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OPERATION AND CALIBRATION OF 85-1 ANTENNA SUPPORT LEG TEMPERATURE MONITOR

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The purpose of this report is to explain the 85' Support Leg Temperature Monitor, used to average the temperature from 2 or more points, for the purpose of determining whether or not Structural Thermal Change is causing a phase shift between the 85's or between 85-1 and the 42' when used in current interferometric programs.

The following is a description of the intended operation and calibration of the antenna support legs temperature monitor presently located on 85-1. The thermistors used are Yellow Springs Instrument Co. Part # 44303 and are embedded ¼" deep in each Support Leg with Budd Gagekote #5 Epoxy.

The thermistors used in this circuit are thermilinear over the range of 0 degrees to 120 degrees F $\pm$ 0.4 degrees F. And the bridge circuit may be calculated to extend the operating temperature range from -30 degrees C to +50 degrees C. The probe itself is given in Fig. 1. The probe is # 707.

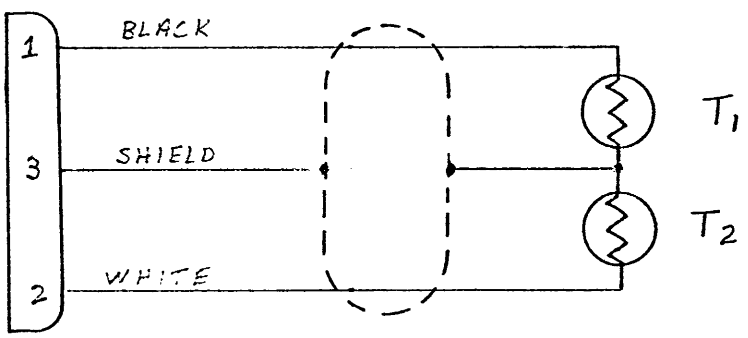


Fig. 1

T_1 and T_2 are the thermal sensing elements.
The resistance of T_1 at 25 degrees C equals 6,000 ohms and the resistance of T_2 at 25 degrees C equals 30,000 ohms.

The calibration and bridge circuit is given in Fig. 2. Shown for one thermistor circuit. In this specific case, all three are calibrated the same way.

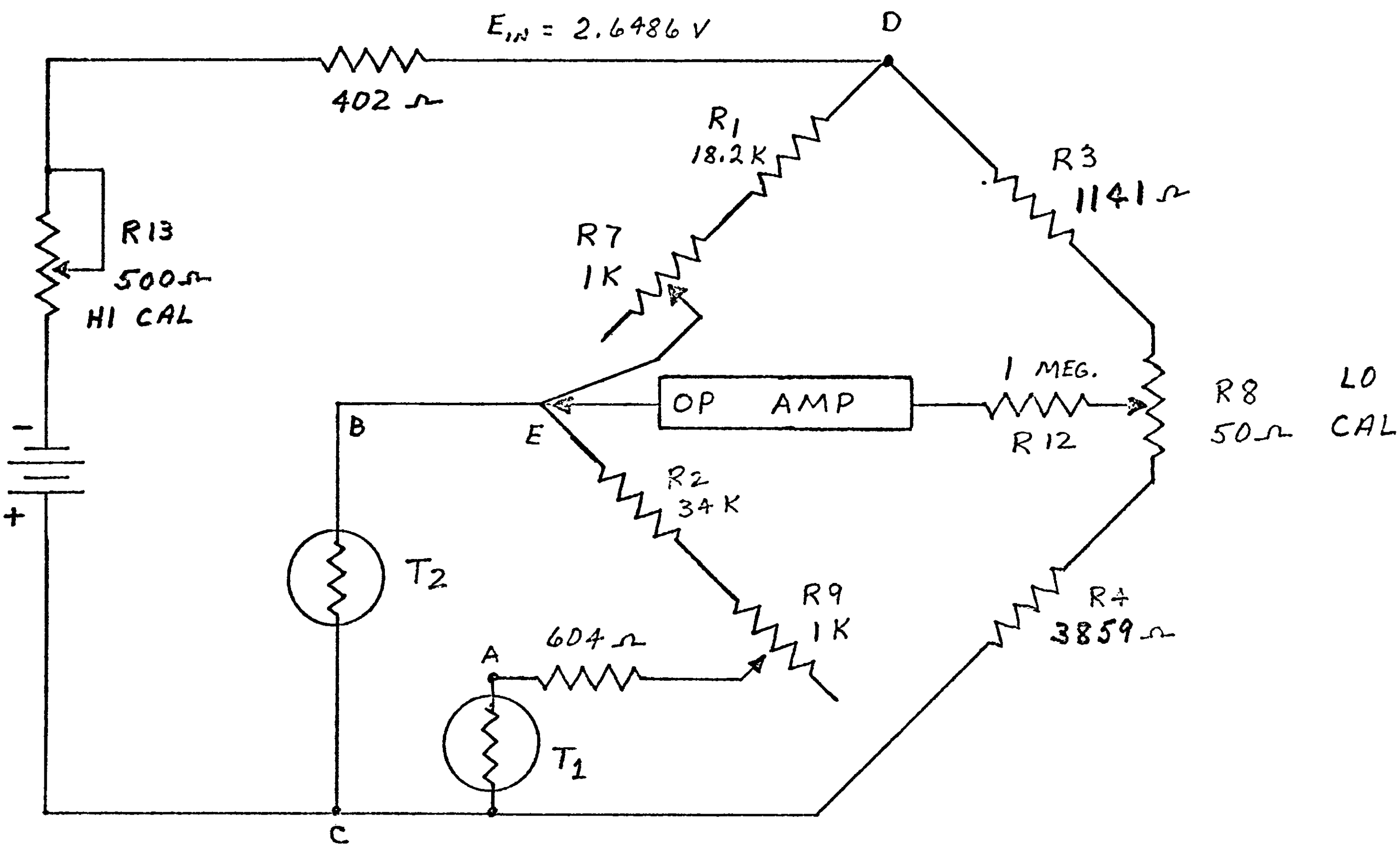


Fig. 2

The temperature operating range of 0 degrees F to 120 degrees F was calculated in the following manner.

1.) The circuit was designed so that 0 degrees F = 0 volts output and 120 degrees F = 1.2 volts output or each 1 degrees F temperature rise = 10 milli volt output. (Note: As used and described later a factor of 5X is introduced in the DDP-116 analog buffer.)

2.) For a temperature range of 0 degrees F to 120 degrees F the basic equation, For degrees F E_{out} = -0.37755% E_{in}/degrees F T + 0.77182, <u>or</u> For degrees C E_{out} = -0.6796% E_{in}/degrees C T + 0.6510 E_{in}.

3.) Calculate E_{in} for 120 degrees F equal to 1.2 V

(E_{out} at 0 degrees F - E_{out} at 120 degrees F) = 1.2 V

(-0.37755% E_{in}/degrees F X 0 degrees F + 0.77182 E_{in}) -

(-0.37755% E_{in}/degrees F X 120 degrees F + 0.77182 X E_{in}) = 1.2 V

0.45306 E_{in} = 1.2 V $\qquad$ E_{in} = 2.6486 V

4.) $E_{out} = 0.37755\%/\text{degrees F } (2.6486 \text{ V})(0^{\circ}\text{F}) + 0.77182 \ (2.6486 \text{ V}) = 2.044 \text{ V}$

5.) $E_{R4} = E_{out1} = E_{in} \dfrac{R_4}{R_3 + R_4}$ or $2.044 = \dfrac{R_4 \ 2.6486}{R_3 \quad R_4}$

Here we choose $R_3 + R_4$ to be 5K. If $R_3 + R_4$ is less than 1K, excessive battery drain will occur. If $R_3 + R_4$ is greater than 5K, some degradation of linearity will occur.

$2.044 = \dfrac{R_4 \ 2.649}{5K} \qquad R_4 = 3{,}859 \ \Omega$

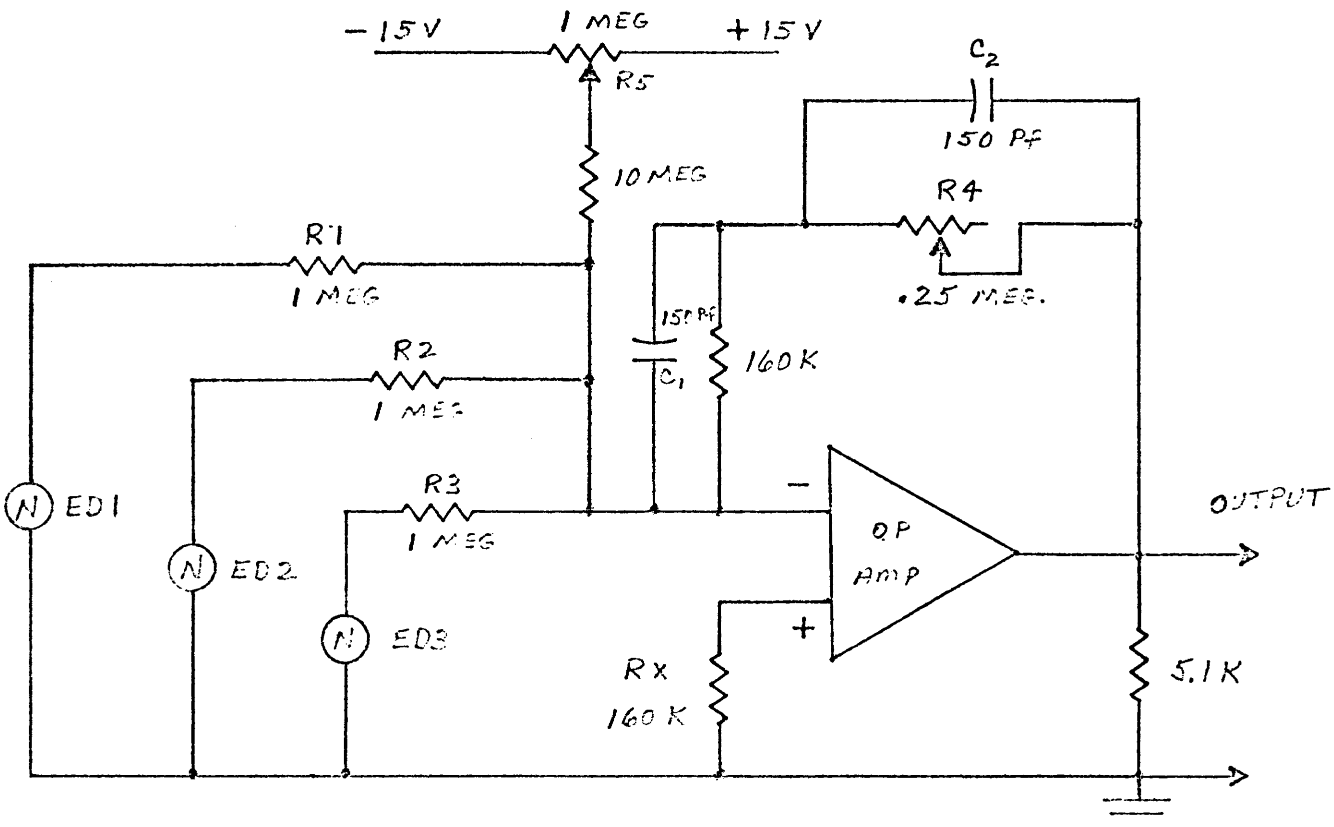
6.) $R_3 = 5K - R_4 \qquad R_3 = 1141 \ \Omega$

7.) R7 is adjusted for 18.7K between points D to E and R9 adjusted for 35.25 K between points E to A.

8.) R8 and R13 are used to adjust the low cal and high cal at the output. In this case, R8 is adjusted for zero volts output at 0 degrees F, and R13 is adjusted for 1.2 V output at 120 degrees F. The thermistor was put in a test chamber where the temperature was controlled at 0 (F) degrees and 120 degrees F. The output was hooked to a digital voltmeter for adjusting.

The three bridge circuits are hooked through a 1 meg resistor as a summing circuit which goes to the input of an op-amp as in Fig. 3.

Fig. 3



1.) $R_1 = R_2 = R_3 = $ 1 meg 1% resistor.

2.) R_4 is used as a ranging pot for adjusting feedback,

R_4 would be set to $\frac{R_1 = R_2 = R_3}{N_R}$ (where N_R = Number of resistors)

3.) R_5 is a 1 meg pot used for DC balance to the op-amp.

4.) $R_X = \frac{1}{1/R_1 + 1/R_2 + 1/R_3}$

5.) C_1 and C_2 are used to eliminate any oscillations that might occur in in the op-amp circuit and thus give a steady DC output.
The op-amp is an analog Model 180J and the power supply is an analog dual op-amp Model 901. The output of the op-amp is connected to terminals 98 and 100 for the common line and terminals 97 and 99 for the output line on the data cable in 85-1 Control Bldg. The data cable is connected to the #42 buffer channel going into the Computer at the Interferometer Control Bldg. The buffer amplifies the input by a factor of 5 for entry into the DDP-116 computer. 100 degrees F will appear as 5.000 volts on the output of the buffer channel.