

TRACO ELECTRONIC AG

TEST REPORT

Model:

TEL 8WI Series

(Serial models please refer to section 1.2)

REPORT NUMBER

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EMC

TEST REPORT

Applicant:	TRACO ELECTRONIC AG SIHLBRUGGSSTRASS 111, CH-6340 BAAR, SWITZERLAND
Product:	DC / DC Power Converter
Model No.:	TEL 8WI Series (Serial models please refer to section 1.2)
Brand Name:	TRACO ELECTRONIC AG
Test Method/ Standard:	EN 55032:2015+A1:2020 EN IEC 61000-3-2:2019+A1:2021 EN 61000-3-3:2013+A1:2019 EN 55035:2017+A11:2020 BS EN 55032:2015+A1:2020 BS EN IEC 61000-3-2:2019+A1:2021 BS EN 61000-3-3:2013+A1:2019 BS EN 55035:2017+A11:2020
Test By:	Intertek Testing Services Taiwan Ltd. Hsinchu Laboratory No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li Shiang-Shan District, Hsinchu City, Taiwan No. 17, Ln. 246, Niupu S. Rd., Xiangshan Dist, Hsinchu City 300075, Taiwan



Mandy Su

Mandy Su
Engineer

Rico Deng

Rico Deng
Reviewer

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Revision History

Report No.	Issue Date	Revision Summary
230800017THC-001	Nov. 01, 2023	<p>Tighter testing of ESD and Magnetic Field tests. After engineer judgment and comparing the version, the difference is the model and the applicant, the difference does not affect the EMC characteristic.</p> <p>Then the test data in this report are based on Report No.: 230400239THC-001</p>

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1. General Information

1.1 Identification of the EUT

Product:	DC / DC Power Converter
Model No.:	TEL 8-2423WI, TEL 8-4811WI
Rated Power:	DC 24 V for TEL 8-2423WI DC 48 V for TEL 8-4811WI
Power Cord:	N/A
Sample receiving date:	2023/04/26
Sample condition:	Workable
Testing date:	2023/05/02 ~ 2023/10/19

1.2 Additional information about the EUT

The customer confirmed the models listed are difference between as below:

Model	Input Voltage (Range) VDC	Output Voltage (Range) VDC
TEL 8-2410WI	24 (9~36)	3.3
TEL 8-2411WI		5
TEL 8-2412WI		12
TEL 8-2413WI		15
TEL 8-2415WI		24
TEL 8-2422WI		±12
TEL 8-2423WI		±15
TEL 8-4810WI	48 (18~75)	3.3
TEL 8-4811WI		5
TEL 8-4812WI		12
TEL 8-4813WI		15
TEL 8-4815WI		24
TEL 8-4822WI		±12
TEL 8-4823WI		±15

For more detail features, please refer to user's Manual.

2. Test Summary

Emission			
Standard	Test Type	Result	Remarks
EN 55032:2015+A1:2020 BS EN 55032:2015+A1:2020	Conducted Emission	PASS	Meet Class A Limit
	Asymmetric mode Conducted emissions	N/A	N/A
	Conducted differential voltage emissions	N/A	N/A
	Radiated Emission	PASS	Meet Class A Limit
EN IEC 61000-3-2:2019+A1:2021 BS EN IEC 61000-3-2:2019+A1:2021	Harmonic current Emissions	N/A	N/A
EN 61000-3-3:2013+A1:2019 BS EN 61000-3-3:2013+A1:2019	Voltage fluctuation & Flicker	N/A	N/A

Immunity (EN 55035:2017+A11:2020/BS EN 55035:2017+A11:2020)				
Standard	Test Type	Minimum Performance Criteria	Result	
IEC 61000-4-2:2008	ESD	Criterion B	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-3:2020	RS	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-4:2012	EFT	Criterion B	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-5:2014/ AMD1:2017	Surge	Criterion B	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-6:2013	CS	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-8:2009	Magnetic Field	Criterion A	PASS	Meets the requirements of Performance Criterion A
IEC 61000-4-11:2020	Dip	Criterion B / Criterion C ^{note1}	N/A	N/A
	Interruption	Criterion C	N/A	N/A
Note: 1. Voltage dips residual voltage <5 %, Performance criteria: Criterion B; Voltage dips residual voltage 70%, Performance criteria: Criterion C;				

Remark: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.

Other Testing: the specification, standard and not taking into account the measurement uncertainty.

3. Test Specifications

3.1 Standards

EN 55032:2015+A1:2020/BS EN 55032:2015+A1:2020 Electromagnetic compatibility of multimedia equipment - Emission requirements

EN IEC 61000-3-2:2019+A1:2021/BS EN IEC 61000-3-2:2019+A1:2021 Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

EN 61000-3-3:2013+A1:2019/BS EN 61000-3-3:2013+A1:2019 Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

EN 55035:2017+A11:2020/BS EN 55035:2017+A11:2020 Electromagnetic compatibility of multimedia equipment. Immunity requirements

3.2 Classification of MME

The MME equipment defines Class A equipment and Class B equipment associated with two types of end-use environment.

The Class B requirements for equipment are intended to offer adequate protection to broadcast services within the residential environment.

Equipment intended primarily for use in a residential environment shall meet the Class B limits. All other equipment shall comply with the Class A limits.

Broadcast receiver equipment is class B equipment.

3.3 Performance criteria

The performance criteria listed below are based on those regulated in the standard.

Criteria A:

The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment 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 by what the user may reasonably expect from the equipment if used as intended.

Criteria B:

During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test.

After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment 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), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Criteria C:

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed.

Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

3.4 Mode of operation during the test

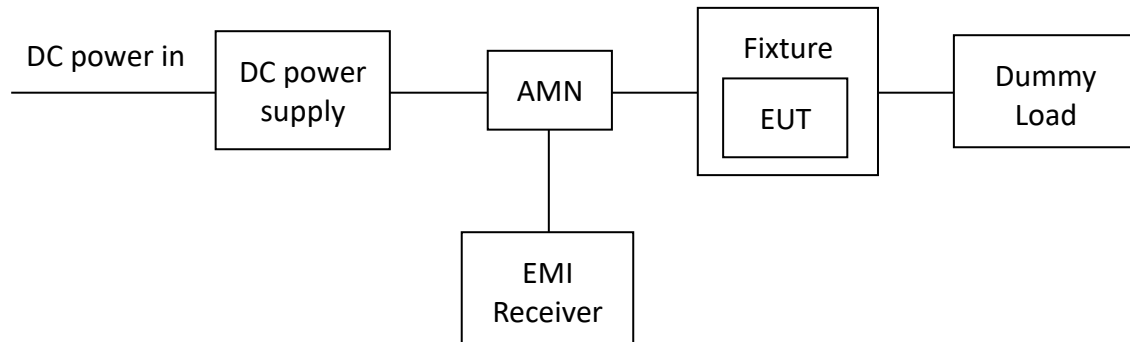
The EUT was installed with dummy load and operated in full load condition.

3.5 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Description of Data Cable
Dummy Load	N/A	N/A	N/A	N/A
DC power supply	Twintex	TP-1603C	N/A	N/A

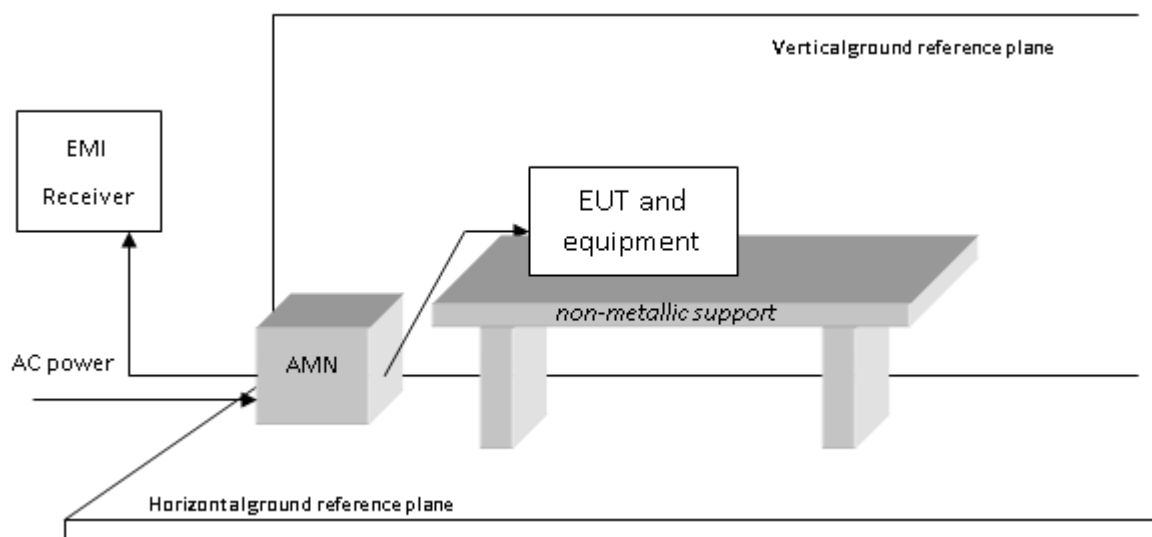
4. Conducted Emission Test

4.1 Test Procedure



The EUT along with its peripherals were placed on a 1.0 meter(W)×1.5meters(L) and 0.8 meter in height wooden table and the EUT was adjusted to maintain a 0.4meter space from a vertical reference plane. The EUT was connected to power mains through a Artificial Mains Network (AMN), which provided 50 ohm 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 AMN was bundled. All connecting cables of EUT and peripherals were moved to find the maximum emission



4.2 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	R&S	ESCI	100059	2022/10/24	2023/10/23
AMN	R&S	ENV216	101159	2022/06/07	2023/06/06
CON-1 Cable	EMC Co.	EMCRG1420 -NM-NM-1500	210215	2023/02/21	2024/02/20
Test software	Audix	e3	V4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

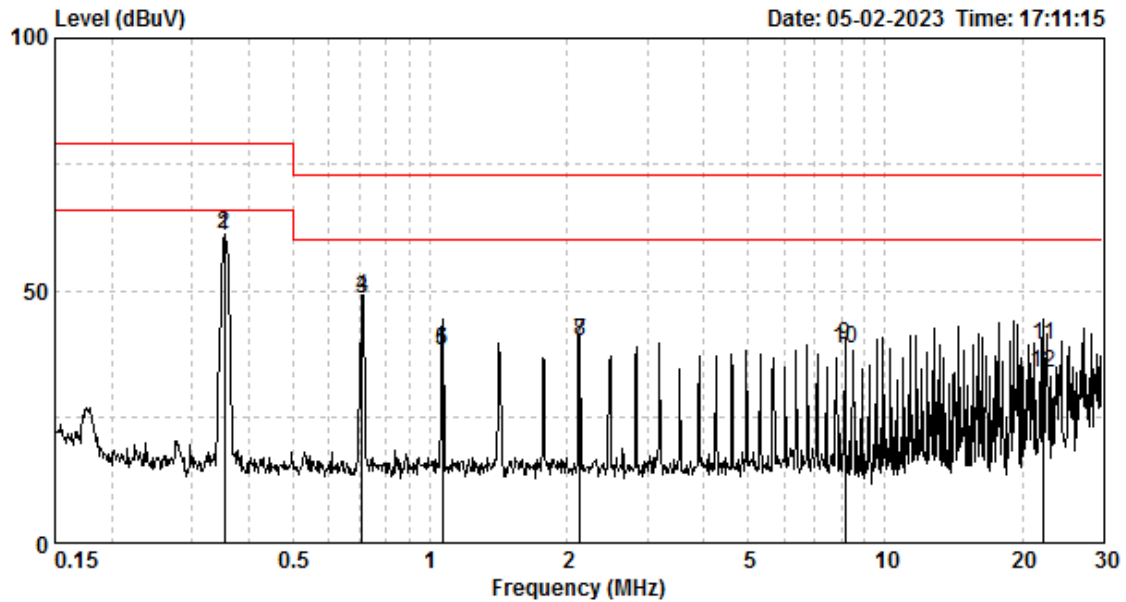
4.3 Conducted Emission Limit

Frequency (MHz)	Class A	
	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	79	66
0.50 to 30.0	73	60
Frequency (MHz)	Class B	
	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.0	60	50

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4.4 Conducted Emission Data

Model No.:	TEL 8-2423WI
Remark:	N/A

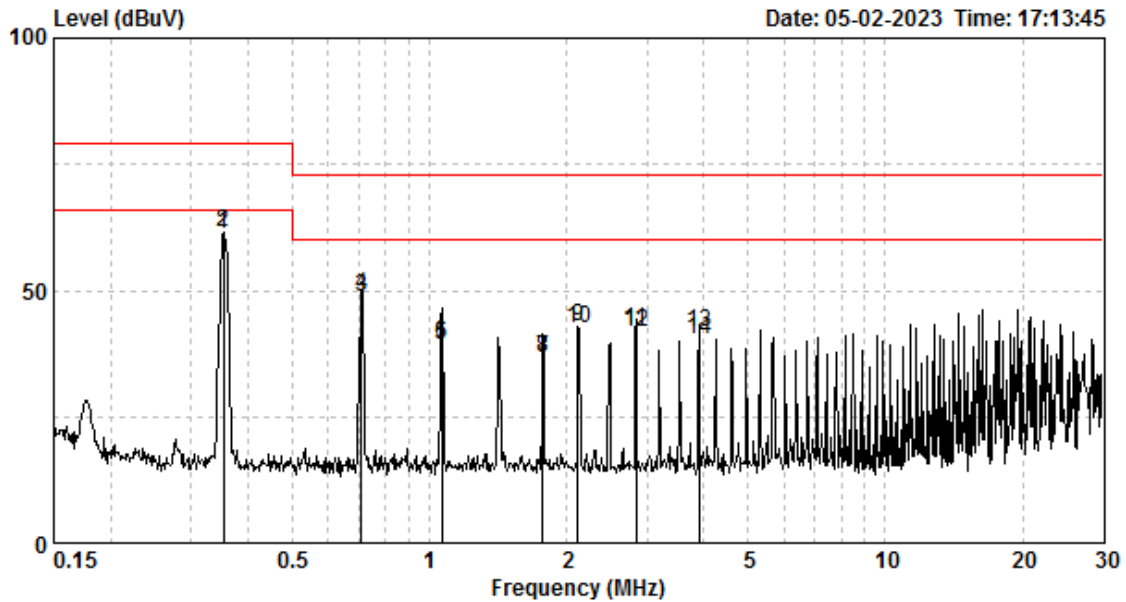


Test voltage :DC 24
 Temp \ Relative Humidity:24°C \ 55%RH
 Atmospheric pressure :1006 hPa

Phase	Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
									QP	AV
LINE	0.354	9.61	51.24	60.85	79.00	51.58	61.19	66.00	-18.15	-4.81
LINE	0.708	9.61	38.67	48.27	73.00	39.03	48.64	60.00	-24.73	-11.36
LINE	1.065	9.61	28.41	38.02	73.00	28.48	38.09	60.00	-34.98	-21.91
LINE	2.133	9.66	30.32	39.98	73.00	30.14	39.80	60.00	-33.02	-20.20
LINE	8.148	9.72	29.53	39.25	73.00	28.66	38.38	60.00	-33.75	-21.62
LINE	22.298	9.80	29.48	39.28	73.00	23.83	33.64	60.00	-33.72	-26.36

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Test voltage :DC 24
 Temp \ Relative Humidity:24°C \ 55%RH
 Atmospheric pressure :1006 hPa

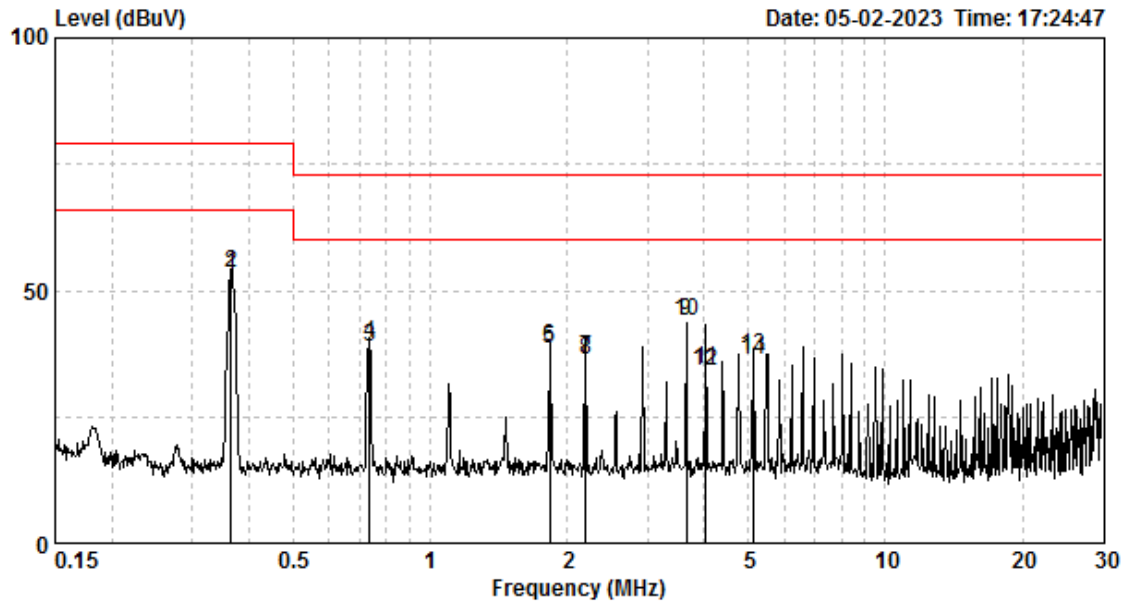
Phase	Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
									QP	AV
NEUTRAL	0.354	9.61	51.53	61.14	79.00	51.86	61.47	66.00	-17.86	-4.53
NEUTRAL	0.708	9.61	39.22	48.83	73.00	39.56	49.17	60.00	-24.17	-10.83
NEUTRAL	1.065	9.61	29.66	39.27	73.00	29.82	39.44	60.00	-33.73	-20.56
NEUTRAL	1.772	9.65	26.87	36.52	73.00	26.96	36.61	60.00	-36.48	-23.39
NEUTRAL	2.121	9.66	32.86	42.52	73.00	33.19	42.85	60.00	-30.48	-17.15
NEUTRAL	2.839	9.65	32.29	41.95	73.00	32.08	41.73	60.00	-31.05	-18.27
NEUTRAL	3.901	9.65	30.70	40.35	73.00	32.27	41.92	60.00	-32.65	-18.08

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

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Model No.:	TEL 8-4811WI
Remark:	N/A

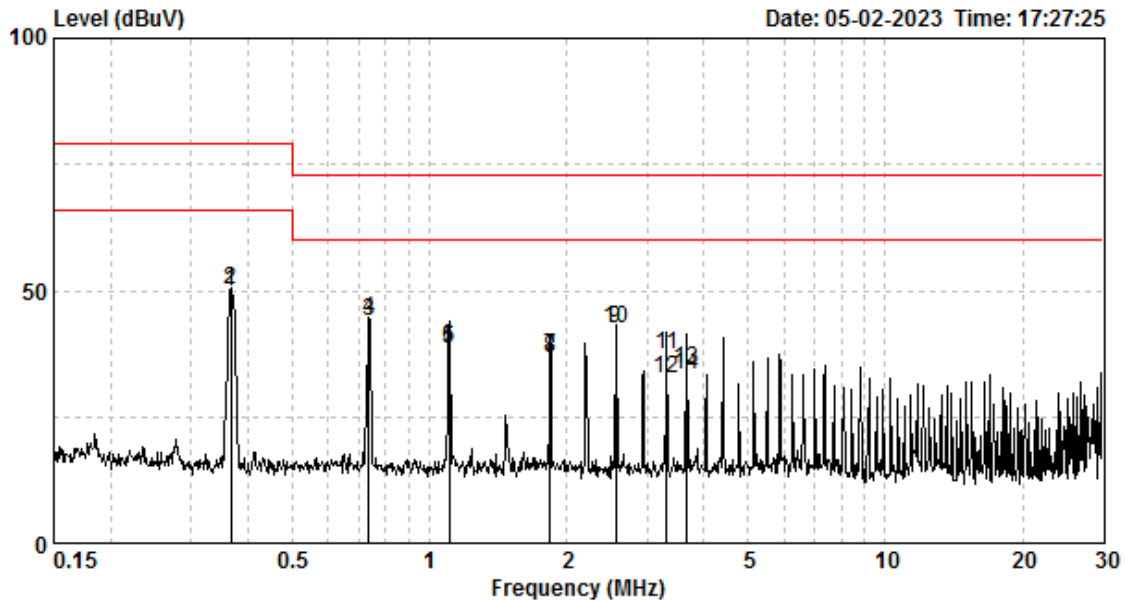


Test voltage :DC 48V
Temp \ Relative Humidity:24°C \ 55%RH
Atmospheric pressure :1006 hPa

Phase	Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
									QP	AV
LINE	0.365	9.61	43.58	53.18	79.00	43.91	53.51	66.00	-25.82	-12.49
LINE	0.735	9.61	29.35	38.95	73.00	29.94	39.55	60.00	-34.05	-20.45
LINE	1.829	9.65	28.84	38.49	73.00	29.04	38.70	60.00	-34.51	-21.30
LINE	2.201	9.66	26.52	36.18	73.00	26.90	36.55	60.00	-36.82	-23.45
LINE	3.661	9.65	34.35	44.00	73.00	34.21	43.86	60.00	-29.00	-16.14
LINE	4.027	9.65	24.53	34.17	73.00	24.74	34.39	60.00	-38.83	-25.61
LINE	5.112	9.70	27.39	37.09	73.00	26.62	36.31	60.00	-35.91	-23.69

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Test voltage :DC 48V
 Temp \ Relative Humidity:24°C \ 55%RH
 Atmospheric pressure :1006 hPa

Phase	Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	
									QP	AV
NEUTRAL	0.367	9.61	40.26	49.86	79.00	40.60	50.21	66.00	-29.14	-15.79
NEUTRAL	0.735	9.61	34.43	44.04	73.00	34.83	44.44	60.00	-28.96	-15.56
NEUTRAL	1.106	9.62	28.86	38.48	73.00	29.33	38.95	60.00	-34.52	-21.05
NEUTRAL	1.839	9.65	26.83	36.49	73.00	27.26	36.92	60.00	-36.51	-23.08
NEUTRAL	2.567	9.66	32.70	42.35	73.00	32.83	42.48	60.00	-30.65	-17.52
NEUTRAL	3.310	9.65	27.80	37.45	73.00	23.06	32.71	60.00	-35.55	-27.29
NEUTRAL	3.681	9.65	24.77	34.42	73.00	23.73	33.38	60.00	-38.58	-26.62

Remark:

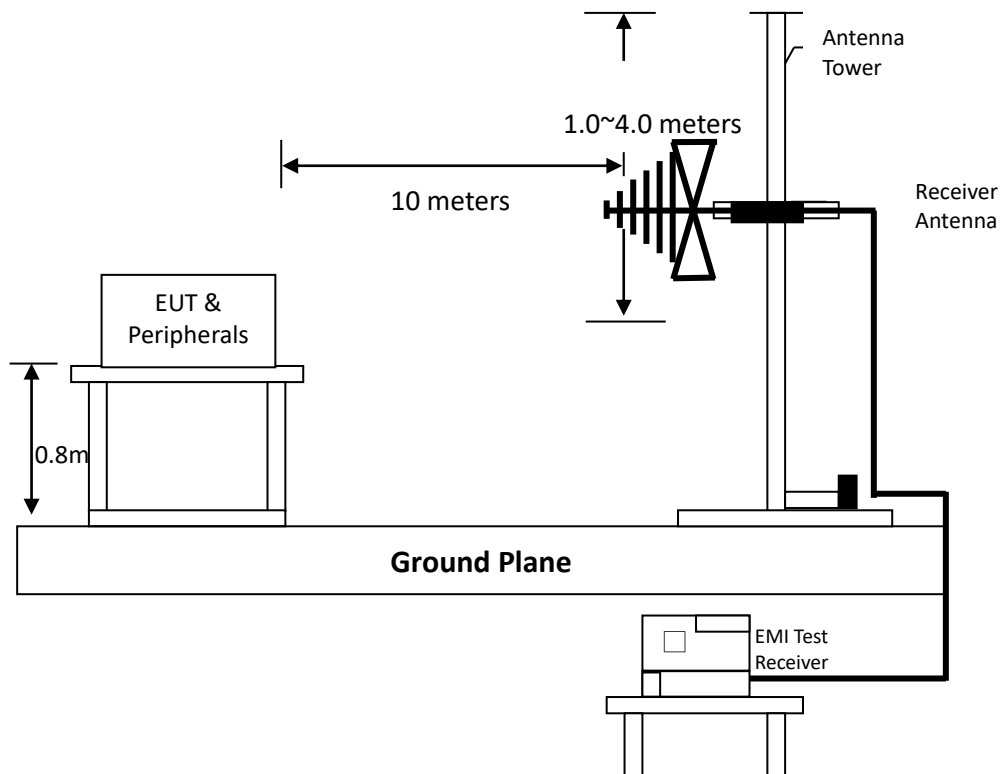
1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

5. Radiated Emission Test

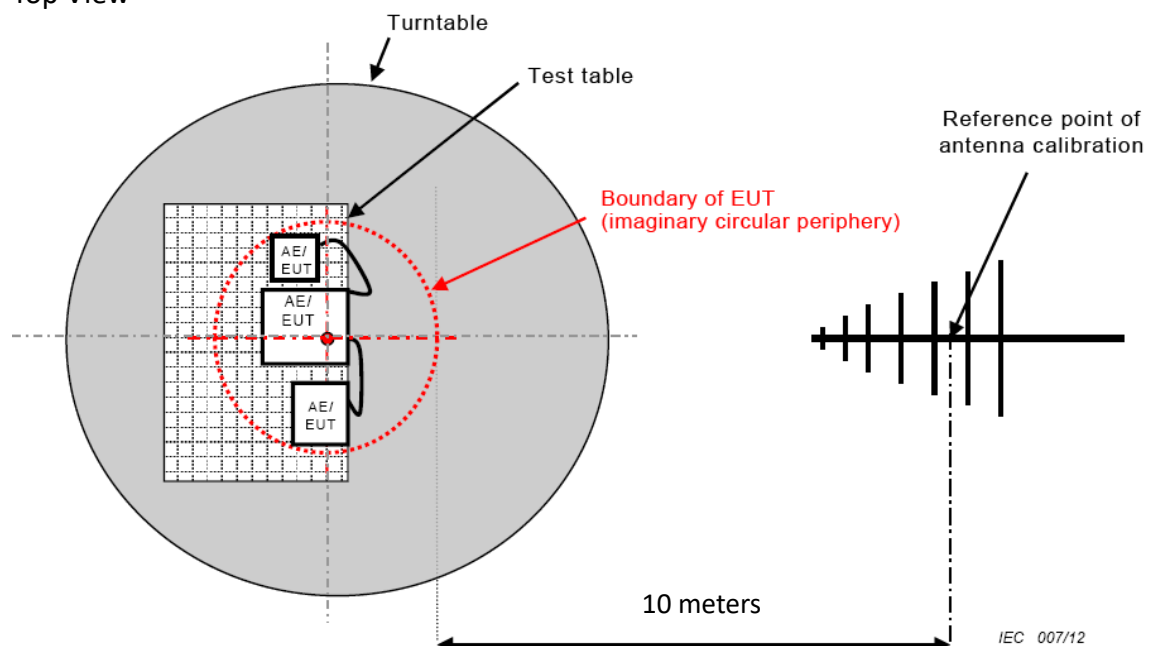
5.1.1 Test Procedure from 30 MHz to 1000 MHz

The figure below shows the test setup, which is utilized to make these measurements.

Side View



Top View



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Radiated testing was performed at 10 meters open area test site. The equipment under test was placed on a turntable top 0.8 meter above ground. The table was 360 degrees to determine the position of the highest radiation. EUT is set 10 meters from the EMI receiving antenna, which is mounted on a variable height mast. The antenna height is varied between one meter and four meters above ground to find the maximum value of the field strength. Both horizontal polarization and vertical polarization of the antenna was set to conduct the measurement.

The bandwidth was set on the EMI meter 120 kHz.

The levels are quasi peak value readings. The frequency spectrum from 30 MHz to 1000 MHz was investigated.

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

5.1.2 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	R&S	ESCS30	825788/014	2023/03/13	2024/03/11
Pre-Amplifier	EM	EM330	060654	2022/07/06	2023/07/05
Bi_log Hybrid Antenna	ETC	MCTD 2786B	BLB17J04019 & JB-5-019	2022/10/04	2023/10/03
OATS_1	Intertek	N/A	N/A	2023/01/16	2024/01/15
OATS-1 Cable	PACIFIC	8D-FB	N/A	2023/04/10	2024/04/08
OATS-1 Cable	PEWC.	N / CFD400-NL	N/A	2023/04/10	2024/04/08
Test software	Audix	e3	V4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

5.1.3 Radiated Emission Limit

Class A		
Frequency (MHz)	Distance (meter)	Limit (dBμV/m)
30~230	10	40
230~1000		47
30~230	3	50
230~1000		57
Class B		
Frequency (MHz)	Distance (meter)	Limit (dBμV/m)
30 to 230	10	30
230 to 1000		37
30 to 230	3	40
230 to 1000		47

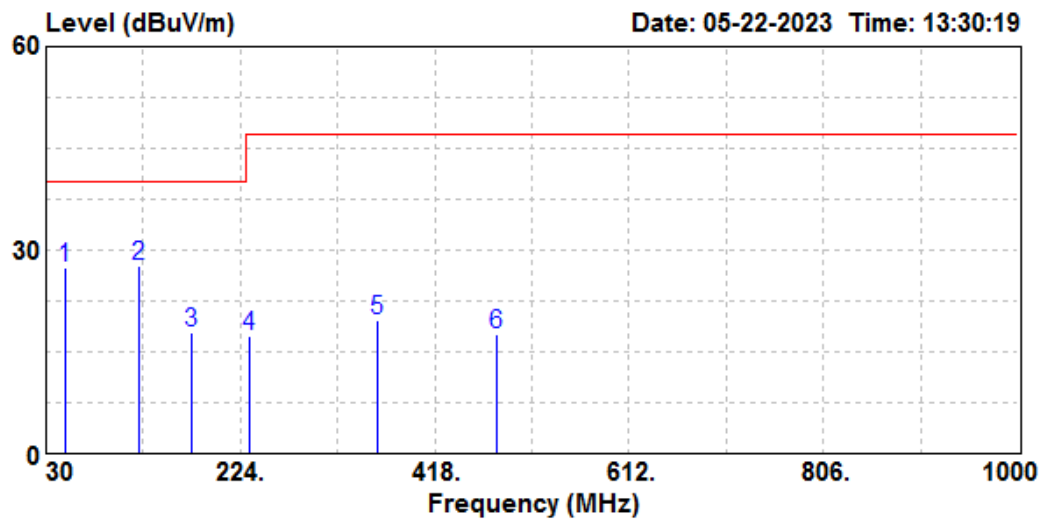
Note:

1. The tighter limit shall apply at the edge between two frequency bands.
2. Distance refers to the distance in meters between the EUT to antenna.

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5.1.4 Radiated Emission Test Data from 30 MHz to 1000 MHz

Model No.:	TEL 8-2423WI
Remark:	N/A

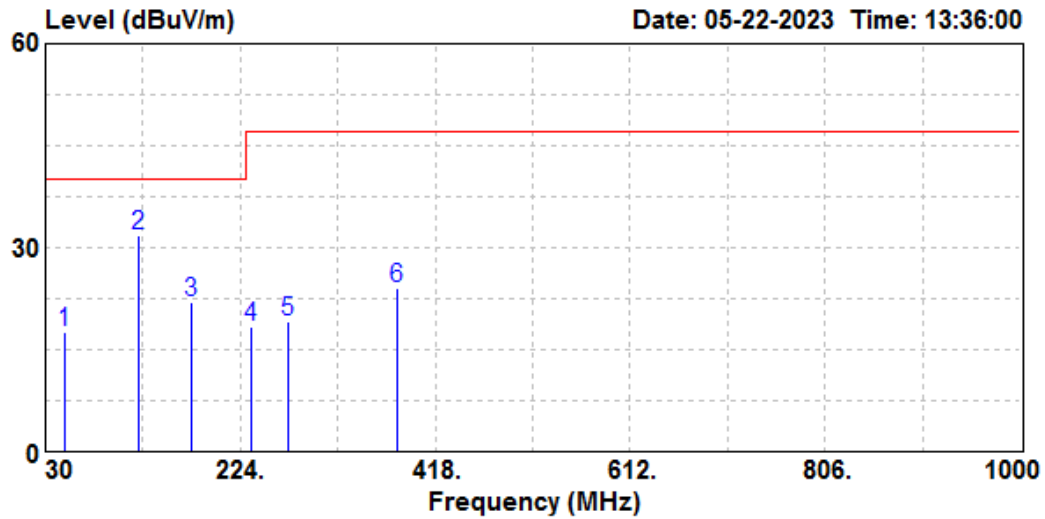


Testing Voltage :DC 24V
Temp. :29 °C
Relative Humidity :56%RH
Atmospheric pressure:1006 hPa

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
49.40	VERTICAL	-10.00	37.38	27.38	40.00	-12.62	QP
122.15	VERTICAL	-5.68	33.32	27.64	40.00	-12.36	QP
175.50	VERTICAL	-11.46	29.24	17.78	40.00	-22.22	QP
232.73	VERTICAL	-9.70	27.07	17.37	47.00	-29.63	QP
360.77	VERTICAL	-5.02	24.66	19.64	47.00	-27.36	QP
480.08	VERTICAL	-2.30	19.98	17.68	47.00	-29.32	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)
- Level (dBμV/m) = Factor (dB) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Testing Voltage :DC 24V
 Temp. :29 °C
 Relative Humidity :56%RH
 Atmospheric pressure:1006 hPa

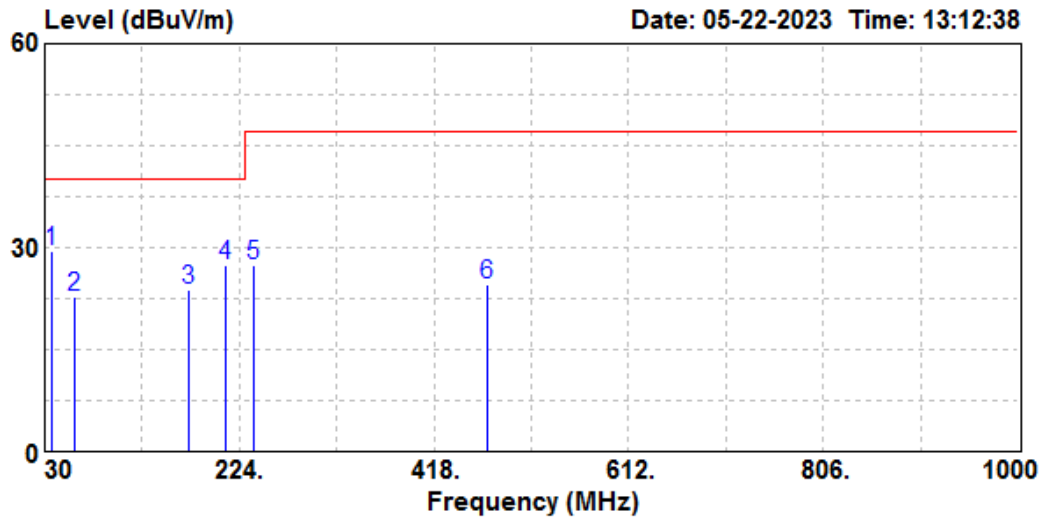
Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
48.43	HORIZONTAL	-9.88	27.54	17.66	40.00	-22.34	QP
123.12	HORIZONTAL	-5.67	37.46	31.79	40.00	-8.21	QP
174.53	HORIZONTAL	-11.42	33.43	22.01	40.00	-17.99	QP
235.64	HORIZONTAL	-9.40	27.78	18.38	47.00	-28.62	QP
271.53	HORIZONTAL	-7.15	26.36	19.21	47.00	-27.79	QP
380.17	HORIZONTAL	-3.96	27.97	24.01	47.00	-22.99	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)
- Level (dBμV/m) = Factor (dB) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)

TEST REPORT

Model No.:	TEL 8-4811WI
Remark:	N/A

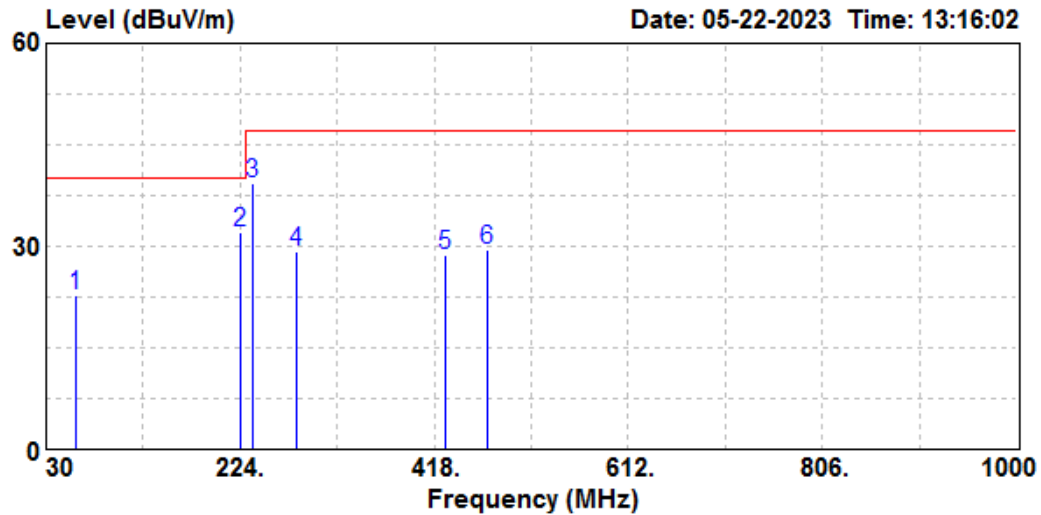


Testing Voltage :DC 48 V
 Temp. :29 °C
 Relative Humidity :56%RH
 Atmospheric pressure:1006 hPa

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
36.79	VERTICAL	-8.56	37.99	29.43	40.00	-10.57	QP
60.07	VERTICAL	-11.85	34.53	22.68	40.00	-17.32	QP
173.56	VERTICAL	-11.34	35.22	23.88	40.00	-16.12	QP
210.42	VERTICAL	-12.31	39.72	27.41	40.00	-12.59	QP
237.58	VERTICAL	-9.22	36.72	27.50	47.00	-19.50	QP
470.38	VERTICAL	-2.37	26.89	24.52	47.00	-22.48	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)
- Level (dBμV/m) = Factor (dB) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)



Testing Voltage :DC 48 V
 Temp. :29 °C
 Relative Humidity :56%RH
 Atmospheric pressure:1006 hPa

Freq	Pol/Phase	Factor	Read Level	Level	Limit Line	Over Limit	Remark
MHz		dB	dBuV	dBuV/m	dBuV/m	dB	
60.07	HORIZONTAL	-11.85	34.59	22.74	40.00	-17.26	QP
224.00	HORIZONTAL	-10.75	42.81	32.06	40.00	-7.94	QP
236.61	HORIZONTAL	-9.31	48.72	39.41	47.00	-7.59	QP
280.26	HORIZONTAL	-6.93	36.08	29.15	47.00	-17.85	QP
428.67	HORIZONTAL	-2.57	31.29	28.72	47.00	-18.28	QP
470.38	HORIZONTAL	-2.37	31.99	29.62	47.00	-17.38	QP

Remark:

- Factor = Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)
- Level (dBμV/m) = Factor (dB) + Read Level (dBμV)
- Over Limit (dB) = Level (dBμV/m) – Limit Line (dBμV/m)

6. Harmonics Test

Since the EUT is connected to DC source, therefore, the test can be waived.

7. Voltage Fluctuations-Flicker Test

Since the EUT is connected to DC source, therefore, the test can be waived.

8. Electrostatic Discharge Immunity Test

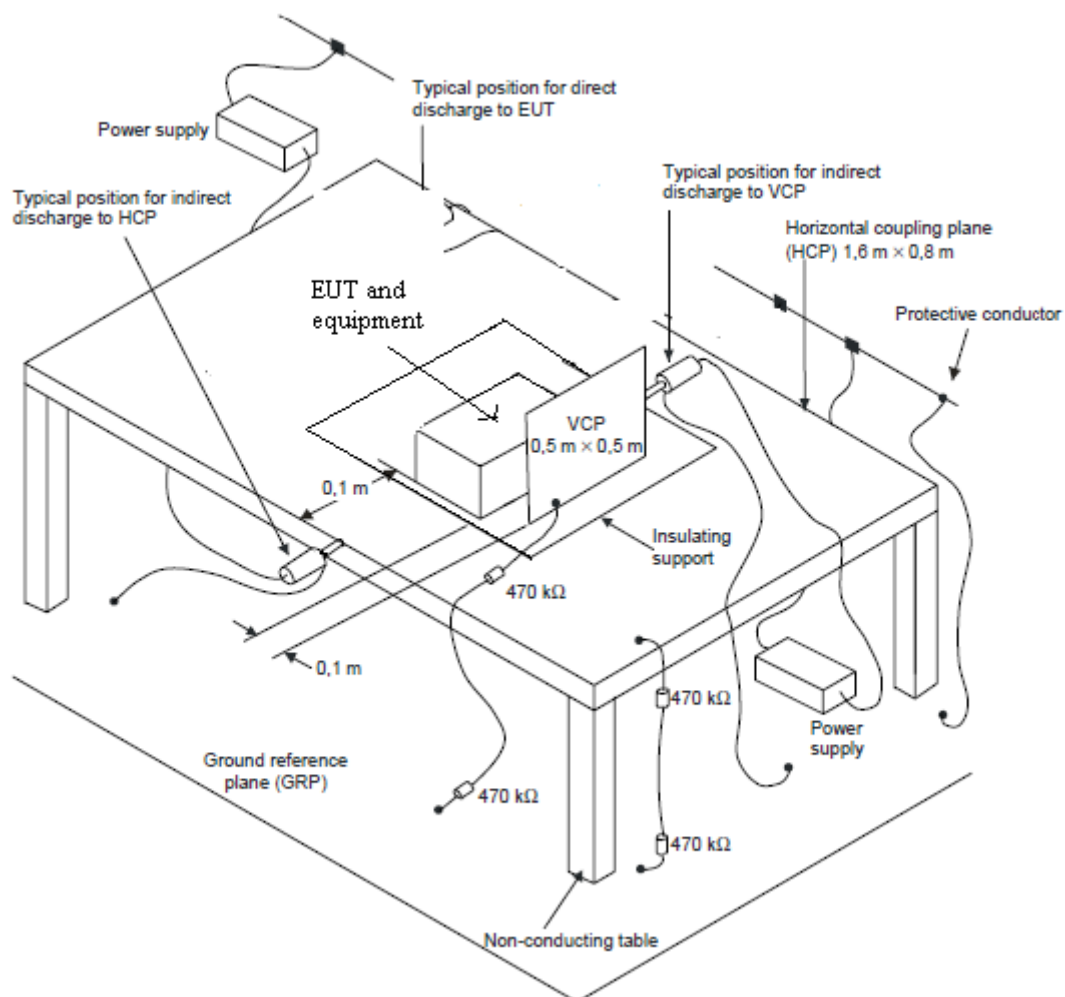
8.1 Purpose

The object of the test is to evaluate the ESD immunity performance of EUT.

8.2 Test Set-Up

A horizontal coupling plane (HCP) was placed on a non-metallic table 0.8 meter above a reference ground plane (RGP) and connected to it with a cable with two 470 k Ω resistors. The EUT was placed on an insulation sheet on the HCP and was operated according to the specified operating mode.

A vertical coupling plane (VCP) was connected to the RGP with a cable with two 470 k Ω resistors.



8.3 Test Specification

Test Standard: IEC 61000-4-2

Test level: Air discharge: +/- 2 kV, +/- 4 kV, +/- 8 kV
Contact discharge: +/- 6 kV

Number of Discharge: Air Direct: 10 discharges per location (each polarity)
Contact Direct & Indirect: 10 discharges per location (each polarity)

Discharge Mode: Single Discharge

Discharge Period: 1 second

8.4 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Electrostatic Discharge System	NoiseKen	ESS-2002	ESS0291088	2023/07/07	2024/07/06

8.5 Test Result

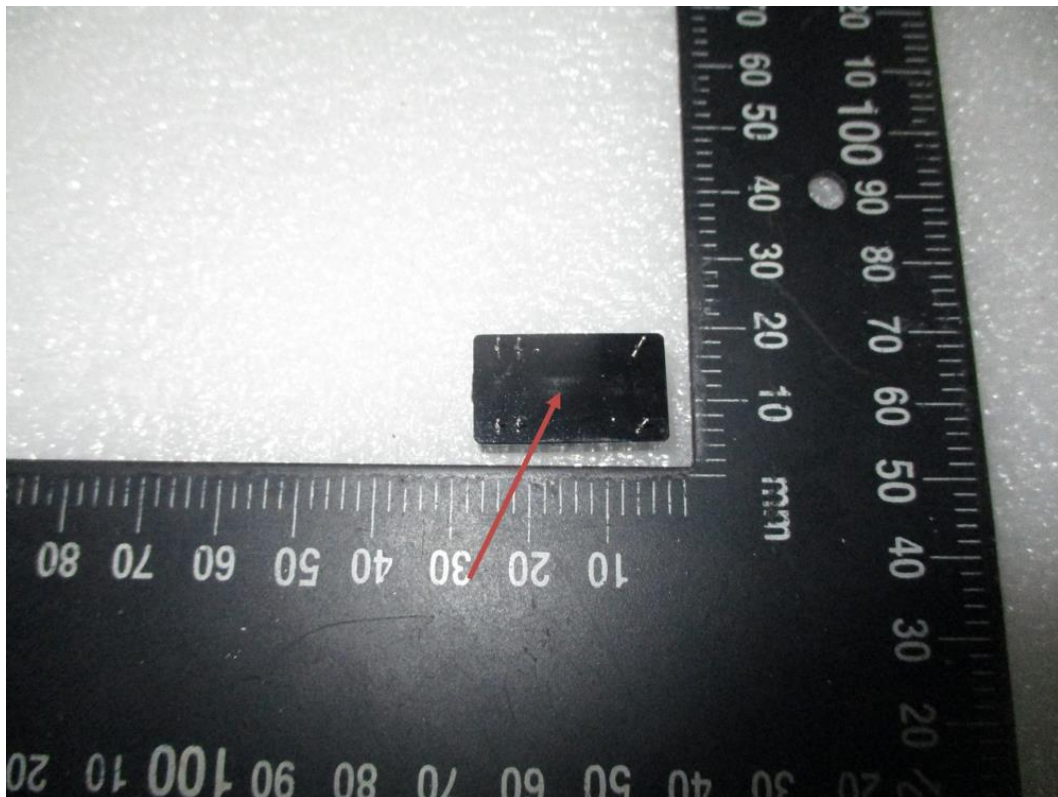
Temperature:	22	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	50	%RH	Test Date:	2023/10/19
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 48V
Remark:	N/A			

Point of Discharge	Applied Voltage (kV)	Number of Discharge	Test Result	Performance Criterion
Contact Test Point	±6	20	PASS	A
Air Test Point	±2	20	PASS	A
	±4	20	PASS	A
	±8	20	PASS	A
VCP (4 sides)	±6	20	PASS	A
HCP (4 sides)	±6	20	PASS	A

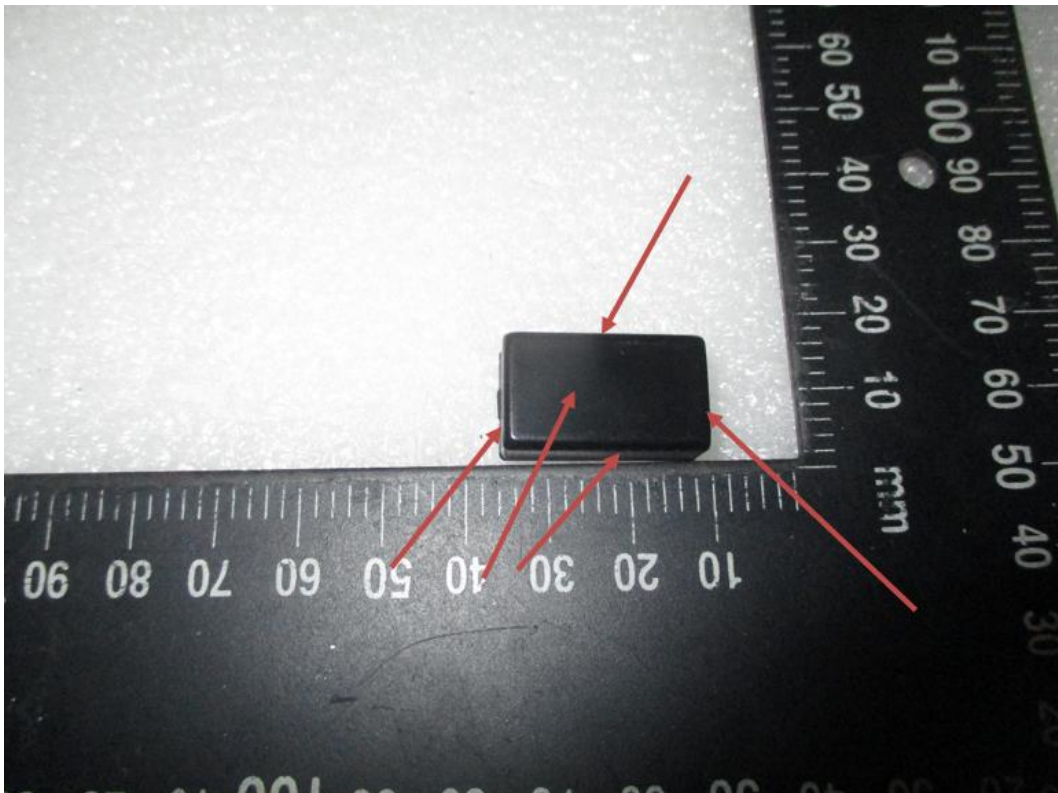
Description of Discharge Point

Contact Discharge <u>1</u> Test points		Air Discharge	
<input type="checkbox"/>	Metallic Screws	<input type="checkbox"/>	Plastic Screws
<input checked="" type="checkbox"/>	Metallic Case	<input checked="" type="checkbox"/>	Plastic Case (gap)
<input type="checkbox"/>	Metallic Connect ports	<input checked="" type="checkbox"/>	Plastic Connect ports
<input type="checkbox"/>	Metallic Junctions	<input checked="" type="checkbox"/>	Plastic Junctions
<input type="checkbox"/>	Others:	<input type="checkbox"/>	LED indicator
		<input type="checkbox"/>	Panel Board
		<input type="checkbox"/>	Others:

Contact Test Point



Air Test Point



9. Radiated, Radio-Frequency, Electromagnetic Field Immunity Test

9.1 Purpose

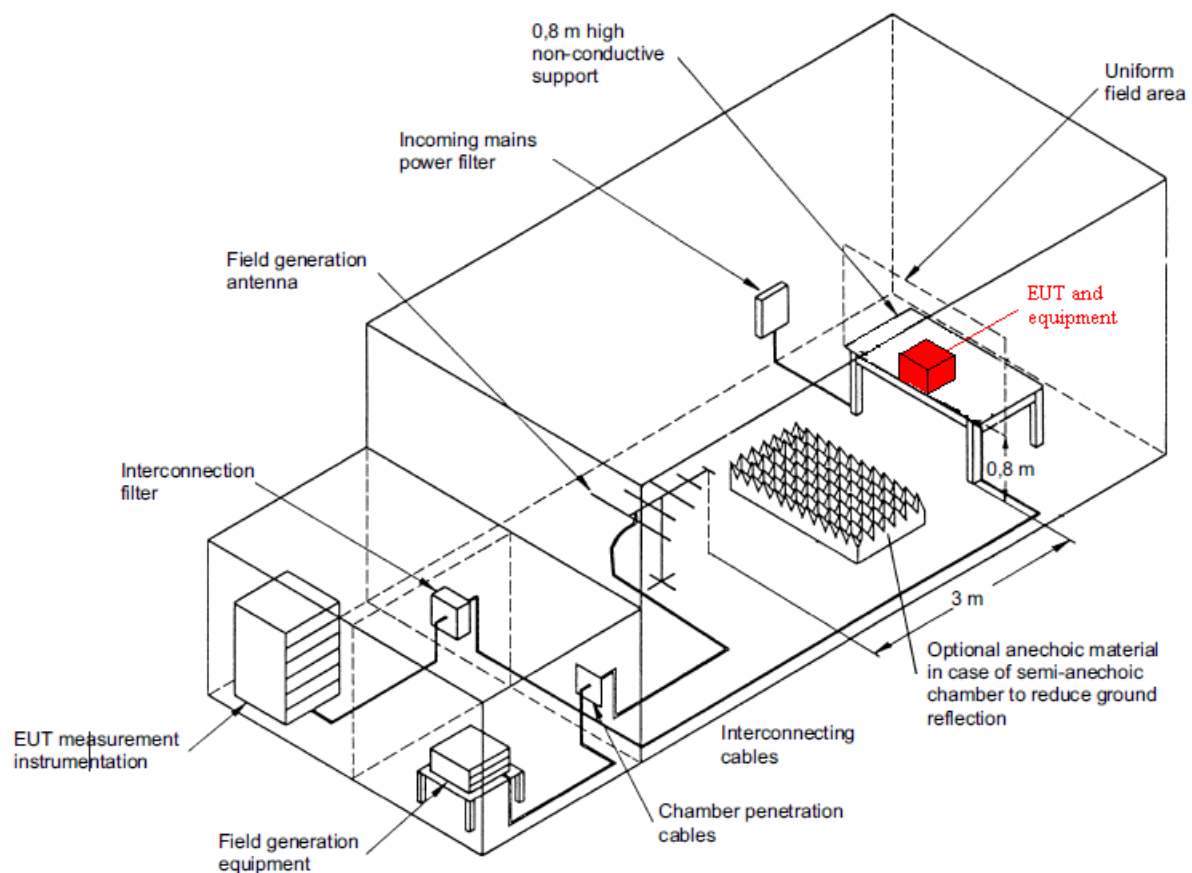
This test method subjects the EUT to a power source of disturbance comprising electric and magnetic field, simulating those coming from intentional RF transmitters.

9.2 Test Set-Up

The EUT was placed on a non-metallic table 0.8 meter above the reference ground plane (RGP) and was operated according to its specified operating mode.

Ferrite tiles/absorbers were placed on the RGP between the EUT and the antenna to reduce the reflections from the RGP. The EUT and its cables were exposed for the electromagnetic field for 1.5 meters vertically and 1.5 meters horizontally.

The distance between antenna and EUT is 3 meters.



9.3 Test Specification

Test Standard:	IEC 61000-4-3
Swept Frequency Range:	80 MHz - 1000 MHz
Spot Frequencies:	1800, 2600, 3500, 5000 MHz ($\pm 1\%$)
Test field strength:	3 V/m, 20 V/m
Modulation:	1 kHz 80% AM
The frequency steps:	1 % , Log sweep
Dwell time:	3 sec
Test ports:	Enclosure port

9.4 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
733 Compact Full Anechoic Chamber	Comtest	9708093	N/A	2022/09/08	2023/09/07
Signal Generator	R&S	SMB100A	102385	2023/02/04	2024/02/03
Field Meter	Narda	NBM-520	D-1426	2022/11/29	2023/11/28
Field Probe	Narda	EF0691	H-0199	2022/11/29	2023/11/28
Power Amplifier	MILMEGA	80RF1000-600	1076330	NCR	NCR
Power Amplifier	MILMEGA	AS0860B-50/50	1076334	NCR	NCR
Log Periodic Antenna	AR	ATL80M1G	0345624	NCR	NCR
Broadband Antenna	FRANKONIA	BTA-S	BTA-S-802	NCR	NCR
Test software	Audix	i2	V5.160923	NCR	NCR

Note: No Calibration Required (NCR).

9.5 Generation of the Electromagnetic Field

The electromagnetic field is generated from a computer controlled signal generator. The output power is amplified and then radiated from broadband log periodic antennas. For each sweep a pre-recorded empty chamber calibration file is used to establish the required field strength. When using these files the field strength inside an area of 1.5/1.0 meters x 1.5 meters is in accordance with the standard.

9.6 Test Results

Temperature:	22	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	50	%RH	Test Date:	2023/05/16
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 48V
Remark:	N/A			

Exposed Side: ☒ Front ☒ Left ☒ Rear ☒ Right

Frequency	Antenna Polarization	Test Level	Test Result	Performance Criterion
80 MHz to 1 GHz	Vertical	3, 20V/m	PASS	A
80 MHz to 1 GHz	Horizontal	3, 20V/m	PASS	A
1800MHz ± 1 %	Vertical	3, 20V/m	PASS	A
1800MHz ± 1 %	Horizontal	3, 20V/m	PASS	A
2600MHz ± 1 %	Vertical	3, 20V/m	PASS	A
2600MHz ± 1 %	Horizontal	3, 20V/m	PASS	A
3500MHz ± 1 %	Vertical	3, 20V/m	PASS	A
3500MHz ± 1 %	Horizontal	3, 20V/m	PASS	A
5000MHz ± 1 %	Vertical	3, 20V/m	PASS	A
5000MHz ± 1 %	Horizontal	3, 20V/m	PASS	A

10. Electrical Fast Transient/Burst Immunity Test

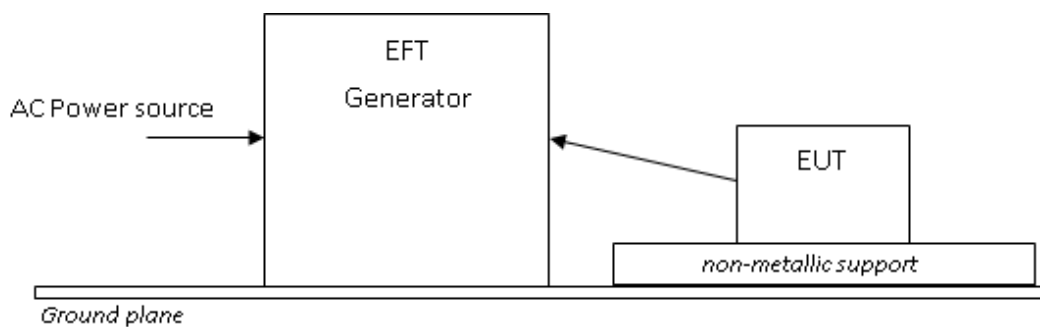
10.1 Purpose

The purpose of this test is to evaluate the EUT performance during the repetitive transient bursts applied to power port and ports for I/O ports.

10.2 Test Set-Up

For I/O ports testing, the EUT was placed on a non-metallic support 0.1 ± 0.01 meter above a reference ground plane (RGP) and operated in the operating mode specified.

Applicable only to cables which according to the manufacturer's specification supports communication on cable lengths greater than 3 meters.



10.3 Test Specification

Test Standard:	IEC 61000-4-4
Voltage peak:	$\pm 0.5\text{kV}$, $\pm 2\text{kV}$ (DC)
Repetition frequency:	5kHz
Wave shape of the pulse:	Rise time $t_r = 5\text{ ns} \pm 30\%$; duration t_d (to 50 %) = $50\text{ ns} \pm 30\%$
Burst duration:	$15\text{ ms} \pm 20\%$ at 5 kHz
Burst period:	$300\text{ ms} \pm 20\%$
Test Duration:	1 min.

10.4 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	TESEQ	NSG 3060	1366	2022/09/26	2023/09/25
CDN	TESEQ	CDN 3061	1342	2022/09/26	2023/09/25
CDN	TESEQ	CDN 3063	1992	2022/09/28	2023/09/27
Clamp	TESEQ	CDN 3425	1682	2022/09/26	2023/09/25
Test software	TESEQ	WIN3000	V1.1.0	NCR	NCR

Note: No Calibration Required (NCR).

10.5 Test Results

Temperature:	22	°C	Model No.:	TEL 8-2423WI
Relative Humidity:	50	%RH	Test Date:	2023/05/09
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 24V
Remark:	N/A			

Level	Polarity	Repetition Rate	DC Power ports Test Result	Signal port & Control port Test Result (see Note 1)	Performance Criterion
0.5 kV	+	5 kHz	PASS	-	A
0.5 kV	-	5 kHz	PASS	-	A
2 kV	+	5 kHz	PASS	-	A
2 kV	-	5 kHz	PASS	-	A

Temperature:	22	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	50	%RH	Test Date:	2023/05/09
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 48V
Remark:	N/A			

Level	Polarity	Repetition Rate	DC Power ports Test Result	Signal port & Control port Test Result (see Note 1)	Performance Criterion
0.5 kV	+	5 kHz	PASS	-	A
0.5 kV	-	5 kHz	PASS	-	A
2 kV	+	5 kHz	PASS	-	A
2 kV	-	5 kHz	PASS	-	A

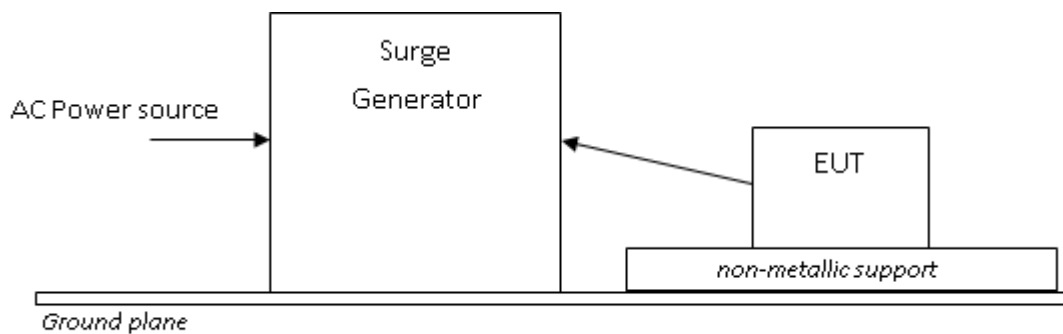
11. Surge Immunity Test

11.1 Purpose

The object of this test is to establish a common reference to evaluate the performance of EUT when subjected to high-energy disturbances on the power and interconnection lines.

11.2 Test Set-Up

The EUT was placed on a non-metallic support 0.8 meter above a reference ground plane and was put into operation according to the specified operating mode.



11.3 Test Specification

Test Standard:	IEC 61000-4-5
Open-circuit test voltage:	± 0.5 kV, ± 1 kV
Waveform(Tr/Th):	1.2/50us Open Circuit Voltage
Phase shifting(AC port only):	0°, 90°, 180°, 270°
Repetition rate:	1 /min (max)
Number of surges:	5 positive and 5 negative at selected points
Test port:	DC port

11.4 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMC Test System	TESEQ	NSG 3060	1366	2022/09/26	2023/09/25
CDN	TESEQ	CDN 3061	1342	2022/09/26	2023/09/25
CDN	TESEQ	CDN HSS-2	38145	2022/09/27	2023/09/26
CDN	TESEQ	CDN 3063	1992	2022/09/28	2023/09/27
Lightning Surge Simulator	NoiseKen	LSS-15AX-C1	LSS07X0800	2023/04/07	2024/04/05
Test software	TESEQ	WIN3000	V1.1.0	NCR	NCR

Note: No Calibration Required (NCR).

11.5 Test Results

11.5.1 Main power ports

Temperature:	25	°C	Model No.:	TEL 8-2423WI
Relative Humidity:	55	%RH	Test Date:	2023/05/09
Atmospheric Pressure:	1005	hPa	Test Voltage:	DC 24V
Remark:	N/A			

Test 5 times for each voltage

Phase			Test Result	Performance Criterion
Volt	Mode	Polarity		
0.5 kV	Positive to Negative	+	PASS	A
	Positive to PE Negative to PE	-	PASS	A
1 kV	Positive to Negative	+	PASS	A
	Positive to PE Negative to PE	-	PASS	A

Temperature:	25	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	55	%RH	Test Date:	2023/05/09
Atmospheric Pressure:	1005	hPa	Test Voltage:	DC 48V
Remark:	N/A			

Test 5 times for each voltage

Phase			Test Result	Performance Criterion
Volt	Mode	Polarity		
0.5 kV	Positive to Negative	+	PASS	A
	Positive to PE Negative to PE	-	PASS	A
1 kV	Positive to Negative	+	PASS	A
	Positive to PE Negative to PE	-	PASS	A

12. Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields

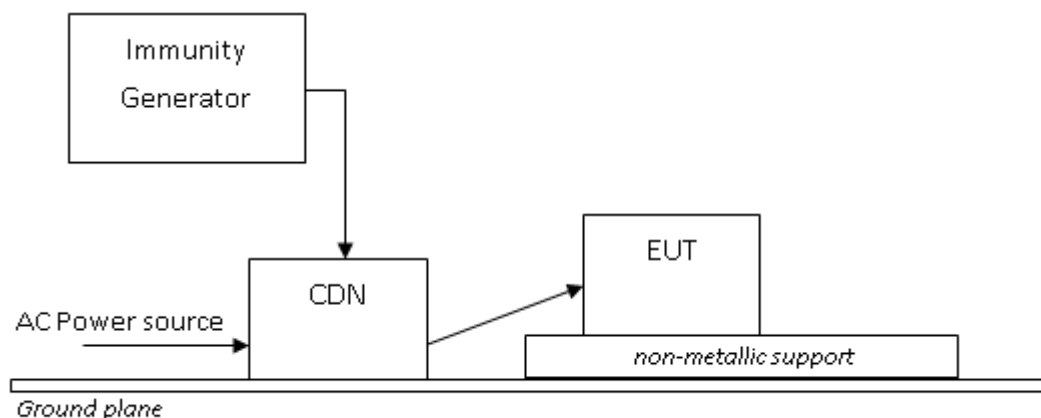
12.1 Purpose

The test method subjects the EUT to a power source of disturbance comprising electric and magnetic field, simulating those coming from intentional RF transmitters.

The measurement is for evaluating the performance of EUT when subjected to RF conducted disturbance.

12.2 Test Set-Up

The EUT was placed on a non-metallic support 0.1 meter above a reference ground plane (RGP) with the coupling/decoupling network (CDN) placed 0.3 meter from the EUT on the RGP.



12.3 Test Specification

Test Standard:	IEC 61000-4-6
Voltage level (e.m.f.):	3Vrms, 10Vrms
Frequency range:	150 kHz ~ 80 MHz
Test Voltage(Vrms):	0.15 MHz ~ 80 MHz: 3V, 10V 0.15 MHz ~ 10 MHz: 3V 10 MHz ~ 30 MHz: 3-1 V 30 MHz ~ 80 MHz: 1V
Frequency Step:	1%, Log sweep
Modulation:	1kHz Sine Wave with 80% Amplitude Modulation
Dwell Time:	3 sec
Test port:	DC port

12.4 Test Equipment

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
CS test system	TESEQ	NSG 4070B-35	41146	2022/07/15	2023/07/14
CDN	TESEQ	CDN M016	62575	2023/03/13	2024/03/11
CDN	Fischer	FCC-801-M2-16A	04017	2022/07/25	2023/07/24
Clamp	TESEQ	KEMZ 801A	41333	2022/07/24	2023/07/23
CDN	Fischer	FCC-801-T8-RJ45	08036	2022/07/25	2023/07/24
CDN	Schaffner	CDN T400	19096	2022/07/25	2023/07/24
Test software	TESEQ	NSG4070	V 1.2.0	NCR	NCR

Note: No Calibration Required (NCR)

12.5 Generation and Calibration of the Disturbance Signal

The disturbance signal is generated from a computer controlled signal generator. The output signal is amplified and injected to the CDN/injection clamp. The disturbance signal level was calibrated as specified in the standard. A power meter was connected to the EUT side of the CDN through a 150 -50Ω adapter. The auxiliary equipment (AE) side of the network was terminated with 150Ω to ground during the calibration. The generator settings obtained during the calibration procedure were later repeated in the tests.

12.6 Test Results

Temperature:	22	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	50	%RH	Test Date:	2023/05/10
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 48V
Remark:	EN 55035			

Frequency	Test Port	Test Level	Test Result	Performance Criterion
0.15MHz ~ 80MHz	DC	3V	PASS	A
0.15MHz ~ 10MHz		3V	PASS	A
10MHz ~ 30MHz		3 ~ 1V	PASS	A
30MHz ~ 80MHz		1V	PASS	A
0.15MHz ~ 80MHz		10V	PASS	A

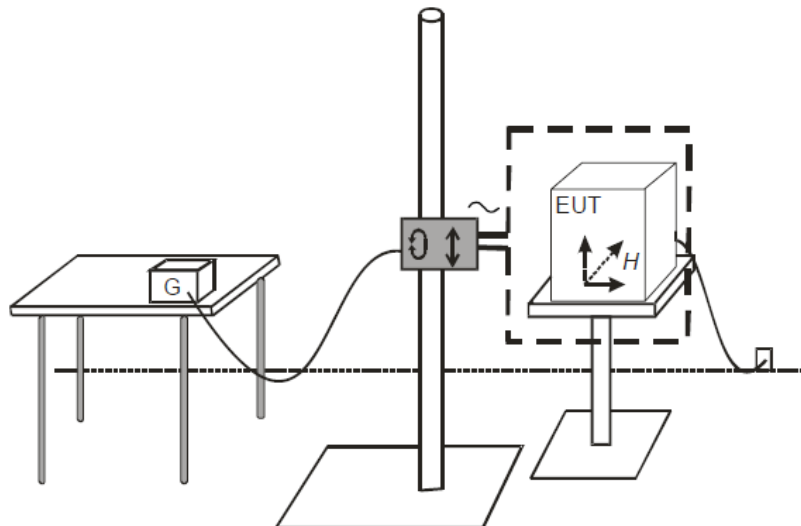
13. Power Frequency Magnetic Field Immunity Test

13.1 Purpose

The measurement is for evaluating the performance of EUT, when subject to power frequency magnetic field disturbance.

13.2 Test Set-Up

The EUT was placed on a wooden table above a reference RGP with the coupling loop antenna arrange the EUT on the RGP.



13.3 Test Condition

Test Standard:	IEC 61000-4-8
Magnetic field strength:	1 A/m, 100 A/m
Power frequencies:	50Hz & 60Hz
Test duration:	1 minute
Magnetic Field Orientation:	X, Y, Z-axis

13.4 Test Equipment.

Test Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Induction Coil Interface	Teseq	INA 2141	1440	2023/08/02	2024/08/01
Magneticfield Coil	Teseq	INA 703	2021	2023/08/02	2024/08/01
Test software	Teseq	Win2120	V 6.00	NCR	NCR

Note: No Calibration Required (NCR).

13.5 Test Result

Temperature:	22	°C	Model No.:	TEL 8-4811WI
Relative Humidity:	50	%RH	Test Date:	2023/10/19
Atmospheric Pressure:	1002	hPa	Test Voltage:	DC 48V
Remark:	N/A			

Continuous Field (50/60 Hz)					Short Duration				
Level	H.Field (A/m)	X	Y	Z	Level	H.Field (A/m)	X	Y	Z
		Performance Criterion					Performance Criterion		
1	1	A	A	A	1	N/A	-	-	-
2	3	-	-	-	2	N/A	-	-	-
3	10	-	-	-	3	N/A	-	-	-
4	30	-	-	-	4	300	-	-	-
5	100	A	A	A	5	1000	A	A	A
X	Special	-	-	-	X	Special	-	-	-

Note: 1. “-” means not applicable
2. Magnetic field ambient level: 0.02 uT

14. Voltage Dips, Short Interruptions and Voltage Variations Immunity Test

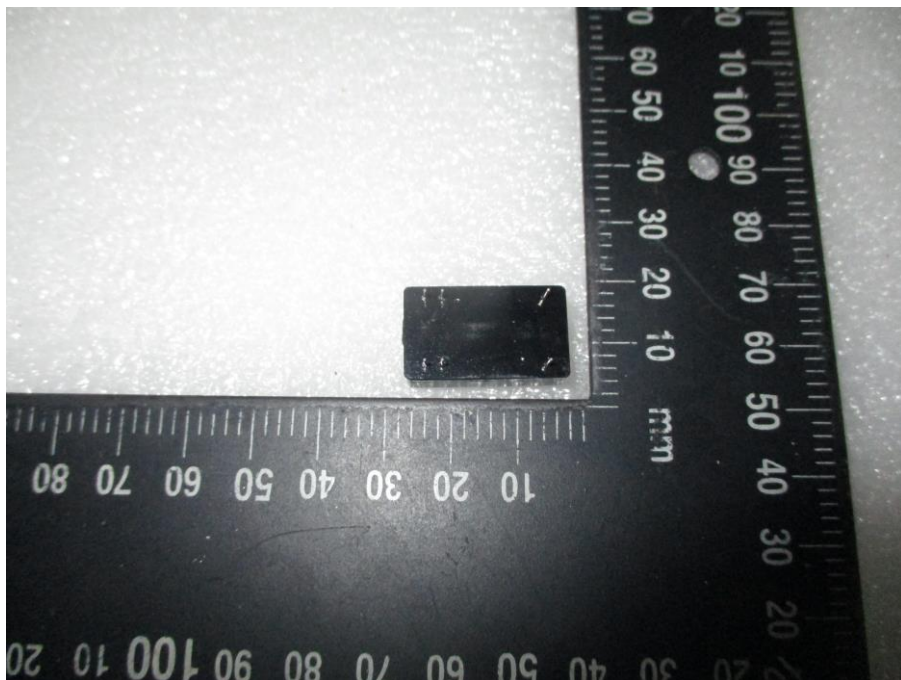
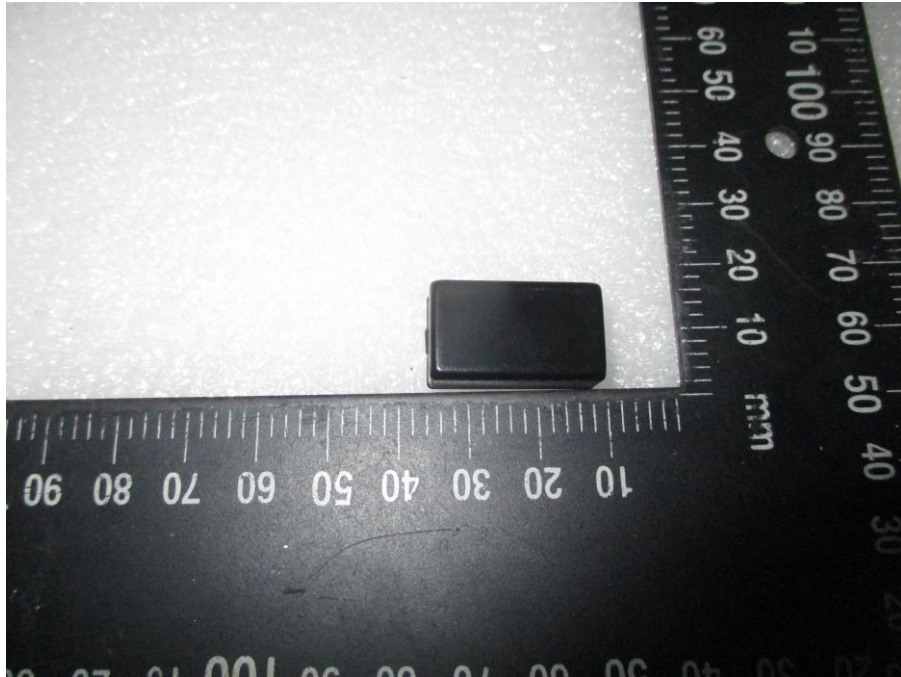
Since the EUT is connected to DC source, therefore, the test can be waived.

Appendix A: Uncertainty

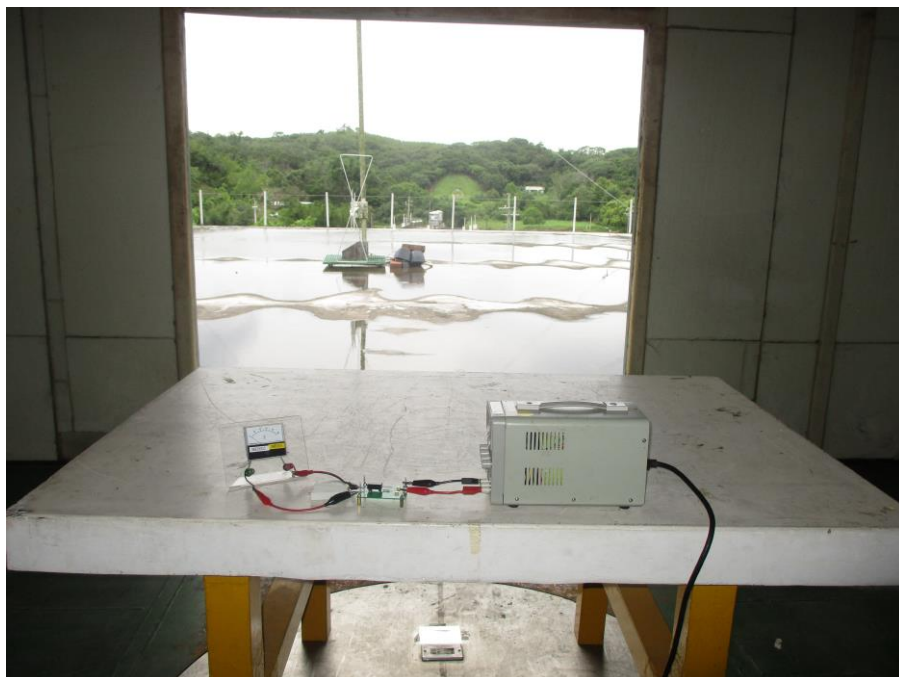
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2.0$.

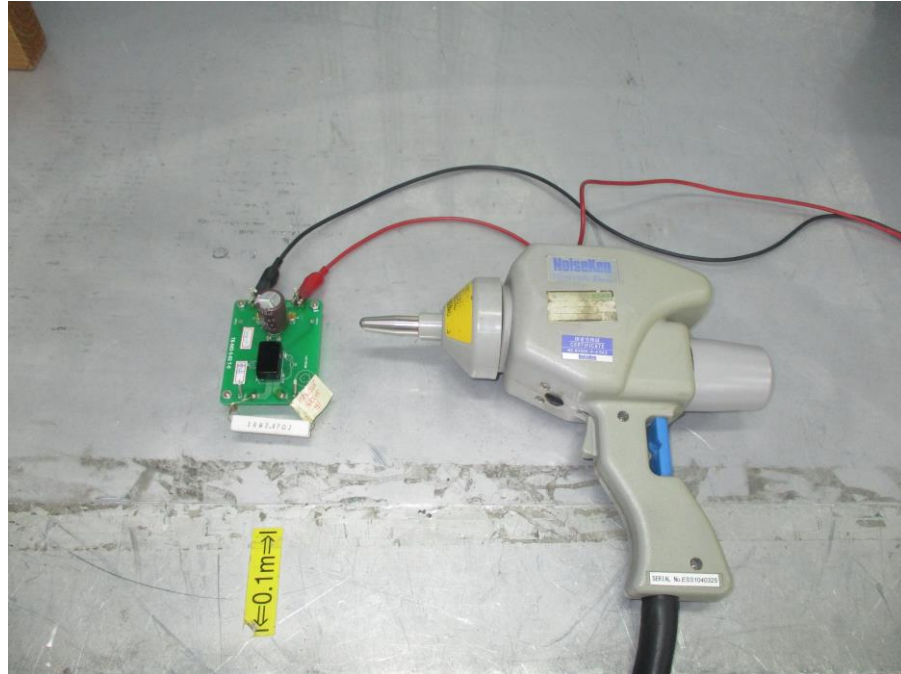
Item	Uncertainty
Conducted disturbance measurements at a mains port from 9 kHz to 30 MHz using a 50 Ω /50 μ H +5 Ω artificial mains network (AMN)	2.86 dB
Conducted disturbance measurements at a telecommunication port from 150 kHz to 30 MHz using an asymmetrical artificial network (AAN)	3.68 dB
Vertically polarized radiated disturbances from 30MHz~1GHz in an open area test site at a distance of 10m	5.12 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in an open area test site at a distance of 10m	4.99 dB
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.16 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.02 dB
Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	5.19 dB
HARMONIC	0.38 %
FLICKER	0.17 %
ESD	14.14 %
RS	1.88 dB
RS (Audio)	1.95 dB
EFT	8.40 %
SURGE	8.40 %
CS	2.10 dB
CS (Audio)	2.17 dB
Mag.	13.00 %
DIP	1.70 %
Ring Wave	8.40 %
Immunity to low-frequency signals	0.17 %

Appendix B: External photo of EUT



Appendix C1: Conducted Emission Test Set-up

Appendix C2: Radiated Emission Test Set-up

Appendix C3: ESD Test Set-up

Appendix C4: RS Test Set-up



Appendix C5: EFT Test Set-up



Appendix C6: Surge Test Set-up



Appendix C7: CS Test Set-up

Appendix C8: Magnetic Field Test Set-up

