

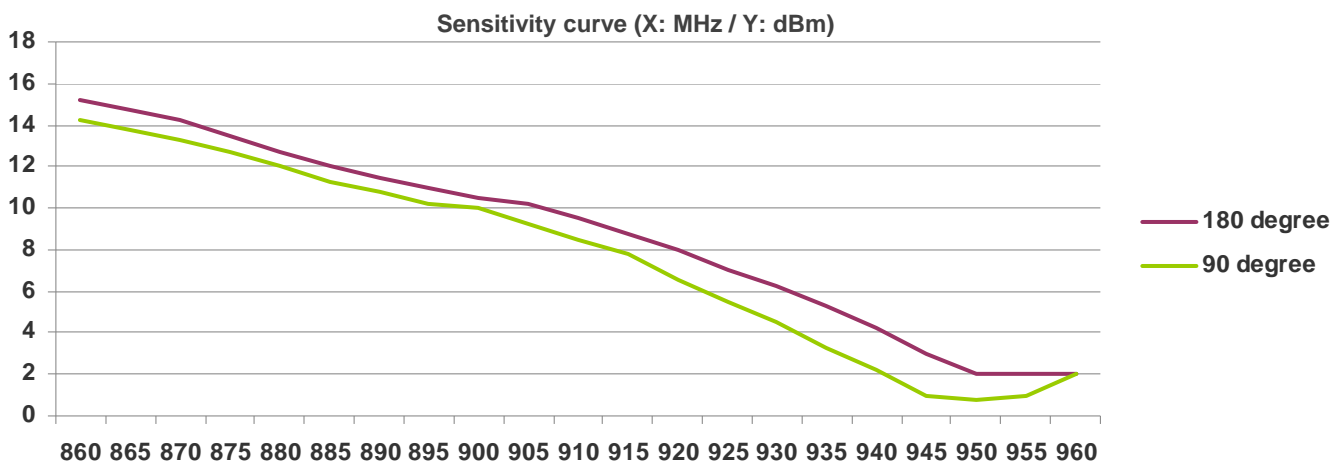
USER'S GUIDE: TITAN TRAY

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1. About tag components

1-1. Why Impinj Monza4QT?

•TRAY is only one product with Monza4QT among Titan tags, in order to achieve good read performance even when reader antenna and tag face vertically each other. Impinj calls it True3D technology. Usually maximum read range is achieved when reader antenna and tag faces in opposite way (180 degree), but with TRAY, same read range can be achieved even when it's 90 degree. (See the graph below) This technology, however, can be realized only in non-metal mounting applications.



1-2. Memory architecture – Impinj Monza4QT

•Please read specification sheet of TITAN TRAY. For further information, please contact RFcamp or visit Impinj's website (www.impinj.com).

1-3. Why glass fiber (PCB FR4) for packaging materials?

•Because it's most stable and market proven materials in electric and antenna industries for + 40 years. Since year of 2004, RFcamp has focused on glass fiber as main materials for tag antenna substrates, because RFcamp has given #1 priority on product consistency and reliability, and has unparalleled unique multi-layer PCB lamination technology, resisting against harshest water ingression and temperature.

1-4. Why wire bonding technology?

•For tag manufacturers, choice of best chip attachment method is the most important, because it determines product reliability under harsh environment. Flip chip method, though it's cheapest, is vulnerable and weakest against temperature shock and mechanical stresses. Soldering method, though it's robust, is expensive and hard to work on small tags. RFcamp, therefore, has chosen wire bonding technology to achieve tag robustness in economical way, since established in year 2004.

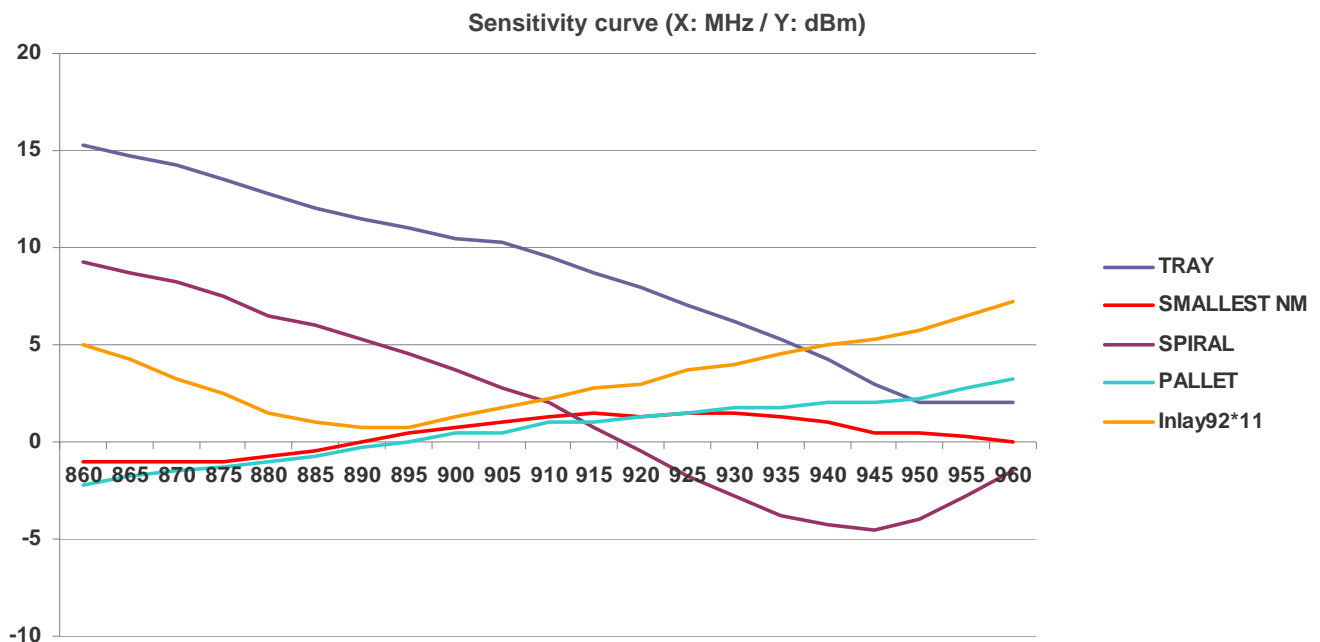
1-5. Why gold plated antenna?

•Chip bonded strength on antenna is highest when antenna is plated gold. Compared with aluminum, copper or silver ink antenna, gold plated antenna enhance >30% higher strength.

2. About tag read performance

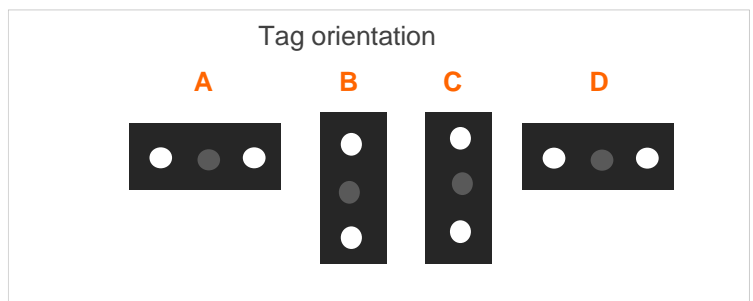
2-1. Main features (compared with other Titan tags)

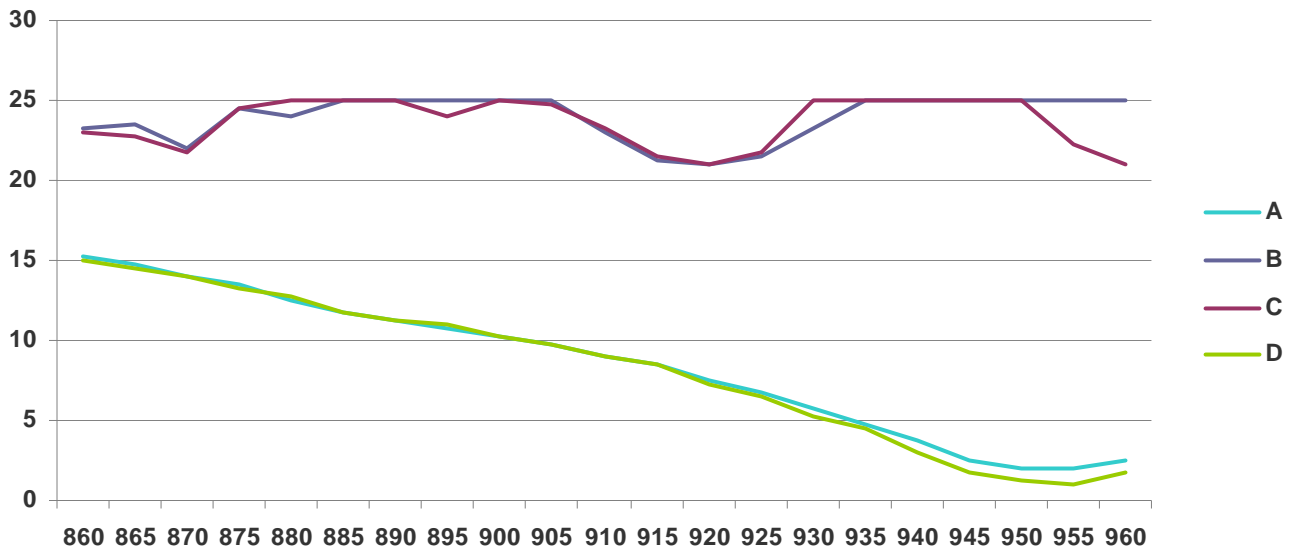
- RFcamp has lined up 4 kinds Titan (Hard) tags for only non-metal applications – TRAY, SMALLEST NM, SPIRAL and PALLET. Among them, TRAY is shortest with 35mm width.
- With its small form factor, TRAY shows moderate read performance and can be applied for frequency band from EU to US band. It performs good in high dielectric environments or surface (please see 2-4. page#5) . And it performs same even when reader antenna and tag faces in 90 degree, with Monza4QT's True3D technology (see page#2, 1-1)
- Here below graph shows sensitivity curve comparison among TRAY, SMALLEST NM, SPIRAL, PALLET and Gen2 inlays of 92mm*11mm from global brand's.



2-2. Tag orientation and read performance

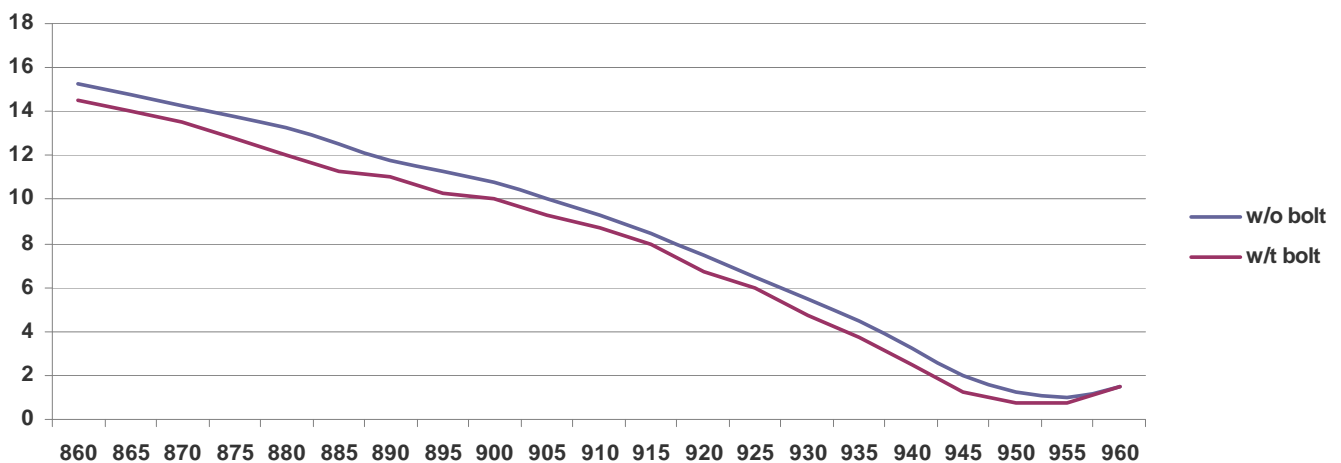
- With rectangular feature, TRAY shows huge read performance difference by how it is oriented.
- See the picture right, and you can see four options of orientation as A, B, C and D and that A and D performs good and same (two curves are overlapped), but B and C performs much behind.





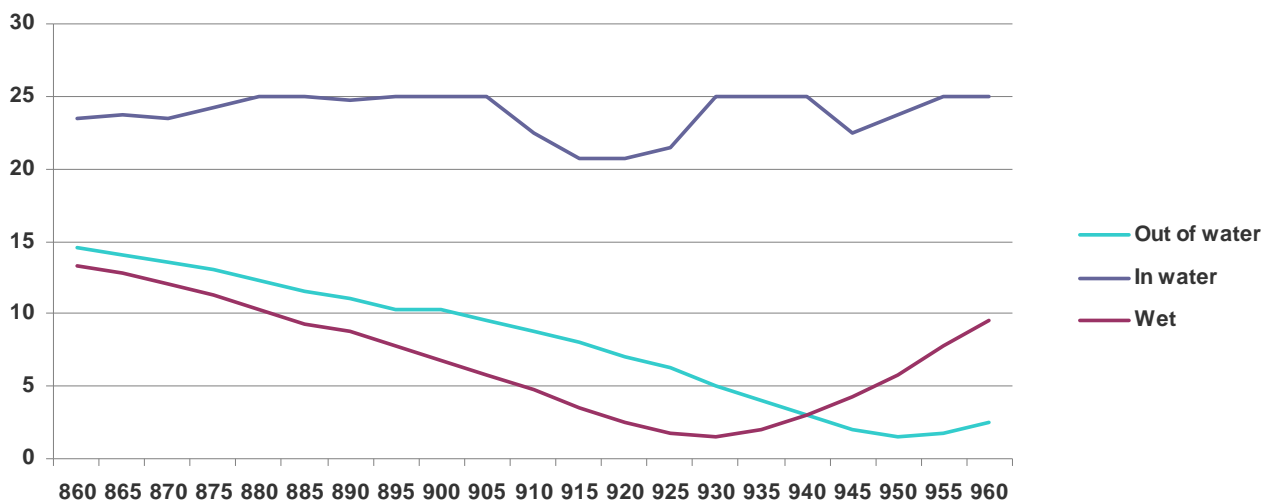
2-3. Tag attachment and read performance

- Unlike other small tags such as INCH TN, INCH, and SMALLET, TRAY's read performance is not influenced by which kinds of bolts (or screws) – metal or plastic – are fastened. Users, therefore, don't have to pay much attention to choice of materials for fasteners.
- Please see the graph below, and there are two sensitivity curves – one is without metal bolt and the other is with metal bolt.



2-4. Environment and read performance

- Temperature: Silicon RFID chips can work only within temperature range between -45°C and 85°C. When temperature goes beyond this range, its performance dramatically declines and at certain point becomes zero. Once temperature gets back in the range, its performance recovers in a few minutes. Even within the range, cold or hot environment may lower both tag and reader performance.
- Humidity: UHF tag performance is significantly influenced by humidity. In high humid atmosphere, tag read performance may decrease by 30% or more.
- Liquids: Though just one drop of water on small UHF tag may decrease tag performance by up to 90%, TRAY reads even better when it's in wet conditions. Here below are three sensitivity curves – TRAY out of water, TRAY in water, and TRAY in wet condition. As can be seen, in wet condition, TRAY reads best, whereas in water, tag can hardly be read.
- RF interference and read performance: Tag performance is significantly influenced by RFI (Radio Frequency Interference) and EMI (Electro-Magnetic Interference). Also ESD (Electrical Static Discharge) may have effects on tag performance.



3. About tag resistance

3-1. Operating temperature

- Read page#5, first paragraph of 2-4.

3-2. Storage and peak temperature

- High temperature: Titan tags can withstand 180°C for 24hrs, 200°C for 6hrs and 208°C for a short time. RFcamp recommends Titan tags be applied at environments under 180°C. Contact RFcamp if environments require tags to withstand high temperature, pressure, mechanical stress and humidity all together.
- Low temperature: Titan tags can withstand -55°C for 168hours. Contact RFcamp if environments require tags to withstand low temperature and mechanical stress together.

3-3. Water ingression

- Titan tags is IP68 compliant, withstand able against 1 meter's water depth for 24 hours. It does not mean, however, tags maintain read performance in water.

3-4. Static electricity

- UHF Gen2 EEPROM silicon chips are comparatively weak against static electricity (ESD) and can survive only 2KV. With robust encapsulation, Titan tags can effective protect silicon chips and can survive 10KV.

3-5. Mechanical stress

- Titan tags have unparalleled robustness with stable gold plated antenna, wire bonding, hardest epoxy chip encapsulation, and multi-layer fiber glass lamination under >180C degree.
- Please read product datasheet for further information on mechanical stress tests Titan tags have undergone.

3-6. Chemical stress

- Please read product datasheet for further information on chemical materials Titan tags can withstand against. If environments require tags to withstand other materials listed in product datasheets, contact RFcamp.

4. About tag attaching method

4-1. Backing adhesive tape, water, chemical and temperature

- For backing adhesive tape on TRAY, 3M300LSE (Also known as 9472LE) is applied.
- It can maintain its bond strength at 90% humidity over 7 days and in water for 100 hours. It can also survive several kinds chemicals including oil, mild acids and alkalis. It can effectively maintain its bond strength under temperature between -45°C and 150°C.
- For more information on 3M300LSE, please contact RFcamp or visit 3M's website (www.3m.com)
- If you require adhesive in extreme temperature or environments, contact RFcamp before searching for alternative by yourself.

4-2. Glue, water, chemical and temperature

- If your application requires higher adhesion under harsher environments, RFcamp recommends two kinds glue – (1) Cemedine's Super X (visit www.cemedine.co.jp) or (2) Loctite's 331 (visit www.loctite.com).
- Compared with 3M300LSE, these two glues are superior in keeping adhesion under water, various chemical materials, and broader temperature range. For further information, please contact RFcamp.

4-3. Metal fastener, mechanical stress and temperature

RFcamp recommends metal bolts or screws for TRAY for enhancing mechanical strength as well as resistance to thermal stress without reducing read performance. (as mentioned in 2-3, page #5).

5. About added service

5-1. Chip pre-programming

- Please note that RFcamp provides chip pre-programming service only for EPC memory sector, not for User memory sector. With MONZA 4QT chips, RFcamp can pre-program chips with codes from 16 bits (4 digits decimal or hex or ASCII) to 128 bits (32 digits decimal or hex or ASCII), upon users' request. Please note that pre-programmable codes be 4 multiple digits.
- Please send chip pre-programming data as Microsoft Excel format or just starting/ending data, if sequentially serialized. RFcamp can pre-program 50K tags on daily basis.

Pre-programmable?	Yes	No
4 multiple digits	0001 99023100 123456781234567812345678	00001 : 5 digits 990231 : 6 digits 12 : 2 digits
Decimal, hex or ASCII	1A234CF0	013456P4 : P - Not programmable

5-2. Customized label

- RFcamp provides quick and reasonably priced customized label service. Standard label media, Avery Dennison made, is white or yellow paper, with polymer film over-laminated for water proof and hard to tear purpose. ZEBRA thermal transfer barcode printer with BARTENDER software prints out variable data with text as well as 1D/2D barcode.
- If users want their own multi colored symbol or logo, please send Adobe Illustrator or Corel Draw file first and discuss cost and lead time.

5-3. Laser marking

- For more robust marking under high temperature, RFcamp recommends direct laser marking on tag surface. With etched yellow color, It can mark variable data and text as well as 1D/2D barcode.
- If users want their own symbol or logo, please send Adobe Illustrator or Corel Draw file first and discuss cost and lead time.

5-4. Direct (silkscreen) printing

- If users want multi colored symbol or text under harsh environment, RFcamp recommends direct mark on tag surface by silkscreen printing. Only fixed data can be printed.
- If users want their own symbol or logo, please send Adobe Illustrator or Corel Draw file first and discuss cost and lead time.