6. Dynamic Frequency Selection (DFS)

Test Procedure and Setup

6.1. Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna	

6.1.1. 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.

6.2. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per *Burst*	Number of *Bursts*	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

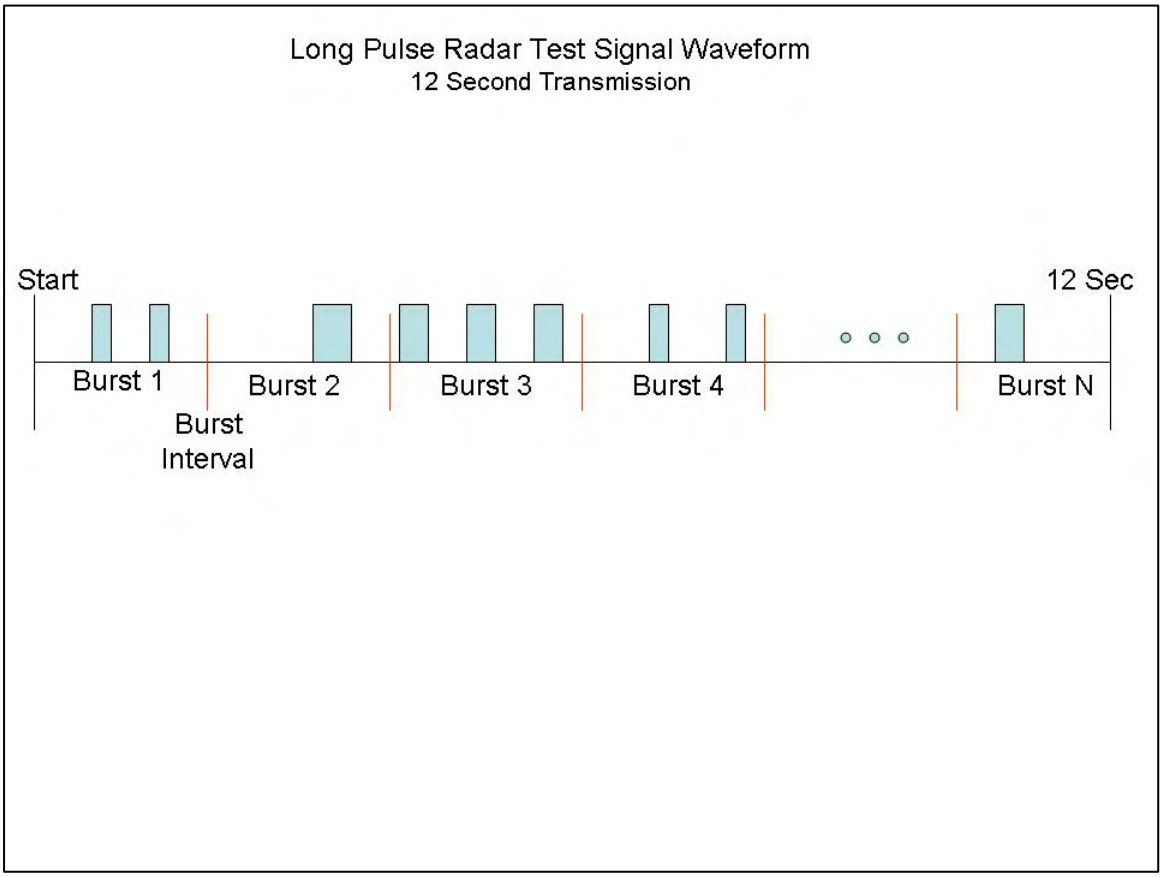
Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst_Count*.
3) Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *Burst* will have the same chirp width. Pulses in different *Bursts* may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5600 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst_Count*. Each interval is of length (12,000,000 / *Burst_Count*) microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and [(12,000,000 / *Burst_Count*) – (Total *Burst* Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 *Bursts* are randomly generated for the *Burst_Count*.
3) *Burst* 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) *Bursts* 2 through 8 are generated using steps 3 – 5.
7) Each *Burst* is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, *Burst* 1 is randomly generated (1 to 1,500,000 minus the total *Burst* 1 length + 1 random PRI interval) at the 325,001 microsecond step. *Bursts* 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. *Burst* 2 falls in the 1,500,001 – 3,000,000 microsecond range).

Graphical representation of the Long Pulse radar Test Waveform.



6.3. Frequency Hopping Radar Test Waveform

Frequency Hopping Radar Test Waveform

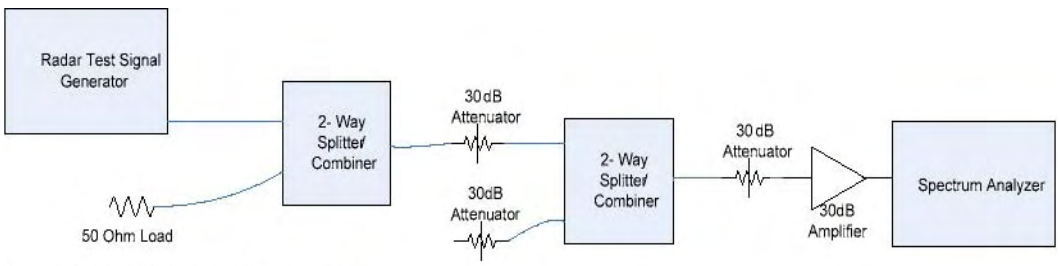
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	.333	300	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

6.4. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz.
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -46dBm (Ref Section 6.6). The 30dB amplifier gain was entered as an amplitude offset on the spectrum analyzer.

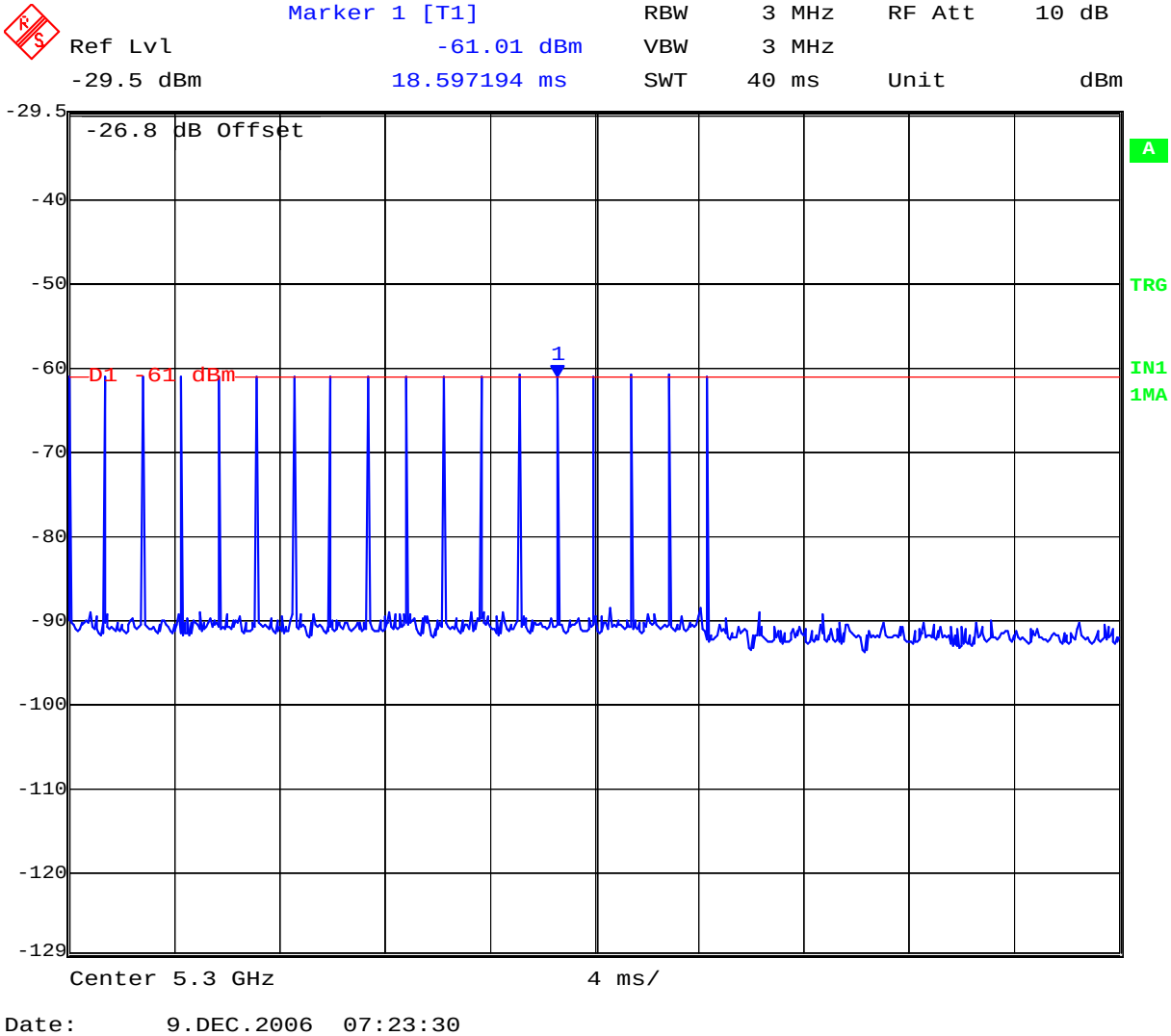


Conducted Calibration Setup

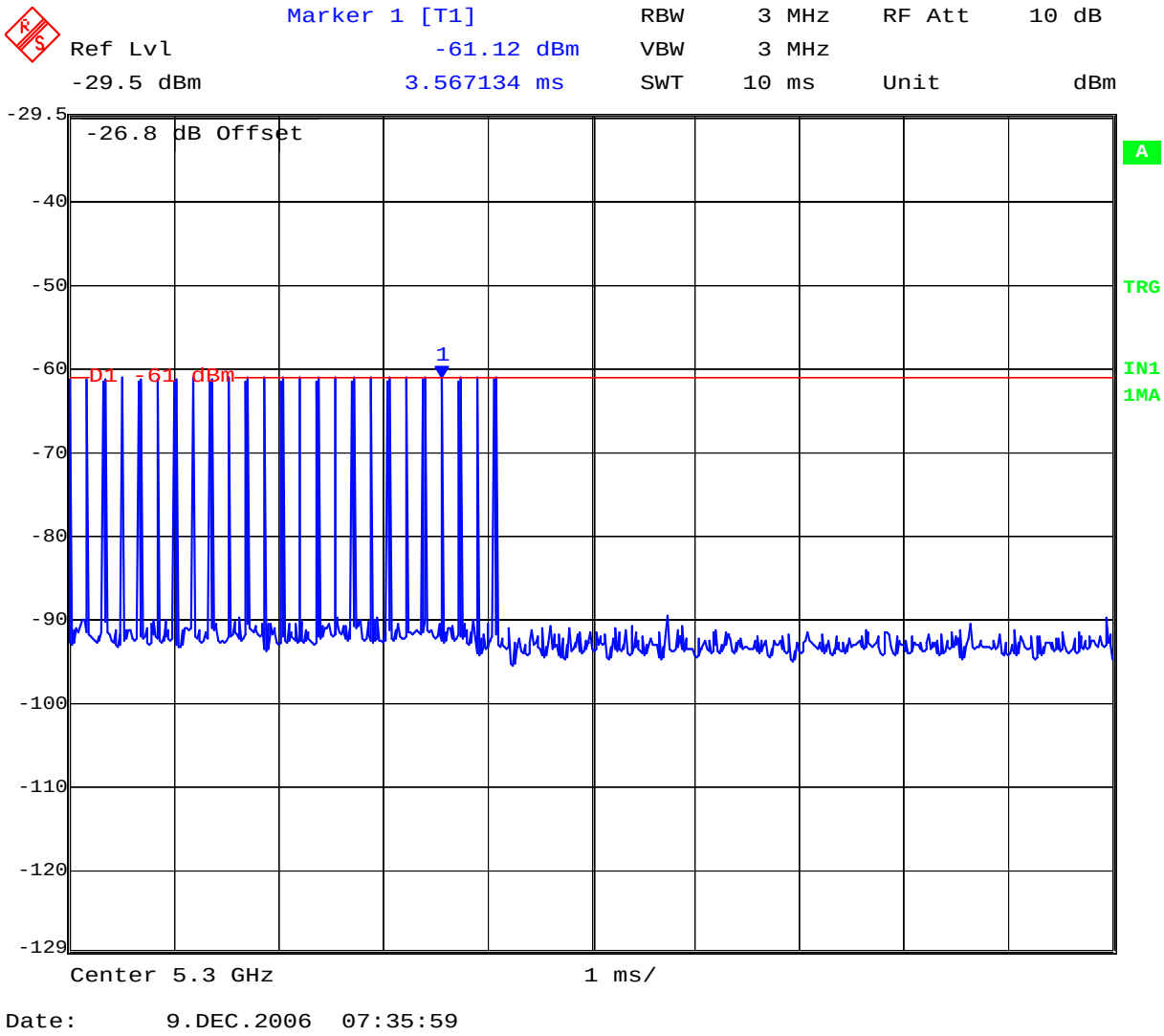
6.5. Radar Waveform Calibration Plots

The following are the calibration plots for required radar waveforms

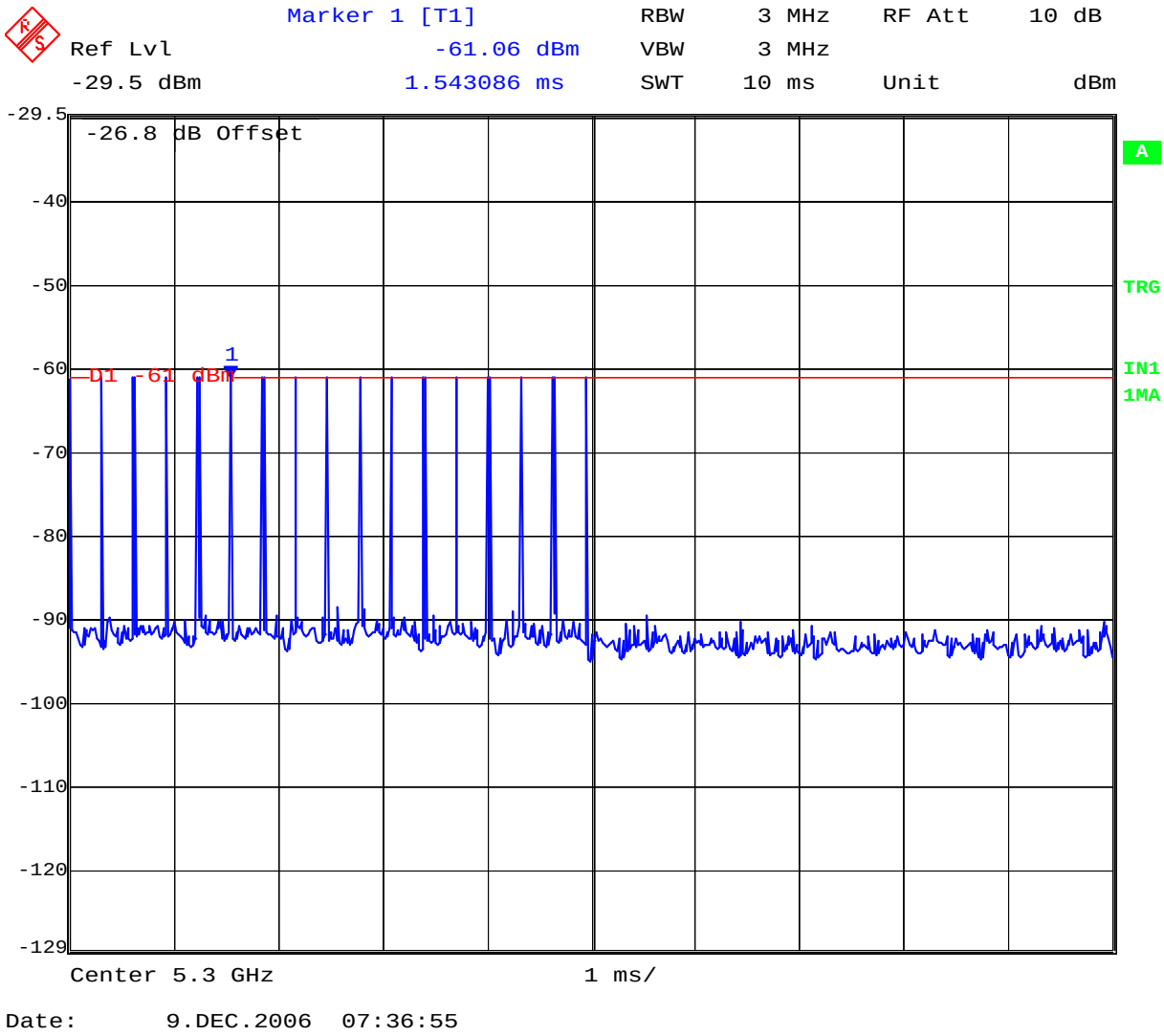
Radar Type 1 - 1uSec Pulse, 700prf, 18 pulses



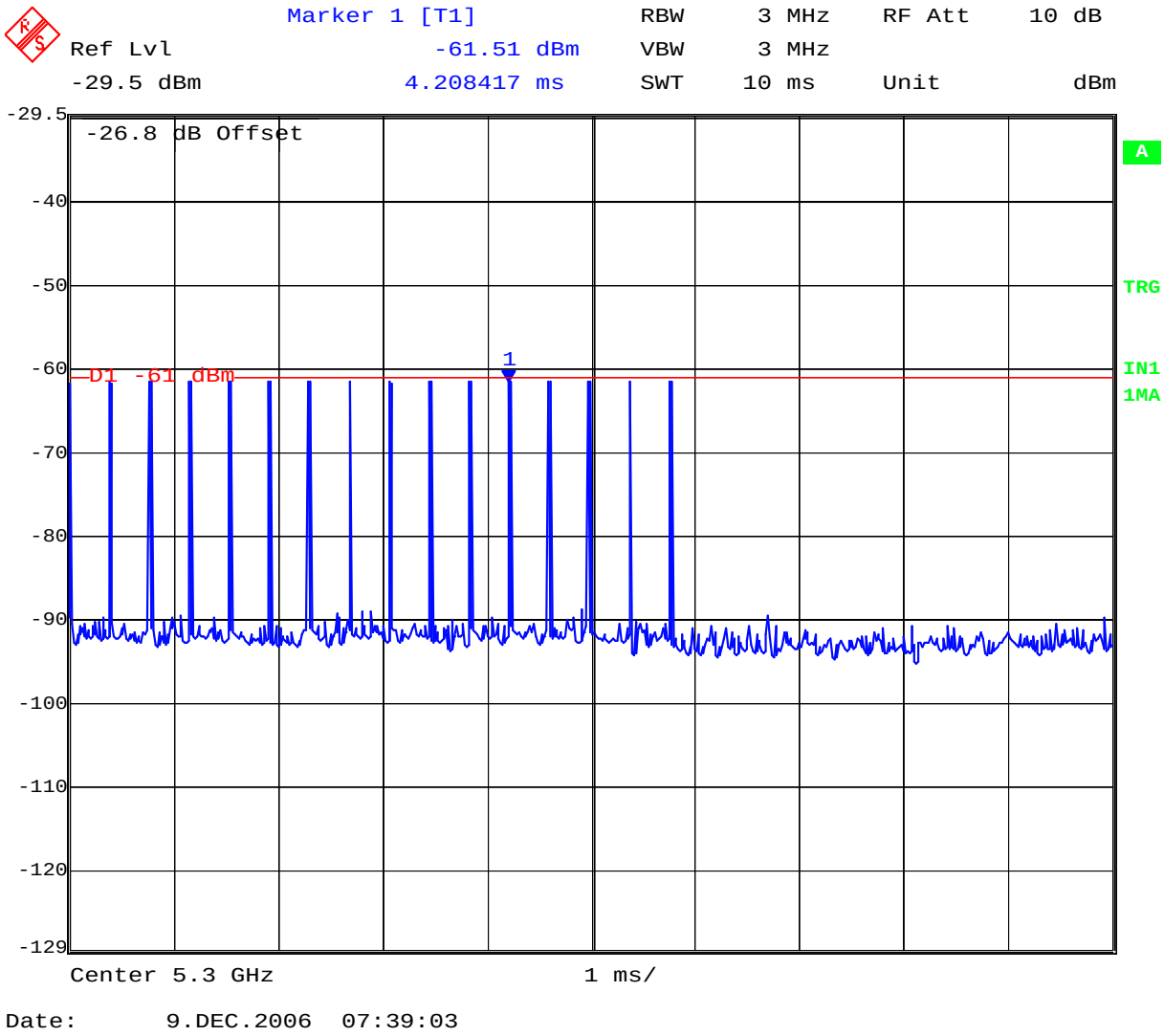
Radar Type 2 - 2.1uSec Pulse Width, 170prf, 25 pulses



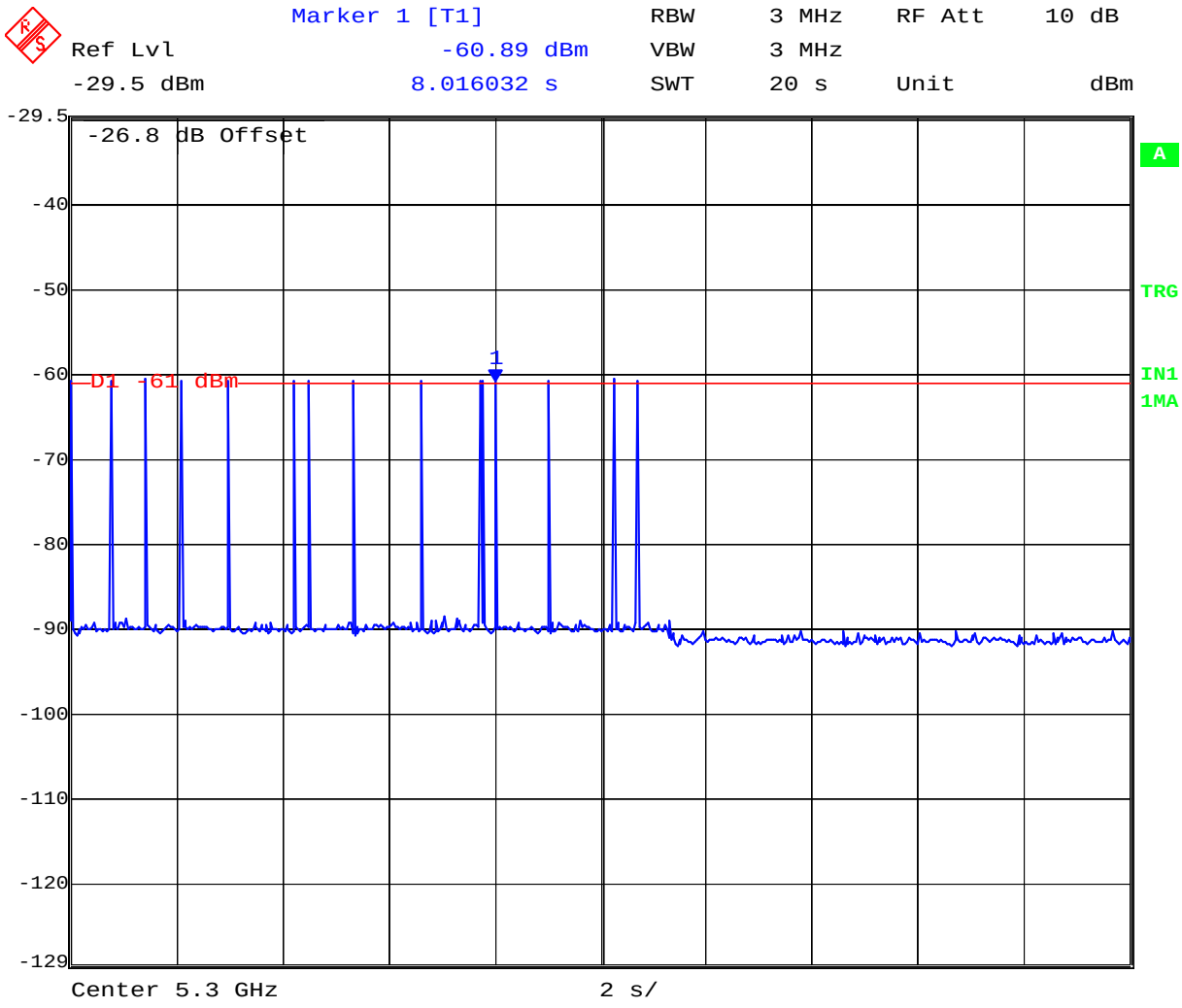
Radar Type 3 - 7.5uSec Pulse Width, 309prf, 17 pulses



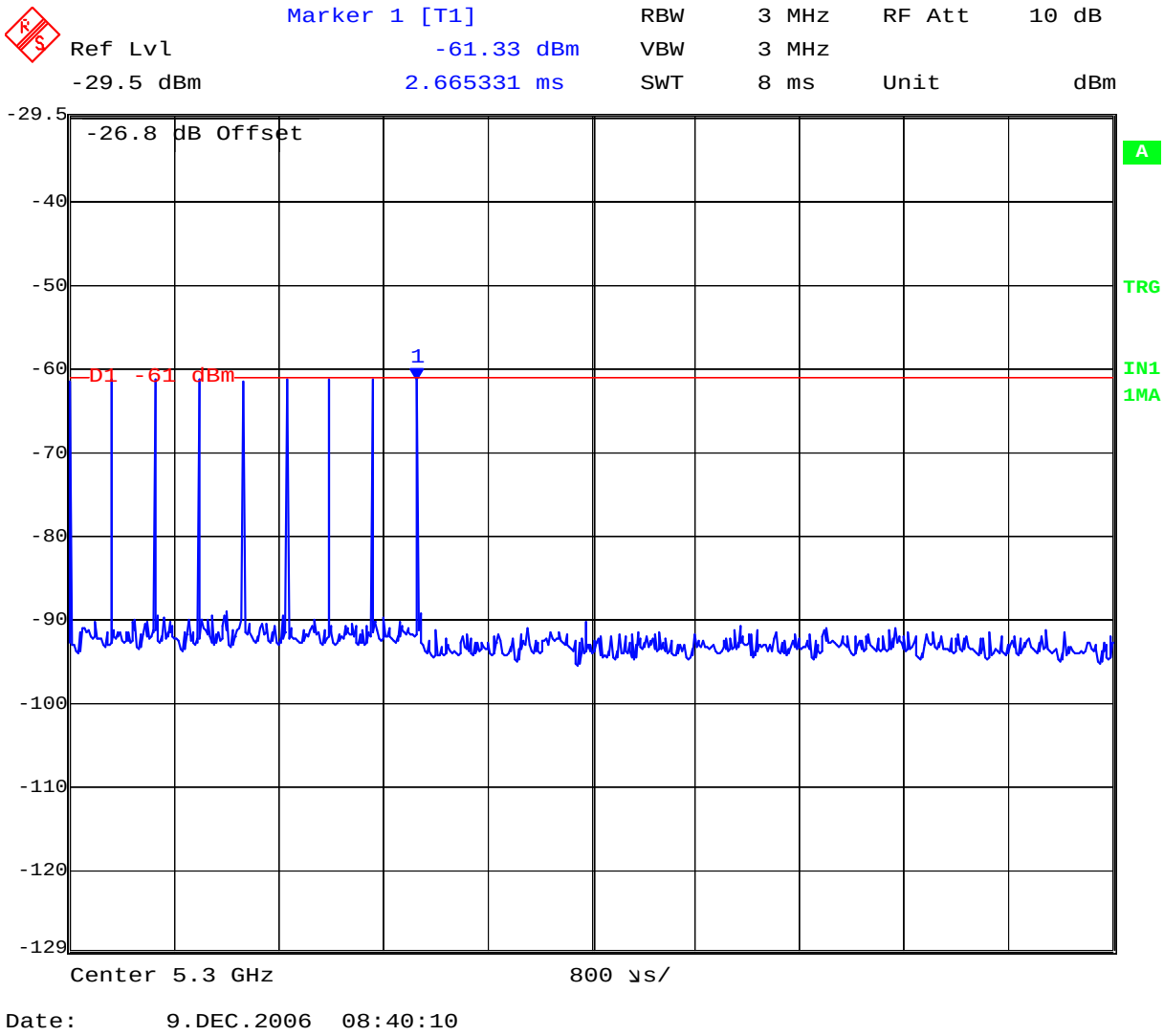
Radar Type 4 - 17.9uSec Pulse Width, 383prf, 16 pulses



Radar Type 5



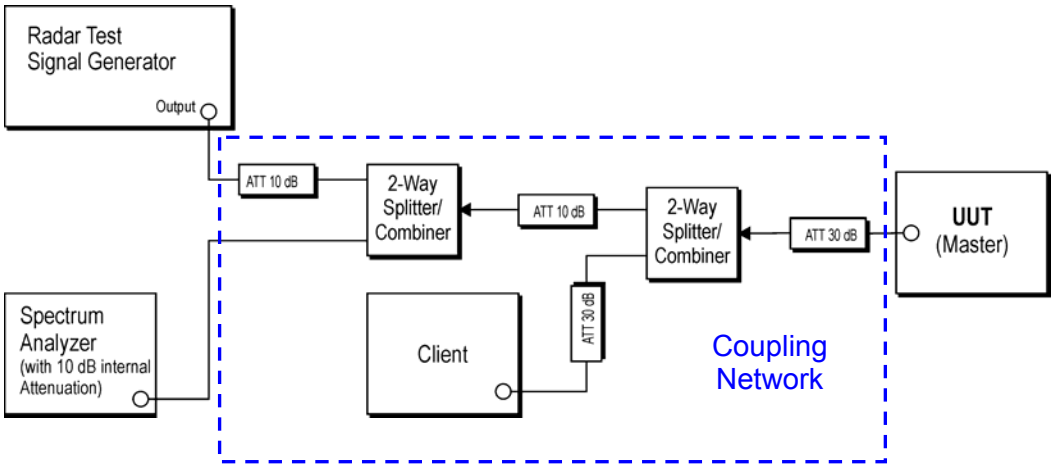
Radar Type 6



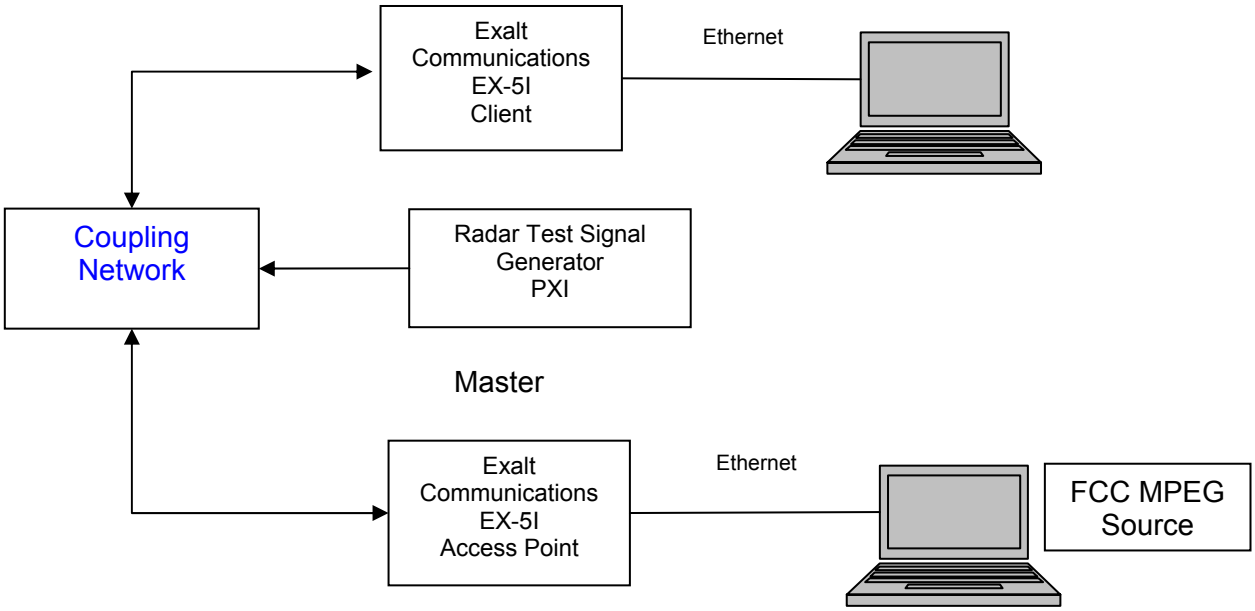
6.6. Test Set Up:

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



DFS Test Configurations

The 99% Bandwidth was measured for all radio configuration (three modulations and four different bandwidths) with the radio set at the channel frequency closest to 5,600 MHz to determine the narrowest bandwidth measurement for which the DFS detection bandwidth should be measured at.

The narrowest bandwidth measurements were selected according to the following table. The bandwidth measurements are held on file.

X – Configuration selected for DFS detection bandwidth measurement.

	8 MHz	16 MHz	32 MHz	64 MHz
QPSK	X		X	X
16QAM		X		
64QAM				

For the frequency bands 5,250 – 5,350 MHz, and 5,470-5,725 MHz the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

Exalt Communications declared a minimum gain antenna of 16 dBi. ;

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

= -62 + 15 + 1

Radar receive signal level = -46 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

6.7. DFS Test Results 8 MHz QPSK

6.7.1. UNII Detection Bandwidth: (8 MHz QPSK)

All UNII channels for this device have identical channel bandwidths and DFS testing was completed in the 5250 - 5350 MHz, & 5470 - 5725 MHz.

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 at a level of -46dBm (Ref Section 6.6). 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:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

EUT Frequency=5500MHz (8 MHz QPSK)											
Radar Frequency (MHz)	**DFS Detection Trials (1=Detection, Blank= No Detection)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Detection Rate (%)**
											0%
5496	0	0	0	0	0	0	0	0	0	0	0%
5497(F_L)	1	1	1	1	1	1	1	1	1	1	100%
5498	1	1	1	1	1	1	1	1	1	1	100%
5499	1	1	1	1	1	1	1	1	1	1	100%
5500	1	1	1	1	1	1	1	1	1	1	100%
5501	1	1	1	1	1	1	1	1	1	1	100%
5502	1	1	1	1	1	1	1	1	1	1	100%
5503	1	1	1	1	1	1	1	1	1	1	100%
5504 (F_H)	1	1	1	1	1	1	1	1	1	1	100%
5505	0	0	0	0	0	0	0	0	0	0	0%
Detection Bandwidth = F_H-F_L = 5504 MHz - 5497 MHz = 7 MHz											
EUT 99% Bandwidth = 8.266 MHz											
8.266 MHz *80% = 6.613 MHz											

For each frequency step the minimum percentage detection is 90%

6.7.2. Initial Channel Availability Check Time (8 MHz QPSK)

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.

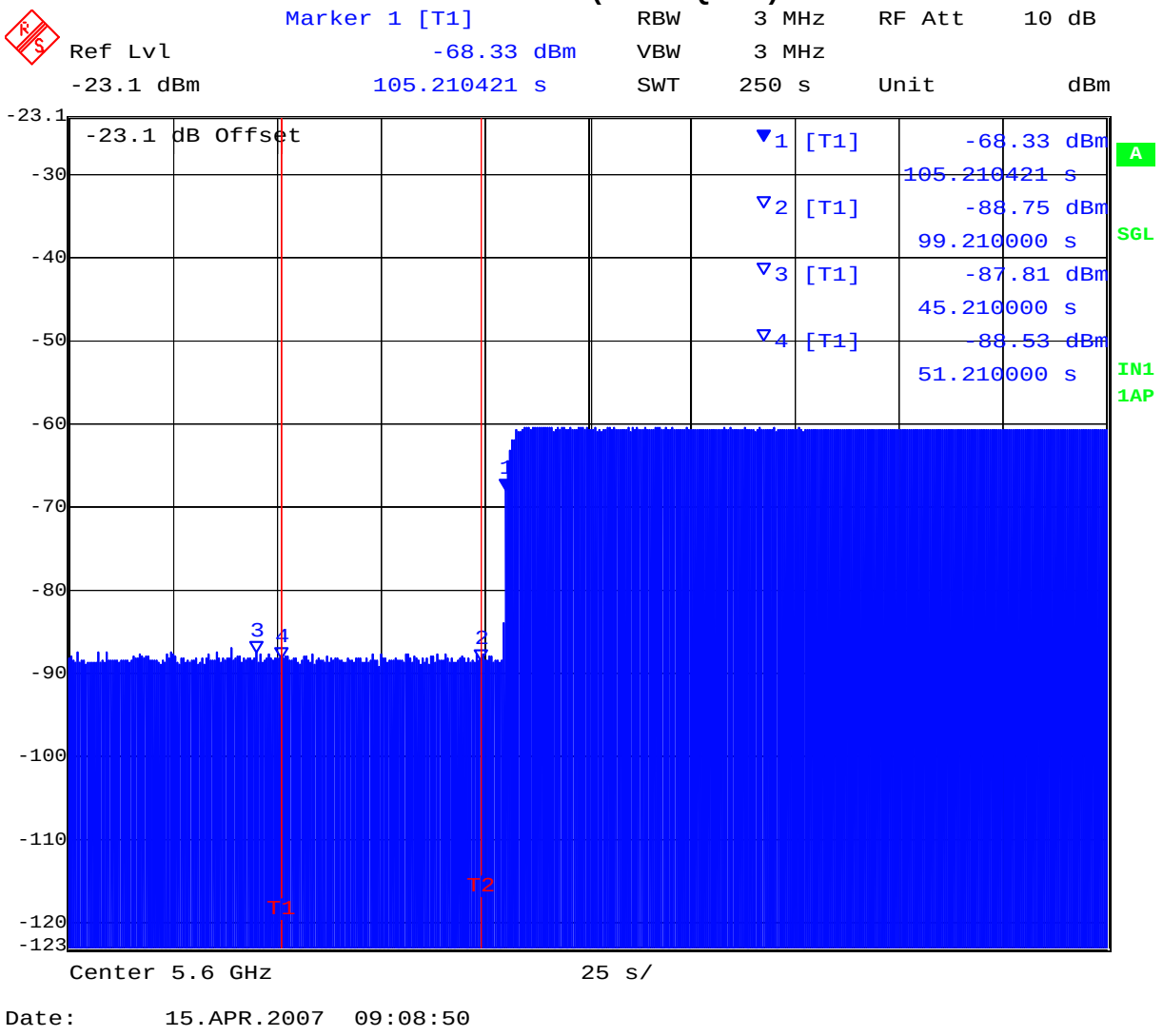
The U-NII device is powered on and be instructed to operate at 5600 MHz. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 3 MHz resolution bandwidth at 5600 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to 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 EUT is powered on at T0. Marker ▼3 denotes the instant when the EUT has completed its power-up sequence and the start of the Channel Availability Check Time that ends after a duration of ▼3 + 60 seconds i.e ▼1 on the following plot.

The Master device requires 45.21 seconds to complete its power-on cycle.

Initial Channel Availability Check Time during power up of EUT
Ch 5600 MHz (8 MHz QPSK)



6.7.3. Radar Burst at the Beginning of the Channel Availability Check Time (8 MHz QPSK)

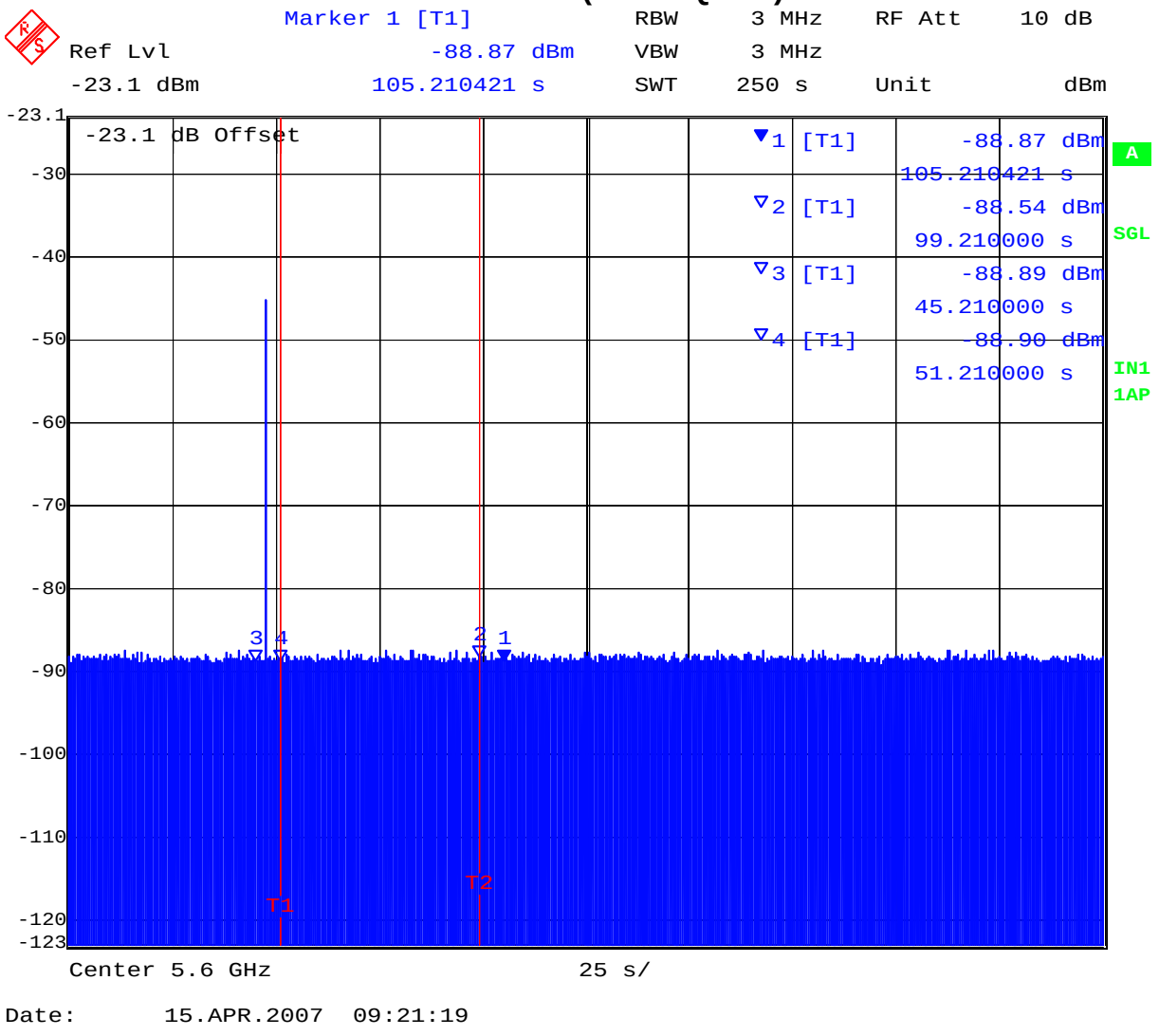
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-46 dBm Ref Section 6.6) occurs at the beginning of the Channel Availability Check Time.

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at ▼3.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions have occurred at 5600MHz.

Channel Availability Check Time at the start of the 60 second Check Time
Ch 5600 MHz (8 MHz QPSK)



6.7.4. Radar Burst at the End of the Channel Availability Check Time: (8 MHz QPSK)

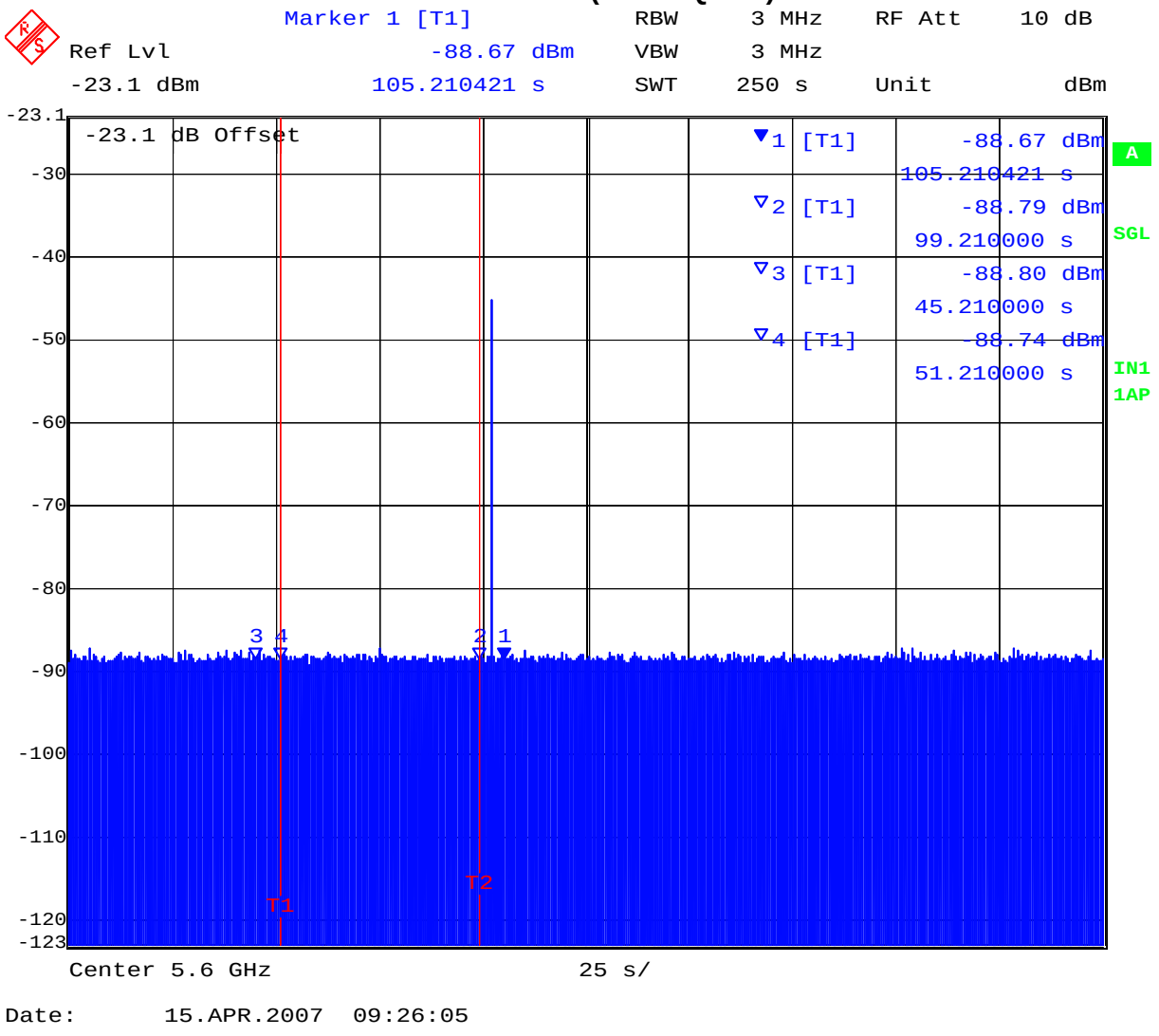
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel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

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single burst of radar type 1 will commence within a 6 second window starting at marker ▼3+ 54 seconds.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions occurred at 5600MHz.

Channel Availability Check Time at the end of the 60 second Check Time
Ch 5600 MHz (8 MHz QPSK)



6.7.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (8 MHz QPSK)

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 captured, collecting nearly 250M samples of data, which included 60ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The Aeroflex PXI was setup to capture data for all transmission events above a threshold level of -46dBm. The PXI time stamps all captured events with respect to T_0 (zero time indicating the start of the measurements sequence) starting the 60 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 60ms

Type 1 burst period 24.277ms

(The period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

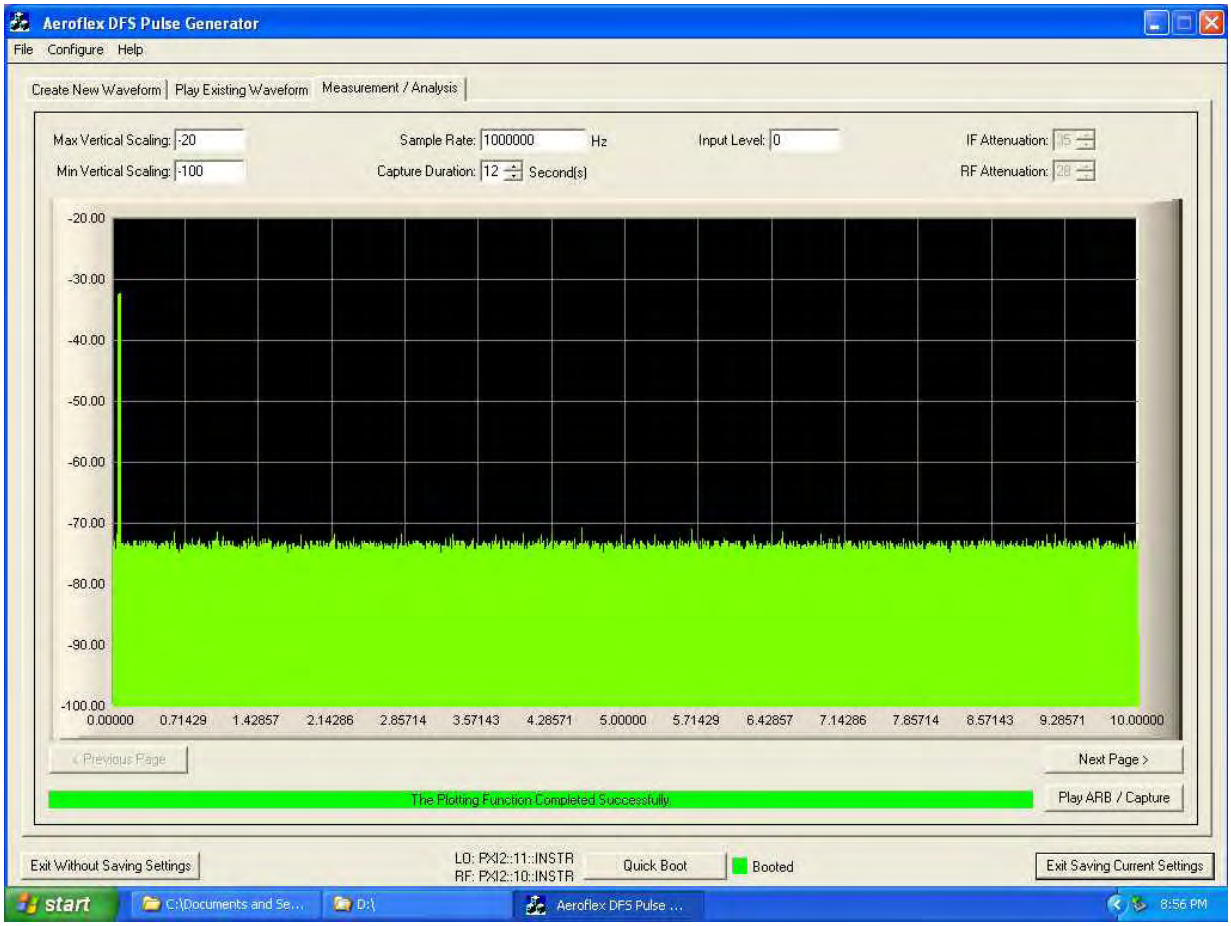
Channel Closing Transmission Time starts at 84.277ms after T_0.

Therefore, pulses seen after this 84.277ms 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 µs of transmission time accrued.

Channel Closing Transmission Time = 0Secs (limit 260 mSecs)

The EUT stopped transmitting data prior to the end of the Type 1 Radar burst, i.e. before the 84.277ms event marker in the measurement sequence, therefore by definition the Channel Closing Time is 0 Seconds.

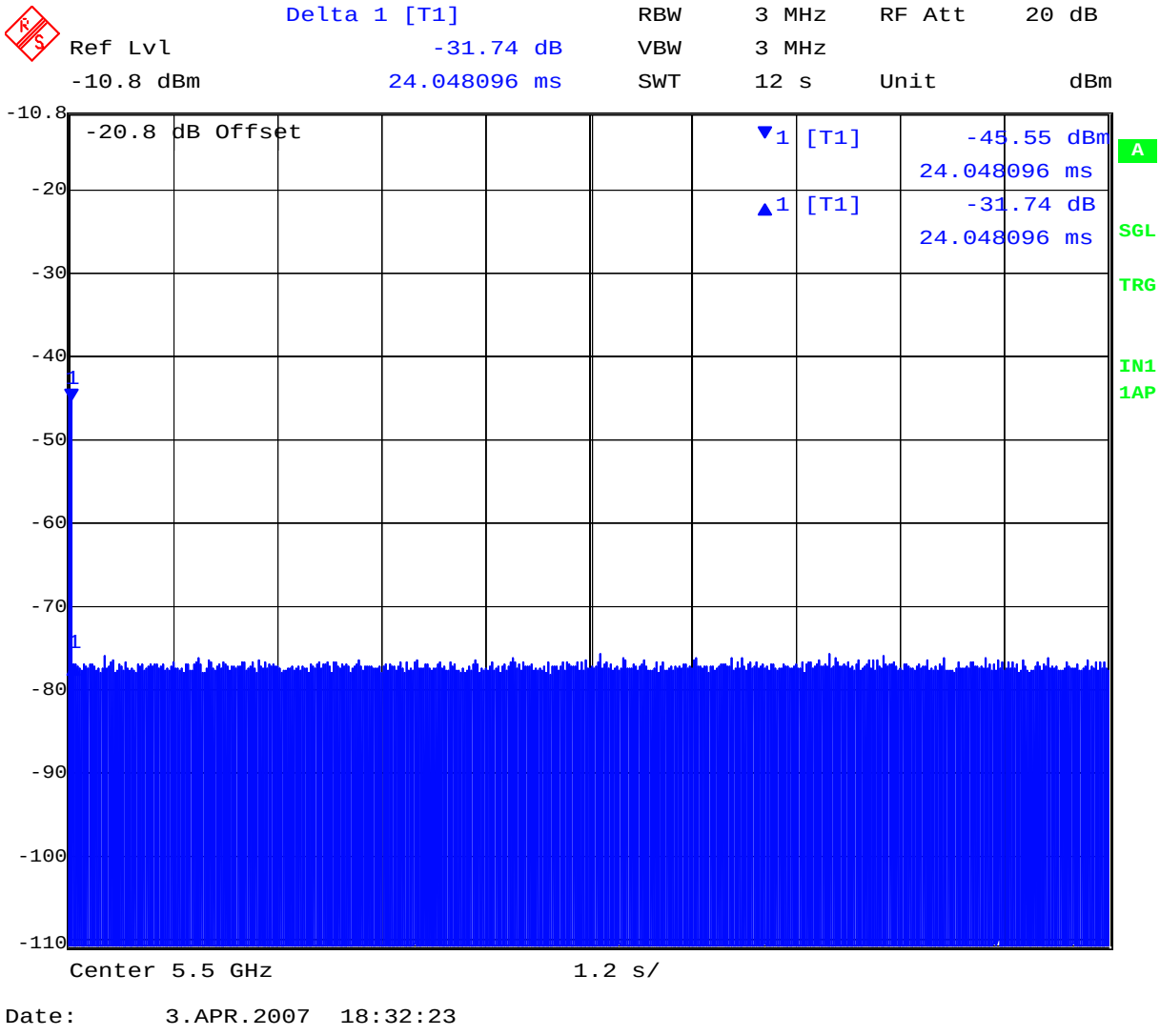
Channel Move Time, Channel Closing Time for Type 1 Radar(8 MHz QPSK) Captured by Aeroflex PXI Test System



Additionally, a redundant conventional spectrum analyzer screen capture is provided to correlate against the digitizer screen capture for verification purposes.

Note;- no pre-trigger data interval (60 mSecs) was included in the following Spectrum Analyzer plot

Channel Move Time, Channel Closing Time for Type 1 Radar(8 MHz QPSK) Captured by Spectrum Analyzer



The following data is the last set of transmission activity data captured by the Aeroflex PXI test System and is used to calculate the Channel Closing Transmission Time for the EUT (8 MHz QPSK) with the intervention of Radar Type 1.

Sample Number: 83699	Rising Edge, Sample Time Stamp	0.083699
Sample Number: 83713	Falling Edge, Sample Time Stamp	0.083713*

* Represents the last transmission activity of the EUT. The 0.083713*second time stamp is used to calculate Channel Move Time.

Channel Move Time (8 MHz QPSK)– Measurement & Calculation Type 1 Radar

The Channel Move Time is calculated using the data captured for the Channel Closing time as follows;-

Channel Move Time = Ft – Pt - Rt

Where;-

Ft = Final transmission activity occurred at 83.713 mSeconds

Pt = Pre-trigger information 60 mS

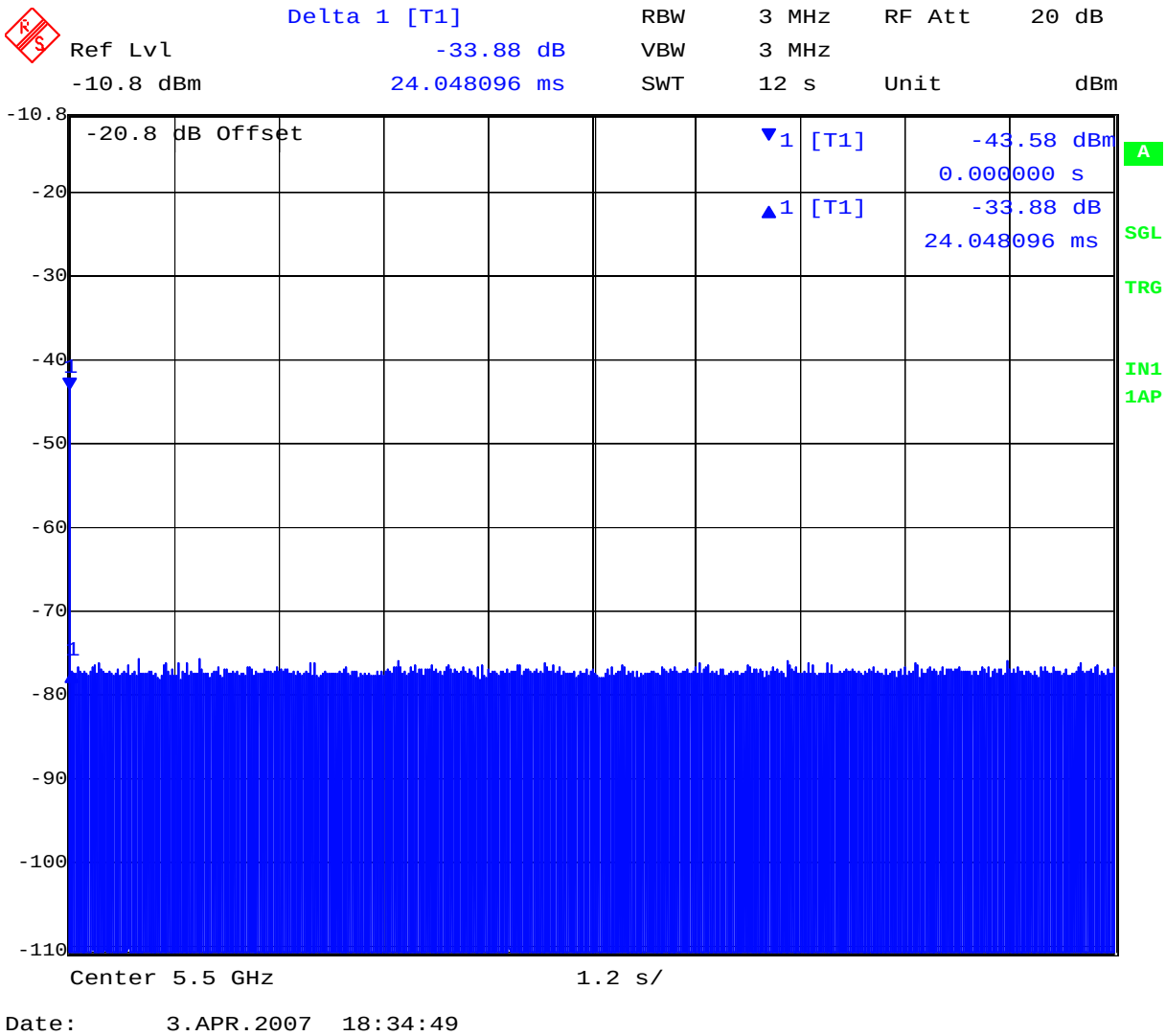
Rt = Type 1 burst period 24.277 mS

(Rt is the period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

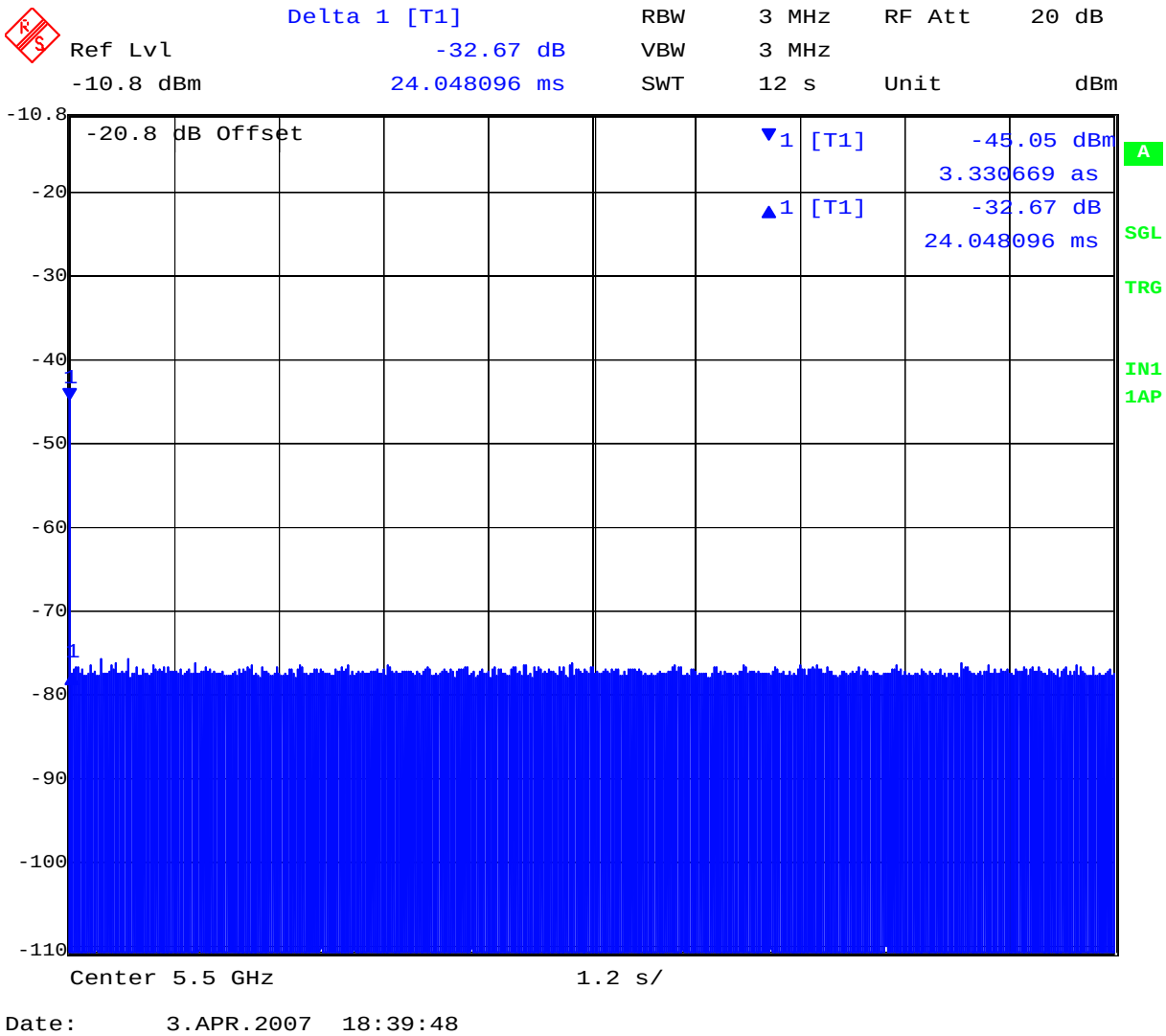
Channel Move Time = 83.713 – 60 – 24.277 = - 0.564 secs

i.e the EUT stopped transmitting data 0.564 mSecs prior to the end of the Type 1 radar burst. The Channel Move Time (by definition) is therefore 0 Seconds.

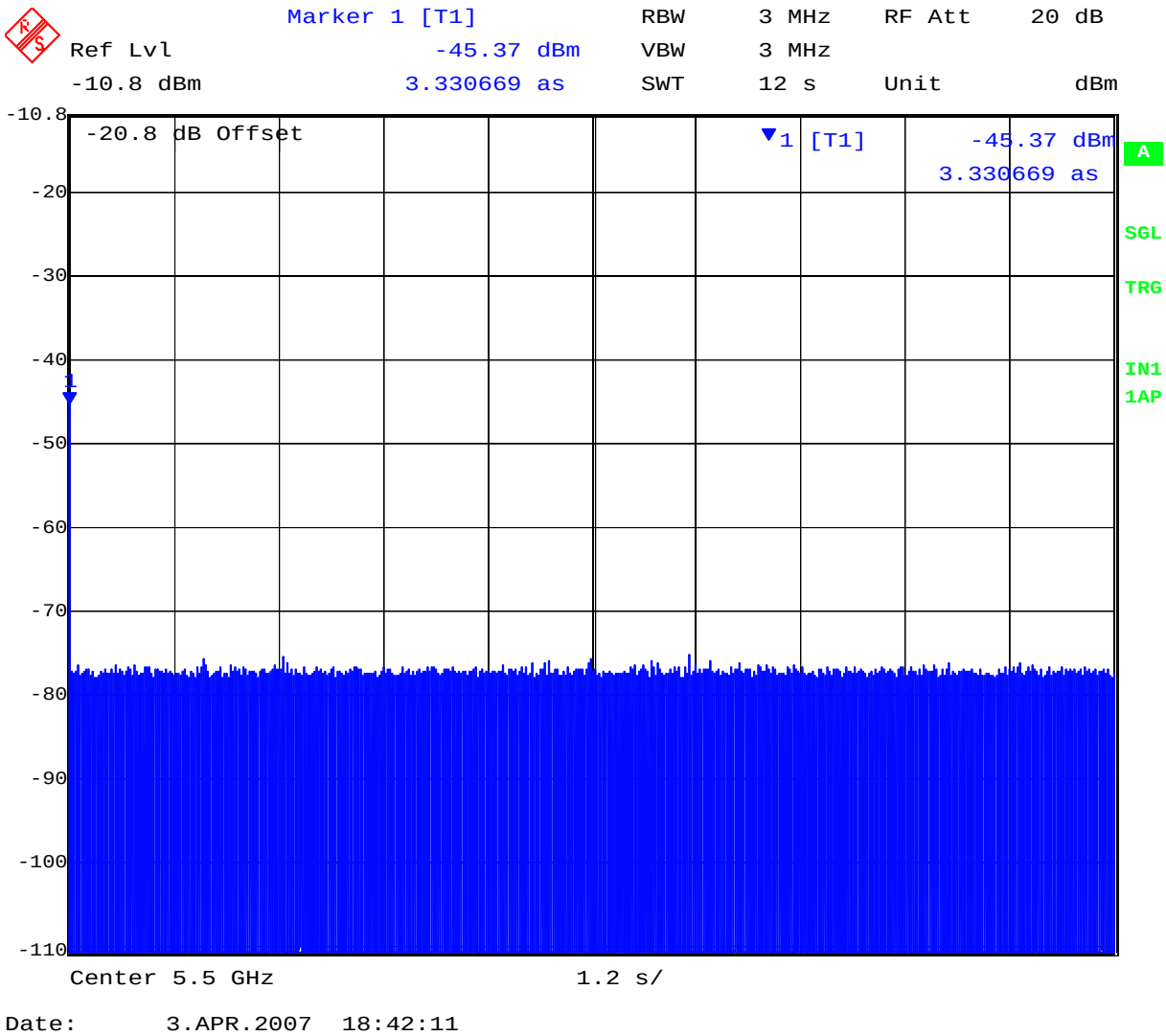
Channel Move Time, Channel closing Transmission Time for (8 MHz QPSK)
Type 2 Radar
1.1µs, 197 prf, 24 pulses



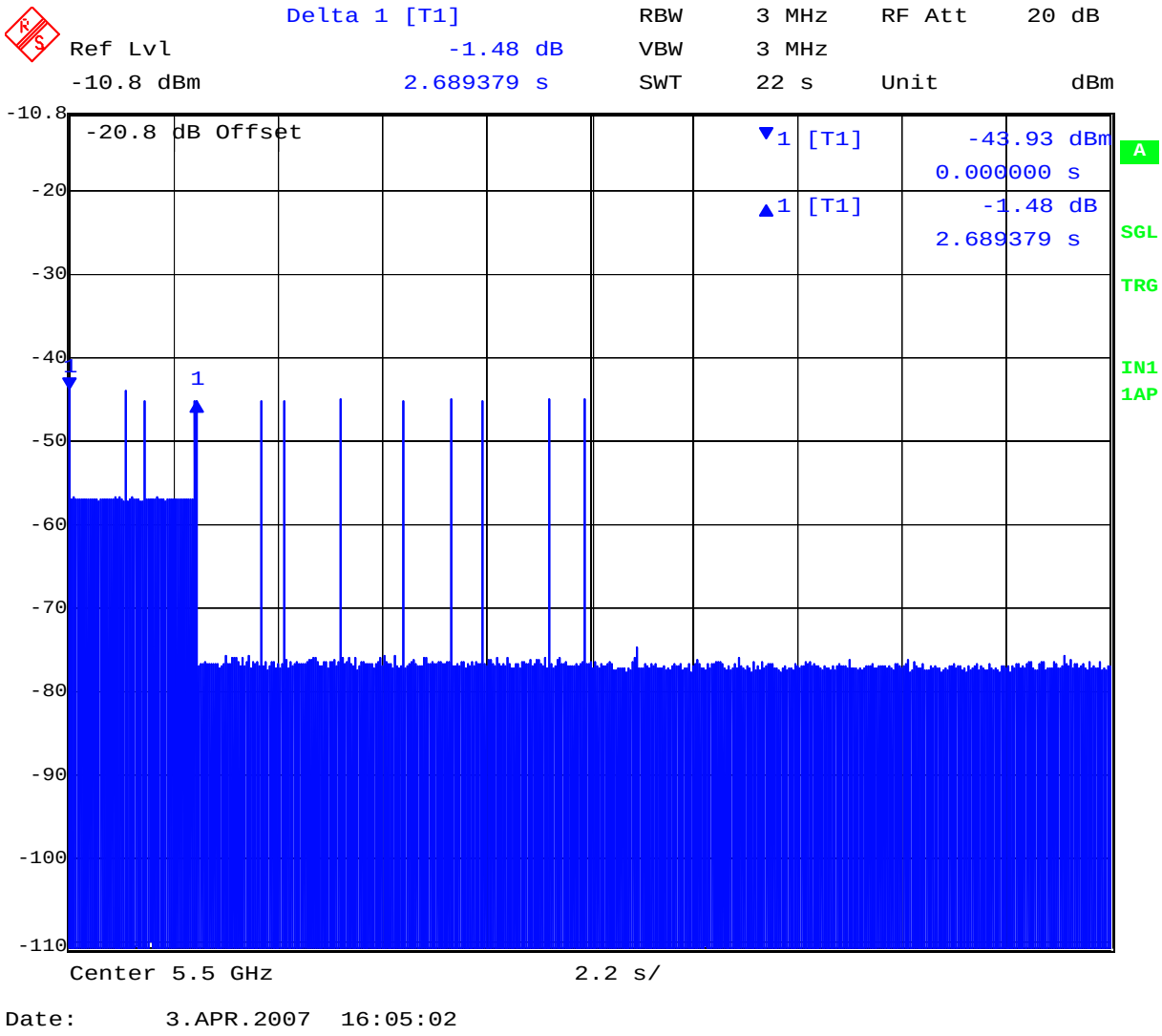
Channel Move Time, Channel closing Transmission Time (8 MHz QPSK) for Type 3 Radar
6.2 µs, 259 prf, 17 pulses



Channel Move Time, Channel closing Transmission Time (8 MHz QPSK) for Type 4 Radar
11.6 µs, 283 prf, 13 pulses

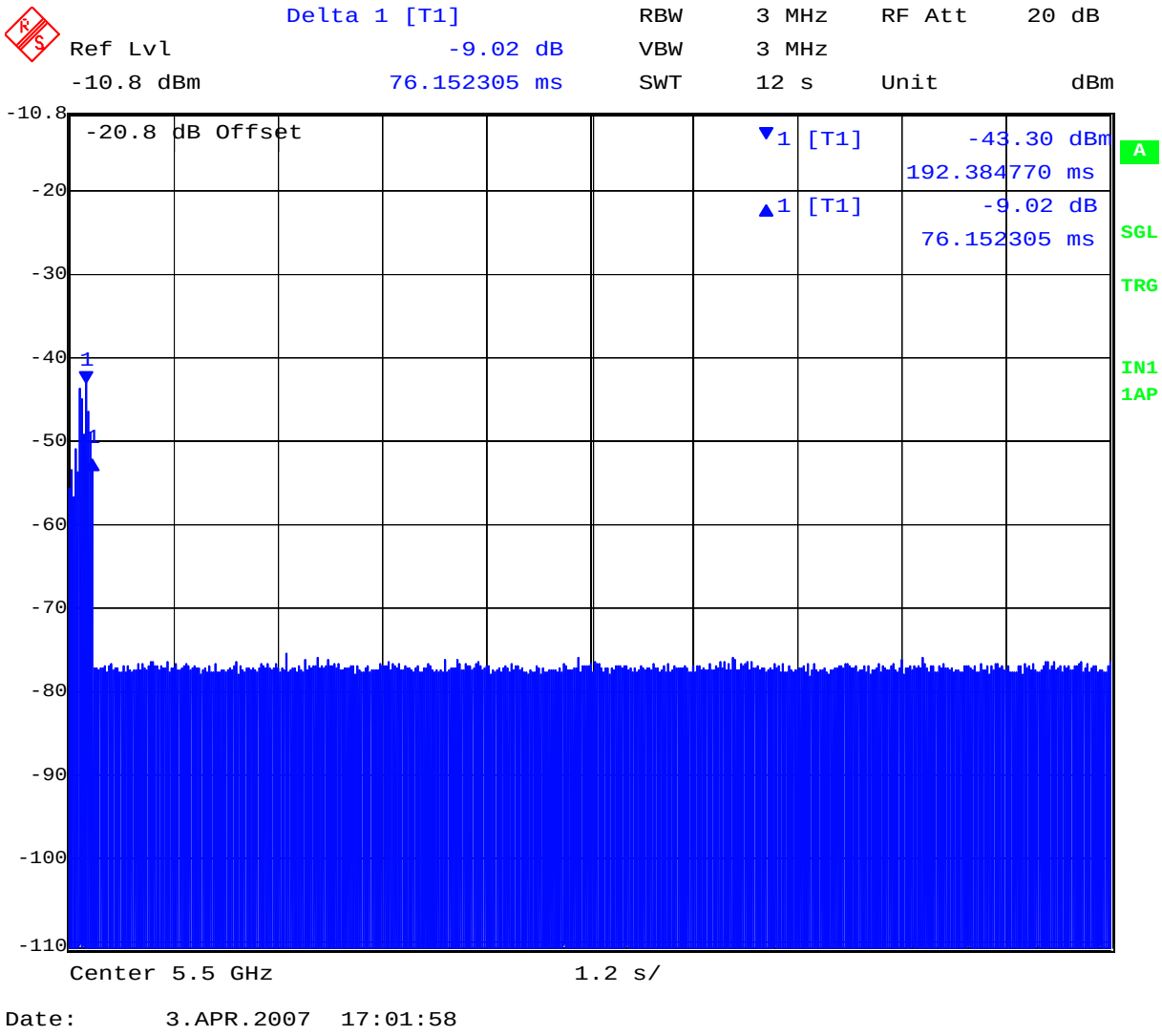


Channel Move Time, Channel closing Transmission Time (8 MHz QPSK) for Type 5 Radar



With reference to the requirements of FCC MO & O 06-96;- The instant that the Chanel Move Time and Channel Closing Time begins for the long Pulse Radar Test Signal is the instant at the end of the 12 Second period defining the Radar Waveform. From the above plot is can be seen that the EUT stopped transmitting data before completion of the Radar Test Signal, therefore the Channel Closing Time and Channel Move time complies with the requirements.

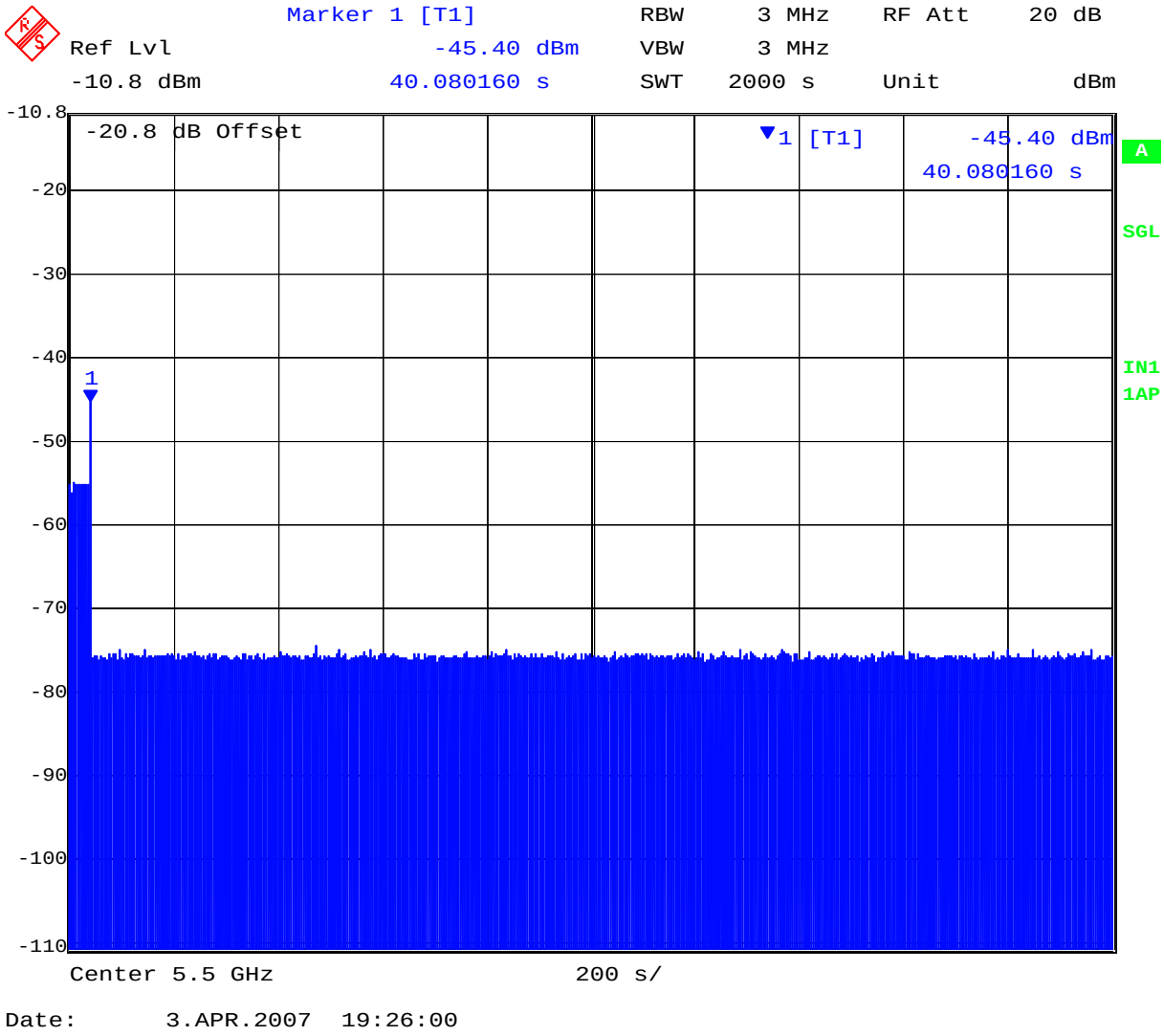
Channel Move Time, Channel closing Transmission Time (8 MHz QPSK) for Type 6 Radar



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 (8 MHz QPSK) Type 1 Radar Ch 5500 MHz



6.7.6. 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 5600 MHz. 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:

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.

(8 MHz QPSK)- Verification of Detection

Trail #	Detection = 1, No Detection = 0			
	Type 1	Type 2	Type 3	Type 4
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1
29	1	1	1	1
30	1	1	1	1
Detection Percentage	100% (>60%)	100% (>60%)	100% (>60%)	100% (>60%)

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

$P_d1 + P_d2 + P_d3 + P_d4 = (100\% + 100\% + 100\% + 100\%) = 100\%$ (> 80%)

(8 MHz QPSK) Radar Type 5 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	100% (>60%)

(8 MHz QPSK) Radar Type 6 - Verification of Detection

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

6.8. DFS Test Results 16 MHZ 16QAM

6.8.1. UNII Detection Bandwidth: (16 MHz 16QAM)

All UNII channels for this device have identical channel bandwidths and DFS testing was completed in the 5250 - 5350 MHz, & 5470 - 5725 MHz.

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 at a level of -46dBm (Ref Section 6.6). 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:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

EUT Frequency=5500MHz (16 MHz 16QAM)											
Radar Frequency (MHz)	**DFS Detection Trials (1=Detection, Blank= No Detection)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Detection Rate (%)**
5491	0	0	0	0	0	0	0	0	0	0	0%
5492 (F_L)	1	1	1	1	1	1	1	1	1	1	100%
5493	1	1	1	1	1	1	1	1	1	1	100%
5494	1	1	1	1	1	1	1	1	1	1	100%
5495	1	1	1	1	1	1	1	1	1	1	100%
5496	1	1	1	1	1	1	1	1	1	1	100%
5497	1	1	1	1	1	1	1	1	1	1	100%
5498	1	1	1	1	1	1	1	1	1	1	100%
5499	1	1	1	1	1	1	1	1	1	1	100%
5500	1	1	1	1	1	1	1	1	1	1	100%
5501	1	1	1	1	1	1	1	1	1	1	100%
5502	1	1	1	1	1	1	1	1	1	1	100%
5503	1	1	1	1	1	1	1	1	1	1	100%
5504	1	1	1	1	1	1	1	1	1	1	100%
5505	1	1	1	1	1	1	1	1	1	1	100%
5506	1	1	1	1	1	1	1	1	1	1	100%
5507	1	1	1	1	1	1	1	1	1	1	100%
5508 (F_H)	1	1	1	1	1	1	1	1	1	1	100%
5509	0	0	0	0	0	0	0	0	0	0	0%
Detection Bandwidth = F_H-F_L = 5308 MHz-5292 MHz = 16 MHz											
EUT 99% Bandwidth = 16.633 MHz											
16.633 MHz *80% = 13.306 MHz											

For each frequency step the minimum percentage detection is 90%

6.8.2. Initial Channel Availability Check Time (16 MHz 16QAM)

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.

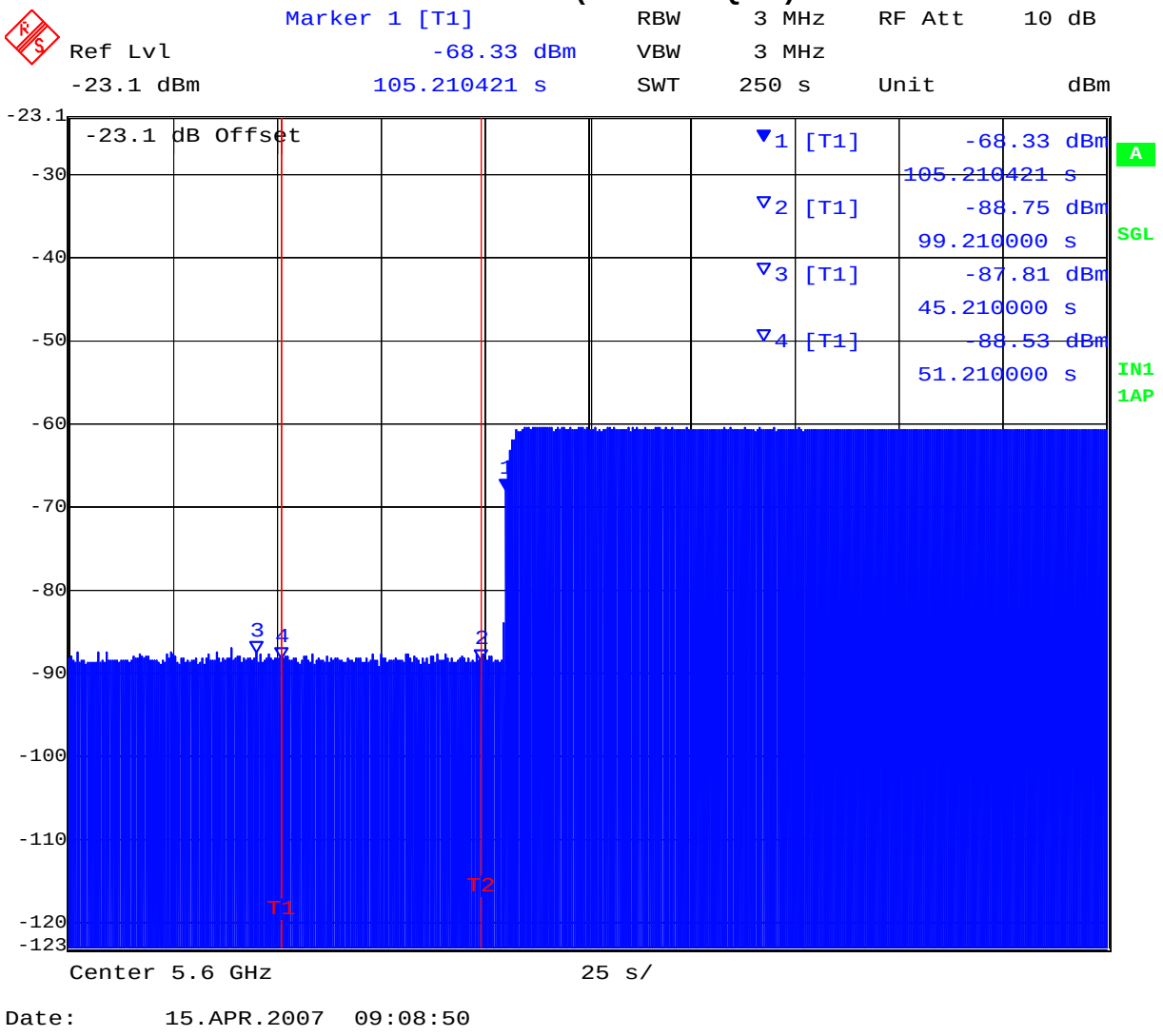
The U-NII device is powered on and be instructed to operate at 5600 MHz. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 3 MHz resolution bandwidth at 5600 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to 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 EUT is powered on at T0. Marker ▼3 denotes the instant when the EUT has completed its power-up sequence and the start of the Channel Availability Check Time that ends after a duration of ▼3 + 60 seconds i.e ▼1 on the following plot.

The Master device requires 45.21 seconds to complete its power-on cycle.

Initial Channel Availability Check Time during power up of EUT
Ch 5600 MHz (16 MHz 16QAM)



6.8.3. Radar Burst at the Beginning of the Channel Availability Check Time (16 MHz 16QAM)

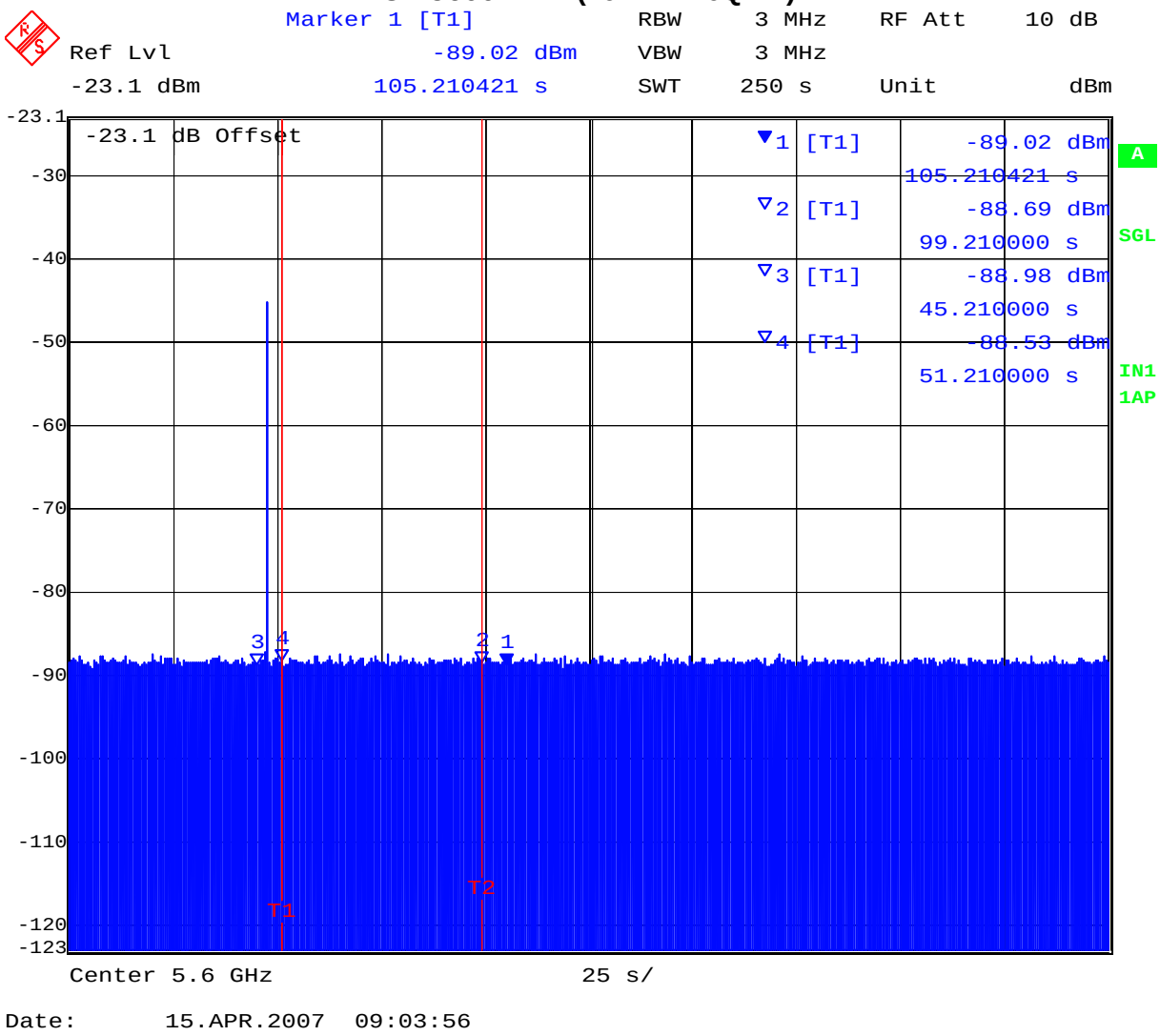
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-46 dBm Ref Section 6.6) occurs at the beginning of the Channel Availability Check Time.

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at ▼3.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions have occurred at 5600MHz.

Channel Availability Check Time at the start of the 60 second Check Time
Ch 5600 MHz (16 MHz 16QAM)



6.8.4. Radar Burst at the End of the Channel Availability Check Time: (16 MHz 16QAM)

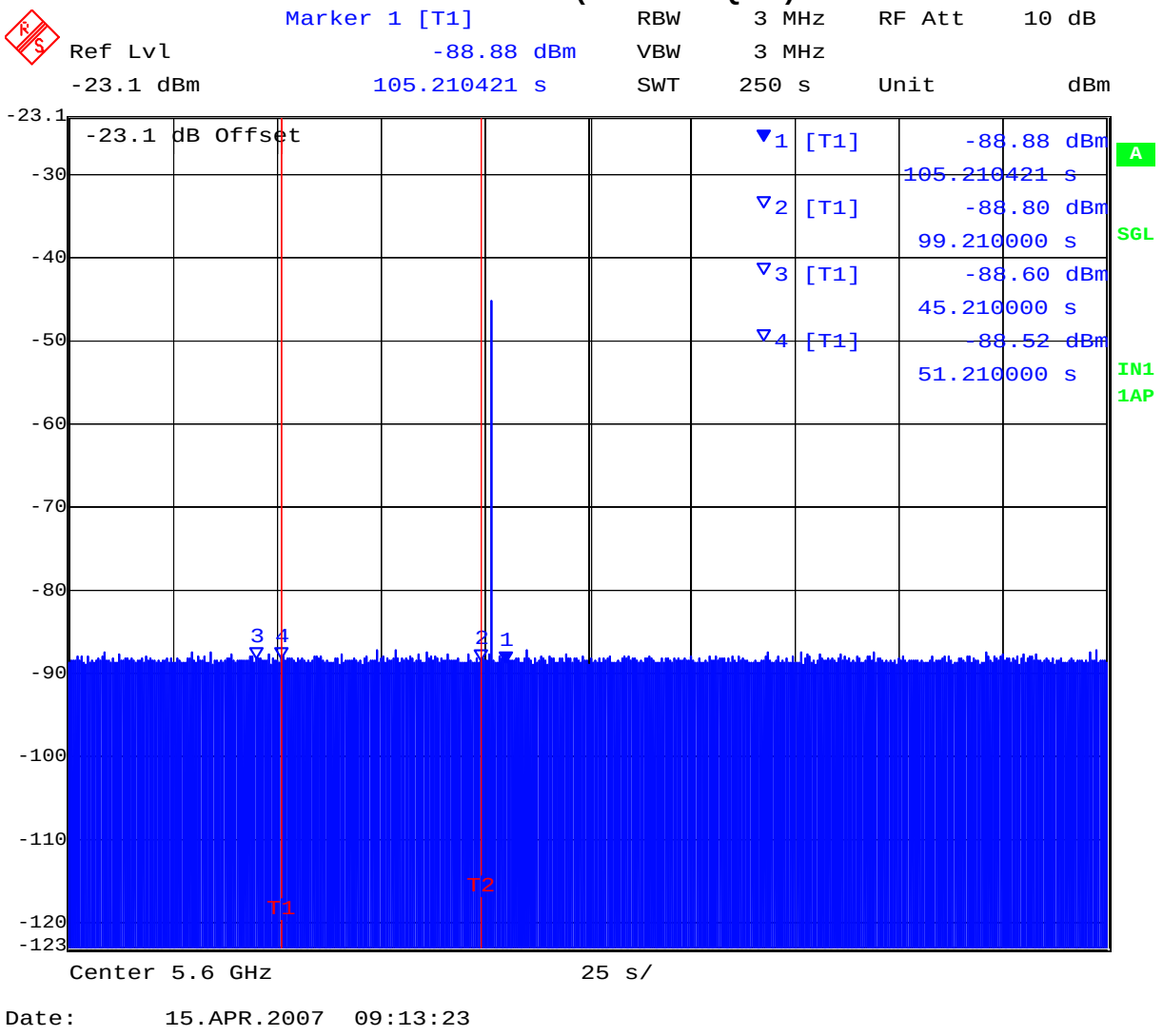
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel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

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single burst of radar type 1 will commence within a 6 second window starting at marker ▼3+ 54 seconds.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions occurred at 5600MHz.

Channel Availability Check Time at the end of the 60 second Check Time
Ch 5600 MHz (16 MHz 16QAM)



6.8.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (16 MHz 16QAM)

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 captured, collecting nearly 250M samples of data, which included 60ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The Aeroflex PXI was setup to capture data for all transmission events above a threshold level of -46dBm. The PXI time stamps all captured events with respect to T_0 (zero time indicating the start of the measurements sequence) starting the 60 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 60ms

Type 1 burst period 24.277ms

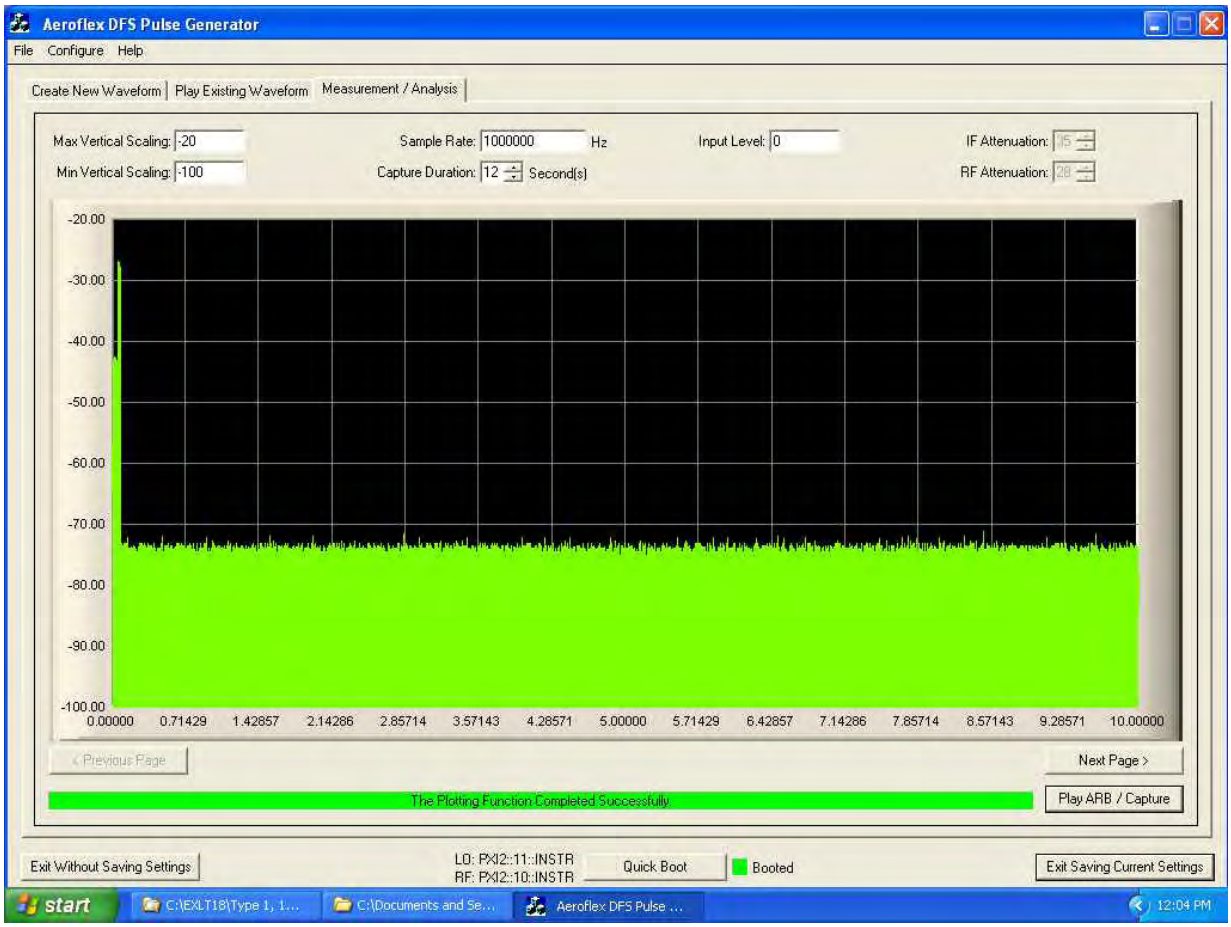
(The period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

Channel Closing Transmission Time starts at 84.277ms after T_0.

Therefore, pulses seen after this 84.277ms 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 16 µs of transmission time accrued.

Channel Closing Transmission Time = 16 µSecs (limit 260 mSecs)

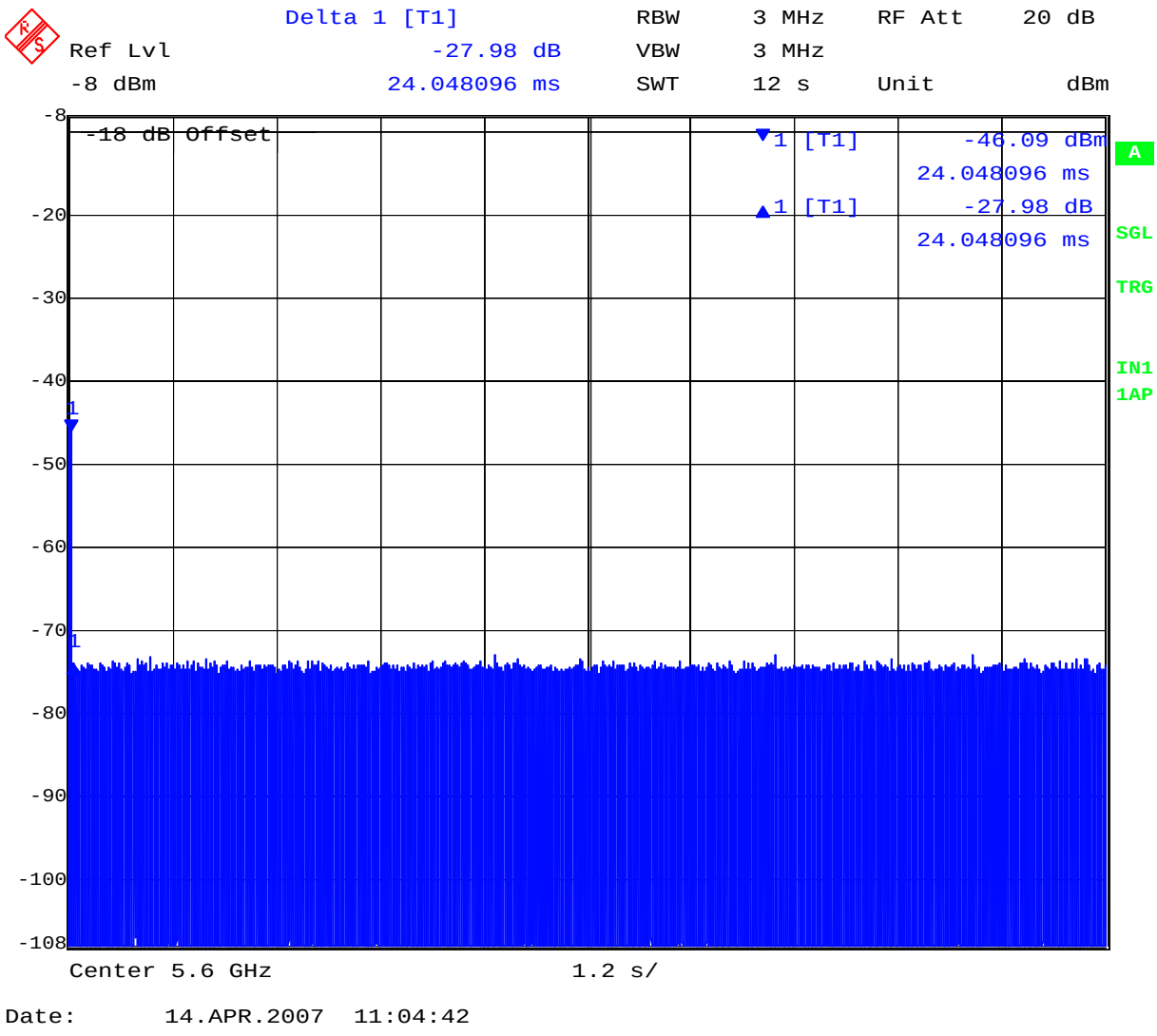
Channel Move Time, Channel Closing Time for Type 1 Radar(16 MHz 16QAM)
Captured by Aeroflex PXI Test System



Additionally, a redundant conventional spectrum analyzer screen capture is provided to correlate against the digitizer screen capture for verification purposes.

Note;- no pre-trigger data interval (60 mSecs) was included in the following Spectrum Analyzer plot

Channel Move Time, Channel Closing Time for Type 1 Radar(16 MHz 16QAM) Captured by Spectrum Analyzer



The following data was captured by the Aeroflex PXI test System and is used to calculate the Channel Closing Transmission Time for the EUT (16 MHz 16QAM) with the intervention of Radar Type 1.

Sample Number: 84270	Rising Edge,	Sample Time Stamp	0.08427	
Sample Number: 84278	Falling Edge,	Sample Time Stamp	0.084278	8E-06
Sample Number: 85698	Rising Edge,	Sample Time Stamp	0.085698	
Sample Number: 85706	Falling Edge,	Sample Time Stamp	0.085706*	8E-06

Total = 1.6E-05 Secs

* Represents the last transmission activity of the EUT. The 0.085706*second time stamp is used to calculate Channel Move Time.

Channel Move Time (16 MHz 16QAM)– Measurement & Calculation Type 1 Radar

The Channel Move Time is calculated using the data captured for the Channel Closing time as follows;-

Channel Move Time = Ft – Pt - Rt

Where;-

Ft = Final transmission activity occurred at 85.706 mSeconds

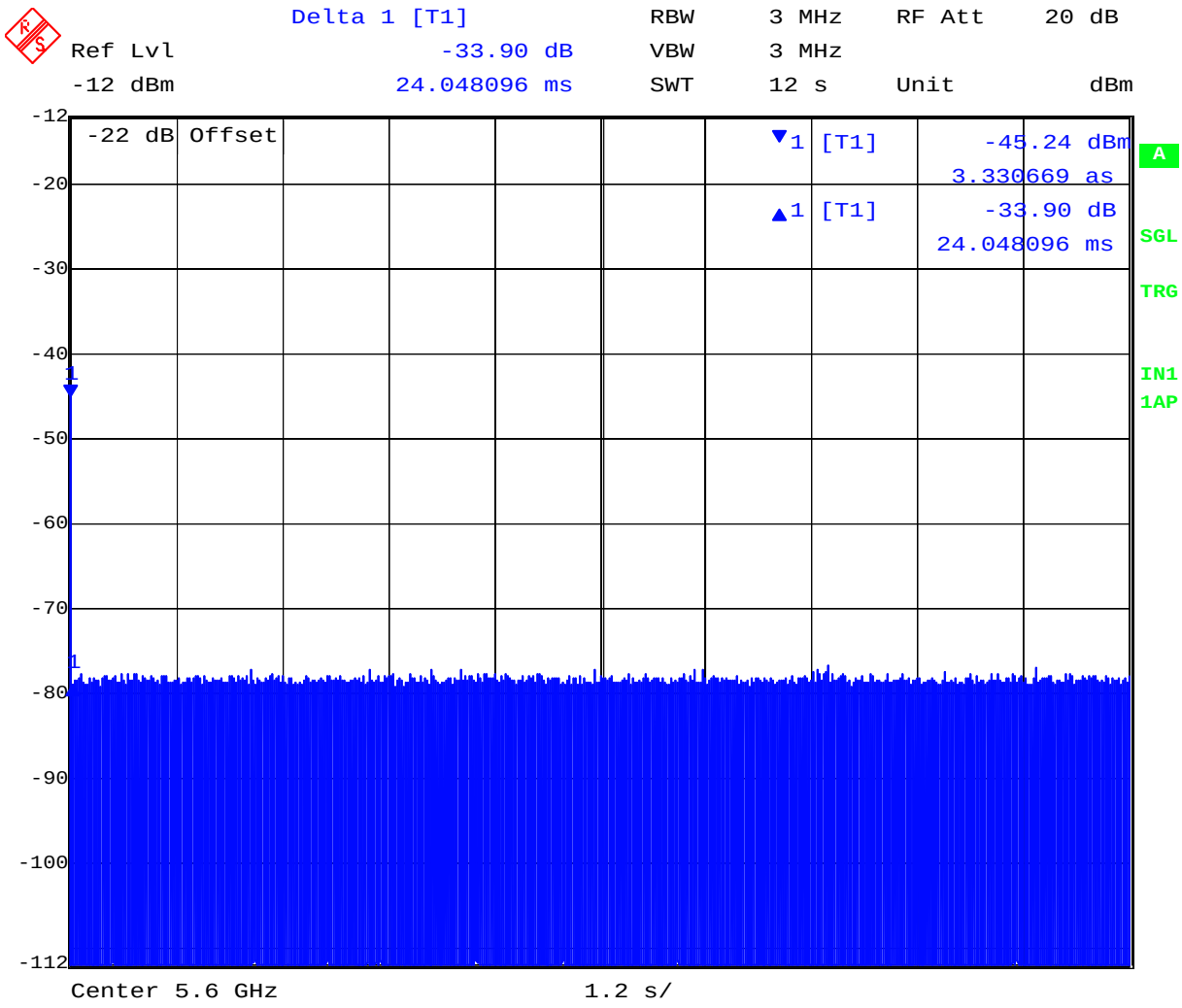
Pt = Pre-trigger information 60 mS

Rt = Type 1 burst period 24.277 mS

(Rt is the period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

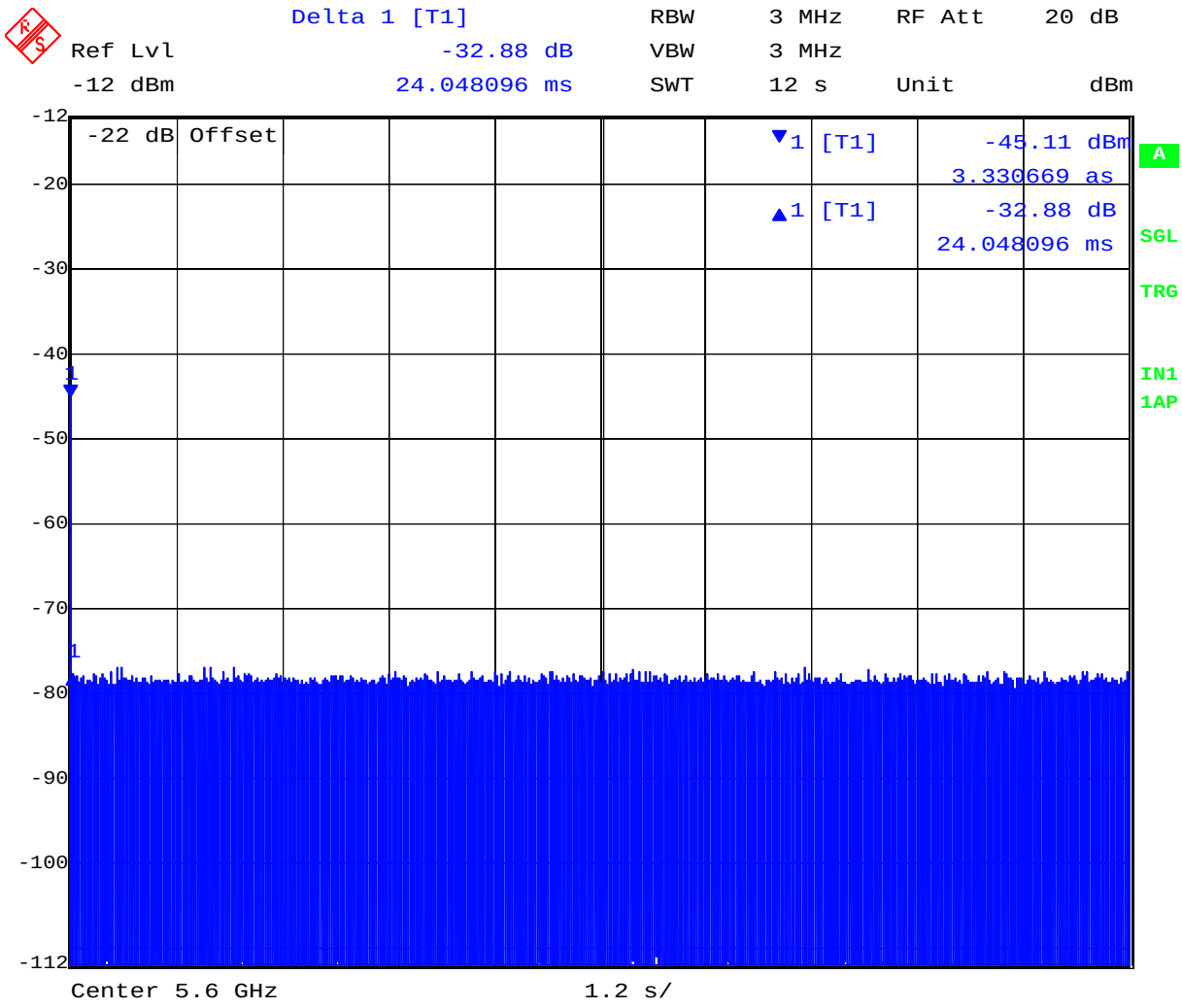
Channel Move Time = 85.706 – 60 – 24.277 = 1.429 mSecs

Channel Move Time, Channel closing Transmission Time for (16 MHz 16QAM)
Type 2 Radar
1.1µs, 197 prf, 24 pulses



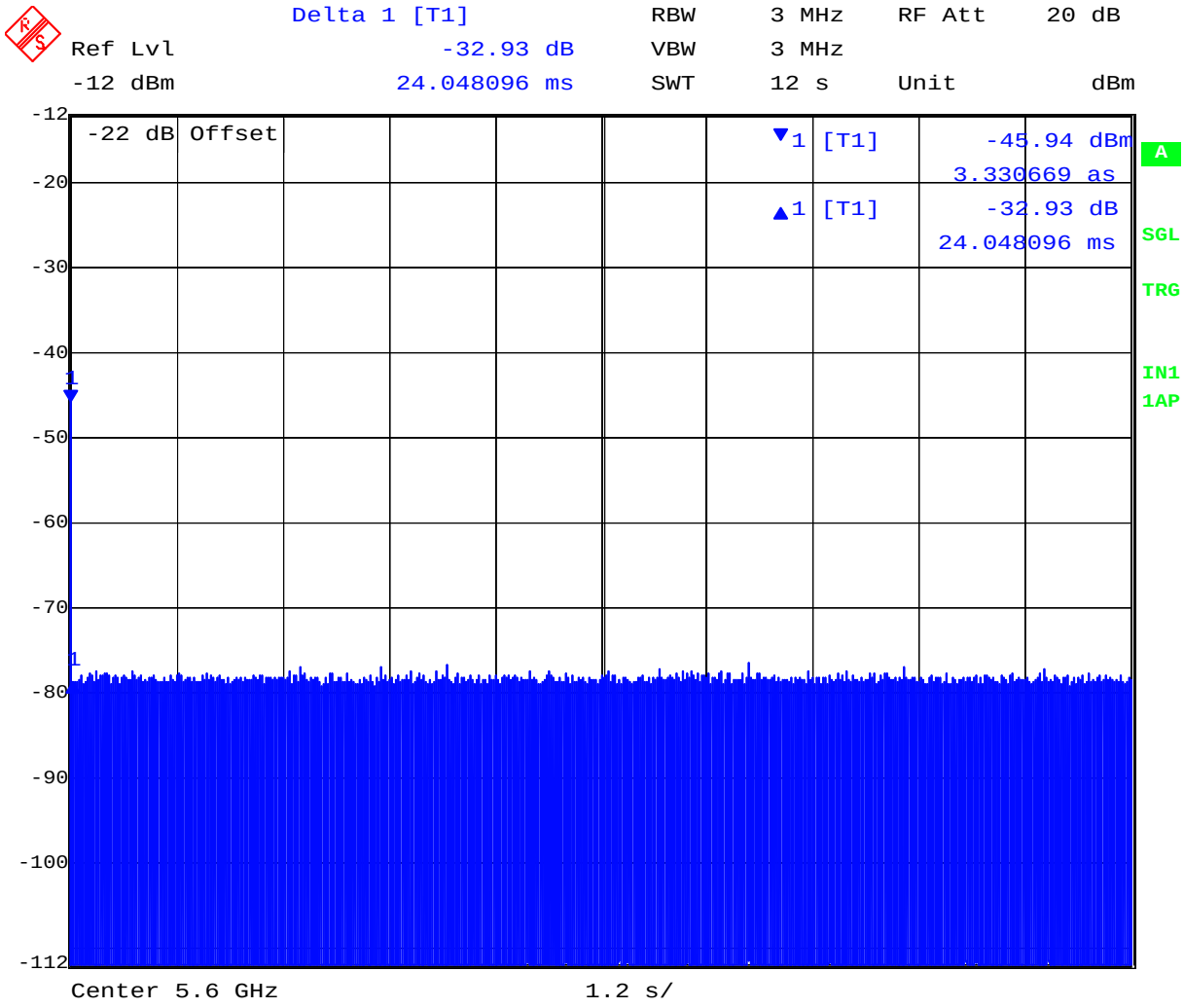
Date: 14.APR.2007 09:43:54

Channel Move Time, Channel closing Transmission Time (16 MHz 16QAM) for Type 3 Radar
6.2 µs, 259 prf, 17 pulses



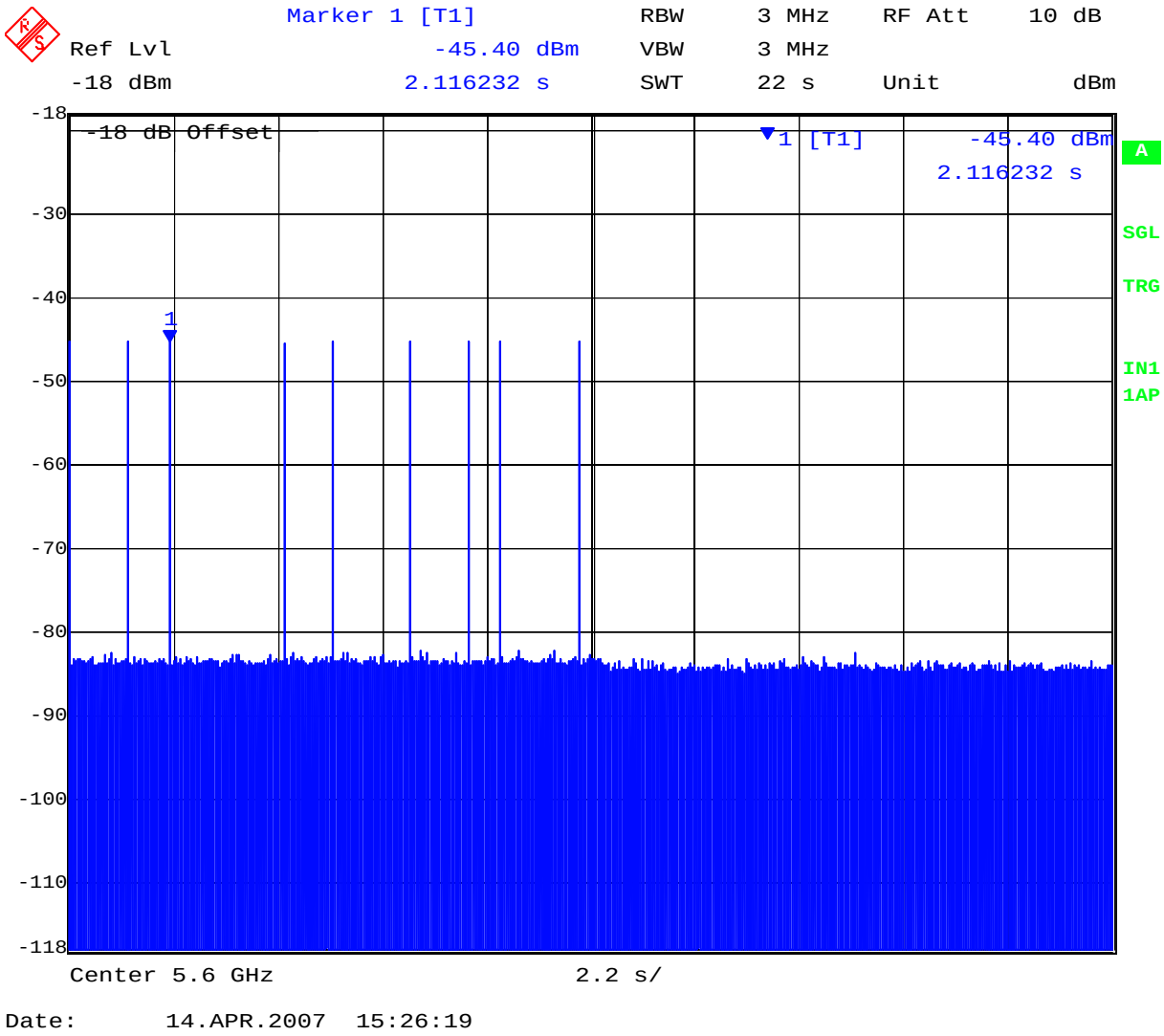
Date: 14.APR.2007 09:56:47

Channel Move Time, Channel closing Transmission Time (16 MHz 16QAM) for Type 4 Radar
11.6 µs, 283 prf, 13 pulses



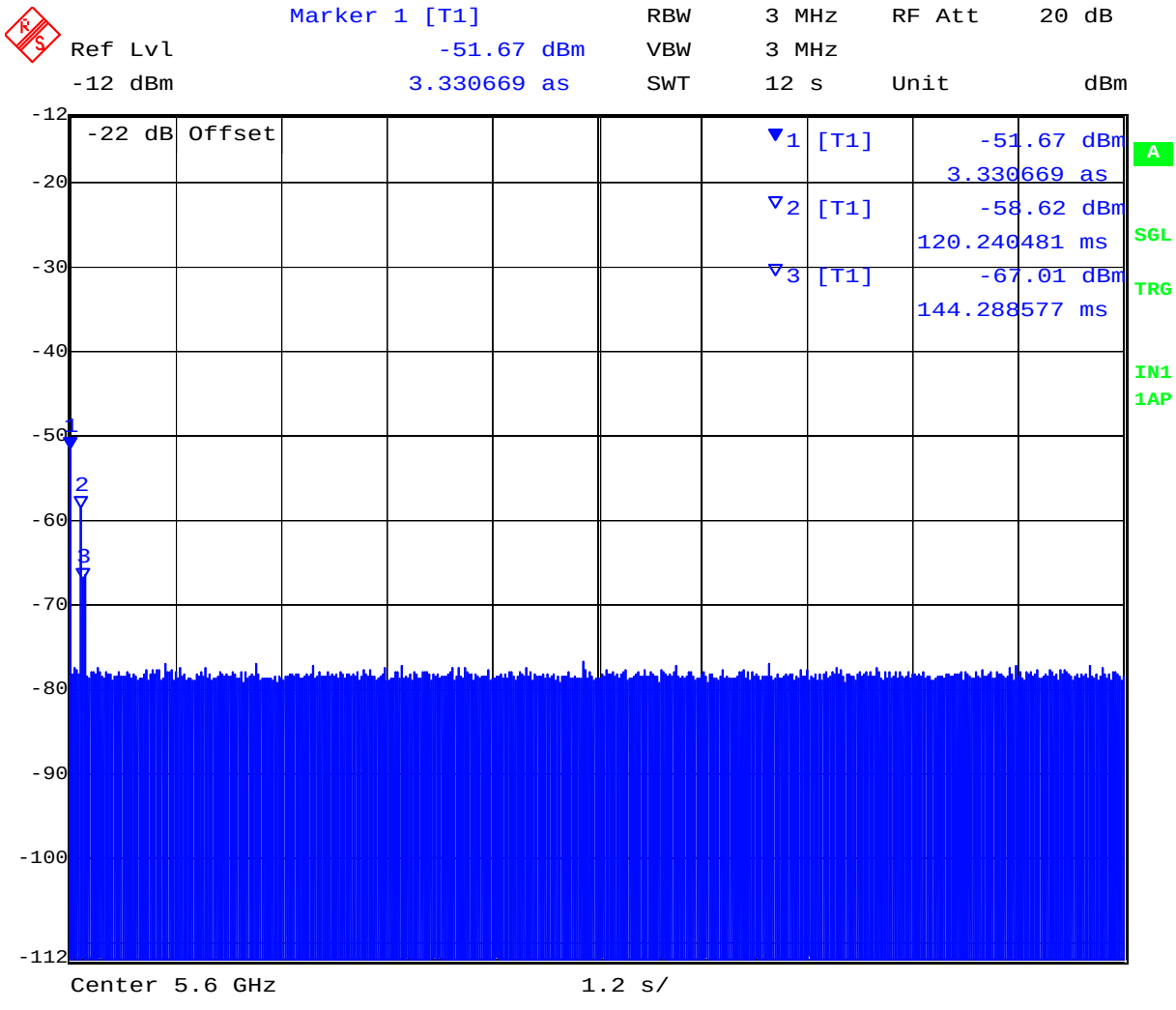
Date: 14.APR.2007 09:58:49

Channel Move Time, Channel closing Transmission Time (16 MHz 16QAM) for Type 5 Radar



With reference to the requirements of FCC MO & O 06-96;- The instant that the Chanel Move Time and Channel Closing Time begins for the long Pulse Radar Test Signal is the instant at the end of the 12 Second period defining the Radar Waveform. From the above plot is can be seen that the EUT stopped transmitting data before completion of the Radar Test Signal, therefore the Channel Closing Time and Channel Move time complies with the requirements.

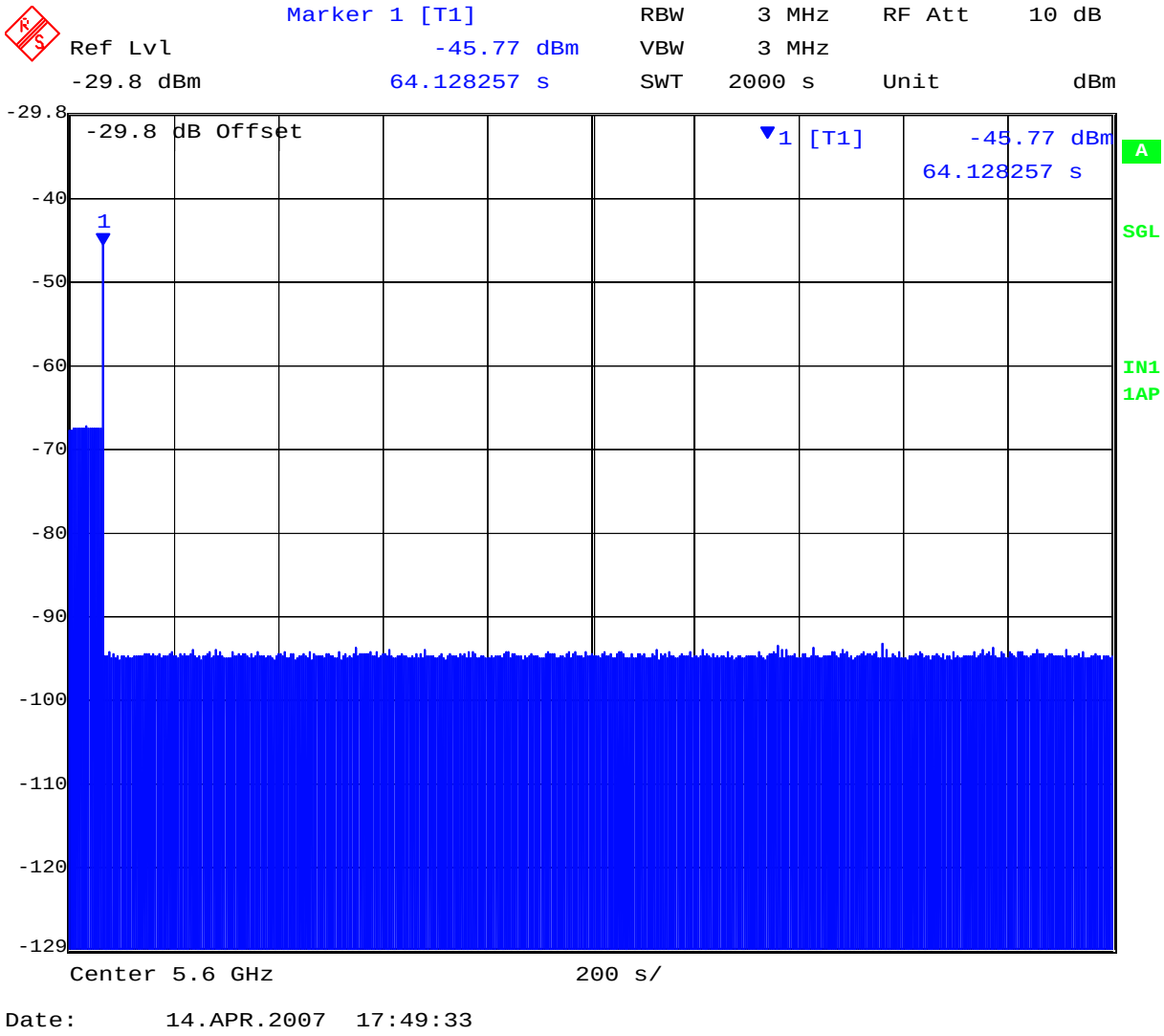
Channel Move Time, Channel closing Transmission Time (16 MHz 16QAM) for Type 6 Radar



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 (16 MHz 16QAM) Type 1 Radar Ch 5500 MHz



6.8.6. 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 5600 MHz. 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:

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.

(16 MHz 16QAM)- Verification of Detection

Trail #	Detection = 1, No Detection = 0			
	Type 1	Type 2	Type 3	Type 4
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1
29	1	1	1	1
30	1	1	1	1
Detection Percentage	100% (>60%)	100% (>60%)	100% (>60%)	100% (>60%)

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

$P_d1 + P_d2 + P_d3 + P_d4 = (100\% + 100\% + 100\% + 100\%) = 100\%$ (> 80%)

(16 MHz 16QAM) Radar Type 5 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	100% (>60%)

(16 MHz 16QAM) Radar Type 6 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	0
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	96.7% (>60%)

6.9. DFS Test Results 32 MHz QPSK

6.9.1. UNII Detection Bandwidth: (32 MHz QPSK)

All UNII channels for this device have identical channel bandwidths and DFS testing was completed in the 5250 - 5350 MHz, & 5470 - 5725 MHz.

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 5600 MHz at a level of -46dBm (Ref Section 6.6). 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:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

EUT Frequency=5600MHz (32 MHz QPSK)											
Radar Frequency (MHz)	**DFS Detection Trials (1=Detection, Blank= No Detection)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Detection Rate (%)**
5585	0	0	0	0	0	0	0	0	0	0	0%
5586(F_L)	1	1	1	1	1	1	1	1	1	1	100%
5587	1	1	1	1	1	1	1	1	1	1	100%
5588	1	1	1	1	1	1	1	1	1	1	100%
5589	1	1	1	1	1	1	1	1	1	1	100%
5590	1	1	1	1	1	1	1	1	1	1	100%
5591	1	1	1	1	1	1	1	1	1	1	100%
5592	1	1	1	1	1	1	1	1	1	1	100%
5593	1	1	1	1	1	1	1	1	1	1	100%
5594	1	1	1	1	1	1	1	1	1	1	100%
5595	1	1	1	1	1	1	1	1	1	1	100%
5596	1	1	1	1	1	1	1	1	1	1	100%
5597	1	1	1	1	1	1	1	1	1	1	100%
5598	1	1	1	1	1	1	1	1	1	1	100%
5599	1	1	1	1	1	1	1	1	1	1	100%
5600	1	1	1	1	1	1	1	1	1	1	100%
5601	1	1	1	1	1	1	1	1	1	1	100%
5602	1	1	1	1	1	1	1	1	1	1	100%
5603	1	1	1	1	1	1	1	1	1	1	100%
5604	1	1	1	1	1	1	1	1	1	1	100%
5605	1	1	1	1	1	1	1	1	1	1	100%
5606	1	1	1	1	1	1	1	1	1	1	100%
5607	1	1	1	1	1	1	1	1	1	1	100%
5608	1	1	1	1	1	1	1	1	1	1	100%
5609	1	1	1	1	1	1	1	1	1	1	100%
5610	1	1	1	1	1	1	1	1	1	1	100%
5611	1	1	1	1	1	1	1	1	1	1	100%
5612	1	1	1	1	1	1	1	1	1	1	100%
5613	1	1	1	1	1	1	1	1	1	1	100%
5614(F_H)	1	1	1	1	1	1	1	1	1	1	100%
5615	0	0	0	1	1	1	1	1	1	1	70%
5616	0	0	0	0	0	0	0	0	0	0	0%
Detection Bandwidth = F_H-F_L = 5614 MHz - 5586 MHz = 28 MHz											
EUT 99% Bandwidth = 32.916 MHz											
32.916 MHz *80% = 26.333 MHz											

For each frequency step the minimum percentage detection is 90%

6.9.2. Initial Channel Availability Check Time (32 MHz QPSK)

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.

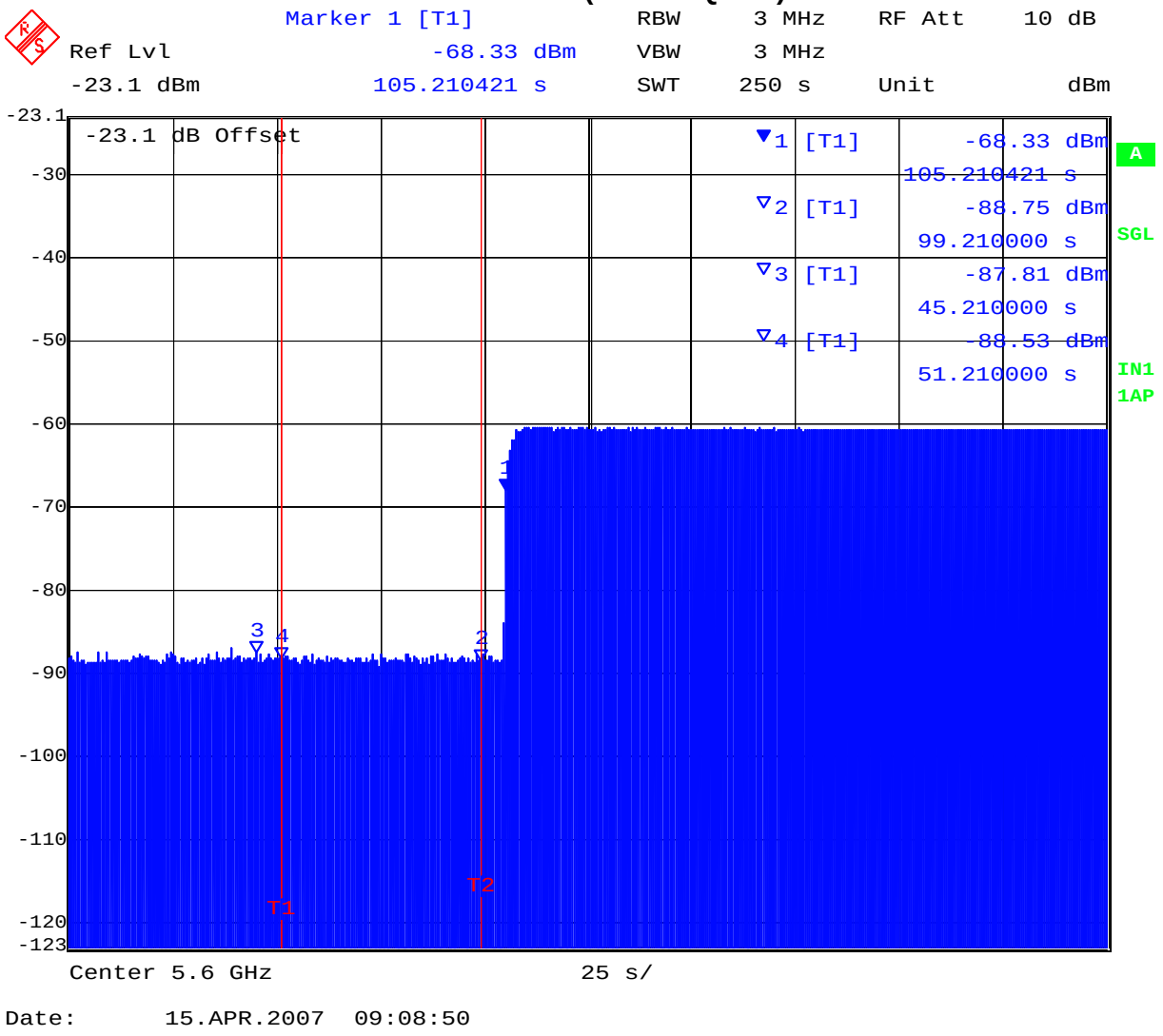
The U-NII device is powered on and be instructed to operate at 5600 MHz. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 3 MHz resolution bandwidth at 5600 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to 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 EUT is powered on at T0. Marker ▼3 denotes the instant when the EUT has completed its power-up sequence and the start of the Channel Availability Check Time that ends after a duration of ▼3 + 60 seconds i.e ▼1 on the following plot.

The Master device requires 45.21 seconds to complete its power-on cycle.

Initial Channel Availability Check Time during power up of EUT
Ch 5600 MHz (32 MHz QPSK)



6.9.3. Radar Burst at the Beginning of the Channel Availability Check Time (32 MHz QPSK)

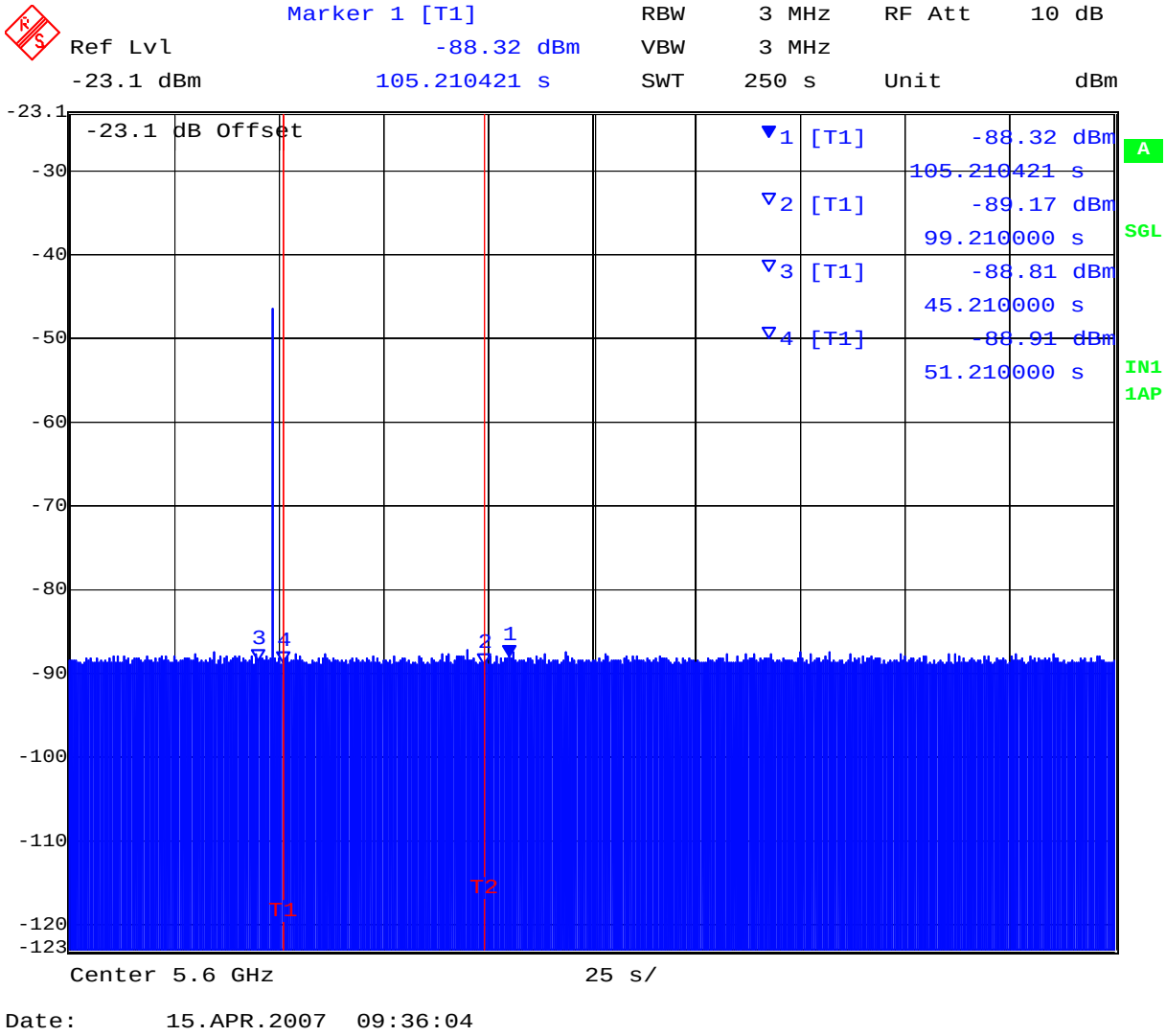
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-46 dBm Ref Section 6.6) occurs at the beginning of the Channel Availability Check Time.

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at ▼3.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions have occurred at 5600MHz.

Channel Availability Check Time at the start of the 60 second Check Time
Ch 5600 MHz (32 MHz QPSK)



6.9.4. Radar Burst at the End of the Channel Availability Check Time: (32 MHz QPSK)

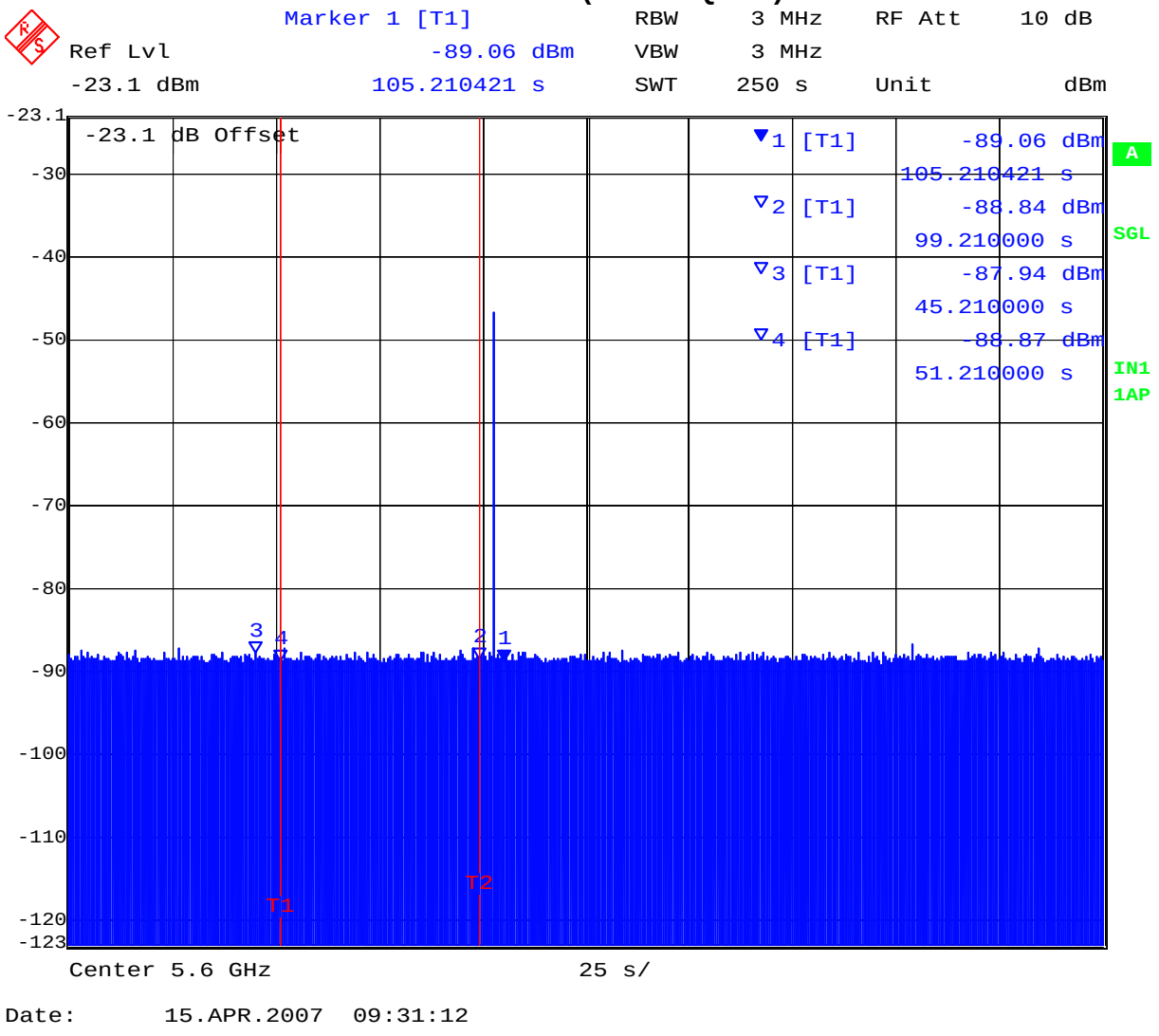
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel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

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single burst of radar type 1 will commence within a 6 second window starting at marker ▼3+ 54 seconds.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions occurred at 5600MHz.

Channel Availability Check Time at the end of the 60 second Check Time
Ch 5600 MHz (32 MHz QPSK)



6.9.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (32 MHz QPSK)

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 captured, collecting nearly 250M samples of data, which included 60ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The Aeroflex PXI was setup to capture data for all transmission events above a threshold level of -46dBm. The PXI time stamps all captured events with respect to T_0 (zero time indicating the start of the measurements sequence) starting the 60 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 60ms

Type 1 burst period 24.277ms

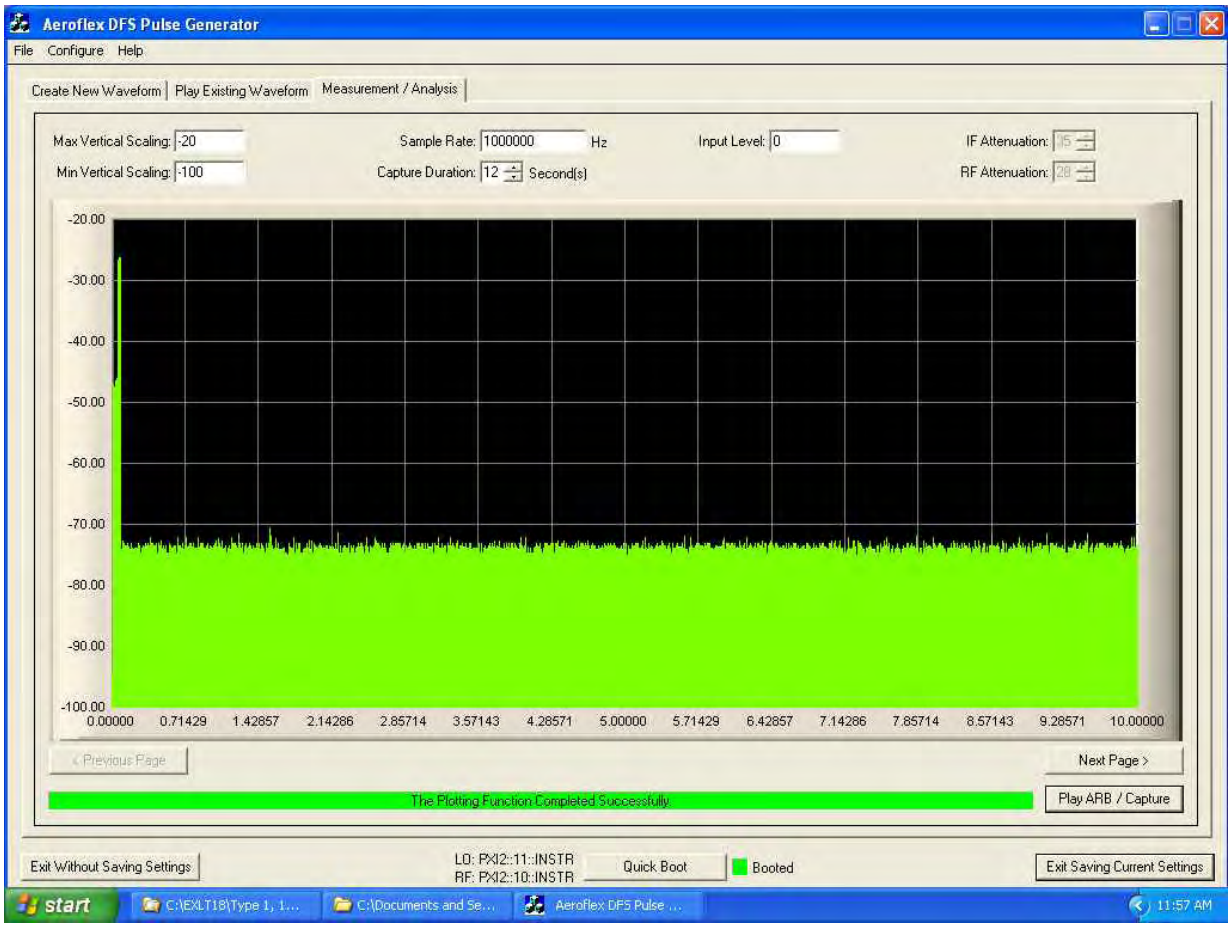
(The period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

Channel Closing Transmission Time starts at 84.277ms after T_0.

Therefore, pulses seen after this 84.277ms 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 5 µs of transmission time accrued.

Channel Closing Transmission Time = 5 µSecs (limit 260 mSecs)

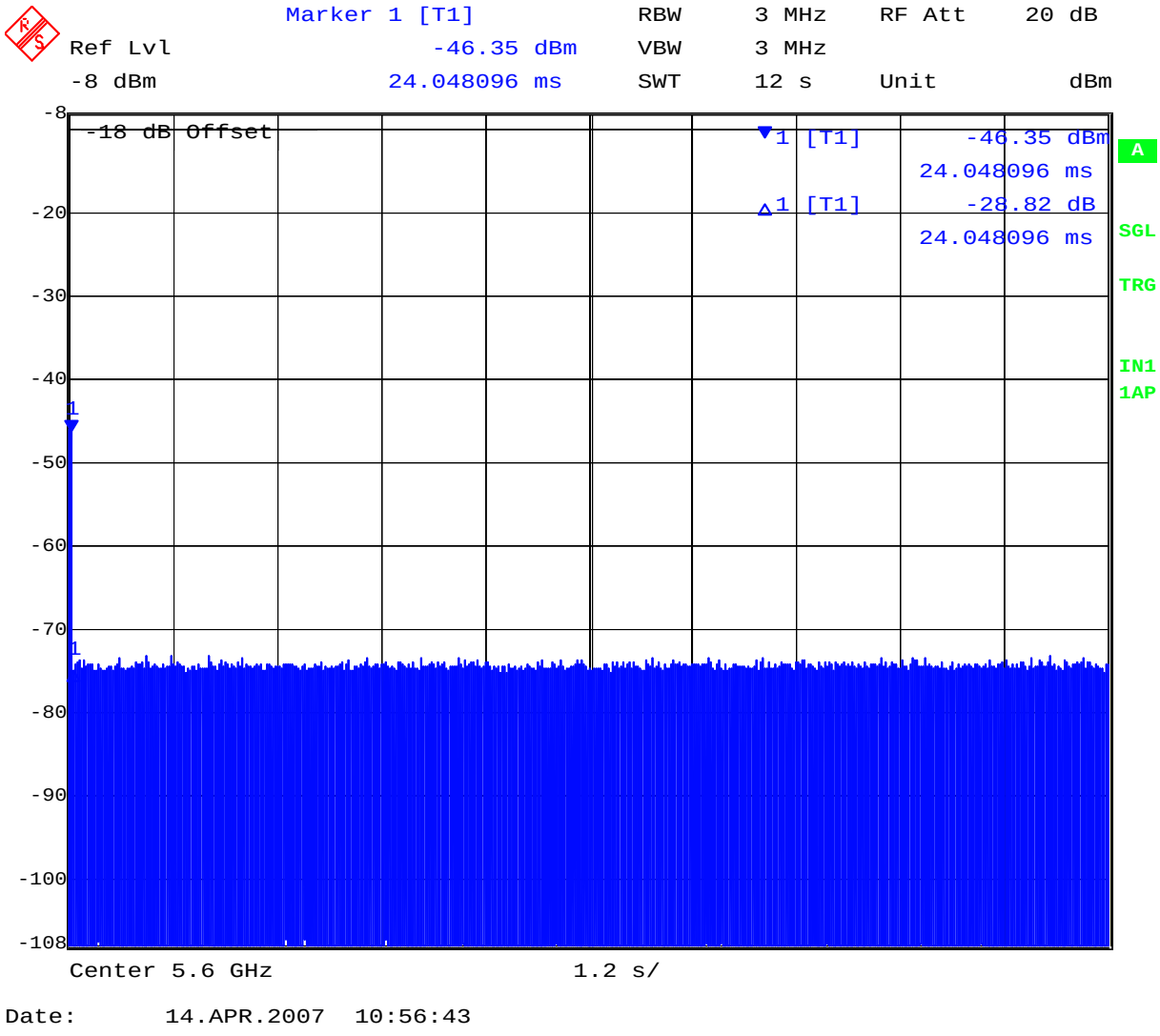
Channel Move Time, Channel Closing Time for Type 1 Radar(32 MHz QPSK)
Captured by Aeroflex PXI Test System



Additionally, a redundant conventional spectrum analyzer screen capture is provided to correlate against the digitizer screen capture for verification purposes.

Note;- no pre-trigger data interval (60 mSecs) was included in the following Spectrum Analyzer plot

Channel Move Time, Channel Closing Time for Type 1 Radar(32 MHz QPSK) Captured by Spectrum Analyzer



The following data was captured by the Aeroflex PXI test System and is used to calculate the Channel Closing Transmission Time for the EUT **(32 MHz QPSK)** with the intervention of Radar Type 1.

Sample Number: 85699	Rising Edge,	Sample Time Stamp	0.085699	
Sample Number: 85704	Falling Edge,	Sample Time Stamp	0.085704*	5E-06

Total = 5E-06 Secs

* Represents the last transmission activity of the EUT. The 0.085704*second time stamp is used to calculate Channel Move Time.

Channel Move Time (32 MHz QPSK)– Measurement & Calculation Type 1 Radar

The Channel Move Time is calculated using the data captured for the Channel Closing time as follows;-

Channel Move Time = Ft – Pt - Rt

Where;-

Ft = Final transmission activity occurred at 85.704 mSeconds

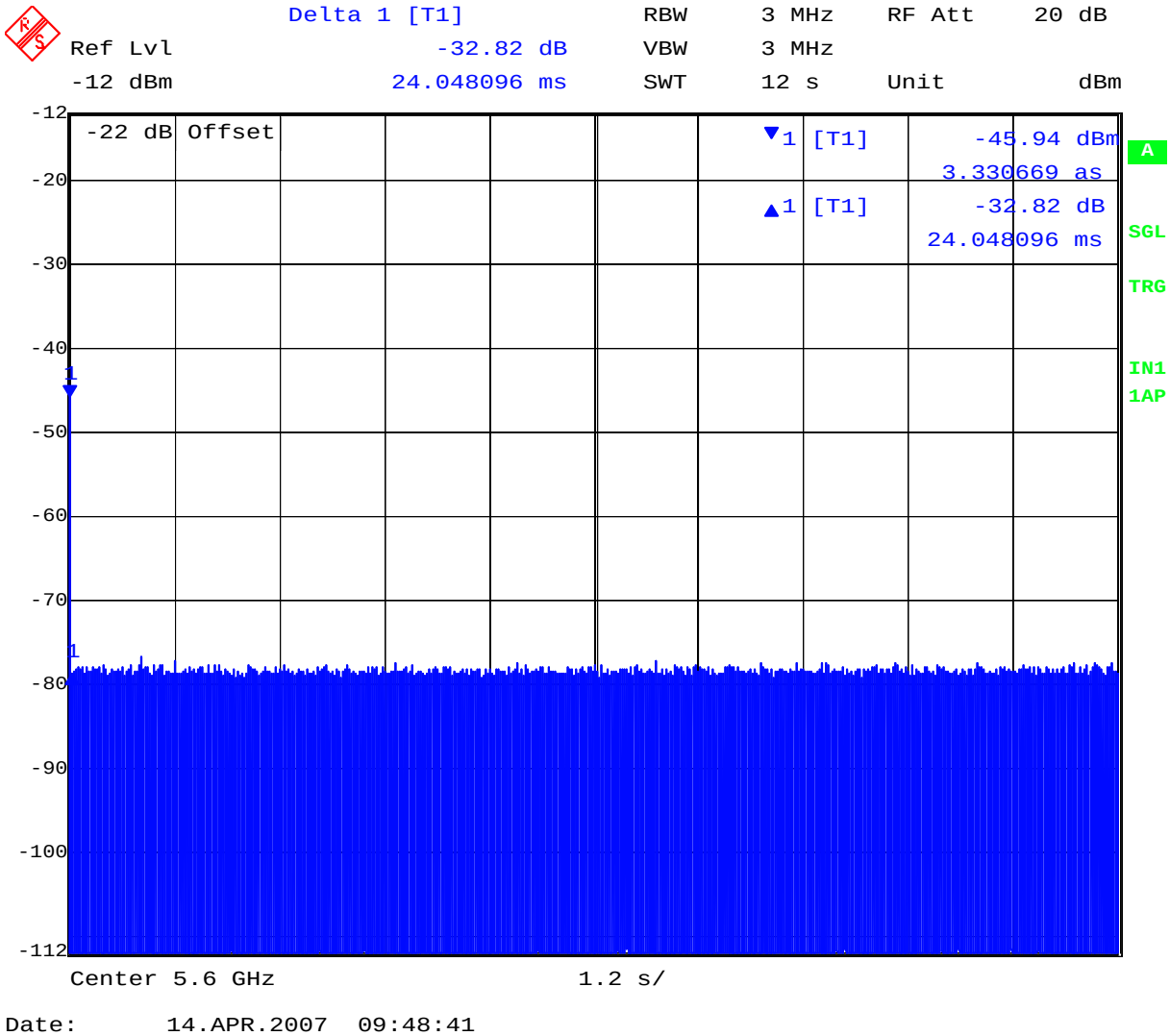
Pt = Pre-trigger information 60 mS

Rt = Type 1 burst period 24.277 mS

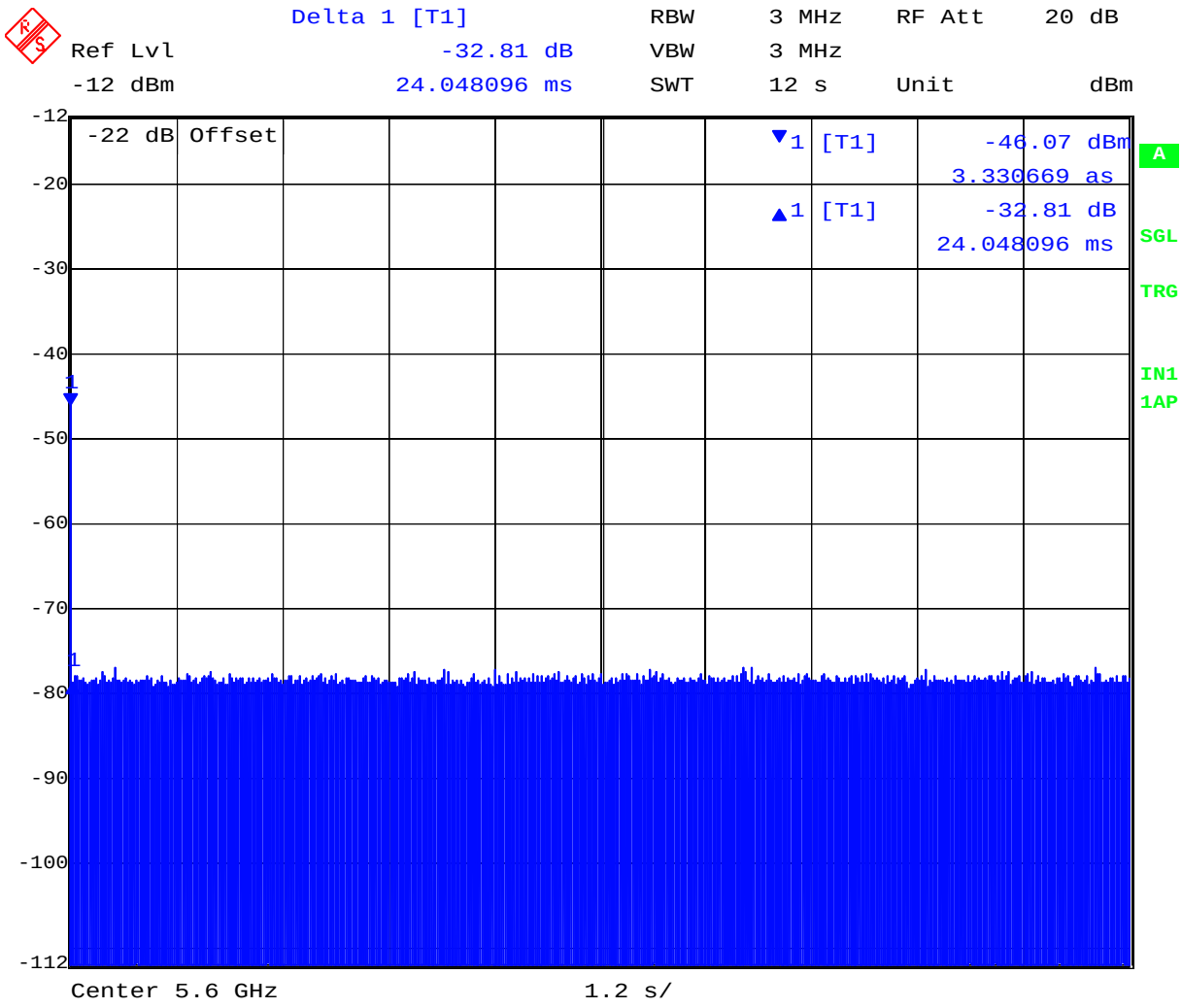
(Rt is the period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

Channel Move Time = 85.704 – 60 – 24.277 = 1.427 mSecs

Channel Move Time, Channel closing Transmission Time for (32 MHz QPSK)
Type 2 Radar
1.1µs, 197 prf, 24 pulses

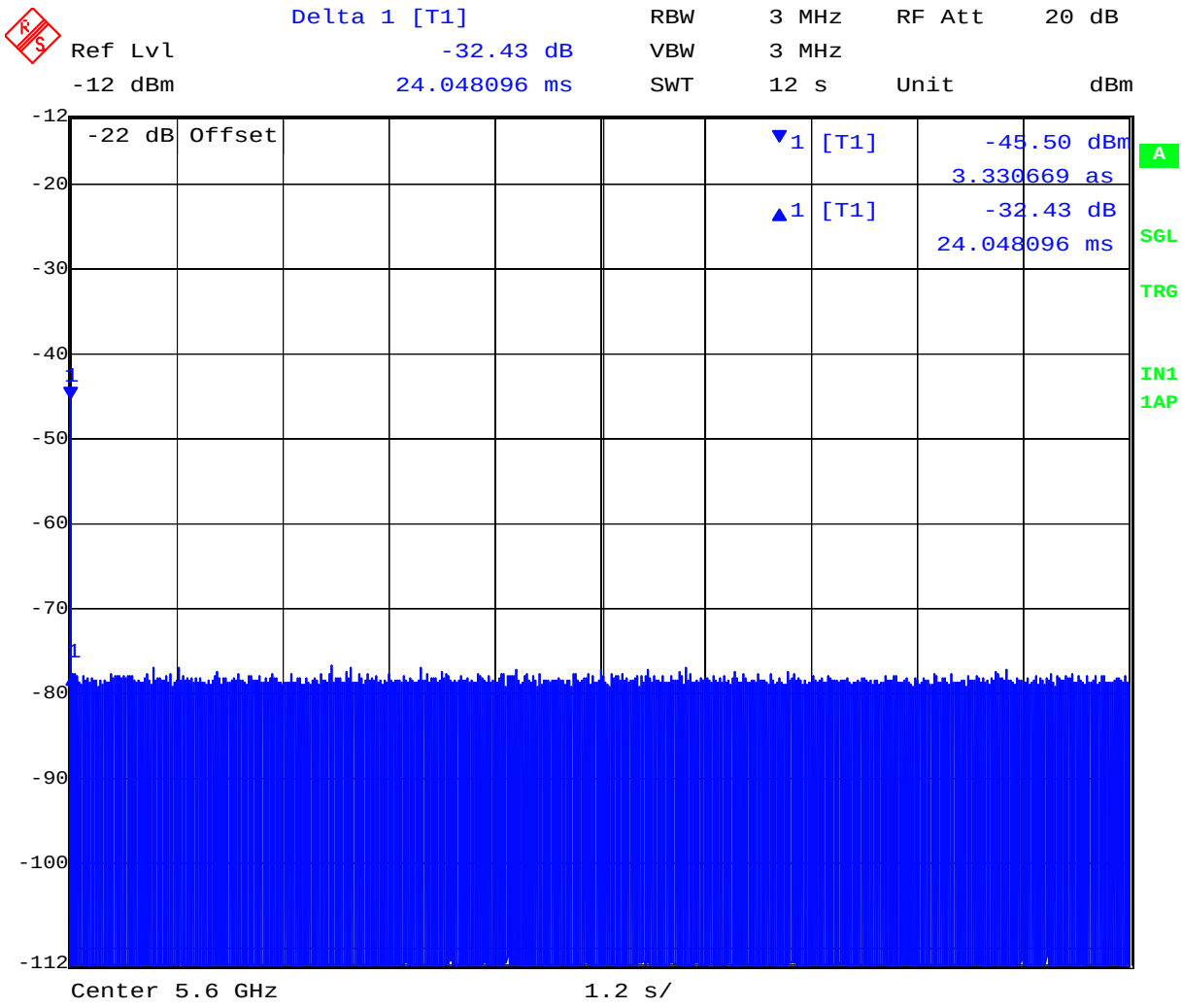


Channel Move Time, Channel closing Transmission Time (32 MHz QPSK) for Type 3 Radar 6.2 µs, 259 prf, 17 pulses



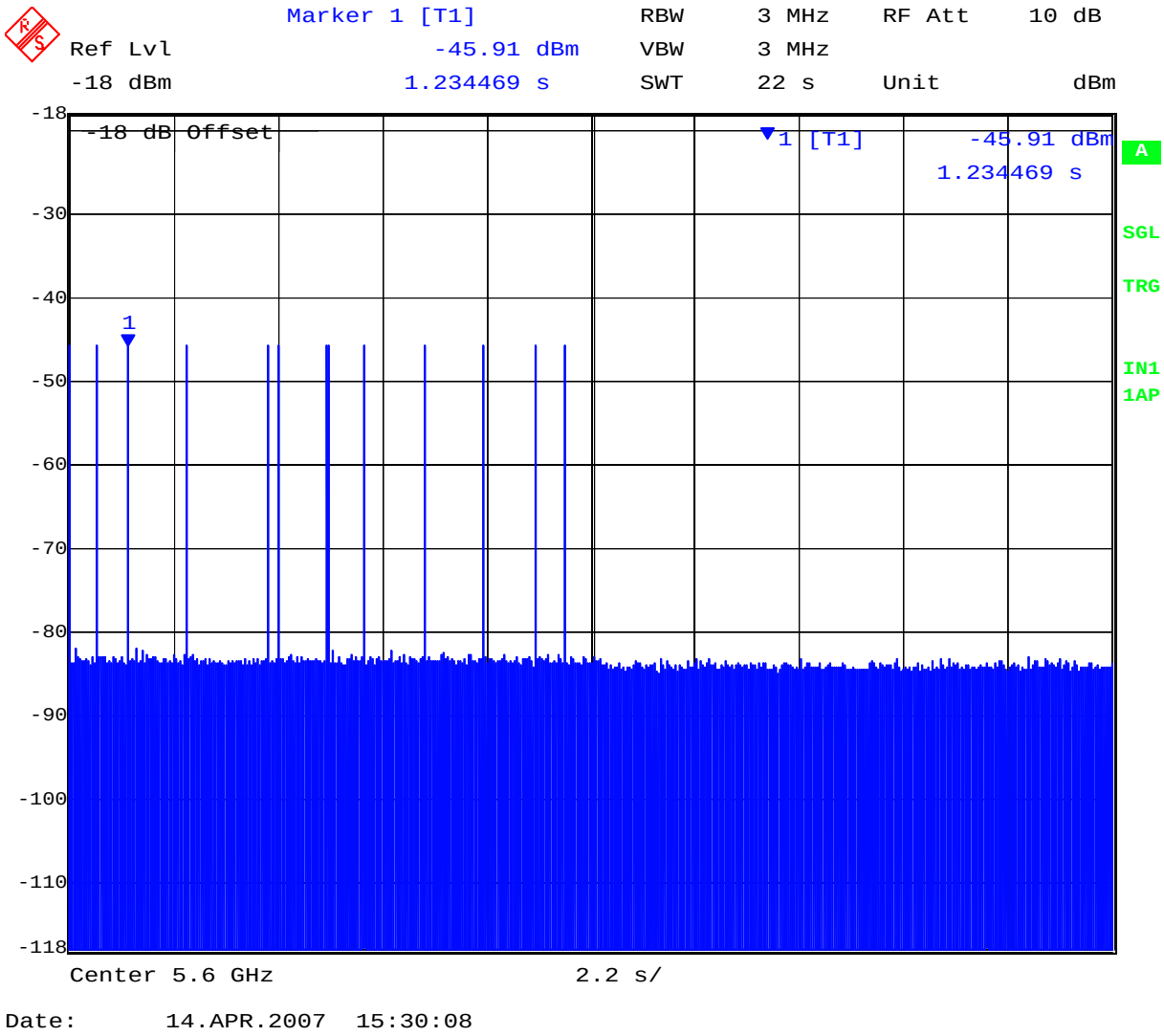
Date: 14.APR.2007 09:55:07

Channel Move Time, Channel closing Transmission Time (32 MHz QPSK) for Type 4 Radar 11.6 µs, 283 prf, 13 pulses



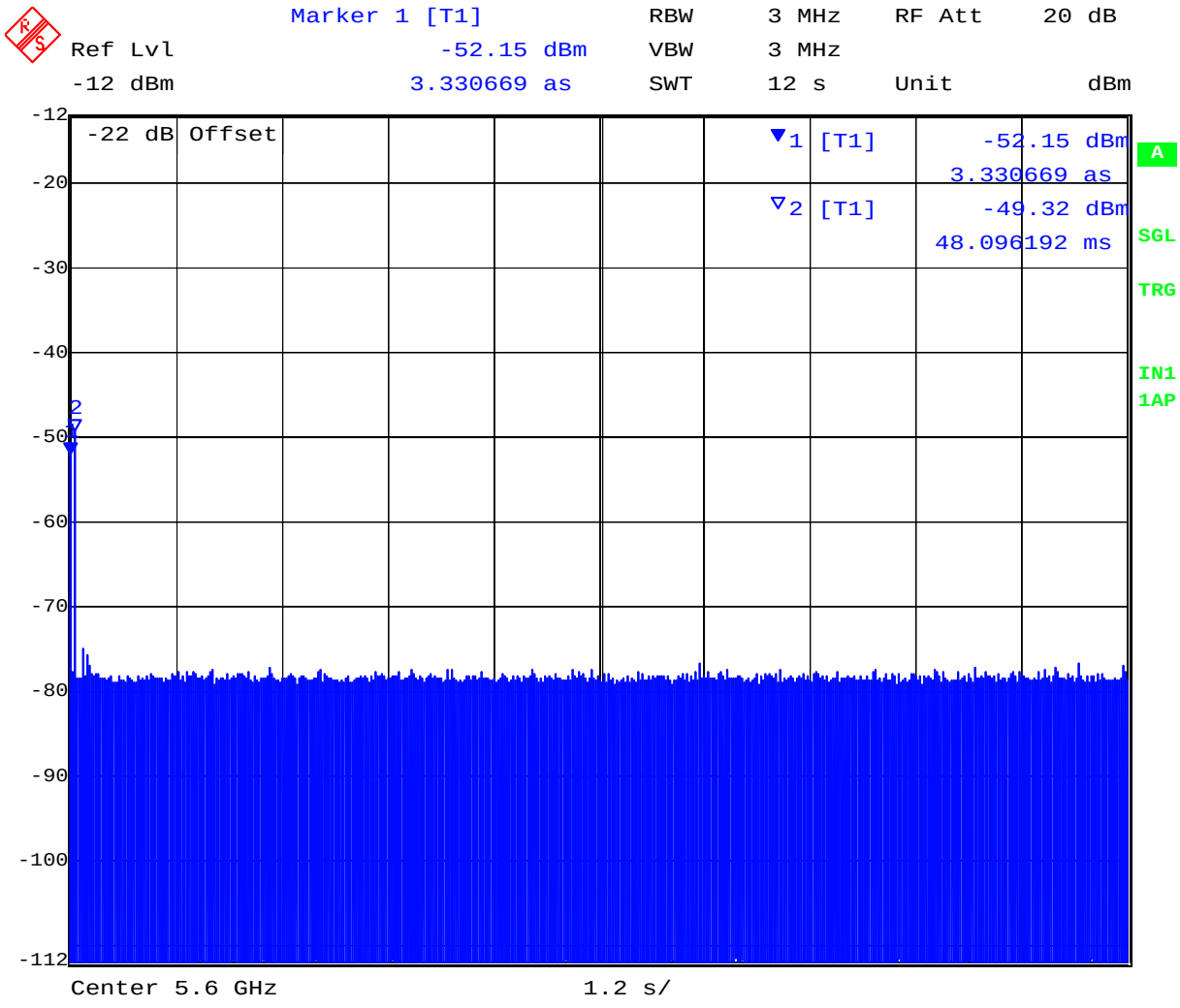
Date: 14.APR.2007 10:00:28

Channel Move Time, Channel closing Transmission Time (32 MHz QPSK) for Type 5 Radar



With reference to the requirements of FCC MO & O 06-96;- The instant that the Chanel Move Time and Channel Closing Time begins for the long Pulse Radar Test Signal is the instant at the end of the 12 Second period defining the Radar Waveform. From the above plot is can be seen that the EUT stopped transmitting data before completion of the Radar Test Signal, therefore the Channel Closing Time and Channel Move time complies with the requirements.

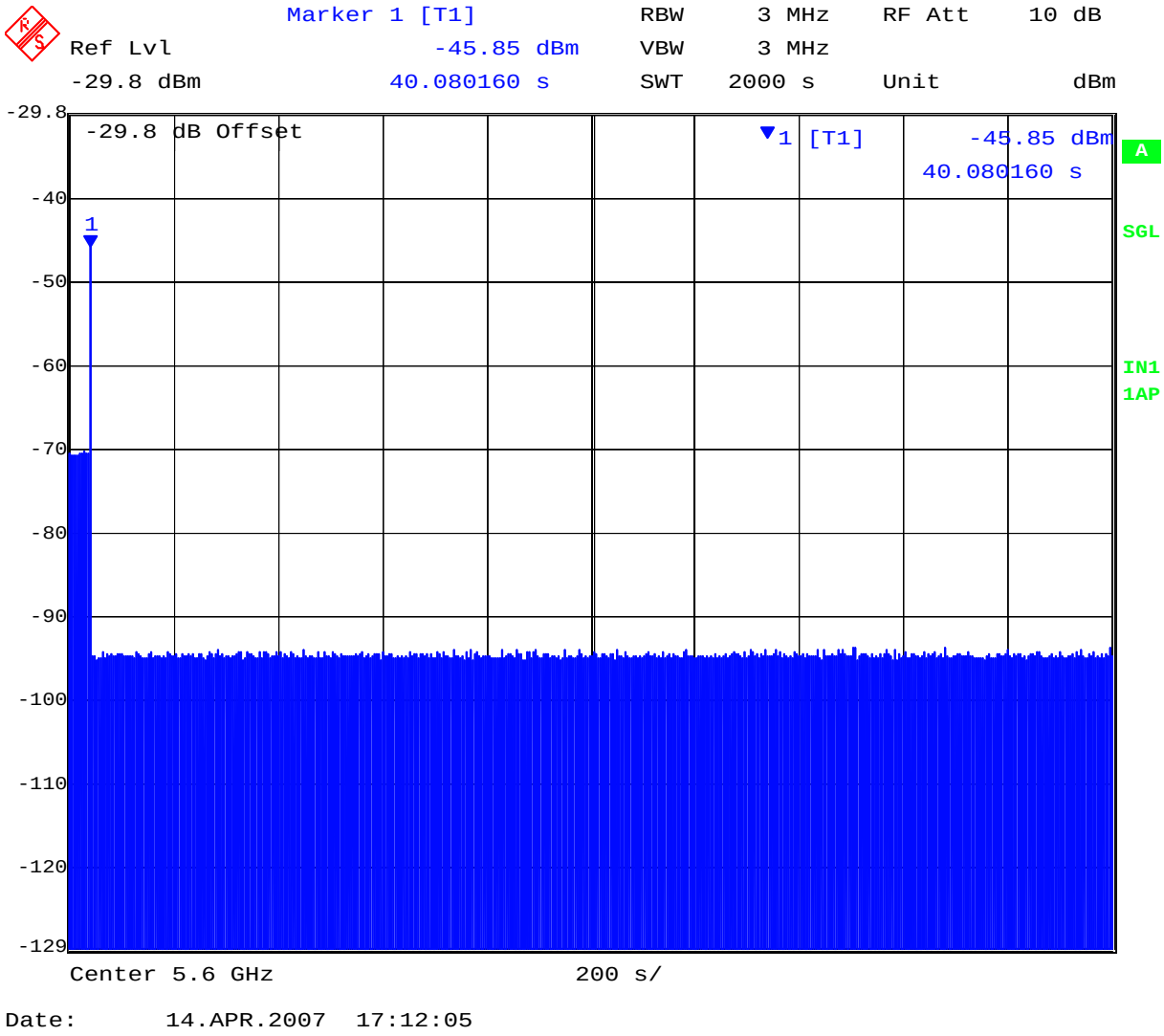
Channel Move Time, Channel closing Transmission Time (32 MHz QPSK) for Type 6 Radar



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 (32 MHz QPSK) Type 1 Radar Ch 5500 MHz



6.9.6. 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 5600 MHz. 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:

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.

(32 MHz QPSK)- Verification of Detection

Trail #	Detection = 1, No Detection = 0			
	Type 1	Type 2	Type 3	Type 4
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1
29	1	1	1	1
30	1	1	1	1
Detection Percentage	100% (>60%)	100% (>60%)	100% (>60%)	100% (>60%)

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

$P_d1 + P_d2 + P_d3 + P_d4 = (100\% + 100\% + 100\% + 100\%) = 100\%$ (> 80%)

(32 MHz QPSK) Radar Type 5 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	100% (>60%)

(32 MHz QPSK) Radar Type 6 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	0
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	96.7% (>60%)

6.10. DFS Test Results 64 MHz QPSK

6.10.1. UNII Detection Bandwidth: (64 MHz QPSK)

All UNII channels for this device have identical channel bandwidths and DFS testing was completed in the 5250 - 5350 MHz, & 5470 - 5725 MHz.

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 5600 MHz at a level of -46dBm (Ref Section 6.6). 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:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.

EUT Frequency=5600MHz (64 MHz QPSK)											
Radar Frequency (MHz)	**DFS Detection Trials (1=Detection, Blank= No Detection)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Detection Rate (%)**
											0%
5567	0	0	0	0	0	0	0	0	0	0	0%
5568 (F_L)	1	1	1	1	1	1	1	1	1	1	100%
5569	1	1	1	1	1	1	1	1	1	1	100%
5570	1	1	1	1	1	1	1	1	1	1	100%
↕	1	1	1	1	1	1	1	1	1	1	100%
	1	1	1	1	1	1	1	1	1	1	100%
5595	1	1	1	1	1	1	1	1	1	1	100%
5596	1	1	1	1	1	1	1	1	1	1	100%
5597	1	1	1	1	1	1	1	1	1	1	100%
5598	1	1	1	1	1	1	1	1	1	1	100%
5599	1	1	1	1	1	1	1	1	1	1	100%
5600	1	1	1	1	1	1	1	1	1	1	100%
5601	1	1	1	1	1	1	1	1	1	1	100%
5602	1	1	1	1	1	1	1	1	1	1	100%
5603	1	1	1	1	1	1	1	1	1	1	100%
5604	1	1	1	1	1	1	1	1	1	1	100%
5605	1	1	1	1	1	1	1	1	1	1	100%
↕	1	1	1	1	1	1	1	1	1	1	100%
	1	1	1	1	1	1	1	1	1	1	100%
5624	1	1	1	1	1	1	1	1	1	1	100%
5625	1	1	1	1	1	1	1	1	1	1	100%
5626	1	1	1	1	1	1	1	1	1	1	100%
5627	0	1	1	1	1	1	1	1	1	1	90%
5628 (F_H)	1	1	1	1	1	1	1	1	1	1	100%
5629	0	0	0	0	0	0	0	0	0	0	
Detection Bandwidth = F_H-F_L = 5628 MHz-5568 MHz = 60 MHz											
EUT 99% Bandwidth = 64.729 MHz											
64.729 MHz *80% = 51.783 MHz											

For each frequency step the minimum percentage detection is 90%

6.10.2. Initial Channel Availability Check Time (64 MHz QPSK)

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.

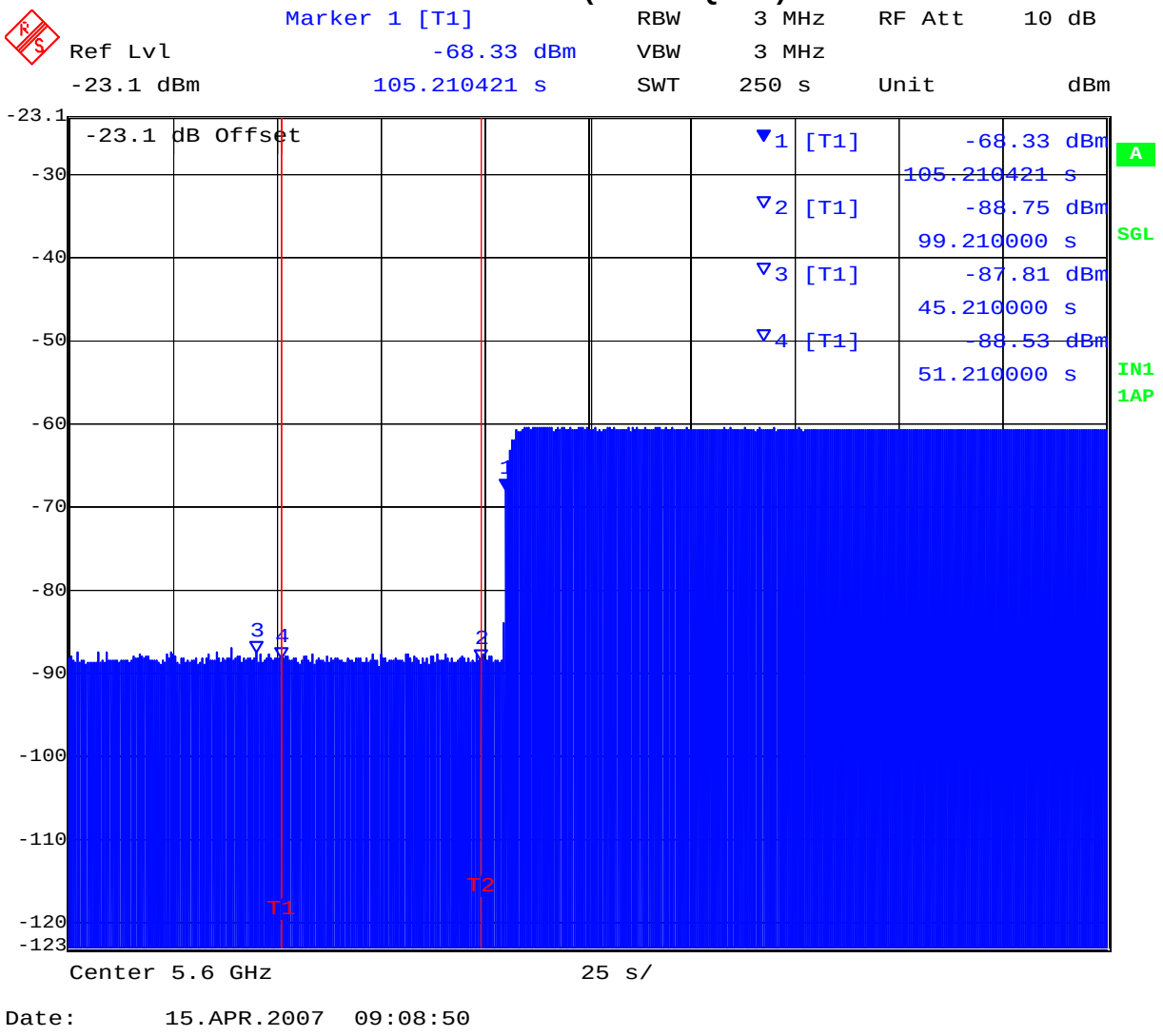
The U-NII device is powered on and be instructed to operate at 5600 MHz. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 3 MHz resolution bandwidth at 5600 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to 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 EUT is powered on at T0. Marker ▼3 denotes the instant when the EUT has completed its power-up sequence and the start of the Channel Availability Check Time that ends after a duration of ▼3 + 60 seconds i.e ▼1 on the following plot.

The Master device requires 45.21 seconds to complete its power-on cycle.

Initial Channel Availability Check Time during power up of EUT
Ch 5600 MHz (64 MHz QPSK)



Date: 15.APR.2007 09:08:50

6.10.3. Radar Burst at the Beginning of the Channel Availability Check Time (64 MHz QPSK)

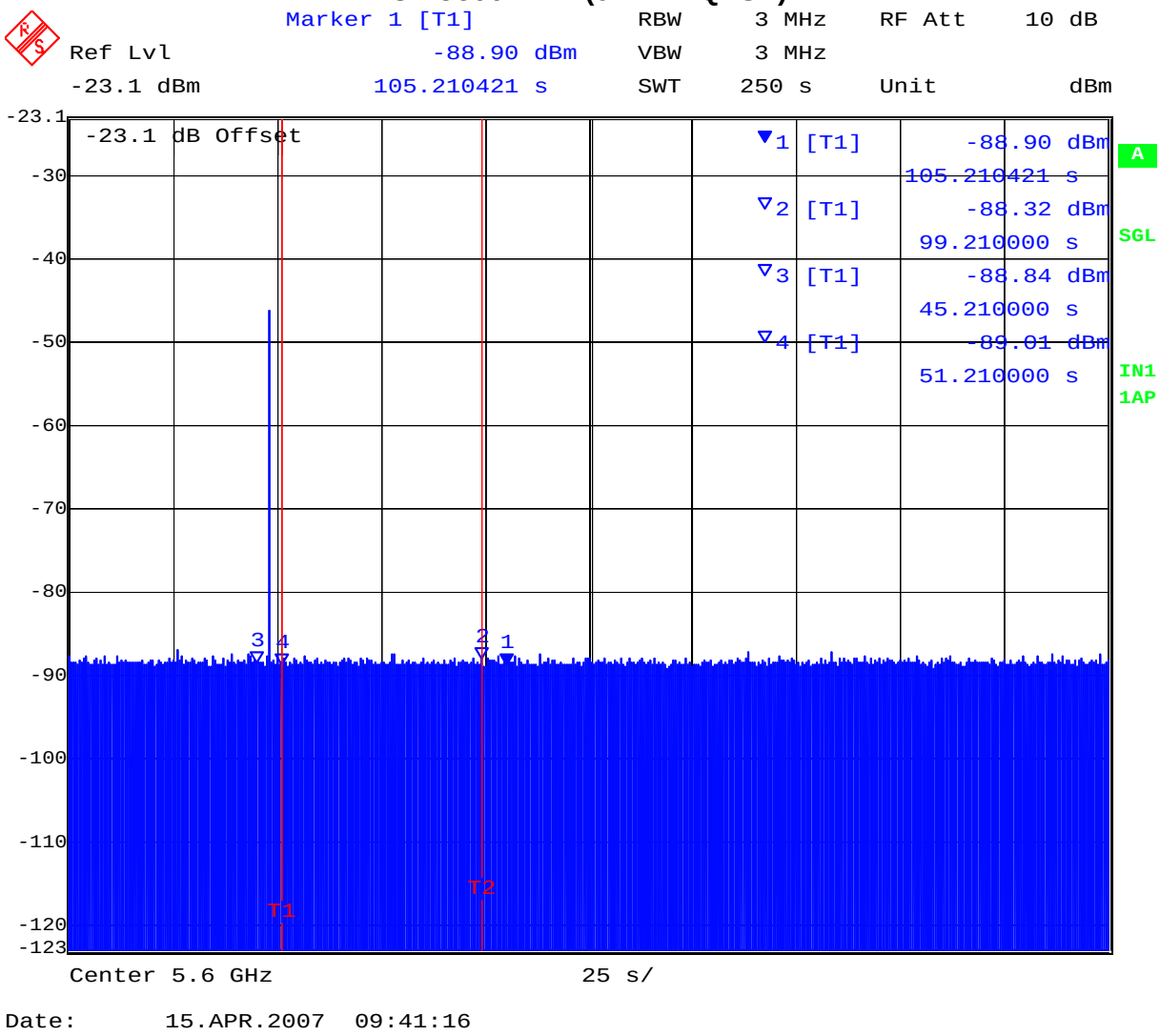
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold + 1 dB (-46 dBm Ref Section 6.6) occurs at the beginning of the Channel Availability Check Time.

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at ▼3.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions have occurred at 5600MHz.

Channel Availability Check Time at the start of the 60 second Check Time
Ch 5600 MHz (64 MHz QPSK)



6.10.4. Radar Burst at the End of the Channel Availability Check Time: (64 MHz QPSK)

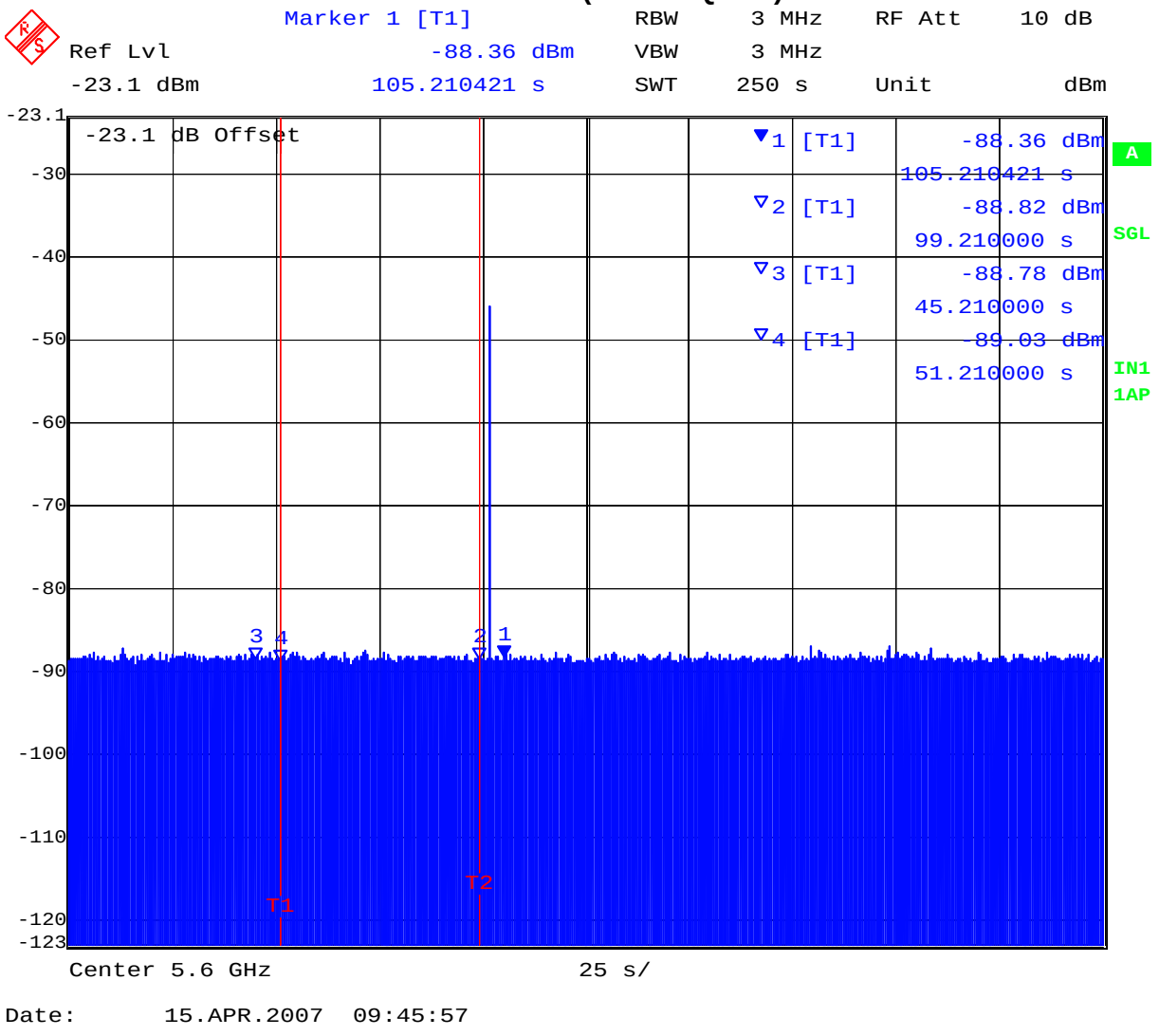
The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel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

The Channel Availability Check Time is defined on the following plot by the 60 second period starting at marker ▼3 and ending at ▼1. A single burst of radar type 1 will commence within a 6 second window starting at marker ▼3+ 54 seconds.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5600MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions occurred at 5600MHz.

Channel Availability Check Time at the end of the 60 second Check Time
Ch 5600 MHz (64 MHz QPSK)



6.10.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period (64 MHz QPSK)

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 captured, collecting nearly 250M samples of data, which included 60ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The Aeroflex PXI was setup to capture data for all transmission events above a threshold level of -46dBm. The PXI time stamps all captured events with respect to T_0 (zero time indicating the start of the measurements sequence) starting the 60 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 60ms

Type 1 burst period 24.277ms

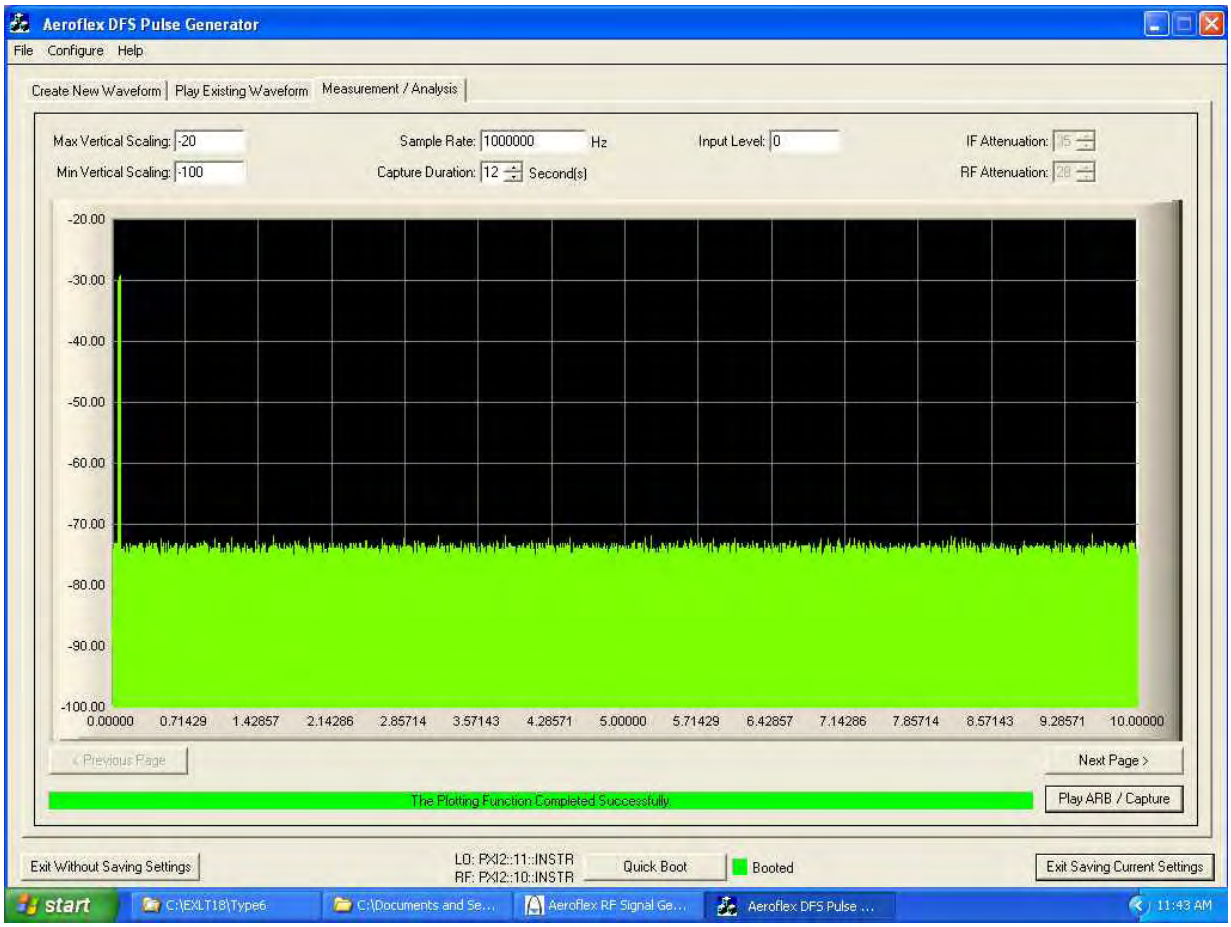
(The period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

Channel Closing Transmission Time starts at 84.277ms after T_0.

Therefore, pulses seen after this 84.277ms 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 8 µs of transmission time accrued.

Channel Closing Transmission Time = 8 µSecs (limit 260 mSecs)

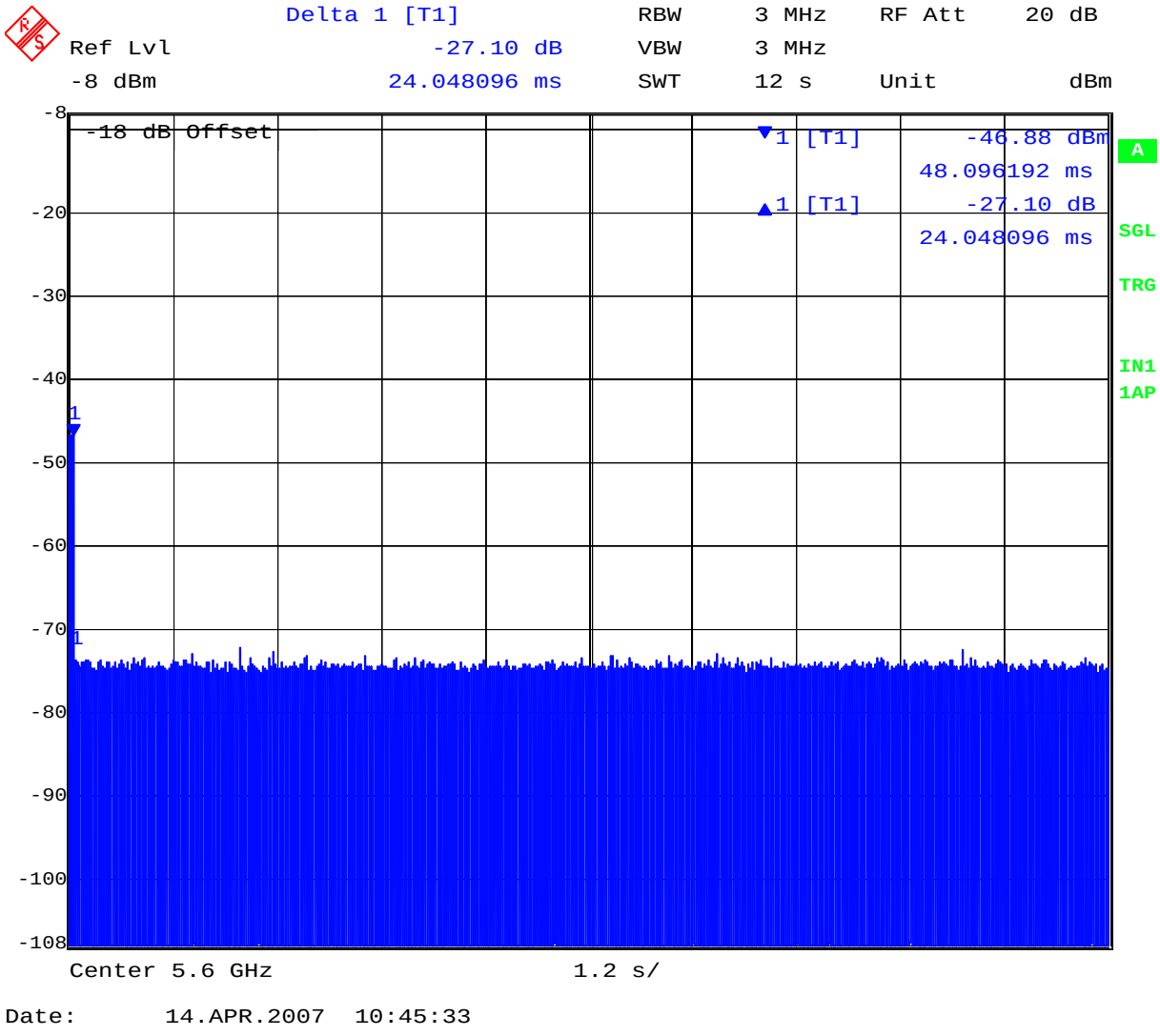
Channel Move Time, Channel Closing Time for Type 1 Radar(64 MHz QPSK)
Captured by Aeroflex PXI Test System



Additionally, a redundant conventional spectrum analyzer screen capture is provided to correlate against the digitizer screen capture for verification purposes.

Note;- no pre-trigger data interval (60 mSecs) was included in the following Spectrum Analyzer plot

Channel Move Time, Channel Closing Time for Type 1 Radar(64 MHz QPSK) Captured by Spectrum Analyzer



The following data was captured by the Aeroflex PXI test System and is used to calculate the Channel Closing Transmission Time for the EUT **(64 MHz QPSK)** with the intervention of Radar Type 1.

Sample Number: 85698	Rising Edge,	Sample Time Stamp	0.085698	
Sample Number: 85706	Falling Edge,	Sample Time Stamp	0.085706*	8E-06

Total = 8E-06 Secs

* Represents the last transmission activity of the EUT. The 0.085706*second time stamp is used to calculate Channel Move Time.

Channel Move Time (64 MHz QPSK)– Measurement & Calculation Type 1 Radar

The Channel Move Time is calculated using the data captured for the Channel Closing time as follows;-

Channel Move Time = Ft – Pt - Rt

Where;-

Ft = Final transmission activity occurred at 85.706 mSeconds

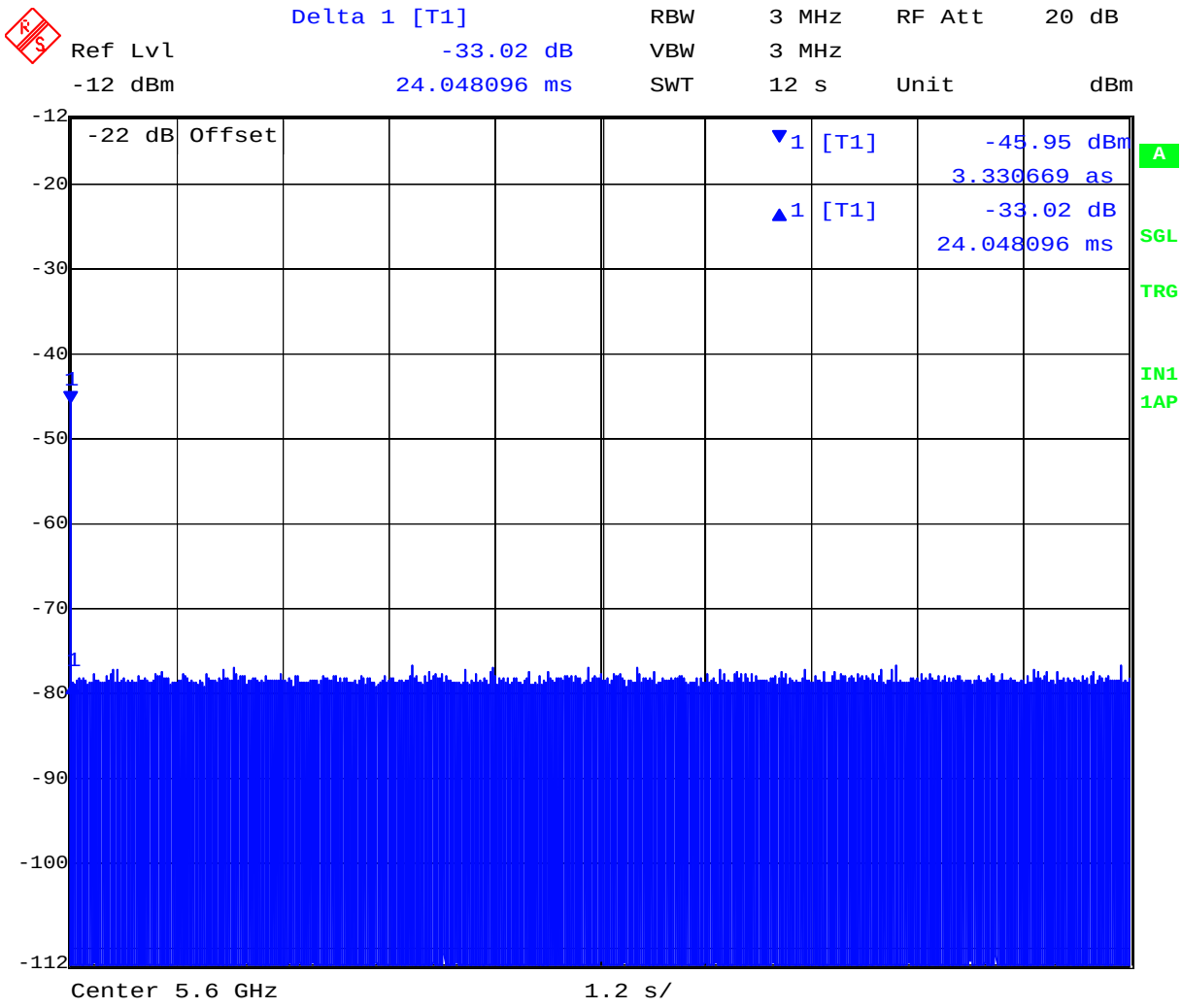
Pt = Pre-trigger information 60 mS

Rt = Type 1 burst period 24.277 mS

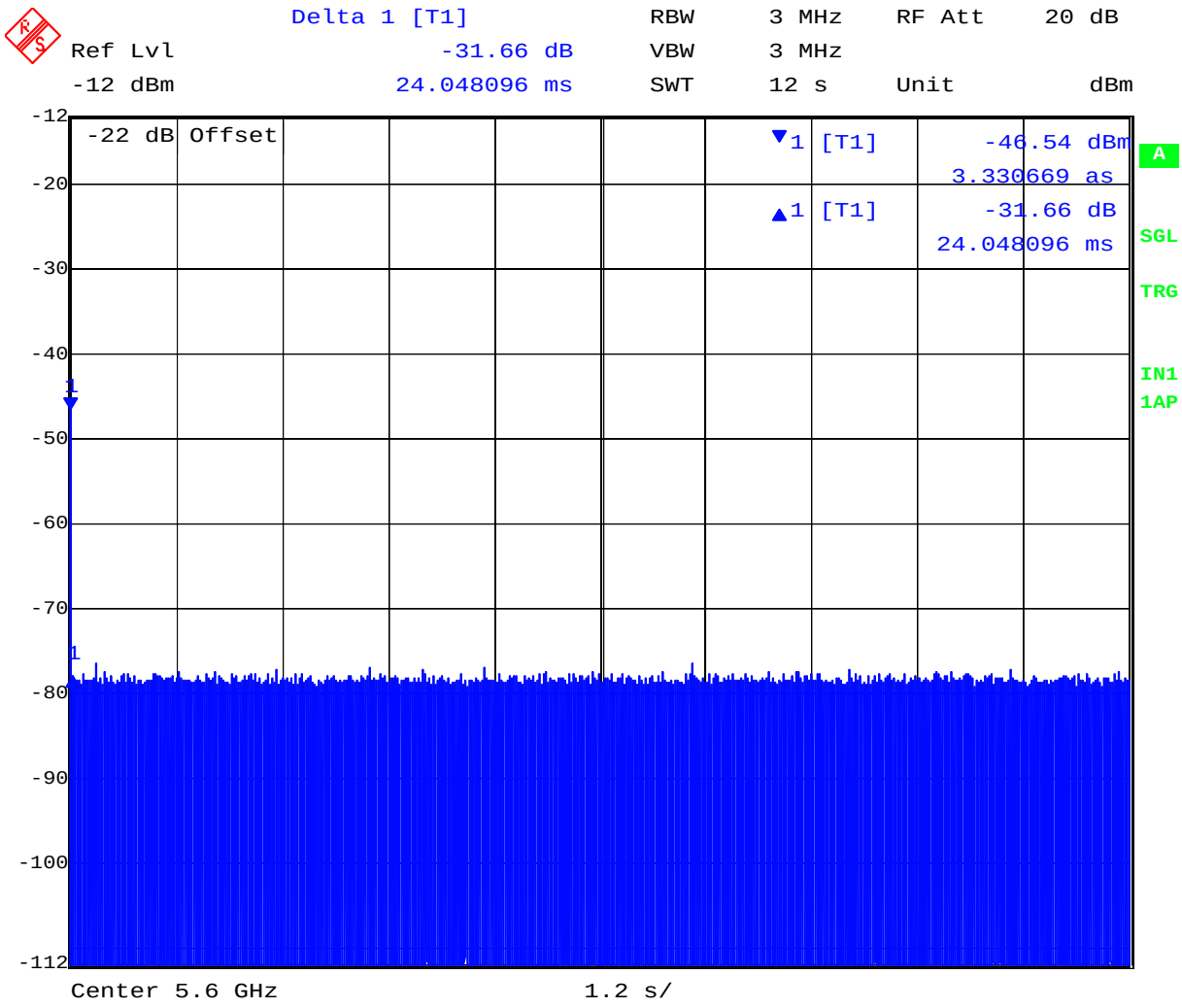
(Rt is the period of the 18 pulse burst includes [17 pulses *1.428mS PRI] = 24.276ms. Then add 1µs pulse width for the final pulse.)

Channel Move Time = 85.706 – 60 – 24.277 = 1.429 mSecs

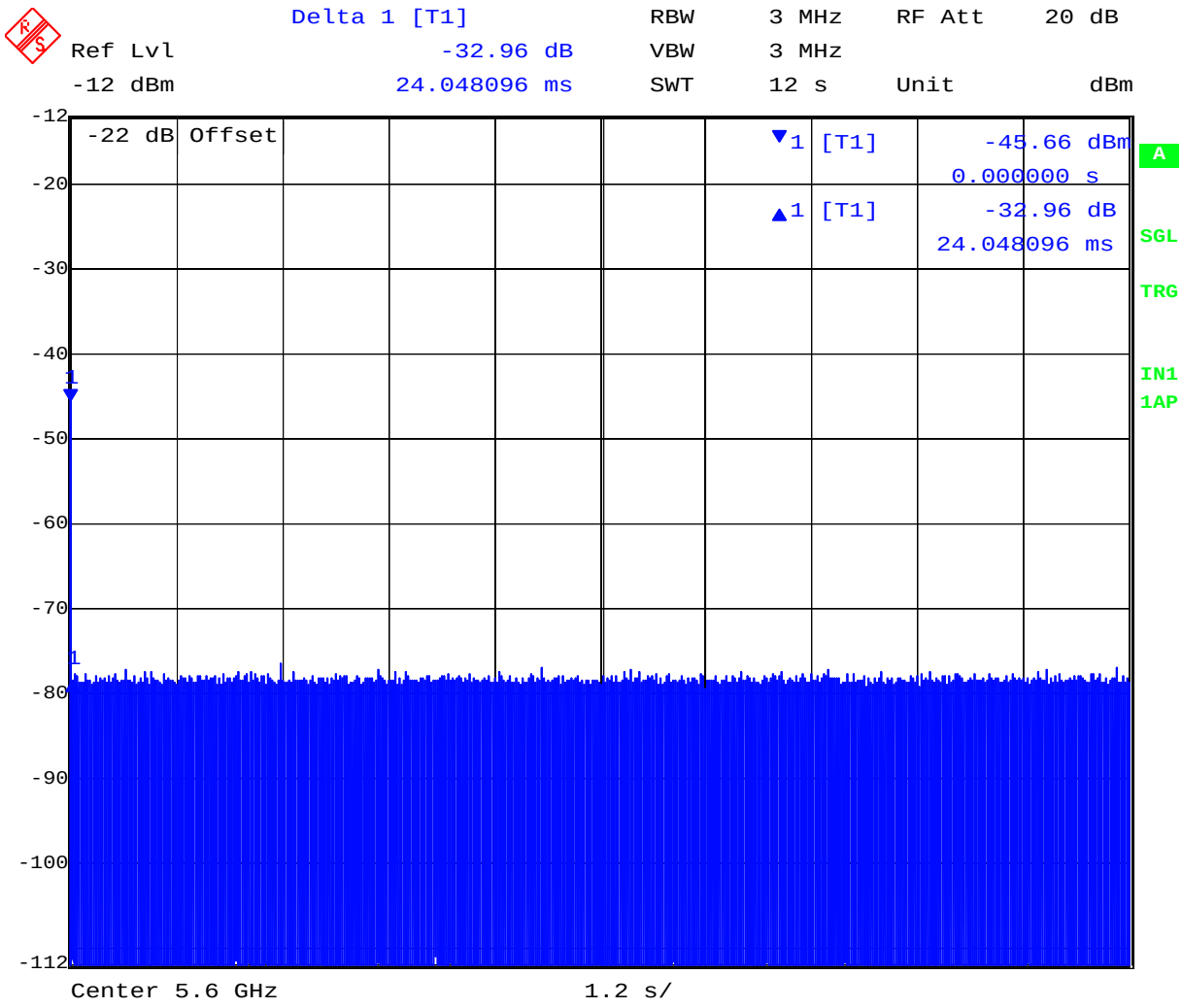
Channel Move Time, Channel closing Transmission Time for (64 MHz QPSK)
Type 2 Radar
1.1µs, 197 prf, 24 pulses



Channel Move Time, Channel closing Transmission Time (64 MHz QPSK) for Type 3 Radar
6.2 µs, 259 prf, 17 pulses

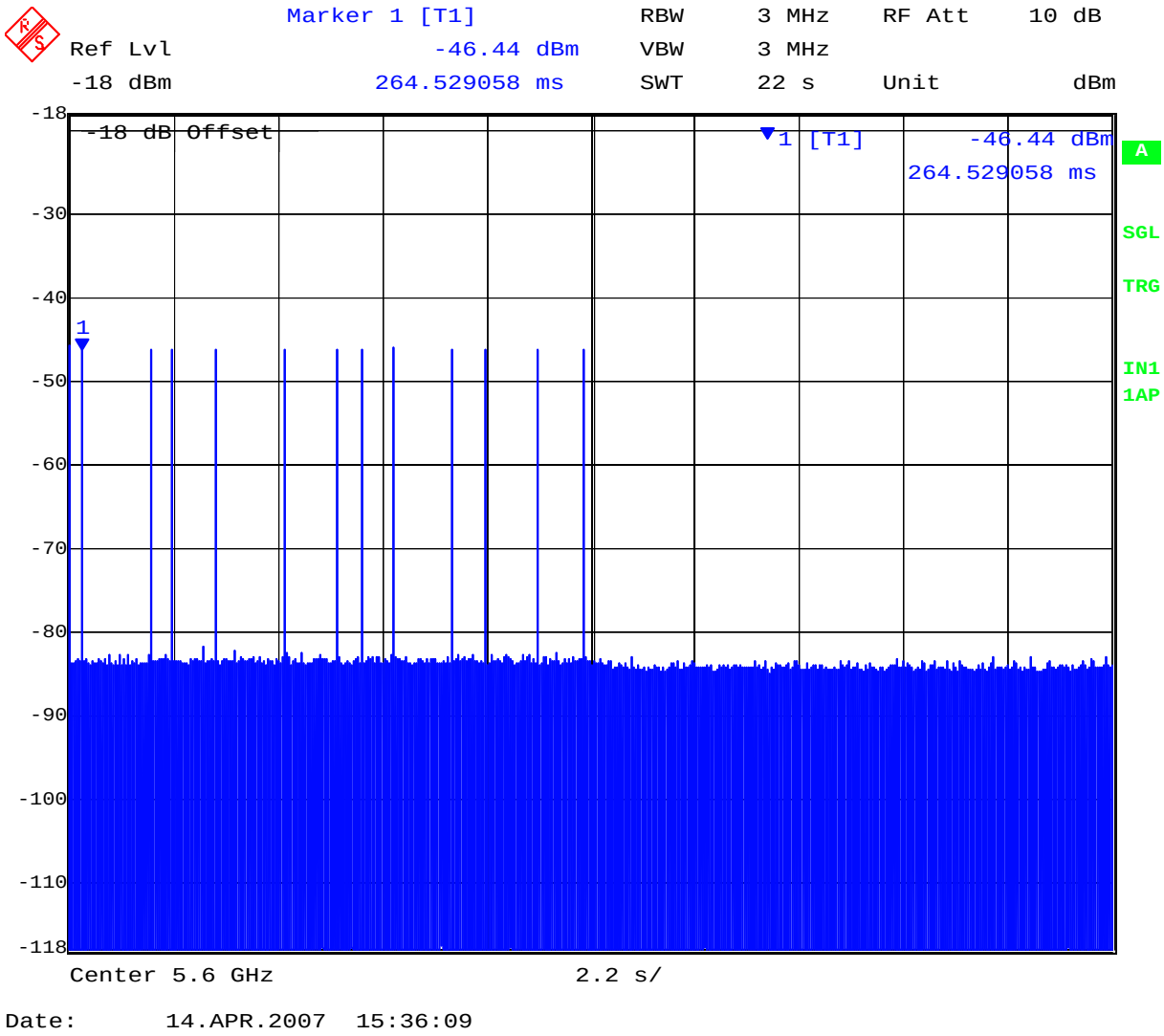


Channel Move Time, Channel closing Transmission Time (64 MHz QPSK) for Type 4 Radar
11.6 µs, 283 prf, 13 pulses



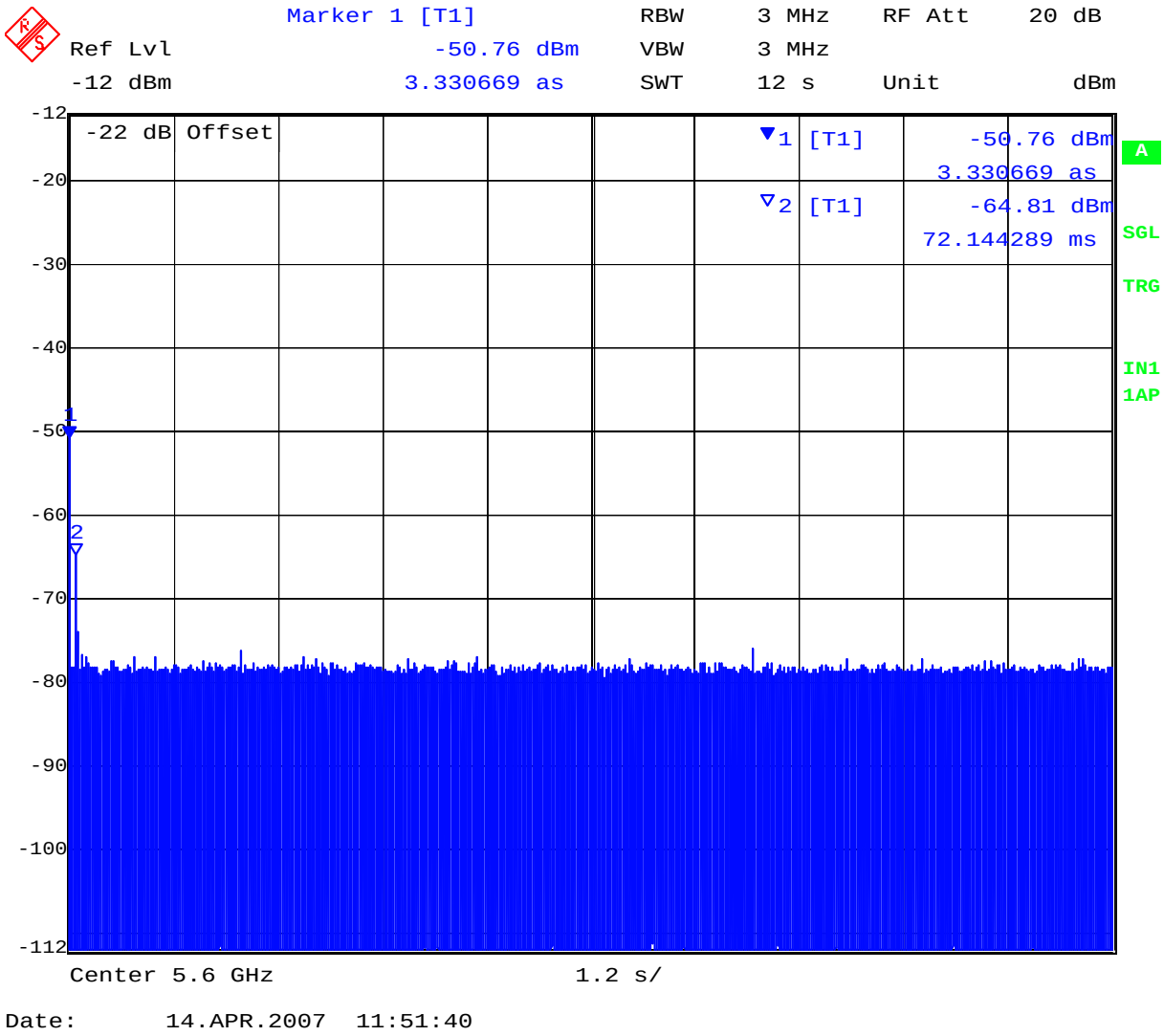
Date: 14.APR.2007 10:02:04

Channel Move Time, Channel closing Transmission Time (64 MHz QPSK) for Type 5 Radar



With reference to the requirements of FCC MO & O 06-96;- The instant that the Chanel Move Time and Channel Closing Time begins for the long Pulse Radar Test Signal is the instant at the end of the 12 Second period defining the Radar Waveform. From the above plot is can be seen that the EUT stopped transmitting data before completion of the Radar Test Signal, therefore the Channel Closing Time and Channel Move time complies with the requirements.

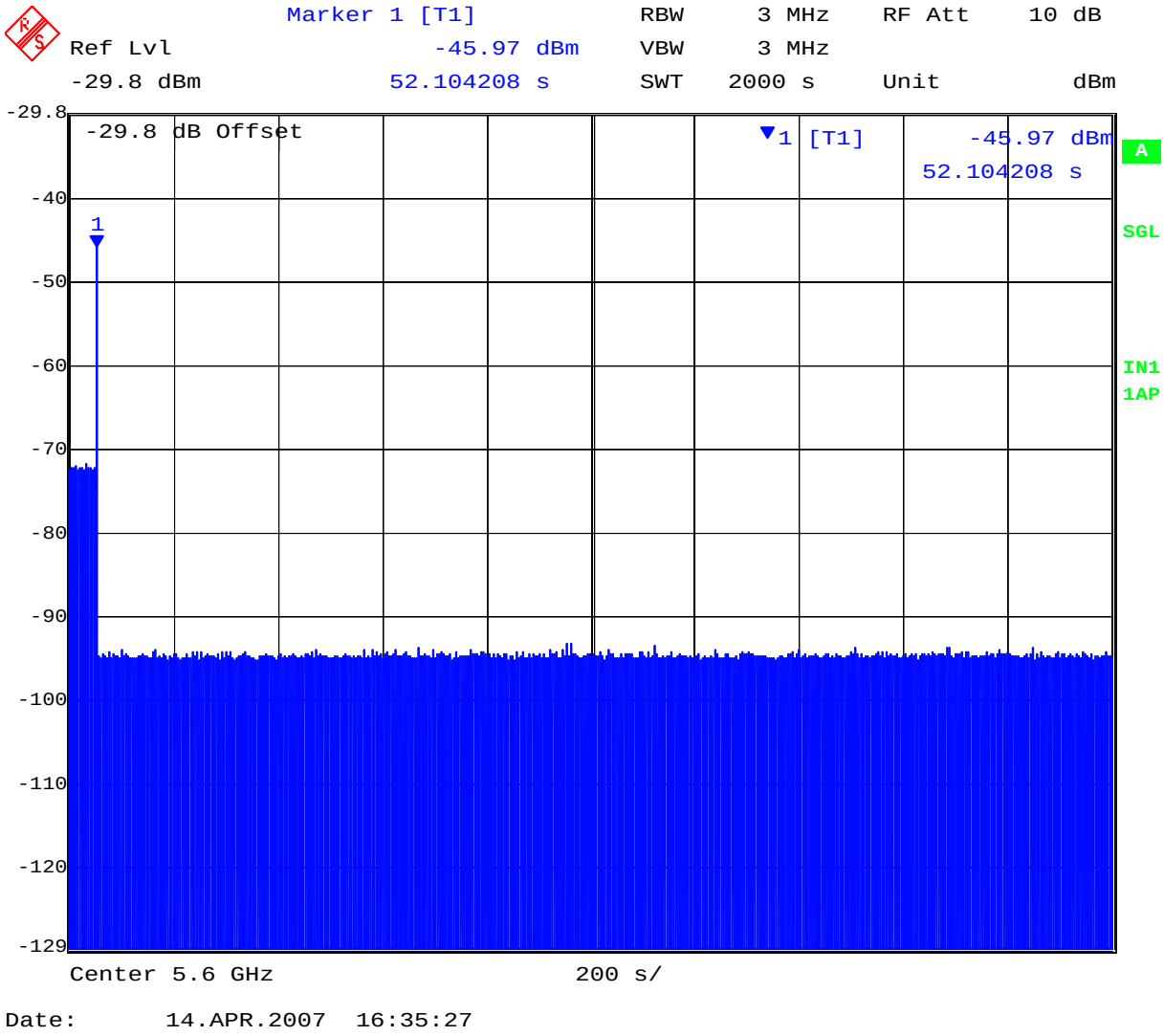
Channel Move Time, Channel closing Transmission Time (64 MHz QPSK) for Type 6 Radar



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 (64 MHz QPSK) Type 1 Radar Ch 5500 MHz



6.10.6. 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 5600 MHz. 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:

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.

(64 MHz QPSK)- Verification of Detection

Trail #	Detection = 1, No Detection = 0			
	Type 1	Type 2	Type 3	Type 4
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1
29	1	1	1	1
30	1	1	1	1
Detection Percentage	**100**% (>60%)	**100**% (>60%)	**100**% (>60%)	**100**% (>60%)

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

$P_d1 + P_d2 + P_d3 + P_d4 = (100\% + 100\% + 100\% + 100\%) = 100\%$ (> 80%)

(64 MHz QPSK) Radar Type 5 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	100% (>60%)

(64 MHz QPSK) Radar Type 6 - Verification of Detection

Trail #	Detection = 1 No Detection = 0
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
Detection Percentage	100% (>60%)

Measurement Uncertainty Time/Power

Measurement uncertainty - Time - Power	 4% 1.33dB

Traceability

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

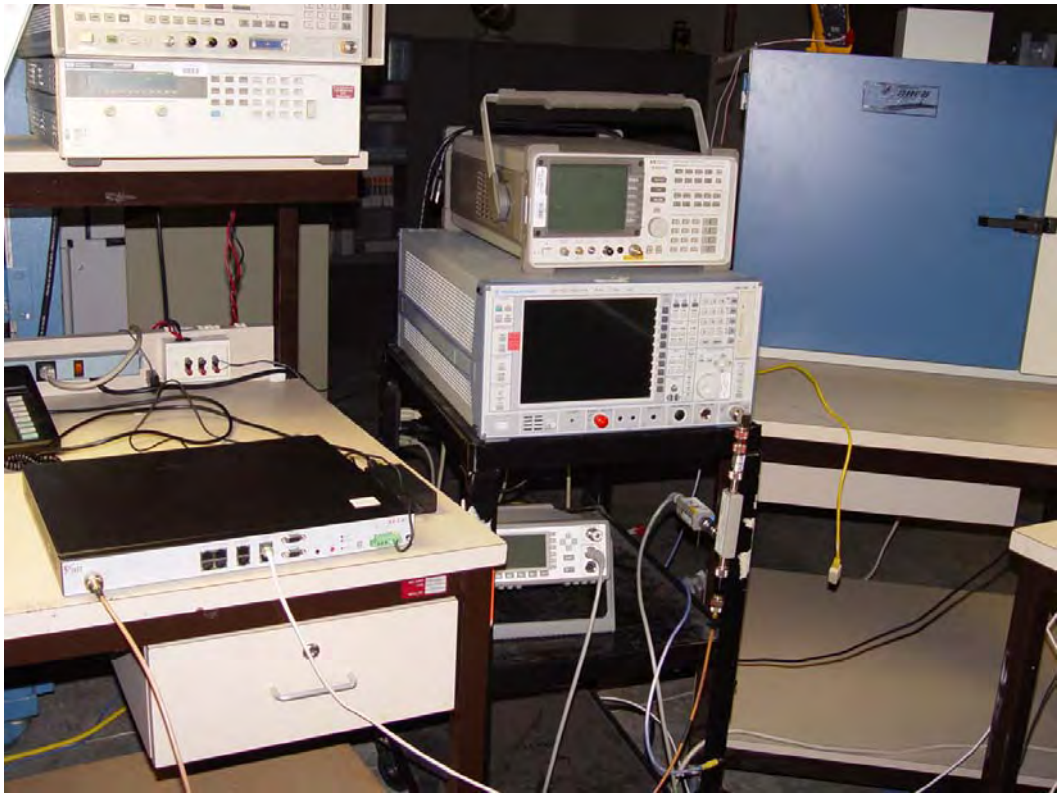
7. PHOTOGRAPHS

7.1. Radiated Emissions (30 MHz-1 GHz)

7.2. Radiated Emissions >1 GHz

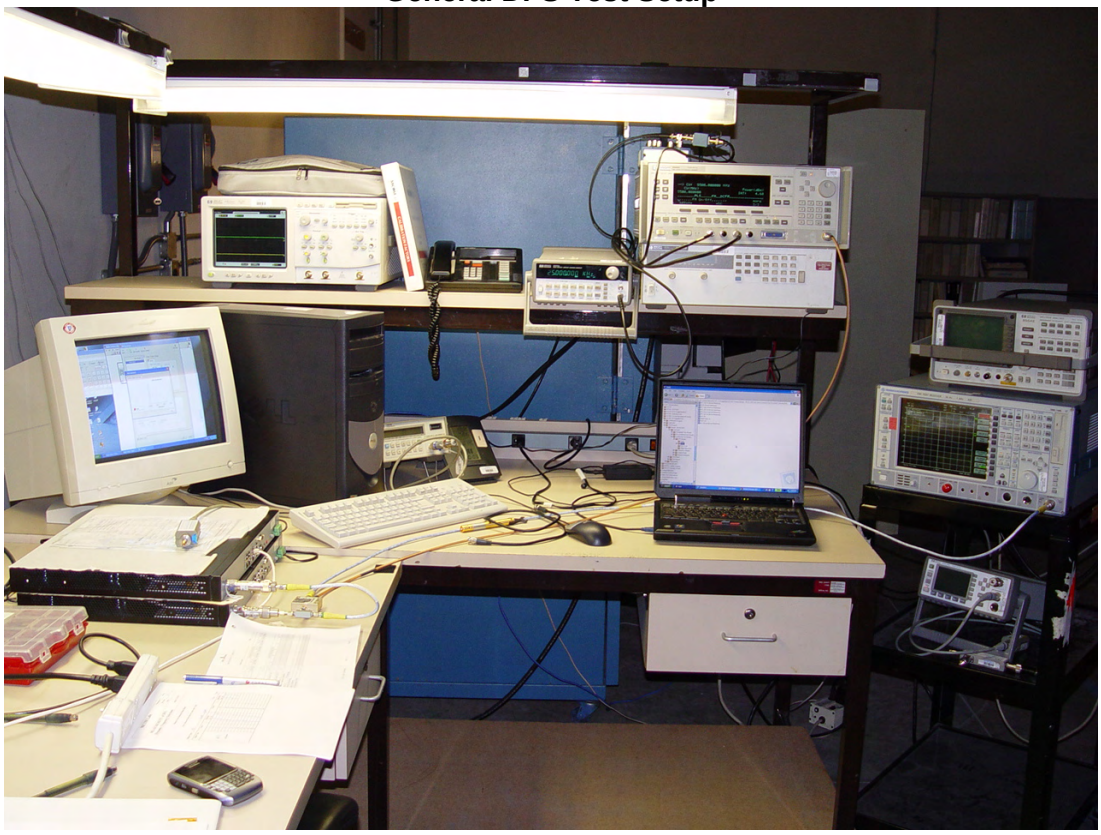
7.3. Conducted Emissions (150 kHz - 30 MHz)

7.4. General Measurement Test Set-Up

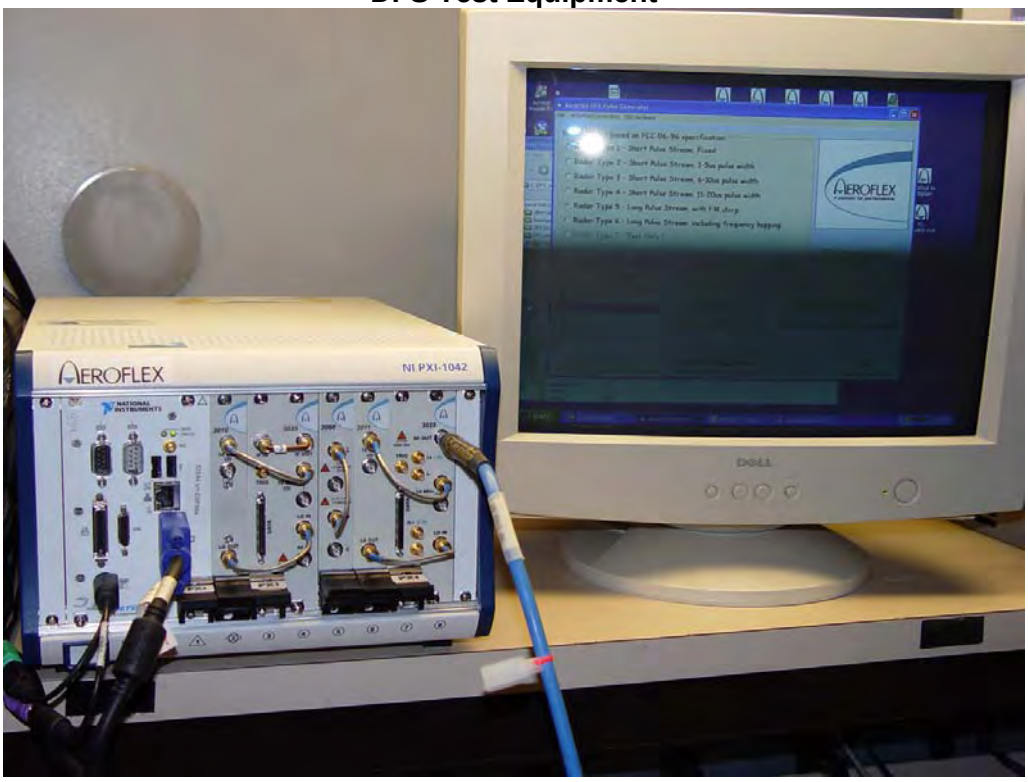


7.5. Dynamic Frequency Selection Test Set-Up

General DFS Test Setup



DFS Test Equipment



DFS Test Equipment

8. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	9205-3882
0134	Amplifier	Com Power	PA 122	181910
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
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
	Radar Signal Generator	Aeroflex	3025, 3010, 3010/11 Opt 1	
	Analyzer	Aeroflex	3035, 3011, 3010/11 Opt 1	
	PXI Chassis	Aeroflex	82536	
	Coupler	Mini-Circuits		
	30dB N-Type Attenuator			
	10dB N-Type Attenuator			
	10dB N-Type Attenuator			

9. Appendix A

As mentioned previously in Section 3.6 "Test Configurations", it was established at the start of the test program that the QPSK modulation scheme has the highest Radiated Emission and Peak Emission levels. The Test Report includes results for all of the QPSK configurations and selected worst case test results for 16QAM and 64QAM configurations.

The worst case test results for 16QAM and 64QAM configurations are reported in this appendix.

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210**.and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.407(b)(2) **15.205(a)** **15.209(a)**	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz	Radiated	Complies	*9.1.1.1*
2.2, 2.6 **A9.3(2)**	Radiated Band Edge	Band edge results	Radiated	Complies	*9.1.1.2*
4.7	Peak Field Strength Measurements		Radiated	Complies	*9.1.1.3*

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*

Band	BW (MHz)	Modulation					
		16QAM			64QAM		
		Low (MHz)	Mid (MHz)	High (MHz)	Low (MHz)	Mid (MHz)	High (MHz)
5.3	8	5260	5296	5332	5260	5296	5332
	16	5265	5296	5327	5265	5296	5327
	32	5272	5290	5308	5272	5290	5308
	64		5290			5290	

9.1.1. Radiated Emissions

9.1.1.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

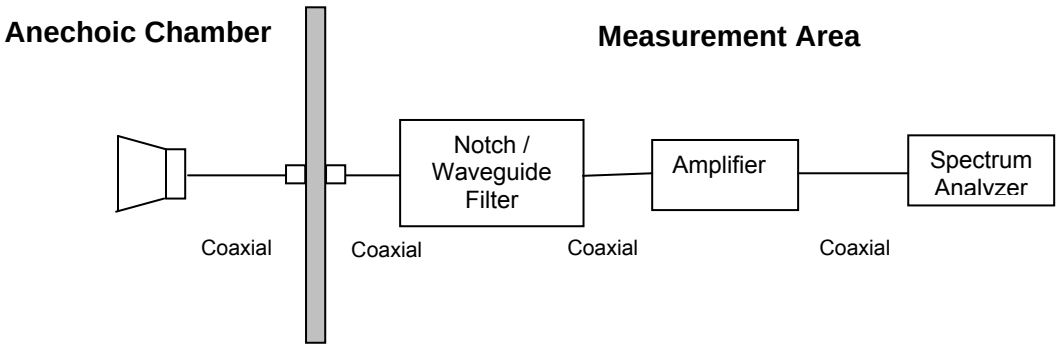
FCC, Part 15 Subpart C §15.407(b)(2), §15.205(a)/15.209(a)
Industry Canada RSS-210 §A9.3(2); §2.2; §2.6; RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength

$E = 1000000 \times \sqrt{30P} / 3$ μV/m, where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m

Measurement Results Transmitter Radiated Spurious Emissions above 1 GHz

Antenna Configuration
28 dBi Panel
37.5 dBi Parabolic

Radio parameters.
Power Level: maximum 28 dBi antenna +2 dBm, 37.5 dBi antenna -7.5dBm
Duty Cycle: 100% (test mode)

Radiated Spurious Emissions above 1 GHz (continued)

16QAM Radiated Emissions 28 dBi Antenna

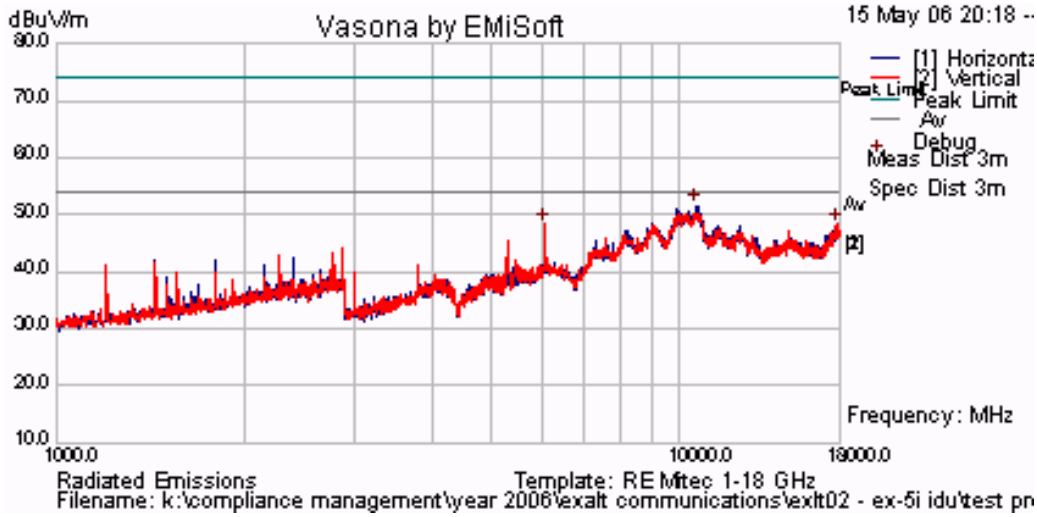
TABLE OF RESULTS – 5,290 MHz 28 dBi Antenna 64 MHz Bandwidth 16QAM

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					54	

Note. No emissions were observed above the limit.

Plot A01

5,290 MHz Radiated Emissions for 28 dBi Antenna 64 MHz Bandwidth 16QAM



Radiated Spurious Emissions above 1 GHz (continued)

64QAM Radiated Emissions 28 dBi Antenna

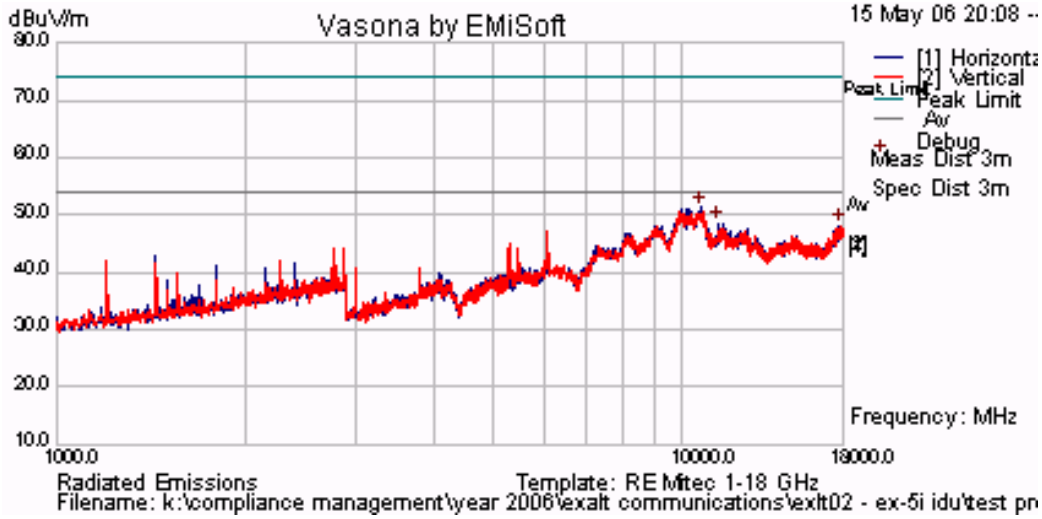
TABLE OF RESULTS – 5,290 MHz 28 dBi Antenna 64 MHz Bandwidth 64QAM

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					54	

Note. No emissions were observed above the limit.

Plot A02

5,290 MHz Radiated Emissions for 28 dBi Antenna 64 MHz Bandwidth 64QAM



Radiated Spurious Emissions above 1 GHz (continued)

16QAM Radiated Emissions 37.5 dBi Antenna

TABLE OF RESULTS –5,290 MHz 37.5 dBi Antenna 64 MHz Bandwidth 16QAM

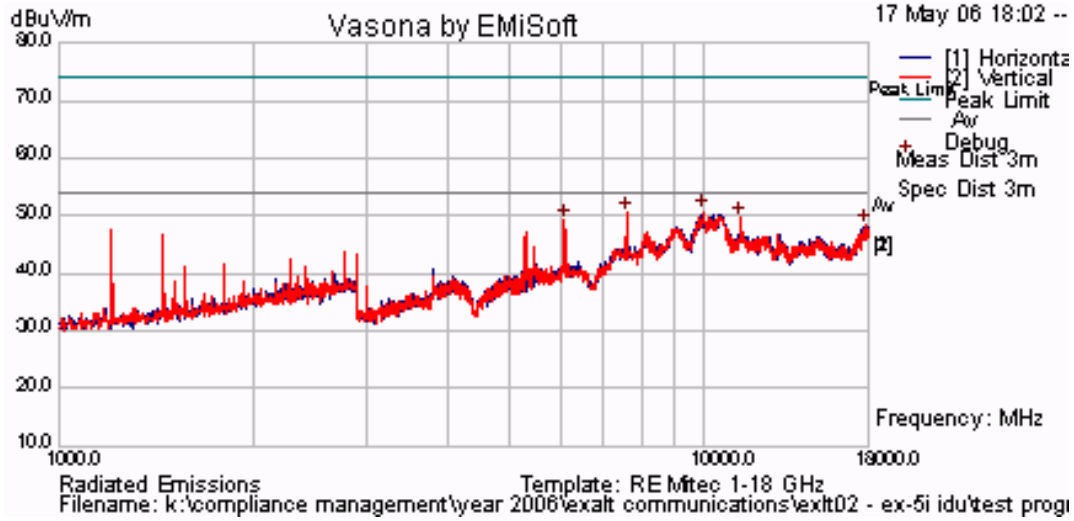
Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					54	

No emissions were observed above the limit.

Radiated Emissions for 37.5 dBi Antenna

Plot A03

5,290 MHz Radiated Emissions for 37.5 dBi Antenna 64 MHz Bandwidth 16QAM



64QAM Radiated Emissions 37.5 dBi Antenna

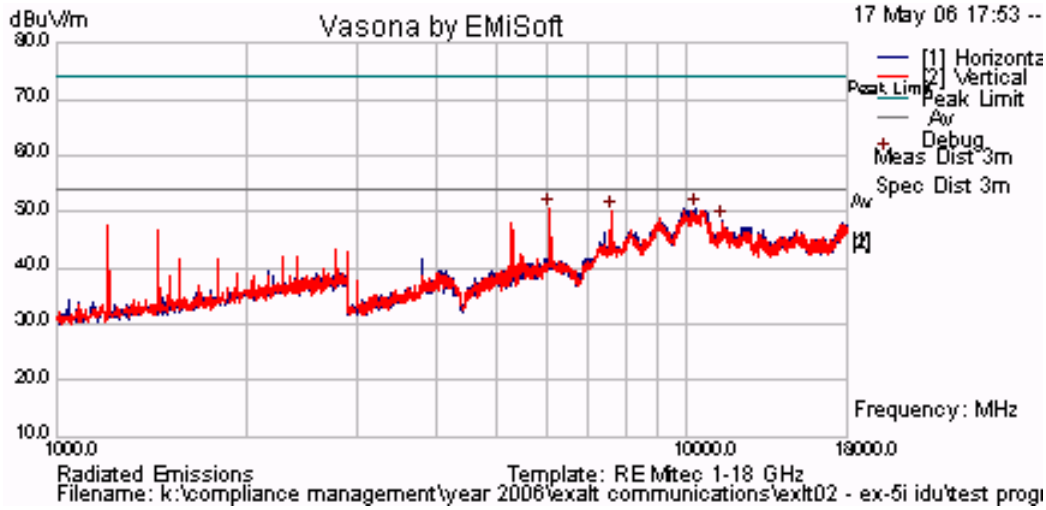
TABLE OF RESULTS – 5,290 MHz 37.5 dBi Antenna 64 MHz Bandwidth 64QAM

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
					54	

No emissions were observed above the limit.

Plot A04

5,290 MHz Radiated Emissions for 37.5 dBi Antenna 64 MHz Bandwidth 64QAM



Specification Limits

15.407 (b)(2). All emissions outside of the 5,150-5,350MHz band shall not exceed an EIRP of -27dBm/MHz.

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

RSS-210 §A9.3(2) For transmitters operating in the 5250-5350 MHz band, all emissions outside the 5150-5350 MHz band shall not exceed -27 dBm/MHz e.i.r.p. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band shall not exceed out of band emission limit of 27 dBm/MHz e.i.r.p. in the 5150-5250 MHz band in order to operate indoor/outdoor, or alternatively shall comply with the spectral power density for operation within the 5150-5250 MHz band and shall be labeled “for indoor use only”.

RSS-Gen §4.7 The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 ‘Measurement of Radiated Emissions’	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

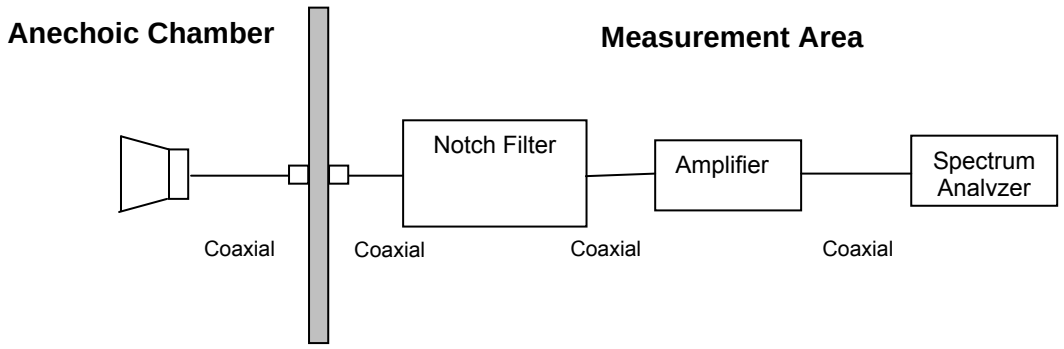
9.1.1.2. Radiated Band-Edge – Restricted Bands

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Band-stop Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Radiated Band Edge - Test Configurations

Antennas

28 dBi Panel Antenna

37.5 dBi Parabolic Antenna

Radiated Band Edge Test Results for 28 dBi Panel Antenna

TABLE OF RESULTS - 5.3 GHz Band - 64 MHz Bandwidth 16QAM

Tx Freq. (MHz)	Restricted Band Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
$5{,}290_{PEAK}$	5,150	62.42	74.00	-11.58
$5{,}290_{AVE}$	5,150	40.87	54.00	-13.13
$5{,}290_{PEAK}$	5,350	72.33	74.00	-1.67
$5{,}290_{AVE}$	5,350	51.29	54.00	-2.71

TABLE OF RESULTS - 5.3 GHz Band - 64 MHz Bandwidth 64QAM

Tx Freq. (MHz)	Restricted Band Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
$5{,}290_{PEAK}$	5,150	62.69	74.00	-11.31
$5{,}290_{AVE}$	5,150	40.87	54.00	-13.13
$5{,}290_{PEAK}$	5,350	72.60	74.00	-1.40
$5{,}290_{AVE}$	5,350	53.97	54.00	-0.03

Radiated Band Edge Test Results for 37.5 dBi Parabolic Antenna

TABLE OF RESULTS - 5.3 GHz Band - 64 MHz Bandwidth 16QAM

Tx Freq. (MHz)	Restricted Band Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
$5{,}290_{PEAK}$	5,150	62.69	74.00	-11.31
$5{,}290_{AVE}$	5,150	40.99	54.00	-13.01
$5{,}290_{PEAK}$	5,350	66.00	74.00	-8.00
$5{,}290_{AVE}$	5,350	44.20	54.00	-9.80

TABLE OF RESULTS - 5.3 GHz Band - 64 MHz Bandwidth 64QAM

Tx Freq. (MHz)	Restricted Band Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
$5{,}290_{PEAK}$	5,150	62.01	74.00	-11.99
$5{,}290_{AVE}$	5,150	40.99	54.00	-13.01
$5{,}290_{PEAK}$	5,350	66.28	74.00	-7.72
$5{,}290_{AVE}$	5,350	45.86	54.00	-8.14

9.1.1.3. Peak Field Strength Measurements

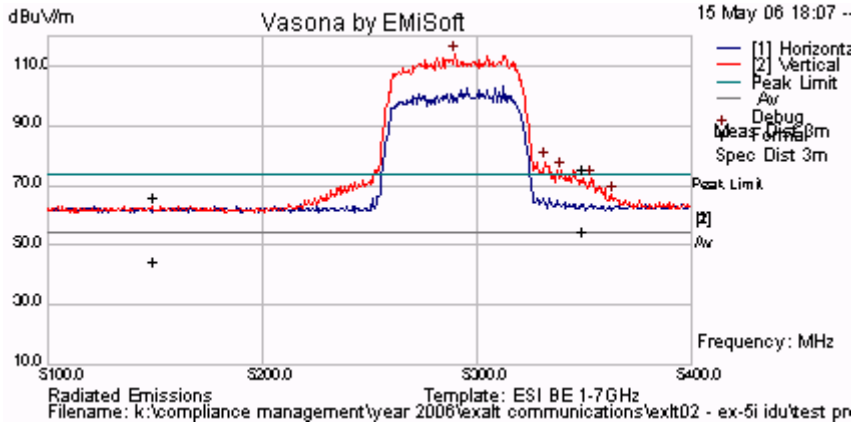
Peak Field Strength Measurements for 28 dBi Antenna

28 dBi Antenna 5,290 **MHz** **64 MHz Bandwidth 16QAM**

Plot A05

28 dBi Antenna 5,290 MHz 64 MHz Bandwidth 16QAM

Peak Emission = 114.95 dBµV/m

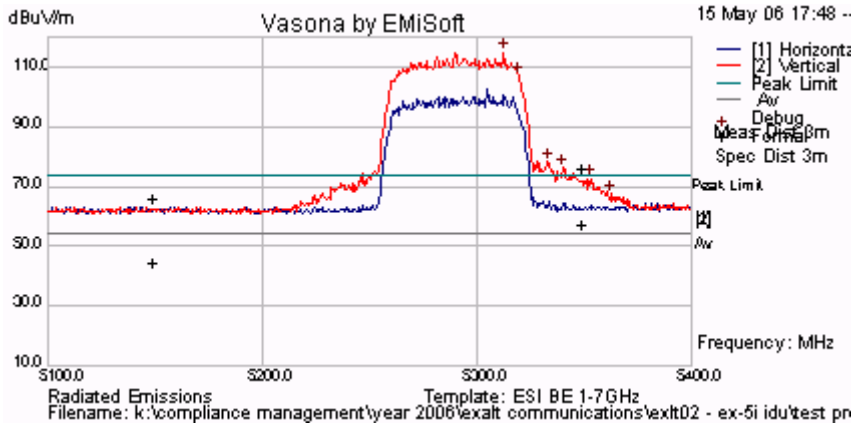


28 dBi Antenna 5,290 **MHz** **64 MHz Bandwidth 64QAM**

Plot A06

28 dBi Antenna 5,290 MHz 64 MHz Bandwidth 64QAM

Peak Emission = 115.02 dBµV/m



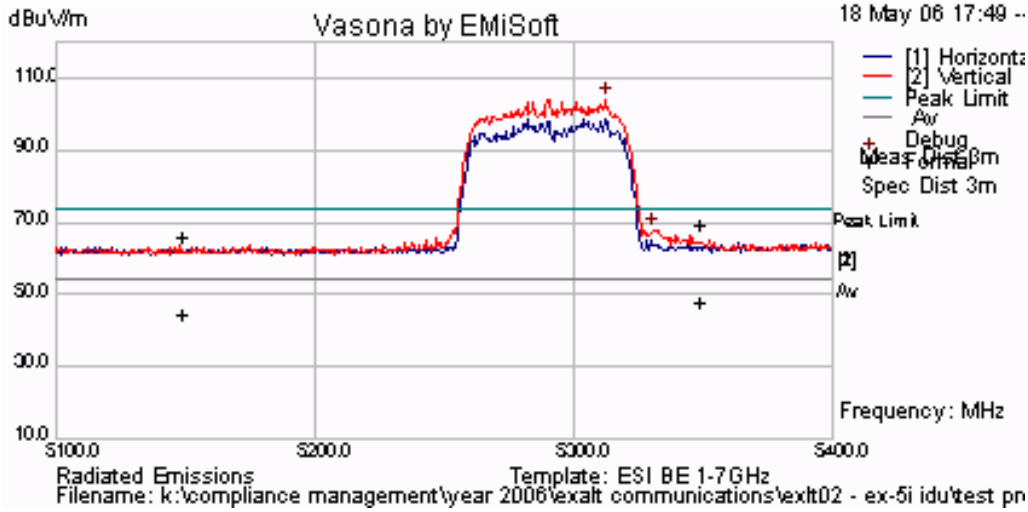
Peak Field Strength Measurements for 37.5 dBi Antenna

37.5 dBi Antenna 5,290 MHz 64 MHz Bandwidth 16QAM

Plot A07

37.5 dBi Antenna 5,290 MHz 64 MHz Bandwidth 16QAM

Peak Emission = 104.31 dBµV/m

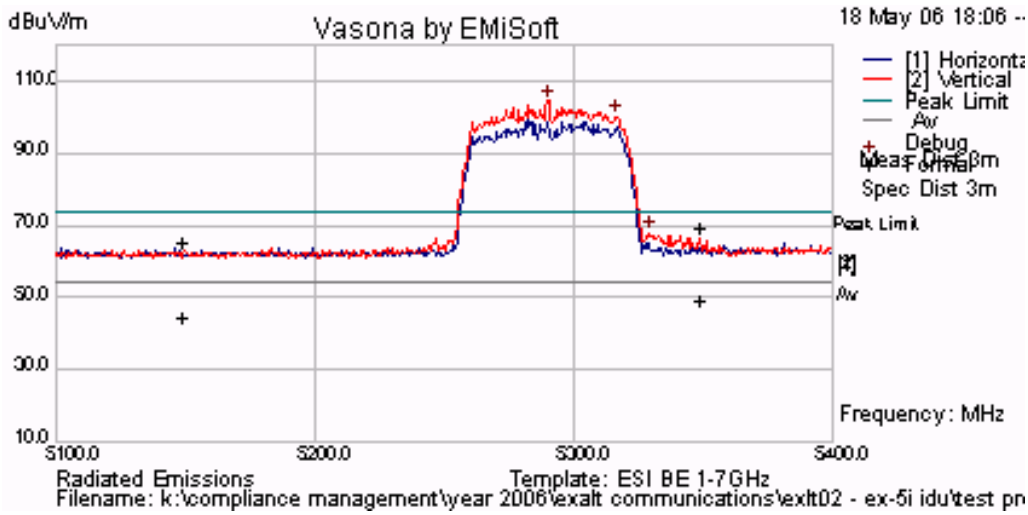


37.5 dBi Antenna 5,290 MHz 64 MHz Bandwidth 64QAM

Plot A08

37.5 dBi Antenna 5,290 MHz 64 MHz Bandwidth 64QAM

Peak Emission = 104.48 dBµV/m



Specification

Limits

15.407 (b)(2). All emissions outside of the 5,150-5,350MHz band shall not exceed an EIRP of -27dBm/MHz.

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

RSS-210 §A9.3(2) For transmitters operating in the 5250-5350 MHz band, all emissions outside the 5150-5350 MHz band shall not exceed -27 dBm/MHz e.i.r.p. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band shall not exceed out of band emission limit of 27 dBm/MHz e.i.r.p. in the 5150-5250 MHz band in order to operate indoor/outdoor, or alternatively shall comply with the spectral power density for operation within the 5150-5250 MHz band and shall be labeled “for indoor use only”.

RSS-Gen §4.7 The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

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