The Difference Setpoint Control 155 is a microprocessor-based control that allows the transfer of heat from a source to a storage tank whenever the temperature difference between the two is greater than the selected $\Delta T$ setpoint. Additional setpoints are also included to help prevent the storage tank from overheating or the source from freezing. Both drainback and draindown systems can be used with this control.

Several displays provide a variety of useful information. The control can display the Maximum and Minimum temperatures measured by both the Storage and Source sensors as well as the total heat transferred from the source to the storage.

- **New Solar Sensor 085 immersion type sensor included!**

### Sequence of Operation

**Powering up the control**

After the Difference Setpoint Control 155 is powered up, the LCD segments are turned on for 3 seconds.

**$\Delta T$ Setpoint**

The control measures the difference between the Source and the Storage temperatures ($\Delta T$). When this $\Delta T$ is greater than the $\Delta T$ setpoint, Relay 1 is turned on to transfer heat from the source to the storage. If the $\Delta T$ drops below the $\Delta T$ setpoint less the $\Delta T$ differential, Relay 1 is turned off.

**Maximum Storage Setpoint**

If the Storage temperature rises above the Maximum Storage setting, Relay 1 is turned off. This relay remains off until the Storage temperature drops below the Maximum Storage setting less its differential.

**Minimum Source Setpoint**

If the Source temperature drops below the Minimum Source setting, Relay 1 is turned off. This relay remains off until the Source temperature rises above the Minimum Source setting plus its differential.

**Draindown**

When the DIP switch is set to draindown, Relay 2 is closed until the Source temperature drops below the Minimum Source setting. If Relay 2 is connected to a drain valve, the heat transfer fluid can be drained from the source when Relay 2 is opened. Once the Source temperature rises above the Minimum Source setting plus the Minimum Source Differential, Relay 2 is closed and the control continues with $\Delta T$ setpoint operation. See the Application Brochures A 155 for the correct wiring of Relay 2.

**Drainback**

If the DIP switch is set to drainback, Relay 2 is turned on (closed) for 3 minutes whenever Relay 1 is turned on. Relay 2 is typically connected to a booster pump to overcome gravity head and prime a siphon.

### Installation

**Caution:** Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury. It is your responsibility to ensure that this control is safely installed according to all applicable codes and standards. This electronic control is not intended for use as a primary limit control. Other controls that are intended and certified must be placed into the control circuit.

**Step One: Getting ready**

Check the contents of this package. If any of the contents listed are missing or damaged, please refer to the Limited Warranty and Product Return Procedure on the back of this brochure and contact your wholesaler or tekmar sales agent for assistance.

**Type 155 includes:**

- One Difference Control 155
- One Universal Sensor 071, One Solar Sensor 085
- Data Brochures D 155, D 070, D 085, D 001
- Application Brochure A 155

**Other information available:**

- Essay E 001

**Note:** Carefully read the Sequence of Operation section in this brochure to ensure that you have chosen the proper control and understand its functions within the operational requirements of your system.
Step Two  Mounting

The control is mounted in accordance with the instructions in the Data Brochure D 001.

Step Three  Rough-in wiring

All electrical wiring terminates in the two wiring chambers at the bottom front of the control. If the control is to be mounted on an electrical box, the wiring can be roughed-in at the electrical box prior to installation of the control (see Brochure D 001). Standard 18 AWG solid wire is recommended for all low voltage wiring to this control.

**Power should not be applied to any of the wires during the rough-in wiring stage.**

- Install the Source Sensor 085 and Storage Sensor 071 according to the instructions in Data Brochure D 085 and D 070, and run the wiring back to the control. Do not connect the wires to the terminals yet.
- **EITHER:** Install a 24 V (ac) Class 2 transformer with a minimum 5 VA rating and run the wiring from the transformer to the control.
- A **Class 2 transformer must be used.** Do not connect either of the transformer secondary wires to ground.
- **OR:** Install a 24 V (dc) source and run the wiring back to the control.
- Run wiring back from the devices connected to Relay 1 and Relay 2.

Step Four  Testing and connecting the wiring

**Caution** These tests are to be performed using standard testing practices and procedures and should only be carried out by properly trained and experienced persons. A good quality electrical test meter, capable of reading from at least 0 — 200 Volts, and at least 0 — 2,000,000 Ohms, is essential to properly test this control. At no time should voltages in excess of 27 V (ac or dc) be measured at any of the wires connected to the control.

**Test the sensors**

- This test must be performed before power is applied to the control and before the sensors are connected to the terminal strip. Test the sensors according to the instructions in the enclosed Data Brochure D 085 and D 070.

**Test the power supply**

- Ensure exposed wires are not grounded or in contact with other wires, then turn on the power supply. If a 24 V (ac) transformer is used, make sure the voltmeter is set to AC. With the voltmeter leads connected to the secondary side of the transformer, you should measure between 21 and 27 V (ac). If a DC power supply is used, make sure the voltmeter is set to DC. Connect the positive lead from the voltmeter to the positive terminal on the DC source and the negative lead from the voltmeter to the negative terminal on the DC source. The voltmeter should measure between 21 and 27 V (dc).
- Turn off the power and complete the electrical connections to the terminal strip of the control.

**Power and output connections**

The installer should test to confirm that no voltage is present at any of the wires.

- **EITHER:** Connect the 24 V (ac) power supply to terminals Power C- and R+ (1 and 2)
- **OR:** Connect the negative (-) lead from the 24 V (dc) source to the Power C- terminal. Connect the positive (+) lead from the 24 V (dc) source to the Power R+ terminal

**Note:** The control will not operate if the DC leads are reversed.

- Connect the Relay 1 controlled device to terminals Relay1 (3 and 4)
- Connect the Relay 2 controlled device to terminals Relay 2 (5 and 6)

**Sensor connections — Caution, voltage is never applied to these terminals**

- Connect the Source Sensor 085 to terminals Com Sen and Src Sen (7 and 8)
- Connect the Storage Sensor 071 to terminals Com Sen and Stor Sen (7 and 9)

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**Settings**

**PROGRAMMING**

- **Press and Release** all three buttons at the same time to begin programming. The first item displayed is the “ΔT setpoint”.
- Press and Release the “item” button to change the display to the “ΔT setpoint”.
- Press and Release the “item” button to change the display to “ΔT Differential”.
- Press and Release the “item” button to change the display to “Minimum Source Setpoint”.
- Press and Release the “item” button to change the display to “Minimum Source Differential”.
- Press and Release the “item” button to change the display to “F°” or “C°”.
- Press and Release the “item” button to change the display to “Maximum Storage Setpoint”.
- Press and Release the “item” button to change the display to “Maximum Storage Differential”.
- Use the arrow keys to switch between “°F” and “°C”.
- Use the arrow keys to set the “Minimum Source Differential”.
- Use the arrow keys to set the “Minimum Source Setpoint”.
- Use the arrow keys to set the “ΔT Differential”.
- Use the arrow keys to set the “ΔT setpoint”.
- Use the arrow keys to set the “Maximum Storage Differential”.
- Use the arrow keys to set the “Maximum Storage Setpoint”.

**Note:** The control automatically exits programming when the buttons are left alone for 20 seconds.
**ΔT Setpoint.** If the difference between the Source and Storage temperatures (ΔT) is greater than this setpoint, Relay 1 is turned on and heat is transferred from the source to the storage.

**ΔT Differential.** This differential setting is used to prevent short cycling of the heat transfer device when the ΔT is near the ΔT setpoint.

**Maximum Storage Setpoint.** If the Storage temperature rises above this setpoint, Relay 1 is turned off.

**Maximum Storage Differential.** This differential setting is used to prevent short cycling of the heat transfer device when the Storage temperature is near the Maximum Storage setpoint.

**Minimum Source Setpoint.** If the Source temperature drops below this setpoint, Relay 1 is turned off and Relay 2 operates according to the requirements of the Draindown or Drainback system.

**Minimum Source Differential.** This differential setting is used to prevent short cycling of the heat transfer device when the Source temperature is near the Minimum Source Setpoint.

### DISPLAY OPERATION

When the control is powered-up, all LCD segments are turned on for 3 seconds.

The current “ΔT” is then displayed. If Relay 1 is closed, a “1” and the word “HEAT” is displayed. If Relay 2 is closed, a “2” is displayed.

Press and Release the “Item” button to view the current “Source” temperature.

Press and Release the “Item” button to view the current “Storage” temperature.

Press and Release the “Item” button to view the current “Source” temperature.

Press and Release the “Item” button to view the current “Storage” temperature.

Press and Release the “Item” button to view the “Minimum Source” temperature measured since this display was cleared.

Press and Release the “Item” button to view the “Maximum Source” temperature measured since this display was cleared.

Press and Release the “Item” button to view the “Minimum Storage” temperature measured since this display was cleared.

Press and Release the “Item” button to view the “Maximum Storage” temperature measured since this display was cleared.

Press and Release the “Item” button to view the “ΔT-hours”.

Press and Release the “Item” button to view the “ΔT-hours”.

Press and Release the “Item” button to view the “ΔT-hours”.

Press and Release the “Item” button to view the “ΔT-hours”.

Press and Release the “Item” button to view the “ΔT-hours”.

When the control is powered-up, the “Item” display was cleared.

Press and Hold the “Item” button to view the “ΔT” setpoint.

Press and Hold the “Up” button to view the “Maximum Source” setpoint.

Press and Hold the “Down” button to view the “Maximum Storage” setpoint.

Press and Hold the “Item” button to view the “ΔT” setpoint.

Press and Hold the “Up” and “Down” buttons for 1 second. The word “Clr” is displayed and the value measured since this display was cleared.

Press and Hold the “Item” button to view the “ΔT” setpoint.

Press and Hold the “Up” and “Down” buttons for 1 second. The word “Clr” is displayed and the value measured since this display was cleared.

**Note:** The control changes from the above displays to the ΔT display if the buttons are left alone for 20 seconds.

### Viewing programmed setpoints

**While the control is displaying any of the current sensor measurements, the setpoints can be viewed by the following:**

- Press and Hold the “Item” button to view the current measurement.
- Press and Hold the “Up” button to view the “Maximum Source” setpoint.
- Press and Hold the “Down” button to view the “Maximum Storage” setpoint.

### Resetting Maximum or Minimum Displays

The above Maximum or Minimum displays can be reset by the following:

- Press and Hold the “Up” and “Down” buttons for 1 second. The word “Clr” is displayed and the value is reset to the current sensor measurement.

**Source temperature** is the temperature measured by the Source Sensor.

**Storage temperature** is the temperature measured by the Storage Sensor.

ΔT is the calculated difference between the Source and Storage temperatures.

**Maximum Source** is the Maximum temperature measured by the Source Sensor since this item was last cleared.

**Minimum Source** is the Minimum temperature measured by the Source Sensor since this item was last cleared.

**Maximum Storage** is the Maximum temperature measured by the Storage Sensor since this item was last cleared.

**Minimum Storage** is the Minimum temperature measured by the Storage Sensor since this item was last cleared.

**Energy Transfer (ΔT-hours).** This display allows the user to estimate the amount of energy transferred from the source to the storage. The energy transfer is displayed by alternating between two numbers. When the °C or °F segment is off, the thousands are displayed. When the °C or °F segment is on, the units are displayed. The energy transfer can be estimated by multiplying the ΔT •hours by the system flow rate (in US GPM) and by the constant K given in the adjacent table.

**Example**

Energy Transfer = ΔT •hours x System flow x K

ΔT • hrs = 005 (thousands) 225 °F (units) = 5225 °F •hours

System flow = 20 US GPM

Fluid = 20% glycol & 80% water, therefore K = 487

Energy Transfer = 5225 x 20 x 487 = 50,892,000 BTU

<table>
<thead>
<tr>
<th>% Glycol by weight</th>
<th>Freezing point</th>
<th>K @ 10°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>32 °F</td>
<td>500</td>
</tr>
<tr>
<td>10%</td>
<td>25.4 °F</td>
<td>496</td>
</tr>
<tr>
<td>20%</td>
<td>15.1 °F</td>
<td>487</td>
</tr>
<tr>
<td>30%</td>
<td>3 °F</td>
<td>477</td>
</tr>
<tr>
<td>40%</td>
<td>-13 °F</td>
<td>462</td>
</tr>
<tr>
<td>50%</td>
<td>-30 °F</td>
<td>439</td>
</tr>
</tbody>
</table>

K values are calculated averages for most ethylene glycol solutions at 50°F (10°C). K increases with higher temperatures.
First observe the system operating parameters. The source of the problem can often be identified by noting a display item which seems unreasonable. Observing what the control is doing, and understanding the sequence of operation greatly aids in troubleshooting. If there is a sensor fault, the control displays an error message. Use the error message table provided below to determine which circuit has the fault and then refer to Step Four for testing of the wiring and sensors.

**Difference Setpoint Control 155**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>D 155, A 155, D 001, D 070, D 085</td>
</tr>
<tr>
<td>Control</td>
<td>Microprocessor control; this is not a safety (limit) control.</td>
</tr>
<tr>
<td>Packaged weight</td>
<td>1.0 lb. (450 g), Enclosure C, PVC plastic</td>
</tr>
<tr>
<td>Dimensions</td>
<td>4-3/4” H x 2-7/8” W x 7/8” D (120 x 74 x 22 mm)</td>
</tr>
<tr>
<td>Approvals</td>
<td>CSA 22.2 No.24 and UL 873, meets class B; ICES &amp; FCC Part 15</td>
</tr>
<tr>
<td>Ambient conditions</td>
<td>Indoor use only, -20 to 120°F (-30 to 50°C), &lt; 90% RH non-condensing.</td>
</tr>
<tr>
<td>Power supply</td>
<td>24 V (ac) ±10%, 50/60 Hz, 3 VA, 24 V (dc) ±10%, 0.03 A</td>
</tr>
<tr>
<td>Relays</td>
<td>240 V (ac) 10 A 1/3 hp</td>
</tr>
<tr>
<td>Sensors</td>
<td>NTC thermistor, 10 kΩ @ 25°C ±0.2°C β=3892</td>
</tr>
<tr>
<td>Control accuracy</td>
<td>±0.5°F (±0.25°C) with up to 1000 feet (300m) of 18 AWG wire to sensors.</td>
</tr>
<tr>
<td>ΔT Setpoint</td>
<td>2 to 90°F (1 to 50°C)</td>
</tr>
<tr>
<td>ΔT Differential</td>
<td>2 to 45°F (1 to 25°C)</td>
</tr>
<tr>
<td>Minimum Source</td>
<td>-22 to 185°F (-30 to 85°C)</td>
</tr>
<tr>
<td>Maximum Storage</td>
<td>-4 to 248°F (-20 to 120°C)</td>
</tr>
<tr>
<td>Max. Storage Diff’</td>
<td>2 to 45°F (1 to 25°C)</td>
</tr>
</tbody>
</table>

**Limited Warranty and Product Return Procedure**

Limited Warranty: The liability under this warranty is limited. The Purchaser, by taking receipt of any tekmar product ("Product"), acknowledges the terms of the Limited Warranty in effect at the time of such purchase sale and acknowledges that it has read and understands such terms. The tekmar Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer's pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each tekmar Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with tekmar's instructions and/or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with tekmar's instructions. The pass-through Limited Warranty does not apply if the returned Product has been damaged by negligence by persons other than tekmar, accident, fire, Act of God, abuse or misuse; or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by tekmar; or if the Product was not installed in compliance with tekmar's instructions and/or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with tekmar's instructions. This WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH THE GOVERNING LAW ALLOWS PARTIES TO CONTRACTUALLY EXCLUDE, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, DURABILITY OR DESCRIPTION OF THE PRODUCT, ITS NON-INFRINGEMENT OF ANY RELEVANT PATENTS OR TRADEMARKS, AND ITS COMPLIANCE WITH OR NON-VIOLATION OF ANY APPLICABLE ENVIRONMENTAL, HEALTH OR SAFETY LEGISLATION; THE TERM OF ANY OTHER WARRANTY NOT HEREBY CONTRACTUALLY EXCLUDED IS LIMITED SUCH THAT IT SHALL NOT EXTEND BEYOND TWENTY-FOUR (24) MONTHS FROM THE PRODUCTION DATE. THE EXTENT TO SUCH LIMITATION IS ALLOWED BY THE GOVERNING LAW.

Product Warranty Return Procedure: All Products that are believed to have defects in workmanship or materials must be returned, together with a written description of the defect, to the tekmar Representative assigned to the territory in which such Product is located. If tekmar receives an inquiry from someone other than a tekmar Representative, including an inquiry from Purchaser (if not a tekmar Representative) or Purchaser Product, all such costs and expenses being subject to Purchaser's agreement and warranty with its customers. Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the tekmar Limited Warranty are the Purchaser's sole responsibility and obligation. Purchaser shall indemnify and hold tekmar harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

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