# User manual

# Immobilizer System

# Type 5NA.920.791.A

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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.

All requirements refer to the specification "WFS 5a V1.9 Master" of the Volkswagen AG.

# 2 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

**Figure 1: Principle of data transmission between transceiver and transponder**

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
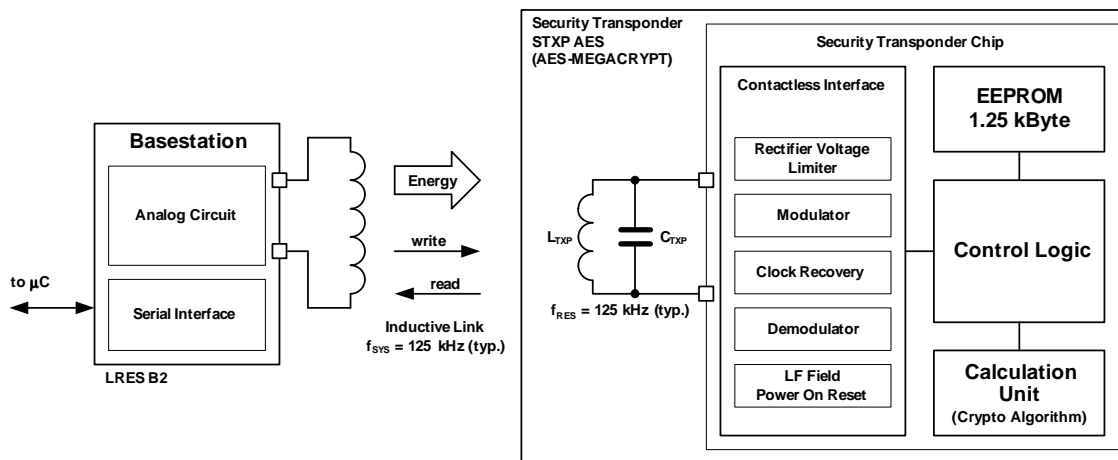
# 3 Power supply

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 passband 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

# 4 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 | $\mu V_{pp}$ | |
| 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 |

# 5        Label Information

<u>Europa</u>:

Continental
5NA.920.791.A


<u>**USA / Kanada:**</u>

Continental
Model: 5NA.920.791.A
FCC ID:KR55NA920791A
IC:7812D-5NA920791A


# 6        Owner Manual


## *Owner Manual Canada*

IC:7812D-5NA920791A

**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.**

# Continental

## *Owner Manual USA*

FCC ID:KR55NA920791A

**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.**