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A SUNSHINE DURATION COUNTER

1. The note discusses a system to record the duration of sunshine, developed in the Central Radiation Laboratory, Poona to work with a sunshine switch constructed by the United States Weather Bureau.

The sunshine recorders generally used are not reliable as the burns depend on the quality of the card and the evaluations depend to a great extent on personal judgement. Also the methods of evaluations used is not uniform throughout the world. It has been noticed that errors of even $\pm$ 10 per cent is possible in the duration of sunshine computed from two of the recorders installed side by side. The present note is an attempt towards a system which will be repeatable and comparable.

In the recording system described by the manufacturer of the sunshine switch (USWB 1958) a relay makes a contact 'on' or 'off' depending on the presence or absence of sunshine. A synchronous motor makes a contact on for two seconds once a minute. When both the contacts are on, the counter is enabled. The author is of the opinion that this method is not quite satisfactory. Imagining an extreme condition where the presence of scattered clouds obscure the sun for two-second intervals when the motor makes the contact, the period will be recorded cloudy as the counter is disabled, and *vice versa*.

2. The power supply frequency of 50 Hz is divided by 3000 to obtain a frequency of one minute which is counted during periods of bright sunshine.

3. The USWB sunshine switch consists of two photoelectric cells connected in opposition. One of them is kept shaded with the result that an output current of the order of microamperes increases during periods of bright sunshine.

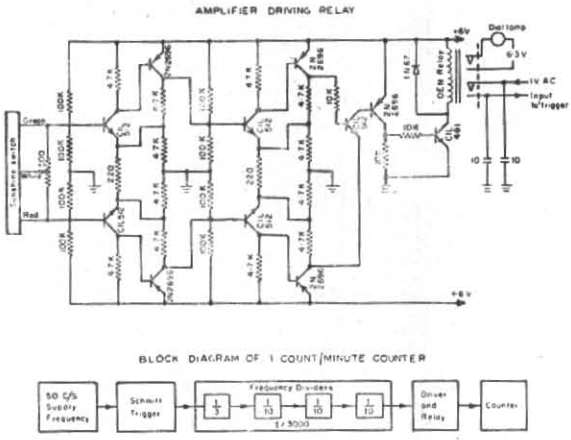

Fig. 1

4. The complete circuit of the amplifier driving a relay is given in Fig. 1. The output of the photoelectric sunshine switch is connected to a 500 ohms potentiometer as shown in the figure. A two-stage high gain differential amplifier amplifies the voltage to a few volts. The difference voltage thus obtained is converted into a single ended output after which it drives an OEN relay through the driver. The difference amplifier has been very carefully designed using matched pairs of transistors and precision components.

Two contacts of the relay which close simultaneously during periods of bright sunshine are utilised, one to enable the counter and another for indication that the counting is on.

5. The block diagram of one-count-a-minute counter is given in Fig. 1. The power supply voltage is stepped down through a transformer to 1 V. This voltage is fed to a Schmitt trigger (Texas Instruments 1963) which converts the sinusoidal wave form to sharp pulses. The pulses are fed to frequency dividers.

The frequency division by a factor of 3000 (50×60) is achieved in four stages using flip flops. The first stage is made up of two flip-flops

in cascade with feed back from fourth to second transistor, in order to obtain frequency division by a factor of three. Each of the following stages consisting of four flip-flops in cascade with feedbacks from eighth to sixth and fourth transistors divide the frequency by a factor of ten (decade counter—Iyer 1974).

The output from the frequency divider which is one pulse per minute is used to work an OEN relay through the relay driver. The relay contacts become on and off once a minute which is used to work anelectro-magnetic telephone counter.

6. *Sensitivity adjustments* — The procedure adopted is the same as that suggested by the manufacturer. The sunshine switch is shaded from direct sunlight and the 500 ohms pot in Fig. 1 is adjusted so that the relay which enables the counter is on the verge of tripping on; the 'on' condition being judged by the lamp.

'The sensitivity adjustment is made when the sky is bright. If done in cloudy weather it may not balance in bright weather; but if balanced in bright weather it will always be in balance in cloudy weather' (Instructions for installing and operating U.S. Weather Bureau Photoelectric sunshine switch).

7. The instrument has been tested and found to be stable under normal variations in ambient temperature and power supply. The accuracy of the counter was found to be better than ± 5 min a day, which was considered to be sufficient for the purpose. A crystal timer may be used for better accuracy.

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REFERENCES

Iyer, N. V. 1974 *Indian J. Met. Geophys.*, **25**, 2, pp. 311-314.

Texas Instruments 1963 *Schmitt trigger, Transistor Circuit Design*, McGraw Hill Publ. pp. 381-383.

USWB 1958 Amplifier, magnetic for photoelectric sunshine switch, Specification No. 044, 421/1.