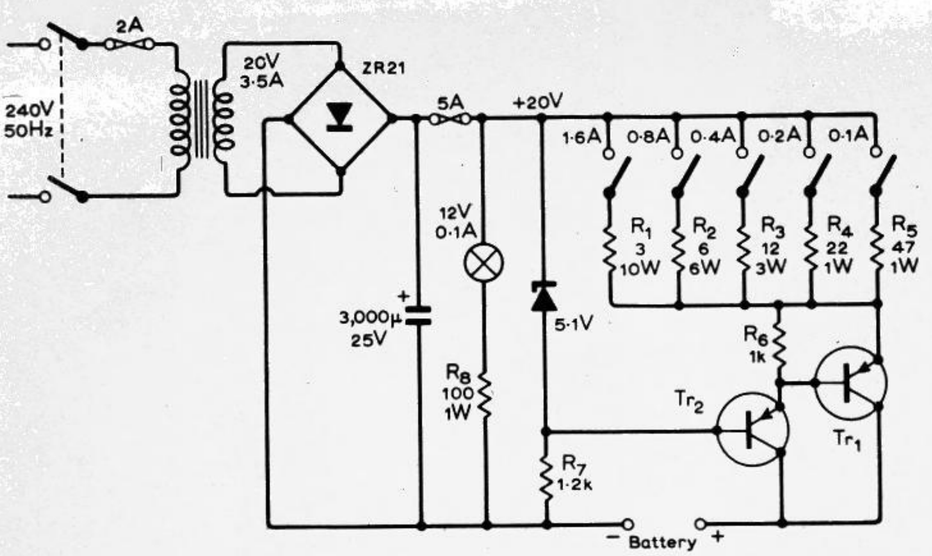
Constant-current battery charger

The circuit consists of a rectified and smoothed d.c. supply of about 20V, which is applied in series with a constant-current regulator to the battery. The current is derived from switched resistors, R_1 to R_5, held at a constant voltage by the zener diode and transistors Tr_1 and Tr_2 which form a Darlington pair. Germanium power transistors such as OC28, OC35, OC36, 2N1021, or similar types are used.

The unit which is used for charging batteries up to 12V has several advantages over conventional battery chargers in that the output terminals may be accidentally short-circuited without damage to components. Also, an ammeter is not necessary, since the current is determined by the selection of switched resistors,



giving a calibrated current which does not alter during charging. Currents from 0.1 to 3.1A may be selected by closing the appropriate switches and the value of current supplied is approximately given by $4.8/R$, where R is the appropriate switched resistor. The charging current may be increased to 10A by uprating the components and selecting different values of R.

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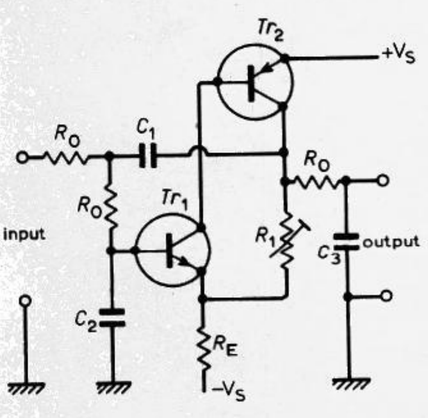
Low-pass active filter

This circuit utilizes a unity gain amplifier configuration, which is stable using a minimum number of components. A wide range of transistors can be used for this amplifier, but low-noise devices are preferable (e.g. 2N2926 for the n-p-n and 2N5354 for the p-n-p). A gain of unity is obtained by choosing R_1 so that $R_1 = h_{ie}\ \beta_1\ \beta_2$. Resistor R_E was chosen to be 2.7kΩ, $V_s(+)$ was 10V and $V_s(-)$ was 15V for the correct d.c. conditions for the transistors.



For a ripple of 0.1dB in the pass band and a fall-off of 20dB/octave after cut-off frequency f_0, choose a convenient value of R_0 and calculate.

$$C_0 = \frac{1}{2\pi\ f_0\ R_0}$$

Now refer to the table below and calculate C_1, C_2 and C_3 by multiplying the appropriate factor by C_0:

For	C_1	C_2	C_3
Multiply C_0 by	2.06	0.29	1.03

The capacitors are chosen to be within 1% of these calculated values.

This circuit allows the possibility of using several stages in cascade without emitter following: a 7th order circuit works very well at about 70dB/octave, but different multiplying factors must be considered.

A high-pass filter of the same order can be designed by inverting the elements R and C in each stage.

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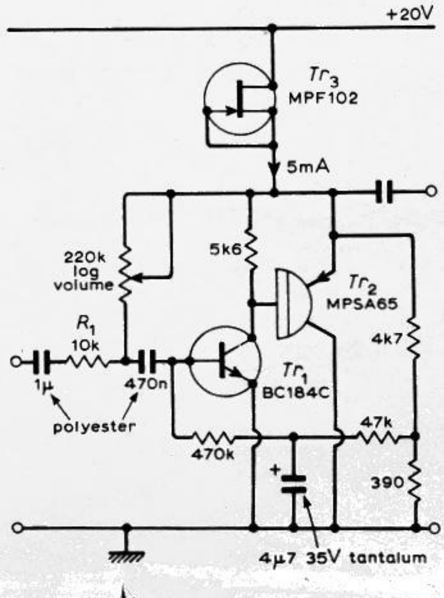
Variable-gain volume control

Large overload capability is not often provided by commercial amplifiers, but can easily be obtained by using a variable-gain volume-control stage at the input of the pre-amplifier. Inverting amplifier circuits can easily be designed which will give overload factors of greater than 40dB at normal listening levels. The circuit shown has a maximum voltage gain of ×22 but this is reduced to nearly zero at the minimum setting of the potentiometer. Sensitivity may be altered by increasing the value of R_1 — e.g. 22kΩ gives a gain of × 10. The inverting amplifier basically has one stage which provides a high open-loop gain (≈ × 2000) by employing a d.c. bootstrap circuit, and applied negative feedback reduces stage distortion to a very low level. Signal-to-noise ratio for the circuit shown is greater than 73dB on a 10mV input. For low noise and distortion the BC184C should be selected to have a current gain of greater than 400, and the field effect transistor (MPF102) should have an I_{DSS} of 5mA or greater. The circuit is tolerant of hum and noise on the supply line and so may be run from a poorly stabilized supply. Total harmonic distortion at a gain of ×22 and 1V r.m.s. output measured 0.025% at 1kHz and 0.05% at 10kHz. Equivalent input noise is less than 2μV, in the bandwidth 20kHz with input shorted to earth; and upper break frequency (–3dB) above 100kHz, with gain ×22.



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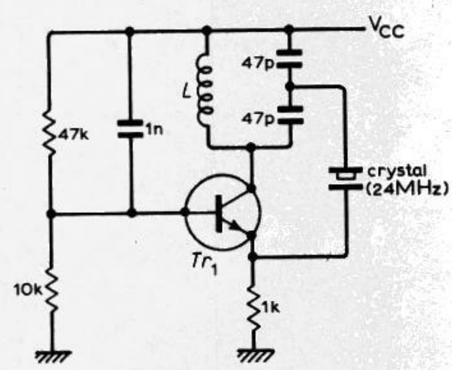
(The symbol shown for Tr_2—the Motorola Darlington transistor type MPSA65 — was originally suggested by J. L. Linsley Hood in his article 'The Liniac', published in *Wireless World* in September 1971. Ed.)

Overtone oscillator

The circuit works well with low activity crystals and is suited to either overtone or fundamental operation. The ratio of the series capacitors controls the amount



of feedback and the inductor, L, resonates with the series capacitors at the desired output frequency, giving an output which may be taken directly from the emitter resistor or by means of link coupling. The transistor Tr_1 is a 2N706 (or similar type) and the circuit operates from a 12V supply.

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