# Low-noise split supply and switched gain signal amplifier

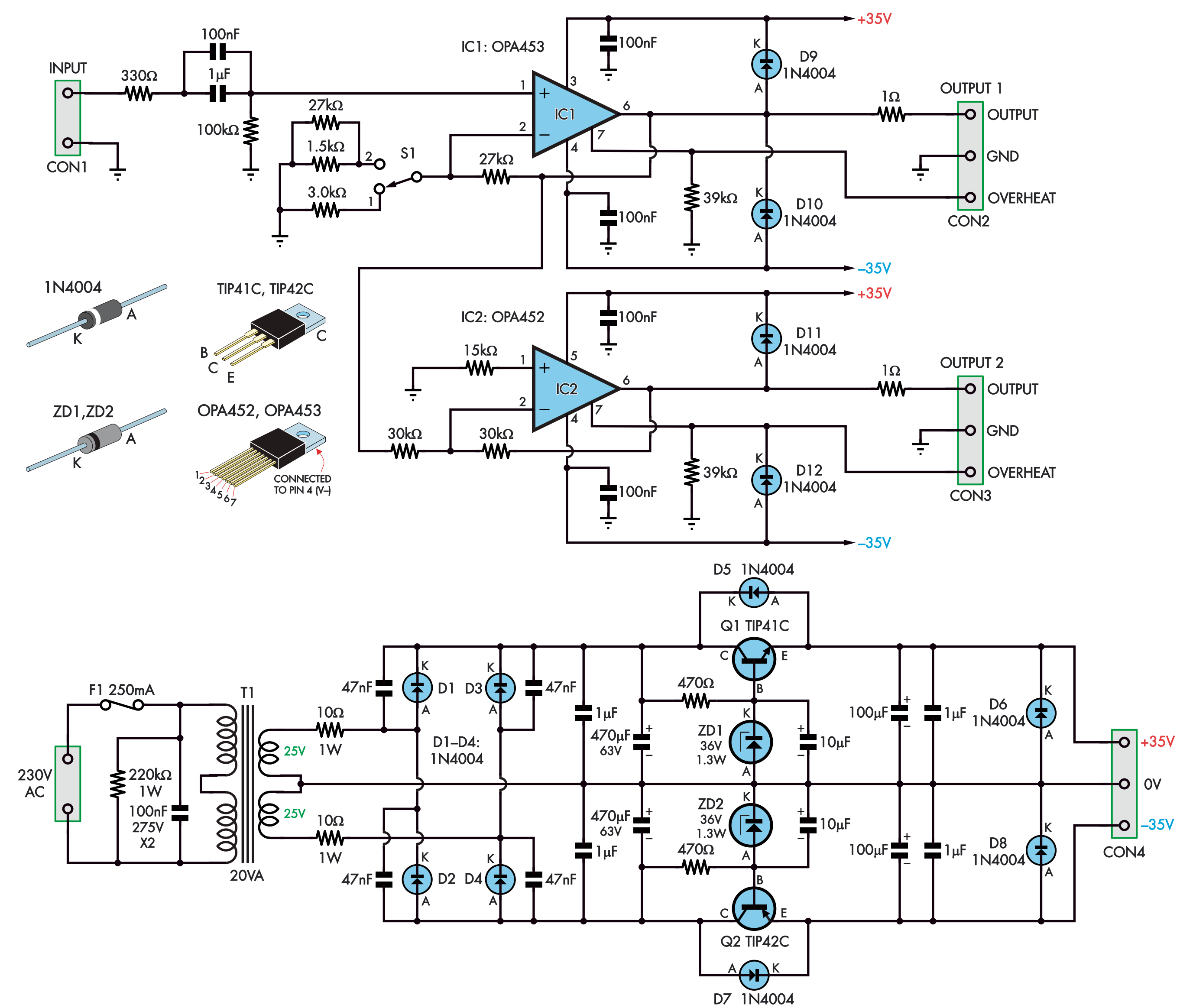
This signal amplifier provides two outputs which are 180° out of phase, with swings of more than 60V peak-to-peak (21V RMS) and the ability to deliver up to ±50mA. This is achieved using OPA452 and OPA453 high-voltage op amps (IC2 and IC1 respectively).

They are powered from well-filtered split supplies derived from a centre-tapped mains transformer, for best performance. Those approximately ±35V DC supply rails are also available for running external circuitry.

Starting with the signal amplifier section, the incoming signal (from a function generator, PC sound output, mobile phone etc) is fed into CON1 and then AC-coupled to non-inverting input pin 1 of IC1. This is an OPA453 which is stable with a gain of at least five times. The gain is set to either 10 times, with switch S1 in the lower position (1), or 20 times with switch S2 in the upper position (2).

The output from pin 6 of IC1 then goes to CON2 via a 1Ω protection resistor. Diodes D9 and D10 protect IC1 from externally applied voltages or spikes from inductive loads. The OVERHEAT pin of CON2 goes high if the internal temperature of IC1 is too hot, in which case IC1 shuts down to protect itself. This would normally only happen if the load current is high for an extended period.

The output from pin 6 of IC1 is also



fed to the inverting input of IC2 via a 30kΩ resistor. The gain of IC2 is set to -1 due to the use of two 30kΩ feedback resistors, with a 15kΩ resistor tying pin 1 to ground, so that the inputs have the same source impedance. As IC2's gain is below five, it is an OPA452, which is internally compensated for stability at a gain of 1 or higher.

The output and protection arrangement is the same for IC2 as for IC1, with the inverted signal going to CON3. Op amps IC1 and IC2 have a low distortion figure of around 0.0008% and high gain bandwidth and slew rate figures. So despite the high output signal swing capability, the circuit's bandwidth is still well over 20kHz (the -3dB point is around 40kHz).

Power comes from a ~20VA 25-0-25 mains transformer (T1) with a 100nF capacitor across its primary for EMI suppression. This has a 220kΩ high-voltage bleeder resistor across it.

The secondary windings of T1 are connected to a bridge rectifier formed from 1A diodes D1-D4, via a pair of 10Ω stopper resistors which help to filter the bridge output and reduce switching spikes. Switching spikes are also attenuated by having 47nF capacitors connected across each of D1-D4.

The DC voltages from the rectifier are filtered by 470µF capacitors with paralleled 1µF capacitors for lower ESR at higher frequencies. These unfiltered rails then go to 'capacitor multiplier' stages built around NPN transistor Q1 and PNP transistor Q2.

These provide effective ripple and noise filtering without many losses, as the gain of the transistors increases the effectiveness of the filter capacitors. Zener diodes between 0V and the bases of these transistors also limit the output voltages to around ±37V, protecting IC1 & IC2 and providing some limited regulation of these rails.

Ideally, IC1, IC2, Q1 and Q2 should be fitted with small flag heatsinks.

**Petre Petrov,**
**Sofia, Bulgaria ($75).**