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TEST REPORT

Report Number	220200096SEL-EMC1
Applicant Name/Address	Navien, Inc. 20 GOODYEAR IRVINE, California 92618
Test Sample Description	
- Product ..... :	Water Treatment
- Model and/or Brand name ..... :	WEC60002AE
- Variant model name..... :	WEC40002AE, WEC62002AE, WEC42002AE
- Manufacturer Name / Address .. :	KD Navien Co., Ltd. 95, Suworam-Gil, Seotan-Myeon, Pyeongtaek-Si, Gyeonggi-Do, 17704, Korea
- Rating(s) ..... :	AC 120 V, 60 Hz, 4.5 A
Receipt of sample(s)	18 Feb. 2022
Date of Test	20 Apr. 2022
Test Method(s)	47 CFR FCC Part 15 Subpart B with ANSI C63.4
Class	Class B
Test Results & Uncertainty	See EMC Results Conclusion
Issue date	03 May. 2022

Note 1. The results shown in this test report refer only to the sample(s) tested.

Note 2: This report shall not be reproduced except in full, without the written approval of Intertek.

Note 3: This laboratory is not accredited for the test results marked as *.

Tested by;

Name: Harry Jeon
Engineer

Approved by;

Name: Shinyeong Lee
Technical Manager

Intertek ETL SEMKO Korea Ltd.

The results shown in this test report are not related to KOLAS accreditation even if Intertek has the accreditation scope under KOLAS.

SECTION 1 CONTENTS

SECTION 2 EMC RESULTS CONCLUSION (WITH JUSTIFICATION)

We tested the Water Treatment, Model: WEC60002AE, to determine if it was in compliance with the relevant US standards as marked on the test report.
We found that the unit met the requirement of FCC Part 15 Subpart B standards when tested as received.

Test Items	Applied Standards	Results			
		Comply	Not Comply	N/A	See Note
Disturbance Voltage	FCC Part 15 Subpart B	☒	☐	☐	☐
Radiated disturbance (Below 1 GHz)	FCC Part 15 Subpart B	☒	☐	☐	☐
Radiated disturbance (Above 1 GHz)	FCC Part 15 Subpart B	☒	☐	☐	☐
Note) When determining the test conclusion, the Measurement Uncertainty of test has been considered.					

Measurement Uncertainty

Conducted Emission	150 kHz – 30 MHz	U = 3.4 [dB]
	(Confidence level approximately 95 %, k = 2)	
Radiated Emissions	9 kHz – 30 MHz	U = 5.1 [dB]
	30 MHz – 1 000 MHz	Horizontal: U = 4.6 [dB] Vertical: U = 4.9 [dB]
	1 GHz – 6 GHz	Horizontal: U = 5.6 [dB] Vertical: U = 5.5 [dB]
	6 GHz – 18 GHz	Horizontal: U = 5.5 [dB] Vertical: U = 5.7 [dB]
	(Confidence level approximately 95 %, k = 2)	

SECTION 3 TEST ENVIRONMENT AND CONDITIONS

Test Environment

Test Item	Test Site	Test date (MM-DD)	Temp (℃)	Humidity (% R.H.)	Pressure (kPa)
Disturbance Voltage	Shielded Room #2	04-20	23.3 ± 1.0	39.7 ± 1.0	-
Radiated disturbance (Below 1 GHz)	10 m chamber	04-20	23.4 ± 1.0	40.4 ± 1.0	
Radiated disturbance (Above 1 GHz)	10 m chamber	-	-	-	

SECTION 4 EUT INFORMATION

Equipment Under Test (EUT):	Water Treatment
Model:	WEC60002AE
Variant Model:	WEC40002AE, WEC62002AE, WEC42002AE
Variant model information:	The model WEC40002AE is dualization model depending on reduced module material quantity (250 ea to 150 ea) and height of injection molding (H312 to H253). The model WEC62002AE is Same as "WEC60002AE" model, additional model name according to sales classification. The model WEC42002AE is Same as "WEC40002AE" model, additional model name according to sales classification.
Serial No.:	-
Rated Voltage:	AC 120 V, 60 Hz, 4.5 A
Tested Voltage:	AC 120 V, 60 Hz
Maximum clock frequency:	24 MHz

SECTION 5 TEST CONFIGURATION, OPERATION MODE AND SET-UP

Test Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer	ETC.
Water Treatment	WEC60002AE	-	KD Navien Co., Ltd.	EUT
Resistance X 2	2 000 W / 450 Ω	-	JEIL	-

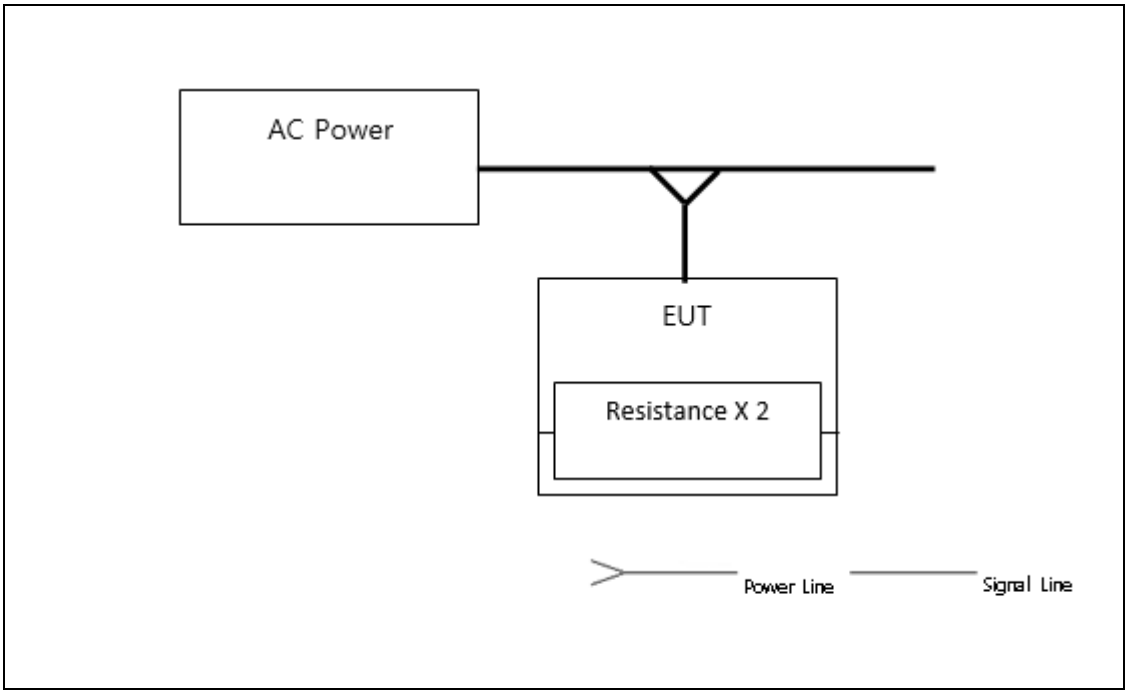
Used cable description

Start		END		CABLE		
Name	I/O Port	Name	I/O Port	Length (m)	Shield	With Ferrite
EUT	AC IN	AC Power	AC OUT	1.8	Unshielded	-

Test Operation Mode

- Normal Operating Mode: After configuring the EUT as shown in the layout diagram, connect the resistance of the EUT to implement and test the operating state.

Test Setup



SECTION 6 EMISSION

Radiated disturbance test

Test Method and Summary

Test standard: FCC Part 15 Subpart B

Used Test Equipment

Control No.	Equipment	Manufacturer	Model No.	Serial No.	Next Cal.	Cal Int.
EMC001	EMI Test Receiver	R & S	ESU40	100478	2023.01.03	1Y
EMC002	EMI Test Receiver	R & S	ESU26	100590	2023.01.03	1Y
EMC025	Biconilog (Type7)	ETS-Lindgren	3142E	00203547	2023.12.09	2Y
EMC028	DRG Horn (Medium)	ETS-Lindgren	3117	00201915	2022.10.18	1Y
EMC074	AMP	R & S	SCU-01D	1904843	2022.06.29	1Y
EMC077	AMP	R & S	SCU-18D	1952128	2022.06.29	1Y
-	CONTROLLER	Innco systems GmbH	CO3000	CO3000/887 /36540815/L	-	-
-	TURN TABLE	Innco systems GmbH	DT3000-2T	-	-	-
-	ANTENNA MASTER	Innco systems GmbH	MA4000-XP-ET	-	-	-

Used Test Software

Software	Manufacturer	Software Version	Used
EMC32	R & S	10.30.00	☒

Operating Environment

Test Voltage: AC 120 V, 60 Hz

Test Setup and Procedure

The EUT along with its peripherals were placed on a non-conducted table with a height of 0.1 m in height table above the reference ground plane.

Rotate the EUT from 0° to 360° and position the receiving antenna at heights from 1 m to 4 m above the reference ground plane continuously to determine associated with higher emission levels and record them.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

For measurements above 1 GHz, place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.

The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

The final measurement antenna elevation shall be that which maximizes the emissions.

Limits

- The test frequency range of Radiated Disturbance measurements are listed below.

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 108	1 000
108 – 500	2 000
500 – 1 000	5 000
Above 1 000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

(1) Limit for Radiated Emission below 1 000 MHz

Frequency range (MHz)	Class A Equipment (10 m distance) Quasi-peak (dBµV/m)	Class B Equipment (3 m distance) Quasi-peak (dBµV/m)
30 to 88	39.0	40.0
88 to 216	43.5	43.5
216 to 960	46.4	46.0
960 to 1 000	49.5	54.0

Note 1) The lower limit shall apply at the transition frequency.
Note 2) Additional provisions may be required for cases where interference occurs.
Note 3) According to 15.109(g), as an alternative to the radiated emission limit shown above, digital devices may be shown to comply with the standards (CISPR), Pub. 22 shown as below.
Note 4) Result (dBµV/m) = Reading (dBµV) + Corr. (Ant. Factor (dB/m) + Cable Loss (dB) – Amp. Gain (dB))
Result: QuasiPeak, Reading: Receiver reading value, Corr.: Correction Factor
Margin = Limit – Result

Frequency range (MHz)	Class A Equipment (10 m distance) Quasi-peak (dBµV/m)	Class B Equipment (10 m distance) Quasi-peak (dBµV/m)
30 to 230	40	30
230 to 1 000	47	37

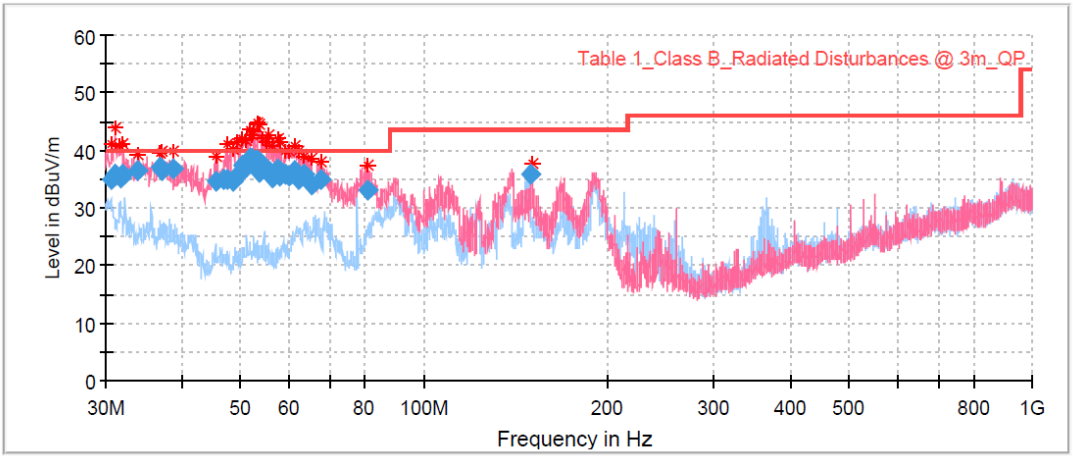
(2) Limits for Radiated Emission above 1 000 MHz at a measuring distance of 3 m

Frequency (GHz)	Class A Equipment		Class B Equipment	
	Peak (dBµV/m)	Average (dBµV/m)	Peak (dBµV/m)	Average (dBµV/m)
1 to 40	80	60	74	54

Note 1) Result (dBµV/m) = Reading (dBµV) + Corr. (Ant. Factor (dB/m) + Cable Loss (dB) – Amp. Gain (dB))
Result: Final value, Reading: Receiver reading value, Corr.: Correction Factor
Margin = Limit – Result
Note 2) If measured at a distance other than 3 m, apply the following formula to compensate the measured value.
Em = Edm + 20*log(d/3) (d: Measured distance)
Em: Result of measured distance correction, Edm: Measured value

Test Data

[30 MHz ~ 1 GHz]



Final_Result

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.59	34.80	40.00	5.20	100.0	V	64.00	-5.96
31.08	35.78	40.00	4.22	100.0	V	72.00	-6.18
31.72	35.22	40.00	4.78	100.0	V	99.00	-6.52
32.05	36.02	40.00	3.98	100.0	V	182.00	-6.70
33.93	36.51	40.00	3.49	129.0	V	132.00	-8.13
36.74	37.03	40.00	2.97	100.0	V	148.00	-9.51
37.22	36.44	40.00	3.56	100.0	V	177.00	-9.75
38.84	36.80	40.00	3.20	100.0	V	216.00	-10.37
45.41	34.79	40.00	5.21	100.0	V	166.00	-13.59
46.92	34.97	40.00	5.03	100.0	V	64.00	-14.45
47.57	34.87	40.00	5.13	100.0	V	120.00	-14.55
48.65	34.67	40.00	5.33	100.0	V	138.00	-14.74
49.35	35.52	40.00	4.48	100.0	V	144.00	-14.88
50.37	37.28	40.00	2.72	148.0	V	196.00	-15.09
50.86	37.22	40.00	2.78	100.0	V	77.00	-15.19
51.88	38.72	40.00	1.28	100.0	V	198.00	-15.06
52.31	38.64	40.00	1.36	100.0	V	200.00	-15.14
52.53	38.20	40.00	1.80	127.0	V	54.00	-15.21
53.39	38.20	40.00	1.80	100.0	V	196.00	-15.35
53.77	36.07	40.00	3.93	163.0	V	64.00	-15.33
54.57	37.06	40.00	2.94	100.0	V	198.00	-15.21
55.33	36.36	40.00	3.64	100.0	V	32.00	-15.07
55.76	36.38	40.00	3.62	115.0	V	216.00	-14.99
56.51	35.34	40.00	4.66	100.0	V	64.00	-15.08
57.43	36.81	40.00	3.19	100.0	V	217.00	-15.11
58.02	35.48	40.00	4.52	118.0	V	64.00	-14.98
59.05	35.76	40.00	4.24	100.0	V	154.00	-14.69
60.12	35.61	40.00	4.39	132.0	V	168.00	-14.82
61.20	36.46	40.00	3.54	100.0	V	235.00	-14.67
62.28	34.93	40.00	5.07	100.0	V	132.00	-14.57
63.41	35.86	40.00	4.14	100.0	V	160.00	-14.62
65.19	34.07	40.00	5.93	190.0	V	256.00	-14.36
67.56	35.09	40.00	4.91	100.0	V	75.00	-14.45
80.71	33.15	40.00	6.85	190.0	V	83.00	-15.14
150.17	35.90	43.50	7.60	100.0	V	74.00	-10.74

Disturbance Voltage test

Test Method and Summary

Test standard : FCC Part 15 Subpart B

Used Test Equipment

Control No.	Equipment	Manufacturer	Model No.	Serial No.	Next Cal.	Cal Int.
EMC004	EMI Test Receiver	R & S	ESR7	101560	2023.01.03	1Y
EMC007	Two-Line V-Network	R & S	ENV216	101982	2022.10.15	1Y

Used Test Software

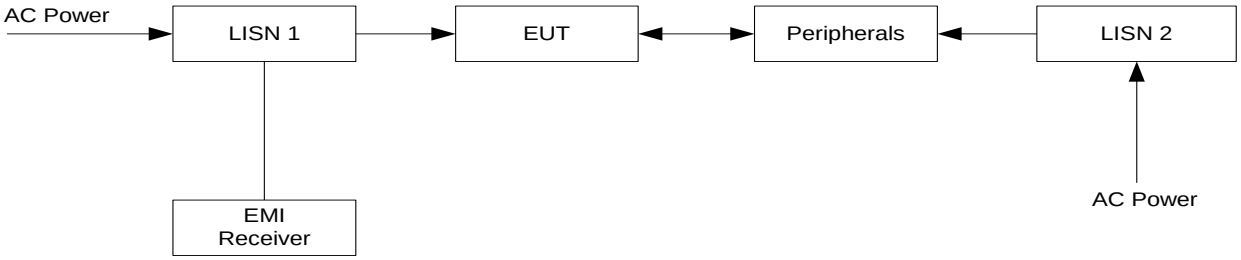
Software	Manufacturer	Software Version	Used
EMC32	R & S	10.28.00	☒

Operating Environment

Test Voltage: AC 120 V, 60 Hz

Test Setup and Procedure

Disturbance Voltage Test at Mains Terminal:



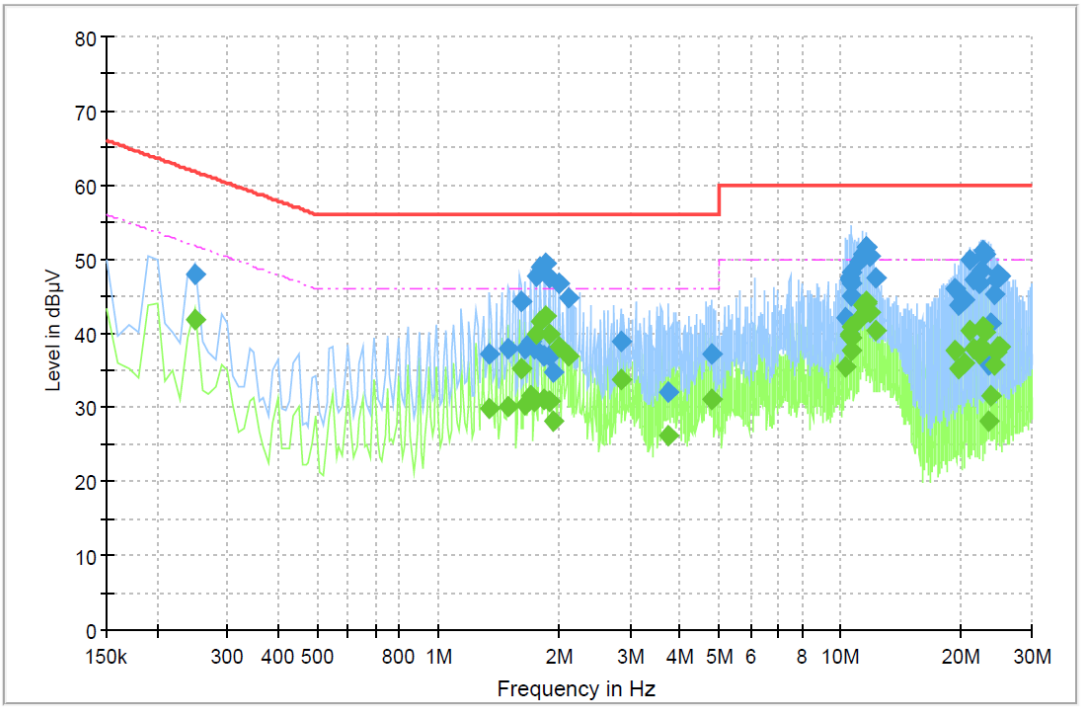
The EUT along with its peripherals were placed on a 0.1 m in height wooden table and the EUT was adjusted to maintain a 0.4 m space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 characteristic coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

Limits

Frequency range (MHz)	Limits dB(µV)			
	Quasi-peak		Average	
	Class A	Class B	Class A	Class B
0.15 to 0.50	79	66 to 56	66	56 to 46
0.50 to 5	73	56	60	46
5 to 30		60		50

Note 1) The lower limit shall apply at the transition frequencies.
Note 2) The limit decreases linearly with the logarithm of the frequency in the range (0.15 ~ 0.5) MHz.
Note 3) Result (dBµV) = Reading (dBµV) + Corr. (Insertion Loss (dB) + Cable Loss (dB))
Result: QuasiPeak/CAverage, Reading: Receiver reading value, Corr.: Correction Factor
Margin = Limit – Result

Test Data



Final_Result

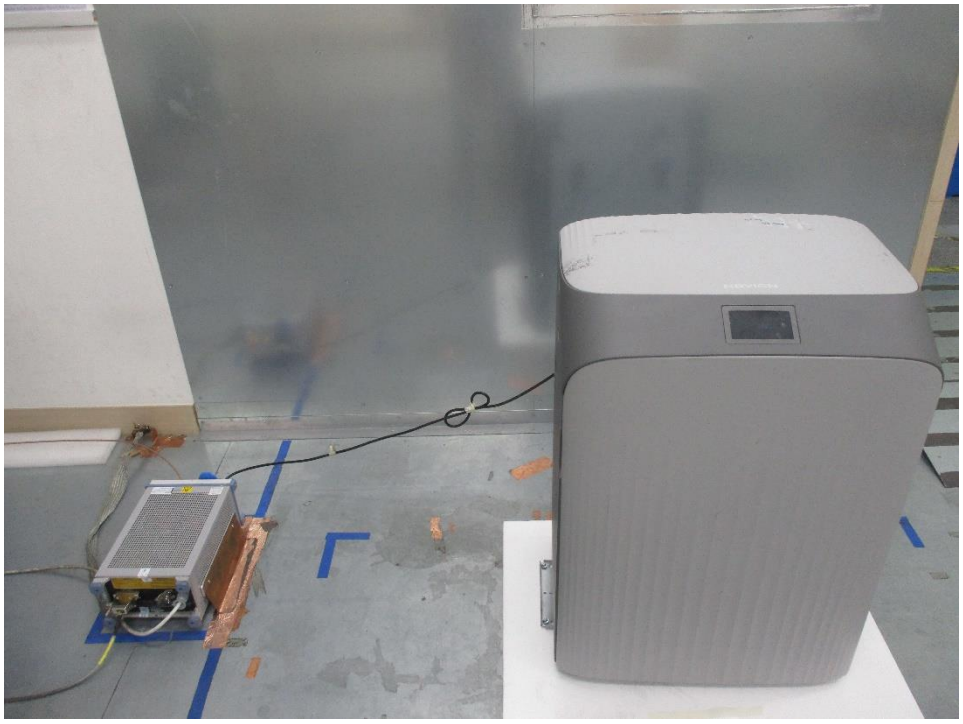
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.249500	---	41.79	51.77	9.99	L1	ON	9.6
0.249500	47.93	---	61.77	13.85	L1	ON	9.6
1.344000	37.09	---	56.00	18.91	N	ON	9.7
1.344000	---	29.85	46.00	16.15	N	ON	9.7
1.493250	37.88	---	56.00	18.12	N	ON	9.7
1.493250	---	30.12	46.00	15.88	N	ON	9.7
1.602700	---	35.11	46.00	10.89	L1	ON	9.7
1.602700	44.35	---	56.00	11.65	L1	ON	9.7
1.642500	---	30.26	46.00	15.74	N	ON	9.7
1.642500	38.00	---	56.00	18.00	N	ON	9.7
1.692250	---	31.47	46.00	14.53	N	ON	9.7
1.692250	38.92	---	56.00	17.08	N	ON	9.7
1.742000	37.80	---	56.00	18.20	N	ON	9.7
1.742000	---	30.86	46.00	15.14	N	ON	9.7
1.751950	47.80	---	56.00	8.20	L1	ON	9.7
1.751950	---	39.84	46.00	6.16	L1	ON	9.7
1.801700	---	41.71	46.00	4.29	L1	ON	9.7
1.801700	48.97	---	56.00	7.03	L1	ON	9.7
1.841500	---	31.08	46.00	14.92	N	ON	9.7
1.841500	36.92	---	56.00	19.08	N	ON	9.7
1.851450	49.42	---	56.00	6.58	L1	ON	9.7
1.851450	---	42.38	46.00	3.62	L1	ON	9.7
1.891250	---	30.91	46.00	15.09	N	ON	9.7
1.891250	36.82	---	56.00	19.18	N	ON	9.7
1.901200	47.35	---	56.00	8.65	N	ON	9.7
1.901200	---	39.96	46.00	6.04	N	ON	9.7
1.941000	---	28.02	46.00	17.98	N	ON	9.7
1.941000	34.82	---	56.00	21.18	N	ON	9.7

Final_Result

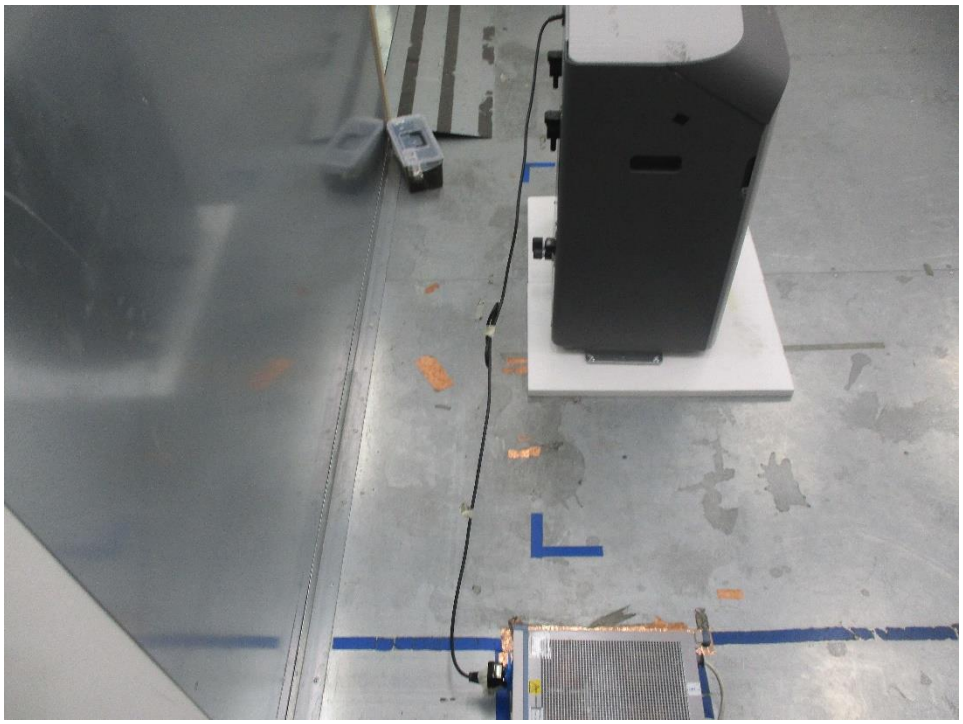
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
2.000700	46.72	---	56.00	9.28	N	ON	9.7
2.000700	---	38.17	46.00	7.83	N	ON	9.7
2.100200	---	37.01	46.00	8.99	N	ON	9.7
2.100200	44.78	---	56.00	11.22	N	ON	9.7
2.846450	---	33.72	46.00	12.28	N	ON	9.7
2.846450	38.83	---	56.00	17.17	N	ON	9.7
3.741950	31.96	---	56.00	24.04	N	ON	9.8
3.741950	---	26.26	46.00	19.74	N	ON	9.8
4.796650	37.21	---	56.00	18.79	N	ON	9.8
4.796650	---	31.10	46.00	14.90	N	ON	9.8
10.358700	---	35.45	50.00	14.55	N	ON	10.1
10.358700	42.04	---	60.00	17.96	N	ON	10.1
10.498000	47.21	---	60.00	12.79	N	ON	10.0
10.498000	---	39.53	50.00	10.47	N	ON	10.0
10.547750	47.41	---	60.00	12.59	N	ON	10.0
10.547750	---	39.86	50.00	10.14	N	ON	10.0
10.597500	---	40.89	50.00	9.11	N	ON	10.0
10.597500	48.23	---	60.00	11.77	N	ON	10.0
10.607450	46.67	---	60.00	13.33	N	ON	10.0
10.607450	---	39.37	50.00	10.63	N	ON	10.0
10.697000	---	37.59	50.00	12.41	N	ON	10.0
10.697000	45.08	---	60.00	14.92	N	ON	10.0
11.104950	49.68	---	60.00	10.32	N	ON	10.0
11.104950	---	41.87	50.00	8.13	N	ON	10.0
11.353700	50.72	---	60.00	9.28	L1	ON	9.9
11.353700	---	43.70	50.00	6.30	L1	ON	9.9
11.602450	---	44.17	50.00	5.83	L1	ON	9.9
11.602450	51.68	---	60.00	8.32	L1	ON	9.9
11.652200	51.57	---	60.00	8.43	L1	ON	9.9
11.652200	---	44.15	50.00	5.85	L1	ON	9.9
11.900950	---	42.90	50.00	7.10	L1	ON	9.9
11.900950	50.49	---	60.00	9.51	L1	ON	9.9
12.199450	47.39	---	60.00	12.61	L1	ON	9.9
12.199450	---	40.27	50.00	9.73	L1	ON	9.9
19.303750	---	37.65	50.00	12.35	N	ON	10.0
19.303750	45.91	---	60.00	14.09	N	ON	10.0
19.751500	---	35.19	50.00	14.81	N	ON	10.0
19.751500	43.75	---	60.00	16.25	N	ON	10.0
20.308700	44.61	---	60.00	15.39	L1	ON	9.9
20.308700	---	35.85	50.00	14.15	L1	ON	9.9
21.104700	49.86	---	60.00	10.14	L1	ON	9.9
21.104700	---	40.44	50.00	9.56	L1	ON	9.9
21.502700	---	37.86	50.00	12.14	N	ON	10.0
21.502700	47.34	---	60.00	12.66	N	ON	10.0
22.209150	46.84	---	60.00	13.16	L1	ON	9.9
22.209150	---	37.21	50.00	12.79	L1	ON	9.9
22.457900	48.55	---	60.00	11.45	N	ON	10.0
22.457900	---	38.26	50.00	11.74	N	ON	10.0
22.706650	51.03	---	60.00	8.97	L1	ON	9.9
22.706650	---	40.87	50.00	9.13	L1	ON	9.9
22.955400	50.72	---	60.00	9.28	N	ON	10.0
22.955400	---	40.18	50.00	9.82	N	ON	10.0
23.413100	35.71	---	60.00	24.29	L1	ON	10.0
23.413100	---	28.10	50.00	21.90	L1	ON	10.0
23.761350	---	31.56	50.00	18.44	N	ON	10.1
23.761350	41.23	---	60.00	18.77	N	ON	10.1
24.109600	---	35.71	50.00	14.29	N	ON	10.1
24.109600	45.35	---	60.00	14.65	N	ON	10.1
24.408100	---	37.39	50.00	12.61	N	ON	10.1
24.408100	47.33	---	60.00	12.67	N	ON	10.1
24.656850	---	38.09	50.00	11.91	N	ON	10.1
24.656850	48.01	---	60.00	11.99	N	ON	10.1
24.905600	---	38.07	50.00	11.93	N	ON	10.1
24.905600	47.60	---	60.00	12.40	N	ON	10.1

SECTION 7 APPENDIX I

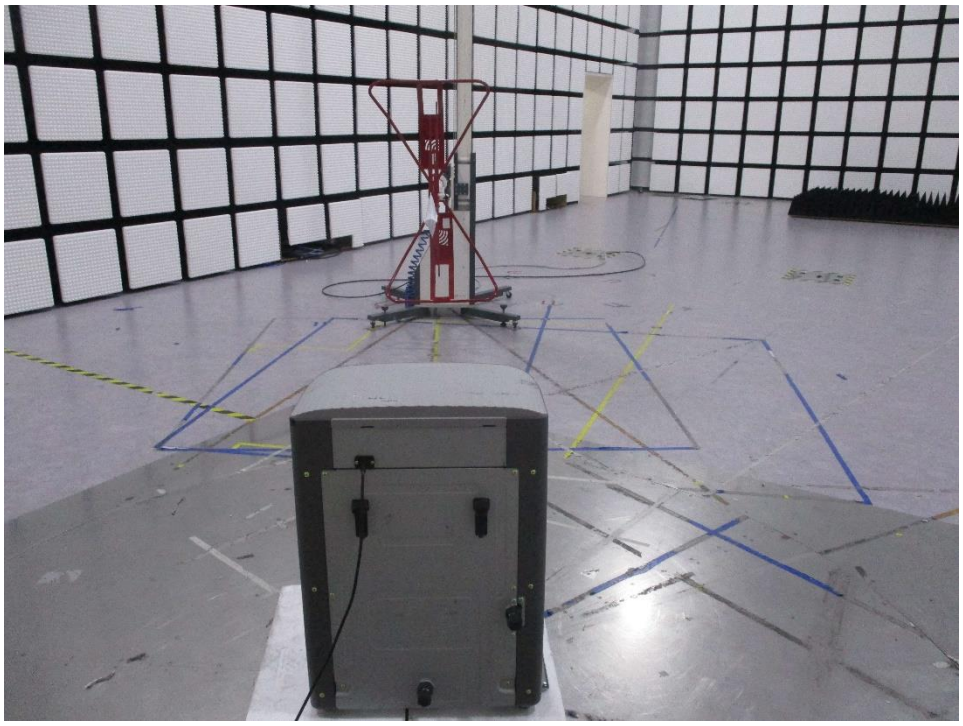
Photographs of Test Configurations



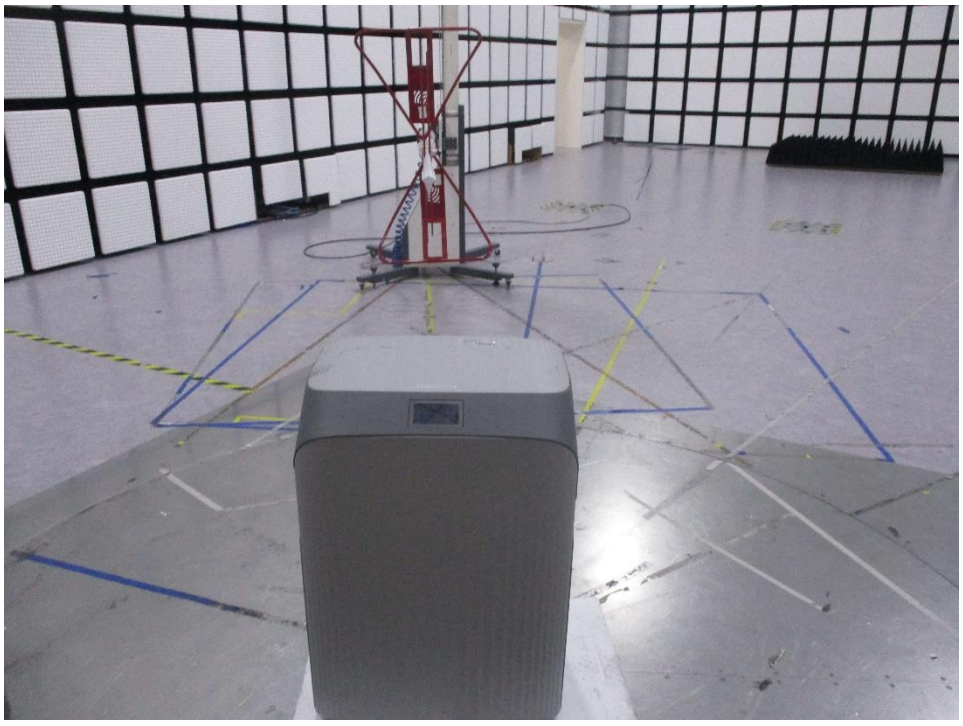
Disturbance Voltage Test



Disturbance Voltage Test



Radiated disturbance (30 MHz ~ 1 GHz)



Radiated disturbance (30 MHz ~ 1 GHz)

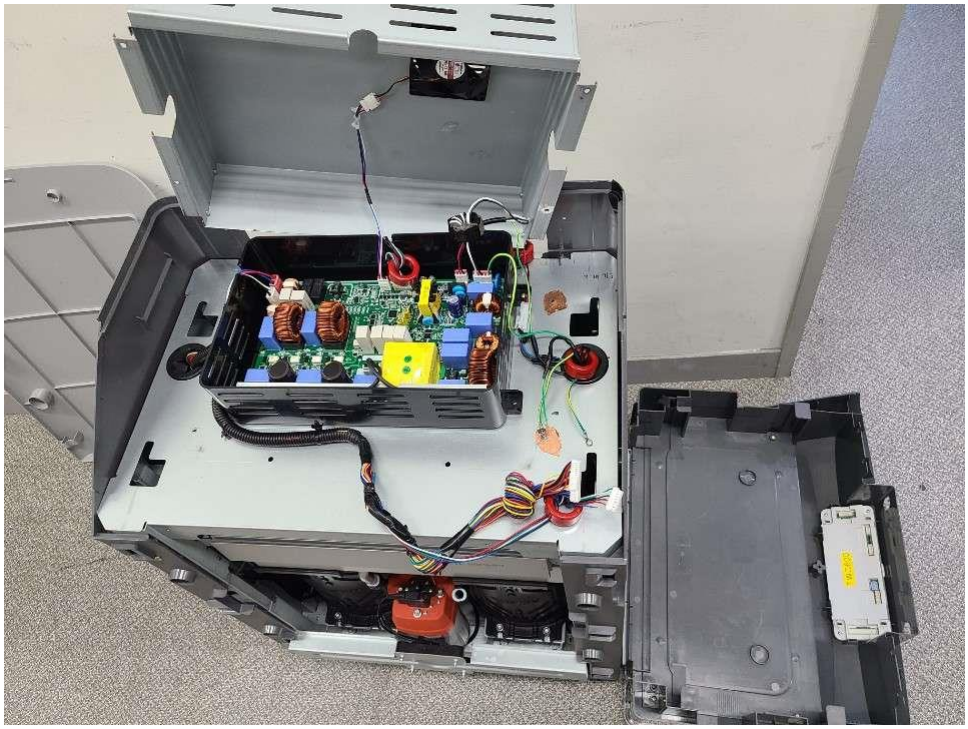
SECTION 8 APPENDIX II

Photographs of EUT

Front

Rear

Resistor



Inside

---- E N D ----