FEATURE

- Compatible with ISO/IEC 15693 Standard
- No External power supply required
- 13.56MHz operating frequency
- Embedded **Total 512 x 8 bit** EEPROM memory
- ASK demodulator
- Support both single and dual sub-carrier operations
- Internal clock recovery circuit
- Support 26.69kbps high data rate, and 6.62kbps low data rate
- Manchester encoding TX data output
- Self-destruct function

eEEPROM Memory

- Up to 448 bytes of user data memory organized in 112 four-byte blocks
- Each block is organized in 4 bytes for one time programming
- Data retention up to 10 years
- Lock bits for each block, AFI, DSFID

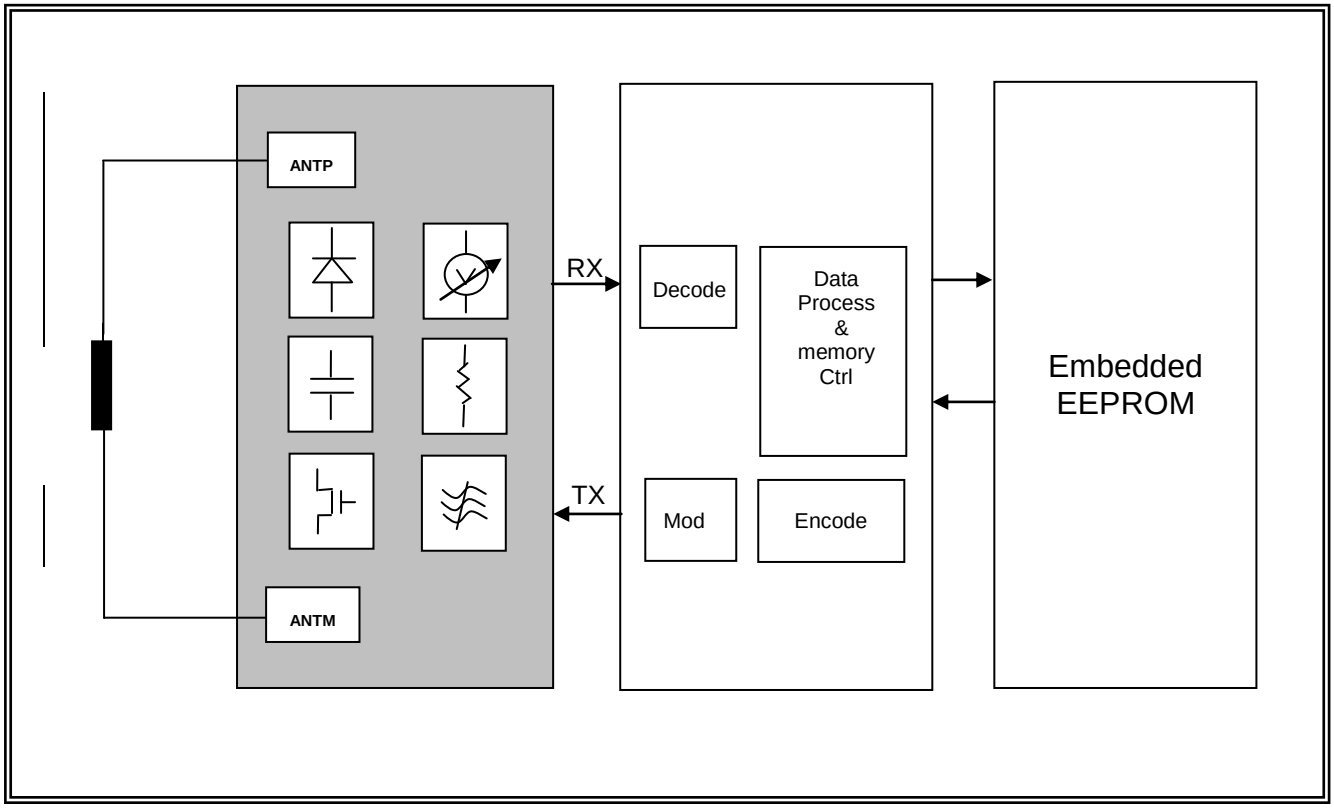


Figure 1: A9212-A Block System Diagram

Pin Descriptions

Symbol	Type	Description
ANTP	-	Antenna pad A
ANTM	-	Antenna pad B
TIO1	-	Reserved
TIO2	-	Reserved
TIO3	-	Reserved

Table 1

Floor Plan

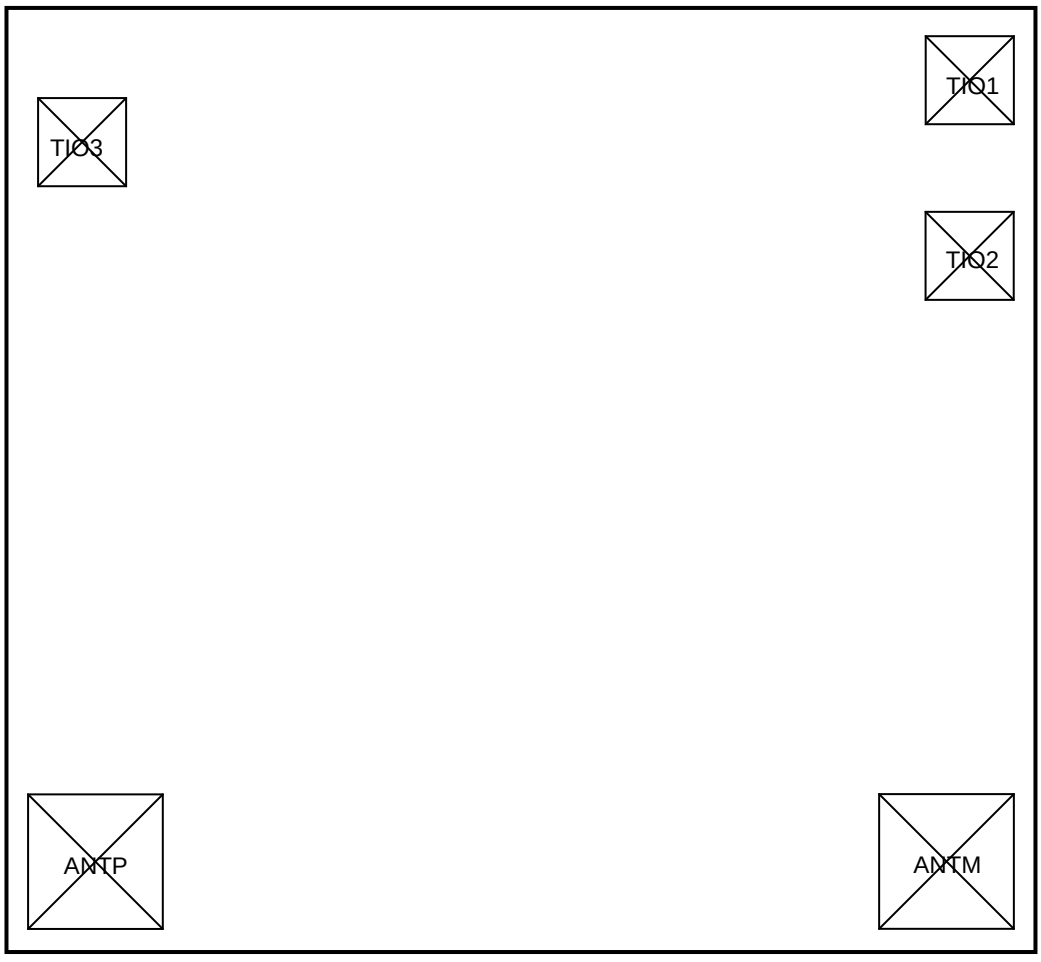


Figure 2: A9212-A Pin-out Diagram

General EEPROM Memory Mapping

EEPROM Address	Byte 0	Byte 1	Byte 2	Byte 3
0x00 ~ 0x03	Reserved	Reserved	Reserved	Reserved
0x04 ~ 0x07	Reserved	Reserved	Reserved	Reserved
0x08 ~ 0x0B	DSFID	Reserved	Reserved	Reserved
0x0C ~ 0x0F	AFI	Reserved	Reserved	Reserved
0x10 ~ 0x13	Lock G	Block 0 ~ Block 7 Lock Status	Block 8 ~ Block F Lock Status	Block 10 ~ Block 17 Lock Status
0x14 ~ 0x17	Block 18 ~ Block 1F Lock Status	Block 20 ~ Block 27 Lock Status	Block 28 ~ Block 2F Lock Status	Block 30 ~ Block 37 Lock Status
0x18 ~ 0x1B	Block 38 ~ Block 3F Lock Status	Block 40 ~ Block 47 Lock Status	Block 48 ~ Block 4F Lock Status	Block 50 ~ Block 57 Lock Status
0x1C ~ 0x1F	Block 58 ~ Block 5F Lock Status	Block 60 ~ Block 67 Lock Status	Block 68 ~ Block 6F Lock Status	Lock E
0x20 ~ 0x23	Block 0			
0x24 ~ 0x27	Block 1			
0x28 ~ 0x2B	Block 2			
0x2C ~ 0x2F	Block 3			
0x30 ~ 0x33	Block 4			
0x34 ~ 0x37	Block 5			
0x38 ~ 0x3B	Block 6			
0x3C ~ 0x3F	Block 7			
//	//			
0x1DC ~ 0x1DF	Block 6F			
0x1E0 ~ 0x1FF	Block 48 ~ 55, Device dependent. Please see respective part number for details			

Table2: EEPROM Memory Mapping Table

Unique Identifier (UID)

MSB LSB

64 57	56 49	48 41	40 1
'E0'	IC Mfg Code (0x33)	Tag Type	IC Manufacturer Serial Number

The UID, in ISO/IEC 15693-3 format, is programmed by IC manufacturer during production process and cannot be changed afterwards.

Bit64 ~ Bit57: Shall be 'E0' according to ISO/IEC 15693-3.
Bit56 ~ Bit49: AMIC IC manufacturer code
Bit48 ~ Bit41: Tag type for AMIC Tag IC A9212-A
Bit40 ~ Bit 1: 40-bit unique serial number.

General Command List

	Command	Command Code	Description
1	Inventory	0x01	Anti-collision sequence. Used for multiple RFID detection
2	Stay Quiet	0x02	Command tag to enter Quiet state (no response)
3	Read Single Block	0x20	Read data from requested block
4	Write Single Bock	0x21	Write data to requested block
5	Lock Block	0x22	Lock the requested block, and the memory block will be locked permantly.
6	Read Multiple Block	0x23	Read the requested blocks
7	Select	0x25	Command tag to enter Selected state
8	Reset To Ready	0x26	Return tag to Ready state
9	Write AFI	0x27	Write AFI value into tag memory
10	Lock AFI	0x28	Lock AFI value and the contents of AFI will be locked permanently
11	Write DSFID	0x29	Write DSFID value into tag memory
12	Lock DSFID	0x2A	Lock DSFID value and the contents of DSFID will be locked permanently
13	Get System Information	0x2B	Retrieve tag system information from memory
14	Get Multiple Block Security Status	0x2C	Receive tag memory block security status

Table3: A9212-A General Commands

Note: For any standard command not described in this data sheet, please see ISO/IEC 15693-3 document for details.

Custom and Proprietary Command List

	Command	Command Code	Description
Custom & Proprietary Commands			
1	Inventory Read	0xA0	Read specific memory content while performing anti-collision algorithm
2	Fast Inventory Read	0xA1	Same as Inventory Read but using high data rate
3	Set EAS	0xA2	Enable EAS function
4	Reset EAS	0xA3	Disable EAS function
5	Lock EAS	0xA4	Lock current EAS state
6	EAS Alarm	0xA5	Respond EAS alarm to reader if EAS enabled
7	Write EAS Code	0xA6	Program EAS code to IC
8	Lock EAS Code	0xA7	Lock EAS code
9	Write Kill Code	0xA8	Program self-destruct password
10	Lock Kill Code	0xA9	Lock self-destruct password
11	Self-destruct	0xAA	Enable IC self destruction feature. Once enabled, IC will be inoperable permanently.

Table4: A9212-A Custom and Proprietary Commands

RFID Tag IC Command and Response

All commands listed above are described in details in ISO/IEC15693-3 documents. Some of the frequent used commands are discussed here for quick reference.

Protocol concept

A9212-A RFID tag IC follows ISO-15693 standard's simplex communication protocol scheme. Reader needs to issue appropriate command before A9212-A RFID tag IC will respond with the corresponding data packet. A9212-A RFID tag IC is designed base upon the one command one action structure.

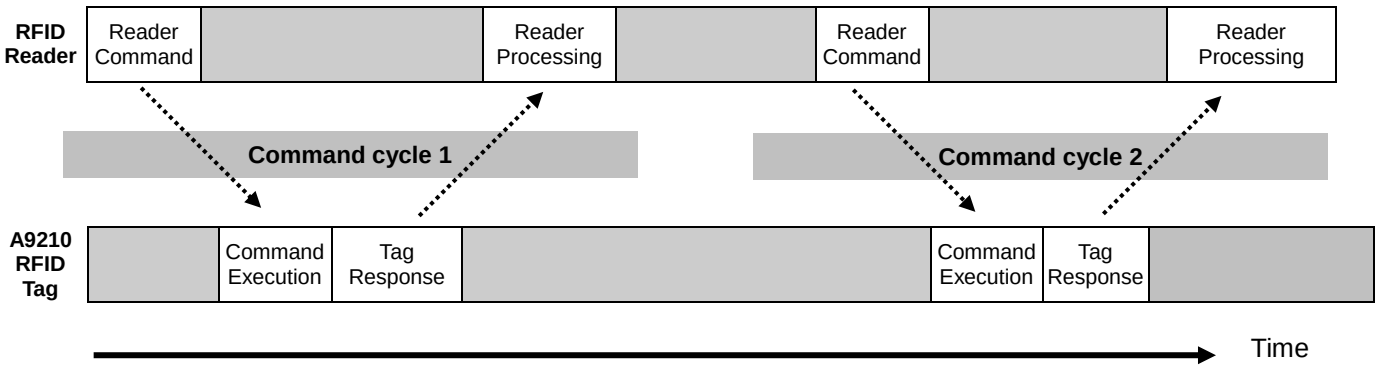


Figure3: A9212-A Command Cycle Diagram

Each reader command and each tag reponse packet are contained in a frame. The frame is delimited by frame delimiters SOF (Start of Frame) and EOF (End of Frame). Each reader command consists of the following fields:

- Flags
- Command code
- Memdatory and optonal parameter fields (command dependent)
- Application data filed
- CRC

Reader command as seen by A9212-A RFID tag IC should have the following format

SOF	Flags	Command Code	Parameters	Data	CRC	EOF

A9212-A RFID Tag IC's response packet consists of the following fields:

- Flags
- one or more parameter fields
- Data
- CRC

SOF	Flags	Parameters	Data	CRC	EOF

Absolute Maximum Rating

Parameter	Symbol	Min	Type	Max	Unit
Storage Temperature	T_{sto}	-55		140	℃
Junction Temperature	T_j	-55		140	℃
Electrostatic Discharge Voltage	V_{ESD}			$2K_{(1)}$	V
Maximum input peak current	$I_{Max\ P-M}$			50	mA
Operating junction temperature	T_{jop}		TBD		℃
Input current	I_{P-M}			30	mA

(1) Applicable for ANTP and ANTM pads

DC Electrical Characteristics

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Operating Frequency	f_{OP}			13.560		MHz
Input Capacitance	C_{in}	V_{P-M}	23	26.0	29	pf
EEPROM Data Retention	t_{ret}	T	-	10	-	Years
EEPROM Write Endurance	n_{wr}			100000		Cycles

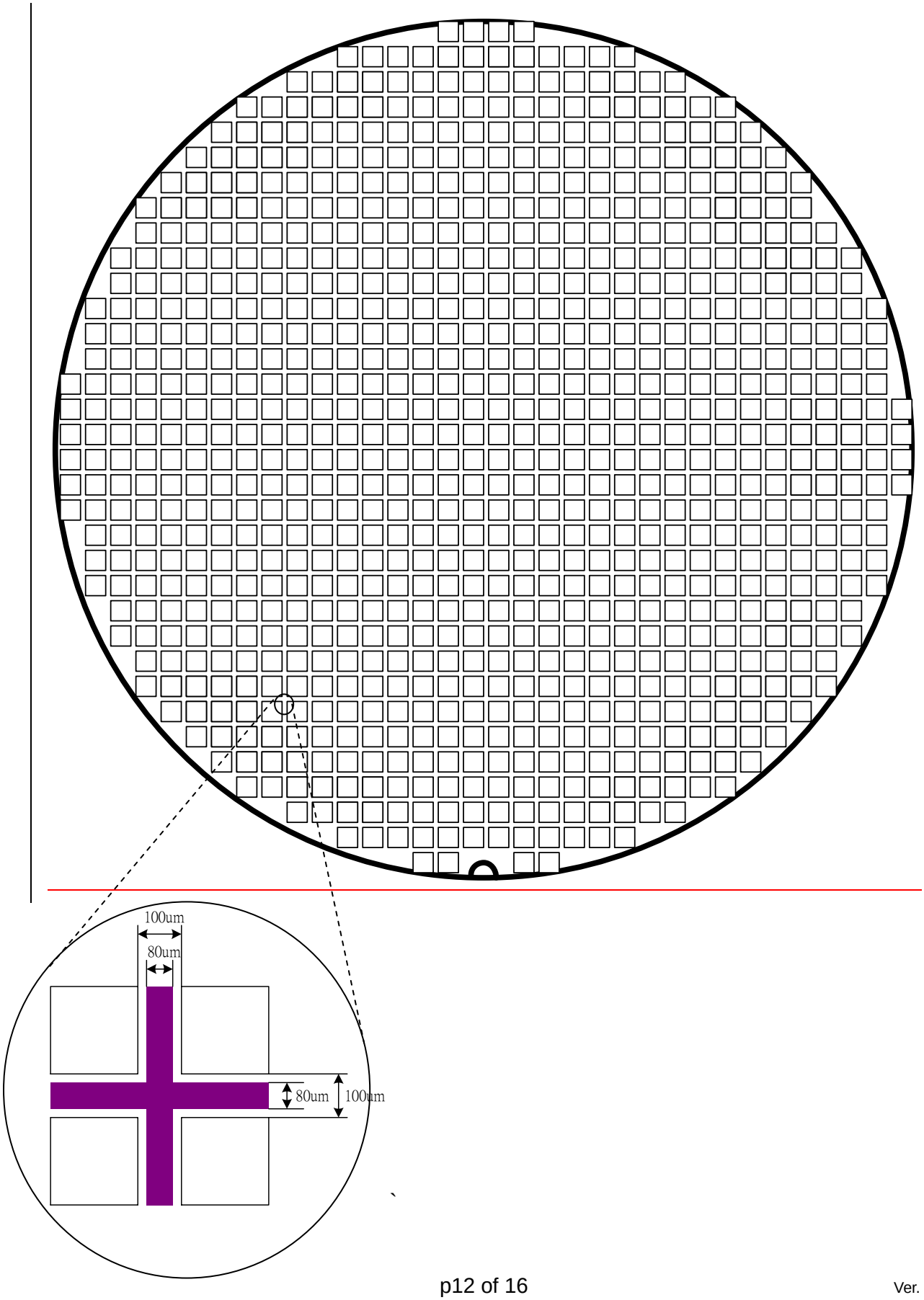
Mechanical Specification

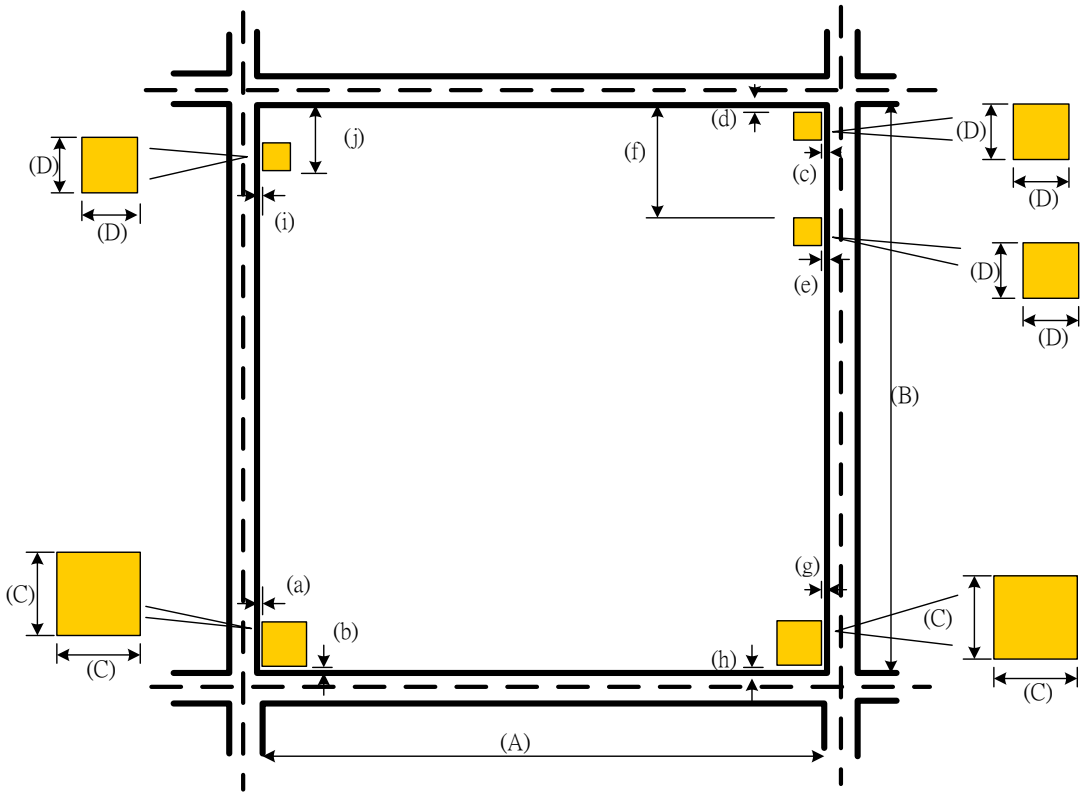
- Wafer diameter: 8”
- Wafer thickness: Raw wafer (725*u*m ± 15 *u*m)
- Backside material: Si
- Backside treatment: Etched; to achieve 30~50% brightness relative to surface
- Backside roughness: Not specified
- Chip size: 1025.1um x 1023.1um
- Scribe line: 80um (with 20um seal ring per side)
- Passivation type: PSG and SIN
- Passivation material: PSG and SIN
- Passivation Thickness: PSG 2.5K Å and SIN 3K Å

Gold Bump Specification

- Bump material: >99.9% pure Au
- Bump hardness: 35 – 80 HV 0.005
- Bump shear strength: >70MPa
- Bump height: 15 ± 3*u*m
- Bump height uniformly:
  - Within a die: ± 2 *u*m
  - Within a wafer: ± 3 *u*m
  - Wafer to wafer: ± 4 *u*m
- Bump flatness: ± 1.5 *u*m
- Bump size:
  - ANTP, ANTM, TIO1, TIO2, TIO3: ANTP, ANTM: 80um x 80um; TIO1, TIO2, TIO3: 60um x 60um
  - Variation: ± 5 *u*m
- Under bump metallization: Sputtered TiW

Wafer Mapping

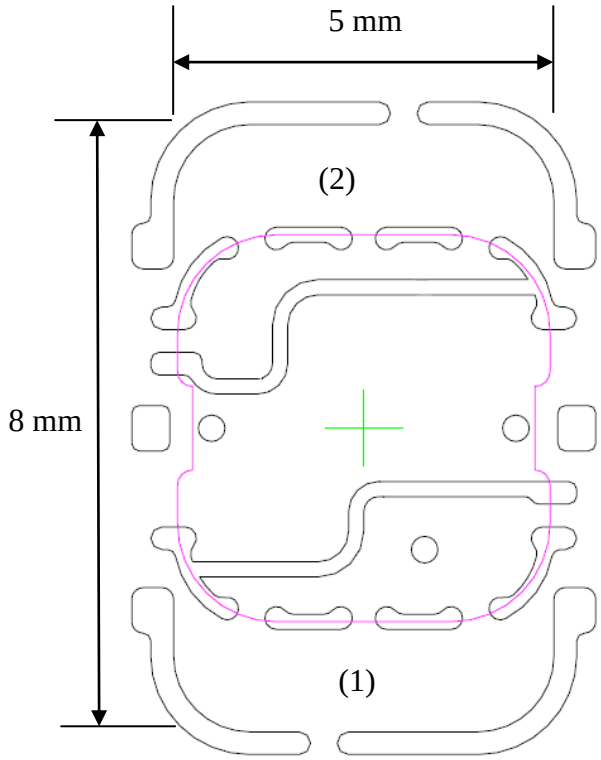




Symbol	Dimension (um)
A	1025.1um
B	1023.1um
C	80.00um
D	60.00um
a	5.00um
b	10.00um
c	5.00um
d	7.67um
e	5.00um
f	238.74um
g	5.00um
h	10.00um
i	5.00um
j	86.10um

Note: All dimensions measure form outer of seal ring to boundary of Pad opening

MOA2 Form Factor



Pads No.	Pad Name
1	ANTM
2	ANTP

Order Information

Part Number	Form Factor	Packaging
A9212-A-W0	Bare dice	Sawn wafer (wafer on blue tape)
A9212-A-W1	Dice with Au Bump	Sawn wafer (wafer on blue tape)
A9212-A-M2	MOA2 / IOA2 module	Reel

Revision History

Revision	Date	Description	by
1.0	02/2010	Initial creation	Q.S.