SL3ICS1202 G2XL

UCode Functional specification

Rev. 1.1 — 10 October 2007
139111

Objective data sheet
CONFIDENTIAL

1. General description

The EPC global UHF Generation 2 Standard allows the commercialised provision of mass adaption of UHF EPC technology for passive smart tags and labels. Main fields of applications will be especially the supply chain management and logistics for worldwide use with especial consideration of European and US regulations to ensure that operating distances of several meters can be realized.

The SL3 ICS 12 02 G2XL is a dedicated chip for passive, intelligent tags and labels supporting the EPCglobal Class 1 Generation 2 UHF RFID standard. It is especially suited for applications where operating distances of several meters and high anti-collision rates are required.

The SL3 ICS 12 02 G2XL is a product out of the NXP Semiconductors UCode product family. The entire UCode product family offers anti-collision and collision arbitration functionality. This allows a reader to simultaneously operate multiple labels / tags within its antenna field. A UCode EPC G2 based label / tag requires no external power supply.

Its contactless interface generates the power supply via the antenna circuit by propagative energy transmission from the interrogator (read / write device), while the system clock is generated by an on-chip oscillator. Data transmitted from interrogator to label / tag is demodulated by the interface, and it also modulates the interrogator’s electromagnetic 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.

founded by Philips

2. Features

2.1 Key features

- Interface fully compatible with UHF EPC G2 standard
- Long-range solutions
- Suitable for UHF RFID, allowing one IC to be used worldwide
- Fast data rate
- Forward link: 40 - 160 kbits/s
- Return link: 40 - 640 kbits/s
- 96 bit EPC, scalable up to 240 bits
- 64 bit tag Identifier
- 32 bit access password
- 32 bit kill password
- Runs on the same hardware infrastructure as the UCode HSL and the UCode EPC1.19

2.2 Key benefits

- Large read range due to high sensitivity
- Consistent performance on different materials due to low Q-factor
- Ease of assembly and high assembly yield due to large chip input capacitance
- Reliable operation in dense reader environment due to high interference suppression
- Highly advanced anti-collision resulting in highest identification speed

2.3 RF Interface Features

- Contact-less transmission of data and supply energy (no battery needed)
- Long-range operating distance
- Operating frequency within the released operating bands from 860 MHz to 960 MHz
- High data integrity: 16 bit CRC, framing
- High anti-collision and inventory speed
- Data rates:
    - R -> T: 40 – 160 kbps,
    - T -> R: 40 – 465 kbps (Divide ratio DR = 8) or 95 – 640 kbps (DR = 64/3)
- Uses a slotted random anti-collision algorithm where the SL3 ICS 12 02 G2XL loads a random (or pseudo-random) number into a slot counter, decrement this slot counter based on interrogator commands, and reply to the interrogator when their slot counter reaches zero. Supports the full mandatory command set as well as optional and Customer commands according to the standard

2.4 Memory Features

- EPC numbers scaleable up to 240 bit
- 64 bit tag identifier (TID)
- 32 bit kill password to permanently disable the tag
- 32 bit access password to allow a transition into the secured transmission state
- Inventoried flags and selected flag support the handling of persistence information

2.5 Security Features

- Lock mechanism (write protection) for individual passwords and individual memory banks allow for permanent lock (permalock) status of a password or memory bank.

3. Applications

- Supply Chain Management
- Asset Management
- Container Identification
- Pallet & Case Tracking

4. Quick reference data

The SL3ICS1002 G2XL supports global operation in different frequency bands. In principle, the SL3ICS1002 G2XL has no restriction on the operating frequency. Based on regulation requirements the SL3ICS1002 G2XL is released for the following frequency band.

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
UHF	Frequency band		860	-	960	MHz

5. Block diagram

The SL3ICS1002 G2XL 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.

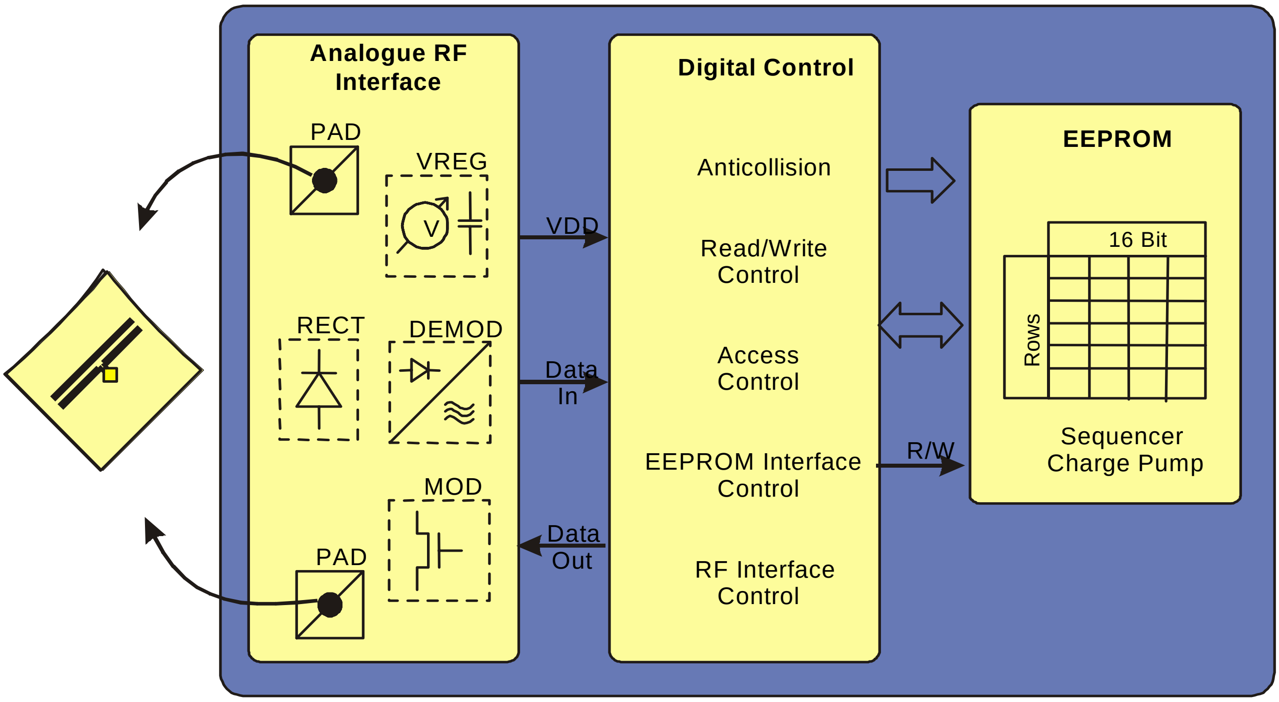
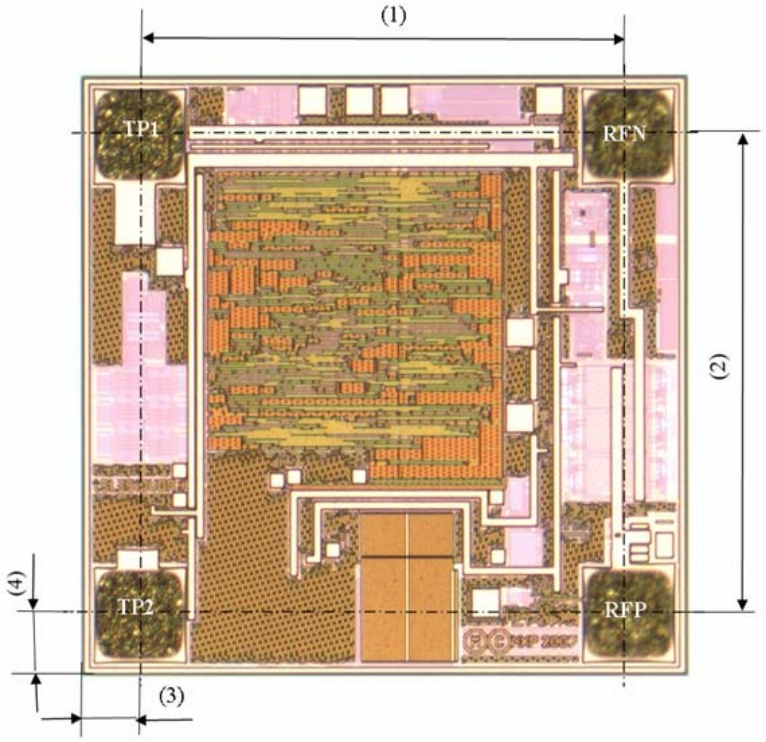


Fig 1. Block diagram of TAG IC

6. Pinning information



(1) bump to bump distance X (TP1 – RFN): 344.6µm
(2) bump to bump distance Y (RFN – RFP): 326.6µm
(3) distance bump to metal sealring X: 43.5µm
(4) distance bump to metal sealring Y: 43.5µm

Fig 2. Pinning

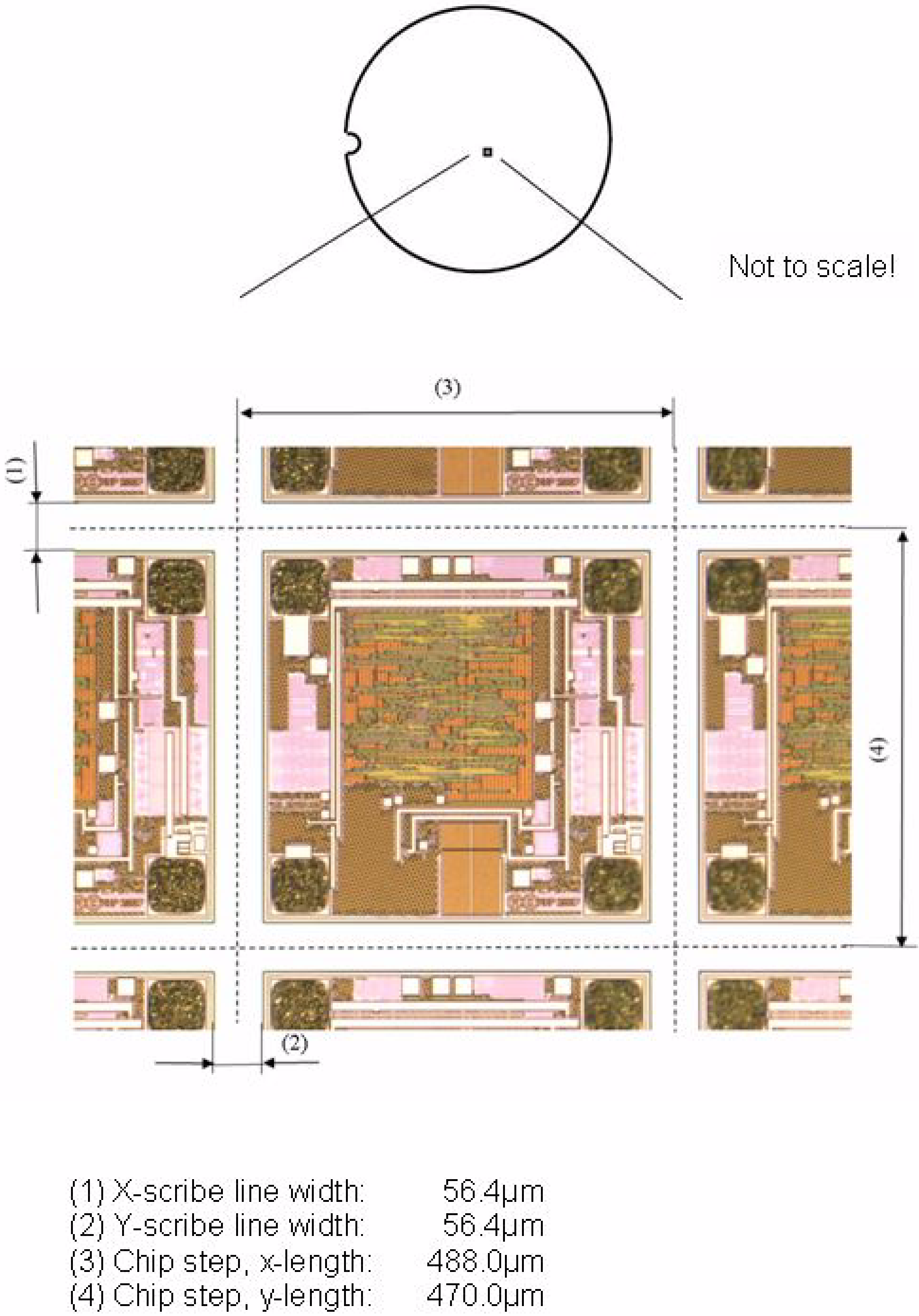


Fig 3. Wafer layout

7. Mechanical specification

7.1 Wafer

- Designation: Each wafer is scribed with batch number and wafer number
- Diameter: 200 mm (8”)
- Thickness: 150 µm ± 15 µm
- Number of pads 4
- Pad location: non diagonal/ placed in chip corners
- Distance pad to pad RFN-RFP 326.6 µm
- Distance pad to pad TP1-RFN: 344.6 µm
- Process: Cmos 0.14 µm
- Batch size: 25 wafers

7.2 Wafer backside

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

7.3 Chip dimensions

- Die size without scribe: 0.414 mm x 0.432 mm = 0.178 mm^2
- Scribe line width: x-dimension: 56.4 µm (scribe line width is measured on top metal layer)

  y-dimension:56.4 µm (scribe line width is measured on top metal layer)

7.4 Passivation on Front

- Type Sandwich structure
- Material: PSG/Nitrid (on top)
- Thickness: 500 nm/600 nm

7.5 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:
  - RFP, RFN 60 x 60 μm
  - TP1, TP2 60 x 60 μm
  - Bump size variation: ± 5 μm
- Under bump metallization: sputtered TiW

8. Limiting values

Table 2. Limiting values[1][2]

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to RFN.

Symbol	Parameter	Conditions	Min	Max	Unit
T_{stg}	Storage temperature range		-55	+125	°C
P_{tot}	Total power dissipation per package		-	30	mW
T_{amb}	Operating temperature		-40	+85	°C
V_{ESD}	Electrostatic discharge voltage	[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 die chip has been mounted into a CDIP8 package.

9. Characteristics

9.1 Memory

Table 3. Memory

Parameter	Size
TID	64 bit
EPC	max 240 bit
EEPROM Data retention	min. 2 years
EEPROM Write endurance	10 000 cycles

9.2 Analog front end

Table 4. Analog front end

Data represent typical values

Parameter	Value	Unit
Input Capacitance (parallel)	0.9	pF
Quality factor (Im (Z_{chip}) / Re (Z_{chip}))	8	
Impedance (915 MHz)	24 -j 195	Ohm
Minimum Operating power	-15	dBm
Backscatter Strength* (min. Power, 4x1 Label)	- 2	dB

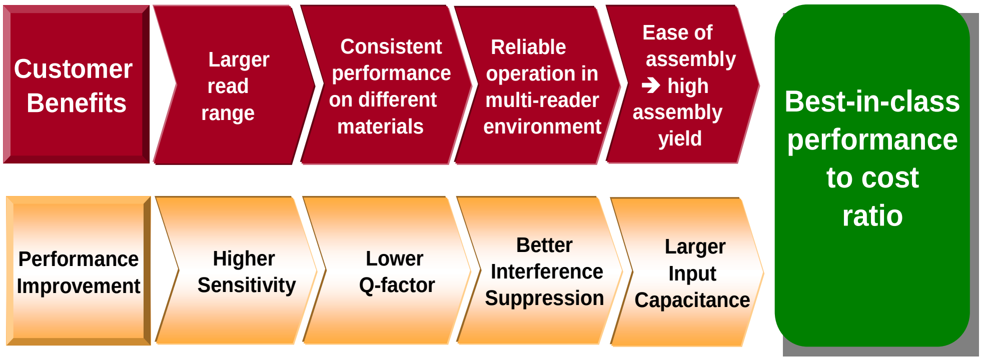
9.3 Interfering signals / Jammer suppression

Table 5. Interfering signals / Jammer suppression

Parameter	Remark	Value	Unit
Modulated Jammer	minimum offset to carrier frequency: > 1.2MHz	-4	dB
In-band Jammer	modulated or unmodulated jammer with offset < 10 kHz	-9	dB

10. Functional description

UCODE G2XM, G2XL: Performance Improvement



	Sensitivity	Q-factor	Interference suppression	Chip input capacitance
UCODE G2XM, UCODE G2XL	30 µW	< 8	-4 dB	0.9 pF
UCODE EPC Gen 2	50 µW	28	-19dB	220 fF

COMPANY CONFIDENTIAL 1

Fig 4. Key features

10.1 Power Transfer

The reader provides an RF field that powers the UCode EPC G2 tag, which contains the SL3ICS1202 G2XL connected to an antenna. The tag antenna transforms the impedance of free space to the chip input impedance in order to get the maximum possible power for the SL3ICS1202 G2XL on the tag.

The RF field, which is oscillating on the operating frequency provided by the reader, is rectified to provide a smoothed DC voltage to the analog and digital modules of the IC.

The antenna that is attached to the chip may use a DC connection between the two antenna pads. Therefore the SL3 ICS 12 02 G2XL also enables loop antenna design. Possible examples of supported antenna structures can be found in the antenna design guide.

10.2 Data Transfer

10.2.1 Reader to tag Link

An interrogator transmits information to the UCode EPC G2 tag by modulating an RF signal in the 860 MHz – 960 MHz frequency range. The tag 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 tags by modulating an RF carrier using DSB-ASK, SSB-ASK or PR-ASK with PIE encoding.

For further details refer to Section 15, Ref. 1, section 6.3.1.2. Interrogator-to-tag (R=>T) communications.

10.2.2 Tag to reader Link

An interrogator receives information from the UCode EPC G2 tag by transmitting a continuous-wave RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the interrogator. The system is reader talks first (RTF) system, meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed by the interrogator.

SL3 ICS 12 02 G2XL backscatter uses a combination of ASK and PSK modulation depending on the tuning and bias point. The backscattered data is either modulated with FM0 baseband or Miller subcarrier.

For further details refer to Section 15, Ref. 1, section 6.3.1.3. tag-to-interrogator (T=>R) communications.

10.3 Operating Distances

RFID tags based on the UCode EPC G2 SL3ICS1002 G2XL silicon may achieve maximum operating distances according the following formula:

$$P_{tag} = EIRP \cdot G_{tag}\left(\frac{\lambda}{4\pi R}\right)^2 \cdot \eta \qquad (1)$$

$$R_{max} = \sqrt{\frac{EIRP \cdot G_{tag} \cdot \lambda^2}{(4\pi)^2 P_{tag}} \cdot \eta} \qquad (2)$$

Note:

P_{tag}....Minimum required RF power for the tag

G_{tag}.... Gain of the tag antenna

EIRP .... Transmitted RF power

λ .... Wavelength

R_{max}....Maximum achieved operating distance for a λ/2-dipole.

η .... Loss factor assumed to be 0.5 considering matching and package losses

Table 6. Operating distances for UCode EPC G2 based tags and labels in released frequency bands

Frequency range	Region	Available power	Calculated read distance single antenna [4][5]	Unit
868.4 to 868.65 MHz (UHF)	Europe [1]	0.5 W ERP	3.6	m
865.5 to 867.6 MHz (UHF)	Europe [2]	2 W ERP	7.1	m
902 to 928 MHz (UHF)	America [3]	4 W EIRP	7.5	m

[1] CEPT/ETSI regulations [CEPT1], [ETSI1].

[2] New CEPT/ETSI regulations. [ETSI3].

[3] FCC 47 part 15 regulation [FCC1].

[4] These read distances are maximum values for general tags and labels. Practical usable values may be lower due to damping by object materials and environmental conditions. A special tag antenna design can help achieve higher values.

[5] The maximum write distance is around 70% of the read distance.

10.4 Air Interface Standards

The SL3ICS1002 G2XL fully supports all parts of the "Specification for RFID Air Interface EPCglobal, EPCTM Radio-Frequency Identity Protocols, Class-1 Generation-2 UHF RFID, Protocol for Communications at 860 MHz – 960 MHz, Version 1.2.0".

11. Physical Layer and Signaling

The interrogator transmits information to the UCode EPC G2 tag by modulating an RF signal in the 860 – 960 MHz frequency range. The tag 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 receives information from the tag by transmitting a continuous-wave RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal for the interrogator. The system is RTF (reader talks first), meaning that a tag modulates its antenna coefficient with an information signal only after being directed to do so by an interrogator.

11.1 Reader to Tag Communication

11.1.1 Physical layer

For interrogator-to-tag link modulation refer to Section 15, Ref. 1, annex H.1 Baseband waveforms, modulated RF, and detected waveforms.

11.1.2 Tag population management layer

An Interrogator manages tag populations using three basic operations:

Select: The operation of choosing a tag population for inventory and access. A Select command may be applied successively to select a particular tag population based on user-specified criteria. This operation is analogous to selecting records from a database.

Inventory: The operation of identifying tags. An Interrogator begins an inventory round by transmitting a Query command in one of four sessions. One or more tags may reply. The interrogator detects a single tag reply and requests the PC, EPC, and CRC-16 from the tag. Inventory comprises multiple commands. An inventory round operates in one and only one session at a time.

Access: The operation of communicating with (reading from and/or writing to) a tag. 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.

11.1.3 Modulation

An interrogator sends information to one or more tags by modulating an RF carrier using double-sideband amplitude shift keying (DSB-ASK), single-sideband amplitude shift keying (SSB-ASK) or phase-reversal amplitude shift keying (PR-ASK) using a pulse-interval encoding (PIE) format. Tags receive their operating energy from this same modulated RF carrier.

Section 15, Ref. 1: Annex H, as well as chapter 6.3.1.2.2.

The SL3 ICS 12 02 G2XL is capable of demodulating all three modulation types.

11.1.4 Data Encoding

The R=>T link is using PIE. For the definition of the therefore relevant reference time interval for interrogator-to-tag signaling (Tari) refer to Section 15, Ref. 1, chapter 6.3.1.2.3. The Tari is specified as the duration of a data-0.

11.1.5 Data rates

Interrogators shall communicate using Tari values between 6.25 µs and 25 µs, inclusive. For interrogator compliance evaluation the preferred Tari values of 6.25 µs, 12.5 µs or 25 µs should be used. For further details refer to Section 15, Ref. 1, chapter 6.3.1.2.4.

11.1.6 RF Envelope for R=>T

A specification of the relevant RF envelope parameters can be found in Section 15, Ref. 1, chapter 6.3.1.2.5.

11.1.7 Interrogator power-up/down waveform

For a specification of the interrogator power-up and power-down RF envelope and waveform parameters refer to Section 15, Ref. 1, chapters 6.3.1.2.6 and 6.3.1.2.7.

11.1.8 Preamble and frame-sync

An interrogator shall begin all R=>T signaling with either a preamble or a frame-sync. A preamble shall precede a Query command and denotes the start of an inventory round. For a definition and explanation of the relevant R=>T preamble and frame-sync refer to Section 15, Ref. 1, chapter 6.3.1.2.8.

11.2 Tag to reader Communication

An interrogator receives information from a tag by transmitting an unmodulated RF carrier and listening for a backscattered reply. The SL3 ICS 12 02 G2XL backscatters by switching the reflection coefficient of its antenna between two states in accordance with the data being sent. For further details refer to Section 15, Ref. 1, chapter 6.3.1.3.

11.2.1 Modulation

The UCode EPC G2 tags communicate information by backscatter-modulating the amplitude and/or phase of the RF carrier. Interrogators shall be capable of demodulating either demodulation type.

11.2.2 Data Encoding

The encoding format, selected in response to interrogator commands, is either FM0 baseband or Miller-modulated subcarrier. The interrogator commands the encoding choice.

11.2.2.1 FM0 baseband

FM0 inverts the baseband phase at every symbol boundary; a data-0 has an additional mid-symbol phase inversion. For FM0 basis functions and generator state diagram, FM0 symbols and sequences and how FM0 transmissions should be terminated refer to Section 15, Ref. 1, chapter 6.3.1.3.2.1.

11.2.2.2 FM0 Preamble

T=>R FM0 signaling begin with one of two defined preambles, depending on the value of the Trext bit specified in the Query command that initiated the inventory round. For further details refer to Section 15, Ref. 1, chapter 6.3.1.3.2.2.

11.2.2.3 Miller-modulated subcarrier

Baseband Miller inverts its phase between two data-0s in sequence. Baseband Miller also places a phase inversion in the middle of a data-1 symbol. For a detailed explanation of the Miller basis functions, generator state diagram, subcarrier sequences and terminating subcarrier transmissions refer to Section 15, Ref. 1, chapter 6.3.1.3.2.3.

11.2.2.4 Miller subcarrier preamble

T=>R subcarrier signaling begins with one of the two defined preambles. The choice depends on the value of the Trext bit specified in the Query command that initiated the inventory round. For further details refer to Section 15, Ref. 1, chapter 6.3.1.3.2.4.

11.2.3 Data Rates

The SL3ICS1002 G2XL IC supports tag to interrogator data rates and link frequencies as specified in Section 15, Ref. 1, chapter 6.3.1.3.3.

11.3 Link Timing

For the interrogator interacting with a UCode EPC G2 tag population exact link and response timing requirements must be fulfilled, which can be found in Section 15, Ref. 1, chapter 6.3.1.5.

11.3.1 Regeneration Time

The regeneration time is the time required if a tag is to demodulate the interrogator signal, measured from the last falling edge of the last bit of the tag response to the first falling edge of the interrogator transmission. This time is referred to as T2 and can vary between 3.0 Tpri and 20 Tpri. For a more detailed description refer to Section 15, Ref. 1, chapter 6.3.1.5.

11.3.2 Start-up Time

For a detailed description refer to Section 15, Ref. 1, chapter 6.3.1.3.4.

11.3.3 Persistence Time

An interrogator chooses one of four sessions and inventories tags within that session (denoted S0, S1, S2, and S3). The interrogator and associated UCode EPC G2 tag population operate in one and only one session for the duration of an inventory round (defined above). For each session, tags maintain a corresponding inventoried flag. Sessions allow tags to keep track of their inventoried status separately for each of four possible time-interleaved inventory processes, using an independent inventoried flag for each process. Two or more interrogators can use sessions to independently inventory a common UCode EPC G2 tag population.

A session flag indicates whether a tag may respond to an interrogator. Tags maintain a separate inventoried flag for each of four sessions; each flag has symmetric A and B values. Within any given session, interrogators typically inventory tags from A to B followed by a re-inventory of tags from B back to A (or vice versa).

Additionally, the SL3 ICS 12 02 G2XL has implemented a selected flag, SL, which an interrogator may assert or deassert using a Select command.

For a description of Inventoried flags S0 – S3 refer to Section 15, Ref. 1 chapter 6.3.2.2 and for a description of the Selected flag refer to Section 15, Ref. 1, chapter 6.3.2.3. For tag flags and respective persistence time refer to Section 15, Ref. 1, table 6.15.

11.4 Bit and Byte Ordering

The transmission order for all R=>T and T=>R communications respects the following conventions:

- within each message, the most-significant word is transmitted first, and
- within each word, the most-significant bit (MSB) is transmitted first,

whereas one word is composed of 16 bits.

To represent memory addresses and mask lengths EBV-8 values are used. An extensible bit vector (EBV) is a data structure with an extensible data range. For a more detailed explanation refer to Section 15, Ref. 1, Annex A.

11.5 Data Integrity

The SL3 ICS 12 02 G2XL ignores invalid commands. In general, “invalid” means a command that (1) is incorrect given the current the SL3 ICS 12 02 G2XL state, (2) is unsupported by the SL3 ICS 12 02 G2XL, (3) has incorrect parameters, (4) has a CRC error, (5) specifies an incorrect session, or (6) is in any other way not recognized or not executable by the SL3 ICS 12 02 G2XL. The actual definition of “invalid” is state-specific and defined, for each tag state, in Section 15, Ref. 1 Annex B and Annex C.

All SL3 ICS 12 02 G2XL backscatter error codes are summarized in Section 15, Ref. 1 Error codes, Annex I. For a detailed description of the individual backscatter error situations which are command specific please refer to the Section 15, Ref. 1 individual command description section 6.3.2.10.

11.6 CRC

A CRC-16 is a cyclic-redundancy check that an interrogator uses when protecting certain R=>T commands, and the SL3 ICS 12 02 G2XL uses when protecting certain backscattered T=>R sequences. To generate a CRC-16 an interrogator or the SL3 ICS 12 02 G2XL first generates the CRC-16 precursor shown in Section 15, Ref. 1 Table 6.14, then take the ones-complement of the generated precursor to form the CRC-16. For a detailed description of the CRC-16 generation and handling rules refer to Section 15, Ref. 1, chapter 6.3.2.1.3.

The CRC-5 is only used to protect the Query command (out of the mandatory command set). It is calculated out of X5 + X3 + 1. For a more detailed CRC-5 description refer to Section 15, Ref. 1, table 6.17.

For exemplary schematic diagrams for CRC-5 and CRC-16 encoder/decoder refer to Section 15, Ref. 1, Annex F.

For a CRC calculation example refer to Section 13.1, Table 23 and Table 24.

12. TAG Selection, Inventory and Access

This section contains all information including commands by which a reader selects, inventories, and accesses a tag population.

An Interrogator manages UCode EPC G2 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 UCode EPC G2 tags. An interrogator begins an inventory round by transmitting a Query command in one of four sessions. One or more tags may reply. The interrogator detects a single tag reply and requests the PC, EPC, and CRC-16 from the tag. 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 15, Ref. 1, Annex E.

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.

12.1 Tag selection, inventory and access

For a detailed description refer to Section 15, Ref. 1, section 6.3.2.

12.1.1 Tag Memory

For the general memory layout according to the standard Section 15, Ref. 1, refer to Figure 6.17. The tag memory is logically subdivided into four distinct banks.

In accordance to the standard Section 15, Ref. 1, section 6.3.2.1. The tag memory of the SL3ICS1002 G2XL is organized in following 4 memory sections:

- Reserved memory
- EPC memory
- TID memory

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

12.1.1.1 Memory Details

Table 7. Memory Details

Address	Type	Content	Initial [1]	Remark
00h – 1Fh	Reserved	kill password: refer to Section 15, Ref. 1, chapter 6.3.2.1.1	all 00h	unlocked memory
20h – 3Fh	Reserved	access password: refer to Section 15, Ref. 1, chapter 6.3.2.1.2	all 00h	unlocked memory
00h – 0Fh	EPC	CRC-16: refer to Section 15, Ref. 1, chapter 6.3.2.1.3		memory mapped calculated CRC
10h – 14h	EPC	Protocol-control bits: refer to Section 15, Ref. 1, chapter 6.3.2.1.4	all 00h	unlocked memory
16h	EPC	XPC indicator: refer to Section 15, Ref. 1, chapter 6.3.2.1.2.2	0b	locked to 0
17h –1Fh	EPC	NSI: refer to Section 15, Ref. 1, chapter 6.3.2.1.4	00h	unlocked memory
20h - 10Fh	EPC	EPC: refer to Section 15, Ref. 1, chapter 6.3.2.1.2.3 or 6.3.2.1.5	undefined [2]	unlocked memory
00h – 07h	TID	allocation class identifier: refer to Section 15, Ref. 1, chapter 6.3.2.1	1110 0010b	locked memory
08h – 13h	TID	tag mask designer identifier: refer to Section 15, Ref. 1, chapter 6.3.2.1	0000 0000 1100b	locked memory
14h – 1Fh	TID	tag model number: refer to Section 15, Ref. 1, chapter 6.3.2.1	TMNR	locked memory
20h – 3Fh	TID	serial number: refer to [Section 15, Ref. 1, chapter 6.3.2.1	SNR	locked memory

[1] This is the initial memory content when delivered by NXP Semiconductors

[2] Contents of this memory area is not defined during chip production

12.1.1.2 Supported EPC types

The EPC types are defined in the EPC Tag Standards document from EPCglobal.

These standards define completely that portion of EPC tag data that is standardized, including how that data is encoded on the EPC tag itself (i.e. the EPC Tag Encodings), as well as how it is encoded for use in the information systems layers of the EPC Systems Network (i.e. the EPC URI or Uniform Resource Identifier Encodings).

The EPC Tag Encodings include a Header field followed by one or more Value Fields. The Header field defines the overall length and format of the Values Fields. The Value Fields contain a unique EPC Identifier and optional Filter Value when the latter is judged to be important to encode on the tag itself.

12.1.2 Sessions and inventoried flags

For a description refer to Section 15, Ref. 1, section 6.3.2.2.

12.1.3 Selected flag

For a description refer to Section 15, Ref. 1, section 6.3.2.3.

12.1.4 Tag States and slot counter

For a description refer to Section 15, Ref. 1, section 6.3.2.4.

12.1.5 Tag State Diagram

For a description refer to Section 15, Ref. 1, section 6.3.2.4 Tag states and slot counter.

- Ready state
- Arbitrate state
- Reply state
- Acknowledged state
- Open state
- Secured state
- Killed state
- Slot counter

Please find the Tag state diagram in Section 15, Ref. 1, figure 6.19. Refer also to Section 15, Ref. 1, Annex B for the associated state-transition tables and to Section 15, Ref. 1, Annex C for the associated command-response tables.

12.2 Managing tag populations

For a detailed description on how to manage an UCode EPC G2 tag population refer to Section 15, Ref. 1, chapter 6.3.2.6.

12.3 Selecting tag populations

For a detailed description of the UCode EPC G2 tag population selection process refer to Section 15, Ref. 1, section 6.3.2.7.

12.4 Inventorying tag populations

For a detailed description on accessing individual tags based on the SL3 ICS 12 02 G2XL refer to Section 15, Ref. 1, section 6.3.2.8.

12.5 Accessing individual tags

For a detailed description on accessing individual tags based on the SL3 ICS 12 02 G2XL refer to Section 15, Ref. 1, section 6.3.2.9.

Please find an example inventory and access of a single UCode EPC G2 tag in Section 15, Ref. 1, Annex E.1.

12.6 Interrogator commands and tag replies

For a detailed description refer to Section 15, Ref. 1, section 6.3.2.11.

12.6.1 Commands

Please find an overview of Interrogator to tag commands in Section 15, Ref. 1, Table 6.16.

Please note that all mandatory commands are implemented on the SL3 ICS 12 02 G2XL according to the standard. Additionally the optional command Access is supported by the SL3 ICS 12 02 G2XL (for details refer to Section 12.10 “Optional Access Command”. Besides also customer commands are implemented on the SL3ICS1002 G2XL (for details refer to Section 12.11 “Custom Commands”.

12.6.2 State Transition Tables

The SL3 ICS 12 02 G2XL responses to interrogator commands are defined by State Annex B transition tables in Section 15, Ref. 1. Following states are implemented on the SL3 ICS 12 02 G2XL:

- Ready, for a description refer to Section 15, Ref. 1, Annex B.1.
- Arbitrate, for a description refer to Section 15, Ref. 1, Annex B.2.
- Reply, for a description refer to Section 15, Ref. 1, Annex B.3.
- Acknowledged, for a description refer to Section 15, Ref. 1, Annex B.4.
- Open, for a description refer to Section 15, Ref. 1, Annex B.5.
- Secured, for a description refer to Section 15, Ref. 1, Annex B.6.
- Killed, for a description refer to Section 15, Ref. 1, Annex B.7.

12.6.3 Command response tables

The SL3 ICS 12 02 G2XL responses to interrogator commands are described in following Annex C sections of Section 15, Ref. 1:

- Power-up, for a description refer to Section 15, Ref. 1, Annex C.1.
- Query, for a description refer to Section 15, Ref. 1, Annex C.2.
- QueryRep, for a description refer to Section 15, Ref. 1, Annex C.3.
- QueryAdjust, for a description refer to Section 15, Ref. 1, Annex C.4.
- ACK, for a description refer to Section 15, Ref. 1, Annex C.5.
- NAK, for a description refer to Section 15, Ref. 1, Annex C.6.
- Req_RN, for a description refer to Section 15, Ref. 1, Annex C.7.
- Select, for a description refer to Section 15, Ref. 1, Annex C.8.
- Read, for a description refer to Section 15, Ref. 1, Annex C.9.
- Write, for a description refer to Section 15, Ref. 1, Annex C.10.
- Kill, for a description refer to Section 15, Ref. 1, Annex C.11.
- Lock, for a description refer to Section 15, Ref. 1, Annex C.12.
- Access, for a description refer to Section 15, Ref. 1, Annex C.13.
- T2 timeout, for a description refer to Section 15, Ref. 1, Annex C.17.
- Invalid command, for a description refer to Section 15, Ref. 1, Annex C.18.

12.6.4 Example data-flow exchange

For data flow-exchange examples refer to Section 15, Ref. 1, Annex K:

- K.1 Overview of the data-flow exchange
- K.2 Tag memory contents and lock-field values
- K.3 Data-flow exchange and command sequence

12.7 Mandatory Select Commands

Select commands select a particular UCode EPC G2 tag population based on user-defined criteria.

12.7.1 Select

For a detailed description of the mandatory Select command refer to Section 15, Ref. 1, section 6.3.2.11.1.1.

12.8 Mandatory Inventory Commands

Inventory commands are used to run the collision arbitration protocol.

12.8.1 Query

For a detailed description of the mandatory Query command refer to Section 15, Ref. 1, section 6.3.2.11.2.1.

12.8.2 QueryAdjust

For a detailed description of the mandatory QueryAdjust command refer to Section 15, Ref. 1, section 6.3.2.11.2.2.

12.8.3 QueryRep

For a detailed description of the mandatory QueryRep command refer to Section 15, Ref. 1, section 6.3.2.11.2.3.

12.8.4 ACK

For a detailed description of the mandatory ACK command refer to Section 15, Ref. 1, section 6.3.2.11.2.4.

12.8.5 NACK

For a detailed description of the mandatory NACK command refer to Section 15, Ref. 1, section 6.3.2.11.2.5.

12.9 Mandatory Access Commands

Access commands are used to read or write data from or to the SL3 ICS 12 02 G2XL memory. For a detailed description of the mandatory Access command refer to Section 15, Ref. 1, section 6.3.2.11.3.

12.9.1 REQ_RN

Access commands are used to read or write data from or to the SL3 ICS 12 02 G2XL memory. For a detailed description of the mandatory Access command refer to Section 15, Ref. 1, section 6.3.2.11.3.1.

12.9.2 READ

For a detailed description of the mandatory Req_RN command refer to Section 15, Ref. 1, section 6.3.2.11.3.2.

12.9.3 WRITE

For a detailed description of the mandatory Write command refer to Section 15, Ref. 1, section 6.3.2.11.3.3.

12.9.4 KILL

For a detailed description of the mandatory Kill command refer to Section 15, Ref. 1, section 6.3.2.11.3.4.

12.9.5 LOCK

For a detailed description of the mandatory Lock command refer to Section 15, Ref. 1, section 6.3.2.11.3.5.

12.10 Optional Access Command

12.10.1 Access

For a detailed description of the optional Access command refer to Section 15, Ref. 1, section 6.3.2.11.3.6.

12.11 Custom Commands

12.11.1 Set Quiet

SetQuiet allows to set the Quiet-EEPROM-System-Bit to 1'b1. If the Quiet-EEPROM Bit is set, the tag shall overrule all memory data and EPC´s CRC16 with Zeros (except the PC and access password). In this mode the commands Read, Write, Kill, Lock, Access, SetQuiet, ChangeEAS, EAS Alarm and Calibrate will be disabled. Only an Anticollision with Select, Query, QueryRep, QueryAdjust, Ack (no truncated reply), NAK, ReqRN will work on the special memory data (all Zeros, except PC/password). Finally the ResetQuiet will work to reset the Quiet mode by resetting the Quiet-EEPROM-System-Bit and Quiet mode.

TAG executes SetQuiet only from the secured state.

TAG´s whose access password is zero ignore the command.

After issuing the SetQuiet an Interrogator shall transmit CW for the lesser of TREPLY or 20ms, where TREPLY is the time between the Interrogator's Set Quiet command and the Tag's backscattered reply. An Interrogator may observe several possible outcomes from a SetQuiet, depending on the success or failure of the Tag's SetQuiet operation:

- The SetQuiet succeeds: After completing the SetQuiet the Tag shall backscatter the reply shown in Table 2.3 comprising a header (a 0-bit), the Tag's handle, and a CRC-16 calculated over the 0-bit and handle. Immediately after this reply the Tag shall render itself to this (Quiet-) mode. If the Interrogator observes this reply within 20 ms then the SetQuiet completed successfully.
- The Tag encounters an error: The Tag shall backscatter an error code during the CW period rather than the reply shown in the EPC GLOBAL Spec (see Annex I for error-code definitions and for the reply format).
- The SetQuiet does not succeed: If the Interrogator does not observe a reply within 20ms then the SetQuiet did not complete successfully. The Interrogator may issue a Req_RN command (containing the Tag's handle) to verify that the Tag is still in the Interrogator's field, and may reinitiate the Set Quiet command.

A SetQuiet shall be prepended with a frame-sync (see EPC GLOBAL Spec).

Upon receiving a valid SetQuiet command sequence a Tag shall render itself quiet. The Tag's reply to the SetQuiet command shall use the extended preamble shown in EPC GLOBAL Spec (Figure 6.11 or Figure 6.15), as appropriate (i.e. a Tag shall reply as if TRext=1 regardless of the TRext value in the Query that initiated the round.

Table 8. Set Quiet command

	Command	RN	CRC-16
# of bits	16	16	16
description	11100000 00000001	handle	

Table 9. Tag reply to a successful set quiet procedure

	Header	RN	CRC-16
# of bits	1	16	16
description	0	handle	

Table 10. SetQuiet command-response table

Starting State	Condition	Response	Next State
ready	all	–	ready
arbitrate, reply, acknowledged	all	–	arbitrate
open	all	-	open
secured	valid handle & invalid access password	–	arbitrate
	valid handle & valid nonzero access password	Backscatter handle, when done	secured
	inalid handle	–	secured
killed	all	–	killed

[1] See also ??

12.11.2 Reset quiet

ResetQuiet allows an Interrogator to resets the QUIET-EEPROM-System-Bit and Quiet mode.If the Quiet-EEPROM Bit is reset, the tag shall behave as described in the EPCglobal Spec. TAG execute ResetQuiet from the open or secured states.

ResetQuiet has the following field:

- Password : 32 bit Access-Password exored with 2 times current RN16

The ResetQuiet command also includes the Tag's handle and a CRC-16. The CRC-16 is calculated over the first command-code bit to the last handle bit.

If a TAG in the open or secured states receives a ResetQuiet with a valid CRC-16 and a valid handle but an incorrect access password, it shall not reply and transit to the arbitrate state.

If a TAG in the open or secured states receives a ResetQuiet with a valid CRC-16 and a valid handle but the QUIET-EEPROM-System-Bit is reset, it shall not write to the QUIET-EEPROM-System-Bit but backscatter the reply shown in Table 3.2

If a Tag in the open or secured states receives a ResetQuiet with a valid CRC-16 but an invalid handle, or it receives a ResetQuiet before which the immediately preceding command was not a Req_RN, it shall ignore the ResetQuiet and remain in its current state.

A ResetQuiet shall be prepended with a frame-sync.

After issuing a ResetQuiet an Interrogator shall transmit CW for the lesser of TREPLY or 20ms, where TREPLY is the time between the Interrogator's ResetQuiet command and the Tag's backscattered reply. An Interrogator may observe several possible outcomes from a ResetQuiet, depending on the success or failure of the Tag's memory-write operation:

- The Write succeeds: After completing the ResetQuiet a Tag shall backscatter the reply shown in Table 3.2 comprising a header (a 0-bit), the Tag's handle, and a CRC-16 calculated over the 0-bit and handle. If the Interrogator observes this reply within 20 ms then the ResetQuiet completed successfully.

- The Tag encounters an error: The Tag shall backscatter an error code during the CW period rather than the reply shown in Table 3.2 (see EPC GLOBAL Spec for error-code definitions and for the reply format).
- The Write does not succeed: If the Interrogator does not observe a reply within 20ms then the ResetQuiet did not complete successfully. The Interrogator may issue a Req_RN command (containing the Tag's handle) to verify that the Tag is still in the Interrogator's field, and may reissue the ResetQuiet command.

The Tag's reply to the ResetQuiet command shall use the extended preamble shown in GLOBAL Spec (Figure 6.11 or Figure 6.15), as appropriate (i.e. a Tag shall reply as if TRext=1 regardless of the TRext value in the Query that initiated the round.

Table 11. Reset quiet command

	Command	Password	RN	CRC-16
# of bits	16	32	16	16
description	11100000 00000010	(access password) ⊗ 2*RN16	handle	

Table 12. Tag reply to a successful ResetQuiet command

	Header	RN	CRC-16
# of bits	1	16	16
description	0	handle	

Table 13. ResetQuiet command-response table

Starting State	Condition	Response	Next State
ready	all	–	ready
arbitrate, reply, acknowledged	all	–	arbitrate
open	Quiet EE sytem bit is set, valid handle & valid access password	Backscatter handle, when done	open
	Quiet EE sytem bit is set, valid handle & invalid access password	–	arbitrate
	Quiet EE sytem bit is set, inalid handle	–	open
	Quiet EE sytem bit is reset	–	open
secured	Quiet EE sytem bit is set, valid handle & valid access password	Backscatter handle, when done	secured
	Quiet EE sytem bit is set, valid handle & invalid access password	–	arbitrate
	Quiet EE sytem bit is set, inalid handle	–	secured
	Quiet EE sytem bit is reset	–	secured
killed	all	–	killed

12.11.3 Change EAS

ChangeEAS allows an Interrogator to sets or resets the EAS-EEPROM-System-Bit. TAG execute ChangeEas from the secured state. TAG´s whose access password is zero ignore the command.

ChangeEas has the following fields:

- ChangeEas specifies whether sets or resets the EAS-EEPROM-System-Bit

The ChangeEas command also includes the Tag's handle and a CRC-16. The CRC-16 is calculated over the first command-code bit to the last handle bit.

If a Tag in the secured states receives a ChangeEas with a valid CRC-16 but an invalid handle, it shall ignore the ChangeEas and remain in its current state.

A ChangeEas shall be prepended with a frame-sync.

After issuing a ChangeEas an Interrogator shall transmit CW for the lesser of TREPLY or 20ms, where TREPLY is the time between the Interrogator's ChangeEas command and the Tag's backscattered reply. An Interrogator may observe several possible outcomes from a ChangeEas, depending on the success or failure of the Tag's memory-write operation:

- The Write succeeds: After completing the ChangeEas a Tag shall backscatter the reply shown in Table 4.2 comprising a header (a 0-bit), the Tag's handle, and a CRC-16 calculated over the 0-bit and handle. If the Interrogator observes this reply within 20 ms then the ChangeEas completed successfully.
- The Tag encounters an error: The Tag shall backscatter an error code during the CW period rather than the reply shown in Table 4.2 (see EPC GLOBAL Spec for error-code definitions and for the reply format).
- The Write does not succeed: If the Interrogator does not observe a reply within 20ms then the ChangeEas did not complete successfully. The Interrogator may issue a Req_RN command (containing the Tag's handle) to verify that the Tag is still in the Interrogator's field, and may reissue the ChangeEas command.

Upon receiving a valid ChangeEas command a Tag shall perform the commanded set/reset operation of the EAS-EEPROM-System-Bit.

If EEPROM-System-Bit will be set, EAS_Alarm function will be active after the next power up.

If EEPROM-System-Bit will be reset, EAS_Alarm function will be inactive after the next power up.

The Tag's reply to a successful ChangeEas shall use the extended preamble, as appropriate (i.e. a Tag shall reply as if TRext=1 regardless of the TRext value in the Query that initiated the round.

Table 14. ChangeEas command

	Command	ChangeEas	RN	CRC-16
# of bits	16	1	16	16
description	11100000 00000011		handle	

Table 15. Tag reply to a successful ChangeEas command

	Header	RN	CRC-16
# of bits	1	16	16
description	0	handle	

Table 16. ChangeEas command-response table

Starting State	Condition	Response	Next State
ready	all	–	ready
arbitrate, reply, acknowledged	all	–	arbitrate
open	all	–	open
secured	valid handle	Backscatter handle, when done	secured
	inalid handle	–	secured
killed	all	–	killed
Starting State	Condition	Response	Next State

12.11.4 EAS Alarm

EasAlarm allows the reader to backscatter an ALARM code. If the EAS-EEPROM-System-Bit is set, the tag shall backscatters the EAS Code (crc5 MSB) If the EAS-EEPROM-Bit is reset the tag ignores this command. TAG execute EASAlarm only from the ready state.
To enable/disable this command initialise the enable_eas bit in EEPROM!

EasAlarm includes the following fields:

- DR (TRcal divide ratio) sets the T=>R link frequency as described in

  EPC GLOBAL Spec ,6.3.1.2.8 and Table 6.11.
- M (cycles per symbol) sets the T=>R data rate and modulation format as shown in

  EPC GLOBAL Spec ,Table 6.12.
- TRext chooses whether the T=>R preamble is prepended with a pilot tone as described in

  EPC GLOBAL Spec 6.3.1.3.2.2 and 6.3.1.3.2.4.

Interrogators shall prepend a EasAlarm with a preamble (see EPC GLOBAL Spec , 6.3.1.2.8).

Upon receiving a EasAlarm,first init the CRC5 with b01001. While sending the EAS Code (CRC5 MSB) the CRC-5 is calculated by input of allways 1 over 64 bits.

Table 17. EAS alarm command

	Command	Inv_Command	DR	M	Trext	CRC-16
# of bits	16	16	1	2	1	16
description	11100000 **00000100**	00011111 11111011	0: DR=8 1: DR=64/3	00: M=1 01: M=2 10: M=4 11: M=8	0: No pilot tone 1: Use pilot tone	

Table 18. Tag reply to a successful eas alarm command

	Header	EAS Code
# of bits	1	64
description	0	CRC5(MSB)

Table 19. EasAlarm command-response table

Starting State	Condition	Response	Next State
ready	EAS-EEPROM-System-Bit is set and nonzero access pwd	Backscatter Alarm code	ready
arbitrate, reply, acknowledged	EAS-EEPROM-System-Bit is set and nonzero access pwd	–	arbitrate
open	EAS-EEPROM-System-Bit is set and nonzero access pwd		open
secured	EAS-EEPROM-System-Bit is set and nonzero access pwd		secured
killed	EAS-EEPROM-System-Bit is set and nonzero access pwd	–	killed

[1] If EAS EEPROM system bit is reset, ignore command

12.11.5 Calibrate

Calibrate allows the tag to backscatter continuously memory data, which is essential for frequency spectrum measurement. TAG execute Calibrate from the secured states.

TAG´s whose access password is zero ignore the command.

The Calibrate command also includes the Tag’s CRC-16. The CRC-16 is calculated over the whole command-code.

A Calibrate shall be prepended with a frame-sync.

Table 20. Calibrate command

	Command	RN16	CRC-16
# of bits	16	16	16
description	11100000 00000101	handle	

Table 21. Tag reply to a successful Calibrate command

	Header	Infinite repeat
# of bits	1	512(looped)
description	0	memory data

Table 22. Calibrate command-response table

Starting State	Condition	Response	Next State
ready	all	–	ready
arbitrate, reply, acknowledged	all	–	arbitrate
secured	nonzero access password	Backscatter infinite	_
	access password is zero	–	secured
killed	all	–	killed

13. Support information

13.1 CRC Calculation EXAMPLE

old RN = 3D5Bh

Table 23. Practical example of CRC calculation for a 'Req_RN' command by the reader

CRC Calculated @ Reader							
		F	**F**	**F**	**F**		
Cmd Code for Req_RN	1	F	F	F	E		
	1	F	F	F	C		
	0	E	F	D	9		
	0	C	F	9	3		
	0	8	F	0	7		
	0	0	E	2	F		
	0	1	C	5	E		
	1	**2**	**8**	**9**	**9**		
First Byte of RN	0	5	1	3	A		
	0	A	2	7	4		
	1	4	4	E	8		
	1	9	9	F	1		
	1	3	3	E	2		
	1	7	7	E	5		
	0	E	F	C	A		
	1	**D**	**F**	**9**	**4**		
Second Byte of RN	0	A	F	0	9		
	1	5	E	1	2		
	0	B	C	2	4		
	1	7	8	4	8		
	1	E	0	B	1		
	0	D	1	4	3		
	1	A	2	8	6		
	1	**4**	**5**	**0**	**C**	**-> ones complement:**	**B A F 3**
=> Command-Sequence: C1 3D 5B BA F3 hex							

Table 24. Practical example of CRC calculation for a 'Req_RN' command by the reader

CRC Calculated @ Tag					
		F	**F**	**F**	**F**
Cmd Code for Req_RN	1	F	F	F	E
	1	F	F	F	C
	0	E	F	D	9
	0	C	F	9	3
	0	8	F	0	7
	0	0	E	2	F
	0	1	C	5	E
	1	**2**	**8**	**9**	**9**
First Byte of RN	0	5	1	3	A
	0	A	2	7	4
	1	4	4	E	8
	1	9	9	F	1
	1	3	3	E	2
	1	7	7	E	5
	0	E	F	C	A
	1	**D**	**F**	**9**	**4**
Second Byte of RN	0	A	F	0	9
	1	5	E	1	2
	0	B	C	2	4
	1	7	8	4	8
	1	E	0	B	1
	0	D	1	4	3
	1	A	2	8	6
	1	**4**	**5**	**0**	**C**
First Byte of CRC	1	9	A	3	9
	0	2	4	5	3
	1	5	8	8	7
	1	A	1	2	F
	1	4	2	5	E
	0	8	4	B	C
	1	0	9	7	8
	0	**1**	**2**	**F**	**0**
Second Byte of CRC	1	3	5	C	1
	1	7	B	A	3
	1	E	7	6	7
	1	C	E	C	E
	0	8	D	B	D
	0	0	B	5	B
	1	0	6	9	7
	1	**1**	**D**	**0**	**F** -> Residue OK

14. Abbreviations

Table 25. Abbreviations

Acronym	Description
CRC	Cyclic redundancy check
CW	continuos wave
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
G2	Generation 2
IC	Integrated Circuit
LSB	Least Significant Byte/bit
MSB	Most Significant Byte/bit
NRZ	Non-return to zero coding
RF	Radio Frequency
RTF	Reader Talks First
Tari	Type A Reference Interval (ISO 18000-6)
UHF	Ultra High Frequency
xx_{hex}	Value in hexadecimal notation

15. References

The following referenced documents are indispensable to the application of this specification. For dated references, only the edition cited applies. For undated references, the latest edition (including any amendments) applies.

[1] EPCglobal: EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz – 960 MHz, Version 1.2.0 Ref. 1

[2] EPCglobal: EPC Tag Data Standards

[3] EPCglobal (2004): FMCG RFID Physical Requirements Document (draft)

[4] EPCglobal (2004): Class-1 Generation-2 UHF RFID Implementation Reference (draft)

[5] European Telecommunications Standards Institute (ETSI), EN 302 208: Electromagnetic compatibility and radio spectrum matters (ERM) – Radio-frequency identification equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W, Part 1 – Technical characteristics and test methods

[6] European Telecommunications Standards Institute (ETSI), EN 302 208: Electromagnetic compatibility and radio spectrum matters (ERM) – Radio-frequency identification equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W, Part 2 – Harmonized EN under article 3.2 of the R&TTE directive

[7] [CEPT1]: CEPT REC 70-03 Annex 1

[8] [ETSI1]: ETSI EN 330 220-1, 2

[9] [ETSI3]: ETSI EN 302 208-1, 2 V<1.1.1> (2004-09-Electromagnetic compatibility And Radio spectrum Matters (ERM) Radio Frequency Identification Equipment operating in the band 865 - MHz to 868 MHz with power levels up to 2 W Part 1: Technical characteristics and test methods.

[10] [FCC1]: FCC 47 Part 15 Section 247

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

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

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

[14] 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

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

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

[17] ISO/IEC 18000-6: Information technology automatic identification and data capture techniques — Radio frequency identification for item management air interface — Part 6: Parameters for air interface communications at 860–960 MHz

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

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

16. Revision history

Table 26. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
139110	10 September 2007	Objective data sheet		new
139111	10 October 2007	Objective data sheet	Removed double section Change EAS, EAS Alarm, Chapter 12.11.7 changed “Reader” to “Tag”	new

17. Legal information

17.1 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.

17.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

17.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of a NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer’s own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

17.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

UCode - is a trademark of NXP B.V.

18. Contact information

For additional information, please visit: **http://www.nxp.com**

For sales office addresses, send an email to: **sales.addresses@www.nxp.com**

19. Tables

20. Figures

21. Contents

continued >>

Date of release: 10 October 2007
Document identifier: 139110

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: sales.addresses@www.nxp.com

Date of release: 10 October 2007

Document identifier: 139110