

SINGLE-ENDED AMPLIFIERS VERSUS BALANCED OUTPUT (BRIDGED) AMPLIFIERS

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Overview

Bridged (differential) amplifiers have long been used as a means of increasing power delivery capacity to a speaker load from the available voltage supply. As effective as this technique is, care must be taken to understand proper usage of this type of amplifier output. In particular, there has been some confusion regarding the proper treatment of the negative output terminals of Tripath's bridged-type audio amplifiers. This document is intended to clarify this issue and explain in general the correct method of amplifier-to-speaker interconnect for bridged output amplifiers such as Tripath Technology's Class-T TA1101B.

Conventional Single-Ended Amplifiers

In conventional, single-ended output amplifiers, the positive output terminal is the active terminal, and the negative output terminal is typically connected to ground. This allows for multiple speakers to share the same negative terminal or wire, and lends itself to speaker connectors of the type which naturally connect one terminal (outer conductor or shield) to the chassis—such as 1/8" mini-jacks, RCA phono jacks, and ¼" headphone jacks. Many speaker accessories also require this sort of configuration—such as "L" (loudness) pads, multiple speaker selector switch boxes, and so forth. These devices presume the negative terminals of all speaker-related devices (for all channels) can be lumped together onto one, single node, which is also generally assumed to be the system ground node. Figure 1 shows one channel of a typical single-ended amplifier output stage connected to a speaker.

In most multi-channel systems, the circuit of Figure 1 is simply repeated, resulting in multiple connections of both amplifier and speaker negative terminals to the ground node.

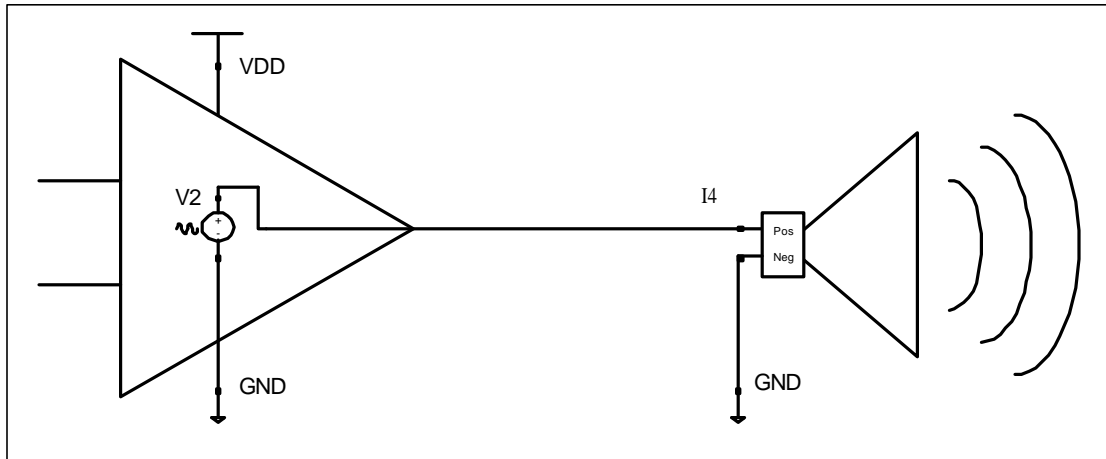


Figure 1: Conventional, single-ended output amplifier.

Bridged (Differential Amplifiers)

The primary difference between single-ended output amplifiers and bridged (or differential) output amplifiers is that the negative terminal of the bridged-output amplifier is active, supplying a voltage equal in amplitude and opposite in phase to the positive terminal. This effectively doubles the available voltage to the speaker load, quadrupling the output power capability ($P=E^2/R$). However, since the negative terminal is active just as the positive terminal is active, the negative terminal must never be connected to ground, to chassis, or to any other amplifier terminal, at any time. Figure 2 shows a typical configuration for one channel of a bridged-output amplifier. Note that connection of the negative terminal to another negative terminal or to ground or even to chassis would short out the V2 voltage source, causing a very high current condition. Under such conditions, an amplifier without over-current protection would likely be damaged. As mentioned above, such a connection should never be made.

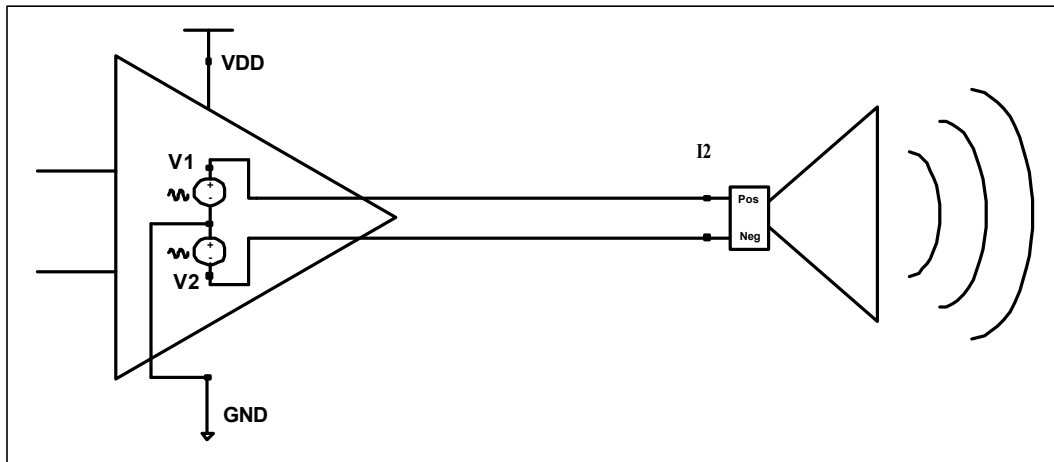


Figure 2: Bridged output amplifier.

Proper Treatment of Bridged Output Amplifiers

A brief set of usage guidelines for bridged amplifiers follows.

Never connect a bridged amplifier's negative output terminal to:

- Ground
- Another negative terminal
- Chassis
- Any other low impedance node

Do not use speaker connectors that connect the negative terminal to ground or chassis, even if a separate (non-stereo type) connector is used for each speaker channel. For example, a conventional 1/8" mini-jack, when mounted in a PC card metal chassis strip, will short its shield (and therefore the amplifier negative output terminal) connection to chassis. The same is true for RCA connectors, 1/4" headphone connectors, and other types. If these connectors are used, they must be mounted in non-conductive material and a separate connector must be used for each amplifier output. Provisions must be made to keep the shield terminals from touching the chassis or one another.

Never connect an oscilloscope probe ground to the bridged amplifier's negative output terminal. Viewing of the amplifier's output signal must be done with a differential probe.

Never connect an audio analyzer's ground to the bridged amplifier's negative output terminal. Audio analyzers must be fed differentially from the positive and negative outputs of the bridged amplifier.

Never gang the negative signal returns from more than one speaker or headphone transducer onto a single wire. Each speaker or headphone transducer (or parallel combination of these) must have its own independent pair of wires from the amplifier outputs all the way to the speaker or transducer. This prohibits the use of conventional, three-conductor headphone jacks such as 1/8" mini-jacks and 1/4" stereo headphone jacks.

Do not use conventional, common-negative speaker selector boxes or L-pads with a bridged amplifier. Fully differential speaker selectors or L-pads must be used to prevent ganging of the negative terminals.