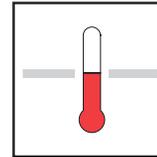


tekmar® - Data Brochure

Difference Setpoint Control 155



D 155

06/10



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 ΔT 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.

ΔT Setpoint

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

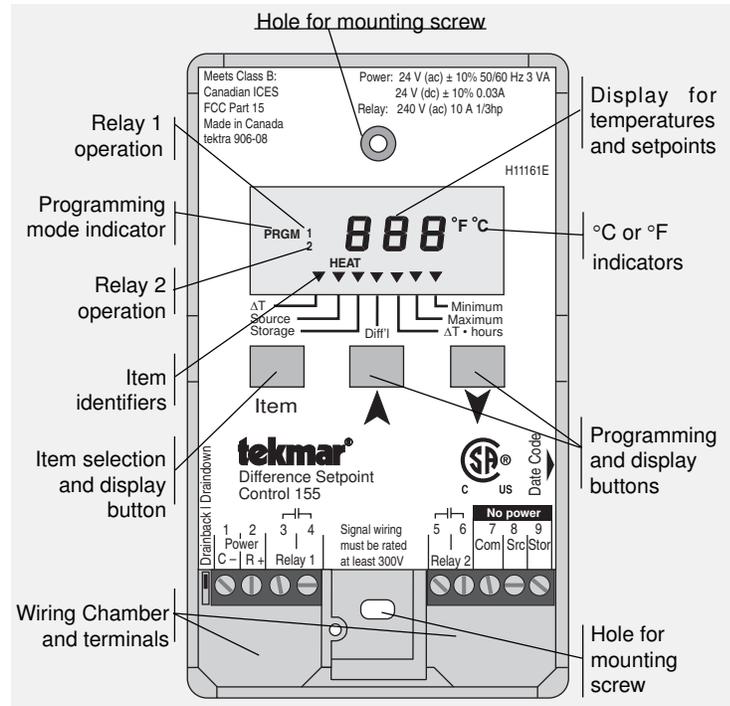
If the Source temperature drops below the Minimum Source setting, Relay 1 is turned off. This relay remains off until the Source temperature rises above the Minimum Source setting plus its differential.

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 ΔT 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 to the control 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.

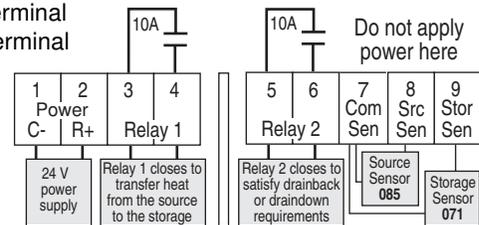
- **EITHER:** Connect the 24 V (ac) power supply to terminals *Power C-* and *R+* (1 and 2)
- **OR:** Connect the negative (-) lead from the 24 V (dc) source to the *Power C-* terminal. Connect the positive (+) lead from the 24 V (dc) source to the *Power R+* terminal

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)



Settings

PROGRAMMING

The programming sequence is as follows:

- ΔT setpoint:** Display shows 10°F. Press and Release all three buttons (Item, Up, Down) to begin programming. The first item displayed is the "ΔT setpoint". Use arrow keys to set the "ΔT setpoint".
- ΔT Differential:** Display shows 5°F. Press and Release the "Item" button to change the display to the "ΔT Differential". Use arrow keys to set the "ΔT Differential".
- Minimum Source Setpoint:** Display shows 40°F. Press and Release the "Item" button to change the display to the "Minimum Source Setpoint". Use arrow keys to set the "Minimum Source Setpoint".
- Maximum Storage Setpoint:** Display shows 10°F. Press and Release the "Item" button to change the display to the "Maximum Storage Setpoint". Use arrow keys to set the "Maximum Storage Setpoint".
- Maximum Storage Differential:** Display shows 10°F. Press and Release the "Item" button to change the display to the "Maximum Storage Differential". Use arrow keys to set the "Maximum Storage Differential".
- Temperature Unit:** Display shows a sun icon. Press and Release the "Item" button to change the display to "°F" or "°C". Use arrow keys to switch between "°F" and "°C".

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.

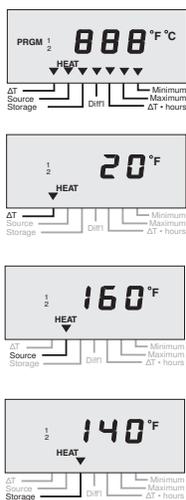
DISPLAY OPERATION

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.

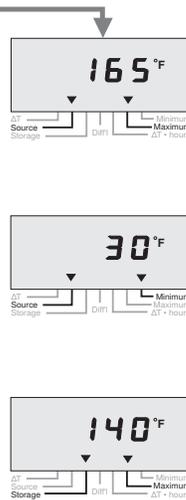
Press and Release the "Item" button to view the current "Storage" temperature.



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

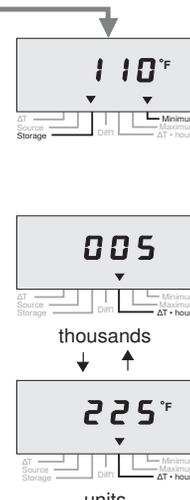
Press and Release the "Item" button to view the "Minimum Source" temperature measured since this display was cleared.

Press and Release the "Item" button to view the "Maximum Storage" 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.

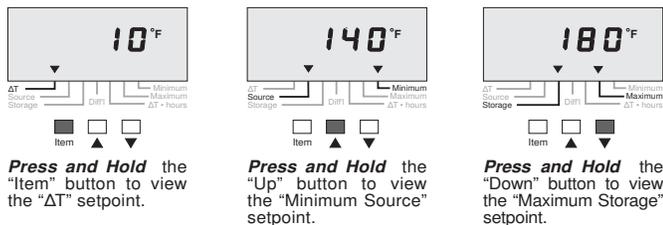
Press and Release the "Item" button to view the "ΔT•hours". The numbers shown to the right indicate 5225 °F•hours.



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:



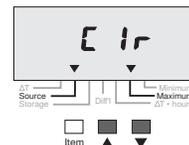
Press and Hold the "Item" button to view the "ΔT" setpoint.

Press and Hold the "Up" button to view the "Minimum 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

% Glycol by weight	Freezing point	K @ 10 °F
0%	32 °F	500
10%	25 °F	496
20%	15 °F	487
30%	3 °F	477
40%	-13 °F	462
50%	-35 °F	439

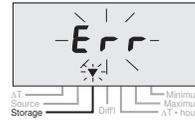
K values are calculated averages for most ethylene glycol solutions at 50 °F (10 °C). K increases with higher temperatures.

Step Five Troubleshooting

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.



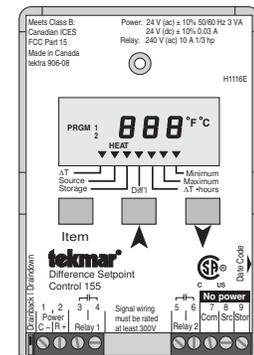
Source Sensor Open/Short Circuit
The display flashes "Err" and the "Source" pointer. Both relays are kept off with this error.



Storage Sensor Open/Short Circuit
The display flashes "Err" and the "Storage" pointer. Both relays are kept off with this error.

Difference Setpoint Control 155

Literature	— D 155, A 155, D 001, D 070, D 085
Control	— Microprocessor control; This is not a safety (limit) control .
Packaged weight	— 1.0 lb. (450 g), Enclosure C, PVC plastic
Dimensions	— 4-3/4" H x 2-7/8" W x 7/8" D (120 x 74 x 22 mm)
Approvals	— CSA C US, CSA 22.2 No 24 and UL 873, meets class B: ICES & FCC Part 15
Ambient conditions	— Indoor use only, -20 to 120°F (-30 to 50°C), < 90% RH non-condensing.
Power supply	— 24 V (ac) ±10%, 50/60 Hz, 3 VA, 24 V (dc) ±10%, 0.03 A
Relays	— 240 V (ac) 10 A 1/3 hp
Sensors included:	— NTC thermistor, 10 kΩ @ 25°C ±0.2°C β=3892
	— One of Universal Sensor 071
	— One of Solar Sensor 085
Control accuracy	— ±0.5°F (±0.25°C) with up to 1000 feet (300m) of 18 AWG wire to sensors.
ΔT Setpoint	— 2 to 90°F (1 to 50°C)
ΔT Differential	— 2 to 45°F (1 to 25°C)
Minimum Source	— -22 to 185°F (-30 to 85°C)
Min. Source Diff'l	— 2 to 45°F (1 to 25°C)
Maximum Storage	— -4 to 248°F (-20 to 120°C)
Max. Storage Diff'l	— 2 to 45°F (1 to 25°C)



The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. Conversely, this Class B digital apparatus complies with Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Regulations. However, if this control does cause harmful interference to radio or television reception, which is determined by turning the control off and on, the user is encouraged to try to correct the interference by reorienting or relocating the receiving antenna, relocating the receiver with respect to this control, and/or connecting the control to a different circuit from that to which the receiver is connected.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Limited Warranty and Product Return Procedure

Limited Warranty The liability of tekmar 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 Product sale and acknowledges that it has read and understands same.

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, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of tekmar under the Limited Warranty shall be limited to, at tekmar's sole discretion: the cost of parts and labor provided by tekmar to repair defects in materials and/or workmanship of the defective product; or to the exchange of the defective product for a warranty replacement product; or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from tekmar, and, without limiting the foregoing in any way, tekmar is not responsible, in contract, tort or strict product liability, for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, secondary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to tekmar during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement 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.

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, TO THE EXTENT THAT 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's customers, regarding a potential warranty claim, tekmar's sole obligation shall be to provide the address and other contact information regarding the appropriate Representative.



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