

Setting the differential

It is important to set the proper differential to ensure that the solar heated fluid is still hotter than the storage tank after cooling off slightly in the supply pipe. To set the differential you need to measure the solar fluid temperature at the collector output and at the input to the storage tank. This can be done by measuring the resistance of a temperature sensor at each position and then referring to the chart on page 7. It is best to do this on a winter morning when the temperature difference will be greatest. Typically 5 to 10F will be fine in northern climates.

This procedure can be done with a separate temperature sensor or with the sensors supplied with the controller. A sensor must be disconnected from the controller to be able to have its resistance measured. If you disconnect a sensor from the controller make sure that the pump control switch is in the "ON" position or you may boil the solar fluid. Remember to switch back to "Auto" when finished.

Secure a sensor at the collector, insulate it and with the system operating measure the resistance using a digital meter set on the Ohms scale. Repeat this procedure at the supply pipe just before it enters the storage tank. Refer to chart on page 7 and find the temperatures at each sensor. Set the controller differential to a value a few degrees above the difference between the two values to ensure best operation even on very cold days.

WARRANTY

All ART•TEC products are covered by a 5 year limited warranty. *Please contact us before returning any product.*
<http://www.arttecsolar.com/warranty.htm>

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ART • TEC Solar Differential Temperature Controller DTC-AT Manual



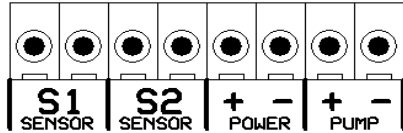
This controller is designed specifically for solar heating applications where the circulation pump is powered by a solar panel or DC power.

The DTC-AT will improve the performance of any DC powered solar heating system. It will switch power to the pump when it determines that one sensor (S1) is hotter than the other (S2). More importantly, it shuts off the pump when the reverse is true.

CONNECTIONS

Mount the DTC-AT indoors where it will be protected from weather.

Remove the cover (4 screws) to access the terminals inside and simply connect power, your pump, and 2 10K temperature sensors.



S1 - collector sensor - 10K thermistor. This sensor reads the temperature of the incoming solar generated heat.

Wrap the sensor with insulation to protect it from ambient temperatures. Solder all wire connections and weatherproof them carefully to prevent corrosion of the connections. **DO NOT** use wire nuts or crimp terminals outside, use heat shrink tubing!

S2 - storage sensor - 10K thermistor reads the temperature of the stored heat. Attach to pipe with a hose clamp, or affix to tank surface and insulate from ambient air.

Try to locate the DTC-AT to minimize the wire length to the sensors. If the wires running to the sensor are more than 6 feet long, they should be twisted as a pair to reduce interference from AC fields, or use pre-twisted wire. Solder and insulate all exterior wire connections with heat shrink tubing.

POWER - connect to solar panel, battery or any 12 to 24VDC source.

Use at least 18 gauge wire for up to 20 foot runs, heavier wire for longer runs. Outdoor wiring should be rated for exterior use. Observe polarity, reverse connections can damage the controller.

PUMP - 12V or 24DC. Observe polarity or the pump will run backwards.

Pump must only be connected to the PUMP terminals and never to the POWER terminals. The DTC-AT will operate from 3.5 to 30 Volts and power a pump rated up to 6 Amps (72 Watts at 12 Volts). Most pumps will begin to operate at 4 Volts.

Temperature to resistance chart for 10K sensors.

°F	OHM	°F	OHM	°F	OHM	°F	OHM	°F	OHM
0	85,387	50	19,900	100	5,827	150	2,044	200	829
1	82,719	51	19,377	101	5,697	151	2,005	201	815
2	80,142	52	18,870	102	5,570	152	1,966	202	802
3	77,656	53	18,377	103	5,446	153	1,929	203	788
4	75,255	54	17,899	104	5,326	154	1,892	204	775
5	72,937	55	17,435	105	5,208	155	1,856	205	763
6	70,698	56	16,985	106	5,094	156	1,821	206	750
7	68,535	57	16,548	107	4,982	157	1,787	207	738
8	66,447	58	16,123	108	4,873	158	1,753	208	726
9	64,428	59	15,711	109	4,767	159	1,720	209	714
10	62,479	60	15,310	110	4,664	160	1,688	210	702
11	60,595	61	14,921	111	4,563	161	1,657	211	691
12	58,774	62	14,543	112	4,464	162	1,626	212	680
13	57,014	63	14,176	113	4,368	163	1,596	213	669
14	55,313	64	13,820	114	4,274	164	1,567	214	658
15	53,669	65	13,473	115	4,183	165	1,538	215	648
16	52,078	66	13,136	116	4,094	166	1,509	216	637
17	50,541	67	12,809	117	4,007	167	1,482	217	627
18	49,054	68	12,491	118	3,922	168	1,455	218	617
19	47,616	69	12,182	119	3,839	169	1,428	219	607
20	46,225	70	11,882	120	3,758	170	1,402	220	598
21	44,879	71	11,589	121	3,679	171	1,377	221	588
22	43,577	72	11,305	122	3,602	172	1,352	222	579
23	42,318	73	11,029	123	3,527	173	1,328	223	570
24	41,099	74	10,761	124	3,454	174	1,304	224	561
25	39,919	75	10,500	125	3,382	175	1,281	225	553
26	38,777	76	10,246	126	3,312	176	1,258	226	544
27	37,671	77	9,999	127	3,244	177	1,235	227	536
28	36,601	78	9,758	128	3,177	178	1,213	228	527
29	35,565	79	9,525	129	3,112	179	1,192	229	519
30	34,561	80	9,297	130	3,049	180	1,171	230	511
31	33,590	81	9,076	131	2,987	181	1,150	231	503
32	32,648	82	8,861	132	2,926	182	1,130	232	496
33	31,737	83	8,651	133	2,867	183	1,110	233	488
34	30,853	84	8,447	134	2,809	184	1,091	234	481
35	29,998	85	8,249	135	2,752	185	1,072	235	473
36	29,169	86	8,056	136	2,697	186	1,054	236	466
37	28,365	87	7,867	137	2,643	187	1,035	237	459
38	27,587	88	7,684	138	2,591	188	1,017	238	452
39	26,832	89	7,506	139	2,539	189	1,000	239	445
40	26,100	90	7,333	140	2,489	190	983	240	439
41	25,391	91	7,164	141	2,440	191	966	241	432
42	24,704	92	6,999	142	2,392	192	950	242	426
43	24,037	93	6,839	143	2,345	193	933	243	420
44	23,391	94	6,683	144	2,299	194	918	244	413
45	22,764	95	6,530	145	2,254	195	902	245	407
46	22,156	96	6,382	146	2,210	196	887	246	401
47	21,566	97	6,238	147	2,167	197	872	247	395
48	20,993	98	6,097	148	2,125	198	857	248	390
49	20,438	99	5,960	149	2,084	199	843	249	384

FEATURES

- Operates from 3.5 to 24 Volts. *30V MAX!*
- Uses standard 10K thermistor temperature sensors
- Manual override switch has ON/AUTO/OFF to simplify testing
- Adjustable differential temperature (4 - 32F)
- Adjustable MAX TEMP shut down/warn (80 - 200F)
- Green LED pump run indicator
- Red over temp warn indicator
- Switches up to 6 Amps (72 Watts)
- Replaceable 6 amp 3AG type fuse inside
- Built in surge protection protects electronic motors
- Ambient Operating Temperature 32 - 158F (0 - 70C)
- Under 3mA power consumption (when load is off)

PV powered pumps

There are basically 2 types of DC pumps used in solar heating. Regular DC pumps made by March etc. and electronic pumps like the EI-Sid and Laing Eco-Circ.

It is recommended that if you live north of Florida that you use a panel with twice the wattage of the pump, e.g. 20 Watt solar panel for 10 Watt pump. This ensures optimal performance early and late in the day.

An option for DC pumps is to use a power optimizer like the PPT line of products made by Solar Converters. These units can let you use a smaller PV panel for the pump. The disadvantage is these devices will start a pump in lower light, which makes the DTC-AT even more necessary!

Surge Protection is Built in

Note that the DTC-AT contains a surge protector which will protect the electronic motors and other electronics like power optimizers. Any voltage over 40 Volts will be clamped inside the DTC - and shorted back to the PV panel.

DC power sources

The power input to the DTC-AT can come from any source of DC voltage including a solar panel, battery or a wall power adapter (wall wart). If powering a 10 Watt pump the wall wart should be sized about double the wattage of the pump. So a 10 Watt pump would need a 12 Volt 1.5 Amp adapter.

CONTROLS



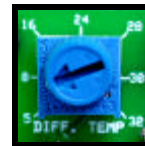
ON - pump is always on.

AUTO - load only powered if S1 is hotter than S2.

OFF - load is off.

The switch is intended primarily for testing, and should be left in the AUTO position for normal operation. The green LED will light to let you know when the load should be operating. When replacing the cover - be sure that the LED aligns with the hole in the cover.

DIFFERENTIAL TEMPERATURE

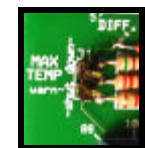


The upper knob adjusts the differential temperature trip point. S1 must be hotter than S2 by the differential before the pump will activate. The range is from 5 to 32 degrees Fahrenheit. Factory default is 5F. See page 8.

STORAGE MAX TEMP WARN/SHUT DOWN



This feature can either warn of a storage over temp condition, or it can also shut off the pump. One can determine the approximate temperature of the tank by turning this knob until the light just comes on and reading the knob scale.



A jumper (J1) is located at the left side of the circuit board. If it is placed HORIZONTALLY so that it overlaps the -warn- text then it will warn by lighting the red indicator only. This is the factory default setting. If the jumper is placed VERTICALLY so that it bridges the 2 pins parallel to the -shut down- text then the pump will shut down as soon as S2

(storage) temperature exceeds the MAX TEMP set point, the red indicator will also light. This setting ranges from 80 to 200F.

MAX TEMP WARN/SHUT DOWN Continued

You must use care in deciding how to use this feature as single pumped glycol systems should never be shut off when in full sun or the collector will stagnate and compromise the antifreeze mixture.

This feature can be used with double pumped systems to disable the secondary pump (heat exchanger to storage).

It can also be used in plain water systems such as batch heaters so long as pressure venting is designed into the system.

If you are not completely clear about how shutting off the circulation pump may impact your system, then do not use the shut down feature.

TROUBLESHOOTING

- If the pump run indicator is on, but the pump is not running, check the fuse.
- If the red over temp indicator is on and the J1 jumper is in the *shut down* position then the pump has been disabled - this is normal.
- Check pump wiring, and polarity.
- Check to ensure that there is light on the solar panel, most pumps will not operate/start at low voltages, however the indicator light will come on at 3.5 Volts.
- Check the PUMP switch, switch it to ON to see if pump runs, and OFF to be sure it does turn off. Leave it on AUTO for normal operation.
- Check for at least 4 Volts at the POWER terminals.
- If the red *over temp* indicator is on AND the *pump run* indicator is ON then the storage tank is above the MAX TEMP set point and your tank may be overheating.
- Are the sensors correctly installed? Remove the sensor wires and test for resistance, it should read 10K Ohms at 77F, or higher resistance at lower temperatures and lower resistance at Higher temperatures. E.G. 200F = 829 Ohms and 50F = 19.9K Ohms.

Sensor location

Pressurized glycol systems.

On single pumped systems (where the heat exchanger is inside the storage tank) the collector (S1) sensor should be mounted to the pipe within 6" of the exit at top of the collector. This ensures a rapid response.

On double pumped systems where one pump circulates the collector to HX and another circulates from HX to storage, the collector (S1) sensor should be attached to the pipe that comes from the collectors about 2-3 feet before it enters the heat exchanger. The DTC-AT should then be used to switch the secondary pump.

The storage sensor (S2) should be located where it measures the lowest temperature of the stored water. This can be the pipe that returns to the heat exchanger from the storage tank, or if you can access the surface of the tank, then attach the sensor to the tank wall near the bottom.

Be sure the sensors are insulated from exposure to ambient air, since this will affect the reading. On pipe runs the sensors can be attached with a pipe clamp and wrapped with insulation.

Drain back systems

The DTC-AT can be used with drain back systems, however an external timing relay may be needed to shut off the high head pump once circulation has been achieved.

High Power pumps

For larger pumps that exceed the 6 Amp capacity of the DTC-AT, an external solid state relay is required. Mechanical relays should not be used as they will not turn on at the lower voltages put out by the solar panel.