SL2S1412; SL2S1512; SL2S1612

ICODE ILT-M

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230330

Product short data sheet
COMPANY PUBLIC

1. General description

The ISO 18000-3 mode 3/EPC Class-1 HF standard allows the commercialized provision of mass adoption of HF RFID technology for passive smart tags and labels. Main fields of applications are supply chain management and logistics for worldwide use.

The ICODE ILT-M is a dedicated chip for passive, intelligent tags and labels supporting the ISO 18000-3 mode 3 RFID standard. It is especially suited for applications where reliable identification and high anti-collision rates are required.

The ICODE ILT-M is a product out of the NXP Semiconductors ICODE product family. The entire ICODE product family offers anti-collision functionality. This allows a reader to simultaneously operate multiple labels/tags within its antenna field. A ICODE ILT-M based label/tag requires no external power supply.

Its contactless interface generates the power supply via the antenna circuit by inductive energy transmission from the interrogator (reader), while the system clock is extracted from the magnetic field. Data transmitted from interrogator to label/tag is demodulated by the interface, and it also modulates the interrogator's magnetic field for data transmission from label/tag to interrogator. A label/tag can be operated without the need for line of sight or battery, as long as it is connected to a dedicated antenna for the targeted frequency range. When the label/tag is within the interrogator's operating range, the high-speed wireless interface allows data transmission in both directions.

2. Features and benefits

2.1 Key features

- 512-bit user memory
- Up to 240-bit of EPC memory
- 96-bit tag identifier (TID) including 48-bit unique serial number
- EAS (Electronic Article Surveillance) functionality
- Recommissioning feature (privacy) with 32-bit kill password
- 32-bit access password to allow a transition into the secured state
- Long read/write ranges due to extremely low-power design
- Reliable operation of multiple tags due to advanced anti-collision (up to 800 tags/s)
- Fast initialization (write EPC)
- Forward link: 25 kbit/s to 100 kbit/s
- Return link: 53 kbit/s to 848 kbit/s

2.2 Key benefits

- High sensitivity provides long read range
- Highly advanced anti-collision resulting in highest identification speed
- Reliable and robust RFID technology suitable noisy environments and dense label populations

2.3 Custom features

- EAS
  Enables the HF RFID tag to be used as EAS tag without the need for a backend data base.

3. Applications

- Healthcare and pharmaceutical supply chain
- Medical lab automation
- Document tracking
- Casino chips
- Laundry automation

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
t_{ret}	retention time	$T_{amb} \leq 55$ °C		50	-	-	year
$N_{endu(W)}$	write endurance			100000	-	-	cycle
f_i	input frequency		[1]	13.553	13.56	13.567	MHz
$V_{i(RMS)min}$	minimum RMS input voltage	operating read/write		1.5	-	1.7	V
$P_{i(min)}$	minimum input power	operating	[2]	-	40	-	µW
C_i	input capacitance	between LA and LB	[3]				
		SL2S1412FUD		-	-	-	pF
		SL2S1512FUD		22.3	23.5	24.7	pF
		SL2S1612FUD		92	97	102	pF

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

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

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

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
SL2S1412FUD	Wafer	sawn, bumped wafer, 120 µm, on film frame carrier, C_i between LA and LB = 0 pF (typical)	-
SL2S1512FUD	Wafer	sawn, bumped wafer, 120 µm, on film frame carrier, C_i between LA and LB = 23.5 pF (typical)	-
SL2S1612FUD	Wafer	sawn, bumped wafer, 120 µm, on film frame carrier, C_i between LA and LB = 97 pF (typical)	-

6. Block diagram

The SL2S1412; SL2S1512; SL2S1612 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, which contains the EPC and the user data.

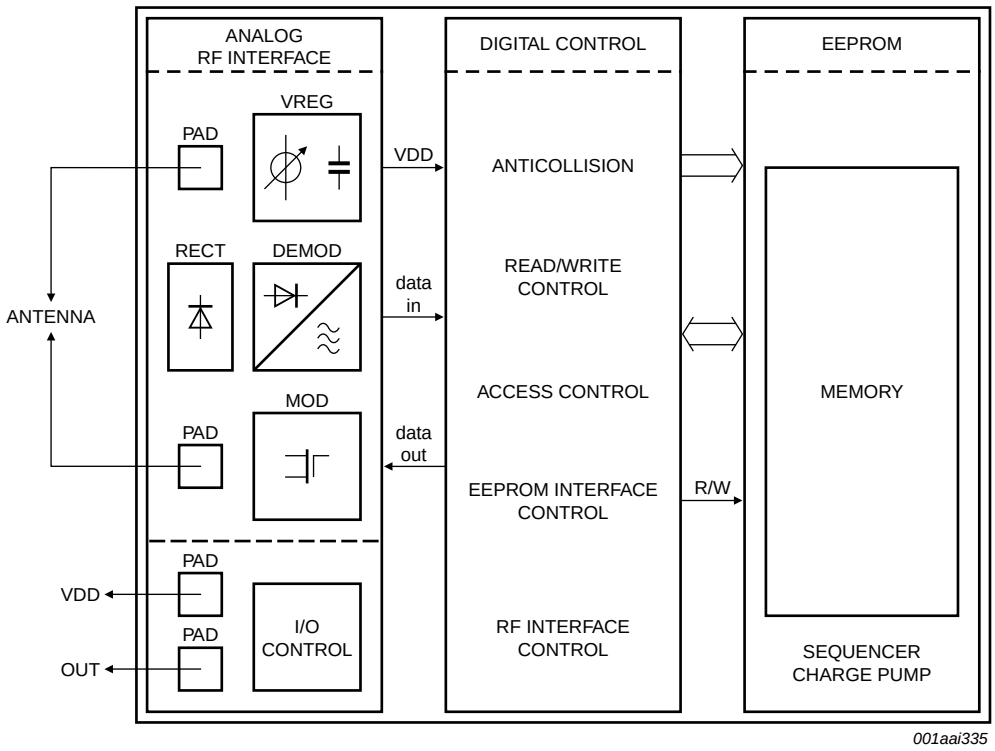

Fig 1. Block diagram

7. Functional description

7.1 Power transfer

Whenever connected to a very simple and cheap 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 ILT-M IC can be operated without line of sight up to a distance of 1.5 m (gate width). No battery is needed.

7.2 Data transfer

7.2.1 Reader to tag Link

An interrogator transmits information to the ICODE ILT-M by modulating an RF signal in the 13.56 MHz frequency. The ICODE ILT-M receives both information and operating energy from this RF signal. Tags are passive, meaning that they receive all of their operating energy from the interrogator's RF waveform.

An interrogator is using a fixed modulation and data rate for the duration of at least an inventory round. It communicates to the ICODE ILT-M by modulating an RF carrier using DSB-ASK with PIE encoding.

For further details refer to Section 11, Ref. 2. Interrogator-to-tag (R=>T) communications.

7.2.2 Tag to reader Link

An interrogator receives information from the ICODE ILT-M by transmitting a continuous-wave RF signal to the tag; the ICODE ILT-M responds by load modulation of the 13.56 MHz carrier frequency, thereby generating modulated sidebands used to transmit an information signal to the interrogator. The system is a reader talks first (RTF) system, meaning that a ICODE ILT-M only responds with an information signal after being directed by the interrogator.

ICODE ILT-M transmits information using ASK modulation. The returned data are either coded with FM0 baseband, Miller with sub carrier or Manchester with sub carrier. The interrogator can select if the ICODE ILT-M shall respond with a sub carrier frequency of 424 kHz or 848 kHz.

For further details refer to Section 11, Ref. 2. tag-to-interrogator (T=>R) communications.

7.3 Air interface standards

The ICODE ILT-M fully supports all parts of the ISO 18000-3 Mode 3 (refer to Section 11, Ref. 1) and the "EPC™ Radio-Frequency Identity Protocols EPC Class-1 HF RFID Air Interface Protocol for Communications at 13.56 MHz, Version 2.0.3" (refer to Section 11, Ref. 2).

8. Memory configuration

This section contains all information including commands by which a reader selects, inventories, and accesses a ICODE ILT-M population

An interrogator manages ICODE ILT-M equipped tag populations using three basic operations. Each of these operations comprises one or more commands. The operations are defined as follows

Select: The process by which an interrogator selects a tag population for inventory and access. Interrogators may use one or more Select commands to select a particular tag population prior to inventory.

Inventory: The process by which an interrogator identifies ICODE ILT-M equipped tags. An interrogator begins an inventory round by transmitting a BeginRound command in one of two sessions. One or more tags may reply. The interrogator detects a single tag reply and requests the PC, EPC, and CRC-16 from the chip. An inventory round operates in one and only one session at a time. For an example of an interrogator inventorying and accessing a single tag refer to Section 11, Ref. 2.

Access: The process by which an interrogator transacts with (reads from or writes to) individual tags. An individual tag must be uniquely identified prior to access. Access comprises multiple commands, some of which employ one-time-pad based cover-coding of the R=>T link.

8.1 Memory

For the general memory layout according to the standard Section 11, Ref. 2. The tag memory is logically subdivided into four distinct banks.

In accordance to the standard Section 11, Ref. 2. The tag memory of the ICODE ILT-M is organized in following 4 memory sections:

Table 3. Memory sections

Name	Size	Bank
Reserved memory (32-bit ACCESS and 32-bit KILL password)	64 bit	00b
EPC (excluding 16 bit CRC-16 and 16-bit PC)	240 bit	01b
TID (including unique 48 bit serial number)	96 bit	10b
User memory	512 bit	11b

The logical address of all memory banks begin at zero (00h).

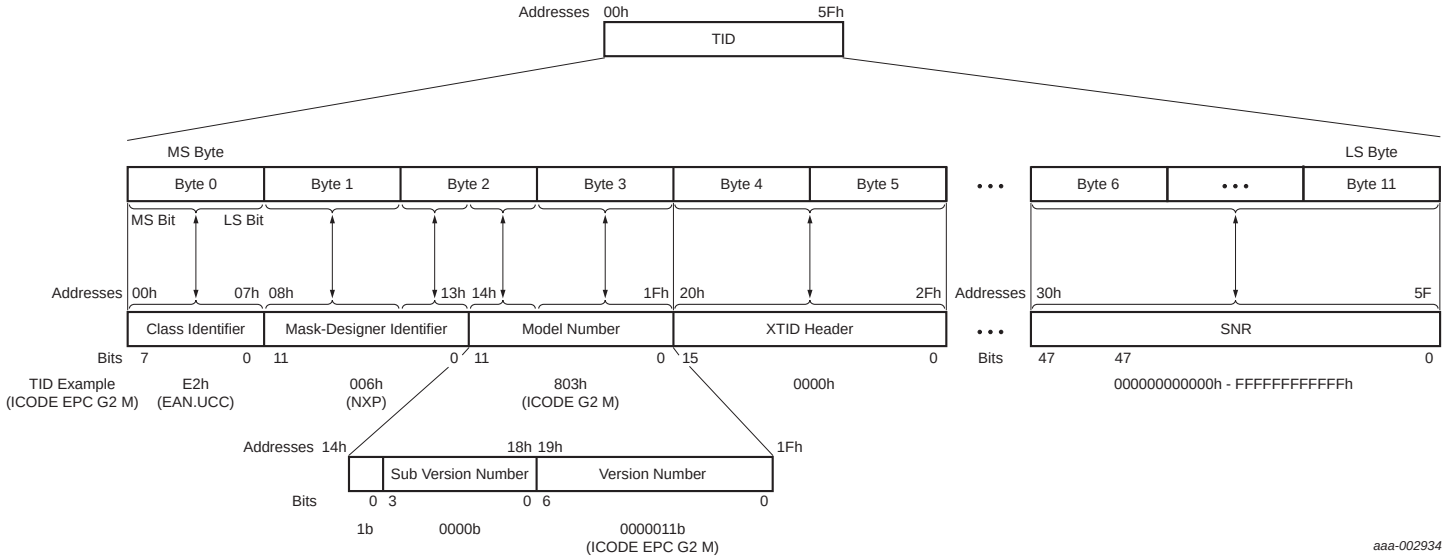

Fig 2. TID for ICODE ILT-M

Table 4. Model number

	SI (Status Indicator Bit)	Sub Version No.	Version (Silicon) No.
ICODE ILT-M	1	0000b	0000011b

9. 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.

10. Abbreviations

Table 6. Abbreviations

Acronym	Description
CRC	Cyclic redundancy check
EEPROM	Electrically Erasable Programmable Read Only Memory
EPC	Electronic Product Code (containing Header, Domain Manager, Object Class and Serial Number)
FM0	Bi phase space modulation
IC	Integrated Circuit
RF	Radio Frequency
RTF	Reader Talks First
HF	High Frequency

11. References

[1] ISO 18000-3M3

[2] EPC™ Radio-Frequency Identity Protocols EPC Class-1 HF RFID Air Interface Protocol for Communications at 13.56 MHz, Version 2.0.3

[3] EPCglobal: EPC Tag Data Standards 1.5

[4] ECC ERC Recommendation 70-03 Annex 9

[5] ISO/IEC Directives, Part 2: Rules for the structure and drafting of International Standards

[6] ISO/IEC 3309: Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures – Frame structure

[7] ISO/IEC 15961: Information technology, Automatic identification and data capture – Radio frequency identification (RFID) for item management – Data protocol: application interface

[8] ISO/IEC 15962: Information technology, Automatic identification and data capture techniques – Radio frequency identification (RFID) for item management – Data protocol: data encoding rules and logical memory functions

[9] ISO/IEC 15963: Information technology — Radio frequency identification for item management — Unique identification for RF tags

[10] ISO/IEC 18000-1: Information technology — Radio frequency identification for item management — Part 1: Reference architecture and definition of parameters to be standardized

[11] ISO/IEC 19762: Information technology AIDC techniques – Harmonized vocabulary – Part 3: radio-frequency identification (RFID)

[12] U.S. Code of Federal Regulations (CFR), Title 47, Chapter I, Part 15: Radio-frequency devices, U.S. Federal Communications Commission

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

[14] Data sheet — SL2S1412; SL2S1512; SL2S1612;– BU-ID document number: 1677**

1. ** ... document version number

12. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
SL2S1412_SL2S1512_ SL2S1612 v. 3.0	20120502	Product short data sheet	-	-

13. Legal information

13.1 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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15. Contents

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