User manual

VAG Immobilizer System

Type 17A 920 790

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1 System overview

The module described within this document is used in the following system environment:

- VAG Immobilizer System WFS 5a

The VAG Immobilizer System WFS 5a is, among other things, an integral part of all MQB instrument clusters.

An immobilizer distinguishes between authorized and unauthorized users and thus it prevents the engine from running unless the correct key (transponder) is present.

The microcircuit inside the key is activated by a small electromagnetic field which induces current to flow inside the key body, which in turn broadcasts a unique binary code which is read by the instrument cluster that includes the immobilizer function. When the cluster determines that the coded key is both current and valid, the ECU activates the fuel-injection sequence.

The immobilizer is an inductive application (Short Range Device), for this reason a radio approval (homologation) is required.

2 Short description of the module

This document describes a car immobilizer circuit based on base station IC LRES B2, which is distributed by Delphi Megamos.

This module performs the following functions:

- Antenna driving with carrier frequency
- 100% AM modulation of the field for writeable transponders (write mode)
- AM/FM demodulation of the antenna signal modulation induced by the transponder (read mode)
- Communication with microcontroller via two wire interface

The immobilizer module is the interface between the transponder inside the key and the microcontroller. The microcontroller controls all functions of the instrument cluster including the transponder communication.

The reader and the transponder are working as a wireless, magnetic coupled communication system, each with a resonance circuit tuned to the system frequency as close as possible. Both circuits have to be tuned on the resonance frequency (125 ± 5 kHz). The reader circuit is working in series resonance, the transponder with a parallel resonance circuit.

The reader provides energy to the transponder by an electromagnetic field. By modulating this field, the reader can transmit (write) data to the transponder (uplink). The transponder will power up and return its on-chip data to the reader (downlink).

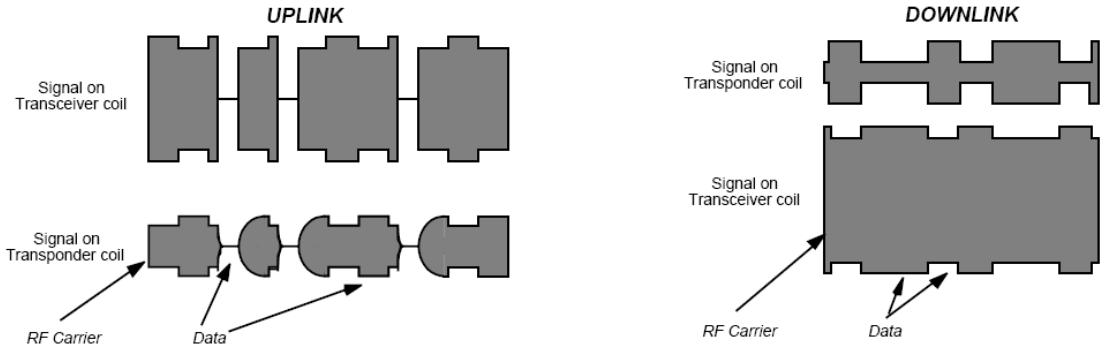

Figure 1: Principle of data transmission between transceiver and transponder

The microprocessor interface (µPI) connects the analog front end (AFE) with the microcontroller. The communication between transceiver and microcontroller is made via two wires (L/Z_IN and L/Z_OUT). L/Z_IN is the data input of LRES B2, L/Z_OUT is an open drain output which is also used as input.

In read mode (observing the messages sent by the transponder) the L/Z_OUT pin provides a digital asynchronous signal coming from demodulator chain.

In write mode, the L_EN signal defines the operation of the microprocessor interface:

- When L_EN is high (Master Mode) µPI synchronizes to transponder listening window and provides on L/Z_OUT pin the bit clock for data which will be sent to transponder via L/Z_IN pin.
- When L_EN pin is low (Slave Mode) microprocessor itself controls the communication with the transponder. L/Z_IN pin is directly controlling internal signal MOD. Signal MOD is directly controlling the antenna drivers. When it is high the drivers are off.

In this module, L_EN is not connected to the micro controller, pin is pulled up to the 5V supply voltage of the immobilizer circuit. This means that the Master Mode is used exclusively.

The oscillator of base station IC is designed for usage of a 4 MHz resonator. Timer part divides the 4 MHz clock signal down to a 125 kHz signal for antenna drivers and µP interface and provides some additional synchronization signals for receiver chain, sampler and short circuit detector.

3 Transponder

The used transponder (STXP AES) is a read/write RF transponder. It transmits Manchester coded data to the transceiver by modulating the amplitude of the electromagnetic field and receives data and commands in a similar way.

The transponder is supplied by carrier of an electromagnetic field induced on the attached coil. The AC voltage is rectified in order to provide a DC internal supply voltage. When the DC voltage crosses the Power-On level, the transponder will enter the Standby Mode and expects commands. In Standby Mode a continuous sequence of Listen Windows (LIW) is generated. During this time, the transponder will turn to the Receive Mode (RM) until it receives a valid RM pattern. The transponder then expects a command to enter the desired mode of operation.

Features:

- Battery-less 125 kHz crypt transponder functionality

- True 32 bit identifier (Long ID)
- Secret-Key in EEPROM (unreadable)
- Free User Memory (UM)
- Data transmission performed by amplitude modulation
- Transmission rate for 125 kHz transponder communication: 4 kbauds
- Special protected dataset storage intended for mileage counter
- Lock-bits to inhibit programming
- Operating temperature range -40 to +85°C
- 125 kHz field frequency
- On chip rectifier and voltage limiter

4 Power supply

Because ANT drivers drive antenna with VDD and VSS power supply levels all variations and noise in power supply are directly fed to antenna resonant circuit. Any supply voltage fluctuations or ripple are transferred into antenna current fluctuations by the antenna driver transistors. This is equal to a current modulation that results in a voltage modulation at the antenna tap point. There is no possibility for the demodulator to distinguish this modulation from the transponder modulation (transponder signal superimposed on antenna voltage is in the range of tens of mV). Especially in the pass band of the demodulator filters (<10 kHz), the system is very sensitive against supply hum and ripple.

For this reason a separate linear voltage regulator is used for the immobilizer circuit. The Enable pin of this regulator is controlled by the microcontroller. The regulator is only enabled during transponder communication.

KL30 voltage for guaranteed immobilizer function and performance:

- Minimum Operating Voltage = 6,5V
- Nominal Operating Voltage = 13,5V
- Maximum Operating Voltage = 17,0V

5 Technical data

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Supply						
Supply Voltage Immobilizer Module	V_{KL30}	6,5	13,5	17,0	V	
Supply Voltage LRES B2	V_{DD}	4,5	5,0	5,5	V	
Current consumption INHIBIT OFF	I_Q			10	µA	V_{INH} = 0 V; Full temp. range
Supply current in Sleep Mode (Quiescent current)	$I_{DDsleep}$			40	µA	Full temp. range
Supply current excluding drivers current in Normal Mode	I_{DDon}		5	10	mA	
Power on reset level	V_{por}	1,4		3,6	V	Full temp. range

AGND level	V_{AGND}	2,35	2,5	2,65	V	Full temp. range
µC interface						
Input logic high	V_{IH}	0,8 V_{DD}			V	Full temp. range
Input logic low	V_{IL}			0,2 V_{DD}	V	Full temp. range
Input leakage current	I_L	-1		+1	µA	Full temp. range
L/Z_OUT sink current	I_{L/Z_OUT}			2,5	mA	
L/Z_OUT output logic low	V_{L/Z_OUT}			0,4	V	
Environment requirements						
Ambient temperature	T_A	-40		+85	°C	
Junction temperature	T_J	-40		+110	°C	
Package thermal resistor	R_{th}	69	70	71	°C/W	
Antenna circuit						
Carrier frequency	f_{ANT}		125		kHz	
Resonant frequency	f_{RES}	120	125	130	kHz	
Antenna voltage	V_{Coil2}	55	75	95	V_{pp}	L_{Coil} = 1.041mH ± 5%, Q_{Coil} = 8.55 ± 15%
Antenna current (RMS)	V_{sense}	30	34	38	mA	L_{Coil} = 1.041mH ± 5%, Q_{Coil} = 8.55 ± 15%
Oscillator						
Oscillator frequency	f_{OSC}		4		MHz	
Antenna drivers						
Output resistance	R_{ADout}		3	6	Ω	I_{A1}=10mA
				9	Ω	I_{A1}=100mA Full temp. range
AM demodulation						
Input sensitivity	V_{sense}		0,85	1,42	mV_{pp}	Full temp. range
Signal on DEMOD_IN with no transitions on DEMOD_OUT	V_{SN}			140	$µV_{pp}$	
DEMOD_IN common mode range	V_{CM}	V_{SS} + 0,5		V_{DD} - 0,5	V	
DEMOD_IN input resistance to AGND	R_{DI}	140	200	260	kΩ	
		100		400	kΩ	Full temp. range

6 Label Information USA and Canada

United States (US)

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Products, which include above-mentioned module, have been approved by the Certification process. They must have a label showing the FCC ID number:

Continental
17A920790
FCC ID:KR517A920790

CANADA

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

Products, which include above-mentioned module, have been approved by the certification process. They must have a label a label showing the IC ID number:

IC:7812D-17A920790

The HVIN (Hardware Version Identification Number) identifies hardware specifications of a product version. The HVIN replaces the ISED Model Number in the legacy E-filing System. An HVIN is required for all products for certification applications.

HVIN: **5a**

Owner Manual:

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.

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