

SLE 66R35E7 / SLE 66R35E7H

Intelligent 1kByte Memory chip with NRG and 7-byte UID

Short Product Information

Devices

- SLE 66R35E7
- SLE 66R35E7H

Features

- Intelligent 1 kByte Memory Chip with NRG (ISO/IEC 14443-3 type A with CRYPTO1) and 7-byte Unique Identification (UID)
- Physical Interface and Anticollision compliant to ISO/IEC14443-2 and -3 Type A
 - Operation frequency 13.56 MHz
 - Data rate 106 kbit/s
- 1 kByte EEPROM
 - Block organization of memory, 16 Sectors with fixed 4 blocks of 16 bytes each
 - User definable access conditions for each memory block
- Security Features
 - 7-byte Unique Identification (UID)
 - Support of 4-byte Random number (RND-ID) and 4-byte fixe non-unique number (FNUID)
 - Features Short-Cut Anticollision scheme to realize backward compatibility to installed infrastructures supporting 4-byte single size UIDs only
 - Mutual three-pass authentication between card and reader for basic security
 - Selective memory access control secured by authentication and access conditions
 - Data encryption for RF channel
 - Dedicated Value Counter
- SLE 66R35E7H implements an adopted SAK parameter value supporting 4-byte infrastructure compatibility

About this document

Scope and purpose

This document describes the features of SLE 66R35E7(H).

Features**Features****Intelligent 1 kByte Memory Chip with NRG and 7-byte Unique IDentification Number****Contactless Interface**

- Physical Interface and Anticollision compliant to ISO/IEC14443-2 and -3 Type A
 - Operation frequency 13.56 MHz; data rate 106 kbit/s
 - Contactless transmission of data and supply energy
 - Anticollision logic: several cards may be operated in the field simultaneously
 - Features Short-Cut Anticollision scheme to realize backward compatibility to installed infrastructures supporting 4-byte single size UIDs only
- Read and Write Distance up to 10 cm and more (influenced by external circuitry i.e. reader and inlay design)
- Short transaction times: typical ticketing transaction < 100 ms; transaction possible when card is moving

1 kByte EEPROM

- Block organization of memory, 16 Sectors with fixed 4 blocks of 16 bytes each
- EEPROM updating time per block < 4 ms
- Endurance > 100.000 erase/write cycles¹
- Data Retention > 10 years¹
- User definable access conditions for each memory block

Security Features

- 7-byte Unique Identifier (UID) according to ISO/IEC 14443-3 Type A
- Support of 4-byte Random Number (RND-ID) and 4-byte fixed non-unique number (FNUID) according to ISO/IEC 14443-3 Type A
- Mutual three-pass authentication between card and reader for basic security
 - 48-bit key length
 - 2 keys per sector enabling key management
 - Transport key at chip delivery
- Selective memory access control secured by authentication and access conditions
- Suited to multifunctional applications: Individual key sets are available for each EEPROM sector
- Data encryption for RF channel
- Dedicated Value Counter
- Data integrity supported by CRC, Parity Check, etc.

Electrical characteristics

- On-chip capacitance 18.3 pF + 10 %
- ESD protection typical 2 kV
- Ambient temperature -25 ... +70°C for the chip

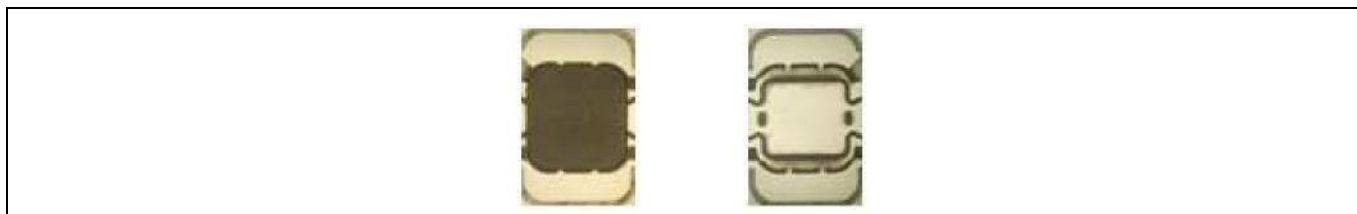
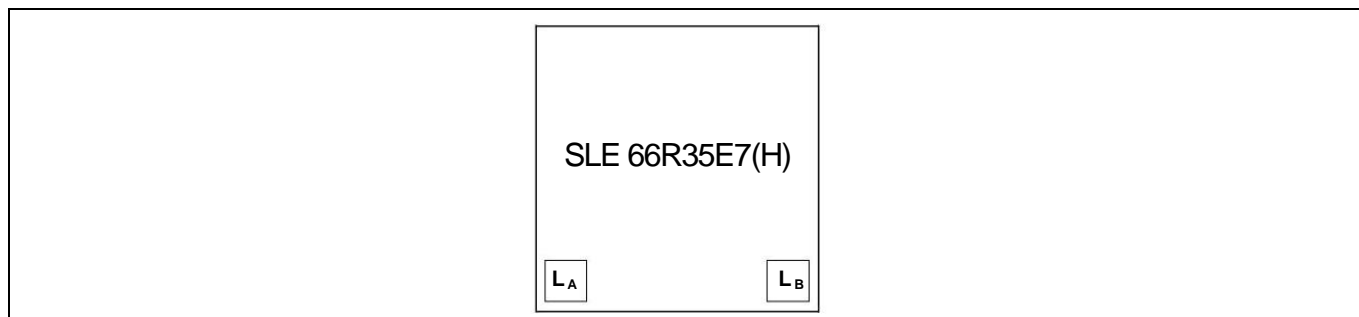
¹ Values are temperature dependant

1 Ordering and packaging information

Table 1 Ordering information

Type	Package	Remark
SLE 66R35E7 C	Die (on wafer)	sawn / unsawn
SLE 66R35E7 NB	Die (on wafer)	NiAu-bumps, sawn
SLE 66R35E7 MCC8	MCC8-2-6	
SLE 66R35E7H C	Die (on wafer)	sawn / unsawn
SLE 66R35E7H NB	Die (on wafer)	NiAu-bumps, sawn
SLE 66R35E7H MCC8	MCC8-2-6	

Note: For further information on technology, delivery forms (wafer thickness or height of NiAu-bump) please contact your local Infineon Technologies sales representative (www.infineon.com).


Figure 1 Pin configuration Module Contactless Card - MCC8-2-6 (top / bottom view)

Figure 2 Pad configuration die
Table 2 Pin description and function

Symbol	Function
L _A	Antenna Connection
L _B	Antenna Connection

2 Overview of a NRG system

The SLE 66R35E7(H) is designed to operate in a NRG system. The system consists of a smart card and a card reader together with an antenna. The card's antenna consists of a simple coil with a few turns embedded in plastic.

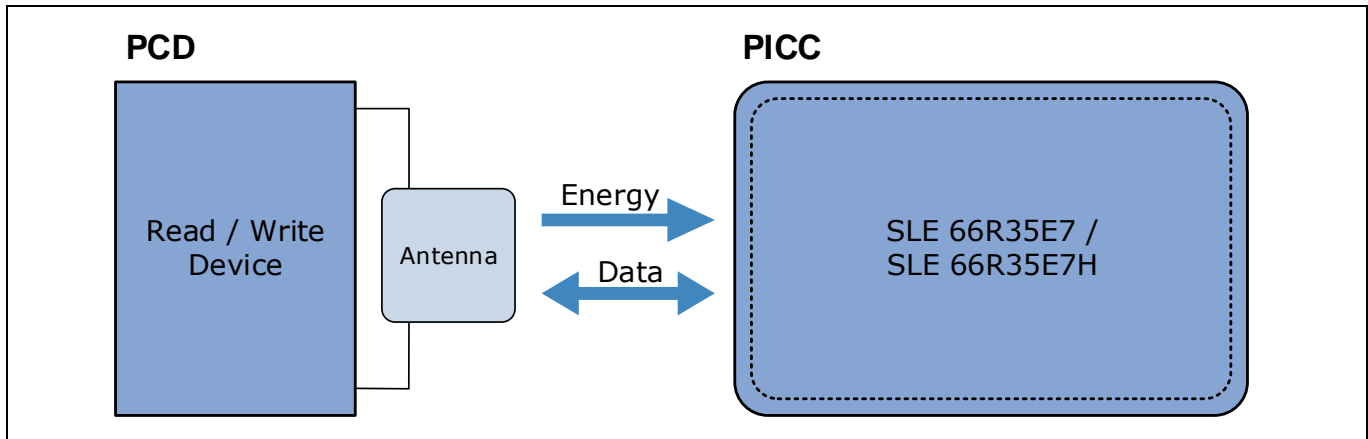


Figure 3 System overview

The operating distance between card and reader antenna is up to 10 cm and more (influenced by external circuitry i.e. reader-antenna configuration).

The RF communication interface transmits at 106 kbit/s resulting in short transaction times, the effect being that a card user can move freely through a reader gate with minimum disruption. A typical ticketing transaction can be handled in less than 100 m/s. Robust contactless transmission means that the card with SLE 66R35E7(H) may also remain in the wallet of the user even if there are coins in it.

An intelligent anticollision function based on the chip's double size unique identifier (uid0-uid6) enables more than one card in the field to operate simultaneously. The anticollision algorithm selects each card individually and enables the execution of a transaction with a selected card is performed correctly without data corruption resulting from other cards in the field.

The SLE 66R35E7(H) supports additional UID configurations allowing to operate SLE 66R35E7(H) in infrastructures running 4-byte (single cascade) anticollision schemes only (short-cut anticollision, Random Number, FNUID). Existing systems can remain unchanged. These options may be configured once during card personalization.

Access to SLE 66R35E7(H) is only allowed after a three-pass authentication. The serial number is unique for each card and cannot be changed. Each data transmission is enciphered. Protection from misuse is done by configurable access conditions that are protected by secret keys used for memory operations such as read or write.

Multi-Application Functionality

The SLE 66R35E7(H) is suited for the use in multi-application schemes, for example combining a transportation fare collection scheme and a ticketing system such as a stadium ticketing. Both applications can be performed with the same card, as hierarchical key management is supported. This means that two different keys for each memory sector can be assigned to enable authentication to that sector.

2.1 Supported standards

The SLE 66R35E7(H) supports the following standards:

- ISO/IEC 14443-1, -2 and -3 Type A
- Tested according to ISO/IEC 10373-6 (PICC Test & Validation)

2.2 Command set

A set of standard ISO/IEC 14443-3 Type A commands is implemented to operate the chip.

Additionally the SLE 66R35E7(H) specific command set is implemented. This facilitates the access to the on-chip integrated memory, supports the execution of authentication, data de- and encryption as well as an increment or a decrement of a dedicated value counter.

Circuit Description

3 Circuit Description

SLE 66R35E7(H) consists of an EEPROM memory of 1 kByte organized in 16 sector with 4 blocks each containing 16 bytes, an analog interface for contactless energy and data transmission and a control unit.

The power supply and data are transferred to SLE 66R35E7(H) via an antenna, which consists of a coil with few turns directly connected to the module. No further external components are necessary. The circuit is designed to communicate with a card-reader at an operating distance of up to 10 cm (or more) depending on the reader-antenna configuration.

The chip is designed to meet the cost-optimized requirements of a basic security level. The targeted applications are transport, corporate access, events and loyalty cards with basic security requirements.

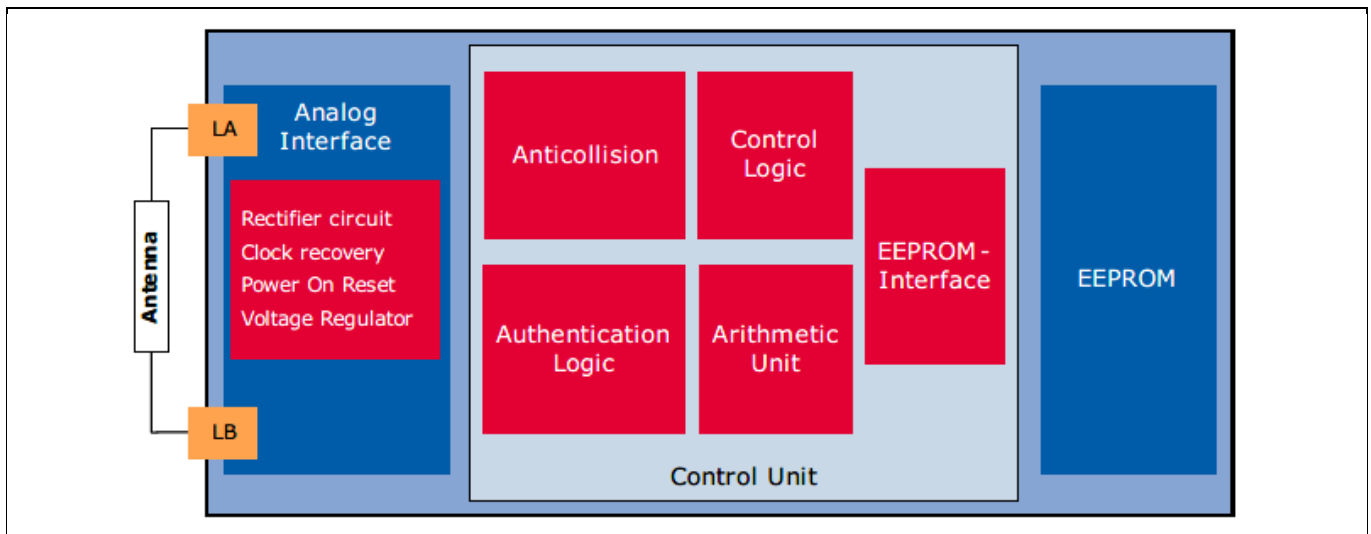


Figure 4 Block diagram

- **Analog Contactless Interface:**

- The Analog Contactless Interface comprises the voltage rectifier, voltage regulator and system clock to supply the IC with appropriate power. Additionally the data stream is modulated and demodulated.

- **Anticollision**

- Internal logic of SLE 66R35E7(H) ensures the recognition of several cards in the field which may be selected and operated in sequence.

- **Authentication Logic**

- Correct execution of any memory operation can only occur after the authentication procedure with a specific key.

- **Control Logic**

- Access to a block is defined by the associated access conditions for that block. These are programmed individually for each block in a sector.

- **Arithmetic Unit**

- Arithmetic Capability: increment and decrement of values stored in a special redundant format.

- **EEPROM:**

- 1 kByte organized in 16 sectors with 4 blocks by 16 bytes each. The last block of each sector is called "Sector Trailer" and is used to store for a pair of secret keys and programmable access conditions for each block.

4 SLE 66R35E7(H) options

SLE 66R35E7(H) supports systems based on single and double size UIDs:

- 7-byte Unique Identifier (UID) according to ISO/IEC 14443-3 Type A
- 4-byte Random Number (RND-ID) according to ISO/IEC 14443-3 Type A
- 4-byte fixed non-unique number (FNUID) according to ISO/IEC 14443-3 Type A

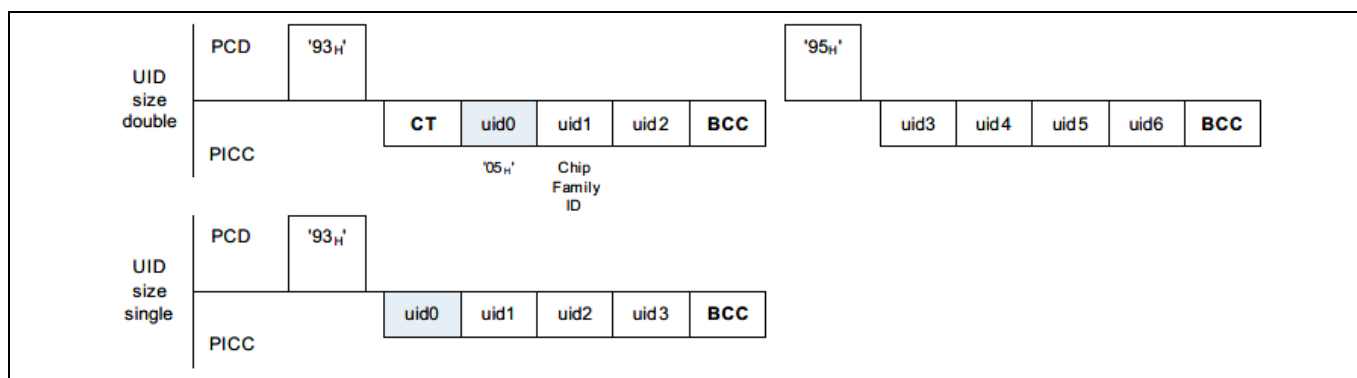


Figure 5 UIDs according to ISO/IEC 14443-3 Type A

4.1 Product overview

Following memory chips with NRG are available (see Table 3):

Table 3 Overview on chip types using NRG technology

Type	UID size	UID type	uid0	Description
SLE 66R35 ^{1 2}	4-byte	UID	xM _H P8 _H	Fixed unique number programmed by manufacturer (M = 1 _H , 5 _H , 7 _H , 9 _H) and (P = 1 _H , 2 _H , 3 _H , 4 _H , 5 _H)
SLE 66R35I	4-byte	FNUID	xF _H	Fixed number, non-unique programmed by manufacturer
SLE 66R35R	4-byte	r-ID	x1 _H	Fixed reused identity number programmed by manufacturer
SLE 66R35E7(H)	7-byte	UID	05 _H	Fixed unique number programmed by manufacturer (delivery default)
	4-byte	FNUID	xF _H	Fixed number, non-unique derived from 7-byte UID (personalization option). The FNUID is not stored in Block 00 _H , it is derived from the 7-byte UID stored in Block 00 _H . The derived value for the uid0 byte is logically OR-ed with 1F _H ; due to that x may have following values: 1 _H , 3 _H , 5 _H , 7 _H , 9 _H , B _H , D _H , F _H
	4-byte	RND-ID	08 _H	uid1 to uid3 is a random number (RND1 - RND3) (personalization option). The RND-ID is not stored in Block 00 _H ; a new RND-ID is generated with every power-up.

¹ The available numbers are already exhausted.

² Discontinued. Consider to use successor products SLE 66R35I, SLE 66R35R, SLE 66R36E7, SLE 66R35E7H.

4.2 Personalization options

SLE 66R35E7(H) can be configured during issuing of a card using the CONFIGURE_UID command.

Table 4 UID options

UID Option	Anticollision and selection
UIDF0	7-byte UID only (delivery default)
UIDF1	7-byte UID and optional usage of short-cut anticollision scheme
UIDF2	4-byte Random number (RND-ID) uid0 = 08 _H uid1 – uid3 = RND1 – RND3
UIDF3	4-byte Fixed number, non-unique ID (FNUID) uid0 = xF _H (x = 1 _H , 3 _H , 5 _H , 7 _H , 9 _H , B _H , D _H , F _H)

4.3 SLE 66R35E7(H) – 7-byte UID configuration

The SLE 66R35E7(H) is delivered as 7-byte UID device.

Block 00_H is configured as shown in Figure 6.

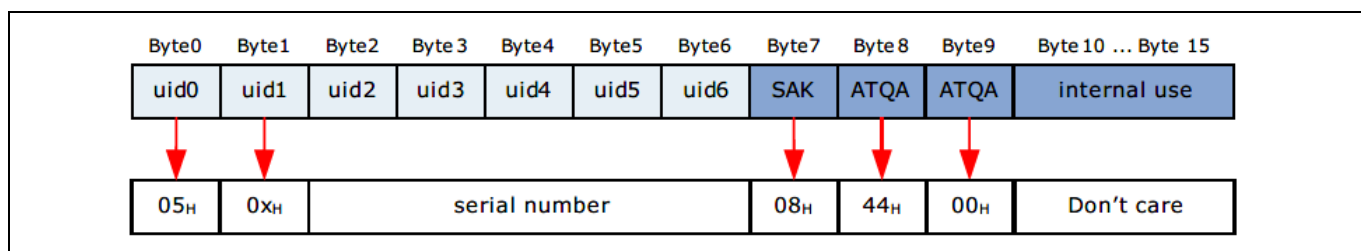


Figure 6 Memory structure block 00_H

- uid0 = 05_H identifies Infineon Technologies as chip manufacturer according to ISO/IEC 7816-6 standard
- uid1 holds the Chip Family Identifier (see Table 5)

Table 5 Chip Family Identifier

uid1 coding ¹	Chip Family	Description
0x _H	SLE 66R35E7(H)	NRG product with 7-byte UID
1x _H	SLE 66RxxS	my-d™ proximity 2
2x _H	SLE 66RxxP	my-d™ NFC
3x _H	SLE 66R01P(N)	my-d™ move (NFC)
7x _H	SLE 66R01L(N)	my-d™ move lean (NFC)
All other		Please contact Infineon Technologies sales

Note: Please also refer to the application note “Anticollision and UID Options” for further information on UIDs as used for Infineon Products.

¹ ‘x_H’ is part of the chip serial number.

SLE 66R35E7(H) options

Anticollision for CL1 (Short-cut) and CL2

The SLE 66R35E7(H) supports the both anticollision schemes cascade level 1 (short-cut anticollision) and 2. The short-cut anticollision allows to operate the SLE 66R35E7(H) even in infrastructures with 4-byte (single cascade) anticollision scheme. Existing systems based on CL1 can remain unchanged.

If the Short-cut anticollision scheme has been enabled (UIDF1 Option, in READY2 / READY2* state the chip accepts:

- a READ (Block 00_H) command: the SLE 66R35E7(H) then executes a state transition to ACTIVE / ACTIVE* state. Following authentication commands will use the last four UID bytes sent to the PCD.
 - o an AUTHENTICATE command to a sector: the SLE 66R35E7(H) then executes a state transition to the AUTHx state applying the UID bytes used for cascade level 1 selection (SEL CL1).

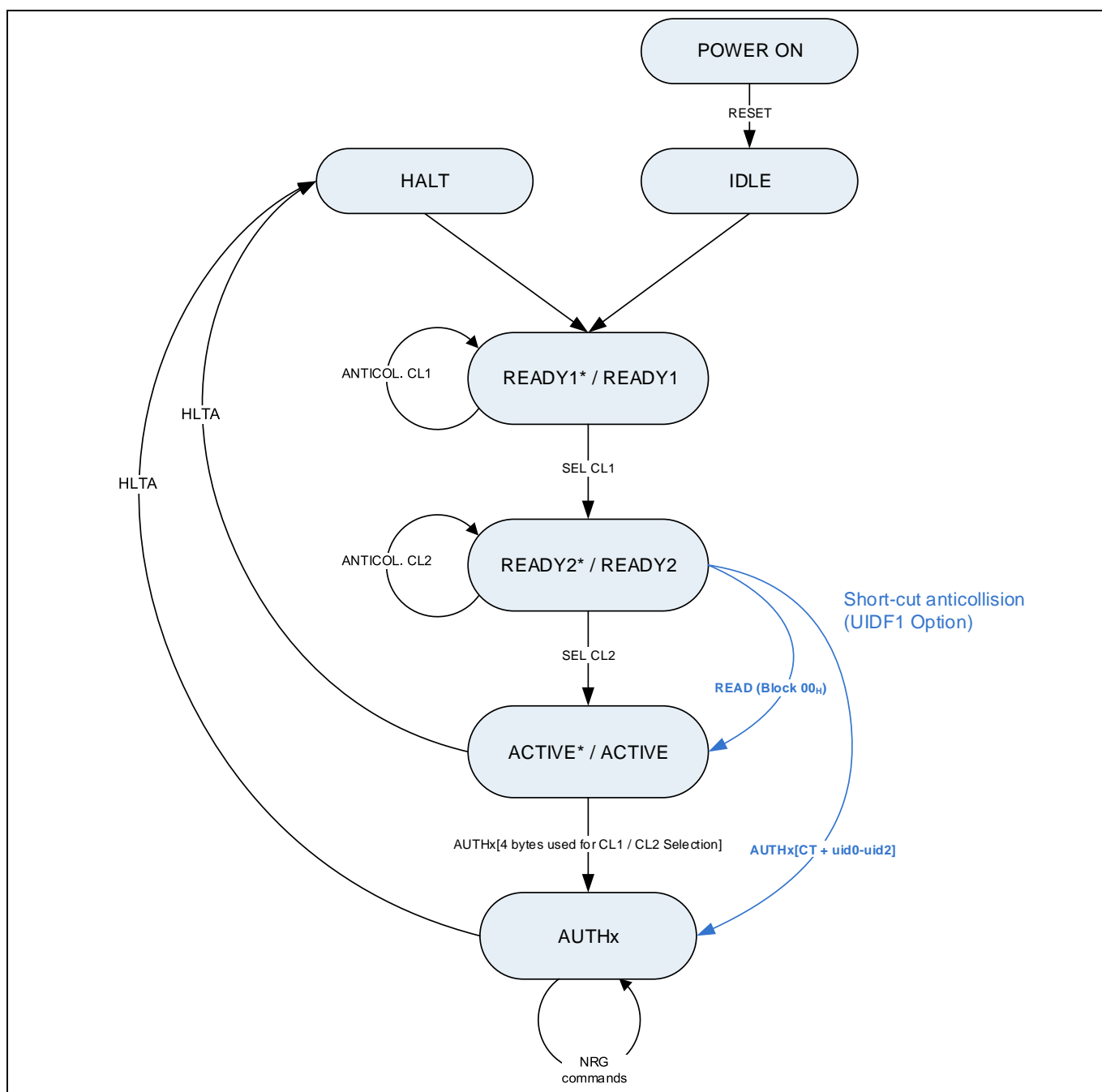


Figure 7 Anticollision for UIDF0 and UIDF1 options

4.4 SLE 66R35E7(H) – 4-byte UID configurations

The SLE 66R35E7(H) also supports single cascade anticollision schemes.

- 4-byte Random Number (RND-ID)
- 4-byte fixed non-unique number (FNUID)

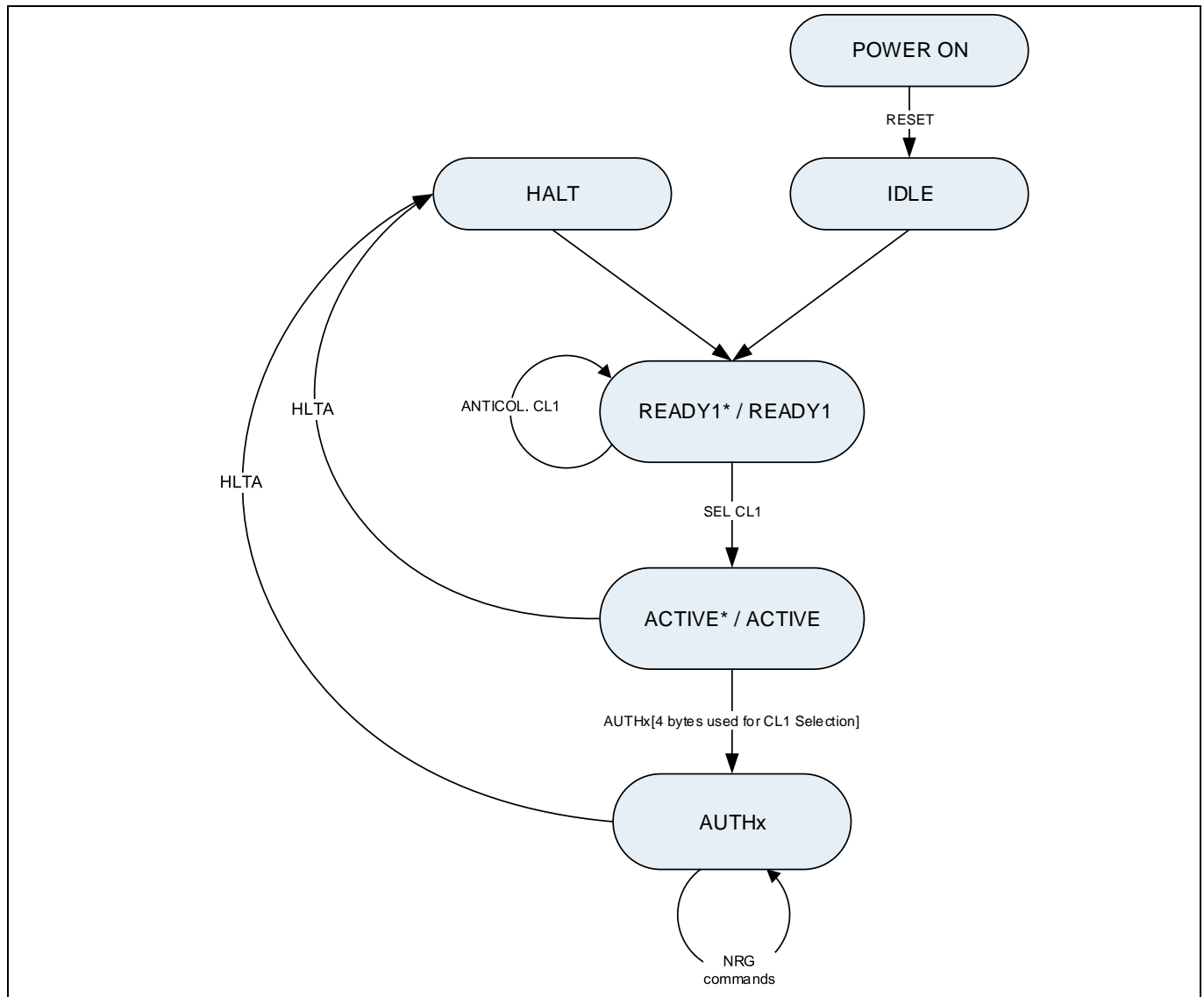


Figure 8 Anticollision for UIDF2 and UIDF3 options

Revision history**Revision history**

Reference	Description
Revision 2.0, 2020-06-22	
all	New document template Editorial changes Adding description for SLE 66R35E7H product version.
Ordering and packaging information	Delivery form MCC2-2-1 removed
Revision 1.1, 2012-02-29	
all	Editorial changes
10	Added information about personalization options
11	Corrected description of state transitions
Revision 1.0, 2011-08-09	
all	Initial version

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