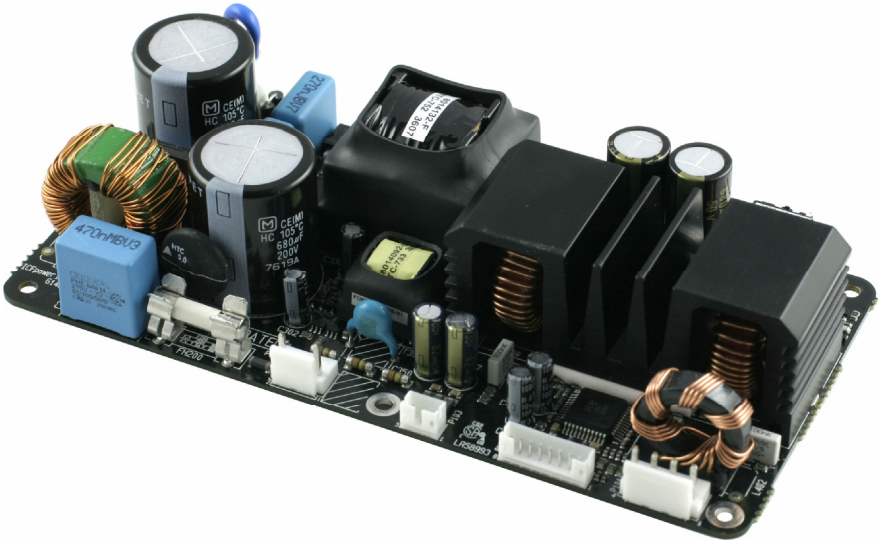
Bang & Olufsen ICEpower a/s, Gl. Lundtoftevej 1b, DK-2800 Lyngby
Phone [45] 45 20 36 00, Fax [45] 45 20 36 99, CVR-no. 25053591
ICEpowerinfo@bang-olufsen.dk, www.icepower.bang-olufsen.com



ICEpower125ASX2 Designer's Manual

2x125W or 1x500W ICEpower Amplifier with integrated ICEpower Supply

Version 1.0

Contents

Introduction

This document is intended as a design-in guide for users of the ICEpower125ASX2 module. This document is to be used in conjunction with the ICEpower125ASX2 Datasheet, which contains details on specifications, pin-configuration and measurements. Since no two applications are alike, the recommendations of this document can only serve as general guidelines for your specific designs.

A key point of this document is that when dealing with high-power switching technologies, you are facing a design challenge regarding proper wiring to ensure that the final product is in compliance with standards on electromagnetic compatibility (EMC). These challenges can be overcome by means of proper module mounting, simple shielding in very compact designs and, most importantly, proper cabling routing.

Important Notes

±24V auxiliary supply

Note that the auxiliary ±24V outputs are protected against over current with a 630mA fuse. Even a brief short circuit on these outputs may result in a defective fuse!

Another very important thing is to be careful of the load capacitance on the AUX supply. Please read the section "Capacitive Loading of the AUX Supply" for more information.

Typical Wiring Diagrams

Simple Stereo Operation (SE version)

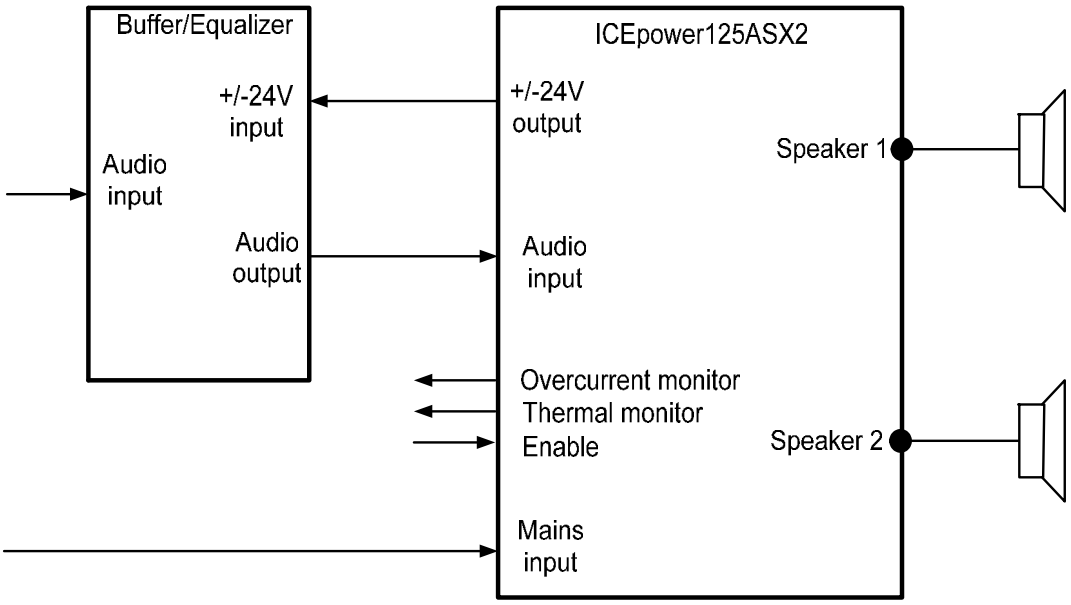


Figure 1: Stereo setup with external signal conditioning.

Mono Operation (BTL version)

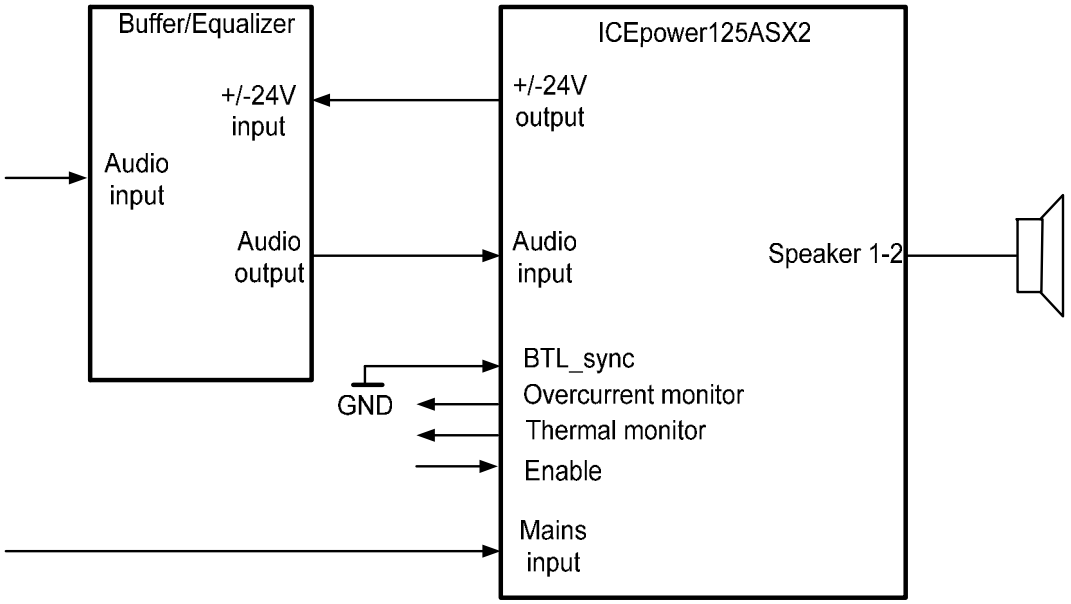


Figure 2: 1 way active loudspeaker (ex. subwoofer) with active crossover.

2-Way Speaker with Active Crossover (SE version)

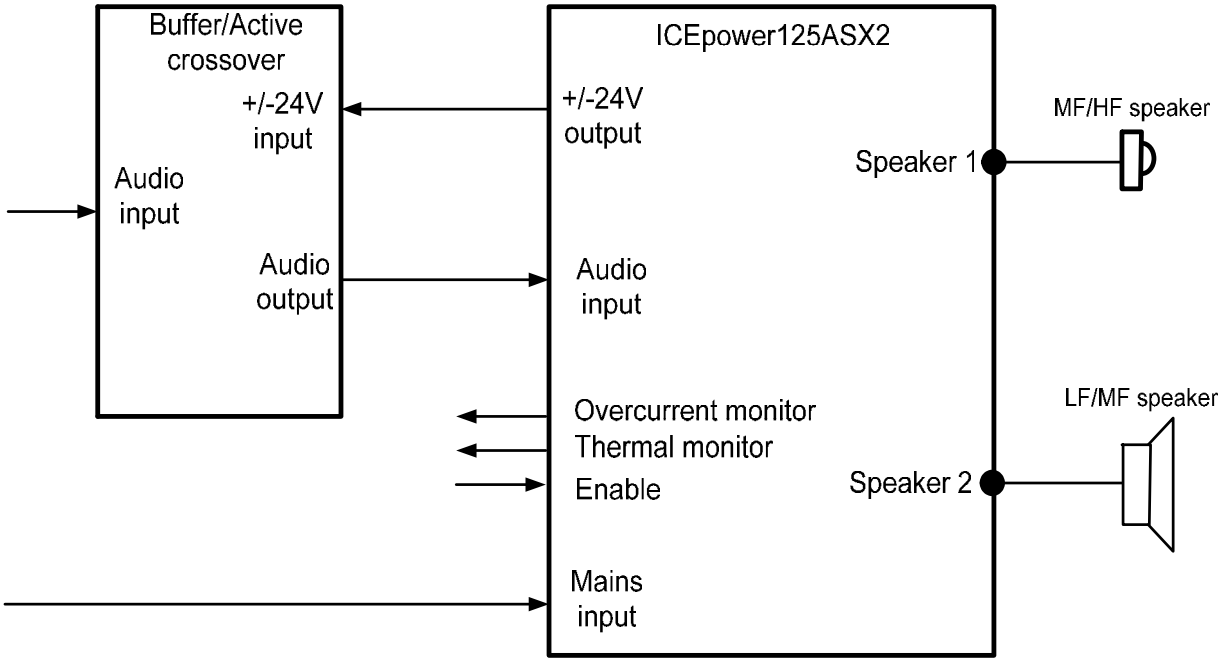


Figure 3: 2-way active loudspeaker with active crossover.

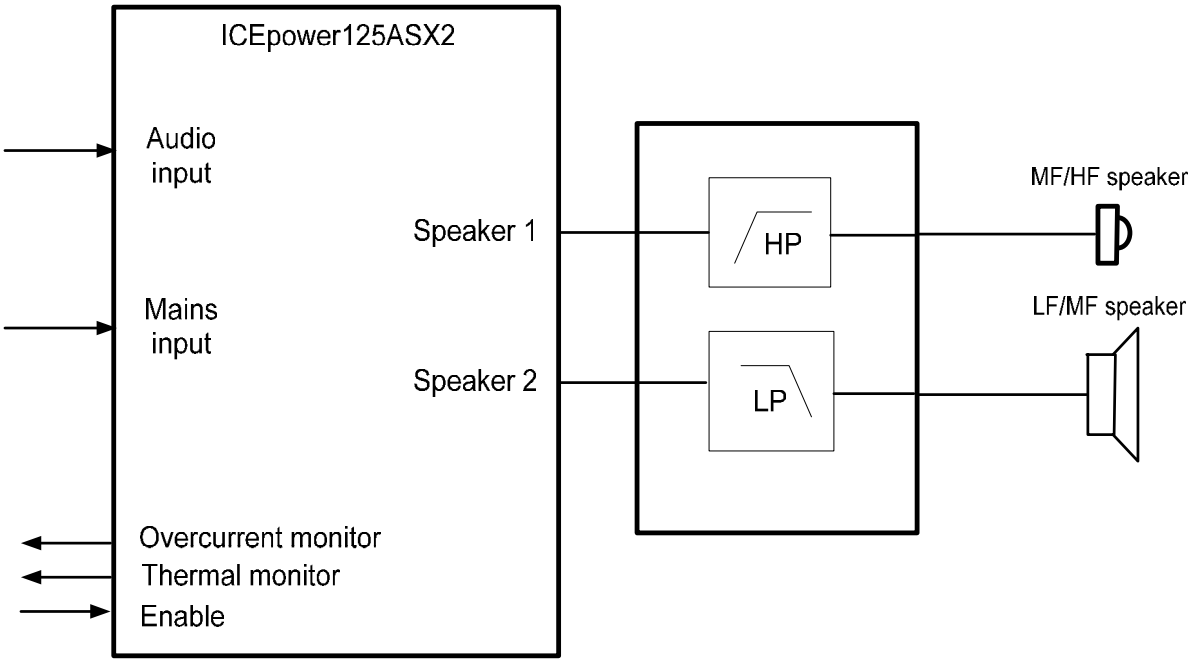


Figure 4. 2-way active loudspeaker with passive crossover.

Different Ways to Power-Up

For further information regarding power-up please refer to the datasheet under the section *Features -Enable pin*.

Mains Switch

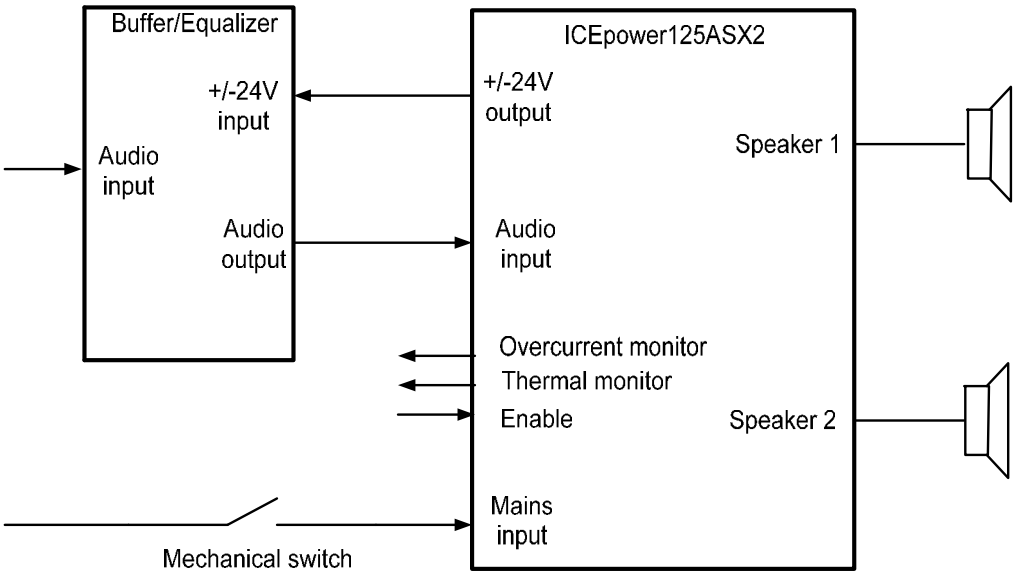


Figure 5: Power-up using mains switch.

Remote Receiver

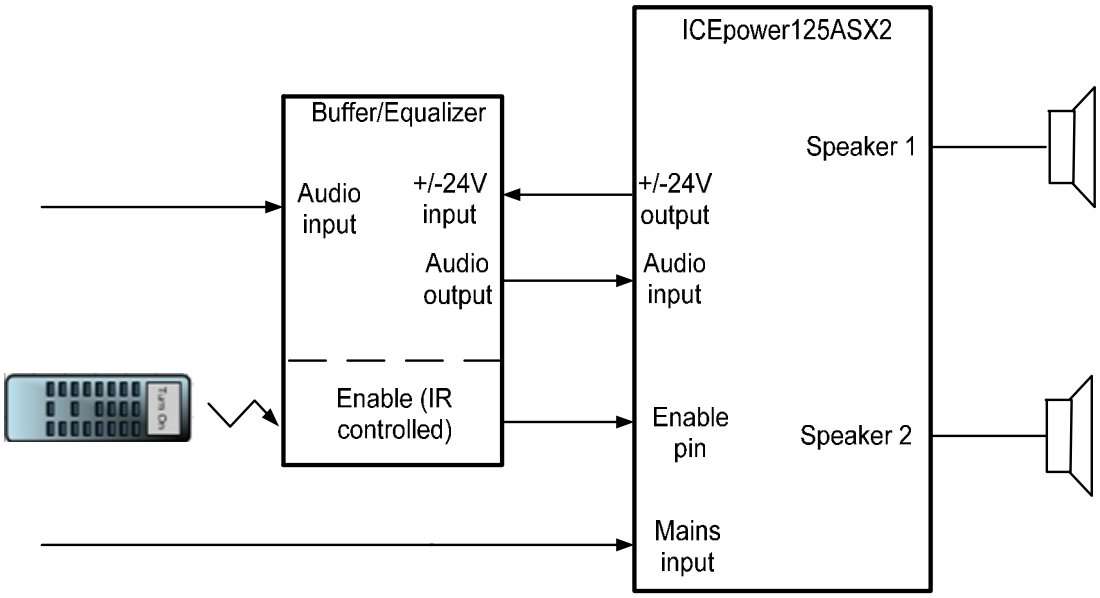


Figure 6: Power-up by remote control (Standby power consumption = 6W when disabled)

Shielding and Grounding of Audio Signals

The analogue audio signal input interface of the ICEpower125ASX2 is intended for single ended signal routing. To eliminate hum and noise due to ground loops and induced noise, proper grounding and cable routing are very important design aspects.

Another issue when dealing with switching amplifiers is that unwanted frequency components may be present at the output of the amplifier. These signals (called spurious output) must be kept to a minimum to avoid audible effects. Avoiding spurious output requires attention to cabling and grounding. Schematics showing the recommended grounding and shielding philosophy can be found in Appendix A.

Capacitive Loading of the AUX Supply

When connecting capacitors to the AUX supply (+/-24V), be sure to have at least 1,2 ohms resistance in series with the AUX supply (max. 1800uF). Capacitors with a value larger than 1800uF require a larger resistor in series as shown in
Figure 7. This is to prevent the auxiliary supply fuse breaking during power up.

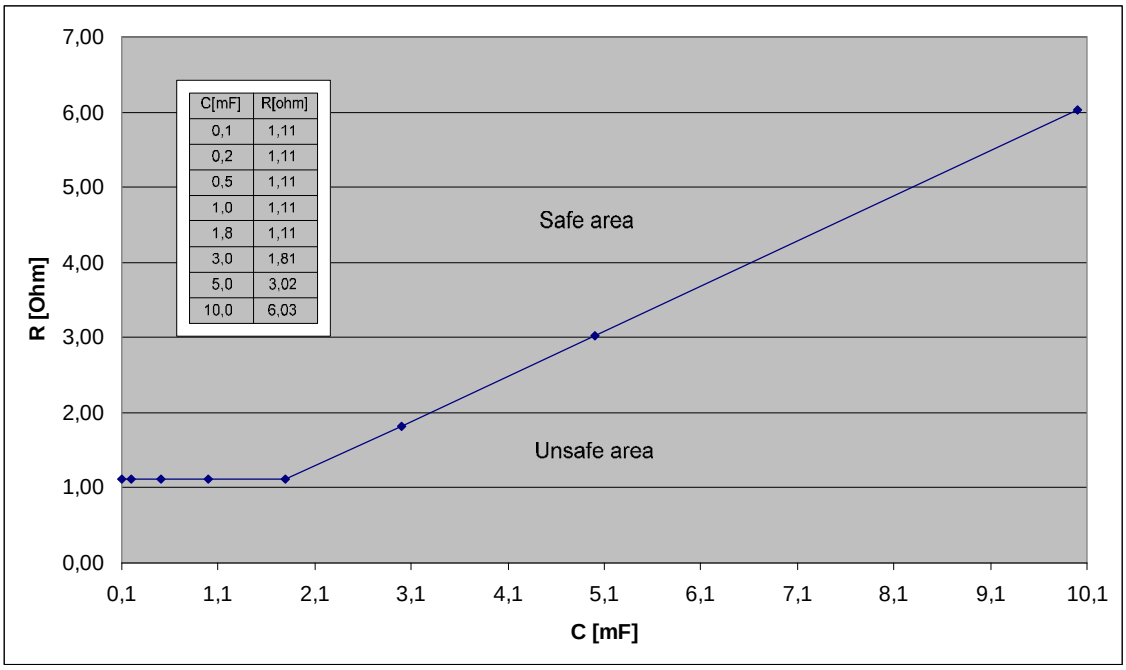


Figure 7: Capacitive loading of the AUX supply

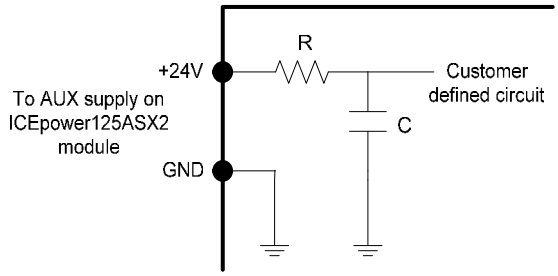


Figure 8: Diagram showing the resistor in series with the capacitor

Pulsed loading on the AUX supply

If the application requires drawing pulsating currents with a frequency of less than 20kHz from the AUX supply special care should be taken to avoid unwanted tones being audible on the output.

Due to the impedance in the ground wire (signal ground and aux ground), which will always be a few milliohms, the current draw through will run in both ground wires (signal ground and aux ground) will create a voltage across the ground wire. This pulsing voltage over the signal ground wire will be modulated over the audio signal and may reach audible levels. Regulating the AUX supply as illustrated below will reduce audibility.

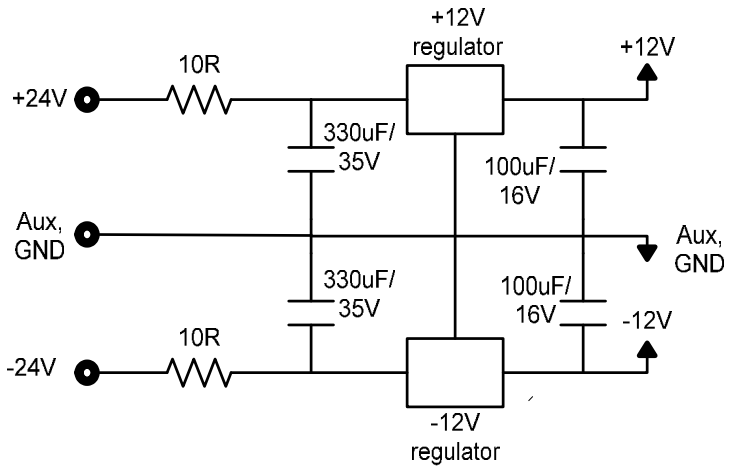


Figure 9: Regulated power stage for external circuitry

DO NOT draw currents larger that 100mA through the signal ground. If higher currents are needed (up to 200mA) use the AUX ground instead. Do not draw high pulsed currents from this supply (+/-12V) as this will also be modulated with the input audio signal. The 10Ω resistor and 330uF capacitor have a cutoff frequency (-3dB) of 48Hz. The resistor can be set to 1 ohm, which makes the cutoff frequency 480Hz, but allows higher current to be drawn from the +/-15V supply. The 100uF capacitors after the linear regulators stiffens the +/-12V supply and dampens the noise.

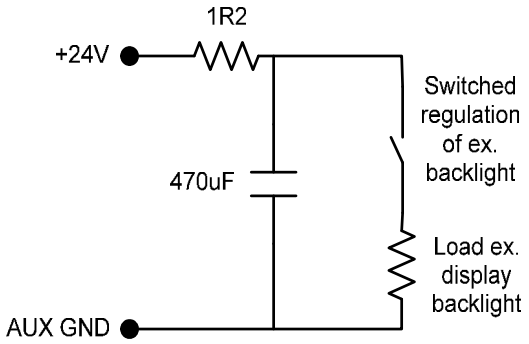


Figure 10: Local decoupling close to switching circuit

Local decoupling close to the switched load also has a good damping effect on the unwanted tone. Remember to place minimum 1,2 ohms resistance in series with the capacitor. The cut-off frequency here is 282Hz. The capacitor can be changed if another cut-off frequency is desired.

A good noise reduction can be achieved with the input circuit shown below, in combination with the circuits mentioned above. All 5k6 resistors should be with 1% or 0.1% tolerance for best performance.

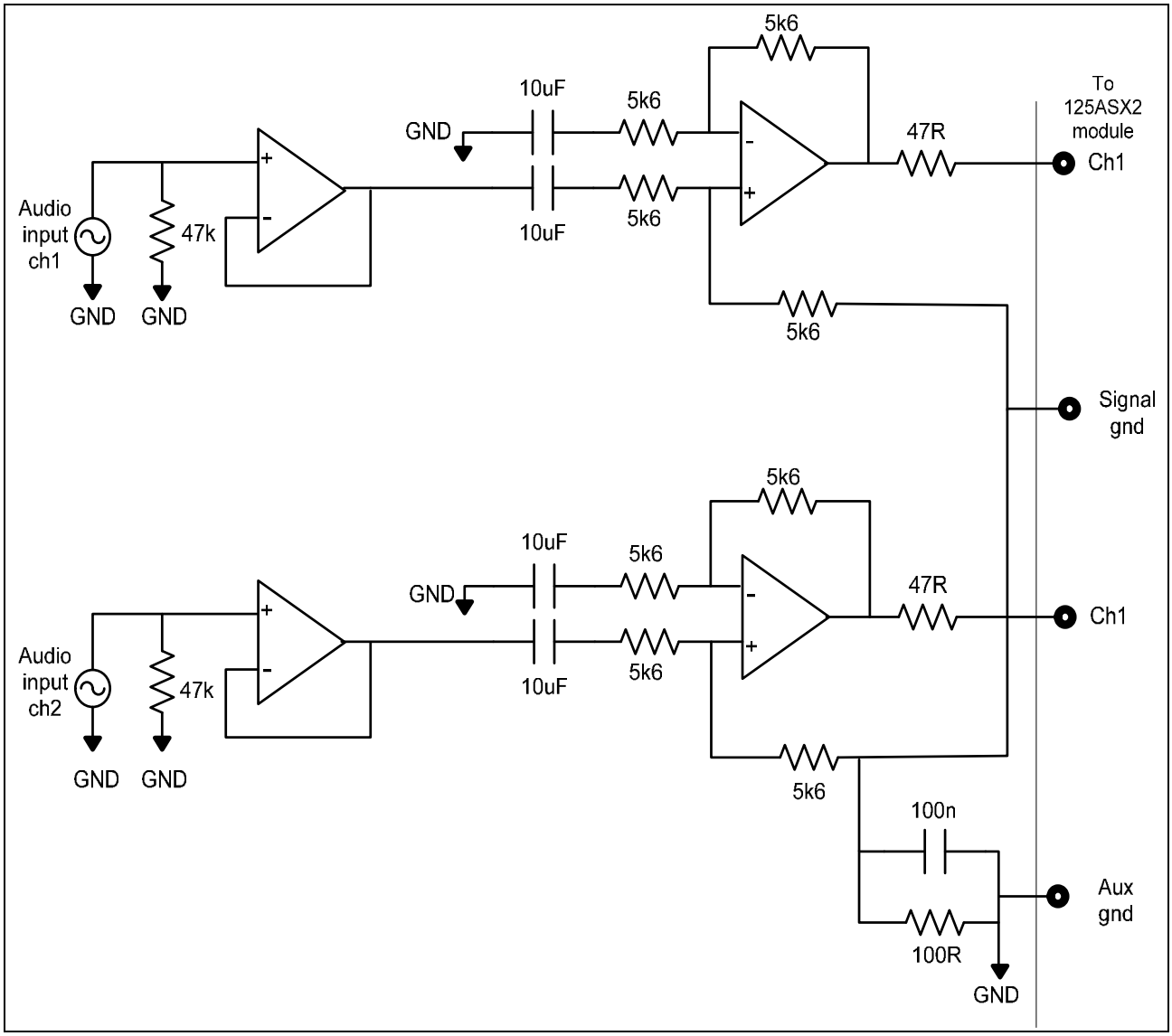


Figure 11 Noise reduction circuit for SE amplifier (conceptual schematic)

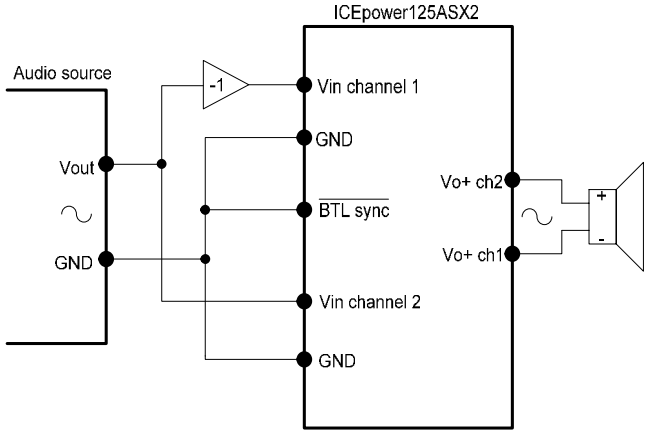


Figure 12: Input wiring diagram for the BTL module

If noise is not an issue, the following input buffer can be used in each channel instead.

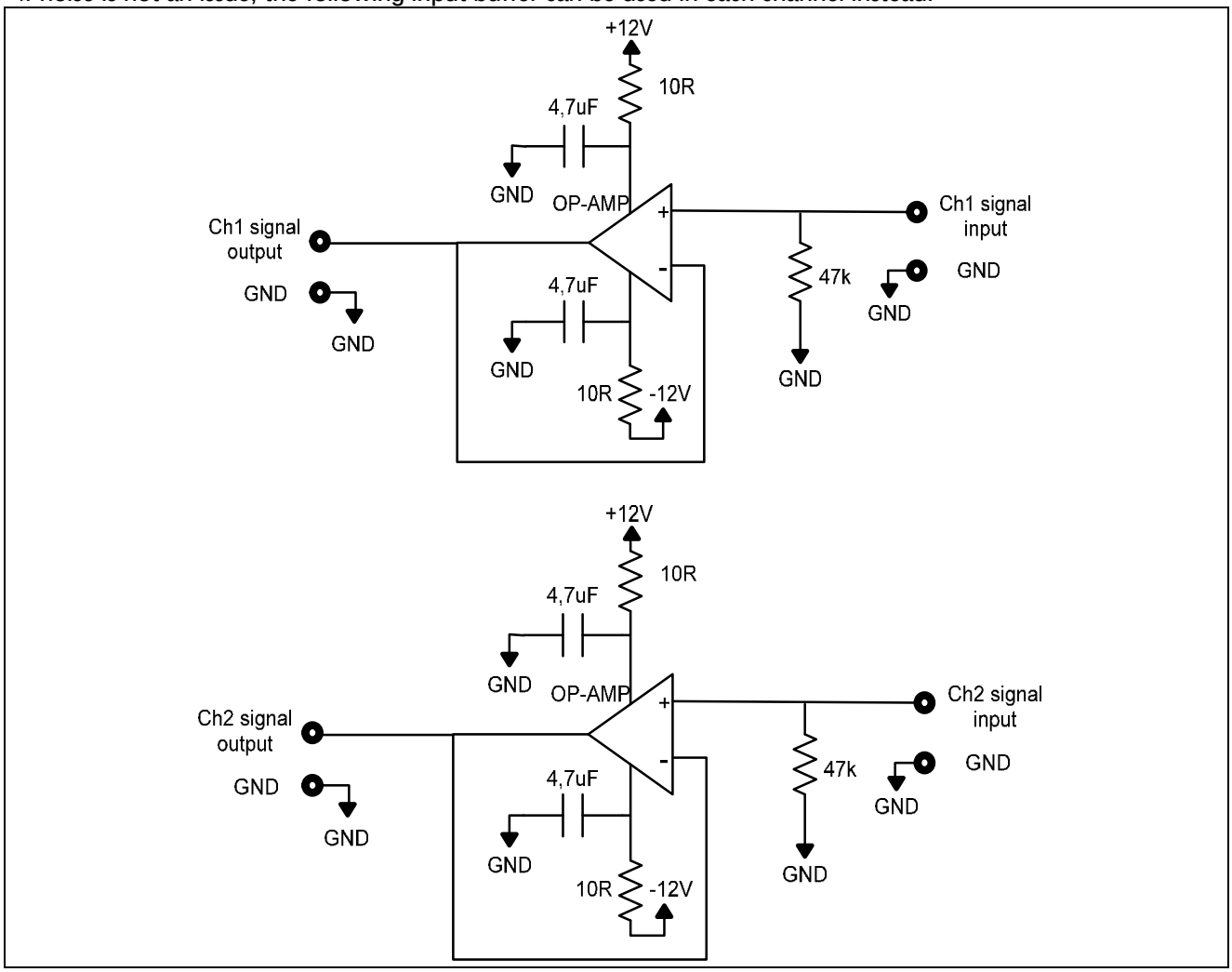


Figure 13: Simple input buffer with reduced noise reduction ability (conceptual schematic)

The input stereo buffer is shown above. Each channel (amplifier) is decoupled with 10Ω and 4.7uF. This decouples unwanted noise and lowers crosstalk between the channels.

This circuit is helpful even in BTL mode if noise is an issue because the amplifier inputs are two SE inputs referenced to ground. All 5k6 resistors should be with 1% or 0.1% tolerance for best performance.

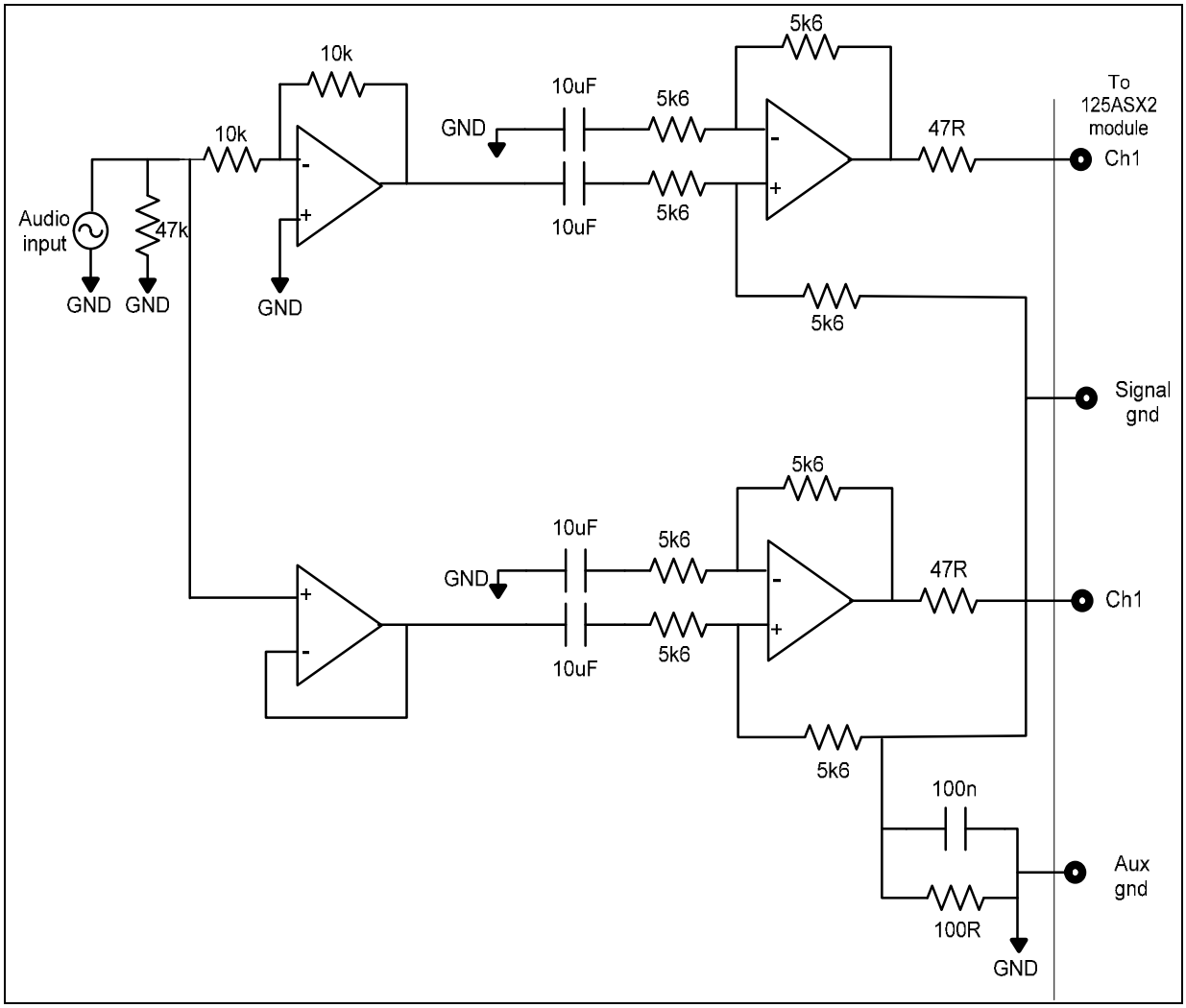


Figure 14 Noise reduction circuit for BTL amplifier (conceptual schematic)

EMI Management

ICEpower amplifiers and power supplies utilize the latest switching technology to offer intelligent, compact and efficient audio power conversion systems. However, operating with fast switching signals generates unwanted high frequency noise. Unless the necessary high frequency design precautions are not taken this noise may exceed the standardized EMI limits.

The ICEpower125ASX2 has been pre-approved according to the following EMC standards:

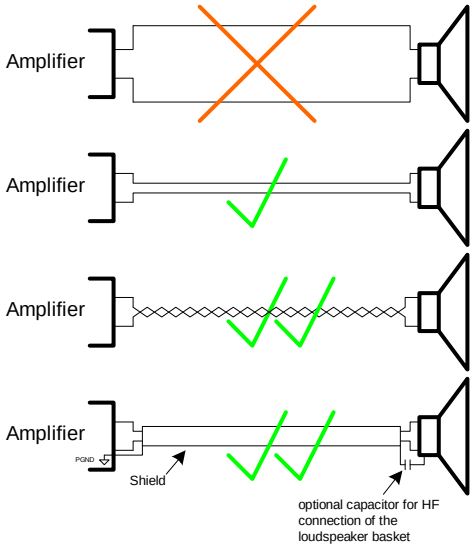
- § EN55013
- § EN55020
- § EN61000-3-2
- § EN61000-3-3
- § EN61000-4-2
- § EN61000-4-3
- § EN61000-4-4
- § FCC part 15-B

The device under test is mounted on a backplane and loaded with a resistive load (see test setup on page 14). The test signal is pink noise corresponding to 1/8th of the rated power dissipated in the load.
Even though the ICEpower50ASX2 module is pre-approved for EMC, it is always necessary to approve the final product according to the applicable standards on EMC.

Do's and Don'ts

Electromagnetic Interference (EMI) is emitted from any cable carrying RF currents. This chapter describes some guidelines to help reduce EMI in an ICEpower system.

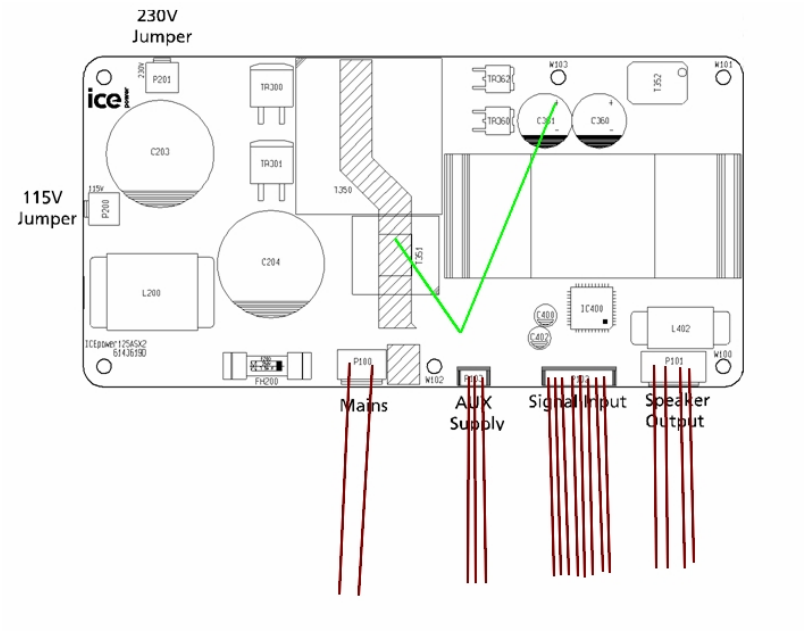
- § Loops conducting RF currents emit EMI. It is important that speaker cables are twisted, shielded or at least run closely paralleled to reduce the loop area as much as possible. The same applies to mains and internal power supply cables as well as signal cables.



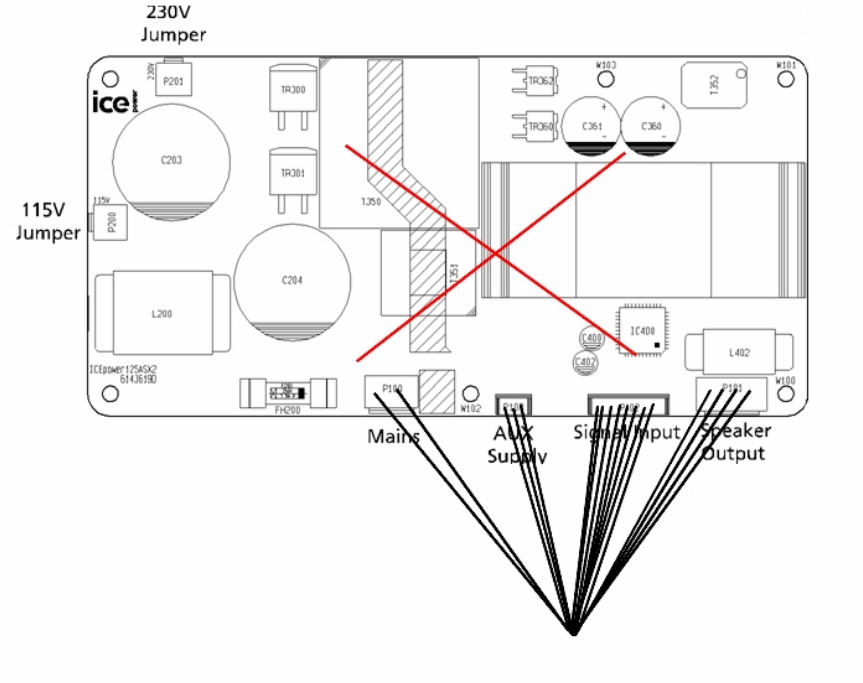
Note: When using shielded loudspeaker cable the shield should not be connected directly to the basket of the loudspeaker. Loudspeakers may short the voice coil to the basket during heavy load resulting in damage to the module due to the short to ground. This can be avoided by making the connection to the basket through a small capacitor.

§ Twist the speaker cables and keep them away from Signal input cables. The AUX supply cables should be kept separate from all other cables and the mains cable should be kept separate from all other cables as well.

§ Keep all the wires as short as possible.

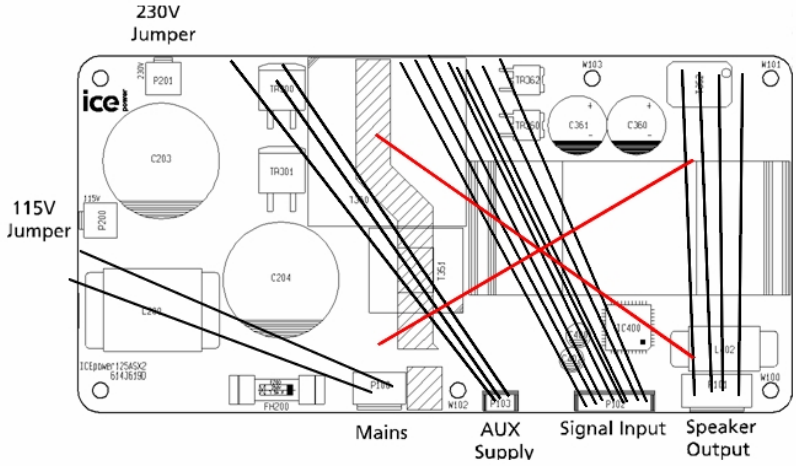


§ Do not bundle input, output and mains cables to the modules!

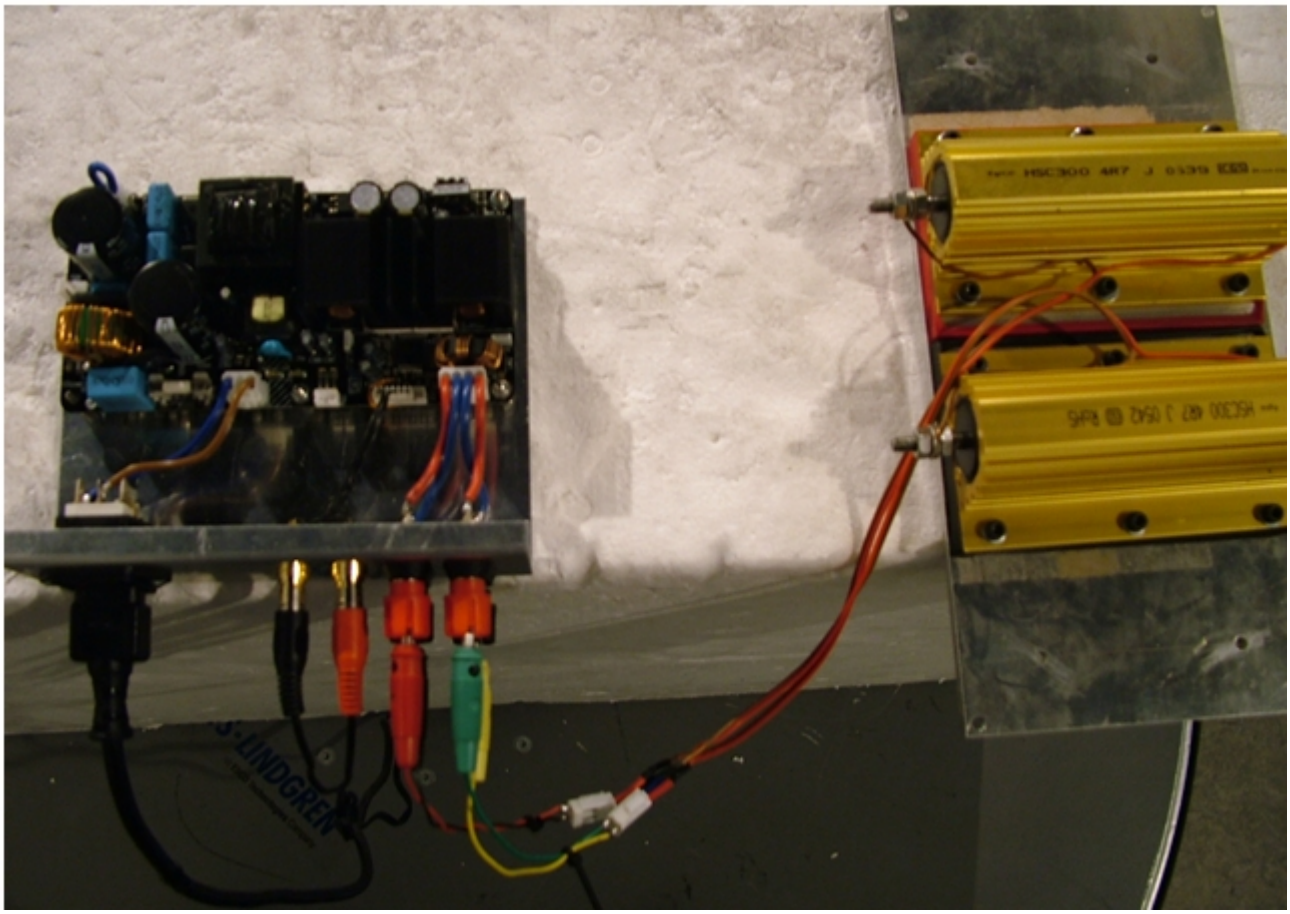


§ Do not run the cables to the modules near the amplifier output coil or the power supply transformer.

§ Keep the mains cable away from the CM filter.



During the ICEpower125ASX2 approvals phase the following internal wiring setup was used:



Note the proper routing of the cables. The speaker terminals were loaded with 4 ohms.

Note: Screw holes were electrically connected to the metal back plate as this improves EMC performance.

Mechanical Mounting

The ICEpower125ASX2 module is designed for mounting either inside or outside the acoustic volume of a speaker enclosure or inside a normal amplifier metal cabinet. The module is mounted by means of the six 3.5mm holes in the board.
Avoid loudspeaker cabinet damping material close to the module and ensure free airflow around the module to maximize thermal performance. Vertical mounting is preferred.

Safety

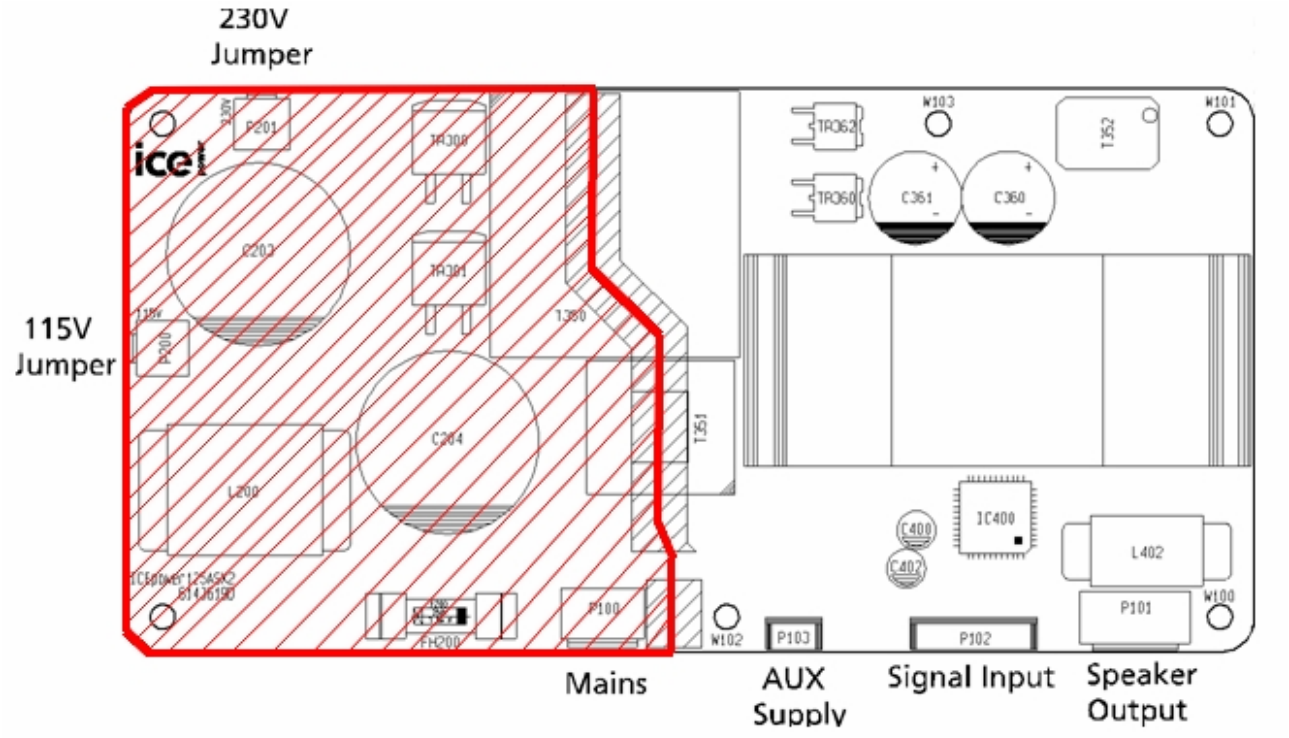
To ease the design-in process the ICEpower125ASX2 module will be safety approved by UL according to the following standards:

Europe: IEC 60065 7th ed.
US: UL60065 7th ed.

Safety class
Class 2 (without earth)

Safety Guidelines

The ICEpower125ASX2 module is developed for class-2 equipment. Therefore all secondary parts must be kept at least 6mm away from the primary side. On the illustration below the primary side is indicated by a red hatching. All components and PCB tracks within this area are connected to the primary side, including components on the back of the PCB.



Thermal Design

General

Even with the high efficiency of the ICEpower125ASX2 module, proper thermal design is very important

When doing the thermal design and tests it is important to note that the amplifiers are to be used for music signal reproduction. Thorough investigations have shown that the RMS level of any music signal does not normally exceed 1/8th of the peak value. Consequently, pink noise with an RMS level corresponding to 1/8th of the rated maximum power should be used as the worst-case signal along with various music signals.

Avoid loudspeaker cabinet damping material close to the module and ensure free airflow around the module to maximize thermal performance. Vertical mounting is preferred.

The ICEpower125ASX2 module has full onboard thermal protection for both the power supply and amplifier section. This protection circuitry shuts down the module if the temperature reaches critical levels.

Notice

Appendix A - Recommended Wiring Diagram