sistor. The base of this transistor is tied to system positive through a resistor, so that the transistor normally does not conduct, and the lamp, in consequence, remains unlighted.

From the base of the lamp control transistor (2N307) to local system negative, in each case, an NPN transistor is connected. This conducts when the base is biased positively relative to the emitter, and is nonconducting when the base is biased negatively. Positive bias for this transistor (2N233) is available from system positive through a high resistance, but this bias is normally bled away through the gate diodes, so that neither transistor is conducting. Only when both diodes connected to the base of the 2N233 are blocked can positive bias get to its base, permitting it to conduct. When this occurs, and at no other time, the base of the 2N307 is connected to local system negative, so that it, in turn, can conduct, completing the circuit through the indicator lamp, which then lights.

In the circuit shown, requisite conditions for lighting the South-southwest lamp occur only when the Southwest and West sectors of the vane contacts are energized by the contactor.

Several workable alternatives to this circuit are possible, this one being preferred at the present state of the art because it works consistently using standard and easily available components. This circuit replaces the costly, noisy and trouble-prone battery of relays used a quarter of a century ago to perform the same function.

5. Alternative operations

Although specifically designed for operating readout lamps from a contacting wind vane, these same circuits can be used with equal success for controlling and operating other electrical loads, such as counters, relays and chronograph pens.

6. Performance and service life

At the present state of the art, the most fallible components in the readout systems outlined are the indicator lamps, which have a nominal life exceeding 1000 hours of continuous service. Lamp life is radically shortened by switching, but most of its ill effects can be reduced by operating the lamps from a high voltage supply in series with a suitable voltage-dropping resistor. This, by reducing turn-on current surges, extends lamp life and virtually eliminates catastrophic failures (burn-outs). Replacements can be made at scheduled times, such as every six months, as light output of the lamps declines due to bulb blackening.

Transistors and diodes have a problematical, but very long, service life, considerably exceeding five years of continuous service with the constants and loads here designated. Other transistors, having about the same characteristics as those specified, will work quite well in these circuits. Manufacturer's heat sink specifications should be followed carefully.

7. Conclusions

Due to advances in the electronic art, the bulky and awkward, but highly dependable ML-117 wind indicator can be replaced by a compact and convenient readout, having at least the same dependability.

Numerous special functions, formerly requiring large banks of relays, which are bulky, noisy and demanding of maintenance, can now be performed by compact, silent and substantially trouble-free diode and transistor circuits.

Improvements in lamp supply circuitry change bulb replacements from a recurrent emergency to a schedulable routine maintenance operation.

An Economical Multiplexer for Use on Radiosondes

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1. Introduction

The need to place more than two sensors aboard a 1680-megacycle radiosonde requires either that more contact points be incorporated in the baroswitch, or that a separate switching device be added to the sonde. Adding more contact points to the baroswitch is not feasible because of dimensional limitations. A switch, consisting of copper strips printed on a circuit board and a wiper arm which contacts one strip at a time as the wiper rotates, is currently used when

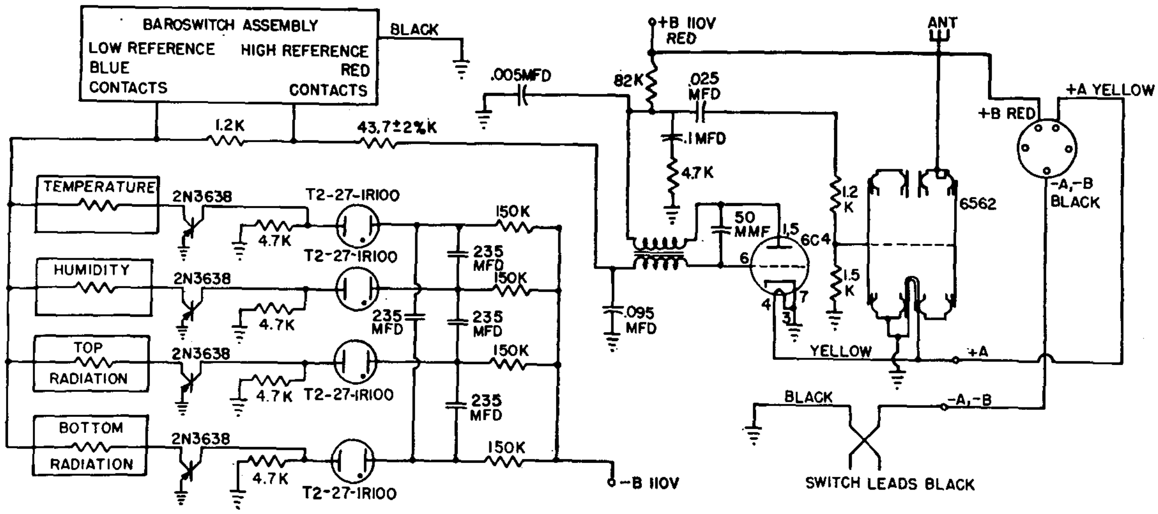

FIG. 1. Schematic circuit of a 1680-megacycle U. S. Weather Bureau radiosonde modified with multiplexer.

additional sensors are required on the sonde. The wiper arm is driven either by a mechanical clockwork motor or by an electric motor. This type of switch has two disadvantages; dirt on the copper strips introduces noise to the transmitted signal, and driving motors can become jammed in field use. The circuit to be described overcomes both of these limitations.

2. Description of multiplexer circuit

The circuit shown in Fig. 1 was developed to switch resistive sensors into the blocking oscillator of a 1680-megacycle radiosonde. The circuit consists of two parts; one being the switching transistors and the other a ring counter which drives the switching transistors in sequence.

The ring counter consists of four 235-μF, 15-V nonpolar electrolytic capacitors[1], 150-kilohm resistors and T2-27-1R100 neon lamps[2] containing a small amount of radioactive material to assure uniform firing characteristics (Bauman, 1964). The capacitors charge until the voltage across one of the capacitors is such that one of the neon lamps discharges. The charge from the capacitors connected to the conducting lamp discharges through that lamp until the voltage across the lamp falls below the extinguishing voltage; these capacitors then recharge. After the lamp is extinguished, the capacitors that were not discharged, discharge across another lamp. This procedure forms a cycle with only one lamp discharging at a time. The discharge time for the lamps is determined by the voltage applied to the circuit, the resistors, capacitors, and the characteristics of the neon lamps in the circuit. All of the neon lamps discharge for nearly equal periods of time. Table 1 shows the discharge time as a function of capacitance. Sensing times less than 1 sec are obtained with smaller capacitors, thereby rendering the present system compatible with telemetry systems operating at faster sampling rates. The 4.7-kilohm resistors are required in the ring counter to maintain the discharging sequence independent of the sensor resistance.

It is impossible to predict the sequence in which the lamps will discharge; the sequence may even change during the first few cycles. However, the sequence remains fixed after the system has operated for about two minutes. The discharging sequence will also change if power to the multiplexer is interrupted. It is, therefore, imperative that the B-battery remain connected to the sonde once the sonde is operating and the switching sequence has been recorded. Once the switching sequence is established, it remains fixed throughout the entire two hour ascent as can be seen in Fig. 2.

Four type 2N3638 switching transistors[3] are connected in the common emitter mode. The ring counter

[1] Capacitor type MTA, available from P. R. Mallory Co., Indianapolis, Ind.

[2] Neon lamp type T2-27-1R100, available from Signalite, Inc., Neptune, N. J.

[3] Transistor type 2N3638, manufactured by Fairchild Semiconductor Corp., Mountain View, Calif.

TABLE 1. Switching duration as a function of capacitance for $R = 150$ kilohms and $E = -110$ V.

Capacitance (μF)	Time (sec)
25	1.7±.5
50	2.0
170	6.7
235	8.9

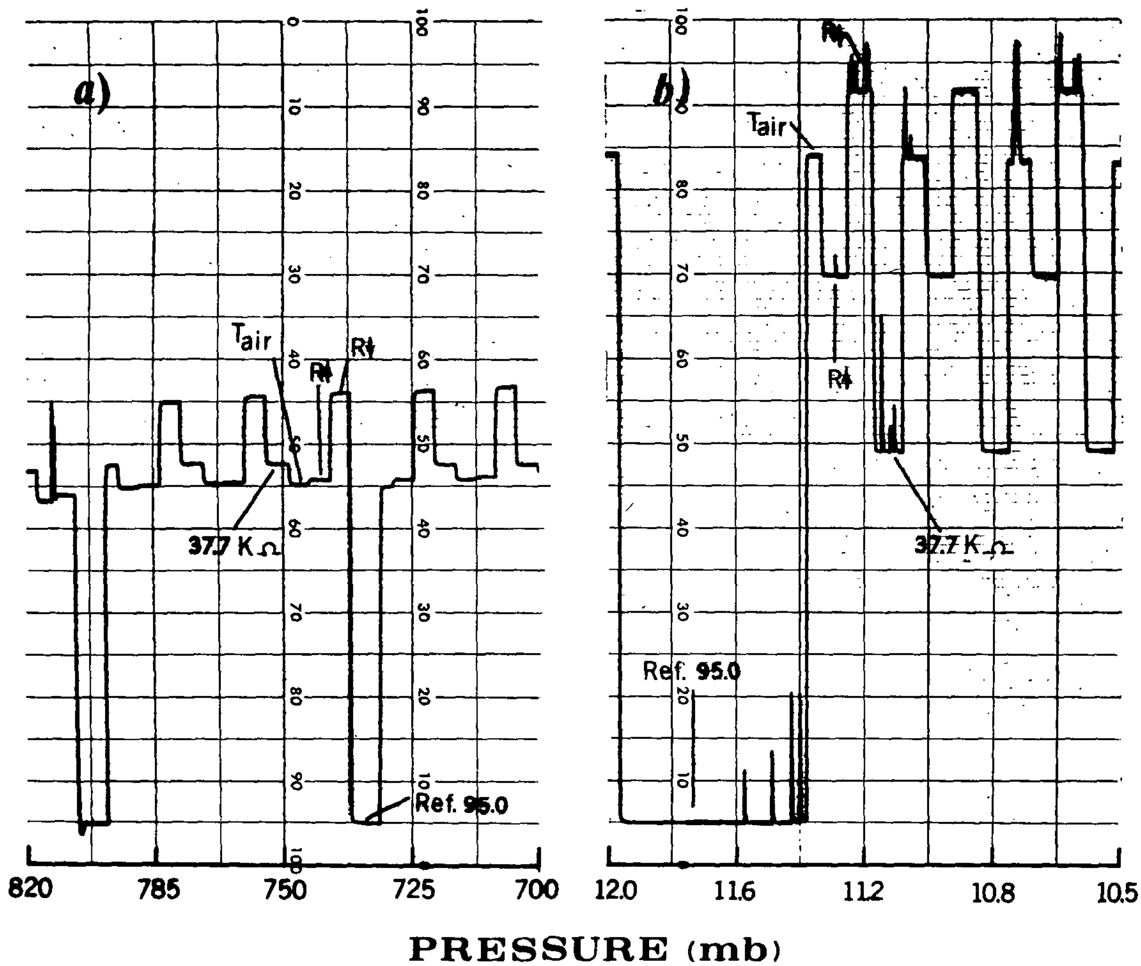

Fig. 2. Samples of data recorded from a radiometer-sonde ascent using multiplexer at pressures of 750 mb (a) and 11 mb (b).

furnishes sufficient current to the bases of the transistors to saturate the transistors, such that the resistance between each of the collectors and emitters is about 5 ohms. When the transistor is cut "off," the resistance between the collector and emitter is greater than 5 megohms. A cold chamber test from 25 to −75C showed that both resistances were sufficiently independent of temperature so as not to change the output frequency of the radiosonde blocking oscillator.

The common base mode of transistor switching was also investigated, but the saturated resistance from collector to base was too temperature sensitive for radiosonde application. This resistance was 2.3 kilohms at 25C and changed with a −200 ohm $(°C)^{-1}$ temperature coefficient.

The 0.1 mW power consumed by the multiplexing circuit is obtained from a second radiosonde type B battery which supplies from −90 to −110 V across the ring counter.

The electronic components of the multiplexer are potted in the form of two blocks to protect them from damage by handling and exposure after the ascent. The block containing all the components excepting the capacitors is mounted in a recess of the battery compartment just below the baroswitch so as to avoid being jarred when the battery is inserted into the sonde. The remaining circuit block containing the capacitors is placed alongside the battery wherever space is available.

The price of a four-sensor multiplexer unit is competitive with the mechanical switching system now in use. The cost of components for a four-sensor multiplexer is about $5.00. However, the cost of the multiplexer increases linearly with the number of sensors, while the cost of the mechanical switch is relatively constant.

3. Results and discussion

The switching unit has been tested in conjunction with a number of Suomi-Kuhn radiometer-sonde ascents. Fig. 2 shows a sample of the data obtained during an ascent at pressures of 750 mb (a) and 11 mb (b).

Fig. 2 demonstrates that this multiplexer circuit introduces negligible noise to the signal and that the sampling sequence is maintained throughout the entire ascent. A fixed 37.7-kilohm resistor was substituted for the humidity sensor shown in Fig. 1; the data of Fig. 2 recorded for this resistor varied over a scale range from 52.0 to 51.2. A similar scale reduction of 0.7 was observed when a 37.7-kilohm resistor connected directly to a radiosonde was tested in a cold chamber over the range of temperatures encountered during an ascent. The observed ordinate shift cannot, therefore, be attributed to the multiplexer. The switching duration increased from 9 sec in Fig. 2a to 15 sec in Fig. 2b due to a decrease in the B-voltage driving the ring counter.

Two modified radiosondes were returned after having been dropped by parachute and exposed to weathering in the field; both multiplexers operated satisfactorily even though one of the sondes was damaged beyond repair.

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A Note on Standardization of Performance of WSR-57 Radars [1]

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1. Current standardization procedures

References to the "standardization" of the U. S. Weather Bureau's network of WSR-57 radars have appeared in several publications since the method was given in the Weather Surveillance Radar Manual (U. S. Weather Bureau, 1960) and later presented by Bigler and Brooks (1963). Without exception, the references have either stated or implied that the attempted standardization achieved the goal stated by those authors when they wrote in 1963 ". . . thus, all WSR-57 radars operate with the same relative receiver performance." When the method is applied to the measurement of reasonably large echo signals on the A or R scopes it is a logical improvement over earlier techniques. However, it is currently being erroneously applied to WSR-57 PPI and RHI data in the determination of echo peripheries and areas in both operational and research situations. Consequently, it warrants a clarification of the actually rather narrow application of the statement.

The method used to "standardize" relative receiver performance, summarized from the Weather Surveillance Radar Manual and still in use is as follows: Three lines are placed on the A or R scope face and the total signal amplitude adjusted such that the top line represents receiver "saturation" and the bottom the base line for the A scope trace from the linear receiver. The third line is 30–40 per cent of the way up from the base line and represents an arbitrary level to which the top of a −103 dbm test signal is set by adjusting the bias voltage or IF gain control. Any time the radar operator wishes to estimate the strength of a signal which *exceeds* that level he applies attenuation to it until he reduces it to the −103 dbm reference level. Then, noting the amount of attenuation applied, he (algebraically) adds it to the −103 dbm value, adds a correction for the difference between the actual transmitter power output and the 500-kW standard, refers to a chart for range correction, and reports the estimated intensity category. A desirable feature of this intensity measurement technique is that for radars having minimum detection capabilities better than −103 dbm, measurements are made in the middle range of the A scope where signal amplitude resolution is much better than at the minimum signal detection region where it would otherwise have to be subjectively distinguished from noise. This standardization procedure is valid to this point.

However, the only reason for the procedure is the fact that it has not been economically possible to standardize either the power output levels of the trans-

[1] Contribution No. 686 from Institute of Marine Science, University of Miami.