MINIVOLT

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In this age of digital things (?) it is nice to dress up the front panel of home-brew equipment with digital readouts. This handsome little digital voltmeter is easy to build and is inexpensive. In the form presented here, it is a single range unit, intended for use with power supplies similar to the ones described in last month's Elektor ('dual regulators').

Since this DVM was designed to replace conventional moving coil panel meters, on such things as power supplies, the price was one of the main design considerations. The unit uses only 6 transistors and three C-MOS integrated circuits: one IC contains four Schmitt triggers, the other ICs each house a decade counter with built-in BCD-to-seven segment decoder/drivers. It features 2½ digit readout and has an acceptable accuracy.

Basic operation

Conversion of the positive input voltage into a quantity that can be digitally displayed is accomplished by converting the input voltage to a current. This current is then used to control a variable frequency oscillator; the output frequency of this oscillator is a linear function of the input voltage. This frequency is counted by the counter unit and displayed.

The counter unit is controlled by a free running oscillator that determines the gate time for the counter stages and resets them just before the start of each count. It also blanks (turns off) the readout during the brief count cycle.

Circuit operation

At first glance, the input circuit may appear to be confusing, but if one breaks it into smaller units it is much easier to understand.

The heart of the DVM is a current-dependent oscillator. This oscillator consists of the following parts: gate N1, D2, C1 in the charge path and C1, T2 and R2 in the discharge path. The input voltage is converted into a discharge current by T1 and T2. These transistors keep the voltage across R2 equal to the input voltage at all times. Since R2 is 1 k, the current through it (the discharge current!) in milliamps is equal to the input voltage in volts. The discharge time of C1 is therefore a linear function of the input voltage.

The time required to charge C1 is always the same. The charge current is supplied from the low impedance output of N1.

If for a moment we assume that pin 2 of N1 is held high, the oscillator circuit can be more easily understood.

The secret that allows N1 to operate as an oscillator is the fact that its switching levels are not the same (hysteresis). If C1 is completely discharged pin 1 is low, making pin 3 high. In this state C1 will be charged rapidly. When the voltage on C1 reaches the upper switching threshold of N1, pin 3 goes low.

D2 prevents C1 from discharging into the output of N1, and since the input (pin 1) is a very high impedance, the only discharge path for C1 is through

Figure 1. Circuit diagram of the 'Minivolt'.