# PURPOSE

The SYSTEM / PRODUCT SPECIFICATION describes the Immobilizer system and the related products, in all their aspects related to the Immobilizer function: technical requirements, configuration, evolutions management, production modes, delivery modes.

On one hand, It is destined for the Customer, in response to his specification (Customer Drawing) and to describe him all the preconisations, implications and limitations for the system use, and on the other hand for Siemens Automotive S.A. as a product general descriptive document and as commitment on the Customer.

# sCOPE

## **Application**

This document describes the whole features of Immobilizer system and function for the HMC Push start system  ; system is named IMMO-HMC.

## **Application scope**

This spec is applied to vehicle uesd CAN input for Engine status.

# General

## **SYSTEM SPECIFICATION**

### IMMO\_ECU Immobilizer LOGIC INPUTS

The IMMO\_ECU has different debouncing time for IGN1 switch depend on the function.

For the Immobilizer function in case of "release message communication" the IGN1 debouncing time is define as :

IGN1 rising edge = 40msecs  
IGN1 falling edge = 180msecs (calibration parameter)

For the Immobilizer function in all other case the IGN1 debouncing time is 20msecs.

|  |  |  |  |
| --- | --- | --- | --- |
| Designation | | Input characteristics | Debouncing in H.P. |
| BH System | L\_IGN1IPM | Logical | IGN1\_FALL\_FILTER  ( typ 0.18sec see calibration parameters chapter) |

### IMMO\_ECU operating voltage range

The IMMO\_ECU normal operating voltage is within the range of 9V-16Volts.

The IMMO\_ECU checks VB (supplier VBAT voltage)(VBAT MAIN) and If VB monitoring detects a VB value less than 9.0Volts the fault detection is inhibited.

## **SYSTEM / PRODUCTS DESCRIPTION**

The described system is a transponder-based immobilizer for an automotive vehicle.

It is destined to equip the HMC Smart key system.

The products constituting the application are the following ones:

- Up to 2 ignition keys with transponder integrated in the key head

- the antenna for energizing and communicate with the transponder with its integrated electronic modulator/demodulator driver

- the IMMO\_ECU control unit(with Smart Key ECU), in which Immobilizer fuction and Passive entry and GO function are managed

- the EMS control unit (Engine Mamanagement System)

- the serial data link between IMM\_ECU and EMS control Unit

- the data link between IMMO\_ECU and ESCL

- the ESCL control unit(Electrical Steering Lock)

- the SMART KEY Fob, able to communicate via LF/RF waves

It is destined to equip the HMC Push start system.

The products constituting the application are the following ones:

* up to 4 ignition keys with transponder integrated in the key head
* the FOB HOLDER has the antenna for energizing and communicate with the transponder with its integrated electronic modulator/demodulator driver
* the PDM, in which transponder function (reading and learning) is managed.
* the Start/Stop button, in which user interface function is managed.
* the IMMO\_ECU control unit (IPM or Smart key ECU), in which Immobilizer function and Passive Entry and Go function are managed
* the EMS control unit (Engine Management System)
* the serial data link between IMMO\_ECU and EMS control unit
* the data link between IMMO\_ECU and ESCL
* the ESCL control unit (Electronic Steering Lock)
* the SMART KEY Fob, able to communicate via LF/RF waves

(these products are not described in this document, but only Immobilizer related requirements – for more details, see corresponding specification)

Plus the standard components,

conforming to Diagnostic standard Keyword Protocol 2000 :

* the Diagnostic Tool
* the serial data links (K lines) between Diagnostic Tool and vehicle ECUs (Electronic Control Units)

Only Immobilizer related requirements of the IMMO\_ECU control unit and EMS control unit are described in this document.



Figure 1

The purpose of the IMMO- HMC system is to provide an additional anti-theft to the vehicle which is installed in, preventing it from an unauthorized use. Checking of user authorization is done by use of a SMART KEY Fob integrating a transmitter/receiver and a crypto-transponder.

In case of a *lockeded* Immobilizer system (unauthorized key), the EMS control unit locks the engine control by cutting off the ignition circuit and the injector's circuit.

To secure the system, the information exchanged between IMMO\_ECU and EMS through the K-line is coded.

The key teaching and the diagnostic of both control units (IMMO\_ECU& EMS) are realized by diagnostic services with the test equipment.

## **TECHNICAL OBJECTIVES**

The antenna is integrated in FOB HOLDER for push start system (see corresponding specification[Ref I][Ref F]).

Tuning tests will define antenna size and configuration.

The SMART KEY Fob is developed by SIEMENS VDO The transponder is implanted inside the Fob housing. (see corresponding specification[Ref I][Ref E]).

The IMMO\_ECU manages the Immobilizer function, which must be compatible with the EMS interface of the existing Immobilizer system for HMC car defined in the Immobilizer Software Specification of EMS.

It manages the Immo. status indicator conforming to the present specification.

The Diagnosis communication between Diagnostic Tool and IMMO\_ECU & EMS control units conforms to the standard Keyword Protocol 2000 – German implementation ([Ref I][Ref B] & [Ref I][Ref C]), and the corresponding diagnostic communication and services specifications.

# requirement

## **SYSTEM FUNCTIONAL FEATURES**

### Key recognizing principle

The Immobilizer system is based on the recognizing of the key or passive recognizing before each cranking request (inserting the key into the FOB HOLDER), by way of an inductive link between the transponder device (integrated in the key head) and the vehicle.

Key recognizing is based on a challenge/response principle with an encryption algorithm whose parameter is a secret key (KTR). The algorithm is determined by the transponder supplier.

There is one and only one secret key for each vehicle.

The secret key is generated during the IMMO\_ECU learning procedure in the car production line (EoL). It must be saved in the non-volatile memory of the IMMO\_ECU and the transponder, associated to the vehicle identification number(VIN) of the production line.

Note:

The Special equipment in Car Production line will produce “Vehicle Secret Code” (PIN code) which is induced from “Vehicle Serial Identification Number”.

This “Vehicle Secret Code” (PIN code) is used during new keys, and/or IMMO\_ECU and/or ESCL and/or PDM replacement and/or keys replacement (see PushStart System specification [Ref I][Ref H] "Learning Description" )

When the IMMO\_ECU learns this “Vehicle Secret Code” (PIN code), two other codes are determined during the first key teaching.

* the KTR secret key
* RSK
* the **VIN-code**, used in the communication between EMS & IMMO\_ECU(see next chapter)

### Communication principle between IMMO\_ECU and EMS

The immobilizer system needs a medial of communication between the IMMO\_ECU (which manages the Immobilizer function) and PDM (which manages the key recognizing through FOB HOLDER ) and the EMS control unit (which controls the engine). This communication is named: release message communication.

The information exchange is necessary to lock or unlock the engine control, or to synchronize the Immobilizer system after the first key teaching.

This information is based on the Vehicle Specific Identification Number (VIN), coded in 2 bytes.

The VIN-code is calculated by the IMMO\_ECU at the first key teaching using data from PIN code, the value 0FFFFh is not authorized (reserved for virgin EMS).

The VIN-code is transmitted from the IMMO\_ECU in the release message communication (only in case of authorized key) using an encoding algorithm.

The VIN-code is automatically learnt by the EMS after receiving the first release response message (that is: after the first key teaching, the EMS internal state being in virgin mode or neutral mode).

The EMS VIN-code is equal 0FFFFh when leaving electronic production.

To get a synchronized Immobilizer system (same VIN-codes in IMMO\_ECU and EMS control units, authorized and programmed keys), virgin keys and virgin control units have to be got and special procedures have to be executed (Factory teaching, After Market teaching – see Key teaching procedures chapter). Some procedures use the Diagnostic tool equipment; the usage of this tool equipment is restricted to authorized persons.

In addition IMMO\_ECU and EMS exchange an other information: the Engine state Model Identification Number (MIN), coded in 1 byte. The MIN is fixed constant value (01H) . The MIN-code is checked by the EMS to authorize the engine running, and checked by the IMMO\_ECU, in order to inhibit any unauthorized use of IMMO\_ECU or EMS in a different system model.

### Communication Line & System constraint

The exchange of the immobilization status between EMS and IMMO\_ECU is made on a dedicated K-line. The IMMO\_ECU manages a communication window during the exchange of status after

1. IGN Off/On transient under power latch or

2. when user attemps Engine start in case of EMS is locked state.

It will be able to use the below signal for the Engine starting will of the user ;

- After begine of Engine Cranking

### System working in nominal mode

#### Principle

Before each cranking request, an authorization is given to unlock the ESCL and the engine control.

Authorization principle is based on the recognition of :

* the SMART KEY Fob control unit (transmitter/receiver) for Passive Start function

This passive recognition is done with an encryption algorithm

(see corresponding specification [Ref I][Ref E]).

* or the SMART KEY Fob transponder , as a backup solution :

This recognition (same principle as the key recognition – see chapter 4.1.1) needs the SMART KEY Fob to be inserted into FOB HOLDER

The IMMO\_ECU can cancel the authentication (SMART KEY Fob and Transponder)

Authentication cancel is based in the recognition of :

* Cancel condition by SMART KEY function.

The same secret key (KTR) is used for the SMART KEY components, PDM and ESCL and for the Transponder (TR).

In the same way, the secret key is generated during the IPM teaching in the car production line (EoL), and then learnt to the other SMART KEY components.

#### System working in nominal mode

The nominal mode supposes that the different elements of the system are programmed (synchronized Immobilizer system) :

* the secret key code is programmed in memory of IMMO\_ECU, ESCL, PDM , SMART KEY Fob
* the learnt SMART KEY Fob identifiers are stored in IMMO\_ECU and PDM memory
* the corresponding VIN-code is learnt and memorized in the EMS memory
* **IMMO\_ECU와 EMS Communication phase** :

The IMMO\_ECU manages a communication window between IMMO\_ECU& EMS as below condition.

- **Ignition ON transition phase** or **Starting Phase**

* **Ignition ON transition phase (using SMART KEY Fob or backup solution with SMART KEY Fob transponder):**

Authentification procedure is described in PushStart system spec.[Ref I][Ref H].

Depend on authentification result the IMMO\_ECU Immobilizer function switches in *lockeded* state or in *released* state

Then, turning ON the ignition switch, the IMMO\_ECU manages a communication window between IMMO\_ECU& EMS with w/up signal, to allow communication between IMMO\_ECU and EMS during a predefined tuned time window (see Calibration parameters chapter).

And then IMMO\_ECU send the releae signal or block signal.

* **Starting Phase (using SMART KEY Fob or backup solution with SMART KEY Fob transponder):**

when user attemps Engine start in case of EMS Immobilizer state<locked state> the EMS should request to IMMO\_ECU for re-authentication .

It will be able to use the below signal for the Engine starting will of the user ;

- After begine of Engine Cranking

* **IMMO\_ECU– EMS Communication phase** :

After this first « Ignition ON transition » phase or Starting phase

a communication between IMMO\_ECU& EMS control units takes place.

The EMS control unit controls the engine in a normal way for starting and running and starts communication with the IMMO\_ECU, sending a VIN request to the IMMO\_ECU and waiting for a valid release message from it until the release time period has ended.

In case of IMMO\_ECU Immobilizer function state is *« lockeded »*, the IMMO\_ECU answer is the « no release » message. EMS enters into the *locked* state, which causes the activation of the immobilization actions of the engine.

In case of IMMO\_ECU Immobilizer function state is *« released »*, the IMMO\_ECU answer is the «  release » message, including the information « IMMO\_ECU in learnt mode » and the VIN-code.

If VIN-code received by the EMS is the same as EMS VIN-code, and if MIN-code received by the EMS is the same as EMS MIN-code, EMS enters in the *unlocked* state, which allows to continue the running of the engine.

If VIN-code received by the EMS is different than EMS VIN-code, or if MIN-code received by the EMS is the different than EMS MIN-code, EMS enters in the *locked* state, which causes the activation of the immobilization actions of the engine.

If the EMS doesn't receive a response message from the IMMO\_ECU within the release time period, EMS enters in the *locked* state, which causes the activation of the immobilization actions of the engine.

If the IMMO\_ECU doesn't receive any EMS request within the defined time-window TMPVDOUT, the IMMO\_ECU Immobilizer function switches in *blocked* state.

If the IMMO\_ECU doesn't send a "*released*" message to the EMS during the defined time-window TMPVDOUT, the IMMO\_ECU Immobilizer function swiches in *lockeded* state".

## **SYSTEM COMPONENTS**

### Ignition key with integrated transponder

The key is constituted with :

* a mechanical part (metallic « key »)
* a transponder component
* top and bottom shells

The used transponder is the Compatible with Security Transponder family Philips PCF7947

#### Transponder functional description

The PDM communicates with the transponder through FOB HOLDER by way of the antenna and its electronic driver which modulates / demodulates the antenna field. The energy transmitted by the modulated signal enables a process in the transponder, and allows it to communicate.

Communication is used to control the transponder, in order to execute basic operation such as :

* reading out some parts of transponder memory
* programming (writing in) some parts of transponder memory
* locking the access to some parts of transponder memory
* initiating the encryption mode

The transponder EEPROM memory contains 4 pages :

* Locked 0, Page 3 – 32 bits : password (24 bits ) / Configuration( 8 bits)
* Locked 0, Page 2 – 16 bits : encryption key(high)
* Locked 0, Page 1 – 32 bits : encryption key(low)
* Locked 0, Page 0 – 32 bits : serial number (programmed and *locked* by transponder manufacturer)

The Encryption key page can be locked (to inhibit any further writing)..

#### Transponder data

Each transponder has a unique serial number (page 0). It is used as an identifier during recognizing process at Ignition ON transition, in order to know if the key belongs to the vehicle (identification).

The encryption key is programmed during teaching procedure with the KTR secret key value, and locked if parameter CALULKTR is not set.

#### Transponder specification

+ Electrical data

Storage temperature - 55 to +125 °C

Operating temperature - 40 to +85 °C

Nominal carrier frequency 125 kHz

### IMMO\_ECU

The SMART KEY specific components ( ESCL, PDM, SMART KEY Fob, ...) are not described into this document. Refer to ([Ref I][Ref D] PIC System specification and [Ref I][Ref H] PushStart System Spec.) for description.

#### Tasks

The IMMO\_ECU is the Car body control unit, which realizes some functions as actuators control, vehicle access control or alarm function.

The Immobilizer function is shared between the IMMO\_ECU and the EMS.

The Immobilizer tasks of the IMMO\_ECU is :

* Communication with KEY for authentication(by Passive entry or Transponder function)
* Communication with the EMS control unit after Ignition ON transition or Ignition ON phase or User attemps engine start in case of EMS Immobilizer state<locked state>(receipt of the EMS request and transmission of release message)
* Commuincation with scan tool (smart key fob transponder teaching, smart key component learning, diagonostic)

##### Immobilizer Function

The Immobilizer function of IMMO\_ECU has two main modes :

The Nominal mode, selected when « Nominal mode » condition is verified.

It is the current mode of use. In this mode, 2 function states are considered :

« *lockeded* » state : in this state, the vehicle should be immobilized

(cranking is not possible)

« *released* » state : in this state, the vehicle can be mobilized

(cranking is possible)

The Teaching mode, selected when IMMO\_ECU receives « Teaching mode » request from diagnostic tool with correct « Vehicle Secret Code » - PIN code.

##### Nominal Mode operation

The nominal mode supposes that the elements of the system are programmed :

the secret key code is programmed in memory of IMMO\_ECU, transponders, ESCL, PDM, SMART KEY Fob

the learnt TRs identifiers are stored in IMMO\_ECU memory and PDM memory.

In other terms, the IMMO\_ECU is in a learnt state, and no key teaching procedure is in progress.

* Operation with SMART KEY Fob (Passive Start) or
* SMART KEY Fob transponder (backup solution):

At Ignition ON transition or user attemps engine start in case of EMS Immobilizer state<locked state>, the IMMO\_ECU immobilizer function can switch to *released* or *lockeded* state depend on the authentication result and waits for the EMS request message during a time-out duration TMPVDOUT (tunable parameter– see Calibration parameters chapter).

Then after, the behavior will depend on the result of this communication:

After receiving the request message from EMS : « EMS in virgin mode » or « EMS in neutral mode » or « EMS in learnt mode », and the correct MIN-code, the IMMO\_ECU will send the response message :

* In *Released* state : « IMMO\_ECU in learnt state » (including IMMO\_ECU VIN-code).
* In *lockeded* state : « no release ».(without VIN-code).

(Note : no check is done with the EMS VIN-code)

After receiving the request message from EMS : « EMS in virgin mode » or « EMS in neutral mode » or « EMS in learnt mode », but incorrect MIN-code, the IMMO\_ECU will send the response message : « no release answer ». whatever IMMO\_ECU is in *release* or *lockeded* state.

In case of no request message is received from EMS within the time-out TMPVDOUT, Immo function should not switch to *locked* state.

##### MIN-code learning

The MIN-code is a fix value, so there is no MIN-code learning procedure.

##### EMS Neutralization request

For special reason, the Diagnostic tool may ask to IMMO\_ECU to send a neutralization request to the EMS in order the EMS changes to the Neutral mode (see Neutralization Services in Communication services chapter).

The Diagnosis mode EMS neutralization service (from Diagnostic tool to IMMO\_ECU) allow getting the "Vehicle Secret Code" (PIN code) corresponding to the vehicle, registered during the Factory mode teaching procedure (see Key Teaching procedure chapter) and use for the VIN code generation."

"Then after, during the release message communication at the next Ignition ON transition, if a correct MIN-code have been received from EMS, the IMMO\_ECU(whatever « IMMO in virgin mode » or « IMMO\_ECU in neutral mode » or « IMMO\_ECU in learnt mode ») will send the response message "EMS should neutralize" instead of other message ("IMMO\_ECU in learnt state" or "no release answer" or "IMMO\_ECU in Virgin state") with coded VIN Code (this VIN code is data inputed from Diagnostic tool )

(Note : no check is done with the EMS VIN-code)

This response must be sent during all communication phase of the current Ignition ON phase.When Ignition key is cut-off, IMMO\_ECU goes back to the nominal mode behavior (no more neutralization request)."

"If there is no Ignition ON transition after neutralization request by Diagnostic tool during 10sec. IMMO\_ECU goes back to the nominal mode."

##### IMMO\_ECU Neutralization request

For special reason, the Diagnostic tool may ask to IMMO\_ECU to send a IMMO\_ECU newtralization request to the IMMO\_ECU in order the IMMO\_ECU changes from learnt mode to the Neutral mode.

The Diagnostic mode IMMO\_ECU Neutralization Service (from Diagnostic tool to IMMO\_ECU) allows getting the “Vehicle Secret Code” (PIN code) corresponding to the vehicle and registered during the Factory mode teaching procedure (see Key Teaching procedures chapter). If the “Vehicle Secret Code” (PIN code) corresponds to the internal KTR secret code, the IMMO\_ECU Neutralization request is accepted by IMMO\_ECU.

Only learnt IMMO\_ECU accpets IMMO\_ECU neutralization request, otherwise IMMO\_ECU will reject.

#### Communication with the EMS

The IMMO\_ECU can always communicate with the EMS.

The IMMO\_ECU can always communicate with the diagnostic tool.

### EMS control unit (Engine Control Management)

#### Tasks

The Immobilizer function is shared between the IMMO\_ECU and the EMS control units.

The Immobilizer tasks of the EMS are :

Communication with the IMMO\_ECU after Ignition ON transition (emission of the EMS request and receipt of release message with VIN-code information)

Communication with the IMMO\_ECU after User attemps engine start in case of EMS Immobilizer state<locked state>. (emission of the EMS request and receipt of release message with VIN-code information)

Comparison of the received VIN-code and decision for locking / unlocking the engine control.

VIN-code learning (at the first receipt of a correct message including VIN-code)

Action concerning the engine control in order to disable / enable the starting and running of the engine, depending of the *locked* / *unlocked* state.

#### Immobilizer function

The main objective of the EMS immobilizer function is to determine whether the starting and running of the engine is enabled or not. For that, two EMS states are considered :

*locked* state : state in which the starting and running of the engine is disabled ; immobilizing actions are executed.

*unlocked* state : state in which the starting and running of the engine is enabled in a normal way.

At each Ignition ON transition or Starting phase

If user attempts engine start in case of EMS Immobilizer state<locked state>.

the EMS control unit is in *unlocked* state (in the hypothesis that anti-scanning strategy is inactive), and it starts a communication with the IMMO\_ECU, sending a VIN request and waiting for the response message, until the release time period has ended (parameter TMPVDOUT).

(See Communication services chapter).

If Ignition on with no cranking by valid key is more than 30sec, EMS sate is changed from unlocked state to locked state . and EMS should start Re-authentication at starting phase.

Re-authentication procedure is same as authentication procedure at ignition on transition.

##### System states (modes)

At the first mounting of the EMS on the car, it is in **Virgin Mode** and will stay in this mode until it can learn the VIN-code by receiving it from the IMMO\_ECU(see VIN-code learning chapter).

if no VIN-code is learnt, the EMS stays into this mode, and changes into the *locked* state.

In this mode, the VIN-code stored in EMS non volatile memory is 0FFFFh.

As soon as the EMS receives the VIN-code and can learn it (see VIN-code learning chapter), it switches to **Learnt Mode** and changes into the *unlocked* state.

In this mode, EMS checks the IMMO\_ECU response at every communication.

If the IMMO\_ECU response message contains the information « IMMO\_ECU in learnt state » and the correct VIN-code and MIN-code, the EMS changes into the *unlocked* state.

If the IMMO\_ECU response message contains the information « Neutral mode request » and the correct VIN-code, the EMS switches to the Neutral Mode, set its VIN-code at 0FFFFh value, and changes into the *locked* state.

In the other cases of IMMO\_ECU response message (« no release » message, incorrect VIN-code, incorrect MIN-code, ...), the EMS changes into the *locked* state.

For special reason, the IMMO\_ECU may ask to the EMS to change to the **Neutral Mode**, in order to allow the learning of a new VIN-code.

In this mode, if the EMS can learn the VIN-code by receiving it from the IMMO\_ECU(see VIN-code learning chapter), the EMS switches to Learning Mode and changes into the *unlocked* state.

If no VIN-code is learnt, the EMS stays into this mode, and into the *locked* state.

In this mode, the VIN-code stored in EMS non volatile memory is 0FFFFh.

##### VIN-code learning

Enabling of VIN-code learning is given if EMS VIN-code has the value 0FFFFh. This occurs in the Virgin Mode (after the first mounting of the EMS on the car), and in the Neutral Mode.

In this case, the VIN-code is learnt as soon as response messages are received from IMMO\_ECU including the information « IMMO\_ECU in learnt state » and the same VIN-codes.

##### Immobilizing actions

The actions concerning the engine control in order to disable the starting and running of the engine are :

fuel injection control stop

ignition control stop

These actions are executed as soon as possible (when a *locked* state is set), in order to stop properly the engine.

### VIRGIN Operations

Special Virgin mode case:

If the PDM is in Virgin mode and detects that SMARTK KEY ECU or IPM is in Virgin mode and that ESCL is in Virgin mode and that a virgin fob is in the FobHolder (Virgin Fob detected at the time of pressing SSB button) then all transitions are same as in learnt mode, except to turn ON starter Relay:

#### Virgin START for PDM

The Virgin start function is used at the production line to move the vehicle to the learning station, where units and Fob teaching is proceeded.

The number of engine cranking by this function is limited (Limited number/Compliance managed by EMS), so that when the maximum number of cranking is reached even if PDM applied the defined sequence the EMS would not allow the start of the engine unless a successful learning is completed.

In case of Virgin start (pre-conditioned by following elements in virgin state: TP, PDM, IPM, ESCL) a special pattern of IGN1 and Starter activation is to be applied so that the EMS recognized this sequence as a "Twice Ignition sequence", this sequence of terminals activation is to be applied by the PDM unit.



Figure 1**:** Virgin Start

REMARK:

If during this cranking sequence SMART KEY ECU or IPM sends request to switch to an other state, the Cranking sequence will be aborted and the change of state will be done.

#### Virgin START for EMS ( TWICE IGNITION ON FUNCTION )

This is a special function for engine start by vehicle manufacturer. The engine can be started for moving from the production line to an area where the key Learning is processed. This function is only perfomed in condition that EMS, smart key system are all Virgin status.

The engine can be started by the sequence

* Ignition on with no cranking,
* Ignition off,
* Ignition on with cranking within a time interval.

The following timing conditions have to be fulfilled for successful start:

- EMS, smart key system are all Vigin stauts.

* first ignition on more than 0.5sec and less than 1.5 sec
* ignition off time is limited by the minimum of 0.2 sec and the maximum of 1.5 sec
* ignition on

The numner of engine starts by “twice ignition on” is limited. The maximum value is defined by S/W constant. (Value is 32, regardless of cranking)

|  |
| --- |
| ☞ Twice Ignition ON Condition:  - ECU & Smart Key system : Virgin only  - 0.5sec ≤ First IGN ON ≤ 1.5sec  - 0.2sec ≤ IGN OFF ≤ 1.5sec  - Ignition ON |
| ☞ Twice Maximun Value: 32 Times(λ-Engine, μ-Engine: 64 Times) |
| ☞ Unlocking Time Of EMS after Twice Ignition ON: 30sec |
| ☞ The EMS is Instantly locked by IGN OFF after Twice Ignition |

### Serial data link between IMMO\_ECU and EMS control unit

#### Electrical Specification

The electrical specification of the serial link is based on the standard ISO 14230-1.

The communication between EMS and IMMO\_ECU (release message communication) is made on the dedicated EMS-COM line (see figure 1).

Because of system definition, no communication with EMS is possible if IGN1 is OFF.

#### Protocol Specification

The protocol has to be distinguished in different cases :

Protocol specification during time of communication between EMS and IMMO\_ECU

(Release message communication) - Immobilizer mode :

* The IMMO\_ECU is defined as Slave. The EMS is defined as Master.
* The other control units are defined as Remote (in general case, they are isolated from EMS and IMMO\_ECU).

Details of protocol are described in Communication Services chapter.

Protocol specification with the Diagnostic tool unit :

* The IMMO\_ECU is defined as Slave*.* The EMS is defined as Slave.
* The other control units are defined as Remote.
* The Diagnostic tool Unit (if present) is defined as Master.
* Communication between EMS and IMMO\_ECU is possible during Diagnostic mode session is active :

Used protocol is described in Communication Services chapter.

Definition of the time window for communication between EMS and IMMO\_ECU:

At each Ignition ON transition, the time window for communication between EMS and IMMO\_ECU starts for a TMPVDOUT tunable time duration.

However, at any time, in case of recognition of the EMS communication on the line, the IMMO\_ECU must start a TMPVDOUT time window for communication between EMS and IMMO\_ECU. This allows the EMS to make a new request (or periodic request) to the IMMO\_ECU (case of EMS reset in cranking phase, without IMMO\_ECU reset, for ex.)

## **Communication services**

### Immobilizer mode communication ( Communication between IMMO\_ECU& EMS )

#### Communication protocol

During this mode, the EMS takes place of the Master in the communication protocol.

(see details in Serial data link chapter)

##### Communication format

Transmission rate: **4.8 kBd +/- 2%**.

Communication type : Point to point bi-directional transmission between IMMO\_ECU and EMS (UART)

Bit format: NRZ

Communication voltage Level:

Logic “1” : Transmission Part: More than 80% of battery voltage

Reception Part: More than 70% of battery voltage

Logic “0”: Transmission Part: More than 20% of battery voltage

Reception Part: More than 30% of battery voltage

Slope Time: Less than 10% of bit time

20%

80%

30%

70%

Slope Time

Bit time

100%

50%

Battery Voltage

Byte format :

**5**



※ clarify next byte start criteria : falling edge before start bit of next byte



##### Initialization of communication

After Ignition on transition or  
After user attemps engine start in case of EMS ***locked*** state during Ignition On state,  
the EMS send the ACK request for immobilizer communication after the initialization time Tini .

The communication frame procedure is followed in order as below ( ACK à Authentication à Synchronization)

But In case of Engine RPM is over than 60rpm within power latch time,

EMS should not restart the immobilizer communication even if ignition on is issed during the EMS is unlocked

and will send the synchronization if Engine state is changed.

EMS and IMMO\_ECU stop the communication if Ign phase is changed from on to off during the immobilizer communication.(EMS don’t save the DTC in that case even if No response of IMMO\_ECU or DATA Error of IMMO\_ECU and IMMO\_ECU don’t save the DTC in this case even if EMS no request or DATA error of EMS)

WUP

K line

Key

Tini

P2

EMS è ICU

On

Off

WUP Ack

ICU è EMS

Request

P2

Answer

P3

EMS è ICU

ICU è EMS

Physical voltage up

With :

40 ms < Tini < 320ms

The IMMO\_ECU must constantly be in a position to detect an EMS frame since the interruption and re-initialization of the communication also takes place in the event of an error.

The IGN off filtering Time of EMS/ICU : 1 ms < Tini < 80ms

Remark:

The Tini time will be adjust in order to send the first Wake Up Pattern after the time needed by IMMO\_ECU to check the Key (transponder communication time).

P2 : Time between end of EMS Request and start of IMMO\_ECU Response(Please see 9.2.1.4)

P3 : Time between end of Immobilizer response and start of an EMS new request (Please see 9.2.1.4)

##### Frame structure

After IGN ON the EMS should send the following wake-up frame : 49H 02H 06H 08H, the IMMO\_ECU will respond with a 69H 02H 50H 52H

At the reception of this 69H 02H 50H 52H the EMS will start the Exchange of immobilization status



|  |  |  |
| --- | --- | --- |
| Bytes | Parameter Name | HEX value |
| #1 | Address | EMS 49H / IMMO\_ECU69H |
| #2 | Message Length (Lengtht) | 07H |
| #3 | Message Identifier (Ident) | 03H - 0EH |
| #4 | Data Byte 1 (#RND byte 1 – MSB) | See DATA paragraph |
| #5 | Data Byte 2 (#RND byte 2 – LSB) | See DATA paragraph |
| #6 | Data Byte 3 (MIN) | 01H |
| #7 | Data Byte 4 (VIN byte 1 – MSB) | See DATA paragraph |
| #8 | Data Byte 5 (VIN byte 2 – LSB) | See DATA paragraph |
| #9 | Cs : checksum | See Checksum paragraph |

BYTES STRUCTURE

The structure of the Header, Data and Checksum bytes is the same (see byte format).

HEADER

The following values are used :

Addr :

All messages sent by the EMS will use Address 49H

All messages sent by the IMMO\_ECU will use Address 69H

*Length* : 07H (always 6 bytes of data and 1 byte for CS)

MESSAGE INDENTIFIER

See chapter 4.3.1.2 for definitions.

DATA

The following values are used :

EMS to I/F Unit

|  |  |
| --- | --- |
| Data | Description |
| Data Byte 1 | RANDOM data(MSB) |
| Data Byte 2 | RANDOM data(LSB) |
| Data Byte 3 | 01H |
| Data Byte 4 | VIN(MSB) Ä ( 1’complement Data byte 1) |
| Data Byte 5 | VIN(LSB) Ä (1’complement Data byte 2) |

Example: Random value 5B73h

VIN C61Fh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data Byte 1 | Data Byte 2 | Data Byte 3 | Data Byte 4 | Data Byte 5 |
| 5B | 73 | 01 | 62 | 93 |

IMMO\_ECUto EMS

|  |  |  |
| --- | --- | --- |
| Data | Discreption | |
| With valid transponder | Without valid transponder |
| Data Byte 1 | (1’complement Received RANDOM(MSB)) Ä 48H | Same as received data 1 form EMS |
| Data Byte 2 | (1’complement Received RANDOM(LSB)) Ä ACH | Same as received data 2 form EMS |
| Data Byte 3 | 01H | Same as received data 3 form EMS |
| Data Byte 4 | VIN(MSB) Ä (1’complement Data byte 1) | Same as received data 4 form EMS |
| Data Byte 5 | VIN(LSB) Ä (1’complement Data byte 2) | Same as received data 5 form EMS |

Where, Ä : exclusive-or

Example : Random value 5B73h

VIN C61Fh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data Byte 1 | Data Byte 2 | Data Byte 3 | Data Byte 4 | Data Byte 5 |
| EC | 20 | 01 | D5 | C0 |

NOTE : 1) If the EMS is virgin state or Neutral state , Data Byte 4 and Data Byte 5 are zero.

2) If the IMMO\_ECU is virgin state or Neutral state, Data Byte 4 and Data Byte 5 are zero.

CHECKSUM BYTE

The checksum byte ( Cs ) inserted at the end of the message block is defined as the simple 8 bit sum series of all bytes in the message, excluding the Address and the checksum.

##### Message STRUCTURE

###### **Autodetection**

EMS AutoDetection Request:

|  |  |  |  |
| --- | --- | --- | --- |
| 49 | 02 | 06 | 08 |

IMMO\_ECU AutoDetection Response:

|  |  |  |  |
| --- | --- | --- | --- |
| 69 | 02 | 50 | 52 |

The communication is used for setting EMS software to Push start system with EMS state (smartKey1). If the IMMO\_ECU does not respond to this command then it will not be ready to accept otr communications.

EMS has 4 type software(smartra2, smartra3, smartKey1, smartKey2) for Immobilzer and at first Ign On EMS detect which type Immobilizer system is installed.

We call this EMS autodetection.

EMS Autodetection flow ;

At the first IGN on ,

* EMS send the Request signal (49 02 06 08)
* IMMO\_ECU send the Response signal(69 02 60 52) : EMS set the software to push start system with EMS state(smartKey1) If EMS received this Response

When EMS detected the Immobilizer type, EMS should keep the software until Neutralization

And EMS must not send this request anymore and send the acknowledge signal with EMS state.

But IMMO\_ECU should send the response (69 02 60 52) anytime regardless of IMMO\_ECU type (Virgin, Neutral, Learnt) if EMS send the request for autodetection(49 02 06 08)

Note: EMS should try this communication for 1.5sec If EMS do not receive the response within P2 time

###### **WAKEUP**

EMS WakeUp Request:

|  |  |  |  |
| --- | --- | --- | --- |
| 49 | **02** | 06 | 08 |

IMMO\_ECU WakeUp Acknowledge Response:

|  |  |  |  |
| --- | --- | --- | --- |
| 69 | **02** | 50 | 52 |

The communication is used for ancknowledge for communiation of EMS with IMMO\_ECU at IGN on

If the IMMO\_ECU does not respond to this command then it will not be ready to accept otr communications.

IMMO\_ECU will resend the EMS state from EMS.

EMS should try this communication if EMS do not receive the response within P2 time or IMMO\_ECU send the different EMS state

Note: Refer the Chapter [9.1.1.5] for communication timing of EMS with IMMO\_ECU

###### **Authentication**

EMS Authentication Request:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 49 | **07** | Identifier | RN1 | RN2 | MIN | VIN1 | VIN2 | CS |

RN1, 2: random number

MIN: 01h (fixed)

VIN1, 2: Coded VIN or Zeros if EMS is virgin or neutral

IMMO\_ECU Authentication Response:

**Authentication Answer**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 69 | **07** | Identifier | RN3 | RN4 | MIN | VIN3 | VIN4 | CS |

RN3, 4: coded random number or RN1, 2 from EMS

MIN: 01h (fixed)

VIN3, 4: Coded VIN or Zeros if EMS is virgin or neutral

The communication is used for Immobilizer authentication.

EMS can know the IMMO\_ECU state and VIN Information.

EMS should try the immobilizer communication with the WUP request, If EMS does not receive the response within P2 time or IMMO\_ECU send the different EMS state.

Note: Refer the Chapter [9.1.1.5] for communication timing of EMS with IMMO\_ECUMes

##### Messages timing

**5**



P1 : Inter-byte time for immobilizer request.

P2 : Time between end of EMS request and start of an immobilizer response.

P3 : Time between end of Immobilizer response and start of an EMS new request

P4 : Inter-byte time for EMS request

※ measurement criteria of P1/P2/P3/P4 timming :   
include Stop bit (2bit) of before byte / not include Start bit (1bit) of next byte

Ex) measure P1 time



With :

* Stop bit (2bit) transmission time £ P1 £ 1 ms
* 18 ms £ P2 £ 40 ms

(the maximum duration for IMMO\_ECU to be ready to send the IMMO Status is 400 ms from Key Off->On)

* 1 ms £ P3 £ 200 100ms
* Stop bit (2bit) transmission time £ P4 £ 2 ms

After Ignition on transition or  
after user attemps engine start in case of EMS ***locked*** state during Ignition On state,  
the EMS ECU starts defined timer (EMS\_Communication\_Window, tunable parameter, default value 1.5s) for communication between EMS ECU and IMMO\_ECU.

In case of no answer message is received from IMMO\_ECU within the time-out P2, EMS ECU should be started again communication by sending WUP message until end of timer EMS\_Communication\_Window.

Refer to chap 9.1.1.5.1 & 9.1.1.5.2 for detail timing.

###### **NO RESPONSE (WUP)**

EMS should try this communication if EMS do not receive the response within P2 time.

This communication will hold on for 1.5sec. (see below timing chart)

wup

.

Request

NO

Response

Immobilizer

Communication

EMS starts

EMS

\_

Communication

\_

Window

Over than P3

(1.5sec)

Request

wup

Over than P3

NO

Response

###### **NO RESPONSE (AUTHENTICATION)**

EMS should try this communication by sending WUP message if EMS do not receive the response within P2 time.

This communication will hold on for 1.5sec. (see below timing chart)

1) OPTION1

WUP

.

Request

WUP

Response

Immobilizer

Communication

EMS starts

EMS

\_

Communication

\_

Window

(1.5sec)

Request

ACK

Over than P3

WUP

.

Request

WUP

Response

Request

AUTH

Over than P3

NO

Response

NO

Response

2) OPTION2

WUP

.

Request

WUP

Response

Immobilizer

Communication

EMS starts

EMS

\_

Communication

\_

Window

(1.5sec)

Request

AUTH

Over than P3

WUP

.

Request

WUP

Response

Request

AUTH

Over than P3

EMS restarts

EMS

\_

Communication

\_

Window

(1.5sec)

NO

Response

NO

Response

##### Communication error

1)SMARTKEY ECU

During communication with the EMS, 4 kinds of errors are defined:

EMS reception error:

à No data

à UART error

à Frame length error

EMS data error

à Header value

à Checksum value

à EMS status Unknown

EMS MIN code error(Wrong MIN code)

These errors set a failure by way of the fault manager for Diagnostic purpose (Diagnostic service for failures reading in document ).

“EMS reception error” failure is set after 5 occurrences of error.

“EMS data error” failure, “EMS MIN code error” failure and « No EMS request » failure are set at the first occurrence of error.

2) EMS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| FAULT | Description | Fault Code | REMARKS | Confirmation time |
| SMARTKEY FAULT | No Response from SMARTKEY | (0This | In case no answer message is received from SMARTKEY UNIT within the time-out P2, EMS ECU should be started again communication by sending WUP message until end of timer EMS\_Communication\_Window (1.5sec).  This error is set there is no response during EMS\_Communication\_Window.  In case that EMS receive NEGATIVE message from SMARTKEY ECU, EMS has not to set DTC.  DTC set is only allowed while IGN1 | 1.5sec |
| Invalid message from  SMARTKEY | P1676 | Data error or timing error  Data error: header value error, checksum value error, SMARTKEY status unknown error.  Timing error: in case P2 time is over than 40ms.  This error is set there is no valid message during EMS\_Communication\_Window.  In case that EMS receive NEGATIVE message from SMARTKEY ECU, EMS has not to set DTC.  DTC set is only allowed while IGN1 | 1.5sec |
| P1696 | Wrong VIN or MIN or RPN  This error is set EMS receive wrong VIN,MIN or RPN. (there is no data or timing error)  In case that EMS receive NEGATIVE message from SMARTKEY ECU, EMS has not to set DTC.  DTC set is only allowed while IGN1 | 1 time |
| EMS Fault | Exceeding the maximum limit of Twice IGN ON(≥32 times)  (λ-Engine, μ-Engine: 64 Times) | P1699 | - | - |

#### Exchange of immobilization status

SERVICES

All messages sent by the EMS will use the Sid= **49h**

All messages sent by the IMMO\_ECU will use the Sid= **69h**

MESSAGES

EMS MESSAGES TO IMMO\_ECU(Request)

VIN request when EMS is in virgin mode:

Ident : 03H

RN 1,2 : random number

MIN : 01H

VIN1,2 : Zeros

VIN request when EMS is in neutral mode:

Ident : 05H

RN1,2 : random number

MIN : 01H

VIN1,2 : Zeros

VIN request when EMS is in learnt mode:

Ident : 07H

RN1,2 : random number

MIN : 01H

VIN1,2 : Coded VIN

IMMO\_ECUMESSAGES TO EMS (Response)

Negative / Neutral mode response for request key Service:

Ident : 04H (« no release answer »)

RN3,4 : dummy data (resend RN1,2 received from EMS)

MIN : 01H

VIN3,4 : dummy data (resend VIN1,2 received from EMS)

Do not learn key Service:

Ident : 09H (« IMMO\_ECU in Virgin state »)

RN3,4 : coded random number

MIN : 01H

VIN3,4 : zeros

Send VIN Service :

Ident : 08H (« IMMO\_ECU in Learnt state »)

RN3,4 : coded random number

MIN : 01H

VIN3,4 : coded VIN in IMMO\_ECU

Neutralization Service:

Ident : 0AH (EMS should neutralize)

RN3,4 : coded random number

MIN : 01H

VIN3,4 : coded VIN from Diagnostic tool

##### Identification number matrix

In below table shows Identification data value between EMS and IMMO\_ECU communication data map.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EMS  state | IMMO\_ECU state | Communication result with  Transponder | | IMMO\_ECU to EMS | Current Data | Engine crank’g | EMS to IMMO\_ECU | | IMMO\_ECU to EMS | |
| Data  1,2 | Data  4,5  (VIN) | Data  1,2 | Data  4,5  (VIN) |
| Key status |
| Virgin  ($03) | Virgin | Virgin | | $09 | Virgin | Possible after twice “IGN ON” only | 5B73 | 0000 | EC20 | 0000 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | | $04 | Learnt | Not  possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | Virgin | | $04 | Virgin | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | Valid | $08 | Learnt | Not  possible | 5B73 | 0000 | EC20 | D5C0 |
| Invalid | $04 | Invalid | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Neutral request  (IMMO\_ECU is Learnt) | Virgin | | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| No TP | | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Learnt | Valid | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Invalid | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Neutral | - | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Neutral  ($05) | Virgin | Virgin | | $09 | Virgin | Not possible | 5B73 | 0000 | EC20 | 0000 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | | $04 | Learnt | Not  possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | Virgin | | $04 | Virgin | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt | Valid | $08 | Learnt | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Invalid | $04 | Invalid | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Neutral request  (IMMO\_ECU is Learnt) | Virgin | | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Learnt | Valid | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Invalid | $0A | Not yet Checked | Not possible | 5B73 | 0000 | EC20 | D5C0 |
| Neutral | - | | $04 | Not yet Checked | Not possible | 5B73 | 0000 | 5B73 | 0000 |
| Learnt  ($05) | Virgin | Virgin | | $09 | Virgin | Not possible | 5B73 | 6293 | EC20 | 0000 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 6293 | 5B73 | 0000 |
| Learnt | | $04 | Learnt | Not possible | 5B73 | 6293 | 5B73 | 0000 |
| Learnt | Virgin | | $04 | Virgin | Not possible | 5B73 | 6293 | 5B73 | 6293 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 6293 | 5B73 | 6293 |
| Learnt | Valid | $08 | Learnt | possible | 5B73 | 6293 | EC20 | D5C0 |
| Invalid | $04 | Invalid | Not possible | 5B73 | 6293 | 5B73 | 6293 |
| Neutral request  (IMMO\_ECU is Learnt) | Virgin | | $0A | Not yet Checked | Not possible | 5B73 | 6293 | EC20 | D5C0 |
| No TP | | $04 | Not yet Checked | Not possible | 5B73 | 6293 | EC20 | D5C0 |
| Learnt | Valid | $0A | Not yet Checked | Not possible | 5B73 | 6293 | EC20 | D5C0 |
| Invalid | $0A | Not yet Checked | Not possible | 5B73 | 6293 | EC20 | D5C0 |
| Neutral | - | | $04 | Not yet Checked | Not possible | 5B73 | 6293 | 5B73 | 6293 |

When IMMO\_ECU is virgin, Valid TP is a virgin TP

When IMMO\_ECU is virgin, Not valid TP is a locked TP or No TP

When IMMO\_ECU is learnt, Valid TP is a Learnt and authenticated TP

When IMMO\_ECU is learnt, Not valid TP is a not learnt TP or no TP

During Teaching procedure, IMMO\_ECU is considered as "Virgin" before 1st key teaching and as "Learnt" after the 1'st key teaching

##### Summarizaton of engine start operation

In below table shows engine cranking condition with IMMO\_ECU and EMS communication ID data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Step | IMMO\_ECU | EMS  state | Command  By TESTER | IMMO\_ECU | | ID | EMS | | Engine Cranking |
| MIN | VIN | MIN | VIN |
| 1 | VIRGIN | VIRGIN | NORMAL | yes |  | ß $03  à $09/04 | yes |  | 04H- Not possible  09H - Possible after twice “IGN KEY ON” only |
| KEY TEACHING | yes | Learnt | ß $03  à08/09/04 | yes | Learnt | No response  - Change step 2 |
| 2 | LEARNT | LEARNT | NORMAL | yes | Yes | ß $07  à $08 / $04 | Yes | Yes | - $08 possible  - $04 not Possible |
| KEY TEACHING | yes | Yes | ß $07  à08/09/04 | Yes | Yes | No response |
| NEUTRAL | yes | Yes | ß $07  à $0A | Yes | Yes | - Not possible  - Change step 3 |
| 3 | LEARNT | NEUTRAL | NORMAL | yes | Yes | ß $05  à $08 / $04 | Yes | Learnt | - $08 possible  - $04 not Possible |
| KEY TEACHING | yes | Yes | ß $05  à08/09/04 | Yes | Learnt | No response |
| NEUTRAL | yes | Yes | ß $05  à $0A | Yes |  | - Not possible |
| 4 | Exchange  TO  VIRGIN | LEARNT | NORMAL | yes |  | ß $07  à $09 / $04 | Yes | yes | - Not possible |
| KEY TEACHING | yes | Learnt | ß $07  à08/09/04 | Yes | yes | No response |
| NEUTRAL | yes | Yes | ß $07  à $0A | Yes |  | - Not possible with  Incorrect VIN |
| 5 | LEARNT | Exchange  TO  VIRGIN | NORMAL | yes | Yes | ß $03  à $08 / $04 | Yes | Learnt | - $08 possible  - $04 not possible  - Change step 2 |
| KEY TEACHING | yes | Yes | ß $03  à08/09/04 | Yes | Learnt | No response  - Change step 2 |
| NEUTRAL | yes | Yes | ß $03  à $0A | Yes |  | - Not possible |
| 6 | LEARNT  Exchange  from  other  vehicle | Exchange  TO  VIRGIN | NORMAL | yes | Yes | ß $03  à $08 / $04 | Yes | yes | - Not possible with  Incorrect VIN |
| KEY TEACHING | yes | Yes | ß $03  à08/09/04 | Yes | yes | No response |
| NEUTRAL | yes | Yes | ß $03 | Yes | yes | - Not possible |
| 7 | LEARNT | LEARNT  Exchange  from  other  vehicle | NORMAL | yes | Yes | ß $07  à $08 / $04 | Yes | yes | - Not possible with  Incorrect VIN |
| KEY TEACHING | yes | Yes | ß $07  à08/09/04 | Yes | yes | No response |
| NEUTRAL | yes | Yes | ß $07  à $0A | Yes | yes | - Not possible with  Incorrect VIN |
| 8 | VIRGIN | NEUTRAL | NORMAL | yes |  | ß $05  à $09 | Yes |  | - Not possible |
| KEY TEACHING | yes | Learnt | ß $05  à08/09/04 | Yes | learnt | No response  - Change step 2 |
| NEUTRAL | yes |  | ß $05  à $0A | Yes |  | - Not possible |
| 9 | NEUTRAL | VIRGIN / LEARNT / NEUTRAL | NORMAL | yes |  | ß$03/ 05 /07  à $04 | Yes |  | - Not possible |
| KEY TEACHING | yes | Learnt | ß$03/ 05 /07  à $04 | Yes | learnt | No response  - Change step 2 |
| NEUTRAL | yes |  | ß$03/ 05 /07  à $04 | Yes |  | - Not possible |

#### End of communication

The Immobilization communication stops after the release time period (parameter TMPVDOUT) if no Ignition key ON transition occurs. Although Immobilization communication stop, IMMO\_ECU should start the communication when EMS request if IGN on

### Diagnostic mode communication

#### Communication protocol

During this mode, the EMS & IMMO\_ECU control units are in Slave mode.

(see details in Serial data link chapter)

Data Link Layer and Service Layer specification are based on Keyword Protocol 2000 (German implementation) standard ([Ref I][Ref B]&[Ref I][Ref C]).

#### IMMO\_ECU related services

Protocol and services of the IMMO\_ECU in the Diagnostic mode are specified in a specific document ([Ref I][Ref A]).

Out of the general Car body functions related services, some Immobilizer function specific services are implemented:

* IMMO\_ECU teaching start  service
* Input PIN code service
* Request teaching 1st key  service
* Request teaching 2nd key  service
* EMS Neutralization  service (request from the Diagnostic tool unit to neutralize the EMS ; the IMMO\_ECU will send the Neutralization response in the next communication with the EMS)
* WriteDataByLocalIdentifier services, in order to write Immobilizer parameters
* ReadDataByLocalIdentifier services, useful to get information about IMMO\_ECU status, parameters and key teaching procedure.(see details in Diagnostic document[Ref I][Ref A])
* SMART KEY Components Learning services (see Diagnostic document[Ref I][Ref A])
* IMMO\_ECU Neutralization service
* ESCL Neutralization service
* PDM Neutralization service

#### EMS related services

No Immobilizer function specific service is implemented for the EMS (except ReadDataByLocalIdentifier services to get information about EMS status).

(see details in Serial communication specification of the corresponding EMS model)

## **KEY TEACHING PROCEDURES**

Refer to PIC System Specification[Ref I][Ref D] " Learning Description"

## **Status indicator**

The status indicator is a LED indicator. It indicates the state of IMMO\_ECU immobilizer function and completion of key teaching.

### Status Led modes

The LAMP driving is dependant of the IMMO\_ECU status.

The LAMP driver is depend on system

* BH system

IMMO\_ECU does not have LAMP driver hardware but transmits C\_ImmoLamp CAN signal to Cluster module in order to indicate IMMO\_ECU status.

* SMK system

IMMO\_ECU contains the LAMP driver hardware for direct connection of on LAMP.(O\_IMMO\_IND)

### Presentation

#### Status LAMP patterns list:

|  |  |  |  |
| --- | --- | --- | --- |
| patterns list | LAMP STATE | SYSTEM | |
| CAN system | Hard wire system |
| LAMP\_SEQ\_ON | LAMP is switched ON | C\_ImmoLamp(=0x02) | O\_IMMO\_IND=ON |
| LAMP\_SEQ\_OFF | LAMP is switched OFF | C\_ImmoLamp(=0x00) | O\_IMMO\_IND=Off |
| LAMP\_SEQ\_AUTH\_ERROR | LAMP is BLINKING 5 times / 1Hz | C\_ImmoLamp(=0x01) | O\_IMMO\_IND=Blinking |
| Non PIC option | LAMP is switched OFF | C\_ImmoLamp(=0x03 or 0x00) | NA |

The condition of PATTERNS LIST is described in [Ref H].

### Global rules for status LAMP pattern

#### RULES:

Immo LED On

à See the Push start system specitication.

Immo Lamp Blinking

à LAMP\_Blinking for 10sec when Authentication Fail

#### Behavior during learning procedures

While a SmartKey FOB Key learning procedure is in progress, the Lamp is switched OFF.

In addition, LAMP\_ON for 700 ms after each successful SmartKey FOB key learnt.

#### NeUtral mode

While the IMMO\_ECU is in Neutral mode, the Lamp is switched OFF.

In addition, LAMP\_SEQ\_ON for 700 ms after each successful SMART KEY FOB key learnt.

## **CALIBRATION PARAMETERS**

Some calibration parameters are mentioned in the previous chapters and can be adjusted or changed before production (within the limit of system compatibility) or in After Market service (for certain parameters only) by way of Diagnostic services, as they are stored in modifiable non volatile memory.

### System parameters

TMPVDOUT : Time-out for release message communication

Variation range : 1 to 25 sec.

Default value : 2 sec.

CALULKTR : Boolean parameter to inhibit the key transponder locking

Variation range : 0, 1

Default value : 0 (« transponder must be locked »)

IDS\_RELEASE\_PERIOD : Authentication success hold time for fast restart mechanism

Variation range : 0 to 60 sec.

Default value : 30 sec.

IGN1\_FALL\_FILTER : IGN1 falling filtering used to EMS communication

Variation range : 0 to 2.55 sec.

Default value : 0.18sec.

# Glossary

***Lockeded*** :

state of IMMO\_ECU Immobilizer function, in which the vehicle should be immobilized.

In this state, cranking is not possible if the optional cranking relay is present.

***Released*** :

state of IMMO\_ECUImmobilizer function, in which the vehicle can be mobilized.

In this state, cranking is possible.

***Locked*** :

state of EMS Immobilizer function, in which the starting and running of the engine is disabled ; immobilizing actions are executed.

***Unlocked*** :

state of EMS Immobilizer function, in which the starting and running of the engine is enabled  in a normal way.

Release message communication :

Communication phase between IMMO\_ECUand EMS during which Immobilizer status and information are exchanged.

MIN code: Model Identification Number

VIN code: Vehicle Specific Identification Number (VIN)

PIN code: P Identification Number (Vehicle Secret Code)

Challenge: The Random number (32bits), which IMMO\_ECU sents to Transponder

Transponder Serial Number:

The Unique numbers (32bits) which are stored in Transponder memory (Page0)

SMART KEY :

the Fob used as identifier for Keyless Passive Entry and

Go functionality (option).

ESCL : Electronic Steering Lock

PDM : Power Distribution Module.

IMMO\_ECU : The ECU, has IMMO-HMC is depond on system

* + - BH System, IPM (In Panel Module)
    - SMK System, Smart Key ECU

EMS : Engine Management System

KTR (ISK): Secret Encryption Key programmed

RSK : Remote Secret Key

# applicable standard

The reference documents are:

* 1. BH system : Diagnostic Services Specification – HMC BH
  2. Keyword Protocol 2000 – Data Link Layer

Recommended Practice

(German implementation)

Status : Version 1.5 : October 1, 1997

* 1. Keyword Protocol 2000 – Implementation of Diagnostic Services

Recommended Practice

(German implementation)

Status : Version 1.5 : October 1, 1997

* 1. BH System : SMART KEY System Specification – HMC PIC BH
  2. BH System : SMART KEY Fob specification – Component specification
  3. BH System : FOB HOLDER System Specification
  4. BH System : BH Warning Requirements
  5. BH System : PushStart System specification – HMC