Unison Research

P40

Stereo integrated valve amplifier with push-pull circuit

Why push-pull ?

An amplifier with push-pull circuit consists of a stage with two power tubes each of which amplifies one half-wave, either positive or negative, of the audio signal. The

special design of the output transformer then enables the correct reconstruction of the amplified signal at the output terminals. The advantage of the push-pull system lies in its ability to produce greater output power than is obtainable from a single-ended design using the same type of valve. This advantage is determined by the greater efficiency of the push-pull system, and means lower heat dissipation for any given output power. The disadvantage of push-pull stages is that, relying on the amplification of two separate half-wave signals by two separate amplifying devices, they must be particularly well engineered in order not to encounter significant distortion.

Historical note

Many years ago Unison Research produced push-pull amplifiers, at a time when it was neither easy nor cheap to obtain high output power from single-ended designs. Examples of such models are the Triode 20, the Power 35 and the very

first Nimbly. Now again Unison Research is making push-pull amplifiers. The new series to which these new models belong starts with the P-40.

The P40

Design of the P-40 amplifier took several months to bring to fruition, despite having the benefit of experience already gained with its larger brother P-70. The P-40 now boasts an impressive specification; 40 watts into a 6 ohm load with full-bandwidth distortion less than 0.2%. This performance is similar to that of a good amplifier using single-ended topology.

Layout

The layout includes an input selector using heremetically-sealed relays. There are 4 inputs, which can be switched to balanced or unbalanced mode according to user preference. The volume potentiometer is an double gang Alps blue series, motorized for remote control.

Amplifier operations are controlled by microchip with SMD technology. The microchip also manages control of volume via infra-red from the remote handset.

The input amplifying stage is made up of one triode ECC83 and one twin-triode ECC82, and this is followed by an output amplifying stage which uses two EL34 valves. The output transformer is manufactured to strict Unison Research specification, and is able to provide 30kHz bandwidth at full output power.

Negative feedback is particularly important in a push-pull amplifier. In this case feedback is taken to the second preamplifying stage. This is in order to ensure that the first triode is kept completely free form feedback.

Development phases of the amplifier

From experience gained in push-pull amplifier design at Unison Research it was clear that the power stage requires a higher and often more deformed driving current compared to that of a single-ended stage. Therefore the output valve driver stage must be of sufficient size and carefully designed to present a low output impedance value.

Another important consideration concerned polarisation of the entire stage, which must be able to allow the full excursion required to drive the power stage in any operating conditions.

To provide the counter-phase signal generation required for push-pull working, in the P-40 a classic phase-splitter stage was chosen. Its special layout ensures that two signals in opposite phase are generated and precisely suited to the correct operation of the amplifier. This is dc coupled to the preceding stage so as to reduce phase rotations, and low frequency stability is thereby greatly improved.

For the first amplifying stage it was decided to adopt a fully zero-feedback triode stage. This ensures a very low level of intermodulation distortion and gives a pleasing natural character to the sound. Overall feedback of the amplifier is then brought to the input of the intermediate stage where it operates with signals that are already significantly amplified, and the amount of feedback in the signal band is kept down to minimum levels.

The power stage consists of a pair of EL34 valves. During the various experimental phases of design it was noted that polarisation of around 40mA allows a good compromise between performance in terms of maximum dissipation, maximum output power and minimum distortion. It was also noted

however that, in the most widely-used classic push-pull circuits it is not possible to maintain a stable level of polarisation during changes of signal level or of mains voltage variations. This often results in- albeit temporary - current starvation or over-polarisation of the output stage.
Moreover, with such designs manual bias current adjustment and balancing of the current in both arms of the push-pull is often required with the amplifier `hot`. This is not very satisfactory, so in order to finally resolve this problem Unison Research has developed a new circuit that is able to guarantee and maintain the correct bias during changes of signal level or changes of voltage, whether in overload conditions or to adjust for alteration of the valves due to ageing. Bias is guaranteed from the first phase of switch-on, even if the amplifier has not yet reached its full operating temperature.

This new circuit is able to continuously monitor both the bias current level and the balance of the two current levels in the two arms of the push-pull, acting automatically to correct the levels as necessary. No manual bias adjustment on the part of the user is needed, and even when a pair of EL34 valves are replaced the adjustment is taken care of automatically.

Having described the structure of the amplifying circuits, it is necessary also to present the design of the power supply stage, which is undoubtedly a very important part of the amplifier. This is made up first of a high capacity Pi-LC type filter stage providing power supply to the output stage of 500V. Then follows a second RC type Pi-cell providing power at 450V to the amplifying stage. The valve filaments are supplied with stabilized dc voltage. A further negative voltage is provided for the bias adjustment system of the EL 34 valves.