FCC DFS Test Report

FCC ID: 2ADZRG240WB

This report concerns (check one): ☐**Original Grant** ☒**Class II Change**

Project No.	**:**	1411C236A
Equipment	**:**	GPON ONU
Model Name	**:**	G-240W-B
Applicant	**:**	Alcatel-Lucent Shanghai Bell Co. Ltd.
Address	**:**	6B602, 388 Ningqiao Road Pudong, Shanghai

Date of Receipt	**:**	Nov. 24, 2014 Apr. 23, 2015
Date of Test	**:**	Nov. 24, 2014 ~ Dec. 19, 2014 Apr. 23, 2015 ~ Apr. 27, 2015
Issued Date	**:**	Apr. 28, 2015
Tested by	**:**	BTL Inc.

Testing Engineer : David Mao
(David Mao)

Technical Manager : Leo Hung
(Leo Hung)

Authorized Signatory : Steven Lu
(Steven Lu)

BTL INC.

No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.

TEL: +86-769-8318-3000 FAX: +86-769-8319-6000

Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with the standards traceable to National Measurement Laboratory (**NML**) of **R.O.C.**, or National Institute of Standards and Technology (**NIST**) of **U.S.A.**

BTL's reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

BTL's reports must not be used by the client to claim product endorsement by the authorities or any agency of the Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and **BTL-self**, extracts from the test report shall not be reproduced except in full with **BTL**'s authorized written approval.

BTL's laboratory quality assurance procedures are in compliance with the **ISO Guide17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Table of Contents Page

REPORT ISSUED HISTORY

Issued No.	Description	Issued Date
BTL-FCCP-3-1411C236	Original Report.	Feb. 12, 2015
BTL-FCCP-3-1411C236A	Compared with theprevious report (BTL-FCCP-3-1411C236), add beamforming function by AC Mode, all test items for AC Modehave been retested and recorded in the test report, the rest are the same.	Apr. 28, 2015

1. CERTIFICATION

Equipment	:	GPON ONU
Brand Name	:	Alcatel-Lucent
Model Name	:	G-240W-B
Applicant	:	Alcatel-Lucent Shanghai Bell Co. Ltd.
Manufacturer	:	Alcatel-Lucent Shanghai Bell Co. Ltd.
Address	:	6B602, 388 Ningqiao Road Pudong, Shanghai
Factory	:	1. Taicang T&W Electronics Co.,Ltd. 2. Shenzhen Gongjin Electronics Co.,Ltd.
Address	:	1. Jiangnan Road 89,Ludu Town,Taicang,Jiangsu 215412,P.R.China 2. No 2&3 Buildings, Mingwei Factory Area, Songgang Road West,No. A Building, 1#Songgang Road Songgang Sub-District,Shenzhen,Guangdong, 518105,P.R.China
Date of Test:	:	Nov. 24, 2014 ~ Dec. 19, 2014 Apr. 23, 2015 ~ Apr. 27, 2015
Test Sample	:	ENGINEERING SAMPLE
Standard(s)	:	FCC Part 15, Subpart E (Section 15.407) FCC KDB 789033 D02 General UNII Test Procedures New Rules v01

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.
The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-3-1411C236A) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

Test result included in this report is only for the DFS Mode part of the product.

2. EUT INFORMATION

2.1EUT SPECIFICATION TABLE

Table 1: Specification of EUT

Product name	GPON ONU
Brand Name	Alcatel-Lucent
Model	G-240W-B
FCC ID	2ADZRG240WB
Software Version	FE56557AFBB29
Hardware Version	3FE 56756 BAAA
Operational Mode	Master
Operating FrequencyRange	5260~5320MHz&5500~5700MHz
Modulation	OFDM

Note: This device was functioned as a ☒Master ☐Slave device during the DF

2.2 DESCRIPTION OF AVAILABLE ANTENNAS TO THE EUT

Antenna Specification:

Ant.	Manufacturer	Model Name	Antenna Type	Connector	Gain (dBi)	Note
4	Airgain	N5x20B	Embedded	N/A	2.90	5GHz
5	Airgain	N5x20B	Embedded	N/A	2.90	5GHz
6	Airgain	N5x20B	Embedded	N/A	2.90	5GHz
7	Airgain	N5x20B	Embedded	N/A	2.90	5GHz

Note:

(1) The EUT incorporates a MIMO function. Physically, the EUT provides four completed transmitters and receivers (4T4R). All transmit signals are completely uncorrelated.

(2) The EUT with Beamforming function, then, Direction gain = GANT+Array Gain, the Array gain=10log(N_{ANT}/N_{SS}). where N_{SS} = the number of independent spatial streams of data. that is Array gain=10log(4/2)=3.01, Directional gain=2.90 + 3.01 = 5.91.

(3) ANT 4 was the worst case for 1TX.

2.3 CONDUCTED OUTPUT POWER AND EIRP POWER

TABLE 3: THE CONDUCTED OUTPUT POWER LIST

TX (11a)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5260~5320	19.56	90.365
5500~5700	18.07	64.121

TX (11n 40MHz)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5270~5310	23.19	208.449
5510~5670	22.60	181.970

TX (11ac 80 MHz)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5290	18.14	65.21
5530	17.75	59.566

2.4 EUT MAXIMUM AND MINIMUM E.I.R.P. POWER

TABLE 4: THE MAX EIRP LIST

TX (11a)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5260~5320	22.46	176.20
5500~5700	20.97	125.03

TX (11n40MHz)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5270~5310	26.09	406.44
5510~5670	25.50	354.81

TX (11ac 80 MHz)

FREQUENCY BAND (MHz)	MAX. POWER	
	OUTPUT POWER(dBm)	OUTPUT POWER(mW)
5290	24.05	254.10
5530	23.66	232.27

3.U-NII DFS RULE REQUIREMENTS

3.1 WORKING MODES AND REQUIRED TEST ITEMS

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 1 and 2 for the applicability of DFS requirements for each of the operational modes.

Table 5: Applicability of DFS requirements prior to use a channel

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	✓	Not required	✓
DFS Detection Threshold	✓	Not required	✓
Channel Availability Check Time	✓	Not required	Not required
Uniform Spreading	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	✓

Table 6: Applicability of DFS requirements during normal operation.

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
DFS Detection Threshold	✓	Not required	✓
Channel Closing Transmission Time	✓	✓	✓
Channel Move Time	✓	✓	✓
U-NII Detection Bandwidth	✓	Not required	✓

3.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

DETECTION THRESHOLD VALUES

Table 7: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection.

Maximum Transmit Power	Value (See Notes 1 and 2)
EIRP≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.

Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.

Table 8: 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 100% of the UNII 99% transmission power bandwidth. See Note 3.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

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 a Channel move (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 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

PARAMETERS OF DFS TEST SIGNALS

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.

Table 9: Short Pulse Radar Test Waveforms.

<table>
<tr><th>Radar Type</th><th>Pulse Width (µsec)</th><th>PRI (µsec)</th><th>Number of Pulses</th><th>Minimum Percentage of Successful Detection</th><th>Minimum Number of Trials</th></tr>
<tr><td>0</td><td>1</td><td>1428</td><td>18</td><td>See Note 1</td><td>See Note 1</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1</td><td>Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a</td><td rowspan="2">$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{PRI_{\mu sec}}\right)\right\}$</td><td rowspan="2">60%</td><td rowspan="2">30</td></tr>
<tr><td>Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A</td></tr>
<tr><td>2</td><td>1-5</td><td>150-230</td><td>23-29</td><td>60%</td><td>30</td></tr>
<tr><td>3</td><td>6-10</td><td>200-500</td><td>16-18</td><td>60%</td><td>30</td></tr>
<tr><td>4</td><td>11-20</td><td>200-500</td><td>12-16</td><td>60%</td><td>30</td></tr>
<tr><td colspan="4">Aggregate (Radar Types 1-4)</td><td>80%</td><td>120</td></tr>
<tr><td colspan="6">Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.</td></tr>
</table>

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. 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. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

Table 10: Long Pulse Radar Test Waveform

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

Table 11: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Numberof Pulsesper Burst	Numberof Bursts	Minimum Percentage of Successful Detection	Minimum Number ofTrials
6	1	333	9	0.333	300	70%	30

4. TEST INSTRUMENTS

Table 1: Test instruments list.

DESCRIPTION	MANUFACTURER	MODEL NO.	Serial No	Calibration Until
EXA Specturm Analyzer	Agilent	N9010A	MY50520044	2015-04-25
Signal Generator	Agilent	E4438C	My49071316	2015-04-25
POWER SPLITTER	Mini-Cicuits	ZFRSC-123-S+	331000910	2015-04-25
POWER SPLITTER	Mini-Cicuits	ZN4PD1-63-S+	SF933501045	2015-04-25
POWER SPLITTER	Mini-Cicuits	ZN2PD-9G-S+	SF012700714	2015-04-25
attenuator	Mini-Cicuits	VAT-30+	30912	2015-04-25
attenuator	Mini-Cicuits	VAT-10+	30909	2015-04-25
Specturm Analyzer	R&S	FSL 6	1004423	2015-11-02
PC	Dell 745	DCSM	G7K832X	--
Netbook	Hp	HSTNN-I69C-3	CNU02203XG	--

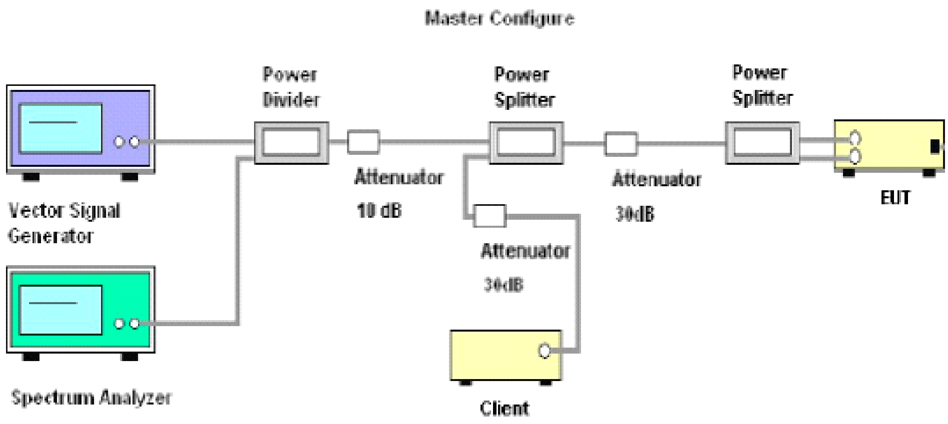
Note: Calibration interval of instruments listed above is one year.

5.EMC EMISSION TEST

5.1DFS MEASUREMENT SYSTEM:

CONDUCTED METHOD SYSTEM BLOCK DIAGRAM

Master Conducted Measurement



SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Freqeuncy Hopping Radar Waveform Generating Subsystem of FCC 06-96. The frequency of the signal generator is incremented in 1 MHz steps from FL to FH for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer set to display 8001 bins on the horizontal axis. The time-domain resolution is 2 msec / bin with a 16 second sweep time, meeting the 10 second short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

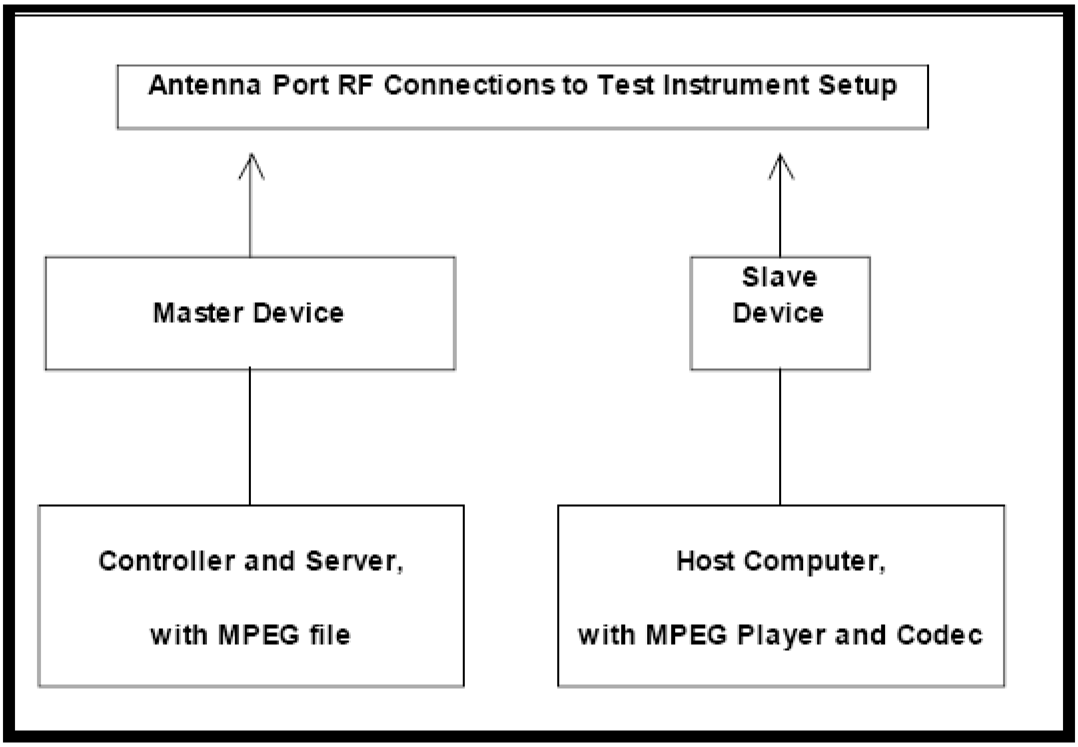
5.2CALIBRATION OF DFS DETECTION THRESHOLD LEVEL:

A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device and the signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –62 dBm as measured on the spectrum analyzer.

Without changing any of the instrument settings, the spectrum analyer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. Measure the amplitude and calculate the difference from –62 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.

The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of –62 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold. Separate signal generator amplitude settings are determined as required for each radar type.



5.3 DEVIATION FROM TEST STANDARD

No deviation.

6. TEST RESULTS

6.1 SUMMARY OF TEST RESULT

Clause	Test Parameter	Remarks	Pass/Fail
15.407	DFS Detection Threshold	Applicable	Pass
15.407	Channel Availability Check Time	Applicable	Pass
15.407	Channel Move Time	Applicable	Pass
15.407	Channel Closing Transmission Time	Applicable	Pass
15.407	Non- Occupancy Period	Applicable	Pass
15.407	Uniform Spreading	Applicable	Pass
15.407	U-NII Detection Bandwidth	Applicable	Pass

6.2 DETELED TEST RESULTS

Clause	Test Parameter	Remarks	Pass/Fail
15.407	DFS Detection Threshold	Applicable	Pass
15.407	Channel Availability Check Time	Applicable	Pass
15.407	Channel Move Time	Applicable	Pass
15.407	Channel Closing Transmission Time	Applicable	Pass
15.407	Non- Occupancy Period	Applicable	Pass
15.407	Uniform Spreading	Applicable	Pass
15.407	U-NII Detection Bandwidth	Applicable	Pass

6.2.1 TEST MODE: DEVICE OPERATING IN MASTER MODE.

Master with injection at the Master. (Radar Test Waveforms are injected into the Master)

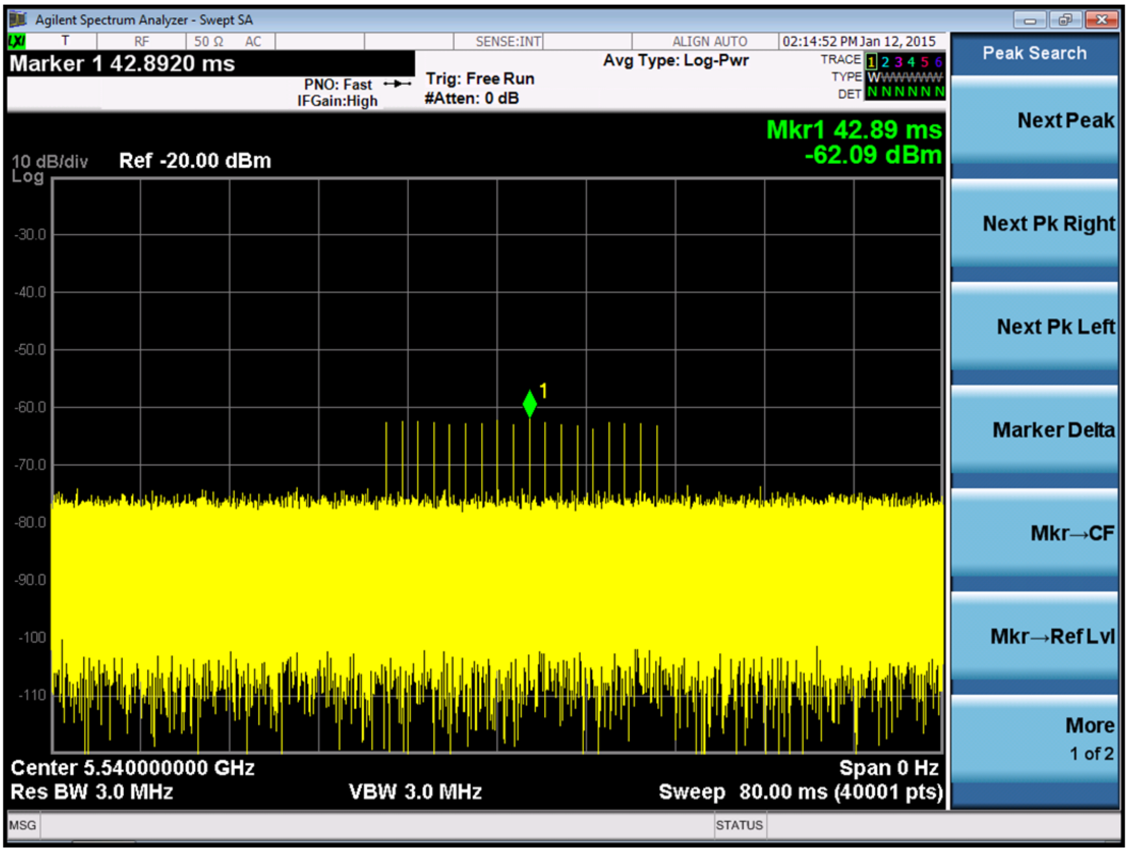
6.2.2 DFS DETECTION THRESHOLD

Calibration:

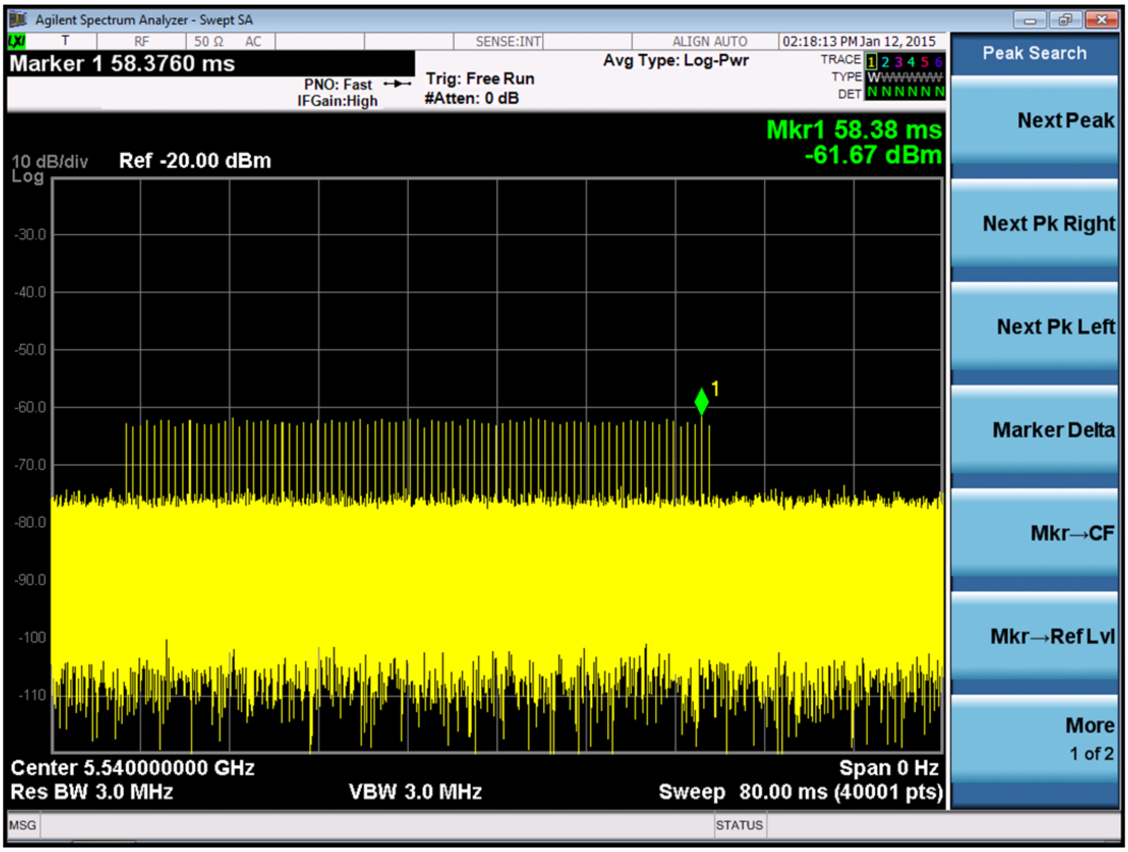
For a detection threshold level of -64dBmand the Master antenna gain is 2.9dBi, required detection threshold is -61.1 dBm (= -64+2.9).

Note: Maximum Transmit Power is more than200 milliwatt in this report, so detection threshold level is -64dBm (please refer to Table 7 [page 9]).

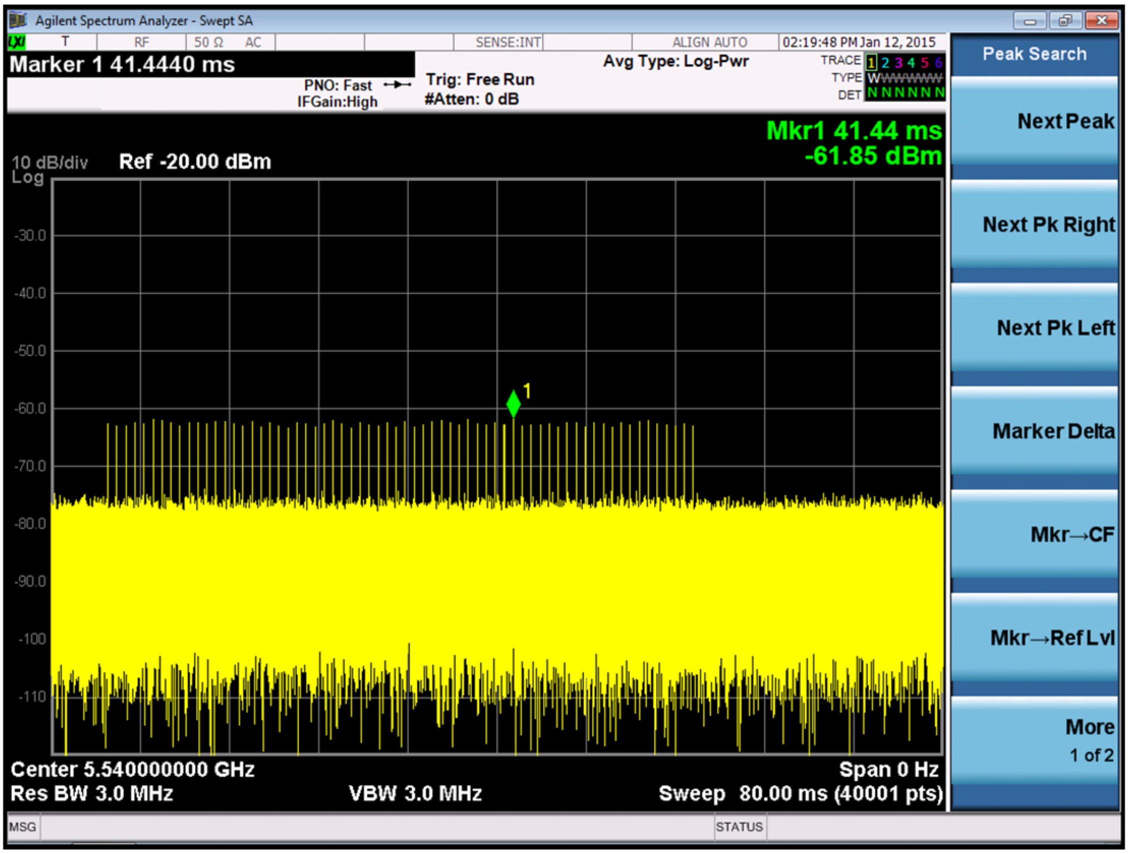
Radar Signal 0



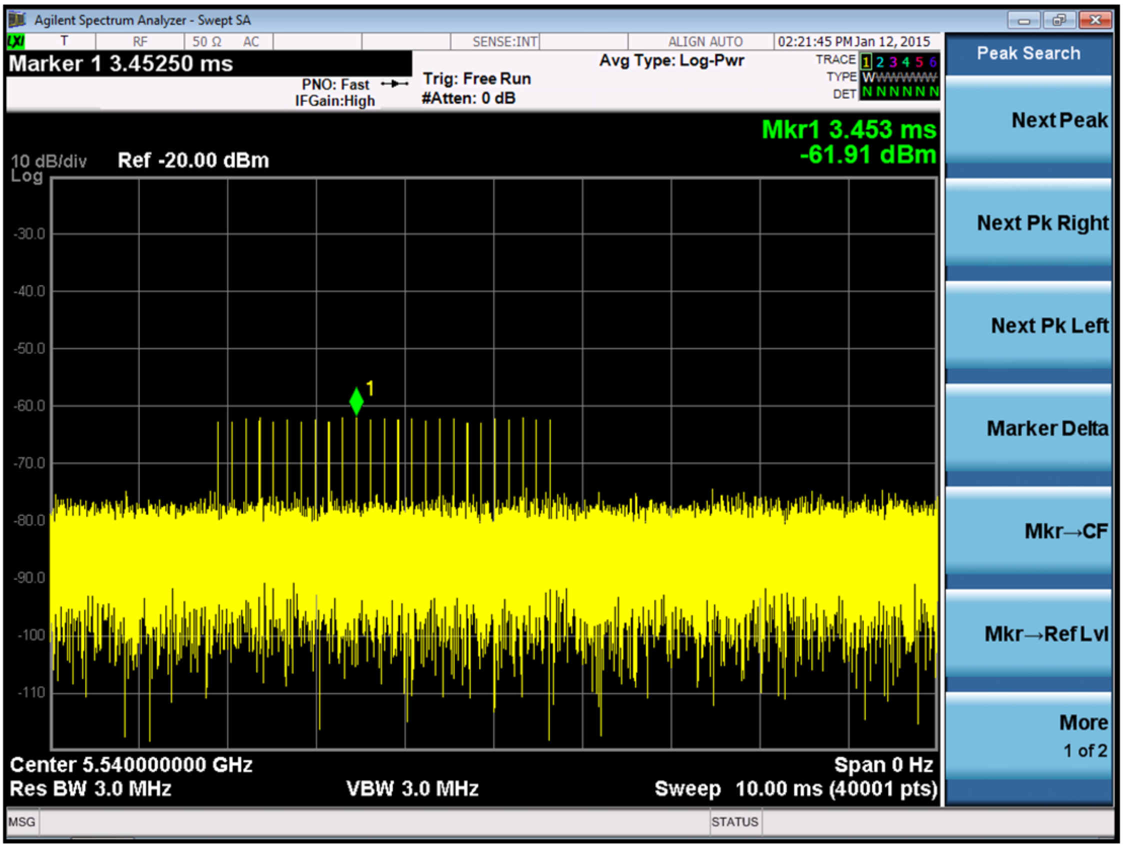
Radar Signal 1-A



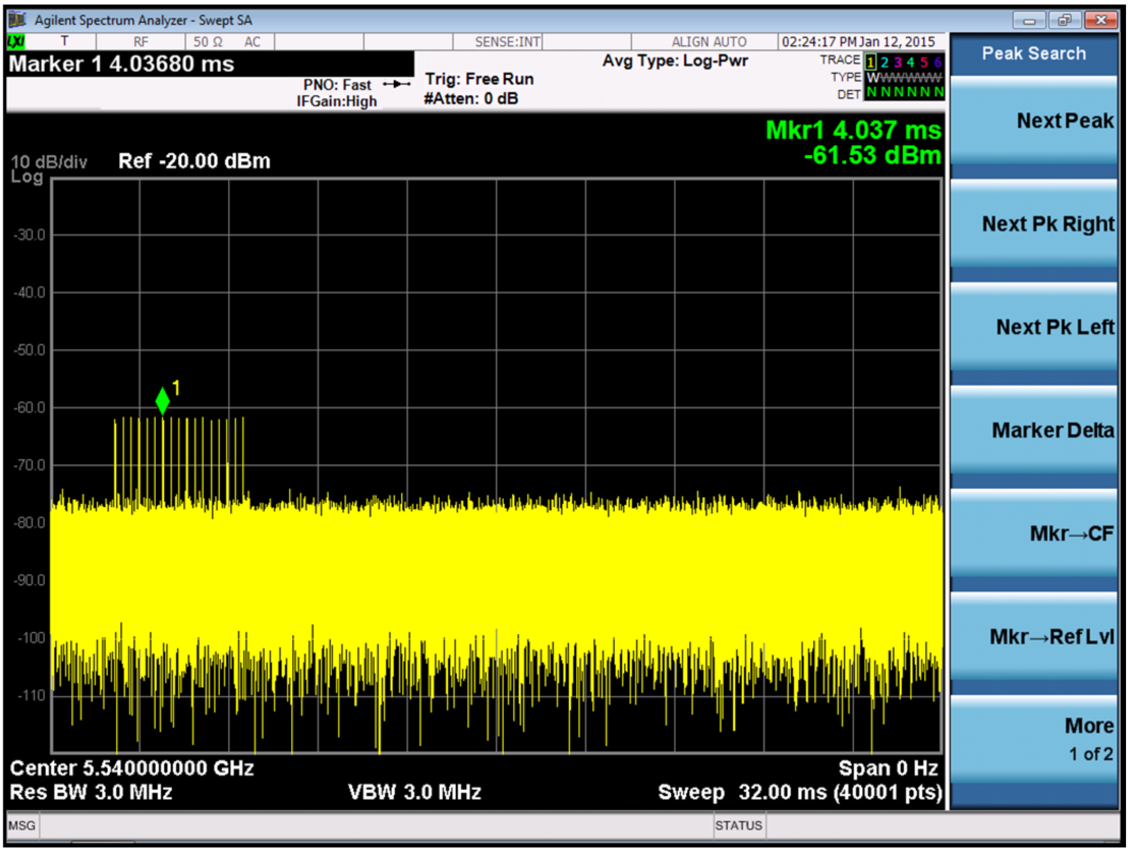
Radar Signal 1-B



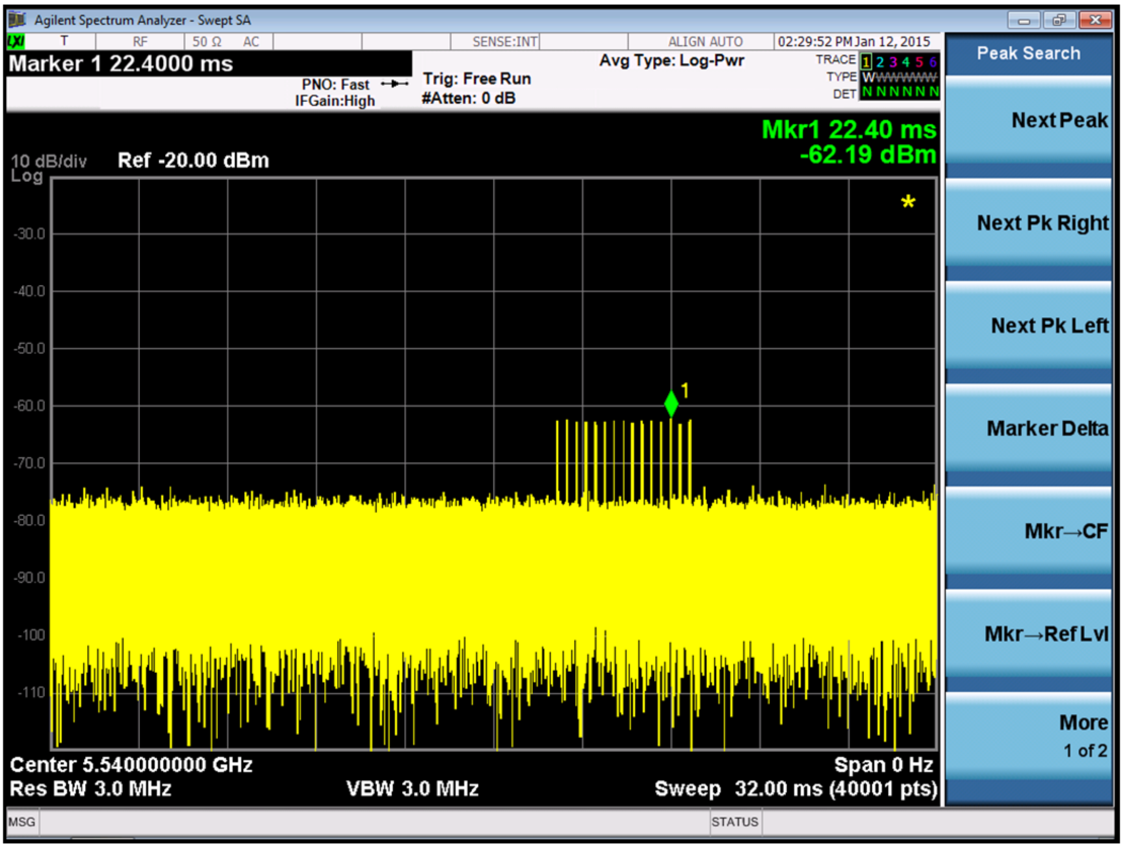
Radar Signal 2



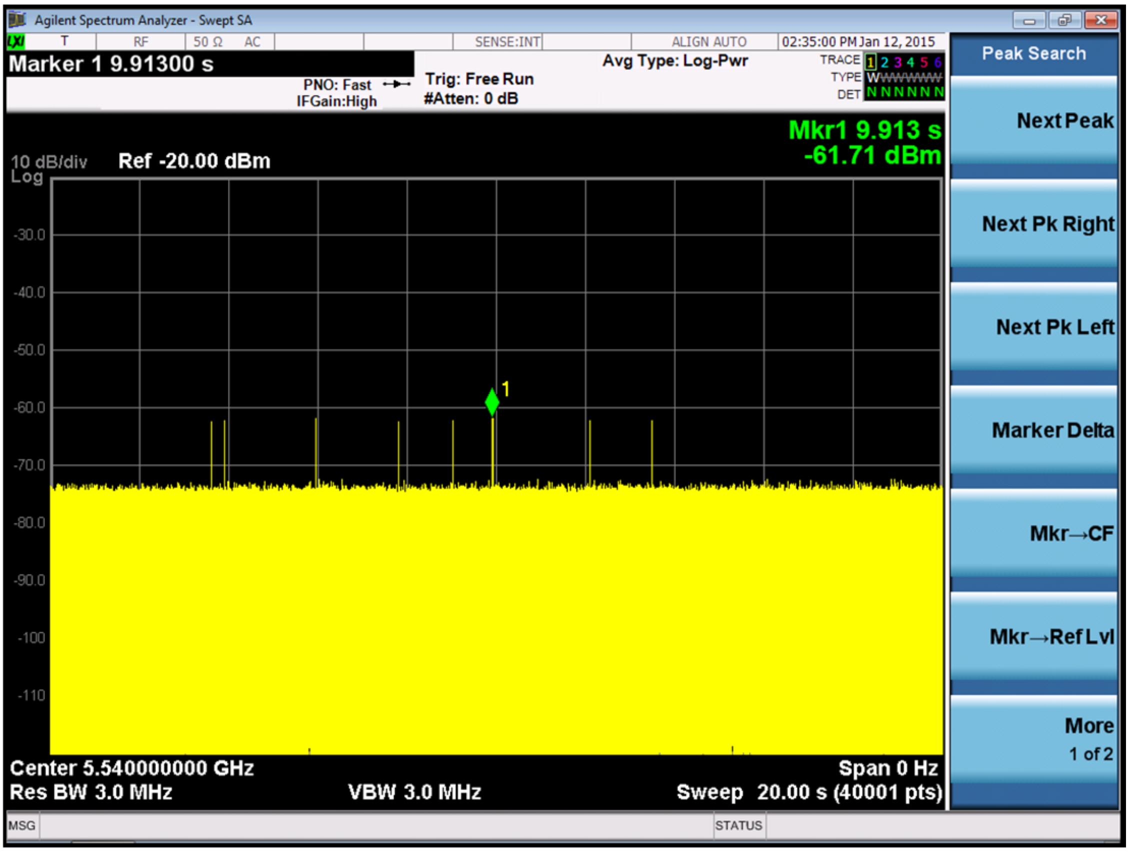
Radar Signal 3



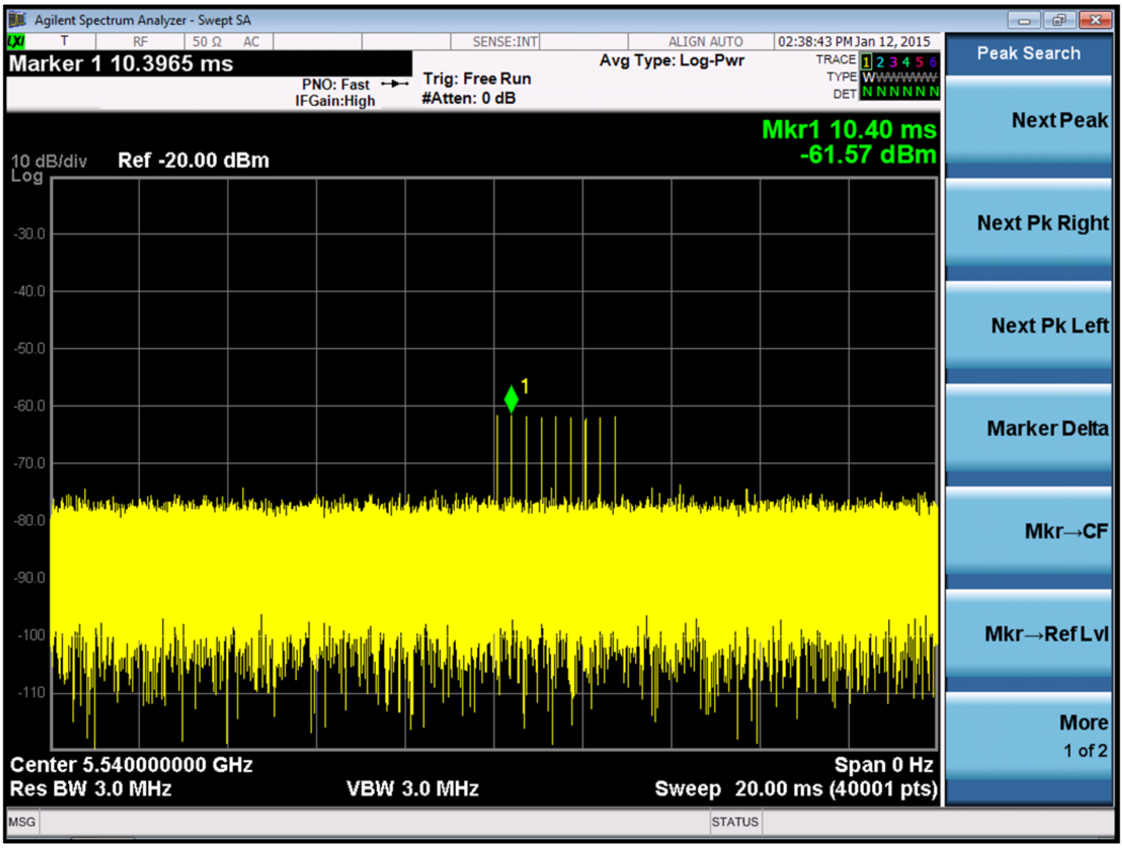
Radar Signal 4



Radar Signal 5



Radar Signal 6

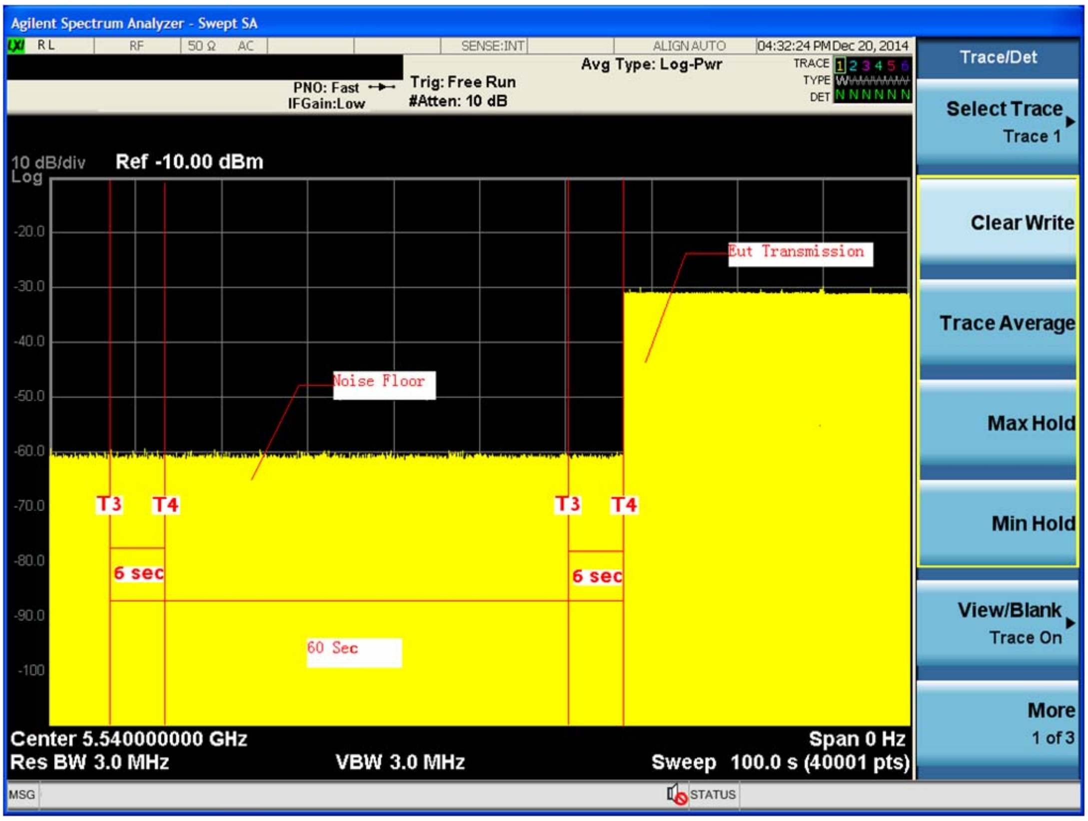


6.2.3 CHANNEL AVAILABILITY CHECK TIME

If the UUT successfully detected the radar burst, it should be observed as the UUT has no transmissions occurred until the UUT starts transmitting on another channel.

11a Mode

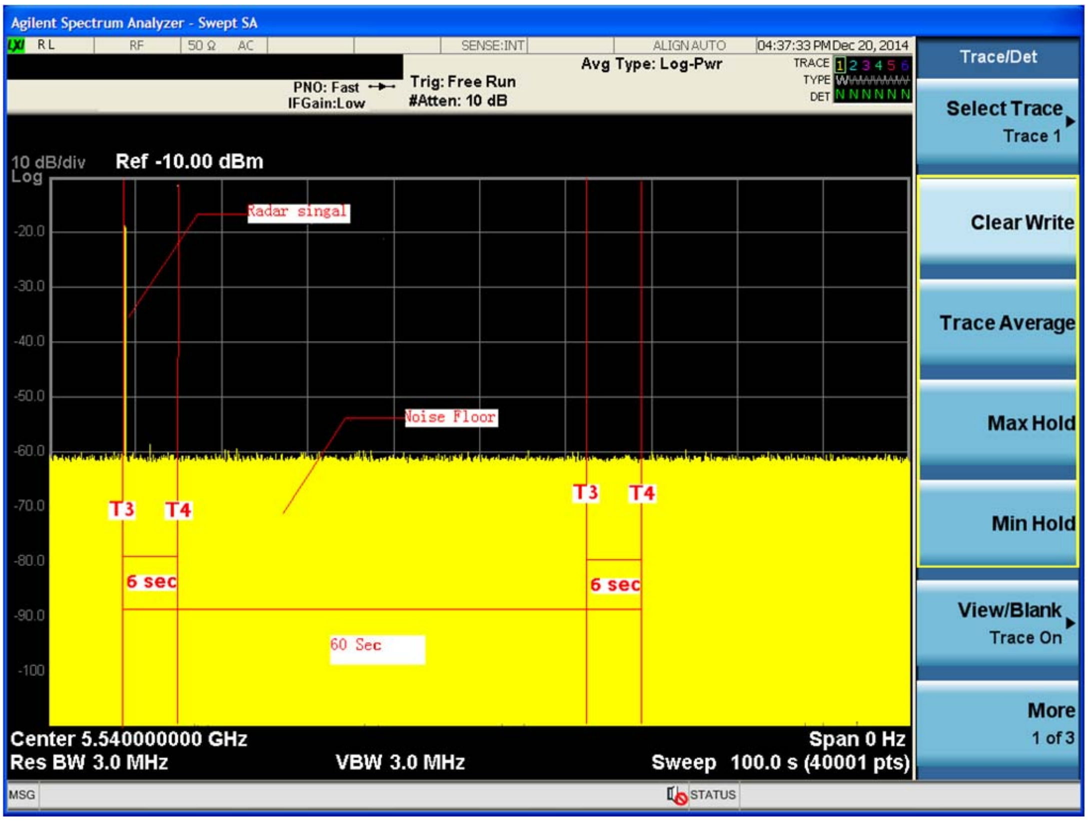
Initial Channel Availability Check Time



Note: T1 denotes the end of power-up time period is 6 second.
T4 denotes the end of Channel Availability Check time is 66 second. Channel Availability Check time is equal to (T4 – T1) 60 seconds.

11a Mode

Radar Burst at the Beginning of the Channel Availability Check Time



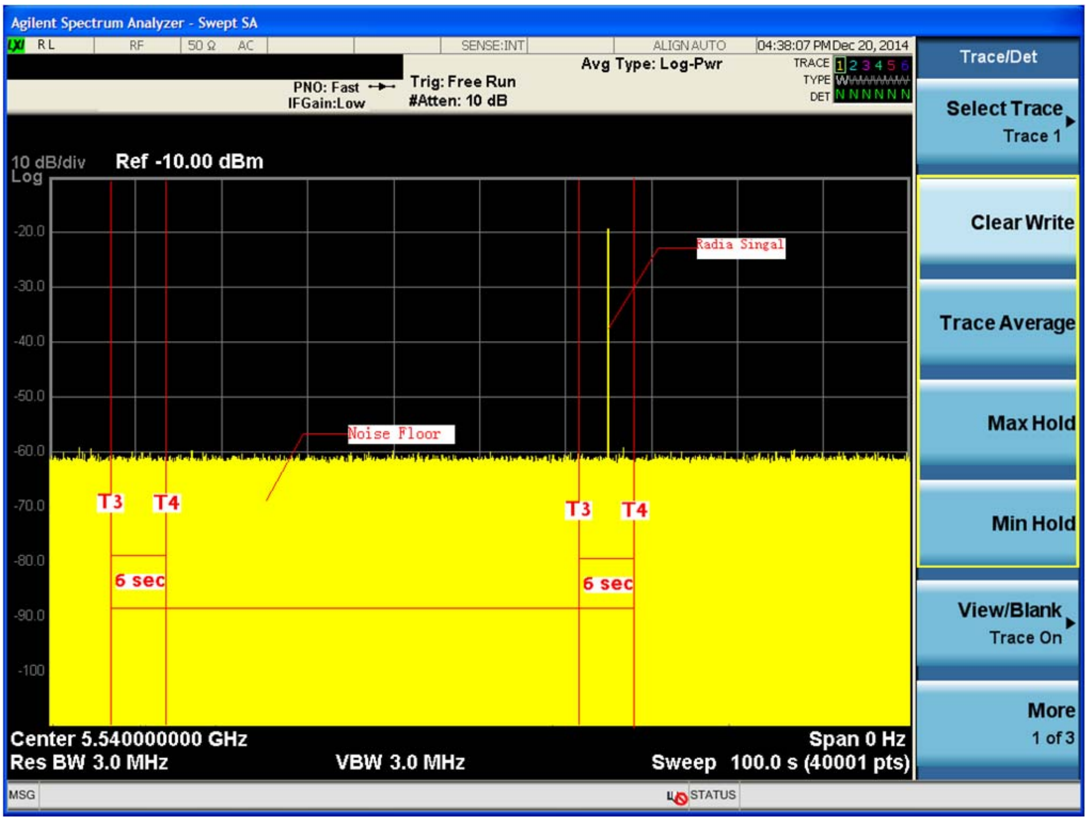
Note: T1 denotes the end of power up time period is 6 second.

T2 denotes 12 second. the radar burst was commenced within a 6 second window starting from the end of power-up sequence.

T4 denotes the 66 second.

11a Mode

Radar Burst at the End of the Channel Availability Check Time



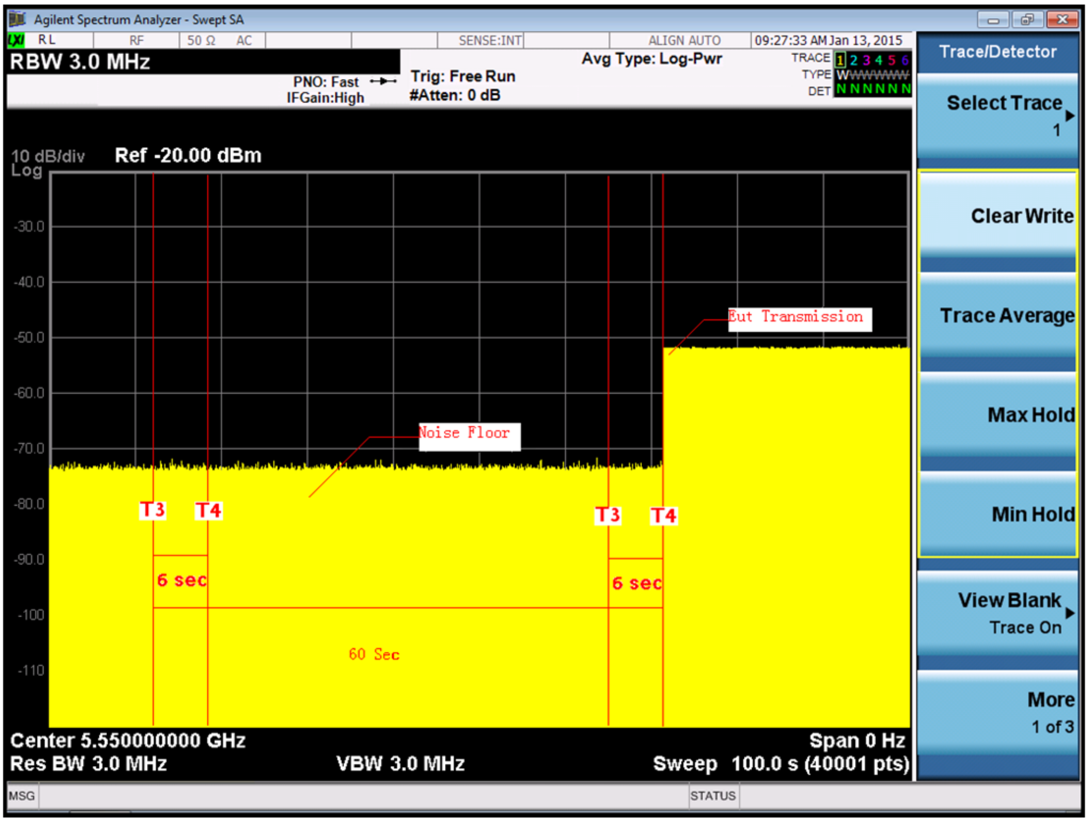
Note: T1 denotes the end of power up time period is 6 second.

T3 denotes 66 second and radar burst was commenced within 54th second to 60th secondindow starting from the end of power-up sequence.

T4 denotes the 66 second

11n 40MHz Mode

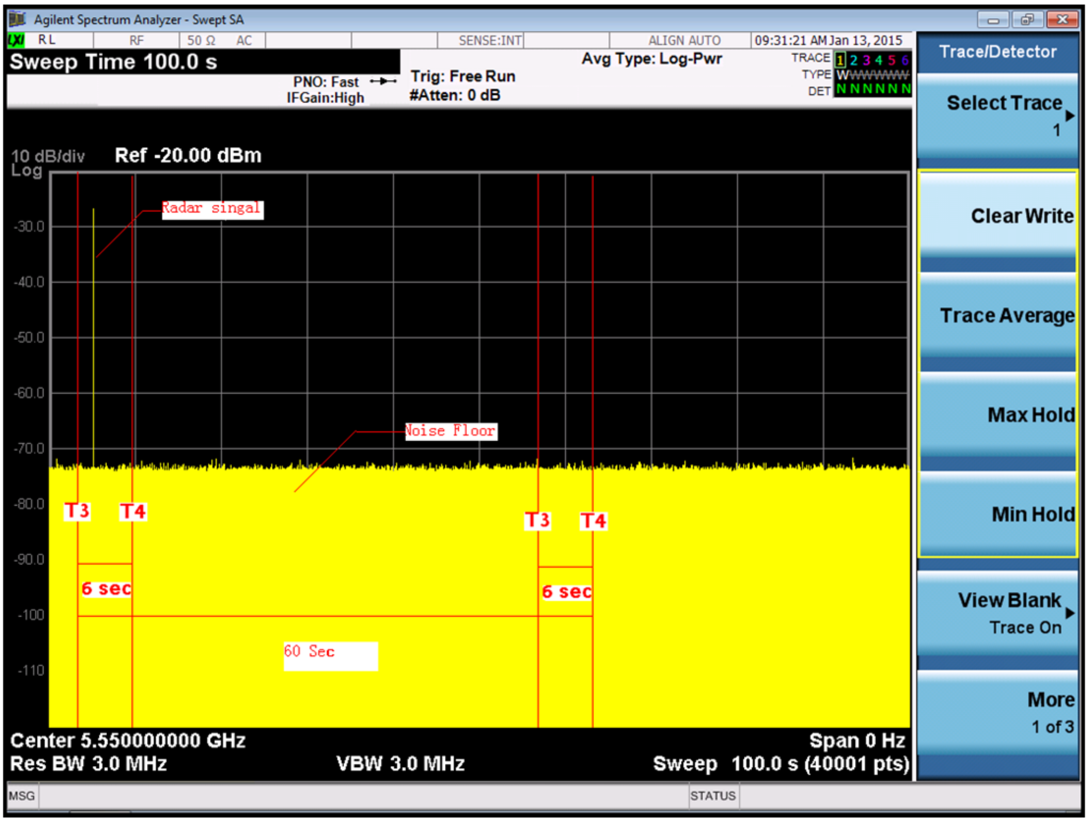
Initial Channel Availability Check Time



Note: T1 denotes the end of power-up time period is 6 second.
T4 denotes the end of Channel Availability Check time is 66 second. Channel Availability Check time is equal to (T4 – T1) 60 seconds.

11n 40MHz Mode

Radar Burst at the Beginning of the Channel Availability Check Time



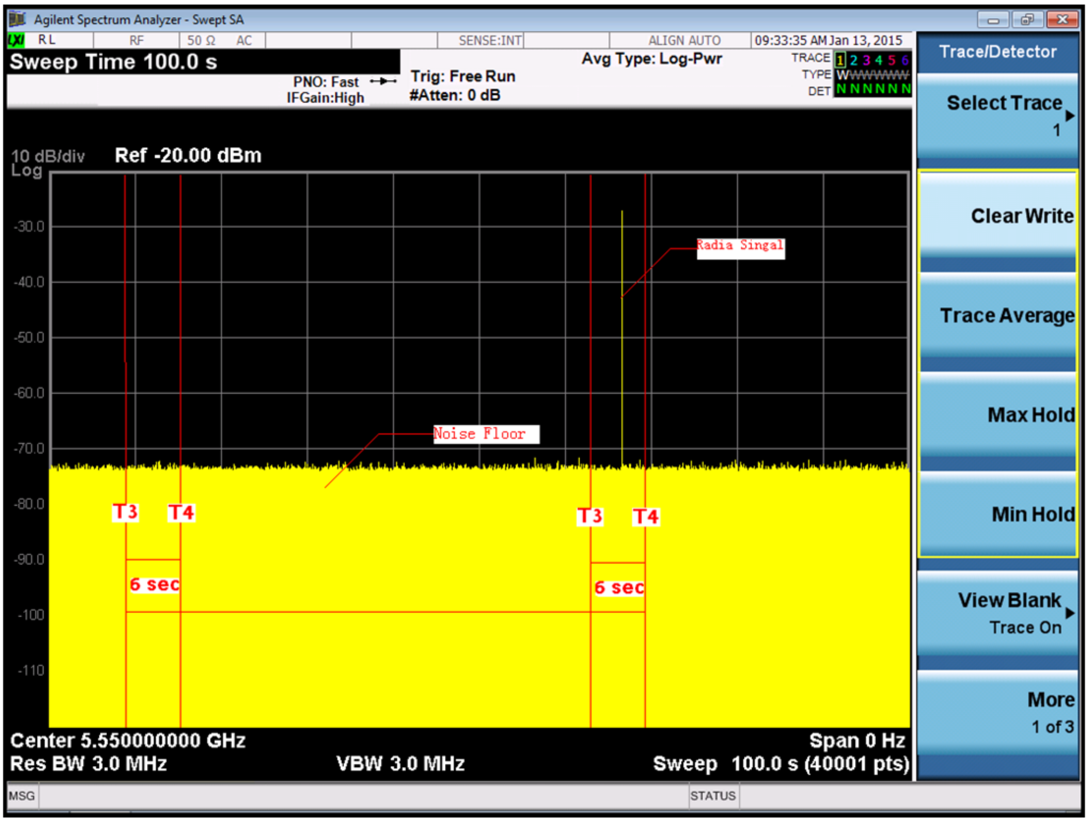
Note: T1 denotes the end of power up time period is 6 second.

T2 denotes 12 second. the radar burst was commenced within a 6 second window starting from the end of power-up sequence.

T4 denotes the 66 second.

11n 40MHz Mode

Radar Burst at the End of the Channel Availability Check Time



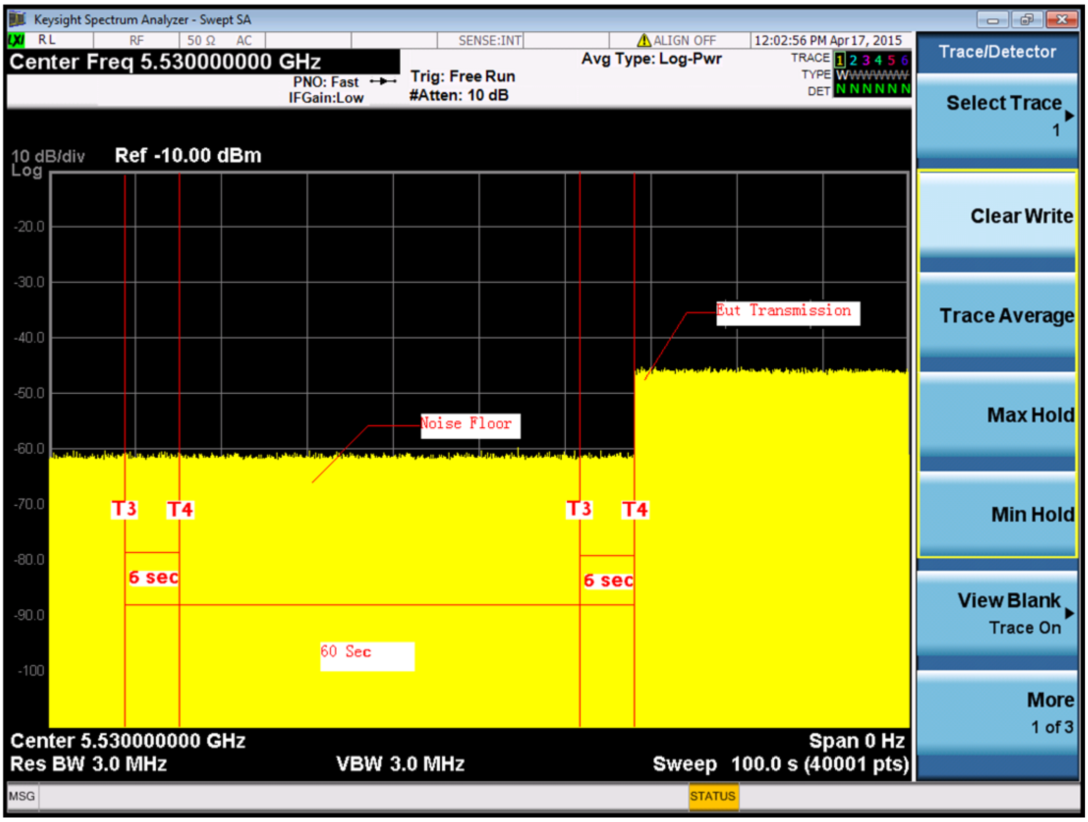
Note: T1 denotes the end of power up time period is 6 second.

T3 denotes 66 second and radar burst was commenced within 54th second to 60th secondindow starting from the end of power-up sequence.

T4 denotes the 66 second

11ac 80MHz Mode

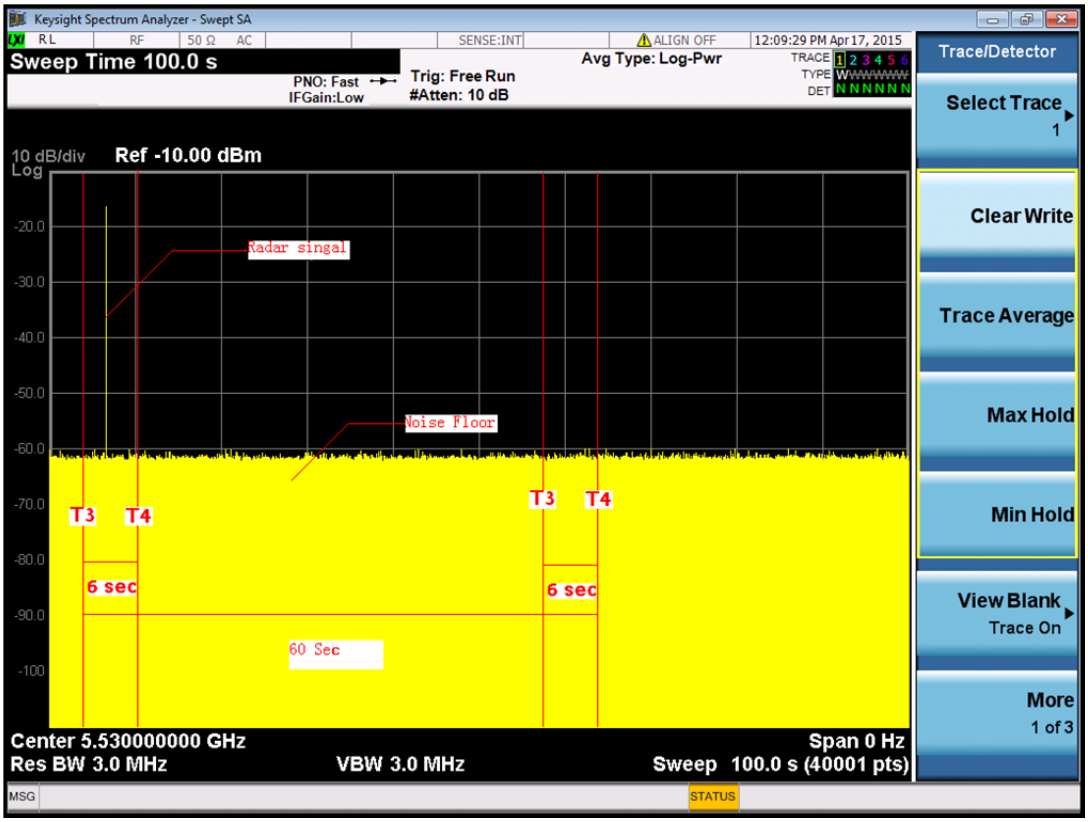
Initial Channel Availability Check Time



Note: T1 denotes the end of power-up time period is 6 second.
T4 denotes the end of Channel Availability Check time is 66 second. Channel Availability Check time is equal to (T4 – T1) 60 seconds.

11ac 80MHz Mode

Radar Burst at the Beginning of the Channel Availability Check Time



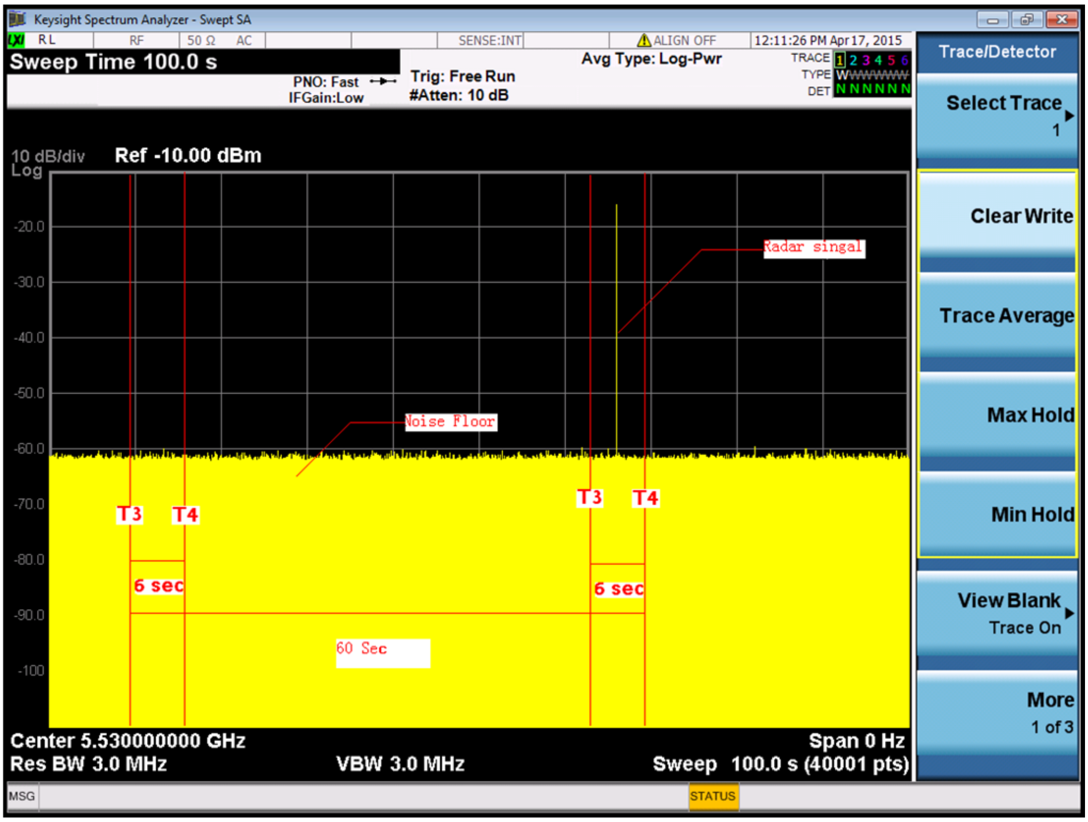
Note: T1 denotes the end of power up time period is 6 second.

T2 denotes 12 second. the radar burst was commenced within a 6 second window starting from the end of power-up sequence.

T4 denotes the 66 second.

11ac 80MHz Mode

Radar Burst at the End of the Channel Availability Check Time



Note: T1 denotes the end of power up time period is 6 second.

T3 denotes 66 second and radar burst was commenced within 54th second to 60th secondindow starting from the end of power-up sequence.

T4 denotes the 66 second