




TEST REPORT

For LORA

Report No. : **CHEW22090078** Report Verification: 

Project No...... : **SHT2103098303EW**

Applicant's name..... : **HARDWARIO a.s.**

Address..... : **U Jezu 525/4, 460 01 Liberec, CZECHIA**

Product Name : **CHESTER**

Trade Mark : **-**

Model No. : **CHESTER**

Listed Model(s) : **-**

Standard : **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

Date of receipt of test sample..... : **Jun. 29, 2022**

Date of testing..... : **Jun. 30, 2022- Sep. 20, 2022**

Date of issue..... : **Sep. 21, 2022**

Result..... : **PASS**

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Testing Laboratory Name : **Shenzhen Huatongwei International Inspection Co., Ltd.**

Address..... : **1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genuyu Road,
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The test report merely correspond to the test sample.

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1. TEST STANDARDS AND REPORT VERSION

1.1. Test Standards

The tests were performed according to following standards:

- [FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
- [ANSI C63.10:2013](#): American National Standard for Testing Unlicensed Wireless Devices
- [KDB 558074 D01 15.247 Meas Guidance v05r02](#): Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of The FCC Rules

1.2. Report version

Revision No.	Date of issue	Description
N/A	2022-09-21	Original

2. TEST DESCRIPTION

Report clause	Test Items	Standard Requirement	Result	Test Engineer
5.1	Antenna Requirement	15.203/15.247(c)	Pass	Pan Xie
	AC Conducted Emission	15.207	N/A	N/A
	Peak Output Power	15.247(b)(3)	Pass*	N/A
	Power Spectral Density	15.247(e)	Pass*	N/A
	6dB Bandwidth	15.247(a)(2)	Pass*	N/A
	99% Occupied Bandwidth	-	Pass*	N/A
	Conducted Band Edge and Spurious Emission	15.247(d)/15.205	Pass*	N/A
5.2	Radiated Band Edge Emission	15.205/15.209	PASS	Pan Xie
5.3	Radiated Spurious Emission	15.247(d)/15.205/15.209	PASS	Pan Xie

Note:

- 1) #1: The test result does not include measurement uncertainty value
- 2) *Refer to module FCC ID: VPYCMABZ

3. SUMMARY

3.1. Client Information

Applicant:	HARDWARIO a.s.
Address:	U Jezu 525/4, 460 01 Liberec, CZECHIA
Manufacturer:	HARDWARIO a.s.
Address:	U Jezu 525/4, 460 01 Liberec, CZECHIA

3.2. Product Description

Main unit information:	
Product Name:	CHESTER
Trade Mark:	-
Model No.:	CHESTER
Listed Model(s):	-
Power supply:	DC 3.6V from Primary lithium battery
Hardware version:	R3.2
Software version:	v1.0.0

3.3. Radio Specification Description

Support function ^{#2} :	LORA
Modulation:	Chip Spread Spectrum
Operation frequency:	903MHz~914.2MHz
Channel number:	8
Channel separation:	1.6MHz
Antenna type:	PCB antenna
Antenna gain ^{#3} :	3.5dBi

Note:

- #2: only show the RF function associated with this report.
- #3: The antenna gain is provided by the applicant, and the applicant should be responsible for its authenticity, HTW lab has not verified the authenticity of its information

3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China	
Connect information:	Tel: 86-755-26715499 E-mail: cs@szhtw.com.cn http://www.szhtw.com.cn	
Qualifications	Type	Accreditation Number
	FCC	762235

4. TEST CONFIGURATION

4.1. Test frequency list

According to section 15.31(m), regards to the operating frequency range over 10 MHz, must select three channels which were tested. The Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the below blue front.

Channel	Frequency (MHz)
CH-L	903.0
CH-M	907.8
CH-H	914.2

4.2. Descriptions of Test mode

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit (duty cycle>98%).
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit (duty cycle>98%). The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data Recorded in the report.

4.3. Test sample information

Test item	HTW sample no.
RF Radiated test items	YPHT21030983005

Note:

RF Radiated test items: Radiated Band Edge Emission, Radiated Spurious Emission

4.4. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The following peripheral devices and interface cables were connected during the measurement:

Whether support unit is used?			
✓ No			
Item	Equipment	Trade Name	Model No.
1			
2			

4.5. Testing environmental condition

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar

4.6. Statement of the measurement uncertainty

Test Item	Measurement Uncertainty
Radiated Emission (30MHz~1000MHz)	4.36 dB
Radiated Emissions (1GHz~25GHz)	5.10 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

4.7. Equipment Used during the Test

● Radiated emission-6th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0127	SAC-3m-02	C11121	2018/09/30	2023/09/29
●	EMI Test Receiver	R&S	HTWE0099	ESCI	100900	2022/08/30	2023/08/29
●	Loop Antenna	R&S	HTWE0170	HFH2-Z2	100020	2021/04/06	2024/04/05
●	Ultra-Broadband Antenna	SCHWARZBECK	HTWE0123	VULB9163	538	2021/04/06	2024/04/05
●	Pre-Amplifier	SCHWARZBECK	HTWE0295	BBV 9742	N/A	2021/11/05	2022/11/04
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-01	N/A	N/A	2022/02/25	2023/02/24
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-02	SUCOFLEX104	501184/4	2022/02/25	2023/02/24
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

● Radiated emission-7th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0122	SAC-3m-01	C11121	2018/09/27	2023/09/26
●	Spectrum Analyzer	R&S	HTWE0098	FSP40	100597	2022/08/25	2023/08/24
●	Horn Antenna	SCHWARZBECK	HTWE0126	9120D	1011	2020/04/01	2023/03/31
●	Broadband Horn Antenna	SCHWARZBECK	HTWE0103	BBHA9170	BBHA9170472	2020/04/27	2023/04/26
●	Pre-amplifier	CD	HTWE0071	PAP-0102	12004	2021/11/05	2022/11/04
●	Broadband Pre-amplifier	SCHWARZBECK	HTWE0201	BBV 9718	9718-248	2022/02/28	2023/02/27
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-01	6m 18GHz S Serisa	N/A	2022/02/25	2023/02/24
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-02	6m 3GHz RG Serisa	N/A	2022/02/25	2023/02/24
●	RF Connection Cable	HUBER+SUHNER	HTWE0119-05	6m 3GHz RG Serisa	N/A	2022/02/25	2023/02/24
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-04	6m 3GHz RG Serisa	N/A	2022/02/25	2023/02/24
●	Test Software	Audix	N/A	E3	N/A	N/A	N/A

5. TEST CONDITIONS AND RESULTS

5.1. Antenna Requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 15.203:

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 permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

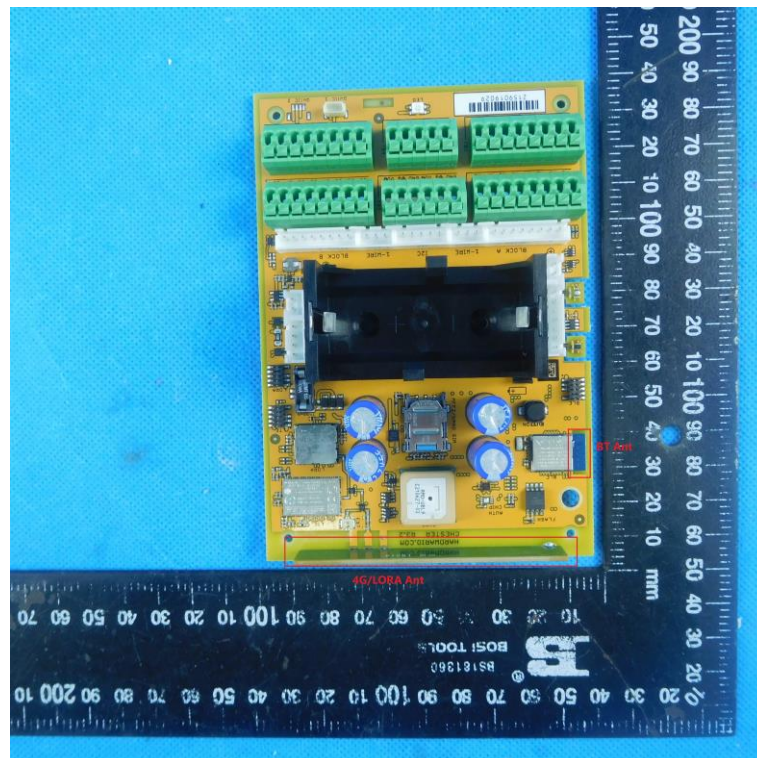
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

TEST RESULT

Passed Not Applicable

The antenna type is a PCB antenna, the directional gain of the antenna less than 6 dBi, please refer to the below antenna photo.



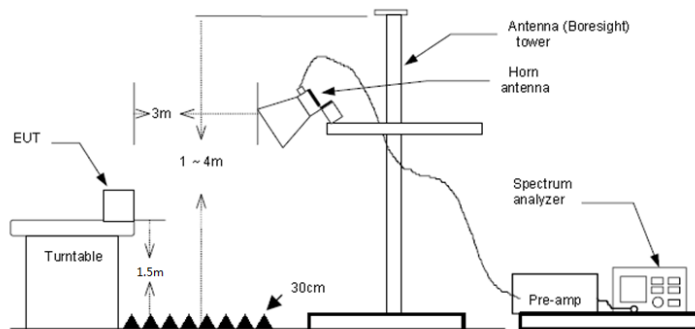
5.2. Radiated Band edge Emission

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, Radiated Emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the Radiated Emissions limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10 .
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10 on radiated measurement.
5. Use the following spectrum analyzer settings:
 - a) Span shall wide enough to fully capture the emission being measured
 - b) Set RBW=100kHz for <1GHz, VBW=3*RBW, Sweep time=auto, Detector=peak, Trace=max hold
 - c) Set RBW=1MHz, VBW=3MHz for >1GHz, Sweep time=auto, Detector=peak, Trace=max hold for Peak measurement

For average measurement:

 - VBW=10Hz, When duty cycle is no less than 98 percent
 - $VBW \geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation, so refer to this clause 5.6 duty cycle.

TEST MODE:

Please refer to the clause 4.2

TEST RESULT

Passed Not Applicable

Note:

- 1) Level= Reading + Factor; Factor =Antenna Factor+ Cable Loss- Preamp Factor
- 2) Over Limit = Level– Limit

Test channel:		CH-L			Polarity			Horizontal		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	902.00	15.30	22.90	10.87	0.00	49.07	83.16	-34.09	Peak	
2	903.28	69.38	22.91	10.87	0.00	103.16	83.16	20.00	Peak	

Test channel:		CH-L			Polarity			Vertical		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	902.00	12.75	22.90	10.87	0.00	46.52	78.78	-32.26	Peak	
2	902.72	65.00	22.91	10.87	0.00	98.78	78.78	20.00	Peak	

Test channel:		CH-H			Polarity			Horizontal		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	914.47	70.89	22.93	10.90	0.00	104.72	84.72	20.00	Peak	
2	928.00	12.32	22.96	10.94	0.00	46.22	84.72	-38.50	Peak	

Test channel:		CH-H			Polarity			Vertical		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	914.47	64.17	22.93	10.90	0.00	98.00	78.00	20.00	Peak	
2	928.00	11.38	22.96	10.94	0.00	45.28	78.00	-32.72	Peak	

NOTE: The limit is calculated by 20dB down from fundamental peak

5.3. Radiated Spurious Emission

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209

Frequency	Limit (dBuV/m)	Value
0.009 MHz ~0.49 MHz	2400/F(kHz) @300m	Quasi-peak
0.49 MHz ~ 1.705 MHz	24000/F(kHz) @30m	Quasi-peak
1.705 MHz ~30 MHz	30 @30m	Quasi-peak

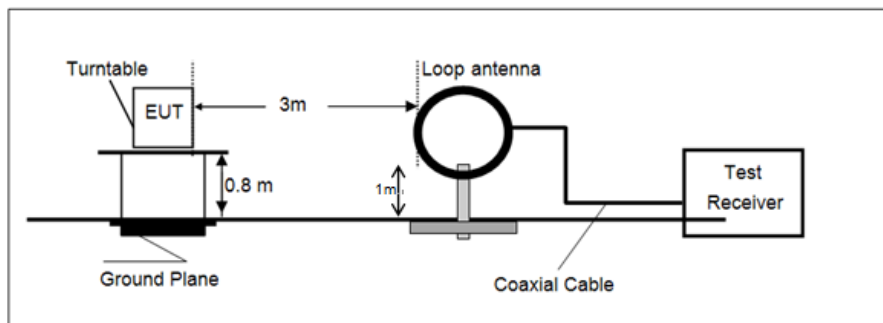
Note: Limit dBuV/m @3m = Limit dBuV/m @300m + 40*log(300/3)= Limit dBuV/m @300m +80,

Limit dBuV/m @3m = Limit dBuV/m @30m +40*log(30/3)= Limit dBuV/m @30m + 40.

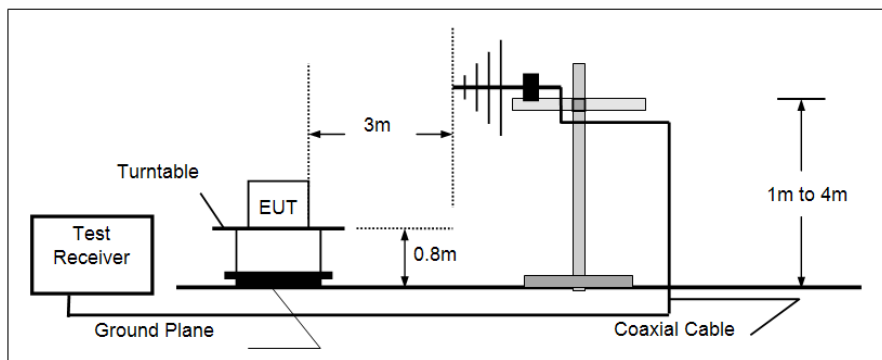
Frequency	Limit (dBuV/m @3m)	Value
30MHz~88MHz	40.00	Quasi-peak
88MHz~216MHz	43.50	Quasi-peak
216MHz~960MHz	46.00	Quasi-peak
960MHz~1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

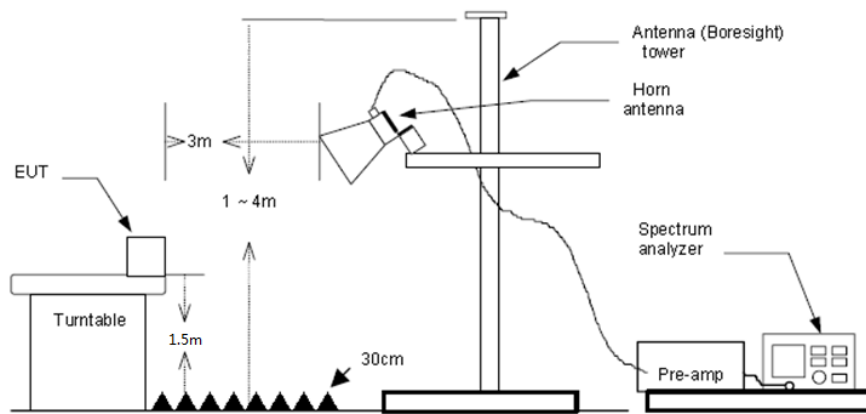
- 9 kHz ~ 30 MHz



- 30 MHz ~ 1 GHz



- Above 1 GHz



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10 .
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
 - a) Span shall wide enough to fully capture the emission being measured;
 - b) Below 1 GHz:
 - RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;
 - If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
 - c) Set RBW=1MHz, VBW=3MHz for >1GHz, Sweep time=auto, Detector=peak, Trace=max hold for Peak measurement
 - For average measurement:
 - VBW=10Hz, When duty cycle is no less than 98 percent
 - $VBW \geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation, so refer to this clause 5.6 duty cycle.

TEST MODE:

Please refer to the clause 4.2

TEST RESULT

Passed **Not Applicable**

Note:

- 1) $Level = Reading + Factor/Transd$; $Factor/Transd = Antenna\ Factor + Cable\ Loss - Preamp\ Factor$
- 2) $Over\ Limit = Level - Limit$
- 3) Average measurement was not performed if peak level is lower than average limit(54 dBuV/m) for above 1GHz.

FOR 9 kHz ~ 30 MHz

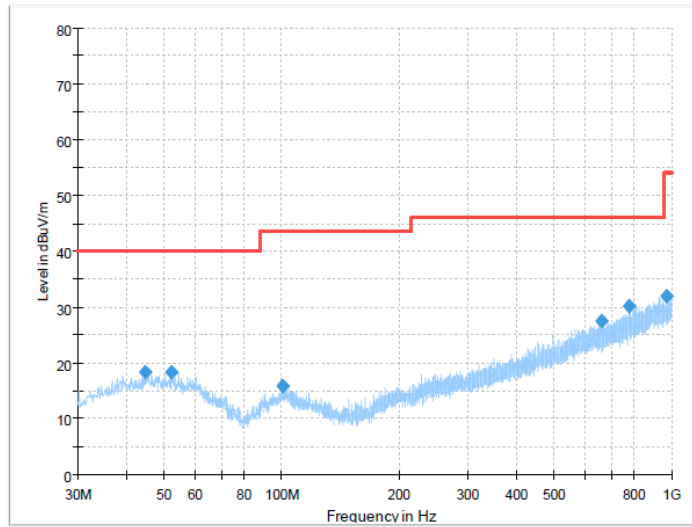
The EUT was pre-scanned this frequency band, found the radiated level 20dB lower than the limit, so don't show data on this report.

FOR 30 MHz ~ 1000 MHz

Have pre-scan all test channel, found CH-L which it was worst case, so only show the worst case's data on this report.

Polarization:

Horizontal



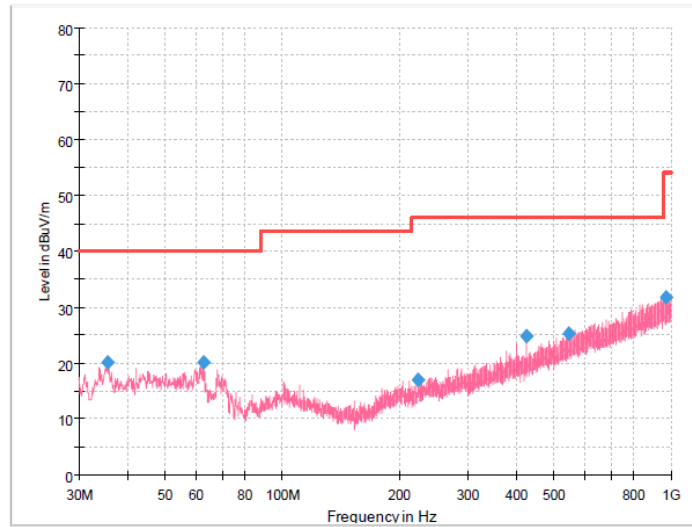
Serif,

Final Result

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
44.550000	18.31	40.00	21.69	100.0	H	111.0	-9.4
52.067500	18.42	40.00	21.58	100.0	H	151.0	-9.3
100.931250	15.96	43.50	27.54	100.0	H	188.0	-10.8
662.197500	27.57	46.00	18.43	100.0	H	170.0	1.6
778.718750	30.16	46.00	15.84	100.0	H	291.0	3.9
969.323750	32.05	54.00	21.95	100.0	H	303.0	7.5

Polarization:

Vertical



Serif,

Final Result

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
35.456250	20.13	40.00	19.87	100.0	V	339.0	-11.0
62.616250	20.18	40.00	19.82	100.0	V	238.0	-10.8
224.121250	16.89	46.00	29.11	100.0	V	297.0	-10.0
423.698750	24.88	46.00	21.12	100.0	V	309.0	-3.8
547.858750	25.28	46.00	20.72	100.0	V	290.0	-0.5
968.112500	31.66	54.00	22.34	100.0	V	320.0	7.5

NOTE: For blocking the fundamental A Notch filter was used in the testing

FOR 1 GHz ~ 10 GHz

Test channel		CH-L			Polarity			Horizontal		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	1065.71	49.93	25.26	2.60	36.96	40.83	74.00	-33.17	Peak	
2	2129.79	49.06	27.46	3.71	37.32	42.91	74.00	-31.09	Peak	
3	3552.58	42.25	29.31	4.87	36.80	39.63	74.00	-34.37	Peak	
4	8145.93	37.59	37.02	7.70	33.40	48.91	74.00	-25.09	Peak	

Test channel		CH-L			Polarity			Vertical		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	2124.37	55.41	27.39	3.71	37.30	49.21	74.00	-24.79	Peak	
2	5762.24	45.80	31.92	6.63	34.86	49.49	74.00	-24.51	Peak	
3	7227.39	40.12	36.45	7.24	34.03	49.78	74.00	-24.22	Peak	
4	8145.93	39.09	37.02	7.70	33.40	50.41	74.00	-23.59	Peak	

Test channel		CH-M			Polarity			Horizontal		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	1063.00	49.43	25.25	2.59	36.96	40.31	74.00	-33.69	Peak	
2	1993.40	45.39	26.07	3.61	37.06	38.01	74.00	-35.99	Peak	
3	3498.74	41.50	29.09	4.79	36.61	38.77	74.00	-35.23	Peak	
4	8063.40	36.57	37.20	7.65	33.32	48.10	74.00	-25.90	Peak	

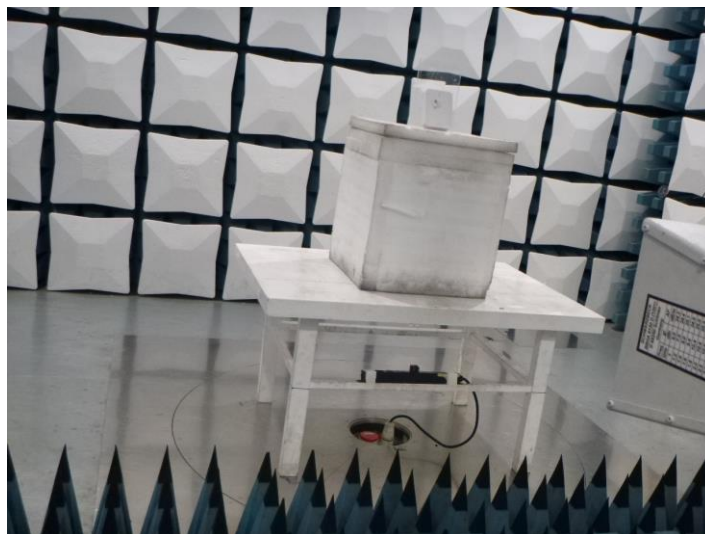
Test channel		CH-M			Polarity			Vertical		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	1668.04	52.37	25.10	3.25	37.18	43.54	74.00	-30.46	Peak	
2	2124.37	49.48	27.39	3.71	37.30	43.28	74.00	-30.72	Peak	
3	5762.24	46.80	31.92	6.63	34.86	50.49	74.00	-23.51	Peak	
4	8166.69	38.45	36.90	7.71	33.43	49.63	74.00	-24.37	Peak	

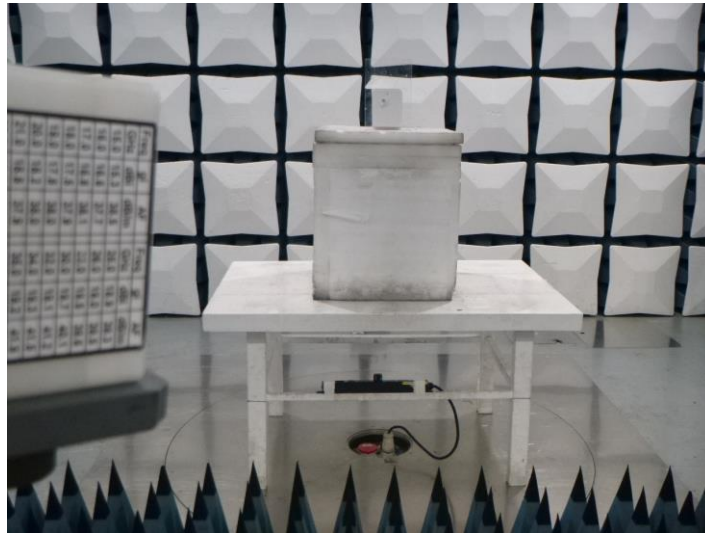
Test channel		CH-H			Polarity			Horizontal		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	1998.48	47.15	26.09	3.62	37.07	39.79	74.00	-34.21	Peak	
2	2352.08	46.82	27.80	3.94	37.51	41.05	74.00	-32.95	Peak	
3	5762.24	41.18	31.92	6.63	34.86	44.87	74.00	-29.13	Peak	
4	8002.06	37.36	37.10	7.61	33.31	48.76	74.00	-25.24	Peak	

Test channel		CH-H			Polarity			Vertical		
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark	
1	1663.80	51.34	25.10	3.24	37.19	42.49	74.00	-31.51	Peak	
2	2124.37	54.55	27.39	3.71	37.30	48.35	74.00	-25.65	Peak	
3	5762.24	46.07	31.92	6.63	34.86	49.76	74.00	-24.24	Peak	
4	7301.36	39.05	36.40	7.30	34.12	48.63	74.00	-25.37	Peak	

6. TEST SETUP PHOTOS

Radiated Emission





7. EXTERNAL AND INTERNAL PHOTOS

Refer to the test report No.: CHTEW22090074

-----END OF REPORT-----