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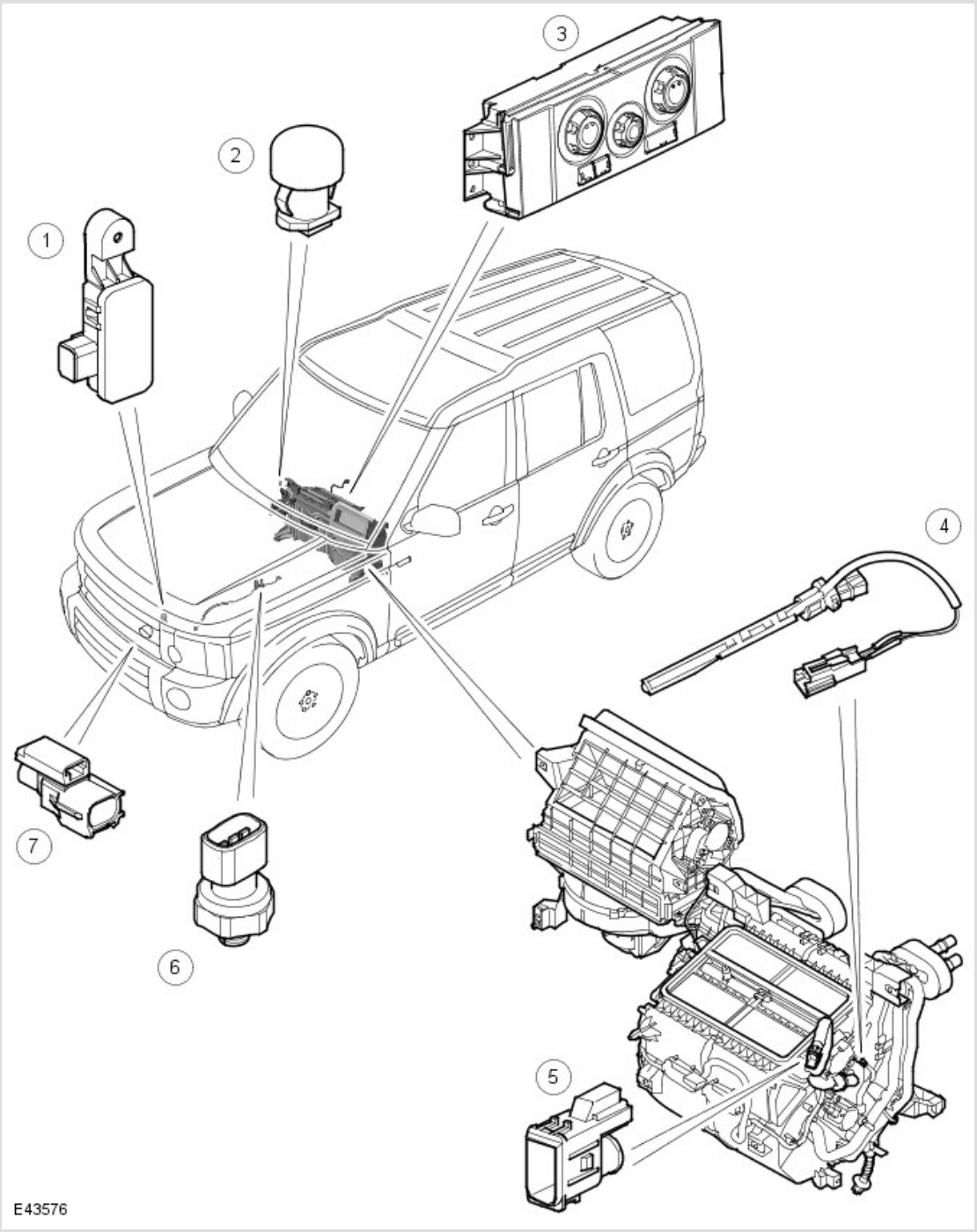
CONTROL COMPONENTS

DESCRIPTION AND OPERATION

COMPONENT LOCATIONS

NOTE:

right-hand drive (RHD) installation shown, left-hand drive (LHD) similar.



ITEM	DESCRIPTION
1	Pollution sensor (Japan only)
2	Sunlight sensor
3	automatic temperature control (ATC) module
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 left-hand (LH) and right-hand (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 ATC module.
- An ambient air 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.

ATC MODULE

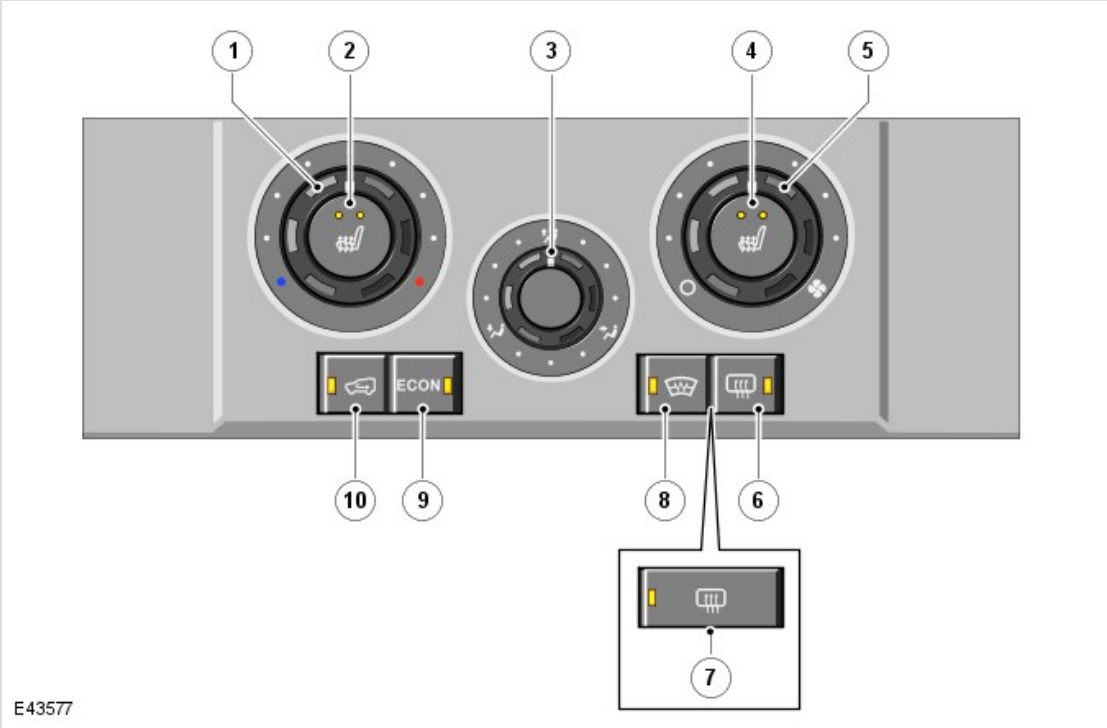
The ATC module is installed in the center console. An integral control panel contains push switches and rotary switches for system control inputs. light emitting diode (LED)s in the switches and switch surrounds illuminate to indicate the current settings of the system. Switch symbols are illuminated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

The ATC module 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 ATC module also controls the following:

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

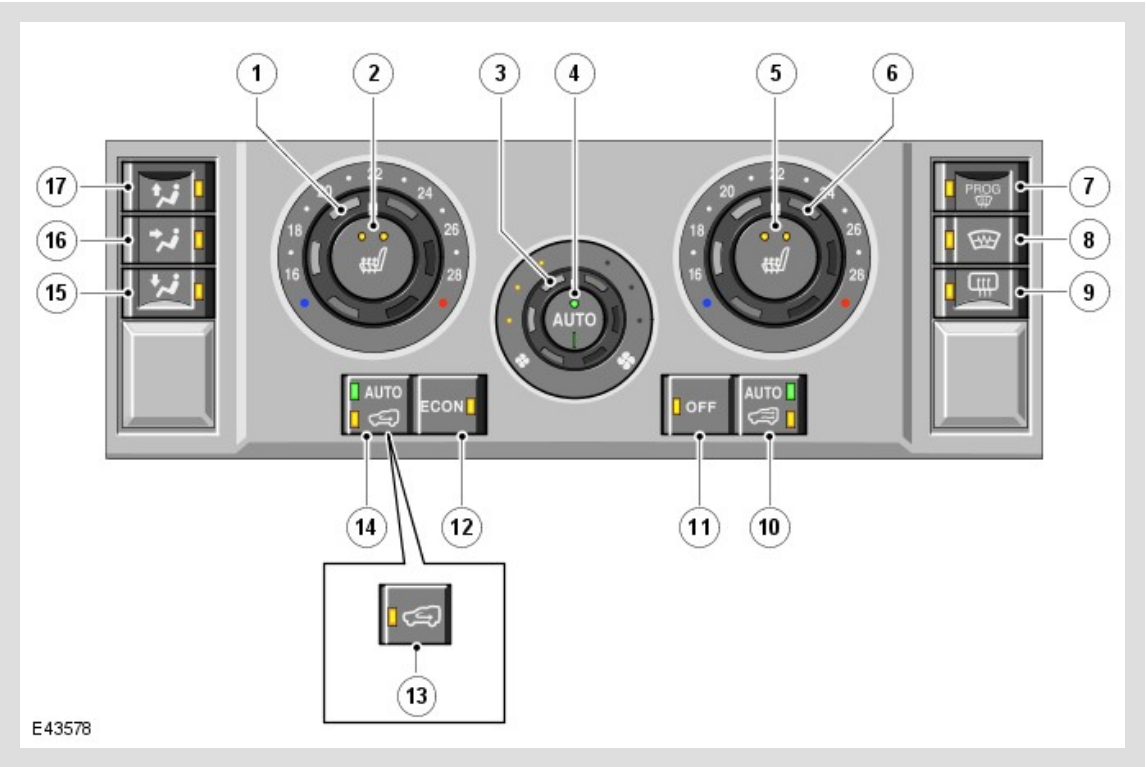
MANUAL SYSTEM CONTROL PANEL



ITEM	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

AUTOMATIC SYSTEM CONTROL PANEL



ITEM	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

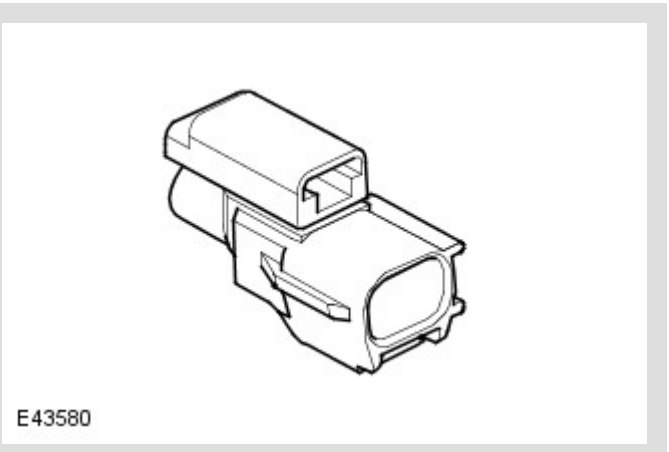
11	System off switch
12	Economy switch
13	Recirculation switch (models without pollution sensing)
14	Recirculation switch (models with pollution sensing)
15	Distribution switch - feet
16	Distribution switch - face
17	Distribution switch - windshield

INPUTS AND OUTPUTS

Four electrical connectors provide the interface between the ATC module and the vehicle wiring.

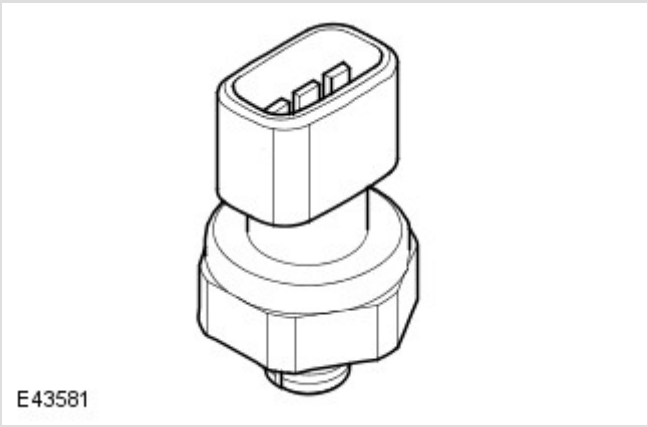
The control system sensors provide hardwired inputs to the ATC module. The ATC module also uses the LIN (local interconnect network) bus to communicate with the auxiliary climate control system and the door motors in the heater assembly, and the medium speed CAN bus to communicate with other control modules on the vehicle. For additional information, refer to: Communications Network (418-00 Module Communications Network, Description and Operation).

AMBIENT AIR TEMPERATURE SENSOR



The ambient temperature sensor is a negative temperature coefficient (NTC) thermistor that provides the ATC module 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



The refrigerant pressure sensor provides the ATC module 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.

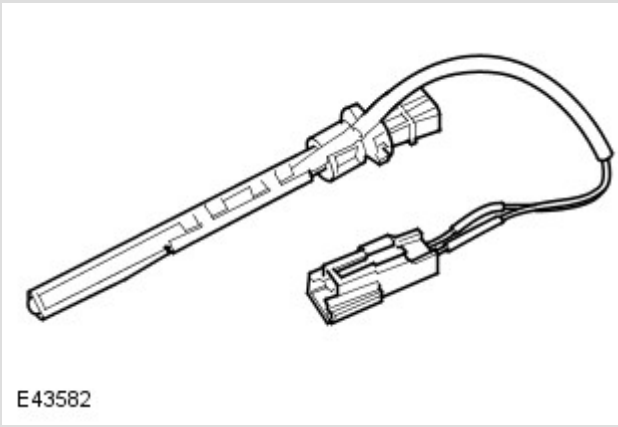
The ATC module supplies a 5 V reference voltage to the refrigerant pressure sensor and receives a return signal voltage, between 0 and 5 V, related to system pressure.

The ATC module 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 ATC module 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 ATC module sets the A/C compressor to the minimum flow position if the pressure:

- Decreases to 1.9 ± 0.2 bar (27.5 ± 3 lbf/in ^{2}): the ATC module loads the A/C compressor again when the pressure increases to 2.8 ± 0.2 bar (40.5 ± 3 lbf/in ^{2}).
- Increases to 33 ± 1 bar (479 ± 14.5 lbf/in ^{2}): the ATC module loads the A/C compressor again when the pressure decreases to 23.5 ± 1 bar (341 ± 14.5 lbf/in ^{2}).

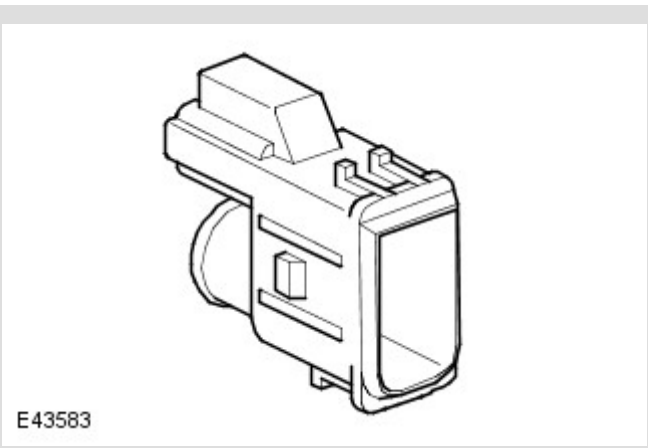
EVAPORATOR TEMPERATURE SENSOR



The evaporator temperature sensor is a NTC thermistor that provides the ATC module 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 ATC module 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



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.

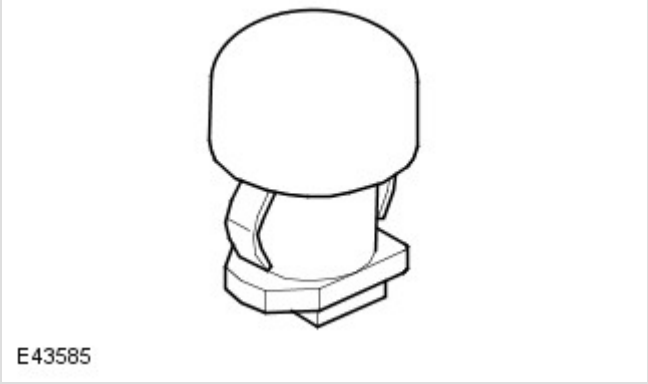
HUMIDITY SENSOR (WHERE FITTED)

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.

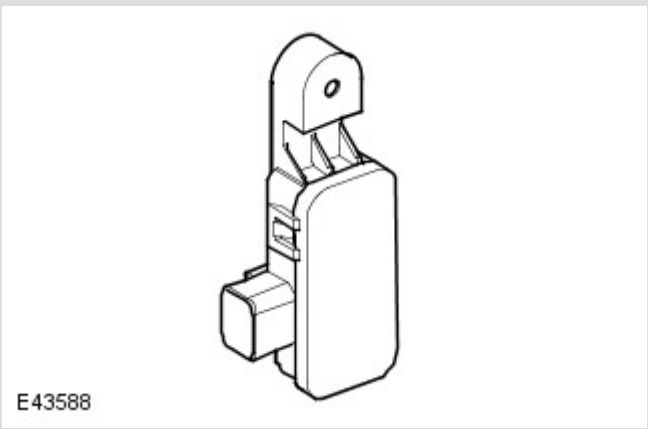
The humidity sensor and the in-vehicle temperature sensor are connected to a PCB (printed circuit board) inside the sensor housing. The PCB is powered by a 5V feed from the ATC module. Separate signals of temperature and relative humidity are transmitted from the PCB to the ATC module.

SUNLIGHT SENSOR



The sunlight sensor consists of two photoelectric cells that provide the ATC module 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 ATC module 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 ATC module.

POLLUTION SENSOR



The pollution sensor allows the ATC module 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 ATC module, and returns separate signals of hydrocarbon and oxidized gases.

If there is a fault with the pollution sensor, the ATC module 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 ATC module using a 400 Hz pulse width modulation (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 ATC module maintains the evaporator at an operating temperature that varies with the in-vehicle cooling requirement. The ATC module 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 humidity control function, the ATC module 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 ATC module 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 ATC module 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 ECM, which uses the calculated value for idle speed control and fueling control. The ATC module 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 ATC module 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 ATC module 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 ECM. For additional information, refer to:

Electronic Engine Controls (303-14A Electronic Engine Controls - 4.0L, Description and Operation),
Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L, Description and Operation),
Electronic Engine Controls (303-14C Electronic Engine Controls - 2.7L Diesel, Description and Operation).
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 ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module stores the status of the electrical load management for 20 seconds. If the engine is re-started within the 20 seconds, the ATC module resumes electrical load management using the stored status. If the engine is re-started after the 20 seconds, the timers are reset and the ATC module re-calculates the status.

If the electrical load is more than the maximum load available, the ATC module 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 ATC module 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 ATC module 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 ATC module (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 ATC module 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, Description and Operation),
Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L, Description and Operation),
Electronic Engine Controls (303-14C Electronic Engine Controls - 2.7L Diesel, Description and Operation).

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 ATC module using LIN bus messages.

The ATC module 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 ATC module signals the stepper motor to adopt the new position.

When maximum cooling or maximum heating is selected, the ATC module overrides any previously selected options and sets the temperature, air source, blower speed and air distribution as detailed in the following table.

NOTE:

* Cold engine lock-out may be invoked, whereby blower operation is suspended until the engine reaches operating temperature.

FUNCTION	MAXIMUM COOLING	MAXIMUM HEATING
Temperature control	Blend door fully closed	Blend door fully open
Air source	Recirculated air	Fresh air
Blower speed	Maximum	Maximum *
Air distribution	Face (with bleed to feet)	Feet and Screen

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 ATC module 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 ATC module using LIN bus messages.

When air distribution is selected to a combination of face and feet, if the air is being heated the distribution is biased towards the feet. If the air is being cooled the distribution is biased towards the face.

BLOWER CONTROL

When A/C is selected or the blower speed is manually selected, the ATC module 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 ATC module 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 ATC module determines the blower speed required from the comfort algorithms. When the blower is in the manual mode, the ATC module 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 ATC module 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 ATC module 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 ATC module. A potentiometer in the motor supplies the ATC module with a position feedback signal for closed loop control.

Provided the intake air has not been manually selected to recirculation, the ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module adopts the higher temperature setting, supplies a power feed to the related front seat heater elements and illuminates two amber LEDs in the switch. At the second press of the switch the ATC module adopts the lower temperature setting and extinguishes one of the LEDs. At the third press of the switch the ATC module 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 ATC module 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 ATC module 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 manually de-selected	20	15	10	5	3

To protect the heater elements, the ATC module 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 ATC module monitors the power feeds to the heater elements and disables the applicable front seat heating if a short or open circuit is detected. The ATC module 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 ATC module. When seat heating is selected, if one of the temperature sensor inputs is within 5 °C (9 °F) below the target temperature, the ATC module 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 °C (18 °F) of each other, the ATC module disables front seat heating until the input decreases below the target temperature setting. The ATC module interprets a temperature sensor input value of -45 °C (-49 °F) or below as an open circuit, and temperature sensor input value of 100 °C (212 °F) or more as a short circuit.

REAR WINDOW HEATER

The ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module controls operation of the windshield heater using the windshield heater relay in the BJB. The ATC module 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 ATC module 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 ATC module 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 ATC module 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 ATC module operates the windshield heater at full power for a fixed time period.

Windshield Heating Phases

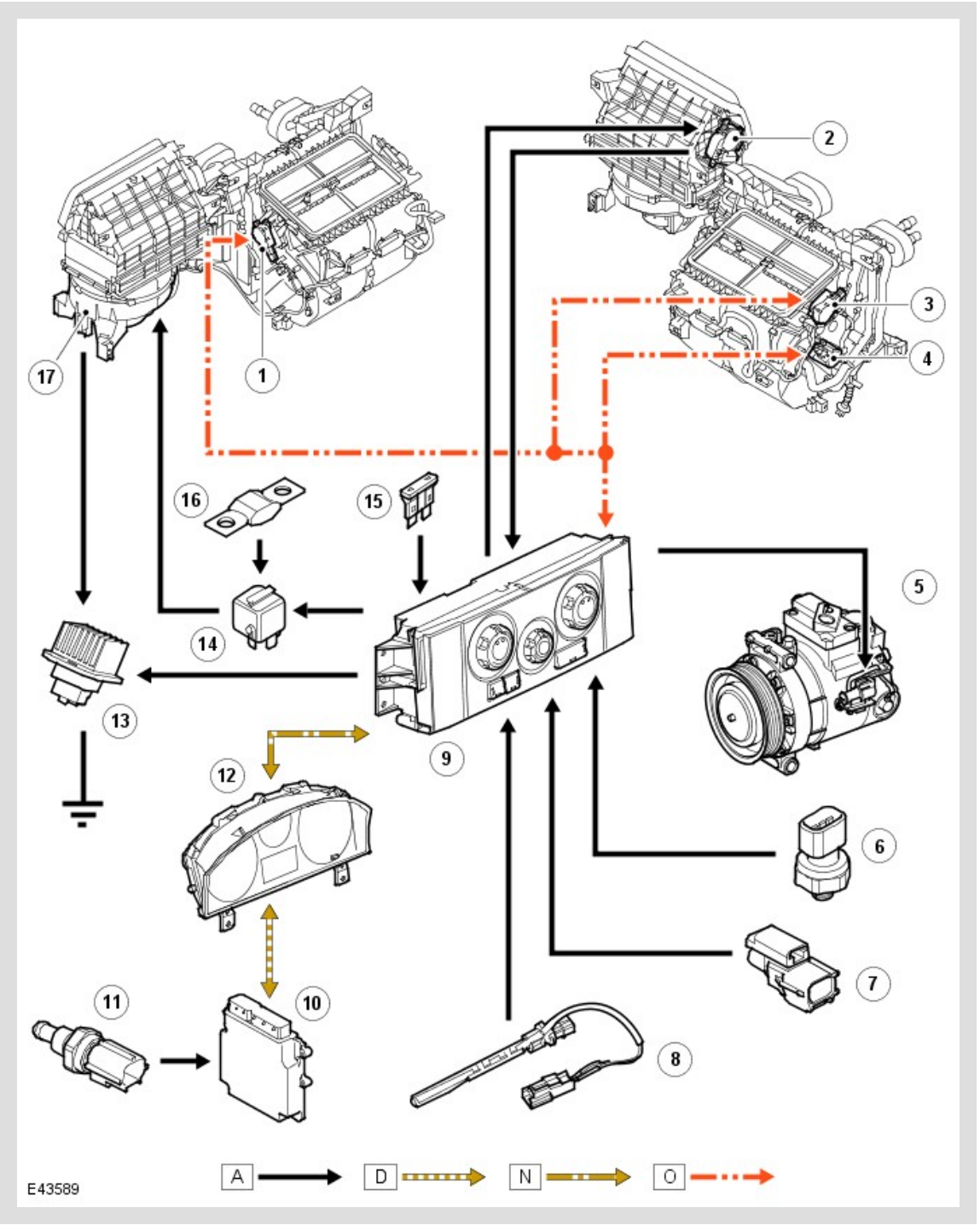
PHASE	TIME, MINUTES

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



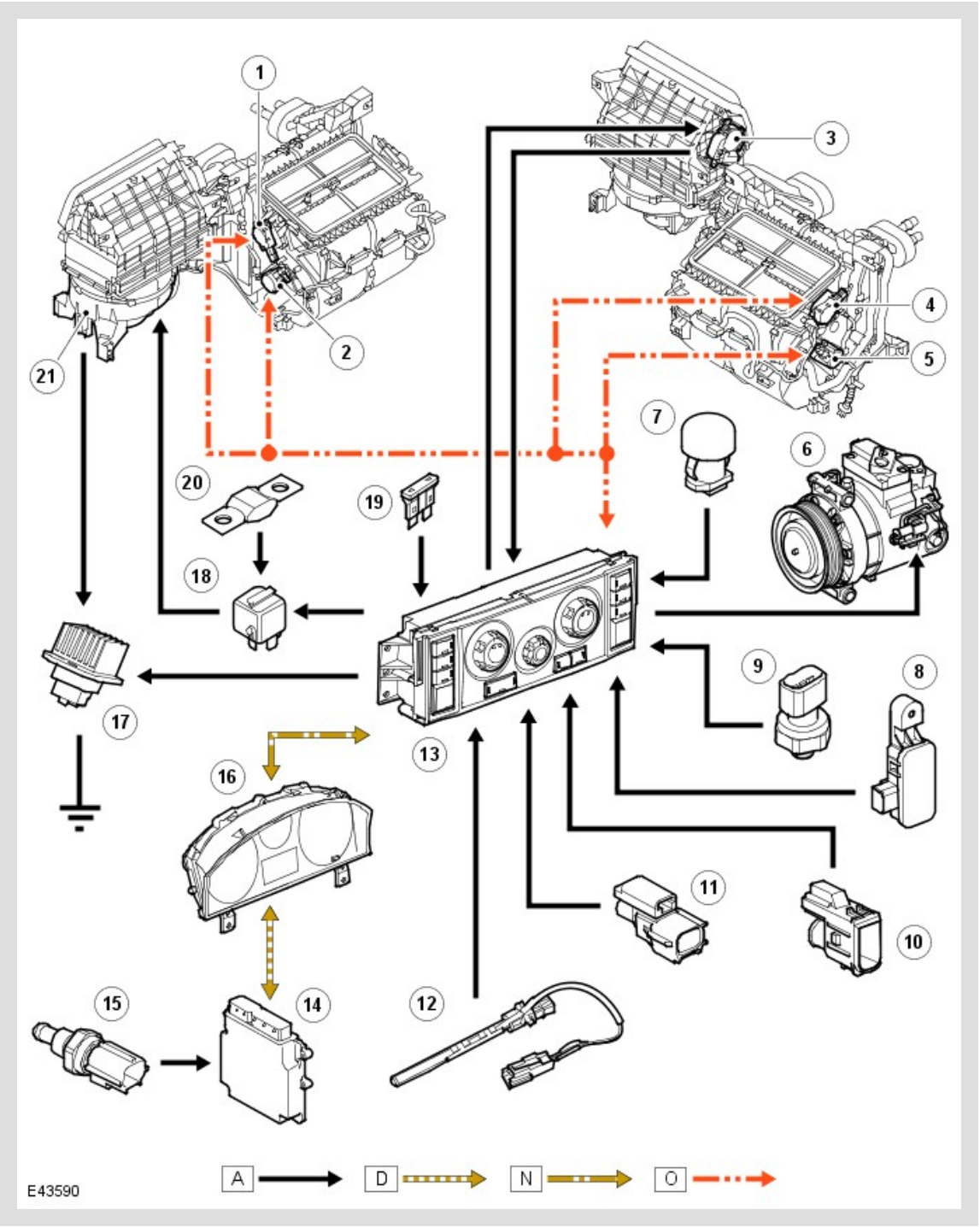
ITEM	DESCRIPTION
1	Face and feet distribution door motor
2	Recirculation door motor
3	Windshield distribution door motor
4	Temperature blend motor
5	A/C compressor solenoid valve
6	Refrigerant pressure sensor
7	Ambient air temperature sensor

8	Evaporator temperature sensor
9	ATC module
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



ITEM	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 (Japan only)
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	ATC module
14	ECM
15	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