



Description

The SMART KEY system is a system that allows the user to access and operate a vehicle in a very convenient way. To access the vehicle, no traditional key or remote control unit is needed.

The user carries a SMART KEY FOB which does not require any conscious actions by the user (e.g. operate a RKE button). The SMART KEY system is triggered by pressing a push button in the door handle.

After being triggered the vehicle sends out a request in a limited range. If the SMART KEY FOB receives this request, it automatically sends a response to the vehicle. Then the system decides whether to perform a particular action (unlocking, locking...) or remain inactive.

Again, a communication between the vehicle and the SMART KEY FOB is needed before any actions will be performed.

The System offers the following features :

- Passive unlock via 4 doors
- Passive locking via 4 doors
- Passive start
- Passive access liftgate via the liftgate lid switch at the liftgate
- Max. 2 fobs can be handled by the system
- Immobilizer backup antenna driver integrated into SSB for TP authentication (i.e. limp home mode)
- Communication with engine management system
- Communication with SRX
- LF-RF communication

1. Passive unlock

The system allows the user to access (unlock) the vehicle without performing any actions with the SMART KEY FOB.

2. Passive locking

The system allows the user to lock the vehicle by pushing a button on door handle with the SMART KEY FOB.

3. Button start

The system allows the user to switch the power modes (Off, Accessory, Ignition), as well as to start and stop the vehicle's engine without performing any actions with the SMART KEY FOB. See Button Engine Start system specification.

4. LIMP HOME Mode

Additionally, the system offers so called "limp home mode", which is the user can operate all vehicle functions by pushing the key into the SSB.

Smart Key ECU (SMK ECU)

The SMK ECU manages all functions related to "Passive Unlock", "Passive Lock" and "Passive Authorization for Engine Start Operation".

It reads the inputs (Push button in door handle, Start Stop Button (SSB), PARK position Switch), controls the outputs (e.g. exterior and interior antennas), and communicates via the CAN as well as a single line interface to further devices of the car.

For communication with the SMART KEY FOB, SMK ECU generates a request (challenge) as an encoded and modulated 125kHz signal at the inductive antenna outputs and receives the SMART KEY FOB's response via the external RF receiver.

The main functional blocks of the SMK ECU are :

- Power supply
- Microcontroller with FLASH Memory
- Single Line Interface to SRX
- Single Line Interface to EMS
- Input stage
- LF antenna amplifier/driver
- CAN communication with BCM

The LF antenna amplifier/driver generates a 125kHz sinusoidal carrier signal which is distributed to the different antennas.

Smart Key FOB

The system supports up to 2 SMART KEY FOBs.

The main functions of the SMART KEY FOB are :

- Passive functionality: receives LF-challenge and sends automatically RF response.
- Classic RKE function by action up to 3 push buttons.
- Transponder-functionality in case of a flat battery or a disturbed communication.

Antennas

1. Emitting LF Antennas :

Inductive antennas in and at the vehicle are used to transform the current, driven by the SMK ECU antenna driver, into a 125 (or 134.2) kHz magnetic field, which is the carrier for the SMART KEY challenge.

Three antennas cover the vehicle's exterior: two antennas in the Door Handles (DS and PS) cover the area around the doors; one antenna in the rear bumper covers the area around the trunk or liftgate.

Up to three antennas cover the vehicle's interior and the trunk or liftgate interior: two in the passenger compartment and one in the trunk room or trunk.

2. Bidirectional Immobilizer Antenna (for Limp Home):

The Immobilizer Backup Antenna is used for sending and receiving data: it emits a magnetic field (125 - 135 kHz challenge) and receives changes in the field strength (response of Transponder).

3. Receiver

The SMART KEY FOB's response is received via the RF receiver.

Door Handle

The front door handles of the two doors (driver door / passenger door) are equipped with emitting LF-antennas to emit the 125kHz signals. The front door handles are also equipped with a push button.

Push Button

The push button in door handle serves as a trigger to indicate the user's intent to unlock or lock the vehicle.

The push buttons are installed at front doors, integrated into the door handles.

Another button is installed at the trunk or liftgate lid.

Operation

Passive Functions

The system allows the user to access the vehicle without having to perform any actions (e.g. RKE button pressing) with the SMART KEY FOB. It is sufficient that a valid SMART KEY FOB is located within a defined and limited range with respect to the vehicle. So the system is capable of detecting and authenticating a SMART KEY FOB in the ranges as specified below.

Operating Range

The SMART KEY FOB receives and interprets a challenge sent from the vehicle via the exterior antennas in a free space range of min. 0.7m measured around the exterior antennas which are integrated in the door handles; refer to the below given picture. The trunk or liftgate access range is also min. 0.7m measured from the antenna position.

The SMART KEY FOB receives and interprets a challenge sent from the vehicle via the exterior antennas in a free space range of min. 0.7m measured around the exterior antennas which are integrated in the door handles; refer to the below given picture

Passive Access (Passive Entry)

Push the door handle button when all doors locked indicates the operator's intent to access the vehicle and thus triggers the system for unlock

Passive Locking (Exit)

Pressing one of the push buttons in the door handles when one of the following condition is fulfilled:

- At least one door is unlocked and two_steps timer is not running or
- Two_steps timer is running and one of the push button except Front Left side is triggered

indicates the operator's intent to lock the vehicle and thus triggers the system for a lock.

Passive liftgate Warning (Sedan only)

Whenever the liftgate is closed, SMK ECU uses a suitable search strategy to avoid liftgate buzzer warning by a fob outside the vehicle. Then SMK searches for a SMART KEY FOB in the interior of the liftgate. If a valid SMART KEY FOB is found in the liftgate, the SMK ECU activates SMK external buzzer (TBD) to inform the user that the liftgate has been closed with a fob inside the liftgate.

SMK will send the liftgate open command to BCM for liftgate reopening if liftgate reopening bit is set(BK)For this functionality, a "valid" SMART KEY FOB means any SMART KEY FOB that belongs to the vehicle, even if it's DEACTIVATED.

NOTICE

- A blind spot in the liftgate similar to any RF disturbance may lead to no liftgate warning. Due to the penetration of the bumper antenna into the liftgate area the lid may open without an Identification Device outside.
- A blind spot in the liftgate similar to any RF disturbance may lead to no liftgate warning

Smart Liftgate

When a user with a valid Smart Key in possession stands in the vicinity of the rear bumper (within LF antenna range) for over 3 seconds, the liftgate is opened.

NOTICE

- Function is set through the User Setting Mode (USM) in the Cluster.

1. Rear bumper antenna detects valid Smart Key in the vicinity.
2. When a valid Smart Key enters the rear bumper antenna range, alert buzzer and hazard lamp is activated 1 time to acknowledge detection.

NOTICE

- Smart Key Unit can detect a Smart Key within 0.7 - 1 m of the rear bumper.
- If the Smart Key stays inside the detection range, alert buzzer and hazard lamp is activated 1 time every second throughout the duration of the Smart Key remaining in the detection range.

3. If the Smart Key remains in the rear bumper detection range (antenna range) for over 3 seconds, alert buzzer and hazard lamp is activated 2 times and the liftgate is opened.

Welcome Light

When a driver holding a smart key approaches the vehicle, the door mirrors and puddle lamps are controlled by smart key authentication.

1. Access to welcome light search mode (Mode that regularly searches for smart key to prevent discharge of vehicle battery)
 - Vehicle converts to armed state by RKE locking or passive locking by the driver.
 - Smart key (SMK) unit searches for deactivation by operating the interior antennas.
 - If smart key is not found inside the vehicle, the smart key (SMK) unit will operate door handle antenna to search for driver approaching the vehicle.
 - Smart key (SMK) unit searches for 3 seconds 3 times by operating the door handle antenna, and if the key is not found for all 3 times, it will enter welcome light search mode.
 - If the door mirror connection mode is activated, the mirror folding operation will be engaged.
2. Welcome light ON
 - In welcome light search mode, smart key is detected when the driver approaches the vehicle.
 - Smart key (SMK) unit sends welcome light ON signal to DDM for 15 seconds via CAN.
 - DDM activates the puddle lamp on the door mirror for 15 seconds. (If the door mirror is connected, mirror unfolding operation will be engaged.)

Remote Starting With Smart Key (only for Middle East Asia)

Start engine by pressing remote start button on smart key in some distance.

(improve convenience for users by activating air conditioning system before boarding vehicle.)

1. Receiving signal distance : MIN 30m (one way signal)
2. Operation time : 10min maximum
3. Operating method
 - (1) start engine : in 4seconds press remote engine starting button longer than 2seconds after door has been locked.
 - (2) stop engine : press remote engine starting button once.
4. Check starting : able to check engine starting through see blinks of emergency light.
5. For security measure : engine would be stopped when the registered smart key is not in the vehicle with driver during remote starting activated.

Smart Key Reminder 1

1. Preconditions :

All terminals OFF & at least one door open & locking status is not locked checked by SMK periodically every 100ms, as long as CAN/LIN active.
2. Event:

At least 1 door knob status changed from unlock to lock.
3. SMK actions :
 - IF NO FOB-IN ACTIVE

SMK performs a search for the fobs in the interior of the vehicle. The same LF-strategy has to be used as it is defined for the ID out warning (registering only, no authentication)
 - IF FOB-IN ACTIVE

SMK search valid TP

If no fob or no TP has been found, no action is required.

If any valid fob or valid TP has been found, SMK unlocks the vehicle by sending a CAN Key Reminder unlock message with the fob number.

If any valid fob has been found, SMK unlocks the vehicle by sending a CAN/LIN Key Reminder unlock message with the fob number.

Smart Key Reminder 2

1. Preconditions :

All terminals OFF & any door (including liftgate) open & no FOB-IN & no locking status (checked by SMK periodically every 100ms, as long as CAN/LIN active)

2. Vehicle action :

Closing last door or liftgate with knobs locked state, or with a locking in progress

3. SMK actions :

Before elapsing 500ms after the closing if all doors are locked then :

- IF NO FOB-IN ACTIVE

SMK performs a search for the fobs in the interior of the vehicle.

The same LF-strategy has to be used as it is defined for the ID out warning (registering only, no authentication)

- IF FOB-IN ACTIVE

SMK search valid TP

If no fob has been found, no action is required.

If any valid fob or valid TP has been found, SMK sends unlock command via CAN and activates ext. buzzer warning.

If any valid fob has been found, SMK sends unlock command via CAN/LIN and activates ext. buzzer warning.

Smart Key Door Lock Warning

Door Lock Warning 1

1. If terminal state is ACC or IGN and all doors are closed and that user triggers a SMK lock, a search is started at the exterior of the vehicle from the side of the trigger.
2. If no valid Fob is found no action is required, but if a valid Fob is found then a Buzzer warning shall be started.
3. If "liftgate Option == On" and "liftgate LockUnlockOption == On" are fulfilled, Lock warning is including liftgate as a door and liftgate lockunlock knob as a door unlock switch.

Door Lock Warning 2

1. If terminal state is OFF and not all doors are closed and that user triggers a SMK lock, a search is started at the exterior of the vehicle from the side of the trigger.
2. If no valid Fob is found no action is required, but if a valid Fob is found then a Buzzer warning shall be started.
3. If "liftgate Option == On" and "liftgate LockUnlockOption == On" are fulfilled, Lock warning is including liftgate as a door and liftgate lockunlock knob as a door unlock switch.

Door Lock Warning 3

1. If terminal state is OFF and ATWS is considered as Disarmed and all doors are closed and that user triggers a SMK lock, a search is started at the Interior of the vehicle;
2. if no valid Fob is found the search for SMK locking will be started, but if a valid Fob is found then a Buzzer warning shall be started.
3. If "liftgate Option == On" and "liftgate LockUnlockOption == On" are fulfilled, Lock warning is including liftgate as a door and liftgate lockunlock knob as a door unlock switch.

Smartkey Lamp Warning

1. If terminal state is ACC or IGN and vehicle speed is less than 3km/h, a periodic search (every 3s) is done at the interior of the vehicle to check that the valid fob is still in the in the vehicle.
2. If no valid Fob is found a Warning is started, but if a valid Fob is found then no action is started.

Failsafe Functions (Backup For Limp Home)

In case of a discharged battery of the SMART KEY FOB or disturbed transmission, the following functions are available:

- Unlocking / locking of doors or trunk (or liftgate depending of the vehicle configuration): use of mechanical key

User Information Functions

ID OUT Warning

1. Preconditions :
 - (ACC or IGN1) & (any door open or liftgate open)
2. Event:

The last opened door is closed
3. SMK action :

SMK searches for a SMART KEY FOB in the interior.

- If no valid SMART KEY FOB is found, the SMK activates external buzzer and also sends ID OUT warning via CAN (exterior buzzer warning and internal buzzer warning).
- If a door is opened and closed again during terminals on and inside valid fob, SMK re-enables the authentication and stops the warning. If the terminal is in ACC, SMK shall turn on immobilizer lamp.

NOTICE

- If there is a LF error (LF overheating or LF antenna failure), the system will have the same behavior as it is with no fob found.

Fob Battery Low Voltage Detection

To detect fob low battery condition, certain battery voltage measurement and low voltage detection strategy are implemented into fob. The measurement of the battery voltage will be done if fob button is pressed or if a LF measurement command is received.

Learning Description

In this chapter, the learning procedure for SMK and FOBs is described.

For the learning of the SMK and FOBs, it's necessary to have a connection to the diagnostic tool.

Learning MODE

Whatever the mode, the learning procedures are managed by the SMK.

Prior to start learning service, Fob-In signal must be active and the vehicle secret code (called as PIN code) should be known.

Teaching MODE

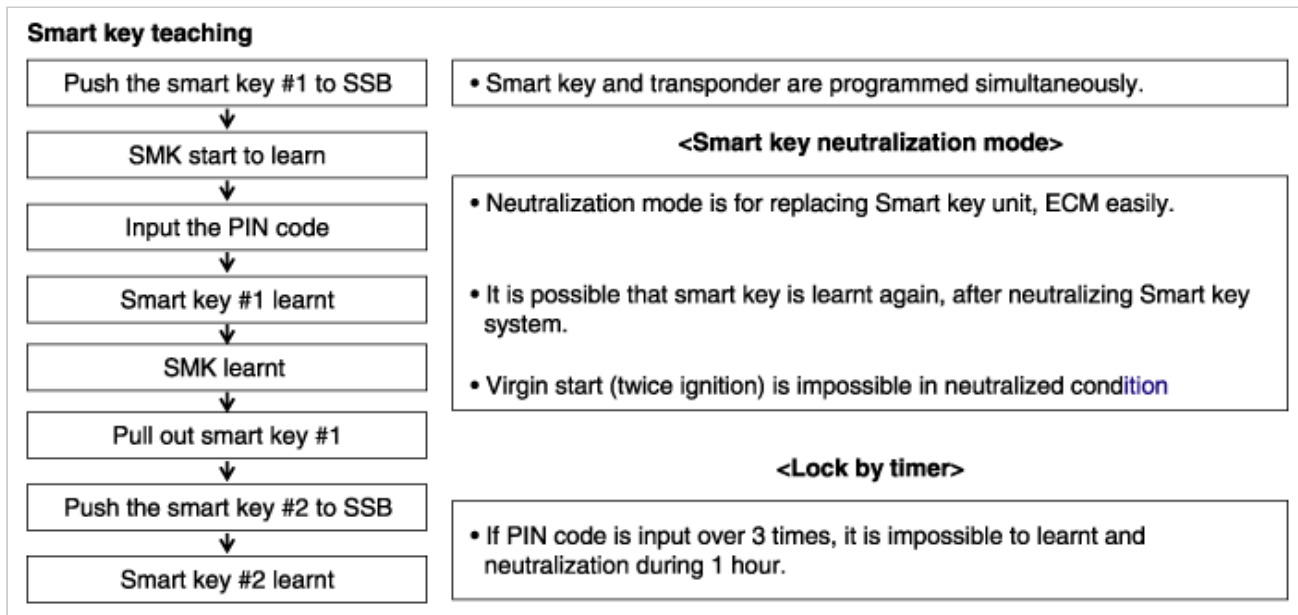
This mode is used by the dealers in order to replace SMK and/or the set of keys, or to register additional keys for an existing system. That means the system already has been learnt with certain PIN Code. The PIN Code is fixed for the life time of the vehicle, therefore the same PIN Code must be used in this mode. Otherwise learning will be failed

Teaching MODE Procedure Description (Step By Step)

Objective : Key teaching procedure at service station

Initial state :

- SMK replacement : SMK is not learnt and SMART FOB are already learnt with same PIN code
- Additional or new keys teaching: SMK are already learnt with same PIN code



Starting After Replacing (Virgin Start)

Starting is possible by following process after replacing new smart key unit, FOB key.

- It is for starting at virgin condition
- All related parts are virgin condition (Smart key, ECM)
- Press brake pedal in P or N range
- Push the start button once with virgin smart key.

