

USER'S GUIDE: TITAN LAUNDRY

1. About tag components.....	2
1-1. Why Alien Higgs3?	
1-2. Memory architecture – Alien Higgs3	
1-3. Why polyimide film for substrate and overlay?	
1-4. Why wire bonding technology?	
1-5. Why gold plated antenna?	
2. About tag read performance.....	3
2-1. Main features (compared with other Titan tags)	
2-2. Tag orientation and read performance	
2-3. Angle b/w reader antenna and tag	
2-4. Read performance when tag gets rounded	
2-5. Read performance when tags in wet cloth	
2-6. Environment and read performance	
3. About tag resistance	6
3-1. Operating temperature	
3-2. Storage and peak temperature	
3-3. Water ingress	
3-4. Static electricity	
3-5. Mechanical stress	
3-6. Chemical stress	
4. About tag attaching method.....	7
4-1. Backing adhesive tape, water, chemical and temperature	
4-2. Glue, water, chemical and temperature	
4-3. Polycarbonate bolt, mechanical stress and temperature	
5. About added service.....	8
5-1. Chip pre-programming	
5-2. Customized label – N/A	
5-3. Laser marking – N/A	
5-4. Direct (silkscreen) printing – N/A	

1. About tag components

1-1. Why Alien Higgs3?

- Because it's one of best performing chips. 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 polyimide film for substrate and overlay?

- Most of flexible tags used in laundry application are with PET film which is cheap, but weak to high temperature. Polyimide film (known as KAPTON) can withstand up to 220C degree and is stable against various chemical stress during laundry process. Also it's very stable in electrical property.
- RFcamp uses polyimide film for both substrate and overlay of tags, both of them are laminated with bonding sheet at 200C degree, in order to maintain its robustness in harsh laundry process. However, please note that polymer film may be easily torn, so without any covered fabric, it may be vulnerable to extreme distortion and twist.

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.

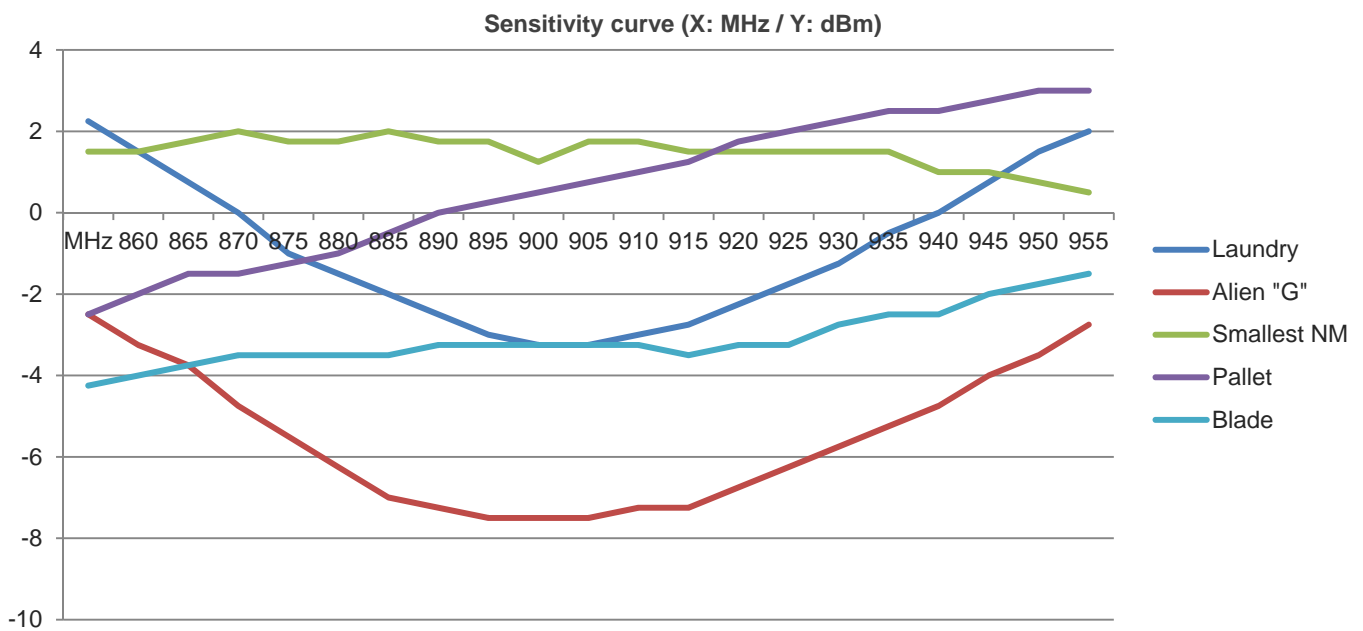
1-5. Why gold plated antenna?

- 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

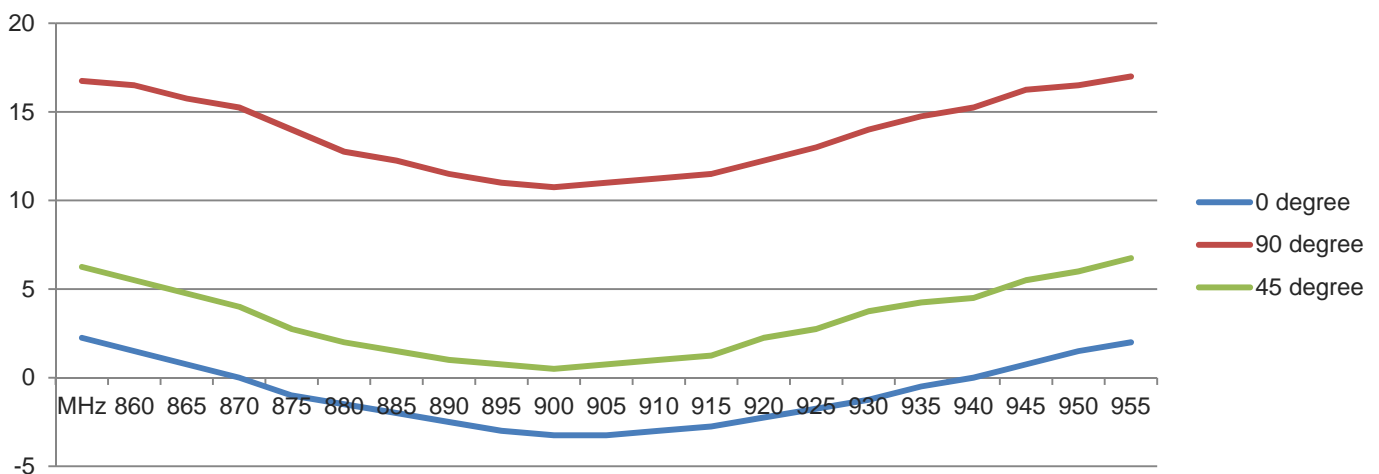
2-1. Main features (compared with other Titan tags)

•LAUNDRY shows stable and broad sensitivity curve from European to US frequency band, as can be seen in the graph below. Compared with other Titan tags for non-metal application (e.g. SMALLEST NM and PALLET), LAUNDRY's shows better sensitivity. 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.



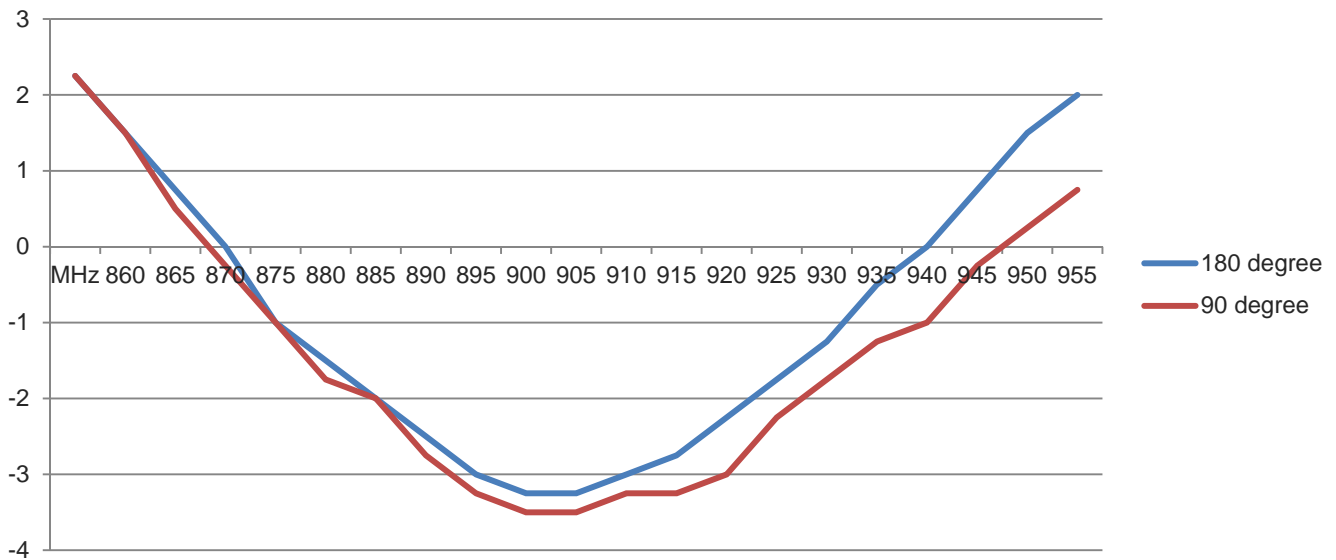
2-2. Tag orientation and read performance

•With slim rectangular feature, LAUNDRY shows significant read performance difference by how it is oriented. Compared with 0 degree's orientation, read range decreases by 30% when it's 45 degree oriented and by 80% when it's 90 degree oriented. See the graph below.



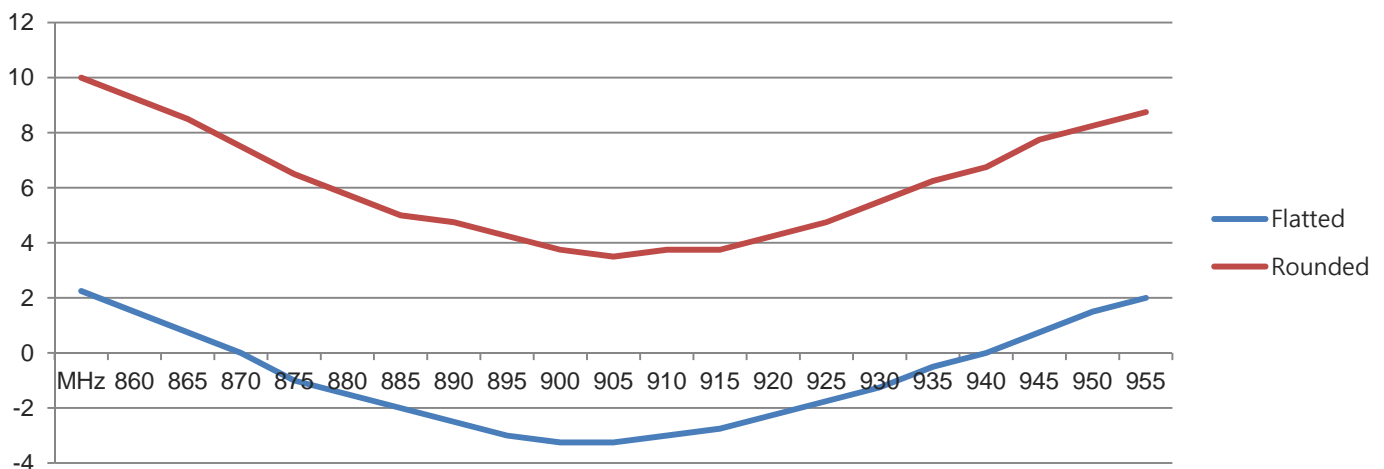
2-3. Angle b/w reader antenna and tag

- 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.
- LAUNDRY'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. This feature is best suitable for laundry application, because laundry's orientation against reader antenna is omni-directional.



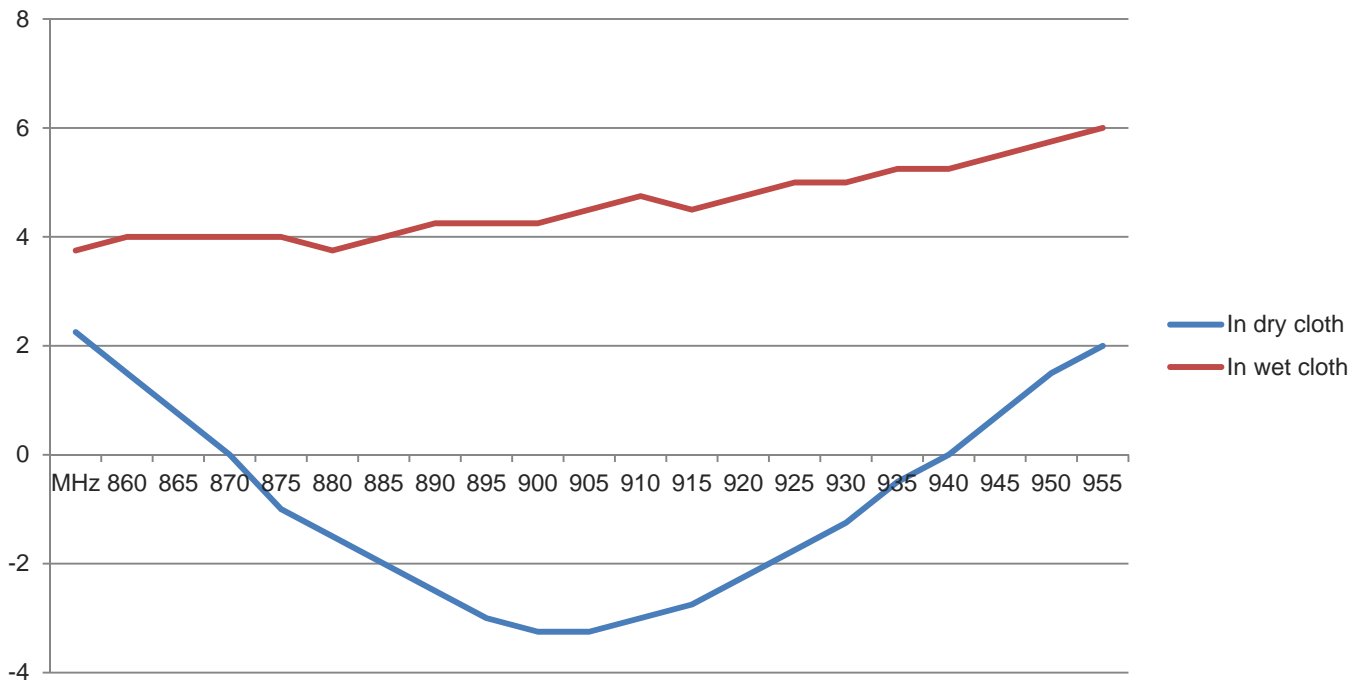
2-4. Read performance when tag gets rounded

- In real laundry, tags can not maintain its flatness but can be rounded in worst case (see the picture right).
- Though sensitivity curve of rounded form is well behind of flatted form, LAUNDRY can read 50% even when it gets rounded, which is also best suitable for laundry application.



2-5. Read performance when tag in wet cloth

- In real laundry, tags should be readable even when clothes are in wet conditions. However, most UHF laundry tags can not read even a few centimeters.
- Though sensitivity curve in wet cloth is well behind in dry cloth, LAUNDRY can still read 20%, which is also best suitable for laundry application.



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.
- **Liquids:** Just one drop of water on small UHF tag may decrease tag performance by up to 90%. Here below are three sensitivity curves – Please see 2-5 for further information.
- **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: LAUNDRY can withstand 200°C for 24hrs. RFcamp recommends, however, LAUNDRY 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: LAUNDRY 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

- Though LAUNDRY has unparalleled robustness with stable gold plated antenna, wire bonding, hardest epoxy chip encapsulation on both sides, and multi-layer polyimide film lamination under >200C degree.

3-6. Chemical stress

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

4. About tag attaching method

- As requested by customer, RFcamp supplies heat curable adhesive tape (by ironing) together with LAUNDRY.
- Heat curable adhesive tape is polyurethane base film with double sided hot-melt adhesive layer with size of 67mm*8mm with thickness of total 180 micron meter.
- Attachment:
 - (1) Put adhesive tape on fabric and peel out release paper.
 - (2) On adhesive tape, locate "Laundry" tag.
 - (3) Heat iron up to around 110C degree.
 - (4) Put iron on laundry tag for 5 seconds.
 - (5) Cool down 10 seconds in ambient temperature.



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

- N/A

5-3. Laser marking

- N/A

5-4. Direct (silkscreen) printing

- N/A