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A transistorized Rocketsonde for measurement of upper atmosphere temperature

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ABSTRACT. This note gives a description of a pulse modulated transistorized rocketsonde instrument package, working on 1680 Mc/s for telemetering temperature information from meteorological sounding rockets. Currently used ground equipments like GMD-1 or WBRT-57 can be used to receive the signals. The package is completely transistorized except for the final transmitting stage which has a sub-miniature tube. H.T. battery, however, is not required for this tube. The change in resistance of the thermistor due to variation in temperature changes the p.r.f. of the modulator between 10 to 200 cps.

1. Circuit Description

The circuit diagram of the transistorized rocketsonde is shown in Fig. 1. The package consists of three major units — (1) a switching circuit, (2) a sensor modulator and buffer amplifier section and (3) a power driver, and r.f. oscillator stage.

The switching circuit consists of a free running multivibrator using BEL type AF 116 transistor with a switching period of 3 seconds. The output from the collectors of the two transistors are connected to the base of the other AF 116 transistor which are alternatively driven to cut off and conduction, thereby switching the temperature sensor and reference resistance alternately.

The sensor modulator stage containing another AF 116 transistor is a blocking oscillator circuit. The p.r.f. is controlled either by a thermistor or the reference resistance, along with the timing capacitor 0·1 μF and 100Ω resistance which are alternately grounded depending upon the collector voltages of the two switched transistor. A diode 202 in the base circuit reduces the effect of I_{co} variation with temperature upon p.r.f. The pulses generated are almost rectangular in shape and of width about 200 μs. OA81 diode across the primary of the transformer is to suppress one half of the pulse which is undesired. The effect of battery impedance is avoided by shunting it with 100μF capacitor.

The negative going modulator pulses are fed to the base of a buffer amplifier stage containing AC128 (BEL make) which is normally in cut off condition. It provides a proper match between modulator and driver stages and reduces the reaction on the modulator.

The driver stage with 2 N441 transistor is also normally biased to cut off with base returned to positive. The amplified pulses are fed to the primary of a pulse transformer and are stepped to 300 volts on load. This is used as a plate supply voltage for the 1680 Mc/s oscillator.

The r.f. oscillator consists of type 5794 or 6562 pencil triode with built in cavity resonators, normally used in radiosonde transmitters. It is plate pulsed by the driver amplifier thereby avoiding the use of H.T. battery pack.

2. Performance of the Instrument

Fig. 2 shows the effect of temperature on the modulator without temperature compensation. Satisfactory temperature compensation was obtained by introducing a thermistor (DLY 330) as shown. This causes a change in the circuit impedance with temperature which corrects p.r.f. as the temperature changes. Consequently the p.r.f. was found to be very stable and does not change by more than one per cent. The corresponding error in temperature measurement is 1·0°C. This error due to the drift on p.r.f. is, however, corrected on the recorder by proper adjustment of the reference frequency. The peak power was computed from average power measurements by means of slotted waveguide and a bolometer bridge. The oscilloscope pictures of the pulse shape at various stages are shown in Fig. 3. Fig. 4 shows the photographs of the instrument package.

3. Chief Characteristics

The chief characteristics of this type of rocketsonde are as follows —

(*a*) Mode of transmission	Pulse modulated
(*b*) Modulation frequency	10–200 cps
(*c*) Pulse width	200 μs

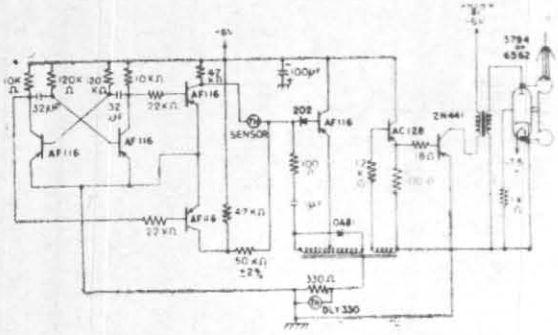

Fig. 1. Circuit diagram of transistorized pulse modulated rocketsonde

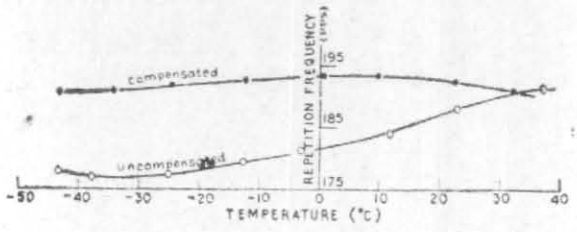

Fig. 2

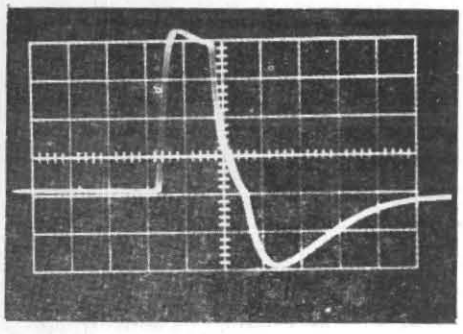

Fig. 3(a). Output of the pulse transformer

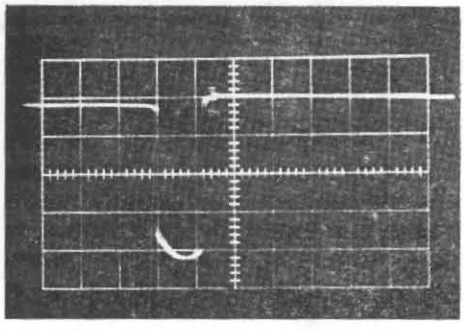

Fig. 3(b). Output of the blocking oscillator

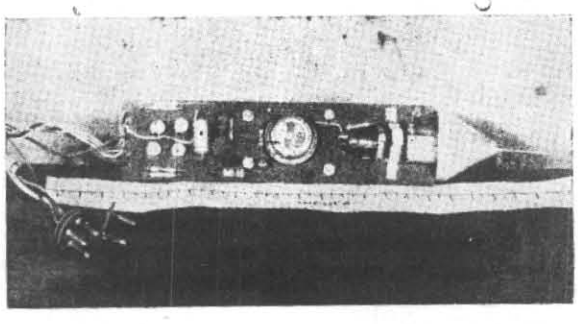

Fig. 4. Met. rocket payload

(*d*) Carrier frequency	1680 Mc/s
(*e*) Peak power	4 W
(*f*) Battery voltage	6 V
(*g*) Volume without battery	625 c.c.
(*h*) Weight without battery	175 gm

This instrument is mostly made of indigenous components except for the pulse transformer, power transistor and transmitting tube.

This is a prototype model which has not yet been flight tested. The package will have to be subjected to temperature, acceleration, shock and vibration tests simulating actual flight conditions.

4. Acknowledgement

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