Audix Technology Corp.
No. 491, Zhongfu Rd., Linkou, Dist.,
New Taipei City244,Taiwan

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FCC 15.247
2.4GHz Test Report

for

Singular Wings Medical Co., Ltd.

11F., No.257, Wenxing Rd., Zhubei City, Hsinchu County 30264, Taiwan (R.O.C.)

Product Name	:	**(1~4)Heart Rate Transmitter** **(5)ECG Recorder**
Model Name	:	**(1)HR-131 (2)HR-101** **(3)HR-111 (4)HR-121** **(5)EC-100**
Brand		**(1~4)BEATINFO** **(5)CARDINOVA**
FCC ID	:	**2ATSRHR-XXX**
Prepared by:	:	**AUDIX Technology Corporation, EMC Department**

Testing Laboratory
1724

TESTING
NVLAP LAB CODE 200077-0

The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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TEST REPORT

Applicant	:	Singular Wings Medical Co., Ltd.
Manufacturer	:	Singular Wings Medical Co., Ltd.
EUT Description		
(1) Product	:	(1~4)Heart Rate Transmitter (5)ECG Recorder
(2) Model	:	(1)HR-131 (2)HR-101 (3)HR-111 (4)HR-121 (5)EC-100
(3) Brand	:	(1~4)BEATINFO (5)CARDINOVA
(4) Power Supply	:	(1)DC 5V (Via USB) (2)DC 3.8V (Via Battery)

Applicable Standards:

Title 47CFRFCC Part 15, Subpart C
ANSI C63.10:2013

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2021. 06. 04

Reviewed by: Annie Yu (Annie Yu/Administrator)

Approved by: Johnny Hsueh (Johnny Hsueh/Section Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2021. 06. 04	Original Report	EM-F200522

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2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	**PASS**
15.247(d)/15.205	Radiated Band Edge and Radiated Spurious Emission	**PASS**
15.247(a)(2)	6dB/Occupied Bandwidth	**PASS**
15.247(b)(3)	Maximum Peak Output Power	**PASS**
15.247(d)	Conducted Band Edges and Conducted Spurious Emission	**PASS**
15.247 (e)	Peak Power Spectral Density	**PASS**
15.203	Antenna Requirement	**Compliance**
Note: The uncertainties value is not used in determining the result.		

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	Singular Wings Medical Co., Ltd. 11F., No.257, Wenxing Rd., Zhubei City, Hsinchu County 30264, Taiwan (R.O.C.)
Manufacturer	Singular Wings Medical Co., Ltd. 11F., No.257, Wenxing Rd., Zhubei City, Hsinchu County 30264, Taiwan (R.O.C.)
Product	(1~4)Heart Rate Transmitter (5)ECG Recorder
Model	(1)HR-131 (2)HR-101 (3)HR-111 (4)HR-121 (5)EC-100 The differences between above models please refer to the following table, others appearance and circuit are the same. The HR-131 have most complicated configuration than other models. We judge HR-131 have worst electrical characteristic so we measured HR-131 only.
Brand	(1~4)BEATINFO (5)CARDINOVA

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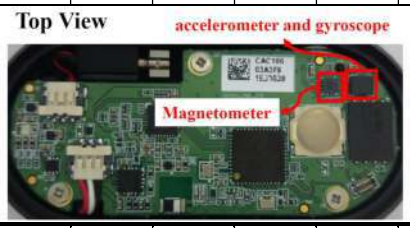
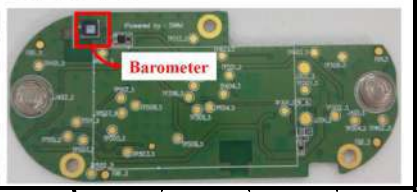
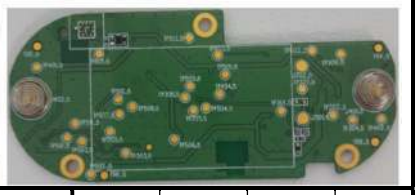
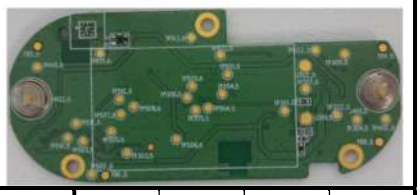
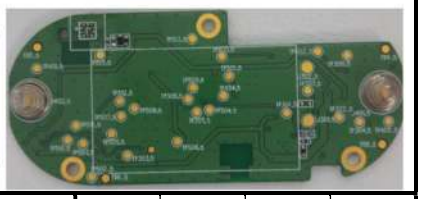
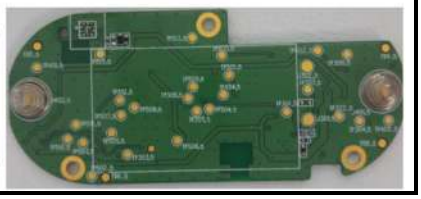
Table: Model different list

Model	Difference											
	Brand	Product Name	Appearance color	Function specification						Internal parts			
				ECG	Respiration	ACC	Gyro	Mag	Baro	ACC	Gyro	Mag	Baro
HR-131	BEATINFO	Heart Rate Transmitter	Black	V	V	V	V	V	V	V	V	V	V
				Top View  Bottom View 									
HR-121	BEATINFO	Heart Rate Transmitter	Black	V	V	V	V	V	-	V	V	V	-
				Top View Bottom View 									
HR-111	BEATINFO	Heart Rate Transmitter	Black	V	V	V	V	-	-	V	V	-	-
				Top View Bottom View 									
HR-101	BEATINFO	Heart Rate Transmitter	Black	V	V	-	-	-	-	-	-	-	-
				Top View Bottom View 									
EC-100	CARDINOVA	ECG Recorder	White	V	V	-	-	-	-	-	-	-	-
				Top View Bottom View 									

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3.2. Description of EUT

Test Model	HR-131
Serial Number	N/A
Power Rating	(1)DC 5V (Via USB) (2)DC 3.8V (Via Battery)
Software Version	N/A
RF Features	BLE
Transmit Type	1T1R
Test Sample	Sample No. / Test Item / Firmware -02 / AC Conduction, RSE, Output Power / N/A
Sample Status	Mass production
Date of Receipt	2020. 10. 20
Date of Test	2020. 10. 29 ~ 2021. 06. 03
Interface Ports of EUT	USB Port x1 (For Charging dock)
Accessories Supplied	● Charging dock ● Micro-USB Cable (For Charging dock) (Optional)

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3.3. Reference Test Guidance

None

3.4. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (GHz)	Max Gain (dBi)
1	WAN3216F245C04	ONEWAVE	Chip Antenna	2.4 - 2.5	1.05

3.5. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
BLE	2402-2480	40	GFSK	1

Channel List							
BLE							
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
37	2402	09	2422	18	2442	28	2462
00	2404	10	2424	19	2444	29	2464
01	2406	38	2426	20	2446	30	2466
02	2408	11	2428	21	2448	31	2468
03	2410	12	2430	22	2450	32	2470
04	2412	13	2432	23	2452	33	2472
05	2414	14	2434	24	2454	34	2474
06	2416	15	2436	25	2456	35	2476
07	2418	16	2438	26	2458	36	2478
08	2420	17	2440	27	2460	39	2480

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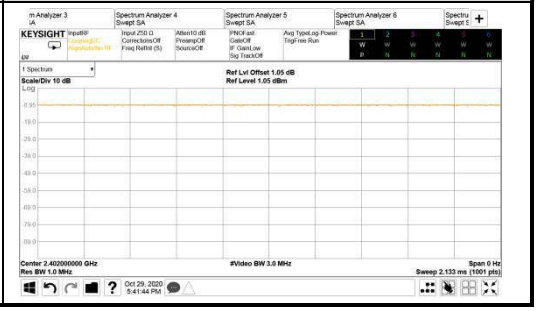
3.6. Descriptions of Key Components

None

3.7. Test Configuration

Mode	TX_{on} (ms)	1/ TX_{on} (kHz)
BLE	N/A	N/A

Mode	T (ms)
BLE	

Item		Mode	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge	BLE	1Mbps	37/39
	Radiated Spurious Emission			37/17/39
Conducted Test Case	6dB/Occupied Bandwidth			37/17/39
	Peak Output Power			37/17/39
	Band Edge			37/39
	Spurious Emission			37/17/39
	Peak Power Spectral Density			37/17/39

Note : ☐Mobile Device
■Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow: ■Lie ☐Side ☐Stand

3.8. Output Power Setting

Mode	Centre Frequency (MHz)	Power Setting
BLE	2402	4
	2440	4
	2480	4

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3.9. Tested Supporting System List

3.9.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	Approval
1.	Notebook PC	hp	TPN-Q189	---	Contains FCC ID: PD93168NG
2.	Notebook PC	ASUS	X5502E	---	Contains FCC ID: PPD-AAR5B225
3.	Charging dock	BeatInfo	CG-100	---	N/A
4.	Test Jig #1	TI	SMARTRF06EBK	---	N/A
5.	Test Jig #2	Singular Wings Medical	E1-B1-20-3-006	---	N/A

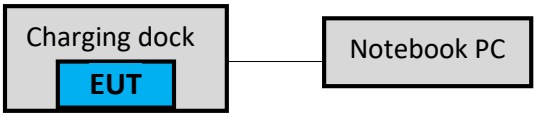
3.9.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	Adapter: hp, M/N PPP-012C-S DC Power Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord: Unshielded, Detachable, 1.0m
2.	Adapter: Enertronix, M/N EXA1208UH DC Power Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core
3.	USB Cable: Unshielded, Detachable, 0.15m
4.	Contact Cable: Unshielded, Detachable, 0.2m
5.	---

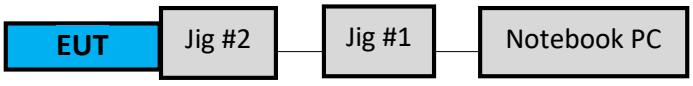
3.10.Setup Configuration

3.10.1. EUT Configuration for Power Line & Radiated Emission

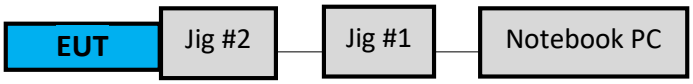
[Charge Mode]



[Radiated Emission]



3.10.1.EUT Configuration for RF Conducted Test Items



3.11.Operating Condition of EUT

Test program “Smart RF Studio 7” is used for enabling EUT BT function under continues transmitting and choosing data rate/ channel.

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3.12.Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) No.8 Shielded Room (2) No.1 3m Semi Anechoic Chamber (3) Fully Anechoic Chamber

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3.13.Measurement Uncertainty

Test Items/Facilities			Frequency Range	Uncertainty
Conduction Test			9kHz-150kHz	±3.7dB
			150kHz-30MHz	±3.5dB
Radiation Test	☒	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.1dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.2dB
			200MHz-1000MHz, 3m, Vertical	±4.1dB
			1GHz-6GHz, 3m	±4.2dB
			6GHz-18GHz, 3m	±4.6dB
	☐	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.9dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.1dB
	☐	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.3dB
			200MHz-1000MHz, 3m, Horizontal	±4.0dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.4dB
			1GHz-6GHz, 3m	±4.5dB
			6GHz-18GHz, 3m	±4.6dB
	☐	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.0dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.2dB
			200MHz-1000MHz, 3m, Vertical	±4.3dB
			1GHz-6GHz, 3m	±4.3dB
			6GHz-18GHz, 3m	±4.7dB
	☒	Fully Anechoic Chamber	30MHz~1000MHz	±4.7dB
			1GHz~18GHz	±5.3dB

Remark：Uncertainty = $ku_c(y)$

Test Item	Uncertainty
6dB Bandwidth	± 0.05kHz
Maximum peak output power	± 0.33dB
Power spectral density	± 0.13dB
Conducted Emission Limitations	± 0.13dB

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4. MEASUREMENT EQUIPMENTLIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2020. 02. 04	1 Year
2.	A.M.N.	R&S	ENV432	101567	2020. 04. 20	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2019. 12. 10	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2020. 01. 05	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2020. 04. 17	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2020. 09. 19	1 Year
7.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

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4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2020. 09. 16	1 Year
2.	Spectrum Analyzer	Keysight	N9030A-526	MY53310269	2020. 01. 16	1 Year
3.	Test Receiver	R & S	ESCS30	100039	2020. 06. 05	1 Year
4.	Amplifier	HP	8447D	2944A06305	2020. 01. 16	1 Year
5.	Microwave Preamplifier	HP	8449B	3008A02678	2020. 02. 27	1 Year
6.	Microwave Amplifier	Keysight	83051A	MY53010042	2020. 08. 05	1 Year
7.	Bilog Antenna	CHASE	CBL6112D	33821	2020. 01. 17	1 Year
8.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2020. 03. 10	2 Years
9.	Horn Antenna	COM-POWER	AH-840	101092	2020. 05. 08	1 Year
10.	2.4GHz Notch Filter	K&L Microwave	7NSL10-2441. 5/E130.5-O/O	1	2020 .07. 24	1 Year
11.	3GHz Notch Filter	Microwave	H3G018G1	484796	2020. 08. 20	1 Year
12.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2020. 01. 31	1 Year
13.	Coaxial Cable	HUBER+ SUHNER	SUCOFLEX 104	RE-29	2020. 09. 19	1 Year
14.	Coaxial Cable	HUBER+ SUHNER	SUCOFLEX 102	RE-30	2020. 09. 19	1 Year
15.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2020. 04. 17	1 Year
16.	Digital Thermo-Hygro Meter	EVERY DAY	E-512	RF-02	2020. 04. 17	1 Year
17.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.
18.	Test Software	Audix	e3	V6.110601	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9020B-544	MY57120357	2020. 01. 10	1 Year
2.	Digital Thermo-Hygro Meter	Shenzhen Datronn Electronics	KT-905	RF	2020. 04. 17	1 Year

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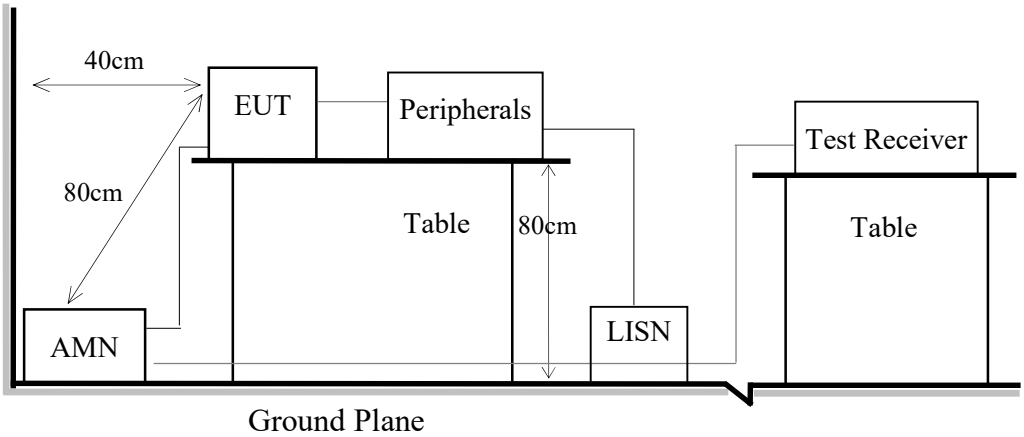
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.9

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dBμV	56 ~ 46 dBμV
500kHz ~ 5MHz	56 dBμV	46 dBμV
5MHz ~ 30MHz	60 dBμV	50 dBμV

Remark1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.
5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).
5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)
5.3.4. Checking frequency range from 150kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

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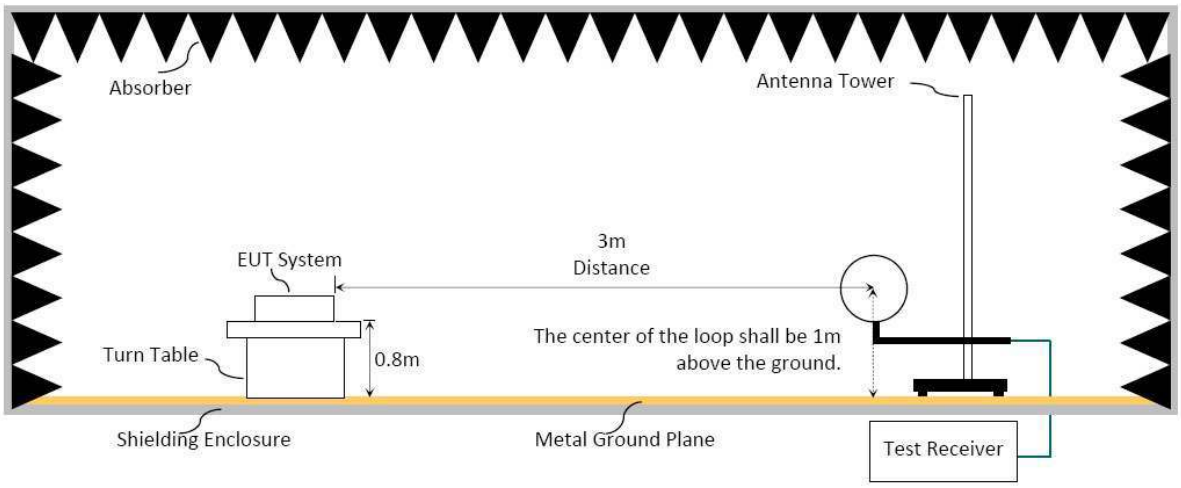
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

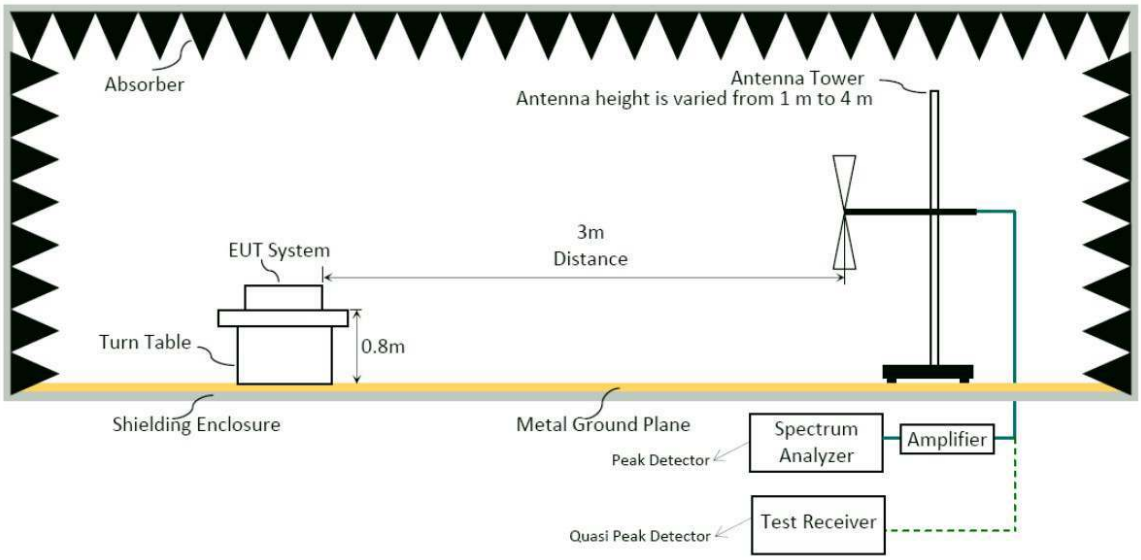
6.1.1. Block Diagram of EUT

Indicated as section 3.9

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000MHz



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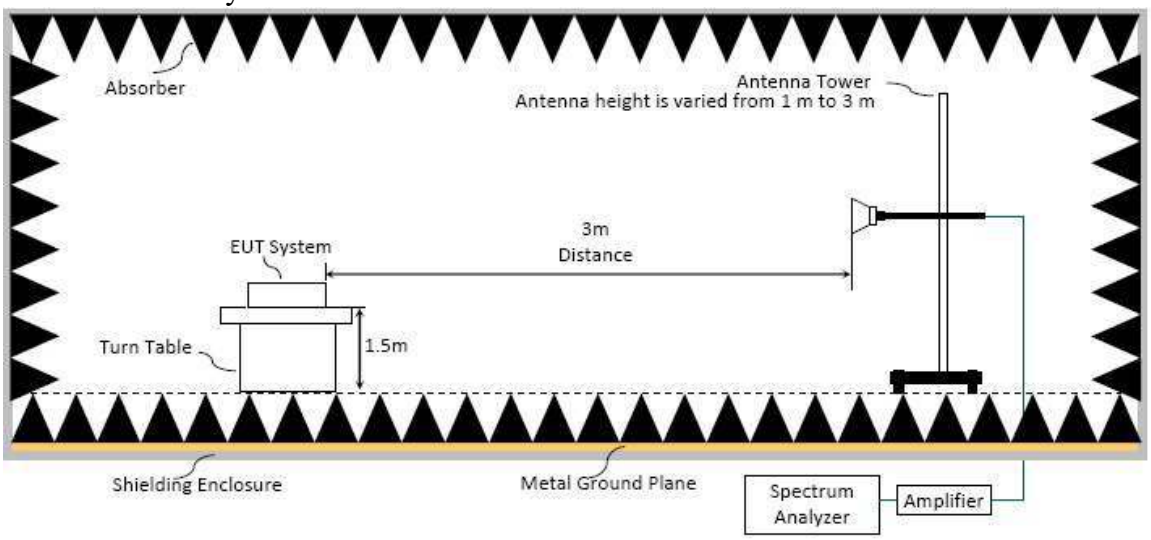
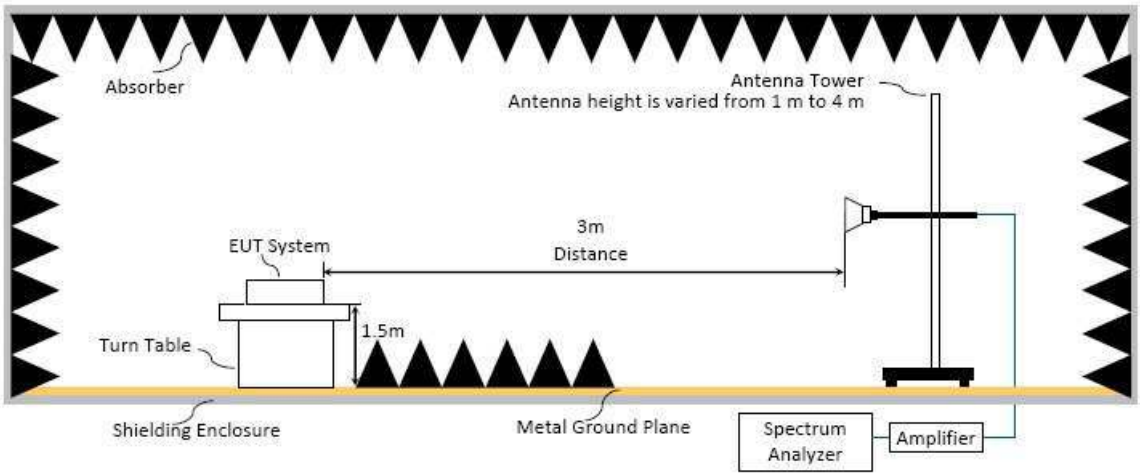
6.1.4. Setup Diagram for above 1GHz

Fully Anechoic Chamber



Semi Anechoic Chamber



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6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205 Section 8.10 table 6, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance(m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6-20 log f(kHz)	2400/f kHz
0.490 - 1.705	30	87.6-20 log f(kHz)	24000/f kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark：(1) dBμV/m = 20 log (μV/m)
(2) The tighter limit applies to the edge between two frequency bands.
(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
(4) Fundamental and emission fall within operation band are exempted from this section.
(5) Pursuant to ANSI C63.10: 6.6.4.3,if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

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6.3. Test Procedure

Frequency Range 9kHz~30MHz:
The EUT setup on the turntable which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level.
In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013regulation.

(1) RBW = 9kHz with peak and average detector.
(2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 25GHz:
The EUT setup on the turn table which has 80cm (for 30-1000MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m (for 30-1000MHz) and from 1m to 3m (for above 1GHz at fully Anechoic Chamber)or from 1 m to 4 m (for above 1GHz at Semi Anechoic Chamber) to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013regulation.

Frequency below 1GHz:
Spectrum Analyzer is used for pre-testing with following setting:
(1)RBW = 120KHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
Note 1: When peak-detected value is lower than limit that the measurement using theQ.P. detector is not required, otherwise using Q.P. for final measurement.
Note 2: When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Frequency above 1GHz to 10th harmonic(up to 25 GHz):
Peak Detector:
(1)RBW = 1MHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final measurement.

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Average Detector:

■**Option 1:**

(1)RBW = 1MHz

(2)VBW ≥ 1/ T.

Modulation Type	T (ms)	1/ T (kHz)	VBW Setting(Hz)
BLE	N/A	N/A	3kHz

N/A: 1/ T is not implemented when duty cycle presented in section 3.6 is ≥98%.

(1)Detector = Peak.

(2)Sweep time = auto.

(3)Trace mode = max hold.

(4)Allow sweeps to continue until the trace stabilizes.

□**Option 2:**

Average Emission Level= Peak Emission Level+ D.C.C.F.

6.4. Measurement Result Explanation

■Peak Emission Level=Antenna Factor + Cable Loss +Meter Reading (including Preamp factor if test used)

■Average Emission Level l=Antenna Factor + Cable Loss + Meter Reading (including Preamp factor if test used)

□Average Emission Level= Peak Emission Level+ DCCF

Duty Cycle Correction Factor (DCCF)= 20log(TX_{on}/TX_{on+off}) presented in section 3.6

□ERP= Peak Emission Level-95.2dB-2.14dB

6.5. Test Results

Please refer to Appendix A.

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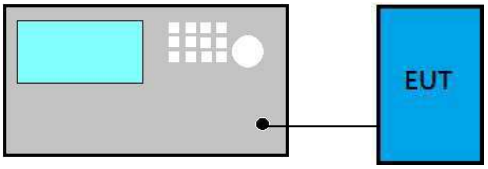
7. 6dB/OCCUPIED BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

The minimum 6dB bandwidth shall be at least 500kHz.

7.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

For 6dB Bandwidth

(1) Set RBW = 100 kHz.
(2) Set the video bandwidth (VBW) ≥ 3 × RBW.
(3) Detector = Peak.
(4) Trace mode = max hold.
(5) Sweep = auto couple.
(6) Allow the trace to stabilize.
(7) Setting channel bandwidth function x to -6dB power to record the final bandwidth..

For 99% Occupied Bandwidth

(1) Set Span range 1.5~5 times the OBW
(2) Set RBW close to1% to 5% of OBW.
(3) Set VBW≥3xRBW.
(4) Detector = Peak.
(5) Trace mode = Max hold
(6) Sweep = Auto couple.
(7) Allow the trace to stabilize.

7.4. Test Results

Please refer to Appendix A

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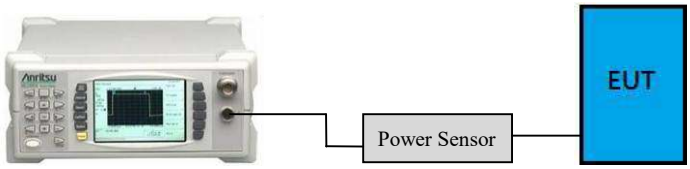
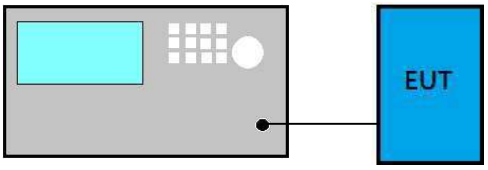
8. MAXIMUM PEAK OUTPUT POWER

8.1. Block Diagram of Test Setup

- For WLAN Function



- For BLE Function



8.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHzis : 1Watt. (30dBm), and E.I.R.P.: 4Watt (36dBm)

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8.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

☐**PKPM1 Peak power meter method:**

EUT is connected to power sensor and record the maximum output power.

■**Maximum peak conducted output power method:**

(1) Set the RBW ≥ DTS bandwidth
(2) Set VBW ≥ 3 × RBW
(3) Set span ≥ 3 × RBW.
(4) Sweep time = auto couple
(5) Detector = peak.
(6) Trace mode = max hold.
(7) Allow trace to fully stabilize.
(8) Use peak marker function to determine the peak amplitude level.

☐**Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.7 is< 98%.

☐**Method AVGSA-2 (Spectrum channel power)**

(1) Set span to at least 1.5 times the OBW
(2) Set RBW = 1 -5%of OBW
(3) Set the video bandwidth (VBW) ≥ 3 × RBW.
(4) Detector = RMS.
(5) Trace mode = trace average at least 100 traces
(6) Sweep = auto couple.
(7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
(8) Duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

8.4. Test Results

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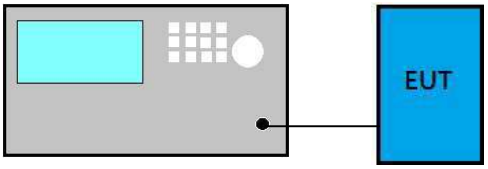
9. EMISSION LIMITATIONS

9.1. Block Diagram of Test Setup



9.2. Specification Limits

In any 100kHz 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 20dB below that in the100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in Section 15.209(a) Section 8.9 table 4is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a) Section 8.10 table 6, must also comply with the radiated emission limits specified in Section 15.209(a) Section 8.9 table 4 (See Section 15.205(c)).

9.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

■Reference Level

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize to find the max PSD as reference level.

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■Emission Level Measurement

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize to find the max level.

9.4. Test Results

Please refer to Appendix A

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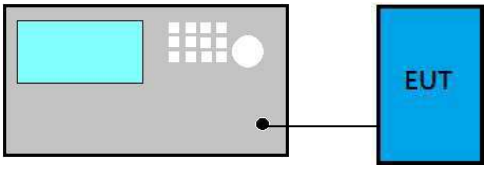
10. POWER SPECTRAL DENSITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band.

10.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

■Method PKPSD (peak PSD)

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize.
(9) Use the peak marker function to determine the maximum amplitude level.
(10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

□Method AVGPSD-2

(1) Using peak PSD procedure step 1 to step 4.
(2) Detector= RMS detector
(3) Sweep time = auto couple
(4) Trace mode = trace averaging over a minimum of 100 traces
(5) Use the peak marker function to determine the maximum amplitude level.
(6) Duty cycle factor is added when duty cycle presented in section 3.7< 98%.
(7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

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11. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPDNDIX A

TEST DATA AND PLOTS

(Model: HR-131)

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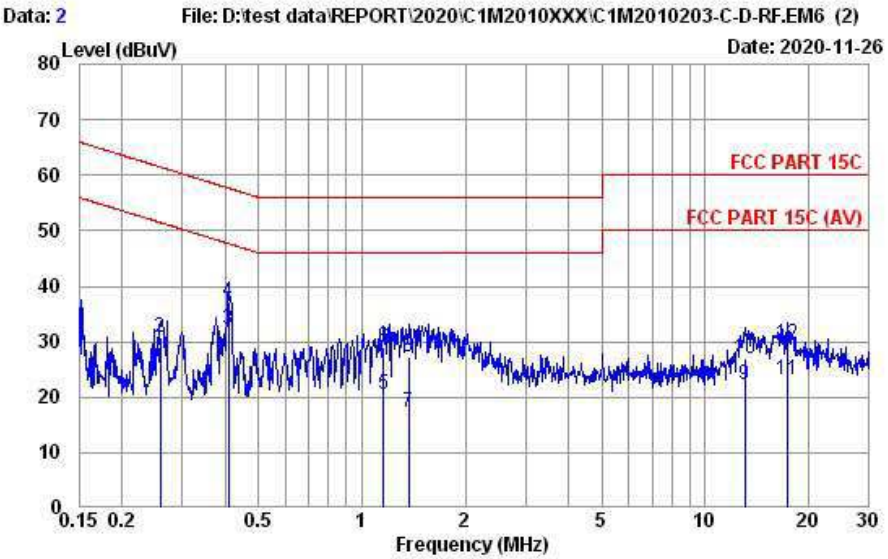
A.1 CONDUCTED EMISSION

Test Date	2020/11/26	Temp./Hum.	25℃/55%
Test Voltage	DC 5V (via Notebook PC)		



Site No. : No.8 Shielded Room
Instrument 1 : Receiver ESR(774)
Instrument 2 : ENV432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C
Environment : 25°C / 55%
EUT Model : HR-131
Test Mode : Charge

Data No. : 2
Phase : LINE
Engineer : Roy Hung
Test Rating : DC 5V

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.259	10.20	0.03	9.85	5.24	25.32	51.47	26.15	Average
2	0.259	10.20	0.03	9.85	10.63	30.71	61.47	30.76	QP
3	0.408	10.20	0.03	9.85	12.01	32.09	47.68	15.59	Average
4	0.408	10.20	0.03	9.85	17.13	37.21	57.68	20.47	QP
5	1.153	10.28	0.04	9.86	0.32	20.50	46.00	25.50	Average
6	1.153	10.28	0.04	9.86	8.84	29.02	56.00	26.98	QP
7	1.367	10.30	0.05	9.86	-2.91	17.30	46.00	28.70	Average
8	1.367	10.30	0.05	9.86	6.93	27.14	56.00	28.86	QP
9	13.057	10.46	0.16	9.93	1.69	22.24	50.00	27.76	Average
10	13.057	10.46	0.16	9.93	6.49	27.04	60.00	32.96	QP
11	17.383	10.55	0.19	9.95	2.38	23.07	50.00	26.93	Average
12	17.383	10.55	0.19	9.95	8.91	29.60	60.00	30.40	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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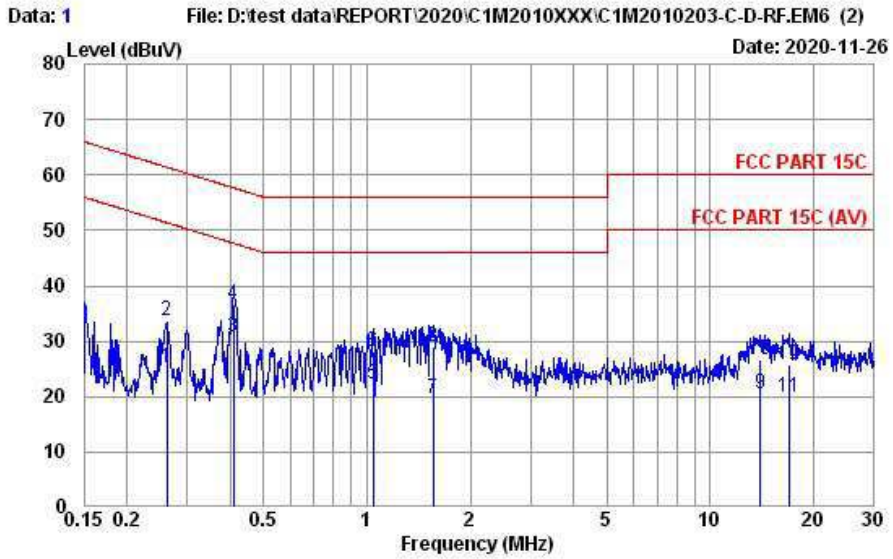
Test Date	2020/11/26	Temp./Hum.	25℃/55%
Test Voltage	DC 5V (via Notebook PC)		



Site No. : No.8 Shielded Room
Instrument 1 : Receiver ESR(774)
Instrument 2 : ENV432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C
Environment : 25°C / 55%
EUT Model : HR-131
Test Mode : Charge

Data No. : 1
Phase : NEUTRAL
Engineer : Roy Hung
Test Rating : DC 5V

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.262	10.20	0.03	9.85	5.18	25.26	51.38	26.12	Average
2	0.262	10.20	0.03	9.85	13.66	33.74	61.38	27.64	QP
3	0.408	10.20	0.03	9.85	10.59	30.67	47.68	17.01	Average
4	0.408	10.20	0.03	9.85	16.62	36.70	57.68	20.98	QP
5	1.043	10.20	0.04	9.86	2.08	22.18	46.00	23.82	Average
6	1.043	10.20	0.04	9.86	7.94	28.04	56.00	27.96	QP
7	1.560	10.30	0.05	9.86	-0.68	19.53	46.00	26.47	Average
8	1.560	10.30	0.05	9.86	8.77	28.98	56.00	27.02	QP
9	13.989	10.66	0.16	9.93	-0.24	20.51	50.00	29.49	Average
10	13.989	10.66	0.16	9.93	5.86	26.61	60.00	33.39	QP
11	17.018	10.79	0.18	9.95	-0.89	20.03	50.00	29.97	Average
12	17.018	10.79	0.18	9.95	4.88	25.80	60.00	34.20	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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A.2 RADIATED EMISSION

Test Date	2020/11/12 ~ 13	Temp./Hum.	23 ~ 24℃/56 ~ 62%
Test Voltage	DC 5V (via Notebook PC)		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

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A.2.1.2 Frequency Below 1 GHz

Mode	BLE	Frequency	TX 2440MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.00	24.20	1.20	26.53	27.11	25.98	40.00	14.02	Peak
323.91	19.96	4.91	25.92	29.69	28.64	46.00	17.36	Peak
474.26	23.09	6.69	27.07	29.70	32.41	46.00	13.59	Peak
837.04	26.38	8.35	27.30	29.36	36.79	46.00	9.21	Peak
919.49	26.94	8.81	27.09	29.43	38.09	46.00	7.91	Peak
945.68	27.09	8.92	27.01	29.36	38.36	46.00	7.64	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
36.79	20.99	1.40	26.52	36.75	32.62	40.00	7.38	Peak
50.37	14.52	1.65	26.50	41.37	31.04	40.00	8.96	Peak
83.35	13.63	2.22	26.37	39.73	29.21	40.00	10.79	Peak
199.75	15.33	3.55	25.87	32.19	25.20	43.50	18.30	Peak
600.36	24.80	7.03	27.48	31.18	35.53	46.00	10.47	Peak
926.28	26.97	8.84	27.07	29.37	38.11	46.00	7.89	Peak

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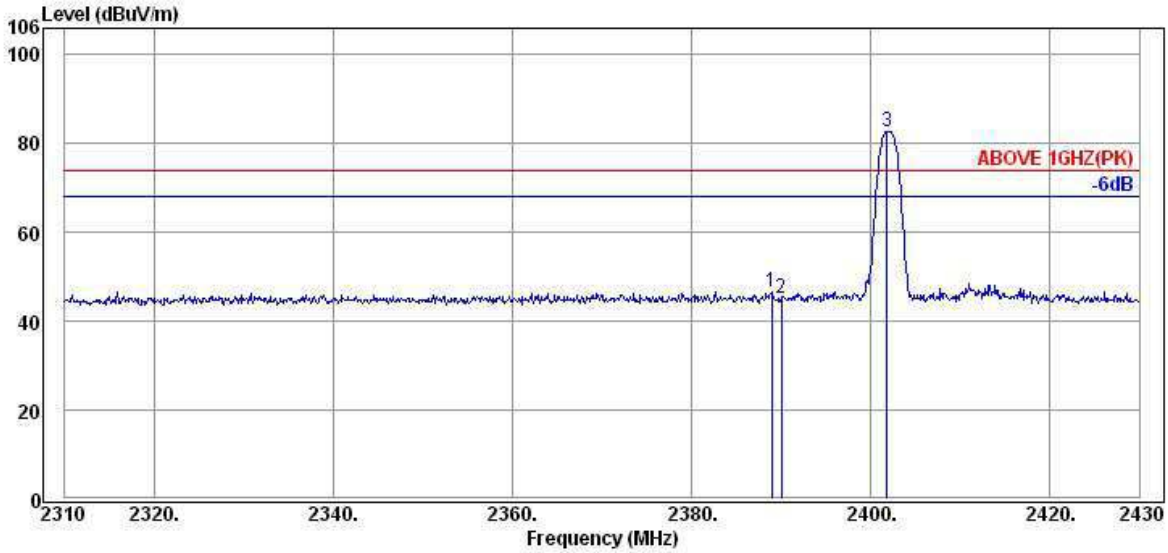
A.2.1.3 Frequency Above 1 GHz to 10th harmonics

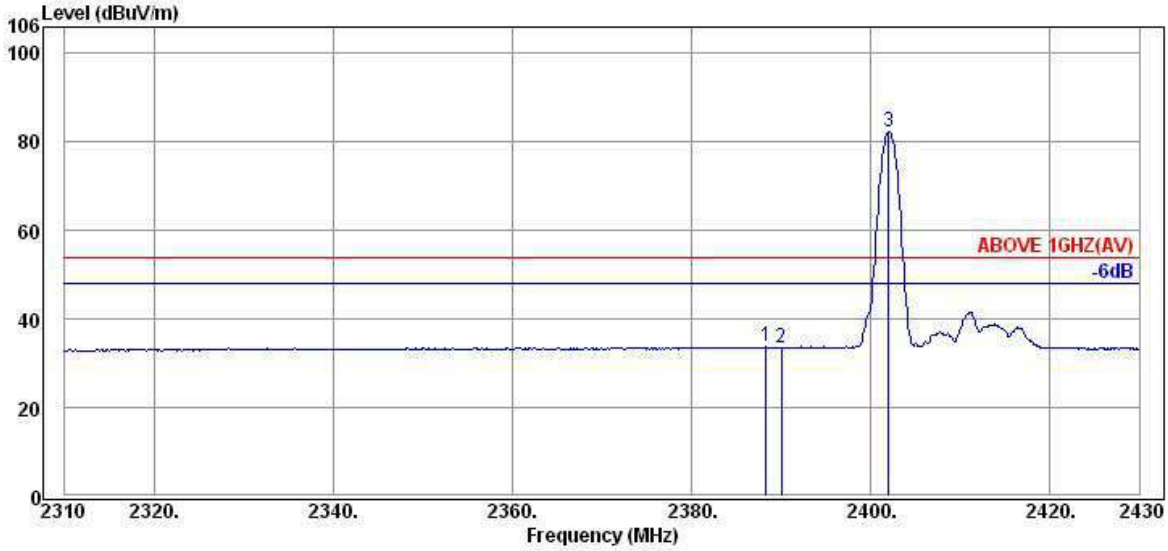
Band Edge:

Mode	BLE	Frequency	TX 2402MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2388.96	32.44	7.95	34.58	40.76	46.57	74.00	27.43	Peak
2390.04	32.44	7.95	34.58	39.49	45.30	74.00	28.70	Peak
2401.80	32.50	7.95	34.59	76.77	82.63	---	---	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2388.36	32.44	7.95	34.58	27.92	33.73	54.00	20.27	Peak
2390.04	32.44	7.95	34.58	27.67	33.48	54.00	20.52	Peak
2402.04	32.50	7.95	34.59	76.39	82.25	---	---	Peak

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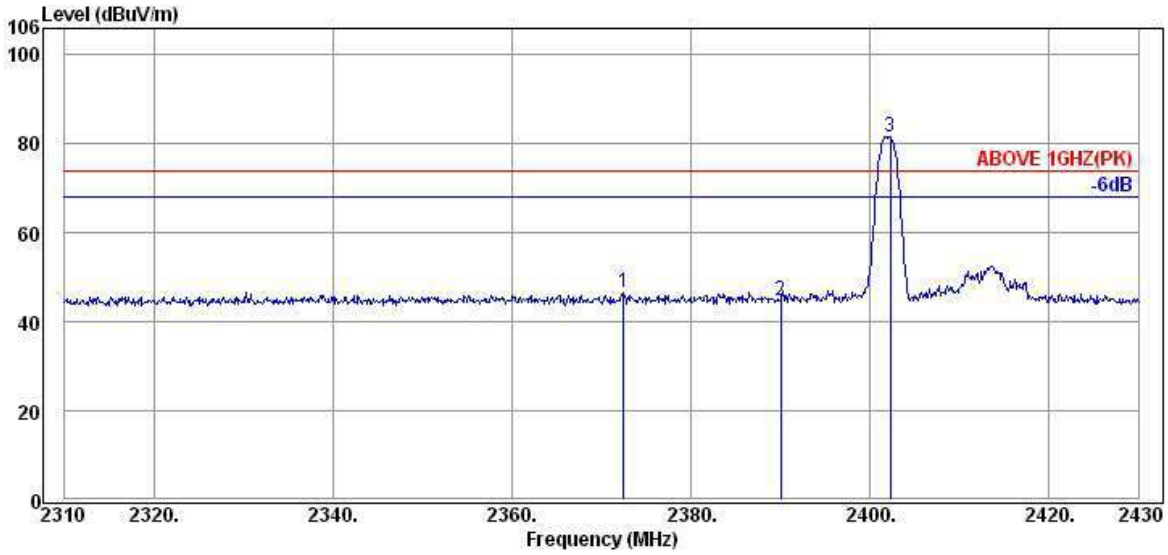
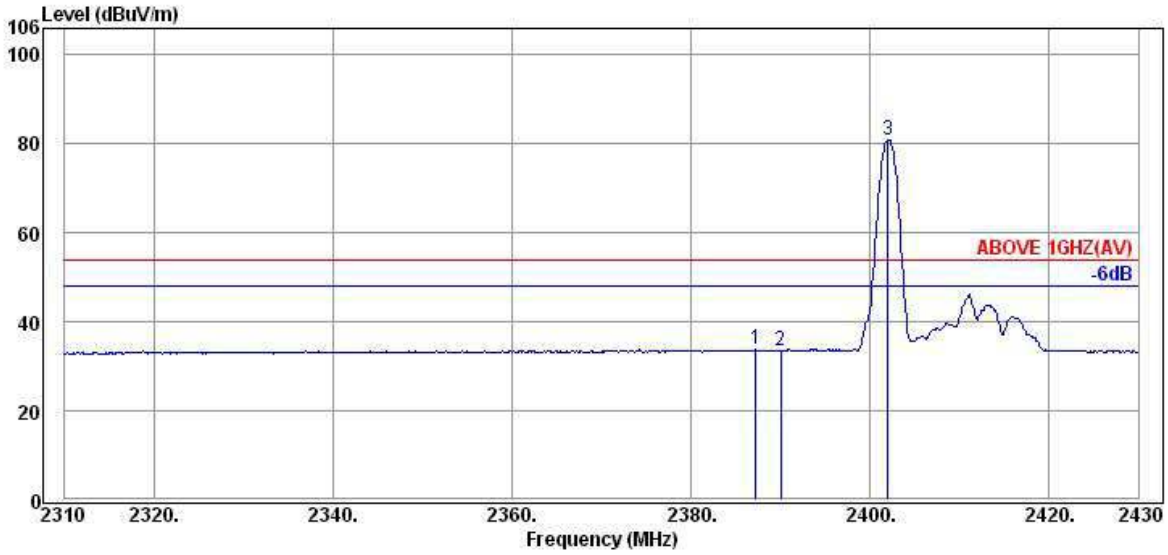
Mode	BLE	Frequency	TX 2402MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2372.52	32.39	7.94	34.58	40.84	46.59	74.00	27.41	Peak
2390.04	32.44	7.95	34.58	38.95	44.76	74.00	29.24	Peak
2402.28	32.50	7.95	34.59	75.63	81.49	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2387.28	32.44	7.95	34.58	27.96	33.77	54.00	20.23	Peak
2390.04	32.44	7.95	34.58	27.73	33.54	54.00	20.46	Peak
2402.04	32.50	7.95	34.59	75.17	81.03	---	---	Peak

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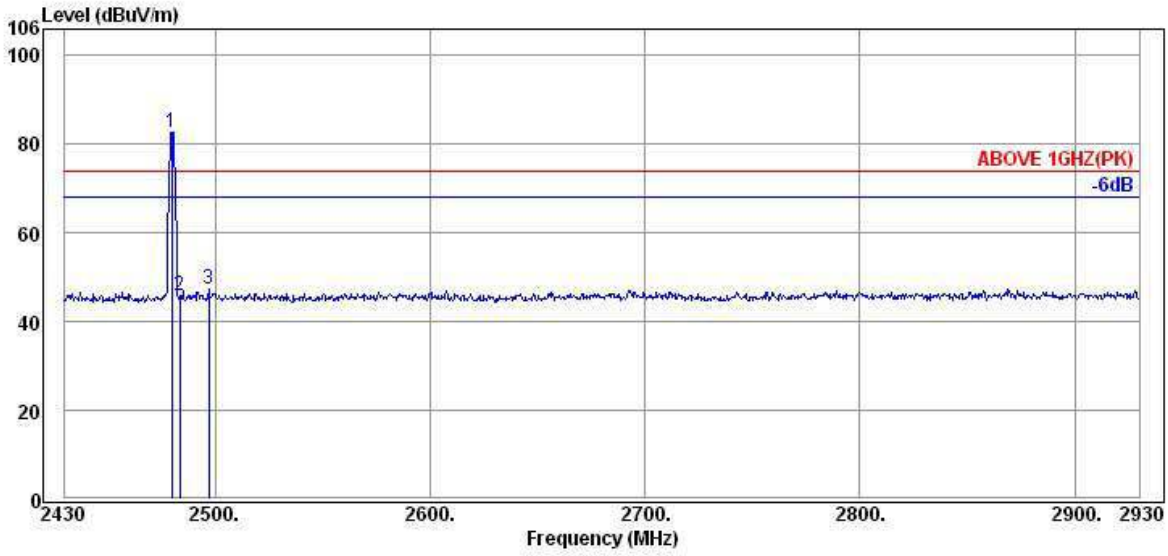
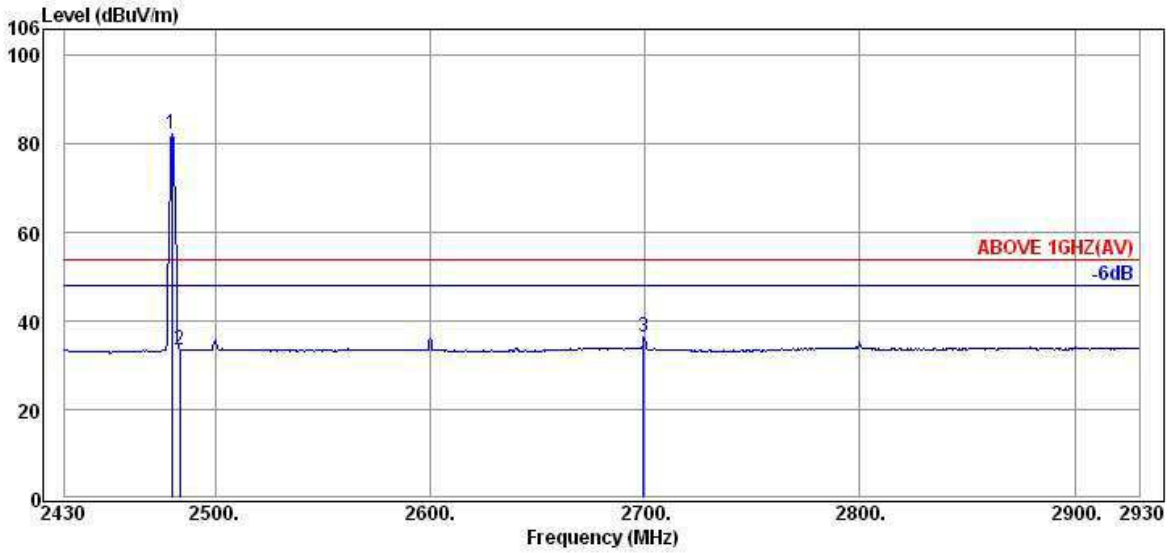
Mode	BLE	Frequency	TX 2480MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	32.11	7.99	34.60	77.19	82.69	---	---	Peak
2483.50	32.14	7.99	34.61	40.29	45.81	74.00	28.19	Peak
2497.00	32.20	8.00	34.61	41.70	47.29	74.00	26.71	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	32.11	7.99	34.60	76.68	82.18	---	---	Peak
2483.50	32.14	7.99	34.61	27.99	33.51	54.00	20.49	Peak
2699.50	32.40	8.09	34.65	30.43	36.27	54.00	17.73	Peak

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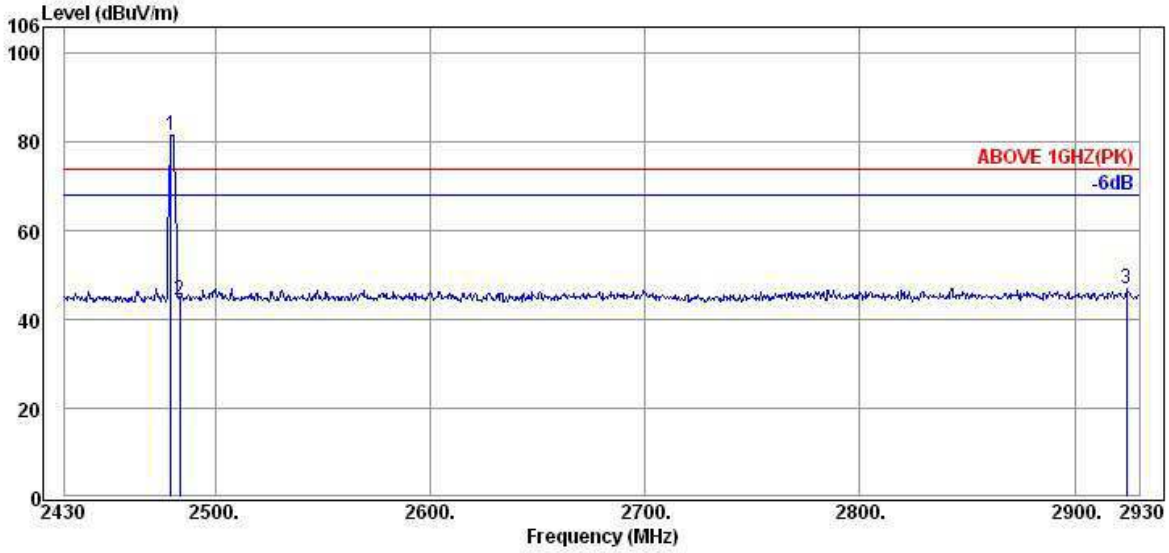
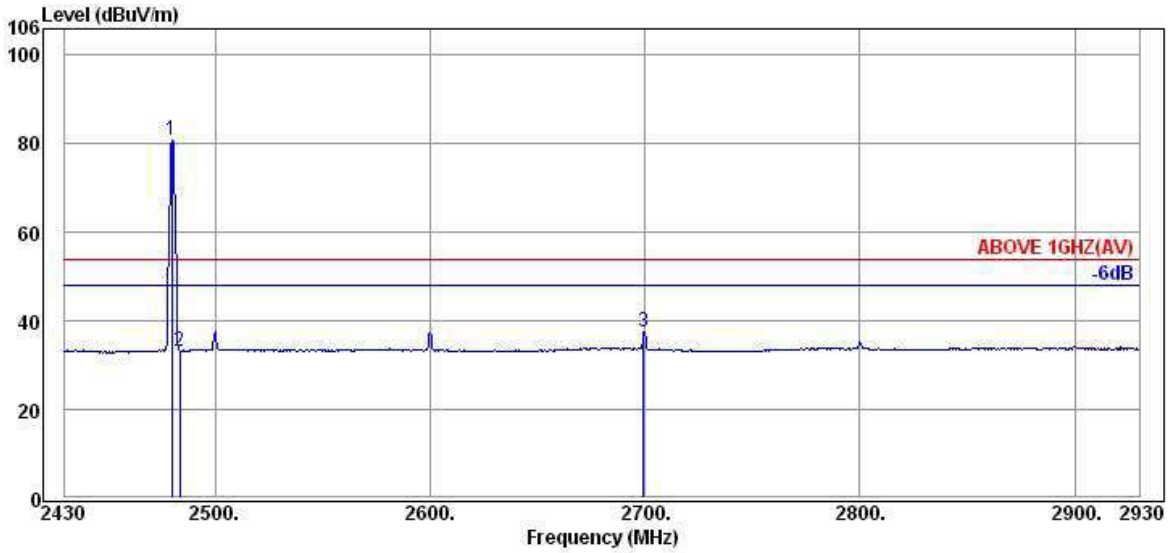
Mode	BLE	Frequency	TX 2480MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2479.50	32.11	7.99	34.60	75.99	81.49	---	---	Peak
2483.50	32.14	7.99	34.61	39.00	44.52	74.00	29.48	Peak
2924.00	32.90	8.19	34.69	40.69	47.09	74.00	26.91	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	32.11	7.99	34.60	75.41	80.91	---	---	Peak
2483.50	32.14	7.99	34.61	27.66	33.18	54.00	20.82	Peak
2699.50	32.40	8.09	34.65	31.59	37.43	54.00	16.57	Peak

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A.2.2 Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

Mode	BLE	Frequency	TX 2402MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.00	34.10	10.49	34.47	38.33	48.45	54.00	5.55	Peak
7205.00	35.60	12.25	34.60	30.88	44.13	54.00	9.87	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4804.00	34.10	10.49	34.47	38.73	48.85	54.00	5.15	Peak
7205.00	35.60	12.25	34.60	32.07	45.32	54.00	8.68	Peak

Mode	BLE	Frequency	TX 2440MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4880.00	34.05	10.54	34.45	36.93	47.07	54.00	6.93	Peak
7319.00	35.60	12.29	34.68	31.53	44.74	54.00	9.26	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4880.00	34.05	10.54	34.45	37.70	47.84	54.00	6.16	Peak
7319.00	35.60	12.29	34.68	33.94	47.15	54.00	6.85	Peak

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Mode	BLE	Frequency	TX 2480MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.00	34.10	10.60	34.44	36.21	46.47	54.00	7.53	Peak
7439.00	35.63	12.36	34.78	33.24	46.45	54.00	7.55	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4960.00	34.10	10.60	34.44	37.32	47.58	54.00	6.42	Peak
7439.00	35.63	12.36	34.78	33.55	46.76	54.00	7.24	Peak

A.2.3 Emissions in Non-restricted Frequency Bands:

Pursuant to KDB 558074 D01 15.247 Meas Guidance v05 that emission levels below the FCC 15.209(a) general radiated emissions limits is not required.

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A.3 6dB BANDWIDTH

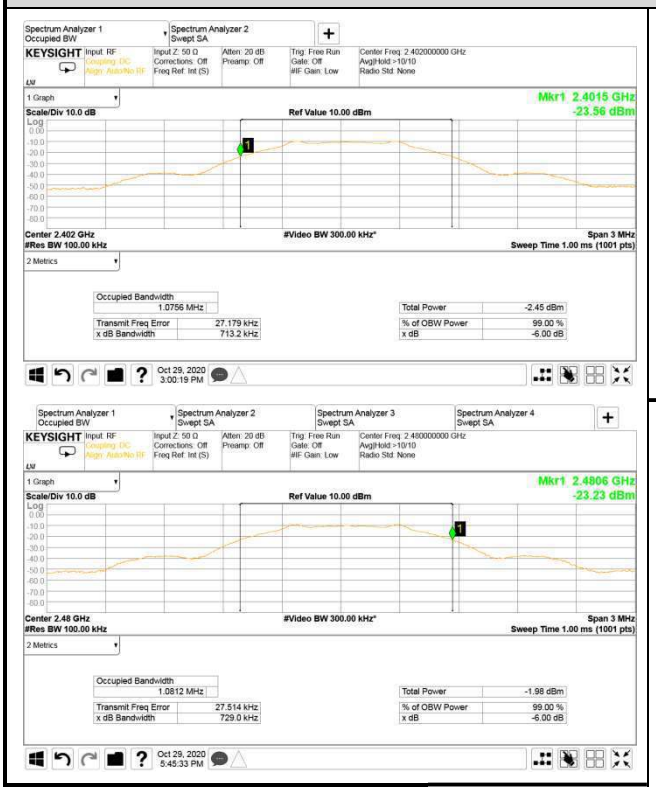
Test Date	2020/10/29	Temp./Hum.	22℃/48%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)

A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz) (Reference only)	Limit
BLE	2402	0.7132	1.0756	>500kHz
	2440	0.7138	1.0634	
	2480	0.7290	1.0812	

A.3.2 Measurement Plots

BLE



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A.4 MAXIMUM PEAK OUTPUT POWER

Test Date	2020/10/29	Temp./Hum.	22℃/48%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)

A.4.1 Peak Output Power

Mode	Centre Frequency (MHz)	MAX Output Power		Limit
		(dBm)	(W)	
BLE	2402	-8.60	0.000138	< 30dBm (1W)
	2440	-7.87	0.000163	
	2480	-7.90	0.000162	

Note: The results have been included cable loss.

A.4.2 Measurement Plots

BLE

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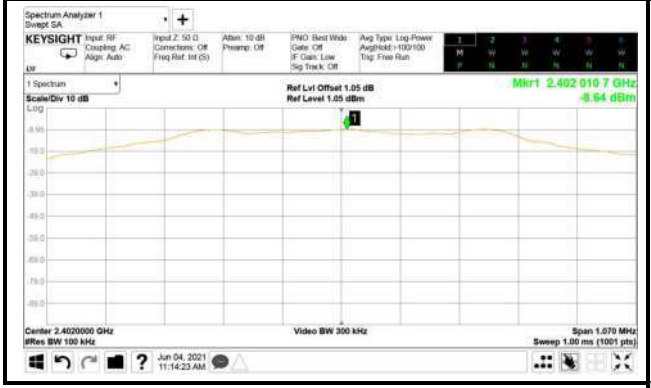
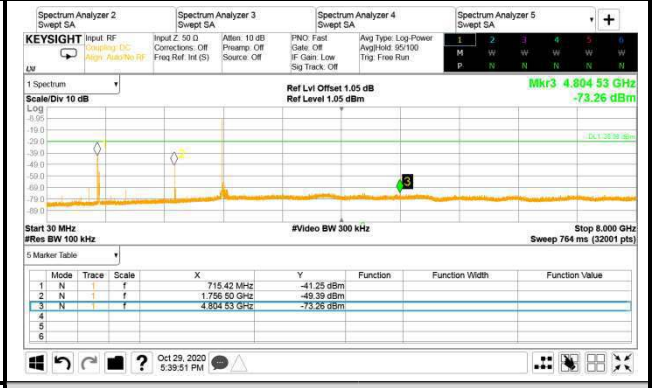
A.5 EMISSION LIMITATIONS

Test Date	2020/10/29 ~ 2021/06/04	Temp./Hum.	22-23℃/48-62%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)
Mode	BLE	Frequency	TX 2402MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

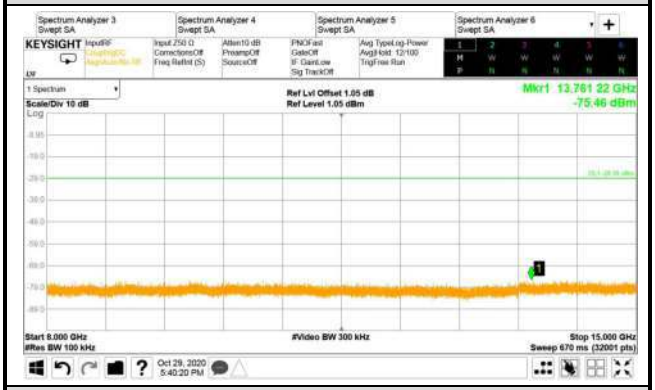
Reference Level



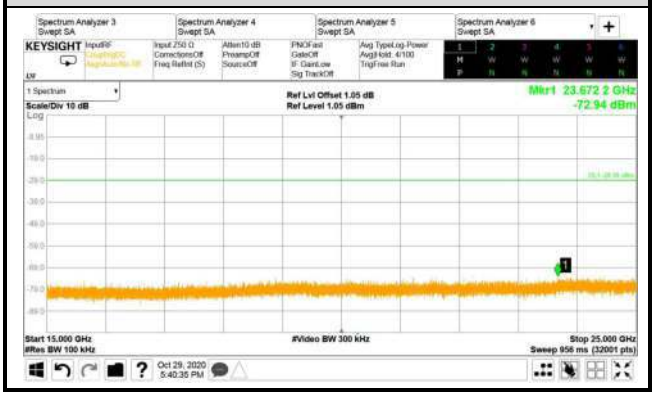
30MHz – 8GHz



8GHz – 15GHz



15GHz – 25GHz



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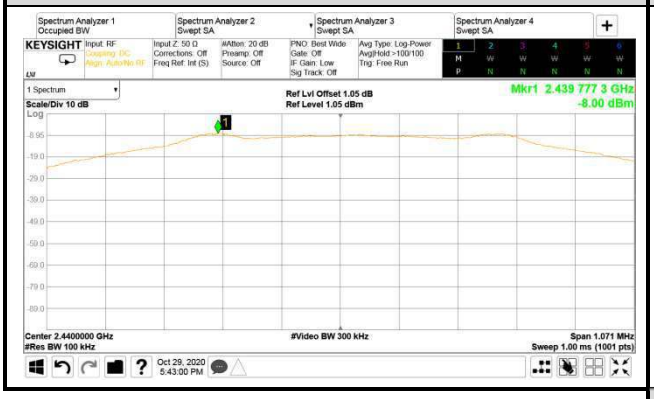
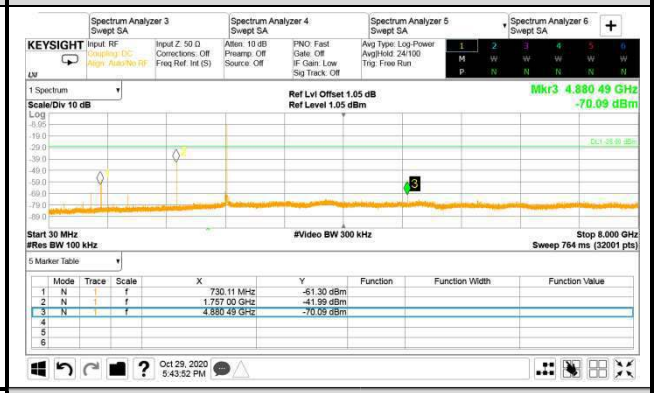
Test Date	2020/10/29	Temp./Hum.	22℃/48%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)
Mode	BLE	Frequency	TX 2440MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

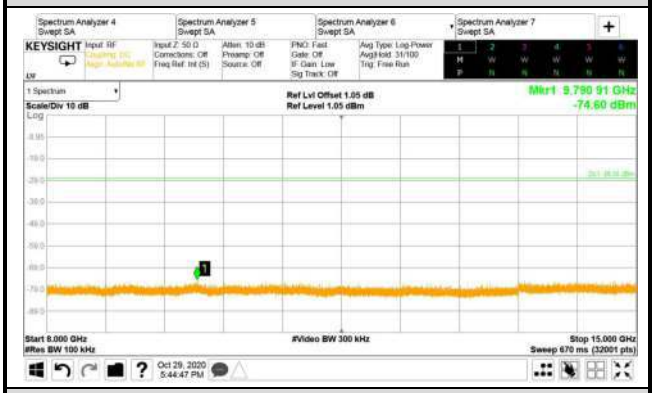
Reference Level



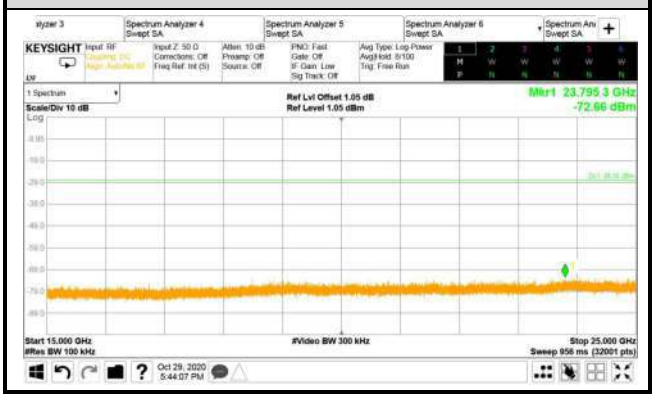
30MHz – 8GHz



8GHz – 15GHz



15GHz – 25GHz



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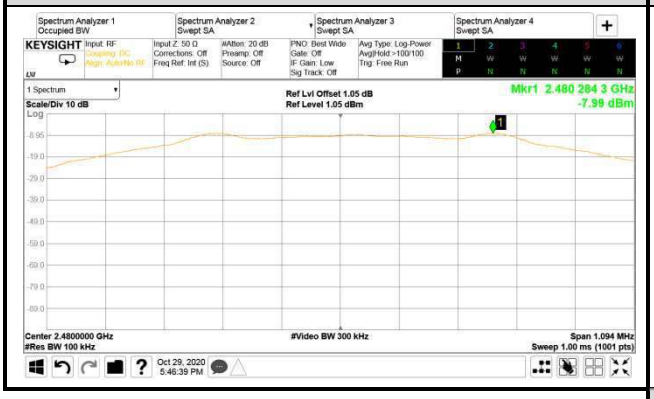
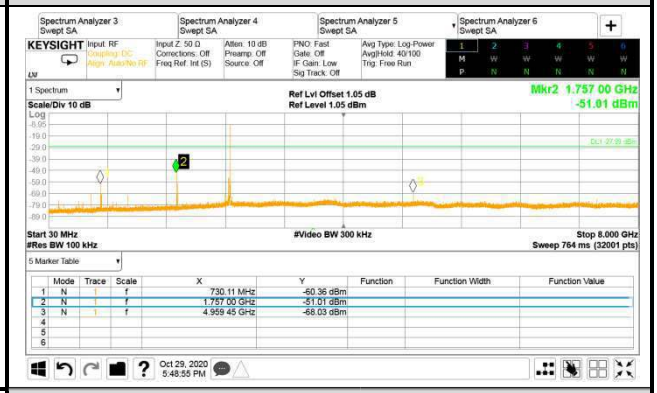
Test Date	2020/10/29	Temp./Hum.	22℃/48%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)
Mode	BLE	Frequency	TX 2480MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

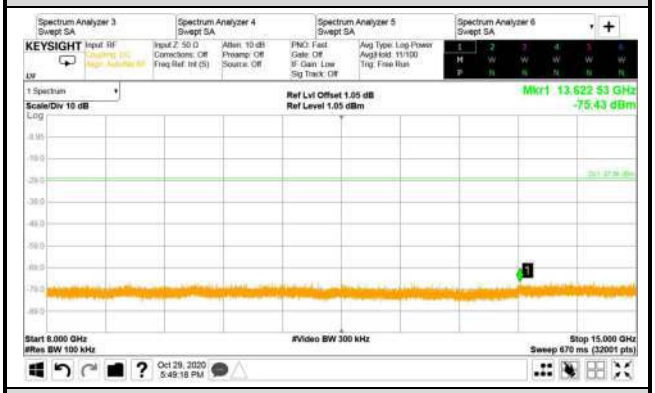
Reference Level



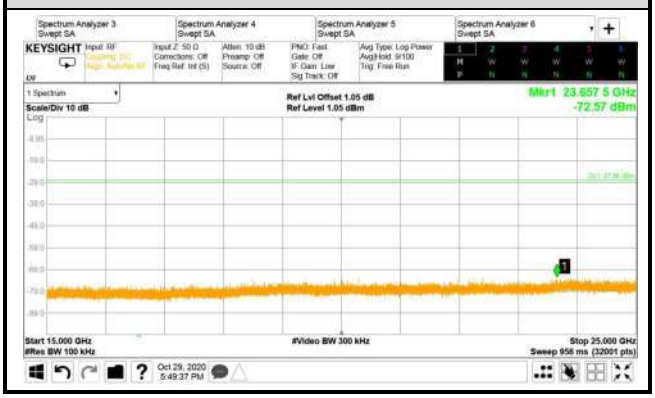
30MHz – 8GHz



8GHz – 15GHz



15GHz – 25GHz



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A.6 POWER SPECTRAL DENSITY

Test Date	2020/10/29 ~ 2021/06/04	Temp./Hum.	22-23℃/48-62%
Cable Loss	1.05dB	Test Voltage	DC 3.8V (via Battery)
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

A.6.1 Power Spectral Density Result

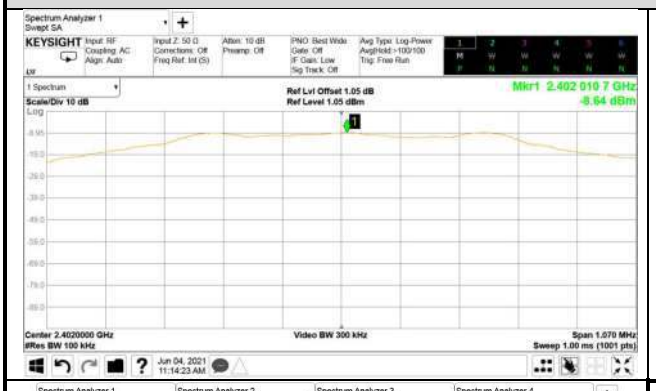
Mode	Centre Frequency (MHz)	Power Spectral Density (dBm)	Limit
BLE	2402	-8.64	< 8 dBm/3kHz
	2440	-8.00	
	2480	-7.99	

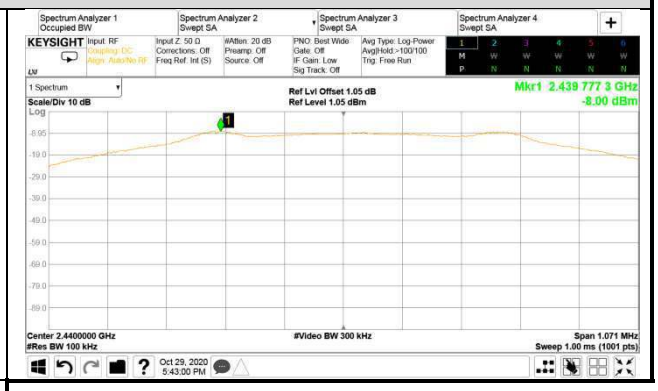
Note: 1. All results have been included cable loss and Simultaneous Factor.

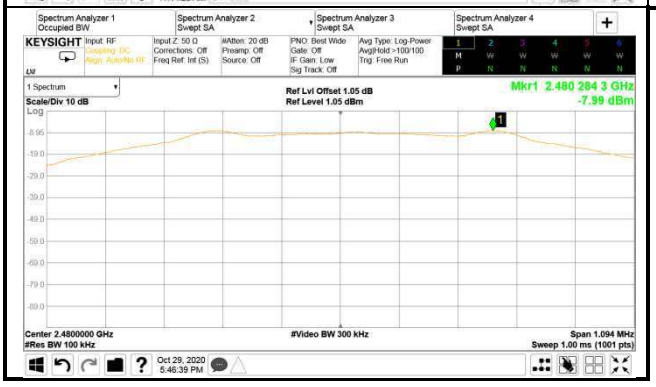
2. For KDB 558074 D01 v05, in the test result, when RBW set at 100kHz is stricter than 3kHz.

A.6.2 Measurement Plots

BLE







Note: All results have been included cable loss and Simultaneous Factor.

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: HR-131)

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