TESTING
CERT #803.01, 803.02, 803.05, 803.06

ADDENDUM TO IMPINJ INC. TEST REPORT FC09-014

FOR THE

RFID READER, IPJ-REV

FCC PART 15 SUBPART C SECTION 15.247 AND RSS-210 ISSUE 7

TESTING

DATE OF ISSUE: AUGUST 12, 2009

PREPARED FOR:

Impinj Inc.
701 N. 34th Street
Seattle, WA 98103

PREPARED BY:

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Date of test: July 23, 2009

Report No.: FC09-014A

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ADMINISTRATIVE INFORMATION

DATE OF TEST: July 23, 2009

DATE OF RECEIPT: July 23, 2009

REPRESENTATIVE: Bill Ashley

MANUFACTURER:
Impinj Inc.
701 N. 34th Street
Seattle, WA 98103

TEST LOCATION:
CKC Laboratories, Inc.
22116 23rd Drive S.E., Suite A
Bothell, WA 98021-4413

TEST METHOD: ANSI C63.4 (2003), RSS-210 Issue 7 and RSS GEN Issue 2

PURPOSE OF TEST:
Original Report: To perform the testing of the RFID Reader, IPJ-REV with the requirements for FCC Part 15 Subpart C Sections 15.207 & 15.247and RSS-210 devices.
Addendum A: To re-test the RFID Reader, IPJ-REV with the requirements for FCC Part 15 Subpart C Sections 15.247 and RSS-210 due to a firmware change to add reduced power channels.

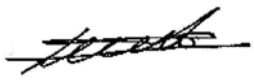
APPROVALS

Steve Behm, Director of Engineering Services

QUALITY ASSURANCE:

Donald Jones, Senior EMC Engineer / Lab Manager

TEST PERSONNEL:



Armando Del Angel, Test Engineer

SUMMARY OF RESULTS

Test	Specification/Method	Results
Average Time of Occupancy	FCC Part 15.247(a)	Pass
Number of Hopping Channels	FCC Part 15.247(a)	Pass
99% Bandwidth	RSS-210 Issue 7 and RSS GEN Issue 2	Pass
Site File No.	FCC 318736 IC 3082C-1	

CONDITIONS DURING TESTING

No modifications to the EUT were necessary during testing.

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

The customer declares the EUT tested by CKC Laboratories was representative of a production unit.

EQUIPMENT UNDER TEST

RFID Reader
Manuf: Impinj Inc.
Model: IPJ-REV
Serial: 37009250045

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

Router
Manuf: Belkin
Model: F5D7230-4
Serial: NA

Laptop
Manuf: Dell
Model: Latitude 0026
Serial: NA

MEASUREMENT UNCERTAINTIES

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

The reported measurement uncertainties are calculated based on the worst case of all laboratory environments from CKC Laboratories, Inc. test sites. Only those parameters which require estimation of measurement uncertainty are reported. The reported worst case measurement uncertainty is less than the maximum values derived in CISPR 16-4-2. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

REPORT OF EMISSIONS MEASUREMENTS

TESTING PARAMETERS

TEMPERATURE AND HUMIDITY DURING TESTING

The temperature during testing was within +15°C and + 35°C.
The relative humidity was between 20% and 75%.

The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. The following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used. When conducted emissions testing was performed, a 10 dB external attenuator was used with internal offset correction in the analyzer.

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the highest readings, this is indicated as a "QP" or an "Ave" on the appropriate rows of the data sheets. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer/receiver readings recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the measuring device called "peak hold," the measuring device had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the quasi-peak detector.

Average

For certain frequencies, average measurements may be made using the spectrum analyzer/receiver. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.

FCC 15.247(a) – NUMBER OF HOPPING CHANNELS

Test Equipment

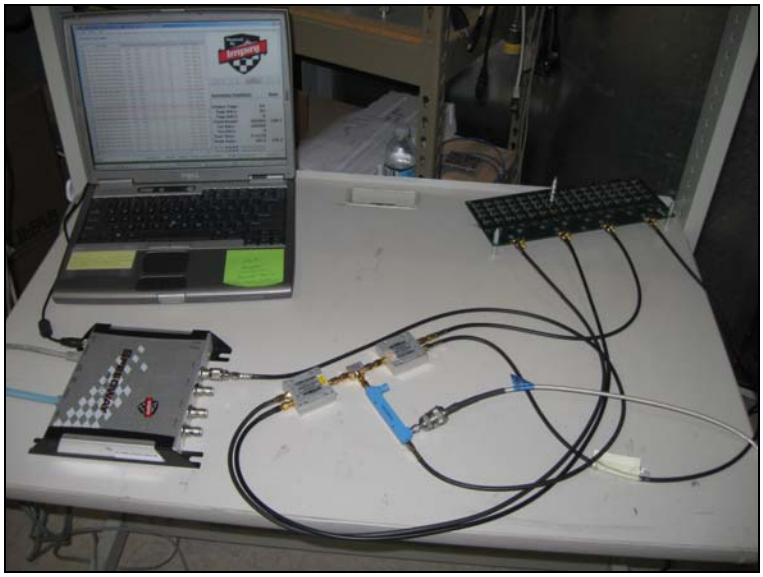
Asset #	Name	Manufacturer	Model	Serial	Cal date	Cal Due
02872	Spectrum Analyzer	Agilent	E4440A	MY46186330	1/31/2008	1/31/2010
03121	Cable	Astrolab	32026-2-29080-84		4/28/2009	4/28/2011
P05748	Attenuator	Pasternack	PE7004-20		4/3/2008	4/3/2010

Test Conditions

For these tests the EUT is configured using a laptop which is connected to it via a router. The RF port of the EUT is connected to the Spectrum Analyzer that is used to make the measurements and also to a board with RFID tags on it so as to simulate a use case. During the test these tags are continuously interrogated by the EUT.

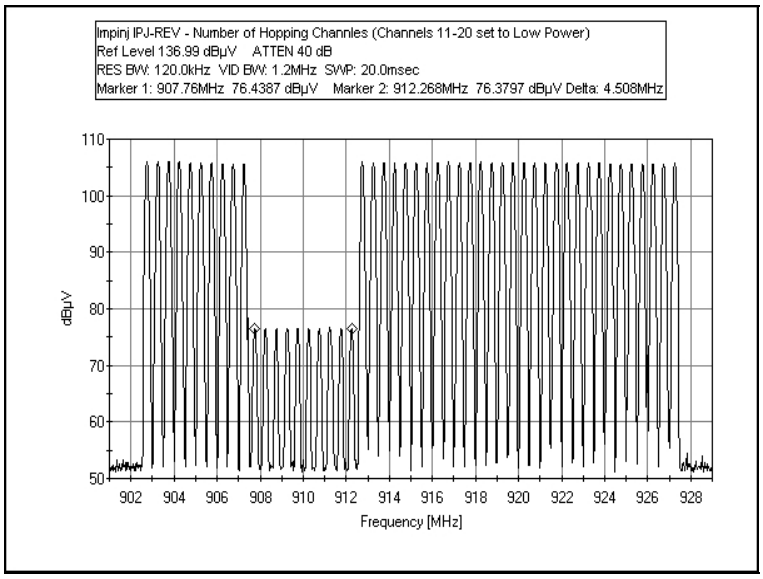
Result: 50 Channels

Test Setup Photos

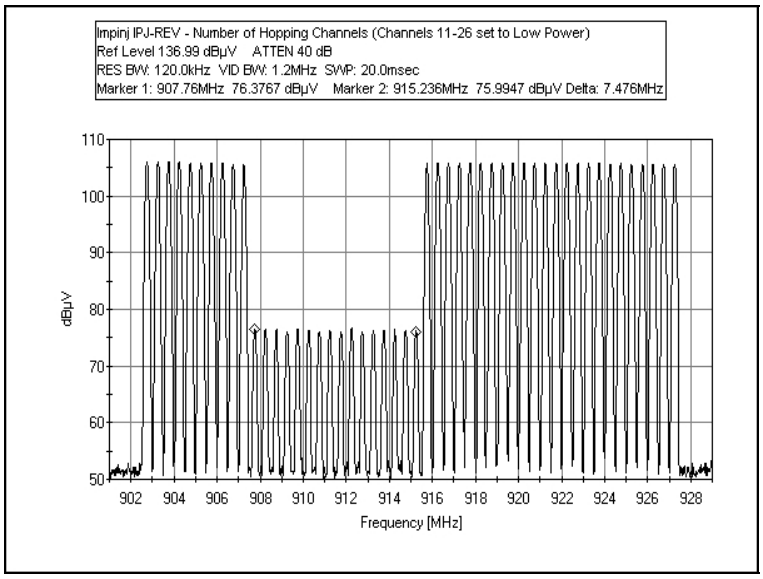


Test Data

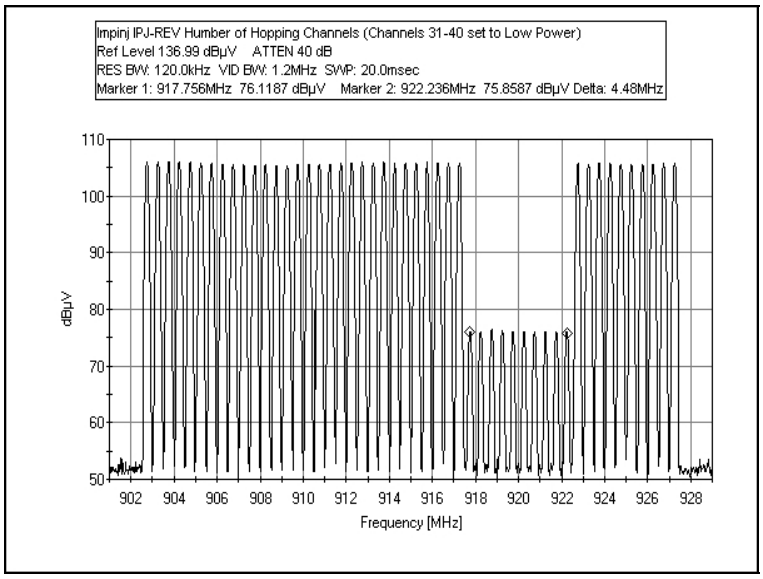
FCC 15.247(a)(1) NUMBER OF HOPPING CHANNELS
LOW POWER MODE - CHANNELS 11-20



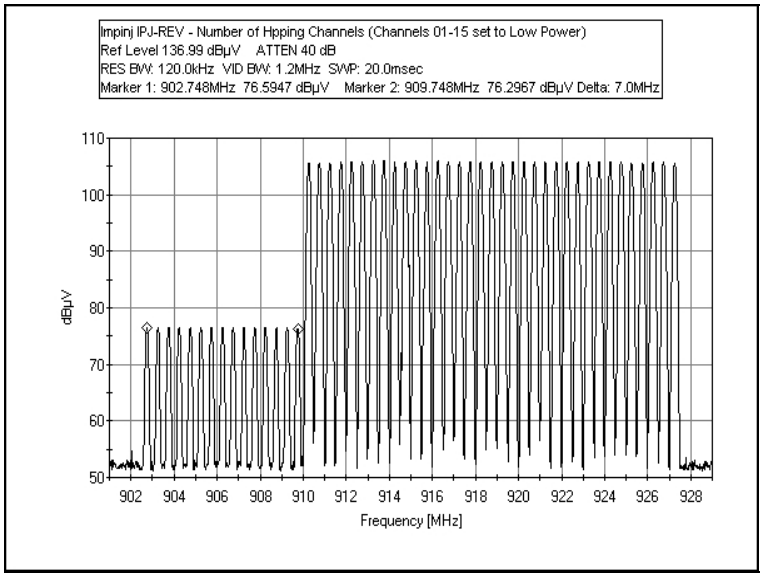
FCC 15.247(a)(1) NUMBER OF HOPPING CHANNELS
LOW POWER MODE - CHANNELS 11-26



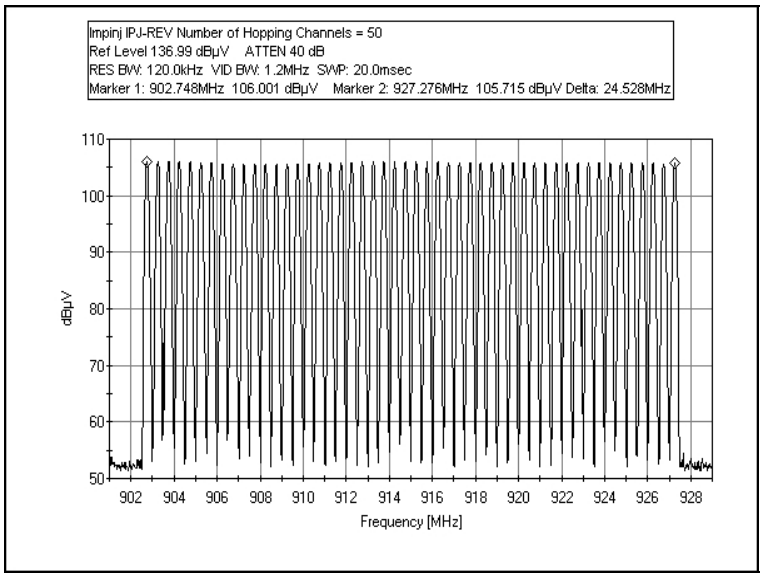
FCC 15.247(a)(1) NUMBER OF HOPPING CHANNELS
LOW POWER MODE - CHANNELS 31-40



FCC 15.247(a)(1) NUMBER OF HOPPING CHANNELS
LOW POWER MODE - CHANNELS 1-15



FCC 15.247(a)(1) NUMBER OF HOPPING CHANNELS
HIGH POWER MODE - CHANNELS 1-50



FCC 15.247(a) – AVERAGE TIME OF OCCUPANCY

Test Equipment

Asset #	Name	Manufacturer	Model	Serial	Cal date	Cal Due
02872	Spectrum Analyzer	Agilent	E4440A	MY46186330	1/31/2008	1/31/2010
03121	Cable	Astrolab	32026-2-29080-84		4/28/2009	4/28/2011
P05748	Attenuator	Pasternack	PE7004-20		4/3/2008	4/3/2010

Test Conditions

For these tests the EUT is configured using a laptop which is connected to it via a router. The RF port of the EUT is connected to the Spectrum Analyzer that is used to make the measurements and also to a board with RFID tags on it so as to simulate a use case. During the test these tags are continuously interrogated by the EUT. Video trace averaging over 200 samples was used in order to take average values. Frequency range of operation is 902.75 to 927.25 MHz.

Low Power Mode:

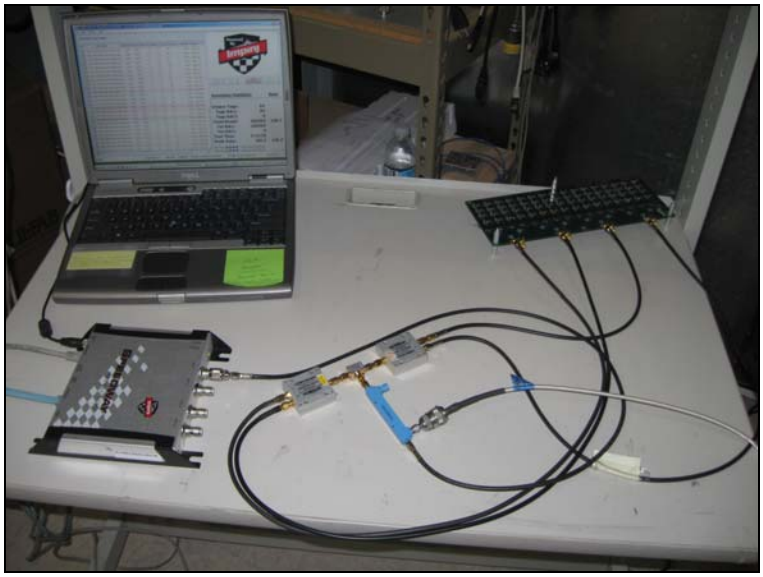
The Low Power mode dwell vary depending on the number of low power channel chosen.
The minimum number of low power channels allowed by the manufacturer is 2 in which the following is measured: There is a pulse train repetition which repeats approximately every 10.26 seconds. There are therefore 1.949 pulse trains every 20 seconds. There are 20 individual pulses per pulse train. Each individual pulse has an average duration of 9.78ms. The pulses were average using video trace averaging over 200 samples. Therefore the average time of occupancy in a 20 seconds window is 1.949*9.78*20 = 381.22ms. This satisfies the 400ms ON time requirement in any 20 second window.

The maximum number of low power channels allowed by the manufacturer is 16 in which the following is measured: There is a pulse repetition which repeats approximately every 10.16 seconds. There are two pulses that occur within the pulse train with periods of 3.12 and 7.02 seconds respectively. There are therefore 3.937 pulses every 20 seconds. Each pulse has an average duration of 99.45ms. The pulses were average using video trace averaging over 200 samples. Therefore the average time of occupancy in a 20 seconds window is 3.937*99.45 = 391.53ms. This satisfies the 400ms ON time requirement in any 20 second window.

High Power Mode:

There is a pulse repetition which repeats approximately every 10.16 seconds. There are therefore 1.968 pulses every 20 seconds. Each pulse has an average duration of 197.4ms. The pulses were average using video trace averaging over 200 samples. Therefore the Average time of occupancy in a 20 seconds window is 1.968*197.4 = 388.48ms. This satisfies the 400ms on time requirement in any 20 seconds window.

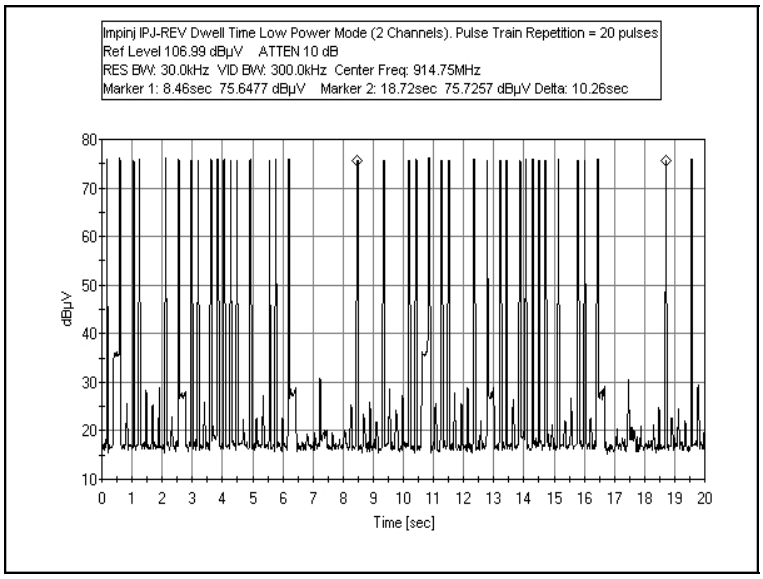
Test Setup Photos



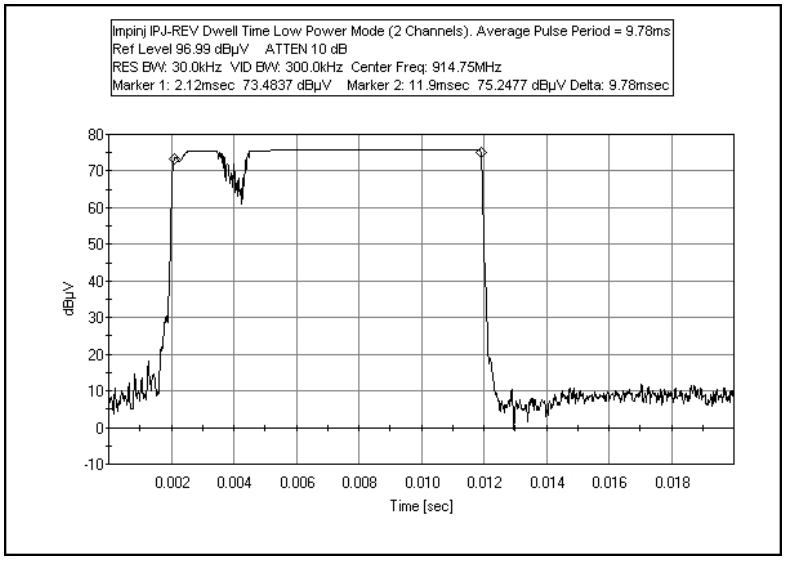
Test Data

Mode	Result	Limit
Low power 2 ch	381.22ms	400ms
Low power 16 ch	391.53ms	400ms
High power 50 ch	388.48ms	400ms

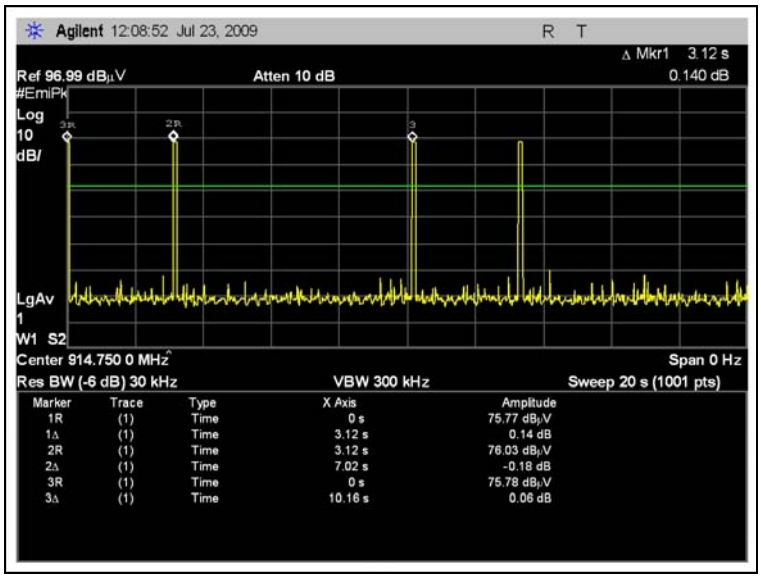
FCC 15.247(a)(1)(i) PULSE REPETITION
LOW POWER MODE - 2 CHANNELS



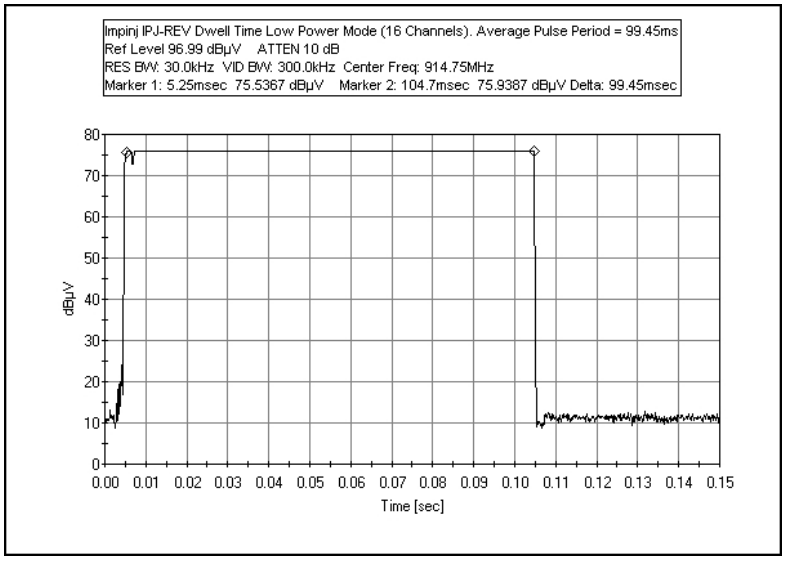
FCC 15.247(a)(1)(i) DWELL TIME
LOW POWER – 2 CHANNELS



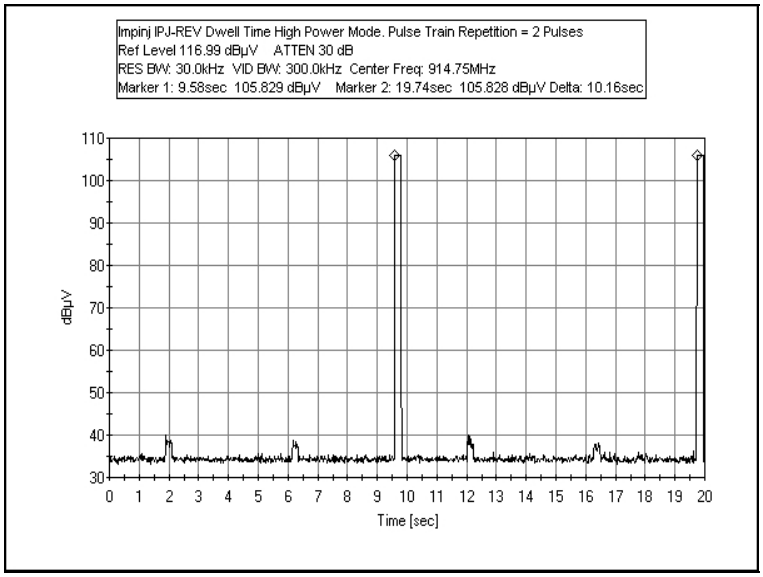
FCC 15.247(a)(1)(i) PULSE REPETITION
LOW POWER MODE - 16 CHANNELS



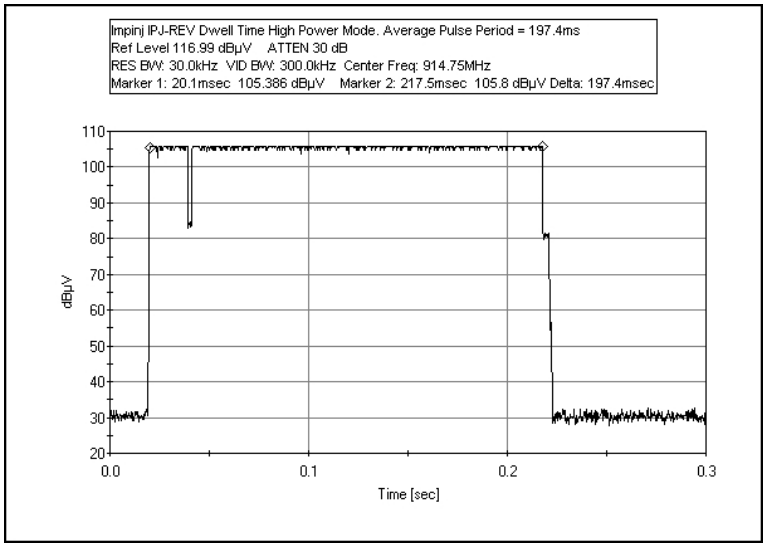
FCC 15.247(a)(1)(i) DWELL TIME
LOW POWER – 16 CHANNELS



FCC 15.247(a)(1)(i) PULSE REPETITION HIGH POWER MODE



FCC 15.247(a)(1)(i) DWELL TIME HIGH POWER



RSS-210 – 99% BANDWIDTH

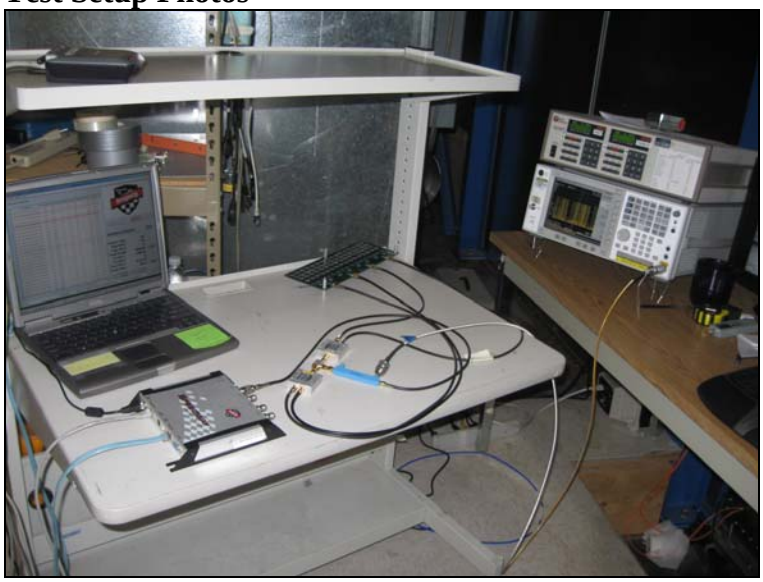
Test Equipment

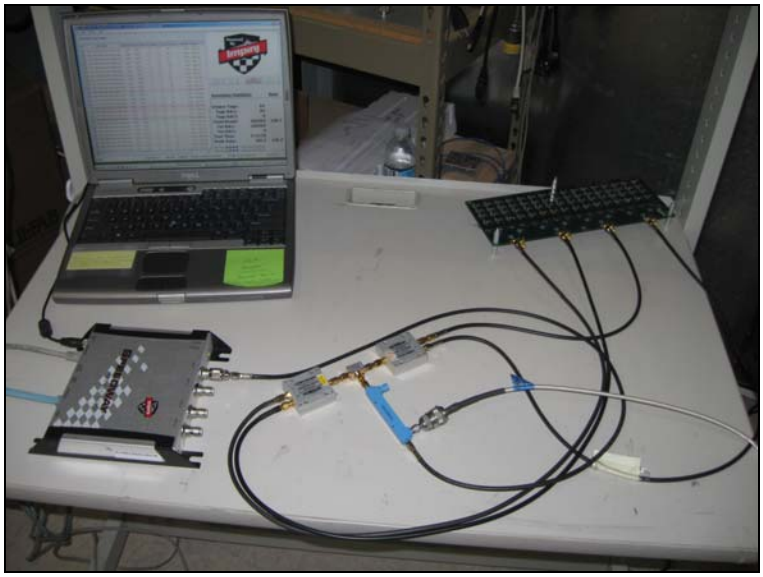
Asset #	Name	Manufacturer	Model	Serial	Cal date	Cal Due
02872	Spectrum Analyzer	Agilent	E4440A	MY46186330	1/31/2008	1/31/2010
03121	Cable	Astrolab	32026-2-29080-84		4/28/2009	4/28/2011
P05748	Attenuator	Pasternack	PE7004-20		4/3/2008	4/3/2010

Test Conditions

The EUT's RF port is connected to a board with RFID tags through a directional coupler; PSA is connected to the FWR Power port of the directional coupler.

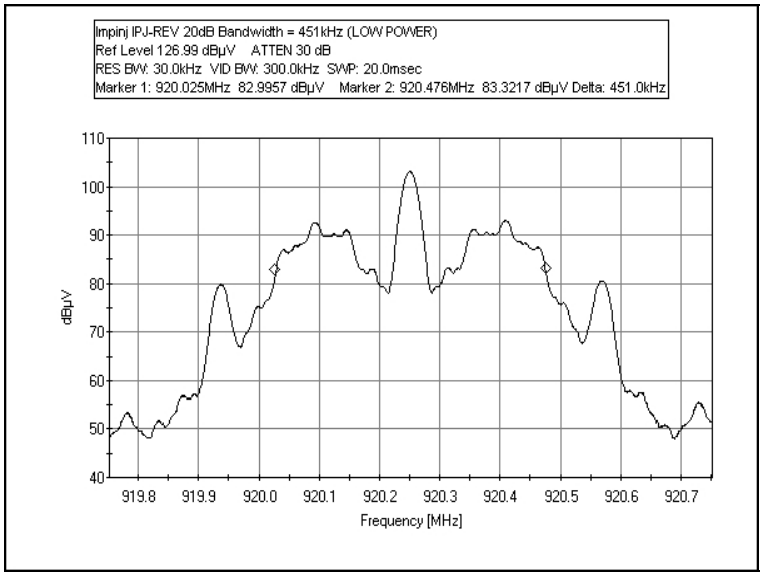
Test Setup Photos



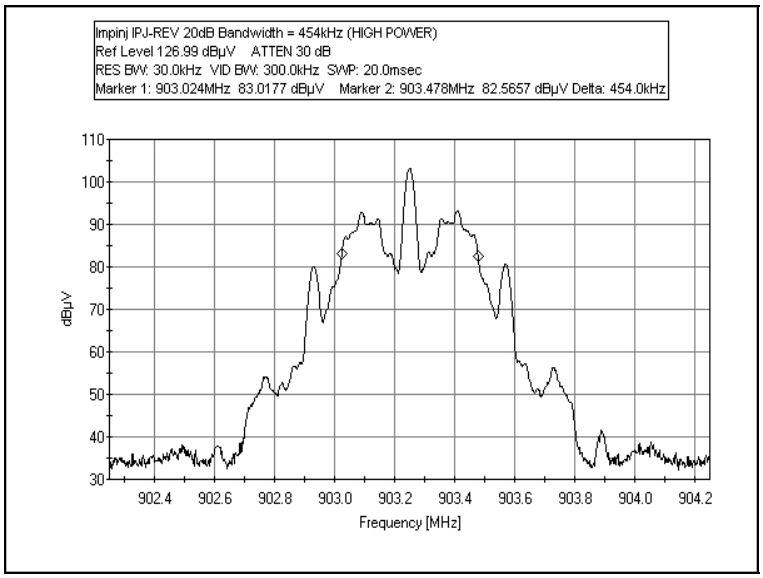


Test Data

LOW POWER



HIGH POWER


Impinj IPJ-REV 20dB Bandwidth = 454kHz (HIGH POWER)
Ref Level 126.99 dBµV ATTEN 30 dB
RES BW: 30.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker 1: 903.024MHz 83.0177 dBµV Marker 2: 903.478MHz 82.5657 dBµV Delta: 454.0kHz
110
100
90
80
70
60
50
40
30
dBµV
902.4
902.6
902.8
903.0
903.2
903.4
903.6
903.8
904.0
904.2
Frequency [MHz]