TEST REPORT

Product	:	Grid Pad 15
Trade mark	:	Smartbox
Model/Type reference	:	GP15A
Serial Number	:	N/A
Report Number	:	EED32M00138906
FCC ID	:	2APXM-GP15A
Date of Issue	:	Aug.10, 2020
Test Standards	:	47 CFR Part 15 Subpart E
Test result	:	PASS

Prepared for:

Smartbox Assistive Technology Limited
Ysobel House, Enigma Commercial Centre,
Sandys Road, Malvern, Worcestershire, UK WR14 1JJ

Prepared by:

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Compiled by: Sunlight Sun — Sunlight Sun

Reviewed by: Jok Yang — Jok Yang

Approved by: Sam Chuang — Sam Chuang

Date: Aug.10, 2020

Check No.:3096327781

2 Version

Version No.	Date	Description
00	Aug.10, 2020	Original

3 Test Summary

Test Item	Test Requirement	Test method	Result
Dynamic Frequency Selection	47 CFR Part 15 Subpart E Section 15.407 (h)	KDB905462 D02	PASS

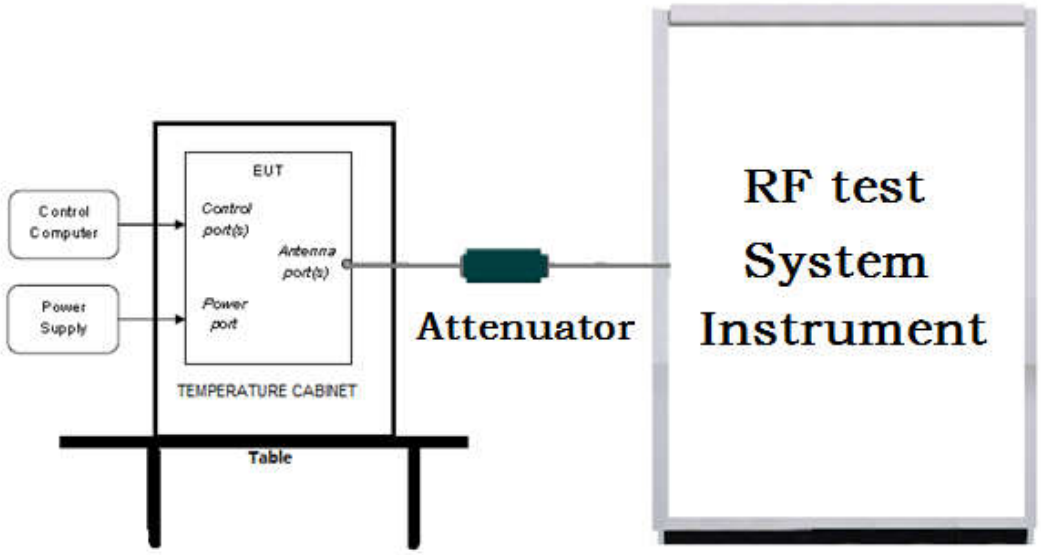
Remark:
The tested sample(s) and the sample information are provided by the client.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radiated Frequency.
CH: In this whole report CH means channel.
Volt: In this whole report Volt means Voltage.
Temp: In this whole report Temp means Temperature.
Humid: In this whole report Humid means humidity.
Press: In this whole report Press means Pressure.
N/A: In this whole report not application

4 Content

5 Test Requirement

5.1 Test setup

5.1.1 For Conducted test setup



5.2 Test Environment

Operating Environment:	
Temperature:	23.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010mbar

5.3 Test Condition

Test channel:

Test Mode	Tx/Rx	RF Channel		
		Low(L)	Middle(cm)	High(H)
802.11a/n/ac(HT20)	5250MHz ~5350 MHz	Channel 52	Channel 56	Channel 64
		5260MHz	5280MHz	5320MHz
802.11n/ac(HT40)	5250MHz ~5350 MHz	Channel54	N/A	Channel62
		5270MHz	N/A	5310MHz
802.11ac(HT80)	5250MHz ~5350 MHz	Channel58	N/A	N/A
		5290MHz	N/A	N/A

6 General Information

6.1 Client Information

Applicant:	Smartbox Assistive Technology Limited
Address of Applicant:	Ysobel House, Enigma Commercial Centre, Sandys Road, Malvern, Worcestershire, UK WR14 1JJ
Manufacturer:	Smartbox Assistive Technology Limited
Address of Manufacturer:	Ysobel House, Enigma Commercial Centre, Sandys Road, Malvern, Worcestershire, UK WR14 1JJ
Factory:	Estone Technology LTD
Address of Factory:	2F, Building No.1, Jia'an Industrial Park, No.2 Long Chang Road, Bao'an, Shenzhen 518101, China.

6.2 General Description of EUT

Product Name:	Grid Pad 15	
Model No.(EUT):	GP15A	
Trade Mark:	Smartbox	
EUT Supports Radios application:	U-NII-2A: 5.25-5.35GHz	
Power Supply:	AC Adapter	MODEL:MANGO40S-12BB-ES INPUT:100-240V~,50/60Hz ,1.0A Max OUTPUT:12V⎓3.33A
	Battery	Model:5080115P Capacity:10000mAh/74Wh Nominal Voltage:7.4V⎓ Limited Charge Voltage:8.4V⎓
Sample Received Date:	May 22, 2020	
Sample tested Date:	May 22, 2020 to Jul. 17, 2020	

6.3 Product Specification subjective to this standard

Operation Frequency:	IEEE 802.11a/n/ac(HT20): 5260MHz ~5320 MHz IEEE802.11n/ac(HT40) 5270MHz ~5310 MHz IEEE802.11ac(HT80) 5290
Channel Numbers:	IEEE 802.11a/n/ac(HT20): 5260MHz ~5320 MHz / 4 channel IEEE802.11n/ac(HT40) 5270MHz ~5310 MHz / 2 channel IEEE802.11ac(HT80) 5290 / 1 channel
Type of Modulation:	DSSS,OFDM
Test Power Grade:	Reference Table 1
Test Software of EUT:	DRTU
Antenna Type and Gain:	PCB antenna, Gain: 1.95 dBi
Test Voltage:	Battery 7.4V

Operation Frequency each of channel

For 802.11a/n/ac(HT20) Operation in the 5260MHz ~5320 MHz MHz band							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
52	5260MHz	56	5280MHz	60	5300MHz	64	5320MHz

For 802.11n/ac(HT40) Operation in the 5270MHz ~5310 MHz band			
Channel	Frequency	Channel	Frequency
54	5190MHz	46	5310MHz

For 802.11ac(HT80) Operation in the 5290 MHz band					
Channel	Frequency	Channel	Frequency	Channel	Frequency
58	5290MHz	N/A	N/A	N/A	N/A

Table 1：

Power Setting-1TX					
Mode	Channel	Frequency	Data Rate	Power Setting	
				chain0	chain1
IEEE 802.11a	52	5260	6Mbps	14.5	14.75
	56	5280		14.5	14.25
	64	5320		14.5	14.25
IEEE 802.11n 20MHz	52	5260	MCS0	14.75	15
	56	5280		14.75	14.5
	64	5320		14.5	14.25
IEEE 802.11n 40MHz	54	5270	MCS0	14.5	14
	62	5310		14.5	13.5
IEEE 802.11ac 20MHz	52	5260	MCS0	14.75	15
	56	5280		14.75	14.5
	64	5320		14.5	14.25
IEEE 802.11ac 40MHz	54	5270	MCS0	14.5	14
	62	5310		14.5	13.5
IEEE 802.11ac 80MHz	58	5290	MCS0	18	18
Power Setting-MIMO					
Mode	Channel	Frequency	Data Rate	Power Setting	
				chain0	chain1
IEEE 802.11n 20MHz	52	5260	MCS0	11.25	11.25
	56	5280		11.25	11.25
	64	5320		11	11
IEEE 802.11n 40MHz	54	5270	MCS0	12	12
	62	5310		11.5	11.5
IEEE 802.11ac 20MHz	52	5260	MCS0	11.25	11.25
	56	5280		11.25	11.25
	64	5320		11	11
IEEE 802.11ac 40MHz	54	5270	MCS0	12	12
	62	5310		11.5	11.5
IEEE 802.11ac 80MHz	58	5290	MCS0	15	13.5

6.4 Description of Support Units

The EUT has been tested with associated equipment below

Associated equipment name		Manufacture	model	S/N serial number	Supplied by	Certification
AE1	Notebook	DELL	DELL 3490	D245DX2	DELL	CE&FCC

6.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd
Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China
Telephone: +86 (0) 755 33683668 Fax:+86 (0) 755 33683385
No tests were sub-contracted.
FCC Designation No.: CN1164

6.6 Deviation from Standards

None.

6.7 Abnormalities from Standard Conditions

None.

6.8 Other Information Requested by the Customer

None.

6.9 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.9×10^{-8}
2	RF power, conducted	0.46dB (30MHz-1GHz)
		0.55dB (1GHz-18GHz)
3	Radiated Spurious emission test	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-12.75GHz)
4	Conduction emission	3.5dB (9kHz to 150kHz)
		3.1dB (150kHz to 30MHz)
5	Temperature test	0.64°C
6	Humidity test	3.8%
7	DC power voltages	0.026%

7 Equipment List

RF test system					
Equipment	**Manufacturer**	**Mode No.**	**Serial Number**	**Cal. Date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
Spectrum Analyzer	Keysight	N9010A	MY54510339	02-17-2020	02-16-2021
Signal Generator	Keysight	N5182B	MY53051549	02-17-2020	02-16-2021
Temperature/ Humidity Indicator	biaozhi	HM10	1804186	07-26-2019	07-25-2020
High-pass filter	Sinoscite	FL3CX03WG18N M12-0398-002	---	---	---
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	---	---
DC Power	Keysight	E3642A	MY56376072	02-17-2020	02-16-2021
PC-1	Lenovo	R4960d	---	---	---
BT&WI-FI Automatic control	R&S	OSP120	101374	02-17-2020	02-16-2021
RF control unit	JS Tonscend	JS0806-2	158060006	02-17-2020	02-16-2021
BT&WI-FI Automatic test software	JS Tonscend	JS1120-3	---	---	---

8 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15E	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
3	KDB789033 D02 General UNII Test Procedures New Rules v01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15 subpart E

Test Results List:

Test Requirement	Test method	Test item	Verdict	Note
47 CFR Part 15 Subpart E Section 15.407 (h)	KDB905462 D02	Dynamic Frequency Selection	PASS	Appendix A)

Appendix A)Dynamic Frequency Selection

Test Limit

FCC according to §15.407 (h), KDB 905462 D02 "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 KDB 905462 D03 " U-NII client devices without radar detection capability.

IC according RSS-247 section 6.3, and it harmonized with FCC Part 15 DFS rules.

The EIRP refer section 4.3 output power measurement in this report.

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
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

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

Additional requirements for devices with multiple bandwidth mods	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

Table 3: Interference Threshold values, Master or Client incorporating In-Service

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
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 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.

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
0	1	1428	18	See Note 1	
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	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.					

Table 6 – Long Pulse Radar Test Signal

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

Table 7 – Frequency Hopping Radar Test Signal

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

Test Procedure

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

The firmware installed in the EUT during testing was:

Firmware Rev: 1030.27.425.2018

The EUT operates over the 5250-5350 MHz range as a Client Device that does not have radar detection capability.

The EUT uses one transmitter connected to two 50-ohm coaxial antenna ports via a diversity switch. Only one antenna port is connected to the test system since the EUT has one antenna only.

The Slave device associated with the EUT during these tests does not have radar detection capability.

WLAN traffic is generated by streaming the video file TestFile.mp2 “6 ½ Magic Hours” from the Master to the Slave in full motion video mode using the media player with the V2.61 Codec package.

The EUT utilizes the 802.11a architecture, with a nominal channel bandwidth of 20 MHz.

The rated output power of the Master unit is < 23dBm (EIRP). Therefore the required interference threshold level is -62 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –62 + 5 = -57dBm.

The calibrated conducted DFS Detection Threshold level is set to -57 dBm. The tested level is lower than the required level hence it provides margin to the limit.

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.

TEST AND MEASUREMENT SYSTEM

System Overview

The measurement system is based on a conducted test method.

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.

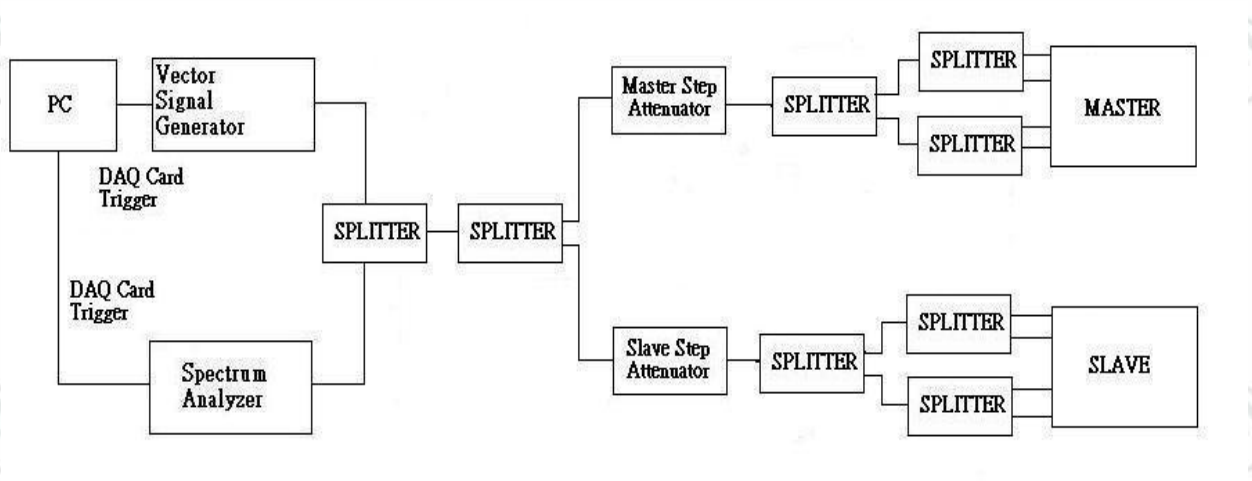
The short pulse types 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

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 Frequency Hopping Radar Waveform Generating Subsystem of FCC 06-96 APPENDIX. 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. The time-domain resolution is 3 msec / bin with a 24 second sweep time, meeting the 22 second long pulse reporting criteria and allowing a minimum of 10 seconds after the end of the long pulse waveform.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), 50 ohm termination would be removed from the splitter so that connection can be established between splitter and the Master and/or Slave devices.

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 –62 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 –62 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference. Confirm that the signal is displayed at –62 dBm. Readjust the RBW and VBW to 3 MHz, set the span to 10 MHz, and confirm that the signal is still displayed at –62 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 –62 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

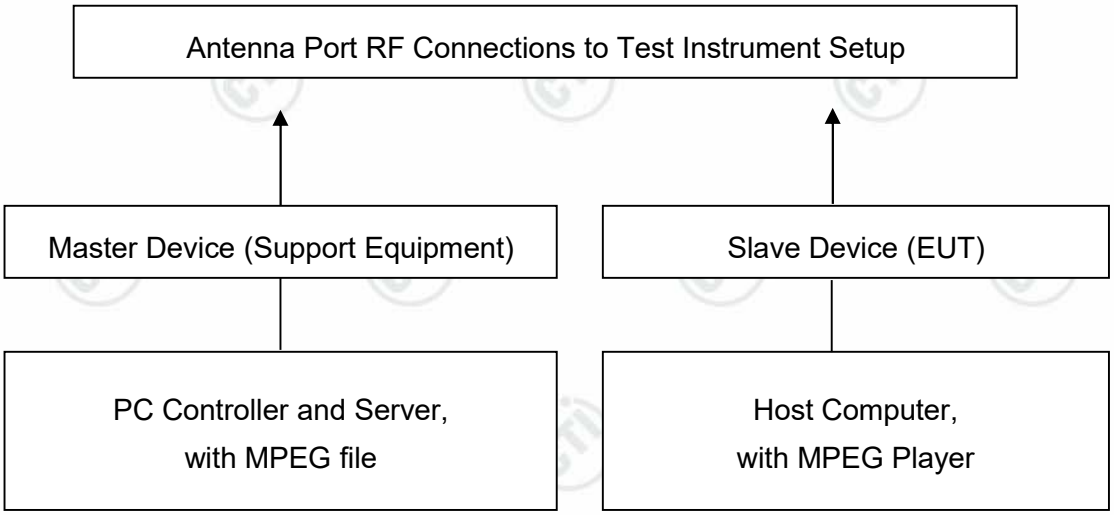
Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection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

Adjustment Of Displayed Traffic Level

Establish a link between the Master and Slave, adjusting the Link Step Attenuator as needed to provide a suitable received level at the Master and Slave devices. 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.

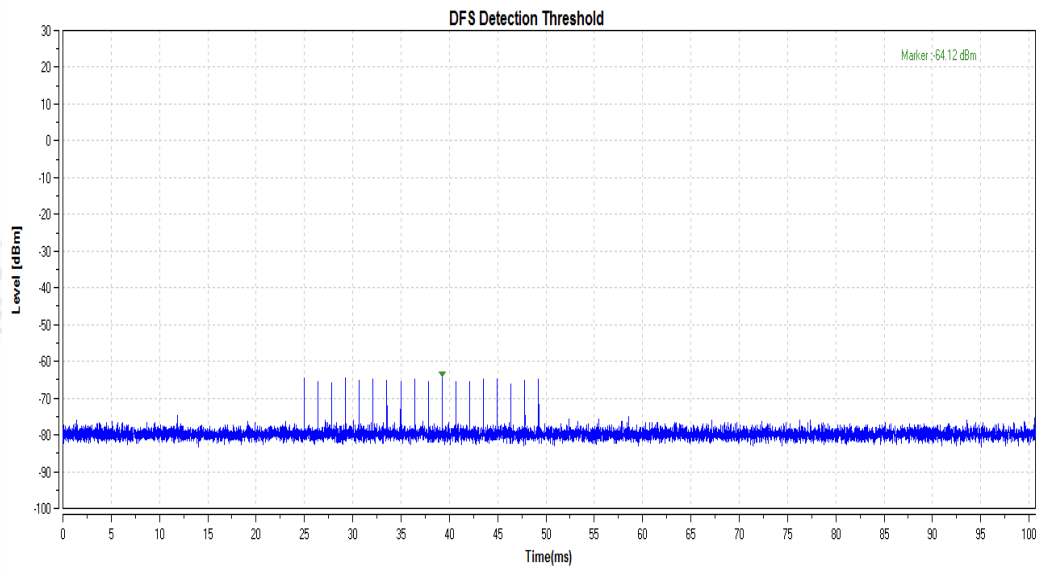
If a different setting of the Master Step Attenuator is required to meet the above conditions, perform a new System Calibration for the new Master Step Attenuator setting.

Test Setup

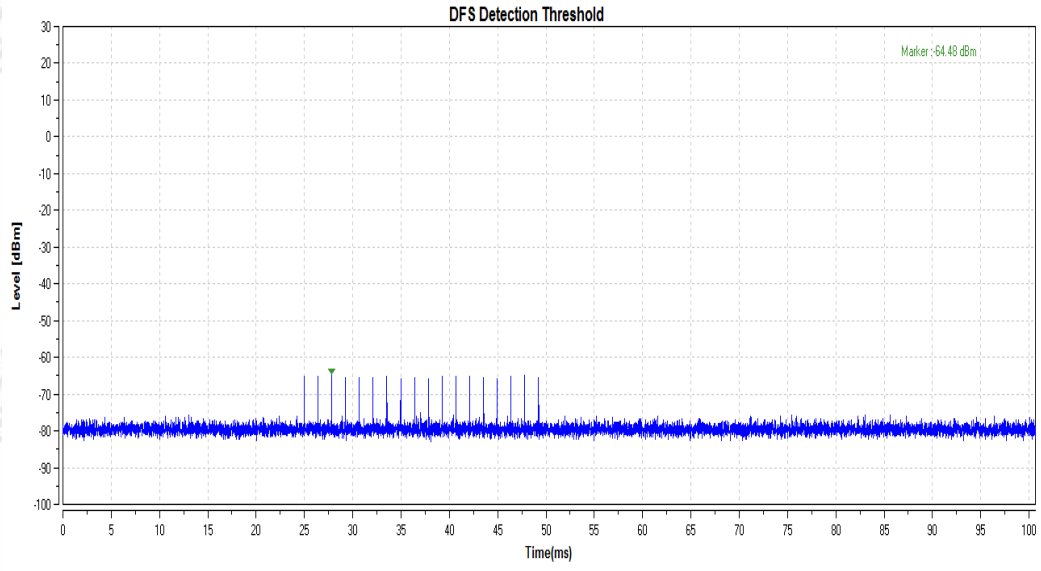

Antenna Port RF Connections to Test Instrument Setup
Master Device (Support Equipment)
Slave Device (EUT)
PC Controller and Server,
with MPEG file
Host Computer,
with MPEG Player

Test Result

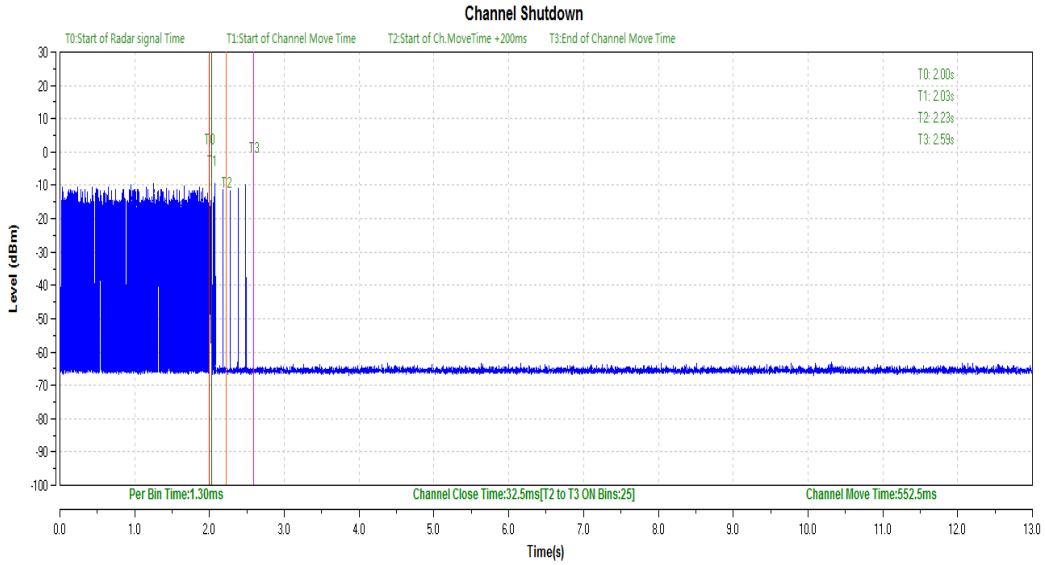
AC20MIMO 5320MHz



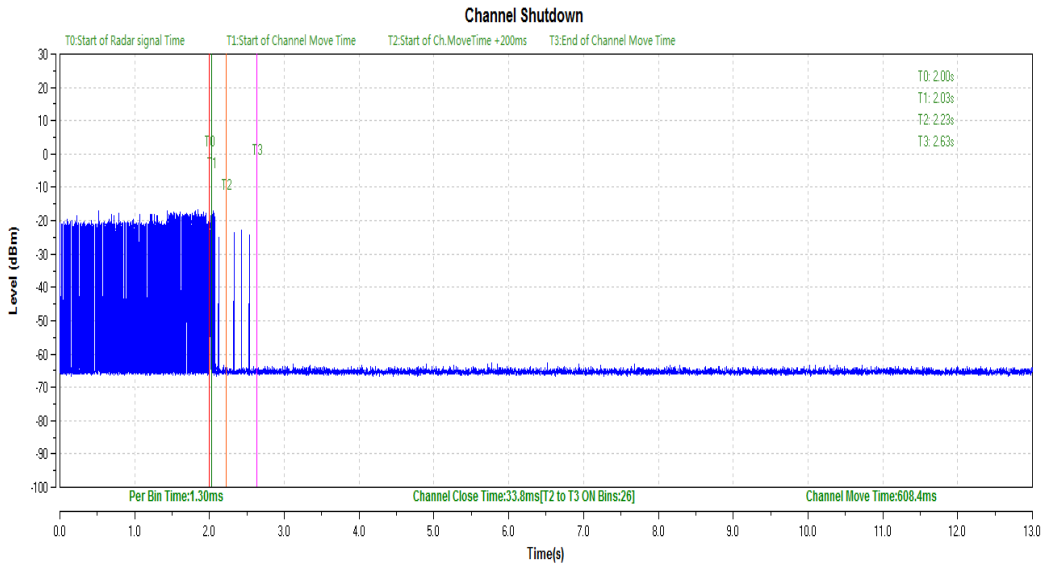
AC80MIMO 5290MHz



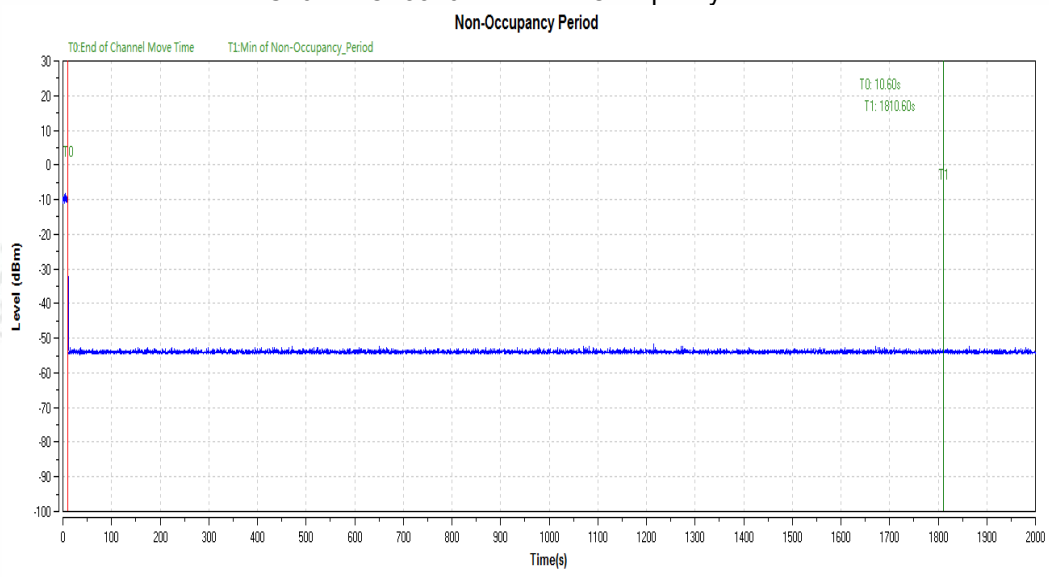
AC20MIMO 5320MHz Channel shutdown



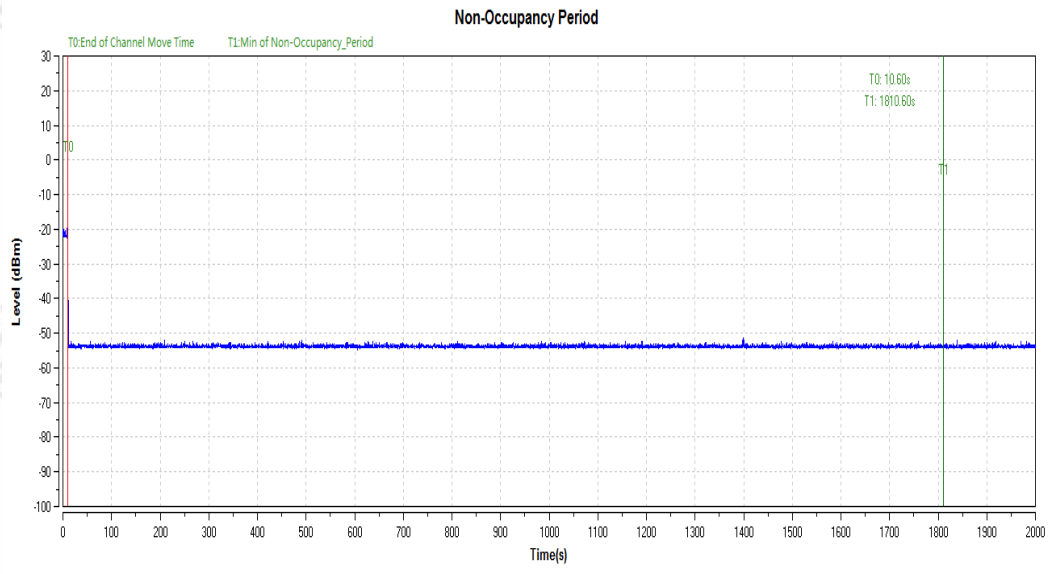
AC80MIMO 5290MHz Channel shutdown



AC20MIMO 5320MHz Non-Occupancy Period



AC80MIMO 5290MHz Non-Occupancy Period



PHOTOGRAPHS OF EUT Constructional Details

Refer to Report No.EED32M00138901 for EUT external and internal photos.

*** End of Report ***