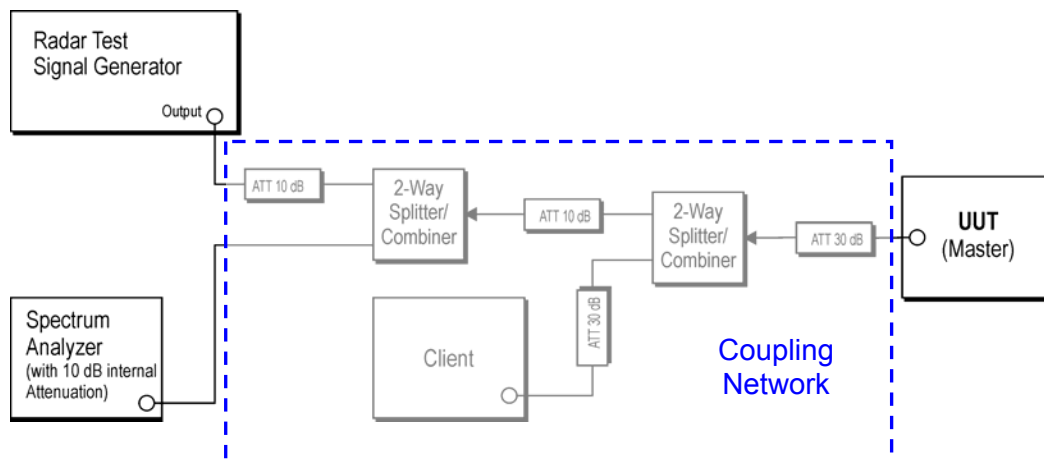


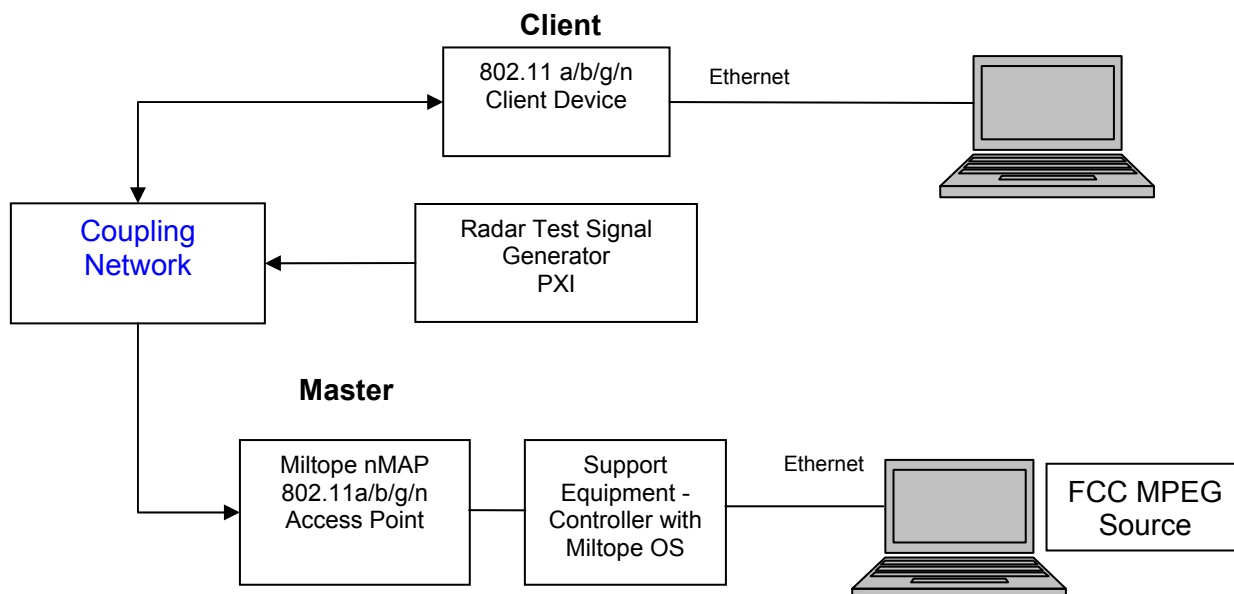
8.1.6. Test Set Up:

Block Diagram(s) of Test Setup

Setup for Conducted Measurements where the EUT is the Master with injection of Radar Test Waveforms at the Master.



Support Equipment Configuration





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Declared minimum antenna gain 0 dBi.

Radar receive signal level = -62 dBm + minimum antenna gain + 1 dB = -61 dBm

$$= -62 + 0 + 1$$

Radar receive signal level = -61 dBm

Measurement Results - Dynamic Frequency Selection (DFS)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57% Pressure: 999 to 1012 mbar

Radio parameters.

Test methodology: Conducted

Device Type: Master

Transmit Power: Maximum

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8.2. Dynamic Frequency Selection (DFS) Test Results

8.2.1. UNII Detection Bandwidth:

All UNII channels for this device have identical channel bandwidths and DFS testing was completed on channel 5,500 MHz (802.11a) and 5510MHz (HT40).

The generating equipment is configured as shown in the Conducted Test Setup above. A single Burst of the short pulse radar Type 1 through 6 was produced at 5500 MHz (802.11a) and 5510 MHz (HT40) at a level of -61 dBm. The EUT is set up as a standalone device (no associated Client and no traffic).

A single radar Burst is generated for a minimum of 10 trials, and the response of the EUT is noted. The EUT must detect the Radar Waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted as F_H .

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted as F_L .

The U-NII Detection Bandwidth is calculated as follows:

$$\text{U-NII Detection Bandwidth} = F_H - F_L$$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power Table of results are continued on the next page.



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EUT Frequency= 5500 MHz

Detection Bandwidth results for EUT in 11a mode

(Detection = √, No Detection = 0)											
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
-17											%
-16											%
-15											%
-14											%
-13											%
-12											%
-11	0	0									0%
-10	√	√	√	√	√	√	√	√	√	√	100%
-9	√	√	√	√	√	√	√	√	√	√	100%
-8	√	√	√	√	√	√	√	√	√	√	100%
-7	√	√	√	√	√	√	√	√	√	√	100%
-6	√	√	√	√	√	√	√	√	√	√	100%
-5	√	√	√	√	√	√	√	√	√	√	100%
-4	√	√	√	√	√	√	√	√	√	√	100%
-3	√	√	√	√	√	√	√	√	√	√	100%
-2	√	√	√	√	√	√	√	√	√	√	100%
-1	√	√	√	√	√	√	√	√	√	√	100%
F0	√	√	√	√	√	√	√	√	√	√	100%
+1	√	√	√	√	√	√	√	√	√	√	100%
+2	√	√	√	√	√	√	√	√	√	√	100%
+3	√	√	√	√	√	√	√	√	√	√	100%
+4	√	√	√	√	√	√	√	√	√	√	100%
+5	√	√	√	√	√	√	√	√	√	√	100%
+6	√	√	√	√	√	√	√	√	√	√	100%
+7	√	√	√	√	√	√	√	√	√	√	100%
+8	√	√	√	√	√	√	√	√	√	√	100%
+9	√	√	√	√	√	√	√	√	√	√	100%
+10	√	√	√	√	√	√	√	√	√	√	100%
+11	0	0									0%
+12											%
+13											%
+14											%
+15											%
+16											%
+17											%

Detection Bandwidth = $F_H - F_L = 5590 - 5510 = 21$ MHz

EUT 99% Bandwidth = 16.733 MHz (ref. bandwidth channel 5500 MHz)

16.733 MHz *80% = 13.3864MHz

For each frequency step the minimum percentage detection is 90%

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HT-40 Detection Bandwidth results for EUT in HT-40 mode (Part 1 of 2)

EUT Frequency= 5510 MHz HT40 (Detection = √, No Detection = 0)											
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
-22											
-21	√	√	0	√	0						
-20	√	√	√	√	√	√	√	√	√	√	100%
-19	√	√	√	√	√	√	√	√	√	√	100%
-18	√	√	√	√	√	√	√	√	√	√	100%
-17	√	√	√	√	√	√	√	√	√	√	100%
-16	√	√	√	√	√	√	√	√	√	√	100%
-15	√	√	√	√	√	√	√	√	√	√	100%
-14	√	√	√	√	√	√	√	√	√	√	100%
-13	√	√	√	√	√	√	√	√	√	√	100%
-12	√	√	√	√	√	√	√	√	√	√	100%
-11	√	√	√	√	√	√	√	√	√	√	100%
-10	√	√	√	√	√	√	√	√	√	√	100%
-9	√	√	√	√	√	√	√	√	√	√	100%
-8	√	√	√	√	√	√	√	√	√	√	100%
-7	√	√	√	√	√	√	√	√	√	√	100%
-6	√	√	√	√	√	√	√	√	√	√	100%
-5	√	√	√	√	√	√	√	√	√	√	100%
-4	√	√	√	√	√	√	√	√	√	√	100%
-3	√	√	√	√	√	√	√	√	√	√	100%
-2	√	√	√	√	√	√	√	√	√	√	100%
-1	√	√	√	√	√	√	√	√	√	√	100%
F ₀	√	√	√	√	√	√	√	√	√	√	100%

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HT-40 Detection Bandwidth results for EUT in HT-40 mode (Part 2 of 2)

EUT Frequency= 5510MHz HT40 (Detection = √, No Detection = 0)											
Radar Frequency (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
F ₀	√	√	√	√	√	√	√	√	√	√	100%
+1	√	√	√	√	√	√	√	√	√	√	100%
+2	√	√	√	√	√	√	√	√	√	√	100%
+3	√	√	√	√	√	√	√	√	√	√	100%
+4	√	√	√	√	√	√	√	√	√	√	100%
+5	√	√	√	√	√	√	√	√	√	√	100%
+6	√	√	√	√	√	√	√	√	√	√	100%
+7	√	√	√	√	√	√	√	√	√	√	100%
+8	√	√	√	√	√	√	√	√	√	√	100%
+9	√	√	√	√	√	√	√	√	√	√	100%
+10	√	√	√	√	√	√	√	√	√	√	100%
+11	√	√	√	√	√	√	√	√	√	√	100%
+12	√	√	√	√	√	√	√	√	√	√	100%
+13	√	√	√	√	√	√	√	√	√	√	100%
+14	√	√	√	√	√	√	√	√	√	√	100%
+15	√	√	√	√	√	√	√	√	√	√	100%
+16	√	√	√	√	√	√	√	√	√	√	100%
+17	√	√	√	√	√	√	√	√	√	√	100%
+18	√	√	√	√	√	√	√	√	√	√	100%
+19	√	√	√	√	√	√	√	√	√	√	100%
+20	√	√	√	√	√	√	√	√	√	√	100%
+21	0	0	0								
Detection Bandwidth = F _H -F _L = 5590-5530 = 41 MHz											
EUT 99% Bandwidth = 36.473 MHz (ref. bandwidth channel 5510 MHz)											
36.473 MHz *80% = 29.178 MHz											

For each frequency step the minimum percentage detection is 90%



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8.2.2. Initial Channel Availability Check Time

This test verifies that the EUT does not emit pulse, control, or data signals on the test Channel until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. This test does not use any Radar Waveforms.

The U-NII device is powered on and setup to operate at 5,495 MHz for 802.11a and 5505 MHz for 802.11n HT40 testing. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 1 MHz resolution bandwidth at 5,495 & 5505 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to the U-NII device.

The EUT should not transmit any pulse or data transmissions until at least 1 minute after the completion of the power-on cycle.

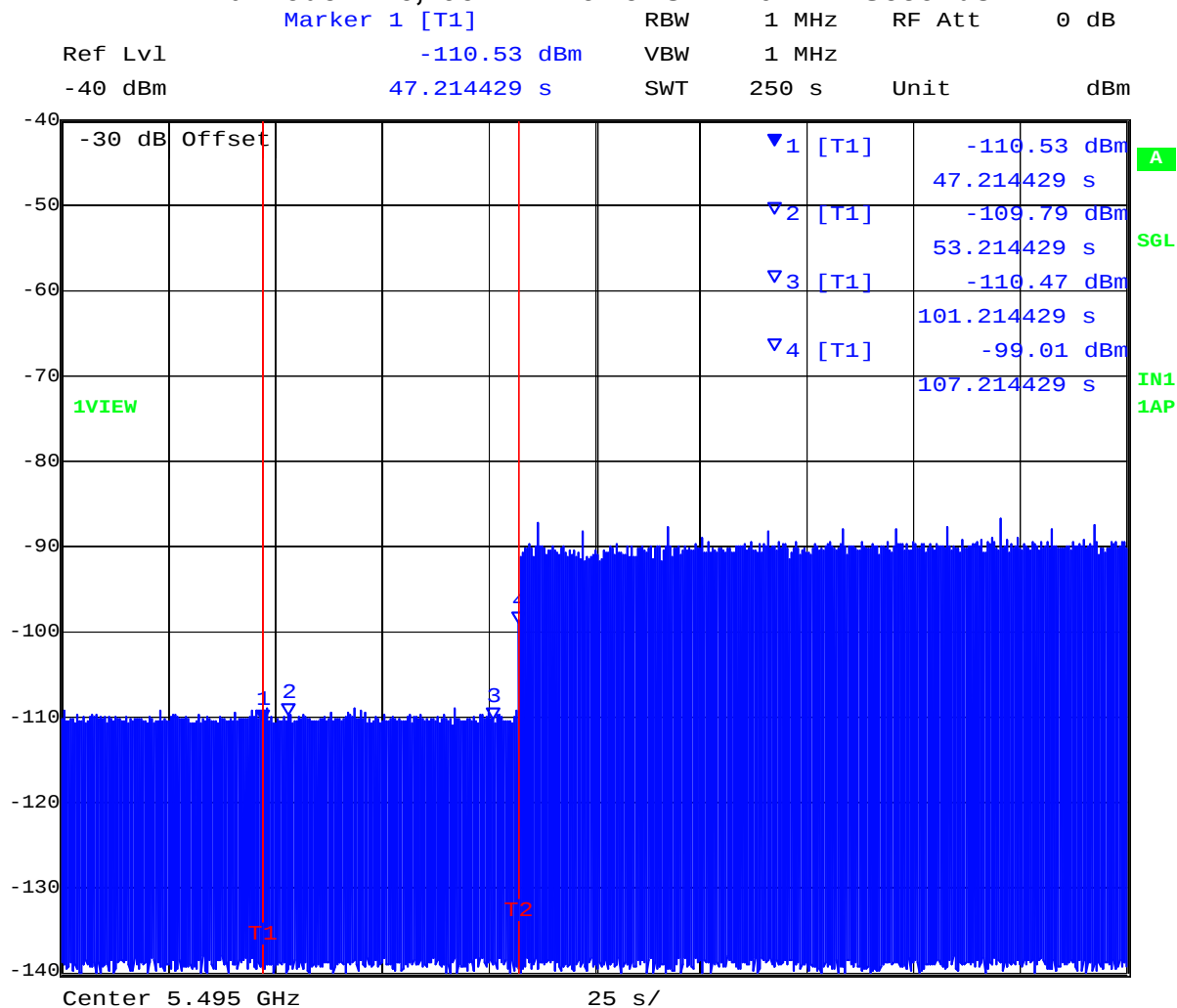
The first red marker line shown on the following plot denotes the instant when the EUT starts its power-up sequence i.e. T_0 (as defined within the FCC's MO&O 06-96 Normative Reference 2). The power-up reference T_0 is determined by the time it takes for the EUT to start "beaconing" i.e. initial beacon – 60 secs = end of power-up.

The Channel Availability Check Time commences at instant T_0 and will end no sooner than $T_0 + 60$ seconds.



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Initial Channel Availability Check Time during power up of EUT
11a mode Ch 5,495 MHz Power On = 107.214 Seconds



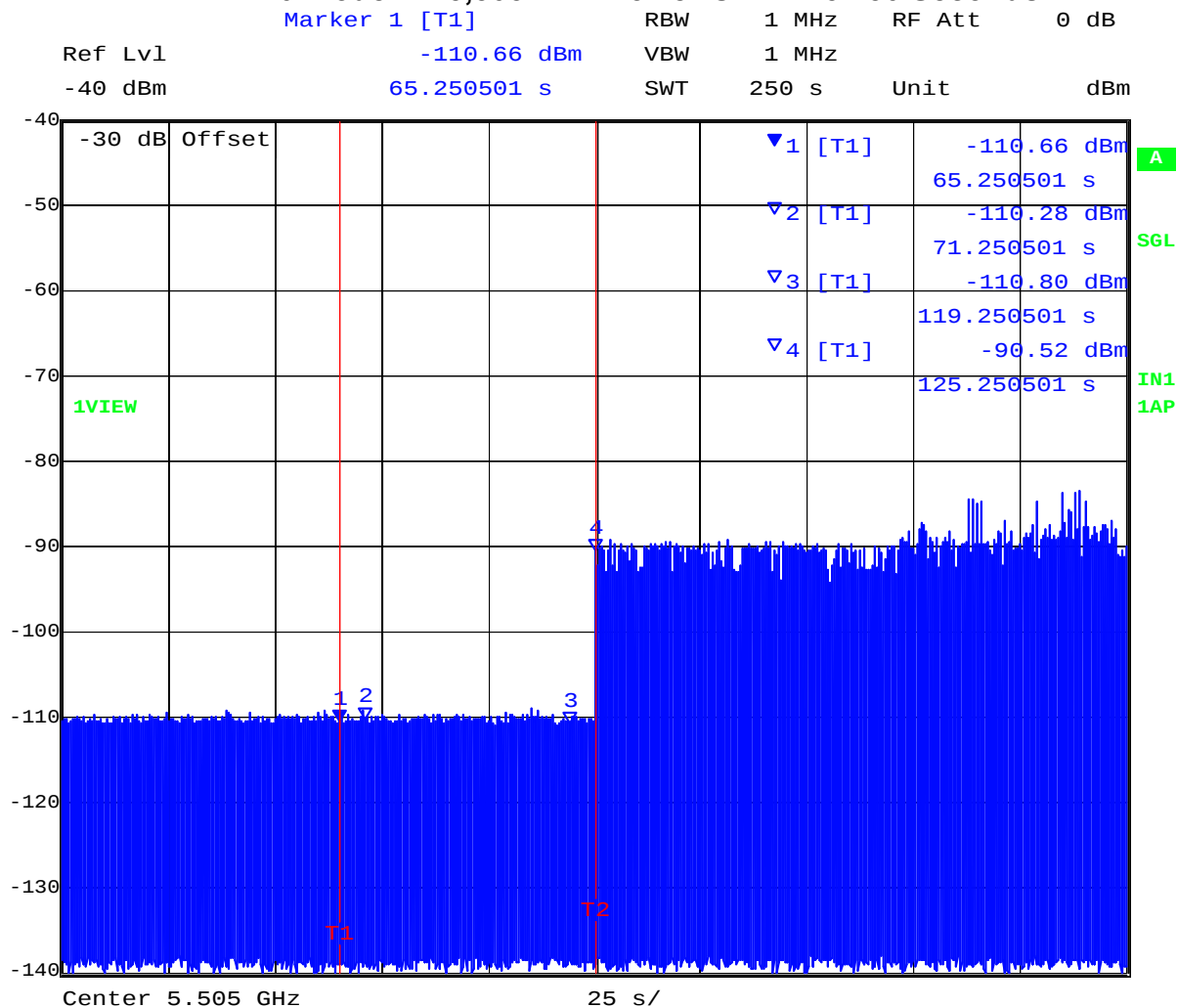
Date: 19.NOV.2010 10:37:29

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Initial Channel Availability Check Time during power up of EUT
11n HT-40 mode Ch 5,505 MHz Power On = 125.250 Seconds



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8.2.3. Radar Burst at the Beginning of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold (-61 dBm) occurs at the beginning of the Channel Availability Check Time.

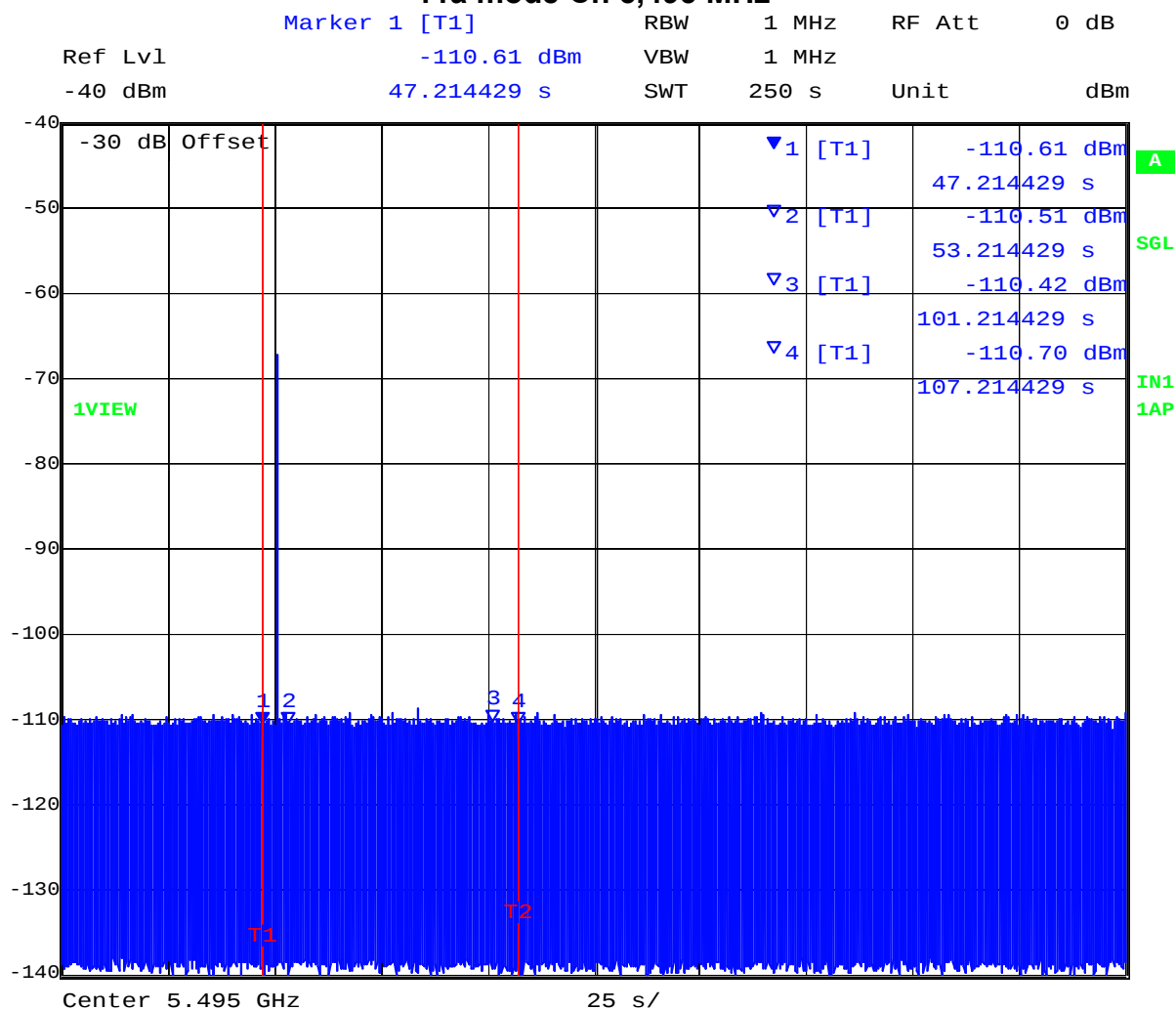
A single Burst of short pulse of radar Type 1 will commence within a 6 second window starting at T_0 (first red marker line on the following plot).

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,495 MHz (802.11a mode) & 5505 MHz (802.11n HT40 mode) will continue for 2.5 minutes after the radar burst has been generated.



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Channel Availability Check Time at the start of the 60 second Check Time
11a mode Ch 5,495 MHz



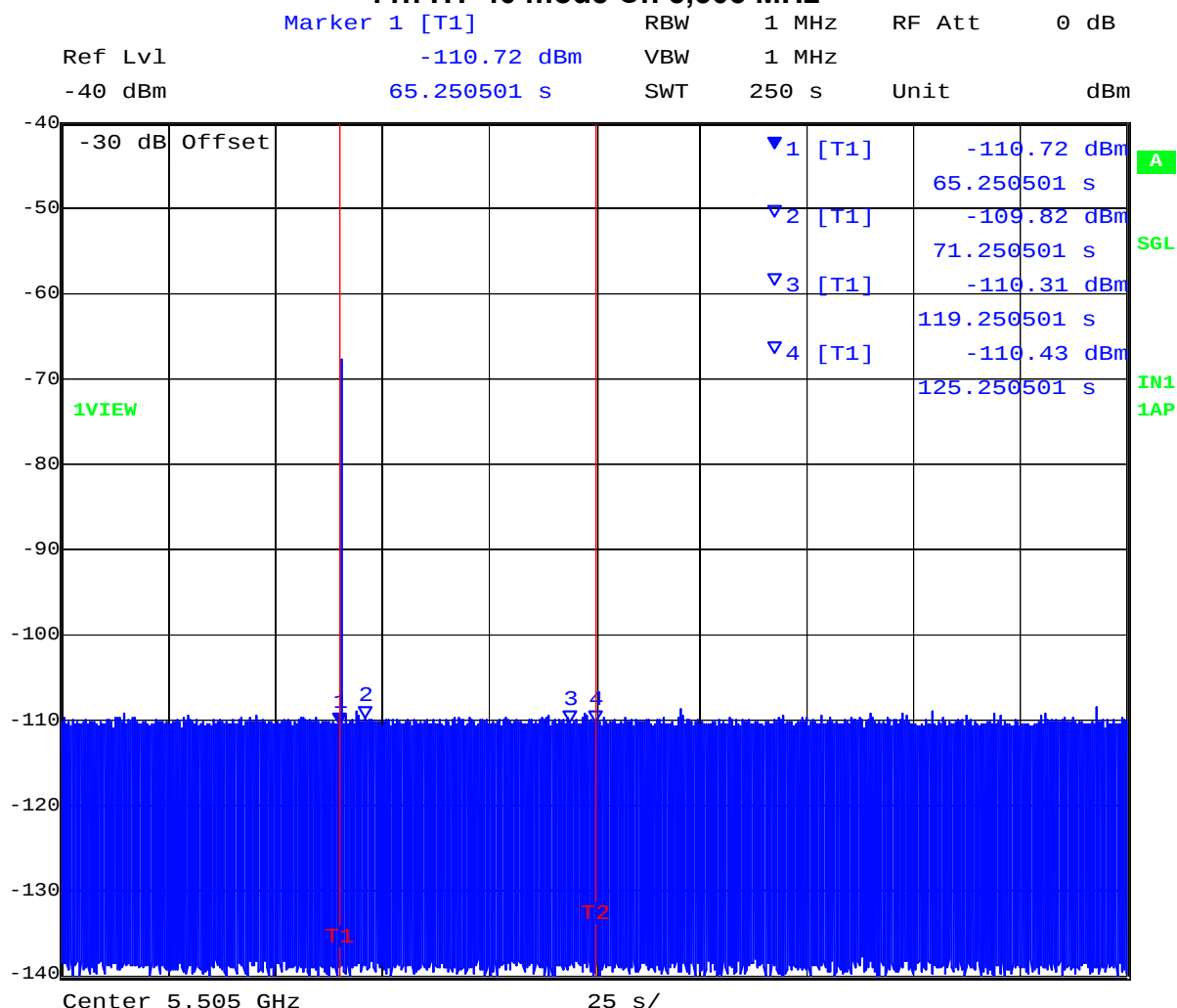
Date: 19.NOV.2010 10:51:24

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Channel Availability Check Time at the start of the 60 second Check Time
11n HT-40 mode Ch 5,505 MHz



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8.2.4. Radar Burst at the End of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel Availability Check Time.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at $T_0 + 54$ seconds. The window will commence at marker 2 and end at the red frequency line T_2 .

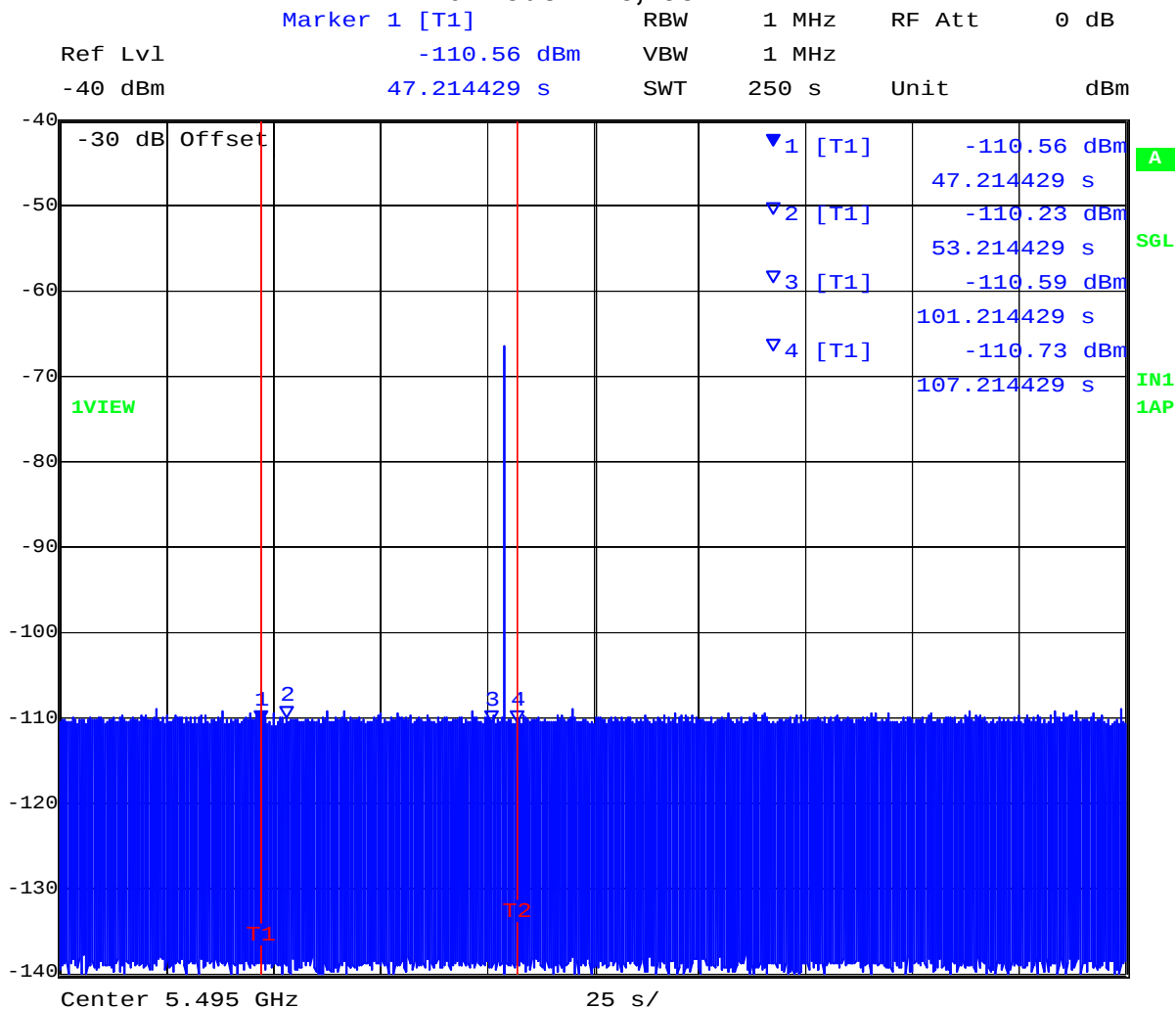
Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported.



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Channel Availability Check Time at the end of the 60 second Check Time

11a mode Ch 5,495 MHz



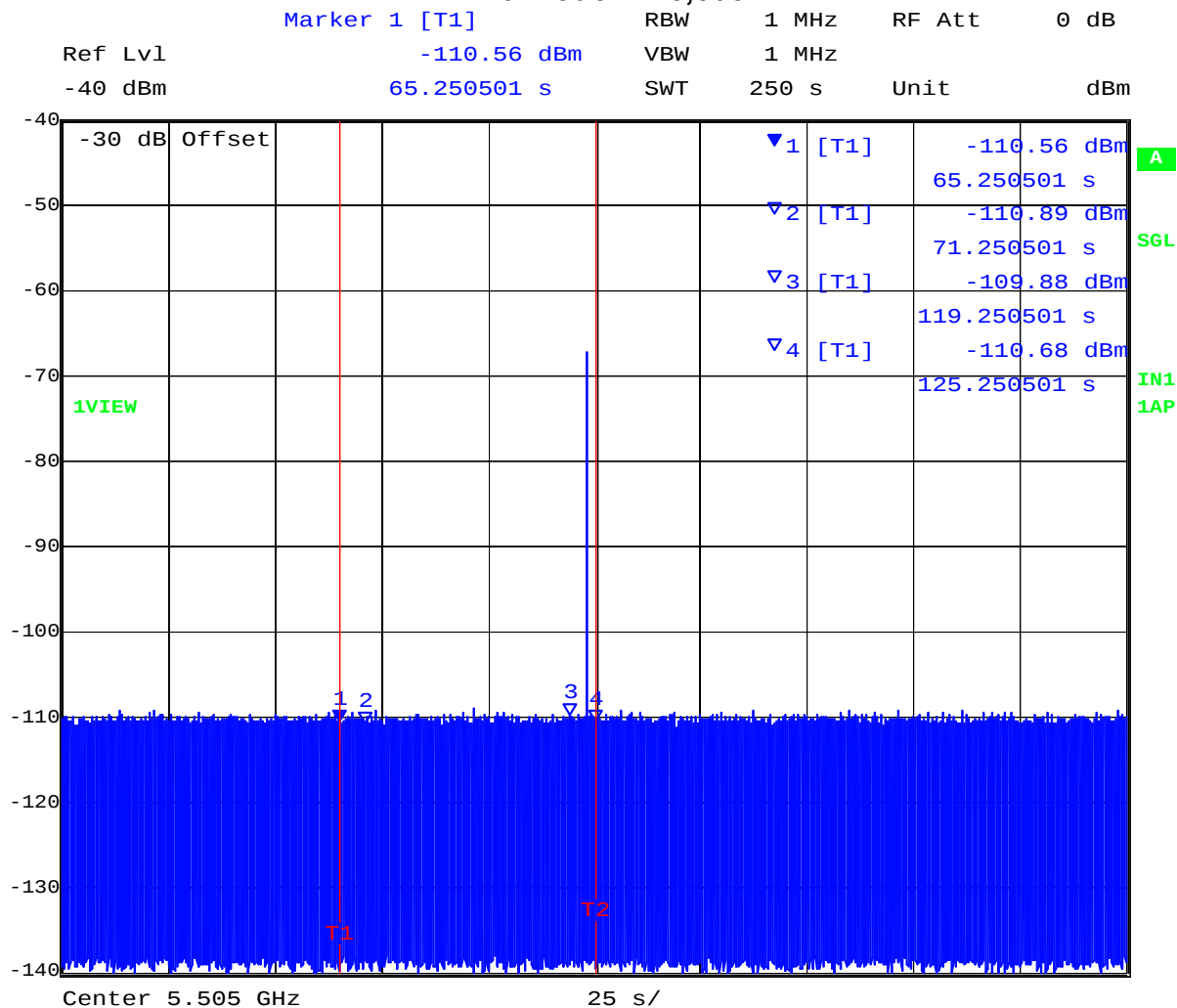
Date: 19.NOV.2010 10:44:15

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Channel Availability Check Time at the end of the 60 second Check Time
11n HT-40 mode Ch 5,505 MHz



Date: 19.NOV.2010 10:23:38

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8.2.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period
FCC §15.407(h)(2)(iii)

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 Client Device will associate with the EUT (Master). 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.

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 T_0 (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 25.7 ms

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.

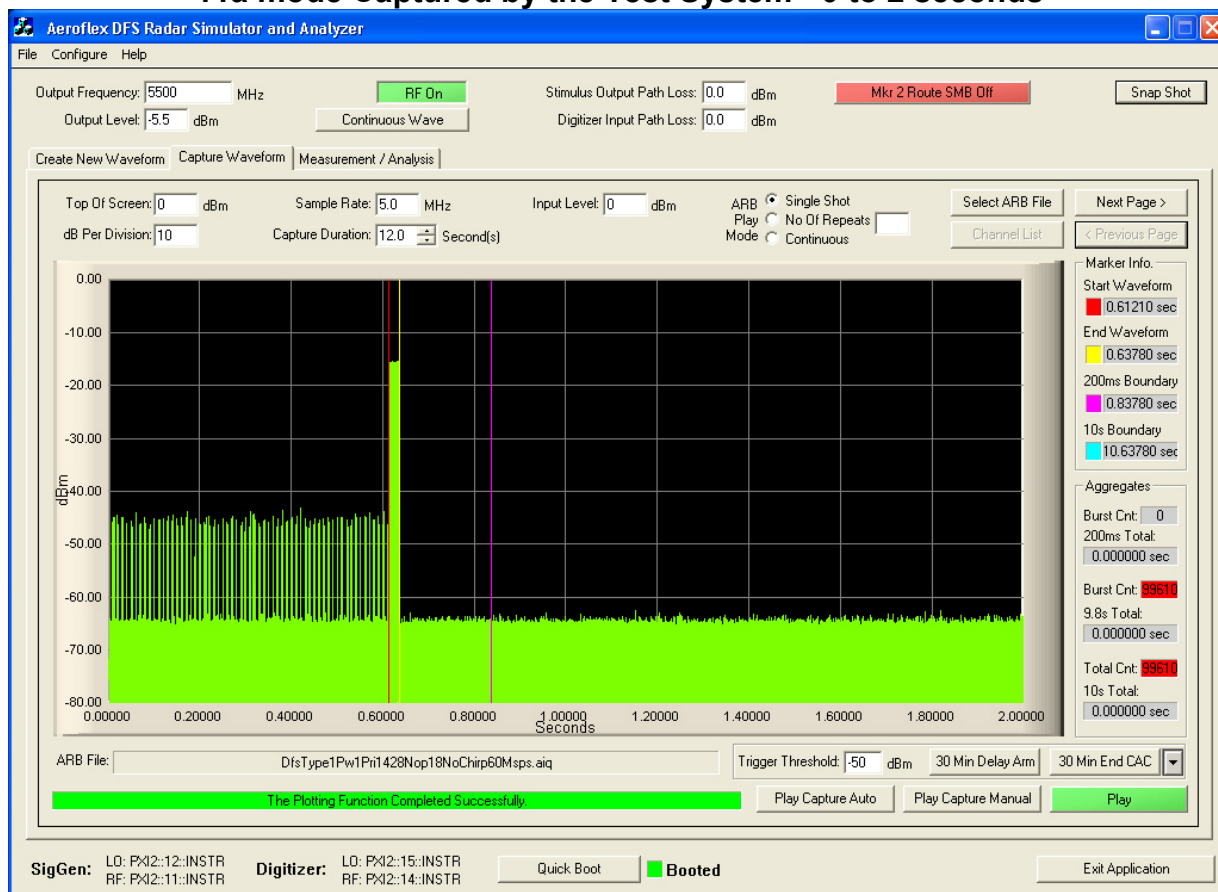


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Therefore, pulses seen after this 637.8 ms boundary are identified and totaled to provide an aggregate total of transmissions in order to determine whether the EUT is compliant with the Channel Closing Transmission Time requirements as described in MO&O FCC 06-96. In this case, it was found that an aggregate total of 0.00 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 5500 MHz (802.11a) = 0.00 mSecs (limit 260 mSecs)

Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 0 to 2 seconds



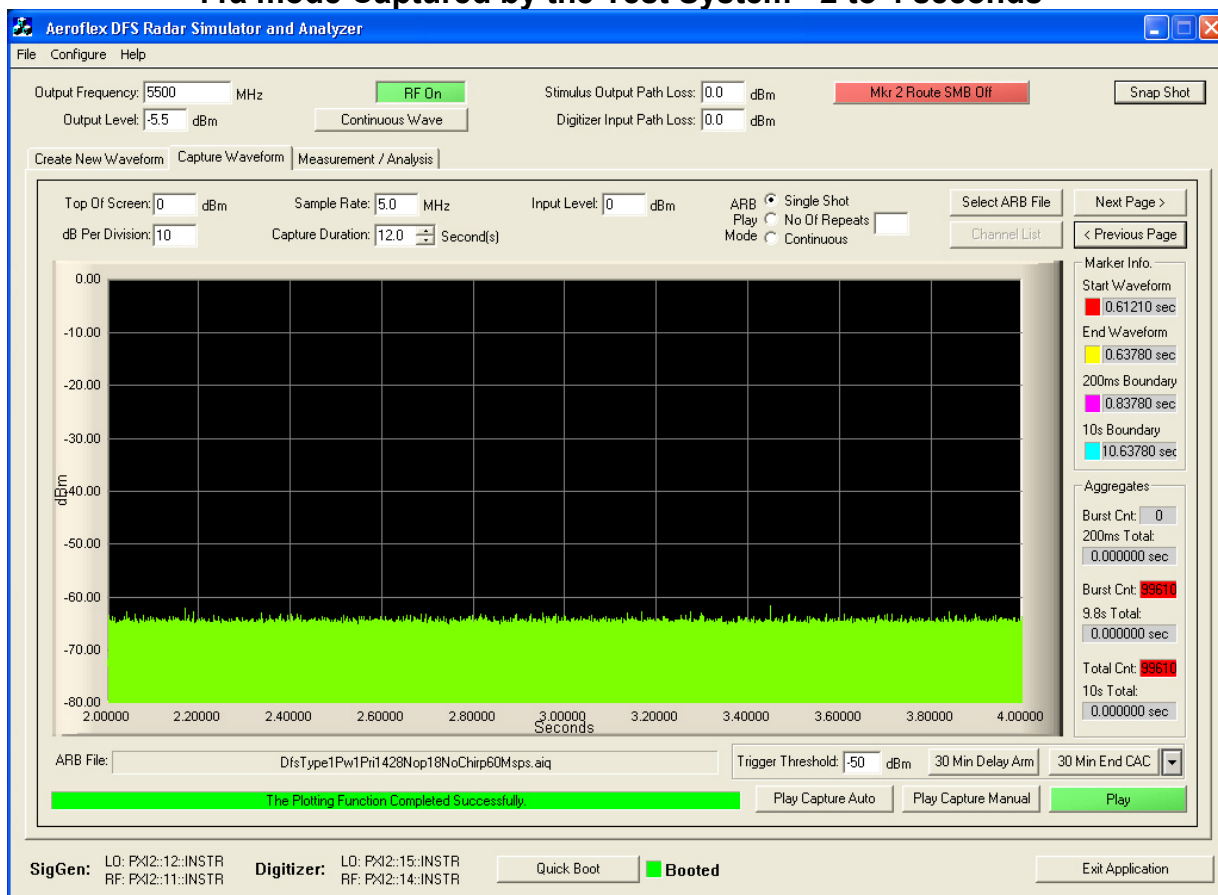
From the plot above it can be seen that the transmission activity within the 200 mS window is 0.0 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 0.00 mS. This is less than the 60 mS limit.

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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 2 to 4 seconds

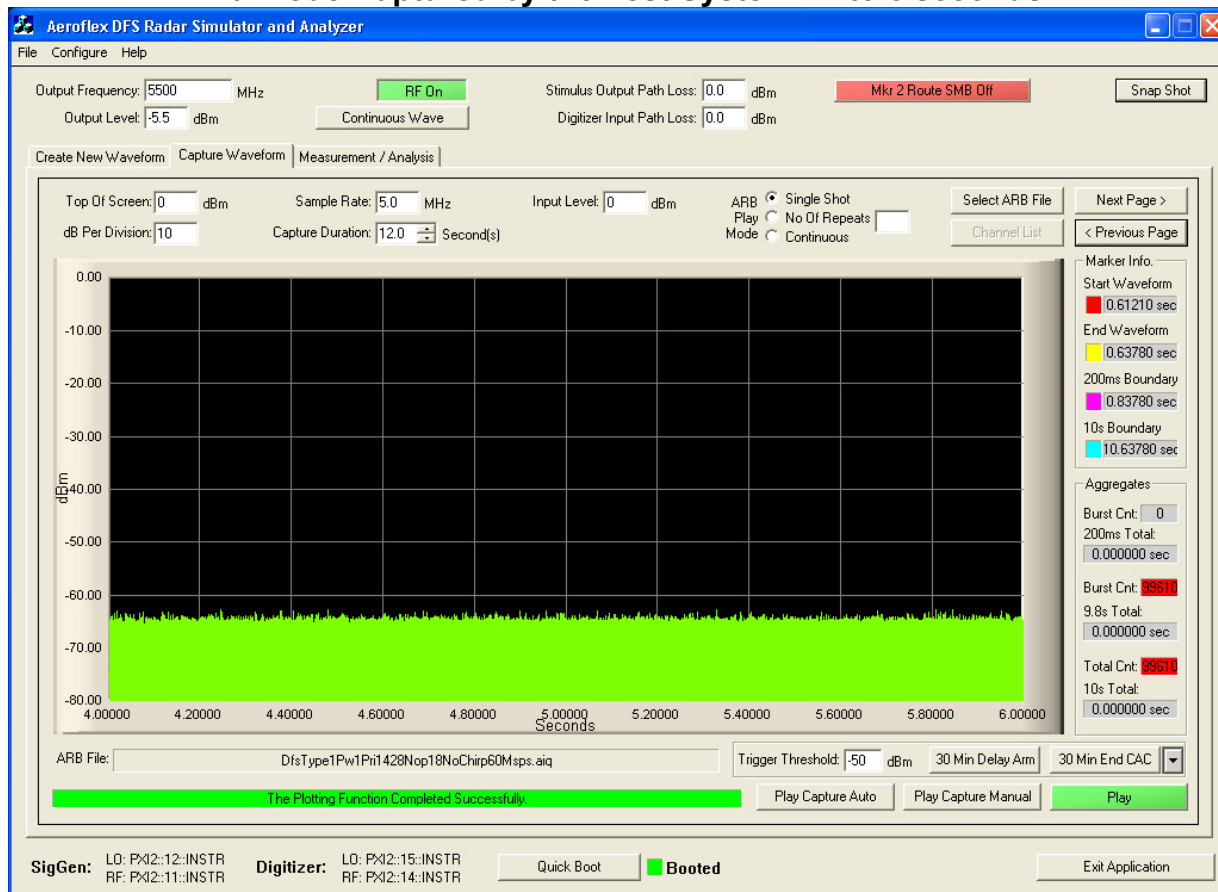


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 4 to 6 seconds

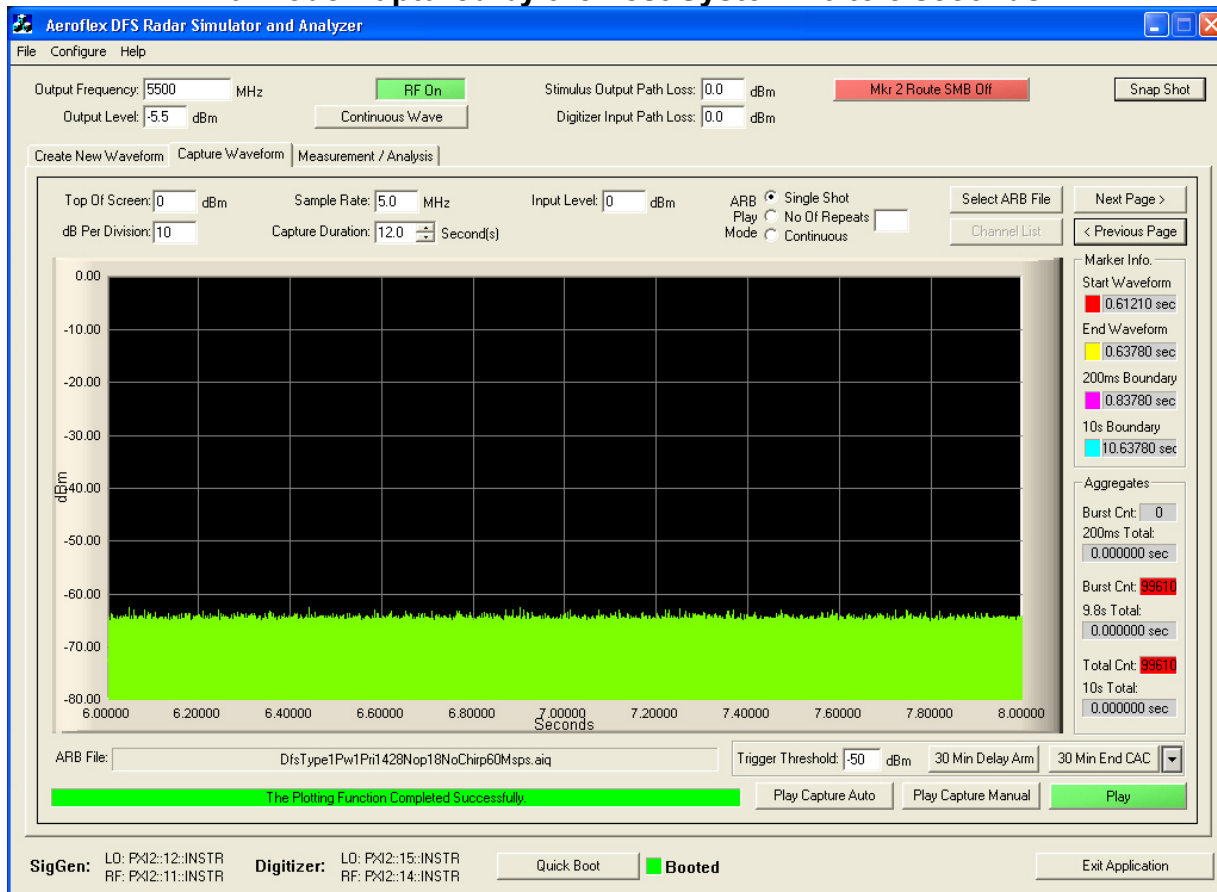


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 6 to 8 seconds

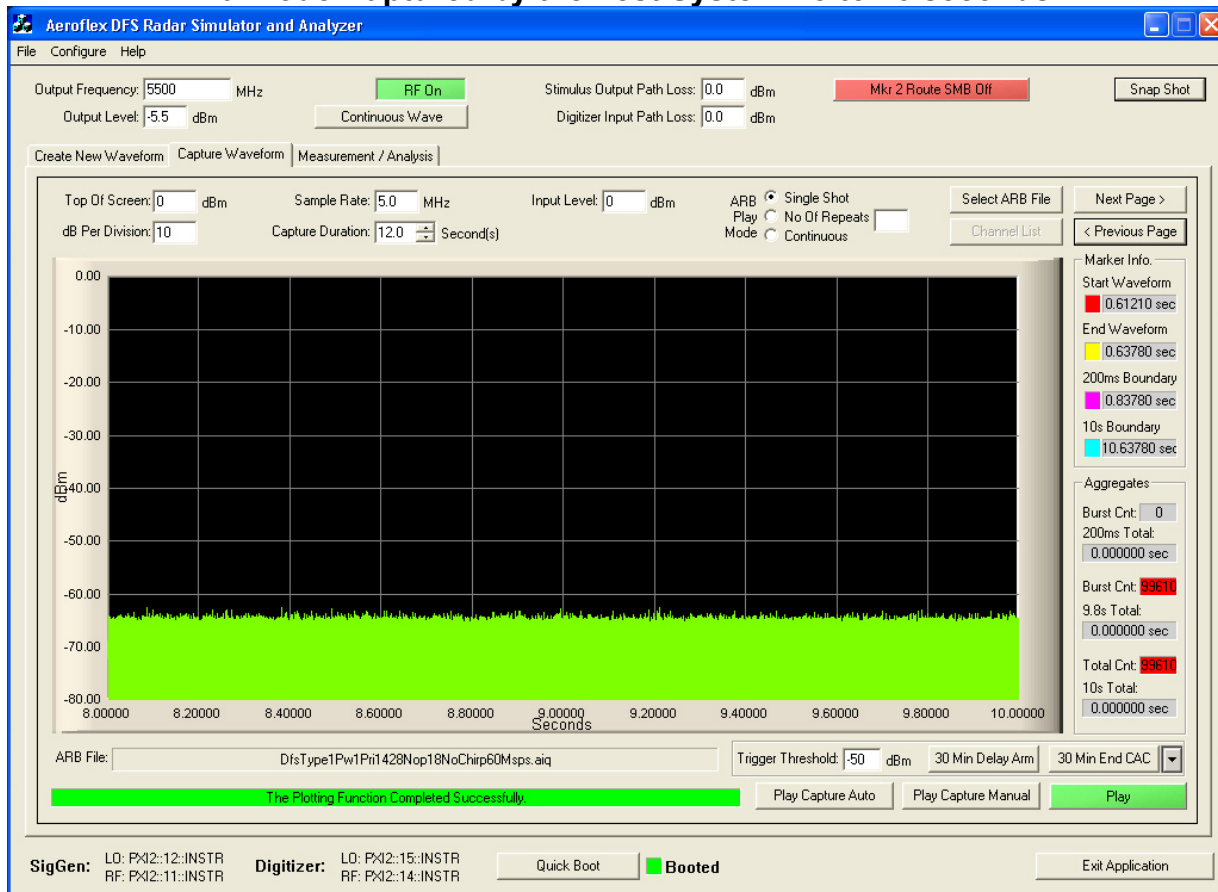


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 8 to 10 seconds

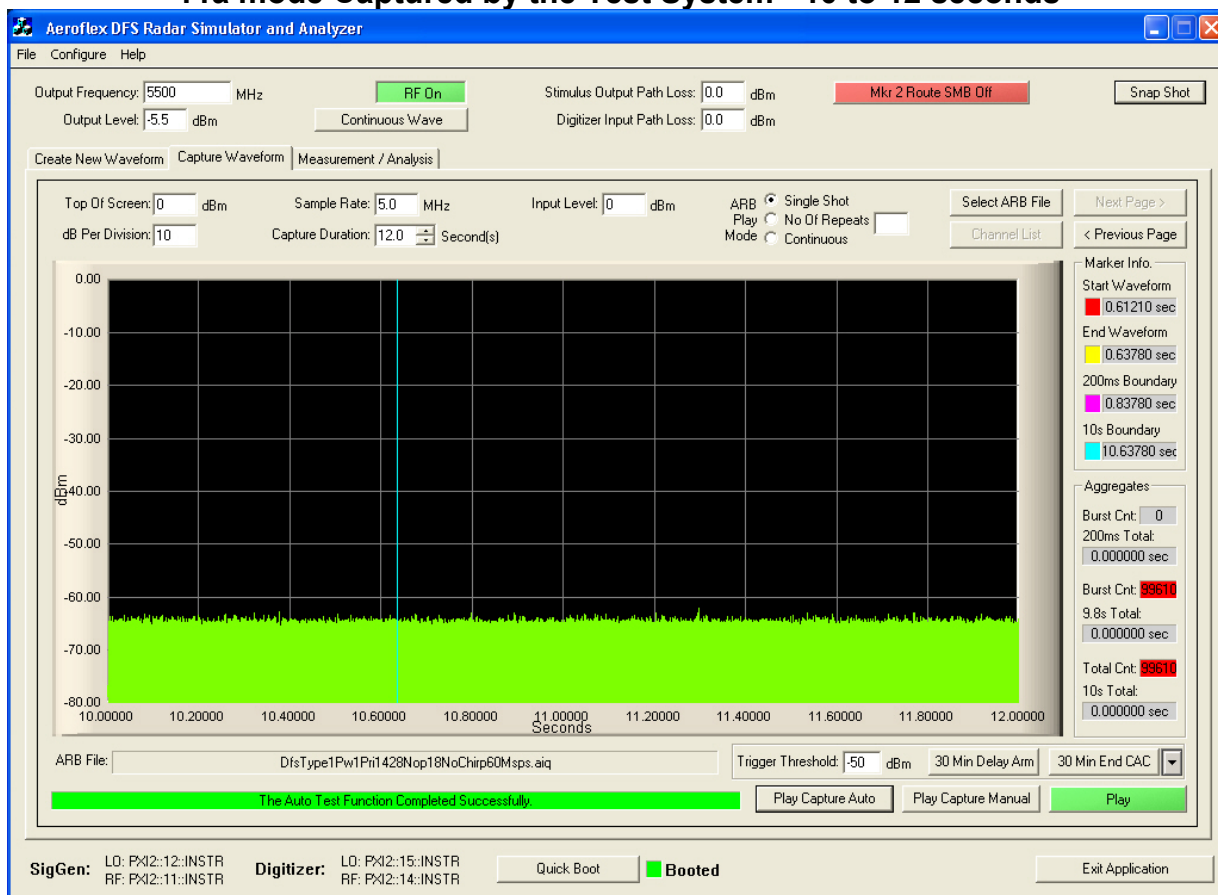


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11a mode Captured by the Test System - 10 to 12 seconds



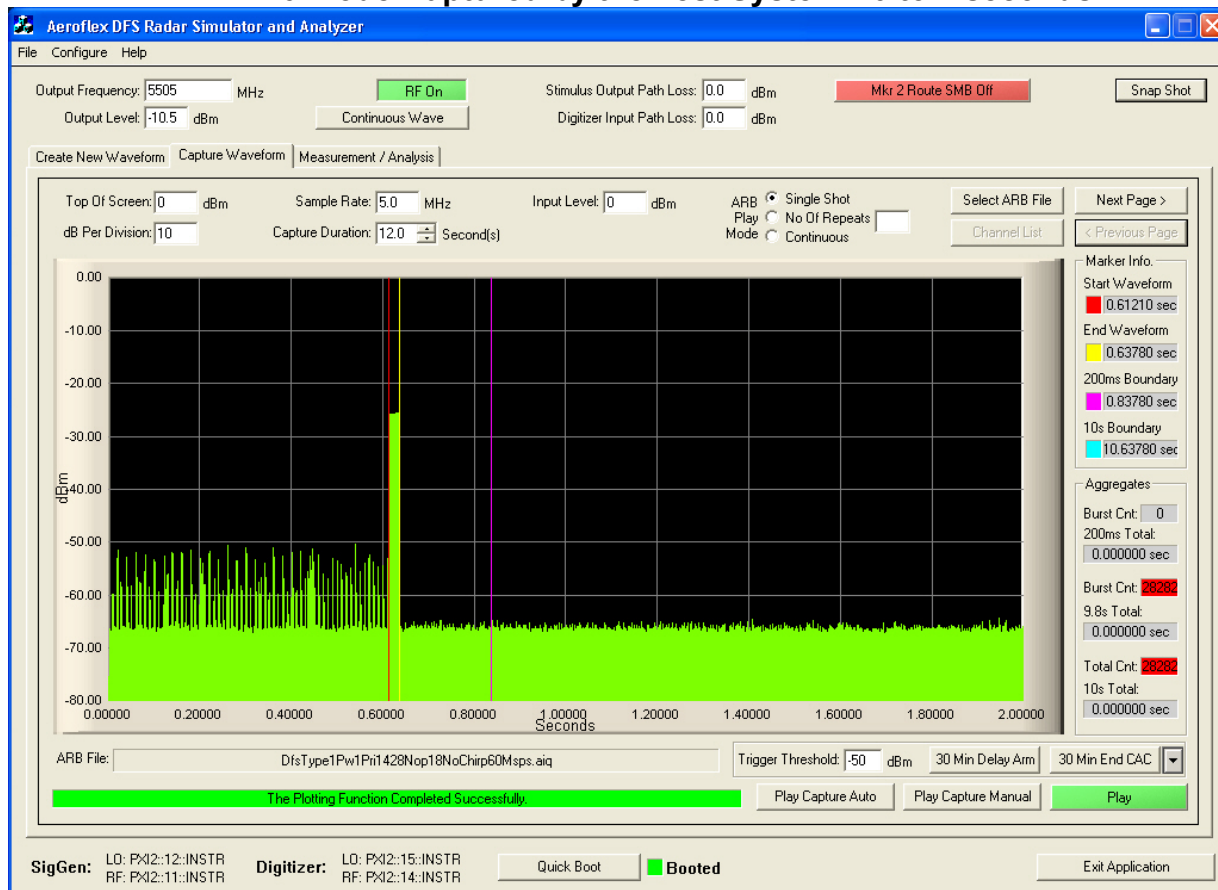
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Channel Closing Transmission Time 5510 MHz (802.11n HT40) = 0.00 mSecs
(limit 260 mSecs)

**Channel Move Time, Channel Closing Transmission Time for Type 1 Radar
11n HT-40 mode Captured by the Test System - 0 to 2 seconds**



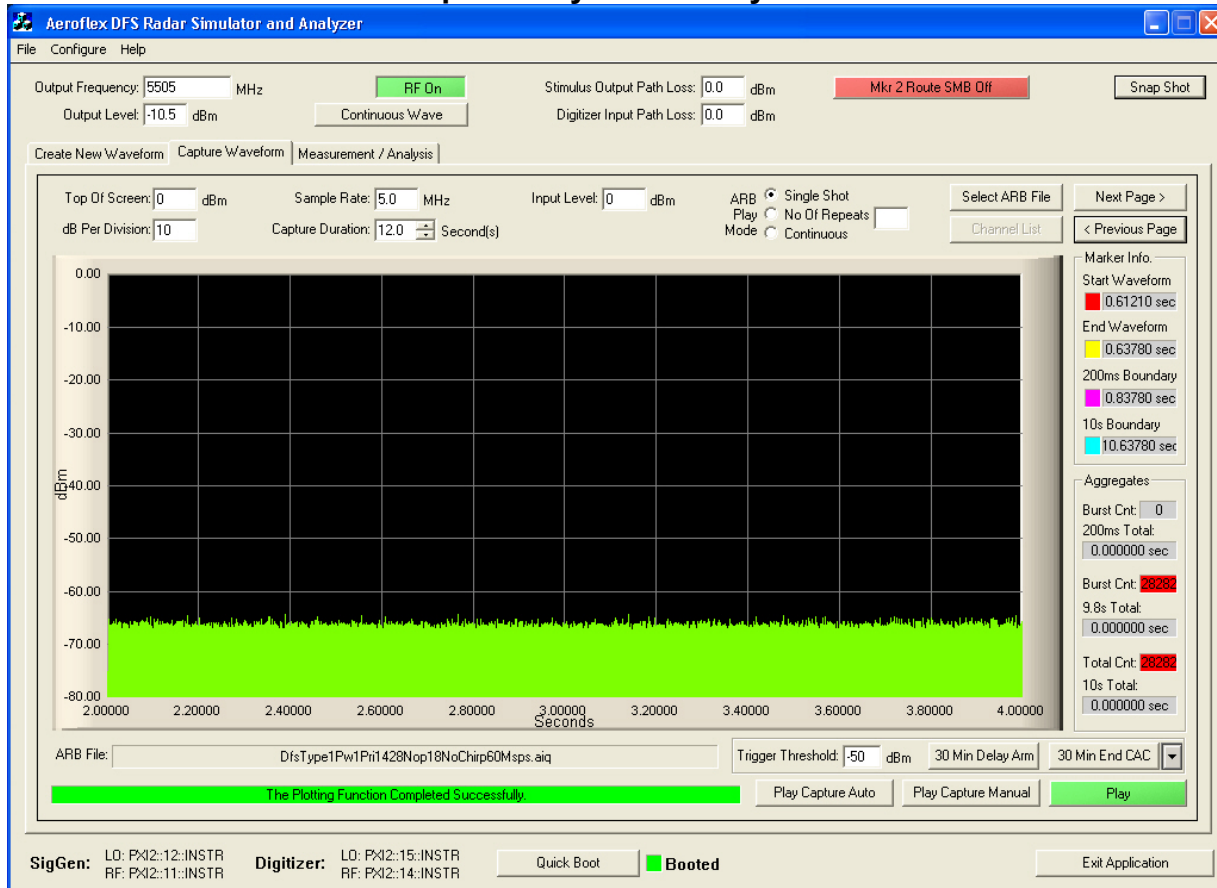
From the plot above it can be seen that the transmission activity within the 200 mS window is 0.0 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 0.00 mS. This is less than the 60 mS limit.

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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11n HT-40 mode Captured by the Test System - 2 to 4 seconds

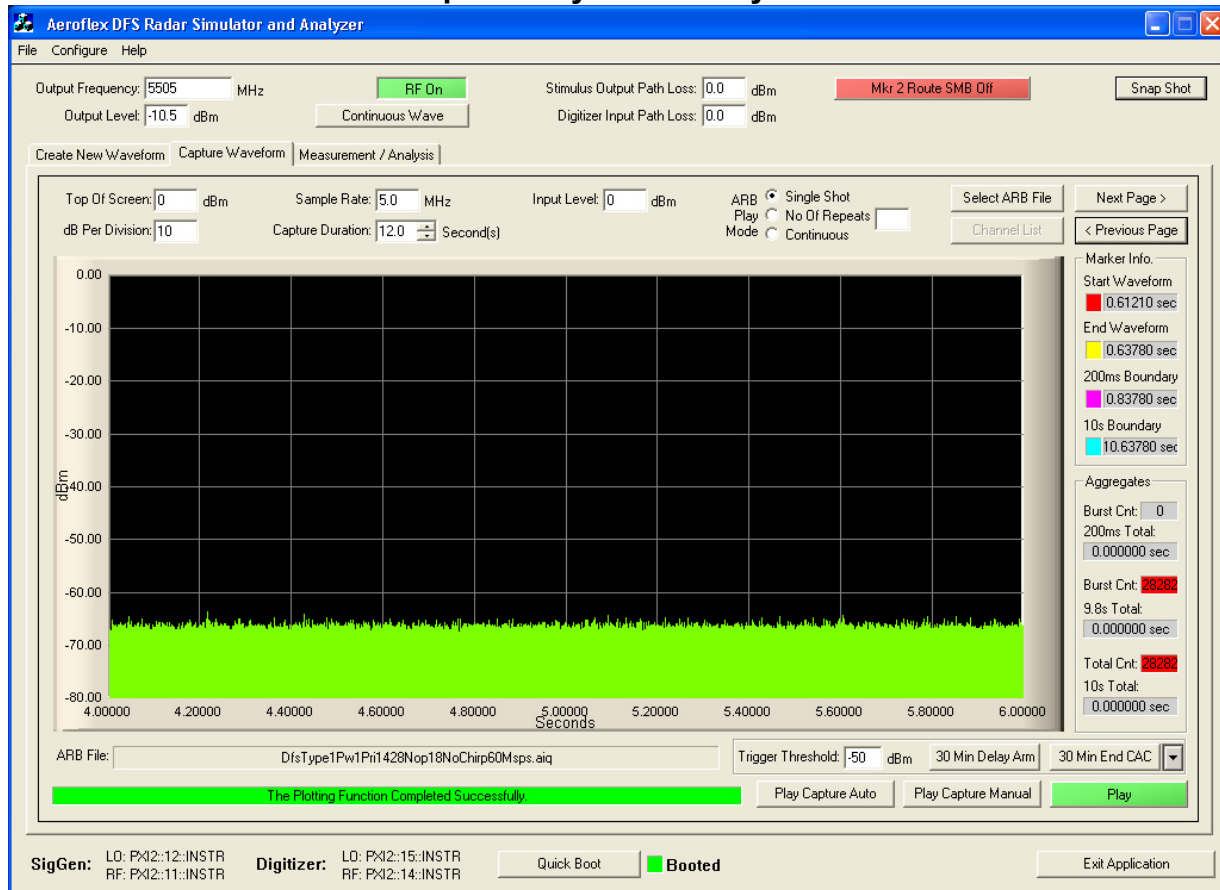


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11n HT-40 mode Captured by the Test System - 4 to 6 seconds

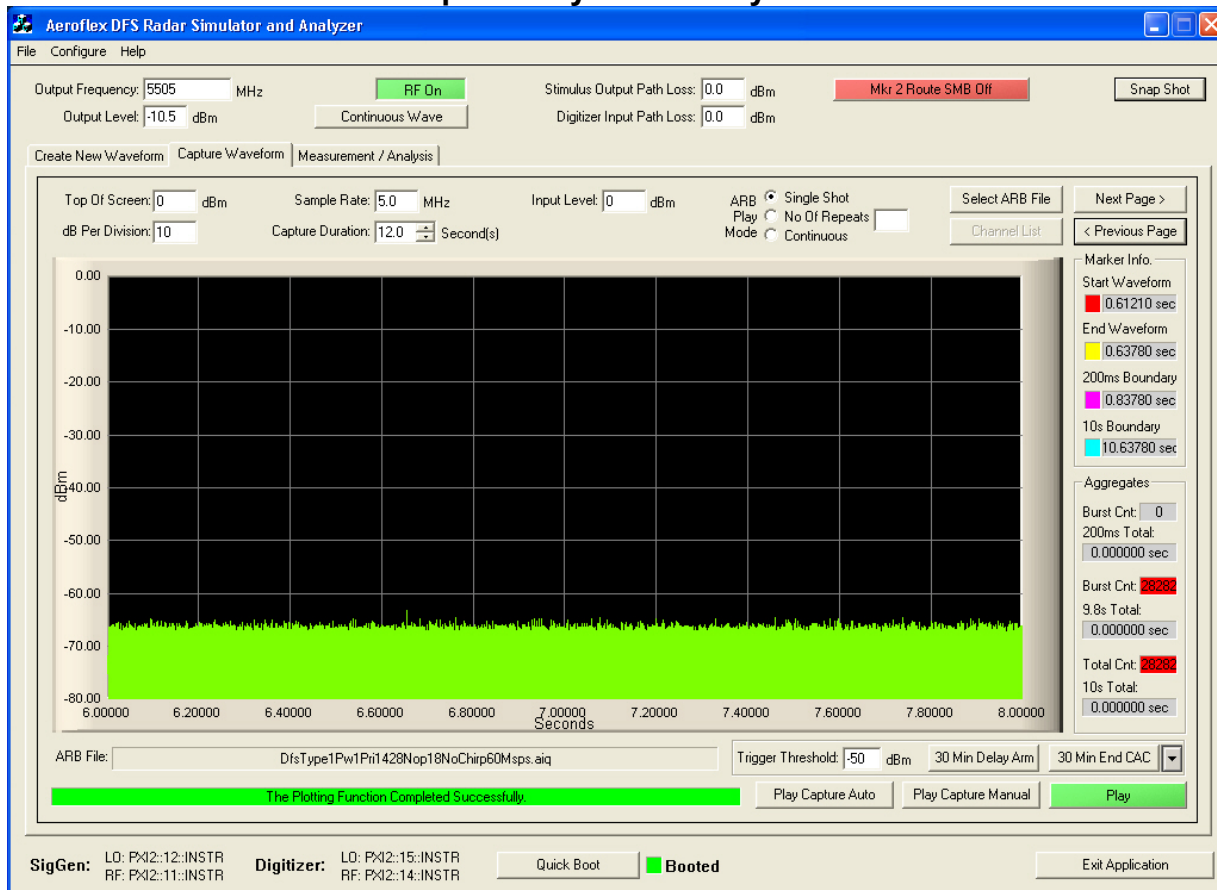


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11n HT-40 mode Captured by the Test System - 6 to 8 seconds

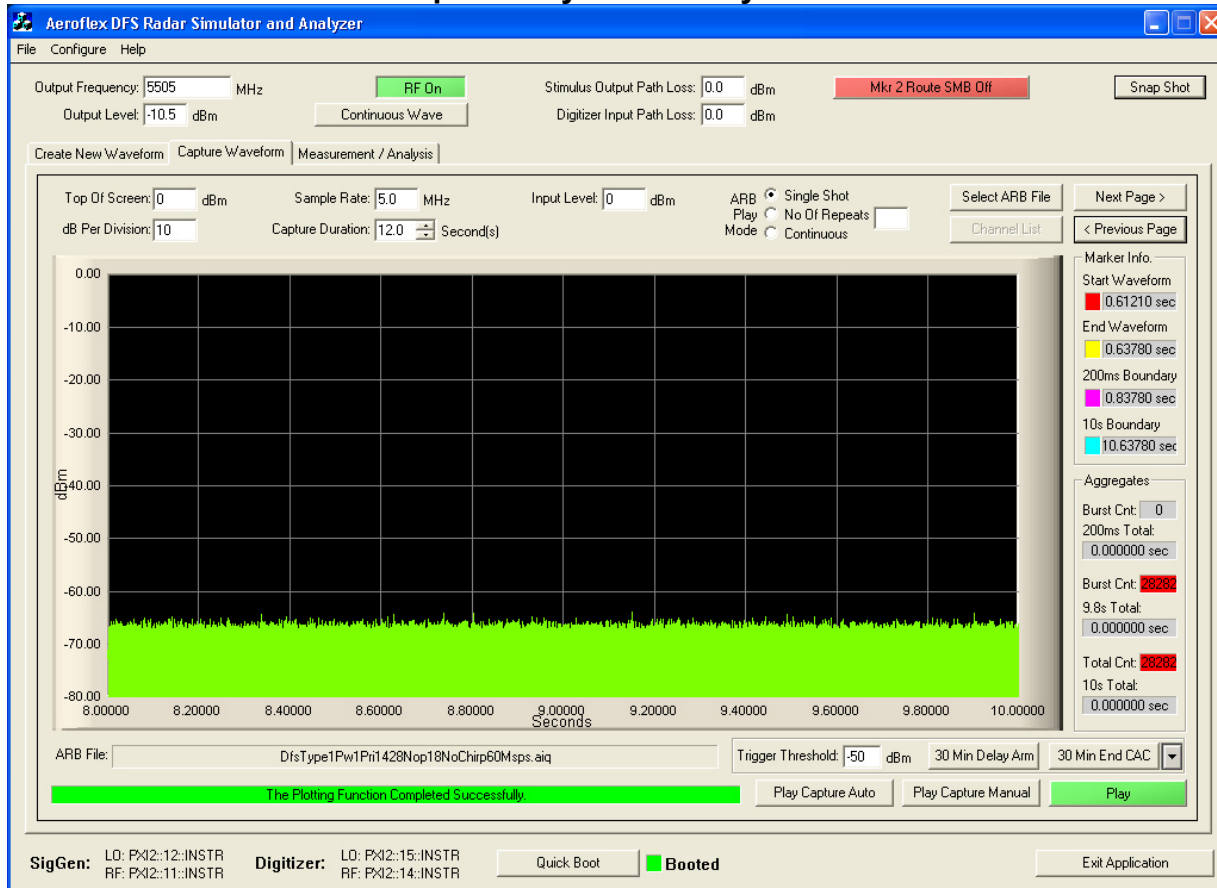


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11n HT-40 mode Captured by the Test System - 8 to 10 seconds

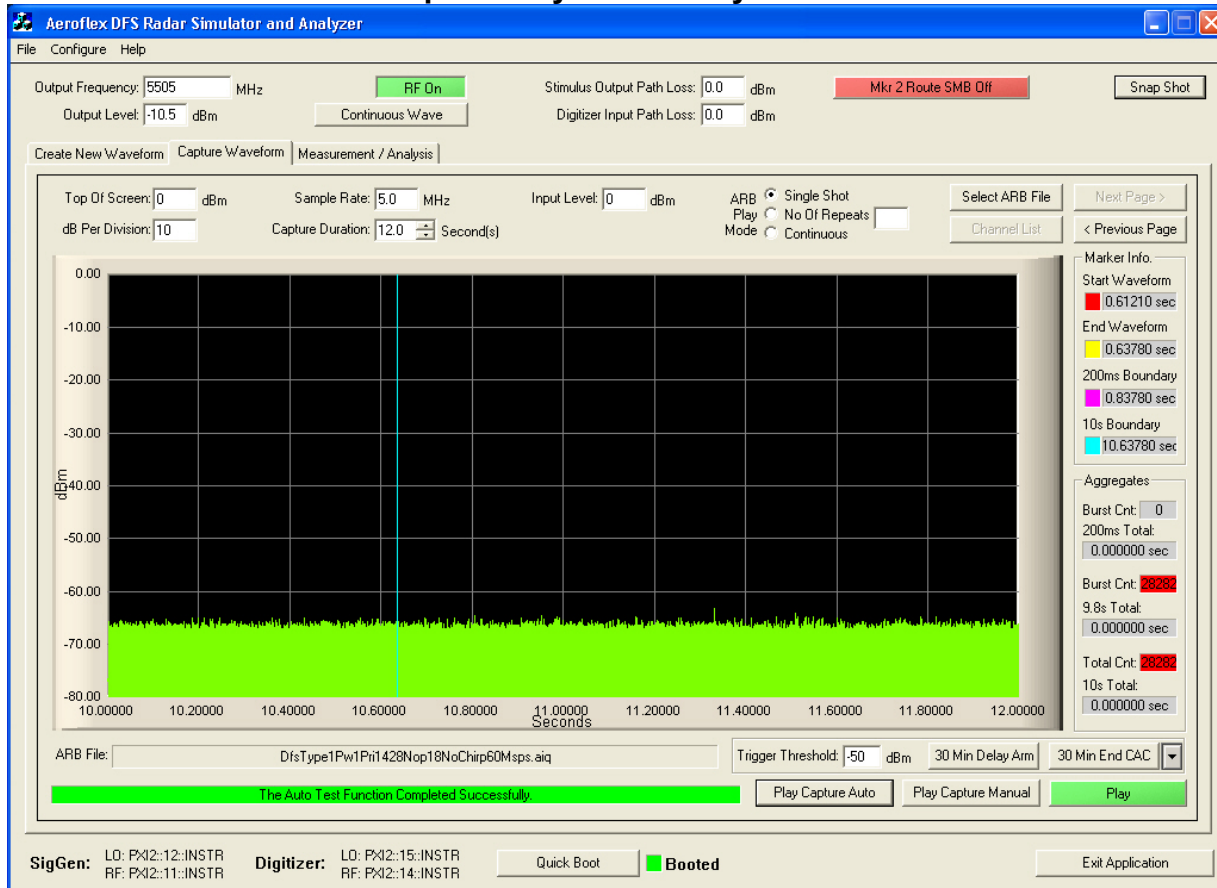


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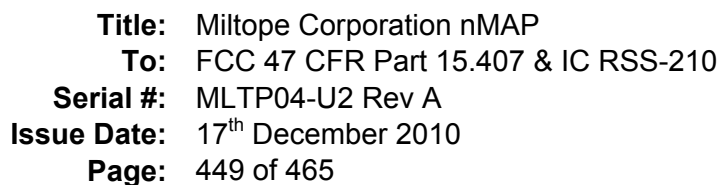


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Channel Move Time, Channel Closing Transmission Time for Type 1 Radar 11n HT-40 mode Captured by the Test System - 10 to 12 seconds



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The EUT is monitored for more than 30 minutes following the channel close/move time to verify no transmissions resume on this Channel.

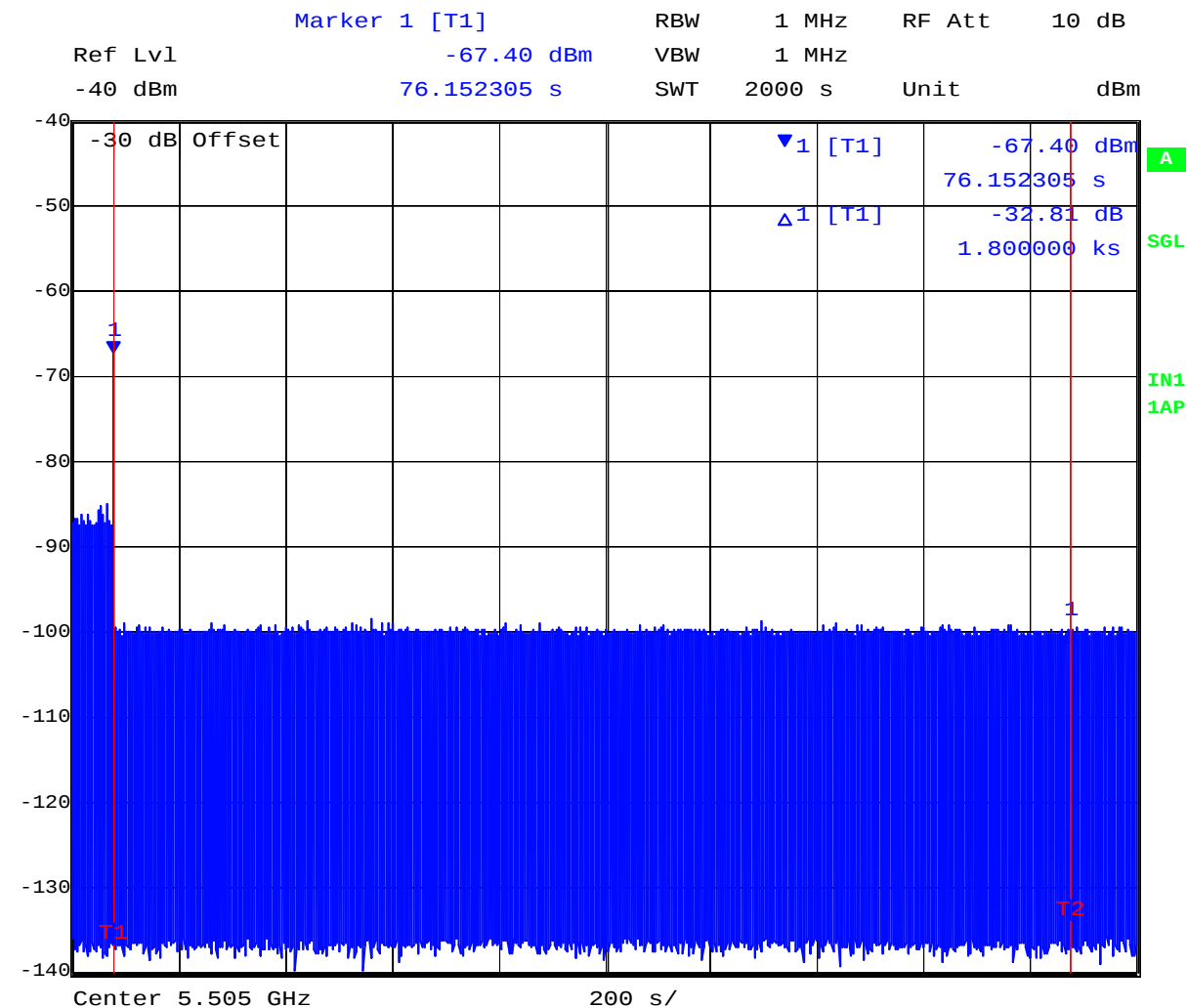
Date: 11.NOV.2010 13:18:45

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30 Minute Non-Occupancy Period Type 1 Radar
11n HT-40 mode Ch 5,505 MHz



Date: 19.NOV.2010 09:14:24

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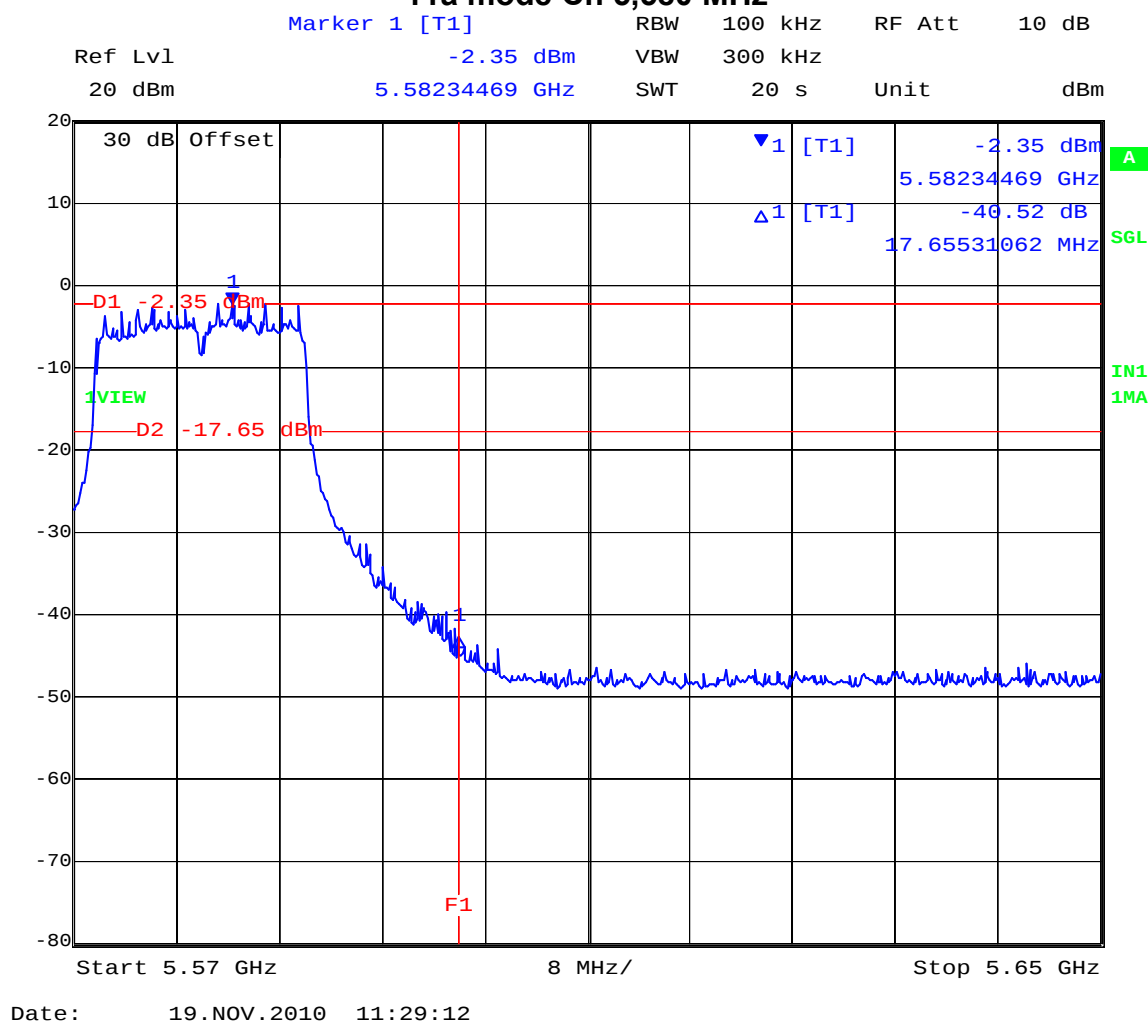
8.2.6. Verification of Non-Operation in the weather radar band 5600 – 5650 MHz

The nMAP does not operate in the weather radar band 5600 – 5650 MHz.

The emissions levels were measured with the EUT in both 11a and HT-40 modes transmitting on the channels closest to the band edges of the 5600 – 5650 MHz band to verify compliance.

5600 – 5650 MHz Lower Band Edge

11a mode Ch 5,580 MHz



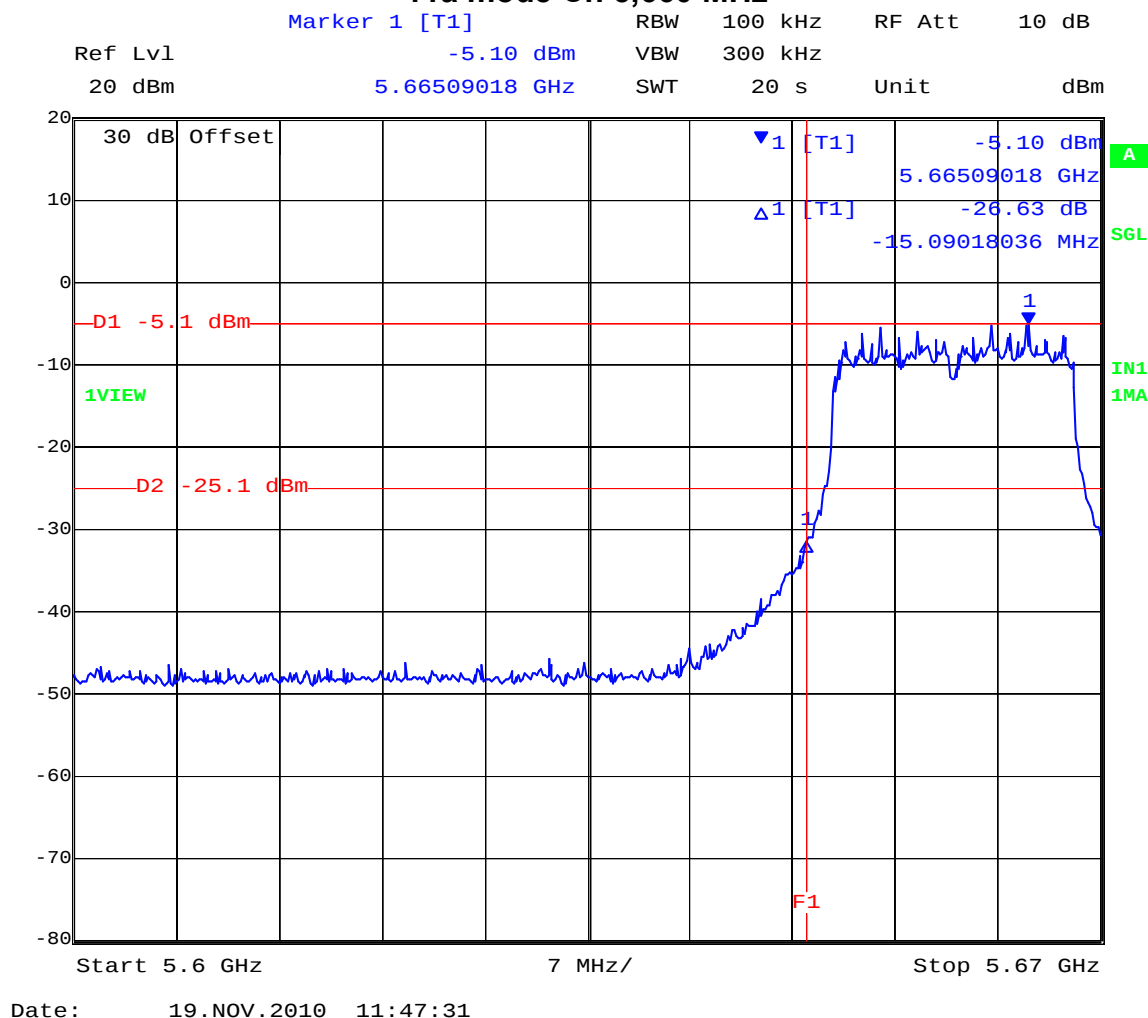
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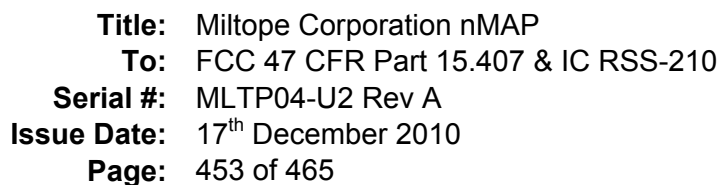
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5600 – 5650 MHz Upper Band Edge

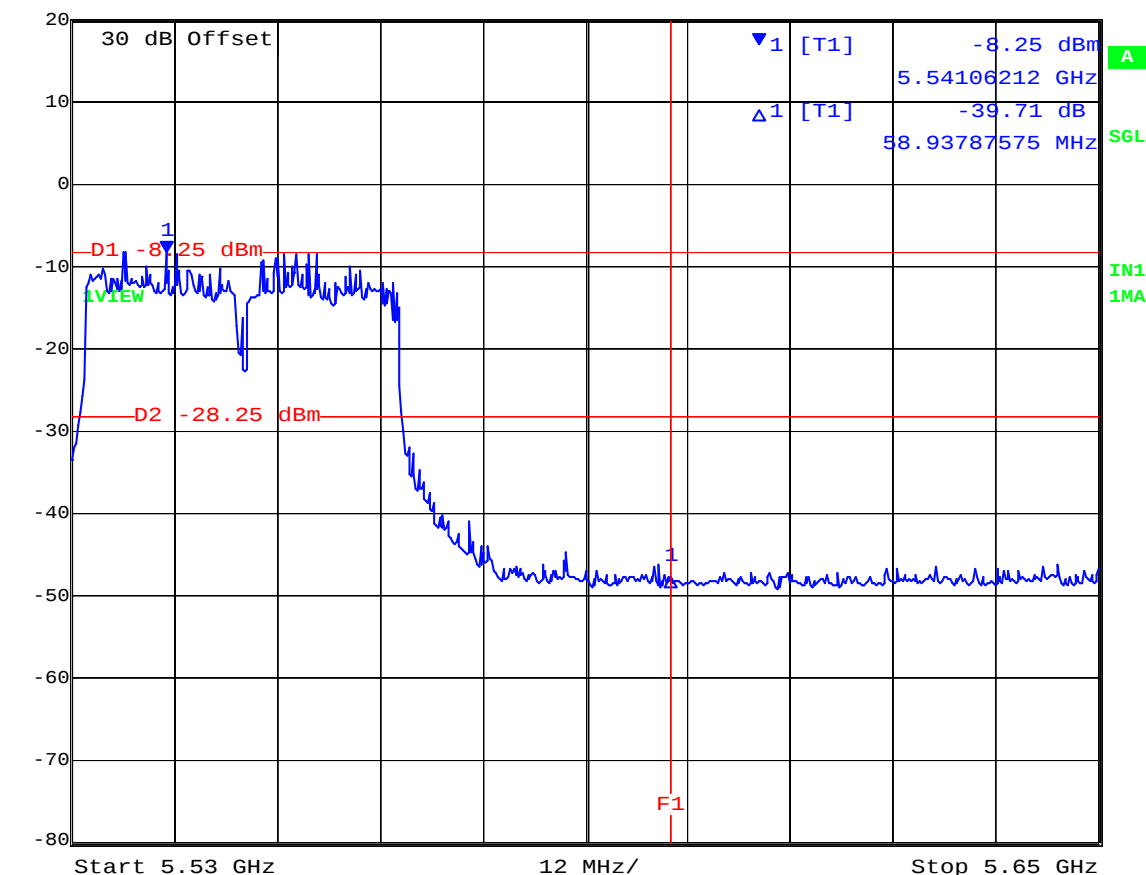
11a mode Ch 5,660 MHz



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Marker 1 [T1]	RBW	100 kHz	RF Att	10 dB
-8.25 dBm	VBW	300 kHz		
5.54106212 GHz	SWT	20 s	Unit	dBm



Date: 19.NOV.2010 11:38:07

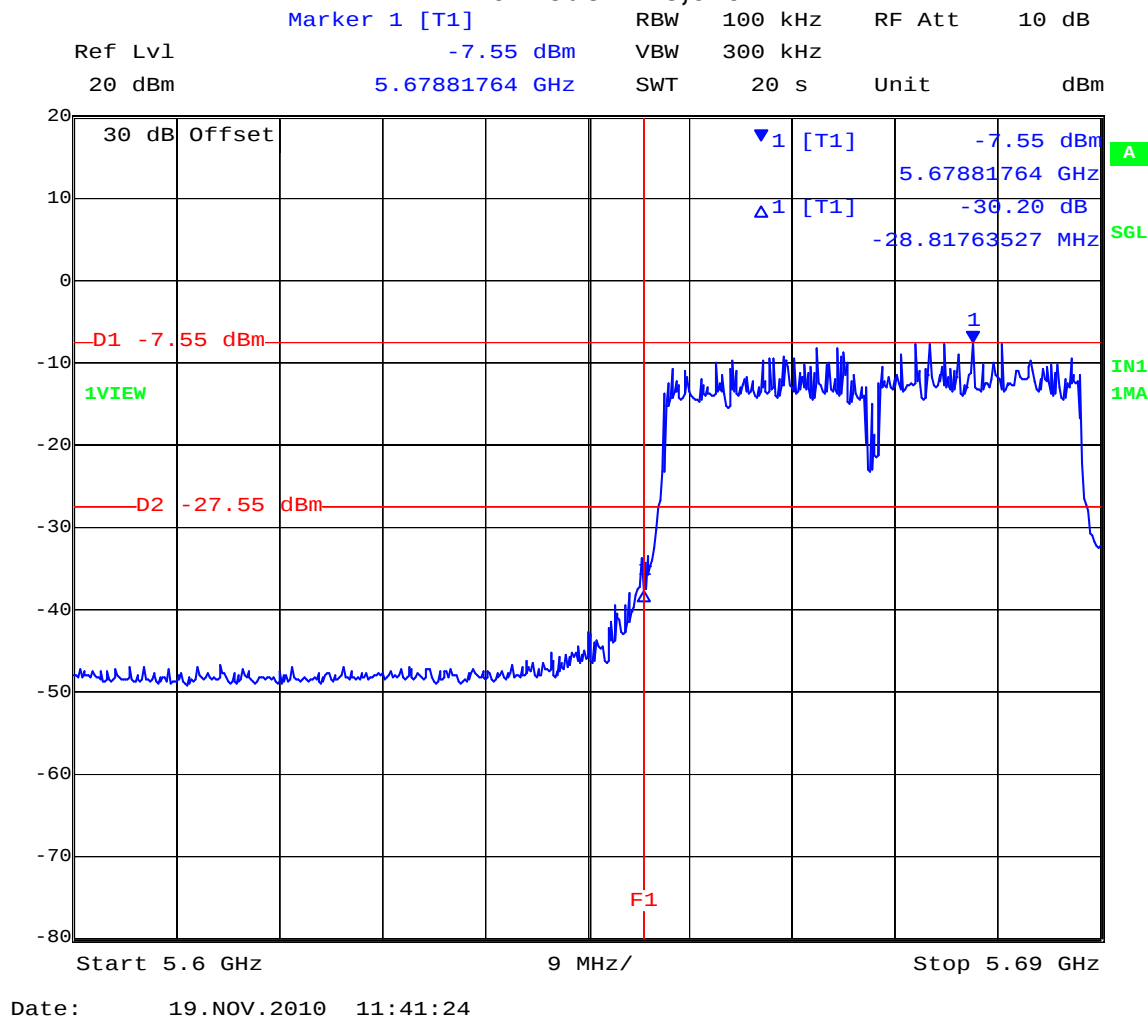
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5600 – 5650 MHz Upper Band Edge

11n HT-40 mode Ch 5,670 MHz



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8.2.7. Statistical Performance Check

The steps below define the procedure to determine the minimum percentage of detection 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 Client Device will associate with the UUT (Master) at 5,500 MHz in 11a mode and 5510 MHz in 11n HT-40 mode. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

The Radar Waveform generator sends the individual waveform for each of the radar types 1-6. Statistical data will be gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

$$\text{Total \# of detections} \div \text{Total \# of Trials} \times 100 = \text{Probability of Detection}$$

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.



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Verification of Detection 5500 MHz 11a mode

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	√	√	√	√	√	√
2	√	√	√	√	√	0
3	√	√	√	√	√	√
4	√	√	√	√	√	√
5	√	√	√	√	√	√
6	√	√	√	0	√	√
7	√	√	√	√	√	√
8	√	√	√	0	√	√
9	√	√	√	0	√	√
10	√	0	√	0	0	√
11	√	√	√	0	√	√
12	√	0	0	√	√	√
13	√	√	√	√	0	√
14	√	0	√	√	√	√
15	√	√	√	√	√	√
16	√	√	√	√	√	√
17	√	0	√	√	√	√
18	√	√	√	√	0	√
19	√	√	√	0	0	0
20	0	0	√	√	√	√
21	0	√	√	√	√	√
22	√	√	√	√	√	√
23	√	0	0	0	√	0
24	√	√	0	√	√	0
25	√	√	√	√	0	√
26	√	√	0	0	0	√
27	√	√	√	√	√	√
28	√	√	0	√	√	√
29	√	√	√	0	√	√
30	√	0	√	√	√	√
Detection Percentage	93.3% (>60%)	80% (>60%)	83.3% (>60%)	70% (>60%)	80% (>80%)	86.6% (>80%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;
 $(Pd1 + Pd2 + Pd3 + Pd4) / 4 = (93.3\% + 80\% + 83.3\% + 70\%) / 4 = 81.65\% (> 80\%)$

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Verification of Detection 5510 MHz HT40 mode

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	√	√	√	√	√	√
2	√	√	√	√	√	√
3	√	√	√	0	√	√
4	√	0	√	√	√	√
5	√	√	√	√	√	√
6	√	√	0	√	√	√
7	√	√	0	0	√	√
8	√	√	√	√	√	√
9	√	0	√	√	0	√
10	√	√	√	0	0	√
11	√	√	√	√	√	√
12	√	√	√	√	√	√
13	√	√	√	√	√	0
14	√	√	√	√	√	√
15	0	√	√	√	0	√
16	√	√	√	√	√	√
17	√	√	√	√	√	√
18	√	√	√	√	0	0
19	√	√	√	0	√	√
20	√	√	0	0	√	√
21	√	0	√	0	√	√
22	√	√	√	√	√	√
23	√	√	√	√	√	√
24	0	√	0	√	√	0
25	√	√	√	√	0	√
26	√	0	√	√	√	√
27	√	√	√	0	√	√
28	√	√	0	√	√	√
29	√	√	√	√	√	√
30	√	√	√	√	√	√
Detection Percentage	93.3% (>60%)	86.7% (>60%)	83.3% (>60%)	76.7% (>60%)	83.3% (>80%)	90% (>80%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;
 $(Pd1 + Pd2 + Pd3 + Pd4) / 4 = (93.3\% + 86.7\% + 83.3\% + 76.7\%) / 4 = 85\% (> 80\%)$

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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

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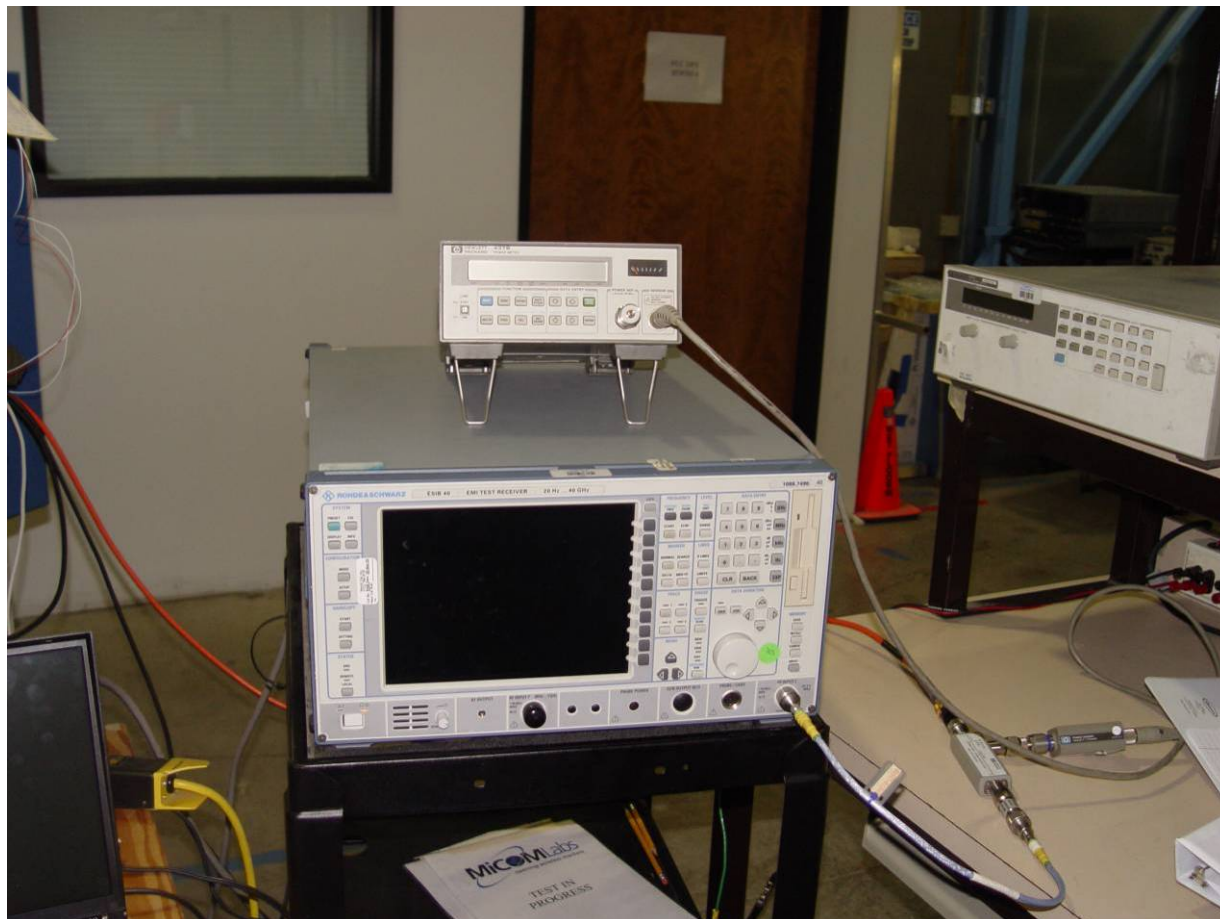
9. PHOTOGRAPHS

9.1. RF Conducted Test Set-up



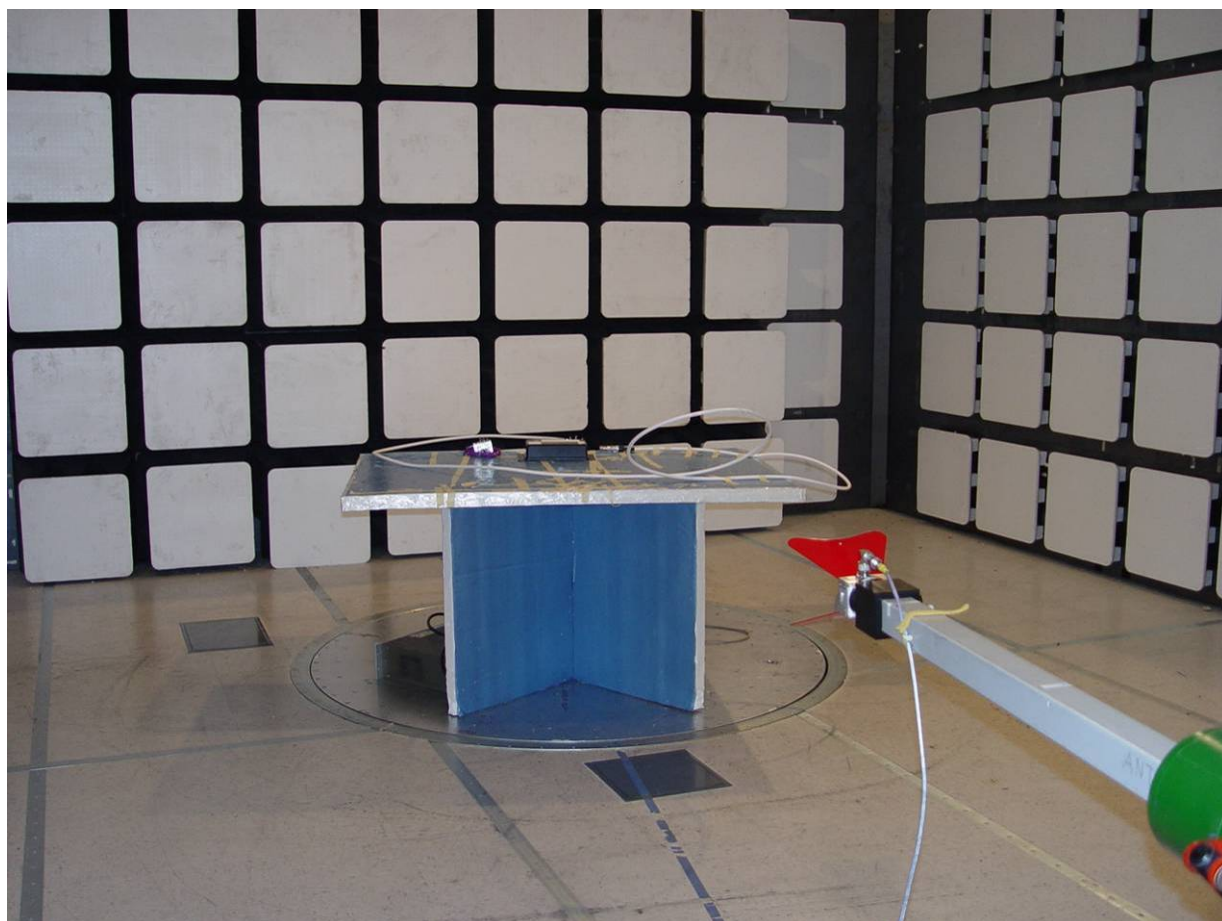
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9.2. Test Instrumentation



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9.3. Radiated Emission Testing



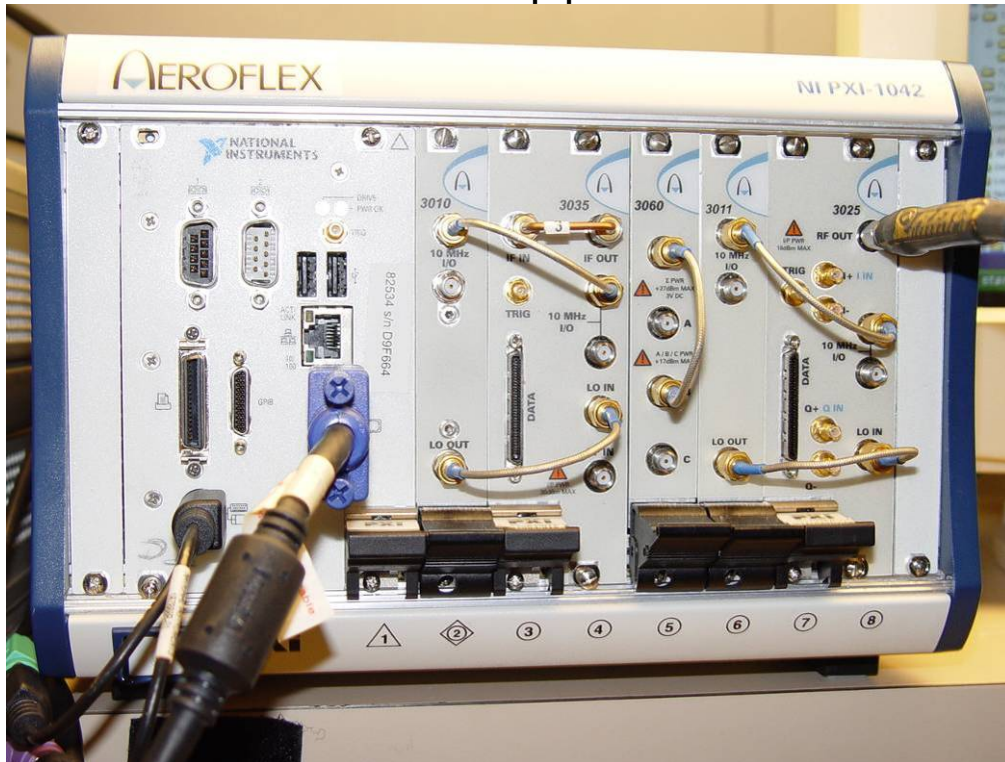
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9.4. Dynamic Frequency Selection Test Set-Up

General DFS Test Setup



DFS Test Equipment



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10. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
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
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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