TI UHF Gen2 IC

Reference Guide

11-09-21-701 June 2006

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Edition One – June 2006

This is the first edition of this **TI's UHF Gen 2 IC - Reference Manual**.

It provides details of Texas Instruments' UHF Gen 2 IC's. This information is intended for use in the assembly process of tested IC's delivered in wafer form. It applies to the following products:

RX-UHF-11111-01, RX-UHF-00001-01

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Read This First

About this Guide

This **Reference Guide (11-09-21-701)** is written for the use by TI partners who are engineers experienced with Radio Frequency Identification Devices (RFID).

Regulatory and safety notes that need to be followed are given Chapter 4.

Conventions

WARNING:

A warning is used where care must be taken or a certain procedure must be followed, in order to prevent injury or harm to your health.

CAUTION:

This indicates information on conditions, which must be met, or a procedure, which must be followed, which if not heeded could cause permanent damage to the system.

Note:

Indicates conditions, which must be met, or procedures, which must be followed, to ensure proper functioning of any hardware or software.

Information:

Indicates conditions, which must be met, or procedures, which must be followed, to ensure proper functioning of any hardware or software.

If You Need Assistance

For more information, please contact the sales office or distributor nearest you. This contact information can be found on our web site at:

http://www.ti-rfid.com.

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CHAPTER 1

Introduction

This chapter introduces you to the Wafers of TI Gen 2 IC's.

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Introduction

1.1 General

Large retailers like Wal-mart and Target in the US and Metro in EU have issued mandates to their suppliers to ship cases & pallets of goods/products with RFID Smart Labels attached. TI's Gen 2 wafers are intended to be supplied to inlay and strap manufacturers, who will use the IC's to create inlays for conversion into labels for case & pallet level retail supply chain applications. The IC's on each wafer are based on the EPCGlobal™ Gen 2 (V1.0.9) specification approved in December of 2004.

TI's UHF Gen 2 IC operates with extremely low power and yet provides long read and write ranges, fast data transfer and high Smart Label throughput, all of which are crucial for the following applications:

- Express parcel delivery
- Airline baggage handling
- Distribution logistics and supply chain management
- Building access badges
- Asset tagging

1.2 Functional Description

A detailed description of the command set, memory and operation of individual IC's is given in Texas Instruments' document "TI UHF Gen 2 Protocol – Reference Guide" (11-09-21-700)

1.3 Ordering Information and Part Numbers

The TI UHF Gen 2 IC is available in the following finishing options:

Part-number	Back-ground	Bumped	Sawn	Mapped
RX-UHF-11111-01	Yes	Yes	Yes	Yes
RX-UHF-00001-01	No	No	No	Yes

Table 1. Part Numbers

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CHAPTER 2

Specification

This chapter provides the electrical and mechanical specifications of TI Gen 2 IC.

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2 Specifications

2.1 Electrical Specification

The following table shows the absolute maximum ratings of the die:

Parameter	Notes	Min	Nom	Max	Units
Input Current, any pin to any pin				1	mA
Input Voltage to any pin (sustained)				1.5	V
Power dissipation,	Ta = 25ºC			1.5	mW
RF input to Antenna terminals				+10	dBm
Storage Temperature		- 40		85	ºC
Operating Temperature		- 40		65	ºC
Assembly survival temperature	1 minute max.			150	ºC
RF exposure	800 to 1000 MHz			+10	dBm
ESD Immunity	CMD	0.5			kV
	HBM	2.0			kV

Table 2. Absolute Maximum Ratings

Note:

Stress beyond the limits listed under “Absolute Maximum Ratings” may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for an extended time may affect device reliability.

Parameter	Symbol	Note	Min	Nom	Max	Units
Operating Temperature	TA		- 40		65	ºC
Carrier Frequency	$f$res		860		960	MHz

Table 3. Recommended Operating Conditions

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Parameter	Symbol	Note	Min	Nom	Max	Units
Operating Supply Current	ICC	Vant = min	1.5	2.5	2.7	µA
Operating Supply Current	ICC	Programming	5.8	6.1	6.3	µA
Change in Modulator Reflection Coefficient	$\Delta\ \Gamma$		≥0.2			
Limiter Clamping Voltage	Vlim		N/A	1.5	N/A	V
Data Retention	tDRET	Ta = 25ºC	10			Years
Write & Erase Endurance	W&E	Ta = 25ºC	100,000			Cycles

Table 4. Electrical Characteristics

Die Parallel Impedance			Europe 866.5 MHz	USA 915 MHz	Japan 953 MHz	Units
READ	-13dB Min Typical Read	Resistance	365	300	270	Ohms
		Capacitance	3.05	3.2	3.35	pF
	- 9dB Read	Resistance	292	260	230	Ohms
		Capacitance	3.05	3.15	3.31	pF
WRITE	-9 dB Min Typical Write	Resistance	310	270	240	Ohms
		Capacitance	3.05	3.19	3.36	pF
	-6 dB Write	Resistance	210	195	185	Ohms
		Capacitance	2.95	3.05	3.22	pF

Table 5. Die Parallel Impedance

Antenna Series Impedance			Europe 866.5 MHz	USA 915 MHz	Japan 953 MHz	Units
READ	-13 dB Min Typical Read	Resistance	9.7	10.6	10.7	Ohms
		Inductance	58.7	55.4	52.7	µH
	- 9dB Read	Resistance	11.9	12.5	12.7	Ohms
		Inductance	57.8	55.5	52.5	µH
WRITE	-9dB Min Typical Write	Resistance	11.3	11.8	11.8	Ohms
		Inductance	58.1	55.1	52.0	µH
	-6 dB Write	Resistance	17.0	17.0	16.1	Ohms
		Inductance	57.3	55.0	52.1	µH

Table 6. Recommended Antenna Series Impedance Values

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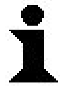

Information:

For complete data on antenna matching, please consult the “Strauss Antenna Design - reference guide” (11-07-21-702)

2.2 Mechanical Wafer Specification

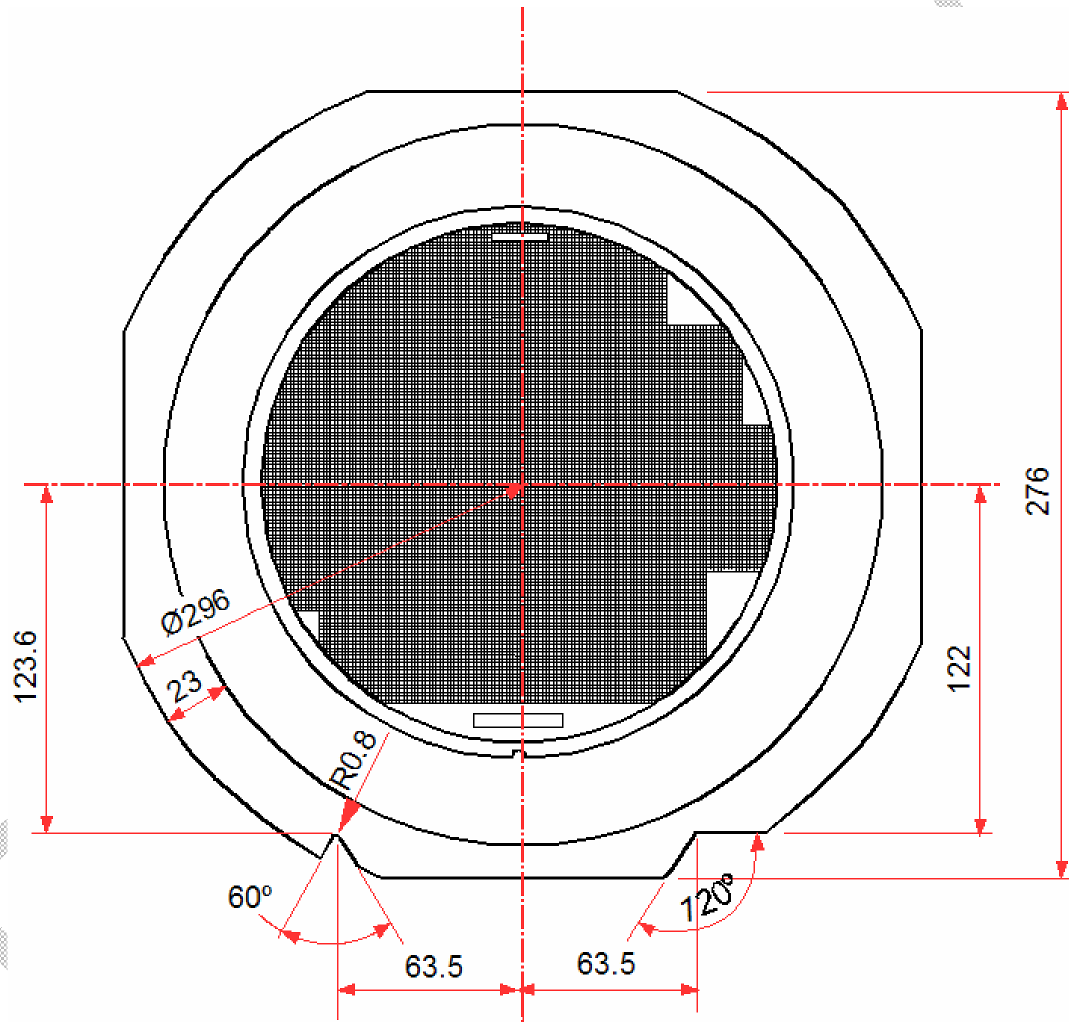

Figure 1. Wafer on FFC

Parameter	Value
Wafer diameter	200 mm ± 0.3 mm (8 inch)
Scribe Line Width	80 µm

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Electrical connection of substrate	VSS potential
Complete dies per wafer	42,000

Table 7. General Mechanical Wafer Specification

Parameter		Value
Backside Material		Si
Roughness Ra Rtm		 500 Angstrom 2500 Angstrom
	Product	
Thickness	RX-UHF-11111-01	152 µm
	RX-UHF-00001-01	710~740 µm
Complete dies per wafer		42,272

Table 8. Mechanical Wafer Specification after Grinding , Sawing on FFC

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2.3 Mechanical Die Specification

Parameter	Value
Bond pad metallization material	Au > 99.9%
Bond Pad Metallization thickness	20 µm
Bond and Test Pad Locations	See Figure 3
Die (Step) Dimensions - including scribe lines	780 × 865 µm
Die (Seal) dimensions – excluding scribe lines	700 × 785 µm
Top-side Passivation Layer	Oxide
Passivation Thickness	1.3 µm

Figure 2. Mechanical Die Parameters

2.4 Bump Specification

Wafer that have been bumped have the following values:

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Parameter	Value
Bump material	> 99.9% Au
Bump hardness	30 ~ 80 Hv
Bump shear strength	> 5 Grs/mil square
Bump height	20 µm
Bump height uniformity	Within 4 µm
Pad opening	65 × 65 µm (octagonal opening)
Scribe width	80 µm

Table 9. Bump Specifications

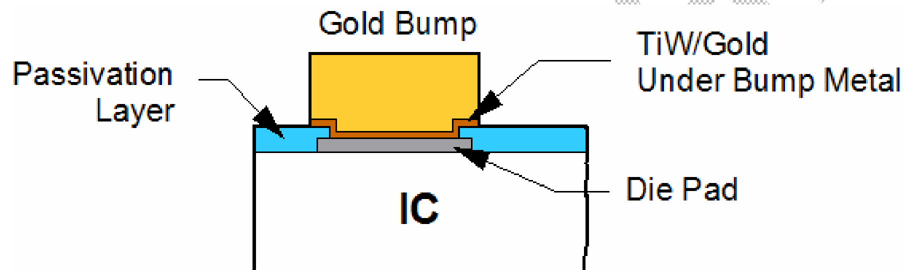

Figure 3. Cross Section of a Bump

Pad	Pad Size	Location	Description
RF	65 × 65 mm	Refer to figure3	This pad must be connected to the antenna
VDD	65 × 65 mm	Refer to figure3	This is only for test and can be left floating
Test	65 × 65 mm	Refer to figure3	This is only for test and can be left floating
GND	65 × 65 mm	Refer to figure3	This pad must be connected to the antenna

Table 10. Description of Bumps

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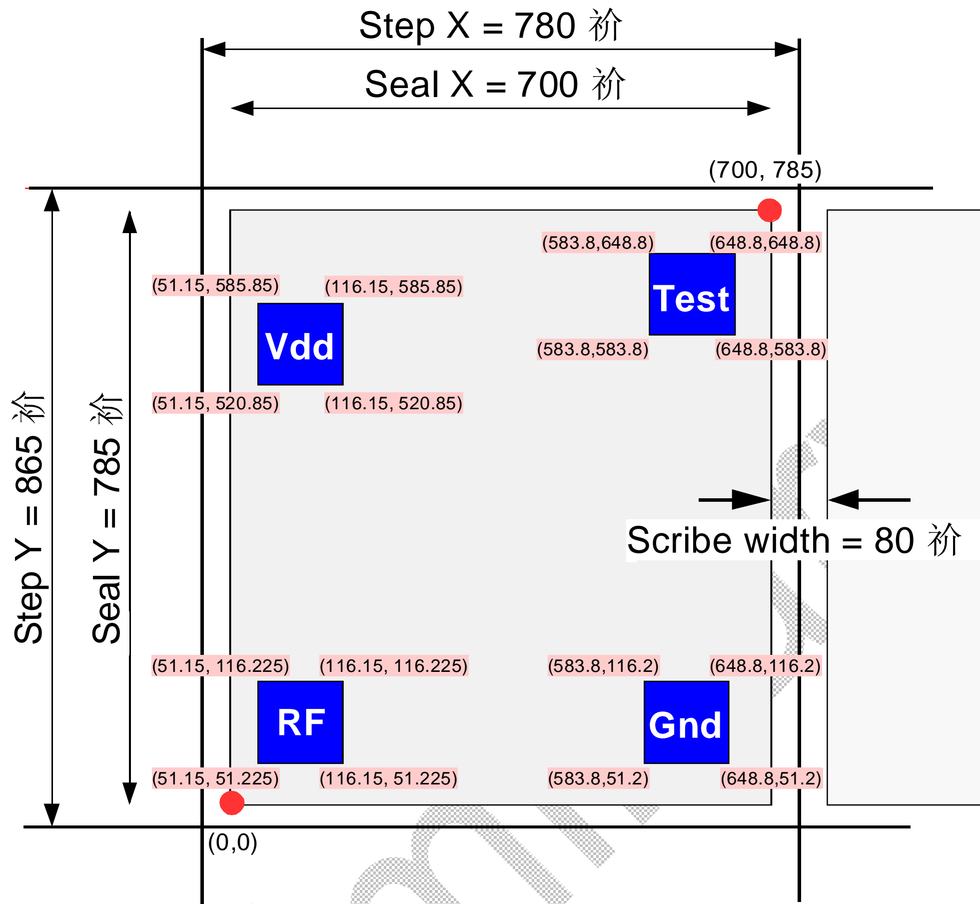

Figure 4. Bond Pad Layout

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CHAPTER 3

Shipping, Packaging & Further Handling

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3 Shipping, Packaging & Further handling

3.1 Lot Definition

A 'Lot' is a quantity of wafers from the same diffusion batch produced under the same uniform conditions. A lot can be up to 24 wafers.

3.2 Wafer Identification

Each wafer is marked with laser marking to identify the wafer. The wafer map file is linked to the wafer ID. There are 2 marks on the wafer.

The following figure shows the position of the wafer identification codes. The reference die position on the wafer is shown below.

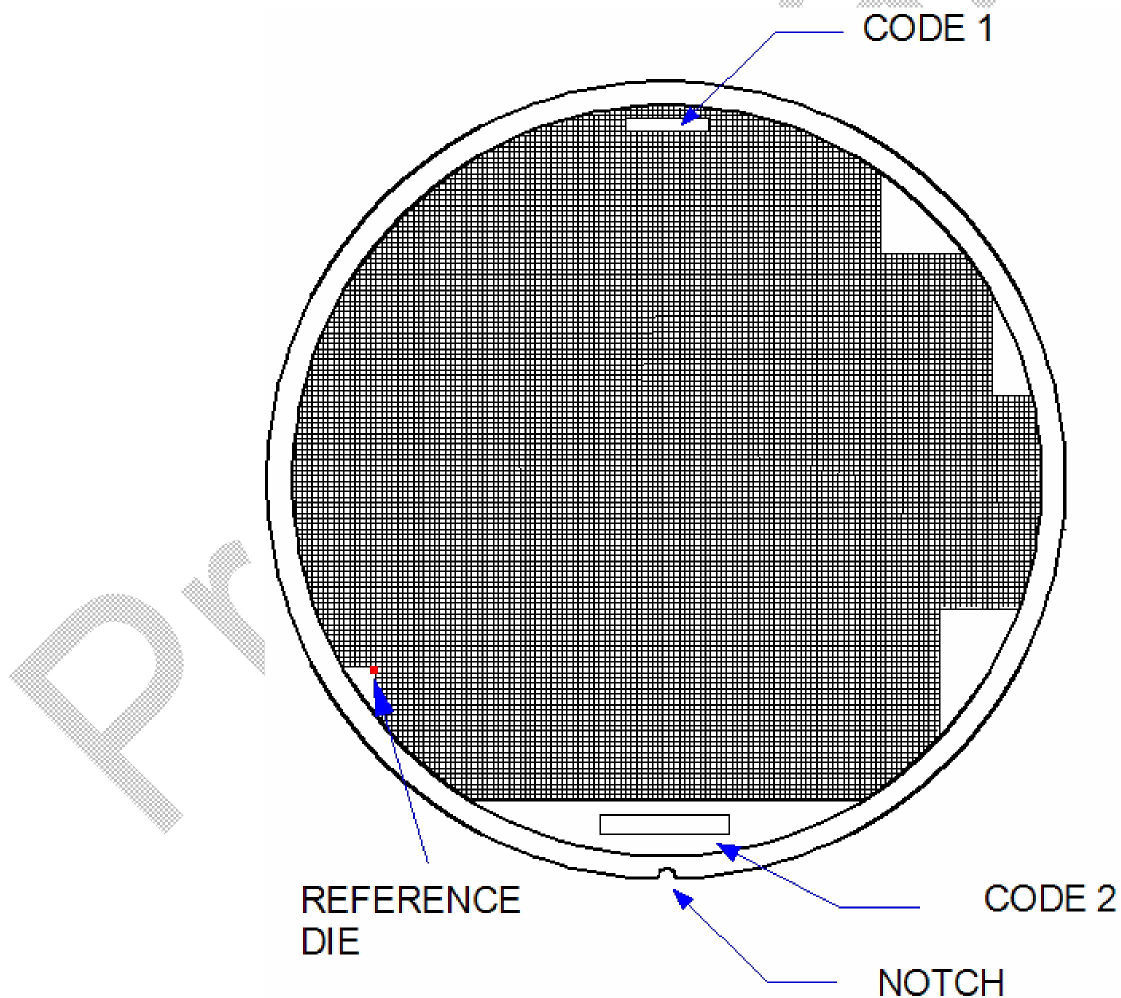

Figure 5. Position of Wafer Identification Codes

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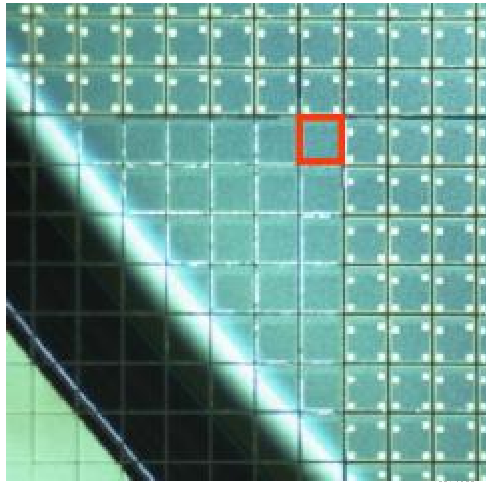

Figure 6. Location of Reference Die

Code 1 is an internal code used by the wafer supplier and should not be referenced. It is located directly opposite the notch.

Code 2 is the Wafer lot number. It will be similar to:

C-5 737 722-10-F4

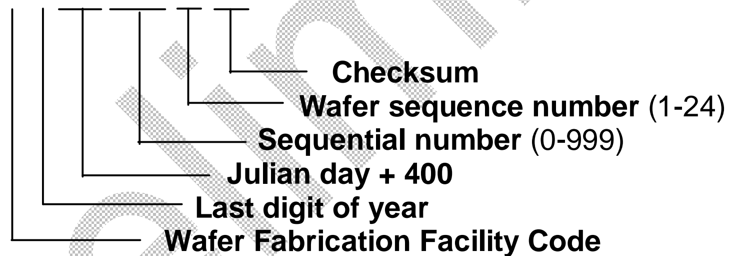

Figure 7. Wafer Identification Code 2

3.3 Wafer Map File

Wafer map files will be provided via password protected FTP access to the specific lots provided to customers or accessible via a password protected website specific to the customer to which the wafers are shipped.

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The data conforms to TI's world-wide standard and is in ASCII format. The most important facts are found in a list similar to the example below. The lot definition is also found in this list along with a record of the dies which passed or failed probe test.

```
FACILITY =DL2-OUT
LOT=5737722
DEVICE=D1ABIX2075R20
WAFERS=02
BIN_NAME.01="G,BIN1"
BIN_NAME.09="REJECT"
X_SIZE=030.709
Y_SIZE=034.055
WAFER_SIZE=200
SCRIBE="BOTTOM,15,NTRL,FAB"
STATUS="PROD"
USER="NOINK"
WAFERID.04=C-5737722-04-D3
NUM_BINS.04=02
BIN_COUNT.04.01=36918
MAP_XY.04.01="Y-68 58/59 89 91 Y-67 56 60/62 74/77 83/84 86/93 124/125"
BIN_COUNT.04.09="Y-71 61/149 Y-70 58/152 Y-69 56/154 Y-68 53/57 60/88 90"
END.
```

3.4 Ink Dot Marking

There is no ink dot marking of the Wafers. All TI Gen 2 IC's are electrically tested and dies which fail this probe test are recorded in the wafer map file. Bump failures are not recorded.

3.5 Packaging for Wafers

The wafers are packed for transportation to protect then against shock, static discharge and contamination in a wafer shipper box of up to 24 wafers. This box is packed in an anti-static moisture bag with silica gel and in a double layered carton.

Note:

If the silica gel has changed color to blue, it is an indication that moisture ingress has occurred.

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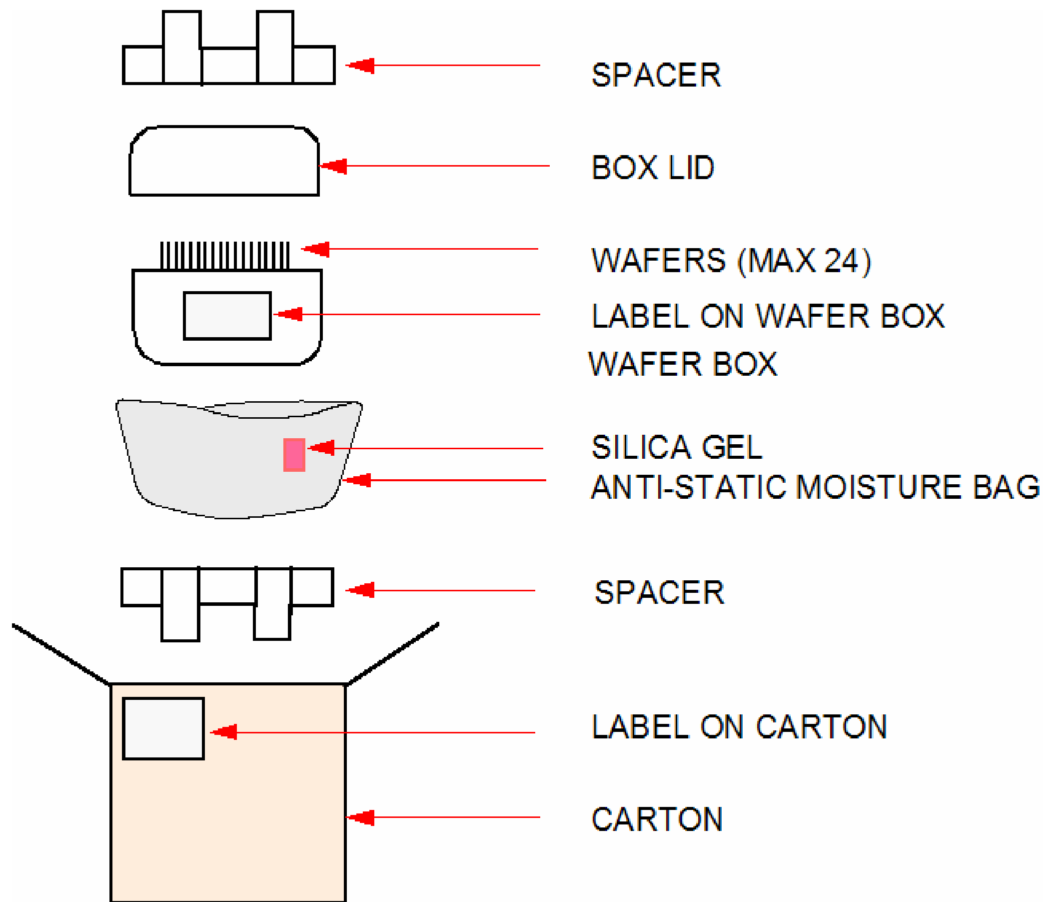

Figure 8. Packaging of Wafers

3.6 Packaging for Sawn Wafers

Sawn wafers are mounted on foil and delivered on standard 8” disco wafer frame (see Figure 1 Wafer on FFC). A special plastic container is used to store up to 24 wafers in frames. This plastic container is packed in an anti-static moisture bag with silica gel and in a double layered carton.

Note:

If the silica gel has changed color to blue, it is an indication that moisture ingress has occurred.

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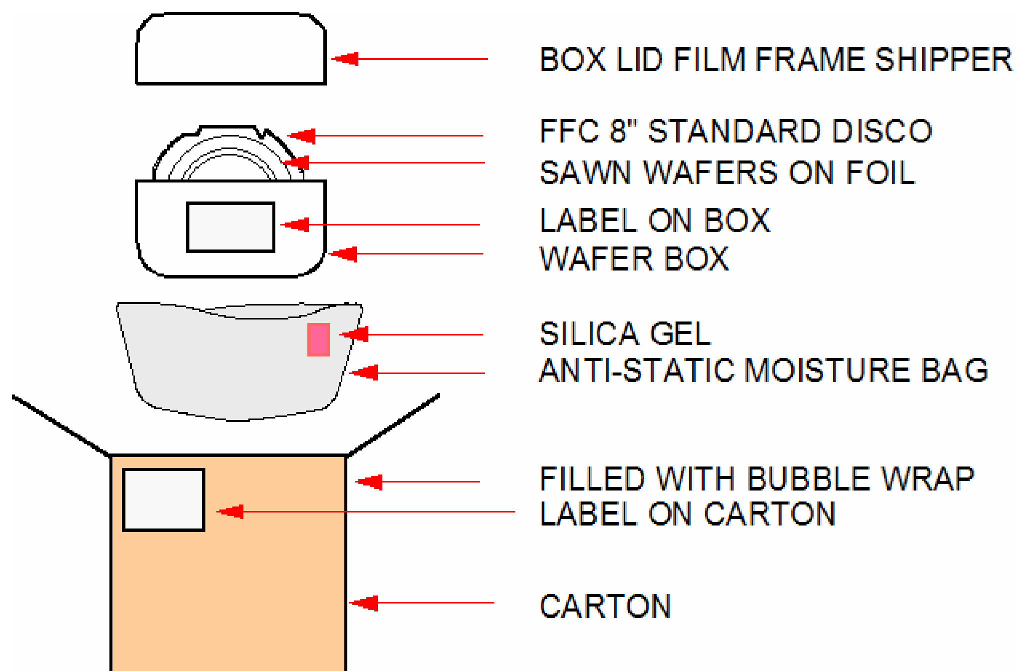

Figure 9. Packaging of Sawn Wafers

3.7 Storage Conditions

The wafers should be kept in the original packing during storage.

Parameter	Value
Temperature	20º C ± 5º C
Atmosphere	Dried N_2 or dried air with 40%~60% r.h.
Duration	Max. 6 months

Table 11. Wafer Storage Conditions

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CHAPTER 4

Regulatory, Safety and Warranty Notices

This chapter describes important safety precautions and regulations

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4 Regulatory, Safety and Warranty Notices

4.1 Regulatory and Safety Notices

An RFID system comprises an RF transmission device, and is therefore subject to national and international regulations.

Any system reading from or writing to a transponder created from an IC, may be operated only under an experimental license or final approval issued by the relevant approval authority. Before any such device or system can be marketed, an equipment authorization must be obtained form the relevant approval authority.

The TI Gen 2 IC's have been manufactured using state-of-the-art technology and in accordance with the recognized safety rules.

Observe precautions in operating instructions

- **Condition for the safe processing, handling and fault-free operation of TI Gen 2 IC's is the knowledge of the basic safety regulations.**
- **All persons who operate with TI Gen 2 IC's must observe the guidelines and particularly the safety precautions outlined in this document.**
- **In addition, basic rules and regulations for accident prevention applicable to the operating site must also be considered.**

4.2 Warranty and Liability

- The "General Conditions of Sale and Delivery" of Texas Instruments Inc or a TI subsidiary apply.

CAUTION:

TI's Transponder IC's are 100% thoroughly tested. It is the responsibility of TI´s customers to evaluate their equipment to ensure, through appropriate process controls, that machine and material parameters are met on an ongoing basis.

TI does not accept warranty claims for material that has already undergone packaging or conversion process.

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4.3 Hazards from Electrostatic Discharge (ESD)

During handling of IC's and wafers, due regard must be given to the build-up of electrostatic charges. See the datasheet.

CAUTION:

ELECTRONIC DEVICES CAN BE DESTROYED BY ELECTROSTATIC ENERGY.

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Appendix A - Terms & Abbreviations

A list of the abbreviations and terms used in the various TI manuals can be found in a separate manual:

TI-RFID Product Manuals – Terms & Abbreviations

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