Service Manual

K.2 Series

Product Models:	K8.2, K10.2, K12.2
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Revision:	A

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K.2 Series Service Manual

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1. Introduction

1.1 Restriction of Hazardous Substances Directive (RoHS)

QSC K.2 Series powered loudspeakers are manufactured to conform to the European Union's RoHS Directive, which reduces the amount of hazardous substances allowed in products for sale within its member nations. In electronic equipment such as audio processors, this applies primarily to certain toxic heavy metals, such as lead, which may be present in electronic components, solder, and other parts.

RoHS-compliant materials

When servicing RoHS-compliant electronic products, it is important for the service technician to use only RoHS-compliant components and solder (lead-free). All replacement parts provided by QSC for RoHS-compliant products are certified as RoHS compliant.

RoHS-compliant tools

Soldering irons and desoldering apparatus used on RoHS-compliant products must also not be contaminated by hazardous substances, such as lead. Therefore, you cannot use the same soldering and desoldering tools for RoHS-compliant products and solder as you do for non-compliant products and solder. You must either use separate soldering irons, desoldering tools and braid, etc., or at the very least designate separate tips and braids and use only the appropriate ones. If you contaminate a tip or braid, even inadvertently, by using it on a non-compliant product or solder, you should no longer use it with RoHS-compliant products or solder.

1.2 Revision history

No revision history yet. First revision released March 2018.

1.3 Service manual contents

Starting late 2017, QSC changed the key contents inside the Service Manual. Because hardware or software may undergo several changes during the life of this product, schematic diagrams, PCB images, and full BOM are not available in this service manual. This new structure will reduce the overall page count and number of revisions, making the service manual easier to navigate.

Please download these supplemental documents from the Service Partner Portal at **www.qsc.com/login** (registration and login are required) or contact QSC for them. The Service Partner Portal is always up-to-date with the latest information and service documents.

1.4 Service bulletins

At the publish date of this service manual, two service bulletins concerning the K.2 Series have been issued. Check the QSC Service Partner Portal or contact QSC Technical Services Group (TSG) for the latest information on applicable service documents.

These service bulletins apply to K.2 series loudspeakers that should be noted:

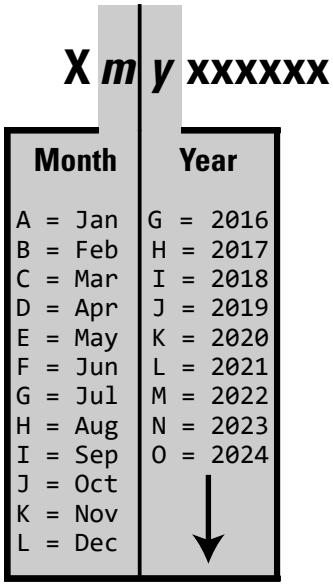
- **K2-001: No power**. Applies to K8.2, K10.2, and K12.2 with serial date code VAHxxxxxx - VHHxxxxxx / GAHxxxxxx - GHHxxxxxx. A very small percentage of K.2 powered loudspeakers built before September 2017 may not power up, either when first turning on the speaker or after some use. The speaker could fail quietly or make a popping sound. After the failure occurs, the amplifier module, which is located on the back of the speaker, is completely non-functional.
- **K2-002: No audio coming out of standby / chirping sounds**. Applies to K8.2, K10.2, and K12.2 with serial date code VAHxxxxxx - VIHxxxxxx / GAHxxxxxx - GIHxxxxxx. A very low percentage of K.2 powered loudspeakers could experience symptoms of no audio while coming out of standby, no audio after being turned on, or random chirping/buzzing sounds. The issue is more susceptible to high amplifier module temperatures and AC input voltages in the range of 125 V - 140 V or 250 V to 280 V.

1.5 Serial Numbers

Serial numbers on QSC K.2 Series powered loudspeakers are nine digits long. The second digit represents the month of manufacture, and the third digit represents the year; use the decoder chart on the right to find the manufacture date. (The first digit is an individual factory code, and the fourth through ninth digits are the sequential identifying number for each individual unit.) The K.2 series is manufactured in 2 different factories "V" and "G".

For example, a serial number of **VDH**xxxxxx would indicate that the product was built at factory "V" in 04/17, or April 2017.

The unit's serial number can be found on a label near the power inlet.



Important Note: The serial number is also stored in the flash memory on the input/DSP board. The K.2 Updater utility (a Windows application) can be used to view the serial number. However, if the input/DSP or amplifier module was replaced, the serial number in flash memory will not match the serial number on the label shipped with the product. Due to this fact, it's recommended to only use the physical serial number label in reference to the product's warranty. If in doubt, please contact QSC for further assistance.

1.6 Required equipment for service

Hardware and Software

- Personal computer (PC) running Windows® 7 or newer operating system with available USB2.0 or newer port
- K.2 Updater utility (not always required)
- USB Type A to microUSB cable

Tools required

- Various hand tools for electronic repair, including Phillips (#1, #2, extra long #2), flat (#2) and Hex (#4, 7mm, 9/32") screwdrivers, putty/butter knife, needle-nose pliers, etc.
- 2.5x or higher magnifier with lamp
- ROHS-compliant (lead-free) soldering iron, desoldering equipment, and solder

Service bench setup

- Custom K.2 series test adapter (for amplifier module bench testing)
- Non-inductive load resistors, configurable as 16Ω (min. 225 watts capacity), as 2Ω (min. 1000 watts capacity).
- XLR male and female cables
- Digital multimeter (DMM) with RMS AC voltage and current
- Oscilloscope (two or more traces, mixed signal, 250 MHz or higher) with digital frequency display
- Balanced signal tone generator, capable of 20 Hz to 20 kHz sine-wave and pink/white noise
- Grounded anti-ESD mat, wrist or ankle strap

2. Product specification and images

K.2 Series Specifications

	K8.2	K10.2	K12.2
Configuration:	Multi-purpose, 2-way powered loudspeaker		
LF Transducer:	8" (203 mm), cone	10" (254 mm), cone	12" (305 mm), cone
HF Transducer:	1.4" (35.6 mm) titanium diaphragm compression driver		
Frequency Response (-6 dB):	59 Hz - 20 kHz	56 Hz - 20 kHz	50 Hz - 20 kHz
Frequency Range (-10 dB):	55 Hz - 20 kHz	50 Hz - 20 kHz	45 Hz - 20 kHz
Nominal Coverage Angle:	105° Axisymetric	90° Axisymetric	75° Axisymetric
Maximum Rated SPL[1]:	128 dB Peak	130 dB Peak	132 dB Peak
Amplifier:	Class D Peak: 1800 W (LF), 225 W (HF)		
Cooling:	Low-noise, variable speed fan		
Controls:	Power 3 x Level Rotary encoder 2 x selection buttons		
Indicators:	Monochrome LCD Display 1.75" x 1" (45 mm x 25.4 mm) 2 x Power LED (front and rear) 3 x Input Signal LED Input A MIC selected LED Input B HI-Z selected LED Limiter active LED		
Connectors:	2 x locking XLR/F ¼" combo (Mic/Line Input and Hi-Z/Line Input 1 x 3.5 mm TRS (Stereo Input) 2 x XLR/M (Loop-thru Output) 1 x XLR/M (Mix Output) 1 x locking IEC power connector		
AC Power Input:	Universal power supply 100 – 240 VAC, 50 – 60 Hz		
AC Power Consumption 1/8th Power:	100 VAC, 2.1 A • 120 VAC, 1.9 A • 240 VAC, 1.1 A		
Enclosure Details			
Enclosure Enclosure:	Impact Resistant ABS		
Attachment Points:	2 x M10 threaded inserts plus integrated Pull-Back		
Color:	Black (RAL 9011)		
Grille:	18 Gauge powered coated steel, internal cloth lining		
Dimensions (H x W x D):	17.7 x 11 x 10.6 in 449 x 280 x 269 mm	20.4 x 12.6 x 11.8 in 519 x 320 x 300 mm	23.7 x 14 x 13.8 in 602 x 356 x 350 mm
Net Weight:	12.2 kg (27 lbs)	14.5 kg (32 lbs)	17.7 kg (39 lbs)
Shipping Weight:	14.4 kg (31.8 lbs)	17.6 kg (38.8 lbs)	21.7 kg (47.8 lbs)
Regulatory:	CE, WEEE, UL, China RoHS, RoHS II, FCC Class B		
Optional Accessories:	K8 Tote, K8 Outdoor Cover M10 Kit-C, K.2 LOC (Lock-Out Cover) K8.2 Yoke	K10 Tote, K10 Outdoor Cover M10 Kit-C, K.2 LOC (Lock-Out Cover) K10.2 Yoke	K12 Tote, K12 Outdoor Cover M10 Kit-C, K.2 LOC (Lock-Out Cover) K12.2 Yoke

[1] Peak SPL is measured on-axis at 1 m, with dynamic pink noise.

✻ With product registration. Visit qsc.com for full details.

Specifications subject to change without notice.

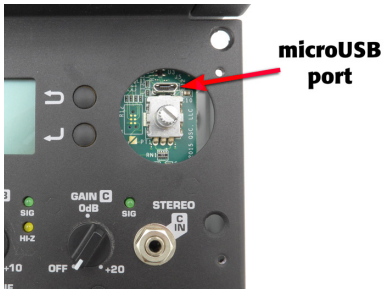
3. Firmware & software

3.1 Firmware revision history

Current revision at the publication of this service manual (December 2017) is: **v1.0.8.5**

Firmware revision	Release date	Notes
1.0.8.5	Pilot	• Initial (Pilot) K.2 firmware release

3.2 Firmware update instructions



Requirements

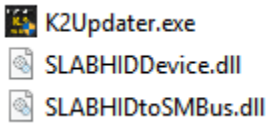
- Windows PC only (native MAC OS not supported)
- USB Type A to microUSB cable
- AC power cord

Scenes

Saved user scenes (input selector setting, preset selection, crossover, delay, EQ, LED, and contrast) are stored in a different flash memory location. These scenes should remain saved and load fine after a successful firmware update.

Updating firmware using the K.2 Updater application

1. Download the latest K.2 Updater application (in .zip format) from the QSC website.
2. Extract the contents of the zip file into a new folder on your computer.
3. View the contents of the new folder. Three files (K2Updater.exe, SLABHIDDEVICE.dll, and SLABHIDtoSMBus.dll) should exist in the folder.



4. Connect the AC power cord to the power inlet on the K.2 amplifier module.
5. Remove the rotary encoder knob (to the right of the LCD screen).
6. Connect the USB Type A to microUSB cable. The Type A end connects to your computer's USB port and the microUSB end connects to the port above the rotary encoder part on the K.2.
7. Turn the amplifier module on by flipping the power switch.
8. Open K2Updater.exe by double-clicking on the file/icon. The K.2 Updater application provides information about the K.2 device in the table.
9. If an update is needed, a button to update the firmware will appear under the "Actions" column. If no update is needed, "Firmware up to date" will appear instead.
10. Click the Update button to proceed with the firmware update.

    Caution: Do not disconnect the USB cable or remove power from the amplifier module during an update!
11. After the update is complete, power cycle the amplifier module and verify the firmware version matches the K.2 Updater version.

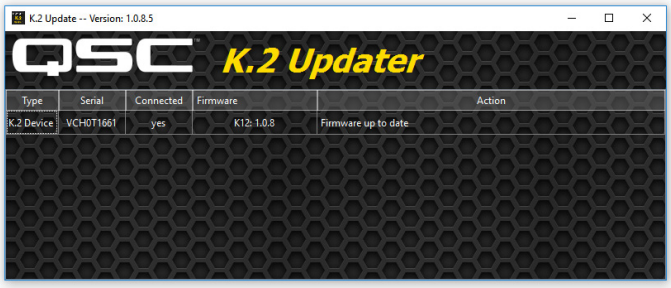


Figure 3.2.1 - K.2 Updater application in Windows OS.

Note: If you receive the message "Please update application. Firmware more recent", then the K.2 Updater application is an older version than the firmware version detected in the K.2 amplifier module. Because individual firmware files are stored and encoded in the K.2 Updater application, you must download a newer version of the K.2 Updater application to peform a firmware update. If in doubt, always download the most recent K.2 Updater from the QSC website.

3.3 Test Mode application

In some cases it may be useful to place the amplifier module into "Test Mode" for bench testing or troubleshooting. To enable Test Mode, use the K.2 Test Mode application on a Windows OS.

Proceed with caution while in Test Mode

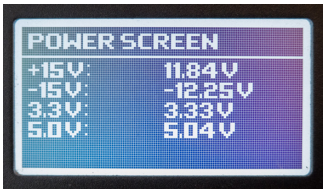
Enabling Test Mode removes DSP limiting, voicing, and EQ. This allows us to test the amplifier module to full power specifications. Please keep in mind the following when using Test Mode:

- DSP limiting is disabled, which allows the maximum output voltage and power to both channels.
- DSP voicing and EQ (including the 2 kHz crossover between channels) is disabled. All frequencies can pass through both LF and HF output channels, providing a mostly flat response output.
- Test Mode should only be used when the amplifier module is disconnected from the K.2 speaker enclosure (effectively disconnecting the LF and HF transducers from the system). ***If Test Mode is enabled when the drivers are connected to the amplifier module and an active input signal is present, there is a risk of damaging the drivers!***

Requirements

The hardware and software requirements for the Test Mode application are similar to the K.2 Updater application.

- Windows PC only (native MAC OS not supported)
- USB Type A to microUSB cable
- AC power cord



Test Mode functions by page

Page / Function	Description
TEST MODE	
TEMP	External temperature reading from temperature sensor (location U8 on the AMP/PSU board, bottom side nearest the heatsink).
MCU TEMP	Internal temperature reading in the Cortex microcontroller die (location U2 on the input/DSP board).
ACV	AC voltage reading from AC voltage monitor circuit (location U9 on AMP/PSU board).
STAND BY	
AUTO	(Default). Start-up timer, AC dead zone, and DC dead zone will places amps in standby. (Not the same as normal Standby mode.)
AMPS ON	Amplifiers always on. Ignore any condition that can put the amplifiers in standby mode.
FAN MODE	
OFF	Fan all the way off - 0%
LOW	Fan at low speed - 50%
HIGH	(Default) Fan at high speed - 100%
TEMP TEST	
OFF	(Default) Temperature test off.
START	Run temperature test. During the test the DSP applies a high level pink noise to the amp channels while the temperature is measured for 45 seconds. If temperature significantly increases, returns a "Pass". If temperature does not increase, returns a "Fail". Primarily used to determine if the temperature sensor U8 is working, but can also be useful to check output.
BURN IN	
OFF	(Default) Burn in test off.
ON	Burn in test on. Commands the DSP to apply a high level pink noise to both amp channels (no timeout).
POWER TEST	
OFF	(Default) Power test off.
ON	Power test on. Adds an LF RMS limiter through the DSP signal path and connects the limit LED to that limiter. The mode allows for long term power testing.
CROSSOVER TEST	Should be renamed to "Cross Talk Test".
BOTH	(Default) Both channels on.
HF / LF OFF	High frequency channel ON. Low frequency channel OFF.
LF / HF OFF	Low frequency channel ON. High frequency channel OFF.
POWER SCREEN	
+15V, -15V, 3.3V, 5.0V	Measures power rails. If the ±15V rails drop below ±12.3V in RUN mode, this could cause the +12VLOW voltage rails to drop to 8-9V, which causes major issues in the amplifier MOSFET gate drivers. In Standby mode, this voltage naturally drops to 8-9V because the PSU is in "Passive (RC) Clamp" mode. The 3.3V and 5.0V rails should be steady and not swing by more than 100mV.

Enabling Test Mode using the K.2 Test Mode application

1. Download the latest K.2 Test Mode application (in .zip format) from the QSC website.
2. Extract the contents of the zip file into a new folder on your computer.
3. View the contents of the new folder. Three files (K2TestMode.exe, SLABHIDDEVICE.dll, and SLABHIDtoSMBus.dll) should exist in the folder.
4. Connect the AC power cord to the power inlet on the K.2 amplifier module.
5. Remove the rotary encoder knob (to the right of the LCD screen).
6. Connect the USB Type A to microUSB cable. The Type A end connects to your computer's USB port and the microUSB end connects to the port above the rotary encoder part on the K.2.
7. Flip the power switch on the amplifier module to turn it on.
8. Open K2TestMode.exe by double-clicking on the file/icon. The K.2 Test Mode application provides information about the K.2 device in the table.
9. To enable Test mode, click on the slider button to move it from Disabled to Enable.

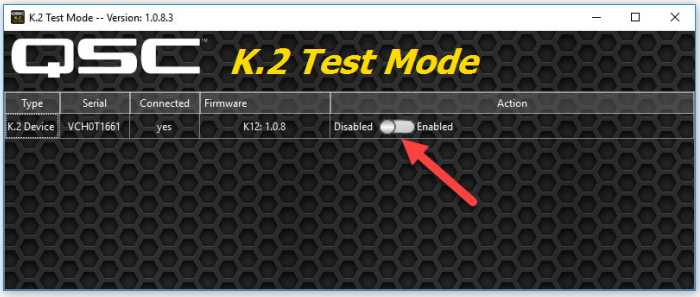


Figure 3.3.1 - Enabling or disabling Test Mode.

10. Power cycle the amplifier module by turning the power switch off, waiting at least 2 seconds, and turning the switch back on.
11. If Test Mode was successfully enabled, the LCD screen will show the Test Mode home screen as shown in Figure 3.3.2 and the amplifier module's fan running in high speed.

    Caution!: Once Test Mode is enabled, do not apply any signal until the amplifier module has been disconnected from the speaker loads. Failure to do so could result in over-driven LF or HF transducers because DSP limiting is disabled. Only use resistive test loads while in Test Mode.

Figure 3.3.2 - Test Mode home page on LCD.

Disabling Test Mode using the K.2 Test Mode application

Always disable Test Mode before returning the amplifier back to service. Follow the instructions below.

1. Repeat steps 4 through 8 in the section above.
2. To disable Test mode, click on the slider button to move it from Enable to Disabled.
3. Power cycle the amplifier module by turning the power switch off, waiting at least 2 seconds, and turning the switch back on.
4. If Test Mode was successfully disabled, the LCD screen will show the default K.2 home screen. See Figure 3.3.3.

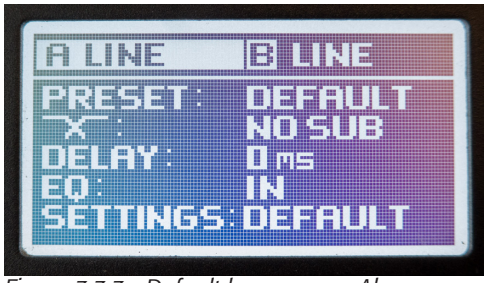


Figure 3.3.3 - Default home page. Always disable Test Mode after returning to service.

4. Operational description

4.1 Series description

The QSC K.2 Series represents the best-in-class loudspeaker for today's demanding audio professionals. The perfect combination of elegant design, superior audio performance, high functionality, simple and intuitive operation, and genuine QSC reliability, K.2 delivers extraordinary results for users in both portable and installed applications.

The 2000 Watt power module delivers ample burst and continuous power for the loudspeaker's premium drivers. It has been designed with very low-noise fan cooling, enabling the enclosures to be used in settings where background noise must be kept to a minimum. Carefully tailored, subtle and sophisticated dynamics processing is used to protect the drivers from damage and the performance from distortion.

Each model is housed in a rugged ABS enclosure with a professional yet unobtrusive appearance that is at home in any application. Each model can be utilized in either main PA or floor monitor applications, while ergonomic handles and a heavy-duty steel grille with fabric lining further enhance overall appearance and functionality. The dual pole cups allow a zero or 7.5 degree downward tilt when deployed on a pole. This allows for more even coverage across the listening area and less problems due to rear wall reflections.

4.2 Model descriptions

The K.2 series has three loudspeaker models: K8.2, K10.2, and K12.2. The enclosures are constructed of ABS plastic and painted over with QSC black (RAL color # 9011). The front grille is 16 gauge steel and finished with black powder coat to best match the enclosure color. Behind the grille is the main baffle of the speaker. The baffle design incorporates a wave guide that determines the coverage angle of the loudspeaker. Attached to the baffle are the two transducers — the low and high frequency. Each model has a different size low frequency woofer. The woofer diameter on the K8.2 is 8", K10.2 is 10" and K12.2 is 12". The bass response of each model is increased as woofer diameter size increases. All models share the same 1.4" titanium high frequency compression driver.

The transducers are powered by a brand new two-channel class D amplifier module, which is fastened to the rear of the enclosure. Unlike the original K series enclosures, the K.2 series enclosures are sealed off in the rear, leaving only a small hole for the Molex connector to fit through. When the amplifier module is fastened to the enclosure, an air-tight seal is created around the Molex connector. The amplifier module is bi-amped. The low frequency channel outputs frequencies below 2 kHz to the low frequency transducer, while the high frequency channel outputs frequencies above 2 kHz to the high frequency transducer.

All K.2 models are effective as mains or monitors. They can be placed sideways in the monitor wedge position. All models share the same handles and hardware. The dual position pole-cup piece is the same on each model. The speakers can be placed on a speaker stand at a 0 or 7.5 angle down-tilt position. Several mounting points are available for vertical suspension with QSC's M10 Kit-C. If horizontal suspension is preferred, a yoke mount kit must be used.

4.3 Amplifier module

Overview

K.2 Series amplifier modules have high power capability and tons of features packed into a custom module that fits into the back of K.2 enclosures. The same hardware is shared between all models, with the only difference being the DSP firmware and exterior labels noting the model. If comparing the bill of material between the K8.2, K10.2 and K12.2, the electronic components would be exactly the same. K.2 Series amplifier modules are specifically designed for K.2 enclosures and transducers. They should not be used in any other QSC powered loudspeaker.

The amplifier module is comprised of four separate PCB assemblies: the AC line filter board, AMP/PSU board, input/DSP board, and LCD board. The AMP/PSU board is a universal switch-mode power supply, working in regions with 120V or 230V AC mains. The AMP/PSU board also contains two class D output stages in a bi-amp configuration. The input/DSP board is comprised of mostly analog/digital audio signal processing, physical input/output connections, and peripheral control (LCD display, buttons, LEDs, potentiometers) for the amplifier module. And finally, the LCD board contains a liquid crystal display, rotary encoder, buttons, and debouncer circuitry.

Detailed information on the circuits in these boards is described in the next sections.

Figure 4.3.1 - Amplifier module

Startup sequence

The startup sequence for K.2 series is similar to the original K series. The PWM controller at U15 charges itself up when AC voltage is present above a certain threshold, approximately 85 Vac. Once U15 has charged up, the switch mode power supply (SMPS) is switched on. During these first seconds, the class D amplifier circuits are disabled by default.

Once auxiliary voltages (±15V, ± 5V, and +12VLOW) rise on the secondary side of the transformer, the microcontroller (MCU) and DSP will begin to boot. All audio outputs are muted in the DSP until the voltages at the AC monitor (circuit at U9) and a couple other internal voltages (+15V, -15V, +5VA_A, and +3.3VD) are measured by the DSP and MCU through ADC inputs. The voltages must be within bounds to continue. If the measured AC voltage is between 100 – 140 Vac, the AC voltage doubler circuit is enabled. The heatsink temperature must also be within an operable range. The DSP and MCU communicate over an SPI bus and both ultimately decide what to do next. If everything checks fine, the DSP and MCU will allow audio output and enable the amplifiers (normal operation).

AC line filter board

The line filter board has an AC input and filtered AC output. The brown wire (AC line) comes from the power switch and blue wire (AC neutral) come straight from the power inlet. When the power switch is turned on, the line filter circuit is energized. The filtered AC output goes to a wiring harness that connects to the AMP/PSU board.

A simple line filter attenuates electrical noise coupled to the AC mains. It's comprised of a fuse and a pair of common-mode inductors with a cross-line capacitor on each side. Between them, a pair of differential-mode capacitors (C42 and C43) connect to earth/ground. Resistor R42 discharges the capacitors when the amplifier is disconnected from AC mains. The fuse at location F41 on the line filter board is not the standard glass tube type. If the fuse blows, a new fuse cannot be easily inserted back in. Soldering is required to replace the fuse.

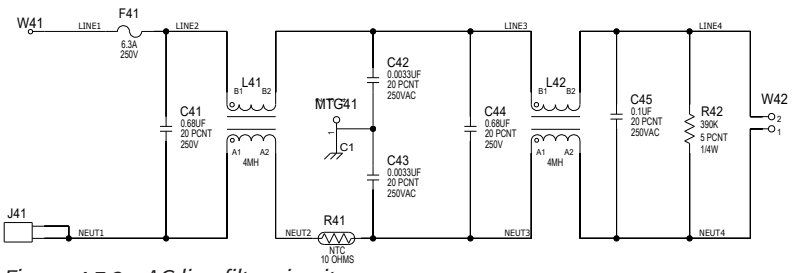


Figure 4.3.2 - AC line filter circuit

Power supply

The amplifier module's switch mode power supply is a regulated, fixed frequency, active clamp flyback. It is similar to a typical flyback converter except that when the main switch is off another switch turns on and recovers the transformer energy into a resonant tank. A typical flyback power supply has good cross-regulation and can operate over a wide input voltage range, but the power dissipation of a passive clamp limits the power level a flyback can reasonably output; adding the active clamp allows a flyback converter to scale to much higher power levels. The power supply accepts universal AC voltages, the incoming mains voltage is bridge rectified to DC and stored in a bank of 2 primary capacitors in series. This rectified voltage varies directly with mains voltage.

The main and clamp FETs, operating at approximately188 kHz, couple energy to the secondary diodes through the transformer. The regulated ±77V secondary voltage is stored in a pair of secondary capacitors, one per rail. Regulation is taken across the entire +144V secondary voltage, relying on proper circuit operation to keep the rails balanced. Adjusting the duty cycle of the PWM signal driving the power supply FETs keeps the power supply's output voltage constant regardless of changes to input voltage or load.

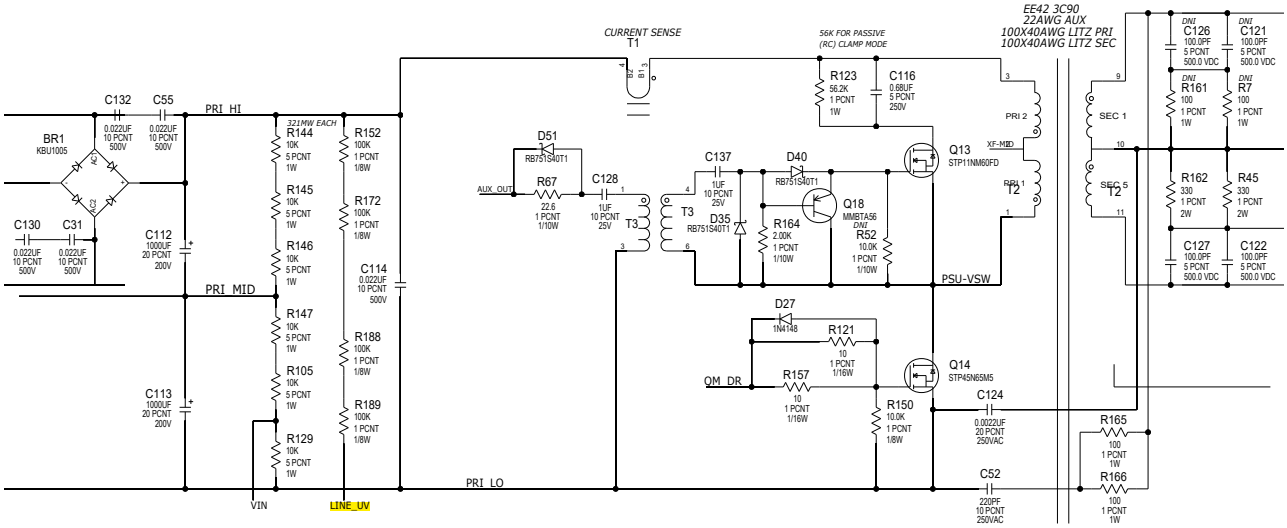


Figure 4.3.3 - Active flyback converter circuit used in the K.2 series SMPS

Auxiliary voltages of ±15V, ± 5V, and +12VLOW are created with separate transformer windings from the main secondary rails, but all windings are tied together at ground. Under load, the amplifiers will pull energy from the main rails and the power supply will increase the duty cycle to compensate and keep the main rails at ±77V; this means the housekeeping voltages increase under load. The auxiliary voltages are used to power numerous circuits across the amplifier module, like the op-amps, DSP, microcontroller, and amplifier drivers.

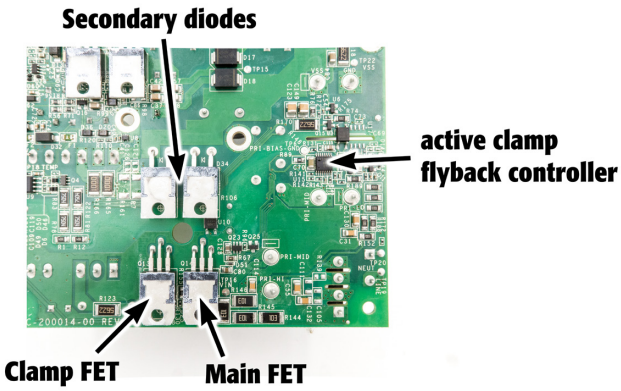


Figure 4.3.4 - SMPS circuit, PCB

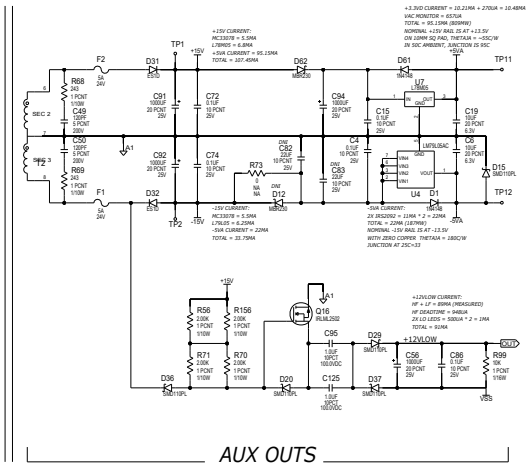


Figure 4.3.5 - Auxiliary voltages on the secondary

Class D amplifier

There are two class D half-bridge amplifiers in the module. One amplifier is designed for low frequency while the other is designed for high frequency. The power MOSFETs in the LF and HF sections are different devices, so pay close attention when replacing them. Each of the amplifiers are a type of class D amplifier called 'self-oscillating', as opposed to a class D amplifier that requires a clock to switch. To avoid interference, the amplifiers oscillate at different frequencies. The LF amplifier oscillates at 372 kHz and the HF amplifier oscillates at 412 kHz. The class D driver used in this design has a built-in PWM modulator, which allows the driver to accept an inverted analog input (as opposed to a PWM input) directly.

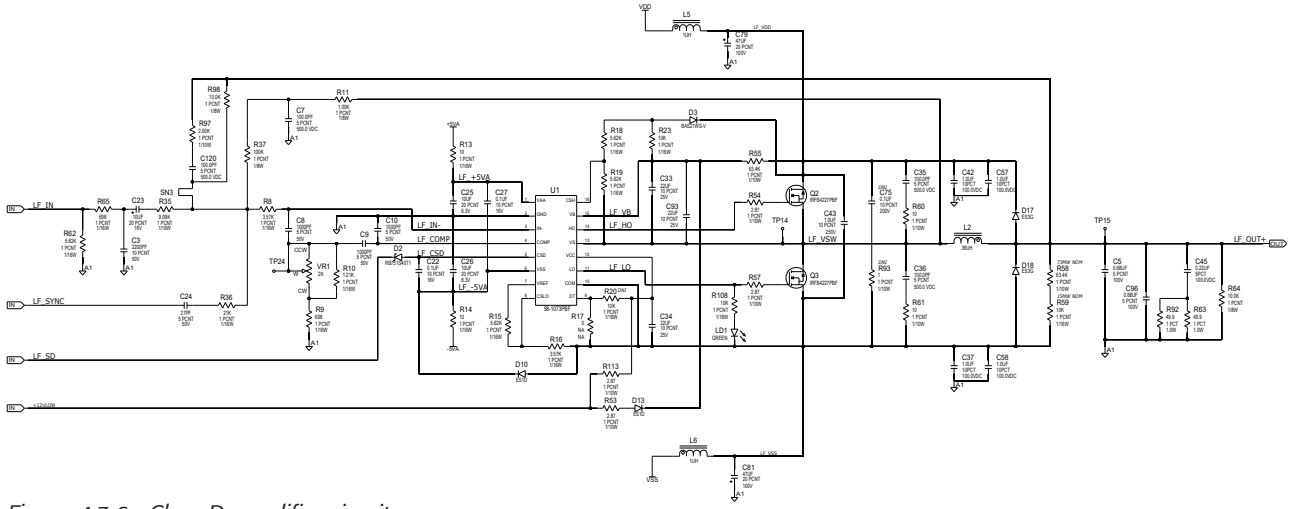


Figure 4.3.6 - Class D amplifier circuit

The modulated switching voltage must be filtered to recover the audio signal before being connected to a transducer. The filter uses a toroid inductor and film capacitor for each channel. In the LF and HF amplifiers, different pairs of inductance/capacitance are utilized since the output frequency and power is drastically different between the two channels. Although not required with the type of self-oscillating amplifier used in the amplifier module, small Zobel filters are present on each channel to aid in stability and help reduce cross-channel interference during over-current (OC) conditions.

A 6-pin molex connector, sticking through the back of the module into the loudspeaker cabinet, brings both amplifier outputs to the transducers via a detachable wire harness. Another pair of wires goes to the front LED which is mounted in the loudspeaker cabinet.

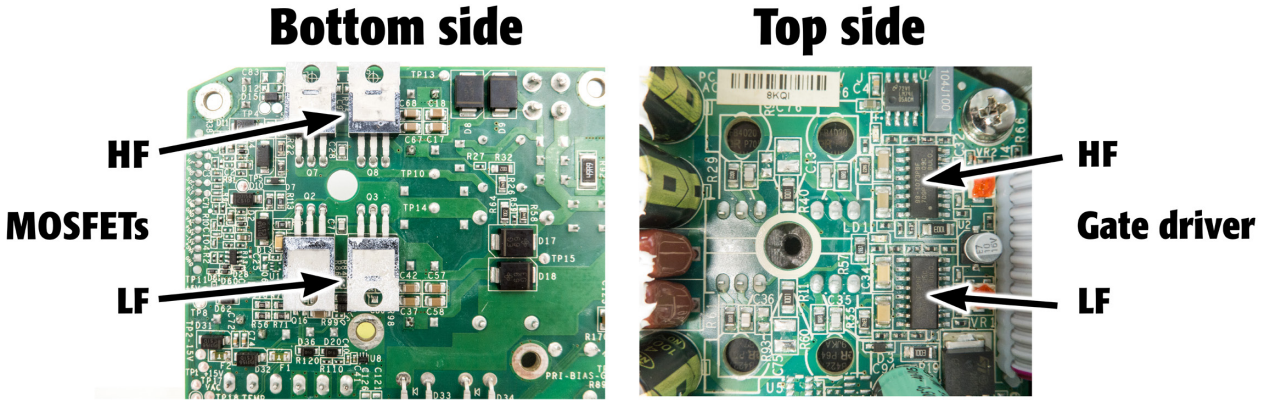


Figure 4.3.7 - Top and bottom sides of the AMP/PSU board, showing the locations of the major Class D components

Input/DSP board

The input section consists of three separate inputs (MIC/LINE, LINE/INST, and AUX STEREO) which are summed together before entering an audio codec that transmits the digitized audio to the DSP. The integrated DSP is configured to process the incoming audio signal and finely tune it (low/high pass filtering, EQ, limiting, compression, and more) before outputting the signal(s) to the amplifier stages. Due to this tuning, the K8.2, K10.2, and K12.2 amplifier modules cannot be interchanged between each other unless their DSP firmwares are changed. There is also a microprocessor on the input/DSP board which manages the LCD display, LEDs, buttons, and rotary encoder.

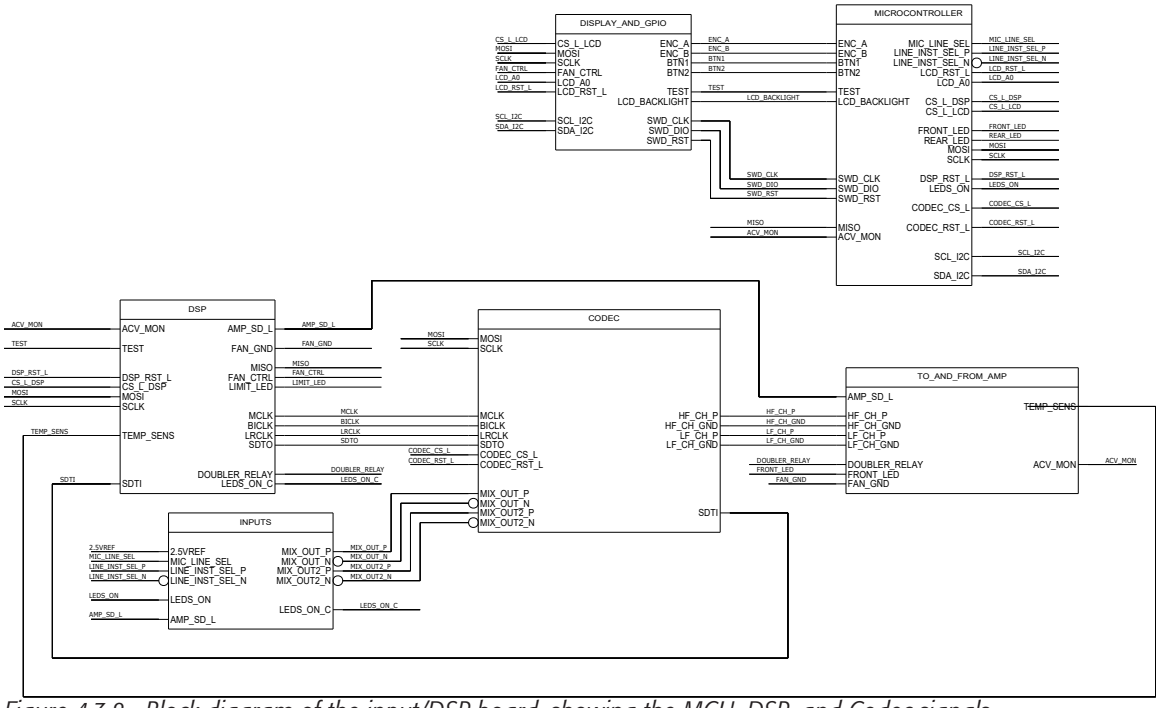


Figure 4.3.8 - Block diagram of the input/DSP board, showing the MCU, DSP, and Codec signals

LCD board

The LCD board contains a monochrome display, microUSB connector, USB/I2C controller, rotary encoder, two navigational buttons, and debouncer circuitry. The USB controller allows for communication over the I2C bus between a computer and the microcontroller on the input/DSP board. The rotary encoder and buttons are read by the microcontroller, so a debouncer circuit is implemented to reduce error. Physical contacts can connect and disconnect multiple times during a button push or release, so a debouncer circuit cleans up the inputs to the microcontroller.

The LCD board is powered by the 3.3V rail, which originates on the input/DSP board and comes into the LCD board at connector J1:pin4. The 5V bus on the microUSB connector does not provide any power to other circuits in the amplifier module, and is only monitored by the USB/I2C controller.

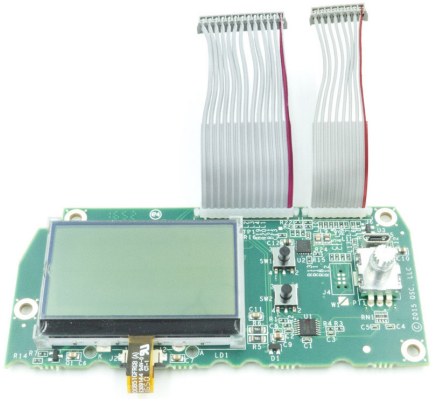


Figure 4.3.9 - LCD board

Protection schemes

The K.2 amplifier module has several protection schemes. The major ones are noted below:

Temperature

A small SMD temperature sensor at location U8 (on the bottom of the AMP/PSU board near diode D33) closely measures the heatsink temperature. The DSP is constantly reading the voltage output of the temperature sensor and pro-actively makes several adjustments.

The fan is one of the adjustments that reacts to temperature fluctuations. The fan turns on when the temperature sensor measures 49 °C. There is a voltage kick start of 1 second to get the fan spinning. The fan will then remain at idle until the module temperature reaches 55 °C. At 55 °C, the voltage to the fan will increase linearly until 70 °C, at which the fan will be at max speed. The fan turns off at 44° C and lower.

The class D amplifiers will shutdown when the temperature has exceeded 80 °C. When the DSP measures approximately 1.30 V on TEMP_SENSE, the DSP will pull SD_L to 0V, which drives AMP_SD_L low as well. Both LF and HF gate drivers at pin4 (CSD) are placed in shutdown, cutting all audio output. The amplifiers will turn back on after the fan cools the heatsink and temperature recovers to a safe level.

Higher temperatures also engage the DSP limiters, which attenuates the DSP output into the codec. This attenuation starts occurring at 70 °C and becomes more aggressive until the signal is fully cut at 80 °C. The attenuation is audible since the LF and HF amplifiers are receiving a lower signal from the DSP.

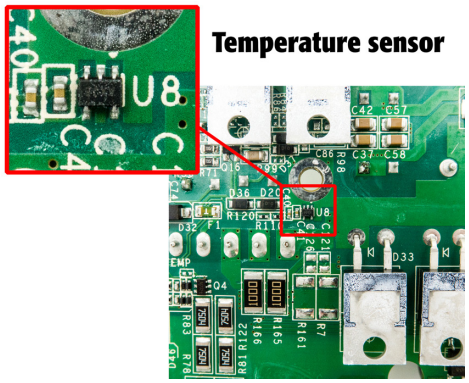


Figure 4.3.10 - Temperature sensor U8

AC voltage monitoring

There are two circuits that monitor the AC voltage in different ways. The first circuit is an AC detector that monitors the AC line at the bridge rectifier. The measured voltage from the detector indirectly has an effect on power supply regulation and bias, affecting the voltage at LINEUV in the active clamp flyback controller (U15 pin 15).

The second circuit is an AC voltage monitor. The output of the monitor (U9 pin7) is read by both the DSP and microcontroller. The **DSP** uses the AC voltage reading in two ways:

- to drive the DOUBLER_RELAY signal high, energizing relay K2 and turning on the voltage doubler at the bridge rectifier
- to place the amplifiers into shutdown mode if AC voltage is too low (below 90 Vac), too high (above 280 Vac), or in an AC dead zone (140 - 180 Vac).

The microcontroller uses the AC voltage reading to display the AC voltage on the status pages on the LCD screen (if Test Mode is activated) and in various diagnostics in firmware.

DSP limiting

Limiting is all internal to the DSP, with the primary purpose of not over-driving either the LF or HF amplifier channels. If the audio input signal exceeds the predetermined tresholds, the DSP actively attenuates the signal down to the upper limit of what the amplifier channels can handle. There are several different limiting scenarios that are proprietary to QSC which cannot be further discussed here.

Shutdown sequence

During normal operation, the AC voltage is constantly being measured by the DSP. When the measured AC voltage drops, whether it be from turning off the power switch or AC service being cut, the DSP mutes audio and shuts down the amplifiers so that a controlled shutdown ensues as internal voltages decay. The SMPS will shut down when the voltage at PRI_HI reaches is below a preset threshold. The circuit was designed so this shouldn't happen during operation.

As a side note, changes in internal voltages can cause audio to stop, but this can only happen in an abnormal situation and should indicate a hardware fault. Over-temperature or under-temperature can cause muting but not shutdown. Hardware fault or product operation outside of design limits may be the cause of shutdown in an abnormal case.

5. Loudspeaker disassembly & repair instructions

To reduce the number of pages in this service manual, all K.2 Series loudspeakers have been combined into one section. The K10.2 powered loudspeaker is referenced for generic disassembly and repair procedures. The K8.2 and K12.2 models are assembled nearly identical to the K10.2.

Slight differences between the K.2 models:

- The K12.2's high frequency transducer is not secured to the front of the baffle with screws. Instead, it's all mounted behind the waveguide on the threaded studs with 4 nuts and 4 washers.
- There is no side handle on K8.2 models.
- K8.2 has a single port on the baffle, while K10.2 and K12.2 models have dual ports.
- The bottom rear foot is a custom shape and not interchangeable between models.
- The pole cup mounting plate is different and not interchangeable between models.

Torque specifications

Torque settings are not included in this service manual because they vary between models.

- All torque values can be found in the Exploded-View drawings.
- Each component that requires proper torque has a square box with a reference number (next to the item number). A legend of all torque values is referenced on the first page.

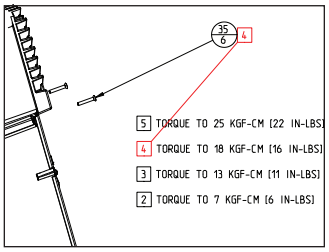


Figure 5.3.1 - Torque values in exploded-view drawings

5.1 Amplifier module

For in-depth removal and installation instructions on components inside the amplifier module, please see "6. Amplifier module disassembly & repair instructions" on page 23.

Removal

1. Disconnect any power and audio cords from the rear of the speaker.
2. Place the speaker upright, preferably near the edge of a table.
3. Remove 2 machine screws that secure the rubber feet to the amplifier module. These screws must be removed to access other screws beneath the rubber feet. See Figure 5.1.1.
4. Remove 6 plastite screws that secure the amplifier module to the speaker cabinet. *Only remove the screws noted in Figure 5.1.2*. There are other screws on the faceplate of the amplifier module that do not need to be removed at this stage.

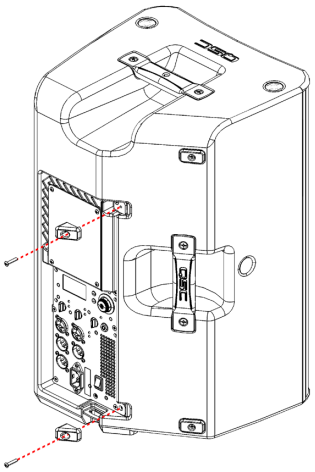


Figure 5.1.1 - Underneath the rubber feet are additional screws.

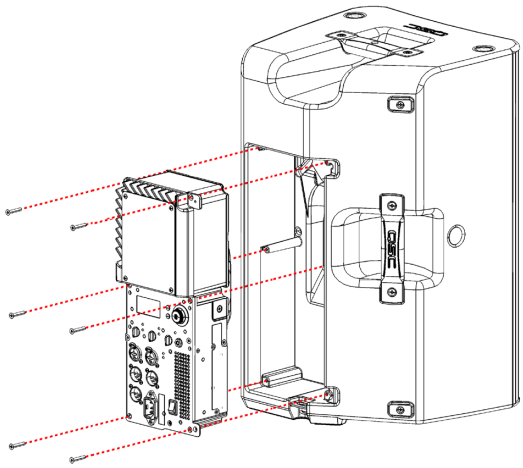


Figure 5.1.2 - Amplifier module with 6 plastite screws.

5. Using a flat head screwdriver or similar tool, gently pry the top-right corner tab of the amplifier module until its loose from the speaker cabinet. See the Figure 5.1.3 for best method to loosening the amplifier module.
6. Gently pull away the amplifier module from the cabinet and angle the module upwards for access to the wiring harness connector.

   Warning: Forcefully pulling the amplifier module out of the cabinet could damage the wiring harness connector on the rear side. The wiring harness must be disconnected before removing the amplifier module.
7. Disconnect the wiring harness from the rear of the amplifier module. Place pressure on the tab of the connector to fully disconnect the wiring harness.

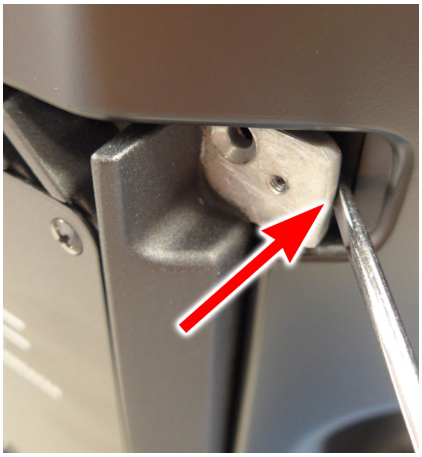


Figure 5.1.3 - Prying amplifier module away from enclosure.

Figure 5.1.4 - Accessing the wiring harness

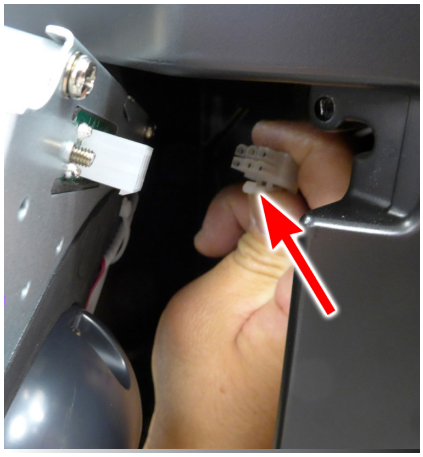


Figure 5.1.5 - Connector removal from amplifier jack.

   Important Tip: To access the connector, route your hand from the bottom of the enclosure and up towards the far back corner of the amplifier module. Placing the speaker upright on the edge of a table will make it easier for your hand and arm to access the connector. See Figure 5.1.4 and Figure 5.1.5 as a visual aide.
8. Fully remove the amplifier module from the enclosure.

Installation

1. Prepare to insert the amplifier module into the speaker cabinet.
2. With one hand holding the wiring harness and the other hand holding the amplifier module, place the module inside the cabinet and connect the wiring harness to the rear connector on the amplifier module.

   Important Tip: This procedure is much easier to perform when the speaker is upright, near the edge of a table. Before connecting, verify that the locking tab on the wiring harness connector is oriented in the same position as the amplifier jack. They should both point down.
3. Verify the connector is "locked" in place by gently pulling the wiring harness away from the jack and making sure it does not easily disconnect.
4. Gently insert the amplifier module completely into the cabinet.
5. Fasten 6 plastite screws that secure the amplifier module to the speaker cabinet. See Figure 5.1.2.
6. Fasten 2 machine screws, including the rubber feet, into the amplifier module. See Figure 5.1.1
7. Amplifier module installation is now complete.

5.2 Front grille

Removal

1. Remove the 7 screws that attach the front grille to the baffle as shown in Figure 5.2.1.
2. Using a putty or butter knife, pry the grille outward and remove it. If the grille is stuck, gently pry along the sides in multiple locations until the grille becomes loose enough to remove.

Installation

1. Verify that the gasket along the sides of the grille is still in place. If you are replacing the grille with a new one, install new gasket to reduce vibrations between the grille and baffle.
2. Fit the side edges of the grille in the space between the baffle and enclosure. Press down gently. Be careful not to bend the grille. If the grille does not fit in the space, the baffle may need to be realigned.
3. Fasten the 7 screws that secure the grille to the baffle.

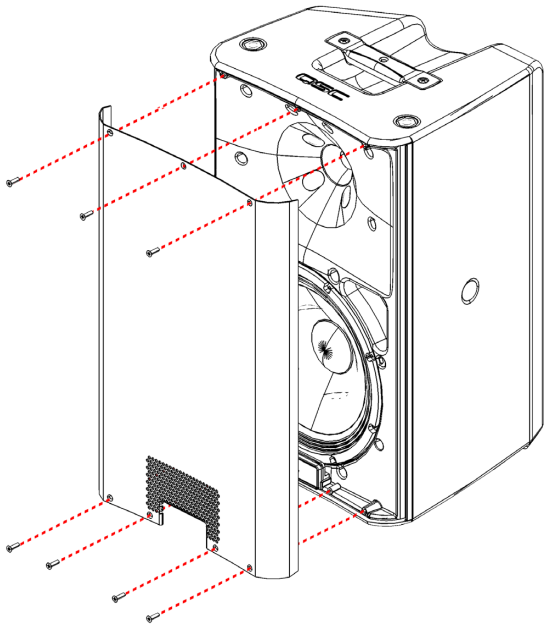


Figure 5.2.1 - Front grille assembly

5.3 Front baffle

Removal

1. To access the front baffle, the front grille must be removed. Follow the **Removal** instructions in "5.2 Front grille".
2. Remove all screws that secure the baffle to the enclosure. See Figure 5.3.1.

   Note: An extra long #4 hex head bit (like p/n WERA 840/4 IMP) is required to access the 2 screws in the middle of the baffle.
3. Partially lift the baffle assembly away from the main enclosure to separate them.
4. Disconnect the molex connector from the rear of the amplifier module (inside the cabinet).
5. You may now fully remove the baffle assembly from the main enclosure.

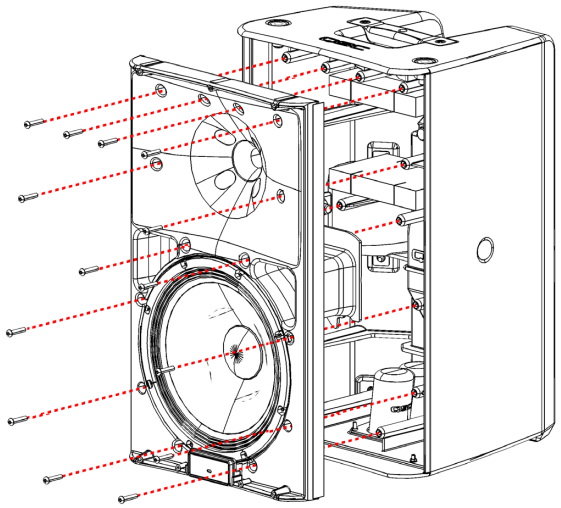


Figure 5.3.1 - Baffle assembly and enclosure

Installation

It's recommend that the LF and HF transducers are installed before reinstalling the baffle to the main enclosure assembly.

1. Verify that the positive and negative terminals on the LF and HF transducers are connected securely to the wiring harness.
2. Verify that the gasket is properly installed around the edge of the baffle.
3. Reinstall all acoustic insulation in both the main enclosure assembly and baffle assembly.
4. Gently place the baffle assembly into the main enclosure. If possible, connect the molex connector to the amplifier module.

   Note: Connecting the wiring harness to the amplifier module at this stage can be difficult. Perform that step after the baffle has been installed by removing the module, connecting the harness, and reinstalling the module.
5. Verify that the small gap between the sides of the main enclosure and the baffle are even. Both sides of the front grille must fit inside these gaps.
6. Fasten the screws that secure the baffle to the enclosure, starting with the corner screws. See Figure 5.3.1.

5.4 High frequency transducer

The K8.2 and K10.2's HF transducer is secured to the baffle by four mounting holes inside the waveguide. Covering the screws are 4 oval labels that allow the high frequency sound waves to propagate out correctly. The K12.2's HF transducer is secured on the baffle as well, but behind the waveguide.

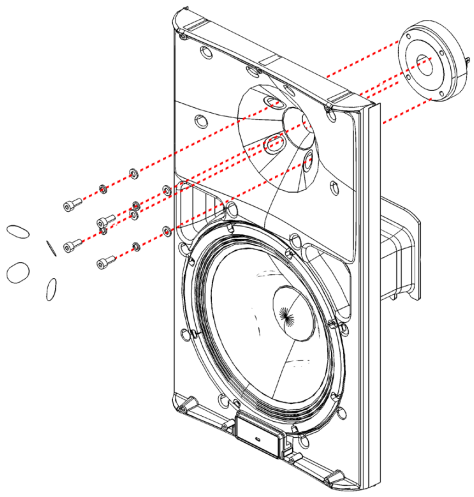


Figure 5.4.1 - K8.2 and K10.2 HF transducer

K8.2 and K10.2 high frequency transducer removal

The front baffle must be fully removed to gain access to the HF transducer.

1. Disconnect the yellow and yellow/black wires from the HF transducer's terminals.
2. Remove the 4 oval labels from the waveguide. Save for re-installation.
3. Remove the 4 screws, 4 washers, and 4 lock-washers that secure the HF transducer to the baffle. See Figure 5.4.1.
4. The HF transducer can now be removed from the baffle.

K12.2 high frequency transducer removal

It's required to remove the baffle from the main enclosure for HF transducer removal.

1. Disconnect the yellow (+) and yellow/black (-) wires from the HF transducer's terminals. ***The faston connectors have a locking tab on them that must be pressed to release the connector from the speaker tab.***
2. Remove the 4 screws, 4 lock washers, and 4 normal washers that secure the HF transducer to the baffle. See Figure 5.4.2.
3. The HF transducer can now be removed from the baffle.

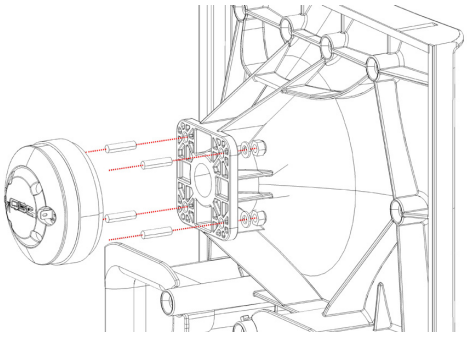


Figure 5.4.2 - K12.2 HF transducer only

Diaphragm replacement

Instead of replacing the entire HF transducer, the transducer can be repaired by replacing the diaphragm. Replacing the diaphragm can be much cheaper than replacing the entire HF transducer. Follow the instructions below to replace the diaphragm.

1. Remove the 4 screws that secure the cover to the frame of the transducer.
2. Lift the cover away from the transducer assembly.
3. Remove the diaphragm as shown in Figure 5.4.3.
4. Clean out the gap that the voice coil sits in. Wipe the edges of the gap with isopropyl alcohol and spray the gap with compressed air to remove all contaminants inside.
5. Install the new diaphragm with the correct orientation.
6. Place the cover back on the transducer assembly.
7. Fasten the 4 screws to secure the cover on the transducer assembly.

Figure 5.4.3 - Diaphragm removal with HF transducer still fastened to baffle

Transducer installation

Simply follow the removal instructions in reverse.

5.5 Low frequency transducer

The LF transducer can be removed and reinstalled without removing the baffle.

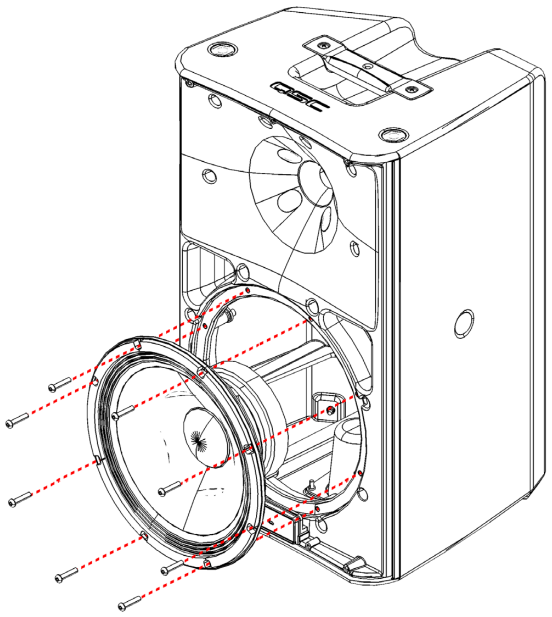


Figure 5.5.1 - LF transducer

Removal

8. Follow the **removal** instructions in "5.2 Front grille".
9. Place the speaker on it's back (or in monitor wedge position) so the LF transducer doesn't fall out after the screws are removed.
10. Remove 8 hex screws around the perimeter of the transducer's frame as shown in Figure 5.5.1.

    Note: A specific hex bit should be used to remove these screws. A standard hex bit may easily strip the heads on the screws.
11. Partially lift the transducer out of the speaker assembly.
12. Disconnect the green (+) and green/black (-) wires from the LF transducer's terminals. ***The faston connectors have a locking tab on them that must be pressed to release the connector from the speaker tab.***
13. Fully remove the transducer from the speaker assembly.

Installation

1. Place the speaker on it's back (or in monitor wedge position).
2. Connect the green (+) and green/black (-) wires from the LF transducer's terminals.

   Important note: This connection must have high retention force! Crimp new fastons (0.205" or 5.21 mm female, 14–16 AWG, insulated straight, with locking tab) to the wiring harness if the old ones are weak or not functional.
3. Gently lower the LF transducer into the speaker assembly, also noting the original LF driver orientation (the +/- LF tabs should be at 2 o'clock).
4. Fasten the 8 screws that secure the transducer to the baffle in a star pattern.

   Note: Be very careful when installing the screws. The screwdriver can easily slip and pierce a hole in the surround or cone of the transducer.

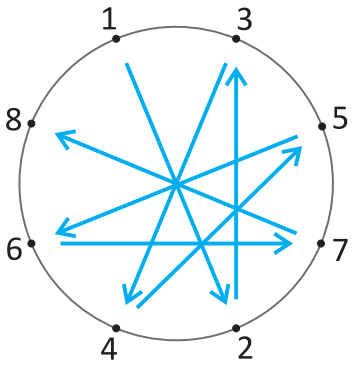


Figure 5.5.2 - LF transducer fasten sequence

5.6 Handles, feet, and pole mount

Handle removal and installation notes

- The handle is secured to the enclosure with machine screws and mounting plates (on the interior of the enclosure).
- Access to the interior of the speaker assembly is usually required to remove and install the handles, due to the limited access of the mounting plate.
- The only way to access the interior of the enclosure is to remove the baffle assembly. See **removal** instructions in "5.3 Front baffle".
- If the machine screw is removed accidentally, the threads on the mounting plate may not align with the enclosure holes. The mounting plates can slide back and forth on the rails inside the enclosure, so make sure they are aligned correctly.
- Reapply a small amount of thread locking fluid to the mounting plate when replacing the handles.

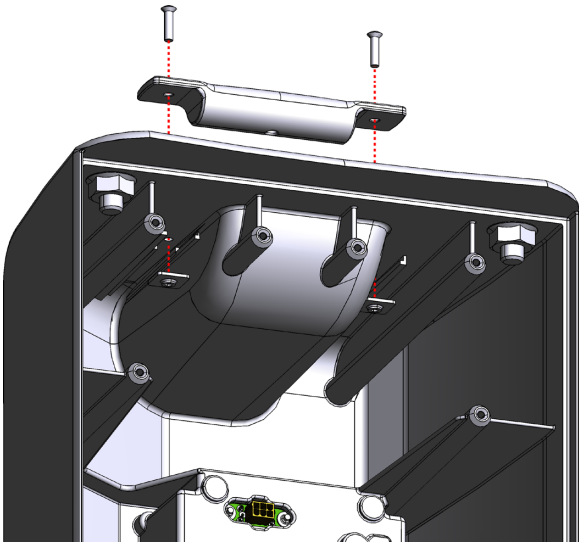


Figure 5.6.1 - Handle, screws, and mounting plates inside the enclosure.

Rubber feet removal and installation notes

- The **round rubber feet** on the bottom of the enclosure are secured with machine screws and nuts (on the interior of the enclosure).
- The **rectangular rubber feet** on the sides of the enclosure are also secured with machine screws and nuts (on the interior of the enclosure). These rubber feet are intended for placing the loudspeaker on its side in the monitor position.
- The **large rubber foot** on the bottom of the enclosure is secured with 3 machine screws. One of the machine screws is fastened to a nut on the interior of the enclosure in a deep, hard-to-reach corner. The other two machine screws are fastened to threads on the pole-cup mounting plate.
- Access to the interior of the speaker assembly is required to remove and install all rubber feet.

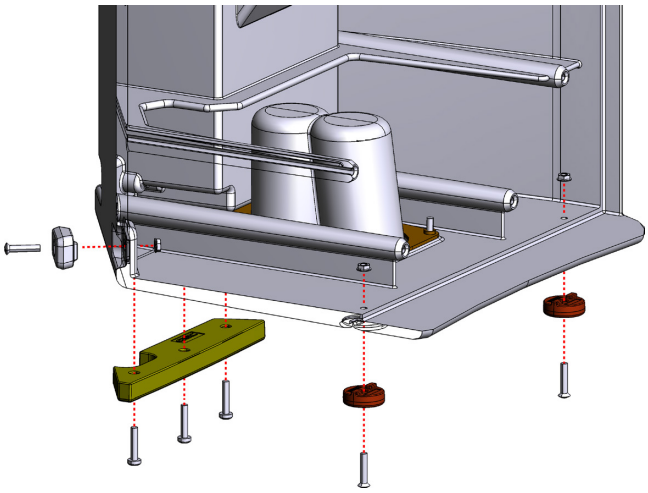


Figure 5.6.2 - Rubber feet in various locations on enclosure.

- The only way to access the interior of the enclosure is to remove the baffle assembly. See **removal** instructions in "5.3 Front baffle".
- Reapply a small amount of thread locking fluid to the nuts when replacing the rubber feet.
- Refer to Figure 5.6.2.

Pole-cup removal and installation notes

- The pole-cup piece is secured to the enclosure with machine screws which are fastened to threads on the pole cup mounting plate.
- The pole-cup piece can be removed from the exterior of the speaker enclosure. Access to the interior is *not required*.
- Reapply a small amount of thread locking fluid to the nuts when replacing the pole-cup piece.
- Refer to Figure 5.6.3.

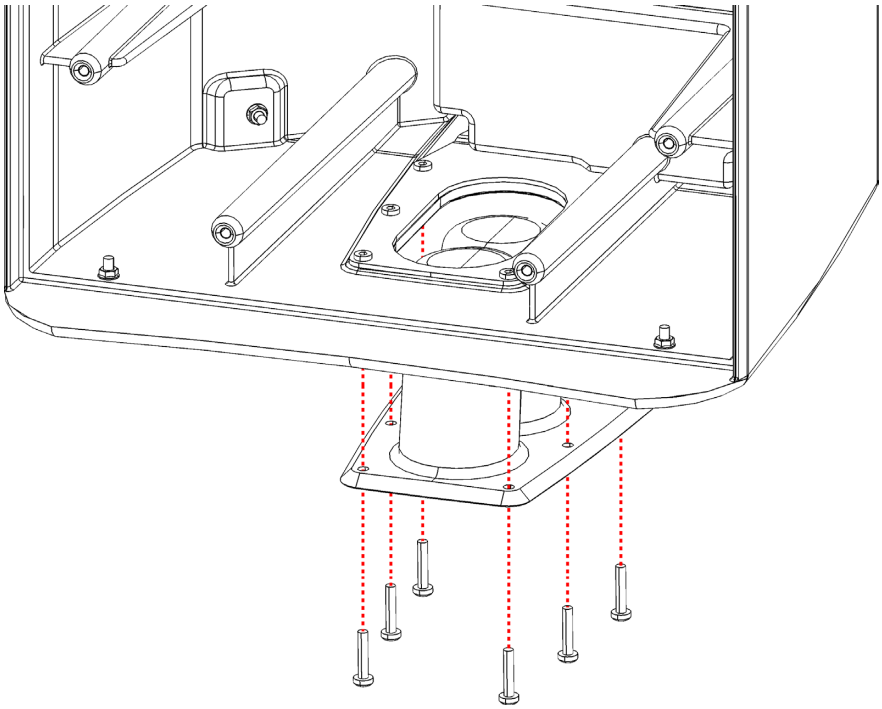


Figure 5.6.3 - Pole cup piece and mounting plate inside the enclosure

6. Amplifier module disassembly & repair instructions

CAUTION: Use proper anti-static procedures when working on the amplifier. Use an anti-static work surface and wear a grounded wrist strap.

WARNING: RISK OF ELECTRICAL SHOCK

High Voltage is present in the main power supply. Proceed with caution.

6.1 Back cover

Removal

5. Disconnect the AC power cord from the amplifier module to reduce the risk of electrical shock.
6. Remove the 3 plastite screws from the front of the amplifier module as shown in Figure 6.1.1a.
7. Remove the 2 plastite screws from the side and 2 machine screws from the rear as shown in Figure 6.1.1b.
8. Remove the metal bracket and pull away the plastic back cover Figure 6.1.1c.

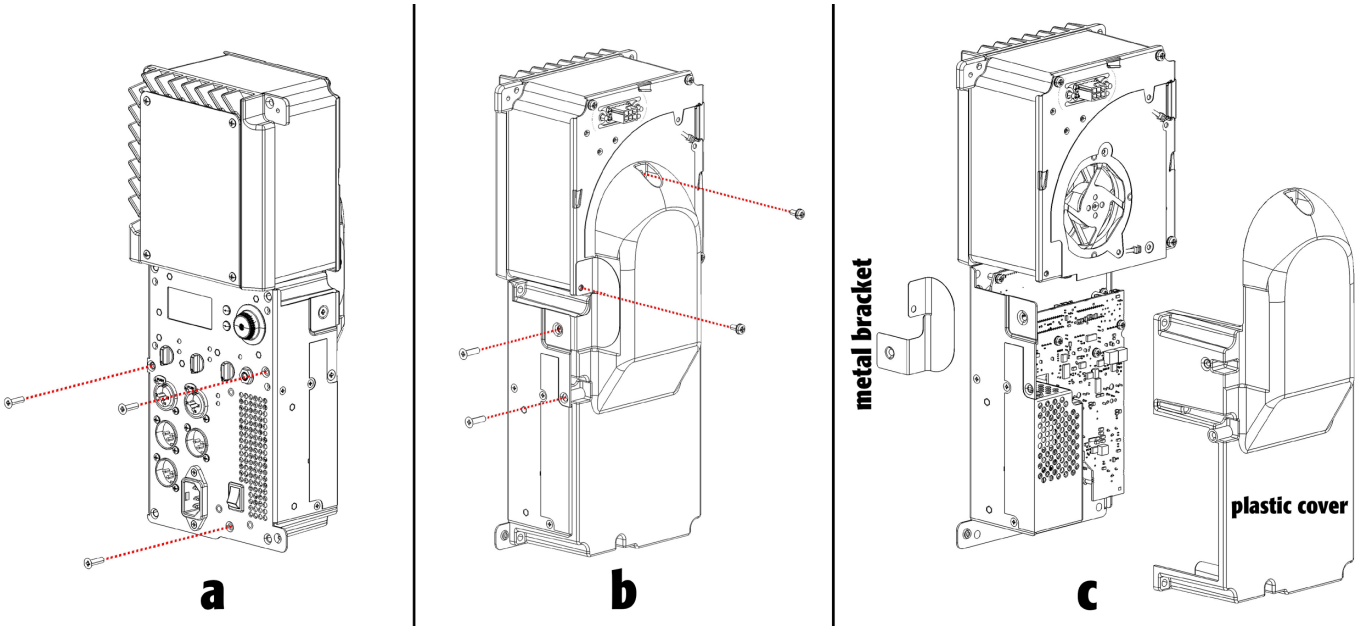


Figure 6.1.1 - Three primary steps involved with removing or installing the back cover from the amplifier module chassis.

Installation

1. Replace and trim excess from any zip ties that were cut or removed during a previous disassembly.
2. Carefully align the plastic back cover onto the amplifier chassis assembly (Figure 6.1.1c).
3. Place the metal bracket in its original location and fasten 1 silver machine screws to secure the bracket in place.
4. Fasten the 1 remaining machine screw to secure the top of the back cover to the amplifier module assembly.
5. Fasten the 2 plastite screws to secure the side of the chassis to the back cover (Figure 6.1.1b).
6. Fasten the 3 plastite screws to secure the front of the chassis to the back cover (Figure 6.1.1a).

Important note: The back cover must be carefully aligned when fastening the front and side plastite screws. Try to avoid destroying the previously cut threads in the plastic back cover by slowly rotating the plastite screws back into the threads. If the thread is marred or stripped inside, the plastic back cover could vibrate when in use.

6.2 AMP/PSU board

Removal

1. Follow the **removal** steps in "6.1 Back cover".
2. Adjust the amplifier module so that the front panel is face down on the work bench.
3. Cut and remove 2 zip ties that secure the ribbon cable to the metal cover. See Figure 6.2.1.
4. Disconnect the 3 ribbon connectors (LED, AMP/PSU, and Fan) from the input/DSP board as shown in Figure 6.2.2. The ribbon cables going to the LCD board can remained connected.
5. Carefully move the large ribbon cable and fold it over the right side of the amplifier module as shown in Figure 6.2.3.

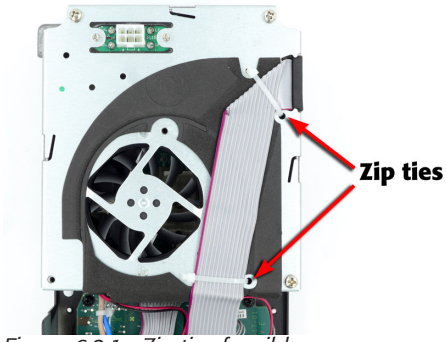


Figure 6.2.1 - Zip ties for ribbon

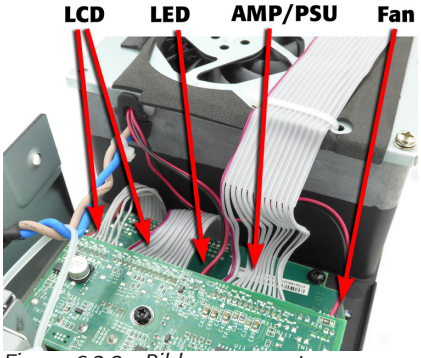


Figure 6.2.2 - Ribbon connectors.

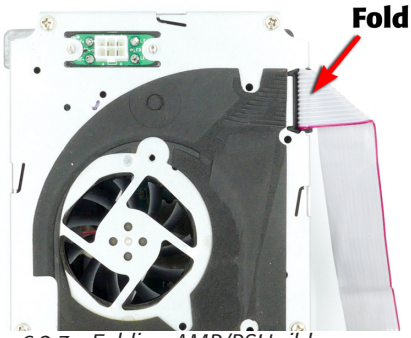


Figure 6.2.3 - Folding AMP/PSU ribbon.

6. Remove the 3 machine screws as shown in Figure 6.2.5.
7. Lift up and rotate the metal cover assembly (which includes the fan and output connector PCB) to provide access to the AMP/PSU board. See Figure 6.2.6 for a visual aide.

   Troubleshooting tip: Leave the cover up in this position while connected to AC power/outputting audio to aide in troubleshooting components on the top-side of the AMP/PSU board.
8. Disconnect the AC wiring harness from AMP/PSU board by putting pressure on the locking tab and lifting the wiring harness up. See Figure 6.2.4.
9. Remove the 2 machine screws that secure the output connector PCB to the metal cover. Set the metal cover assembly aside.
10. Remove the 7 short machine screws that secure the PCB to the heatsink chassis. See Figure 6.2.6.

Figure 6.2.4 - AC wiring harness

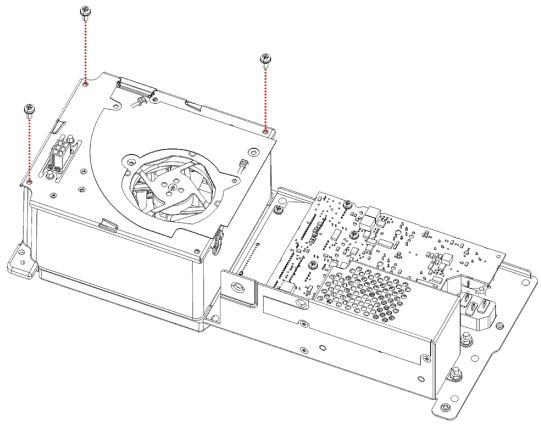


Figure 6.2.5 - Metal cover removal/installation steps

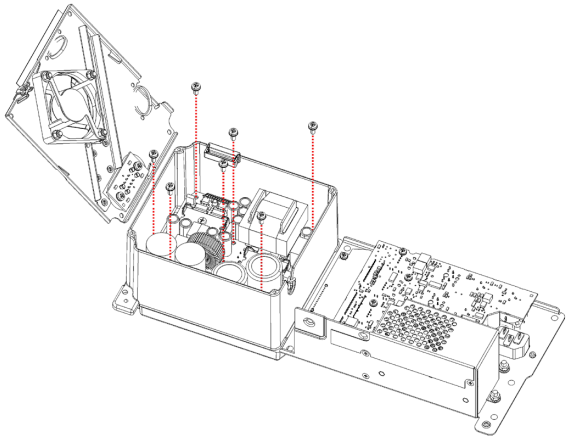


Figure 6.2.6 - Metal cover rotated up for AMP/PSU access

11. Remove the 2 long machine screws, 2 metal springs, and 2 plastic clamps. See Figure 6.2.7.
12. Lift the AMP/PSU board straight out of the chassis.

    Important note: Carefully lift the AMP/PSU board out of the chassis in a straight upward direction to reduce the risk of misaligning the insulation pads on the heatsink. If the insulation pads are moved in this step, they must be realigned when installing a new AMP/PSU board.

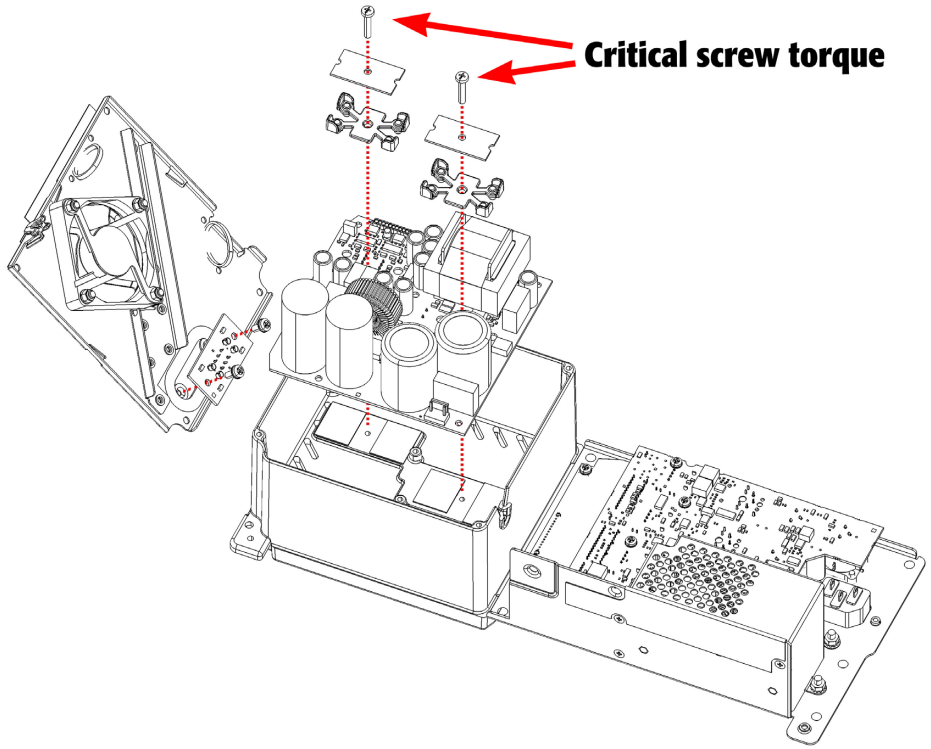


Figure 6.2.7 - AMP/PSU removal and installation, including output board attached to metal cover.

Installation

Before reinstalling an AMP/PSU board, it's very important to the take extra time to inspect the power MOSFETs on the bottom of the PCB, reapply thermal grease to the insulation pads, and align them.

1. Prepare the AMP/PSU board for installation. Reapply a thin but uniform layer of thermal grease to the 4 insulation pads on the heatsink.
2. Carefully align and place the AMP/PSU board into the heatsink cavity, verifying that the body of the power components (MOSFETs and diodes) on the bottom of the PCB is not making contact with the metal heatsink.

   Important note: If the power components are touching the metal heatsink, a catastrophic failure could occur when powering up for the first time after installation.
3. Fasten the 7 short machine screws to secure the AMP/PSU board to the heatsink chassis.
4. Install the 2 plastic clamps, 2 metal springs, and 2 long machine screws, specifically in that order.
5. Fasten the 2 long machine screws at a torque of 28.8 kgf-cm (25 in-lbs).

   Important note: The torque specification on these 2 screws is ***very critical*** to ensure good heat transfer between the electrical component and heatsink. Sufficient clamp force is required to achieve the best result.

Prepare the metal cover, route wires and ribbon

6. Install 2 zip ties into the holes on the metal cover. They will later be used to secure the ribbon cable to the cover.
7. Route the large ribbon cable coming from the AMP/PSU board along the side walls of the heatsink near the rubber grommet. Lightly fold the ribbon cable at a 90 degree angle over the rubber grommet. See Figure 6.2.9.
8. With the metal cover still facing up, route the fan and front LED wires (2 conductor) around the fan and into the rubber grommet as seen in Figure 6.2.8.
9. Connect the AC wiring harness to the corner of the AMP/PSU board. Verify the connector latch is in the locked position. Gently tug on the wiring harness to verify sufficient latching.
10. Dress the blue and brown AC wires through the rubber grommet as shown in Figure 6.2.10.
11. Align the output connector board to the metal cover and fasten the 2 machine screws to secure.
12. Align the metal cover to the heatsink and verify that all ribbon cables and wires are correctly placed.

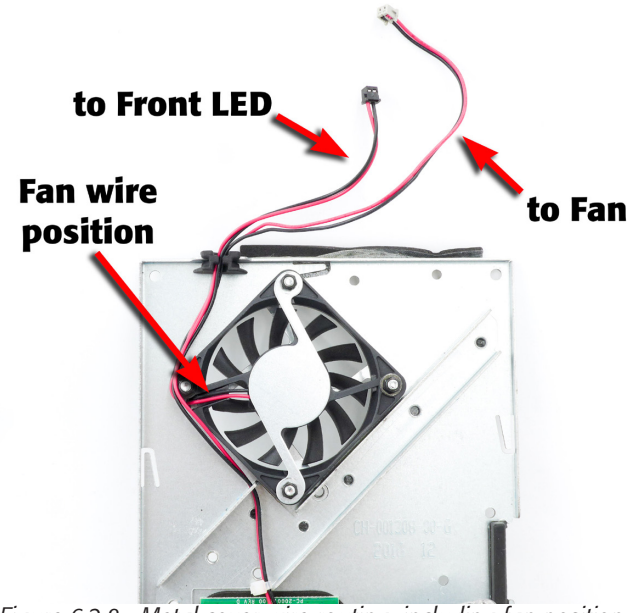


Figure 6.2.8 - Metal cover wire routing, including fan position

Important note: The ribbon cable and wires can easily get pinched in this step. Verify the placement of all wires before proceeding to the next step.


Figure 6.2.9 - Ribbon cable fold over

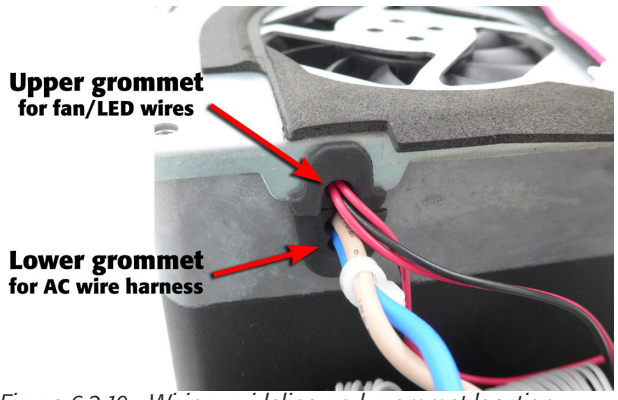


Figure 6.2.10 - Wiring guideline and grommet location

13. Fasten the 3 machine screws to secure the metal cover to the heatsink as shown in Figure 6.2.5.
14. Route and lightly fold the large ribbon cable in the orientation shown in Figure 6.2.1.
15. Lightly tighten the 2 zip ties that were installed in step 6 and trim excess.
16. Connect the 3 ribbon connectors as shown in Figure 6.2.2. Verify that the fan and front LED 2-conductor wires are connected to the appropriate locations.

6.3 Input/DSP board

Removal

1. Follow the **removal** steps in "6.1 Back cover".
2. Disconnect all 5 ribbon cables from the input/DSP board (Figure 6.2.2).
3. Remove the 3 gain knobs from the front of the amplifier module. See Figure 6.3.1. *The rotary encoder knob doesn't need to be removed.*
4. Remove the nut on the 3.5mm jack using a 10mm wrench or nut driver.
5. Remove the 10 plastite screws that secure the XLR connectors to the front panel as shown in Figure 6.3.2.
6. Remove the 3 machine screws that secure the input/DSP PCB to the chassis standoffs as shown in Figure 6.3.2.
7. The input/DSP board can now be removed from the amplifier module.

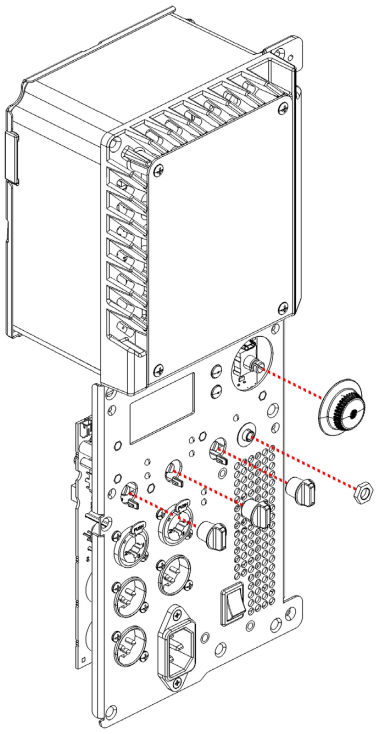


Figure 6.3.1 - Knobs and 3.5mm jack nut

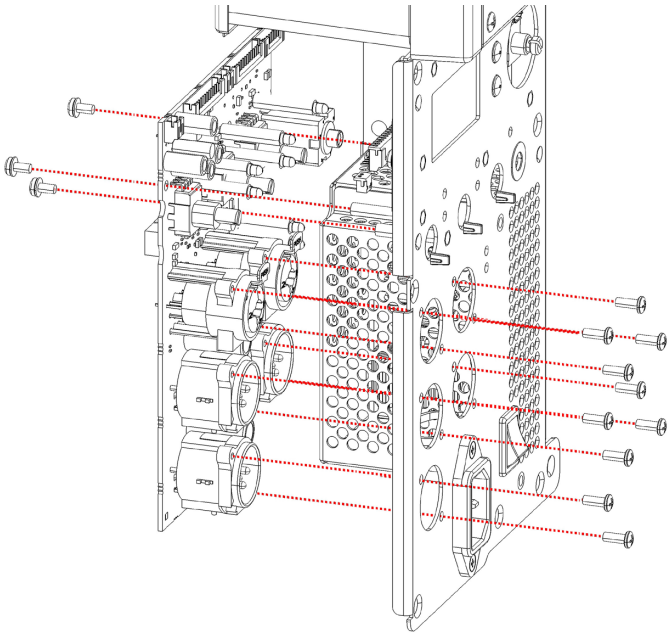


Figure 6.3.2 - Input/DSP board assembly to chassis front plate

Installation

1. Prepare the input/DSP board for installation. Verify the LCD board is already mounted to the chassis because it cannot be installed after the input/DSP board is already mounted.
2. Insert the input/DSP board into the chassis.

   Important note: When mounting the input/DSP board into the chassis, the latches on the input XLRs must be inserted into the holes on the chassis first. Once complete, verify that the LEDs on the input/DSP board are properly aligned before proceeding to next steps. Fastening the screws without aligning the LEDs into the chassis holes can smash or bend the LEDs.
3. Fasten the 3 machine screws that secure the input/DSP PCB to the chassis standoffs as shown in Figure 6.3.2.
4. Fasten the 10 plastite screws that secure the XLR connectors to the front panel as shown in Figure 6.3.2.
5. Fasten (by hand) the nut on the 3.5mm jack using a 10mm wrench or nut driver. ***Do not over-torque!***
6. Install the 3 gain knobs and 1 rotary encoder knob (if removed) to their appropriate locations. See Figure 6.3.1.
7. Connect all 5 ribbon cables back to their original locations on the input/DSP board as shown in Figure 6.2.2.

6.4 LCD board

Removal

To remove the LCD board from the amplifier module chassis, the input/DSP board must first be removed for access.

1. Follow the **removal** steps in "6.3 Input/DSP board".
2. Remove the large knob from the rotary encoder shaft (Figure 6.3.1).
3. Remove the 4 machine screws that secure the LCD board to the chassis stand-offs as shown in Figure 6.4.1.
4. Remove the LCD board out of the chassis and set aside.

   Important note: Two small plastic buttons (Enter and Return) may fall off the LCD board when removing it. When replacing the LCD board with a new one, reuse the buttons.

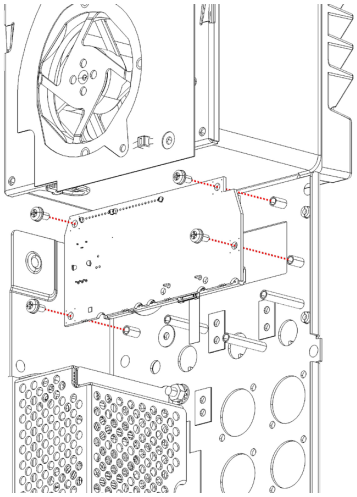


Figure 6.4.1 - LCD board assembly

Installation

The input/DSP must be removed from the chassis before installing the LCD board.

1. Prepare the new LCD board for installation.
2. Verify the ribbon cable connection on the LCD display is secure and in the locked position. See Figure 6.4.2.
3. Insert the two small plastic buttons to their appropriate locations.
4. Place the LCD board into the chassis, verifying the buttons are still in place.
5. Fasten the 4 machine screws that secure the LCD board to the chassis stand-offs as shown in Figure 6.4.1.
6. Install the large knob onto the rotary encoder shaft.

Figure 6.4.2 - Ribbon cable on LCD

6.5 EMI shield and AC line filter board

Removal

The EMI shield can be removed without removing the input/DSP board, but it is not recommended due to limited access and specialty tools. The easiest way to remove the AC line filter board is to first remove the input/DSP board, as noted in the instructions below.

1. Follow the **removal** steps in "6.3 Input/DSP board".

EMI shield removal

2. Cut the zip tie at the top corner of the EMI shield to loosen the AC wiring harness.
3. Remove the 3 machine screws that secure the EMI shield as shown in Figure 6.5.1.
4. Remove the 2 nuts from the threaded standoffs using a 7mm wrench or nut driver. See Figure 6.5.1.
5. Lift the EMI shield out of the chassis and set aside.

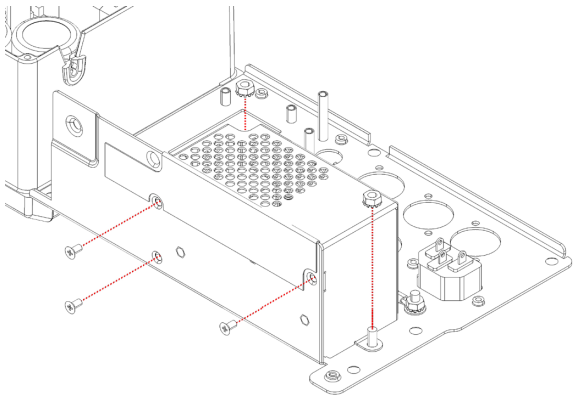


Figure 6.5.1 - EMI shield assembly in amplifier chassis

AC line filter board removal

The brown (line) and blue (neutral) wires coming from the AC line filter board are routed to a jack on the AMP/PSU board.

6. Remove the metal cover to disconnect the AC wiring harness from the AMP/PSU board.
7. Disconnect the faston connectors from the AC line filter board.
8. Remove the 5 machine screws that secure the board to the chassis standoffs as shown in Figure 6.5.2.
9. Remove the AC line filter board from the chassis and set aside.

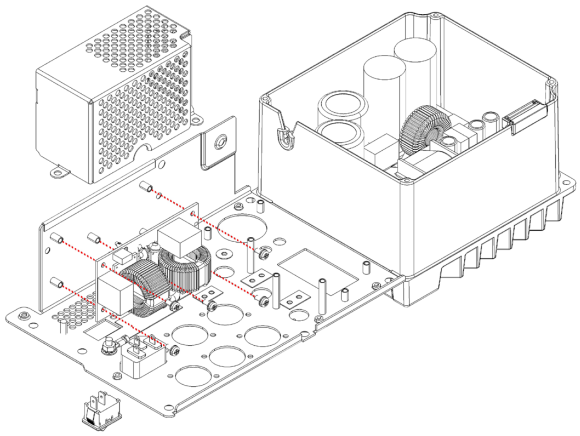


Figure 6.5.2 - AC line filter board assembly to amplifier chassis

Installation

AC line filter board installation

1. Prepare the AC line filter board for installation. Adjust any AC wires and reroute accordingly.
2. Align and install the AC line filter board onto the chassis standoffs.
3. Fasten the 5 machine screws that secure the board to the standoffs as shown in Figure 6.5.2.
4. If required, route the AC wiring harness and connect it the corner of the AMP/PSU board. Verify the connector latch is in the locked position. Gently tug on the wiring harness to verify sufficient latching.

EMI shield installation

5. Carefully install the EMI shield into the chassis. Verify the AC wiring dressing at the bottom and sides of the shield to ensure they are not pinched. See Figure 6.5.4.

   Caution: High voltage on the AC wires is present. Verify that the AC wires are not pinched or loose!

6. Fasten the 2 nuts to the threaded standoffs using a 7mm wrench or nut driver. See Figure 6.5.1.
7. Fasten the 3 machine screws to secure the EMI shield to the chassis as shown in Figure 6.5.1.
8. Install the zip tie at the top corner of the EMI shield to secure the AC wiring harness. Trim excess.

   Important note: AC wire routing and placement is very critical. If these installation steps are not done correctly, the AC line could induce noise and cross-talk into the input/DSP circuits.

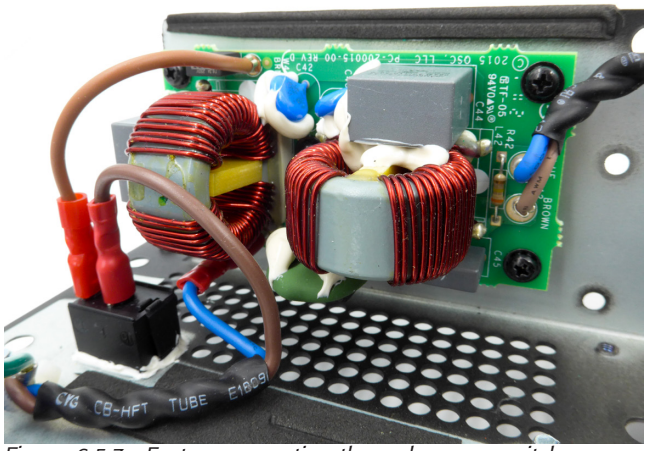


Figure 6.5.3 - Faston connection through power switch

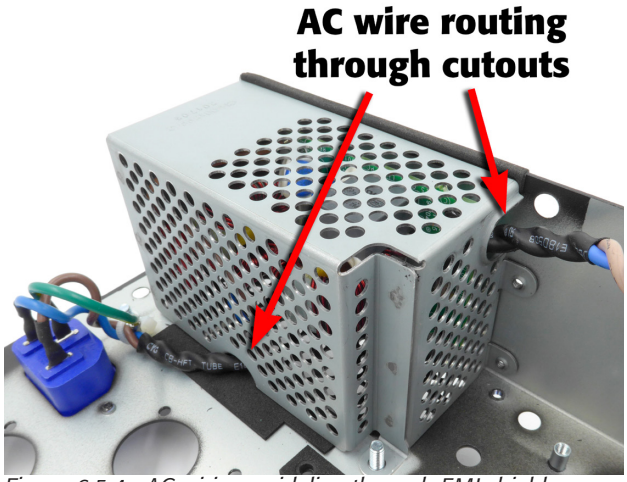


Figure 6.5.4 - AC wiring guideline through EMI shield cutouts

6.6 Fan

To replace the fan, remove the metal cover from the heatsink to gain access to the fan hardware.

Removal

1. Follow **removal** steps 1 — 7 in "6.2 AMP/PSU board".
2. With the metal cover up, remove the 4 hex nuts that secure the fan to the metal cover standoffs. Use a 5mm wrench or nut driver. See Figure 6.6.1.
3. Remove the 2 washers and custom fan bracket.
4. Remove the fan from the standoffs and set aside.

Installation

1. Install the new fan over the standoffs, noting the wire position in Figure 6.2.8.
2. Place the 2 washers and custom fan bracket over the standoffs.
3. Fasten the 4 hex nuts using a 5mm wrench or nut driver using a torque of 8 kgf-cm (7 in-lbs). *Do not over-torque*.
4. Follow installation steps 6 — 16 in "6.2 AMP/PSU board" on page 24 to reassemble the amplifier module.

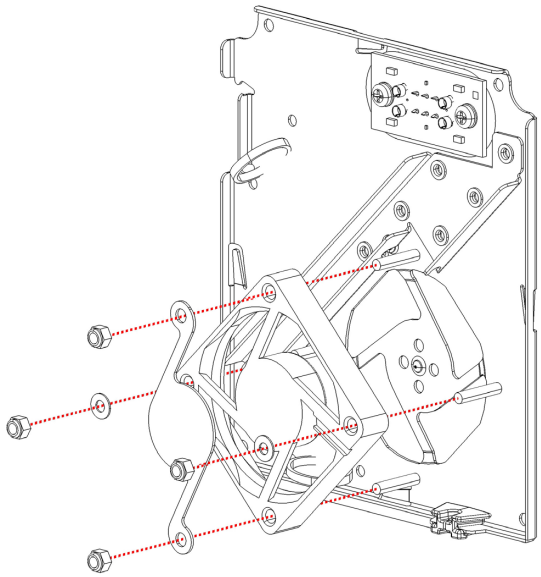
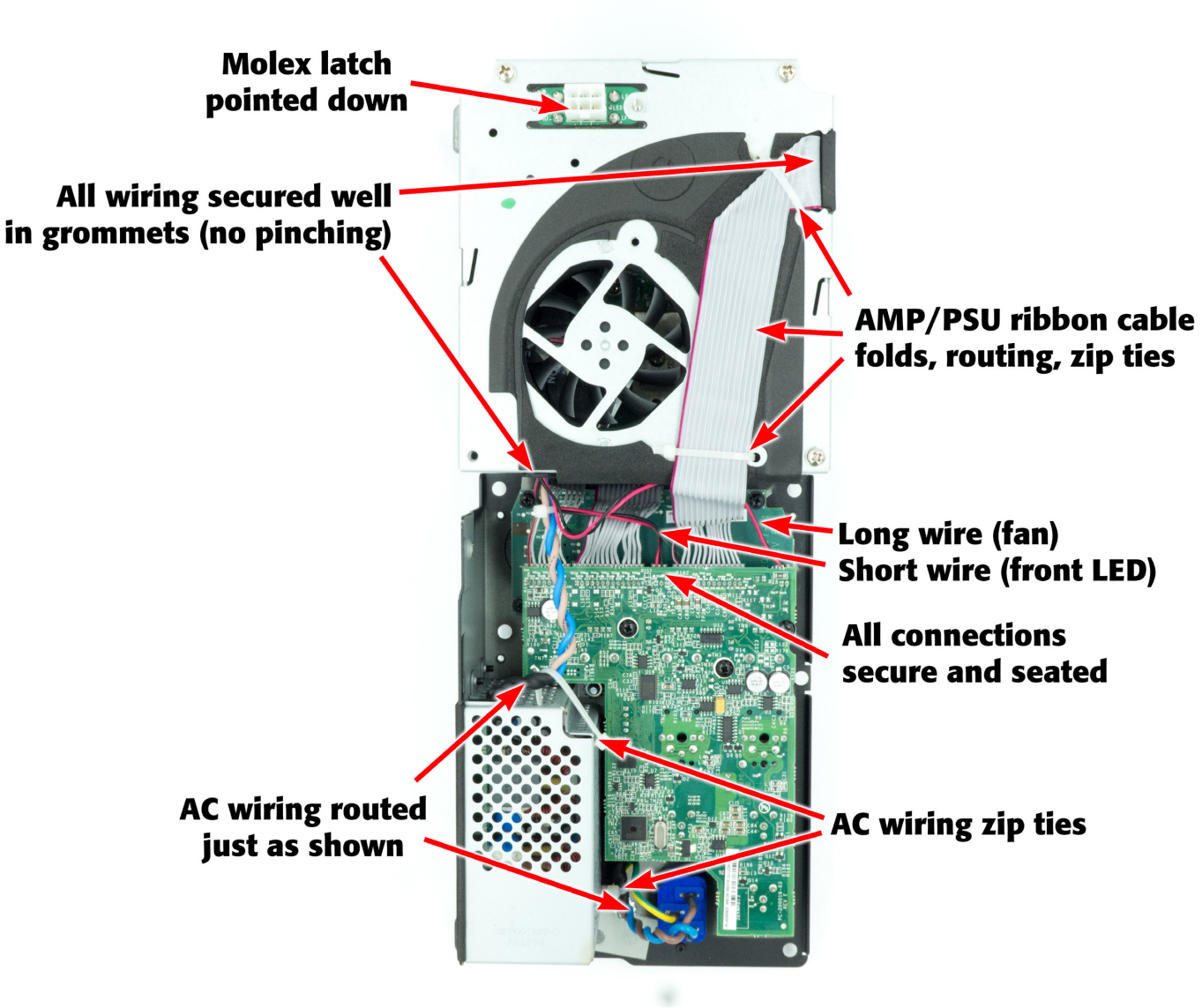


Figure 6.6.1 - Fan assembly to metal cover.

6.7 Amplifier module reference

Use the reference below as a visual aide for reassembly of the amplifier module. The amplifier module should look like this before installing the back cover to the amplifier chassis.



7. Testing

7.1 Requirements

Hardware

- Digital multimeter with RMS AC voltage and current
- Digital clamp-on ampere meter
- Dual-trace oscilloscope
- Audio distortion analyzer with built-in low-distortion audio sine wave generator and resolution of 0.01%, 20 - 20k Hz (or better)
- Non-inductive load resistors, configurable as 16Ω (min. 225 watts capacity), as 2Ω (min. 1000 watts capacity).

  Note: Either connection of the test load should not be connected to any electrical ground system.
- Variable AC voltage source, such as a Variac or Powerstat variable transformer, with a rated current capacity of up to 25A for 120V or 12A for 230V.
- Class D filter, i.e. Audio Precision AUX-0025
- Custom K.2 series test adapter

Audio Precision (AP) Test Procedures

If an Audio Precision distortion analyzer is available, please contact QSC for the test procedure files. They are available upon request.

Molex pinout (output connector)

The molex jack, which connects to the speaker's internal wiring harness, is located on the back of the amplifier module. The LF/HF outputs and front LED can be tested via the molex jack. See the pin-out diagram in Figure 7.1.1.

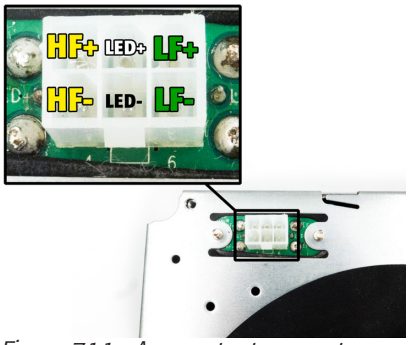


Figure 7.1.1 - Amp output connector

K.2 Series test adapter

For testing an amplifier module under load or viewing the output waveform on an oscilloscope, a test adapter can be easily constructed by using a K8.2, K10.2, or K12.2 spare wiring harness. Place a compatible connector with your test load bank (like a dual binding post connectors as in Figure 7.1.2) or Speakon connectors. Please refer to the wire colors diagram and wiring harness part lists below.

Wire Color	Connection
Green	LF +
Green / black	LF -
Yellow	HF +
Yellow / black	HF -
White	Front LED anode
White / black	Front LED cathode

Model	Wire harness p/n
K8.2	WC-000613-00
K10.2	WC-000614-00
K12.2	WC-000615-00

*Any wire harness part number can be used as a test adapter for all models

Figure 7.1.2 - K.2 Series test adapter with dual binding post connectors, made from a K.2 wire harness.

7.2 Amplifier module testing

The next sections discuss standalone bench testing of the amplifier module (when removed from the speaker enclosure).

Model verification

For verifying the model and firmware version, navigate the menu: *HOME Menu -> SETTINGS*. The model and the firmware version are located on the topline as shown in Figure 7.2.1.

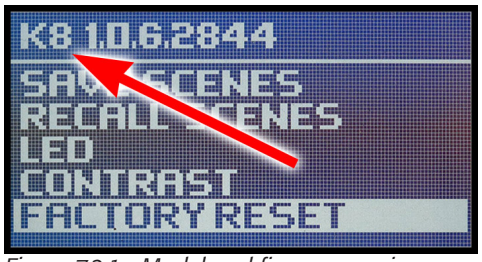


Figure 7.2.1 - Model and firmware verison

Test setup

Please see the setup diagram in Figure 7.2.2 for a visual representation of the test setup.

1. Connect the K.2 test adapter to the amplifier module's output connector.
2. Connect a test load to the output terminals of the adapter.
3. Connect the Class D filter inputs to the output terminals of the adapter.
4. Connect the distortion analyzer to the Class D filter. Enable the 80k Hz low pass filter.
5. Connect a dual-channel oscilloscope to the following test points:
   - Ch1 - a 10X (vertical sensitivity - 2 V/cm) scope probe to the Class D filter output.
   - Ch2 - a 1X (vertical sensitivity - 0.1 V/cm) scope probe to the distortion analyzer output.
6. Set the output of function generator to: 0.00 Vrms, 1 kHz, sine wave.
7. Connect the output of the signal generator to either Ch.A or Ch.B input connector of the amplifier module. Do not use stereo input Ch.C.
8. Plug the amplifier module into a variac and set up an AC line current monitor.
9. Turn the K.2 power switch on.

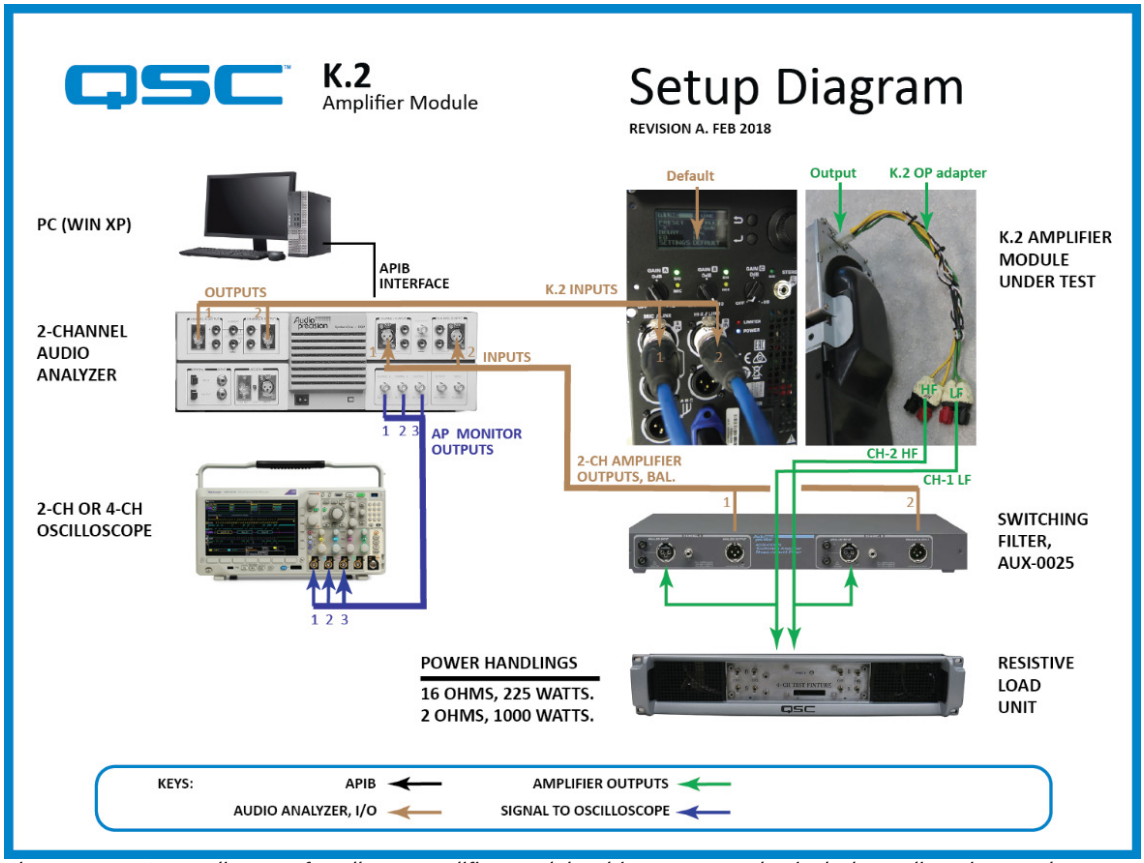


Figure 7.2.2 - Setup diagram for all K.2 amplifier models. This test setup also includes a distortion analyzer.

Part 1: General checks (power up, mute delay, and turn-on sequence)

The purpose of these steps is to remove any previous settings saved in the amplifier so we can test without any modifications done to the EQ. We will also verify the proper power up sequence. If the amplifier module's power LEDs or LCD screen continually blink during power up, there may be an issue with the power supply or amplifier section.

1. Using a variac, slowly increase the AC voltage going into the amplifier while monitoring the AC current. Maximum current should be no greater than 0.5 A at 120 V or 0.3 A at 230 V.

   Note: The amplifier module should come out of protect above 85Vac in 6 seconds or less. The dead voltage range is 135V - 165V. Abort the test if the amplifier draws excessive AC current.
2. Verify the blue power indicator is lit and home screen is displayed on the LCD screen.
3. Reset the K.2 module to factory default: *HOME Menu -> SETTINGS -> FACTORY RESET -> YES*
4. Turn the unit off and observe that all of the LEDs go off.
5. Turn the unit on and observe the turn-on sequence:
   - Verify the Blue LED and LCD screen turn on within 3 seconds or less.
   - In the next second, verify the LCD is displaying information on screen.
   - In the next 2 seconds, listen for a relay click (120 V only).
   - Finally, verify the fan does not spin (if temperature is less than 50C).
6. Verify the amplifier is running with default settings.

Part 2: Verifying Ch.1 (LF): 2 OHM POWER vs. DISTORTION at 400Hz.

1. Set the output of function generator: 0.55 Vrms, 400 Hz, sine wave.
2. Turn the gain control of inputs Ch.A, B, and C to the minimum (counter-clockwise).
3. Feed the function generator's output to input Ch.A.
4. Apply a 2 Ω load to Ch.1 (LF)
5. Slowly turn the gain control A to maximum while checking the power measurement; it should be approximately 250 watts, +/-50 watts with less than or equal to 0.1% THD.
6. Turn the gain control A to minimum and repeat steps 3 through 5 with input Ch.B.

Part 3: Ch.1 short circuit and 2 ohm load recovery (150 WATTS, 1% THD, 2.8A@120V).

1. Set the output of function generator: 0.45 Vrms, 1 kHz, sine wave.
2. Turn the gain control of inputs Ch.A, B, and C to minimum (counter-clockwise).
3. Apply a 2 Ω load to Ch.1 (LF).
4. Feed the generator's output to input Ch.A and turn the gain control A to maximum (clockwise).
5. Verify output power; it should be approximately 150 watts, +/-50 watts.
6. Apply a short to Ch.1 (LF) output and verify short limit protection.

   Note: The PSU may shut down intermittently before it can run steadily and safely in output short condition.
7. Verify the AC line current draw; it should drop below 1.0A.
8. Remove the short and verify the amplifier module recovers into 2 Ω.
9. Turn the gain control A to minimum and continue next test.

Part 4: Verifying Ch.2 (HF): 16 OHM POWER vs. DISTORTION at 8k Hz.

1. Set the output of function generator: 0.45 mVrms, 8k Hz, sine wave.
2. Turn the gain control of inputs Ch.A, B, and C to the minimum (counter-clockwise).
3. Feed the function generator's output to input Ch.A.
4. Apply a 16 Ω load to Ch.2 (HF)
5. Slowly turn the gain control A to maximum while checking the power measurement; it should be approximately 40 watts, +/-10 watts with less than or equal to 1.0% THD.
6. Turn the gain control A to minimum and continue next test.

Part 5: Ch.2 short circuit and 16 ohm load recovery (40 WATTS, 0.1% THD, 0.7A@120V).

1. Set the output of function generator: 0.45 Vrms, 8 kHz, sine wave.
2. Turn the gain control of inputs Ch.A, B, and C to minimum (counter-clockwise).
3. Apply a 16 Ω load to Ch.2 (HF).
4. Feed the generator's output to input Ch.A and turn gain control A to maximum (clockwise).
5. Verify output power; it should be approximately 40 watts, +/-10 watts.
6. Apply a short to Ch.2 (HF) output and verify short limit protection.
7. Verify the AC line current draw; it should drop below 0.5A.
8. Remove the short and verify the amplifier recovers into 16 Ω.
9. Turn the gain control A to minimum and continue next test.

Part 6: Thermal test.

1. Set the output of function generator: 1.5 Vrms, pink noise.
2. Turn the gain control of Inputs Ch.A, B, and C to minimum (counter-clockwise).
3. Apply a 2 Ω load to Ch.1 (LF) and a 16 Ω load to Ch.2 (HF).
4. Feed the generator's output to Input A and turn the gain control A to maximum (clockwise).
5. Verify the AC line current is approximately 3.0A @120Vac or 1.5A @ 230Vac.
6. Run this test for 5 minutes and then stop. Verify that fan increases in speed as heat sink temperature rises. You can hear the fan noise near the front heat sink, behind the QSC logo.
7. Switch the test load to OFF and let the amplifier cool down for at least 2 minutes.

Part 7: Verifying residual noise.

1. Disconnect all the inputs from the amplifier
2. Apply a 2 Ω load to Ch.1 (LF) and a 16 Ω load to Ch.2 (HF).
3. Measure residual noise level produced into the load by the amplifier. The noise level should be 100 dB down from full rated output power.

Part 8: Shock test

The purpose of this test is to look for intermittent connections (like broken leads) that may exist within the amplifier module boards and assemblies.

1. Set the output of function generator: 0.45 Vrms, 1 kHz, sine wave.
2. View the Ch. 1 (LF) output waveform on an oscilloscope.
3. Using a rubber mallet, lightly bang the back or side of the amplifier module a couple of times. Verify that you don't lose the signal on the oscilloscope. Verify that the power is not lost. If a rubber mallet is not available, lightly bang the amplifier on the work bench.
4. Set the output of function generator: 0.45 Vrms, 8 kHz, sine wave.
5. View the Ch. 2 (HF) output waveform on an oscilloscope.
6. Repeat step 3.

Figure 7.2.3 - Lightly applying force to the amplifier module to find intermittent connections.

7.3 Loudspeaker testing

Once a K.2 Series loudspeaker is fully assembled it must be tested to meet all audio specifications. This final step is required to verify that the amplifier module powers the transducers, no distortion is present, and that the speaker meets SPL specifications. See Figure 7.3.1 for a test setup diagram.

Part 1: System setup

1. Verify that the amplifier module is in a normal mode, not test-mode!
2. Reset the K.2 module to factory default: *HOME Menu -> SETTINGS -> FACTORY RESET -> YES*
3. Verify that Ch. A is in LINE mode (not MIC).
4. Connect the output of the audio sine wave generator to input Ch.A and set the gain to the 12 o'clock or 0 dB position.
5. Set the SPL meter approximately 1 meter in front of the loudspeaker, directly on axis with its centerline.
6. Power up the speaker and begin the tests in the next steps.

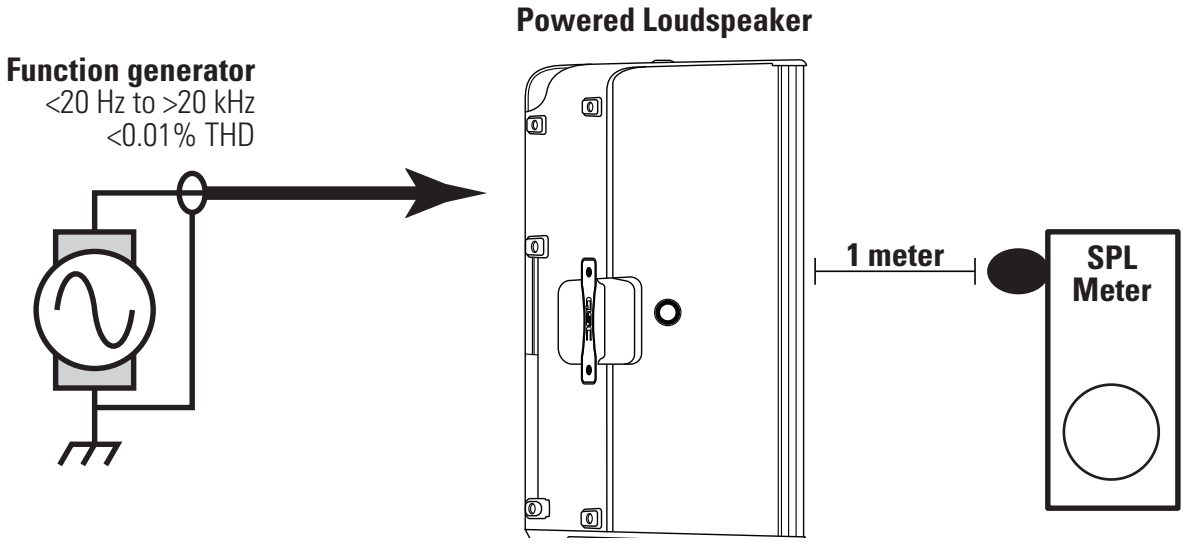


Figure 7.3.1 - Loudspeaker testing setup using an audio sine generator and SPL meter.

Part 2: Measuring sensitivity (sound pressure level)

1. Set the output of function generator: 0.00 Vrms, 100 Hz, sine wave
2. Hold the SPL meter 1 meter in front of the loudspeaker, directly on axis with its centerline. Measure and take note of the sound pressure.
3. Gradually adjust the generator amplitude and/or the amplifier module gain until the SPL in the table below meets or exceeds the SPL dB numbers.
4. Compare your measurements with the data in the table below.
5. Change the generator frequency to 5 kHz and repeat the measurement.

Model	100 Hz SPL (dB)	5 kHz SPL (dB)
K8.2	107 ± 3	104 ± 3
K10.2	107 ± 3	104 ± 3
K12.2	108 ± 3	104 ± 3

Note: These figures apply only to on-axis measurements. If the SPL meter's microphone is not on-axis with respect to the loudspeaker, the relative SPL measured at 5 kHz may be significantly lower.

Part 3: Measuring peak SPL

1. Set the output of function generator: 0.00 Vrms, dynamic pink noise
2. Hold the SPL meter 1 meter in front of the loudspeaker, directly on axis with its centerline. Measure and take note of the sound pressure level.
3. Gradually adjust the generator amplitude and/or the amplifier module gain until the SPL in the table below meets the SPL dB numbers.
4. Compare your measurements with the data in the table below.

Model	Peak SPL (dB)
K8.2	128
K10.2	130
K12.2	132

Part 4: Frequency sweep

Turn up the signal generator or amplifier module gain until the SPL at 1 meter distance is suitably loud, about 100 to 105 dB.

Step or sweep the generator frequency from about 20 Hz up to about 20 kHz. Listen for a clean, undistorted tone; any buzzes, rattles, distortion, etc., could indicate a defective transducer, loose hardware, damaged enclosure, or other problem that must be corrected.

8. Troubleshooting tips

For additional troubleshooting information on K.2 Series powered loudspeakers, please see the "K.2 Series Service Troubleshooting Guide" document available on the QSC Service Partner Portal. QSC will frequently revise the Troubleshooting Guide document as new common failures are found.

The troubleshooting contents inside this service manual are strictly tips that will help you troubleshoot the loudspeaker.

WARNING: RISK OF ELECTRICAL SHOCK

High Voltage is present in the main power supply. Proceed with caution.

Safety first

- The filter capacitors between PRI_HI / PRI_LO and VSS / VDD store a lot of energy! The voltage on these rails takes at least 10 minutes to fully discharge. If you are performing rework or repair, always discharge both voltage rails.
- **PRI_LO is NOT chassis ground**. Do not use an oscilloscope or DMM connected to earth ground.

8.1 General tips

AC mains fuse

- If the AC mains fuse blows, a soldering iron is required to replace it. To measure for an open AC fuse, use the tip noted in "8.2 Testing the AC mains fuse and line filter components".
- The fuse is not field-replaceable by an end-user, see location in Figure 9.14.1.

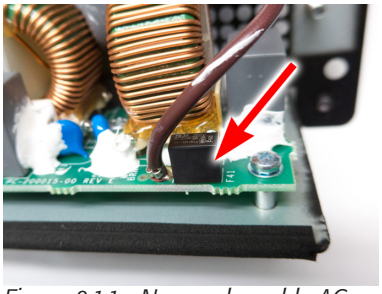


Figure 8.1.1 - Non-replaceable AC mains fuse location at F41.

Power supply

- If the PSU is not running and no LEDs are turning on, check the voltage across PRI_HI and PRI_LO for approximately 320 - 340 Vdc. Check the voltage across resistor R147 for approximately 55 Vdc.
- If the PSU does not come out of a pulse-skipping mode, check for shorted diodes D23, D24, and D51. Also check U2, Q8, and Q7 (in the HF amplifier section).
- If excess transformer noise is heard in normal mode, check the PWM at U15. Also check U4 for bad solder or failed components nearby.

Power supply modes: active vs. passive

The SMPS is in active clamp mode in these scenarios:

- During normal operation
- When the MOSFET Q13 is switching
- When the power supply is idling, but not yet in standby mode (passive clamp)

The SMPS is in passive clamp mode in these scenarios:

- During standby operation (after no input signal has been detected for 3 minutes)
- When MOSFET Q13 is not switching and is acting as a diode.

Amplifier circuit

- If VSS/VDD are dipping or the PSU relay is clicking when amplifiers are enabled, check for shorted diodes in one or both channels over-current protection circuits.
- If only one amplifier is not running, check the +12VLOW rail to that channel. Check for poor solder connections. Check the gate driver IC and also the green LED in that channel.
- If both amplifiers aren't running, there is a universal issue with the voltage rails that the amplifier circuits uses. Check the ±15V, ± 5V, and +12VLOW rails in the AUX OUTS circuit of the power supply.

8.2 Testing the AC mains fuse and line filter components

By following this tip, the EMI shield does not need to be removed in order to test the AC mains fuse or line filter components. Because there are only resistive and inductive components between the input and filtered output of the line filter, a DMM can be used to probe the AC wiring connections noted below to test the line filter components.

Performing this test will determine if:

- AC mains fuse F41 is open
- Inductor L41 or L42 has a broken lead (intermittent connections may not be detected though)
- NTC inrush filter R41 is broken or open (Figure 8.2.1)

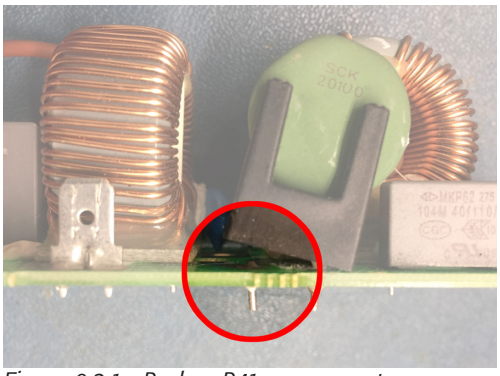


Figure 8.2.1 - Broken R41 component

Procedure

1. Disconnect any AC power from the amplifier module.
2. Remove the AMP/PSU metal cover (which holds the fan) to gain access to the AC wiring harness.
3. Disconnect the wiring harness from the AMP/PSU board and pull the harness out of the heatsink for easy access.
4. Turn the power switch ON.
5. Using a DMM in Ω mode, make two separate measurements (Figure 8.2.2 shows the brown wires being probed):
   - **AC LINE**: One lead on the AC inlet terminal (brown wire), the other lead on the AC wiring harness pin (brown wire).
     - Okay if short-circuit (less than 1 Ω) is measured.
     - If an open circuit is measured, the mains fuse F41 is probably open. Alternatively, inductor L41 or L42 could also have broken leads.
   - **AC NEUTRAL**: One lead on the AC inlet terminal (blue wire), the other lead on the AC wiring harness pin (blue wire).
     - Okay if 10 Ω is measured.
     - If an open-circuit is measured, NTC inrush resistor R41 is probably broken or open. Alternatively, inductor L41 or L42 could also have broken leads.

Figure 8.2.2 - Measurement locations for testing the AC line filter board components

8.3 Bypassing the AC line filter

If you would like to power up the amplifier module without the AC line filter, build a custom wiring harness like pictured in Figure 8.3.2. By injecting AC into the AMP/PSU board directly, the AC line filter is bypassed. This tip is especially useful if you want to power-up the amplifier module and check basic functions, but can't because the AC mains fuse is open.

Warning: Risk of electrical shock! Proceed with extreme caution when using this method.

Perform safe testing practices

- Always have an external fuse (5A or less) or resettable current trip device connected in line with the AC wires.
- Use a rated power switch to apply AC power to the board. Hot-plugging is not recommended.
- Be very careful of any exposed conductors on the custom wire harness. AC is present on these exposed conductors!
- Do not run full-power tests when the AC line filter is bypassed.

Testing notes

- An example connection using a custom wiring harness is seen in Figure 8.3.1.
- This tip should only by performed to check basic amplifier functions and to determine if the AC line filter board is bad.
- Do not perform final amplifier bench tests with the AC line filter bypassed. The amplifier will not pass all tests due to the unfiltered AC input.

Figure 8.3.1 - Bypassing the AC line filter using a custom AC wiring harness

Figure 8.3.2 - Custom AC wiring harness for K.2. Add a resettable 3A circuit breaker in series for added protecetion (not pictured).

8.4 Power supply MOSFETs and repair

Power supply failure is often related to shorted power MOSFETs Q13 and Q14. Both MOSFETs often fail together, but just one can fail in some instances. Unfortunately most power supply MOSFET failures cause catastrophic damage to PCB traces or cascading damage to other components down/up stream. Check all components in the schematic below before deciding to perform a component-level repair.

Symptoms:

- no power
- The PSU attempts to start but does not succeed.

Failure verification:

- Q13 or Q14 shorted between any two pins of gate, source, or drain. (verifiable from the top of the PCB, with the clamp off - Figure 8.4.1)

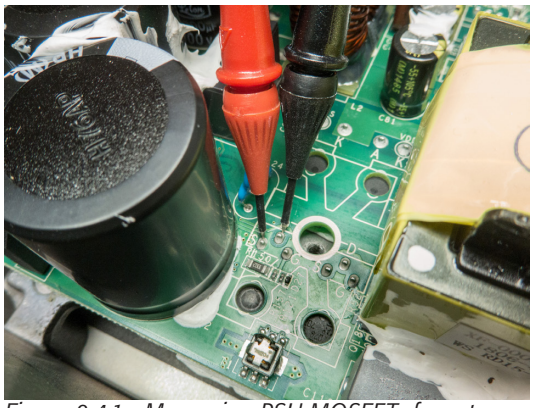


Figure 8.4.1 - Measuring PSU MOSFETs from top

Repair notes:

- First consider replacing the AMP/PSU board with a new one. Repairing the power supply at a component level is not recommended due to the complexity and small components in the circuit.
- Use the highlighted schematic in Figure 8.4.2 as a component check guide. Replace components in red and check components in blue.
- Q13 and Q14 don't always fail in pairs, but always replace both when one has failed.
- A failure of Q14 could cause direct damage to the PWM controller at U15. If this occurs, replace the board with a new one instead of repairing.
- Check gate drive components (resistors and diodes) tied to gate signals QM-DR and AUX_OUT.
- If the LEDs or LCD screen blink but the module won't start, suspect a failure to the power supply controller, U15.
- AC current draw at idle should be 0.1—0.3A at 120Vac and 0.1—0.2A at 230Vac. If the idle current is not in this range, there is a problem.
- **MOSFET clamping:** Take good care during the reassembly process when replacing the power MOSFETs. Apply a fresh and thin layer of thermal grease on the MOSFET body. The torque specification on the 2 clamp screws is very critical to ensure good heat transfer between the electrical component and heatsink. Sufficient clamp force is required to achieve the best result. Refer to the installation steps in "6.2 AMP/PSU board".

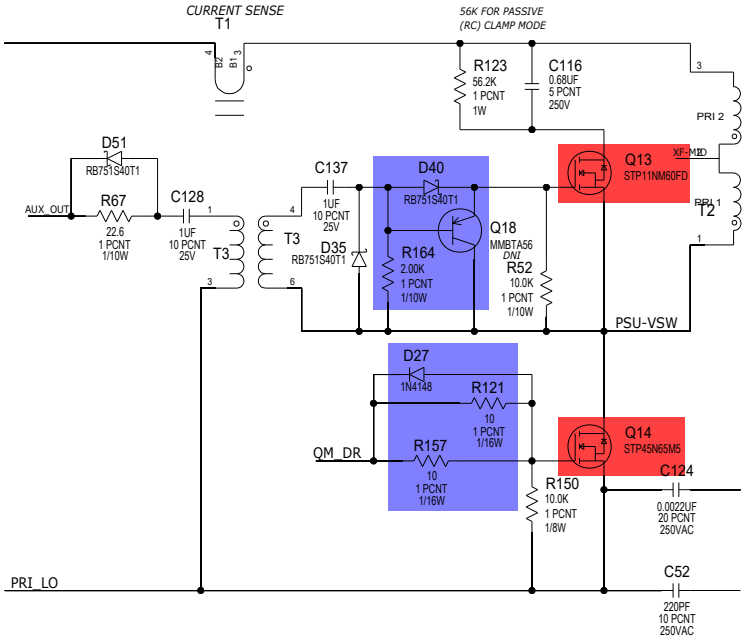


Figure 8.4.2 - Some components to check if the MOSFETs fail.

8.5 Amplifier MOSFETs

During amplifier section failure, both MOSFETs often fail together, but just one can fail in some instances. Most MOSFET failures can be repaired as long as failure does not cascade past the gate resistors and into the gate drive controllers. Check all components in the schematic below before deciding to perform a component-level repair.

Symptoms:

- One channel not outputting audio (after verifying signal output is okay from the codec)
- Amplifier module will not power up - keeps restarting
- one channel not outputting audio (with verified output from the DSP into the amplifier section)

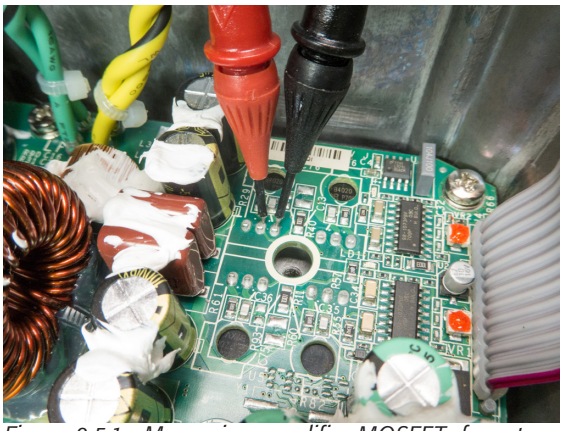


Figure 8.5.1 - Measuring amplifier MOSFETs from top

Failure verification:

- MOSFETs Q2 / Q3 (LF) or Q7 / Q8 (HF) are shorted between any two pins of gate, source, or drain (verifiable from the top side of PCB as seen in Figure 8.5.1)

Repair notes:

- The LF and HF amplifiers use ***different MOSFET pairs***! Do not mix them.
- Use the highlighted schematic in Figure 8.5.2 as a component check guide. Replace components in red and check components in blue.
- The MOSFETs almost always fail in pairs. Always replace both MOSFETs with new.
- Check the gate resistors tied to the MOSFETs for open circuit.
- The gate driver ICs can easily fail when the MOSFETs short.
- An amp FET failure can also fail the secondary rectifiers; check for shorted D33—34.
- Check the two resistors and diode tied to +12VLOW. If the gate driver IC fails, these components usually fail as well.
- You may check that the amplifier is switched on by simply looking at the small green LED (LD1 or LD2) on the top-side of the AMP/PSU board. The LED is constantly driven on during switching.
- Check the transducer associated with the failed amp section (LF or HF) for a shorted or open voice coil.
- **MOSFET clamping:** Take good care during the reassembly process when replacing the power MOSFETs. Apply a fresh and thin layer of thermal grease on the MOSFET body. The torque specification on the 2 clamp screws is very critical to ensure good heat transfer between the electrical component and heatsink. Sufficient clamp force is required to achieve the best result. Refer to the installation steps in "6.2 AMP/PSU board".

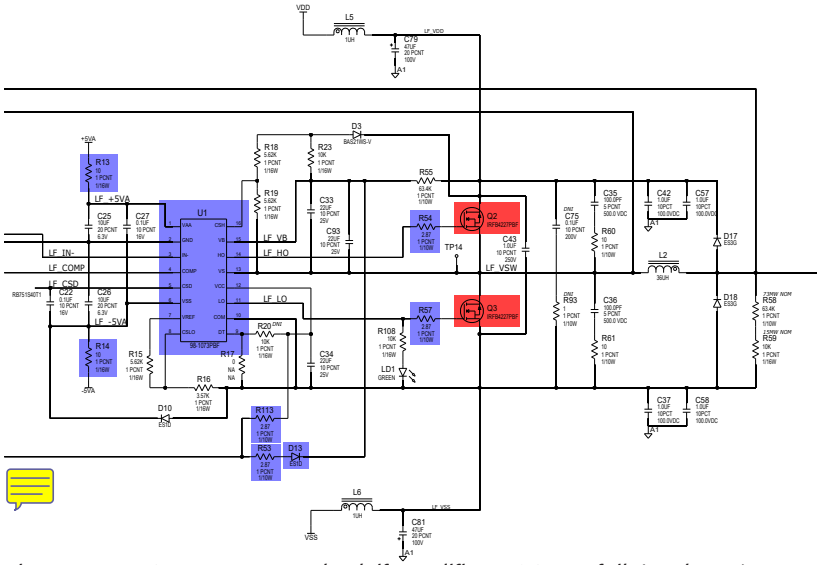


Figure 8.5.2 - Components to check if amplifier MOSFETs fail (LF shown)

8.6 LF and HF amplifier LEDs

Each amplifier section has an LED that is driven at LF_LO and HF_LO output of the gate driver (pin11). If the amplifier is on and switching, the LED will constantly illuminate green, which is a good indication that the amplifier circuit is working. The LF amplifier section uses LD1 and the HF amplifier section uses LD2. These two LEDs can give us a good information about the behavior of the amplifier circuit.

LED behavior notes:

- During normal operation, LD1 and LD2 should always be on together. If just one LED is turned on, then the LED that is turned off most likely has a problem in the correlating amplifier section.
- During standby operation, LD1 and LD2 should always be off. In standby the DSP shuts down the amplifiers.
- If both LEDs are turned off *and* the amplifier is in normal operation, look at the +12VLOW rail and the secondary power rails (VDD and VSS).
- If *both* LEDs are randomly turning off and on at the same time, an issue with the +12VLOW rail could cause this behavior. Check the components in the AUX OUTS section in the power supply. Also, this issue may be related to service bulletin K2-002.
- Recycle AC power to start the amplifier in normal operation, or, input a low amplitude signal to keep the amplifier running in normal mode.

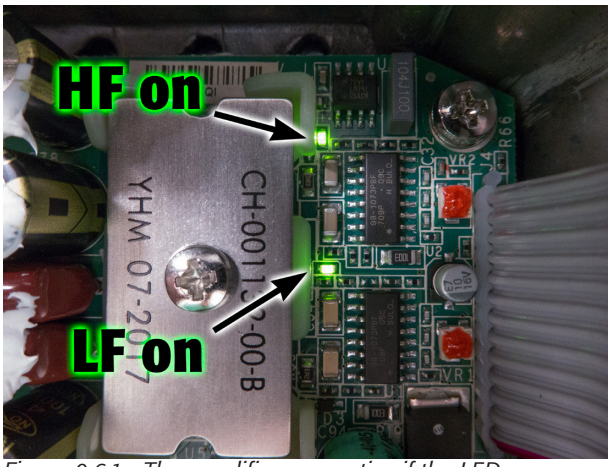


Figure 8.6.1 - The amplifiers are active if the LEDs are on

8.7 +12VLOW voltage rail failures

The class D amplifiers require a steady voltage from the +12VLOW rail to correctly function. If this rail fluctuates, the class D amplifiers could pulse off and on. If the rail is too low, the class D amplifiers will latch into a shutdown mode and not allow audio output. +12VLOW is generated on the secondary side of the transformer T2 in the AUX OUTS circuit.

Symptoms:

- All 3 signal LEDs (Ch.A, Ch.B, and Ch.C) turned on without signal input
- Chirping or buzzing sound heard in speaker, especially when coming out of standby mode.
- No audio, especially when coming out of standby mode.

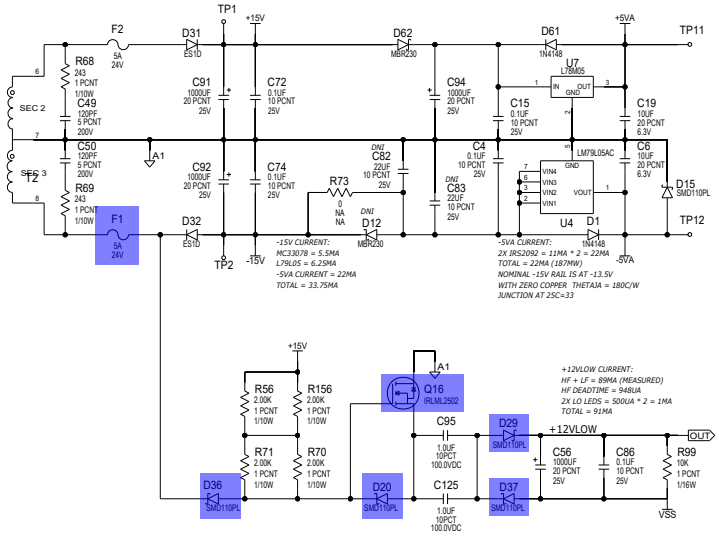


Figure 8.7.1 - Components to check if +12VLOW rail has failed

+12VLOW notes:

- If the chirping/buzzing sound is heard, or there is no audio when coming out of standby, please refer to the latest Service Bulletin. The AMP/PSU board may need to be replaced with a new one.
- If the amplifiers LEDs are not turned on *during normal operation*, the +12VLOW rail could have failed. Immediately check the -15V rail on the input/DSP board at J11 pin3.
  - The +12VLOW and -15V voltage rails are generated after fuse F1. If +12VLOW has a shorted component, it will probably cause F1 to blow. The -15V rail will also measure 0 Vdc if F1 is open.
  - SMD MOSFET Q16 could be the culprit. Q16 is located on the bottom side of the AMP/PSU board. Also check the Schottky diodes in the circuit as highlighted in Figure 8.7.1.

8.8 Testing the input/DSP and LCD boards

Swapping known good boards to isolate failure

One of the easiest troubleshooting steps is to swap a board with a known good one. It is recommended to keep a "golden unit" of each board in your lab. It's very simple to swap the input/DSP and LCD boards, even with the original boards still installed in the amplifier chassis.

Important note: If performing a swap with the original board installed in the chassis, place some insulation material between the original and golden board to avoid electrical shock and shorting.

Input/DSP board swap

1. Remove the 3 larger ribbon cables (ignore the 2-pin ones) from the original input/DSP board.
2. Connect the 3 ribbon cables to their appropriate locations in the golden input/DSP board. See Figure 8.8.1.
3. Verify all basic functions with the golden input/DSP board. If they fix the original problem, replace the input/DSP board with a new one.

LCD board swap

1. Remove the 2 larger ribbon cables that connect the input/DSP board to the LCD board.
2. Connect the 2 ribbon cables coming from the LCD board to their appropriate locations on the input/DSP board. See Figure 8.8.2.
3. Verify all basic functions with the golden LCD board. Verify that the rotary encoder, buttons, and LCD screen work correctly. If they fix the original problem, replace the LCD board with a new one.

Figure 8.8.1 - Testing with a golden input/DSP board (verified)

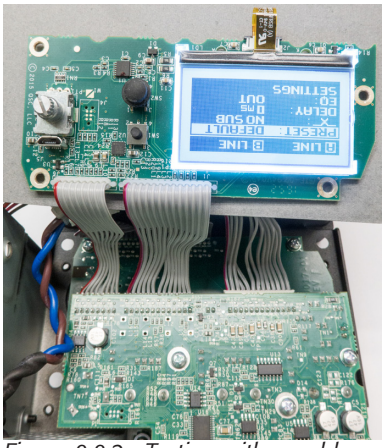


Figure 8.8.2 - Testing with a golden LCD board

LEDs on the input/DSP boards

Monitoring the blue power LED and several green LEDs on the input/DSP board may aide in troubleshooting. See Figure 8.8.3 for location of the LEDs on the board. The input/DSP can be powered on outside the chassis with or without the LCD board connected.

- **Blue LD8**: If LD7 is steady, the +5V_A rail is good and MCU is working (or at least driving the signal LEDS_ON, which turns on the blue LED).
- **Green LD8**: If LD8 is steady, the +5VA rail is good.
- **Green LD9**: If LD9 is steady, the +15V rail is good.
- **Green LD10**: If LD10 is steady, the -15V rail is good.
- **Green LD12**: If LD12 is steady, the buck regulator at U19 is working correctly and the +3.3VD rail (which powers the MCU and DSP). If the LED is pulsing, check the +15V input from the AUX power supply, the buck regulator components, and circuits that use the +3.3VD rail.

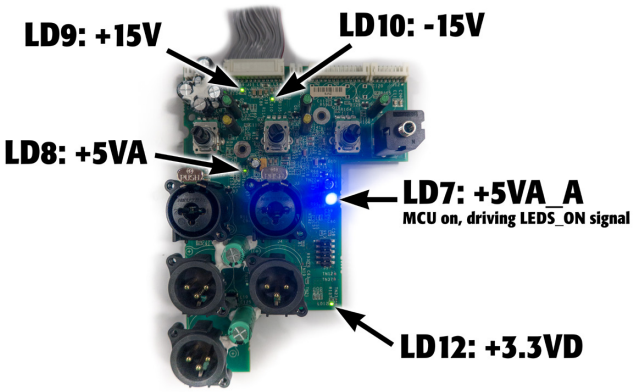


Figure 8.8.3 - LED locations and associated voltage rails

Applying an external DC supply

When disconnected from the AMP/PSU board, you can power up the input/DSP and LCD boards using an external DC power supply set to +15V. Using this tip, you can quickly determine whether the input/DSP or LCD board has failed by isolating them from the AMP/PSU board. This tip will also give you insight about the ±15V and ± 5V AUX rails on the SMPS secondary side, particularly in a loaded (ribbon cable connected) or unloaded (ribbon cable disconnected) scenario.

You can power up the boards either inside or outside the amplifier chassis. It's best to make a 13-pin wiring harness. You can re-use an old 13-pin AMP/PSU ribbon cable by cutting it short and stripping the wires on pin4 and pin13 for hook-clip connection to the external power supply. See Figure 8.8.4 for a custom wiring harness example.

Figure 8.8.4 - Custom 13-pin wire harness for external DC supply

When you're ready to start testing, use a single-rail power supply set to +15V. Remove the AMP/PSU ribbon cable from the input/DSP board and connect pin4 (+15V) and pin13 (GND) at J11. See Figure 8.8.5 for example connections.

Notes on external DC supply testing:

- *Do not have AC connected to the amplifier module when using an external supply!*
- For safety, set the current trip of the DC supply to 250 mA.
- When the LCD backlight is on, the approximate current draw from the 15V external supply is 140 mA. When the backlight is off, the current draw is 130 mA.
- If the MCU is running, blue LED LD7 will be steady.
- Major circuits on the input/DSP board should work when powering up. The MCU, DSP, LCD, and push buttons should all be functional because they are powered from the +3.3VD rail, which is derived from the +15V auxiliary rail.
- Because only the +15V supply is being applied, the input/DSP board is not 100% functional. Several op-amps, buffers, and the audio codec run off different voltage rails, which are not present using the external DC supply.

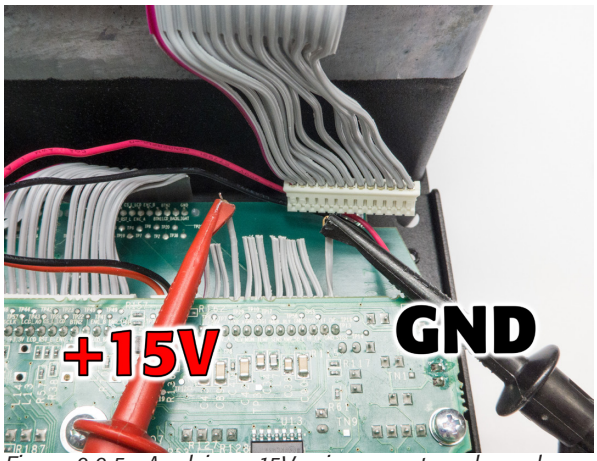


Figure 8.8.5 - Applying +15V using an external supply

- Updating the firmware on the input/DSP board with the external DC supply connected is okay!

8.9 LCD ribbon

The LCD screen is mounted onto the LCD board, with the control and data lines coming through a ribbon cable at J2. A flat style ribbon with copper pins is used. The connector at J2 is the push-to-lock type, which lends itself to potential assembly error when connecting the ribbon to the board. The ribbon must be near perfectly straight in the connector when it is locked down. If the individual pins do not make good contact, the LCD screen will not work properly.

Symptoms

- LCD does not display anything on screen
- LCD works, but does not display anything distinguishable
- LCD intermittently works
- LCD backlight never turns on, or is flashing (this could also be related to a broken LCD at the solder pins).

Repair notes

- If you find any issues with the LCD ribbon or connector, it's best to just replace the entire LCD board with a new one.
- Do not try to fix the ribbon cable or connector

8.10 Input section failure

Transient voltages originating from external sources input to the XLR, 1/4", or 3.5mm jacks could cause input circuit failure in the differential section, especially to differential resistors. As with most input circuit failure, multiple components in the input circuit can fail. The higher the intensity and length of time of the transient voltage seen at the input, the more components will fail downstream.

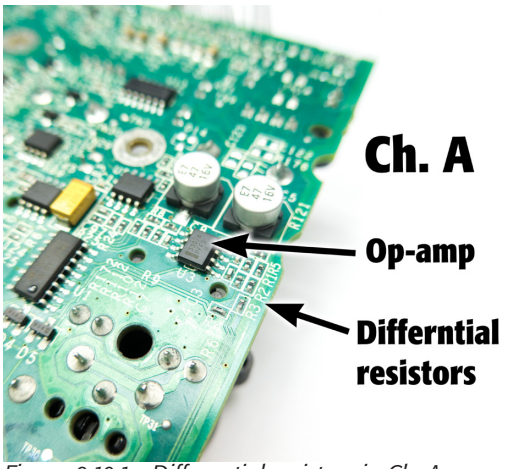


Figure 8.10.1 - Differential resistors in Ch. A

Symptoms

- Channel A, B, or C does not receive input signal
- Without an input connected, channel A, B, or C outputs noise when the gain is increased
- Without an input connected, the green signal LED always on

Failure verification

- When a known good signal (sine wave recommended) is input to the failed channel, signal integrity is compromised after the op-amp output of U3 or U4 (on the input/DSP board).

Repair notes

- Before repairing, try to determine if the end user had MIC (Ch. A) or INST (Ch. B) modes on. These modes enable high gain in the differential op-amp circuits, which could cause additional damage upstream.
- Channel A (MIC LINE) is much more susceptible to failure than the other channels. The differential resistors R3 and R4 are usually the first component to fail.
- High frequency oscillations on the input could cause the inductors right after the XLR inputs to fail.
- If ***all 3 signal LEDs*** are on without input, it may be related to a different failure in the +12VLOW circuit (see page 43).
- After repairing, pay close to the gain section when bench testing the amplifier module

8.11 Fan issues and overheating

A functional fan is required for normal use of the K.2 series. If the fan does not work, the amplifier module will easily overheat, go into thermal protection, and shutdown the amplifiers. Most fan issues are related to broken/stuck fan blades, disconnected fan wires, or shorted fan circuitry.

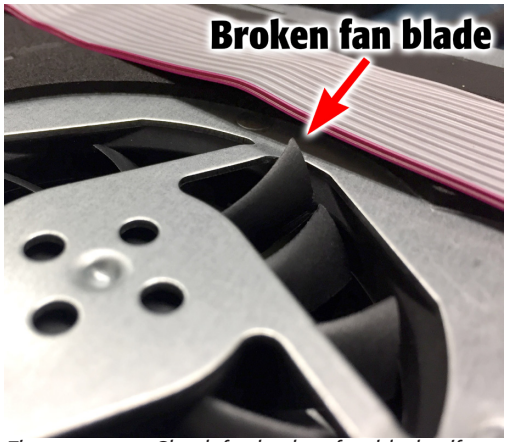


Figure 8.11.1 - Check for broken fan blades if there is an over temperature condition.

Symptoms

- Overheating - amplifier heatsink is hot when touched.
- Audio suddenly stops

Failure verification

- Fan does not spin when temperature is above 50 C (you can use Test Mode App to view the temperature on the LCD screen, rather than actually measuring the temperature).

Repair notes

- The root cause may simply be a disconnected fan wire.
- Check for broken or stuck fan blades as in Figure 8.11.1. Try to spin the fan with your fingers. It should freely move.
- Disconnect the fan. Measure the voltage across the fan pins at J7 on the input/DSP board when temperature is over 50 C. There should be at least 9 volts across the fan pins. If not, then the fan drive circuit has failed. Check transistor Q2, resistor R28, and the +15V_A power rail.

8.12 Front LED

The most common cause of front LED malfunction is a bad LED or internal wiring harness. The LED drive circuit is almost never an issue.

Failure verification

- Front LED does not turn on (after verification that the LED is turned on through the LCD menu)

Repair notes

- It's easier to check the front LED from the rear of the speaker through the molex connector. This will save time.
- Use a DMM in diode-check mode to apply voltage across the wiring harness at the molex connector pins. If the LED does not illuminate, either the wiring harness is pinched/cut or the LED is out.
- To replace the LED, you must remove the grille and baffle from the enclosure.
- Separating the baffle assembly from the enclosure is the easiest way to replace the LED and check the wire harness.
- Use the K.2 test adapter to verify the amplifier module is outputting the LED signal. The blue LED on the test adapter will illuminate if the LED signal is good.

8.13 Internal wiring harness

Sometimes the wires to the LF transducer (green and green/black) or HF transducer (yellow and yellow/black) disconnect from the transducer terminals because they were not properly locked into place during assembly.

Symptoms:

- Missing or intermittent high and/or low frequencies
- Crackling noises in loudspeakers

Failure verification:

- A faston connector is disconnected from one of the terminals on the LF or HF transducers.
- A wire is loose inside the molex connector that connects to the amplifier

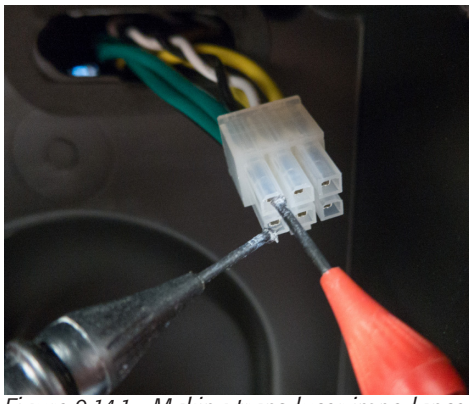


Figure 9.14.1 - Making transducer impedance measurements at the molex connector.

Repair notes:

- Making measurements from the rear of the speaker (after removing the amplifier module) at the 6-pin molex connector can quickly provide information about the condition of the transducers and front LED:
    - The LF transducer (green wires) measures approximately 1.6 ohms
    - The HF transducer (yellow wires) measures approximately 14 ohms
    - The front LED can be turned on (illuminated) if you place your DMM in diode-check mode.
- The faston connectors have latches that lock the connector in place. Gently tug on the wires after connecting them to the transducer terminals to verify that they are locked.
- Inspect all six wires in the wiring harness. Gently pull each one separately to make sure it is well secured in the Molex connector. If any wire is loose and easily pulls out of the connector, replace the wiring harness assembly - do not repair it.
- The wiring harness should be slack enough to not put excessive stress on the connections, but taut enough that the wires will not flop around and possibly make noise. If the harness wires are too taut, cut off the tie-wraps and install new ones in a way that provides more slack. Attach the wires to the driver terminals, while making sure the polarity is correct.
- Plug a low-distortion audio sine wave generator into a 1/4" or XLR input connection on the amplifier module. Gradually sweep the frequency from 20 Hz to 20 kHz. All frequencies should be audible and free of distortion or rattling. You should notice the sound crossing over from the woofer to the horn at about 2 kHz. If one of the transducers is disconnected internally because of the wiring harness, it will be very obvious with the sine-wave sweep.

8.14 Transducer issues

There are many different types of failures for transducers in K.2 series loudspeakers. The most common issues found are the following: spider becomes unglued from the frame, cone tears near the surround, burnt voice coil (because of an amplifier module failure), and voice coil rubbing on edge of magnet. These are often manufacturing issues but they do not occur very often.

Symptoms:

- Missing or intermittent high and/or low frequencies
- Distorted sound

Failure verification:

- Tears in cone or surround, glue application issue, magnet damage, or other obvious transducer failures
- Open circuit measured across the transducer's terminals (or at the molex connector)
- Can hear obvious distortion when powering the transducer with a sine-wave tone using a separate amplifier (not the amplifier module).

Repair notes:

LF transducer

- The low frequency transducer can be replaced without removing the baffle.
- Verify the gasket is installed on the replacement transducer Spare part K.2 LF transducers should come with the gasket pre-installed.
- Verify the orientation of the LF transducer is correct. The wire tabs should be at the 2 o'clock position.

  Important note: When refastening the low frequency transducer to the baffle, tighten the screws in a crisscross pattern (Figure 8.14.1). Be careful to not damage the surround on the replacement transducer when fastening screws. The surround cannot be repaired except by replacing the entire driver...Again!

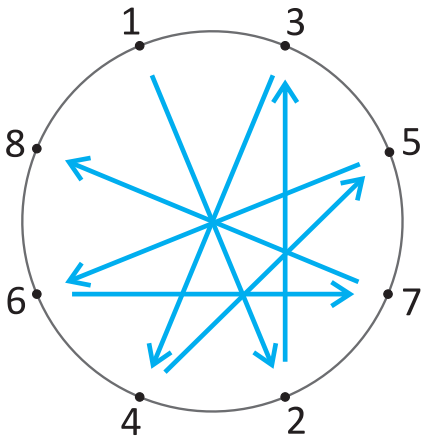


Figure 8.14.1 - Use a crisscross pattern when tightening LF transducer screws

HF transducer

- To replace the high frequency transducer, the baffle must be removed.
- All K.2 Series models share the same HF transducer.
- A diaphragm replacement is available for the HF transducer. This is a cost-saving alternative and is recommended.

- Note the wire color in the table below for each model.

Wire Color	Connection
Green	LF +
Green / black	LF -
Yellow	HF +
Yellow / black	HF -
White	Front LED anode
White / black	Front LED cathode

- Before attaching the grille, do a quick test on the loudspeaker. Plug a low-distortion audio sine wave generator into a 1/4" or XLR input on the amplifier module. Gradually sweep the frequency from 20 Hz to 20 kHz. All frequencies should be audible and free of distortion or rattling. You should notice the sound crossing over from the woofer to the horn at about 2 kHz.

9. Schematics, exploded-view drawings, and BOM

Starting late 2017, QSC changed the key contents inside the Service Manual. Because hardware or software may undergo several changes during the life of this product, schematic diagrams, exploded viewd drawings, PCB images, and full BOM are not available in this service manual. This new structure will reduce the overall page count, PDF file size, and number of revisions, making the service manual easier to navigate.

Please download these supplemental documents from the Service Partner Portal at **www.qsc.com/login** (registration and login are required) or contact QSC for them. The Service Partner Portal is always up-to-date with the latest information and service documents.

Contact information

Service manuals and other service documents are available for download from www.qsc.com via the Service Partner Portal. If you need any further information regarding this service procedure, please contact QSC Technical Services at the addresses or numbers below.

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Fax: +1 (714) 754-6173

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