

USER'S GUIDE: TITAN PALLET

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1. About tag components

1-1. Why Alien Higgs3?

- Because it's the best performing chip for metal mounting tags. Though it's most expensive, RFcamp has used Higgs3 – made by Alien Technology – since it was firstly released in 2008. Impinj has released comparably good chips – Monza4 and 5 – in recent years, but RFcamp will go together with Higgs3 in order to maintain our product consistency and keep trust among our long term customers.
- Nevertheless, RFcamp is always keen on new released chips from Impinj and NXP, and if we find out change of chips is needed for customer satisfaction, we will change it anytime.

1-2. Memory architecture – Alien Higgs3

- Higgs3 has total 800 bits memory, comprised of 96 EPC bits (extensible to 480 bits), 512 user bits, 64 bits unique TID, 32 bits Access and 32 bits Kill Passwords. Due to its flexible memory architecture, customers can easily allocate EPC and User memory for different uses. For further information, please contact RFcamp or visit Alien's website (www.alientechnology.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, while other tag makers focus on polymer, ceramic, etc. RFcamp has given #1 priority on product consistency and reliability, though pursuing new materials is also important.
- Recently, there appear several tag manufacturers who copy our glass fiber tags, but they can not copy our quality. RFcamp has unparalleled unique multi-layer PCB lamination technology, resisting against harshest water ingress and temperature conditions.

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. Some says soldering is not costly. It's correct, however, only when they adopt cheap and low temperature soldering process. Tags from this cheap soldering method can not withstand > 120°C degree.
- 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?

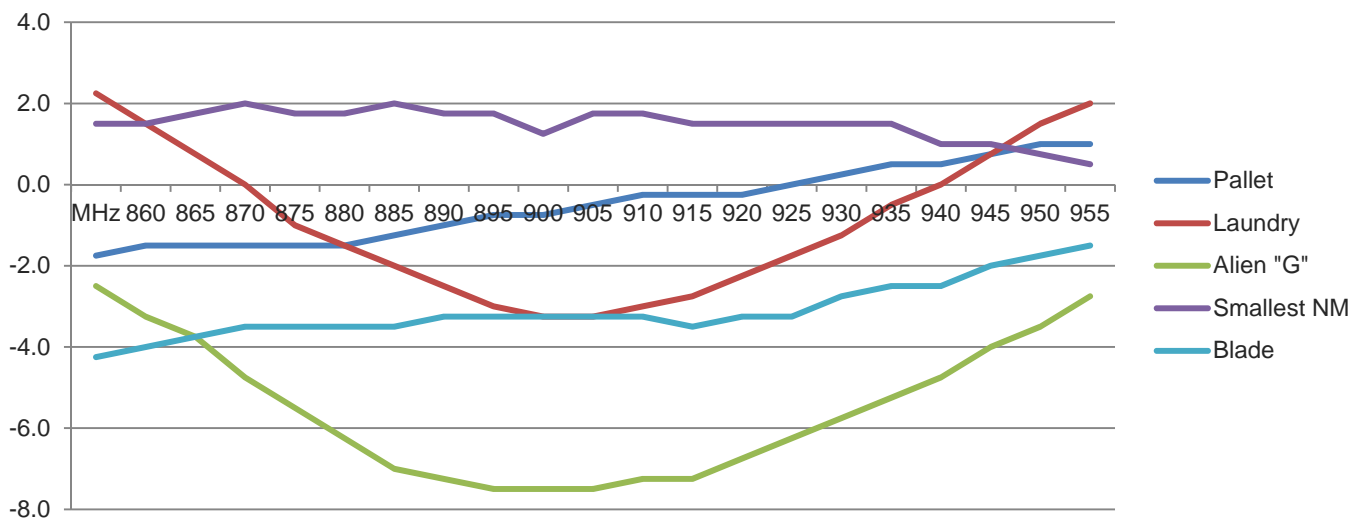
- Chip bonded strength on antenna is highest when antenna is plated gold. Compared with aluminum, copper or silver ink antenna, gold plated antenna enhance >30% higher strength.

2. About tag read performance

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

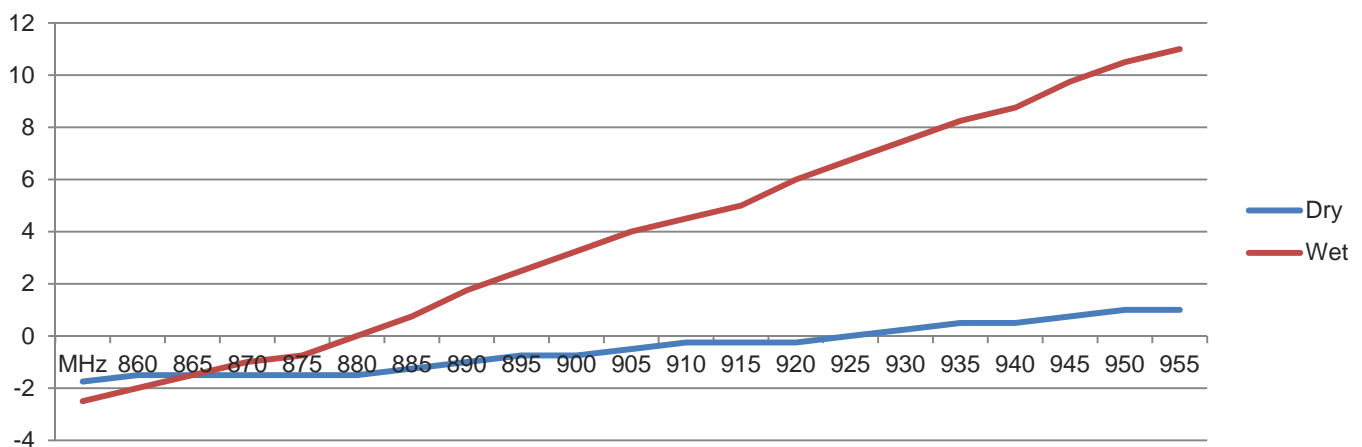
•PALLET performs stable read across both European and US frequency band, but performs better in European frequency band. PALLET performs better than SMALLEST NM, but performs same or a little behind of LAUNDRY. With its flat curve feature, however, it shows reliable read both in and on plastic containers (regardless of their dielectric constant). For user's comparison, sensitivity curve of best read performing inlay in the world, Alien Technology's G-Inlay (also known as ALN9654G) is referred in the graph.

Sensitivity curve (X: MHz / Y: dBm)



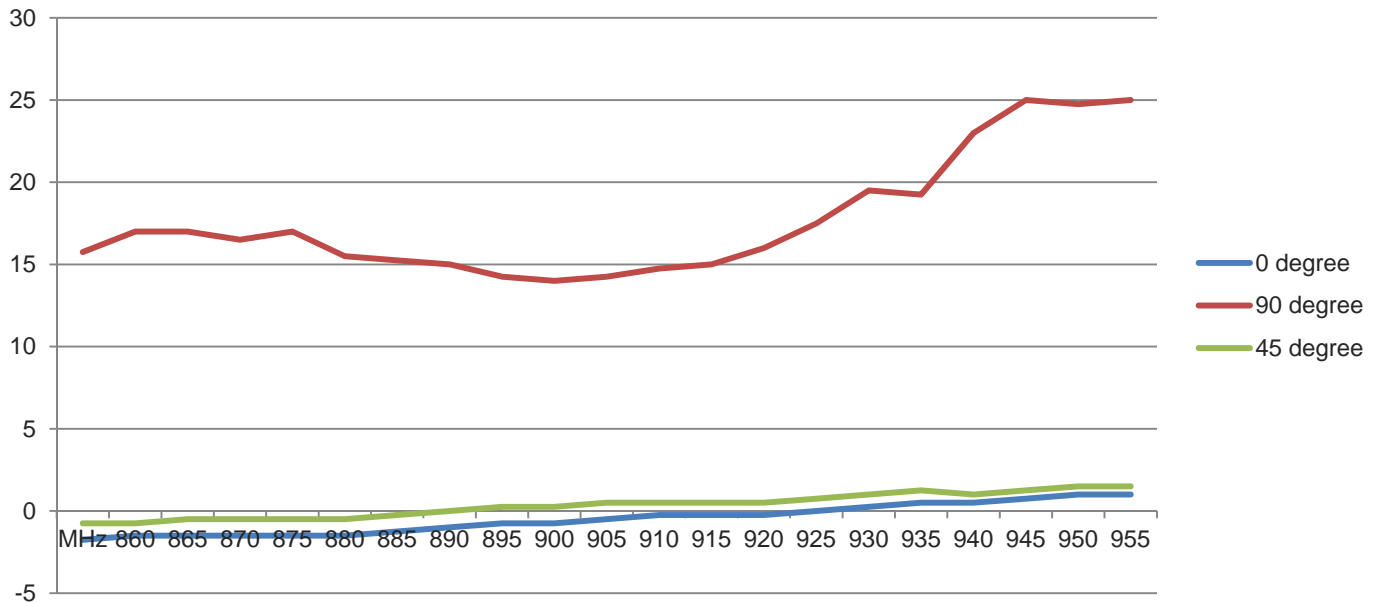
2-2. Read performance in wet condition

•Like all UHF tags, PALLET's read performance is reduced as it gets wet. As can be seen in the graph below, reduction of read increases as resonant frequency goes up. Therefore, in European frequency band, PALLET can read almost same in wet condition, but as frequency goes up to US band, PALLET reads only 50% or less in wet condition.



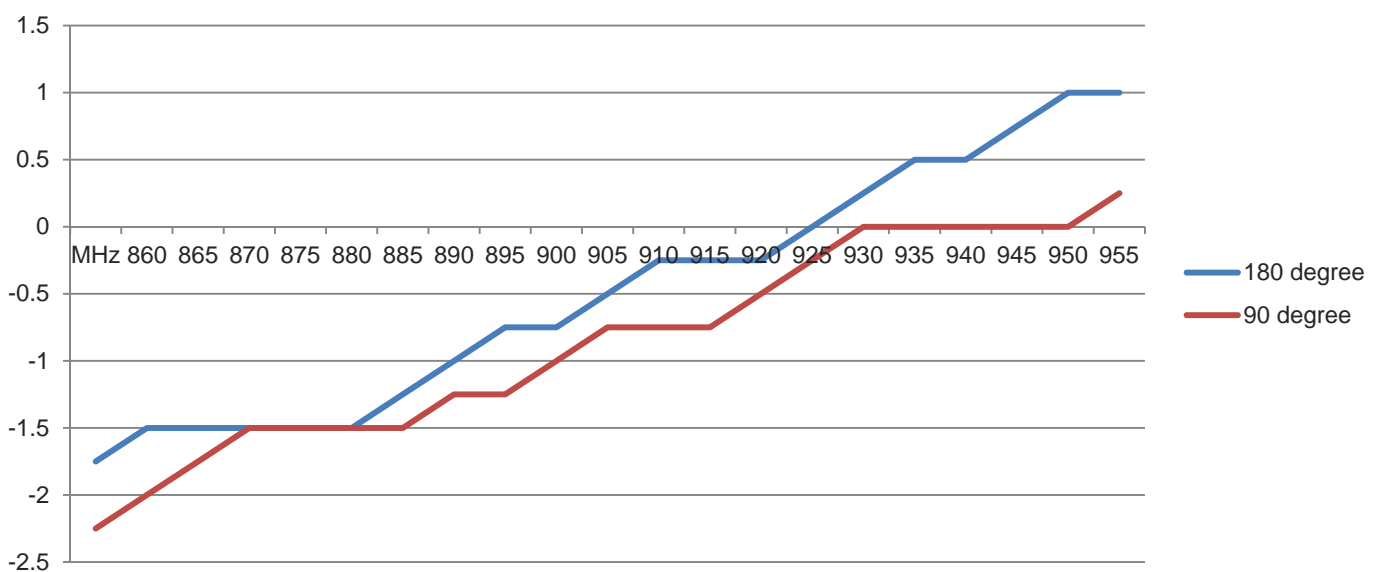
2-3. Tag orientation and read performance

- With rectangular feature, PALLET shows huge read performance difference by how it is oriented.
- See the picture right, and you can see three options of orientation as 0, 45 and 90 degree. When tag is oriented 0 and 45 degree, they perform almost same, but as it goes up to 90 degree, it performs well behind.



2-4. Angle b/w reader antenna and tag

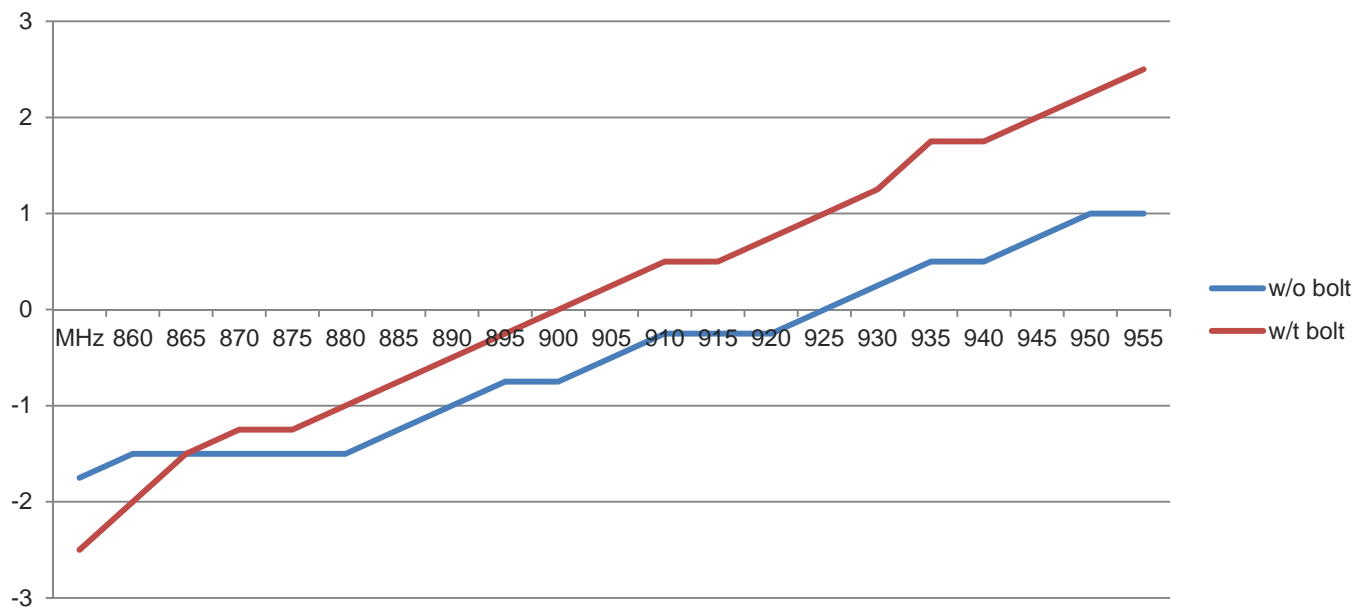
- In RFID, best read performance can be gained when reader antenna faces tag in 180 degree, and decreases as facing angle gets to 90 degree.
- However, PALLET's sensitivity curve, as can be seen in the graph below, is same or better in read performance, even when angle gets to 90 degree.



2-5. Tag attachment and read performance

•PALLET's sensitivity curve is very stable and flat, which means PALLET is not sensitive to thickness or materials of backing adhesive tape layer or glue. Users can choose any adhesive without any read performance compensation.

•However, PALLET's read performance is a little more influenced when you apply metal bolt or screw, shifting down 10MHz or more. Here below is two curves – w/t and w/o metal bolts. Users, therefore, should be careful in applying M3 or similar metal screw or bolt or should accept 20% shorter read performance.



2-6. 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.

•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 2-6.

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 to 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 PALLET, 3M468MP is normally 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 3M468MP, please contact RFcamp or visit 3M's website (www.3m.com).
- If you require more 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 3M468MP, these two glues are superior in keeping adhesion under water, various chemical materials, and broader temperature range.

4-3. Metal fastener, mechanical stress and temperature

Users can choose metal or plastic fasteners – bolts or screws –, but when it's metal fasteners, 10 ~20% read performance reduction is inevitable. (as mentioned in 2-5, page #5).

4-4. Development of non-metal bracket

- RFcamp recommends users discuss polymer bracket development with RFcamp from the beginning. Sometimes bracket's effects on tag read performance is too significant that tag should be modified or re-developed in order to maintain user's required minimum read performance.
- RFcamp believes that most time and cost saving way is to discuss in details with RFcamp.

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. Alien Higgs3 chips, with its flexible memory architecture, can allocate 512 bits to EPC memory sector. (see 1-2, page#2). Therefore, RFcamp can pre-program chips with codes from 16 bits (4 digits decimal or hex or ASCII) to 512 bits (128 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.