FCC Part 15E
DFS TEST REPORT

of

E.U.T. : Wireless 11n AP

FCC ID. : TGN-AN0100

Model No. : AN0100

for

APPLICANT : TiVo Inc.

ADDRESS : 2160 Gold St., Alviso, CA 95002 USA

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO.34, LIN 5, DINGFU TSUEN, LINKOU SHIANG
TAIPEI COUNTY, TAIWAN, 24442, R.O.C.
Tel : (02)26023052 Fax : (02)26010910
http://www.etc.org.tw ; e-mail: emc@etc.org.tw
Report Number : 09-10-RBF-181

TEST REPORT CERTIFICATION

Applicant : TiVo Inc.
2160 Gold St., Alviso, CA 95002 USA

Description of EUT

a) Type of EUT : Wireless 11n AP
b) Trade Name : TiVo
c) Model No. : AN0100
d) Power Supply : I/P: 100-240Vac 50/60Hz 0.3A;
O/P: 12Vdc 0.5A

Regulation Applied : FCC Rules and Regulations Part 15 Subpart E §15.407 (h) (2008)

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in §15.407 (h) and FCC 06-96 appendix "compliance measurement procedures for unlicensed-national information infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection", and the test results were founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Date Test Item Received	:	Oct. 26, 2009
Date Test Campaign Completed	:	Oct. 26, 2009
Date of Issue	:	Oct. 28, 2009

Test Engineer : _____
(Falcon Shi, Engineer)

Check By : _____
(Charles Wang, Supervisor)

Approve & Authorized Signer : _____
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

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1 GENERAL INFORMATION

1.1 PRODUCT INFORMATION

a) Type of EUT : Wireless 11n AP
b) Trade Name : TiVo
c) Model No. : AN0100
d) Power Supply : I/P: 100-240Vac 50/60Hz 0.3A;
O/P: 12Vdc 0.5A

1.2 DESCRIPTION OF EUT

Overview Of EUT With Respect To §15.407 (H) Requirements

1. The firmware installed in the EUT during testing was: Firmware Rev: S638
2. The EUT operates over the 5250-5350 MHz and 5470-5725 MHz range as a Client Device that does not have radar detection capability.
3. The antenna assembly utilized with the EUT has a gain of 2.67 dBi for ANT1 and 1.80 dBi for ANT2.
4. The highest power level is 26.06 dBm EIRP in the 5260 ~ 5320MHz band.
5. The highest power level is 26.27 dBm EIRP in the 5470 ~ 5725MHz band.
6. WLAN traffic is generated by streaming the video file TestFile.mpg "6 ½ Magic Hours" from the Master to the Slave in full motion video mode using the media player.
7. TPC is not required since the maximum EIRP is less than 500 mW (27 dBm).
8. The EUT utilizes the 802.11a/n architecture, with a nominal channel bandwidth of 20 MHz and 40MHz.
9. The Master Device is a Cisco Aironet IOS Access Point, FCC ID: LDK102061 & FCC ID: LDK102062.
10. The rated output power of the EUT is > 23dBm (EIRP). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –64 + 1 + 1.8 = -61.2 dBm.
11. The calibrated conducted DFS Detection Threshold level is set to –61.2 dBm.

Manufacturer's Statement Regarding Uniform Channel Spreading

The end product implements an automatic channel selection feature at startup such that operation commences on channels distributed across the entire set of allowed 5GHz channels. This feature will ensure uniform spreading is achieved while avoiding non-allowed channels due to prior radar events.

1.3 TEST METHODOLOGY

According to §15.407 (h) and FCC 06-96 appendix "compliance measurement procedures for unlicensed-national information infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection".

1.4 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at NO.34, LIN 5, DINGFU TSUEN, LINKOU SHIANG TAIPEI COUNTY, TAIWAN, 24442, R.O.C.
This site has been fully described in a report submitted to your office, and accepted in a letter dated Aug. 05, 2008

2 PROVISIONS APPLICABLE

2.1 WORKING MODES AND REQUIRED TEST ITEMS

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non- Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform spreading	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required	Yes

2.2 TEST LIMITS AND RADAR SIGNAL PARAMETERS

DETECTION THRESHOLD VALUES

Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	**Value (See Notes 1 and 2)**
≥ 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. 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.	

Table 4: 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 U-NII 99% transmission 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 Waveform*.

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 1 is used and for each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

RADAR TEST WAVEFORMS

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of 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

Table 6 – Long Pulse Radar Test Waveform

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

Table 7 – Frequency Hopping Radar Test Waveform

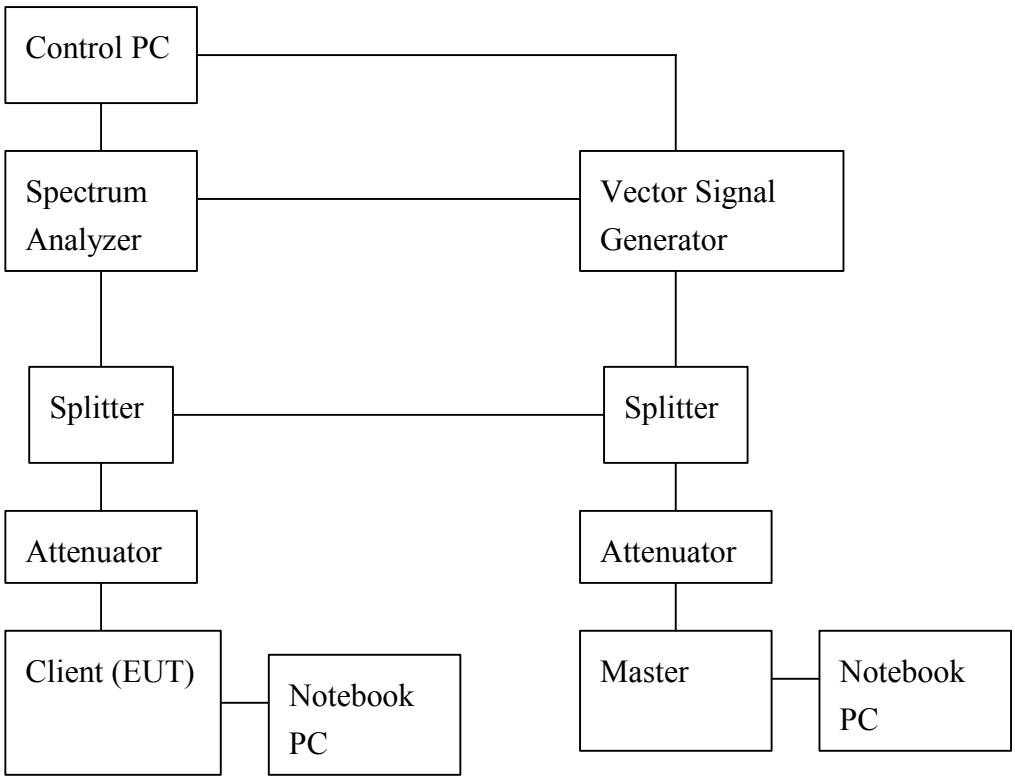
Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

3. TEST AND MEASUREMENT SYSTEM

3.1 DFS MEASUREMENT SYSTEM

The measurement system is based on a conducted test method.
The DFS Measurement System consists of two subsystems: (1) the Radar Signal Generating Subsystem and (2) the Traffic Monitoring Subsystem. The control PC is necessary for generating the Radar waveforms. The traffic monitoring subsystem is specified to the type of the EUT.

Conducted Method System Block Diagram



System Calibration

Connect the spectrum analyzer to the test system in place of the master device. Set the signal generator to CW mode. Adjust the amplitude of the signal generator to yield a measured level of –64 dBm on the spectrum analyzer.
Without changing any of the instrument settings, reconnect the spectrum analyzer to the Common port of the Spectrum Analyzer Combiner/Divider and connect a 50 ohm load to the Master Device port of the test system.
Measure the amplitude and calculate the difference from –64 dBm. Adjust the Reference

Level Offset of the spectrum analyzer to this difference. Confirm that the signal is displayed at –64 dBm. Readjust the RBW and VBW to 3 MHz, set the span to 10 MHz, and confirm that the signal is still displayed at –64 dBm.
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 –64 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.

Adjustment Of Displayed Traffic Level

Establish a link between the Master and Slave. Stream the video test file to generate WLAN traffic. Confirm that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold. Confirm that the displayed traffic is from the Master Device. For Master Device testing confirm that the displayed traffic does not include Slave Device traffic. For Slave Device testing confirm that the displayed traffic does not include Master Device traffic.
If a different setting of the Master Step Attenuator is required to meet the above conditions, perform a new System Calibration for the new Master Step Attenuator setting.

3.2 TEST & SUPPORT EQUIPMENT LIST

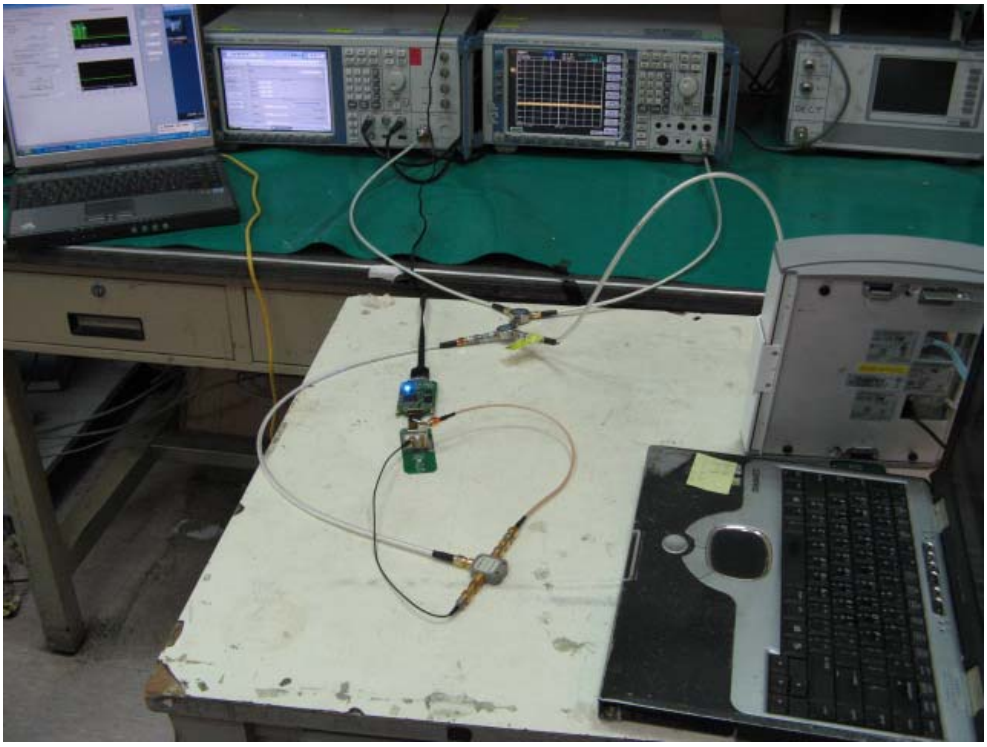
Test Instruments:

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2009/09/10	2010/09/09
Vector Signal Generator	Rohde & Schwarz	SMU 200A	2009/05/11	2010/05/10

SUPPORT EQUIPMENT

Equipment	Manufacturer	Model No.	Serial No.	FCC ID
Cisco Aironet IOS Access Point	Cisco	AIR-AP1252AG-A-K9	FTX1225907R	LDK102061 LDK102062
Notebook PC	COMPAQ	PP2130	P2812TC	FCC DoC
Notebook PC	DELL	PP25L	HR648 A02	E2K4965AG NM
Notebook PC	ASUS	L1400	2614010195	FCC DoC

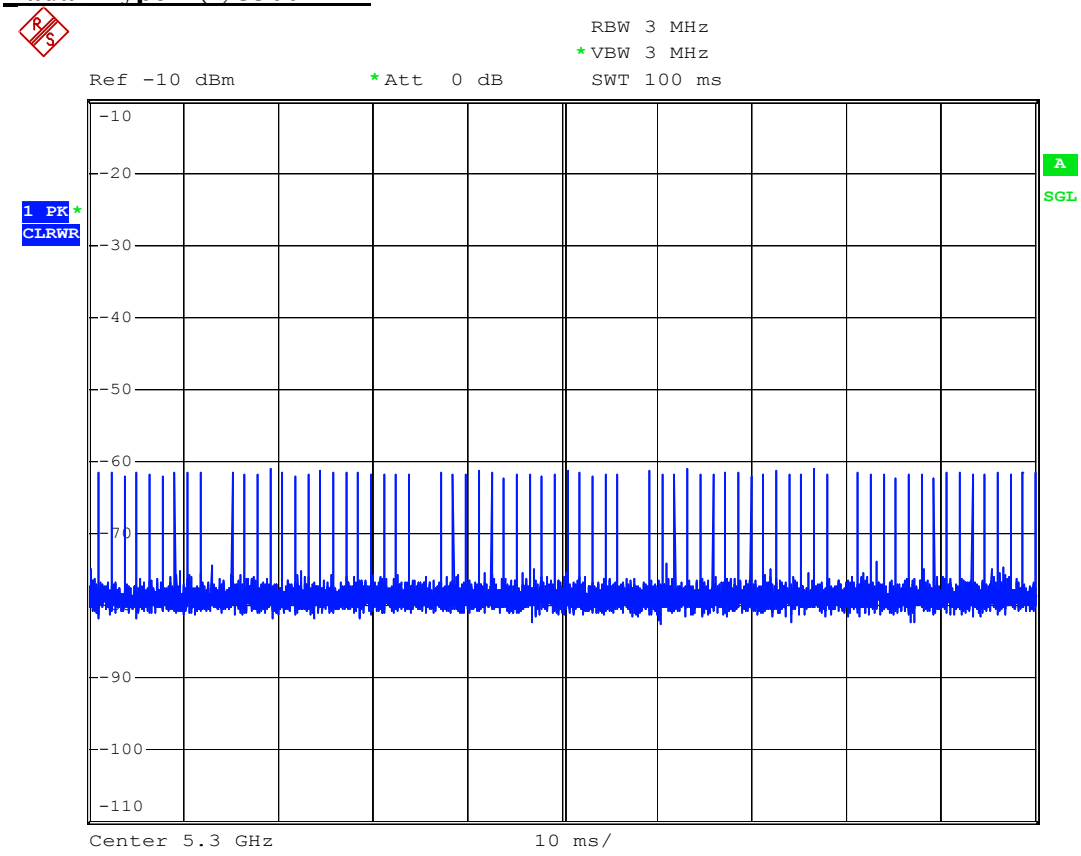
3.3 TEST SETUP PHOTOS



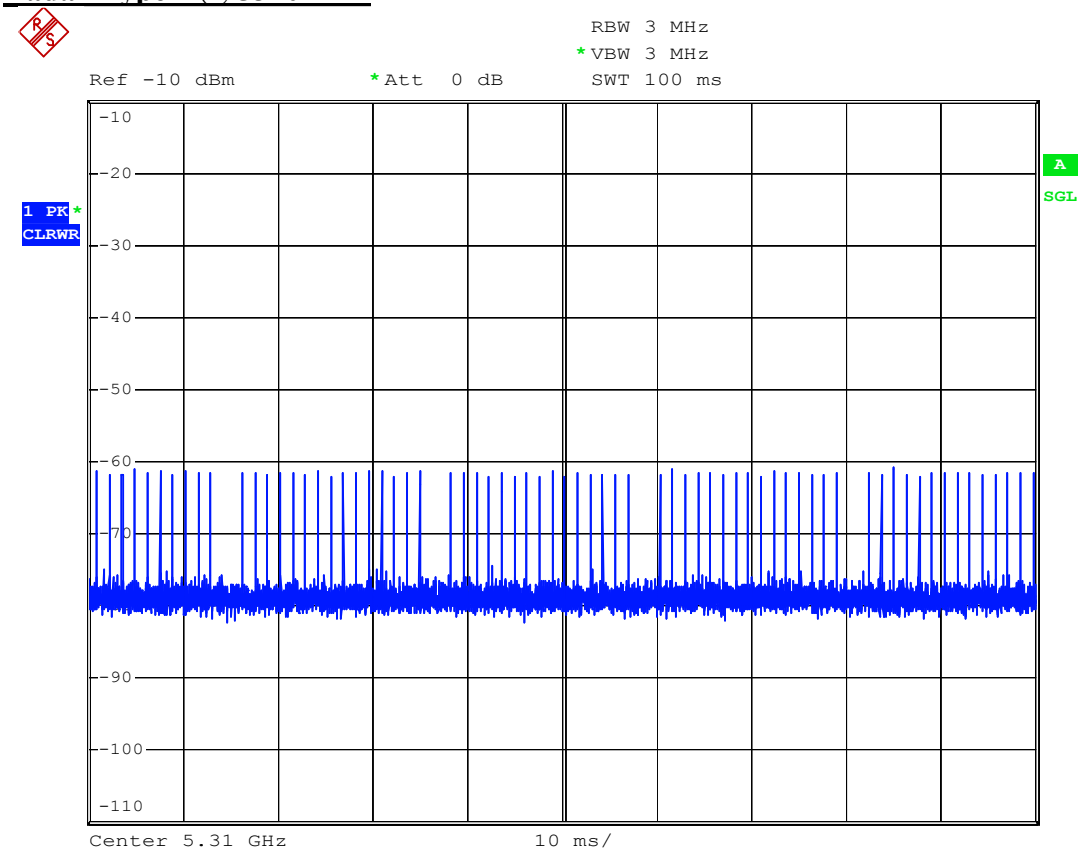
4 TEST RESULTS

4.1 PLOTS OF RADAR WAVEFORMS

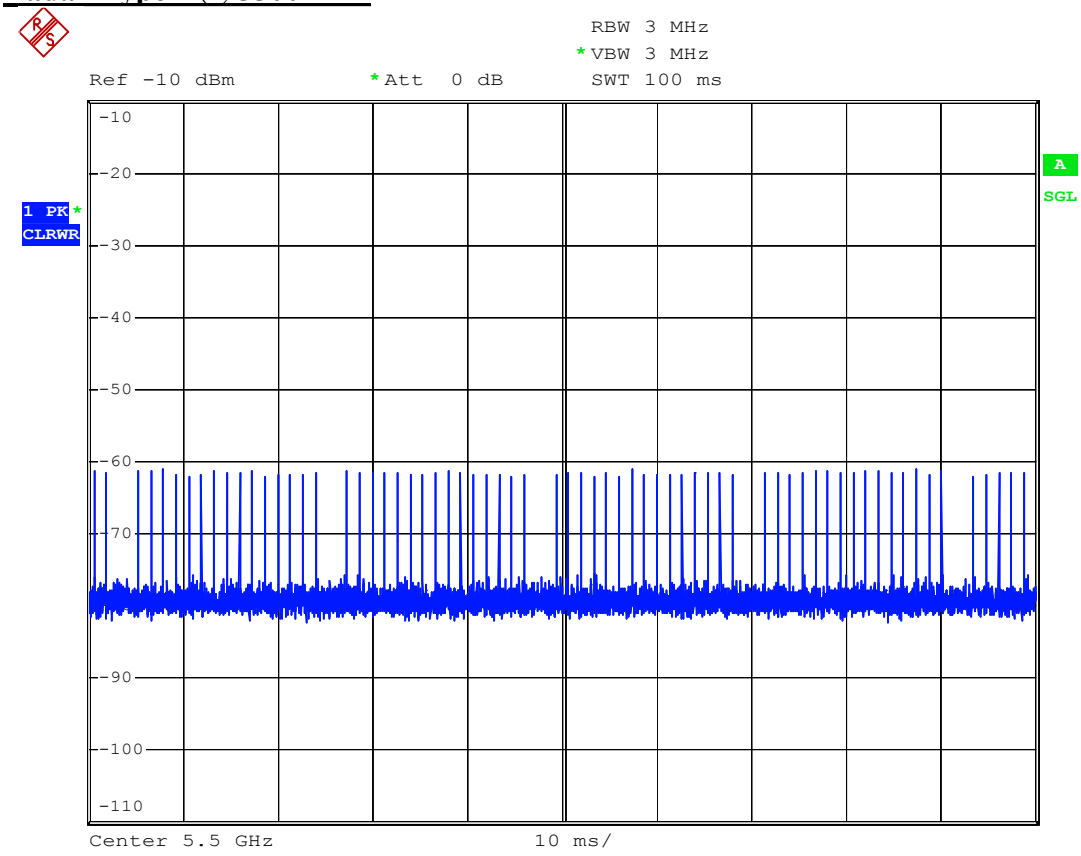
Radar Type 1 @ 5300MHz



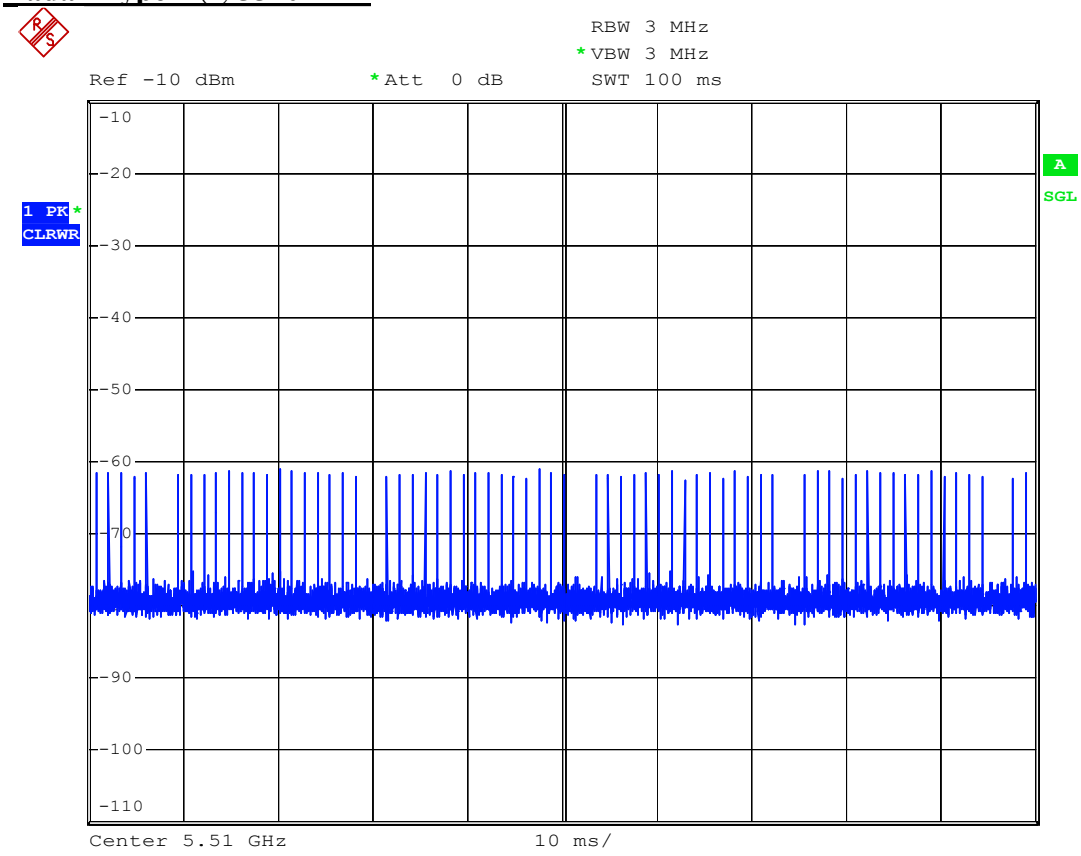
Radar Type 1 @ 5310MHz



Radar Type 1 @ 5500MHz

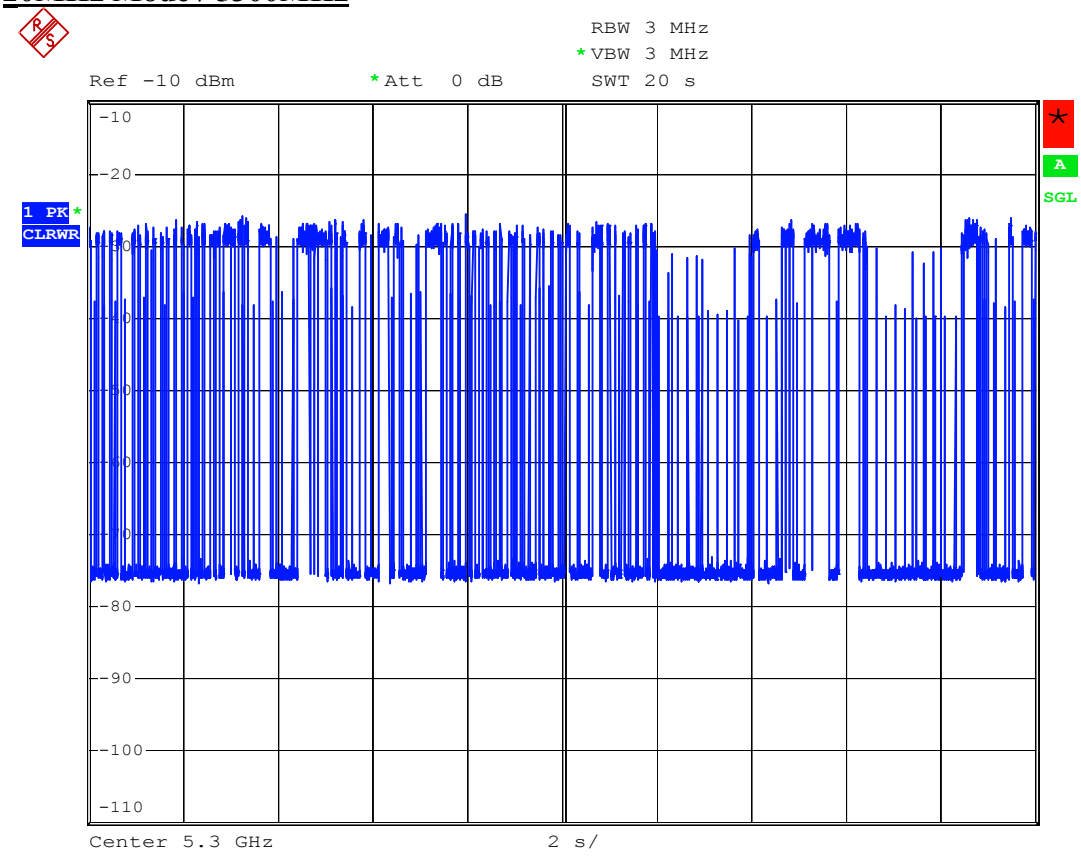


Radar Type 1 @ 5510MHz

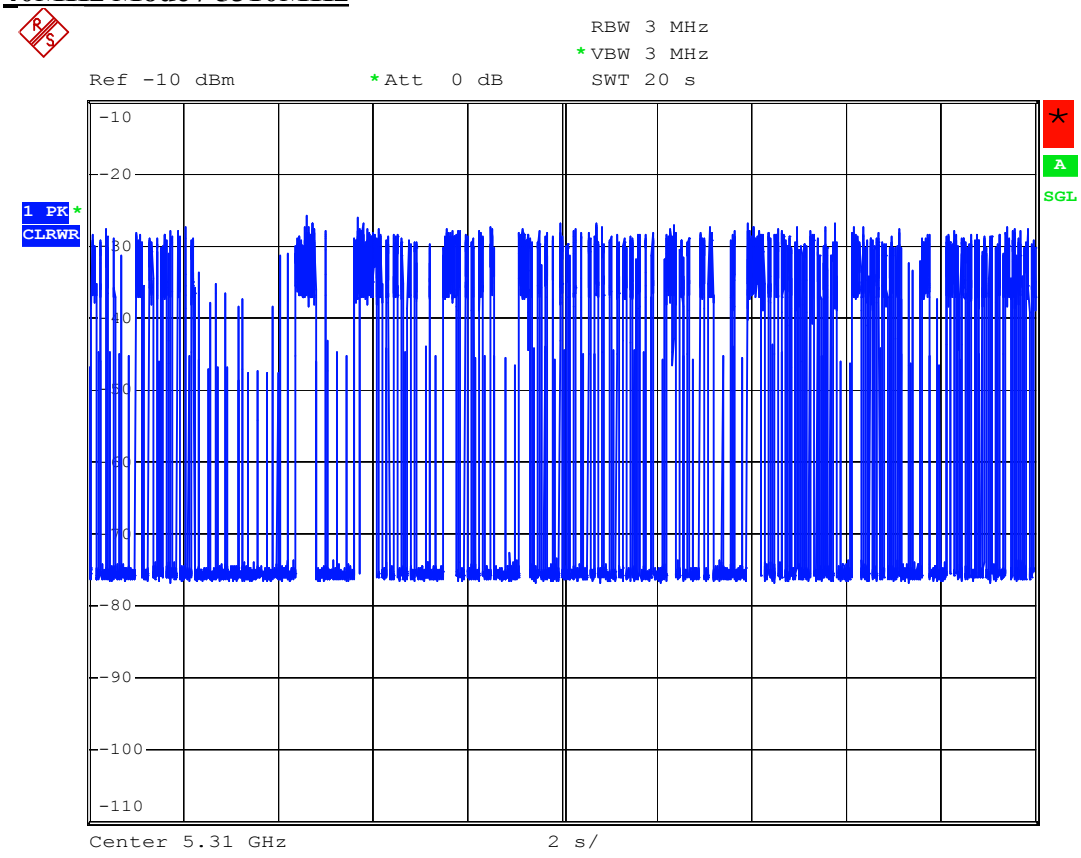


4.2 PLOT OF WLAN TRAFFIC

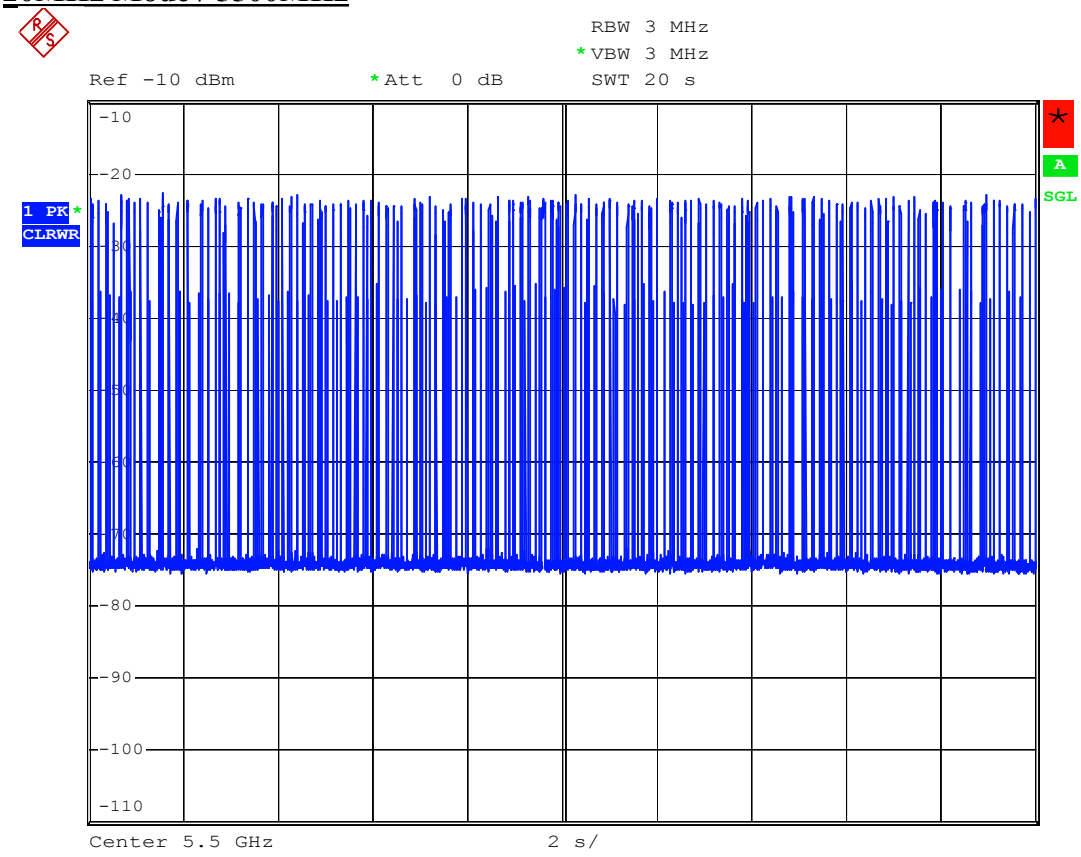
20MHz Mode / 5300MHz



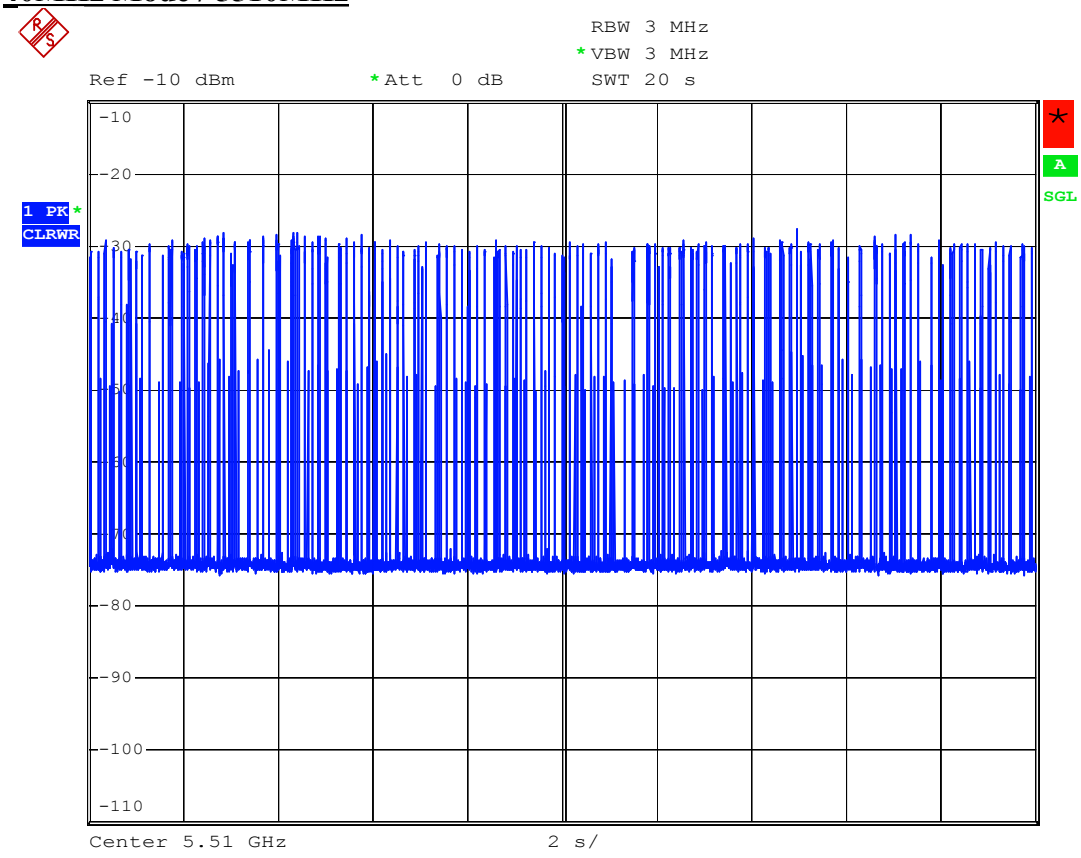
40MHz Mode / 5310MHz



20MHz Mode / 5500MHz



40MHz Mode / 5510MHz



4.3 CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

RESULTS

Mode	Channel Move Time (sec)	Limit (sec)
20MHz Mode / 5300MHz	0.5975	10
40MHz Mode / 5310MHz	0.4125	10
20MHz Mode / 5500MHz	0.4725	10
40MHz Mode / 5510MHz	0.5500	10

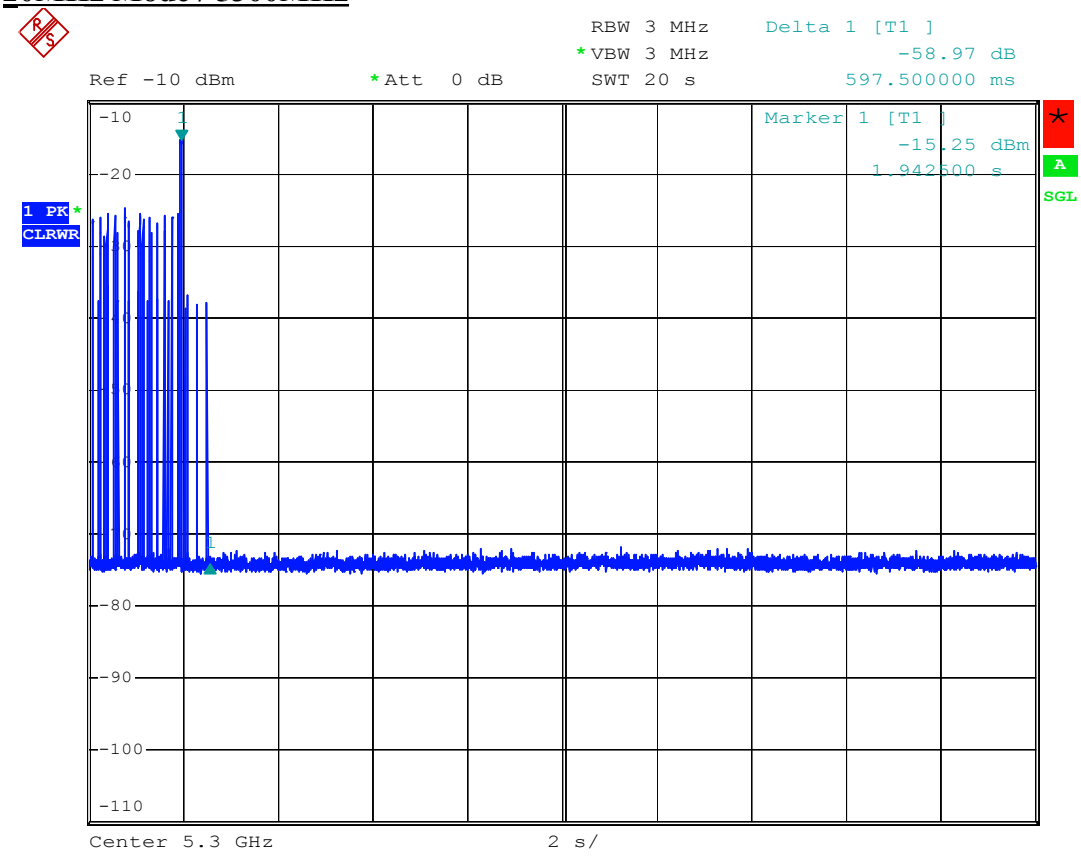
Mode	Aggregate Channel Closing Transmission Time (msec)	Limit (msec)
20MHz Mode / 5300MHz	32	60
40MHz Mode / 5310MHz	32	60
20MHz Mode / 5500MHz	16	60
40MHz Mode / 5510MHz	32	60

REPORTING NOTES

The reference marker is set at the end of last radar pulse.
The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.
The aggregate channel closing transmission time is calculated as follows:
Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)
The observation period over which the FCC aggregate time is calculated begins at (Reference Marker + 200 msec) and ends no earlier than (Reference Marker + 10 sec).

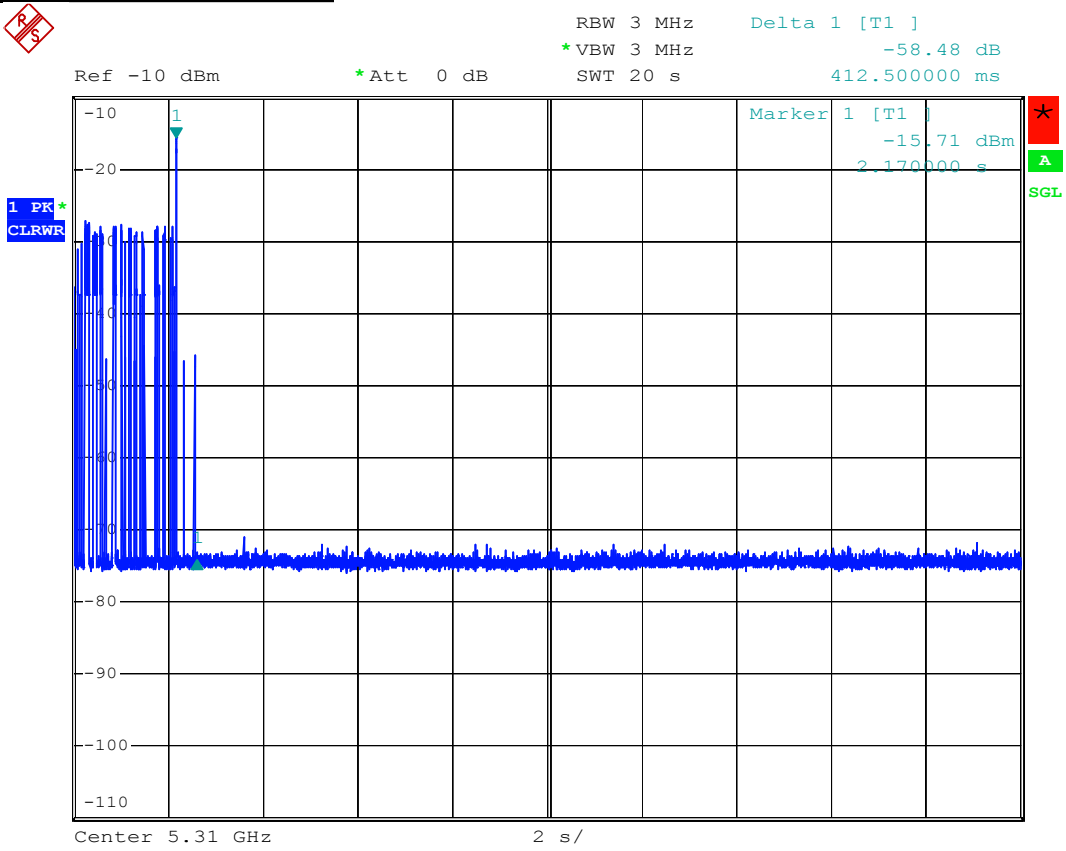
CHANNEL MOVE TIME

20MHz Mode / 5300MHz



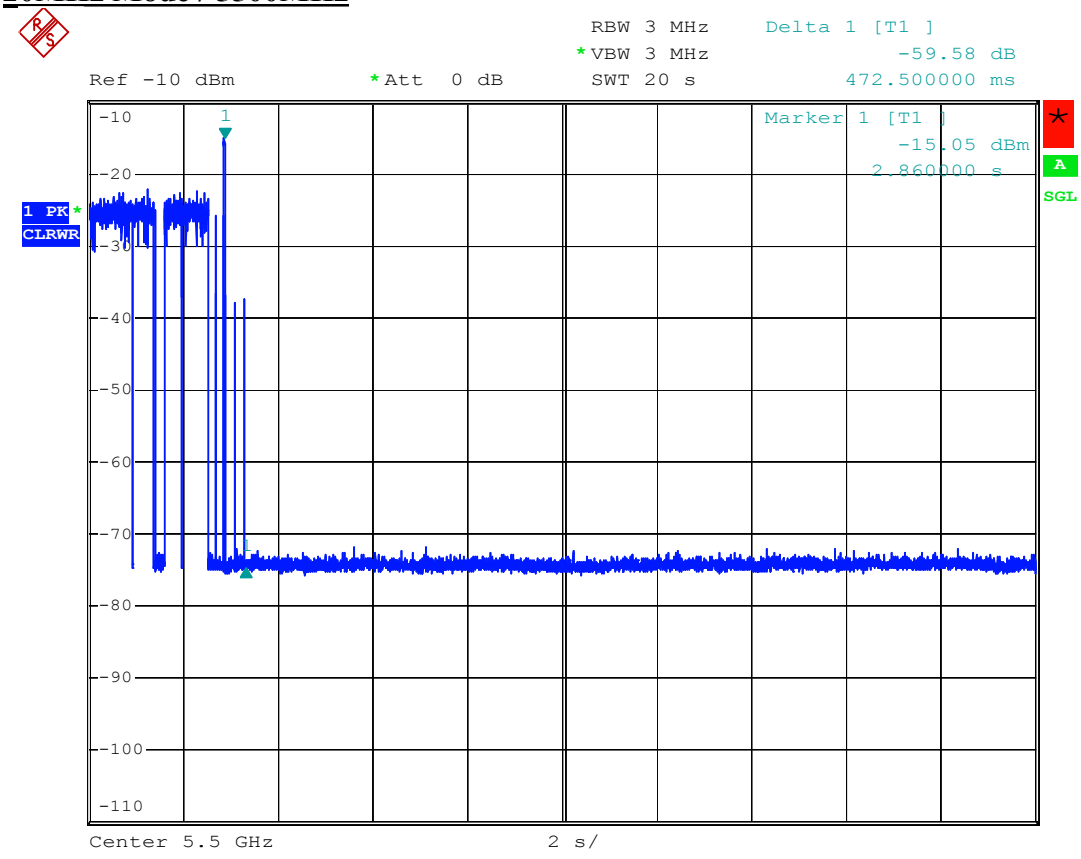
CHANNEL MOVE TIME

40MHz Mode / 5310MHz



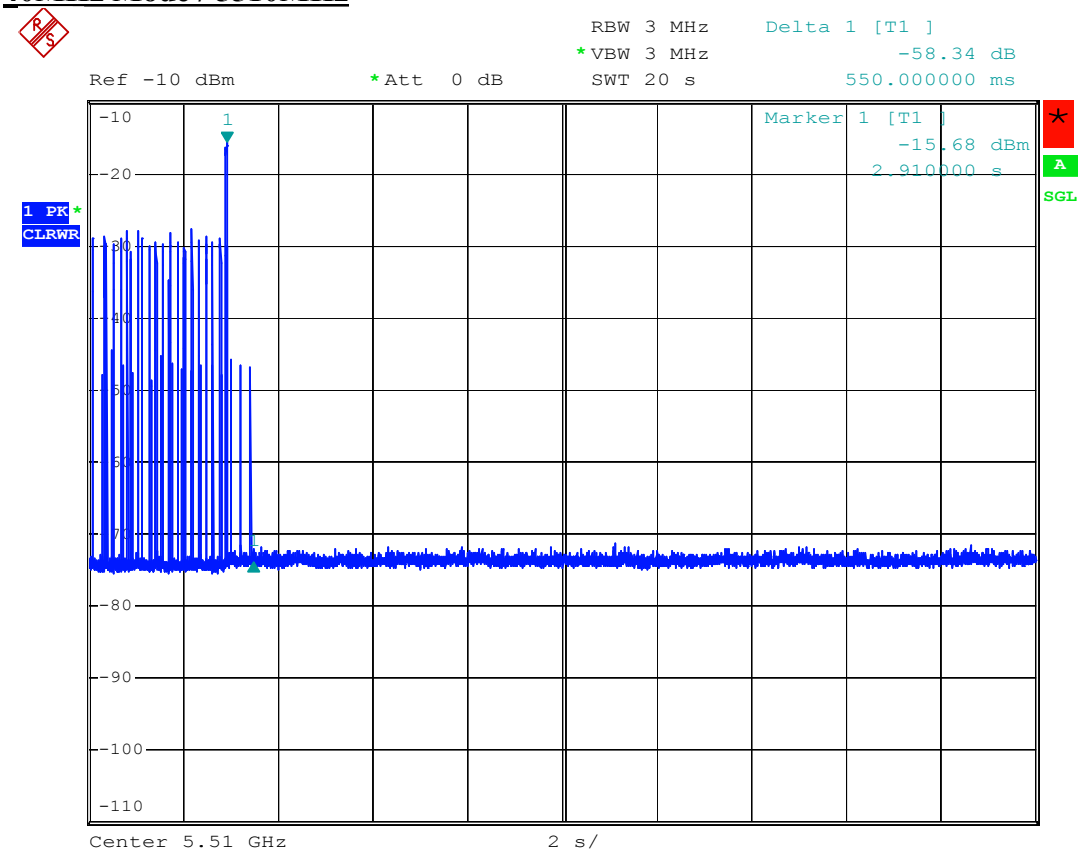
CHANNEL MOVE TIME

20MHz Mode / 5500MHz



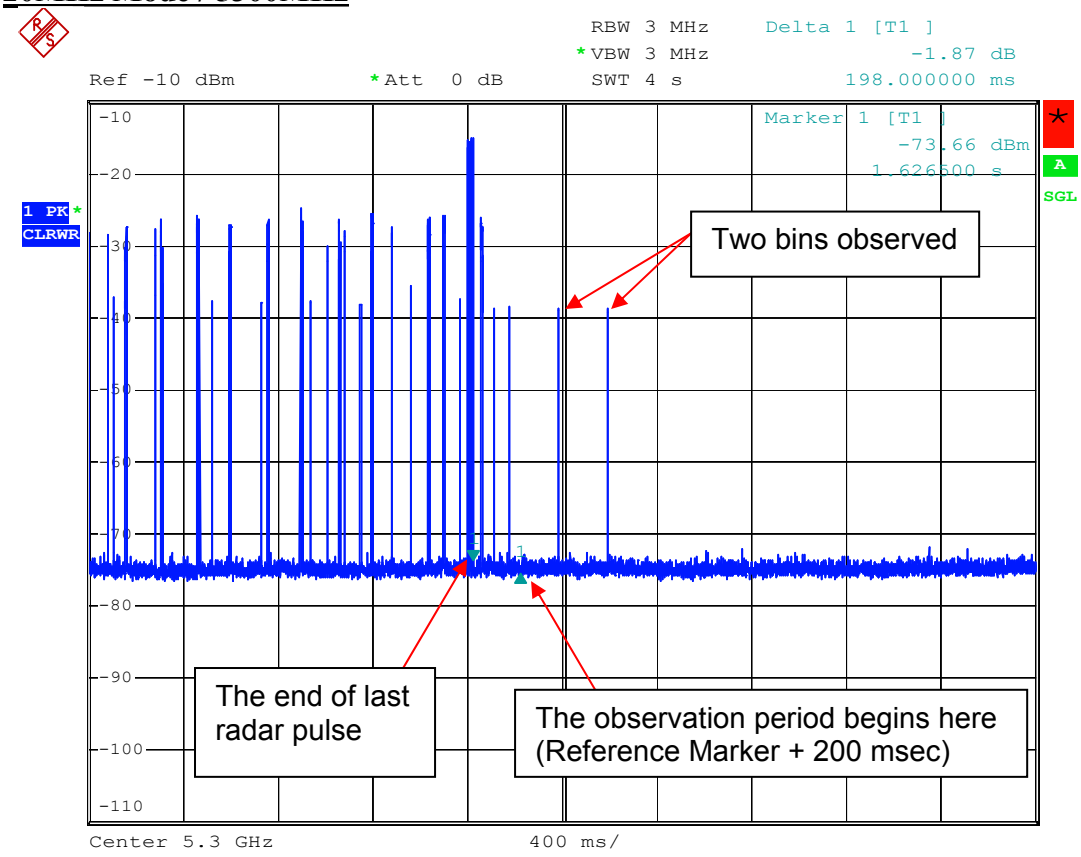
CHANNEL MOVE TIME

40MHz Mode / 5510MHz



CHANNEL CLOSING TIME

20MHz Mode / 5300MHz



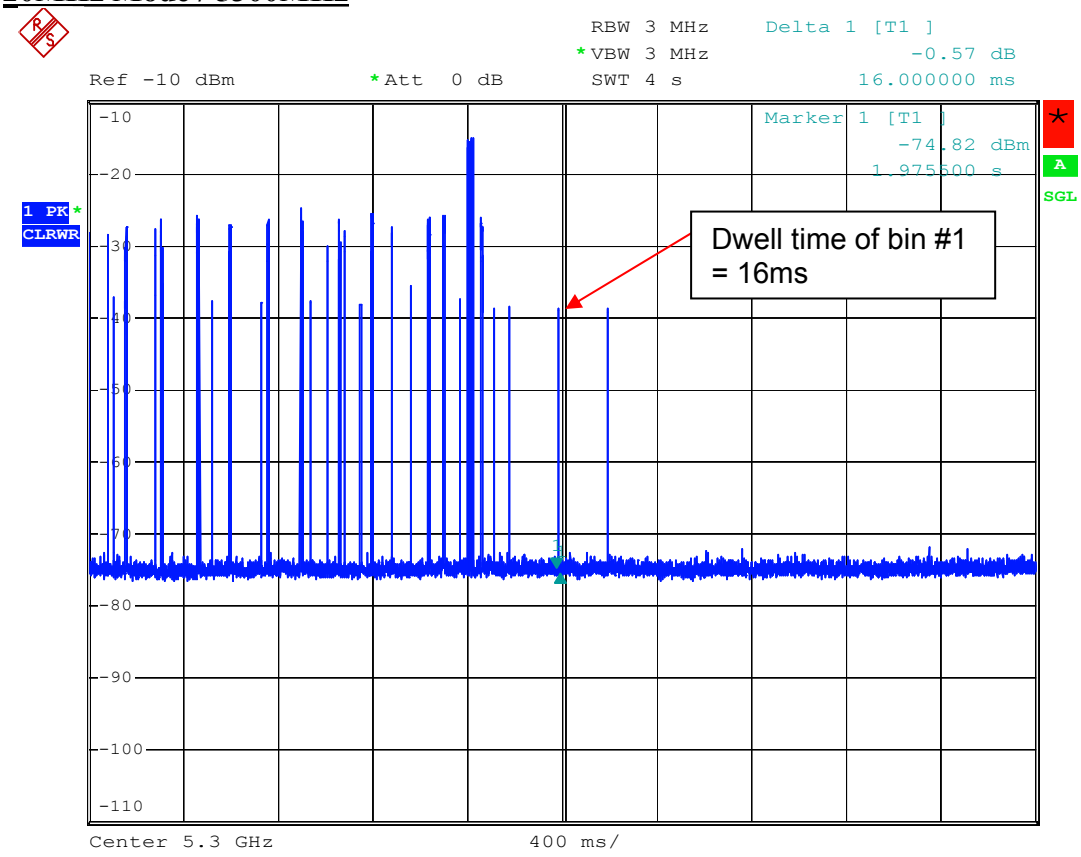
Aggregate Transmission Time =

(Number of analyzer bins showing transmission) * (dwell time per bin)

= 2 * 16 ms = 32 ms

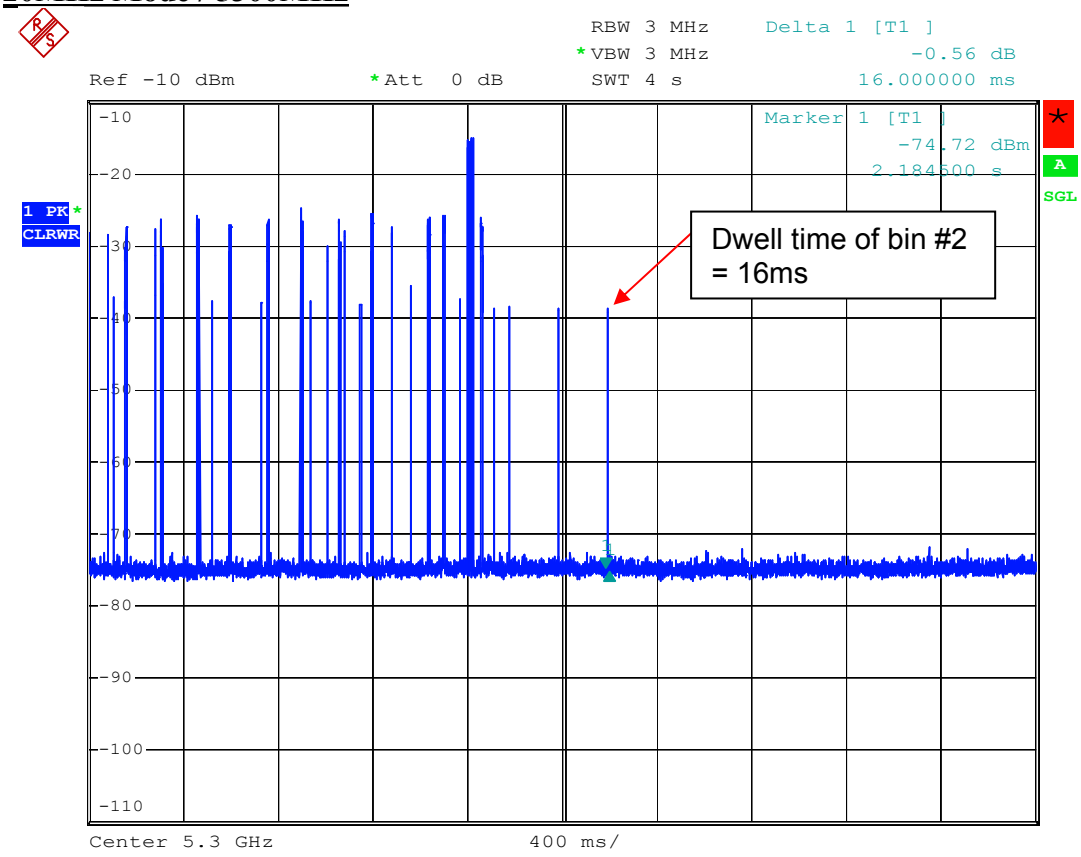
CHANNEL CLOSING TIME

20MHz Mode / 5300MHz



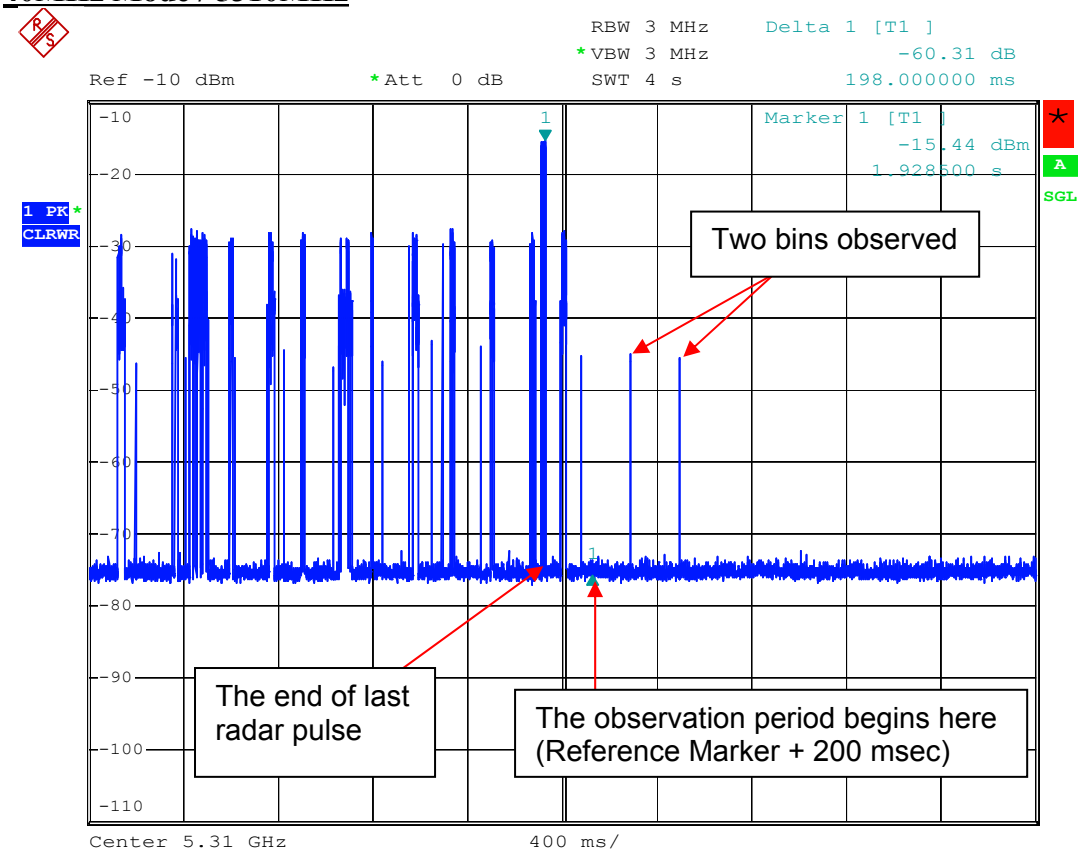
CHANNEL CLOSING TIME

20MHz Mode / 5300MHz



CHANNEL CLOSING TIME

40MHz Mode / 5310MHz



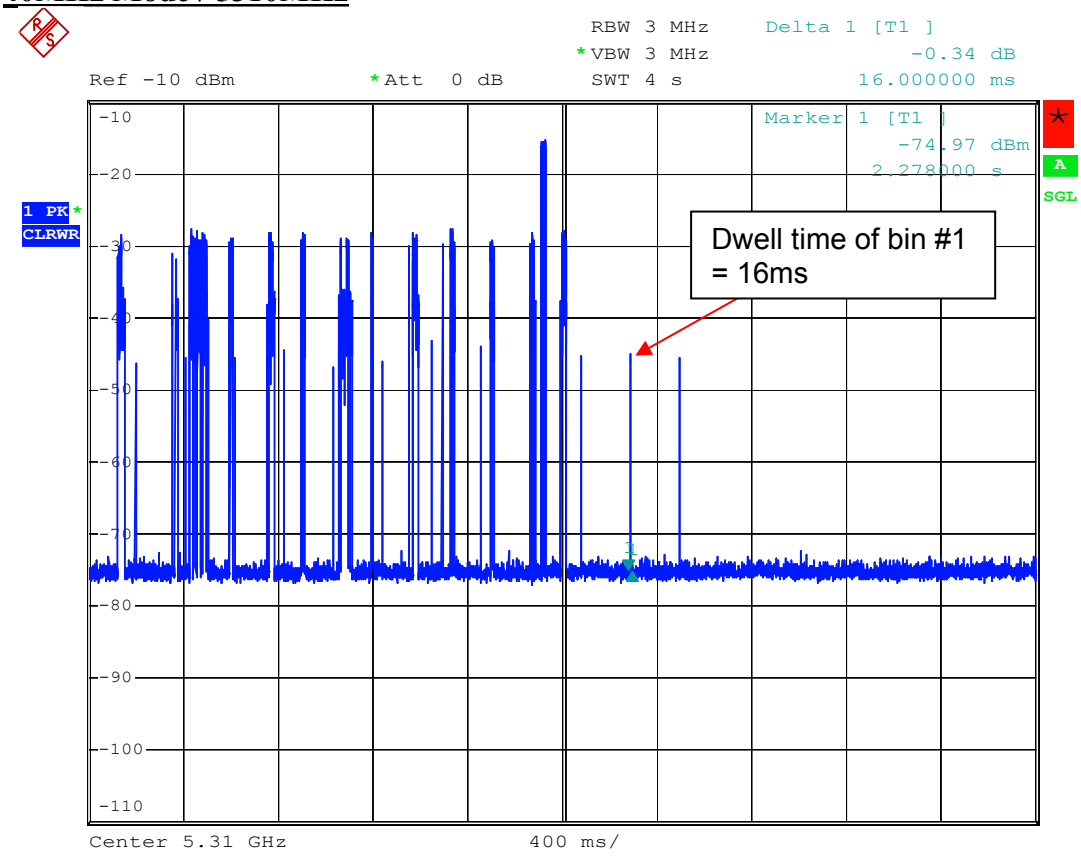
Aggregate Transmission Time =

(Number of analyzer bins showing transmission) * (dwell time per bin)

= 2 * 16 ms = 32 ms

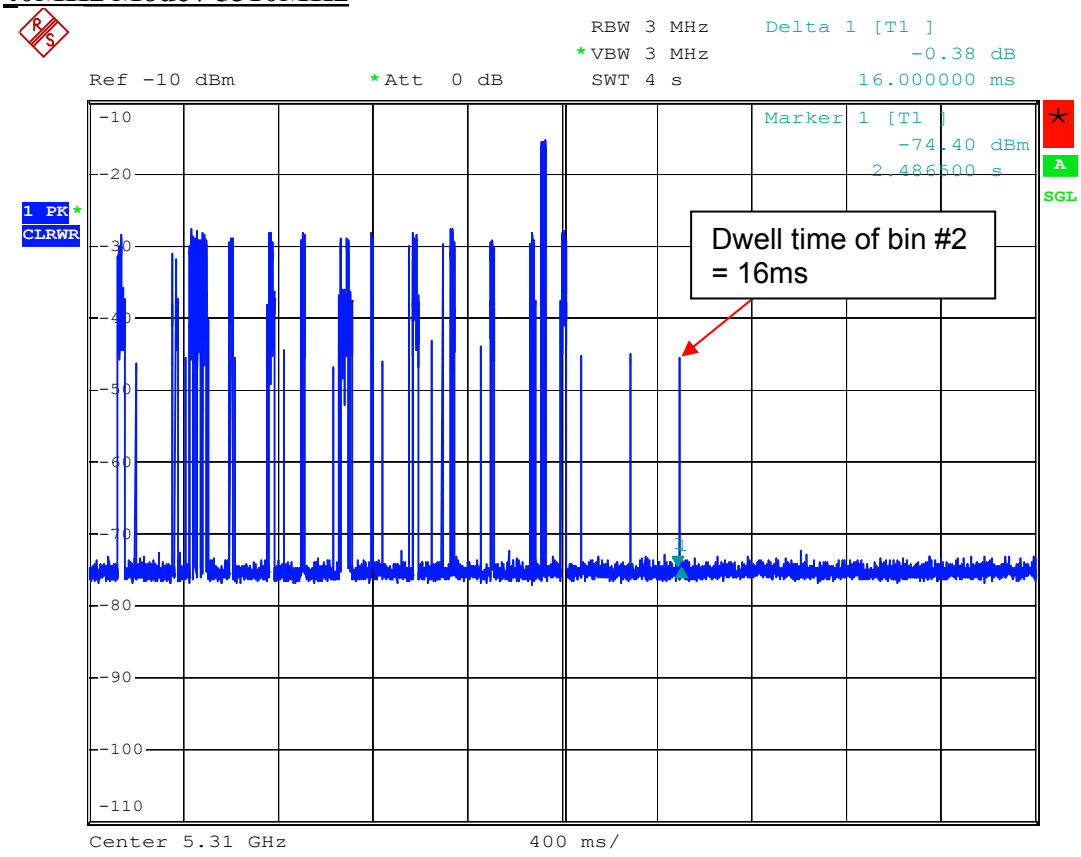
CHANNEL CLOSING TIME

40MHz Mode / 5310MHz



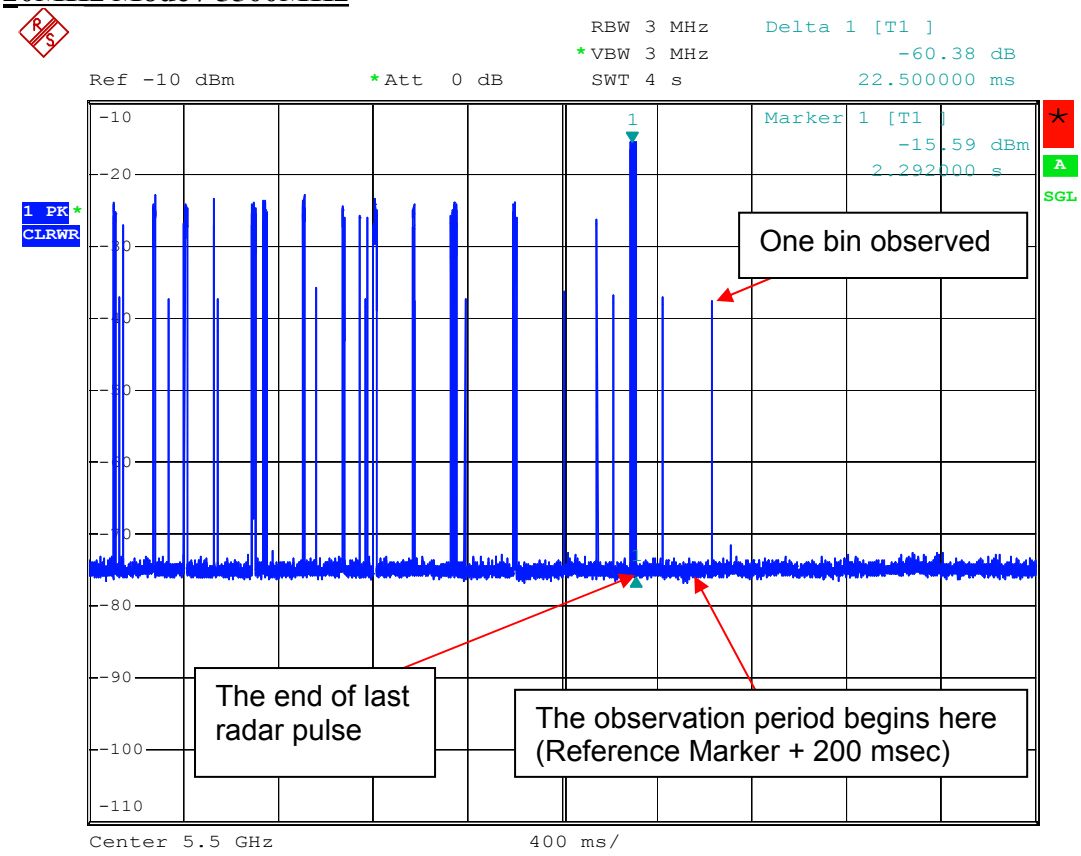
CHANNEL CLOSING TIME

40MHz Mode / 5310MHz



CHANNEL CLOSING TIME

20MHz Mode / 5500MHz



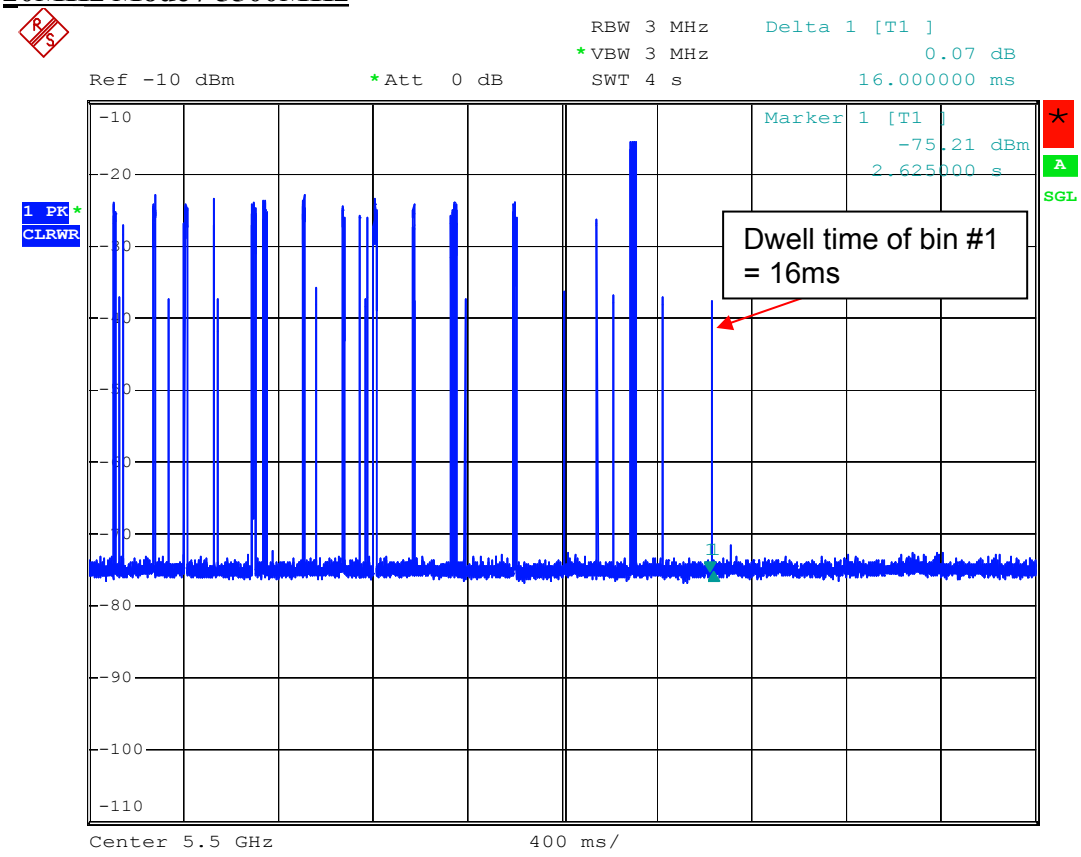
Aggregate Transmission Time =

(Number of analyzer bins showing transmission) * (dwell time per bin)

= 1 * 16 ms = 16 ms

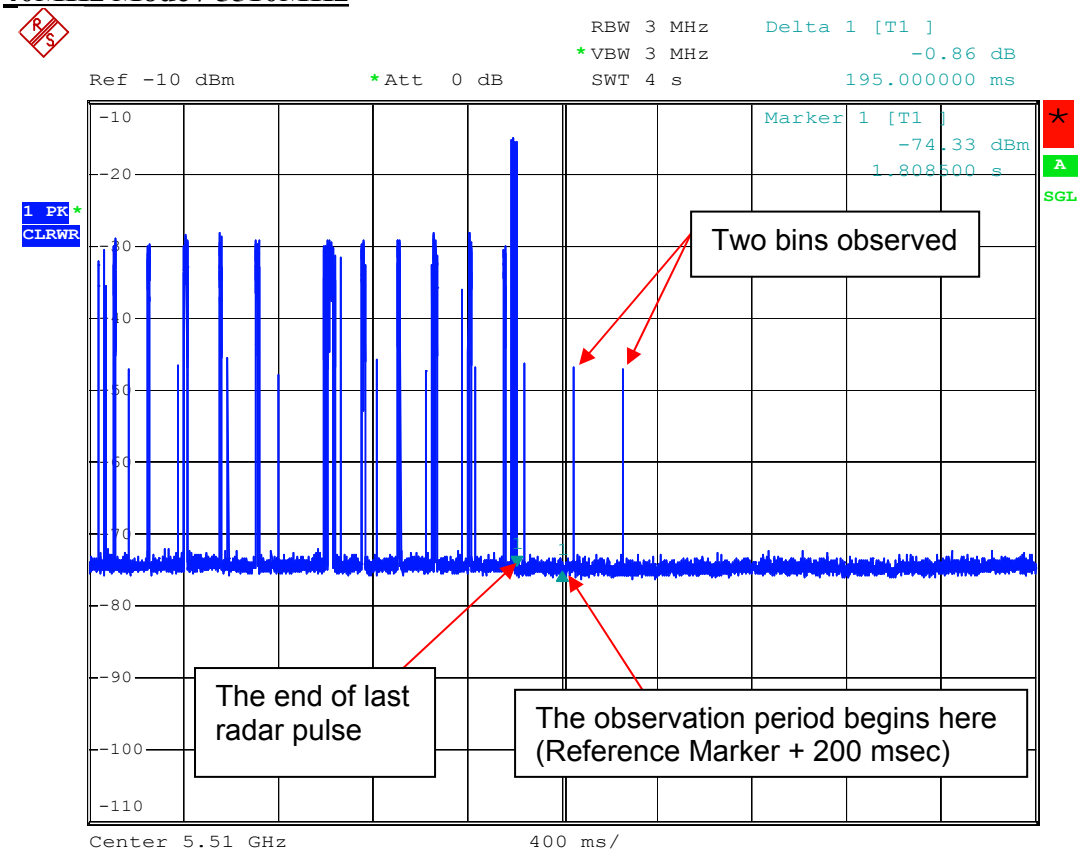
CHANNEL CLOSING TIME

20MHz Mode / 5500MHz



CHANNEL CLOSING TIME

40MHz Mode / 5510MHz



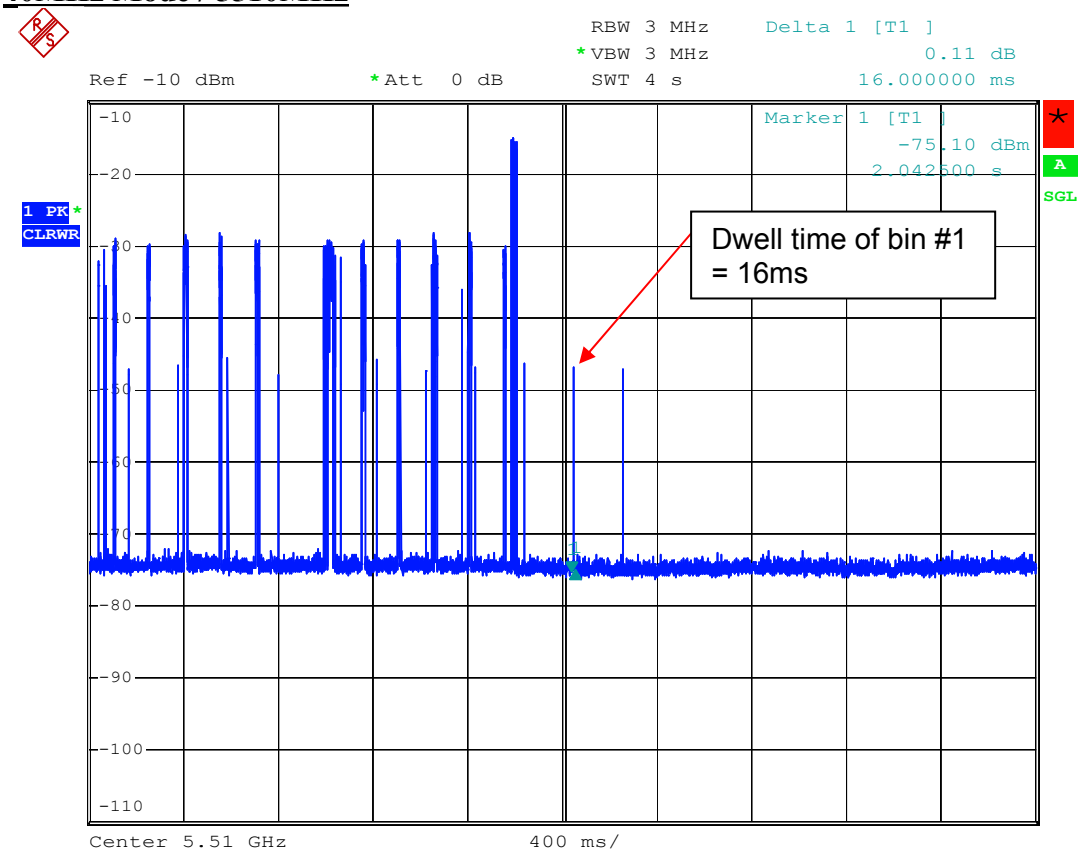
Aggregate Transmission Time =

(Number of analyzer bins showing transmission) * (dwell time per bin)

= 2 * 16 ms = 32 ms

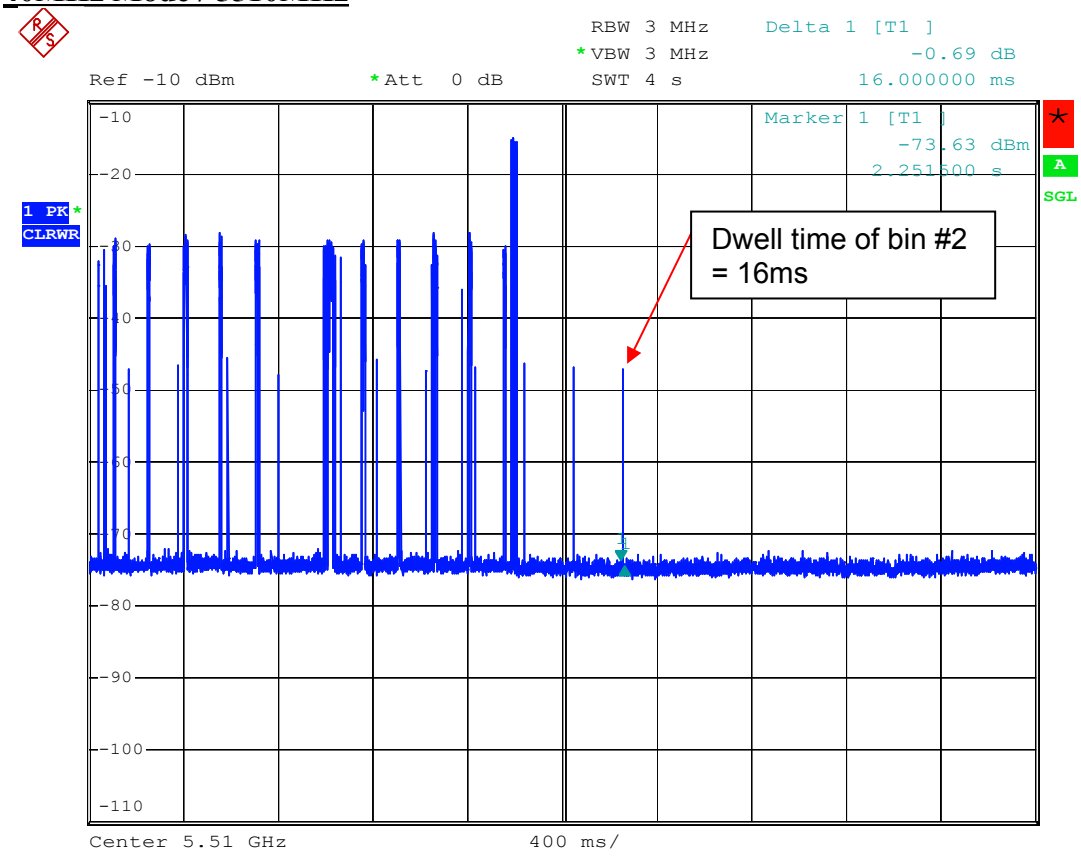
CHANNEL CLOSING TIME

40MHz Mode / 5510MHz



CHANNEL CLOSING TIME

40MHz Mode / 5510MHz



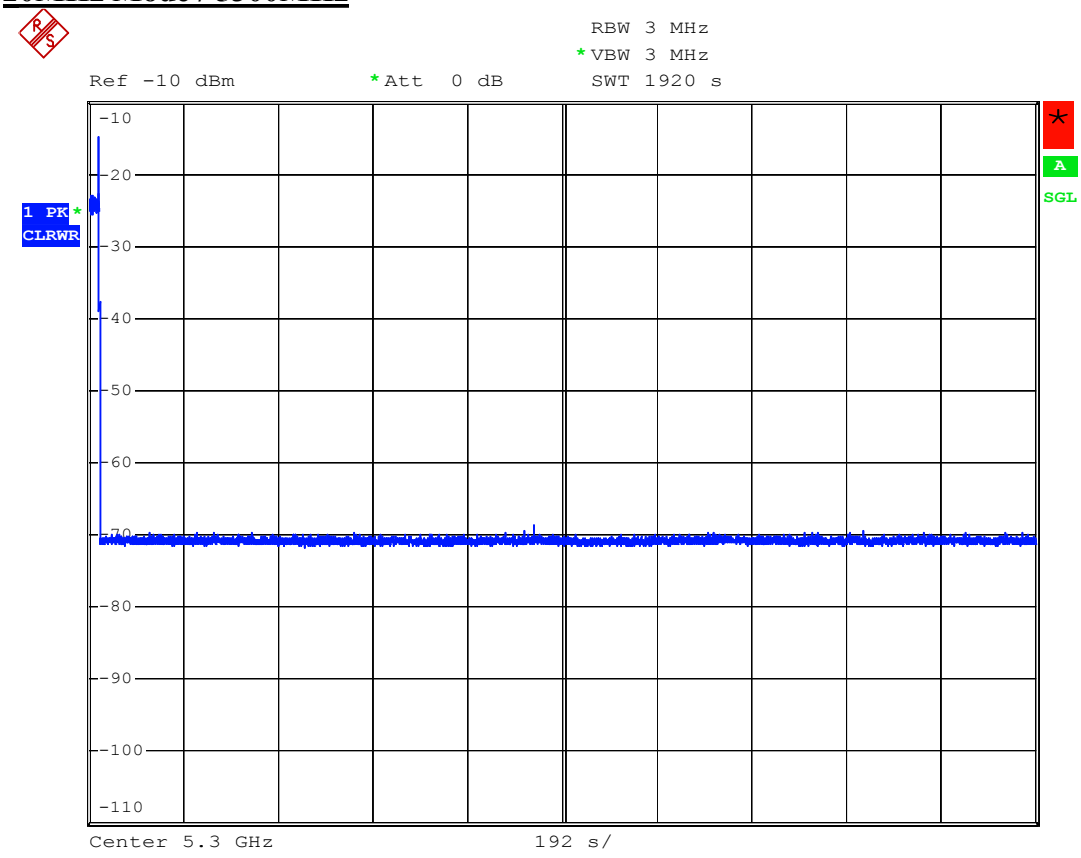
4.4 NON-OCCUPANCY PERIOD

RESULTS

No EUT transmissions were observed on the test channel during the 30-minute observation time.

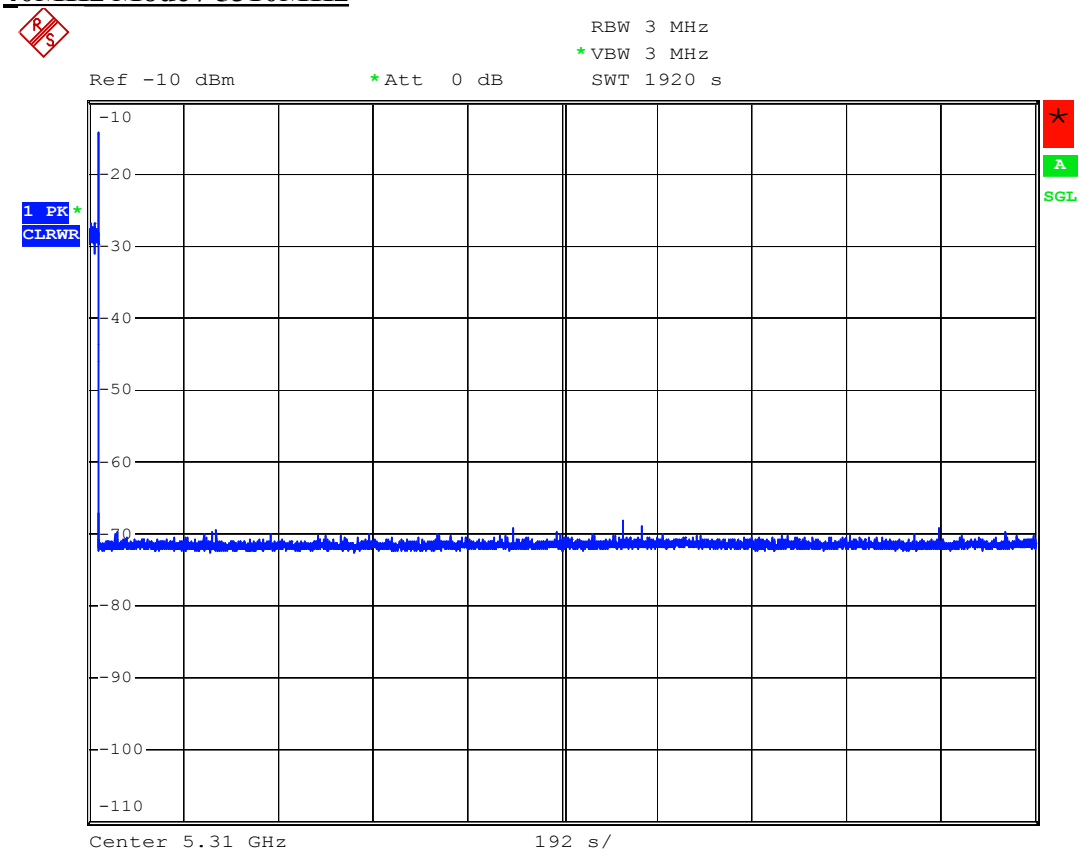
NON-OCCUPANCY PERIOD

20MHz Mode / 5300MHz



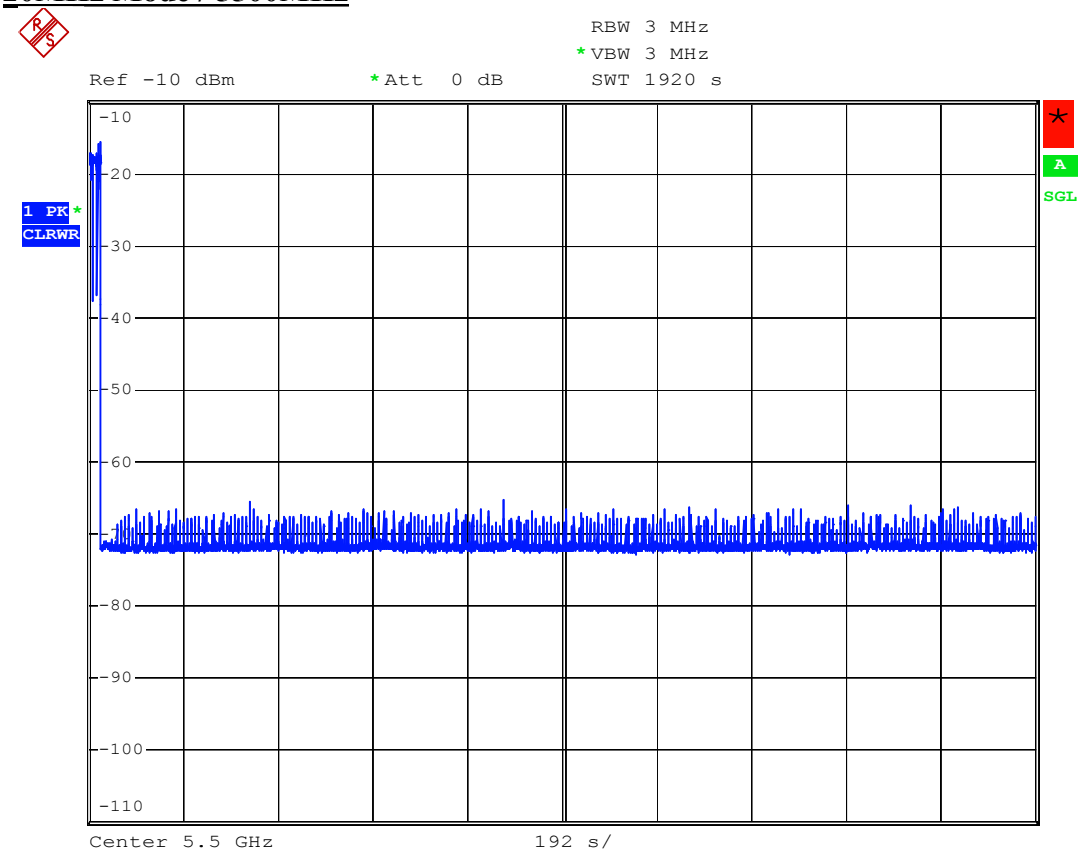
NON-OCCUPANCY PERIOD

40MHz Mode / 5310MHz



NON-OCCUPANCY PERIOD

20MHz Mode / 5500MHz



NON-OCCUPANCY PERIOD

40MHz Mode / 5510MHz