5.1.9.14. 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 25.70 ms

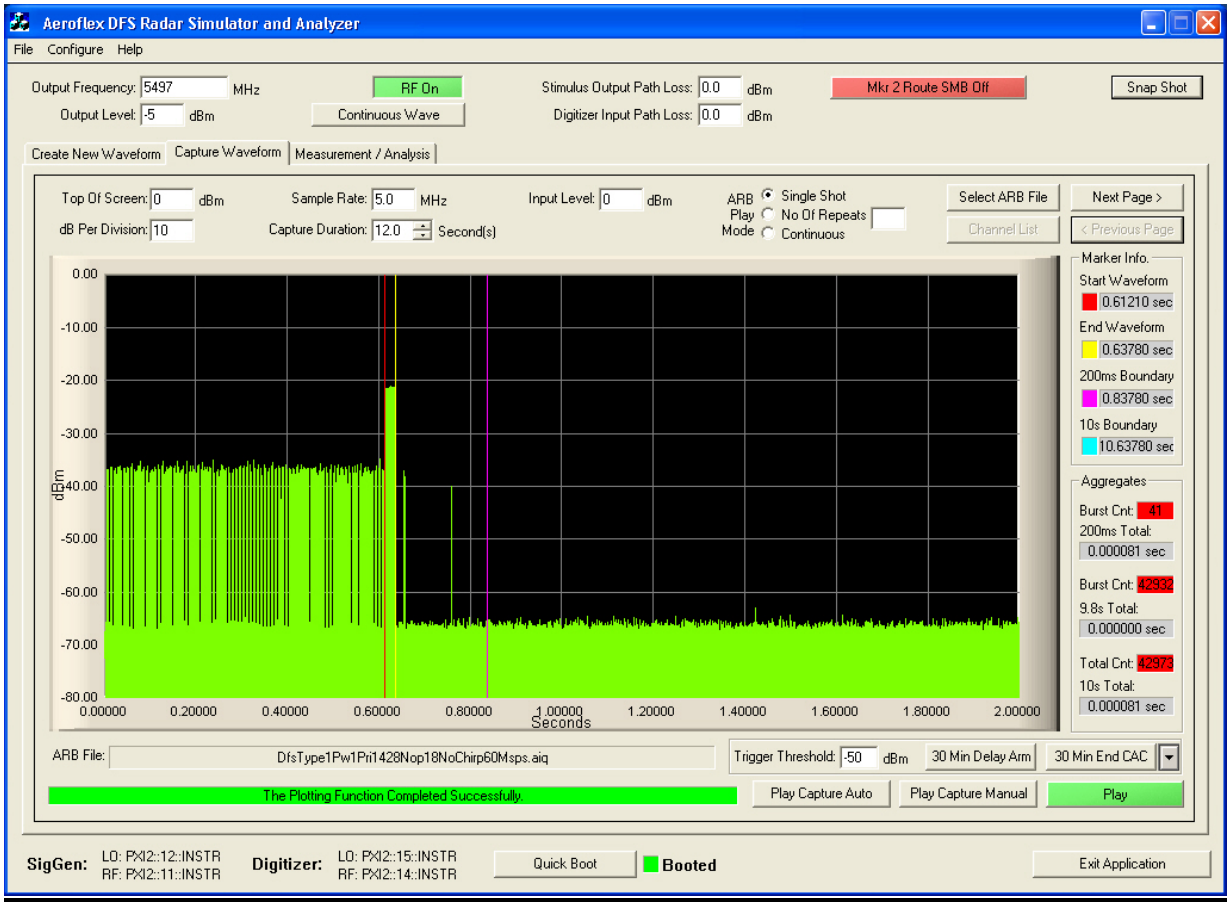
(The period of the 18 pulse burst includes [18 pulses *1.428mS PRI] = 25.704 ms. Then add 1 µs pulse width for the final pulse.)

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 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).

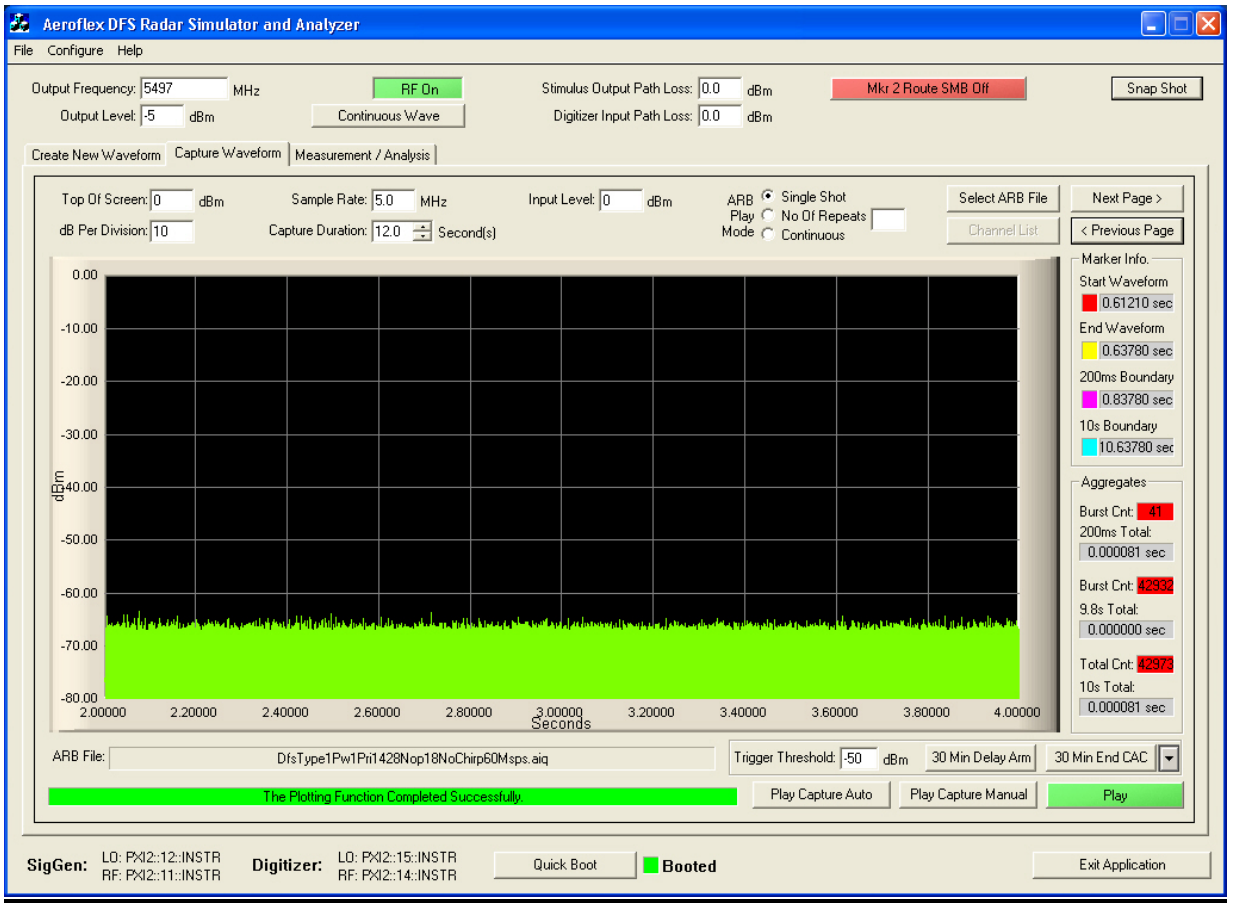
Channel 5,500 MHz
Channel Closing Transmission Time (802.11a) = 0.081 mSecs (limit 260 mSecs)
Channel Move Time (802.11a) = 0.1222 Secs (limit 10 Secs)

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

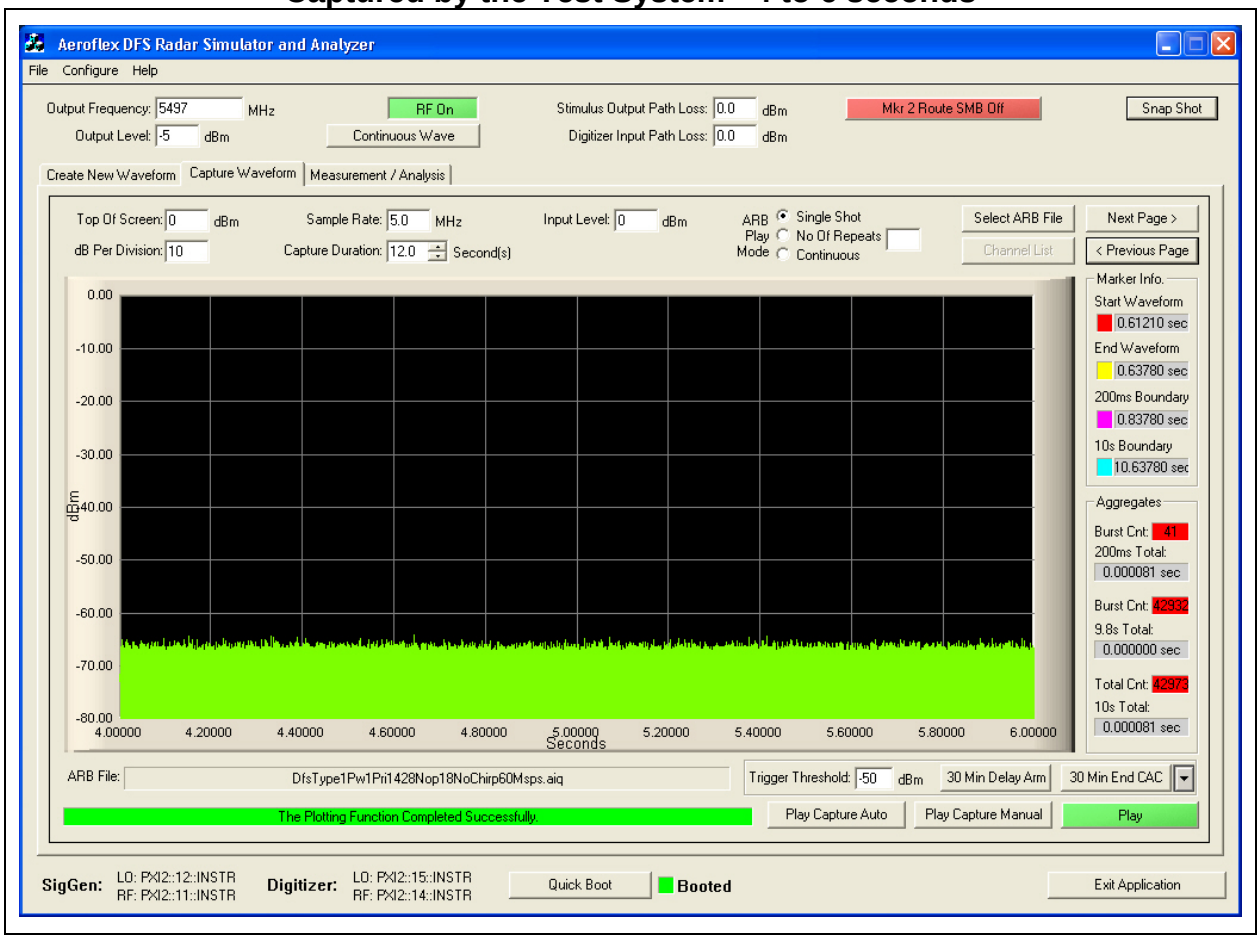


From the plot above it can be seen that the transmission activity within the 200 mS window is 0.081 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 0.0 Sec. This is less than the 60 mS limit.

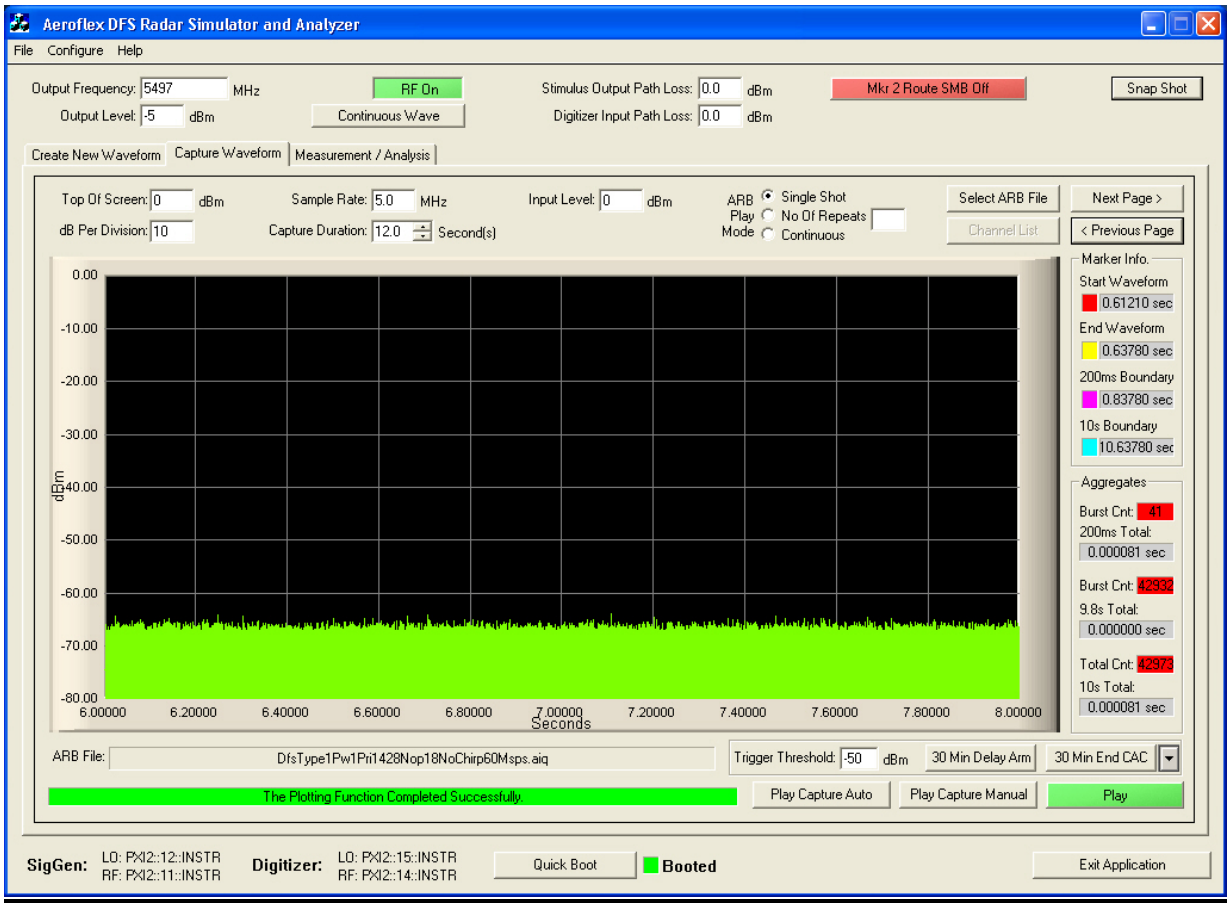
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 2 to 4 seconds



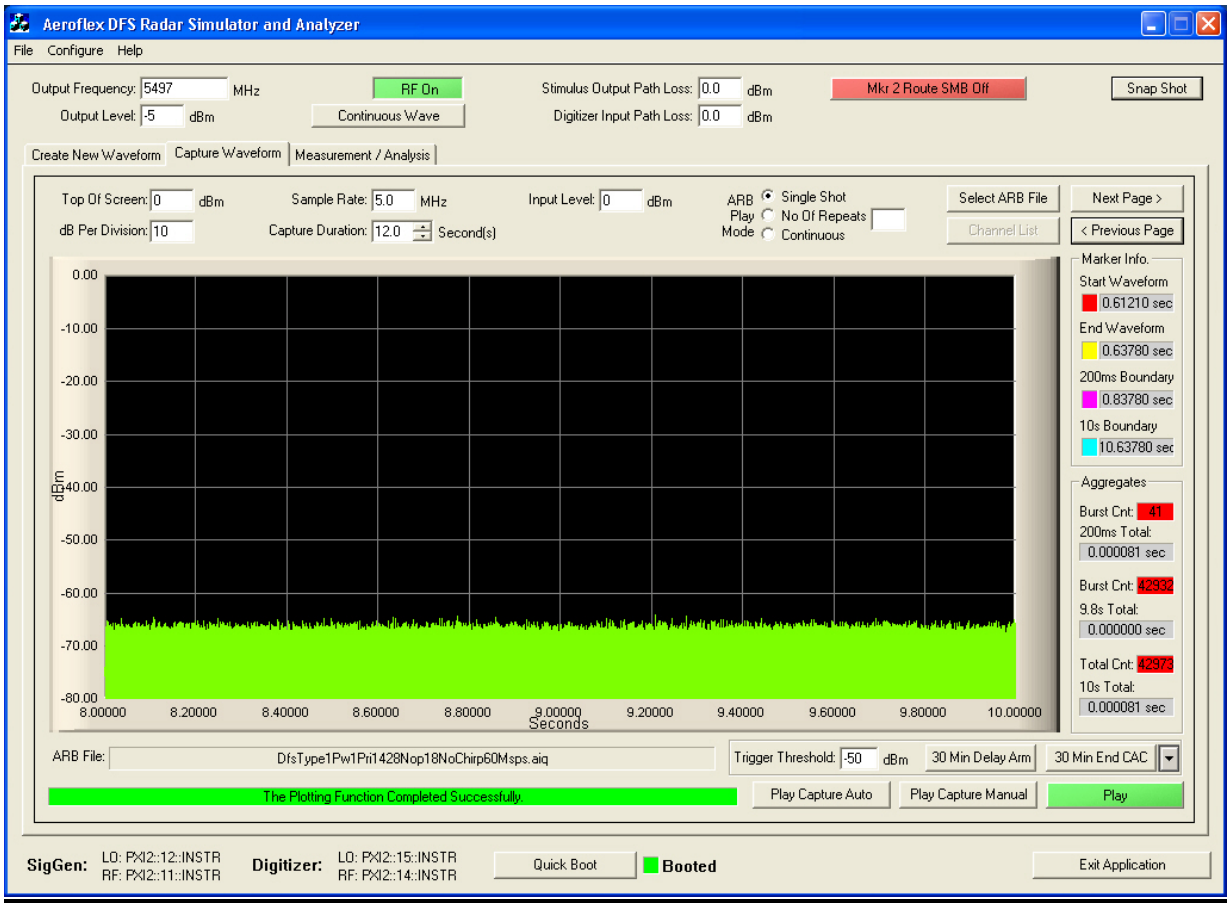
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 4 to 6 seconds



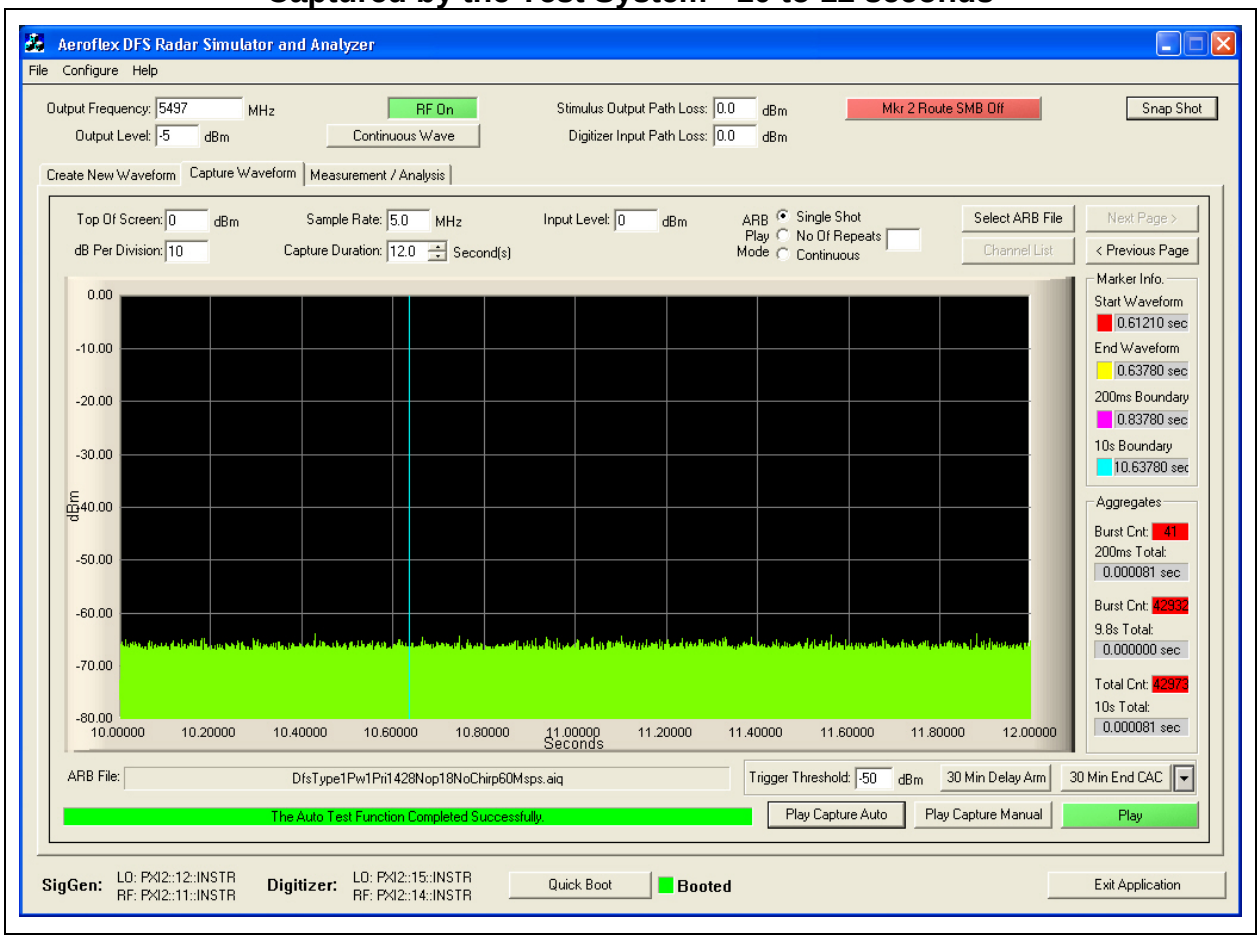
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 6 to 8 seconds



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



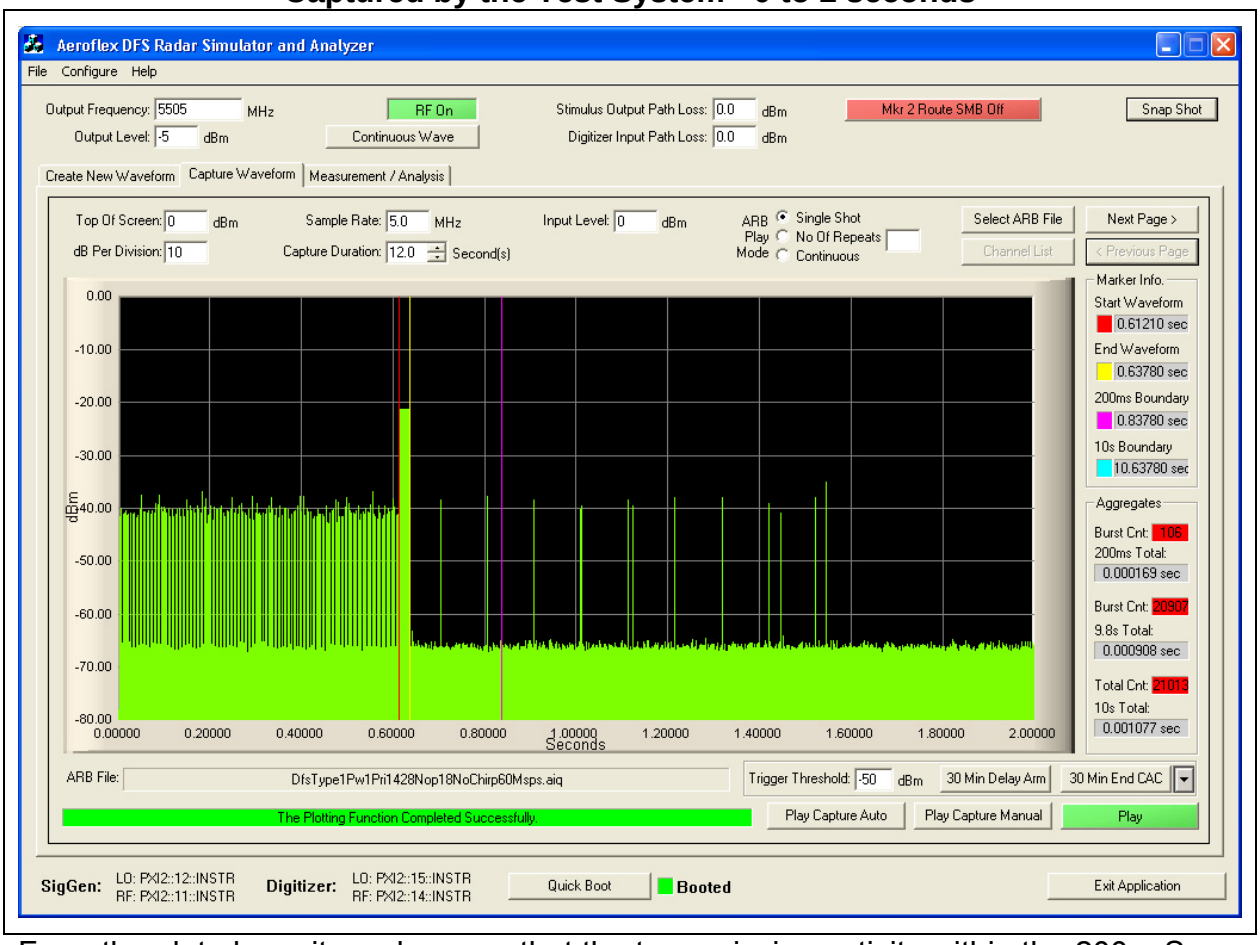
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 10 to 12 seconds



Channel 5,510 MHz
Channel Closing Transmission Time (802.11n HT40) = 1.077 mSecs (limit 260 mSecs)

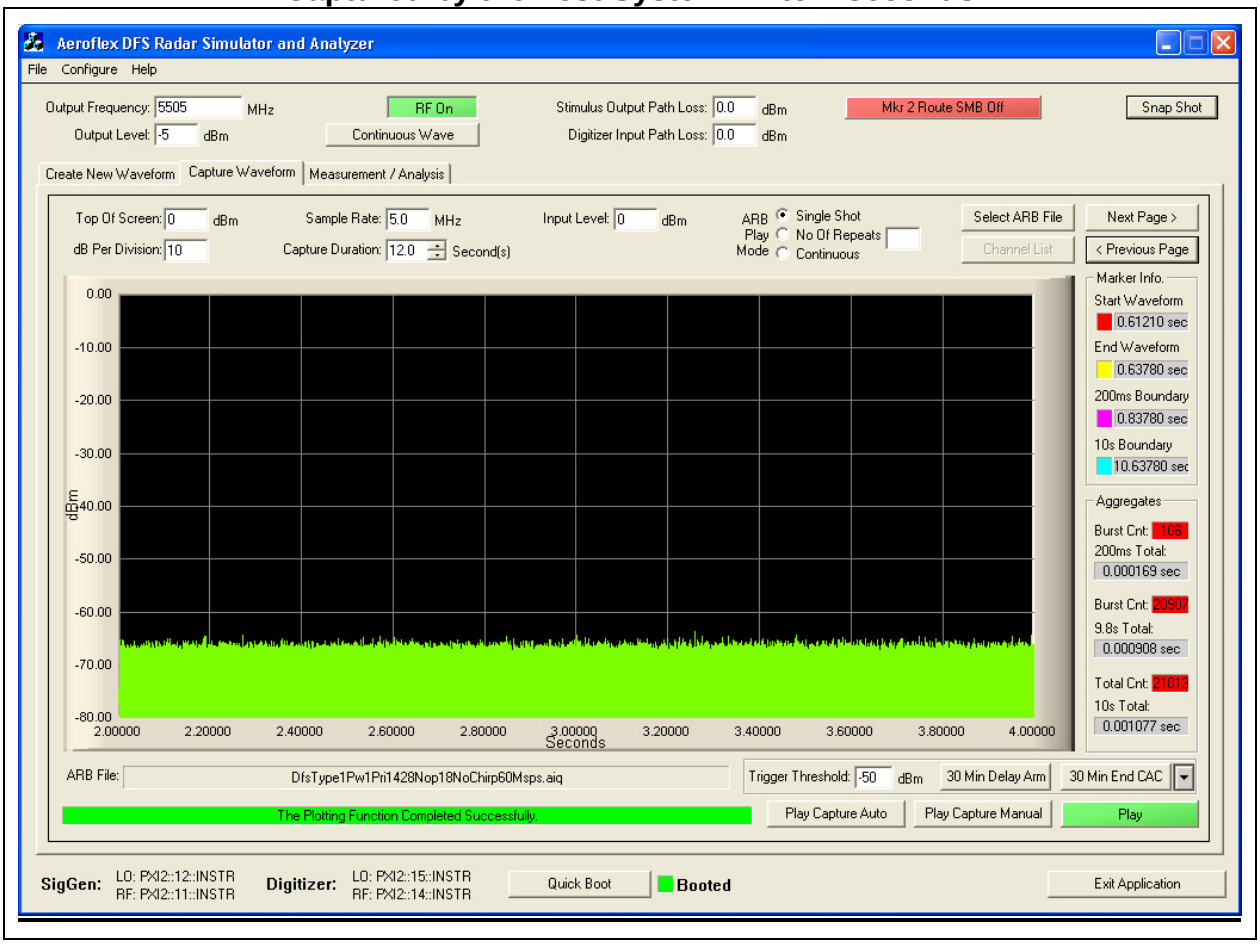
Channel Move Time (802.11n HT40) = 0.9122 Secs (limit 10 Secs)

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

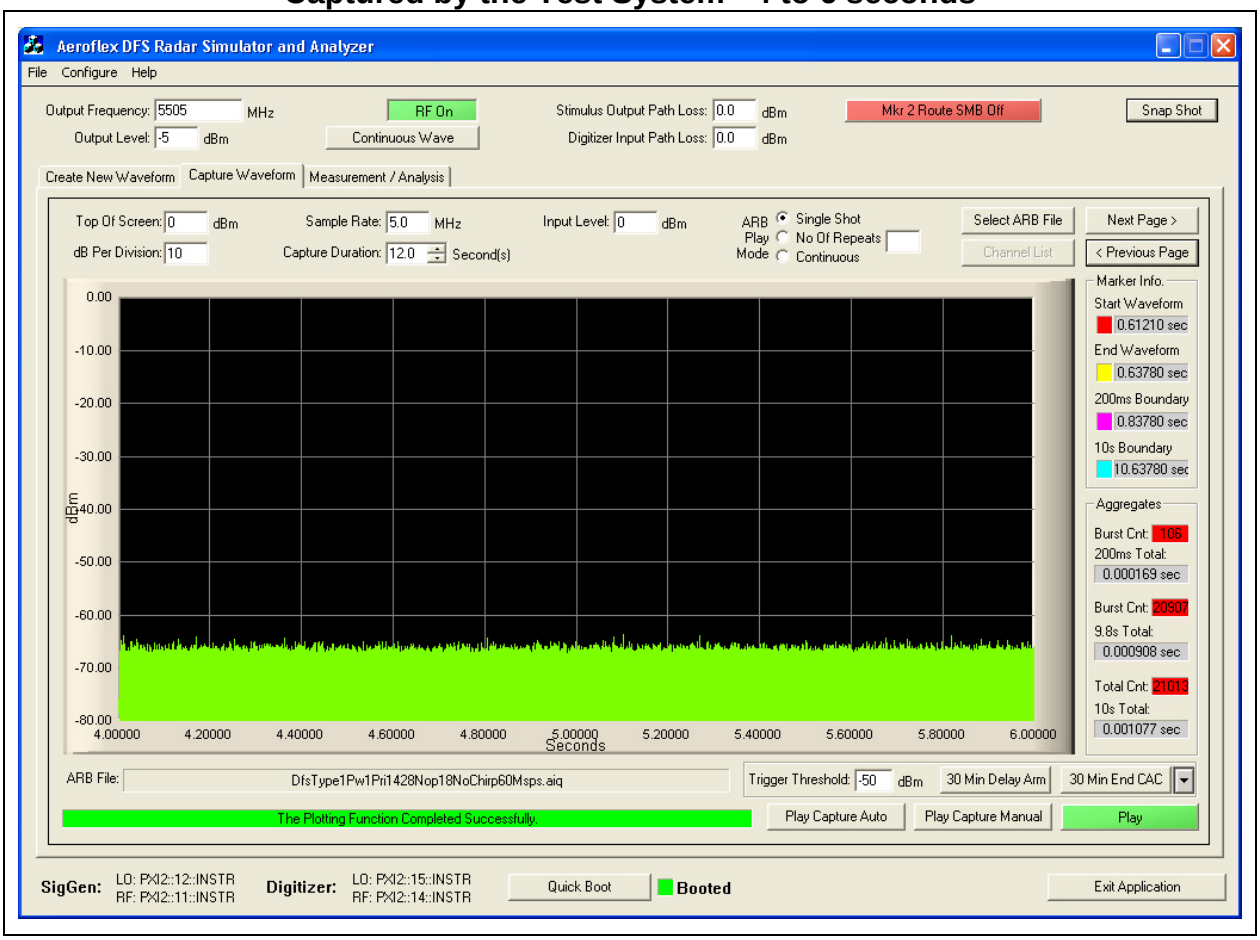


From the plot above it can be seen that the transmission activity within the 200 mS window is 0.169 mS (see 200 mS Total). From the following plots which shows all additional activity within the remained of the 10 sec measurement window it can be determined that the aggregate transmission is 0.908 mS. This is less than the 60 mS limit.

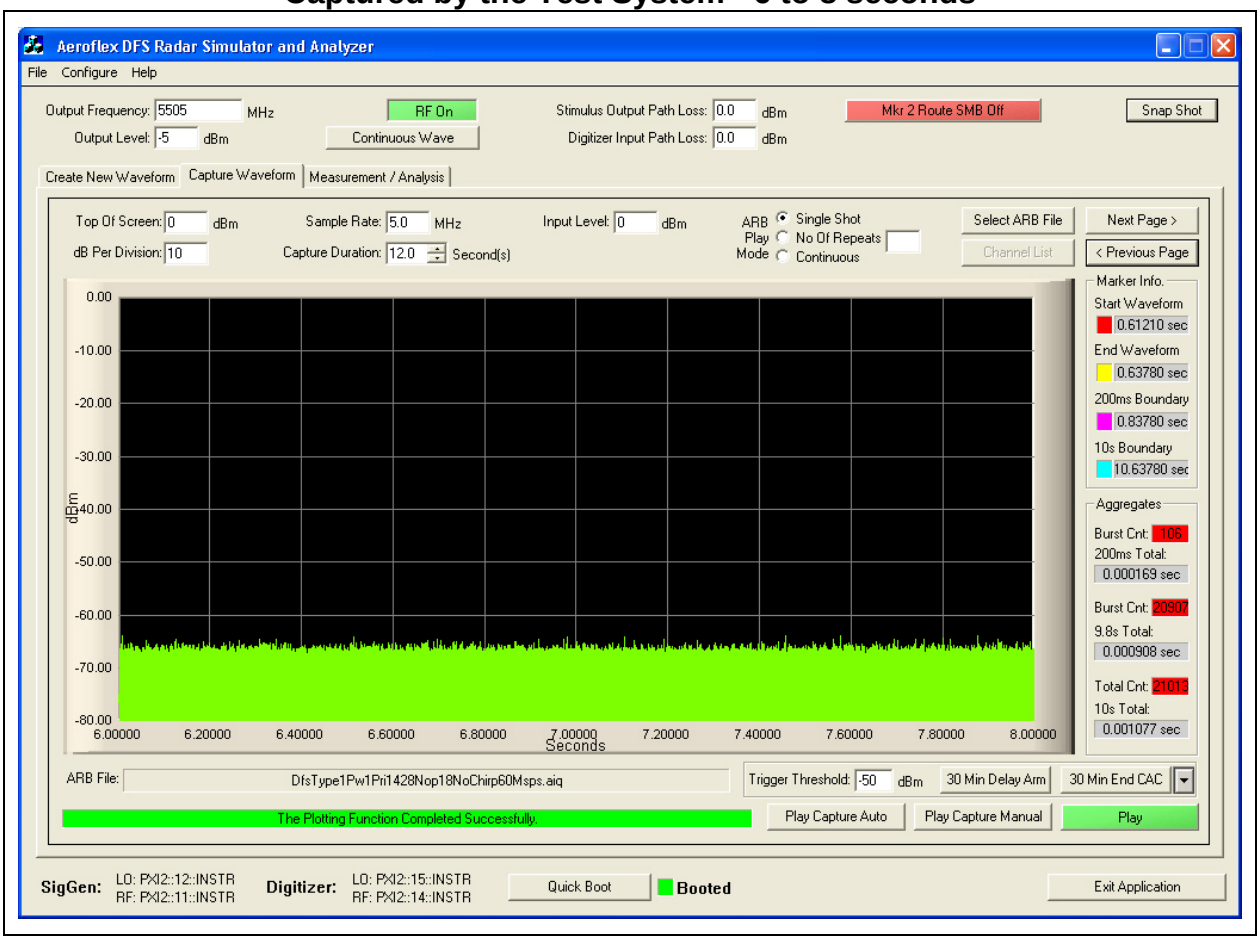
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 2 to 4 seconds



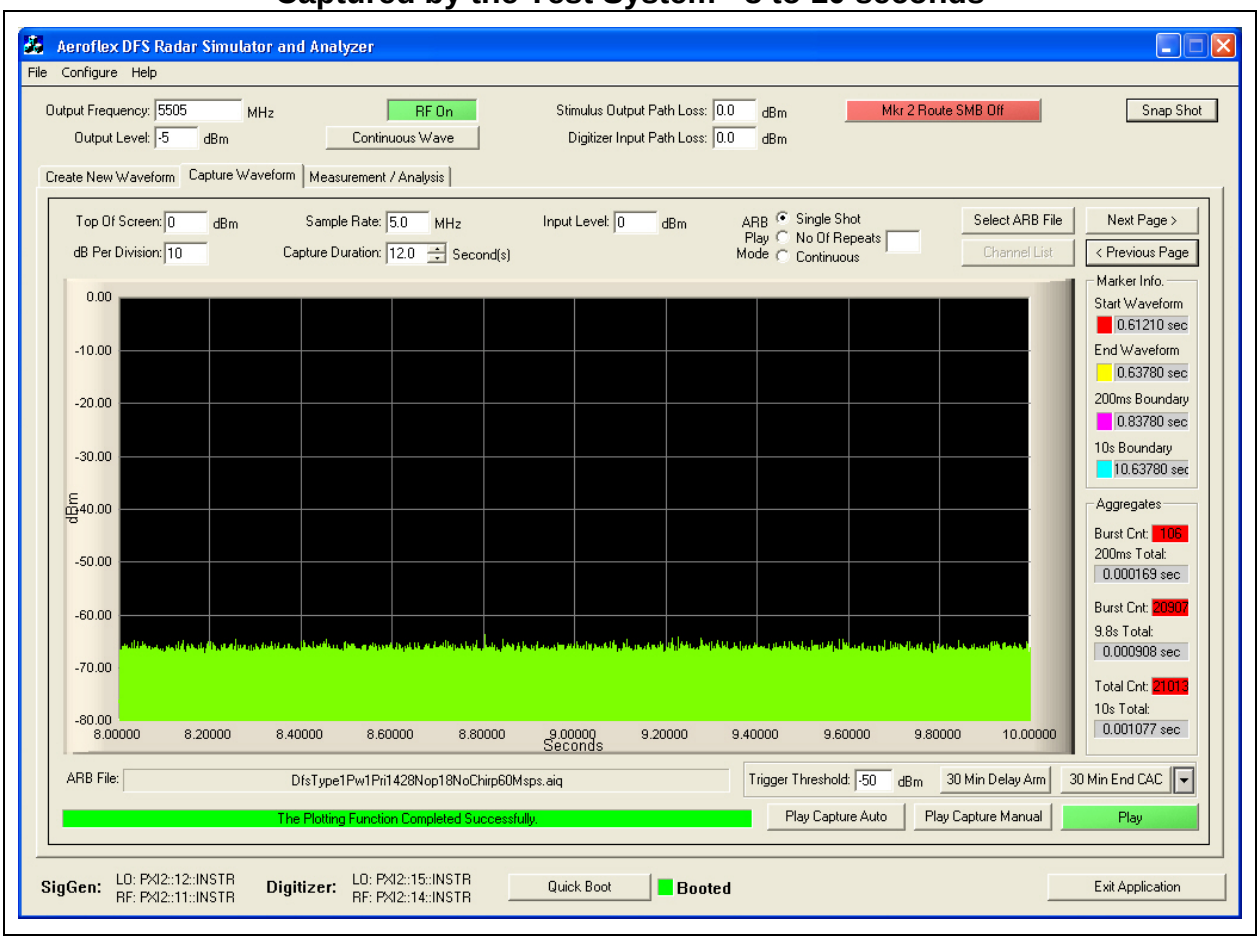
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 4 to 6 seconds



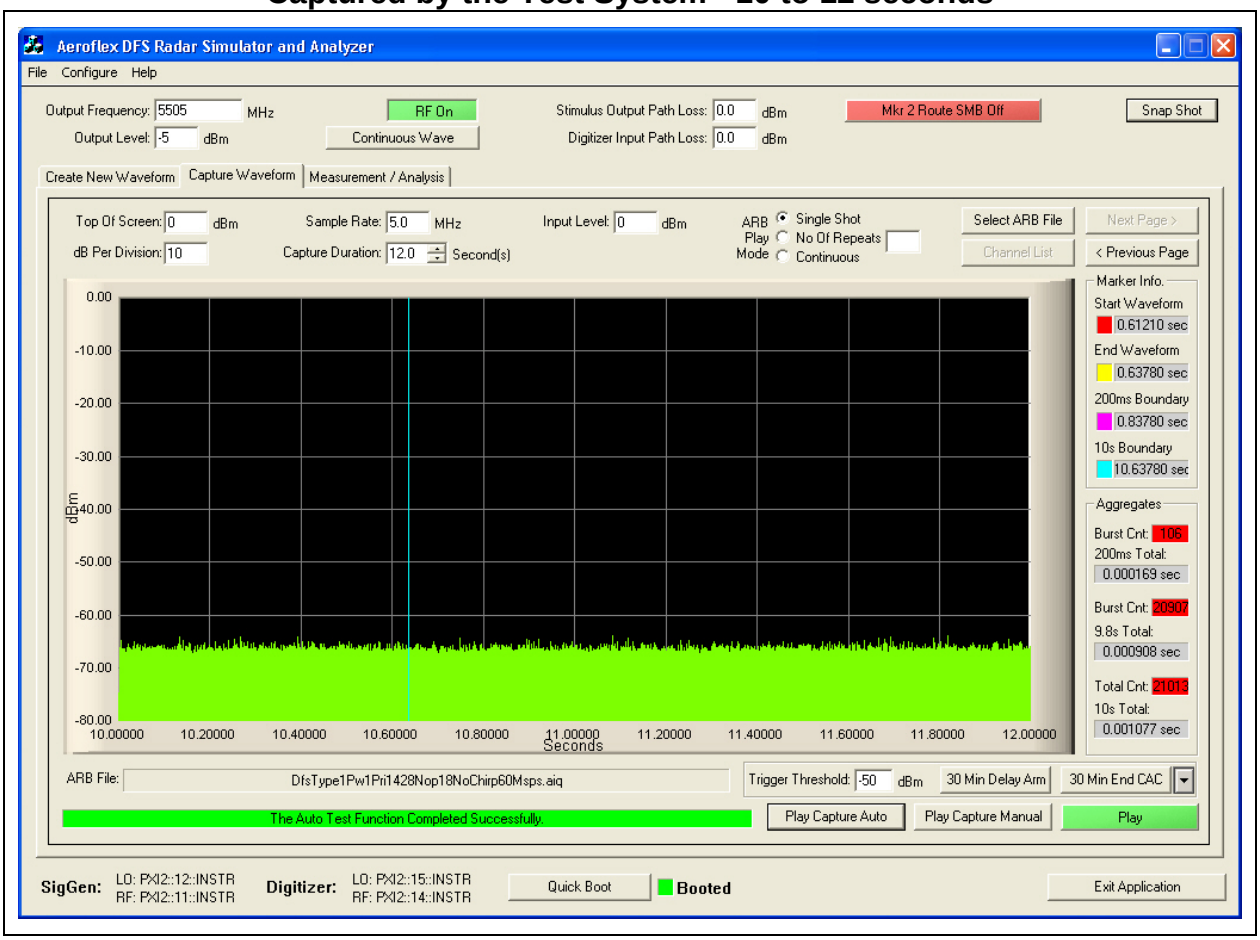
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 6 to 8 seconds



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



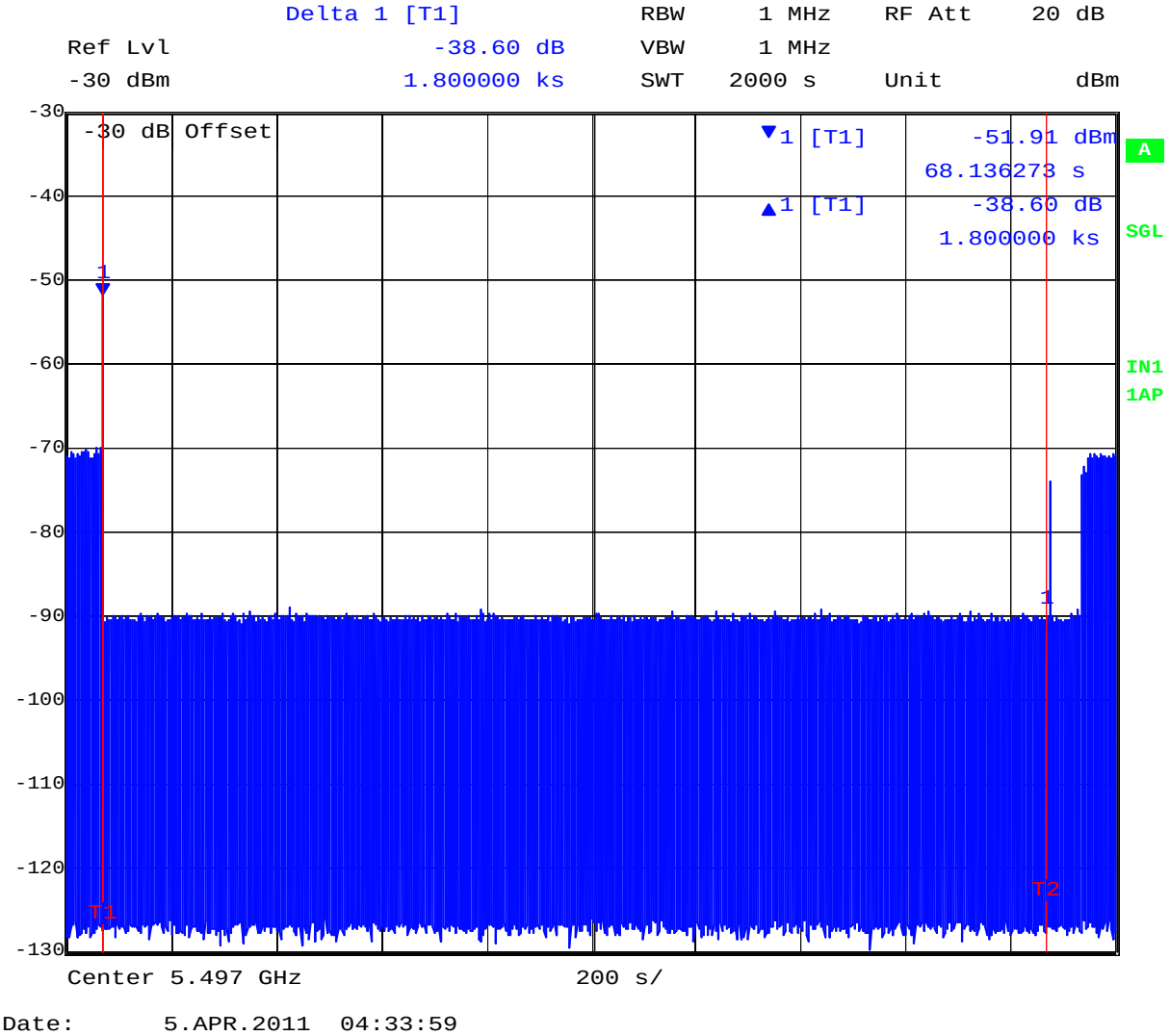
Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 10 to 12 seconds



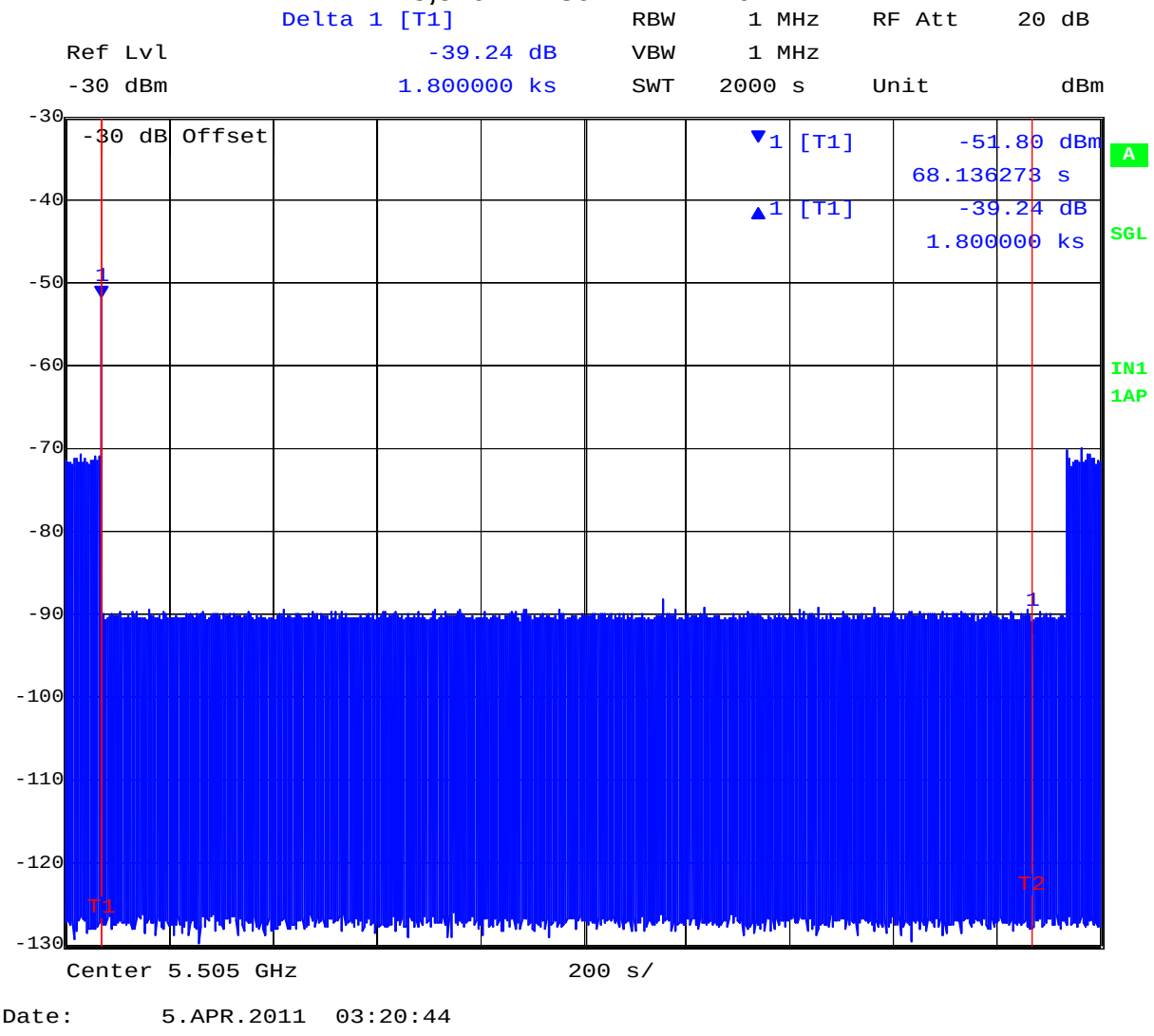
30 Minute Non-Occupancy Period

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

30 Minute Non-Occupancy Period Type 1 Radar
5,500MHz 802.11a



30 Minute Non-Occupancy Period Type 1 Radar
5,510 MHz802.11n HT40



5.1.9.15. 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 5,500MHz 802.11a and 5,510MHz 802.11n HT40.

Radar Types 1 through 6 was produced at 5,497 MHz (802.11a) and 5,505 MHz (802.11n HT40) at a level of -61 dBm (Ref Section 5.1). 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:

Total # of detections ÷ Total # of Trials × 100 = 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.

Verification of Detection 5,500MHz 802.11a

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	√	√	√	√	√	√
2	√	√	√	√	√	√
3	√	√	√	√	√	√
4	√	√	√	√	√	√
5	√	√	√	√	0	√
6	√	√	√	√	√	0
7	0	√	√	√	√	0
8	√	√	√	√	√	√
9	√	√	√	√	√	√
10	0	0	√	√	√	√
11	√	√	√	√	√	√
12	√	√	0	√	√	√
13	√	√	√	√	√	√
14	0	√	0	√	√	√
15	√	0	√	√	0	√
16	√	0	√	√	√	√
17	0	0	√	√	0	√
18	√	√	√	√	0	√
19	0	√	√	√	√	√
20	0	√	√	√	√	0
21	0	√	√	0	0	√
22	√	√	√	0	√	0
23	√	0	√	√	0	√
24	√	0	√	√	√	√
25	0	√	√	√	√	√
26	√	√	√	√	√	0
27	√	0	√	0	√	0
28	√	√	0	0	√	√
29	√	√	√	√	√	0
30	√	0	√	√	√	0
Detection Percentage	73.3% (>60%)	73.3% (>60%)	90% (>60%)	86.6% (>60%)	80% (>80%)	73.3% (>70%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$(P_d1 + P_d2 + P_d3 + P_d4) / 4 = (73.3\% + 73.3\% + 90\% + 86.6\%) / 4 = 80.8\ \%\ (> 80\%)$

Verification of Detection 5,510MHz 802.11n HT40

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	√	√	√
11	√	0	√	√	√	√
12	√	0	√	√	√	√
13	√	0	√	√	√	√
14	√	0	0	√	√	√
15	√	√	√	√	√	√
16	0	√	√	√	√	√
17	√	√	√	√	√	√
18	√	√	0	√	√	√
19	√	√	√	√	0	√
20	√	√	0	√	√	√
21	√	√	√	√	√	0
22	√	√	√	√	√	√
23	√	√	0	√	√	√
24	√	√	√	√	0	√
25	√	√	√	√	√	√
26	√	√	√	√	√	0
27	√	√	√	0	√	√
28	√	0	√	0	0	√
29	√	0	0	√	√	0
30	√	√	√	√	√	0
Detection Percentage	96.6% (>60%)	70% (>60%)	80% (>60%)	93.3% (>60%)	83.3% (>80%)	86.6% (>70%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$(P_d1 + P_d2 + P_d3 + P_d4) / 4 = (96.6\% + 70\% + 80\% + 93.3\%) / 4 = 84.975\ \%\ (> 80\%)$

Measurement Uncertainty Time/Power

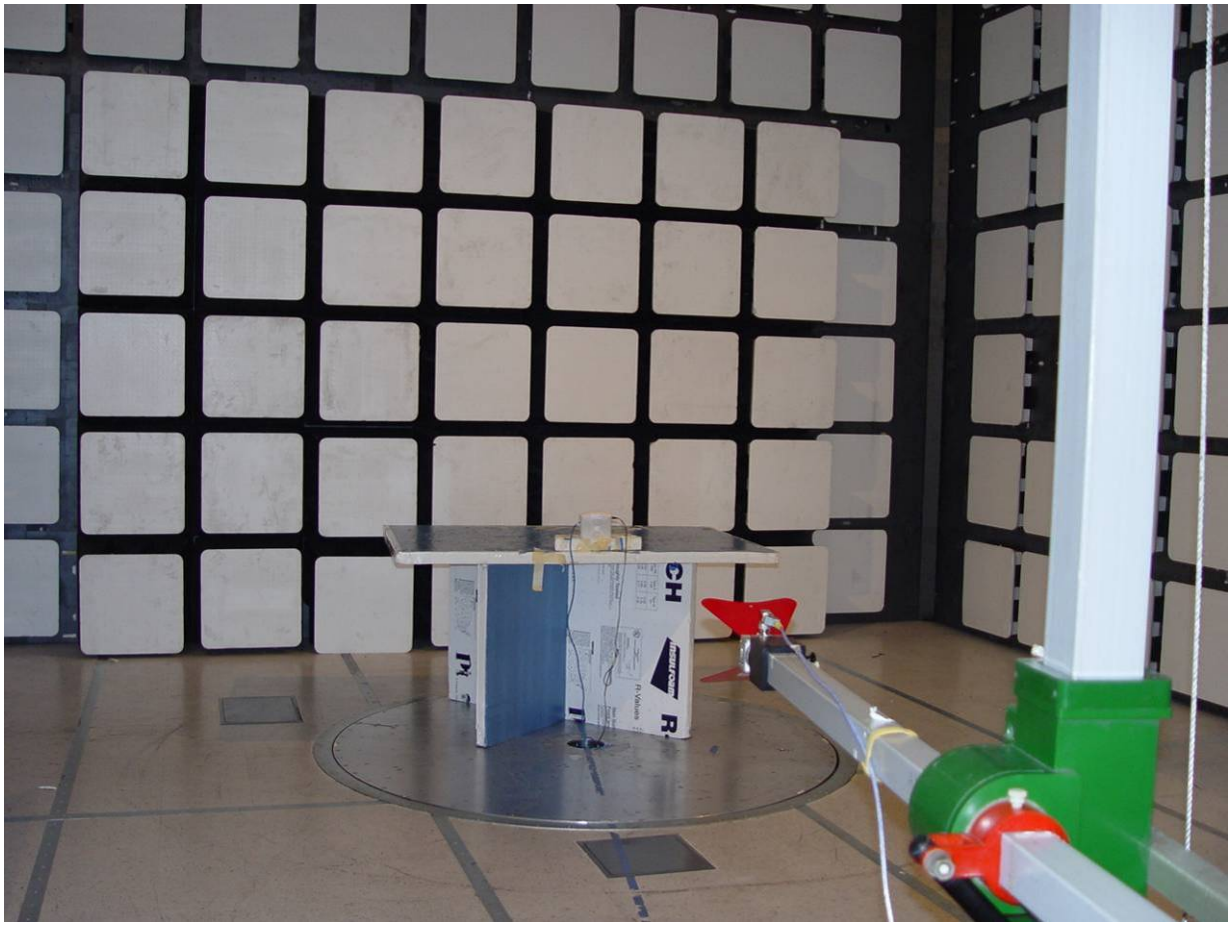
Measurement uncertainty	
- Time	4%
- Power	1.33dB

Traceability

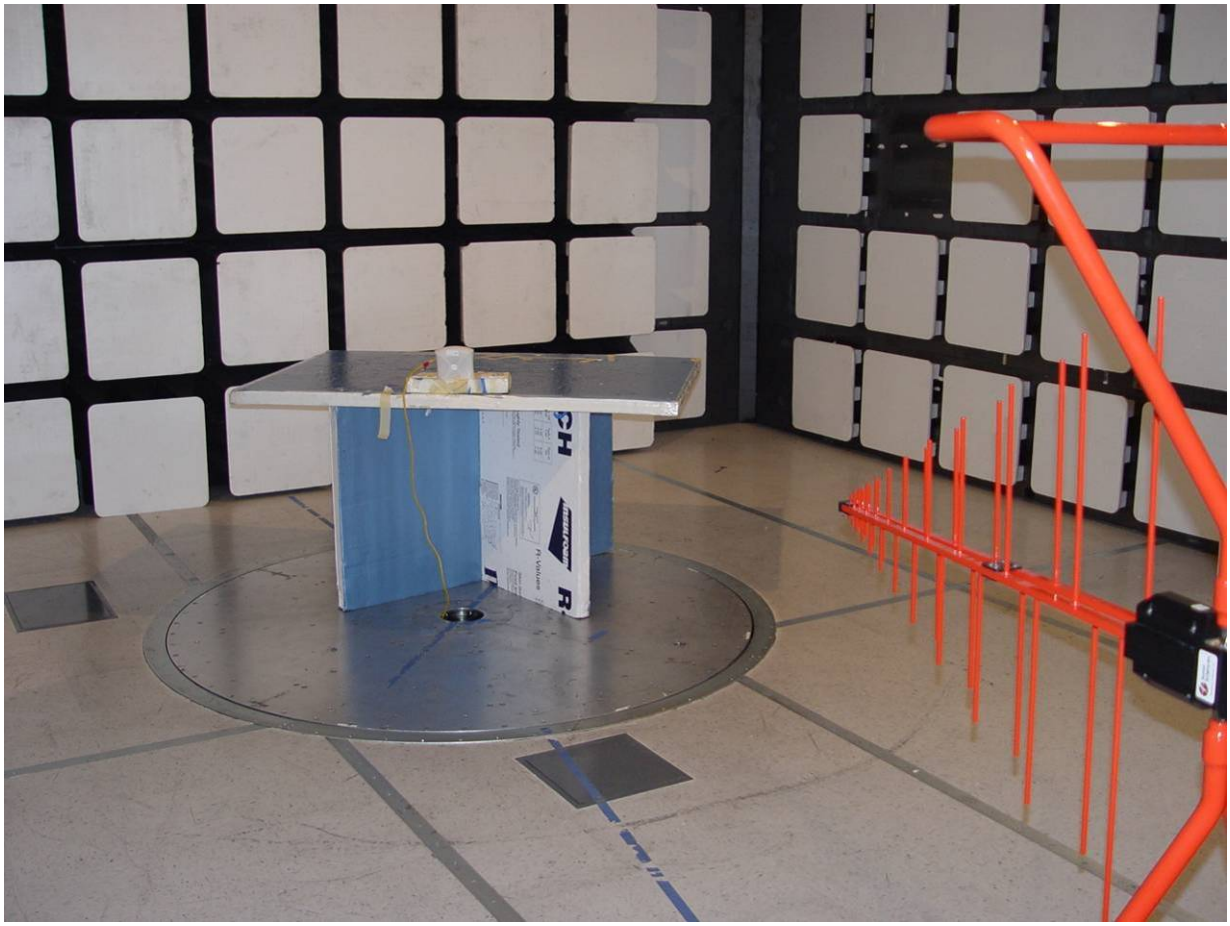
Test Equipment Used
0072, 0083, 0098, 0116, 0132, 0158, 0313, 0314, 0193, 0223, 0252, 0253, 0251, 0256, 0328, 0329

6. PHOTOGRAPHS

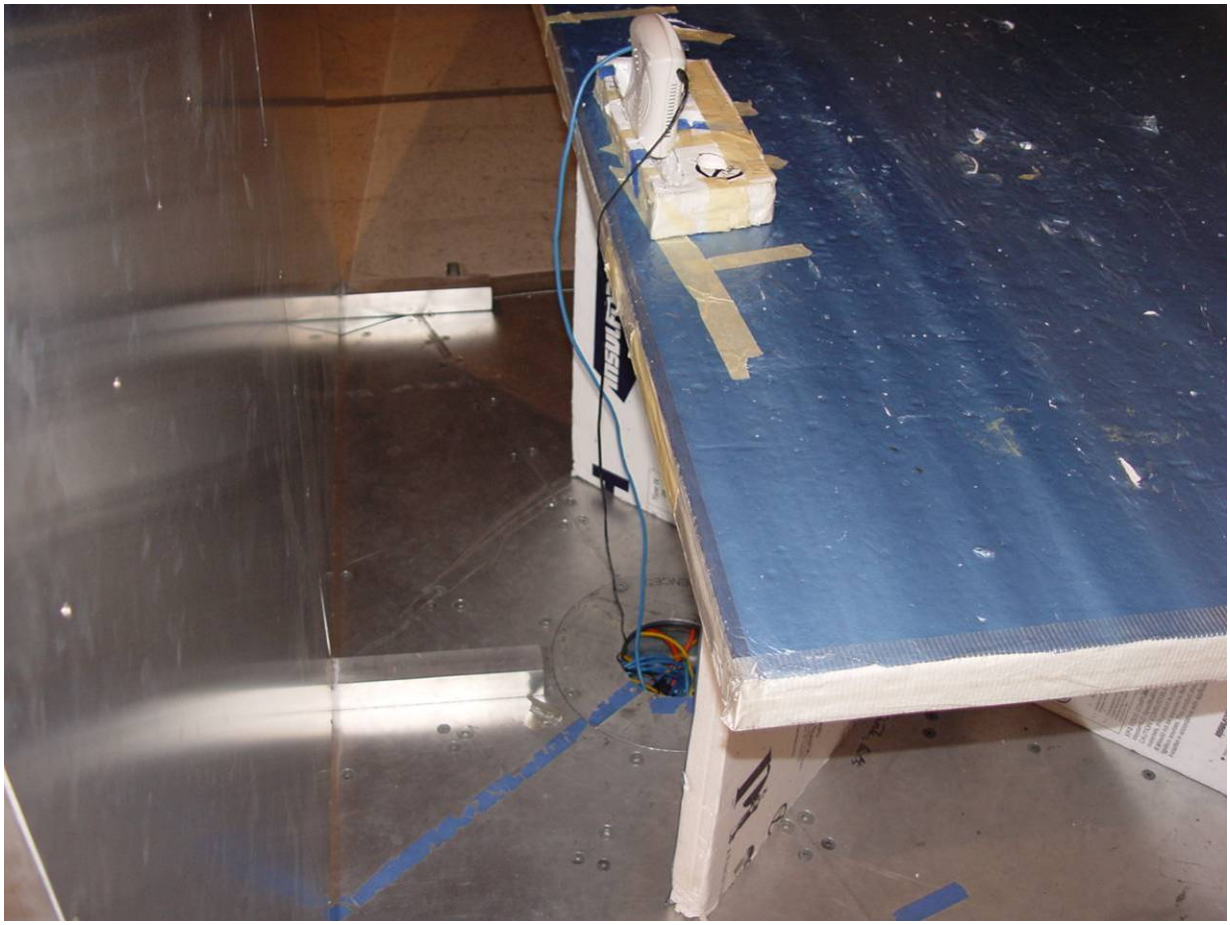
6.1. Radiated Emissions > 1GHz



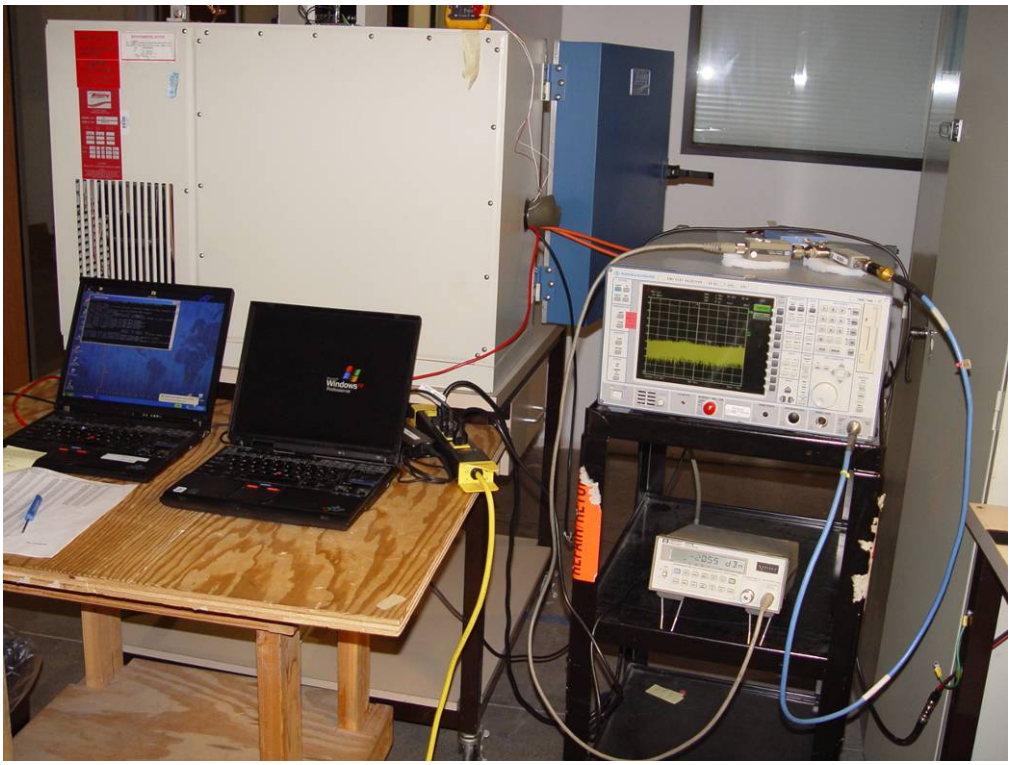
6.2. Radiated Emissions < 1GHz



6.3. AC Wireline Conducted Emissions



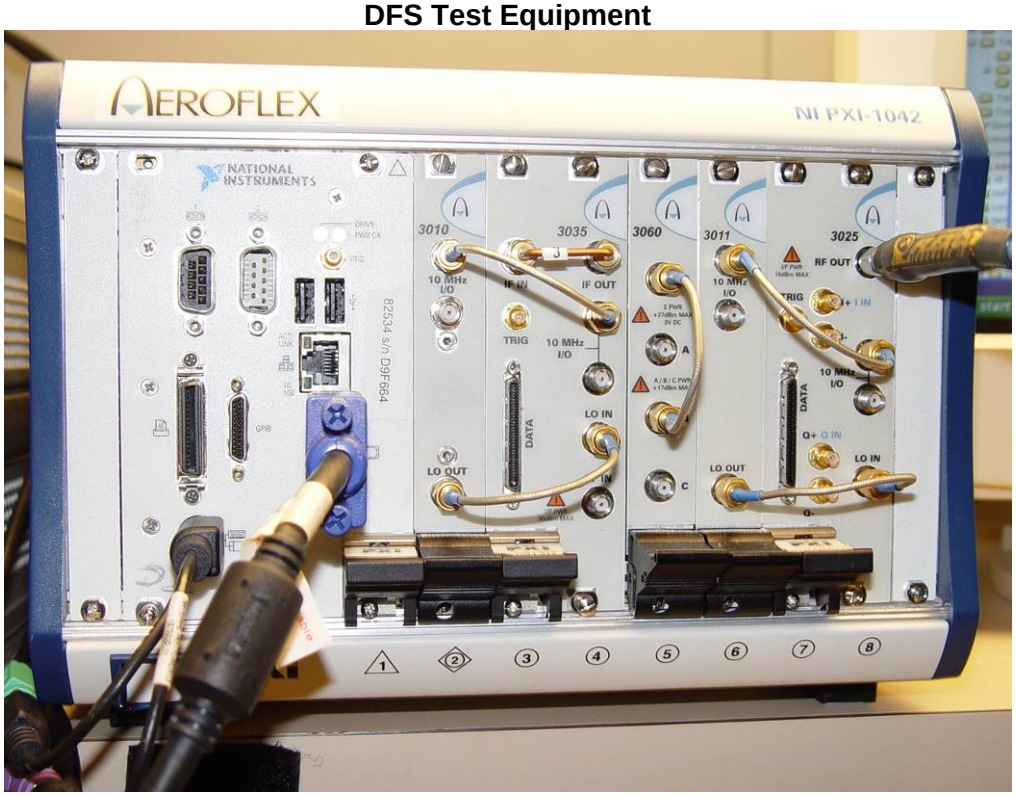
6.4. Conducted RF Measurement Test Set-Up



6.5. Dynamic Frequency Selection Test Set-Up

General DFS Test Setup

DFS Test Equipment



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
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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