



Application Note

TID MEMORY MAPS FOR MONZA SELF-SERIALIZATION

TECHNICAL REFERENCE

TABLE OF CONTENTS

| | | |
|----------|--|-----------|
| 1 | Introduction | 1 |
| 2 | Monza Self-Serialization Formulas | 2 |
| 2.1 | Monza Series | 3 |
| 2.2 | Monza Series Cycle Counter | 3 |
| 2.3 | Serialization Bits..... | 3 |
| 2.4 | Impinj M800 Series Memory Map | 5 |
| 2.5 | Impinj M700 Series Memory Map | 6 |
| 2.5.1 | Example - Impinj M750 Series 2 Serial Number | 7 |
| 2.6 | Monza 6 Family TID Memory Map | 9 |
| 2.6.1 | Example – Monza R6-P Series 1 Serial Number | 11 |
| 2.7 | Monza 5 TID Memory Map..... | 13 |
| 2.7.1 | Example – Monza 5 Series 1 Serial Number | 14 |
| 2.8 | Monza 4 TID Memory Map..... | 16 |
| 2.9 | Monza X Family TID Memory Map | 18 |
| 3 | Notices | 20 |

1 INTRODUCTION

RFID (radio frequency identification) 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 (electronic product code) 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 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 endpoint ICs. 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 Impinj endpoint ICs
- 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 Impinj endpoint ICs

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 an Impinj endpoint ICs.

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.

Table 1: TID Bits for Impinj Tag Chip Models

| SERIALIZATION FAMILY | TAG CHIP | 1 ST 32-BITS OF TID | NOTES |
|----------------------|------------------|--------------------------------|---|
| Monza | Impinj M830/M850 | E280 11B0 | The memory map is one-time configurable for these tag chips, but the tag model number does not change with memory configuration |
| Monza | Impinj M781 | E280 11C1 | |
| Monza | Impinj M780 | E280 11C0 | |
| Monza | Impinj M775 | E2C0 11A2 | |
| Monza | Impinj M770 | E280 11A0 | |
| Monza | Impinj M750 | E280 1190 | |
| Monza | Impinj M730 | E280 1191 | |
| Monza | Monza R6-P | E280 1170 | |
| Monza | Monza R6-A | E280 1171* | Wafer Mask Revision: 000 Product has reached end of life (EOL) |
| Monza | Monza R6-B | E280 1171* | Wafer Mask Revision: 001 Product has reached end of life (EOL) |
| Monza | Monza R6 | E280 1160 | |
| Monza | Monza 5 | E280 1130 | Product has reached end of life (EOL) |
| Monza | Monza 4D | E280 1100 | |
| Monza | Monza 4E | E280 110C | |
| Monza | Monza 4QT | E280 1105 | |
| Monza | Monza 4i | E280 1114 | Product has reached end of life (EOL) |
| MonzaX | Monza X-2K | E280 1140 | Product has reached end of life (EOL) |
| MonzaX | Monza X-8K | E280 1150 | |

*Monza R6-A and Monza R6-B share the same Tag Model Number (TMN) but they can be distinguished by their wafer mask revision numbers. Monza R6-A has a wafer mask revision value of 000₂, and Monza R6-B has a wafer mask revision value of 001₂.

2 MONZA SELF-SERIALIZATION FORMULAS

To accommodate differences in TID serial number structures between Impinj endpoint ICs and to enable forward compatible innovation in future generations of Impinj endpoint ICs, 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.

2.1 Monza Series

- Impinj endpoint ICs 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 Impinj endpoint ICs 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.

2.2 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 Impinj M800, M700, 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.

2.3 Serialization Bits

Impinj endpoint ICs come with a 48-bit serialized number found in bits 30_h-5F_h of TID memory. This number may include 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 Impinj endpoint ICs 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 | FFFFFFFFFFFFFFFF80000000 | [61-bits Data][35-bit Serial Number] |
| 36 | FFFFFFFFFFFFFFFF00000000 | [60-bits Data][36-bit Serial Number] |
| 37 | FFFFFFFFFFFFFFFFE0000000 | [59-bits Data][37-bit Serial Number] |
| 38 | FFFFFFFFFFFFFFFFC0000000 | [58-bits Data][38-bit Serial Number] |
| 96 | 000000000000000000000000 | [96-bit Serial Number] |

2.4 Impinj M800 Series Memory Map

Table 3: Impinj M800 Series TID Memory Map

| IMPINJ M800 SERIES TID MEMORY BANK | | | | | | | | | | | | | | | | |
|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 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 | 1 | 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 |

| MEMORY MAP LEGEND | | | | |
|----------------------------------|----------------------------------|------|------------------|---|
| Segment | Location | Bits | Binary | Value |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) |
| Security Indicator (S bit) | 09 _h | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 000110110000 | Impinj M830 and M850 tag models share the same tag model number |
| 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 |
| Reserved for Future Use | 50 _h -54 _h | 5 | xxxxx | |
| Monza Series ID | 55 _h -56 _h | 2 | 01 | Supports Series 0 – Series 3 |
| Serial Number | | 38 | | |

Note: The values for x denotes the unique serialization values for each chip.
 *The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 10000000001_b or 801_h.

- **Impinj M800, Series 0 [00] – Series 3 [11] 96-bit Serial Number Formula**

[00h:07h] [08h:13h] [14h:1Fh] 1010 0101 0000 0 [30h:32h] 000 [50h:56h] [57h:5Fh] [40h:4Fh] [33h:3Fh]

- **Impinj M800, Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula**

[57h:5Fh] [40h:4Fh] [33h:3Fh]

2.5 Impinj M700 Series Memory Map

Table 4: Impinj M700 Series TID Memory Map

| IMPINJ M700 SERIES TID MEMORY BANK | | | | | | | | | | | | | | | | |
|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 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 | M | M | M | M | M | M | M | M |
| 00 _h -0F _h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | S | 0 | 0 | 0 | 0 | 0 | 0 |

| MEMORY MAP LEGEND | | | | |
|----------------------------------|----------------------------------|------|------------------|---|
| Segment | Location | Bits | Binary | Value |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) |
| Security Indicator (S bit) | 09 _h | 1 | S | S-bit indicates <i>Authenticate</i> or <i>Challenge</i> commands supported <ul style="list-style-type: none"> • “1” for Impinj M775 • “0” for all other devices |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 0001MMMMMMMM | Impinj M700 series, where the 8 M-bits specifies the tag model <ul style="list-style-type: none"> • “10010001” for Impinj M730 • “10010000” for Impinj M750 • “10100000” for Impinj M770 • “10100010” for Impinj M775 • “11000000” for Impinj M780 • “11000001” for Impinj M781 |
| 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 |
| Reserved for Future Use | 50 _h -54 _h | 5 | 00000 | |
| Monza Series ID | 55 _h -56 _h | 2 | 01 | Supports Series 0 – Series 3 |
| Serial Number | | 38 | | |

Note: The values for x denotes the unique serialization values for each chip, and the M denotes the model specific TMN numbers.
 *The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

- Impinj M700, Series 0 [00] – Series 3 [11] 96-bit Serial Number Formula

[00h:07h] [08h:13h] [14h:1Fh] 1010 0101 0000 0[30h:32h] 000[50h:56h] [57h:5Fh] [40h:4Fh] [33h:3Fh]

- Impinj M700, Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula

[57h:5Fh] [40h:4Fh] [33h:3Fh]

2.5.1 Example - Impinj M750 Series 2 Serial Number

Table 5: TID Memory Map EXAMPLE – Impinj M750 Series TID E2801190200069F009420300

| IMPINJ M750 TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 _h -4F _h | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 30 _h -3F _h | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 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 | 1 | 0 | 0 | 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 |

| MEMORY MAP LEGEND | | | | |
|----------------------------------|----------------------------------|------|--|---|
| Segment | Location | Bits | Binary | Value |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) |
| Security Indicator (S bit) | 09 _h | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | Impinj |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 000110010000 | "0" for Impinj M750 |
| 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 | 011 | Indicates the Mask Revision for the tag |
| Reserved for Future Use | 50 _h -54 _h | 5 | 00000 | |
| Monza Series ID | 55 _h -56 _h | 2 | 01 | Supports Series 0 – Series 3 |
| Serial Number | | 38 | 1000000000000100 1010000100100111 110000 | |

*The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

- **Impinj M750 Example, Series 2 [10] 96-bit Serial Number Formula**

```
[00h:07h] [08h:13h] [14h:1Fh] 1010 0101 0000 0[30h:32h] 000[50h:56h] [57h:5Fh] [40h:4Fh] [33h:3Fh]
```

- 96-bit Serial Number (binary):

```
1110 0010 1000 0000 0001 0001 1001 0000 1010 0101 0000 0011
0000 0000 0110 0000 0000 0001 0010 1000 0100 1001 1111 0000
```

- 96-bit Serial Number (hex):

```
E280 1190 A503 0060 0128 49F0
```

- **Impinj M750 Example, Series 2 [10] 38-bit Serial Number Formula**

```
[57h:5Fh] [40h:4Fh] [33h:3Fh]
```

- 38-bit Serial Number (binary):

```
10 0000 0000 0001 0010 1000 0100 1001 1111 0000
```

- 38-bit Serial Number (hex):

```
20012849F0
```

2.6 Monza 6 Family TID Memory Map

Table 6: Monza 6 TID Memory Map

| IMPINJ MONZA 6 SERIES TID MEMORY BANK | | | | | | | | | | | | | | | | |
|---------------------------------------|----------------------------------|---|------|------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 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 | M | M | M | M | M |
| 00 _h -0F _h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MEMORY MAP LEGEND | | | | | | | | | | | | | | | | |
| Segment | Location | | Bits | Binary | Value | | | | | | | | | | | |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 | | | | | | | | | | | |
| XTID Indicator (X bit) | 08 _h | | 1 | 1 | Indicates the presence of an extended TID (XTID) | | | | | | | | | | | |
| Security Indicator (S bit) | 09 _h | | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands | | | | | | | | | | | |
| File Indicator (F bit) | 0A _h | | 1 | 0 | Does not implement the <i>FileOpen</i> command | | | | | | | | | | | |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | | 9* | 000000001 | | | | | | | | | | | | |
| Tag Model Number (TMN) | 14 _h -1F _h | | 12 | 0001011MMMM | Monza 6 family, where MMMMM specifies the Monza 6 tag model (See Table 7) | | | | | | | | | | | |
| 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 | | | | | | | | | | | |
| Integra™ TID Parity | 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 | | | | | | | | | | | | | |

Note: The values for x denotes the unique serialization values for each chip, and the M denotes the model specific TMN numbers.
 *The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

Table 7: Monza 6 Model Numbers

| TAG MODEL | TAG MODEL NUMBER | WAFER MASK REVISION |
|------------|------------------|---------------------|
| Monza R6 | 000101100000 | 011 |
| Monza R6-A | 000101110001 | 000 |
| Monza R6-B | 000101110001 | 001 |
| Monza R6-P | 000101110000 | 000 |

- **Monza 6 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]

- **Monza 6 Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula**

[55h:5Fh] [40h:4Fh] [35h:3Fh]

- 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.

2.6.1 Example – Monza R6-P Series 1 Serial Number

Table 8: TID Memory Map EXAMPLE – Monza R6-P TID E280117020001089CCEB08DF

| MONZA 6 TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Word | 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 |

| MEMORY MAP LEGEND | | | | |
|----------------------------------|----------------------------------|------|--|---|
| Segment | Location | Bits | Binary | Value |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) |
| Security Indicator (S bit) | 09 _h | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | Impinj |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 000101110000 | Tag model number (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 |
| Integra™ TID Parity | 33 _h | 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 | 0001101111111001100 1110101100010001001 | 30037989513 (decimal) |

*The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

- **Monza R6-P 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]
```

- 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
```

- **Monza R6-P Example, Series 0 [00] – Series 3 [11] 38-bit Serial Number Formula**

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

- 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
```

2.7 Monza 5 TID Memory Map

Table 9: Monza 5 TID Memory Map

| IMPINJ MONZA 5 TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|----------------------------------|------|------------------|---|---|---|-----|---|---|---|---|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | 0** | x | x | x | x | x | x | x | x | x |
| 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 |
| MEMORY MAP LEGEND | | | | | | | | | | | | | | | | |
| Segment | Location | Bits | Binary | Value | | | | | | | | | | | | |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 | | | | | | | | | | | | |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) | | | | | | | | | | | | |
| Security Indicator (S bit) | 09 _h | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands | | | | | | | | | | | | |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command | | | | | | | | | | | | |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | Impinj | | | | | | | | | | | | |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 000100110000 | Monza 5 family TMN | | | | | | | | | | | | |
| EPC Tag Data Standard Header | 20 _h -2F _h | 16 | 0010000000000000 | Supports extended TID (XTID) – 48-bit SN | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | |
| Serial Number | | 38 | | | | | | | | | | | | | | |

Note: The values for X will be replaced by the unique serialization values for each chip.

* The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 10000000001_b or 801_h.

** This bit is always fixed to zero on Monza 5. For this reason, it is not included in the Serial Number formula.

Table 10: Monza 5 Model Numbers

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

- **Monza 5 Series 0 [00] 96-bit Serial Number Formula**

```
[00h:07h] [08h:13h] [14h:1Fh] [30h:33h] [50h:52h] 0 0000 0000 0000 0 [53h:54h] 0 0000
0 [55h:5Ch] [41h:4Fh] [5Dh:5Fh] [40h] [38h:3Fh]
```

- **Monza 5 Series 0 [00] 38-bit Serial Number Formula**

```
000 [55h:5Ch] [41h:4Fh] [5Dh:5Fh] [40h] [38h:3Fh]
```

- **Monza 5 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]
```

- **Monza 5 Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula**

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

2.7.1 Example – Monza 5 Series 1 Serial Number

Table 11: TID Memory Map EXAMPLE – Monza 5 TID E280113020003993EEE1088E

| IMPINJ MONZA 5 TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|----------------------------------|---|------|--|---|---|-----|---|---|---|---|---|---|---|---|---|
| Bit Address | 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 |
| MEMORY MAP LEGEND | | | | | | | | | | | | | | | | |
| Segment | Location | | Bits | Binary | Value | | | | | | | | | | | |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 | | | | | | | | | | | |
| XTID Indicator (X bit) | 08 _h | | 1 | 1 | Indicates the presence of an extended TID (XTID) | | | | | | | | | | | |
| Security Indicator (S bit) | 09 _h | | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands | | | | | | | | | | | |
| File Indicator (F bit) | 0A _h | | 1 | 0 | Does not implement the <i>FileOpen</i> command | | | | | | | | | | | |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | | 9* | 000000001 | Impinj | | | | | | | | | | | |
| Tag Model Number (TMN) | 14 _h -1F _h | | 12 | 000100110000 | Monza 5 family | | | | | | | | | | | |
| EPC Tag Data Standard Header | 20 _h -2F _h | | 16 | 0010000000000000 | Supports extended TID (XTID) – 48-bit SN | | | | | | | | | | | |
| 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 | | | | | | | | | | | |
| Serial Number | | | 38 | 0001000111011101 1101110000110110 010011 | | | | | | | | | | | | |

* The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

** This bit is always fixed to zero on Monza 5. For this reason, it is not included in the Serial Number formula.

- **Monza 5 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]
```

- 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):

```
E28011303000020477770D93
```

- **Monza 5 Example – Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula**

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

- 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
```

2.8 Monza 4 TID Memory Map

Table 12: Monza 4 TID Memory Map

| IMPINJ MONZA 4 TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|----------------------------------|---|------|------------------|--|---|---|---|---|---|-----|---|---|---|---|---|
| Bit Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | x | x | x | x | 0** | x | x | x | x | x |
| 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 | M | M | M | M | M |
| 00 _h -0F _h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MEMORY MAP LEGEND | | | | | | | | | | | | | | | | |
| Segment | Location | | Bits | Binary | Value | | | | | | | | | | | |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 | | | | | | | | | | | |
| XTID Indicator (X bit) | 08 _h | | 1 | 1 | Indicates the presence of an extended TID (XTID) | | | | | | | | | | | |
| Security Indicator (S bit) | 09 _h | | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands | | | | | | | | | | | |
| File Indicator (F bit) | 0A _h | | 1 | 0 | Does not implement the <i>FileOpen</i> command | | | | | | | | | | | |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | | 9* | 000000001 | Impinj | | | | | | | | | | | |
| Tag Model Number (TMN) | 14 _h -1F _h | | 12 | 0001000MMMM | Monza 4 family, where MMMMM specifies the Monza 4 tag model (See Table 13) | | | | | | | | | | | |
| 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 | 01 | Supports Series 0 – Series 3 | | | | | | | | | | | |
| Serial Number | | | 38 | | | | | | | | | | | | | |

Note: The values for X will be replaced by the unique serialization values for each chip.

* The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 10000000001_b or 801_h.

** This bit is always fixed to zero on Monza 5. For this reason, it is not included in the Serial Number formula.

Table 13: 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 |

- **Monza 4 Series 0 [00] 96-bit Serial Number Formula**

```
[00h:07h] [08h:13h] [14h:1Fh] [30h:33h] [50h:52h] 0 0000 0000 0000 0 [53h:54h] 0 0000
0 [55h:5Ch] [41h:4Fh] [5Dh:5Fh] [40h] [36h:39h] [3Ch:3Fh]
```

- **Monza 4 Series 0 [00] 38-bit Serial Number Formula**

```
000 [55h:5Ch] [41h:4Fh] [5Dh:5Fh] [40h] [36h:39h] [3Ch:3Fh]
```

- **Monza 4 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] [3Bh] [36h:39h] [3Ch:3Fh]
```

- **Monza 4 Series 1 [01] – Series 3 [11] 38-bit Serial Number Formula**

```
[55h:5Fh] [40h:4Fh] [34h:35h] [3Bh] [36h:39h] [3Ch:3Fh]
```

2.9 Monza X Family TID Memory Map

Table 14: Monza X TID Memory Map

| IMPINJ MONZA X TID MEMORY BANK | | | | | | | | | | | | | | | | |
|----------------------------------|---|---|---|---|---|---|-----|---|---|---|---|---|---|---|---|---|
| Word | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 50 _h -5F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 40 _h -4F _h | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 30 _h -3F _h | x | x | x | x | x | x | 0** | x | x | x | x | x | x | x | x | x |
| 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 | 0 | M | 0 | 0 | 0 | 0 |
| 00 _h -0F _h | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| MEMORY MAP LEGEND | | | | |
|----------------------------------|----------------------------------|------|------------------|--|
| Segment | Location | Bits | Binary | Value |
| ISO / IEC 15963 Class Identifier | 00 _h -07 _h | 8 | 11100010 | GS1 EPCglobal Class 1 Gen 2 |
| XTID Indicator (X bit) | 08 _h | 1 | 1 | Indicates the presence of an extended TID (XTID) |
| Security Indicator (S bit) | 09 _h | 1 | 0 | Does not implement <i>Authenticate</i> or <i>Challenge</i> commands |
| File Indicator (F bit) | 0A _h | 1 | 0 | Does not implement the <i>FileOpen</i> command |
| Mask Designer Identifier (MDID) | 0B _h -13 _h | 9* | 000000001 | Impinj |
| Tag Model Number (TMN) | 14 _h -1F _h | 12 | 0001010M0000 | Tag Model Number, where M specifies either Monza X-2K or Monza X-8K (See Table 15) |
| 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 | Supports Series 0 – Series 3 |
| Monza Series ID | 53 _h -54 _h | 2 | 11 | Series rollover indicator |
| Serial Number | | 38 | | |

Note: The values for X will be replaced by the unique serialization values for each chip.

* The GS1 currently defines the MDID as the 9 bit value from 0B_h to 13_h in the Tag Data Standard (TDS). A previous TDS definition included the X, S and F bits in the MDID. For applications using a 12-bit MDID, the value would be 100000000001_b or 801_h.

** This bit is always fixed to zero on Monza 5. For this reason, it is not included in the Serial Number formula.

Table 15: Monza X Model Numbers

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

- **Monza X 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]
```

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

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

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