Thermatic fan controller for a vehicle

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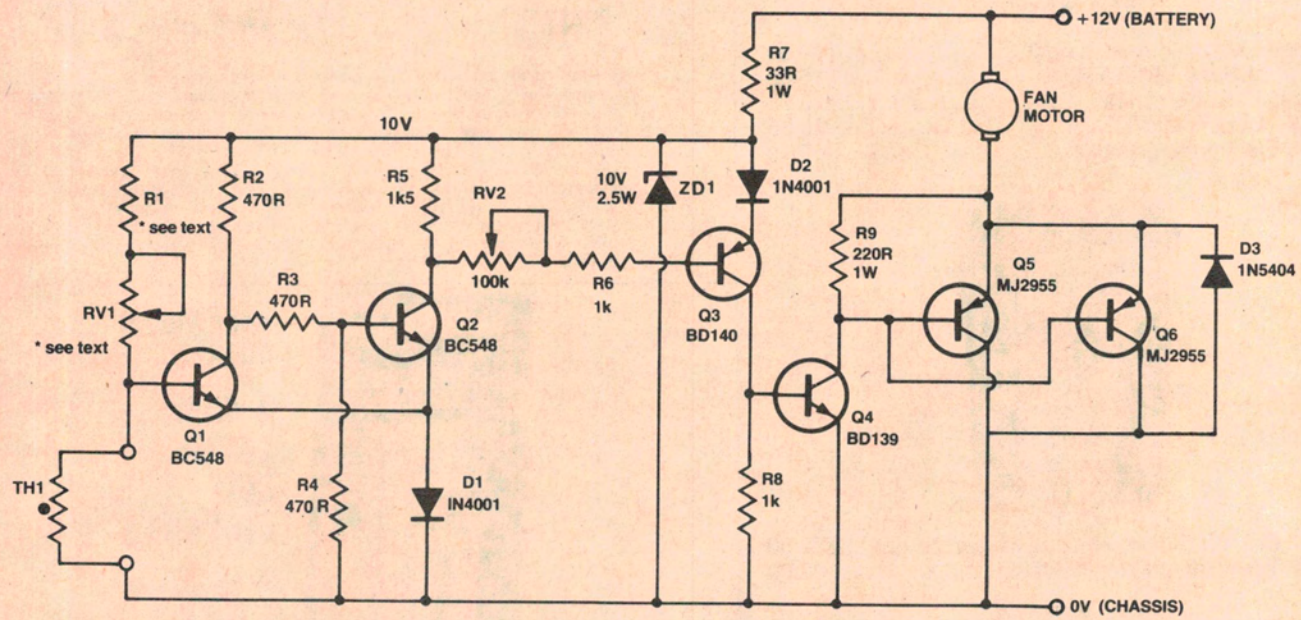

RECENTLY I decided to install a thermatic fan to my car but was dismayed to find that the price was around $80.

This discovery sent me off to the local wreckers where I was able to purchase a fan for $15. Unfortunately, the temperature control for this fan was unsuitable as it was fixed at the wrong temperature and was not adjustable.

I began putting together a few circuits to switch the fan on when the engine reached the desired temperature. Apart from turning the fan on at the right temperature, the circuit would have to turn it off once a predetermined lower temperature had been reached so that the engine would be maintained within its normal operating temperature range. A few circuits I tried had a tendency to 'hang on' past this lower temperature which was definitely an undesirable situation. I eventually solved this problem by using the circuit shown here.

Circuit operation

Engine temperature is sensed by a thermistor, TH1, mounted at a convenient point on the engine block. This thermistor controls a Schmitt trigger (Q1 and Q2) which drives several power transistors (Q5 and Q6), connected in series with the fan motor, via two intermediate stages (Q3 and Q4).

So that the operating points of the Schmitt trigger remain stable despite supply voltage variations (as much as 30% in 12 V systems) the collector supply to Q1 and Q2 is stabilised at 10 V by zener diode ZD1. This also ensures supply line spikes do not cause spurious operation of the fan.

Potentiometer RV1 sets the switch-on temperature while RV2 sets the switch-off temperature.

When the engine is below the required temperature the voltage drop across TH1 should be above 1.2 V. Thus, Q1 will be on and Q2 will be off. As no collector current flows in Q2, Q3 and Q4

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will be off and no base drive will be applied to Q5/Q6. Thus, the latter transistors do not conduct and the fan will be idle.

When the engine reaches the required temperature, the voltage drop across TH1 will fall below 1.2 V (preset using RV1) and Q1 will turn off. Q2 then turns on and base current will be supplied to Q3 via D1, Q2, RV2 and R6, turning Q3 on. This turns Q4 on which applies base drive to Q5 and Q6, turning them hard on, operating the fan.

Diode D3 prevents back-emf spikes from destroying the two MJ2955s when the unit turns them off.

There will be a certain amount of hysteresis in the operation of the Schmitt trigger. However, the collector current in Q2 will vary as Q1 will turn on gradually when the temperature drops below the preset switch-on temperature. Thus the base current to Q4 will vary. The point at which insufficient current is supplied to Q3 can be set by varying RV2.

Construction

The whole unit was constructed in a die-cast aluminium box which was bolted to the vehicle chassis inside the engine compartment. The MJ2955s were mounted directly on the case, no insulation is required as the collectors are connected to 0V in any case. General construction is non-critical. However, I used a pc board and supported it by soldering the common connection copper area to the backs of the pots which were mounted on the box.

The thermistor I used had a resistance of 34 ohms at 77°C (170°F). In general, R1 and RV1 are selected such that the voltage across the thermistor TH1 is 1.2 V when the engine is at its recommended operating temperature (or in the middle of its operating temperature range). Whatever thermistor you use, you will need to know its resistance at that temperature. Knowing this, you can calculate R1 and RV1 as follows:

$R1 = 4 \times R_{TH1}$ (at operating temp.)

$RV1 = 6 \times R_{TH1}$ (at operating temp.)

Having calculated these values, use the component nearest in value above that calculated. The correct setting of switch-on temperature should be within the range of RV1. Values used in my unit were, R1 = 150R, RV1 = 250R.

You will need an engine temperature meter of some sort to set the on and off points correctly.

All resistors should be of the rating specified. Those used around Q1 and Q2 (R1 to R5) may be ¼-watt types, but ½-watt or higher rated types may be more reliable. I did not find it necessary to use low value emitter resistors on the MJ2955s to assist current sharing (though it may be a good idea to match a pair for Vbe . . . Ed.). The current through the fan motor when connected directly across the battery was 8.6 amps. In this circuit it draws 7.7 amps but the loss did not noticeably affect the cooling. ●