TEST REPORT

Verified Code: 706652

Report No.:	E20210426746801-12	**Application No.:**	E20210426746801
Client:	Lumi United Technology Co., Ltd.		
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen.China		
Sample Description:	Camera Hub G3		
Model:	CH-H03		
Test Specification:	CFR 47, FCC Parts Subpart E Unlicensed National Information Infrastructure Devices		
Receipt Date:	2021-06-09		
Test Date:	2021-07-07 to 2021-07-12		
Issue Date:	2021-09-08		
Test Result:	Pass		

Prepared By:	**Reviewed By:**	**Approved By:**
Test Engineer	Technical Manager	Manager
Yang Zhaoyun	Wu Haoting	

Other Aspects:

Note:Note

Abbreviations: *ok / P = passed; fail / F = failed; n.a. / N = not applicable;*

The test result in this test report refers exclusively to the presented test sample. This report shall not be reproduced except in full, without the written approval of GRGT.

DIRECTIONS OF TEST

1. **This station carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.**

2. **The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.**

3. **If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.**

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1. TEST RESULT SUMMARY

CFR 47, FCC Parts Subpart E(§15.407)			
Item	**Test Mode**	**FCC Standard Section**	**Result**
Channel Closing Transmission Time	IEEE 802.11a5320MHz/5700MHz IEEE 802.11ac VHT80 5290MHz/5530MHz	15.407(h)	PASS
Channel Move Time	IEEE 802.11a5320MHz/5700MHz IEEE 802.11ac VHT80 5290MHz/5530MHz	15.407(h)	PASS

Note:Recorded the worst case results in this report

2. GENERAL DESCRIPTION OF EUT

2.1. APPLICANT

Name:	Lumi United Technology Co., Ltd.
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen.China

2.2. MANUFACTURER

Name:	Lumi United Technology Co., Ltd.
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen.China

2.3. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	Camera Hub G3
Model No.:	CH-H03
Adding Model:	/
Trade Name:	Aqara
FCC ID:	2AKIT-CHH03
Power Supply:	DC5V power supplied by adapter
Adapter Specification:	Adapter 1-US Plug Model:A8A-050200U-US1 Input:100-240V~ 50/60Hz 0.35A Output:5.0V ⎓ 2.0A
Operation Frequency:	U-NII-2A: 5250 MHz~5350 MHz U-NII-2C: 5470 MHz~5725 MHz
Modulation type:	OFDM
Number Of Channel	U-NII-2A: IEEE 802.11a / n HT20 / ac VHT20: 4 Channels IEEE 802.11n HT40 / ac VHT40: 2 Channels IEEE 802.11acVHT80: 1 Channel U-NII-2C: IEEE 802.11a / n HT20 / ac VHT20: 11 Channels IEEE 802.11n HT40 / ac VHT40: 5 Channels IEEE 802.11ac VHT80: 2 Channel
Channels Spacing:	IEEE 802.11a: 20MHz IEEE 802.11n HT20: 20MHz IEEE 802.11n HT40: 40MHz IEEE 802.11acVHT20: 20MHz IEEE 802.11acVHT40: 40MHz IEEE 802.11acVHT80: 80MHz
Antenna Specification:	Internal antenna 2dBi gain (Max.)

Temperature Range:	-10℃~40℃
Hardware Version:	A20-GHC01-MIAN-X4
Software Version:	3.2.8_0003.0004
Sample No:	E20210426746801-0005
Note:	/

2.4. TEST OPERATION MODE

Mode No.	Description of the modes
1	IEEE 802.11a mode (5320MHz, 5700MHz)
2	IEEE 802.11acVHT80 mode (5290MHz, 5530MHz)

DFS Operation Mode Information

□	Master
□	Slave with radar detection
■	Slave without radar detection
□	WithTPC
□	WithoutTPC

Description of EUT

Overview of EUT with respect to §15.407 (H) requirements

EUT is a camera device. It only has two antennas, Zigbee and Wi-Fi. It is a slave device that does not have radar detection capabilities. EUT is tested by running data stream with AP equipment and connecting to the test system through Wi-Fi antenna.

2.5. LOCAL SUPPORTIVE INSTRUMENTS

Name of Equipment	Manufacturer	Model	Serial Number	Note
Router	FiberHome	SR1041D	/	/

3. LABORATORY AND ACCREDITATIONS

3.1. LABORATORY

The tests & measurements refer to this report were performed byShenzhenEMC Laboratory of Guangzhou GRG Metrology & Test Co,.Ltd.

Add : No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China

P.C. : 518000

Tel : 0755-61180008

Fax : 0755-61180008

3.2. ACCREDITATIONS

Our laboratoriesare accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA	A2LA(Certificate#:2861.01)
China	CNAS(L0446)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	Industry Canada (Company Number: 24897)
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http://www.grgtest.com

3.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	Horizontal	30MHz～1000MHz	4.3dB
		1GHz～18GHz	5.6dB
	Vertical	30MHz～1000MHz	4.3dB
		1GHz～18GHz	5.6dB
Conduction Emission		9 kHz ~ 150 kHz	2.8 dB
		150 kHz ~ 10 MHz	2.8 dB
		10 MHz ~ 30 MHz	2.2 dB

This uncertainty represents an expanded uncertainty factor of k=2.

4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9010A	MY52221469	2022-04-16
Vector signal generator	Agilent	N5182A	MY50142870	2021-10-08
Simultaneous sampling DAQ	Tonscend	JS0806-2	186060020	2021-10-08

Note: The calibration interval of the above test instruments is 12 months.

5. EIRP POWER

Band	Test Mode	Maximum Conducted Power(dBm)	Antenna Gain	Total EIRP Power (dBm)
UNII-2A (5250MHz~ 5350 MHz)	IEEE802.11 a	10.39	2.00	12.39
	IEEE802.11n HT20	10.16		12.16
	IEEE802.11ac VHT20	8.51		10.51
	IEEE802.11n HT40	10.53		12.53
	IEEE802.11ac VHT40	8.46		10.46
	IEEE802.11ac VHT80	9.05		11.05
UNII-2C (5470 MHz~ 5725 MHz)	IEEE802.11 a	8.91	2.00	10.91
	IEEE802.11n HT20	8.27		10.27
	IEEE802.11ac VHT20	6.82		8.82
	IEEE802.11n HT40	8.77		10.77
	IEEE802.11ac VHT40	6.67		8.67
	IEEE802.11ac VHT80	7.00		9.00

6. DYNAMIC FREQUENCY SELECTIONREQUIREMENTS

6.1.DFS OVERVIEW

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	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 6: 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

6.2.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 spectraldensity 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 testtransmission waveforms to account for variations in measurement equipment. This will ensure that thetest 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 662911D01

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% transmissionpower bandwidth. See Note 3.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed withRadar 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	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	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.					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. Ifmore than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additionalwaveform must also be unique and not repeated from the previous waveforms. If more than 30waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with TestB and must also be unique and not repeated from the previous waveforms in Tests A or B.
For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 μsec is selected, the number of pulses would be Roundup $\{(1/360)(19\times10^6/3066)\}$ = Round up $\{17.2\}$ = 18.

Table 10: Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulsesper Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number ofTrials
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 11: Frequency Hopping Radar Test Waveform

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

DESCRIPTION OF EUT

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

The firmware installed in the EUT during testing was:
Firmware Rev: 3.2.8_0003.0004

The EUT is a Slaver Device.

The EUT operates over the 5250-5350 MHz ,5470-5725 MHzrange as a Client Device that does not have radar detection capability.

The antenna assembly utilized with the EUT has a gain of 2 dBi.

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 using the iperf software to send packets from the Master IP address to the Slave IP address.

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

The Master Device is a FiberHome802.11a/b/g/n/ac Access Point, FCC ID: 2AV2N-SR1041D.

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 + 2 = -60dBm.

The calibrated conducted DFS Detection Threshold level is set to -60dBm. 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.

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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 and the same manufacturer / model Vector Signal Generator as the NTIA. The hopping signal generating system utilizes the simulated hopping method.

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, with the initial starting point randomized at run-time.

The signal monitoring equipment consists of a spectrum analyzer with the capacity to display 8192 bins on the horizontal axis. A time-domain resolution of 2 msec / bin is achievable 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. A time-domain resolution of 3 msec / bin is achievable 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.

Frequency Hopping Signal Generation

The hopping burst generator is a High Speed Digital I/O card plugged into the control computer. This card utilizes an independent hardware clock reference therefore the output pulse timing is unaffected by host computer operating system latency times.

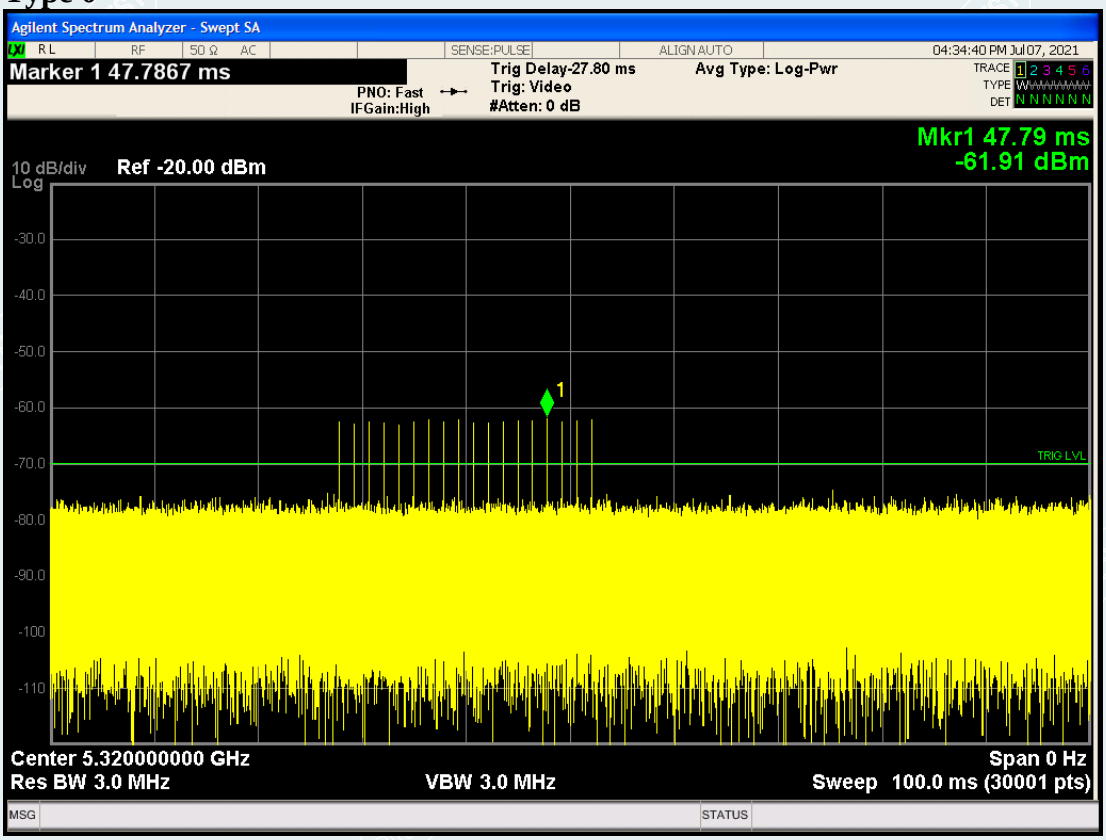
The software selects the hopping sequence as a 100-length segment of the August 2005 NTIA hopping frequency list. This list contains 274 unique pseudorandom sequences. Each such sequence contains 475 frequencies ordered on a random without replacement basis. Each successive trial uses a contiguous 100- length segment from within each successive 475-length sequence in the list. The initial starting point within the list is randomized at run-time such that the first 100-length segment is entirely contained within the first 475-length sequence. The starting point of each successive trial 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.

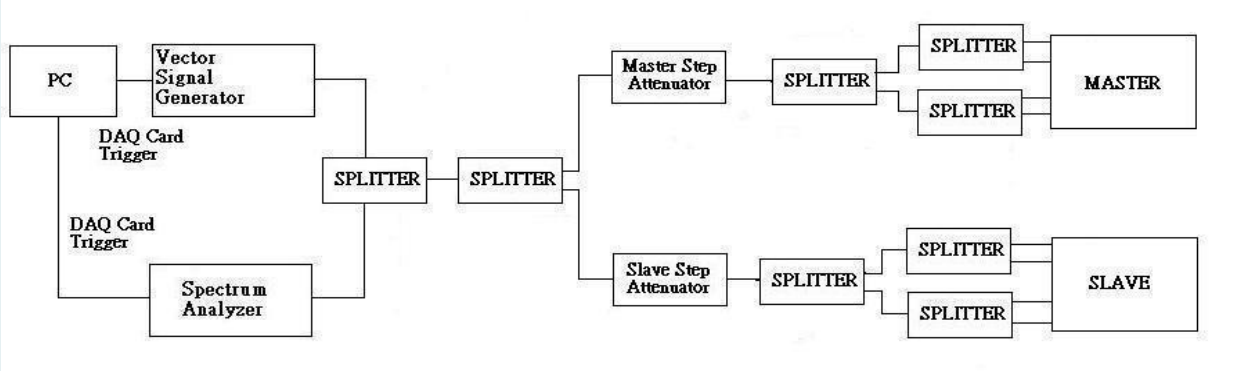
TEST PLOTS

IEEE 802.11a5320MHz

Type 0



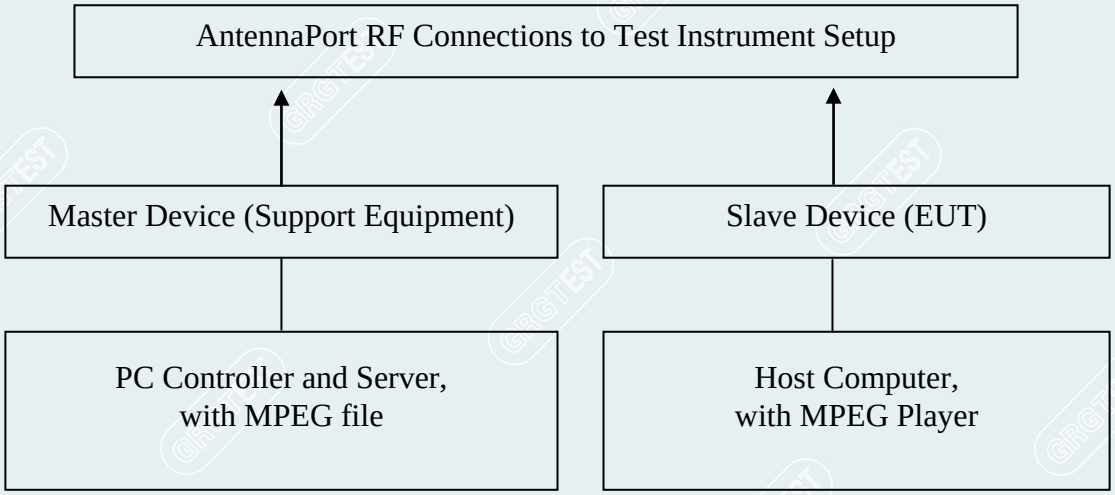
6.3.CONDUCTED METHOD SYSTEM BLOCK DIAGRAM



6.4.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 –62dBm 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 –62dBm. 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 –62dBm 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.

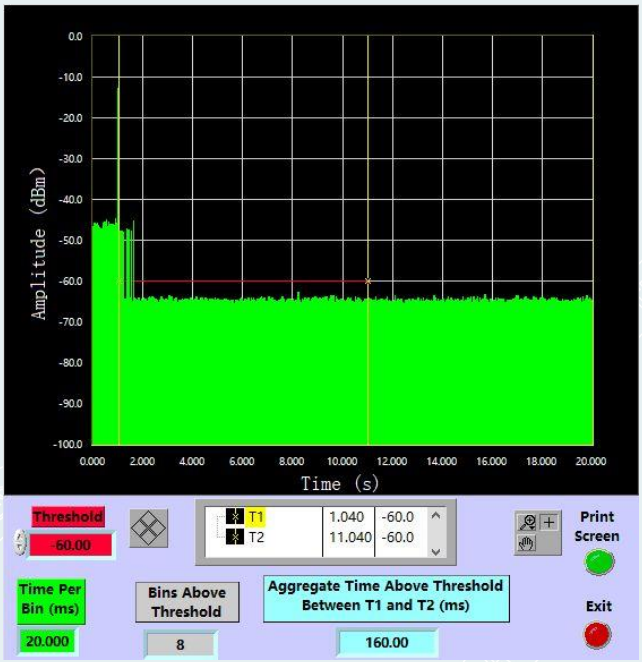


6.5.DEVIATION FROM TEST STANDARD

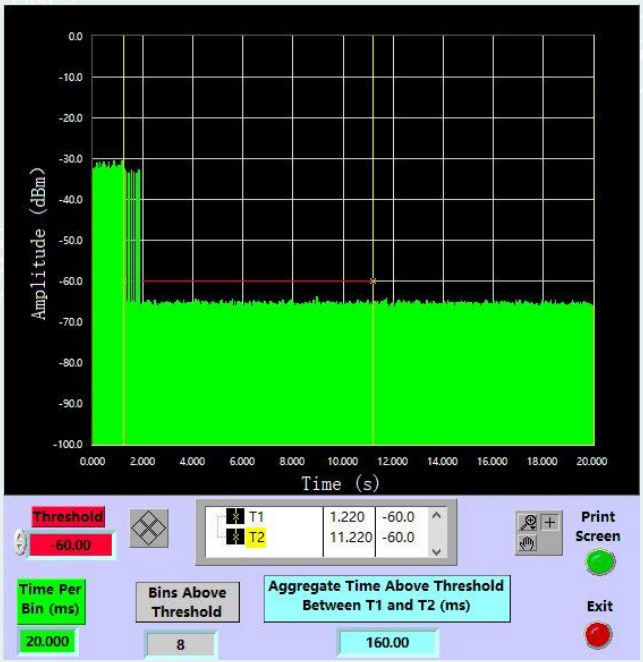
No deviation.

6.6.TEST RESULTS

Test Mode	Test frequency (MHz)	Channel Move Time (s)	Limit(s)	Result
IEEE 802.11a	5320	0.16000	10	Pass
	5700	0.16000	10	Pass

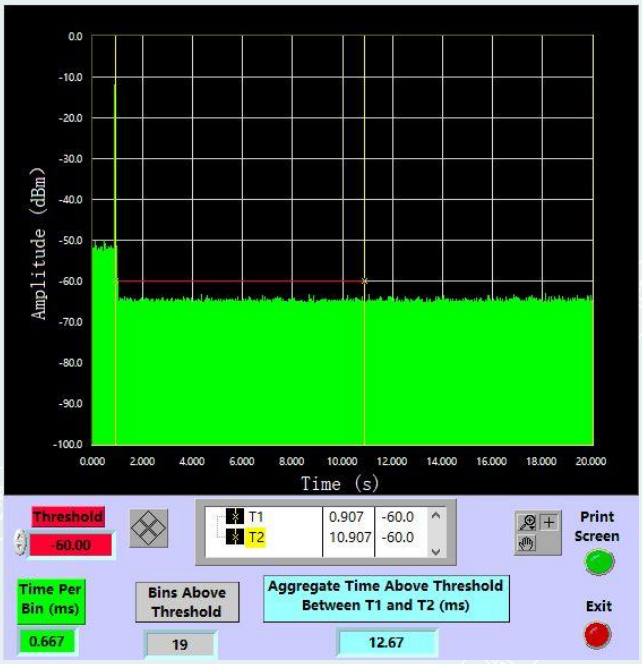


5320MHz

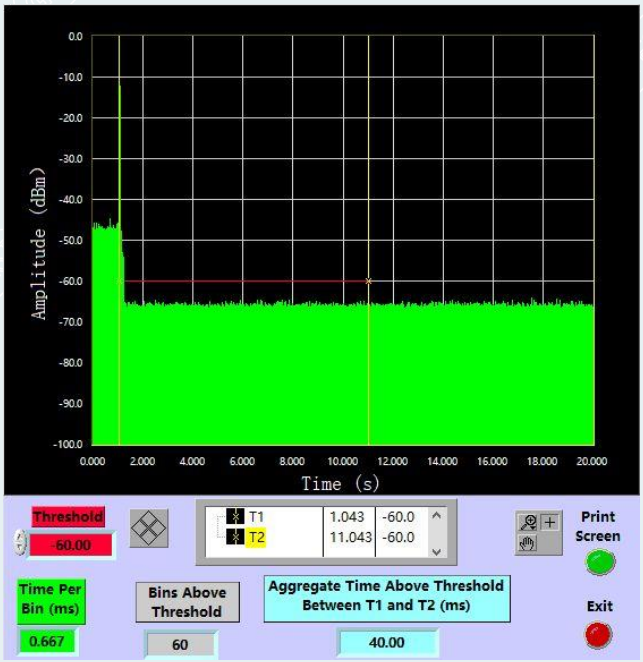


5700MHz

Test Mode	Test frequency (MHz)	Channel Move Time (s)	Limit(s)	Result
IEEE 802.11ac 80	5290	0.01267	10	Pass
	5530	0.04000	10	Pass



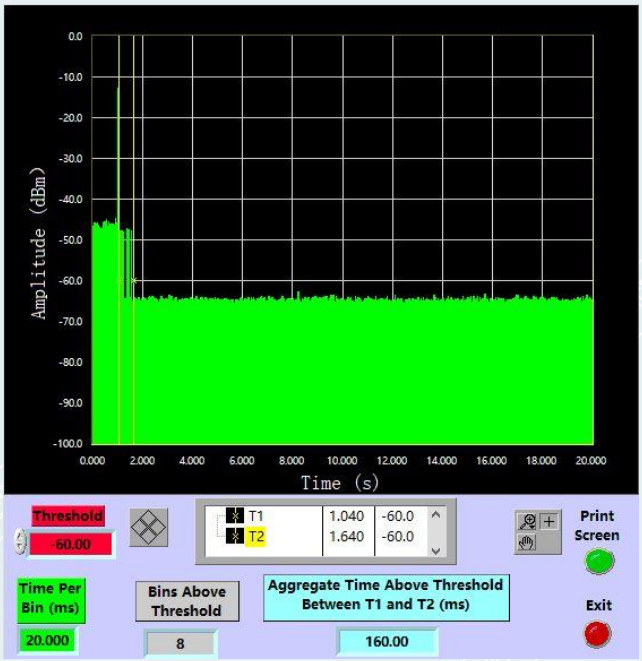
5290MHz



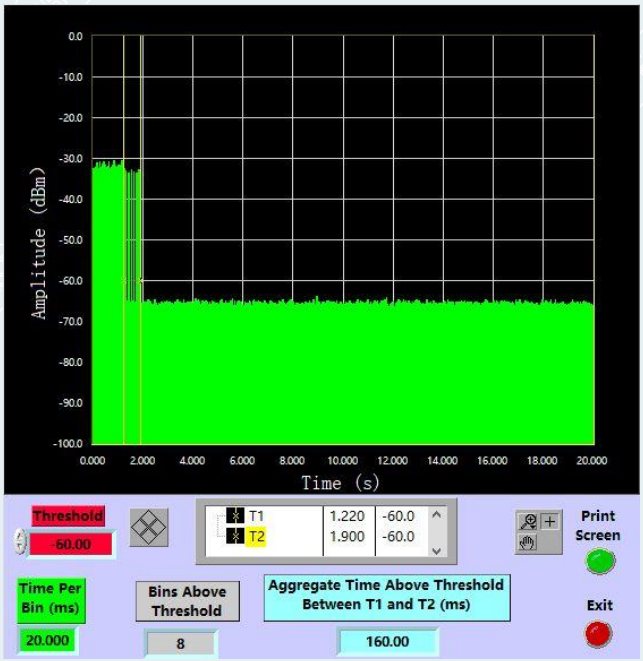
5530MHz

Reference Channel Closing Time

Test Mode	Test frequency (MHz)	Channel Closing Transmission Time(s)	Limit (s)	Result
IEEE 802.11a	5320	0.16000	0.26	Pass
	5700	0.16000	0.26	Pass

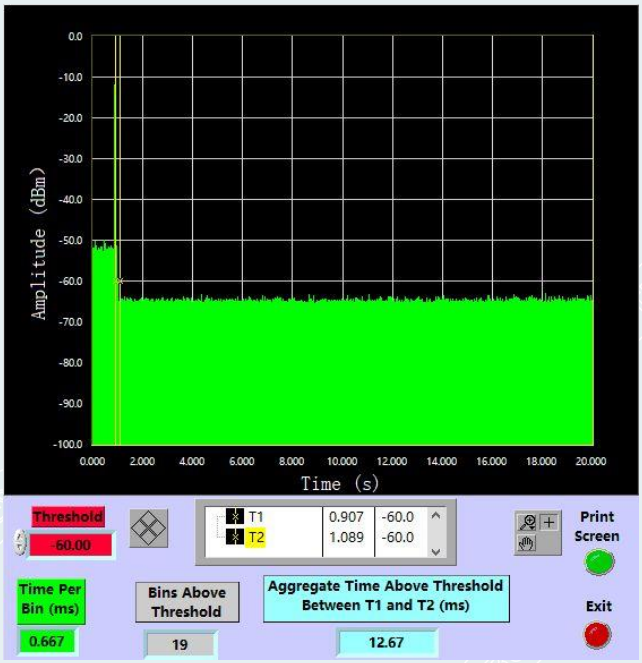


5320MHz

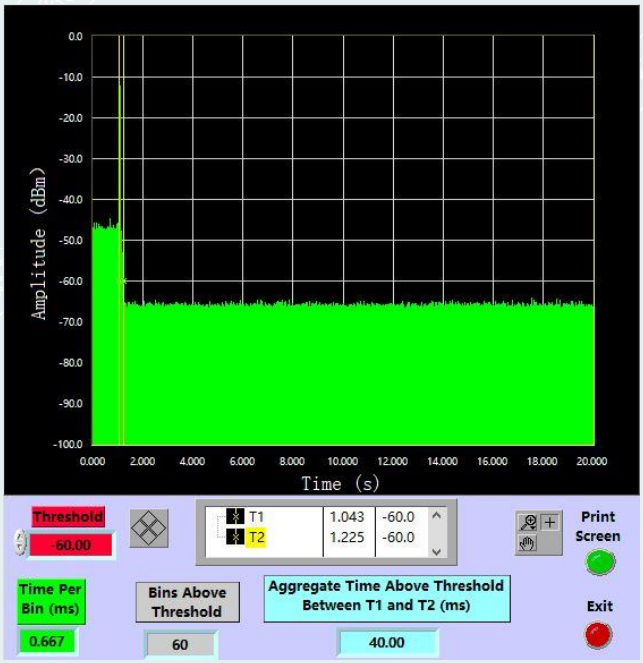


5700MHz

Test Mode	Test frequency (MHz)	Channel Closing Transmission Time (s)	Limit (s)	Result
IEEE 802.11ac 80	5290	0.01267	0.26	Pass
	5530	0.04000	0.26	Pass



5290MHz



5530MHz

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