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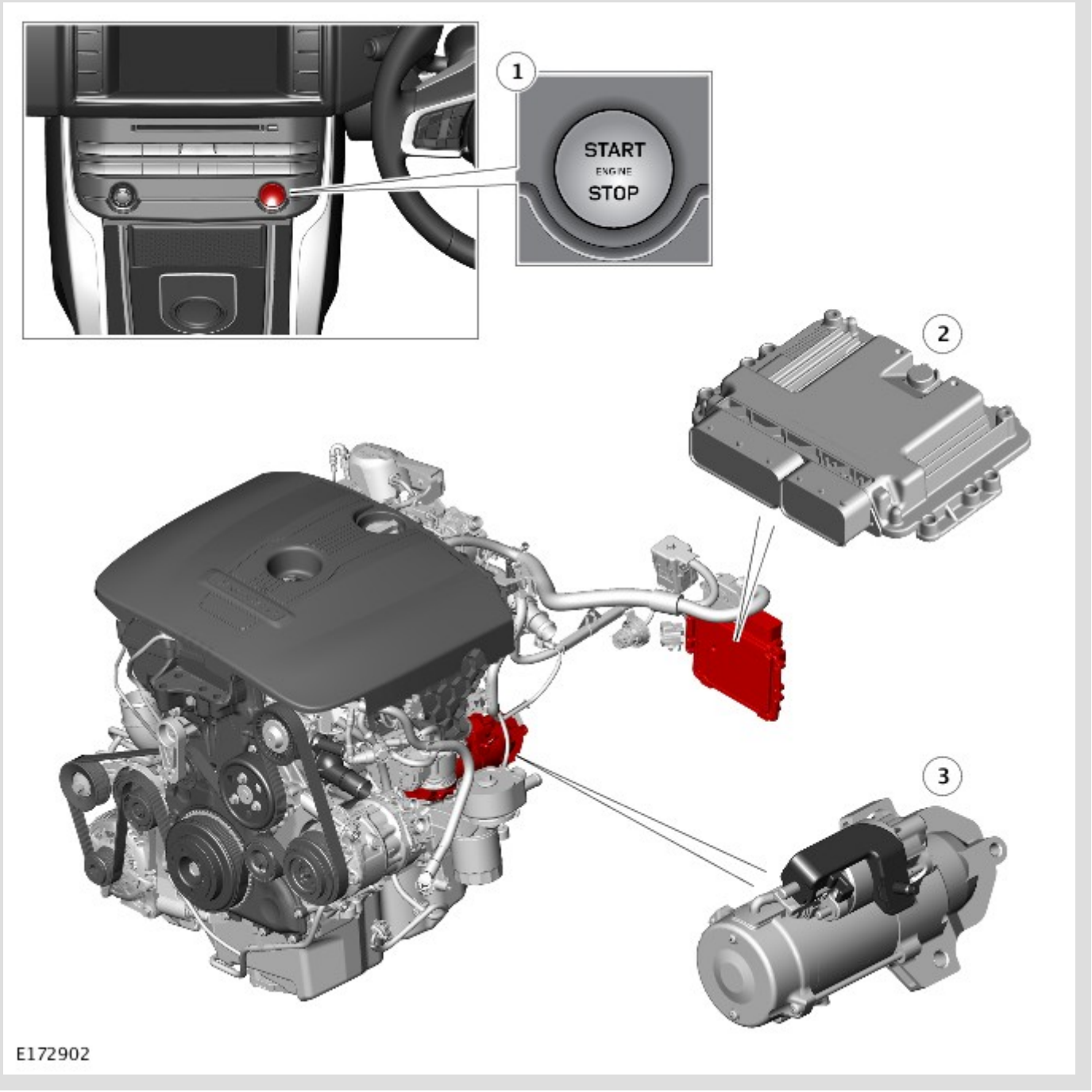
2017.0 XE (X760), 303-06B

STARTING SYSTEM - GTDI 2.0L PETROL

DESCRIPTION AND OPERATION

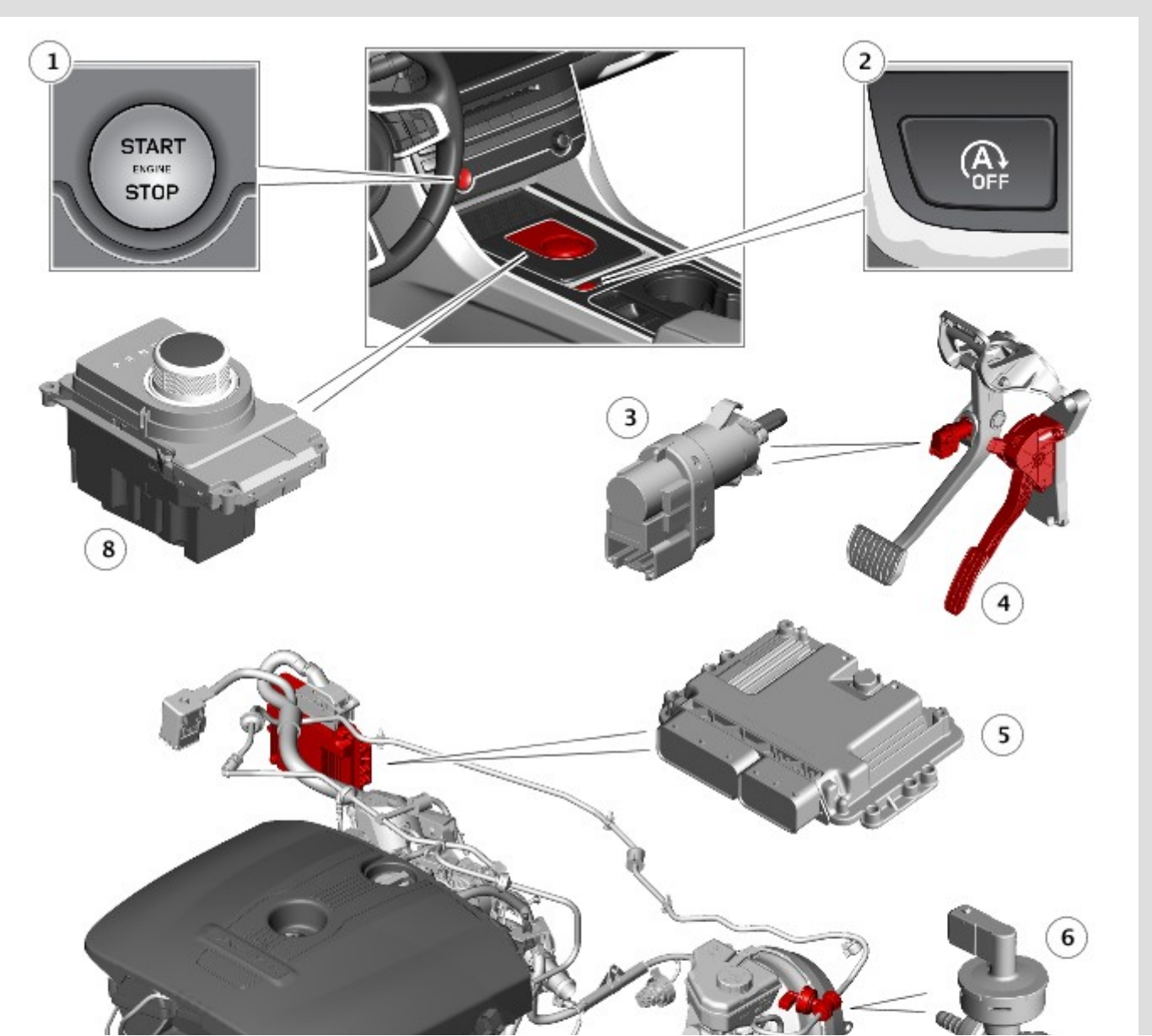
COMPONENT LOCATION - SHEET 1 OF 2 - STARTING SYSTEM, VEHICLES WITHOUT AUTO STOP/START

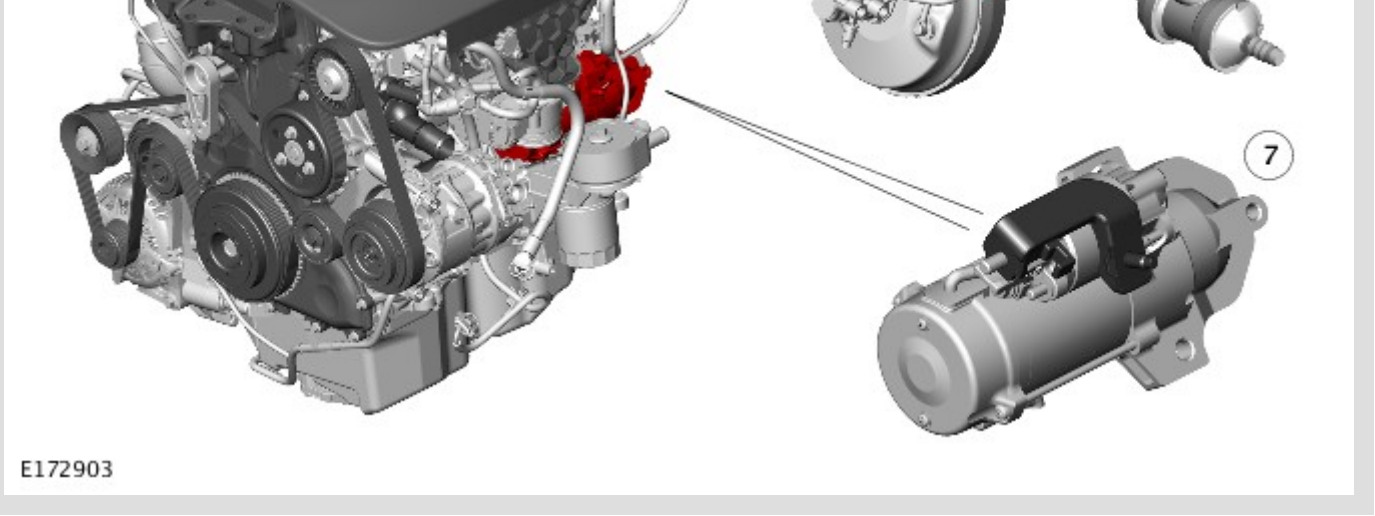


ITEM	DESCRIPTION
1	Stop/start switch

ITEM	DESCRIPTION
2	Powertrain Control Module (PCM)
3	Starter motor

COMPONENT LOCATION - SHEET 2 OF 2 - STARTING SYSTEM, VEHICLES WITH AUTO STOP/START





ITEM	DESCRIPTION
1	Stop/start switch
2	Auto stop/start switch
3	Brake pedal switch
4	Accelerator Pedal Position (APP) sensor
5	Powertrain Control Module (PCM)
6	Brake vacuum switch
7	Starter motor
8	Transmission Control Switch (TCS)

OVERVIEW

Depending on the market specification the engines are fitted with one of two types of starting system:

- Vehicles without auto stop/start system.
- Vehicles with auto stop/start system.

Both types of starting system are passive systems controlled by the Powertrain Control Module (PCM). The PCM initiates starting system operation when a valid smart key is in the vehicle and the engine stop/start switch is pressed.

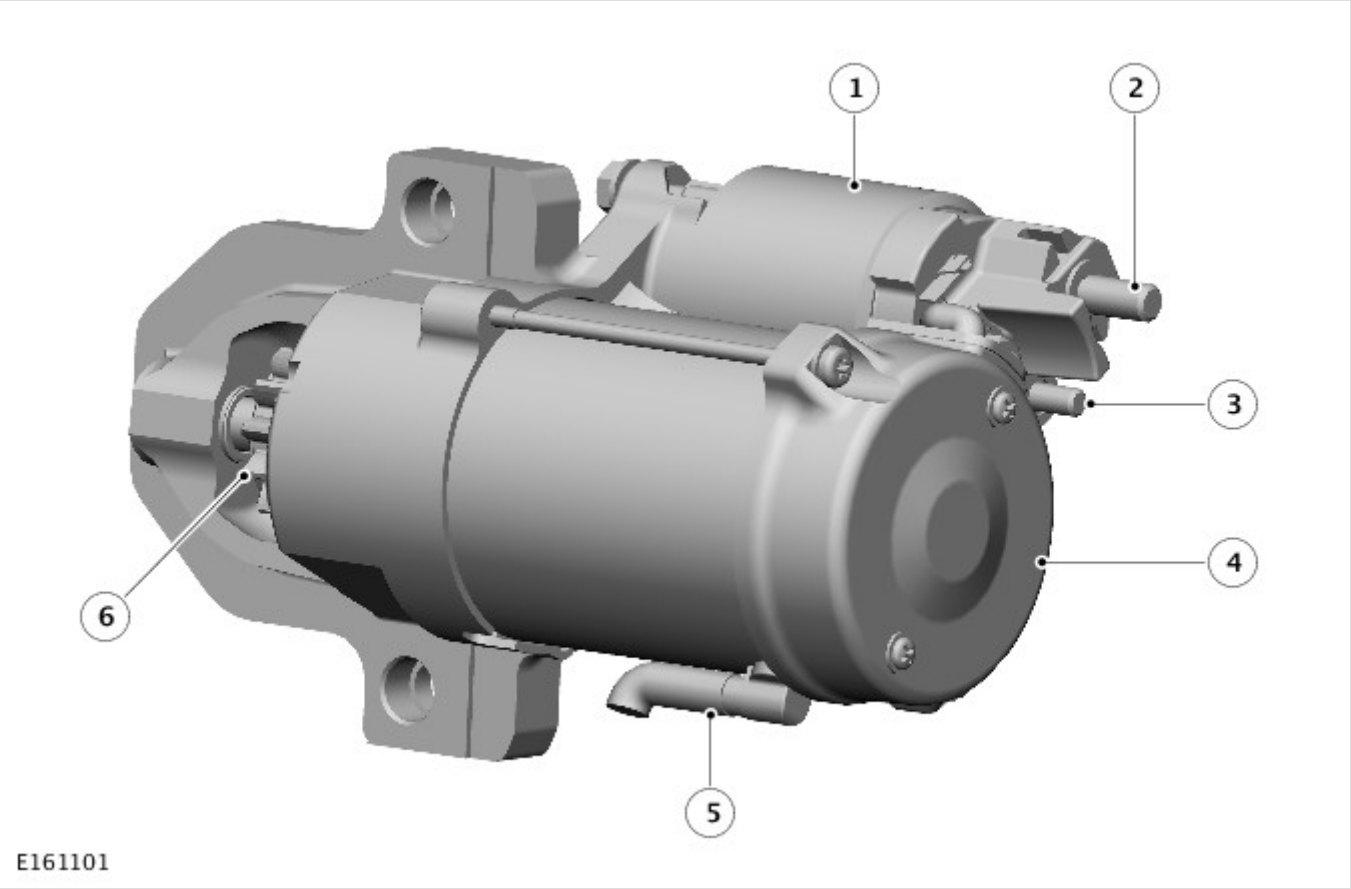
The PCM controls operation of the starter motor using a starter relay in the Engine Junction Box 2 (EJB 2), on vehicles with and without auto stop/start system.

On vehicles with auto stop/start system the PCM interacts with other vehicle systems to determine when stop/start operation is required. The auto stop/start warning indicator provides a visual indication of when the engine is stopped in a stop/start cycle. The stop/start function is automatically activated each time an ignition cycle occurs. However, if required the driver can deactivate the system using auto stop/start switch.

Vehicles with auto stop/start system incorporate a brake vacuum sensor to enable the PCM to monitor the pressure in the brake booster during stop/start operation.

DESCRIPTION

STARTER MOTOR



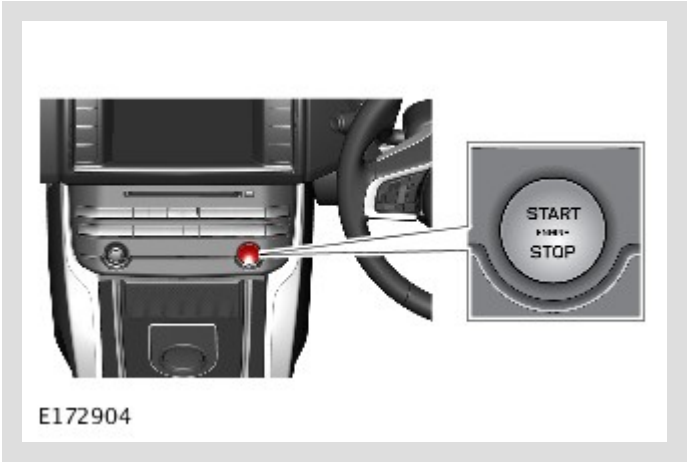
ITEM	DESCRIPTION
1	Solenoid
2	Motor power connecting stud
3	Solenoid power connecting stud
4	Motor
5	Breather
6	Pinion gear

The starter motor is attached to the cylinder block, at the joint between the transmission and the engine. The pinion gear of the starter motor protrudes through an aperture in the transmission housing, adjacent to the ring gear on the drive plate.

The starter motor has the motor located directly behind the pinion gear. The motor is geared directly to the pinion gear and is a pre-engaged type comprising a series wound motor and an over-running clutch.

The starter solenoid is connected to a power feed from the starter relay in the Engine Junction Box 2 (EJB 2), which is controlled by the Powertrain Control Module (PCM). When the starter solenoid is energized it engages the pinion gear with the ring gear and simultaneously closes a switch to supply the motor with power from the starter fuse on the battery positive terminal.

STOP/START SWITCH



The stop/start switch is installed in the Integrated Control Panel (ICP) and is hardwired to the Body Control Module/Gateway Module (BCM/GWM) assembly. When the switch is pressed two signal lines from the BCM/GWM assembly are connected to ground.

AUTO STOP/START WARNING INDICATOR

The auto stop/start warning indicator is located in the Instrument Cluster (IC). The warning indicator illuminate when the engine stops during a stop/start cycle, then expire when the engine restarts. The warning indicator is controlled by a High Speed (HS) Controller Area Network (CAN) powertrain systems bus message from the PCM.

AUTO STOP/START SWITCH

The auto stop/start switch is located in the JaguarDrive Switchpack (JDS), which is located in the floor console. An amber Light Emitting Diode (LED) in the auto stop/start switch remains illuminated while the stop/start system is active. The auto stop/start switch sends a signal to the Body Control Module/Gateway Module (BCM/GWM) assembly using the HS CAN comfort systems bus, to inform the BCM/GWM assembly when on or off.

BRAKE VACUUM SWITCH

To ensure the brake system is never compromised, a brake vacuum switch is installed on stop/start vehicles to monitor vacuum reserves in the brake booster. The brake vacuum switch is mounted in the vacuum pipe and hardwired to the Powertrain Control Module (PCM). If the brake vacuum decreases below a set threshold while stop/start is enabled, the PCM either:

- Restarts the engine to replenish the vacuum reserves.
- Inhibits the engine shutting down if vacuum reserves are not sufficient.

An example of vacuum reserves depleting, is by the driver repeatedly pressing the brake pedal while the engine is shutdown during an auto stop/start stop. This action will initiate an engine restart when vacuum reserves decrease below the set threshold.

If a fault develops with the brake vacuum sensor a Diagnostic Trouble Code (DTC) will be logged in the PCM.

OPERATION

AUTO STOP/START SYSTEM

At the beginning of a drive cycle, when the stop/start switch is operated, the auto stop/start system operates in the same way as on vehicles without stop/start.

The auto stop/start system is controlled by the Powertrain Control Module (PCM) and the Body Control Module/Gateway Module (BCM/GWM) assembly via High Speed (HS) Controller Area Network (CAN) powertrain systems bus messages and signals from other system components and modules to determine the correct conditions for system operation. The auto stop/start system detects when it is appropriate to stop and start the engine.

The auto stop/start system automatically stops the engine in appropriate conditions, resulting in zero tailpipe emissions and saving fuel that would otherwise be used idling the engine when stationary. When the driver is ready to move off, the engine instantly restarts. Sophisticated controls ensure that the stop/start system does not compromise the needs of either the driver or the vehicle.

By default the stop/start system is enabled at the start of each ignition cycle. The auto stop/start system can be enabled or disabled using the auto stop/start switch in the floor console. The Light Emitting Diode (LED) in the auto stop/start switch is extinguished when the stop/start system is disabled.

Software within the PCM controls the operation of the stop/start system. In addition to its own dedicated components the auto stop/start system encompasses many other vehicle systems. Complex technology interconnects these systems and ensures all the necessary conditions are satisfied by monitoring, among others:

- Brake hydraulic system pressure
- Transmission Control Switch (TCS) position
- Road speed
- The state of vital vehicle systems
- Environmental conditions.

If all necessary conditions are satisfied the stop/start system will automatically stop the engine if:

- The vehicle stops from a speed greater than 4 km/h (2.5 mph).
- Sufficient pressure is applied to the brake pedal to ensure the vehicle is stationary and the transmission is in D (Drive) or S (Sport), or the vehicle is stationary and P (Park) or N (Neutral) selected on the TCS.

The driver will be notified that the engine stops by the auto stop/start warning indicator being illuminated in the Instrument Cluster (IC). Other warnings normally associated with an engine stoppage, for example the ignition and low oil pressure indicators, are suppressed so will not illuminate during an engine stoppage in a stop/start cycle.

To restart the engine, the driver simply releases the brake pedal or presses the accelerator pedal. The PCM then operates the starter motor and starts the engine.

If system conditions are not approved by the PCM the auto stop/start system will not behave as expected, examples of this are:

- System inhibit: the engine will continue running even though the vehicle is stationary with the brake pedal pressed and the TCS in D (Drive) or S (Sport), or the vehicle is stationary and the TCS is in P (Park) or N (Neutral).
- System override: the engine has been stopped by the stop/start system but conditions have since changed, this will activate an early automatic engine restart.

These interventions are to ensure the stop/start system does not impact on:

- Vehicle and occupant safety
- Driver requirements
- Occupant comfort
- Vehicle on-road and off-road capabilities.

Although the main control logic for stop/start operation resides in the PCM the Body Control Module/Gateway Module (BCM/GWM) assembly has software to communicate engine stoppage inhibits to the PCM. In some instances, depending on the reason for the system intervention the driver will be notified, via the message center, of the reason for the intervention.

Stop Inhibitors

The following conditions will prevent the auto stop/start system from stopping the engine:

Driver effected stop inhibitors:

- Driver switches off the auto stop/start system
- A steering wheel paddle switch has been used to select a gear
- Brake pedal not fully pressed
- Accelerator pedal depressed
- Hood is open
- Driver door is open
- Driver seatbelt is not fastened
- Climate control system used above calibrated threshold
- Windshield demist is operating

- Trailer electrical connection detected.

Vehicle system effected stop inhibitors:

- Brake booster vacuum below threshold
- Battery cold cranking capability below threshold
- Battery state of charge is low
- Catalytic converter outside either pre or post calibration range
- Engine coolant temperature below threshold
- Engine oil temperature below threshold.

Environmental effected stop inhibitors:

- Ambient air temperature above 40 °C (104 °F)
- Ambient air temperature below 0 °C (32 °F).

Start Initiators

When the engine stops within the auto stop/start cycle the following conditions will initiate an early restart within the same auto stop/start cycle:

Driver effected start initiators:

- Driver switches off the stop/start system
- The accelerator pedal is pressed
- A steering wheel paddle switch is operated to select a gear
- Reverse (R) is selected on the TCS
- Vehicle speed above calibrated threshold 3 km/h (2 mph) (a restart will only occur if the transmission is in neutral and the driver is present, for example, the driver seatbelt remains fastened and the driver door remains latched)
- Brake booster vacuum below threshold (driver operating brake pedal)
- A higher climate control blower speed is selected

- Windshield demist is activated.

Vehicle system effected start initiators

- Battery cranking capability is near its lower threshold
- Battery state of charge is near its lower threshold
- Windshield demist activates
- The passenger compartment temperature decreases below or increases above the selected thresholds.

Environmental effected start initiators

- Ambient air temperature rises above 40 °C (104 °F)
- Ambient air temperature falls below 0 °C (32 °F).

The maximum engine stop duration is 270 seconds, the vehicle will restart after this duration.

Start Inhibitors

When the engine stops within a stop/start cycle certain conditions will prevent an automatic restart:

Driver effected start inhibitors:

- Hood has been opened
- Driver seatbelt is disengaged (this is an automatic start inhibitor therefore the engine can be restarted by depressing the clutch pedal)
- Driver door is unlatched (this is an automatic start inhibitor therefore the engine can be restarted by depressing the clutch pedal).

Vehicle system inhibitor:

- There is a system fault.

Auto Stop/Start Starter Motor Strategy

Engine restart without starter motor intervention

When the PCM detects engine restart parameters resulting from a driver action or system request, the PCM activates the fuel injection and ignition systems to allow the engine to continue to operate. This is available at a variable engine speed threshold which depends on engine type.

Engine restart with starter motor intervention

If the PCM cannot restart the engine without intervention, the restarting of the engine is controlled via the starter motor. The starter motor has the capability of engaging with the transmission ring gear whilst still rotating.

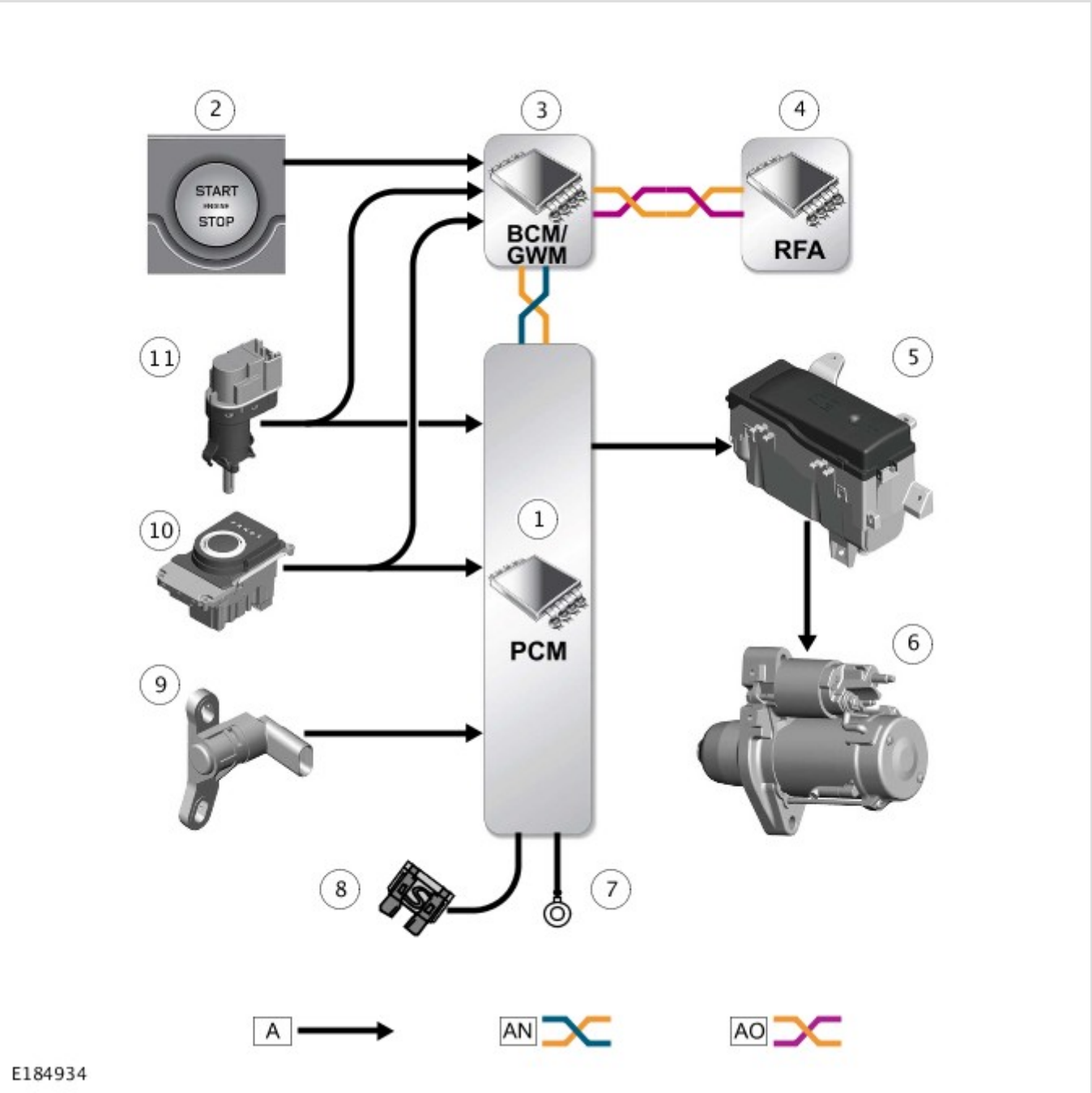
If an engine restart is initiated, the PCM activates the starter motor via the starter relay at the earliest opportunity to rotate the engine, then on the first available compression the PCM operates the fuel injection and ignition systems to restart the engine in less than 0.36 sec.

TRAILER TOWING

The auto stop/start system will automatically disable when trailer lights are detected by the BCM/GWM assembly, this information is then transmitted to the PCM. It is not possible for the system to detect when a trailer power plug is inserted in the vehicle towing connector, so it uses operation of the trailer lights as its indicator.

The trailer towing system inhibits auto stop/start operation as it is possible that trailer power requirements could interfere with the operation of the battery monitoring system. In particular, a trailer battery could reverse the feed current to the vehicle during an engine cranking event, this could possibly confuse the battery monitoring system into detecting an unrealistically small current at engine cranking.

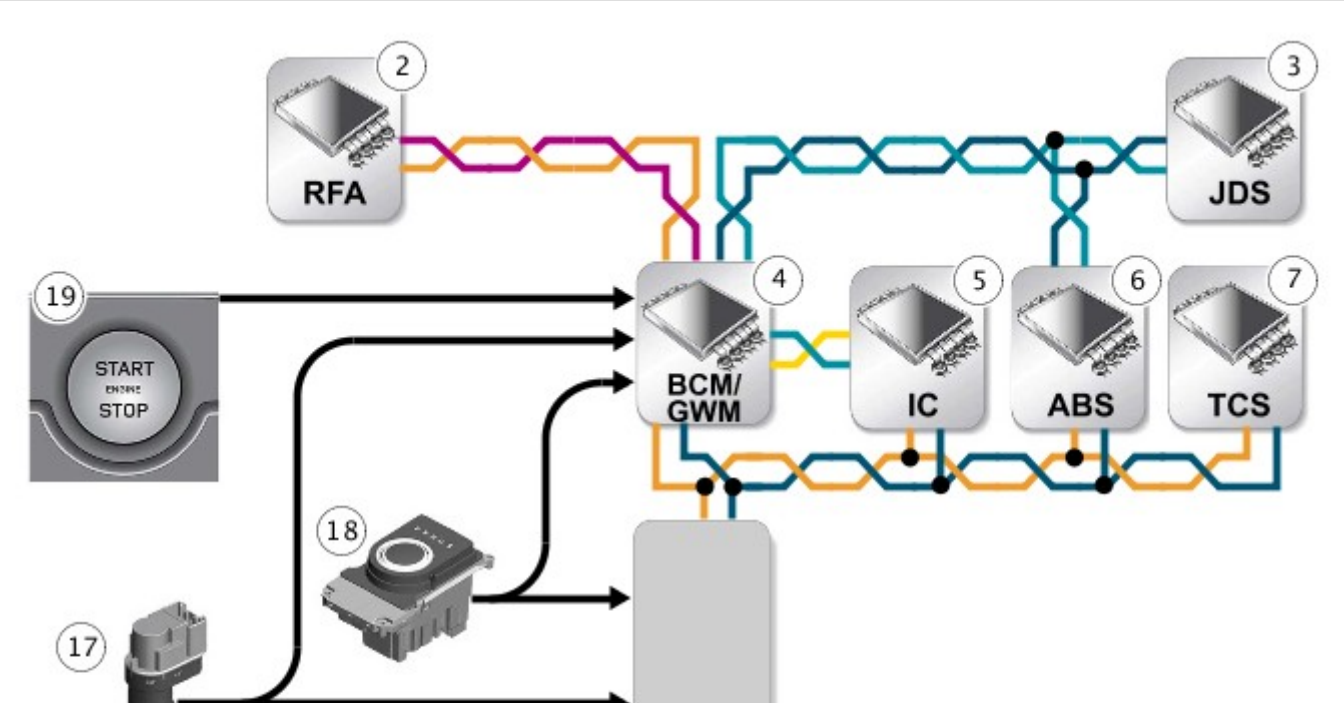
INPUT/OUTPUT DIAGRAM - SHEET 1 OF 2 - STARTING SYSTEM WITHOUT AUTO STOP/START

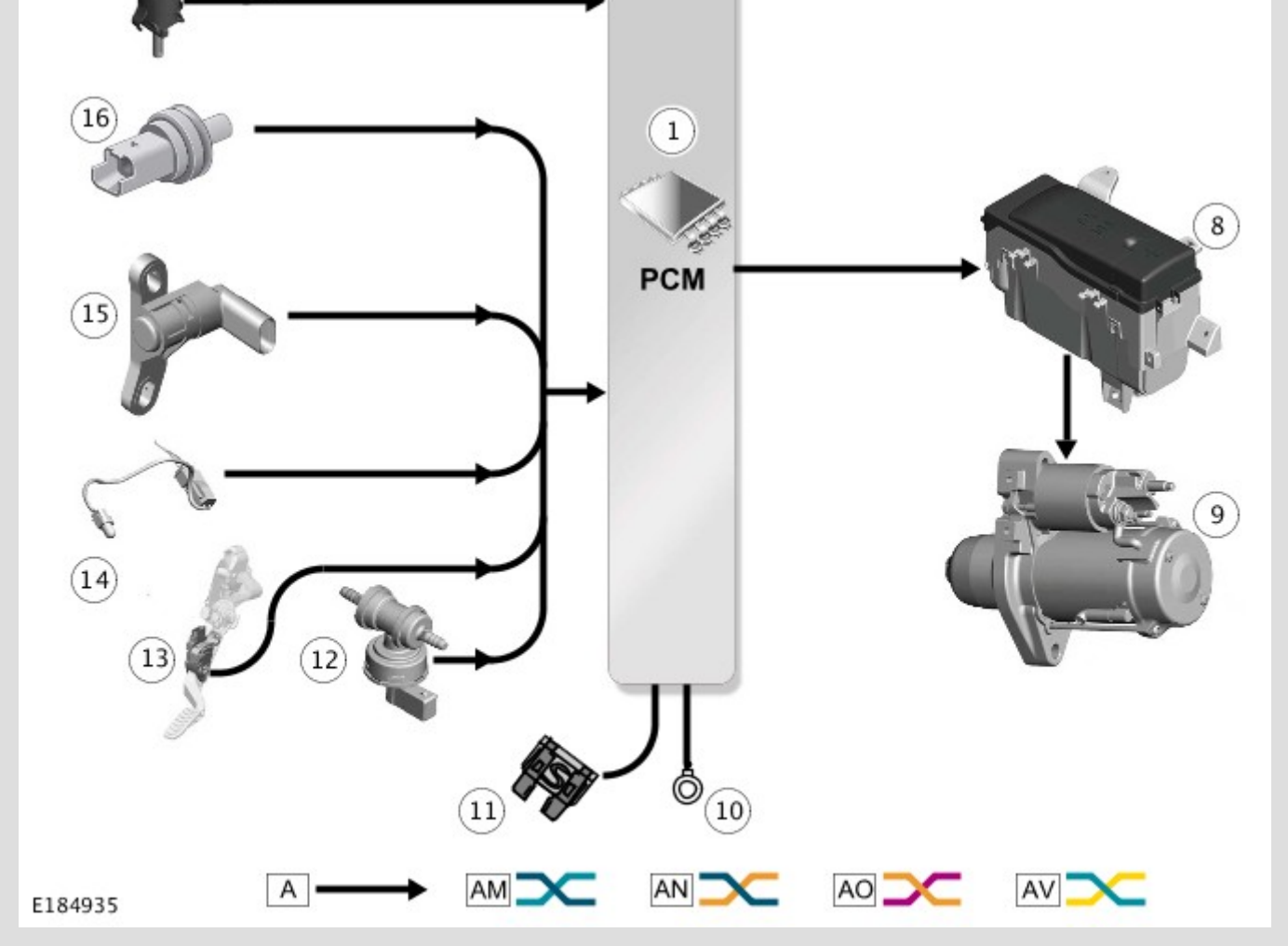


A = HARDWIRED; AO = MEDIUM SPEED (MS) CONTROLLER AREA NETWORK (CAN) BODY SYSTEMS BUS; AN = HIGH SPEED (HS) CONTROLLER AREA NETWORK (CAN) POWERTRAIN SYSTEMS BUS.

ITEM	DESCRIPTION
1	Powertrain Control Module (PCM)
2	Stop/start switch
3	Body Control Module/Gateway Module (BCM/GWM) assembly
4	Remote Function Actuator (RFA)
5	Engine Junction Box 2 (EJB 2)
6	Starter motor
7	Ground
8	Power supply
9	Crankshaft Position (CKP) sensor
10	Transmission Control Switch (TCS) - park/neutral signal
11	Brake pedal switch

INPUT/OUTPUT DIAGRAM - SHEET 3 OF 3 - STARTING SYSTEM WITH AUTO STOP/START - AUTOMATIC TRANSMISSION





A = HARDWIRED; AM = HIGH SPEED (HS) CONTROLLER AREA NETWORK (CAN) CHASSIS SYSTEMS BUS; AN = HS CAN POWERTRAIN SYSTEMS BUS; AO = MEDIUM SPEED (MS) CAN BODY SYSTEMS BUS; AV = HS CAN COMFORT SYSTEMS BUS.

ITEM	DESCRIPTION
1	Powertrain Control Module (PCM)
2	Remote Function Actuator (RFA)
3	JaguarDrive Switchpack (JDS)
4	Body Control Module/Gateway Module (BCM/GWM) assembly

ITEM	DESCRIPTION
5	Instrument Cluster (IC)
6	Anti-lock Brake System (ABS) control module
7	Transmission Control Switch (TCS)
8	Engine Junction Box 2 (EJB 2)
9	Starter motor
10	Ground
11	Power supply
12	Brake vacuum switch
13	Accelerator Pedal Position (APP) sensor
14	Ambient Air Temperature (AAT) sensor
15	Crankshaft Position (CKP) sensor
16	Ambient Air Temperature (AAT) sensor
17	Brake pedal switch
18	Transmission Control Switch (TCS) - park/neutral signal
19	Stop/start switch