

Automatic Temperature Control User's Guide

General Information:

The Automatic Temperature Control (ATC) allows for true interior cab temperature control and continuously variable blower fan speed through the use of microprocessor and solid state sensor technology.

Features:

Backlit Operator Panel Embossed Touchpad with Tactile Feedback 0.3" High Green LED, 3½ Digit Digital Display Display in Degrees Fahrenheit or Celsius (Operator Selectable) On-Board Diagnostics – Error Codes and Real Time Advanced 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 5 cycles/minute Maximum Low Voltage System Lock Out Temperature Control Range: 60° to 90°F (16° to 32°C) Compressor Clutch Circuit Current Monitoring

Control Operation Specifications:

Major System Components:

ECU Module Control Panel Electronic Water Valve Cab Air Temperature Sensor: Monitors the average cab air temperature Duct Air Temperature Sensor: Monitors the air temperature in the air ducts Evaporator Temperature Probe: Prevents ice from forming in the evaporator core: Less than 34°F (1°C) clutch cut out, greater than 37°F (3°C) clutch on

Controlled Devices:

A/C Compressor Clutch Circuit Blower Fan Motor Electronic Heater Water Valve Condenser Fan Request

Control Panel Operation



PWR - 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.

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.

FAN UP / DOWN - Overrides the automatic fan speed control (AUTO) 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 the minimum fan speed is reached. The speed setting will be shown for 5 seconds before returning to the set point temperature display. The fan speed is maintained until it is changed or if the AUTO key is depressed.

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. An indicator light on the digital display indicates when this mode is active. Note that defrost (DEF) overrides the ECON function.

AUTO (Automatic Blower Speed Control) - Places the system in automatic blower speed control mode. 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.

MODE (°C/°F) – Toggles the display units between degrees Celsius and degrees Fahrenheit. The display will show the units selected.

DEF (**Defrost icon**) – Positions the fresh/recirc air door to the fresh position and turns on the A/C compressor clutch for dehumidification. A panel indicator light indicates when this mode is active. Note that selecting defrost may override previous settings for ECON or FRESH. This will be indicated by the state of the ECON and FRESH key indicator lights. When the defrost mode is de-selected, the system will return to previously selected modes.

FRESH – Not used in this system.

General System 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 pushbuttons. 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). 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

This mode is used to de-ice, defrost, or defog the windows by pressing the key with the defrost icon. 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) and increase the blower speed to maximum fan (not AUTO).

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.

Pressing the defrost key when it is active (indicated by an illuminated light) will deactivate the defrost mode and the system will return to the settings that were in place before the defrost mode was enabled.

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). 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.

VENTILATION (FRESH/RECIRC)

The unit draws in a fixed mix of outside air (via a pressurizer) and recirculated air. This allows the cab to maintain a positive cab air pressure to prevent excessive dust from entering the cab. In addition, fresh air prevents the air in the cab from becoming stale and humid.

Inspect and replace both the fresh air and recirculated air filters regularly to obtain proper cab pressurization, optimized unit performance, and correct temperature regulation.

System Logic and Component Functions

AUTOMATIC TEMPERATURE CONTROL (ATC)

The ATC system is always active and tries to maintain the cab at the set point temperature selected by the operator.

A/C COMPRESSOR CLUTCH CONTROL

The A/C compressor 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 or the evaporator temperature sensor. In addition, the clutch may be disabled by exceeding the limits of the system dual function (binary) high/low refrigerant pressure cut out switch. This switch is located on the refrigerant liquid (high side) line and is connected in series between the clutch control signal from HVAC unit and the compressor clutch coil.

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 34°F (1°C) clutch off and 37°F (3°C) clutch on.

The compressor clutch current will be continuously monitored whenever the clutch is commanded to be engaged. An error condition will be reported if the current is greater than or less than predetermined threshold levels.

ELECTRONIC HEATER WATER VALVE

This system utilizes an electronic proportional water valve. The system will automatically control the engine coolant flow into the heater core.

CAB AIR TEMPERATURE SENSOR

This sensor measures the average cab temperature. It is **CRITICAL** that the senor is not obstructed or covered and is clean for proper temperature control operation.

DUCT AIR TEMPERATURE SENSOR

This sensor measures the average temperature of the conditioned duct air. This sensor is required for proper temperature control operation.



EVAPORATOR TEMPERATURE PROBE

The evaporator temperature probe is inserted into the evaporator core. Verify that the probe is making good contact with the evaporator fins and is not loosely inserted.

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 mode, when warm air is needed, the duct temperature sensor keeps the blower in low speed until the heater core warms up. This prevents high speed cold air from blowing out of the ducts.

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

MANUAL FAN SPEED CONTROL

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.

CONDENSER FAN REQUEST SIGNAL

If the system requires more than a 50% A/C compressor-on duty cycle to maintain cooling, the ATC will output a condenser fan request signal (+12VDC, 100mA max). This signal will remain on until the system no longer requires any A/C at 0% duty cycle. In this state, the signal will be zero volts (ground).

Voltage Levels:

Control Panel Connector 6-Pin Deutsch DT06-6S

- 1 +12V Power
- 2 Back Light Power: +12V turns the backlighting on
- 3 Ground
- 4 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 will be approximately 2.5V.
- 5 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 will be approximately 2.5V.
- 6 Not Used (Plug)

ECU Connector 35-pin Amp 776164-1

- 7 Duct Temperature Signal (+5V when sensor is disconnected)
- 8 Water Valve Actuator Feedback
- 10 Cab Temperature Signal (+5V when sensor is disconnected)
- 11 Evaporator Temperature Signal (+5V when sensor is disconnected)
- 13 +12Volt Power
- 16 Evaporator Temperature Sensor Ground
- 17 Cab Temperature Sensor Ground
- 19 Duct Temperature 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 will be approximately 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 will be approximately 2.5V.
- 24 Compressor Clutch Control Output (+12V, 8 Amps max when clutch requested on)
- 33 Water Valve Actuator PWM Control Signal
- 35 Condenser Fan Request Signal (+12V, 100mA max when fan requested on)

ECU Connector 2-Pin Delphi 12033769

- A Blower control PWM Pull-to-Ground, Ground when blower is set to maximum speed
- B Ground

Water Valve Actuator Connector 4-Pin Deutsch DT06-4S

- 1-+12V Power
- 2 Control Signal
- 3 Feedback Signal
- 4 Ground

Cab Air Temperature Sensor Connector 2-Pin Delphi 12162197

- A Signal (+5V when sensor is disconnected)
- B Ground

Duct Air Temperature Sensor Connector 2-Pin Delphi 12162197

- A Signal (+5V when sensor is disconnected)
- B Ground



Evaporator Temperature Sensor 2-Pin Delphi 12010973

- A Signal (+5V when sensor is disconnected)
- B Ground

Blower Motor Connections

RED – +12 Volts

WHITE - Ground when blower is set to maximum speed

Electrical Wiring:



Troubleshooting:

The diagnostic mode can be accessed through the control panel. With the system turned on, pressing the PWR and AUTO keys at the same time will display the error codes, advanced diagnostics and firmware version numbers. Each press of the PWR and AUTO keys will toggle through the three modes and then back to normal operation. A flow chart summary is shown below:



<u>Wagner</u>

Error Code Mode

With the system turned on, press the PWR and AUTO keys at the same time to enter the error code mode. Any errors will be displayed on the control panel display. Repeated pressed of the PWR key will scroll through any multiple errors. After five seconds, the system will exit the Error Code Mode and return to normal operation. The error codes are as follows:

No Faults	E0	
Cab Sensor Shorted	E1	
Cab Sensor Open	E2	
Evap Probe Shorted	E3	
Evap Probe Open	E4	
Duct Sensor Shorted	E5	
Duct Sensor Open	E6	
Pressure Transducer Open	E11	NOT USED
Pressure Transducer Shorted	E12	NOT USED
Water Valve Actuator Error	E13	
Fresh/Recirc Actuator Error	E14	NOT USED
Charge Sensor Shorted	E15	NOT USED
Charge Sensor Open	E16	NOT USED
Electronics or Comm. Error	E17	
Clutch Open	E18	
Clutch Shorted	E19	
No Refrigerant	E20	NOT USED
Low Refrigerant	E21	NOT USED
High Pressure	E22	NOT USED
Low Voltage Error	E23	

Advanced Diagnostics

The 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 A/C system problems.

From the error code mode, press the PWR and AUTO keys at the same time to enter the advanced diagnostics mode. The text CAB will be displayed on the control panel. After a few seconds, the cab temperature measurement will be displayed (in degrees F or degrees C, depending on which units have been previously selected). Pressing the PWR key repeatedly will cycle through the available real time diagnostics.

The following diagnostics are available:

CAB	Cab Air Temperature (°F or °C)
DUCT	Duct Air Temperature (°F or °C)
EVAP	Evaporator Core Temperature (°F or °C)
HEAT	Water Valve Command (% of valve open)
A-C	A-C Clutch Request (On/Off)
FAN	Blower Fan Speed (% of maximum fan speed)
DEF	Defrost Request (On/Off)
HI-P	NOT USED - High Side Pressure (psig/bar)
FRSH	NOT USED - Fresh/Recirc Door Position (% fresh air)
COND	Condenser Fan Request Status (On/Off)
REF	NOT USED - Refrigerant Charge Level (ADC Reading: 0 to 255)
CLUT	Compressor Clutch Current (Amps)
VOLT	System Voltage (DC Volts)

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, in order to evaluate the response of the system to different settings.

Firmware Version

The firmware version of the control panel and ECU can be displayed. From the Advanced Diagnostics mode, press the PWR and AUTO keys at the same time. The text CTRL will be displayed and after a few seconds, the control panel firmware version number will be displayed. Pressing the PWR key will toggle to the ECU firmware version.

The following firmware version information is available:

CTRL	Control Panel Version
ECU	ECU Version

Exiting the Diagnostic Mode

Pressing the PWR and AUTO keys at the same time will cycle through the various diagnostic modes and the normal operation mode. Continue pressing the PWR and AUTO keys until the normal set point temperature is displayed to exit the diagnostic mode.

Additional Troubleshooting:

No Display

Connect power to the Control Panel and verify that all display segments illuminate briefly. Verify that the Control Panel is plugged into the wire harness and press the PWR key. Check to see if wire harness is wired into the vehicle properly.

No Fan

Turn up fan with the Fan UP key.

Make sure fan is plugged into wire harness, verify all wiring connections.

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.

Verify that the valve can shut off completely by setting the controls to the coldest temperature and checking 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

Verify that the correct voltage is present at the clutch relay on the wire harness.

Inspect and verify all wiring connections.

Inspect the expansion valve, evaporator probe and/or refrigerant pressure switch.

Inspect compressor and clutch assembly and replace clutch if necessary.

Inspect and replace the ECU if necessary.

Verify that ECON mode is not enabled (ECON mode locks out the AC).

The system is not controlling the cab temperature properly.

Inspect the Cab and Duct Air Temperature sensors. Verify that the recirculation vent inlet is not obstructed.

Inspect and replace recirculation vent air filter if necessary.

Change the setpoint temperature in small increments.

Verify that the water valve is working properly (see No Heat)

Verify that the flow through the water valve is going in the correct direction.

Verify that the compressor clutch is working properly (see No Cooling)

The evaporator core is icing up and restricting airflow.

Inspect the Evaporator Temperature 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.

Replace the evaporator core if necessary.