SL2S2512

ICODE SLIX-N1

Rev. 1.0 — 26 February 2010
178010

Objective data sheet
CONFIDENTIAL

1. General description

The ICODE SLIX-N1 IC is a customer specific chip for intelligent label applications like product authentication in different industries like pharmacy, medical devices and alcohol, as well as production management like in laundries and other different areas of the industry. This IC is part of 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-N1 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 allows to transmit data with up to 53 kbit/s.

1.2 Anticollision

An intelligent anticollision function allows to operate more than one tag 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

1. Unique Identifier (UID)

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

2. Customer Identifier (CID)

   The CID can not be altered and is unique. The CID allows the customer to identify his transponder in an application.
   The CID of the SL2S2512 is XXXX hex and exclusively for TagSys.

3. Password protected EAS

   With the 32-bit EAS password the addressed label can be set in a mode that the EAS status can only be changed if the right EAS password is transmitted to the label within the mentioned commands.

2. Features and benefits

2.1 ICODE SLIX-N1 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 free available)
- Fast data transfer: up to 53 kbit/s
- High data integrity: 16-bit CRC, framing
- True anticollision
- Electronic Article Surveillance (EAS)
- Application Family Identifier (AFI) supported
- Data Storage Format Identifier (DSFID)
- Additional fast anticollision read
- Write distance equal to read distance

2.2 EEPROM

- No user memory
- 40 years data retention
- Write endurance of 100 000 cycles (EAS, AFI and DSFID)

2.3 Security

- Unique identifier for each device
- Unique customer identifier
- Lock mechanism for DSFID, AFI, EAS
- Password (32-bit) protected EAS

3. Applications

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

4. Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
SL2S2512EUD/AF	Wafer	Sawn wafer 120 μm on film frame carrier	-

5. Block diagram

The SL2S2512 IC consists of three major blocks:

- Analog RF Interface
- Digital Controller
- EEPROM

The analog part provides stable supply voltage and demodulates data received from the reader for being processed by the digital part. Further, the modulation transistor of the analog part transmits data back to the reader.

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

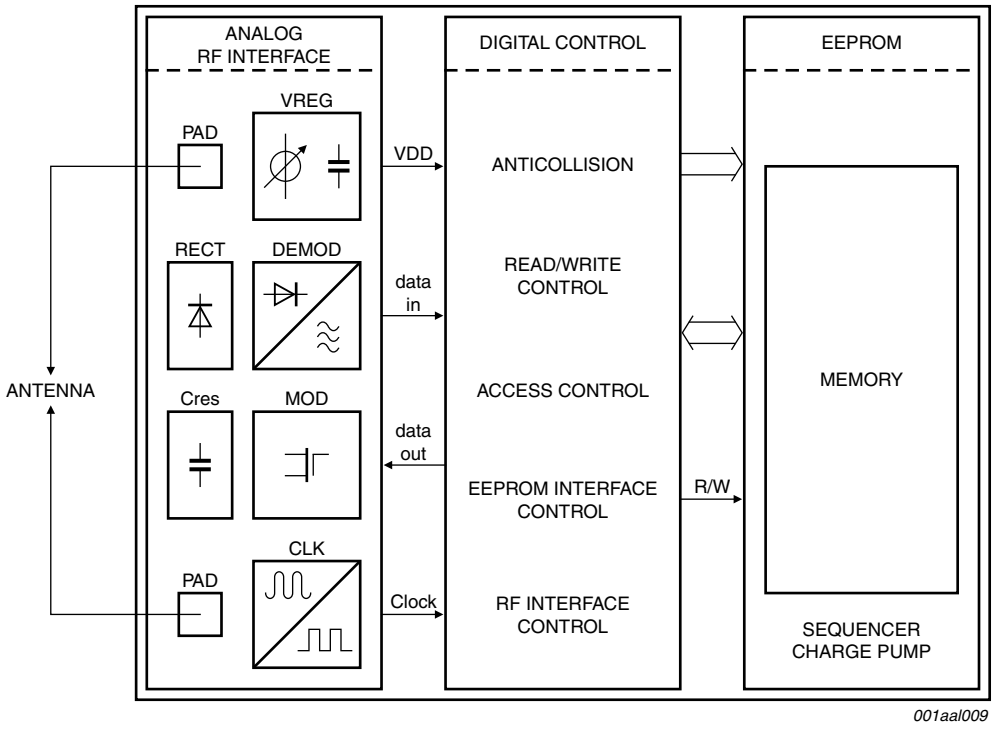
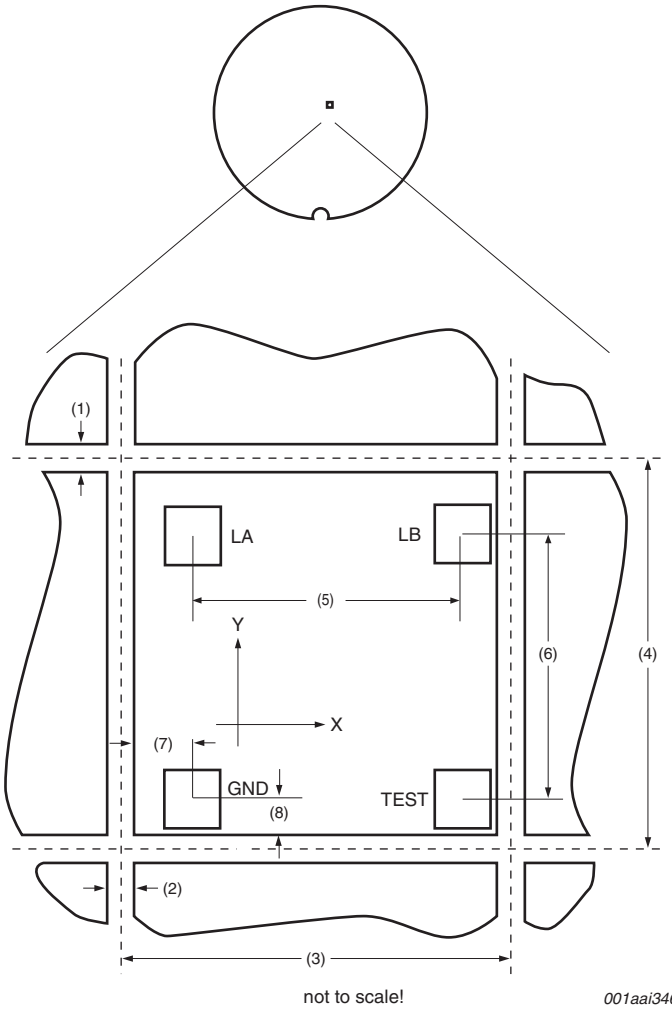


Fig 1. Block diagram of SL2S2512

6. Wafer layout and pinning information



(1) X-scribe line width: 15 μm

(2) Y-scribe line width: 15 μm

(3) Chip step, X-length: 535 μm

(4) Chip step, Y-length: 499 μm

(5) Bump to bump distance X (LA - LB): 400 μm

(6) Bump to bump distance Y (LB - TEST): 360 μm

(7) Distance bump to nitride edge X: 75 μm

(8) Distance bump to nitride edge Y: 45 μm

Bump size X x Y: 60 μm x 60 μm

Fig 2. Wafer layout and pinning information

7. Mechanical specification

7.1 Wafer specification

See Ref. 6 “General specification for 8” wafer on UV-tape with electronic fail die marking”.

7.1.1 Wafer

- Designation: each wafer is scribed with batch number and wafer number
- Diameter: 200 mm (8”)
- Thickness: 120 μm ± 15 μm
- Process: CMOS 0.14 μm
- Batch size: 25 wafers
- Dies per wafer: 110050

7.1.2 Wafer backside

- Material: Si
- Treatment: ground and stress release
- Roughness: R_a max. 0.5 μm, R_t max. 5 μm

7.1.3 Chip dimensions

- Die size without scribe: 520 μm x 484 μm = 25168 μm^2
- Scribe line width:
  X-dimension: 15 μm (scribe line width is measured between nitride edges)
  Y-dimension: 15 μm (scribe line width is measured between nitride edges)
- Number of pads: 4
- Pad location: non diagonal/placed in chip corners
  Distance pad to pad LA-LB: 400 μm
  Distance pad to pad LB-TEST: 360 μm

7.1.4 Passivation on front

- Type: sandwich structure
- Material: PE-Nitride (on top)
- Thickness: 1.75 μm total thickness of passivation

7.1.5 Au bump

- Bump material: > 99.9% pure Au
- Bump hardness: 35 – 80 HV 0.005
- Bump shear strength: > 70 MPa
- Bump height: 18 μm
- Bump height uniformity:
  - within a die: ± 2 μm
  - within a wafer: ± 3 μm
  - wafer to wafer: ± 4 μm
- Bump flatness: ± 1.5 μm
- Bump size:
  - LA, LB: 60 x 60 μm
  - TEST, GND: 60 x 60 μm
  - Bump size variation: ± 5 μm
- Under bump metallization: sputtered TiW

7.1.6 Fail die identification

No inkdots are applied to the wafer.

Electronic wafer mapping (SECS II format) covers the electrical test results and additionally the results of mechanical/visual inspection.

See Ref. 6 “General specification for 8” wafer on UV-tape with electronic fail die marking”.

7.1.7 Map file distribution

See Ref. 6 “General specification for 8” wafer on UV-tape with electronic fail die marking”.

8. Functional description

8.1 Block description

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).

8.2 Memory organization

8.2.1 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 numbering of the 64 bits is done according to ISO/IEC 15693-3 starting with the LSB 1 and ending with the 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 “04” hex for NXP Semiconductors).

The TAG type of the SL2S2512 is “0D” hex.

Table 2. Unique identifier

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

8.2.2 Customer identifier

The 16-bit unique customer identifier (CID) is programmed during the production process and cannot be changed afterwards. The unique CID is granted to the customer.

The CID of the SL2S2512 is “XXXX” hex.

8.2.3 Configuration of delivered ICs

ICODE SLIX-N1 ICs are delivered with the following configuration by NXP Semiconductors:

- Unique identifier is unique per device and read only.
- Customer identifier is unique per customer and read only.
- Status of EAS mode is not defined.
- AFI is supported and not defined.
- All EAS Password bytes are 00h.
- DSFID is supported and not defined.

Remark: Due to the fact that the EAS mode is undefined at delivery, the EAS mode shall be set (enable or disable) according to your application requirements during the test or initialization phase.

Remark: If the EAS password protection will not be required in the targeted application it is recommended to write a random EAS password during the label initialization.

8.3 Communication principle

For detailed description of the protocol and timing please refer to ISO/IEC 15693-2 (modulation, bit-coding, framing, Ref. 2) and ISO/IEC 15693-3 (anticollision, timing, protocol, Ref. 3).

8.4 Supported commands

8.4.1 Mandatory commands

8.4.1.1 INVENTORY

As defined in ISO/IEC 15693-3.

8.4.1.2 STAY QUIET

As defined in ISO/IEC 15693-3.

8.4.2 Optional commands

8.4.2.1 SELECT

As defined in ISO/IEC 15693-3.

8.4.2.2 RESET TO READY

As defined in ISO/IEC 15693-3.

8.4.2.3 WRITE AFI

As defined in ISO/IEC 15693-3.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

8.4.2.4 LOCK AFI

As defined in ISO/IEC 15693-3.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

8.4.2.5 WRITE DSFID

As defined in ISO/IEC 15693-3.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

8.4.2.6 LOCK DSFID

As defined in ISO/IEC 15693-3.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

8.4.2.7 GET SYSTEM INFORMATION

As defined in ISO/IEC 15693-3.

The TAG type of the SL2S2512 is “0D” hex.

8.4.3 Custom commands

The manufacturer code of NXP Semiconductors is defined in ISO/IEC 7816-6A1 (Ref. 5). It has the value “04” hex.

For the structure of custom commands please refer to ISO/IEC 15693-3.

If not explicitly specified differently all address modes are supported.

8.4.3.1 STAY QUIET PERSISTENT

Command code = BC hex

When receiving the STAY QUIET PERSISTENT command, the label IC enters the persistent quiet state and will not send back a response.

Remark: The STAY QUIET PERSISTENT command provides the same behaviour as the mandatory STAY QUIET command with the only difference at a reset (power off). The label IC will turn to the ready state, if the power off time is exceeding the persistent time.

When in persistent quiet state:

- the label IC will not process any request where Inventory_flag is set,
- the label IC will process any addressed request.

The label IC will exit the persistent quiet state when:

- reset (power off) exceeding the persistent time,
- receiving a SELECT request. It shall then go to the Selected state.
- receiving a RESET TO READY request. It shall then go to the Ready state.

The Stay STAY QUIET PERSISTENT shall always be executed in addressed mode (Select_flag is set to 0 and Address_flag is set to 1).

Table 3. Request format

SOF	Flags	STAY QUIET PERSISTENT	IC Mfg code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits	16 bits	

8.4.3.2 GET RANDOM NUMBER

The GET RANDOM NUMBER command is required to receive a random number from the label IC. The passwords that will be transmitted with the SET PASSWORD command have to be calculated with the password and the random number (see Section 8.4.3.3 "SET PASSWORD").

The different passwords are addressed with the password identifier.

Table 4. Request format

SOF	Flags	GET RANDOM NUMBER	IC Mfg code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

Table 5. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 6. Response format when error_flag is NOT set

SOF	Flags	Random number	CRC16	EOF
	8 bits	16 bits	16 bits	

8.4.3.3 SET PASSWORD

Command code = B3 hex

With the SET PASSWORD command the EAS password can be transmitted to the label to get access to EAS (if the EAS password has been enabled). The SET PASSWORD command has to be executed just once for the related password if the label is powered.

The SET PASSWORD command can only be executed in addressed or selected mode.

The XOR password has to be calculated with the password and two times the received random number from the last GET RANDUM NUMBER command:

XOR_Password[31:0] = Password[31:0] XOR {Random_Number[15:0], Random_Number[15:0]}

The EAS password is addressed with the password identifier.

Table 7. Request format

SOF	Flags	SET PASSWORD	IC Mfg code	UID	Password identifier	XOR password	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	8 bits	32 bits	16 bits	

Table 8. Password Identifier

Password identifier	Password
10h	EAS

Table 9. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 10. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Remark: If the IC receives an invalid password, it will not execute any following command until a Power-On Reset (RF Reset) is executed.

8.4.3.4 WRITE PASSWORD

Command code = B4 hex

With the WRITE PASSWORD command a new password will be written into the related memory, if the related old password has already been transmitted with a SET PASSWORD command before and the addressed password is not locked (see Section 8.4.3.5 “LOCK PASSWORD”).

Remark: The WRITE PASSWORD command can only be executed in addressed or selected mode. The new password takes effect immediately which means that the new password has to be transmitted with the SET PASSWORD command to get access to protected blocks.

The EAS password is addressed with the password identifier.

The timing of the command is write alike.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

Table 11. Request format

SOF	Flags	WRITE PASSWORD	IC Mfg code	UID	Password identifier	Password	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	8 bits	32 bits	16 bits	

Table 12. Password Identifier

Password identifier	Password
10h	EAS

Table 13. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 14. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.4.3.5 LOCK PASSWORD

Command code = B5 hex

With the LOCK PASSWORD command the addressed password will be locked if the related password has already been transmitted with a SET PASSWORD command before. A locked password cannot be changed any longer.

The EAS password is addressed with the password identifier.

The timing of the command is write alike.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

Table 15. Request format

SOF	Flags	LOCK PASSWORD	IC Mfg code	UID	Password identifier	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	8 bits	16 bits	

Table 16. Password identifier

Password identifier	Password
10h	EAS

Table 17. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 18. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.4.3.6 INVENTORY READ

Command code = A0 hex

When receiving the inventory read request, the ICODE SLIX IC performs the same as in the anticollision sequence, with the difference that instead of the UID and the DSFID the requested response is defined by additional options.

8.4.3.5.1 Standard mode

The ICODE SLIX-N1 does not respond to a standard Inventory Read command as it is defined for the ICODE SLI because the ICODE SLIX-N1 does not have a user memory.

To use the same command code the command is extended with additional options. The use od the additional options is indicated be the most significant bit of the Mask length byte.

If the most significant bit of the mask length byte is equal 0 the ICODE SLIX-N1 IC remains silent.

8.4.3.5.2 Extended Mode

If the most significant bit of the Mask Length byte is equal 1 the response format is defined by the extended option byte.

The request contains:

- Flags
- Inventory Read command code
- IC Manufacturer code
- AFI (if the AFI flag is set)
- Mask length (most significant bit equal 1)
- Extended Options
- Custom ID (CID)
- Mask value (if mask length > 0)
- CRC 16

Table 19. Inventory Read (extended mode)

SOF	Flags	Inventory Read	IC Mfr. code	AFI	Mask Length	ext. Options	CID (Custom ID)	Mask Value	CRC 16	EOF
	8 bits	8 bits	8 bits	8 bits optional	8 bits MSB = 1	8 bits	16 bits	0 to 64 bits	8 bits	

The inventory_flag must be set to 1.

The meaning of flags 5 to 8 is according to table 5 in ISO/IEC 15693-3.

Table 20. Extended options

Bit number	Value	Feature
1 (LSB)	**0**	**RFU**
2	0	UID will be transmitted as in regular mode (truncated reply)
	1	Complete UID will be transmitted (independent from mask length)
3	**1**	**RFU**
4	0	
	1	Custom ID (CID) will be transmitted in the response (return link)
5	**1**	**RFU**
6	**0**	**RFU**
7	**0**	**RFU**
8 (MSB)	**0**	**RFU**

If the option flag in the request is set to 1 the response contains the truncated or complete UID depending on the extended option flag 2.

If the option flag in the request is set to 0 the UID is not part of the response.

Table 21. Response format

SOF	Flags	Optional CID (Custom ID)	Optional truncated UID OR complete UID	CRC16	EOF
	8 bits	16 bits	0 to 64 bits	16 bits	

The mechanism and timing of the INVENTORY READ command performs the same as at the INVENTORY command which is described in clause 8 of ISO/IEC 15693-3.

If the UID is requested in the truncated format the re-transmitted UID can be calculated as follows:

16 slots: 64 - 4 - mask length rounded up to the next byte boundary
1 slot: 64 - mask length rounded up to the next byte boundary

Example: mask length = 30

Returned: 64 - 4 - 30 = 30 gives 4 bytes

Table 22. Example

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	UID
mask value incl. padding with zeros								transmitted by Interrogator
				returned value				transmitted by ICODE SLIX IC

8.4.3.7 FAST INVENTORY READ

Command code = A1 hex

When receiving the FAST INVENTORY READ command the ICODE SLIX-N1 IC behaves the same as in the INVENTORY READ command with the following exceptions:

The data rate in the direction ICODE SLIX-N1 IC to the interrogator is twice as defined in ISO/IEC 15693-3 depending on the datarate_flag 53 kbit/s (high data rate) or 13 kbit/s (low data rate).

The data rate from the interrogator to the ICODE SLIX-N1 IC and the time between the rising edge of the EOF from the interrogator to the ICODE SLIX-N1 IC remain unchanged (stay the same as defined in ISO/IEC 15693-3).

In the direction ICODE SLIX-N1 IC to the interrogator only the single subcarrier mode is supported.

8.4.3.8 SET EAS

Command code = A2 hex

This command sets the EAS bit to 1.

The timing of the command is write alike.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

Remark: This command maybe password protected. refer to 8.4.3.11

Table 23. Request format

SOF	Flags	SET EAS	IC Mfg. code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

Table 24. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 25. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.4.3.9 LOCK EAS

Command code = A4 hex

This command locks the current state of the EAS bit.

The timing of the command is write alike.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

Remark: This command maybe password protected. refer to 8.4.3.11

Table 26. Request format

SOF	Flags	LOCK EAS	IC Mfg. code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

Table 27. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 28. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.4.3.10 RESET EAS

Command Code = A3 hex

This command sets the EAS bit to 0.

The timing of the command is write alike.

Option 0 (option flag is not set) is supported.

Option 1 (option flag set) is supported.

Remark: This command maybe password protected. refer to 8.4.3.11

Table 29. Request format

SOF	Flags	RESET EAS	IC Mfg. code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

Table 30. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 31. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.4.3.11 EAS ALARM

Command code = A5 hex

If the EAS bit is set to 1 the EAS response is returned from the ICODE SLIX-N1 IC.

Table 32. Request format

SOF	Flags	EAS	IC Mfg. code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

If an error is detected the ICODE SLIX-N1 IC remains silent

Table 33. Response format

SOF	Flags	EAS sequence	CRC16	EOF
	8 bits	256 bits	16 bits	

EAS sequence (starting with the LSB, which is transmitted first; read from left to right):

11110100 11001101 01000110 00001110 10101011 11100101 00001001 11111110

00010111 10001101 00000001 00011100 01001011 10000001 10010010 01101110

01000001 01011011 01011001 01100001 11110110 11110101 11010001 00001101

10001111 00111001 10001011 01001000 10100101 01001110 11101100 11110111

If the EAS bit is set to 0 the ICODE SLIX-N1 IC remains silent.

8.4.3.12 PASSWORD PROTECT EAS

Command code = A6 hex

This command enables the password protection for EAS if the EAS password has been transmitted before with the SET PASSWORD command.

Option flag is set to 0 EAS will be password protected.

Remark: Independent of the option flag this write-alike command will be executed like a write command with option flag 0 (option flag not set).

Once the EAS password protection is enabled a change back to unprotected EAS is not possible.

The timing of the command is write alike (as write command with option flag 0).

Table 34. Request format

SOF	Flags	PASSWORD PROTECT EAS	IC Mfg code	UID	CRC16	EOF
	8 bits	8 bits	8 bits	64 bits optional	16 bits	

Table 35. Response format when error_flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

Table 36. Response format when error_flag is NOT set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

8.5 Error handling

8.5.1 Transmission errors

According to ISO/IEC 15693 the label IC will not respond if a transmission error (CRC, bit coding, bit count, wrong framing) is detected and will silently wait for the next correct received command.

8.5.2 Not supported commands or options

If the received command or option is not supported, the behavior of the label IC is depending on the addressing mechanism.

8.5.2.1 Non Addressed Mode

The label IC remains silent.

8.5.2.2 Addressed or Selected Mode

The addressed or selected label IC responds with the error code “0F” hex (error with no information given or error code is not supported).

If the inventory flag or the protocol extension flag is set the label IC will not respond if the command or option is not supported.

8.6 Data integrity

Following mechanisms are implemented in the contactless communication link between interrogator and label to ensure very reliable data transmission:

- 16-bit CRC per block
- Bit count checking
- Bit coding to distinguish between "1", "0", and no information
- Channel monitoring (protocol sequence and bit stream analysis)

8.7 RF interface

The definition of the RF interface is according to the standard ISO/IEC 15693-2 and ISO/IEC 15693-3.

9. Limiting values

9.1 Limiting values wafer

Table 37. Limiting values[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-LB	[4]	-	±60	mA_{peak}
I_I	input current	LA-LB		-	30	mA_{rms}
V_{ESD}	electrostatic discharge voltage	Human body model	[3]	-	±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 section 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] For ESD measurement, the IC has been mounted into a CDIP8 package.

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

10. Characteristics

10.1 Wafer characteristics

10.1.1 Memory characteristics

Table 38. Memory characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
EEPROM characteristics						
t_{ret}	retention time	$T_{amb} \leq 55$ °C	40	-	-	year
$N_{endu(W)}$	write endurance	T_{amb} = 22 °C	100000	-	-	cycle

10.1.2 Interface characteristics

Table 39. Interface characteristics[1]

Symbol	Parameter		Min	Typ	Max	Unit
f_{oper}	operating frequency	[2]	13.553	13.56	13.567	MHz
V_{LA-LB}	minimum operating voltage read/write		1.5	-	1.7	V_{rms}
P_{min}	minimum operating power	[3]	-	25	-	µW
C_{LA-LB}	input capacitance between LA - LB	[4]	22.3	23.5	24.7	pF
$t_{persistent}$	persistent time	[5]	2	-	-	s

[1] Typical ratings are not guaranteed. These values listed are at room temperature.

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

[3] Including losses in the resonant capacitor and rectifier.

[4] Measured with an HP4285A LCR meter at 13.56 MHz and 2 V_{rms}

[5] The maximum persistent time strongly depends on the temperature.

11. Abbreviations

Table 40. 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
EOF	End Of Frame
IC	Integrated Circuit
LSB	Least Significant Byte/Bit
MSB	Most Significant Byte/Bit
RF	Radio Frequency
UID	Unique IDentifier

12. 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 – BL-ID document number: 1093**[1]

1. ** ... document version number

13. Revision history

Table 41. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
178010	20100226	Objective data sheet	-	-

14. Legal information

14.1 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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16. Tables

17. Figures

18. Contents

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