Test of NuTune MRX 2010

To: FCC 47 CFR Part 15.407

Test Report Serial No.: TELE02-B8 Rev B

TEST REPORT

FROM

MiCOMLabs

Test of NuTune MRX 2010

To: FCC 47 CFR Part 15.407

Test Report Serial No.: TELE02-B8 Rev B

This report supersedes TELE02-B8 Rev A

Applicant: NuTune
High Tech Campus 32
Eindhoven, NL-5656AE
The Netherlands

Product Function: Wireless Access Point –
Client Device without Radar Detection

Copy No: pdf   **Issue Date:** 10th October 2008

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED

CERTIFICATE #2381.01

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ACCREDITATION, LISTINGS & RECOGNITION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025.   The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01.   MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America

Federal Communications Commission (FCC) Listing #: 102167

Canada

Industry Canada (IC) Listing #:4143A-2

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	US0159
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT)	I	
	Bureau of Standards, Metrology and Inspection (BSMI)	I	

DOCUMENT HISTORY

Document History		
Revision	**Date**	**Comments**
Draft		
A	8th October 2008	Initial release.
B	10th October 2008	Clarification of monitoring of beacons in Section 5.1.4.

1. <u>TEST RESULT CERTIFICATE</u>

Applicant:	NuTune	Tested By:	MiCOM Labs, Inc.
	High Tech Campus 32		440 Boulder Court
	Eindhoven, NL-5656AE		Suite 200
	The Netherlands		Pleasanton
			California, 94566, USA
EUT:	Wireless Access Point	Telephone:	+1 925 462 0304
Model:	MRX 2010 Configured as Client Device without Radar detection	Fax:	+1 925 462 0306
S/N:	006037800 87C		
Test Date(s):	21st to 26th August 2008	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.407	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
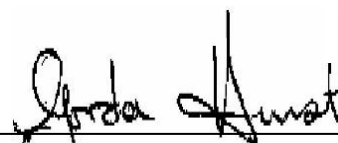
Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

A2LA ACCREDITED
CERTIFICATE #2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

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2. <u>REFERENCES AND MEASUREMENT UNCERTAINTY</u>

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.407	2007	Code of Federal Regulations
(ii)	FCC 06-96	June 2006	Memorandum Opinion and Order
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy
(ix)	FCC Public Notice – DA 02-2138	2002	Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices

2.2.   Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the NuTune MRX 2010 as a Client Device without Radar detection in the frequency ranges 5250 to 5350 MHz, and 5470 to 5725 MHz to FCC Part 15.407 DFS requirements only
Applicant:	NuTune High Tech Campus 32 Eindhoven, NL-5656AE The Netherlands
Manufacturer:	As applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	TELE02-B8 Rev B
Date EUT received:	21st July 2008
Standard(s) applied:	FCC 47 CFR Part 15.407
Dates of test (from - to):	21st to 26th August 2008
No of Units Tested:	1
Type of Equipment:	802.11a/b/g/n Wireless Access Point, 2x3 Spatial Multiplexing MIMO configuration
Location for Use:	Indoor and outdoor operation
Applicants Trade Name:	NuTune
Model(s):	MRX 2010
FCC ID	WOPMRX2010C2
Software Release	2.3.5
Hardware Release	C2
Location for use:	Indoor Only
Declared Frequency Range(s):	5,250 to 5,350 MHz 5,470 to 5,725 MHz,
Type of Modulation:	Per 802.11 – OFDM
Declared Nominal Output Power: (Average Power)	+18 dBm
EUT Modes of Operation:	802.11a/b/g/n (20 & 40 MHz)
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	3.3 Vdc 0.9 A
Operating Temperature Range:	Declared range 0 to +60ºC
Frequency Stability:	±15 ppm max
Equipment Dimensions:	50.8 mm X 56.2 mm X 4.2 mm
Weight:	14g
Primary function of equipment:	Transmission of Video (HD TV), data and voice

3.2.   Scope of Test Program

The scope of this program was to test the NuTune MRX 2010 wireless Access Point as a Client Device without Radar detection in Channel Bandwidths 20 MHz, and 40MHz configurations for compliance with the Dynamic Frequency Selection (DFS) requirements of FCC 47 CFR Part 15.407 and the FCC specification Memorandum Opinion and Order FCC 06-96. The Client configured device was tested with another NuTune MRX 2010 wireless Access Point configured as a Master device with full radar detection.

The antennas used with the MRX 2010 are detailed in section 3.4 "Antenna Details".

One frequency was chosen (5,500 MHz) from the operating channels of the UUT within 5,470 – 5,725 MHz band for DFS testing per the requirements of FCC specification "Memorandum Opinion and Order FCC 06-96", Section 7.8 "DFS Conformance Test Procedures".

U-NII devices operating in the 5,250 – 5,350 MHz and 5,470 - 5,725 MHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

DFS performance testing was completed conductively.

NuTune MRX 2010
Wireless Access Point

3.3.   Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
Client (EUT)	Access Point	NuTune	MRX 2010	006037800 87C
Master	Access Point	NuTune	MRX 2010	006037800 87D
Support	Power Supply	VOLTCRAFT/Amplus	9935	20082954
Support	Laptop PC	IBM	Thinkpad	None

3.4.   Antenna Details

a.   Rubber Ducky 2.5 dBi @ 2.4GHz / 5.5 dBi @ 5GHz

3.5.   Cabling and I/O Ports

Number and type of I/O ports

1.   10/100 Ethernet X 2

2.   USB Port

3.   4mm socket for 18 Vdc supply

3.6.   Test Configurations

Matrix of test configurations

Operational Mode	Test Frequency (MHz)	Band Width Variant (MHz)
802.11a	5500	20 MHz
	5510	40 MHz

DFS testing was performed on the customer equipment configured as;-

1). Client device without radar detection;- in accordance with the following table.

Requirement	Operational Modes
	Client Without Radar Detection
DFS Detection Threshold	Not Required
Channel Closing Transmission Time	Yes
Channel Move Time	Yes
U-NII Detection Bandwidth	Not Required

3.7.   Equipment Modifications
The following modifications were required to bring the equipment into compliance:

1. NONE

3.8.   Deviations from the Test Standard
The following deviations from the test standard were required in order to complete the test program:

1. NONE

4. <u>TEST SUMMARY</u>

List of Measurements - Dynamic Frequency Selection (DFS)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407(h)(2)** and **FCC Memorandum Opinion and Order FCC 06-96 (Compliance Measurement procedures for Unlicensed National Information Infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection).**

Tests performed on NuTune MRX-2010 Master Device

Section	Test Items	Description	Condition	Result	Test Report Section
7.8.3	In-Service Monitoring	In-Service Monitoring for Channel Move Time and Channel Closing Transmission Time	Conducted	Complies	5.1.3

Note 1: Test results reported in this document relate only to the items tested
Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria
Note 3:Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

5. Dynamic Frequency Selection (DFS)

5.1. Test Procedure and Setup

FCC, Part 15 Subpart C §15.407(h)
FCC 06-96 Memorandum Opinion and Order

5.1.1. DFS Response requirement values

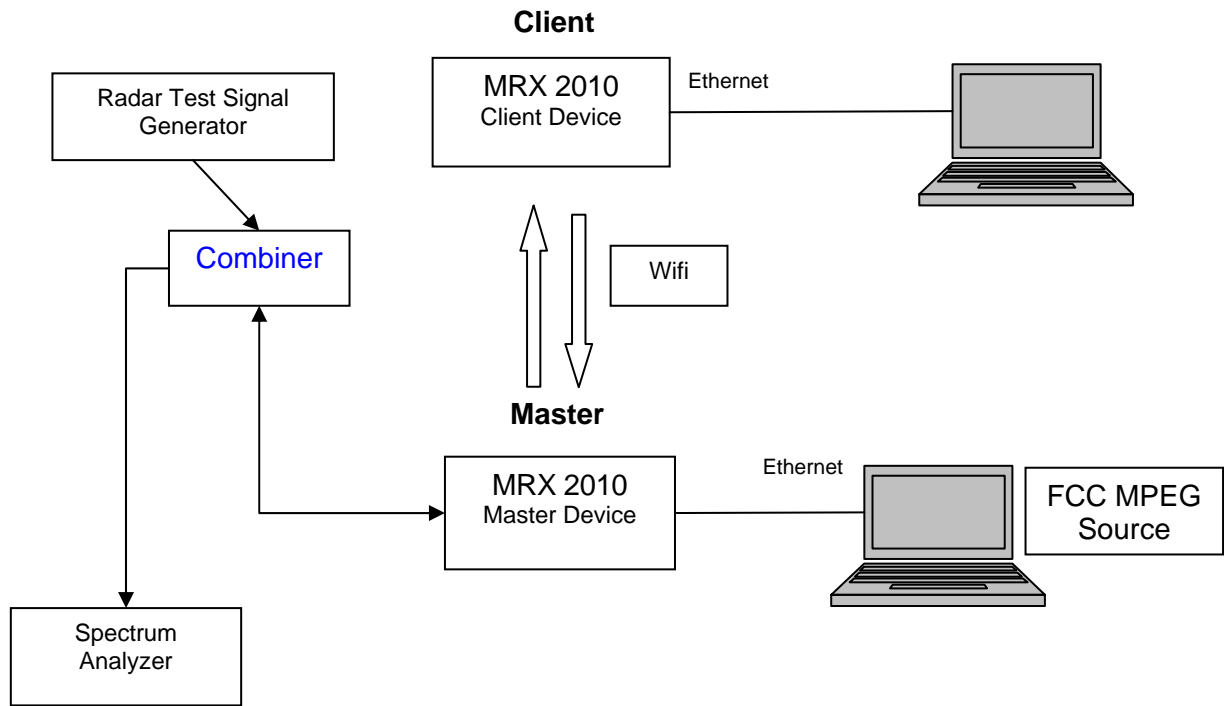| Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 80% of the 99% power bandwidth See Note 3.

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

5.1.2. Test Set Up:

Block Diagram(s) of Test Setup

```
                                    Client
  ┌───────────────────┐      ┌──────────────────┐  Ethernet   ┌──────────┐
  │ Radar Test Signal │      │    MRX 2010      │─────────────│  laptop  │
  │    Generator      │      │  Client Device   │             └──────────┘
  └───────────────────┘      └──────────────────┘
            │
            ▼                        ▲ │
  ┌───────────────────┐             │ │       ┌──────────┐
  │    Combiner       │             │ │       │   Wifi   │
  └───────────────────┘             │ ▼       └──────────┘
       │        ▲
       │        │                  Master
       │        └──────────►┌──────────────────┐  Ethernet   ┌──────────┐  ┌──────────────┐
       │                    │    MRX 2010      │─────────────│  laptop  │  │  FCC MPEG    │
       │                    │  Master Device   │             └──────────┘  │   Source     │
       │                    └──────────────────┘                           └──────────────┘
       ▼
  ┌───────────────────┐
  │     Spectrum      │
  │     Analyzer      │
  └───────────────────┘
```

5.1.3. Client Device - In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time FCC §15.407(h)(2)(iii)

Tests Performed on Client Device (without radar detection)

Requirement	Operational Mode Client Without Radar Detection
DFS Detection Threshold	Not Required
Channel Closing Transmission Time	Yes
Channel Move Time	Yes
U-NII Detection Bandwidth	Not Required

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Master Device was associated with the EUT (Client). The requisite MPEG video file ("TestFile.mpg" available on the NTIA website at the following link http://ntiacsd.ntia.doc.gov/dfs/) is streamed from the master device (AP) to the client.

20 MHz Bandwidth Channel Closing Transmission Time - Measurement

A Type 1 waveform was introduced to the EUT, from which a 12 second transmission record was digitally captured, collecting nearly 250M samples of data, which included in excess of 600 ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the radar waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The test system was set-up to capture all transmission data for access point events above a threshold level of -50 dBm. The test equipment time stamps all captured events with respect to T0 (zero time indicating the start of the measurements sequence) starting the 612.1 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period   612.1 ms

Type 1 burst period   25.705 ms

(The period of the 18 pulse burst includes [18 pulses *1.428mS PRI] = 25.704 ms. Then add 1 µs pulse width for the final pulse.)

Channel Closing Transmission Time starts immediately after the last radar pulse is transmitted i.e. 637.8 ms after the start of the trace capture period.

Therefore, pulses seen after this 637.8 ms boundary are identified and totaled to provide an aggregate total of transmissions in order to determine whether the EUT is compliant with the Channel Closing Transmission Time requirements as described in MO&O FCC 06-96. In this case, it was found that an aggregate total of 2.334 ms of transmission time accrued. This value is found at the right hand side at the foot of the following plot (10s Total).

Channel Closing Transmission Time = 2.334 mSecs (limit 260 mSecs)

Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
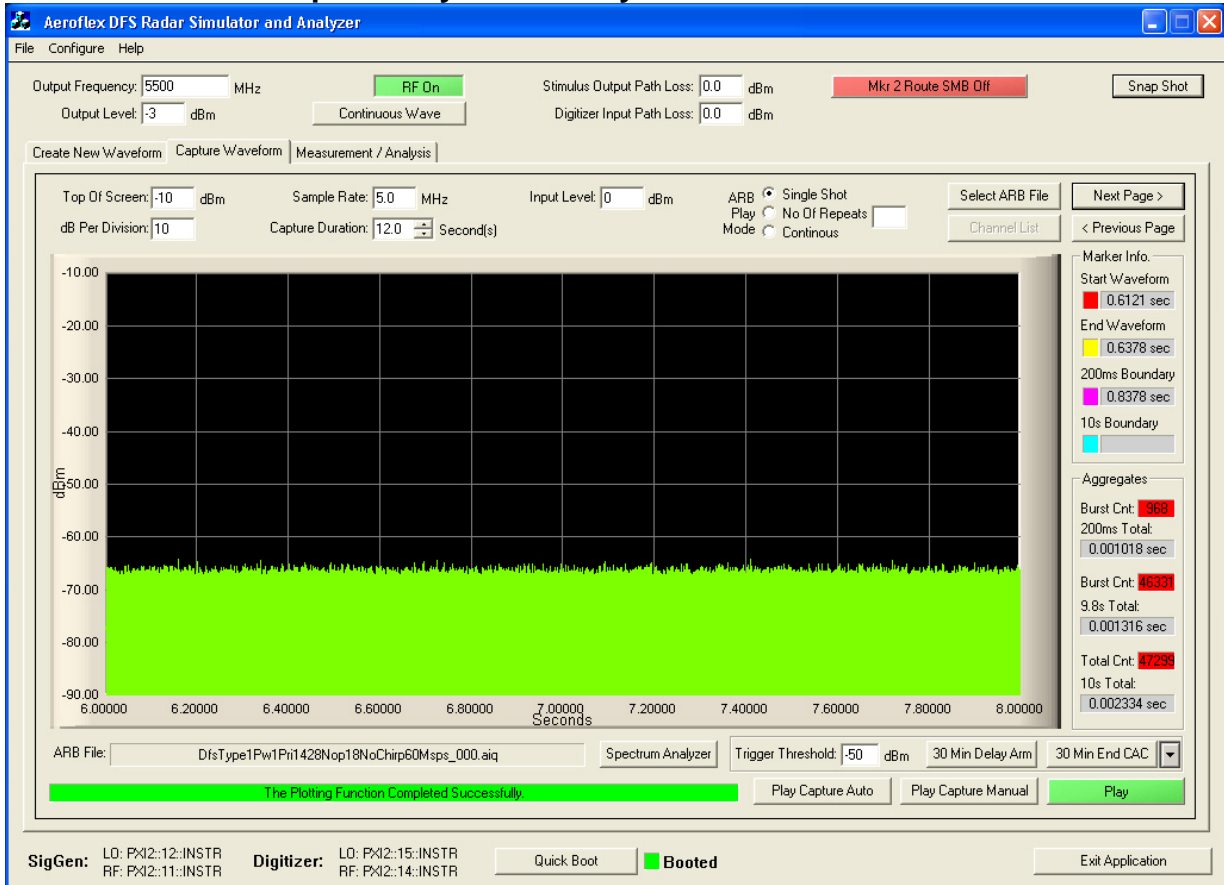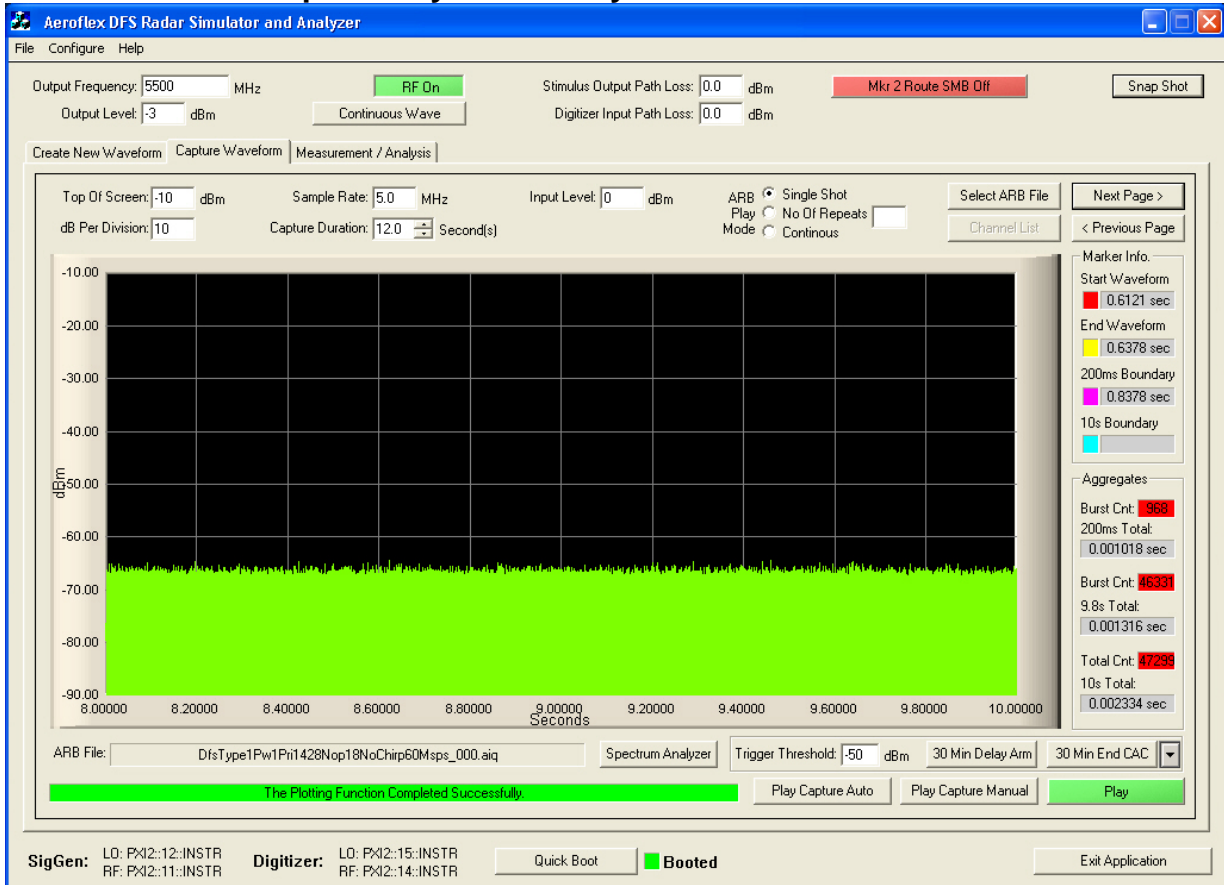**Captured by the Test System - 0 to 2 seconds**
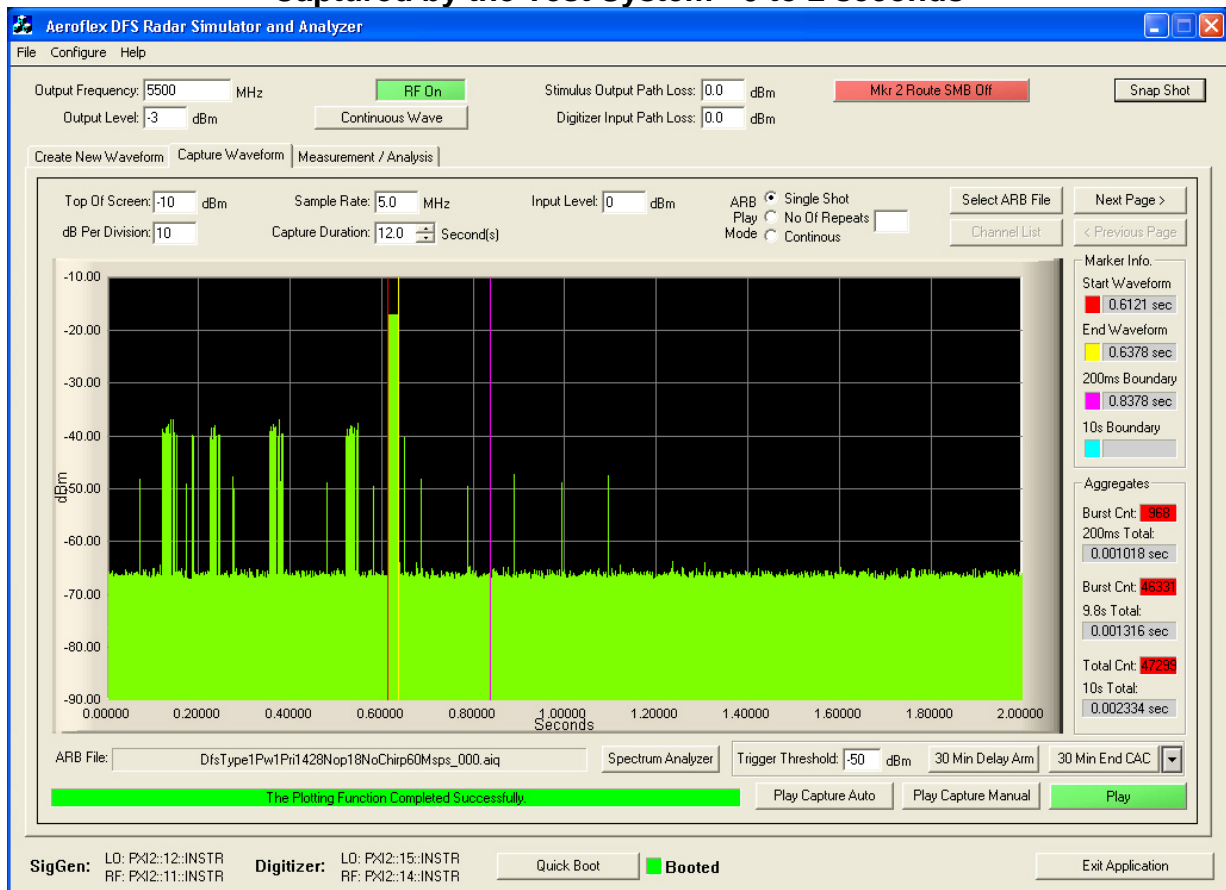
From the plot above it can be seen that the transmission activity within the 200 mS window is1.018 ms (see 200 ms Total). From the following plots which shows all additional activity within the remainder of the 10 sec measurement window it can be determined that the aggregate transmission is 1.316 ms. this is less than the 60 mS limit.

Last Transmitter Activity = 1.100 Seconds
Last Radar Activity = 0.6378 Seconds
Channel Move Time = Last Transmitter Activity – Last Radar Activity = 1.100 – 0.6378
Channel Move Time = 0.4622 secs (Limit 10 secs)

**Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission
Time for Type 1 Radar
Captured by the Test System - 2 to 4 seconds**

Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 4 to 6 seconds

Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 6 to 8 seconds

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Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 8 to 10 seconds

Client Device 20 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 10 to 12 seconds
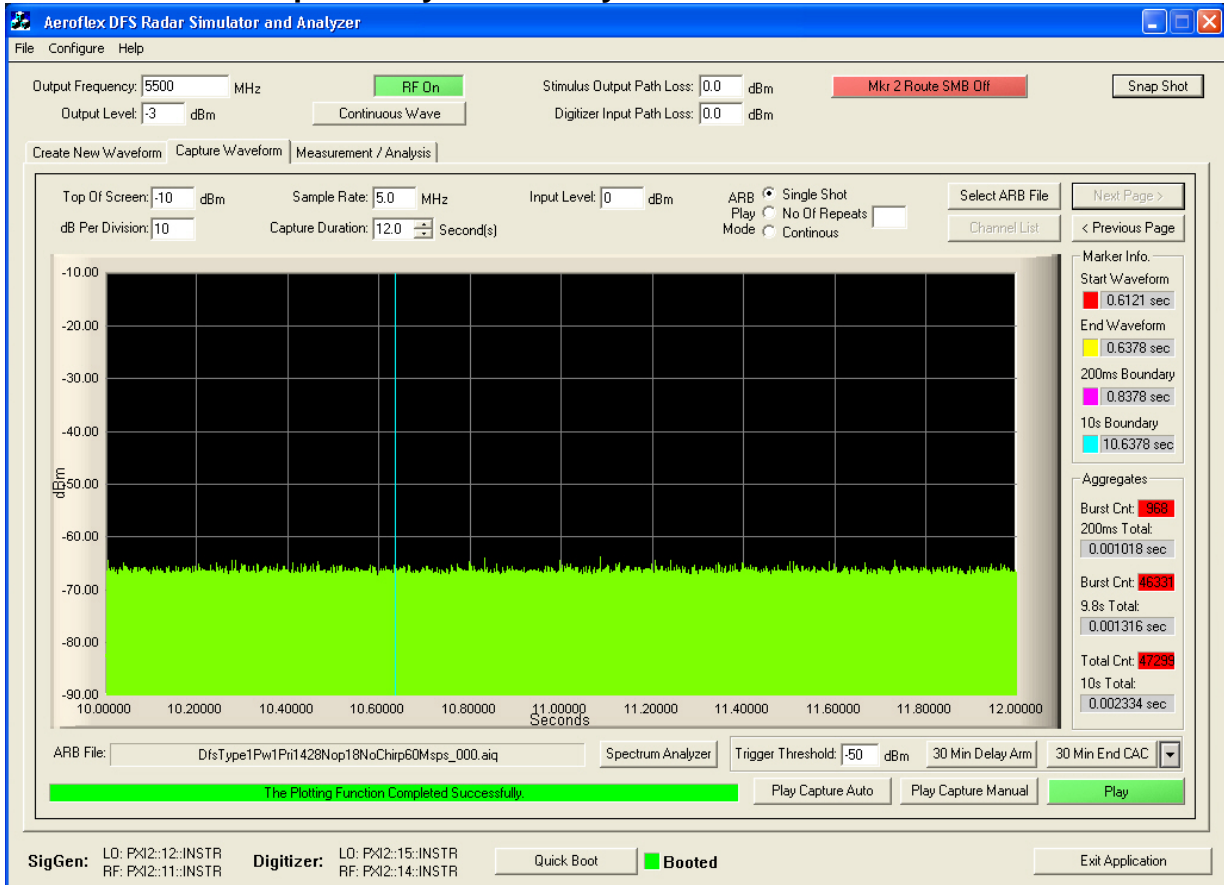
40MHz Bandwidth

Channel Closing Transmission Time = <u>**2.326 mSecs (limit 260 mSecs)**</u>

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 0 to 2 seconds
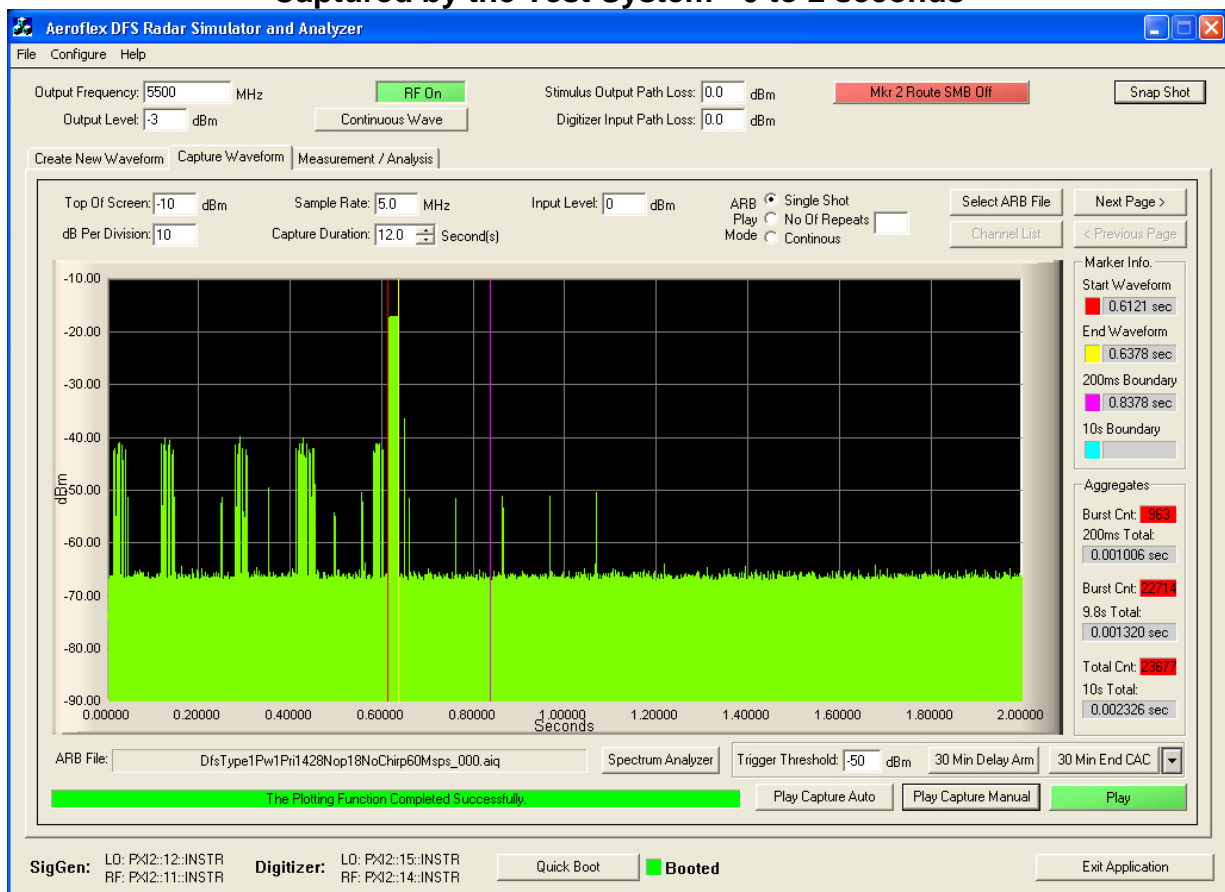
From the plot above it can be seen that the transmission activity within the 200 mS window is 1.006 ms (see 200 ms Total).   From the following plots which show all additional activity within the remainder of the 10 sec measurement window it can be determined that the aggregate transmission is 1.320 ms. This is less than the 60 mS limit.
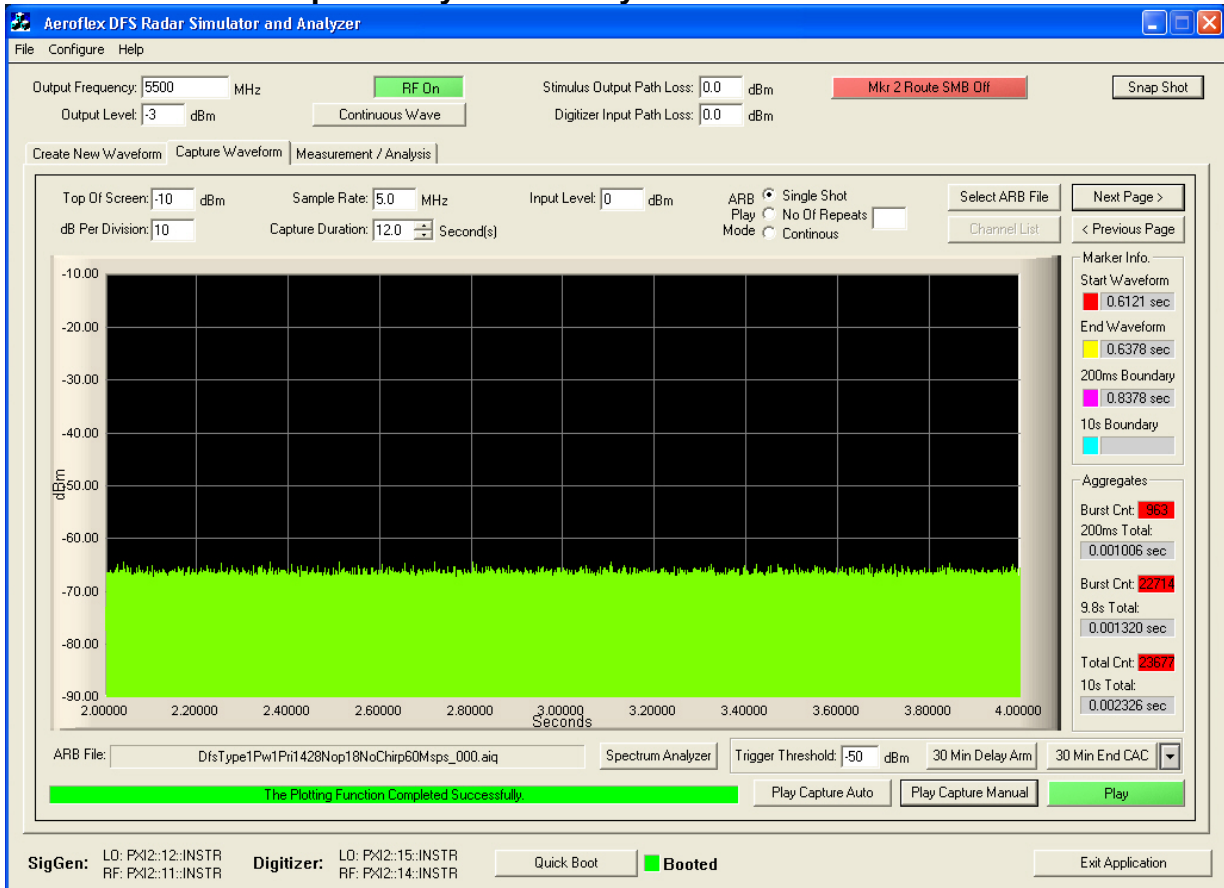
Last Transmitter Activity = 1.090 Seconds
Last Radar Activity = 0.6378 Seconds
Channel Move Time = Last Transmitter Activity – Last Radar Activity = 1.090 – 0.6378

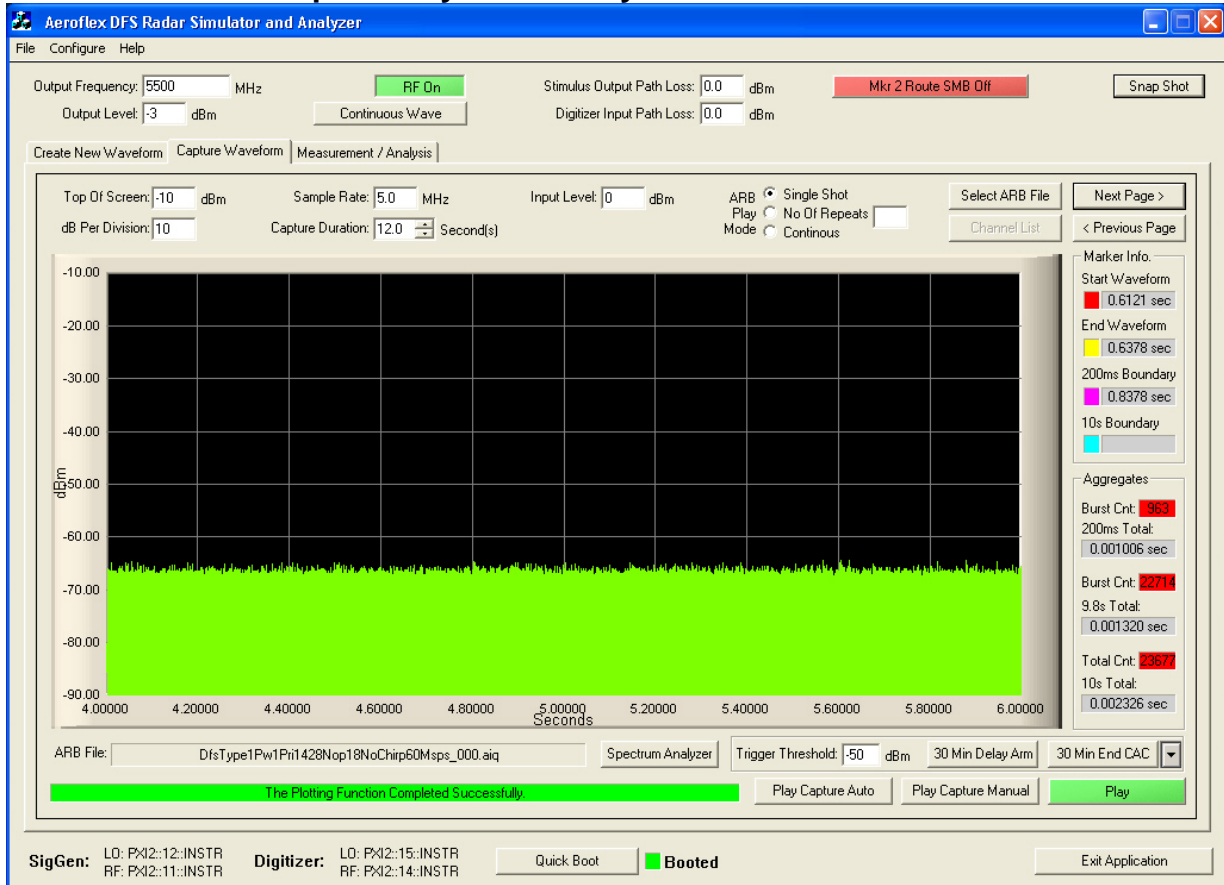**Channel Move Time =** 0.4522 secs (Limit 10 secs)

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
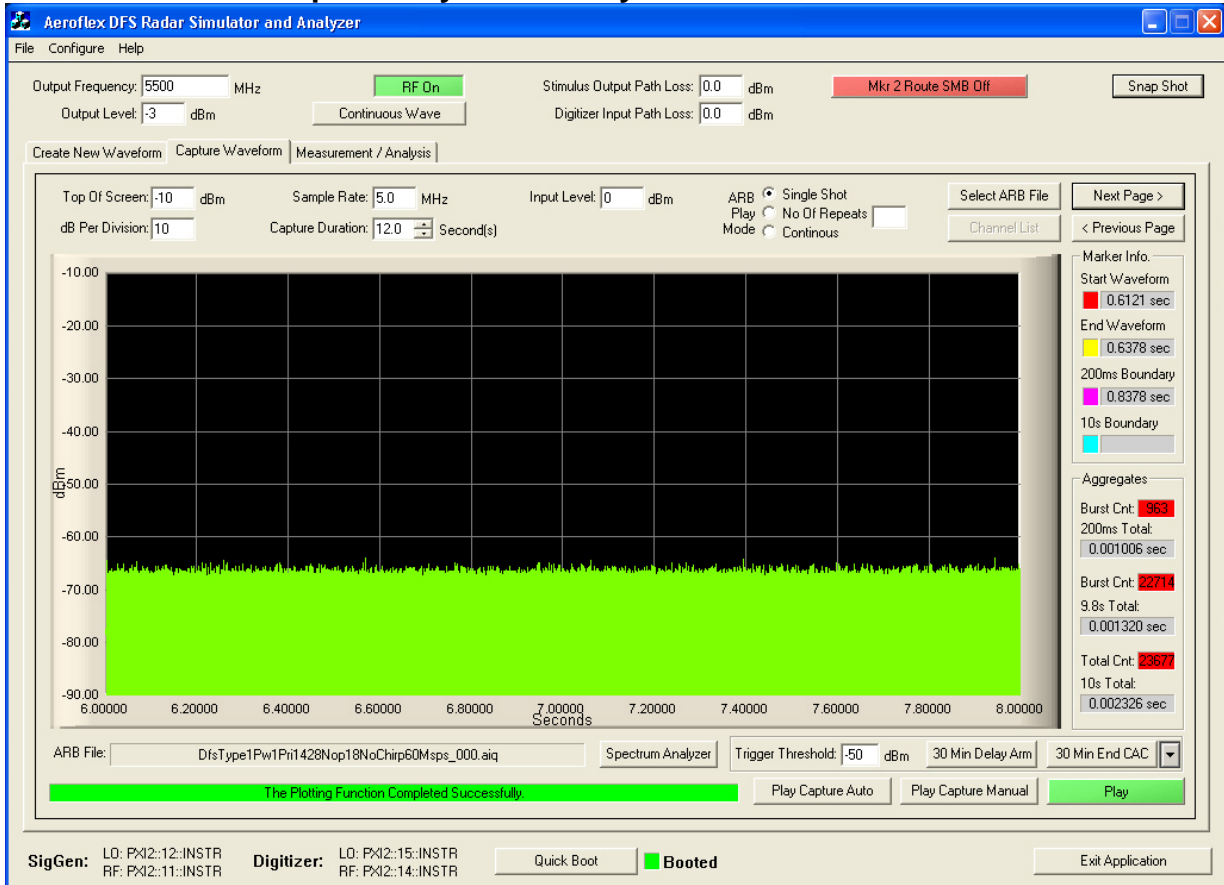**Captured by the Test System - 2 to 4 seconds**

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 4 to 6 seconds

Aeroflex DFS Radar Simulator and Analyzer

File   Configure   Help

Output Frequency: 5500 MHz   RF On   Stimulus Output Path Loss: 0.0 dBm   Mkr 2 Route SMB Off   Snap Shot

Output Level: -3 dBm   Continuous Wave   Digitizer Input Path Loss: 0.0 dBm

Create New Waveform | Capture Waveform | Measurement / Analysis

Top Of Screen: -10 dBm   Sample Rate: 5.0 MHz   Input Level: 0 dBm   ARB ● Single Shot   Select ARB File   Next Page >

dB Per Division: 10   Capture Duration: 12.0 Second(s)   Play ○ No Of Repeats   Channel List   < Previous Page
          Mode ○ Continous

Marker Info.
Start Waveform
■ 0.6121 sec
End Waveform
■ 0.6378 sec
200ms Boundary
■ 0.8378 sec
10s Boundary

Aggregates
Burst Cnt: 963
200ms Total:
0.001006 sec

Burst Cnt: 22714
9.8s Total:
0.001320 sec

Total Cnt: 23677
10s Total:
0.002326 sec

ARB File: DfsType1Pw1Pri1428Nop18NoChirp60Msps_000.aiq   Spectrum Analyzer   Trigger Threshold: -50 dBm   30 Min Delay Arm   30 Min End CAC

The Plotting Function Completed Successfully.   Play Capture Auto   Play Capture Manual   Play

SigGen: LO: PXI2::12::INSTR   RF: PXI2::11::INSTR   Digitizer: LO: PXI2::15::INSTR   RF: PXI2::14::INSTR   Quick Boot   ■ Booted   Exit Application

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
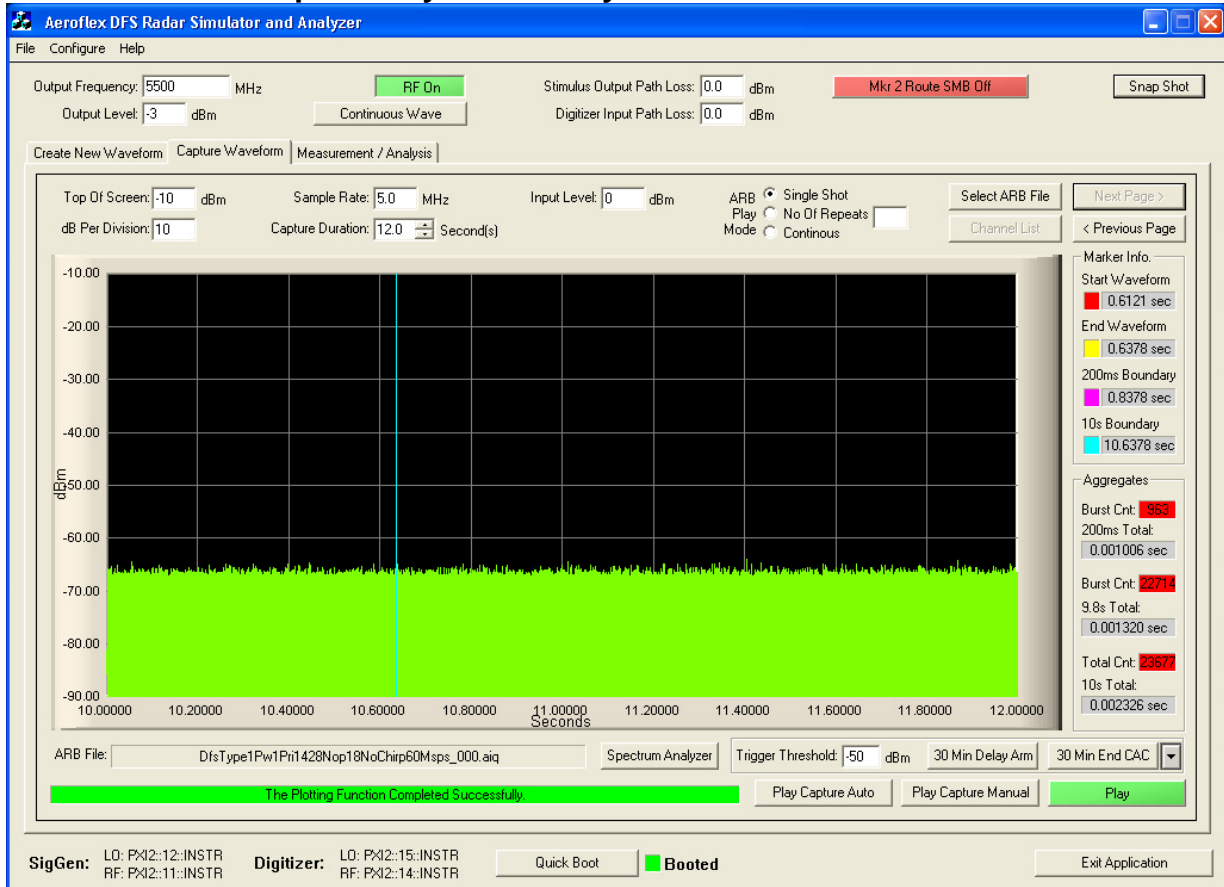## Captured by the Test System - 6 to 8 seconds

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
Captured by the Test System - 8 to 10 seconds

Client Device 40 MHz BW - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
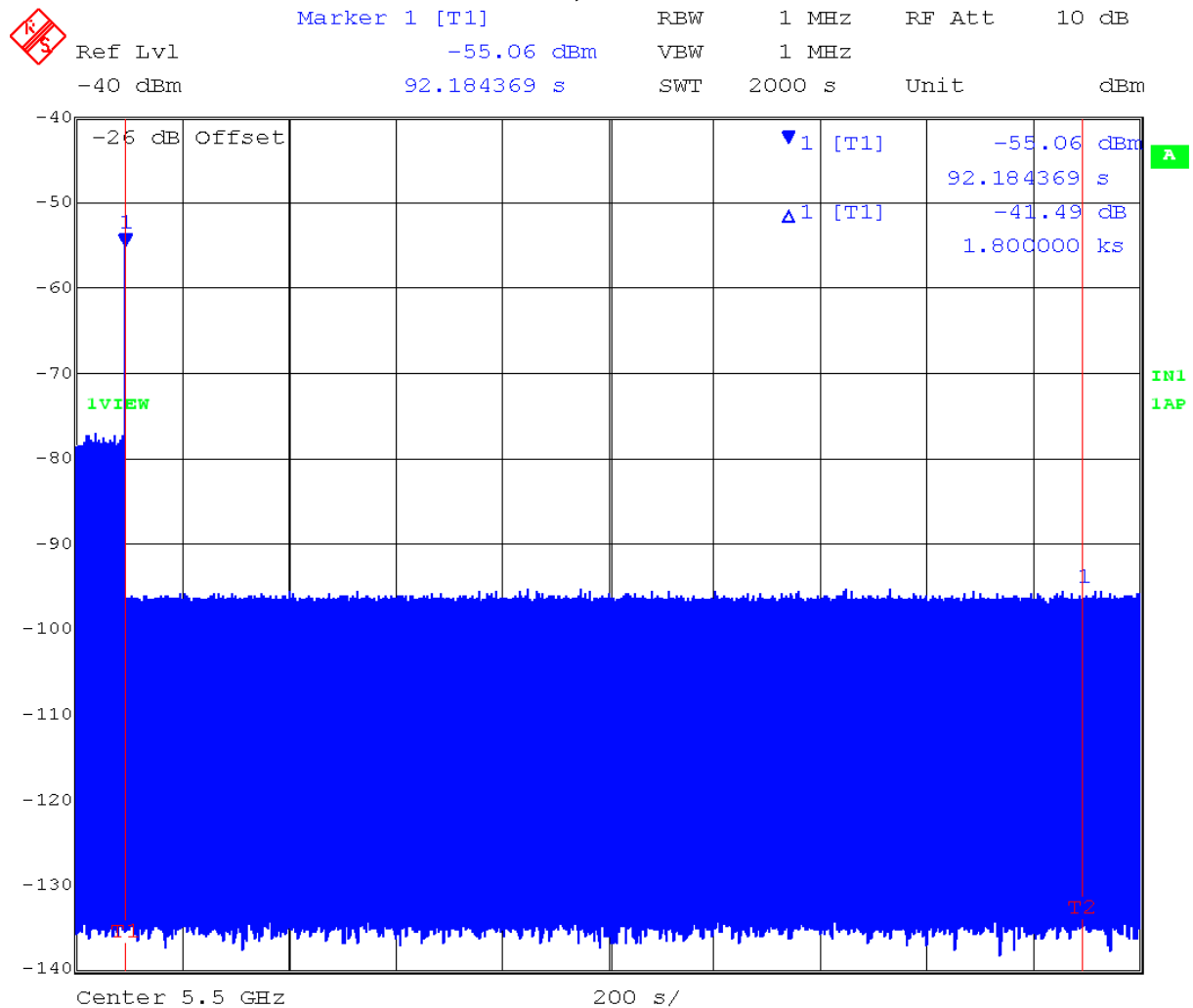## Captured by the Test System - 10 to 12 seconds

5.1.4. 30 Minute Non-Occupancy Period

The EUT is monitored for more than 30 minutes following the channel close/move time to verify no transmissions, including beacons, resume on this Channel.
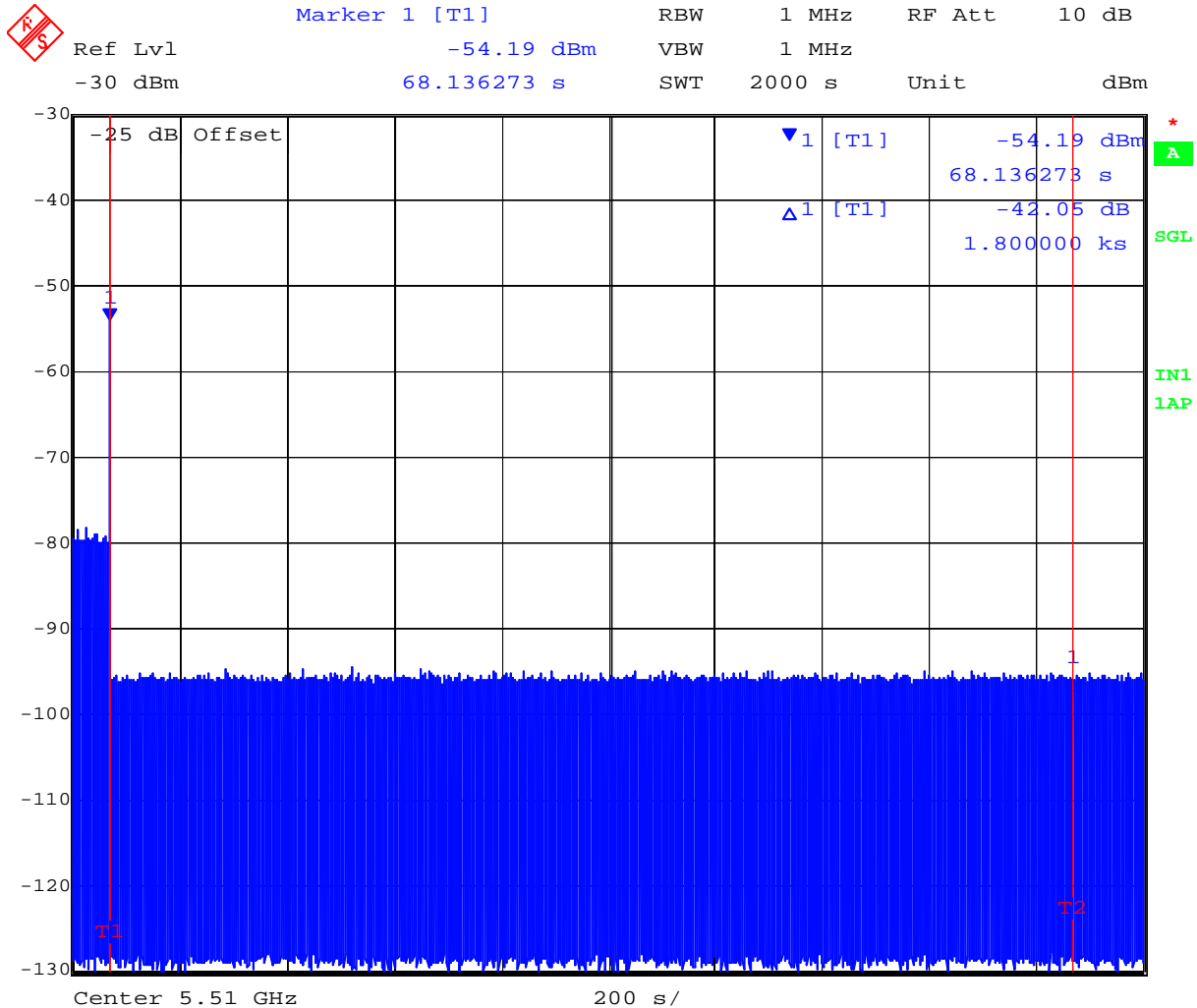
20 MHz Band Width 30 Minute Non-Occupancy Period Type 1 Radar Ch 5,500 MHz

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40 MHz Band Width 30 Minute Non-Occupancy Period Type 1 Radar Ch 5,510 MHz

	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
Ref Lvl	-54.19 dBm	VBW	1 MHz		
-30 dBm	68.136273 s	SWT	2000 s	Unit	dBm

Center 5.51 GHz   200 s/

Measurement Uncertainty Time/Power

Measurement uncertainty		
	- Time	4%
	- Power	1.33dB

Traceability

Test Equipment Used
0072, 0083, 0098, 0116, 0132, 0158, 0313, 0314, 0193, 0223, 0252, 0253, 0251, 0256, 0328, 0329

6. PHOTOGRAPHS

6.1. Dynamic Frequency Selection – Conducted Test Set-Up

General DFS Test Setup
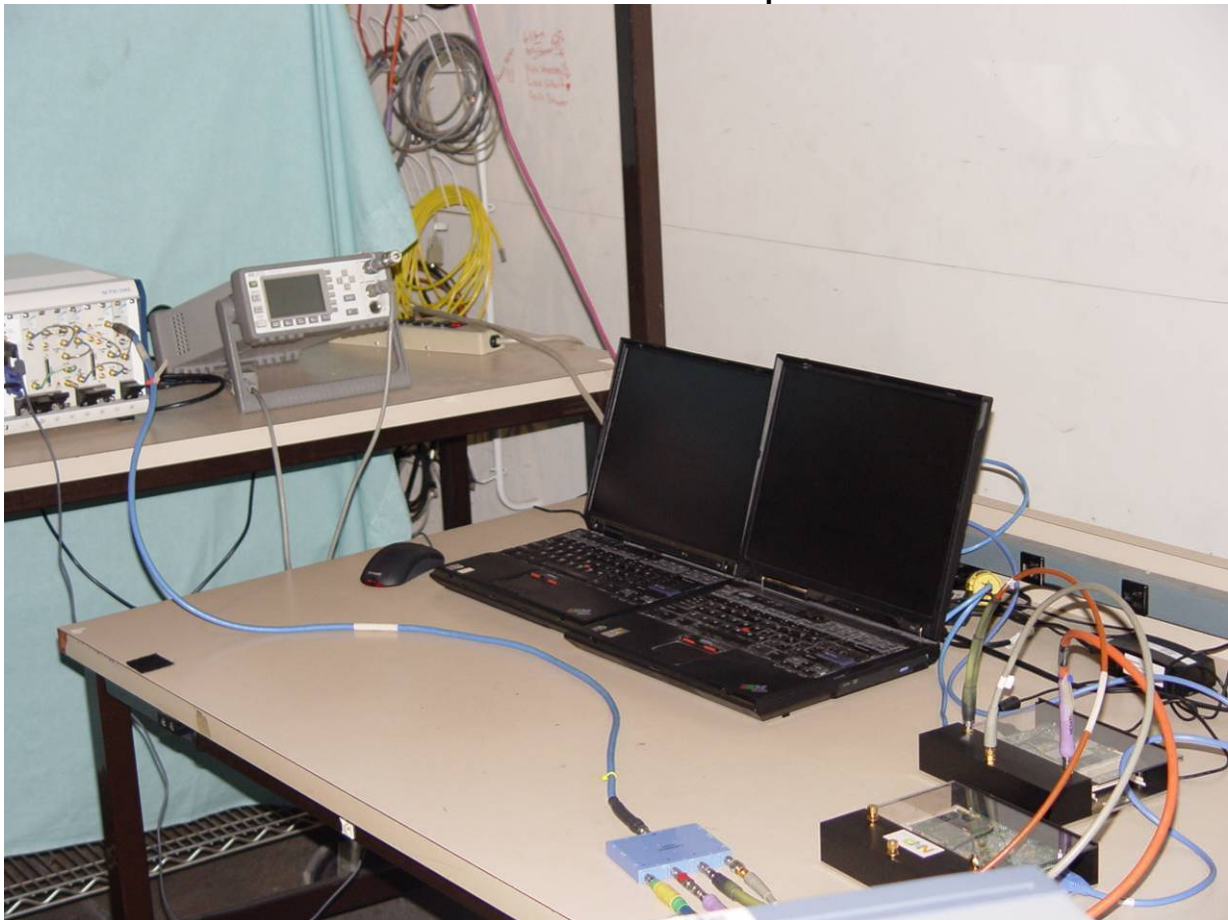
DFS Test Equipment

7. <u>TEST EQUIPMENT DETAILS</u>

Asset #	Instrument	Manufacturer	Part #	Serial #
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002

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Pleasanton, CA 94566, USA
Tel: 1.925.462.0304
Fax: 1.925.462.0306
www.micomlabs.com