NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VIRGINIA

ELECTRONICS DIVISION INTERNAL REPORT No. 170

COOLING FAN SPEED CONTROL

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AUGUST 1976

NUMBER OF COPIES: 150

This report describes a circuit for the speed control of an electronic equipment cooling fan. The requirement developed out of the need for lower noise fans in the standard chassis used to house the standard NRAO wire wrap cards. Manufacturers had discontinued the manufacture of certain low speed fans.

The following sections briefly describe the circuit and include schematics and graphs. The tests were run on a feather fan and a sentinel fan, both manufactured by Rotron and considered the standard for the chassis. A little experimentation should be carried on by anyone using the circuit to determine exact values for the fan or fans used.

As can be seen from Figure 6, using the same components gave different minimum speeds for the two fans. The temperatures of the two fans were measured in their hottest area at 25°C and 35°C. The results were:

FAN MODEL	APPLIED V	SPEED	FAN T °C	AMBIENT T °C
Feather	65V	2180 rpm	46°	25°
Feather	120V	3320 rpm	45°	25°
Sentinel	65V	1430 rpm	53°	25°
Sentinel	120V	3320 rpm	48°	25°

As can be seen above, the feather fan temperature was only 1°C higher at the slower speed. This would have a fairly small effect on the life of the fan and it could probably be run even slower - maybe 1600 to 2000 rpm. The sentinel fan increased its temperature by 5° at the lower speed. This may shorten its life by six months to a year - rough estimate from life curves. Therefore, this fan should probably be run a little faster at minimum speed - maybe 1600 to 2000 rpm. Because the two types of fans have different minimum speeds with the same circuit components, they should not be run off the same control circuit if the system contains both types of fans.

The basic unit of the speed control is a bridge that compares two signals. One of them is the output of an oscillator, the other is the output of the transducer (thermister) as is shown in Figure 1, which is a block diagram of the speed control circuit. When the signal from the oscillator is greater than the signal from the thermister, the thyristor is on. Otherwise, it is off. Figure 2 illustrates this point by showing the waveshapes for the various conditions.

Figure 3 is the schematic diagram of the circuit. A few notes about this circuit follow:

1. An inductive load is being driven and thus the trigger pulse and the input voltage (120V 60 Hz) are not in phase. To compensate for this a capacitor is connected between terminals 5 and 7 (of the CA 3059) to delay the trigger pulse.

2. The dynamic range of the circuit was designed so that at a temperature of 25°C the input voltage to the fans would be approximately 60V which would produce half speed, and at 35°C the input voltage to the fans should be 120V - full speed. The 20K ohm potentiometer in one side of the bridge satisfies this requirement.

3. The temperature - speed values given above were used as a typical example. If different ranges are desired, different settings of the potentiometer can be made. Also, for different ranges between the upper and lower temperatures, variations in the circuit can be made. For example, a resistor can be put in series or in parallel with the thermistor.

On the next standard chassis we use requiring fans we will make a standard printed circuit for the above circuit.

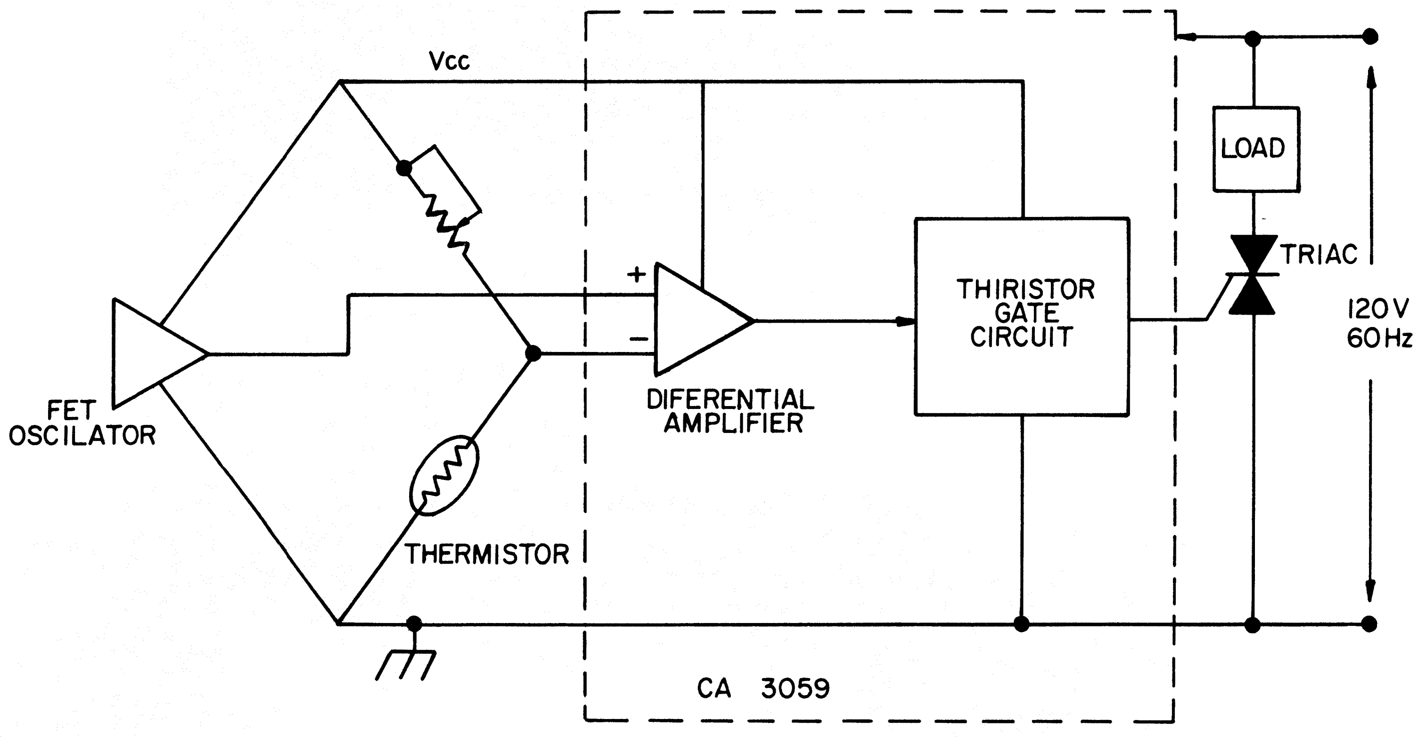

Vcc
LOAD
TRIAC
THIRISTOR GATE CIRCUIT
120 V 60 Hz
+
−
FET OSCILATOR
DIFERENTIAL AMPLIFIER
THERMISTOR
CA 3059

FIG. 1

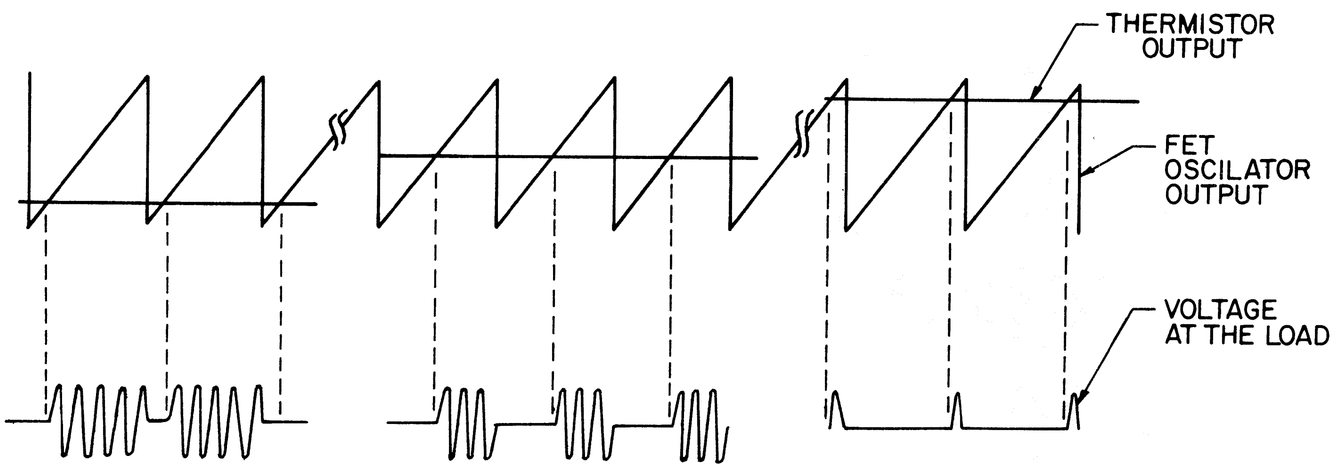
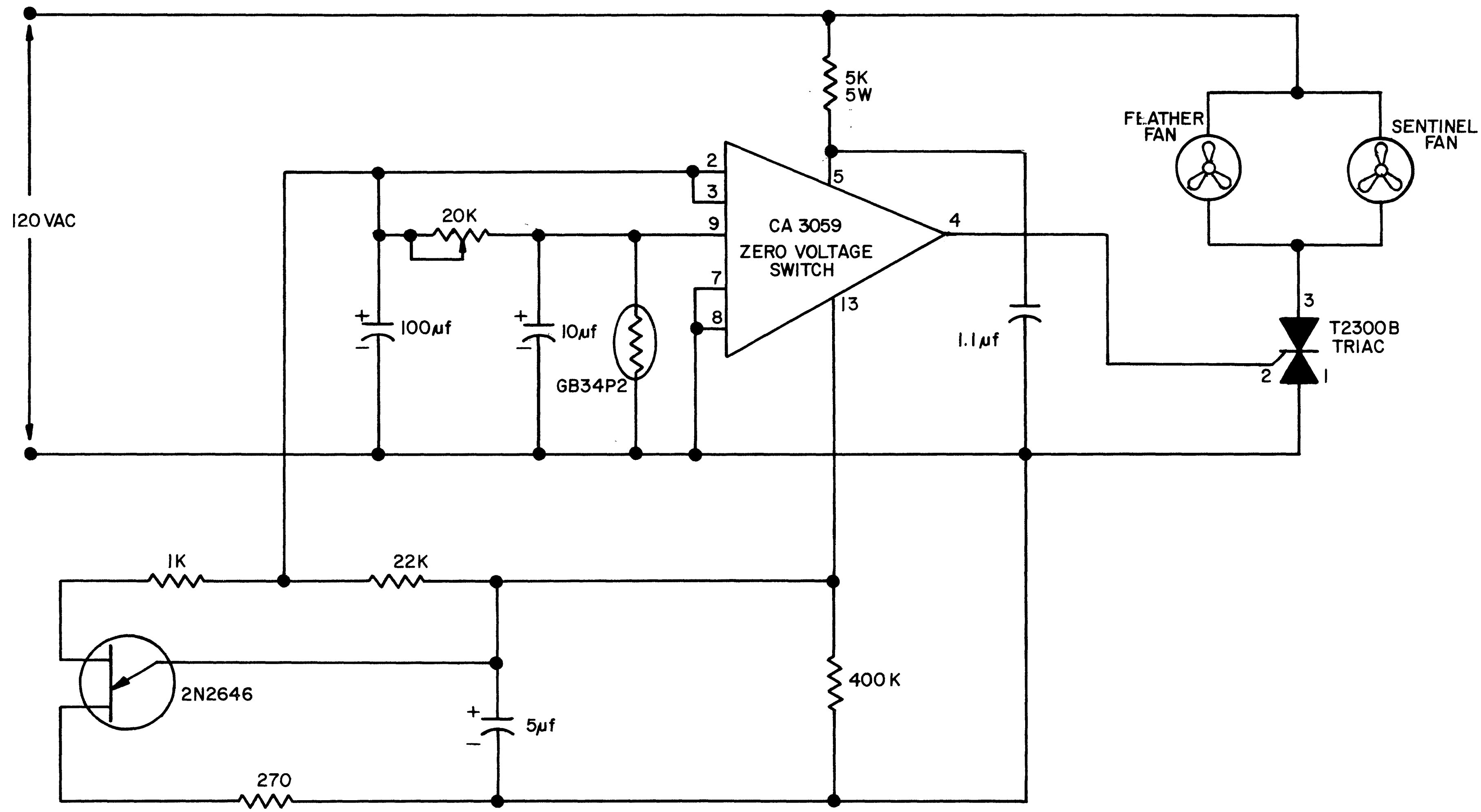

THERMISTOR OUTPUT
FET OSCILATOR OUTPUT
VOLTAGE AT THE LOAD

FIG. 2



FAN MOTOR SPEED CONTROL CIRCUIT
FIG. 3

WAVEFORMS OUTPUTS

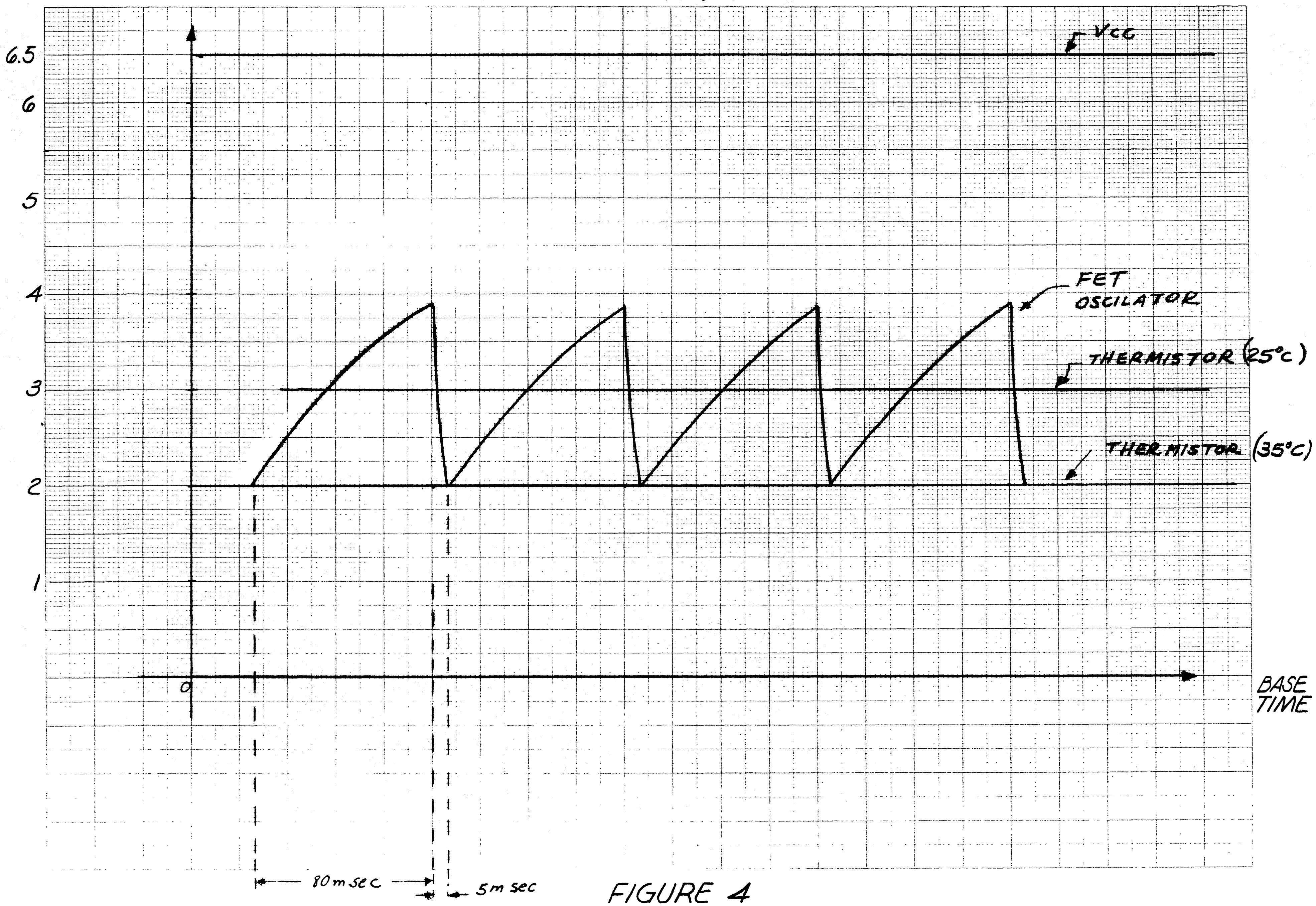


FIGURE 4

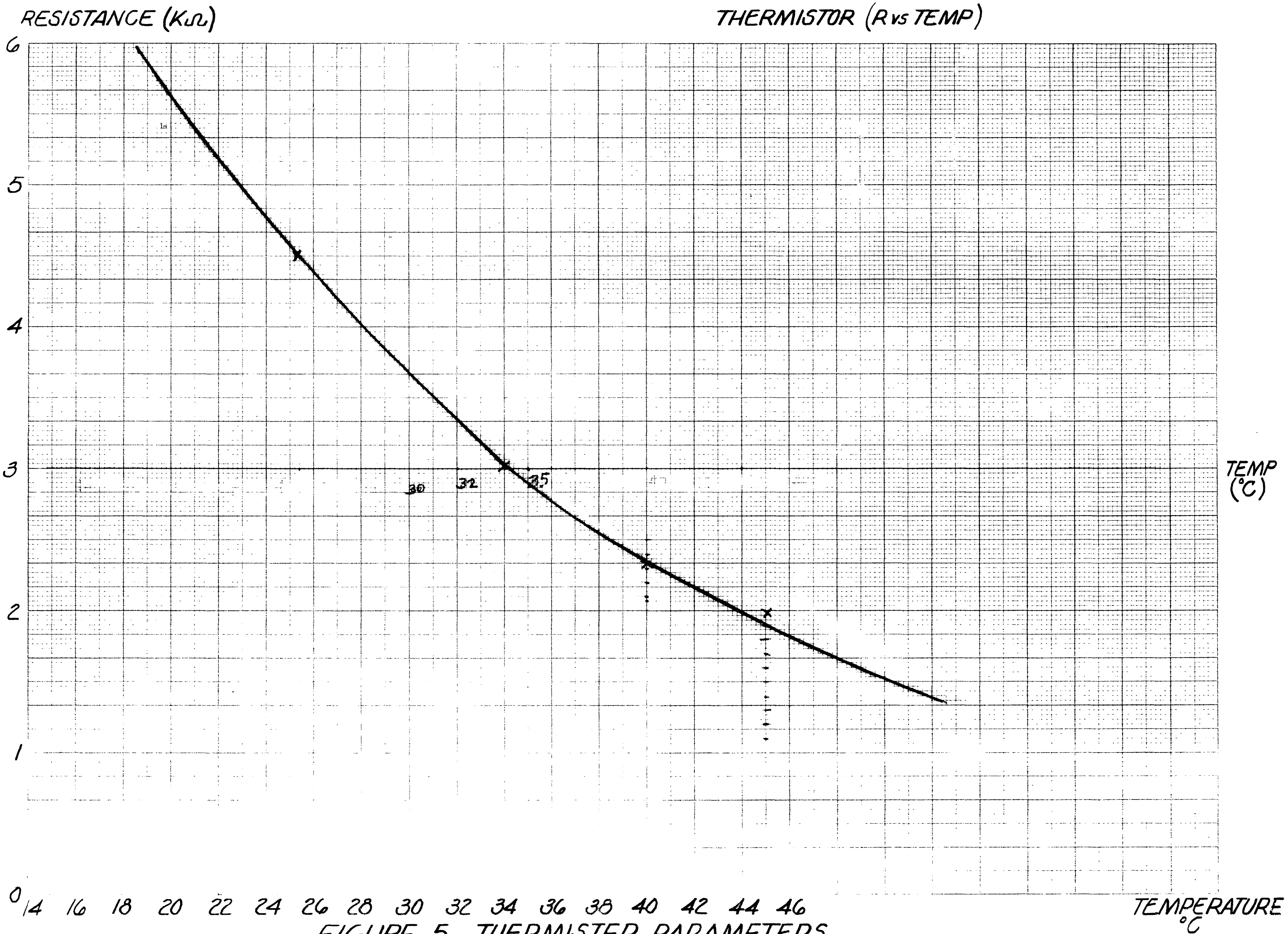
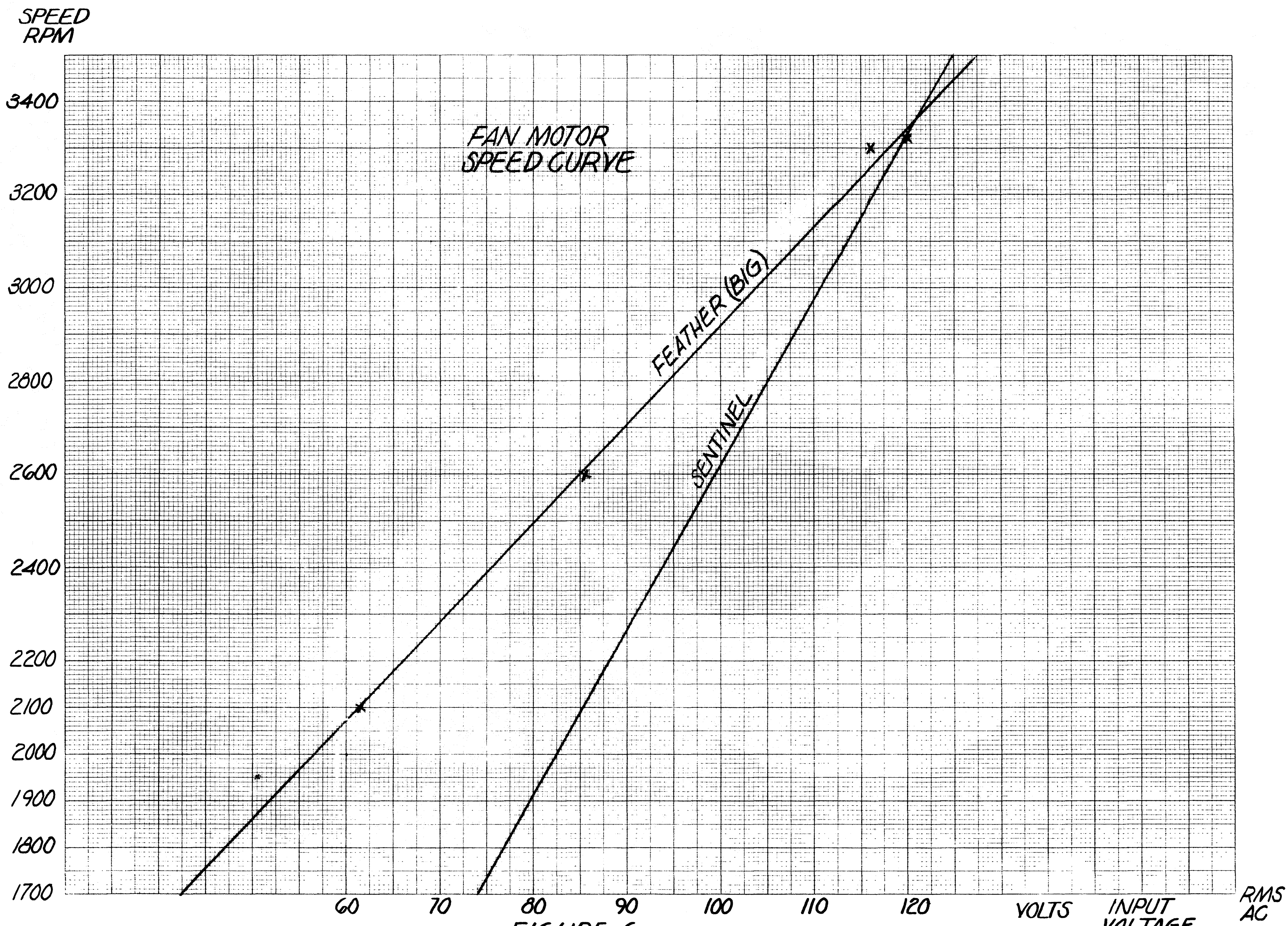


FIGURE 5 THERMISTER PARAMETERS



SPEED
RPM
3400
3200
3000
2800
2600
2400
2200
2100
2000
1900
1800
1700
FAN MOTOR
SPEED CURVE
FEATHER (BIG)
SENTINEL
60
70
80
90
100
110
120
VOLTS
INPUT
VOLTAGE
RMS
AC

FIGURE 6