



RF TEST REPORT

Applicant	Shanghai Smawave Technology Co., Ltd
FCC ID	2AU8HSPH320-AQ
Product	Industrial smart handheld terminal
Brand	Smawave
Model	SPH320-aq
Report No.	R2212A1268-R2
Issue Date	January 12, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2/ FCC CFR 47 Part 96**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Summary of Measurement Results

No.	Test Type	Clause in FCC rules	Verdict
1	Maximum Effective Isotropic Radiated Power	96.41 (b)	PASS
2	Radiated Spurious Emission	2.1051 / 96.41(e)	PASS
Date of Testing: December 15, 2022 ~ December 16, 2022 Date of Sample Received: December 12, 2022			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

Only Radiated Spurious Emission is tested for SPH320-aq in this report, and because of the change of antenna gain, Effective Isotropic Radiated Power also re evaluated. Other test items refer to the LTE Module report (Report No.: R2003A0164-R1, FCC ID: 2AU8HMGM5607A).



1. Test Laboratory

1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test Facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
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E-mail: xukai@ta-shanghai.com

2. General Description of Equipment under Test

2.1. Applicant and Manufacturer Information

Applicant	Shanghai Smawave Technology Co. ,Ltd
Applicant address	3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China
Manufacturer	Shanghai Smawave Technology Co. ,Ltd
Manufacturer address	3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China

2.2. General Information

EUT Description			
Model	SPH320-aq		
IMEI	862165040696625		
Hardware Version	V1.0.2		
Software Version	20230106_01_SPHX20-aq_NDAC_V1.0.23		
Power Supply	Battery / AC adapter		
Antenna Type	Internal Antenna		
Antenna Gain	Frequency (MHz)	Gain (dBi)	
	3640	-1.4	
	3660	-0.9	
	3680	-0.7	
	3700	-1.0	
Test Mode(s)	LTE Band 43/48;		
Test Modulation	QPSK, 16QAM, 64QAM;		
LTE Category	6		
Maximum EIRP	17.66 dBm		
Rated Power Supply Voltage	3.8V		
Operating Voltage	Minimum: 3.7V Maximum: 4.4V		
Operating Temperature	Lowest: -20°C Highest: +60°C		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	LTE Band 43	3650 ~ 3700	3650 ~ 3700
	LTE Band 48	3650 ~ 3700	3650 ~ 3700
EUT Accessory			
Adapter	Manufacturer: Zhuzhou Dachuan Electronic Technology Co.,Ltd Model: DCT12W050200ZZ-H1 (Adapters: 94001-00001-EU; 94001-00002-UK; 94001-00003-US)		
Battery	Manufacturer: GuangDong FengHua New Energy Co., Ltd. Model: FHPK626263P		



Note:

1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.
2. According to TCB workshop October, 2014 RF Exposure Procedures Update (Overlapping LTE Bands): LTE Band 43 (Frequency range: 3650 ~ 3700 MHz) is covered by LTE Band 48 (Frequency range 3650 ~ 3700 MHz) due to same frequency range, same maximum tune up limit and same channel bandwidth.
3. There is more than one Adapter, each one should be applied throughout the compliance test respectively, and however, only the worst case (94001-00003-US) will be recorded in this report.



3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR 47 Part 96 (2022)

ANSI C63.26-2015

Reference standard:

FCC 47 CFR Part 2 (2022)

FCC KDB 971168 D01 Power Meas License Digital Systems v03r01

FCC KDB 940660 D01 Part 96 CBRS Eqpt v03

4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (X axis, vertical polarization) and the worst case was recorded.

All mode and data rates and positions were investigated. Subsequently, only the worst case emissions are reported.

The following testing in LTE is set based on the maximum RF Output Power.

Test modes are chosen to be reported as the worst case configuration below:

Test modes are chosen as the worst case configuration below for LTE Band 48.

Test items	Modes	Bandwidth (MHz)				Modulation		RB			Test Channel		
		5	10	15	20	QPSK	16QAM/ 64QAM	1	50%	100%	L	M	H
Maximum Effective Isotropic Radiated Power	LTE 48	O	O	O	O	O	O	O	O	O	O	O	O
Radiated Spurious Emission	LTE 48	O	-	-	O	O	-	O	-	-	-	O	-
Note	1. The mark "O" means that this configuration is chosen for testing. 2. The mark "-" means that this configuration is not testing.												

5. Test Case

5.1. Maximum Effective Isotropic Radiated Power

Ambient Condition

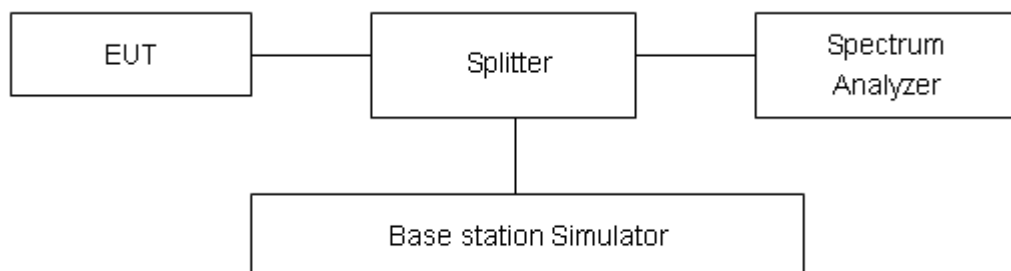
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The EIRP of the low, middle and high channels were measured.

RBW is set to 10MHz, VBW is set to 10MHz for LTE Band 48 (5MHz/10MHz/15MHz/20MHz).

Test Setup



A transmitter port of EUT is connected to the input of a signal analyzer. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Limits

Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) of any End User Device must comply with the limits shown in following table:

Rule Part 96.41(b) specifies that

Device	Maximum EIRP (dBm/10MHz)	Maximum PSD (dBm/MHz)
End User Device	23	n/a

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 1.19$ dB

Test Results

Refer to the section 6.1 of this report for test data.



5.2. Radiated Spurious Emission

Ambient Condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

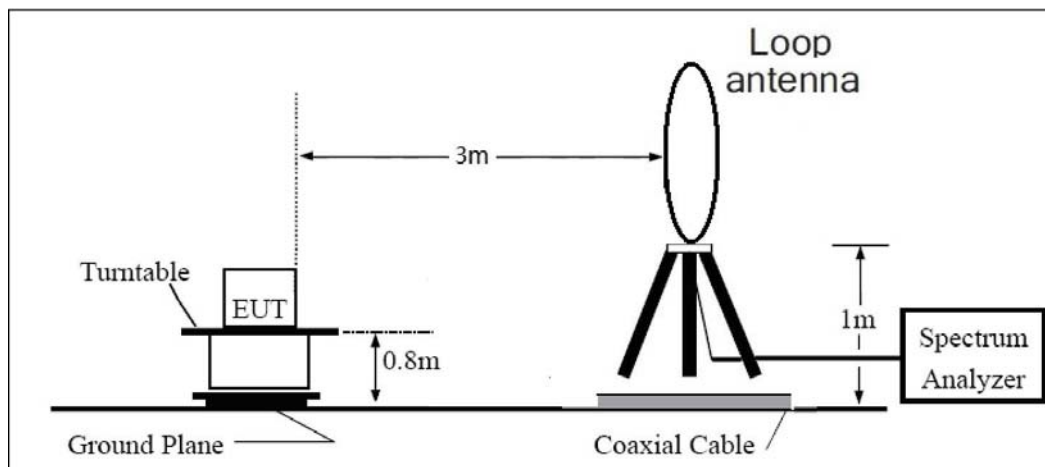
1. The testing follows FCC KDB 971168 D01 v03r01 Section 5.8 and ANSI C63.26.
2. Below 1GHz: The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H). Above 1GHz: (Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.) The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).
3. A loop antenna, A log-periodic antenna or horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz, and the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
7. The measurement results are obtained as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{PAg} - \text{Pcl} + \text{Ga}$$

The measurement results are amend as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{Pcl} + \text{Ga}$$
8. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole, $\text{ERP} = \text{EIRP} - 2.15\text{dBi}$.

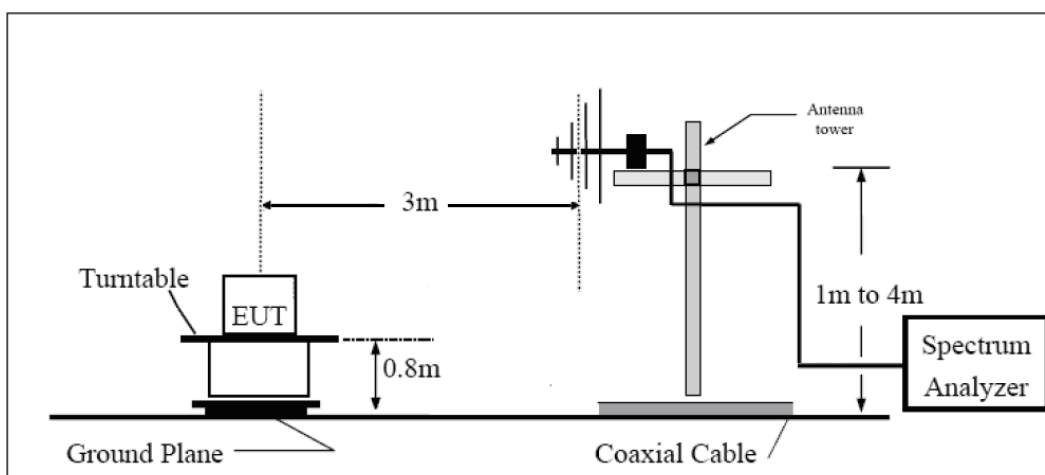
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test Setup

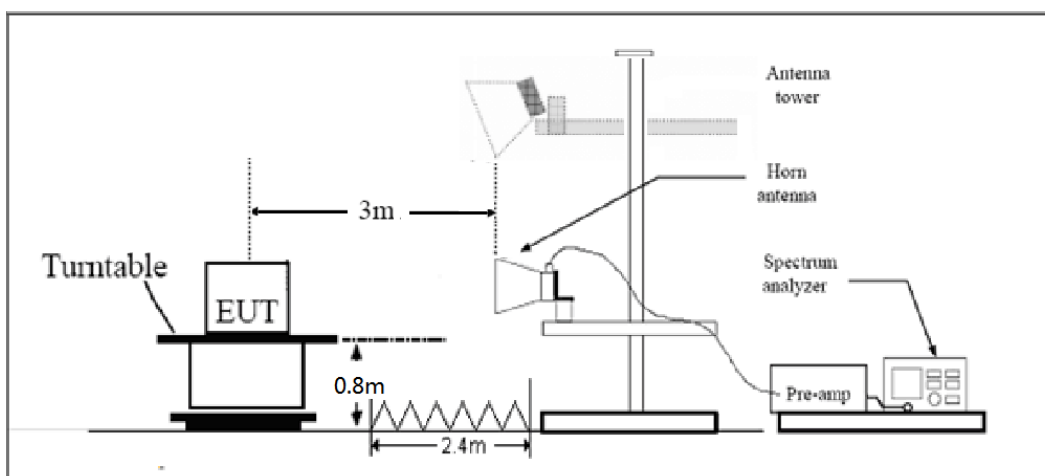
9KHz~ 30MHz



30MHz~~~ 1GHz



Above 1GHz



Note: Area side: 2.4mX3.6m

Limits

Rule Part 96.41(e) (2) specifies that “*Additional protection levels*. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed –25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed –40dBm/MHz.”

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 3.55$ dB.

Test Results

Refer to the section 6.2 of this report for test data.

6. Test Result

6.1. Maximum Effective Isotropic Radiated Power

The measurement is performed for both of horizontal and vertical antenna Polarization, and only the data of worst mode is recorded in this report.

LTE Band 48						
RB	Modulation	Bandwidth (MHz)	Channel	Frequency (MHz)	Maximum PSD (dBm/10MHz)	EIRP(dBm)
100%	QPSK	5	55265	3552.5	18.95	17.55
			55990	3625	19.76	17.66
			56715	3697.5	17.25	16.25
		10	55290	3555	17.56	16.16
			55990	3625	18.81	16.71
			56690	3695	16.35	15.35
		15	55315	3557.5	16.57	15.17
			55990	3625	17.67	15.57
			56665	3692.5	14.87	13.87
		20	55340	3560	16.14	14.74
			55990	3625	16.88	14.78
			5660	3690	14.18	13.18
	16QAM	5	55265	3552.5	18.96	17.56
			55990	3625	18.86	16.76
			56715	3697.5	16.26	15.26
		10	55290	3555	17.83	16.43
			55990	3625	18.08	15.98
			56690	3695	15.79	14.79
		15	55315	3557.5	16.46	15.06
			55990	3625	16.98	14.88
			56665	3692.5	14.36	13.36
		20	55340	3560	15.41	14.01
			55990	3625	16.56	14.46
			5660	3690	13.85	12.85
	64QAM	5	55265	3552.5	18.93	17.53
			55990	3625	18.81	16.71
			56715	3697.5	16.25	15.25
		10	55290	3555	17.67	16.27
			55990	3625	17.97	15.87
			56690	3695	15.43	14.43
		15	55315	3557.5	16.20	14.8
			55990	3625	16.82	14.72



			56665	3692.5	14.06	13.06
		20	55340	3560	15.48	14.08
			55990	3625	16.21	14.11
			5660	3690	13.65	17.55



6.2. Radiated Spurious Emission

LTE Band 48 QPSK 5MHz CH Middle, RB 1

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	7245.00	-58.70	4.2	11.35	Vertical	-51.55	-40.00	11.55	245
3	10867.50	-53.66	5.1	12.05	Vertical	-46.71	-40.00	6.71	25
4	14490.00	-56.44	5.8	14.23	Vertical	-48.01	-40.00	8.01	124
5	18112.50	--	--	--	--	--	--	--	--
6	21735.00	--	--	--	--	--	--	--	--
7	25357.50	--	--	--	--	--	--	--	--
8	28980.00	--	--	--	--	--	--	--	--
9	32602.50	--	--	--	--	--	--	--	--
10	36225.00	--	--	--	--	--	--	--	--

Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst emission was found in the antenna is Vertical position.

LTE Band 48 QPSK 20MHz CH Middle, RB 1

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	7230.00	-54.92	4.2	11.35	Vertical	-47.77	-40.00	7.77	142
3	10845.00	-55.34	5.1	12.05	Vertical	-48.39	-40.00	8.39	147
4	14460.00	-58.85	5.8	14.23	Vertical	-50.42	-40.00	10.42	24
5	18075.00	--	--	--	--	--	--	--	--
6	21690.00	--	--	--	--	--	--	--	--
7	25305.00	--	--	--	--	--	--	--	--
8	28920.00	--	--	--	--	--	--	--	--
9	32535.00	--	--	--	--	--	--	--	--
10	36150.00	--	--	--	--	--	--	--	--

Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst emission was found in the antenna is Vertical position.



7. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Signal Analyzer	R&S	FSV30	100815	2022-12-10	2023-12-09
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2020-04-02	2023-04-01
TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	391	2022-09-29	2025-09-28
Horn Antenna	Schwarzbeck	BBHA 9120D	1594	2020-12-17	2023-12-16
Software	R&S	EMC32	9.26.0	/	/

*****END OF REPORT *****



ANNEX A: The EUT Appearance

The EUT Appearance are submitted separately.



ANNEX B: Test Setup Photos

The Test Setup Photos are submitted separately.