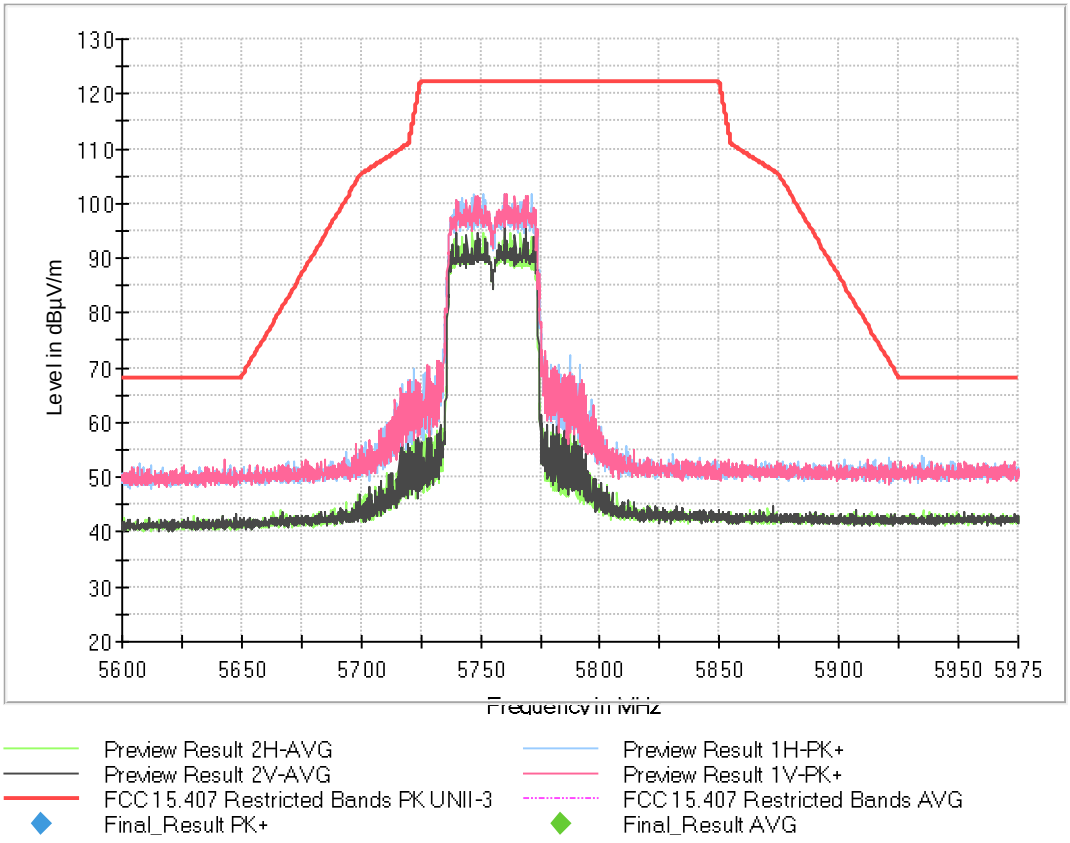
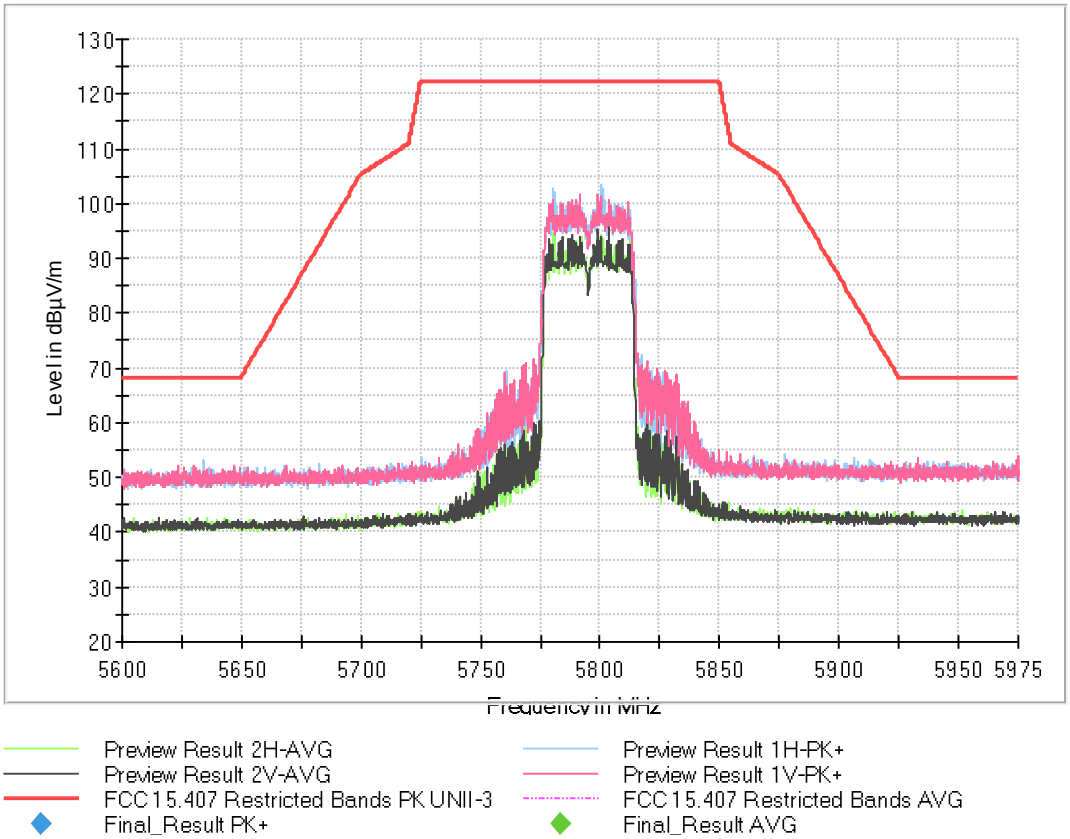
- **MIMO 802.11 n40:**

  - Low Channel:

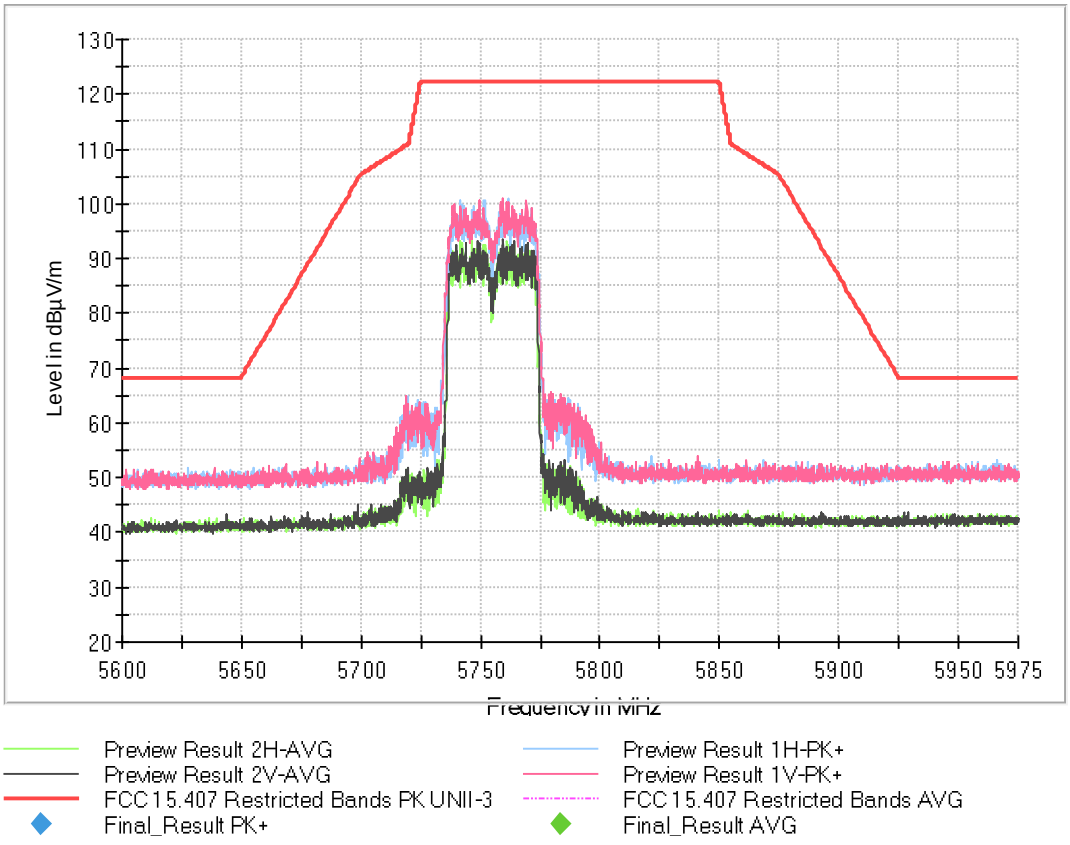


- High Channel:

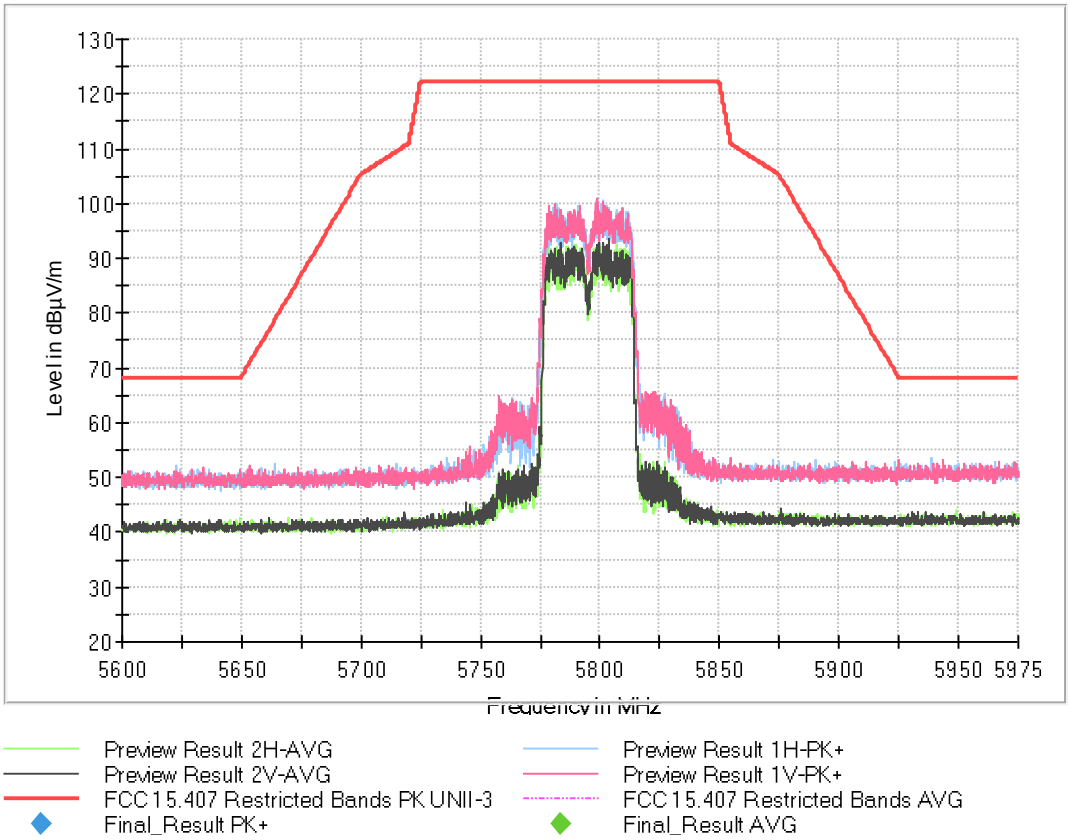


- **MIMO 802.11 ac40:**

  - Low Channel:

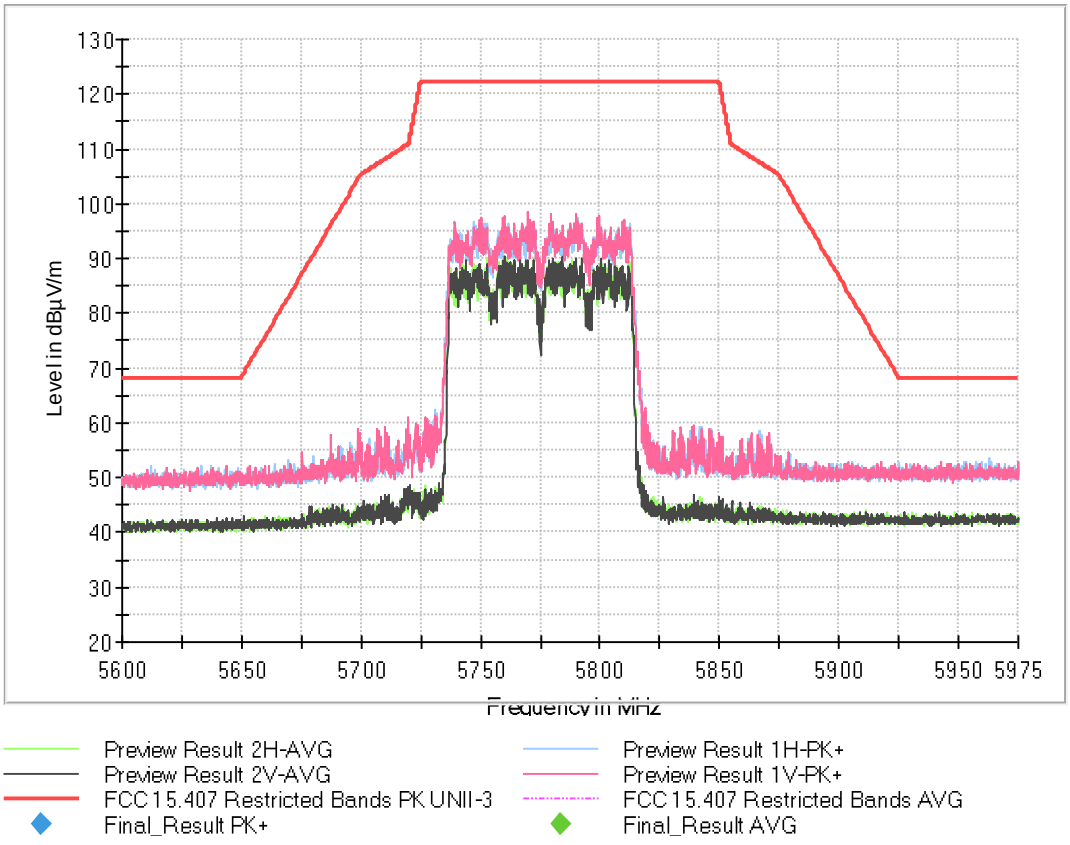


- High Channel:



- **MIMO 802.11 ac80:**

  - Single Channel:



Appendix F: DFS for Slave Device Operational Mode

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TEST CONDITIONS

(*) Declared by the Client.

POWER SUPPLY (*):

Vnominal:	115 Vac
Type of Power Supply:	AC power

ANTENNA (*):

Type of Antennas:	Monopoles (printed on PCB). 2 antennas.
Maximum Declared Antenna Gain Chain 0:	+3.1 dBi
Maximum Declared Antenna Gain Chain 1:	+5.0 dBi

Directional Antenna Gain Calculations for CDD MIMO In-Band Measurements:

U-NII-1, U-NII-2A, U-NII-2C & U-NII-3:

For 2Tx CDD MIMO modes, in accordance with KDB 662911 D01 v02r01 Section F)2)f)(ii) y F)2)e)ii), directional gain, directional gain was calculated as follows:

$N_{SS} = 1$, $N_{ANT} = 2$, $G_{ANT0} = +3.1$ dBi, $G_{ANT1} = +5.0$ dBi

$$\text{Directional Gain} = 10\log\left[\frac{\sum_{j=1}^{N_{SS}}\left(\sum_{k=1}^{N_{ANT}} g_{j,k}\right)^2}{N_{ANT}}\right] = 10\log\left[\frac{\sum_{j=1}^{1}\left(\sum_{k=1}^{2} g_{j,k}\right)^2}{2}\right]$$

$$= 10\log\left[\frac{(g_{1,1}+g_{1,2})^2}{2}\right] = 10\log\left[\frac{\left(10^{\frac{G_1}{20}}+10^{\frac{G_2}{20}}\right)^2}{2}\right] = 10\log\left[\frac{\left(10^{\frac{3.1}{20}}+10^{\frac{5.0}{20}}\right)^2}{2}\right] = 7.12 \text{ dBi}$$

TEST FREQUENCIES (*):

Band U-NII-2A:

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac204080 2x2) / U-NII-2A	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO)	
	802.11n HT20: MCS0 to MCS23 (1 or 2 spatial stream with either SISO or 2 chain MIMO CDD)	
	802.11n HT40: MCS0 to MCS23 (1 or 2 spatial stream with either SISO or 2 chain MIMO CDD)	
	802.11ac VHT20: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
	802.11ac VHT40: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
	802.11ac VHT80: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
Setting of cores / ports:	WLAN1, WLAN2, WLAN12	
Beamforming:	No.	
Frequency Range:	5250 - 5350 MHz	
Operating Channel Bandwidth:	20 MHz	
Transmission Channels:	Channels	Channel Frequency (MHz)
	Low: 52	5260
Operating Channel Bandwidth:	40 MHz	
Transmission Channels:	Channels	Channel Frequency (MHz)
	Low: 54	5270
	High: 62	5310
Operating Channel Bandwidth:	80 MHz	
Transmission Channels:	Channels	Channel Frequency (MHz)
	Single: 58	5290

Band U-NII-2C:

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac204080 2x2) / U-NII-2C	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO)	
	802.11n HT20: MCS0 to MCS23 (1 or 2 spatial stream with either SISO or 2 chain MIMO CDD)	
	802.11n HT40: MCS0 to MCS23 (1 or 2 spatial stream with either SISO or 2 chain MIMO CDD)	
	802.11ac VHT20: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
	802.11ac VHT40: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
	802.11ac VHT80: MCS0 to MCS9 (1 or 2 spatial stream) (SISO, or MIMO with CDD without TxBF)	
Setting of cores / ports:	WLAN1, WLAN2, WLAN12	
Beamforming:	No.	
Frequency Range:	5470 - 5725 MHz	
Operating Channel Bandwidth:	80 MHz	
Transmission Channels:	Channels	Channel Frequency (MHz)
	Low: 106	5530

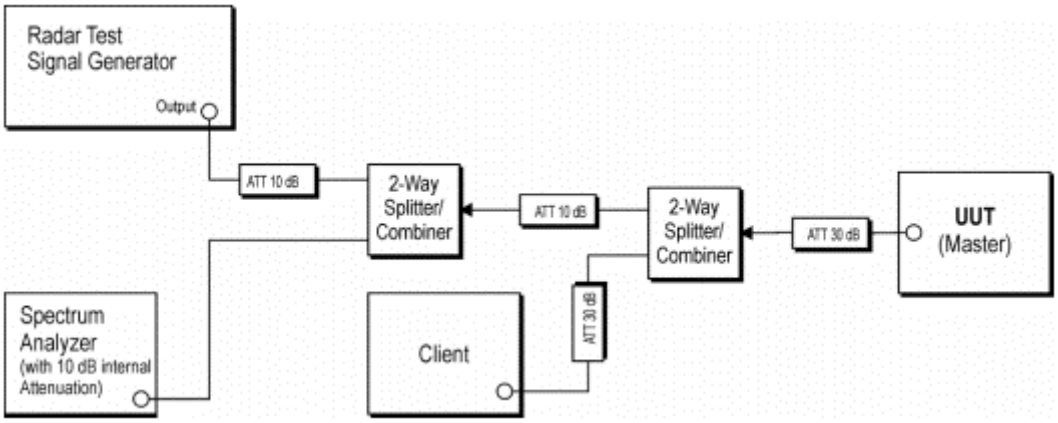
The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017 and KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

The EUT was tested in the following operating mode:

- Normal mode working as Client without radar detection.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



FCC 15.407 (h)(2), KDB 905462 D02 7.8.3 / RSS-247 6.3.2 In-Service Monitoring

SPECIFICATION:

* KDB 905462 D02 7.8.3: The following DFS parameters are verified during In-Service Monitoring:

- Channel Closing Transmission Time.
- Channel Move Time.
- Non-Occupancy Period.

One frequency will be chosen from the Operating Channels of the UUT within the 5250-5350 MHz or 5470-5725 MHz bands.

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 100% of the U-NII 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.	

RESULTS:

Bandwidth:	**80 MHz**
Test Channel:	Channel 58 (5290 MHz)
Radar Type:	0.
DFS Detection Threshold:	-64 dBm
Radar Burst Level:	-63 dBm (Radar Burst with a level equal to the DFS Detection Threshold + 1dB)
Operation Mode:	Data transfer continuously with Iperf UDP protocol.

Special case for IEEE 802.11ac clients operating with 80 MHz BW modes: Client devices with 80 MHz BW mode can be tested with an approved master operating in 40 MHz BW mode. Test procedures for client devices with 80 + 80 MHz and 160 MHz BW modes must be approved using Pre-Approval Guidance (PAG) procedures (KDB Publication 388624). This is an interim solution until a few IEEE 802.11ac master devices with the various BW modes are approved.

Channel Closing Transmission Time:

DUT Frequency (MHz)	Radar Type No.	CCTT Type of Value	CCTT No. of Pulses found	CCTT Tx Time (ms)
5310.000000	0	first 200 ms	1	0.012
5310.000000	0	remaining 10.0 second(s) period	0	0.000

Channel Move Time:

DUT Frequency (MHz)	Radar Type No.	CMT Tx Time (s)	CMT Limit (s)
5310.000000	0	0.000	10.000

Non-Occupancy Period:

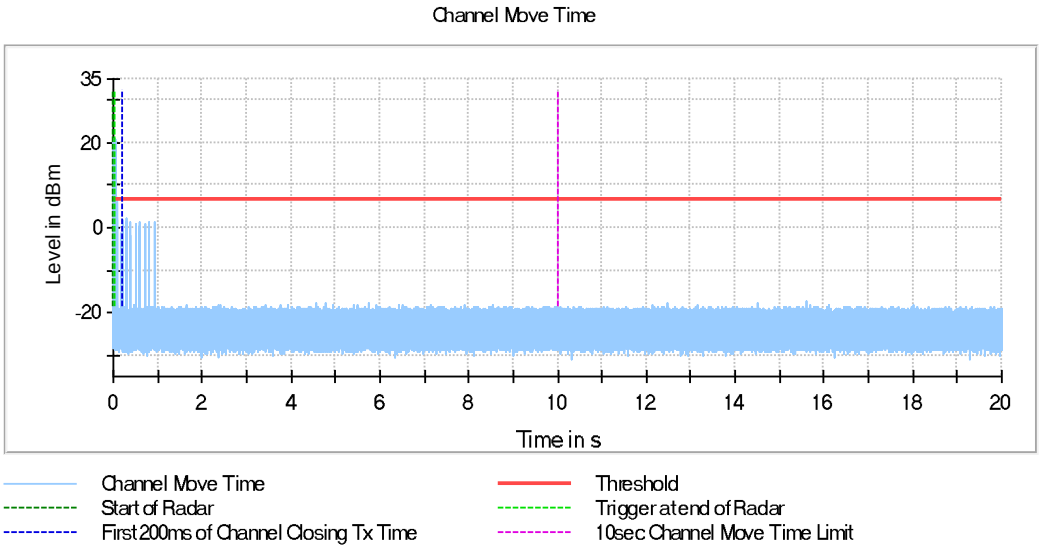
DUT Frequency (MHz)	Radar Type No.	NOP No. of Pulses found	NOP No. of Pulses Limit	NOP Tx Time (s)	NOP Tx Time Limit (s)	DUT Frequency (MHz)
5310.000000	0	0	0	0.000	0.000	5310.00000

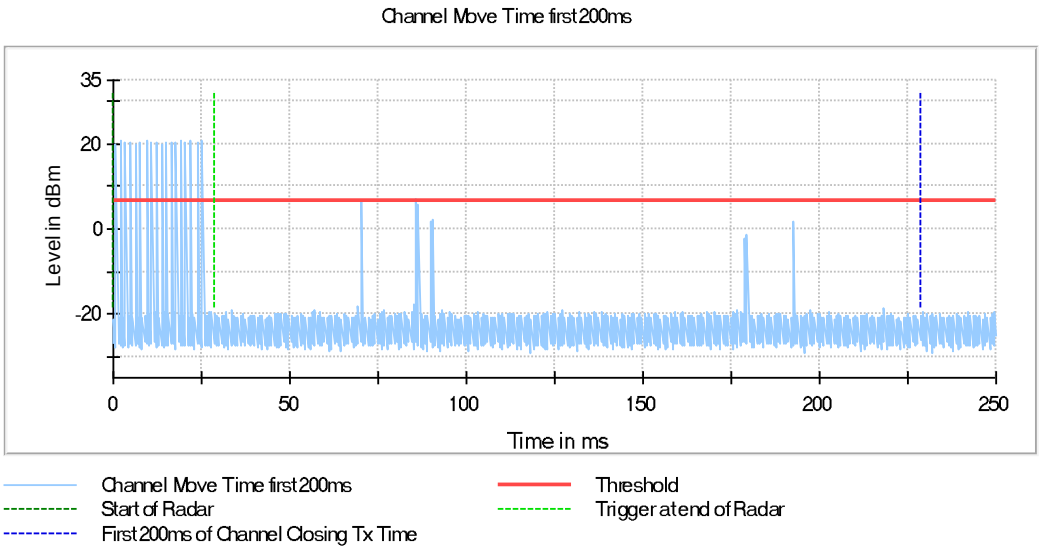
Transmitting Test:

DUT Frequency (MHz)	Tx-Test Tx OnTime (µs)	Tx-Test Tx OnTime Limit	Tx-Test No. of Pulses found
5231.000000	0	0	-

Verdict: PASS

Channel MoveTime:

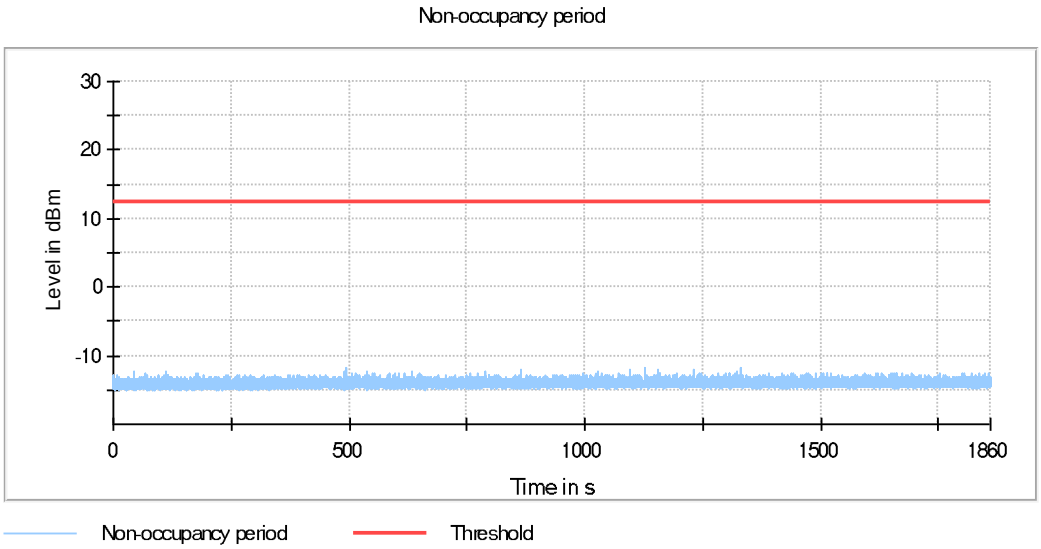




The measurement settings for Channel MoveTime is as follows:

Setting	Instrument Value	Target Value
Center Frequency	**5.31000 GHz**	**5.31000 GHz**
Span	**ZeroSpan**	**ZeroSpan**
RBW	**3.000 MHz**	**>= 3.000 MHz**
VBW	**3.000 MHz**	**>= 3.000 MHz**
SweepPoints	**30001**	**~ 30001**
Sweeptime	**20.000 s**	**20.000 s**
Reference Level	**-10.000 dBm**	**AUTO**
Attenuation	**0.000 dB**	**0.000 dB**
Detector	**MaxPeak**	**MaxPeak**
SweepCount	**1**	**1**
Filter	**3 dB**	**3 dB**
Trace Mode	**Clear Write**	**Clear Write**
Sweeptype	**Sweep**	**AUTO**
Preamp	**off**	**off**
Trigger	**External**	**External**
Trigger Offset	**0.000 s**	**0.000 s**

Non-Occupancy Period:



The measurement settings for Non-occupancy period is as follows:

Setting	Instrument Value	Target Value
Center Frequency	5.31000 GHz	5.31000 GHz
Span	ZeroSpan	ZeroSpan
RBW	3.000 MHz	>= 3.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	30001	~ 30001
Sweeptime	1.860 ks	1.860 ks
Reference Level	-10.000 dBm	AUTO
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Clear Write	Clear Write
Sweeptype	Sweep	AUTO
Preamp	off	off