



# Instruction Sheet

## 00<sup>®</sup> Variable Speed Delta T (00-VDT)

102-359

SUPERSEDES: May 1, 2010

EFFECTIVE: October 1, 2010

Plant ID# 001-3927

The Variable Speed Delta T 00<sup>®</sup> Cartridge Circulator (00-VDT) is a microprocessor-based pump which automatically adjusts its performance to deliver the optimal heat transfer based on the actual operation of the system. The 00-VDT regulates the temperature to provide a fixed temperature difference ( $\Delta T$ ) of between 5 - 50°F between two field installed sensors.

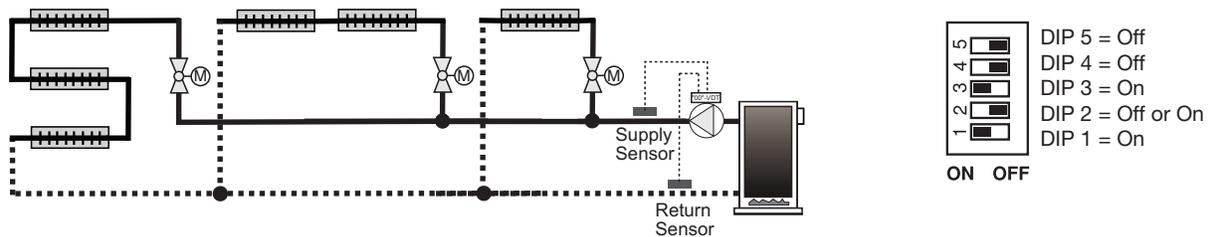
### Variable Speed Differential Temperature Control

Variable speed pumping to maintain a set differential temperature (delta T or  $\Delta T$ ) between two sensors allows for automatic adjustment of the pump's performance to match the load of the system or zone, eliminate velocity noise in zone valve systems and conserve energy.

Since delta T is directly related to flow rate, the pump's speed continually adjusts to the required BTU per hour. In almost all applications the design of the system was based on being able to maintain a certain delta T and figured by using the universal hydronics equation of  $BTU/hr = GPM \times 500 \times \Delta T$ . Given that, any time there is a change to the heat load (i.e. warmer day or greater heat loss from a structure) then the GPM should change to match the required BTU/hr. This is achieved when the variable speed 00-VDT Circulators automatically and continually adjust their GPM output (by varying speed) to match the required BTU/hr output of the system, no matter the changes in heat load, while always maintaining the designed delta T between a supply and return sensor.

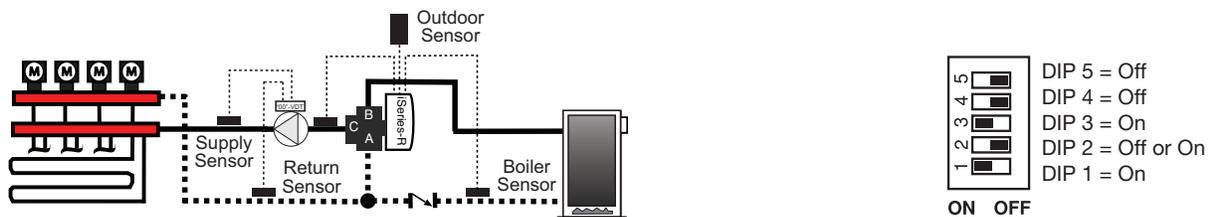
### Applications

#### Delta T Across a Series Loop System Using Zone Valves



The 00-VDT Variable Speed Circulator adjusts its speed to maintain the differential temperature (based on the RANGE dial setting) between the supply sensor and the return sensor whenever a heat demand is present. This will increase overall comfort and sharply reduce boiler short-cycling. The 00-VDT will also control velocity noise issues in the system, eliminating the need for a pressure differential bypass valve.

#### Delta T Across Multi-Zone Radiant Manifolds with Loop Actuators



The 00-VDT Variable Speed Circulator adjusts its speed to maintain the differential temperature (based on the RANGE dial setting) between the supply sensor and the return sensor whenever a heat demand is present. The 00-VDT will also eliminate velocity noise by slowing the actual flow rate through the zone to the minimum required to deliver proper heat. If other zones on the manifold open, the 00-VDT will increase its speed to deliver the required BTU's, while at the same time maintaining the designed for delta T across the radiant system.

See [www.taco-hvac.com](http://www.taco-hvac.com) for additional applications for the 00-VDT circulators.



A Taco resource – saving product

## Pump Selection

The circulator should be sized, using conventional sizing practices, based on the required head and flow for the system or zone on which the circulator is being installed.

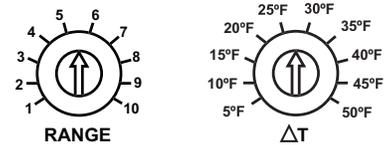
## Sequence of Operation

### Power Up and Heat Request

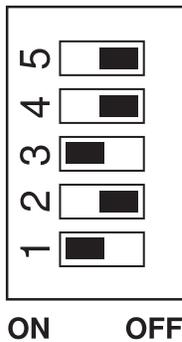
Whenever the 00-VDT is powered up, the green PWR LED turns on. The 00-VDT starts operating once a heat request signal is present at the Heat Request (Ht Req) terminals. The heat request terminals come factory jumpered so the pump will start as soon as it is powered up. The jumper may be removed and a heat request signal may be provided by external end switches from zone valves or Taco ZVC/SR series zone controls, applying a dry contact closure or a powered 24 V (ac) signal across the Ht Req terminals. Once a heat request signal is present, the green HEAT REQ LED turns on.

### Delta T Setting and Operation

Once a heat request is present, the 00-VDT operates to provide a fixed  $\Delta T$  between the supply sensor (S2) and the return sensor (S1). The fixed  $\Delta T$  is set using the RANGE dial, where 5°F and 50°F corresponds to 1 and 10 respectively on the RANGE dial, with the temperature increasing in 5°F increments. The percent output (% OUT) LED flashes at different rates based on the speed of the pump.



### Dip Switch Settings



- DIP Switch 5: Output Characteristic = Off or On
- DIP Switch 4: Output Response = Off
- DIP Switch 3: Mode of Operation = On
- DIP Switch 2: Minimum Speed = Off or On
- DIP Switch 1:  $\Delta T$  Operation = On

### Minimum Variable Speed Output

When the 00-VDT is configured for reverse acting mode ( $\Delta T$  operation), a minimum variable speed output is incorporated during operation to insure proper flow across both sensors. In this case, the variable speed output is adjusted between the selected minimum variable speed output percentage and full output. Depending on the amount of system resistance in your application, select the preferred minimum variable speed output from the table to the right. The 00-VDT also provides full output for 30 seconds when the Heat Request appears, then resumes normal operation.

Minimum Variable Speed Output	
DIP switch 2 = Off	DIP switch 2 = On
Normal (default)	Lower

Note: Minimum variable speed output is not available when configured for Direct Acting Mode (DIP switch 3 set to Off).

### Pump Start-up

When the 00-VDT is powered up, the circulator operates at full speed for 30 seconds before varying its speed anywhere between minimum and full speed as required to maintain the selected differential temperature.

In Direct Acting Mode (DIP switch 3 = Off) the speed of the circulator will ramp up as required to maintain the selected differential temperature.

### Exercising

Every 72 hours of no operation, the 00-VDT is designed to exercise for 10 seconds in order to prevent precipitate build-up in the pump. The % OUT LED turns on during the exercising function.

**WARNING: Wiring connections must be made in accordance with all applicable electrical codes.**

**CAUTION: To prevent electrical shock, disconnect electric power to system at main fuse or circuit breaker box until installation is complete. When a service switch is installed, more than one disconnect switch may be required to deenergize this device for servicing.**

### Powering the Control

Insert the line voltage wires through the knockout of the enclosure and connect the live wire to the H terminal and the neutral wire to the N terminal on the PC Board. Ensure that no power is present during this process.

### Heat Request

The heat request signal may be provided by the factory installed jumper or the jumper can be removed and a heat request signal may be provided by external end switches from zone valves or Taco ZVC/SR series zone controls, applying a dry contact closure or a powered 24 V (ac) signal across the Ht Req terminals.

### Sensors

Do not apply power to these terminals as this will damage the PC Board. The wiring terminals for the sensors may be removed for ease of installation.

Do not run the wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference (EMI), shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to the Com terminal on the PC Board and not to earth ground.

### Sensor Installation and Placement

The sensors can be strapped directly to the pipe using a cable tie. Insulation should be placed around the sensor to reduce the effect of air currents on the sensor measurement. The sensors should be placed downstream of a pump or after an elbow or similar fitting. This is especially important if large diameter pipes are used because the thermal stratification within the pipe can result in erroneous sensor readings. Proper sensor location requires that the fluid is thoroughly mixed within the pipe before it reaches the sensor.

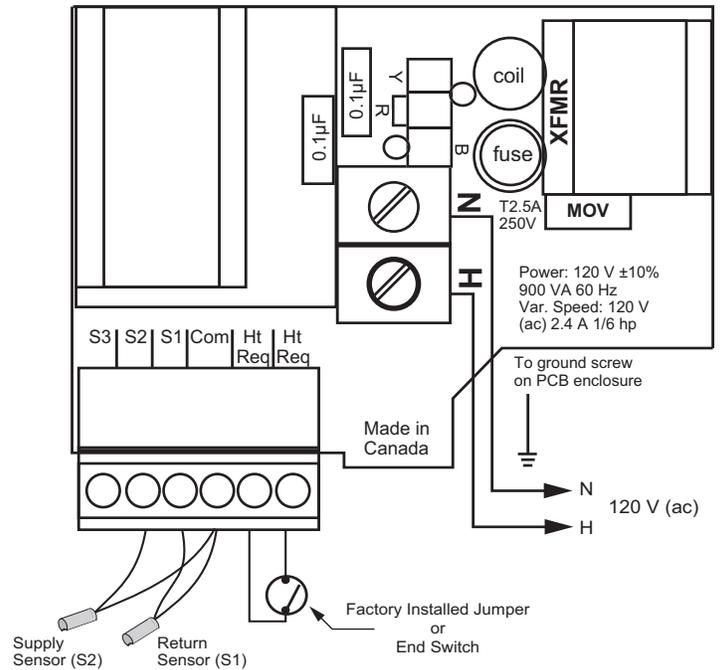
If the system sensor is used to measure duct (air) temperature, the sensor should be mounted in such a manner that it measures the average duct outlet temperature.

#### Return Sensor (S1)

Connect the two wires from the return sensor (S1) directly into the Com and S1 terminals on the PC Board.

#### Supply Sensor (S2)

Connect the two wires from the supply sensor (S2) directly into the Com and S2 terminals on the PC Board.



## Troubleshooting

As in any troubleshooting procedure, it is important to isolate a problem as much as possible before proceeding. The error messages greatly simplify troubleshooting of the 00-VDT. When the 00-VDT flashes an error message, identify the fault and follow standard testing procedures to confirm the problem. If you suspect a wiring fault, return to the wiring section on this brochure and carefully check all external wiring and wiring connections.

For your safety and protection from permanent damage to the microprocessor, the 00-VDT includes a 2.5 A (250 VAC) field replaceable fuse.

### Multi-Status LED

LED	LED Status	00-VDT Status
PWR	Solid	Power On
HEAT REQ	Solid	Heat Request
% OUT	Flash (Solid)	Variable Speed Output
HEAT REQ	Flash	System Sensor S1 Fault. 00-VDT does not operate.
RED OUT	Flash	System Sensor S2 Fault. 00-VDT does not operate.
HEAT REQ and RED OUT	Flash	Boiler Sensor S3 Fault. No sensor should be connected to S3. 00-VDT does not provide boiler protection.
POWER, HEAT REQ and RED OUT	Flash	No sensors connected, or incompatible mode and sensor combination.

### Testing the Sensors

A good quality test meter capable of measuring up to 5,000 k $\Omega$  (1 k $\Omega$  = 1000 $\Omega$ ) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with a good quality digital thermometer.

First measure the temperature using the thermometer and then measure the resistance of the sensor at the 00-VDT. The wires from the sensor must not be connected to the PC Board while this test is performed. The wiring terminals are easily removed by pulling them from the PC Board. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.

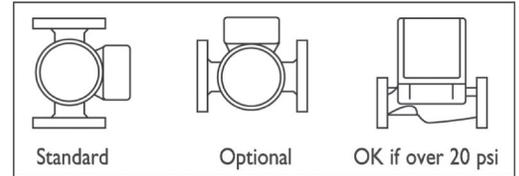
Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$
-30	-34	234,196	30	-1	34,558	90	32	7,334	150	66	2,045
-20	-29	165,180	40	4	26,099	100	38	5,828	160	71	1,689
-10	-23	118,018	50	10	19,900	110	43	4,665	170	77	1,403
0	-18	85,362	60	16	15,311	120	49	3,760	180	82	1,172
10	-12	62,465	70	21	11,883	130	54	3,050	190	88	983
20	-7	46,218	80	27	9,299	140	60	2,490	200	93	829

## Application

1. Maximum operating pressure: 125 psi (862 kPa) on all "00" Series Circulators.
2. Maximum water temperature not to exceed nameplate rating.
3. Cast iron circulators are to be used for closed loop systems. Bronze circulators are to be used for open loop, fresh water, or potable water systems.
4. Taco Cartridge circulator pumps are for indoor use only – employer uniquement a l'intérieur.

## Installation

1. Mounting position – Circulator must be mounted with the motor in a horizontal position. It may be mounted vertically with the motor up, provided that the system pressure is at least 20 psi (138 kPa).
2. Rotating body – Body has an arrow on the front that indicates direction of flow. To rotate body, remove the four body bolts, rotate body and replace bolts. Make sure that the junction box is **NOT** located underneath the circulator. (The junction box must **NOT** be located in the 6 o'clock position, as viewed from the motor end.)
3. Electrical connections – Observe all applicable codes when connecting to power supply. The motor is impedance protected, and does not require overload protection. The pump cannot run backwards.



**WARNING: Do not use in swimming pool or spa areas; pump has not been investigated for this application.**

**WARNING: In the event the retaining screws have been pulled out of the housing, DO NOT replace them. Use of any other screw may short out the stator windings, creating a risk of electrical shock.**

**CAUTION: When installing electrical connections, do not apply mechanical loads to the capacitor box; otherwise, retaining screws may be pulled out of the housing, making circulator unusable.**

4. Fill system with tap water – The system must be filled before operating the circulator. The bearings are water lubricated and should not be allowed to operate dry. Filling the system will result in immediate lubrication of the bearings. It is always good practice to flush a new system of foreign matter before starting the circulator.
5. Circulator operation – Operate the circulator for 5 minutes immediately after filling system to purge remaining air from the bearing chamber. This is especially important when installing the circulator during the off-season.

**CAUTION: The addition of petroleum based fluids or certain chemical additives to systems utilizing TACO equipment voids the warranty.**

**CAUTION: Use supply wires suitable for 90°C – ATTENTION: Employer des fils d'alimentation adequats pour 90°C.**

**WARNING: To avoid electrical shock, disconnect the power supply to the circulator and the main electrical unit.**

## Replacing Cartridge Assembly

1. Disconnect the electrical supply.
2. Reduce system pressure to 0 psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove the body bolts and swing motor assembly away from the body.
4. Pull cartridge out of the motor housing.
5. Install replacement cartridge, making sure that the cover plate is between the cartridge flange and motor.
6. Make sure the replacement cartridge corresponds to the full circulator product number. A complete parts list is available from your local plumbing supply wholesaler.
7. Reassemble the circulator using the new gasket and bolts supplied.
8. Follow the "Installation" procedure to start up the circulator.

## **Replacing Integral Flow Check (IFC) Assembly (if applicable)**

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1. Disconnect the electrical supply.
2. Reduce system pressure to 0 psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Loosen flange bolts and remove entire circulator from the system to access the flange mounted IFC.
4. Remove IFC, using needle nose pliers.
5. Install replacement IFC by pressing valve into casing until it is firmly seated.
6. Follow the "Installation" procedure to start up the circulator.

## **Replacing Circuit Board**

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1. Disconnect the electrical supply and all field wiring to the circuit board.
2. Unplug the 3-pin plastic connector that connects the motor to the circuit board.
3. Bend the lip of the capacitor base to ease the removal of the circuit board. Pull the circuit board up and out.
4. Reverse directions to install the new circuit board.

## **Notes**

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## LIMITED WARRANTY STATEMENT

Taco, Inc. will repair or replace without charge (at the company's option) any Taco 00 Series circulator or circulator part which is proven defective under normal use within three (3) years from the date of manufacture.

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local Taco stocking distributor or Taco in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local Taco stocking distributor or Taco. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the

addition of petroleum-based fluids or certain chemical additives to the systems, or other abuse, will not be covered by this warranty.

If in doubt as to whether a particular substance is suitable for use with a Taco product or part, or for any application restrictions, consult the applicable Taco instruction sheets or contact Taco at (401-942-8000).

Taco reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. Taco reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

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This warranty gives the purchaser specific rights, and the purchaser may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

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