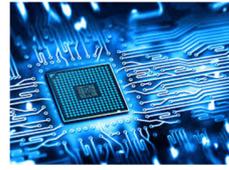


INCREASING AMPLIFIER OUTPUT

TDS-024 Issue 01 Zitel Technical Bulletin



Thank you for your interest in Zitel - we are a UK based manufacturer of PAGA/MBS and Intercom products. Our systems are mainly designed for use in the Military, Marine, Hazardous Oil, Gas and Petrochemical industries.

This technical document describes the arrangements required to increase single ended power amplifier drive capability by bridging. The temptation is to parallel amplifier outputs – which can be done – but not without possible detrimental consequences.

BRIDGING THE 350A AUDIO AMPLIFIER

Where the Public Address and General Alarm/Main Broadcast System is required to drive loudspeaker loads that exceed the rating of the 350A 350Watt amplifier a doubling of power capability can be achieved by connecting two amplifier modules together. The resulting 700Watt single ended output will drive a load impedance of 14Ohms into a 100Volt line.

(It should be noted that when the amplifier set is fully loaded the resulting line current will be 7Amperes which could result in significant losses in the field cable connecting the amplifier output to the target loudspeaker load. Standard interconnecting field cable cross sectional area is typically 2.5mm², copper losses on a 200Meter cable length, for a fully loaded 700Watt circuit, would result in a volt drop of approximately 20Volts which is above the advised maximum of 15Volts RMS.)

Amplifier bridging can be used either:

- a) On installations where additional loudspeakers have to be added by extending from an existing fully loaded circuit.
- b) Where post-amplifier switching is employed on a multi-zone application where individual amplifier assignment on a per zone basis would be cost prohibitive.
- c) High power speaker arrays are envisaged – for example on a Mass Evacuation system where the amplification is locally placed thereby eliminating excessive field cable copper losses.

There are two methods for connecting two amplifiers together to achieve double the power rating; *parallel* the amplifier outputs, or *series* the amplifier outputs. Paralleling of amplifier outputs is not advised for the following reasons:

- a) Failure of one amplifier could inhibit the operation of the second amplifier. For example, a short circuit in the amplifier output stage would be transferred to the remaining healthy amplifier with the result that output from the set would be completely lost.
- b) The two amplifier outputs must deliver a signal that is exactly in phase. Theoretically this is possible, but in practice tolerances within the amplifier hardware make this requirement a challenge.

This high power line source array shown left (see DS273), for a Mass Evacuation application, would benefit from locally placed bridged amplifier output capability.

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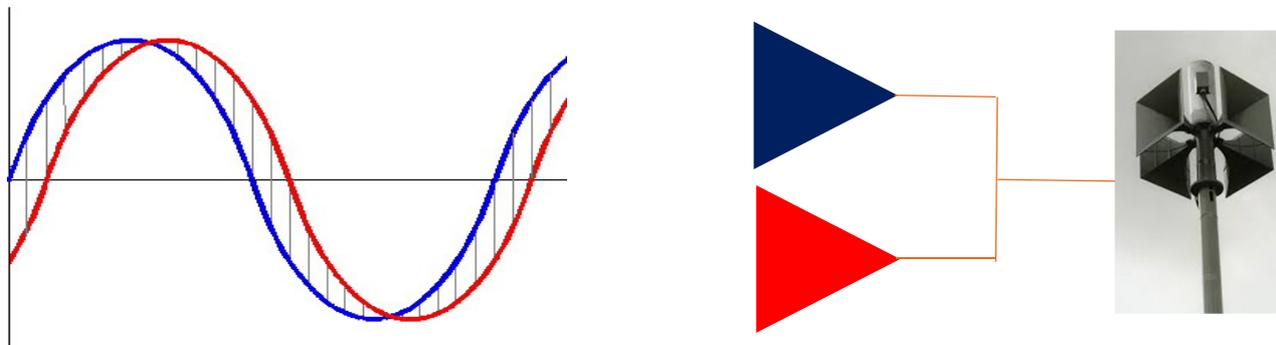
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Parallel amplifier output consequences

The consequence of connecting two out-of-phase amplifier outputs in parallel results in the following undesirable affects:

Excessive current flow in the output stage and possible damage to the amplifier(s).

Instability/oscillation which will result in excessive high current in the output stage or highly distorted broadcasts or over heating of the amplifier or spurious audible tone broadcasts or all of these effects combined.



Blue trace = Amplifier 1, Red trace = Amplifier 2

Note the phase difference due to component tolerance, this becomes increasingly apparent as signal frequency rises.

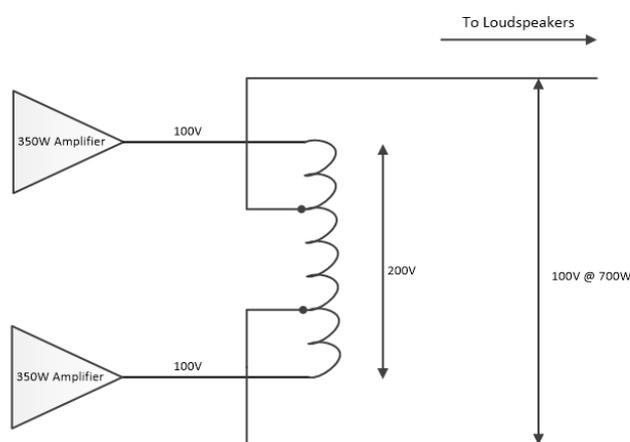
Series amplifier advantages and disadvantage

Series amplifier outputs eliminates the risk of common mode failure and 'out-of-phase' output signal coupling.

A major advantage of the series configuration is that catastrophic failure of one amplifier cannot impact on the remaining amplifier performance.

The disadvantage of series amplifier outputs is that the resulting line voltage is doubled, i.e. from 100Volts to 200Volts necessitating the installation of a transformer to restore the line voltage to standard 100Volt line. Ziztel make a bridging transformer type BT 700 which is specifically designed to enable coupling of two 350A amplifiers to achieve 700Watt single ended capability. See data sheet DS237 for details of BT700. Note that the transformer is specially designed for audio applications, a conventional power transformer configuration will introduce severe losses especially at the high frequencies required to pass 'out of band' line supervisory tones.

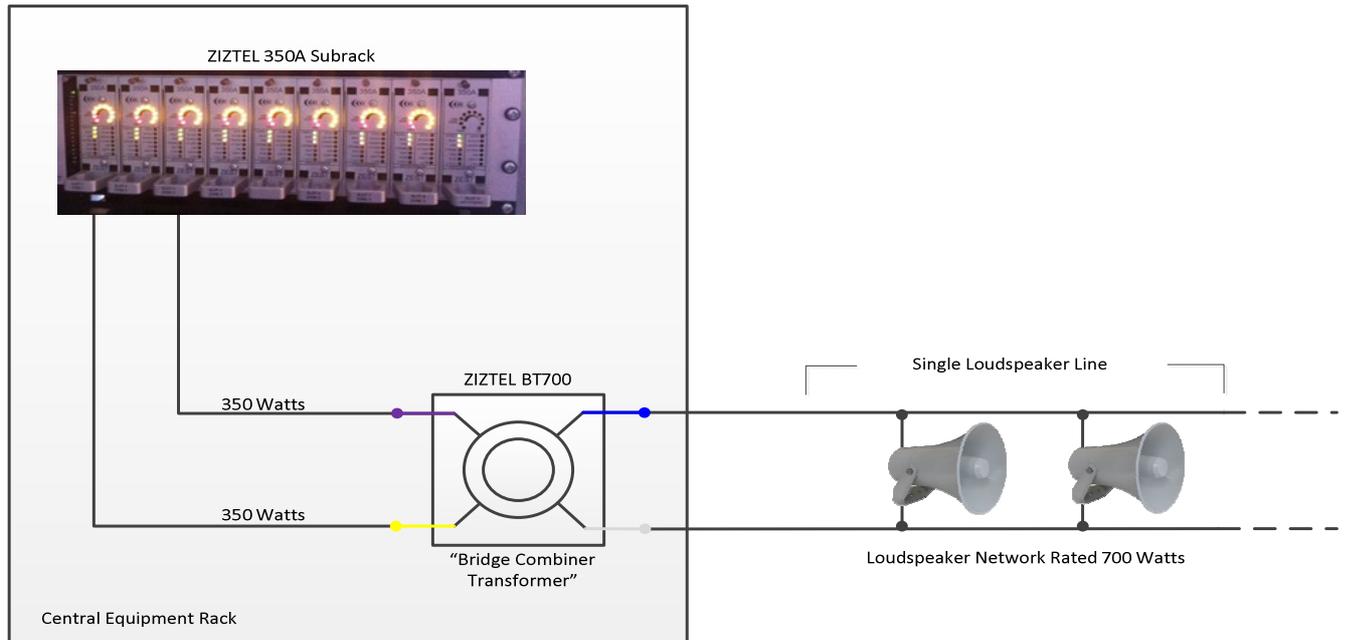
Amplifier Bridge to Achieve Double Power



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Unlike a parallel configuration, where one amplifier in fault could inhibit the healthy operational unit, the use of the BT700 ensures PAGA service from the remaining healthy amplifier albeit at a reduced level.

In the case of failure of one amplifier the associated final line output voltage from the transformer would drop from $100V_{RMS}$ to $50V_{RMS}$, the net result would be a loss of 6dBA in loudspeaker sound pressure level enabling a degree of PAGA service to still be maintained.

The BT700 transformer is located in the amplifier rack termination compartment (MDF) and wired to either LTD003 or LTD007 termination devices depending on whether radial/star (LTD007) or loop (LTD003) wired loudspeaker field cabling circuits are implemented.

Effect on Hot standby amplifier configuration

The use of BT700 bridge does not in any way impact on the specification and implementation of a hot standby amplifier, in the event that there is a 350A failure detected in the amplifier sub rack, the hot standby automatically replaces the suspect unit regardless of whether it is part of a bridge or is stand alone.

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