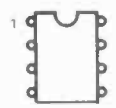
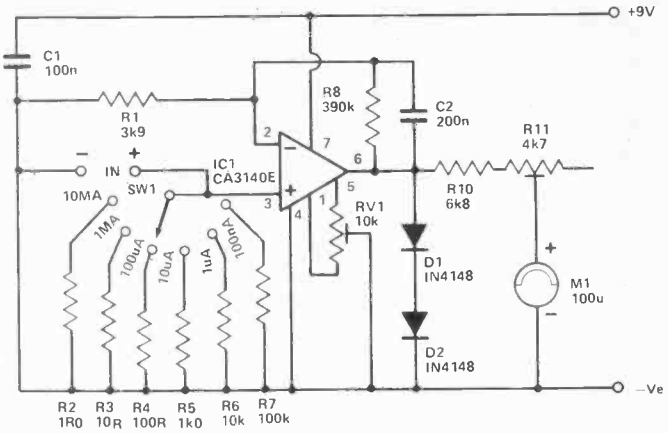
Designer Circuits

NANOAMP METER





R1 TO R7 ARE CLOSE TOLERANCE TYPES

It is not possible to accurately measure currents of a few microamps or less using an ordinary panel meter or multimeter. In order to make such measurements it is necessary to use an active circuit such as the one shown here. It can be built as a self-contained unit or used as part of an instrument requiring a highly sensitive current meter. The sensitivity is from 100 nA to 10 mA FSD in six ranges; the higher ranges being included to permit calibration, and because many multimeters have very few low current ranges.

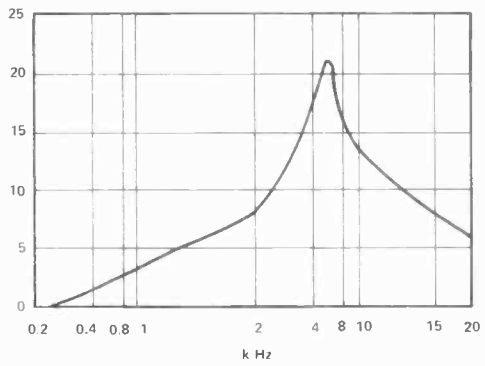
M1 is connected in a 1 V FSD voltmeter circuit which also uses R10 and R11. The latter is adjusted to give the unit the correct sensitivity. IC1 is an Op Amp connected in the non-inverting mode and having a DC voltage gain of about 100 times (set by feedback network R8-R1). C2 reduces the AC gain to only about unity so as to improve stability and immunity to stray pick-up. The non-inverting input of the IC1 is biased to the 0 V rail by whichever of the range resistors (R2-R7) is selected by SW1. In theory this gives zero output voltage and no meter deflection, but in practice it is necessary to compensate for small offset voltages using offset null control, RV1.

If an input current is connected to the unit, a voltage will be developed across the selected range resistor, this voltage being amplified to produce a positive meter deflection. With R2 switched into circuit, 10mA is needed to give full scale deflection of M1, since 10mA will cause 10mV to be developed across R2 ($E = I \times R$, $= 0.01\ A \times 1\ ohm$, $= 0.01\ V$ or 10 mV), and this will be amplifier one hundred fold by IC1 to give one volt at the output. On successive ranges the range resistor is raised by a factor of ten, reducing by a factor of ten the current required at the input to develop 10mV and give full scale deflection of M1.

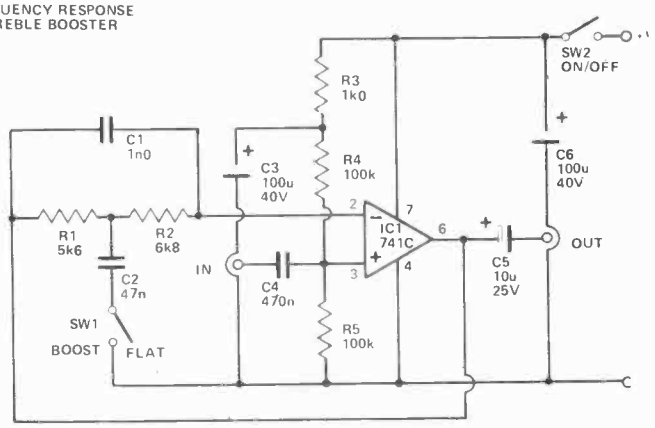
This arrangement relies on the amplifier having a very high input impedance so that it does not drop a significant amount of input current, and this is achieved by using a FET input op amp having a typical input resistance of 1.5 million meg ohms. D1 and D2 prevent the output voltage of IC1 from exceeding more than about 1.3 volts, and they thus protect M1 against overloads.

When adjusting RV1 start with its slider at the pin 5 end of the track (there should be a strong deflection of M1), and then back it off just far enough to zero the meter, and no further.

TREBLE BOOSTER



THE FREQUENCY RESPONSE OF THE TREBLE BOOSTER



A treble booster circuit can be used with an electric guitar (and also electronic instruments) to boost the higher order harmonics and give a more "brilliant" sound. A circuit of this type gives a fairly flat response at bass and most middle audio frequencies, with the upper-middle and lower treble frequencies being given a substantial amount of boost. It is normal to give only a modest amount of emphasis to the upper-treble in order to give good stability and a low noise level, and this also prevents the output from sounding too harsh. The frequency response of this treble booster is shown in the accompanying graph.

The circuit is basically just an op. amp. (IC1) used in the non-inverting amplifier mode. The non-inverting input is biased by R4 and R5 via a decoupling network which is comprised of R3 and C3. C4 and C5 give DC blocking at the input and output respectively. With SW1 open there is virtually 100% negative feedback through R1, R2, and C1, giving the circuit unity gain and a flat response. Closing SW1 brings C2 into circuit, and this decouples some of the feedback through R1 and R2 at frequencies of more than a few hundred Hz, giving the required rising response. Feedback through C1 at high treble frequencies causes the response to fall away about 5.5kHz, and prevents the very high frequency harmonics from being excessively emphasised.

As the unit has unity gain at frequencies where boost is not applied it can simply be connected between the instrument and the amplifier.