F1 Model 812

Flexible Array Loudspeaker

F1 Subwoofer

Training for Electronics Repair and Servicing

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July 25, 2015

Agenda

- Scope
- Functional Overview
  - Product Overview
  - Disassembly Procedures
  - Boards
  - Cable Layout
  - Power Flow
  - Audio Flow
- Troubleshooting

Scope

- This training to include:
  - Functional technical overview
  - Disassembly
  - Troubleshooting
- Additional documentation not covered here:
  - Schematics
  - Latest Owner's manual

System Overview

F1 System Basics

F1 Model 812

8 Twiddler Array
12 Inch Woofer

Built-in Stand

Included with Subwoofer

F1 Subwoofer

Two 10 Inch Woofers

Product Features

F1 Model 812 Powered Loudspeaker System

- **Flexible Array:** Direct sound where it is needed
- **Vertical Array:** Delivers Wide Consistent Sound Coverage
- **Woofer Behind Array:** Efficient use of product size
- **No Fan:** Longer Product Life
- **Built In Stand with Subwoofer:** Convenient mounting
- **Pole Mount Bracket:** May be pole mounted

Technical Features: Power Supply and Amplifier

- **PFC** (Power Factor Correction): Universal AC Power
- **LLC Power Supply**: Regulated +/-64V Power Rails
- **Class-D Amplifier:** Output Current Protection
- **Cooling**: Woofer Port Airflow across Heatsinks
- **Thermal Protection**

F1 Features

Carton Contents

Each loudspeaker is packaged separately with the items indicated below.

F1 Model 812 Flexible Array Loudspeaker

F1 Model 812 Loudspeaker

AC power cord*

Owner's Guide

F1 Subwoofer

F1 Subwoofer with built-in stand

AC power cord*

Owner's Guide

The appropriate power cord(s) for your region is included.

F1 Features

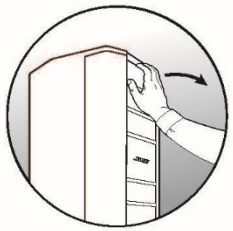
Using the Flexible Array

You can shape the coverage pattern by moving the position of the top and bottom array. The array position is held in place by magnets that trigger internal sensors that adjust EQ according to array shape.

Adjusting the array

Pushing the array in

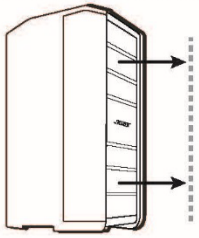
Pulling the array out



Four coverage patterns

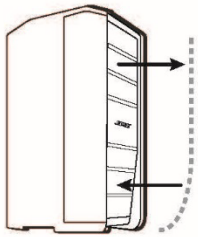
Straight pattern

Pull top and bottom array out



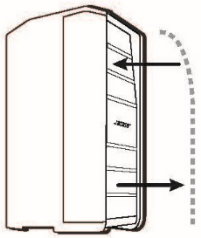
J pattern

Pull top array out, push bottom array in.



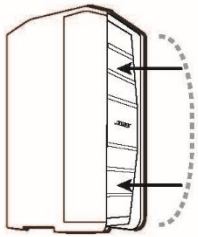
Reverse-J pattern

Push top array in, pull bottom array out.



C pattern

Push top and bottom array in.

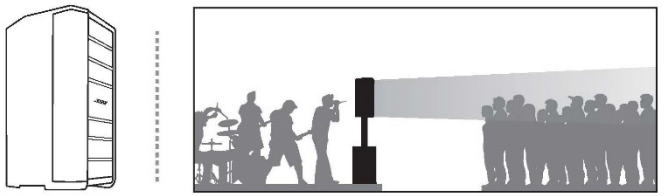


F1 Features

Applications

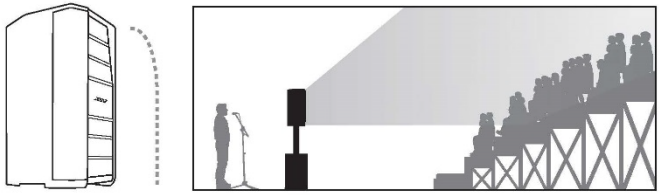
Straight pattern

Use the straight pattern when the audience is standing and their heads are approximately at the same height as the loudspeaker.



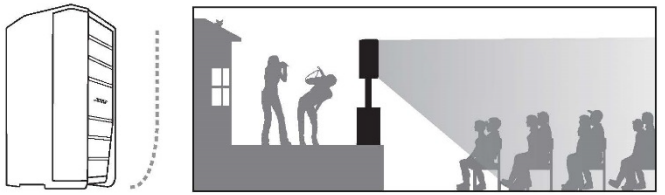
Reverse-J pattern

The reverse-J pattern is good for an audience in raked seating that starts at loudspeaker height and extends above the top of the loudspeaker.



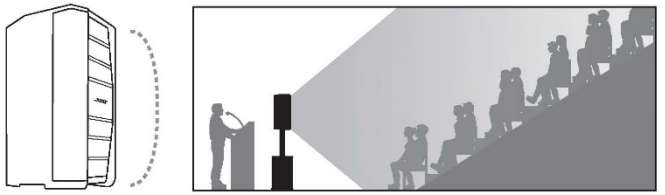
J pattern

The J pattern works well when the loudspeaker is up on a raised stage and the audience is seated below on the floor.



C pattern

Use the C pattern for raked seating in an auditorium when the first row is on the floor with the loudspeaker.



F1 Model 812 Control Panel

Operation

F1 Model 812 Control Panel

Note: For a complete list of LED indications and behaviors, see "LED Indicators" on page 20.

SIGNAL/CLIP: Displays the input signal status in color.

- Green = signal present.
- Red = signal clipping, input signal too high

VOLUME: Adjusts channel volume.

SIGNAL INPUT: Selector switch sets input sensitivity for input type. Combo connector accepts XLR mic connector or ¼" phone plug (TRS balanced or TS unbalanced cables).

- **MIC** selects sensitivity for microphone inputs (dynamic or self-powered mics only) – use only when a mic is connected directly to the input.
- **LINE** selects sensitivity for line-level inputs, for example, from a mixing console or DJ controller.

SIGNAL/CLIP: Displays the input signal status in color.

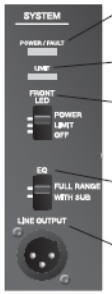
- Green = signal present.
- Red = signal clipping, input signal too high.

VOLUME: Adjusts channel volume.

RCA connectors: Analog stereo input for audio sources such as DJ controllers and other line-level sources. Left and right are summed, producing a mono audio output and mono signal to LINE OUTPUT (XLR).

- Left (White)
- Right (Red)

¼" phone connector: Provides analog input for guitars and other instruments. Accepts TRS balanced or TS unbalanced cables.



POWER/FAULT:

- Blue = power on.
- Red = fault condition.

LIMIT:

- Amber = system limiting (protection mode).

FRONT LED:

- **POWER** enables front LED to indicate power status.
- **LIMIT** engages a limiting display on the front LED.
- **OFF** turns off the front LED.

EQ: (See "Power On/Off Sequence" on page 12.)

- **FULL RANGE** allows the loudspeaker to function without high-pass filtering.
- **WITH SUB** engages a high-pass filter (100 Hz) when using the loudspeaker with the F1 subwoofer. Recommended when using with F1 Subwoofer.

LINE OUTPUT:

- Balanced XLR line output provides a mix of input 1 and 2, post input volume control. Can be used to daisy chain speakers together.

F1 Subwoofer Control Panel

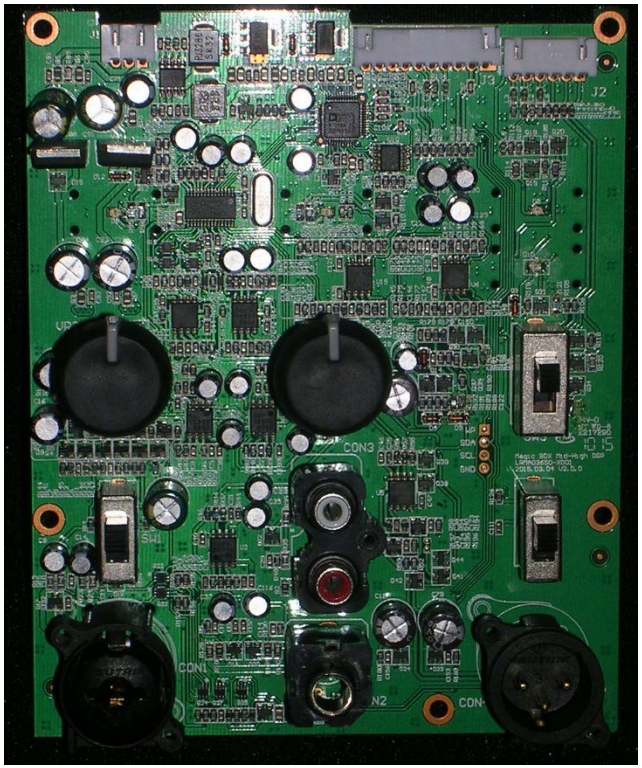
F1 Control (I/O –DSP) Boards

F1 Model 812 DSP

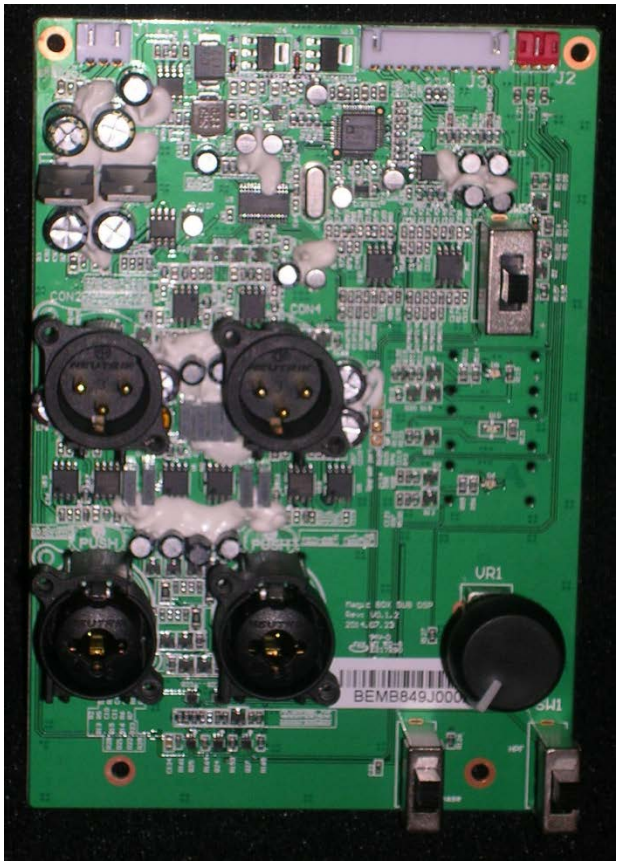
F1 Subwoofer DSP

F1 Control (I/O – DSP) Boards

F1 Model 812 DSP

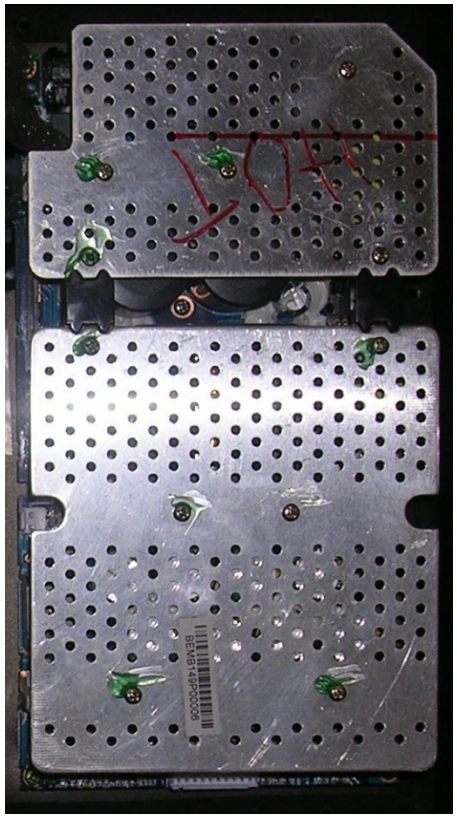


F1 Subwoofer DSP



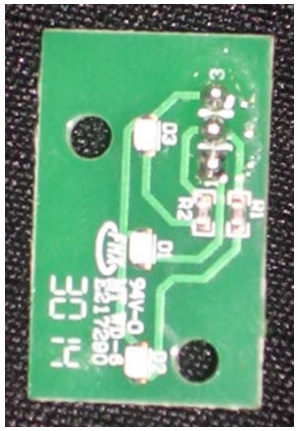
F1 Power Supply & Amplifier

Same PS & Amp used for Model 812 and Subwoofer
(Different Panels)

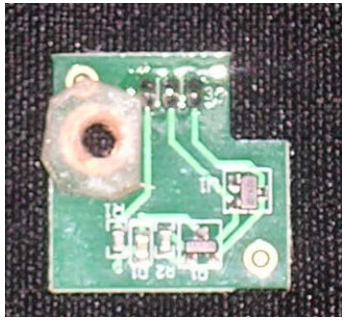


F1 Front LED and Hall Sensor Boards

LED Board for Front Display



Hall Sensor Board for F1 812 Array Position Sense Top & Bottom



F1 Model 812
Disassembly Procedure

F1 Amplifier (used for both Model 812 and Subwoofer) Disassembly Procedure

CAUTION: SHOCK HAZARD

The F1 amplifier has high voltage (400 VDC) between the heatsink and much of the circuitry on the power supply PCB during operation. In addition, the power amplifier PCBs have a large amount of capacitance on the boards that retain a dangerous charge for a significant period of time. (10 mins)

- **DO NOT touch the power supply heatsink when the amplifier is operating.**
- **DO NOT use the power supply heatsink as a ground point for test equipment. Damage to your equipment could result.**
- Allow at least ten (10) minutes after operation before removing the cover or attempting to replace a PCB assembly.

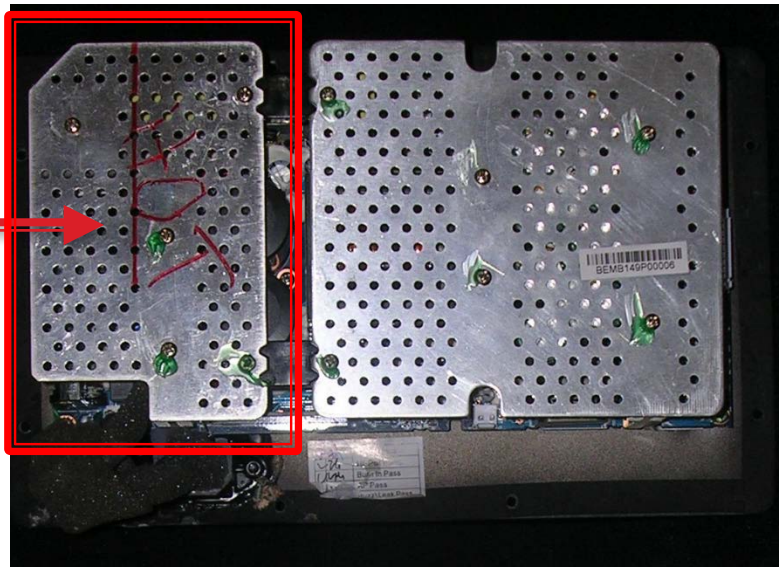
F1 Amplifier (used for both Model 812 and Subwoofer) Disassembly Procedure

CAUTION: SHOCK HAZARD

The F1 amplifier has high voltage (400 VDC) on the heatsink and much of the circuitry on the power supply PCB during operation. In addition, the power amplifier PCBs have a large amount of capacitance on the boards that retain a dangerous charge for a significant period of time. (10 minutes)

Power Supply Heatsink

Hazardous Voltage



F1 Model 812 Disassembly Procedure

Important Note: The top and rear handles and their inserts are not replaceable for safety reasons. Do not attempt to remove them. They are not stocked as repair parts.

Some components internal to the loudspeaker enclosure, such as the internal brackets and the left and right SMPS cover are not replaceable.

1. Foot Removal

1.1 Remove the one screw that secures the foot to the loudspeaker enclosure.

1.2 Lift off the foot.

F1 Model 812 Disassembly Procedure

2. Front Grille Removal

Note: The front center and upper and lower grilles are simply press-fit into slots in the Twiddler® baffle.

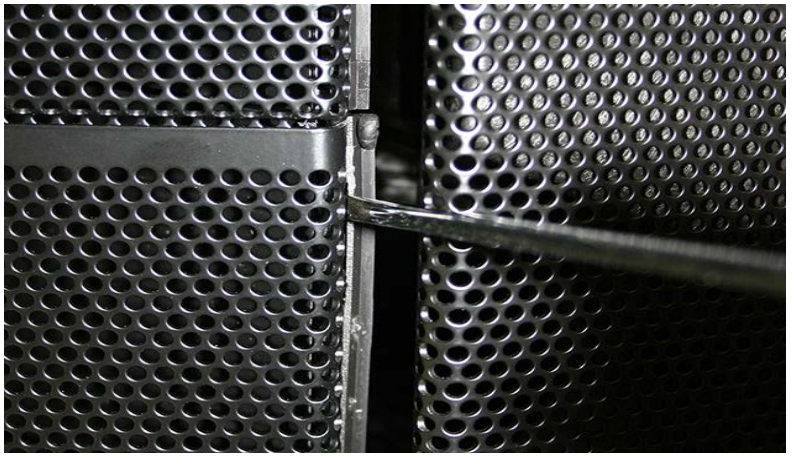
2.1 Using a heavy duty straight pick or thin screwdriver, press the tool in between the side of the grille and the array baffle plastic.

2.2 Gently pry the grille forward toward the front of the speaker to be able to grasp it.

2.3 Grasp the grille section you wish to remove. Carefully pull the grille straight off toward you, one side at a time until it is clear of the array baffle. Lift off the grille.

Re-assembly Note: When re-installing the grilles, use an angle tool to support the slot of the array baffle that the grille seats into. This will make it easier to replace the grille.

Note: The Bose® logo is attached to the center grille. Replacement center grilles DO NOT come with the logo attached. You will need to either re-use the old logo or order a new one.

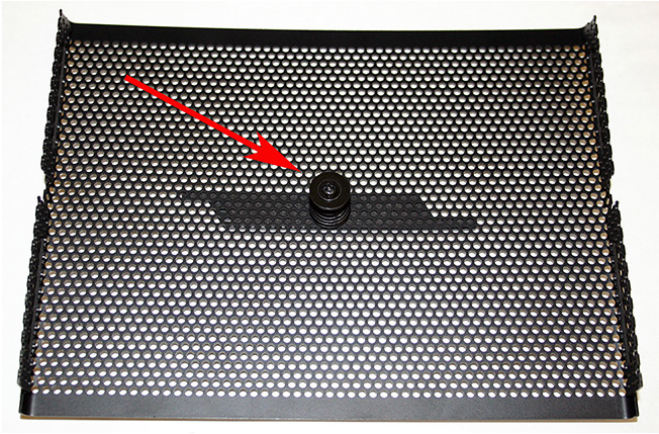


F1 Model 812 Disassembly Procedure

3. Logo Removal

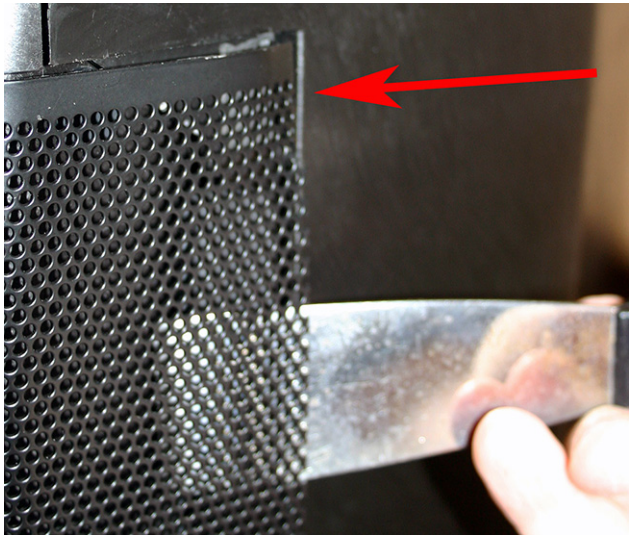
3.1 Remove the center grille section using procedure 1.

3.2 Remove the screw, washer and spring that secure the logo to the center grille section. Lift off the logo.



4. Side Grille Removal

4.1 Using a flat plastic tool, move the grille sides away from the loudspeaker enclosure until the retaining tabs are clear of the enclosure. There are four retaining tabs per grille.
Note: Take care to not damage the loudspeaker enclosure or the side grille.



4.2 Once the retaining tabs are clear, pull the side grille straight off from the front of the enclosure.

F1 Model 812 Disassembly Procedure

5. Twiddler® Removal

5.1 Remove the front grilles using procedure 2.

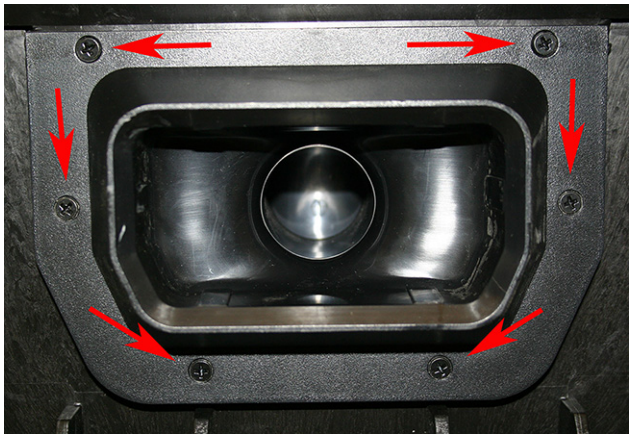
5.2 Remove the 4 screws that secure the driver you wish to remove. Lift the driver out of the baffle.

5.3 Remove the two Faston connectors from the driver. Lift out the driver. **Note:** Be sure to observe polarity when connecting the new driver.

F1 Model 812 Disassembly Procedure

6. Stand Mount Interface Removal

6.1 Remove the six screws that secure the stand mount to the bottom of the loudspeaker enclosure.



6.2 Carefully lift the stand mount interface away from the loudspeaker enclosure. Take care to not damage the mount interface gasket. **Note:** If you damage the gasket, you can order a replacement.

6.3 Lift off the stand mount interface.

Note: After replacement, ensure that there are no air leaks using the test procedures in this service manual.

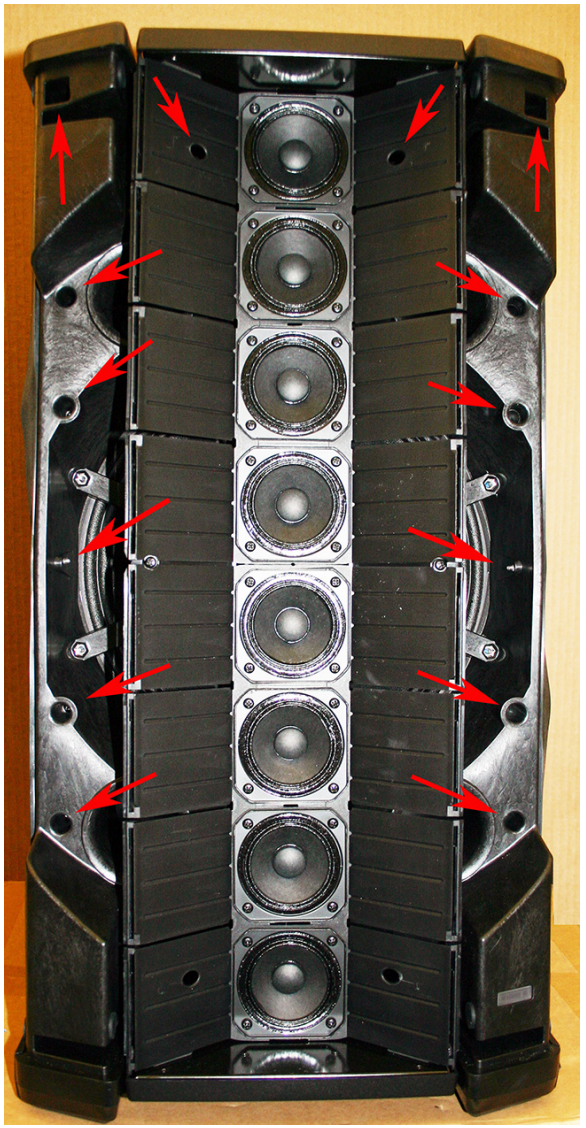
F1 Model 812 Disassembly Procedure

7. Woofer Removal

Notes:
- The woofer is located behind the woofer baffle and the Twiddler array. You must remove the woofer baffle to access the woofer.
- There is no need to remove the Twiddler baffles or drivers to remove the woofer baffle.

7.1 Remove the feet and center and side grilles using procedures 1, 2 and 3.

7.2 Locate and remove the baffle retention screws. There are a total of twelve. Also remove the two silver colored screws
located in the middle of the sides of the enclosure. Do not remove the four black screws along the sides of the enclosure.
I**mportant Note:** There are 2 screws located behind the top two holes in the upper Twiddler baffle. You will need a long Phillips-head screwdriver to reach them. There are no screws located behind the two holes in the lower Twiddler baffle.
Re-assembly Note: The four self-tapping screws go in the holes at the top of the enclosure and the eight machine screws are used along the sides.



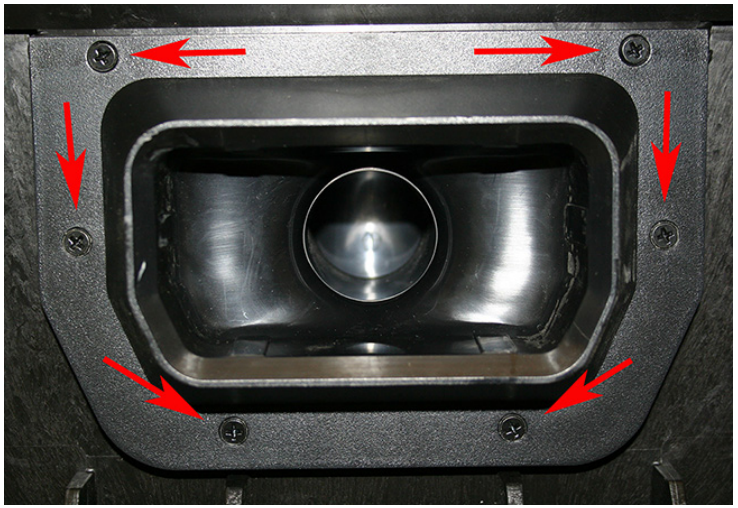
F1 Model 812 Disassembly Procedure

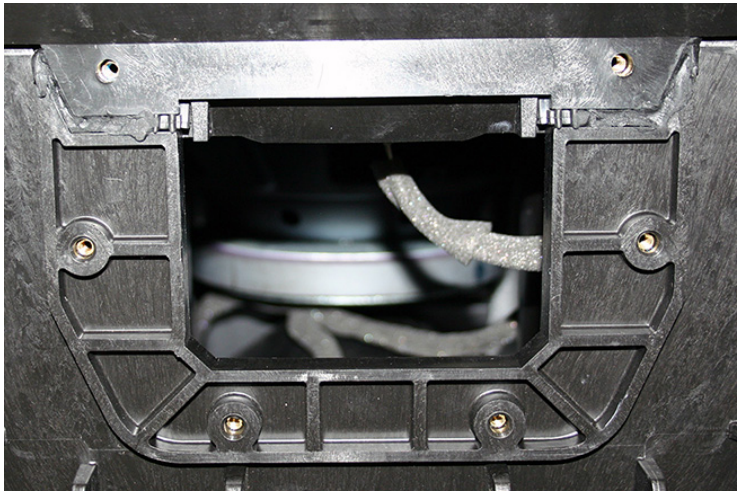
7.3 Place the loudspeaker onto its back. Remove the stand mount interface using procedure 6.

7.4 Once the screws are removed, you are ready to separate the woofer baffle from the loudspeaker enclosure.

Separate the front section of the enclosure from the rear section by pulling them apart at the opening left by the removal of the stand mount interface. Refer to the photo at right.

Lift off the front enclosure section. Once the front section has come loose, you can rest the ports on the internal brackets to allow disconnecting the wiring harnesses.
Note: Take care to not damage the large main enclosure gasket. You will need to re-use it. If you do damage it, you can order a replacement.





F1 Model 812 Disassembly Procedure

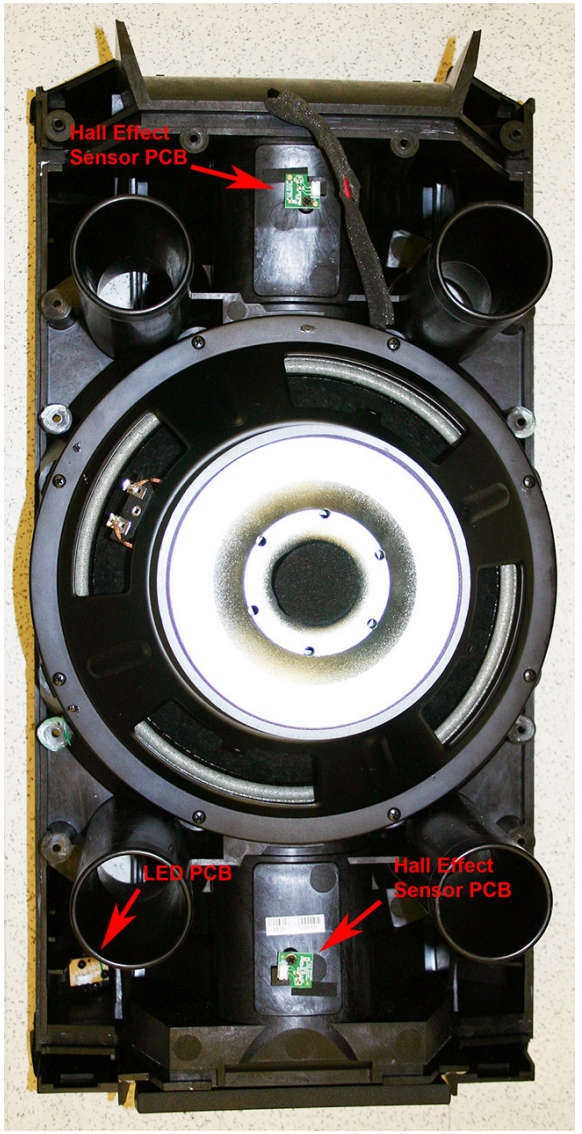
7.5 Disconnect the two Faston connectors from the woofer. Disconnect the wiring harnesses at the LED PCB, the two Hall Effect Sensor PCBs and the Twiddler array connector. Lift off the front enclosure section.

7.6 Place the front enclosure section face down on the bench. Remove the eight screws that secure the woofer to the woofer baffle. Lift off the woofer.

Notes:

- Be sure to correctly place the main enclosure gasket in the groove along the edge of the enclosure to ensure there are no air leaks after the woofer baffle is replaced.

- After woofer baffle replacement, ensure that there are no air leaks using the test procedures in this service manual.

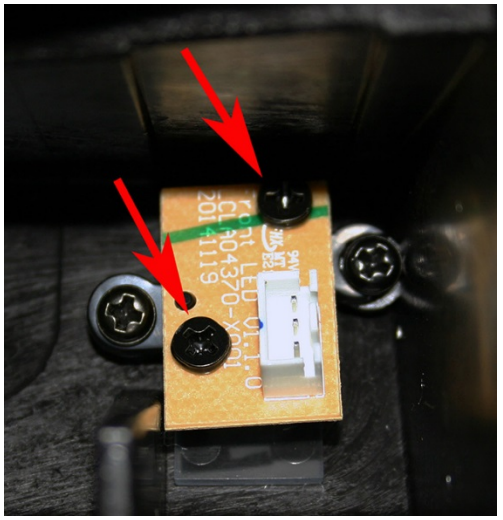


F1 Model 812 Disassembly Procedure

8. LED PCB Removal

8.1 Perform steps 7.1 to 7.5 to remove the front baffle section.

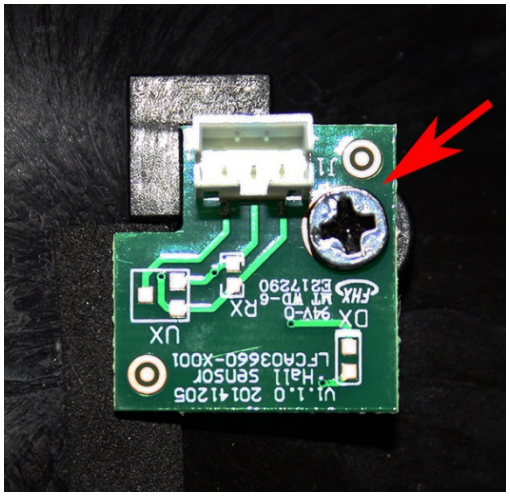
8.2 Locate the LED PCB on the back of the front enclosure section. Refer to the photo at right. Remove the two screws that secure the PCB to the front enclosure. Lift off the PCB assembly.



9. Hall Effect Sensor PCB Removal

9.1 Perform steps 7.1 to 7.5 to remove the front baffle section.

9.2 Locate the Hall Effect Sensor PCB that you wish to remove on the back of the front enclosure section. Refer to the photo at the bottom of the previous page.
Note: There are two Hall Effect Sensor PCBs, an upper and a lower. Be sure to remove the correct PCB assembly.



9.3 Remove the one screw that secures the PCB to the front enclosure. Lift off the PCB assembly.

F1 Model 812 Disassembly Procedure

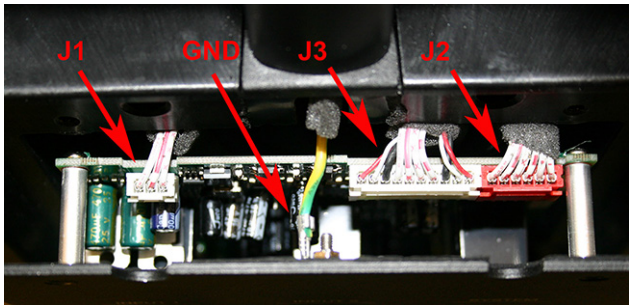
10. DSP / I-O PCB Assembly Removal

10.1 Remove the six screws that secure the DSP / I-O PCB assembly to the loudspeaker enclosure.

10.2 Carefully lift the DSP / I-O PCB assembly away from the enclosure. Take care to not damage the gasket.

10.3 Disconnect the ground connection wire. Retain the nut for re-use.

10.4 Disconnect the three wire harnesses at J1, J2 and J3. Lift off the PCB assembly.



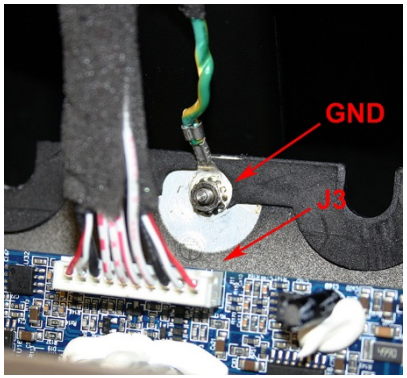
F1 Model 812 Disassembly Procedure

11. SMPS / Amplifier PCB Assembly Removal

11.1 Remove the eight screws that secure the SMPS / Amplifier assembly to the loudspeaker enclosure.

11.2 Carefully lift the SMPS / Amp assembly away from the enclosure. Take care to not damage the gasket.

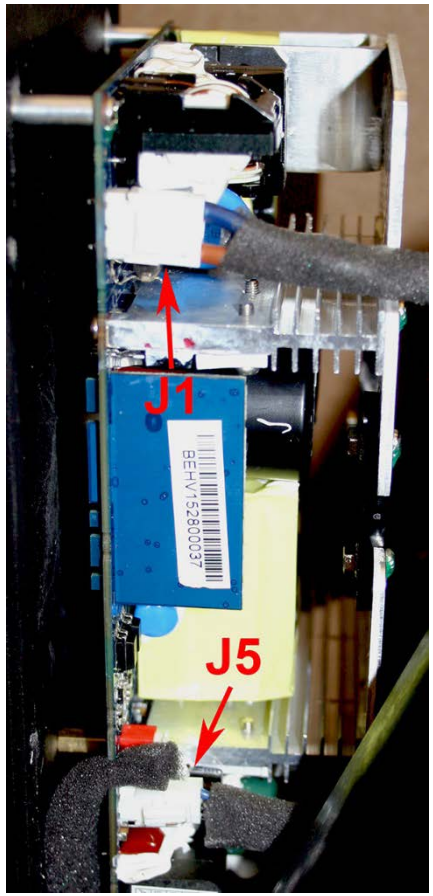
11.3 Disconnect the ground connection wire. Retain the nut for re-use. Disconnect the wiring harness at J3.

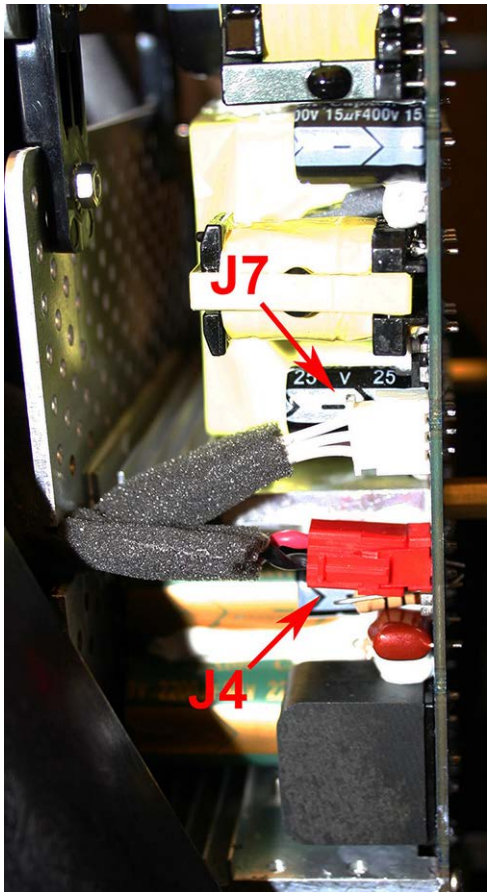


F1 Model 812 Disassembly Procedure

11.4 Disconnect the AC wiring harness at J1. Disconnect the three wire harnesses at J4, J5 and J7.
Note: J4 and J5 are located across the PCB assembly from each other. The J4 connector is red and the J5 connector is white. Lift off the SMPS / Amp assembly.

Important Note: The SMPS / Amplifier PCB assembly is a densely packed assembly with many components secured with glue to prevent vibration and buzzing. Component level repair is NOT recommended for this assembly.





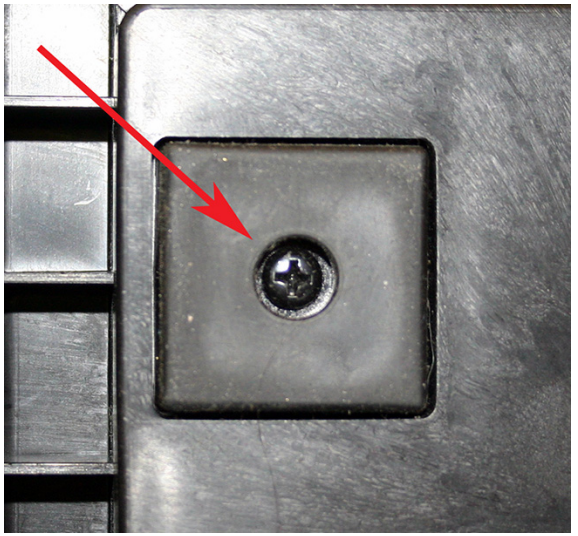
F1 Subwoofer Disassembly Procedure

Important Note: The top, bottom and rear handles and their inserts are not replaceable for safety reasons. Do not attempt to remove them. They are not stocked as repair parts.

1. Foot Removal

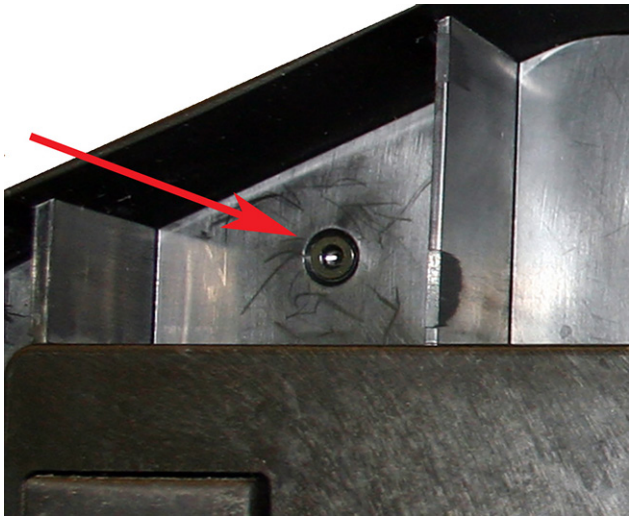
1.1 Remove the one screw that secures the foot to the loudspeaker enclosure.

1.2 Lift off the foot.



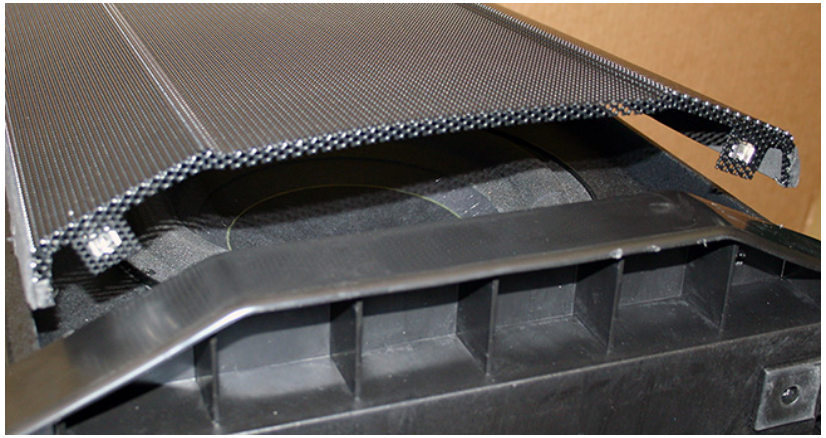
2. Grille Removal

2.1 At the bottom of the loudspeaker, below the cabinet edge, remove the two hex head T15 size screws that secure the grille to the loudspeaker enclosure.



F1 Subwoofer Disassembly Procedure

2.2 Pull the bottom edge of the grille away from the speaker, and slide it down until it comes out of the groove at the top of the enclosure. Lift off the grille.

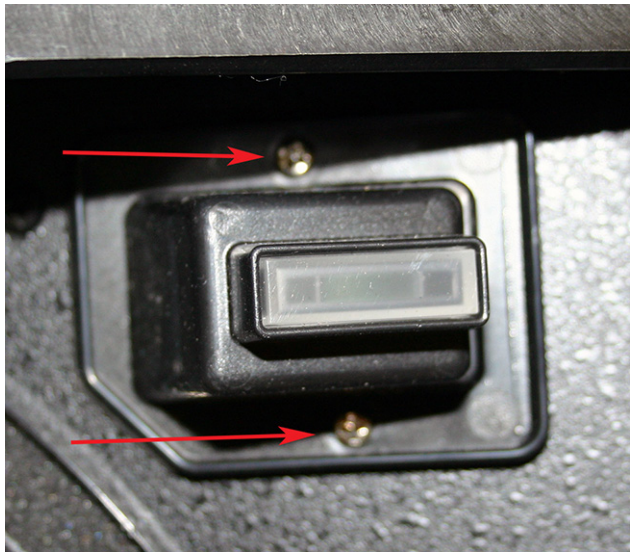


3. LED PCB Removal

3.1 Remove the grille using procedure 2.

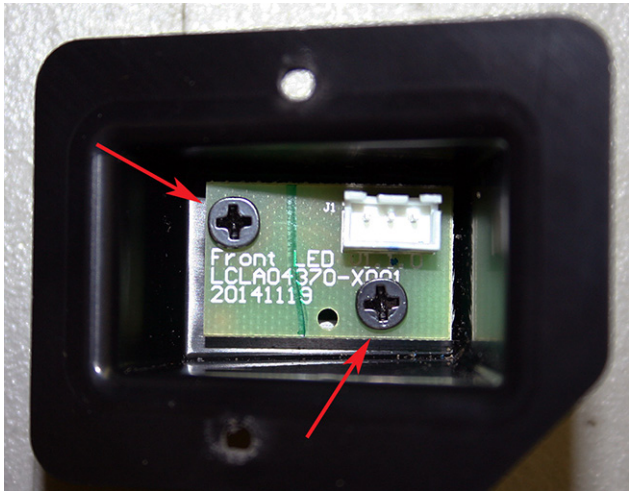
3.2 The LED PCB housing is located at the top right corner of the loudspeaker. Remove the two screws that secure the LED PCB housing to the enclosure.

3.3 Disconnect the wiring harness from the connector. Lift off the LED PCB housing.



F1 Subwoofer Disassembly Procedure

3.4 Remove the two screws that secure the PCB assembly to the housing. Lift out the PCB assembly.

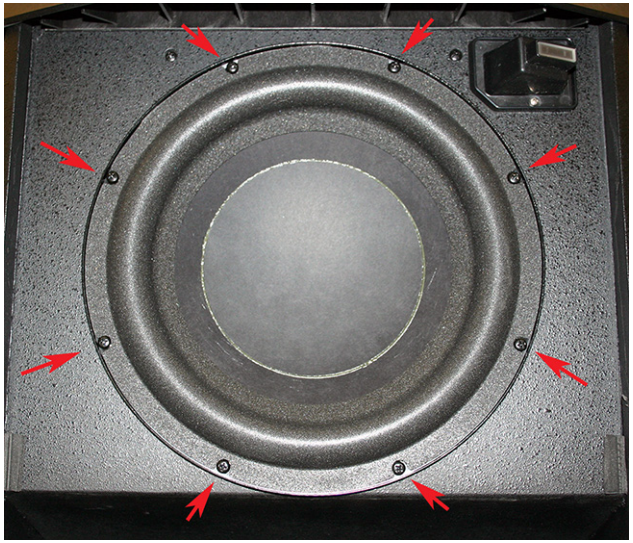


4. Woofer Removal

4.1 Remove the grille using procedure 1.

4.2 Remove the eight screws that secure the woofer you wish to remove. Lift out the woofer.

4.3 Disconnect the two Faston connections. Lift out the woofer.
Note: Be sure to observe polarity when re-connecting the woofer harness to the new woofer.

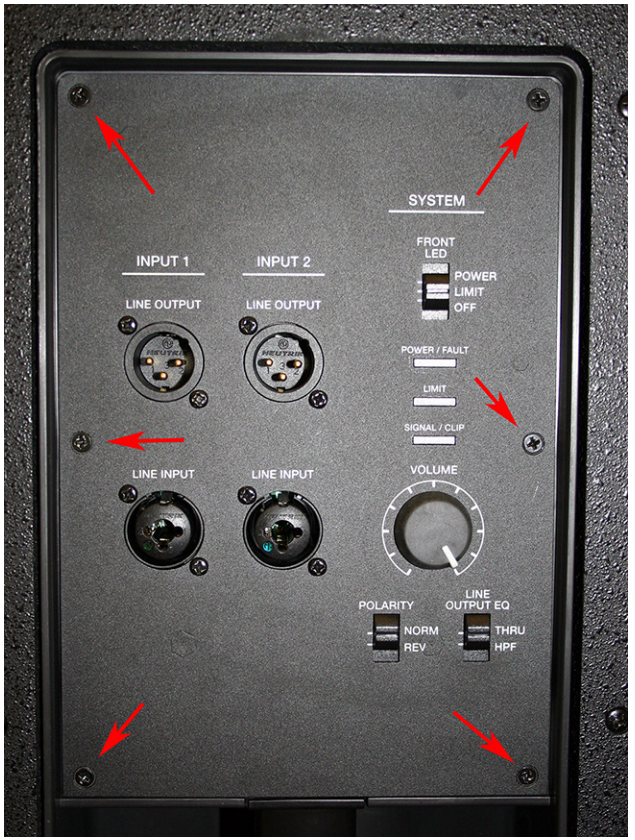


F1 Subwoofer Disassembly Procedure

5. DSP / I-O PCB Assembly Removal

5.1 Remove the six screws that secure the DSP / I-O PCB assembly to the loudspeaker enclosure. Take care to not strip the screw heads.

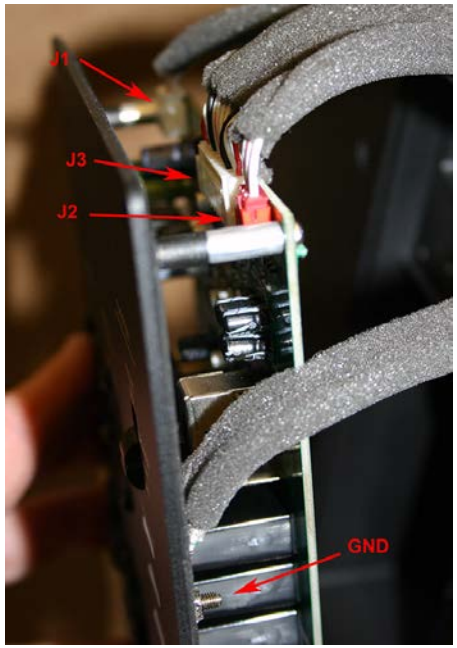
5.2 Carefully lift the DSP / I-O PCB assembly away from the enclosure. Take care to not damage the gasket.



F1 Subwoofer Disassembly Procedure

5.3 Disconnect the ground connection wire. Retain the nut for re-use.

5.4 Disconnect the three wire harnesses at J1, J2 and J3. Lift off the DSP / I-O PCB assembly.



5.5 Remove the knob. Remove the eight screws that secure the XLR jacks to the input panel.

5.6 Turn over the DSP PCB subassembly. Remove the four screws that secure the PCB assembly to the input panel. Lift off the PCB assembly.

F1 Subwoofer Disassembly Procedure

6. SMPS / Amplifier PCB Assembly Removal

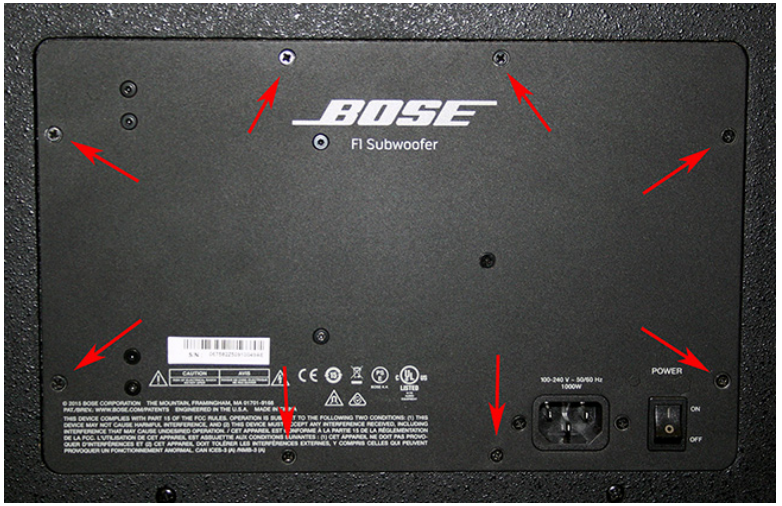
Important Note: The SMPS / Amplifier PCB assembly is a densely packed assembly with many components secured with glue to prevent vibration and buzzing. Component level repair is NOT recommended for this assembly.

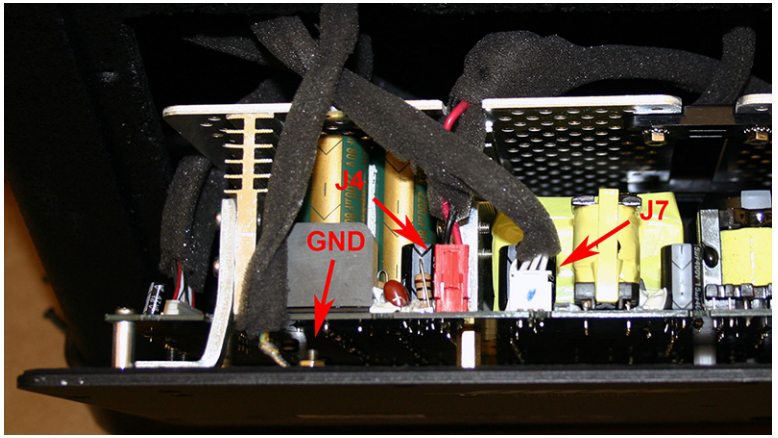
6.1 Remove the eight screws that secure the SMPS / Amplifier assembly to the loudspeaker enclosure. Take care to not strip the screw heads.

6.2 Carefully lift the SMPS / Amp assembly away from the enclosure. Take care to not damage the gasket.

6.3 Disconnect the ground connection wire. Retain the nut for re-use.

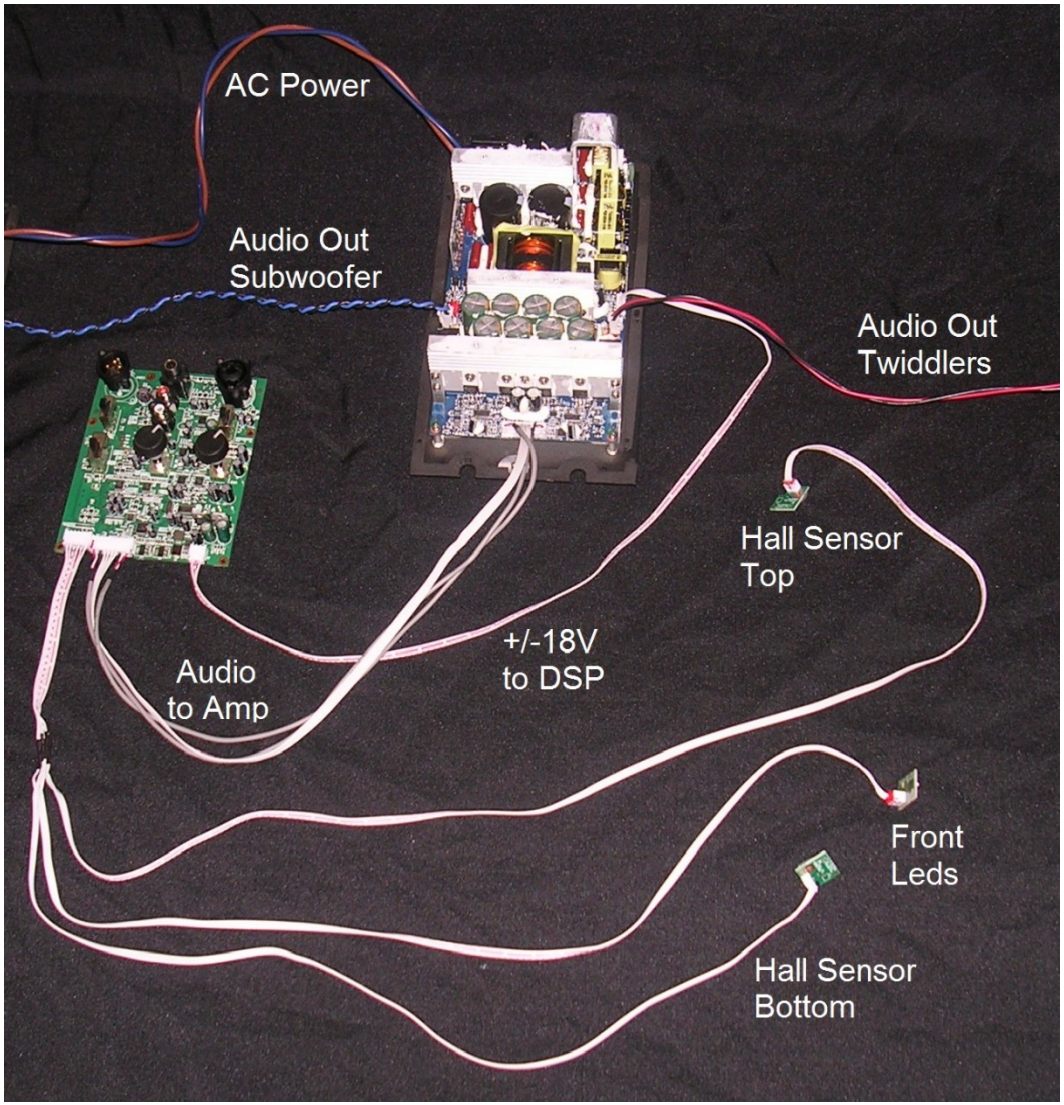
6.4 Disconnect the three wire harnesses at J4, J5 and J7. Lift out the SMPS / Amp sub-assembly. **Note:** J5 is located opposite J4 on the other side of the PCB assembly from the view shown at right.



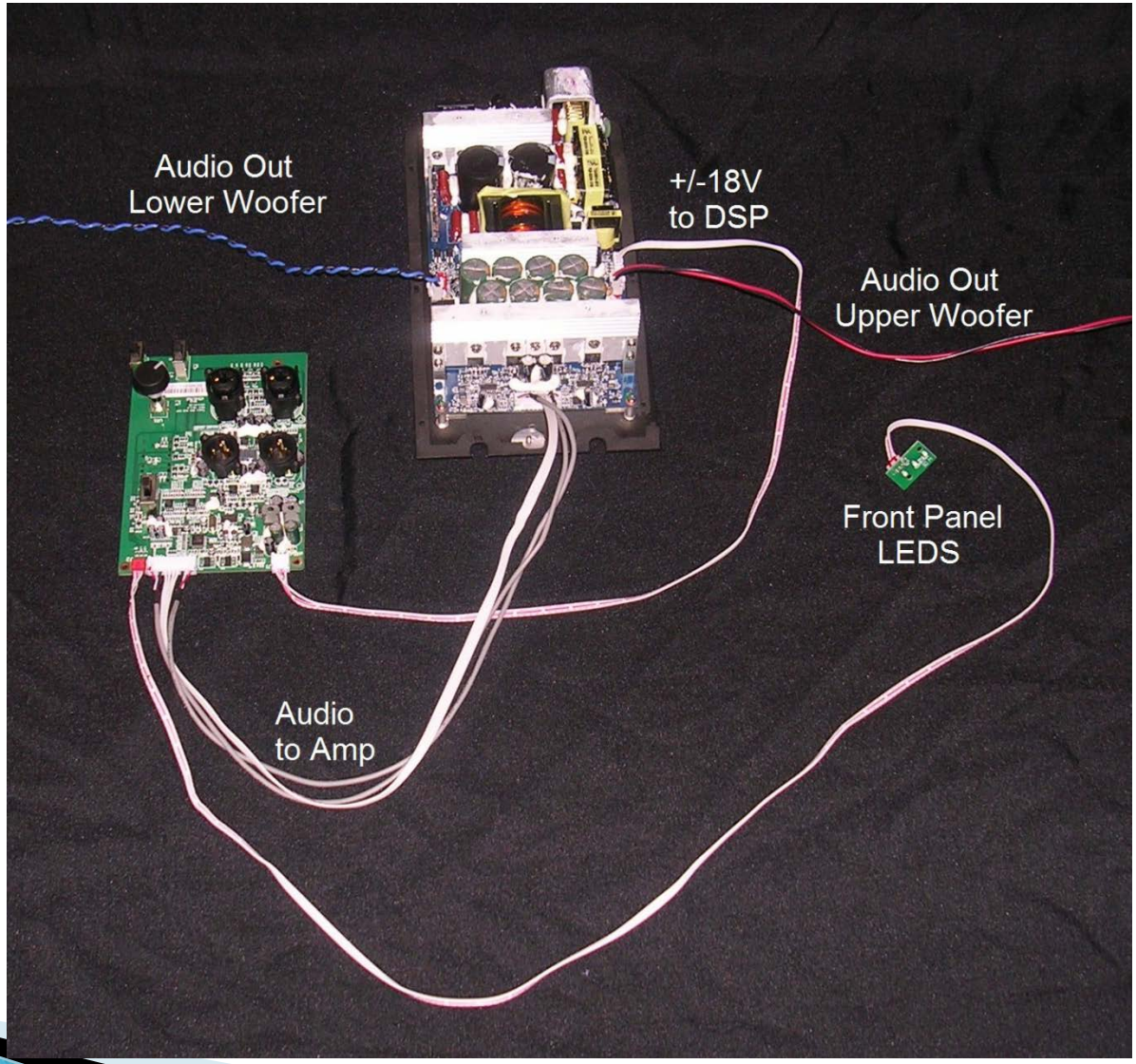


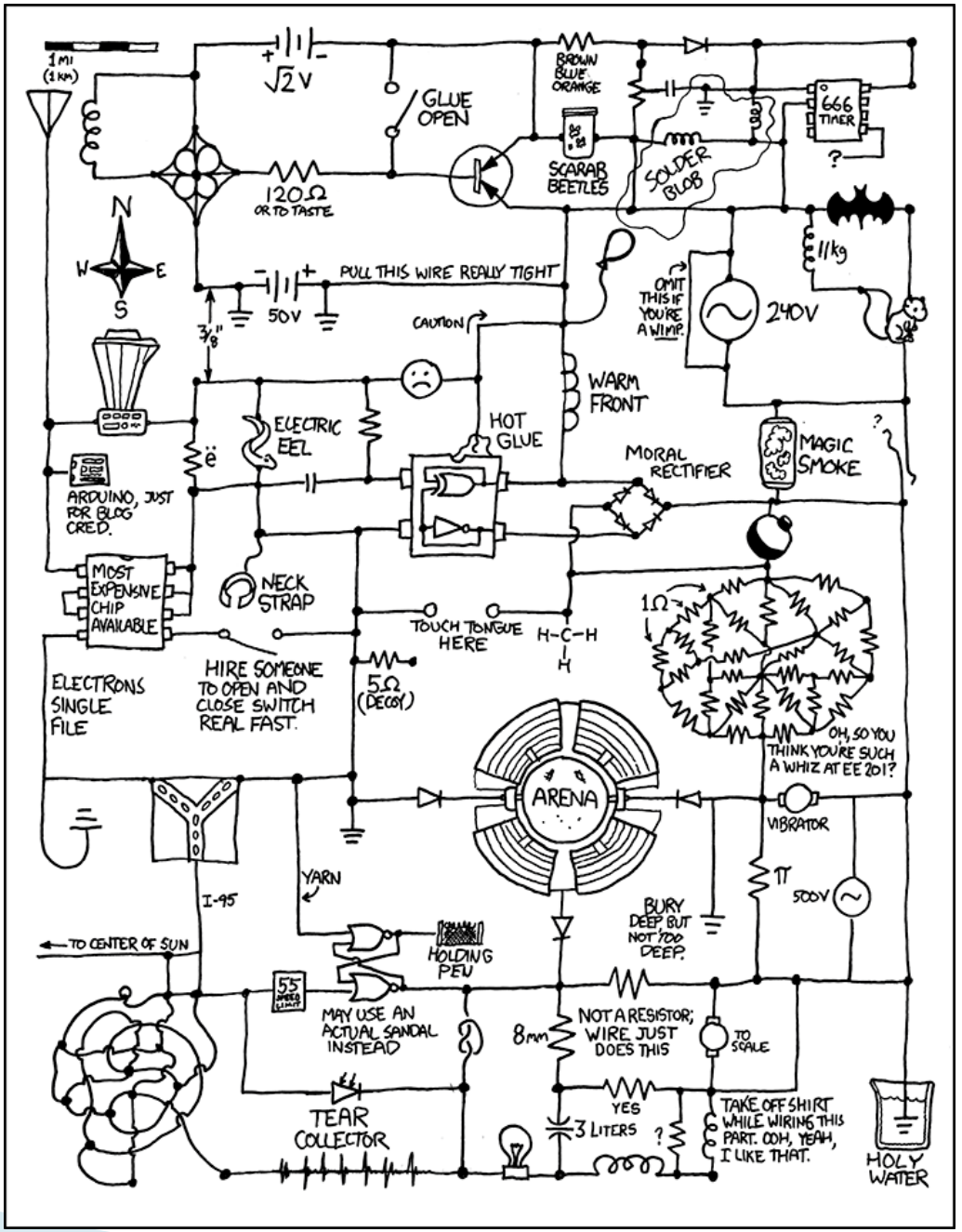
F1 Architecture

F1 Model 812 Cabling



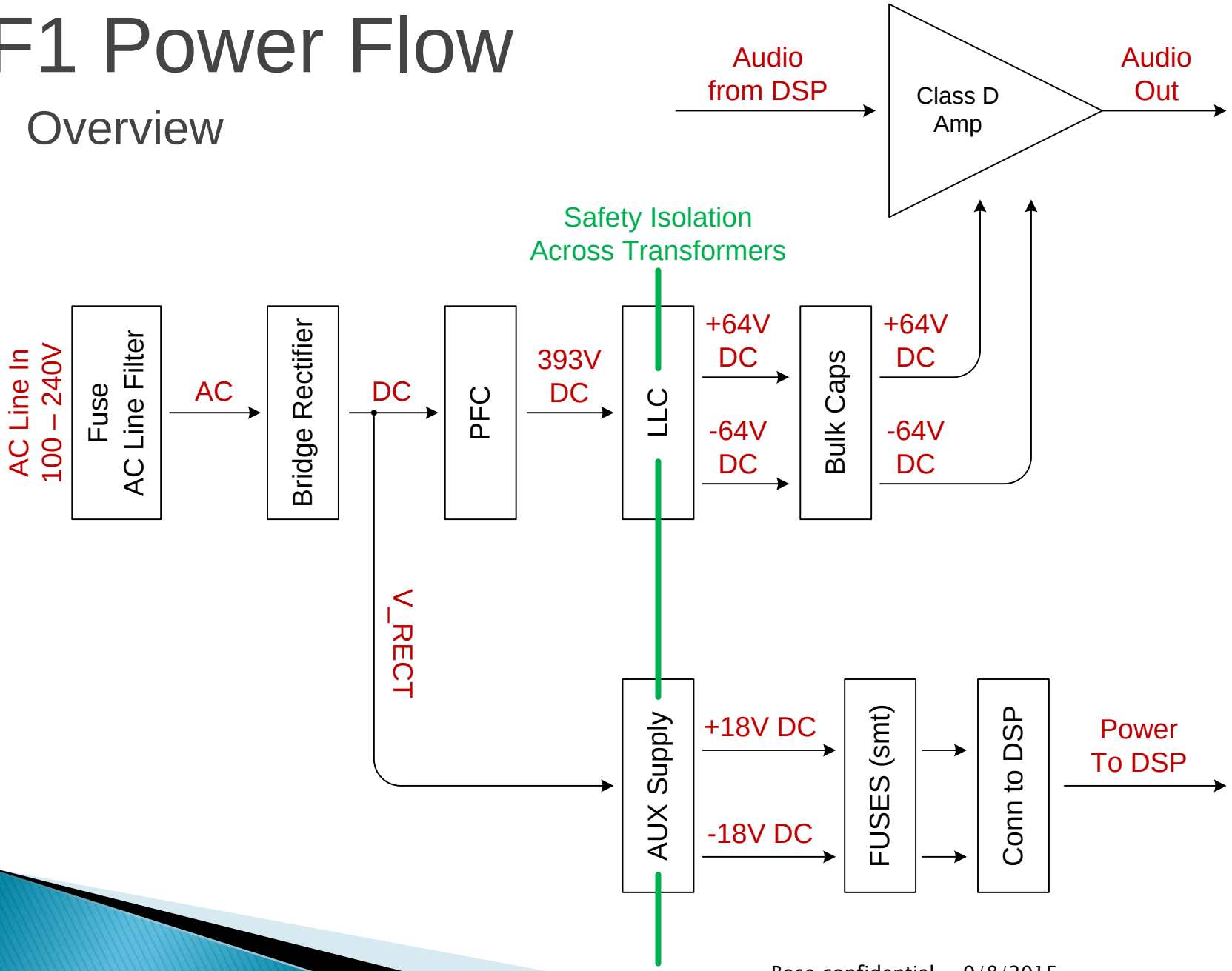
F1 Subwoofer Cabling



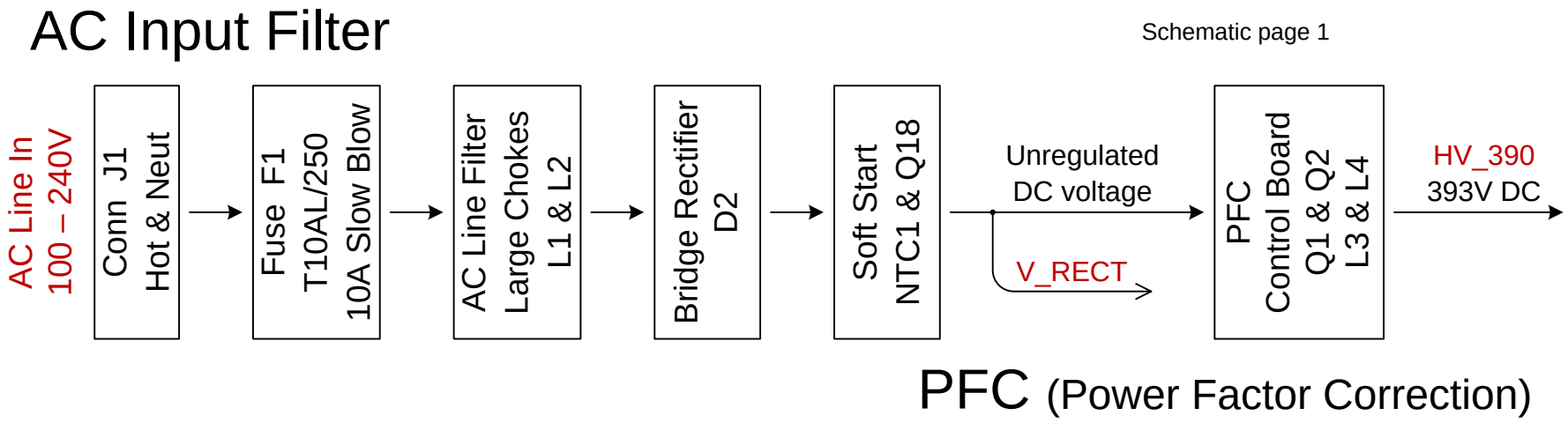

1 MI (1 KM)
√2 V
GLUE OPEN
BROWN BLUE ORANGE
666 TIMER
SCARAB BEETLES
SOLDER BLOB
120Ω OR TO TASTE
N
W
E
S
PULL THIS WIRE REALLY TIGHT
50V
3/8"
CAUTION
OMIT THIS IF YOU'RE A WIMP.
240V
1/kg
WARM FRONT
ELECTRIC EEL
HOT GLUE
MORAL RECTIFIER
MAGIC SMOKE
ARDUINO, JUST FOR BLOG CRED.
MOST EXPENSIVE CHIP AVAILABLE
NECK STRAP
TOUCH TONGUE HERE
H-C-H H
1Ω
ELECTRONS SINGLE FILE
HIRE SOMEONE TO OPEN AND CLOSE SWITCH REAL FAST.
5Ω (DECOY)
OH, SO YOU THINK YOU'RE SUCH A WHIZ AT EE 201?
ARENA
VIBRATOR
1T
500V
YARN
I-95
BURY DEEP BUT NOT TOO DEEP.
TO CENTER OF SUN
HOLDING PEN
55 SPEED LIMIT
MAY USE AN ACTUAL SANDAL INSTEAD
8mm
NOT A RESISTOR; WIRE JUST DOES THIS
TO SCALE
YES
3 LITERS
TEAR COLLECTOR
TAKE OFF SHIRT WHILE WIRING THIS PART. OOH, YEAH, I LIKE THAT.
HOLY WATER

F1 Power Flow

Overview



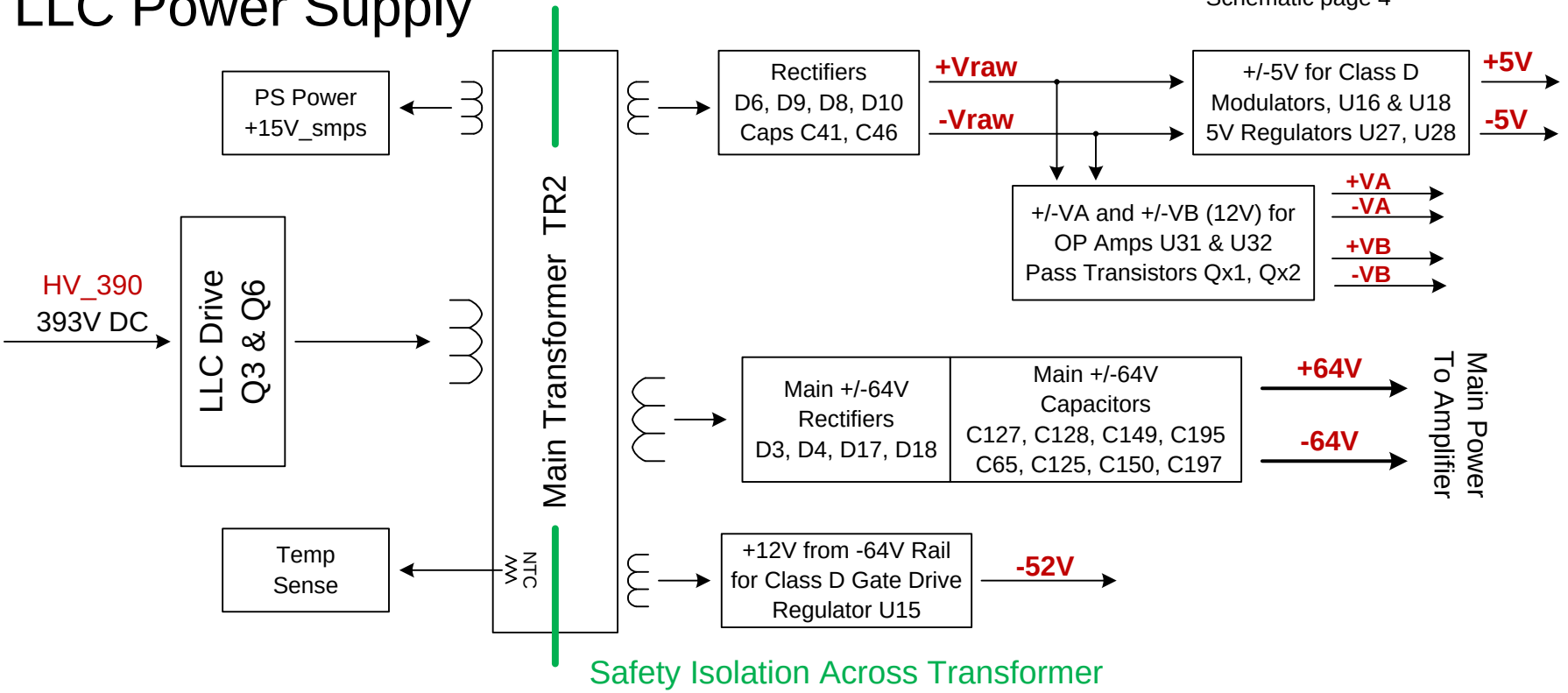
F1 Power Flow



F1 Power Flow

LLC Power Supply

Schematic page 4

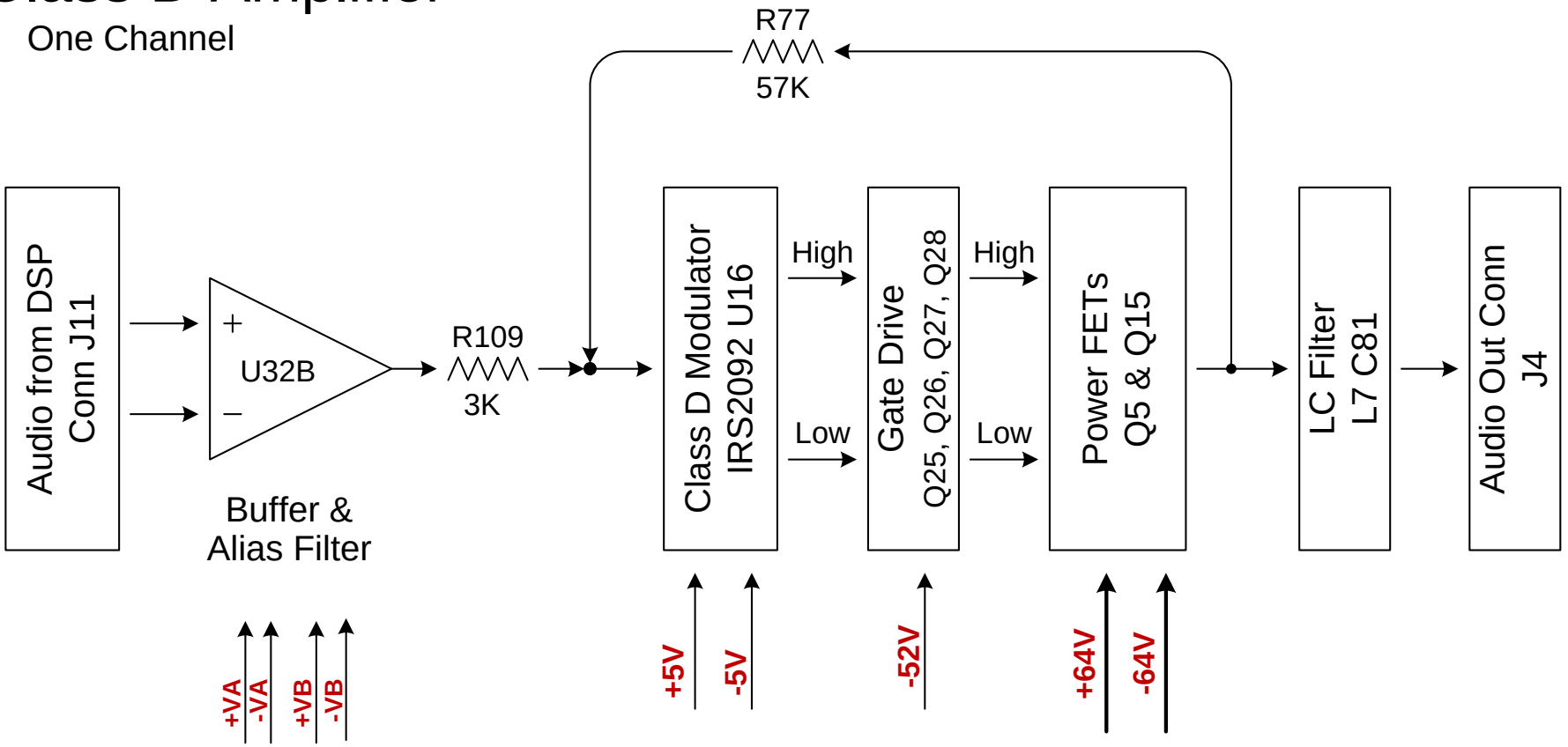


F1 Power Flow

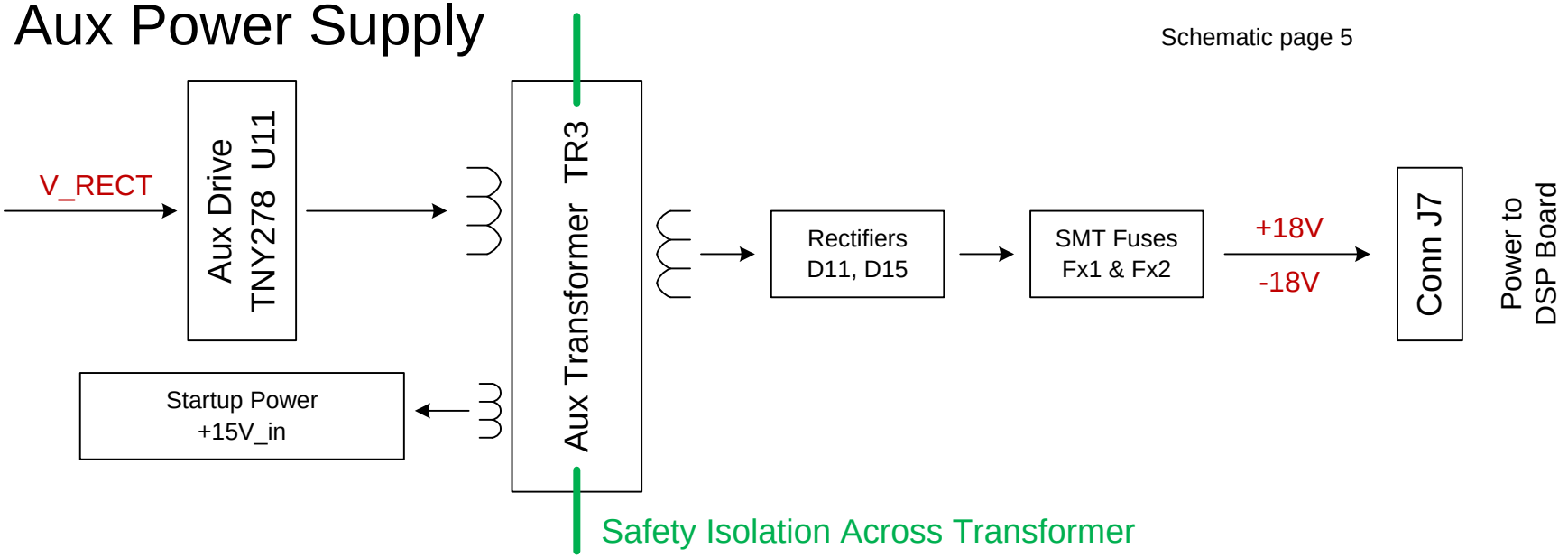
Schematic page 6

Class D Amplifier

One Channel



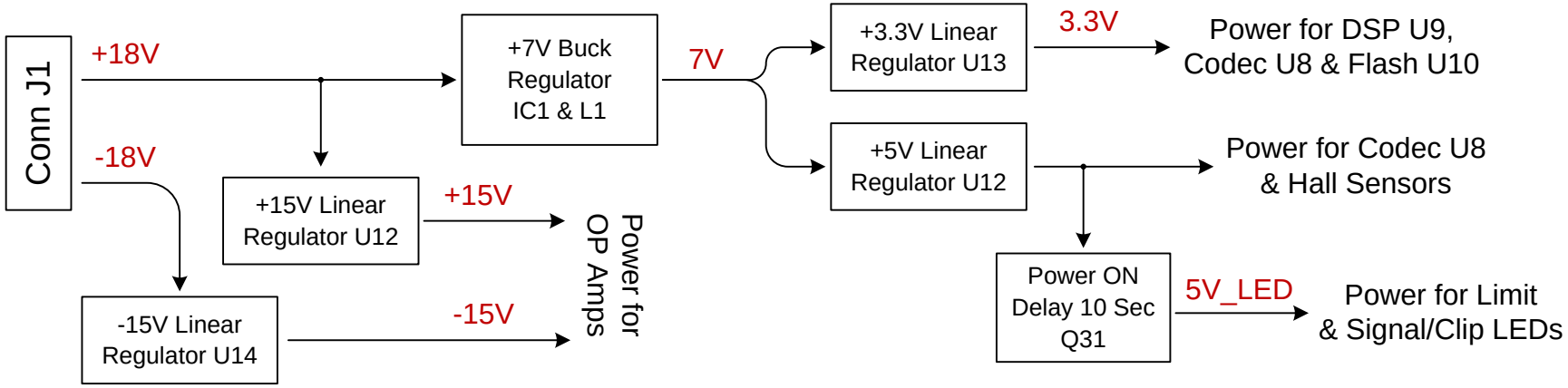
F1 Power Flow



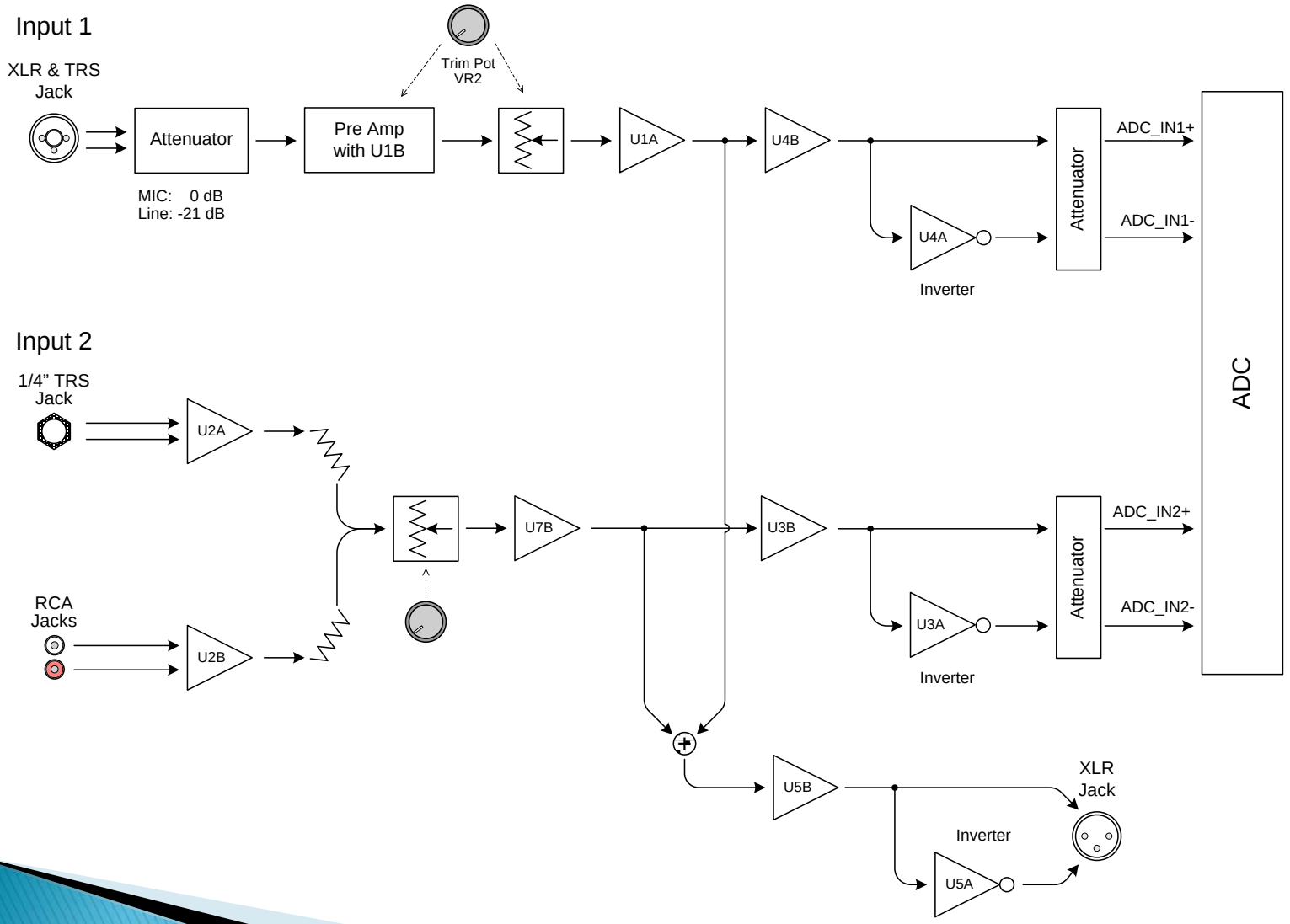
F1 Power Flow

DSP Board Power

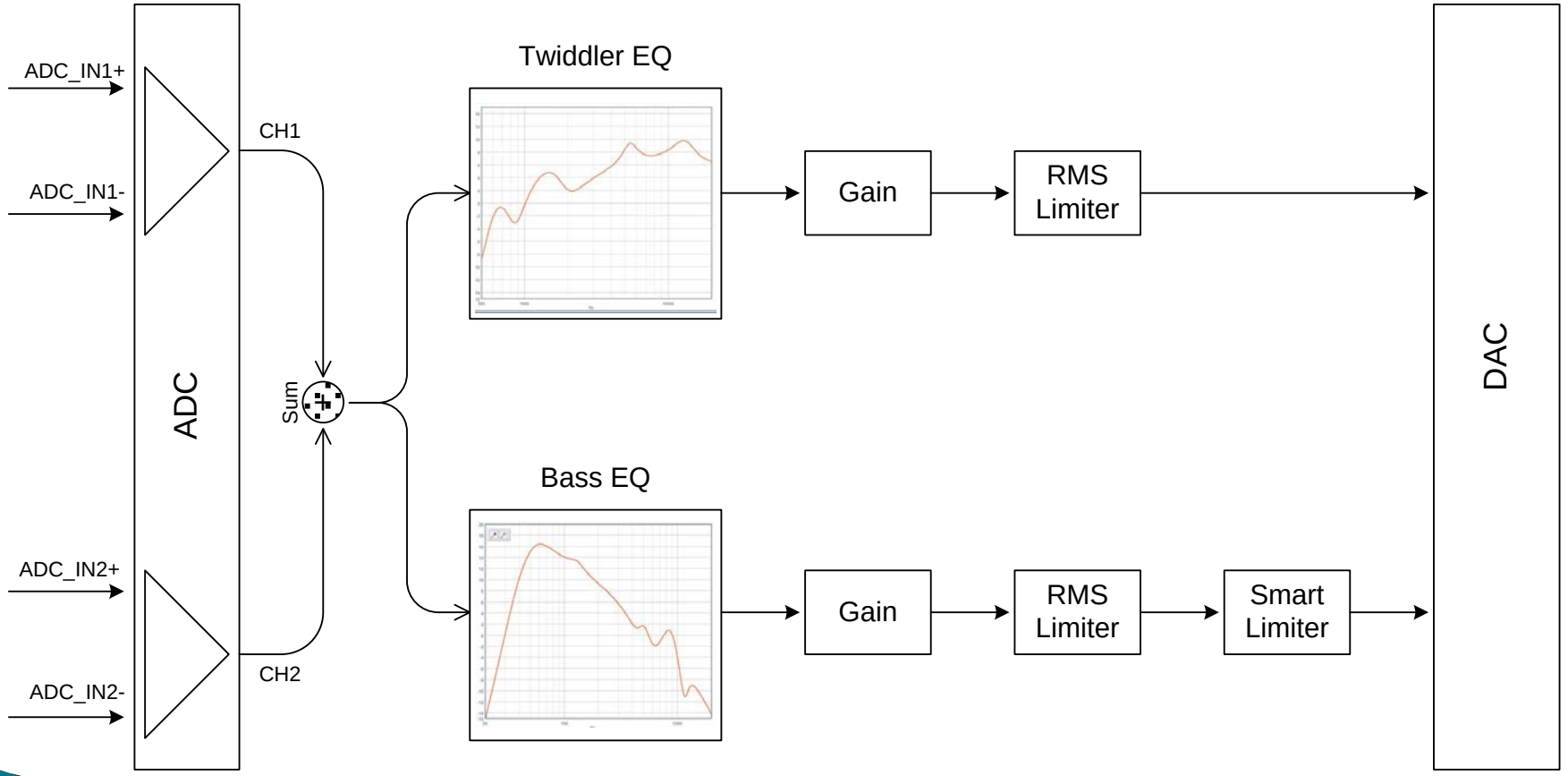
DSP Board Schematic page 3



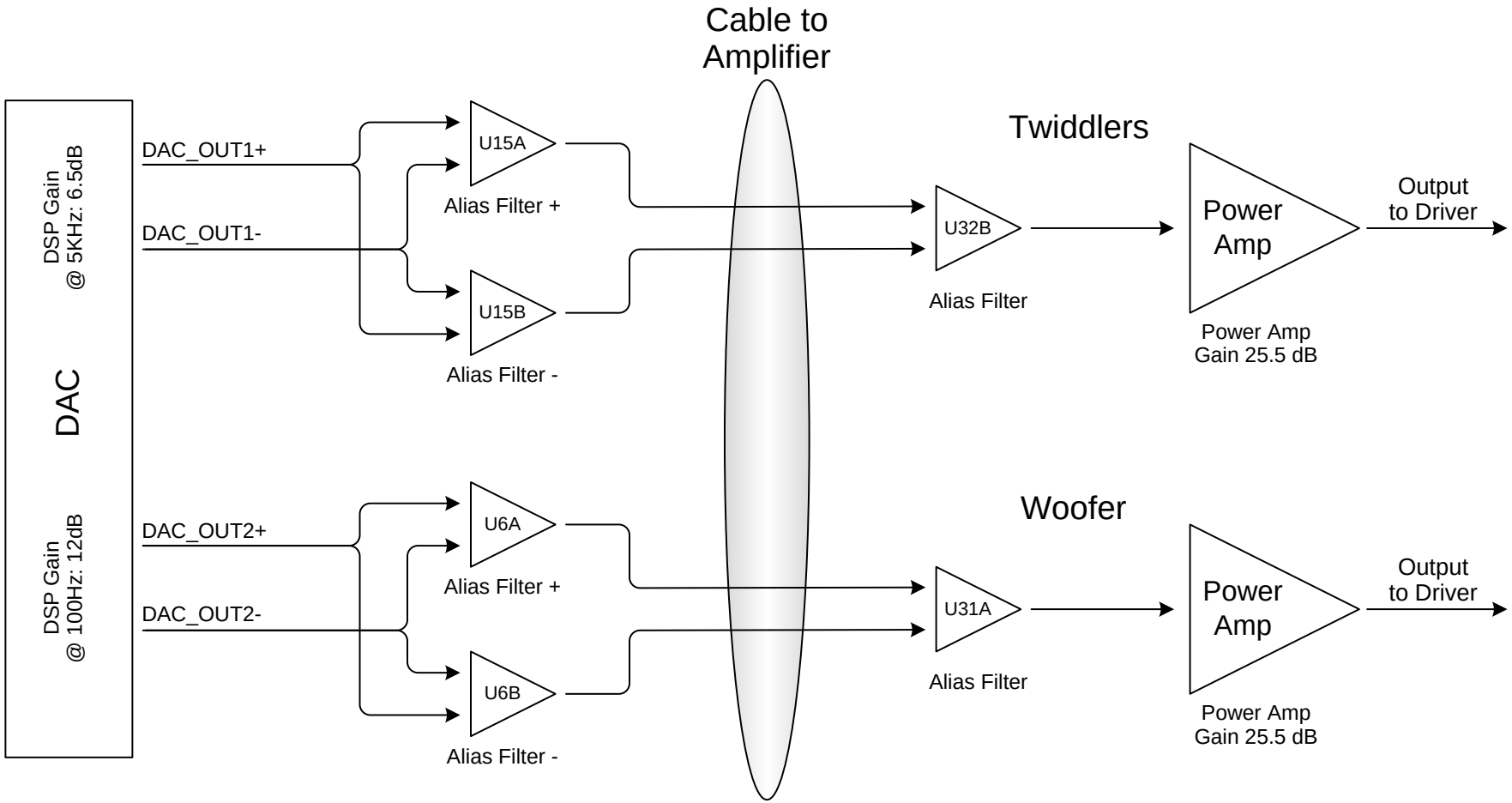
F1 Audio Flow: Model 812 - Input



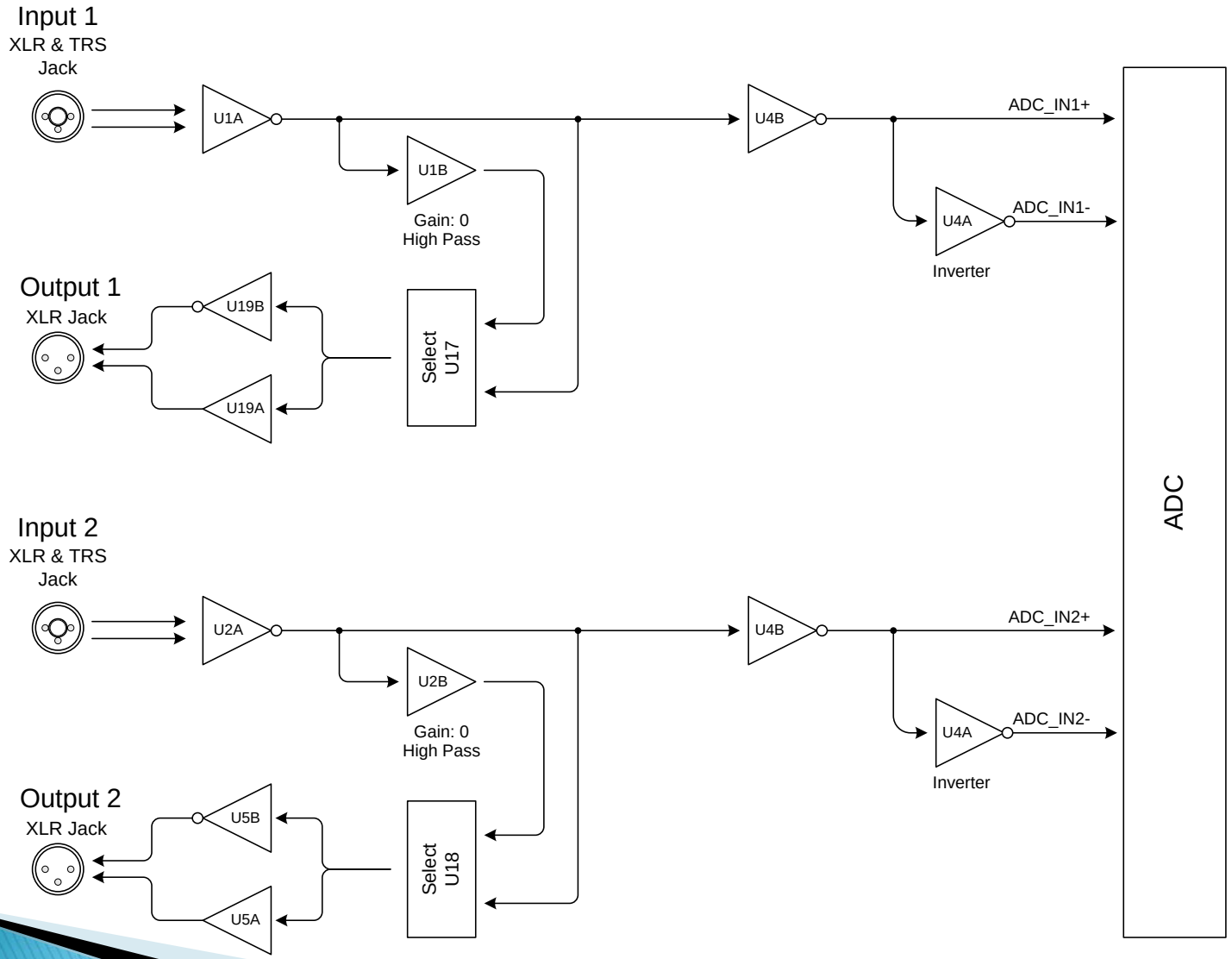
F1 Audio Flow: Model 812 - DSP



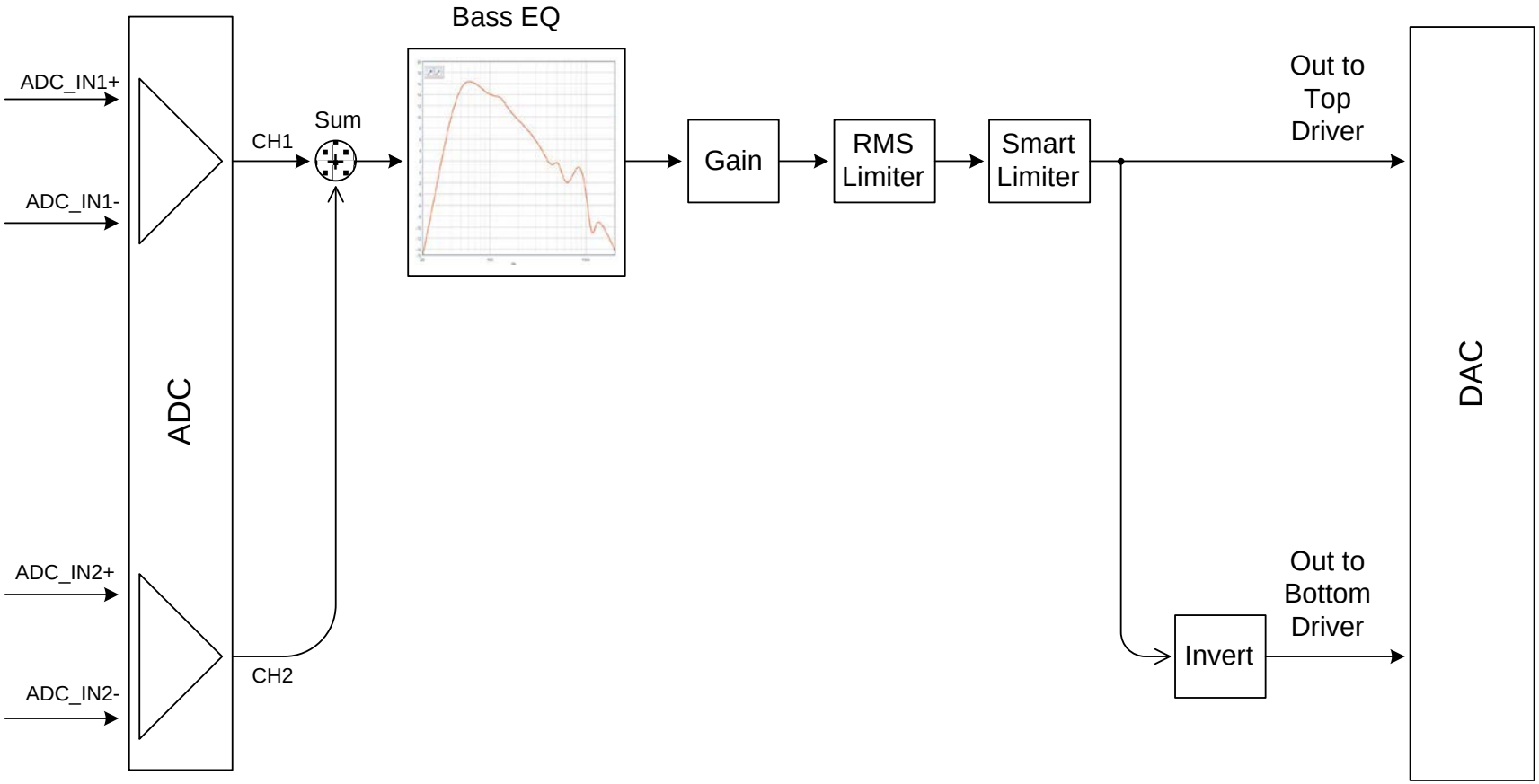
F1 Audio Flow: Model 812 - Amp



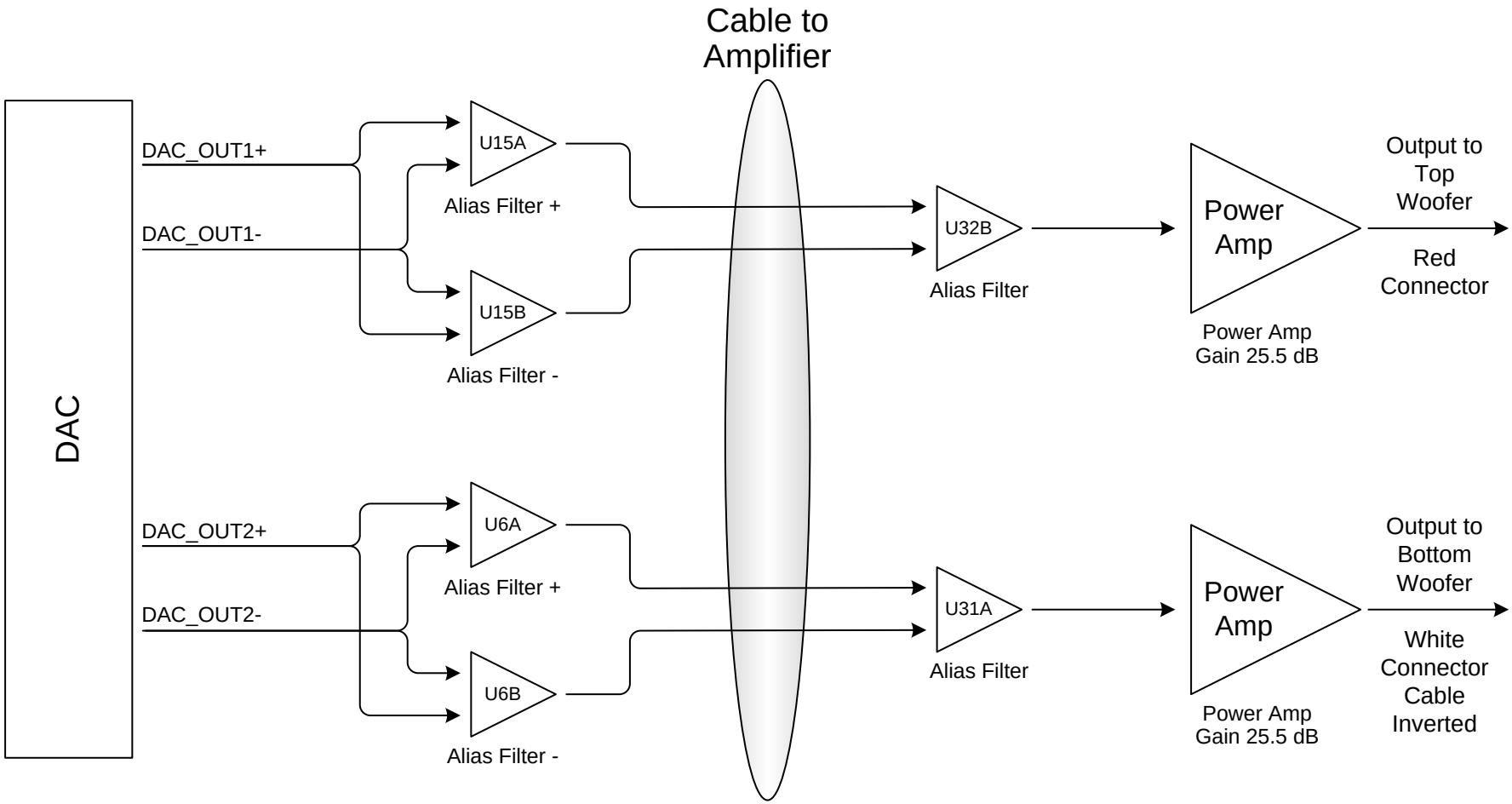
F1 Audio Flow: Subwoofer - Input



F1 Audio Flow: Subwoofer - DSP



F1 Audio Flow: Subwoofer - Amp



Troubleshooting

- Start w/ customer complaint
- Observe power up
- Replace board if failure is obvious
- Or, replace with known good board to further isolate the problem

Overview

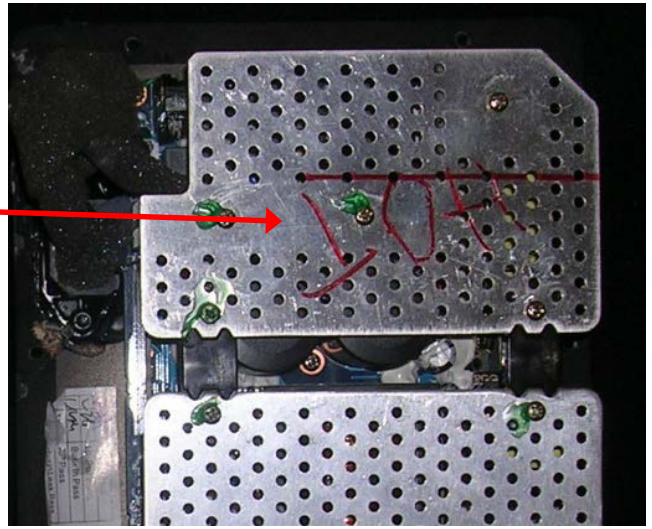
- Cool product
  - Two PCBs
    1. Input and DSP
    2. Power Supply and Amplifier
  - Internal Firmware on DSP
    - Firmware can be Reloaded Externally using Aardvark Adapter

Troubleshooting

- Debug to Board level
  - DSP Board
  - Power Supply & Amplifier Board

WARNING

Components on the Power Supply
Under the smaller heat sink
Have a very long bleed down time
And take 20 minutes to discharge
From 390Vdc down to 60Vdc



Troubleshooting: High Voltage Warning

WARNING

Components on the Power Supply under the smaller heat sink have a very long bleed down time and take 20 minutes to discharge from 390Vdc down to 60Vdc after AC Power is unplugged or unit turned Off.

When the PS & Amp Board is removed from the Cover Plate the voltage exposed is shown on the next slide.

Troubleshooting: HV Discharge

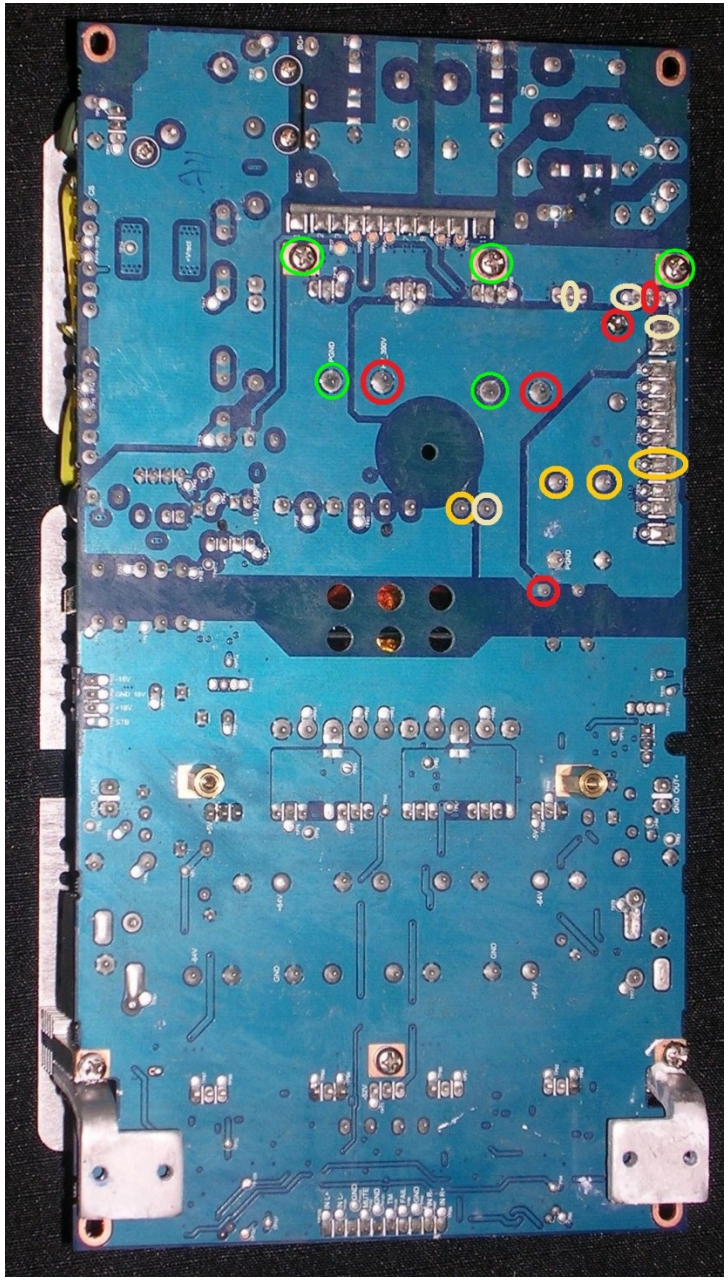
High Voltage (390Vdc AC Side Power) may be discharged by placing a 5K Ohm 5W resistor Between any Red and Green Points shown for 10 seconds

Red: HV_390V

Green: PGND

Yellow & White:

Between HV_390V and PGND



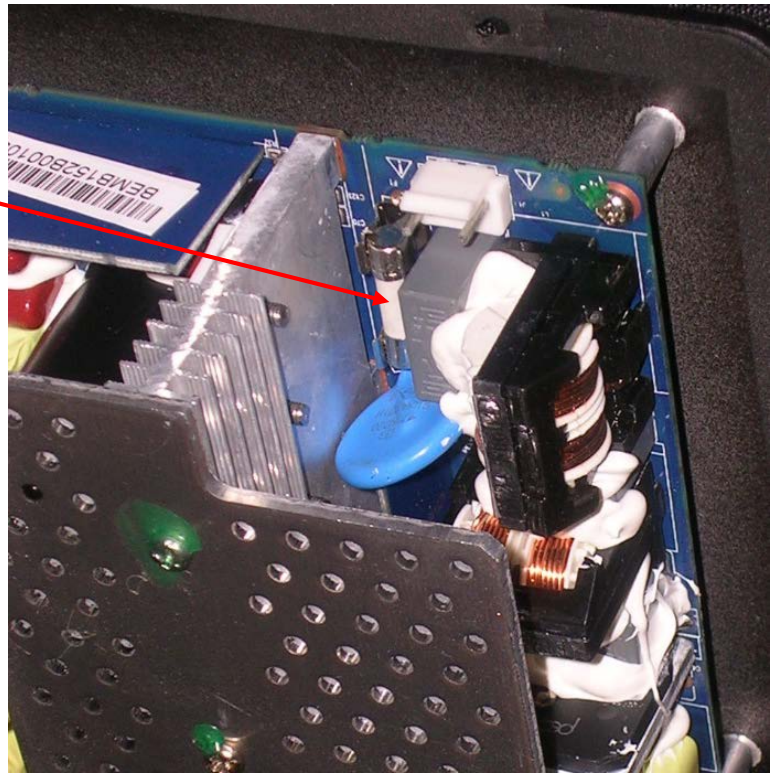
Troubleshooting: Dead or No LEDS

- Dead or No LEDs
  - Check AC Power Cable and On/Off Switch
  - Suspect Power Supply:

    Power/Fault will always be Green or Red when DSP has power
  - Blame Management (always !)
  - May be Blown Fuse: F1, Fx1, or FX2: All on Power Supply

Troubleshooting: Dead or No LEDS

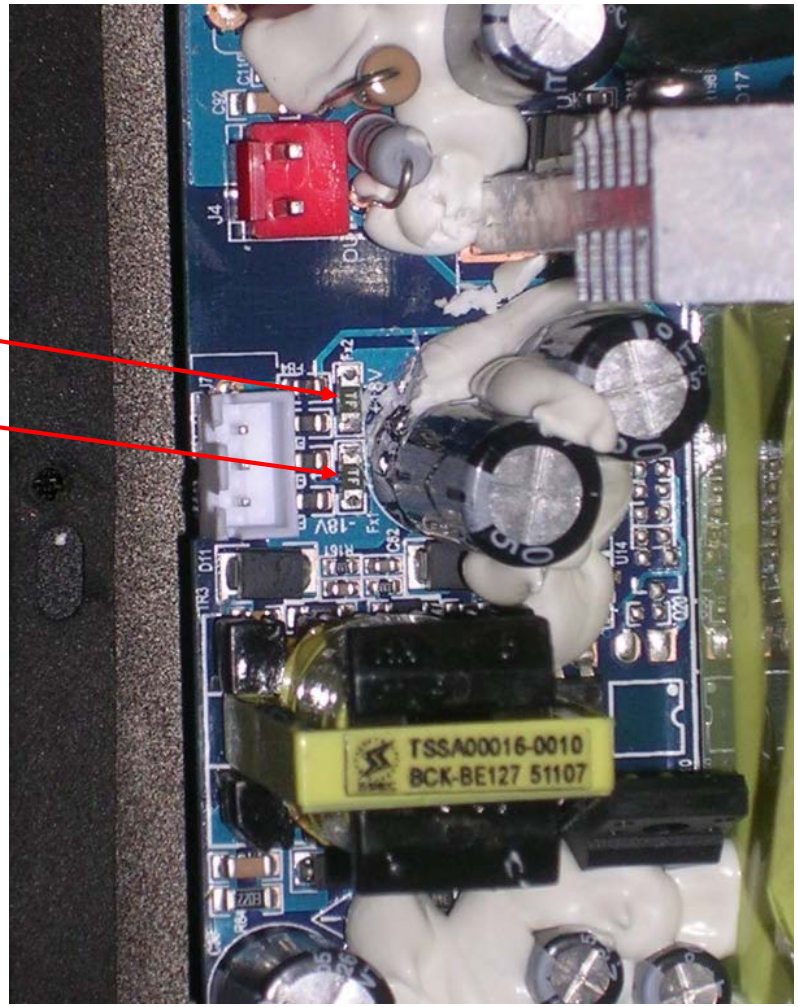
AC Line Fuse F1



Troubleshooting: Dead or No LEDS

Fuses on PS for
DSP Power:
+18V Fx2
-18V Fx1

Note: Plugging the DSP in with Power On will blow these.



Troubleshooting: No Audio Out

- With Audio applied, No SIGNAL/CLIP indication
  - Verify Audio Source: 0 dBV is good level to use
  - Volume knob is up (Noon).
  - Check Both Channels
  - One channel works and the other does not: Bad DSP Board
  - Neither channel: Verify DSP Code Rev using F1 Update Tool
  - Reload Code if Aardvark Interface is working
  - Otherwise suspect defective DSP Board

Troubleshooting: No Audio Out

- With Audio applied, SIGNAL/CLIP active
  - LEDs are driven by DSP, so audio path to DSP is good
  - Check Audio Cable from DSP to PS is fully seated
  - Check Cables from Amplifier to Drivers
  - Replace Amplifier
  - Replace DSP Board

Troubleshooting: Poor Audio Out

- Audio Out Sounds Bad
  - What kind of junk are they playing ? (GIGO)
  - Verify Input Cables are properly plugged in
  - Check Audio Cable from DSP to PS is fully seated
  - Verify that -18V is on DSP Power Connector
  - Replace DSP Board
  - Replace Amplifier

Questions?

- Next is software update procedure