Document : **User Manual for SMK2.7**

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Contents list **Page**

1. System configulation

1.1 Scope of SMART KEY SYSTEM

The System offers the following features:

- passive access to two doors and trunk; driver side, passenger side, and trunk/tailgate
- passive start after interior detection of the SMART KEY FOB
  (without interior trunk detection)
- LF-RF communication (based on Continental's SMART KEY system)
- passive access/locking of the two front doors via a toggle push button in the door handles
- passive access trunk/tailgate via the trunk lid switch at the trunk
- immobilizer backup solution integrated into SMK 2.7
- communication to the engine management system via a single line interface
- communication to the ESCL via a single line interface
- block of the steering column by the ESCL device

1.2 short description of the SYSTEM

1.2.1 General Definition of SMART KEY

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 SMART KEY system is triggered by pressing a push button in the door handle.

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

In a similar manner, the SMART KEY system is triggered by pressing a start-stop button in the dash board.

After triggered, the vehicle sends out a request in a limited range(especially interior region). If the SMART KEY FOB receives this request, SMART KEY FOB automatically sends a response to the vehicle. Then the system decides whether to perform a particular action (terminal status change…) or to remain inactive.

1.2.2 Wireless Communication

Electromagnetic waves are used to exchange information between the vehicle and the SMART KEY FOB. Both, vehicle and SMART KEY FOB are equipped with a transmitter, a receiver and several antennas.

1.2.3 Concept Description

With this concept it is possible to have a set of interior antennas that cover the vehicle's interior and a set of exterior antennas that cover the vehicle's exterior.
For an unambiguous separation between the vehicle's interior and exterior it is sufficient that at least one area is covered exactly by the corresponding operating ranges of the antennas.

The functions of the SMART KEY system have to be provided in a clearly defined and limited range. For the up-link from the vehicle to the SMART KEY FOB, a magnetic field with a frequency of 125 kHz and ASK modulation is used.

Technical aspects of 125 kHz – magnetic field:

- virtually no reflections,
- cubical decrease of field strength → allows good range control,
- released frequency band (ISM),
- high penetration,
- low quiescent current demand due to 125 kHz input stage (SMART KEY FOB),
- less sensitive for detuning compared to higher frequency.

For the down-link from the SMART KEY FOB to the vehicle, the standard radio frequency (RF) is used (similar to the classic remote control functions) with FSK modulation.

1.2.4 System Architecture

The system is designed as an optional system, making it possible to equip vehicles of the same car-Line with different levels of access control systems.

The system is suitable to be integrated into an existing architecture that provides central locking functions with standard remote control. This proposal assumes that the following functions / devices are already present in the vehicle's architecture.

- Central locking system (latch / motor – drivers etc.)
- Standard body control functions
- Warning buzzer

1.2.5 Main Functions

- The system allows the user to access and exit (unlock and lock) the vehicle without performing any actions with the SMART KEY FOB.
- The system allows the user to control ESCL lock/unlock, to operate relaies to provide power(Off, Accessory, Ignition) to other ECU, and to start/stop the vehicle's engine without performing any actions with the SMART KEY FOB.
- Additionally, the system offers the user can operate all vehicle functions by contacting the Fob to the Start/stop button, which have Immobilizer antenna(terminal control fuction), and by inserting the mechanical key blade into the door handle(Passive access function).

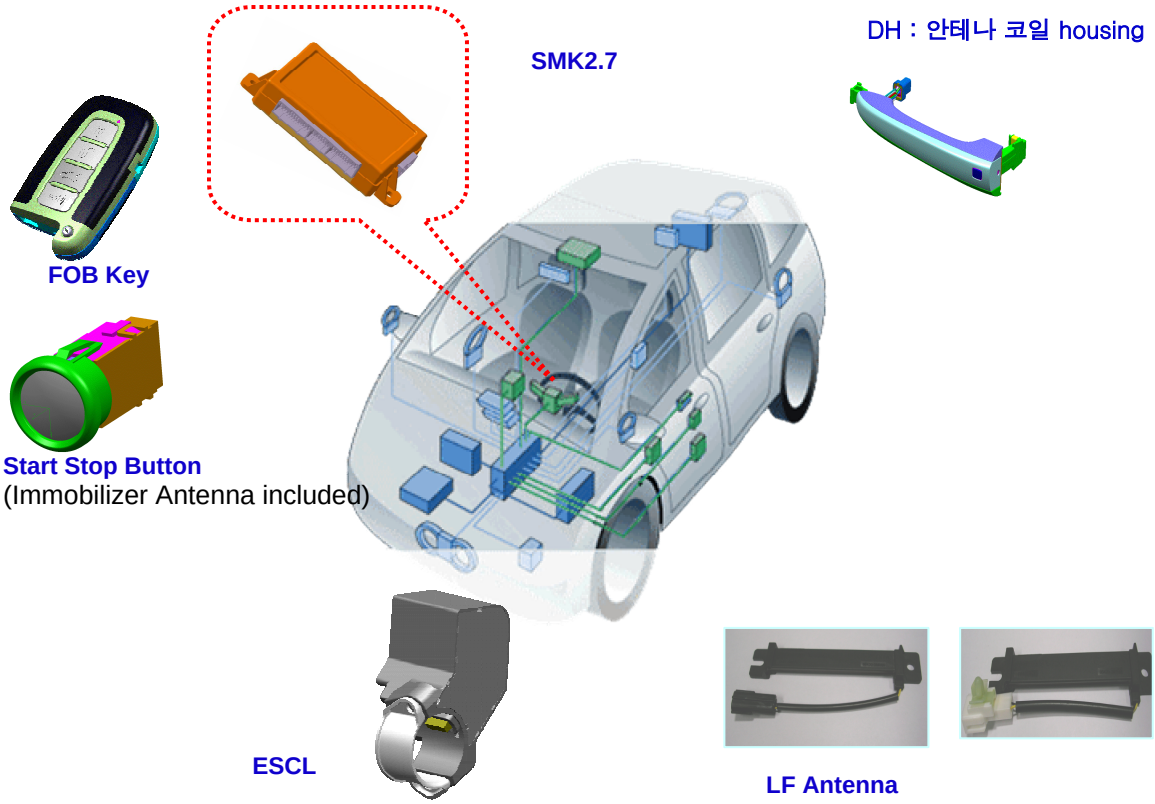


Figure 1: Offered System Components

1.3 System Overview / Block Diagram

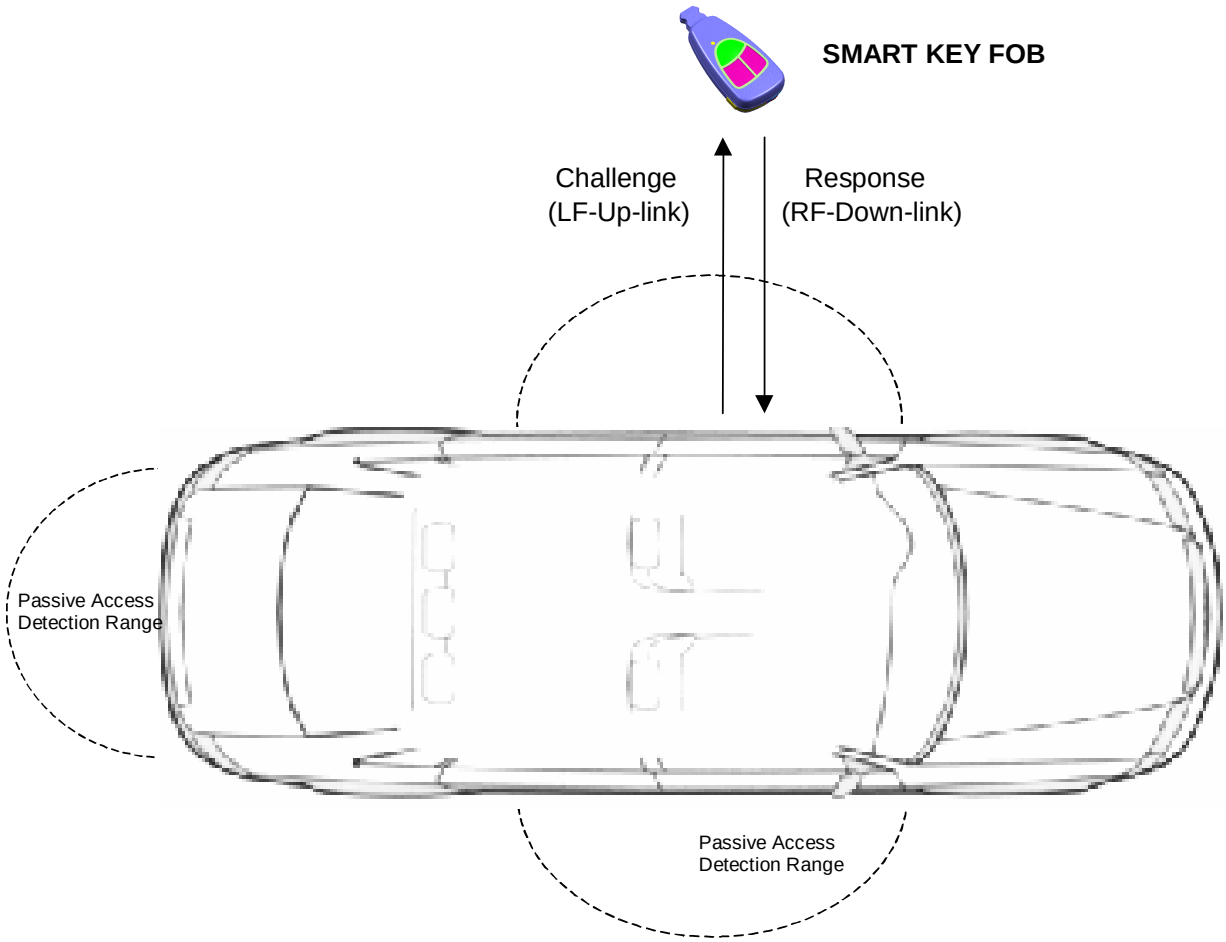


Figure 2: Principle of Communication

2.2 Pin Description

Function	I/O	Connect or No	Description	Type	Remarks
Analog Input	VBAT_CPU	A14	Supply power to SMK 2.7 VBAT_CPU(Battery voltage) monitoring signal input	Pull down	
	VBAT_LOAD	A1	Supply power to terminal control relay/ backup supply to SMK 2.7 VBAT_LOAD(Battery voltage) monitoring signal input	Pull down	
	-	-	VBD voltage monitoring signal input	Pull down	
	-	-	SSUR(Software Step-Up Regulator) output voltage feedback monitoring signal input	Pull down	
	A_ACC	A6	Accessory voltage monitoring signal input	Pull down	
	A_IGN1	A4	Ignition1 voltage monitoring signal input/ Supply power to starter relay output	Pull down	
	A_IGN2	A7	Ignition2 voltage monitoring signal input	Pull down	
	O_ACC_RLY	A19	Accessory relay control output diagnosis signal input	-	
	O_STARTER_RLY	A17	Starter relay control output diagnosis signal input	-	
	O_IGN1_RLY	A5	Ignition1 relay control output diagnosis signal input	-	
	O_IGN2_RLY	A18	Ignition2 relay control output diagnosis signal input	-	
	O_ESCL_BAT	A15	ESCL(Electronic Steering Column Lock) power supply output diagnosis signal input	-	**ESCL option**
	O_ESCL_GND	A2	ESCL(Electronic Steering Column Lock) ground supply output diagnosis signal input	-	**ESCL option**
	O_ESCLEnable	B7	ESCL(Electronic Steering Column Lock) Enable output diagnosis signal input	-	**ESCL option**
	A_RESERVE	A20	Reserved analog signal input	Pull down	**RESERVE**
Logic Input	L_SSB_SW1	A25	Starter Stop Button switch1 signal input	Pull up	
	L_SSB_SW2	A8	Starter Stop Button switch2 signal input	Pull up	
	L_DRVToggle Button	B9	Driver door toggle button switch signal input	Pull up	
	L_ASTToggle Button	A26	Assistant door toggle button switch signal input	Pull up	
	L_ESCLUnlock	B10	Unlock signal input for ESCL(Electronic Steering Column Lock)	Pull up	**ESCL option**
	L_BrakeSW	B5	Brake pedal pressing signal input	Pull down	
	L_StopLampFuse	B4	Stop lamp fuse failure detection signal input	Pull down	
	L_StartFeedback	B13	Parking/ Neutral (P/N) inhibit start switch acquisition signal input	Pull down	
	L_PPosition	B12	Parking Position signal input	Pull up	
	L_TrunkLidSW	A21	Trunk Lid switch signal input	Pull up	
	L_AST_capa_sensor	C17	Assistant capa sensor signal input	Pull up	
	L_DRV_capa sensor	C6	Driver capa sensor signal input	Pull up	
	L_RAST_capa_sensor	C14	Rear assistant capa sensor signal input	Pull up	
	L_RDRV_capa_sensor	B3	Rear driver capa sensor signal input	Pull up	
	L_RASTToggle Button	A22	Rear assistant door toggle button switch signal input	Pull up	
	L_RDRVToggle Button	A9	Rear driver door toggle button switch signal input	Pull up	
Output	O_ACC_RLY	A19	Accessory relay control output	High side	

	O_STARTER_RLY	A17	Starter relay control output	High side	
	O_IGN1_RLY	A5	Ignition1 relay control output	High side	
	O_IGN2_RLY	A18	Ignition2 relay control output	High side	
	O_ESCL_BAT	A15	ESCL Electronic Steering Column Lock) power source control output	High side	**ESCL option**
	O_ESCL_GND	A2	Ground source supply for ESCL(Electronic Steering Column Lock)	Low side	**ESCL option**
	O_ESCLEnable	B7	ESCL(Electronic Steering Column Lock) Enable control output	High side	**ESCL option**
	O_SSB_ILLUM_PWR	C13	Starter Stop Button illumination power source output	High side	
	O_SSB_ILLUM_GND	C1	Starter Stop Button illumination ground source output	Low side	
	O_SSB_LED_AMBER/ACC	B16	Starter Stop Button AMBER/ACC LED output	Low side	
	O_SSB_LED_BLUE/IGN	C12	Starter Stop Button BLUE/IGN LED output	Low side	
	O_SSB_LED_OFF	C3	Starter Stop Button OFF LED output	Low side	
	O_IMMO_IND	C2	IMMO indicator LED output	Low side	
	O_EXTERIOR_BUZZER	B11	Exterior Buzzer control output	High side	
VS	F_WheelSpeed	B8	Vehicle Speed data input from brake system		
RPM	F_RPM	A23	RPM frequency data input from EMS		
LF Antenna Output	O_DRV_SIDE_ANTENNA_pwr	C11	Driver side antenna power output		
	O_DRV_SIDE_ANTENNA_gnd	C22	Driver side antenna power ground		
	O_AST_SIDE_ANTENNA_pwr	C10	Assistant side antenna power output		
	O_AST_SIDE_ANTENNA_gnd	C21	Assistant side antenna power ground		
	O_BUMPER_ANTENNA_pwr	C9	Bumper antenna power output		
	O_BUMPER_ANTENNA_gnd	C20	Bumper antenna power ground		
	O_TRUNK_ANTENNA_pwr	C8	Trunk antenna power output		
	O_TRUNK_ANTENNA_gnd	C19	Trunk antenna power ground		
	O_INTERIOR_ANTENNA#1_pwr	C5	Interior Antenna#1 power output		
	O_INTERIOR_ANTENNA#1_gnd	C16	Interior Antenna#1 power ground		
	O_INTERIOR_ANTENNA#2_pwr	C4	Interior Antenna#2 power output		
	O_INTERIOR_ANTENNA#2_gnd	C15	Interior Antenna#2 power ground		
	O_HATSHELF_ANTENNA_pwr	C7	hatshelf Antenna power output		
	O_HATSHELF_ANTENNA_gnd	C18	hatshelf Antenna power ground		
Immo Ant. Output	O_IMMO_ANT_pwr	B6	O_IMMO Antenna power output		
	O_IMMO_ANT_gnd	B14	O_IMMO Antenna power ground output		
High speed CAN	C_CAN_H	B2	High speed CAN network communication line(high)		
	C_CAN_L	B1	High speed CAN network communication line(low)		
Low speed CAN	B_CAN_H	A12	Low speed CAN network communication line(high)		
	B_CAN_L	A13	Low speed CAN network communication line(low)		
EMS Com	EMS_COM	A24	EMS(Engine Management System) communication line		
ESCL Com.	ESCL_COM	A11	ESCL(Electronic Steering Column Lock) communication line		**ESCL option**
Diagnostic	DIAG_K	B15	Diagnostic Communication line K for Tester		
RF Com.	RF_COM	A10	RF Communication line		
Ground	POWER_GND1	A3	Power ground1		
	POWER_GND2	A16	Power ground2		

2.3 SMK2.7 ECU

SMK 2.7 ECU manages all functions related to “Passive Access”, “Passive Unlocking” , “Passive Authorization for Operation”, "Terminal control" .

SMK 2.7 ECU reads the inputs (Door Lock/unlock, SSB SW, ESCL unlock status, PARK position Switch, Brake input SW etc.), controls the outputs (e.g. exterior or interior antennas, terminal control output, ESCL power, Immobilizer antenna), and communicates via the CAN/LIN (depends on the vehicle) as well as a single line interface to further devices of the car.
For the communication with the SMART KEY FOB, SMK 2.7 ECU generates a request (challenge) as an encoded and modulated 125 kHz signal at the inductive antenna outputs and receives the SMART KEY FOB’s response via the external RF receiver.
Or for immobilizer communicaiton, SMK 2.7 ECU sends 125Khz LF signal to SSB's immobilizer antenna, and receives Response from Immobilizer antenna.

The main functional blocks of the SMK 2.7 ECU are:

- Power supply
- Microcontroller with FLASH Memory
- Single Line Interface to ESCL
- Single Line Interface to EMS
- Input stage
- LF antenna amplifier/driver
- Immobilizer Antenna output
- ESCL power supply
- Terminal Control(ACC, IGN1/2, Start Rly)
- CAN communication with Other ECU
- Immobilizer communication

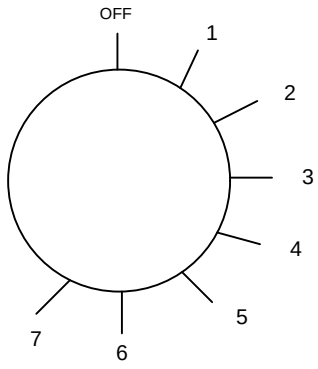
The LF antenna amplifier/driver generates a 125 kHz sinusoidal carrier signal, which is distributed to the different antennas.

The signal for Interior antenna and exterior antenna is 100%-ASK modulated by switching on and off the carrier (the data is Manchester encoded). The power of the carrier is adjustable by software, which means, it is possible to set the power level of the antenna driver for every LF-telegram (e.g. power level stored in the EEPROM) in case of PASE LF Antenna.

And also the signal for immobilizer antenna is ASK modulated signal. Amplitude Shift Keying for write and AM/PM for the read operation. The receiver charteristics(amplifier gain, filter cutoff frequencies) can be optimized to system and transponder requirements.

3 SMK 2.7 ECU Test Board for homologation

3.1 Shape of tool box



3.2 Switch

No.	Output	Remark
OFF	ALL ANTENNA OUTPUT OFF	
1	DRV ANTENNA OUTPUT	
2	AST ANTENNA OUTPUT	
3	BUMPER ANTENNA OUTPUT	
4	INTERIOR1 ANTENNA OUTPUT INTERIOR2 ANTENNA OUTPUT	
5	HATSHELF ANTENNA OUTPUT	
6	TRUNK ANTENNA OUTPUT	
7	IMMO ANTENNA OUTPUT	

3.3 Method to use Test board

- Prepare VB, GND wire to connect Tool Box.
- Connect Power(VB, GND) to Tool Box.
- Connect Harness connector to SMK ECU Unit.
- After selecting swich No. , give VB power to test board.(Do not give overvoltage)

FCC / IC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

The device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter. Users are not permitted to make changes or modify the device in any way.
Any changes or modifications (including the antennas) made to this device that are not expressly approved by the manufacturer may void the user's authority to operate the equipment.

RF du FCC d'exposition aux radiations: Cet equipement est conforme a l'exposition de la FCC rayonnements RF limites etablies pour un environnement non contrôle. Cet appareil et son antenne ne doivent pas etre co-localises ou fonctionnant en conjonction avec une autre antenne ou transmetteur.

Note : This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications, However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Modifications not expressly approved by the manufacturer could void the user àuthority to operated the equipment under FCC rules.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisee aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.