STEREO FALL 1976

The Superb Crown D-150A: A Lab-Quality Amp for the Home

Crown D-150A dual-channel power amplifier. Dimensions: 17 inches wide by 5¼ inches high by 8¾ inches deep. Weight: 24 lbs. Crown warrants the D-150A to meet or exceed all published specifications for a period of three years from date of original purchase. If your component does not perform to specification within that time, Crown will repair or replace the unit at no cost to you. In addition, Crown will pay all the U.S. round-trip shipping charges for the defective unit.

The well-acclaimed Crown D-150 power amplifier has been updated with improved specs and is now called the D-150A. It features DC coupling throughout—there isn't even an input coupling capacitor—and is rated for operation from DC to 20 kHz into loads of 4 ohms or greater. A "Signal Programmed Automatic Current Executor" (SPACE control) protects the amplifier from shorts, opens, etc., prevents turn-on transients, and allows for operation into any impedance, including totally reactive loads. Crown claims that its special protective circuit operates without flyback transients or thumps. The absence of thumps is due, no doubt, to the total DC coupling of the unit. Overheating is detected by a thermal breaker, and there is a 4-amp line fuse for added protection. The output stage is a quasi-complementary-symmetry design, biased for "Class AB + B operation," an approach Crown pioneered to minimize crossover distortion and heating. The D-150A is rated at 80 watts per channel (19 dBW) into an 8-ohm load. One of the special features of the D-150A is its monophonic capability. A rear-panel switch selects either mono or stereo mode; if mono is selected, the mono speaker hookup is bridged across the two outputs, and, *voilà*, you get twice the power output into twice the impedance (160 watts into 16

ohms)—and even more into 8-ohm loads, as our tests showed.

The appearance of the amp is very "professional," verging on laboratory styling. It can be rack-mounted, or an optional walnut enclosure can be purchased for home use. The front panel is a heavy brushed-aluminum extrusion, with a black leatherette insert on the bottom. Two knobs on the panel control the level, and a matching knob operates the power switch. A red legend illuminates when the power is on. The mono/stereo switch is mounted on the upper portion of the rear panel, along with a pair of phone (not phono) jacks for the signal inputs. (You will need phono-jack-to-phone-plug adapters, or cables terminating in a phone plug, for hookup.) Also on the rear, but recessed deeply into the amplifier, are the output pairs (dual, color-coded banana jacks), the 4-amp line fuse, and a heavy 3-wire power cable. Crown includes the mating plugs and in-line speaker fusing along with the amplifier.

The D-150A performed flawlessly during our bench tests. Frequency response into an 8-ohm load was absolutely flat from 10 Hz (as low as we measured) to 20 kHz. It was down less than ¼ dB at 30 kHz, 1 dB at 70 kHz, and 3 dB at 135 kHz. (A word of caution: Since the D-150A is DC-coupled and is quite powerful, we'd recommend a good subsonic filter in the preamp to minimize the chance of speaker damage if the phono stylus is accidentally dropped, or even for playing warped records.) The separation was exceptionally good—better than 80 dB out to 500 Hz, and still better than 70 dB at 10 kHz. The THD was lower than we could measure, throughout the audio band, at both the 0-dBW (1-watt), and 19-dBW (80-watt) levels, whether one or both channels were driven. The damping factor was the highest we have measured to date: better than 1,000 at 20 Hz and 100 Hz, 500 at 1 kHz, and 60 at 10 kHz. While you can't really make any effective use of that sort of damping, the measurement *does* testify to the inclusion of a large amount of over-all negative feedback. The maximum voltage gain was 26.4 dB, which means that a 135-mv input would produce a 0-dBW level into 8 ohms (1.21 volts for the 80-watt rating). This is in the stereo mode; in mono, the gain is precisely doubled. The A-weighted output noise, at maximum gain from a shorted input, was an excellent –106 dBW. With the input-level control set for a voltage gain of 20 dB, the A-weighted noise was –100 dBW. This was also the "worst case" noise and reflected the noise contribution of the input control.

The clipping level occurred at 19.6 dBW (93 watts) into 8 ohms, with both channels driven; 20.2 dBW (105 watts) from a single channel. Into 16 ohms, the corresponding figures were 17.3 dBW (54 watts), and 17.5 dBW (56 watts). Into 4 ohms, we registered 21.8 dBW (151 watts) with both channels going, and 22.5 dBW (178 watts) from a single channel. When strapped for mono operation, the D-150A really started putting out the watts. We clocked 22.7 dBW (186 watts) into 16 ohms, increasing to 24.7 dBW (295 watts) into 8 ohms. At 4 ohms, we popped the fuse before the measurement could be made, but no damage was done. We wouldn't have been surprised to see another couple of dBW, which would have been equivalent to almost 500 watts. After the FTC preconditioning, the entire unit was very warm, but not uncomfortably so. (The entire case, including the front panel, serves as the heat sink. In actual use, however, the D-150A is as cool as a cucumber, thanks to the AB + B biasing.)

There's really nothing to say about the audition. The D-150A is clearly one of the finest amplifiers we've heard. With a dynamic range of 120 dB or more (almost 126 dB with an 8-ohm load under normal operating conditions), flat frequency response, and close to zero distortion, it just isn't there. No noise, no audible distortion, no clicks or pops—just pure music. And we were particularly impressed with the over-all quality and informational content of the instruction book.

This is an amplifier for the perfectionist audiophile—a piece of equipment of laboratory precision and performance.

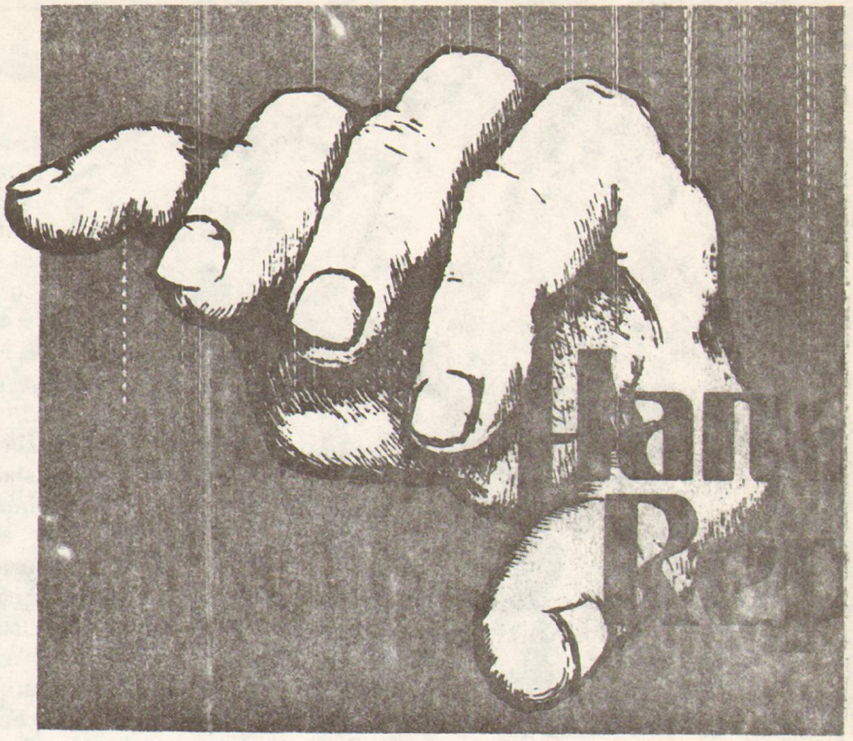
Addendum: The Crown D-150A is now equipped with the unique distortion indicator, IOC (see seperate sheet for details).

Crown International Inc., Dec., 1977.

CURRENT PRICE: D-150A $549.00;
Cabinet: $45.00
(subject to change)

CROWN D150A IOC POWER AMPLIFIER

By Brian Roth and Jim Ford

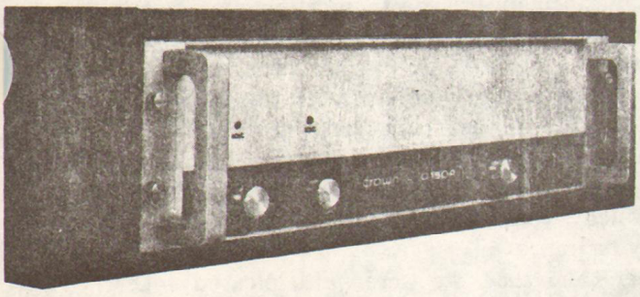


General Description: Crown International is probably the most widely known brand of power amplifiers in the professional audio industry. Their original DC300 (introduced in the late 1960s) established the initial standards for high-powered, solid-state amplifiers. The D150A under review is basically a little brother to the latest DC300A series.

Rated at 80 watts per channel with an 8-ohm load, the D150A qualifies as being a basic, no-frills amplifier. The extruded aluminum front plate serves as the mounting surface for a pair of input volume controls, a rotary power switch, a power indicator lamp and a LED labeled "IOC" above each of the channel volume controls.

The rear panel provides quarter-inch phone jacks for audio input to each channel and dual banana jacks for the loudspeaker connections. A slide switch located above the input jacks converts the D150A from the normal dual channel (stereo) mode to monaural operation with a higher output power rating. A fuse holder and a permanently affixed power cord are the remaining features on the rear.

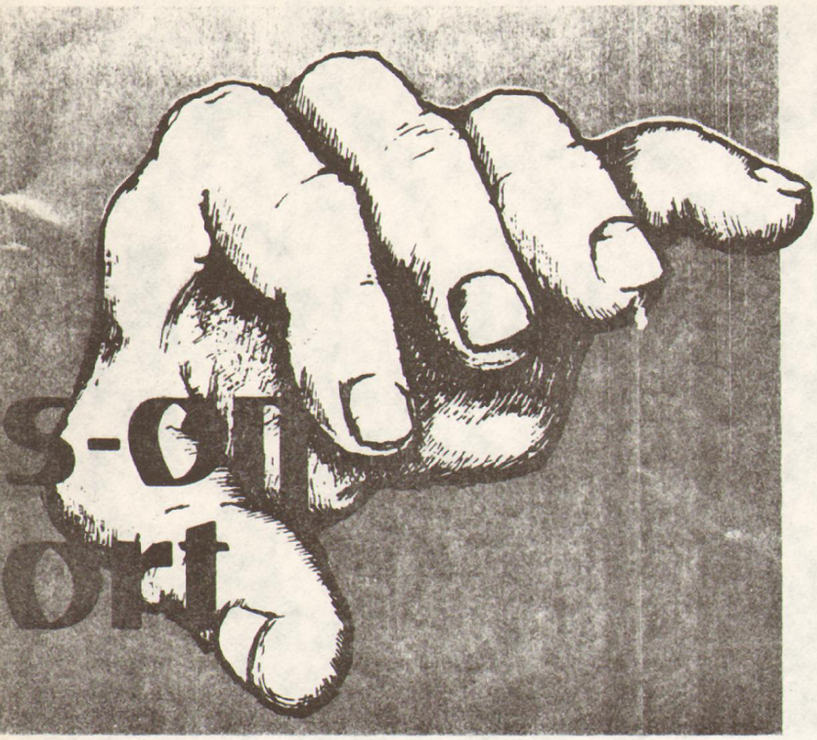
The main chassis of the ampifier is a U-shaped aluminum extrusion that is attached to the front panel extrusion by means of six screws. Protruding from the rear of the chassis are two metal cages—one covers the printed circuit card and the other protects the power transformer and the power supply electrolytic filter capacitors (which are rated at 9400 mfd each). Two extruded heat sinks that are secured to the main chassis are also visible from the rear. Ease of disassembly and internal access for servicing is very good.



The output power transistors are attached to the main chassis which, along with the front panel and other metal parts, serves as a heat sink. Thus, it could be stated that the entire amplifier is a heat sink; a rather novel approach to the heat dissipation problem inherent in any power amp.

As we mentioned earlier, a pair of LEDs labeled IOC (which stands for Input/Output Comparator) are mounted on the front panel. These are designed to illuminate if the output signal and input signal are significantly different as would happen during overdrive or similar conditions. Many amplifiers contain clipping indicators that typically are activated if the output signal exceeds a preset voltage that is (hopefully) at or just below the point at which the amplifier clips. Unfortunately, this type of sensing circuit will not detect an overdrive condition if the amplifier's protection circuitry (which automatically reduces the maximum output voltage to avoid smoking the power transistors) has been triggered by an excessively low impedance speaker load. Thus, with standard clipping indicator designs, it is possible for the amplifier to be generating gross amounts of distortion without any hint from the LEDs.

Crown's approach eliminates this type problem by means of its comparison action. If the output signal is not a good replica of the input, regardless of the cause, the IOC recognizes this and the LED will flash. This is accomplished by monitoring the internal overall negative feedback loop. Under abnormal conditions, an error signal that represents the difference between the input and output signals is generated on the negative feedback line as the amplifier attempts to correct the output signal. If this error signal is of sufficient amplitude, the IOC circuit detects the condition and trips the LED. This is an excellent approach to overload indicator design since it utilizes an already existing error signal line that is a basic part of the amplifier's normal circuitry.



The owner's manual is quite thorough and includes not only operating instructions but schematics, parts lists and printed circuit board component layout diagrams.

Field Test: We have had considerable experience with the D150A series due to the fact that we regularly utilize it as the high-frequency amplifier in our road P.A. system. An examination of the circuit diagram of the D150A IOC revealed few, if any, changes from previous models. Nonetheless, we connected the amplifier to JBL 4315 and 4343 monitors for A-B comparison with several other highly regarded power amps. At moderate listening levels, the D150A compared favorably with the other amps. We detected a slight amount of "roughness" on the top end with complex program material even though the IOC indicators were extinguished, but this was a minor defect. Compared with the other amplifiers of the same or higher power output, we found that the D150A could often be driven into a higher amount of clipping before the sound quality became totally unacceptable.

The action of the IOC lights was quite interesting. They were positive in operation with sufficient "memory" to remain illuminated long enough to be visible. They triggered before any excessive amounts of distortion were audible, which makes them quite useful.

With 8-ohm loads on each channel and high-listening levels, the amplifier became only moderately warm. Double 4315 loads on each channel (4-ohm nominal impedance) caused the D150A to become much warmer, but not to the point of excessive temperature. We had noted from our earlier examination that the amplifier includes an overheat sensor by the output transistors to disconnect power in the event of excessive heat build-up. However, we were unable to shut the amp down due to overheating even with a 4-ohm-per-channel load.

Next, we evaluated the D150A performance as a high-frequency (above 1.5 kHz) amplifier in our 3-way P.A. system. With a 4-ohm-per-channel load, the amplifier ran only slightly warm, although we should point out that our amp racks include several fans to eliminate heat build-up.

Since we do not feel that a sound system should be used as a distortion generator (like some we've heard!), the IOC feature was judged to be most useful in operating the system properly. Clipped waveforms, particularly in the high-frequency region, are not only sonically unpleasant, but also extract their toll in the form of blown diaphragms in horn drivers.

Initially, the IOC frequently informed us of amplifier clipping (this was verified by monitoring the amplifier output with an oscilloscope). To avoid feeling guilty about producing distortion (practicing what we preach), we made a slight reduction in overall volume. Not only did the LEDs settle down, the sound quality improved! It dawned on us that if more sound companies used amplifiers with *effective* output overdrive indicators, perhaps the fidelity of "live" sound would dramatically increase. After all, what self-respecting soundman would want to watch all the overload indicators on his power amps stay continuously lit?

The IOC indicators also demonstrated the extent of transient peaks in the program material of a "live" performance. Even though the average output level of the D150A was well below clipping, the IOCs nevertheless would flash from time to time.

We did have one complaint with the design of the amplifier. The input phone jacks did not hold their mating phone plugs very securely. During normal handling, the plugs backed out of the jacks with the subsequent result of no output! This situation could clearly be improved.

Other than that, we were quite pleased with the D150A. The strong mechanical design and quality audio performance were definitely above average.

Lab Test: As usual, we tested the amplifier with a 115 volt power line voltage since we feel that this represents normal field conditions as opposed to the commonly utilized 120 volts (which will naturally result in a higher output power before clipping).

The D150A easily met its rated harmonic and intermodulation distortion levels as indicated in the

tables. At middle and high frequencies we noted the presence of crossover distortion "spikes" from the output of our distortion analyzer. These were not much stronger than the other harmonic distortion components which generally were 3rd harmonics.

Frequency response was not quite so good as claimed; at 52 kHz the response was down 1 dB although this should not be objectionable.

Square-wave response with an 8-ohm load was excellent, although it exhibited some ringing when a 2 mfd capacitor was added in parallel with the 8-ohm resistor.

We were able to induce thermal shutdown of the D150A by operating into a 4-ohm-per-channel load with a sine-wave input. This is probably the reason why Crown does not specify power output ratings at 4 ohms since the amplifiers must comply with the FTC power measurement method to be sold on the home entertainment market. However, the continuous sine-wave signals are not particularly representative of actual program. Thus, we feel that even under worst case conditions the D150A can be successfully operated with a 4-ohm-per-channel load if sufficient air movement is provided around the amplifier.

The protection circuits were quite effective. No harm was done even when using a large screwdriver as an output load! We found that the protection mode was entered at slightly higher than a 2-ohm load which should preclude its activation with a nominal 4-ohm-output load impedance.

We checked the performance of the D150A when operated in the monaural mode. In this status, both channels are utilized to drive a single load. Output power under this condition measured an impressive 290 watts RMS with an 8-ohm load.

While we had the amplifier on the bench, we attempted to fool the IOC circuitry, but to no avail. At high output levels at 75 kHz when slew rate limiting reduced the maximum output power, the IOCs faithfully reported the condition. Any time the amplifier's THD exceeded about .05% the LEDs would flash. Short duration narrow pulses also failed to trick the IOC. This is a most effective overload indicator.

We have not yet mentioned the low-frequency characteristics of the amp which extends all the way to DC (0 Hz). While this insures minimal phase shift in the bass range, the user must be aware that the D150A is capable of amplifying DC from a malfunctioning piece of equipment driving the amp's input. This can cause burn-outs of loudspeaker voice coils. Thus, it is very important to be sure that all equipment driving the D150A has circuit arrangements (output transformer or coupling capacitors) that will not allow DC to pass into the amplifier's input. We would have been happier if the D150A had included a speaker load disconnection relay that is activated by the presence of DC at the output.

The electronic components used in the D150A were definitely above average, and should help minimize breakdowns.

All in all, we were very pleased with the overall performance, both in the field and on the bench.

Conclusions: It seems that at least once a week someone introduces a new power amplifier. Invariably, the sales force of these companies makes comparisons between their products and the Crown line.

We have recently heard several amplifiers that sounded a little cleaner than the D150A. However, we have yet to find another amp in this power range that sounds *significantly* better. Additionally, very few other amplifiers can match the D150A's sturdy mechanical and electrical design. We feel that the strongest point of the D150A is its durability which has been proven by a multitude of users (and abusers). The IOC indicators should also prove to be a most useful feature that will assist in proper operation of the amplifier.

The D150A should be seriously considered whenever a reliable workhorse of moderate power output is required.

CONTINUOUS SINE WAVE POWER AT CLIPPING, 1 kHz

Load Impedance	One Channel Driven	Both Channels Driven
4 ohms	163 watts RMS	150 watts RMS
8 ohms	90 watts RMS	88 watts RMS
16 ohms	56.25 watts RMS	52.5 watts RMS

TOTAL HARMONIC DISTORTION AT VARIOUS POWER LEVELS AND FREQUENCIES, 8-OHM LOADS, BOTH CHANNELS DRIVEN

Power Output	Frequencies		
	20 Hz	1 kHz	20 kHz
80 watts	.003%	.003%	.018%
20 watts	.003%	.004%	.02%
5 watts	.004%	.0045%	.035%
1.25 watts	.008%*	.01%*	.05%

*Mainly Noise

INTERMODULATION DISTORTION PER SMPTE METHOD (60 Hz AND 7000 Hz MIXED 4:1) 8-OHM LOAD, BOTH CHANNELS DRIVEN

Power Output	Intermodulation Distortion
80 watts	.004%
8 watts	.006%
.8 watts	.009%

OUTPUT NOISE (dB LEVELS ARE REFERENCED TO 80-WATT OUTPUT AT 8 OHMS OR 25.3 VOLTS RMS)

Test Condition	Output Noise 20 Hz — 20 kHz Unweighted
Ch. 1 Vol. Max	40 microvolts or .0002 microwatts (−116 dB)
Ch. 1 Vol. Min	45 microvolts or .00025 microwatts (−115 dB)
Ch. 2 Vol. Max	40 microvolts or .0002 microwatts (−116 dB)
Ch. 2 Vol. Min	35 microvolts or .00015 microwatts (−117 dB)

CROSSTALK (dB LEVELS ARE REFERENCED TO 80-WATT OUTPUT LEVEL AT 8 OHMS OR 25.3 VOLTS RMS)

Ch. 1 driven, Ch. 2 under measurement

Frequency	Ch. 2 Vol. min	Ch. 2 Vol. max
20 Hz	−107 dB	−106 dB
1 kHz	−103.75	−99 dB
20 kHz	−88.75 dB	−79 dB

Ch. 2 driven, Ch. 1 under measurement

Frequency	Ch. 1 Vol. min	Ch. 1 Vol. max
20 Hz	−100 dB	−100 dB
1 kHz	−100 dB	−99 dB
20 kHz	−91 dB	−86 dB

Amcron D150 power amplifier

By Hugh D Ford

The Amcron D150 is a dual channel power amplifier which is very conservatively rated at a total of 150 watts (75 watts per channel) but is capable of delivering over twice this power into 4-ohm loads. To look at, the amplifier is rather old fashioned and can only be described as ugly, but inspection within the covers gives the immediate impression of a modern well built workhorse.

With the exception of the power supply and the power transistors all the components for the two channels are mounted on a single high-quality printed circuit board. The power transistors are mounted onto the main chassis adjacent to the printed board so that there is virtually no wiring associated with the amplifier and also the complete chassis is in the form of a massive black anodised heat sink, including the amplifier covers and two substantial fins.

Inputs to the amplifier are two 6.35mm jack sockets which are in the form of unbalanced inputs and feed directly onto the input gain potentiometers which are two screwdriver operated controls to the rear of the amplifier. These are the only amplifier controls, there being no pre-set controls anywhere in the circuitry; something that I always regard as a very good design point. The outputs consist of two pairs of terminals which also accept 'banana' plugs on the standard 19mm spacing. Inputs and outputs, as well as the mains fuseholder are clearly labelled, together with the usual warnings. However the rating plate indicated that the amplifier was wired for 120V operation, it being shown on a tie-on label that the amplifier was wired for 250V operation — this is a small detail that could be improved.

The amplifier's power supply is an entirely conventional arrangement using a bridge rectifier to provide symmetrical positive and negative rails which are decoupled by large electrolytic capacitors. The primary of the mains transformer consists of two 120V windings which are used in parallel for 120V operation, or in series for 240V operation, the changeover being achieved by soldered links.

Whilst the amplifier's input is capacitor coupled to the input stages, the remainder of the amplifier is DC coupled and does not include any electrolytic capacitors in the signal paths where they might be responsible for the introduction of distortion as the result of hysteresis effects. The input stages are contained in a dual low noise integrated circuit, one half of which is used for each channel. The signal then undergoes two stages of amplification before feeding the driver transistors. The output stages work in a class AB+B mode so that there is no quiescent current through the output transistors which only act when the output signal amplitude becomes large.

Protection against overload is provided by two mechanisms: firstly, the heat sink temperature is monitored, and should the temperature rise be excessive the incoming mains power supply is disconnected until the temperature drops. Secondly, the output voltage and current are sensed and should either become excessive the drive to the output transistors is reduced in such a way that distortion is not introduced to any significant extent. In practice the amplifier could be short-circuited at full power without any objections — only sparks across the short! If the amplifier was over-driven for prolonged periods the thermal trip operated when the chassis was just too hot to hold, and switched back into operation after a few minutes.

A very comprehensive instruction book is provided, and this includes detailed performance data comprising an unusually detailed specification as well as some eleven performance curves covering the major parameters. Also included are details of accessories, and most important for an amplifier of this power capability, recommended precautions in use such as inserting protective fuses in the loudspeaker lines.

The instruction books also gives warning about certain precautions that must be taken when measuring the performance of high power amplifiers, and it will not be amiss to reiterate some of the problems in this review. When measuring the power capability of any amplifier it is of course important to use load resistors which at worst are within +1%, which represents a possible 2% error in power, and this must apply when the amplifier is delivering its full wattage into the load. It follows that any makeshift loads such as electric fire elements are completely out of the question, as not only are they unstable, but also inductive. Further precautions must be taken to control the incoming mains voltage, as the common 6% reduction in mains voltage will lead to a loss of 18 watts from a 150 watt amplifier if, as is normal, the main power supplies are not stabilised. Precisely the same problem applies to output voltage measurement which must be to at least within +0·1dB.

The following review measurements were obtained with a load box capable of retaining an accuracy of +0·5% and dissipating some 1,200 watts into heat-sunk and forced air cooled resistors. Critical voltage measurements are quoted from a digital voltmeter which is accurate to within +0·02dB.

Initial investigations were directed at the maximum available output power at the clipping point, and in this respect the two channels were to all intents and purposes identical giving 102 watts of 1kHz sinewave into 8 ohms with one channel driven, or 169 watts into 4 ohms. With both channels operating the output into 8 ohms was 88 watts per channel. In all cases the clipping was completely symmetrical, and as is shown in **Fig. 1** the amplifier gives immediate recovery from severe overload without any after effects. Operation into a load of 8 ohms in parallel with 2μF did not produce any undue ringing effects or instability, as can be seen from **Fig. 2** which shows the 10kHz output into both 8 ohms and 8 ohms in parallel with 2μF when a very fast risetime squarewave is fed to the input. In fact the amplifier is intentionally slew rate limited to avoid damage to the output transistors by radio frequency inputs, such that the rise time of the output voltage was limited to 6·2 volts per microsecond.

For reasons that will become apparent, it is virtually impossible to measure the harmonic distortion in the output, and even intermodulation distortion is very difficult to measure. The following are the results from measuring intermodulation distortion by the SMPTE method using tones of 50Hz and 7kHz mixed in the ratio 4:1 and employing an instrument with a residual distortion indication of 0·002%.

Power output (equivalent peak sinewave output)	*Channel 1*	*Channel 2*
75 watts RMS	less than 0·002%	*less than 0·002%*
7·5 „ „	0·003%	„ „ „
750 mW „	0·003%	0·003%
75 mW „	0·005%	0·006%
7·5 mW „	0·012%	0·012%

As a rough rule of thumb with linear devices the harmonic distortion is in the order of a quarter of the SMPTE intermodulation distortion: this implies a harmonic distortion content of less than 0·0005% at 75 watts output which is such a low level that I do not know of any commercial equipment that would have any hope of making the measurement. In fact the distortion of the lowest distortion oscillator known to me is some six times worse than this amplifier!

Reverting to the other end of the scale, the noise performance of the amplifier is also really excellent, with the following figures being measured into an 8 ohm load with the input short circuited.

Condition	*Noise reference 75 watts output* *Channel 1*	*Channel 2*
Wideband 2Hz to 200kHz	-110·9dB	-110·0dB
Wideband 20Hz to 20kHz	-119·8dB	-116·9dB
'A' Weighted	-121·8dB(A)	-122·7dB(A)

The above figures include all mains frequency hum components, which are in fact below noise level, the 50Hz hum in the output being measured at a mere 15 microvolts (-124dB).

As may be expected the frequency response, as shown in **Fig. 3**, is as flat as a pancake in the audio band being better than +0·1dB from 20Hz to 40kHz and then falling to -3dB at some 130kHz. The amplifier is not however recommended for continuous power applications above 20kHz according to the manufacturer.

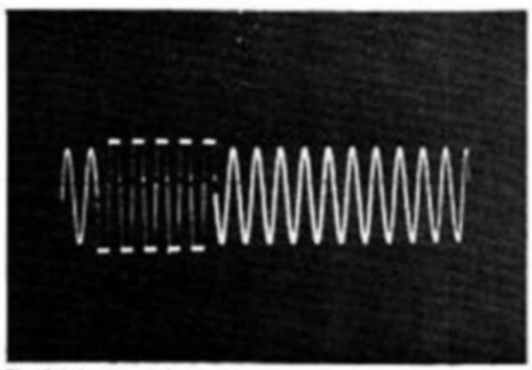


Fig. 1 1Hz overload

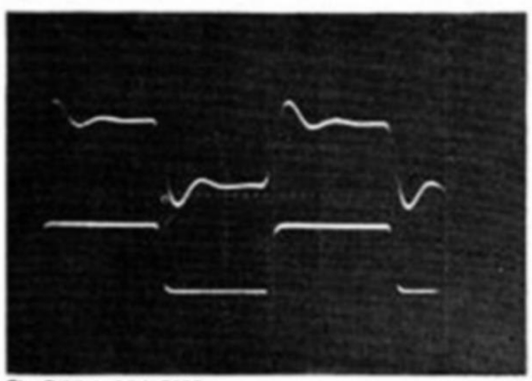
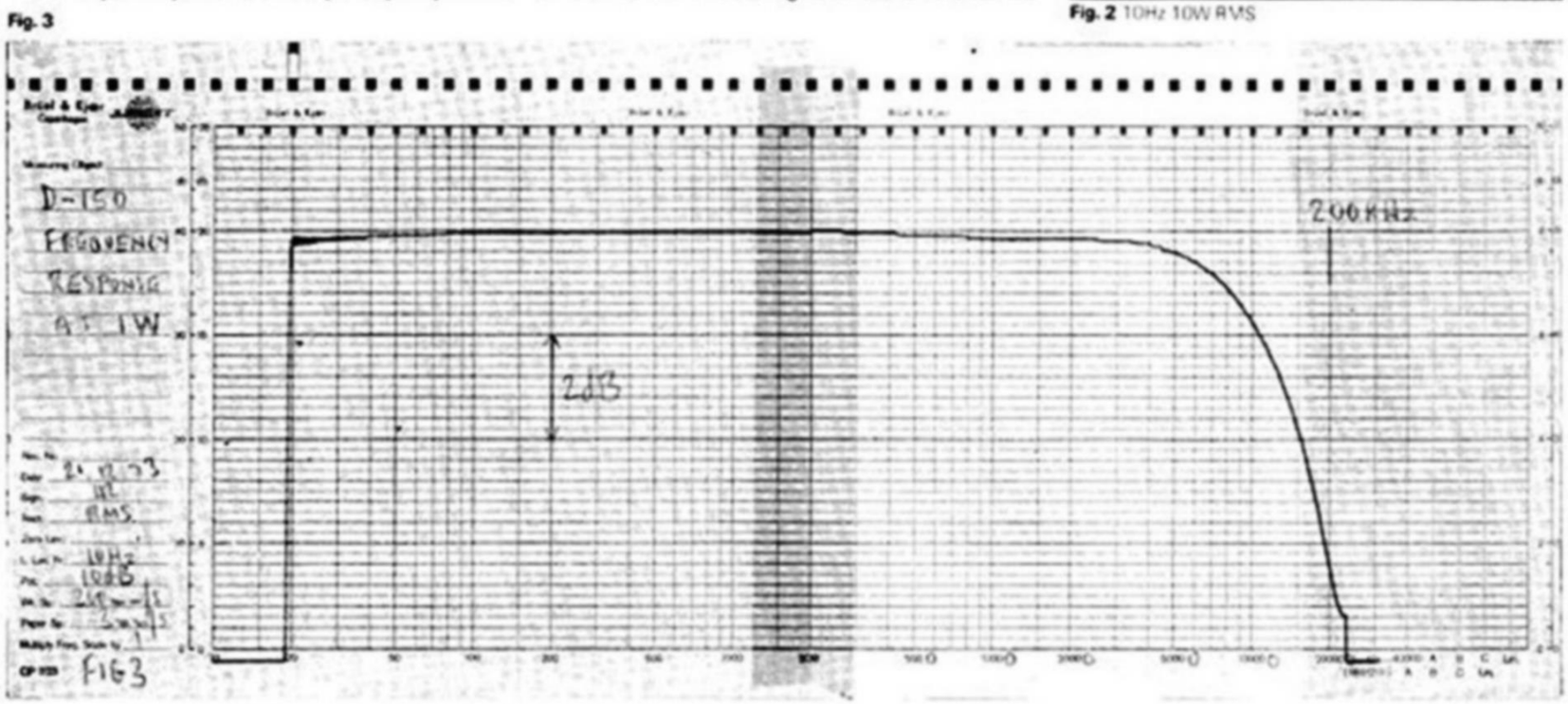


Fig. 2 10Hz 10W RMS

Fig. 3



The power response, as depicted in **Fig. 4**, is also extremely flat up to 40kHz when running at the rated power of 75 watts per channel with both channels operating. However, at higher frequencies the amplifier became unstable at high powers and a second sample of the D150 showed the same tendency. I cannot see that this instability can possibly have any mal-effect when the amplifier is used as an audio amplifier, even where stereo subcarriers or tape bias is present in the input, but for industrial useage the instability could be a considerable embarrassment.

Likewise, the phase shift in the audio band and above is well behaved at low powers, as shown in **Fig. 5**, but funny things happen at high powers at ultrasonic frequencies.

The output impedance was found to be 0·02 ohms below 1kHz, giving a damping factor of some 400 with 8 ohm loads. As is to be expected the output impedance increases with frequency from 0·03 ohms at 2kHz to 0·15 ohms at 20kHz, all of which are very low and require really heavy loudspeaker wiring if maximum damping is to be retained. As with all DC coupled amplifiers there is some DC offset between the output terminals, which if it were too large would produce a mechanical offset of a loudspeaker cone — in the case of the D150 this offset remained less than 3mV over the possible operating temperature range of the amplifier, which is an excellent standard.

Crosstalk between channels with one channel delivering 75 watts into 8 ohms and the other channel with its input set to maximum gain and shorted was found to be — 106dB up to 1kHz from where it rose at a rate approximating 6dB per octave — there is certainly no cause for complaint in this department.

The actual input impedance was virtually constant at 29,000 ohms for each channel independent of input gain setting, the input sensitivity being identical for both channels at 1·22V input for 75 watts output into 8 ohms. The input sensitivity and input impedance, together with the useful range of the input sensitivity control which is satisfactory for up to 10V input, make the amplifier well matched for use across the common line impedances but some caution is required when selecting a suitable domestic pre-amplifier because many do not give an adequate output voltage.

Consideration must also be given to including high and low pass filters either in the pre-amplifier, or between the power amplifier and the pre-amplifier because the Amcron D150 has more than adequate bandwidth and power to wreck the majority of woofers with sub-audio frequencies, or tweeters with ultrasonic frequencies.

Suitable filters are suggested in the comprehensive instruction book supplied with the D150, and whilst the filters are certainly not a necessity they are a wise precaution, as are the recommended fuses in the loudspeakers leads which can well avoid very expensive accidents with loudspeakers.

Summary

As an audio frequency amplifier the Amcron D150 offers a really first class performance, to such an extent that measurements on the amplifier tax the most sophisticated instrumentation to its limits.

Naturally such performance costs money, but the performance of this amplifier is way ahead of the generally available amplifiers and I have no hesitation on giving it the strongest recommendation for use as a loudspeaker driver. However, in other fields it does have stability limitations at high powers which may detract from its usefullness.

As with any other high power amplifier it is capable of inflicting extensive damage to loudspeakers, I therefore would underline the manufacturer's recommendations for taking precautions in its use.

Fig 4

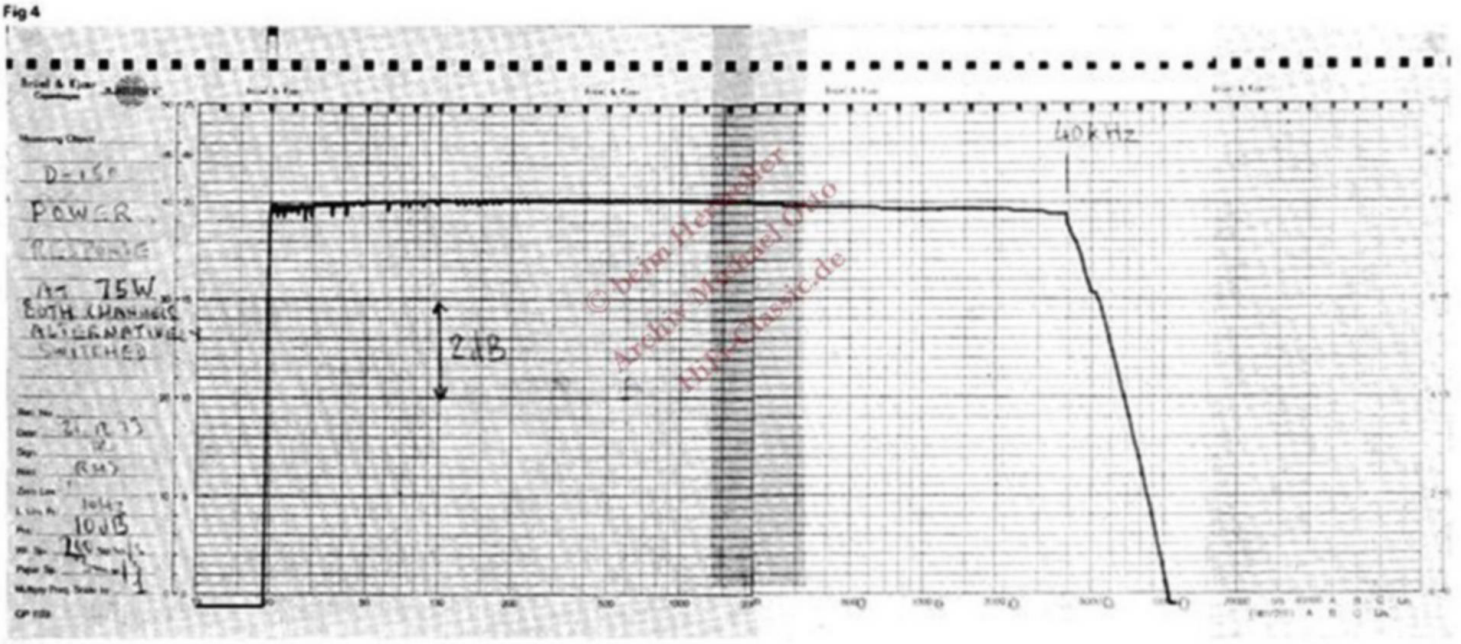
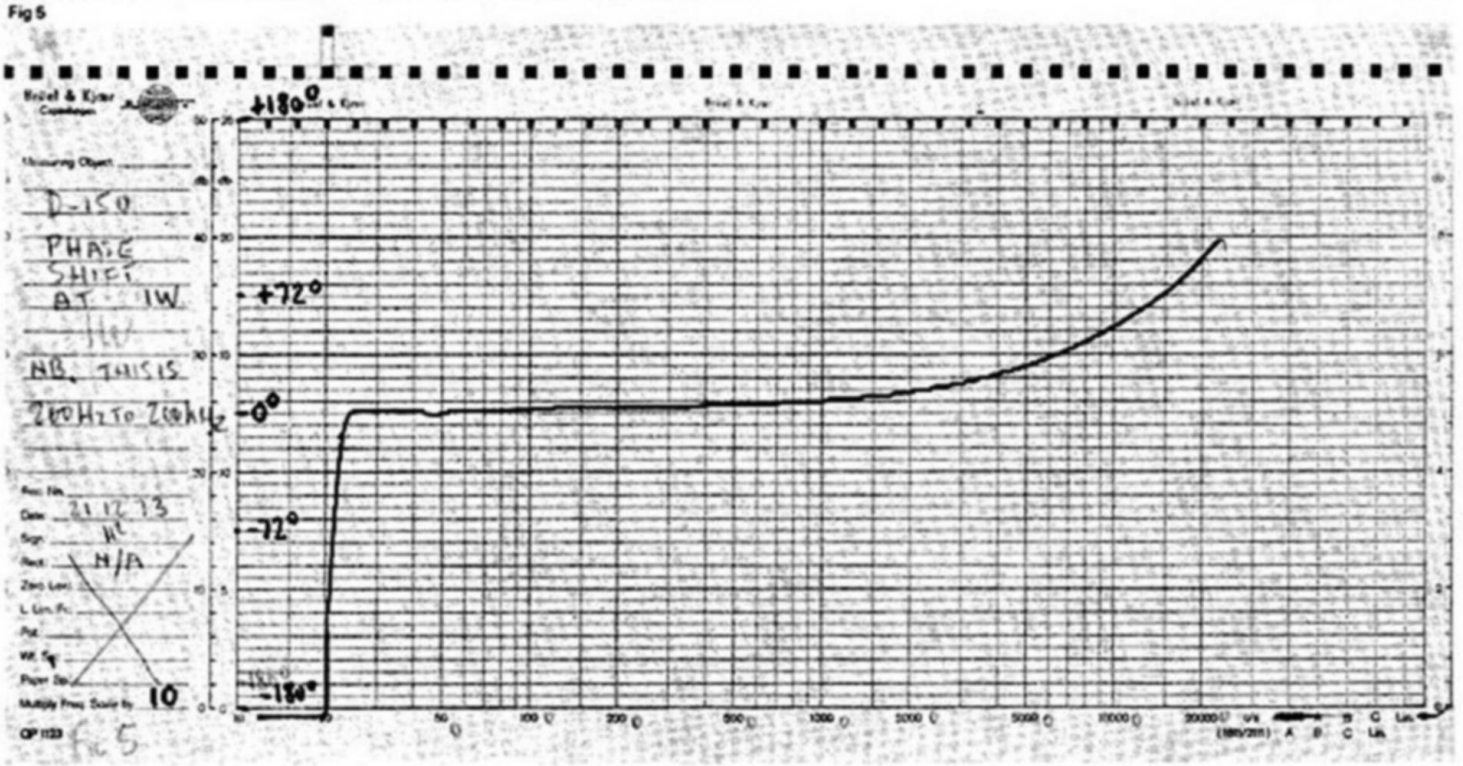


Fig 5



Crown DC300A Stereo Power Amplifier

By Larry Zide

Wow! Just when I was becoming convinced that nothing could improve on the original DC300 power amplifier (I have two) along comes Crown, no less, to say that it has improved that model in the form of the DC300A.

Not that the original super-power basic amplifier could not stand improving. (The perfect amplifier has not yet been built.) But it is awfully hard to tell the two apart, and even hard to measure them apart.

The DC300 was not always happy with certain speaker loads. With highly capacitive-inductive loads such as those presented by transformers used in certain speakers, mostly electrostatics, the amplifier's protective circuits were activated and a frying noise could be heard. This in no way damaged either amplifier or speaker, but it certainly didn't sound too good.

The DC300A is a redesign, mostly of the built-in protection circuits, to eliminate this problem.

The new model is simplified externally, but more sophisticated internally. Front panel fuses have been eliminated. (Not put in a different position—*eliminated.*) The output transistors have been doubled, making a conservative design even more conservative.

Crown is basically building this amplifier for professional use. As such, it must not only work with all speakers at all power levels and be sonically superior, it must also be utterly reliable. This the DC300 was and the 300A is, if possible, even more so.

Subjectively, this amplifier comes as close to the theoretical straight-wire-with-gain as the state of the art permits.

Inputs are by phone jacks, so adapters will be needed to fit hi-fi type phono jacks. Outputs are standard banana type double connectors that will accept wire, single bananas or double plugs. They are color-coded for polarity.

I haven't even mentioned the power capability of this amplifier. It is conservatively rated at 150 watts per channel into 8-ohm loads. It is also capable of more output into 4-ohm loads. Crown claims this amplifier will deliver maximum power safely into 2.5-ohm loads. So it is an amplifier well suited to situations where multiple speaker systems are being driven.

Now, let's look at what this particular amplifier actually can deliver.

PERFORMANCE TESTS

All power tests were done with both channels driven. With an 8-ohm load, this amplifier delivers 175 watts per channel. At this power, it can be loaded with capacitors, inductors, shorts, opens, or anything without harm, or in the case of inductors and capacitors, serious signal deterioration.

If the DC300A provides such power to 8 ohms, what will it do to a

Crown DC300A stereo power amplifier.

4-ohm load? Both channels driven, it will clip at 330 watts per channel. That's a lot of power.

But power alone is not all important. Frequency response continues to go from d.c. to 50 kHz flat out. At the extreme of 50 kHz the deviation from a line drawn with a ruler is less than a 10th of a decibel. I reached the -2 dB point at 85 kHz.

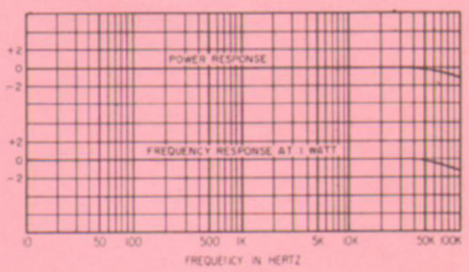
Distortion. It takes a detailed search to find some. Crown gave me some impressive looking curves to indicate total harmonic distortion at rated power output. Most of the provided curves, as in the case of my measurements, are simply at the residual of my instruments. Above 10 kHz, I began to rise above my residual slightly, reaching the hardly bad figure of 0 14 per cent at 20 kHz, full power! This may not be a distortionless amplifier, but if things like this keep being built, I will have to get significantly better test equipment. My present equipment has a residual at mid-band frequencies (somewhat better at high frequencies) of about 0.008. That *used* to be good enough.

I can measure little better when it comes to intermodulation distortion. Again, I found that the residual of my equipment was hardly nudged by this amplifier. At full power I measured residual; at 1 watt, residual; at 0.1 watt, 0.013 per cent. Some of this figure may be noise.

Speaking of noise, I am only certain that the noise is more than 120 dB below full output.

Pulse tones, and anything else I could think to throw at this amplifier, were exercises in frustration. I just couldn't make it perform less than perfectly.

Someday, someone will produce a "better" amplifier. But I wonder if I'll be able to recognize it. Surely, it is possible to build even more powerful amplifiers and there is justification for trying. But remember, a doubling of power is only 3 dB more output. So 660 watts per channel into 4 ohms would be needed for this small but significant gain. Until that time, the DC300A must reign as king of the mountain.



Crown DC300A: Power/frequency response. Power response indicated. 0 dB=200W per channel into 8 ohms.

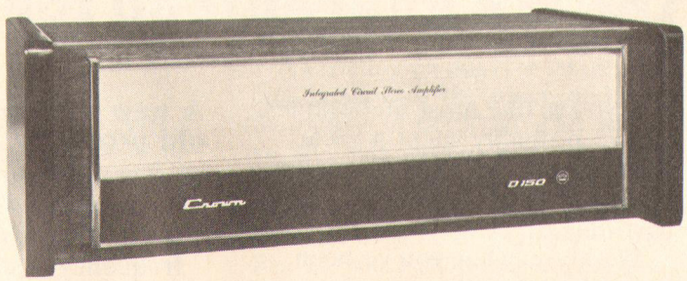
List price of the DC300A is $695. A wooden enclosure is available optionally as a dress-up feature.

By the way, I almost forgot to say that the DC300A can be paralleled for double mono power. So, if you want that extra 3 dB, all you need are *two* DC300A amplifiers.

"Reprinted from *Stereo & Hi-Fi Times*, Fall - 1973"

Equipment Profiles

Crown IC-150 Integrated Circuit Stereo Console



Crown D-150 Dual Channel Power Amplifier

MANUFACTURER'S SPECIFICATIONS

IC-150:

Frequency Response, High Level: ±0.6 dB, 3 Hz to 100kHz with High Impedance Load. ±0.1 dB, 10 Hz to 20 kHz with IHF load (100 KOhm in Parallel with 1000 pF). **Phono:** ±0.5 dB from standard RIAA response curve. **Phase Response, High Level:** typically +1° to −7°, 20 Hz to 20 kHz with high impedance load; +1° to −12°, 20 Hz to 20 kHz with IHF load; **Phono:** typically ±5° additional phase shift, 20 Hz to 20 kHz. **Total Harmonic Distortion:** Essentially too low to measure. **Intermodulation Distortion:** Less than 0.01% at 2.5 volts out; typically less than 0.002% at 2.5 volts out and less than 0.004% at 10.0 volts output. **Hum and Noise, High Level Inputs:** 90 dB below rated output of 2.5 volts. (Typically, 100 dB below rated output with IHF "A" weighted measurement). **Phono Inputs:** 80 dB below 10 mV input (typically 0.5 μV). **Gain, Hi Level Inputs:** 20.8 dB ±0.2 dB. **Phono Inputs:** Adjustable between 50 and 70 dB by means of input level controls. **Rated Output:** 2.5 volts. **Maximum Output:** 10 volts.

D-150:

Frequency Response: ±0.1 dB 20 Hz to 20 kHz at 1 watt into 8 ohm load; ±1 dB 4 Hz to 100 kHz. **Power Output at Clipping:** Typically 100 watts rms per channel into 8 ohms, 180 watts rms per channel into 4 ohms. **IHF Power Output:** Typically 210 watts rms into 8 ohm loads; 400 watts rms into 4 ohm loads. **IM Distortion:** Less than 0.01% at 75W. THD: Less than 0.05% from 20 to 20,000 Hz, 75W. **Damping Factor:** Greater than 200 up to 1 kHz, 8 ohm load. **Hum and Noise:** 110 dB below 75 watts rms (unweighted band limited from 20 Hz to 20 kHz typically measures 119 dB). **Load Impedance:** 4 ohms or greater. Stable with all speaker loads. **Input sensitivity:** 1.19 volts ±2% for 75 watts into 8 ohm load. **Input Impedance:** 25 Kohms. **Power Response:** ±1 dB, 5 Hz to 20 KHz at 75 watts rms into 8 ohm load.

General Specifications

D-150:

Dimensions: 17 in W. x 5¼ in. H. x 8¾ in. D., 19-in. rack mounting hardware available. **Weight:** 24 lbs. with front panel. **Price:** $429.00: less front panel $399.00: optional cabinet available.

Dimensions: 17 in. W. x 8⅝ in. D x 6½ in. H. **Price:** $269.00; optional walnut cabinet, $33.00.

It is rare that the editors of AUDIO will review two important pieces of equipment produced by the same manufacturer in one issue. In the case of Crown's IC-150 stereo console and the matching D-150 power amplifier, the two units are so ideally suited to each other that to discuss one without fully evaluating its companion would be to do both an injustice. One of the few other stereo power amplifiers we have ever measured that could justifiably be used with the IC-150 control unit is Crown's higher powered DC-300, and since not everyone will even consider a 400 watt rms amplifier (or a price tag of $685.00, found on the DC-300) the D-150, at $429.00 plus the IC-150 at $269.00 form a combination at just under $700.00 that will appeal to the serious audio enthusiast who, very simply, wants the *best* specifications that have ever been incorporated in a preamplifier/amplifier component pair.

The IC-150 stereo console is shown in its optional walnut cabinet (Model 5-D), but it can be shelf mounted nearly as attractively without this optional extra. The brushed anodized aluminum and black front panel is relatively simple in layout, when you consider the flexibility of control functions afforded by the thoughtful layout. The top portion of the panel contains six knobs, two of which are really dual concentric types, and two push-push buttons. The rotary knobs include a seven position selector switch (two phono inputs, tuner, two auxiliary inputs and two tape inputs), a volume control, a balance control, a continuous control labelled PANORAMA and dual concentric BASS and TREBLE controls. The PANORAMA control acts somewhat like a MODE selector, except that its action is continuous. When rotated fully counterclockwise, normal stereo reproduction is afforded, with full separation. As you rotate the knob towards its mid-position, left-right blending takes place until a monophonic mix is achieved. Clockwise rotation of this control beyond the center point begins to

restore stereo separation, this time in a reverse sense (that is, left and right channels become reversed) until, at the extreme clockwise position, full separation is restored. Thus, this one cleverly conceived control offers the advantages of a true BLEND control (a much needed feature which was popular on some equipment in the early days of stereo but which for some obscure reason was dropped from components more recently) plus the needed features of a conventional MODE switch. The two push-push buttons introduce loudness-compensation and serve to by-pass the tone controls when absolutely flat response is desired. The lower portion of the panel contains five rectangular push buttons which are also of the "push-to-make, push-to-break" variety and control such functions as TAPE 1 and TAPE 2 monitoring, low frequency filtering, high frequency filtering, and power on/off.

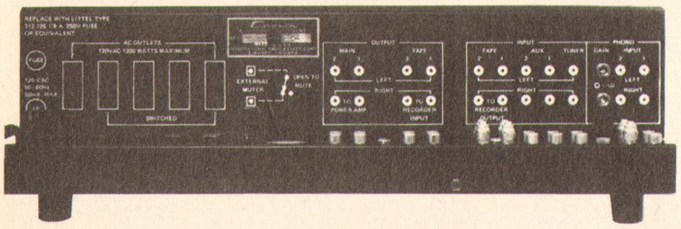


Fig. 1—Rear panel of the Crown IC-150.

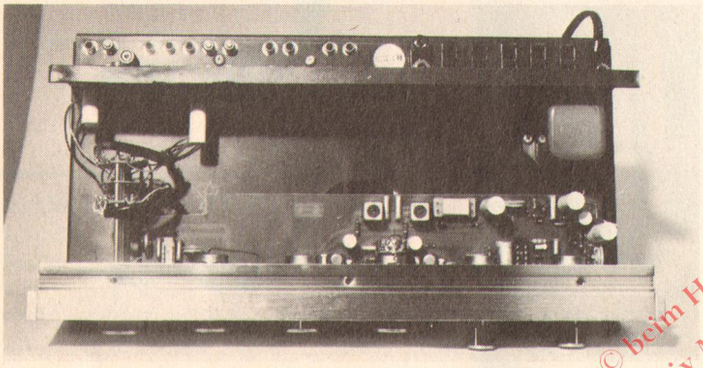


Fig. 2—View from above the Crown IC-150

As can be seen in Fig. 1, all rear panel connections are made in a horizontal plane, but the designations are printed on the vertical back wall, making them easy to read. This arrangement has the additional advantage of avoiding any protrusions from the back of the unit. Starting at the left of the rear panel, we see an a.c. line fuse followed by five convenience a.c. outlets (of which four are switched and one, intended for your phono turntable or changer, is unswitched). A pair of terminal posts come next, and these are for the optional connection of a remote electronic muting switch, which will be described later. There follow pairs of main and tape output jacks, pairs of tape input jacks and the necessary auxiliary, tuner and phono input jacks. The latter are associated with screwdriver-type level adjustments, which are to be set according upon your cartridge output.

Figure 2 shows the deceptively simple looking innards of the IC-150. All major components of small dimensions are mounted on glass (G-10) printed circuit board which is firmly supported mechanically. The magnetically shielded power transformer can also be seen over to the extreme right of the photo. Figure 3, taken from Crown's instruction manual, is a signal flow diagram showing the sequence of events that an input signal undergoes from the input jacks to the outputs. It should be noted, by the way, that the output impedance of the IC-150 is 600 ohms and, if terminated in that impedance (as would be the case in professional use), it will deliver a maximum output of 5 volts. With high impedance terminations (as, for example, when used with the matching D-150 power amplifier) maximum output will be as high as 10 volts rms. The phono preamp circuit board contains a total of nine

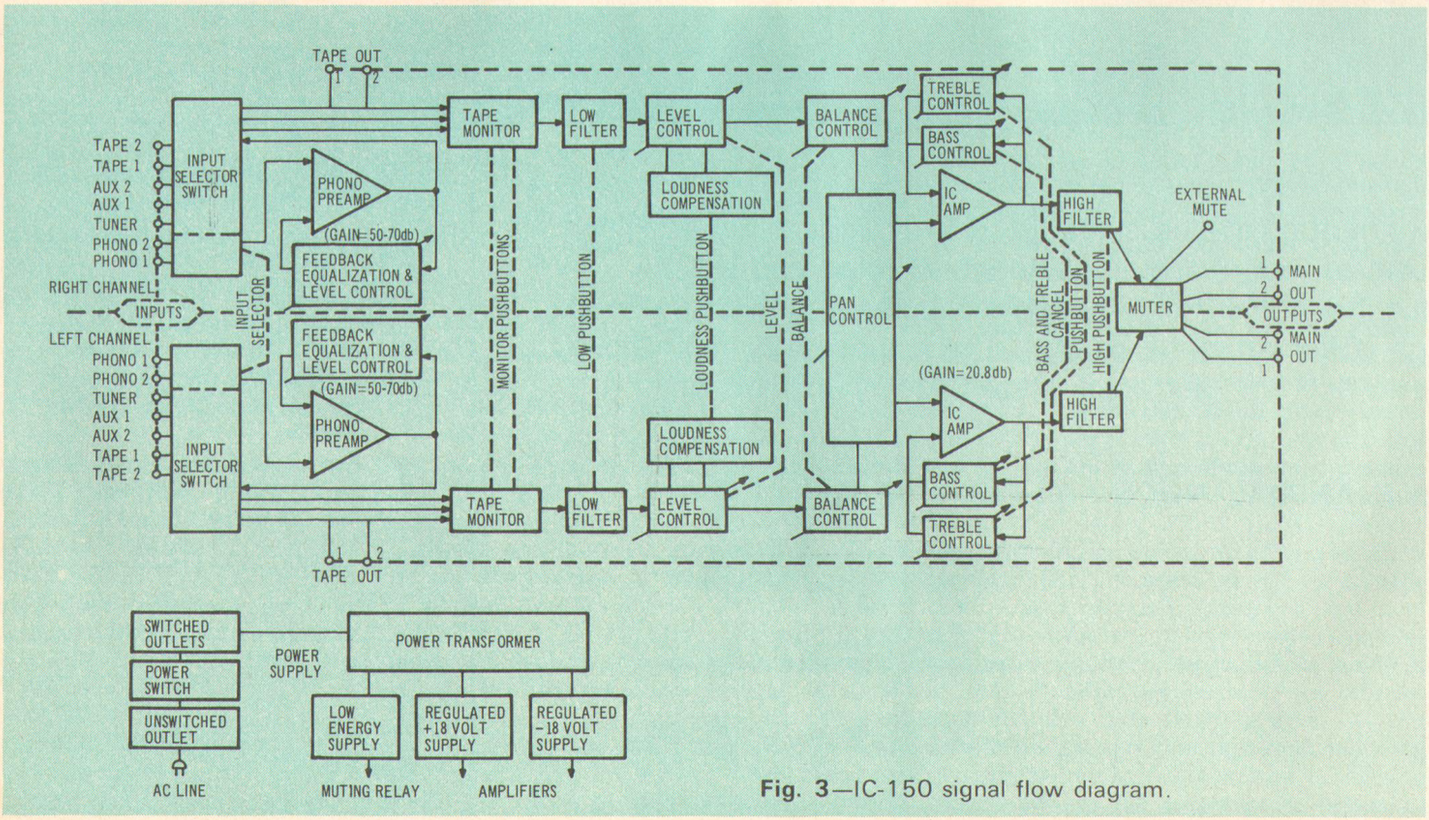


Fig. 3—IC-150 signal flow diagram.

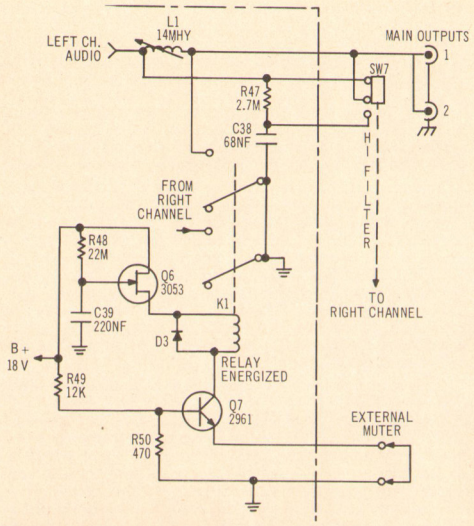


Fig. 4—Partial schematic of the muting circuit in the Crown IC-150.

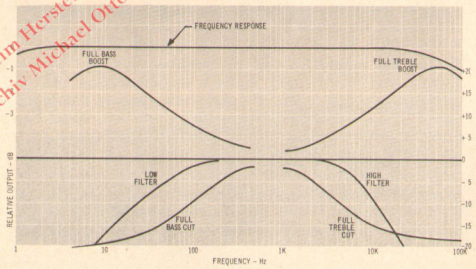


Fig. 5—Frequency response, tone control range, and filter characteristics of the Crown IC-150.

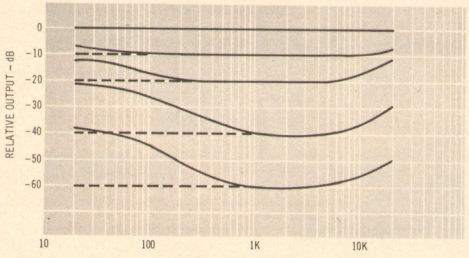


Fig. 6—Loudness-contour characteristics of the IC-150 at various settings of the volume control with loudness circuits ON.

transistors (four per channel plus one voltage regulating transistor) and all resitors involved in the equalization feedback circuits are 1% tolerance components while critical capacitors have a tolerance of 2½%! The electronics of the high-level input amplification circuits is built around two IC's, each of which contains the equivalent of 22 transistors and 14 diodes. In addition, there are 13 more bipolar transistors (nine of which are used in the phono preamp stages), one FET (field effect transistor), two zener diodes and eight diodes.

A partial schematic of the external muting circuit is shown in Fig. 4. When power is initially applied to the IC-150, the muting relay contacts tie the output to "ground." The muting relay remains unenergized until an R-C circuit charges and turns on the FET, which in turn energizes the relay and removes the short from the output. This process takes about five seconds, during which any turn-on transients are permitted to die out before the speakers are connected to the circuit. As can be seen in Fig. 4, removal of the "short" across the external mute terminals opens the emitter circuit of Q7 and prevents the relay from ever becoming energized. Thus, a remote simple SPST switch can serve to mute the system at any time from the comfort of your easy chair.

Electrical Measurements

We had no trouble plotting frequency response and tone control action (shown in Fig. 5), nor was filter response a problem (see same Fig. 5). Loudness contours are shown for various settings of the volume control when the "loudness" switch is depressed (see Fig. 6). We were able to measure hum and noise levels of approximately –93 dB below 2.5 volts output and equivalent phono noise (phono inputs shorted) at about .50 *microvolts* and to confirm RIAA equalization as being as close to perfect as our interpolation of fractions of a dB on our expanded scale a.c. VTVM would permit. However, when it came time to measure IM and THD, our test setup proved to be completely useless. As stated in previous reviews, we are rather proud of our new test equipment lower limits of 0.03% THD and 0.05% IM, but of what use are these new pieces of equipment when we are confronted with an IM figure (for 10 volts output) of 0.002%? In the interest of a complete report, however, we present Fig. 7, which is nothing more than a plot of the IM figures which appeared on the individual test sheet that accompanied our Model IC-150. Please read the scales *carefully*, as they are deliberately expanded beyond anything we normally show and, above all, feel free to take Crown's word for it, as we humbly do.

We shall reserve comment on our listening tests until after the discussion of the D-150 companion amplifier, since, as

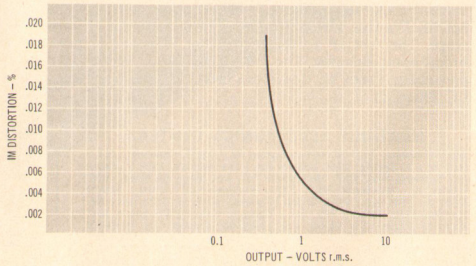


Fig. 7—IM distortion of the IC-150 as measured by the manufacturer. (Note the expanded scale of percentages.)

stated, all listening tests were done using both products hooked up together.

D-150 Power Amplifier

The D-150 dual power amplifier's optional front panel and walnut enclosure, again, need not be used except as dress items, since the power amplifier is fully enclosed as it comes and, in our view, somewhat more awe inspiring at that, as shown in Fig. 8. The major cover shown in the photo (which contains the serial identification label, etc.) is removable and, when removed, discloses the massive power transformer, as seen in Fig. 9. The photo also shows the pair of input jacks (phone jack type), above which are located a pair of screwdriver input level adjustments, and the speaker output terminals which utilize standard ¾-in. center-to-center MDP terminals intended for the dual banana plugs normally associated with test equipment interconnecting cables. These are supplied in the accessory bag with each unit. Also included in the accessory bag are in-line fuse receptacles and cables which are strongly recommended as the right way to connect from amplifier output terminals to speaker systems, in the interest of speaker protection. A handy nomograph in the very complete instruction manual helps you to select the proper fuse size for your speakers based upon their impedance and their peak music power rating.

An "underneath the chassis" view of the D-150 is shown in Fig. 10 which discloses the driver and output transistors. Input stages and associated components are located on a p.c. board which cannot be seen in this view. The D-150 has two direct coupled amplifier circuits which employ a dual IC amp and silicon transistors in all amplifier stages. As Crown explains in their instruction booklet, the dual IC op-amp used is of extremely low noise type and has a large gain-bandwidth. As a result of its use as an input voltage amplifier, a maximum amount of feedback can be applied with resultant reduction of distortion to previously unattainable low values. At a typical full output of 75 watts (8 ohms), IM has been measured by Crown as 0.002%. By implication, THD might be expected to be approximately 0.0005% which *neither* Crown nor we could legitimately measure.

The output stages are essentially in a quasi-complimentary format. In this version of an output circuit, however, the driver transistors carry the bias current, while the output transistors serve only as boosters. The output transistors "sense" when the driver transistors are delivering significant current to the direct coupled loads and then take over and deliver the required large load currents.

The output circuit is protected by a V-I (volt-ampere) limiter which limits the drive to the output configuration whenever the output transistors are overloaded and acts instantly to relieve the overload, acting only so long as the overload exists. In addition, a thermal switch is mounted on the chassis surface which protects the amplifier against insufficient ventilation. If it becomes too hot, a.c. power to the amplifier will be interrupted until the temperature falls back to a safe level, at which time power is automatically restored. The excellently written and organized instruction manual details additional protection schemes which the user might incorporate external to the amplifier but these are primarily directed at speaker protection, since the amplifier itself is deemed "fail safe" under any conditions. Positive and negative power supplies (±45 volts) permit direct coupling to the loudspeaker and the voltage offset at the point of connection is guaranteed to be less than 10 mV. Filtering of each of the supplies is by means of a 9400 μF, 50 volt capacitor of massive proportions. The power transformer, incidentally, is suitable for 240 volt or 120 volt applications and is safe at any power line frequency from 50 Hz to 400 Hz.

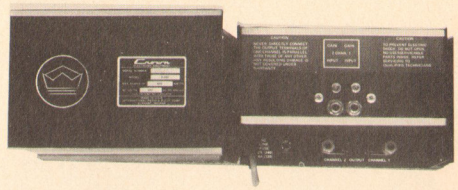


Fig. 8—D-150 amplifier with decorative panel and walnut enclosure removed.

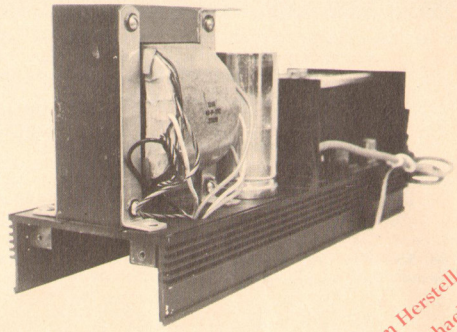


Fig. 9—Close up of the D-150's power transformer and one filter capacitor.

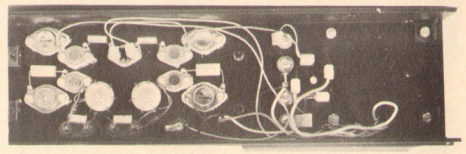


Fig. 10—The D-150's entire chassis acts as a heat sink for the driver and output transistors.

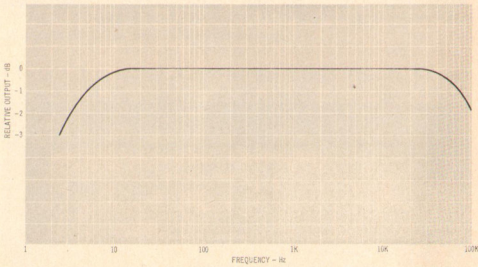


Fig. 11—Frequency response at 1 watt rms, 8-ohm load of the D-150.

so perfectly "clean" in its reproduction capabilities. Evidently, less perfect amplifiers can often "mask" the deficiencies of certain types of poorly recorded material (we're speaking primarily of discs). There was, unfortunately, no single source of program that could fully utilize the dynamic range inherent in the IC-150/D-150 combination. That is, any signal source (FM, phono, tape) we tried invariably resulted in reproduced noise and/or hum that was greater than the inherent noise and/or hum which we didn't hear when listening to the equipment alone, with similar gain settings. If that sounds discouraging or suggests the question, "why buy something this good?", bear in mind that over the last decade, tape dynamic range, for example, has been improved by at least 10 dB or more. If such trends continue, it may not be long before you'll be able to feed a signal source to this superb preamplifier and amplifier that is as good as they are. If *you* want the very best control chassis and power amplifier we've ever tested in this power class and can afford the price, our endorsement of the Crown IC-150 and D-150 is completely given without *any* reservations (unless, of course, you feel you need MORE power, in which case there's always the Crown 300!) *Leonard Feldman*

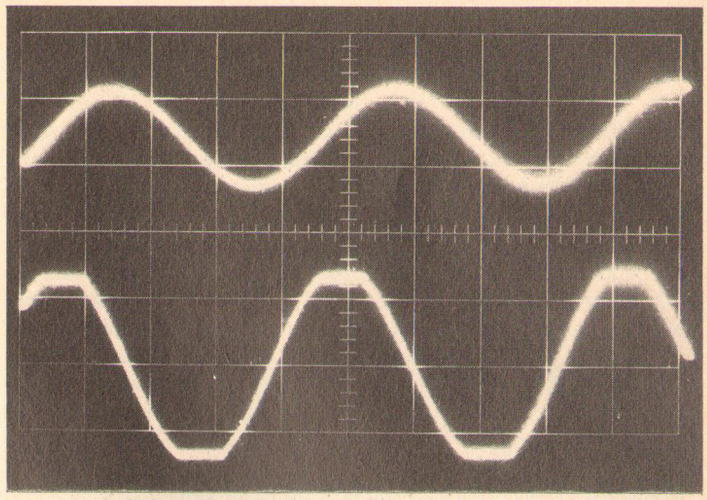


Fig. 15—Scope photo of clipped 110 watt rms signal (per channel) from the D-150 shows perfect symmetry of clipping and no evidence of "power supply collapse."

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