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Technical Bulletin

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Models:	CA / CV Series			**Applicable Serial #:**	ALL
Status:	INFORMATIVE			**Recipients:**	ALL

CA / CV Series Module Replacement

Models affected: **CV2500, CV4250, CV8125, CA2250, CA2500, CA4250, CA6160, CA8125**

Explanation: **Procedure for diagnosing and replacing Amplifier and PSU modules**

Revision history:

V1.0
Initial Revision

Introduction

This technical bulletin explains the procedure for diagnosing a fault with an amplifier channel module or PSU, in both the CV and CA series amplifiers. It is recommended to read the information in this introductory section before attempting diagnosis of fault conditions, because it provides key background information as to why certain faults present in certain ways.

Both series of amplifiers utilise the same PSU and amplifier modules, and integrate them in a similar way. With the exception of the CA2250, all models utilise 2 PSU modules, and therefore feature two separate groups of channels, referred to as the "odd" (1, 3, 5, 7) and "even" (2, 4, 6, 8) channel groups. The CA2250 model is unique, in that it features a single PSU module, and therefore a single unified group of odd and even channels.

Due to the way in which the amplifier modules in the odd and even channel groupings share a PSU, if the amplifier control logic determines that it is necessary to "wake" one or more of the amplifier channels on a PSU, all of the amplifier channels on that PSU must be simultaneously brought out of standby and given power. This is a fundamental requirement of the CA and CV design, and has consequences for the behaviour of the amplifier under different types of fault condition.

The amplifier fault conditions can be categorised into two separate types:

- Fault conditions affecting a single channel in isolation, without requiring additional intervention from a PSU module.

  Typically, these are transient and recoverable, e.g. over-temperature, a speaker load which is too high for the channel, or a short-circuit on the speaker line. Self-recovery will usually occur as soon as the module has cooled, the load is corrected, or the short-circuit is removed. No further action is typically necessary for this kind of fault.

  Fault conditions which do not require intervention from a PSU module, will only illuminate the "protect" LED for the amplifier channel that has the fault, allowing for easy identification of the primary issue.

  It is also possible for a single amplifier module to fail in a way which is permanent and non-recoverable. This requires the replacement of the specific amplifier module identified by the channel protect LED.

- Fault conditions which affect an entire channel group (odd or even), or all channels in the case of a CA2250, due to intervention from the PSU, or because the fault condition is originating in the PSU itself.

  It is possible for a PSU to be thermally overloaded, for example, in a power-sharing scenario, where multiple channels on the same PSU are delivering a total speaker load of more than 500W, and this would lead to the temporary shutdown of the PSU.

  Shutting down the PSU will lead to the shutdown of all of the amplifier modules on that PSU, due to the loss of the high voltage rails. Multiple channel protect LEDs would illuminate to indicate this. However, this type of shutdown would be temporary, and the PSU would quickly recover and re-instate all of its amplifier channels to normal operation. No further action should be necessary, beyond the review of the total speaker wattage loading for that PSU, for example.

  A DC protect condition on one or more amplifier channels, will always require the intervention of the PSU for those channels, because it requires the high-voltage DC supply rails to be turned off, to prevent possible damage to the connected speakers. If the high-voltage supply rails are turned off, then all amplifier modules connected to that PSU, will also go into protect, and will therefore illuminate their "protect" LEDs. DC protect conditions will never self-recover, and external AC mains power must be removed, via disconnection of the mains cable, or other external power switching mechanism. The front-panel "soft" power switch will not clear this type of condition. A DC protect condition in a particular amplifier module, will generally require the replacement of that module, as it usually indicates failure of the output stage. As all protect LEDs will be illuminated, it may not be obvious which module has failed. This will require a process of elimination to identify the failed module.

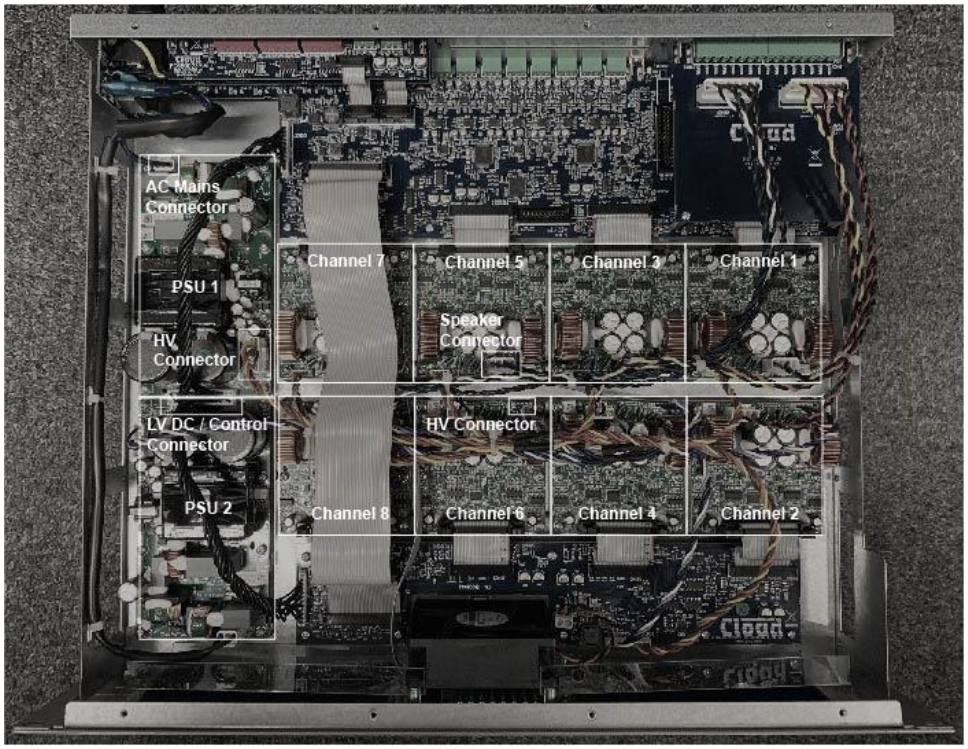
The remainder of this technical bulletin, describes the equipment and procedures necessary to safely identify and replace, faulty PSUs and amplifier modules.

Equipment required

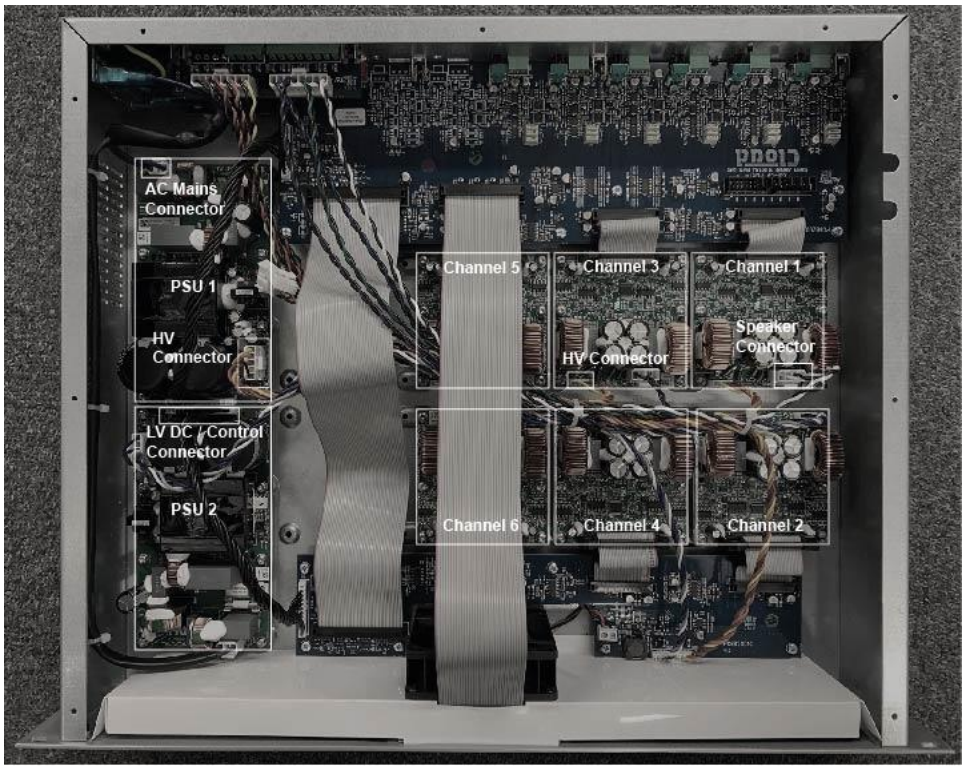
- PH0 screwdriver (CV Series chassis screws only)
- PZ1 screwdriver (CA Series chassis screws and amplifier / PSU module M3 machine screws)
- Digital multi-meter, set to DC volts, with a selected range suitable for reading up-to 100v DC.
- 1Kohm, 2W power resistor, with exposed connections sheathed, and connected to a pair of insulated-body probes (e.g. multi-meter type probes) which can be used to selectively discharge power supply rails. E.g.

Amplifier layouts

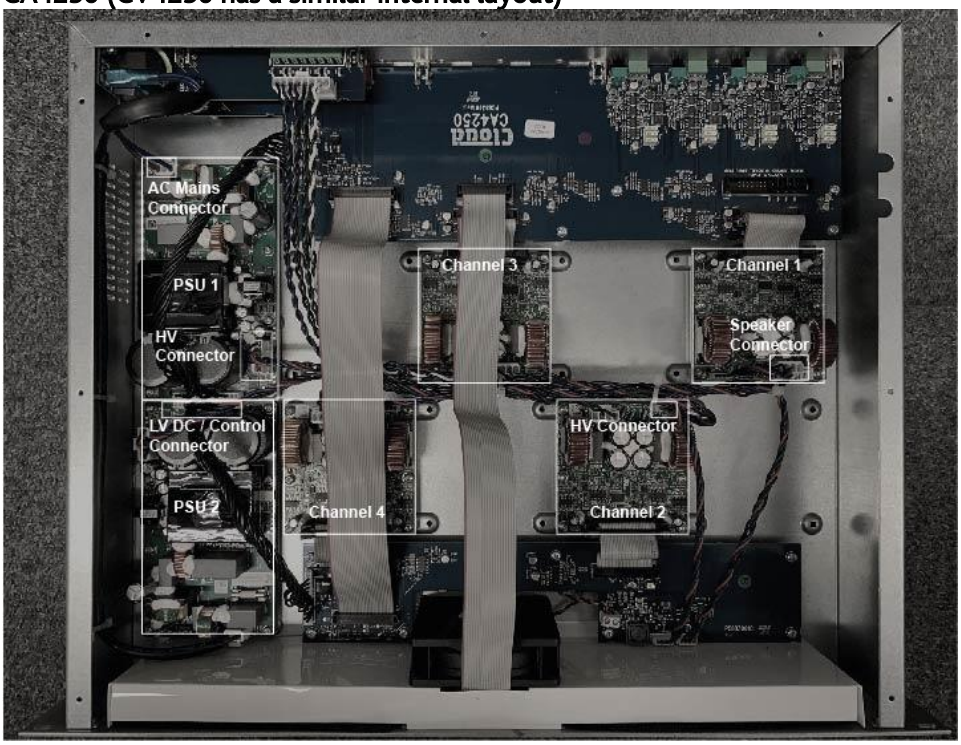
CV8125 (CA8125 has a similar internal layout)



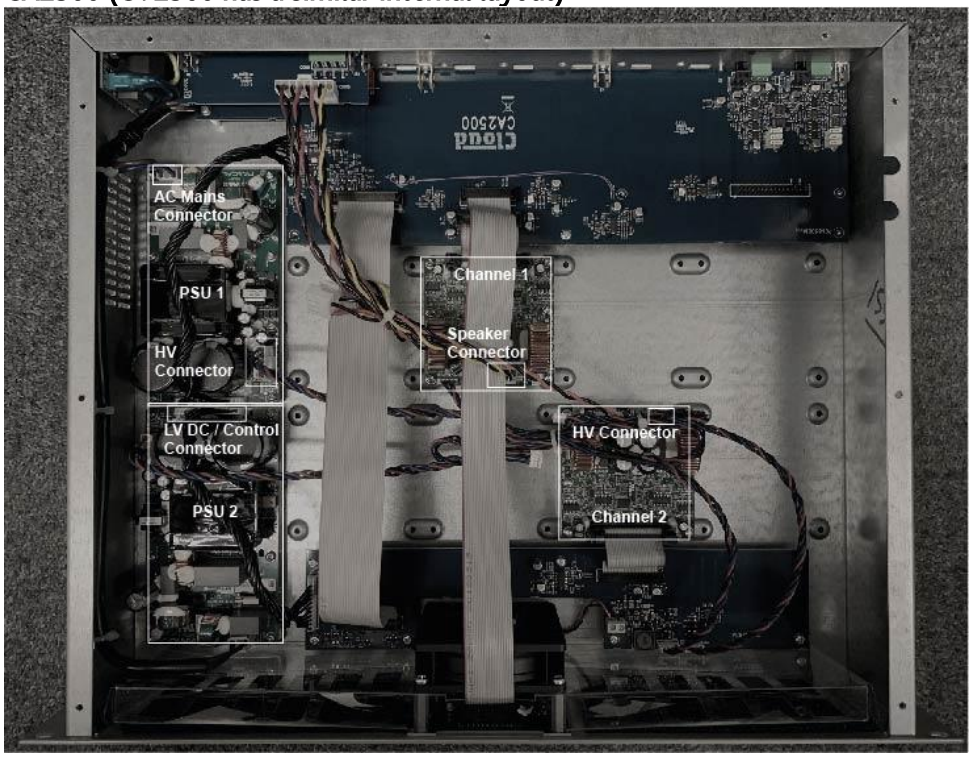
CA6160



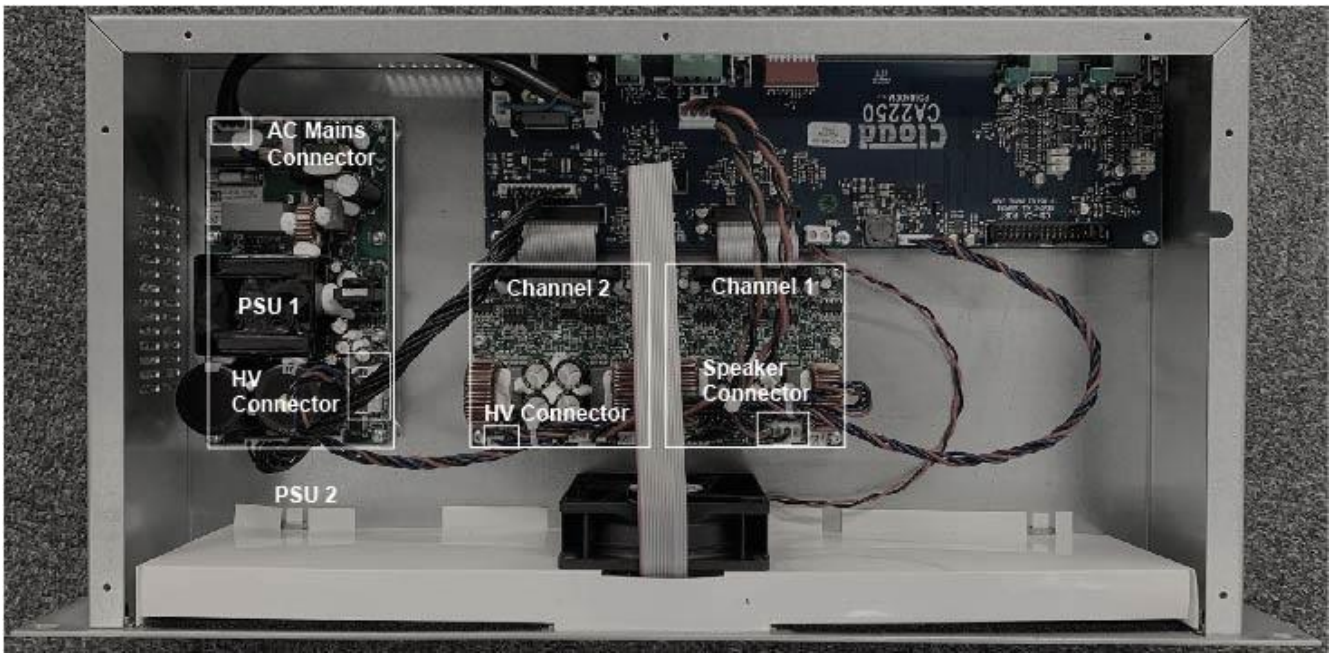
CA4250 (CV4250 has a similar internal layout)



CA2500 (CV2500 has a similar internal layout)



CA2250

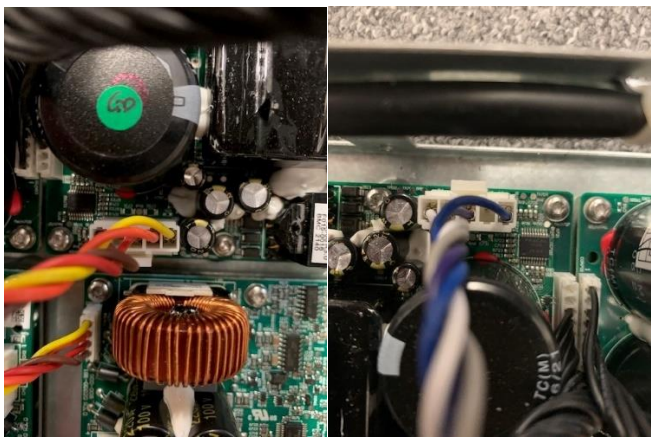


General PSU discharge procedure

Observe the following discharge procedure in all cases, after each time AC mains power has been re-applied and removed from the amplifier. Failure to follow this procedure before disconnecting or reconnecting cables to the PSU or amplifier modules, will cause irreparable damage:

1. Turn the amplifier off, and remove the AC mains supply. Wait 30s.
2. Discharge the power supply PSU1 (CA2250) or power supplies PSU1 and PSU2 (all other models) using the following procedure:

    2.1. Locate the larger, white, 4-pin high-voltage DC power connection on the PSU, as shown in the following image. This will be used in conjunction with the resistor / probe tool to bridge the PSU rails and discharge them, individually.



PSU1 **PSU2**

2.2. For PSU1, short the brown wire (+70v) to the red wire (0v) by poking the tips of the probes into the open top of the connector housing, ensuring the probe tips touch the crimp bodies. Hold for 10 seconds, to allow the PSU rail to discharge to 0v through the power resistor.

2.3. Repeat for the orange (-70v) and red (0v) wires, and the yellow (Vdrive) and red (0v) wires.

2.4. For PSU2, the process is the same, but the sequence is as follows. Place the probes on: blue & purple, grey & purple and white & purple.

Note: Earlier production models of the CV amplifiers, featured the same wire colours for both PSU high-voltage connections. For these units, repeat the colour sequence used for PSU2 for PSU1.

3. Use a multi-meter and confirm that the voltage has been discharged from the power supplies.

3.1. For PSU1, measure inside the connector housing as before, probing between brown and red, orange and red, and yellow and red, and check that there is close to 0v between these pairs of wires.

3.2. For PSU2, repeat the measuring process, for the blue & purple, grey and purple and white & purple pairs.

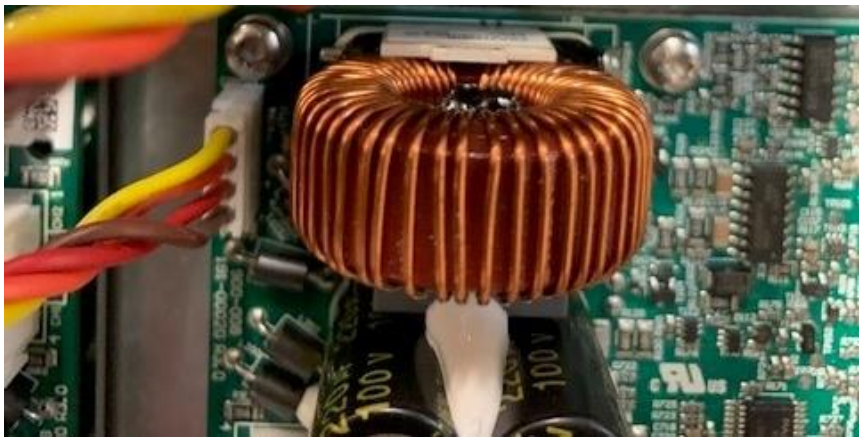
3.3. If there is any residual voltage present above approximately 2v, then use the resistor and probes to attempt to discharge the problematic supply rails for a further 10 seconds.

3.4. Repeat the sub-steps of step 3 to confirm that the supply rails are now discharged.

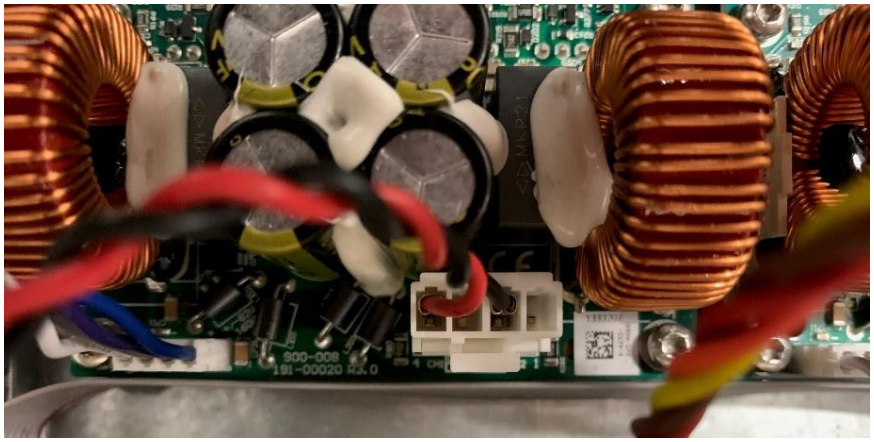
Procedure for removing and replacing an amplifier module

Observe the following procedure for disconnecting an amplifier module from the amplifier, prior to replacement, or during diagnostics:

1. Remove the small 4-pin power connector from the amplifier module which is being replaced. This should pull out vertically with a small amount of pulling force applied to the cable just above the plug. The connector is shown below, to the left of the picture.



2. Remove the larger, 4-pin speaker cable from the amplifier module which is being replaced. Squeeze the connector to compress and open the clip, and then pull upwards on the connector body to disconnect it.



3. Remove the 26w ribbon cable from the amplifier module which is being replaced. Push outwards on the vertical clips at each side of the connector, and this will automatically eject the ribbon cable header.

4. At this stage, the module is now electrically isolated from the rest of the circuitry, and can be removed by turning the amplifier upside-down, and unscrewing the 4 M3 machine screws which go through the chassis base and into the module. The module will then simply drop out, with its aluminium baseplate intact.

   Note: do not remove the Torx screws from the top side of the modules, as this will separate the module from its baseplate, and is not the correct way to remove the module from the chassis.

The procedure for replacing and re-connecting an amplifier module, is the reverse of this process:

1. Ensure the PSU rails are fully discharged, using the above discharge procedure.
2. Screw the module into the chassis using 4off M3 machine screws.
3. Connect the 26w ribbon cable from the front or rear main PCBs to the module.
4. Connect the speaker output cable to the amplifier module.
5. Finally, connect the small, 4-pin JST connector which provides the high-voltage DC supplies to the amplifier module.

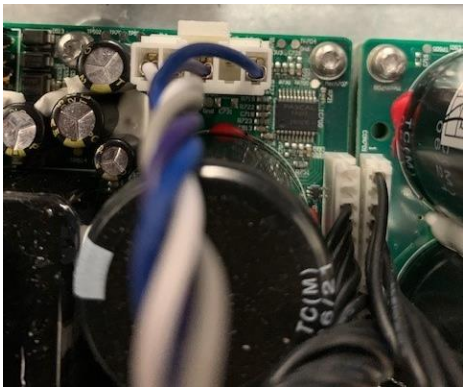
Procedure for removing and replacing a PSU module

Observe the following procedure for removing a PSU module from the amplifier, prior to replacement, or during diagnostics:

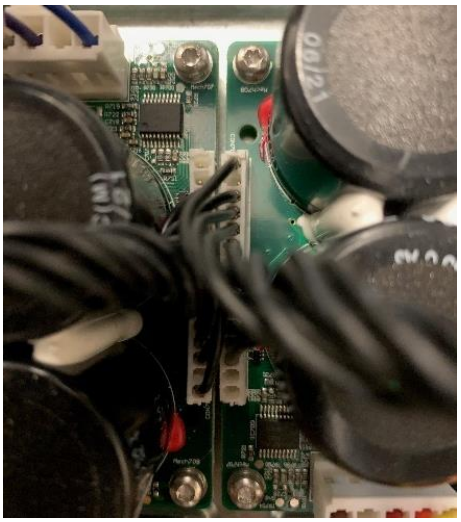
1. Ensure the PSU rails are fully discharged, using the above discharge procedure.

2. Remove the 3-pin AC mains connector from the input of the PSU. Squeeze the connector to compress and open the clip, and then pull upwards on the connector body to disconnect it.

3. Remove the 4-pin high-voltage DC supply connector from the PSU. Squeeze the connector to compress and open the clip, and then pull upwards on the connector body to disconnect it.



4. Remove the 15-pin low-voltage DC supply and control connector from the PSU. This can be removed by pulling gently on the black cables at either side of the connector body, to lift it vertically out of the socket.



5. At this stage, the PSU module is electrically isolated from the rest of the amplifier circuitry and can be removed, by turning the amplifier upside-down, and unscrewing the 4 M3 machine screws which go through the chassis base and into the PSU. The PSU will then simply drop out, with its aluminium baseplate intact.

   Note: do not remove the Torx screws from the top side of the PSU, as this will separate the PSU from its baseplate, and is not the correct way to remove the it from the chassis. The replacement PSU will be supplied with its own baseplate pre-fitted.

The procedure for replacing and re-connecting a PSU module, is the reverse of this process:

1. Screw the PSU into the chassis, using the 4off M3 machine screws.
2. Connect the 15-pin, low-voltage DC supply and control connector.
3. Connect the 4 pin, high-voltage DC supply connector.
4. Connect the 3 pin, AC mains input connector.

Procedure for Diagnosis and Replacement

1. Prior to making a diagnosis, make a note of which protect LEDs are illuminated, and then remove mains power from the amplifier. Leave the amplifier to stand for a minute to let the power supplies discharge as much as possible.
2. Disconnect all speaker loads from the rear connections of the amplifier, making a note of which connection is for which amplifier, so that the speakers can be correctly re-instated later.
3. The amplifier chassis lid should be removed, and a visual check made that all cable loom connectors are securely seated in their respective sockets and are making proper connection. These are:

   3.1. **CA2250:**

      3.1.1. **1off** multi-conductor, black, cable loom from PSU1 to the main PCB

      3.1.2. **1off** multi-tapped, high-voltage power cable from PSU1 and feeding each amplifier module, as well as feeding the high-voltage fan circuit on the main PCB

      3.1.3. **1off** speaker output cable loom

   3.2. **All other models:**

      3.2.1. **2off** multi-conductor, black, cable loom from PSU1 and PSU2 to the rear and front main PCBs, respectively.

      3.2.2. **2off** multi-tapped, high-voltage power cable from PSU1 to the odd numbered amplifier modules (1, 3, 5, 7) and from PSU2 to the even-numbered amplifier modules (2, 4, 6, 8). Both of these also feed the high-voltage fan circuit on the front PCB. Note that on amplifiers featuring fewer than 8 channels, some of the taps on this high-voltage cable may be tied-off as they are not required.

      3.2.3. **2off** speaker output cable loom, connecting the amplifier modules to the rear-panel speaker output PCB.

4. A visual inspection should be made at this point, looking for evidence of bulging, domed, or burst capacitors, or other obvious signs of failure, on the amplifier channel modules and PSUs. **Do not touch the**

exposed metal tops of any of the capacitors, or any other PSU or amplifier module circuitry, as there may be residual high-voltages present. Any suspect capacitors can at this stage, however, be safely marked on the top, using a plastic-bodied, Sharpie pen, or similar.

5. **Using extreme caution**, with the chassis lid still removed, reconnect the power, and ensure the amplifier is switched on via the front panel. The temporary removal of mains power and associated prolonged shutdown time, may have cleared some of the fault conditions, ie. any thermal or load-related protect states.

6. Apply input signals as appropriate to "wake" the amplifier channels from APD standby, so that they receive their high-voltage power, and their channel protect status can be properly displayed on the front panel LEDs.

7. Determine which protect LEDs are now illuminated:

   7.1. A single Channel in the "odd" or "even" channel group, or (excluding CA2250) a channel from each group

   The issue concerns the amplifier module for the amplifier channel which has the protect LED illuminated. **This amplifier module should be replaced.**

   Excluding CA2250, this scenario is also relevant to situations where there is more than one channel from the "odd" or "even" group in protect, but where not all of the channel protect LEDs in that group are illuminated. **All modules showing protect should be replaced.**

   7.2. All channels in an odd (1, 3, 5, 7) or even (2, 4, 6, 8) channel group, or both channels in a CA2250 model.

   The issue is likely a critical failure (e.g. DC protect failure, or short-circuit) of a single amplifier module for one of the channels on PSU1 (odd channels in protect, or the amplifier is a CA2250) or PSU2 (even channels in protect) and a process of elimination will be required to determine which module is causing the condition.

   Or, the issue may be due to an overloading or failure of the PSU1 or PSU2 modules, as determined by whether the odd, or even channels are in protect. The CA2250, which only features PSU1, will show both channels in protect if the PSU is overloaded. In this scenario, it is reasonable to start by assuming a faulty amplifier module before considering a faulty PSU, unless the amplifier as a whole has been exhibiting other abnormal operational behaviour alongside the channel protect condition.

   7.3. All odd and even channels (not CA2250)

   As 7.2, above, but there is a failure of a channel module on each PSU, or an overloading of both PSU1 and PSU2.

8. Where the presentation of protect LEDs at this stage, differs from that which was noted in step 1 above, it may be necessary to later check the connected speaker wattage loadings of the other channels originally in protect, as well as testing the speaker cabling for short-circuits. Protect conditions that have cleared after the removal and restoration of the AC mains power supply, are not generally associated with actual module failure.

9. Where some, but not all, amplifier modules on a given PSU have been identified as still being in protect, then these modules should be replaced.

   9.1. Follow the general PSU discharge procedure, described below, to ensure that the amplifier power supplies are fully discharged.

   9.2. Follow the procedure for removing an amplifier module, described below, to disconnect each of the amplifier modules that are in protect.

9.3. Replace the amplifier modules that have been removed, with new modules, following the procedure to replace amplifier modules.

10. Where all channels on a particular PSU (or both PSUs) are in protect (all "odd" channels, all "even" channels, or all channels) then it is necessary to narrow-down the fault to the specific modules causing the issue, as well as ruling out an issue with the relevant PSU. This is a process of elimination, and is most easily performed as follows:

10.1. Follow the general PSU discharge procedure, to ensure that the amplifier power supplies are fully discharged.

10.2. Follow the procedure for removing an amplifier module, to disconnect all of the amplifier modules connected to PSU1 ("odd" channels, or both channels in a CA2250) or PSU2 ("even" channels, not present on a CA2250). Make a note of which branches of the wiring looms are connected to which modules, so they can be reconnected later. There is no need to physically remove the amplifier modules from the chassis, at this stage.

10.3. Carefully re-connect the AC mains cable and power on the amplifier from the front panel.

10.4. Apply signal to "wake" all of the channels from APD sleep.

10.5. Observe whether the protect LEDs are still illuminated for the amplifier modules that have been disconnected.

If they are all still illuminated, then this points to a potential issue with the PSU module – follow the general discharge procedure a second time, and then remove and replace the PSU module at this stage. Then continue with these steps.

If the protect LEDs for the disconnected channels, are no-longer illuminated, then one or more of the amplifier modules have a fault and will require replacement. To determine which of the modules is at fault:

10.5.1. Follow the general discharge procedure, to make the amplifier safe and prevent damage to the modules

10.5.2. Reconnect a single amplifier module. At this stage, pay particular attention to any modules which were found to have domed or bulging capacitors in the initial checks – it is reasonable to eliminate these modules as early as possible in the testing process.

10.5.3. Carefully re-connect the AC mains cable and power-on the amplifier via the front panel.

10.5.4. Apply signal to "wake" all of the channels from APD sleep.

10.5.5. Check whether the relevant protect LED is now illuminated

If **YES** – this module is faulty and should be replaced. Follow the general discharge procedure, and then disconnect, remove and replace the module.

If **NO** – this module is OK, and can be left in circuit. Repeat the above steps, from 10.5.1 onwards, to introduce the existing modules back into the amplifier, until all problematic modules have been replaced and all working modules have been re-introduced.

Note: It is critically important to repeat the discharge procedure before connecting or disconnecting any cables inside the amplifier. Irreparable damage may result if this procedure is not correctly followed.

10.6. Repeat the sub-steps for step 10 for the other PSU in the amplifier, if all the channels for that PSU are showing a protect indication.

11. The amplifier should now be in a fully-operational state.
    11.1. Carefully re-connect the AC mains cable and power on the amplifier from the front panel.
    11.2. Apply signal to “wake” all of the channels from APD sleep.