TEST REPORT

Product Name	:	Haylou Solar
Brand Mark	:	N/A
Model No.	:	Haylou-LS05, Haylou-LS05-1
FCC ID	:	2AMQ6-LS05
Report Number	:	BLA-EMC-202004-A2001
Date of Sample Receipt	:	2020/4/13
Date of Test	:	2020/4/13 to 2020/4/23
Date of Issue	:	2020/4/23
Test Standard	:	47 CFR Part 15, Subpart C 15.247
Test Result	:	Pass

Prepared for:

Dongguan Liesheng Electronic Co., Ltd.
13/F, Project Phrase 2 of GaoshengTechTower, No.5, Longxi Road, Nancheng, Dongguan, Guangdong, China

Prepared by:

BlueAsia of Technical Services(Shenzhen) Co.,Ltd.
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No. 448 Bulong Road, Bantian Street, Longgang District, Shenzhen,China
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Compiled by: Jozu.

Review by: Sweet.Liang

Approved by:

Date: 2020/4/23

REPORT REVISE RECORD

Version No.	Date	Description
00	2020/4/23	Original

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1 TEST SUMMARY

Test item	Test Requirement	Test Method	Class/Severity	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.4:2014	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass

2 GENERAL INFORMATION

Applicant	Dongguan Liesheng Electronic Co., Ltd.
Address	13/F, Project Phrase 2 of GaoshengTechTower,No.5, Longxi Road, Nancheng, Dongguan, Guangdong, China
Manufacturer	Dongguan Liesheng Electronic Co., Ltd.
Address	13/F, Project Phrase 2 of GaoshengTechTower,No.5, Longxi Road, Nancheng, Dongguan, Guangdong, China
Product Name	Haylou Solar
Test Model No.	Haylou-LS05

3 GENERAL DESCRIPTION OF E.U.T.

Hardware Version	V1.0
Software Version	V1.0

Operation Frequency:	2402MHz-2480MHz
Modulation Type:	GFSK
Channel Spacing:	2MHz
Number of Channels:	40
Antenna Type:	Internal Antenna
Antenna Gain:	0.58dBi

4 TEST ENVIRONMENT

Environment	Temperature	Voltage
Normal	25°C	DC3.7V

5 TEST MODE

TEST MODE	TEST MODE DESCRIPTION
Transmitting mode	Keep the EUT in continuously transmitting mode with modulation.
Remark: *Full battery is used during all test except ac conducted emission*	

6 MEASUREMENT UNCERTAINTY

Parameter	Expanded Uncertainty (Confidence of 95%)
Radiated Emission	±4.34dB
Radiated Emission	±4.24dB
Radiated Emission	±4.68dB
AC Power Line Conducted Emission	±3.45dB

Parameter	Expanded Uncertainty (Confidence of 95%)
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3.0 dB
Unwanted Emissions, conducted	±3.0 dB
Temperature	±3 °C
Supply voltages	±3 %
Time	±5 %
Radiated Emission (30MHz ~ 1000MHz)	±4.35 dB
Radiated Emission (1GHz ~ 18GHz)	±4.44 dB

7 DESCRIPTION OF SUPPORT UNIT

Device Type	Manufacturer	Model Name	Serial No.	Remark
PC	HASEE	K610D	N/A	N/A
AC Adapter	UGREEN	CD112	N/A	N/A

8 LABORATORY LOCATION

All tests were performed at:
BlueAsia of Technical Services(Shenzhen) Co., Ltd.
IOT Test Centre of BlueAsia
No. 448 Bulong Road, Bantian Street, Longgang District, Shenzhen,China
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673
No tests were sub-contracted.

9 TEST INSTRUMENTS LIST

Test Equipment Of Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Shield room	SKET	833	N/A	6/10/2018	6/9/2021
Receiver	R&S	ESPI3	101082	5/7/2019	5/7/2020
LISN	R&S	ENV216	3560.6550.15	7/4/2019	7/3/2020
LISN	AT	AT166-2	AKK1806000003	12/18/2019	12/17/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A

Test Equipment Of Conducted Band Edges Measurement					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Radiated Spurious Emissions					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Chamber	SKET	966	N/A	5/8/2018	5/7/2021
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Receiver	R&S	ESR7	101199	5/7/2019	5/6/2020
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	7/14/2018	7/13/2020
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	7/14/2018	7/13/2020

Amplifier	SKET	LNPA-0118-45	N/A	7/4/2019	7/3/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	2/14/2019	2/13/2020
Controller	SKET	N/A	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-02	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-03	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-01	N/A	N/A	N/A

Test Equipment Of Radiated Emissions which fall in the restricted bands					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Chamber	SKET	966	N/A	5/8/2018	5/7/2021
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Receiver	R&S	ESR7	101199	5/7/2019	5/6/2020
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	7/14/2018	7/13/2020
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	7/14/2018	7/13/2020
Amplifier	SKET	LNPA-0118-45	N/A	7/4/2019	7/3/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	2/14/2019	2/13/2020
Controller	SKET	N/A	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-02	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-03	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-01	N/A	N/A	N/A

Test Equipment Of Conducted Spurious Emissions					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020

Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Power Spectrum Density					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Conducted Peak Output Power					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Minimum 6dB Bandwidth					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

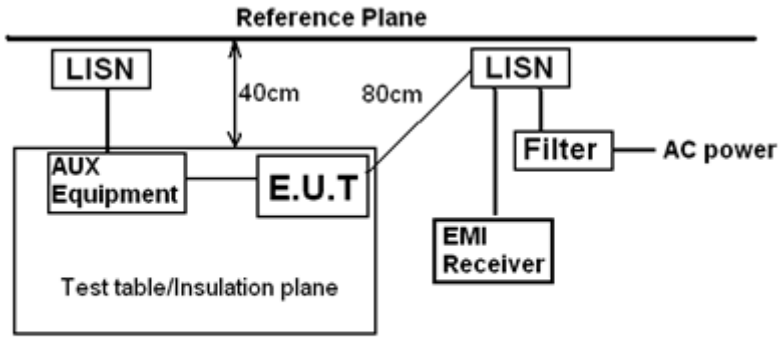
CONDUCTED EMISSIONS AT AC POWER LINE (150KHZ-30MHZ)

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	60%

LIMITS

Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
*Decreases with the logarithm of the frequency.		

BLOCK DIAGRAM OF TEST SETUP



Remark
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

PROCEDURE

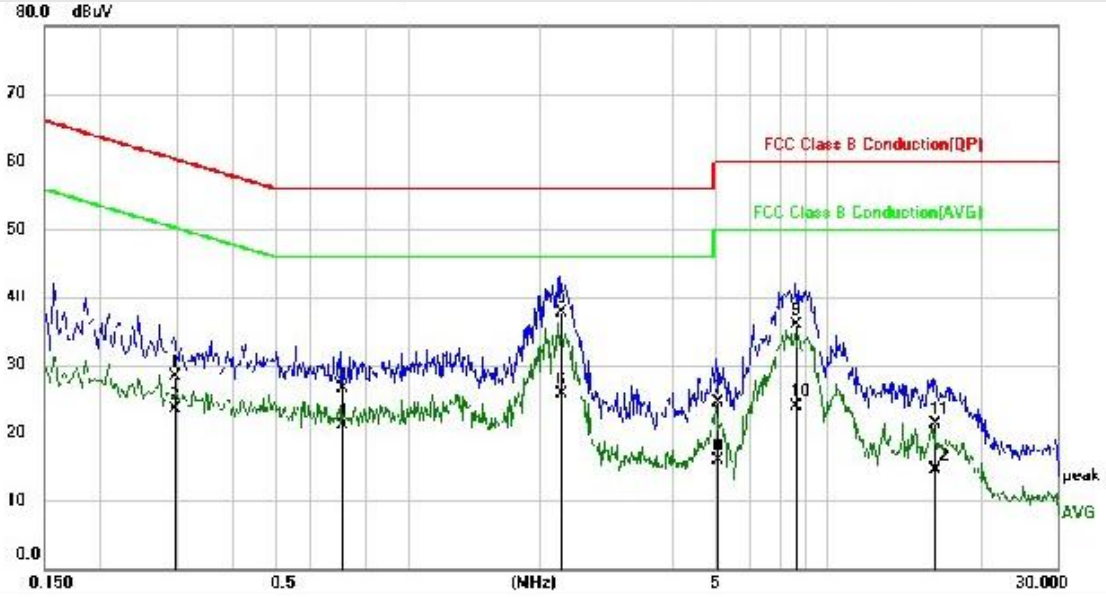
1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50?H + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as

the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.
Remark: LISN=Read Level+ Cable Loss+ LISN Factor

TEST DATA

[TestMode: TX]; [Line: Line]

Power:AC120V/60Hz



Site

Limit: FCC Class B Conduction(QP)

EUT: Haylou Solar

M/N: Haylou-LS05

Mode: BT mode

Note:

Phase: *L1*

Power:

Temperature: 26

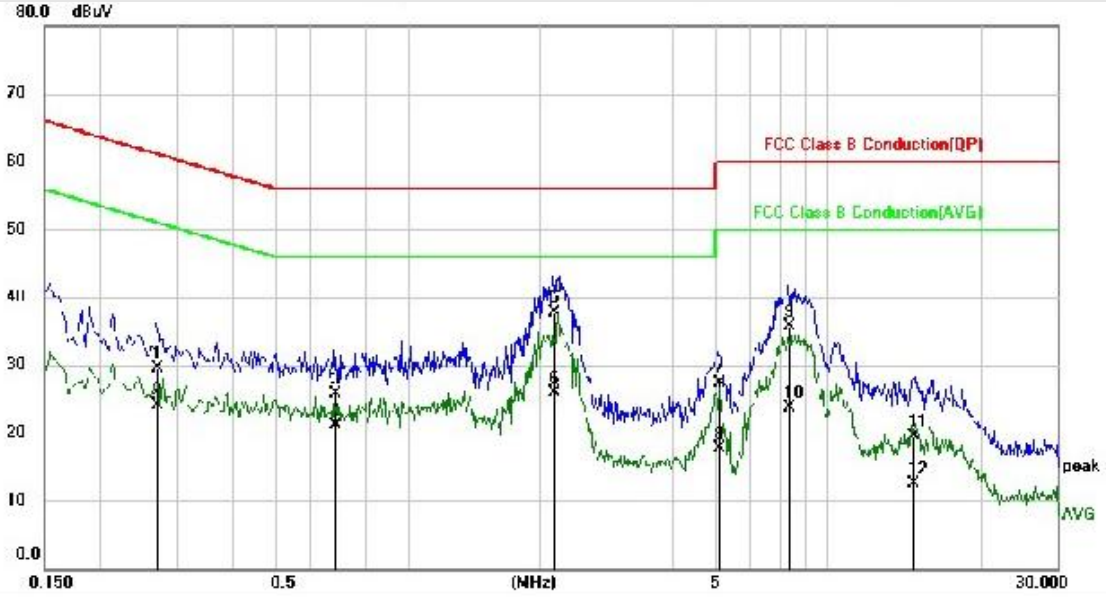
Humidity: 60 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2940	18.51	9.79	28.30	60.41	-32.11	QP	
2		0.2940	13.67	9.79	23.46	50.41	-26.95	AVG	
3		0.7100	16.86	9.68	26.54	56.00	-29.46	QP	
4		0.7100	11.43	9.68	21.11	46.00	-24.89	AVG	
5	*	2.2300	27.95	9.82	37.77	56.00	-18.23	QP	
6		2.2300	15.98	9.82	25.80	46.00	-20.20	AVG	
7		5.0420	14.54	9.88	24.42	60.00	-35.58	QP	
8		5.0420	5.93	9.88	15.81	50.00	-34.19	AVG	
9		7.6180	26.06	9.86	35.92	60.00	-24.08	QP	
10		7.6180	14.06	9.86	23.92	50.00	-26.08	AVG	
11		15.7180	11.41	9.96	21.37	60.00	-38.63	QP	
12		15.7180	4.58	9.96	14.54	50.00	-35.46	AVG	

Test Result: Pass

[TestMode: TX]; [Line: Nutral]

Power:AC120V/60Hz



Site

Limit: FCC Class B Conduction(QP)

EUT: Haylou Solar

M/N: Haylou-LS05

Mode: BT mode

Note:

Phase: N

Power:

Temperature: 26

Humidity: 60 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2700	19.61	9.82	29.43	61.12	-31.69	QP	
2		0.2700	14.20	9.82	24.02	51.12	-27.10	AVG	
3		0.6860	16.03	9.74	25.77	56.00	-30.23	QP	
4		0.6860	11.33	9.74	21.07	46.00	-24.93	AVG	
5	*	2.1540	27.79	9.86	37.65	56.00	-18.35	QP	
6		2.1540	16.00	9.86	25.86	46.00	-20.14	AVG	
7		5.0860	17.43	9.91	27.34	60.00	-32.66	QP	
8		5.0860	7.79	9.91	17.70	50.00	-32.30	AVG	
9		7.3580	25.81	9.85	35.66	60.00	-24.34	QP	
10		7.3580	13.85	9.85	23.70	50.00	-26.30	AVG	
11		14.0660	9.52	10.00	19.52	60.00	-40.48	QP	
12		14.0660	2.46	10.00	12.46	50.00	-37.54	AVG	

Test Result: Pass

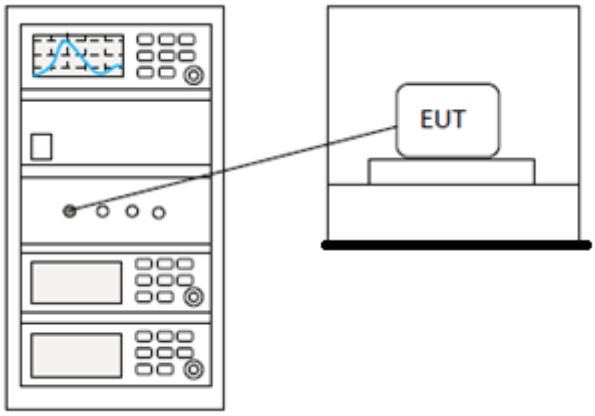
CONDUCTED BAND EDGES MEASUREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	24℃
Humidity	56%

LIMITS

Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

RADIATED SPURIOUS EMISSIONS

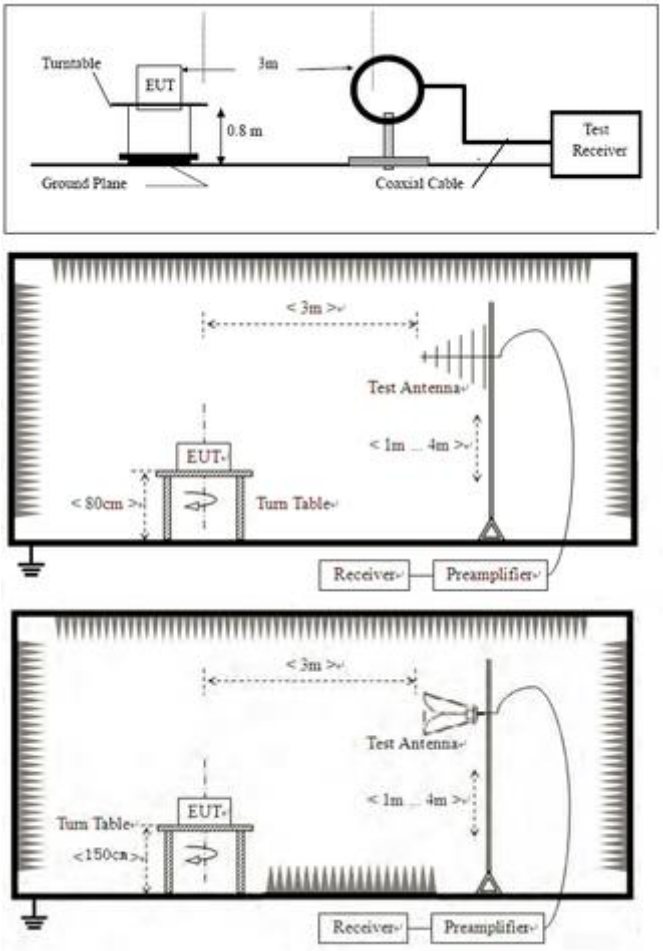
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.4,6.5,6.6
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	24℃
Humidity	55%

LIMITS

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
j. Repeat above procedures until all frequencies measured was complete.

Remark:
1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor ¨C Preamplifier Factor
3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

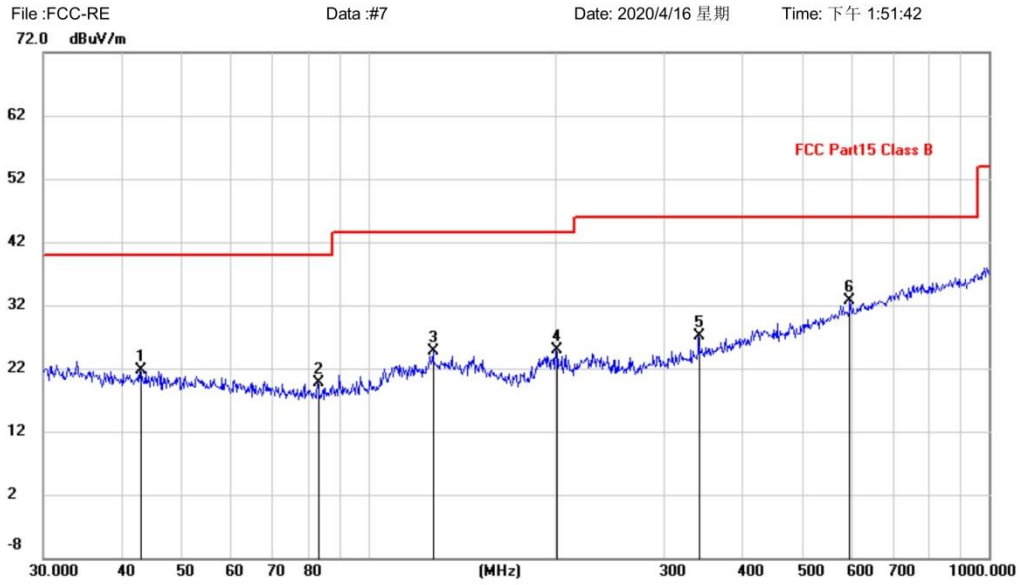
TEST DATA

[TestMode: TX]						
Test channel:lowest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804.00	43.4	2.38	45.78	74	-28.22	Vertical
7206.00	45.69	2.17	47.86	74	-26.14	Vertical
9608.00	46.03	2.06	48.09	74	-25.91	Vertical
12010.00	*			74		Vertical
14412.00	*			74		Vertical
4804.00	44.46	2.38	46.84	74	-27.16	Horizontal
7206.00	46.31	2.17	48.48	74	-25.52	Horizontal
9608.00	45.07	2.06	47.13	74	-26.87	Horizontal
12010.00	*			74		Horizontal
14412.00	*			74		Horizontal
Test channel:Middle						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882.00	42.23	0.17	42.4	74	-31.6	Vertical
7323.00	45.58	1.43	47.01	74	-26.99	Vertical
9764.00	48.02	1.26	49.28	74	-24.72	Vertical
12205.00	*			74		Vertical
14646.00	*			74		Vertical
4882.00	45.00	0.17	45.17	74	-28.83	Horizontal
7323.00	47.74	1.43	49.17	74	-24.83	Horizontal
9764.00	46.69	1.26	47.95	74	-26.05	Horizontal
12205.00	*			74		Horizontal
14646.00	*			74		Horizontal
Test channel:Highest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960.00	42.17	1.04	43.21	74	-30.79	Vertical

7440.00	46.62	2.59	49.21	74	-24.79	Vertical
9920.00	45.48	2.74	48.22	74	-25.78	Vertical
12400.00	*			74		Vertical
14880.00	*			74		Vertical
4960.00	44.58	1.04	45.62	74	-28.38	Horizontal
7440.00	46.36	2.59	48.95	74	-25.05	Horizontal
9920.00	47.18	2.74	49.92	74	-24.08	Horizontal
12400.00	*			74		Horizontal
14880.00	*			74		Horizontal
Test Result: Pass						

[TestMode: TX]; [Polarity: Horizontal]

Radiated Emission Measurement



Site
Limit: FCC Part15 Class B
EUT: Haylou Solar
M/N: Haylou-LS05
Mode: BT mode
Note:

Polarization: ***Horizontal***
Power: DC3.7V
Distance: 3m

Temperature:
Humidity: %

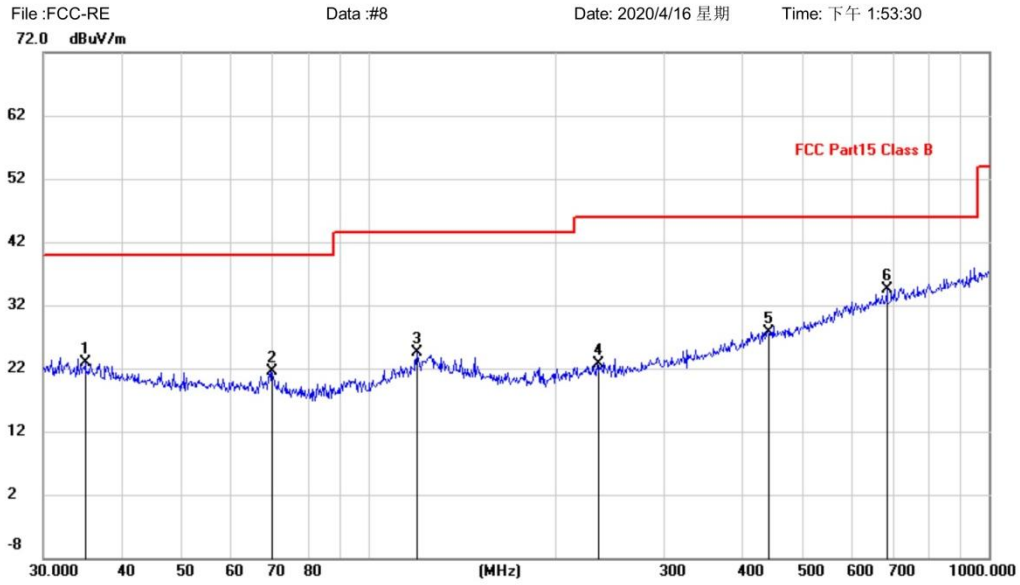
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		42.8998	-2.65	24.35	21.70	40.00	-18.30	QP			
2		82.9385	0.43	19.23	19.66	40.00	-20.34	QP			
3		127.2176	1.72	22.91	24.63	43.50	-18.87	QP			
4		200.6881	4.87	20.06	24.93	43.50	-18.57	QP			
5		340.7817	1.89	25.12	27.01	46.00	-18.99	QP			
6	*	597.2234	1.47	31.15	32.62	46.00	-13.38	QP			

*:Maximum data x:Over limit !:over margin 〈Reference Only

Test Result: Pass

[TestMode: TX]; [Polarity: Vertical]

Radiated Emission Measurement



Site
Limit: FCC Part15 Class B
EUT: Haylou Solar
M/N: Haylou-LS05
Mode: BT mode
Note:

Polarization: ***Vertical***
Power: DC3.7V
Distance: 3m

Temperature:
Humidity: %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		35.0048	-0.30	23.19	22.89	40.00	-17.11	QP			
2		69.8450	0.23	21.21	21.44	40.00	-18.56	QP			
3		119.8556	1.78	22.68	24.46	43.50	-19.04	QP			
4		234.1684	0.01	22.60	22.61	46.00	-23.39	QP			
5		440.1963	-0.18	27.86	27.68	46.00	-18.32	QP			
6	*	684.7454	1.99	32.46	34.45	46.00	-11.55	QP			

*:Maximum data x:Over limit !:over margin 〈Reference Only

Test Result: Pass

RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

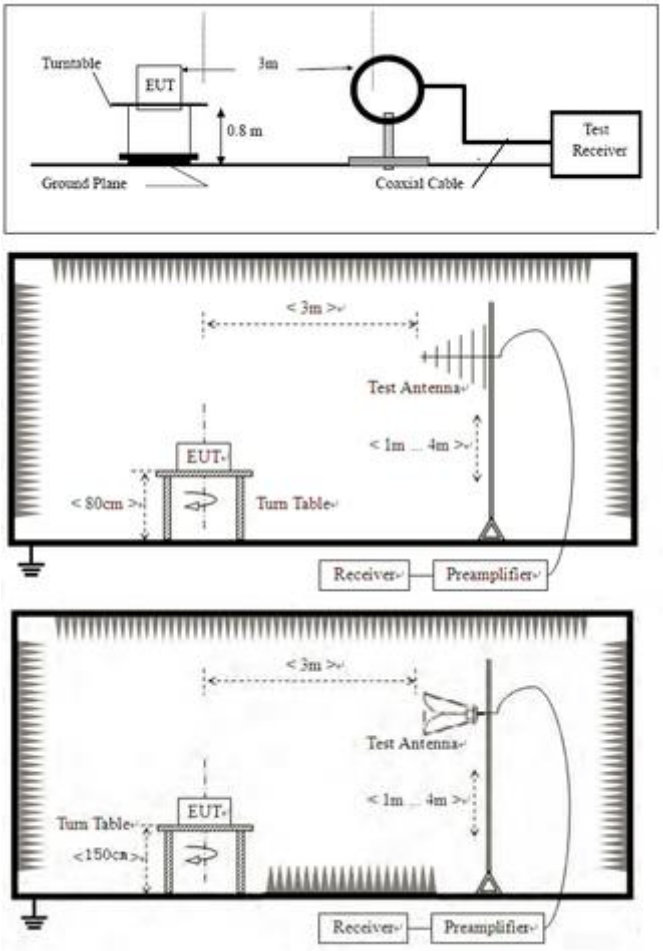
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	24℃
Humidity	55%

LIMITS

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
j. Repeat above procedures until all frequencies measured was complete.
Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

TEST DATA

[TestMode: TX]						
Test channel:lowest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310	44.97	-4.2	40.77	74	-33.23	Horizontal
2390	45.95	-3.88	42.07	74	-31.93	Horizontal
2310	45.12	-4.49	40.63	74	-33.37	Vertical
2390	48.78	-4.21	44.57	74	-29.43	Vertical
Average value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310	31.69	-4.2	27.49	54	-26.51	Horizontal
2390	31.97	-3.88	28.09	54	-25.91	Horizontal
2310	32.19	-4.49	27.7	54	-26.3	Vertical
2390	33.41	-4.21	29.2	54	-24.8	Vertical
Test channel:Highest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.5	50.18	-3.38	46.8	74	-27.2	Horizontal
2500	44.74	-3.3	41.44	74	-32.56	Horizontal
2483.5	46.14	-3.77	42.37	74	-31.63	Vertical
2500	50.37	-3.7	46.67	74	-27.33	Vertical
Average value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.5	33.17	-3.38	29.79	54	-24.21	Horizontal
2500	33.25	-3.3	29.95	54	-24.05	Horizontal
2483.5	32.55	-3.77	28.78	54	-25.22	Vertical
2500	32.65	-3.7	28.95	54	-25.05	Vertical
Test Result: Pass						

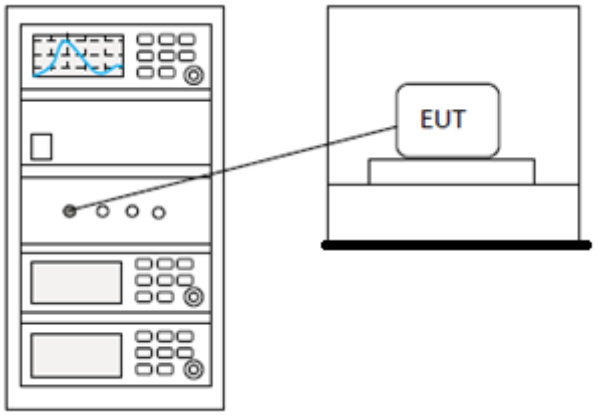
CONDUCTED SPURIOUS EMISSIONS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	57%

LIMITS

Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

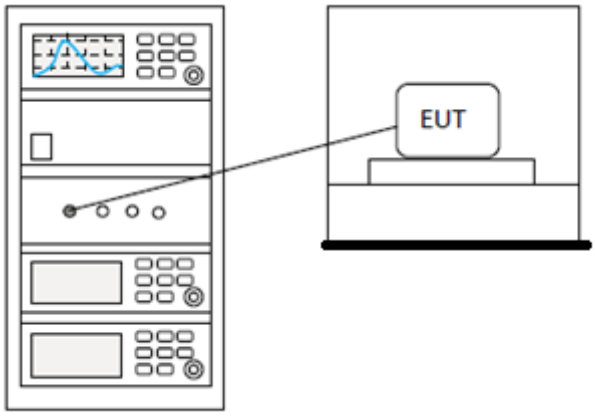
POWER SPECTRUM DENSITY

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 11.10.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	57%

LIMITS

Limit:	≤8dBm in any 3 kHz band during any time interval of continuous transmission

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

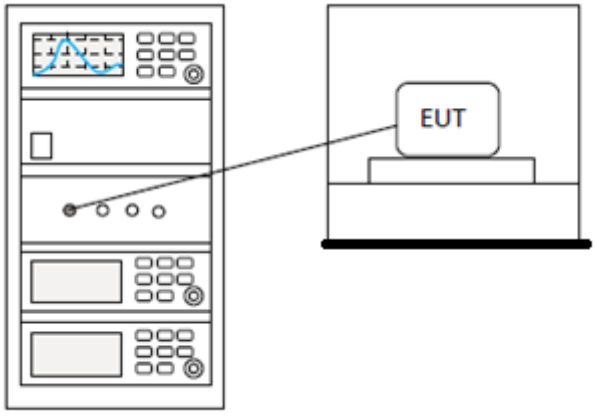
CONDUCTED PEAK OUTPUT POWER

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	57%

LIMITS

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥50 hopping channels
	0.25 for 25≤ hopping channels <50
	1 for digital modulation
2400-2483.5	1 for ≥75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

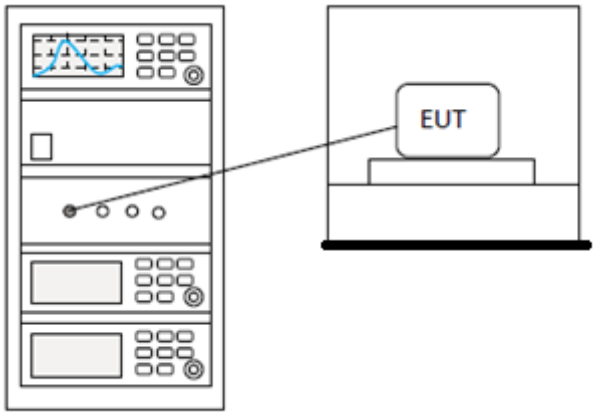
MINIMUM 6DB BANDWIDTH

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.4:2014
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	57%

LIMITS

Limit:	≥500 kHz

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

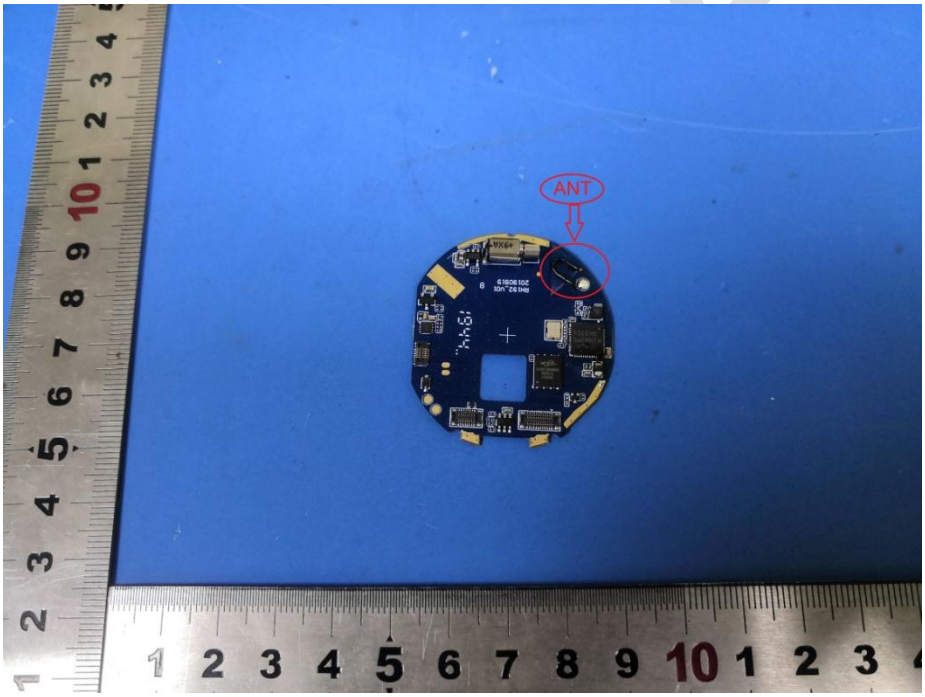
ANTENNA REQUIREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	N/A

CONCLUSION

Standard Requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0.58dBi.



10 APPENDIX

Appendix1

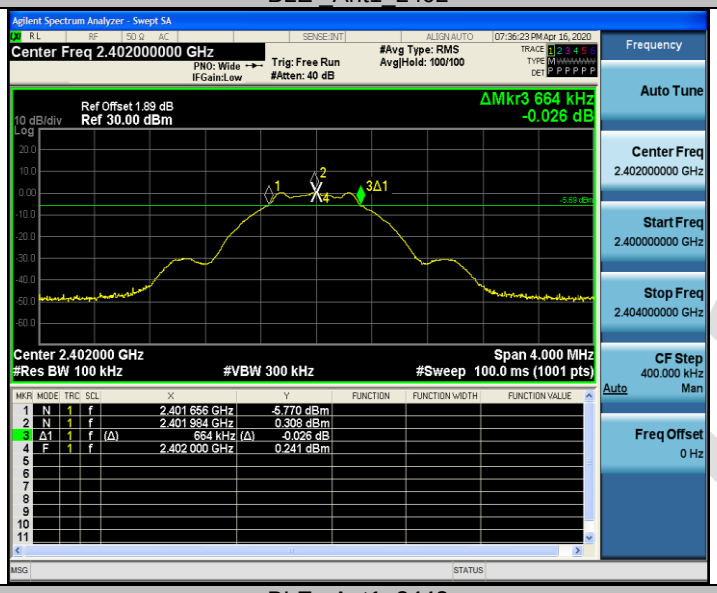
10.1 APPENDIX: DTS BANDWIDTH

Test Result

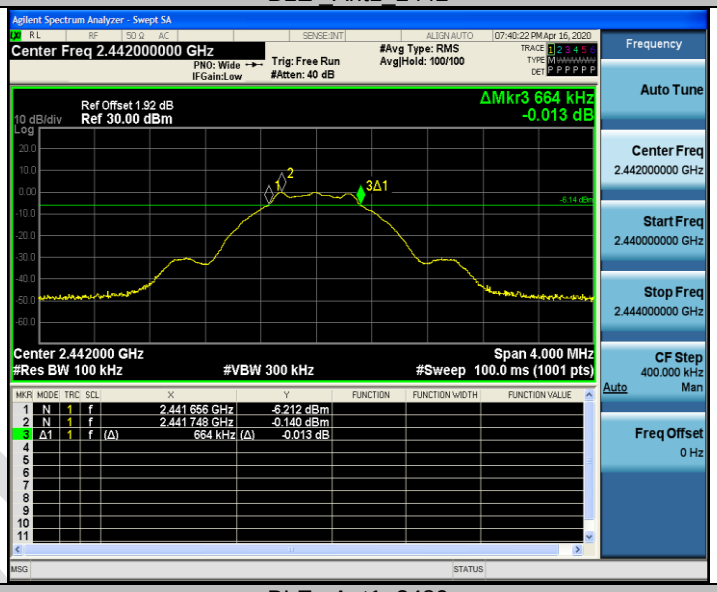
TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE	Ant1	2402	0.664	2401.656	2402.320	>=0.5	PASS
		2442	0.664	2441.656	2442.320	>=0.5	PASS
		2480	0.680	2479.652	2480.332	>=0.5	PASS

Test Graphs

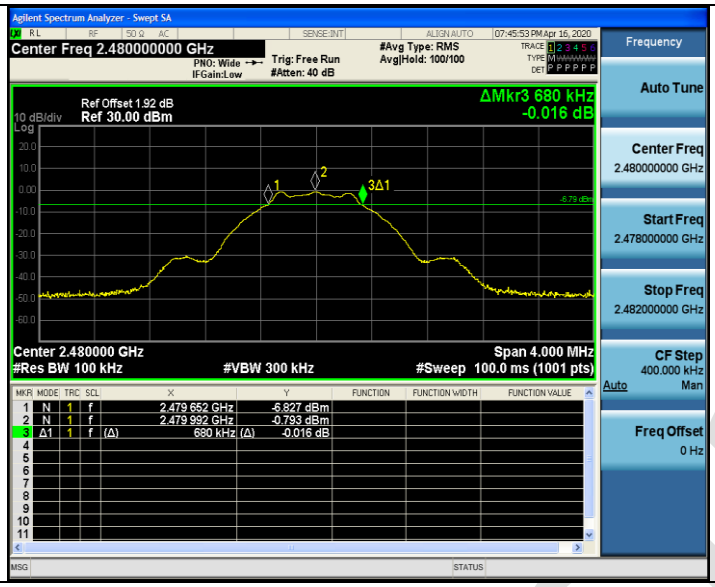
BLE _Ant1_2402



BLE _Ant1_2442



BLE _Ant1_2480


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:45:53 PM Apr 16, 2020
Frequency
Ref Offset 1.92 dB
10 dB/div
Ref 30.00 dBm
ΔMkr3 680 kHz
-0.016 dB
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
#Sweep 100.0 ms (1001 pts)
1 N 1 f 2.479 652 GHz -6.827 dBm
2 N 1 f 2.479 992 GHz -6.793 dBm
3 Δ1 1 f (Δ) 680 kHz (Δ) -0.016 dB
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478000000 GHz
Stop Freq
2.482000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz

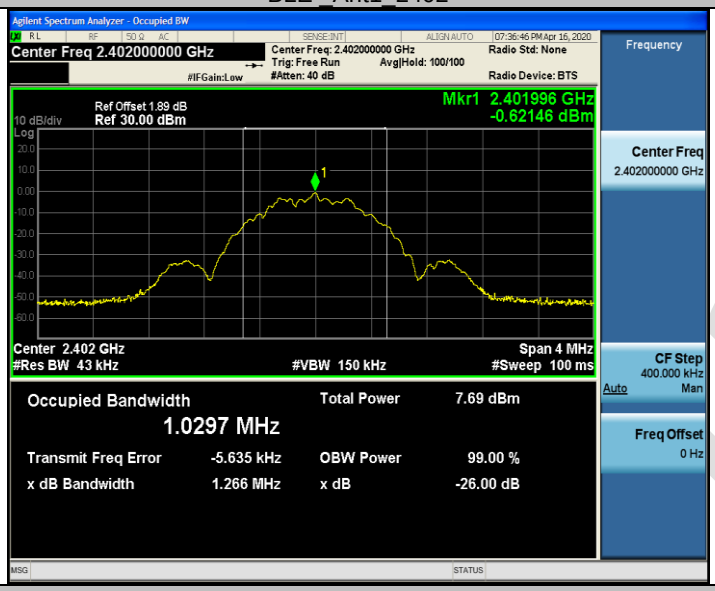
10.2 APPENDIX: OCCUPIED CHANNEL BANDWIDTH

Test Result

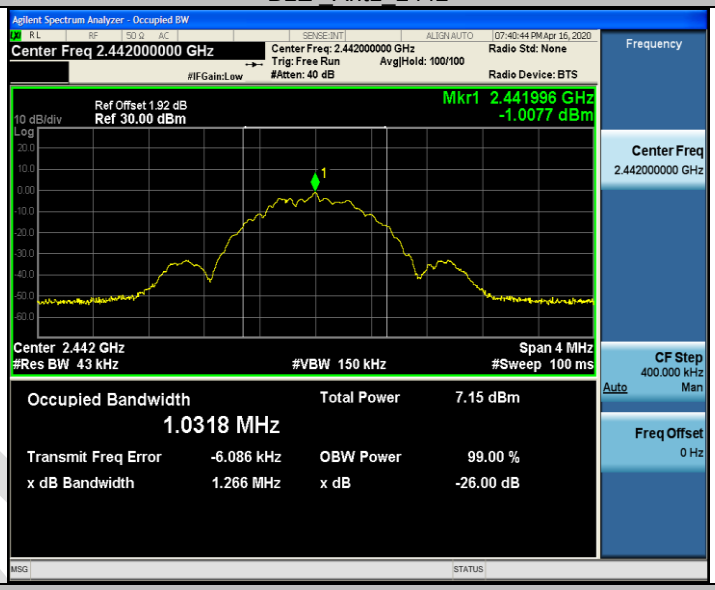
TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE	Ant1	2402	1.0297	2401.480	2402.509	---	PASS
		2442	1.0318	2441.478	2442.510	---	PASS
		2480	1.0374	2479.474	2480.511	---	PASS

Test Graphs

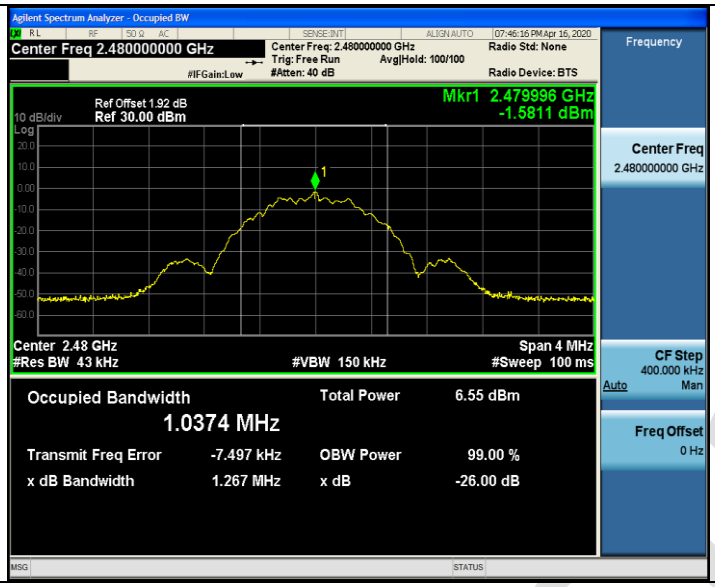
BLE _Ant1_2402



BLE _Ant1_2442



BLE _Ant1_2480


Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#Atten: 40 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
07:46:16 PM Apr 16, 2020
Frequency
Ref Offset 1.92 dB
10 dB/div
Ref 30.00 dBm
Log
Mkr1 2.479996 GHz
-1.5811 dBm
Center 2.48 GHz
#Res BW 43 kHz
#VBW 150 kHz
Span 4 MHz
#Sweep 100 ms
Occupied Bandwidth
1.0374 MHz
Total Power 6.55 dBm
Transmit Freq Error -7.497 kHz
OBW Power 99.00 %
x dB Bandwidth 1.267 MHz
x dB -26.00 dB
Center Freq
2.480000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

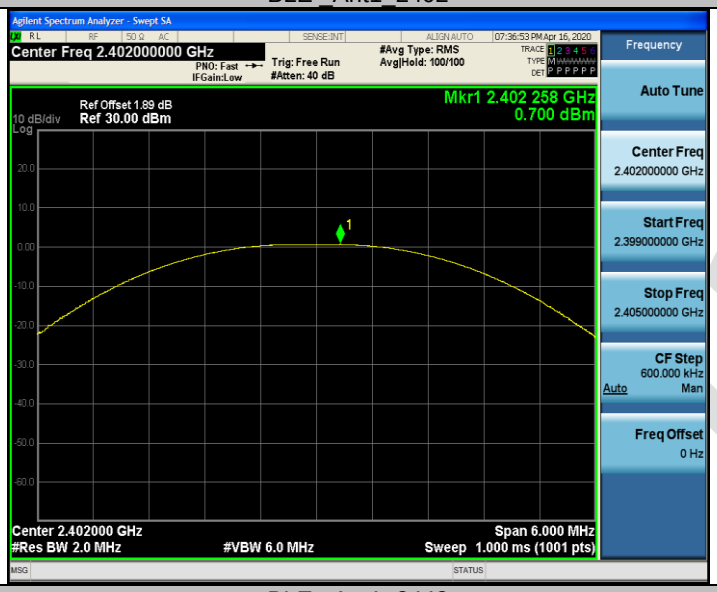
10.3 APPENDIX: MAXIMUM CONDUCTED OUTPUT POWER

Test Result

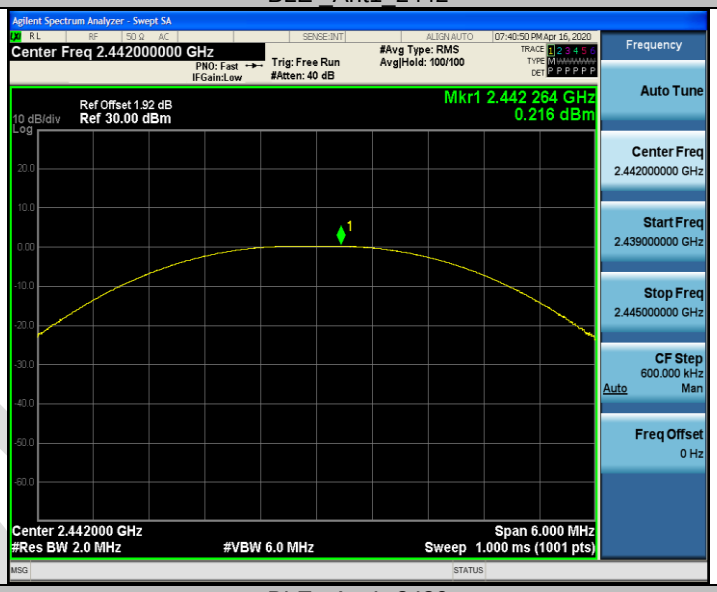
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	2402	0.7	<=30	PASS
		2442	0.22	<=30	PASS
		2480	-0.4	<=30	PASS

Test Graphs

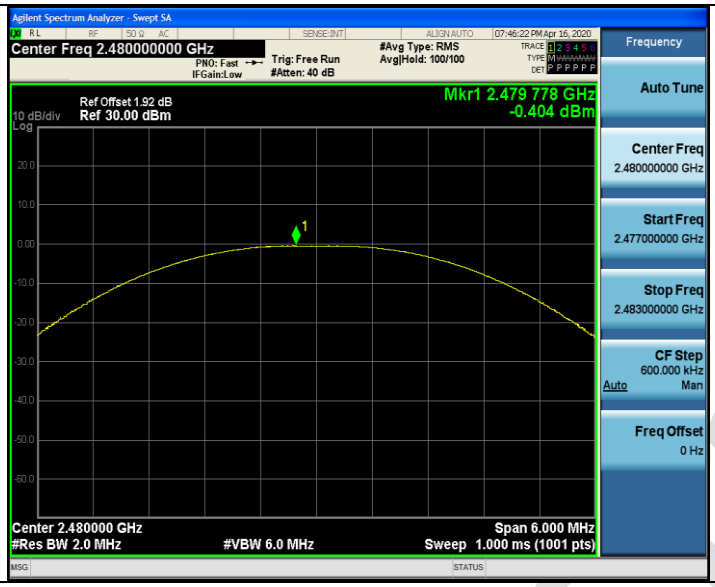
BLE _Ant1_2402



BLE _Ant1_2442



BLE _Ant1_2480


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:46:22 PM Apr 16, 2020
Ref Offset 1.92 dB
10 dB/div
Ref 30.00 dBm
Log
Mkr1 2.479 778 GHz
-0.404 dBm
Center 2.480000 GHz
#Res BW 2.0 MHz
#VBW 6.0 MHz
Span 6.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.477000000 GHz
Stop Freq
2.483000000 GHz
CF Step
600.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

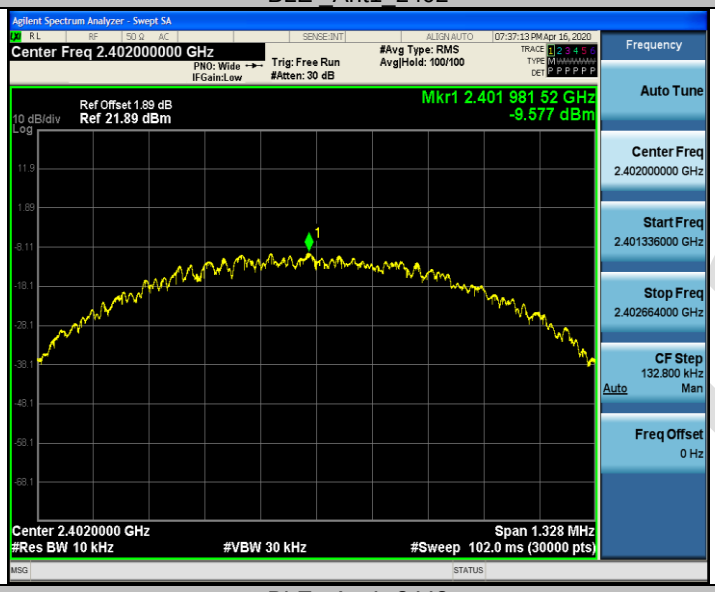
10.4 APPENDIX: MAXIMUM POWER SPECTRAL DENSITY

Test Result

TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
BLE	Ant1	2402	-9.58	<=8	PASS
		2442	-9.77	<=8	PASS
		2480	-9.99	<=8	PASS

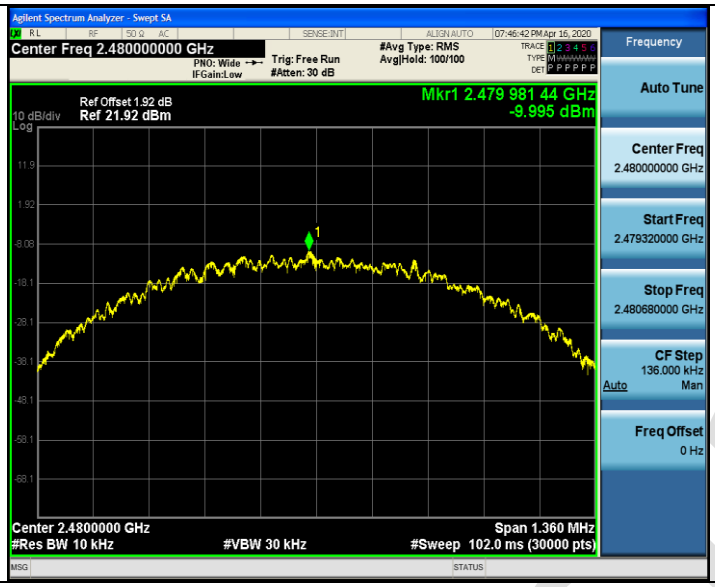
Test Graphs

BLE _Ant1_2402



BLE _Ant1_2442

BLE _Ant1_2480


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:46:42 PM Apr 16, 2020
Frequency
Ref Offset 1.92 dB
10 dB/div
Ref 21.92 dBm
Log
Mkr1 2.479 981 44 GHz
-9.995 dBm
11.9
1.92
-8.08
-18.1
-28.1
-38.1
-48.1
-58.1
-68.1
Center 2.4800000 GHz
#Res BW 10 kHz
#VBW 30 kHz
Span 1.360 MHz
#Sweep 102.0 ms (30000 pts)
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.479320000 GHz
Stop Freq
2.480680000 GHz
CF Step
136.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

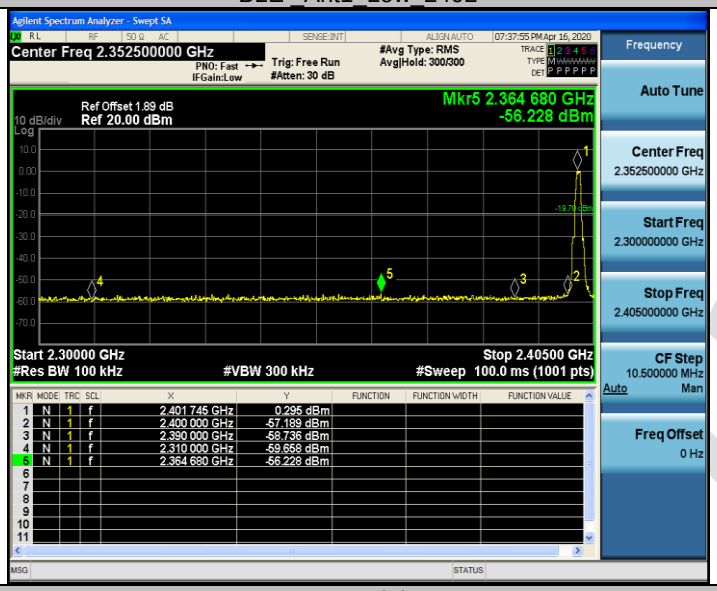
10.5 APPENDIX:BAND EDGE MEASUREMENTS

Test Result

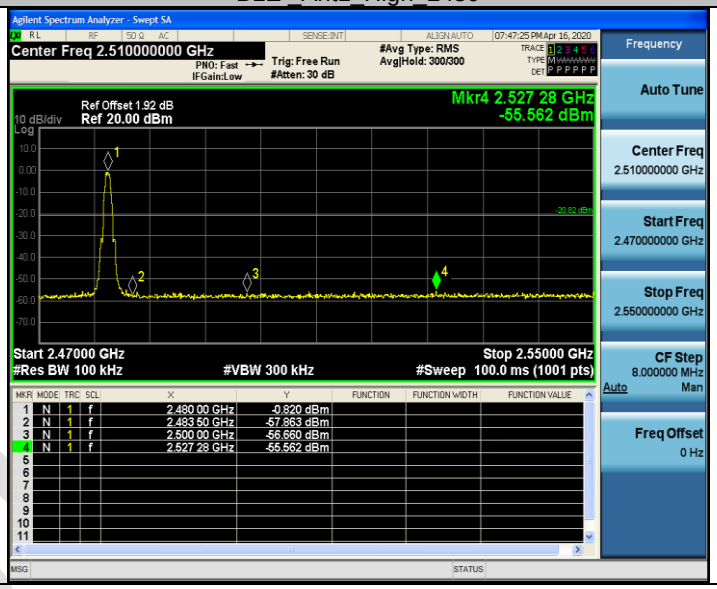
TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	Low	2402	0.30	-56.23	<=-19.7	PASS
		High	2480	-0.82	-55.56	<=-20.82	PASS

Test Graphs

BLE _Ant1_Low_2402



BLE _Ant1_High_2480



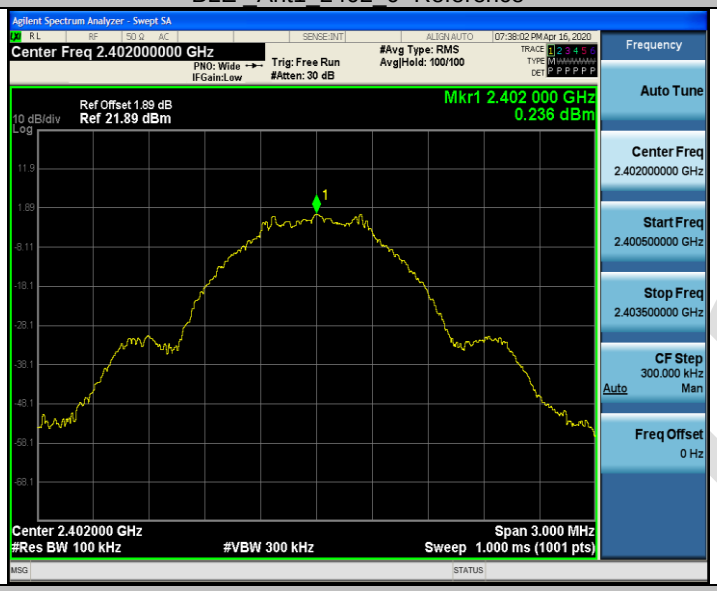
10.6 APPENDIX:CONDUCTED SPURIOUSEMISSION

Test Result

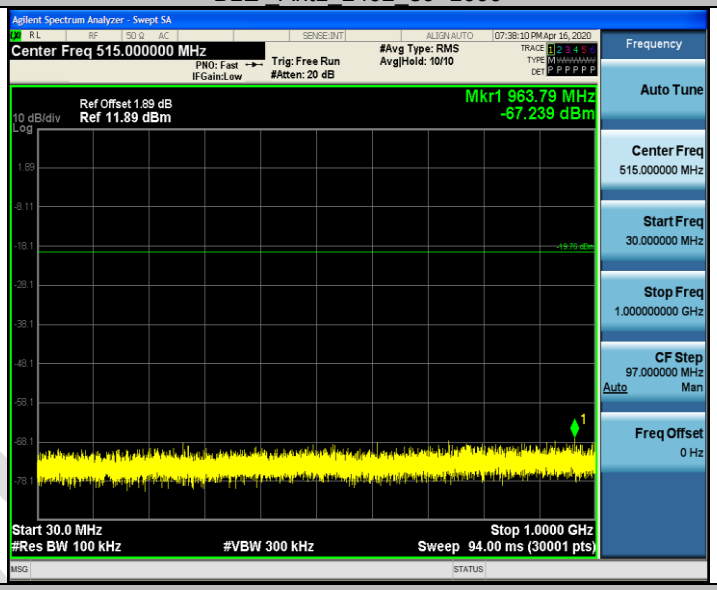
TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	2402	Reference	0.24	0.24	---	PASS
			30~1000	30~1000	-67.239	<=-19.764	PASS
			1000~26500	1000~26500	-54.059	<=-19.764	PASS
		2442	Reference	-0.86	-0.86	---	PASS
			30~1000	30~1000	-45.127	<=-20.863	PASS
			1000~26500	1000~26500	-53.512	<=-20.863	PASS
		2480	Reference	-1.53	-1.53	---	PASS
			30~1000	30~1000	-68.174	<=-21.534	PASS
			1000~26500	1000~26500	-53.689	<=-21.534	PASS

Test Graphs

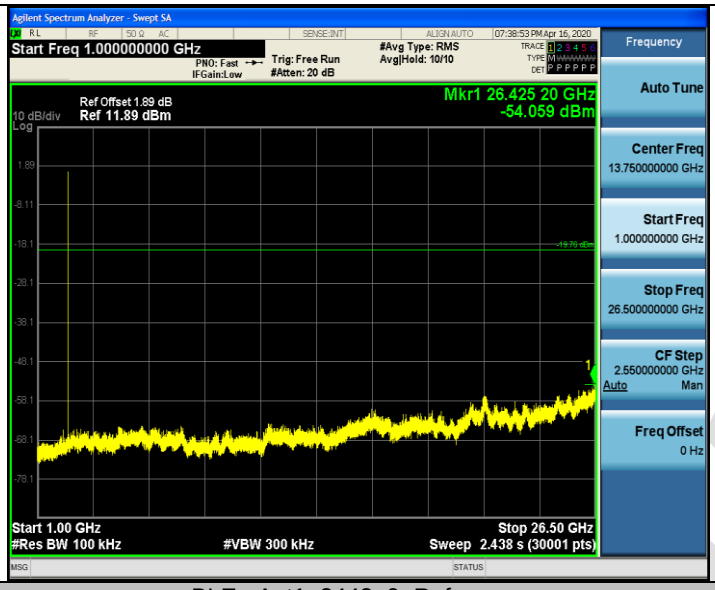
BLE _Ant1_2402_0~Reference



BLE _Ant1_2402_30~1000

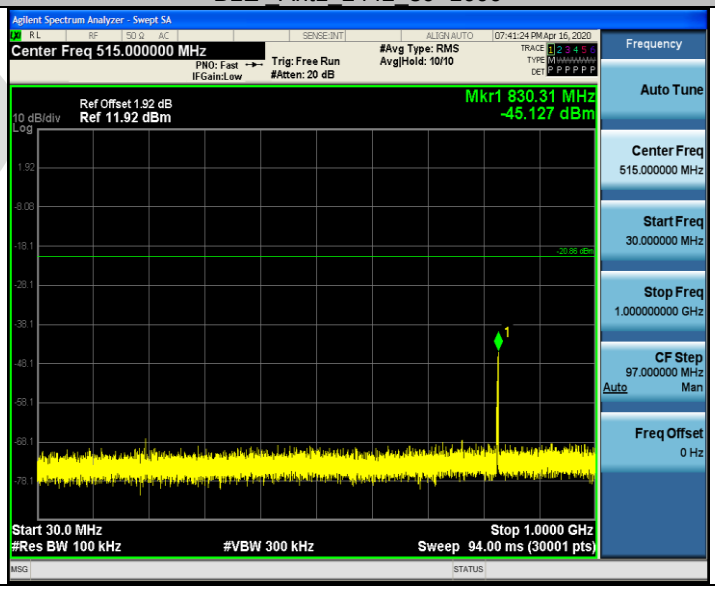


BLE _Ant1_2402_1000~26500



BLE _Ant1_2442_0~Reference

BLE _Ant1_2442_30~1000



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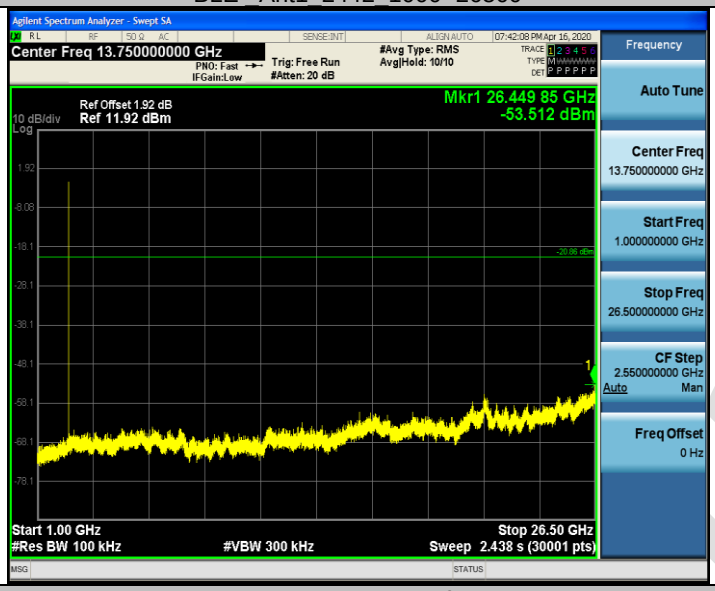
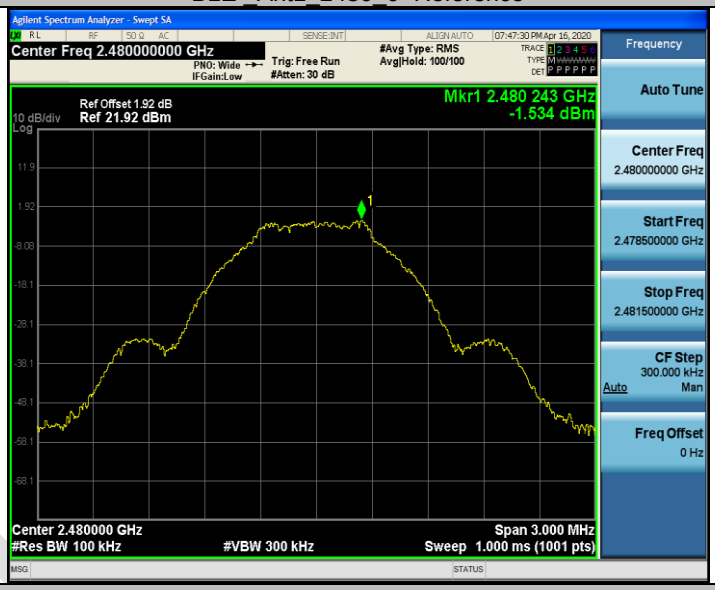
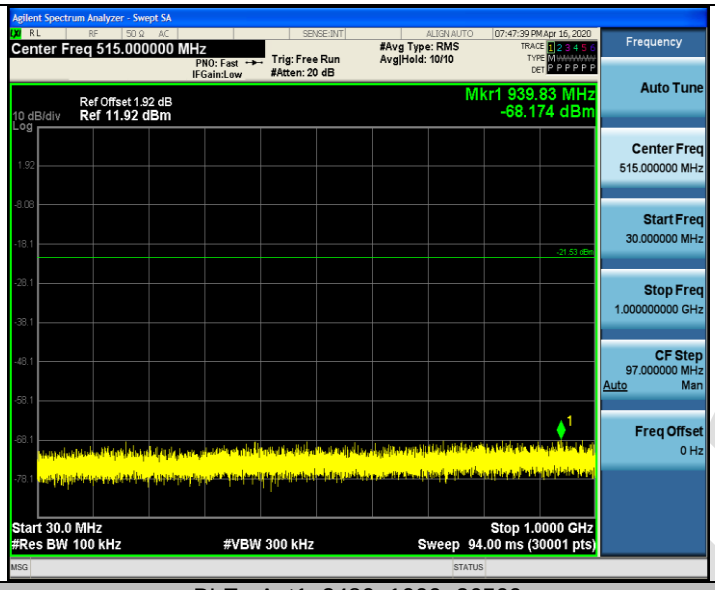
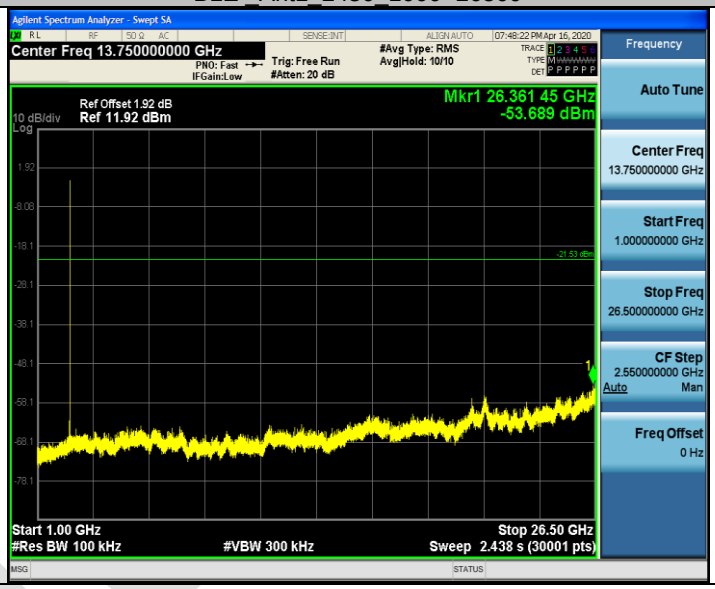

BLE _Ant1_2480_0~Reference

BLE _Ant1_2480_30~1000



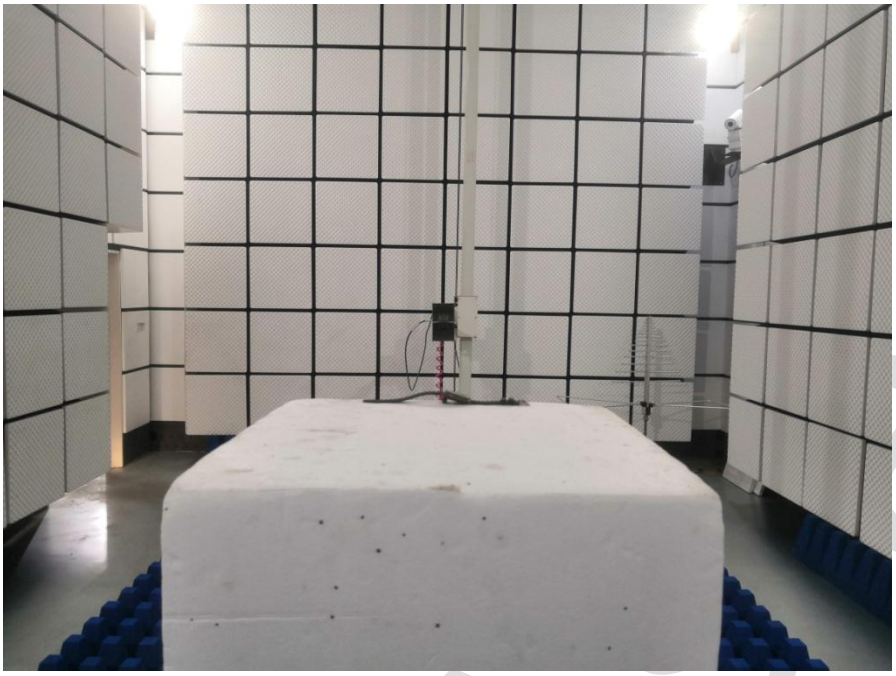
BLE_Ant1_2480_1000~26500



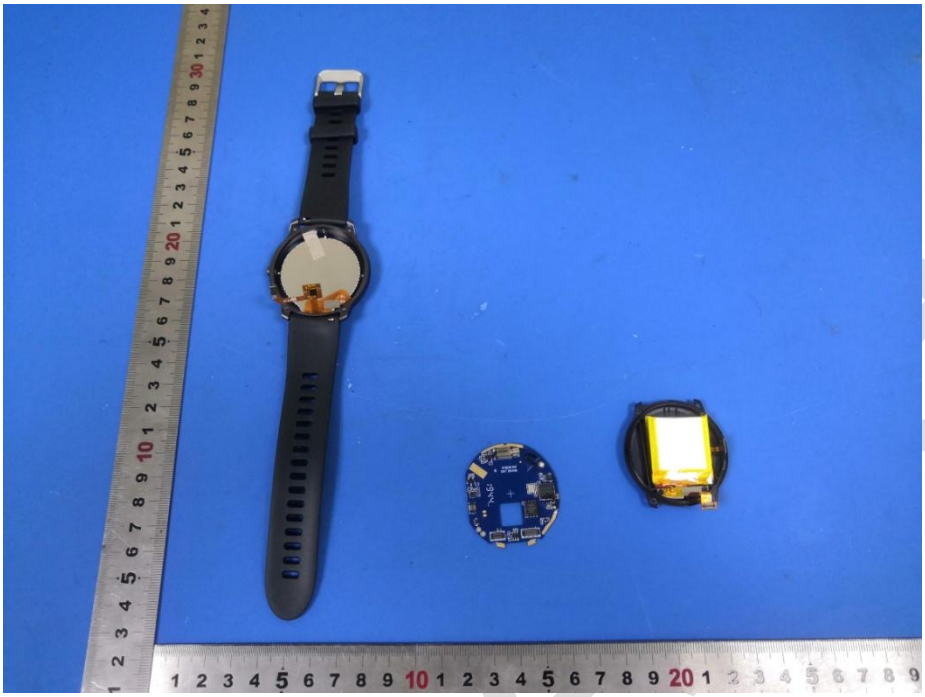
APPENDIX A: PHOTOGRAPHS OF TEST SETUP

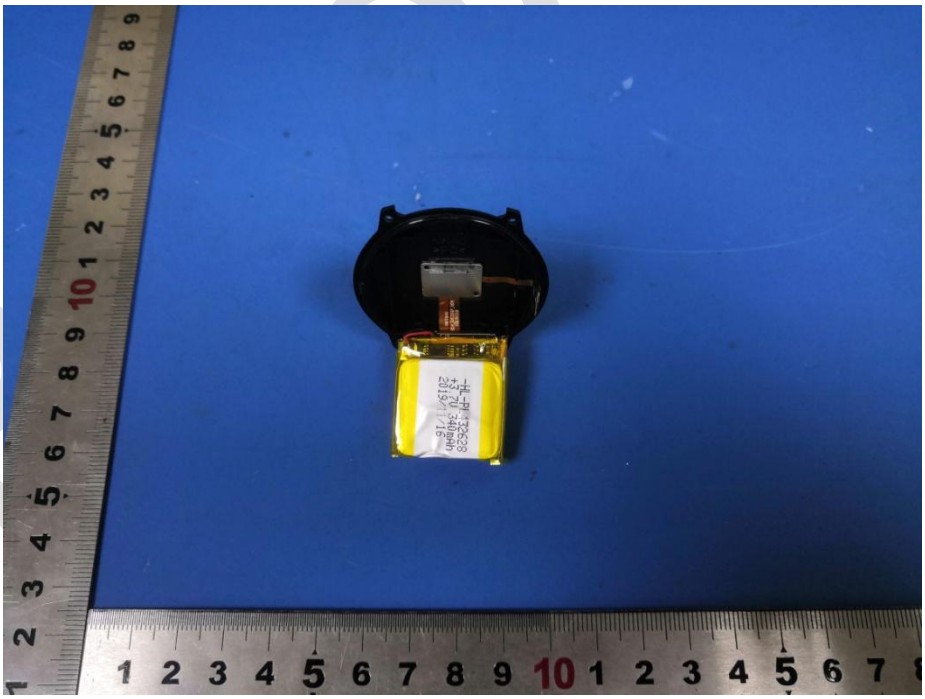
Conducted Emissions at AC Power Line (150kHz-30MHz)

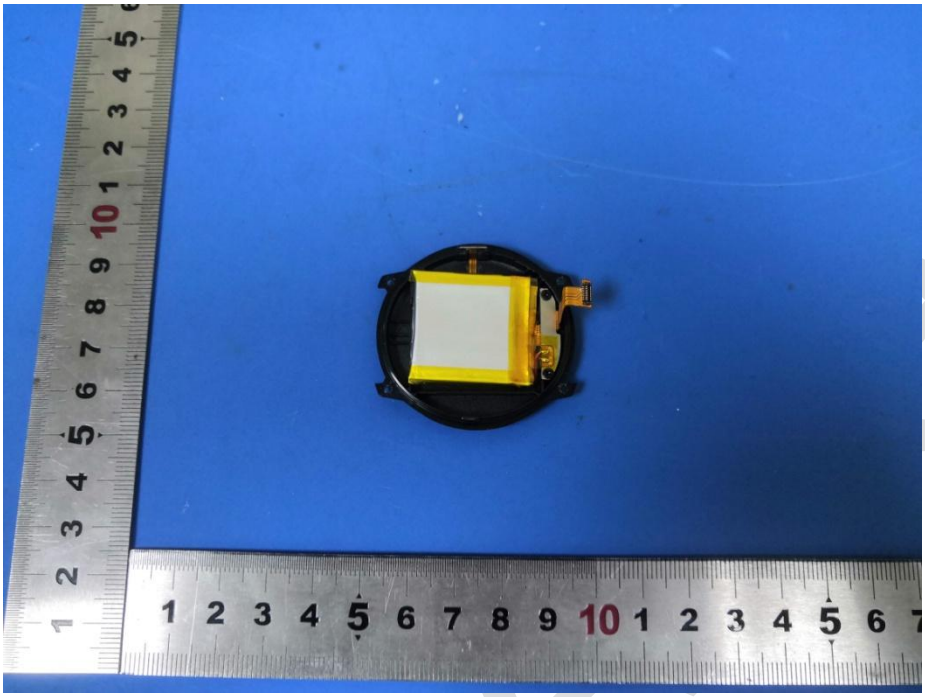
Radiated Spurious Emissions

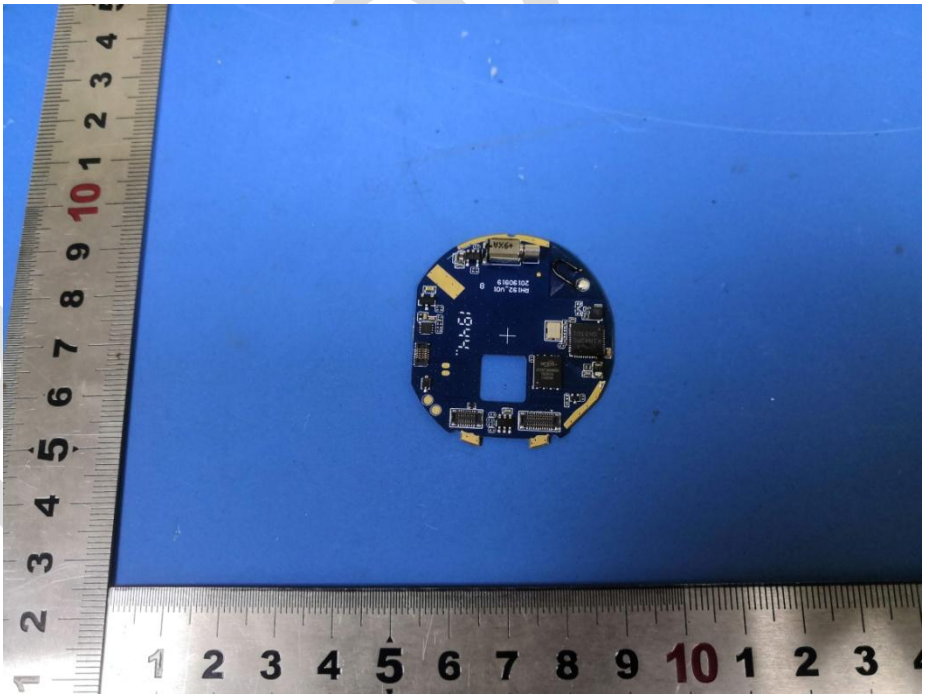


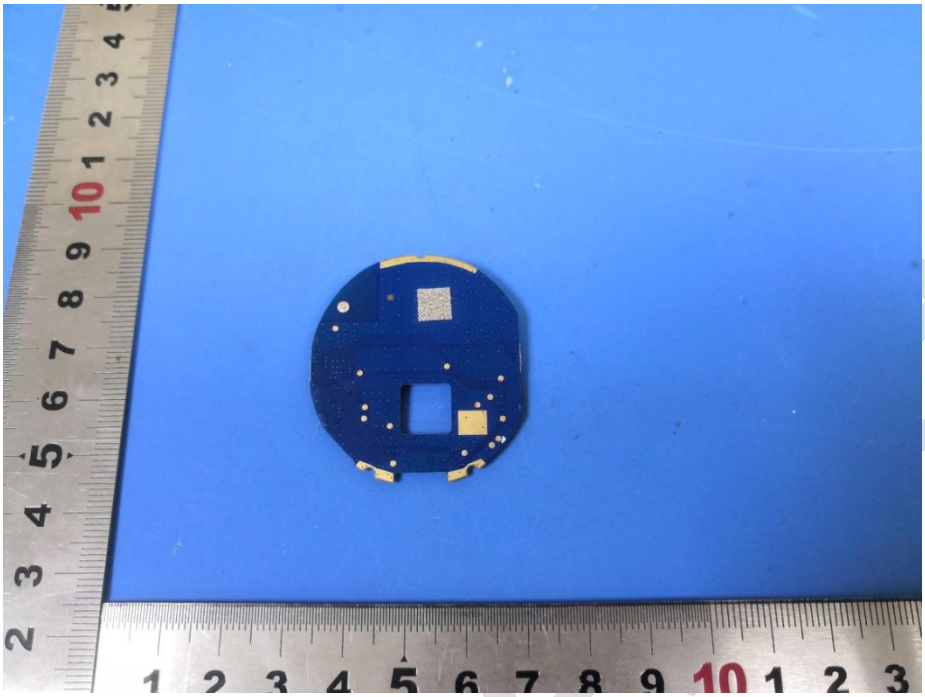
APPENDIX B: PHOTOGRAPHS OF EUT

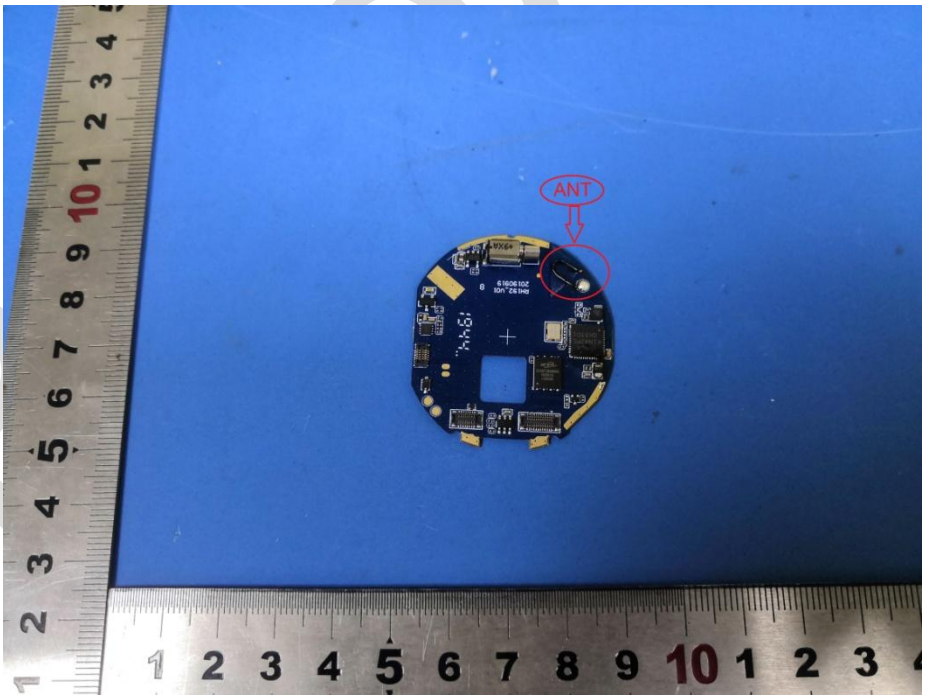








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----END OF REPORT----

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