

OC-150
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S1P3-11-7

OC-150
OUTPUT CONTROL
CONSOLE

TABLE OF CONTENTS

SECTION I	GENERAL OPERATION	PAGE
	Introduction	1
	Warranty & Unpacking	1
	Quick Summary	2
	Front Panel Control Functions	2
	Rear Panel Connectors	3
	Complete Connection of Inputs	4
	Complete Connection of Outputs	5
	Common Usage Procedures	6
	Mounting Instructions	8
	Specifications	9
 SECTION II	 TECHNICAL DESCRIPTION AND USE	
	Introduction	11
	Input/Output Specs	12
	Meter Response and Interpretation	12
	Circuit Description	18
	Headphone Attenuator Switches	18
	Crosstalk & Separation	18
	Care of the OC-150	18
	220 Volt Conversion	18
	Warranty Service	19

LIST OF ILLUSTRATIONS

	TITLE	PAGE
1-1	OC-150 Pictorial.....	1
1-2	Front Panel Control Functions	2
1-3	Rear Panel Connectors	3
1-4	Complete Connections of the Inputs (Foldout)	4
1-5	Complete Connections of the Outputs (Foldout)	5
1-6	Mounting Dimensions	8
2-1	OC-150 Pictorial	11
2-2	Voltage and Current with Reactance	14
2-3	V-I Output Graph	15
2-4	Speaker Impedance Curve	15
2-5	Impedance - Power Graph	17
2-6	OC-150 Flow Diagram	17
2-7	220 Volt Conversion	19

INTRODUCTION

With the purchase of a CROWN OC-150, you have greatly expanded the flexibility of your Hi-Fi system. You now have output flexibility comparable to the input versatility made famous by the CROWN IC-150. Once again, this CROWN product offers uncompromised value, not in frilly gimmicks, but in honest-to-goodness function; all at an attractive price.

This is not to say that the price is the only attraction. The esthetics of the OC-150 smartly match the uncluttered styling of the acclaimed "150" line, the D-150 and the IC-150. The new features are not offered on any of our other products, and bring the ultimate in output switching and monitoring right to your finger tips.

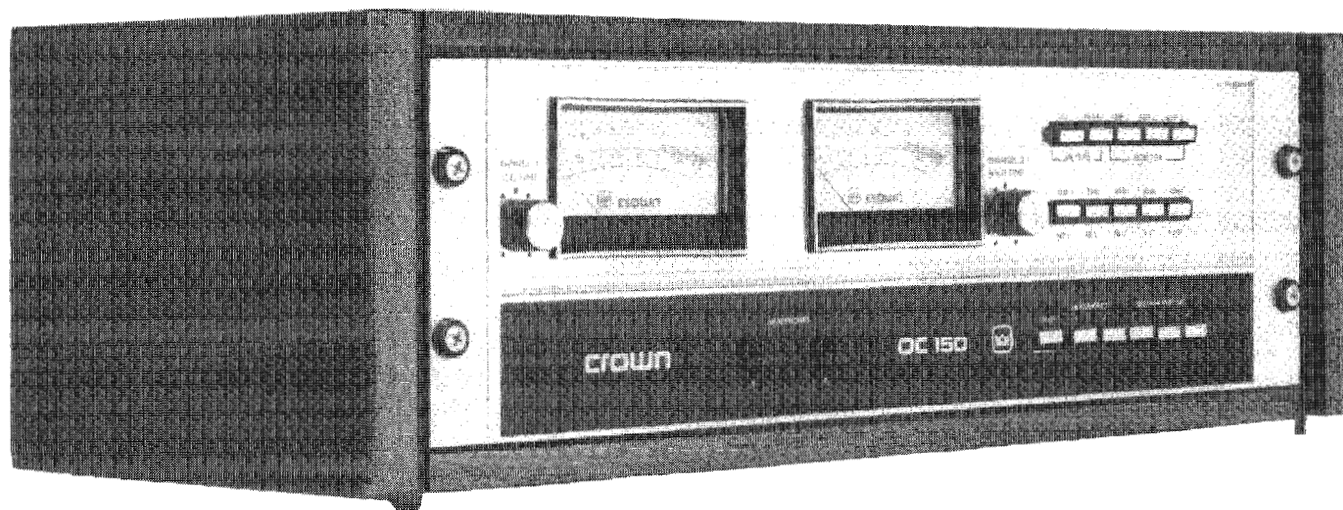


FIG. 1-1

Please inspect the control center for any damage incurred in transit. Since the unit was carefully inspected and tested at the factory, it left the factory unmarred. If damage is found, notify the transportation company immediately. Only the consignee 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 an occasion to transport or ship the unit.

Be sure to return the warranty registration form to the factory for full warranty-service coverage.

CROWN guarantees this equipment to perform as specified. CROWN also warrants the components and workmanship of this equipment to be free from defects for a period of 90 days from date of purchase.

This warranty does not extend to fuses, and/or component or equipment damage due to negligence, misuse, shipping damage or accident; or if the serial number has been defaced, altered or removed.

An application for a FREE 3 year WARRANTY TITLE is included with this manual. Upon receipt of this completed form, CROWN will issue the Warranty Title — subject to the conditions contained therein. This title applies to the original end-purchaser and will be issued only upon the receipt of the application.

We urge that you take full advantage of this coverage — fill in and mail the application now!

QUICK SUMMARY

The OC-150 is an OUTPUT CONTROL CENTER. It is connected in a hi-fi system **between** the power amplifier(s) and the speaker system(s).

1. The meters read either VU in db, or rms equivalents of true peaks, in volts.
2. Output from 1, 2, or 3 amplifier(s) can be monitored on the meters, one at a time, switch selected.
3. Up to three speaker systems, in any combination are switch selected from Amp #1 input.
4. From input #2, three headphone outputs are available. The rear panel electrostatic strip is direct. Front panel jacks 1 and 2 are switch selected and fed through the attenuator switch, on rear panel.

Details below:

FRONT PANEL CONTROL FUNCTIONS

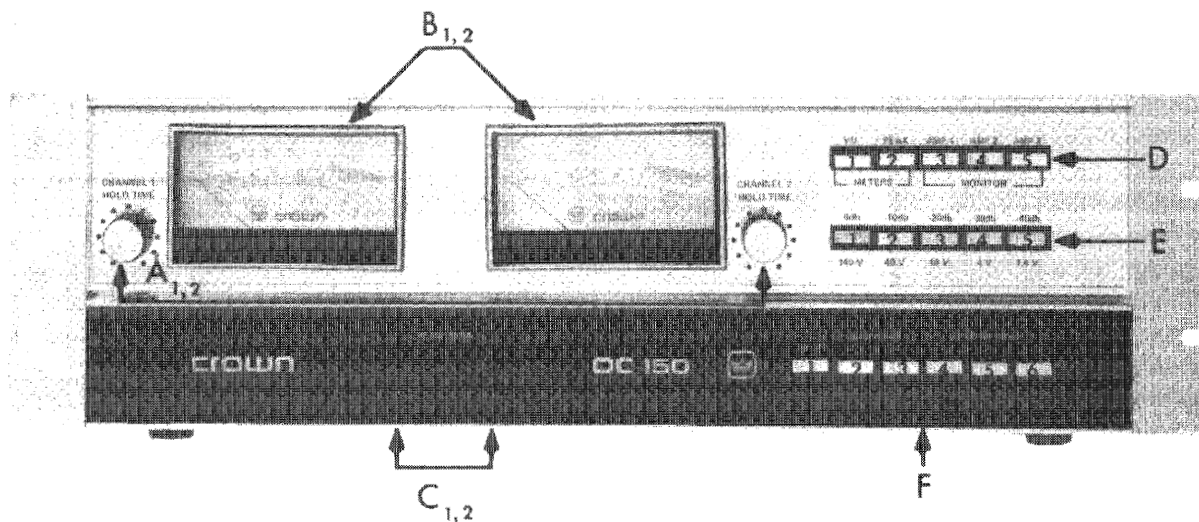


FIG. 1-2

A. HOLD TIME CONTROLS

1, 2 — determine how long the meters will hold a voltage reading, when in the peak mode. Variable from zero to infinity.

B. METERS

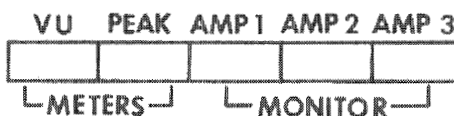
1, 2 — can be used to monitor output signal levels, either VU or PEAK. Meter scales are calibrated in db and volts.

C. HEADPHONE JACKS

1, 2 — connected through headphone selector switch and the attenuator switch to Amp #2 input. If intended for use with Amp #1 input, an external jumper must be used between Amp #1 and Amp #2 inputs. (See caution, page 4.)

D. METER/MONITOR SWITCH

- 1 — VU — when depressed, meters act as VU meters. Meters calibrated in db.
- 2 — PEAK — when depressed, meters read rms equivalents, of true signal peaks, in volts.
- 3 — Amp #1 — when depressed signal from input #1 is fed to meters.
- 4 — Amp #2 — when depressed signal from input #2 is fed to meters.
- 5 — Amp #3 — when depressed, signal from input #3 is fed to meters.



E. RANGE SWITCH

1, 2, 3, 4, 5 — determine the sensitivity of the meters, both in VU and in PEAK modes. Full scale ranges are expressed in db and volts. (See Impedance vs. Voltage, Power graph, page 17.)

0	-10	-20	-30	-40
☐	☐	☐	☐	☐
140V	40V	14V	4V	1.4V

F. SPEAKER SELECTOR SWITCH

1 — ON/OFF — AC power to meter circuits.
 2, 3 — HEADPHONES — select headphone jack 1 and/or 2.
 4, 5, 6 — SPEAKER SYSTEMS — select any or all (in parallel) of speaker systems 1, 2 and 3. Routes signal from input #1 to selected output(s).

HEADPHONES			SPEAKERS		
ON-OFF	1	2	1	2	3
☐	☐	☐	☐	☐	☐

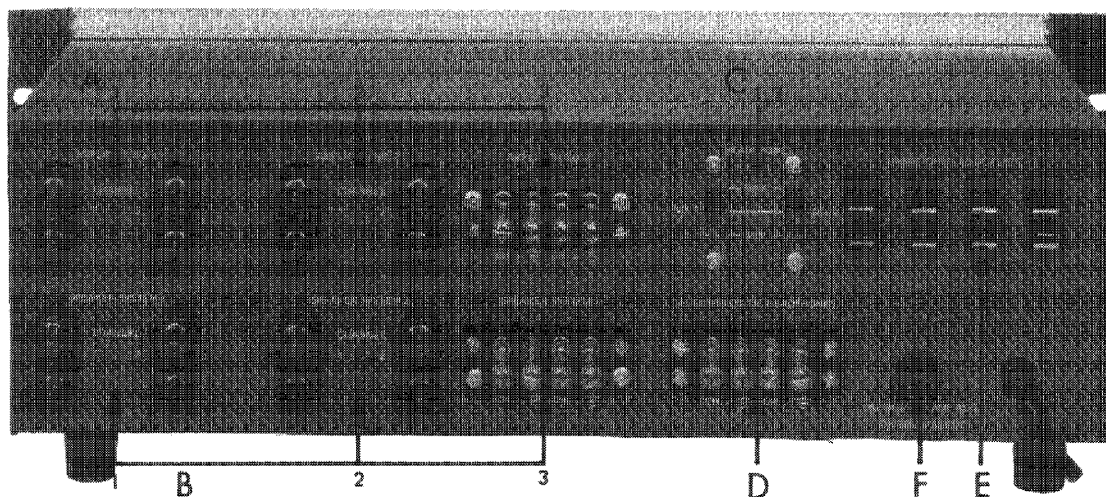
REAR PANEL CONNECTORS

FIG. 1-3

A. AMPLIFIER INPUTS

1 — Amp #1 — Signal fed to meters (when AMP #1 is depressed) and to speaker selector switch, then to selected speaker system.

2 — Amp #2 — Signal fed to meters, (when AMP #2 is depressed) to electrostatic headphone barrier strip (D), and through the attenuator switch (C) to headphone selector switch, then to headphone jacks on front panel.

3 — Amp #3 — Barrier strip type — signal fed to meters only (when AMP #3 is depressed).

B. SPEAKER OUTPUTS

(Fed from Input #1 through speaker selector switch.)

- 1, 2 — Dual binding post type
- 3 — Barrier strip type

C. HEADPHONE ATTENUATOR SWITCH

(Fed from Input #2)

1, 2 — selects the amount of attenuation desired (see page 6) for either headphone jack (1 and 2) on front panel.

D. ELECTROSTATIC HEADPHONE OUTPUT

Barrier strip type compatible with self-powered boxes common to many types of electrostatic headphones. Connected directly to Amp #2 input with no attenuation.

E. AC OUTLETS

Unswitched, available for powering accessory equipment (1250 watts maximum).

F. AC FUSEHOLDER

Use only type MDL 1/8 Amp fuse.

INPUT CONNECTIONS

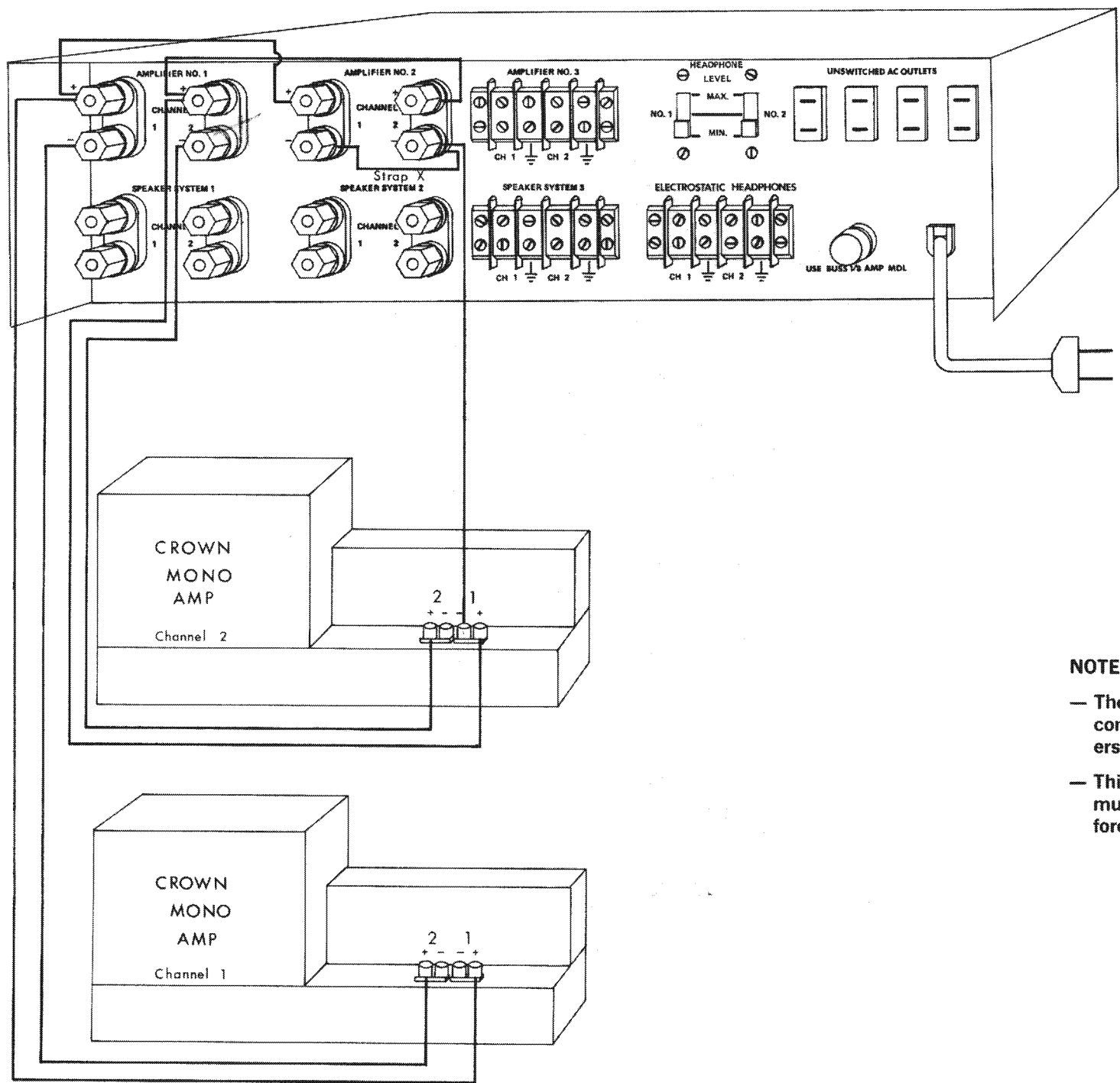
FOLD OUT

- Amp inputs #1, #2 and #3 all have isolated grounds, both channel-to-channel, and from the chassis. Amplifiers with balanced outputs may be used without problems.
- Amp #2 input is connected to the front panel headphone jacks via the headphone selector switch. Mechanically, these stereo jacks have common grounds. To keep input #2 balanced, the ground return for channel 1 has been deliberately eliminated. (Strap "X", see schematic, MI-260.) Thus input #2 can be used as a balanced input for metering only; no signal will be present on channel 1 at the headphone jacks. The electrostatic barrier strip may be used as a balanced output.
- Most present-day amplifiers have a common ground between channels. Thus strap "X" is not needed for normal operation. If single channel operation is desired, then strap "X" must be installed. Additionally, a similar strap could be added to all inputs, and the speaker cables could be reduced to 3-conductor cables.

CAUTIONS

- Any load connected to a balanced output must have isolated grounds! Just because electrostatic headphone boxes have four wires does not mean the set has isolated grounds!
- Never parallel the OC-150 input terminals, except in the case of using one amplifier for speakers and headphones. Any time an unbalanced input is paralleled to another input(s), all inputs involved become unbalanced!
- With strap "X" connected, you cannot use a balanced amplifier (such as any CROWN amp operating in mono) into input #2.

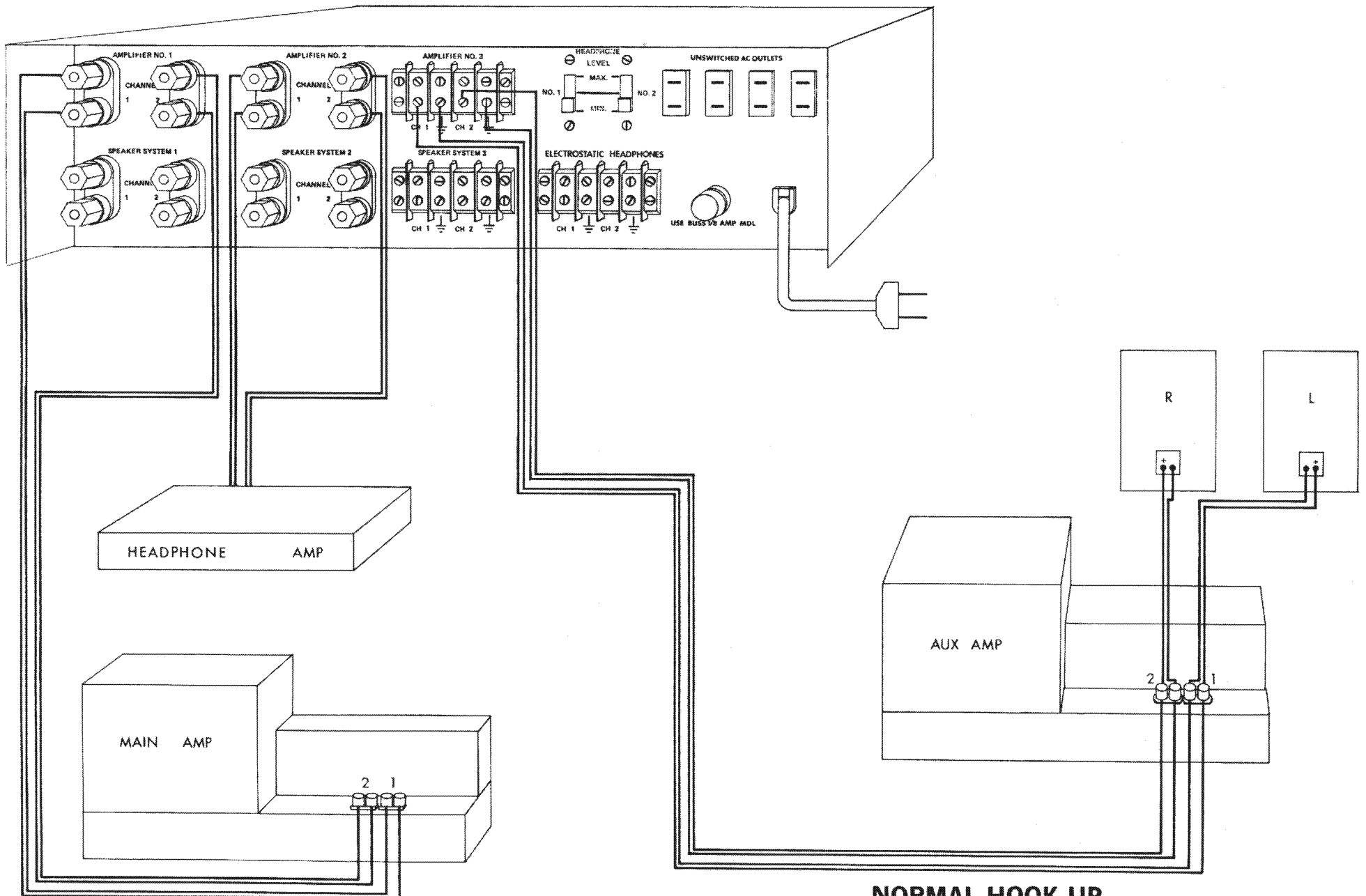
For special hook-up diagram for CROWN mono amps, see INPUT CONNECTIONS FOLDOUT. This hook-up provides full power to the speakers and half power to the headphone jacks.



CROWN MONO AMP HOOK-UP

NOTES:

- The ground return for channel 1 is through the common ground of the input lines to the two amplifiers.
- This hook-up applies to CROWN amplifiers only! You must be certain of how the grounds are connected before you connect any other amps in this configuration.



NORMAL HOOK-UP

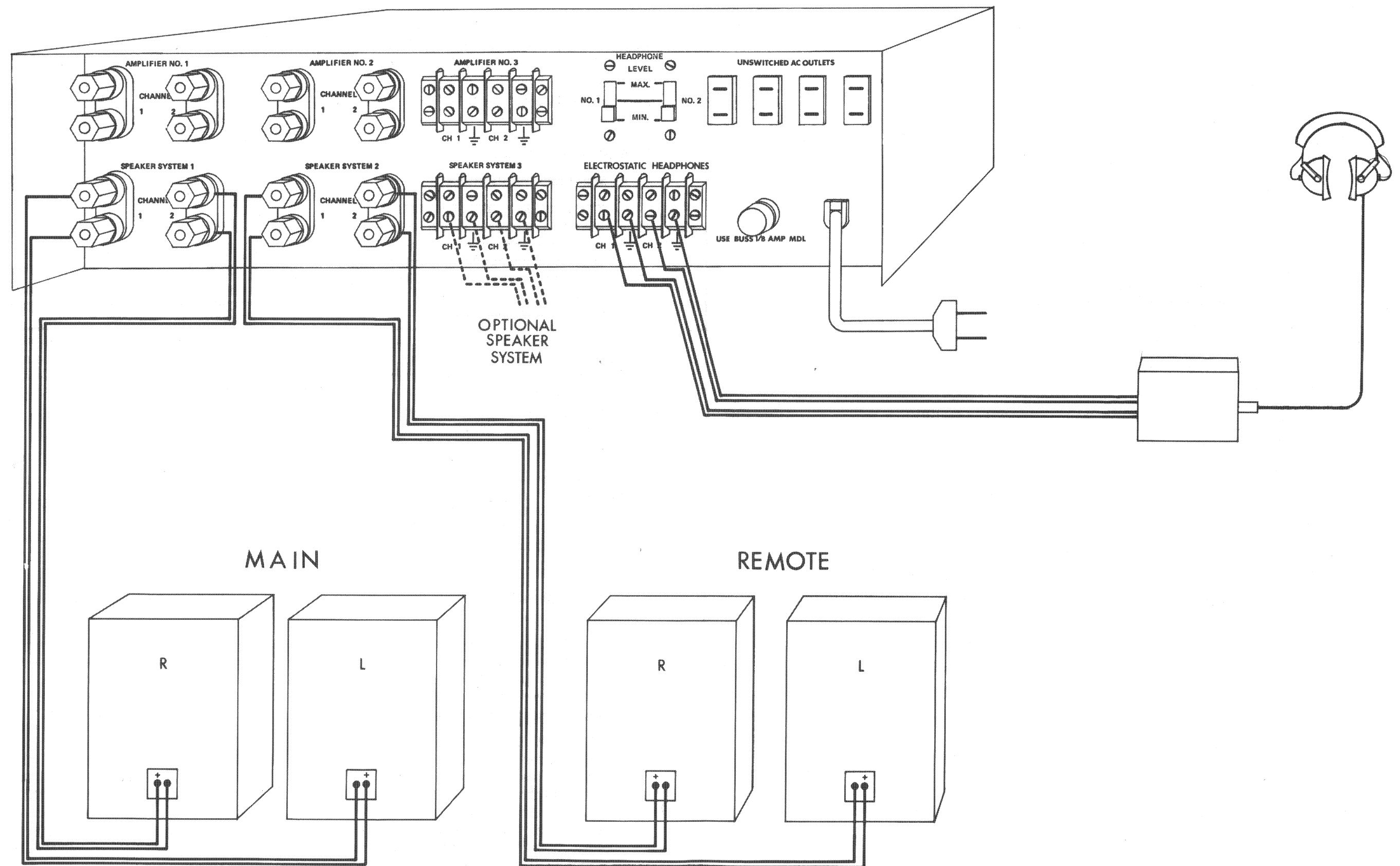
NOTES:

- Add two-conductor jumpers from Input #1 to Input #2 for headphone and speaker output from one amplifier.

OUTPUT CONNECTIONS

FOLD OUT

- Observe proper phasing of speakers.**
- If you are using a power amplifier other than a CROWN, be very careful that you don't exceed the amplifier's power capabilities by decreasing the load impedance too far. For example, by depressing two speaker selector switches and a headphone set at the same time, the resultant impedance would be 2.7 ohms, if all three were 8 ohm systems.**
- Be certain to fuse speakers according to the manufacturer's recommendations.**
- Use headphone jacks cautiously to avoid overpowering headphones or damaging hearing.**



COMMON USAGE PROCEDURES

Your OC-150 has many possible uses. The following discussion can be used as a guide for possible applications. Your own specific equipment as well as your personal listening habits will determine exactly how you use the OC-150.

1. SYSTEM SWITCHING

A. SPEAKERS/HEADPHONES

With a speaker system hooked to each of the three sets of outputs on the back panel, you can select one or all of the systems by depressing the appropriate button(s) on the front panel selector switch. Thus from one location you can control main speakers and two sets of remote speakers.

If you want to add headphones to your system, up to three pairs can be added; two with the front panel jacks, and one with the terminal strip on the back panel. Either of the two jacks can be selected with the front panel selector. The terminal strip is "on" all the time.

Since high power at the headphone jacks represents a potential health hazard, (such as shattered ear drums) your OC-150 includes attenuator switches which feed the two headphone jacks on the front panel. If you turn up the volume to drive inefficient speakers, and then switch to an efficient headphone set, you will need to use one of the attenuator positions.

It is good practice to always turn down the volume, switch to an attenuator position, then carefully increase the volume for a comfortable listening level. **Never** switch to headphones while wearing the set.

The "MAX" position of the attenuator switch patches the signal straight through to the phones. The center position inserts a 17 db pad, and the "MIN" position inserts a 24 db pad. With these combinations it should be possible to balance between speakers and headphones, or two headphone sets, for comfortable listening levels.

NOTE: If you desire to eliminate all turn-on thumps and noise, simply disengage all speaker/headphone switches before turning on the power amplifier. Allow 5 seconds for warm-up, then select your choice of speakers.

B. AMPLIFIERS

The OC-150 has three "amplifier-output" inputs. The monitor switch on the front panel switches these inputs into the metering circuit. These three switches only program the meters, they do not select amplifier outputs. So for example, you can select any of three amplifiers to monitor at the meters, but you will not change the output to the speakers. (The speaker switch is tied directly to Amp #1 input).

Amp #1 input is the "main" input. It is connected to the speaker selector switch.

Amp #2 input is the headphone amplifier input, and is hooked directly to the electrostatic headphone terminal, and through the attenuator switches to the headphone selector switch.

Amp #3 input is only for metering, and is hooked to the monitor switch.

If you have only one amplifier, and want to use speakers and headphones, a jumper must be connected between Amp #1 and Amp #2 inputs. The amplifier may then be connected to either input.

CAUTION: Never connect two amplifier outputs in parallel. If a jumper is used between any amp input terminals, **ONLY ONE AMPLIFIER MAY BE CONNECTED TO THOSE INPUTS!** Also because of the common grounds at the headphone jacks, **BALANCED LINES MAY NOT BE USED WITH AMP #2 INPUT, OR IN ANY INPUT PARALLELED WITH AMP #2.**

2. SYSTEM MONITORING

A. SPEAKERS/HEADPHONES

With the OC-150, you can monitor the voltage levels to any loudspeaker or headphone in your system.

When the meters are properly programmed and the readings correctly interpreted, you can determine the drive signal to any speaker. By using the speaker/headphone switches you can choose any load for monitoring the signal level. Thus it is easy to compare relative efficiency of different headphones or speakers in your system.

For example, if a given speaker produces a certain sound pressure level at a meter reading of 25 volts, and another speaker produces the same sound pressure level at only 15 volts, you know the latter is the more efficient.

The monitoring system can also be used for balancing channels. Turn the pre-amp to mono, and adjust the amplifier input controls for equal meter readings on both channels. If the speakers are identical, this will accurately balance the channels.

NOTE: The meters are programmed as follows:

Select the desired type of reading, VU or PEAK. If PEAK, adjust the hold time controls for desired length of time at which voltage will be displayed on meter.

Select correct range with range switch.

B. AMPLIFIERS

The amplifier switch on the front panel switches the output from any of three amplifiers into the metering circuit. The application of this feature is the ability to monitor levels from any amplifier in the

system. For example, you could monitor the levels from the headphone amplifier, or from the rear channel amplifier in a quad system. You could also check the levels to different elements of a bi-amped system.

This monitor switching does not affect the program to the speakers, but affects only what the meters read.

3. PROGRAM EVALUATION

With the metering circuitry of the OC-150 it is possible to perform an objective evaluation of program materials. With the unique peak catch and hold circuit, you can actually "catch" signal peaks. These readings are sent to the meter where they are displayed as rms equivalent voltages. (If you want true peak values, multiply the meter readings by 1.414.) With a known load, this is readily convertible to power. (Refer to Section II, Technical Information).

A careful observation of peak and average readings will reveal a lot of information about program material. For example, how does the peak power produced from a large orchestral passage compare to that of a rock band at a given loudness level from the speakers? You might want to examine which frequencies seem to be producing the peak power from different sources. Does a wide-band source (such as a full orchestra) produce the same loudness, at a given meter reading, as a single flute?

You can see the many applications for careful metering of signal levels in comparing programs. Your imagination is the next step in actually using your OC-150.

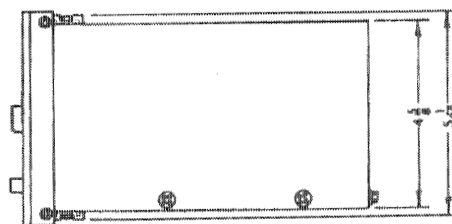
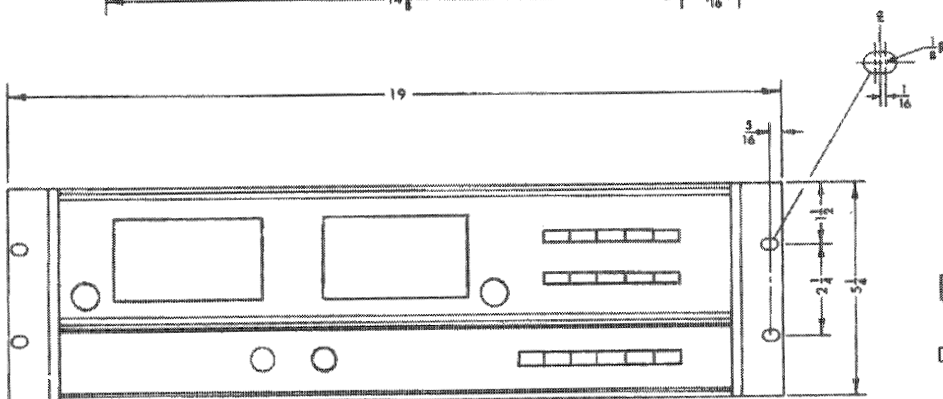
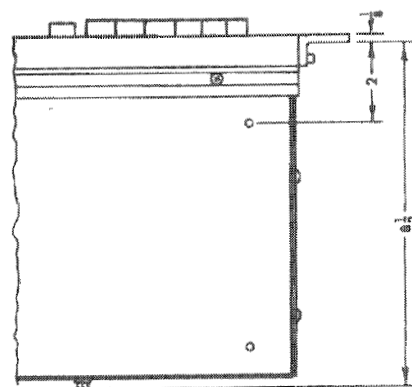
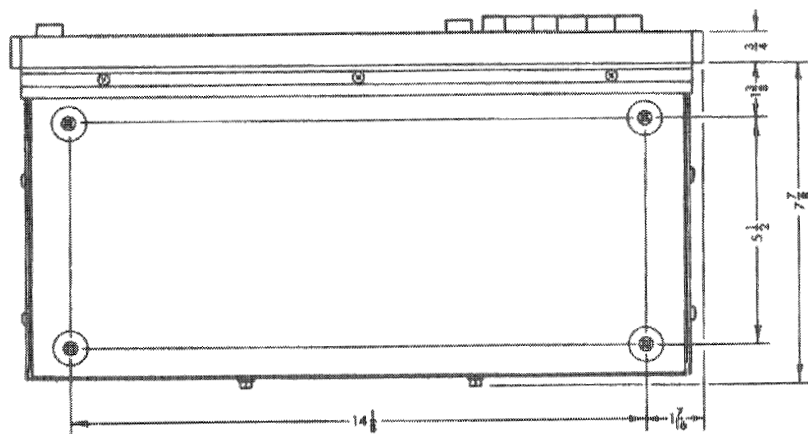
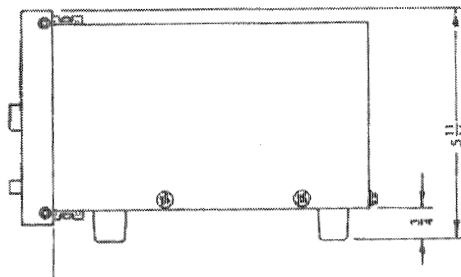
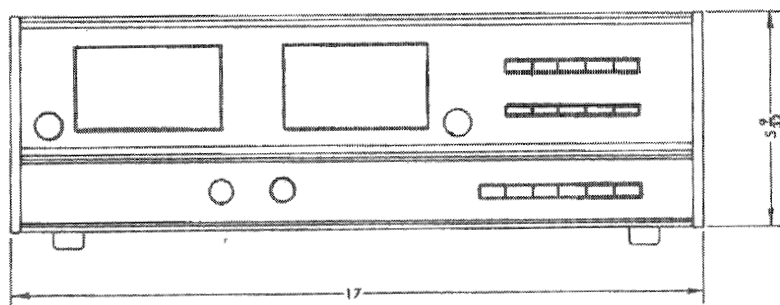
MOUNTING INSTRUCTIONS

There are four basic ways to display your OC-150: custom mounted, mounted in the accessory 5-R walnut cabinet, standard 19-inch rack mounted, or free standing in its attractive vinyl cover.

CUSTOM MOUNTED - A full size template of the OC-150 is enclosed in the rear of the manual. This template also includes dimensions for the shelf which is recommended.

ACCESSORY CABINET - Your OC-150's appearance for shelf or table mounting will be enhanced when installed in the model 5-R walnut cabinet.

First, remove the four rubber feet from the bottom cover retaining the screws. Slide the OC-150 carefully into the **front** opening in the 5-D and secure with the four screws and the new **lower** feet packed with the 5-R cabinet. **WARNING: DO NOT OVERTIGHTEN SCREWS.**



SPECIFICATIONS

METER RESPONSE	+0, -1.0 dB from 20 Hz to 20 KHz
METER ACCURACY	$\pm 3\%$ of full scale, all ranges
AC OUTLETS	Four, unswitched. Total current capability, 15 A.
POWER REQUIREMENTS	10 watts at 120 VAC
TRANSFORMER PRIMARY	120/220 VAC, 40-400 Hz
SEMICONDUCTOR COMPLEMENT	Four integrated circuits, six bipolar transistors, four FET, eight diodes. Discrete device equivalent: 120 bipolar transistors, 16 signal diodes, 8 FET's, 4 zener diodes.
DIMENSIONS	5¼" H x 17" W x 8¾" behind panel.
WEIGHT	10 lbs., with walnut enclosure, 19 lbs.

SECTION II

TECHNICAL INFORMATION

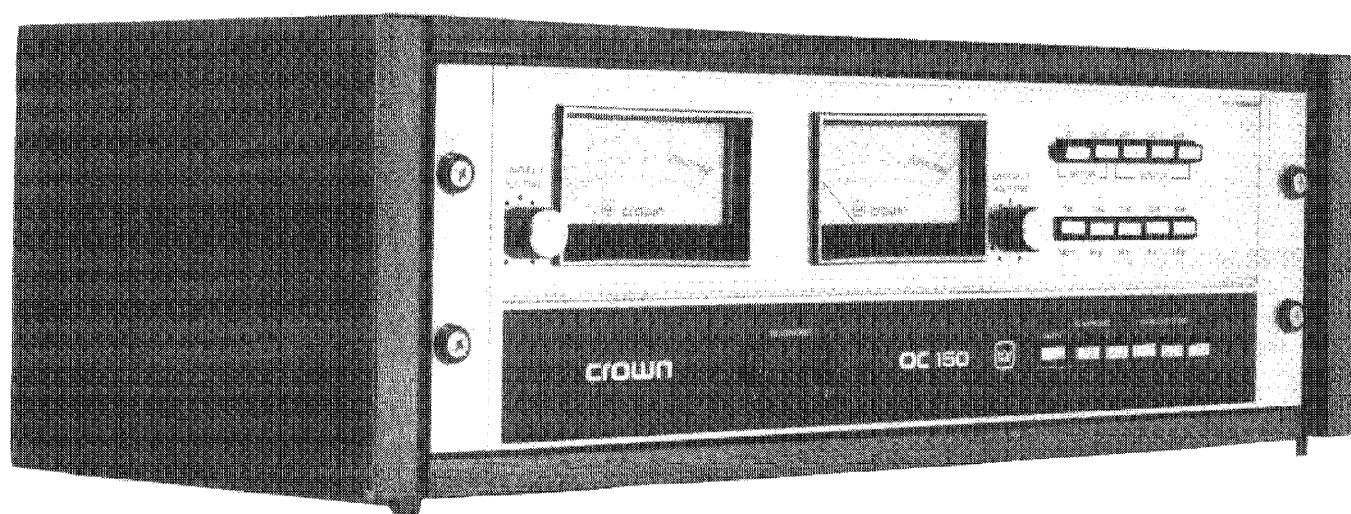


FIG. 2-1

INTRODUCTION

The OC-150 is essentially a mechanical device, designed with simplicity and precision. As such it

should greatly enhance the output flexibility of your hi-fi system.

INPUT/OUTPUT SPECS

Since it is a mechanical (switching) device, the OC-150 does not alter the output from an amplifier in any way. The switching is precise and uses break-before-make contacts to protect the associated amplifier outputs from accidental shorting. In addition, the amplifier inputs have an electrical lockout to further guard against accidental paralleling.

AC power is provided for the OC-150 only to power the metering circuits. The switching mechanism will function even with the power turned off.

In addition, four convenience outlets are provided on the rear panel to power accessory equipment. These outlets are unswitched and remain on as long as the OC-150 power plug is plugged into a "live" source. A very convenient source is one of the switched outlets on the pre-amp.

METER RESPONSE/INTERPRETATIONS

Many Hi-Fi systems include a metering system which reads the output voltage across the amplifier terminals. The tendency for most users, is to make some type of association between meter readings and power output. While a relationship does exist between voltage and power, it is not a simple matter to determine in a hi-fi system - particularly when a complex waveform, such as music, is used as a program source. So as a takeoff point, we need to review the basic characteristics of measuring circuits and meter movements, themselves.

As the frequency of a signal increases, it becomes increasingly difficult for a meter movement to follow the sudden changes of signal level. In fact if an AC signal of about 10 Hz or higher were applied to a center-zero, dc meter, the pointer could only manage to vibrate around zero. Because of the physical properties of the movement, it simply can not follow the rapidly changing voltage. The result is a smoothing out or simplifying of the waveform, the reading being an average. If that waveform is a sine wave, the average is zero, so the meter, being an average responding meter, reads zero.

We could try to use a direct AC reading meter, but again because of mechanical difficulties, the usable frequency limit is in the vicinity of 400 Hz.

If we would rectify a sine wave with a full wave rectifier, and connect a dc meter to this output, the meter would smooth out the waveform and indicate an average value of about .637 times the peak output. (The rectified waveform consists of positive halves only of the sine wave; two positive halves, per cycle of input.) We could calibrate the scale to read anything we wanted, such as average, effective (rms), or peak. As long as the signal remains a steady sine wave, we can make accurate power computations when measuring across a known load where:

P= Power in watts

E= Level (average, rms, peak, etc.) of the signal in volts

R= Resistance of the load in ohms

What happens when the signal is no longer a steady sine wave? Let's look at our meter when the input is a music program.

Even though our meter is accurately calibrated to read rms or peak voltages with a sine wave, when the complex music signal is rectified and applied to the meter, the best the sluggish meter can do is indicate some type of average reading. We totally miss all the quick peaks of the high frequencies. (Here an oscilloscope would be the only measuring device capable of responding fast enough to catch and display these peaks. However, our eye is not always fast enough to see the peaks, so even this is not greatly accurate.) At this point, what has happened to our voltage readings and power computations?

It takes a lot of complicated mathematics to render those voltage readings useful for power computations. Using an analysis tool called the Gaussian distribution curve, it is possible to predict (over a long period of time) what the signal levels of a music program will be. Most of us average hi-fi'ers don't have the mathematical know-how or the patience to use this process, so for us the meter readings are

only relative voltage readings, and almost meaningless for accurate power computations.

This helps us to make an observation: (Rule of thumb #1.) Unless the input is a steady sine wave, you can forget about taking a reading and deciding precisely how much power output your amplifier is delivering.

This observation also applies to VU meters (and the so-called peak reading VU meters since we've already decided that a meter can't possibly follow the peaks in a complex wave form). A VU meter is simply a dc meter with a special fudge factor built into the calibration so that it reads Volume Units. A Volume Unit is essentially the same as a db. VU's are always referenced to a defined power level. (One milliwatt across a 600 ohm load.) In addition, a VU meter must conform to a defined response time.

At this point you are probably wondering what useful purpose meters could possibly have. As long as you keep rule of thumb #1 clearly in mind, the meters can serve as a valuable aid in program comparison. For example, it is generally safe to assume that a higher average voltage reading means more power. Notice we didn't say how much power! This assumption could be used for comparing amplifier outputs, with different load combinations, or different types of music.

The OC-150 offers this type of relative comparison with the meters functioning in the VU mode. And this is only the beginning. The OC-150 also offers a PEAK mode, or to describe this function completely, a peak "catch and hold" mode.

If there was some way to actually measure peaks, even with complex wave forms, we would have a lot of useful information on our hands. For example, the peaks tell us whether the amplifier is clipping and thus what level of distortion to expect. Accurate peak voltages also help us to determine the peak power, if the load is known.

The OC-150 in the peak catch and hold mode will provide accurate storage of peak voltages. The circuit is designed so that all the inherent limitations of a meter movement are by-passed. Here's how it works.

The waveform is sampled electronically using a sensing circuit which measures even the fastest peaks. This measurement is stored electronically, and then sent to the meters. The hold time controls determine how long this stored information is held at the meter terminals. The hold time is adjustable from zero to infinity, so the slow meter movement can take all the time in the world getting up to the peak reading. When the pointer stops movement, you are observing a voltage peak that occurred some fraction of a second previously. The meter scales are calibrated to read rms equivalent values, so if you want a peak value, multiply the meter reading by 1.414.

Once a peak is caught and held, the meter will remain at that level until a peak of higher value comes along. If you want to see as many peaks, at different levels, as possible, a short hold time is necessary. Remember, as long as the meter comes to a stop, it is reading an rms equivalent to a true peak. In essence we have trickily outwitted the proverbial old slow meter movement. Rather neat, eh?

Up to this point we have assumed a test-bench situation when relating voltage readings to power. That is, we have assumed that the load was non-reactive; and the resistance value was known. Power calculations follow with ohm's law; $P = \frac{E^2}{R}$.

What happens to power output if we substitute a speaker (reactance and resistance) for our resistive load?

When an amplifier supplies power to a purely resistive load, the current through the resistance, and the voltage across it are exactly in phase. That is, peaks and zeros of the current and voltage wave forms occur simultaneously. If a pure reactance is substituted for the resistance, the current is no longer in phase with the voltage, but leads or lags by 90° depending on whether the reactance is capacitive or inductive.

In any practical load, such as a loudspeaker, the load is complex, consisting of both resistance and reactance. These two quantities are added by a technique using phasors (quantities which include both an amplitude and a phase angle) and the resultant, called impedance, is the real load the amplifier "sees".

The net result of this complex impedance causes the voltage and current waveforms to be out of phase by some angle less than 90° . See figure 2-2.

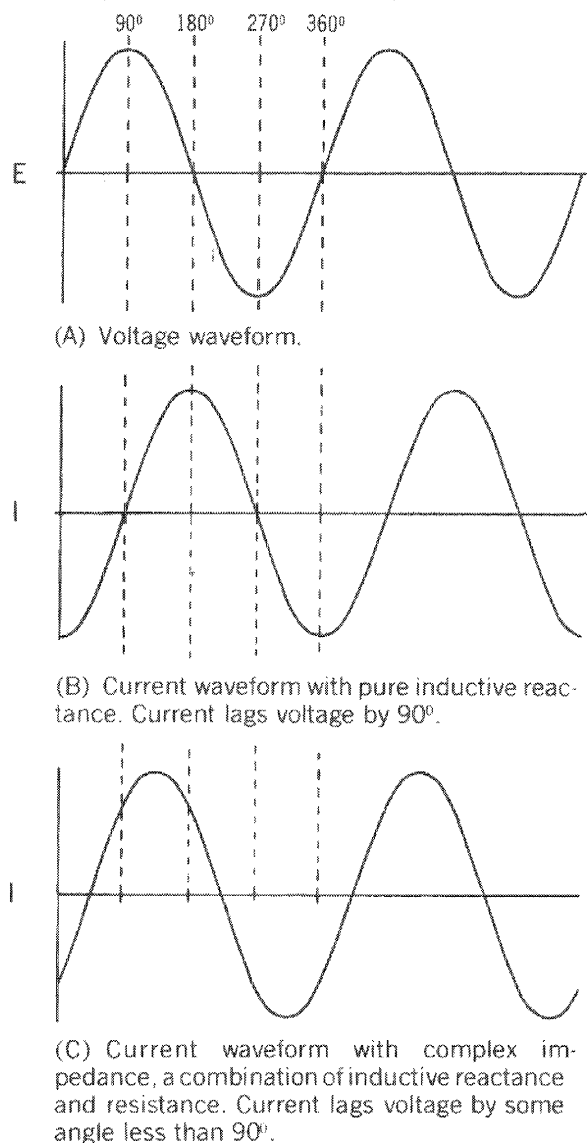


FIG. 2-2

Now back to our original question. Let's look at a typical loudspeaker, a complex load, consisting of inductive reactance and resistance. It has been determined that this speaker represents an 8 ohm impedance at 1kHz.

We will set up our test by using a 1kHz input signal to the amplifier of sufficient level to cause an output voltage of 10 volts across the speaker terminals.

With this information, we can compute the power to be $P = \frac{E^2}{Z}$

$$P = \frac{10^2}{8} = \frac{100}{8} = 12.5 \text{ watts}$$

Does this mean that the speaker is dissipating the 12.5 watts as acoustical power across the complex impedance. In a simplified analysis, we can account for the total power (12.5 watts) from the amplifier, being dissipated in four areas.

- (1) Some of the power is dissipated as heat across the resistive part of the impedance. This is essentially wasted power since it does not produce any acoustical result. Resistance is found in such places as in the wire of the speaker's voice coil.
- (2) Some of the power is dissipated as heat in the amplifier itself because of the reactive component of the impedance. One of the characteristics of pure reactance is that it cannot dissipate any power.

Rather it serves as an energy storage device. This stored energy will be returned to the amplifier and wasted as heat. Look again at figure 2-2. Notice that in each cycle two periods of time exist when the voltage is positive while the current is negative. (This is due to the reactive component causing a phase shift.) It is during these two periods of time, that negative power is produced, and the stored power in the reactance is returned to the amplifier to be wasted as heat. It should be clear from this, that to drive a pure reactive load would be pointless as it would only cause amplifier heating.

- (3) Some of the total power is transformed and dissipated as acoustical energy. This is because the inductive reactance (voice coil) is situated in a magnetic field. The applied AC power causes the voice coil to move. Since the voice coil is attached to a large diaphragm which in turn causes compressions and rarefactions of the surrounding air, acoustical energy is produced.

- (4) Some power is lost due to inefficiencies in the loudspeaker. Interaction of the voice coil with the magnetic field causes heating of the magnetic core. This heat is all wasted, producing no acoustical effect.

It can be seen from this, that of the 12.5 watts total, perhaps only a small portion has been translated into actual acoustical energy. How much reactance is present, how much resistance, and other factors such as speaker efficiency determine the net result. It should be clear that highly reactive speakers (such as electrostatic systems) represent a difficult load and severely limit the amplifier's efficiency.

Notice the V-I output graph, figure 2-3. The straight line through the middle represents the load line for an 8 ohm resistive load. Notice that no negative power is produced (voltage and current are in phase). The ellipse in the center represents an 8 ohm impedance load line. (The 8 ohm impedance consists of 3 ohms resistance and 7.42 ohms inductive reactance at 1kHz.) Notice because of the phase shift, 68° in this case, the straight line has become an ellipse, and then for two periods of time through the 360° cycle, negative power is produced.

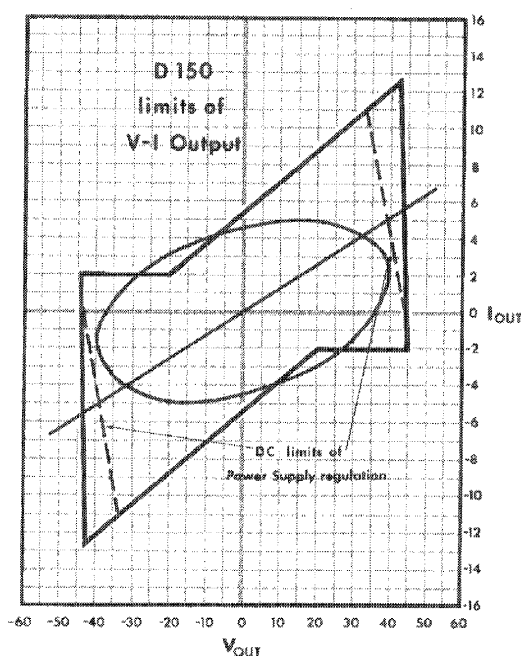


FIG. 2-3

It should be clear that the ideal load in terms of producing acoustical energy would be one which minimizes the reactive component (high amplifier efficiency) while optimizing the desired dissipation component, (low inductance high efficiency speaker). Also the resistance of the load should be kept at a minimum. In practical terms this ideal is difficult to achieve and amplifiers should therefore be designed to handle high reactances without over heating.

At this point the observant reader has probably noticed that we have employed only one frequency in describing complex loads. We have one parting point to ponder before we can be satisfied in knowing what the OC-150's voltage readings are telling us. (You didn't expect anything simple with so sophisticated a system?)

Notice the graph of fig. 2-4. This is a plot of a "typical" speaker system impedance over the audio bandwidth.

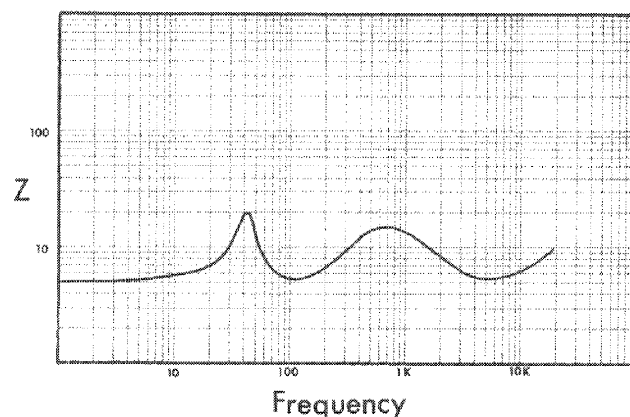


FIG. 2-4

Since reactance varies with frequency, the ratio of reactance to resistance, and thus impedance, varies with frequency also.

When a music program is used as a source and is applied to speaker terminals, the impedance seen by the amplifier becomes very complex, being slightly different for each frequency component present. Since the impedance varies, the amount of power at different frequencies also varies.

Speaker manufacturers have tried many schemes

for smoothing out the effect of frequency on impedance. For instance, by careful design of the speaker enclosure it is possible to smooth out some of the wide variations in impedance. But speaker impedance is still not linear with frequency. Many variables affect impedance, such as cabinet resonance and crossover characteristics. These and other factors lead to the type of impedance curve illustrated in fig. 2-4.

Speaker impedance is usually given as a nominal value, such as 8 ohms or 4 ohms. This is a rough approximation of an average impedance for the range of audio frequencies.

The overall effect of uneven power response (due to varying impedance) may not be as dismaying as it appears. Here by the application of inverse Murphy's Law, we end up with a beneficial twist of fate.

A loudspeaker is largely voltage sensitive rather than power sensitive. Since an amplifier will deliver a constant voltage over a range of impedances, the audible effect of the changing power is not always noticeable. Even though the impedance of a speaker may drop at a certain frequency, in many speakers, the efficiency drops at that frequency as well. The net result is that while more power is produced at that frequency, more of it is lost as heat, and the acoustical output level is unchanged.

All of the preceding indicates the difficulties involved in accurately interpreting OC-150 voltage readings, using a music program as source, with an amplifier driving a complex load. It is apparent that you must be satisfied with relative or comparative interpretations. For specific computations you must use a test bench set-up. (Sine wave and resistive load). Each departure from this test situation introduces new variables which require very careful (and complicated) analysis. By the time you have tuned in an FM stereo signal and hooked up your favorite speakers, the voltage readings on the OC-150 are chiefly useful as a comparative analysis tool.

You might try computing power using the nominal rated impedance of the speaker system. It should be clear from the above discussion, however, that the results may be far from accurate. If the load is a pure resistance, then the graph of fig. 2-5 may be used to compute power. Look again at fig. 2-3. Notice that the more reactive the load becomes, the farther the graph departs from a straight line. Because the reactance produces negative power, the amplifier loses efficiency. This means less of the total power is delivered to the load.

Now to examine the usefulness of the OC-150 voltage readings. In fig. 2-5 the vertical column represents voltage. The horizontal column represents power. We have drawn three load lines on this graph. You must pick the line that comes the closest to your load impedance.

If your impedance is a pure resistance, you will be approaching 100% efficiency. (This won't produce much acoustical energy, but it's great for heating your room.) As your load impedance becomes reactive, your amplifier efficiency goes down. However, it is this reactive component which produces acoustical energy. So we are looking at a trade-off between high inductance (good energy transfer) and the corresponding high reactance (amplifier inefficiency).

If we could take an 8 ohm speaker, and vary the ratio of reactance to resistance from pure resistance to pure reactance, the amplifier would supply the same power through the entire range. At the extreme end of pure resistance, the load would dissipate all the power, with 100% amplifier efficiency. At the other extreme of pure reactance, the amplifier would dissipate all the power for an efficiency of 0%. Somewhere in between these extremes, we would find a compromise between amplifier efficiency and maximum acoustical energy.

As you use the graph of figure 2-5, keep the above discussion in mind and you will not be enticed into making erroneous statements about how much power your speakers are producing.

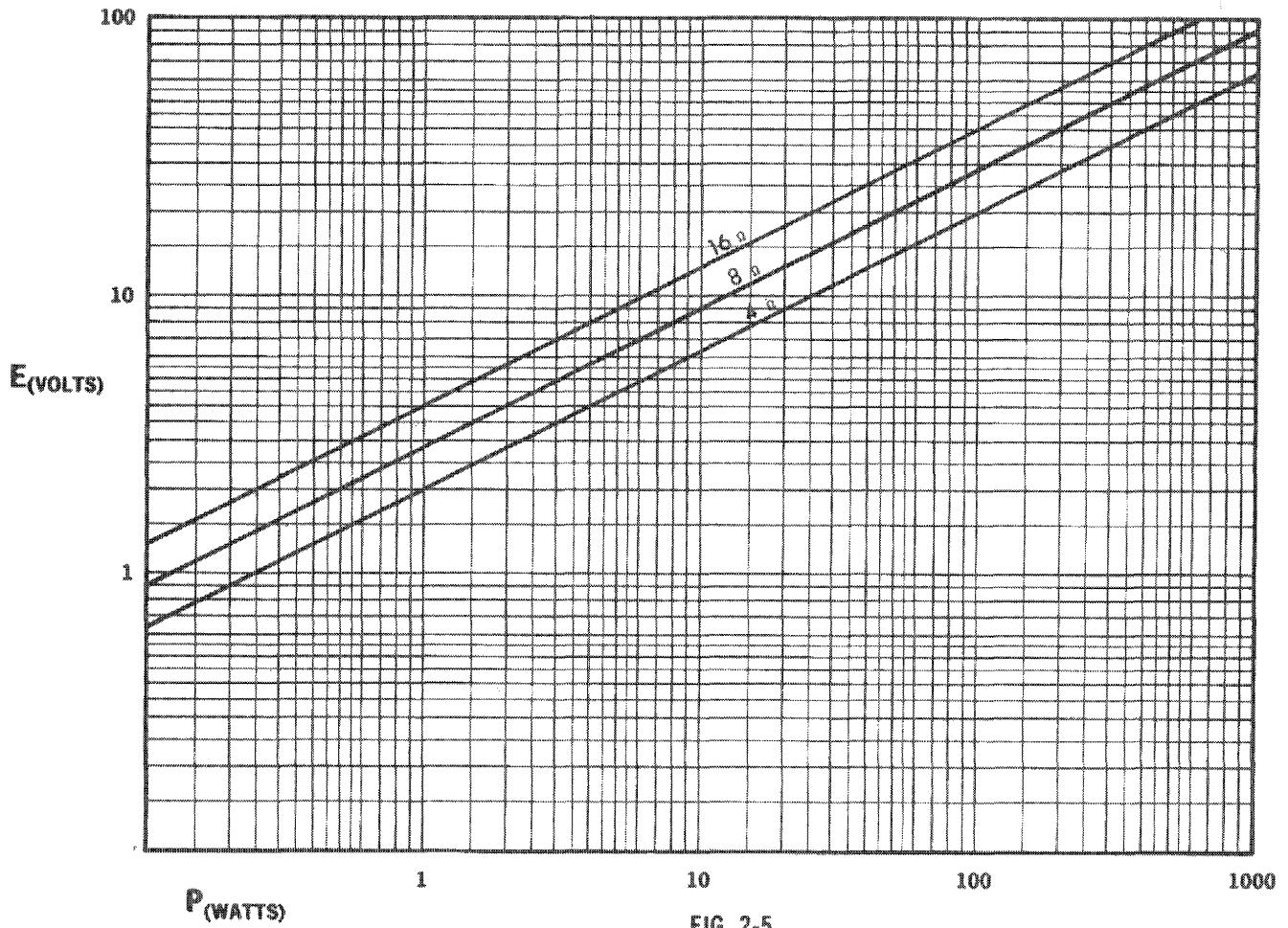


FIG. 2-5

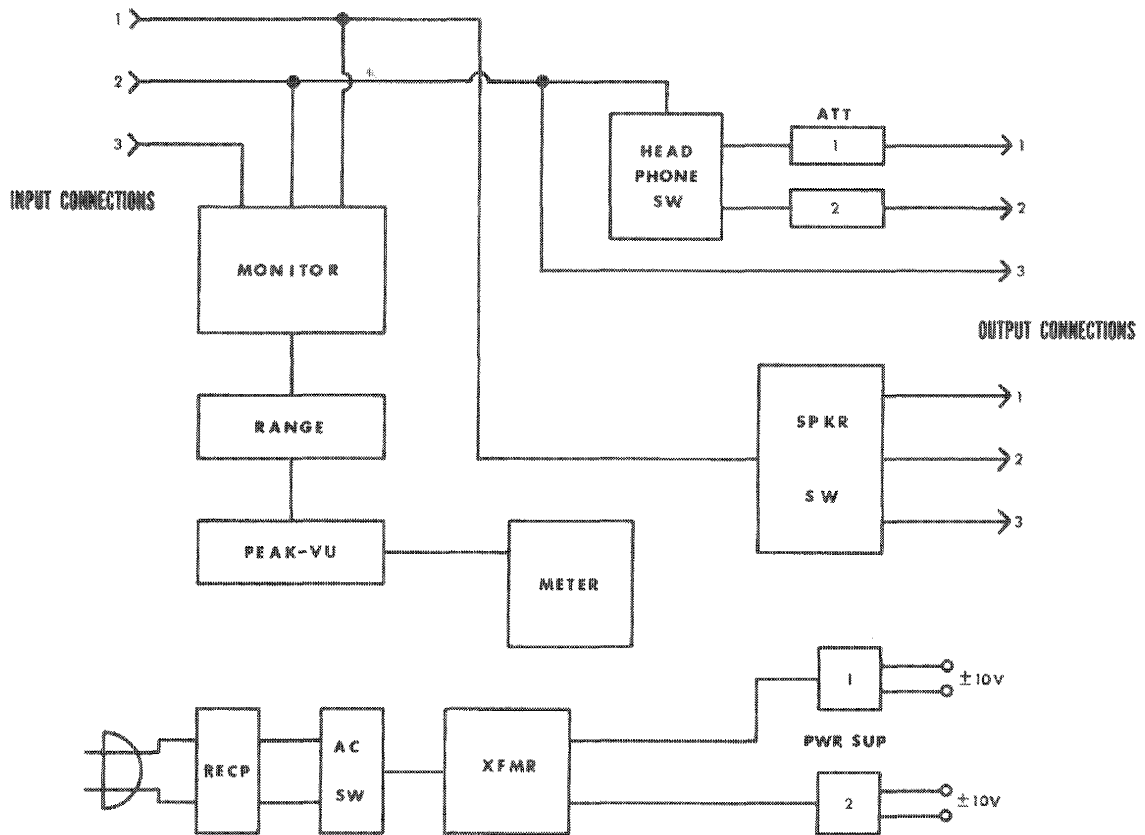


FIG. 2-6

CIRCUIT DESCRIPTION

AC power to the OC-150 is used to drive the meter circuits. The transformer has two 8V secondaries, one is taken to each meter board. Each meter board contains its own power supply, a full wave rectifier with a capacitive input filter. Output voltages are ± 10 vdc, non-regulated.

The uniqueness of the OC-150 metering system is that the information fed to the meters is electronically derived. With the hold circuit the information is held at the meter terminals, so the accuracy of the readout is not dependent upon meter response time.

A sampling of the signal is fed to an op-amp rectifier which yields negative dc pulses. These pulses are negative regardless of input signal polarity, and are fed to a unity gain, inverting amplifier. Output from the inverting amplifier is fed to two RC networks (one a storage network, the other a timing network). Output from these networks is fed to a pair of FETs where any input offset is balanced out. Finally, the information is taken to another unity gain op-amp, and from there to the meter.

The two RC networks form the heart of the circuit. The storage network has a very short time constant which allows the network to charge and discharge very quickly with signal peaks.

The timing network operates in conjunction with an op-amp comparator switch and determines the hold time for the information at the storage network. Part of the timing network is the hold time control on the front panel. This control, and the PEAK-VU switch simply change the charging time in the timing network. So in the VU mode (or if the hold time control is turned all the way down) the meters are driven with a real time signal; there is no hold action.

HEADPHONE ATTENUATOR SWITCHES

Because of the relative efficiency of most headphones, it is easy to produce large sound pressure levels with low or medium power amplifiers. A 200 watt amplifier would represent a "lethal dose" of power to most headphones. It is for this reason that

attenuators are inserted in series with the headphone jacks on the front panel of the OC-150.

Two levels of attenuation are available, 17db and 24db. The attenuators are activated by three-position slide switches on the rear panel.

To illustrate the usefulness of the attenuators, let's set up a typical headphone monitoring system. We'll assume an impedance of 8 ohms with an efficiency such that 3 volts across the 8 ohm impedance produces a comfortable listening level. Using Ohm's law the power is 1.13 watts. Now if we would switch to the 17db attenuation position, we could increase the voltage to 21.4 volts and still keep 3 volts across our headphones. The new power is 57.2 watts. Similarly, by using the 24db attenuation position, the voltage/power could be increased to 49.8 volts or 310 watts.

CROSSTALK AND SEPARATION

Since the OC-150 is a high signal level switching device, crosstalk is limited to lead dress, and mechanical construction of the switches. The OC-150 has been carefully engineered with high quality switches. For any practical purposes, the crosstalk is so far below average listening power levels, that it may be considered non-existent.

CARE OF THE OC-150

If the leatherette case of the OC-150 is scratched, the scratches can be removed with powder, followed by washing with a dishwashing detergent and water. Furniture polish can be used to polish the cover.

220 VOLT CONVERSION

Conversion for operation with 220 VAC is accomplished simply with a soldering iron. Figure 2-7 shows the two hook-ups. Conversion should be done in the following steps:

- (1) Remove the top cover of the OC-150. Locate the four wires from the transformer going to a terminal strip. (Left hand rear corner, terminal strip is mounted on rear panel.)
- (2) Unsolder and remove the wire going from terminal 1 to the main AC bus (base wire connecting one side of all the AC receptacles).
- (3) Unsolder the black wire from terminal 1, and solder it up on the main AC bus.
- (4) Unsolder the black/yel wire from terminal 2 and move it to 1, solder it with the black/green wire.
- (5) Replace the 1/8 MDL fuse with a 1/16 A fuse.
- (6) Change the line cord tag to read 220 VAC.

WARRANTY SERVICE

If a problem is encountered, and after a careful check of system hook-ups the problem persists, the unit should be taken to a dealer.

He will be able to arrange for authorized service by CROWN personnel. In the event this proves impossible, call or write CROWN International, 1718 West Mishawaka Rd., Elkhart, IN 46514. Your communication will be handled by our service department, and information on repair work will be available.

For any warranty work, be sure to fill out the warranty form completely. This form is included at the back of

the manual, along with an order form for factory packing material. All shipping must be done in a factory pack.

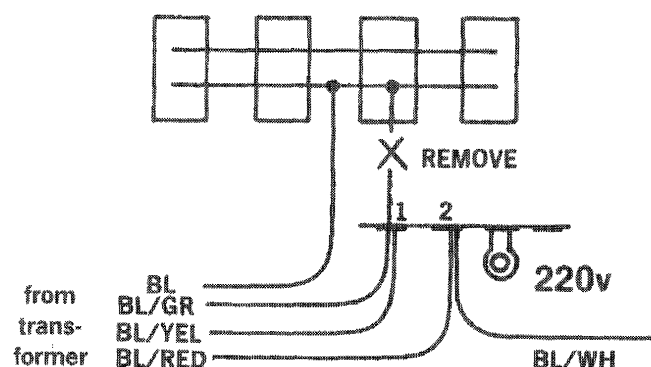
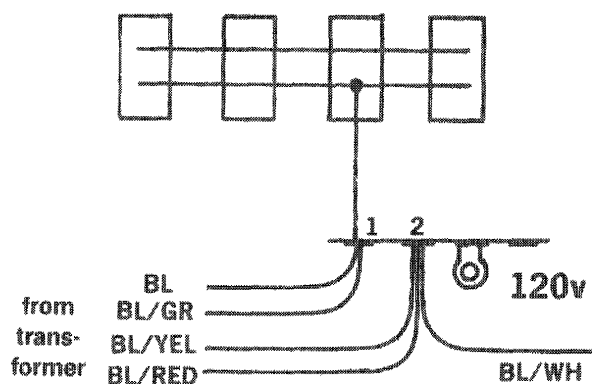


FIG. 2-7

OC-150 PARTS LIST

Schem. #	Description	CPN	Notes
	OC-150 Meter Board	Q 41298 -3	
	CAPACITORS		
C1	.01 MF disc ceramic	1751	
C2	.22 MF filmatic mylar	3218	
C3	.47 MF filmatic mylar	3191	
C4, C5	250 MF 30V	3680	
C6	5 PF mica	2820	
C7, C8	100 MF 12V	2869	
	RESISTORS		
R1	10K ohm 2 watt 1% CF	3940	
R5	10K ohm .5 watt 1% MF	2343	
R2, R3, R4	20K ohm .5 watt 1% MF	3752	
R6	41.2K ohm .5 watt 1% MF	3127	
R7	180K ohm .25 watt 10%	2884	
R8, R14	15 ohm .25 watt 10%	3614	
R9	1.8M ohm .25 watt 10%	2887	
R10	2.2K ohm .25 watt 10%	2628	
R11, R43	22K ohm .25 watt 10%	3302	
R12, R13, R44, R45	1K ohm .25 watt 10%	2627	
R15	100K ohm .25 watt 10%	2883	
R16	2M ohm .25 watt 10%	3199	
R17	2K ohm trim pot	2871	
R18	4.7K ohm .5 watt 10%	1640	
R19	3.9K ohm .5 watt 10%	1059	
R20	5.6 ohm 2 watt 10%	3896	

OC-150 Parts List (Cont'd.)

Schem. #	Description	CPN	Notes
SEMICONDUCTORS			
Q1, Q2, Q3	2N3859A	2961	
Q4	2N4125	3625	
Q5, Q6	2N5459 FET	3053	Must be a matched pair
IC-1, IC-2	RC4558 Dual op-amp	3919	
D1, D2, D3, D4	1N4148	3181	
D5, D6	1N4003	2851	
MISC. HARDWARE			
	PC board	9508	
	8 pin dual in-line IC socket	3451	
	lamp socket	1262	Mounts over PC board
	#1866 6.3V .25A lamp	2899	
FRONT PANEL ASSEMBLY			
RESISTORS			
R21, R22	25K Audio taper pot	3494	Hold time controls
R23, R24	1.74K ohm .25 watt 1% film	3929	Mount on range switch
R25, R26	392 ohm .25 watt 1% film	3928	Mount on range switch
R27, R28	113 ohm .25 watt 1% film	3927	Mount on range switch
R29, R30	49.9 ohm .25 watt 1% film	3926	Mount on range switch
MISC. HARDWARE			
	OC-150 Front Panel	3759	
	OC-150 FP Overlay	3784	
SW1	OC-150 PB selector switch	3746	VU-Peak-Amp
SW2	OC-150 PB range switch	3745	
SW3	OC-150 PB Power Switch	3744	Headphone/speaker

OC-150 Parts List (Cont'd.)

Schem. #	Description	CPN	Notes
Misc. Hdwe. Cont'd.			
	PC switch mounting board	9531	PC board terminals for SW3
	Main switch bracket	3923	Bracket for SW1 & SW3
	Switch sub-bracket	3922	Bracket for SW2
	#4 x 3/16 PAN SMC Screw	3898	Fastens SW1, 2, 3, to brackets
	6-32 x 3/8 HEX screw	3322	Used to fasten both switch brackets to front panel
	#6 internal star washers	1823	Used to fasten switch brackets to panel
	6-32 HEX nuts	1829	Used to fasten switch brackets to panel
	N112B 3-Cond. phone jack	3507	Headphone jacks
	Black knurled nut	3495	Used to secure 3507
	Black washer	3628	Used to secure 3507
	3/8" internal star washer	2188	Used to secure 3507
	VU meter	3747	Includes bezel & all hdwe.
	1/4" aluminum spacer	2179	Used between meter terminals & meter PC board
	1/4" internal star washer	2365	Used to mount R21, 22 inside panel
CHASSIS ASSEMBLY			
RESISTORS			
R31, R32, R33	100 ohm 10 watt 10% wire	3899	Mount on terminal strips
R34, R35, R36			
R37, R38			
R39, R40, R41, R42	8.2 ohm 1 watt 5%	3900	Mount on headphone attenuator switches
MISC. HARDWARE			
	OC-150 chassis	3751	
	3PDT slide switch	3755	Headphone attenuator switches
	HTA fuseholder	3256	

OC-150 Parts List (Cont'd.)

Schem. #	Description	CPN	Notes
	Misc. Hdwe. Cont'd.		
	MDL 1/8A fuse	3905	
	3 # 18-8' power cord, male	3474	
	Heyco strain relief	2803	Secures power cord
	AC flush receptacle	2432	
	Dual binding post	2823	Input/output terminals
	4-141-4 barrier strip	3736	Input/output #3, headphone #3
	Flush expansion nut	2543	Mount in edges of chassis
T1	46-P-31 power transformer	3760	
	6 - 32 HEX spacer	3251	Used to mount T1
	6 - 32 x 1/4 BHP screw	1954	Used to fasten T1 to speakers
	#6 internal star washer	1823	Used to fasten T1 to speakers
	#6 solder lug	3163	Ground lug for green wire from power cord.
	1-G-2 terminal strip	1266	Mounts on one screw of headphone barrier strip
	8J6AJ terminal strip	3503	Mount over screws from barrier strips
	6-32 x 3/4 BHP screw	2135	Used 4 places to mount 3503
	#6 internal star washers	1823	Used 4 places to mount 3503
	6 - 32 HEX nut	1889	Used 4 places to mount 3503
	8 - 32 x 5/8 RHS screw	2228	Used to mount 3 barrier strips
	#8 internal star washers	1951	Used to mount 3 barrier strips
	8 - 32 HEX nuts	1986	Used to mount 3 barrier strips

OC-150 Parts List (Cont'd.)

Schem. #	Description	CPN	Notes
	Misc. Hdwe. Cont'd.		
	3/4" rubber feet	2945	Mount to bottom of chassis
	#8 x 1" SMT screw	2088	Used to mount feet
	#D control knob	3512	Hold time control knobs
	#8 x 3/8 PHSMT screw	3319	Used to fasten front panel to chassis
	COVERS, ACCESSORIES, LABELS		
	OC-150 Top cover	9539	
	8 - 32 x 1/2 THP screw	1869	Fastens top cover to chassis
	#8 x 3/8 PHSMT screw	3319	Fastens top cover to front panel
	5" rack mount ears	3341	
	6 - 32 x 3/4 SCP screw	1858	Fasten rack ears to front panel
	5" end bars	3462	Used when rack mounting is not desired. Secured with 1858 screws
	Serial tag	3693	

OC-150 TEST

1. Input offset on panel meters.
 - Apply power to unit, with no input, meters should read zero
2. Calibration
 - Apply 120 VAC to Amp #1 input. (both channels)
(Use true rms peak equivalent AC meter with variac to obtain 120 VAC calibrating source.) Set range switch to 140 V, meter switch to "VU"; adjust R17 for 120V reading on panel meters.
3. Set meter switch to "PEAK" and turn "hold-time" controls to full CW. Remove signal from input (#2 above). Meter reading should hold at 120 V for 10 - 15 seconds.
4. Switch range switch to 14 V, turn "hold-time" controls to full CCW and feed in a 10 Volt signal to Amp #1 input. (Use the output from an amplifier to obtain a 10 V signal) Meters should read ≈ 10 V.
5. Switch range switch to 1.4 V, feed in a 1 volt signal. Meters should read ≈ 1 V.
6. Feed in a 7.8 V 1KHz signal to Amp #2 input. Take output from stereo headphone jacks and feed to an external AC rm. Switch headphone attenuator switch to "max". Voltmeter should read 7.8 V. (0db on +10 V scale) Switch to middle position. Voltmeter should read ≈ 1.2 V (-17db). Switch to "min" position. Voltmeter should read $\approx .62$ V (-22db).

SERVICE HINTS

1. Most failures will be due to switch failures.
2. Step 1.
 - if meters don't read zero FETS, (Q5 & Q6) may not be matched properly.
 - if Q1 is open, a turn-on transient may appear as an input offset.
3. Step 3
 - if Q1 is leaky, the circuit will catch a peak, but hold time will not be adjustable.
4. Step 4, 5
 - if meters seem jumpy on low ranges, check Q3 or Q4 for noise. (These are the constant current supply.)
5. Step 6
 - If readings differ drastically, check to make sure R39 or R40 are in circuit. These provide a load for the attenuator calibration.

SERVICE BULLETIN

TO: ALL SERVICE CENTERS

DATE: 23 July 1975

RE: OC-150 METER CIRCUIT

FROM: Technical Service

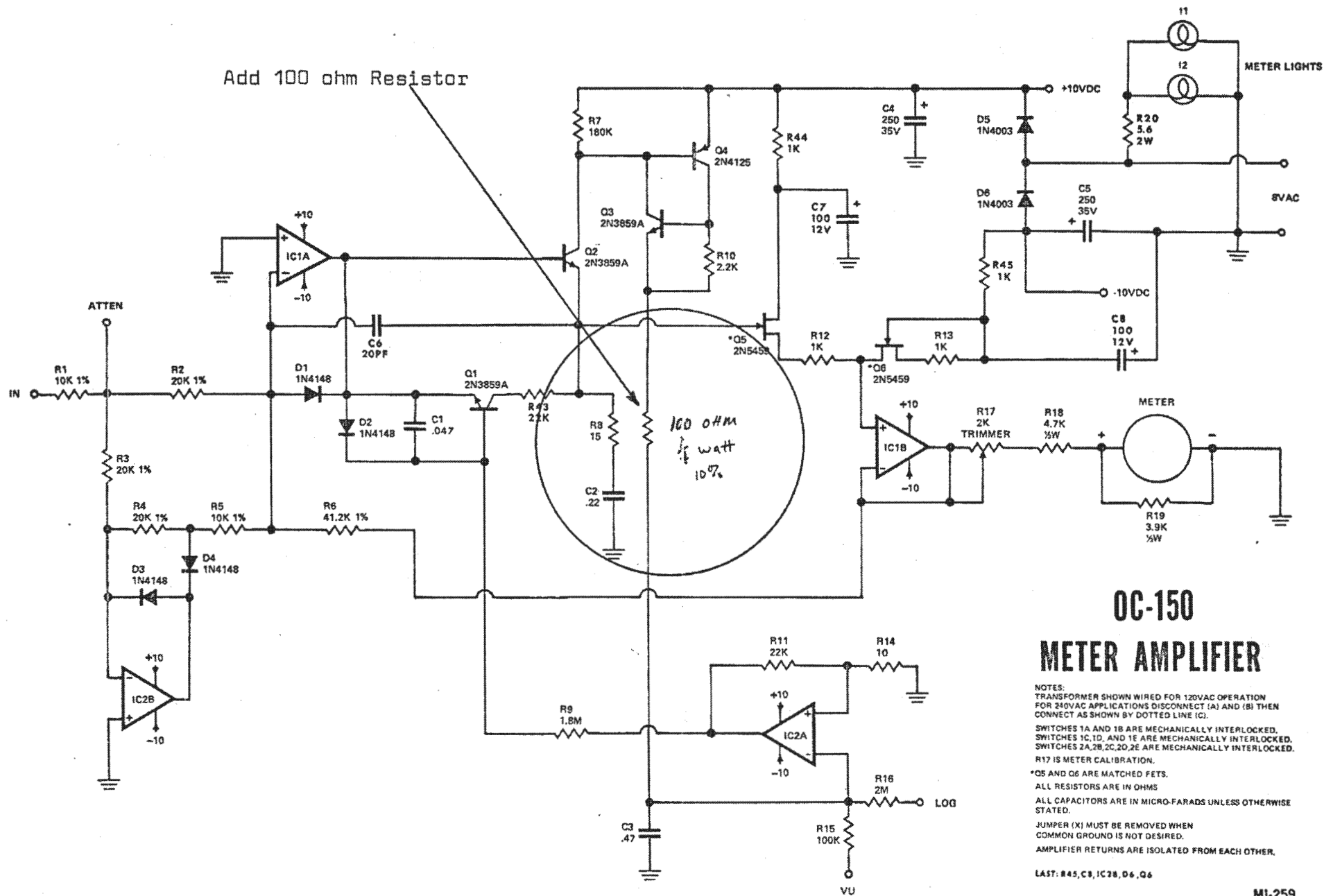
Widespread failure of the metering circuits in the OC-150 has been traced to secondary breakdown of Q3 and Q4. This is caused by the current surge required to charge the timing capacitor, C3. A simple modification will prevent secondary breakdown and improve reliability.

A 100 ohm, 1/4 watt resistor (CPN 2872) is added between C3 and the emitter of Q3. The enclosed board layout and schematic illustrate the modification.

Q3 and/or Q4 failure symptoms are several. Typical problems are permanent hold on the meters, and jittery meter movements, usually with higher than normal readings.

Any evidence of leakage (in the hold mode) can be improved by swapping the 2961 (2N3859A) transistors with 2962 (TZ-81) at Q1 and Q2.

The 100 ohm resistor modification should be performed to all in-house units, and routinely done to all service units.



OC-150 METER AMPLIFIER

NOTES:
TRANSFORMER SHOWN WIRED FOR 120VAC OPERATION
FOR 240VAC APPLICATIONS DISCONNECT (A) AND (B) THEN
CONNECT AS SHOWN BY DOTTED LINE (C).

SWITCHES 1A AND 1B ARE MECHANICALLY INTERLOCKED.
SWITCHES 1C, 1D, AND 1E ARE MECHANICALLY INTERLOCKED.
SWITCHES 2A, 2B, 2C, 2D, 2E ARE MECHANICALLY INTERLOCKED.
R17 IS METER CALIBRATION.

*Q5 AND Q6 ARE MATCHED FETS.

ALL RESISTORS ARE IN OHMS

ALL CAPACITORS ARE IN MICRO-FARADS UNLESS OTHERWISE
STATED.

JUMPER (X) MUST BE REMOVED WHEN
COMMON GROUND IS NOT DESIRED.

AMPLIFIER RETURNS ARE ISOLATED FROM EACH OTHER.

LAST: R45, C8, IC2B, D6, Q6

M1-259

Drill Holes
Add 100 ohm Resistor

Cut Trace

