Dynamic Frequency Selection (DFS) Equipment Authorization

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DFS General Information

- U-NII Frequency Bands:

  5.15-5.35, 5.47-5.725, and 5.725-5.825 GHz
- Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC):

  5.25-5.35 GHz and 5.47-5.725 GHz band
- R&O: U-NII/DFS Rules (FCC 03-287)
  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-287A1.pdf
- R&O: Compliance Measurement Procedures for U-NII Devices Incorporating DFS (FCC 06-96)
  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-06-96A1.pdf

Transition Status

- **Certifications must comply with DFS and TPC requirements**
- Class II Permissive change filings on grandfathered equipment can be filed until July 20, 2007
- All devices imported and marketed must comply after July 20, 2007

TCB Exclusions

- Currently, TCBs cannot authorize DFS devices with radar detection capability
- TCBs can authorize DFS client devices without radar detection capability
  - Must not have an “ad-hoc” or “peer-to-peer” mode
  - Requires the following DFS tests
    - Channel Closing Transmission Time
    - Channel Move Time
- Pre Grant sample call for devices with radar detection capability and future sample monitoring

Equipment Authorization

- Equipment Class – NII
- Note code ND – This device complies with the TPC and DFS requirements in Section 15.407(h)
  - Used only for permissive changes for devices that were previously non-compliant (grandfathered)
- Part 15 non-channelized radio service – Grant must list lowest and highest carrier frequency for each band
- Operational description:
  - IP or Frame Based
  - EUT: master or client and ancillary equipment
- Test setup description
  - Radar Simulation: alternative hopping setup
  - Radar Simulation verification
  - Channel loading
  - Master and client configurations

DFS Sample Test Data

- **Test Parameters**
  - Device: (Manufacturer) U-NII Master
  - Power: 500 mW
  - Protocol: IP Based
  - DFS Detection Threshold: -64 dBm
  - Radar Simulator Level (Threshold + 1 dB): -63 dBm
  - Radar Test Frequency (Bin 1-5) = 5300 MHz
  - Client Device Used for Test Configuration:
    (Manufacturer) Client PCMCIA FCC ID: XXXXX
  - Alternative Hopping Method: NTIA Approved
  - File Data Transfer: NTIA Approved Data Stream

DFS Sample Test Data (Con't.)

- Radar Detection BW
  - Detection BW (15 MHz) > 80% Power BW
    (13.12 MHz from EMC Test Report) **PASS**
- Performance Requirement Checks
  - 30 Minute Non-Occupancy: **PASS**
  - Initial Channel Availability Check Time:
    No transmissions at 5300 MHz for 61.5 sec. **PASS**
  - Radar Burst at Beginning of Channel Availability Check Time:
    No transmissions at 5300 MHz **PASS**
  - Radar Burst at End of Channel Availability Check Time:
    No transmissions at 5300 MHz **PASS**

DFS Sample Test Data (Con't.)

- In-Service Monitoring
  - Channel Closing Transmission Time: <10 ms **PASS**
  - Channel Move Time: 2.08 sec. **PASS**
  - Aggregate Transmission Time: 222 µs **PASS**
- Statistical Performance Check

  (Percentage of successful radar detections)

– Bin 1	90%	**PASS**
– Bin 2	86.6%	**PASS**
– Bin 3	83.3%	**PASS**
– Bin 4	93.3%	**PASS**
– Bin 5	100%	**PASS**
– Bin 6	93.3%	**PASS**
– Aggregate (Bin 1-4)	88.3%	**PASS**

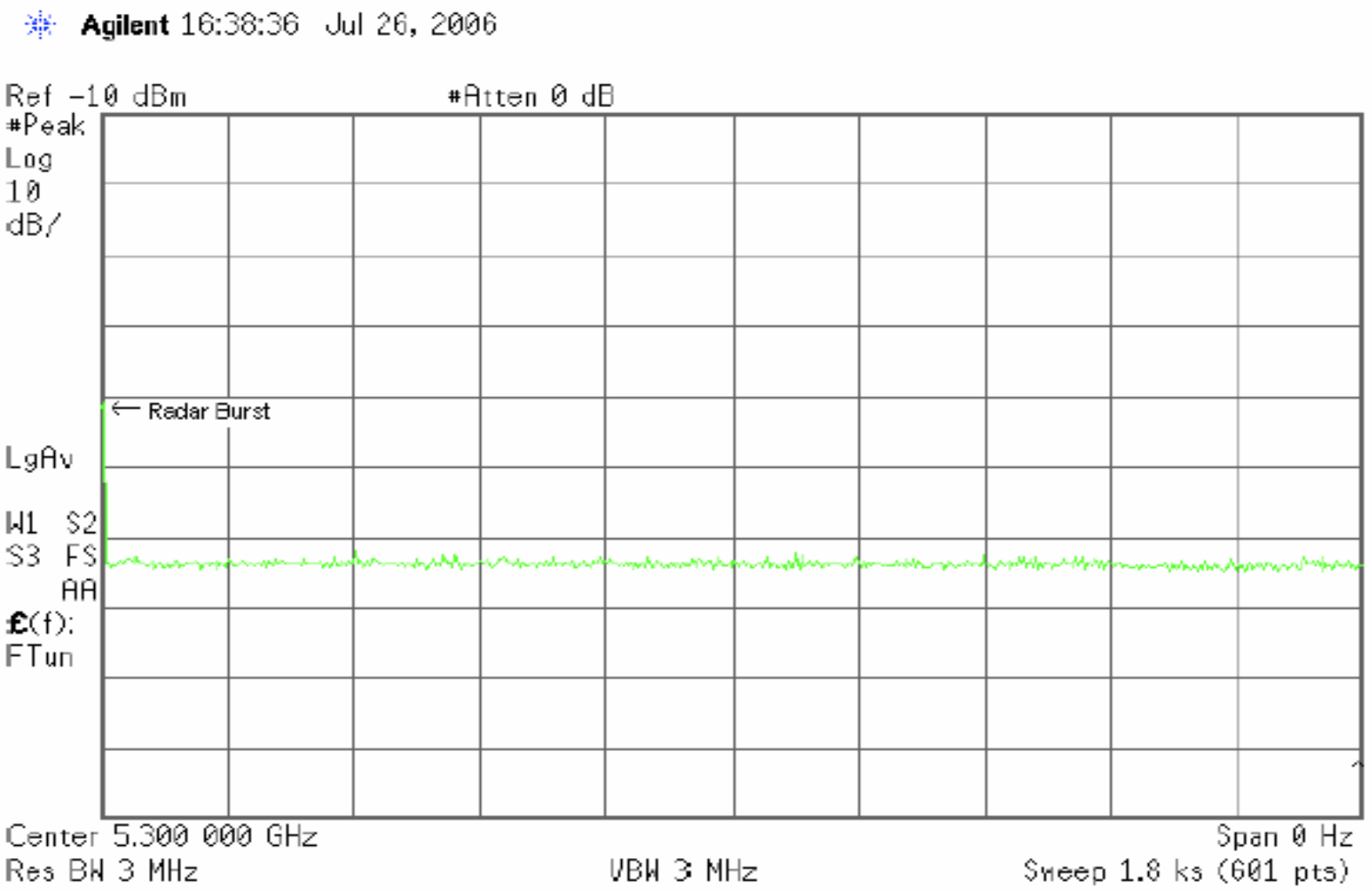
  - **Aggregate is the average of Bin 1 through Bin 4 in %**

DFS Sample Test Data (Con't.)

Radar Detection BW											
EUT Default Frequency (MHz) = 5300 Bin 1											
	DFS Detection Trials (1=Detection, 0= Not Detected)										
Radar Freq. (MHz)	1	2	3	4	5	6	7	8	9	10	Detection Rate (%)
5292	0	0	0	0	0	0	0	0	0	0	0%
5293 (F_l)	1	1	1	1	1	1	1	1	1	1	100%
5294	1	1	1	1	1	1	1	1	1	1	100%
5295	1	1	1	1	1	1	1	1	1	1	100%
5296	1	1	1	1	1	1	1	1	1	1	100%
5297	1	1	1	1	1	1	1	1	1	1	100%
5298	1	1	1	1	1	1	1	1	1	1	100%
5299	1	1	1	1	1	1	1	1	1	1	100%
5300	1	1	1	1	1	1	1	1	1	1	100%
5301	1	1	1	1	1	1	1	1	1	1	100%
5302	1	1	1	1	1	1	1	1	1	1	100%
5303	1	1	1	1	1	1	1	1	1	1	100%
5304	1	1	1	1	1	1	1	1	1	1	100%
5305	1	1	1	1	1	1	1	1	1	1	100%
5306	1	1	1	1	1	1	1	1	1	1	100%
5308 (F_h)	1	1	1	1	1	1	1	1	1	1	100%
5309	0	0	0	0	0	0	0	0	0	0	0%
Detection Bandwidth = $F_h - F_l$ = 15 MHz											
EUT 99% Bandwidth = 16.4 MHz											
80% of EUT 99% Bandwidth = 13.12 MHz											

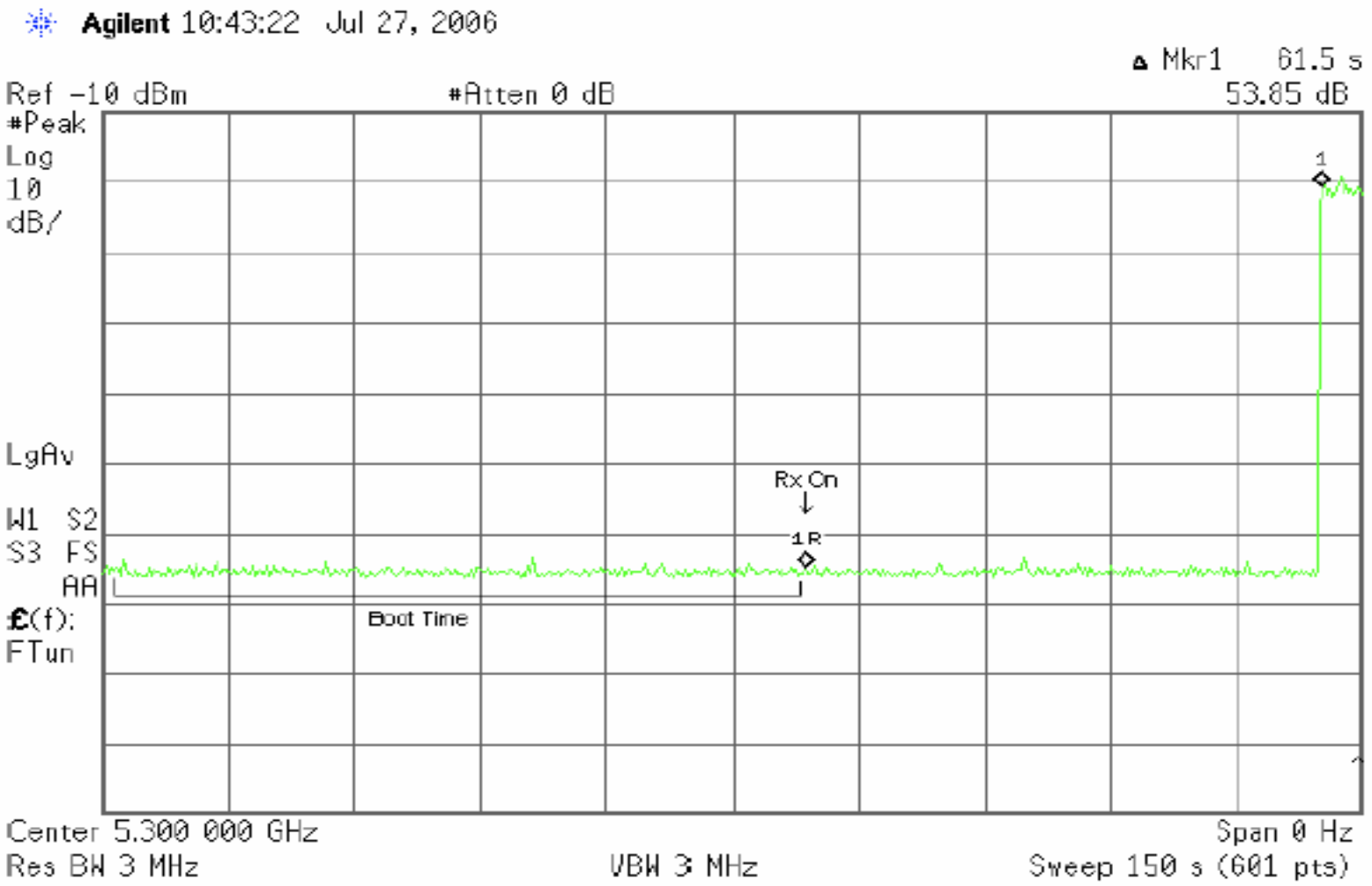
DFS Sample Test Data (Con't.)

30 Minute Non-Occupancy



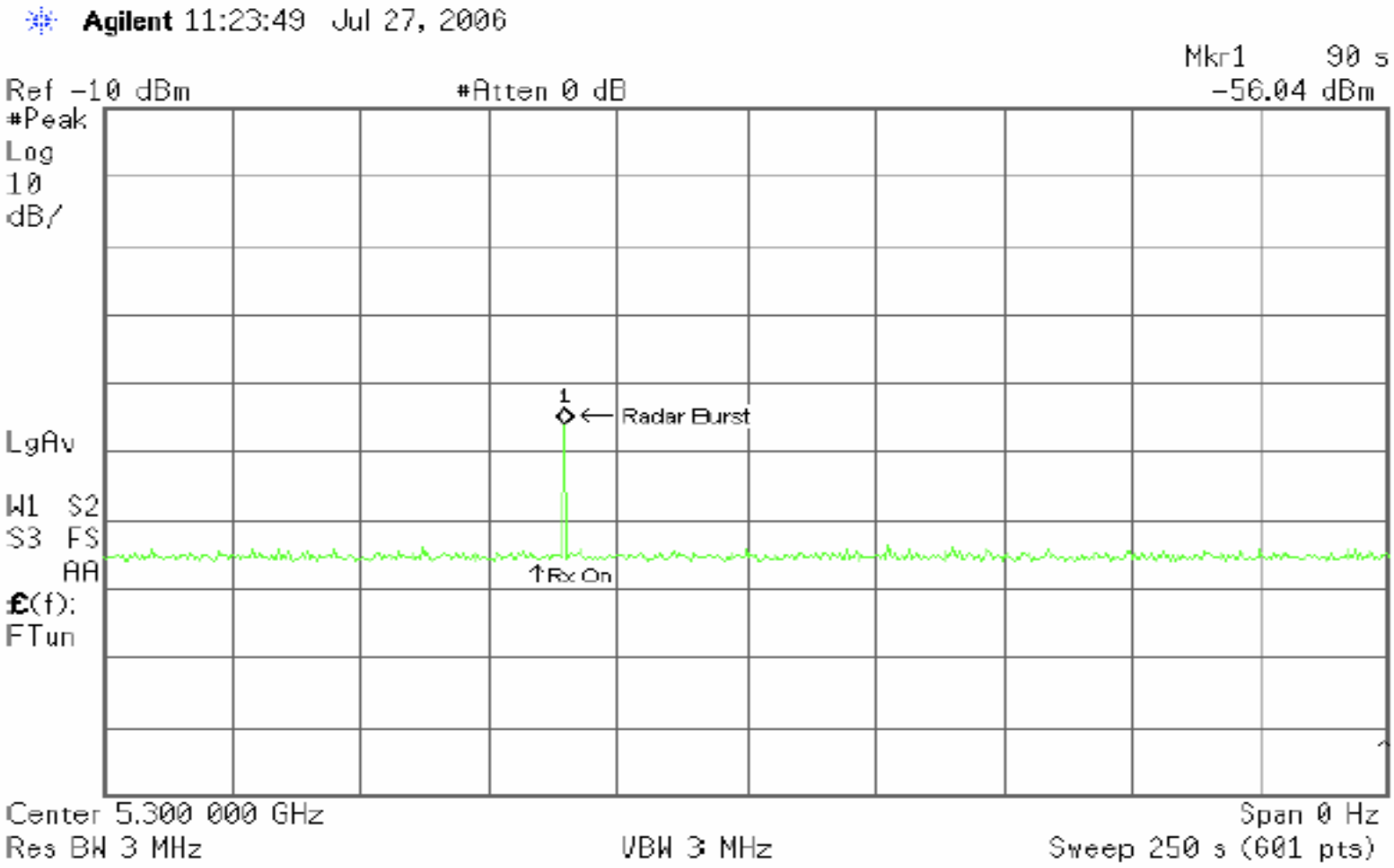
DFS Sample Test Data (Con't.)

Initial Channel Availability Check Time



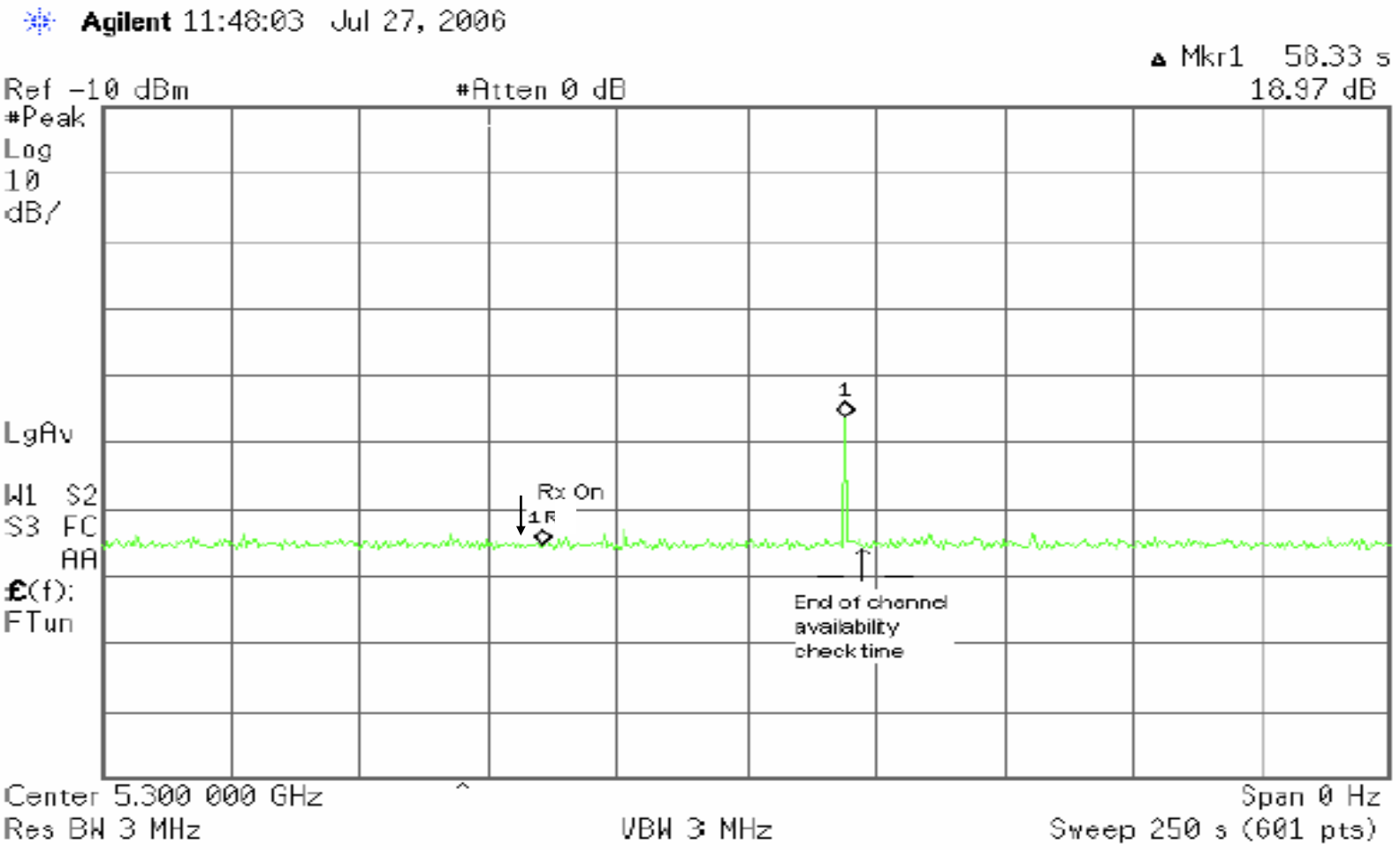
DFS Sample Test Data (Con't.)

Radar Burst at Beginning of Channel Availability Check Time



DFS Sample Test Data (Con't.)

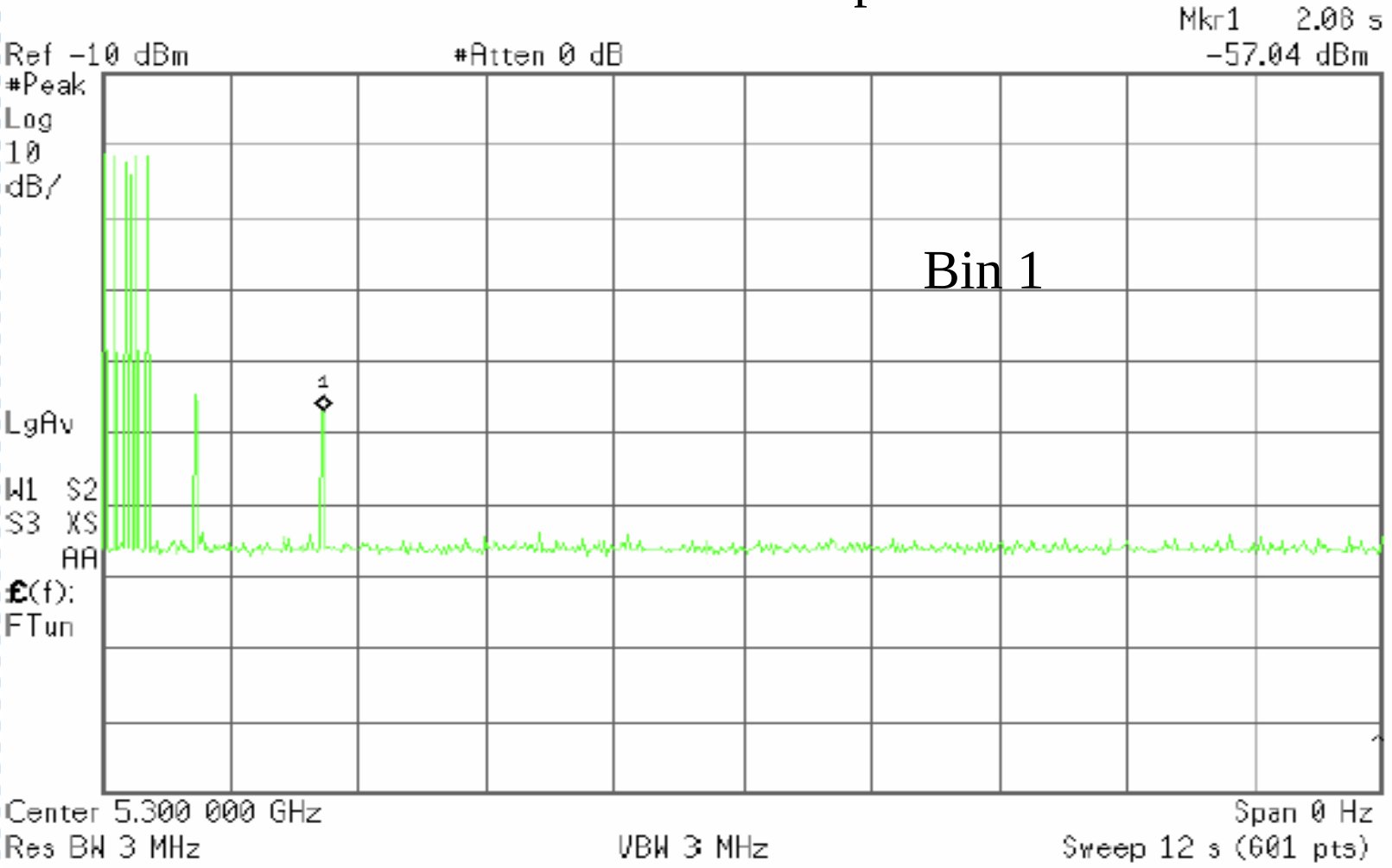
Radar Burst at End of Channel Availability Check Time



DFS Sample Test Data (Con't.)

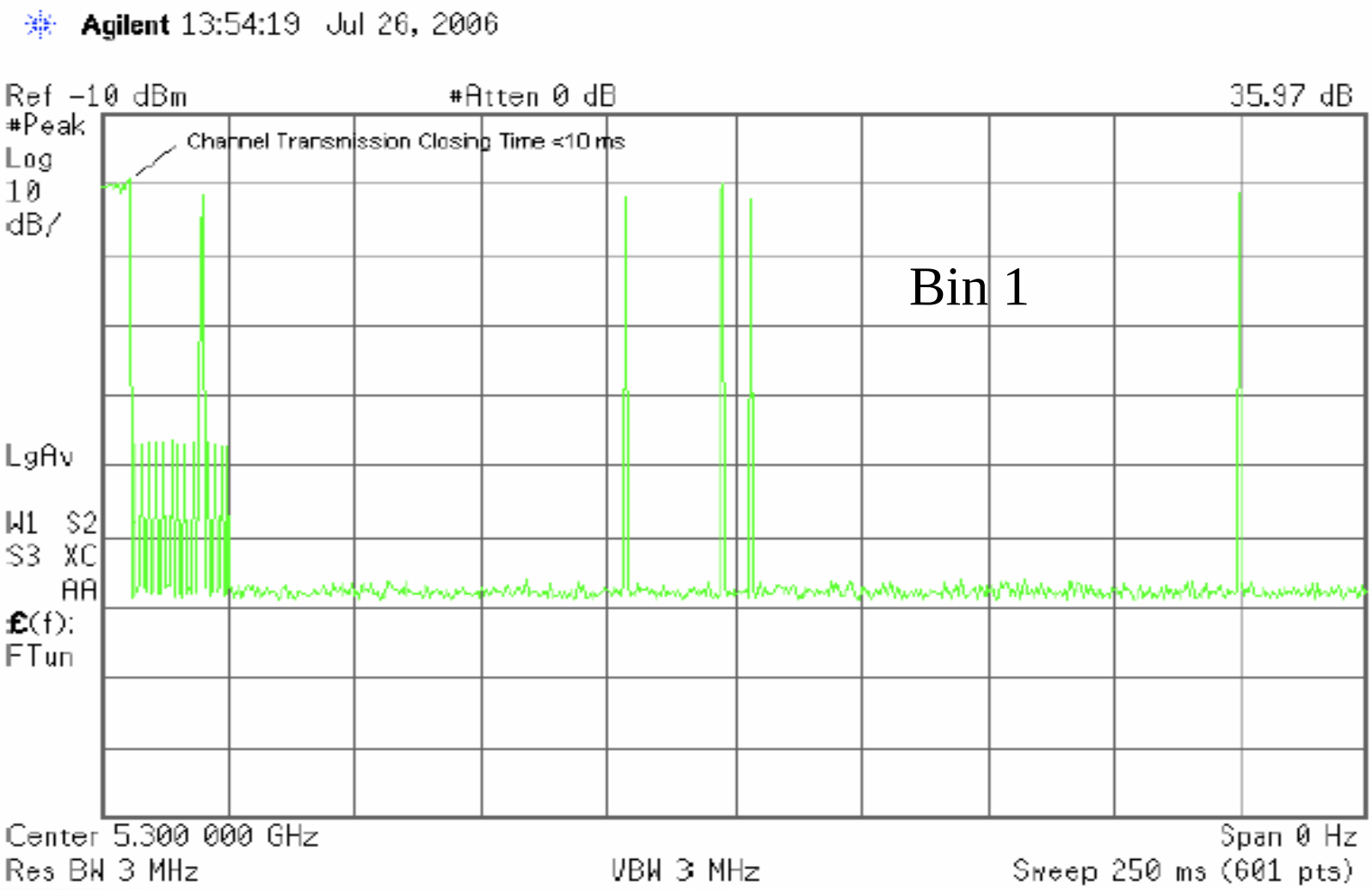
Channel Closing Transmission Time

Note: Repeat for Bin 2 to 5



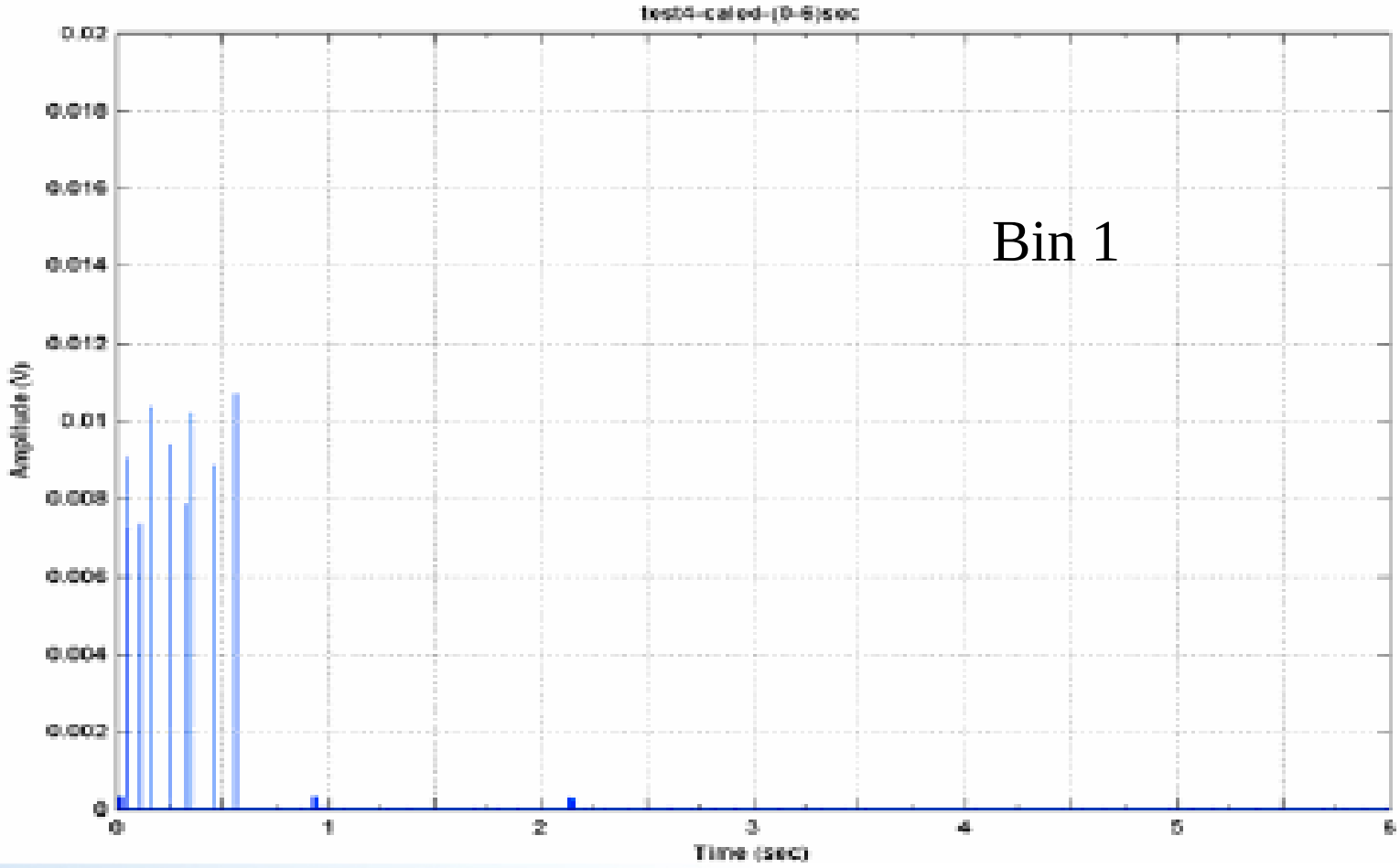
DFS Sample Test Data (Con't.)

Channel Move Time

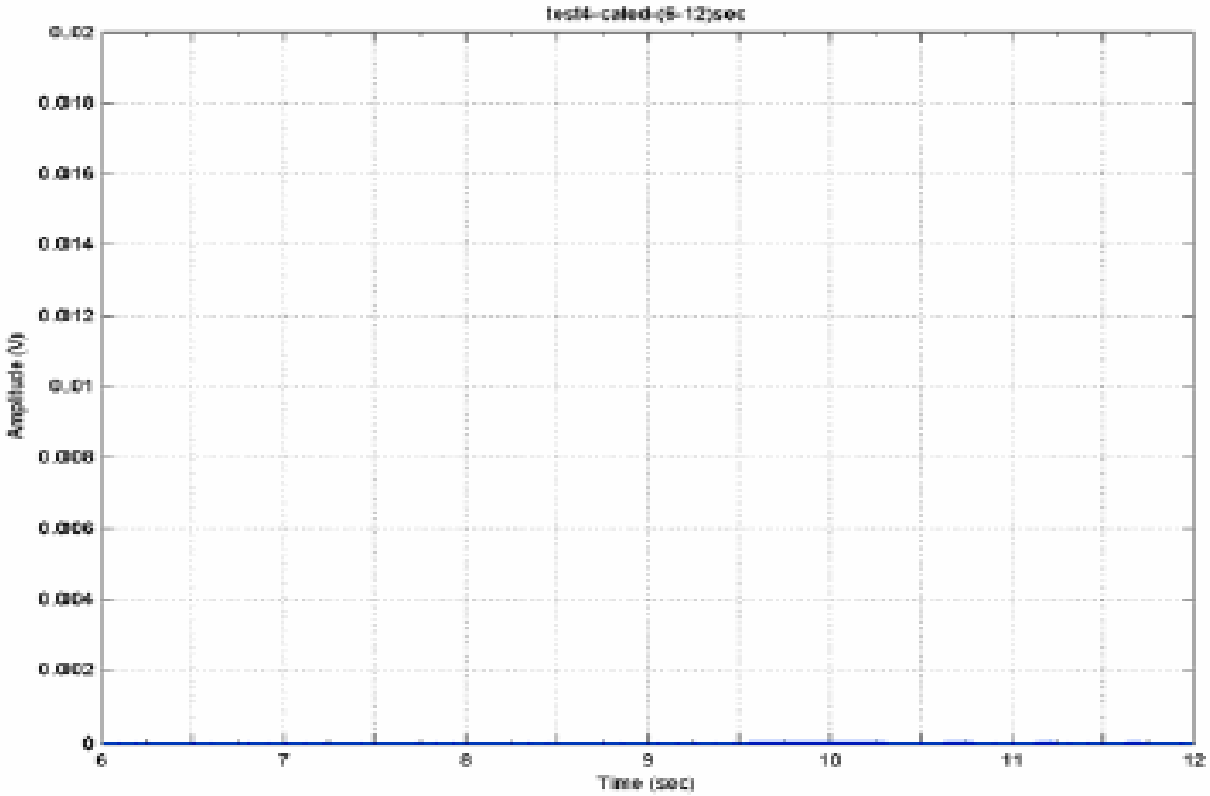


DFS Sample Test Data (Con't.)

Non-Occupancy Period



DFS Sample Test Data (Con't.)



PercentThreshold = '60'
Threshold = 0.0064
TimeAboveThresh = 2.2227e-004 (Aggregate 222 µs)
PercentTimeAboveThresh = 0.0019

DFS Sample Test Data (Con't.)

BIN 1 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
See Appendix for Bin 2 - 6 **Bin 1** Fixed Pulse	1	Yes	16	Yes
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	Yes	20	Yes
	6	Yes	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	Yes	24	No
	10	Yes	25	Yes
	11	No	26	Yes
	12	Yes	27	Yes
	13	Yes	28	Yes
	14	Yes	29	Yes
	15	Yes	30	Yes

90% Detections

DFS Issues

- Do the clients without DFS radar detection capability have to be retested if a lower gain antenna is used?
  - No: Section 15.204(c) applies
- Ad-hoc mode - external software (ie: operating systems, drivers) can force the device into "ad-hoc" mode operation as defined in 802.11
  - Check the User's Manual
  - If not clear, ask questions
- Consult FCC for devices which have different operational characteristics than 802.11

Questions and Answers

Thanks!

Appendix – Bin 2 to 6 Sample

BIN 2 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
Bin 2 Refer to Radar Signal Characteristics Section for Pulse Characteristics for Each Trial	1	Yes	16	Yes
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	Yes	20	Yes
	6	No	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	Yes	24	Yes
	10	Yes	25	No
	11	Yes	26	Yes
	12	Yes	27	Yes
	13	No	28	Yes
	14	Yes	29	Yes
	15	Yes	30	Yes

86.6% Detections

Appendix – Bin 2 to 6 Sample

BIN 3 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
Bin 3 Refer to Radar Signal Characteristics Section for Pulse Characteristics for Each Trial	1	Yes	16	Yes
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	No	20	No
	6	Yes	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	No	24	No
	10	Yes	25	Yes
	11	Yes	26	Yes
	12	Yes	27	Yes
	13	No	28	Yes
	14	Yes	29	Yes
	15	Yes	30	Yes

83.3% Detections

Appendix – Bin 2 to 6 Sample

BIN 4 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
Bin 4 Refer to Radar Signal Characteristics Section for Pulse Characteristics for Each trial	1	Yes	16	Yes
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	Yes	20	Yes
	6	Yes	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	Yes	24	Yes
	10	Yes	25	Yes
	11	Yes	26	Yes
	12	Yes	27	Yes
	13	No	28	Yes
	14	Yes	29	No
	15	Yes	30	Yes

93.3% Detections

Appendix – Bin 2 to 6 Sample

BIN 5 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
Bin 5 Refer to Radar Signal Characteristics Section for Radar Burst Characteristics for Each Trial	1	Yes	16	Yes
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	Yes	20	Yes
	6	Yes	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	Yes	24	Yes
	10	Yes	25	Yes
	11	Yes	26	Yes
	12	Yes	27	Yes
	13	Yes	28	Yes
	14	Yes	29	Yes
	15	Yes	30	Yes

100% Detections

Appendix – Bin 2 to 6 Sample

BIN 6 – Statistical Performance Check

Radar Type	Trial #	Detection Yes / No	Trial #	Detection Yes / No
Bin 6 Hopping Radar	1	Yes	16	No
	2	Yes	17	Yes
	3	Yes	18	Yes
	4	Yes	19	Yes
	5	Yes	20	Yes
	6	Yes	21	Yes
	7	Yes	22	Yes
	8	Yes	23	Yes
	9	Yes	24	Yes
	10	Yes	25	Yes
	11	Yes	26	Yes
	12	Yes	27	No
	13	Yes	28	Yes
	14	Yes	29	Yes
	15	Yes	30	Yes

93.3% Detections

Appendix – Radar Characteristics

Radar Signal Characteristics – Bin 2, 3, and 4

Bin #	Pulse Width(us)	Pri(us)	Pulses/Burst
2	3.5	220	24
2	2.2	150	25
2	3.0	214	27
2	3.3	199	25
2	1.6	158	26
2	1.0	202	28
2	3.6	198	29
2	2.0	208	28
2	3.5	201	28
2	1.4	223	28
2	2.5	200	29
2	5.0	154	27
2	4.4	206	25
2	3.2	199	26
2	2.1	214	29
2	3.1	207	27
2	2.5	162	29
2	2.7	158	26
2	2.1	155	23
2	4.0	150	24
2	2.7	157	25
2	3.0	163	23
2	2.8	172	29
2	1.8	155	25
2	4.9	194	26
2	3.0	153	23
2	1.2	189	25
2	3.8	154	26
2	4.6	208	25
2	3.2	230	28

Note: Repeat for Bin 3 and 4

Appendix – Radar Characteristics

Radar Signal Characteristics – Bin 5

Note: Repeat for all 30 waveforms

Waveform Num = 1
Num of Bursts = 17
Burst Interval (us) = 705882.0

Burst #	Off Time (us)	# Pulses	Chirp (MHz)	PW (us)	Pulse 1 Pri(us)	Pulse 2 Pri(us)	Pulse 3 Pri(us)	Start Loc (us)	Start Burst Interval(us)	End Burst Interval(
1	269024	1	18.0	75	1081	0	0	269024	0	705881
2	712258	2	7.0	65	1164	1050	0	982363	705882	1411763
3	645671	2	12.0	70	1549	1742	0	1630248	1411764	2117645
4	947370	1	15.0	95	1543	0	0	2580909	2117646	2823527
5	736326	1	17.0	55	1688	0	0	3318778	2823528	3529409
6	762740	2	11.0	70	1337	1439	0	4083206	3529410	4235291
7	697571	3	15.0	90	1181	1386	1092	4783553	4235292	4941173
8	632680	1	10.0	95	1017	0	0	5419892	4941174	5647055
9	274723	1	10.0	60	1288	0	0	5695632	5647056	6352937
10	1265149	1	14.0	60	1906	0	0	6962069	6352938	7058819
11	215897	3	20.0	90	1838	1161	1812	7179872	7058820	7764701
12	1026351	2	11.0	95	1402	1967	0	8211034	7764702	8470583
13	803031	1	13.0	75	1411	0	0	9017434	8470584	9176465
14	365025	3	6.0	50	1700	1270	1184	9383870	9176466	9882347
15	1135938	3	20.0	65	1542	1249	1573	10523962	9882348	10588229
16	324945	1	19.0	50	1894	0	0	10853271	10588230	11294111
17	1112017	1	7.0	85	1950	0	0	11967182	11294112	11999993

Total number of pulses in waveform = 29