High Z Voltmeters

A voltmeter having a very high impedance can be made using a field effect transistor amplifier. Figure 49 shows a basic circuit for this purpose, and one which can be readily developed into a more ambitious instrument.

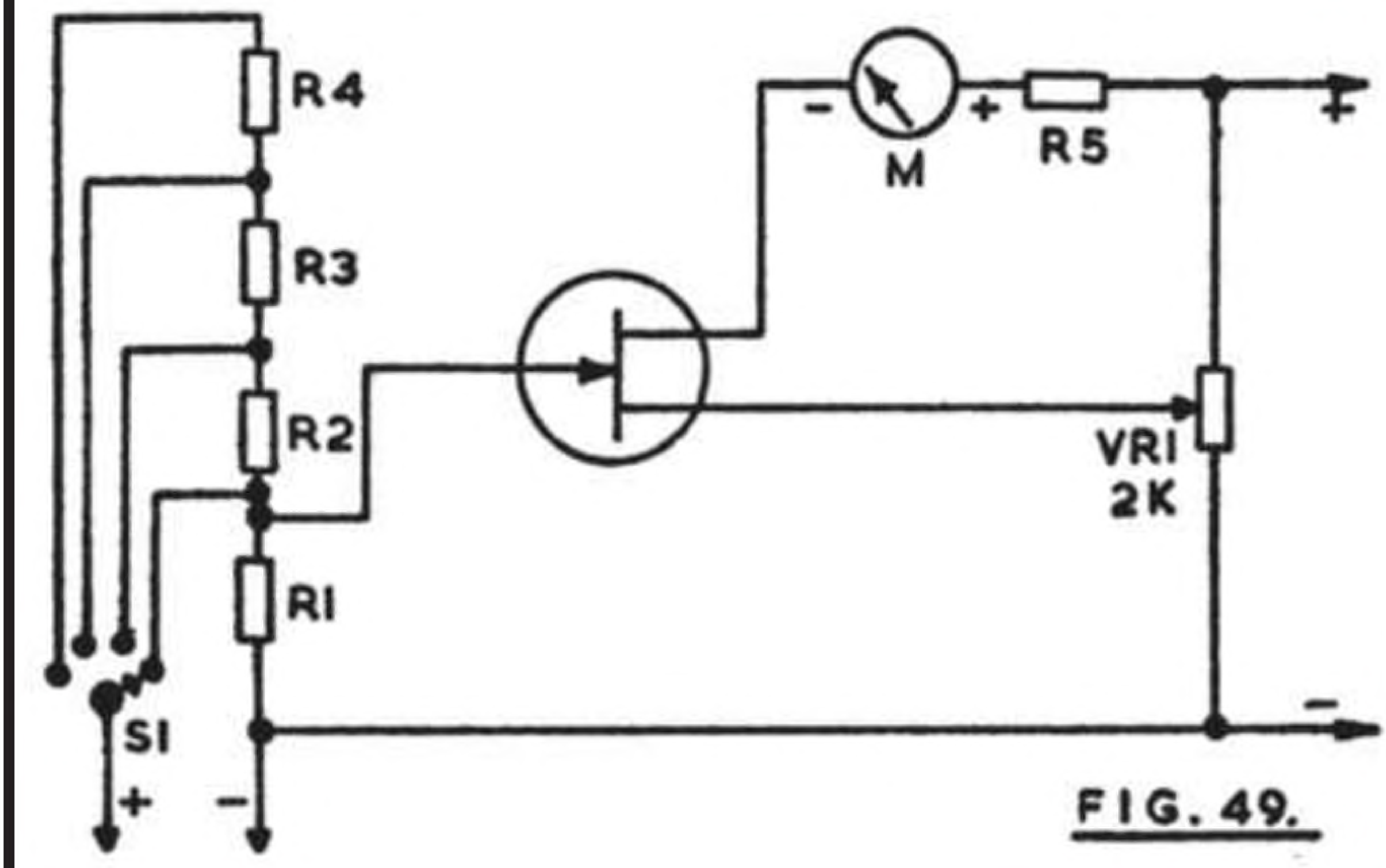

FIG. 49.

With no external voltage present, R1 maintains the gate of the FET at negative, and VR1 is set so that source current through the meter M is negligible. When the gate is made positive, M shows the source current. R5 is merely a limiting resistor, to protect the meter.

Using 1 megohm for R1, and 10 megohm resistors for R2, P3 and R4 ranges from approximately 0.5v to 15v will be obtained. The loading imposed by the instrument on a 15v circuit will be over 30 megohms. S1 selects various ranges.

A 100uA meter is used. R5 can then be 100k. A linear scale is not obtained, but individual calibration is readily made by means of a potentiometer with voltmeter, allowing any wanted voltage to be applied to the test leads. The potentiometer can be 5k, with the calibration meter clipped from wiper to one outer tag.

VR1 in Figure 49 can be of lower value, with suitably chosen fixed resistors at positive and negative ends. This avoids any possibility of severe missetting. For a 10v supply a 500 ohm control can be used, with 1.5k to positive and 470 ohm to negative lines.

2 Meg/V 0-10V Meter

The circuit in Figure 50 can be used to measure up to 10v, with an input resistance of greater than 20 megohms. R1 may be incorporated in the prod, and can be two 10 megohm resistors in series.

TR1 and TR2 are balanced by means of VR1 so that no potential appears across the meter, with no input voltage. A voltage at the gate of TR1 upsets this, and current flows in the meter circuit. In use, VR1 is set so that a correct zero is obtained, with no voltage under test.

The exact deflection obtained with the 100uA meter will depend on R1, R2, R3 and R4, and other factors. With the values

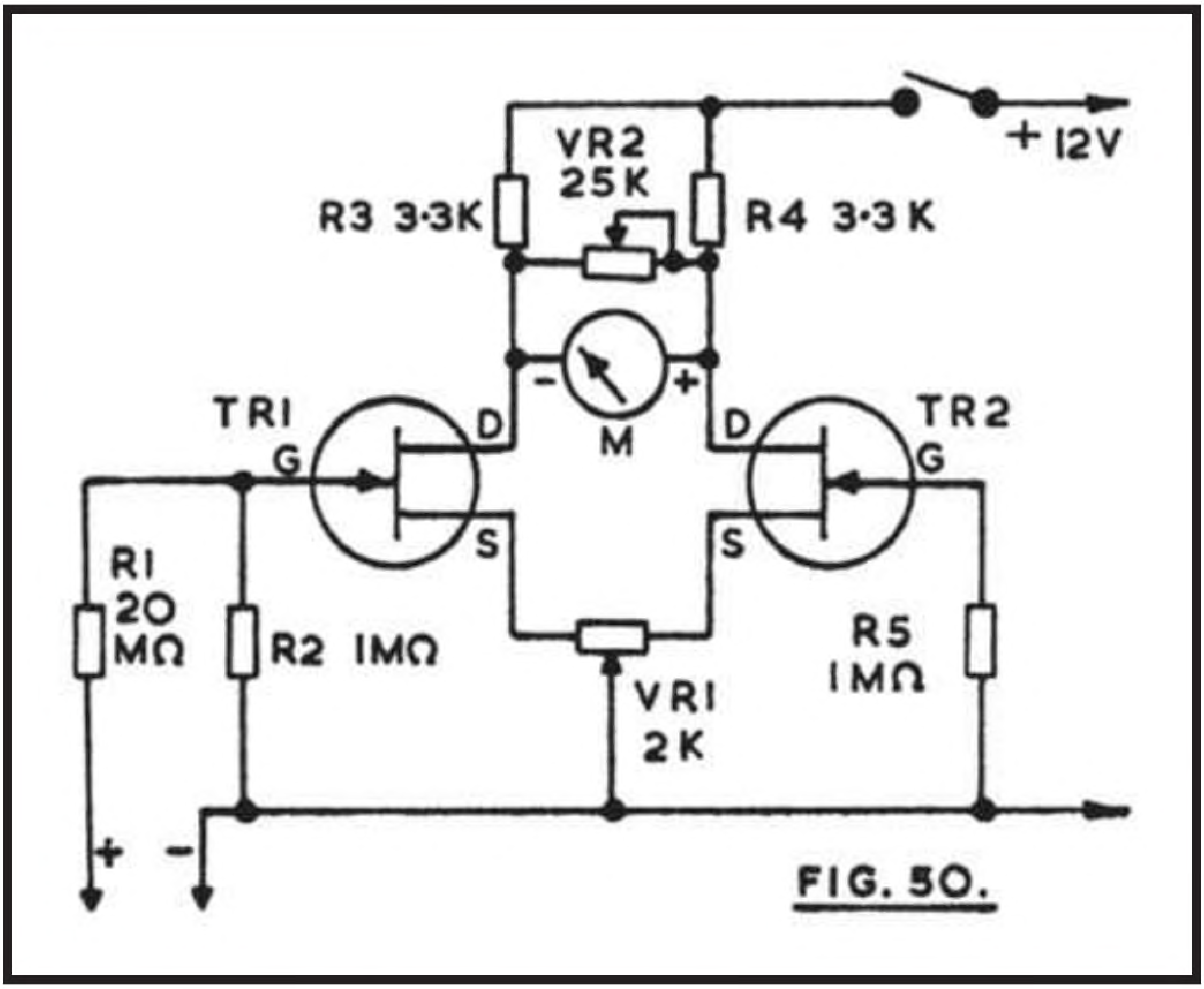

FIG. 50.

given, a deflection of somewhat over 100uA arose, with 10v. Therefore VR2 is provided, and is a variable shunt, reducing the meter sensitivity and allowing setting so that 10v will give a full-scale reading. After setting zero with VR1, VR2 is adjusted so that the current is 100uA, with 10v input. Other readings then closely follow the linear scale. E.g. 10uA is 1v, 20uA is 2v, 30uA is 3v, and so on. It is thus not necessary to provide a separately calibrated scale, for general purposes.

Two 2N3819 FETs can be used. The meter is 1k DC resistance. If R1 is to stay at 20 megohm, substantial changes to sensitivity can be obtained by altering the value of R2. This will allow the instrument to provide the required range, or to permit the use of alternative items in its construction.

A NOTE ON COMPONENT VALUES

There is normally considerable latitude in the values of those capacitors which are fitted for coupling and by-pass purposes. Here, components of 4.7nF and 5nF, and like values, can be considered as identical.

It is only in resonant circuits, and frequency-sensitive circuits (such as a tone control) that values should in general be as shown, unless modified for the purposes described .In view of the variety of markings, which appear for capacitors, and on the components themselves, the following is worth noting:

1,000pF	=	1nF	=	0.001uF
5,000pF	=	5nF	=	0.005uF
10,000pF	=	10nF	=	0.01uF
50,000pF	=	50nF	=	0.05uF

Similarly, 47nF = 0.047uF, 100nF = 0.1uF, and so on. The voltage ratings of capacitors will normally be somewhat higher than the actual voltage present.

With any of the circuits given here, 5 percent, ¼ watt resistors can be used. Potentiometers for volume or tone control or similar purposes where virtually no current passes from wiper to element may be small carbon types. Where appreciable current passes, wire wound potentiometers are preferred.