

Project No: TM-2108000061P
Report No.: TMWK2108000306KR

IC: 20383-TSC70G3
FCC ID: 2AGTY-TSC-70-G3

Page: 1 / 31
Rev.: 01

FCC 47 CFR PART 15 SUBPART C & INDUSTRY CANADA RSS-210

TEST REPORT

For

Touchscreen Controller

Model No.: TSC-70-G3, TSC-101-G3



Trade Name:

Issued to

QSC, LLC

1675 MacArthur Blvd. Costa Mesa, CA 92626 United States

Issued by

Compliance Certification Services Inc.

Wugu Laboratory

**No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City, Taiwan.**

Issued Date: July 20, 2023

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Report No.: TMWK2108000306KR

Page: 2 / 31

Rev.: 01

Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	July 5, 2023	Initial Issue	ALL	Doris Chu
01	July 20, 2023	See the following Note Rev.(01)	P.5	Allison Chen

Note:

Rev.(01)

1. Modify antenna type.



TABLE OF CONTENTS

1. TEST RESULT CERTIFICATION.....	4
2. EUT DESCRIPTION	5
3. TEST METHODOLOGY	6
3.1 EUT CONFIGURATION	6
3.2 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS.....	6
3.3 RSS GEN SECTION 8.10 RESTRICTED BANDS OF OPERATIONS	7
3.4 DESCRIPTION OF TEST MODES	8
4. TEST SUMMARY.....	9
5. INSTRUMENT CALIBRATION.....	10
5.1 MEASURING INSTRUMENT CALIBRATION	10
5.2 MEASUREMENT EQUIPMENT USED	10
5.3 MEASUREMENT UNCERTAINTY	11
5.4 FACILITIES AND TEST LOCATION	11
6. SETUP OF EQUIPMENT UNDER TEST	12
6.1 SETUP CONFIGURATION OF EUT	12
6.2 SUPPORT EQUIPMENT	12
7. FCC PART 15.225 REQUIREMENTS & RSS-210 REQUIREMENTS.....	13
7.1 OCCUPIED BANDWIDTH(99%) AND 20 DB BANDWIDTH.....	13
7.2 FUNDAMENTAL AND RADIATED EMISSIONS	15
7.3 FREQUENCY STABILITY	25
7.4 POWERLINE CONDUCTED EMISSIONS.....	29
APPENDIX A PHOTOGRAPHS OF TEST SETUP	A-1

1. TEST RESULT CERTIFICATION

Applicant: QSC, LLC
1675 MacArthur Blvd. Costa Mesa, CA 92626 United States

Manufacturer: Advantech Co., Ltd.
No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District,
Taipei 114, Taiwan, R.O.C.

Equipment Under Test: Touchscreen Controller



Trade Name:

Model No.: TSC-70-G3, TSC-101-G3

Date of Test: March 14 ~ 16, 2022

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C& RSS-210 Issue 10 and RSS-GEN Issue 5	Compliance
Statements of Conformity	
Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.	

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.225.

The test results of this report relate only to the tested sample identified in this report.

Approved by:



Shawn Wu
Supervisor
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	Touchscreen Controller
Model No.	TSC-70-G3, TSC-101-G3
Model Discrepancy	TSC-70-G3: 7 inches TSC-101-G3: 10.1 inches
Trade	
Received Date	January 6, 2022
Power Supply	50VDC, 0.5A from POE
Frequency Range	13.56MHz
Modulation Technique	ASK
Number of Channels	1 Channel
Antenna Requirement	Antenna type: Loop Antenna
HW Version	A101
SW Version	tscg3_dvt2 firmware
EUT Serial #	1
NFC controller IC	STMicroelectronics / ST25R3911B

Remark:

1. For more details, refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.
3. Disclaimer: The variant model numbers / trademarks are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.225.

The tests documented in this report were performed in accordance with IC RSS-210, IC RSS-Gen, and ANSI C63.10: 2013

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

3.3 RSS GEN SECTION 8.10 RESTRICTED BANDS OF OPERATIONS

Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

- The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).
- Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.
- Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

Table 7 – Restricted frequency bands ^{Note 1}			
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	608 - 614	9.0 - 9.2
0.495 - 0.505	16.69475 - 16.69525	960 - 1427	9.3 - 9.5
2.1735 - 2.1905	16.80425 - 16.80475	1435 - 1626.5	10.6 - 12.7
3.020 - 3.026	25.5 - 25.67	1645.5 - 1646.5	13.25 - 13.4
4.125 - 4.128	37.5 - 38.25	1660 - 1710	14.47 - 14.5
4.17725 - 4.17775	73 - 74.6	1718.8 - 1722.2	15.35 - 16.2
4.20725 - 4.20775	74.8 - 75.2	2200 - 2300	17.7 - 21.4
5.677 - 5.683	108 - 138	2310 - 2390	22.01 - 23.12
6.215 - 6.218	149.9 - 150.05	2483.5 - 2500	23.6 - 24.0
6.26775 - 6.26825	156.52475 -	2655 - 2900	31.2 - 31.8
6.31175 - 6.31225	156.52525	3260 - 3267	36.43 - 36.5
8.291 - 8.294	156.7 - 156.9	3332 - 3339	Above 38.6
8.362 - 8.366	162.0125 - 167.17	3345.8 - 3358	
8.37625 - 8.38675	167.72 - 173.2	3500 - 4400	
8.41425 - 8.41475	240 - 285	4500 - 5150	
12.29 - 12.293	322 - 335.4	5350 - 5460	
12.51975 - 12.52025	399.9 - 410	7250 - 7750	
12.57675 - 12.57725		8025 - 8500	
13.36 - 13.41			

Note 1: Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

3.4 DESCRIPTION OF TEST MODES

The EUT had been tested under engineering test mode condition and the EUT staying in continuous transmitting mode.

All modes and data rates were investigated and it was determined that ISO 14443A/B and ISO 18092 Type y, 106/212/424/848 kbps.

All data rates were investigated and it was determined that 106 Kbps was considered worst-case. Therefore, all testing was performed in 106 Kbps mode.

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: EUT power by POE (10 inches) Mode 2: EUT power by POE (7 inches)
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement Above 1G	
Test Condition	Radiated Emission Above 1G
Power supply Mode	Mode 1: EUT power by POE (7 inches) Mode 2: EUT power by POE (10 inches)
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☐ Placed in fixed position. ☐ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☒ Placed in fixed position at Z-Plane (H-Plane)

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1: EUT power by POE (7 inches) Mode 2: EUT power by POE (10 inches)
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

1. The worst mode was record in this test report.
2. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement. The worst case(Z-Plane) were recorded in this report
3. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.



Report No.: TMWK2108000306KR

Page: 9 / 31

Rev.: 01

4. TEST SUMMARY

FCC Standard Sec.	IC Standard Sec.	Chapter	Test Item	Result
15.203	RSS-GEN Sec. 8.3	2	Antenna Requirement	Pass
15.215	RSS-210	8.1	Occupied Bandwidth (99%) and 20dB Bandwidth	Pass
15.209	RSS-210	8.2	Radiated Emissions	Pass
15.225	RSS-210	8.3	Frequency Stability	Pass
15.207	RSS-GEN Sec. 8.8	8.4	AC Power-line Conducted Emission	Pass

5. INSTRUMENT CALIBRATION

5.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

RF Conducted Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
EXA Signal Analyzer	KEYSIGHT	N9010B	MY55460167	09/07/2021	09/06/2022
Loop Probe	LANGER EMV-TECHNIK	RF-R 50-1	02-2644	01/24/2022	01/23/2023
Thermostatic/ Humidity Chamber	TAICHY	MHG-150LF	930619	09/17/2021	09/16/2022
Software	N/A				

3M 966 Chamber Test Site					
Equipment	Manufacturer	Model	S/N	Cal Date	Cal Due
Bilog Antenna	Sunol Sciences	JB3	A030105	07/19/2021	07/18/2022
Coaxial Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/23/2022	02/22/2023
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	12/28/2021	12/27/2022
Loop Ant	COM-POWER	AL-130	121051	04/07/2021	04/06/2022
Pre-Amplifier	EMEC	EM330	060609	02/23/2022	02/22/2023
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	12/06/2021	12/05/2022
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 6.11-20180413				

Conducted Emission Room					
Name of Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
CABLE	EMCI	CFD300-NL	CERF	06/28/2021	06/27/2022
EMI Test Receiver	R&S	ESCI	100064	07/05/2021	07/04/2022
LISN	SCHAFFNER	NNB 41	03/10013	02/15/2022	02/14/2023
Software	EZ-EMC(CCS-3A1-CE)				

Remark:

- Each piece of equipment is scheduled for calibration once a year.
- N.C.R. = No Calibration Request.

5.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	± 2.213 dB
Channel Bandwidth	± 2.7 %
Frequency Stability	± 0.03 ppm
Radiated Emission_9kHz-30MHz	± 3.761 dB
Radiated Emission_30MHz-200MHz	± 3.473 dB
Radiated Emission_200MHz-1GHz	± 3.946 dB

Remark: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

5.4 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

CAB identifier: TW1309

Test site	Test Engineer	Remark
AC Conduction Room	Jack Chen	-
Radiation	Ray Li	-
RF Conducted	Allen Shen	-

Remark: The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC public Access Link (PAL) database, FCC Registration No. :444940, the FCC Designation No.:TW1309



Report No.: TMWK2108000306KR

Page: 12 / 31
Rev.: 01

6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix A for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

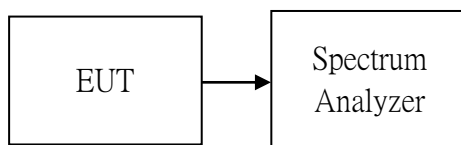
No.	Device Type	Brand	Model	Series No.	FCC ID
1	NB	ASUS	PU451L	N/A	N/A

Remark:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

7. FCC PART 15.225 REQUIREMENTS & RSS-210 REQUIREMENTS

7.1 OCCUPIED BANDWIDTH(99%) AND 20 dB BANDWIDTH TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW & VBW (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth (VBW) shall not be smaller than three times the RBW value.
4. Record the max. reading.

TEST RESULTS

No non-compliance noted.

Temperature: 22.8°C

Humidity: 57% RH

Tested by: Allen Shen

Test Date: March 14, 2022

Test Condition	Frequency(MHz)	Occupied Bandwidth 99% (kHz)	20 dB Bandwidth (kHz)
NFC	13.56	2.318	2.717



Report No.: TMWK2108000306KR

Page: 14 / 31
Rev.: 01

Test Plot



7.2 FUNDAMENTAL AND RADIATED EMISSIONS

LIMIT

According to §15.225

- (a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts / meter at 30 meters.
- (b) Within the bands 13.410 – 13.553 MHz and 13.567 -13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts / meter at 30 meters.
- (c) Within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz the field strength of any emissions shall not exceed 106 microvolts / meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz and shall not exceed the general radiated emission limits in §15.209.

According to §15.225, 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 (MHz)	Field Strength (µV/m at meter)	Measurement Distance (meter)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

According to RSS 210 §B.6

The field strength of any emission shall not exceed the following limits:

- (a) 15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553-13.567 MHz;
- (b) 334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz;
- (c) 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz; and
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

Below 30 MHz

Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement Distance (metres)
9-490 kHz Note 1	6.37/F (F in kHz)	300
490-1,705 kHz	63.7/F (F in kHz)	30
1.705-30 MHz	0.08	30

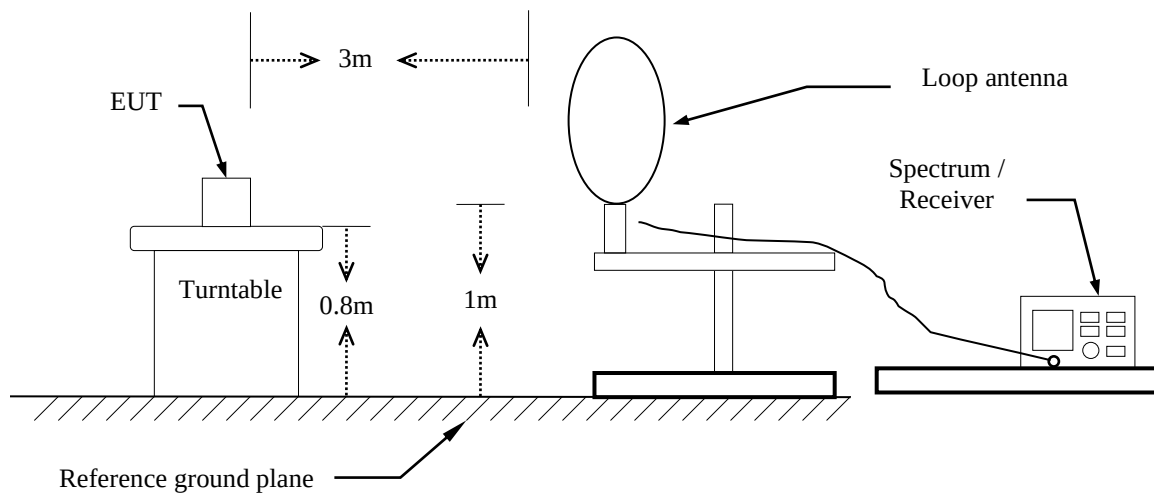
Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Above 30 MHz

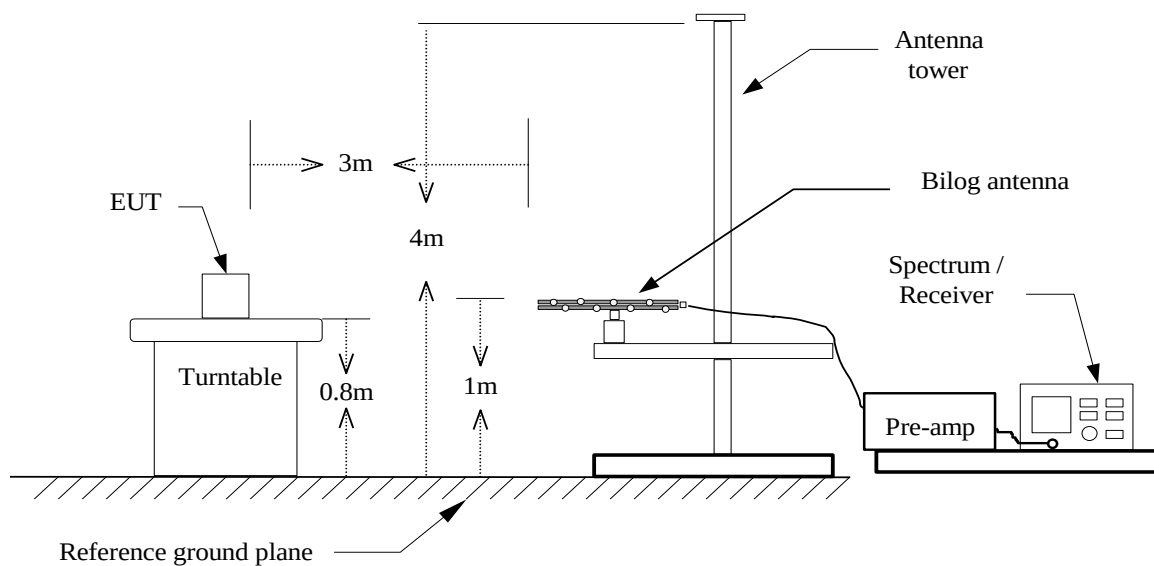
Frequency	Field strength (µV/m at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Test Configuration

9kHz ~ 30MHz



30MHz ~ 1GHz



TEST PROCEDURE

For 9kHz ~ 30MHz

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, The center of the loop shall be 1 m above the ground then to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Set the spectrum analyzer in the following setting as:
9KHz-490KHz : RBW=200Hz / VBW=1kHz / Sweep=AUTO
490KHz-30MHz : RBW=10kHz / VBW=30kHz / Sweep=AUTO
6. Repeat above procedures until the measurements for all frequencies are complete.

For 30MHz ~ 1GHz

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:
RBW=100kHz / VBW=300kHz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

Remark :

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Operation Mode: TX mode

Test Date:

March 16, 2022

Temperature: 22.4°C

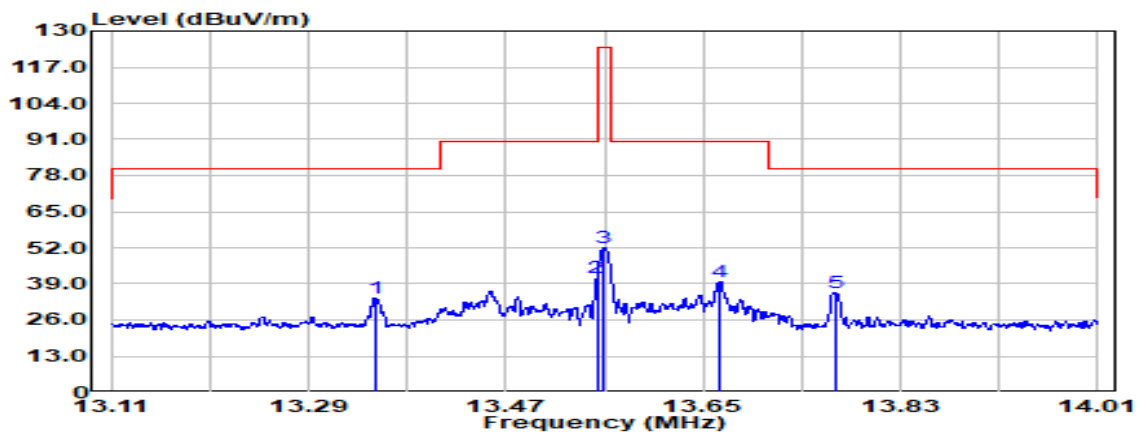
Tested by:

Ray Li

Humidity: 51% RH

Polarity:

Ver.

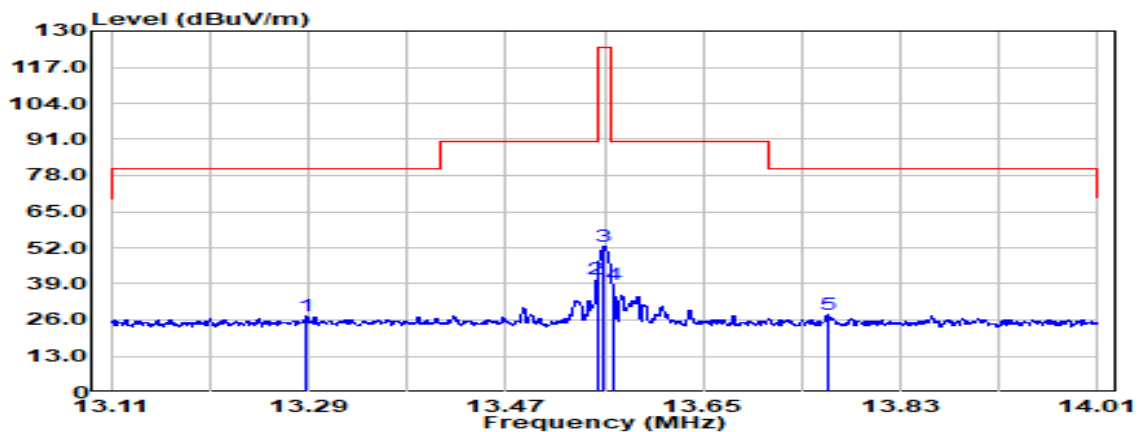


No.	Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1	13.351	Peak	18.74	15.31	34.05	80.51	-46.46
2	13.553	Peak	26.01	15.31	41.32	90.47	-49.15
3	13.560	Peak	36.80	15.31	52.11	124.00	-71.89
4	13.665	Peak	24.51	15.31	39.82	90.47	-50.65
5	13.770	Peak	20.73	15.30	36.04	80.51	-44.47

Remark:

1. Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).
4. 9kHz to 490kHz Limit(@3m) = 2400(F/kHz)+ 40*Log (300 meters/3 meters)
490kHz to 1.705MHz Limit (@3m) = 2400(F/kHz)+ 40*Log (30 meters/3 meters)
1.705MHz to 30MHz Limit (@3m) = 30 + 40*Log (30 meters/3 meters)

Operation Mode:	TX mode	Test Date:	March 15, 2022
Temperature:	23.1°C	Tested by:	Ray Li
Humidity:	53 % RH	Polarity:	Hor.



No.	Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
1	13.288	Peak	12.14	15.31	27.45	80.51	-53.05
2	13.553	Peak	25.55	15.31	40.86	90.47	-49.61
3	13.560	Peak	36.98	15.31	52.28	124.00	-71.72
4	13.567	Peak	23.32	15.31	38.63	90.47	-51.84
5	13.763	Peak	12.64	15.30	27.94	80.51	-52.56

Remark:

- Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- Margin (dB) = Result (dBUV/m) – Limit (dBUV/m).
- 9kHz to 490kHz Limit(@3m) = 2400(F/kHz)+ 40*Log (300 meters/3 meters)
490kHz to 1.705MHz Limit (@3m) = 2400(F/kHz)+ 40*Log (30 meters/3 meters)
1.705MHz to 30MHz Limit (@3m) = 30 + 40*Log (30 meters/3 meters)

Operation Mode: TX mode **Test Date:** March 15, 2022
Temperature: 23.1°C **Tested by:** Ray Li
Humidity: 53 % RH **Polarity:** Ground



No.	Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1	13.352	Peak	11.75	15.31	27.06	80.51	-53.45
2	13.553	Peak	17.87	15.31	33.18	90.47	-57.29
3	13.560	Peak	27.11	15.31	42.42	124.00	-81.58
4	13.567	Peak	16.48	15.31	31.79	90.47	-58.68
5	13.898	Peak	10.98	15.30	26.28	80.51	-54.22

Remark:

- Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).
- 9kHz to 490kHz Limit(@3m) = 2400(F/kHz)+ 40*Log (300 meters/3 meters)
490kHz to 1.705MHz Limit (@3m) = 2400(F/kHz)+ 40*Log (30 meters/3 meters)
1.705MHz to 30MHz Limit (@3m) = 30 + 40*Log (30 meters/3 meters)

9kHz ~ 30MHz

Operation Mode: TX mode

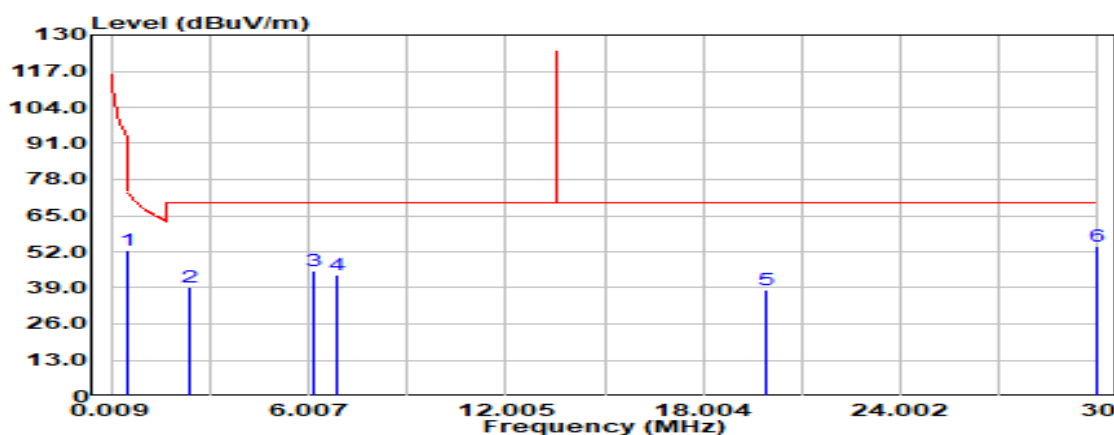
Test Date: March 16, 2022

Temperature: 22.4°C

Tested by: Ray Li

Humidity: 51 % RH

Polarity: Hor.



No.	Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
1	0.478	Peak	39.41	13.31	52.72	94.01	-41.29
2	2.389	Peak	25.12	13.90	39.02	69.54	-30.52
3	6.160	Peak	30.54	14.82	45.36	69.54	-24.18
4	6.846	Peak	28.72	14.92	43.64	69.54	-25.90
5	19.881	Peak	22.89	15.21	38.10	69.54	-31.44
6	29.940	Peak	40.65	13.33	53.98	69.54	-15.56

Remark:

- 9kHz to 490kHz Limit(@3m) = $2400(F/\text{kHz}) + 40 \cdot \log(300 \text{ meters}/3 \text{ meters})$
490kHz to 1.705MHz Limit (@3m) = $2400(F/\text{kHz}) + 40 \cdot \log(30 \text{ meters}/3 \text{ meters})$
1.705MHz to 30MHz Limit (@3m) = $30 + 40 \cdot \log(30 \text{ meters}/3 \text{ meters})$



Report No.: TMWK2108000306KR

Page: 23 / 31

Rev.: 01

30MHz ~ 1GHz

Operation Mode: TX mode

Test Date:

March 16, 2022

Temperature: 22.4°C

Tested by:

Ray Li

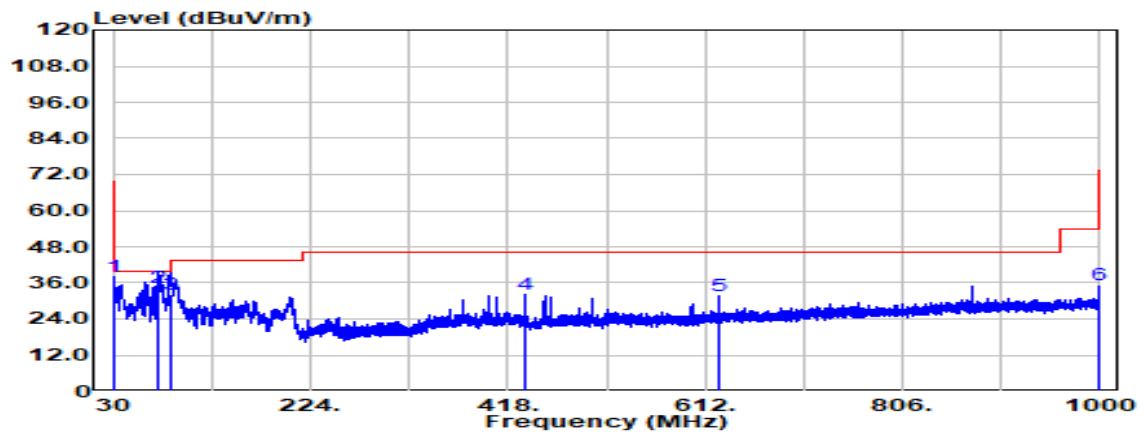
Humidity: 51 % RH

Polarity:

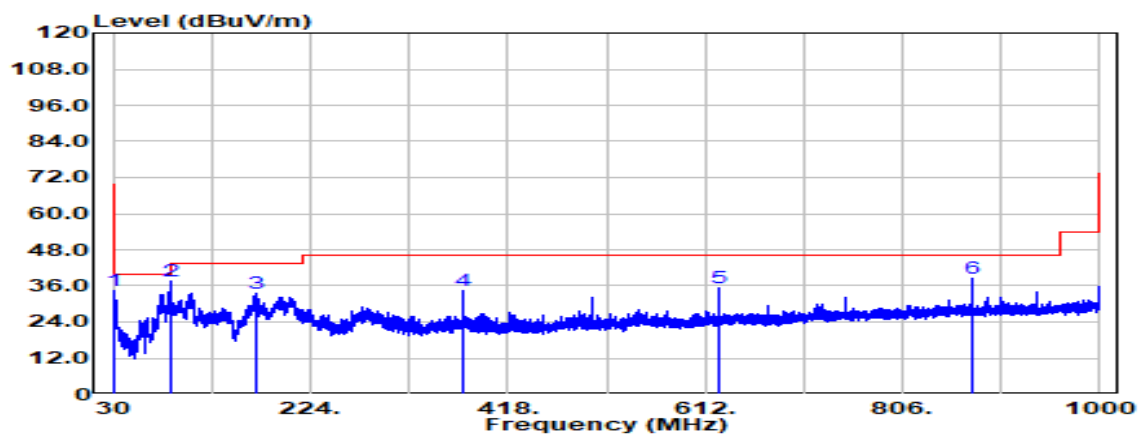
Ver. / Hor.

Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB	Polarity
30.000	Peak	40.97	-2.71	38.26	40.00	-1.74	V
75.226	QP	49.88	-15.51	34.37	40.00	-5.63	V
86.260	QP	48.58	-16.23	32.35	40.00	-7.65	V
433.884	Peak	37.05	-5.10	31.95	46.00	-14.05	V
624.974	Peak	32.83	-1.26	31.57	46.00	-14.43	V
1000.000	Peak	30.70	4.53	35.23	54.00	-18.77	V
30.121	Peak	37.30	-2.78	34.52	40.00	-5.48	H
86.018	Peak	53.77	-16.26	37.52	40.00	-2.48	H
169.559	Peak	44.85	-11.36	33.49	43.50	-10.01	H
375.078	Peak	41.50	-7.12	34.38	46.00	-11.62	H
624.974	Peak	36.68	-1.26	35.42	46.00	-10.58	H
874.991	Peak	36.13	2.26	38.38	46.00	-7.62	H

Vertical



Horizontal



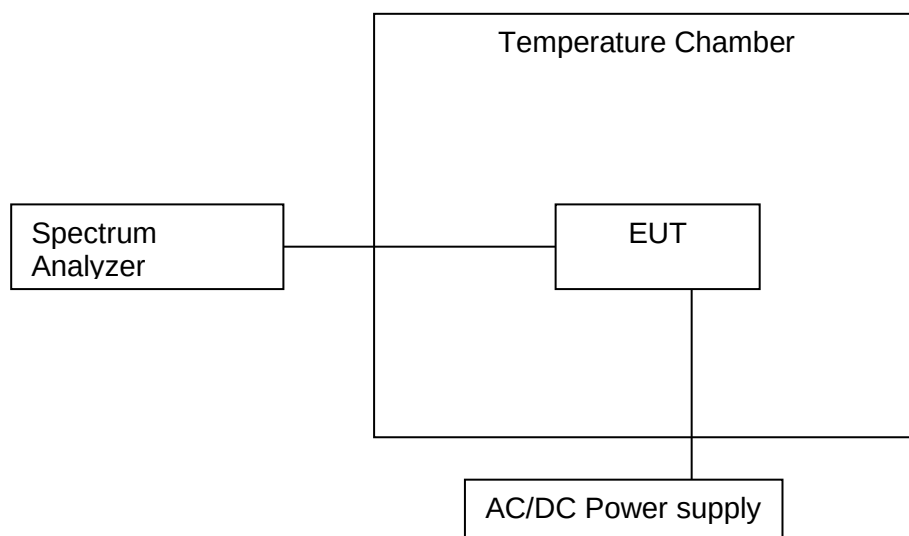
7.3 FREQUENCY STABILITY

LIMIT

According to §15.225(e) and RSS-210, B.6,
The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Configuration

Temperature and Voltage Measurement (under normal and extreme test conditions)



TEST PROCEDURE

1. Turn the EUT off, and place it inside the environmental temperature chamber.
2. Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
3. Set the spectrum analyzer as RBW=1kHz, VBW = RBW, Span = 200kHz, Sweep = auto.
4. Turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.
5. Switch off the EUT and Lower the chamber temperature by not more than 10 °C and allow the temperature inside the chamber to stabilize.
6. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
7. Repeat step 4 through step 6 down to the lowest specified temperature.



Report No.: TMWK2108000306KR

Page: 26 / 31
Rev.: 01

TEST RESULTS

No non-compliance noted.

Temperature: 22.8°C

Humidity: 57% RH

Tested by: Allen Shen

Test Date: March 14, 2022

TEST DATA

Startup				
A. Temperature Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
50	-20	13.5600088	0.00880	+/- 1.356
50	-10	13.5600086	0.00860	+/- 1.356
50	0	13.5599968	-0.00320	+/- 1.356
50	10	13.5599928	-0.00720	+/- 1.356
50	20	13.5600045	0.00450	+/- 1.356
50	30	13.5600017	0.00170	+/- 1.356
50	40	13.5600052	0.00520	+/- 1.356
50	50	13.560006	0.00600	+/- 1.356
B. Supply Voltage Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
57.5	20	13.5600044	0.00440	+/- 1.356
50	20	13.5600045	0.00450	+/- 1.356
42.5	20	13.5599982	-0.00180	+/- 1.356

2 minutes				
A. Temperature Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
50	-20	13.5600023	0.00230	+/- 1.356
50	-10	13.5599959	-0.00410	+/- 1.356
50	0	13.5600095	0.00950	+/- 1.356
50	10	13.559999	-0.00100	+/- 1.356
50	20	13.5600098	0.00980	+/- 1.356
50	30	13.5600062	0.00620	+/- 1.356
50	40	13.5600095	0.00950	+/- 1.356
50	50	13.5600053	0.00530	+/- 1.356
B. Supply Voltage Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
57.5	20	13.5599968	-0.00320	+/- 1.356
50	20	13.5600098	0.00980	+/- 1.356
42.5	20	13.5600093	0.00930	+/- 1.356

5 minutes				
A. Temperature Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
50	-20	13.5599928	-0.00720	+/- 1.356
50	-10	13.5599945	-0.00550	+/- 1.356
50	0	13.560002	0.00200	+/- 1.356
50	10	13.5599933	-0.00670	+/- 1.356
50	20	13.5600089	0.00890	+/- 1.356
50	30	13.560004	0.00400	+/- 1.356
50	40	13.5599948	-0.00520	+/- 1.356
50	50	13.5599994	-0.00060	+/- 1.356
B. Supply Voltage Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
57.5	20	13.5600038	0.00380	+/- 1.356
50	20	13.5600089	0.00890	+/- 1.356
42.5	20	13.559992	-0.00800	+/- 1.356

10 minutes				
A. Temperature Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
50	-20	13.5599935	-0.00650	+/- 1.356
50	-10	13.5599916	-0.00840	+/- 1.356
50	0	13.5599957	-0.00430	+/- 1.356
50	10	13.5600076	0.00760	+/- 1.356
50	20	13.5599971	-0.00290	+/- 1.356
50	30	13.56001	0.01000	+/- 1.356
50	40	13.5600036	0.00360	+/- 1.356
50	50	13.560008	0.00800	+/- 1.356
B. Supply Voltage Variation				
Power Supply	Environment	Frequency	Delta (kHz)	Limit (kHz)
Vdc	Temperature (°C)	(MHz)		
57.5	20	13.5600022	0.00220	+/- 1.356
50	20	13.5599971	-0.00290	+/- 1.356
42.5	20	13.5599924	-0.00760	+/- 1.356

7.4 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), for an intentional radiator 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, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.



Report No.: TMWK2108000306KR

Page: 30 / 31

Rev.: 01

TEST RESULTS

Operation Mode: Mode 1

Test Date: March 14, 2022

Temperature: 23.5°C

Tested by: Jack Chen

Humidity: 54% RH

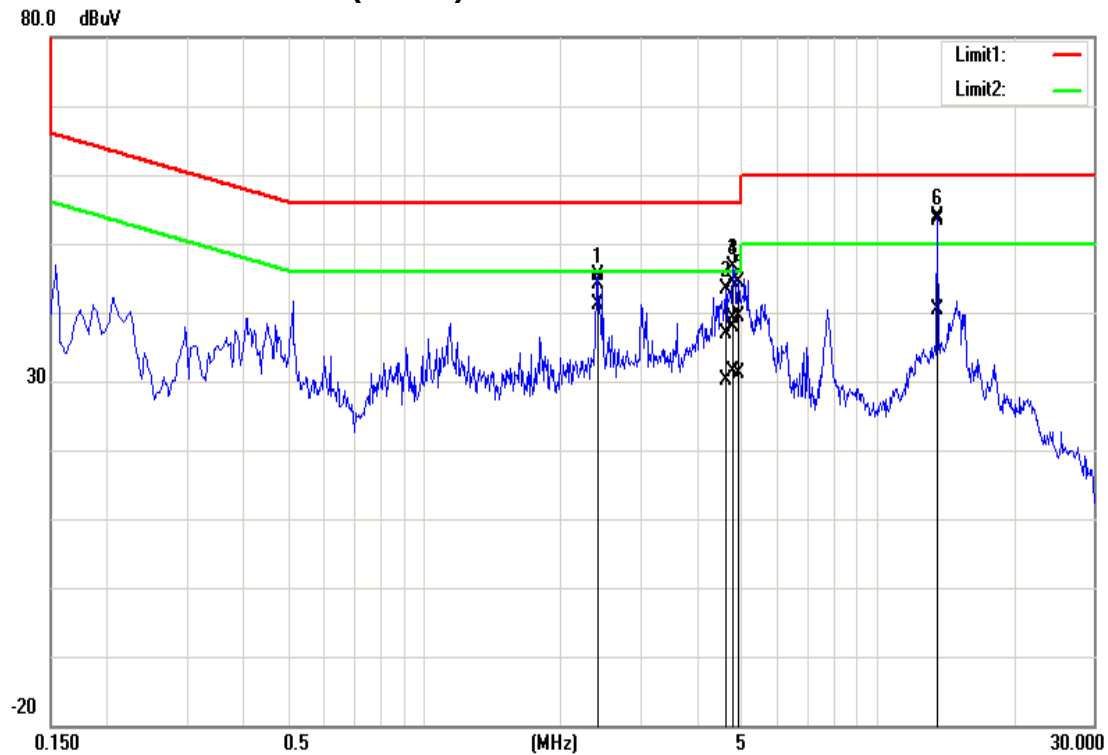
Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB/m)	QP Result (dBuV/m)	AV Result (dBuV/m)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
2.4140	33.90	30.84	10.25	44.15	41.09	56.00	46.00	-11.85	-4.91	L1
4.6460	26.66	19.87	10.30	36.96	30.17	56.00	46.00	-19.04	-15.83	L1
4.7540	27.47	21.16	10.30	37.77	31.46	56.00	46.00	-18.23	-14.54	L1
4.8220	34.18	28.89	10.30	44.48	39.19	56.00	46.00	-11.52	-6.81	L1
4.9460	29.03	20.72	10.30	39.33	31.02	56.00	46.00	-16.67	-14.98	L1
13.5620	42.96	30.03	10.37	53.33	40.40	60.00	50.00	-6.67	-9.60	L1
0.2860	43.16	35.97	10.17	53.33	46.14	60.64	50.64	-7.31	-4.50	N
0.3020	28.31	19.61	10.18	38.49	29.79	60.19	50.19	-21.70	-20.40	N
0.3340	25.17	19.47	10.18	35.35	29.65	59.35	49.35	-24.00	-19.70	N
0.4060	29.07	23.05	10.18	39.25	33.23	57.73	47.73	-18.48	-14.50	N
0.6780	36.27	29.99	10.18	46.45	40.17	56.00	46.00	-9.55	-5.83	N
4.8300	33.39	26.43	10.29	43.68	36.72	56.00	46.00	-12.32	-9.28	N

Remark:

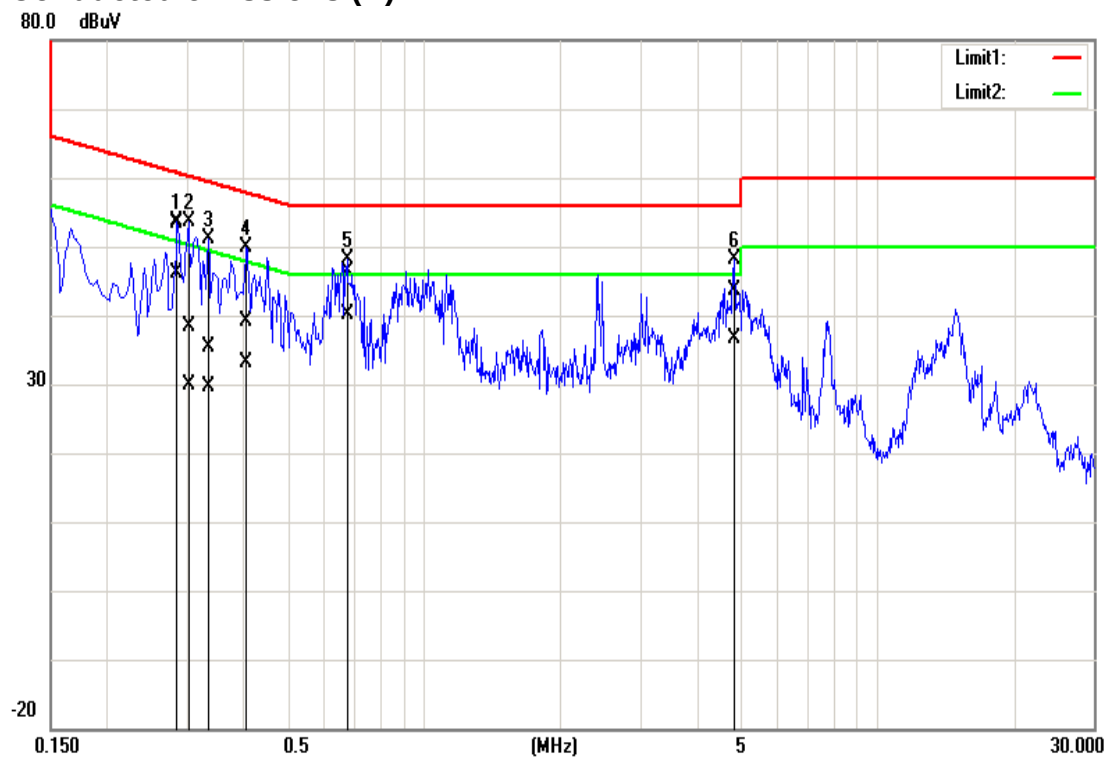
1. The measuring frequencies range between 0.15 MHz and 30 MHz.
2. The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.
3. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10kHz. The IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz.
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)
5. "-" means Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.

Test Plots

Conducted emissions (Line 1)



Conducted emissions (N)



- End of Test Report -