TECHNICAL NOTE

AN INEXPENSIVE RANDOM-NOISE GENERATOR

It is often desirable to mask unwanted sounds from the experimental cubicle, but the cost (upwards of \$250) of commercially available noise generators, may be prohibitive. The components for the noise generator described here can be purchased for approximately \$18. This circuit provides enough output to drive some audio power amplifiers directly, but an audio pre-amplifier for higher power levels, and to control volume and tone, is probably preferable. Some representative amplifier kits that will serve this purpose are Eico Model HF20, or Heathkit Model AA-23, both of which have the required sensitivity and a power output of about 20 w. They are priced between \$40 and \$50.

A schematic diagram of the circuit is shown in Fig. 1; its performance is detailed in Table 1.

In a narrow voltage range (corresponding to a zener current of approximately 20 microamperes) near the breakdown knee of a silicon zener diode, junction avalanche effects produce a considerable noise voltage (Motorola Inc., 1959). This characteristic is used effectively in the present noise-generator circuit. A zener diode, CR6, is the noise source which is biased by potentiometer R3. The adjustment of R3 is critical, because maximum noise output occurs only over a narrow voltage range. Since the voltage level is critical, a zener-diode shunt regulator, consisting of R2 and

Fig. 1. Schematic diagram of noise generator and power supply.

Table 1

Noise-generator performance specifications. Figures given are for slow line-voltage drifts. Regulation is much better for rapid line fluctuations (period ≤ 1 sec).

Frequency range	20 cps to 22 kcps ± 1.5 db ¹
Waveform (over the above bandwidth)	Approximate gaussian amplitude distribution ²
Output voltage	100 millivolts p.p. $\pm 20\%$ ³
Zener current at maximum noise output	20 microamperes $\pm 20\%$ ³
Output impedance	1,000 ohms
Input voltage range	90 to 140 v ac RMS, 50 to 60 cps
Regulation (sound-level change for given input voltage change within the above range) ..	± 0.2 db for a change of ± 2.0 v ac RMS ⁴ ± 0.5 db for a change of ± 3.0 v ac RMS ± 1.5 db for a change of ± 4.5 v ac RMS ± 2.5 db for a change of ± 6.0 v ac RMS

¹Measured on a General Radio Type 1910-A Recording Wave Analyzer, using a 50-cps constant-bandwidth filter. The noise generator operated into a 100-kilohm resistive load.

²For termination resistances greater than or equal to 10 kilohms; loads much greater than this produce clipping. Also, individual zener diodes vary slightly.

³Four IN3026 zener diodes were tested in this circuit and their characteristics fell within this range of values.

⁴Measured with a General Radio Sound-Level Meter Type 1565-A, using the "C", or flat frequency weighting curve with the "S", or slow meter response.

CR5, is incorporated in the design. This regulator reduces voltage changes occurring at the input and permits operation of the noise generator during deviations from "set" input voltage.

Components C1, R1, and C2 form a π filter which attenuates the ac ripple component of the output from full-wave bridge rectifier (CR1-4). If a well-regulated 24 to 28 v dc power supply is available, savings can be realized by using it to power the noise generator. For operation at this voltage, change the value of the current limiting resistor, R2, to 470 ohms.

The regulator diode, CR5, is not temperature-compensated; thus, some slight readjustment of R3 may be necessary within the first few minutes until the operating temperature stabilizes. With the circuit values

chosen, all components operate within their rated power dissipations at all settings of potentiometer R3. When a reasonably constant voltage is supplied and the potentiometer adjusted for maximum noise output, the circuit is stable and requires no maintenance.

REFERENCE

Silicon zener diode handbook, First ed., Motorola Inc., 1959.

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