Application Note

IMPINJ®

MONZA®

TID MEMORY MAPS FOR MONZA SELF-SERIALIZATION

Version 3.0

www.impinj.com

TABLE OF CONTENTS

1 INTRODUCTION

RFID tags have been applied to billions of apparel items and an increasing number of retailers are requesting RFID tagged items from their suppliers. RFID systems require that each item have a unique serial number so that it can be identified or counted; so brand owners are faced with the challenge of managing and encoding unique serial numbers across their global, and often complex, supply chains.

In the past, brand owners only had a choice between implementing and administering their own IT-based serialization systems or outsourcing serial number management to one or more qualified third-party service bureaus. These options for implementing or outsourcing serialization may force brand owners to change their business processes in ways that increase costs or decrease their supply chain responsiveness and flexibility.

With Monza® Self-Serialization brand owners have an easy-to-deploy and scalable EPC serialization method based on Impinj's breakthrough tag chip serial number management and an ecosystem of high-performance encoding solutions. Monza Self-Serialization enables brand owners to generate a serial number directly from their tag's Monza chip, eliminating the need for IT systems to coordinate, distribute and synchronize serial numbers. In addition, brand owners gain control and flexibility to choose when, where and how they manage their RFID tagging processes and deliver properly tagged products.

At the heart of Monza® Self-Serialization are Impinj's Monza family of tag chips. Boasting leading encoding performance and built-in scalable serialization, these tag chips are supported by a global ecosystem of high quality inlay manufacturers and service bureaus. Monza® Self-Serialization allows RFID printer encoders and inline or bulk encoding solutions based on the Impinj ItemEncode® software to construct a unique Serialized Global Trade Item Number (SGTIN) under the hood, using existing IT-based barcode and variable data management business processes.

Monza Self-Serialization allows:

- Scalable serialization built into Monza tag chips
- SGTIN serial numbers generated directly from Monza's unalterable Tag Identifier (TID)
- EPC data quality and integrity with verifiable SGTIN at any point in supply chain
- Forward compatible with future generations of Monza tag chips

Monza Self-Serialization is an easy to deploy and scalable chip-based serialization method for item-level RFID tagging where a unique EPC serial number is generated from the unalterable serialized Tag Identifier (TID) and encoded as part of a unique Electronic Product Code (EPC) into the EPC memory bank of a Monza tag chip.

This application note documents the use of the unalterable serialized Tag Identifier (TID) for generating serial numbers which may be stored in the EPC memory bank. For details on using Monza Self-Serialization for the serialization of Serialized Global Trade Item Number (SGTIN) EPC and implementation best practices for brand owners and those implementing support in encoding systems, please refer to the application note "Monza Self-Serialization" found on www.impinj.com.

2 MONZA TAG CHIP MODELS

Table 1 – TID Bits for Monza Models

SERIALIZATION FAMILY	TAG CHIP	1ST 32-BITS OF TID
Monza	Monza R6-P	E2801170
Monza	Monza R6-A	E2801171
Monza	Monza S6-C	E2801173
Monza	Monza R6	E2801160
Monza	Monza 5	E2801130
Monza	Monza 4D	E2801100
Monza	Monza 4E	E280110C
Monza	Monza 4QT	E2801105
Monza	Monza 4i	E2801114
MonzaX	Monza X-2K	E2801140
MonzaX	Monza X-8K	E2801150

2.1 Monza Self-Serialization Formulas

To accommodate differences in TID serial number structures between Monza tag chip families and to enable forward compatible innovation in future generations of Monza tag chips, Impinj utilizes Monza model specific “formulas” to specify which bits should be used from the TID and how those bits should be ordered to construct a unique serial number that can be used in EPC compliant or other customer specific tag data schemas.

2.2 Monza Series

- Monza tag chips contain 2-bit Monza Series ID in the TID memory bank to identify the serial number pool that the serial number was generated from. These tag chips can support Series 0 [00] through Series 3 [11].
- Currently, there are two different serialization families: Monza and MonzaX.
- For a serialization family and a given series there is a unique set of 38-bit serial number values which may be shared across multiple tag chip models. Serial numbers are not unique across multiple series and serialization families. As an example, Monza R6 Series 1 and Monza 5 Series 1 are each independent SKUs that contain

serial numbers from the same Monza Series 1 serial number pool. Meanwhile, Monza 4 Series 0, Monza 5 Series 1 and Monza X-8K Series 3 span multiple serialization families and multiple series, so these serial numbers come from different pools and would not be guaranteed unique.

- End users can utilize Monza Self-Serialization on tag chips with different serial number sources (Example: Monza 5 Series 1 and Monza 4 Series 0) by assigning a unique serialization prefix (MSB of generated 38-bit serial number) to each.
- The 96-bit TIDs and 96-bit serial numbers for all Monza tags are unique.
- Currently the “Monza” serialization family uses Series 1 and the “MonzaX” serialization family uses Series 3 specifically for the Monza X tag chip family.

2.3 Monza Series Cycle Counter

- The Series Cycle Counter is a Series specific 1-bit value that increments when the series rolls over.
- The cycle counter is used to identify series rollover by downstream customers and to maintain 96-bit TID uniqueness.
- The cycle counter is not contained in the TID memory of Monza 5, Monza 4, Monza X-2K or Monza X-8K tag chips and is always set to zeros. The Monza 6 family tag chips supports the cycle counter in TID NVM.

2.4 Serialization Bits

Monza tag chips come with a 48-bit serialized number found in bits 30_h-$5F_h$ of TID memory. This number includes additional information such as the Monza Series ID and the Monza Series Cycle Counter along with a 38-bit serial number that is unique for a serialization family for a given series as defined for each Monza tag chip in the following sections.

The table below shows how the bits from Monza Self-Serialization are used for generating serialized 96-bit EPC values.

Table 2 – Supported EPC Memory Serialization Bits When Using Monza Self-Serialization

BITS	DATA (ZEROS FROM MSS)	VALUES
35	FFFFFFFFFFFFFFF800000000	[61-bits Data][35-bit Serial Number]
36	FFFFFFFFFFFFFFF000000000	[60-bits Data][36-bit Serial Number]
37	FFFFFFFFFFFFFFE000000000	[59-bits Data][37-bit Serial Number]
38	FFFFFFFFFFFFFFC000000000	[58-bits Data][38-bit Serial Number]
96	000000000000000000000000	[96-bit Serial Number]

2.5 Monza 6 Family TID Memory Map

Monza 6 TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50_h-$5F_h$																
40_h-$4F_h$																
30_h-$3F_h$																
20_h-$2F_h$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10_h-$1F_h$	0	0	0	1	0	0	0	1	0	1	1	x	x	x	x	x
00_h-$0F_h$	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

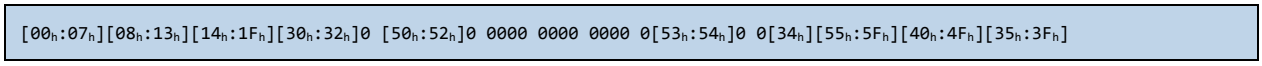
Segment	Location	Bits	Binary	Value
ISO / IEC 15963 Class Identifier	00_h-07_h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08_h-13_h	12	100000000001	Impinj
Tag Model Number (TMN)	14_h-$1F_h$	12	0001011xxxxx	Monza 6 family
EPC Tag Data Standard Header	20_h-$2F_h$	16	0010000000000000	Supports extended TID (XTID) – 48-bit SN
Wafer Mask Revision	30_h-32_h	3		Indicates the Mask Revision for the tag
	33_h	1	Parity	Bit is set to guarantee bits 30:5F have even parity
Reserved for Future Use	50_h-52_h	3	000	
Monza Series ID	53_h-54_h	2	01	Supports Series 0 – Series 3
Monza Series Cycle Counter	34_h	1	0	Series rollover indicator
Serial Number		38		

Figure 1 – Monza 6 TID Memory Map

Table 3 – Monza 6 Model Numbers

TAG MODEL	TAG MODEL NUMBER	WAFER MASK REVISION
Monza R6	000101100000	011
Monza R6-A	000101110001	000
Monza R6-P	000101110000	000
Monza S6-C	000101110011	000

Series 0 [00] – Series 3 [11] 96-bit Serial Number Formula



Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula

Figure 2 – Monza 6 Serial Number Formulas

Implementation notes:

- Monza 6 family tag chip's EPC is pre-serialized using the 96-bit serial number formula above.
- Last 48-bits of TID should always have even parity.

2.5.1 Example – Monza R6-P Series 1 Serial Number

This example demonstrates using the Monza Self-Serialization formula outlined above to generate 96-bit and 38-bit serial numbers from the TID.

Monza R6-P TID: E280117020001089CCEB08DF

Monza 6 TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50_h-$5F_h$	0	0	0	0	1	0	0	0	1	1	0	1	1	1	1	1
40_h-$4F_h$	1	1	0	0	1	1	0	0	1	1	1	0	1	0	1	1
30_h-$3F_h$	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1
20_h-$2F_h$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10_h-$1F_h$	0	0	0	1	0	0	0	1	0	1	1	1	0	0	0	0
00_h-$0F_h$	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

Segment	Location	Bits	Binary	Value
ISO / IEC 15963 Class Identifier	00_h-07_h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08_h-13_h	12	100000000001	Impinj
Tag Model Number (TMN)	14_h-$1F_h$	12	000101110000	Monza R6-P
EPC Tag Data Standard Header	20_h-$2F_h$	16	0010000000000000	Supports extended TID (XTID) – 48-bit SN
Wafer Mask Revision	30_h-32_h	3	000	Indicates the Mask Revision for the tag
	33h	1	1	Bit is set to guarantee bits 30:5F have even parity
Reserved for Future Use	50_h-52_h	3	000	
Monza Series ID	53_h-54_h	2	01	Supports Series 0 – Series 3
Monza Series Cycle Counter	34_h	1	0	Series rollover indicator
Serial Number		38	00011011111111001001110101100010001001	30037989513 (decimal)

Figure 3 – Monza 6 TID Memory Map Example

Series 0 [00] – Series 3 [11] 96-bit Serial Number Formula

```
[00h:07h][08h:13h][14h:1Fh][30h:32h]0 [50h:52h]0 0000 0000 0000 0[53h:54h]0 0[34h][55h:5Fh][40h:4Fh][35h:3Fh]
MSB                                                                                                    LSB
```

Series 1 96-bit Serial Number (binary): 1110 0010 1000 0000 0001 0001 0111 0000 0000 0000 0000 0000 0000 0010 0000 0110 1111 1110 0110 0111 0101 1000 1000 1001

Series 1 96-bit Serial Number (hex): E280117000000206FE675889

Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula

```
[55h:5Fh][40h:4Fh][35h:3Fh]
MSB                    LSB
```

Series 1 38-bit Serial Number (binary): 00 0110 1111 1110 0110 0111 0101 1000 1000 1001

Series 1 38-bit Serial Number (hex): 06FE675889

Figure 4 – Monza 6 Serial Number Formulas Example

2.6 Monza 5 TID Memory Map

Monza 5 TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50h-5Fh																
40h-4Fh																
30h-3Fh																
20h-2Fh	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10h-1Fh	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0
00h-0Fh	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

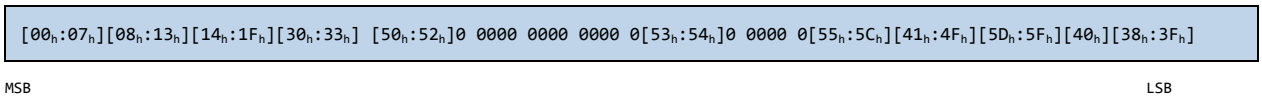
Segment	Location	Bits	Binary	Value
ISO / IEC 15963 Class Identifier	00h-07h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08h-13h	12	100000000001	Impinj
Tag Model Number (TMN)	14h-1Fh	12	000100110000	Monza 5
EPC Tag Data Standard Header	20h-2Fh	16	0010000000000000	Supports extended TID (XTID)
Wafer Mask Revision	30h-33h	4		Indicates the Mask Revision for the tag
Reserved for Future Use	50h-52h	3	000	
Monza Series ID	53h-54h	2	01	Supports Series 0 – Series 3
Monza Series Cycle Counter		0	N/A	Series rollover indicator
Serial Number		38		

Figure 5 – Monza 5 TID Memory Map

Table 4 – Monza 5 Model Number

TAG MODEL	TAG MODEL NUMBER	WAFER MASK REVISION
Monza 5	000100110000	0011

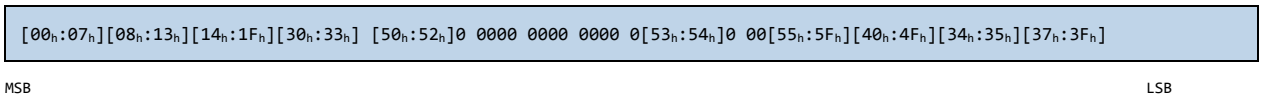
Series 0 [00] 96-bit Serial Number Formula



Series 0 [00] 38-bit Serial Number Formula

Figure 6 – Monza 5 Serial Number Formulas (Series 0)

Series 1 [01] – Series 3 [11] 96-bit Serial Number Formula



Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula

Figure 7 – Monza 5 Serial Number Formulas (Series 1 through 3)

2.6.1 Example – Monza 5 Series 1 Serial Number

This example demonstrates using the Monza Self-Serialization formula outlined above to generate 96-bit and 38-bit serial numbers from the TID.

Monza 5 TID: E280113020003993EEE1088E

Monza 5 TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50_h-$5F_h$	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0
40_h-$4F_h$	1	1	1	0	1	1	1	0	1	1	1	0	0	0	0	1
30_h-$3F_h$	0	0	1	1	1	0	0	1	1	0	0	1	0	0	1	1
20_h-$2F_h$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10_h-$1F_h$	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0
00_h-$0F_h$	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

Segment	Location	Bits	Binary	Value
ISO / IEC 15963 Class Identifier	00_h-07_h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08_h-13_h	12	100000000001	Impinj
Tag Model Number (TMN)	14_h-$1F_h$	12	000100110000	Monza 5
EPC Tag Data Standard Header	20_h-$2F_h$	16	0010000000000000	Supports extended TID (XTID)
Wafer Mask Revision	30_h-33_h	4	0011	Indicates the Mask Revision for the tag
Reserved for Future Use	50_h-52_h	3	000	
Monza Series ID	53_h-54_h	2	01	Supports Series 0 – Series 3
Monza Series Cycle Counter		0	N/A	Series rollover indicator
Serial Number		38		

Figure 8 – Monza 5 TID Memory Map Example

Series 1 [01] – Series 3 [11] 96-bit Serial Number Formula

```
[00h:07h][08h:13h][14h:1Fh][30h:33h] [50h:52h]0 0000 0000 0000 0[53h:54h]0 00[55h:5Fh][40h:4Fh][34h:35h][37h:3Fh]
MSB                                                                                                          LSB
```

Series 1 96-bit Serial Number (binary): 1110 0010 1000 0000 0001 0001 0011 0000 0011 0000 0000 0000 0000 0010 0000 0100 0111 0111 0111 0111 0000 1101 1001 0011

Series 1 96-bit Serial Number (hex): E2801130300020477770D93

Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula

```
[55h:5Fh][40h:4Fh][34h:35h][37h:3Fh]
MSB                                                                                                          LSB
```

Series 1 38-bit Serial Number (binary): 00 0100 0111 0111 0111 0111 0000 1101 1001 0011

Series 1 38-bit Serial Number (hex): 0477770D93

Figure 9 – Monza 5 Serial Number Formulas Example

2.7 Monza 4 TID Memory Map

Monza 4 TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50_h-$5F_h$																
40_h-$4F_h$																
30_h-$3F_h$																
20_h-$2F_h$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10_h-$1F_h$	0	0	0	1	0	0	0	1	0	0	0	x	x	x	x	x
00_h-$0F_h$	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

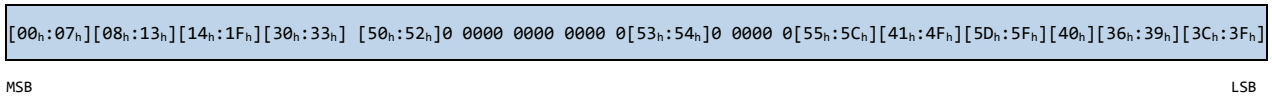
Segment	Location		Binary	Value
ISO / IEC 15963 Class Identifier	00_h-07_h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08_h-13_h	12	100000000001	Impinj
Tag Model Number (TMN)	14_h-$1F_h$	12	0001000xxxxx	Monza 4 family
Tag Data Standard Header	20_h-$2F_h$	16	0010000000000000	Supports extended TID (XTID)
Wafer Mask Revision	30_h-33_h	4		Indicates the Mask Revision for the tag
Reserved for Future Use	50_h-52_h	3	000	
Monza Series ID	53_h-54_h	2	01	Supports Series 0 – Series 3
Monza Series Cycle Counter		0	N/A	Series rollover indicator
Serial Number		38		

Figure 10 – Monza 4 TID Memory Map

Table 5 – Monza 4 Model Numbers

TAG MODEL	TAG MODEL NUMBER	WAFER MASK REVISION
Monza 4D	000100000000	0111
Monza 4E	000100001100	0111
Monza 4QT	000100000101	0111
Monza 4i	000100010100	0111

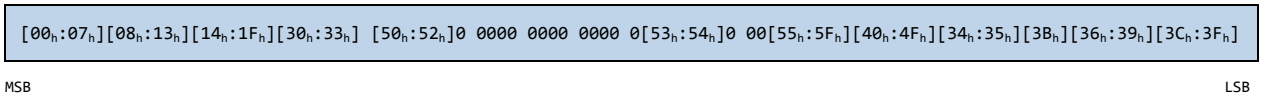
Series 0 [00] 96-bit Serial Number Formula



Series 0 [00] 38-bit Serial Number Formula

Figure 11 – Monza 4 Serial Number Formulas (Series 0)

Series 1 [01] – Series 3 [11] 96-bit Serial Number Formula



Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula

Figure 12 – Monza 4 Serial Number Formulas (Series 1 through 3)

2.8 Monza X Family TID Memory Map

MonzaX Family TID Memory Bank																
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
50_h-$5F_h$																
40_h-$4F_h$																
30_h-$3F_h$																
20_h-$2F_h$	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10_h-$1F_h$	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0
00_h-$0F_h$	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0

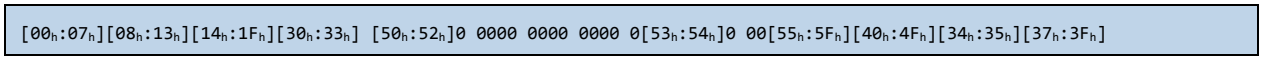
Segment	Location	Bits	Binary	Value
ISO / IEC 15963 Class Identifier	00_h-07_h	8	11100010	GS1 EPCglobal Class 1 Gen 2
Mask Designer Identifier (MDID)	08_h-13_h	12	100000000001	Impinj
Tag Model Number (TMN)	14_h-$1F_h$	12	0001010X0000	
EPC Tag Data Standard Header	20_h-$2F_h$	16	0010000000000000	Supports extended TID (XTID)
Wafer Mask Revision	30_h-33_h	4		Indicates the Mask Revision for the tag
Reserved for Future Use	50_h-52_h	3	000	
Monza Series ID	53_h-54_h	2	11	Supports Series 0 – Series 3
Monza Series Cycle Counter		0	N/A	Series rollover indicator
Serial Number		38		

Figure 13 – Monza X TID Memory Map

Table 6 – Monza X Model Numbers

TAG MODEL	TAG MODEL NUMBER	WAFER MASK REVISION
Monza X-2K	000101000000	0010
Monza X-8K	000101010000	0001

Series 1 [01] – Series 3 [11] 96-bit Serial Number Formula



Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula

Figure 14 – Monza X Serial Number Formulas (Series 1 through 3)

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