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SimpleDTC Differential Temperature Controller Features

**Inputs:** Two (2) temperature sensor inputs + 1 onboard temperature Sensor

Uses NTC 10K sensors

**Outputs:** Two (2) dry relay contact outputs (with N.O, COMMON contacts) (120VAC/30VDC, 5 amps breaking).

**Universal Power Input:** DC: 8–32 VDC or 12-24VAC power input : approx 1.0W maximum power consumption with both relays active. Can be used on solar only systems.

**Supported Control Modes:** Differential Heating/Cooling, Heat / Cool Thermostat, ON/OFF

**Connectivity:** Screw terminals for all inputs, outputs, and power connections for ease of installation and maintenance.

**Display & HMI:** 3 Digit 7 SEGMENT Display, 4 capacitive pushbuttons for operation, configuration, and status monitoring via the display.

**Programmable:** The SimpleDTC is fully programmable with FLASH memory configuration backup for automatic power restarting with no configuration necessary. Real time monitoring of the controller operation, temperature inputs values and historical Hi/Low temps, and relay states are provided on the display.

**Mounting:** The SimpleDTC controller can be mounted via a DIN rail with an optional DIN rail installation kit.
Block Diagram


Board Size: 3.25” x 3.25” x 1”

General Description
The SimpleDTC Differential Temperature Controller is a full featured two output temperature controller with the ability to control two temperature control loops simultaneously.

It has two external temperature sensor inputs that support many common 10K NTC temperature sensors to make it extremely flexible and simple to retrofit older temperature controllers. The controller itself has one onboard temperature sensor that can be used as well. The controller is optimized to use the sensors sold with the controller and these will be the most accurate.

The SimpleDTC supports a wide range of power inputs. It can be powered from 12V - 32V nominal DC power or 12VAC - 24VAC AC power. It can also be powered directly from a solar panel so long as VOC of the panel < 32VDC.

Configuration and monitoring of the controller is extremely easy. You can configure the controller by using the touch buttons and 7 segment display. Nothing external is needed for programming.

The SimpleDTC has two independent output relays that can switch either DC or AC loads (upto 30VDC or upto 120VAC, 5 Amps).
Applications of SimpleDTC Differential Temperature Controllers

Solar Hot Water / Solar Air Heating, Root Cellar and Attic Cooling - Differential Temperature Control – Fully Configurable with DeltaT On / Off, HIGH/LOW shutdown temperatures for controlling temperature maximums and minimums, and freeze protection options. The controller is configurable for either heating or cooling modes of differential control.

Thermostat Heat / Cool Control – Fully Configurable thermostat with set point and dwell adjust, industrial temperature range (-30F - 257F). Use for Heat dump control on solar hot water systems, heating calls for solar hot water systems, etc.

Configurable Control - All parameters of the controller can be configured and monitored on the display. Configuration settings are stored in non-volatile memory and reloaded automatically at power up.
Touch Buttons
The SimpleDTC has 4 touch buttons along the bottom of the printed circuit board. These are used to configure the controller and monitor its operation. Touching them with a finger for about a second activates the button.

1. **STATUS / CONFIG Button** - Pressing this button will take you to the main menu where you can select to either monitor the temperatures and relay status of the controller during operation by choosing the “Sho” selection; or configure the controllers two configurable relay ports by choosing the “Con” selection. Additionally you can choose the “HLS” selection to view the high and low temperatures recorded since the last view of the menu. The choices are selected by using the UP and DOWN arrow buttons to choose and the ENTER to go to the selection.

2. **ENTER Button** - This button is used to accept the current displayed option or updated values you’ve selected. Normally the ENTER button is used after selecting a parameter with the UP and DOWN adjustment arrow buttons.

3. **UP / DOWN Arrow Buttons** - These buttons are used to adjust and select parameter choices. Use these buttons to choose menu options or adjust values.
Configuring the Controller

The SimpleDTC supports 6 different programmable control modes for each relay. Any mode can be selected for either relay from the “Con” menu.

From the “dsp” : Display Modes : after pressing the setup / status button you should see the dsp message. To enter configuration mode, select “Con” with the arrows and <ENTER> to enter configuration mode.

Once in Configuration mode, the controller will display “Pr=” followed by a selection field for selecting which relay you wish to configure. Use the <ARROWS> to select either RL1, or RL2 to select configuration of RELAY 1 or RELAY 2 operation.

After selecting which relay to configure, you will be able to select the function of that relay. The display will show “Fn=” followed by six selectable options. The options for controlling each relay are shown below along with their configurable variable options.

1. **Force Off** (Off): This control mode will keep the relay off all the time.

2. **DeltaT Heat** (dH): This control mode is used for solar hot water and solar air heating using differential control. Anytime you want to collect and store heat, use this mode
   a. Heating Sensor: **The controller will use S1 input for the heating sensor**.
   b. Heat Storage Sensor: **The controller will use S2 input for the heat storage sensor**.
   c. “dn=”: **DeltaT On**: Use this variable to set how many degrees hotter the heating sensor is than the heat storage sensor before turning on the relay. Setting to higher values will reduce short cycling the pump. The value you set here must be greater than the DeltaT Off value to function. Range: 2-99 degrees.
   d. “dF=”: **DeltaT Off**: Use this variable to set how many degrees hotter the heating sensor is than the heat storage sensor before turning off the relay. This is normally set to a low value and is used to account for losses between the collector and the tank. The value you set here must be less than the DeltaT On value to function correctly. Range: 1-9 degrees.
   e. “HS” : **Maximum Storage Temperature**: Use this variable to set the maximum temperature you want your heat storage to get. For air heating this might be 80F, for a steel water tank this could be 180F depending on your application. When the Tank is greater than this setting, the relay will not turn on. It will keep it off until temperature on storage drops below Max storage temperature - 3F. Range: 0-255 degrees.
   f. “FP=” : **Freeze Protect**: This setting (when set for YES) will turn on the output relay when the heating sensor gets below 34F. Mainly used for non-drainback systems to protect against freezing pipes. Range: YES (ON), NO (OFF)
3. **DeltaT Cool**: This control mode is used for root cellar and attic cooling using differential control. Anytime you want to collect and store cold, use this mode.
   a. Cooling Sensor: The controller will use S1 input for the cooling sensor.
   b. Cool Storage Sensor: The controller will use S2 input for the cool storage sensor.
   c. “dn=: DeltaT On : Use this to set how many degrees cooler the cooling sensor is than the cool storage sensor before turning on the relay. Setting to higher values will reduce short cycling the pump. The value you set here must be greater than the DeltaT Off value to function properly. Range: 2-99 degrees.
   d. “dF=: DeltaT Off : Use this to set how many degrees cooler the cooling sensor is than the cool storage sensor before turning off the relay. This is normally set to a low value and is used to account for losses between the collector and the tank. The value you set here must be less than the DeltaT On value to function correctly. Range: 1-9 degrees.
   e. “LS=: Lowest Storage Temperature: Use this to set the minimum temperature you want your cool storage to get. For root cellar cooling this might be 40F. When the cool storage is less than this setting, the relay will not turn on. It will be reenabled when the cool storage temperature > Low Storage Temp + 3 degrees. Range: 0-255 degrees.

4. **Heat Thermostat (HE)**: This control mode is used for heat thermostat. Anytime you want to keep something hotter than a setpoint temperature by controlling a heating source.
   a. “Sr=: Temperature Input Sensor: This allows you to choose which temperature sensor input will be used for monitoring the thermostat temperature. Range: S1, S2, SL input
   b. “SP=: Setpoint Temperature: This parameter is set to the desired setpoint temperature for the thermostat. Range: -30 - 257 degrees
   c. “HS=: Hysteresis: Use this to control how much hysteresis used with the setpoint. When set to a value > 0, this will keep the heating on past the setpoint by the hysteresis value. Can be used to reduce short cycling. As an example if setpoint is 50 and hysteresis is 5, controller will turn on at 51 and turn off at 45. Range: 0-99 degrees.

5. **Cool Thermostat (CL)**: This control mode is used for cool thermostat. Use this anytime you want to keep something cooler than a setpoint temperature by controlling a cooling source.
   a. “Sr=: Temperature Input Sensor: This allows you to choose which temp sensor input will be used for monitoring the thermostat temperature. Range: S1, S2, SL input
   b. “SP=: Setpoint Temperature: This parameter is set to the desired setpoint temperature for the thermostat. Range: -30 - 257 degrees
   c. “HS=: Hysteresis: Use this to control how much hysteresis temperature. When set to a value > 0, this will keep the heating on past the setpoint by the hysteresis value. Can be used to reduce short cycling. As an example if setpoint is 50 and hysteresis is 5, the controller will turn on at 51 and turn off at 45. Range: 0-99 degrees.
6. **Force On**: This control mode is used to keep the relay on all the time that proper power is applied to the controller.

**After setting all the parameters for a given relay control mode, the controller will display “SAP”:** Saving All Parameters. This is when the controller stores the new control parameters in non-volatile memory and the settings are saved. Upon turning off and turning back on power, the previously saved settings will remain active.

### Displaying Status Information for the Controller

From the “dsp” : Display Modes : after pressing the setup / status button you should see the dsp message. To enter Status Display mode, select “Sho” with the arrows and <ENTER> to enter Status mode.

The “Sho” selection will continuously cycle thru the following display parameters:

- S1= label for sensor 1 reading
- <Current Temperature of Sensor 1>
- S2= label for sensor 2 reading
- <Current Temperature of Sensor 2>
- LS= label for local on board temperature sensor
- <Current Temperature of local temperature sensor>
- r<X: relay state 1><relay state 2>: Current relay state for relay 1 and relay 2. Values are ‘0 or 1’ meaning relay OFF (0) or ON (1)

REPEAT from TOP of list

To Exit this menu press the SETUP / CONFIG Button.

### Displaying High and Low Temperature Data on Controller

From the “dsp” : Display Modes : after pressing the setup / status button you should see the dsp message. To enter High/Low Display mode, select “HLS” with the arrows and <ENTER> to enter High Low Temperatures display mode.
The “HLS” selection will cycle thru the following temperature sensor historic data

“H1=” label for sensor 1 high temperature

<Highest Temperature of Sensor 1 since last read>

“H2=” label for sensor 2 high temperature

<Highest Temperature of Sensor 2 since last read>

“HL=” label for local temperature sensor high temperature

<Highest Temperature of local sensor since last read>

“L1=” label for sensor 1 low temperature

<Lowest Temperature of Sensor 1 since last read>

“L2=” label for sensor 2 low temperature

<Lowest Temperature of Sensor 2 since last read>

“LL=” label for local temperature sensor low

<Lowest Temperature of local sensor since last read>

“CLr” - The controller resets the HI/Lo Temps to current temps

After displaying the “CLr” message, the controller will return to the main menu. The controller will automatically enter the status display mode after about 4 minutes of inactivity. Press the SETUP/CONFIG button at any time to change the display mode.
In this example relay 1 is configured for DeltaT Heating and controls a pump for a solar hot water heating system. Relay 2 is configured for a simple Heat Thermostat call for controlling a pump to move hot water thru a radiant floor. It uses the local temperature sensor for the setpoint HEAT call.
Installation Information

Always connect the power to the unit last. Always disconnect power to the unit first before servicing or changing wiring. It is important to remember that power from external power supplies may be present on the output contact even when the device is not powered since they are generated external to the device. **Ensure output wiring is powered down before working on!!!**

First, Connect Sensor Wiring:

**Input Sensors:** Connect external temperature sensors to any available S1-S2 input first. If you need to extend the temperature sensor wiring, use a twisted pair type wire like telephone line or Ethernet cable if available. Generally extending sensor wiring up to 100 ft is ok and will not result in appreciable error. Passive sensors have no polarity and can be connected in any orientation to a single input pair.

Do not bridge sensor inputs to multiple devices. Sensors should only be tied to one controller at a time.

**Once the controller is in operation, if you see “OPn” or “CLd” for the temperature status, that is indicating that the controller is measuring the sensor as either OPEN (not connected) or CLOSED (SENSOR input appears shorted). Check for loose wiring or shorts if this occurs.**

Second, Connect Output Wiring:

Always disconnect and unplug all power wiring to any load device before connecting!!! Use output fuses in-line with each output load to protect end equipment and controller from shorts at the load. Verify all
wiring connections to load devices before powering any circuits. Consult local code requirements and wiring requirements. The N.O. terminal is “normally open” with no power connected.
When the controller turns on a relay, the N.O. pin will be connected to the C pin (Common).

When the controller turns off a relay, the N.O. pin and C pin (Common) will be disconnected.

All Relay pins are dry contact (no electrical power present) when disconnected.

For switching power to loads, connect external power to the center C pin. Connect the N.O. pin to the load device power input pin. When the relay is turned on, the relay will close and power will go to the load device (pump, fan, etc) and turn it on.

Third, Connect Power to Power Input:

The SimpleDTC power input supports both DC and AC input voltages. 8-32VDC input power as well as 12-24 VAC input power. The unit is low power, requiring less than 1W of power to operate. The power input is on the left two screw terminals. The power input has a bridge rectifier so you can’t connect up the power wiring backwards so long as you only use the two power input pins.

Note: If you are using the same power supply for DC load devices, do not use the power ground connection wire for the load return wire. Always use separate wires for output load grounds and input power.

Verify your power supply meets the requirements with a meter before connecting to controller input. It’s good practice to use a switch and fuse to connect power to the unit.

This controller will operate off of a solar panel. Verify the VOC max of your panel is < 32VDC before using. 12VDC solar panels should all work, with 24VDC panels, verify VOC max rating before using. If
using solar power with a battery, connect the controller to the 12V or 24V battery directly with separate wires. **Do not attach power input to the charging output of a PWM controller as this may damage the controller.**

After applying power to the unit, it will initialize and go thru a diagnostic commissioning phase before it begins operating and controlling the outputs. There is about a 30 second lag between initial power up and actively controlling the relays. This protects against clattering relays during periods of low solar power when the controller can shutdown and restart due to insufficient power on the input.
SimpleDTC Board Physical Dimensions

The SimpleDTC is approx. 3.25 x 3.25 x 1 inches
Side view of controller showing optional DIN clip connected to a DIN rail.

The DIN rail clips can be used to hang the controller on a DIN rail. The din rail kit consists of two clips, screws and a small piece of DIN rail. In this picture the din rail has been mounted to a small electrical box. (Note: I realized after the photo was taken that the clip shown is upside down. The clip is made to hang on the top rail with the thicker part of the clip. FYI) When installing, hang the clip on the top rail, then swing the controller down and push near the bottom of the board to capture the DIN clip onto the bottom rail. You should hear a “Click”.
Mounting Enclosure Ideas

Using the optional DIN rail kit, it’s easy to mount the controller in an off the shelf AC disconnect box from Lowes / Home Depot. Simply take the fuse holder and block out with a nut driver / screwdriver and then mount the DIN rail to the case. These make safe enclosures and are very cost effective (< $10). You can also just screw the PCB to a wood board with a rubber mount underneath the board using the available mounting holes on the side.
Hardware / Electrical Specifications

**Power Input:**
- **Power Input (DC/AC):** 8-32.0 VDC, 12-24VAC nominal
- **Power Consumption:** ~1W max with all relays on, 0.3W with relays off

**Inputs - Temperature Inputs (S1, S2):**
- **Temperature Inputs:** 10K NTC Type2
- **Temperature Sensor Range:** -30F – 257F

**Outputs - Dry Relay Contacts, 2 Contacts (N.O,COM.) (R1-R2):**
- **Dry RELAY Contact Output (R1-R2):** 5 Amp Continuous, 30VDC Max DC Voltage, 120VAC Max AC Voltage

**HMI LED Display and Touch Pushbuttons:**
- **Display Type:** 3 Digit 7 segment LED display
- **Touch Buttons (Capacitive) - 4 buttons:** Touch for approx 1 seconds to activate

**Environmental Specifications:**
- **Operating Temperature:** -30C – 65C
- **Storage Temperature:** -40C – 85C
- **Relative Humidity:** 1 – 99%, non-condensing

**Screw Terminal Specifications:**
- **Wire Gauge:** 14-26 AWG
- **Current:** 10A
- **Voltage:** 300V
ORDERING INFORMATION

See www.mydtcstore.com for ordering information and pricing.

WARRANTY

The SimpleDTC controller comes with a 1 year warranty. We service what we sell.

Contact smith100griggs@gmail.com by email for warranty service.

Warranty is null and void if the unit has been modified in any way.
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