SL2S2002; SL2S2102

ICODE SLIX

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Product short data sheet
PUBLIC

1. General description

The ICODE SLIX IC is a dedicated chip for intelligent label applications such as libraries, product authentication in different industries such as pharmaceutical, medical devices and alcohol, as well as production management in different areas of the industry. This IC is the third generation of a product family of smart label ICs based on the ISO standards ISO/IEC 15693 (Ref. 1) and ISO/IEC 18000-3 (Ref. 4), prolonging a successful story of NXP in the field of vicinity identification systems.

The ICODE system offers the possibility of operating labels simultaneously in the field of the reader antenna (anticollision). It is designed for long range applications.

1.1 Contactless energy and data transfer

Whenever connected to a very simple and easy-to-produce type of antenna (as a result of the 13.56 MHz carrier frequency) made out of a few windings printed, winded, etched or punched coil, the ICODE SLIX IC can be operated without line of sight up to a distance of 1.5 m (gate width). No battery is needed. When the smart label is positioned in the field of an interrogator antenna, the high speed RF communication interface enables data to be transmitted up to 53 kbit/s.

1.2 Anticollision

An intelligent anticollision function enables several tags to operate in the field simultaneously. The anticollision algorithm selects each tag individually and ensures that the execution of a transaction with a selected tag is performed correctly without data corruption resulting from other tags in the field.

1.3 Security and privacy aspects

- Unique IDentifier (UID):

  The UID cannot be altered and guarantees the uniqueness of each label.

- Password protected EAS and AFI functionality:

  The 32-bit EAS/AFI password enables the addressed label to be set in a mode where the EAS status and the AFI value can only be changed if the correct EAS/AFI password is transmitted to the label within the mentioned commands.

2. Features and benefits

2.1 ICODE SLIX RF interface (ISO/IEC 15693)

- Contactless transmission of data and supply energy (no battery needed)
- Operating distance: up to 1.5 m (depending on antenna geometry)
- Operating frequency: 13.56 MHz (ISM, world-wide licence freely available)
- Fast data transfer: up to 53 kbit/s
- High data integrity: 16-bit CRC, framing
- True anticollision
- Password protected Electronic Article Surveillance (EAS)
- Password protected Application Family Identifier (AFI)
- Data Storage Format IDentifier (DSFID)
- Additional fast anticollision read
- Write distance equal to read distance

2.2 EEPROM

- 1024 bits, organized in 32 blocks of 4 bytes each
- 50 years data retention
- Write endurance of 100000 cycles

2.3 Security

- Unique identifier for each device
- Lock mechanism for each user memory block (write protection)
- Lock mechanism for DSFID, AFI, EAS
- Password (32-bit) protected EAS and AFI functionality

3. Applications

- Libraries
- Item level tagging in pharmaceutical supply chains
- Counterfeit protection for consumer goods
- Industrial applications
- Asset and document tracking

4. Quick reference data

Table 1. Quick reference data

Typical ratings are not guaranteed. The values listed are at room temperature.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Wafer EEPROM characteristics							
t_{ret}	retention time	$T_{amb} \leq 55$ °C		50	-	-	year
$N_{endu(W)}$	write endurance			100000	-	-	cycle
Interface characteristics							
f_i	input frequency		[1]	13.553	13.56	13.567	MHz
C_i	input capacitance	between LA and LB	[2]				
		SL2S2002FUD SL2S2002FTB		22.3	23.5	24.7	pF
		SL2S2102FUD SL2S2102FTB		92	97	102	pF

[1] Bandwidth limitation (± 7 kHz) according to ISM band regulations.

[2] Measured with an HP4285A LCR meter at 13.56 MHz and 2 V RMS.

5. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
SL2S2002FUD	wafer	sawn, bumped wafer, 120 µm, on film frame carrier, C_i between LA and LB = 23.5 pF (typical)	-
SL2S2102FUD	wafer	sawn, bumped wafer, 120 µm, on film frame carrier, C_i between LA and LB = 97 pF (typical)	-
SL2S2002FTB	XSON3	plastic extremely thin small outline package; no leads; 3 terminals; body 1 x 1.45 x 0.5 mm; C_i between LA and LB = 23.5 pF (typical)	SOT1122
SL2S2102FTB	XSON3	plastic extremely thin small outline package; no leads; 3 terminals; body 1 x 1.45 x 0.5 mm; C_i between LA and LB = 97 pF (typical)	SOT1122

6. Block diagram

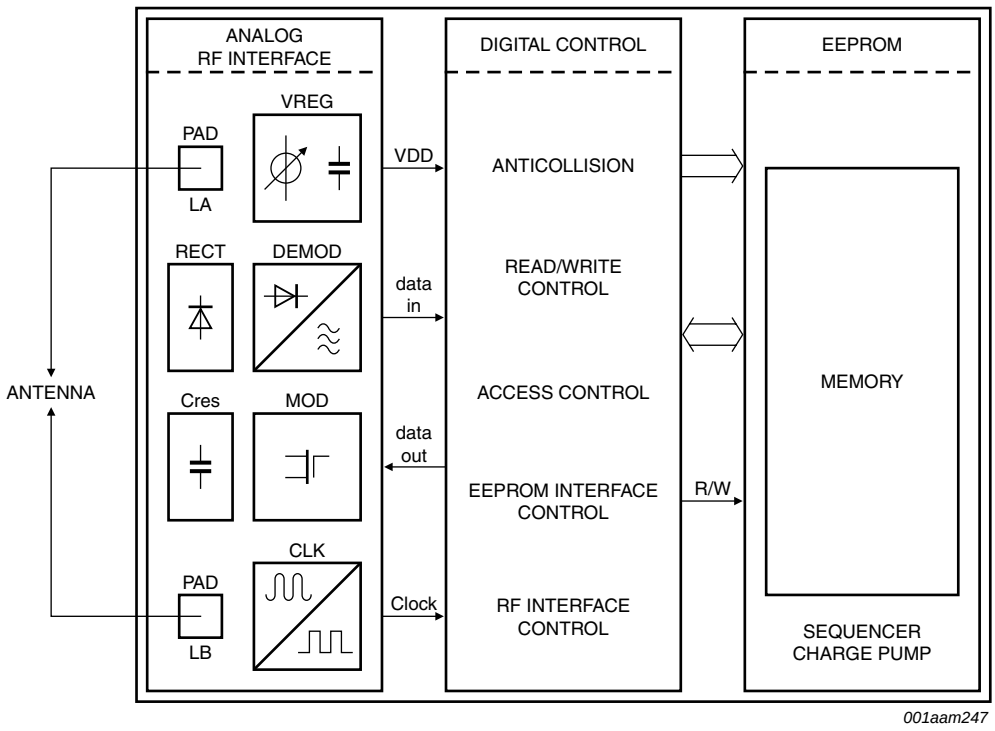

Fig 1. Block diagram of ICODE SLIX

7. Functional description

7.1 Block description

The ICODE SLIX IC consists of three major blocks:

- Analog RF interface
- Digital controller
- EEPROM

The analog section provides stable supply voltage and demodulates data received from the reader for processing by the digital section. The analog section's modulation transistor also transmits data back to the reader.

The digital section includes the state machines, processes the protocol and handles communication with the EEPROM.

The label requires no internal power supply. Its contactless interface generates the power supply and the system clock via the resonant circuitry by inductive coupling to the interrogator. The interface also demodulates data that are transmitted from the interrogator to the ICODE Label, and modulates the electromagnetic field for data transmission from the ICODE Label to the interrogator.

Data are stored in a non-volatile memory (EEPROM).

7.2 Memory organization

The 1024 bit EEPROM memory is divided into 32 blocks. A block is the smallest access unit. Each block consists of 4 bytes (1 block = 32 bits). Bit 0 in each byte represents the least significant bit (LSB) and bit 7 the most significant bit (MSB), respectively.

The memory is divided into 2 parts:

- Configuration area

  Within this part of the memory all required information is stored, such as UID, write protection, access control information, passwords, AFI and EAS. This memory area cannot be directly accessed.

- User memory

  Within the 896 bit memory area the user data are stored. Direct read/write access to this part of the memory is possible depending on the related write protection conditions.

Table 3. Memory organization

Block	Byte 0	Byte 1	Byte 2	Byte 3	Description
					Configuration area for internal use
0					User memory:
1					28 blocks,
2					4 bytes each,
:	:	:	:	:	112 bytes in total.
25					
26					
27					

Blocks 0 to 27 can be addressed with read and write commands only.

7.2.1 Unique identifier

The 64-bit unique identifier (UID) is programmed during the production process according to ISO/IEC 15693-3 and cannot be changed afterwards.

The 64 bits are numbered according to ISO/IEC 15693-3 starting with LSB 1 and ending with MSB 64. This is in contrast to the general used bit numbering within a byte.

The TAG type is a part of the UID (bit 41 to 48, next to the manufacturer code which is “04h” for NXP Semiconductors).

The TAG type of the ICODE SLIX IC is “01h”.

Bit 37 is set to logic 1 for the ICODE SLIX IC which indicates that this type supports the password protected EAS/AFI feature (not supported by ICODE SLI SL2ICS2001 with bit 37 set to logic 0).

Table 4. Unique identifier

MSB							LSB
64:57	**56:49**	**48:41**	**40:1**				
“E0”	“04”	“01”	IC manufacturer serial number				
UID 7	UID 6	UID 5	UID 4	UID 3	UID 2	UID 1	UID 0

8. Limiting values

Table 5. Limiting values (Wafer)[1][2]

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
T_{stg}	storage temperature			−55	+125	°C
P_{tot}	total power dissipation			-	125	mW
T_j	junction temperature			−40	+85	°C
$I_{i(max)}$	maximum input current	LA to LB; peak	[3]	-	±60	mA
I_I	input current	LA to LB; RMS		-	30	mA
V_{ESD}	electrostatic discharge voltage	Human body model	[4]	-	±2	kV

[1] Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any conditions other than those described in the operating conditions and electrical characteristics sections of this specification is not implied.

[2] This product includes circuitry specifically designed for the protection of its internal devices from the damaging effects of excessive static charge. Nonetheless, it is suggested that conventional precautions be taken to avoid applying greater than the rated maxima.

[3] The voltage between LA and LB is limited by the on-chip voltage limitation circuitry (corresponding to parameter I_I).

[4] For ESD measurement, the IC was mounted in a CDIP8 package.

9. Abbreviations

Table 6. Abbreviations

Acronym	Description
AFI	Application Family Identifier
CRC	Cyclic Redundancy Check
DSFID	Data Storage Format IDentifier
EAS	Electronic Article Surveillance
EEPROM	Electrically Erasable Programmable Read Only Memory
IC	Integrated Circuit
LCR	Inductance, Capacitance, Resistance
LSB	Least Significant Byte/Bit
MSB	Most Significant Byte/Bit
RF	Radio Frequency
UID	Unique IDentifier

10. References

[1] **ISO Standard —** ISO/IEC 15693 - Identification cards - Contactless integrated circuit cards - Vicinity cards.

[2] **ISO Standard —** ISO/IEC 15693-2 -Identification cards - Contactless integrated circuit cards - Vicinity cards - Part 2: Air interface and initialization.

[3] **ISO Standard —** ISO/IEC 15693-3 -Identification cards - Contactless integrated circuit cards - Vicinity cards - Part 3: Anticollision and transmission protocol.

[4] **ISO Standard —** ISO/IEC 18000-3 - Information technology - Radio frequency identification for item management - Part 3: Parameters for air interface communications at 13.56 MHz.

[5] **ISO Standard —** ISO/IEC 7816-6 - Identification cards - Integrated circuit cards - Part 6: Interindustry data elements for interchange.

[6] **General specification for 8” wafer on UV-tape with electronic fail die marking —** Delivery type description – BU-ID document number: 1093**[1].

[7] **SL2S2002; SL2S2102 —** Product data sheet – BU-ID document number: 1780**

1. ** ... document version number

11. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
SL2S2002_SL2S2102_SDS v.3.2	20110110	Product short data sheet	-	SL2S2002_SL2S2102_SDS v.3.1
Modifications:	• Type numbers SL2S2002FTB and SL2S2102FTB added			
SL2S2002_SL2S2102_SDS v.3.1	20101005	Product short data sheet	-	-

12. Legal information

12.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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14. Tables

Table 1. Quick reference data 3
Table 2. Ordering information 3
Table 3. Memory organization 6
Table 4. Unique identifier 6
Table 5. Limiting values (Wafer)[1][2] 7
Table 6. Abbreviations 8
Table 7. Revision history 9

15. Figures

Fig 1. Block diagram of ICODE SLIX 4

16. Contents

1 General description 1
1.1 Contactless energy and data transfer 1
1.2 Anticollision 1
1.3 Security and privacy aspects 1
2 Features and benefits 2
2.1 ICODE SLIX RF interface (ISO/IEC 15693) . . . 2
2.2 EEPROM 2
2.3 Security 2
3 Applications 2
4 Quick reference data 3
5 Ordering information 3
6 Block diagram 4
7 Functional description 5
7.1 Block description 5
7.2 Memory organization 5
7.2.1 Unique identifier 6
8 Limiting values 7
9 Abbreviations 8
10 References 8
11 Revision history 9
12 Legal information 10
12.1 Data sheet status 10
12.2 Definitions 10
12.3 Disclaimers 10
12.4 Trademarks 11
13 Contact information 11
14 Tables 12
15 Figures 12
16 Contents 13

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