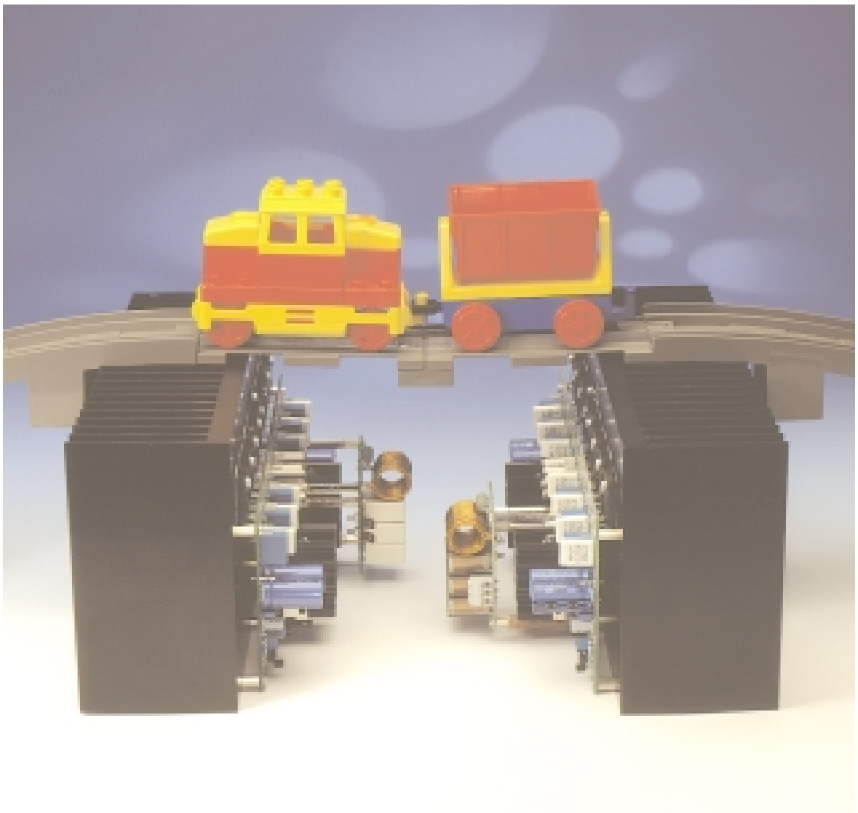
Titan 2000

Part 5: half-bridging two single amplifiers



In the introduction to Part 1 it was stated that the Titan 2000 could deliver up to 2000 watts of 'music power', a term for which there is no standard definition but which is still used in emerging markets. Moreover, without elaboration, this statement is rather misleading, since the reader will by now have realized that the single amplifier cannot possibly provide this power. That can be attained only when two single Titan amplifiers are linked in a half-bridge circuit. The true power, that is, the product of the r.m.s. voltage across the loudspeaker and the r.m.s current flowing into the loudspeaker, is then 1.6 kilowatts into a 4-ohm loudspeaker.

Design by T. Giesberts

BRIDGING: PROS AND CONS

Bridging, a technique that became fashionable in the 1950s, is a way of connecting two single output amplifiers (valve, transistor, BJT, MOSFET, push-pull, complementary) so that they together control the passage of an alternating current through the loudspeaker. This article describes what is strictly a half-bridge configuration, a term not often used in audio electronics. When audio engineers speak of bridge mode, they mean the full-bridge mode in which four amplifiers are used.

In early transistor audio power amplifiers, bridging was a means of achieving what in the 1960s were called public-address power levels as high as,

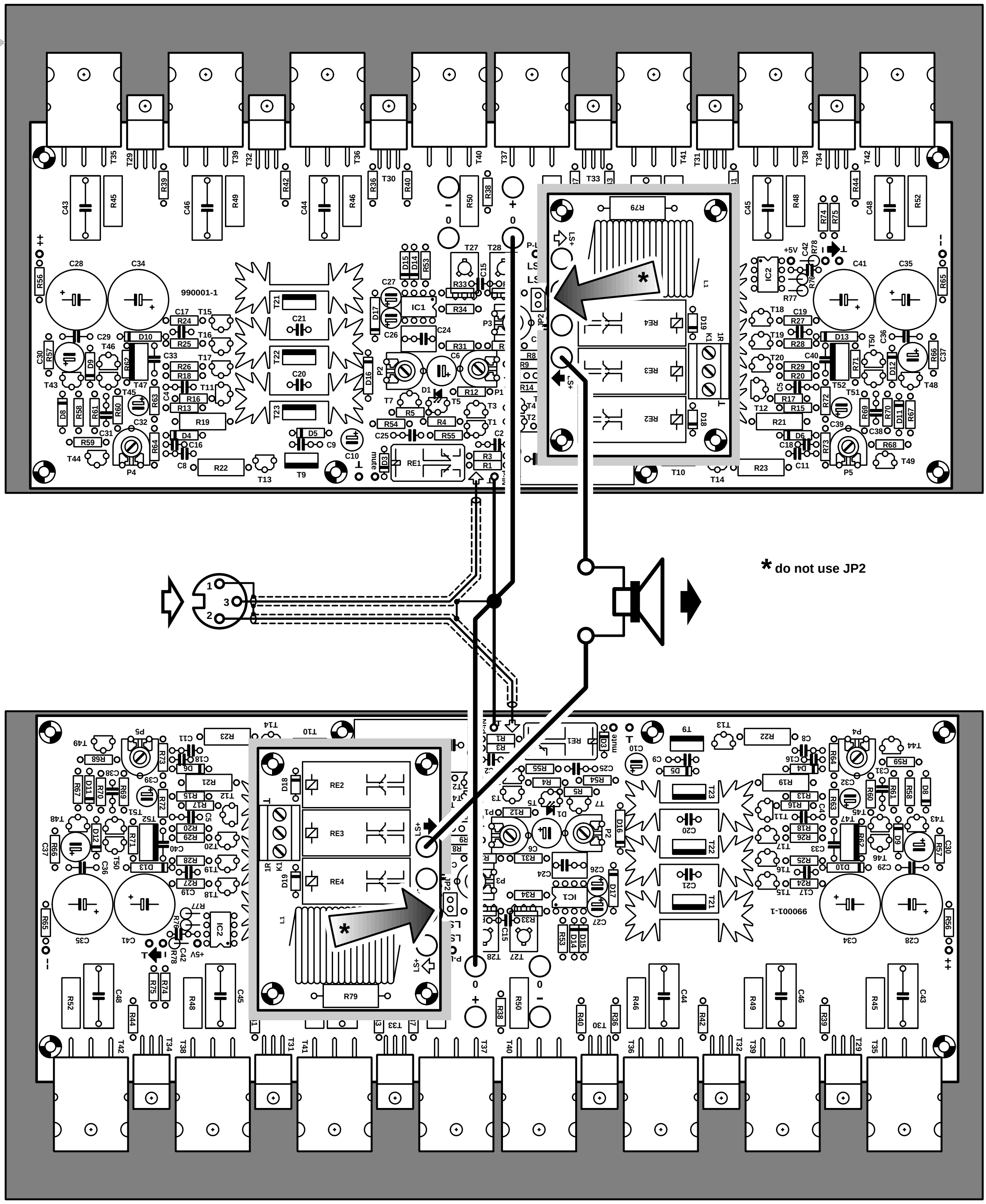


Figure 17. The interlinking required to form a half-bridge amplifier from two single Titan 2000 units. Note that the resulting balanced input may be reconverted to an unbalanced one with the Brangé design (Balanced/unbalanced converters for audio signals) published in the March 1998 issue of this magazine. The PCB for that design (Order no. 980026) is still stocked.

say 50–80 W into 8 Ω. Such power levels were then way beyond of what the voltage ratings of output transistors would permit.

Bridging is considered by many to be a good thing, since it automatically provides a balanced input (drive). However, opponents will quickly point out that it halves output damping, doubles the circuitry and virtually cancels even-order harmonics created in the amplifier.

Opponents also claim that bridging amplifiers is tedious and requires too much space. It is, however, not simple either to design a single amplifier with the same power output and the requisite power supply. A single 2 kW amplifier requires a symmetrical supply voltage of ±130 V, that is, a total of 260 V. The power supply for this would be quite a design. And where would a designer find the drivers and output transistors for this? Advocates point out that bridging amplifiers have the advantage of requiring a relatively low supply voltage for fairly high output powers.

Bridging just about doubles the rated output power of the single amplifier. Again, opponents point out that loudness does not only depend on

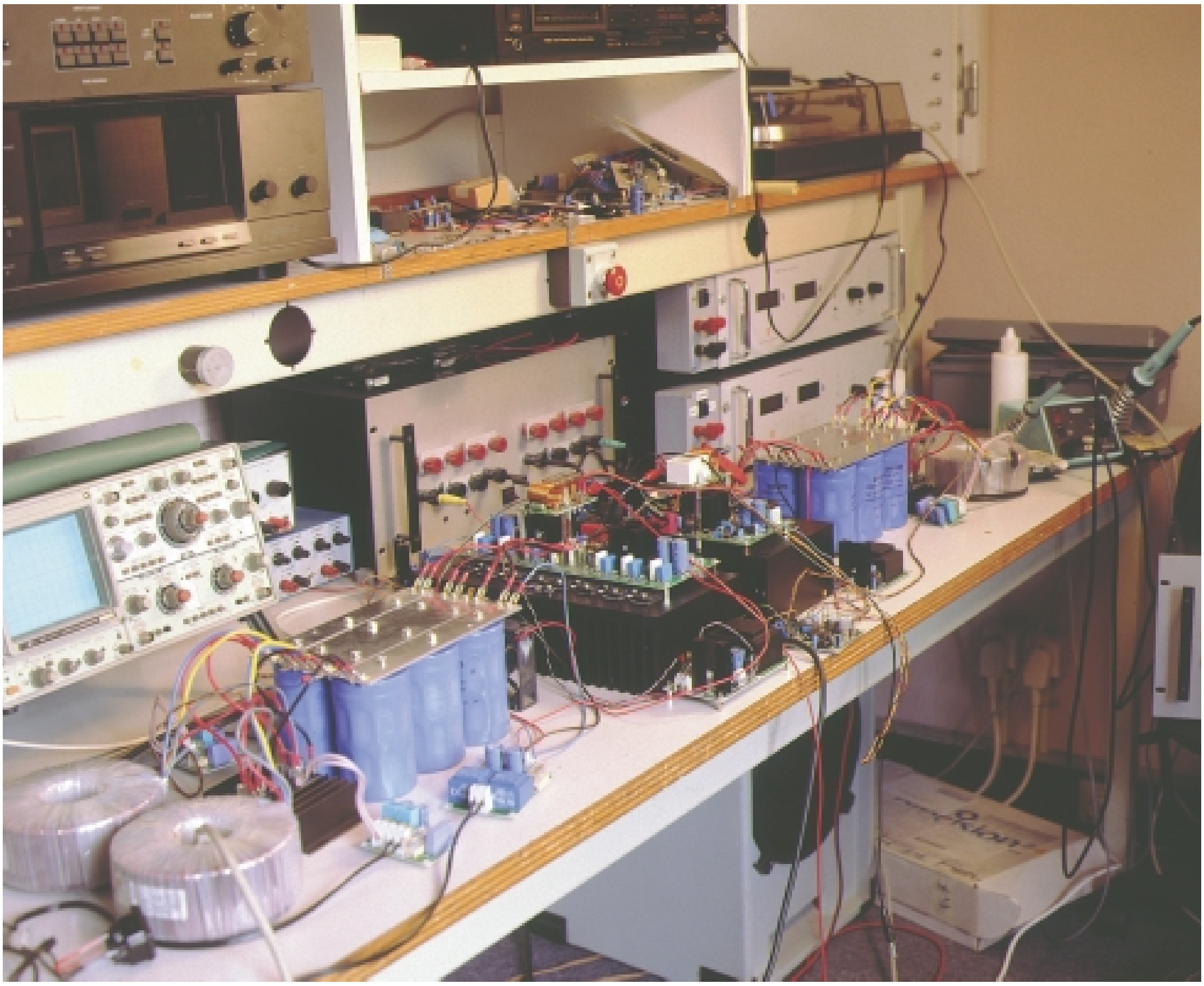


Figure 18. Test setup for the prototype half-bridge amplifier (centre). Note the large power supplies at the left and right of the amplifier.

the amplifier, but also on the loudspeaker. Bear in mind, they say, that just changing a loudspeaker with a sensitivity of, say, 90 dB_{SPL} per watt per metre to one with a sensitivity of 93 dB_{SPL} per watt per metre is equal to doubling the amplifier power rating.

Clearly, bridging two amplifiers is a mixture of good and bad audio engineering and sonics.

INTERCONNECTING

It is, of course, necessary that two completed single Titan 2000 amplifiers are available, each with its own power supply. It should then be possible to simply interlink the earths of the two units, use the inputs as a common balanced input, and connect the loudspeaker between terminals LS+ on the two amplifier. However, a few matters must be seen to first.

Owing to the requisite stability, it is imperative that the two amplifiers are juxtaposed with the space between them not exceeding 5 cm (2 in). They should, of course, be housed in a common enclosure.

The interwiring is shown in **Fig-ure 17**. Make sure that the power supplies are switched off and that the smoothing capacitors have been discharged before any work is carried out.

Start by interlinking the negative supply lines (terminals 0) with insulated 40/02 mm wire. Remove the insulation at the centre of the length of wire since this will become the central earthing point for the new (balanced) input. Link the ⊥ terminals on both boards to the new central earth with 24/02 mm insulated wire.

Connect the loudspeaker terminals to the LS+ terminals on the two boards with 40/02 mm insulated wire.

Link pins 2 and 3 of the XLR connector to the input terminals on the boards with two-core screened cable. Solder the screening braid to pin 1 of the XLR connector and to the new central earthing point.

Finally, on both boards remove jumper JP_2 from the relevant pin strip.

FINALLY

When all interconnections between the boards as outlined have been made, the single amplifiers form a half-bridge amplifier. If all work has been carried out as described, there should be no problems.

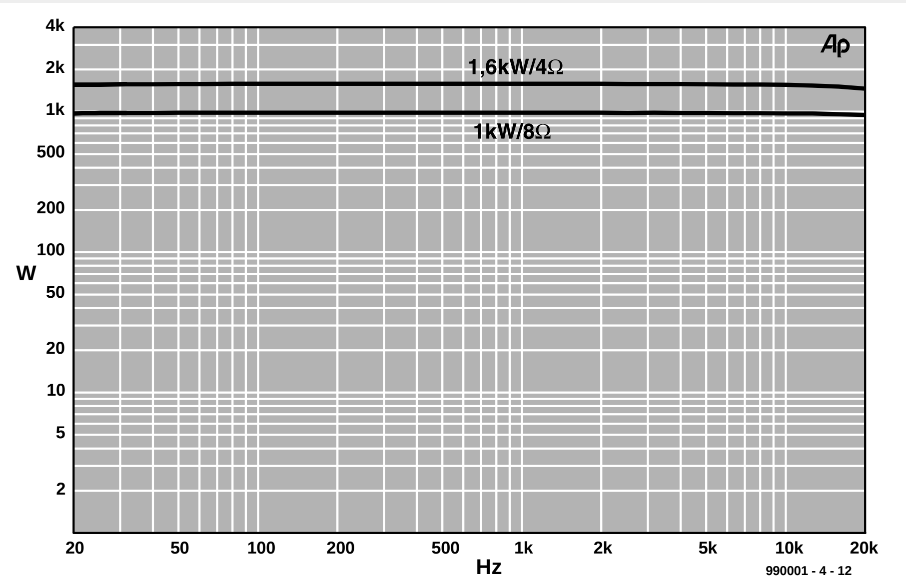
In the design stages, network R_9-P_1, inserted into the circuit with pin jumper JP_1 (see Part 1), was considered necessary for common-mode suppression. However, during the testing of the prototype, the network was found to be superfluous. It may be retained if the half-bridge amplifier is to be used with a second half-bridge amplifier for stereo purposes, when it may be used to equalize the amplifications of the two half-bridge amplifiers.

[990001]

Parameters

With a supply voltage of ±70 V (quiescent ±72 V) and a quiescent current of 200–400 mA

Input sensitivity		2.1 V r.m.s.
Input impedance		87 kΩ
True power output for 0.1% THD		950 W into 8 Ω; 1.5 kW into 4 Ω
True power output for 1% THD		1 kW into 8 Ω; 1.6 kW into 4Ω
Power bandwidth		1.5 Hz – 220 kHz
Slew limiting		170 V μs^{-1}
Signal+noise-to-noise ratio (at 1 W into 8 Ω)		97 dB (A-weighted
		93 dB (B=22 kHz)
Total harmonic distortion (B=80 kHz)		
	at 1 kHz	0.0033% (1 W into 8 Ω)
		0.002% (700 W into 8 Ω)
		0.0047% (1 W into 4 Ω)
		0.006% (700 W into 4 Ω)
	at 20 kHz	0.015% (700 W into 8 Ω)
		0.038% (1200 W into 4 Ω)
Intermodulation distortion		
	(50 Hz:7 kHz = 4:1)	0.0025% (1 W into 8 Ω)
		0.0095% (500 W into 8 Ω)
		0.004% (1 W into 4 Ω)
		0.017% (500 W into 4 Ω)
Dynamic intermodulation distortion		
	(square wave of 3.15 kHz and	0.0038% (1 W into 8 Ω)
	sine wave of 15 kHz)	0.0043% (700 W into 8 Ω)
		0.005% (1 W into 4 Ω)
		0.0076% (1200 W into 4 Ω)
Damping (with 8 Ω load)		≥ 350 (at 1 kHz)
		≥ 150 (at 20 kHz)
Open-loop amplification		×8600
Open-loop bandwidth		53 kHz
Open-loop output impedance		3.2 Ω



A comparison of these parameters with the specifications given in Part 4 ((May 1999 issue) show that they are generally in line. In fact, the intermodulation distortion figures are slightly better. Because of this, no new curves are given here other than power output (1 kW into 8 Ω and 1.6 kW into 4 Ω) vs frequency characteristics for 1 per cent total harmonic distortion.

During listening tests, it was not possible to judge the half-bridge amplifier at full volume, simply because there were no loudspeakers available that can handle this power output. However, up to 200 W true power output, the half-bridge amplifier sounds exactly the same as the single amplifier. Instrument test figures show no reason to think that the performance at higher output powers will be degraded.