Application Note

IMPINJ MONZA X-2K DURA TO MONZA X-8K DURA CONVERSION

TRANSITION GUIDELINES AND BENEFITS

Version 1.0

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1 INTRODUCTION

Impinj has ended production of the Impinj Monza X-2K Dura RAIN RFID tag chips. The last date to place orders is July 10, 2020. The replacement device for the Impinj Monza X-2K Dura is the Monza X-8K Dura. The Impinj Monza X-8K has the same features as the Monza X-2K but has a larger package size and additional memory. The Impinj Monza X-8K is designed to be drop-in compatible with the recommend Printed Circuit Board (PCB) footprint as shown in both device datasheets, enabling you to easily transition your Impinj Monza X-2K design to the Monza X-8K tag chip.

This application note is a technical guide outlining the considerations for end users transitioning from the Impinj Monza X-2K to Monza X-8K. It details important differences between Impinj Monza X family tag chips and specific recommendations to ensure design compatibility when working with the larger package size of the Impinj Monza X-8K.

1.1 Reference Documents

*EPC Radio-Frequency Identity Protocols Generation-2 UHF RFID Protocol for Communications at 860 MHz – 960 MHz (Gen2 Specification, version 1.2.0 May 2008) (*https://www.gs1.org/standards/epc-rfid/uhf-air-interface-protocol).

Impinj Monza X-2K Dura Tag Chip Product Brief / Datasheet (https://support.impinj.com/hc/en-us/articles/202756848-Monza-X-2K-Dura-Product-Brief-Datasheet).

Impinj Monza X-8K Dura Tag Chip Product Brief / Datasheet (https://support.impinj.com/hc/en-us/articles/202756868-Monza-X-8K-Dura-Product-Brief-Datasheet).

2 IMPINJ MONZA X-8K COMPARISON TO MONZA X-2K

The Impinj Monza X family of tag chips are built to allow design compatibility between both chips. The two primary differences between the Impinj Monza X-2K and Monza X-8K tag chips are that the Monza X-8K chip has additional memory and larger package size. Table 1 shows the feature comparison between the chips.

Table 1: Impinj Monza X-2K and Monza X-8K Feature Comparison

FEATURE	IMPINJ MONZA X-2K DURA	IMPINJ MONZA X-8K DURA
EPC Memory	128 bits	128 bits
User Memory	2176 bits	8192 bits
Read Sensitivity	-19.1 / -26.1 BAP	-19.1 / -26.1 BAP
Write Sensitivity	-14.1 / -26.1 BAP	-14.1 / -26.1 BAP
Write Speed	4.7 ms per 32 bits	4.7 ms per 32 bits
UMI Bit Setting	Computed	Set to 0, Programmable
Access Password	Yes	Yes
Kill Password	Yes	Yes
***BlockPermalock* Blocks**	5	16
QT Memory Profiles	Yes	Yes
TagFocus™ Mode	Yes	Yes
FastID™ Mode	Yes	Yes
Write-Wakeup Mode	Yes	Yes
R_p Port Parameter	1.6 kΩ	1.6 kΩ
C_p Port Parameter	1.0 pF	1.0 pF
RF Ports	2	2
Self-Serialization (TID)	Yes	Yes
I2C Communication	Yes	Yes
Configurable I2C Address	Yes	Yes
Monza X API Compatibility	Yes	Yes
IC Package	XQFN, 8 Lead	XQFN, 8 Lead
Package Dimensions	1.6 mm x 1.6 mm x 0.35 mm	2.0 mm x 2.0 mm x 0.35 mm
Monza X Universal Footprint Compatibility	Yes	Yes

2.1 Tag Memory

Impinj Monza X family tag chips have different amounts of User memory for each chip:

- Monza X-2K: 2176 bits
- Monza X-8K: 8192 bits.

Tag chips may be identified by reading the first 32 bits of TID memory. The values, in hex, are below.

- Monza X-2K: E2801140
- Monza X-8K: E2801150

Additionally, these chips have differences between the User Memory Indicator (UMI) bit function and the number of *BlockPermalock* blocks available. These differences are described in the following sections.

2.1.1 Protocol Control Bits and User Memory Indicator (UMI) Bit

As per the Gen2 specification, EPC memory contains a 16-bit cyclic-redundancy check word (CRC16) at memory addresses 00_h to $0F_h$, 16 protocol-control bits (PC) at memory addresses 10_h to $1F_h$, and an EPC value beginning at address 20_h.

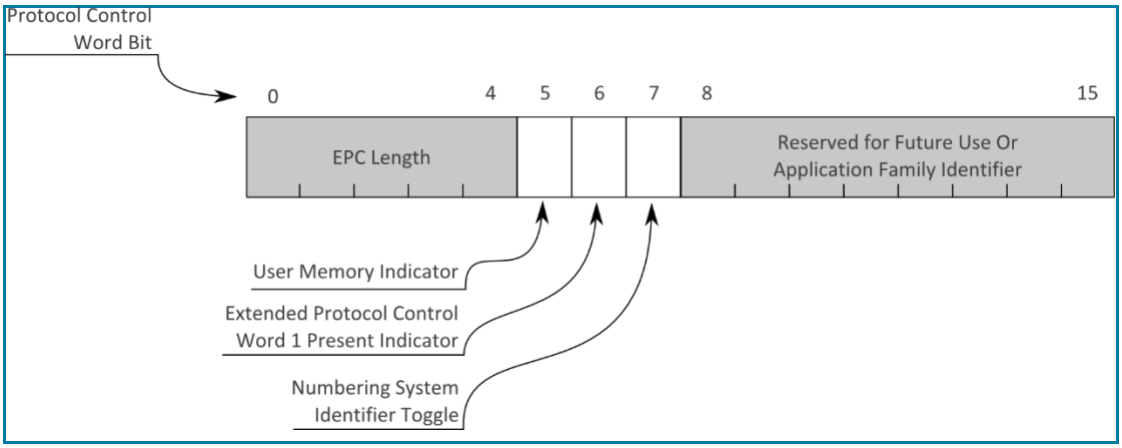
As shown in Figure 1, the PC bits include:

- A five-bit EPC length
- A one-bit User-memory indicator (UMI)
- A one-bit extended protocol-control word 1 indicator (XI), fixed to 0
- A nine-bit programmable numbering system identifier (NSI)

The UMI bit is located at EPC bit address 15_h. The UMI bit is set to a default value of 0 for all Impinj Monza X family tag chips but will change based on the programming of the Monza X tag chip as described below.

The factory-programmed value of the PC bits is 3000_h.

Figure 1: Protocol Control Bits



2.1.1.1 Impinj Monza X-2K UMI Bit Function: Computed

For the Impinj Monza X-2K, the UMI bit is computed based on bits in User memory. The computed UMI bit value is calculated from the bitwise OR of bits 03_h through 07_h in the first word of User memory.

For the Impinj Monza X-2K, the computed UMI bit is only readable from the Gen2 interface. When accessing the tag chip from the I2C interface, there is a separately readable and writable NVM bit that is addressable at the same memory location which may never be seen from Gen2.

2.1.1.2 Impinj Monza X-8K UMI Bit Function: Set to 0 and Programmable

For the Impinj Monza X-8K, the UMI bit is initially set to 0. The UMI bit is NVM memory and is both readable and writeable from either the Gen2 or I2C interfaces. The UMI bit value is the same for I2C and Gen2. The I2C master or RAIN RFID reader may re-write the UMI bit to indicate data has been stored in the User memory bank.

2.1.2 *BlockPermalock* Comparison

Impinj Monza X tag chips support the optional Gen2 *BlockPermalock* command. *BlockPermalock* can permanently lock blocks of User memory individually and independent of the locking capabilities of the *Lock* command, which allows locking an entire memory field. The number of blocks available depends on the tag chip. The Impinj Monza X-8K has more blocks available than the Monza X-2K, allowing more permanently lockable blocks of User memory. Note that the first five blocks are identical between Impinj Monza X family tag chips.

- Monza X-2K: 5 blocks
- Monza X-8K: 16 blocks

A user may permanently lock any or all blocks from either the Gen2 interface or I2C interface. Once a block is permanently locked, it may not be unlocked using Gen2 or I2C, with one exception: block zero may always be written or unlocked from the I2C interface. Impinj Monza X tag chips ignore the *BlockPermalock* status for block zero from the I2C interface.

Note that a large portion of the Impinj Monza X-8K User memory bank has no *BlockPermalock* blocks, while the entire Monza X-2K User memory bank is divided into *BlockPermalock* blocks.

The following tables present the *BlockPermalock* blocks for the Impinj Monza X family of tag chips.

Table 2: Impinj Monza X-2K *BlockPermalock* Blocks

USER MEMORY BANK BIT RANGE	BLOCKS	I2C BLOCKPERMALOCKABLE	GEN2 BLOCKPERMALOCKABLE
2048 - 2175	BLOCK 4 (128 bits)	Yes	Yes
1536 - 2047	BLOCK 3 (512 bits)	Yes	Yes
1024 - 1535	BLOCK 2 (512 bits)	Yes	Yes
512 - 1023	BLOCK 1 (512 bits)	Yes	Yes
0 - 511	BLOCK 0 (512 bits)	No	Yes

Table 3: Impinj Monza X-8K *BlockPermalock* Blocks

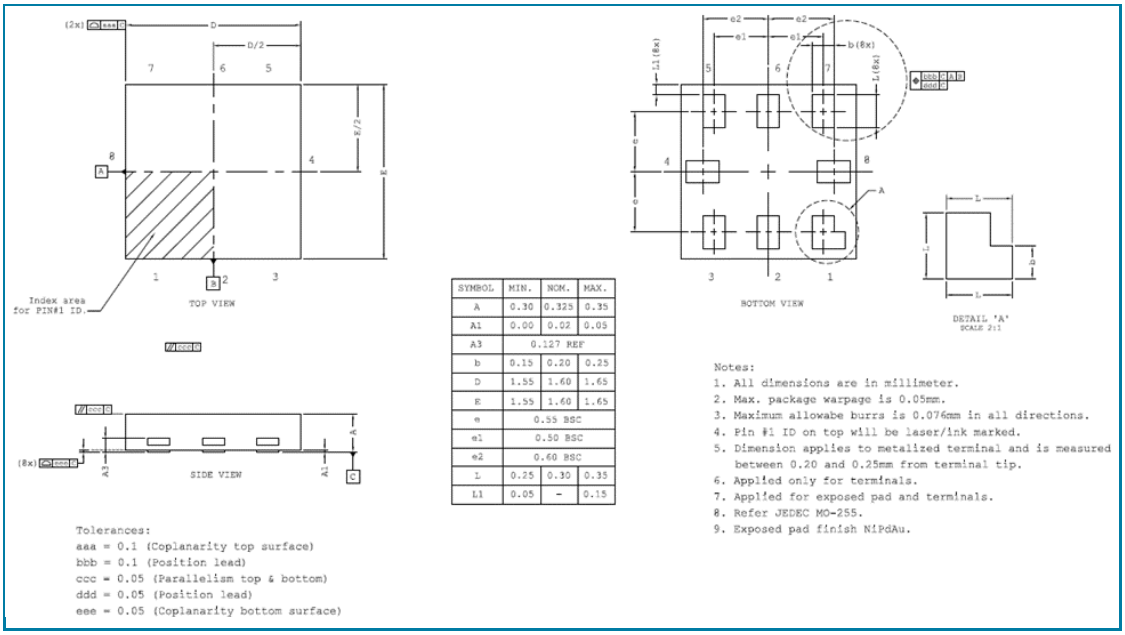
USER MEMORY BANK BIT RANGE	BLOCKS	I2C BLOCKPERMALOCKABLE	GEN2 BLOCKPERMALOCKABLE
3584 - 8191	REST OF USER MEMORY (NO *BlockPermalock* BLOCKS)	No	No
3456 - 3583	BLOCK 15 (128 bits)	Yes	Yes
3328 - 3455	BLOCK 14 (128 bits)	Yes	Yes
3200 - 3327	BLOCK 13 (128 bits)	Yes	Yes
3072 - 3199	BLOCK 12 (128 bits)	Yes	Yes
2944 - 3071	BLOCK 11 (128 bits)	Yes	Yes
2816 - 2943	BLOCK 10 (128 bits)	Yes	Yes
2688 - 2815	BLOCK 9 (128 bits)	Yes	Yes
2560 - 2687	BLOCK 8 (128 bits)	Yes	Yes
2432 - 2559	BLOCK 7 (128 bits)	Yes	Yes
2304 - 2431	BLOCK 6 (128 bits)	Yes	Yes
2176 - 2303	BLOCK 5 (128 bits)	Yes	Yes
2048 - 2175	BLOCK 4 (128 bits)	Yes	Yes
1536 - 2047	BLOCK 3 (512 bits)	Yes	Yes
1024 - 1535	BLOCK 2 (512 bits)	Yes	Yes
512 - 1023	BLOCK 1 (512 bits)	Yes	Yes
0 - 511	BLOCK 0 (512 bits)	No	Yes

2.2 Physical Specifications

The package sizes for the Impinj Monza X tag chips are listed below:

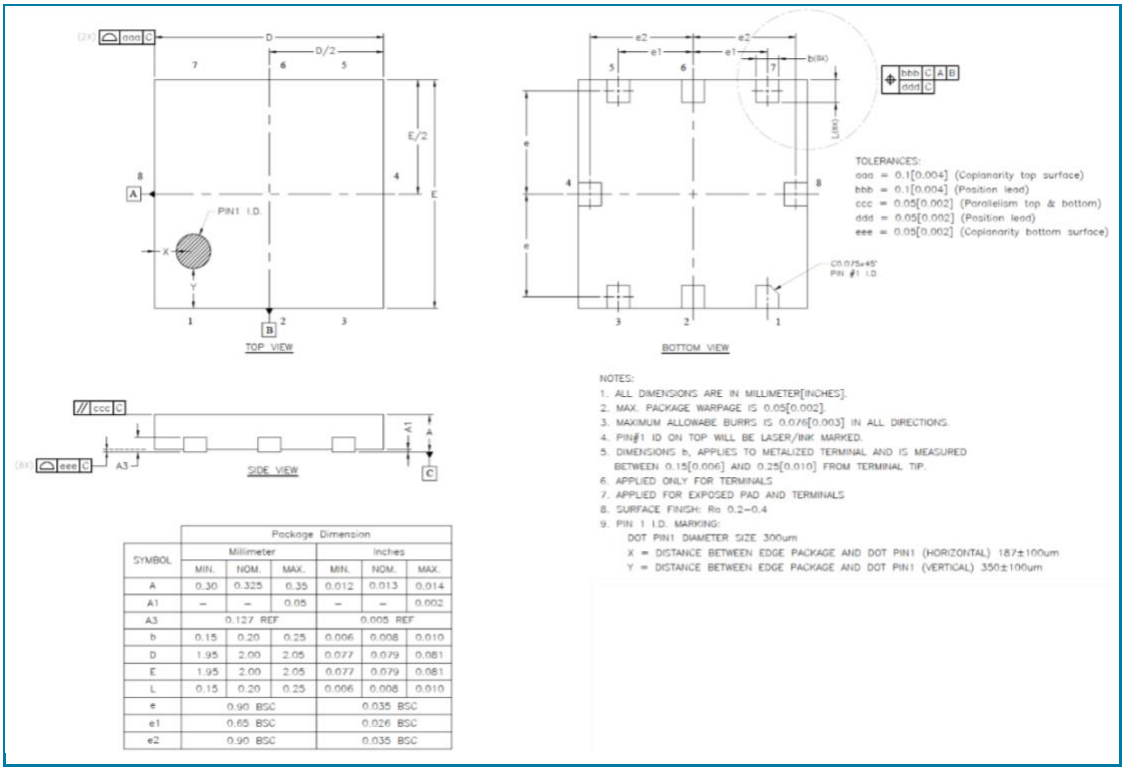
- Monza X-2K: 1.6 mm x 1.6 mm x 0.35 mm
- Monza X-8K: 2.0 mm x 2.0 mm x 0.35 mm

Figure 2: Impinj Monza X-2K Mechanical Dimensions



SYMBOL	MIN.	NOM.	MAX.
A	0.30	0.325	0.35
A1	0.00	0.02	0.05
A3		0.127 REF	
b	0.15	0.20	0.25
D	1.55	1.60	1.65
E	1.55	1.60	1.65
e		0.55 BSC	
e1		0.50 BSC	
e2		0.60 BSC	
L	0.25	0.30	0.35
L1	0.05	-	0.15

Figure 3: Impinj Monza X-8K Mechanical Dimensions*



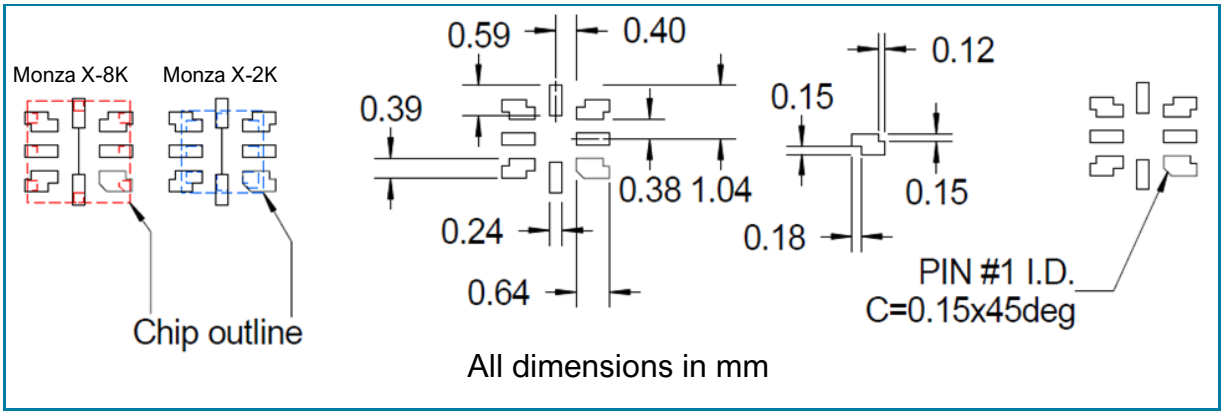
SYMBOL	Package Dimension					
	Millimeter			Inches		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.30	0.325	0.35	0.012	0.013	0.014
A1	–	–	0.05	–	–	0.002
A3	0.127 REF			0.005 REF		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	1.95	2.00	2.05	0.077	0.079	0.081
E	1.95	2.00	2.05	0.077	0.079	0.081
L	0.15	0.20	0.25	0.006	0.008	0.010
e	0.90 BSC			0.035 BSC		
e1	0.65 BSC			0.026 BSC		
e2	0.90 BSC			0.035 BSC		

**The position of the Pin1 I.D. marking dot in the Mechanical Dimensions is specified for Monza X-8K Dura chips manufactured on or after date code "1807" as shown on the package box label, or "807" as shown on the product markings (see Product Delivery Specifications). Parts produced before this date code have a Pin1 I.D. marking positioned 100um closer to the vertical center line (B) of the package.*

2.2.1 *Impinj Monza X Universal Footprint Compatibility*

The Impinj Monza X-8K is designed to be a drop-in replacement for Monza X-2K if the recommended PCB layout footprint in Figure 4 is used. This is the same footprint shown in the Impinj Monza X-2K and Monza X-8K datasheets.

Figure 4: Recommended Common Layout Footprint for Impinj Monza X Tag Chips



3 ANTENNA DESIGN CONSIDERATIONS

The Impinj Monza X-2K and Monza X-8K tag chips have the same pinout and the same tag chip impedance values. Using the universal footprint, the Impinj Monza X-8K will be drop-in compatible with Impinj Monza X-2K antenna designs.

For more information on designing antennas for Impinj Monza X tag chips, refer to the Monza X Antenna Design Application Note on the Impinj Support website[1].

4 PRODUCT DELIVERY SPECIFICATIONS

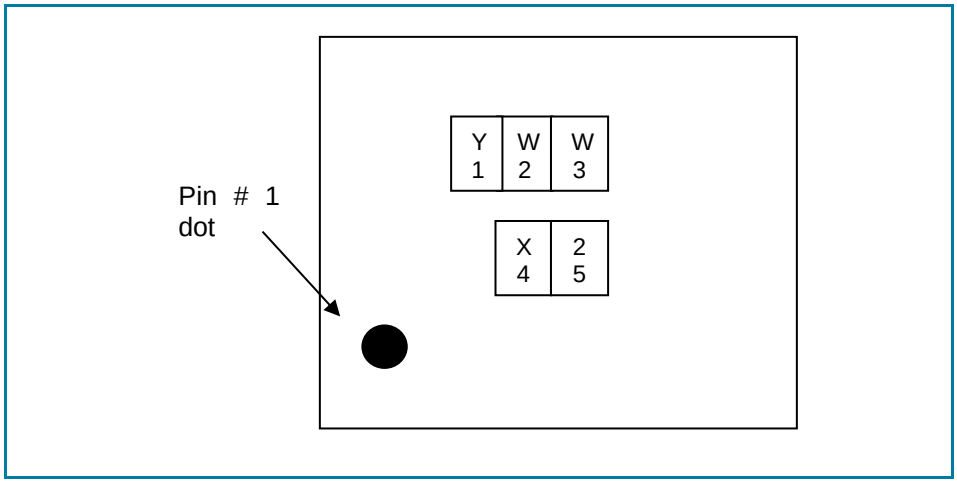
Both Impinj Monza X tag chips are delivered on tape and reel, following the specifications as described in the product datasheets.

4.1 Product Markings

The product marking specifications (see Figure 5, Figure 6, and Figure 7) have been updated with more detailed specifications for the Impinj Monza X-8K. Additionally, the single-digit year of production rolls over for Impinj Monza X-8K in 2020. Production of the Impinj Monza X-2K stopped prior to 2020.

4.1.1 Impinj Monza X-2K Marking Specifications

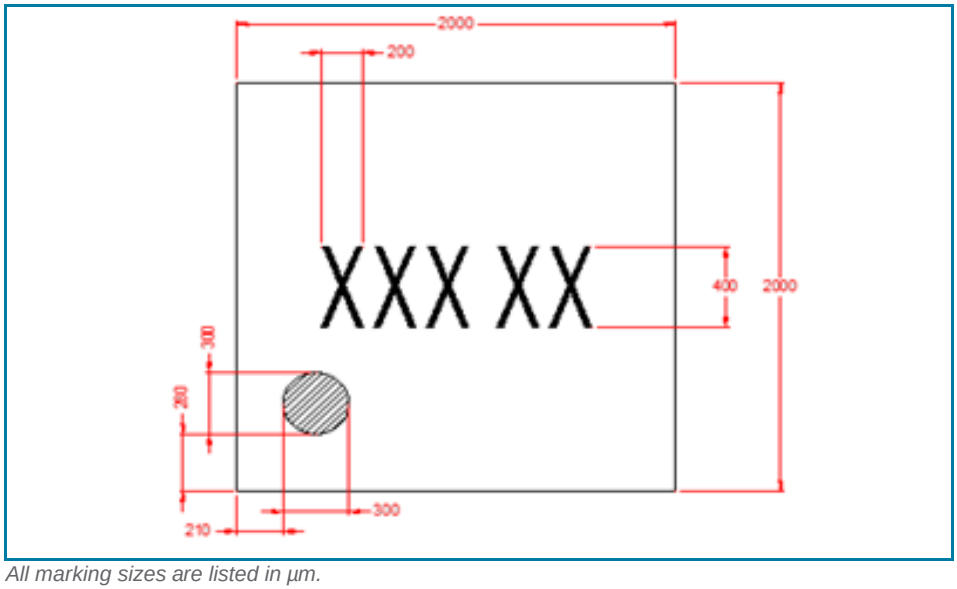
Figure 5: Impinj Monza X-2K Marking Specifications



- Y= Year of production (e.g. 1 = 2011, 2 = 2012 …)
- WW = Work Week of production
- X2 = Product Code (Monza X-2K Dura)

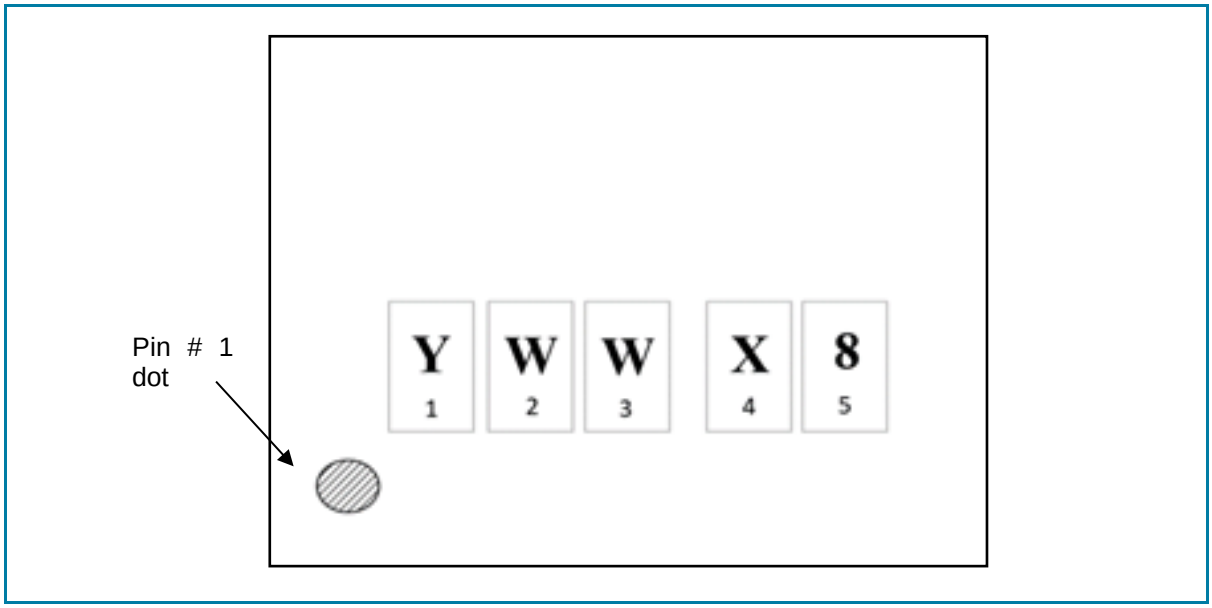
4.1.2 Impinj Monza X-8K Marking Specifications

Figure 6: Impinj Monza X-8K Marking Sizes Diagram (µm)



All marking sizes are listed in µm.

Figure 7: Impinj Monza X-8K Marking Specifications



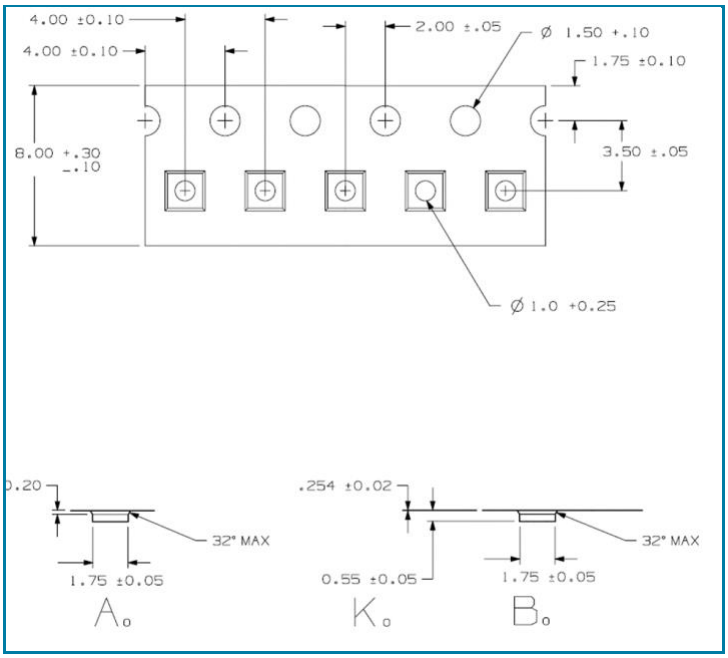
This is the Product Marking as it appears on the Impinj Monza X-8K chip. Note that YWW will be replaced with the production year and work week. For example: "012" would represent the year 2020 and work week 12.

- Y= Year of production (e.g. 0 = 2020, 1 = 2021…)
- WW = Work Week of production
- X8 = Product Code (Monza X-8K Dura)

4.2 Tape and Reel Specification

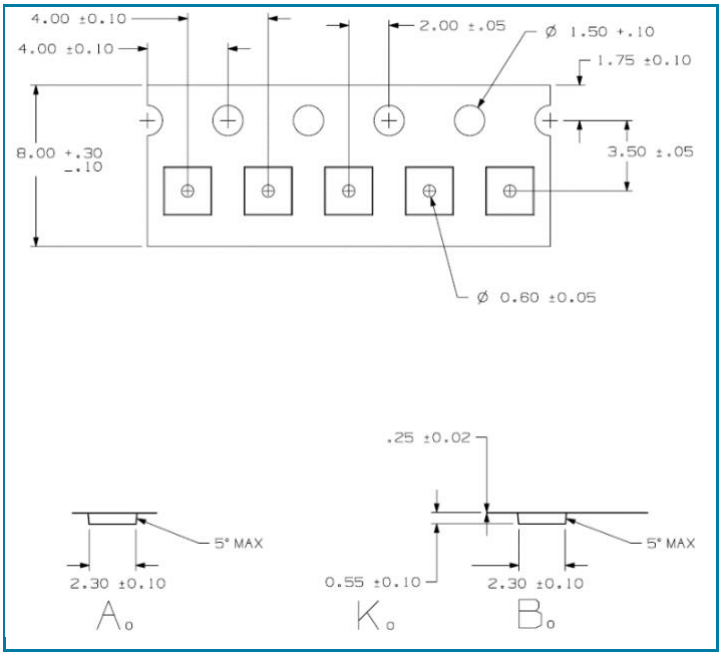
The tape and reel specifications (see Figure 8 and Figure 9) are nearly identical between Impinj Monza X tag chips. The pitch is identical, but the cavity size is larger for Impinj Monza X-8K to accommodate the larger package size.

Figure 8: Impinj Monza X-2K Tape and Reel Specification



Parts per reel / Minimum order quantity: 3000

Figure 9: Impinj Monza X-8K Tape and Reel Specification



Parts per reel / Minimum order quantity: 3000

5 EXTERNAL REFERENCES

[1] Support Link: *Monza X Antenna Design Application Note* (https://support.impinj.com/hc/en-us/articles/202756888-Monza-X-Antenna-Design-Application-Note)

6 NOTICES