DUNLAP CLARKE

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MODEL 1000

# 17656

DUNLAP CLARKE

DREADNAUGHT
250

500

1000

SERVICE MANUAL

TABLE OF CONTENTS

## POWER AMPLIFIER OPERATING INSTRUCTIONS

### 2.1 - CONTROLS AND ADJUSTMENTS

A TOTAL OF FIVE CONTROLS ARE LOCATED ON THE FRONT PANEL OF THE AMPLIFIER. THEY INCLUDE TWO INDEPENDENT LEVEL CONTROLS (ONE FOR EACH CHANNEL), A LIGHTED PUSH-BUTTON POWER SWITCH, AND TWO METER RANGE SELECTOR SWITCHES. THE GAIN OF EACH CHANNEL IS MAXIMIZED WHEN THE CONTROLS ARE ROTATED FULLY CLOCKWISE. THE GAIN OF BOTH THE MODEL 1000 AND THE MODEL 500 IS 30 DB AT MAXIMUM LEVEL. THE RANGE SWITCHES ARE CALIBRATED FOR;

0 DB FULL POWER

-3 DB HALF POWER

-10 DB ONE TENTH POWER

-20 DB ONE ONE HUNDREDTH POWER

FOR SINE WAVE SIGNALS AT LOADS OF 8 OR 4 OHMS

THE 1000 HAS A 3 POSITION TOGGLE SWITCH ON THE REAR PANEL WHICH CONTROLS THE SPEED OF TWO COOLING FANS. THE FANS MAY BE RUN AT HALF SPEED, FULL SPEED OR COMPLETELY SHUT OFF. THREE FUSEHOLDERS ARE LOCATED ON THE REAR PANEL. THE CENTER FUSE IS THE A.C. POWER LINE AND THE OTHER TWO ARE THE SPEAKER FUSES.

### 2.2 - PROTECTION MECHANISMS

A) SHORT CIRCUITS- THE DREADNAUGHTS ARE PROTECTED BY AN ULTRA-FAST ACTING ALL SOLID STATE CIRCUIT WHICH IS A UNIQUE FEATURE OF ONLY DUNLAP-CLARKE AMPLIFIERS. IF THE OUTPUT OF THE AMPLIFIER IS SHORTED WHEN THE AMPLIFIER IS TURNED ON THE PROTECTION CIRCUIT WILL DISABLE THE AFFECTED CHANNEL. THIS MEANS NO DEFLECTION WILL BE OBSERVED ON THE METERS WHEN A SIGNAL IS DRIVEN INTO THE SHORTED CHANNEL. IF THE CHANNEL IS SHORTED AFTER THE AMP IS TURNED ON THE METER IN THE AFFECTED CHANNEL WILL FALL TO BELOW 0 WHEN THE SHORT IS APPLIED. NEVER SHORT THE AMPLIFIER OUTPUT UNNECESSARILY!

B) Low Impedance and Reactive Overloads - The protection circuits can also be triggered by overloading the amplifier, (loads below 2 ohms or unusually reactive loads paralleled), and then overdriving the amplifier. In other words a Dreadnaught will drive any impedance and any load but only to a load limit determined by the safe area of the output transistors and the analogue to digital power dissipation computer in the protection circuit. When a channel is overdriven the sound output will fall to zero and the meter deflection will fall to zero. If the meters show a deflection and no sound is coming from one or both channels turn the amplifier off and check the speaker fuses. On occasion very low impedance loads in P.A. systems will trigger the protection circuit in the amp on turn-on. In these cases a speaker switch may be required.

C) Open Circuits - A little known fact concerning power amplifiers is that at high frequencies they are subjected to increased current demands even with a "no load" situation. Special techniques are employed in the output circuit of the Dreadnaughts to prevent class A operation and secondary breakdown in the output transistors.

D) D.C. Transients - Transients below 15 hz are a particularly severe problem with superpower amplifiers because of their obvious high output power and extended low frequency response. A dropped tone arm, noisy switch, preamp turn on transient, or input cable carelessly connected with the amp levels turned up may result in blown low frequency drivers in even the finest speakers, not to mention possible amplifier failure. For these reasons the power output of the Dreadnaughts is limited below 10 hz. The amplifier power response is flat but the protection circuit is made extra sensitive below 10 hz.

E) Thermal Design - The thermal design of the Dreadnaughts is exceedingly conservative more as a matter of preference and philosophy than in regard to new rulings by the F.T.C. We believe a healthy margin in heat sinking should be available for the high demands of P.A. applications and for cases where ventilation may be sub-optimal. Each unit has a thermal cut-out mounted on one of the heat sinks which can activate the amplifiers power dissipation limiting circuit thereby disabling the thermally overloaded channel. This protection circuit will not be triggered under full power conditions with adequate ventilation.

F) INDUCTIVE FLYBACK TRANSIENTS - THE PROTECTIVE MECHANISMS EMPLOYED BY DUNLAP CLARKE DO NOT RESULT IN ANY SPIKES, PULSES OR OTHER SPURIOUS SIGNALS. IN ADDITION LARGE FLYBACK DIODES ARE USED TO ALLOW RETURN OF SIGNALS GENERATED WHEN LARGE TRANSIENTS ARE PUMPED INTO REACTIVE LOADS BY THE AMPLIFIER.

G) HIGH FREQUENCY OSCILLATIONS AND ACOUSTIC FEEDBACK WILL TRIGGER THE PROTECTION CIRCUIT WHEN THEY REACH CERTAIN AMPLITUDES.

THIS AMPLIFIER IS VERY THOROUGHLY PROTECTED. IF YOU GET NO SIGNAL FROM A CHANNEL FOR ANY OF THE ABOVE REASONS, TURN YOUR AMPLIFIER OFF AND WAIT APPROXIMATELY 100 SECONDS. THE PROTECTION CIRCUIT WILL RESET DURING THAT TIME AND YOU MAY RESUME OPERATION. IF THE CIRCUIT DOES NOT RESET, DISCONNECT THE LOAD AND TURN THE UNIT OFF AGAIN, THIS TIME ALLOWING 2 MINUTES. TURN THE LEVEL CONTROLS UP AND APPLY A SIGNAL TO THE AMP. IF YOU GET A DEFLECTION ON THE METERS THE AMPLIFIER IS FINE AND YOU CAN RECONNECT THE LOAD. IF YOUR AMP REPEATEDLY BLOWS LINE FUSES OF THE SIZE RECOMMENDED IN THIS MANUAL THE AMPLIFIER HAS BEEN DAMAGED. DO NOT PERSIST WITH LARGER AND LARGER FUSES - TAKE YOUR AMP TO YOUR LOCAL WARRANTY STATION AND HAVE IT REPAIRED. AS LONG AS THE POWER SWITCH LIGHT COMES ON AND THE METERS LIGHT UP THERE ARE NO MAJOR PROBLEMS WITH YOUR AMPLIFIER. LOOK FOR SYSTEM SHORTS, OVERLOADS, GROUND LOOPS, ETC. BEFORE ASSUMING YOUR AMP IS DEFECTIVE!!

## I. THEORY OF OPERATION

### I-A: INTRODUCTION

This manual covers the three power amplifiers in the Dreadnaught line. The service technicians will find it useful to read through the manual and perform the tests on a working unit. Any problems with test set up, ground loops, etc. should be resolved before an actual repair is attempted. The amplifier circuit card has many factory selected parts and being essentially direct coupled is difficult to trouble-shoot. If a problem can be traced to the board, it is less expensive and faster to return the card (rather than the whole amp) to the factory for repair.

MODEL 250:

Basic Stereo Amp 125 watts @ 8Ω

Front panel: Illuminated power on/off pushbutton
2 L.E.D. shutdown indicators.

Rear panel: RCA input jacts, 5 way binding post output jacks, speaker and line fuses.

MODEL 500:

Basic Stereo Amp 150 watts @ 8Ω

Front panel: Type 1- Illuminated power on/off pushbutton input level attenuators, meters and meter range switches.

Front panel: Type 2- Illuminated power on/off pushbutton input level attenuators, meters, and L.E.D. shutdown indicators.

Rear panel: RCA input jacks, 5 way binding post output jacks, speaker and line fuses.

MODEL 1000:

Basic Stereo Amp 250 watts @ 8Ω

Front panel: Type 1- illuminated power on/off switch pushbutton, input level attenuators, meters and meter range switches.

Front panel: Type 2- Illuminated power on/off pushbutton, input level attenuators, meters and L.E.D. shutdown indicators.

Rear panel: RCA input jacks, parallel set of 5 way binding post output jacks for each channel, speaker and line fuses, 3 position fan switch.

### I-B: POWER SUPPLY

Power supplies in all 3 amps have a center-tapped transformer, full wave bridge rectifier and 2 large electrolytic capacitors, providing plus and minus voltages. Included in the power supply are high freq. bypass capacitors and G.E.M.O.V. (varistor) on the transformer, high freq. bypass caps and

I-B: POWER SUPPLY (cont.)
and bleeder resistors across the electrolytics, and two diodes which provide a chassis ground reference to the floating input lines, protecting the amp from input ground lines with A.C. line leakage. The printed circuit card on the electrolytics also serves as the main tie point for various ground lines. (see fig. H)

I-C: METERS
Models 500 and 1000 only. Type 1 front panel has a 5 position meter range switch which selects the "0" on the meter scale to indicate full power (0), $\frac{1}{2}$ power (-3), 1/10 power (-10), 1/100 power (-20) or off. Type 2 front panel has the meter hard wired at the amp card to indicate $\frac{1}{2}$ power (-3).

Both types are calibrated for sine waves and act as average responding voltmeters. For non-sinusoid waveforms, ie. music, the actual overload point will vary depending on the peak to average ratio of the program material. Due to the "stiffness" of the power supply and high current capability of the output stage, the Dreadnaughts perform closer to a constant voltage source than many high power amps, and will continue to deliver proportionally higher power to decreasing load impedenances until the protection circuit activates or fuses blow. Therefore, the "0"db on the VU meter indicates that the full power capability of the amp has been reached. A 500 producing 35 volts into 8 ohms (sine wave) is delivering 150 watts. If another 8 ohm load is added in parellel with the first bringing the total to 4 ohms, the amp is delivering 300 watts while the meter still indicates "0" or full power.

The meter drive signal is taken before the output speaker fuse. If the meter is deflecting in response to an input signal but there is no output, it can be assumed that the speaker fuse is blown. The fuse supplied with the unit is a maximum size suitable for program material, a smaller size can be used to protect speaker with limited power handling capability. Damping factor degradation will vary with fuse size, with smaller fuses being the worst.. The meters are also D.C. coupled and will indicate the presence of D.C. offset. This feature can provice a quick check of the amplifier D.C. offset in field service troubleshoot.

I-D: PROTECTION CIRCUIT
The protection circuit consists of a frequency weight output voltage sense, an output current sense, an active network to calculate the relative

I-D: PROTECTION CIRCUIT (cont.)
magnitude and phase of voltage and current. The output of the active network drives on S.C.R. switch which removes the bias when tripped. Current production amps also include a recycling network which will reset the S.C.R. one second after it trips, thus restoring normal operation automatically. If the overload condition continues the S.C.R. will not reset and the recycling circuit will continue to cycle every second until the overload is removed.

Earlier units must be turned off and let stand several minutes until the power supply capacitors discharge fully. Then the unit can be turned back on to resume normal operation. Most of the protection circuitry is located on the amp card.

I-E: PRINTED CIRCUIT AMPLIFIER CARD:
The amp cards (one per channel) have 22 pin gold flashed contacts. To insure low ohmic connections, both card and connector must be clean. A pencil eraser will clean the card fingers. (Never use an abrasive) Use a good quality contact cleaner (Blue Shower) on the socket. When reinstalling the amp cards, make sure the insulating washer goes between the chassis standoff and the P.C. card ground plane.

The input signal "signal" enters the card at pin 2 with pin 1 as the cable shield. There is a resistor (330 - 600 ohms) in the input line plus the attenuator. (see fig. G) The input is applied to the gain matched discreet diff. amp (Q1 and Q2) via a bandpass filter. For P.A. and disco applications, the corner frequency can be moved up to 40 Hz by replacing C1 with a .15uf cap.

Because the filter has a single pole the roll off remains fixed at 6db/octave. If low frequencies from turntables or microphones cause the protection circuit to trip,a good 18db/octave filter, such as found on the D.C.E. Model 10 pre-amp, should be used in front of the power amp. This will allow most program material to pass while steeply rolling off below audio frequencies.

Cards with recycling protection circuitry employ an input limiter consisting of R110-115, D103-104 and Q105-106. Earlier cards with manual reset protection use factory selected 5.6v Zener diodes D1 + D2 to clamp the input signal to a safe level. Q5 is a constant current source for the diff. amp with R9 providing D.C. offset nulling. D3 is a triple

I-E: PRINTED CIRCUIT AMPLIFIER CARD (cont.)

junction diode with a constant drop of nominally 2.1 V.D.C. Q6 on manual reset cards is factory selected for high gain. On recycling cards Q16 has been added to form a darlington with inherently high gain, thus eliminating the neccesity of selecting Q6. The rest of the bias string is made up of Q9 and thermal feedback diodes (diodes are mounted in heatsink) R24 adjusts bias current. Q3 and Q4 function as a Class A darlington and provide final voltage gain. Drivers Q10 and Q11 feed post drivers and output stage. Overall feedback is applied to the diff. amp via C5 and R12. Q7 and Q8 are capacitor multipliers reducing the ripple from the row supply voltage.

Voltage sense for the protection circuit is fed to Q13 and 14 via bandpass filter C20, C21, R31, R3. Current sense is derived from the voltage drop across R57, R58. Voltage and current information are processed by Q12 and Q15 and when the safe operating area of the output devices is approached the S.C.R. switch is tripped which shorts the bias string.

In a short circuit condition the voltage sense is "0" but the current sense increases rapidly as input signal rises. Q12 and 15 start to conduct and voltage at the gate of the S.C.R. rises until it turns on and shuts down the amp.

Under normal operation (with a normal load) as the current sense increases, tending to turn on Q12 and Q15, voltage sense is also rising tending to shunt current away from Q12 and 15 via Q13 and 14 to ground through R36. This action prevents voltage from rising at the gate of the S.C.R.

If the output voltage frequency is above 20KHz or below 20 Hz it is attenuated by the bandpass filter and not as much current will be shunted away from Q12 and 15. Under these conditions the S.C.R. will trip earlier for out of band frequencies.

The last parameter that affects the trip point is the phase relation of output voltage to output current. As the load becomes more reative and voltage sense information arrives at Q12 and Q15 leading or lagging current sense, the amount of current shunted away is reduced until Q12 conducts enough to trip the S.C.R.

I-E: PRINTED CIRCUIT AMPLIFIER CARD (cont.)
Automatic recycling cards also have an oscillator (Q102, 103, 104) which resets the S.C.R. every second until normal operation resumes.

I-F: OUTPUT SECTION
The Model 250 has 4 output devices and 2 post drivers per channel. A P.N.P. post driver drives 2 N.P.N. output devices. An N.P.N. post driver drives 2 P.N.P. output devices. The Model 500 has 6 output devices and 2 post drivers per channel. The Model 1000 has 8 output devices and 2 post drivers per channel. All output devices and post drivers are factory selected for the differenct models and should not be switched from model to model and should not be replaced with off the shelf devices.

Models 1000 and 500 have 2 large diodes mounted on the resistor card (emitter + bias resistors). These diodes provide a path from output line to power supply to protect the output stage from back emf generated by reactive loads.

## II PERFORMANCE VERIFICATION

II-A: TEST EQUIPMENT:
As specified or equivilant:

1. Sound Technology 1700B with I.M. Dist. Analyser
2. Hewlet-Packard 427A voltmeter (.1 vdc full scale)
3. 10MHz dual trace oscilloscope
4. 20 amp 0-140 V.A.C. Variac
5. Four 8 ohm 250 watt load resistors with heatsink

II-B: PRELIMINARY:
On models 500 and 1000 check meter mechanical zero after power has been off for 10 minutes. If neccesary, adjust screw on front of meter so that the pointer falls over the first division of the scale. Once the adjustment has been made back the screw off slightly so the pointer is decoupled from the adjuster. (Standard practice for mechanical zero adj.)

Power unit up to 120 VAC with Variac and let idle for 15 minutes while the amp reaches operating temperature.

II-C: D.C. OFFSET:
Connect a floating (with respect to power ground) D.C. voltmeter (.1 VDC range) to the output jacks of one channel. Voltage should measure within $\pm$ 10 mV of

II-C: D.C. OFFSET (cont.)
0 V.D.C. repeat for other channel. If adjustment is neccesary, refer to fig. A or D for location of OFFSET control. As operating temperature increases the offset will tend to drift slightly more positive.

II-D: BIAS
Connect the negative lead of the floating D.C. voltmeter (1 VDC range) to the speaker common of one channel. Connect the positive lead to the collector screw of the 2N6609 post driver of the same channel. (Fig. B,C, or E) It is important to have the offset adjusted properly before bias is checked because offset erros will add or subtract from bias readings. Bias should measure a nominal + 500mV for Models 250 and 500. For Model 1000 the nominal valve is +490mV. Repeat for other channel. Check the negative bias level by measuring between speaker common and 2N3773 post driver. Plus and minus bias "voltages" should track within 20mV if offset is 0. As temperature increases, bias "voltage" decreases slightly.

If adjustment is called for refer to Fig. A or D. Note that as the control is rotated a peak in bias "voltage" is reached and then the level falls off again. The correct level can be reached at two different points on the control With an analog voltmeter it is possible to see the speed at which the voltage rises and falls. On one side of the peak the voltage falls quite rapidly, on the other the voltage falls more slowly. Set the pot for the correct "voltage" on the slow side of the peak. "Voltage" is proportioned to bias current.

II-E: TOTAL HARMONIC DISTORTION:
Check offset and bias (Sec. II-B, C, D) if within tolerances do not adjust. Power the unit with the Variac and maintain 120 volt line throughout the test. Connect an 8 ohm load resistor (of sufficient power handling capability) directly to the output jacks.

Output leads of test equipment should also be connected directly to the output jacks. Do not tie the common jacks of left and right channels together. This only completes a ground loop as the jacks are joined at the power supply. See application

II-E: TOTAL HARMONIC DISTORTION (cont.)
note for headphone use when using 3 conductor (stereo) phone plugs. Also never connect the red jacks of right and left channels together. Connect an oscillator to the input jack and drive the amp to full power at 20KHz. For an 8 ohm load the full power voltage will be:

| | | |
|---|---|---|
| Model 250 | 31.6 rms | $V=\sqrt{P \times R}$ |
| Model 500 | 34.6 rms | |
| Model 1000 | 44.7 rms | |

Input level attenuator should be set fully C.W. for tests, but should be turned down C.C.W. when repatching or switching oscillator. T.H.D. should be well below .25%; typically .19%.

Reduce power output to 100mW. THD should be well below .25%; typically .1%.

These are the worst case points to measure the distortion, a check of 1KHz 50 watt should yield .01% typically.

II-F: INTERMODULATION DISTORTION (SMPTE)
With an 8 ohm load, apply the 7KHz: 60Hz I.M. input signal. Measure I.M.D. at 100 mW and full power. IMD at these points is typically .03%. Special care must be observed in making ground connections between different pieces of test gear. It may be helpful to float the 3rd wire ground of the amp and use a single piece of test equipment as the power line ground reference.

II-G: PROTECTION CIRCUIT TEST
Speaker fuses in the Model 500 and 1000 must be replaced with 10 amp fast blow for this test.

Connect a 500 watt 4Ω load resistor to one output. Set sine wave oscillator for 20KHz. Increase input signal to 2 volts rms out. Amp should not shutdown, set oscillator for 30KHz and increase level, amp should shut down at 34 volts ± 3 volts. Do not increase input level above 2.0 volts. Amps with recycling cards will reset automatically when input level is reduced. Non-recycling cards must be reset by turning off power switch and either waiting several minutes or by using no less than an 8Ω high wattage resistor to bleed positive and negative power supply at the cap. card. (never use a direct short to discharge a power supply)

II-G: PROTECTION CIRCUIT TEST (cont.)
When amp is reset change oscillator to 20Hz. Increase input level to 3 volts (max. on Sound Tech 1700B). Amp should not shut down. Change oscillator to 10 Hz and slowly increase level, amp should shut down at 10 volts ± 2 output. The bandpass filter at the input of the voltage sense causes the amp to shut down at the 10Hz and 30KHz test.

II-H: LAST BUT NOT LEAST TEST:
Place the amp in a music system capable of handling high power and check for normal operation.

## III: TROUBLESHOOTING GUIDE

III-A: PROTECTION CIRCUIT HAS ACTIVATED
Each channel has an independant protection circuit, so it is possible to have one or both channels shutdown. If a channel is shutdown, meters and on/off pushbutton will remain illuminated but there will be no meter deflection. Amps with L.E.D.'s will indicate a shutdown condition and if equipped with recycling protection will reset automatically in one second if the overload is transient. If overload is continuous the L.E.D. will blink and a sharp pop will be heard from the speakers until the overload is removed. Amps with non-recycling protection will have to be turned off for several minutes at which time the reason for shutdown should be investigated. If an amp with non-recycling protection is in a shutdown condition and the load is removed the D.C. offset may rise. This is normal. There is no current behind this voltage and if a load is present it will drop to "0".

III-B: NORMAL CAUSES OF PROTECTION CIRCUIT ACTIVATING
The protection can be triggered by an abnormal load and a normal input or a normal load and an abnormal input or a combination of the two. The first case could be a short across the output in which case very little input signal will cause shutdown. If the load is approximately 2Ω with little phase shift, the amp will provide fairly high power levels but can be triggered if program material contains significant energy below 20Hz, ie. turntable rumble, live microphones. As the load becomes more severe (lower impedance, more reactive, less efficient) it becomes imperitive to provide a clean program source.

III-B: NORMAL CAUSES OF PROTECTION CIRCUIT ACTIVATING (cont.)

With less severe loads the protection circuit will tolerate more "garbage" in the program material. The protection circuit is also sensitive to frequencies above 20K. While this is not typically a problem, large amounts of R.F. or tape decks in rewind can trigger the circuit.

The Model 250 has a thermal sensor which trips at 180°F. If the heat sink becomes too hot the A.C. line will be opened. When temperature drops the sensor will reset. If the temperature sensor is triggered the system should be checked as this represents a very abnormal condition.

III-C: ABNORMAL PROTECTION CIRCUIT ACTIVATION

After the above information has been considered and the protection circuit is suspect, especially if there is a significant difference between the two channels, refer to Sec. II-G for test procedures. As a troubleshooting aide the P.C. amp cards may be swapped to see if the problem is on the card or in the frame. Be sure P.C. card fingers are clean. Always bleed power supply before removing P.C. cards and remember to position the insulating washers correctly. The cards should be returned to their original location once the problem has been localized as the card-frame combination has been optimized at the factory.

If the trouble is in the frame, check the condition of the current sampling resistor R57 and 58. Amps with recycling cards must have pin 10 connected to power supply ground or have the two ground planes (pin 1 and 10) on the card jumped together at the two blank holes on the right side of the board.

If the trouble is in the card check Q12 for leakage, it should be $< 50$ ua @ 160v. Iceo. If trouble persists cards should be sent to the factory.

III-D: MAIN FUSE BLOWS REPEATEDLY

Live fuse size for the Model 1000 is 10 amp fast blow (3AG-10A). Model 500 and 250 8amp fast blow (3AG-8A). If the fuse blows as soon as the amp is turned on the most likely cause is a shorted output stage. To check the output device, connect an ohmeter between the hot ouput jack and the collector screw of an output device (not a post driver) a

III-D: MAIN FUSE BLOWS REPEATEDLY (cont.)
short indicates at least one bad device. Check all the devices. If the measurement reveals no shorts (be sure speaker fuses are good) check between speaker common and the collector screws. A short indicates a defective insulating washer or bad power supply. Power supply shorts can be traced by removing the plus and minus screws on the large electrolytic capacitors and measuring wires separately unitl the short is found. Be careful to discharge caps before working on them. If output devices are found to be shorted they must be replaced with factory selected units. If the devices are 2N5631/2N6031 remove all the devices from the amp, both channels including post drivers and return them to the factory. If the devices are 2N3773/2N6609 return the defective ones for replacement. The two series of devices should not be mixed.

III-E: POWERING A UNIT UP AFTER REPAIR

A Variac should always be used to power up the amp after a catastrophic failure. An A.C. current meter is also very useful. If a current meter is not available use a 1.5 amp fast blo fuse in the Variac and raise the line voltage slowly to 30 VAC. If a problem still exists the fuse will blow protecting the amp. If the line voltage is raised too quickly the inrush of current to the electrolytics will blow the fuse. If a current meter is available the line should be raised slowly enough to keep current below 2 amps.

Due to the complementry output stage and constant current sources in the gain stages the amp will bias up and be operational at 30 VAC line. The offset will not be optimized and of course the output power will be limited but an operational check can be made.

If the unit does not draw excessive current ($>2$ amps) at a 30 volt line, check the offset and bias (II-B,C,D) Do not adjust the offset unless it is more than 400mV as it will change with full line voltage. If there is no bias the protection circuit has probably activated. If bias and offset are OK apply a 1KHz signal to the inputs and check for normal operation with no load. Next, slowly raise the A.C. line to 120 VAC. Check signal again using distortion analyzer prefably with scope output to look for oscillations or instabilities. If OK, replace 1.5 amp fuse with the proper size and proceed with performance verification (II).

III-F: TROUBLESHOOTING HIGH THD

If an amp fails to meet high frequency distortion figures, set up amp for 20KHz full power and monitor distortion products on scope. If products are primarily 2nd harmonic check D.C. offset. If offset is ±10 mV of 0 and the amp card is of the non-recycling type using Zener diodes for input voltage limiting (D1 and D) remove the card and lift one end at the series diodes up to eliminate them from the circuit. Repeat the dist. test. If the figures improve send the defective diodes to the factory for replacements. These diodes must be selected for low dist.

If the figures do not improve or if the amp card is the recycling type, set the unit up to monitor 20KHz full power dist. and slowly adjust offset adjustment and see if it is possible to improve figures by setting offset away from "0". Do not turn the pot to the stops as it is possible to blow the unit, also 400 + 80K filters such as found on the Sound Technology Dist. Analyzer will allow easier interpretation of the test. If the 2nd harmonic is reduced by tweaking the offset pot, remove card and take out Q1 and Q2. These devices should have equal gain. If replacements are needed contact the factory.

Excessive dist. at 20KHz 100mW level is most commonly caused by insufficient bias. If the bias measures 490mV for Model 1000 and 500mV models for 500 and 250 swap the cards to see if the problem is in the frame or the card. If the problem is in the frame try swapping the post drivers right to left channel. If the problem is in the card contact the factory. Avoid the temtation to adjust the bias above recommended values. This will reduce 100mW 20K dist. but will also reduce output power cause the unit to run hot while idling, possibly going into thermal run away as well as compromizing I.M. distortion.

III-G: TROUBLESHOOTING HIGH I.M. DISTORTION

The high power I.M. figure is affected by the bias setting. The section on adjusted bias calls for the control to be set on the "slow" side. The reason for this will be obvious if the I.M. is monitored while rotating the bias control. We have found that if R12 is a carbon film resistor the I.M. figure improves slightly. Current production models all use carbon

III-G: TROUBLESHOOTING HIGH I.M. DISTORTION (cont.)
films, contact the factory for replacement if you have an early unit. Lastly the recycling cards have a different ground return for the protection circuit which improves I.M. figures somewhat.

## IV: APPLICATION NOTES

### IV-A: RACK MOUNTING

The model 250 may be mounted by securing the front panel to a standard 19" rack, Models 500 and 1000 must have support from the bottom or rear of the unit as well as securing the front panel because of the extra weight. The fans on the Model 1000 should be used in either the low or high speed position such that the heat sinks do not get uncomfortably warm to the touch. If the rack has little air circulation, a fan will have to be added to the rack when used to house a 250 or 500.

Avoid the use of sliding drawers as the weight of the unit may cause the rack to tip when drawers are extended.

### IV-B: HEADPHONE CONNECTIONS

Direct connection of headphone to the output terminals of the amp is undesirable for three reasons:

1. Possibility of ear damage from high S.P.L. or blown out drivers.
2. Connecting right and left channel output terminals together when $\frac{1}{4}$" stereo phone plugs are inserted or removed from mating jacks.
3. Not realizing full potential signal to noise performance because the signal will have to be attenuated somewhere in front of the amplifiers 27db of voltage gain.

Refer to fig. F for details on headphone pad construction. Using this pad prevents the 3 problems listed above from degrading amplifier performance. The values given are optimized for Ross Pro 4-AA. Other headphones with different impedances may require slight alterations in the divider. If volume out is too low, change the 82 ohm resistor to a lower value (75-68). If the level is too high, raise the value of the 82 ohm resistor (91-120).

IV-C: TRANSFORMER WIRING FOR 100 - 240 VAC LINES

Dreadnaught Amplifiers equipped with Universal Power Transformer may be wired for 100, 120, 200 and 240 Volt A.C. power lines 50/60Hz. See fig. H. Amplifiers with standard transformers must only be connected to a 120 Volt line. Care should be taken to make sure the amplifier does not see more than a + 5% - 20% deviation from the nominal voltage the transformer is wired for. Higher voltages will jepordize the output transistors and could lead to failure via secondary breakdown. It is also important that the house wiring be heavy enough to maintain the nominal voltage while delivering high peak currents. Avoid extension cords and pre-amp A.C. sockets. If the house lights dim on loud passages, the A.C. line is not heavy enough. A properly installed 20 amp line (120 VAC) should be adequate for the Model 1000. Meter lamps will normally dim on high peaks, if dimming becomes excessive peak clipping will occur also.

## SEC. 3.1 OPERATING PRECAUTIONS

A) FUSE YOUR SPEAKERS IN ACCORD WITH THE WARRANTY SET FORWARD BY THE SPEAKER MANUFACTURER. DUNLAP CLARKE DOES NOT WARRANT ANY TRANSDUCER AGAINST OVERPOWERING BY THE DREADNAUGHT AMPLIFIERS.

B) NEVER PARALLEL THE RIGHT AND LEFT CHANNEL OUTPUTS

C) NEVER SHORT THE INPUT GROUND TO THE SPEAKER GROUNDS. TO DO SO CREATES A GROUND LOOP WHICH MAY CAUSE OSCILLATIONS WHICH CAN DAMAGE THE AMPLIFIER.

D) A.C. LINE FUSE SIZE FOR THE MODEL 500 IS A 10 AMP FAST BLOW AGC10 FOR CONTINOUS POWER TESTING AND A 6 AMP SLOW BLOW FOR NORMAL USE IN SPEAKER SYSTEMS. (MDL 6)

MODEL 1000 FUSE SIZE AGC 12 FOR CONTINUOUS POWER TESTING AND MDL 8 FOR NORMAL SPEAKER USE.

THE USE OF SHORTS, SLUGS, OR FUSES LARGER THAN THE SIZE SPECIFIED ABOVE WILL VOID THE WARRANTY.

E) THE PROPER LINE VOLTAGE FOR DUNLAP CLARKE AMPLIFIERS IS 120 VOLTS UNLESS OTHERWISE SPECIFIED.

F) MAKE ALL SPEAKER CONNECTIONS AND INPUT CONNECTIONS PRIOR TO TURNING THE UNIT ON.

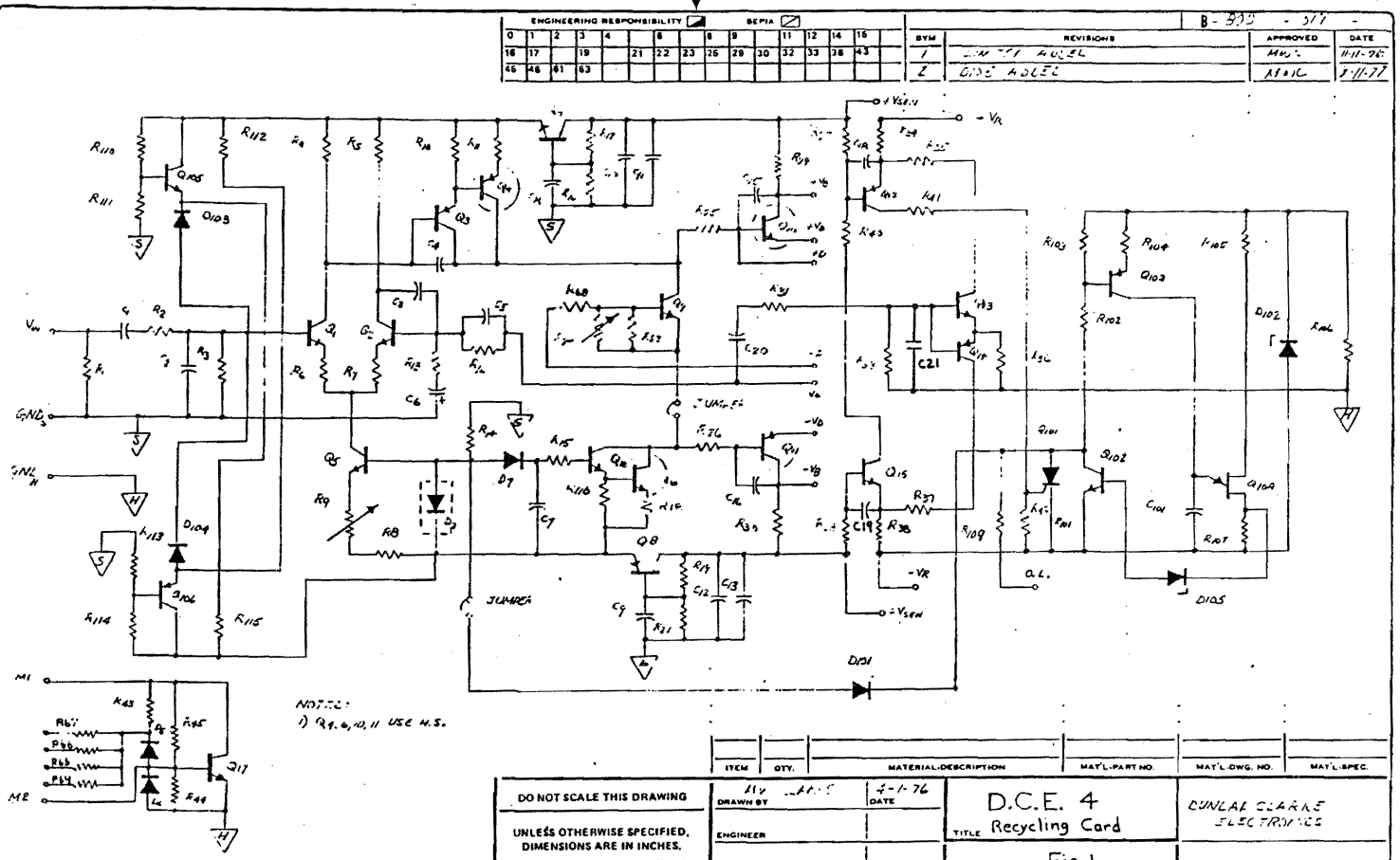
G) NEVER CHANGE THE FUSES WITH THE UNIT ON. THIS PREVENTS THE POSSIBILITY OF ELECTRICAL SHOCK.

H) AVOID DRIVING THE AMP AT FREQUENCIES ABOVE 20 KHZ FOR EXTENDED PERIODS OF TIME.

I) NEVER CONNECT THE OUTPUT OF THE AMP TO AN ACTIVE LOAD SUCH AS THE AC LINE. NEVER CONNECT THE AMP TO A BATTERY.

J) ALWAYS PLACE THE AMPLIFIER IN AREAS WHERE ADEQUATE VENTILATION IS ASSURED.

K) ALWAYS MINIMIZE THE AMPLIFIER'S LEVEL CONTROLS WHEN USING THE PREAMPLIFIER FUNCTION SELECTOR SWITCH OR WHEN TURNING OTHER COMPONENTS ON.



NOTES:
1) Q1, 6, 10, 11 USE M.S.

| ENGINEERING RESPONSIBILITY | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | | 6 | | 8 | 9 | | 11 | 12 | 14 | 15 | |
| 16 | 17 | | 19 | | 21 | 22 | 23 | 25 | 29 | 30 | 32 | 33 | 38 | 43 | |
| 45 | 46 | 61 | 63 | | | | | | | | | | | | |

SEPIA

B - 800 - 017 -

| SYM | REVISIONS | APPROVED | DATE |
|---|---|---|---|
| 1 | [illegible] ADDED | [illegible] | 11-11-76 |
| 2 | CODE ADDED | [illegible] | 2-11-77 |

| ITEM | QTY. | MATERIAL-DESCRIPTION | MAT'L-PART NO. | MAT'L-DWG. NO. | MAT'L-SPEC. |
|---|---|---|---|---|---|

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY [illegible] DATE 4-1-76

ENGINEER

RELEASE TO PROD.

SUPERSEDED DWG.

TITLE D.C.E. 4 Recycling Card

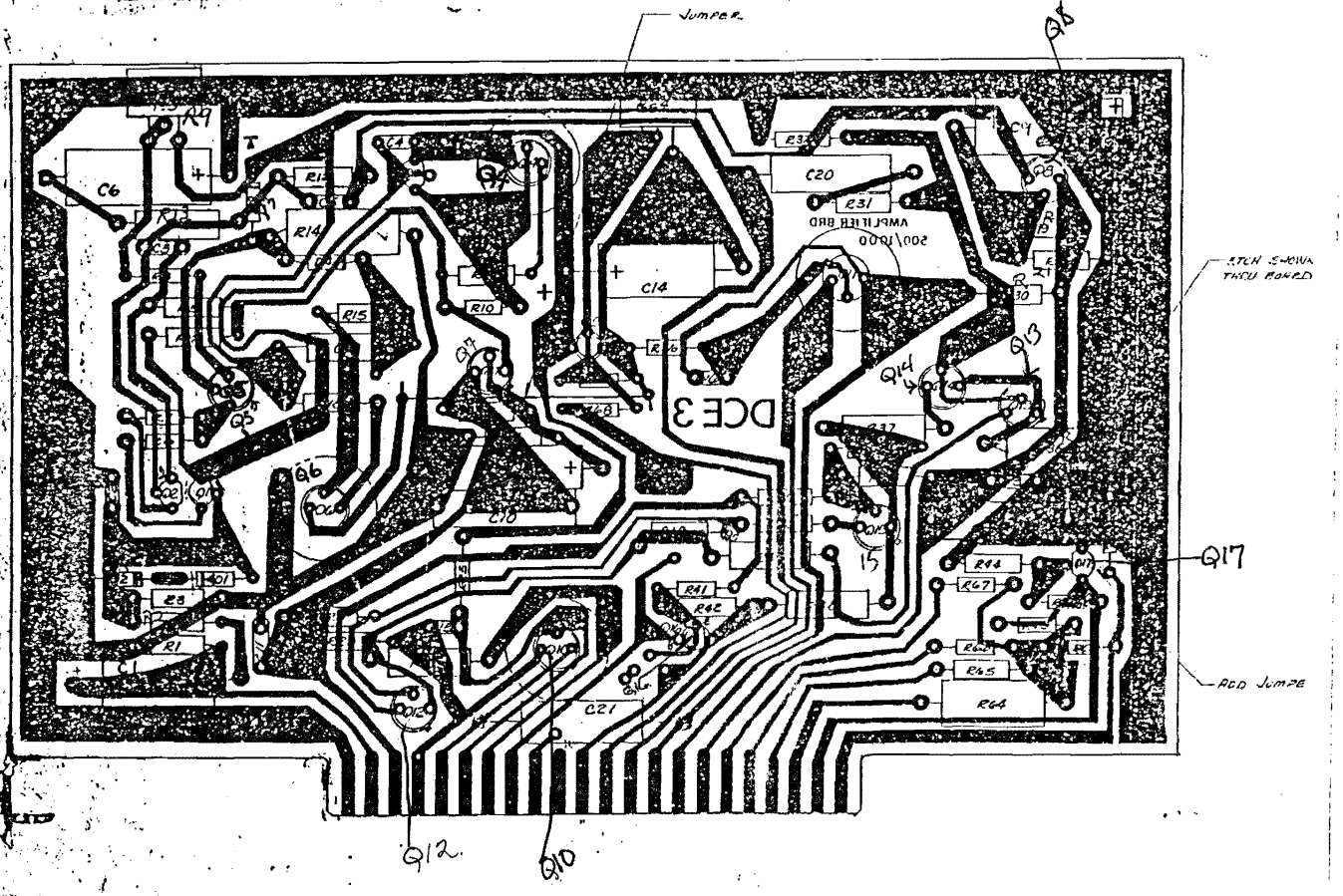
NEXT ASSEMBLY Fig L

FINISH SCALE

DUNLAP CLARKE ELECTRONICS

PART NUMBER B - 800 - 017 -

SHEET 1 OF 1




STAMP APPROPRIATE MODEL NO ON B.O.D IE. "500" "1000"

STAMP APPROPRIATE REVISION LETTER TO BRD APPROX AS SHOWN

INSTALL TEFLON-PADS, ITEM 66 TO ALL FOLLOWING TRANSISTORS Q1-Q7 AND Q10-Q13, Q15 (9 PLACES)

APPLY THERMAL COMPOUND, ITEM 63 TO ALL METAL CASE TRANSISTORS, AS SHOWN, Q8, Q6, Q9, Q11, 4 PLACES

FROM [illegible] HEAT SINKS, ITEM 64, TORQUE RETAINING SCREW IN HEAT SINK WITH A TORQUE

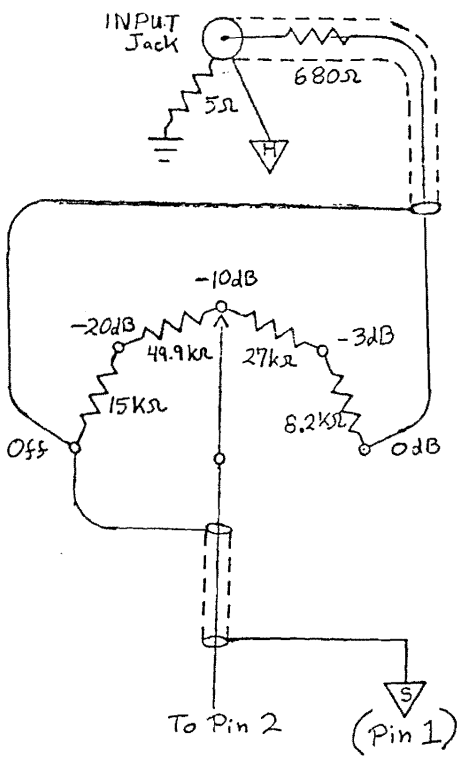

INPUT
Jack
680Ω
5Ω
H
-10dB
-20dB
49.9kΩ
27kΩ
-3dB
15KΩ
8.2KΩ
Off
0dB
To Pin 2
S
(Pin 1)

Fig. G.

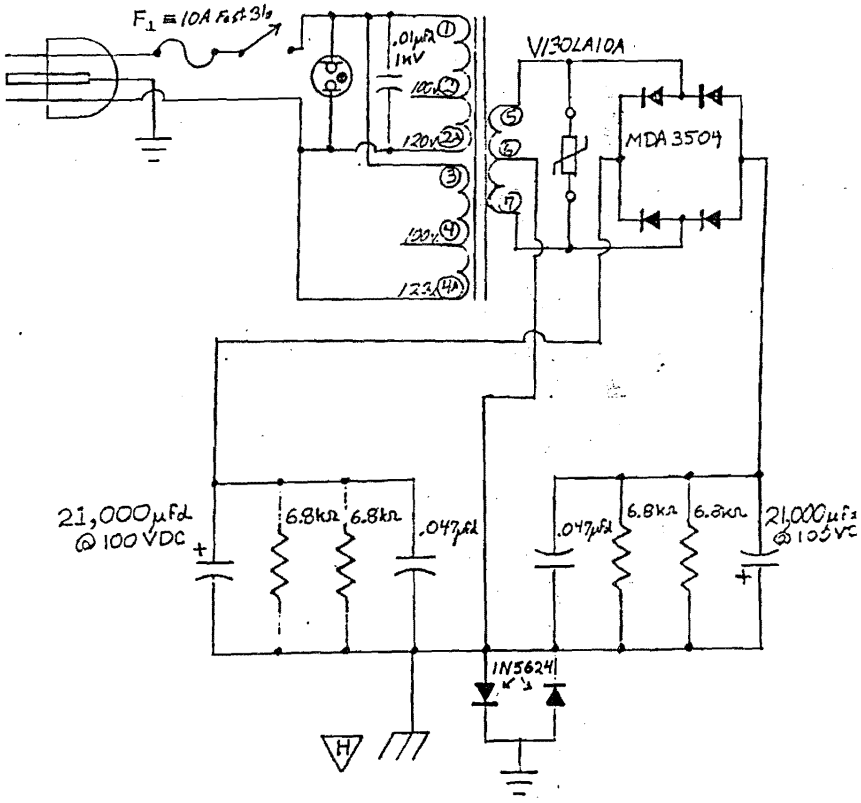
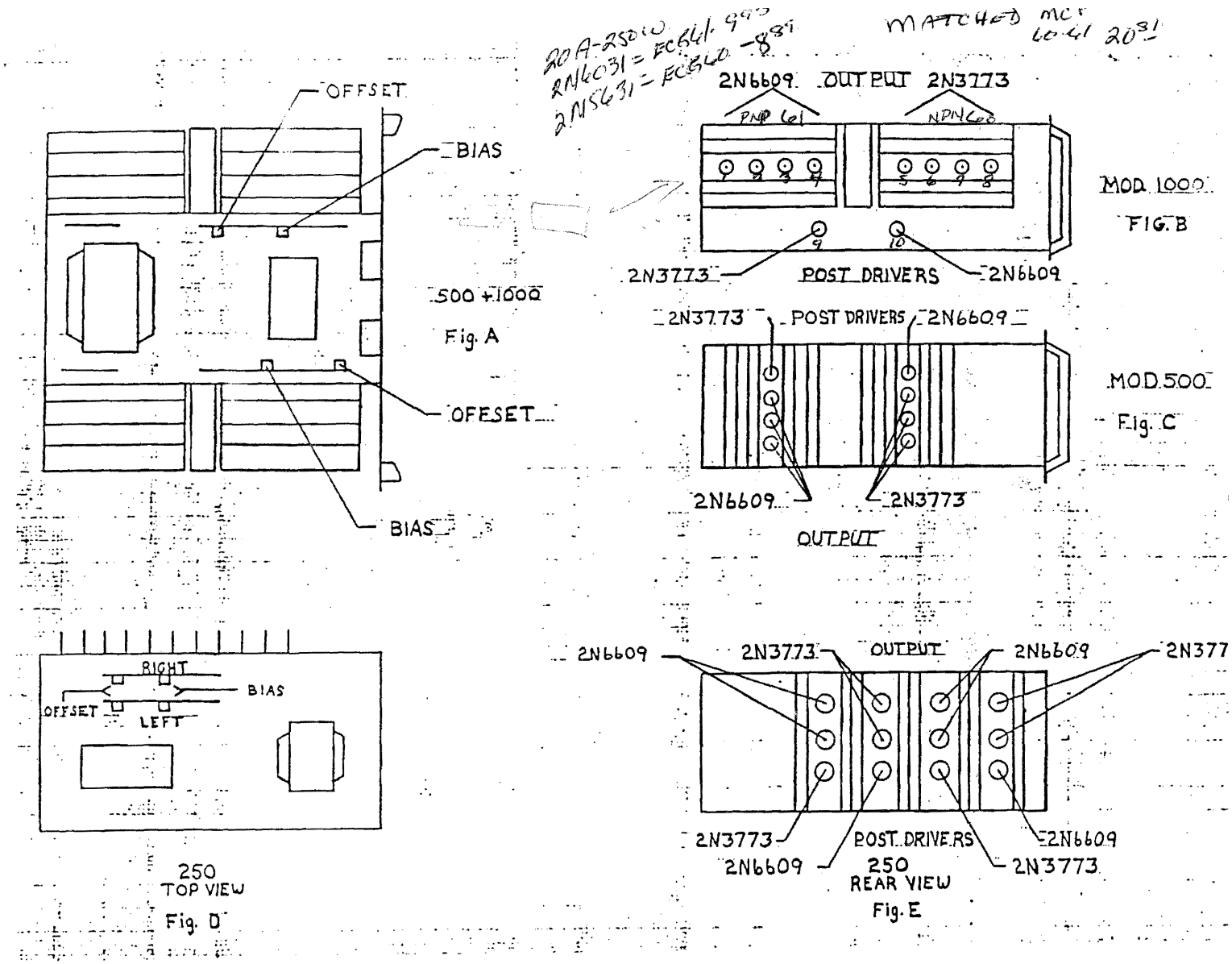

F1 = 10A Fast Blo
.01μfd
1KV
100V
120V
130V
123V
V130LA10A
MDA3504
21,000μfd
@100VDC
6.8kΩ
6.8kΩ
.047μfd
.047μfd
6.8kΩ
6.8kΩ
21,000μfd
@105VDC
1N5624
H

Fig. H


20A-2500
2N6031 = EC641. 99
2N5631 = EC640 -8.
MATCHED MC
6041 2031
OFFSET
BIAS
500 +1000
Fig. A
OFESET
BIAS
2N6609 OUTPUT 2N3773
PNP 6el
NPN 6e8
MOD. 1000
FIG. B
2N3773
POST DRIVERS
2N6609
2N3773
POST DRIVERS
2N6609
MOD. 500
Fig. C
2N6609
2N3773
OUTPUT
RIGHT
BIAS
OFFSET
LEFT
250
TOP VIEW
Fig. D
2N6609
2N3773
OUTPUT
2N6609
2N377
2N3773
2N6609
POST DRIVERS
250
REAR VIEW
2N3773
2N6609
Fig. E

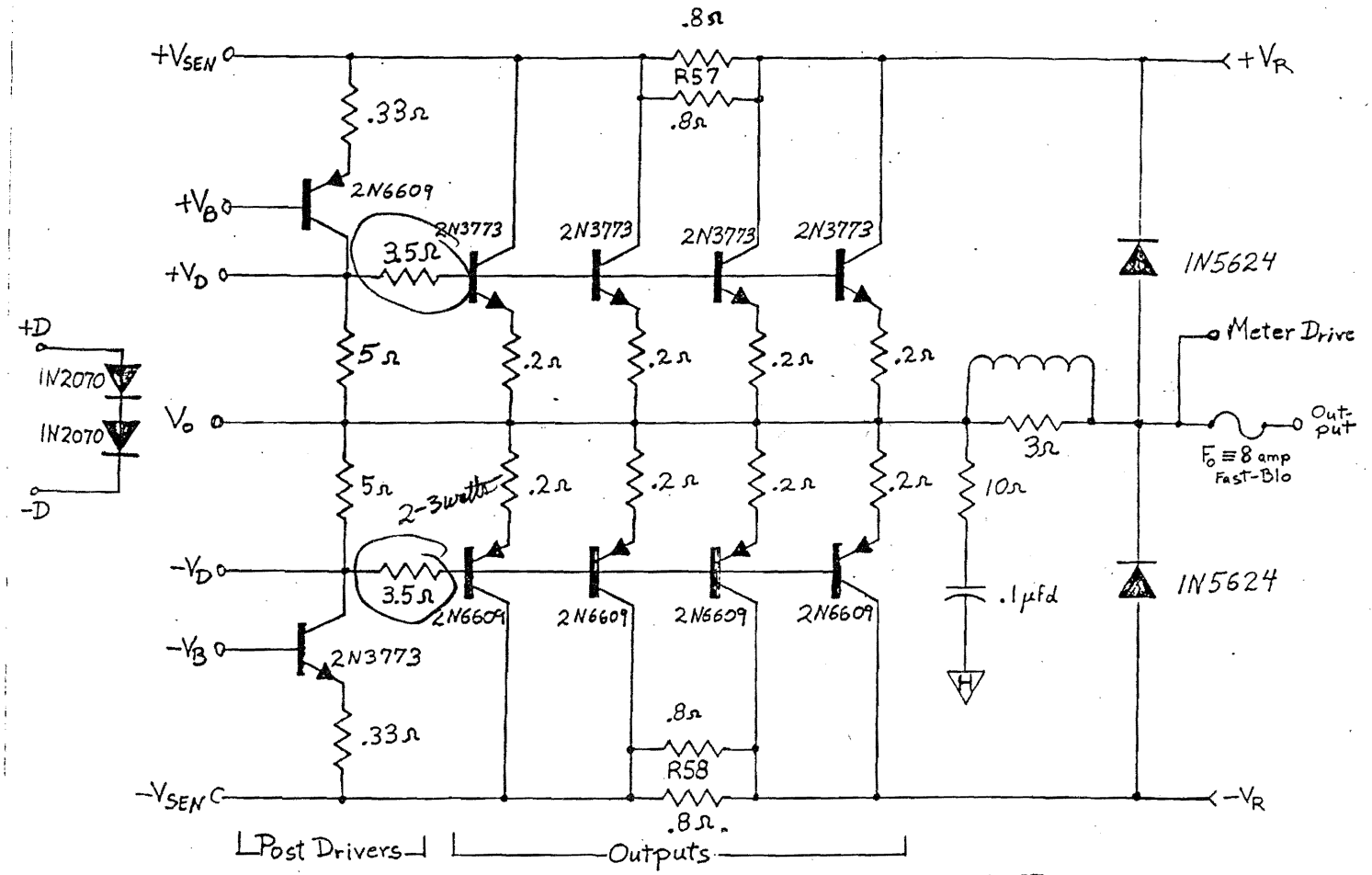
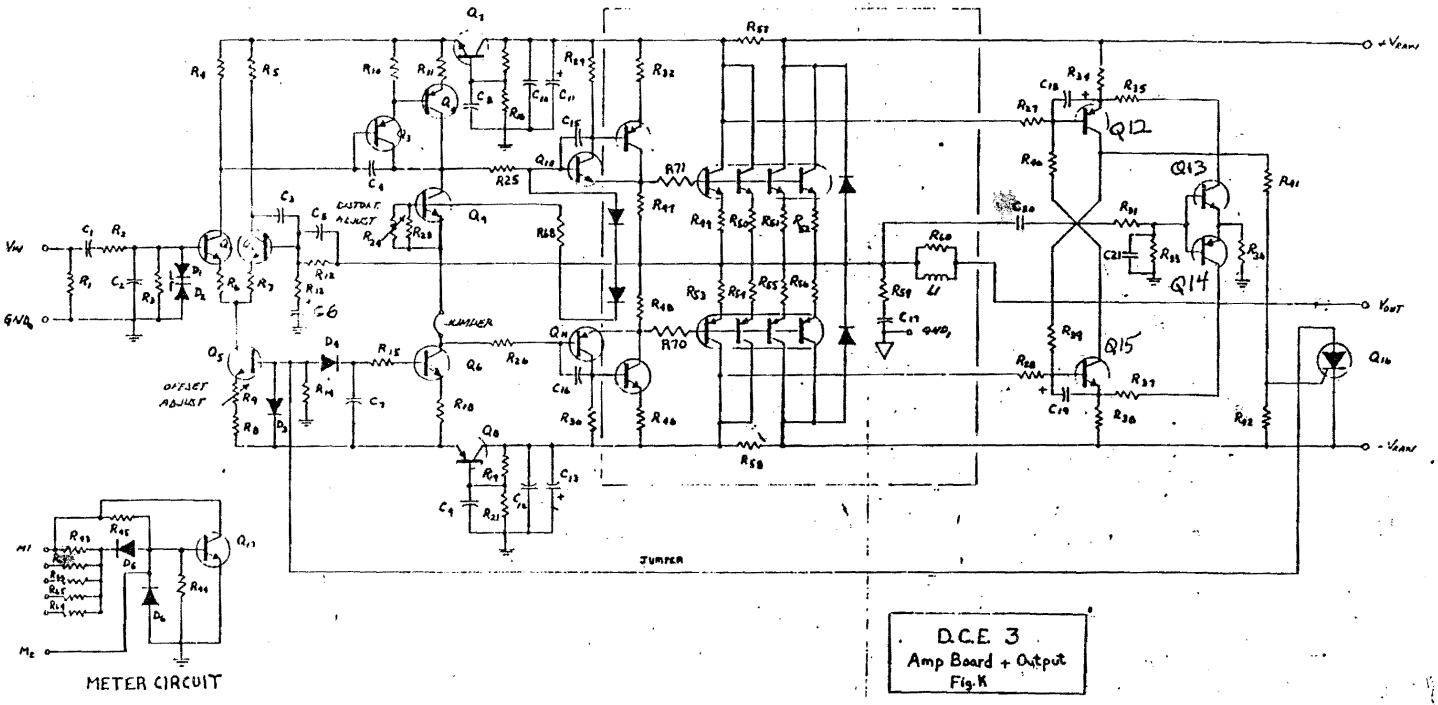
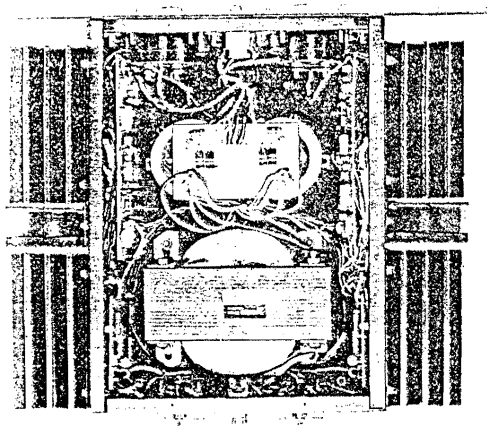

+VSEN
+VB
+VD
+D
IN2070
IN2070
-D
Vo
-VD
-VB
-VSEN
.33Ω
2N6609
3.5Ω
2N3773
5Ω
5Ω
2-3watts
3.5Ω
2N6609
2N3773
.33Ω
.8Ω
R57
.8Ω
.8Ω
R58
.8Ω
.2Ω
3Ω
10Ω
.1μfd
+VR
-VR
IN5624
IN5624
Meter Drive
Output
Fo ≡ 8 amp Fast-Blo
Post Drivers
Outputs

Fig J.




D.C.E. 3
Amp Board + Output
Fig. K



## Model 1000 specifications

| | |
|---|---|
| continuous power output per channel with both channels driven into 8 ohms across 20 to 20,000 Hz at less than 0.25% total harmonic distortion | 250 watts |
| continuous power output per channel with both channels driven into 4 ohms across 20 to 20,000 Hz at less than 0.25% total harmonic distortion | 500 watts |
| total harmonic distortion from 0.1 watt to 250 watts per channel with both channels driven into 8 ohms across 20 to 20,000 Hz | 0.25% maximum<br>0.025% typical |
| intermodulation distortion at 60 and 7,000 Hz mixed 4:1 at any power from 0.01 watt to 250 watts into 8 ohms | 0.1% maximum<br>0.025% typical |
| frequency response at 250 watts per channel | 20 to 20,000 Hz, ±0.5 dB, -0dB |
| frequency response at 1 watt per channel | 20 to 20,000 Hz, ±0.05 dB |
| slew rate | greater than 25V/μs |
| signal to noise ratio | 100 dB minimum |
| load impedance | 2 ohms or greater |
| input impedance | 100 k ohms |
| input sensitivity | 1.75 volts RMS for full output |
| power line requirements | 120 VAC, 60 Hz |
| power consumption at maximum rated power | 1,250 watts |
| power consumption at idle | 50 watts maximum |
| temperature rise at full power fan on low (silent) speed | less than 40°C |
| dimensions, amplifier only | 19"W x 7"H x 12"D |
| dimensions, including case | 20½"W x 8½"H x 16½"D |
| net weight, amplifier only | 70 pounds |
| net weight, including case | 80 pounds |
| shipping weight, amplifier only | 80 pounds |
| shipping weight, including case | 90 pounds |

## Model 500 specifications

**(identical to Model 1000 except for the following)**

| | |
|---|---|
| continuous power output per channel into 8 ohms | 150 watts |
| continuous power output per channel into 4 ohms | 300 watts |
| input sensitivity | 1.2 volts RMS for full output |
| power consumption at maximum rated power | 950 watts |
| temperature rise at full power | 60°C maximum |
| dimensions, amplifier only | 19"W x 7"H x 12"D |
| dimensions, including case | 20½"W x 8½"H x 13½"D |
| net weight, amplifier only | 45 pounds |
| net weight, including case | 53 pounds |
| shipping weight, amplifier only | 55 pounds |
| shipping weight, including case | 63 pounds |
| case material, both models | genuine oiled walnut veneer over flakeboard core |

## front panel features

- power on-off switch, lighted push-button
- professional quality meters with true VU characteristics
- five position meter switch indicates following power levels at 100% or 0VU
  - 0 full power
  - -3 half power
  - -10 one-tenth power
  - -20 one-hundredth power
  - Off meter out of circuit
- individual channel level controls to balance unequal drive from preamp and prevent amplifier overload
- standard Western Electric panel dimensions and drilling for ease of rack mounting

## rear panel features

- power line fuse, 8 amp fast blow (may be increased to 12 amp at user discretion without risk of amplifier damage)
- speaker line fuses, 8 amp fast blow (may be decreased for additional speaker protection at discretion of user)
- standard banana jack power output terminals for two sets of speakers per channel
- three position cooling fan switch, off for most home listening, low (silent) speed for demanding audiophile applications, high speed for industrial or rack mount applications (Model 1000 only; Model 500 does not require fan)
- RCA type phono jacks for line level audio inputs

Dunlap Clarke Electronics warrants its products to be free from defects in materials or workmanship for a period of three years from date of sale to the user. The unit must be delivered to and picked up from an authorized Dunlap Clarke warranty station or the factory. This warranty covers repair and/or replacement of any part found by the manufacturer or warranty station to be defective, including any associated labor cost. This warranty does not apply to units subjected to accidental damage or misuse in violation of operating instructions, units repaired or altered by other than the factory or its authorized service stations, and units with removed or defaced serial number.

specifications subject to change

Made in USA

57510M

THE WARRANTY APPLIES ONLY TO THE ORIGINAL PURCHASER AND IS NOT TRANSFERABLE.

DUNLAP-CLARKE ELECTRONICS SHALL HAVE NO LIABILITY WHATSOEVER FOR CONSEQUENTIAL DAMAGES. THE SOLE RESPONSIBILITY OF DUNLAP-CLARKE ELECTRONICS, INC. UNDER THIS WARRANTY SHALL BE LIMITED TO THE REPAIR OF THE PRODUCT, OR REPLACEMENT THEREOF, IN THE SOLE DISCRETION OF DUNLAP-CLARKE ELECTRONICS.

DUNLAP CLARKE ELECTRONICS

*Quality Audio Equipment*

## PARTS AND LABOR WARRANTY

DUNLAP-CLARKE ELECTRONICS, INC. WARRANTS YOUR DREADNAUGHT POWER AMPLIFIER TO BE FREE OF MANUFACTURING DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF THREE YEARS. (PARTS AND LABOR)

TO VALIDATE YOUR WARRANTY, YOU MUST FILL OUT AND MAIL THE WARRANTY REGISTRATION CARD TO DUNLAP-CLARKE ELECTRONICS, 40 CREIGHTON ST., CAMBRIDGE, MASS. 02140 WITHIN TEN DAYS FOLLOWING THE DATE OF PURCHASE.

FOR WARRANTY REPAIR, SEND THIS PRODUCT TO DUNLAP-CLARKE ELECTRONICS, 14 CHARLES ST., NEEDHAM HEIGHTS, MASS. 02194, OR TO AN AUTHORIZED DUNLAP-CLARKE SERVICE STATION. ALL SHIPPING CHARGES MUST BE PREPAID, DUNLAP-CLARKE WILL PAY RETURN SHIPPING CHARGES TO ANY DESIGNATED POINT IN THE UNITED STATES. ALL UNITS MUST BE SHIPPED WITH THE ORIGINAL PACKING MATERIAL, OTHERWISE FACTORY AUTHORIZATION TO SHIP IS REQUIRED.

THIS WARRANTY IS VOID IF THE SERIAL NUMBER HAS BEEN ALTERED OR REMOVED; IF THE PRODUCT IS MODIFIED OR REPAIRED IN ANY MANNER WHICH DUNLAP-CLARKE BELIEVES MAY AFFECT THE RELIABILITY OF THE PRODUCT; IF THE PRODUCT IS NOT OPERATED IN ACCORDANCE WITH THE INSTRUCTION MANUAL.