TEST REPORT

KCTL Inc.
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Gyeonggi-do 18516 Republic of Korea
Tel : 82-31-286-5881 Fax : 82-31-8059-1154
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KCTL

1. Client

- Name : LS ELECTRIC Co., Ltd.
- Address : 68, Wolmyeong-ro #201, Heung deok-gu, Cheongju-si Chungcheongbuk-do 28437, Korea
- Date of Receipt : 2020-12-07

2. Use of Report : -

3. Name of Product / Model : Motor control racking system / U-MCRS

4. Manufacturer / Country of Origin : LS ELECTRIC Co., Ltd. / Korea

5. Date of Test : 2020-12-18 to 2020-12-21

6. Location of Test : ■ Permanent Testing Lab □ On Site Testing (Address: -)

7. Test method used : FCC Part 15 Subpart B
ICES-003 Issue 6

8. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Changrok Kim (Signature)	Technical Manager Name : Byungyeon Kim (Signature)

2021-02-19

KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2020-12-29	Originally issued	-
2021-02-19	Delete photographs of test setup and EUT photographs / Add FCC ID	Delete pages : 16, 22-23, 27-29 / 9

General remarks for test reports

Nothing significant to report.

Contents

1. Applicant information

Applicant:	LS ELECTRIC Co., Ltd.
Address:	68, Wolmyeong-ro #201, Heung deok-gu, Cheongju-si Chungcheongbuk-do 28437, Korea
Telephone:	+82-43-261-6493
Fax:	+82-43-261-6630
E-mail:	mkseo@lselectric.co.kr
Contact name:	Minkyu Seo
Manufacturer:	LS ELECTRIC Co., Ltd.
Address:	68, Wolmyeong-ro #201, Heung deok-gu, Cheongju-si Chungcheongbuk-do 28437, Korea
Telephone:	+82-43-261-6493
Fax:	+82-43-261-6630
E-mail:	mkseo@lselectric.co.kr
Contact name:	Minkyu Seo

2. Laboratory information

Address

KCTL Inc. (Hwaseong Lab.)

28, Mosan-gil, Jeongnam-myeon, Hwaseong-si, Gyeonggi-do, 18516, Korea

Telephone Number: 82 31 286 5881

Facsimile Number: 82 31 8059 1154

FCC Site Designation No: KR0040

KOLAS NO.: KT231

VCCI NO.: 1980

SITE MAP

3. Test system configuration

3.1 Operation environment

	Temperature	Humidity	Pressure
Shielded Room (CE)	18.0 °C	47.1 % R.H.	-
Chamber 10 m (RE)	18.5 °C	47.2 % R.H.	-

Test site

These testing items were performed following locations;

Test item	Test site
Conducted Emission	Shielded Room
Radiated Emission (Below 1 GHz)	10 m Chamber

3.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC.
The factors contributing to uncertainties are test receiver, cable loss, antenna factor calibration, Antenna directivity, antenna factor variation with height, antenna phase center variation, antenna frequency interpolation, measurement distance variation, site imperfection, mismatch, and system repeatability. Based on CISPR 16-4-2, the measurement uncertainty level with a 95 % confidence level was applied.

Conducted Emission measurement_AMN (Confidence level about 95 %, k = 2)		
Shielded Room	150 kHz ~ 30 MHz : 2.5 dB	
Radiated Emission measurement (Confidence level about 95 %, k = 2)		
10 m Chamber	30 MHz ~ 1 GHz	3 m : 4.9 dB
		10 m : 4.9 dB

3.3 Measurement Program

These test items were performed by software programs;

Test item	Measurement Program	Used
Conducted Emission	TEPTO-DV/AM V 4.1.0083 (tsj corporation)	☒
Radiated Emission(Below 1 GHz)	TEPTO-DV/AM V 4.1.0083 (tsj corporation)	☒

4. Description of EUT

4.1 General information

No.	Classification	RATING
1	Control Power	AC 84~270V, DC 84~280V (Free voltage)
2	Motor	1. AC120(DC125) → DC110V Motor 2. AC240V(DC250) → DC220V Motor
3	Rating Frequency	1. 50/60Hz
4	SIZE	1. CONTROLLER: INCLUDE CASE 415(W) x 257(D) x 73(H) Main PCB 330(W) x 200(D) x 40(H) Relay PCB 110(W) x 62(D) x 35(H) 2. WIRED REMOTE CONTROL: 209.3(W) x 84.1(D) x 38.4(H)(mm) PCB 200(W) x 75(D) x 25(H)
5	Communication Port	Ethernet Port 3ea (Communication Remote control Modbus / PLC Connecting)
6	Communications Protocol	MODBUS (According to the LS electric MODBUS Standard)
7	Quantity of MODBUS Address	Rotary Switch 3ea (Total : 259ea)

4.2 Product description

Type of product	Motor control racking system
Model name (Basic)	U-MCRS
Model name (Variant)	-
Difference	-
Trade name	-
FCC ID	2AYQX-U-MCRS
Testing voltage	AC 120 V, 60 Hz / DC 84 V / DC 280 V
Input range	AC (84-270) V, (50/60) Hz / DC (84-280) V
Internal clock frequency	8 MHz

4.3 Auxiliary equipments

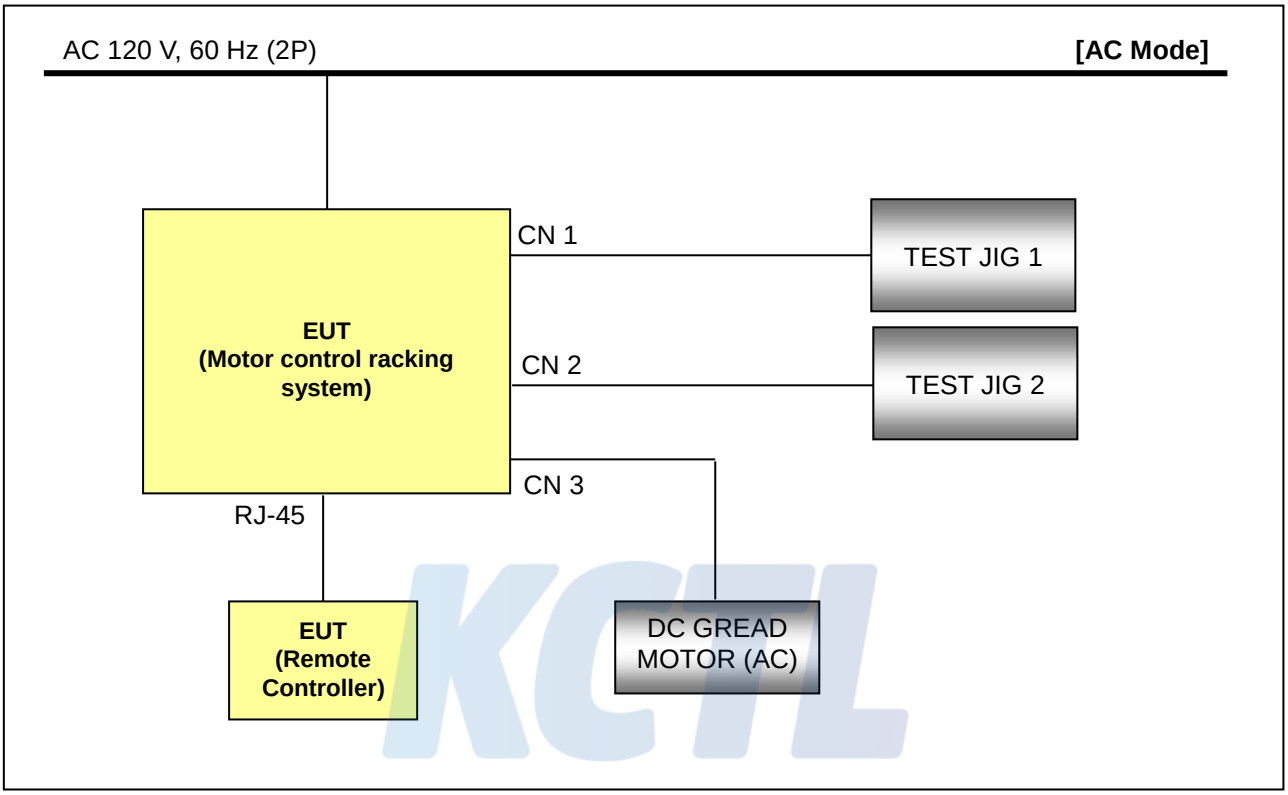
[AC Mode]

Type	Model / Part #	S/N	Manufacturer
TEST JIG 1	-	-	-
TEST JIG 2	-	-	-
DC GREAD MOTOR (AC)	-	-	DONGJIN MOTOR IND CO., LTD.

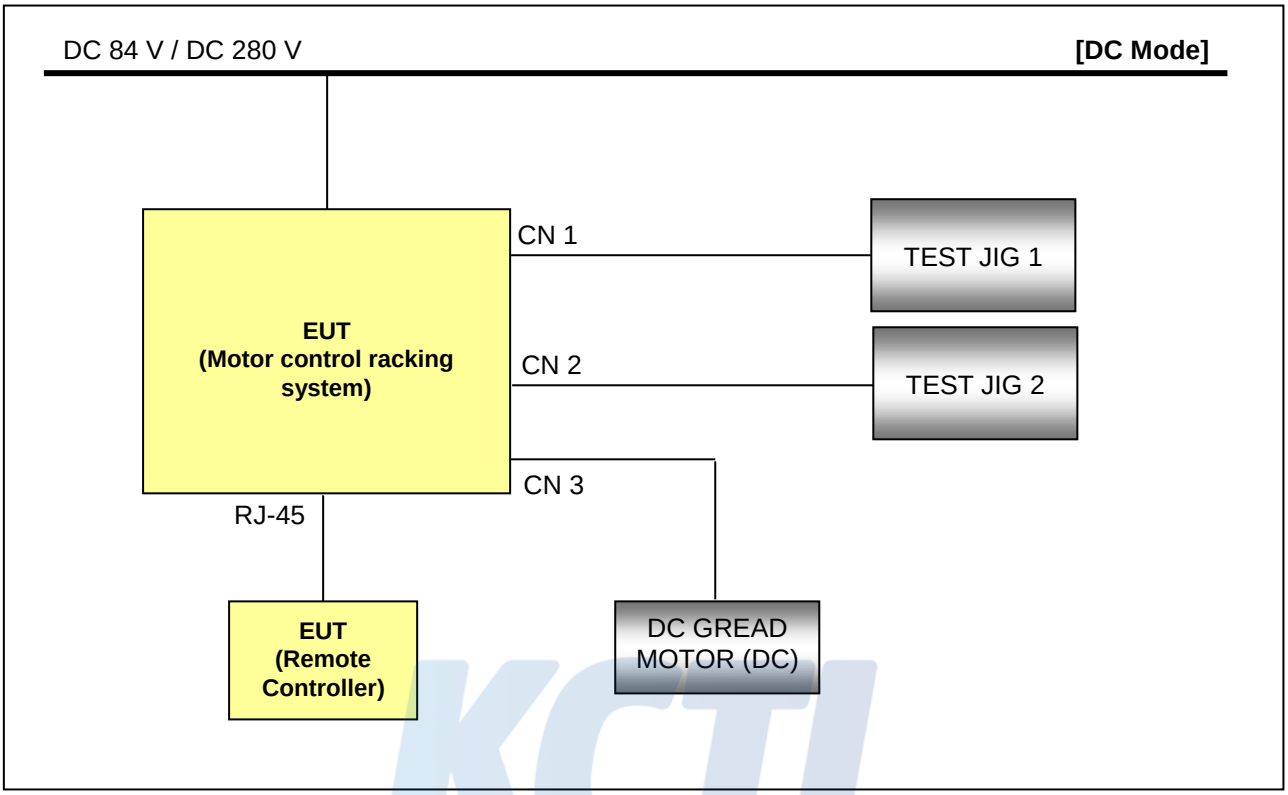
[DC Mode]

Type	Model / Part #	S/N	Manufacturer
TEST JIG 1	-	-	-
TEST JIG 2	-	-	-
DC GREAD MOTOR (DC)	-	-	DONGJIN MOTOR IND CO., LTD.

4.4 Test configuration



	Start		End		Cable	
	Name	I/O port	Name	I/O port	Length (m)	Spec.
1	**EUT (Motor control racking system)**	CN 1	TEST JIG 1	-	0.1	Unshield
2		CN 2	TEST JIG 2	-	0.3	Unshield
3		CN 3	DC GREAD MOTOR (AC)	-	1.0	Unshield
4		RJ-45	**EUT (Remote Controller)**	RJ-45	3.0	Shield



	Start		End		Cable	
	Name	I/O port	Name	I/O port	Length (m)	Spec.
1	**EUT (Motor control racking system)**	CN 1	TEST JIG 1	-	0.1	Unshield
2		CN 2	TEST JIG 2	-	0.3	Unshield
3		CN 3	DC GREAD MOTOR (DC)	-	1.0	Unshield
4		RJ-45	**EUT (Remote Controller)**	RJ-45	3.0	Shield

4.5 Operating conditions

The EUT was configured as normal intended use.

Test mode	Normal operating
1 [AC Mode]	After powering on the EUT, it was tested while monitoring the normal operation status of the EUT. - Since the motor is not operated during EUT operation, normal operation is checked before and after the test.
2 [DC Mode]	

5. Summary of test results

5.1 Summary of EMI emission test results

Applied	Test items	Test method	Result
☒	Conducted Emission	ANSI C63.4:2014, Class A FCC Part 15 Subpart B ICES-003 Issue 6	Pass
☒	Radiated Emission	ANSI C63.4:2014, Class A FCC Part 15 Subpart B ICES-003 Issue 6	Pass

Note: The Radiated Emission test of above 1 GHz was not performed, as the max. internal clock frequency of the EUT was below 108 MHz (8 MHz).

These results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations.

6. Test results

6.1 Conducted Emissions

Test specification	FCC Part 15, Section 15.107, Class A ICES-003 Issue 6		
Testing voltage	AC 120 V, 60 Hz		
Test facility	Shielded Room		
Date	2020-12-21		
Temperature (°C)	18.0 °C	Humidity (% R.H.)	47.1 % R.H.
Remarks	Pass		

6.1.1 Limits of conducted emissions measurement

☒ AC main

Frequency [MHz]	Class A (dB(μV))		Class B (dB(μV))	
	Quasi-peak	Average	Quasi-peak	Average
0.15 ~ 0.5	79	66	66 ~ 56[1)]	56 ~ 46[1)]
0.5 ~ 5	73	60	56	46
5 ~ 30	73	60	60	50

[1)] The limit decreases linearly with the logarithm of frequency

6.1.2 Measurement procedure

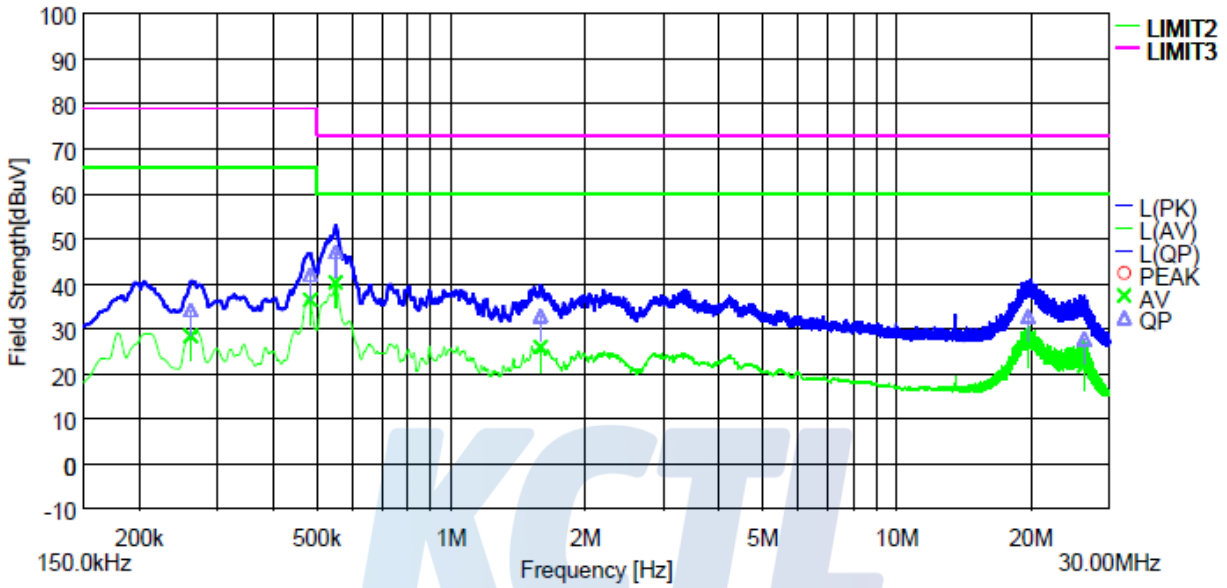
The measurements were performed in a shielded room. EUT was setup as shown in photograph and placed on a non-metallic table height of 0.8 m above the reference ground plane. The rear of table was located 0.4 m to the vertical conducted plane. EUT was power through the LISN, which was bonded to the ground plane. The LISN power was filtered. Each EUT power lead, except ground (safety) lead was individually connected through a LISN to input power source. EUT signal cables that hung closer than 0.4 m to the Horizontal metal ground 0.3 m ~ 0.4 m long. The power cord was bundles in the center. All peripheral equipment was powered from a sub LISN. The LISN and ISN were positioned 0.8 m from the EUT. Peak and Average detection were used in preliminary testing and Quasi-peak and Average detections were used at final measurement.

6.1.3 Used equipments

Equipment	Model	Serial No.	Makers	Next Cal. Date	Used
Two Line V-Network	ENV216	101371	Rohde & Schwarz	2021-09-17	☒
EMI TEST RECEIVER	9010F	020WW40403	NARDA	2021-06-18	☒

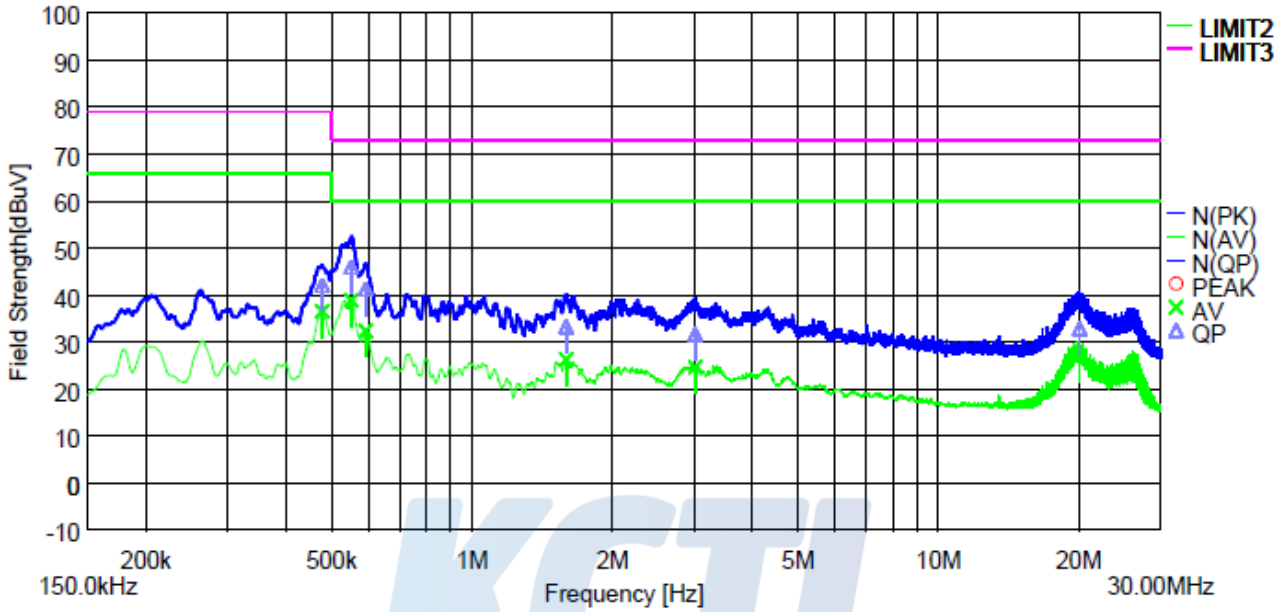
6.1.4 Conducted emissions measurement result

AC Main



Freq.	Mode	Level			Factor			PEAK	CAV	QP	Limit			Margin		
		PEAK	CAV	QP	LISN	Loss	Gain				PEAK	CAV	QP	PEAK	CAV	QP
[MHz]		[dBuV]			[dB]			[dBuV]			[dBuV]			[dB]		
0.26043	L	---	18.80	24.50	9.65	0.04	0.00	---	28.49	34.19	---	66.00	79.00	---	37.51	44.81
0.48334	L	---	26.62	32.22	9.86	0.07	0.00	---	36.55	42.15	---	66.00	79.00	---	29.45	36.85
0.55082	L	---	30.51	37.25	9.85	0.05	0.00	---	40.41	47.15	---	60.00	73.00	---	19.59	25.85
1.58764	L	---	16.31	23.14	9.71	0.07	0.00	---	26.09	32.92	---	60.00	73.00	---	33.91	40.08
19.70838	L	---	17.02	22.71	9.92	0.22	0.00	---	27.15	32.84	---	60.00	73.00	---	32.85	40.16
26.36485	L	---	11.95	17.87	9.71	0.28	0.00	---	21.94	27.86	---	60.00	73.00	---	38.06	45.14

[L]



Freq.	Mode	Level			Factor			PEAK	CAV	QP	Limit			Margin		
		PEAK	CAV	QP	LISN	Loss	Gain				PEAK	CAV	QP	PEAK	CAV	QP
[MHz]		[dBuV]			[dB]			[dBuV]			[dBuV]			[dB]		
0.47720	N	---	26.70	32.25	9.84	0.06	0.00	---	36.61	42.16	---	66.00	79.00	---	29.39	36.84
0.55082	N	---	29.07	36.14	9.84	0.05	0.00	---	38.96	46.03	---	60.00	73.00	---	21.04	26.97
0.59172	N	---	22.56	31.40	9.83	0.06	0.00	---	32.45	41.29	---	60.00	73.00	---	27.55	31.71
1.59173	N	---	16.63	23.54	9.70	0.07	0.00	---	26.40	33.31	---	60.00	73.00	---	33.60	39.69
3.01096	N	---	14.92	21.89	9.67	0.13	0.00	---	24.72	31.69	---	60.00	73.00	---	35.28	41.31
20.10307	N	---	17.27	22.96	9.71	0.21	0.00	---	27.19	32.88	---	60.00	73.00	---	32.81	40.12

[N]

6.2 Radiated Emission

Test specification	FCC Part 15, Section 15.109, Class A ICES-003 Issue 6		
Testing voltage	AC 120 V, 60 Hz / DC 84 V / DC 280 V		
Test facility	10 m Chamber		
Test distance	10 m		
Date	2020-12-18		
Temperature (°C)	18.5 °C	Humidity (% R.H.)	47.2 % R.H.
Remarks	Pass		

6.2.1 Limits of radiated emission measurement

☒ Limits below 1 ㎓

Frequency [㎒]	Class A (dB(㎶/m)) @ 10 m	Class B (dB(㎶/m)) @ 3 m
30-88	39	40
88-216	43.5	43.5
216-960	46.4	46
Above 960	49.5	54

☐ Limits above 1 ㎓

Frequency [㎓]	Class A @ 3 m		Class B @ 3 m	
	Average limit (dB(㎶/m))	Peak limit (dB(㎶/m))	Average limit (dB(㎶/m))	Peak limit (dB(㎶/m))
1 ~	60	80	54	74
Note - The lower limit applies at the transition frequency.				

6.2.2 Measurement procedure

The test was done at a 10 m Chamber with a quasi-peak detector.
EUT was placed on a non-metallic table height of 0.8 m above the reference ground plane.
Cables were folded back and forth forming a bundle 0.3 m to 0.4 m long and were hanged at a 0.4 m height to the ground plane. Cables connected to EUT were fixed to cause maximum emission.
Test was made with the antenna positioned in both the horizontal and vertical planes of polarization.
The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

6.2.3 Used equipments

Equipment	Model no.	Serial no.	Makers	Next Cal. Date	Used
Test Receiver	ESCI	100561	Rohde & Schwarz	2021-09-18	☒
BI-LOG Ant.	CBL6112D	55442	Teseq GmbH	2021-12-27	☒
Amplifier	310N	185938	SONOMA	2021-01-02	☒

6.2.4 Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.
The sample calculation is as follow:

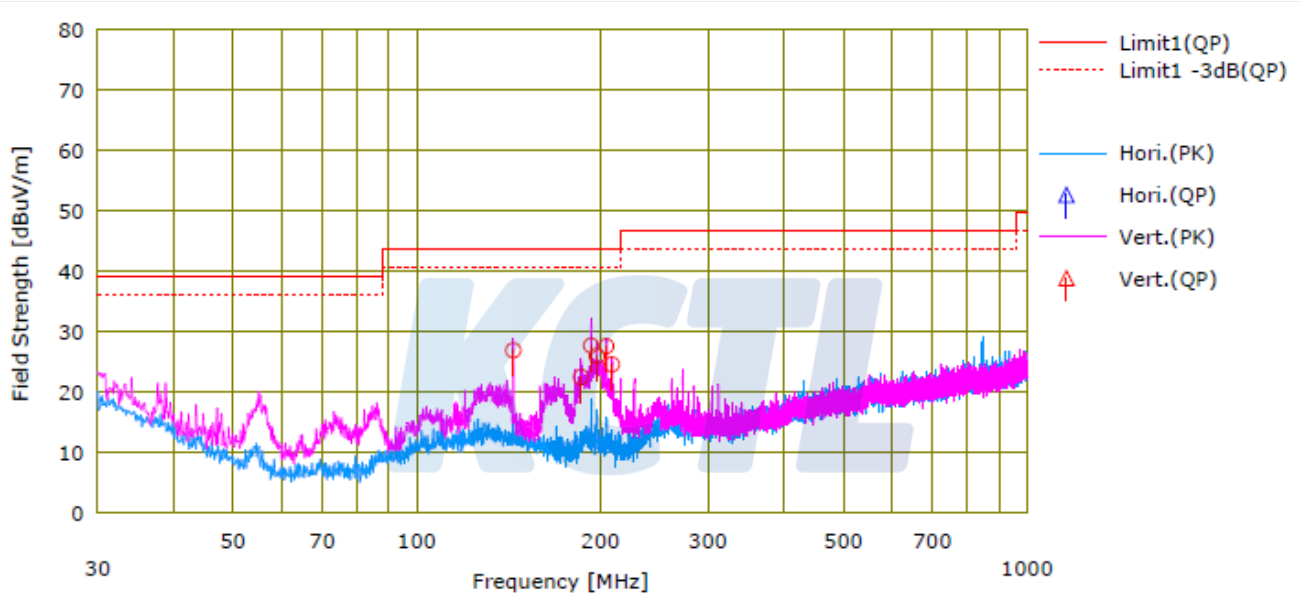
Result QP[dB(μV/m)] = Reading QP[dB(μV)] + C.Fac [dB/m]
Result QP : The final measure
Reading QP : Instrument readings
C.Fac : ANT FACTOR [dB/m] + LOSS [dB] - GAIN [dB]
ANT FACTOR: Antenna Factor
LOSS: Cable Loss
GAIN: Amplifier Gain

6.2.5 Radiated emission measurement result

Graph and Data

[AC 120 V]

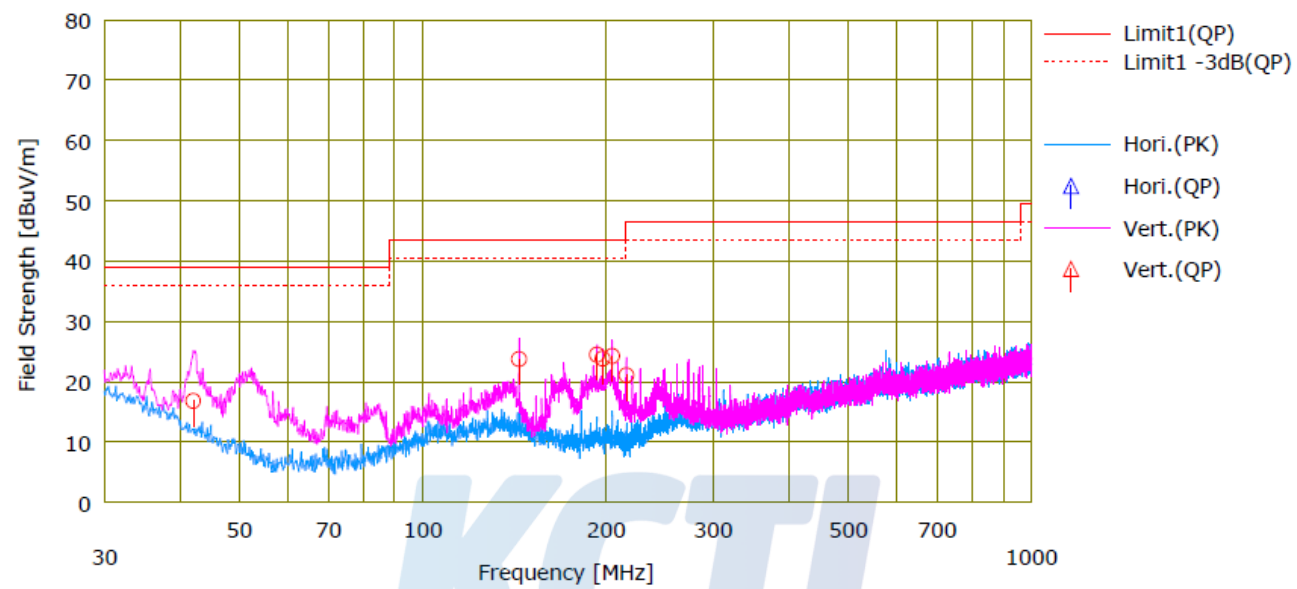
30 ㎒ ~ 1 ㎓



No.	Freq. [MHz]	Readin <QP> [dBuV]	C.Fac [dB/m]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	143.981	40.18	-13.47	26.71	43.50	16.79	Vert.	127	166	BI LO	
2	185.930	37.52	-15.23	22.29	43.50	21.21	Vert.	177	72	BI LO	
3	193.089	42.48	-14.98	27.50	43.50	16.00	Vert.	165	253	BI LO	
4	197.327	40.56	-14.76	25.80	43.50	17.70	Vert.	214	14	BI LO	
5	204.474	42.24	-14.84	27.40	43.50	16.10	Vert.	116	295	BI LO	
6	208.843	39.36	-14.99	24.37	43.50	19.13	Vert.	220	311	BI LO	

[DC 84 V]

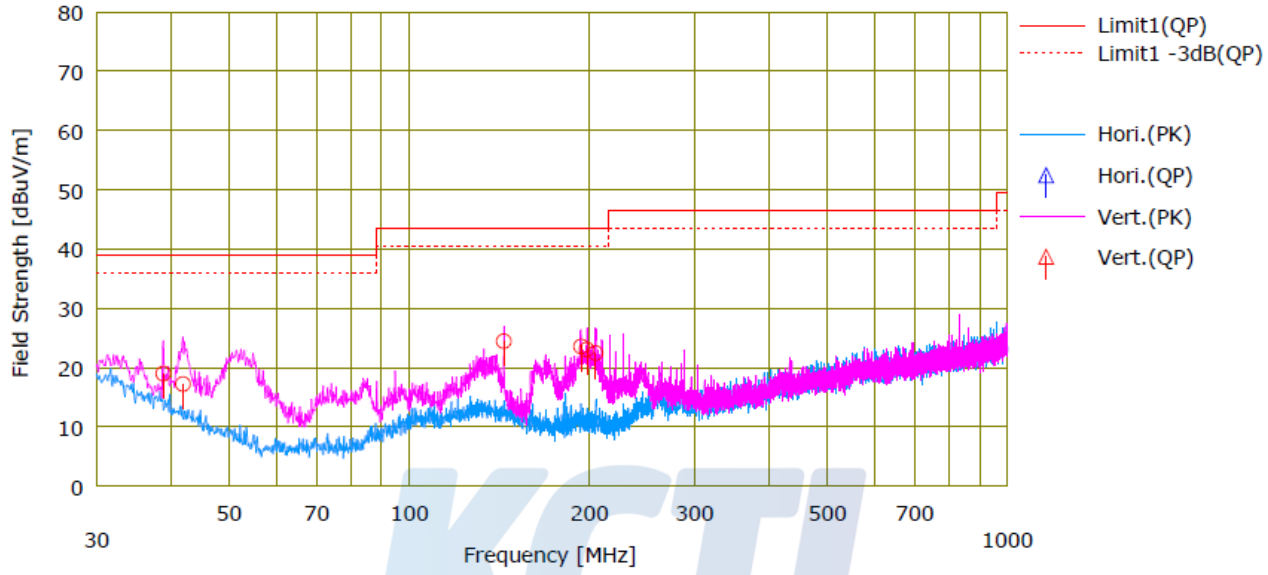
30 ㎒ ~ 1 ㎓



No.	Freq. [MHz]	Readin <QP> [dBuV]	C.Fac [dB/m]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	42.003	29.74	-12.94	16.80	39.00	22.20	Vert.	142	0	BI LO	
2	143.976	37.19	-13.47	23.72	43.50	19.78	Vert.	138	80	BI LO	
3	193.321	39.43	-14.98	24.45	43.50	19.05	Vert.	189	170	BI LO	
4	197.567	38.62	-14.76	23.86	43.50	19.64	Vert.	197	336	BI LO	
5	204.715	39.11	-14.84	24.27	43.50	19.23	Vert.	154	360	BI LO	
6	216.118	36.25	-15.17	21.08	46.50	25.42	Vert.	163	303	BI LO	

[DC 280 V]

30 ㎒ ~ 1 ㎓



No.	Freq. [MHz]	Reading <QP> [dBuV]	C.Fac [dB/m]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	38.851	30.15	-11.18	18.97	39.00	20.03	Vert.	142	342	BI LO	
2	41.883	30.08	-12.87	17.21	39.00	21.79	Vert.	102	55	BI LO	
3	143.973	37.91	-13.47	24.44	43.50	19.06	Vert.	166	186	BI LO	
4	193.815	38.55	-14.98	23.57	43.50	19.93	Vert.	182	357	BI LO	
5	198.051	37.83	-14.77	23.06	43.50	20.44	Vert.	145	285	BI LO	
6	205.083	37.29	-14.85	22.44	43.50	21.06	Vert.	135	277	BI LO	