

# DIFFERENTIAL CONTROLS

Differential controls are used in virtually all active systems that use liquid collectors except photovoltaic powered designs. A differential controller uses an electronic comparator circuit which constantly measures the output of two thermistors which are called sensors. The sensors change their resistance upon a change in temperature and the controller turns equipment ( normally pumps and blowers) on and off depending on the **difference** in temperature between the two sensors. This type of control maximizes the efficiency of hot water systems by always transferring energy from the collectors whenever even slight gains are available. Controllers normally turn pumps on when the collector(s) is between 5 and 20 degrees F. above the storage cold water. When the collector temperature falls to between 5 to 10 degrees above the tank cold water temperature the pump turns off. Systems with heat exchangers normally have differentials of about 15 to 20 "on" and 5 to 10 "off ". Direct pump systems have lower differentials since there is no loss through a heat exchanger.

Controllers made today also have a storage high limit of 160 to 180 degrees which is field settable. Many controls also allow for a thermostat to be connected and also have options for digital readouts of collector and storage temperatures.

Swimming pool differentials have very low turn on and turn off differentials and high limits. Typically a 3 to 5 degree turn on and 1 to 2 degree turn off.

## SENSOR RESISTANCE AT DEGREES F. A MULTI-METER IS REQUIRED.

**Resistance in K (1000) Ohms**

**NOTE: Resistance declines as temperature rises - all new controls use 10 K sensors**

TEMP	10K	3K	TEMP	10K	3K
27	39.8	11.9	107	5.0	1.5
32	32.6	9.8	112	4.5	1.4
37	28.3	8.5	117	4.0	1.2
42	24.7	7.4	122	3.6	1.1
47	21.5	6.5	127	3.2	1.0
52	18.9	5.7	132	2.9	0.9
57	16.5	5.0	137	2.6	0.8
62	14.5	4.4	142	2.4	0.7
67	12.8	3.8	147	2.2	0.6
72	11.3	3.4	152	2.0	0.6
77	10.0	3.0	157	1.8	0.5
82	8.8	2.7	162	1.6	—
87	7.9	2.4	167	1.5	0.4
92	7.0	2.1	172	1.4	—
97	6.3	1.9	177	1.2	—
102	5.6	1.7	182	1.1	0.3

## SIMPLE CONTROLS FOR SOLAR DOMESTIC HOT WATER SYSTEMS

