FAQs UCODE G2X

Frequently asked customer questions

Rev. 1.1 — 28th April 2009 | Application note

Document information

Info	Content
Keywords	UCODE G2XM, UCODE G2XL, RFID
Abstract	This document is a summary of answers to frequently asked customer questions. General Note: If question and answers refer to UCODE G2XM and UCODE G2XL the two ICs are denoted as “UCODE G2X”.

founded by Philips

Revision history

Rev	Date	Description
1.1	20090428	Update Chapters 4.10, 4.13, 5.17, 6.8, 6.9
1.0	20081111	First, initial release. Author : Barbara Ribic, Customer Application Support

Contact information

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1. Index of Questions

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2. Introduction

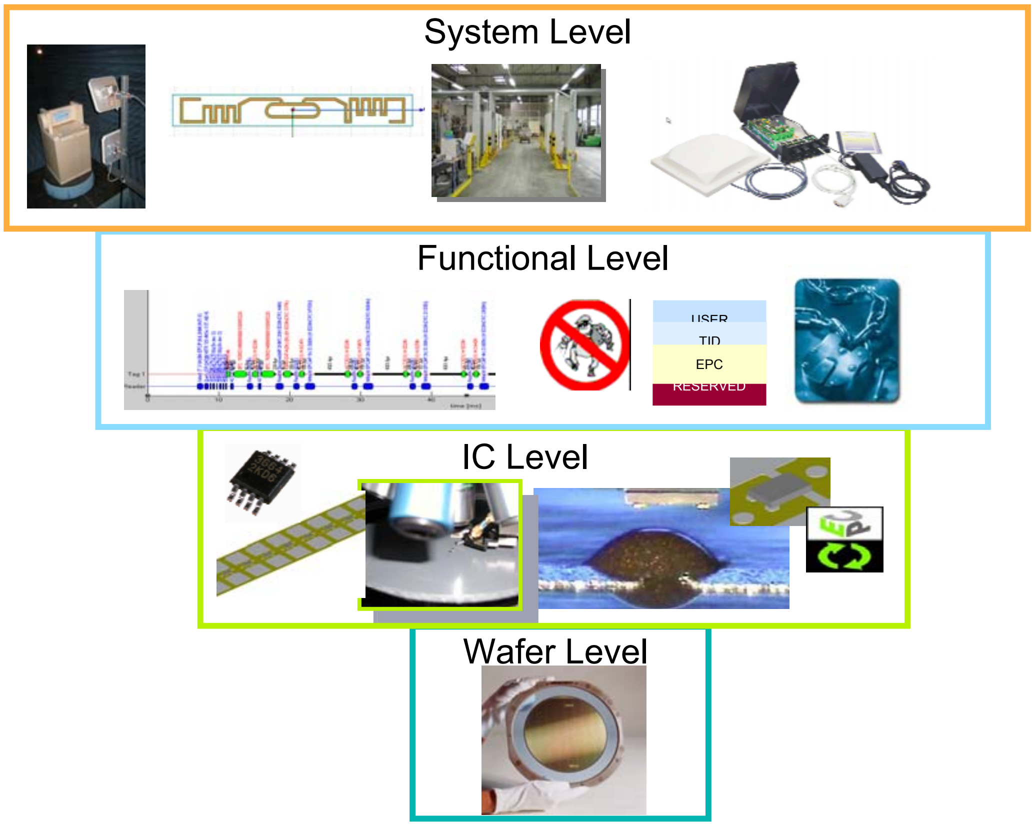


Fig 1. Structure of the UCODE FAQ document

This document is structured in 4 levels:

- Wafer Level: This chapter refers to wafer handling and wafer storage. Mainly relevant for label/inlay manufacturers.
- IC Level: Contains information such as physical limits of the IC, IC characterization, delivery options and standardization. Mainly relevant for label/inlay manufacturers, end customers;
- Functional Level: Answers questions related to memory , commands (read, write EAS) and protocol (eg write speed). Mainly relevant for end customers, system integrators.
- System Level: Covers topics such as readers supporting UCODE G2X, label antenna designs, programming application related data into the memory. Mainly relevant for end customers, system integrators.

3. Wafer Level

3.1 How long can customers store the wafers?

Sawn wafer must be kept in their original packing whilst in storage.

Storage conditions:

• Temperature:20 °C ± 5 °C

• Climate:40% to 60% r.h. or dried N2 atmosphere

• Duration of storage: max. 6 month

The 6 months storage duration start after the UV exposure of the wafer. Year and calendar week are noted in the “datecode” field on the paper label on the wafer box.

These conditions apply only for the wafer. The boundary conditions of the bare die are specified in the product data sheet.

3.2 Can assembly machines handle the small die size?

Two assembly machine manufacturers guarantee the correct handling of the UCODE G2X dies.

For Mühlbauer machines there is an upgrade toolkit available, which enables the small die handling.

Find below the statements of assembly machine manufacturers:

Conclusion

The evaluation was in general very straight forward and successful. It could be verified that flipped bumped dies of size 0.4 x 0.4 x 0.15 mm can be picked and bonded reliably and stable over a longer period of time at full production speed.

Fig 2. Confirmation small die handling from Datacon

As Mühlbauer is a very future oriented turn key equipment solution provider for the RFID industry with a complete equipment portfolio for strap- and inlay production as well as label converting (see attached schematics), we want to herewith officially announce the capability to process the future NXP chip generations on Mühlbauer RFID flip chip equipment:

Fig 3. Confirmation small die handling from Mühlbauer

4. IC Level

4.1 What effects does UV radiation have on the IC?

Semiconductors in general are susceptible to light exposure. Using a label with the active side (bump-side) of the IC exposed to direct sunlight may reduce the performance of a label.

Important note:

There will be no loss of memory content and no reduction of the IC lifetime due to daylight exposure.

4.2 What can a label manufacturer do to decrease the influence of UV radiation in the end application?

→ Back side of the chip should face the light source;

Light exposure of the non-active side of the chip has less impact on the

sensitivity than the exposure of the bumped side of the chip.

→ Label graphics to cover active chip area;

→ Larger landing pads to cover more area of active (bumped) chip side.

4.3 How do X-Rays and Gamma-Rays influence the IC and what does it mean for the end application?

Typical applications for X-Rays are airport luggage scanners and devices for medical diagnosis. In general the intensity of X-Rays in these applications is below 20 Gray.

This does not have any performance decreasing or malfunctioning effect on the UCODE G2X IC.

4.4 Would the UCODE G2X survive a reflow process?

The UCODE G2X ICs are specified for a storage temperature up to 125° C. Although it is out of the specification, we do not expect a negative impact after a short time temperature exposure of 250°. For reflow soldering a dedicated package is available.

4.5 Can the TSSOP8 package be used for reflow soldering? What are the limitations?

The TSSOP8 package is designed for SMT and the reflow soldering process. The package is qualified according JEDEC, hence the following application note applies:[3]

4.6 What kind of delivery types exist of the UCODE G2X?

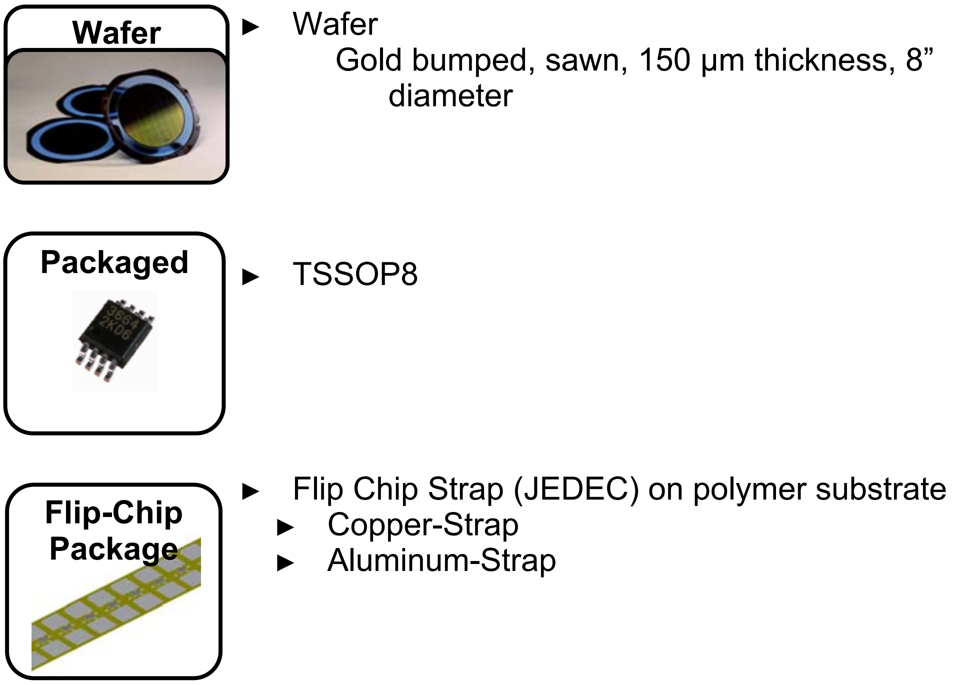


Fig 4. Delivery Options of UCODE G2X

4.7 Are special delivery options possible?

Special delivery forms of wafers, such as unbumped, unsawn, thinned to 75µm are technically possible. Please contact your NXP Sales person in order to discuss details.

4.8 Which pins are used for antenna connection with the TSSOP8 Package?

Pin 1 and Pin 8 of the TSSOP8 package are internally connected to the antenna pads (see Fig 5). Details can be found in the product data sheet.

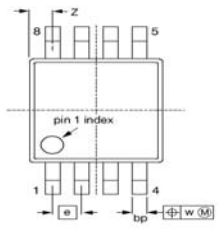


Fig 5. TSSOP8 Pins

4.9 Which pins can be used to attach the antenna (bare die assembly), which pins shall not be connected?

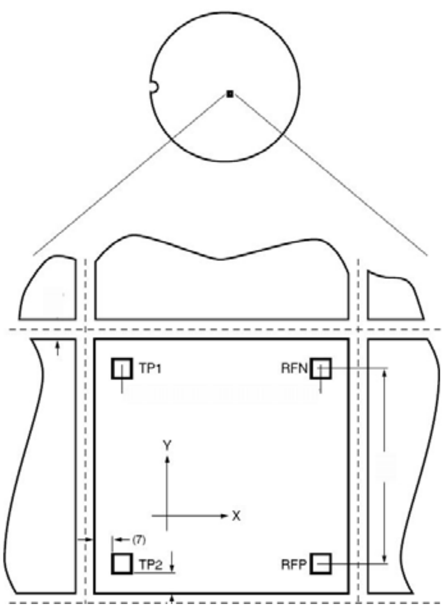


Fig 6. 4 Pins of UCODE G2X

RFN/RFP: These pins are used for attaching the antenna. The impedance will be unchanged, as described in the datasheet. No change if you connect a loop antenna.

Additional connections:

TP1/TP2 : Can be connected without side effects.

RFN/TP1: This is not evaluated in our tests. However, we do expect that it works, and we do not expect a change in impedance or performance.

RFN/TP1/TP2: This is not evaluated in our tests. However, we do expect that it works, and we do not expect a change in impedance or performance.

RFP/TP2: This connection results in an impedance change. The value is not specified and unknown. We do not recommend connecting these pins.

RFP/TP1/TP2: This connection results in an impedance change. The value is not specified and unknown by us. We do not recommend connecting these pins.

4.10 How are P_{min} value and chip impedance - as defined in the datasheet - measured?

Step 1: Determine the minimum chip operating power under 50 Ohm conditions ($P_{min\ chip\ @50\ Ohm}$):

In order to measure the $P_{min\ chip\ @50\ Ohm}$ of the bare die, the IC pads are contacted with the needles of a pico probe station in a calibrated measurement setup.

Measurement setup (see Fig 7):

An arbitrary waveform generator (AWG) modulates a QUERY command upon the RF carrier (output of the signal generator SG). The IC will answer with a 16-bit random number, according to the EPC global specification. The IC answer is detected by an UHF probe (signal detector).Then the transmitted power of the SG is reduced until the IC stops answering. $P_{min\ chip\ @50\ Ohm}$ is the lowest power level, at which the IC is still responding.

Step 2: Determine IC Impedance.

Measurement setup (Fig 8):

The Network analyzer (50 Ohms) is connected to the IC (bare die).

The power level is set to $P_{min\ chip\ @50\ Ohm}$ at the chip inputs. At this power level the impedance Z_{Chip} is measured.

Step 3: Determine $P_{min\ chip}$

The minimum power level at the IC can be calculated via the mismatch loss:

$$P_{\min} = P_{\min chip @ 50 Ohm} (1 - \Gamma^2)$$

$$\Gamma = \frac{Z_{chip} - Z_0}{Z_{chip} + Z_0}$$

Γ ……..reflection coefficient [ ]

$Z_0 = 50\ \Omega$

$(1-\Gamma^2)$…mismatch loss [ ]

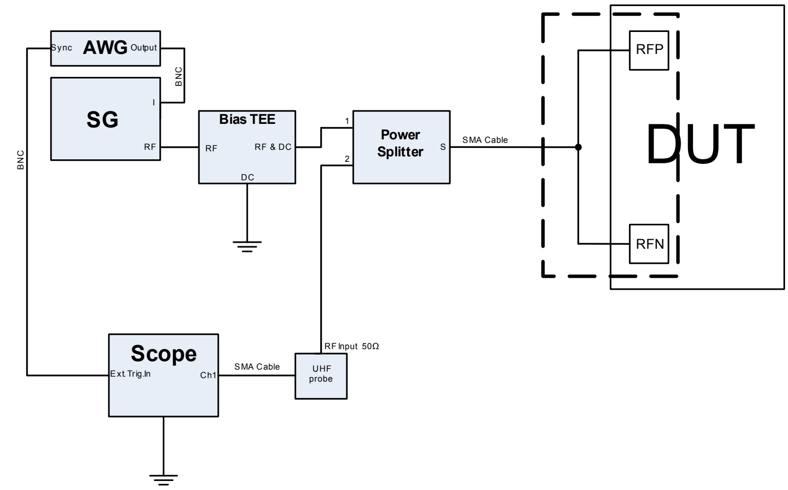


Fig 7. Measurement Setup for $P_{min\ chip\ @50\ Ohm}$

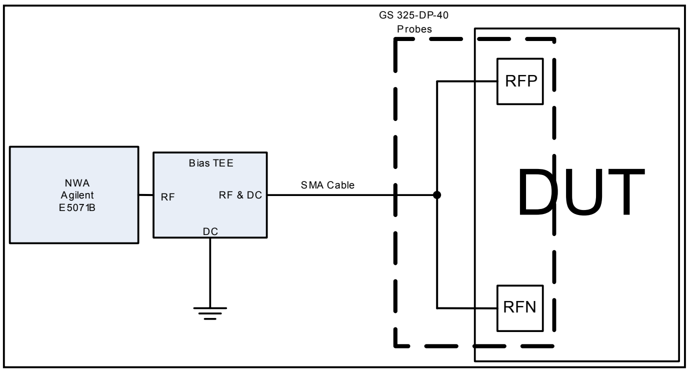


Fig 8. Measurement setup for P_{min} and impedance.

4.11 Which standards are the UCODE G2XM and the UCODE G2XL compliant to?

UCODE G2XL and UCODE G2XM have passed the *Conformity* and *Interoperability* tests at EPCglobal.

Both ICs are certified according to UHF EPCglobal Gen2 standard V1.0.9, and are compliant to EPCglobal Gen2 standard V1.1.0.

→Conformity: compliant to EPCglobal Generation 2 standard V1.0.9

→Interoperability: certifies that UCODE G2X works with EPCglobal certified infrastructure.

4.12 Are the UCODE G2X ICs also certified for ISO 18000-6C?

The UCODE G2X ICs are not ISO certified. However, they are compliant to ISO 18000-6C. The differences between the EPC C1G2 specification and the ISO 18000 6C standard are minor. It concerns denotations (as for example the TID is called UID in the ISO standard) and not the communication via the air interface itself.

An EPC compliant chip can be identified as the TID starts with “$E2_h$”, while an ISO chip will have the value “$E0_h$” as first part of the UID.

4.13 What happens when the data retention of 50 years is elapsed?

The guaranteed data endurance for the G2X is 50 years. The endurance is actually not limited by the used memory technology but by the product qualification process. For this reason a much longer memory endurance (or data retention time) can actually be expected.

In case of “expiry” there would be no communication at all possible with the IC anymore.

4.14 What happens if the entire IC memory is erased, eg by targeted UV radiation exposure?

In this case also internal bit would be erased and the IC would transit into the “killed” state. No communication will be possible anymore.

5. Functional Level

5.1 What is the difference between UCODE G2XM and UCODE G2XL in terms of performance and functionality?

The only difference between UCODE G2XM and UCODE G2XL is the user memory. According to EPC global, user memory is optional. UCODE G2XM has 512 bits of pure user memory, while the UCODE G2XL has no user memory.

Both ICs have the same functionality and the same commands, including custom commands.

The performance is also equal. Pmin and impedance are the same, which results in the same read range in case the same antenna design and assembly process is used.

5.2 How is the memory structure of the UCODE G2X ICs?

Table 1 shows the memory map of UCODE G2XM. It consists of 4 memory banks, of which 3 are mandatory.

The reserved memory (bank 00) contains the 32 bit kill password and the 32 bit access password. At IC delivery the passwords have a default value of zero. In order to kill a label, the kill password must be set to a non-zero value prior to performing the kill command.

The EPC memory (bank 01) has a size of 240 bits, which can be programmed by the end user. 96 bits are mandatory by EPC global. The 240 bits extended EPC are an extra feature of both UCODE G2X ICs. The ICs are delivered by NXP with a default 96 bit EPC number:

UCODE G2XM: 3005 FB63 AC1F 3681 EC88 0468

UCODE G2XL: 3005 FB63 AC1F 3841 EC88 0467

The TID memory (bank 10) contains 64 bit including a 32 bit unique serial number (Tag ID), which is written and locked by NXP after manufacturing and testing of the wafer.

The user memory (bank 11) is optional. The UCODE G2XM has 512 bit of user memory, which is delivered with a default value of zero. The UCODE G2XL has no user memory.

Table 1. Memory Map UCODE G2XM

Bank	Memory address	Type	Content	Initial	Remark
Bank 00	00h-1Fh	Reserved	Kill password	All 00h	Unlocked
	20h – 3Fh	Reserved	Access password	All 00h	Unlocked
Bank 01	00h – 0Fh	EPC	CRC 16		Memory mapped calculated CRC
	10h – 14h	EPC	Backscatter Length	00110b	unlocked
	15h	EPC	Reserved for future use	0b	unlocked
	16h	EPC	Reserved for future use	0b	Hardwired to 0
	17h –1Fh	EPC	Numbering system indicator	00h	unlocked
	20h - 10Fh	EPC	EPC	[1]	unlocked
Bank 10	00h-07h	TID	Allocation class identifier	1110 0010b	locked
	08h-13h	TID	Tag mask designer identifier	0000 0000 0110b	locked
	14h-1Fh	TID	Tag model number	TMNR	locked
	20h-3Fh	TID	Serial number	SNR	locked
Bank 11	00h-1FFh	User	User memory	undefined	unlocked
[1]	UCODE G2XM: 3005 FB63 AC1F 3681 EC88 0468				
	UCODE G2XL: 3005 FB63 AC1F 3841 EC88 0467				

5.3 Is the TID really unique and locked?

Yes, the G2X TID is unique and permanently locked during chip manufacturing. Fig 9 shows the structure of the TID.

It contains an 8-bit ISO 15963 allocation class identifier (11100010b for EPCglobal) [00h-07h], a 12-bit Tag mask-designer identifier [08h-13h], and a 12-bit Tag model number [14h to 1Fh] and a 32 bit serial number.

The 32 bit serial number is not mandatory, and is a special feature of the UCODE G2X ICs.

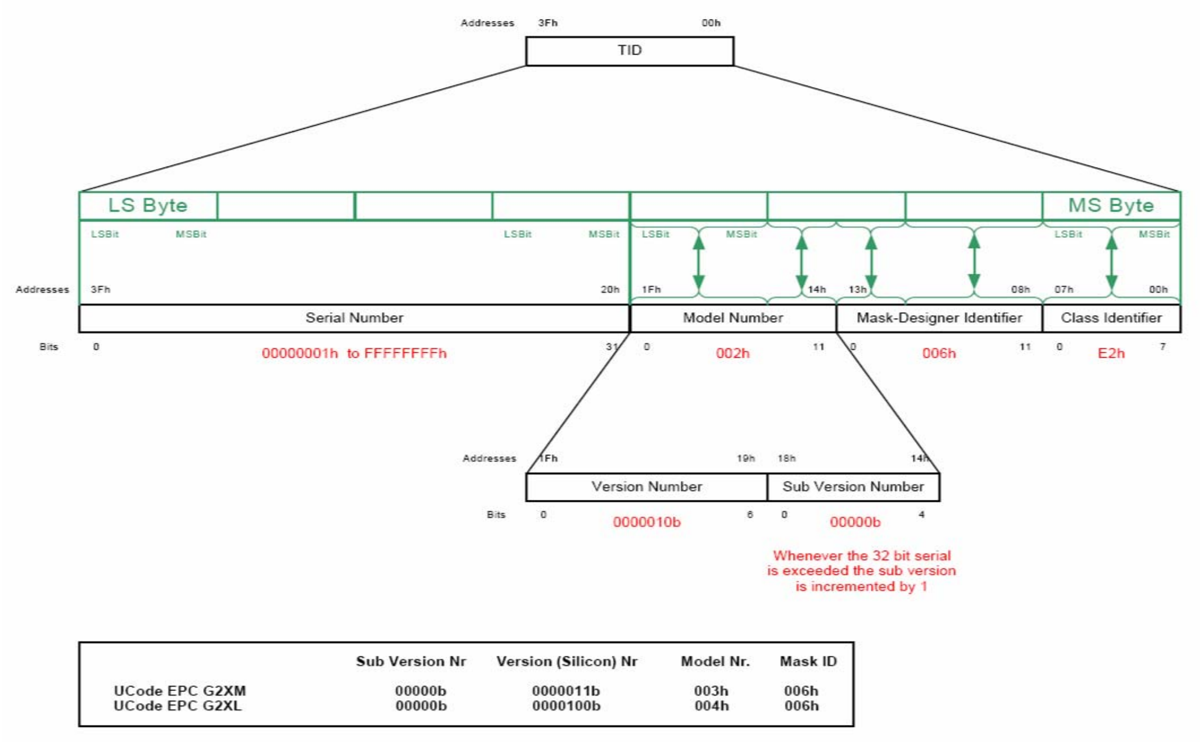


Fig 9. Structure of the UCODE TID

5.4 Can NXP deliver the IC preprogrammed with a customized EPC and/or a customized TID?

Yes, based on volume commitment a customized preprogrammation is possible. However, the TID value cannot be completely changed. Class Identifier and mask-designer identifier are fixed for compliance reasons. The model number could be customized.

Please contact your NXP sales person for further discussions.

5.5 How can I make the UCODE G2X answer with 240 bit EPC during the inventory instead of the default 96 bit?

By default the value of the PC field is 3000 hex / **0011 0**000 0000 0000b, which makes the tag backscatter 96 bit EPC number.

The bit length of the backscatter is defined by the first 5 bits : 0011 0 corresponding to the decimal value of 6. This means the backscatter length is 6 words (= 6*16 = 96 bits)

The PC field is located at the address 10-14hex of the EPC memory bank.

For making the tag backscatter 240 bits, write following value in the PC (Protocol Control) field:

Hexadecimal: 7800hex

Binary **: 0111 1**000 0000 0000b

0111 1 = 15 dec --> 15*16 bits = 240

5.6 What is the write speed of the UCODE G2X?

The physical writing time for one memory block (16 bits) is typically 6 ms. This is measured from the ending of the write command (reader) until the beginning of the IC reply to a successful write.

The reader may wait up to 20 ms for the tag reply to a successful write command, which ensures the reader that the data has been written correctly.

Locking a memory bank takes typically 9 ms.

5.7 How long does it take to write the 512bit user memory?

The EPC C1 Gen2 command sequence for a write operation is the following:

Step 1: Inventory:

(Reader)Query

(Tag)RN16

(Reader)ACK

(Tag)PC, EPC

Time estimation: approximately 5 ms. The total time for inventory depends on the choice of the Q value (Query Command), the choice of link frequencies, and the reader itself.

Step 2: Write (16 bit):

(Reader) ReqRN

(Tag) RN16

(Reader) Write (containing address where to write, EPC/Usermemory/Reservedmemory)

(Tag) IC writing time (6 ms)

(Tag) RN16

(Reader) Time till Reader acknowledges the RN16 (~50us - max 20ms)

Time estimation: approximately 15 ms.

It strongly depends on the reader, since the time between the ICs RN16 and the reader Acknowledge can take between 50 us and 20 ms!

After the inventory (step 1), the write cycle (step 2) is repeated until 512 bits are fully written.

For the writing of 512 bit user memory the calculated writing time is as follows:

5 ms (inventory) + (32*15ms) = 485 ms

Example: Measured writing and reading times of Sirit IN510:

Test	**[s]**
Write 240 bit EPC ID	0.28
Write 512 bit User Memory	0.43
Read 240 bit EPC ID	0.12
Read 512 bit User Memory	0.13

5.8 Is the write speed a function of Power?

No

5.9 How is the ratio between minimum write and minimum read range?

The write range as defined in the datasheet is > 50% of the read range. Typically it will be 70%.

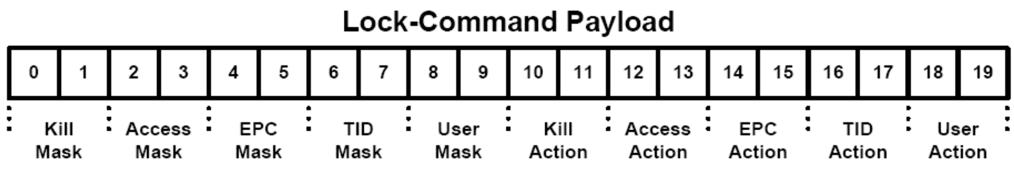
5.10 How does the locking process work?

The LOCK command from the reader is defined in Fig 10:

	Command	Payload	RN	CRC-16
# of bits	8	20	16	16
description	11000101	Mask and Action Fields	handle	

Fig 10. LOCK command

The mask and action fields define, which kind of LOCK should be performed on which memory bank



Masks and Associated Action Fields

	Kill pwd		Access pwd		EPC memory		TID memory		User memory	
	0	1	2	3	4	5	6	7	8	9
Mask	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write	skip/ write
	10	11	12	13	14	15	16	17	18	19
Action	pwd read/ write	perma lock	pwd read/ write	perma lock	pwd write	perma lock	pwd write	perma lock	pwd write	perma lock

Fig 11. Mask and action fields

The choice of the action fields (bit number 14-19) determines if a memory bank (EPC, TID, User) should be locked, permalocked, permanently unlocked or open.

Bit numbers 10-13 are the dedicated action bits for the reserved memory. The setting of these bits determines if a password should be readable and writeable, permanently readable and writeable, readable and writeable only with password, or permanently not readable and writeable.

The table of bit values is given in the EPC global standard [1] (table 6.39).

5.11 Can I lock every memory bank?

Bank 00 (reserved memory): If the kill and/or access passwords are locked they are rendered both unwriteable and unreadable, but still usable by the Kill and Access commands, respectively ("pwd read/write" in Fig 11).

Bank 01 (EPC memory): If the EPC memory is locked, it is still readable but not writeable ("pwd write" in Fig 11).

Bank 10 (TID): Is delivered programmed and permalocked by NXP.

Bank 11 (user memory): If the user memory is locked, it is still readable but not writeable ("pwd write" in Fig 11).

5.12 Can I lock only certain words within one memory bank?

No

5.13 Can the passwords (Kill password, Access password) be read protected?

Yes. If the kill and/or access passwords are locked they are rendered both unwriteable and unreadable, but still usable by the Kill and Access commands, respectively ("pwd read/write" in Fig 11).

5.14 Can the Kill functionality be disabled?

Yes. In order to be able to perform the kill command, the kill password must be set to a non-zero value. If the Kill password is permalocked to the value zero, the Kill command is permanently disabled.

5.15 How long does the UCODE G2X keep its inner state if it is moved out of the reader field?

The communication between IC and reader is interrupted as soon as the reader field decreases below the minimum threshold level, and the IC goes back to "ready" state as soon as it is powered up again.

However, it is possible to set a flag as soon as the reader has inventoried a tag, and the tag will keep this inventoried flag for a defined persistence time. The duration of the persistence time depends on which session is used, and there is also the option to use the selected flag. The persistence times are defined as follows in the EPC Global Class1 Gen2 Specification.

This feature is for example used in gate applications. If the reader needs to inventory a big amount of tags, it is important that it reads in a few seconds all tags at least one time. In order to limit the reads per one tag, the reader would inventory the tag population in session 3 (as an example), and therefore recognize if a tag has been already inventoried or not.

The reader defines which session to use in the Query command.

A more detailed description can be found in the EPC global specification [1]

Flag	Required persistence
S0 inventoried flag	Tag energized: Indefinite Tag not energized: None
S1 inventoried flag[1]	Tag energized: Nominal temperature range: 500ms < persistence < 5s Extended temperature range: Not specified Tag not energized: Nominal temperature range: 500ms < persistence < 5s Extended temperature range: Not specified
S2 inventoried flag[1]	Tag energized: Indefinite Tag not energized: Nominal temperature range: 2s < persistence Extended temperature range: Not specified
S3 inventoried flag[1]	Tag energized: Indefinite Tag not energized: Nominal temperature range: 2s < persistence Extended temperature range: Not specified
Selected (**SL**) flag[1]	Tag energized: Indefinite Tag not energized: Nominal temperature range: 2s < persistence Extended temperature range: Not specified

Note 1: For a randomly chosen and sufficiently large Tag population, 95% of the Tag persistence times shall meet the per-sistence requirement, with a 90% confidence interval.

Fig 12. Session Flags Persistance times.

5.16 What are typical persistence times of the UCODE G2X?

The average time was measured for how long the session / selected flags remain set, while the tag is not energized:

Session 1 : 1 second

Session 2 / Session 3 / SL flag : 60 seconds

5.17 How does the EAS feature work exactly?

The EAS bit is located in the system memory. It is not part of the EPC C1 Gen2 memory banks, which can be accessed by a reader.

The EAS function consists of 2 commands, the ChangeEAS and the EASalarm.

ChangeEAS:

With the Change EAS command the EAS system Bit is set or reset. The

IC needs to be at SECURED state. The access password can be zero or have a non-zero value .

Practical example:

Set the access password to eg: 1234 1234 by sending a Write command to the "reserved" memory bank (20h to 3Fh).

Execute the Change EAS command (including the parameters 1234 1234, and also the value 0 or 1 (set or reset the bit)).

What the reader should do in the background to execute the Change EAS command:

The reader needs to execute several commands in the back ground, before the EAS System bit can be changed. Following command flow is necessary in order to get the IC into the SECURED state and sending the Change EAS command:

Select (optional)

Query

ACK

ReqRN

Access (2 times)

Change EAS

EASalarm:

The alarm part is very fast and simple. The IC needs to be in READY state (powered up by the reader field). As soon as it receives an EASalarm command from a reader, it will backscatter a 64 bit alarm code (always the same sequence).

Upon receiving the alarm sequence, the reader can initiate an alarm.

All leading reader manufacturers have the EAS commands implemented. Make sure to use the latest firmware version!

5.18 How long does it take to change the EAS bit?

Fig 13 shows a screenshot of a typical reader – tag communication of 30 ms.

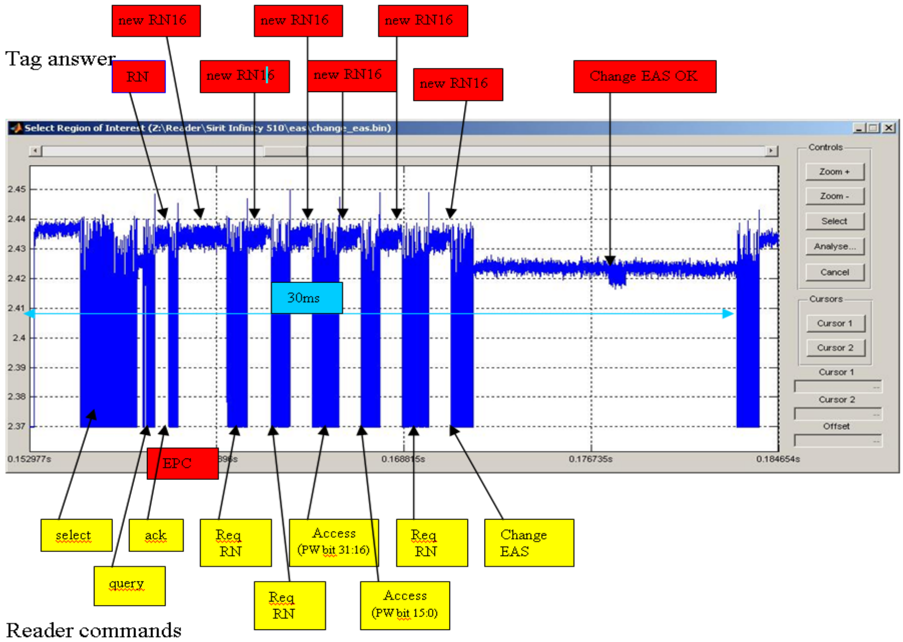


Fig 13. Reader-Tag Communication for changing the EAS bit.

6. System Level

6.1 Which reader companies offer currently products which can handle 240 bit EPC field and 512 bit user memory?

This information is based on feedback NXP got directly from corresponding reader companies:

Alien, ATID, Asiana, AWID (maximal 25 words per command), Caen, CSL, Feig, Intermec, Motorola (240 bit EPC only), Omron, Samsys (512 bit user memory), Siemens (512 bit user memory only), Sirit, Smart ID, Thing Magic, Tricon.

For the detailed information, please ask your NXP contact person for the “Infrastructure Compatibility List”.

6.2 Which reader companies offer currently products which have the custom commands (EAS, Read Protect, Calibrate) implemented?

This information is based on feedback NXP got directly from corresponding reader companies:

ATID, Asiana (except calibrate), Feig, Intermec, Sirit, Smart ID (except calibrate), Thing Magic, Tricon (except calibrate)

For the detailed information, please ask your NXP contact person for the “Infrastructure Compatibility List”.

6.3 Is a TID-based inventory possible, if there is a tag population of equal EPC numbers?

As defined in the EPC global specification, an inventory is always based on the EPC number. If all tags in the field have the same EPC number, the only way to address tag by tag is to work with a TID based select command. That means in practice that one tag after the other needs to be first addressed with a Select command, prior to the Query command. All following operations (read/write) happen after the selection.

As a second variant the TID number could be read and then written to the EPC memory.

In order to use the efficiency of the Gen 2 protocol, it is recommended to use different EPC numbers for the inventory of a tag population

6.4 How many ASCII signs can be written into the user memory / EPC memory of the UCODE G2XM?

In general the data written into the EPC memory or the user memory can have all kinds of encodings.

Example: 7-bit ASCII code:

512 / 7 =~ 73 ASCII characters.

while with one ASCII character all alphanumeric information can be encoded with a pool of 128 signs per character.

If 4 bits per character are used, one character can only be one out of 16 signs. This would in general mean hexadecimal scheme 0-9, A-F.

The user memory can be programmed with 512/4 = 128 hexadecimal characters.

The EPC field (240 bits for UCODE G2XM and UCODE G2XL) can be programmed with 34 7-bit ASCII characters or 60 hexadecimal characters.

6.5 Can the EPC number be chose randomly?

If the application is a closed loop system, yes. For open loop applications, the programmed EPC number needs to be an official EPC global number.

6.6 How many tags can be read per second?

This question can be answered from two points of view:

First, the theoretical identification rate can be simulated. It takes into account the available channels (depending on national regulations) and the backscatter link frequency at which the IC is responding:

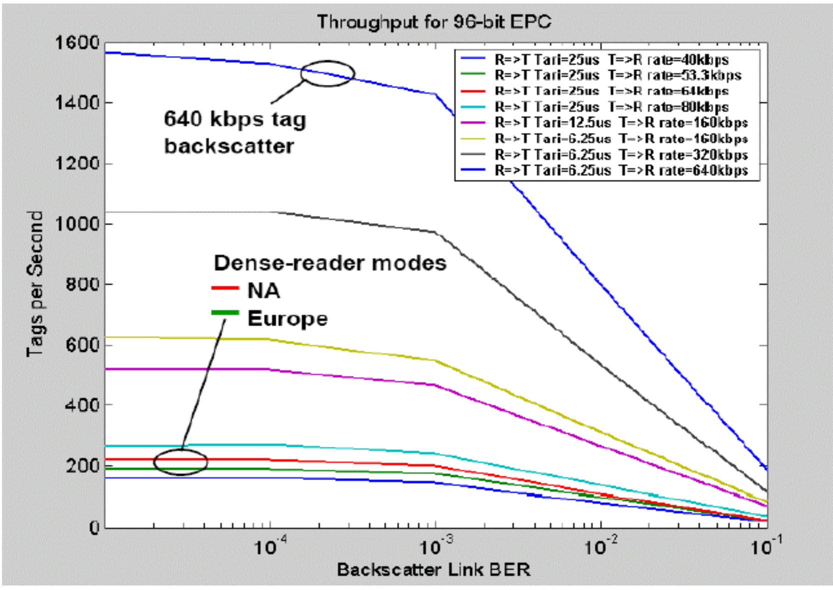


Fig 14. Theoretical throughput of a 96 bit EPC

Fig 14 outlines the impact of the back scatter data rate and of the regulation, but the ideal case, not taking into account anticollision and environmental influences.

The second, more important view is the practical consideration. In one of our tests that were done in the NXP Reference Design Center, 175 tags per second could be identified using the dense reader mode and a Mercury 5 reader.

6.7 Are the uplink and downlink data rates they set automatically or manually?

This depends fully on the reader (and/or the reader software). The backscatter link frequency, at which the tag answers to the reader, is determined in the QUERY command sent from the reader to the tag during inventory.

6.8 Does NXP also provide label antenna designs for the UCODE G2X ICs?

Yes:

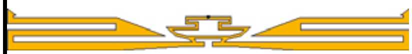
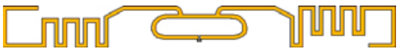
Antenna Design	Layout	Description
Range: Far Field **Name: FF98-4**		Dimension: 98mm x 10mm Works best up to Epsilon r = 4 **Application Note 0969** Far Field Reference Antenna Design
Range: Far Field **Name: FF95-8**		Dimension: 95mm x 10mm Works best up to Epsilon r = 8 **Application Note 0969** Far Field Reference Antenna Design
Range: General Purpose **Name: GP33**		Dimension: 33mm x 24mm **Application Note 0972** General Purpose Reference Antenna Design
Range: Mid Range **Name: MR34**		Dimension: 34mm x 15mm **Application Note 1523** Mid Range ILT Reference Antenna Design
Application: Fashion / airline baggage tagging **Name: OmniDir50**		Dimension: 50mm x 30mm **Application Note 1538** Fashion Reference Antenna Design
Range: Short Range **Name: SSR7**		Dimension: inner diameter 7 mm **Application Note 1615** Reference Antenna Design Short Range Ring
Application: Airline tag **Name: Air80**		Dimension. 80 mm x 35 mm; **Application Note 1685** Baggage Tag reference antenna design

Fig 15. NXP reference Designs for UCODE G2X

The “*Reference Antenna Design Agreement”* has to be signed by any customer who wants to use NXP reference designs. The conditions are:

– Antenna must be used with NXP UCODE ➔ in that case no licensing charges apply

– NXP does not indemnify on antenna IP
– General terms and conditions apply

Reference antenna designs can be used for both, UCODE G2XL and G2XM chips

Gerber files and applications notes to be ordered through DOC control.

6.9 How is the performance of a label being characterized?

The most important measurement of a label is the minimum power measurement over the EPC global frequency band.

The minimum power measurements are carried out in an anechoic chamber, according to the measurement setup described in the EPC global document “Tag Performance Parameters and Test Methods Version 1.1.1”.

The information gained from this measurement method is the minimal required power level at the label for powering the IC. This minimal power (P_{min}) is measured for a defined frequency range from 840 MHz to 990 MHz.

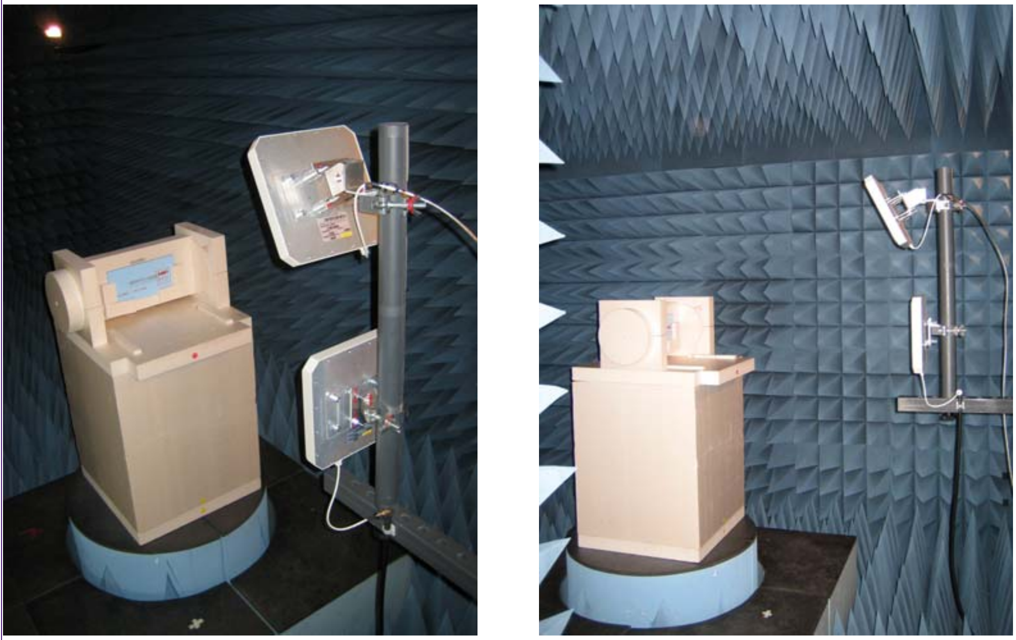


Fig 16. Test Setup in the Anechoic Chamber

It is not sufficient to test labels in free air, because in the most application the labels are applied on a certain material. For this reason the RDC defined Reference Materials which are used to test labels and tags on it. The permittivity of a carrier material determines to a major extend the impact on the label performance in terms of detuning (down shift of the resonance frequency)

Table 2 and Fig 17 show the Reference Materials and their permittivity values.

Table 2. Permittivity Values of the Reference Materials

PTFE	PMMA	PC	PET	PU/PUR	KITE	CARP	Glass
2,12 – 2,2	2,98 –3,02	3,19 –3,23	3,64–3,68	4,05 – 4,12	5,75 – 5,81	5,78 – 5,87	12,3 – 12,5

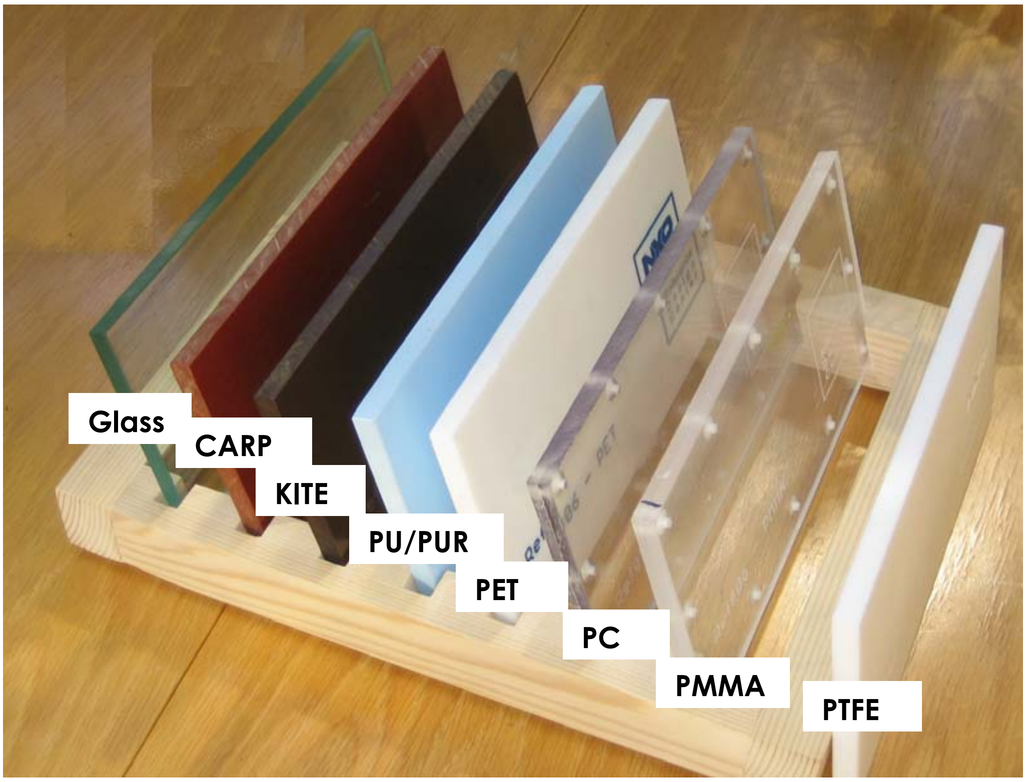


Fig 17. NXP Reference Materials

6.10 Which criteria shall a good label fulfill?

The most important criteria are that a label meets the requirements of the end application.

In order to judge, for what purposes a label could be used, following general parameters can be considered:

Bandwidth of a label: The flatter the P_{min} curve is, the less influence a carrier material will have.

P_{min} at the resonance frequency: The minimum power value depends of course strongly on the size of the label (effective antenna area). As a principle consideration the minimum power of the IC can be considered. This is -15 dBm. Therefore, this is a value that can be achieved by an antenna design with a good impedance match and stable assembly.

Detuning on material: The Pmin of a label on different reference materials gives an idea of how broad the spectrum of potential end applications for this label is.

Assembly stability: The minimum power level curves of a larger amount of labels (> 20 pcs) from one production line show the assembly stability.

As an example Fig 18 shows the Pmin behavior of the NXP reference antenna design “FF-95-8”.

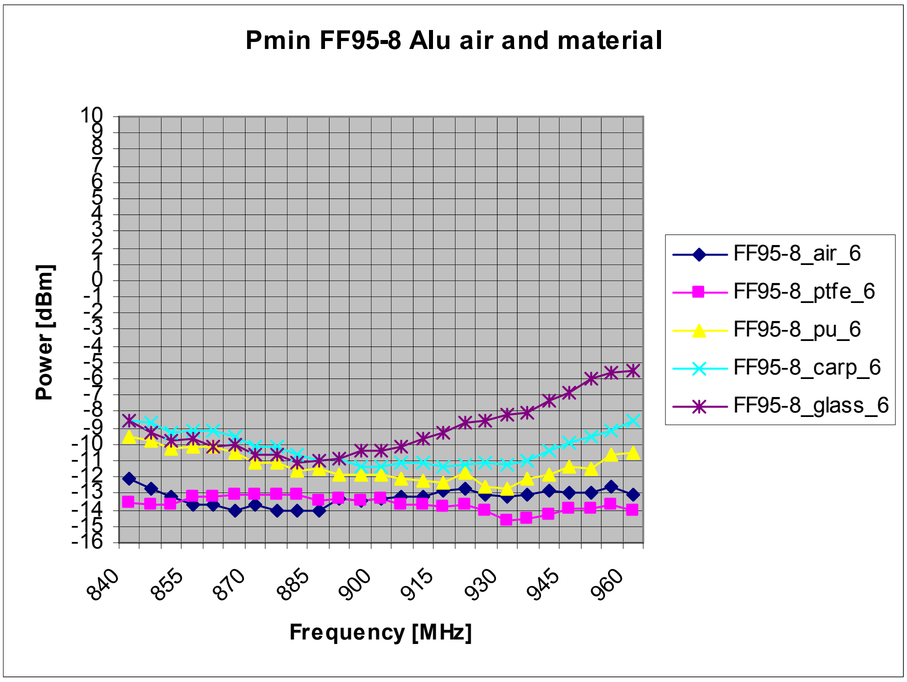


Fig 18. Pmin on air and on reference materials of the NXP FF98-5 design, mass produced aluminum labels.

6.11 Does UCODE G2X also work under the new Chinese UHF RFID frequency regulation (840.25 MHz to 844.75 MHz)?

Yes, both UCODE G2X ICs are specified to work without performance decrease from 840 MHz upwards.

6.12 In which countries UHF may be used, and which are the regulations?

Please check following link from EPC global [2]. It is a table containing the actual UHF regulations world wide:

7. More questions?

7.1 What documentation is available on the UCODE G2X?

- *SL3ICS1002 G2XM UCODE functional specification
- *SL3ICS1202 G2XL UCODE functional specification
- AN 1629 UHF RFID Label Antenna Design
- *Application Note 0968 Package and Assembly Guideline for the UCODE G2XM G2XL
- **Application Note 0969_Far Field Reference Antenna design for the UCODE G2XM_G2XL IC
- **Application Note 0971_Far Field Antenna Design
- **Application Note 0972 General Purpose Reference Antenna Design for the UCODE G2XM G2XL IC
- **Application Note 1523 Mid Range ILT Reference Antenna Design for the UCODE G2XM / G2XL IC
- **Application Note 1538_ Fashion Reference Antenna Design for the UCODE G2XM_G2XL IC
- **Application Note 1685 Baggage tag Reference Antenna Design for the UCODE G2XM G2XL IC
- **Application Note 1615_Reference Antenna Design Short Range Ring SRR7

*) valid NDA is required

**) valid NDA and “reference antenna design agreement” are required. (see chapter 6.8).

7.2 How can I get the UCODE G2X documents?

Please contact your NXP sales person. The document will be required via NXP Document Control. In case of document updates, the customer will get automatically a notification.

7.3 Does NXP offer technical trainings?

NXP offers a 2 days UCODE training. Please ask your NXP sales person for more information.

8. References

[1] EPC Global Specification

http://www.epcglobalinc.org/standards/uhfc1g2/uhfc1g2_1_1_0-standard-20071017.pdf

[2] UHF RFID Frequency regulations

http://www.epcglobalinc.org/tech/freq_reg/RFID_at_UHF_Regulations_20090105.pdf

[3] Reflow soldering:

http://www.nxp.com/acrobat_download/packages/Surface_mount_reflow_soldering.pdf

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10. Contents

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