



**CROWN**®

# **INSTRUCTION MANUAL**

**POWER LINE FOUR  
STEREO AMPLIFIER**



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## **POWER LINE FOUR STEREO AMPLIFIER**

**CROWN INTERNATIONAL, INC. 1718 W. MISHAWAKA RD. ELKHART, INDIANA 46517**

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K80088-6

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. It does not cover all the possible contingencies which may arise during operation, installation, or maintenance. Should special problems arise, or further information be desired, please contact the Crown International Customer Services Department.

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## **WARNING**

**TO PREVENT SHOCK OR FIRE HAZARD DO NOT EXPOSE TO  
RAIN OR MOISTURE!**

## **CAUTION**

**TO PREVENT ELECTRIC SHOCK DO NOT USE THIS  
(POLARIZED) PLUG WITH AN EXTENSION CORD,  
RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES  
CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE.**

## **ATTENTION**

**POUR PREVENIR LES CHOCs ELECTRIQUES NE PAS  
UTILISER CETTE FICHE POLARISEE AVEC UN  
PROLONGATEUR. UNE PRISE DE COURANT OU UNE AUTRIE  
SORTIE DE COURANT, SAUF SI LES LAMES PEUVENT ETRE  
INSEREES A FOND SANS EN LAISSER AUCUNE PARTIE A  
DECOUVERT.**

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## SECTION 1 GENERAL INFORMATION

### 1.1 Introduction/Purpose of Equipment

The Crown® Power Line Four is a single or dual channel, high output power amplifier. Because of its attractive design and reliable construction, it is an ideal selection for the sincere audio enthusiast. To familiarize yourself with its many features, we recommend studying this manual thoroughly. We also suggest at this time that you pay special attention to the Crown warranty which will help to assure your total satisfaction with the Power Line Four power amplifier (Fig. 1.1).



*Fig. 1.1 Power Line Four Power Amplifier*

### 1.2 Features

The Power Line Four power amplifier has an output capability of 165 watts per channel minimum RMS into an 8 ohm load over a bandwidth of 20Hz-20KHz. This same amplifier when bridged and operating as a single (mono) channel unit, will displace 330 watts minimum into a 16 ohm load. Extremely low harmonic and intermodulation distortion and low noise, add to its high quality characteristics.

An amber "on/off" lamp illuminates when the Power pushbutton is depressed, allowing visual observation of the unit's power status even at long distances.

Other front panel LED's are the Crown IOC™(Input/Output Comparator) and Frequency Analyzing Display. The red, IOC™ lamps not only

indicate the operating condition of the unit (clipping, overload, etc.) but also glow when the unit is in the Stand-by mode. Three colored lamps, make up the Frequency Analyzing Display which attests to the fact that output signal does exist and also shows what frequencies (low, mid or high) make up that signal. This feature is particularly helpful for monitoring the amplifier output during system troubleshooting.

Input Level controls for both channels are detented for exact "resetability" and more accurate control. The detents also provide less chance of accidental movement should they be bumped or jarred.

To help eliminate annoying thumps or pops which can occur upon turn-on, a four second mute/delay circuit is incorporated. As additional aid, protection against accidental DC being fed through the amplifier (and possibly destroying speakers) is provided in the Low Frequency Interrupt circuit.

A thermal circuit automatically places the unit in the Stand-by mode should overheating occur due to insufficient ventilation.

The output transistor circuitry operates in the Crown designed, Multi-Mode™ configuration where at low listening levels, it functions as a Class A circuit, at medium power levels Class A plus B and at high levels, a Class AB+B. At each level, the Crown Multi-Mode™ circuit offers optimum performance and extremely low distortion (see Section 4.2 for further detail). Protection against shorted and low impedance loads is provided with dependable V-I current limiting as well as protection against overloaded power supplies, input overload and high frequency overload blowups.

A front panel output monitor jack is provided not only for headphone use, but also as an additional output source should access be necessary from the front.

Conventional unbalanced pin jacks provide an input signal path to the unit.

The output signal uses standard MDP banana jacks, mounted in a manner to allow simple connection especially for mono signals.

An external Mono /Stereo slide switch provides quick and easy conversion for determining the Power Line Four's operating configuration as a single or dual channel amplifier.

Sturdy, zinc die cast handles are also standard. They provide easier handling when mounting the unit and over-all better mobility when transporting by hand.

### 1.3 Service Policies

Due to the sophisticated circuitry of your unit, only qualified, fully trained technicians should be allowed to service it. Please observe the following label on the unit: **CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT OPEN. NO USER SERVICABLE PARTS INSIDE. REFER SERVICING TO A QUALIFIED TECHNICIAN.**

For service, return the unit to the factory in the original packing or in replacement packing obtainable from the Crown factory. For warranty service, the unit must be returned to the factory or an approved service station (Amcron customers consult your local representative). In either case, fill out and enclose the Service Information form located at the rear of this manual. This will help to ensure a speedy and effective response.

Crown will pay shipping costs (in the U.S.) for warranty service upon receiving copies of all shipping receipts.

Before returning your unit to the factory for service, authorization should be obtained from the Crown Technical Service Department. All shipments should be sent UPS or truck freight (insured). The factory will then return your serviced unit by one of the above methods.

Upon receipt of the warranty registration card from your dealer, Crown will automatically send you the Crown Care Card. This is a plastic, wallet-sized card (Fig. 1.2) This is your warranty certificate.

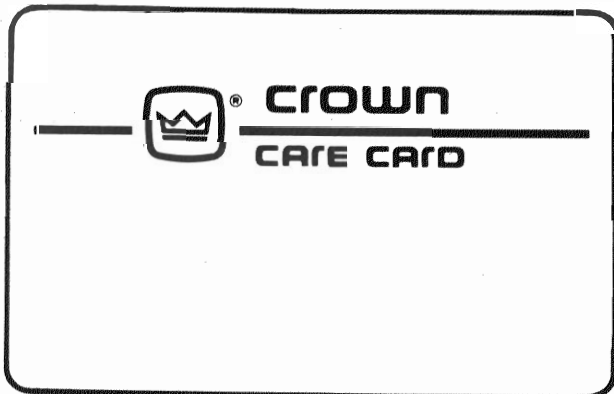


Fig. 1.2 Crown Care Card

Printed on it will be your name, the model number and serial number of your new Crown unit, and the expiration date of the warranty on that product.

Crown will replace lost Care Cards at no charge and will issue new cards for repurchased units.

When you need service for your unit from an authorized Crown Service Station, simply present your Crown Care Card. It is all the identification you need. With it, the service station can promptly initiate any needed paperwork. It will save you time and effort.

The Crown Care Card is also your proof of ownership should you need it for insurance or legal reasons. It is also a convenient place to look for the serial number should you want to write to the factory for any reason.

### 1.4 Glossary of Terms

**A-B Test:** Evaluating relative performance of two (or more) components or systems by changing quickly from one to the other. Most high fidelity dealers have A-B test facilities.

**AGC:** Automatic Gain Control. A type of circuit used to maintain the output volume of a receiver constant, regardless of variations in the signal strength applied to the receiver.

**Attenuation:** A decrease in signal magnitude from one point to another, or the process causing this decrease.

**Balanced Input:** A three wire input system where the voltages and currents in two of the wires are equal in magnitude but opposite in polarity with respect to ground which is the third wire. The impedance of a balanced input is usually low. (600 ohms or less)

**Balun:** A device used for the transformation from an unbalanced line or system to a balanced line or system, or vice versa. The term is derived from balance to unbalance transformer.

**Bandpass Filter:** A filter that allows transmission of alternating signals whose frequencies are between given upper and lower cutoff values, while substantially attenuating all frequencies outside this band.

**Biamp:** The use of independent amplifiers to feed the bass and treble portions of a loudspeaker or loudspeakers with a crossover network. The purpose is to help reduce intermodulation between bands when a system is overloaded. It also reduces the cost of implementing good, low loss precision crossover networks.

**Butterworth Filter:** A filter that exhibits the flattest possible response in the passband. The response rolls off smoothly into the stop band, where it approaches a constant slope of  $6n$  db/octave; where  $n$  is the number of

poles in the network, i.e. a single pole is 6dB, two pole 12dB, 3 pole 18dB, etc.

**Capture Ratio:** The ability of a receiver to reject a weaker station whose frequency is the same as that of the desired station. This measurement will be in dB. The smaller the figure, the better the spec.

**Ceramic Filter:** A bandpass filter using a piezoelectric substrate material.

**Channel:** A channel is a complete sound path. A single channel, or monophonic system, has one channel. A stereophonic system has at least two full channels designated as left (A) and right (B). Monophonic material may be played through a stereo system; both channels will carry the same signal. Stereo material, if played on a monophonic system, mixes and emerges as a monophonic sound.

**Channel Separation:** Specified in dB, channel separation is the ratio of the measurable output of one channel to the unwanted output of the (undriven) opposite channel.

**Clipping:** The truncation of peaks of a signal due to exceeding the operating range of an electronic circuit. Normally, it refers to the result of voltage limitations in the circuit.

**Corner Frequency:** The frequency at which a filter goes from a condition of passing the signal unattenuated to "rolling off" or attenuating the signal according to its frequency. It is sometimes referred to as the "cutoff" frequency or the "break" frequency. It is also defined as 3dB below the unattenuated output level of the signal.

**Cross Modulation:** In FM signals, a type of intermodulation that occurs when the carrier of the desired signal is modulated by an undesirable signal. Each signal is of independent origin.

**Crossover Frequency:** The frequency at which a dividing network delivers equal power to the upper and lower frequency channels when both are terminated in specified loads.

**Crossover Network:** A selective network used to divide the audio frequency output of an amplifier into two or more bands of frequency. The band below the crossover frequency is fed the woofer loudspeaker while the high frequency band is fed the tweeter. Also called dividing network and loudspeaker dividing network.

**Crosstalk:** Signal leakage from one signal source into another.

**Damping:** Controlling of vibrations, response, or resonances which if unchecked, would cause coloration of the sound.

**Damping Factor:** A numerical indication of an amplifier's ability to decrease unwanted loudspeaker movements. Damping factor can be found by dividing the load impedance by the amplifier's output impedance.

**Decibel:** A numerical expression of acoustic or electrical ratios, such as the relative intensity of a sound or the relative strength of a signal. One (dB) is about the smallest change in sound perceptible to the ear.

**Decoder:** A matrix of logic elements that selects one or more output channels according to the combination of input signals present. Can be used in FM to recover stereo signals of a stereo encoded multiplex transmission.

**De-emphasis:** In FM signals, restoring the pre-emphasized (for proper transmission characteristics) signal to result in a "flat" frequency response curve.

**Distortion:** Unwanted noise, or sounds which didn't exist in the studio when the original recording was made. Harmonic distortion produces tones harmonically related to a single, pure tone. Intermodulation distortion (IM) introduces new tones caused by mixing of two or more original tones. Phase distortion, or non-linear phase shift, disturbs timing sequence between a tone and its related overtones. Distortion which creates new spectra are expressed in percentages and phase distortion in degrees of phase shift or seconds of group delay vs. frequency errors.

**Dynamic Range:** The difference between the most intense and the least intense levels in a sound system.

**EAROM:** EAROM stands for Electrically Alterable Read Only Memory which is an integrated circuit chip used to store information without power applied (used in the FM1).

**Equalization:** Frequency response manipulation to meet the requirements of recording, and an inverse manipulation on playback to restore the original. Also known as compensation for acoustic problems of listening rooms.

**Feedback:** Sending a "part" of a system's output back to the input. Positive feedback may lead to unstable conditions such as PA system "howling" due to sound from the speakers being fed back thru the microphone and amplified again. Another form is low frequency interference created when vibrations from loudspeakers are picked up by the cartridge and amplified again. However, carefully controlled negative feedback in electronic circuits can be used to help reduce distortion and control stability.

**Flutter:** Rapid variation in the speed of a turntable or tape transport. Flutter causes a wavering of musical pitch.

**Frequency Response:** This term indicates any amplitude variations in a system output signal with respect to frequency. This measurement is made with a constant level input signal.

**Gain:** The ratio of an amplifier's output voltage to its input voltage.

**Headroom:** Stated in dB, headroom is the difference between the signal level and the limits of the sound system ie; the ratio of power available to power used.

**Hertz:** As in cycles-per-second, not rental agency.

**High Pass/Low Pass Filter:** High pass - a filter having a single transmission band extending from some critical, or cutoff, frequency other than zero, up to infinite frequency. Low pass - a filter network which passes all frequencies below a specified frequency with little or no loss but discriminates strongly against higher frequencies.

**IF:** An Intermediate Frequency is a frequency to which a signal wave is shifted locally as an intermediate step in FM transmission or reception.

**Image Response:** Response of a superheterodyne receiver to the image frequency, as compared to the response to the desired frequency.

**Input Sensitivity:** The input voltage required to drive an amplifier to its rated output.

**IOC™:** Stands for Input-Output Comparator. An extremely sensitive Crown circuit used to indicate, via a front panel LED, the fact that the operating limits of an amplifier are being exceeded resulting in output non-linearity.

**LED:** Light Emitting Diode. A PN junction that emits light when biased in the forward direction.

**Limitter:** A circuit in which the output amplitude is substantially linear with regard to the input up to a pre-determined value and substantially constant thereafter.

**Load:** A device that absorbs power and converts it into the desired form.

**LSI:** Large Scale Integration is an integrated circuit chip housing a large number of active devices.

**Mixer:** A device having two or more inputs, usually adjustable, and a common output, which operates to combine linearly in a desired proportion the separate input signals to produce an output signal.

**Monitoring Amplifier:** A power amplifier used primarily for evaluation and supervision of a program.

**Multipath Delay:** In FM the existence of more than one signal path between transmitter and receiver. The two signals arriving at different times causes distortion.

**Music Power:** This rating expresses the ability of an amplifier to handle short duration power peaks, as opposed to sustained power levels. An amplifier may only be capable of putting out 45 watts if that level is continuous, but it may be able to handle 60 watt peaks (such as might occur in a musical passage), if the peaks do not last too long.

**Muting Circuit:** In FM, a circuit which cuts off the receiver output when the r-f carrier reaching the first detector is at or below a pre-determined intensity.

**Pre-emphasis:** A process in a system designed to emphasize the magnitude of some frequency components with respect to the magnitude of others, to reduce adverse effects, such as noise, in subsequent parts of the system.

**PLL:** Phase Lock Loop; a circuit for synchronizing a variable local oscillator with the phase of a transmitted signal. Can be used in FM as a synthesizer circuit as well as a stereo decoder in the multiplex system.

**Polar Curve:** A pattern used to show the directional characteristics of antennas, microphones or speakers.

**Quartz Crystal:** A complete assembly, comprising a piezoelectric quartz-crystal element mounted, housed, and adjusted to the desired frequency. Such a device is commonly employed for purposes of frequency control, frequency measurement and electric wave filtering.

**Rotor:** A motor driven assembly which turns an antenna so that it can be aimed in the direction of best reception.

**SAW Filter:** Surface Acoustic Wave; commonly used as a bandpass filter. Device transmits surface acoustic waves on a piezoelectric substrate. Used in the FMI for low FM distortion.

**Selectivity:** In FM a measure of the extent to which a receiver is capable of differentiating between the desired signal and disturbances at other frequencies.



**Sensitivity:** A receiver specification indicating the smallest input signal strength required to produce an output signal whose characteristics are standardized and used as a reference.

**Signal:** A visible, audible or other conveyor of information.

**Signal-To-Noise-Ratio:** Measured in dB, signal to noise ratio is a relative term meaning the ratio between the desired output signal and the interference or noise. A typical figure would be 60dB which stands for a ratio of 1000-1.

**Superheterodyne:** A method of receiving radio waves in which the process of heterodyne reception is used to convert the voltage of the received wave into a voltage of an intermediate, but usually superaudible frequency, that is then detected.

**Synthesizer:** A Phase Lock Loop (PLL) system which constructs an oscillator signal by phase locking it to a reference times (X) the ratio of two integers (reference is usually a quartz crystal oscillator).

**Triamp:** The use of three separate amplifiers to drive the high, middle and low frequency sections of a speaker system.

**Varactor:** A two terminal semiconductor device in which the electrical characteristic of primary interest is a voltage-dependent capacitance. Used in FM tuner inputs for voltage controlled timing.

**Wow:** Distortion caused in sound reproduction by slow variation in speed of the turntable or tape. (See flutter.)



## SECTION 2

# SPECIFICATIONS AND PERFORMANCE

### 2.1 General Specifications

**Hum and Noise (20Hz-20KHz):** 112dB below rated output.

**Phase Response:** +0, -15 degrees 10-20KHz at 1 watt.

**Input Impedance:** 30K ohm, +20%.

**Amplifier Output Protection:** Short, mismatch, and open circuit proof. Limiting is instantaneous with no flyback pulses, thumps, cutout, etc. No premature limiting transients.

**Overall Protection:** AC line fused. Thermal switch in control logic protects against overheating caused by insufficient ventilation. Controlled slewing rate voltage amplifiers protect overall amplifier against RF burnouts. Input overload protection is furnished by internal resistance at inputs of amp.

**Low Frequency Interrupt:** Interrupts output drive (standby mode) with automatic sampling every four seconds. Activates at DC outputs greater than 10V or low frequency outputs greater than 10V at 2Hz.

**Turn-on:** Four second delay with minimum thumps and no dangerous transients.

**DC Output Offset (shorted input):** 10 millivolts or less, internally adjustable to zero.

**Power Supply:** 1 kilowatt transformer with massive computer-grade filter capacitors storing over 48 joules of energy. Two regulated supplies for complete isolation and stability.

**Power Requirements:** Requires 50-400Hz AC with selectable taps for 100, 120, 200, 220 and 240V  $\pm 10\%$  operation. Draws 40 watts or less on idle, 560 watts at 330 watts total output.

**Heat Sinking:** Massive black-anodized heat sinks are thermally joined with the chassis, thereby utilizing the entire amplifier as a heat sink.

**Chassis:** All aluminum construction for maximum heat conduction and minimum weight.

**Controls:** Pushbutton on/off power switch. Independent Input Level controls. Rear panel Stereo/Mono slide switch.

**Display:** Three pair of LED's form a Frequency Analyzing Display. A pair of red LED's indicate the action of the IOC™ circuitry. An amber LED is used as a Power indicator.

**Connectors:** AC Line - two wire male connector. Input - standard pin jacks; unbalanced, Output - color coded dual binding posts on 3/4 inch centers. Output Monitor - 1/4" stereo phone jack.

**Dimensions:** 19 inch (48.3cm) standard rack mount, 7 inches (17.8cm) high, 10.125 inches (25.7cm) deep from mounting surface of front panel. Handles extend 2.38 inches (6cm) from front panel.

**Weight:** Approximately 55 pounds (24.9kg) net weight.

**Finish:** Two finishes are available: brushed and satinized aluminum front panel (shown in this manual) or a black polyester vinyl coated aluminum front panel. Zinc diecast handles.

### 2.2 Stereo Specifications

**Output Power:** 165 watts per channel minimum RMS (both channels operating) into an 8 ohm load over a bandwidth of 20Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage. 265 watts per channel minimum RMS (both channels operating) into a 4 ohm load over a bandwidth of 20Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage.

**Frequency Response:**  $\pm 0.1$ dB 10-20KHz at 1 watt into 8 ohms; +0dB, -1.5dB 10Hz-100KHz.

**1KHz Power:** 180 watts RMS into 8 ohms, per channel, both channels operating, 0.1% total harmonic distortion.

**Harmonic Distortion:** Less than 0.001% from 20Hz-800Hz, and increasing linearly to .025% at 20KHz at 165 watts RMS per channel into 8 ohms.

**I.M. Distortion (60Hz-7KHz 4:1):** Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 165 watts into 8 ohms, per channel.

**Slewing Rate:** 16 volts per microsecond (slewing rate is the maximum value of the first derivative of the output signal, or the maximum slope of the output signal).

**Damping Factor:** Greater than 400, DC-400Hz into 8 ohms.

**Output Impedance:** Less than 7 milliohms in series with less than 3 microhenries.

**Load Impedance:** Rated for 4 and 8 ohm usage; safely drives any load including completely reactive loads.

**Voltage Gain:** 20.6  $\pm$ 2% or 26.3  $\pm$ 0.3dB at maximum gain.

**Input Sensitivity:** 1.76 volts  $\pm$ 2% for 165 watts into 8 ohms.

**Output Signal:** Unbalanced, dual channel.

## 2.3 Monaural Specifications

**Output Power:** 330 watts minimum RMS into a 16 ohm load over a bandwidth of 20Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage. 530 watts minimum RMS into an 8 ohm load over a bandwidth of 20Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage.

**Frequency Response:**  $\pm$ 0.15dB, 10-20KHz at 1 watt into 16 ohms; +0dB, -1dB 10-60KHz at 1 watt into 16 ohms.

**1KHz Power:** 360 watts RMS into 16 ohms; 0.1% total harmonic distortion.

**Harmonic Distortion:** Less than 0.001% from 20Hz-800Hz and increasing linearly to .025% at 20KHz at 330 watts into 16 ohms.

**I.M. Distortion :** Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 330 watts into 16 ohms, per channel.

**Slewing Rate:** 32 volts per microsecond.

**Damping Factor:** Greater than 400, DC-400Hz into 16 ohms.

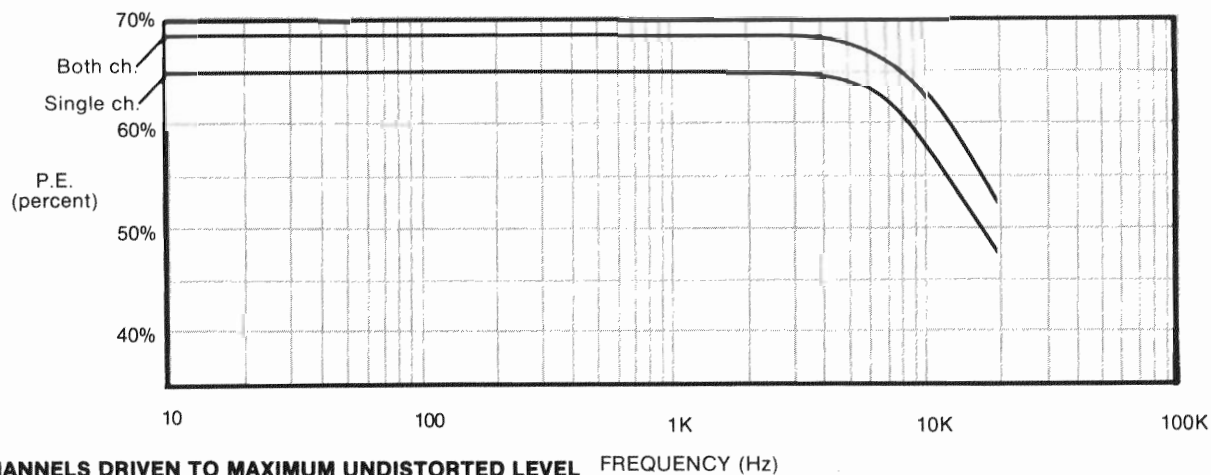
**Output Impedance:** Less than 15 milliohms in series with less than 6 microhenries.

**Load Impedance** Rated for 8 and 16 ohm usage; safely drives any load including completely reactive loads.

**Voltage Gain:** 41.2  $\pm$ 2% or 32.3  $\pm$ 0.2dB at maximum gain.

**Input Sensitivity:** 1.76 volts for 330 watts into 16 ohms.

**Output Signal:** Balanced, single channel.



**BOTH CHANNELS DRIVEN TO MAXIMUM UNDISTORTED LEVEL** FREQUENCY (Hz)  
**120 VAC LINE IN**  
**8 OHM LOAD**

Fig. 2.1 Nominal Power Efficiency

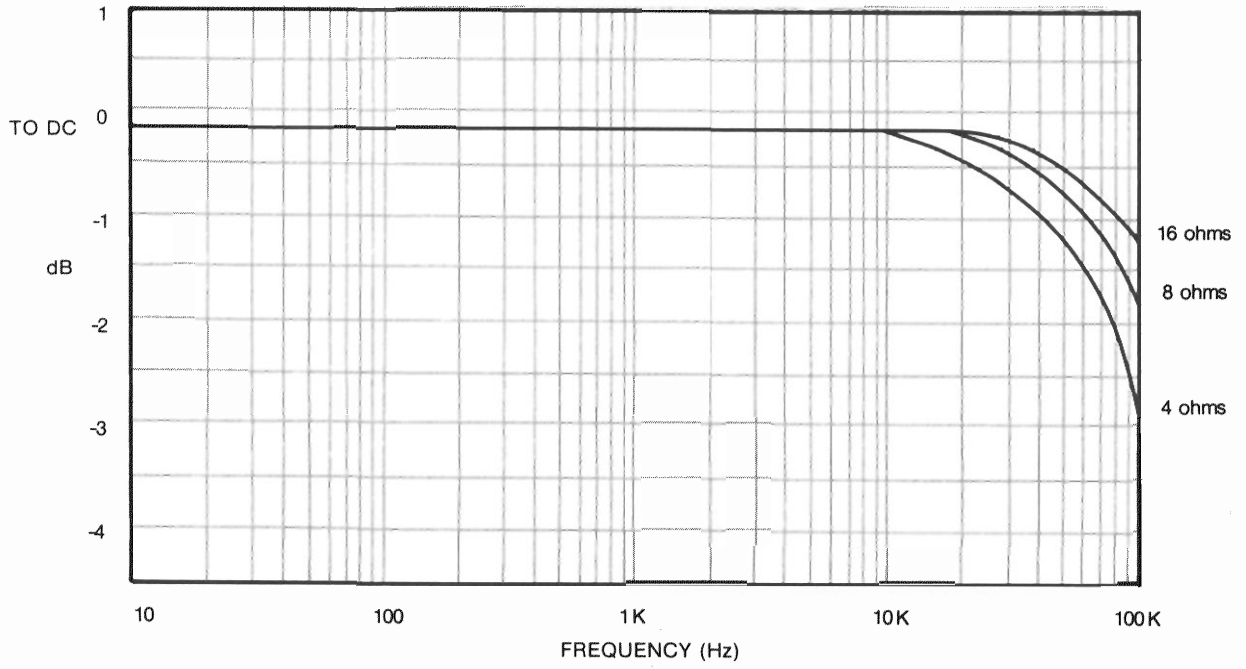


Fig. 2.2 Nominal Frequency Response

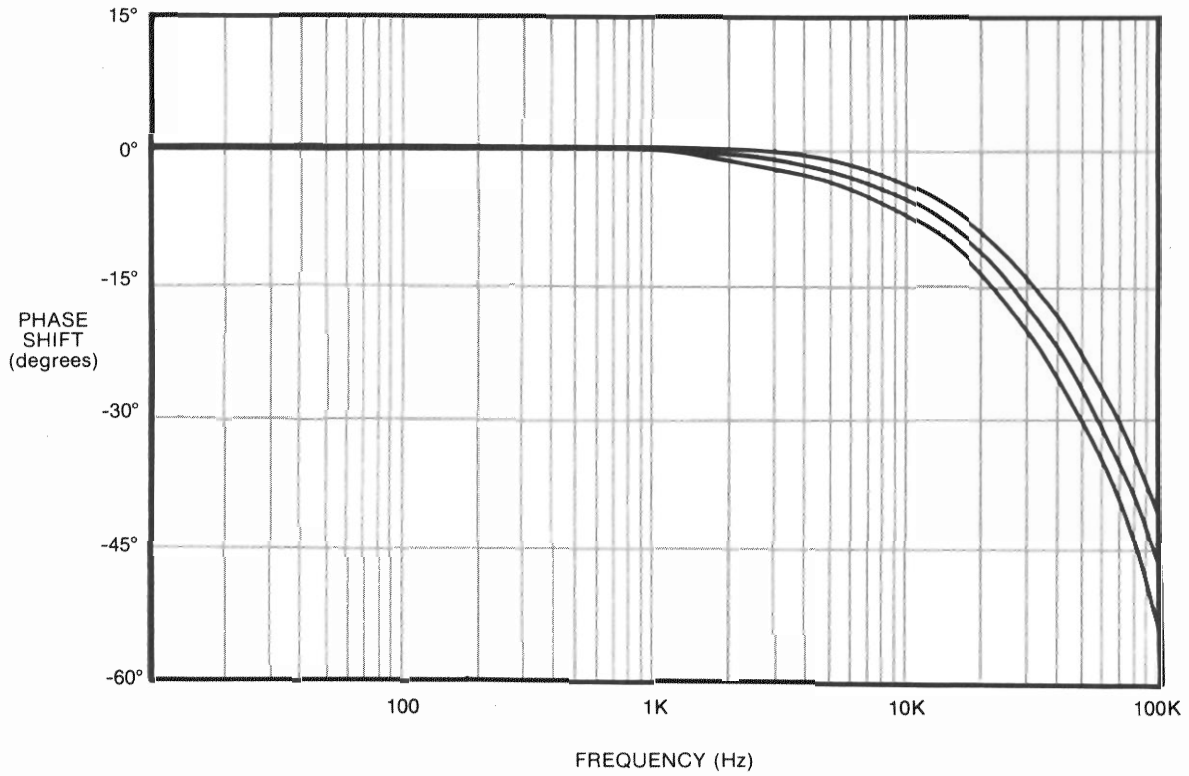
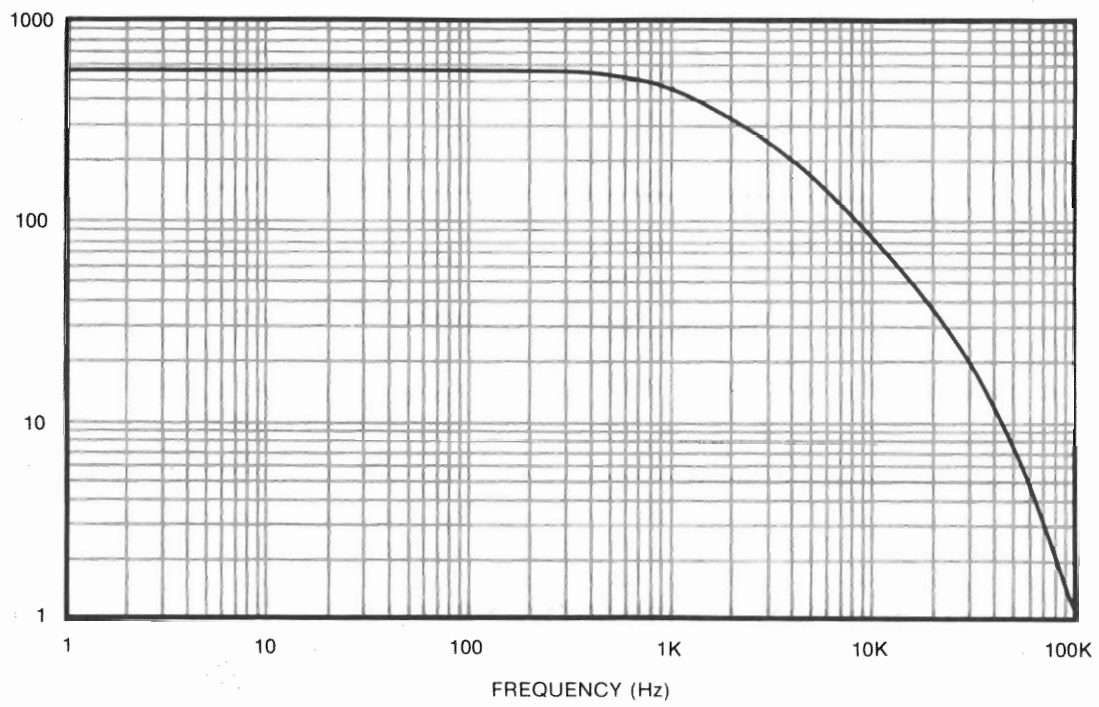
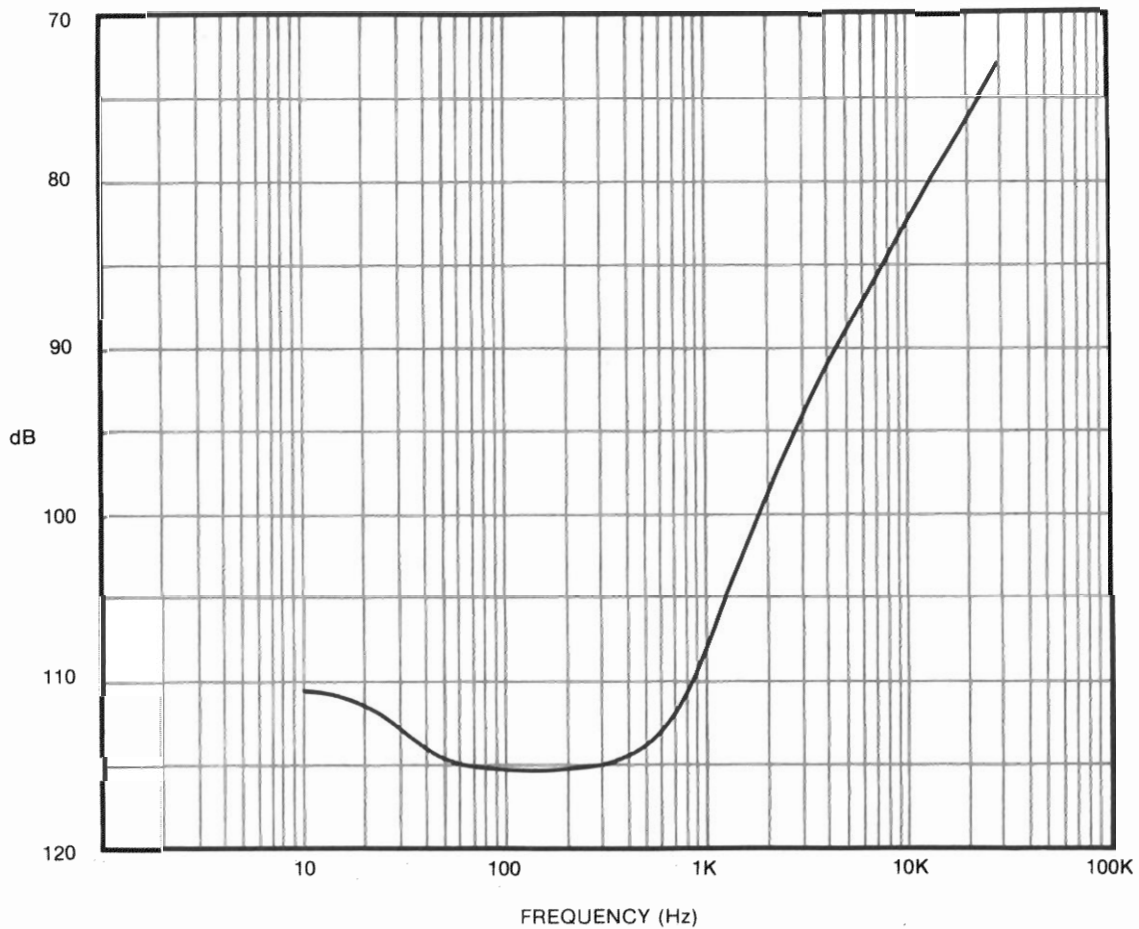


Fig. 2.3 Nominal Phase Response

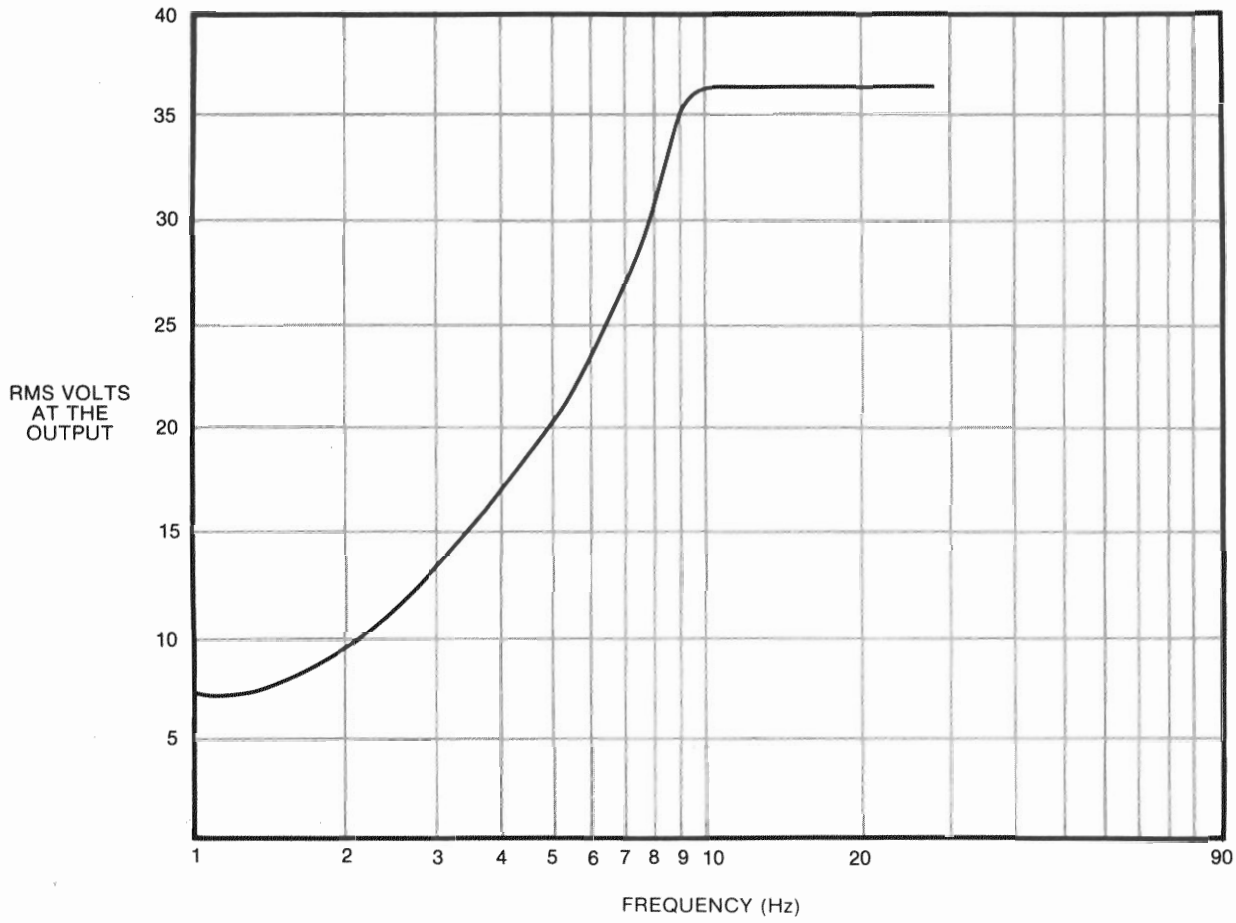


*Fig. 2.4 Typical Damping Factor*

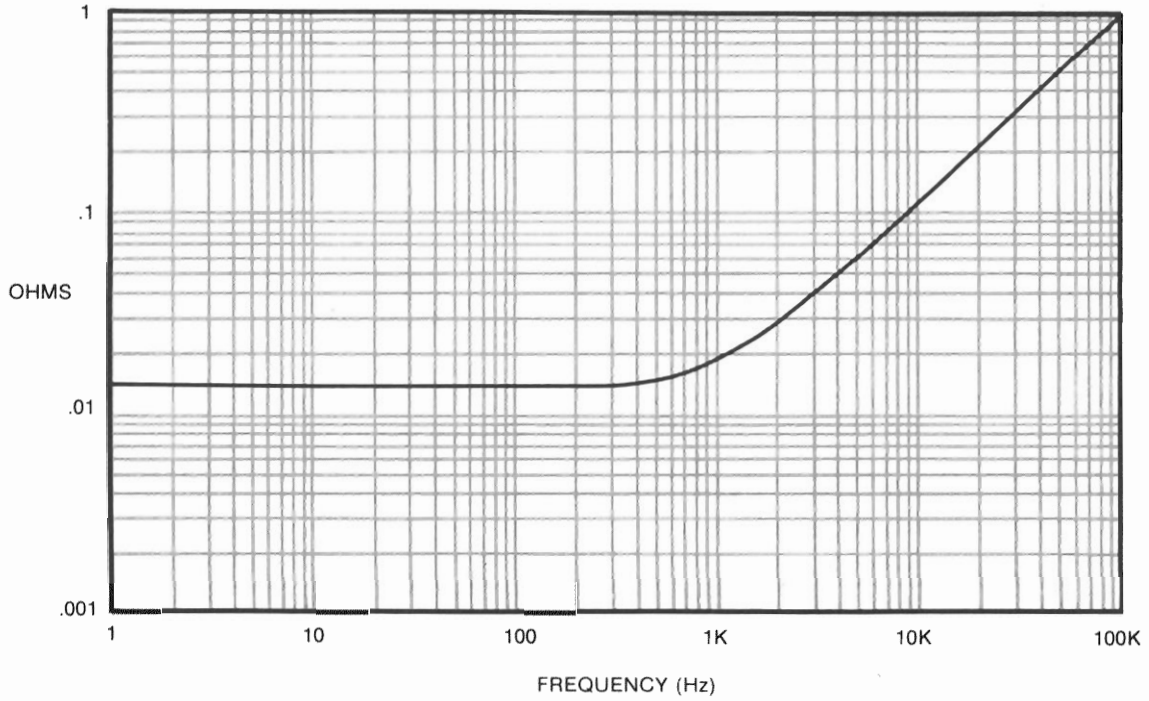


**ONE CHANNEL DRIVEN AT 165 WATTS**  
**1K OHM TERMINATOR USED ON NON-DRIVEN INPUT**

*Fig. 2.5 Typical Crosstalk*

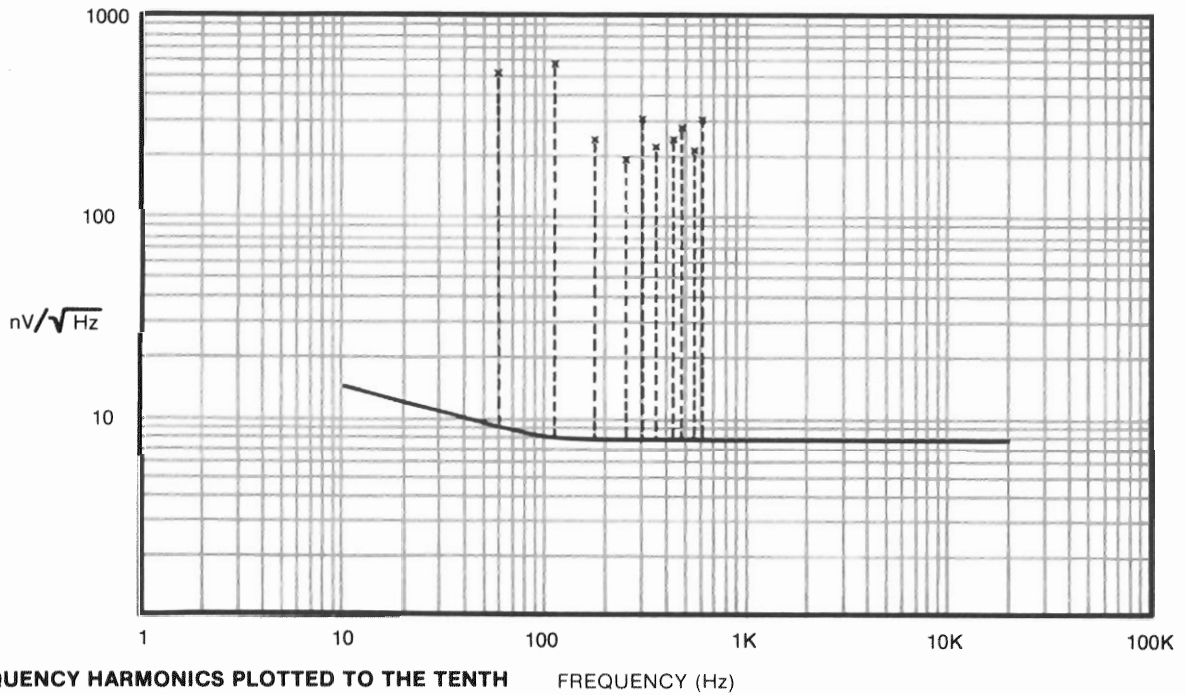


*Fig. 2.6 Low Frequency Interrupt Action*



#12 WIRES INSTALLED FROM OUTPUT BOARD TO BINDING TERMINALS  
MEASUREMENTS TAKEN AT OUTSIDE OF BINDING POSTS

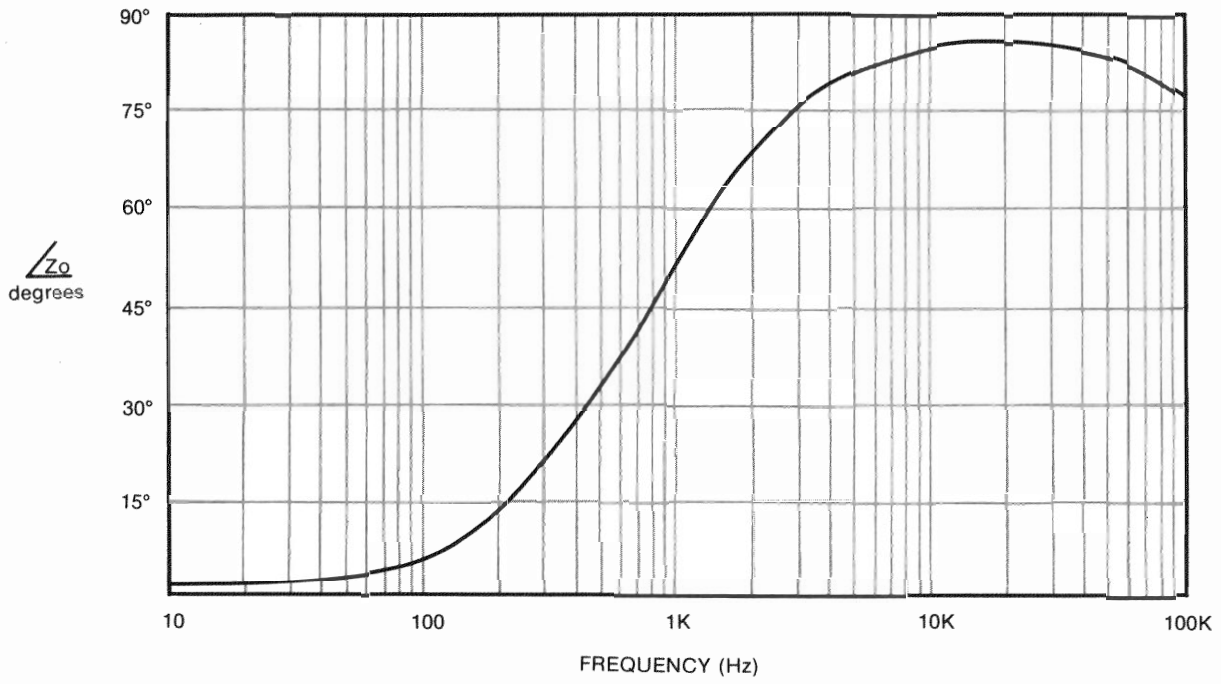
Fig. 2.7 Typical Output Impedance



LINE FREQUENCY HARMONICS PLOTTED TO THE TENTH  
OUTPUT IS INDICATED BY (X) ON EXTENDED DOTTED LINES

Fig. 2.8 Nominal Noise Spectrum





*Fig. 2.9 Nominal Output Phase Angle*



## SECTION 3

# INSTALLATION AND OPERATION

### 3.1 Unpacking

As soon as the unit is received, please inspect for any damage incurred in transit. Since the unit was carefully inspected and tested at the factory, it left unmarred. If damage is found, notify the transportation company immediately. Only the cosignee may institute a claim with the carrier for damage during shipment. However, Crown will cooperate fully in such an event. Be sure to save the carton as evidence of damage for the shipper's inspection.

Even if the unit arrived in perfect condition, as most do, it is advantageous to save the packing materials. They will prove valuable in preventing damage should there ever be occasion to transport or ship the unit. Note the carton and internal pack - each is designed for protection during transit. **DO NOT SHIP THE UNIT WITHOUT THIS FACTORY PACK!**

Be sure to return the warranty registration yourself or through your dealer within ten days to receive your Care Card.

### 3.2 Accessories Supplied

The Power Line Four comes complete with an Instruction Manual and:

- 4 mounting screws
- 4 nylon washers
- 2 fuses
- 2 fuse holders
- 2 banana plugs
- 2 wire nuts
- 2 6' pin-pin cables

### 3.3 Mounting

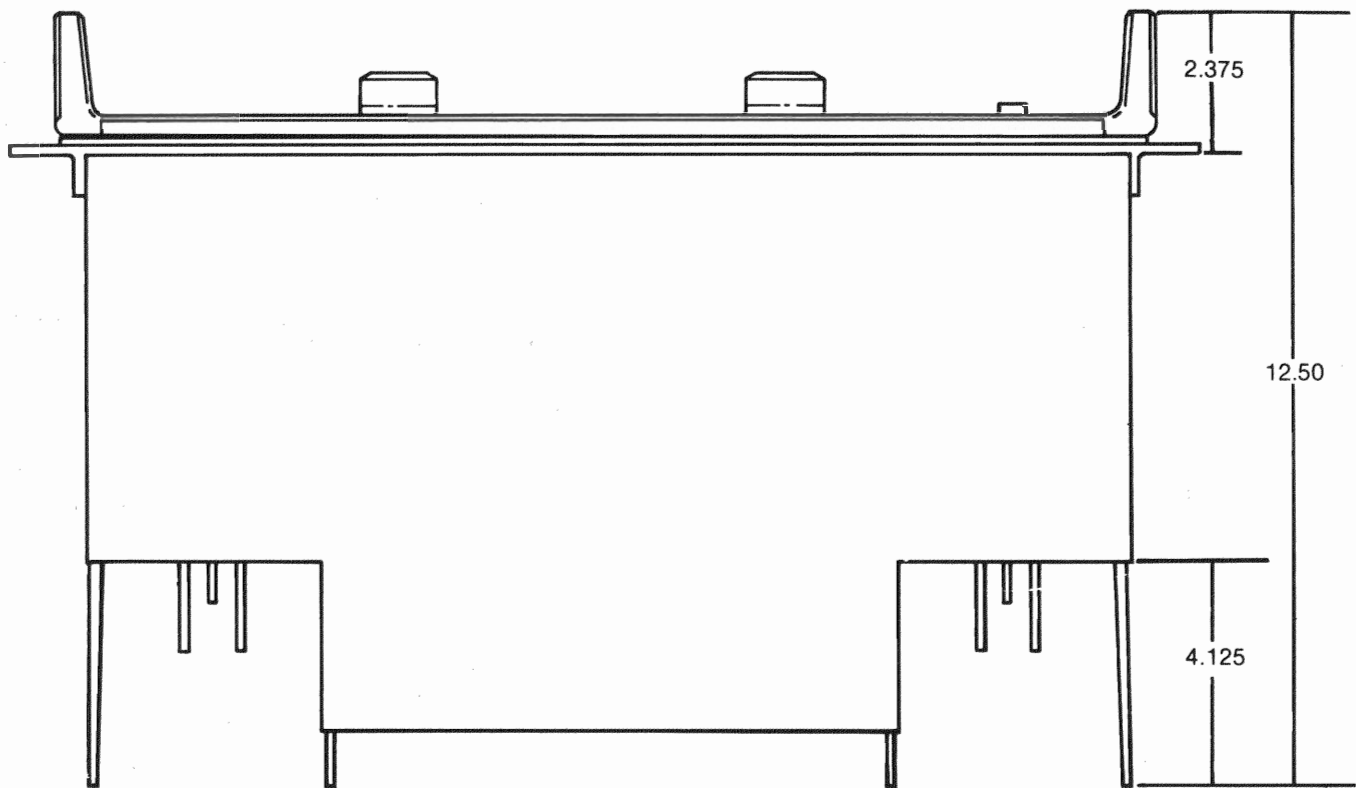
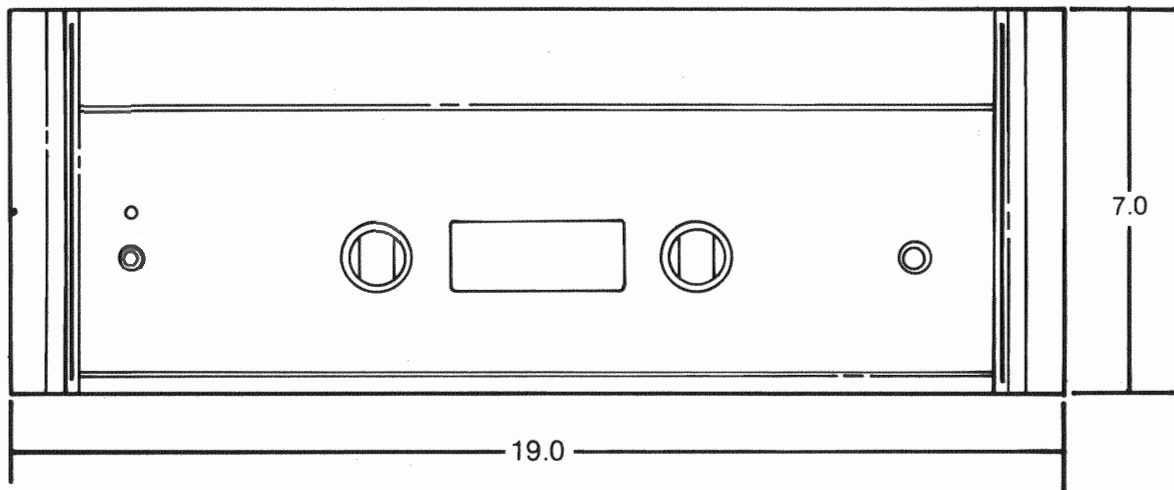
The Power Line Four may be mounted in either a Crown walnut cabinet (other hardwoods available upon request) or a customized cabinet of your own design. In each case, standard 19" width spacing should be utilized as shown in Fig. 3.1. Sufficient ventilation should be provided for the unit in order to avoid premature activation of the Stand-by mode. Ideally, a rack clearance of 1 3/4" should be

allowed above and below the unit for hot air discharge. If two or more Power Line Four's are mounted above one another the 1 3/4" clearance rule still applies.

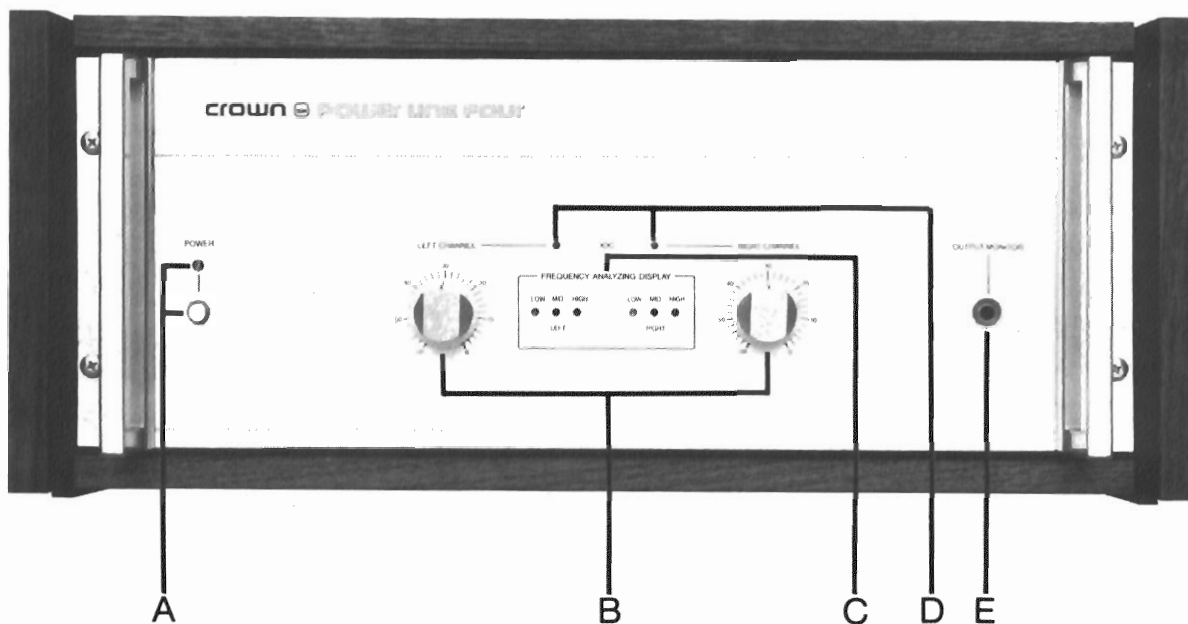
### 3.4 Operating Precautions

The following are a number of operating precautions given as an aid to understanding proper and improper amplifier usage.

1. Use care in making connections, selecting signal sources and controlling the output level. Crown is not liable for any damage done to loads. For helpful hints on load protection, see Section 3.10.
2. Never parallel the output with any other amplifier's output. Such connection does not result in increased power output. Damage incurred by such operation is not covered under warranty.
3. Never drive a transformer coupled device or any other device which appears as a low frequency short (less than 3 ohms at DC) without a series isolating capacitor. Such operation may damage the device and/or needlessly waste output power.
4. Do not short the ground lead of an output cable to the input signal ground as oscillations may result from forming such a ground loop.
5. Because of potential shock hazard or damage to the unit, never remove the covers!
6. Operate the amplifier from AC mains of not more than 10% above or below the selected line voltage and only 50-60Hz. Failing to comply with these frequency limits will also invalidate the warranty.
7. Never connect the output to a power supply output, battery, or power mains. Damage caused by such hook-up is not covered by the warranty.
8. Tampering in the circuitry by unqualified personnel or the making of unauthorized circuit modifications, invalidates the warranty.



*Fig. 3.1 Power Line Four Mounting Dimensions*



*Fig. 3.2 Power Line Four Front Panel*

### 3.5 Controls and Adjustments

The following paragraphs refer to the front and rear panel diagrams (Fig. 3.2 and Fig. 3.3).

#### A. Power Switch/Indicator

This pushbutton when depressed, will activate the Power Line Four and also cause the amber indicator to glow if all proper power requirements are being met. Also, upon turn-on the IOC™ indicators will illuminate for approximately four seconds while the unit is in the Stand-by mode (turn-on mute delay).

#### B. Input Level Controls

Both Input Level Controls are detented with thirty-one positions. This provides more accurate control of the input signal as well as the ability to adjust the input level to a previously desired setting with identical results. The detents are also helpful in preventing movement of the controls should they be accidentally bumped or jarred.

#### C. Frequency Analyzing Display

These LED's (yellow, green and orange) make up the Frequency Analyzing Display of the Power Line Four. Besides general monitoring of the output signal, it provides a convenient method of observing whether or not a signal has been interrupted somewhere from the system's input to output. In addition, it can be used to

amplifier, speakers or room. Each of the three lights represent a frequency range; orange = high, green = mid and yellow = low. During normal audio passages, all three indicators should be lit or flash occasionally with respect to the frequency range of the musical information. In other words, if a flute is being amplified, one would expect the orange light to flash as compared to a bass guitar which would illuminate the yellow indicator.

#### D. IOC Indicators

IOC™ (Input Output Comparator) indicators are red in color and stand alone above the Signal Presence Indicators. IOC™ is a Crown designed and developed circuit which helps the user identify any problems the unit may be experiencing such as excessive input signal, improper load impedance or even an amplifier based problem. Occasional flashing with music programs peaks is normal however, continuous illumination indicates a problem and should be investigated. **Note:** IOC™ indicators also double as Stand-by indicators and will glow at any time this feature is active (turn-on delay, Low Frequency Interrupt and temperature overload.).

#### E. Output Monitor

This jack provides access to the stereo output signal with a front panel, standard 1/4" phone jack. As with the main output, its level is controlled by the Input Level Controls.

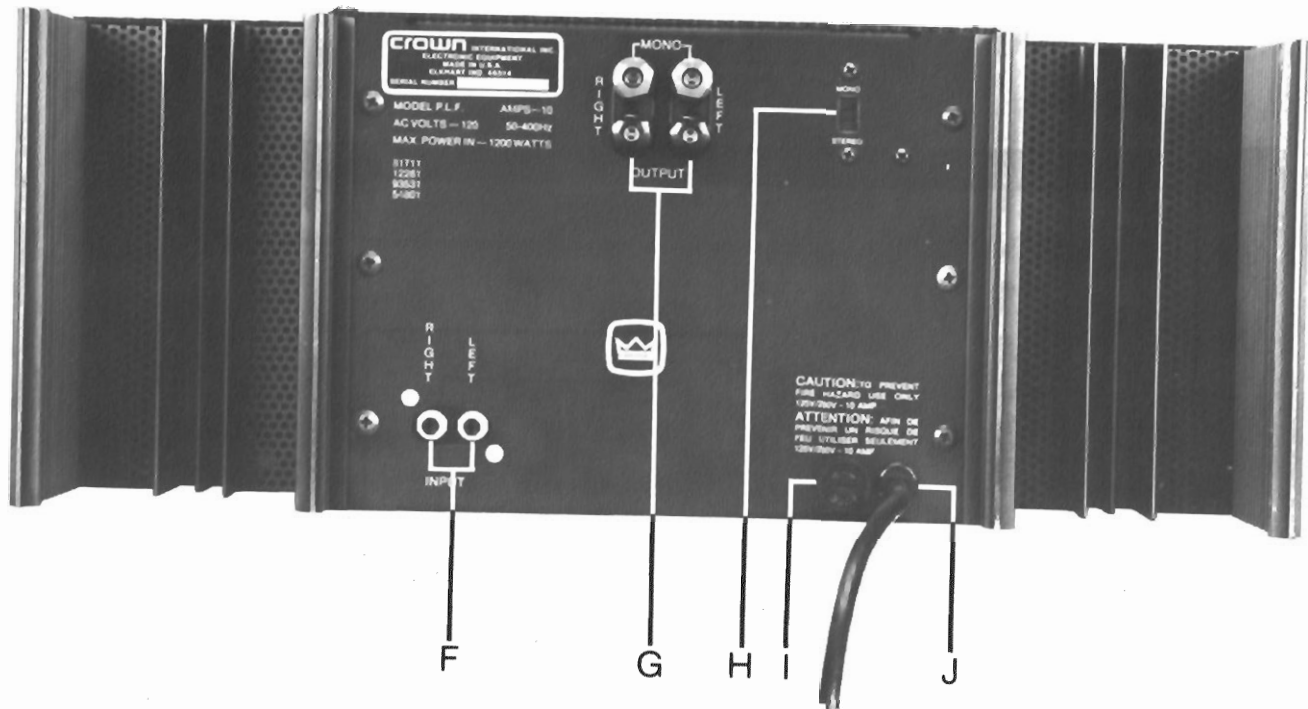


Fig. 3.3 Power Line Four Rear Panel

Also note that the monitor output jack signal and the main output are connected in parallel and can produce a high power signal simultaneously. If monitor output is desired without main output, it will be necessary to disconnect the main speaker outputs. Impedance mismatches should also be watched closely in order not to go below the recommended 4 ohm stereo load impedance rating by "ganging" several speakers/headphones together in parallel. Headphones with an 8 ohm or higher impedance rating are recommended (see Section 3.7 for hook-up details).

#### F. Input Phone Jacks

Conventional input signal hook-up is supplied with unbalanced, pin jacks.

#### G. Main Output Jacks

The Power Line Four main output jacks are of the standard MDP banana type. These jacks are mounted in such a manner to allow easy mono connection with only one MDP dual banana plug rather than two (see Section 3.8).

#### H. Mono/Stereo Switch

This rear panel slide switch determines whether the unit is to perform as a single (mono) or dual (stereo) channel amplifier. Section 3.9 shows all necessary connections that must be made for mono use.

#### I. Fuse

Fuse replacement should not normally be necessary unless AC mains conversion is needed (see Section 3.11) or the fuse has blown due to excessive voltage applied to the unit.

#### J. AC Line Cord

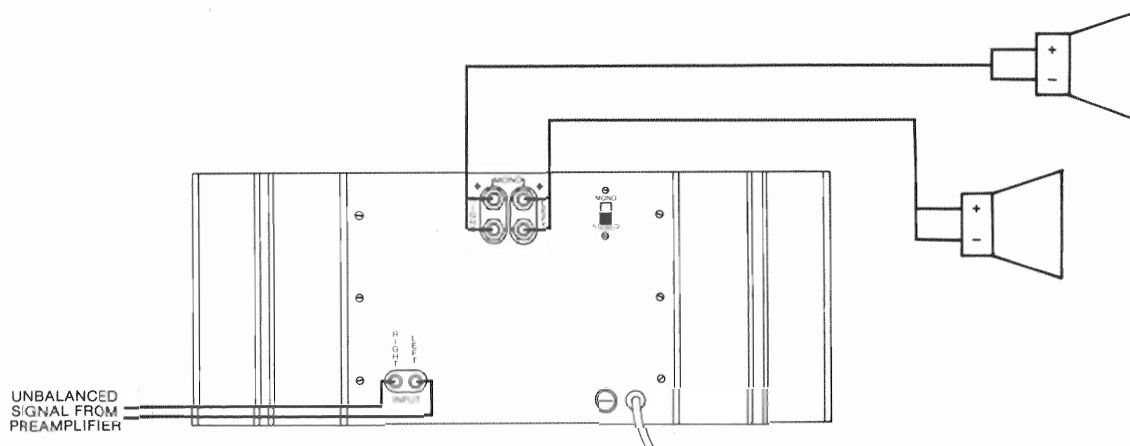
The Power Line Four is furnished with a two-wire, heavy duty plug as standard equipment. Instructions for connecting power are located in the following section.

### 3.6 Connecting Power

The Power Line Four is furnished with a standard two-wire AC plug. The reason for this is that sound systems tend to function audibly better when the individual components are tied together only through their input and output cable ground rather than with both the AC ground and signal cable ground. This method reduces the chances for multiple ground paths or loops.

**Note:** Crown assumes no liability whatsoever for operation of ungrounded auxiliary equipment, nor for the violation of UL or electrical codes.

The Power Line Four may be connected for any of five AC operating voltages: 100, 120, 200, 220 and 240 VAC. Converting from one to another is a fairly complex operation and should be attempted by a competent technician only. See your Crown dealer should alteration become necessary.



*Fig. 3.4 Typical Stereo Hookup*

### 3.7 Connecting Input/Output Lines

All input and output connections (except monitor) are made from the rear panel of the Power Line Four. Figure 3.4 is a hook-up diagram that may be followed for most conventional stereo systems.

It is always wise to remove power from the unit and turn the Input Level Controls fully counterclockwise while making connections, especially if the load is a speaker. This will eliminate any chance of loud blasts. **Crown is not liable for damage incurred to any transducer due to its being overpowered!**

When connecting input lines, use the standard pin jacks.

Connecting the inputs will require observance of three basic precautions: undesirable signals to the inputs, ground loops, and feedback from the output(s) to input(s).

For loudspeaker-driving applications, the input should be free of large sub-sonic or undesired low frequencies, as they could cause unnecessary activation of the Low Frequency Interrupt circuitry. A simple visual test for DC on the inputs is to slowly turn up the Input Level control with the amp turned on, and then watch for displacement of the loudspeaker cone. If very much movement is observed or if the units Low Frequency Interrupt circuitry activates and causes the unit to go into the stand-by mode (IOC lit), the DC content may be excessive and may require the use of an input blocking

capacitor. Only a low leakage type paper, mylar or tantalum capacitor should be used for this purpose.

A second precaution is "ground-loops" - electronic jargon for undesirable circulating circuits flowing in a grounding system. A common form of loop (possibly resulting in hum at the output) is a pair of input cables whose area is subjected to a magnetic field. In practice, both cables should be tied together along their length, and away from power cords. Tying the input and output grounds together may also form a ground loop.

A third precaution is feedback oscillation from AC power lines. Proper grounding and isolation of inputs of common AC line devices is a good practice.

Output connectors should be of such a type to reliably handle the units output signal. One type of output connector is available for use on the Power Line Four: MDP banana type jacks. Since banana plugs are used, care should be taken so that the connector is kept "snug fitting" as frequent plugging and unplugging will loosen the connector.

The gauge and length of speaker cable is directly proportional to the resistance; as the wire diameter decreases (higher gauge number) and/or the length increases, the resistance rises. Because an increase in cable resistance effectively increases the source impedance of the amplifier (as seen by the speaker), the cable affects the damping factor (see Glossary of Terms). Figure 3.5 is a nomograph which illustrates the

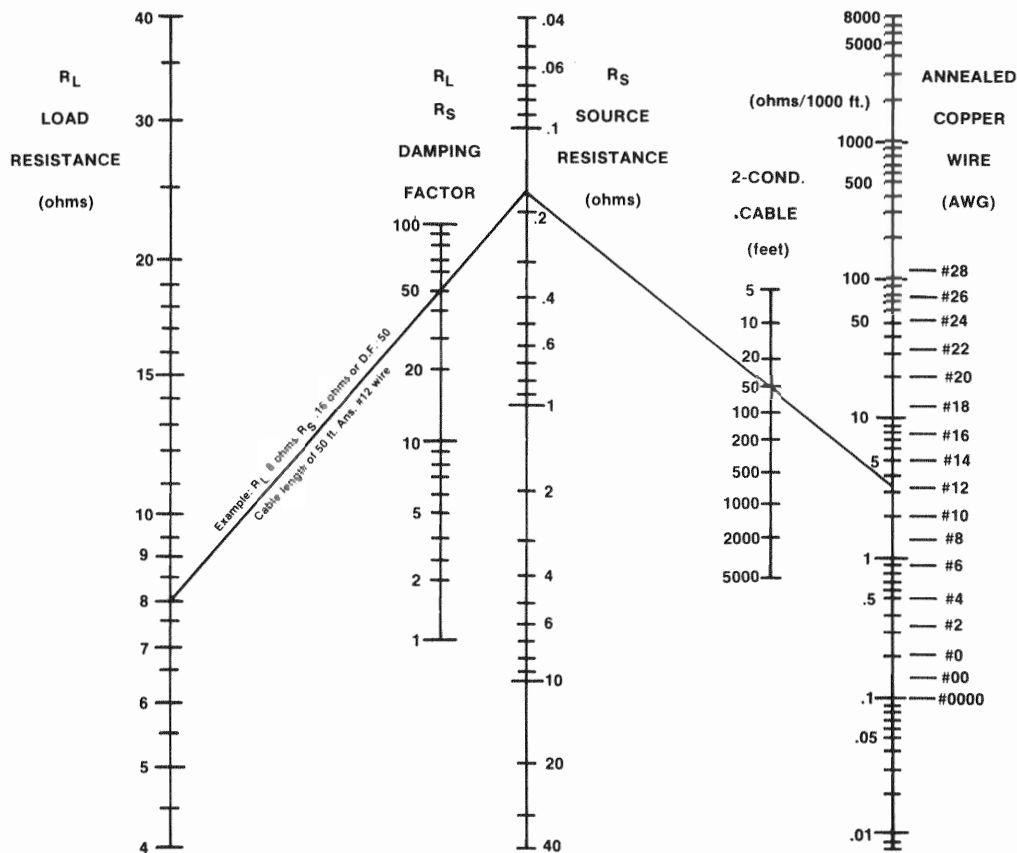


Fig. 3.5 Source Resistance and Damping Factor vs. Length and Size of Output Leads

relationship between load impedance, damping factor, wire gauge and length.

As can be seen from the example in Fig. 3.5, a 50 ft. length of #12 AWG annealed copper wire (two conductor) yields a combined amplifier/cable source impedance of 0.16 ohms. Given a typical 8 ohm load impedance, this results in an effective damping factor of 50 (not the rated 400, DC-400Hz that would be obtained were there zero ohms cable resistance). From this example it can be seen that larger diameter (lower wire gauge number) wire, should be used for longer cables.

For dynamic moving-coil loudspeakers (as most are), the value of  $R_L$  should be preferably that measured by an ohmmeter across the voice coil (speaker terminals) rather than the manufacturers rating. For electrostatic speakers and such, the manufacturers rated impedance should be used for  $R_L$ .

Output cables should always be carefully laced together so that large magnetic fields are not formed, resulting from current carrying loops. Such fields often will couple with the input signal path and result in undesired feedback and oscillations. Of course the output cables

should never be routed with the input cables for the same reason.

Amplifier input and output grounds should never be joined externally to the unit. Such a connection is almost always a form of regenerative feedback and results in system oscillations. High frequency coupling between output signals and input grounds and signals is frequently difficult to eliminate. A common cause of this problem is capacitive coupling through the AC mains where the output and input signals are attached to AC powered devices. In some situations the only solution may be to low pass filter the input to the amplifier.

Under normal stereo conditions, a load impedance of no lower than four ohms total across each channel of the Power Line Four, should be used. This means it will be necessary to exercise caution when connecting more than one transducer to an output terminal. Remember, two 8 ohm speakers in parallel produce a total impedance of 4 ohms and two 4 ohm speakers in parallel produce a total of 2 ohms. On the other hand, two 8 ohm speakers in series, produce a total impedance of 16 ohms and so forth. Headphones, when connected to the front panel jack contribute to the over-all load impedance as well.

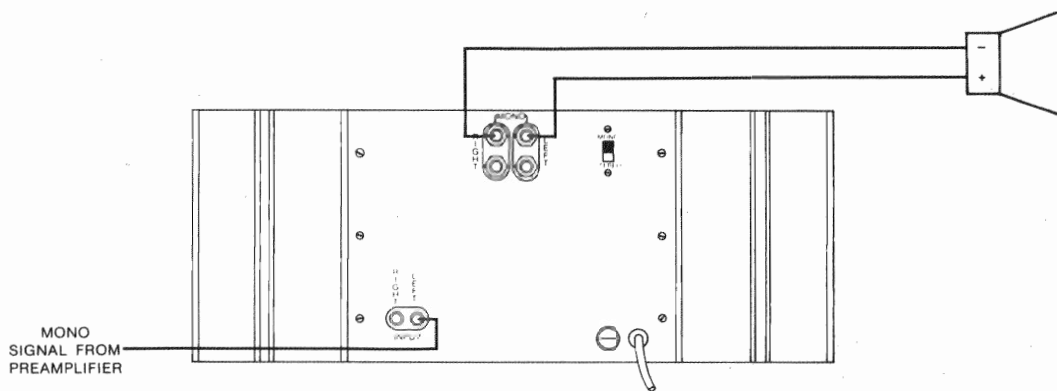


Fig. 3.6 Typical Mono Hookup

### 3.8 Mono Operation

To change the Power Line Four from stereo to mono mode, simply move the rear panel slide switch to the Mono position. No internal modifications are necessary, however a special wiring scheme (see Fig. 3.6) should be followed.

The input circuitry of the Power Line Four is altered in the mono mode so that the two amplifiers are added for mono output. This means that only the left channel Input and Level control, should be used.

**Note:** The right channel input jacks and Level control are not defeated in the Mono mode. However, the right channel input should not be used in this mode. If a right channel input is added to the left channel input, distortion may result. If right channel is used alone, a very low power output will occur. For best results, unplug the input to right channel when operating in the mono and turn its front panel Input Level control fully CCW.

The output signal from the Power Line Four in Mono is balanced and is isolated from the chassis and from the input grounds. MDP banana jacks are to be used as the output connector, but with only one dual-pin banana plug connected to the red (+) or "hot" terminals.

**Caution:** Be certain that all equipment (meters, switches, etc.) connected to the mono output lines is balanced. Both sides of the line must be totally isolated from the input grounds to the Power Line Four. If this is not observed, severe oscillation may result.

Total speaker impedance should not be lower than 8 ohms in the mono mode. Should the load impedance go below 8 ohms (possibly by paralleling several speakers together), it is possible to unnecessarily activate the thermal protection circuitry to the point of needless activation of the Stand-by circuitry.

### 3.9 Protection Mechanisms

Crown power amplifiers are widely known for their quality construction, high reliability and extensive internal protection circuitry. The Power Line Four is no exception. It provides protection against all forms of load mis-matching, overloaded or Low Frequency Interrupt signal information being fed to the input, excessive temperature and overloaded power supplies.

Should a speaker connected to the output of the unit ever become open, shorted or mismatched (too low impedance rating), protection will be provided by a fast-acting limiter circuit which instantaneously limits the output power to a maximum safe stress value. The audible effects of this circuit resembles that of crossover notch distortion (muffled snapping sound). Speaker systems which are truly four ohms or greater (stereo mode) will not activate this protection circuit.

DC applied to the input should never cause accidental speaker damage because of the Low Frequency Interrupt circuit which automatically senses DC at the output and places the unit into the stand-by mode. After the problem is removed, the unit will return to normal operation.



Thermal protection is provided for each channel independently should the amplifier's internal operating temperature exceed the safe operating area of the output devices. Like the Low Frequency Interrupt the unit will go into the Stand-by mode, but will remain there until excess heat has dissipated.

### 3.10 Load Protection Methods

The most common of all load protection methods is a fuse in series with the load. The fuse may be single, fusing the overall system, or (in the case of multi-element speaker systems), may be multiple with one fuse for each speaker. Fuses help prevent damage due to prolonged overload, but provide essentially no protection against damage that may be done by large transients. To minimize the problem, high speed instrumentation fuses such as Little fuse 36100 series are recommended. For a nomograph showing fuse size vs. loudspeaker ratings, refer to Fig. 3.7.

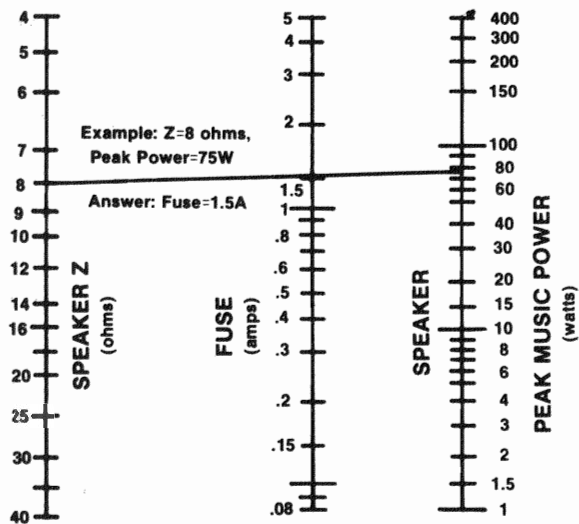


Fig. 3.7 Fuse Selector Nomograph for Loudspeaker Protection

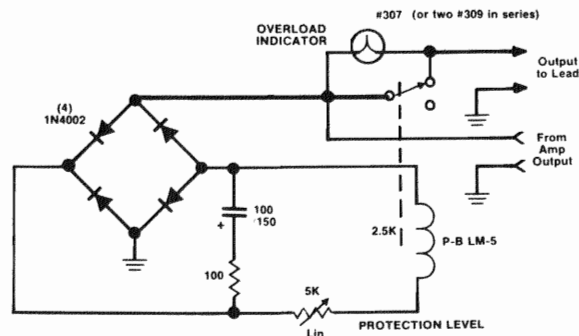


Fig. 3.8 Relay Controlled Protector with Overload Indicator

Another form of load protection is shown schematically in Fig. 3.8. This circuit may be assembled with parts available from your local electronics shop. Whenever the load is overdriven a relay switches a lamp in series with the load, smoothly relieving the overload. The lamp then doubles as an overdrive indicator as it glows. If overdrive is unreasonably severe, the lamp will serve as a fuse. By adjusting the relay tension and the protection level control, this system is useful from 25 to 200 watts for a typical 8 ohm load.



## SECTION 4

# TECHNICAL INFORMATION

### 4.1 General Information

This section provides moderately technical information for those interested in the electrical operation of the Power Line Four. It is **not** service information and should therefore not be used as such. Always refer servicing to the Crown factory or a qualified Crown Service Center.

### 4.2 Block Diagram Explanation

Refer to the block diagram, Fig. 4.1. The diagram does not show all circuit connections or feedback loops due to circuit complexity, but there is sufficient data to grasp the function of each circuit. Note also that only the left channel is shown for simplicity.

An input signal is fed to the initial Main Amplifier stage via standard unbalanced pin jacks. At this stage, the maximum gain of the amplifier is established. However, it is possible to vary the input signal level with the variable potentiometer, preceding the Main Amplifier. The main operational amplifier used in this circuit provides ultra-low noise specifications, particularly for audio use. The input bias compensation stage, directly related to the Main stage, helps control a DC drift that may occur with a unique temperature-controlled circuit.

At the output of the Main Amplifier, is the IOC™ circuitry which works in conjunction with the error correcting signal of the main op amp. Any time a small "non-linearity" exists in the amplifier, an error signal appears at the output of the main op amp (via the feedback loop of the unit). This produces an abnormally high value, exceeding the "window" of the IOC™ and illuminating the LED. Since transient overload can happen rapidly, a pulse stretching circuit is added so the eye can detect the LED lighting.

A pair of gated switches follow next in line and provide a method of controlling the signal path through the unit. When a signal is obtained from the Control stage, these switches allow the signal to pass through the unit uninterrupted. However should the Delay, Thermal or Low Frequency Interrupt circuits become activated, the

control stage will cause the switches to open, blocking the signal to the output stages.

The Signal Translator stage combined with the push-pull Last Voltage Amplifier, form a voltage amplifier stage of the Power Line Four. Virtually no voltage amplification is performed beyond these stages.

Current amplification circuitry (otherwise known as the Crown \*Multi-Mode™ circuit) consists of basically three stages: the Predriver, the Driver and the Output transistor stage. With low level signals, the Multi-Mode™ circuit has been designed to function as a Class A circuit, with the drivers always biased on. This provides the optimum low distortion for which the Class A circuit is famous, but reserves its use only for the low-level situations for which it is optimum. When the signal asks the output to move into middle power ranges, the Multi-Mode circuit immediately changes state to a "Class A plus B" mode in which the drivers continue to operate in Class A and are always on; but the output devices move smoothly into a Class B operation to provide the additional power needed to boost the output signal to the desired level.

Finally, at highest levels, the first and second stage drivers go into an AB mode, with divided responsibilities for positive and negative portions of the signal, with the third-stage output devices operating in Class B to develop the desired power.

At each level, the Crown Multi-Mode™ circuit thus offers optimum performance in terms of extremely low distortion (whether measured in music-type signals or with more traditional test signals) and in terms of circuit efficiency.

Connected next is the protection circuitry which is activated when a predetermined amount of voltage and/or current is drawn across the output stage sense resistors. This protection signal is then in turn fed back to the limiting circuit which limits any increase in the bias servo voltage to the power devices. Feedback paths are indicated as such.

\*For additional information on the Multi-Mode™ circuit request "A Crown White Paper. Theory and Operation of the Crown Multi-Mode™"

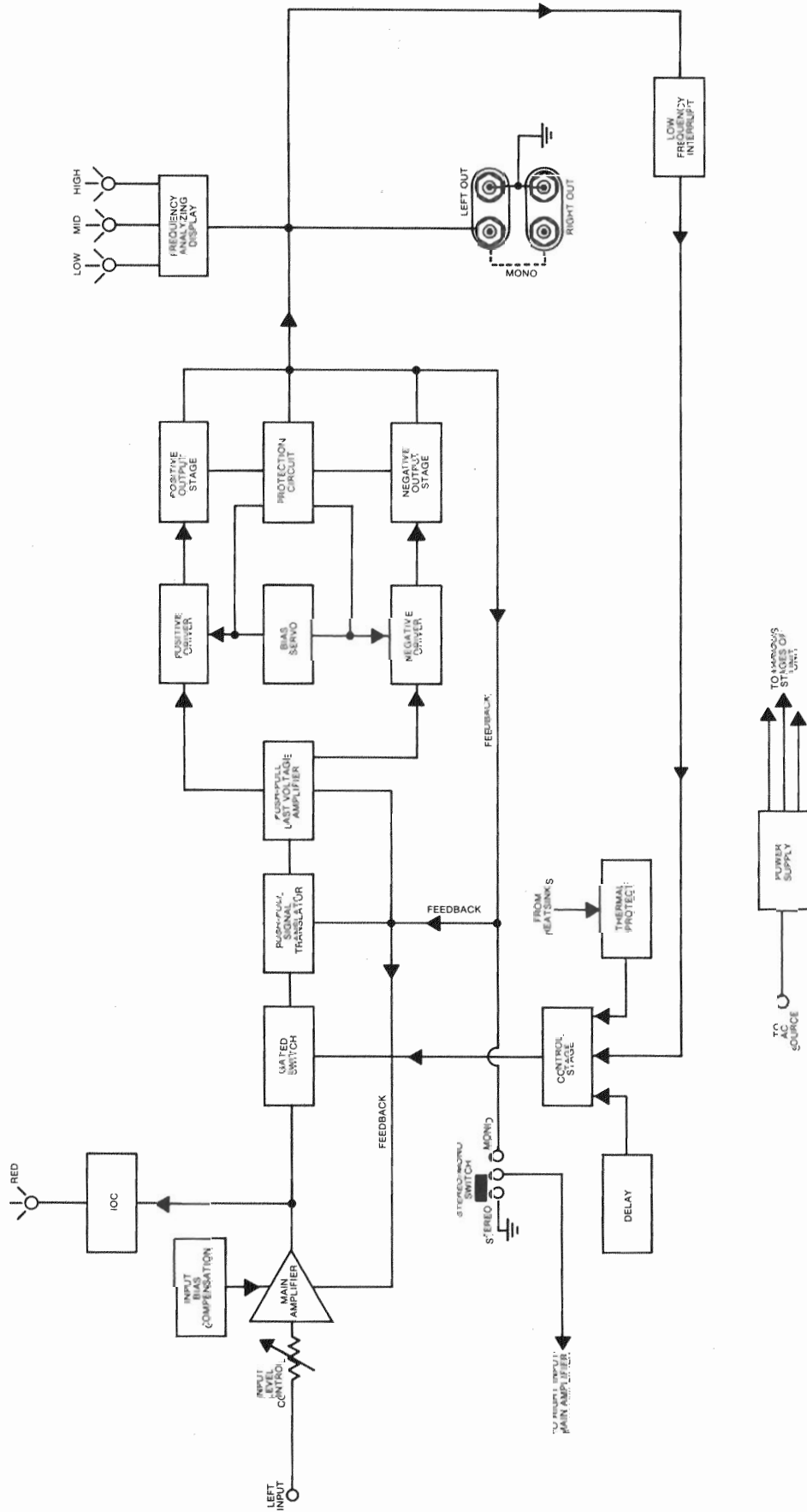


Fig. 4.1 Power Line Four Block Diagram



Before the signal reaches its final output destination, it confronts the Frequency Analyzing Display circuitry. At any time an output signal of .25V RMS volt or more is monitored at this point, all or several (depending on the frequency range of the output signal information) of the LED's will light. Also at this point, a portion of the channel 1 output is sent to the Stereo/Mono switch where it will feed the input of the channel 2 Main amplifier when in the Mono mode.

Output jack configuration on the rear panel of the Power Line Four are MDP or banana jacks. Only the positive terminals are used when the amplifier is in the bridged or Mono mode.

The power supply is a continuous-duty type. The main DC supplies are full-wave capacitor input type with heavy duty chassis heatsinked diodes. The main amplifiers, thermal protect and other supplementary circuitry, are powered by zener regulated power supplies. The temperature compensated bias current source, along with the biasing of the push-pull Signal Translator Stage, is from well regulated zener supplies. The results: no distortion or noise due to mis-biasing from line voltage variations.