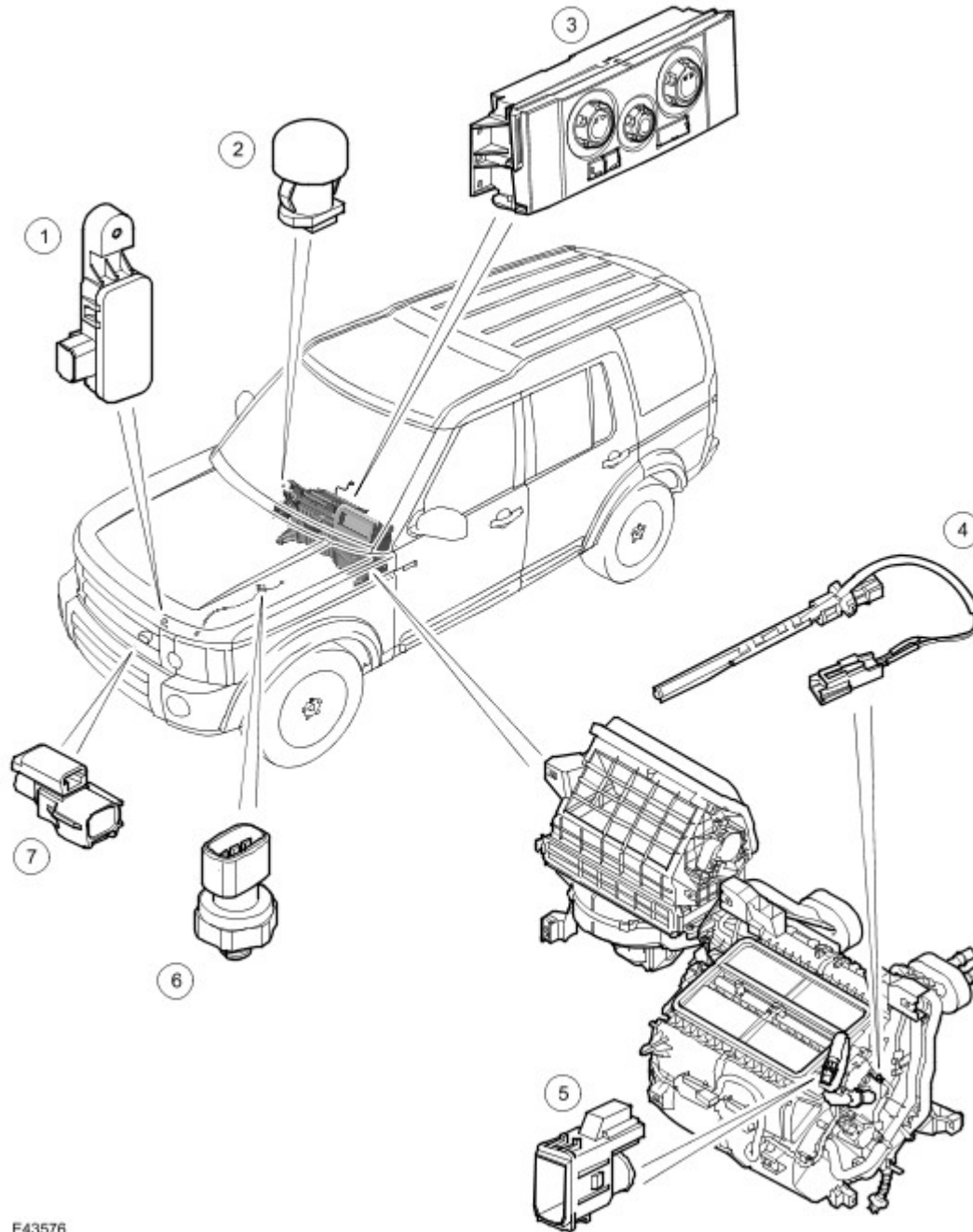


Control Components

COMPONENT LOCATIONS



E43576

Item	Part Number	Description
1	-	Pollution sensor (Japan only)
2	-	Sunlight sensor
3	-	ATCM
4	-	Evaporator temperature sensor

5	-	In-vehicle temperature sensor; In-vehicle temperature and humidity sensor (Japan only)
6	-	Refrigerant pressure sensor
7	-	Ambient air temperature sensor

GENERAL

The control system operates the Air Conditioning (A/C) system and the heating and ventilation system to control the temperature, volume and distribution of air from the heater.

Either a manual or an automatic control system is installed in the vehicle. The manual system maintains a constant heater outlet temperature, to both sides of the passenger compartment, with manual control of the intake air source, blower speed and air distribution. The automatic system automatically adjusts the temperature, volume and distribution of the air from the heater to maintain the individual temperature levels selected for the LH and RH sides of the passenger compartment. The automatic system also has manual overrides for the intake air source, blower speed and air distribution. The manual and automatic systems both include:

- An Automatic Temperature Control Module (ATCM).
- An ambient temperature sensor.
- A refrigerant pressure sensor.
- An evaporator temperature sensor.

The automatic system incorporates the following additional components:

- An in-vehicle temperature sensor.
- A sunlight sensor.

The automatic system in the Japan market also incorporates:

- A pollution sensor.
- A humidity sensor.

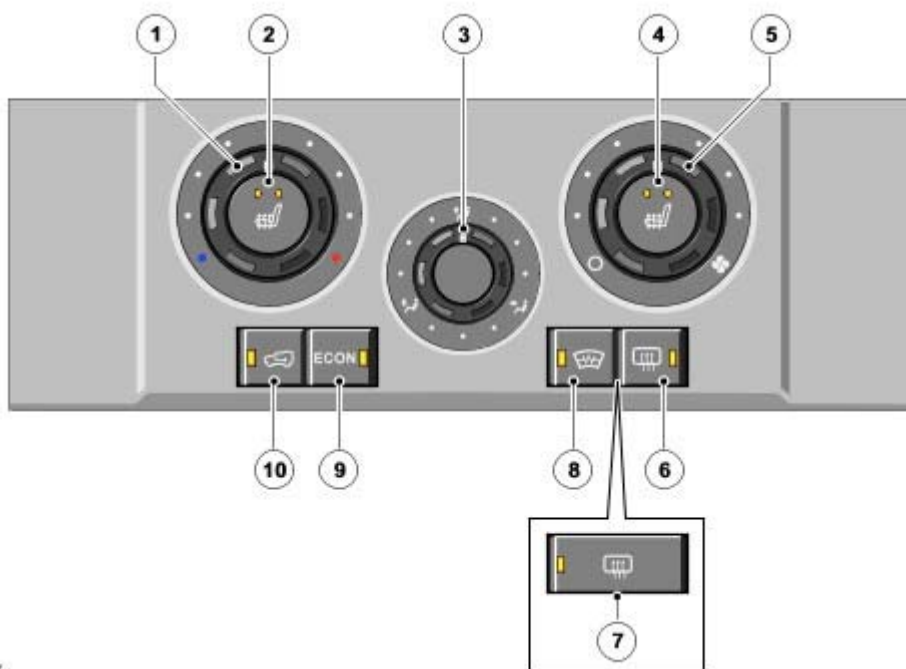
ATCM

The ATCM is installed in the center console. An integral control panel contains push switches and rotary switches for system control inputs. LED's in the switches and switch surrounds illuminate to indicate the current settings of the system. Switch symbols are illuminated when the side lamps or headlamps are on.

The ATCM processes inputs from the control panel switches, system sensors and the medium speed Controller AREA Network (CAN) bus, then outputs the appropriate control signals to the A/C system and the heating and ventilation system. In addition to controlling the A/C system and the heating and ventilation system, the ATCM also controls the following:

- The front seat heaters. For additional information, refer to [Seats \(501-10 Seating\)](#)
- The rear window heater. For additional information, refer to [Glass, Frames and Mechanisms \(501-11 Glass, Frames and Mechanisms\)](#)
- The windshield heater. For additional information, refer to [Glass, Frames and Mechanisms \(501-11 Glass, Frames and Mechanisms\)](#)
- The windshield washer jet and exterior mirror heaters. For additional information, refer to [Rear View Mirrors \(501-09 Rear View Mirrors\)](#)

Manual System Control Panel



E43577

Item	Part Number	Description
1	-	Temperature switch
2	-	LH front seat heater switch
3	-	Distribution switch
4	-	RH front seat heater switch
5	-	Blower switch
6	-	Rear window heater switch (models with heated windshield)
7	-	Rear window heater switch (models without heated windshield)
8	-	Windshield heater switch (where fitted)
9	-	Economy switch
10	-	Recirculation switch

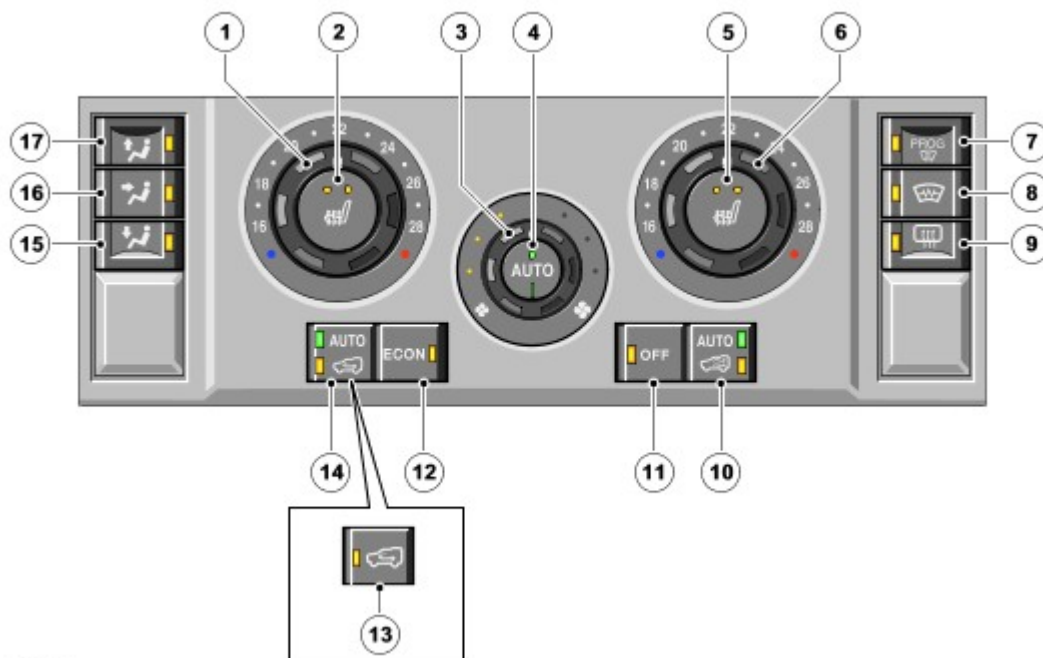
The switches on the manual ATCM control panel have the following functions:

- Temperature Switch:** Adjusts the heater temperature output. The switch can rotate through 240°, from full cold to full hot. Minor detents define small steps of the switch. Amber LED's in the switch surround illuminate to indicate the temperature setting.
- LH and RH Seat Heater Switches:** Activates the heater elements in the seat cushion and seat back at one of two heat levels. The first press of the switch energizes the heater elements at the higher heat setting and illuminates two amber LED's in the switch. A second press of the switch sets the heater elements to the lower heat setting and extinguishes one of the LED's. A further press of the switch de-energizes the heater elements and extinguishes the second LED. The seat heaters remain on until selected off or the ignition is switched off.
- Distribution Control Switch:** For manual adjustment of air distribution. The switch can rotate through 360°. 12 primary detents define the distribution settings of: Face only; 3 face/feet; feet only; 3 feet/screen; screen only; 3 screen/face. Minor detents define small steps between the primary detents. Amber LED's in the switch surround illuminate to indicate the distribution setting.
- Blower Switch:** For manual adjustment of blower speed. The switch can rotate through 240°, from off to maximum speed. Eight primary detents define the off position and seven blower speeds. Minor detents define small steps between the primary detents. Amber LED's in the switch surround illuminate to indicate the selected blower speed.
- Rear Window Heater Switch:** Enabled only with the engine running. Pressing the switch energizes the rear window heater for a set time period, until the switch is pressed again, or until the engine stops, whichever occurs first. An amber LED in the switch is illuminated while the heater is on.
- Windshield Heater Switch:** Enabled only with the engine running. Pressing the switch energizes the windshield heater for a set time period, until the switch is pressed again, or until the engine stops, whichever occurs first. An

amber LED in the switch is illuminated while the heater is is on.

- **Economy Switch:** Reduces the A/C compressor output to a minimum displacement condition x 5%, reducing the engine load required to operate the system. An amber LED in the switch is illuminated when the economy mode is selected on.
- **Recirculation Switch:** For selection of fresh or recirculated air. An amber LED in the switch is illuminated when recirculated air is selected.

Automatic System Control Panel



E43578

Item	Part Number	Description
1	-	LH temperature switch
2	-	LH front seat heater switch
3	-	Blower switch
4	-	Automatic mode switch
5	-	RH front seat heater switch
6	-	RH temperature switch
7	-	Programmed defrost switch
8	-	Windshield heater switch
9	-	Rear window heater switch
10	-	Auxiliary climate control switch
11	-	System off switch
12	-	Economy switch
13	-	Recirculation switch (models without pollution sensing)
14	-	Recirculation switch (models with pollution sensing)
15	-	Distribution switch - feet
16	-	Distribution switch - face
17	-	Distribution switch - windshield

The switches on the automatic ATCM control panel have the following functions:

- **LH and RH Temperature Switches:** Adjusts the nominal temperature settings of the LH and RH sides of the passenger compartment. The switch can rotate through 270°, between full cold and full hot. The switch surrounds are graduated in 2° increments between 16 and 28 °C. Minor detents define 1 °C steps over the range of the switch. Amber LED's in the switch surround illuminate to indicate the temperature setting. When maximum cold is selected, the ATCM also automatically sets the air source to recirculated air, blower speed to maximum and distribution to face. When maximum hot is selected, the ATCM also automatically sets the air source to fresh air, blower speed to maximum and distribution to footwell.
- **LH and RH Seat Heater Switches:** Activates the heater elements in the seat cushion and seat back at one of two heat levels. The first press of the switch energizes the heater elements at the higher heat setting and illuminates two LED in the switch. A second press of the switch sets the heater elements to the lower heat setting and extinguishes one of the LED's. A further press of the switch de-energizes the heater elements and extinguishes the second LED. The seat heaters remain on until selected off or the ignition is switched off.
- **Blower Switch:** For manual adjustment of blower speed. The switch can rotate through 240°, from off to maximum speed. Eight primary detents define the off position and seven blower speeds. Minor detents define small steps between the primary detents. When blower speed is manually adjusted, amber LED's in the switch surround illuminate to indicate the selected blower speed. The LED's remain off when blower speed is under automatic control.
- **Automatic Mode Switch:** Activates the automatic modes for the A/C system, blower speed and distribution. Separate amber LED's in the automatic mode switch illuminate to show when the blower and the distribution are in automatic mode. Manually selecting the blower speed or a distribution switch extinguishes the related LED.
- **Programmed Defrost Switch:** Activates a program that automatically selects: inlet air to fresh air; distribution to screen only; blower to speed 5; rear screen heater on; windshield heater on (where fitted), A/C system to automatic mode. An amber LED in the switch is illuminated while the defrost program is active.
- **Windshield Heater Switch:** Energizes the windshield heater for a set time period, until the switch is pressed again or until the engine stops, whichever occurs first. An amber LED in the switch is illuminated while the heater is on.
- **Rear Window Heater Switch:** Enabled only with the engine running. Pressing the switch energizes the rear window heater for a set time period, until the switch is pressed again or until the engine stops, whichever occurs first. An amber LED in the switch is illuminated while the heater is on.
- **Auxiliary Climate Control Switch:** Cycles the auxiliary climate control system through the three operating states of manual mode, automatic mode and off. Two amber LED's in the switch illuminate to indicate the operating state: one LED is illuminated for manual mode and two are illuminated for automatic mode.
- **Off Switch:** Switches off all of the functions controlled by the ATCM (all tell-tale LED's are extinguished). The temperature blend door is set to the full cold position (if the A/C system is in the automatic mode, if the A/C system is in the economy mode the current door position is retained); the air source is set to recirculation; the current distribution settings are retained; the blower speed is set to zero. Where fitted, the seat heater switches and the auxiliary climate control switch can still be operated without re-activating the ATCM. The ATCM is re-activated, with all functions in the previous operating state, by a second press of the off switch or by pressing the economy switch. The ATCM can also be re-activated, with the associated effect, by the following switches: The automatic mode switch. Any air distribution switch. The blower switch. The programmed defrost switch. The recirculation switch.
 - The automatic mode switch.
 - Any air distribution switch.
 - The blower switch.
 - The programmed defrost switch.
 - The recirculation switch.
- **Economy Switch:** Reduces the A/C compressor output to a minimum displacement condition x 5%, reducing the engine load required to operate the A/C compressor. An amber LED in the switch is illuminated when the economy mode is selected on.
- **Recirculation Switch:** For selection of fresh or recirculated air. On models without pollution sensing, an amber LED in the switch is illuminated when recirculated air is selected. On models with pollution sensing, the recirculation switch incorporates two amber LED. The first press of the switch sets the recirculation flaps to automatic mode and illuminates one LED. A second press of the switch manually selects recirculated air and illuminates the second LED. A further press of the switch manually selects fresh air and extinguishes the two LED.
- **Distribution Switches (Windshield, Face and Footwell):** For manual selection of air distribution in any combination of windshield, face and footwell outlets. Each switch has a LED which illuminates when the related distribution mode is selected.
-

Inputs and Outputs

Four electrical connectors provide the interface between the ATCM and the vehicle wiring.

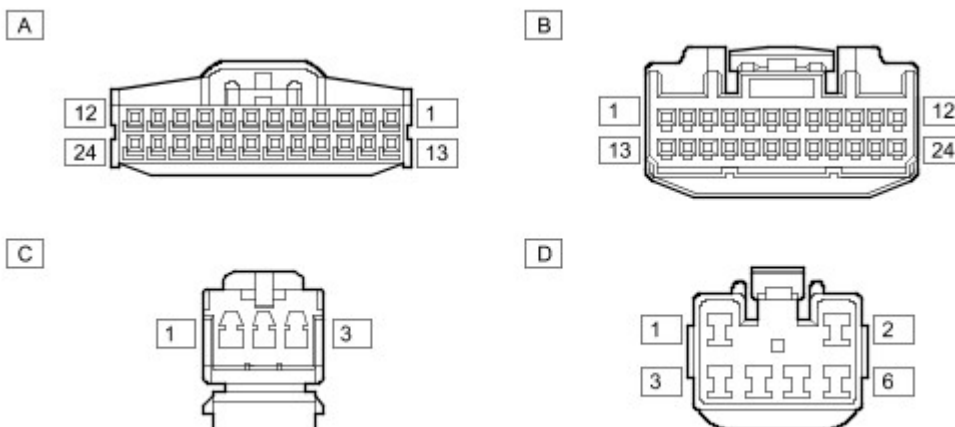
The control system sensors provide hardwired inputs to the ATCM. The ATCM also uses the LIN bus to communicate with the auxiliary climate control system and the door motors in the heater assembly, and the medium speed CAN bus to communicate with other control modules on the vehicle. For additional information, refer to [Communications](#)

[Network](#) (418-00 Module Communications Network)

ATCM Harness Connectors

NOTE :

A = C1629; B = C1630; C = C2655; D = C2295



E43579

ATCM Harness Connector C1629 Pin Details

Pin No.	Description	System		Input/Output
		Manual	Automatic	
1	Sensor 5V reference voltage (refrigerant pressure, humidity, sunlight as applicable)	Yes	Yes	Output
2	Pollution sensor NO signal	No	Yes	Input
3	In-vehicle temperature sensor signal	No	Yes	Input
4	Refrigerant pressure sensor signal	Yes	Yes	Input
5	Sunlight sensor RH signal	No	Yes	Input
6	Pollution sensor PWM signal	No	Yes	Output
7	Blower relay coil	Yes	Yes	Output
8	Not used	-	-	-
9	Medium speed CAN bus low	Yes	Yes	Input/Output
10	Medium speed CAN bus high	Yes	Yes	Input/Output
11	Pollution sensor power feed	No	Yes	Output
12	Not used	-	-	-
13	Sensor ground (refrigerant pressure, ambient air temperature, pollution, humidity, in-vehicle temperature and front seat temperature, as applicable)	Yes	Yes	Input
14	Pollution sensor HC/CO signal	No	Yes	Input
15	Ambient air temperature sensor signal	Yes	Yes	Input
16	Humidity sensor signal	No	Yes	Input
17	Sunlight sensor LH signal	No	Yes	Input
18	Windshield heater relay	Yes	Yes	Input
19	Washer jets/exterior mirrors heater relay	Yes	Yes	Input
20	LIN bus (on models with auxiliary climate control)	Yes	Yes	Input/Output
21	Medium speed CAN bus low	Yes	Yes	Input/Output

22	Medium speed CAN bus high	Yes	Yes	Input/Output
23	Compressor solenoid valve -	Yes	Yes	Input
24	Compressor solenoid valve +	Yes	Yes	Output

ATCM Harness Connector C1630 Pin Details

Pin No.	Description	System		Input/Output
		Manual	Automatic	
1 and 2	Not used	-	-	-
3	Recirculation motor power feed/ground	Yes	Yes	Input/Output
4	Recirculation motor power feed/ground	Yes	Yes	Input/Output
5 to 8	Not used	-	-	-
9	Recirculation door motor feedback potentiometer signal	Yes	Yes	Input
10	Not used	-	-	-
11	Distribution and temperature blend motor ground	Yes	Yes	Input
12	Sensor power feed (evaporator temperature, recirculation motor feedback, as applicable)	Yes	Yes	Output
13	Distribution and temperature blend motor power	Yes	Yes	Output
14	Distribution and temperature blend motor LIN bus	Yes	Yes	Input/Output
15 and 16	Not used	-	-	-
17	Blower module power drive	Yes	Yes	Output
18	Blower motor voltage sense	Yes	Yes	Input
19	Not used	-	-	-
20	Evaporator temperature sensor signal	Yes	Yes	Input
21 to 23	Not used	-	-	-
24	Recirculation door motor ground	Yes	Yes	Input

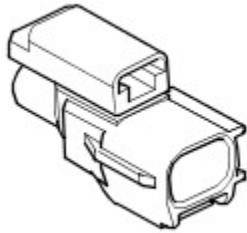
ATCM Harness Connector C2295 Pin Details

Pin No.	Description	System		Input/Output
		Manual	Automatic	
1	Seat heater power supply, right	Yes	Yes	Input
2	Seat heater power supply, left	Yes	Yes	Input
3	Power supply to right front seat heaters	Yes	Yes	Output
4	Right front seat temperature sensor	Yes	Yes	Input
5	Left front seat temperature sensor	Yes	Yes	Input
6	Power supply to right front seat heaters	Yes	Yes	Output

ATCM Harness Connector C2655 Pin Details

Pin No.	Description	System		Input/Output
		Manual	Automatic	
1	Permanent battery power supply	Yes	Yes	Input
2	Not used	-	-	-
3	Ground	Yes	Yes	Output

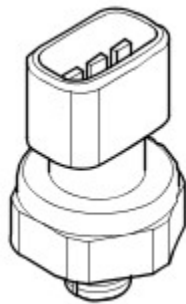
AMBIENT AIR TEMPERATURE SENSOR



E43580

The ambient temperature sensor is a Negative Temperature Coefficient (NTC) thermistor that provides the ATCM with an input of external air temperature. The sensor is attached to a bracket on the rear of the bumper beam, on the vehicle center-line.

REFRIGERANT PRESSURE SENSOR



E43581

The refrigerant pressure sensor provides the ATCM with a pressure input from the high pressure side of the refrigerant system. The refrigerant pressure sensor is located in the refrigerant line between the condenser and the thermostatic expansion valve.

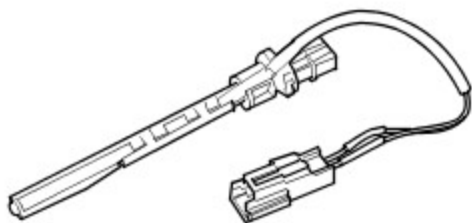
The ATCM supplies a 5 V reference voltage to the refrigerant pressure sensor and receives a return signal voltage, between 0 and 5 V, related to system pressure.

The ATCM uses the signal from the refrigerant pressure sensor to protect the refrigerant system from extremes of pressure and to calculate A/C compressor load on the engine. The ATCM also transmits the A/C compressor load value to the Engine Control Module (ECM), via the medium speed CAN bus, instrument pack and high speed CAN bus, for use in controlling the speed of the engine cooling fan.

To protect the system from extremes of pressure, the ATCM sets the A/C compressor to the minimum flow position if the pressure:

- Decreases to 1.9 ± 0.2 bar (27.5 ± 3 lbf/in²): the ATCM loads the A/C compressor again when the pressure increases to 2.8 ± 0.2 bar (40.5 ± 3 lbf/in²).
- Increases to 33 ± 1 bar (479 ± 14.5 lbf/in²): the ATCM loads the A/C compressor again when the pressure decreases to 23.5 ± 1 bar (341 ± 14.5 lbf/in²).

EVAPORATOR TEMPERATURE SENSOR

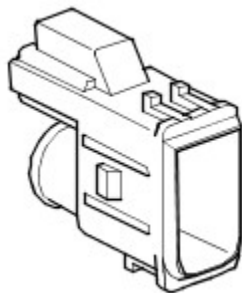


E43582

The evaporator temperature sensor is a NTC thermistor that provides the ATCM with a temperature signal from the downstream side of the evaporator. The evaporator temperature sensor is installed in the right side of the heater assembly casing.

The ATCM uses the input from the evaporator temperature sensor to control the load of the A/C compressor and thus the operating temperature of the evaporator.

IN-VEHICLE TEMPERATURE SENSOR



E43583

The in-vehicle temperature sensor is a NTC thermistor installed behind a grill on the driver side of the center console finisher. The sensor is connected to a tube, the other end of which is connected to a venturi on the side casing of the heater. An air bleed from the heater, through the venturi, induces a flow of air down the tube, which draws cabin air through the grill and over the sensor.

HUMIDITY SENSOR (WHERE FITTED)

The humidity sensor is a capacitive device integrated into the in-vehicle temperature sensor (see above).

The humidity sensor element is built out of a film capacitor on different substrates. The dielectric is a polymer which absorbs or releases water proportional to the relative humidity of the air being drawn through the sensor, and thus changes the capacitance of the capacitor. For protection, the sensor element is contained in a nylon mesh cover.

The humidity sensor and the in-vehicle temperature sensor are connected to a Printed Circuit Board inside the sensor housing. The PCB is powered by a 5V feed from the ATCM. Separate signals of temperature and relative humidity are transmitted from the PCB to the ATCM.

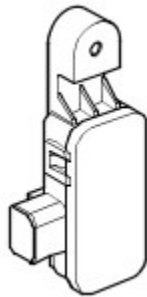
SUNLIGHT SENSOR



E43585

The sunlight sensor consists of two photoelectric cells that provide the ATCM with inputs of light intensity, one as sensed coming from the left of the vehicle and one as sensed coming from the right. The inputs are a measure of the solar heating effect on vehicle occupants, and are used by the ATCM to adjust blower speed, temperature and distribution to improve comfort. The sensor is installed in the center of the fascia upper surface and is powered by a 5V feed from the ATCM.

POLLUTION SENSOR



E43588

The pollution sensor allows the ATCM to monitor the ambient air for the level of hydrocarbons and oxidized gases such as nitrous oxides, sulphur oxides and carbon monoxide. The sensor is attached to a bracket on the front-end carrier, at the top left corner of the condenser.

The pollution sensor is powered by a battery voltage feed from the ATCM, and returns separate signals of hydrocarbon and oxidized gases.

If there is a fault with the pollution sensor, the ATCM disables the automatic operation of the recirculation door.

SYSTEM OPERATION

A/C Compressor Control

The variable displacement A/C compressor is permanently driven by the engine. The flow of refrigerant through the A/C compressor, and the resultant system pressure and evaporator operating temperature, is regulated by the refrigerant solenoid valve. Operation of the refrigerant solenoid valve is controlled by the ATCM using a 400 Hz Pulse Width Modulated (PWM) signal. The duty cycle of the PWM signal is calculated using the following parameters:

- A/C compressor torque.
- A/C compressor torque maximum.
- A/C cooling status.
- A/C demand.
- A/C refrigerant pressure.
- Ambient air temperature.
- Blower speed.
- Engine cranking status.
- Evaporator temperature.
- Transmission gear status.

When A/C is selected, the ATCM maintains the evaporator at an operating temperature that varies with the in-vehicle cooling requirement. The ATCM increases the evaporator operating temperature, by reducing the refrigerant flow, as the requirement for air cooling decreases, and vice versa. During an increase of evaporator operating temperature, to avoid compromising the dehumidification function, the ATCM controls the rate of temperature increase, which keeps the cabin humidity at a comfortable level.

When the economy mode is selected, the PWM signal holds the refrigerant solenoid valve in the minimum flow position, effectively switching off the A/C function.

The ATCM incorporates limits for the operating pressure of the refrigerant system. When the system approaches the high pressure limit, the duty cycle of the PWM signal is progressively reduced until the system pressure decreases. When the system pressure falls below the low pressure limit, the duty cycle of the PWM signal is held at its lowest setting, so that the A/C compressor is maintained at the minimum stroke, to avoid depletion of lubricant from the A/C compressor. The protection algorithm is calculated at a high rate, to enable early detection of the rapid pressure changes possible if a system fault develops.

A/C Compressor Torque

The ATCM uses refrigerant pressure, evaporator temperature and engine speed to calculate the torque being used to drive the A/C compressor. The calculated value is broadcast on the medium speed CAN bus for the Engine Control Module (ECM), which uses the calculated value for idle speed control and fueling control. The ATCM also compares the calculated value with a maximum A/C compressor torque value received from the ECM over the medium speed CAN bus. If the calculated value exceeds the maximum value, the ATCM signals the refrigerant solenoid valve to reduce the refrigerant flow, to reduce the torque being used to drive the A/C compressor. By reducing the maximum A/C compressor torque value, the ECM is able to reduce the load on the engine when it needs to maintain vehicle performance or cooling system integrity.

Idle Speed Control

In order to maintain A/C cooling performance, the ATCM requests an increase in engine idle speed if the evaporator temperature starts to rise while the refrigerant solenoid valve is already set to the maximum flow rate. The increase in engine idle speed is requested in three stages, using a medium speed CAN bus message to the Engine Control Module (ECM). For additional information, refer to [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - 4.0L) For additional information, refer to [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - 4.4L) For additional information, refer to [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - 2.7L Diesel)

The need for a change in idle speed is determined as follows:

- If the evaporator temperature increases by 3 °C (5.4 °F), or to 6 °C (10.8 °F) above the target operating temperature, over a 10 seconds period, the first stage of idle speed increase is requested.
- When the first stage of idle speed increase is set, if the evaporator temperature increases by 3 °C (5.4 °F), or increases to 12 °C (21.6 °F) above the target operating temperature, over a 9 seconds period, the second stage of idle speed increase is requested.
- When the second stage of idle speed increase is set, if the evaporator temperature increases by 3 °C (5.4 °F), or increases to 15 °C (27 °F) above the target operating temperature, over a 10 seconds period, the third stage of idle speed increase is requested.
- When an idle speed increase is set, if the evaporator temperature decreases by 3 °C (5.4 °F) over a 10 seconds period, the next stage down of idle speed increase is requested.

Electrical Load Management

The ATCM manages the vehicle electrical loads to:

- Maintain the vehicle battery in a healthy state of charge.
- Ensure adequate power is available for defrost demisting during engine warm-up.
- Ensure adequate power is available for A/C during extended periods with the engine at idle speed.
- To maintain system voltage within acceptable limits.
- To provide adequate power to meet customer expectations.

Electrical load management is achieved by increasing the engine idle speed and controlling the electrical load of systems that do not affect the driveability or safety of the vehicle.

During the engine warm-up period, the ATCM manages the electrical load to make sure that the battery voltage is maintained above a pre-determined level. The battery voltage level that is maintained and the duration of the start period varies with ambient air temperature and engine coolant temperature. After the engine warm-up period, the ATCM manages the electrical load to make sure that the requested electrical load does not exceed the generator output.

The duration of the engine warm-up period depends on the ambient air temperature and the engine coolant temperature when the ignition is switched on, as detailed in the following table:

Engine Warm-up Times

Ambient Air Temperature, °C (°F)	Engine Coolant Temperature, °C (°F)			
	<10 (<50)	>10 to <30 (>50 to <86)	>30 to <60 (>86 to <140)	>60 (>140)
Warm-up Period, Minutes				
>10 (>50)	15	15	15	15
>5 to <10 (>41 to <50)	15	15	15	15
>0 to <5 (>32 to <41)	10	15	15	15
>-10 to <0 (>14 to <32)	10	10	15	15
<-10 (<14)	5	5	10	15

The ATCM calculates the electrical load from the battery voltage and generator output voltage, and compares the result against the maximum load available from the generator. The calculation is averaged across the first 20 seconds after the engine starts, and subsequently averaged every 60 seconds. When the ignition is turned off, the ATCM stores the status of the electrical load management for 20 seconds. If the engine is re-started within the 20 seconds, the ATCM resumes electrical load management using the stored status. If the engine is re-started after the 20 seconds, the timers are reset and the ATCM re-calculates the status.

If the electrical load is more than the maximum load available, the ATCM requests an increase of engine idle speed using the medium speed CAN bus message to the ECM. If an electrical load imbalance remains after an increase in engine idle speed, or if the electrical load is more than the capacity of the charging system, the ATCM reduces the electrical load by reducing the power of some vehicle systems or inhibiting their operation. The number of systems controlled depends on the electrical load reduction required. The systems controlled, and the order in which their power is reduced or they are inhibited, are contained in three priority tables. The table used depends on the ambient air temperature, battery temperature and engine coolant temperature:

- The cold start table is used when the ambient air temperature is less than 5 °C (41 °F) and the engine coolant temperature is less than 30 °C (86 °F).
- The hot start table is used when the ambient air temperature is 5 °C (41 °F) or more and the engine coolant temperature is less than 30 °C (86 °F).
- The continuous table is used when battery temperature is more than 5 °C (41 °F) and the engine coolant temperature is more than 50 °C (122 °F).
- If none of above conditions are met, the ATCM adopts the last used table.

Cold Start Electrical Load Management

Priority		System
Power Reduction	Inhibited	
1	-	Air suspension
2	-	Front seat heaters
3	-	Entertainment system
-	4	Front seat heaters
5	-	Auxiliary climate control blower
6	-	Rear window heater
7	-	Windshield washer jet and exterior mirror heaters
-	8	Windshield washer jet and exterior mirror heaters
9	-	Windshield heater

10	-	Primary climate control blower
-	11	Auxiliary climate control blower
-	12	Rear window heater
-	13	Windshield heater

Hot Start Electrical Load Management

Priority		System
Power Reduction	Inhibited	
-	1	Front seat heaters; windshield washer jet and exterior mirror heaters
2	-	Windshield heater
3	-	Rear window heater
4	-	Air suspension
5	-	Entertainment system
-	6	Windshield heater
-	7	Rear window heater
8	-	Auxiliary climate control blower
-	9	Auxiliary climate control blower

Continuous Electrical Load Management

Priority		System
Power Reduction	Inhibited Operation	
-	1	Front seat heaters
2	-	Windshield heater
3	-	Rear window heater
4	-	Auxiliary climate control blower
5	-	Air suspension
6	-	Entertainment system
-	7	Auxiliary climate control blower

Engine idle speed changes, and electrical load changes of systems not under direct control of the ATCM (air suspension and entertainment), are initiated using the appropriate medium speed CAN bus message. When partial operation is requested:

- The air suspension system still performs height changes but reduces air compressor operation by not replenishing the reservoir.
- The entertainment system restricts the maximum volume level and reduces the output frequency bandwidth.

Cooling Fan Control

The ATCM determines the amount of condenser cooling required from the refrigerant pressure, since there is a direct relationship between the temperature and pressure of the refrigerant. The cooling requirement is transmitted to the ECM in a medium speed CAN bus message. The ECM controls the condenser cooling using the cooling fan. For additional information, refer to [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - 4.0L)

For additional information, refer to [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - 4.4L)

For additional information, refer to [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - 2.7L Diesel)

Air Temperature Control

Air from the evaporator enters the heater assembly, where temperature blend doors direct a proportion of the air through the heater core to produce the required discharge air temperature. On the automatic control system two temperature blend doors operate independently to enable independent temperature selection for the left and right sides of the vehicle interior. The temperature blend doors are operated by a single stepper motor on manual systems and two stepper motors on automatic systems. The stepper motor(s) are controlled by the ATCM using LIN bus messages. For additional information, refer to [Communications Network](#) (418-00 Module Communications Network)

The ATCM calculates the stepper motor position required to achieve the selected temperature and compares it against the current position, which is stored in memory. If there is any difference, the ATCM signals the stepper motor to adopt the new position.

Air temperature is controlled automatically unless maximum heating or maximum cooling is selected. The required air temperature may be adjusted between 16 °C (61 °F) and 28 °C (82 °F) using the air temperature control switches. The control algorithms then attempt to maintain the desired set temperature.

Turning the temperature switches fully counterclockwise gives maximum available cooling. Turning the temperature switches fully clockwise gives maximum available heating. When maximum cooling or maximum heating is selected, the comfort algorithm adopts an appropriate strategy for the air distribution, blower speed, A/C and air source functions, except where a function is under manual control.

On the automatic system, the temperature control of one zone can be compromised by the other zone being set to maximum heating or maximum cooling. True maximum heating or maximum cooling can only be obtained with both controls set to the same maximum state.

When the economy mode is selected, the automatic temperature control function still operates, but with no cooling capability the minimum discharge temperature achievable will be ambient air temperature plus any heat pick up in the air intake path.

Air Distribution Control

When the A/C is in the automatic mode, the ATCM automatically controls air distribution according to a comfort strategy. Automatic control is overridden when one of the manual modes is selected. Air distribution remains manually controlled until the automatic mode is selected again. The distribution doors are operated by two stepper motors, which are controlled by the ATCM using LIN bus messages.

Blower Control

When A/C is selected or the blower speed is manually selected, the ATCM energizes the coil of the blower relay in the Battery Junction Box (BJB). The energized blower relay supplies battery power to the blower motor, which is grounded through the blower control module. The speed of the blower is controlled by a PWM signal from the ATCM to the blower control module. The blower control module regulates the blower motor voltage in relation to the PWM signal.

When the blower is in the automatic mode the ATCM determines the blower speed required from the comfort algorithms. When the blower is in the manual mode, the ATCM operates the blower at one of seven fixed speeds as selected on the control panel.

Programmed Defrost

The programmed defrost function automatically provides the maximum defrosting of the vehicle. When the programmed defrost function is selected, the ATCM configures the control system as follows:

- Automatic mode off.
- Air inlet to fresh air, manual control.
- Selected temperature unchanged, automatic control.
- Air distribution set to screen mode, manual control.
- Blower speed set to speed 5, manual control.
- Rear screen heater and windshield heater (if applicable) selected on.
- A/C mode in automatic.

The programmed defrost function is cancelled by one of the following:

- Selecting any distribution switch. The system response will be identical to the normal manual distribution control

- operation.
- Selecting the automatic switch. This will restore the system to fully automatic operation.
- Selecting the programmed defrost switch again. This returns the system to the state in use immediately before the programmed defrost function was first selected.
- Turning the ignition off.

The blower speed can be adjusted manually without terminating the programmed defrost function.

Intake Air Control

The source of intake air is automatically controlled unless overridden by manual selection of recirculation. Under automatic control the ATCM determines the required position of the recirculation door from the comfort strategy and the input from the pollution sensor (if fitted). The recirculation door is operated by an electric motor, which is controlled by hardwired analogue signals from the ATCM. A potentiometer in the motor supplies the ATCM with a position feedback signal for closed loop control.

Provided the intake air has not been manually selected to recirculation, the ATCM adjusts the recirculation door to reduce the ram effect produced by the forward motion of the vehicle.

When the ignition switch is turned off, the ATCM evaluates the ambient air temperature. If the ambient air temperature is less than a pre-determined value, the intake air source is set to recirculation, to prevent the ingress of damp air while the vehicle is parked.

When the vehicle is in the transportation mode, the ATCM sets the intake door to recirculation every time the ignition is turned off, regardless of the ambient air temperature.

Pollution Sensing

With a pollution sensor fitted to the vehicle, the ATCM controls the intake air source to reduce contamination of the intake air by external pollutants. This function is fully automatic, but can be overridden by manual selection of the intake air source.

Humidity Sensing

With a humidity sensor fitted, the ATCM controls the moisture content of the air in the vehicle. This is achieved by raising the evaporator temperature to increase the humidity of the air entering the vehicle, and reducing the evaporator temperature to reduce the humidity of the air entering the vehicle.

Front Seat Heaters

The front seat heaters are enabled when the ignition switch is position II, and operate at one of two temperature settings. With the first press of a front seat heater switch the ATCM adopts the higher temperature setting, supplies a power feed to the related front seat heater elements and illuminates two amber LED's in the switch. At the second press of the switch the ATCM adopts the lower temperature setting and extinguishes one of the LED's. At the third press of the switch the ATCM de-energizes the heater elements and extinguishes the second LED. The seat heaters remain on until selected off or the ignition is turned off.

The ATCM receives an input from a temperature sensor in each front seat, and regulates the power feed of the heater elements to control the seat temperature at the appropriate temperature setting between 35 and 45 °C (95 and 113 °F). The actual temperature settings vary with the type of seat covering, to allow for the different heat conduction properties of the different materials.

When the front seat heaters are activated at the higher temperature setting, the ATCM automatically resets them to the lower temperature after a time delay. The length of the time delay depends on the in-vehicle temperature.

Temperature Reset Time Delay

In-vehicle Temperature, °C (°F)	<-15 (5)	-15 to -10 (5 to 14)	-10 to 0 (14 to 32)	0 to 15 (32 to 59)	15 to 25 (59 to 77)	>25 (77)
Time Delay, minutes	Remains at higher temperature until	20	15	10	5	3

	manually de-selected					
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To protect the heater elements, the ATCM disables front seat heating if battery voltage exceeds 16.5 ± 0.3 volts for more than 5 seconds. Front seat heating is re-enabled when battery voltage decreases to 16.2 ± 0.3 volts.

The ATCM monitors the power feeds to the heater elements and disables the applicable front seat heating if a short or open circuit is detected. The ATCM also disables seat heating if the seat temperature rises significantly above the target temperature setting.

The plausibility of the temperature sensor inputs is also monitored by the ATCM. When seat heating is selected, if one of the temperature sensor inputs is within $5\text{ }^{\circ}\text{C}$ ($9\text{ }^{\circ}\text{F}$) below the target temperature, the ATCM monitors the sensor input for a temperature increase and checks that it is between the minimum and maximum working temperatures. If a temperature sensor input is at the high end of the working range, while the ambient air temperature and the engine temperature are within $10\text{ }^{\circ}\text{C}$ ($18\text{ }^{\circ}\text{F}$) of each other, the ATCM disables front seat heating until the input decreases below the target temperature setting. The ATCM interprets a temperature sensor input value of $-45\text{ }^{\circ}\text{C}$ ($-49\text{ }^{\circ}\text{F}$) or below as an open circuit, and temperature sensor input value of $100\text{ }^{\circ}\text{C}$ ($212\text{ }^{\circ}\text{F}$) or more as a short circuit.

Rear Window Heater

The ATCM controls operation of the rear window heater using medium speed CAN messages to operate the rear window heater relay in the Central Junction Box (CJB). The control module in the CJB interprets the CAN messages and switches the ground connection of the relay coil to operate the rear window heater. While the rear window heater relay is energized, a battery power feed is connected to the rear window heater elements. Rear window heater operation is only enabled when the engine is running.

The ATCM operates the rear window heater in heating cycles of varying power and time. The heating cycle used depends on the ambient air temperature and whether it is the initial or subsequent operation during the current ignition cycle.

When the rear window heater switch is pressed, the ATCM illuminates an LED in the switch and initiates the appropriate heating cycle. The LED remains illuminated until the rear window heater is selected off, the heating cycle is completed or the engine stops. If the engine stalls or the ignition is turned off, rear window heating resumes if the engine is re-started within 20 seconds.

On the initial selection of rear window heating, the ATCM uses a short or long defrost phase at full power, followed by a low power phase. The defrost phase used depends on the ambient temperature. During the low power phase, the rear window heater relay is cycled off for 80 seconds and on for 40 seconds.

On subsequent operations, during the same ignition cycle, the ATCM operates the rear window heater at full power for a fixed time period.

Rear Window Heating Phases

Phase	Time, minutes
Short defrost (-5°C (23°F) and above)	10
Long defrost (less than -5°C (23°F))	15
Low power	20
Subsequent operation	10

Windshield Heater

The ATCM controls operation of the windshield heater using the windshield heater relay in the BJB. The ATCM switches the ground connection of the relay coil to operate the windshield heater. While the windshield heater relay is energized, a battery power feed is connected to each of the two windshield heater elements. Windshield heater operation is only enabled when the engine is running.

The ATCM operates the windshield heater in heating cycles of varying power and time. The heating cycle used depends on the ambient air temperature and whether it is the initial or subsequent operation during the current ignition cycle.

When the windshield heater switch is pressed, the ATCM illuminates an LED in the switch and initiates the appropriate heating cycle. The LED remains illuminated until the windshield heater is selected off, the heating cycle is completed or the engine stops. If the engine stalls or the ignition is turned off, windshield heating resumes if the engine is re-started

within 20 seconds.

On the initial selection of the windshield heater, the ATCM uses a short or long defrost phase at full power, followed by a low power phase. The defrost phase used depends on the ambient temperature. During the low power phase, the windshield heater relay is cycled off for 80 seconds and on for 40 seconds.

On subsequent operations, during the same ignition cycle, the ATCM operates the windshield heater at full power for a fixed time period.

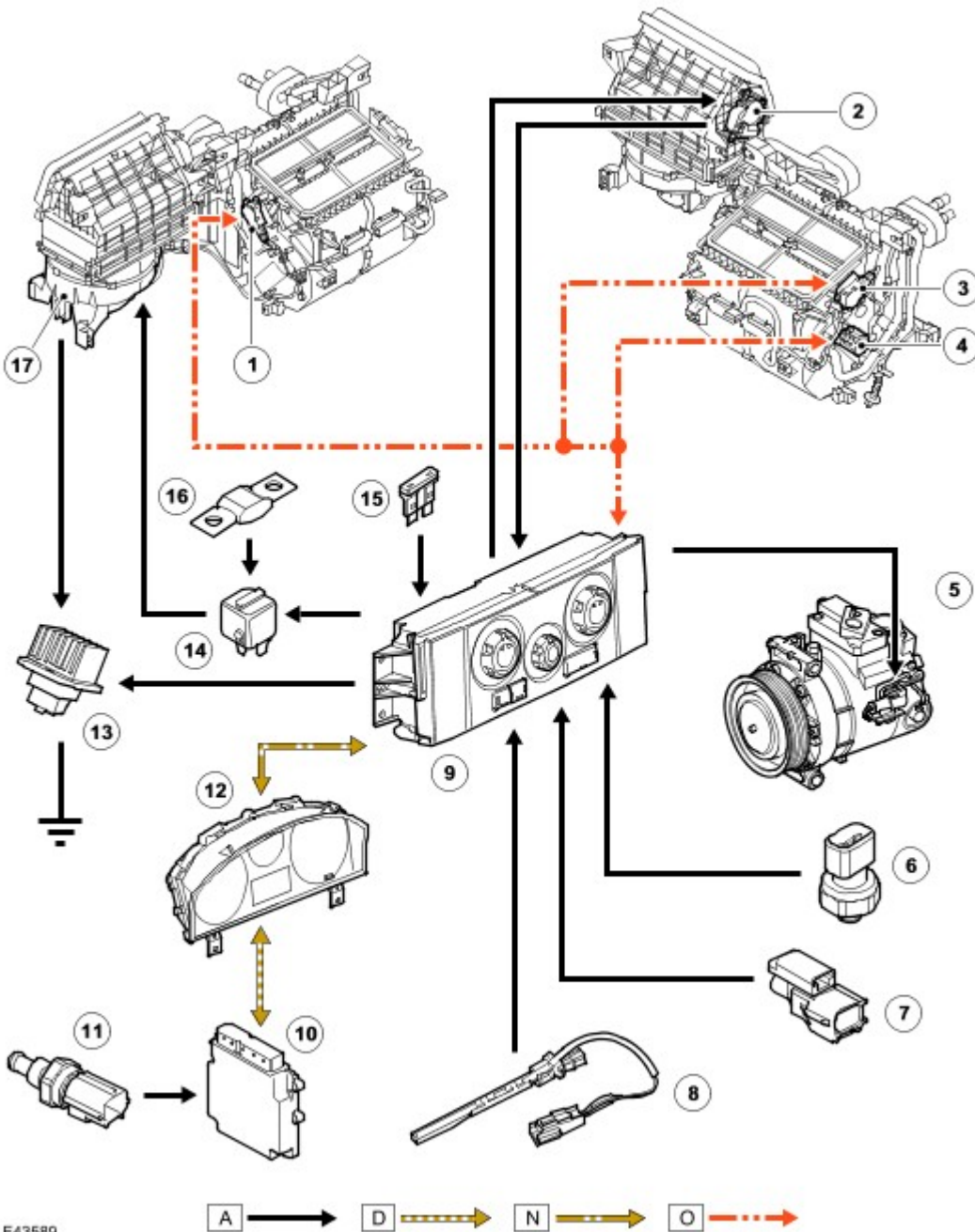
Windshield Heating Phases

Phase	Time, minutes
Short defrost (-5°C (23°F) and above)	3
Long defrost (less than -5°C (23°F))	5
Low power	10
Subsequent operation	3

MANUAL SYSTEM CONTROL DIAGRAM

NOTE :

A = Hardwired connections; D = High speed CAN bus; N = Medium speed CAN bus; O = LIN bus



E43589

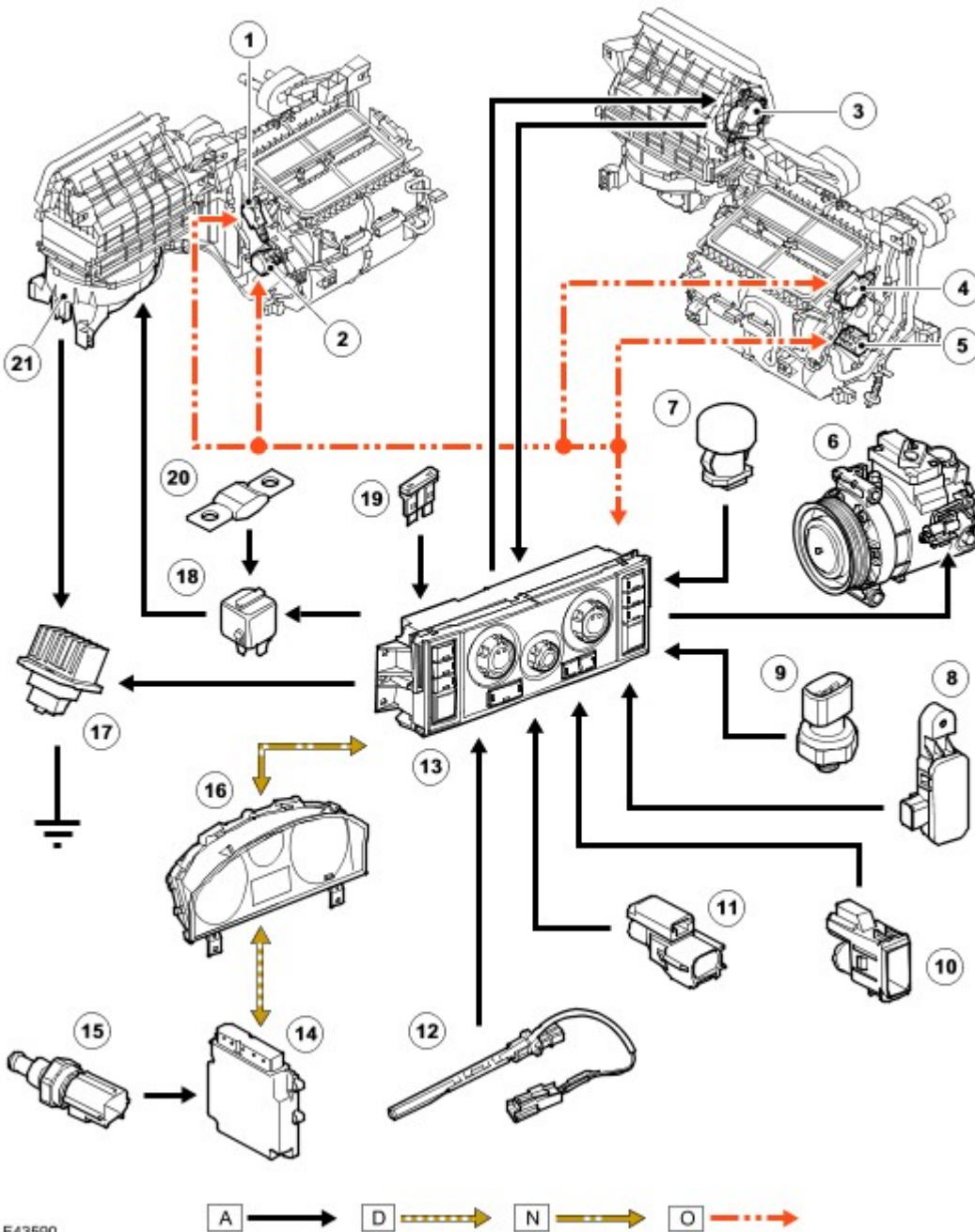
Item	Part Number	Description
1		Face and feet distribution door motor
2		Recirculation door motor
3		Windshield distribution door motor
4		Temperature blend motor
5		A/C compressor solenoid valve
6		Refrigerant pressure sensor
7		Ambient air temperature sensor
8		Evaporator temperature sensor
9		ATCM
10		ECM

11		Engine Coolant Temperature (ECT) sensor
12		Instrument cluster
13		Blower control module
14		Blower relay
15		Fuse 51P, CJB (permanent battery power feed)
16		Fusible link 12E, BJB
17		Blower

AUTOMATIC SYSTEM CONTROL DIAGRAM

NOTE :

A = Hardwired connections; D = High speed CAN bus; N = Medium speed CAN bus; O = LIN bus



E43590

Item	Part Number	Description
1		Face and feet distribution motor
2		LH temperature blend motor
3		Recirculation motor
4		Windshield distribution motor
5		RH temperature blend motor
6		A/C compressor solenoid valve
7		Sunlight sensor
8		Pollution sensor
9		Refrigerant pressure sensor

10		In-vehicle temperature sensor (automatic system, all except Japan) or in-vehicle temperature and humidity sensor (automatic system, Japan only)
11		Ambient air temperature sensor
12		Evaporator temperature sensor
13		ATCM
14		ECM
15		Engine Coolant Temperature (ECT) sensor
16		Instrument cluster
17		Blower control module
18		Blower relay
19		Fuse 51P, CJB (permanent battery power feed)
20		Fusible link 12E, BJB
21		Blower