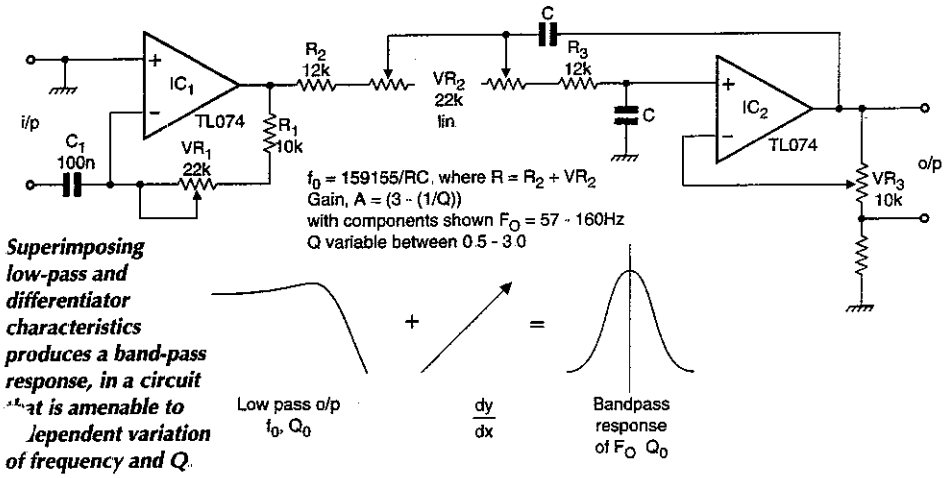
Low-frequency filter with variable Q and centre frequency



Superimposing low-pass and differentiator characteristics produces a band-pass response, in a circuit that is amenable to independent variation of frequency and Q.

If you increase the gain of a second-order low-pass filter by 6dB/octave, the result is a band-pass filter, as the diagram shows This obvious but elegant procedure enables the design of a variable-frequency band-pass filter which also has variable Q.

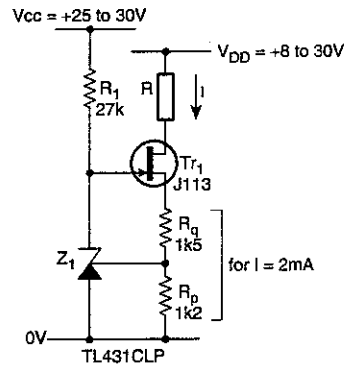
Frequency and Q of the low-pass filter around IC_2 are easily and independently varied by VR_2 and VR_3, which means that the pass band is variable over several octaves and, with the components shown, Q varies in the 0.5-3 range. Gain of the op-amp must be at least $20\times Q^2$ at the centre frequency.

Increasing gain with frequency due to the action of the differentiator is countered by VR_1
The prototype circuit works well as a speaker equaliser

Jeff Macaulay
Chichester, Sussex

Programmable current source

Although constant-current diodes such as the *J500* series are simple to use, they cannot be adjusted and drift with temperature. The circuit shown here uses a *TL431CLP* adjustable shunt regulator to allow variation in the range 50µA-5mA to be determined by the value of R_p, which may be a variable resistor, if required.



Current source is variable from 50µA to 5mA. May be used to give a floating reference voltage, where R is a resistor whose top end is connected to an 'unknown' potential V_{dd}. Then $V_{ref} = -2.5(R/R_p)$ with respect to V_{dd}.

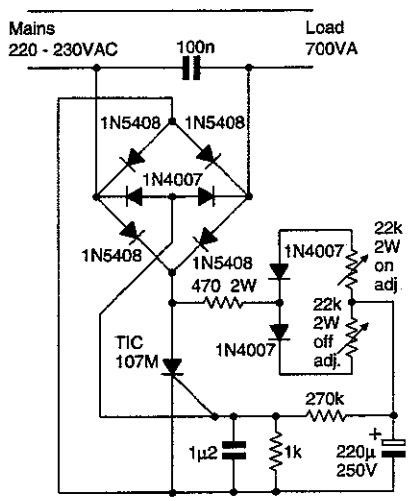
Output current is given by $I=E/R_p$, E being the reference voltage of the regulator: typically 2.5V to within 2% and having a temperature coefficient of 50ppm/°C Coupling to the j-fet provides a very high output impedance: 100MΩ at 2mA and 4.7kΩ load switched from 20V to 30V.

Rejection of supply variations is around 85dB at 100Hz in the circuit as shown, maintaining this performance up to about 25kHz; for even better rejection, split R_1 and decouple the common point

To avoid the need to scale R_q/R_p in the ratio $^5/_4$ when varying output current, replace R_q by a small 3.3V zener.

C J D Catto
Cambridge

Repetitive zero-crossing ac switch



Having an on period adjustable from 0 3s to 4s and an off period between 0 2s and 10s, this switch controls a resistive or inductive load of up to 700VA.

Scr *TIC 107M* switches at the mains zero point, since the two diodes keep the gate at cathode potential except during a short period around zero crossing A delay determined by the 1.2µF capacitor puts the switching point more or less in the middle of this period, although the analogue nature of the circuit makes absolute accuracy difficult to achieve.

Inductive ac loads such as motors and solenoids up to 700VA can be controlled by this zero-crossing switch, which can be adjusted in frequency and on/off times.

When the scr gate voltage reaches its trigger voltage as the electrolytic charges, the scr conducts and will remain in conduction while there is enough sustaining current as the capacitor discharges The scr shown was chosen for its sensitive gate characteristic to avoid the need for a large capacitor. The 0.1µF capacitor bypasses spikes from either supply or load.

Frequency is reasonably stable, but is slightly affected by temperature and supply voltage.

D Di Mario
Milan
Italy