

Bipolar square wave generator

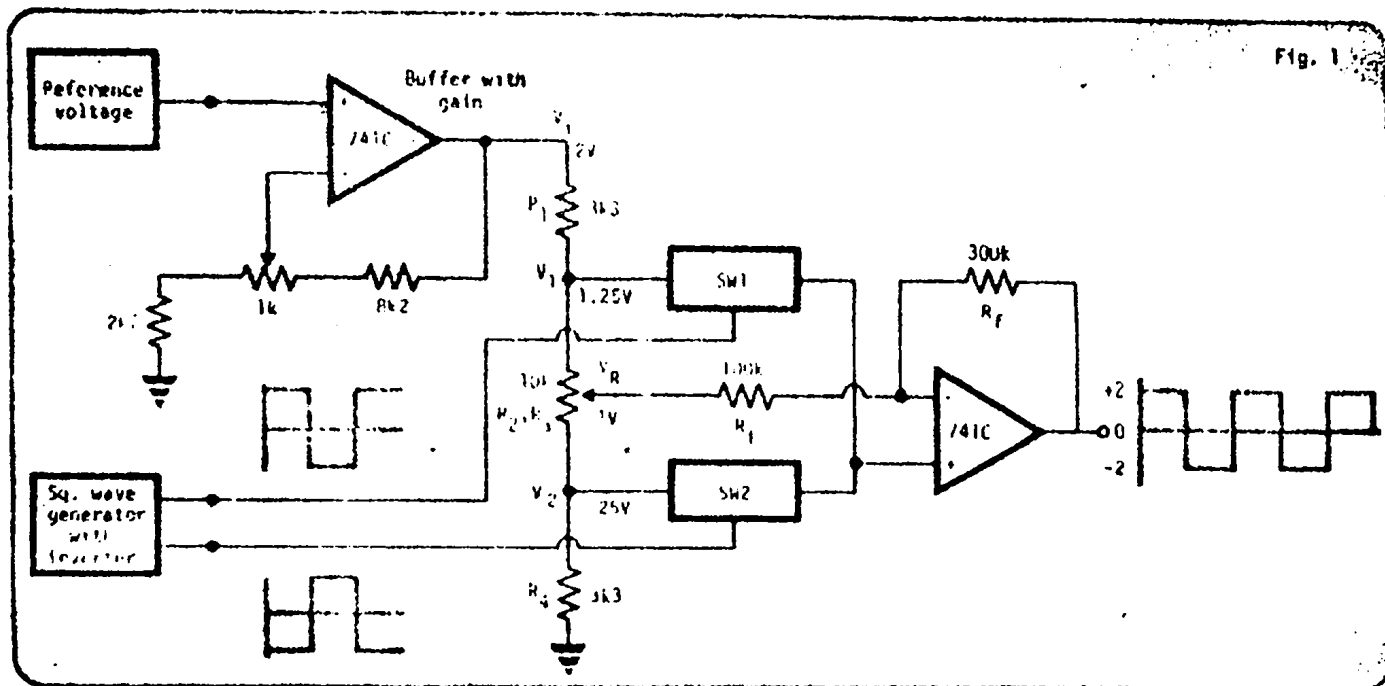


Fig. 1

There are several techniques for generating a bipolar square wave with equal positive and negative amplitudes using operational amplifiers. If the rail voltages are equal and opposite and have the required temperature stability, then allowing the output to strike the rail voltages is one possible method, though the high frequency performance of the amplifier could limit the rise and fall times of the output waveform. Limiting the output via back-to-back zeners is another technique, though care should be taken to select zeners with identical breakdown voltages and an amplifier capable of supplying

the zener breakdown current. A more elegant technique involves the use of switches to sample the required positive and negative reference voltages. A switching technique using only a single reference voltage, as opposed to two reference voltages for the techniques mentioned above is shown in Figure 1.

FET switches 1 and 2 are operated at the required square wave frequency. The output is given by:

$$V_o = V_{1,2} (1 + R_f/R_i) - V_{R1} R_f/R_i \quad \dots 1$$

$$\text{where } V_1 = \frac{R_2 + R_3 + R_4}{R_1 + R_2 + R_3 + R_4} \cdot V_1$$

and

$$V_2 = \frac{R_4}{R_1 + R_2 + R_3 + R_4}$$

if R_1 is assumed large enough to prevent loading of the potential divider chain. For equal positive and negative amplitudes we have from equation 1.

$$(V_1 + V_2) \cdot (1 + R_f/R_i) = 2V_{R1} \quad \dots 2$$

Because of possible loading effects, it is practical to make R_2 , R_3 a trim potentiometer and adjust it to obtain equal positive and negative excursions. Varying the gain of the buffer amplifier varies the amplitude of the output V_o . Practical values for a circuit used for conductivity measurements of sea-water are

$$V_1 = 2 \text{ volts} \quad R_1 = 10K$$

$$V_{R1} = 1 \text{ volt} \quad R_2, R_3 = 10K$$

trim pot

$$V_2 = 1.25 \text{ volts} \quad R_4 = 3.3K$$

$$V_2 = 0.25 \text{ volts} \quad R_1 = 100K$$

$$V_o = \pm 2.0 \text{ volts} \quad R_f = 300K$$

By disconnecting one switch and by-passing the other, it is possible to accurately set the positive and negative amplitudes independently using a digital voltmeter.

The authors wish to thank Director, National Institute of Oceanography for permission to publish this note.

V. B. Peshwe and E. Desa.
National Institute of Oceanography India.