




EMC TEST REPORT

KOSTEC CO., Ltd. 28(175-20, Annyeong-dong) 406-gil sejaro, Hwaseong-si, Gyeonggi-do, Korea Tel:031-222-4251, Fax:031-222-4252	Report No. : KST-CEE-220032	 KOSTEC Co., Ltd. http://www.kostec.org
1. Applicant <ul style="list-style-type: none">• Name : KG AUTO Co.,Ltd.• Address : 45, Sojeongsandan 4-ro, Sojeong-myeon, Sejong-si, Republic of Korea		
2. Test Item <ul style="list-style-type: none">• Product Name: Sign Tower(Indicating Tower)• Model Name: KG-SFB-D2-5L		
3. Manufacturer <ul style="list-style-type: none">• Name : KG AUTO Co.,Ltd.• Address : 45, Sojeongsandan 4-ro, Sojeong-myeon, Sejong-si, Republic of Korea		
4. Date of Test : Jul. 14, 2022 to Jul. 16, 2022		
5. Test Method Used : EN IEC 61000-6-4:2019 Electromagnetic compatibility (EMC)-Part 6-4:Generic standards -Emissionstandard for industrial environments EN IEC 61000-6-2:2019 Electromagnetic compatibility (EMC)-Part 6-2:Generic standards - Immunityfor industrial environments		
6. Test Result : Pass		
7. Note: None		
<p>The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report is not related to KOLAS accreditation.</p>		
Affirmation	Tested by Name : Kyung-Min, Kim (Signature) 	Technical Manager Name : Chang-Ho, Lee (Signature) 
2022 . 07 . 25 .		
KOSTEC Co., Ltd.		

Revision History of Test Report

Rev.	Revisions	Effect page	Reviewed	Date
-	Initial issue	All	Chang-Ho, Lee	Jul. 25 2022

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1. General Information

1.1 Information of EUT

Product Name	Sign Tower(Indicating Tower)
Model Name	KG-SFB-D2-5L
Serial No.	None
Type of Sample Tested	Pre-production
Supplied Power for Test	DC 24 V
Port	DC In
Ground	Without-ground

This information was provided by the customer

Clock used	Below 108 MHz	
High Frequency Used	Below 108 MHz	
Model differences		
Model name	Difference	Tested (checked)
KG-SFB-D2-5L	Basic Model (the basic model that was fully tested)	<input checked="" type="checkbox"/>
KG-S-D2-5L, KG-SF-D2-5L, KG-SB-D2-5L	Variant Models	-

1.2 Applicants Information

Applicant	KG AUTO Co.,Ltd.
Address	45, Sojeongsandan 4-ro, Sojeong-myeon, Sejong-si, Republic of Korea
Telephone No.	+82-44-715-7650
Facsimile No.	+82-44-715-7651
Contact person	KIM KYUNG-HUN (69progress@kgauto.co.kr)

2. Information of Testing Laboratory

Test laboratory and address

KOSTEC Co., Ltd.

28(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

Telephone Number: 82-31-222-4251

Facsimile Number: 82-31-222-4252

Registration information

KOLAS No.: KT232

RRA(National Radio Research Agency): KR0041

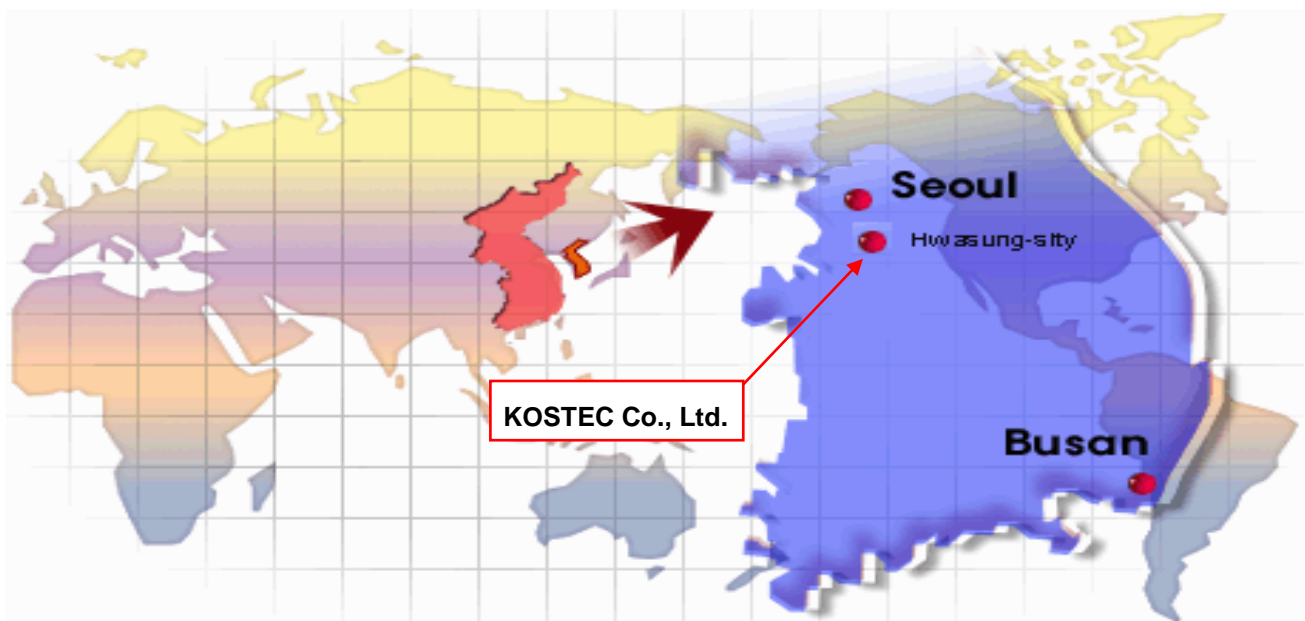
FCC Designation No.: KR0041

IC Designation No.: KR0041

VCCI Membership No. : 2005

VCCI Registration No. of EMI site: R-14202 / C-14685 / G-10834 / T-12225

Route Map of Measurement Facility



3. Test System Configuration

3.1 Operation Environment

Test Items	Test date	Temp (°C)	Humidity (%R.H.)	Pressure (kPa)
Emission				
Conducted Emission	-	-	-	-
Radiated Emission (Below 1 GHz)	Jul. 15	21	49	
Radiated Emission (Above 1 GHz)	Jul. 15	21	49	
Harmonics Current	-	-	-	
Flicker	-	-	-	
Immunity				
Electro Static Discharge	Jul. 14	22	50	100.0
Radio Frequency Electromagnetic Fields	Jul. 14	23	47	-
Electric Fast Transient	Jul. 14	22	48	-
Surge	-	-	-	-
Conducted Immunity	Jul. 14	28	46	-
Magnetic Field Susceptibility	-	-	-	-
Voltage Dips, Short Interruptions and Voltage Variations	-	-	-	-

3.2 Measurement Uncertainty

Test Items	k_p	Expanded Uncertainty	Note
Emission			
Conducted Emission (AC Main Power Ports)	2	±3.44 dB	-
Conducted Emission (Asymmetric mode)	2	±3.44 dB	-
Conducted Emission (Differential voltage)	2	±0.96 dB	-
Radiated Emission (Below 1 GHz)	2	±4.26 dB	-
Radiated Emission (Above 1 GHz)	2	±3.68 dB	-
Radiated Emission (FM receivers)	2	±4.26 dB	-
Immunity			
Electro Static Discharge	2	5 %	-
Radio Frequency Electromagnetic Fields	2	The calibration procedure : 1.78 dB The Level Setting : 2.16 dB	-
Electric Fast Transient	2	±10 %	-
Surge	2	±10 %	-
Conducted Immunity	2	±2.34 %	-
Magnetic Field Susceptibility	2	±5 %	-
Voltage Dips, Short Interruptions and Voltage Variations	2	±5 %	-

3.3 Sample calculation

Conducted Emission

The field strength is calculated by adding the LISN factor, cable loss from the measured reading. The sample calculation is as follows:

FS = MR + Factor
 MR = Meter Reading
 Factor = Ant. Factor, Cable Loss, etc

If MR is 30 dB, LISN Factor 1 dB, CL 1 dB
 The result (MR) is 30 + 1 + 1 = 32 dB μ V

4. Condition and Procedure for Test activities

4.1 Configuration of EUT

Description	Model or Part No.	Serial No.	Manufacturer
Sign Tower (Indicating Tower)	KG-SFB-D2-5L	None	KG AUTO Co.,Ltd.

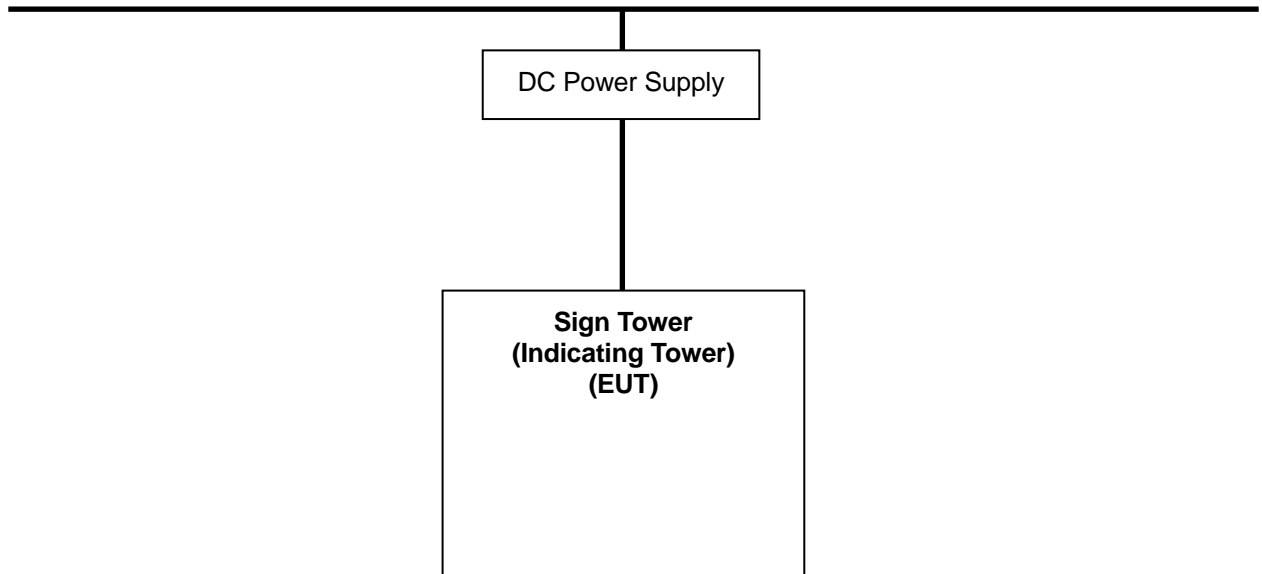
4.2 Used Peripherals

Description	Model or Part No.	Serial No.	Manufacturer
DC Power Supply	UP-3005T	000112	UNICORN CO.,LTD.

4.3 Used cables

Cable Type	Shield	Length (m)	Ferrite	Connector	Connection Point 1	Connection Point 2
DC In	No	2.5	No	Line	EUT	DC Power Supply

4.4 EUT Test Configuration



4.5 Operating conditions

After setting, the EUT was tested with short the port of the EUT, observed the operation status through the LED

5. Summary of Test Results

5.1 Modification to the EUT

-

5.2 Standards & results

Basic Standards	Test Item	Result
EN IEC 61000-6-4	Conducted & Radiated Emissions	PASS
EN 61000-3-2	Limits for harmonics current emissions	N/A
EN 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems	N/A
EN 61000-4-2	Electrostatic discharge immunity test	PASS
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test	PASS
EN 61000-4-4	Electrical fast transient/burst	PASS
EN 61000-4-5	Surge	N/A
EN 61000-4-6	Conducted disturbances, induced by radio-frequency fields	PASS
EN 61000-4-8	Power frequency magnetic field immunity test	N/A
EN 61000-4-11	Voltage dips, short interruptions and voltage variations	N/A

Note 1) N/A mean is Not Applicable.

Note 2) Decision rule: The statement of conformity in this report was judged according to the specification limits of the standard without considering uncertainty.

5.3 Performance criteria

The variety and the diversity of the apparatus within the scope of this document make it difficult to define precise criteria for the evaluation of the immunity test results.

If as a result of the application of the tests defined in this standard the apparatus becomes dangerous or unsafe then the apparatus shall be deemed to have failed the test. A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on the following criteria:

Performance criterion A: The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operating of the controls.

6. Test Result

6.1 Conducted emission

6.1.1 Measurement procedure

Mains

The measurements were performed in a shielded room. The EUT was placed 0.4 m from vertical metal reference of plane at the least 2 m by 2 m, was kept at least 0.8 m from any other metal surface. EUT was placed on a non-metallic table 0.8 m above horizontal metal reference plane. And EUT was placed 0.4 m from vertical ground plane. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.

Each EUT power lead, except ground (safety) lead, was individually connected through a LISN to input power source. Both lines of power cord, live and neutral, were measured.

6.1.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Test receiver	ESCS30	100111	Rohde & Schwarz	2023. 01. 17	-
EMI RECEIVER	ER-30	L0910A010	LIG	2022. 08. 30	-
Pulse Limiter	ESH3-Z2	100097	Rohde & Schwarz	2023. 01. 17	-
Pulse Limiter	ESH3-Z2	100022	Rohde & Schwarz	2023. 01. 17	-
LISN	ESH3-Z5	100147	Rohde & Schwarz	2023. 01. 17	-
LISN	ESH2-Z5	100044	Rohde & Schwarz	2023. 01. 18	-
LISN	ESH2-Z5	100060	Rohde & Schwarz	2023. 01. 18	-
LISN	3825/2	9402-2163	EMCO	2023. 01. 18	-
DTV MODULATOR	TVB599A	23.53.20.15.09. 00.00.23	TELEVIEW	2023. 01. 19	-
Test Program	ESxS-K1 Ver2.2	None	Rohde & Schwarz	-	-
Test Program	ETS2008 Ver2.40	None	LIG	-	-

6.1.3 Test data

AC Mains

< Class A >

Freq. [MHz]	Factor [dB]		POL	QP				CISPR-AV			
	LISN	CABLE +P/L		Limit [dB(μ V)]	Reading [dB(μ V)]	Result [dB(μ V)]	Margin [dB]	Limit [dB(μ V)]	Reading [dB(μ V)]	Result [dB(μ V)]	Margin [dB]
-	-	-	-	-	-	-	-	-	-	-	-

- * LISN: LISN insertion Loss, Cable: Cable Loss, P/L: pulse limiter factor
- * L: Line. Live, N: Line. Neutral
- * Reading: test receiver reading value (with cable loss & pulse limiter factor)
- * Result = LISN + Reading

Telecommunication port (RJ-45)

Freq. [MHz]	Factor [dB]		QP				CISPR AV			
	ISN	CABLE +P/L	Limit [dB(μ V)]	Reading [dB(μ V)]	Result [dB(μ V)]	Margin [dB]	Limit [dB(μ V)]	Reading [dB(μ V)]	Result [dB(μ V)]	Margin [dB]
-	-	-	-	-	-	-	-	-	-	-

- * ISN : ISN insertion Loss, Cable: Cable loss, P/L : Pulse limiter factor
- * Reading : Test receiver reading value
- * Result = ISN + Cable + P/L + Reading

6.1.4 Conducted disturbance test graph

This test doesn't apply to EUT because the EUT uses DC 24 V power.

6.2 Radiated Emission

6.2.1 Measurement procedure

A pretest was performed at 10 m distances in a semi-anechoic chamber for searching correct frequency. The final test was done at a 10 m area test site with a quasi-peak detector. EUT was placed on a non-metallic table height of 0.8 m above the reference 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.

6.2.2 Used equipment

10 m Semi-Anechoic chamber (Below 1 GHz)

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Test Receiver	ESCI7	100823	R&S	2023. 01. 17	●
Test Receiver	ESPI	100488	Rohde & Schwarz	2023. 01. 17	-
Biconilog Antenna	3142B	1745	EMCO	2024. 04. 27	●
Biconilog Antenna	3142B	9910-1432	EMCO	2024. 04. 08	-
AMPLIFIER	TK-PA6S	120009	TESTEK	2023. 01. 17	-
AMPLIFIER	TK-PA01S	220109-L	TESTEK	2023. 04. 29	●
Antenna Master	MA4000-EP	None	Innco systems GmbH	-	●
Turn Table	None	None	Innco systems GmbH	-	●
DTV MODULATOR	TVB599A	23.53.20.15.09 .00.00.23	TELEVIEW	2023. 01. 19	-

3 m Semi-Anechoic chamber (Above 1 GHz)

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Test Receiver	ESCI7	100823	Rohde & Schwarz	2022. 08. 30	-
Test Receiver	ESI	837514/004	Rohde & Schwarz	2023. 01. 17	-
Test Receiver	ESCI7	100969	Rohde & Schwarz	2023. 01. 17	●
Horn Antenna	3115	2996	EMCO	2023. 02. 10	-
Horn Antenna	3115	9605-4834	EMCO	2023. 03. 02	●
Broadband Horn Antenna	BBHA 9170	743	SCHWARZBECK MESS-ELEKTRONIK	2023. 01. 21	-
Antenna Master	AT13	None	AUDIX	-	●
Turn Table	None	None	AUDIX	-	●
Antenna Master	MA4000-EP	None	Innco systems GmbH	-	-
Turn Table	None	None	Innco systems GmbH	-	-
AMPLIFIER	TK-PA6S	120009	TESTEK	2023. 01. 17	-
AMPLIFIER	8449B	3008A02577	Agilent	2023. 01. 17	-
AMPLIFIER	8449B	3008A00149	H.P	2022. 08. 31	●
DTV MODULATOR	TVB599A	23.53.20.15.09 .00.00.23	TELEVIEW	2023. 01. 19	-

6.2.3 Test Data

a) Below 1 GHz

< Class A >

Freq. [MHz]	Reading [dB(μV)]	POL	H [m]	Factor			Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
				ANT. [dB/m]	CABLE [dB]	AMP. [dB]			
35.56	10.04	V	1.0	20.16	1.21	51.95	40.00	10.04	29.96
44.82	9.80	V	1.0	15.67	1.34	51.93	40.00	9.80	30.20
102.09	6.61	H	4.0	14.16	2.14	51.84	40.00	6.61	33.39
236.23	12.19	V	1.3	18.34	3.32	51.88	47.00	12.19	34.81
376.27	16.88	H	3.8	21.99	4.31	52.33	47.00	16.88	30.12
440.97	18.65	V	1.4	23.06	4.66	52.70	47.00	18.65	28.35

* Result & Reading : Test receiver reading value (Included ANT., CABLE and AMP. factor)

* POL = Antenna Polarization / H = Antenna Height * Receiving Antenna Mode : Horizontal, Vertical

* ANT. = Antenna factor / CABLE = used Cable loss / AMP.: Gain of the Amplifier

b) Above 1 GHz

< Class A >

Freq. [GHz]	Reading		POL	H [m]	Factor				Peak			CISPR Average		
	Peak [dB(μV)]	Average [dB(μV)]			ANT. [dB/m]	CABLE [dB]	AMP. [dB]	Distance [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]	Limit [dB(μV/m)]	Result [dB(μV/m)]	Margin [dB]
1.226	34.07	24.25	H	1.0	24.93	2.11	35.61	0.83	76.00	34.90	41.10	56.00	25.08	30.92
1.179	36.18	24.54	V	1.0	24.84	2.01	35.60	0.83	76.00	37.01	38.99	56.00	25.37	30.63

* Result = Reading + Distance

* Reading : Test receiver reading value (Included ANT., CABLE and AMP. factor)

* POL = Antenna Polarization / H = Antenna Height * Receiving Antenna Mode : Horizontal, Vertical

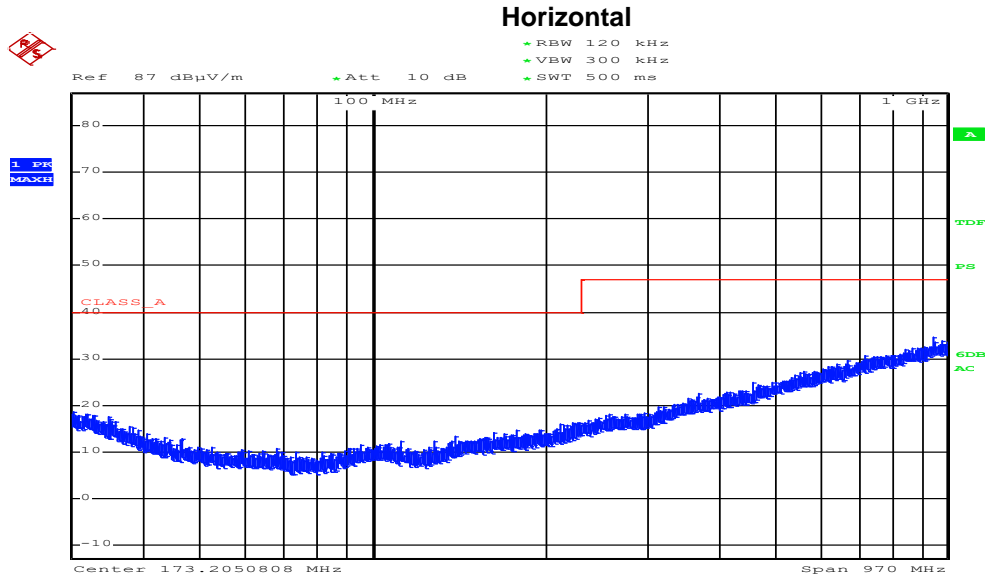
* ANT. = antenna factor / CABLE = used cable loss / AMP.: Gain of the Amplifier /

Distance : Distance compensation value

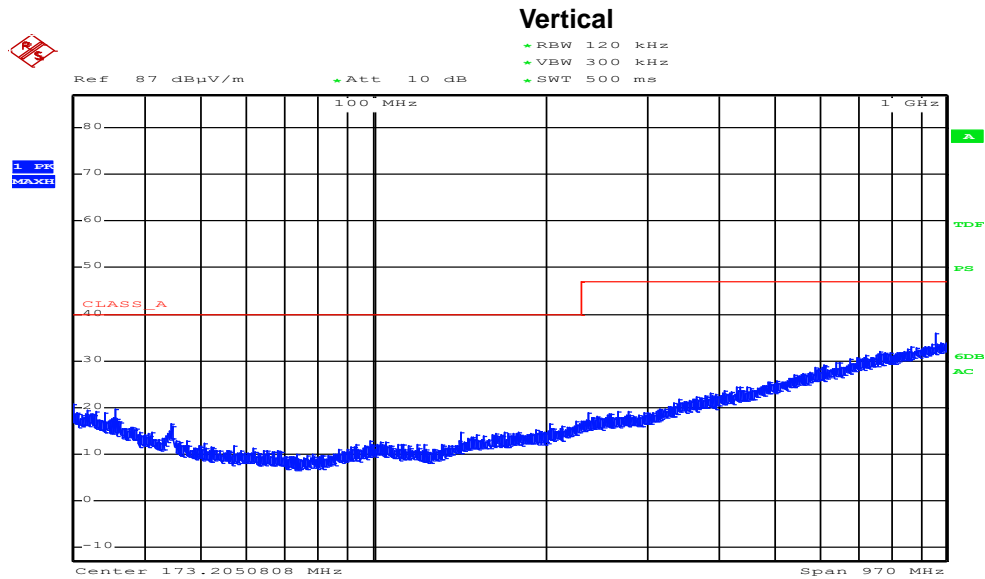
※ Except for the above data, the emission levels were very low, so that the other data are not reported.
(See Radiated Emission Graph)

6.2.4 Radiated emission test graph

a) Below 1 GHz

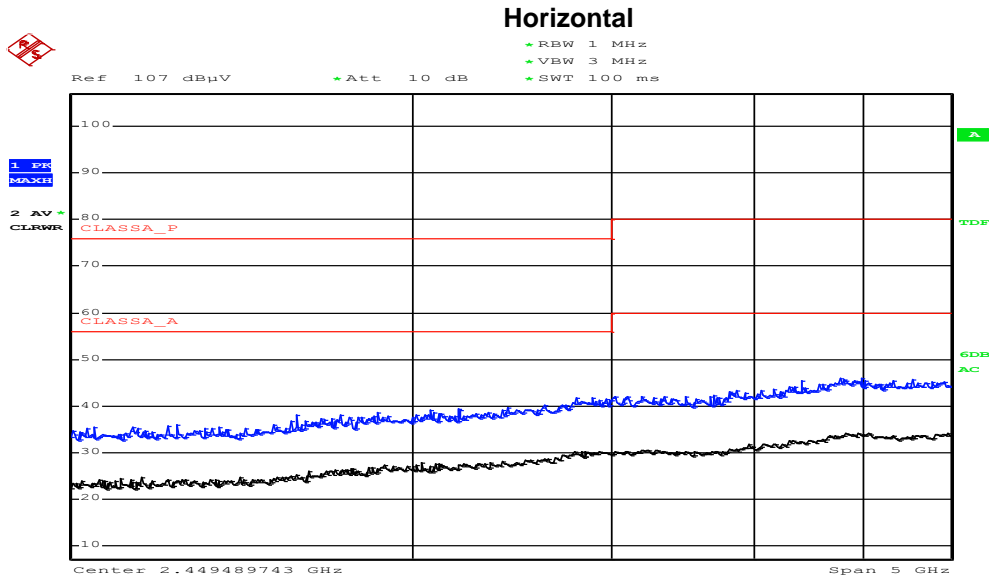


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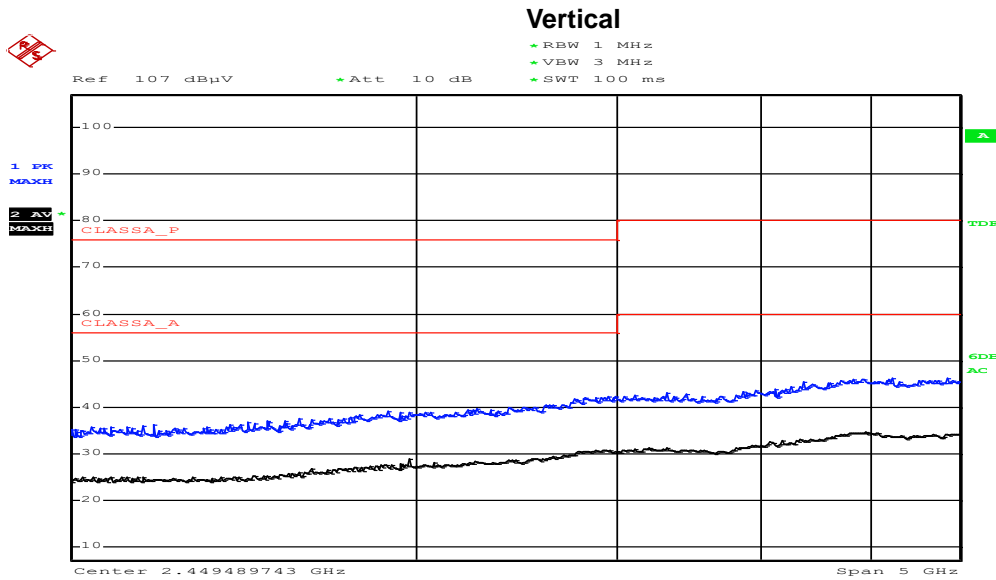


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b) Above 1 GHz



Date: 15.JUL.2022 15:45:03



Date: 15.JUL.2022 15:52:40

6.3 Electro Static Discharge

6.3.1 Measurement procedure

A ground reference plane was located on the floor, and connected to earth via a low impedance connection. The return cable of the ESD generator was connected to the reference plane. In case of floor standing equipment, EUT was placed on the reference plane on 10 cm of insulating Support. In case of tabletop equipment, EUT was placed on a wooden table 0.8 m above the reference grounded floor.

A horizontal coupling plane (HCP) was placed on the table, and Connected to the reference plane via a 470 k Ω resistor located in each end (0.5 mm insulating support between EUT and HCP). In both cases a vertical coupling plane (VCP) of 0.5 X 0.5 m was located 10 cm from the EUT's sides. The VCP was connected to the reference plane in the same matter as the HCP.

6.3.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Electrostatic Discharge Simulator	ESS-2000	ESS0432654	NOISEKEN	2023. 01. 20	●
ESD Simulator	ESS-B3011A	ESS17Z7382	NOISEKEN	2023. 02. 10	-
HCP	-	-	-	-	●
VCP	-	-	-	-	●
DTV MODULATOR	TVB599A	23.53.20.15.09.0 0.00.23	TELEVIEW	2023. 01. 19	-

6.3.3 Test data

Test specifications

Test specification : EN 61000-4-2

Criteria required : B

Kind of discharges

- Contact discharge
- Air discharge
- HCP
- VCP

Discharge voltages

- Contact discharge : ± 4 kV
- Air discharge : ± 2 kV, ± 4 kV, ± 8 kV

Discharge impedance

- 330 Ω / 150 pF
- 2 k Ω / 330 pF

Number of discharge

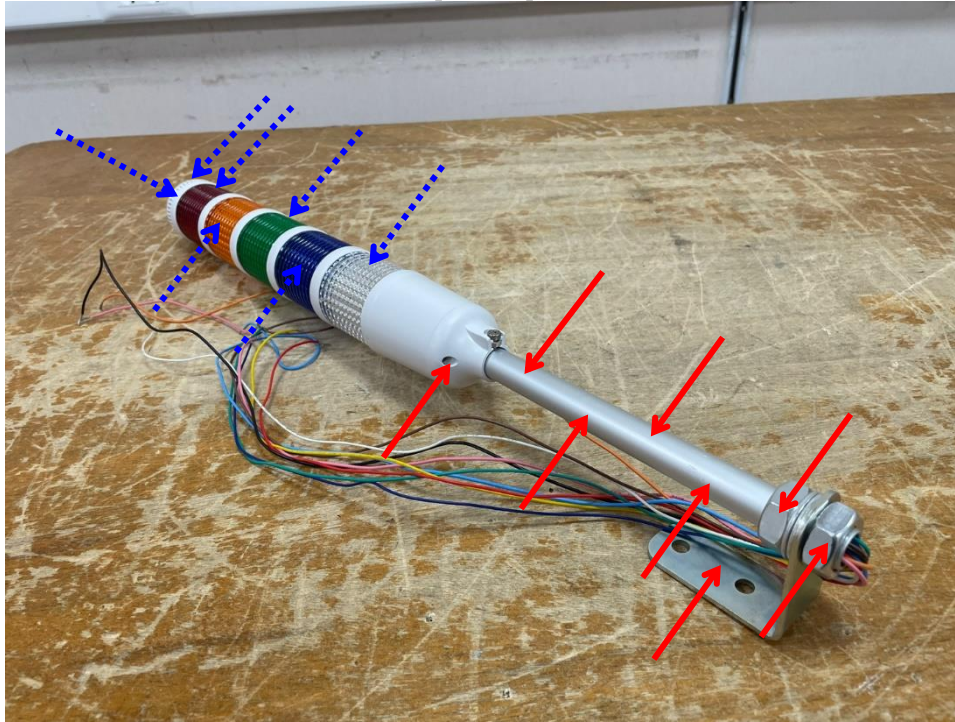
- ≥ 50 (+ : 25, - : 25) at all test point for each point

Test point

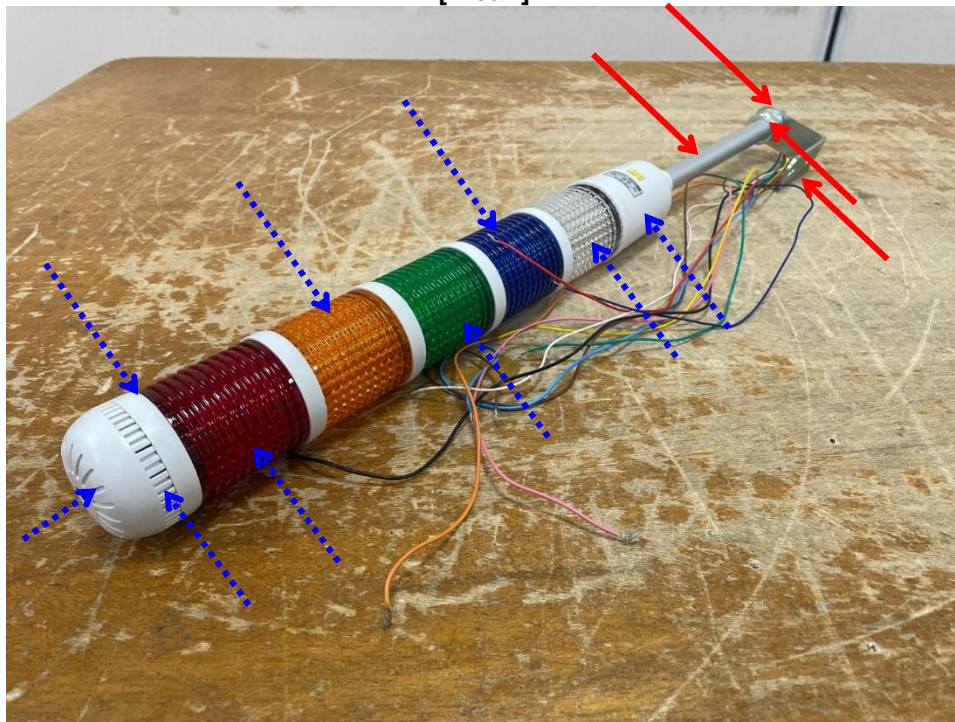
- Air discharge <----->

- Contact discharge <----->

[Front]



[Rear]



Table

Test point	Test level [kV]	Air/ Contact	Polarity (+ / -)	Result
* HCP/VCP	4	Contact	+ / -	A
Front, Rear, Top, Left, Right (Case)	2, 4, 8	Air	+ / -	A
Bottom (Chassis)	4	Contact	+ / -	A
Bolt	4	Contact	+ / -	A

* Indirect contact discharges were applied to the HCP and VCP.

Test results

Pass : [A] Fail

Comment : There was no change of operation status during above testing.

6.4 Radio frequency Electromagnetic Fields

6.4.1 Measurement procedure

The test was performed at 3 m full anechoic chamber.
 For floor standing equipment, the EUT was standing on the floor, isolated from the ferrite core.
 For tabletop equipment, the EUT was located on a wooden table 0.8 m above the floor.
 The EUT was tested all sides, horizontal and vertical polarization.
 The field uniformity was calibrated for 3 V/m, 10 V/m.

6.4.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
ESG Analog Signal Generator	E4428C	MY49070323	Agilent	2023. 01. 17	●
Power Meter	NRVD	100401	Rohde & Schwarz	2023. 01. 18	●
Power Sensor	NRV-Z4	100536	Rohde & Schwarz	2023. 01. 18	●
Power Sensor	NRV-Z4	100537	Rohde & Schwarz	2023. 01. 18	●
Directional coupler	DC6080	303256	Amplifier Research	-	●
BI-DIRECTIONAL COUPLER	ZGDC35-93HP+	0294	Mini-Circuits	-	●
System Interface	SI-300	120898	EMC Automation	-	●
RF Amplifier	150W1000	303048	Amplifire Reserch	-	●
RF Amplifier	BLMA 1060-60/50D	118344	BONN Elektronik	-	●
Biconilog Antenna	3142B	9910-1432	ETS-Lindgren	-	-
Ultra broadband Antenna	HL562	100076	Rohde & Schwarz	-	●
Microwave Log. -Per. Antenna	STLP9149	9149-117	SCHWARZBECK MESS-ELECTRONIK	-	●
Test Program	TDK Radiated Immunity Lab (V 4.125)	None	TDK	-	●
15 MHz FUNCTION/ARBHITRARY WAVEFORM GENERATOR	33120A	US36038310	H.P.	2023. 01. 18	-
Audio Analyzer	1121	14401	BOONTON ELECTRONICS CORP.	2023. 01. 18	-
Telephone Analyzer	DD-5601CID	520007186	CREDIX	2023. 01. 18	-
FILTER	3202	6506	KROHN-HITE CORP	2023. 01. 18	-
Measuring Amplifier Box	2609	1365937	Bruel & Kjaer	-	-
AMP BOX	AWM-01	082207	TDK	-	-
TIME WAVE	DSP-599zx	36789	TIME WAVE	-	-
TIME WAVE	DSP-599zx	36790	TIME WAVE	-	-
DYNAMIC SIGNAL ANALYZER	35670A	MY42507678	Agilent	2023. 01. 18	-
Sound Calibrator	4231	2588802	Bruel & Kjaer	2023. 01. 19	-
Impedance Box	TIB-R1	150035	TESTEK	-	-
DTV MODULATOR	TVB599A	23.53.20.15.09.00.00.23	TELEVIEW	2023. 01. 19	-

6.4.3 Test data

Test specifications

Test Specification : EN 61000-4-3

Criteria required : A

Frequency range

80 MHz – 1000 MHz 1.4 GHz – 6 GHz

Test level

1 V/m 3 V/m 10 V/m

Modulation

AM : 1 kHz, 80 % PM : 200 Hz, 50 % duty cycle

Frequency step

log 1 % step log 3 % step log 5 % step

Dwell time

3 s 2 s 1 s

Test point

Front Rear Left Right

Test results

Pass : [A] Fail

Table .Result for Radio frequency electromagnetic fields

Frequency range	Level [V/m]	Antenna	Positions	Result
80 MHz – 1000 MHz	10	H / V	Front	A
			Left	A
			Right	A
			Rear	A
1.4 GHz – 6 GHz	3		Front	A
			Left	A
			Right	A
			Rear	A

Comment : There was no change of operation status during above testing.

6.5 Electric Fast Transient

6.5.1 Measurement procedure

A ground reference plane was located on the floor.
EFT generator was connected to reference ground plane via low impedance connection.
For floor standing equipment, EUT was placed on a 0.1 m wooden table.
For tabletop equipment, EUT was placed on a wooden table(0.8 m) above the reference plane.

6.5.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
EMC IMMUNITY TEST SYSTEM	CCS 600	ES0801622	3ctest	2022. 08. 31	-
Capacitive Coupling Clamp	HFK	None	EM TEST	2023. 01. 17	-
COMPACT IMMUNITY TEST SYSTEM	AXOS 5	181806	HAEFELY TEST AG	2023. 01. 17	●
Capacitive Coupling Clamp	IP4B	181968	HAEFELY TEST AG	2023. 01. 17	-
DTV MODULATOR	TVB599A	23.53.20.15.09 .00.00.23	TELEVIEW	2023. 01. 19	-

6.5.3 Test data

Test specifications

Test Specification: EN 61000-4-4

Criteria required: B

Coupling

AC mains Signal Telecommunication line DC mains

Test level

AC mains : ±2 kV DC mains : ±2 kV Signal : ±1 kV

Test mode

- AC main:

L + N L + PE N + PE L + N + PE

- DC main:

P + N

- Signal : -

Burst frequency: 5 kHz, 5/50 ns

Coupling time: ≥ 60 sec

Test results

Pass : [A] Fail

Comment : There was no change of operation status during above testing.

6.6 Surge

6.6.1 Measurement procedure

A ground reference plane was located on the floor.
 SURGE generator was connected to reference ground plane via low impedance connection.
 For floor standing equipment, EUT was placed on a 0.1 m wooden table.
 For tabletop equipment, EUT was placed on a wooden table(0.8 m) above the reference plane.

6.6.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
CDN	CNV 508 S1	1001-05	EM TEST	-	-
CDN	CNV 508 S2	1001-06	EM TEST	-	-
Surge Generator	TSS 500M4	1201-04	EM TEST	2022. 08. 31	-
EMC IMMUNITY TEST SYSTEM	CCS 600	ES0801622	3ctest	2022. 08. 31	-
COMPACT IMMUNITY TEST SYSTEM	AXOS 5	181806	HAEFELY TEST AG	2023. 01. 17	-
DTV MODULATOR	TVB599A	23.53.20.15. 09.00.00.23	TELEVIEW	2023. 01. 19	-

6.6.3 Test data

Test specifications

Test specification: EN 61000-4-5

Criteria required: B

Coupling

AC mains Signal Telecommunication line DC mains

Test level

AC mains : ± 0.5 kV, 1 kV DC mains : ± 0.5 kV
 Signal : ± 1 kV Telecommunication line : ± 2 kV

Test mode

L + N L + PE N + PE L + N + PE

Coupling impedance

$40 \Omega + 0.5 \mu\text{F}$ 40Ω $10 \Omega + 9 \mu\text{F}$ $18 \mu\text{F}$

Coupling time : > 5 sec

Number of surge: 5

Phase : $0 \sim 360^\circ / 90^\circ$ Step

Test results

Pass: [-] Fail

Comment : This test doesn't apply to EUT because the EUT uses DC 24 V power.

6.7 Conducted Immunity

6.7.1 Measurement procedure

A ground reference plane was located on the floor.

For tabletop equipment, the test was performed on a ground reference plane on a 0.8 m wooden table. The EUT was isolated 0.1 m isolating support. The ground plane was connected to floor reference ground plane via low impedance connection. For floor standing equipment, EUT was placed on a 0.1 m wooden table. This test were Performed using CDN for mains, clamp for signal. and injection probe.

6.7.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Attenuator	ATT 6/75	1001-22	EM TEST	2023. 01. 17	-
TEST SYSTEM FOR CONDUCTED AND RADIATED IMMUNITY	NSG 4070	540130	TESEQ	2023. 01. 17	●
Attenuator	DAM-12W	None	FRANKONIA EMV-Mess-System GmbH	2023. 01. 17	●
CDN	CDN-M2/32A	510010550005	EM TEST	2023. 01. 17	●
CDN	CDN-M3/32A	510010320014	EM TEST	2023. 01. 17	-
CDN	CDN-M5/32A	5100102S0003	EM TEST	2023. 01. 17	-
CDN	CDN-T2	0302-02	EM TEST	2023. 01. 17	-
EM clamp	EM101	35611	Luthi Elektronik-Feinmechank AG	2023. 01. 19	-
EM INJECTION CLAMP	F-2031-32mm	401	FISCHER CUSTOM COMMUNICATIONS	2023 .02. 07	-
CDN	FCC-801-T8	9961	FISCHER CUSTOM COMMUNICATIONS INC.	2023. 01. 17	-
CDN	FCC-801-M2-25A	9977	FISCHER CUSTOM COMMUNICATIONS INC.	2023. 01. 17	-
CDN	FCC-801-M3-25A	99136	FISCHER CUSTOM COMMUNICATIONS INC.	2023. 01. 17	-
SIGNAL Generator	8648C	3847U02501	H.P.	2023. 01. 17	-
Power Amplifier	275LC-CE	8008-1	KALMUS	-	-
Test Program	TDK Conducted Immunity Lab (V 4.124)	None	TDK	-	-
15 MHz FUNCTION/ARBITRARY WAVEFORM GENERATOR	33120A	US36038310	H.P.	2023. 01. 18	-
Audio Analyzer	1121	14401	BOONTON ELECTRONICS CORP.	2023. 01. 18	-
Telephone Analyzer	DD-5601CID	520007186	CREDIX	2023. 01. 18	-
FILTER	3202	6506	KROHN-HITE CORP	2023. 01. 18	-
Measuring Amplifier Box	2609	1365937	Bruel & Kjaer	-	-
AMP BOX	AWM-01	082207	TDK	-	-
TIME WAVE	DSP-599zx	36789	TIME WAVE	-	-
TIME WAVE	DSP-599zx	36790	TIME WAVE	-	-
DYNAMIC SIGNAL ANALYZER	35670A	MY42507678	Agilent	2023. 01. 18	-
Sound Calibrator	4231	2588802	Bruel & Kjaer	2023. 01. 19	-
Impedance Box	TIB-R1	150035	TESTEK	-	-
DTV MODULATOR	TVB599A	23.53.20.15.09.0 0.00.23	TELEVIEW	2023. 01. 19	-

6.7.3 Test data

Test specifications

Test specification: EN 61000-4-6

Criteria required: A

Frequency range

150 kHz – 80 MHz 150 kHz – 230 MHz 150 kHz – 500 MHz

Coupling

AC main : -
 DC main : CDN-M2/32A
 Signal : -

Test level

1 V 3 V 10 V

Modulation

AM: 1 kHz, 80 % PM: 1 Hz, 50 % duty cycle

Frequency step

Log 1 % step log 3 % step log 5 % step

Dwell time

3 s 2 s 1 s

Test results

Pass: [A] Fail

Comment : There was no change of operation status during above testing.

6.8 Magnetic Field Susceptibility

6.8.1 Test Procedure

The Magnetic field to which equipment is subjected may influence the reliable operation of equipment and systems.

The following tests are intended to demonstrate the immunity of equipment when subjected to power frequency magnetic fields related to the specific location and installation condition of the equipment (e.g. proximity of equipment to the disturbance source).

The power frequency magnetic field is generated by power frequency current in conductors or, more seldom, from other devices (e.g. leakage of transformers) in the proximity of equipment.

As for the influence of nearby conductors, one should differentiate between :

- the current under normal operating conditions, which produces a steady magnetic field, with a comparatively small magnitude;
- the current under fault conditions which can produce comparatively high magnetic fields but of short duration, until the protection devices operate (a few milliseconds with fuses, a few seconds for protection relays).

The test with short duration magnetic field related to fault conditions, requires test levels that differ from those for steady state conditions; the highest value apply mainly to equipment to be installed in exposed places of electrical plants.

Frequency range	50 Hz
Field level	3 A/m
Duration	60 seconds each axis
Axis of orientation	X-axis, Y-axis and Z-axis

6.8.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Current transformer	MC2630	D5101	EM TEST	2022. 09. 01	-
Magnetic Field coil	MS100	0401-16	EM TEST	-	-
Motorized Variac	MV2616	1101-03	EM TEST	-	-
SLIDE-AC	None	None	None	-	-
CLAMP-ON GROUND RESISTANCE TESTER	5601	10080105K	PROVA	2022. 09. 02	-
Ultra Compact Generator	UCS 500 M6A	0401-15	EM Test	-	-

6.8.3 Test data

Test specifications

Test specification : EN 61000-4-8

Criteria required : A

Test Point

Power

Pulse

Damped Oscillatory

Axis of Orientation

X

Y

Z

Test level

1 A/m

3 A/m

10 A/m

Comment : This test does not apply, because EUT does not contain components susceptible to magnetic fields.

6.9 Voltage Dips, Short Interruptions and Voltage Variations

6.9.1 Test Procedure

The EUT shall be connected to the test generator with the shortest power supply cable specified by the EUT manufacturer. If no cable length is specified, it shall be the shortest possible length suitable to the application of the EUT. Tests on 3-Phase EUT must be accomplished by using 3 sets of equipment mutually synchronized.

Type designation of the EUT.

- Information on possible connections (plugs, terminals, etc.) and corresponding cables and peripherals,
- Input power of equipment to be tested,
- Representative operational modes of the EUT for the test,
- Performance criteria used and defined in the technical specifications.

If the actual operating signal sources are not available to the EUT, they may be simulated.

Voltage Dips and Short Interruptions

- The EUT shall be tested for each selected combination of test level and duration with a sequence of three dips/interruptions with intervals of 10 seconds minimum (between each test event). Each representative mode of operation shall be tested.

Voltage Variations

- The EUT is tested to each of the specified voltage variations. Three times at 10 second intervals for the most representative modes of operations.

6.9.2 Used equipments

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
COMPACT IMMUNITY TEST SYSTEM	DIP 116	181640	HAEFELY TEST AG	2023. 01. 17	-
COMPACT IMMUNITY TEST SYSTEM	AXOS 5	181806	HAEFELY TEST AG	2023. 01. 17	-
EMC IMMUNITY TEST SYSTEM	CCS 600	ES0801622	3ctest	2022. 08. 31	-
VOLTAGE VARIATION	VMT 2216SV	ES0471605	3ctest	2022. 08. 31	-
MULTIFUNCTION AC/DC POWER SOURCE	NETWAVE 30-400	P1826221268	EM TEST	2022. 08. 30	-
Test Program	Net.control (V.2.1.6)	EM TEST	EM TEST	-	-
DTV MODULATOR	TVB599A	23.53.20.15.09 .00.00.23	TELEVIEW	2023. 01. 19	-

6.9.3 Test data

Test specifications

Test specification: EN 61000-4-11

Criteria required: B, C, C, C

Overshoot/undershoot

- Less than 5 % of the change in voltage

voltage rise and fall time

- 1 μ s – 5 μ s

Phase shifting

- 0° 180° 360°

Phase relationship of voltage dips and interruptions with the power frequency

- Less than + 5° Less than + 10°

Test Voltage

- 100 V 220 V 230 V 240 V

Test Frequency

- 50 Hz 60 Hz

6.9.4 Test Result

Phenomena	Reduction	Period		Criteria	Result
		50 Hz	60 Hz		
Voltage Dip	100 %	1	1	B	-
Voltage Dip	60 %	10	12	C	-
Voltage Dip	30 %	25	30	C	-
Interruption	100 %	250	300	C	-

Comment : This test doesn't apply to EUT because the EUT uses DC 24 V power.

6.10 Harmonics Current

6.10.1 Test Procedure

EUT was connected to the Power Analyzer system. Measurements were conducted on all active phases, for harmonics 1-40 th of the mains frequency (50 Hz or 60 Hz). A pure AC main was supplied to the system from two power supply units. The units supply an AC main, free of harmonics or distortion of any kind. An overview of the harmonic emission is presented as numeric.

6.10.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Harmonics & Flicker Analyzer	DPA 500	0701-05	EM TEST	2023. 01. 19	-
AC source	ACS 500	0102-02	EM TEST	-	-
Test Program	dpa.control (V5.4.9.0)	None	EM TEST	-	-
MULTIFUNCTION AC/DC POWER SOURCE	NETWAVE 30-400	P1826221268	EM TEST	2022. 08. 30	-
THREE-PHASE FLICKER IMPEDANCE	AIF 503N32.1	P1826221539	EM TEST	2023. 05. 19	-
DIGITAL POWER ANALYZER	DPA 503N	P1743206206	EM TEST	2022. 11. 19	-
Test Program	net.control (V2.1.1)	None	EM TEST	-	-

5.9.3 Test Result

This test doesn't apply to EUT because the EUT uses DC 24 V power.

6.11 Flicker

6.11.1 Test Procedure

EUT was connected to the Power Analyzer system. Measurements were conducted to obtain the desired flicker parameters. The measuring time depends on which parameters are to be measured:

- ◆ 2 hours for Long Time Flicker assessment (Plt)
- ◆ 10 minutes for Short Time Flicker assessment (Pst)
- ◆ 1-10 minutes for Dmax, Dc and Dt assessment (depending on EUT switch-rate)

A pure AC main was supplied to the system from two power supply units. The units supply an AC main, free of harmonics, fluctuations or distortion of any kind. Defined impedance was located between the supply unit and the EUT.

A measurement table and a graphic presentation of the “Worst Case” probability function of Short Time Flicker during this session (if measured) are presented in the report.

Instrumentation used during this session:

6.11.2 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Used
Harmonics & Flicker Analyzer	DPA 500	0701-05	EM TEST	2023. 01. 19	-
AC source	ACS 500	0102-02	EM TEST	-	-
Test Program	dpa.control (V5.4.9.0)	None	EM TEST	-	-
MULTIFUNCTION AC/DC POWER SOURCE	NETWAVE 30-400	P1826221268	EM TEST	2022. 08. 30	-
THREE-PHASE FLICKER IMPEDANCE	AIF 503N32.1	P1826221539	EM TEST	2023. 05. 19	-
DIGITAL POWER ANALYZER	DPA 503N	P1743206206	EM TEST	2022. 11. 19	-
Test Program	net.control (V2.1.1)	None	EM TEST	-	-

6.11.3 Test Result

This test doesn't apply to EUT because the EUT uses DC 24 V power.

7. Test Setup and EUT Photographs

Conducted Emission (Front)_AC Mains

N/A

Conducted Emission (Rear)_AC Mains

N/A

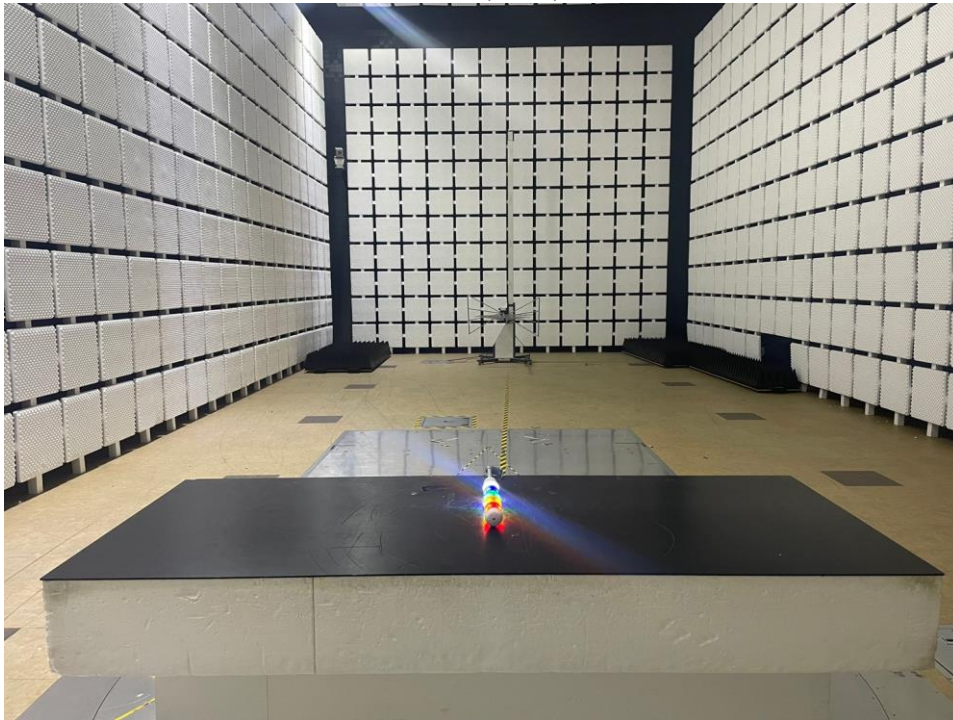
Conducted Emission (Front)_Telecommunication port

N/A

Conducted Emission (Rear)_Telecommunication port

N/A

Radiated Emission (Front) Below 1 GHz



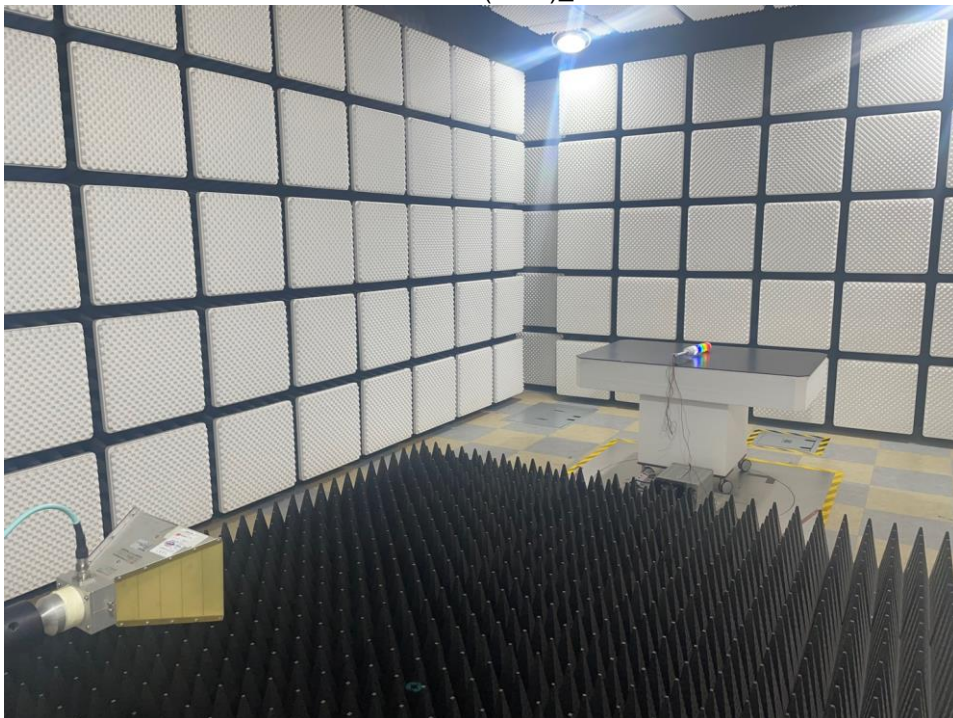
Radiated Emission (Rear) Below 1 GHz



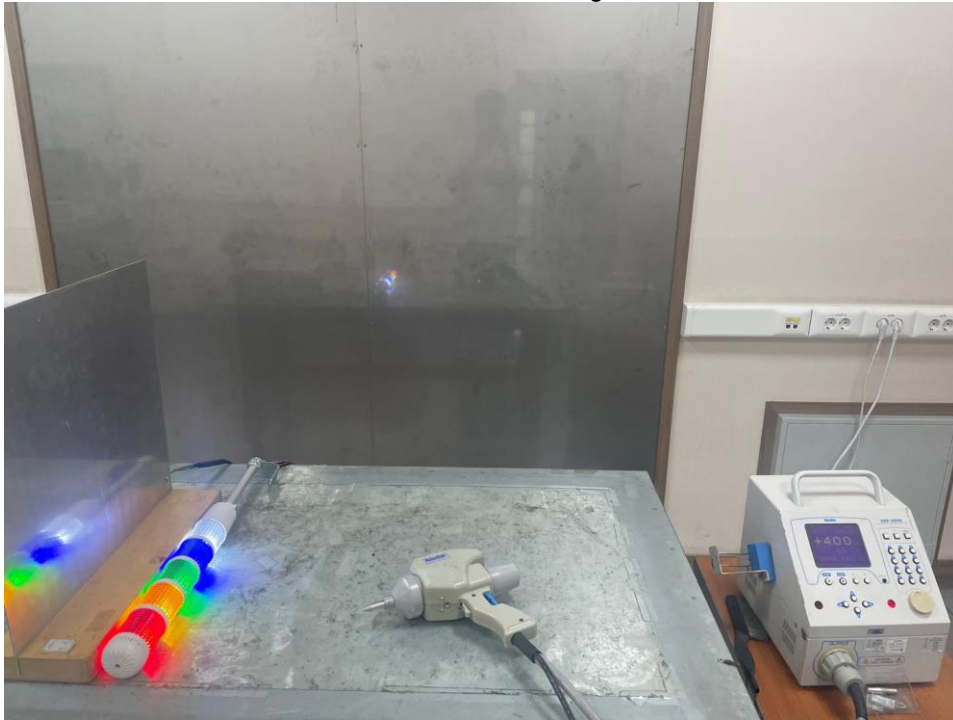
Radiated Emission (Front)_Above 1 GHz



Radiated Emission (Rear)_Above 1 GHz



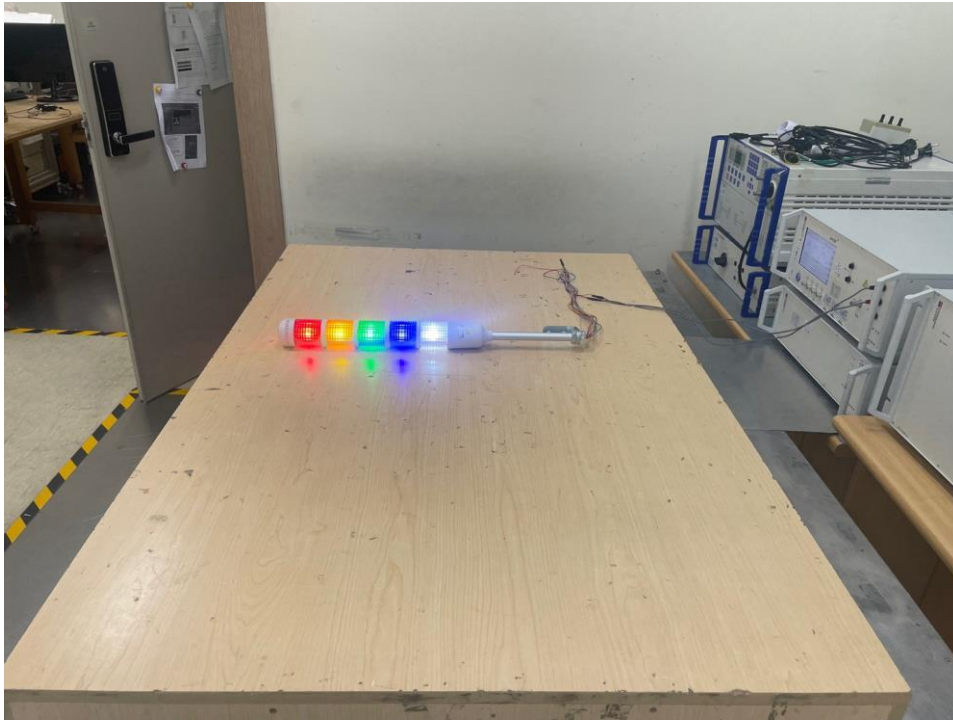
Electrostatic Discharge



Electromagnetic Field Immunity



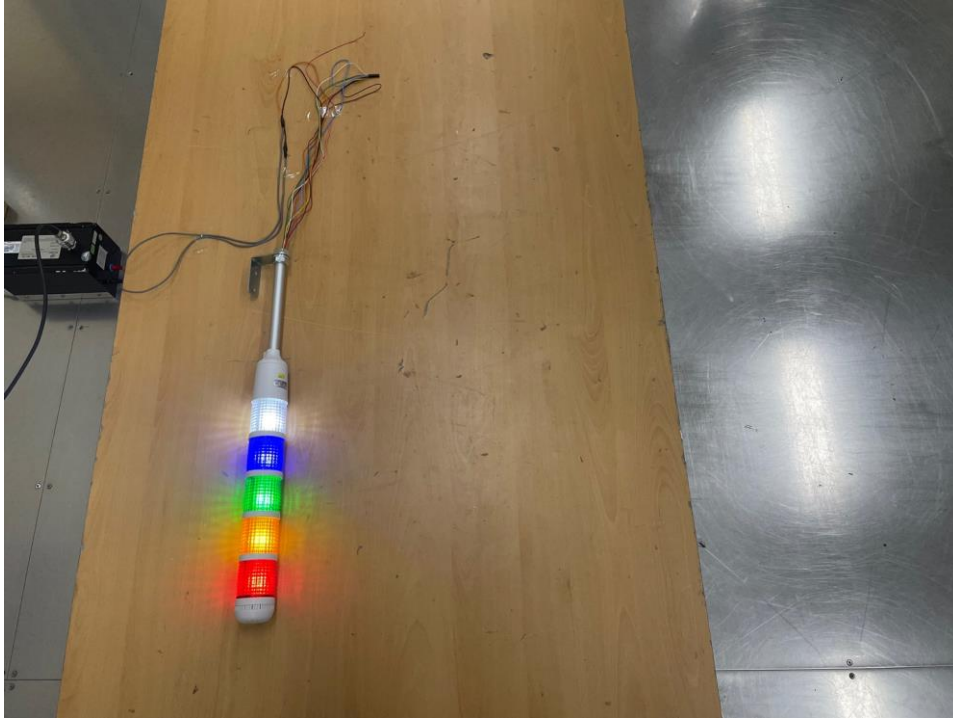
Electrical Fast Transient / Burst



Surge

N/A

Conducted Immunity



Magnetic Field Susceptibility

N/A

Voltage Dips & Interruption

N/A

Harmonics / Flicker

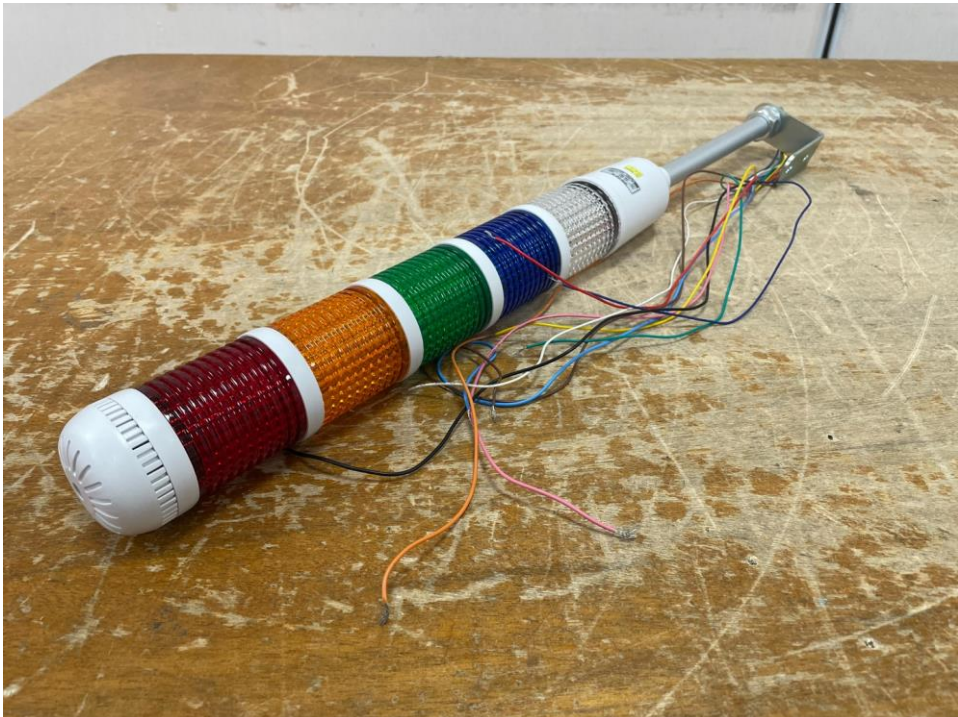
N/A

EUT

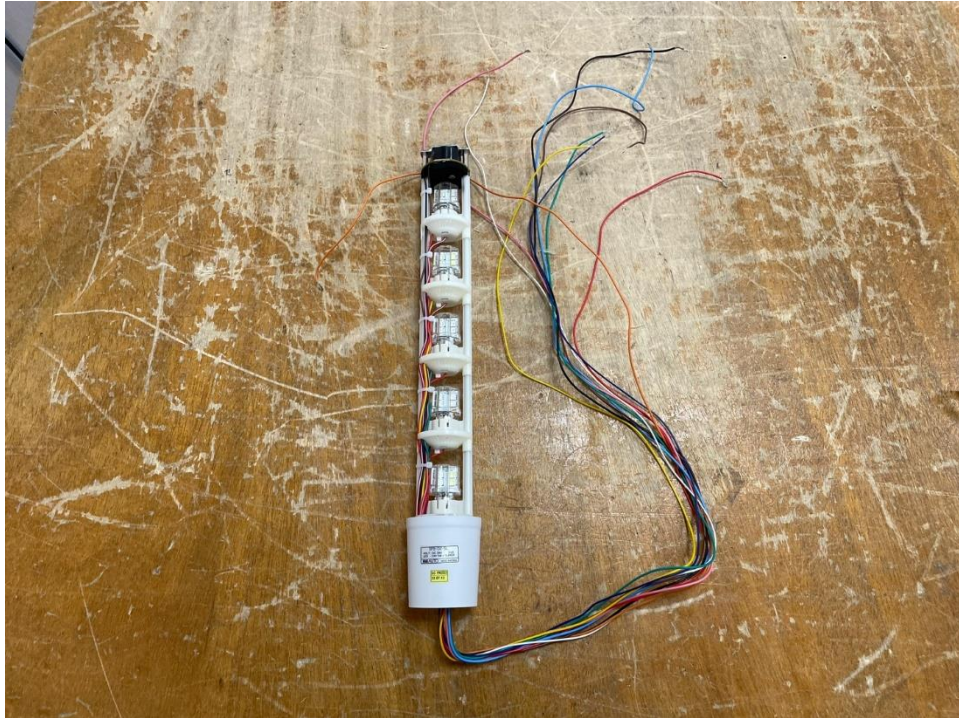
Front



Rear



Inside



Port

