



FCC Test Report

APPLICANT : RealWear, Inc.
EQUIPMENT : Head Mounted Tablet
BRAND NAME : i.safe MOBILE, realwear
MODEL NAME : T21S
FCC ID : 2AJOR2101SAA
STANDARD : 47 CFR Part 15 Subpart B
CLASSIFICATION : Certification
TEST DATE(S) : Sep. 12, 2023 ~ Sep. 26, 2023

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI C63.4-2014 and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia



Approved by: Jason Jia

Sportun International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China



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APPENDIX A. SETUP PHOTOGRAPHS



REVISION HISTORY



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.107	AC Conducted Emission	< 15.107 limits	PASS	Under limit 11.02 dB at 0.176 MHz
3.2	15.109	Radiated Emission	< 15.109 limits	PASS	Under limit 1.33 dB at 138.16 MHz for Quasi-Peak

Conformity Assessment Condition:

The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account. Please refer to each test results in the section "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1. General Description

1.1. Applicant

RealWear, Inc.

600 Hatheway Road, Vancouver, WA, 98661

1.2. Manufacturer

i.safe MOBILE GmbH

i_Park Tauberfranken 10, 97922, Lauda-Koenigshofen, Germany

1.3. Product Feature of Equipment Under Test

Product Feature	
Equipment	Head Mounted Tablet
Brand Name	i.safe MOBILE, realwear
Model Name	T21S
FCC ID	2AJOR2101SAA
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ac VHT20/VHT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/VHT160 WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160 WLAN 6GHz 802.11a/ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE GNSS
SN	Conduction: D2B6P806N2761109 Radiation: D2B6P806N2760903
HW Version	A
SW Version	1.0.4-14-T.NAVIGATOR-Z1.S
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.



1.4. Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx Frequency	802.11b/g/n/ac/ax: 2400 MHz ~ 2483.5 MHz 802.11a/n/ac/ax: 5150 MHz ~ 5250 MHz; 5250 MHz ~ 5350 MHz; 5470 MHz ~ 5725 MHz; 5725 MHz ~ 5850 MHz; 802.11a/ax: 5925 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Rx Frequency	802.11b/g/n/ac/ax: 2400 MHz ~ 2483.5 MHz 802.11a/n/ac/ax: 5150 MHz ~ 5250 MHz; 5250 MHz ~ 5350 MHz; 5470 MHz ~ 5725 MHz; 5725 MHz ~ 5850 MHz; 802.11a/ax: 5925 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz GNSS : 1559 MHz ~ 1610 MHz, 1164 MHz ~ 1215 MHz
Antenna Type	WLAN: PIFA Antenna Bluetooth: PIFA Antenna GNSS: 1559 MHz ~ 1610 MHz : patch Antenna 1164 MHz ~ 1215 MHz : PIFA Antenna
Type of Modulation	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM) 802.11ax: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM) Bluetooth LE : GFSK Bluetooth (1Mbps) : GFSK Bluetooth (2Mbps) : π/4-DQPSK Bluetooth (3Mbps) : 8-DPSK GNSS : BPSK

1.5. Modification of EUT

No modifications are made to the EUT during all test items.



1.6. Test Location

Sportun International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sportun International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sportun Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CO01-KS 03CH04-KS 10CH01-KS	CN1257	314309

1.7. Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH04-KS	AUDIX	E3	210616
2.	10CH01-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8. Applicable Standards

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

- 47 CFR Part 15 Subpart B
- ANSI C63.4-2014

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.



2. Test Configuration of Equipment Under Test

2.1. Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2014 and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

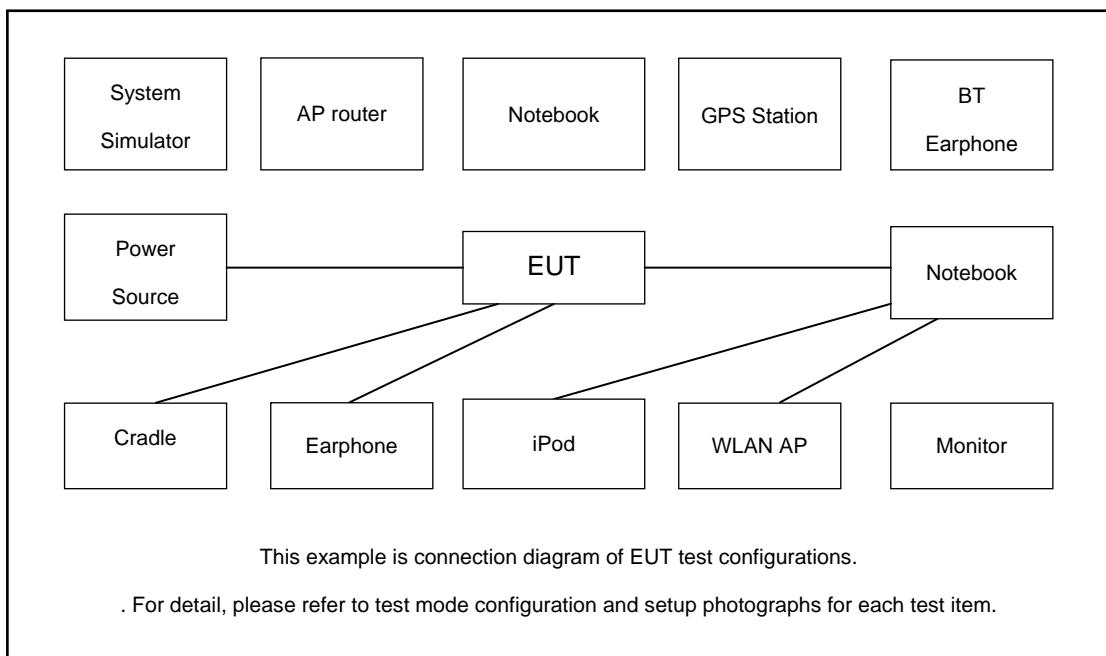
Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (30MHz to the 5th harmonic of the highest frequency or to 40 GHz, whichever is lower).

Test Items	Function Type
AC Conducted Emission	Mode 1: Bluetooth Idle + WLAN (2.4G) Idle + Camera(Recording) + Earphone + Battery + USB Cable (Charging from Adapter) Mode 2: Bluetooth Idle + WLAN (5G) Idle + GNSS Rx + Earphone + Battery + USB Cable (NB USB Data Link to EUT (eMMC)) Mode 3: Bluetooth Idle + WLAN (2.4G) Idle + MPEG4(Run Color Bar) + Earphone + Battery + USB Cable (EUT (eMMC) USB Data Link to NB) Mode 4: Bluetooth Idle + WLAN (6E) Idle + MPEG4(Run Color Bar) + Earphone + Battery + USB Cable (Charging from Adapter)
Radiated Emissions	Mode 1: Bluetooth Idle + WLAN (2.4G) Idle + Camera(Recording) + Earphone + Battery + USB Cable (Charging from Adapter) Mode 2: Bluetooth Idle + WLAN (5G) Idle + GNSS Rx + Earphone + Battery + USB Cable (NB USB Data Link to EUT (eMMC)) Mode 3: Bluetooth Idle + WLAN (2.4G) Idle + MPEG4(Run Color Bar) + Earphone + Battery + USB Cable (EUT (eMMC) USB Data Link to NB) Mode 4: Bluetooth Idle + WLAN (6E) Idle + MPEG4(Run Color Bar) + Earphone + Battery + USB Cable (Charging from Adapter)

Remark:

1. The worst case of AC is mode 3; only the test data of this mode is reported.
2. The worst case of RE is mode 3; only the test data of this mode is reported.
3. Data Link with Notebook means data application transferred mode between EUT and Notebook.

2.2. Connection Diagram of Test System



The EUT has been associated with peripherals pursuant to ANSI C63.4-2014 and configuration operated in a manner tended to maximize its emission characteristics in a typical application

2.3. Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Lenovo	thinkplus-BH3	N/A	N/A	N/A
2.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	Unshielded AC I/P cable 1.8m
3.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded, 1.8m
4.	Vector Signal Generator	R&S	SMBV100A	258305	N/A	N/A
5.	Adapter	realwear	CK18W02U	N/A	N/A	N/A
6.	Earphone	apple	NA	N/A	N/A	N/A
7.	Hard Disk	Lenovo	F310	DoC	Shielded, 1.2m	N/A

2.4. EUT Operation Test Setup

The EUT was attached to the Bluetooth earphone or WLAN AP, and the following programs installed in the EUT were programmed during the test.

1. Data application is transferred between notebook and EUT via USB cable.
2. Turn on camera to capture images.
3. Turn on MPEG4 function.
4. Turn on GNSS function to make the EUT receive continuous signals from GNSS station.



3. Test Result

3.1. Test of AC Conducted Emission Measurement

3.1.1 Limits of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

<Class B Limit>

Frequency of emission (MHz)	Conducted limit (dBuV)	
	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.

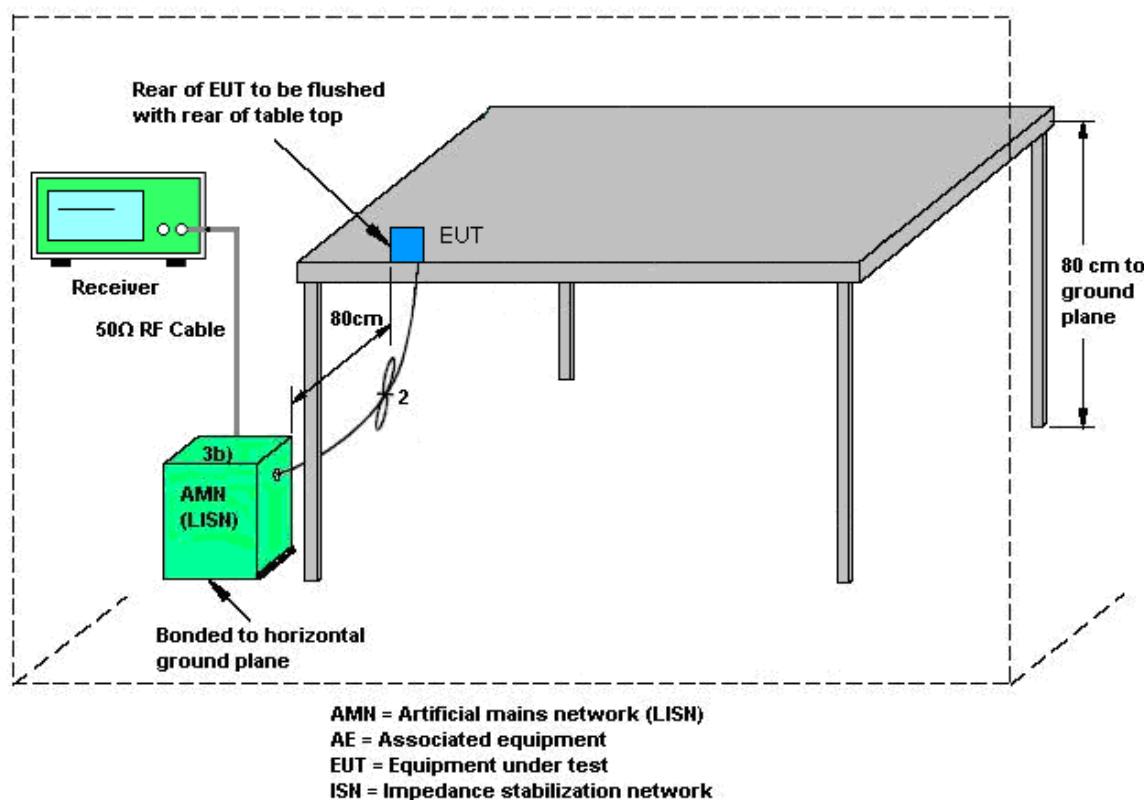
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedure

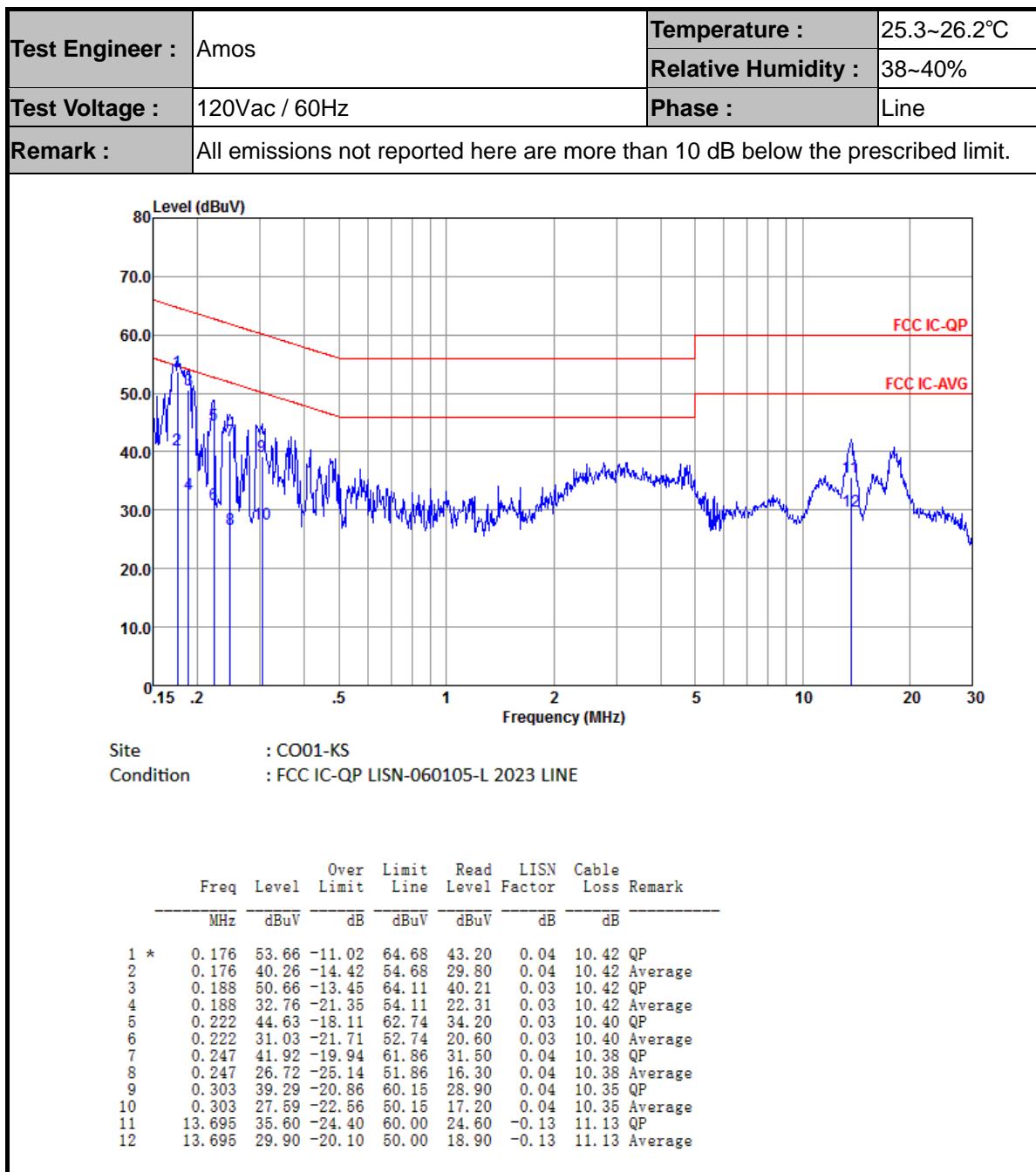
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

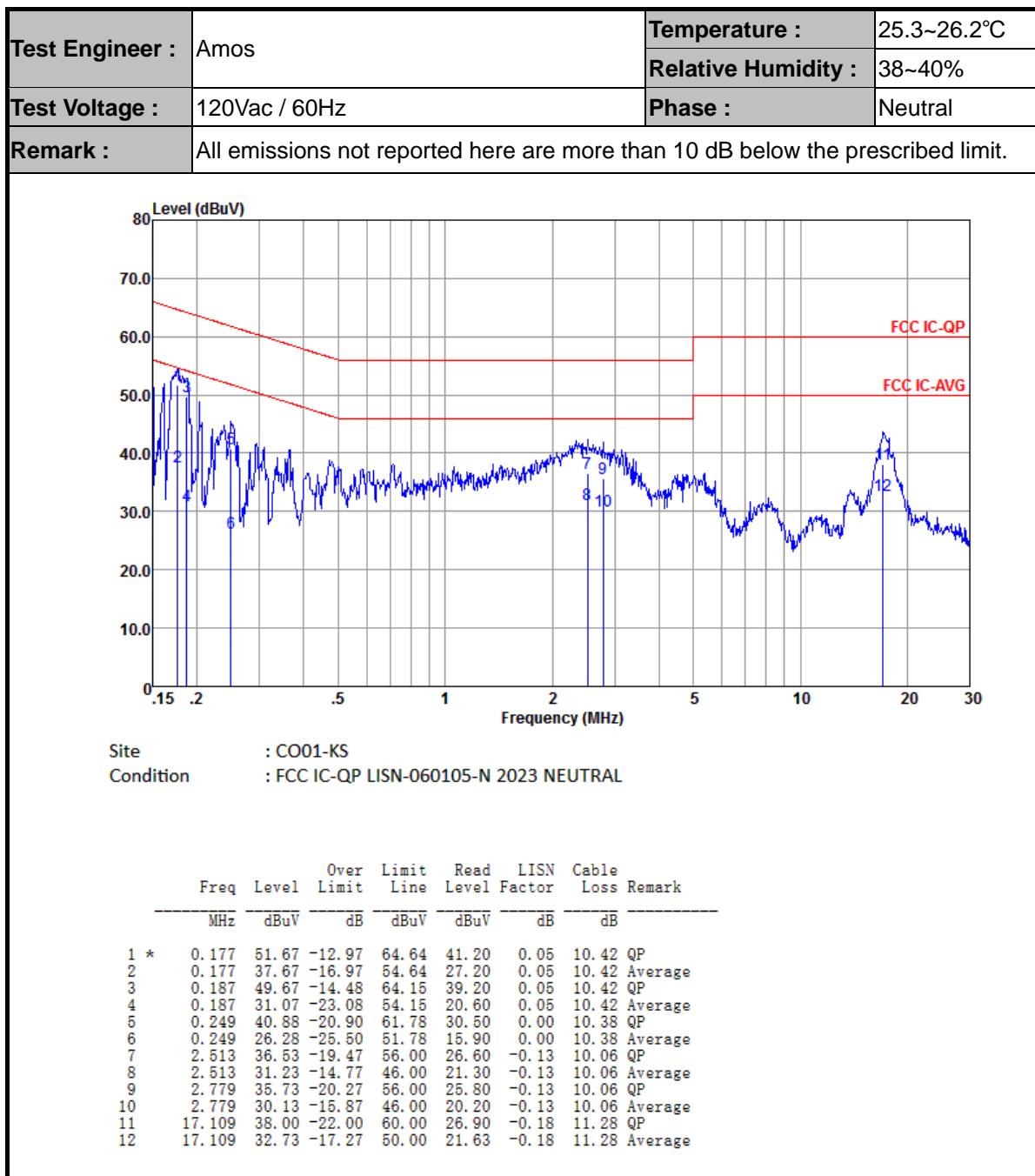
3.1.4 Test Setup





3.1.5 Test Result of AC Conducted Emission





Note:

1. Level(dB μ V) = Read Level(dB μ V) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dB μ V) - Limit Line(dB μ V)



3.2. Test of Radiated Emission Measurement

3.2.1. Limit of Radiated Emission

The emissions from an unintentional radiator shall not exceed the field strength levels specified in the following table:

<Class B Limit>

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: Measurement below 1GHz follows the CISPR 22 limit line as below :

15.109 (g) As an alternative to the radiated emission limits shown in paragraphs (a) and (b) of this section, digital devices may be shown to comply with the standards contained in Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement"

<CISPR 22 Class B Limit>

Frequency (MHz)	Field Strength (dBuV/meter)	Measurement Distance (meters)
30 – 230	30	10
230 – 1000	37	10

3.2.2. Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

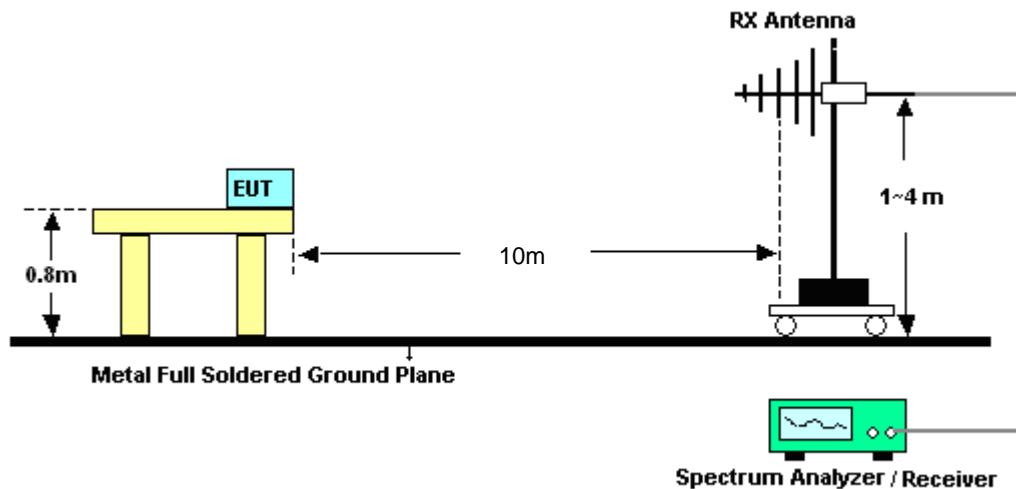


3.2.3. Test Procedures

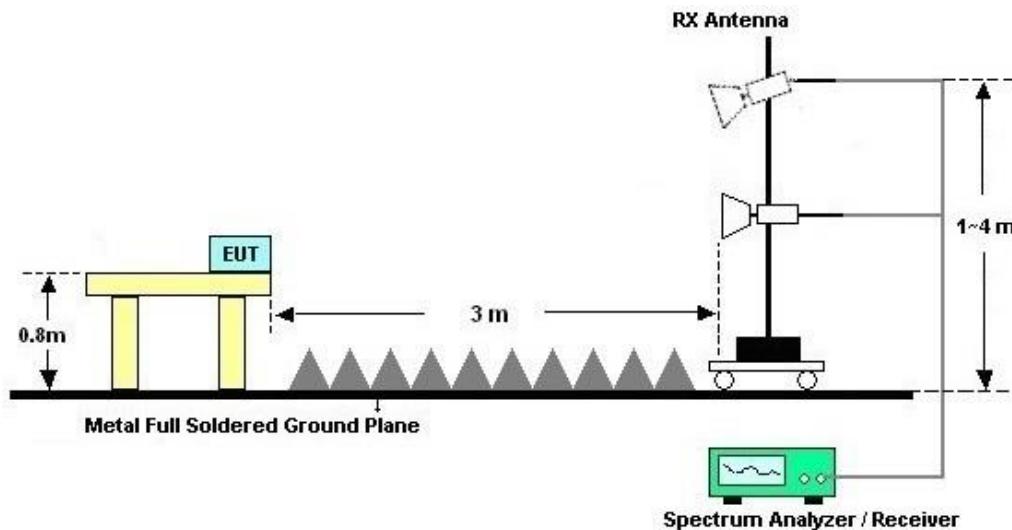
1. The EUT was placed on a turntable with 0.8 meter above ground.
2. The EUT was set 10 meters (30M~1G) and 3 meters (1G~ 40G) from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest radiation.
4. The antenna is a Bi-Log antenna and its height is adjusted between one to four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. 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.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120kHz/VBW=300kHz for frequency below 1GHz; RBW=1MHz VBW=3MHz (Peak), RBW=1MHz/VBW=10Hz (Average) for frequency above 1GHz).
7. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.
8. Emission level (dB μ V/m) = 20 log Emission level (μ V/m)
9. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
10. Exploratory radiated emissions testing of handheld and/or body-worn devices shall include rotation of the EUT through three orthogonal axes (X/Y/Z Plane) to determine the orientation (attitude) that maximizes the emissions.

3.2.4. Test Setup of Radiated Emission

For radiated emissions from 30MHz to 1GHz

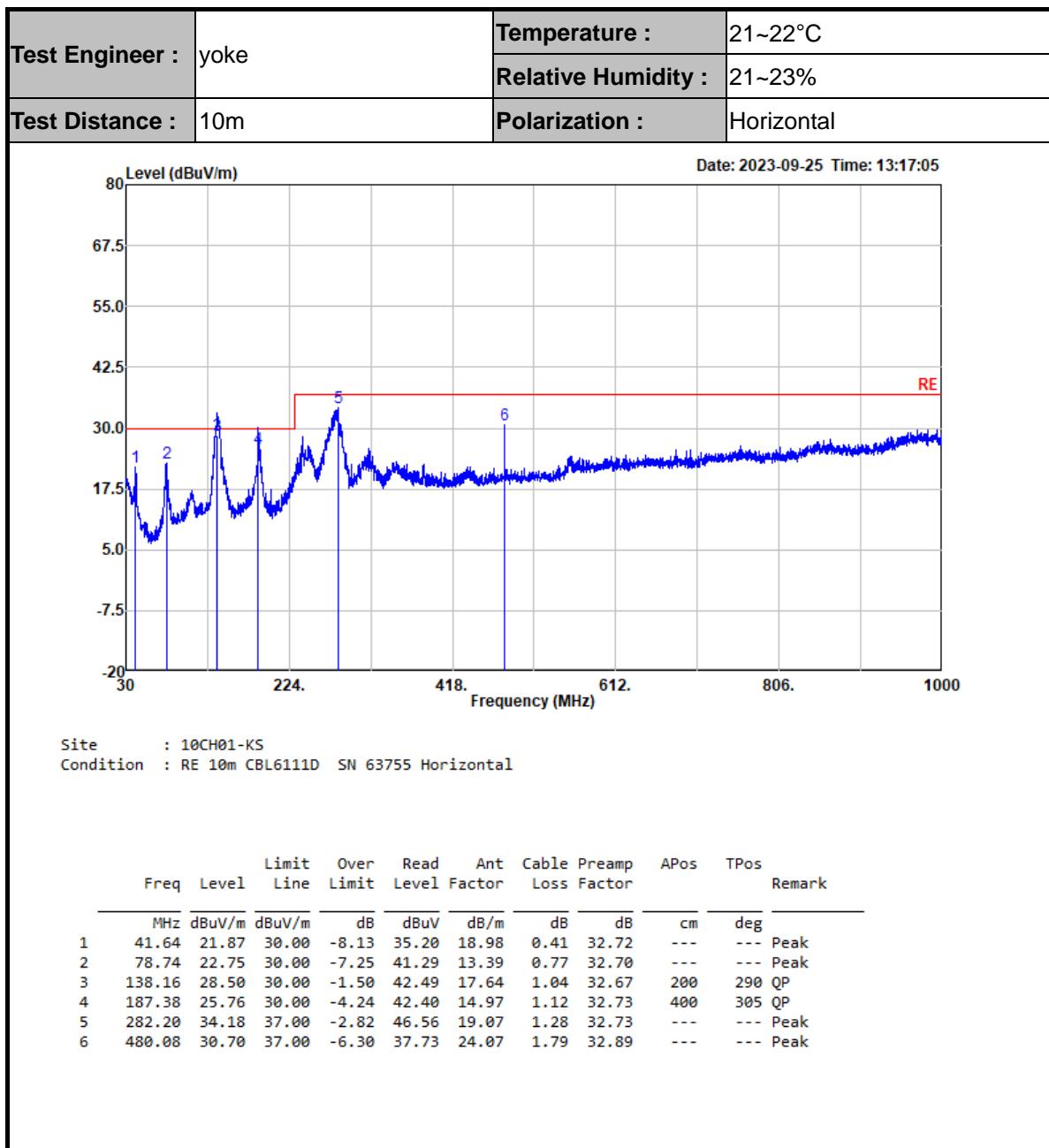


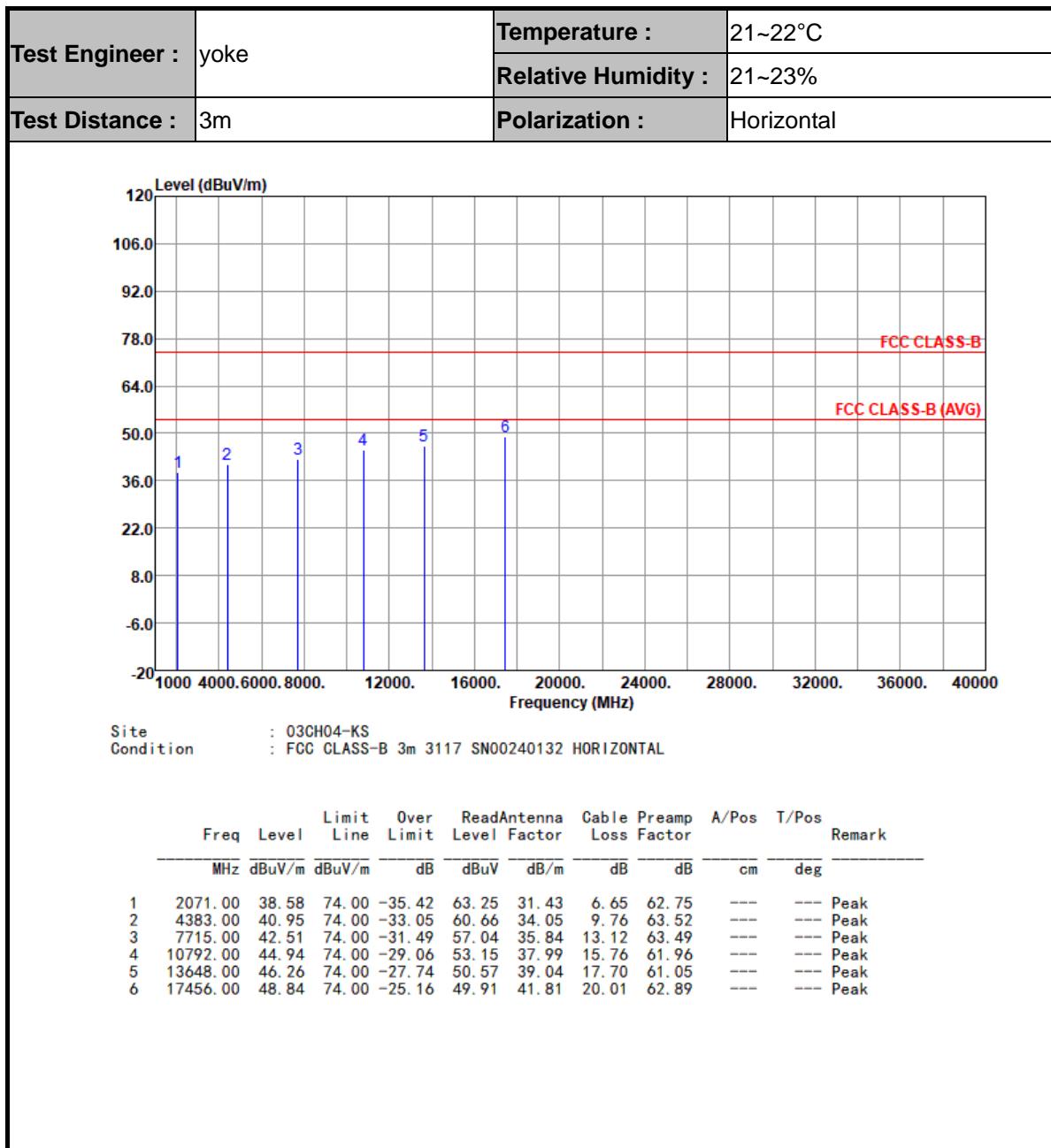
For radiated emissions above 1GHz

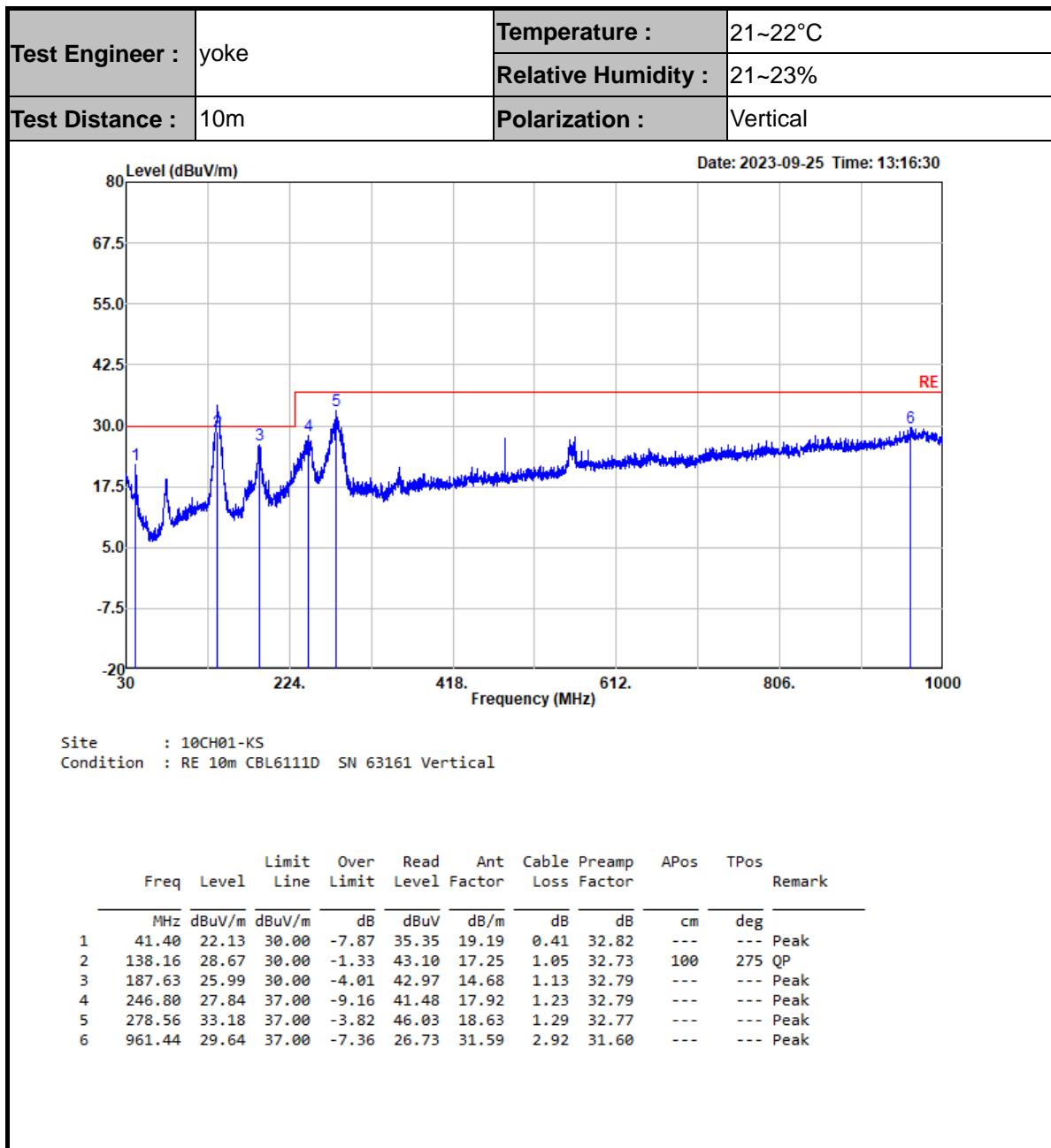


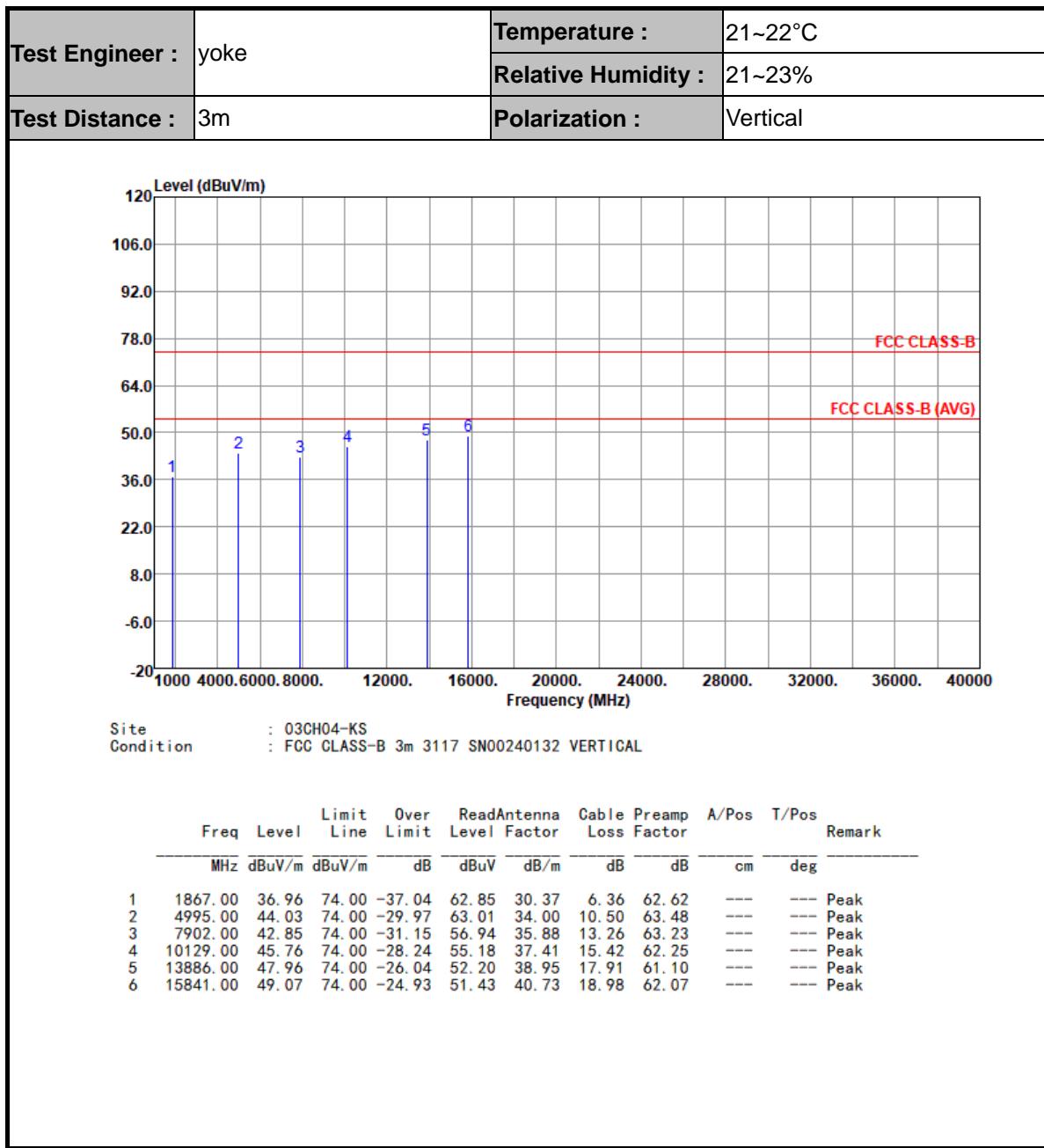


3.2.5. Test Result of Radiated Emission









Note:

1. Level(dB μ V/m) = Read Level(dB μ V) + Antenna Factor(dB/m) + Cable Loss(dB) - Preamp Factor(dB)
2. Over Limit(dB) = Level(dB μ V/m) – Limit Line(dB μ V/m)



4. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Bilog Antenna	TESEQ	CBL6111D	63161	30MHz~1GHz	Nov. 02, 2022	Sep. 25, 2023~Sep. 26, 2023	Nov. 01, 2023	Radiation (10CH01-KS)
Bilog Antenna	TESEQ	CBL6111D	63755	30MHz~1GHz	Nov. 02, 2022	Sep. 25, 2023~Sep. 26, 2023	Nov. 01, 2023	Radiation (10CH01-KS)
EMI test receiver	R&S	ESR7	102630	9KHz~7GHz	Oct. 11, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 10, 2023	Radiation (10CH01-KS)
EMI test receive	R&S	ESR7	102631	9KHz~7GHz	Oct. 11, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 10, 2023	Radiation (10CH01-KS)
Amplifier	SONOMA	310N	422544	9KHz ~1GHz	Oct. 12, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 11, 2023	Radiation (10CH01-KS)
Amplifier	SONOMA	310N	422545	9KHz ~1GHz	Oct. 12, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 11, 2023	Radiation (10CH01-KS)
Antenna Mast	EM	MBD-400-1	NA	1 m~4 m	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (10CH01-KS)
Controller	EM	3000-1	NA	NA	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (10CH01-KS)
Turn Table	EM	T-300-1	NA	0~360 degree	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (10CH01-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57471079	10Hz-44G,MAX 30dB	Oct. 12, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1284	1GHz~18GHz	Oct. 16, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 08, 2023	Sep. 25, 2023~Sep. 26, 2023	Jan. 07, 2024	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2023	Sep. 25, 2023~Sep. 26, 2023	Jan. 04, 2024	Radiation (03CH04-KS)
Amplifier	Agilent	8449B	3008A02370	1Ghz-18Ghz	Oct. 12, 2022	Sep. 25, 2023~Sep. 26, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Sep. 25, 2023~Sep. 26, 2023	NCR	Radiation (03CH04-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Sep. 12, 2023	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2022	Sep. 12, 2023	Oct. 12, 2023	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Sep. 12, 2023	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP0000008 11	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2022	Sep. 12, 2023	Oct. 11, 2023	Conduction (CO01-KS)

NCR: No Calibration Required



5. Measurement Uncertainty

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.94 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)-03CH04-KS

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.90 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)-03CH04-KS

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.26 dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz) - 10CH01-KS (Horizontal)

Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y))	5.14dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz) - 10CH01-KS (Vertical)

Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y))	5.12dB
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