RF TEST REPORT

Report No.: 17070669-CE-R4

Supersede Report No.: N/A

Applicant	HUMAX Co., Ltd.
Product Name	Cable Set-top box
Main Model No.	1008R-HDD-XXX(XXX=A~Z)
Serial Model No.	1008C-STB-XXX(XXX=A~Z)
Test Standard	FCC Part 15.407: 2017, ANSI C63.10: 2013
Test Date	January 11, 2018
Issue Date	January 12, 2018
Test Result	☑ Pass ☐ Fail
Equipment complied with the specification	☑
Equipment did not comply with the specification	☐

Aaron Liang	David Huang	
Aaron Liang Test Engineer	David Huang Checked By	

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Test result presented in this test report is applicable to the tested sample only

Issued by:

SIEMIC (SHENZHEN-CHINA) LABORATORIES

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Laboratories Introduction

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In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Scope
USA	EMC, RF/Wireless, SAR, Telecom
Canada	EMC, RF/Wireless, SAR, Telecom
Taiwan	EMC, RF, Telecom, SAR, Safety
Hong Kong	RF/Wireless, SAR, Telecom
Australia	EMC, RF, Telecom, SAR, Safety
Korea	EMI, EMS, RF, SAR, Telecom, Safety
Japan	EMI, RF/Wireless, SAR, Telecom
Singapore	EMC, RF, SAR, Telecom
Europe	EMC, RF, SAR, Telecom, Safety

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1. Report Revision History

Report No.	Report Version	Description	Issue Date
17070669-CE-R4	NONE	Original	January 12, 2018

2. Customer information

Applicant Name	HUMAX Co., Ltd.
Applicant Add	HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu Yongin-si, Gyeonggi-do South Korea 17040
Manufacturer	HUMAX Co., Ltd.
Manufacturer Add	HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu Yongin-si, Gyeonggi-do South Korea 17040

3. Test site information

Test Lab:

Lab performing tests	SIEMIC (Shenzhen-China) LABORATORIES
Lab Address	Zone A, Floor 1, Building 2 Wan Ye Long Technology Park South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108
FCC Test Site No.	535293
IC Test Site No.	4842E-1
Test Software	Radiated Emission Program-To Shenzhen v2.0

4. Equipment under Test (EUT) Information

Description of EUT:	Cable Set-top box
Main Model:	1008R-HDD-XXX(XXX=A~Z)
Serial Model:	1008C-STB-XXX(XXX=A~Z)
Date EUT received:	August 11, 2017
Test Date(s):	January 11, 2018
Equipment Category：	NII
Antenna Gain:	WIFI(2.4G): Antenna (Green): 1.9 dBi Antenna (Gray): 2.8 dBi Antenna (Black): 1.7 dBi WIFI(5150-5250MHz): Antenna (Green): 3.9 dBi Antenna (Gray): 3.8 dBi Antenna (Black): 2.5 dBi WIFI(5250-5350MHz): Antenna (Green): 3.8 dBi Antenna (Gray): 3.9 dBi Antenna (Black): 3.8 dBi WIFI(5470-5725MHz): Antenna (Green): 3.6 dBi Antenna (Gray): 3.9 dBi Antenna (Black): 3.7 dBi WIFI(5725-5850MHz): Antenna (Green): 3.8 dBi Antenna (Gray): 3.8 dBi Antenna (Black): 2.7 dBi RF4CE: Antenna 0: 2.35 dBi Antenna 1: 2.28 dBi
Antenna Type:	Dipole antenna RF4CE: PCB antenna
Modulation Type:	802.11b: DSSS 802.11g/n20/n40/a/ac20/ac40/ac80: OFDM RF4CE: O-QPSK

RF Operating Frequency (ies):	WIFI: 802.11b/g: 2412-2462 MHz(TX/RX) WIFI: 802.11n(20M): 2412-2462 MHz; 5180-5240 MHz; 5260-5320 MHz; 5500-5700 MHz; 5745-5825 MHz ; (TX/RX) WIFI: 802.11n(40M): 2422-2452 MHz; 5190-5230 MHz; 5270-5310 MHz; 5510-5710 MHz; 5755-5795 MHz ; (TX/RX) 802.11a: 5180-5240 MHz; 5260-5320 MHz; 5500-5700 MHz; 5745-5825 MHz ; (TX/RX) 802.11ac 20: 5180-5240 MHz; 5260-5320 MHz; 5500-5700 MHz; 5745-5825 MHz ; (TX/RX) 802.11ac 40: 5190-5230 MHz; 5270-5310 MHz; 5510-5710 MHz; 5755-5795 MHz ; (TX/RX) 802.11ac 80: 5210 MHz; 5290 MHz; 5530-5690 MHz; 5775 MHz ; (TX/RX) RF4CE: 2405-2480 MHz
Number of Channels:	WIFI :802.11b/g: 11CH WIFI :802.11a: 25CH WIFI :802.11n20: 11CH(2.4GHz); 25CH(5GHz) WIFI :802.11n40: 7CH(2.4GHz); 12CH(5GHz) WIFI :802.11ac20: 25CH WIFI :802.11ac40: 12CH WIFI :802.11ac80: 6CH RF4CE:16CH
Power supply:	Adapter Model: ADP-30LR A Input: 100-240V~0.5A, 50/60Hz Output: 12V DC, 2.5A
Port:	Please refer to the user manual
Trade Name :	LGI
FCC ID:	O6ZEOS-1008C

5. Test Summary

The product was tested in accordance with the following specifications.

All testing has been performed according to below product classification:

Test Item	Test standard	Test Method/Procedure	Result
UNII Detection Bandwidth	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A
Initial Channel Availability Check Time	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A
Radar Burst at the Beginning of the Channel Availability Check Time	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A
Radar Burst at the End of the Channel Availability Check Time	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A
In-Service Monitoring - Channel Move Time	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	Pass
In-Service Monitoring - Channel Closing Transmission Time	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	Pass
In-Service Monitoring - Non-Occupancy Period	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A
Statistical Performance Check	47CFR15.407 (h)	905462 D02 UNII DFS Compliance Procedures New Rules v02	N/A

Measurement Uncertainty

Emissions		
Test Item	**Description**	**Uncertainty**
Dynamic frequency selection (DFS) Conducted Measurement	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2	±1.5dB

Note1:

Operating frequency bands and mode of EUT

Operational Mode	Operating Frequency Range	
	5250~5350MHz	5470~5725MHz
Client without radar detection and ad hoc function	V	V

6. Measurements, Examination And Derived Results

6.1 Dynamic Frequency Selection (DFS)

6.1.1General introduction

Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥ 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 spectra 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.	

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 facilitating 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.	

Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. 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

1. Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum
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 { (1/360) * (19 $10_6/PRI_{usec}$	60%	30
		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.					

2. 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 Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

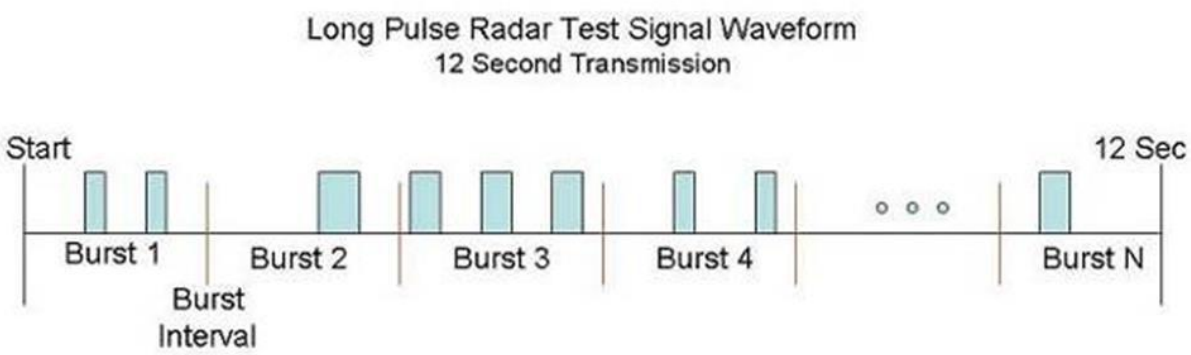
1) The transmission period for the Long Pulse Radar test signal is 12 seconds.

2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The s9tart time for each Burst is chosen independently.

A representative example of a Long Pulse radar test waveform:

1) The total test signal length is 12 seconds.
2) 8 Bursts are randomly generated for the Burst Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.

6) Bursts 2 through 8 are generated using steps 3 – 5.
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range)



3. Frequency Hopping Radar Type

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

For the Frequency Hopping Radar Type, the same Burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected 1 from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

6.1.2 Radar Waveform Calibration

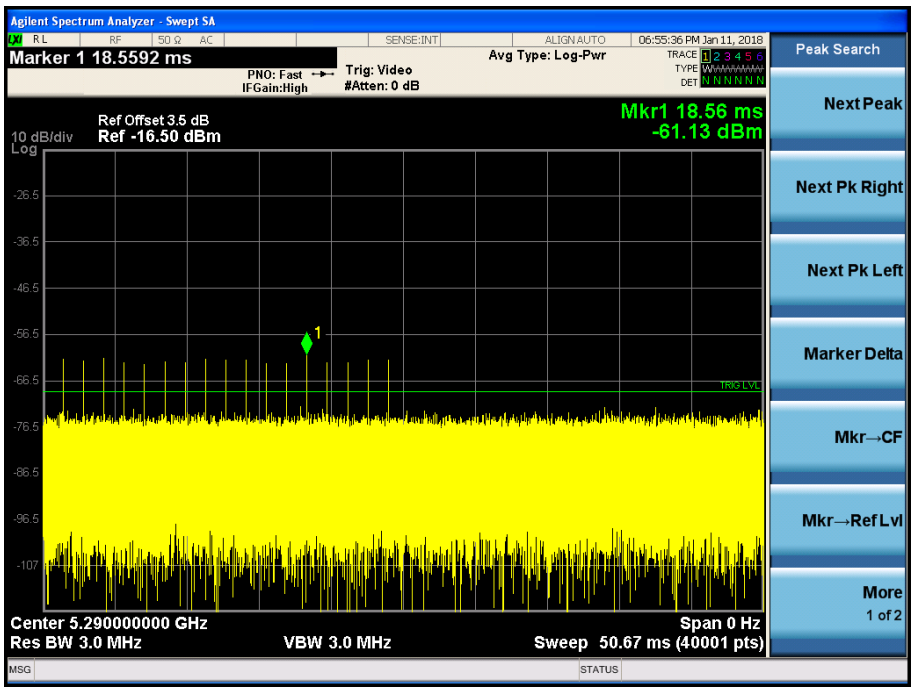
The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz.

For a detection threshold level of -62dBm and the Master antenna gain is -0.98 dBi for the band 5250-5350MHz, and -0.26 dBi for the band 5470-5725MHz., required detection threshold is -62.98dBi for the band 5250-5350MHz, and -62.26 dBi for the band 5470-5725MHz.

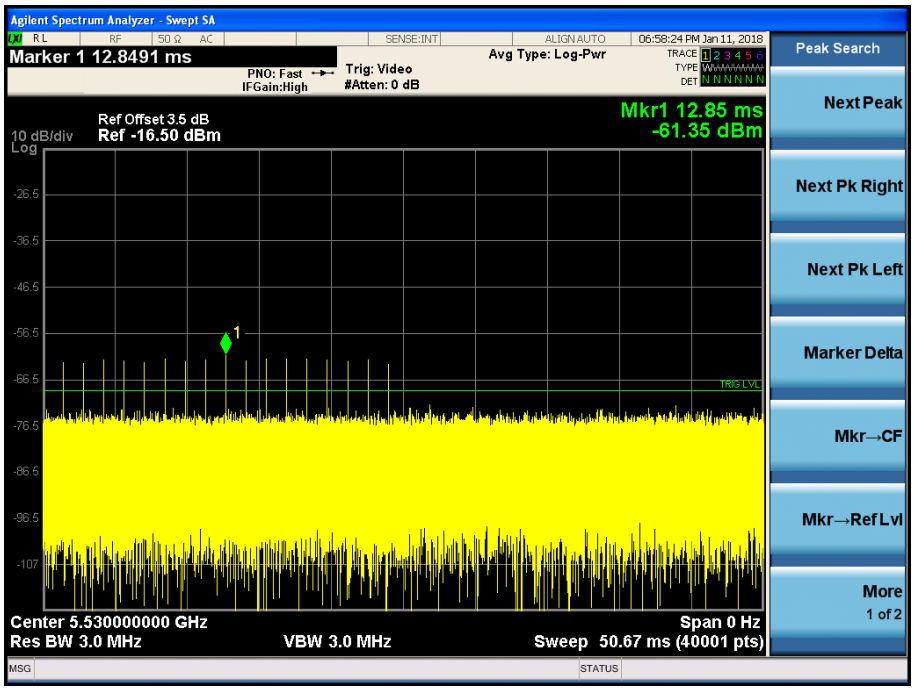
Note: Maximum Transmit Power is less than200 milliwatt in this report, so detection threshld level is -62dBm

The device transmits one type of radar as specified in the DFS Order.

The Required detection threshold is -61.30dBm = -62 +0.7dBi. The conducted radar burst level is set to -61.30dBm.



5290-Radar signal



5530-Radar signal

6.1 In-Service Monitoring for Channel Move Time , Channel Closing Transmission Time and Non- Occupancy Period

These tests define how the following DFS parameters are verified during In-Service Monitoring; Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB is generated on the Operating Channel of the U-NII device.

the UUT (Client) operating as a Client Device will associate with master at Mid Channel. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test. At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at -62dBm. Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the DFS Response requirement values table.

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.	

Channel Closing Transmission Time- Measurement

A type 1 waveform was introduced to the EUT and the Spectrum Analyzer sweep time was set to 1s for monitoring and capturing the plot. A LabView program was created to collect trace data and capturing the plot. The program will calculate the channel closing time base on the spectrum analyzer result. The result will be calculated based on FCC procedure.

C= N*Dwell

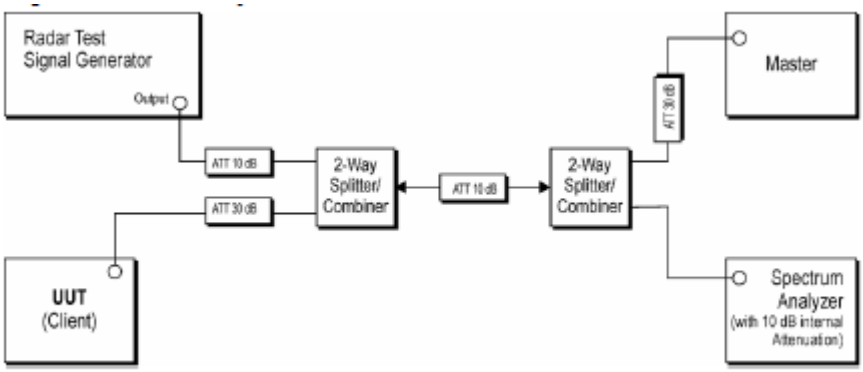
C is the closing time, N is the number of spectrum analyzer sampling bins showing a U-NII transmission and dwell is the dwell time per bin.

Dwell= S/B

Where Dwell is the dwell time per spectrum analyzer sampling bin, S is the sweep time and B is the number 0f spectrum analyzer sampling bins.

10.1.4 DFS Test Setup

Test Setup Block Diagram

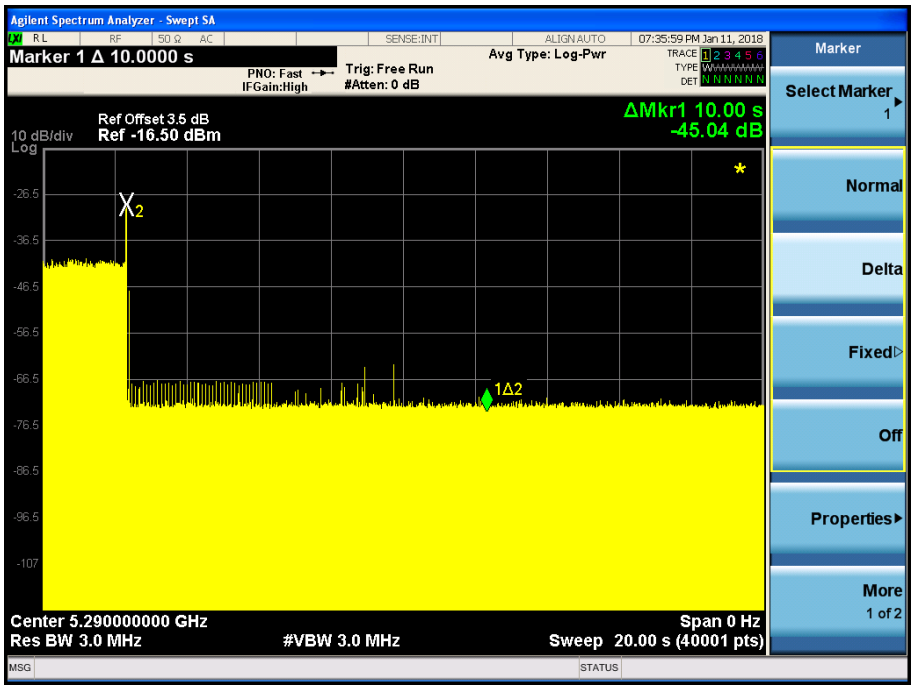


The radio was set at the center channel frequency of tested Channel.
A FCC approved mater device – (FCC ID: Q87-WBV-AP230) AP was used to link with the UUT (Client) device.

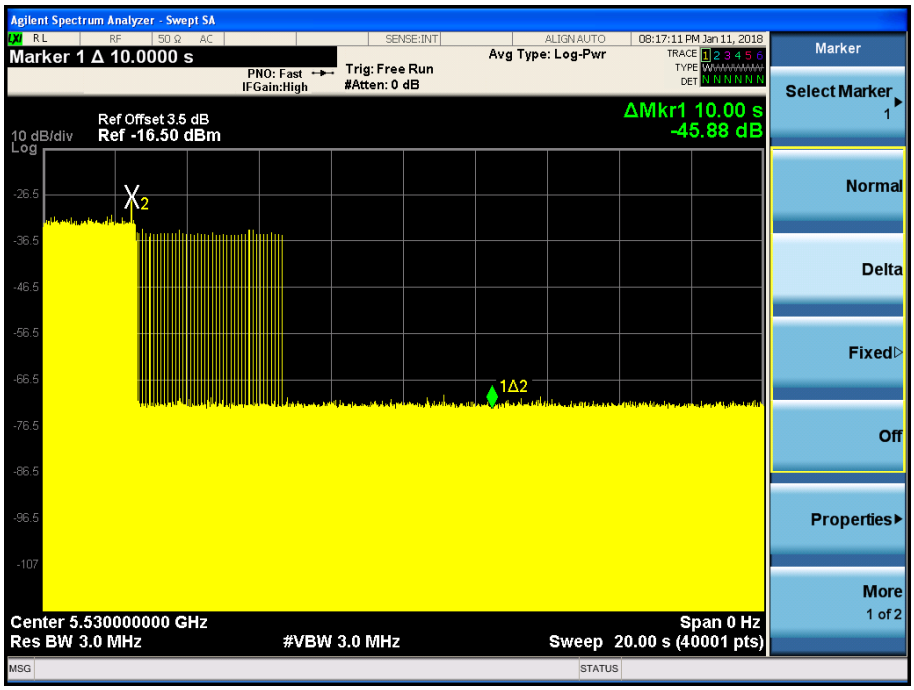
For the frequency bands 5250MHz to 5725MHz the master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

Channel Move Time Test Result

ac80 – 5290MHz

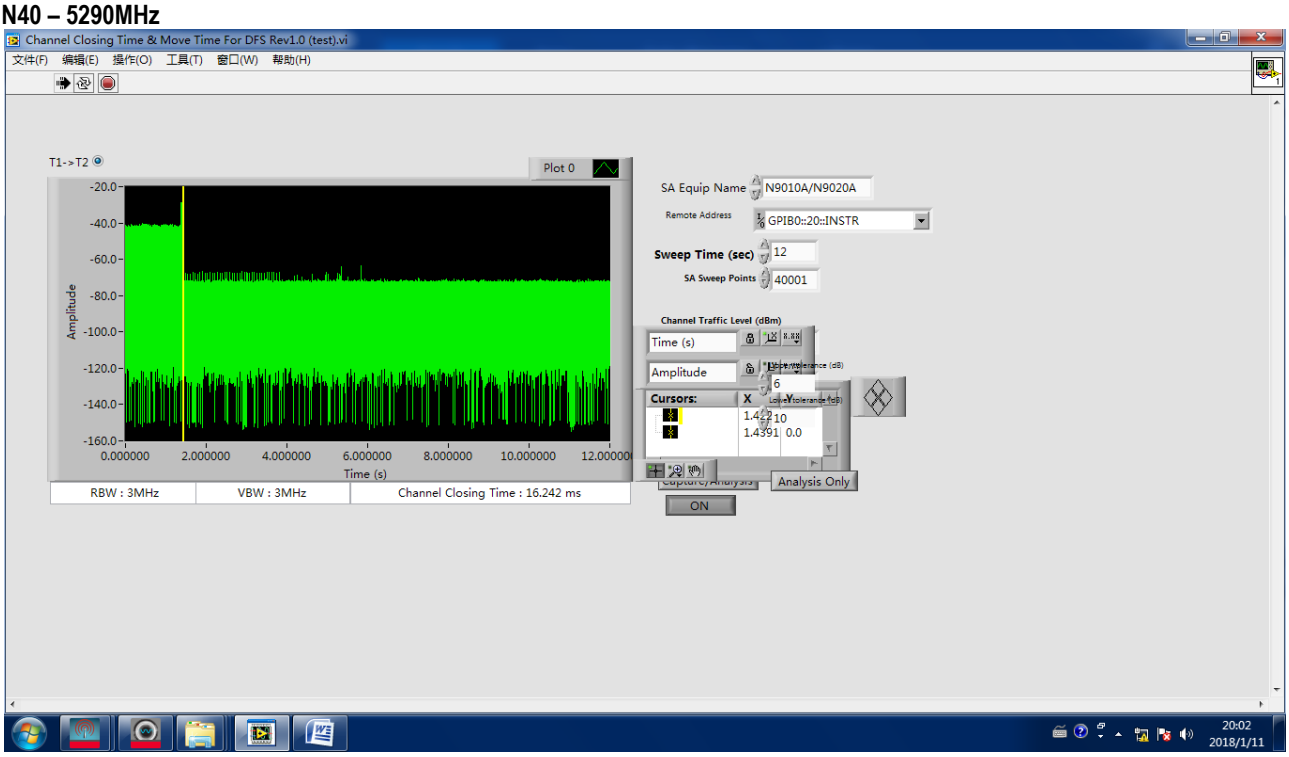


Ac80 – 5530MHz

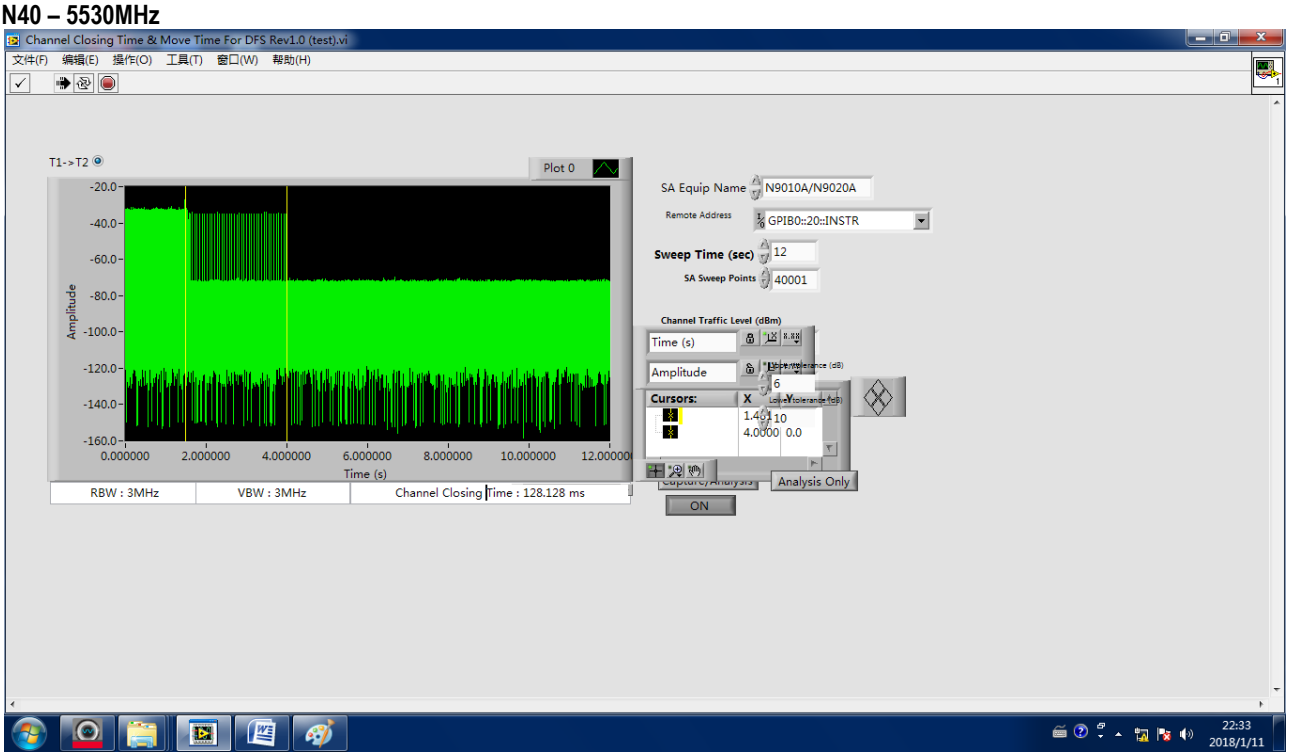


Channel Closing Transmission Test Result

N40 – 5290MHz



N40 – 5530MHz



Annex A. TEST INSTRUMENT

Annex A.i. TEST INSTRUMENTATION & GENERAL PROCEDURES

Instrument	Model	Serial #	Cal Date	Cal Due	In use
Radiated DFS Measurement					
Keysight Signal Analyzer	N9020A	MY49100060	11/14/2017	11/13/2018	☑
Splitter/Combiner (Mini-Circuit)	PD-2/8-2S	XA022154	11/14/2017	11/13/2018	☑
Splitter/Combiner (Mini-Circuit)	PD-2/8-2S	XA022155	11/14/2017	11/13/2018	☑
Splitter/Combiner (Mini-Circuit)	PD-2/8-2S	XA022159	11/14/2017	11/13/2018	☑
Agilent Signal Generator	MXG N5182A	MY50140530	11/16/2017	11/15/2018	☑

Annex B. TEST SETUP AND SUPPORTING EQUIPMENT

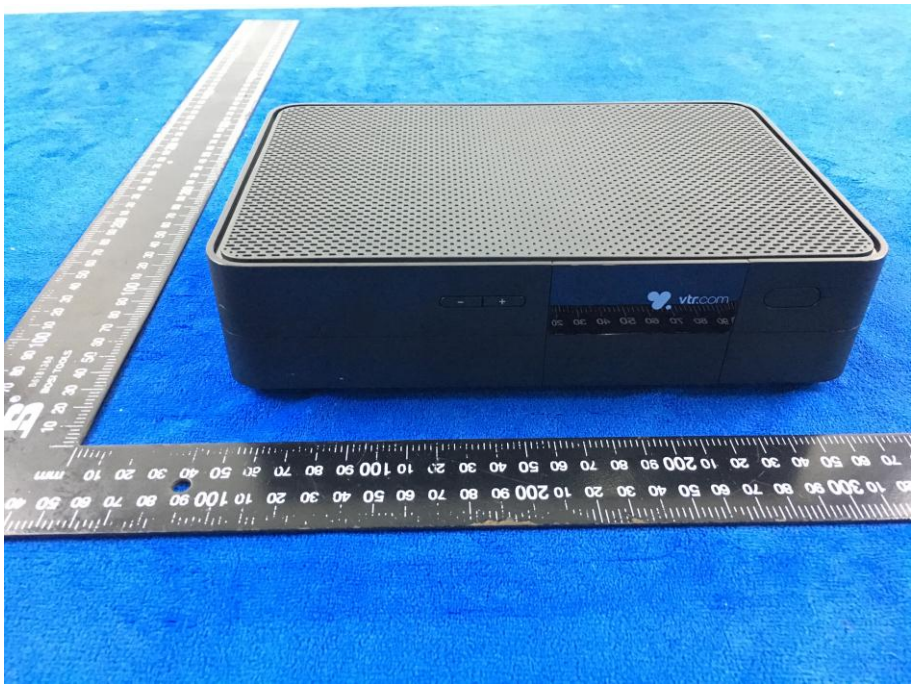
Annex B.i. Photograph EUT External Photo

Adapter - Front View

EUT - Front View

EUT - Rear View

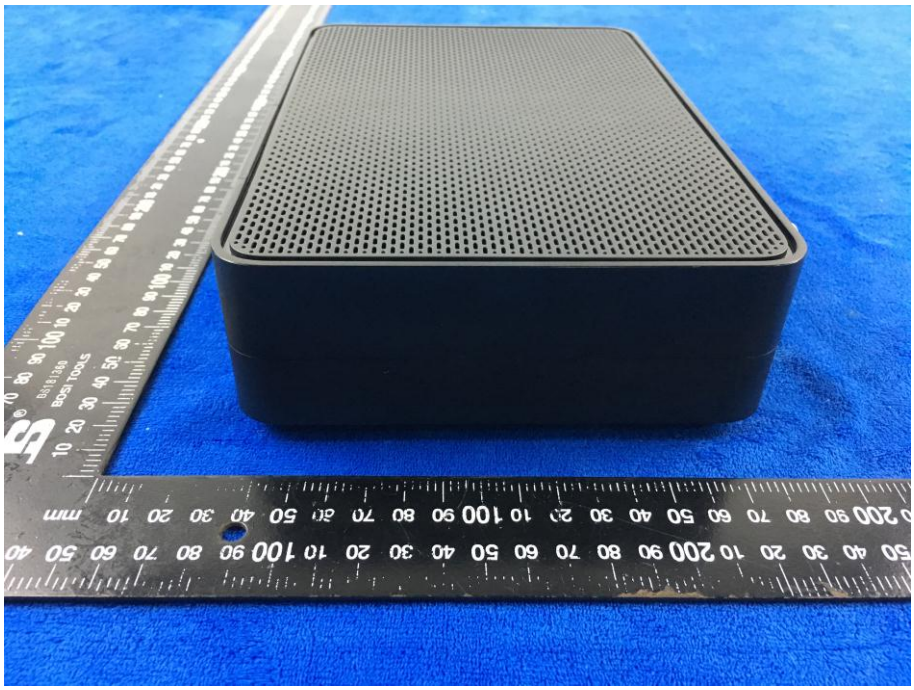
EUT - Top View



EUT - Bottom View

EUT - Left View

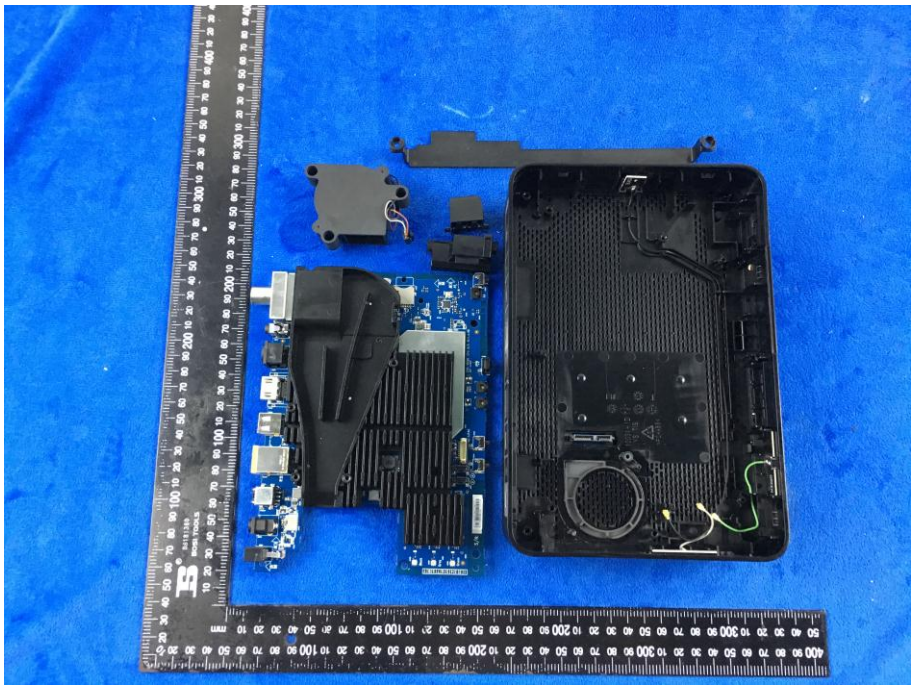
EUT - Right View



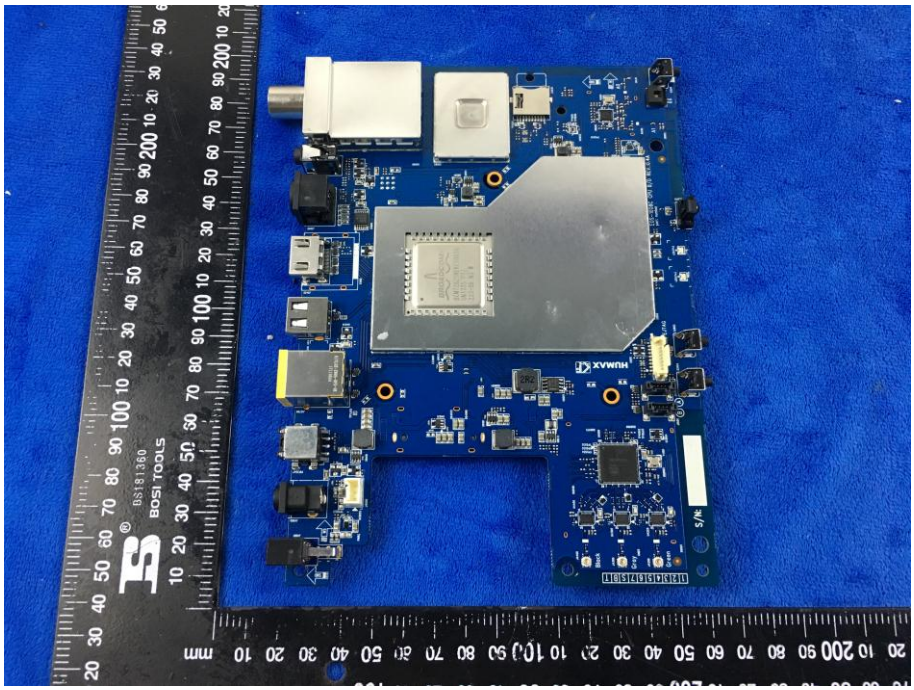
Annex B.ii. Photograph: EUT Internal Photo

Cover Off - Top View 1

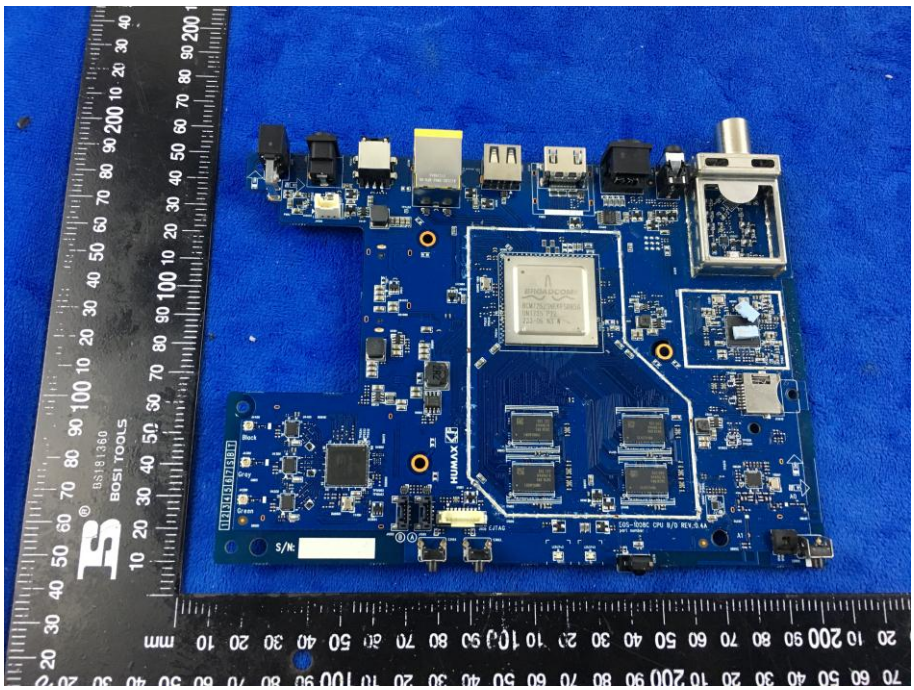
Cover Off - Top View 2



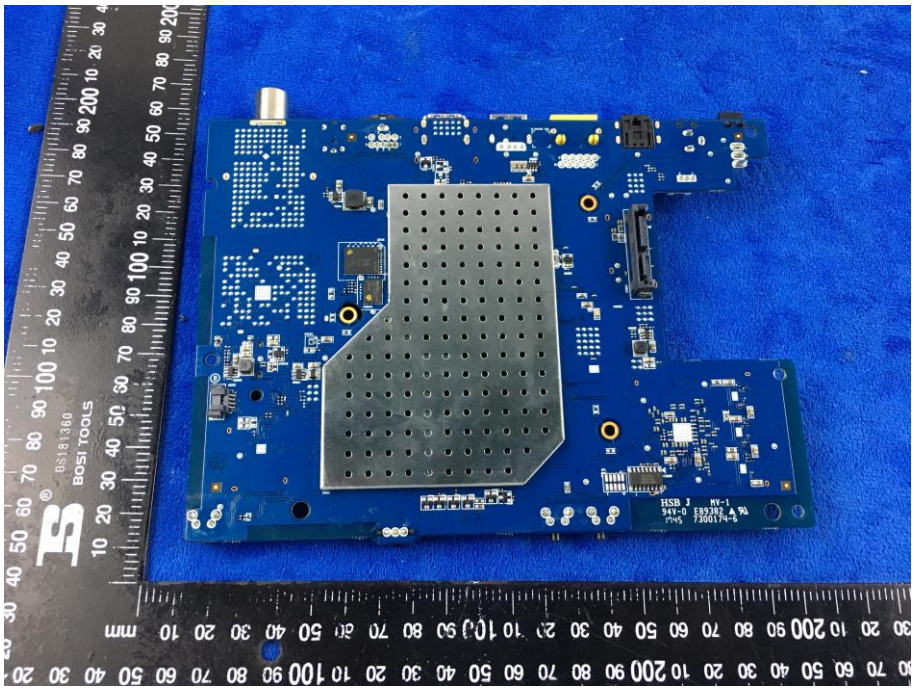
Mainboard with Shielding - Top View



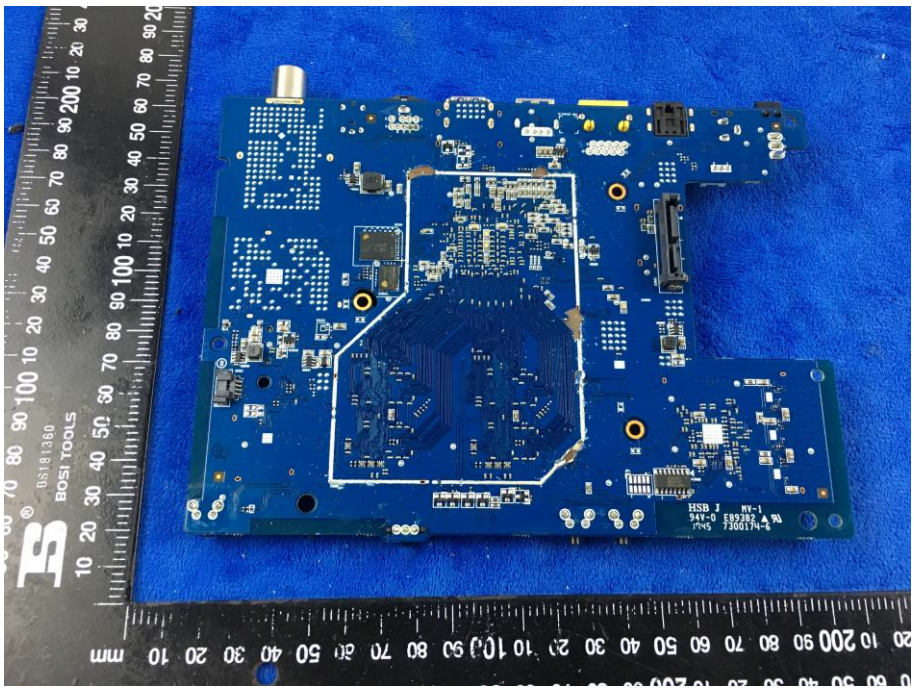
Mainboard without Shielding - Top View



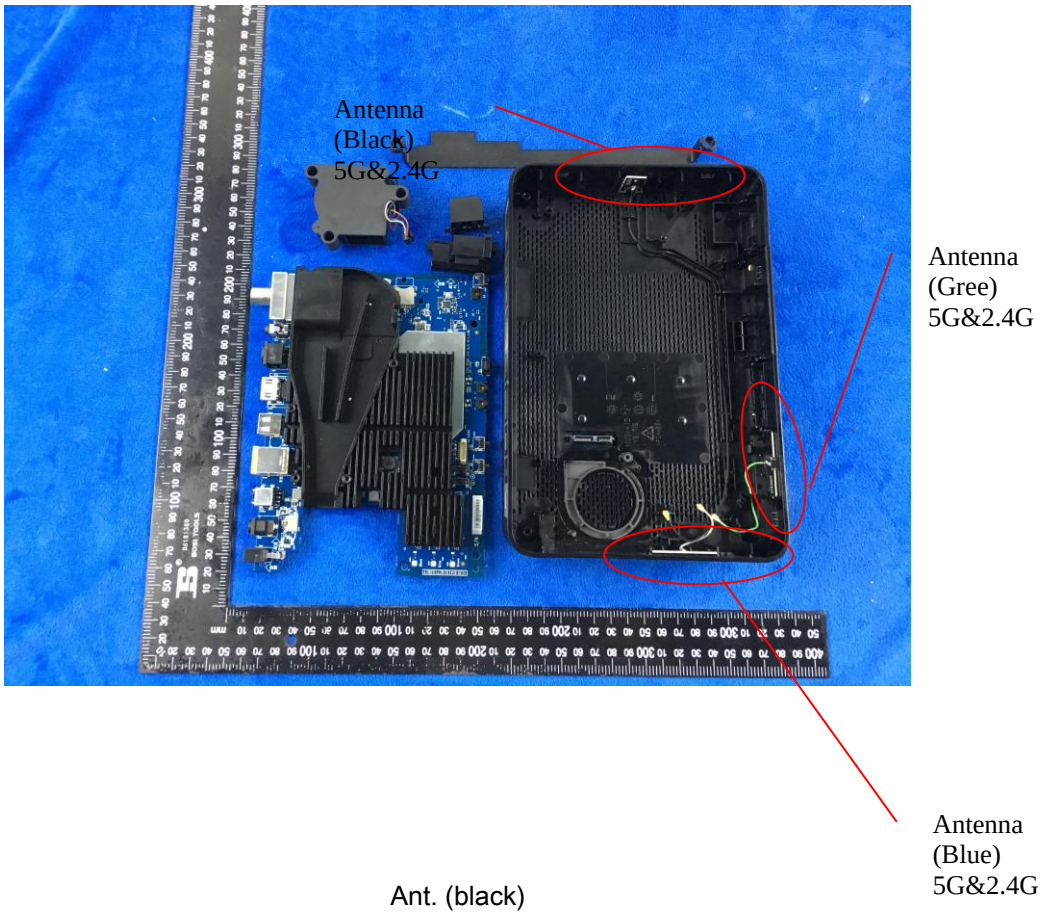
Mainboard with Shielding - Bottom View



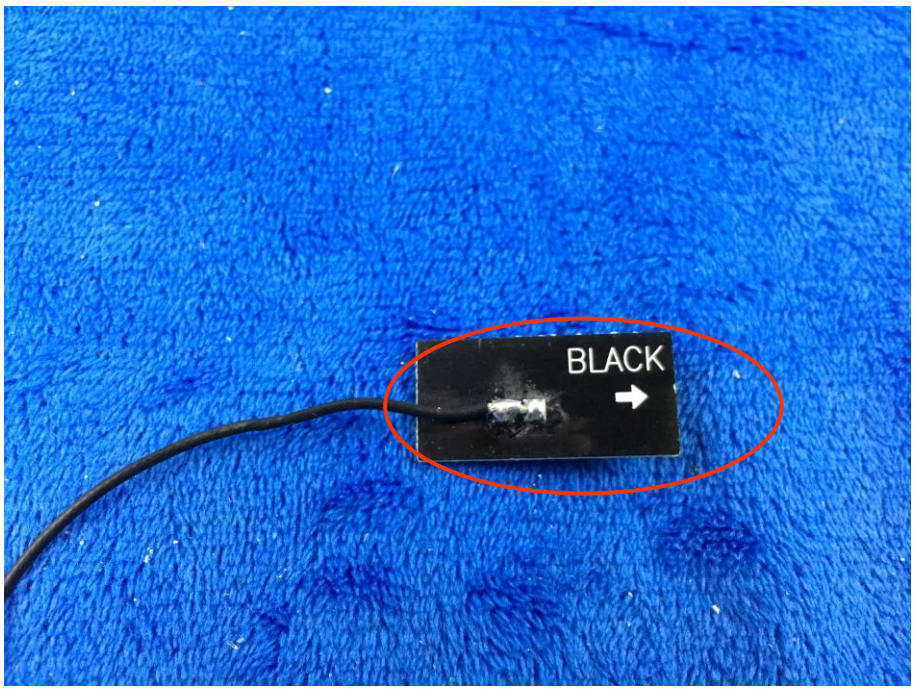
Mainboard without Shielding - Bottom View



2.4G&5G Antenna View



Ant. (black)



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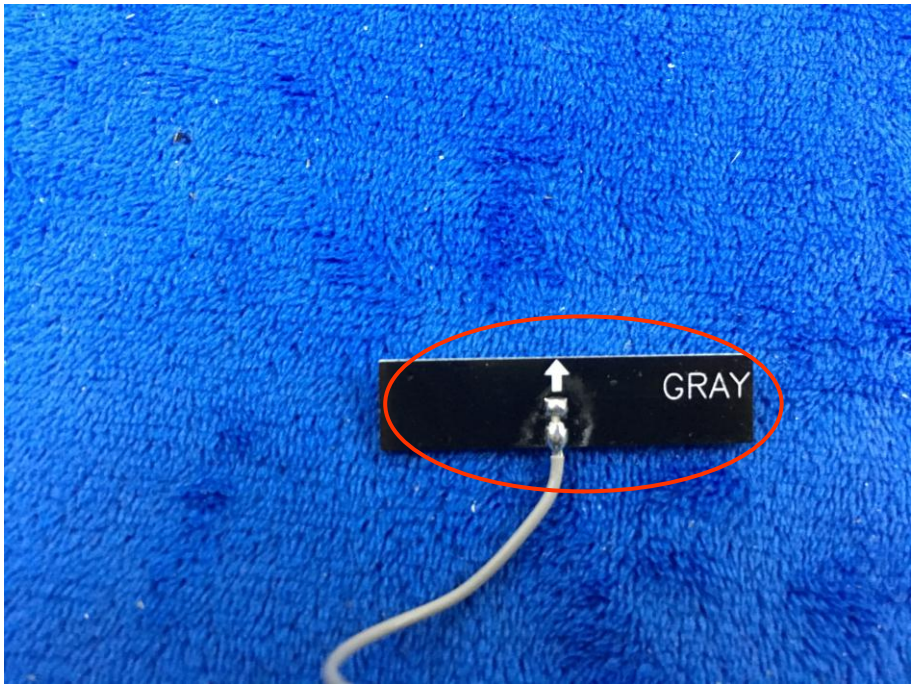

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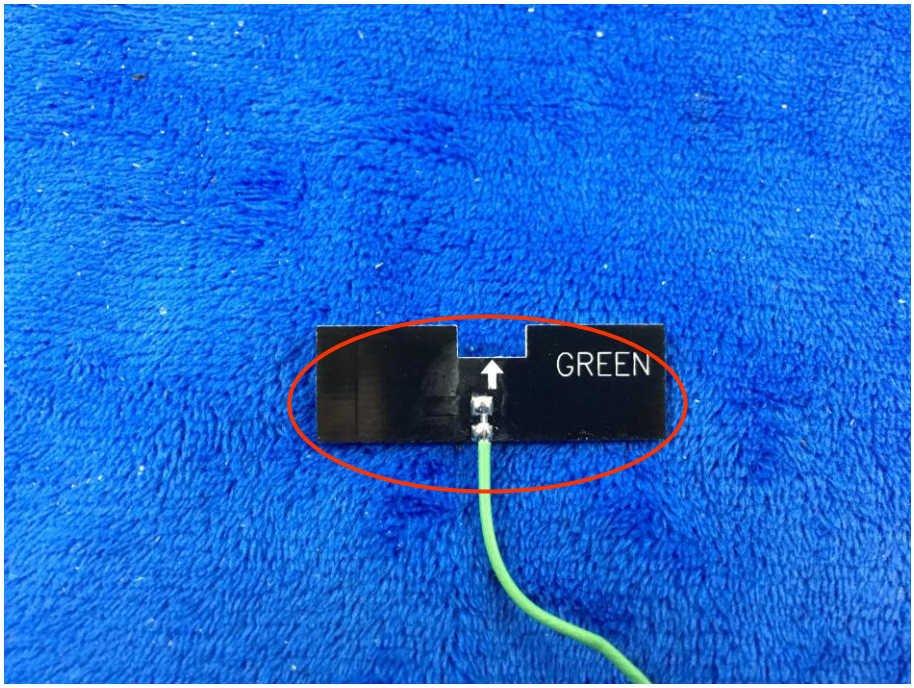
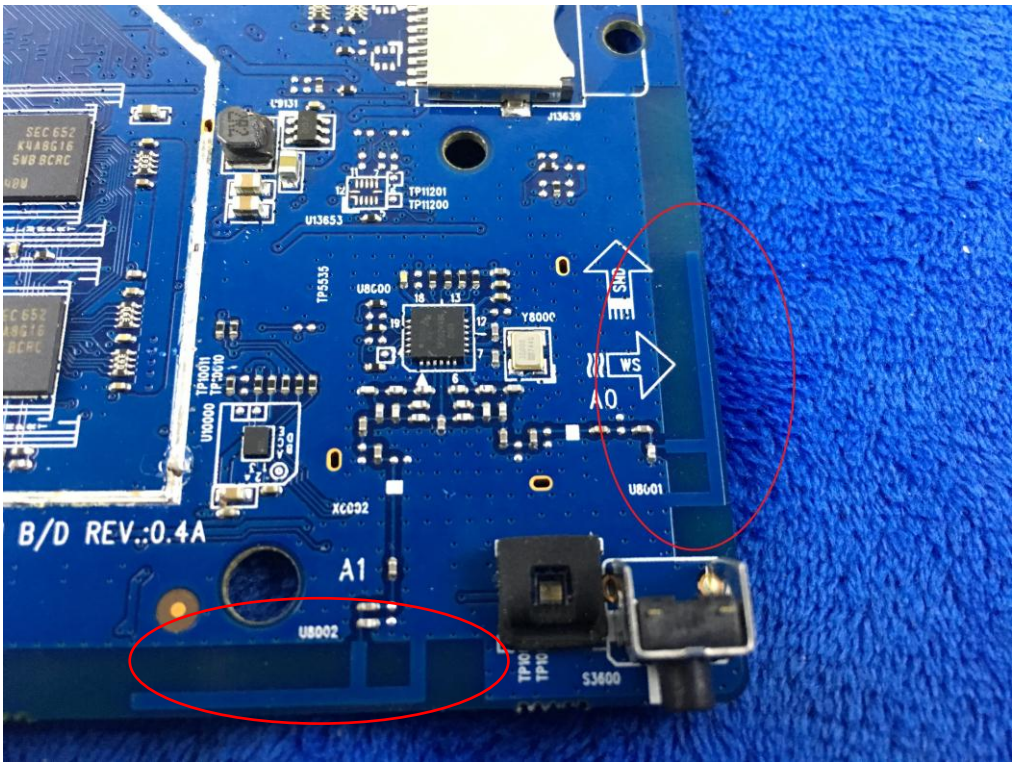


Zigbee (RF4CE)



Annex B.iii. Photograph: Test Setup Photo

Annex C. i. SUPPORTING EQUIPMENT DESCRIPTION

The following is a description of supporting equipment and details of cables used with the EUT.

Supporting Equipment:

Manufacturer	Equipment Description	Model	Serial No
Aerohive	Access point	AP230	N/A
DELL	Laptop	E6530	N/A

Annex C.ii. EUT OPERATING CONDITIONS

The following is the description of how the EUT is exercised during testing.

Test	Description Of Operation
Emissions Testing	The EUT was continuously transmitting to stimulate the worst case.

Annex D. User Manual / Block Diagram / Schematics / Partlist

See attachment

Annex E. DECLARATION OF SIMILARITY

Humax Co., Ltd.

To: SIEMIC ,775 Montague Expressway, Milpitas, CA 95035,USA

Declaration Letter

Dear Sir,

For our business issue and marketing requirement, we would like to list 2 model numbers on the **FCC&CE** certificates and reports, as following:

Model No.: 1008R-HDD-XXX(XXX=A~Z) , 1008C-STB-XXX(XXX=A~Z)

FCC ID: O6ZEOS-1008C

We declare that, all the model PCB, Antenna and Appearance shape, accessories are the same. The difference of these is listed as below:

Main Model No	Serial Model No	Difference
1008R-HDD-XXX(XXX=A~Z)	1008C-STB-XXX(XXX=A~Z)	1008R-HDD-XXX(XXX =A~Z) has internal 3.5 " HDD, 1008C-STB-XXX(XXX =A~Z) without HDD.

Printed name/ title: Inseok Seo / Senior Engineer

Address: HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu Yongin-si, Gyeonggi-do South Korea 17040