

Shenzhen CTL Testing Technology Co., Ltd. Tel: +86-755-89486194 E-mail: ctl@ctl-lab.com

TE	EST REPORT FCC PART 15.247				
Report Reference No.:	CTL2405071031-WF01				
Compiled by: ( position+printed name+signature)					
Tested by: ( position+printed name+signature)	Yapeng Jin (Test Engineer)				
Approved by: ( position+printed name+signature)	Ivan Xie (Manager)				
Product Name:	Smart watch				
Model/Type reference	E31				
List Model(s)	N/A				
Trade Mark	Letsfit				
FCC ID	2BAS2-E31				
Applicant's name:	HOTOEM Information Technology Company Limited				
Address of applicant	Flat 1908,19/F,Harbour Center,25 Harbour Road,Wan Chai,Hong Kong				
Test Firm	Shenzhen CTL Testing Technology Co., Ltd.				
Address of Test Firm	Zone A, 1st Floor, Warehouse 2, Baisha Logistics Company, No. 3011 Shahe West Road, Nanshan District, Shenzhen				
Test specification:					
Standard:	<b>FCC Part 15.247:</b> Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.				
TRF Originator					
Master TRF					
Date of receipt of test item:	May 13, 2024				
Date of Test Date	May 14, 2024 - May 24,2024				
Date of Issue	May 27, 2024				
Result	esult Pass				
Shenzhen CTL Testing Technolog	y Co., Ltd. All rights reserved.				

This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen CTL Testing Technology Co., Ltd. is acknowledged as copyright owner and source of the material. Shenzhen CTL Testing Technology Co., Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

# **TEST REPORT**

Test Report No. :	CTL	2405071031-	WF01	May 27, 2024 Date of issue
			6 T	
Equipment under Test	:	Smart watch		
Sample No	:	CTL24050710	031	
Model /Type	-	E31		
Listed Models	:	N/A		
Applicant	:	HOTOEM Inf Limited	ormation Tec	chnology Company
Address	:	Flat 1908,19/ Chai,Hong Ko		nter,25 Harbour Road,Wan
Manufacturer	:	Chongqing z	houhai intel	ligent technology Co.,Ltd.
Address	:		ue Road, Shu	g Intelligent Industrial Park, angfengqiao Street, Yubei
Test res	ult			Pass *

\*In the configuration tested, the EUT complied with the standards specified page 5.

The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.



## Page 3 of 45

# \*\* Modified History \*\*

Revisions	Description	<b>Issued Data</b>	Report No.	Remark
Version 1.0	Initial Test Report Release	2024-05-27	CTL2405071031-WF01	Tracy Qi
		100		
1.04	0		6	

## V1.0

Table of Contents	Page
1. SUMMARY	5
1.1. TEST STANDARDS	
1.3. TEST FACILITY	
1.4. Statement of the measurement uncertainty	6
2. GENERAL INFORMATION	8
2.1. Environmental conditions	
2.2. GENERAL DESCRIPTION OF EUT	8
2.3. DESCRIPTION OF TEST MODES AND TEST FREQUENCY	9
2.4. EQUIPMENTS USED DURING THE TEST	
2.5. Related Submittal(s) / Grant (s)	
2.6. MODIFICATIONS	
3. TEST CONDITIONS AND RESULTS	
3.1. Conducted Emissions Test	
3.2. RADIATED EMISSIONS AND BAND EDGE	
3.3. Maximum Peak Output Power	
3.4. 20dB Bandwidth	
3.5. FREQUENCY SEPARATION	
3.6. NUMBER OF HOPPING FREQUENCY	
3.7. TIME OF OCCUPANCY (DWELL TIME)	
3.8. Out-of-band Emissions	
3.9. PSEUDORANDOM FREQUENCY HOPPING SEQUENCE	
3.10. Antenna Requirement	
4. TEST SETUP PHOTOS OF THE EUT	
5. PHOTOS OF THE EUT	





## 1. SUMMARY

## **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 v05r02: KDB558074 D01 15.247 Meas Guidance v05r02

## 1.2. Test Description

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i)	20dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Peak Output Power	PASS
FCC Part 15.247(a)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1)	Frequency Separation	PASS
FCC Part 15.205/15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge Compliance of RF Emission	PASS
FCC Part 15.203/15.247 (b)	Antenna Requirement	PASS



## 1.3. Test Facility

## 1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.

Zone A, 1st Floor, Warehouse 2, Baisha Logistics Company, No. 3011 Shahe West Road, Nanshan District, Shenzhen

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.10 and CISPR 32/EN 55032 requirements.

### 1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

## CNAS-Lab Code: L7497

Shenzhen CTL Testing Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

## A2LA-Lab Cert. No. 4343.01

Shenzhen CTL Testing Technology Co., Ltd, EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

## IC Registration No.: 9618B

## CAB identifier: CN0041

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 9618B on Jan. 22, 2019.

## FCC-Registration No.: 399832

## **Designation No.: CN1216**

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832, December 08, 2017.

## 1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power Radiated	±2.20 dB	(1)
Radiated Emission9KHz~30MHz	±3.66dB	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
20dB Emission Bandwidth	±1.9%	(1)
Carrier Frequency Separation	±1.9%	(1)

Maximum Power Spectral Density Level	±0.98 dB	(1)
Number of Hopping Channel	±1.9%	(1)
Time of Occupancy	±0.11%	(1)
Max Peak Conducted Output Power	±0.98 dB	(1)
Band-edge Spurious Emission	±1.21dB	(1)
	9kHz-7GHz:±1.09dB	
Conducted RF Spurious Emission	7GHz-26.5GHz: ±	(1)
	3.27dB	

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

## 2. GENERAL INFORMATION

## 2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

## 2.2. General Description of EUT

Product Name:	Smart watch
Model/Type reference:	E31
Power supply:	DC 3.8V from battery
Bluetooth:	
Version:	Supported BR/EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Monopole Antenna
Antenna gain:	-1.74dBi

Note1: For more details, please refer to the user's manual of the EUT. Note2: Antenna gain provided by the applicant.

## 2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

### **Operation Frequency :**

Channel	Frequency (MHz)	
00	2402	
01	2403	
38	2440	
39	2441	
40	2442	
77	2479	
78	2480	

Preliminary tests were performed in each mode and packet length of BT, and found worst case as bellow, finally test were conducted at those mode and recorded in this report.

Test Items	Worst case		
Conducted Emissions	DH5 Middle channel		
Radiated Emissions and Band Edge	DH5		
Maximum Conducted Output Power	DH5/2DH5/3DH5		
20dB Bandwidth	DH5/2DH5/3DH5		
Frequency Separation	DH5/2DH5/3DH5 Middle channel		
Number of hopping frequency	DH5/2DH5/3DH5		
Time of Occupancy (Dwell Time)	DH1/DH3/DH5 Middle channel 2DH1/2DH3/2DH5 Middle channel 3DH1/3DH3/3DH5 Middle channel		
Out-of-band Emissions	DH5/2DH5/3DH5		

## 2.4. Equipments Used during the Test

Conduc	cted Emission			L Pro		
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal.Due
EMI	Test Receiver	ROHDE & SCHWARZ	ESCI	1166.5950.03	2024/04/30	2025/04/29
	LISN	R&S	ESH2-Z5	860014/010	2024/04/30	2025/04/29
Limitator ROHDE & ESH3-Z		ESH3-Z2	100408	2024/04/30	2025/04/29	
Software:						
Name of Software:					Version:	1
ES-K1		V1.71				

and Edge					
Manufacturer	Model N	No.	Serial No.	Calibration Date	Calibration Due Date
Da Ze	ZN3090	00A	/	2024/04/30	2025/04/29
Schwarzbeck			824	2023/02/13	2026/02/12
Sunol Sciences Corp.	DRH-1	18	A062013	2021/12/23	2024/12/22
Amplifier Agilent				2024/04/30	2025/04/29
Amplifier Brief&Smart L				2024/05/03	2025/05/02
EMI Test Receiver R&S E				2024/04/30	2025/04/29
Keysight	N9020	A (	MY53420874	2024/05/01	2025/04/30
100	1			10	100
oftware		Version			
ow 1GHz)		V1.1.4.2			
ve 1GHz)				V1.1.4.2	
	Manufacturer Da Ze Schwarzbeck Sunol Sciences Corp. Agilent Brief&Smart R&S Keysight Keysight	Manufacturer Model N   Da Ze ZN3090   Da Ze ZN3090   Schwarzbeck VULE   9168   Sunol DRH-1   Sciences DRH-1   Corp. Agilent   Agilent 84491   Brief&Smart LNA-40   R&S ESC   Keysight N9020   oftware out 1GHz)	ManufacturerModel No.Da ZeZN30900ADa ZeZN30900ASchwarzbeckVULB 9168Sunol Sciences Corp.DRH-118Sunol Sciences Corp.DRH-118Agilent8449BBrief&SmartLNA-4018R&SESCIKeysightN9020AoftwareImage: Second Sec	ManufacturerModel No.Serial No.Da ZeZN30900A/Da ZeZN30900A/SchwarzbeckVULB 9168824Sunol Sciences Corp.DRH-118A062013Agilent8449B3008A02306Brief&SmartLNA-40182104197R&SESCI1166.5950.03KeysightN9020AMY53420874oftwareow 1GHz)	ManufacturerModel No.Serial No.Calibration DateDa ZeZN30900A/2024/04/30Da ZeZN30900A/2024/04/30SchwarzbeckVULB 91688242023/02/13Sunol Sciences Corp.DRH-118A0620132021/12/23Agilent8449B3008A023062024/04/30Brief&SmartLNA-401821041972024/05/03R&SESCI1166.5950.032024/04/30KeysightN9020AMY534208742024/05/01oftwareVersionV1.1.4.2

Maximum Peak Output Power & 20dB Bandwidth & Frequency Separation & Number of hopping frequency & Dwell Time & Out-of-band Emissions

inclucing a price rune o						
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date	
Spectrum Analyzer	Keysight	N9020A	MY53420874	2024/05/01	2025/04/30	
Temperature/Humidity Meter Ji Yu		MC501	1	2024/05/04	2025/05/03	
Test Software		100				
Name of Software Version						
TST-PA	SS		V2.0			

## 2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.6. Modifications

No modifications were implemented to meet testing criteria.



# 3. TEST CONDITIONS AND RESULTS

## 3.1. Conducted Emissions Test

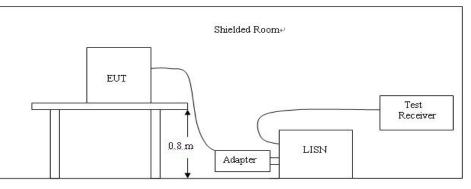
## LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

	Limit (d	BuV)
Frequency range (MHz)	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.

## **TEST CONFIGURATION**



## TEST PROCEDURE

- 1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
- 2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
- 3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
- 4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5. All support equipments received AC power from a second LISN, if any.
- 6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8. During the above scans, the emissions were maximized by cable manipulation.

### TEST RESULTS

40 ----30 ----20 -----10 ------10 ------20 150k

Remark: All modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High

channel; only the worst result of GFSK Low Channel was reported as below:

Shenzhen CTL Testing Technology Co., Ltd.     Voltage Mains Test FCC PART 15 C     EUT:   E31     Manufacturer:   HOTOEM Information Technology Company Limited     Operating Condition:   BT 2402MHz     Test Site:   /     Operator:   JYP     Test Specification:   AC 120V/60Hz     Comment:   /     Start of Test:   5/16/2024 / 9:07:44AM     SCAN TABLE:   "Voltage (9K-30M) FIN" Short Description:	Voltage Mains Test FCC PART 15 C     EUT:   E31     Manufacturer:   HOTOEM Information Technology Company Limited     Operating Condition:   BT 2402MHz     Test Site:   /     Operator:   JYP     Test Specification:   AC 120V/60Hz     Comment:   /     Start of Test:   5/16/2024 / 9:07:44AM	
EUT: E31 Manufacturer: HOTOEM Information Technology Company Limited Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	EUT: E31 Manufacturer: HOTOEM Information Technology Company Limited Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level[dBµV] 70 60	
Manufacturer: HOTOEM Information Technology Company Limited Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Manufacturer: HOTOEM Information Technology Company Limited Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage	
Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Operating Condition: BT 2402MHz Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 	
Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Test Site: / Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 	
Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Operator: JYP Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 60	
Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Test Specification: AC 120V/60Hz Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M)FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 60	
Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Comment: / Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 	
Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN"	Start of Test: 5/16/2024 / 9:07:44AM SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 60	
SCAN TABLE: "Voltage (9K-30M) FIN"	SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level[dBµV] 70 60	
SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage	Short Description:     150K-30M Voltage       Level [dBµV]     70       60	
70		

2M

Frequency [Hz]

3M

4M 5M 6M

8M 10M

20M

30M

#### MEASUREMENT RESULT: "CTL240516009 fin"

600k 800k 1M

300k

x x MES CTL240516009\_fin

400k

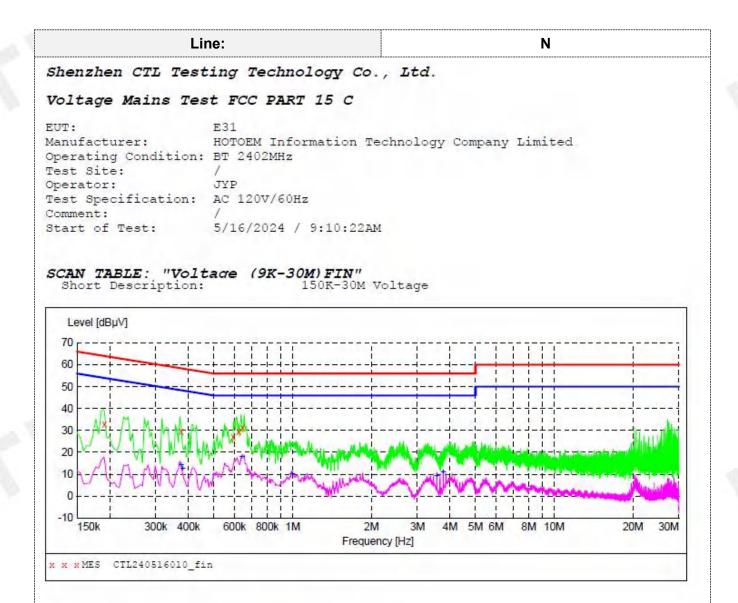
5/16/2024 9:10AM Frequency Level Transd Limit Margin Detector Line PE MHz dBuV dB dBuV dB 0.379500 29.70 10.0 58 28.6 QP L1 GND 0.636000 32.90 10.0 56 23.1 QP L1 GND 33.20 22.8 0.640500 10.0 56 QP L1 GND 23.0 0.645000 33.00 10.0 56 L1 GND QP 0.654000 32.00 10.0 56 24.0 L1 GND QP

#### MEASUREMENT RESULT: "CTL240516009 fin2"

5/16/2024	9:10AM						
Frequency MH:		Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.379500	11.20	10.0	48	37.1	AV	L1	GND
0.604500	17.00	10.0	46	29.0	AV	L1	GND
0.645000	20.60	10.0	46	25.4	AV	L1	GND
1.855500	11.80	10.1	46	34.2	AV	L1	GND
3.763500	12.80	10.1	46	33.2	AV	L1	GND
3.862500	11.30	10.1	46	34.7	AV	L1	GND

#### V1.0

#### Page 14 of 45



#### MEASUREMENT RESULT: "CTL240516010 fin"

5/16/2024 9:1	2AM						
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.190500	33.00	10.0	64	31.0	QP	N	GND
0.375000	29.40	10.0	58	29.0	QP	N	GND
0.591000	26.90	10.0	56	29.1	QP	N	GND
0.622500	29.50	10.0	56	26.5	QP	N	GND
0.645000	31.10	10.0	56	24.9	QP	N	GND

#### MEASUREMENT RESULT: "CTL240516010 fin2"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.375000	14.10	10.0	48	34.3	AV	N	GND
0.379500	12.40	10.0	48	35.9	AV	N	GND
0.640500	18.10	10.0	46	27.9	AV	N	GND
0.996000	9.90	10.1	46	36.1	AV	N	GND
3.561000	9.20	10.1	46	36.8	AV	N	GND
3.763500	10.70	10.1	46	35.3	AV	N	GND

V1.0

## 3.2. Radiated Emissions and Band Edge

## Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

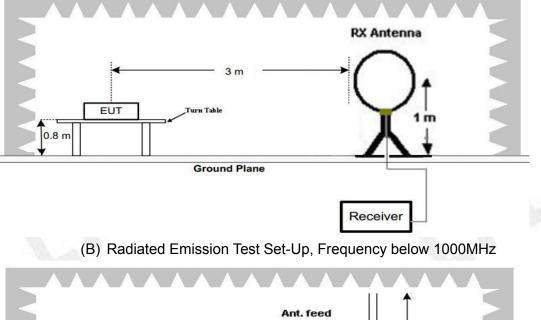
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

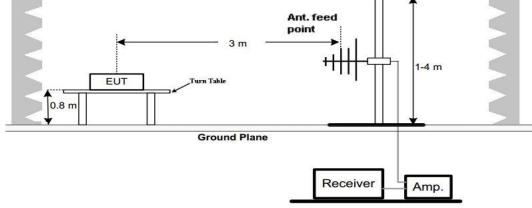
	Radiated emission limits								
Frequency (MHz)	Distance (Meters)	Radiated (dBµV/m)	Radiated (µV/m)						
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)						
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)						
1.705-30	3	20log(30)+ 40log(30/3)	30						
30-88	3	40.0	100						
88-216	3	43.5	150						
216-960	3	46.0	200						
Above 960	3	54.0	500						

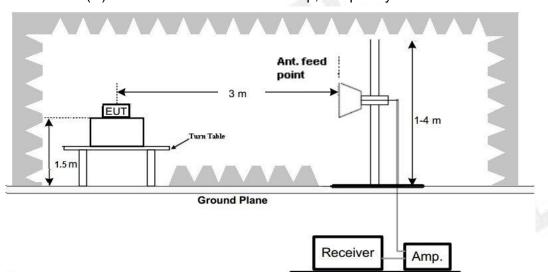
Radiated emission limits

### **TEST CONFIGURATION**









(C) Radiated Emission Test Set-Up, Frequency above 1000MHz

### **Test Procedure**

- Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
- 2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
- 3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4. Repeat above procedures until all frequency measurements have been completed.
- 5. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement –X, Y, and Z-plane. The X-plane results were found as the worst case and were shown in this report.

#### **TEST RESULTS**

Remark:

- 1. We measured Radiated Emission at GFSK,  $\pi/4$  DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode..
- 2. For below 1GHz testing recorded worst at GFSK DH5 low channel.
- Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, Found the emission level are attenuated 20dB below the limits from 9 kHz to 30MHz, so it does not recorded in report.

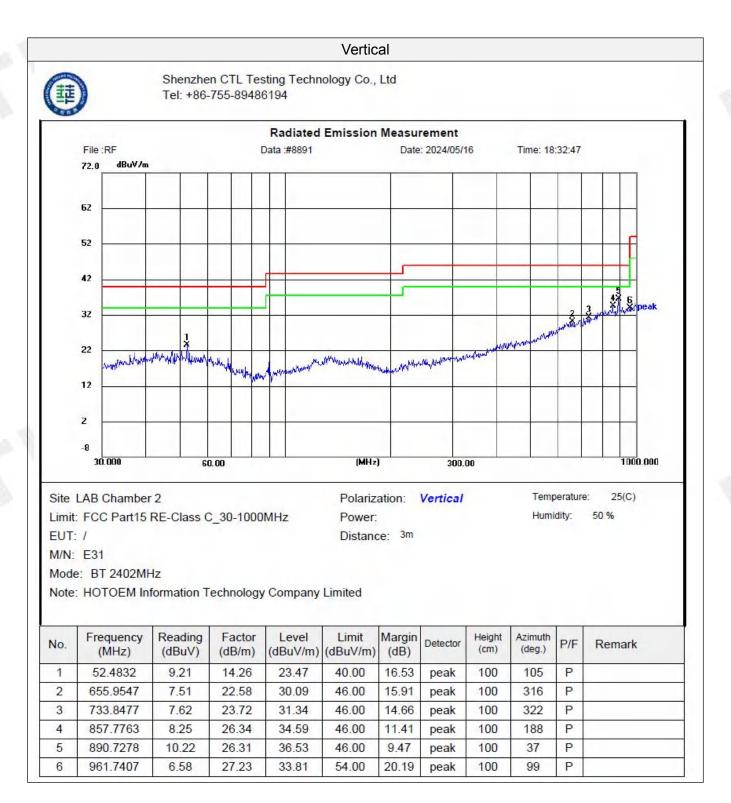
V1.0

#### Page 17 of 45

### For 30MHz-1GHz

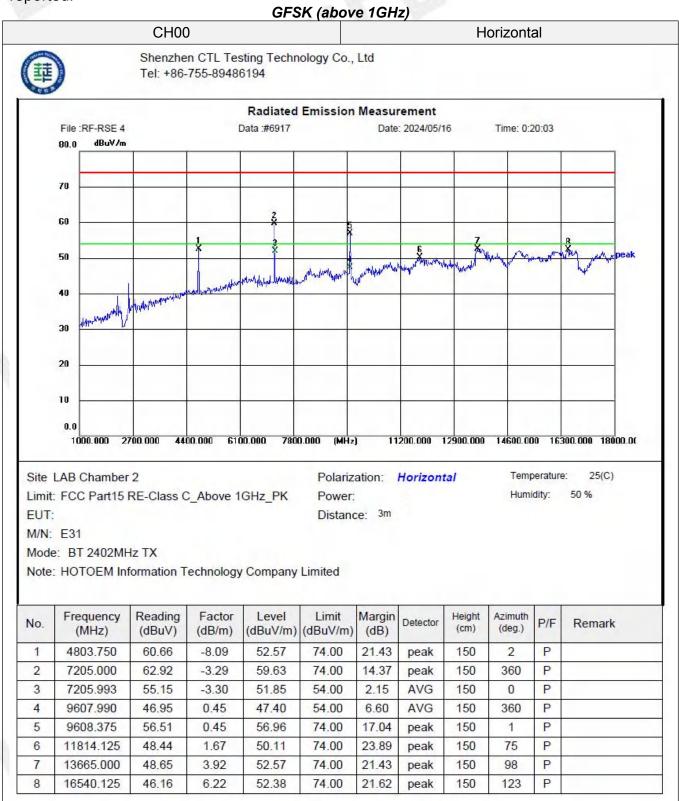


#### Page 18 of 45

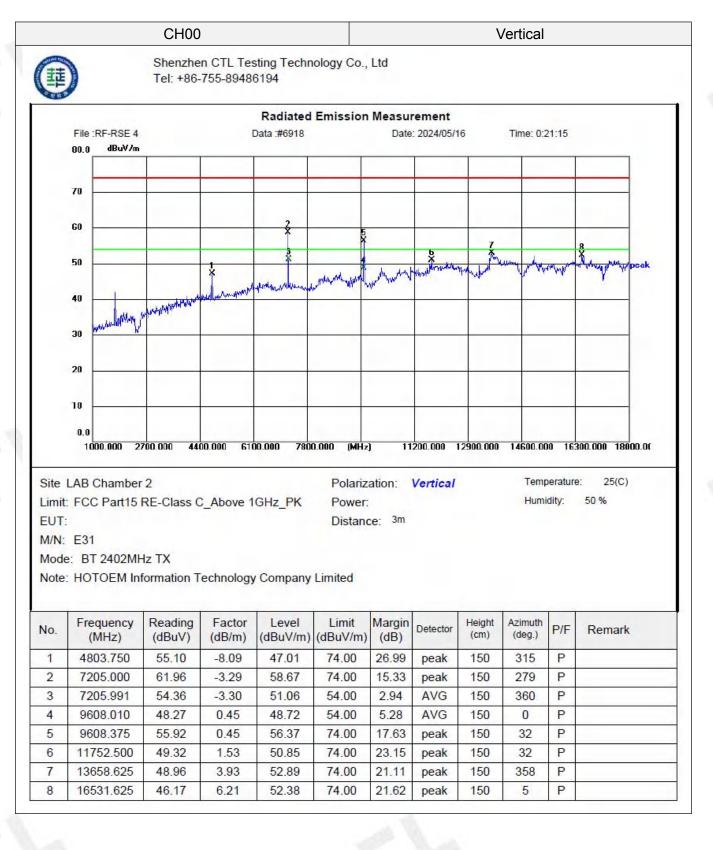


#### For 1GHz to 25GHz

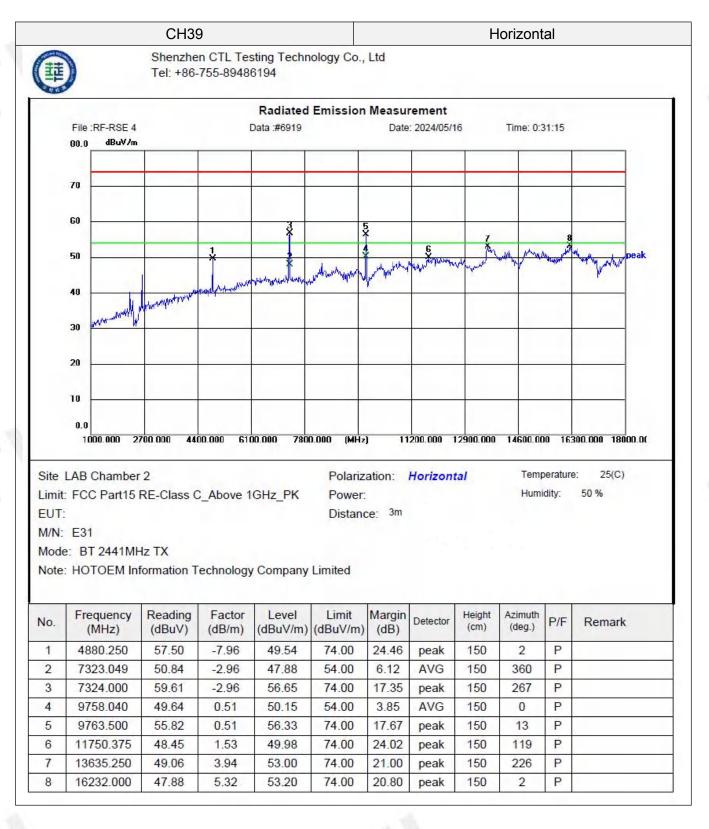
Note: GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.



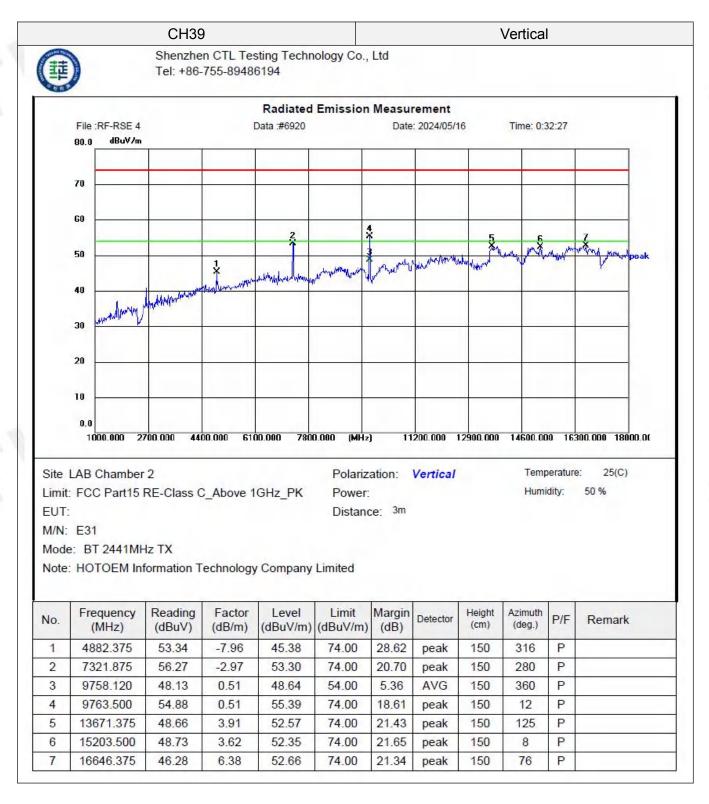
#### Page 20 of 45



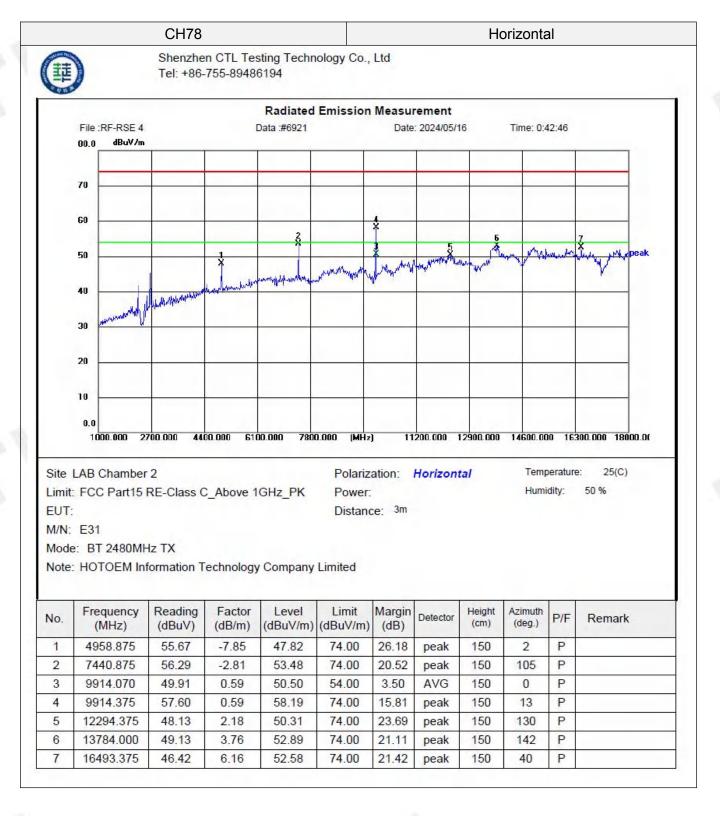
#### Page 21 of 45



#### Page 22 of 45

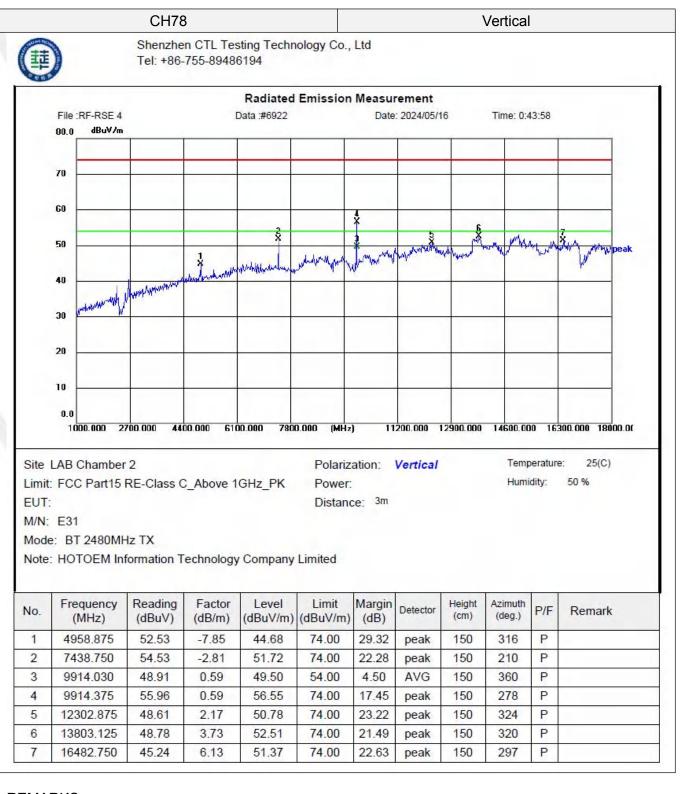


#### Page 23 of 45



#### Page 24 of 45

Report No.: CTL2405071031-WF01



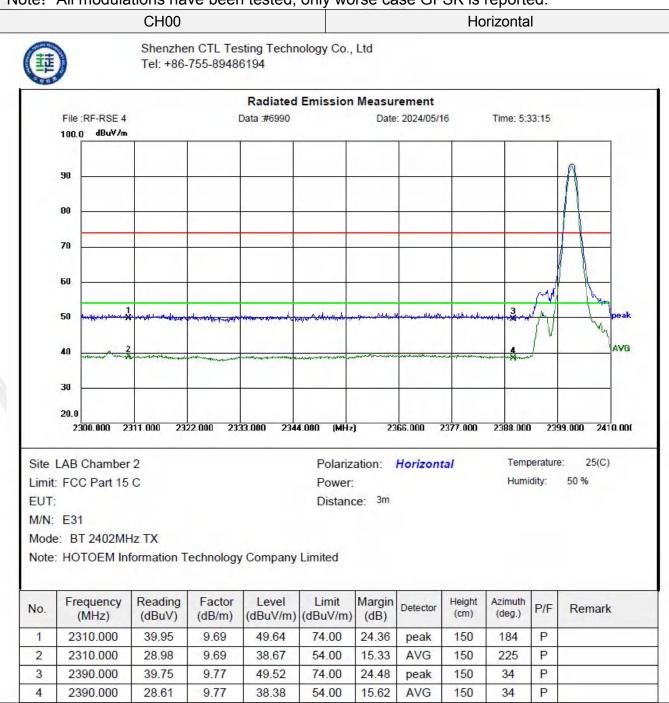
#### **REMARKS**:

- 1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 3. Margin value = Limit value- Emission level.
- 4. PK detector measurement value is lower than the average limit. Therefore, there is no need to test AV detector measurements.
- 5. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
- 6. Other emissions are attenuated 20dB below the limits from 9kHz to 30MHz, so it does not recorded in report.
- 7. 18GHz-26GHz not recorded for no spurious point have a margin of less than 6 dB with respect to the limits.

#### Page 25 of 45

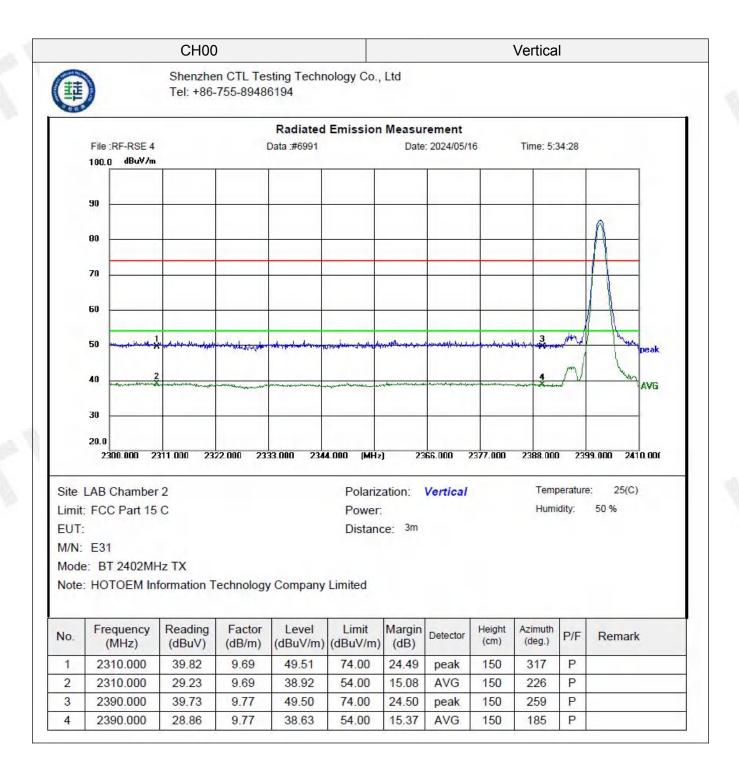
#### Results of Band Edges Test (Radiated)

Note: All modulations have been tested, only worse case GFSK is reported.





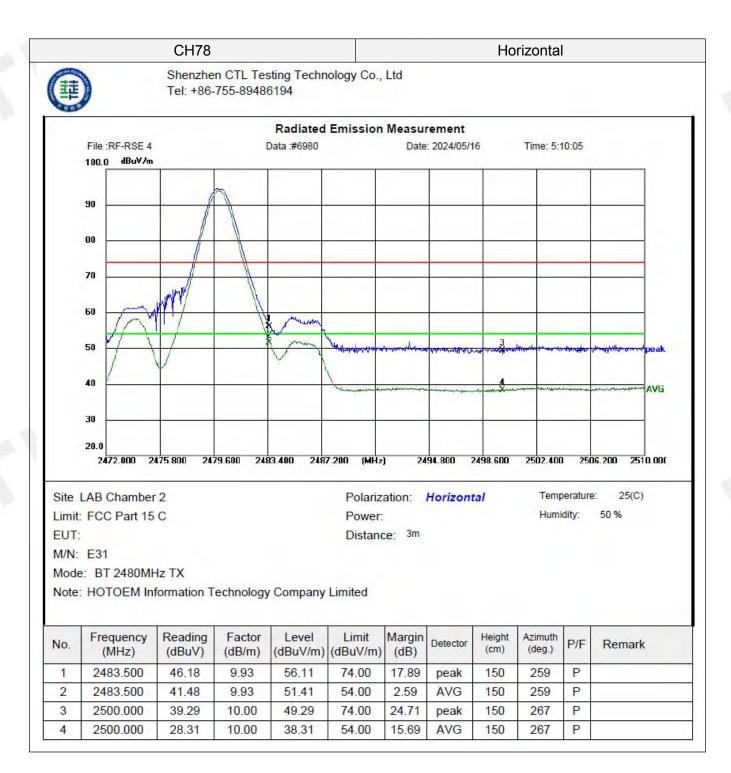
#### Page 26 of 45





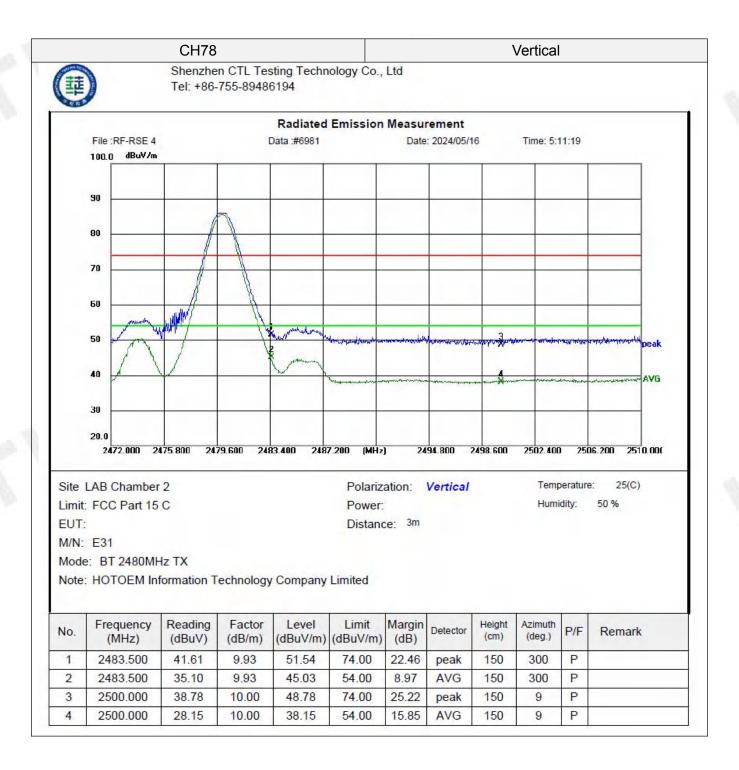
V1.0

#### Page 27 of 45





#### Page 28 of 45





## 3.3. Maximum Peak Output Power

## Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

### Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum.

### **Test Configuration**



### Test Results

Raw data reference to Section 2 of document No. CTL2405071031-WF01\_Appendix of BT.

## 3.4. 20dB Bandwidth

## <u>Limit</u>

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

## Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 91 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

## **Test Configuration**



## Test Results

Raw data reference to Section 1 of document No. CTL2405071031-WF01\_Appendix of BT.

## 3.5. Frequency Separation

### LIMIT

According to 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3\*20dB bandwidth of the hopping channel, whichever is greater.

### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with300 KHz RBW and 300 KHz VBW.

### **TEST CONFIGURATION**



### TEST RESULTS

Raw data reference to Section 3 of document No. CTL2405071031-WF01\_Appendix of BT.

## **3.6. Number of hopping frequency**

## Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

### Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 300 KHz RBW and 300 KHz VBW.

## **Test Configuration**



### Test Results

Raw data reference to Section 4 of document No. CTL2405071031-WF01\_Appendix of BT.

## 3.7. Time of Occupancy (Dwell Time)

## <u>Limit</u>

The average time of occupancy on any channel shall not be greater than 400 milliseconds within a period of 400 milliseconds multiplied by the number of hopping channels employed.

## Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 910 KHz RBW and 910 KHz VBW, Span 0Hz.

## **Test Configuration**



## Test Results

Raw data reference to Section 5 of document No. CTL2405071031-WF01\_Appendix of BT.

## 3.8. Out-of-band Emissions

### 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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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.

### Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

### Test Configuration



#### Test Results

Raw data reference to Section 6 of document No. CTL2405071031-WF01\_Appendix of BT.

## 3.9. Pseudorandom Frequency Hopping Sequence

### TEST APPLICABLE

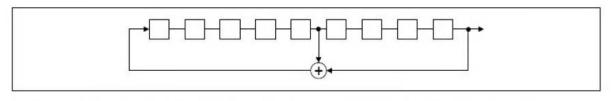
### For 47 CFR Part 15C section 15.247 (a) (1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### EUT Pseudorandom Frequency Hopping Sequence Requirement

The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:

0	2	4	6	62	64	78	1	73	75 7
٦				 T		T		 	
						1			
						1		1	
				 		<u>l</u>		 L	

Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

## 3.10. Antenna Requirement

## Standard Applicable

For intentional device, according to FCC 47 CFR 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.

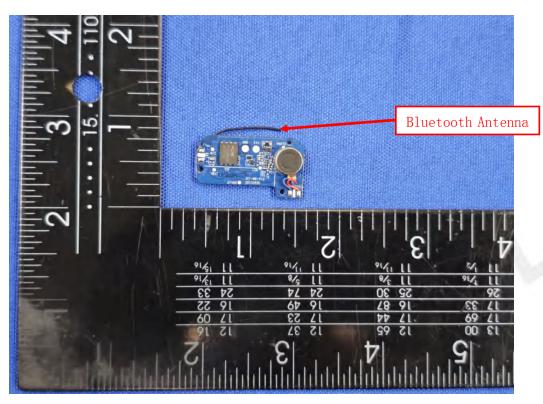
And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

## Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

## Antenna Connected Construction

The maximum gain of antenna was -1.74dBi.



4. Test Setup Photos of the EUT

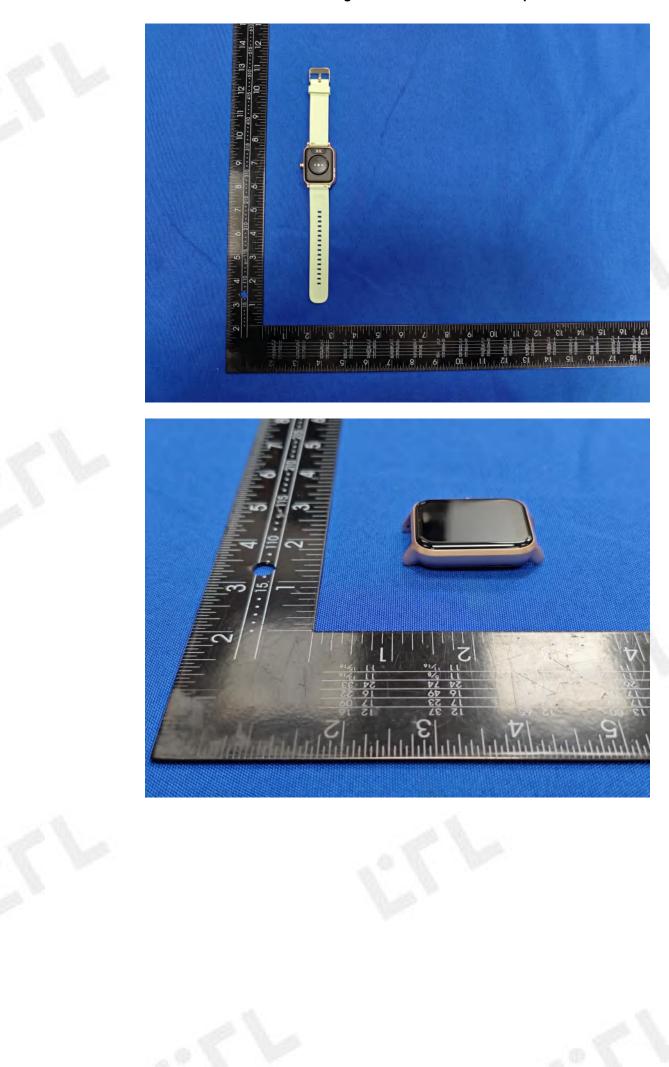


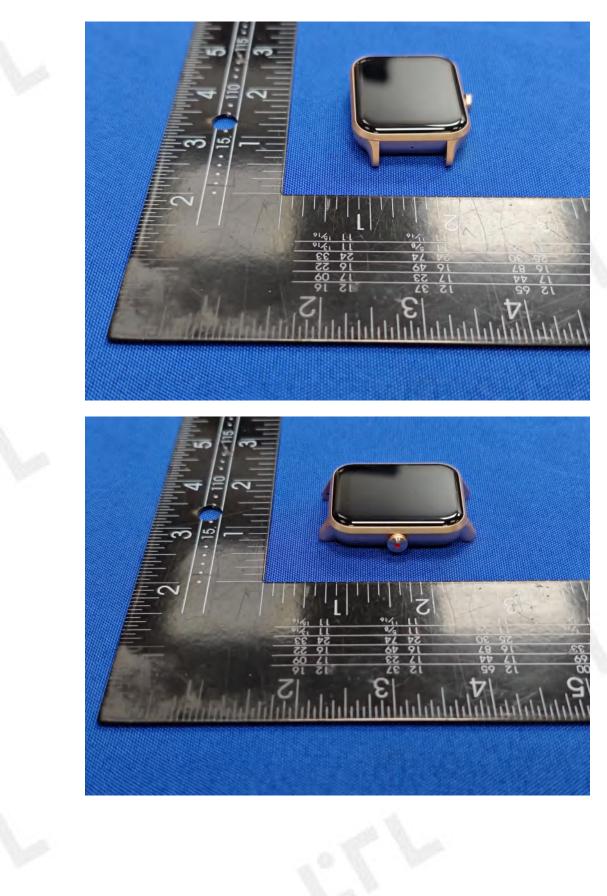


## 5. Photos of the EUT

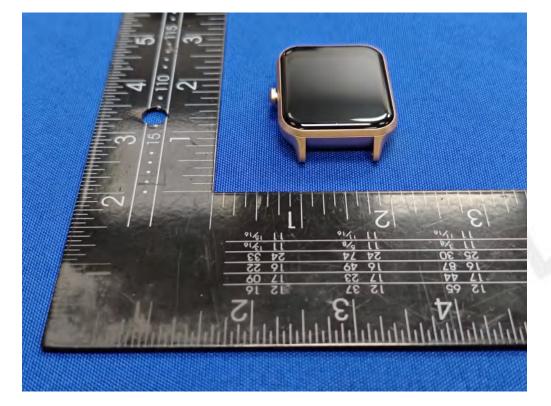








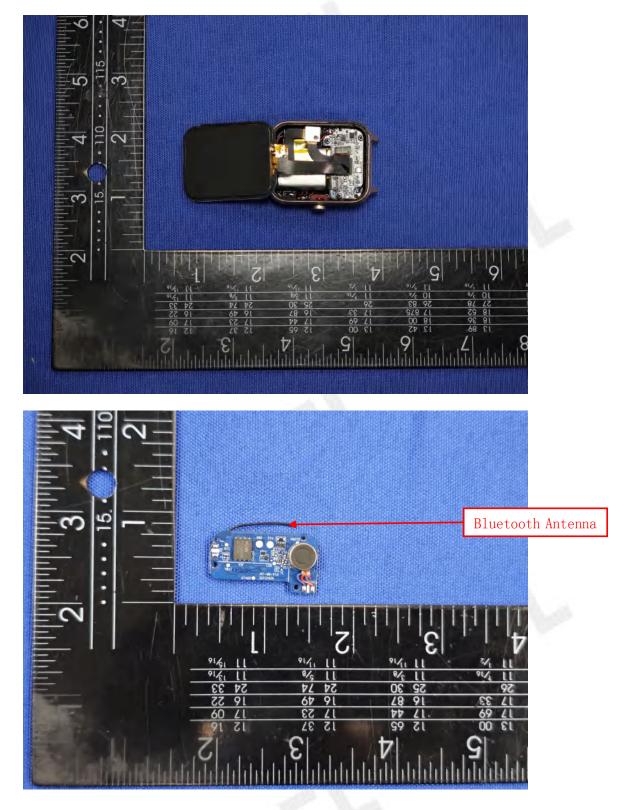


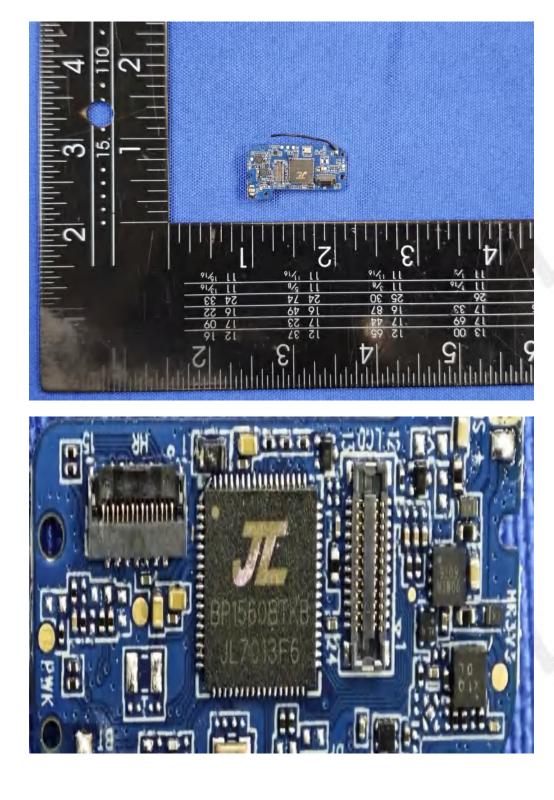




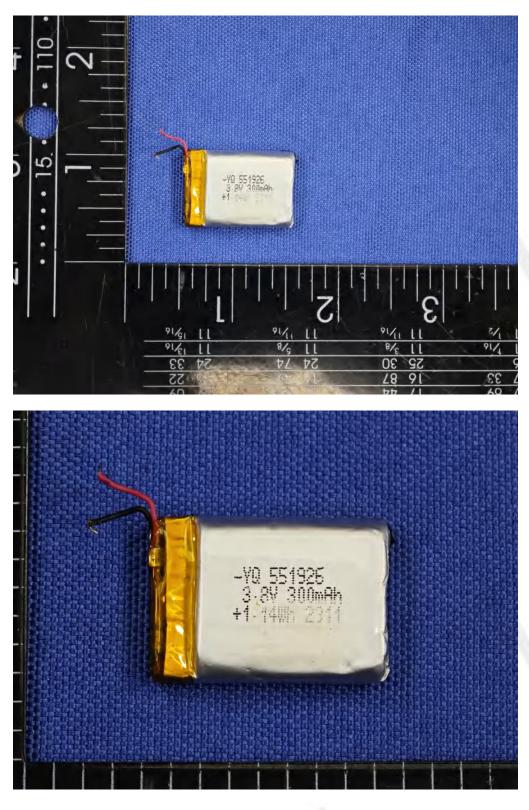












##