



TEST REPORT

APPLICANT : dormakaba EAD GmbH
PRODUCT NAME : data collection terminal
MODEL NAME : 9600-K6 BLE WiFi
BRAND NAME : dormakaba
FCC ID : NVI-KT9600K6BWL
STANDARD(S) : 47 CFR Part 15 Subpart C
RECEIPT DATE : 2019-05-20
TEST DATE : 2019-06-22 to 2019-07-01
ISSUE DATE : 2019-07-04

Edited by:

Zeng Xiaoying
Zeng Xiaoying (Rapporteur)

Approved by:

Peng Huarui
Peng Huarui (Supervisor)

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DIRECTORY

1. Technical Information	4
1.1. Applicant and Manufacturer Information	4
1.2. Equipment Under Test (EUT) Description	4
1.3. Test Standards and Results	5
1.4. Environmental Conditions	5
2. 47 CFR Part 15C Requirements	6
2.1. Antenna Requirement	6
2.2. Conducted Emission	7
2.3. Radiated Emission	11
2.4. Frequency Tolerance	17
2.5. 20dB Bandwidth	19
Annex A Test Uncertainty	21
Annex B Testing Laboratory Information	22



Change History		
Version	Date	Reason for change
1.0	2019-07-04	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	dormakaba EAD GmbH
Applicant Address:	Albertistr. 3, 78056 Villingen-Schwenningen, Germany
Manufacturer:	In-Tech Electronics Ltd
Manufacturer Address:	Unit A, 13/F, Wing Tai Centre, 12 Hing Yip Street, Kwun Tong Kowloon, Hong Kong

1.2. Equipment Under Test (EUT) Description

Product Name:	data collection terminal	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	02	
Software Version:	V5	
Operating Frequency:	13.56MHz	
Modulation Type:	ASK	
Antenna Type:	PCB Antenna	
Accessory Information:	Battery	
	Brand Name:	Renata
	Model No.:	CR2450N
	Serial No.:	(N/A, marked #1 by test site)
	Capacity:	540mAh
	Rated Voltage:	3.0V
	Charge Limit:	N/A

Note 1: This test report is updated from report (Report No.: SZ17070027W31, FCC ID: NVI-KT9600K6LWL), based on the similarity between before, the motherboard, WIFI modules are the same as before, except that the RFID module has some changes. The changes are as follows: BT module is installed in the BT position reserved on the RFID board. The changes do not affect the results of Conducted Emission, for other test results we had tested and recorded in this report.



1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15 (10-1-15 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	15.207	Conducted Emission	Aug 21, 2017	Peng Xuewei	PASS ^{Note1}
3	15.209 15.225(a)(b) (c)(d)	Radiated Emission	Jun 22, 2019	Peng Xuewei	PASS
4	15.225(e)	Frequency Tolerance	Jul 01, 2019	Peng Xuewei	PASS
5	15.215(c)	20dB Bandwidth	Jun 19, 2019	Peng Xuewei	PASS

Note 1: The test results of this test items in this report refer to the test report (Report No.: SZ17070027W31).

Note 2: The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013. The EUT has been tested under continuous operating condition.

1.4. Environmental Conditions

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

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106



2. 47 CFR Part 15C Requirements

2.1. Antenna Requirement

2.1.1. Applicable Standard

According to FCC 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 shall be considered sufficient to comply with the provisions of this section.

2.1.2. Result:

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

Result: Compliant

2.2. Conducted Emission

2.2.1. Test Requirement

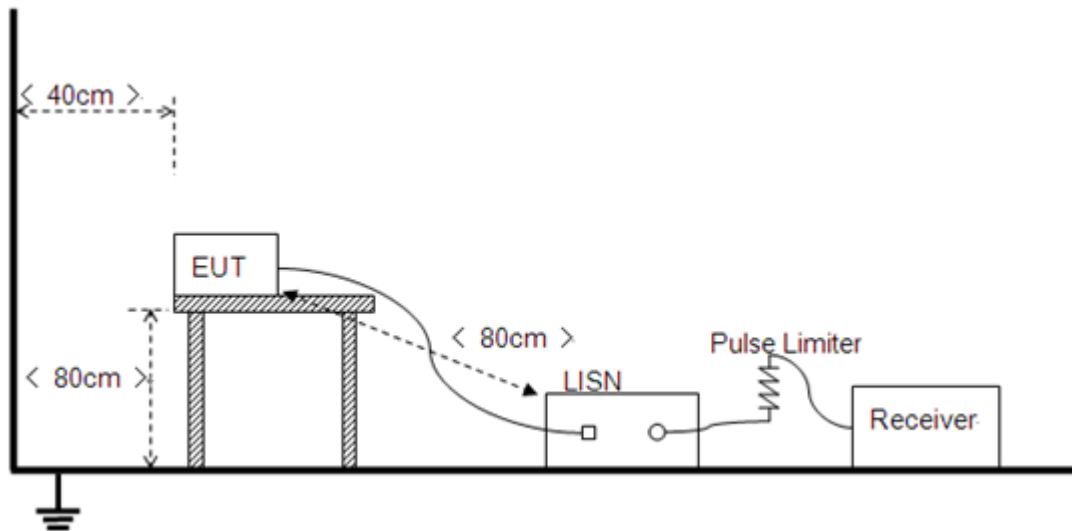
According to FCC section 15.207, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE:

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.2.2. Test Setup



The EUT is placed on a 0.8m high insulating table, which stands on the grounded conducting floor, and keeps 0.4m away from the grounded conducting wall. The EUT is connected to the power mains through a LISN which provides 50Ω/50μH of coupling impedance for the measuring instrument. A Pulse Limiter is used to protect the measuring instrument. The factors of the whole test system are calibrated to correct the reading.



2.2.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test setup:

Test Mode: EUT + Network Cable + Ethernet POE Switch +Adapter+RFID TX

Test voltage: AC 120V/60Hz

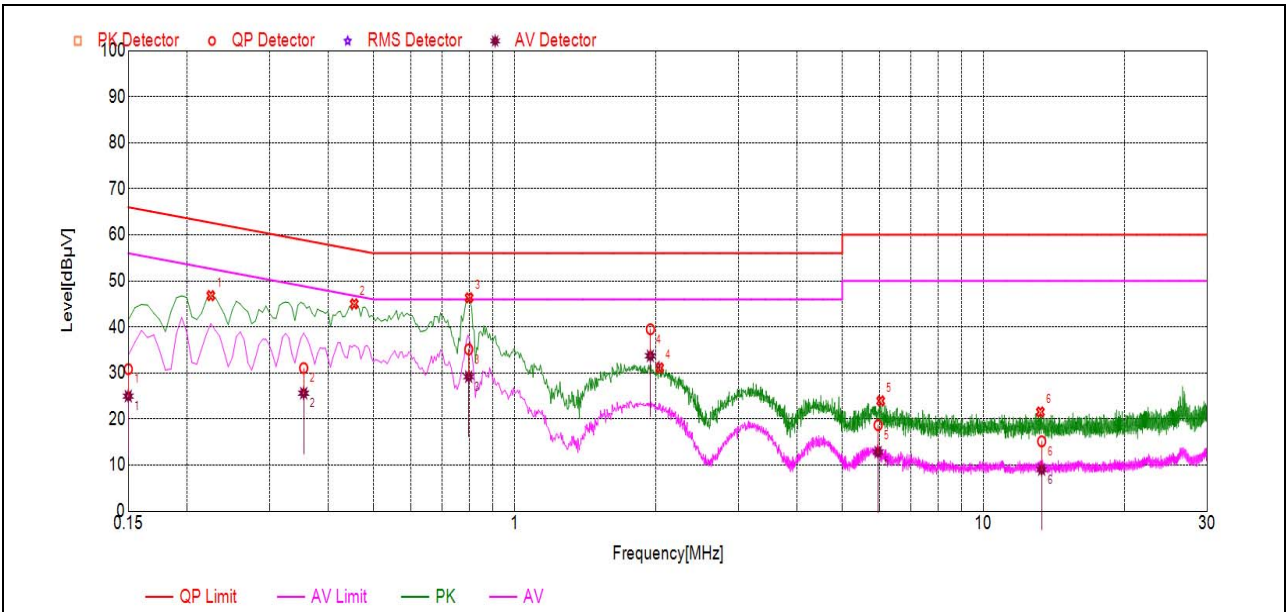
The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V]} = U_R + L_{\text{Cable loss}} \text{ [dB]} + A_{\text{Factor}}$$

U_R : Receiver Reading

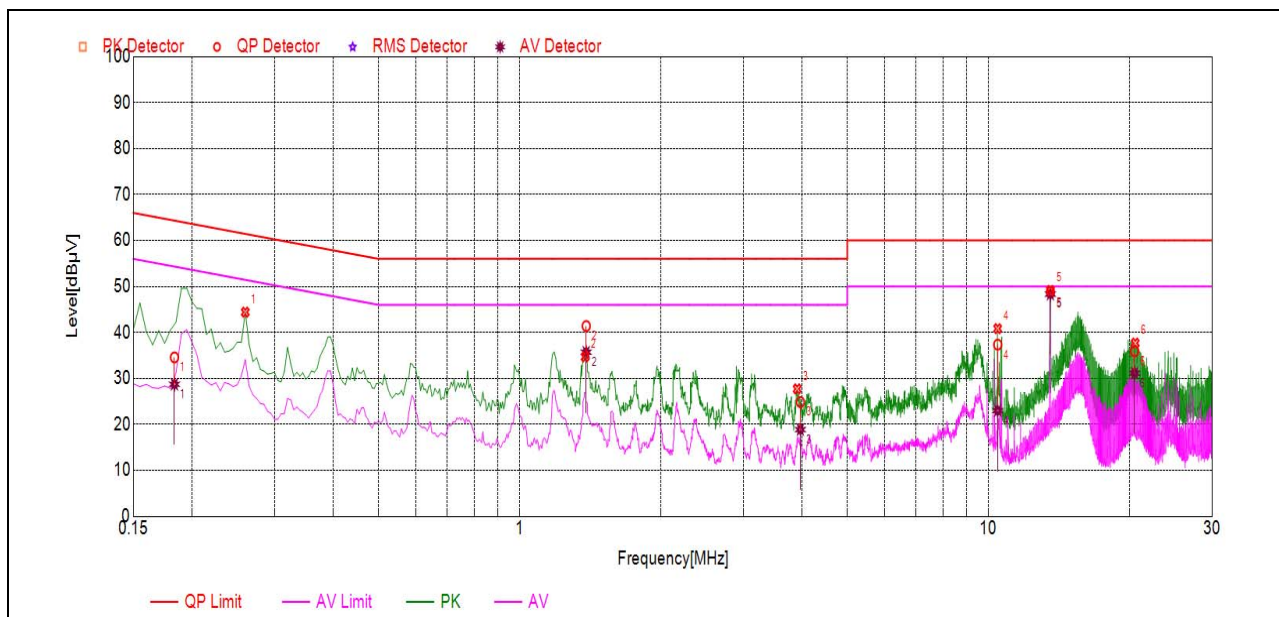
A_{Factor} : Voltage division factor of LISN

B. Test Plots:



(L Phase)

NO.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.15	31.00	25.21	66.00	56.00	Line	PASS
2	2.1858	31.36	25.46	56.00	46.00		PASS
3	3.1678	33.71	24.32	56.00	46.00		PASS
4	10.3218	34.92	33.23	60.00	50.00		PASS
5	13.5596	47.19	47.10	60.00	50.00		PASS
6	21.3488	38.59	33.12	60.00	50.00		PASS



(N Phase)

NO.	Fre. (MHz)	Emission Level (dBμV)		Limit (dBμV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1836	34.57	28.73	65.04	55.04	Neutral	PASS
2	1.3872	41.40	35.71	56.00	46.00		PASS
3	3.9716	24.86	18.87	56.00	46.00		PASS
4	10.4678	37.35	22.99	60.00	50.00		PASS
5	13.56	48.75	48.32	60.00	50.00		PASS
6	20.5016	35.93	31.16	60.00	50.00		PASS



2.3. Radiated Emission

2.3.1. Test Requirement

Radiated Emission <30MHz (9 kHz-30MHz, E-field)

According to FCC section 15.225, for <30MHz, Radiated emissions were measured according to ANSIC63.4. The EUT was set to transmit at the highest output power. The EUT was set 30 meter away from the measuring antenna. The loop antenna was positioned 1 meter above the ground from the center of the loop. The measuring bandwidth was set to 10KHz. (Note: During testing the receive antenna was rotated about its axis to maximize the emission from the EUT)

There was no detected Restricted bands and Radiated Spurious emission below 30MHz. The 30m limit was converted to 3m Limit using square factor(x) as it was found by measurements as follows;
 $3\text{ m Limit(dBuV/m)} = 20\log(X) + 40\log(30/3) = 20\log(15848) + 40\log(30/3) = 124\text{dBuV}$

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency range (MHz)	Field Strength@30m		Field Strength@3m
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
Below 13.110	30	29.5	69.5
13.110 ~ 13.410	106	40.5	80.5
13.410 ~ 13.553	334	50.5	90.5
13.553 ~ 13.567	15.848	84	124
13.567 ~ 13.710	334	50.5	90.5
13.710 ~ 14.010	106	40.5	80.5
Above 14.010	30	29.5	69.5

NOTE: a) Field Strength ($\text{dB}\mu\text{V/m}$) = $20 \cdot \log[\text{Field Strength} (\mu\text{V/m})]$.

b) In the emission tables above, the tighter limit applies at the band edges.

Radiated Emission >30MHz (30MHz-1GHz, E-field)

According to FCC section 15.205, the field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

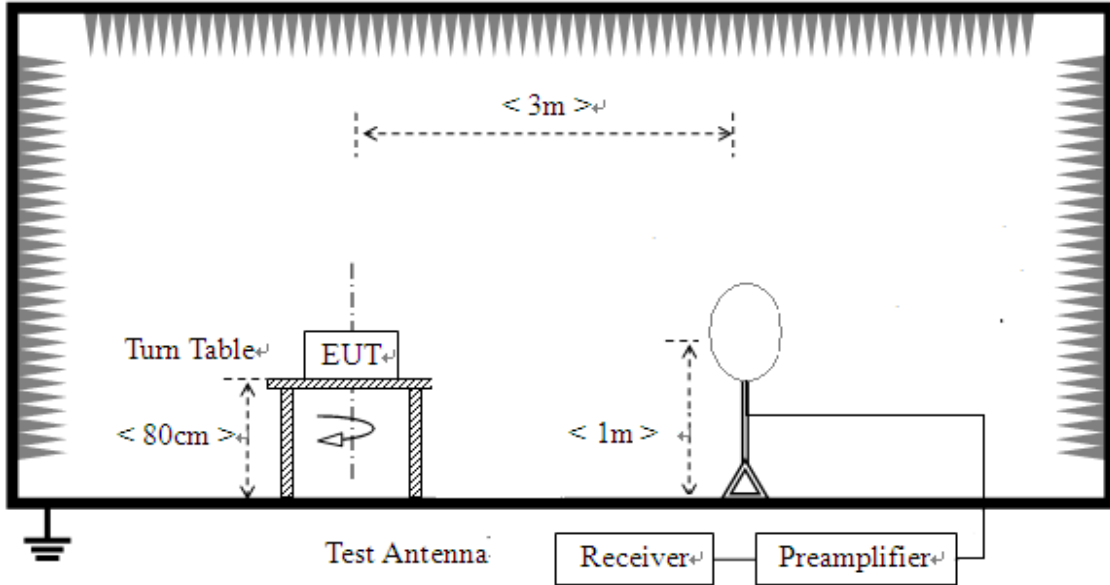
Frequency range (MHz)	Field Strength	
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

NOTE: a) Field Strength ($\text{dB}\mu\text{V/m}$) = $20 \cdot \log[\text{Field Strength} (\mu\text{V/m})]$.

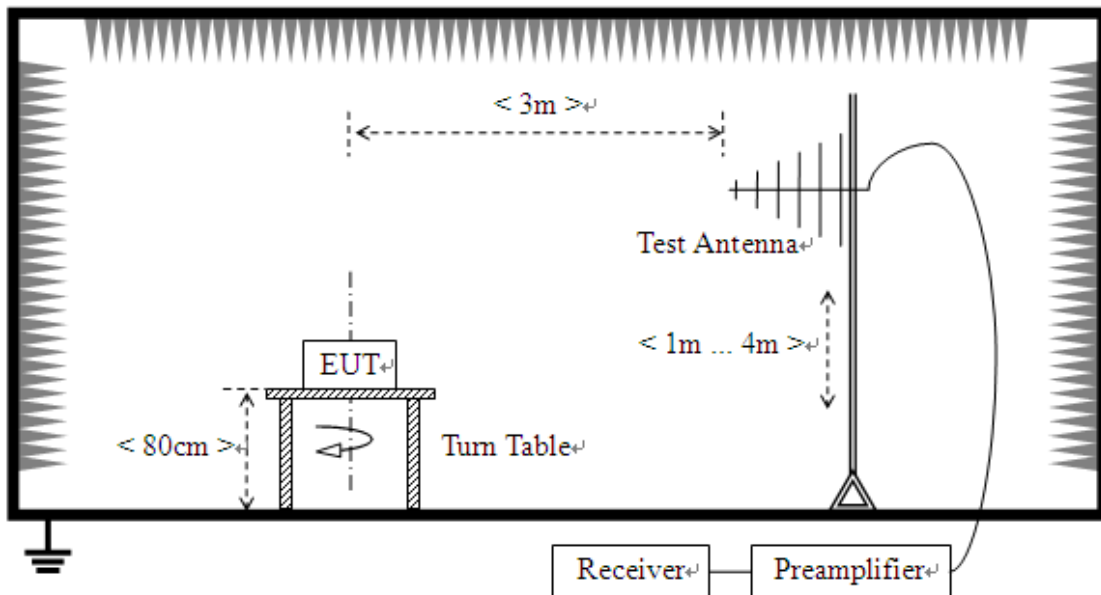
b) In the emission tables above, the tighter limit applies at the band edges.

2.3.2. Test Setup

1) For radiated emissions below 30MHz



2) For radiated emissions from 30MHz to 1GHz



The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading. The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from the Test Antenna, which is mounted on a variable-height antenna master tower.

For the test Antenna:

In the frequency range of 9 kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) was used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

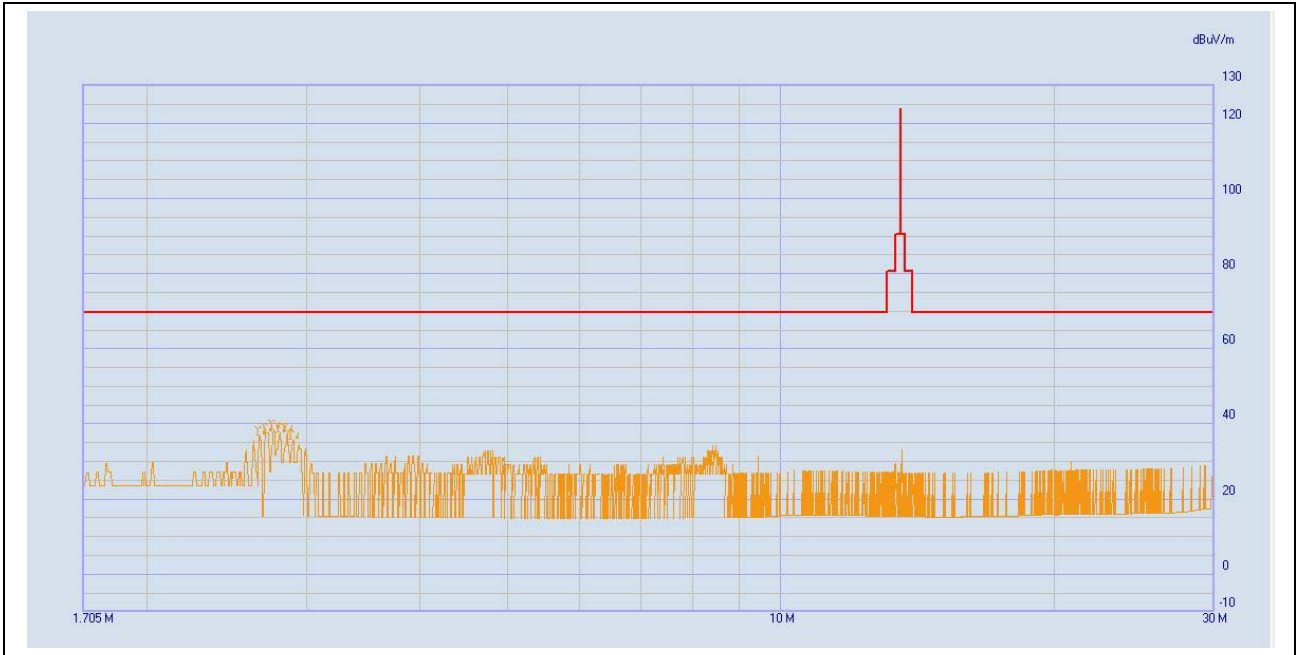
2.3.3. Test Result

A. Radiated Emission <30MHz (1.075MHz-30MHz, E-field, opened)



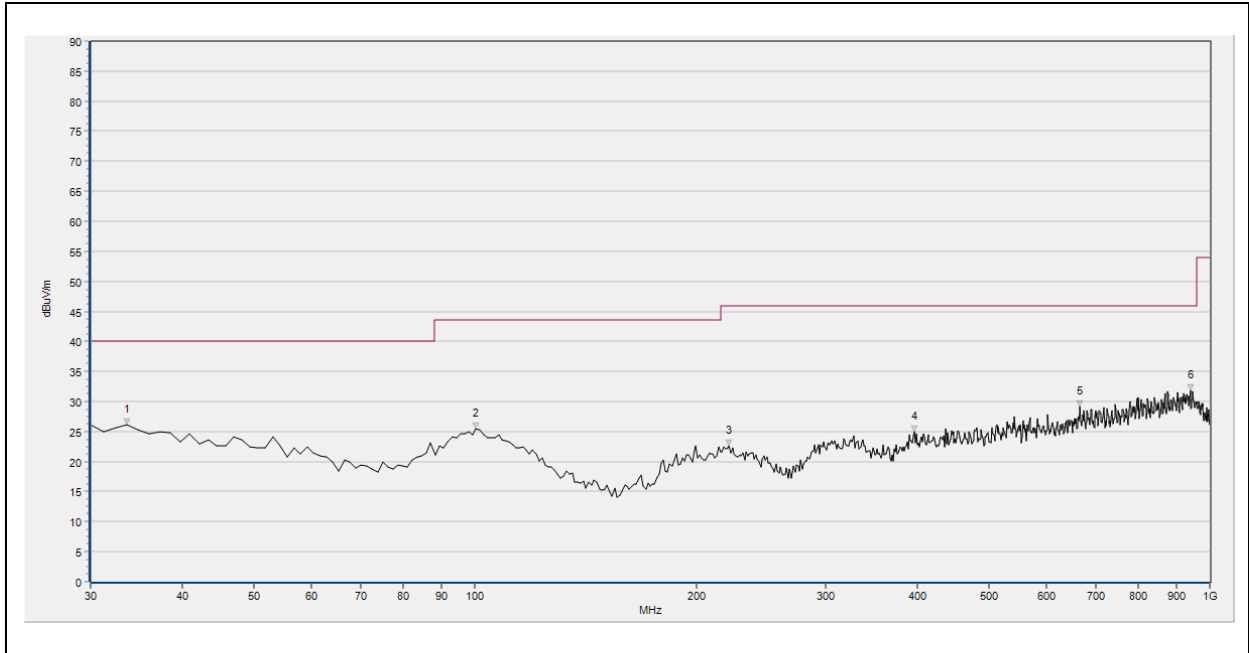
NO.	Frequency (MHz)	Detector Type	Level at 3m (dBμV/m)	Limit at 3m (dBμV/m)
1	2.620	Quasi Peak	35.72	69.5
2	2.665	Quasi Peak	37.67	69.5
3	2.710	Quasi Peak	38.50	69.5
4	2.755	Quasi Peak	38.51	69.5
5	2.855	Quasi Peak	36.79	69.5
6	13.56	Quasi Peak	35.57	124

B. Radiated Emission <30MHz (1.075MHz-30MHz, E-field, closed)



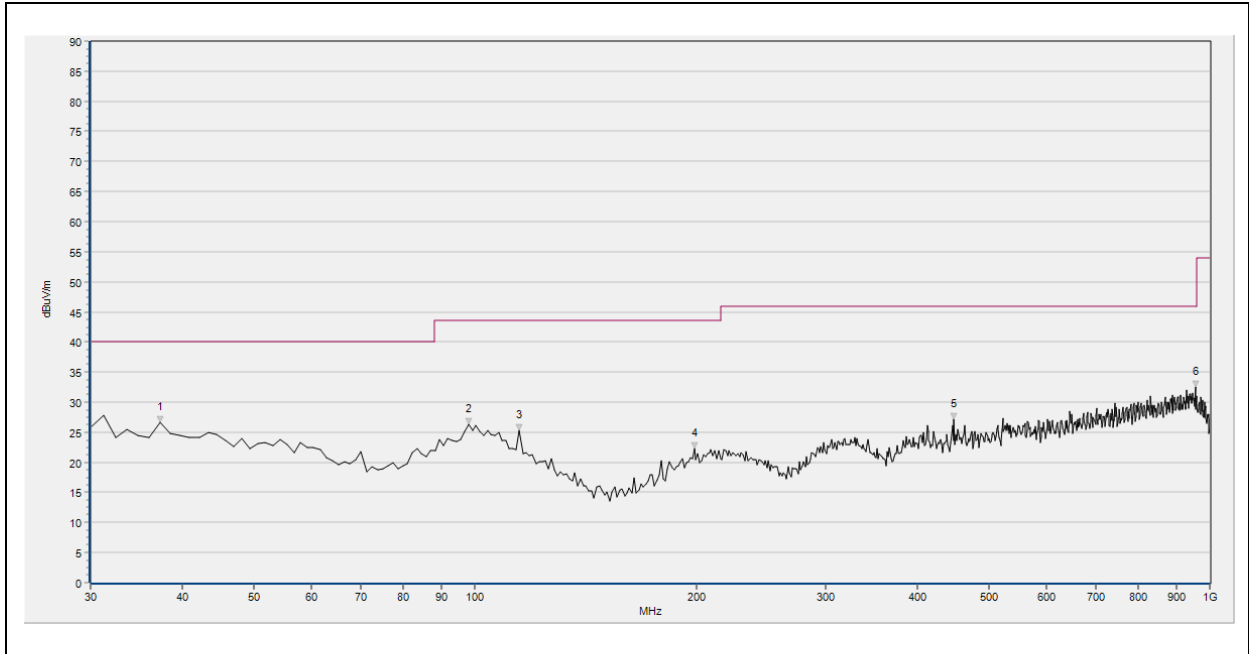
NO.	Frequency (MHz)	Detector Type	Level at 3m (dBµV/m)	Limit at 3m (dBµV/m)
1	2.665	Quasi Peak	36.76	69.5
2	2.715	Quasi Peak	37.68	69.5
3	2.760	Quasi Peak	38.52	69.5
4	2.805	Quasi Peak	37.68	69.5
5	2.855	Quasi Peak	37.70	69.5
6	13.555	Quasi Peak	33.07	124

C. Radiated Emission >30MHz (30MHz-1GHz)



(30MHz – 1GHz, Test Antenna Horizontal)

No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	33.642	26.08	N/A	N/A	N/A	40.00	N/A	H	PASS
2	100.413	25.42	N/A	N/A	N/A	43.50	N/A	H	PASS
3	221.815	22.57	N/A	N/A	N/A	46.00	N/A	H	PASS
4	396.633	24.92	N/A	N/A	N/A	46.00	N/A	H	PASS
5	666.145	29.14	N/A	N/A	N/A	46.00	N/A	H	PASS
6	940.513	31.77	N/A	N/A	N/A	46.00	N/A	H	PASS



(30MHz – 1GHz, Test Antenna Vertical)

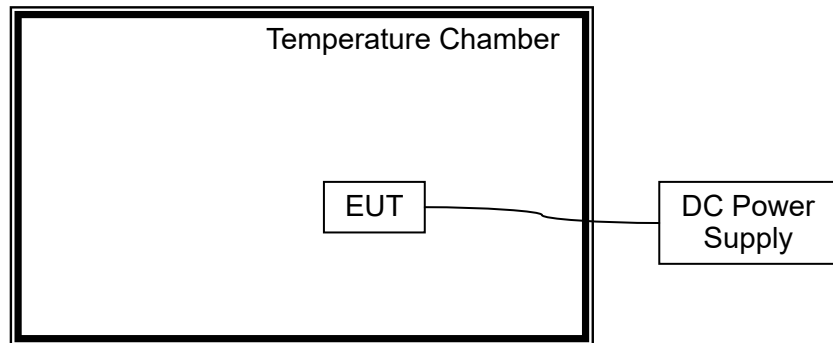
No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	37.284	26.68	N/A	N/A	N/A	40.00	N/A	V	PASS
2	97.985	26.24	N/A	N/A	N/A	43.50	N/A	V	PASS
3	114.981	25.35	N/A	N/A	N/A	43.50	N/A	V	PASS
4	198.748	22.30	N/A	N/A	N/A	43.50	N/A	V	PASS
5	448.836	27.07	N/A	N/A	N/A	46.00	N/A	V	PASS
6	956.295	32.47	N/A	N/A	N/A	46.00	N/A	V	PASS

2.4. Frequency Tolerance

2.4.1. Test Requirement

According to FCC section 15.225, the devices operating in the 13.553~13.567 MHz shall maintain the carrier frequency within 0.01% of the operating frequency over the temperature variation of -20°C to +50°C using an environmental chamber. The primary supply voltage is varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

2.4.2. Test Setup



The EUT, which is powered by the DC Power Supply directly, is located in the Temperature Chamber. The EUT was measured by transmitter mode continuously.



2.4.3. Test Result

Operating Frequency: 13,560,000 Hz

Deference Voltage: 48V

Deviant Limit: $\pm 0.01\%$

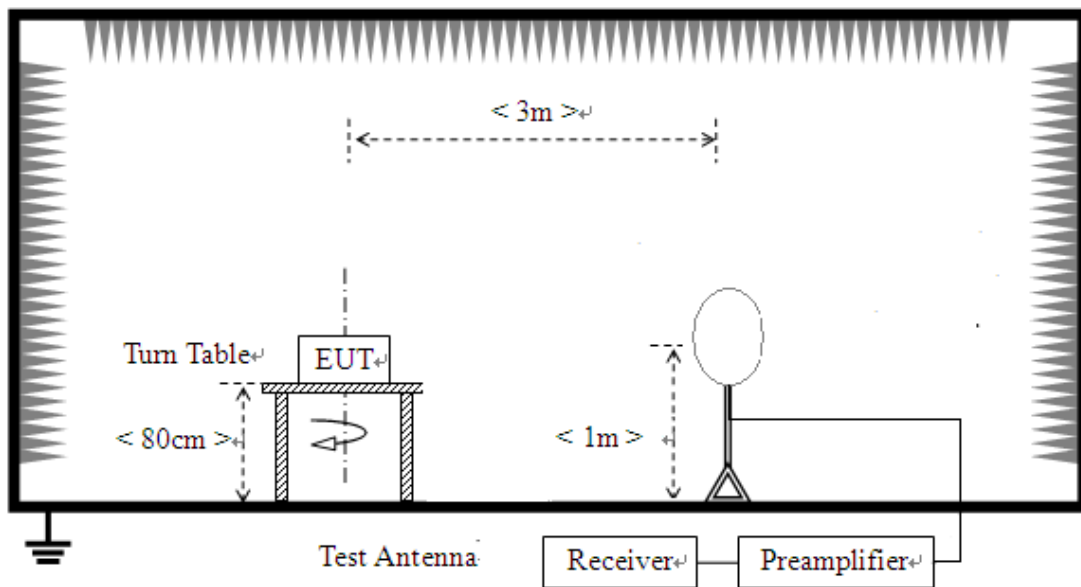
VOLTAGE (%)	Test Conditions		Fre. Dev. (Hz)	Deviation (%)	Verdict
	Power (VDC)	Temperature (°C)			
100	48	-20	422	0.00311	PASS
100		-10	387	0.00285	
100		0	376	0.00277	
100		+10	381	0.00281	
100		+20	346	0.00255	
100		+25	337	0.00249	
100		+30	374	0.00276	
100		+40	395	0.00291	
100		+50	445	0.00328	
85		40.8	+20	262	
115	55.2	+20	304	0.00224	

2.5.20dB Bandwidth

2.5.1. Standard Applicable

According to FCC section 15.215(c), the 20dB bandwidth should be contained within the frequency band designated in the rule section under which the EUT is operated, it was measured with a spectrum analyzer connected the EUT while the EUT is operating in transmission mode.

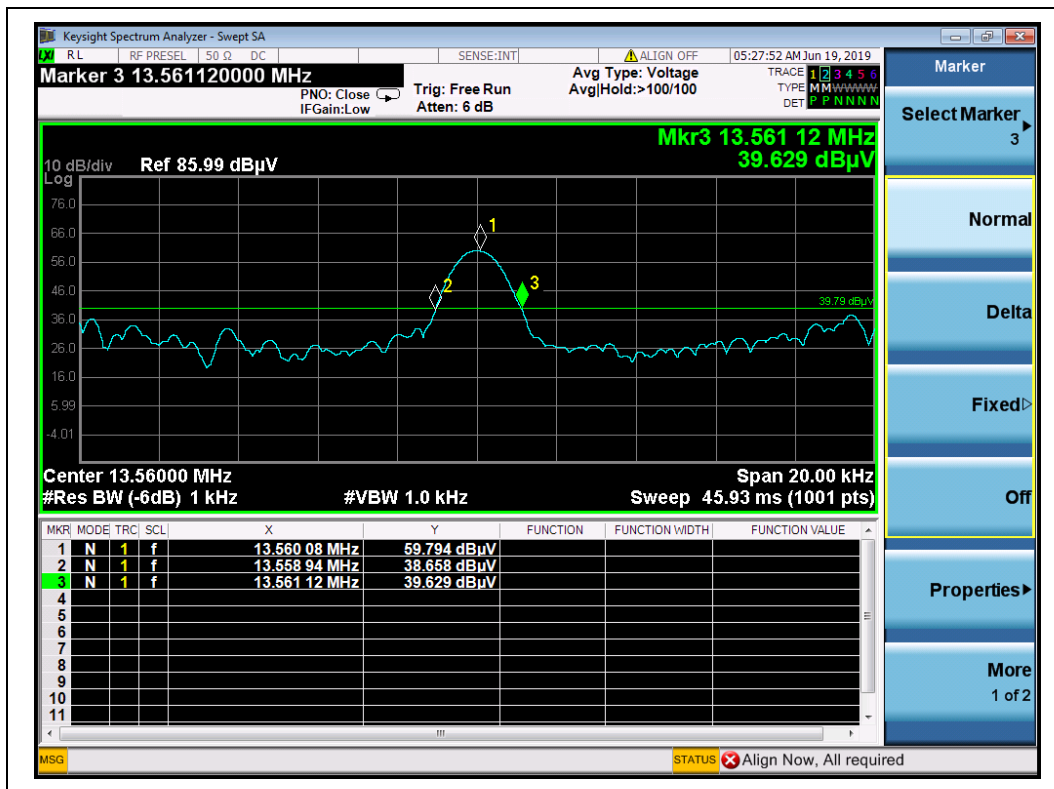
2.5.2. Test Setup





2.5.3. Test Result

Centre Frequency	Measurement		Limit		Verdict
	20dB Bandwidth (kHz)	Frequency Range (MHz)	20dB Bandwidth (kHz)	Frequency Range(MHz)	
13.56MHz	1.92	13.5589 to 13.5611	14	13.553 to 13.567	Pass





Annex A Test Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Radiated Emission:	$\pm 3.1\text{dB}$
Conducted Emission:	$\pm 1.8\text{dB}$
Bandwidth	$\pm 5\%$
Frequency Tolerance	$\pm 5\%$



Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.



4. Test Equipments Utilized

4.1 Test Equipments

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Receiver	Agilent	N9038A	MY54130016	2018.08.04	2019.08.03
Coaxial Cable	Morlab	EMC02	CB02	N/A	N/A
Anechoic Chamber	CRT	9m*6m*6m	N/A	2017.11.19	2020.11.18
Test Antenna – Bi-Log	Schwarzbeck	VULB 9163	9163-519	2019.05.08	2020.05.09
Test Antenna -Loop	Schwarzbeck	FMZB 1519	1519-022	2019.02.15	2020.02.14
DC Power Supply	Good Will Instrument Co.,Ltd.	N/A	N/A	2019.04.16	2020.04.15
Temperature Chamber	YOMA	(N/A)	(N/A)	2019.01.22	2020.01.21

4.2 Test Software Utilized

Model	Version Number	Producer
MORLAB EMCR V1.2	Version 1.0	MORLAB

————— END OF REPORT —————