BCC Reader Evaluation

Version 0.3

February 14, 2008

Prepared for:PSMFC

PTAGIS

PIT Tag Information Systems

Columbia Basin | ptagis.org

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- **INTRODUCTION**

Background

The BCC reader was developed in incremental stages. Each stage of the development was an effort to improve the read quality of PIT tags on a large 18 x 18 ft antenna. Given this, all 4 readers that were manufactured have subtle or obvious physical and functional differences that at times hinder quick and deliberate repairs of the system. This situation required that all 4 readers be reworked by the manufacture so that each reader is equal to each other physically and functionally.

Purpose of Document

The purpose of this document is to define what repairs and upgrades were done by the manufacture to the 4 units and also to document performance of these units.

Definitions and Acronyms

This section provides the definitions of terms and acronyms used in the document.

1.1.1 Acronyms

1) PSMFC Pacific States Marine and Fisheries Commission
2) DF Destron-Fearing Corp. (Formerly Digital Angel Corp.)
3) BCC Bonneville Corner Collector
4) PTAGIS PIT Tag Acquisition / Graphical Information System
5) ANF Ambient Noise Floor

References

This section lists reference documents. Each document is identified by title, report number, date, and publishing organization for ease of finding it from the sources listed below in detail.

1) BCC Reader Operations Manual; Digital Angel Corp; Copy write 2006;
2) BCCReaderEval09Feb07.doc; PTAGIS; PSMFC; November 5, 2002.

- **PROJECT SUMMARY**

The goals and objectives of this project are to ensure that the BCC readers equally perform electronically and are mechanically the same to ensure a more efficient and predictable spare equipment base. PTAGIS staff traveled to DA in order to monitor the repairs and determine the performance of each reader with the help of DA staff.

- **SUMMARY OF REPAIR EVENTS**

1.1.2 Status of Readers upon Arrival at DA. January 7th, 2008.

1. Alex was working the current measuring inductor in each of the readers. The inductor circuit was not complete and was still in a state of R&D. Alex finished 1 prototype and installed the device on Reader # 3. Reader 03 was then moved into the outside tent area where further evaluation of the current device was performed.

2. It was found that the device was getting hot and not performing as expected. At that point, 10 wraps of winding was taken from the internal toroid inductor of the measuring device in order to lower the Q of the device. This action appeared to resolve the heating problem but then it was discovered that the device did not linearly track correctly through out the entire current range of the transceiver. After ~ 1 ½ hrs of troubleshooting, for the sake of progress, it was decided that to move on past this issue and resolve later in the week when Yuri is back at work.
3. For the record, a lot of time in the afternoon was spent setting up the test equipment in the tent and moving equipment along with fine tuning of the transceiver. Some random noise events were observed that hindered the tuning process.

1.1.3 Repair and Analysis. January 8th, 2008.

1. Initial read range tests on serial # 3 began this afternoon.
2. As of 4:41 CT, the baseline (Readability, Hit rate at a given distance) for reader 03 has been established. This information collected is only the start and has no meaning relative to any of the other readers.
3. A fair amount of time was required to substantiate the test outline that was originally defined. This was due to erroneous noise levels and changes in the ambient noise floor of the transceiver.
4. Testing will continue in the same manner on the other transceivers and will hopefully start to see differences in each reader so that we can pick the best performer that will set the standard for the rest of the units.

1.1.4 Physical Comparison amongst Units. January 9th, 2008.

Documented and evaluated the physical differences between readers. Refer to "Reader Physical Differences and Revision Comparison." See table 1. on the next page.

Table 1:

Unit Serial #	FW Ver.	PCB Board Rev. (All PCB's)	Cap Style	DC Wiring	External Connectors	Noteworthy Items
01	March 13th, 2003 22:35:45	A	Polyester Box	Color Code different	OK	Unit has deficient DSP from # 03. Unit will stay at DF
02	March 13th, 2003 22:35:45	A	Mica Film	OK	OK	None
03	March 13th, 2003 22:35:45	A	Polyester Box	OK	OK	Unit has good DSP from # 01.
04	March 13th, 2003 22:35:45	A	Mica Film	OK	OK	None

- Testing of the transceivers continued inside of the circus tent. Most of the day was spent fighting erroneous noise issues. It started to become apparent the tent facility did not provide any noise immunity whatsoever and provided no useful information that would facilitate the reader comparison evaluation.

Decision point:

- **It became apparent that no useful information could be obtained inside the tent due to random noise.**

- *The above situation was unfortunate in that using the 17 x 17 foot antenna would have provided more accurate information as to how the readers were performing beings that the reader was specifically designed for that size geometry.*
- Given the situation, it was decided to look at other options and test methodologies that would provide more accurate information for reader efficiency comparison.

1.1.5 Repair and Analysis. January 10th, 2008.

Decision Point:

Consulting with Yuri Smirnoff, it was decided that moving into the RF room and using a smaller 27" x 27" antenna would be adequate in order to evaluate the readers performance based on the performance criteria.

Yuri then suggested that performing a "Receiver Frequency Sensitivity Test" would be prudent. This test would effectively characterize the sensitivity of the receiver in each unit.

1.1.6 Repair and Analysis. Test Location Moved to RF Room.

Read Range Test Outline and Rational

After consulting with the DF engineers, it was determined that the ability of a reader to read a PIT tag at a given distance and documenting the "Hit Rate" at that distance would prove to be an effective means of gauging the performance of the reader . Other parameters that were also documented for comparative analysis were:

Ambient Noise Floor Readings. This reading determines what the noise levels were in the RF room prior to any PIT tag being introduced in the antenna field.

FDX-B Voltage Levels(PIT tag in field at a given distance) These readings indicate how much energy is required before the PIT tag can be read.

Hit Rate of Tag at a Given Distance. This information will tell how well the reader is deciphering tag information when compared to other readers.

Prior to performing the read range test, the transceivers were thoroughly tuned and optimized. Alex from DA exclusively performed all of the tuning on all transceivers. This was decided in order to best preserve the integrity of the test results rather than have other people interpret the information differently.

Electrical Constants for all Readers:

- Antenna Operating Current: 19.0 App.
- Exciter Voltage: 31.5 Vpp
- DC PS Current Draw: 2.6 App DC

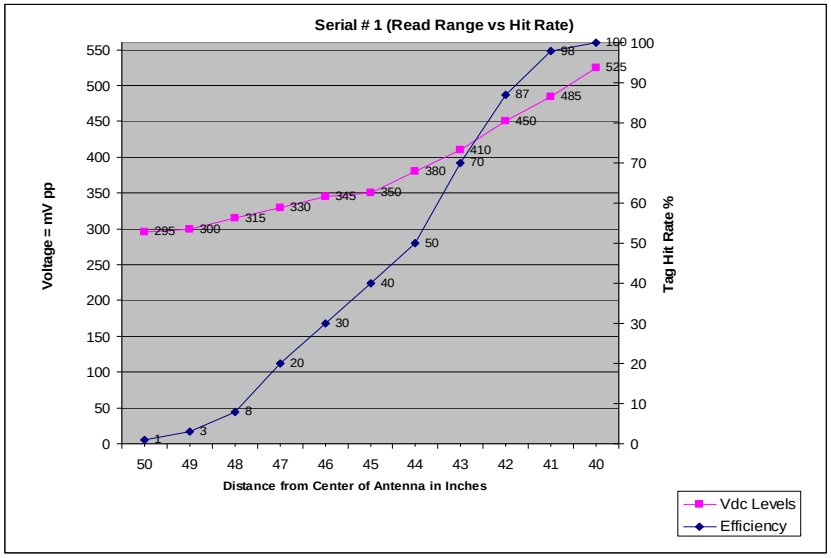
Antenna Characteristics:

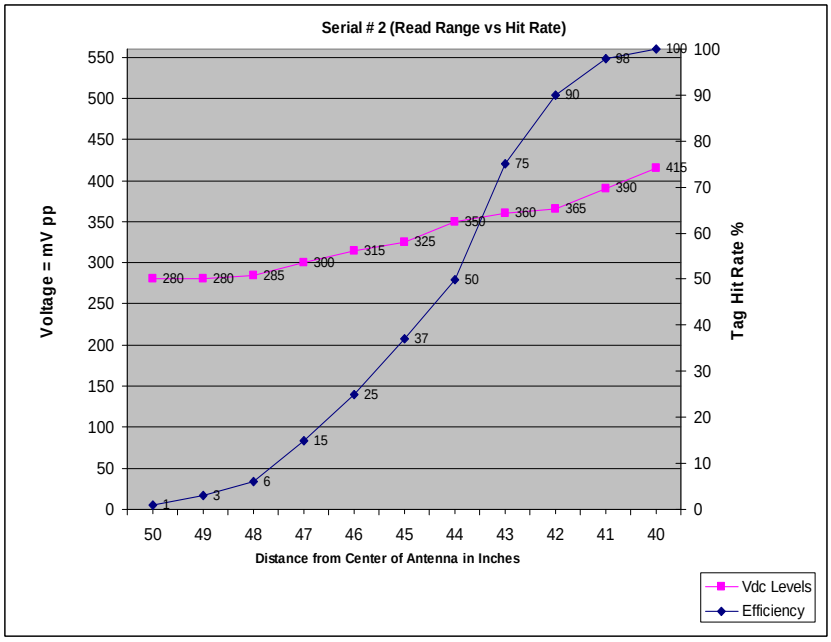
- Size: 27"x27" square
- Configuration: Square, 2 coils, 8 wraps each in parallel with each other.
- Inductance: 404 uH
- Q: 210 @ 100 Khz

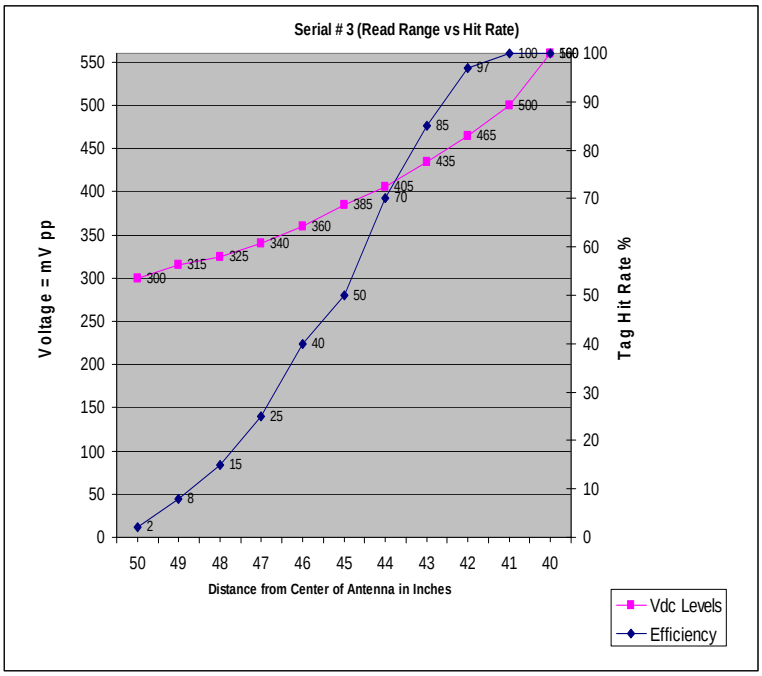
The below picture shows the physical layout of the test facility.

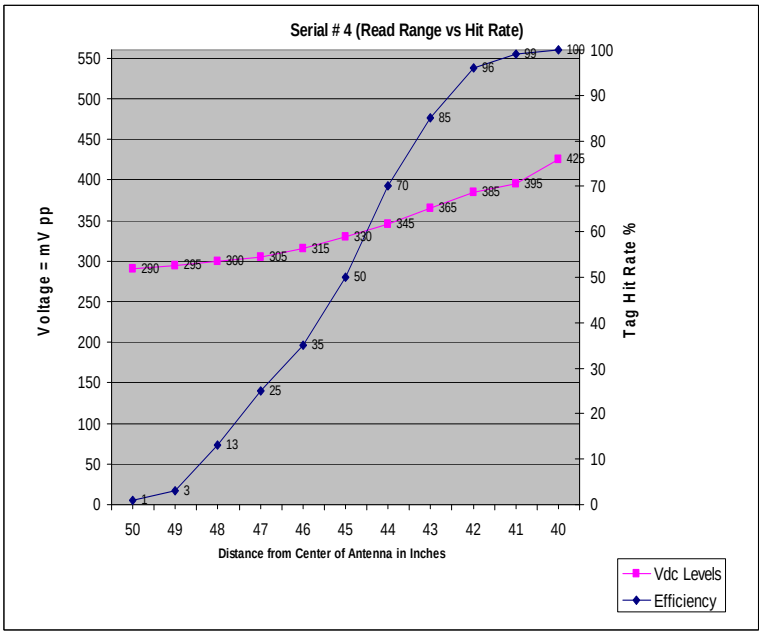
1.1.7 Read Range Test Results for each transceiver.

Below graphs plot Hit Rates Vs Distance from center of antenna Vs FDX-B levels.


Serial # 1 (Read Range vs Hit Rate)
Voltage = mV pp
Tag Hit Rate %
Distance from Center of Antenna in Inches
Vdc Levels
Efficiency
295 300 315 330 345 350 380 410 450 485 525
1 3 8 20 30 40 50 70 87 98 100


Serial # 2 (Read Range vs Hit Rate)
Voltage = mV pp
Tag Hit Rate %
Distance from Center of Antenna in Inches
Vdc Levels
Efficiency
280 280 285 300 315 325 350 360 365 390 415
1 3 6 15 25 37 50 75 90 98 100





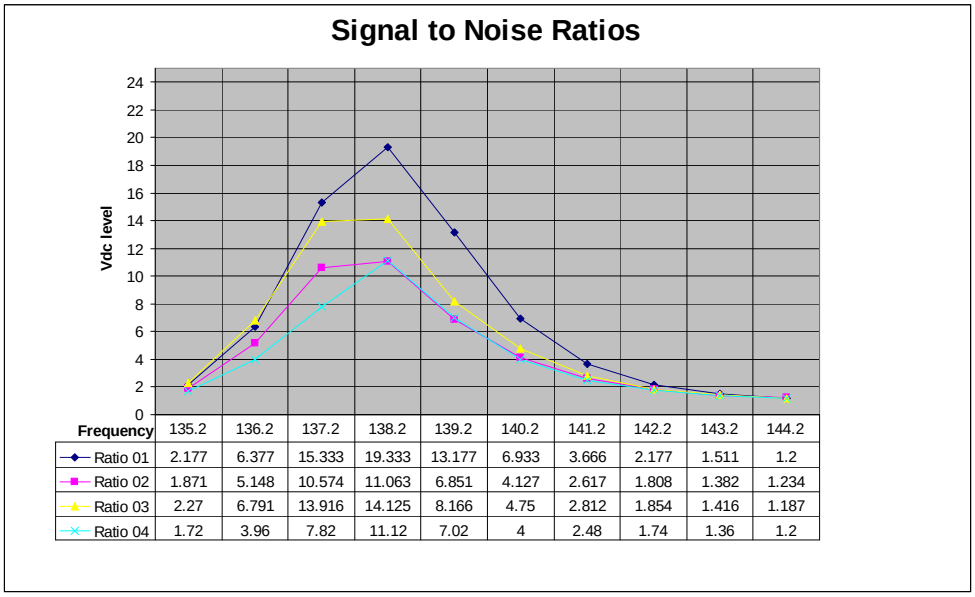
1.1.8 Receiver Sensitivity Test Plots

Test Outline and Criteria.

- Read and Record the Ambient Noise Floor (ANF) of each transceiver
- Utilizing a signal generator, a 1 Vpp sinusoidal wave signal injected at the antenna lead connections of each transceiver.
- Starting at 135.2 Khz and stepping up in 1 Khz increments to 144.2 Khz

- Record FDX-B level at each step increment.
- Calculate the S and N ratios SNR = (Psignal/Pnoise) based on values recorded at each step.
- All fixtures, drive voltages and antenna current regarding this test is the same as stated in the Hit Rate test.

The following graph shows the Signal to Noise Ratios of each receiver.



Frequency	135.2	136.2	137.2	138.2	139.2	140.2	141.2	142.2	143.2	144.2
Ratio 01	2.177	6.377	15.333	19.333	13.177	6.933	3.666	2.177	1.511	1.2
Ratio 02	1.871	5.148	10.574	11.063	6.851	4.127	2.617	1.808	1.382	1.234
Ratio 03	2.27	6.791	13.916	14.125	8.166	4.75	2.812	1.854	1.416	1.187
Ratio 04	1.72	3.96	7.82	11.12	7.02	4	2.48	1.74	1.36	1.2

• SUMMARY OF MODIFICATIONS TO ALL READERS

- All boards were checked and updated if it was necessary.
- All internal connections were standardized.
- Antenna Current Measurement Modules were installed on all transceivers, tested and calibrated. If calibrated properly the reading error should not exceed 0.5 A_{p-p} at either extreme.
- Ethernet cables were replaced with shielded ones.
- Serial Port connectors were fixed on two transceivers.
- Main Ground feed-through connector was replaced with a ground stud connector.
- DSP board that had weaker performance was fixed by replacing the ADC chip.
- Displays were removed from CPU boards to prevent shorting of its pins through memory card's case on the opposite side of the board. The display was used for debugging purposes during development process and at this point does not have any use.
- FBB signal wire on DSP boards was replaced with shielded cable to prevent picking up noise from digital portion of the board.

- Transceivers were tested and calibrated; all covers and doors were installed; all missing components were replaced (main ground cables, thumb screws, door hinge pins, etc.); all connectors were properly labeled.

Readers Locations as of February 14th, 2008:

- Serial # **2** and **3** are being returned to PSMFC for use at the BCC channel
- Serial # **1** will stay at Destron Fearing as a spare for testing STR performance.
- Serial # **4** has been sent to STR for firmware development and changes.