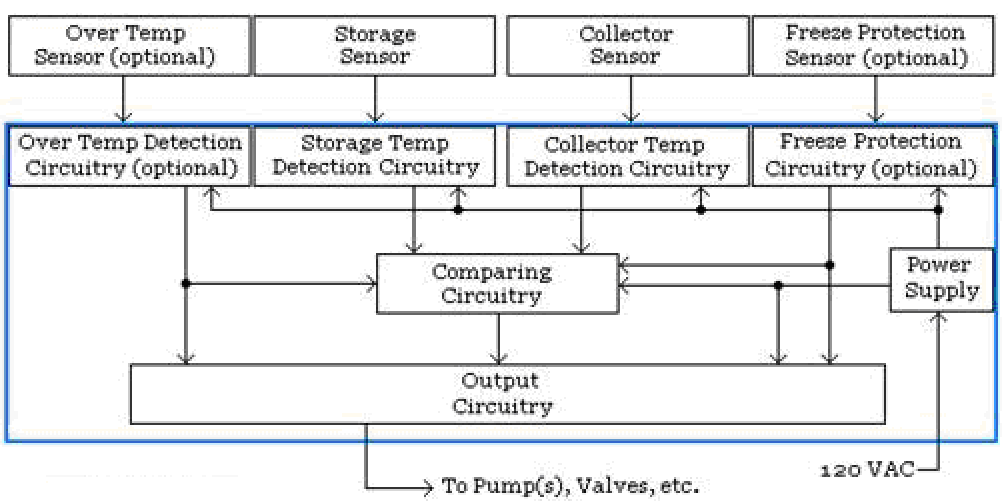
2.3 DIFFERENTIAL TEMPERATURE CONTROLLERS

The controls of any solar heating system can be considered its "brains". With the aid of temperature sensors, it can "see" the temperatures of the panels and storage. It can determine when heat is available for collection and make the decision as to when to start and stop the heat collection process. With the help of actuators such as pumps, fans, valves, and dampers various system operating modes can be dictated by the control system.

The simplest control systems are those used in DHW systems and are usually called differential temperature controllers (DTCs). They are basically a comparing circuit that compares the temperature of the panel to that of the storage. When the temperature of the panel exceeds that of the storage by a set amount, generally 8°F to 20°F, a signal is sent by the DTC to turn on the actuating devices. When the temperature of the panel drops to a temperature that is generally 3°F to 5°F above the storage temperature, the DTC removes the on signal. The collector to storage temperature differential at which the DTC turns on is called the turn on differential temperature, or turn on delta T. The collector to storage temperature at which the DTC turns off is called the turn off differential temperature or turn off delta T. The difference between the turn on and turn off delta T is called the temperature hysteresis.

Figure 10 is a block diagram of a basic DTC. Although

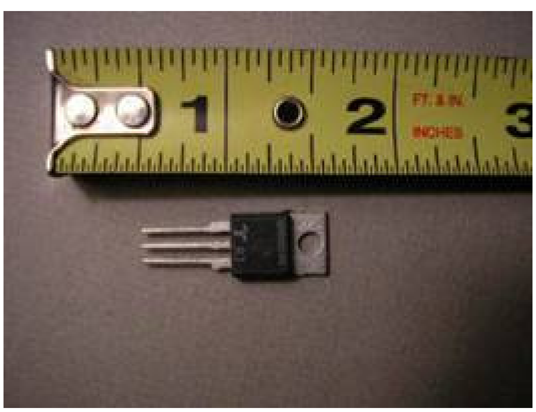


A Block Diagram of a Basic DTC

Figure 10

there are variations to this block diagram, it is basic in nature, and most commercial DTCs in use today use this scheme.

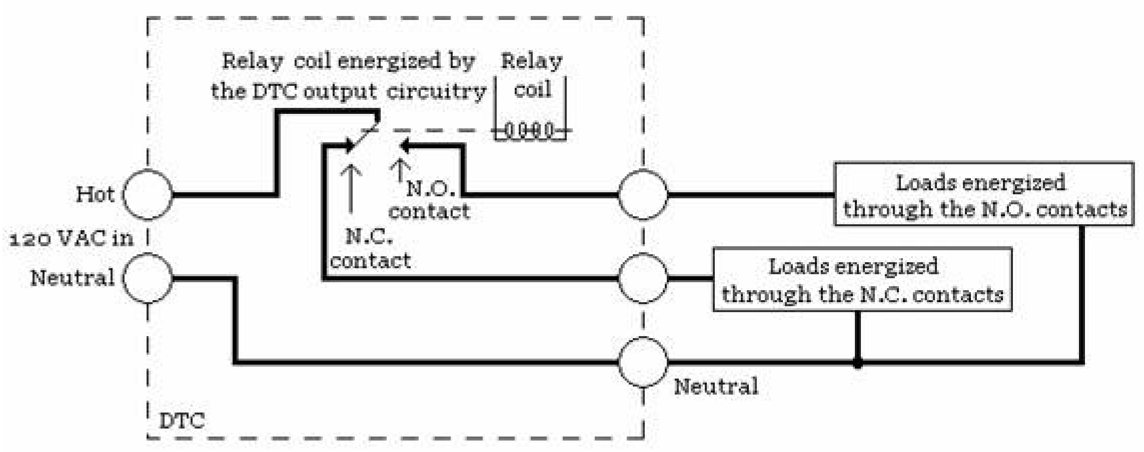
Power is usually supplied to the DTC from 120 VAC household power. The 120 VAC is converted to a lower value DC voltage usable to the solid state electronics within the DTC. This DC power is supplied to the collector temperature detection circuitry and collector sensor. The collector temperature detection circuitry "sees" the collector temperature as an electrical resistance that changes with temperature. As a result of this resistance and DC power supplied to the circuit, a voltage is developed within the detection circuit that is fed to the comparing circuitry. The DC power from the power supply is also supplied to the storage temperature detection circuitry, which operates identically to the collector temperature detection circuitry. The two voltages fed to the comparing circuitry are constantly compared.



Triac
Figure 11

When the comparing circuitry sees that the collector temperature is greater than that of the storage by a set amount, it sends a signal to the output circuitry. The circuitry, depending upon the brand and model of DTC, will (1) switch 120 VAC via a solid state triac (see Figure 11) or relay to the output load, (2) switch a low voltage via a relay to the output load, or (3) energize a relay whose contacts can be wired by the user with whatever power is required for use.

When the output loads are supplied power directly by the DTC, they are wired directly to the DTC output wires or terminals. When the output of the DTC is closure of a set of relay contacts, the wiring to the output is as shown in Figure 12.



DTC Relay Closure Output Wiring

Figure 12

Two additional circuits shown in Figure 10 are the freeze and over temperature protection circuits. Not all DTCs incorporate these circuits, so they are shown as optional. Usually, separate sensors, either resistive or thermal switches, are used for freeze and over temperature protection circuitry, which when activated, will send a signal to the output circuitry. The type of output will depend upon the type of protection the DTC is designed for. Subsequent sections describe the various types of freeze and over temperature protection in general use and the detailed methods of their implementation.

Regardless of the type of output capabilities of the DTC, care must always be taken not to connect loads that exceed the output power rating (capability) of the DTC.