DYNAMIC SOUNDS ASSOCIATES

Amp I

USER MANUAL

120 VAC Operation

DSA
Dynamic Sounds Associates

Naples, Florida

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Amp I
USER MANUAL

WELCOME

Dynamic Sounds Associates welcomes you to our world of the finest possible audio electronic products. We thank you for your purchase and we assure you many years of musical enjoyment. We are always available to answer your questions and we welcome comments regarding our products. Feel free to contact us at any time through our website at www.dynamicsounds-assoc.com or by sending messages directly to info@dynamicsounds-assoc.com. We look forward to your feedback and will gladly respond to all questions and comments.

IMPORTANT INFORMATION

1. All units are set to operate on 120VAC ONLY unless a label is applied to the back panel by the power plugs indicating 240VAC operation. Operating a unit set for 120VAC on 240VAC will cause permanent damage and void the warranty.

2. Dynamic Sounds Associates reserves the right to make changes or modifications to future units without prior announcement. Any such changes or modifications will be for the purposes of improving the mechanical or sonic performance. Dynamic Sounds Associates is under no obligation to incorporate any changes or modifications into prior units; however, it may be possible to provide upgrade packages for prior units—if desired—at a cost.

3. Registering your component with us by using the form at the conclusion of this manual, will allow us to contact you with potential product upgrade information.

Information regarding upgrades may also be requested by e-mail to **info@dynamicsounds-assoc.com.**

1.0 GETTING STARTED

We know you are eager to get your new *Amp I* into play. This section will provide preliminary information on the features of the *Amp I* and familiarize you with the *layout* of the controls and the connectors. **Section 2.0** will guide you through the process of setting up the *Amp I* and making the proper connections. **Section 3.0** will provide additional information on the operation and use of the features of the *Amp I.* **Section 4.0** will provide more detailed information on the overall design and capabilities of the *Amp I* and can be reviewed at your leisure. **Section 5.0** will provide information on how to make adjustments to the *Amp I* to maintain its high degree of performance. The *Amp I* comes pre-adjusted after a burn-in period and, during normal operation, should not require checking and adjusting more than once/year.

NOTE: The *Amp I* uses both natural (convective) and forced (fan) cooling in its design. However, even though ultra-low noise fans are used at a reduced speed, there is some very small amount of residual fan noise. Any attempt to eliminate or further reduce this noise by disconnecting fans or restricting the air flow—either forced or convective—may result in serious damage to the unit. Any such damage is NOT covered by the DSA warranty, and may result in the warranty being voided.

1.1 Unpacking

The *Amp I* should be carefully removed from the packaging material and shipping container.

CAUTION: The Amp I is very heavy (85 lbs.) and assistance may be required in lifting it out of the shipping container. The handles on the back panel can be used to remove the unit from the shipping container and there are two large "lifting handles" mounted on the top of the unit which are designed for lifting the Amp I from its container and getting it into the desired location. These handles may be removed after getting the Amp I into its desired location. (See Section 5.5.)

The following items should also be found in the *Amp I* shipping container:

- Two shielded power cords (one 18 gauge and one 14 gauge)
- #0- 6" long Philips screwdriver
- Plastic bag containing:
    - 1/8" hex key
    - 5/32" hex key
    - Two 10A 5mm x 20mm fuses
    - Four 10-32 button-head 3/8" hex bolts
- Plastic bag containing one set of replacement air filters
    - 1 – 80mm filter
    - 4 – 60mm filters

1.2 Critical Mass Isolators

The Critical Mass Isolators (footers) are pre-installed on the *Amp I* and also provide support for the unit during shipping. Other than ensuring that these are firmly screwed into the bottom of the *Amp I*, no further attention to them is required. Though not recommended, other footers can be used; but, they must be capable of being screwed into the 10-32 holes on the *Amp I* bottom panel **and provide a minimum of 1" clearance between the bottom of the unit and any supporting platform.**

NOTE: The *Amp I* may be turned over to lie on the back panel to check the tightness of the footers and for changing the air filters for the tower fans. (See Section 5.4.) The handles on the back panel will protect the connectors on the back panel from damage; however, ensure that the large speaker connectors are fully screwed in to their closed position before laying the unit on the back panel.

1.3 First Look at the Amp I

After unpacking your *Amp I* and ensuring that all of the parts are provided, you should take a few moments to familiarize yourself with the features on the front and back panels.

1.3.1 Front Panel

The front panel is shown in **Figure 1**. The dominant feature is the full height central column which is divided into two sections:

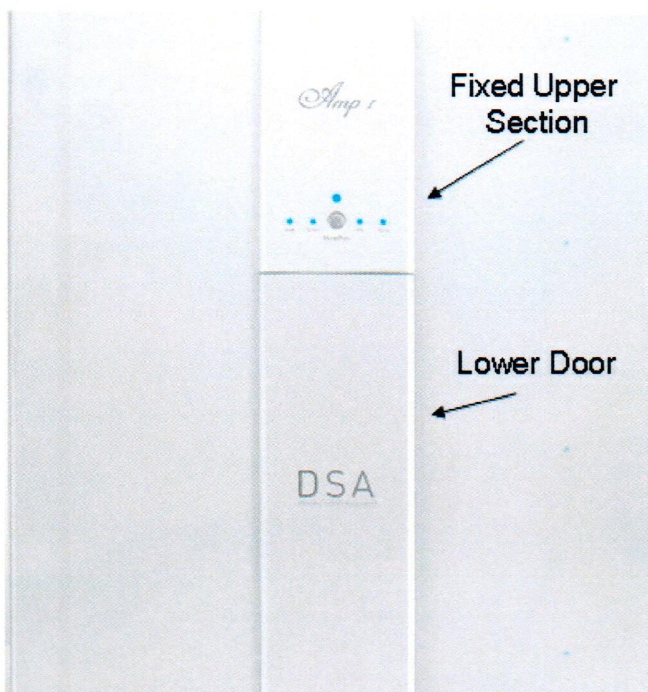

Figure 1 - Front Panel View of *Amp I*

1.3.1.1 The fixed upper section, shown in **Figure 2,** contains:

- Mode selection button that selects the operating mode (Standby or Run)
- Mode select LED that indicates which operating mode is active
- Status LEDs

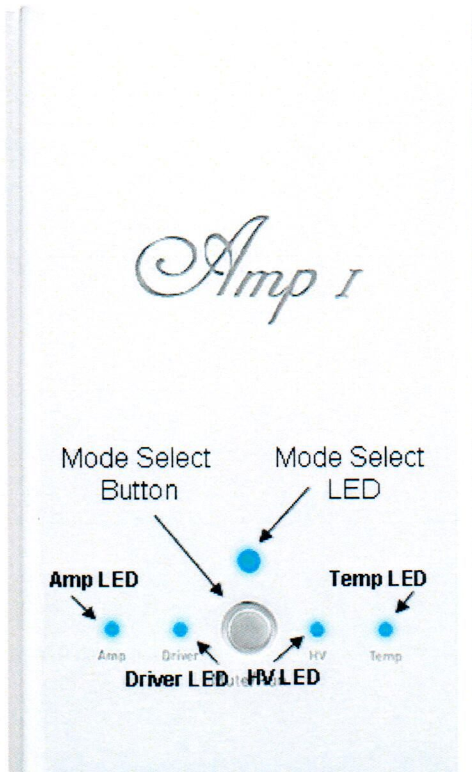

Figure 2 – View of Upper Central Portion of Front Panel

The multi-color status LEDs are used to indicate the status of the *Amp I* as follows: (See Section 3.1.)

- Amp LED – Indicates status of amplifier-stage power supply
- Driver LED – Indicates status of driver-stage power supply
- HV LED – Indicates status of output-stage high voltage power supply
- Temp LED – Indicates temperature of the output-stage heat sinks.

1.3.1.2 The lower section is a door that opens to the left which reveals:

- Button for dimmer control of blue LEDs
- Embedded LCD meter
- Toggle switches for selecting items to be monitored with the LCD meter
- Instruction sheet for using LCD meter

Figure 3 shows these in greater detail. The blue LED dimmer only controls the intensity of

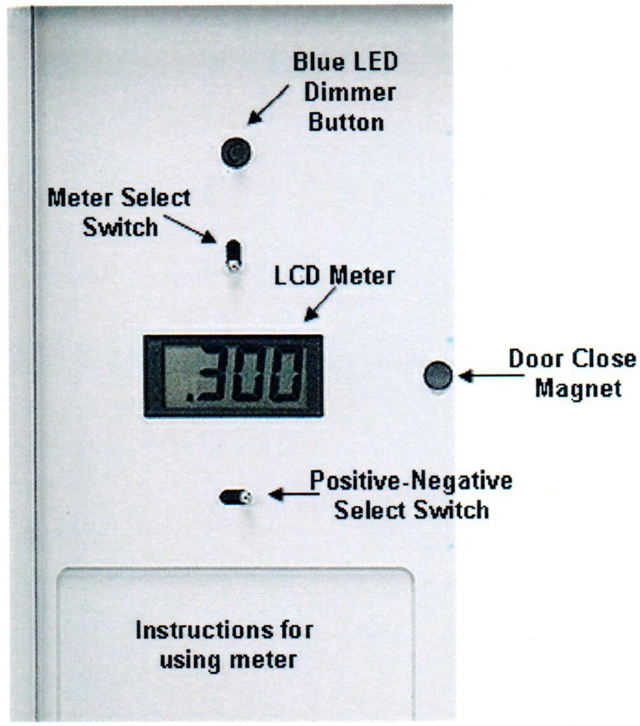

Figure 3 – View Behind Lower Door

the LEDs when they are blue. Any other color will remain at normal intensity. Pressing the **Blue LED Dimmer Button** multiple times dims the blue LEDs in the following sequence:

Full bright → Slight dimming → Reduced intensity → Max dimming → Full bright

The **Meter Select Switch** has three positions which select specific operating values to be displayed on the LCD meter. These are:

- Toggle up -- Output offset voltage (the positive-negative select switch is not used)
- Toggle center -- Output-stage operating voltages
    - In this position the positive-negative select switch displays the negative output-stage voltage (toggle to the left), or positive output-stage voltage (toggle to the right)
- Toggle down -- Output-stage bias current
    - In this position the positive-negative switch operates as above, but displaying bias current on the negative and positive sides of the output-stage.

Instructions for the use of these switches and the LCD meter are mounted below the Positive-Negative switch. See **Section 5.0** for use of the switches and meter for adjustment purposes.

1.3.2 Back Panel

The back panel contains AC power and audio connections. A view of the *Amp I* back panel is shown in **Figure 4**.

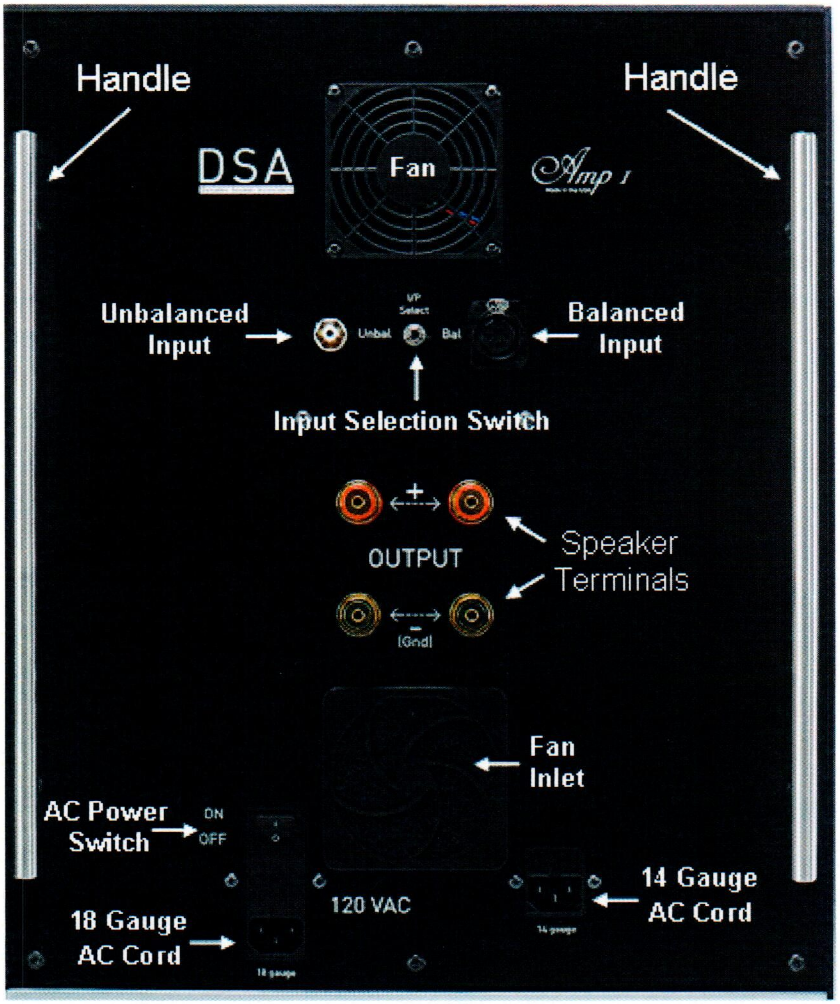

Figure 4 – Back Panel View of *Amp I*

- There are two AC power receptacles, one on the lower left for use with the 18gauge power cable and one on the lower right for the 14gauge power cable.
  - The AC receptacle for the 18gauge (smaller diameter) cable has an integral AC power switch and fuse holder that is located between the power receptacle and the switch. This is the main power On-Off AC switch.

Turning on this switch will provide power for the amplifier and driver sections of the *Amp I*, as well as providing 10VDC for operation of the control functions and the LEDs on the front panel.

- o The 14gauge power cable (larger diameter) only provides AC power for the output-stage DC voltages. If this cable is not connected, the *Amp I* will not provide any output power to the loudspeakers.

NOTE: Both AC receptacles have integral fuse holders. (See section 2.2 for instructions on changing fuses.)

- There are both unbalanced (RCA) and balanced (XLR) audio input connectors on the back panel. Input selection is made using the toggle switch located between the two input connectors. The direction of the toggle indicates which input is selected. Selecting one of the inputs will disable the other.

- There are two sets of loudspeaker connectors to permit bi-wiring of loudspeakers. Both sets of connectors provide identical audio signals. The terminals with the red marking rings are the "signal" connectors and those with the black marking rings are system (signal) ground.

- In addition to the power and audio connectors, there is a cooling fan mounted on the back panel. The fan exhaust is near the top of the panel, and the inlet with filter is below the loudspeaker connectors. This fan provides cooling air for the internal volume of the *Amp I* and operates when the output-stage DC power is on. Removal of the filter for cleaning is discussed in **Section 5.4**.

- There is a pair of long handles mounted on the back panel, as shown. These are for use in moving the *Amp I*, in conjunction with the lifting handles, and also to support the unit when it is necessary to tip it onto its back side. (**See Section 5.4**)

2.0 SETUP AND INSTALLATION

The setup of the *Amp I* consists of three steps:

(1) Placing the *Amp I* in its desired operating location
(2) Connecting the power cables
(3) Selecting the appropriate input and connecting the input cable
(4) Connecting the output connectors to the loudspeaker using high-quality speaker cables.

These steps will be addressed in the following sections.

2.1 Proper Placement of the Amp I

The *Amp I* should be placed on a sturdy platform that will provide adequate support for the unit and permit access to the back panel for cable connections and air flow for the back panel fan. To allow for unrestricted exit air flow for the fans that cool the output-stage internally-mounted heat sinks, a minimum of 12" clearance above the unit is recommended. Clearance at either side of the unit should be a minimum of 6" to permit convection airflow to cool the external heat sinks mounted on the side panels. A minimum of 12" clearance is recommended for the back panel which allows for both cooling air and access to the input and output cables.

NOTE: The Critical Mass Isolators are designed to keep the bottom of the unit 1" above the supporting platform. DO NOT use footers that provide less than 1" of bottom clearance, or place the *Amp I* on carpet, or other soft surface, that will reduce this clearance. Doing so may impede the fan-driven air flow for the output-stage heat sinks and result in serious damage to the unit. Damage resulting from restricted cooling air flow for any of the cooling systems is NOT covered under the DSA Warranty.

2.2 Connecting the Power Cables

There are two different power cables to be used and they should be connected to the appropriate AC receptacle. The *Amp I* output stage uses a power transformer with a high current capacity which is why a 14 gauge power cable is provided. Using the 18 gauge cable in place of the 14 gauge cable may result in reducing the voltage and current capability of the *Amp I* output stage.

NOTE: Fuses can only be changed when the power cord is removed from the AC receptacle. To change fuses, follow these steps:

- 18 gauge AC receptacle: Remove power cord and, using a small flat blade screwdriver, pry out the central "block" between the AC receptacle and the switch. This block has two replacement fuses (1.5A, 5mm x 20mm) contained within. Remove them and replace the fuses held in the two fuse clips. Replace the fuse block by pressing it in firmly until flush with housing (it will only insert in one orientation). Reinsert AC power cord.

- 14 gauge AC receptacle: Remove power cord and, using fingers, squeeze the two clips on either side of the fuse block above the power cord receptacle and pull out the fuse block. Two replacement fuses (10A, 5mm x 20mm) are provided in a plastic bag that comes with the *Amp I.* Replace the old fuses and push the fuse block into position until it "clicks" into place. Reinsert AC power cord.

2.3 Selecting the Input, Gain, and Connecting the Input Cable

Using the back panel toggle switch, select either the unbalanced (RCA) or balanced (XLR) input and connect the appropriate audio cable. The *Amp I* comes set up to provide a constant gain of 25dB, regardless of which input is selected. However, if desired or required, it can be easily changed to provide the additional 6dB of gain available when using the balanced input, thus giving a total gain of 31dB. Making this change will not alter the gain when using the unbalanced connector which will remain at 25dB. (See **Section 5.3** for instructions on making this change.)

NOTE: There is a small blue LED indicator on the amplifier circuit board that illuminates when the balanced input is selected and the gain is 31dB. This can be seen as a blue light inside the chassis and is readily seen through the cooling slots in the *Amp I* top panel. If the LED is not illuminated when the balanced input is selected, the gain is 25dB.

2.4 Connecting the Loudspeaker Cables

High-quality speaker cables should be used to connect these output terminals to their respective loudspeaker terminals. The loudspeaker connectors will accommodate either spade or banana terminations. When using spade terminations, the cables should be entered horizontally from the outside. The large knob should be firmly tightened to secure the speaker cables.

When using banana plug terminations, they are inserted into the central hole on the output connectors. The smaller outer knob on the connectors is then used to tighten the banana plug termination. (There is a small set screw on this knob that can be used to lock it in place.)

3.0 OPERATION OF THE *AMP I*

The *Amp I* has two operational modes, Standby and Run. After turn-on, these are selected by repeatedly pressing the **Mode Select Button** on the front panel. This will cause the modes to cycle as follows:

Standby → Run → Standby → Run → Standby → etc.

3.1 Standby Mode

After connecting the input and output cables and inserting the power cords into the AC receptacles, the *Amp I* can be turned on using the power switch on the 18 gauge AC module on the back panel. Almost immediately, the Amp LED and the Temp LED will turn from red to blue. **(If the Temp LED turns red during operation, the output-stage heat sinks are too hot and the output-stage HV will be turned off.)** Then, after 2-3 seconds, the Driver LED will also go from red to blue. The HV LED will remain red and the Mode Select LED above the front panel button will have an orange color. (Refer to **Figure 2** for LED identification.) The *Amp I* is now in the **Standby Mode**. This is a low power consumption mode, but it keeps the amplifier and driver circuits operational and allows them to temperature stabilize. The *Amp I* may be left in this mode at any time and for long periods of time, if desired, with no harm to the unit.

NOTE: A failure of either the amplifier or driver power supplies to obtain the proper operating voltages will be indicated by their respective LEDs remaining red. If this should occur, the unit will not proceed to the Run Mode. The unit should be turned off and the manufacturer contacted for instructions.

3.2 Run Mode

From the **Standby Mode**, a press of the Mode Select Button will engage the **Run Mode**. The output-stage high voltage power supply will be turned on (relays will be heard to "click") and the fan on the back panel will start. The HV LED will turn blue indicating that high voltage for the output stage is available and the cooling fans for the internally mounted output-stage heat sink towers will start. Once the HV LED has turned blue, and after an approximate 1 sec time delay, the output-stage voltage regulators will be turned on and the output stage will start to conduct bias current. The output-stage regulators take about 5-6 sec to reach full voltage. During the time that the output-stage voltage regulators are charging, the Mode Select LED will turn green. Once the regulators have reached full voltage the Mode Select LED will turn blue indicating that the unit is in the **Run Mode**. If audio signal is applied during the regulator turn-on time, audio signal will began to be heard from the speakers; however, full power will not be available until the Mode Select LED turns blue.

CAUTION: The external heat sinks mounted on the side panels provide cooling for the output-stage positive and negative voltage regulators. In the run mode these will become hot to the touch, which is to be expected. Avoid contacting these heat sinks when hot to prevent possible burns.

NOTE: An internal "latch" circuit is engaged approximately 7 sec after turn-on. After this short interval, a failure in either the amplifier or driver power supplies, or if the output-stage heat sink towers become too hot, the appropriate LEDs will turn red, and the output stage high voltage will be turned off. The latch circuit will prevent the high voltage from turning on again—even if the fault self corrects—without turning the unit off at the power switch and re-starting the unit after a 30-sec delay. In the "latched" condition the Mode Select LED will also turn red as an indication that the latch circuit is engaged.[1] In the event of a "latch up" from an over temperature condition, leaving the unit in the run mode without pressing the Mode

[1] The most likely reason for this to occur will be a lack of adequate cooling air for the output heat sinks, resulting in an over-temperature condition after a period of operation.

Select Button will keep the heat sink cooling fans operating to lower the heat sink temperature more rapidly.

4.0 DESIGN PHILOSOPHY AND IMPLEMENTATION

The solitary goal of the DSA *Amp I* is to provide amplification of the selected source material without compromising the source in any way. To achieve this goal, the *Amp I* is based on a "no-compromise" design using best engineering principles and the finest of components. Designing the *Amp I* to operate as a Class A amplifier[2] was a critical decision in the design. Class A operation was selected for its ability to provide low distortion and maximum control of the loudspeaker drivers throughout the Class A operating regime. The decision to design the *Amp I* to provide a full 125W of Class A power into an 8 Ohm load represented a balance between the need to dissipate the heat generated by the Class A operation, the size of the necessary power transformers, and the amount of power required to drive modern high efficiency loudspeakers.

The *Amp I* does not employ any form of loop or global feedback to achieve the desired throughput gain. Instead, each gain stage of the *Amp I* has internal feedback to ensure that all forms of distortion are held to very low levels, and that each stage has a dynamic range capability that greatly exceeds that of the source material. The absence of loop feedback eliminates transient inter-modulation distortion, which is a common byproduct of configurations where the gain is achieved through the use of intra-stage loop feedback, and it also makes the *Amp I* insensitive to phase shifts caused by the output load.

4.1 Amplifier-stage

The block design of the *Amp I* is shown in **Figure 5**, and as can be seen the amplifier-stage is a fully balanced DC coupled design following the input selection. When using an unbalanced input, the negative side of the balanced input is grounded to prevent it from adding interference, and the throughput gain is a fixed 25dB. The precision 6dB attenuators are based on a "T-pad" constant-impedance design and, when selected, are only active on the positive and negative sides of the balanced input to maintain a total throughput gain of 25dB. (See **Section 5.3** to prevent attenuator operation with balanced input.) The attenuators are bypassed for the unbalanced input.

The gain stages are all FET[3], including the unity gain inverter between the inverted output of the first gain stage and the input of the second gain stage. The purpose of the inverter is to invert the out-of-phase output from the first gain stage and provide drive signals to the second gain stage that are in phase. This is required for proper operation of the push-pull

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[2] Class A operation implies that both positive and negative output devices are conducting current throughout the complete output voltage cycle.

[3] The first stage is a cascoded stage using a low noise dual JFET and MOSFETs. All subsequent stages are MOSFET.

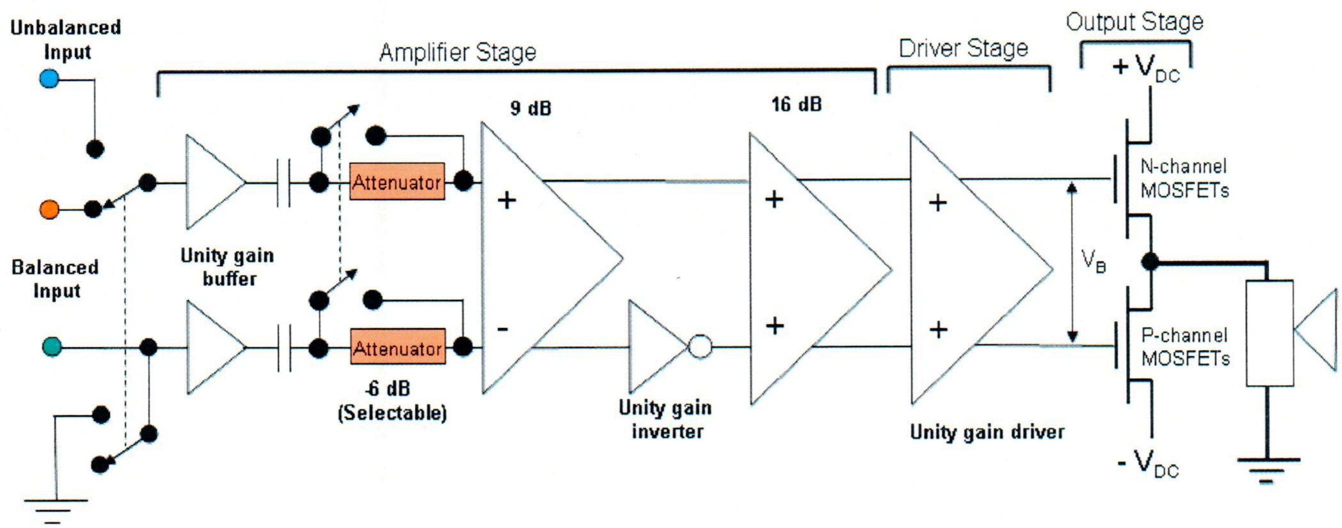

Figure 5 – Block Diagram of *Amp I*

output-stage. The output-stage bias current for Class A operation is set by adjusting the DC difference, V_B, between the two identical outputs from the second gain stage.

4.2 Driver Stage

The purpose of the unity gain driver-stage is to isolate the amplifier stage from the high input capacitance presented by the multiple high power MOSFETs that comprise the output stage. The driver stage uses four power MOSFETs in a dual Class A drive configuration—one pair for each of the output-stage inputs—and is fully capable of driving a very high capacitive load over a wide frequency range. The driver stage is largely responsible for the very wide bandwidth of the *Amp I.*

4.3 Output-stage

The *Amp I* push-pull output-stage consists of eight high power MOSFETs arranged in parallel combinations of four N-channel devices and four P-channel devices. Each of the high power MOSFETs has a 0.1 Ohm source resistor which helps to linearize their operation and compensate for slight differences in the gate-source voltages at the operational bias current levels. The operating bias current is set to provide 125W of Class A operation with an 8 Ohm load. However, the *Amp I* will extend smoothly into Class B[4] operation under heavy load current conditions driving low impedance loads. (See Appendix A.) The measured output impedance of the *Amp I* is 0.2 Ohm at 1 kHz.

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[4] In Class B operation only one of the output devices is conducting current during all, or a portion, of the output voltage cycle. Many audio power amplifiers operate in what as known as Class AB which implies that they are in a Class A regime for low power, but transition to Class B at higher power levels.

4.4 Power Supply

The *Amp I* uses two custom-made shielded toroidal transformers and three power supplies. The transformers each have dual primary windings to permit 120VAC or 240VAC operation, and the individual power supplies are isolated from each other. The low-power transformer operates the amplifier and driver-stage and the high-power transformer is for the output-stage. Following the initial DC rectification and filtering, the amplifier, driver and output-stages each have their own voltage regulators providing highly-stable positive and negative voltages as required. To ensure a low impedance path for the high DC currents involved in the design of a Class A amplifier, the *Amp I* power supply employs a 1/8" thick solid metal ground plane that provides the "system" ground for the amplifier.

4.4.1 Amplifier and Driver-stage Voltage Regulators

The amplifier and driver stages utilize voltage regulators that are designed to maintain constant rail voltages for the amplifier and the driver. The design of both stages is such that they draw a constant current regardless of the signal levels; thus, their regulators can be relatively simple in design. For the amplifier, the regulators are based on a high-voltage version of a standard adjustable regulator package. The regulated voltage rails for the amplifier are set for ±80VDC from an input voltage of ± 90VDC.

The driver regulator is based on a precision zener diode that controls the gate voltage on a power Darlington transistor which performs as a series-pass regulator. There is a separate zener diode-Darlington combination for the positive and negative voltage rails of the driver. The regulated driver rails are set for ±65VDC, from an input voltage of ± 75VDC.

When turned on, both the amplifier and driver regulators reach their design output voltages in approximately 0.5 seconds.

4.4.2 Output-stage Voltage Regulators

The output-stage voltage regulators are of the series-pass regulator type, using high power MOSFETs as the series-pass device. However, due to the high voltage and current required for the output stage, both the positive and negative regulator circuits are designed to have a slow turn-on, and require approximately 5 sec to reach full voltage. This not only reduces the surge currents when turned on, but also greatly reduces the strain on the individual regulator components and extends their operating life. When fully operational, the output-stage regulators provide ± 55VDC at the required bias current from an input voltage of ± 65VDC. The output of each voltage regulator has a 39,000μF/75VDC capacitor to provide the surge current required by peak signals.

The output-stage regulators also incorporate high-current/short-circuit protection.[5] This protection limits the amount of current that can be delivered to the load and protects both the output-stage voltage regulators and the output-stage power MOSFETs. It operates by sampling the amount of DC current drawn by the output-stage power MOSFETs and operates in conjunction with the 39,000μF capacitor on the output of each regulator. When the current demands from the voltage regulators exceed ± 7A, the protection is initiated, but with a time constant that is dependent on the amount of over current and the nature and frequency of the waveform causing the excess current draw. The protection circuits are activated primarily by low frequency signals of high amplitude and provide protection when the *Amp I* is driving loads < 8 Ohms, or when it attempts to drive a short circuit. Driving an 8 Ohm load at full output will not activate the protection circuitry. The good news is that in actual use the *Amp I* will rarely—if ever—have the protection circuit trip.

Note: When the combination of excess current and the time period involved reaches a threshold, the protection circuitry will place the *Amp I* into the Standby mode, after which the Run mode can be activated by pressing the Mode Select Button.

5.0 ADJUSTMENTS, CHANGING GAIN AND MAINTENANCE

The *Amp I* has only two adjustments that may be required to maintain full operational capability. These involve setting the output offset voltage and output-stage bias current. These adjustments are made through the top panel of the unit and their respective locations are shown in **Figure 6**. These adjustments should be made only after the amplifier has been operating in the **Run Mode** for several hours to ensure that all components have reached thermal equilibrium. These adjustments will require use of the 1/8" hex key (supplied) and the 6" long, #0 Philips head screwdriver (supplied).

Note: There are insulated "chimneys" surrounding each of the adjustment controls so there is no danger of touching or damaging any of the electrical components of the *Amp I* while making these adjustments

5.1 Output Offset Adjustment

With reference to **Figure 6** and also **Figure 3,** proceed as follows: (This adjustment should be performed without an input signal.)

- Using the 1/8" hex key, remove the 10-32 button-head screw labeled Output Offset Adjustment.
- Move the toggle of the Meter Adjust Switch behind the front panel door to the "up" position.

[5] There are separate protection circuits for the positive and negative voltage rails to the output-stage. Either one, or both, can detect excess regulator current and cause both output-stage voltage regulators to shutdown together.

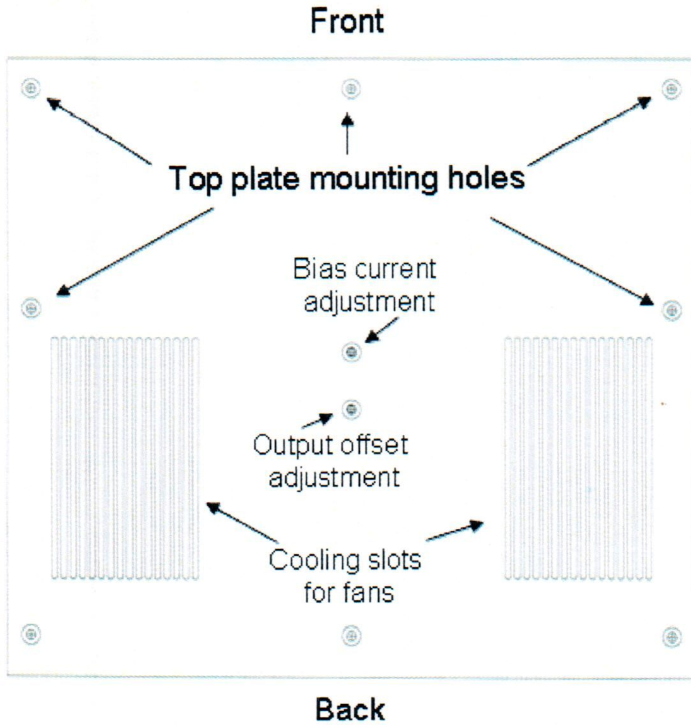

Figure 6 – View of Top Panel

- Note the voltage reading on the LCD front panel meter. (The maximum voltage is ± 1.999 VDC.)
- If the reading shows a voltage greater than ± 0.050 VDC, insert the screwdriver into the adjustment hole and engage the adjustment control. (A slight wiggling of the screwdriver may be required to properly engage the control.)
- Once engaged, rotate the screwdriver to obtain a reading less than ± 0.050 VDC.
- Remove the screwdriver and replace the screw in the adjustment hole.

5.2 Output Bias Current Adjustment

With reference to **Figure 6** and also **Figure 3,** proceed as follows**:** (This adjustment should be performed without an input signal.)

- Using the 1/8" hex key, remove the 10-32 button-head screw labeled Bias Current Adjustment.
- Move the toggle of the Meter Adjust Switch behind the front panel door to the "bottom" position, and move the toggle of the Positive-Negative Select Switch to the "right" (positive) position.
- Note the reading on the LCD meter. The meter is reading the bias current through a 0.1Ohm resistor. Thus, a 3A bias current will show as 0.300 VDC on the meter. (Typically, as the unit warms up, the bias current will drop slightly, so a bias current reading between 0.285 and 0.305 is acceptable.)

- Move the toggle of the Positive-Negative Select Switch to the "left" (negative) position. The reading on the meter should be very close to that measured previously, but negative.
- If the bias current measured in both the positive and negative switch positions is within the range of ± 0.285 to ± 0.305, no adjustment is required. If the voltages are out of this range, insert the screwdriver into the adjustment hole and engage the adjustment control. (A slight wiggling of the screwdriver may be required to properly engage the control.)
- Adjust the bias control until the voltages measured in both positive and negative switch positions are in the range of ± 0.285 to ± 0.305.
- Remove the screwdriver and replace the screw in the adjustment hole.

5.3 Changing Throughput Gain

To increase the gain when using the balanced (XLR) input by 6dB, proceed as follows:

- If access to the top of the unit is restricted, move it to a location where it is possible to see into the top of the unit after removing the top panel. (It may be necessary to re-install the lifting handles, if they were removed, to move the unit to a proper location. See **Section 5.5**.)
- Ensure that the unit is turned off and the power cords are removed from their receptacles. Also, remove any audio cables that restrict moving the unit or access to the inside of the unit.
- Using the supplied 1/8" hex key, remove the eight 10-32 button-head screws around the perimeter of the top panel, as shown in **Figure 6**, and remove the top panel. The amplifier board, shown in **Figure 7**, will now be visible between the two output heat sink towers.
- Referring to **Figure 7**, find the jumper connector located adjacent to one of the large input coupling capacitors.
- Using your fingers, remove the jumper and keep it with the additional amplifier parts in case it is to be re-installed at some future time.
- Replace the top panel and using the 1/8" hex key re-install the eight 10-32 button head screws that hold the top panel in place.
- Reconnect the power cords and any other cables that were removed.

When the gain has been increased by 6dB, the gain can be reduced, if desired, when using the balanced (XLR) connector by re-installing the jumper following the above instructions.

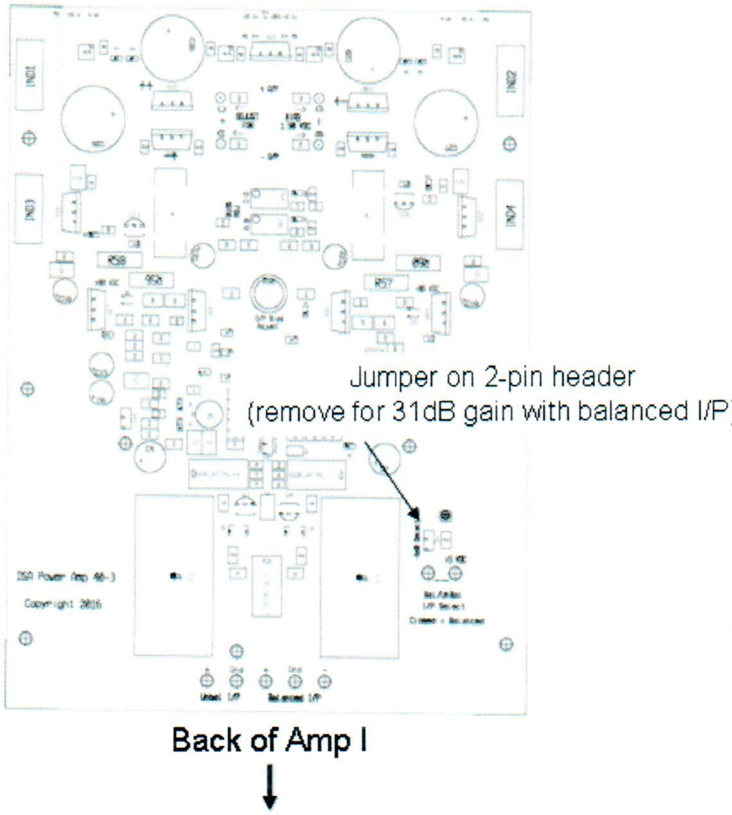

Figure 7 – Amplifier Board with Location of Jumper Connector

5.4 Changing Fan Filters

There are two sets of filters to be cleaned or changed periodically[6]. The process for changing the filters is similar for both sets and requires the use of a small flat-blade screwdriver to pry off the plastic covers that hold the filter elements in place.

5.4.1 Back Panel Filter

The filter for the back panel fan is located in the fan inlet below the output connectors. The plastic cover for the element is easily pried off with a small flat-blade screwdriver. After removing the cover and either cleaning or replacing the filter element, insert the filter element and press the plastic cover over it until it snaps into place.

---

[6] The filters should be checked every 3-4 months or more frequently if the unit is operating in a dusty environment. The filter on the back panel can be used as a guide. When it begins to show a "white" or "fuzzy" appearance, it is probably time to clean or replace the filters.

5.4.2 Heat Sink Filters

There are two filters for each of the two output-stage heat sinks, and these are accessible from the bottom of the unit. The steps to clean or change these filters are:

- Remove the audio cables and power cords from the back of the unit
- Ensure that the speaker connectors are screwed in completely.
- Move the unit to a location where it can be tipped over onto the back panel. (It may be necessary to re-install the lifting handles, if they were removed, to move the unit to a proper location. See **Section 5.5**.)
- Tip the unit onto the back panel—the back panel handles will support the unit and prevent damage to the connectors on the back panel.
- Using a small flat screwdriver, pry off the plastic covers on each of the filters (4).
- After cleaning, or replacing, the filter elements, re-install them and press the filter covers on until they snap into place.
- Return the unit to its original location and re-connect the power and audio cables.

5.4.3 Filter Element Replacement Parts

A complete set of replacement filters is provided with the unit. If additional replacements are required, they can be purchased from various vendors. The part numbers for each filter element are:

- 80 mm Back panel filter (1) -- Qualtek P/N: 09325-M/45 (pack of 5)
- 60 mm Heat sink filter (4) -- Orion fans P/N: M60-45

5.5 Removing or Installing the Lifting-Handles

The lifting-handles can be removed as follows:

- Using the supplied 5/32" hex key, remove the 10-32 socket-head screws that hold the handles onto the top panel.
- After removing the handles, use the supplied 10-32 button-head screws (4) and the supplied 1/8" hex key to screw the button-head screws into the empty holes.
- Save the handles, the 10-32 x3/4" socket-head screws (4) and the 5/32" hex key in case the handles need to be reinstalled at a later date.

To install the lifting handles, follow the above procedure in reverse order, starting with removal of the four 10-32 button-head screws using the 1/8" hex key.

SPECIFICATIONS

Design Topology	Mono-block Power Amplifier	
Gain stages:	Balanced	
Output-stage:	Push-pull	
AC Voltage	120 VAC (240VAC option)	
Fuse Type and Rating	2 x Buss GMC (5x20 mm) 1.5 A 2 x Buss GMC (5x20 mm) 10 A	
Dimensions (with Critical Mass footers)	17" (W) x 14-1/2" (D) x 19" (H)	
Weight	85 lbs	
Connectors		
Input	1- XLR (Balanced), 1- RCA (Unbalanced)	
Output	2-pair binding posts for spade or banana connectors	
Input Impedance (Independent of input)	10k Ohm	
Output Impedance (Measured at 1kHz)	0.2 Ohms	
Total Gain	Unbalanced input: 25dB Balanced input: 25db, 31dB (user selectable)	
Frequency Response (-3dB response)	3Hz – 225kHz	
Output Phase Relative to Input	Non-inverted	
Output Noise (Shorted input)	2mV peak-to-peak (0.7mV RMS) -90dB re 1V RMS input	
Output-stage Compliment	4 x 2SK135 (N-channel MOSFET) or equivalent 4 x 2SJ50 (P-channel MOSFET) or equivalent	
Maximum Output Voltage	100 volts peak-to-peak (35.3V RMS)	
THD @ 1kHz	< 1% at max power output	
Maximum Power Output vs. Load (Ohms) (See Appendix A)	Class A Operation	Class B Operation[7]
4 Ohms	72 W (bias-current limited)	310 W (voltage limited)
8 Ohms	125 W (bias-current limited)	155 W (voltage limited)
16 Ohms	78 W (voltage limited)	N/A

[7] The *Amp I* smoothly transitions to Class B mode as the signal level increases. However, since it is in Class A mode for lower signal levels, there is no cross-over distortion as the signal transitions from positive to negative, or vice-versa.

WARRANTY

All DSA products carry a three (3) year warranty against defects in material, components, and workmanship. This warranty becomes effective on the date of purchase, or the date of shipping, which ever is later. To ensure proper registration of the product, and to validate the warranty, it is necessary to return the warranty registration card below. (This card may be scanned and e-mailed to info@dynamicsounds-assoc.com if preferred.) Under the terms of the warranty, repairs will be made at manufacturer's cost, including return shipping to the user during the warranty period. The user is responsible for shipping costs to the manufacturer for warranty repairs. Charges for unauthorized service and shipping are not covered under this warranty. This warranty is null and void where it is apparent that misuse, accident, neglect, and tampering with or modifications by other than DSA have damaged the product. The warrantor assumes no liability for property damage or any other incidental or consequential damage whatsoever which may result from a failure or misuse of this product.

Prior to returning any product for warranty repairs, or adjustments, it is necessary to obtain a return authorization number (RAN). Products returned without a RAN will be returned without repair. To obtain a RAN, send an e-mail to support@dynamicsounds-assoc.com. Identify the product, the serial number and provide a brief description of the problem with the product. You will receive an RAN by return e-mail message.

DETACH THIS PORTION AND SEND TO DSA TO COMPLETE REGISTRATION

Dynamic Sounds Associates
1754 Persimmon Ct.
Naples, FL 34109

MODEL__________________________ SERIAL No. ________________________

PURCHASE/SHIPPING DATE ____

NAME OF OWNER ____

ADDRESS ____

CITY, STATE, COUNTRY, ZIP _______________________________________

TELEPHONE No. ____

E-MAIL ____

APPENDIX A

DESIGNING FOR CLASS A POWER

A.1 WHY?

The first question to be asked has to be, "Why design a Class A power amp, are you crazy?" When I embarked on this journey this was the typical response that I received from more than one audiophile—and one well respected designer of audio electronics. The cons seemed to be numerous, including:

- "It's a room heater"
- Heavy transformers and heat sinks
- "You'll need high capacity circuit breakers in your listening room"
- "Why bother, Class AB, and now Class D amps[8] are just so much better (lighter, cooler, more efficient, cheaper, etc.)"
- Very inefficient compared to other approaches

There were many more, but they primarily focused on how hard it is to get Class A done right (i.e., keeping it cool, and not blowing up). There were also some who grudgingly admitted that pros for Class A included:

- Low distortion---especially at the zero voltage crossover point
- Great dynamics and high bandwidth were possible
- Linear power supplies instead of switching power supplies
- Reduced EMI

In spite of the negative comments, I was convinced that the pros outweighed the cons and a big, linear, Class A solid-state power amplifier was what I wanted to design and build[9]. I also believe that the performance of the DSA *Amp I* has not only met all of the initial design goals—it has obliterated them! Yes, it runs warm but does not require a dedicated air conditioning system; it has "explosive dynamics" resulting from a bandwidth that exceeds those of typical power amplifiers by almost an order of magnitude. And, it is capable of painting a sound stage that is rock solid, well defined, and without congestion from the lowest levels to ear shattering volumes.[10]

Now that the DSA *Amp I* has been realized, how was the design—primarily of the output stage—realized, and what—if any—were the tradeoffs that had to be considered? It helps

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[8] Class C amps also exist, but they are only used in radio frequency applications where accurate waveform replication is not required.

[9] The focus for all of the DSA designs has been to use solid-state devices instead of vacuum tubes. I prefer the flexibility that solid-state offers, but I choose to use FET devices instead of bi-polar because their operating mechanisms, and characteristics, are very similar to those of vacuum tubes.

[10] Reading some of the latest audiophile magazines, it would seem that high powered Class A amps are making a comeback.

to start with an understanding of how a Class A solid-state power output stage operates since it is the "heart" of the amplifier.

A.2 UNDERSTANDING THE SOLID STATE CLASS A OUTPUT STAGE

For a solid-state power amplifier to operate in the push-pull Class A regime it is required that the output devices never lose bias current. In other words, the "push" and the "pull" devices are always conducting. This ensures that the amplifier is always exerting maximum control over the loudspeaker being driven; but it also implies a low operating efficiency and a large amount of DC power going into heat. A simplified diagram of a solid-state push-pull output stage is shown in **Figure A1**. The drive devices (MOSFETs shown here)[11] have gate-to-source voltages V_{T1} and V_{T2}, with bias currents I_{B1} and I_{B2}, respectively, set by the fixed bias voltage V_B. The loudspeaker presents a particular load resistance (typically a function of frequency) however it has a nominal or specified resistance, R_L, which can be used for analysis purposes. The small resistances[12], R, are used to linearize the changes in bias currents.

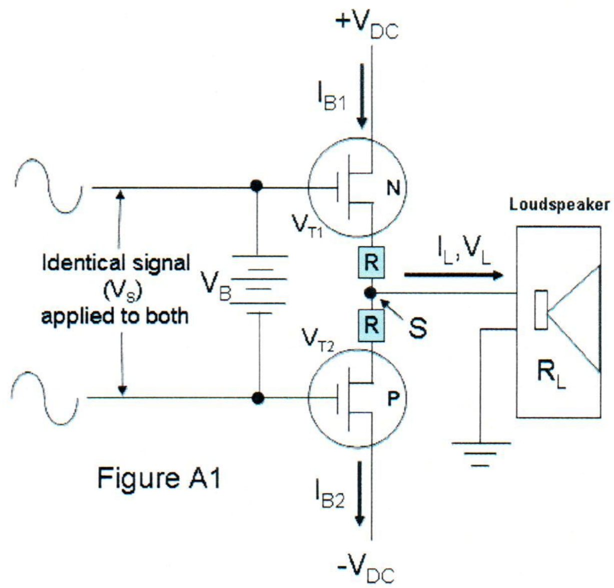

Figure A1

The equations that govern this simple circuit are:

$$I_{B1} - (I_L + I_{B2}) = 0 \quad (1)$$

where the "-" implies that current is leaving the summing junction S. And,

$$V_{T1} + R \bullet I_{B1} + V_{T2} + R \bullet I_{B2} = V_B \quad (2)$$

These can be rewritten as:

$$I_{B1} - I_{B2} = I_L \quad (3)$$

and

$$I_{B1} + I_{B2} = [V_B - (V_{T1} + V_{T2})] / R . \quad (4)$$

In the presence of a signal which changes the currents in the circuit, we have

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[11] The same circuit can also employ bi-polar transistors. Typically multiple paralleled output devices of each polarity will be required to handle the necessary power levels for both FETs and bi-polar devices.
[12] Typically small fractions of an Ohm.

$\Delta I_{B1} - \Delta I_{B2} = \Delta I_L$ (5)

and

$\Delta I_{B1} + \Delta I_{B2} = -(\Delta V_{T1} + \Delta V_{T2})] / R.$

With the reasonable first-order assumption that $\Delta V_{T1} \sim -\Delta V_{T2}$, the latter becomes

$\Delta I_{B1} + \Delta I_{B2} = 0$. (6)

. Combining equations (5) and (6) gives

$2 \bullet \Delta I_{B1} = \Delta I_L = -2 \bullet \Delta I_{B2}$ (7)

The limit for Class A operation is where one of the devices no longer has bias current after which the amplifier goes into Class B operation[13], thus the maximum value of ΔI_{B1} is when I_{B2} =0. (Equally, the maximum value of ΔI_{B2} is when $I_{B1} = 0$.) This bias current, I_{B0}, is the steady-state or "quiescent" bias current. Because the maximum load current for Class A operation is $2 \bullet I_{B0}$, the value of I_{B0} sets the Class A upper power limit for a given load resistance.

A.3 DETERMINING MAXIMUM POWER LEVELS

The power output of an amplifier can be specified in two different ways, and this fact is often used by manufactures to obfuscate the true power levels and whether or not they represent Class A power, Class B power, or some combination of Class A and B, referred to as Class AB.

The two basic (and identical) equations for power level are:

Output power = $(V_{L\text{-}RMS})^2 / R_L$ (8)

Output power = $(I_{L\text{-}RMS})^2 \bullet R_L$ (9)

The notation "RMS" indicates that the values of load current and voltage are "average" values for a continuous sine wave. (The difference between RMS and peak values is $X_{Peak} = X_{RMS} \bullet 2^{1/2}$, where "X" is voltage or current.) For an amplifier to operate in the Class A mode, equation (9) is appropriate since Class A operation implies that the output devices are conducting current throughout the complete voltage cycle and the bias current is the dominant factor. Consider a Class A amplifier operating at 125W into 8 Ohms. From (9) we have

$125 = (I_{L\text{-}RMS})^2 \bullet 8$, or $(I_{L\text{-}RMS})^2 = 15.625$

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[13] In Class B operation only one of the output devices is conducting current. As to which one, it depends on the direction of the instantaneous voltage waveform.

and $I_{L\text{-}RMS} \sim 4A$. However, this is the so called "RMS" value of I_L. To handle the complete waveform in a Class A mode, it is necessary to look at the peak current which is given by

$$I_{L\text{-}peak} = I_{L\text{-}RMS} \bullet 2^{1/2} = I_{L\text{-}RMS} \bullet 1.414 \sim 5.7A.$$

We have shown previously that the load current is twice the bias current I_{B0}, thus the required value of I_{B0} to provide 5.7A of $I_{L\text{-}peak}$ is ~ 2.85A. To provide some margin at the upper power limit, and to allow for some reduction in bias current with increasing output-stage heat sink temperature, the output-stage of the DSA *Amp I* is biased at a nominal 3A. This corresponds to a nominal maximum Class A power level of 144 W.

The DSA *Amp I* can also provide up to 100V of peak-to-peak output voltage[14] which, using (8) results in

$$100 / (2 \bullet 1.414) \sim 35.4\ V_{RMS} \Rightarrow (35.4)^2 / 8 = 156\ W.$$

Thus, any additional amount of power above 125 W – 144 W will be provided in a Class B mode.

These values imply that the DSA *Amp I* is well "balanced" for driving an 8 Ohm load since the power limits for Class A operation and voltage limited operation are reasonably close.

From an efficiency standpoint, the *Amp I* is relatively inefficient as expected of a Class A amp. While the voltage rails for the output stage are regulated at ± 55VDC, the input voltages to the output stage regulators are ± 65VDC; and, it is this latter, higher voltage that has to be considered in calculating the efficiency. The total DC power dissipated in the output stage---including the regulators—is

$$130\ (V) \bullet 3\ (A) = 390\ W.$$

Hence, at 125W of output power, the *Amp I* is operating at an efficiency of only 32%.

A.4 OPERATION AT OTHER LOAD RESISTANCES

Having knowledge of the DSA *Amp I* output bias current and maximum output voltage, we can now determine Class A and Class B power levels given different load resistances.

- **Using a 4 Ohm load**

Before we can use equations (8) and (9) to analyze the operation of the DSA *Amp I,* we need to look at the required peak current into the load at full output voltage, given by:

$$100 / (2 \bullet 4) = 12.5\ A,$$

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[14] This limit is established in the amplifier-stage and not the driver or output-stages.

However, due to the over current protection in the output-stage voltage regulators (See **Section 4.4.2**), the maximum **average** load current that can be provided by the *Amp I* is ~7 A without activating the protection circuit. Using equation (9), we then have

$$7^2 \bullet 4 \sim 200\text{W} \ ,$$

which represents the maximum **average** power the *Amp I* can provide to a 4 Ohm load without exceeding the 7A limit controlled by the protection circuit in the output-stage voltage regulators. Nevertheless, since most music consists of a wide range of signal levels and frequencies, the *Amp I* can actually provide a much greater power level into a 4 Ohm load without triggering the protection circuits. This is largely due to the 39,000μF capacitors that are on the output of the output-stage voltage regulators. These capacitors are a reservoir of charge to support instantaneous current for a few signal cycles to avoid drawing the excess current from the output-stage regulators. The regulators recharge the capacitors between the peaks loads of the output signal.

A detailed simulation was performed of the output-stage and the associated voltage regulators with the protection circuit. This simulation looked at two different **continuous** waveforms[15], a sine wave and a square wave, and at two different output voltage levels as shown in **Table A1**. The purpose was to estimate the time required for the protection

Sine Wave	Square Wave
28 VRMS	78 V p-p
35 VRMS	100 V p-p

Table A1

circuit to trigger a shutdown as a function of frequency and output voltage when driving a 4 Ohm load. The RMS voltages shown have the same peak-to-peak values as their corresponding square wave voltage values. The reason for looking at both types of waveforms was to show the impact of square waves which have a greater charge draw on the 39,000 μF capacitors than sine waves of the same peak-to-peak voltage. The results are shown in **Figure A2**.

From **Figure A2** we can see that for the case of continuous sine wave signals, even at full output voltage (35 VRMS), the protection circuit will only be tripped at frequencies of 30 Hz, or below and the time for the protection circuit to trip is a strong function of the frequency. A continuous 30 Hz full-amplitude sine wave will take about 3.5 sec before it causes the protection circuit to trip.[16] However, at 10 Hz, it will only take about 1.5 sec due to the greater load the lower frequency places on the output-stage regulators and the

[15] The simulation only considered the case of a continuous signal. The majority of listening material does not involve continuous frequencies, but is a mixture of many frequencies simultaneously—a much less stressful situation.

[16] For continuous frequencies greater than the end point of the curves shown in Figure A2, the protection circuit was not tripped.

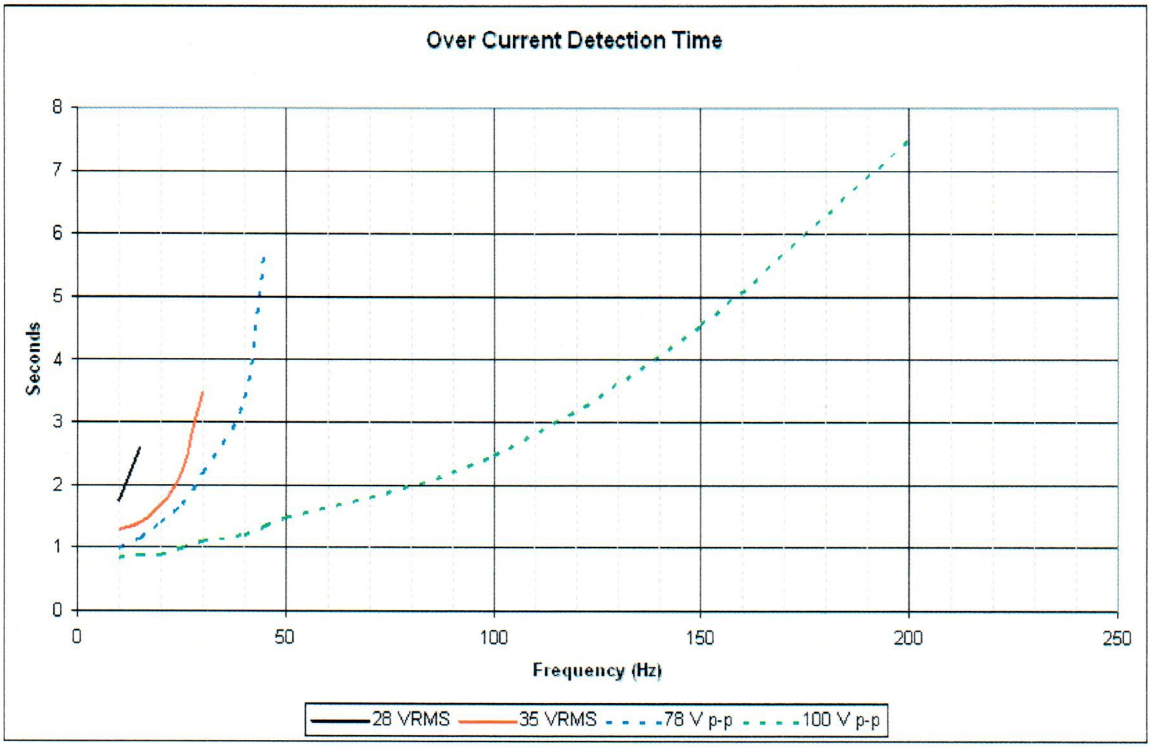

Figure A2

39,000µF capacitors. At 28 VRMS, corresponding to 200W output into 4 Ohms, the impact of the protection circuit is minimal and only occurs at frequencies < 15 Hz.

A continuous square wave is much more stressing in terms of output current draw, as can be seen in **Figure A2**. For a 78 V peak-to-peak square wave (corresponding to 28 VRMS for a sine wave), the protection circuit is tripped for frequencies < 45 Hz, and the time before tripping is highly dependent on the frequency. For square waves > 45 Hz, there was no impact on the protection circuit. When considering a full amplitude square wave the impact is even greater. The protection circuit will trip at frequencies up to 200 Hz; and, at lower frequencies the protection circuit will trip within a few seconds as the current drain on the output-stage voltage regulators becomes excessive. The good news is that these results represent extreme cases and in actual use the *Amp I* will rarely—if ever—have the protection circuit trip during routine operation.

Since we have seen that most sine wave frequencies have little impact on the *Amp I*, we can use equation (8) to determine the maximum power, based on a sine wave with 100 volts peak-to-peak output voltage (35.4 VRMS). This gives

$$(35.4)^2 / 4 = 310 \text{ W}$$

as the maximum output power into a 4 Ohm load. However, using the DSA *Amp I* bias current values with equation (9), and a 4 Ohm load, we have

$$[(2 \bullet 3\text{A})/1.414]^2 \bullet 4 = 72 \text{ W}$$

which represents the Class A output power limit into a 4 Ohm load. Thus, the DSA *Amp I* will switch to Class B operation for output powers greater than 72 W up to its maximum voltage limited power level of 310W into a 4 Ohm load in most cases.[17]

- **Using a 16 Ohm load**

As before, we need to look at the peak current that can be driven into the load, given by:

$$100 / (2 \bullet 16) = 3.125 \text{ A}$$

which corresponds to a required bias current of 1.56 A. Since this is less than the bias current of 3 A used in the *Amp I*, the *Amp I* will **always** drive a 16 Ohm load in Class A operation. And, since the peak current is not sufficient to force voltage limiting by the output-stage voltage regulators, the maximum *Amp I* power level is determined solely by the amount of peak voltage available when driving a 16 Ohm load. For this determination we only need equation (8) that gives

$$(35.4)^2 / 16 = 78 \text{ W},$$

which represents the *Amp I* **voltage limited** power into a 16 Ohm load.

A.5 QUO VADIS?

Where do we go from here? What is next, and what is possible? We believe that the basic *Amp I* architecture can be readily expanded to power amplifiers having 200-500W of Class A power. The major challenge in this expansion is the cooling of the output stage. Since the *Amp I* is, and will remain, a mono-block design there exists plenty of room for heat sink expansion to handle the additional power requirements. The use of ultra-low noise fans will continue to be a design feature since it greatly enhances the cooling ability of the heat sinks. Custom made transformers to provide the necessary output stage voltages and currents are readily available. And the high power MOSFETs used in the *Amp I* can be found through several suppliers. The rail voltages for the amplifier and driver stages will need to be increased, but this is also a relatively simple task. The basic designs are not stressed in their current configurations and will easily support higher voltages. The only real question to be answered is how much power is sufficient? There must come a point where power amplifiers in the >1kW (or > 1 HP[18]) category are not required for high quality audio reproduction, but instead are satisfying some basic need based on a "more is better" philosophy without any real audio purpose. In all but the most extreme examples, power amplifiers in the 200-500 W realm should be more than adequate.

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[17] This represents an example of Class AB operation. The amplifier supports Class A operation to some power level and then transitions smoothly into Class B operation for the peak signal levels.

[18] Horsepower. 1 HP = 746 W