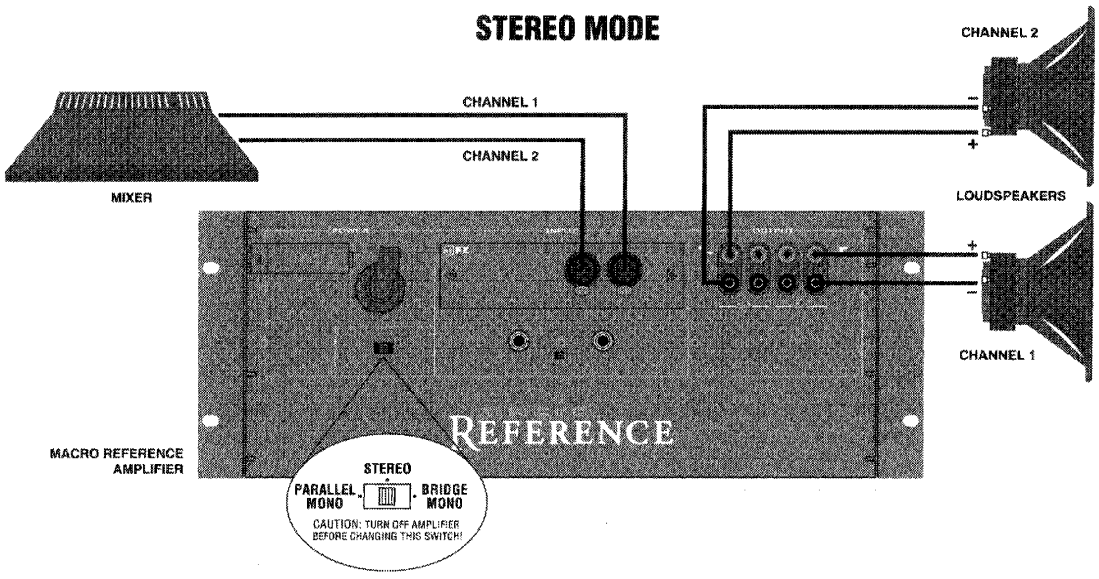


Fig. 3.4 Stereo Wiring

3.3.2 Bridge-Mono Operation

Bridge-Mono mode is intended for driving loads with a net impedance of 4 ohms or greater. (See Parallel-Mono if the load is less than 4 ohms.) Installing the amplifier in Bridge-Mono mode is very different from the other modes and requires special attention.

To put the amplifier in Bridge-Mono mode, turn the amplifier off and slide the Stereo-Mono switch toward the right (as you face the back panel). Both outputs receive the signal from Channel 1 with the output of Channel 2 inverted so it can be bridged with the Channel 1 output. DO NOT USE THE CHANNEL 2 INPUT or the signal level and quality may be greatly degraded. Keep the Level control of Channel 2 turned completely down (counterclockwise).

Note: The input jack and level control of Channel 2 are not defeated in Bridge-Mono mode. Any signal fed into Channel 2 will work against and add to or distort the signal in Channel 1.

Connect the load across the Channel 1 and 2 red binding posts with the positive lead from the load attaching to a red post of Channel 1 and the negative lead of the load attaching to a red post of Channel 2 as shown in Figure 3.5. THE BLACK BINDING POSTS ARE NOT USED AND SHOULD NOT BE SHORTED. The load must be balanced (neither side shorted to ground).

CAUTION: Be certain all equipment (meters, switches, etc.) connected to the mono output is balanced. To prevent oscillations, both sides of the line must be isolated from the input grounds.

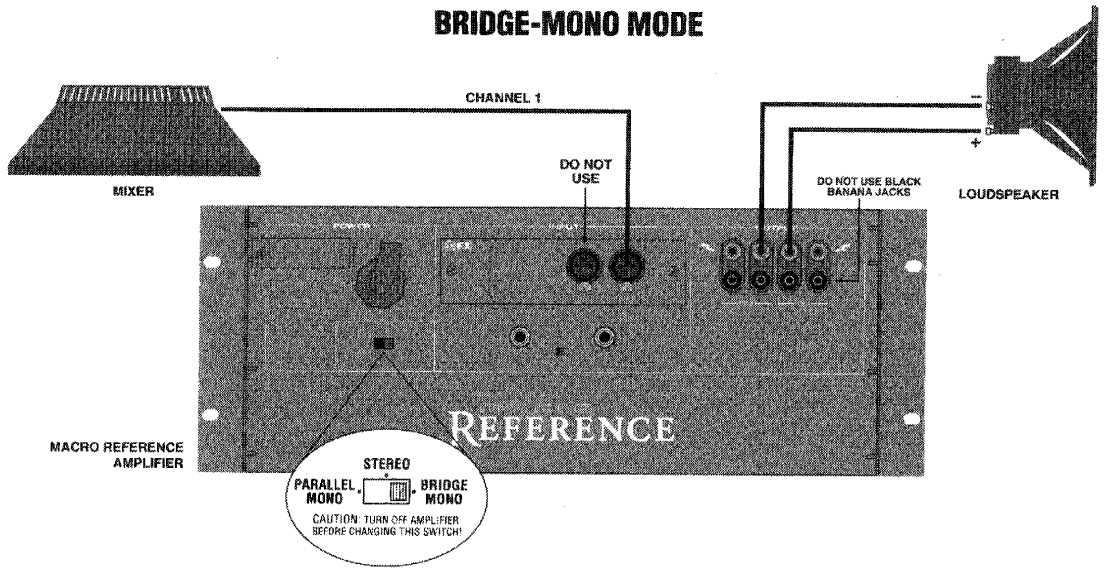


Fig. 3.5 Bridge-Mono Wiring

3.3.3 Parallel-Mono Operation

Parallel-Mono mode is intended for driving loads with a net impedance less than 4 ohms. (See Bridge-Mono if the load is 4 ohms or greater.) Installing the amplifier in Parallel-Mono mode is very different from the other modes and requires special attention.

CAUTION: Do not attempt to operate in Stereo or Bridge-Mono mode until the Parallel-Mono jumper is first removed. Failure to do so will definitely cause inefficient operation, high distortion and excessive heating.

To put the amplifier in Parallel-Mono mode, first turn it off, then slide the Stereo-Mono switch to the left (as you face the back). Connect the input signal to Channel 1 only. DO NOT USE THE CHANNEL 2 INPUT or the signal level and quality may degrade greatly. Keep the level control of Channel 2 turned completely down (full counterclockwise).

Note: It is normal for the IOC indicator of Channel 2 to stay on in Parallel-Mono mode.

The input jack and Level control of Channel 2 are not defeated in Parallel-Mono mode. Any signal fed into Channel 2 will work against and add to or distort the signal in Channel 1.

Install a jumper wire between a red binding post of both Channel 1 and 2 that is at least 14 gauge in size. Then, connect the load to the output of Channel 1 as shown in Figure 3.6. The positive lead from the load connects to a red binding post of Channel 1 and the negative lead from the load connects to a black binding post of Channel 1.

CAUTION: Remove the jumper wire before changing to any mode except Parallel-Mono.

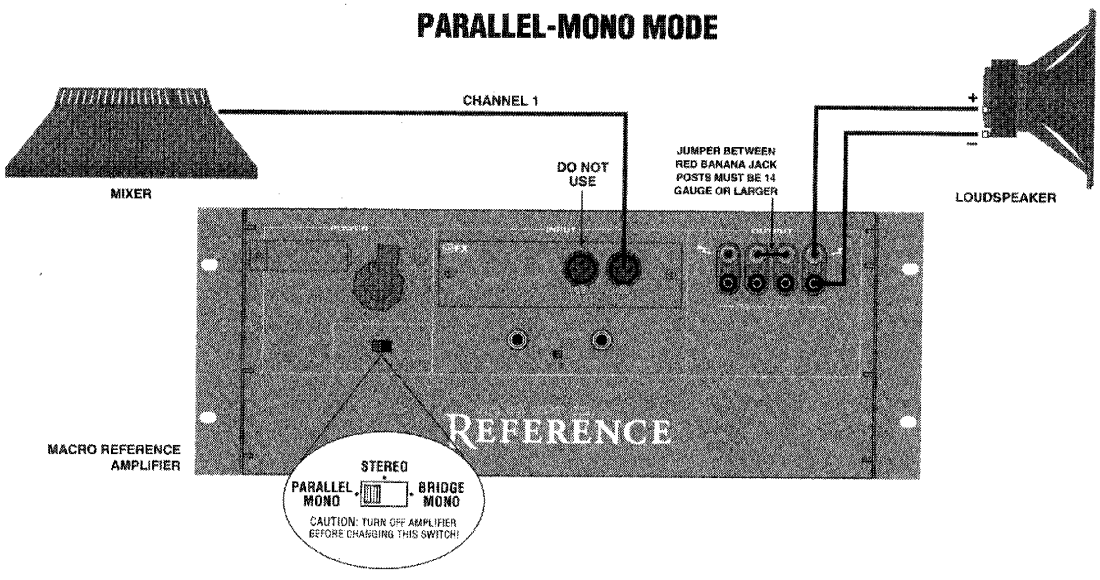


Fig. 3.6 Parallel-Mono Wiring

3.3.4 Input Connection

Both the balanced XLR and phone jack inputs have a nominal impedance of 10 K ohms (5 K ohms with unbalanced wiring) and will accept the line-level output of most devices. Female XLR input connectors are provided on the standard P.I.P.-FX input module (other *P.I.P.* modules are described in Section 9). Correct input wiring will depend on two factors: (1) whether the input signals are balanced or unbalanced, and (2) whether the signal source floats or has a ground reference. Figures 3.7 and 3.8 show the recommended connection techniques for each type of signal source.

The amplifier's built-in 1/4 inch input phone connectors can be wired similarly for balanced or unbalanced, floating or ground-referenced sources. They have a standard tip-ring-sleeve (TRS) configuration: the tip is positive (+), the ring is negative (–) and the sleeve is ground (see Figure 3.9). Wiring for various sources follows the XLR wiring guidelines shown in Figures 3.7 and 3.8.

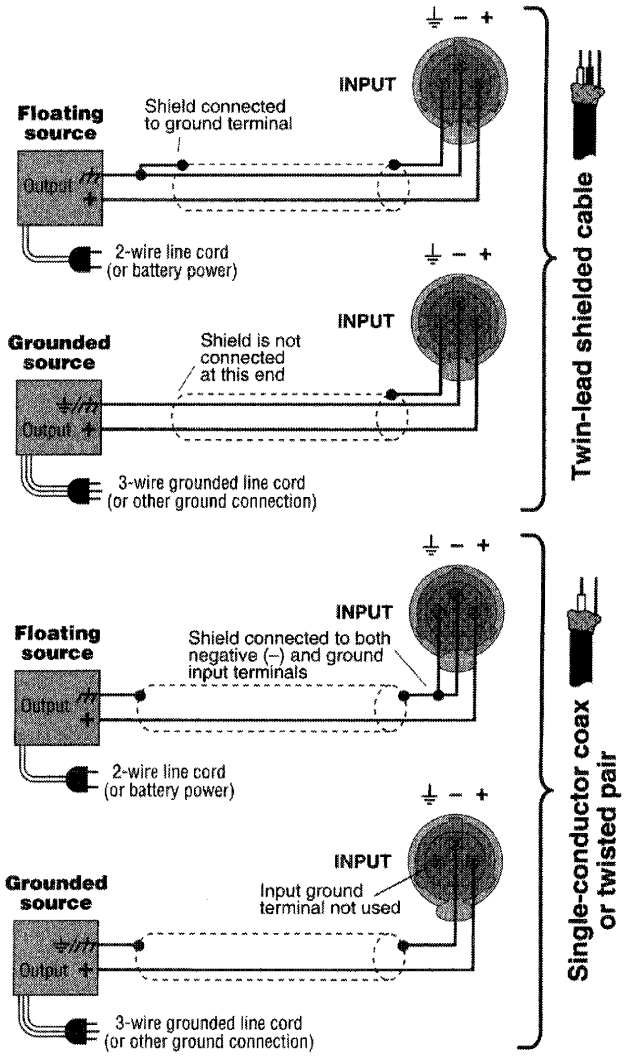


Fig. 3.7 Unbalanced Input Wiring

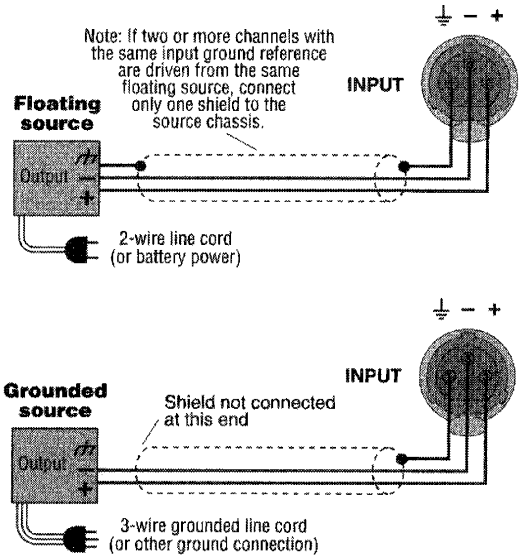


Fig. 3.8 Balanced Input Wiring

If a *P.I.P.* module is installed other than the P.I.P.-FX, P.I.P.-BB or P.I.P.-FMX, you should not connect input signals to the phone jacks. The phone jacks are in parallel with the output of the *P.I.P.* module, so the source connected to the phone jacks could backfeed into the *P.I.P.* and generate a distortion in the output. The phone jacks can be used as "daisy chain" outputs to feed the post-processed signal from the *P.I.P.* to the input of other amplifiers.

Please follow the instructions in Section 3.3.2 and 3.3.3 if the amplifier will be used in either Bridge-Mono and Parallel-Mono mode. Remember, do not use the Channel 2 input in either mono mode.

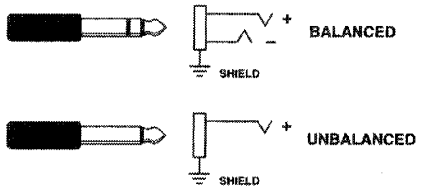


Fig. 3.9 Balanced and Unbalanced Phone Plugs

SOLVING INPUT PROBLEMS

Sometimes large **subsonic** (subaudible) **frequencies** are present in the input signal. These can damage loudspeakers by overloading or overheating them. To attenuate such frequencies, place a capacitor in series with the input signal line. The graph in Figure 3.10 shows some possible capacitor values and how they affect the frequency response. Use only low-leakage paper, mylar or tantalum capacitors.

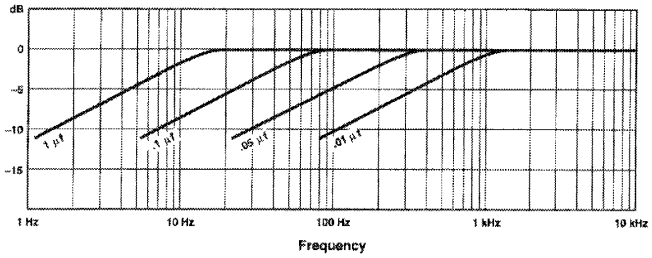


Fig. 3.10 Subsonic Filter Capacitors

Another problem to avoid is the presence of large levels of **radio frequencies** or RF in the input signal. Although high RF levels may not pose a threat to the amplifier, they can burn out tweeters or other loads which are sensitive to high frequencies. Extremely high RF levels can also cause your amplifier to prematurely activate its protection circuitry, resulting in inefficient operation. RF can be introduced into the signal by local radio stations and from the bias signal of many tape recorders. To prevent this from happening, place an appropriate low-pass filter on the input(s). Some examples are shown below for unbalanced wiring:

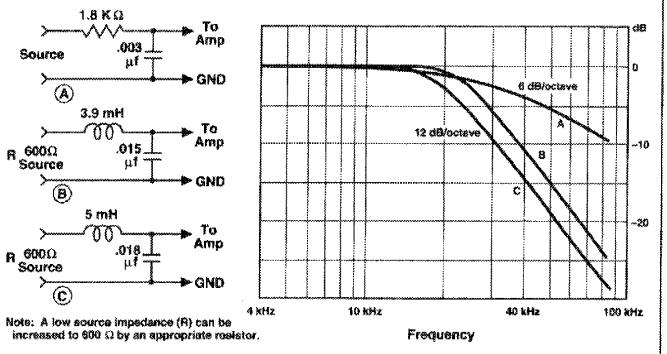


Fig. 3.11 Unbalanced RFI Filters

For balanced input wiring use one of the examples in Figure 3.12. Filters A, B and C correspond to the unbalanced filters above. Filter D also incorporates the subsonic filter described previously.

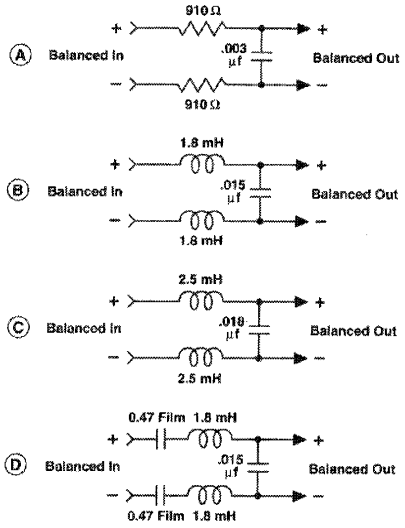


Fig. 3.12 Balanced RFI Filters

Tip: The P.I.P.-FX which came with your amplifier has plenty of room on its circuit board for the input filters.

A third problem to avoid is **ground loops**. These are undesired currents which flow in a grounded system and which usually cause hum in the output. A common source of ground loops is the placement of input cables parallel to power cables or near power transformers. The ground loop occurs when the magnetic field generated by the 60/50 Hz alternating current in the power cables or transformers is induced into the input cables. To prevent this you can lace the input

Input Wiring Tips

1. Use only shielded cable. The higher the density of the shield (the outer conductor), the better the cable. Spiral wrapped shield is not recommended.

2. When using unbalanced lines, keep the cables as short as possible. Avoid cable lengths greater than 10 feet (3 meters).

3. Do not run signal cables together with high-level wiring such as loudspeaker wires or AC cords. (This greatly lessens the chance of hum or noise being induced into the input cables.)

4. Turn the entire system off before changing any connections and turn the Level controls all the way down before powering the system back up. Crown is not liable for damage incurred when any transducer or component is overdriven.

cables along their length. (Lacing the cables helps reduce magnetically-induced current by minimizing the cross-sectional area between conductors which could bisect a magnetic field.) It is also very important to locate input cables away from power cables and power transformers.

Ground loops will also occur when the input and output grounds are tied together. DO NOT CONNECT THE INPUT AND OUTPUT GROUNDS TOGETHER. Tying the input and output grounds together can also cause **feedback oscillation** from the load current flowing in the loop. To avoid this problem use proper grounding, isolate the inputs, and isolate other common AC devices. If necessary, the input signal ground can be isolated from the mains AC ground with the ground lift switch located on the back panel of your amplifier (see Figure 2.2 and Section 4.4).

3.3.5 Output Connection

Consider the power-handling capacity of your load before connecting it to the amplifier. Crown is not liable for damage incurred at any time due to its being overpowered. The use of loudspeaker protection fuses is highly recommended (see Section 3.3.6). Please also pay close attention to the Operating Precautions in Section 4.1.

Use Good Connectors

1. Male connectors on loudspeaker cables should not be exposed to prevent possible short circuits.
2. Connectors which might accidentally cause the two channels to be tied together when making and breaking connections should not be used. (A common example is the standard 3-wire stereo phone plug.)
3. Connectors which can be plugged into AC power receptacles should never be used.
4. Connectors having low current-carrying capacity should not be used.
5. Connectors having any tendency to short should never be used.

Use loudspeaker cables of sufficient gauge (thickness) for the length used. The resistance introduced by inadequate loudspeaker cables will reduce both the output power and the motion control of the loudspeakers. The latter problem occurs because the damping factor decreases as the speaker cable resistance increases. This is very important because the amplifier's excellent damping factor can be easily negated by using insufficient loudspeaker cables.

Use the following procedure to find the recommended wire gauge (AWG or American Wire Gauge) for your system.

HOW TO DETERMINE APPROPRIATE WIRE GAUGE

1. Decide what damping factor you want the system to have. Your amplifier is capable of providing an excellent damping factor of 20,000 from 10 to 200 Hz into an 8 ohm load (Stereo mode). Typical damping factors are 50 or lower. Higher damping factors yield greater motion control of loudspeakers.

2. Calculate the required source impedance. This is done by dividing the impedance of the loudspeaker by the desired damping factor as shown below:

$$\text{Source Impedance} = \frac{\text{Loudspeaker impedance}}{\text{Damping Factor}}$$

3. Determine the loudspeaker cable length. **Important:** Keep the length as short as possible.

4. Calculate the maximum allowable wire resistance per 1,000 feet (305 meters) for the cable by dividing the source impedance times 1,000 by twice the cable distance as shown below:

$$\text{Ohms per 1000 ft} = \frac{\text{Source Impedance} \times 1000}{\text{Cable Length (ft)} \times 2}$$

The reason the cable length is multiplied by 2 is to account for both the conductors feeding the speaker.

5. Use the table at right to find the wire gauge (AWG) with a resistance equal or less than the maximum allowable wire resistance calculated above. *Note: The smaller the AWG, the bigger the wire.*

Ohms per 1000 ft	AWG No.
0.059	0000
0.064	000
0.081	00
0.102	0
0.126	1
0.159	2
0.200	3
0.254	4
0.319	5
0.403	6
0.508	7
0.605	8
0.808	9
1.018	10
1.284	11
1.619	12
2.042	13
2.575	14
3.247	15
4.094	16
5.163	17
6.510	18
8.210	19
10.35	20
13.05	21
16.46	22
20.76	23
26.17	24
33.00	25
41.62	26
52.48	27
66.17	28

Fig. 3.13 AWG from Ohms/1000 ft.

Example: Drive an 8 ohm loudspeaker with a damping factor of 1,000. First, calculate the required source impedance as 8 ohms ÷ 1,000 = 0.008 ohms. Since the loudspeaker cable must be 10 feet (3 m) long the

maximum allowable wire resistance is (0.008 ohms x 1,000) ÷ (10 ft x 2) = 0.4 ohms per 1,000 ft. Next, check the table to find the corresponding wire gauge. It shows that 6-gauge wire is very close with a resistance of 0.403 ohms per 1,000 feet. Answer: Use 6-gauge wire or larger.

Tip: If the required gauge is too large you can use more than one cable. A rule of thumb is that every time you double the number of conductors of equal gauge, you subtract 3 from the apparent gauge. In the previous example you could reduce the wire gauge to 9 by doubling the number of conductors. Or you could use four 12-gauge conductors.

SOLVING OUTPUT PROBLEMS

Sometimes **high frequency oscillations** occur which can cause your amplifier to prematurely activate its protection circuitry and result in inefficient operation. The effects of this problem are similar to the effects of the RF problem described on page 15. To prevent high frequency oscillations from occurring:

1. Lace each loudspeaker conductor pair together. (Do NOT lace loudspeaker cables from different amplifiers together.) This minimizes the chance of them acting like an antenna to transmit or receive the high frequencies which can cause oscillation.
2. Avoid using shielded loudspeaker cable.
3. Avoid long cable runs where the loudspeaker cables from different amplifiers share a common cable tray or cable jacket.
4. Never connect the amplifier's input and output grounds together.
5. Never tie the outputs of multiple amplifiers together.
6. Keep loudspeaker cables well separated from input cables.
7. Install a low-pass filter on each input line (similar to the RF filters described in the Input Connection Section).
8. Install the input wiring according to the instructions in the Input Connection Section.

Another problem to avoid is the presence of large **subsonic currents** when primarily inductive loads are used. Examples of inductive loads are 70-V step-up transformers and electrostatic loudspeakers.

Inductive loads can appear as a "short" at low frequencies, causing the amplifier to produce large low-frequency currents and unnecessarily activate its protection circuitry. Always take the precaution of installing a high-pass filter at the inputs to the amplifier when a predominantly inductive load is used. A 3-pole (18 dB per octave) filter with a –3 dB frequency of 50 Hz is recommended. (Depending upon your application, it may be more desirable to use a filter with an even higher –3 dB frequency.) Such a filter should eliminate the subsonic frequency problems mentioned in the Input Connection Section.

Another way to prevent the amplifier from activating its protection systems early and also protect inductive loads from large low-frequency currents is to connect a 590 to 708 mF nonpolarized capacitor and 4 ohm, 20 watt resistor at the output of the amplifier and in series with the positive (+) lead of the transformer. This is depicted in Figure 3.14 below.

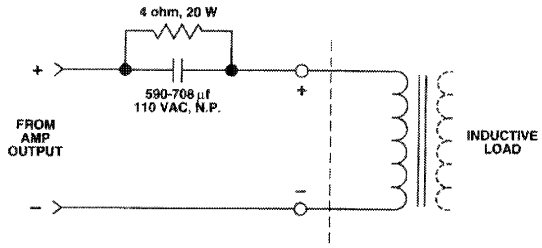


Fig. 3.14 Inductive Load (Transformer) Network

Note: The components shown in Figure 3.14 are commonly available from most electronic supply stores.

3.3.6 Additional Load Protection

Because the amplifier generates enormous power, it may be desirable to protect loudspeakers (or other sensitive loads) from damage due to excessive power. A common way to do this is to put a fuse in series with the load. The fuse may be single, fusing the overall speaker system or it may be multiple, with one fuse on each driver. The nomograph in Figure 3.15 shows fuse size versus loudspeaker peak power rating. It can be used to determine what size fuse to use.

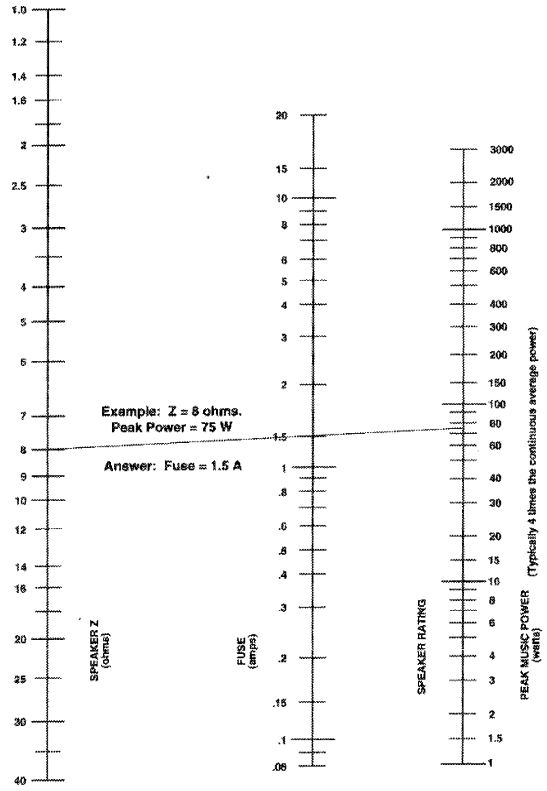


Fig. 3.15 Loudspeaker Fuse Selector Nomograph

Fuses help prevent damage due to prolonged overload, but provide essentially no protection against damage from large transients. To minimize this latter problem, use high-speed instrument fuses such as the Littlefuse 361000 series. If the loudspeaker is only susceptible to damage caused by prolonged overload (such as overheating), use a fuse or circuit breaker having the same slow thermal response as the loudspeaker itself (such as a slow-blow fuse).

3.3.7 AC Mains Power Requirements

Each *Macro Reference* amplifier is furnished with a three-wire AC plug. Use an isolated power receptacle whenever possible with adequate current (see Section 8 for more details). Excessive line voltages 10% or higher above the rated voltage of the amplifier may cause damage. For example, do not exceed a line voltage of 132 VAC for models rated for 120 VAC operation.

All specifications in this manual are referenced at 120 VAC mains unless otherwise noted. Specifications are derived using a peak mains voltage equal to the true peak of 120 VRMS sine wave with both output channels fully loaded. Performance variations will occur at other AC mains voltages and frequencies. Line regulation problems can reduce the available power.

4 Operation

4.1 Precautions

Although the *Macro Reference*, itself, is protected from external faults, the following precautions should be followed for safety and optimum operation:

1. There are important differences among the Stereo, Bridge-Mono and Parallel-Mono operating modes (see Section 3.3).
2. **WARNING: Do not change the position of the Stereo-Mono switch unless the amplifier is first turned off.**
3. **CAUTION: In Parallel-Mono mode, a jumper is used between the Ch.1 & 2 red binding posts (amplifier outputs). Be sure to remove this jumper for Bridge-Mono or Stereo mode; otherwise inefficient operation, high distortion and excessive heating will definitely occur.** Check the Stereo-Mono switch on the back panel for proper position.
4. Turn the amp off and unplug it from the AC mains before removing a *P.I.P.* module.
5. Use care when making connections, selecting signal sources and controlling the output level. The load you save may be your own.
6. Do not short the ground lead of an output cable to the input signal ground. This may form a ground loop and cause oscillations.
7. Operate the amplifier from AC mains of not more than 10% variation above or below the selected line voltage and only the specified line frequency.
8. Never connect the output to a power supply output, battery or power main. Damage incurred in this way is not covered by the warranty.
9. Tampering with the circuit by unqualified personnel, or making unauthorized circuit changes invalidates the warranty.

Remember: Crown is not liable for any damage resulting from overdriving components in your system.

4.2 Indicators

The front panel has several helpful indicator LEDs.

The **Enable indicator** is provided to show the amplifier has been turned on (or enabled) and that its low voltage power supply and on-demand forced air cooling system are working. It does not indicate the status of the high voltage power supplies. For example, the Enable indicator will stay on in the improbable event that

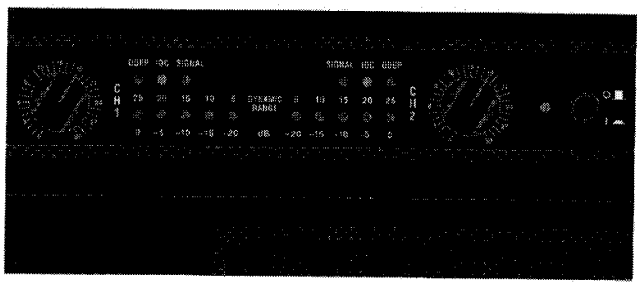


Fig. 4.1 Indicators

one or both channels overheat causing an internal shut down of the high voltage supplies.

The ***ODEP* indicators** glow brightly to confirm the normal operation of Crown's patented Output Device Emulation Protection circuitry. They glow brightly to show the presence of thermal-dynamic energy reserve under the present operating conditions. They dim proportionally as the energy reserve decreases. In the rare event that there is no reserve, the indicators will turn off and *ODEP* will proportionally limit the drive level of the output stages so the amplifier can continue safe operation even when the operating conditions are severe. (For a more detailed description of *ODEP*, see Section 4.3.1.)

The *ODEP* indicators also turn off if the high voltage power supplies are put in "standby" mode or the amplifier's circuit breaker is tripped. The standby mode is activated if excessive voltage, DC or heavy common-mode current is detected at an output or if the thermal protection system of the power transformer is activated. (For more information see the table in Figure 4.2 and Section 4.3.3.)

The ***IOC* indicators** serve as sensitive distortion meters to provide *proof of performance*. The *IOC* (Input/Output Comparator) circuitry compares the incoming signal's waveform to that of the outgoing signal. Any difference between the two is distortion. The *IOC* indicators flash if there is a difference of 0.05% or more. Because transient distortion happens quickly, a 0.1 second (approximate) "hold delay" keeps the indicators on long enough to be easily noticed. It is normal for them to light momentarily when the amplifier is first turned on. *Note: The Channel 2 IOC indicator will stay on in Parallel-Mono mode.*

The *IOC* indicators also serve as overload indicators, flashing brightly with a 0.5 second (approximate) hold delay when an excessive input signal begins to cause early clipping distortion at an input.

In abnormal situations where one or both of the amplifier's high voltage power supplies temporarily go into standby mode, the *IOC* indicators will stay on with full brightness. They resume normal operation when the amplifier is no longer in standby mode.

The **Signal presence indicators** flash synchronously with the output audio signals. A flashing indicator shows that the signal source is both at the input and output of the amplifier because it indicates that audio is present in the signal path after the input gain stages and level controls. *Note: The Signal presence indicators may not flash if the input level is low.*

The **Dynamic Range / Level meters** are five-segment output meters which can be set to monitor either the dynamic range or the relative level of the output signal. They are initially set as dynamic range meters at the factory. A switch, located behind the front panel, selects the mode of operation (see Section 4.4 for full instructions on changing the switch). As dynamic range meters they show the ratio of the peak to average power of each channel in dB. The dynamic range may be high for some audio sources, like live audio or a quality digital or analog recording, or it may be low for other sources, like typical AM or FM radio. As output level meters they show how high the output levels are in dB relative to full power. At 0 dB the unit is at full power or 760 W into 8 ohm loads (stereo).

Indicator Status	Amplifier Condition
ODEP IOC SIGNAL OFF OFF OFF	**There is no power to the amplifier.** Possible reasons: (1) The amplifier Enable switch is off. (2) The amplifier is not plugged into the power receptacle. (3) The AC mains circuit breaker has been tripped. (4) The amplifier rear panel reset switch has been tripped.
ODEP IOC SIGNAL ON OFF OFF	**Normal operation with NO input signal.** Possible reasons: (1) There is no input signal. (2) The amplifier level control(s) are turned down.
ODEP IOC SIGNAL OFF ON OFF	**No output: The amplifier is in standby mode.** Possible reasons: (1) A *P.I.P.* module like an IQ-P.I.P. has turned the high voltage supplies off. (2) The amplifier has just been turned on and is still in the 4 second mute delay. (3) The DC protection circuitry has been activated. (4) The fault protection circuitry has been activated. (5) The transformer thermal protection circuitry has been activated. (6) The overvoltage protection circuitry has been activated.
ODEP IOC SIGNAL OFF OFF Flash	***ODEP* limiting is about to begin.** Possible reasons: (1) The amplifier air filters are blocked and need to be cleaned. (2) There is insufficient cooling—inadequate air flow and/or the air is too hot. (3) The amplifier is driving too many loudspeakers for the selected stereo-mono mode—the load impedance is too low. (4) The amplifier is continuously operating at a high level with a high input signal.
ODEP IOC SIGNAL ON OFF Flash	**Normal operation with an input signal.** The *ODEP* indicator will stay on at full intensity to show that there is reserve thermal-dynamic energy and the Signal presence indicator will flash to show that an audio signal is present.
ODEP IOC SIGNAL OFF ON Flash (ON)	**Distorted output: *ODEP* limiting has been activated.** Possible reasons: (1) The amplifier air filters are blocked and need to be cleaned. (2) There is insufficient cooling—inadequate air flow and/or the air is too hot. (3) The amplifier is driving too many loudspeakers for the selected Stereo-Mono mode—the load impedance is too low. (4) The amplifier is continuously operating at a high level with a high input signal.
ODEP IOC SIGNAL ON ON (Flash) ON (Flash)	**The output is exceeding 0.05% distortion.** Possible reason: The input signal level is too high. OR **Channel 2 only: The amplifier is in Parallel-Mono mode.** The Channel 2 Signal/*IOC* always turns on to full brightness whenever the amplifier Stereo-Mono switch is moved to the Parallel-Mono position.

Fig. 4.2 ODEP, IOC and Signal Presence Indicator Status

4.3 Protection Systems

The *Macro Reference* includes several protection system that enable it to weather harsh operating environments. The preceding chart in Figure 4.2 shows how their operation can be observed with the indicators.

4.3.1 *ODEP*

Crown invented *ODEP* to solve two long-standing problems in amplifier design: To prevent amplifier shutdown during demanding operation and to increase the efficiency of output circuitry.

To do this, Crown established a rigorous program to measure the *safe operating area* (SOA) of each output transistor before installing it in an amplifier. Next, Crown designed intelligent circuitry to simulate the instantaneous operating conditions of those output transistors. Its name describes what it does: Output Device Emulation Protection or *ODEP*. It not only simulates the operation of the output transistors but it also compares their operation to their known SOA. If it sees that more power is about to be asked of them than they are capable of delivering under present conditions, it immediately limits their drive level until it falls within their SOA. The limiting is proportional and is kept to an absolute minimum—only what is required to prevent output transistor damage.

This level of protection enables Crown to increase output efficiency to never-before-achieved levels while at the same time greatly increasing amplifier reliability.

This on-board intelligence is monitored two different ways. First, there are *ODEP* indicators provided on the front panel to show that everything is functioning perfectly and to alert if limiting begins. Second, *ODEP* data is fed to the *P.I.P.* connector at the back of the amplifier so advanced *P.I.P.* modules like the IQ-P.I.P. can use it to make decisions and control the amplifier.

With *ODEP* the show won't stop because you get the maximum power with the maximum protection.

4.3.2 Standby Mode

At the heart of the protection systems is the standby mode which removes power from the high voltage supplies to protect both the amplifier and the loads connected to it.

The standby mode can be activated by four different situations. First, if dangerous subsonic frequencies or direct current (DC) are detected in the amplifier's output, the unit will activate its **DC / low frequency protection** circuitry and cause the affected channel(s) to go into standby mode. This protects the loads and prevents oscillations. The unit resumes normal operation just as soon as the amplifier no longer detects dangerous low frequency or DC output. Although it is extremely unlikely that you will ever activate the amplifier's DC / low frequency protection system, improper source materials such as square waves or input overloads that result in excessively clipped signals can activate this system.

The amplifier's **fault protection** system will place an amplifier channel into standby mode in rare situations where heavy common-mode current is detected in the channel's output. The amplifier should never output heavy common-mode current unless its circuitry is damaged in some way. Going into standby mode prevents further damage.

The amplifier's **transformer thermal protection** circuitry is activated in very unusual circumstances where the unit's transformer temperature rises to unsafe levels. Under these abnormal conditions, the amplifier will place both channels into standby mode. The amplifier will return to normal operation after the transformer cools to a safe temperature. See Section 4.3.3.

The amplifier's **overvoltage protection** circuitry will also place the amplifier into standby mode whenever excessive voltage is detected. Remember that the unit should not be operated with AC mains that are over 10% above the rated voltage of your unit.

4.3.3 Transformer Thermal Protection

All *Macro Reference* amplifiers have transformer thermal protection. It protects the power supplies from damage in the rare event that the temperature of the power transformer rises too high.

A thermal switch embedded in the power transformer removes power to the high voltage power supplies if it detects excessive heat. If this happens, the *ODEP* and Signal indicators will turn off and the *IOC* indicators will turn on. The switch automatically resets itself as soon as the transformer has cooled to a safe temperature. After it resets, the amplifier returns to normal operation.

It is extremely unlikely that you will ever see a *Macro Reference* amplifier activate transformer thermal protection as long as the amplifier is operated within rated conditions (see the specifications in Section 7). *ODEP* is designed to keep the amplifier working under very severe conditions. Even so, higher than rated output levels, excessively low impedance loads and unreasonably high input signals can generate more heat in the transformer than in the output devices and cause this protection system to activate.

Macro Reference amplifiers are designed to keep working long after other amplifiers would have failed. But even when the limits of a *Macro Reference* are exceeded, it will still protect itself—and your investment—from damage.

4.3.4 Circuit Breaker

A circuit breaker is provided on the back panel to prevent excessive current being drawn by the high voltage power supplies. Units rated for 100-120 VAC power have a 30 amp circuit breaker. Units rated for 220-240 VAC power have a 15 amp circuit breaker.

4.4 Controls

The **Enable switch** is located on the front panel so you can easily turn the amplifier on or off. If you ever need to make any wiring or installation changes, don't forget to disconnect the power cord also. Please follow these steps when first turning on your amplifier:

1. Turn down the level of your audio source. Example: Turn down the master volume of your mixer.
2. Turn down the Level controls of the amplifier (if they are not already down).
3. Turn on the Enable switch. The Enable indicator beside the switch should glow. During the four second mute delay which immediately follows, the *IOC* and Signal presence indicators may flash unpredictably and the *ODEP* indicators will stay off. After the mute delay, the *ODEP* indicators should come on with full brilliance and the *IOC* and Signal presence indicators should function normally. Remember, the Channel 2 *IOC* indicator will remain on when the amplifier is in Parallel-Mono mode.
4. After the mute delay, turn up the level of your audio source to the maximum desired level.
5. Turn up the Level controls of the amplifier until the maximum desired sound level is achieved.
6. Turn down the level of your audio source to its normal range.

For ease of use, the **Level controls** are also located on the front panel. Each control has 31 detents to help you repeat an exact setting. Important: In either Bridge-Mono or Parallel-Mono mode turn down the Channel 2 Level control and use only the Channel 1 control.

The **Meter Mode switch** is located behind the front panel. Use it to select the operating mode of the meters. To change it follow these steps:

1. Turn the amplifier off and disconnect its power cord from the AC mains power receptacle.
2. Remove the front panel (four Phillips-head screws).
3. Locate the Meter Mode switch as shown in Figure 4.3. Slide it to the left if you want the meter to function as an output level meter. Slide it to the right if you want it to indicate the dynamic range of the output signal.
4. Replace the front panel and reconnect the power cord.

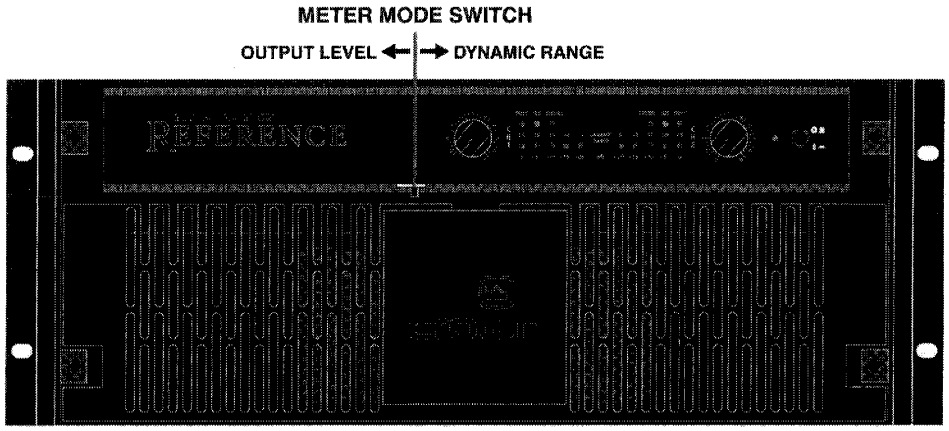


Fig. 4.3 Meter Mode Switch

The **Input Sensitivity switch** is located inside the rear of the amplifier and is factory-set to a fixed voltage gain of 26 dB. This is equivalent to an input sensitivity of 3.9 V for rated output into 8 ohms. If desired, it can be switched to a sensitivity of 0.775 V or 1.4 V. Here is the procedure:

1. Turn off the amplifier and disconnect its power cord from the AC mains power receptacle.
2. Remove the *P.I.P.* module (two screws).
3. Locate the sensitivity switch access hole inside the chassis opening as shown in Figure 4.4. It is located just above the phone jack inputs.
4. Set the switch to the desired position noted on the access-hole label.
5. Replace the *P.I.P.* module and reconnect the power cord.

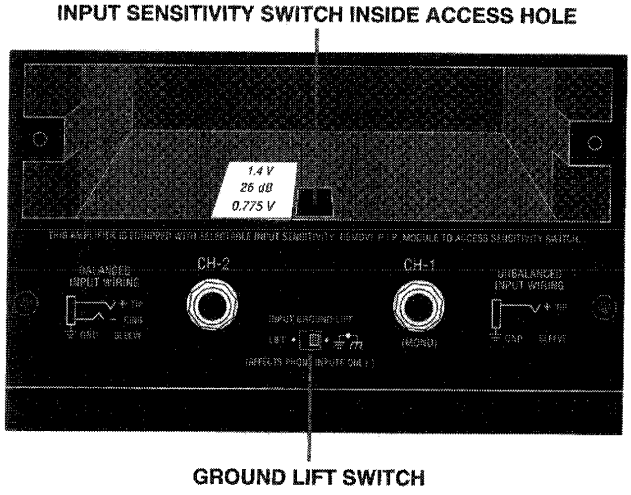


Fig. 4.4 Input Sensitivity and Ground Lift Switches

The **Ground Isolation switch** is located on the rear panel and can provide isolation between the phone jack input signal ground and the AC ground. It affects only the phone input jacks and has no affect on the input connectors on the *P.I.P.* module. Sliding the switch to the left isolates or "lifts" the grounds by placing an impedance between the sleeve of each phone input jack and the circuit ground.

Note: When a P.I.P. module is plugged into the amplifier, only the noninverted and inverted signal lines are connected in parallel with the corresponding lines of the input phone jacks. The signal grounds are not paralleled. For example, XLR pins 2 and 3 are connected in parallel with the tip and ring of the corresponding phone jack. However, pin 1 of the XLR is not connected in parallel with the sleeve of the phone jack.

The **Reset switch** is located on the rear panel to protect the power supplies against overload. Switching it to the left disconnects the power cord from the power supplies. Switching it to the right reconnects the power cord to the power supplies. If the reset switch trips, the Enable indicator will turn off. If this should ever happen, turn off the Enable switch and flip the Reset switch back to the on position. Then turn the Enable switch back on. If it trips again or the amplifier fails to operate properly, contact an authorized service center or Crown's Technical Support Group.

4.5 Filter Cleaning

Dust filters are provided on the air intakes to the cooling system. If this filter becomes clogged, the unit will not cool as efficiently as it should and may produce lower-than-normal output levels due to high heat diffuser temperature. The cleaning instructions for the dust filter vary slightly depending upon the type of front panel your *Macro Reference* has.

To clean, remove the front panel (four Phillips-head screws). The filters are permanently attached to the front panels of engraved electroluminescent units.

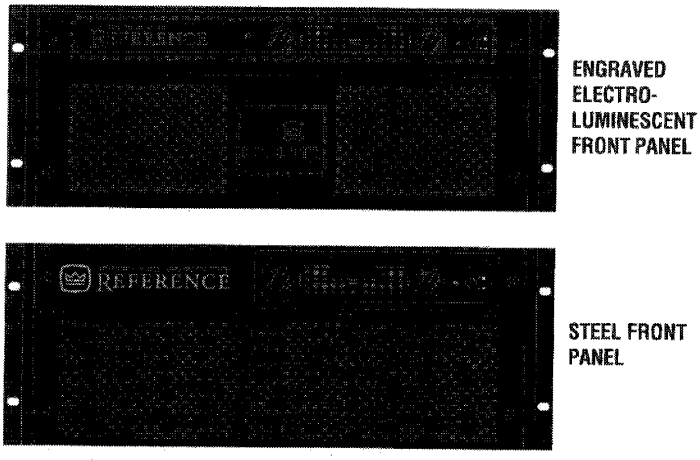


Fig. 4.5 Macro Reference Front Panels

Clean their filters and front panel as a unit. Units with steel front panels have a single separate filter element behind the front panel that can be easily removed and cleaned separately. Use mild dishwashing detergent and warm water to clean the filter(s) and dry them thoroughly before reassembly

Dust filters are not 100% efficient—long term this may require that the internal heat diffusers be cleaned by a qualified technician. Internal cleaning information is available from our Technical Support Group.

5 Service

This unit has very sophisticated circuitry which should only be serviced by a fully trained technician. This is one reason why each unit bears the following label:

CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT REMOVE COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO A QUALIFIED TECHNICIAN.

5.1 Worldwide Service

Service may be obtained from an authorized service center. (Contact your local Crown/Amcron representative or our office for a list of authorized service centers.) To obtain service, simply present the bill of sale as proof of purchase along with the defective unit to an authorized service center. They will handle the necessary paperwork and repair.

Remember to transport your unit in the original factory pack. We will pay the surface shipping costs both ways **for warranty service** to the authorized service center nearest to you after receiving copies of all shipping receipts. You must bear the expense of all taxes, duties, and customs fees when transporting the unit.

5.2 North American Service

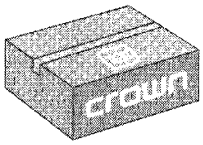
Service may be obtained in one of two ways: from an authorized service center or from the factory. You may choose either. It is important that you have your copy of the bill of sale as your proof of purchase.

5.2.1 Service at a North American Service Center

This method usually saves the most time and effort. Simply present your bill of sale along with the defective unit to an authorized service center to obtain service. They will handle the necessary paperwork and repair. Remember to transport the unit in the original factory pack. A list of authorized service centers in your area can be obtained from our Technical Support Group.

5.2.2 Factory Service

To obtain factory service, fill out the *Service Information Card* in the back of this manual and send it along with proof of purchase and the defective unit to the Crown factory. Enclose a letter explaining the nature of the problem and what service you would like. Include your return shipping address and telephone number.



Always use the original factory pack to transport the unit.

The unit must be shipped in the original factory pack. If you don't have the original shipping container, contact us and a replacement will be sent promptly.

Crown will pay ground shipping costs both ways in the United States **for warranty service** upon receiving copies of all shipping receipts. Shipments should be sent "UPS ground." (If the unit is under warranty, you may send it C.O.D. for the cost of shipping via UPS ground.) The factory will return the unit via UPS ground. Please contact us for other arrangements.

Crown Audio Division
Tech. Support / Factory Service
57620 County Road 105
Elkhart, Indiana 46517 U.S.A.
Phone: 1-219-294-8200
U.S.A.: 1-800-342-6939
Fax: 1-219/294-8301

6 Technical Information

6.1 Overview

The *Macro Reference* incorporates several new technological advancements including real-time computer simulation, low-stress output stages, and an advanced thermal diffuser embodiment.

Extra circuitry limits temperature and current to safe levels—making it highly reliable and tolerant of faults. Unlike many lesser amplifiers, it can operate at its voltage and current limits without damage.

The *Macro Reference* is protected against all common hazards that plague high-power amplifiers, including shorted, open or mismatched loads; overloaded power supplies; excessive temperature, chain-destruction phenomena, input-overload damage, and high-frequency blowups. The unit protects loudspeakers from DC in the input and output signal and from turn-on/turn-off transients.

Real-time computer simulation is used to create an analog of the junction temperature of the output transistors (herein referred to as the output devices). Current is limited only when the device temperature becomes excessive—and just by the minimum amount necessary. This patented approach maximizes the available output power and eliminates overheating—the major cause of device failure.

The four-quadrant topology used in the *Macro Reference* output stages is called the *grounded bridge*, and makes full use of the power supply at all times. This patented topology also provides peak-to-peak voltages available to the load that are four times the voltage the output devices are exposed to.

The *grounded bridge* topology is ground-referenced. Composite devices are constructed to function as gigantic NPN and PNP devices, since the available currents exceed the limits of available devices. Each output stage has two of these composite NPN and PNP devices.

The devices connected to the load are referred to as "high-side NPN and PNP" and the devices connected to ground are referred to as "low-side NPN and PNP." Positive current is delivered to the load by increasing conductance simultaneously in the high-side NPN and low-side PNP stage, while decreasing conductance of the high-side PNP and low-side NPN in synchrony.

The two channels may be used together to double the voltage (bridge-mono) or the current (parallel-mono) presented to the load. This feature gives the user flexibility in maximizing the power available to the load.

A wide-bandwidth multiloop design is used for state-of-the-art compensation. This produces ideal behavior and ultra-low distortion values.

Aluminum extrusions have been widely used for heatsinks in power amplifiers due to their low cost and reasonable performance. However, measured on a watts per pound or watts per volume basis, the extrusion technology doesn't perform nearly as well as the thermal diffuser technology developed for the *Macro Reference*.

Our thermal diffusers are fabricated from custom convoluted fin stock that provides an extremely high ratio of area to volume, or area to weight. Since all the output devices are mounted directly to the diffusers they are electrically "live." Making them electrically live allows improved thermal performance by eliminating the insulating interface underneath the output devices. The chassis itself is used as part of the thermal circuit, maximizing available cooling resources.

6.2 Circuit Theory

Power is provided by low-field toroidal power transformer T1. The secondaries of T1 are full-wave rectified by D17, D18, D1-4 and filtered by large computer-grade capacitors. A thermal switch embedded in the transformer protects it from overheating. Monolithic regulators provide a regulated ±15 volts.

6.2.1 Stereo Operation

For simplicity, the discussion of stereo operation will refer to one channel only. Mono operations will be discussed later. Please refer to the block diagram in Figure 6.1 and the schematics provided.

The input signal at the phone jack passes directly into the balanced gain stage (U104-A). Use of a *P.I.P.* module for input signal causes the input signal to pass through the *P.I.P.* and then to the balanced gain stage.

The balanced gain stage (U104-A) causes balanced-to-single-ended conversion to take place using a difference amplifier. From there, gain is controlled with the front-panel level controls and the internal input sensitivity switch. (The input sensitivity switch is located through the *P.I.P.* opening in the rear panel. See page 23.) The error amp (U104-C) amplifies the difference between the output signal and the input

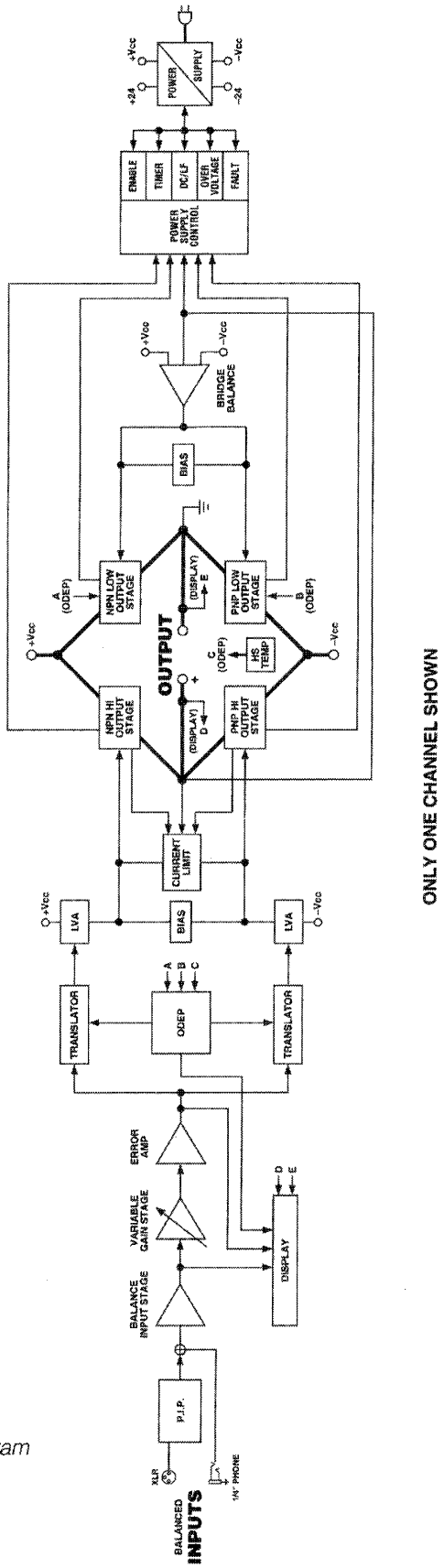


Fig. 6.1 Circuit Block Diagram

signal from the gain stage, and drives the voltage-translator stage.

The voltage-translator stage channels the signal to the Last Voltage Amplifiers (LVA), depending on the signal polarity, from the error amp U104-C. The +LVA (Q104,Q105) and the –LVA (Q110,Q111), with their push-pull effect through the bias servo Q318, drive the fully complementary output stage.

The bias servo Q318 is thermally coupled to the thermal diffuser, and sets the quiescent bias current in the output stage to lower the distortion in the crossover region of the output signal.

With the voltage swing provided by the LVAs, the signal then gains current amplification through the triple Darlington emitter-follower output stage.

The bridge-balanced circuit (U104-D) receives a signal from the output of the amplifier, and differences it with the signal at the VCC supply. The bridge-balanced circuit then develops a voltage to drive the bridge-balanced output stage. This results in the VCC supply having exactly one-half of the output voltage added to their quiescent voltage. Bias servo Q300 sets the quiescent current point for the bridge-balanced output stage.

The protection mechanisms that affect the signal path are implemented to protect the amplifier under real-world conditions. These conditions are high instantaneous current, excessive temperature, and operation of the output devices outside safe conditions.

Q107 and Q108 act as a conventional current limiter, sensing current in the output stage. When current at any one instant exceeds the design criteria, the limiters attenuate the drive from the LVAs, thus limiting current in the output stage to a safe level.

To further protect the output stages, a specially developed *ODEP* circuit is used (Output Device Emulation Protection). It produces an analog output proportional to the always-changing *safe operating area* margin of the output transistor. This output controls the translator stage previously mentioned, removing any further drive that may exceed the *safe operating area* of the output stage.

Thermal sensor S100 gives the *ODEP* circuits vital information on the operating temperature of the thermal diffusers on which the output devices are mounted.

A DC protection circuit continuously monitors the outputs. If it senses the presence of DC across the output leads and shuts down the power supply until the DC is removed. This protects the load from DC no matter what the cause.

6.2.2 Bridge-Mono Operation

By setting the rear panel Stereo-Mono switch to Bridge-Mono, the user can convert the amplifier into a bridge-mono amplifier. With a signal applied to the Channel 1 input jack, and the load between the red banana posts on the back panel, a double-voltage output occurs.

The Channel 1 output feeds the Channel 2 error amp U204-C. Since there is a net inversion, Channel 2 output is out of polarity with Channel 1. This produces twice as much voltage across the load. Each of the channel's protection mechanisms work independently if a fault occurs.

6.2.3 Parallel-Mono Operation

With the Stereo-Mono switch set to Parallel-Mono, the output of Channel 2 is paralleled with that of Channel 1. A suitable high-current-handling jumper must be connected across the red banana posts to gain the benefits of this mode of operation.

The signal path for Channel 1 is the same as previously discussed, except that Channel 1 also drives the output stage of Channel 2. The balanced input, error amp, translators, and LVAs of Channel 2 are disconnected and no longer control the Channel 2 output stage. The Channel 2 output stage and protection mechanisms are also coupled through S1 and function as one.

In Parallel-Mono mode, twice the current of one channel can be obtained. Since the *ODEP* circuit of Channel 2 is coupled through S1, this gives added protection if a fault occurs in the Channel 2 output stage. The *ODEP* circuit of Channel 2 will limit the output of both output stages by removing the drive from the Channel 1 translator stages.

7 Specifications

Performance

Note: The following applies to 120 VAC units in Stereo mode with 8 ohms loads and an input sensitivity of 26 dB gain unless otherwise specified.

Frequency Response: ±0.1 dB 20 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio: Greater than 120 dB (A-weighted) below rated output at 26 dB gain.

Bandwidth: 3 Hz to 100 kHz.

IM Distortion (IMD): Less than 0.005% from 760 W through –10 dB, increasing smoothly to a maximum of 0.025% at –40 dB, measured at 26 dB gain.

Damping Factor: Greater than 20,000 from 10 Hz to 200 Hz. 1,800 at 1 kHz.

Power

Power Bandwidth:

10 Hz to 25 kHz –1.0 dB.
7 Hz to 27 kHz –1.5 dB.
5 Hz to 28 kHz –2.0 dB.
4 Hz to 30 kHz –3.0 dB.

Output Power:

Note: Watts per channel in Stereo mode with 0.025% or less THD while both channels are driven.

760 watts into 8 ohms.
1,160 watts into 4 ohms.

Load Impedance: Rated for 4–16 ohm usage only. Safe with all types of loads, even reactive ones.

Required AC Mains: 50/60 Hz, 120 VAC ±10%. (Also available for 100, 200, 220/230 and 240 VAC.) Draws less than 90 watts at idle. With a continuous 760 watt 1 kHz sinewave output into 8 ohms in Stereo mode, as many as 26 amps are drawn from a 120 VAC source.

It is extremely important to have adequate AC power for the amplifier. Power amplifiers cannot create energy—they must have the required ***voltage and current*** *to deliver the undistorted rated power you expect.*

Controls

Enable: A push-button located on the front panel to turn the amplifier on and off.

Level: A signal level control with 31 detents for each channel, located on the front panel.

Stereo-Mono: A three-position switch located on the back panel which selects between Stereo, Bridge-Mono, and Parallel-Mono modes of operation.

Input: A three-position switch located inside the amplifier selects between three input sensitivities: 1) A sensitivity of 0.775 V for full rated output; 2) A fixed voltage gain of 26 dB; or 3) A sensitivity of 1.4 V for full rated output.

Meter Mode: A two-position switch located behind the front panel which sets the output display meter on the front panel a either a dB Dynamic Range meter or a dB Level meter.

Ground Lift: A two-position switch located on the back panel which can be used to isolate the audio signal ground from the chassis (AC) ground.

Reset: 30-amp circuit breaker located on the back panel which protects the power supplies.

Indicators

Enable: This indicator is on while the amplifier is on to show that the low-voltage power supply is operating.

ODEP: Two multifunction indicators that show the thermal-dynamic reserve energy status of each channel. Normally they are brightly illuminated to show that reserve energy is available. In the rare event there is no reserve, they will dim in proportion to *ODEP* limiting. They remain off if a tripped breaker, blown fuse or thermal shutdown occurs. (In the case of a thermal shutdown, the amplifier will automatically return to normal operation after cooling.)

IOC: Normally off, these two indicators flash in the unlikely event the output waveform differs from that of the input by 0.05% or more. In this way, they act as sensitive distortion indicators to provide dynamic proof of performance. *Note: It is normal for the Channel 2 IOC indicator to remain on in Parallel-Mono mode.*

Signal: Two Signal presence indicators flash in sync with the audio signal to show its presence.

Dynamic Range / Level Meter: Two five-segment meters (one per channel) display either the output dynamic range in dB or the output level in dB. (Your unit comes factory-set to display dynamic range.) As dynamic range meters they show the ratio of the peak to average power of each channel. As output level

meters they show how high the output levels are relative to full power.

Input/Output

Input Connector: Balanced phone jacks on chassis and internal *P.I.P.* connector. (Balanced 3-pin XLR connectors are provided on P.I.P.-FX which is a standard feature.)

Input Impedance: Nominally 10 K ohms, balanced. Nominally 5 K ohms, unbalanced.

Input Sensitivity: Switchable between 0.775 V or 1.4 V for rated output or a fixed voltage gain of 26 dB. (See Section 4.4 for more information.)

Output Connector: Two pair of color-coded 5-way dual binding posts (banana jacks) for each channel.

Output Impedance: Less than 10 milliohms in series with less than 2 microhenries.

DC Output Offset: (Shorted input) ±2 millivolts.

Output Signal

Stereo: Unbalanced, two-channel.

Bridge-Mono: Balanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive and not removed from operation.

Parallel-Mono: Unbalanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

Protection

If unreasonable operating conditions occur the protection circuitry limits the drive level to protect the output transistor stages, particularly in the case of elevated temperature. Transformer overheating will result in a temporary shutdown. Controlled slew-rate voltage amplifiers protect the unit against RF burnouts. Input overload protection is furnished at the amplifier input to limit current.

Turn On: No dangerous transients. Four second turn-on delay. *Note: This may be changed by resistor substitution. Contact Crown's Technical Support Group for details.*

Construction

Black splattered-coat steel chassis. The chassis utilizes specially designed "flow-through" ventilation from front to side. Two front styles are available. One has a deluxe engraved electroluminescent backlit front panel and the other has a steel front panel.

Cooling: Convection cooling with computerized, on-demand proportional fan assist. Includes custom heat diffusers and patented circuitry for uniform dissipation.

Dimensions: 19 inch (48.3 cm) standard rack mount (EIA Std. RS-310-B), 7 inch (17.8 cm) height, 16 inch (40.6 cm) depth behind mounting surface, 2.75 inch (7 cm) in front of mounting surface.

Weight: 56.5 lbs (25 kg). Center of gravity is approximately 6 inches (15 cm) behind front mounting surface. Shipping weight is approximately 70 lbs (31 kg).

8 AC Power Draw & Thermal Dissipation

This section provides detailed information about the amount of power and current drawn from the AC mains by a *Macro Reference* and the amount of heat produced under various conditions. The calculations presented here are intended to provide a very realistic and reliable depiction of the amplifiers. The following assumptions were made:

- The amplifier efficiency at full rated power is estimated to be 65%.
- Quiescent power draw is assumed to be 90 watts (an almost negligible amount for full-power calculations). Actually, the *Macro Reference* is less than 90 watts.
- Quiescent thermal dissipation equals 105 btu/hr at 90 watts.
- Amplifier output power is the maximum average rating at the specified load.
- Duty cycle of pink noise is 50%.
- Duty cycle of highly compressed rock n' roll midrange is 40%.
- Duty cycle of rock n' roll is 30%.
- Duty cycle of background music is 20%.
- Duty cycle of continuous speech is 10%.
- Duty cycle of infrequent, short duration voice paging is 1%.

Here are the equations used to calculate the data presented in Figure 8.1:

$$\text{AC Mains Power Draw (watts)} = \frac{\text{Rated amplifier output with both channels driven (watts)} \times \text{Duty Cycle}}{\text{Amplifier Efficiency (.65)}} + \text{Quiescent Power Draw (90 watts)}$$

The ambient power draw of 90 watts is a maximum figure, and assumes the cooling fan is running.

$$\text{Thermal Waste (btu/hr)} = \left[(1 - \text{Power to Loads}) + \text{Ambient Power Draw (90 watts)} \right] \times 3.415$$

or

$$\text{Thermal Dissipation (btu/hr)} = \left(\frac{\text{Rated amplifier output both channels (watts)} \times \text{Duty Cycle} \times .35}{\text{Amplifier Efficiency (.65)}} + \text{Quiescent Power Draw (90 watts)} \right) \times 3.415$$

The constant 0.35 is the inefficiency (1.00–0.65) and the factor 3.415 converts watts to btu/hr. Thermal dissipation in btu is divided by the constant 3.968 to convert to kcal.

To change the power draw in watts to current draw in amperes, use the following equation:

$$\text{Current Draw (amperes)} = \frac{\text{AC Mains Power Draw (watts)}}{\text{AC Mains Voltage} \times \text{Power Factor (.83)}}$$

The current draw values shown in Figure 8.1 depend on the AC mains voltage (power draw and thermal dissipation are typical for any AC voltage).

Macro Reference

Duty Cycle	AC Mains Power Draw (Watts)	Current Draw (Amps) 90–105 V	Current Draw (Amps) 220–240 V	Thermal Dissipation btu/hr	Thermal Dissipation kcal	AC Mains Power Draw (Watts)	Current Draw (Amps) 90–105 V	Current Draw (Amps) 220–240 V	Thermal Dissipation btu/hr	Thermal Dissipation kcal	AC Mains Power Draw (Watts)	Current Draw (Amps) 90–105 V	Current Draw (Amps) 220–240 V	Thermal Dissipation btu/hr	Thermal Dissipation kcal
50%	205	2.1	1.1	445	115	270	2.7	1.4	520	130	320	3.2	1.6	585	145
40%	185	1.9	0.9	385	100	245	2.5	1.3	495	125	295	2.9	1.4	560	140
30%	160	1.6	0.8	325	85	215	2.2	1.1	450	115	260	2.6	1.3	515	130
20%	140	1.4	0.7	285	70	190	1.9	1.0	410	105	230	2.3	1.1	475	120
10%	115	1.1	0.6	245	60	160	1.6	0.8	360	90	195	1.9	1.0	420	105

Fig. 8.1 Power Draw, Current Draw and Thermal Dissipation at Full Rated Power for the Listed Duty Cycles

9 Accessories

9.1 *P.I.P.* Modules

One advantage of using a *Macro Reference* is the ability to customize it using *P.I.P.* (Programmable Input Processor) modules. Each *Macro Reference* is equipped with a *P.I.P.* card edge connector inside the back panel. The modules install easily:

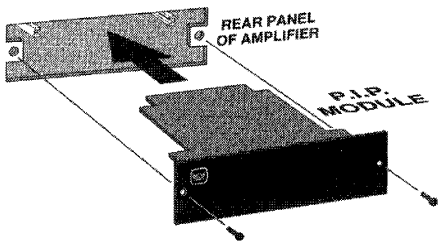
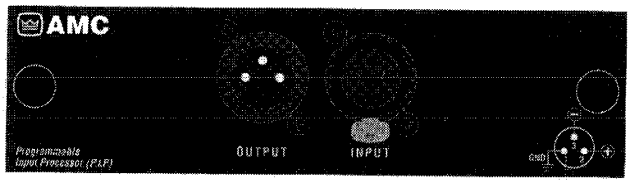


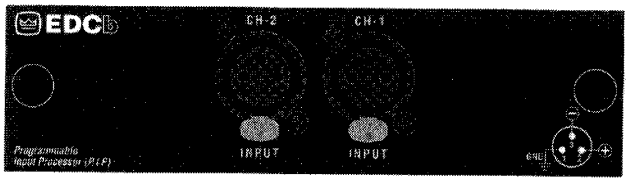
Fig. 9.1 Installing a P.I.P. Module

WARNING: Disconnect power to the amplifier when installing or removing a *P.I.P.* module.

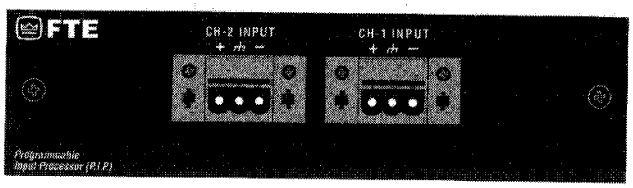
Here are some of the available *P.I.P.* modules:



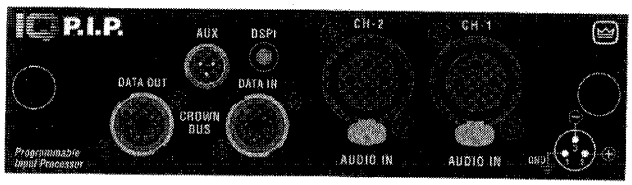
P.I.P.-AMC unites many features of the P.I.P.-XOV and P.I.P.-CLP. It offers a variable 4th-order Linkwitz-Riley and an *IOC*-driven, variable threshold compressor. In addition, it provides "constant-directivity" horn equalization and filter-assisted B_6 vented box equalization. Biamping and triamping capabilities are provided via XLR connectors.



P.I.P.-EDCb combines a sophisticated error-driven compressor and smooth limiter with a subsonic filter on each channel. The compressors have adjustable attack and release times and can be set to track each other. The compressors activate when an input signal is large enough to clip the input, an *IOC* error occurs, or the output exceeds its threshold. The subsonic filters have corner frequencies of 24, 28, 32 and 36 Hz.

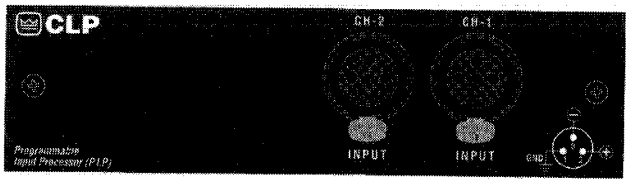


P.I.P.-FTE includes all P.I.P.-FXT features, and adds 12 dB/octave RFI filters, variable 18 dB/octave high-pass filters, and 6 dB/octave 3 kHz shelving networks for "constant-directivity" horn equalization. Quick-connect barrier blocks are provided for input.



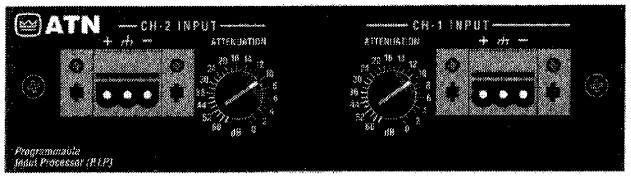
IQ-P.I.P. v1.3 integrates the amplifier into Crown's patented *IQ System*.® The *IQ System* provides centralized computer control of 1 to 2,000 amplifiers. Each amplifier channel can be monitored and controlled from an inexpensive personal computer. Mic and/or line level signals can also be controlled and routed with optional *MPX-6*,™ *SMX-6*™ or *AMB-5*™ mixer/multiplexers, as well as the MRX series matrixers.

IQ-P.I.P. v1.4 *Smart Amp*™ offers the monitoring and control features of the IQ-P.I.P. v1.3 plus the capability to function as a stand-alone unit as a part of *IQ System's distributed intelligence*.™ Features include a smooth output limiter for "transparent" loudspeaker protection, power supply gates for reduced energy consumption, *ODEP* conservation that protects the output devices with precision input signal control, interrupt-driven reporting that lets you define the error conditions and configurable electrical short detection.

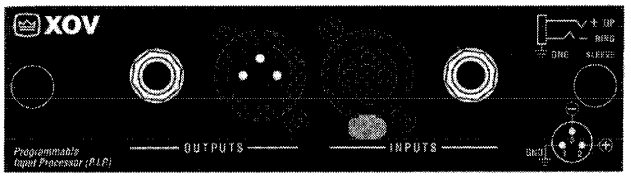


P.I.P.-CLP is designed to detect and prevent overload. Its compressor is driven by the amplifier's built-in *IOC* error detection circuitry. Unlike typical signal-driven compressors, it only compresses the signal to prevent overload. It can deliver up to 13 dB of additional headroom without begin noticed.

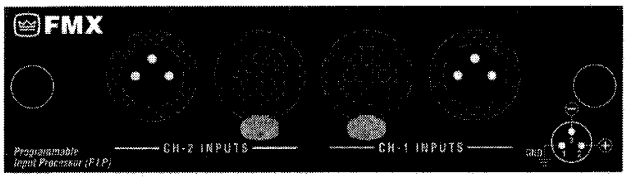
P.I.P.-ISO is designed especially for 25 to 140 V distribution systems where UL®-listed isolation is required. Using it (along with minor amplifier modifications) the amplifier outputs are safely isolated from both the input terminals and the chassis.



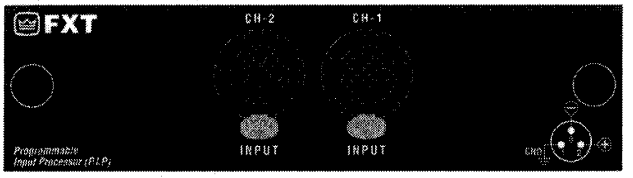
P.I.P.-ATN includes all the P.I.P.-FTE features plus a 32-step precision attenuator for each channel.



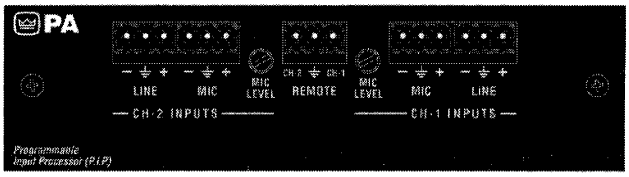
P.I.P.-XOV is a versatile 18 dB/octave mono crossover/filter with biamping and triamping capabilities.



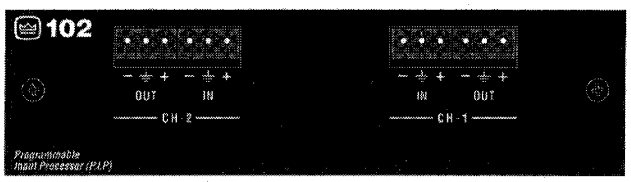
P.I.P.-FMX facilitates "daisy-chaining" of balanced amplifier inputs. Female to male 3-pin XLR connectors are used to passively bridge the inputs.



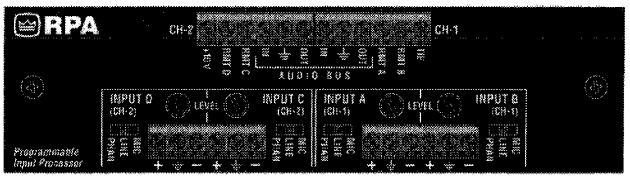
P.I.P.-FXT uses balanced 1:1 transformers to isolate the amplifier from the input signal. It has balanced female 3-pin XLR connectors.



P.I.P.-PA adds a switchable balanced low-Z microphone input and a balanced line-level input to each channel. Timed fader circuitry with remote switching provides fades from mic to line and back.



P.I.P.-102 is a two-channel module providing equalization based on the BOSE® 102 controller. It has balanced Phoenix® removable barrier block connectors. Each input and daisy-chain output channel can be configured for straight-through operation, 102 equalization or 102 equalization with bass-cut.



P.I.P.-RPA adds many features of a 4x2 mixer to your amplifier. Its four inputs accept mic-level or line-level input. It offers priority switching ("voice-over") of each input and remote level control with the RPA-RMT. Other features include bus inputs and outputs, adjustable input sensitivity, phantom power and RFI suppression. Input isolation transformers are optional.

For more information on these or other *P.I.P.s* under development, contact your local dealer or Crown's Technical Support Group.

crown

macro REFERENCE

Owner's Manual

Contents

Illustrations

MACRO REFERENCE

Welcome

The stunning realism of the Macro Reference attests to its technical excellence. With a dynamic range so large it surpasses the limitations of 20-bit digital audio, this amp cruises while the rest of your audio components catch their breath.

At the heart of the Macro Reference is an ultimately damped, high-excursion circuit design so advanced it can adapt to match the instantaneous demands of the audio signal. It has the highest dynamic transfer function available, allowing your ears and your loudspeakers to relax. It is the closest thing to a "straight wire with gain" ever created.

Superior motion control of your loudspeakers is achieved with ultimately damped outputs so you hear deeper, tighter bass than you've ever heard before. Low-frequency transient response must be heard to be fully appreciated.

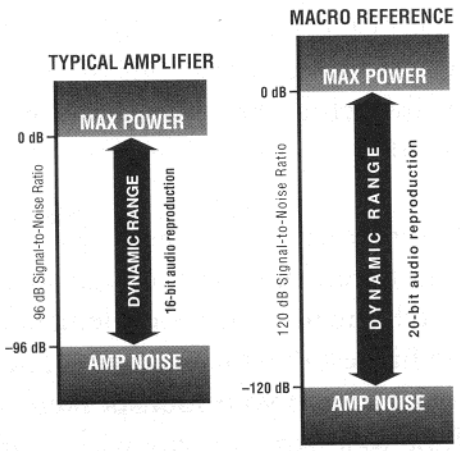
Great care has been taken with the routing of each wire, the layout of each circuit board, and the selection of each component. As a result, its sonic integrity is without peer.

This manual is dedicated to helping you enjoy your Macro Reference to the fullest. The next three pages will peek under the hood at some of its distinguishing and unconventional technology. Pages 5-6 provide an overview of the controls, indicators and connectors. The installation instructions begin on page 7.

Features

20-bit Dynamic Range

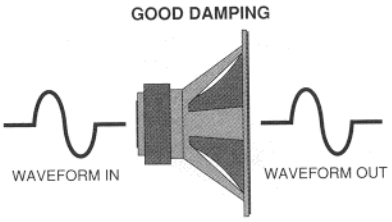
In the early days of digital recording when 16-bit audio was the norm, a power amplifier only had to reproduce a signal with a dynamic range of 96 dB. Today, with the coming of 20-bit digital technology, that dynamic range has increased to 120 dB!

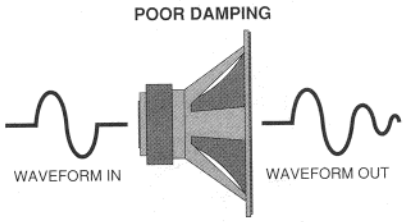


By pushing the noise floor lower and the maximum power ceiling higher, the Macro Reference exceeds this need with over 120 dB of dynamic range.

Ultimate Damping

Damping is the ability to quiet unwanted loudspeaker cone movement. It is similar to the damping your shock absorbers provide when you drive your car over a rough road. Damping is essential to good transient response—especially at low frequencies. Ideally, a properly damped loudspeaker cone will stop moving the instant the signal stops. The sound waves it creates should exactly match the waveform of the original signal.





An underdamped loudspeaker cone continues to move after the signal has stopped, muddying transient response.

An amplifier's damping factor tells how well it can damp a loudspeaker. It is calculated by dividing the loudspeaker impedance by the amplifier's output impedance. With an 8 ohm loudspeaker, the Macro Reference has a phenomenal low-frequency damping factor of over 20,000! The result: razor-sharp bass unlike anything you have ever experienced.

Magnetic Field Efficiency

The backbone of a solid power amplifier is a solid power supply. The Macro Reference uses a custom designed, tape-wound, low-noise toroidal supply with

an extremely high power density. Toroids, known for their tight regulation and low external electromagnetic fields, also provide superior efficiency and are mechanically quieter.

Built-In Distortion Meter

It's one thing to claim low distortion on a test bench and another thing to claim it in the real world. That's one reason why your Macro Reference includes a sophisticated built-in distortion meter—to prove its claim. We call it an *IOC*® circuit because it is an Input/Output Comparator. It tirelessly compares the waveform of the input signal to the waveform of the output signal and if it finds a variation of 0.05% or more, it flashes the *IOC* indicator of the offending channel.

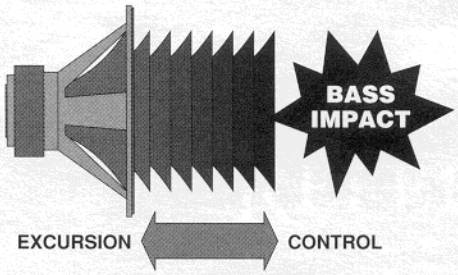
The *IOC* indicators also help you find the source of distortion by showing you where it is *not*—not in your Macro Reference.

High Energy Reserves

With its high voltage and high current headroom, the Macro Reference has phenomenal energy reserves. And because it can sustain high current as well as high voltage output, it can easily drive even low-impedance loads to full power.

High Excursion Control

Many modern woofers can take far more peak power than most amplifiers can produce. Without adequate power, these loudspeakers cannot achieve full excursion and low-frequency output suffers.



The Macro Reference has a massive power rating of 760 watts/channel into 8 Ω—enough muscle for very serious loudspeaker excursion control. The result: outstanding bass impact!

Unparalleled Protection

If an amplifier has any protection circuitry, it usually uses a current limiting scheme or V-I limiting like we patented in the 1960s with our famous DC-300. Such schemes are not suitable for an amplifier with the performance of the Macro Reference.

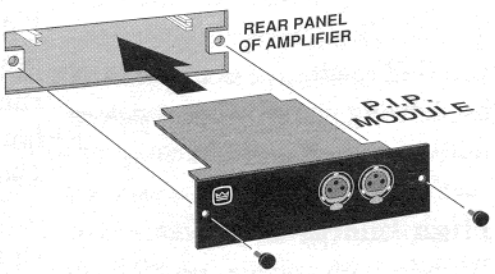
It uses the most advanced version of our Output Device Emulator Protection (*ODEP*™)

circuitry. With it, the real-time operating environment of the power transistors is simulated and compared to their known safe operating area. Even their stress history is analyzed. If *ODEP* predicts they are about to exceed their limits, their drive level is proportionally reduced. You get maximum power with maximum protection!

ODEP indicators, normally on, show normal operation. They dim in the rare event protection limiting is required.

Very Flexible

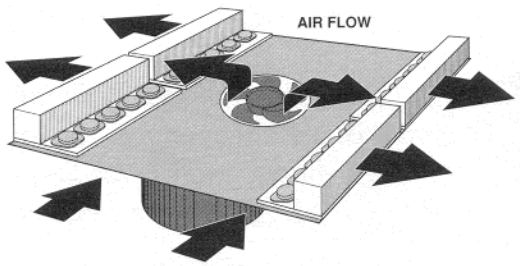
Rarely are two amplifiers used alike. Some require crossover networks; others use custom equalization; still others use state-of-the-art error-driven compressors.



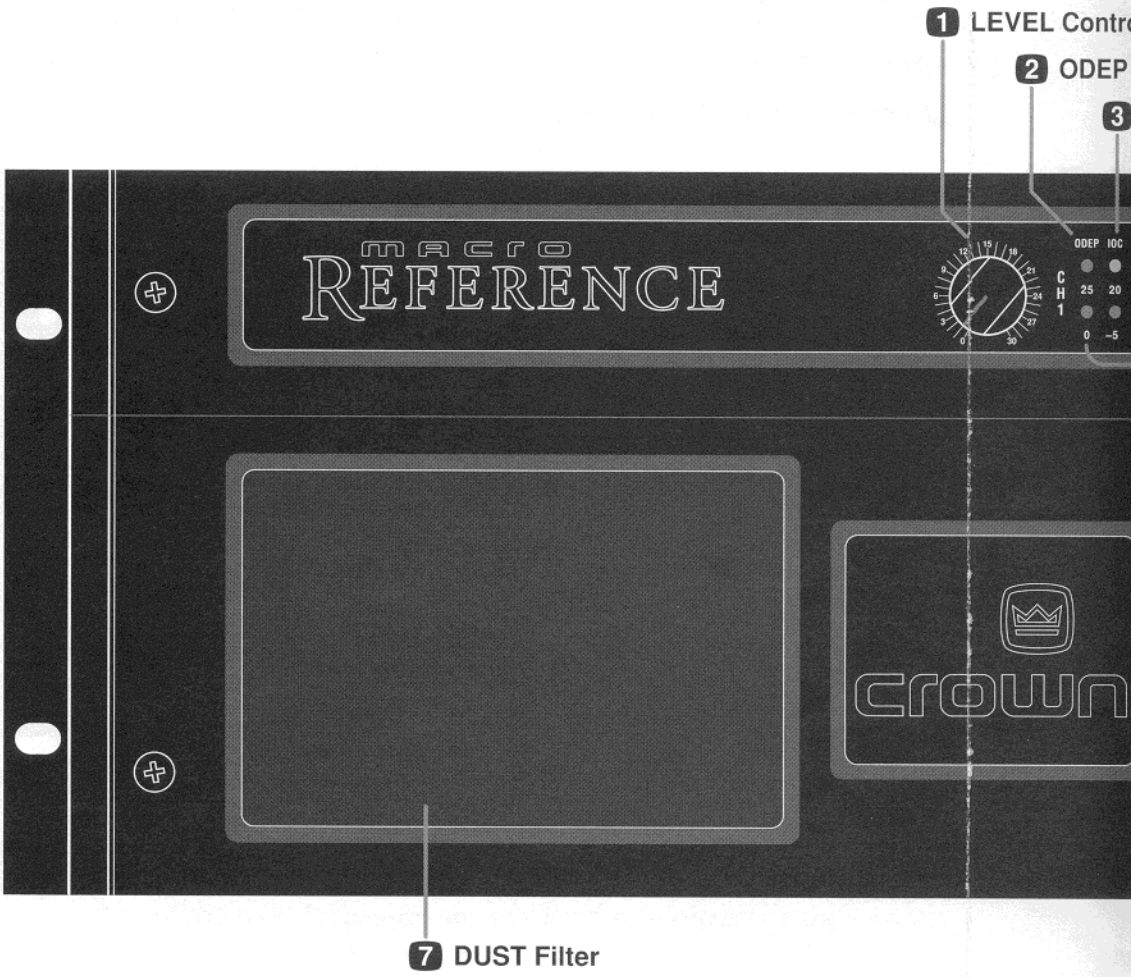
That's why your Macro Reference features a unique Programmable Input Processor (*P.I.P.*®) expansion system. It lets you add *P.I.P.* modules to accomplish this and more. Like remote computer control, error-driven limiting, or, as standards are established, digital-to-analog conversion (see also pages 32-33).

Infinitely Variable Cooling

Heat is one of an amplifier's worst enemies. That's why the Macro Reference contains the most advanced cooling system available in a power amp.



A patented design enables all output transistors to be mounted directly on electrically live thermal diffusers for maximum heat transfer. When necessary, this conduction/convection cooling is assisted by an infinitely-variable-speed fan. It draws air across the power transformer and main circuit board and pushes it across the power transistors and out the super-efficient diffuser exhaust vents. Careful engineering allows it to operation very quietly in critical-listening environments. It turns on only when needed and only to the degree necessary.



Controls & Indicators

1 LEVEL Control

The level of each channel is controlled by the convenient level controls mounted on the front panel. Each one has 31 detents for precise adjustment.

2 *ODEP* Indicator

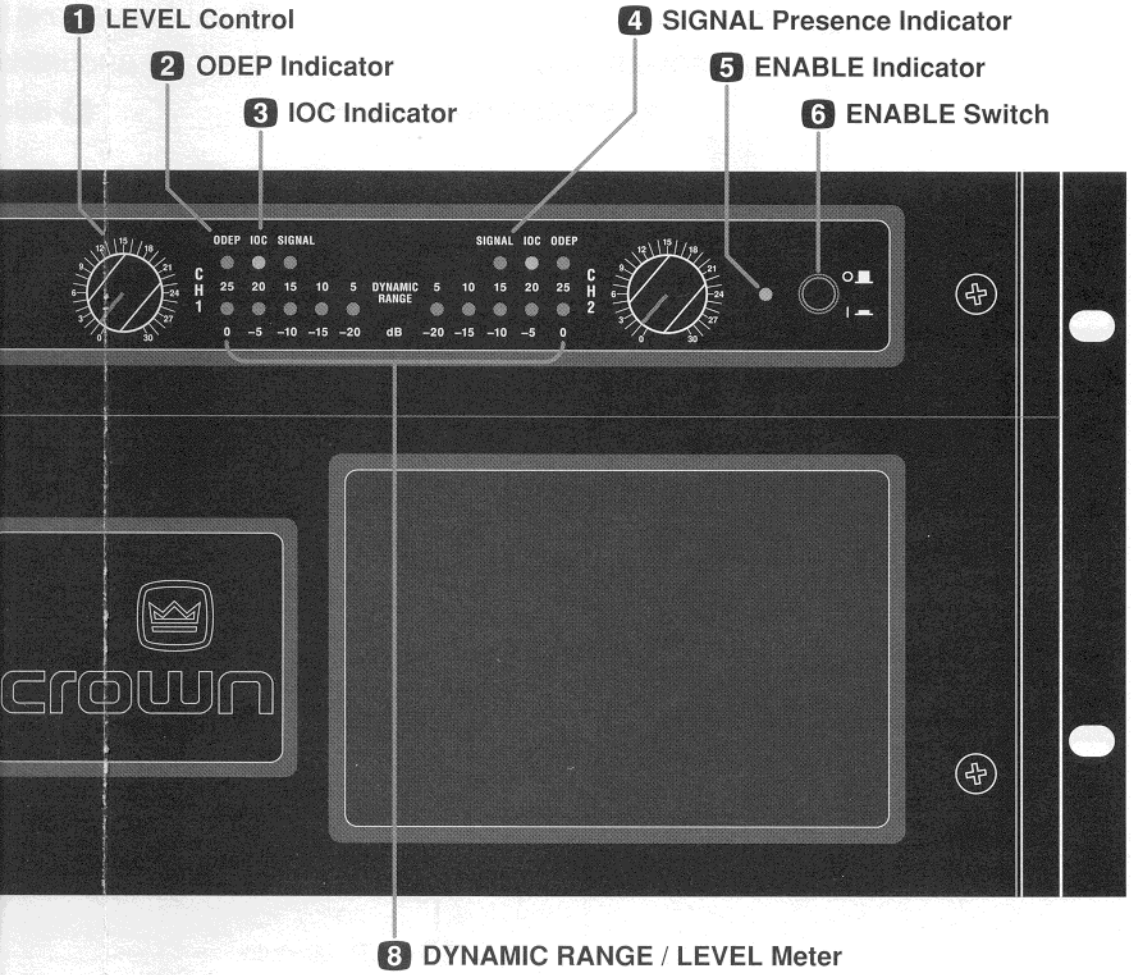
The *ODEP* indicators glow brightly to confirm the normal operation of the Output Device Emulator Protection circuitry and the presence of reserve thermal-dynamic energy. In the rare event there is no reserve, they dim in proportion to *ODEP* limiting. Under such conditions the output stages are protected by proportionally limiting their drive level so the amplifier can continue to operate safely even when the operating conditions are severe.

3 *IOC* Indicator

The total distortion level of each channel is monitored by the Input/Output Comparator. If distortion of any kind exceeds 0.05%, the indicator of the affected channel(s) will flash. *Note: It is normal for the IOC indicator of Channel 2 to remain on when the amplifier is placed in Parallel-Mono mode. (See page 10 for further details.)*

4 SIGNAL Presence Indicator

The presence of an audio signal is confirmed by the Signal indicators. Each one flashes in sync with the input signal. *Note: The Signal indicators may not flash if the input level is low.*



5 ENABLE Indicator

After the amplifier is "enabled" or turned on, this indicator will remain on.

6 ENABLE Switch

The amplifier is "enabled" or turned on by pressing this push-button switch.

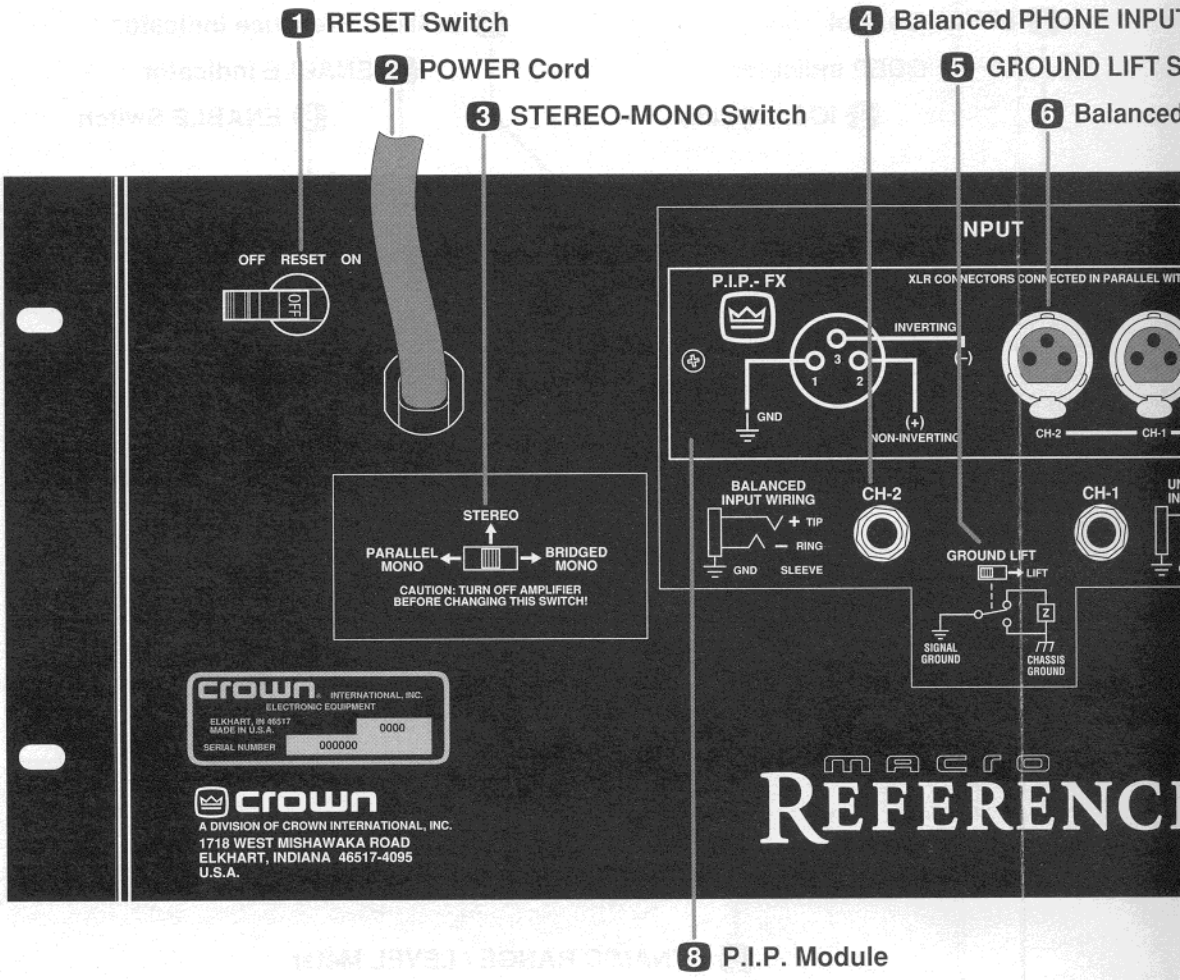
Caution: In addition to turning the unit off, you should always unplug the it from the AC mains before making any installation changes.

7 DUST Filter

The air drawn inside the amplifier is filtered by the dust filters mounted behind the front panel. They can be easily cleaned or replacement filter module can be ordered from the Crown Parts Department (telephone: 1-800-342-6939, part no: K 7429-0).

8 DYNAMIC RANGE / LEVEL Meter

A five-segment output meter is provided for each channel. It is set as a dynamic range meter at the factory and shows the dynamic range in dB. (It computes dynamic range as the ratio of the peak to average power level.) The meter can also be switched to an output level meter. As a level meter it displays the output power relative to full power. For example, at 0 dB the output power would be 760 watts per channel while driving 8 ohm loads. See pages 19-21 for further details.



Controls & Connectors

1 RESET Switch

A 30-amp circuit breaker, conveniently located on the rear panel, acts as a reset switch to protect the power supplies.

2 POWER Cord

A power cord with a grounded three-blade plug is used to connect the AC mains.

3 STEREO-MONO Switch

The three operating modes of the Macro Reference are controlled by this switch. Stereo mode is available for normal two-channel operation. Bridged-Mono mode is available to drive a single load with an impedance equal to or greater than 4 ohms. Parallel-Mono mode is available to drive a single load with an impedance less than 4 ohms. *Important: Do NOT change this switch unless the amplifier is first turned off. (See pages 8-10.)*

4 Balanced PHONE INPUT Jack

A balanced ¼-inch phone jack is provided at the input of each channel. They may be used with either balanced (tip, ring, sleeve) or unbalanced (tip, sleeve) input wiring.
Caution: The Channel 2 input should NOT be used in either mono mode.

5 GROUND LIFT Switch

The input signal ground may be isolated from the AC ground with this switch to help prevent the hum created by unwanted ground loops. It affects only the phone input jacks. It has no

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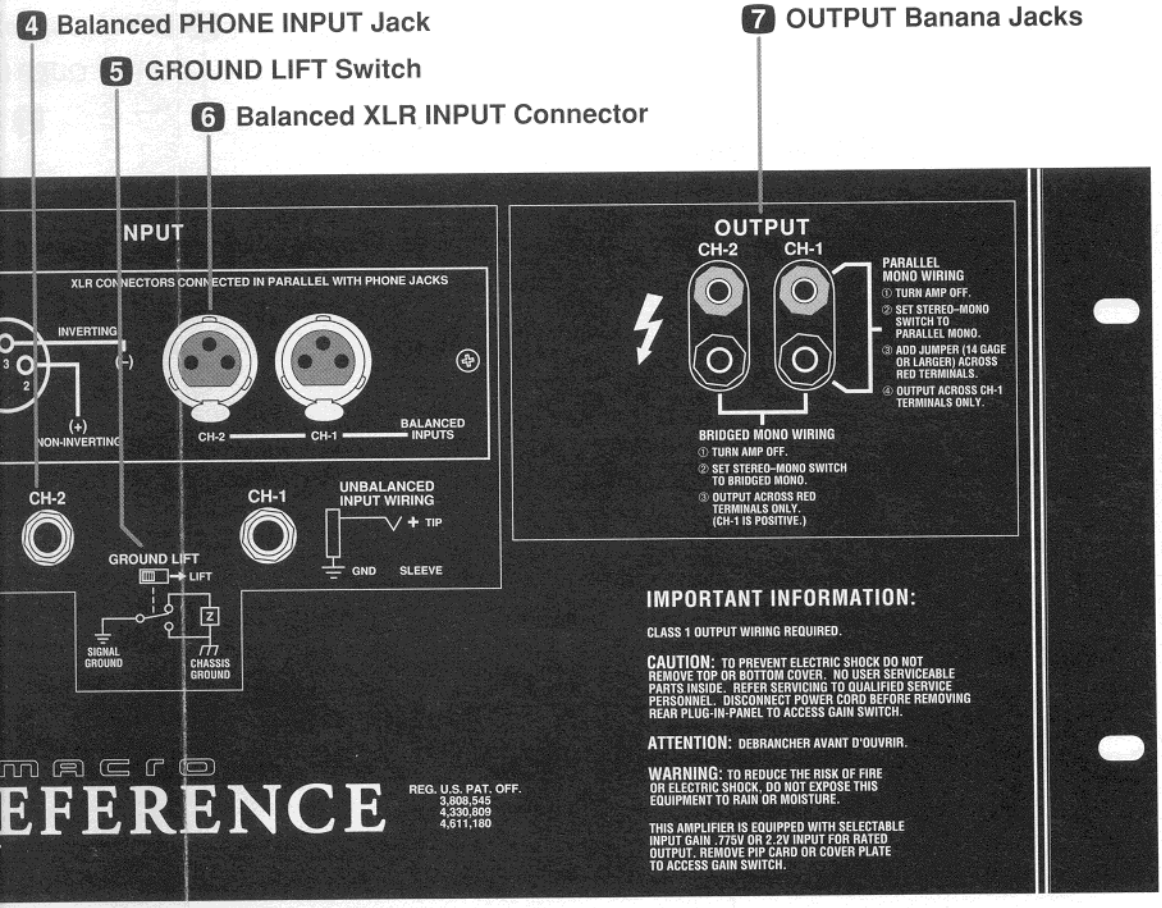


odule

affect upon the XLR input connectors on the *P.I.P.* module. Activating the switch inserts an impedance between the sleeve of each phone input jack and the circuit ground.

6 Balanced XLR INPUT Connector

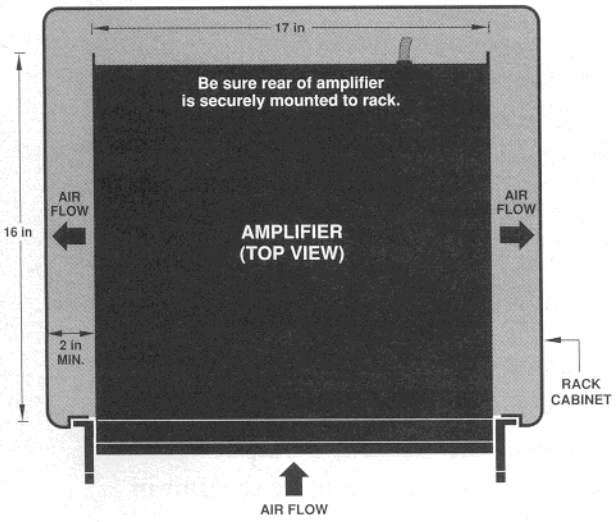
A balanced 3-pin female XLR connector is provided at the input of each channel on the P.I.P.-FX which comes as a standard feature of the Macro Reference. The P.I.P.-FX places the XLR inputs in parallel with the phone input jacks. *Caution: The Channel 2 input should NOT be used in either mono mode.*

7 OUTPUT Banana Jacks

Versatile gold banana jacks are provided for output. They will accept banana plugs (the preferred connection method), bare wire or spade lugs.

8 *P.I.P.* Module

The Macro Reference includes our powerful Programmable Input Processor expansion feature to enable you to plug in custom input/control modules. Modules plugged into the *P.I.P.* connector are placed in series with the inputs to the amplifier and parallel to the phone input jacks. A P.I.P.-FX is included as a standard feature to provided balanced XLR inputs. It has no internal circuitry and can be used along with the phone input jacks to facilitate "daisy chaining" multiple amplifiers. See pages 32-33 for a list of the available *P.I.P.* modules.



Installation

Your amplifier can be easily mounted into a standard 19-inch equipment rack. When doing so, securely fasten the rear of the amplifier because it is heavy.

Cooling

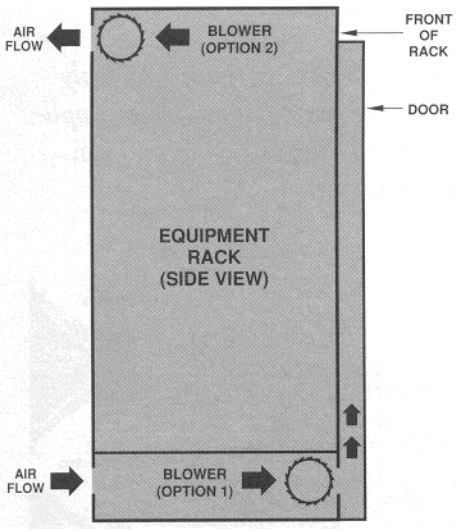
Never block the air vents. Allow for a minimum air flow of 45 cubic feet per minute. To accomplish this, keep the amplifier's side air vents at least 2 inches away from the sides of the rack cabinet.

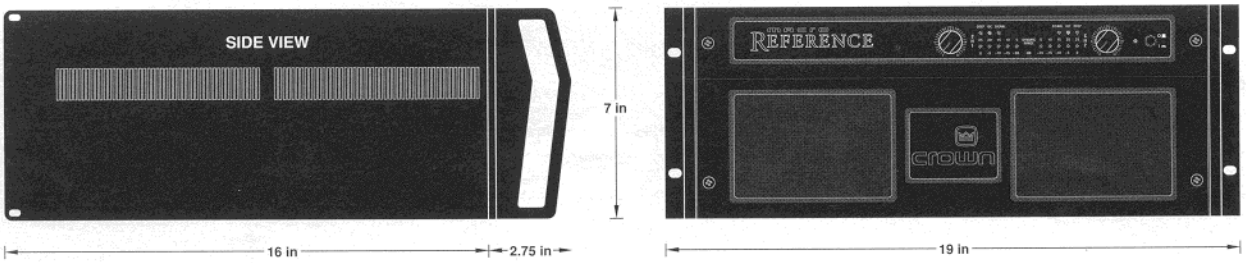
If the operating environment is hot and/or the equipment rack is sealed, you may need to add additional cooling to the rack. A rack-mountable "squirrel cage" blower can be easily added.

Two options for doing this are shown at left. Option 1 should be used when a solid door is installed over the front of the rack. It requires an auxiliary fan to pressurize the space behind the door with air drawn from outside the rack. Option 2 uses an auxiliary fan to evacuate air from racks having no solid door.

Always be sure that an auxiliary cooling fan draws fresh cool air into the rack and not recycled hot air.

A commercial furnace filter should also be added to prefilter the air if the air supply is unusually dusty.





Wiring

Caution: Always remove power from the unit and turn the level controls off before making or changing connections. This will eliminate any chance of loud blasts or damage to the loudspeakers. Use care when making connections, selecting signal sources and adjusting the output level. The load and ears you save may be your own!

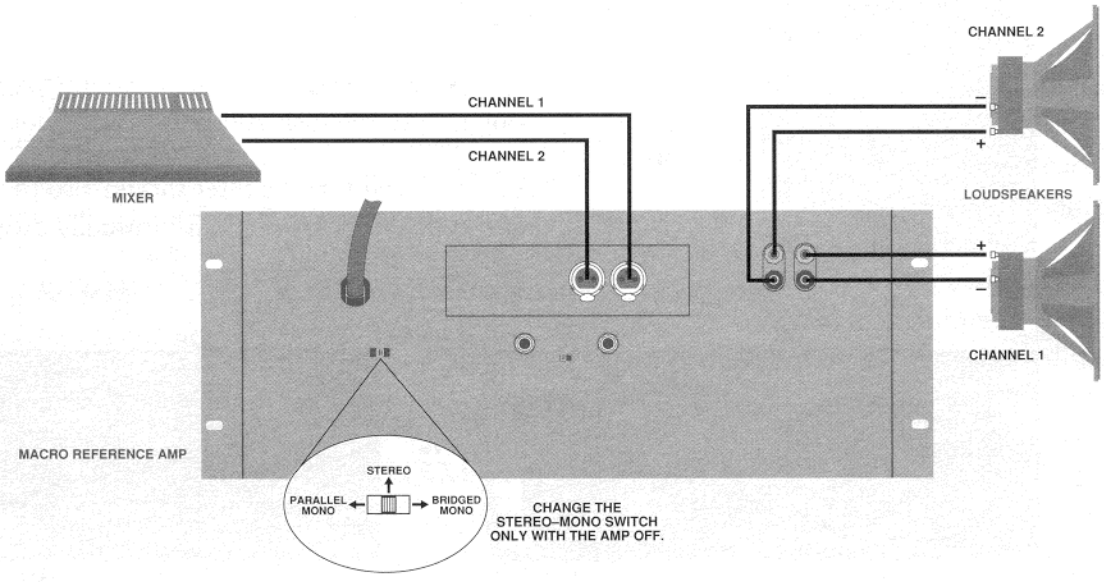
There are three major ways to wire your amplifier. Each has VERY IMPORTANT differences which are discussed next.

STEREO

Wiring the amplifier for stereo or two-channel operation is very intuitive. The Channel 1 input feeds the Channel 1 output and the Channel 2 input feeds the Channel 2 output. To place the unit in STEREO mode, first turn it off, then slide the Stereo-Mono switch on the back panel to the center position. Finally, connect the output and input wiring as shown in the illustration below.

Caution: In STEREO mode never parallel the two outputs by directly tying them together or parallel them with the output of any other amplifier. Such connection does <u>not</u> increase the output power and can prematurely activate the protection circuitry.

Stereo



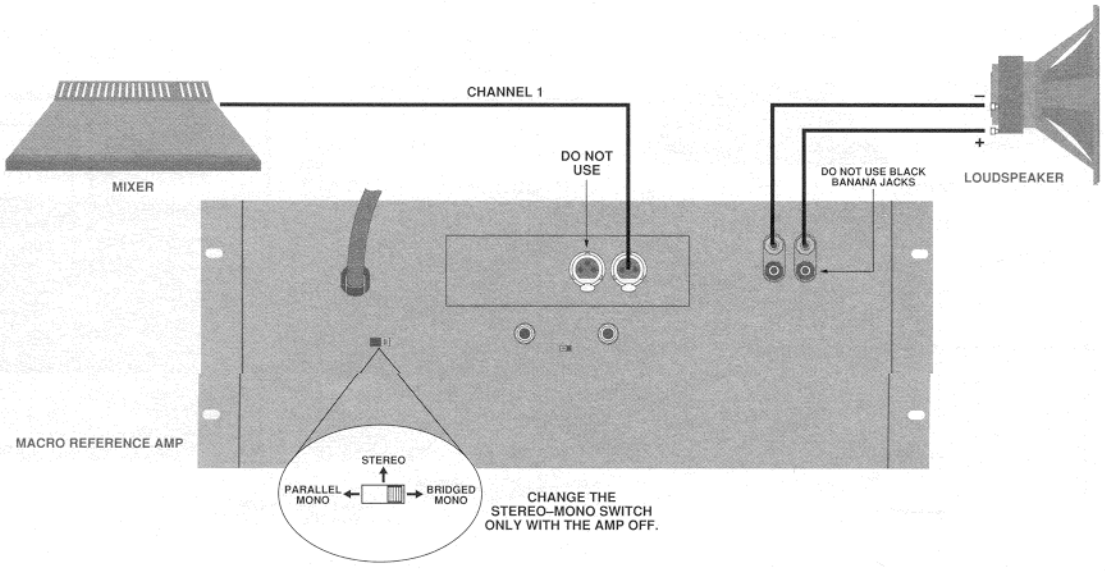
BRIDGED-MONO

This is one of two mono or single-channel modes of operation for your amplifier. BRIDGED-MONO mode is intended for loads with a total impedance equal to or greater than 4 ohms. Use the PARALLEL-MONO mode if the load is less than 4 ohms.

To place the amplifier in BRIDGED-MONO mode, first turn it off, then slide the Stereo-Mono switch on the back panel to the right. Next, connect the output wiring as shown in the illustration below. Note that the load is connected across the two red banana posts—the black posts are not used and should <u>not</u> be shorted. The positive lead of the load should connect to the red post of Channel 1 and the negative lead should connect to the red post of Channel 2. *Important: The load must be balanced (neither side shorted to ground).* Finally, connect the input signal to the input of Channel 1 only. The Channel 2 input should not be used and its level control should be turned off (full counterclockwise).

Caution: Be certain that all equipment (meters, switches, etc.) connected to the mono output lines is balanced. To prevent oscillations, both sides of the line must be totally isolated from the input grounds.

Bridged-Mono



PARALLEL-MONO

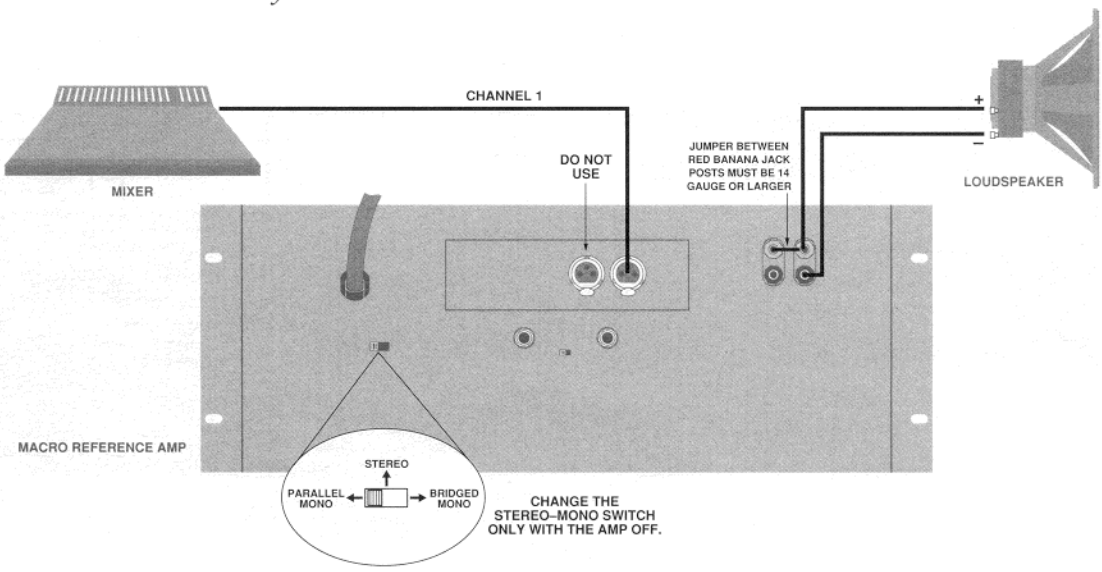
This is another of the two mono or single-channel modes of operation for your amplifier. PARALLEL-MONO mode is intended for loads with a total impedance less than 4 ohms. Use the BRIDGED-MONO mode if the load is equal to or greater than 4 ohms.

To place the amplifier in PARALLEL-MONO mode, first turn it off, then slide the Stereo-Mono switch on the back panel to the left. Next, install a jumper between the two red banana posts and connect the output wiring as shown in the illustration below. The jumper should be at least 14 gauge wire. The positive lead of the load should connect to either of the red posts and the negative lead should connect to either of the black posts. Finally, connect the input signal to the input of Channel 1 only. The Channel 2 input should not be used and its level control should be turned off (full counterclockwise).

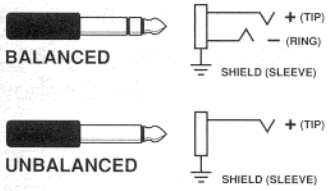
Caution: When wired for PARALLEL-MONO mode, do not attempt to operate in STEREO or BRIDGED-MONO mode until the jumper is removed and the output appropriately changed.

Please note: In PARALLEL-MONO mode, the Channel 1 IOC indicator serves both paralleled channels. The Channel 2 IOC indicator will stay on to serve as a PARALLEL-MONO indicator.

Parallel-Mono



Input Wiring Tips



1. Use only shielded cable. The higher the density of the shield (the outer conductor), the better the cable. Spiral wrapped shield is not recommended.
2. When using unbalanced lines, keep the cables as short as possible. Avoid cable lengths greater than 10 feet.
3. Do not run signal cables together with high-level wiring such as loudspeaker wires or AC cords. (This greatly lessens the chance of hum or noise being induced into the input cables.)
4. Turn the entire system off before changing any connections and turn the level controls all the way down before powering the system back up. Crown is not liable for damage when any transducer or component is overdriven.

Input Connection

Both the XLR and phone jack inputs are balanced and have a nominal impedance of 10 K ohms (5 K ohms if unbalanced wiring is used) and will easily accept the line-level outputs of most devices. The XLR inputs are provided on a P.I.P.-FX input module which is included as a standard feature. Many other *P.I.P.* modules are optionally available to customize your amplifier. See the Accessories section at the end of this manual for a brief description of them.

Normally you should not use the phone jack inputs if a *P.I.P.* module other than a P.I.P.-FX or P.I.P.-FMX is installed. The phone jacks are in parallel with the output of the *P.I.P.* module. If the phone jack inputs are used, the signal could backfeed into the output of the *P.I.P.* and generate a distorted input signal.

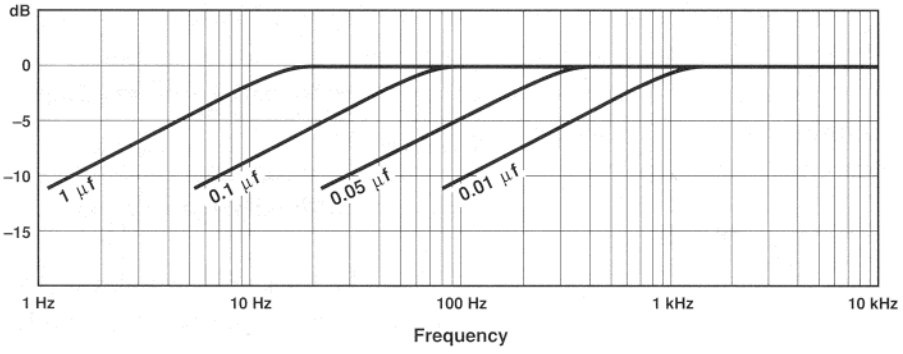
The P.I.P.-FX and P.I.P.-FMX are exceptions because they contain only XLR connectors and have no circuitry. Therefore, they allow the phone jack inputs to be used to "daisy chain" to other amplifiers.

Please follow the instructions in the preceding section regarding BRIDGED-MONO and PARALLEL-MONO mode wiring. In both cases the Channel 2 input should not be used.

SOLVING INPUT PROBLEMS

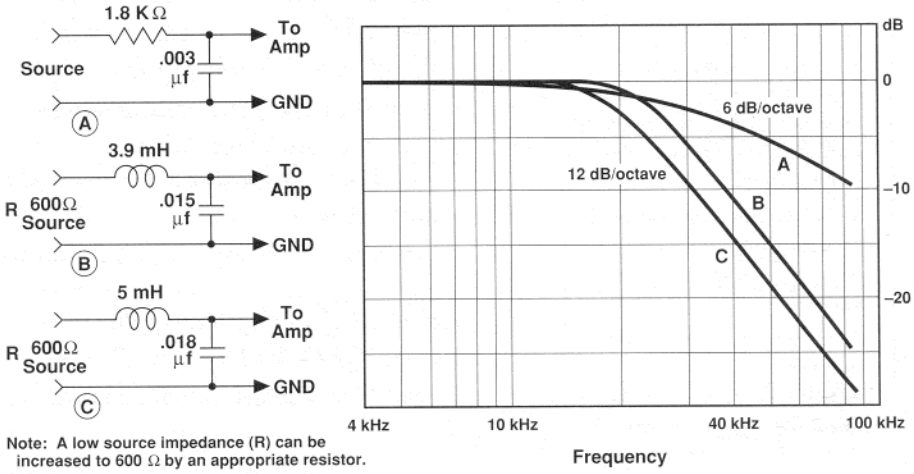
Sometimes large **subsonic** (subaudible) **frequencies** are present in the input signal. These can damage loudspeakers by overloading or overheating them. To attenuate such frequencies, place a capacitor in series with the input signal line. The graph below shows some possible capacitor values and how they affect the frequency response. Use only low-leakage paper, mylar or tantalum capacitors.

Subsonic Filter Capacitors



Another problem to avoid is the presence of large levels of RF or **radio frequencies** in the input signal. Although high RF levels may not pose a threat to the amplifier they can burn out tweeters or other loads which are sensitive to high frequencies. Extremely high RF levels can also cause your amplifier to prematurely activate its protection circuitry, resulting in inefficient operation. RF can be introduced into the signal by local radio stations and from the bias signal of many tape recorders. To prevent this from happening, place an appropriate low-pass filter on the input(s). Some examples are shown below for unbalanced wiring:

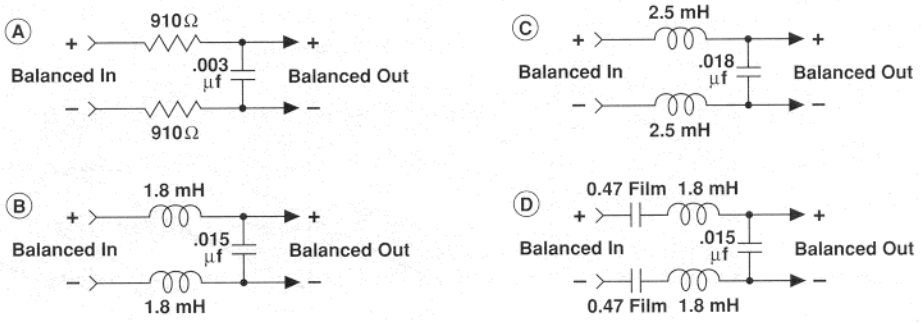
Unbalanced RF Filters



Note: A low source impedance (R) can be increased to 600 Ω by an appropriate resistor.

For balanced input wiring use one of the examples below. Filters A, B and C correspond to the unbalanced filters above. Filter D also incorporates the subsonic filter described on the previous page.

Balanced RF Filters



Tip: The P.I.P.-FX, which came with your amplifier, has plenty of room on its empty circuit board for the input filters.

A third problem to avoid is the problem of **ground loops**. These are the undesired currents which flow in a grounded system and which usually cause hum in the output. A common source of ground loops is the placement of input cables parallel to power cables or near power transformers. The ground loop occurs when the magnetic field generated by the 60 Hz alternating current in the power cable or transformer is induced into the input cables. To prevent this you can lace the input cables along their length. (Lacing the cables helps cancel magnetically induced current.) It is also very important to locate the input cables away from power cables and power transformers.

Ground loops will also occur when the input and output grounds are tied together. DO NOT CONNECT THE INPUT AND OUTPUT GROUNDS TOGETHER. Tying the input and output grounds together can also cause **feedback oscillation** from the load current flowing in the loop. To avoid this problem use proper grounding, isolate the inputs, and isolate other common AC devices. If necessary the input signal ground can be isolated from the mains AC ground with the ground lift switch located on the back panel of your amp (see also pages 6 and 21).

Use Good Connectors

1. Male connectors on loudspeaker cables should not be exposed to prevent possible shorts.
2. Connectors which might accidentally cause the two channels to be tied together during making and breaking connections should not be used. (A common example is the standard 3-wire stereo phone plug.)
3. Connectors which can be plugged into AC power receptacles should never be used.
4. Connectors having low current-carrying capacity should not be used.
5. Connectors having any tendency to short or having shorted leads should never be used.

Output Connection

Consider the power-handling capacity of your load before connecting it to the amplifier. Crown is not liable for damage incurred at any time due to its being overpowered. The use of loudspeaker protection fuses is highly recommended (see page 16). Please pay close attention to the Operating Precautions (page 17).

Use loudspeaker cables of sufficient gauge (thickness) for the length used. The resistance introduced by inadequate speaker cables will reduce both the output power and the motion control of the loudspeakers. The latter problem occurs because the damping factor decreases as the speaker cable resistance increases. This is very important because you can easily negate the superior damping factor of the Macro Reference by using mediocre speaker cables.

Ohms per 1000 ft	AWG No.
0.059	0000
0.064	000
0.081	00
0.102	0
0.126	1
0.159	2
0.200	3
0.254	4
0.319	5
0.403	6
0.508	7
0.605	8
0.808	9
1.018	10
1.284	11
1.619	12
2.042	13
2.575	14
3.247	15
4.094	16
5.163	17
6.510	18
8.210	19
10.35	20
13.05	21
16.46	22
20.76	23
26.17	24
33.00	25
41.62	26
52.48	27
66.17	28

Use the following procedure to find the recommended wire gauge (AWG or American Wire Gauge) for your system.

HOW TO DETERMINE APPROPRIATE WIRE GAUGE

1. Decide what damping factor you want the system to have. Your amplifier is capable of providing a phenomenal damping factor of 20,000 from 10 to 200 Hz into an 8 ohm load. Typical damping factors are 50 or lower. Higher damping factors yield greater motion control of loudspeakers.

2. Calculate the required source impedance. This is done by dividing the impedance of the loudspeaker by the desired damping factor as shown below:

$$\textbf{Source Impedance} = \frac{\textbf{Loudspeaker Impedance}}{\textbf{Damping Factor}}$$

3. Measure how long the loudspeaker cable must be. *Important: keep the length as short as possible.*

4. Calculate the maximum allowable wire resistance per 1000 feet for the cable by dividing the source impedance times 1000 by twice the cable distance as shown below:

$$\textbf{Ohms per 1000 ft} = \frac{\textbf{Source Impedance} \times \textbf{1000}}{\textbf{Cable Length (ft)} \times \textbf{2}}$$

   The reason why the cable length is multiplied by 2 is because both of the two conductors feeding the loudspeaker must be included in the calculation.

5. Use the table at left to find the wire gauge (AWG) with a resistance equal to or less than the maximum allowable wire resistance calculated above. *Note: The smaller the AWG, the bigger the wire.*

Example: We want to drive an 8 ohm loudspeaker with a damping factor of 1,000 so we calculate the required source impedance as 8 ohms ÷ 1,000 = 0.008 ohms. Our loudspeaker cable must be 10 feet long so we calculate the maximum allowable wire resistance as (0.008 ohms x 1000) / (10 ft x 2) = 0.4 ohms per 1000 ft. Next we look on the table to find the corresponding wire gauge and we see that 6-gauge wire is very close with a resistance of 0.403 ohms per 1000 feet. Answer: Use 6-gauge wire or larger.

Hint: If this gauge is too large you can use more than one cable. A rule of thumb is that every time you double the number of conductors of equal gauge, you subtract 3 from the apparent gauge. In our previous example you could double the number of cables feeding the loudspeaker. This would allow you to drop the wire gauge to 9. Or you could use four 12-gauge cables.

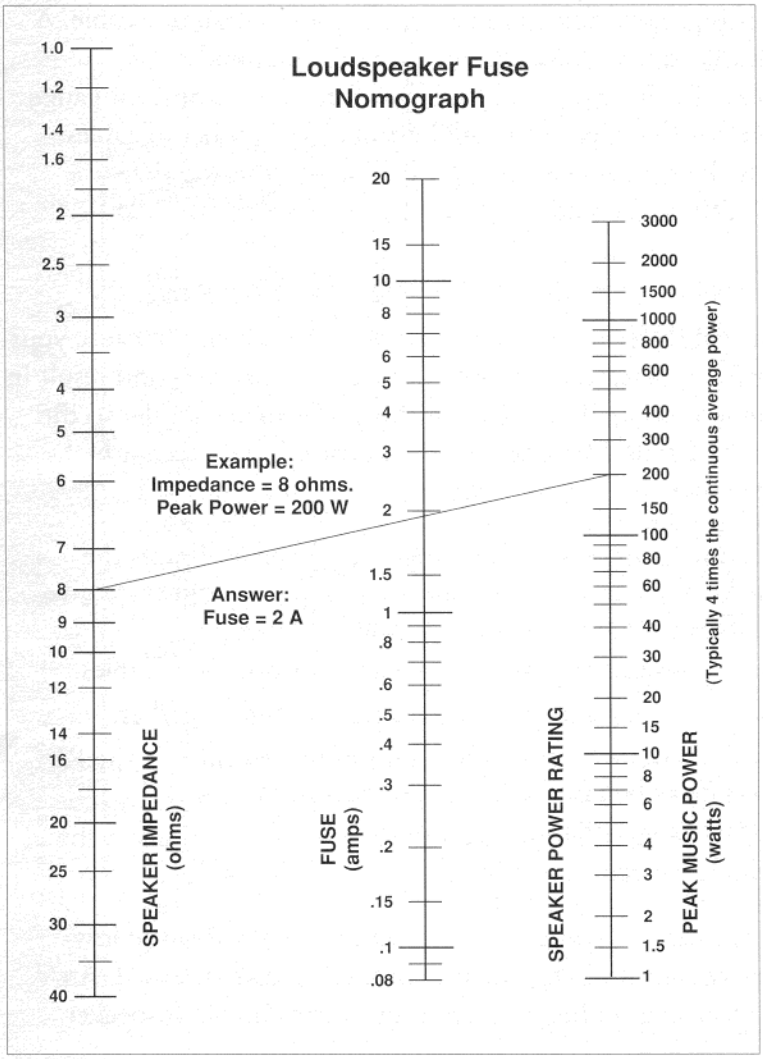
SOLVING OUTPUT PROBLEMS

Sometimes **high-frequency oscillations** occur which can cause your amplifier to prematurely activate its protection circuitry and result in inefficient operation. The effects of this problem are similar to the effects of the RF problem described on page 12. To prevent high-frequency oscillations from occurring:

- ❑ Lace the loudspeaker cables together. This minimizes the chance of them acting like an antenna to transmit or receive the high frequencies which can cause oscillation.
- ❑ Keep loudspeaker cables well separated from input cables.
- ❑ Never connect the input and output grounds together.
- ❑ Install a low-pass filter on each input line (similar to the RF filters described in the Input Connection section).
- ❑ Install the input wiring according to the instructions in the Input Connection section.

Another problem to avoid is the presence of large **subsonic low-frequency currents** when primarily inductive loads are used. An example of such an inductive load is an electrostatic loudspeaker.

Inductive loads can appear as a "short" at low frequencies, causing the amplifier to produce large low-frequency currents and unnecessarily activate its protection circuitry. Always take the precaution of installing a high-pass filter at the inputs to the amplifier when a predominantly inductive load is used. A 3-pole (18 dB per octave) filter with a –3 dB frequency of 50 Hz is recommended. (Depending upon your application, it may be more desirable to use a filter with an even higher –3 dB frequency.) Such a filter should eliminate the subsonic frequency problems mentioned in the Input Connection section.



LOAD PROTECTION

Since your amplifier can generate enormous power, you may desire to protect your loudspeakers or other sensitive loads from damage resulting from excessive power. A common way to do this is to place a fuse in series with the load.

Typical fuses help prevent damage due to prolonged overload, but provide little if any protection against sudden large transients. To minimize this latter problem, use high-speed instrument fuses such as the Littlefuse 361000 series. If, on the other hand, the loudspeaker is only susceptible to damage caused by prolonged overload (such as overheating), use a fuse or circuit breaker having the same slow thermal response as the loudspeaker (such as a slow-blow fuse).

The nomograph at left shows fuse size versus loudspeaker peak power rating. It can be used to determine what size fuse to use.

AC Mains Power Requirements

Each Macro Reference amplifier is furnished with a three-wire AC plug. Use an isolated wall outlet whenever possible with adequate current (see page 30 for further details). Line voltages greater than 132 VAC will actuate an internal control circuit which protects the amplifier.

When testing the amplifier, the peak mains voltage must be equivalent to the peak voltage of a 120 VRMS sine wave when at full load. Line voltage problems can reduce the available output power.

Operation

Your amplifier is well protected from any external hazards; however, it is wise to adhere to the following precautions for safe operation:

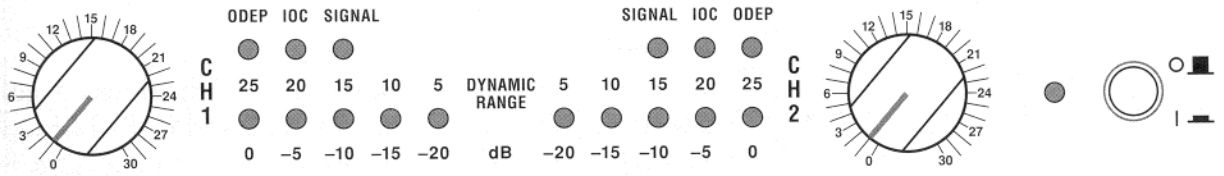
Precautions

1. There are important differences in each of the three operating modes (STEREO, BRIDGED-MONO and PARALLEL-MONO). Refer to the Wiring section beginning on page 8 for further details.
2. **WARNING: Do not change the position of the Stereo-Mono switch unless the amplifier is first turned off.**
3. **CAUTION: In PARALLEL-MONO mode, a jumper is used between the red banana posts (outputs). Be sure to remove it for BRIDGED-MONO or STEREO operation; otherwise inefficient operation, high distortion and excessive heating will definitely occur.** Check the Stereo-Mono switch on the back panel for proper position.
4. Turn the amp off and unplug it from the AC mains before removing a *P.I.P.* card or before removing and cleaning the dust filter.
5. Use care when making connections, selecting signal sources and controlling the output level. The load and ears you save may be your own!
6. Do not short the ground lead of an output cable to the input signal ground. This may form a ground loop and cause oscillations.
7. Operate the amplifier from AC mains no greater than 132 or less than 108 VAC and only at 60 Hz.
8. Never connect the output of the amplifier to a power supply output, battery or power main.
9. Do not tamper with the circuitry or allow an unqualified person to service your amplifier or the warranty will be made invalid.

Remember: Crown is not liable for any damage resulting from overdriving other components in your system.

Indicators

The front panel contains several helpful indicators. These are shown below and on page 5.



The **Enable indicator** signals that the amplifier has been turned on or enabled. It is driven by the low-voltage power supply only and does not indicate the high-voltage power supply status. Because of this, it will remain on if the high-voltage supplies are disrupted. For example, the Enable indicator will remain on in the improbable event that one or both channels overheat causing an internal shut down of the high-voltage supplies. *Note: The AC mains transformer is always powered. This is why the amplifier must be unplugged from the AC mains before any wiring changes are made.*

The ***ODEP* indicators** glow brightly to confirm normal operation of Crown's patented Output Device Emulator Protection circuitry. They also indicate the presence of ample thermal-dynamic energy reserve for the current operating conditions. In the rare event there are not adequate energy reserves, the indicators will dim in proportion to *ODEP* limiting.

HOW *ODEP* WORKS

Crown invented *ODEP* to solve two long-standing problems in amplifier design: To prevent amplifier shutdown during demanding operation and to increase the efficiency of output circuitry. To do this, Crown established a rigorous program to measure each output transistor before installing it in an amplifier. In this way the *safe operating area* (SOA) of each device is known. Next, Crown designed intelligent circuitry to simulate the instantaneous operating conditions of those output transistors. Its name describes what it does: Output Device Emulator Protection or *ODEP*. It not only simulates the operation of the output transistors but it also compares their operation to their known SOA. If it sees that more power is about to

be asked of them than they are capable of delivering under current conditions, it immediately limits their drive level until it falls within their SOA. The limiting is proportional and is kept to an absolute minimum—only what is required to prevent output transistor damage. This level of protection enables Crown to increase output efficiency to never-before-achieved levels while at the same time greatly increasing amplifier reliability. Finally, this on-board intelligence is monitored two different ways. First, there are *ODEP* indicators provided on the front panel to show that everything is functioning perfectly and to alert if limiting begins. Second, *ODEP* data is fed to the *P.I.P.* connector at the back of the amplifier so advanced *P.I.P.* modules like the IQ-P.I.P. can use it to make decisions and control the amplifier. With *ODEP* the show won't stop because you get the maximum power with the maximum protection.

The ***IOC* indicators** function as sensitive distortion meters (Input/Output Comparators) to provide *proof of performance.* They flash in the unlikely event that the waveform of the output signal differs from that of the input by 0.05% or more. It is normal for them to turn on momentarily when the amplifier is first turned on. Also, the Channel 2 *IOC* indicator will stay on in PARALLEL-MONO mode.

The **Signal presence indicators** are provided to give visual indication that an audio signal is present at the input of the amplifier. The indicators flash synchronously with the input signal level. If the input signal is weak or at a very low level, it might not cause the indicators to flash at all.

The **Dynamic Range / Level meters** are five-segment output meters which can be set to monitor either the dynamic range of the output signal or the relative level of the output signal. They are initially set as dynamic range meters at the factory. A switch, located behind the front panel, is used to set them (see page 20 for full instructions on changing the switch). As dynamic range meters they show the ratio of the peak to average power of each channel in dB. The dynamic range may be high for some audio sources, like live audio or a quality digital or analog recording, or it may be low for other sources, like typical AM or FM radio. As output level meters they show how high the output levels are in dB relative to full power. At 0 dB the unit is at full power or 760 W into 8 ohm loads (stereo).

Controls

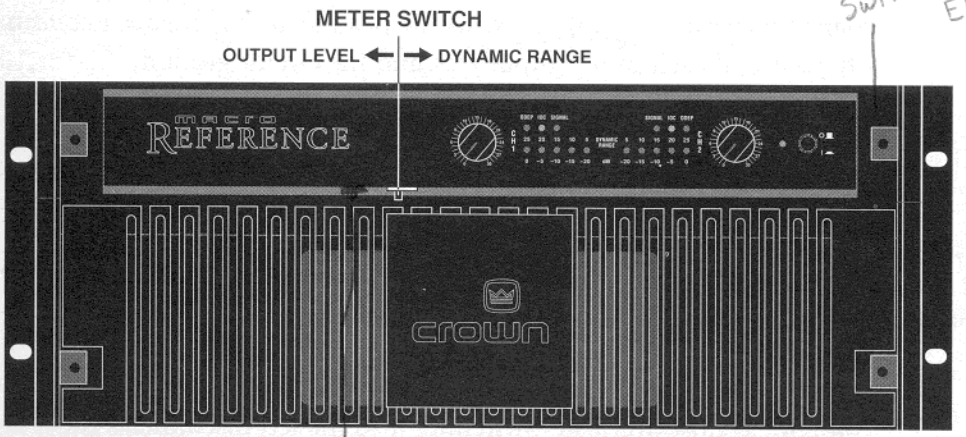
The **Enable switch** is located on the front panel so you can easily turn the amplifier on or off. *Remember to also disconnect the power cord before making any wiring or installation changes.* Please follow these steps to set the maximum level when turning on your amplifier for the first time:

1. Turn down the level of your audio source. Example: Turn down the master volume of your mixer.
2. Turn down the level controls of the amplifier (if they are not already down).
3. Turn on the Enable switch. The Enable indicator beside the switch should glow. During the four second mute delay which immediately follows, the *IOC* and Signal presence indicators will flash unpredictably and the *ODEP* indicators will stay off. After the mute delay, the *ODEP* indicators should come on with full intensity and the *IOC* and Signal presence indicators should function normally. *Remember: The Channel 2 IOC indicator will remain on in PARALLEL-MONO mode.*
4. After the mute delay, turn up the level of your audio source to the maximum desired level.
5. Turn up the Level controls of the amplifier until the maximum desired sound level is achieved.
6. Turn down the level of your audio source to its normal range.

The **Level controls** are also located on the front panel for ease of use. Each control has 31 detents to help you repeat an exact setting. *Important: In either BRIDGED-MONO or PARALLEL-MONO mode turn down the Channel 2 Level control and use only the Channel 1 control.*

The **Dynamic Range / Level meter switch** is located behind the front panel. To change it follow these steps:

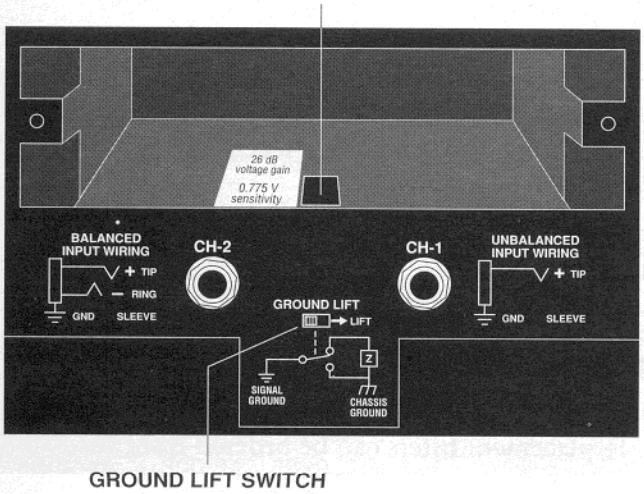
1. Turn the amplifier off and disconnect its power cord from the AC mains power receptacle.
2. Remove the front panel (four Phillips-head screws).



3. Locate the Dynamic Range / Level meter switch as shown at left and set it to the desired position. The right position selects the Dynamic Range meter. The left position selects the Level meter.

4. Replace the front panel and reconnect the power cord.

The **Input Sensitivity switch** is located inside the rear of the amplifier and is factory-set to 0.775 V for rated output into 8 ohms. If desired, it can be switched to a fixed voltage gain of 26 dB. When set to the fixed-gain position, the input sensitivity is 3.9 V for full output. Here is the procedure:



1. Turn the amplifier off and disconnect its power cord from the AC mains power receptacle.

2. Remove the *P.I.P.* module (two screws).

3. Locate the sensitivity switch access hole inside the chassis opening shown at left. It is located just above the phone input jacks.

4. Set the switch to the desired position noted on the access-hole label. (Move the switch toward the front panel to set the sensitivity for a voltage gain of 26 dB or move the switch toward the rear panel for a sensitivity of 0.775 V for rated power.)

5. Replace the *P.I.P.* module and reconnect the *power cord.*

The **Ground Isolation switch** is located on the rear panel and can provide isolation between the input signal ground and the AC ground. It affects only the phone input jacks and has no affect on the input connectors on the *P.I.P.* module. Sliding the switch to the

right isolates or "lifts" the grounds by placing an impedance between the sleeve of each phone input jack and the circuit ground.

Note: When a P.I.P. module is plugged into the amplifier, only the noninverted and inverted signal lines are connected in parallel with the corresponding lines of the input phone jacks. The signal grounds are not paralleled. For example, XLR pins 2 and 3 are connected in parallel with the tip and ring of the corresponding phone jack. However, pin 1 of the XLR is not connected in parallel with the sleeve of the phone jack.

The **Reset switch** is located on the rear panel to protect the power supplies against overload. Switching it to the left disconnects the power cord from the power supplies. Switching it to the right reconnects the power cord to the power supplies. If the reset switch trips, the Enable indicator will turn off. If this should ever happen, turn off the Enable switch and push the Reset switch back to the on position. Then turn the Enable switch back on. If the Reset switch trips again or the amplifier fails to operate properly, contact an authorized service center or the Crown factory for service.

Filter Cleaning

A dust filter is provided on each air intake to the cooling system. They are located on the front panel of the amplifier. If the filters become clogged, the amplifier will not cool as efficiently as it should and may produce lower-than-normal output levels due to high heat-diffuser temperature.

To clean, remove the front panel of the amplifier to gain access to the filters. There are only four Phillips-head screws to remove. The filters are designed to be cleaned while still attached to the front panel. Use a mild dishwashing detergent and warm water to clean them. Make sure both the filters and the front panel are dry before reinstalling them. Replacement filters can be ordered from the factory.

Dust filters are not 100% efficient—long term use will require that the internal heat diffusers be cleaned by a qualified technician. Internal cleaning information is available from our Technical Services Department.

Service

Your amplifier has very sophisticated circuitry which should only be serviced by a fully trained technician. This is one reason why each unit bears the following label:

CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT OPEN. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO A QUALIFIED TECHNICIAN.

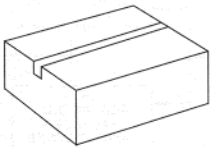
Crown customers may obtain service two ways: from an authorized Crown Service Center or from the factory. You may choose either method. It is important that you have your copy of the bill of sale as your proof of purchase.

Service at a Crown Service Center

This method usually saves you the most time and effort. Simply present your bill of sale along with the defective unit to an authorized Crown Service Center to obtain service. They will handle the necessary paperwork and repair. Remember to transport your unit in the original factory pack.

Crown Factory Service

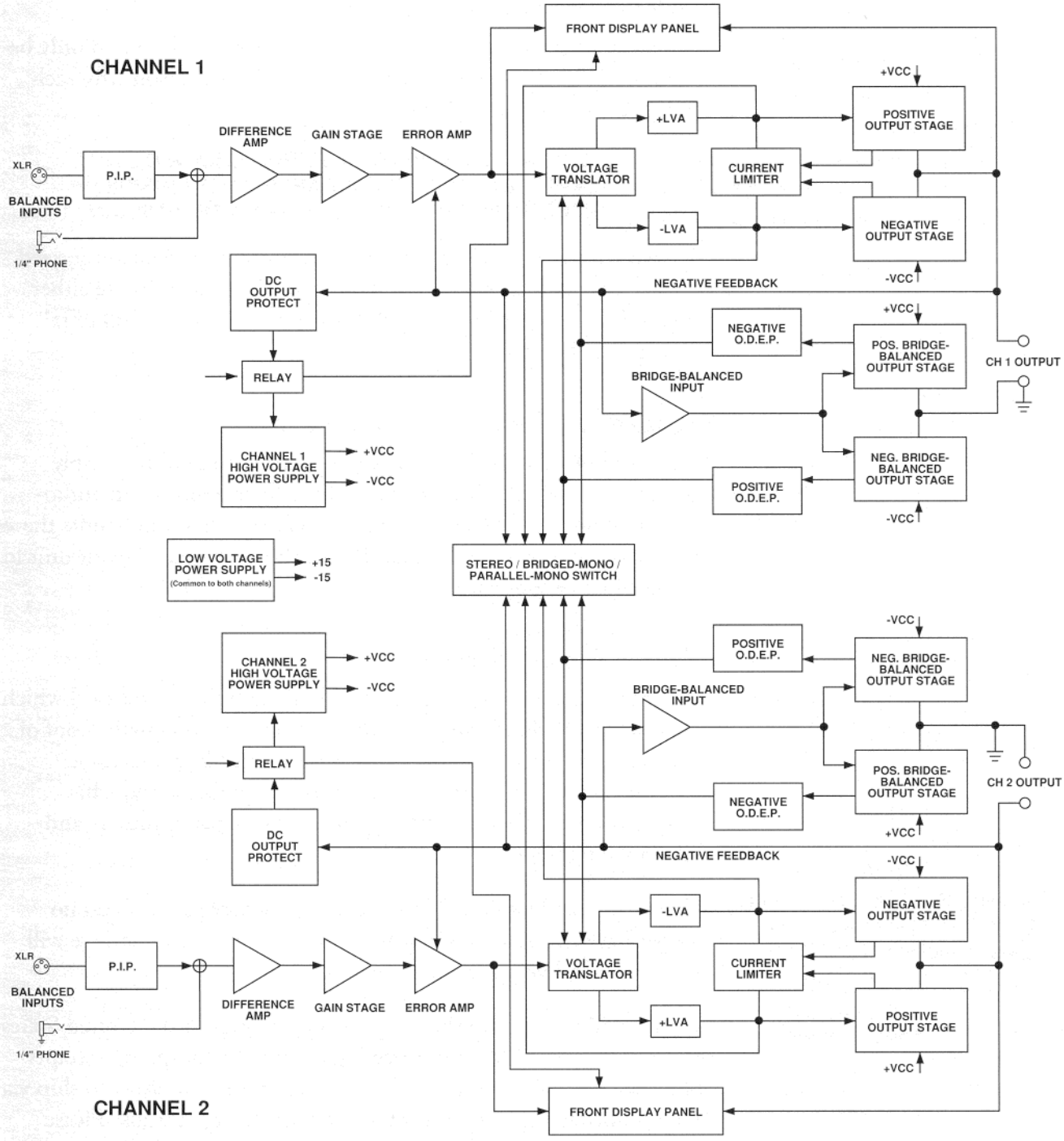
To obtain factory service, fill out the Service Information card which came in an envelope with your unit and send it along with proof of purchase and the unit in need of service to the Crown factory. Enclose a letter explaining the nature of the problem and what service you would like. Include your return shipping address and telephone number.



Crown
Technical Services Department
1718 West Mishawaka Road
Elkhart, Indiana 46517-4095
Phone: 1-800/342-6939
or: 1-219/294-8200
Fax: 1-219/294-8365

The unit must be shipped in the original factory pack. If you no longer have the original shipping container, contact us and we will promptly send you a replacement.

Crown will pay surface shipping costs both ways in the United States **for warranty service** upon receiving copies of all shipping receipts. Shipments should be sent by truck. (The unit is too heavy to ship via UPS.) The factory will return your serviced unit via truck. Please contact our Shipping Department at 219/294-8246 if other arrangements are necessary.


CHANNEL 1
FRONT DISPLAY PANEL
+VCC
POSITIVE OUTPUT STAGE
+LVA
DIFFERENCE AMP
GAIN STAGE
ERROR AMP
XLR
P.I.P.
VOLTAGE TRANSLATOR
CURRENT LIMITER
BALANCED INPUTS
-LVA
NEGATIVE OUTPUT STAGE
1/4" PHONE
-VCC
DC OUTPUT PROTECT
NEGATIVE FEEDBACK
+VCC
NEGATIVE O.D.E.P.
POS. BRIDGE-BALANCED OUTPUT STAGE
CH 1 OUTPUT
BRIDGE-BALANCED INPUT
RELAY
CHANNEL 1 HIGH VOLTAGE POWER SUPPLY
+VCC
-VCC
NEG. BRIDGE-BALANCED OUTPUT STAGE
POSITIVE O.D.E.P.
-VCC
LOW VOLTAGE POWER SUPPLY
(Common to both channels)
+15
-15
STEREO / BRIDGED-MONO / PARALLEL-MONO SWITCH
-VCC
POSITIVE O.D.E.P.
NEG. BRIDGE-BALANCED OUTPUT STAGE
CHANNEL 2 HIGH VOLTAGE POWER SUPPLY
+VCC
-VCC
BRIDGE-BALANCED INPUT
RELAY
POS. BRIDGE-BALANCED OUTPUT STAGE
CH 2 OUTPUT
NEGATIVE O.D.E.P.
+VCC
DC OUTPUT PROTECT
NEGATIVE FEEDBACK
-VCC
NEGATIVE OUTPUT STAGE
-LVA
XLR
P.I.P.
VOLTAGE TRANSLATOR
CURRENT LIMITER
BALANCED INPUTS
+LVA
POSITIVE OUTPUT STAGE
DIFFERENCE AMP
GAIN STAGE
ERROR AMP
1/4" PHONE
+VCC
FRONT DISPLAY PANEL
CHANNEL 2

Technical Excellence

The Macro Reference incorporates several new technological advancements including real-time computer simulation, low-stress output stages, and an advanced thermal diffuser embodiment.

Extra circuitry is incorporated to limit temperature and current to safe levels—making it highly reliable and tolerant of faults. Unlike many lesser amplifiers, it can operate at its voltage and current limits without self-destructing.

The Macro Reference is protected against all common hazards that plague high-power amplifiers, including shorted, open or mismatched loads; overloaded power supplies; excessive temperature, chain-destruction phenomena, input-overload damage, and high-frequency blowups. The unit protects loudspeakers from DC in the input signal and from turn-on/turn-off transients. It also detects and prevents unwanted DC on the outputs.

Real-time computer simulation is used to create an analog of the junction temperature of the output transistors (herein referred to as the output devices). Current is limited only when the device temperature becomes excessive—and just by the minimum amount necessary. This patented approach maximizes the available output power and eliminates overheating—the major cause of device failure.

The four-quadrant topology used in the Macro Reference grounded output stages is called the *grounded bridge*™, and makes full use of the power supply at all times. This patented topology also provides peak-to-peak voltages available to the load that are twice the voltage the output devices are exposed to.

The *grounded bridge* topology is ground-referenced. Composite devices are constructed to function as gigantic NPN and PNP devices, since the available currents exceed the limits of available devices. Each output stage has two of these composite NPN devices and two composite PNP devices.

The devices connected to the load are referred to as "high-side NPN and PNP" and the devices connected to ground are referred to as "low-side NPN and PNP." Positive current is delivered to the load

by increasing conductance simultaneously in the high-side NPN and low-side PNP stage, while decreasing conductance of the high-side PNP and low-side NPN in synchrony.

The two channels may be used together to double the voltage (bridged-mono) or the current (parallel-mono) presented to the load. This feature gives the user flexibility in maximizing the power available to the load.

A wide-bandwidth multiloop design is used for state-of-the-art compensation. This produces ideal behavior and results in ultra-low distortion values.

Aluminum extrusions have been widely used for heatsinks in power amplifiers due to their low cost and reasonable performance. However, measured on a watts per pound or watts per volume basis, the extrusion technology doesn't perform nearly as well as the thermal diffuser technology developed for the Macro Reference.

Our thermal diffusers are fabricated from custom convoluted fin stock that provides an extremely high ratio of area to volume, or area to weight. Since all the output devices are mounted directly to the diffusers they are electrically "live." Making them electrically live allows improved thermal performance by eliminating the insulating interface underneath the output devices. The chassis itself is used as part of the thermal circuit, maximizing available cooling resources.

Circuit Theory

Power is provided by low-field toroidal power transformer T1. The secondaries of T1 are full-wave rectified by D17, D18, D1-4 and filtered by large computer-grade capacitors. A thermal switch embedded in the transformer protects it from overheating.

Monolithic regulators provide a regulated ±15 volts.

STEREO OPERATION

For simplicity, the discussion of stereo operation will refer to one channel only. Mono operations will be discussed later.

Please refer to the block diagram on page 24 and the schematics provided with your amplifier.

The input signal at the phone jack passes directly into the balanced gain stage (U104-A). Use of a *P.I.P.* module for input signal causes the input signal to pass through the *P.I.P.* and then to the balanced gain stage.

The balanced gain stage (U104-A) causes balanced-to-single-ended conversion to take place using a difference amplifier. From there, gain is controlled with the front-panel level controls and the internal input sensitivity switch. (The input sensitivity switch is located through the *P.I.P.* opening in the rear panel. See page 21.) The error amp (U104-C) amplifies the difference between the output signal and the input signal from the gain stage, and drives the voltage-translator stage.

The voltage-translator stage channels the signal to the Last Voltage Amplifiers (LVA), depending on the signal polarity, from the error amp U104-C. The +LVA (Q104,Q105) and the –LVA (Q110,Q111), with their push-pull effect through the bias servo Q318, drive the fully complementary output stage.

The bias servo Q318 is thermally coupled to the thermal diffuser, and sets the quiescent bias current in the output stage to lower the distortion in the crossover region of the output signal.

With the voltage swing provided by the LVAs, the signal then gains current amplification through the triple Darlington emitter-follower output stage.

The bridge-balanced circuit (U104-D) receives a signal from the output of the amplifier, and differences it with the signal at the VCC supply. The bridge-balanced circuit then develops a voltage to drive the bridge-balanced output stage. This results in the VCC supply having exactly one-half of the output voltage added to their quiescent voltage. D309, D310, D311 and a trimmer resistor set the quiescent current point for the bridge-balanced output stage.

The protection mechanisms that affect the signal path are implemented to protect the amplifier under real-world conditions. These conditions are high instantaneous current, excessive temperature, and operation of the output devices outside safe conditions.

Q107 and Q108 act as a conventional current limiter, sensing current in the output stage. When current at any one instant exceeds the design criteria, the limiters attenuate the drive from the LVAs, thus limiting current in the output stage to a safe level.

To further protect the output stages, a specially developed *ODEP* circuit is used (Output Device Emulator Protection). It produces an analog output proportional to the always-changing *safe operating area* margin of the output transistor. This output controls the translator stage previously mentioned, removing any further drive that may exceed the *safe operating area* of the output stage.

Thermal sensor S100 gives the *ODEP* circuits vital information on the operating temperature of the thermal diffusers on which the output devices are mounted.

Should the amplifier fail in such a way that would cause DC across the output lead, the DC protection circuit senses this and shuts down the power supply until the DC is removed.

BRIDGED-MONO OPERATION

By setting the rear panel Stereo-Mono switch to BRIDGED-MONO, the user can convert the amplifier into a bridged-mono amplifier. With a signal applied to the Channel 1 input jack, and the load between the red banana posts on the back panel, a double-voltage output occurs.

The Channel 1 output feeds the Channel 2 error amp U204-C. Since there is a net inversion, Channel 2 output is out of polarity with Channel 1. This produces twice as much voltage across the load. Each of the channel's protection mechanisms work independently if a fault occurs.

PARALLEL-MONO OPERATION

With the Stereo-Mono switch set to PARALLEL-MONO, the output of Channel 2 is paralleled with that of Channel 1. A suitable high-current-handling jumper must be connected across the red banana posts to gain the benefits of this mode of operation.

The signal path for Channel 1 is the same as previously discussed, except that Channel 1 also drives the output stage of Channel 2. The balanced input, error amp, translators, and LVAs of Channel 2 are disconnected and no longer control the Channel 2 output stage. The Channel 2 output stage and protection mechanisms are also coupled through S1 and function as one.

In PARALLEL-MONO mode, twice the current of one channel alone can be obtained. Since the *ODEP* circuit of Channel 2 is coupled through S1, this gives added protection if a fault occurs in the Channel 2 output stage. The *ODEP* circuit of Channel 2 will limit the output of both output stages by removing the drive from the Channel 1 translator stages.

Specifications

Performance

Note: 8 ohm loads were used unless specified otherwise.

Frequency Response: ± 0.1 dB 20 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio: Greater than 120 dB (A-weighted) below rated output at 26 dB gain.

Bandwidth: 3 Hz to 100 kHz.

IM Distortion: Less than 0.005% from 760 watts through –10 dB, increasing smoothly to a maximum of 0.025% at –40 dB, measured at 26 dB gain.

Damping Factor: Greater than 20,000 from 10 Hz to 200 Hz. 1,800 at 1 kHz.

Power

Power Bandwidth:

10 Hz to 25 kHz –1.0 dB.
7 Hz to 27 kHz –1.5 dB.
5 Hz to 28 kHz –2.0 dB.
4 Hz to 30 kHz –3.0 dB.

Output Power:
Note: Watts per channel in STEREO mode with 0.02% or less THD while both channels driven.

760 watts into 8 ohms.
1,160 watts into 4 ohms.
1,500 watts into 2 ohms.

Load Impedance: Rated for 16, 8, 4, and 2 ohm usage only. Safe with all types of loads, even reactive ones.

Required AC Mains: 60 Hz, 120 VAC (±10%). Draws 70 watts or less at idle. Draws as high as 26 amps with a continuous 1 kHz sinewave output of 760 watts into 8 ohms in STEREO mode.

It is extremely important to have adequate AC power available to the amplifier. Power amplifiers cannot create energy—they must have the required voltage and current to deliver the undistorted rated wattages you expect.

Controls

Enable: A pushbutton located on the front panel to turn the amplifier on and off.

Level: A signal level control with 31 detents for each channel, located on the front panel.

Stereo-Mono: A three-position switch located on the back panel which selects between STEREO, BRIDGED-MONO, and PARALLEL-MONO modes of operation.

Input: A two-position switch located inside the amplifier selects between two input sensitivities. (A voltage gain of 26 dB or a sensitivity of 0.775 V for full rated output.)

Dynamic Range / Level Meter: A two-position switch located behind the front panel sets the display meter on the front panel as either a dB Dynamic Range meter or a dB Level meter.

Ground Lift: A two-position switch located on the back panel which can be used to isolate the audio signal ground from the chassis (AC) ground.

Reset: A 30-amp circuit breaker located on the back panel which protects the power supplies.

Indicators

Enable: This indicator is on while the amplifier is on to show that the low-voltage power supply is operating.

ODEP: Two multifunction indicators which show the thermal-dynamic reserve energy status of each channel. Normally they are brightly illuminated to show that reserve energy is available. In the rare event there is no reserve, they will dim in proportion to *ODEP* limiting. They remain off if a tripped breaker, blown fuse or thermal shutdown occurs. (In the case of a thermal shutdown, the ampli-

fier will automatically return to normal operation after cooling.)

IOC: Two indicators which are normally off. In the unlikely event the output waveform differs from that of the input by 0.05% or more, they will flash. In this way, they act as sensitive distortion indicators to provide proof of performance. *Note: It is normal for the Channel 2 IOC indicator to remain on in PARALLEL-MONO mode.*

Signal: Two Signal presence indicators flash in sync with the input signal to show its presence.

Dynamic Range / Level Meter: Two five-segment meters (one per channel) display either the output dynamic range in dB or the output level in dB. (Your unit comes factory-set to display dynamic range.) As dynamic range meters they show the ratio of the peak to average power of each channel. As output level meters they show how high the output levels are relative to full power.

Input/Output

Input Connector: Balanced phone jacks on chassis and internal *P.I.P. connector. (Balanced 3-pin XLR* connectors are provided on P.I.P.-FX which is a standard feature.)

Input Impedance: Nominally 10 K ohms, balanced. Nominally 5 K ohms, unbalanced.

Input Sensitivity: Switchable between 0.775 V (unbalanced) for rated output or a fixed voltage gain of 26 dB. (See page 21 for more information.)

Output Connector: Color-coded dual binding posts (banana jacks).

DC Output Offset: (Shorted input) ±2 millivolts.

Output Signal

Stereo: Unbalanced, two-channel.

Bridged-Mono: Balanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

Parallel-Mono: Unbalanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

Protection

If unreasonable operating conditions occur the protection *circuitry limits the drive level to* protect the output transistor stages, particularly in the case of elevated temperature. Transformer overheating will result in a temporary shutdown of that particular channel. Controlled slew-rate voltage amplifiers protect the unit against RF burnouts. Input overload protection is furnished at the amplifier input to limit current.

Turn On: No dangerous transients. Four second turn-on delay. *Note: This may be changed by resistor substitution. Contact Crown Technical Services Department for details.*

Construction

Black splattered-coat steel chassis and engraved back-lit front panel. Chassis utilizes specially designed "flow-through" ventilation from front to side panels.

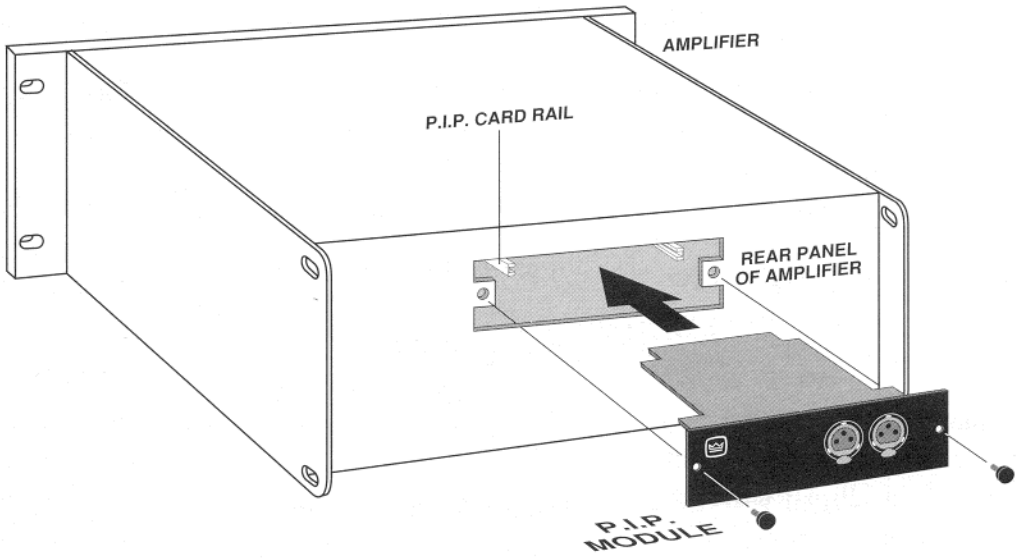
Cooling: Convection cooling with computerized, proportional fan assist. Includes custom heat diffusers and patented circuitry to promote uniform dissipation.

Dimensions: 19-inch standard rack mount (EIA Std. RS-310-B), 7-inch height, 16-inch depth *behind mounting surface, 2.75"* inch in front of mounting surface.

Weight: *56.5 lbs. Center of* gravity is approximately 6 inches behind front mounting surface.

Accessory *P.I.P.* Modules

One of the advantages of the Macro Reference is its ability to be quickly customized via *P.I.P.* (Programmable Input Processor) modules. It comes equipped with a *P.I.P.* card edge connector inside the rear panel. The modules install easily as shown below.



Here are some of the *P.I.P.* modules available:

P.I.P.-AMC is the newest of our *P.I.P.* modules, and combines all the capabilities you need most in one high-performance package. DIP programable, the AMC features a 4th-order Linkwitz-Riley crossover network, "constant directivity" horn equalization, B_6 vented box equalization and a sign-driven/error-driven variable-threshold compressor. In addition, the AMC can be used for bi-amping, tri-amping, and "daisy chaining" of amplifiers.

P.I.P.-FTE has balanced 1:1 isolation transformers, a 12 dB/octave RF filter, a variable 18 dB/octave subsonic (high-pass filter), and a 6 dB/octave 3 kHz shelving network for "constant-directivity" horn equalization. Special quick-connect barrier blocks (Buchanan connectors) are provided for input.

IQ-P.I.P. integrates the Macro Reference into Crown's patented and expanding *IQ System®*. Our *IQ* (Intelligence Quotient) *System* offers centralized remote computer control of 1 to 2,000 amplifiers. (Each channel of each amplifier can be monitored and individually controlled from an inexpensive personal computer. A total of 15 functions can be either monitored or controlled.) Microphone and/or line level signals can also be controlled and routed with optional *MPX-6™* multiplexers. And an optional IQ-COM-Q tape controller enables pre-recorded commands to be played back from a simple audio tape deck to control the system, thus eliminating the need to have a computer in the field with each *IQ System.*

P.I.P.-CLP is designed to detect and prevent overload. The same error-detecting circuit that is used to signal the *IOC* indicator is used to activate this error-driven compressor. It is not a typical signal-driven compressor but a circuit to prevent any overload. It can yield up to 13 dB of additional signal safety margin without noticeable program change.

P.I.P.-ISO is designed especially for 25 to 140 V distribution systems where full isolation is required. Using it, along with minor amplifier modifications, the amplifier outputs are safely isolated from both the input terminals and the chassis.

P.I.P.-ATN adds a 32-step precision attenuator to each channel to the features of the P.I.P.-FTE. These include balanced 1:1 isolation transformers, 12 dB/octave RF filter, variable 18 dB/octave subsonic (high-pass) filter, and a 6 dB/octave 3 kHz shelving network.

P.I.P.-XOV is a versatile, economical mono 12 or 18 dB/octave crossover/filter which offers bi-amping and tri-amping capability.

P.I.P.-FMX facilitates "daisy-chaining" several amplifier balanced inputs together. It comes with female-to -male 3-pin XLR connectors which passively bridge the input of the amplifier.

P.I.P.-FXT uses balanced 1:1 transformers to isolate the source from the inputs. It comes with balanced female 3-pin XLR connectors.

Contact your dealer or the Crown Technical Services Dept. for additional information on these and other *P.I.P.*s under development.

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