which protect against reversed supply polarity (note: D1 is not installed if the preamp is built on a single PCB with the amplifier).

Amplifier

The signal from the volume control pot is fed via CON5, an RF filter network (100Ω/100pF) and a 470nF capacitor to IC2, the AN7511 chip input. This time, the input bias resistor is 1MΩ and there is no bias resistor at input pin 2 of IC2 since it has internal biasing (30kΩ to ground). The combination of the 470nF coupling capacitor and a 30kΩ input impedance gives a low-frequency roll-off of -3dB at around 11Hz.

The balanced outputs from IC2 are at pins 6 and 8. The pin 6 output signal is in-phase with the input signal, while the pin 8 output is inverted. The overall gain is typically 34dB, so a 30mV input will give an output of around 1V RMS or 125mW into 8Ω.

Note that due to this bridged output configuration, the recommended minimum speaker impedance is 8Ω.

Pin 1 of IC2 is the standby input (SBY) which, if pulled low, shuts down the amplifier and puts IC2 into a low-power mode where it consumes around 1µA rather than the typical quiescent current of 30-60mA. This can be controlled using an SPST switch or by a microcontroller.

The 10µF capacitor from pin 1 of IC2 to ground, combined with the associated 100kΩ resistor, forms a "soft start" circuit which prevents clicks and pops from the speaker when power is first applied. The 10µF capacitor is initially discharged and so pin 1 is held at ground, enabling the standby feature. This capacitor charges through the 100kΩ resistor and so IC2 comes out of standby a short time after power is applied, when the circuit voltages have had time to settle.

Similarly, the 10kΩ resistor from pin 1 of CON6 to pin 1 of IC2 limits the rate at which the shutdown feature is enabled, preventing a sudden transition which would cause the output to also generate a transient, resulting in a loud sound from the speaker.

Note that these resistors consume some additional current in standby mode (V_{CC} ÷ 110kΩ), giving a total standby current of up to 120µA at maximum supply voltage.

There is also a separate mute input at pin 4 of IC2. This allows the output

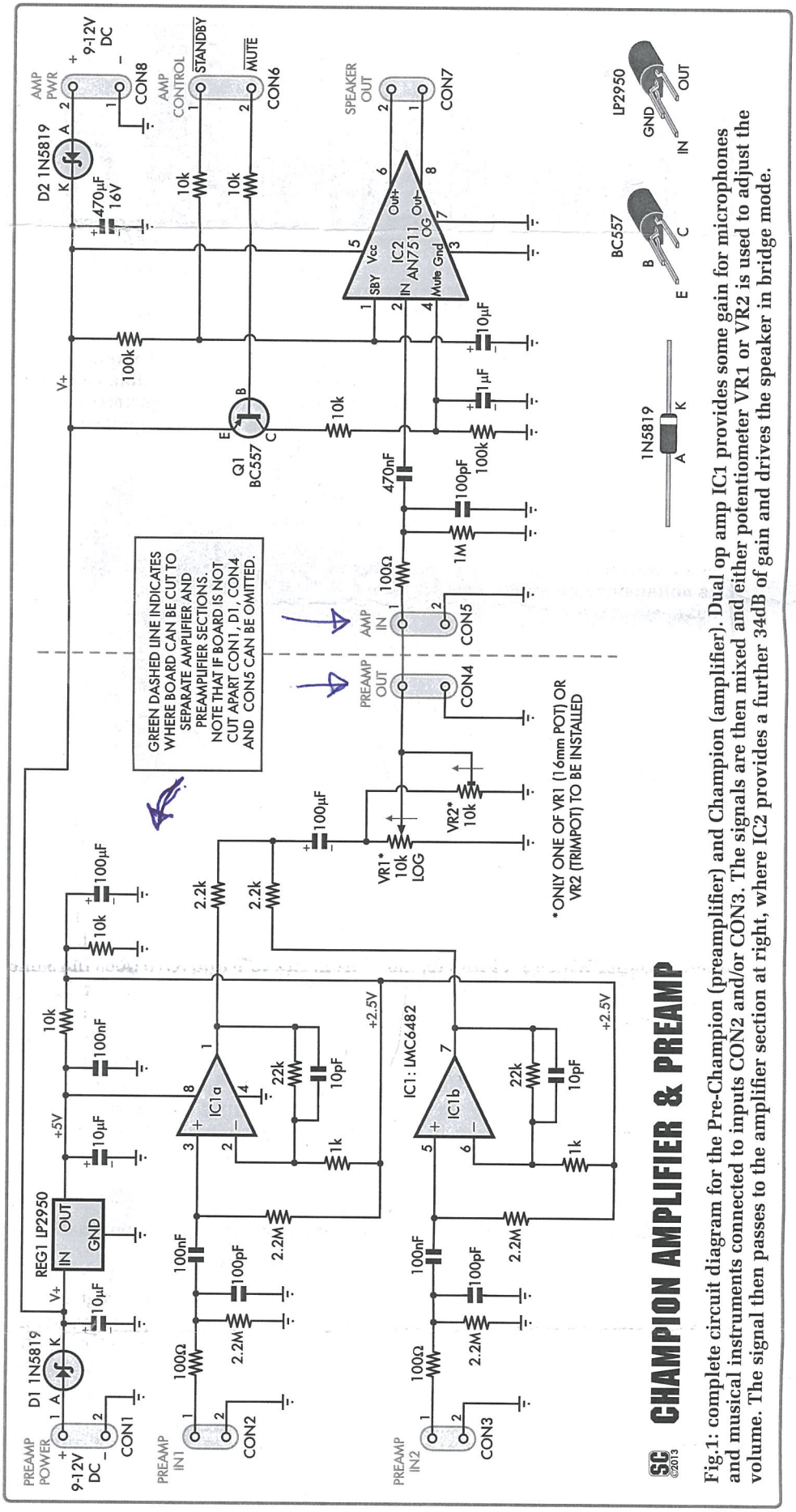


Fig.1: complete circuit diagram for the Pre-Champion (preamplifier) and Champion (amplifier). Dual op amp IC1 provides some gain for microphones and musical instruments connected to inputs CON2 and/or CON3. The signals are then mixed and either potentiometer VR1 or VR2 is used to adjust the volume. The signal then passes to the amplifier section at right, where IC2 provides a further 34dB of gain and drives the speaker in bridge mode.

the IC to deliver twice the RMS voltage to the speaker, for up to four times the power.

Thus, as already noted, the Champion punches well above its class, giving around 7W peak power into an 8Ω load from a 12V supply. Mind you, the Champion can't deliver that sort of power continuously. The small DIP chip package simply can't deal with the dissipation under those conditions continuously and thermal limiting quickly kicks in, even if a heatsink is fitted.

The continuous power available (depending on supply voltage) is around 2W. That's still quite a bit better than the LM386.

The LM386 also needs more external components than the AN7511, despite having fewer features. The LM386 needs a "Zobel network" at its output (resistor and capacitor) for stability whereas the AN7511 doesn't. The LM386 also needs a large DC-blocking capacitor between its output and the speaker but because the AN7511 drives the speaker in bridge mode, no DC blocking capacitor is required. All we really need to build a working circuit around the AN7511 is a bypass capacitor, AC coupling for the signal input and some RC filters for the mute and standby control pins.

In standby mode, the AN7511's current consumption drops to just 1µA so if used in combination with (say) a microcontroller, the AN7511 won't draw any power unless you are actually using it. The mute and standby features are designed to avoid clicks and pops when the unit goes into and out of standby, too.

Features & Specifications

Features

- Wide operating voltage range
- Bridged output gives high power at low supply voltages
- Low parts count
- Low distortion
- Preamplifier compatible with microphones & electric guitars
- Preamplifier has two inputs, mixed 1:1
- Mute and standby control
- Over-temperature protection (auto-limiting)

Specifications

Operating voltage range: 4-13.5V

Output power: up to 4W continuous (see Fig.3); 7W peak

Music power: 3W @ 9-12V

Signal-to-noise ratio: ~65dB

Frequency response: -2.5dB @ 20Hz, -0.3dB @ 20kHz (see Fig.5)

THD+N, 1kHz: ~0.25% (see Fig.4)

Gain: 34dB for Champion, up to 58dB with Pre-Champion

Input sensitivity, Champion only: 52mV RMS @ 5V, 125mV RMS @ 9-12V

Input sensitivity, Pre-Champion + Champion: 2mV RMS @ 5V, 5mV RMS @ 9-12V

Quiescent current: 2mA (Pre-Champion) + 30-60mA (Champion)

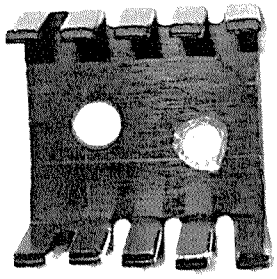
Standby current: 2mA (Pre-Champion) + 40-120µA (Champion)

The Pre-Champion

As good as the Champion is, we know that many readers will want a companion preamplifier to go with it, just as the CHAMP had the Pre-CHAMP. But whereas the Pre-CHAMP was a very basic 2-transistor circuit, the preamplifier for the Champion is a special low-voltage op amp IC that has considerably better performance. This will enable you to use the Champion with a microphone or many musical instruments, such as electric guitars.

We have designed a small PCB to

Heatsink Modification



If a 10mm ~ 14mm wide heatsink is not available, a 19mm wide one can be used. However, it will require drilling another mounting hole, as shown here.