Immobilizer System Description in EMS System

unction Introduction

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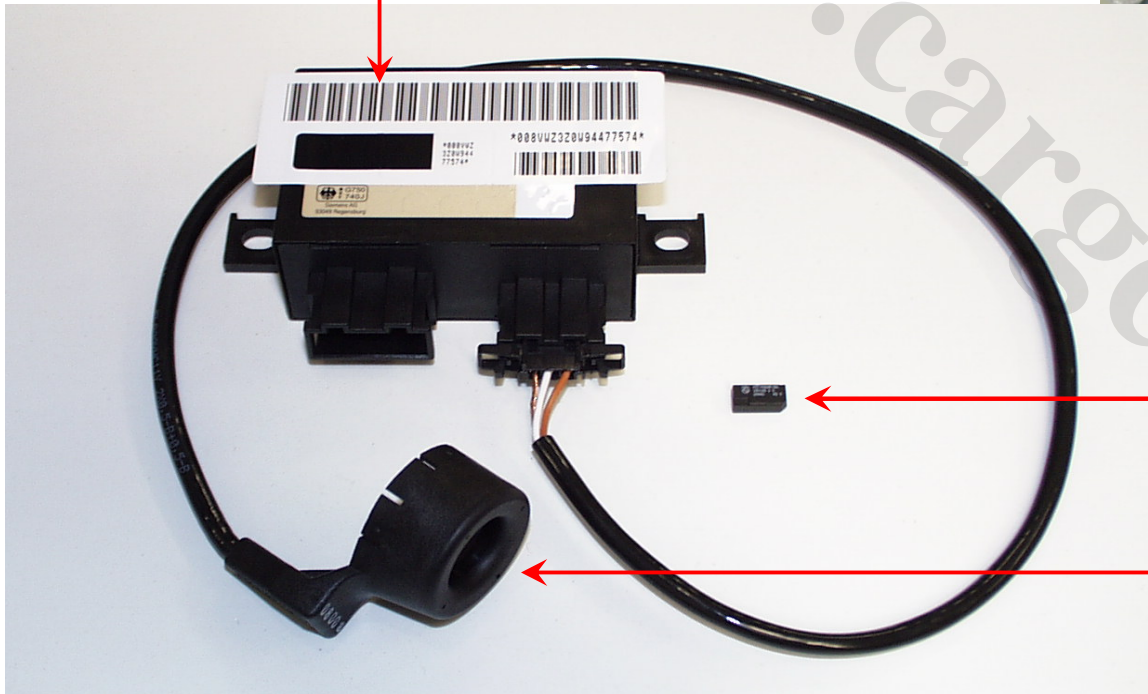
< Flash Memory Key type >

< Wheel Lock type >

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Immobilizer system has many types of working.

The purpose of the immobilizer system is to **immobilize the vehicle** except authorized person key.

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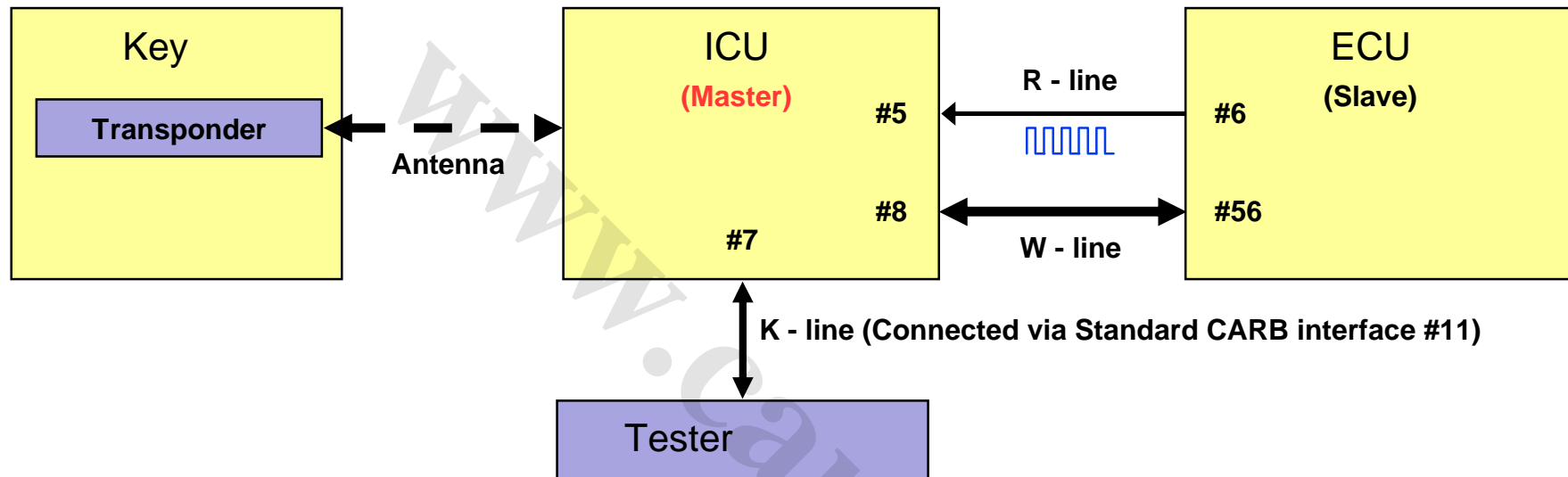
Continental Immobilizer System

Engine Control Unit (ECU)

Immobilizer ECU (ICU)

Transponder

Antenna

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Continental Immobilizer System Configuration

Key

Transponder

Antenna

ICU
(Master)

#5

#8

#7

R - line

W - line

ECU
(Slave)

#6

#56

K - line (Connected via Standard CARB interface #11)

Tester

During authentication process, ICU and ECU communicate via R-line and W-line for sending an taking challenge and response.

During authentication process, ICU and Transponder communicate through Antenna for sending and taking fix code, challenge and response.

During system initialization process, ECU Reset and ECU Reprogram Service, ICU communicates with Tester via K-line.

∈ For blue highlighted terms, refer to Key Words pages.

ECU & ICU State

Virgin

ECU reprogramming service

ECU reset service

ECU reprogramming service

Learnt

Neutral
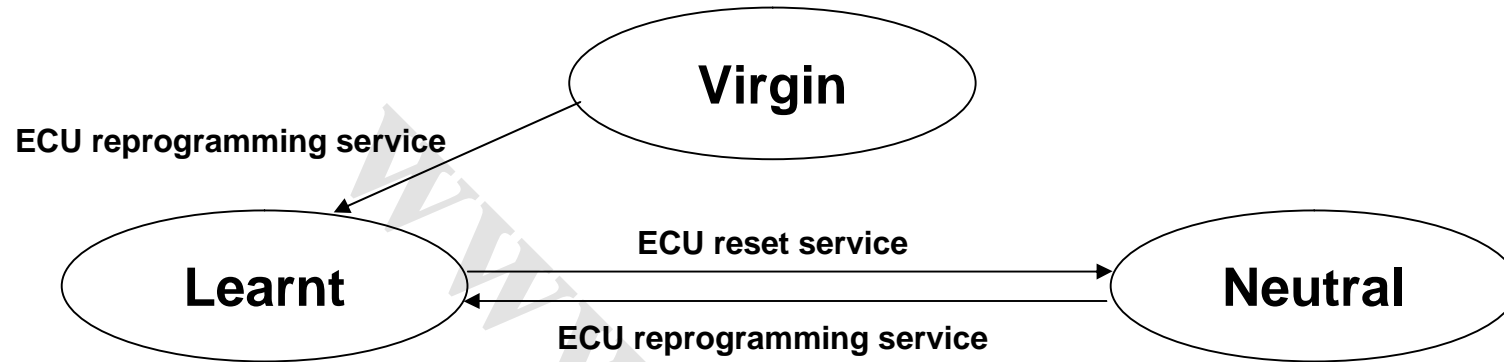
- **ECU**

  - Virgin: Virgin ECU, it never connected with ICU and tester. So, no Secret Key and no Security Code are memorized in the non-volatile memory (NVMY) of ECU.

  - Learnt: Secret Key and Security Code were programmed in the NVMY of ECU by ICU and tester.

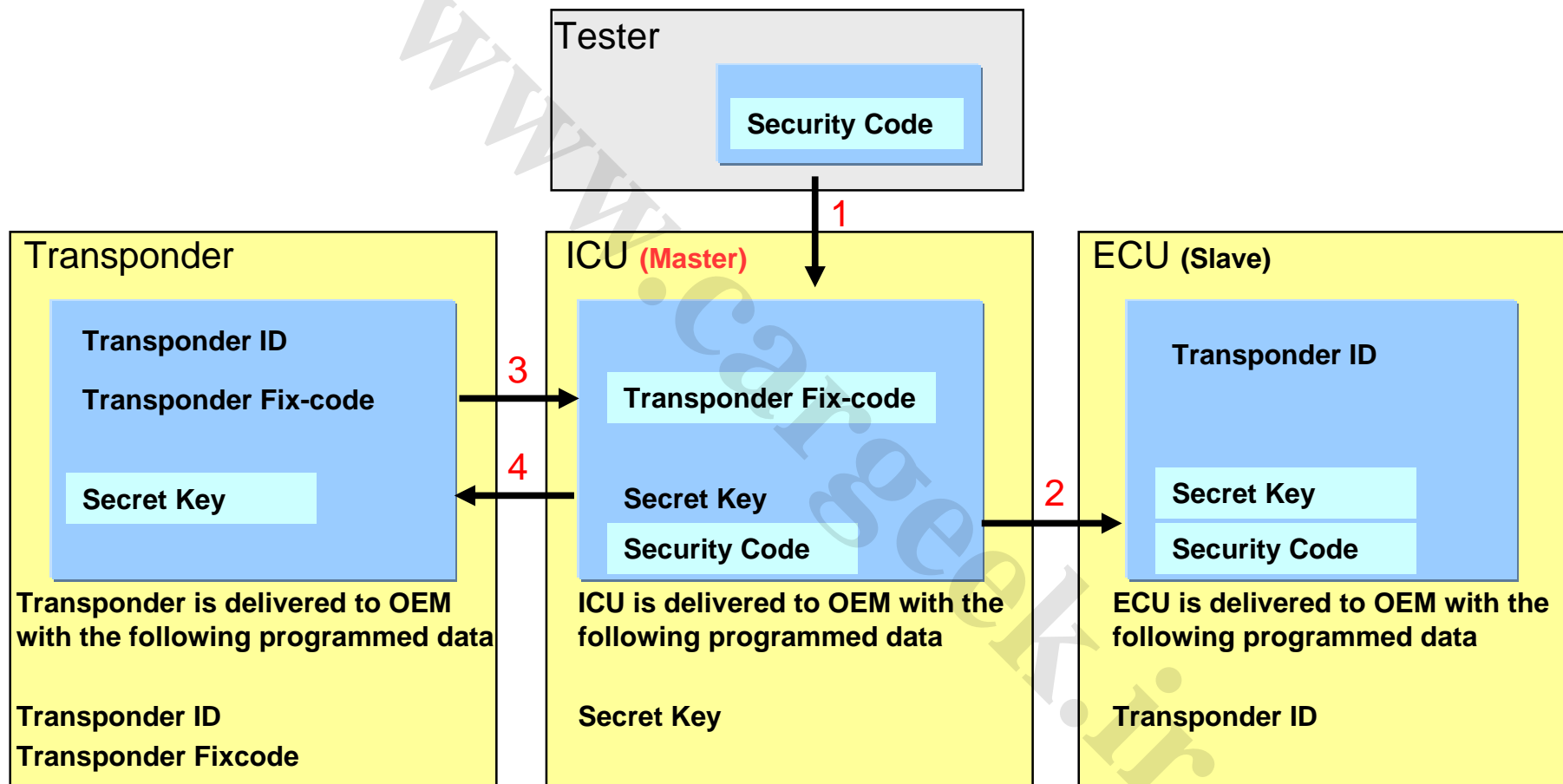 - Neutral: ECU is reset by ICU and tester, but Secret Key and Security Code are being existe in the NVMY of ECU.

  - € ECU state only can be changed by ICU and Tester with right security code.

- **ICU**

  - Valid ICU: ICU has the same Secret Key and Security Code with ECU. It is OK on ECU side

  - Invalid ICU: ICU has a different Secret Key and Security Code with ECU. It is not OK on ECU side.

low does it work ?

Immobilizer System Initialization

Tester

Security Code

1

Transponder

Transponder ID

Transponder Fix-code

3

Secret Key

4

Transponder is delivered to OEM with the following programmed data

Transponder ID
Transponder Fixcode

ICU (Master)

Transponder Fix-code

Secret Key

Security Code

2

ICU is delivered to OEM with the following programmed data

Secret Key

ECU (Slave)

Transponder ID

Secret Key

Security Code

ECU is delivered to OEM with the following programmed data

Transponder ID

€ Process flows according to "Red highlighted number".

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low does it work ?

ECU reset and reprogramming with using Tester
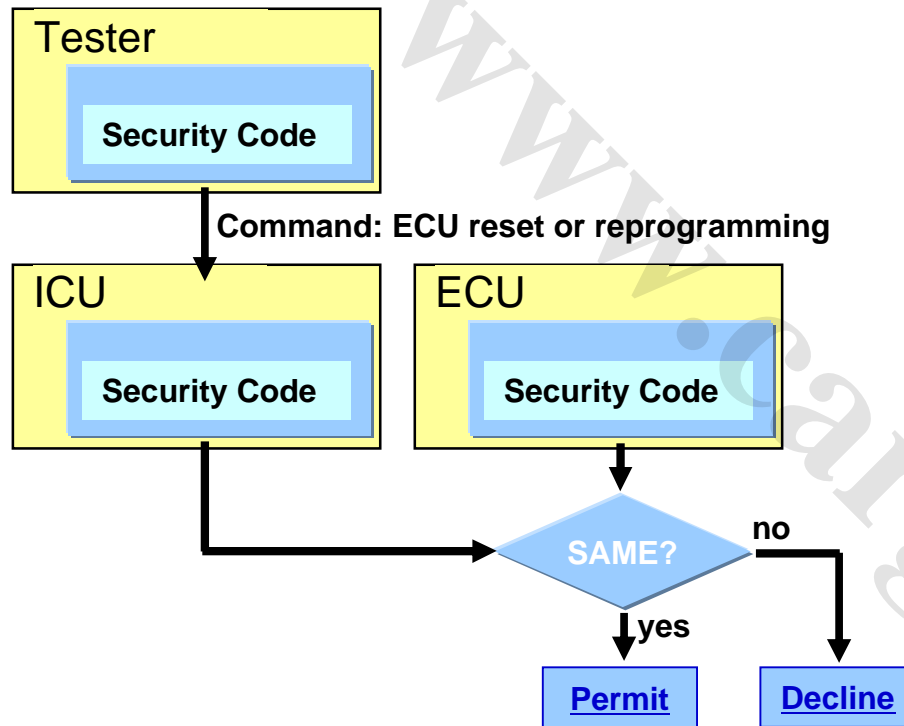
- ⊙ Same Security Code was stored in ECU and ICU by Tester when initialization of virgin ECU and virgin ICU. (See page #6)

- ⊙ When ECU is commanded to transfer status like below, all components (Tester, ICU and ECU) must have same Security Code. If not, ECU is not accepted to transfer status due to secure the security of vehicle.
  - ⊙ Reset (Neutralization)
  - ⊙ Reprogramming

- ⊙ **Due to the above reasons, Right Security Code should be managed by only OEM to secure the security of vehicle.**

€ **Immobilizer system must be initialized using "Right Security Code" by Tester**.
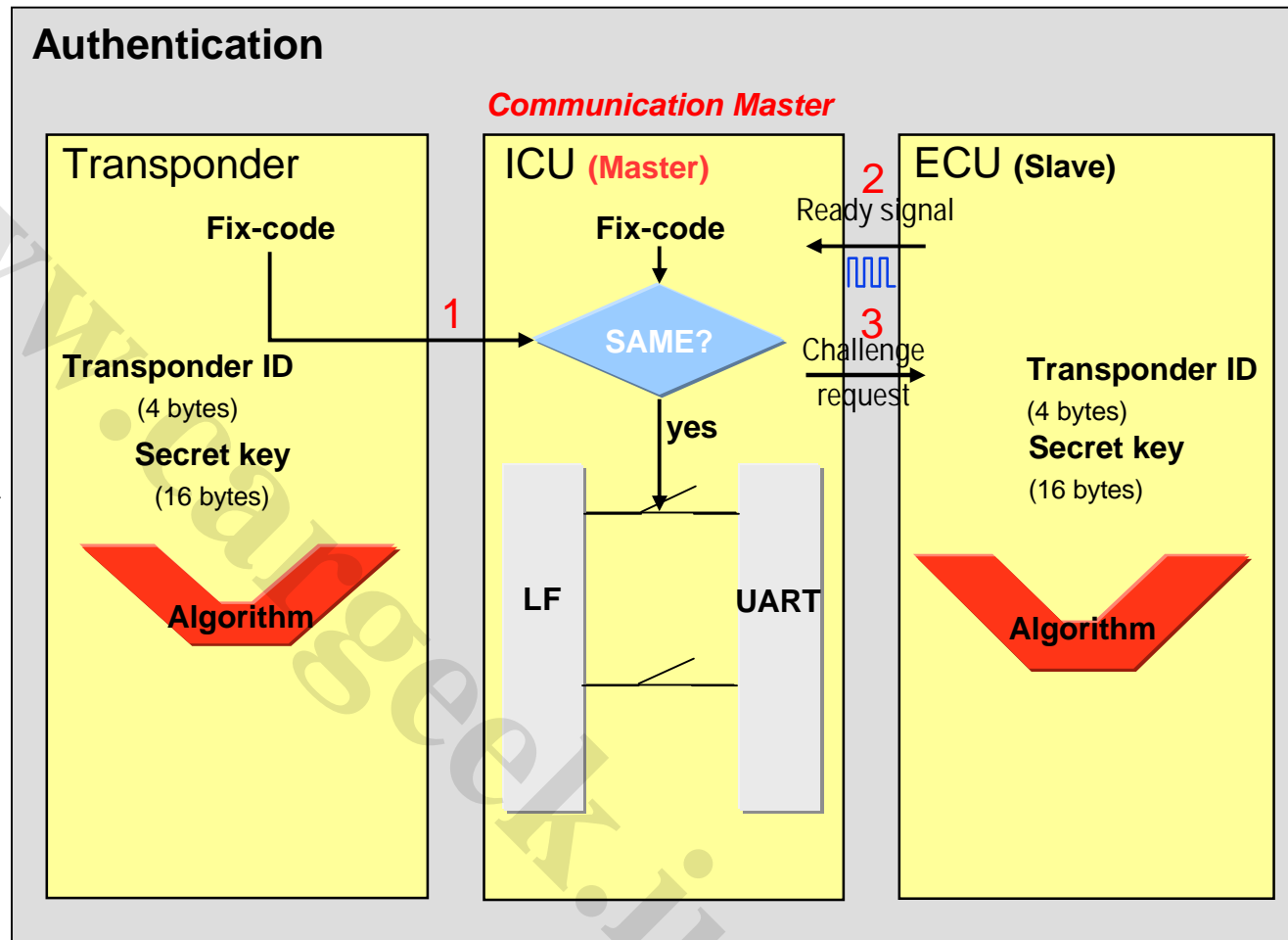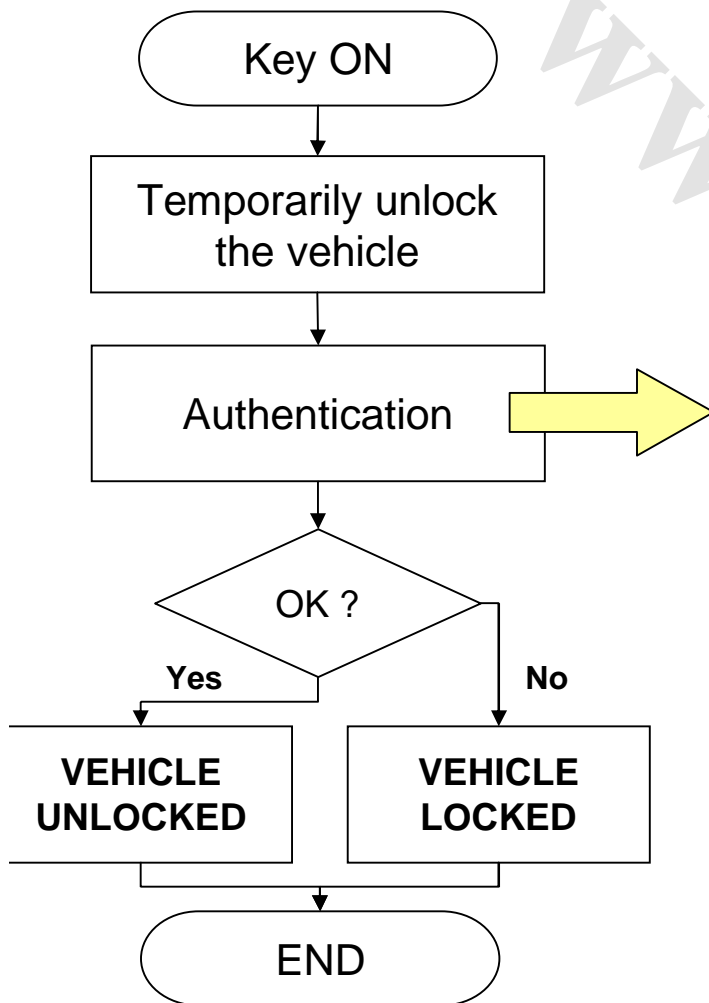
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low does it work ?

System Authentication

€ Process flows according to "Red highlighted number".

€ The ICU works as like a master and EMS works as
like a slave. All functionality is handled on ICU.

Ontinental

low does it work ?

System Authentication


```
Key ON
  ↓
Temporarily unlock the vehicle
  ↓
Authentication
  ↓
OK ?
 Yes → VEHICLE UNLOCKED
 No → VEHICLE LOCKED
  ↓
END
```

Authentication

Communication Master

Transponder

Fix-code

Transponder ID
(4 bytes)

Secret key
(16 bytes)

Algorithm

ICU (Master)

Fix-code

SAME?

yes

LF

UART

ECU (Slave)

2
Ready signal

1

3
Challenge request

Transponder ID
(4 bytes)

Secret key (16 bytes)

4
Challenge
(6 bytes)

Algorithm

5
Challenge
(6 bytes)

6
Response
(6 bytes)

7
Response
(6 bytes)

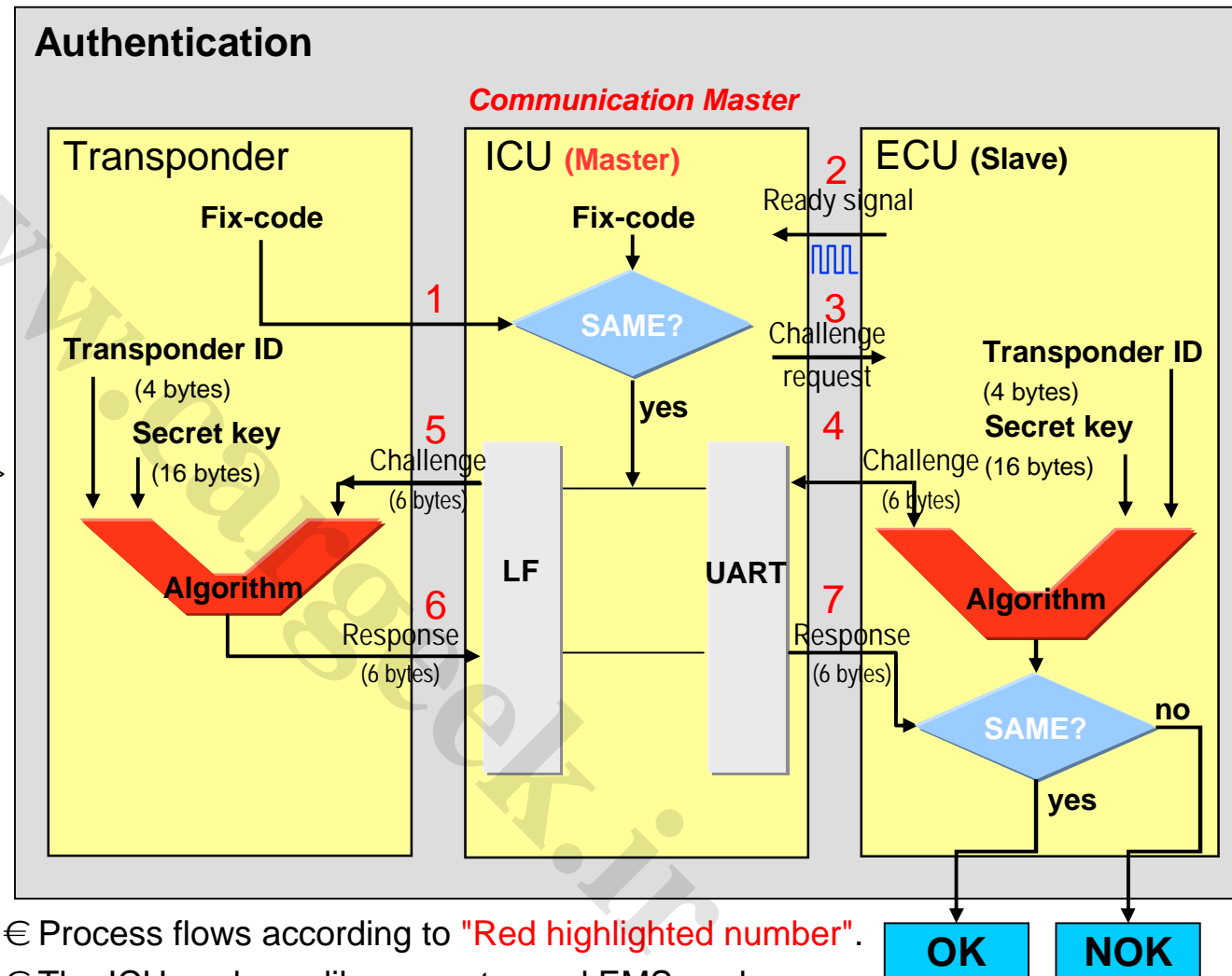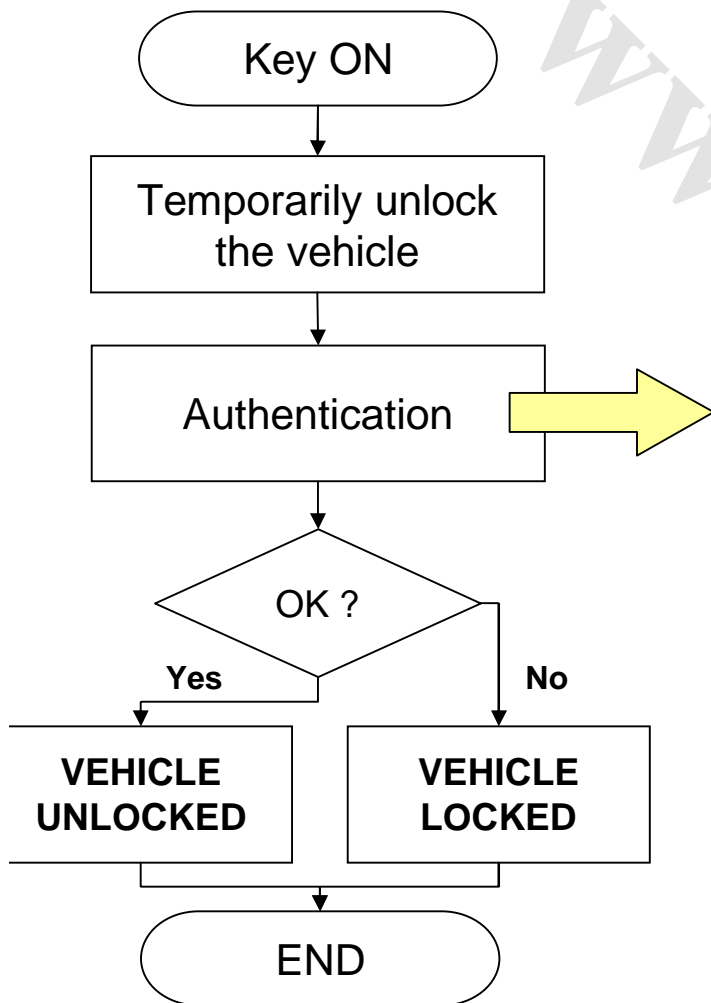**SAME?** no

yes

OK   **NOK**

€ Process flows according to "Red highlighted number".
€ The ICU works as like a master and EMS works as like a slave. All functionality is handled on ICU.

Continental Immobilizer System Failure

All system failures which are generated during initialization and authentication are represented by Vehicle Locked and fault code in ICU or ECU.

- *Caution: Following DTC codes are just explained about communication and immobilizer system configuration error in side of ECU. But it's difficult to know why communication error is generated or what configuration of immobilizer system is invalid through it. If you want to know it, Check the DTC code saved in ICU.*

With tester for vehicle check, fault code which is generated by ECU can be checked on a vehicle.

- P1661: Immobilizer system configuration not correct

  - Secret Key / Security Code in ECU are not programmed yet.

    - ex. In case state of ECU is virgin or neutral.

ECU	ICU	TP	DTC
Virgin	All states (invalid, not programmed)	All states (No TP, invalid, not programmed)	P1661
Neutral			

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Continental Immobilizer System Failure

- P1656: Communication, related to Challenge and Code Service both request and response, failure with ICU

  - Challenge Service is not OK or wrong received from ICU.

  - Code Service is not OK or wrong received from ICU.

    - ex. ICU or TP is not programmed, state of virgin or neutral.

    - ex. ICU or TP is invalid.

ECU	ICU	TP	DTC
Learnt	Not programmed	No TP	P1656
		Invalid	
		Not programmed	
	Invalid	No TP	
		Invalid	
		Not programmed	
	Valid	No TP	
		Invalid	
		Not programmed	

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Continental Immobilizer System Failure
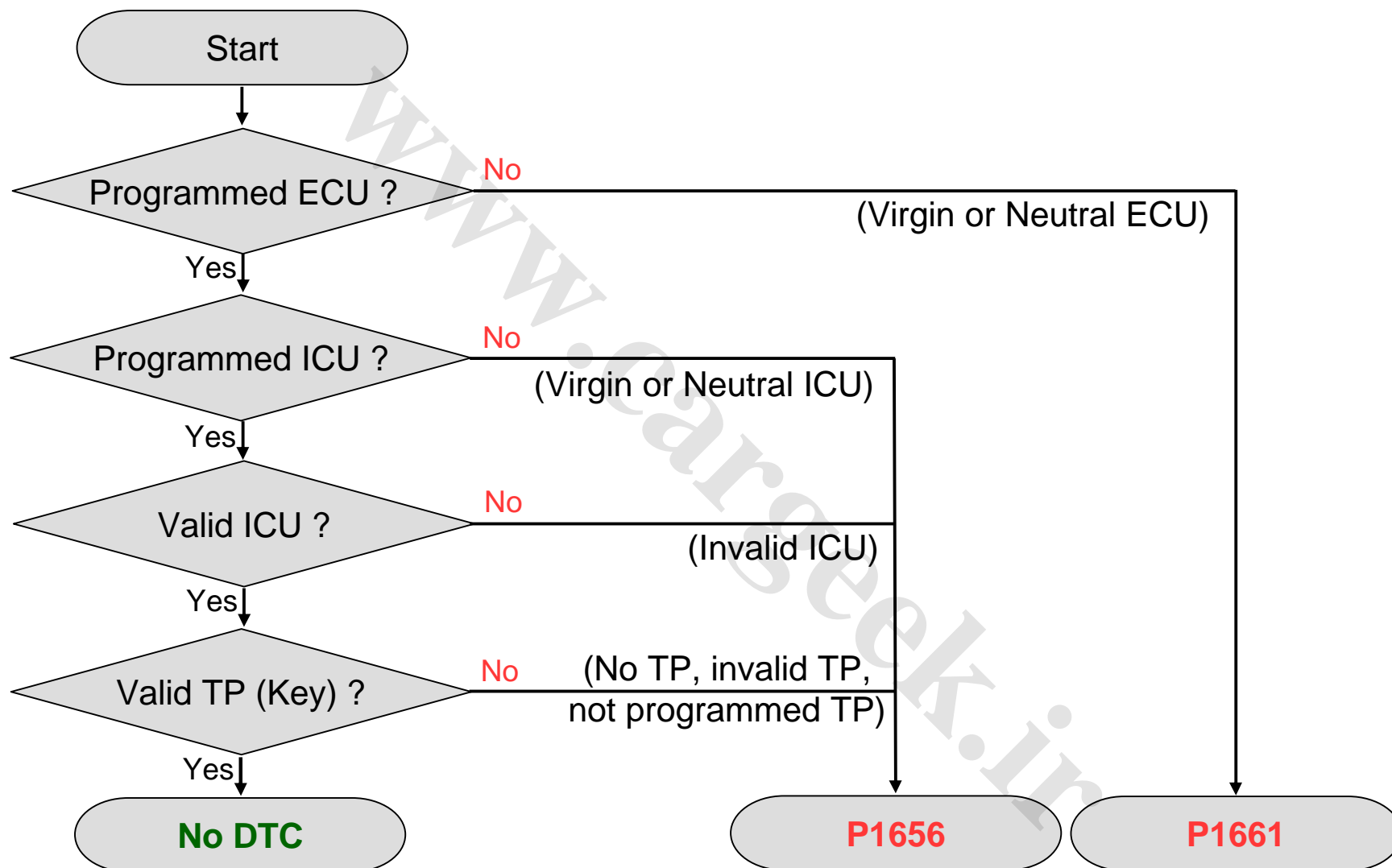
Keywords #1

Secret Key

The Secret Key is a 16 Byte code which is unique to each system (Vehicle), stored in the Transponder, ICU and in ECU. The Secret Key is used during the authentication process by Transponder and ECU as an input variable for the crypto algorithm.

Transponder Fix-code

The Transponder Fix-code is a 4 Byte code which is unique to each key, stored in the Transponder and ICU. The Fix-code is used during the authentication process to identify, whether this key is valid for the car or not.

Transponder ID

The Transponder ID is a 4 Byte code which is the same for all STEC Immobilizer, stored in Transponder and ECU. The Transponder ID is used during the authentication process by Transponder and ECU as an input variable for the crypto algorithm.

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Keywords #2

Challenge

The Challenge is a 6 Byte random number which is generated in ECU. The Challenge is sent to Transponder during the authentication and is used by Transponder and ECU as an input variab for the crypto algorithm.

Response

The Response is a 6 Byte code which is the output of the crypto algorithm. The Response is calculated in the Transponder and sent to ECU during the authentication.

Security code

The **Security Code** is a 2 Byte code which is unique to each Immobilizer system (depends on the vehicle), stored in ICU and in ECU. The **Security Code** is used by a diagnostic tester to enable programming functions (e.g. key learning) in ICU and in ECU.

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Keywords #3

ECU reset service

ECU state can be changed from Learnt to Neutral with Tester via K-line. After the Power Latch (PWL) time, ECU state is changed.

ECU reprogramming service

ECU state can be changed from Virgin/Neutral to Learnt with Tester via K-line. After the PWL time, ECU state is changed.

ECU challenge service

After ICU receives ready signal from ECU via R-line, ICU requests Challenge to ECU.

ECU code service

After ICU receives Response from Transponder, ICU sends the Response to ECU.

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Recommendation of Continental

Careful treatment and management for Security Code

A security code should be carefully treated and managed 1 by 1 matched with each vehicle for security strategy. Normally VIN (Vehicle Identification Number) is used for managing security code.

i.e. When some problems are in IMMO system (i.e. ICU damaged, Key lost, ECU damaged, etc) if the security code for the vehicle are managed and treated by maker, only the failed component of IMMO system (Key, ICU or ECU) can be replaced with new one and programmed with the original security code.

Check fault code of ECU and ICU

ECU and ICU has diagnostic fault code for immobilizer system in itself. So if a vehicle has a problem on cranking due to vehicle locked, fault code can be checked with diagnostic tester and the cause of the problem can be found even in a repair shop.

i.e. As described before (page #10, 11), ECU has 2 fault codes. One is for configuration check and another is for communication check. But, except configuration fault (P1661), communication problem can't be clarified only with ECU because ICU works as Master of communication. So fault code in ICU should be checked and analyzed at first when vehicle is locked.

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nmobilizer System Description in ECU

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