

## CinemaAcoustics ENGINEERING NOTES

Note 001, 15 Apr 98

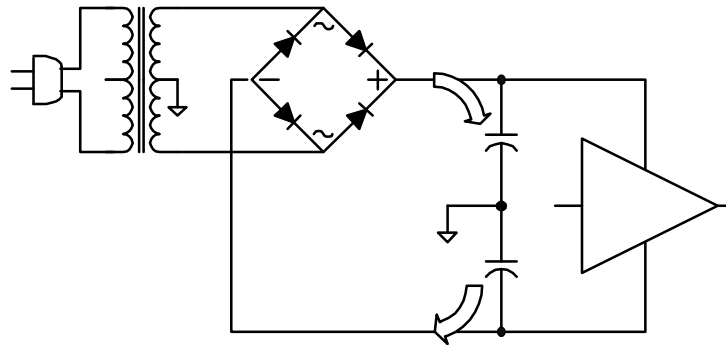
### ELECTRICAL PANEL CIRCUIT BREAKERS FOR POWER AMPLIFIERS

Power amplifiers can have large surge currents at power-up. Good planning will insure that your electrical panel circuit breakers will not accidentally trip when powering-up your amps. We recommend the use of thermal-type circuit breakers in your electrical panels. If you are using magnetic-type circuit breakers, you will need to employ a higher rating than that needed with a thermal breaker. Our recommendations are shown in the table below.

<i>Amplifier</i>	<i>Thermal</i>	<i>Magnetic</i>
CA-A540	10 A	15 A
CA-A800	20 A	25 A

Magnetic breakers require a higher rating as they inherently are fast-acting, causing them to trip unnecessarily with normal power surges. Thermal breakers, on the other hand, will safely integrate normal power surges and require a high sustained current before tripping.

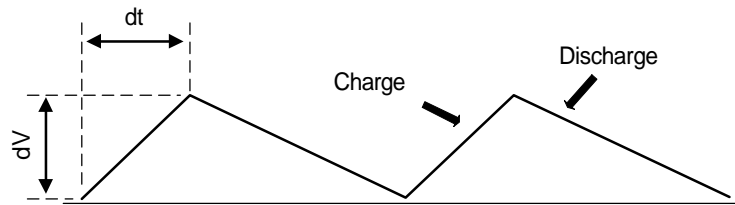
Why does the power surge exist? All power amplifiers rely upon stored energy in their power supply to faithfully reproduce audio signals in their speakers. In analog-type amplifiers this energy is stored in the power supply capacitors. Referring to the power supply drawing below, the capacitors receive their charge through the power transformer and bridge rectifier.



Capacitor Charging Path

In use, the capacitors are constantly being charged by the mains power at twice the rate of the line frequency. They are also constantly discharged by the current draw of the amplifier and speaker. High power low frequency signals will sustain a high discharge. An excessive discharge will cause a significant loss of power to the speaker. To overcome this potential loss of power, a large

amount of energy storage is needed, requiring a large amount of capacitance. The typical waveform of the capacitors during use is shown in the figure below.



Capacitor Charge-Discharge Waveform

The current at the mains input can be determined as follows. The rise in voltage during a charge period is represented by the term  $dV$ , and the time over which the capacitor charges is represented by the term  $dt$ . The capacitor value itself is represented by  $C$ . During power-on, the capacitor has to be charged to its full operating voltage, which means there is a large  $dV$ . The current required at the AC input of the amplifier is directly proportional to the term  $C \cdot dV/dt$ . In other words, with a large  $C$  and a large  $dV$ , we have a large surge current.

The surge current at the AC power mains can be reduced by reducing  $C \cdot dV/dt$ . In practice, this can be accomplished by either reducing the value of capacitance  $C$  or increasing the resistance of the transformer windings. Increasing the winding resistance reduces the charging current and thus increases the value of  $dt$ .

*Both of the above solutions will reduce the cost of the amplifier. However, neither solution is attractive for a professional product.* By reducing the capacitance, we reduce the storage capacity of the amplifier and thus reduce its sustained power performance, particularly at low frequencies. By increasing the resistance of the transformer windings, we reduce the rate at which the stored energy in the amplifier is renewed, and thus we also reduce sustained power performance.

CinemAcoustics amplifiers place quality ahead of profits, and do not make any compromise in their design. The result is that you may have to use higher valued circuit breakers with our amps, but in doing so, you are giving your audience more power and better sound.

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