

測試報告

報告編號：BTL-NCC-5-2107C091
產品名稱：平板電腦
廠牌：Lenovo
主型：IP Duet 5 Chromebook 13Q7C6
系列型：N/A
申請人名稱：荷蘭商聯想股份有限公司台灣分公司
申請人地址：臺北市中山區樂群三路128號16樓
製造廠商：Lenovo PC HK Limited
器材型：WLAN 5GHz DFS Slave
樣品編號：DG2021071510
檢驗標準：低功率射頻器材技術規範: NCC LP0002(109-07-01)
試驗結果：符合

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認可登錄編號：0659
認可範圍：9 kHz - 40 GHz
認可有效期限：2018/08/21~2021/08/20

本測試報告內所記載之測試結果以及待測試設備系統之組成，係依照上述檢驗標準所規定之量測方法實施。

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報告發行歷史紀錄

報告版本	內容	發行日期
R00	初始報告。	110 年 08 月 18 日

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低功率射頻器材測試紀錄表

項次	測試項目	適用規範	測試結果	測試設備	結果判定
1	動態頻率選擇(DFS)	低功率射頻器材技術規範 5.7.7.2 節	Page 17	Page 13	合格

1. APPLIED STANDARDS

國家通訊傳播委員會低功率射頻器材技術規範/低功率 0002 (LP0002) (109-07-01)
FCC Part 15, Subpart E (Section 15.407)
FCC KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

1.1 OTHER RELEVANT STATEMENT

1. 本測試報告屬新設計之機型，申請新的型式認證。
2. 此產品具有 Bluetooth (EDR+LE), WLAN2.4G, WLAN5G 與 DFS Slave 功能。

功能	報告編號	備註
Bluetooth EDR	BTL-NCC-1-2107C091	-
Bluetooth LE	BTL-NCC-2-2107C091	-
WLAN 2.4G	BTL-NCC-3-2107C091	-
WLAN 5G	BTL-NCC-4-2107C091	-
DFS Slave	BTL-NCC-5-2107C091	本報告

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Table 1: Specification of EUT

Equipment	平板電腦
Brand Name	Lenovo
Test Model	IP Duet 5 Chromebook 13Q7C6
Series Model	N/A
Model Difference(s)	N/A
Power Source	1# DC Voltage supplied from AC adapter. 2# Battery supplied. (1)Model: L21D4PG0 (2)Model: L21M4PG0
Power Rating	1# I/P:100-240V ~ 50/60Hz 0.9A O/P: 5.0 --- 3.0A or 9.0V --- 3.0A or 10.0V --- 3.0A 2# DC 7.72V, 5330mAh
Operating Frequency Range	5250 MHz to 5350 MHz 5470 MHz to 5725 MHz
Modulation	IEEE 802.11a/n/ac: OFDM
Operational Mode	Slave

Note:

1. This device was functioned as a:

☐ Master ☒ Client device without radar detection ☐ Client device with radar detection

2. Channel List:

5250 MHz 到 5350 MHz頻段					
IEEE 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802.11n (HT40) IEEE 802.11ac (VHT40)		IEEE 802.11ac (VHT80)	
頻道 (CH)	頻率 (MHz)	頻道 (CH)	頻率 (MHz)	頻道 (CH)	頻率 (MHz)
52	5260	54	5270	58	5290
56	5280	62	5310		
60	5300				
64	5320				

5470 MHz 到 5725 MHz 频段					
IEEE 802.11a IEEE 802.11n (HT20) IEEE 802.11ac (VHT20)		IEEE 802.11n (HT40) IEEE 802.11ac (VHT40)		IEEE 802.11ac (VHT80)	
频道 (CH)	频率 (MHz)	频道 (CH)	频率 (MHz)	频道 (CH)	频率 (MHz)
100	5500	102	5510	106	5530
104	5520	110	5550	122	5610
108	5540	118	5590		
112	5560	126	5630		
116	5580	134	5670		
120	5600				
124	5620				
128	5640				
132	5660				
136	5680				
140	5700				

3. Antenna Specification:

代号	製造商	P/N	類型	連接頭	增益值 (dBi)
1	South Star	N12-7723-R0A	PIFA	N/A	-0.63
2	South Star	N12-7723-R0A	PIFA	N/A	-0.91
1	ZhongTianXun	2.00004363	PIFA	N/A	1.76
2	ZhongTianXun	2.00004363	PIFA	N/A	1.41

Note:

- (1) Both groups of antennas were evaluated and found the worst case was the ZhongTianXun, so only the worst case was recorded in this test report.
- (2) This EUT supports CDD, and all antenna gains are not equal, so Directional gain= $10\log[(10^{G1/20}+10^{G2/20}+...+10^{GN/20})^2/N]$ dBi, that is Directional gain= $10\log[(10^{1.76/20}+10^{1.41/20})^2/2]$ dBi =4.60.
- (3) The antenna gain is provided by the manufacturer.

2.2 CONDUCTED OUTPUT POWER AND EIRP

Table 2: The Output Power and e.i.r.p. List

Mode: TX IEEE 802.11ac (VHT80)				
Frequency Band (MHz)	Max. Output Power (dBm)	Directional Gain	Max. e.i.r.p. (dBm)	Max. e.i.r.p. (mW)
5250~5350	14.64	4.60	19.24	83.95
5470~5725	14.59	4.60	19.19	82.99

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	✓	✓	✓
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.

Max.imum Transmit Power	Value (See Notes 1 and 2)
e.i.r.p. $\geq$ 200 milliwatt	-64 dBm
e.i.r.p. < 200 milliwatt and Power pectral density < 10 dBm/MHz	-62 dBm
e.i.r.p. < 200 milliwatt that do not meet the power pectral 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.

Note 3: e.i.r.p. 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.

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$	60%	30
		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			
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
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

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 8: 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 Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen(The center frequency for each of the 30 trials of the Bin 5 radar shall be randomly selected within 80% of the Occupied Bandwidth.) Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type waveforms, then each additional waveform must also be unique and not repeated from the previous waveforms.

Table 9: Frequency Hopping 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 Number of Trials
6	1	333	9	0.333	300	70%	30

4. MEASUREMENT INSTRUMENTS LIST

Table 10: Test Instruments List.

Description	Manufacturer	Model No.	Serial No.	Calibration Until
Spectrum Analyzer	Keysight	N9010A	MY54200240	2022/5/26
MXG Vector Signal Generator	Agilent	N5182B	MY51350711	2022/3/24
10dB Attenuators	Mini-Circuits	VAT-10+	N/A	2022/5/12
20dB Attenuators	Mini-Circuits	VAT-20+	N/A	2022/5/12
30dB Attenuators	Mini-Circuits	VAT-30+	N/A	2022/5/12
POWER SPLITTER	Mini-Circuits	ZFRSC-183-S+	N/A	2022/5/12
POWER SPLITTER	Mini-Circuits	ZFRSC-123-S+	N/A	2022/5/12
AP	Check Point	L-71W	NX1604D20118-0	N/A

Note:

- (1) Calibration interval of instruments listed above is one year.
- (2) Wi-Fi Router's FCC ID: YHI-NW121

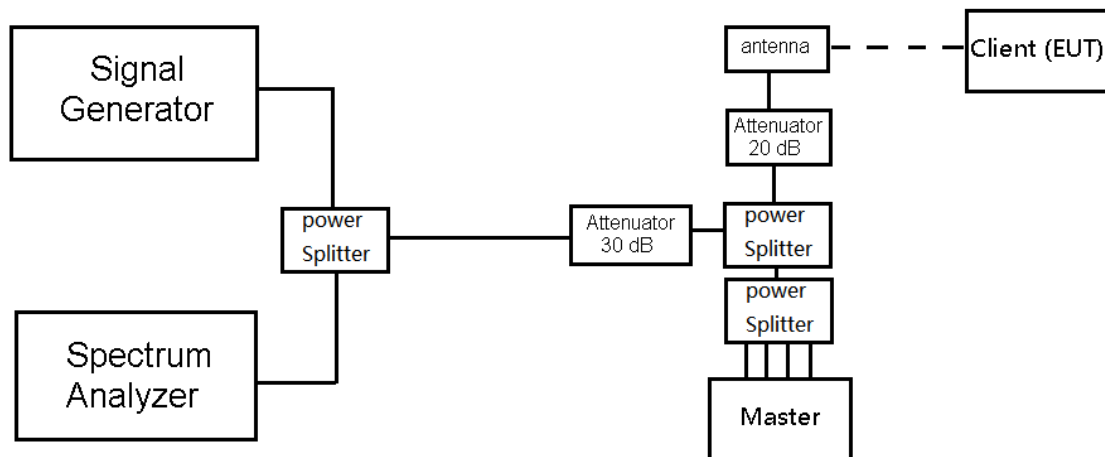
5. DYNAMIC FREQUENCY SELECTION (DFS) TEST

5.1 DFS MEASUREMENT SYSTEM

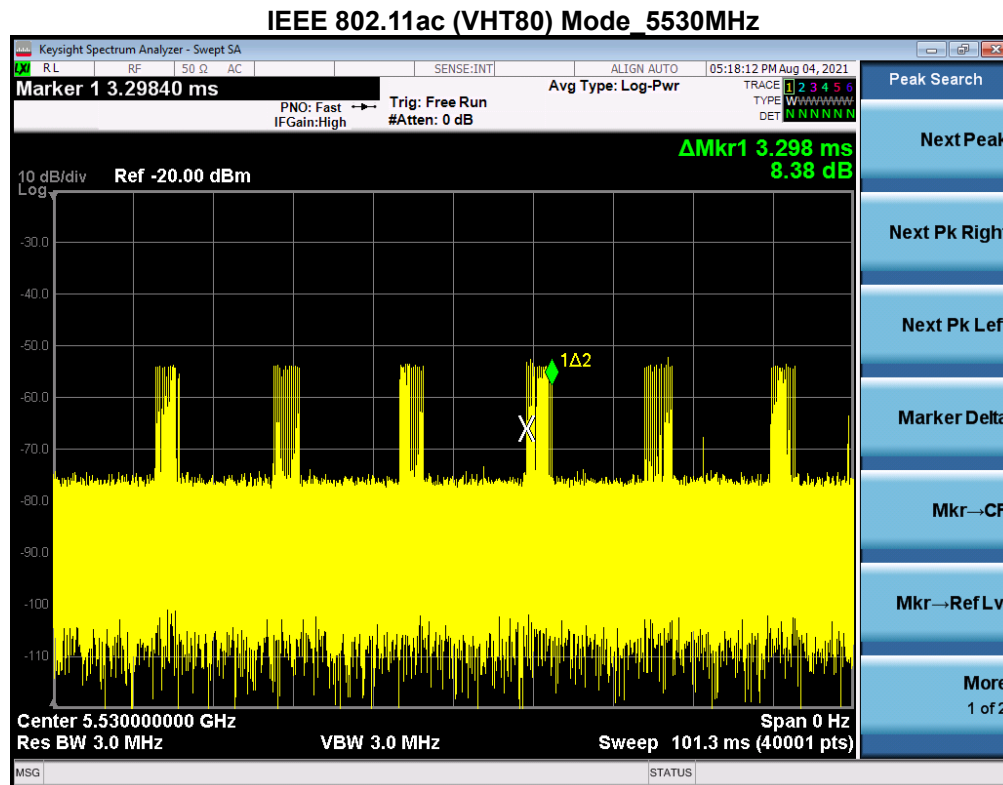
Test Precedure

1. Master device and client device are set up by conduction method as the following configuration.
2. The client device is connected to notebook and to access a IP address on wireless connection with the master device.
3. Then the master device is connected to another notebook to access a IP address.
4. Finally, let the two IP addresses run traffic with each other through the Run flow software "Lan test" to reach 17% channel loading as below

Setup



Channel Loading



Frequency (MHz)	Marker Delta (ms)	Number	On Time (ms)	Total Time (ms)	Dutycycle (%)	Limit (%)
5530	3.298	6	19.788	101.3	19.53	17.00

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 Frequency 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.

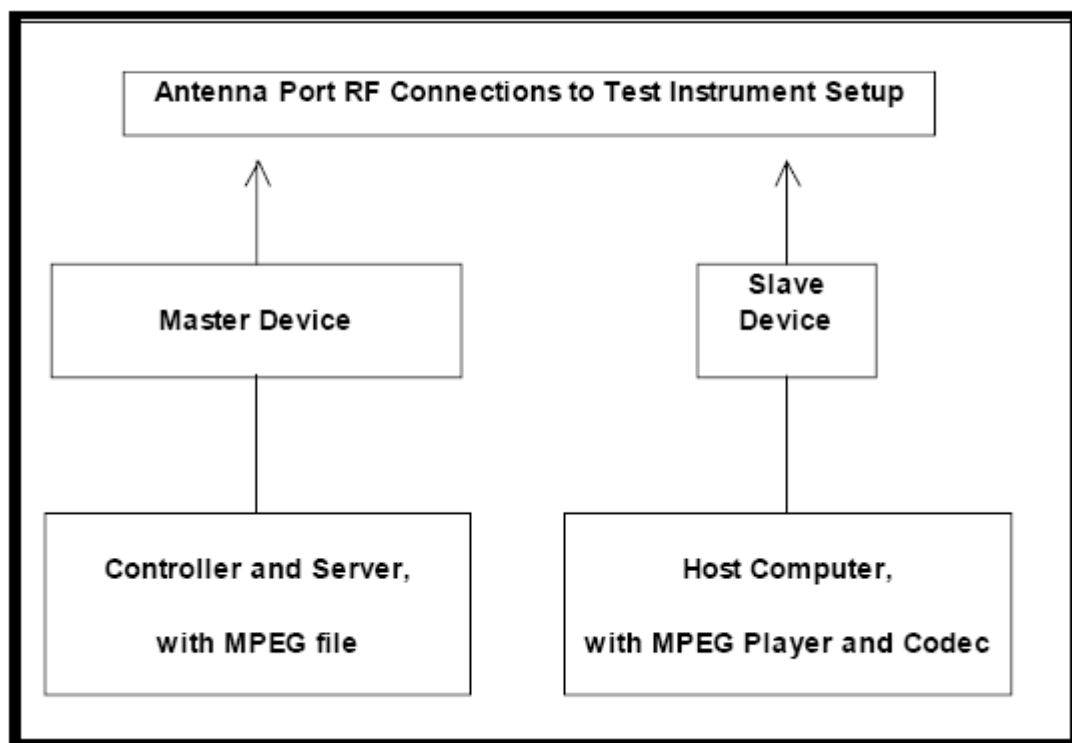
5.2 CALIBRATION OF DFS DETECTION THRESHOLD LEVEL

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 analyzer 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 RESULTS

Clause	Test Parameter	Test Mode and Channel	Remarks	Result
15.407	DFS Detection Threshold	-	No Applicable	N/A
	Channel Availability Check Time	-	Not Applicable	N/A
	Channel Move Time	IEEE 802.11ac (VHT80) Mode 5530MHz	Applicable	Pass
	Channel Closing Transmission Time	IEEE 802.11ac (VHT80) Mode 5530MHz	Applicable	Pass
	Non- Occupancy Period	IEEE 802.11ac (VHT80) Mode 5530MHz	Applicable	Pass
	Uniform Spreading	-	Not Applicable	N/A
	U-NII Detection Bandwidth	-	Not Applicable	N/A

6.2 DEVICE OPERATING IN MASTER MODE

The EUT is slave equipment, it need a master device when testing.
Master with injection at the Master. (Radar Test Waveforms are injected into the Master)

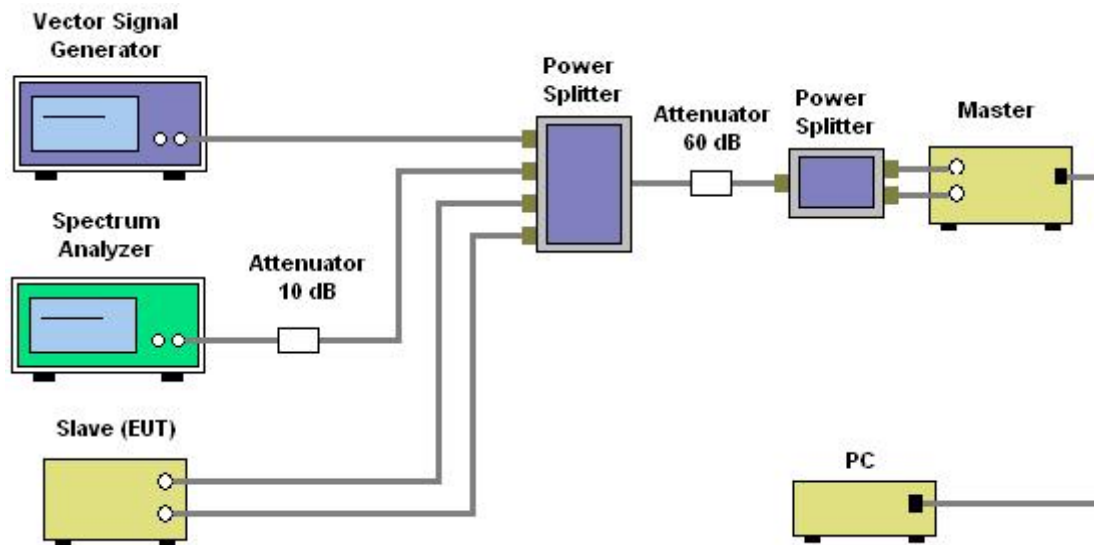
6.3 DFS DETECTION THRESHOLD

Calibration:

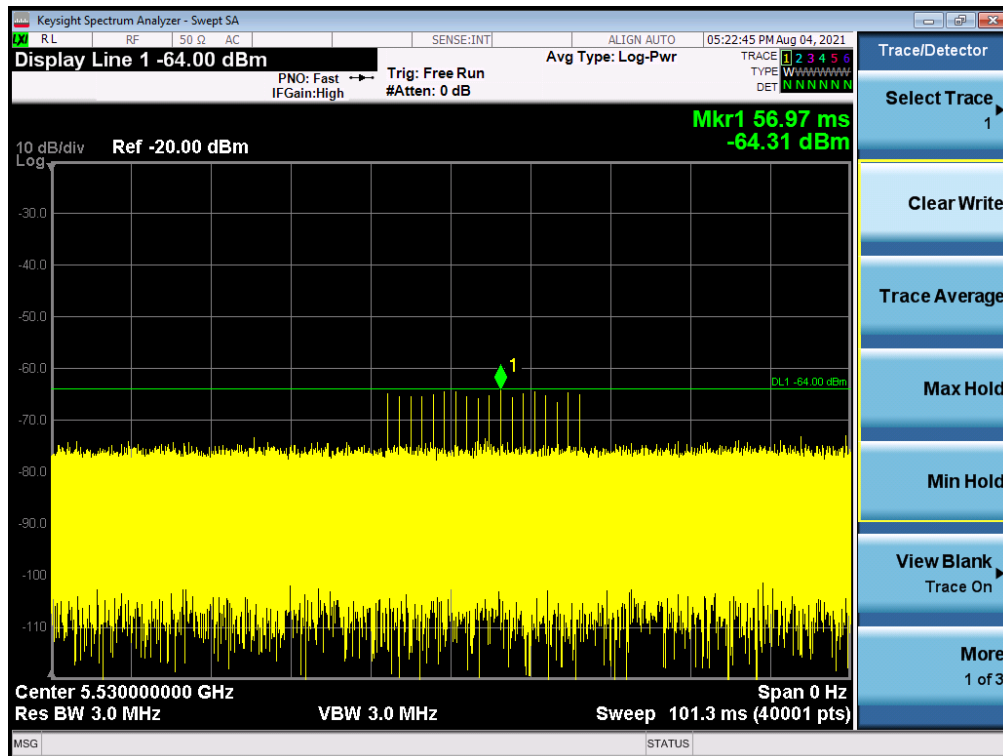
The EUT is slave equipment and it with the lowest gain is 6.68 dBi.
For a detection threshold level of -62dBm and the master antenna gain is 2.90 dBi, required detection threshold is -61.10 dBm ($= -64+2.90$).

Note: Maximum Transmit Power is more than 200 milliwatt in this report, so detection threshold level is -64dBm.

Setup



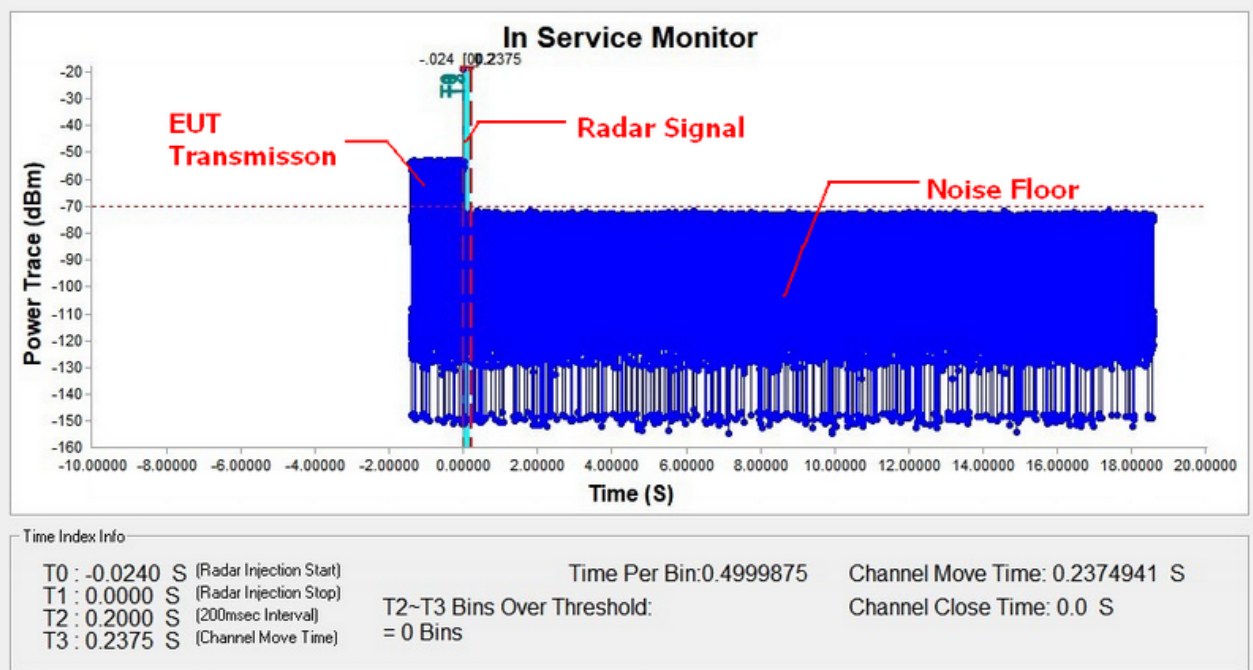
Radar Signal 0



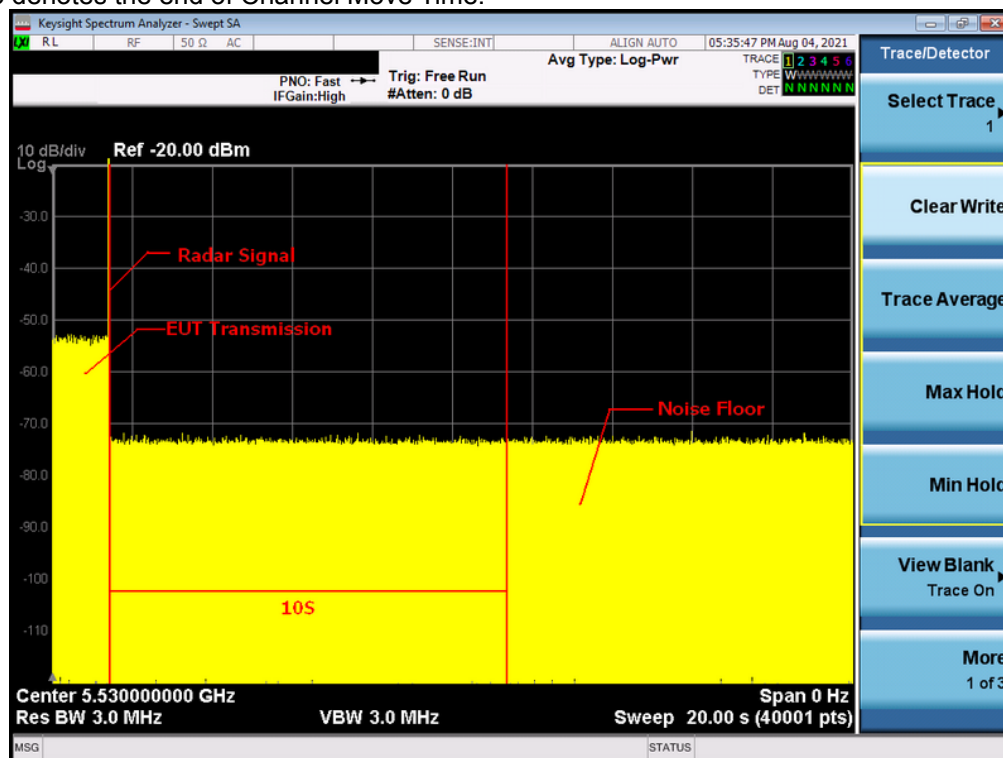
6.4 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME WLAN TRAFFIC

TX (IEEE 802.11ac (VHT80) Mode) _5530MHz

Radar signal 0



Note: T0 denotes the Radar Injection Start.
T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the data transmission time of 200ms from T1.
T3 denotes the end of Channel Move Time.



Note: An expanded plot for the device vacates the channel in the required 500ms

IEEE 802.11ac (VHT80) Mode_5530MHz		
Item	Measured Value(s)	Limit(s)
Channel Move Time	0.2374941	10
Channel Close Time	0.0	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period

6.5 NON-OCCUPANCY PERIOD

During the 30 minutes observation time, UUT did not make any transmissions on a channel after a radar signal was detected on that channel by either the Channel Availability Check or the In-Service Monitoring.

IEEE 802.11ac (VHT80) Mode_5530MHz

