

Service Instructions for

- 589698
- 590796

Automatic Temperature Control

INSTALLATION INSTRUCTIONS

The Red Dot Automatic Temperature Control (ATC) is the latest in Red Dot electronic controllers. The ATC allows for true interior cab temperature control and continuously variable blower fan speed through the use of advanced microprocessor and solid state sensor technology. The unit is designed to be easily installed as a retrofit unit. Red Dot can also accommodate specific customer requirements for OEM applications.

Product Features

- Backlit Operator Panel
- Embossed Touchpad with Tactile Feedback
- 0.3" High Red LED Digital Display
- Display in Degrees Fahrenheit or Celsius (Operator Selectable)
- On-Board Real Time Diagnostics
- Resume Last Setting on Startup Memory Feature
- Press and hold down to Increment Temperature and Fan Speed Settings (The settings will increment as long as the key is depressed)
- Electronic Evaporator Freeze Protection
- A/C Clutch Cycling Limited to 4 cycles/minute Maximum

Control Operation Specifications

- Temperature Control Range: 60° to 90°F (16° to 32°C)
- Blower Fan Speed Control: Pulse Width Modulation,
- Max Current: 30 Amps at 12V, 15 Amps at 24V

Temperature Sensors

- Cab Air Temperature Sensor:
Monitors the average cab air temperature
- Evaporator Core Probe:
Prevents ice from forming in the evaporator core
- Duct Air Sensor:
Monitors the system outlet duct air temperature

Controlled Devices

- A/C Compressor Clutch Circuit
- Blower Fan Motor
- Heater Water Valve

Major System Components

- ECU/Power Interface Controller Module
- Control Panel
- Electronic Water Valve
- Air Temperature Sensors
- Evaporator Probe

Operator Control Panel



ON/OFF - Powers vehicle Heater-A/C control system on or off. The LED numeric display is illuminated when the unit is turned on. The display will show the current set point temperature.

AUTO - Places the system in a fully automatic temperature control mode including fan speed. A panel indicator light indicates when this mode is active. The system will adjust the blower fan speed to the lowest setting necessary to maintain the cab temperature at the displayed set point temperature.

DEF (Defrost icon) - Energizes the A/C system to allow for rapid de-humidification of the cab. The A/C will be enabled even if the set point temperature requires heat. A panel indicator light indicates when this mode is active.

FAN UP/DOWN - Overrides the automatic fan speed control feature. Increments fan speed up or down in 11 steps. The digital display indicates the fan speed setting as a percentage or "HI" when maximum fan speed is reached or "LO" when minimum fan speed is reached then returns to normal display 5 seconds after either key is depressed. The set point fan speed is maintained until it is changed or if the AUTO key is depressed.

TEMPERATURE UP/DOWN - Increments the set point temperature up or down. The system will control the electronic water valve and/or the A/C compressor clutch to hold the cab temperature as closely as possible to the set point temperature. °C/°F - Toggles the display units between degrees Celsius and degrees Fahrenheit. The display will show the units selected.

ECON (Economy Mode) - When depressed, locks out the A/C function. The control uses only fresh air, fan speed, and water valve control to maintain the set point temperature. Depressing the ECON key will return the system back to normal operation. A panel indicator light indicates when this mode is active. Note that defrost (DEF) overrides the ECON function.

General Operation

Heater Operation

The ATC automatically controls the Heater-A/C to maintain the cab air temperature close to the set point selected by the temperature control push buttons. The ATC will adjust the air temperature blown through the ducts to maintain this temperature. If more heat is desired, increase the set point temperature by pushing the up temperature button. If less heat is desired, decrease the set point by pushing the down temperature button.

To obtain maximum heating, set the set point temperature to 90°F (32°C) or higher. The system will put out maximum heat continuously, even if the cab temperature exceeds the set point temperature. Turn the blower fan speed to maximum fan (not AUTO).

In AUTO mode, the fan speed will increase as necessary to warm up the cab to the set point temperature. Once the cab reaches the set point temperature, the fan speed will decrease.

Finer temperature control can be obtained by leaving the control panel in °F units. The temperature units can be changed from °F to °C or °C to °F by toggling the °C/°F button. The current temperature unit will then be shown on the digital display.

A comfortable set point for heating is between 72°F (22°C) and 78°F (26°C). Change the temperature set point in small amounts for best results. Once a comfortable temperature is reached, this temperature will be maintained without adjusting the set point.

Defrosting Or Defogging Operation

The defrost (DEF) mode is used to de-ice, defrost, or defog the windows. In certain cold or humid conditions, more heat and airflow is required to clear the windows. The set point temperature and the blower speed should be adjusted as necessary to maintain a clear windshield at all times. For maximum defrost, increase the set point temperature to the

maximum setting (90°F or 32°C) or higher and increase the blower speed to maximum fan (not AUTO).

Note that the air conditioner is enabled when in defrost mode. The A/C is used to dehumidify the air entering the cab to remove the fog from the windshield.

Air Conditioner (A/C) Operation

The ATC automatically controls the Heater-A/C to maintain the cab air temperature close to the set point selected with the temperature control pushbuttons. The ATC will adjust the air temperature blown through the ducts to maintain this temperature. If more cooling is desired, decrease the set point temperature by pushing the down temperature button. If less cooling is desired, increase the set point by pushing the up temperature button.

To obtain maximum cooling, set the set point temperature to 60°F (16°C) or lower. The system will put out maximum cooling continuously, even if the cab temperature drops below the set point temperature. Turn the blower fan speed to maximum fan (not AUTO).

In AUTO mode, the fan speed will be adjusted as necessary to keep the cab at the set point temperature. The farther away the cab temperature is from the set point, the higher the fan speed.

Finer temperature control can be obtained by leaving the control panel in °F units. The temperature units can be changed from °F to °C or °C to °F by toggling the °C/°F button. The current temperature unit will then be shown on the digital display.

A comfortable set point for cooling is between 68°F (20°C) and 74°F (23°C). Change the temperature set point in small amounts for best results. Once a comfortable temperature is reached, this temperature will be maintained without adjusting the set point.

System Function

Automatic Fan Speed Control (AUTO)

The fan speed is determined by the system as required. The fan speed is based on the difference between the set point temperature and the actual cab temperature. The greater the difference, the greater the fan speed.

If the cab temperature is "too hot" and heating is occurring, or if the cab temperature is "too cold" and cooling is occurring, then the fan speed will be held at minimum. This condition can occur when the cab is heating or cooling quickly, and the temperature "overshoots" the set point temperature.

In AUTO fan speed mode, all fan speed changes are done gradually.

Manual Mode Fan Speed Control (Low..High)

Fan speed will directly correspond to fan speed control setting. In automatic or manual mode, the initial fan speed on startup will gradually increase from "off" to the desired fan speed.

A/C Compressor Clutch Control

The A/C clutch can be active in any mode except OFF. The clutch is activated as required to maintain the set point temperature. In defrost mode, the clutch is forced on to provide cab air dehumidification. In the event of a cab temperature sensor error, the system will operate in a "manual" temperature control mode with a set point of 60°F (16°C) corresponding to full air conditioning, 75°F (24°C) corresponding to neutral (no cooling or heating), and 90°F (32°C) corresponding to full heat. Set point settings in between will generate the proportional amount cooling or heating.

In any mode, the clutch activation can be disabled by the ECON setting, the evaporator temperature sensor, the low refrigerant pressure cut out switch, or the high refrigerant pressure cut out switch.

The evaporator temperature sensor trip points will be determined by the system to maintain the desired cab temperature. As less cooling is required, the evaporator temperature sensor trip points will increase, so as to maintain a fairly constant core temperature. In the case of full A/C or in the case of defrost mode, the evaporator temperature sensor trip points will be 31°F (-1°C) clutch off and 35°F (2°C) clutch on.

Installation Instructions

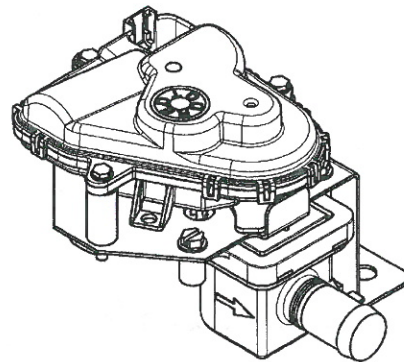
Control Panel

Use the paper mounting template included in the kit to cut an opening for the control panel. Secure the control panel with the mounting bracket and hardware. Do not over-tighten the bracket.

Connect the gray six pin connector on the wire harness to the control panel wire harness jumper and connect the white six pin connector from the jumper to the control panel. Attach the snap on ferrite core around the wires of the control panel wire harness jumper close to the white six pin connector.

Heater Water Valve

This system utilizes an electronic proportional water valve. The valve will control the engine coolant flow into the heater core. The valve is fully sealed and may be located in the engine compartment of the vehicle but away from extreme sources of heat such as turbos or exhaust manifolds.



Any existing water valve on the inlet hose of the heater core should be removed and the Red Dot electronic water valve should be inserted. The water valve is compatible with 5/8 inch or 16mm I.D. heater hose. Hoses should be secured with hose clamps (not included). Adapters (not included) may be necessary if the hoses are too large or too small to be attached to the fittings on the electronic water valve. Note the proper direction of the coolant flow as shown by the arrow on the valve body in the diagram below.

The gray four pin connector on the wire harness should be inserted into the water valve electronic actuator.

Cab Air Temperature Sensor

This sensor measures the average cab temperature and must be positioned in a location which represents the average cab temperature. A fan is incorporated into the sensor to produce a continuous flow of air across the temperature sensing element. It is CRITICAL that the small fan in the sensor turns freely and that the sensor is not affected by heated or cooled air from vent outlets or fresh air inlets. The sensor should not be obstructed or covered for proper temperature control operation.

The connector of this sensor should be inserted into the white four pin connector on the wire harness.

Duct Air Temperature Sensor

This sensor measures the average duct outlet temperature. It should be positioned in the air duct after the heat exchanger cores where it will receive constant conditioned air flow regardless of louver position. The sensor should not be located too close to the heat exchanger cores or in a location where

Installation Instructions *(continued)*

the sensor will get wet. The sensor should be able to accurately measure the duct air temperature for proper cab temperature control.

A spring clip provided in the kit can be used to retain the sensor in a mounting hole. The two pin gray connector on the kit harness plugs into the body of this sensor.

Evaporator Probe

Disconnect and remove any existing mechanical evaporator thermostat. Jumper the thermostat wires together. Insert the Red Dot electronic evaporator probe (copper probe with black wires) into the evaporator in the same location and to the same depth as the one that was just removed. Verify that the probe is making good contact with the evaporator fins and is not loosely inserted.

Connect the black two pin connector (with brown wires) on the wire harness to the evaporator probe connector.

Power Leads

The 12 gauge RED and BLACK wires provide power to the ATC system. A 30 Amp fuse may be incorporated into the wire harness. If one is not present, connect the red wire to a fuse or circuit breaker of sufficient size. It is very important that a good power and ground connection be made.

Blower Motor

The 12 gauge RED wire connects directly to the positive lead of the blower fan motor and the 12 gauge WHITE wire connects to the negative lead of the blower motor. **WARNING DO NOT** use a chassis grounded blower. **DO NOT** connect the negative lead of the blower motor to ground. **DO NOT** connect the WHITE wire to ground. The blower current under continuous operation should not draw more than 15 Amps for a 24V system or more than 30 Amps for a 12V system. Exceeding this current may cause the ECU module to fail.

Compressor Clutch

The 16 gauge BLACK w/ WHITE STRIPE wire should be connected to the positive lead of the A/C compressor clutch assembly. If a ground lead is present on the clutch, it should be connected to ground. A 15 Amp or appropriately sized fuse may be incorporated into the clutch lead on the wire harness. If this is not present, the circuit should be fused as required.

IMPORTANT NOTE Any existing pressure cut out switches (normally closed) should be retained in line with the clutch circuit. If the existing pressure switches are not rated to carry the full clutch current, a relay circuit (not included) should be designed to interrupt power to the A/C compressor clutch.

ECU Power Interface Control Module

The ECU should be mounted in an area that does not exceed 185°F (85°C). Although the ECU is moisture resistant, it should not be located in an area where it will be submerged, pressure washed, or otherwise exposed continuously to water. It is preferable to mount the unit inside the passenger compartment of the vehicle.

Connect the black two pin connector (with black and white wires) and the large 35 pin connector on the wire harness to the ECU.

Lengthening Wires

Any of the kit wires may be lengthened by splicing in extensions of the appropriate gauge wire. GXL wire is recommended. Excessive lengthening of the power and blower wires may result in voltage drop and loss of blower performance. All connections should be verified as making solid contact and should not generate heat during operation.

Electrical Schematic

Refer to wiring diagram RD-6-5453 for the most current wiring information.

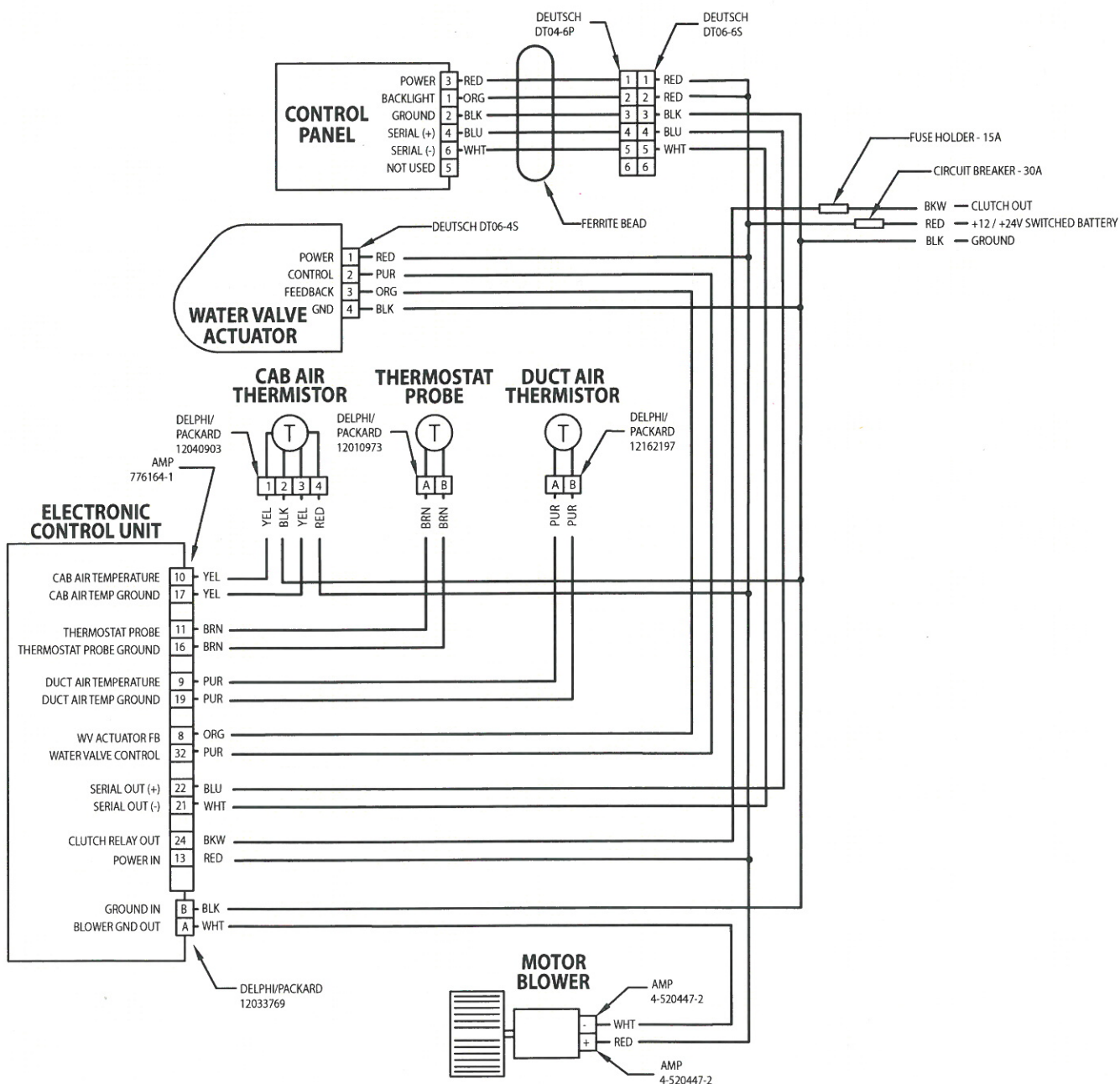
35-Pin ECU Connector

- 8 Water Valve Actuator Diagnostic Feedback
- 9 Duct Air Temperature Sensor Signal: Varies between 0 and +5VDC
- 10 Cab Air Temperature Sensor Signal: Varies between 0 and +5VDC
- 11 Evaporator Temperature Sensor Signal: Varies between 0 and +5VDC
- 13 Power In: +12VDC or +24VDC Switched Ignition
- 16 Sensor Ground
- 17 Sensor Ground
- 19 Sensor Ground
- 21 Serial(-): Input/Output provides serial information link between the ECU and the control panel. This line should be connected to the Serial(-) line on the control panel. In

- use, this line will be a serial stream of 0V/5V signals. The average voltage reading on this pin will be around 2.5V.
- 22 Serial(+): Input/Output provides serial information link between the ECU and the control panel. This line should be connected to the Serial(+) line on the control panel. In use, this line will be a serial stream of 0V/5V signals. The average voltage reading on this pin will be around 2.5V.
- 24 Clutch Output: +12VDC or +24VDC when the A/C compressor clutch is on.
- 32 Water Valve Actuator Control Signal: Varies between 0 and Supply Voltage

2-Pin ECU Connector

- A Chassis Ground
- B Blower Control Signal (Ground Side): 0 to 100% duty cycle



Troubleshooting

Fault Codes:

To display fault codes depress the ON key three times in rapid succession. The digital display will then display any active fault codes. Pressing the ON key again repeatedly will scroll through any existing error codes. After 5 seconds without further key presses, the system will exit the diagnostics mode and return to normal operation.

No Faults Detected	Displayed: E0
Cab Sensor Shorted	Displayed: E1
Cab Sensor Open	Displayed: E2
Evap Probe Shorted	Displayed: E3
Evap Probe Open	Displayed: E4
Outlet Duct Sensor Shorted	Displayed: E5
Outlet Duct Sensor Open	Displayed: E6
Water Valve Shorted	Displayed: E9
Water Valve Open	Displayed: E10
No Communications with ECU	Displayed: E17

Advanced Diagnostics:

The Red Dot ATC Advanced Diagnostics control panel allows the technician to see real time system information on the control panel display that will assist in A/C-heater servicing. This real time information can help the service technician diagnose certain system problems.

To display advanced diagnostics, depress the ON key three times in rapid succession (fault codes displayed) then immediately press and hold the ON key for 5 seconds. The text "CAB" will be displayed. After a few seconds, the real time value of the cab temperature measured by the ATC is displayed. This value, as well as any other value displayed by the control panel, will continuously update. Pressing the ON key again repeatedly will scroll through all of the available diagnostics information.

CAB	Cab Air Temperature
EVAP	Evaporator Core Temperature
DUCT	Duct Air Temperature
A-C	A/C Clutch Request (On/Off)
HEAT	Water Valve Position (0 to 100% Open)
FAN	Blower Fan Output (0 to 100% Maximum)

Note that the system can be operated normally while in advanced diagnostics mode, including changing the temperature set point or changing the blower fan speed, to evaluate the response of the system.

The firmware revision display mode is activated by pressing and holding the "ON" key for five seconds while the advanced diagnostics display mode is active. Press the "ON" key to cycle between the following displays:

ECU	ECU module revision.
CTRL	Control panel revision.

To exit the advanced diagnostic mode, turn the system OFF.

Additional Troubleshooting

No Display

- Turn on Control Panel with the ON key.
- Check to see if the display illuminates.
- Verify that the Control Panel is plugged into the wire harness.
- Check to see if wire harness is wired into vehicle properly.

No Fan

- Turn up fan with the Fan UP key.
- Make sure fan is plugged into wire harness, verify all wiring connections. The blower fan is controlled by the ATC on the GROUND side of the fan motor.
- Verify that the circuit breakers or fuses are intact.
- If all other functions work properly, replace Electronic Control Unit (ECU).

No Heat

- Turn up heat with the Temperature UP key. Use the advanced diagnostics to verify that the water valve is commanded open.
- Inspect and verify all wiring connections.
- Verify that any coolant shut off valves on the engine are open.
- Verify that warm coolant is flowing into the heater core by testing the heater hoses.
- Inspect and replace the electronic water valve if necessary.
- Inspect and replace ECU if necessary.

No Cooling

- Turn down heat with the Temperature DOWN key and enable the defrost mode. Use the advanced diagnostics to verify that the A/C clutch is requested ON.
- Verify that the system is fully charged with refrigerant.
- Verify that voltage is present at the compressor clutch
- Inspect and verify all wiring connections.
- Inspect and replace refrigerant high pressure and/or low pressure cut out switches if necessary.
- Inspect compressor and clutch assembly and replace clutch if necessary.
- Inspect and replace ECU if necessary.

The system is not controlling the cab temperature properly.

- Inspect the Cab Air Temperature sensor. Verify that the sensor fan is spinning freely.
- Make sure that the Cab Air Temperature sensor is located properly.
- Verify that the Duct Air Temperature sensor is functioning and located properly.
- Change the setpoint temperature in small increments.
- Verify that the water valve is working properly (see No Heat)
- Verify that the compressor clutch is working properly (see No Cooling)

The evaporator core is icing up and restricting airflow.

- Inspect the Evaporator Core Probe.
- Verify that the probe is making good contact with the evaporator fins and is not loosely inserted.
- Reposition the probe and check the core temperature during operation using the advanced diagnostics.