TEST REPORT

of

EN 50155
(EMC, Characteristic, Environmental Test)

Product : **TEP 150 Series**

Model: **TEP 150-2412WI; TEP 150-2413WI;
TEP 150-2415WI; TEP 150-2416WI;
TEP 150-2418WI; TEP 150-4812WI;
TEP 150-4813WI; TEP 150-4815WI;
TEP 150-4816WI; TEP 150-4818WI;
TEP 150-7212WI; TEP 150-7213WI;
TEP 150-7215WI; TEP 150-7216WI;
TEP 150-7218WI;
TEP 150-2412WI-O; TEP 150-2413WI-O;
TEP 150-2415WI-O; TEP 150-2416WI-O;
TEP 150-2418WI-O; TEP 150-4812WI-O;
TEP 150-4813WI-O; TEP 150-4815WI-O;
TEP 150-4816WI-O; TEP 150-4818WI-O;
TEP 150-7212WI-O; TEP 150-7213WI-O;
TEP 150-7215WI-O; TEP 150-7216WI-O;
TEP 150-7218WI-O**

Brand: **TRACO POWER**

Applicant: **TRACO ELECTRONIC AG**

Address: **Sihlbruggstrasse 111 CH-6340 Baar
Switzerland**

Test Performed by:

International Standards Laboratory Corp.

<LT LAB>
*Address:
No. 120, Lane 180, Hsin Ho Rd.,
Lung-Tan Dist., Tao Yuan City 325, Taiwan
*Tel: 886-3-407-1718; Fax: 886-3-407-1738

Report No.:**ISL-19LE783CE50155-MA**

Issue Date :**December 13, 2019**

This report totally contains 86 pages including this cover page and contents page.

Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

Contents of Report

1. General

1.1 Certification of Accuracy of Test Data

Standards:	Please refer to 1.2
Equipment Tested:	TEP 150 Series
Model:	TEP 150-2412WI; TEP 150-2413WI; TEP 150-2415WI; TEP 150-2416WI; TEP 150-2418WI; TEP 150-4812WI; TEP 150-4813WI; TEP 150-4815WI; TEP 150-4816WI; TEP 150-4818WI; TEP 150-7212WI; TEP 150-7213WI; TEP 150-7215WI; TEP 150-7216WI; TEP 150-7218WI; TEP 150-2412WI-O; TEP 150-2413WI-O; TEP 150-2415WI-O; TEP 150-2416WI-O; TEP 150-2418WI-O; TEP 150-4812WI-O; TEP 150-4813WI-O; TEP 150-4815WI-O; TEP 150-4816WI-O; TEP 150-4818WI-O; TEP 150-7212WI-O; TEP 150-7213WI-O; TEP 150-7215WI-O; TEP 150-7216WI-O; TEP 150-7218WI-O
Brand:	TRACO POWER
Applicant:	TRACO ELECTRONIC AG
Sample received Date:	July 22, 2019
Final test Date:	EMI: refer to the date of test data EMS: December 4, 2019
Test Site:	Chamber 02; Chamber 14; Conduction 03; Immunity 02
Test Distance:	10M (EMI test)
Temperature:	refer to each site test data
Humidity:	refer to each site test data
Input power:	Conduction input power: DC 48V Radiation input power: DC 48V Immunity input power: DC 48V

Test Result:	**PASS**
Report Engineer:	Cheryl Tung
Test Engineer:	Hasan Yu Hasan Yu
Approved By:	Benson Chen Benson Chen / Associate Director

1.2 Test Standards

The tests which this report describes were conducted by an independent electromagnetic compatibility consultant, International Standards Laboratory Corp. in accordance with the following

☒EN 50155: 2017 for EMC, Environmental and Characteristic
☒EN 50121-3-2: 2016 for EMC
☒EN 60068-2-1: 2007 for Environmental
☒EN 60068-2-2: 2007 for Environmental
☒EN 60068-2-30: 2005 for Environmental
☒EN 61373: 2010 for Environmental

Characteristic Test					
Report Clause	Performed Item	EN 50155 Reference Clause(s)	Reference Standard	Result	Location of Test
2.1	Visual Inspection	13.4.1	-	PASS	ISL LAB
2.2	Power Supply Test (Supply variations and Temporary supply dips)	13.4.3.2 13.4.3.3 5.1.1.2 5.1.1.3	-	PASS	ISL LAB
2.3	Power Supply Test (Interruptions of voltage supply)	13.4.3.4 5.1.1.4		PASS	ISL LAB
2.4	Power Supply Test (Supply charge-over)	13.4.3.5 5.1.3	-	PASS	ISL LAB
2.5	Insulation Test	13.4.9	-	PASS	ISL LAB

Electromagnetic Compatibility (EMC)					
Report Clause	Performed Item	EN 50155 Reference Clause(s)	Reference Standard	Result	Location of Test
3.1	Power Line Conducted Emission Measurement	13.4.8	EN 50121-3-2 EN 61000-6-4	PASS	ISL LAB
3.2	Radiated Emission Measurement	13.4.8	EN 50121-3-2 EN 61000-6-4	PASS	ISL LAB
3.3	Electrostatic Discharge Susceptibility Test	13.4.8	EN 50121-3-2 EN 61000-4-2	PASS	ISL LAB
3.4	Radio- Frequency interference (RFI) susceptibility Test	13.4.8	EN 50121-3-2 EN 61000-4-3	PASS	ISL LAB
3.5	Transient Burst Susceptibility Test	13.4.8	EN 50121-3-2 EN 61000-4-4	PASS	ISL LAB
3.6	Surges Test	13.4.8	EN 50121-3-2 EN 61000-4-5	PASS	ISL LAB
3.7	Radio- Frequency, Conducted Disturbances Immunity Test	13.4.8	EN 50121-3-2 EN 61000-4-6	PASS	ISL LAB

Environmental Tests					
Report Clause	Performed Item	EN 50155 Reference Clause(s)	Reference Standard	Result	Location of Test
4.1	Low temperature star-up test	13.4.4	EN 60068-2-1	PASS	ISL LAB
4.2	Dry Heat Test	13.4.5	EN 60068-2-2	PASS	ISL LAB
4.3	Cyclic Damp Heat Test	13.4.7	EN 60068-2-30	PASS	ISL LAB
4.4	Random Vibration Test	12.2.11	EN 61373	PASS	GTTI LAB
4.5	Increased Random Vibration Test	12.2.11	EN 61373	PASS	GTTI LAB
4.6	Shock Test	12.2.11	EN 61373	PASS	GTTI LAB

GTTI LAB= GOLDEN-TECH TECHNOLOGIES INC.

1.2.1 Performance Criteria for Compliance

Performance criterion A:

The apparatus shall continue to operate as intended during and after the test/event. No degradation of performance or loss of function is allowed.
Changes of actual operating state or stored data are not allowed.
If agreed between the involved parties, the normal performance level (all functions are working as specified) can be replaced by a minimum performance level.

Performance criterion B:

The apparatus shall continue to operate as intended after the test/event.
During the test/event, degradation of performance is however allowed.
Changes of actual operating state or stored data are not allowed.

Performance criterion C:

During the test/event temporary loss of function is allowed. The equipment could:

- automatically restart. The normal performance shall be obtained within a maximum defined time.
  After this time the equipment shall retain the previous operating state and shall work as intended.
  The loss of significant data is not allowed; or
- manually restart or process controlled restart. In this case this shall be agreed between user and supplier and/or clearly defined in the user manual. In this case the user manual shall be available to the user at the tender stage.

NOTE Significant stored data are application dependent and stated into the Performance specifications.

1.2.2 Performance Criteria for Compliance: EN 50121-1 (only for EMC)

Performance criterion A: The apparatus shall continue to operate as intended during and 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. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from 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 are allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from 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 operation of the controls.

1.3 Description of EUT

EUT

Description	TEP 150 Series
Condition	Pre-Production
Model/Type reference	TEP 150-2412WI; TEP 150-2413WI; TEP 150-2415WI; TEP 150-2416WI; TEP 150-2418WI; TEP 150-4812WI; TEP 150-4813WI; TEP 150-4815WI; TEP 150-4816WI; TEP 150-4818WI; TEP 150-7212WI; TEP 150-7213WI; TEP 150-7215WI; TEP 150-7216WI; TEP 150-7218WI; TEP 150-2412WI-O; TEP 150-2413WI-O; TEP 150-2415WI-O; TEP 150-2416WI-O; TEP 150-2418WI-O; TEP 150-4812WI-O; TEP 150-4813WI-O; TEP 150-4815WI-O; TEP 150-4816WI-O; TEP 150-4818WI-O; TEP 150-7212WI-O; TEP 150-7213WI-O; TEP 150-7215WI-O; TEP 150-7216WI-O; TEP 150-7218WI-O
Brand	TRACO POWER
Test Model	TEP 150-4815WI
Serial Number	N/A
Highest working frequency:	330 KHz
The radiation test should be tested till	6GHz

Inside the EUT are listed below:

Model Name	Input	Output	Output Current (A)@Full load
TEP 150-7218WI	110VDC	48VDC	3.2
TEP 150-4815WI	48VDC	24VDC	6.3

For EMI test configuration:

Model Name	Input	Output	Remarks
TEP 150-4815WI	48VDC	24VDC	No

For EMS (No include Electrical Fast transients/burst immunity & Surge Immunity) test configuration:

Model Name	Input	Output	Remarks
TEP 150-4815WI	48VDC	24VDC	No

For Electrical Fast transients/burst immunity & Surge Immunity test configuration:

Model Name	Input	Output	Remarks
TEP 150-4815WI	48VDC	24VDC	With an external input filter capacitor (Nippon chemi-con KY series, 220 μF/100V)

Different Model list:

Model Number	Input Range	Output Voltage	Output Current @Full Load
	VDC	VDC	A
TEP 150-2412WI	9 ~ 36	12	12.5
TEP 150-2413WI	9 ~ 36	15	10
TEP 150-2415WI	9 ~ 36	24	6.3
TEP 150-2416WI	9 ~ 36	28	5.4
TEP 150-2418WI	9 ~ 36	48	3.2
TEP 150-4812WI	18 ~ 75	12	12.5
TEP 150-4813WI	18 ~ 75	15	10
TEP 150-4815WI	18 ~ 75	24	6.3
TEP 150-4816WI	18 ~ 75	28	5.4
TEP 150-4818WI	18 ~ 75	48	3.2
TEP 150-7212WI	43 ~ 160	12	12.5
TEP 150-7213WI	43 ~ 160	15	10
TEP 150-7215WI	43 ~ 160	24	6.3
TEP 150-7216WI	43 ~ 160	28	5.4
TEP 150-7218WI	43 ~ 160	48	3.2
TEP 150-2412WI-O	9 ~ 36	12	12.5
TEP 150-2413WI-O	9 ~ 36	15	10
TEP 150-2415WI-O	9 ~ 36	24	6.3
TEP 150-2416WI-O	9 ~ 36	28	5.4
TEP 150-2418WI-O	9 ~ 36	48	3.2
TEP 150-4812WI-O	18 ~ 75	12	12.5
TEP 150-4813WI-O	18 ~ 75	15	10
TEP 150-4815WI-O	18 ~ 75	24	6.3
TEP 150-4816WI-O	18 ~ 75	28	5.4
TEP 150-4818WI-O	18 ~ 75	48	3.2
TEP 150-7212WI-O	43 ~ 160	12	12.5
TEP 150-7213WI-O	43 ~ 160	15	10
TEP 150-7215WI-O	43 ~ 160	24	6.3
TEP 150-7216WI-O	43 ~ 160	28	5.4
TEP 150-7218WI-O	43 ~ 160	48	3.2

For Electrical Fast transients/burst immunity & Surge Immunity test requirements

Model Reference	Increase countermeasure components
TEP 150-24□□WI	With an external input filter capacitor (Nippon chemi-con KY series, 470 μ F/50V.)
TEP 150-48□□WI	With an external input filter capacitor (Nippon chemi-con KY series, 220 μ F/100V)
TEP 150-72□□WI	With an external input filter capacitor (Nippon chemi-con KXJ series, 150 μ F/200V.)
□□= Output voltage: 12, 15, 24, 28, 48	

For interruption voltage supply classes & supply change-over classes test requirements
Recommended external capacitor for EN50155 Class S2

MODEL reference	D1	Cin
TEP 150-24□□WI	VB60100C / 100V / 60A	11000uF /50v
TEP 150-48□□WI	VB30200C / 200V / 30A	2460uF /100v
TEP 150-72□□WI	LQA20B300C / 300V / 20A	680uF /100v

Recommended external capacitor for EN50155 Class S3

MODEL reference	D1	Cin
TEP 150-24□□WI	VB60100C / 100V / 60A	22000uF /50v
TEP 150-48□□WI	VB30200C / 200V / 30A	5740uF /100v
TEP 150-72□□WI	LQA20B300C / 300V / 20A	1360uF /200v

Recommended external capacitor for EN50155 Class C2

MODEL reference	Cin
TEP 150-24□□WI	33000uF /50v
TEP 150-48□□WI	8200uF /100v
TEP 150-72□□WI	2040uF /200v

EMI Noise Source:
Please refer to the technical documents.
EMI Solution:
Please refer to the technical documents.

1.4 Description of Support Equipment

No	Unit	Model Serial No.	Brand	Power Cord	FCC ID
1	Programmable DC power supply	PSW 160-21.6 S/N: GEP152281	GWINSTEK	Non-shielded	N/A
2	Dummy Load	N/A S/N: N/A	N/A	N/A	N/A

2. Characteristic Test

2.1 Visual Inspection

2.1.1 Inspection Requirement:

The visual inspection shall be carried out to ensure that the equipment construction meets its specified requirements.

2.1.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.1

2.1.3 Inspection Result

Date : 2019/07/22	Temperature : 20 ℃	Engineer : Hasan Yu
EUT Model Name : TEP 150-4815WI	Humidity : 51.6 %	Barometer Pressure: 99.8 kPa Standard: EN 50155 12.2.1
Voltage/Freq: 48Vdc		
Visual inspection requirement:		
The visual inspection shall be carried out to ensure that the equipment is of sound construction and, so far as can be ascertained, meets its specified requirements. A visual inspection shall also be carried out after a type test has been performed to check whether any damage or deterioration has occurred resulting from the tests.		

Inspection item	Result
EUT outside	OK
EUT function	OK

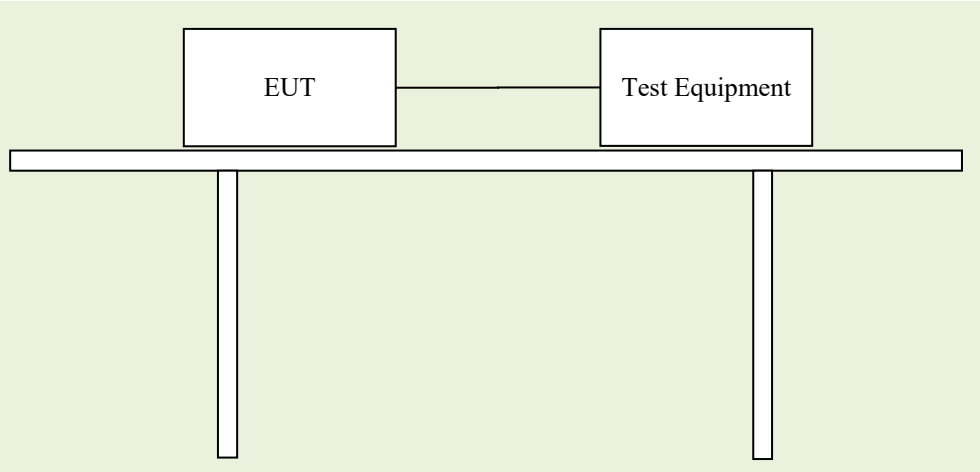
Before test：Ok



+Vi +Vi -Vi -Vi Ctrl +Vo -Vo Trim1 Trim2

2.2 Power supply test (Supply variation and temporary supply dips)

2.2.1 Test Setup



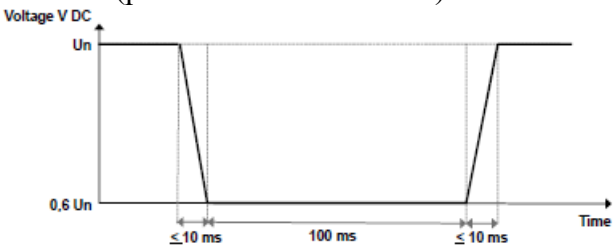
2.2.2 Test Procedure

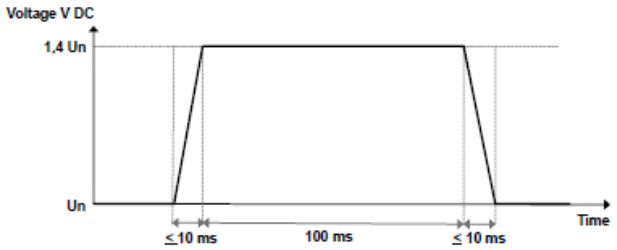
Test Procedures were referred to EN 50155 sub-clause 13.4.3.2, 13.4.3.3, 5.1.1.2 & 5.1.1.3

2.2.3 Test Requirement

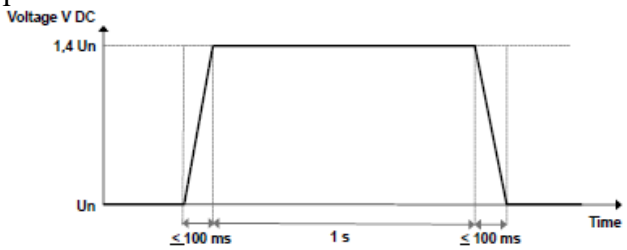
☒D.C. supplied equipment:
Test performed to prove correct functioning at nominal supply voltage and at the upper and lower limits of specified voltage as defined below:
Minimum Continuous voltage: 0.7 *Un* Maximum Continuous voltage: 1.25 *Un*

Voltage fluctuations (e.g. during start-up of auxiliary equipment or voltage oscillations of battery chargers) lying between 0.6 *Un* and 1.4 *Un* and not exceeding 0.1 s shall not cause deviation of function (performance criterion A).





For temporary supply overvoltages up to 1,4 *Un* lasting no more than 1 s the equipment shall fulfil performance criterion B.



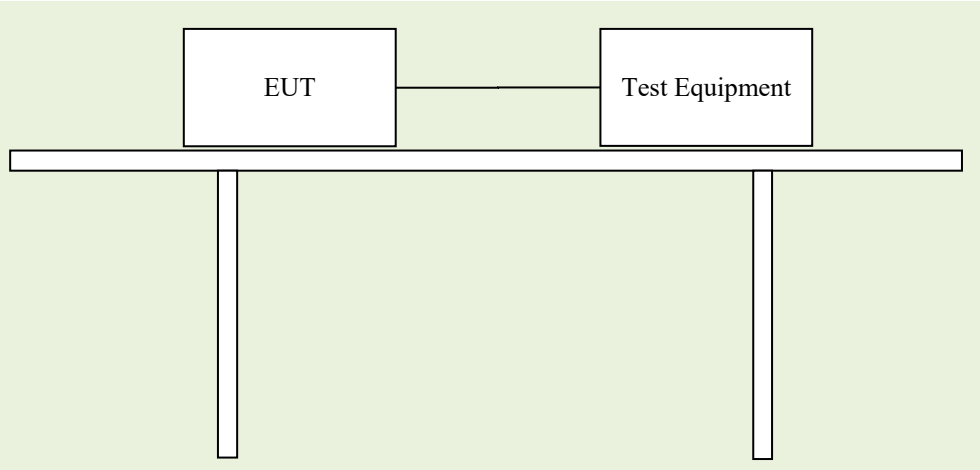
☐A.C. supplied equipment:
Test performed to prove correct functioning at:
Nominal voltage and frequency;
The upper and lower limits of voltage and frequency are in all combinations.

2.2.4 Test Result

Date : 2019/11/18		Temperature : 24 ℃		Engineer : Hasan Yu	
EUT Model Name : TEP 150-4815WI		Humidity : 59 %		Barometer Pressure: 99.5 kPa	
Test mode: Full load				Standard: EN 50155	
Voltage/Freq: 48Vdc					
Variations of Voltage supply	Level	Voltage	Test Time	EUT Status	Comments
Minimum voltage	0.7 Un	33.6Vdc	10 min	Pass	
Nominal voltage	Un	48Vdc	10 min	Pass	
Maximum voltage	1.25 Un	60Vdc	10 min	Pass	
Voltage fluctuations	Level	Voltage	Test Time	EUT Status	Comments
High voltage	1.4 Un	67.2Vdc	0.1 s	Pass	
Low voltage	0.6 Un	28.8Vdc	0.1 s	Pass	
High voltage	1.4 Un	67.2Vdc	1 s	Pass	
High voltage	1.25 Un	60Vdc	1 s	Pass	

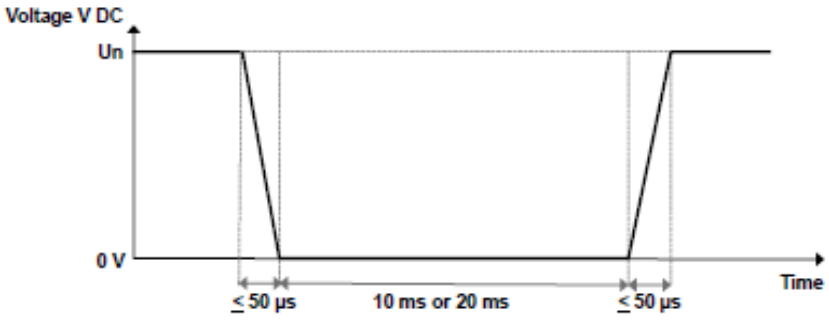
2.3 Power supply test (Supply Interruption)

2.3.1 Test Setup



2.3.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.3.4 & 5.1.1.2



2.3.3 Test Requirement

Interruptions of input voltage as defined below:

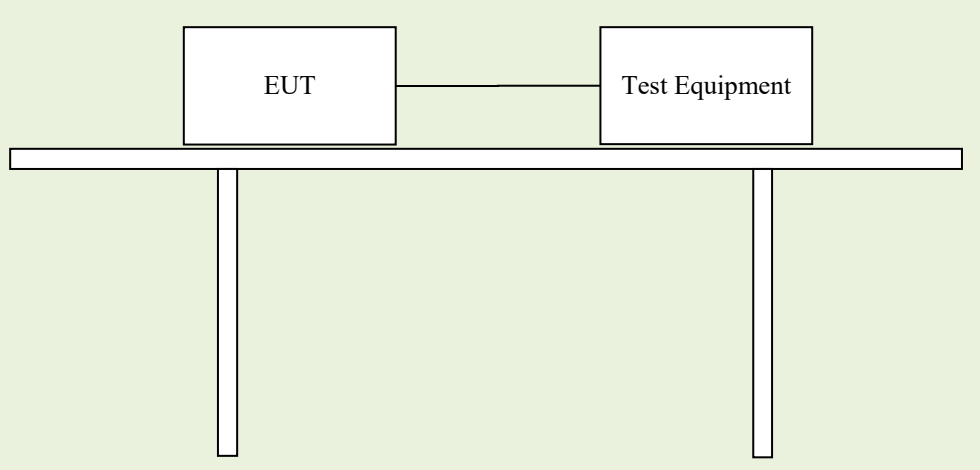
Class	Requirements	Duration of the interruption time Tint
S1	No performance criterion is requested but the equipment shall continue to operate as specified after the voltage interruption.	This test is not required.
S2	The equipment shall behave according performance criterion A.	10 ms
S3	The equipment shall behave according performance criterion A.	20 ms

2.3.4 Test Result

Date : 2019/11/18		Temperature : 24 ℃		Engineer : Hasan Yu	
EUT Model Name : TEP 150-4815WI		Humidity : 59 %		Barometer Pressure: 99.2 kPa	
Test mode: Full load				Standard: EN 50155	
Voltage/Freq: 48Vdc					
Interruptions of voltage supply	Level	Voltage	INT time	EUT Status	Comments
Class S1:Voltage interruptions	Un	48Vdc	0 s	Pass	
Class S2:Voltage interruptions	0 Un	0Vdc	10ms	Pass	Note1
Class S3:Voltage interruptions	0 Un	0Vdc	20ms	Pass	Note2
Note1: Add aluminum electrolytic capacitor test (Nippon Chemi-con KY series, 2460μF/100V)					
Note2: Add aluminum electrolytic capacitor test (Nippon Chemi-con KY series, 5740μF/100V)					

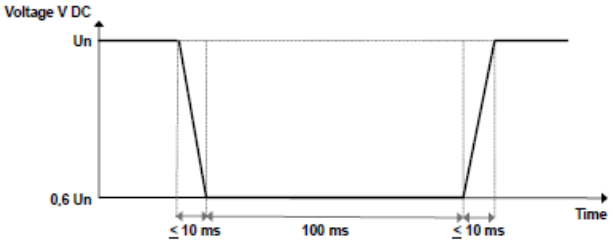
2.4 Power supply test (Supply Change Over)

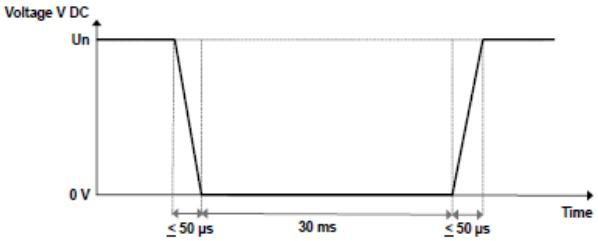
2.4.1 Test Setup



2.4.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.3.5 & 5.1.3





2.4.3 Test Requirement

- Class C1 at 0.6 *Un* during 100ms (without interruptions) **Performance criterion A;**
- Class C2: during a supply break of 30 ms starting at *Un* **Performance criterion B.**

2.4.4 Test Result

Date : 2019/11/18		Temperature : 24 ℃		Engineer : Hasan Yu	
EUT Model Name : TEP 150-4815WI		Humidity : 59 %		Barometer Pressure: 99.2 kPa	
Test mode: Full load				Standard: EN 50155	
Voltage/Freq: 48Vdc					
Supply change over	Level	Voltage	INT time	EUT Status	Comments
Class C1:60% residual voltage	0.6 Un	28.8Vdc	100ms	Pass	
Class C2:0% residual voltage	0 Un	0Vdc	30ms	Pass	Note
Note1: Add aluminum electrolytic capacitor test (Nippon Chemi-con KY series, 8200μF/100V)					

2.5 Insulation Test

2.5.1 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.9

2.5.2 Test Requirement

☒**Insulation measurement Test: 500VDC**
The insulation resistance test carried out at 500 VDC and the values recorded.
The test repeated after the voltage withstand test.
Test acceptance requirements:
There shall be no fundamental deterioration from the initial measurement.

☒**Voltage withstand test:**

Nominal battery voltages and/or I/O voltage	Test Voltage
＜ 72Vdc or 50Vac $_{rms}$	500Vac or 750Vdc
72Vdc ≦ Vdc ＜ 125Vdc or from 50 to 90 Vac $_{rms}$	1000Vac or 1500Vdc
125Vdc ≦ Vdc ＜ 315Vdc or from 90 to 225 Vac $_{rms}$	1500Vac or 2200Vdc

Test acceptance requirements:
Neither disruptive discharge nor flashover shall occur.

2.5.3 Test Result

Date : 2019/11/19	Temperature : 21.5 ℃	Engineer : Jimmy Wen
EUT Model Name : TEP 150-4815WI	Humidity : 55.0 %	Equipment: SE 7452, TH110-POSE,
Test mode: Full load	Barometer Pressure: 99.2 kPa	Standard: EN 50155

Insulation Test Requirement :

1.Insulation measurement Test :

The insulation resistance test shall be carried out at 500 Vdc and the values recorded.
The test shall then be repeated after the voltage withstand test.
There shall be no fundamental deterioration from the initial measurement.

Test item	Test Time	Insulation measurement test		Comments
		before withstand	after withstand	
Primary side to secondary side	1 min	48.843GΩ	50GΩ	Pass
Primary side to secondary side	1 min	50GΩ	50GΩ	Pass

2.Voltage Withstand test

500Vac or 750Vdc for nominal battery voltages below 72 Vdc (or 50 Vac).
1000Vac or 1500Vdc for nominal battery voltage from 72Vdc up to 125Vdc, (or from 50 to 90 Vac), and
1500Vac or 2200Vdc for nominal battery voltage above 125Vdc and up to 315Vdc, (or from 90 to 225 Vac).
Neither disruptive discharge nor flashover shall occur

Test item	Test Voltage	Test Time	Result	Comments
Primary side to secondary side	500Vac	1 min	0.56mA	Pass
Primary side to secondary side	2250Vdc	1 min	0.0003mA	Pass

Date : 2019/11/25	Temperature :22.5 ℃	Engineer : Jimmy Wen
EUT Model Name : TEP 150-4815WI	Humidity : 59.1 %	Equipment: N-396T, THS-B4T-150, TH110-POSE,SE 7452
Power :	Barometer Pressure: 99.2 kPa	Standard: EN 50155 insulation test
Support Unit :	Test mode:	

Insulation Test Requirement after first run:

1.Insulation measurement Test :

The insulation resistance test shall be carried out at 500 Vdc and the values recorded.
The test shall then be repeated after the voltage withstand test.
There shall be no fundamental deterioration from the initial measurement.

Test item	Test Time	Insulation measurement test		Comments
		before withstand	after withstand	
Primary side to secondary side	1 min	2755MΩ	3038MΩ	Pass

2.Voltage Withstand test

500Vac or 750Vdc for nominal battery voltages below 72 Vdc (or 50 Vac).
1000Vac or 1500Vdc for nominal battery voltage from 72Vdc up to 125Vdc, (or from 50 to 90 Vac), and
1500Vac or 2200Vdc for nominal battery voltage above 125Vdc and up to 315Vdc, (or from 90 to 225 Vac).
Neither disruptive discharge nor flashover shall occur

Test item	Test Voltage	Test Time	Result	Comments
Primary side to secondary side	500Vac	1 min	0.679mA	Pass

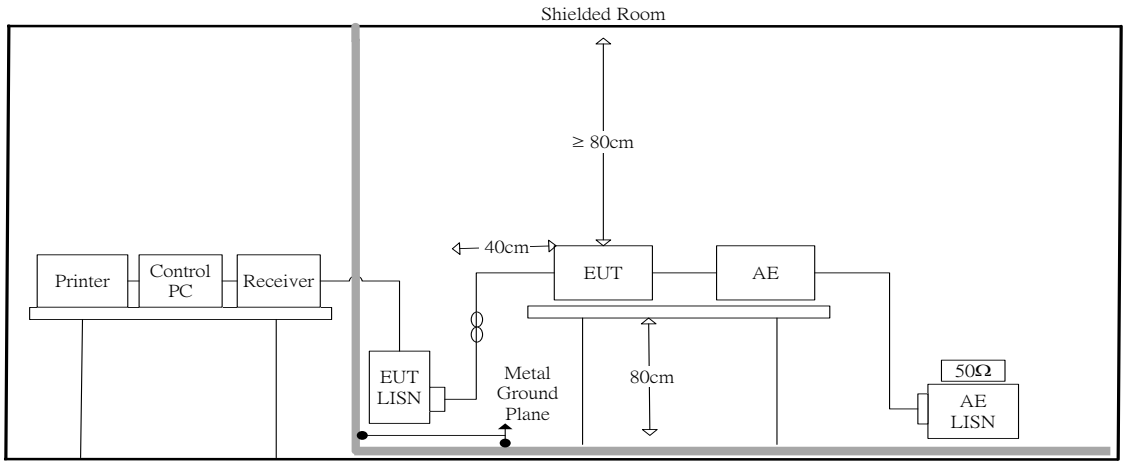
3. Electromagnetic Compatibility (EMC)

Test Procedures were referred to EN 50155 sub-clause 13.4.8.
All EMC tests of the electronic equipment shall be carried out according EN 50121-3-2.

3.1 Power Main Port Conducted Emissions

3.1.1 Test Setup and Procedure

3.1.2 Test Setup



3.1.3 Test Procedure

The measurements are performed in a shielded room site; The EUT was placed on non-conduction 1.0m x 1.5m table, which is 0.8 meters above an earth-grounded.

Power to the EUT was provided through the LISN which has the Impedance (50ohm/50uH) vs. Frequency Characteristic in accordance with the standard. Powers to the LISNs were filtered to eliminate ambient signal interference and these filters were bonded to the ground plane. Peripheral equipment required to provide a functional system (support equipment) for EUT testing was powered from the second LISN through a ganged, metal power outlet box which is bonded to the ground plane at the LISN.

The interconnecting cables were arranged and moved to get the maximum measurement. Both the line of power cord, hot and neutral, were measured. All of the interface cables were manipulated according to EN 55016-2-1 / CISPR 16-2-1 requirements.

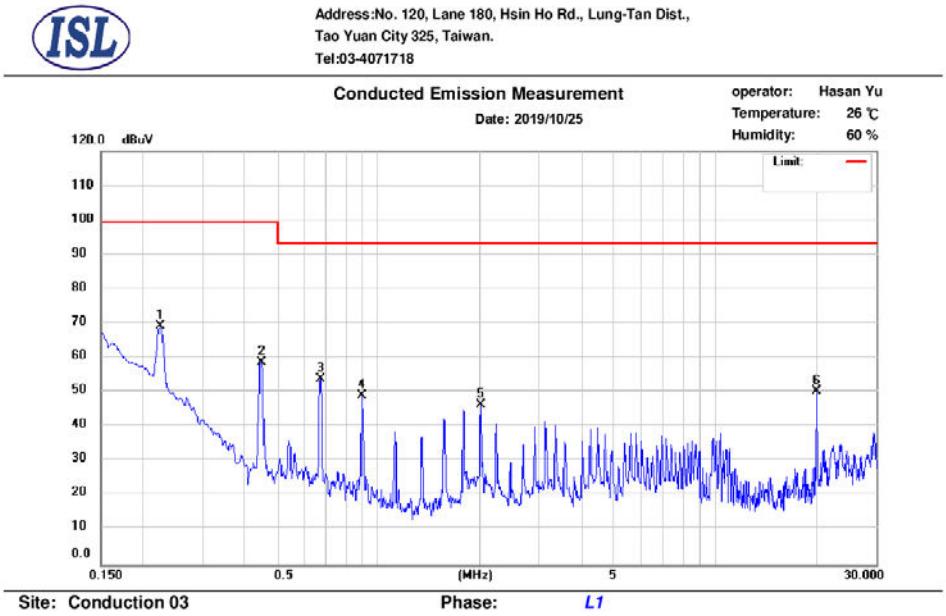
The highest emissions were analyzed in details by operating the spectrum analyzer in fixed tuned mode to determine the nature of the emissions and to provide information which could be useful in reducing their amplitude.

3.1.4 EMI Receiver/Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range:	150KHz--30MHz
Detector Function:	Quasi-Peak Mode
Resolution Bandwidth:	9KHz

3.2 Conduction Test Data: Configuration 1

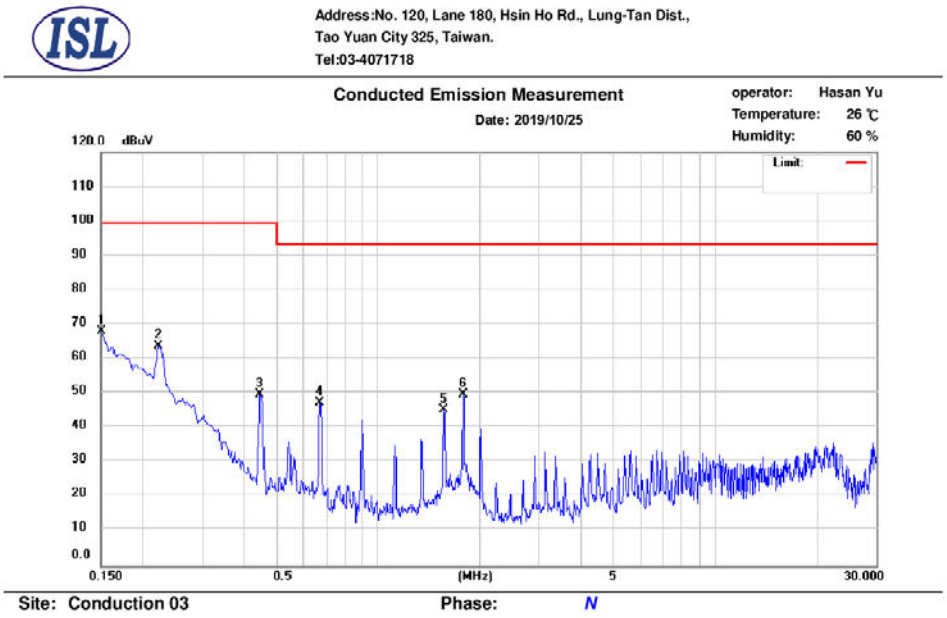
-Line



No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)
1	0.224	59.16	58.93	10.13	69.29	99.00	-29.71
2	0.448	49.11	49.37	10.14	59.25	99.00	-39.75
3	0.672	43.95	44.21	10.15	54.10	93.00	-38.90
4	0.897	39.00	39.20	10.15	49.15	93.00	-43.85
5	2.016	33.52	33.65	10.18	43.70	93.00	-49.30
6	20.005	8.08	3.84	10.39	18.47	93.00	-74.53

Note:
Margin = QP Emission – Limit
QP Emission = QP_R + Correct Factor
Correct Factor = LISN Loss + Cable Loss

-Neutral



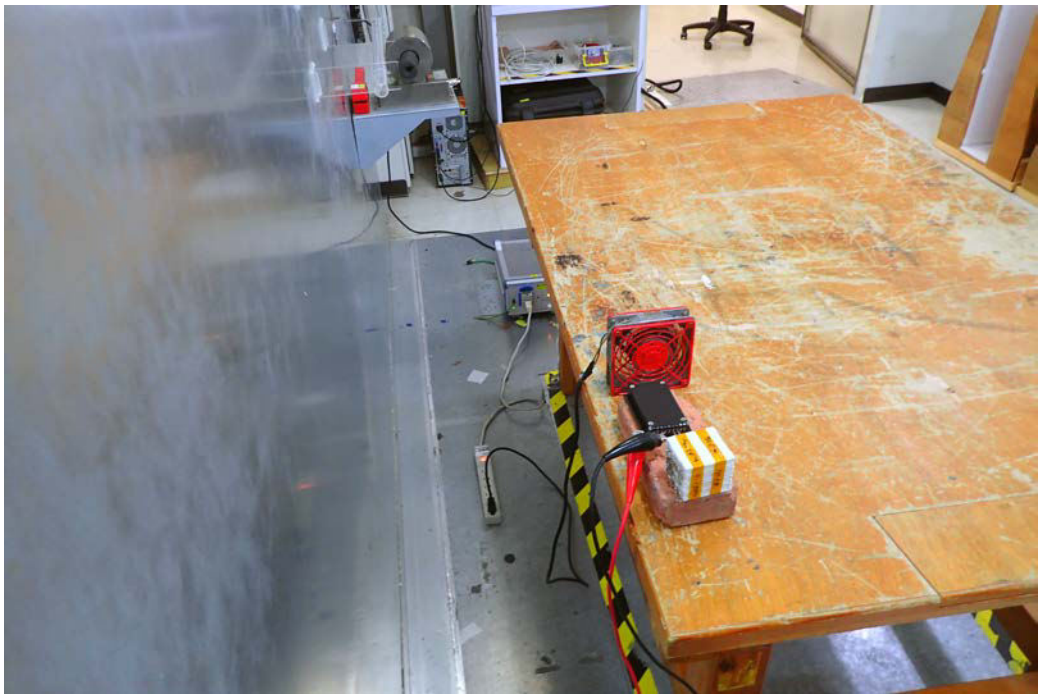
No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)
1	0.150	56.10	52.33	10.12	66.22	99.00	-32.78
2	0.223	52.95	51.92	10.13	63.08	99.00	-35.92
3	0.447	39.72	39.95	10.14	49.86	99.00	-49.14
4	0.670	38.91	39.12	10.15	49.06	93.00	-43.94
5	1.567	34.93	35.12	10.17	45.10	93.00	-47.90
6	1.790	39.11	39.37	10.17	49.28	93.00	-43.72

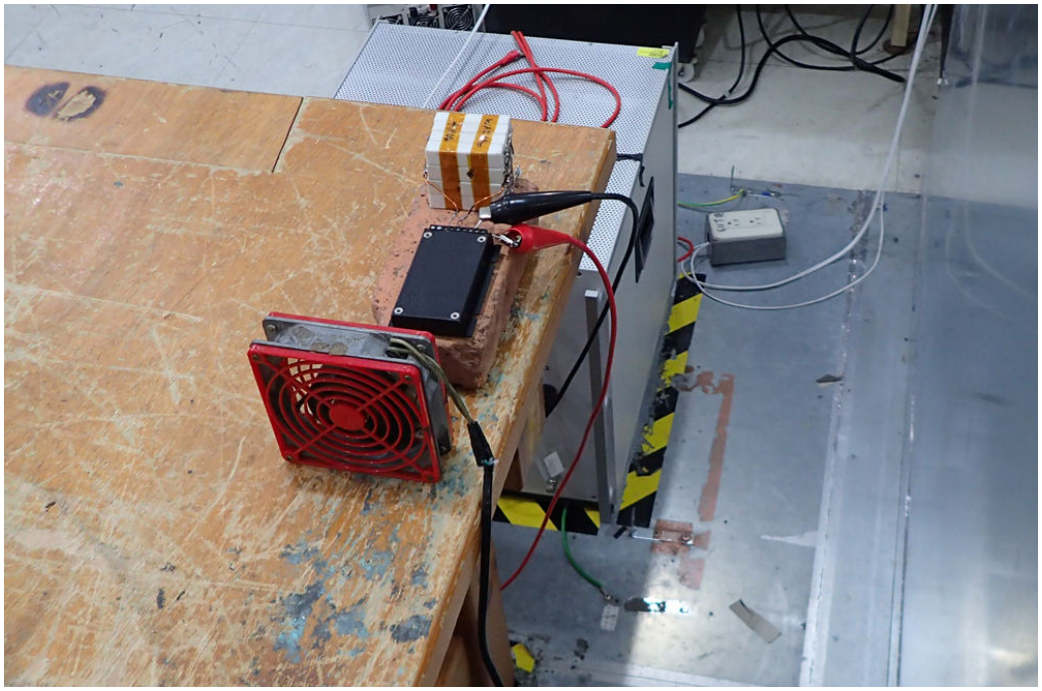
Note:
Margin = QP Emission – Limit
QP Emission = QP_R + Correct Factor
Correct Factor = LISN Loss + Cable Loss

3.2.1 Test Setup Photo

Front View

Back View

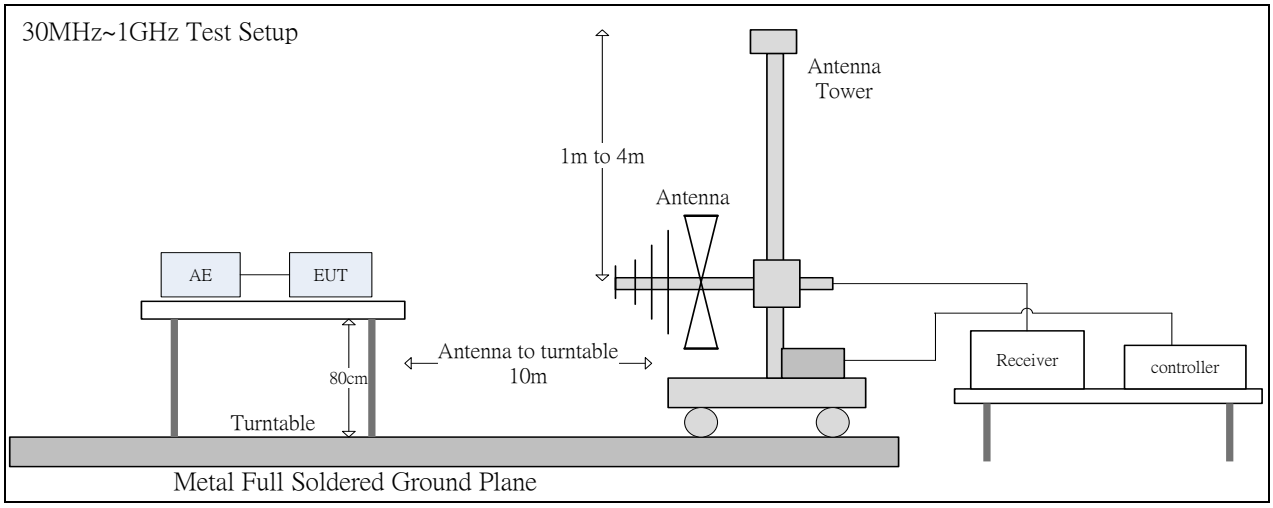


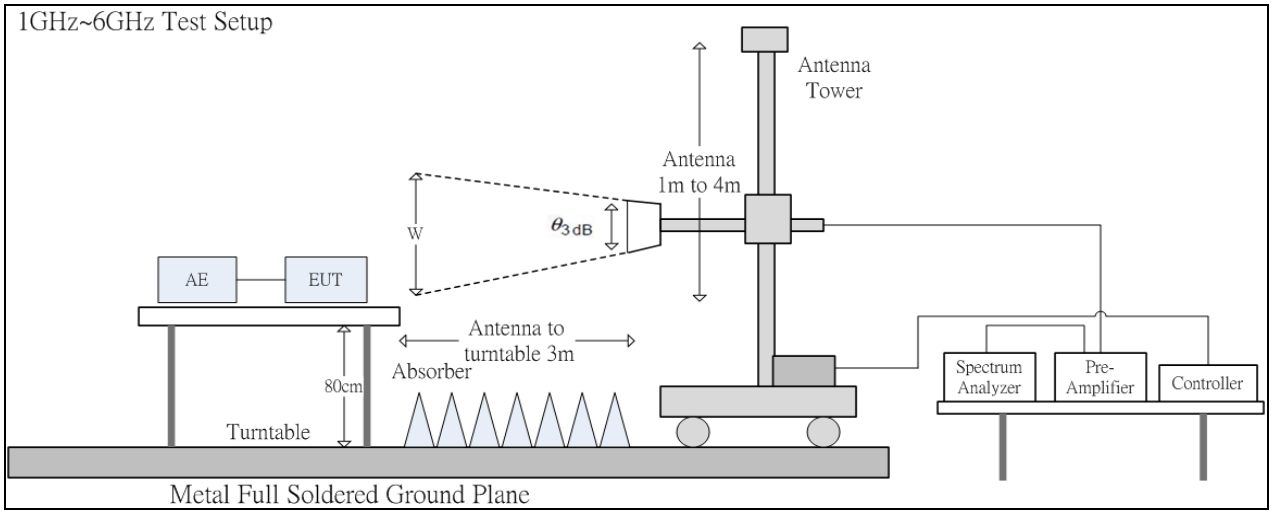


3.3 Radiated Disturbance Emissions

3.3.1 Test Setup and Procedure

3.3.2 Test Setup





The 3dB beam width of the horn antenna used for the test is as shown in the table below.

Frequency (GHz)	E-plane	H-plane	$\theta_{3\,dB}$ (min)	d= 3 m
				w (m)
1	88°	147°	88°	5.79
2	68°	119°	68°	4.04
3	73°	92°	73°	4.44
4	70°	89°	70°	4.20
5	55°	60°	55°	3.12
6	63°	62°	62°	3.60

3.3.3 Test Procedure

The radiated emissions test will then be repeated on the open site or chamber to measure the amplitudes accurately and without the multiple reflections existing in the shielded room. The EUT and support equipment are set up on the turntable of one of 10 meter open field sites or 10 meter chamber. Desktop EUT are set up on a wooden stand 0.8 meter above the ground or floor-standing arrangement shall be placed on the horizontal ground reference plane. The test volume for a height of up to 30 cm may be obstructed by absorber placed on the ground plane.

For the initial measurements, the receiving antenna is varied from 1-4 meter height and is changed in the vertical plane from vertical to horizontal polarization at each frequency. The highest emissions between 30 MHz to 1000 MHz were analyzed in details by operating the spectrum analyzer and/or EMI receiver in quasi-peak mode to determine the precise amplitude of the emissions. The highest emissions between 1 GHz to 6 GHz were analyzed in details by operating the spectrum analyzer in peak and average mode to determine the precise amplitude of the emissions.

At the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. The interconnecting cables were arranged and moved to get the maximum measurement. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. All of the interface cables were manipulated according to EN 61000-6-4 requirements.

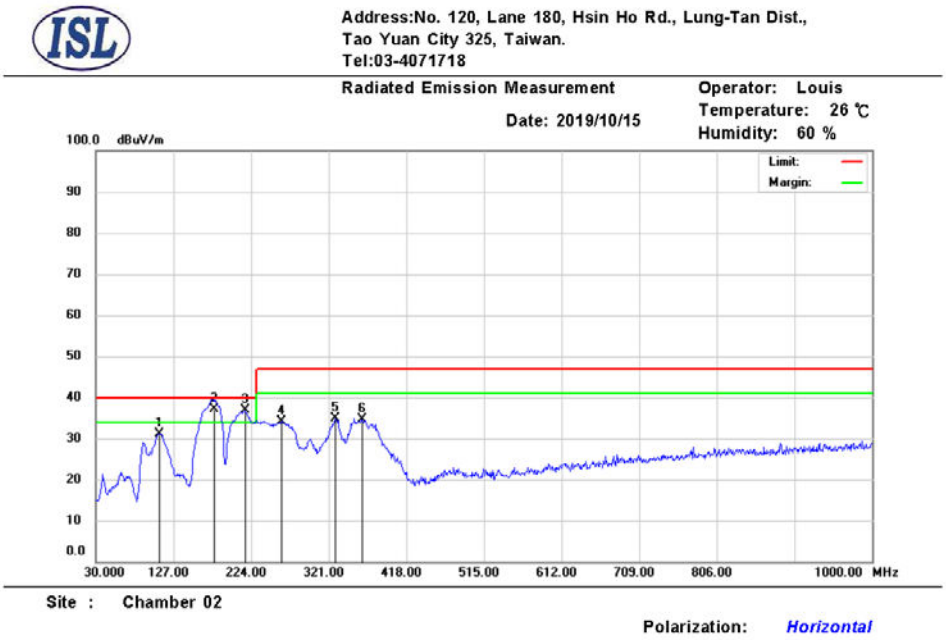
The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. If the highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz. If the highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz, the measurement shall only be made up to 2 GHz. If the highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz, the measurement shall only be made up to 5 GHz. If the highest frequency of the internal sources of the EUT is above 1 GHz, the measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less.

3.3.4 Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range:	30MHz--1000MHz
Detector Function:	Quasi-Peak Mode
Resolution Bandwidth:	120KHz

Frequency Range:	Above 1 GHz to 6 GHz
Detector Function:	Peak / Average Mode
Resolution Bandwidth:	1MHz

3.4 Radiation Test Data: Configuration 1
-Horizontal



Mk.	Frequency (MHz)	RX_R (dBuV)	Correct Factor(dB/m)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.Pos (cm)	Tab.Pos (deg.)	Detector
1	109.54	50.69	-19.52	31.17	40.00	-8.83	350	176	peak
2	179.27	54.07	-16.87	37.20	40.00	-2.80	350	173	QP
3	216.24	55.22	-18.37	36.85	40.00	-3.15	350	184	peak
4	261.83	49.81	-15.78	34.03	47.00	-12.97	350	47	peak
5	328.76	47.86	-13.05	34.81	47.00	-12.19	300	55	peak
6	362.71	46.92	-12.37	34.55	47.00	-12.45	250	54	peak

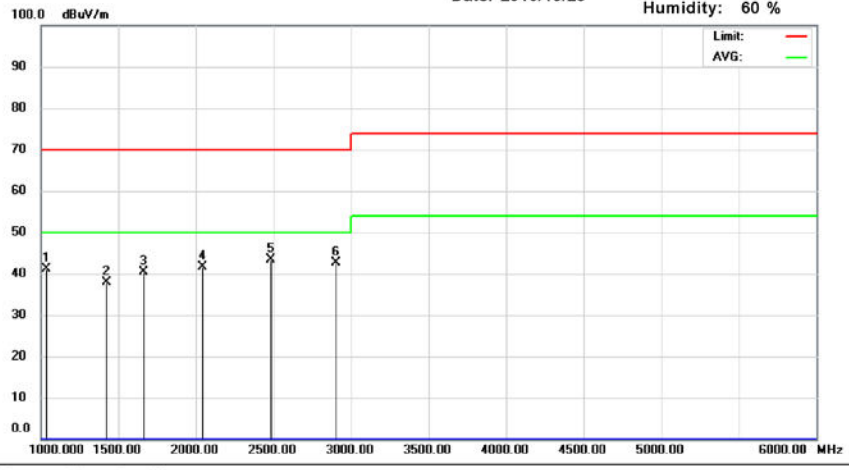
* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss

BILOG Antenna Distance: 10 meters

Address:No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist.,
Tao Yuan City 325, Taiwan.
Tel:03-4071718

Radiated Emission Measurement
Date: 2019/10/28

Operator: Kevin Chan
Temperature: 26 ℃
Humidity: 60 %



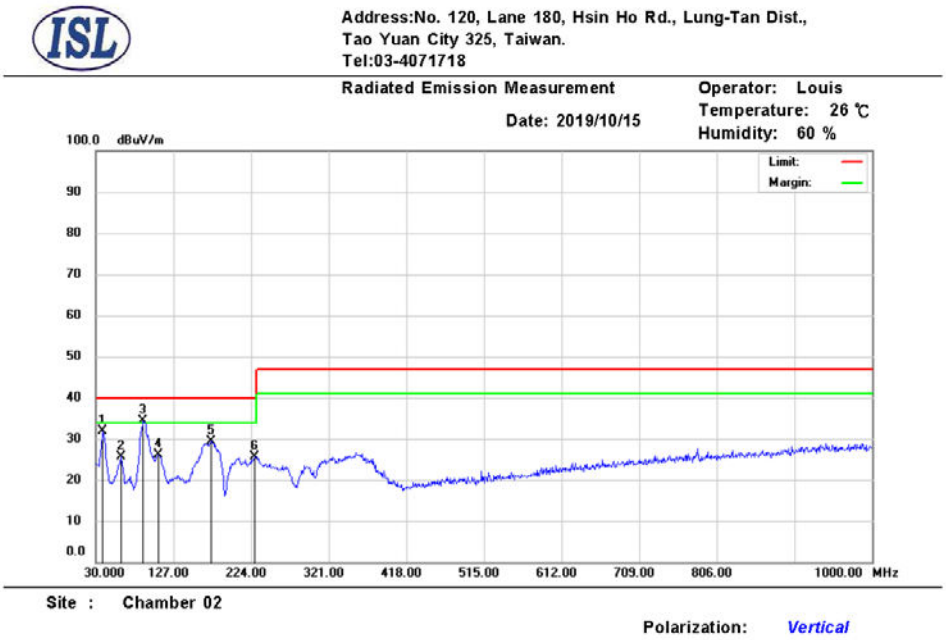
Site : Chamber 14

Polarization: *Horizontal*

Mk.	Frequency (MHz)	RX_R (dBuV)	Correct Factor(dB/m)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.Pos (cm)	Tab.Pos (deg.)	Detector
1	1035.00	58.13	-16.98	41.15	70.00	-28.85	149	315	peak
2	1420.00	54.03	-16.07	37.96	70.00	-32.04	200	170	peak
3	1665.00	56.14	-15.84	40.30	70.00	-29.70	200	0	peak
4	2040.00	54.35	-12.73	41.62	70.00	-28.38	149	331	peak
5	2485.00	55.48	-12.16	43.32	70.00	-26.68	149	179	peak
6	2905.00	54.53	-11.90	42.63	70.00	-27.37	200	290	peak

* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 3 meters
Above 1GHz test, if the peak measured value meets the average limit, it is unnecessary to perform the average measurement.

-Vertical



Mk.	Frequency (MHz)	RX_R (dBuV)	Correct Factor(dB/m)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.Pos (cm)	Tab.Pos (deg.)	Detector
1	38.73	49.68	-17.83	31.85	40.00	-8.15	100	333	peak
2	62.01	43.33	-17.77	25.56	40.00	-14.44	100	356	peak
3	89.17	56.88	-22.47	34.41	40.00	-5.59	150	324	peak
4	107.60	45.95	-19.80	26.15	40.00	-13.85	100	131	peak
5	174.53	45.74	-16.29	29.45	40.00	-10.55	400	139	peak
6	228.85	43.72	-18.08	25.64	40.00	-14.36	100	295	peak

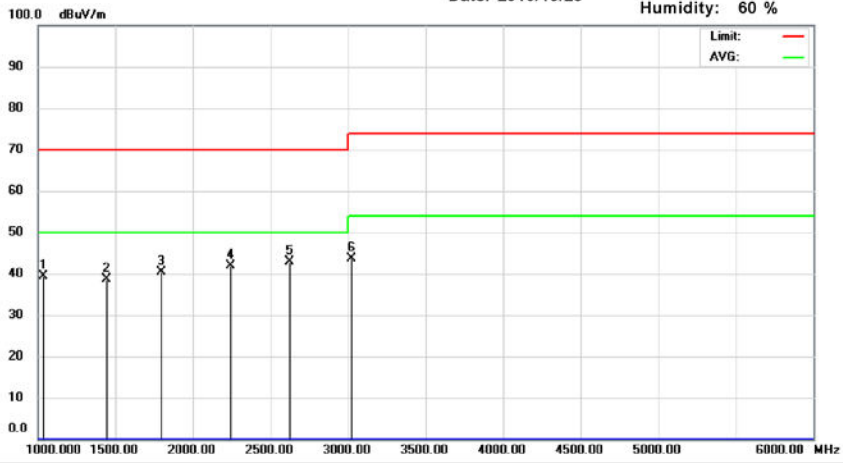
* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss

BILOG Antenna Distance: 10 meters

Address:No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist.,
Tao Yuan City 325, Taiwan.
Tel:03-4071718

Radiated Emission Measurement
Date: 2019/10/28

Operator: Kevin Chan
Temperature: 26 ℃
Humidity: 60 %



Site : Chamber 14

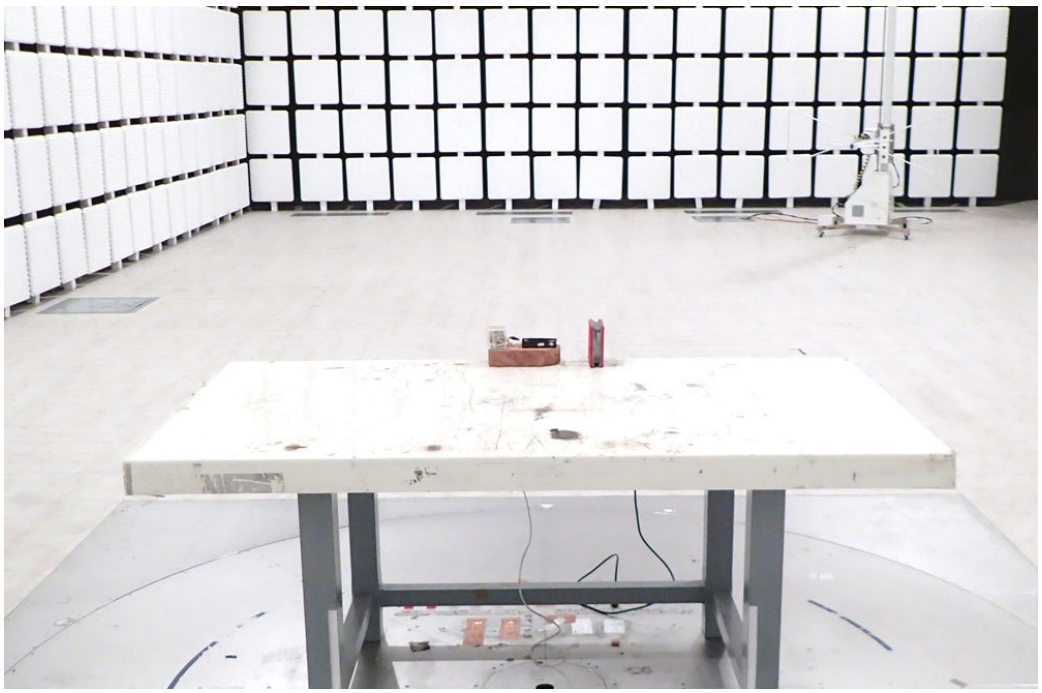
Polarization: Vertical

Mk.	Frequency (MHz)	RX_R (dBuV)	Correct Factor(dB/m)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.Pos (cm)	Tab.Pos (deg.)	Detector
1	1035.00	56.45	-16.98	39.47	70.00	-30.53	200	320	peak
2	1440.00	54.77	-16.22	38.55	70.00	-31.45	100	70	peak
3	1795.00	55.02	-14.56	40.46	70.00	-29.54	100	0	peak
4	2245.00	54.56	-12.76	41.80	70.00	-28.20	100	335	peak
5	2620.00	54.99	-12.02	42.97	70.00	-27.03	100	208	peak
6	3025.00	54.98	-11.42	43.56	74.00	-30.44	100	31	peak

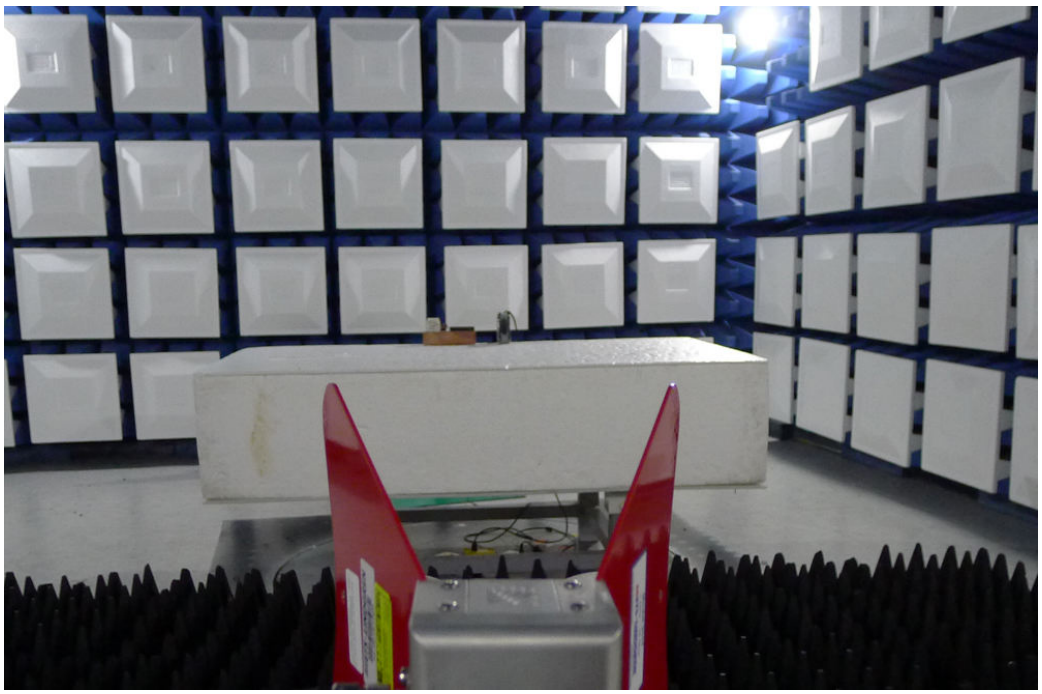
* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 3 meters
Above 1GHz test, if the peak measured value meets the average limit, it is unnecessary to perform the average measurement.

3.4.1 Test Setup Photo

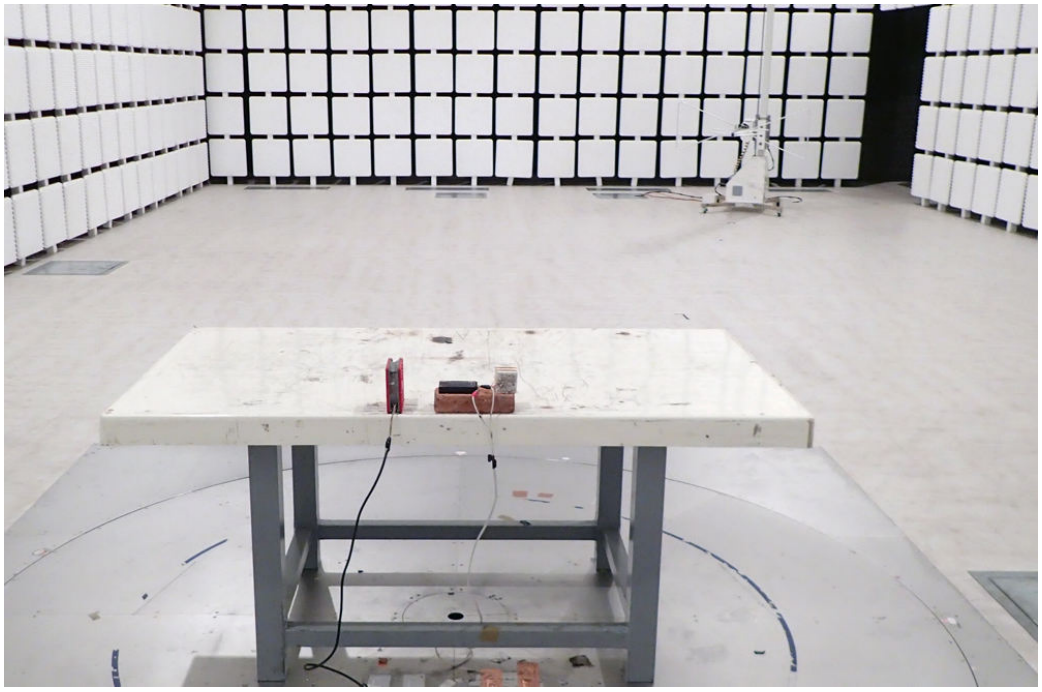
Front View (30MHz~1GHz)



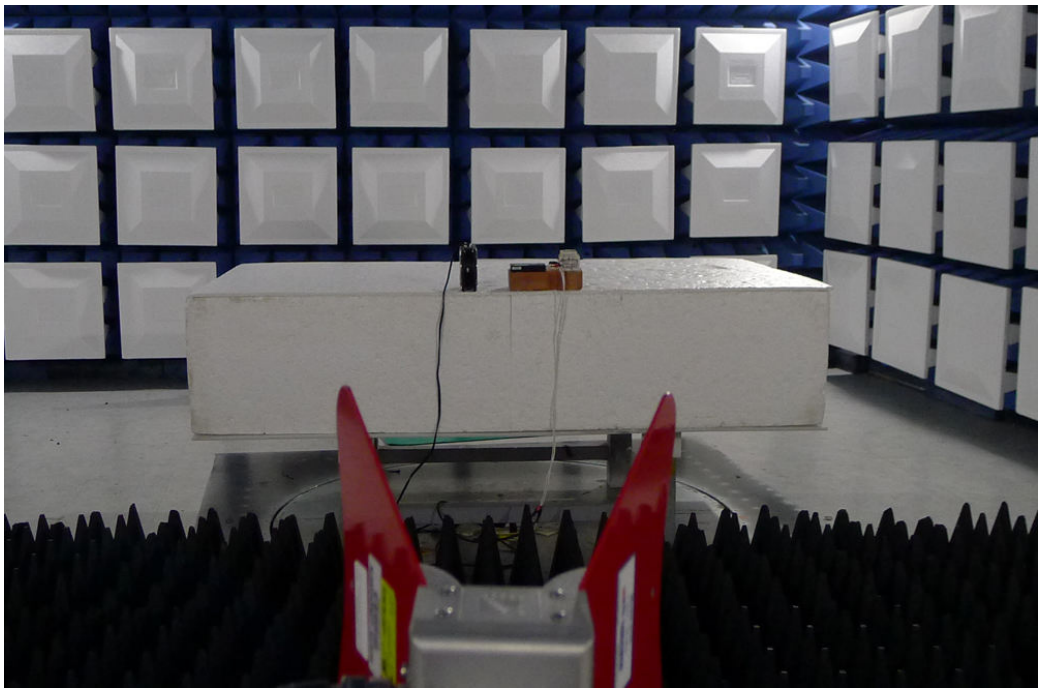
(1GHz~6GHz)



Back View (30MHz~1GHz)



(1GHz~6GHz)



3.5 Electrostatic discharge (ESD) immunity

3.5.1 Test Specification

Port:	Enclosure
Basic Standard:	EN 61000-4-2/ IEC EN61000-4-2 (details referred to Sec 1.2)
Test Level:	Air +/- 2 kV, +/- 4 kV, +/- 6 kV, +/- 8 kV Contact +/- 4 kV, +/- 6 kV
Criteria:	B
Test Procedure	refer to ISL QA -T4-E-S7

Selected Test Point

Air: discharges were applied to slots, aperture or insulating surfaces. 10 single air discharges were applied to each selected points.

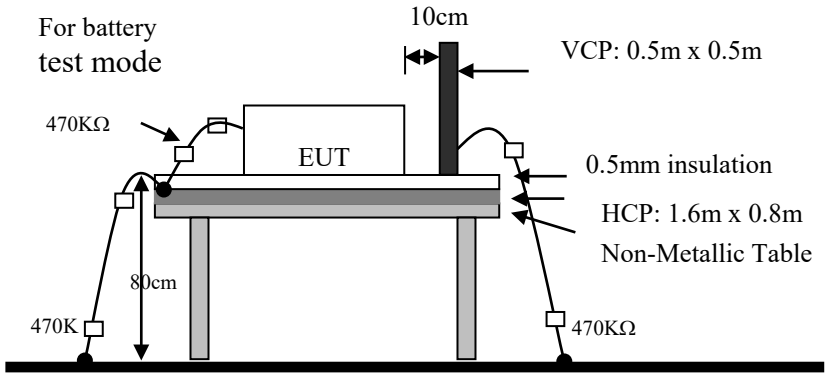
Contact: 10 discharges to the selected contact points.

Indirect Contact Points: 10 discharges were applied to center of one edge of VCP and each EUT side of HCP with 10 cm away from EUT.

Energy-Storage Capacitor:150 pF; Discharge Resistor:330 Ω

3.5.2 Test Setup

EUT is 1m from the wall and other metallic structure. When Battery test mode is needed, a cable with one 470KΩ resister at two rare ends is connected from metallic part of EUT and screwed to HCP.



3.5.3 Test Result

Performance of EUT complies with the given specification.

3.5.4 Test Data: Configuration 1

Basic Standard	EN 61000-4-2	Date
EUT Model Name	TEP 150-4815WI	2019-10-28
		Engineer
Barometer Pressure	98.2kPa	Juanwei
Temperature	22℃	Equipment & Test Site
Humidity	40%	EM TEST(Model: Dito)
Voltage/Freq.	48 Vdc	

A=criteria A, B=criteria B, C=criteria C

→Blue arrow represent Air discharge point

→Red arrow represent Contact discharge point

ND=No Discharge; Meets criteria but unable to obtain an electrostatic discharge (ESD) at this test point.
X=EUT DOES NOT meet the acceptance criteria
A=criteria A, B=criteria B, C=criteria C

Contact Discharge	Voltage kV 25 Discharge @ 1 PPS										
Test Location	+4	-4	+6	-6							Comments
1	A	A	A	A							
2	A	A	A	A							
3	A	A	A	A							
4	A	A	A	A							
5	A	A	A	A							
6	A	A	A	A							
Air Discharge	Voltage kV 10 Discharge @ 1 PPS										
Test Location	+2	-2	+4	-4	+8	-8					Comments
1	A	A	A	A	A	A					
2	A	A	A	A	A	A					
3	A	A	A	A	A	A					
4	A	A	A	A	A	A					
5	A	A	A	A	A	A					
6	A	A	A	A	A	A					
Indirect Discharge	Voltage kV 25 Discharge @ 1 PPS										
Test Location	+4	-4	+6	-6							Comments
VCP Front	A	A	A	A							
VCP Right	A	A	A	A							
VCP Left	A	A	A	A							
VCP Back	A	A	A	A							
Test Location	+4	-4	+6	-6							Comments
HCP Front	A	A	A	A							
HCP Right	A	A	A	A							
HCP Left	A	A	A	A							
HCP Back	A	A	A	A							

Additional Notes: A=criteria A, B=criteria B, C=criteria C

3.5.5 Test Point

Red arrow lines indicate the contact points, and blue arrow lines indicate the air points.

Figure 1 : Test Point Assignments Discharge:

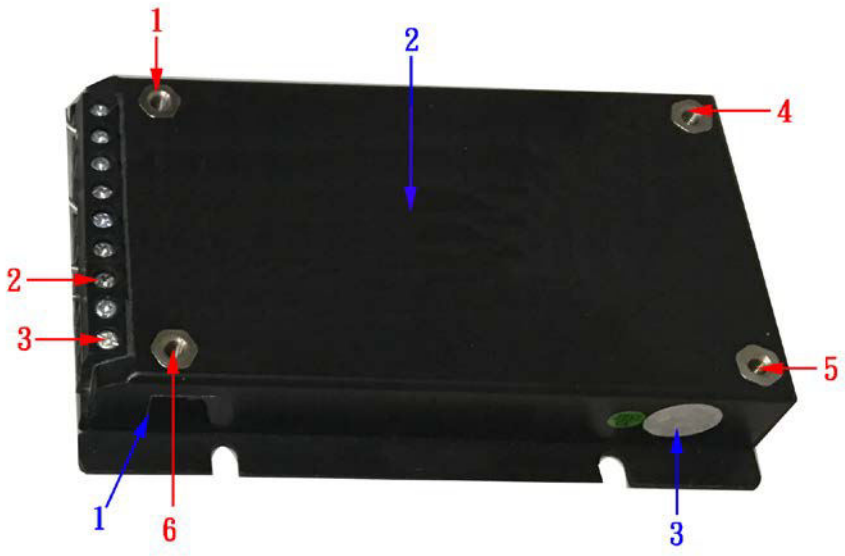
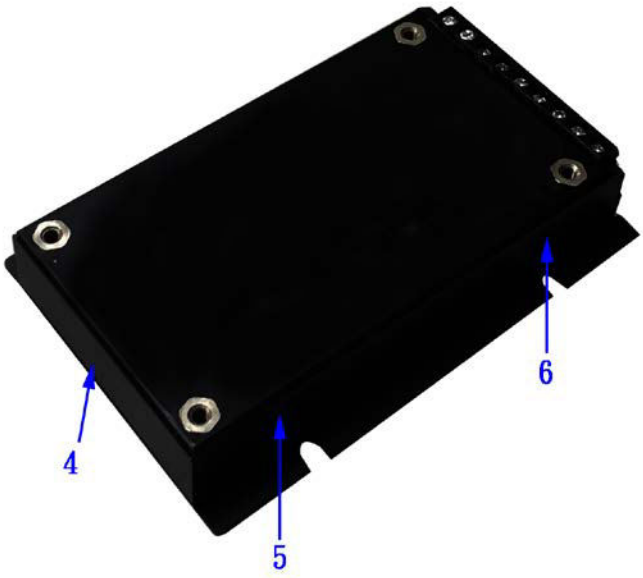
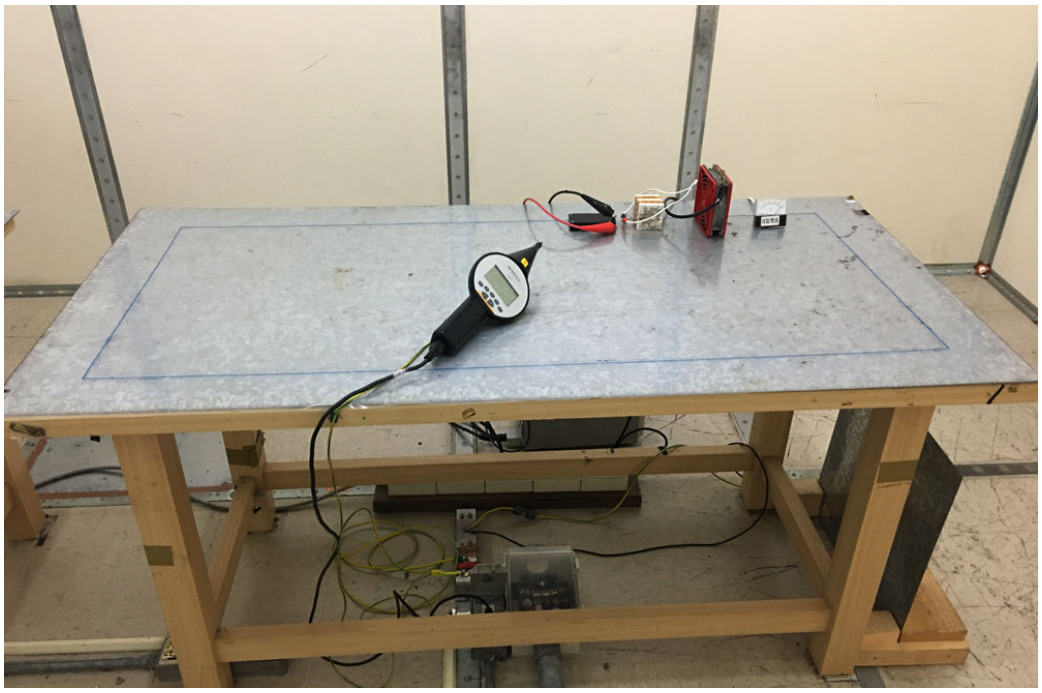


Figure 2 : Test Point Assignments Discharge:



3.5.6 Test Setup Photo



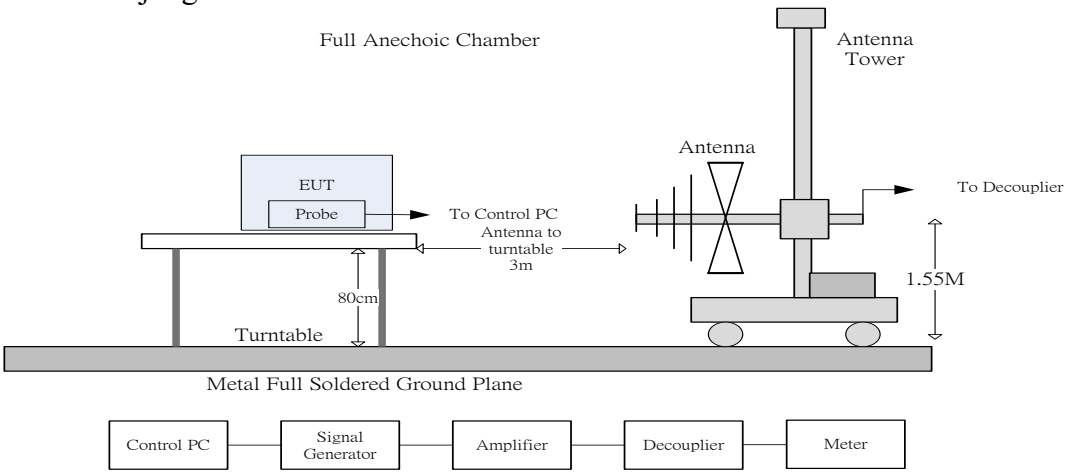
3.6 Radio-Frequency, Electromagnetic Field immunity

3.6.1 Test Specification

Port:	Enclosure
Basic Standard:	EN 61000-4-3/ IEC EN61000-4-3 (details referred to Sec 1.2)
Frequency range/Test Level:	80 MHz to 1000 MHz: 20 V/m 1400 MHz to 2000 MHz: 10 V/m 2000 MHz to 2700 MHz: 5 V/m 5100 MHz to 6000 MHz: 3 V/m
Modulation:	AM 1KHz 80%
Frequency Step:	1% of last step frequency
Dwell time:	3s
Polarization:	Vertical and Horizontal
EUT Azimuth Angle	☒0° ☒90° ☒180° ☒270°
Criteria:	A
Test Procedure	refer to ISL QA -T4-E-S8

3.6.2 Test Setup

The field sensor is placed at one calibration grid point to check the intensity of the established fields on both polarizations. EUT is adjusted to have each side of EUT face coincident with the calibration plane. A CCD camera and speakers are used to monitor the condition of EUT for the performance judgment.



3.6.3 Test Result

Performance of EUT complies with the given specification.

3.6.4 Test Data: Configuration 1

Basic Standard	EN 61000-4-3	Date
EUT Model Name	TEP 150-4815WI	2019-11-05
		Engineer
Barometer Pressure	100.3kPa	Hasan Yu
Temperature	25℃	Equipment & Test Site
Humidity	54%	Chamber 04
Voltage/Freq.	48 Vdc	

A=criteria A, B=criteria B, C=criteria C

EUT Angle	Frequency		Dwell time	Modulation	Level (V/m)	Antenna Polarization	EUT Status	Comments
	Range (MHz)	Steps %						
0° (front)	80-1000	1	3s	80% @ 1KHz	20	Vertical	A	
90° (left)	80-1000	1	3s	80% @ 1KHz	20	Vertical	A	
180° (back)	80-1000	1	3s	80% @ 1KHz	20	Vertical	A	
270° (right)	80-1000	1	3s	80% @ 1KHz	20	Vertical	A	
0° (front)	80-1000	1	3s	80% @ 1KHz	20	Horizontal	A	
90° (left)	80-1000	1	3s	80% @ 1KHz	20	Horizontal	A	
180° (back)	80-1000	1	3s	80% @ 1KHz	20	Horizontal	A	
270° (right)	80-1000	1	3s	80% @ 1KHz	20	Horizontal	A	

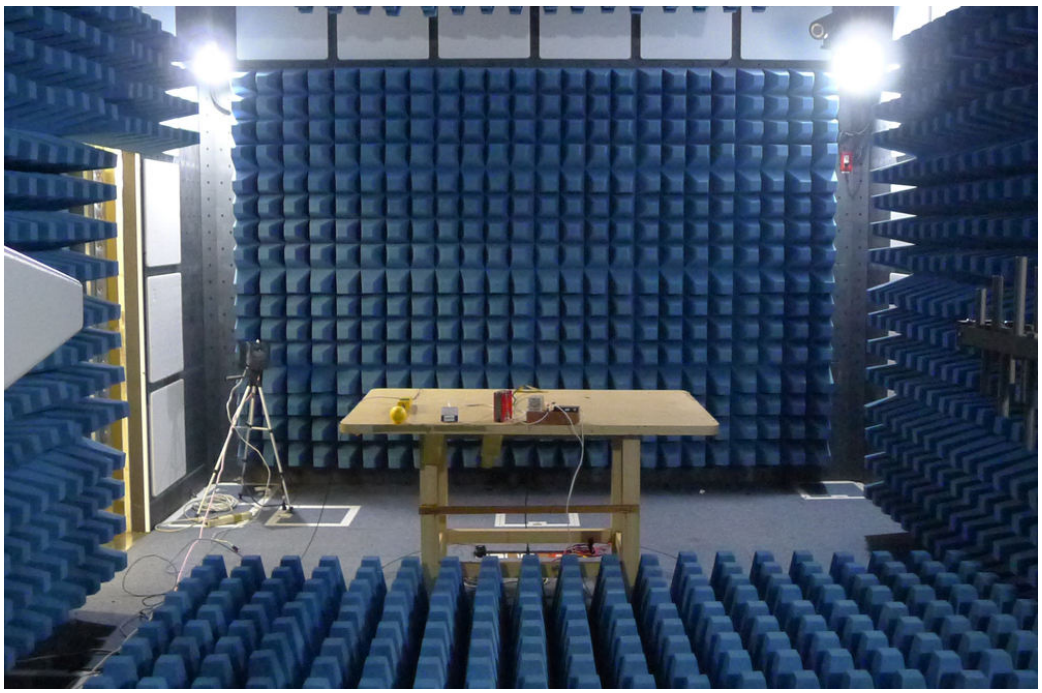
EUT Angle	Frequency		Dwell time	Modulation	Level (V/m)	Antenna Polarization	EUT Status	Comments
	Range (MHz)	Steps %						
0° (front)	1400-2100	1	3s	80% @ 1KHz	10	Vertical	A	
90° (left)	1400-2100	1	3s	80% @ 1KHz	10	Vertical	A	
180° (back)	1400-2100	1	3s	80% @ 1KHz	10	Vertical	A	
270° (right)	1400-2100	1	3s	80% @ 1KHz	10	Vertical	A	
0° (front)	1400-2100	1	3s	80% @ 1KHz	10	Horizontal	A	
90° (left)	1400-2100	1	3s	80% @ 1KHz	10	Horizontal	A	
180° (back)	1400-2100	1	3s	80% @ 1KHz	10	Horizontal	A	
270° (right)	1400-2100	1	3s	80% @ 1KHz	10	Horizontal	A	

EUT Angle	Frequency		Dwell time	Modulation	Level (V/m)	Antenna Polarization	EUT Status	Comments
	Range (MHz)	Steps %						
0° (front)	2000-2700	1	3s	80% @ 1KHz	5	Vertical	A	
90° (left)	2000-2700	1	3s	80% @ 1KHz	5	Vertical	A	
180° (back)	2000-2700	1	3s	80% @ 1KHz	5	Vertical	A	
270° (right)	2000-2700	1	3s	80% @ 1KHz	5	Vertical	A	
0° (front)	2000-2700	1	3s	80% @ 1KHz	5	Horizontal	A	
90° (left)	2000-2700	1	3s	80% @ 1KHz	5	Horizontal	A	
180° (back)	2000-2700	1	3s	80% @ 1KHz	5	Horizontal	A	
270° (right)	2000-2700	1	3s	80% @ 1KHz	5	Horizontal	A	

EUT Angle	Frequency		Dwell time	Modulation	Level (V/m)	Antenna Polarization	EUT Status	Comments
	Range (MHz)	Steps %						
0° (front)	5100-6000	1	3s	80% @ 1KHz	3	Vertical	A	
90° (left)	5100-6000	1	3s	80% @ 1KHz	3	Vertical	A	
180° (back)	5100-6000	1	3s	80% @ 1KHz	3	Vertical	A	
270° (right)	5100-6000	1	3s	80% @ 1KHz	3	Vertical	A	
0° (front)	5100-6000	1	3s	80% @ 1KHz	3	Horizontal	A	
90° (left)	5100-6000	1	3s	80% @ 1KHz	3	Horizontal	A	
180° (back)	5100-6000	1	3s	80% @ 1KHz	3	Horizontal	A	
270° (right)	5100-6000	1	3s	80% @ 1KHz	3	Horizontal	A	

Additional Notes: A=criteria A, B=criteria B, C=criteria C

3.6.5 Test Setup Photo



3.7 Electrical Fast transients/burst immunity

3.7.1 Test Specification

Basic Standard:	EN 61000-4-4/ IEC EN61000-4-4 (details referred to Sec 1.2)
Battery referenced ports (except at the output of energy sources) Auxiliary a.c. power input ports (rated voltage ≤ 400 V rms)	+/- 2 kV
Rise Time:	5ns
Hold Time:	50ns
Repetition Frequency:	5KHz
Criteria:	A
Test Procedure	refer to ISL QA -T4-E-S9

Test Procedure

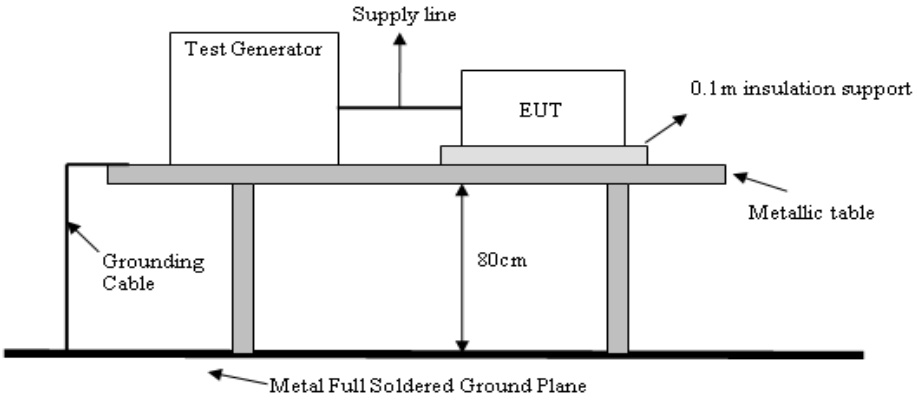
The EUT was setup on a nonconductive table 0.1 m above a reference ground plane.

Test Points	Polarity	Result	Comment
Line	+	N	60 sec
	-	N	60 sec
Neutral	+	N	60 sec
	-	N	60 sec
Line to Neutral	+	N	60 sec
	-	N	60 sec

Note: 'N' means normal, the EUT function is correct during the test.

3.7.2 Test Setup

EUT is at least 50cm from the conductive structure.



3.7.3 Test Result

Performance of EUT complies with the given specification.

3.7.4 Test Data: Configuration 1

Basic Standard	EN 61000-4-4	Date
EUT Model Name	TEP 150-4815WI	2019-11-11
		Engineer
Barometer Pressure	102.2kPa	Hasan Yu
Temperature	25℃	Equipment & Test Site
Humidity	56%	EM TEST (Model: UCS-500 M6B)
Voltage/Freq.	48 Vdc	

A=criteria A, B=criteria B, C=criteria C

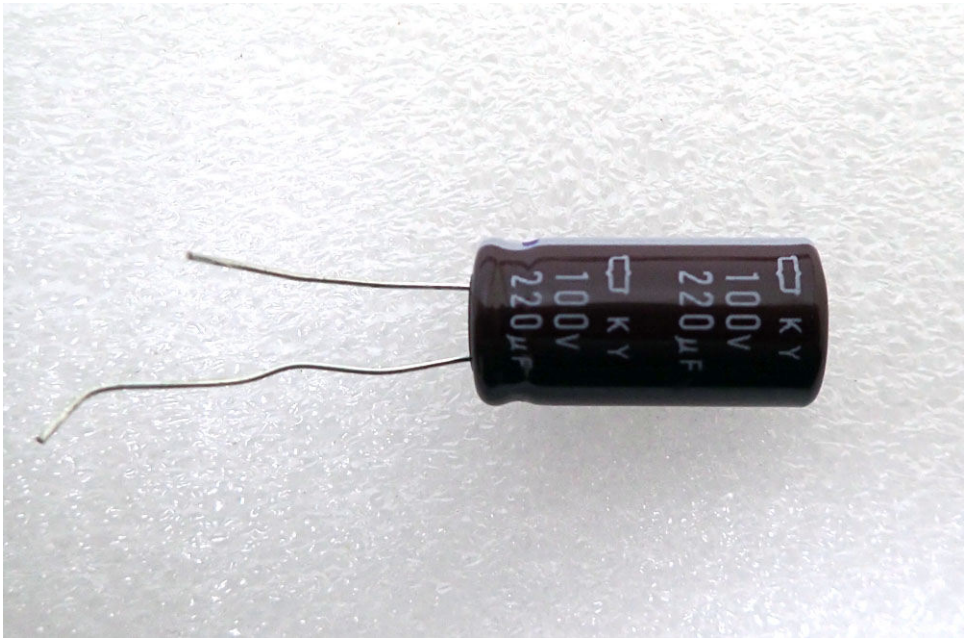
AC Power Port: ☐	DC Power Port: ☑	LAN Port: ☐	Telephone Port: ☐

DC Power Port

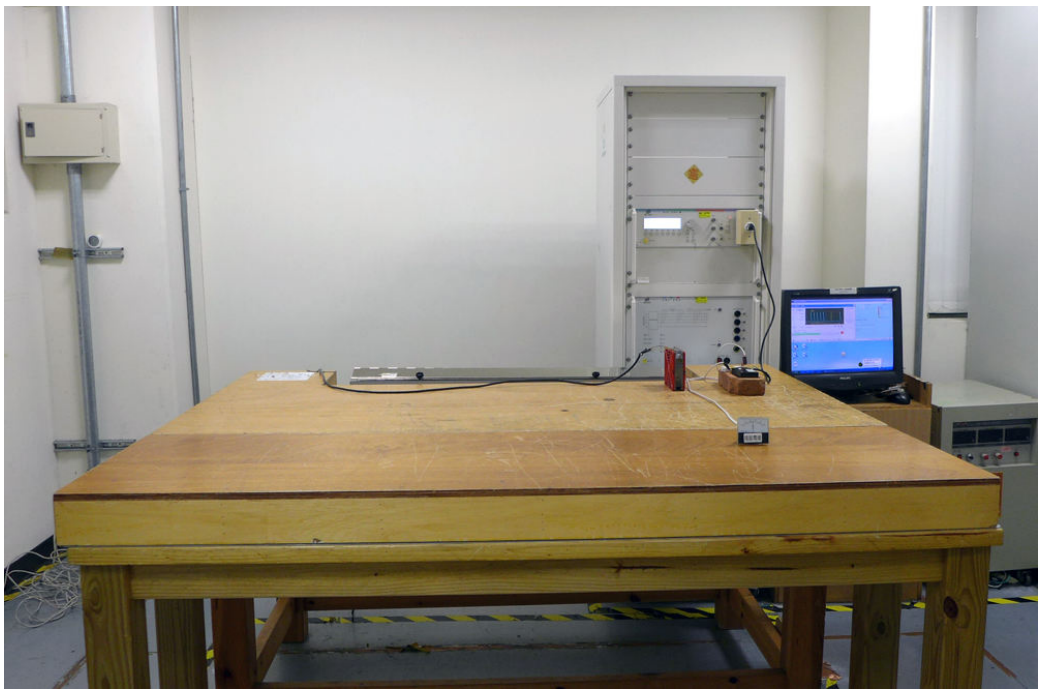
Line Under Test	Voltage Level	Severity Level	Pulse Polarity	Burst Repetition Rate	Test Duration	EUT Status	Comments
Line	2.0kV	3	+	300ms / 5.0kHz	1 Minutes	A	
Line	2.0kV	3	-	300ms / 5.0kHz	1 Minutes	A	
Neutral	2.0kV	3	+	300ms / 5.0kHz	1 Minutes	A	
Neutral	2.0kV	3	-	300ms / 5.0kHz	1 Minutes	A	
Line- Neutral	2.0kV	3	+	300ms / 5.0kHz	1 Minutes	A	
Line- Neutral	2.0kV	3	-	300ms / 5.0kHz	1 Minutes	A	

Additional Notes: A=criteria A, B=criteria B, C=criteria C

NOTE:
With an external input filter capacitor (Nippon chemi-con KY series, 220 μF/100V)



3.7.5 Test Setup Photo

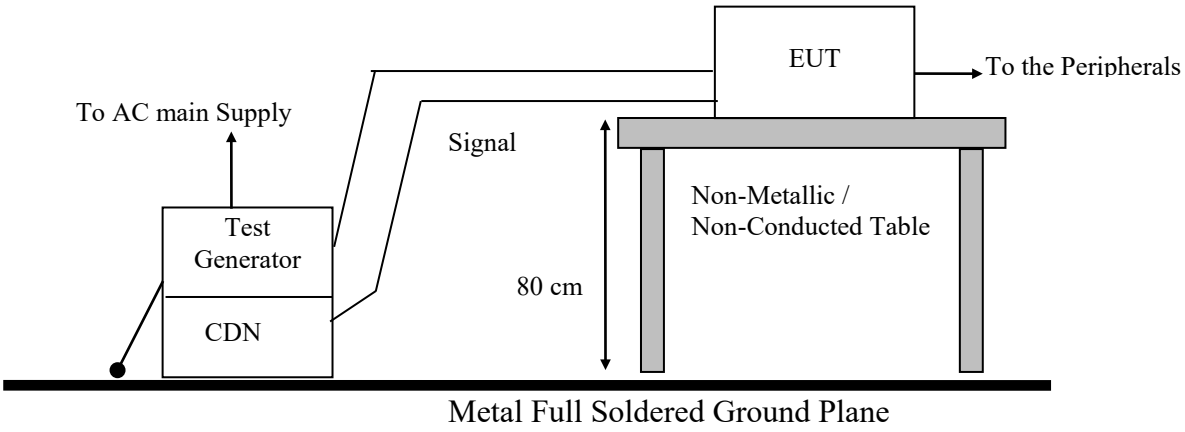


3.8 Surge Immunity

3.8.1 Test Specification

Basic Standard:	EN 61000-4-5/ IEC EN61000-4-5 (details referred to Sec 1.2)
Battery referenced ports (except at the output of energy sources) Auxiliary a.c. power input ports (rated voltage ≤ 400 V rms)	Line to Line: 42 Ω, 0.5 μF +/- 0.5 kV, +/- 1 kV
Rise Time:	1.2us
Hold Time:	50us
Repetition Rate:	60 seconds, 5 time/each condition
Angle:	☒0° ☒90° ☒180° ☒270°
Criteria:	B
Test Procedure:	refer to ISL QA -T4-E-S10

3.8.2 Test Setup



3.8.3 Test Result

Performance of EUT complies with the given specification.

3.8.4 Test Data: Configuration 1

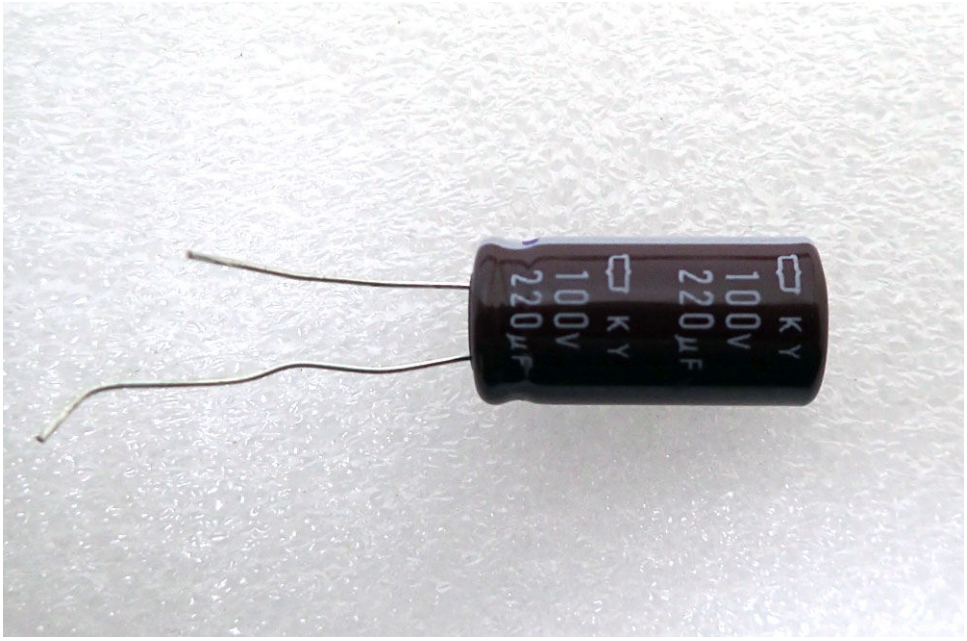
Basic Standard	EN 61000-4-5		Date
EUT Model Name	TEP 150-4815WI		2019-11-08
			Engineer
Barometer Pressure	102.2kPa		Hasan Yu
Temperature	25℃		Equipment & Test Site
Humidity	56%		EMC PARTNER (Model:IMU3000)
Voltage/Freq.	48 Vdc		
A=criteria A, B=criteria B, C=criteria C			
AC Power Port: ☐	DC Power Port: ☑	LAN Port: ☐	Telephone Port: ☐

DC Power Port

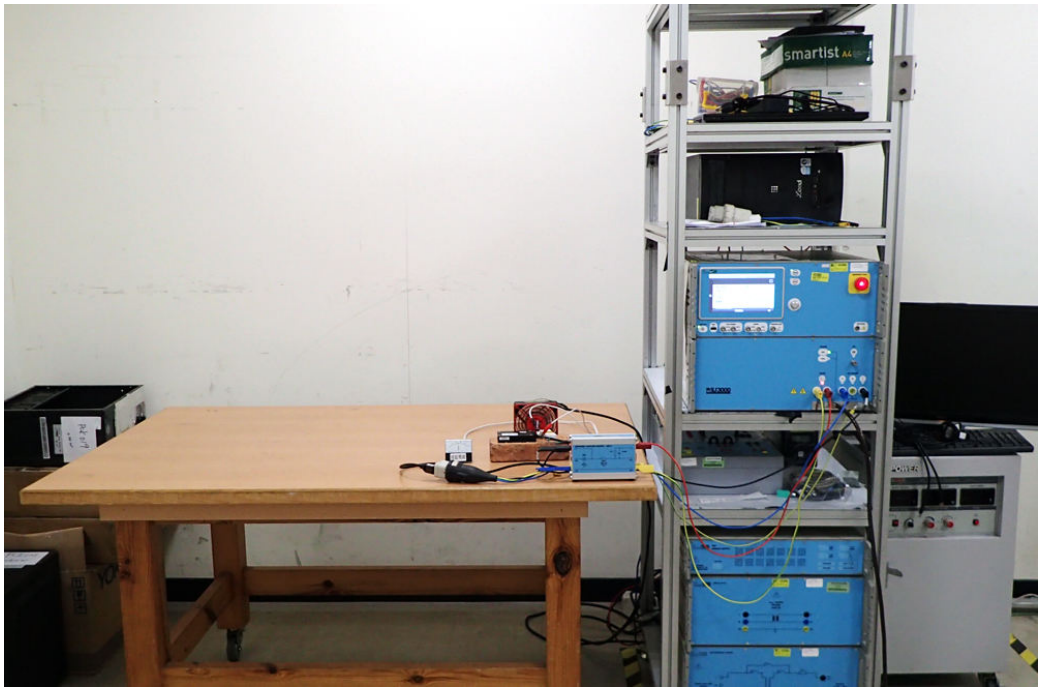
Line Under Test	Voltage	Level	Polarity	Repetition Rate	Cycle	Pulse Position	EUT Status	Comments
Line-Neutral	+0.5kV	1	42Ω	60 sec	5		A	
Line-Neutral	−0.5kV	1	42Ω	60 sec	5		A	
Line- Neutral	+1.0kV	2	42Ω	60 sec	5		A	
Line- Neutral	−1.0kV	2	42Ω	60 sec	5		A	
Line- Neutral	+2.0kV	2	42Ω	60 sec	5		A	
Line- Neutral	−2.0kV	2	42Ω	60 sec	5		A	

Additional Notes: A=criteria A, B=criteria B, C=criteria C

NOTE:
With an external input filter capacitor (Nippon chemi-con KY series, 220 μF/100V)



3.8.5 Test Setup Photo

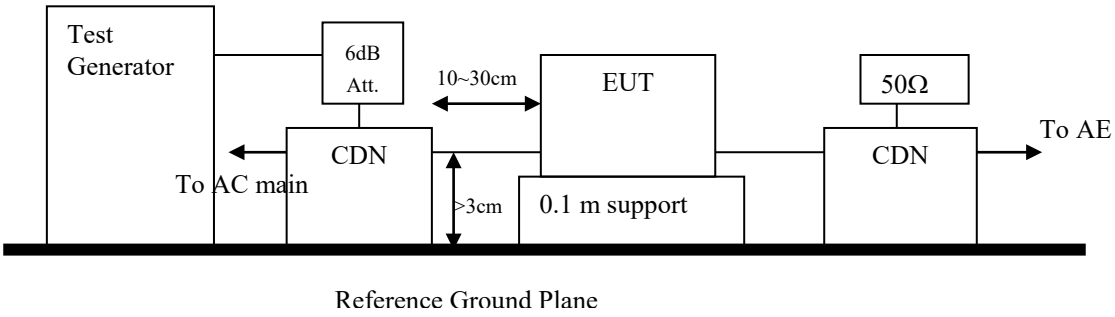


3.9 Immunity to Conductive Disturbance

3.9.1 Test Specification

Basic Standard:	EN 61000-4-6/ IEC EN61000-4-6 (details referred to Sec 1.2)
Battery referenced ports (except at the output of energy sources) Auxiliary a.c. power input ports (rated voltage ≤ 400 V rms)Test Level:	10 V
Modulation:	AM 1KHz 80%
Frequency range:	0.15 MHz - 80MHz
Frequency Step:	1% of last Frequency
Dwell time:	3s
Criteria:	A
CDN Type:	CDN M2+M3, Clamp
Test Procedure	refer to ISL QA -T4-E-S11

3.9.2 Test Setup



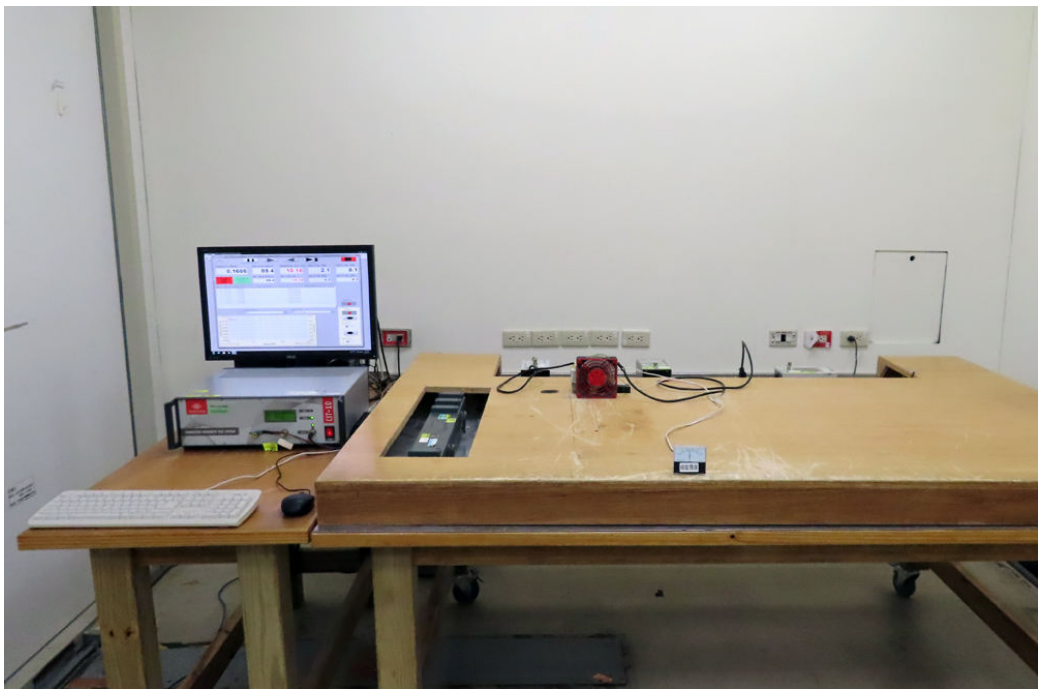
3.9.3 Test Result

Performance of EUT complies with the given specification.

3.9.4 Test Data: Configuration 1

Basic Standard	EN 61000-4-6				Date		
EUT Model Name	TEP 150-4815WI				2019-11-08		
					Engineer		
Barometer Pressure	102.2kPa				Hasan Yu		
Temperature	25℃				Equipment & Test Site		
Humidity	56%				FRANKONIA (Model: CIT-10/75)		
Voltage/Freq.	48 Vdc						
A=criteria A, B=criteria B, C=criteria C							
DC Power Port							
Line Under Test	Frequency		Level	Modulation	Dwell time	EUT Status	Comments
	Range (MHz)	Steps %					
DC Power Port	0.15 to 80	1	10V	80% @ 1kHz	3s	A	
Additional Notes: A=criteria A, B=criteria B, C=criteria C							

3.9.5 Test Setup Photo

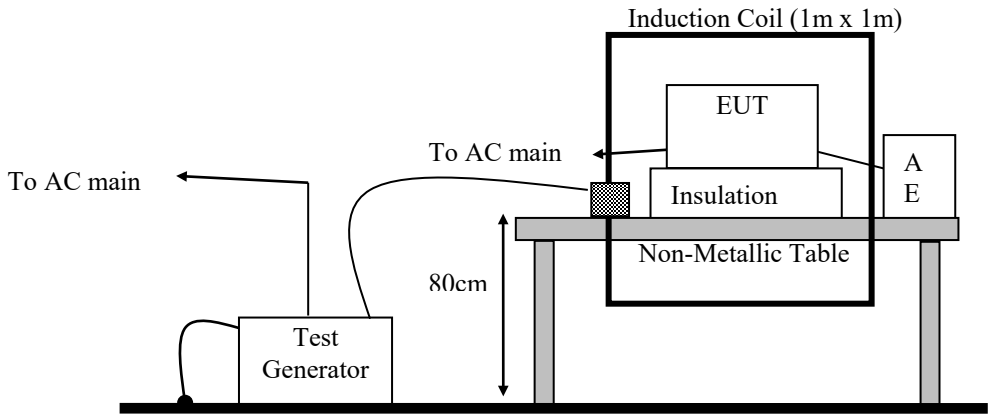


3.10 Power Frequency Magnetic Field immunity

3.10.1 Test Specification

Port:	Enclosure
Basic Standard:	EN 61000-4-8/ IEC 61000-4-8 (details referred to Sec 1.2)
D.C. systems Test Level:	100A/m(continuous),1000A/m(1s)
Polarization:	X, Y, Z
Criteria:	A
Test Procedure	refer to ISL QA -T4-E-S12

3.10.2 Test Setup



3.10.3 Test Result

Performance of EUT complies with the given specification.

3.10.4 Test Data: Configuration 1

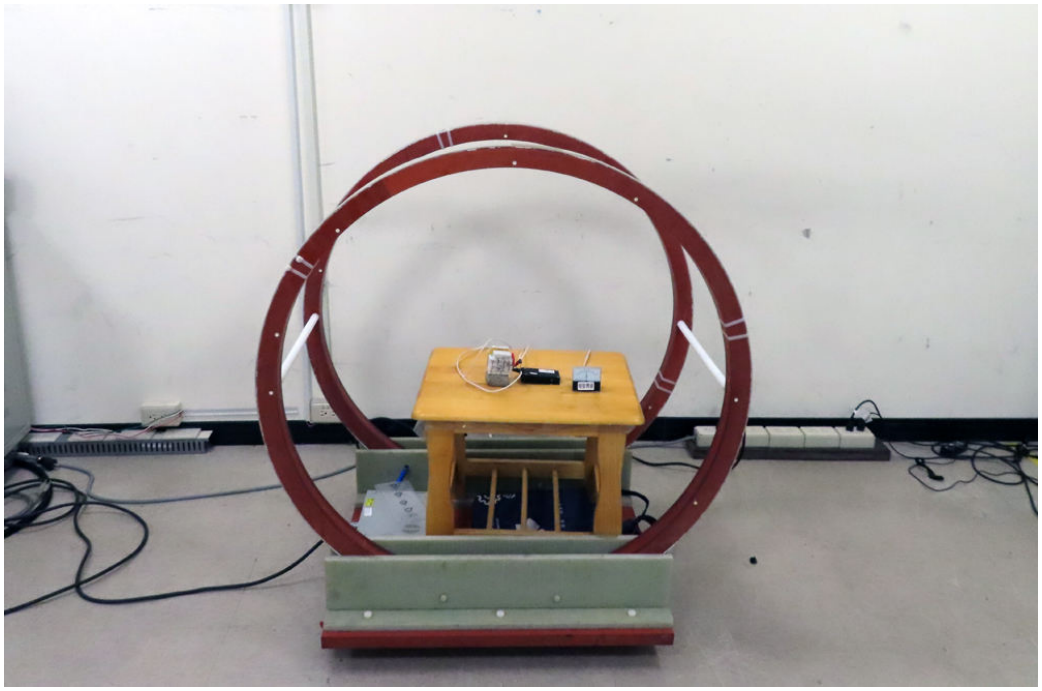
Basic Standard	EN 61000-4-8	Date	
EUT Model Name	TEP 150-4815WI	2019-11-12	
Power		Engineer	
Barometer Pressure	100.3kPa	Hasan Yu	
Temperature	24℃	Equipment & Test Site	
Humidity	56%	Magnetic Field Immunity Loop Brand: Pic Model:PMF1000 & Magnetic Field Test AC Power Source Brand: Pic Model: AC Power Source	
Voltage/Freq.	48 Vdc		

A=criteria A, B=criteria B, C=criteria C

Antenna Polarization	Frequency (Hz)	Test Level	Test Duration	EUT Status	Comment
X	0	100 A/m	1 Minutes	A	
Y	0	100 A/m	1 Minutes	A	
Z	0	100 A/m	1 Minutes	A	
X	0	1000 A/m	1 Second	A	
Y	0	1000 A/m	1 Second	A	
Z	0	1000 A/m	1 Second	A	

Additional Notes: A=criteria A, B=criteria B, C=criteria C

3.10.5 Test Setup Photo



4. Environmental Tests

4.1 Low temperature start-up test

4.1.1 Test Ambience

Temperature:21℃ ± 2℃
Humidity: 53% ± 6%

4.1.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.4

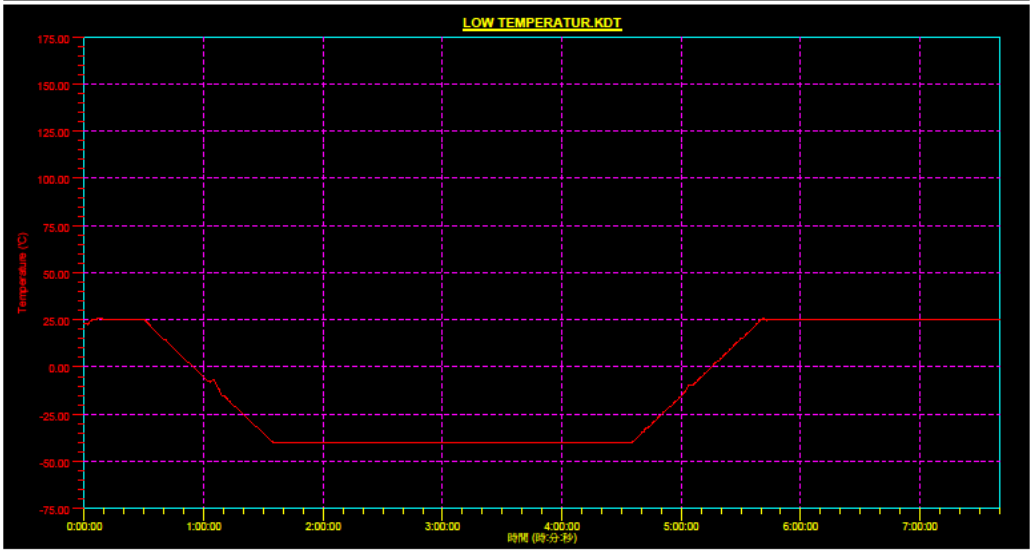
4.1.3 Test Condition

Temperature: -40℃, test 2 hours.
Performance Check: The performance check was carried out before and after the cooling test.

4.1.4 Test Result

A. Photo of test Setup was shown in 4.1.5
B. Testing data were shown as below
C. Test specimen was visually inspected after test. No physical damage occurred.
D. The function of specimen was normal during and after the cooling test.
E. According to test result, the specimen passed the EN 50155 sub-clause 13.4.4 Low temperature start-up test.

KSON DAT Viewer Report



檔案名稱: G:\low temperatur.kdt

時間範圍: 14:12:47 11/19/2019 - 21:52:47 11/19/2019
時間範圍: 0:00:00 - 7:40:00

Y軸:
Temperature('C) -75.000 ~ 175.000

曲線:
1. Temperature('C)

16:20:47 Monday, November 25, 2019 Page 1/1

4.1.5 Test Setup Photo

4.2 Dry Heat Test

4.2.1 Test Ambience

Temperature:21℃ ± 2℃
Humidity: 53% ± 6%

4.2.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.5

4.2.3 Test Condition

Temperature: 70℃ at 6 hours and 70℃ at 6 hours + 85℃(70℃+15℃) at 10min
6 hours at 70℃ and rises 15 °C 10 min after 6 hours at 70℃.
Performance Check:
The performance check was carried out before, during and after the Dry Heat Test.

4.2.4 Test Result

A. Photo of test Setup was shown in 4.1.5.
B. The EN 50155 table 1/Class OT4 Dry heat testing data were shown in Figure 1.
C. The EN 50155 table2/Class ST1 Dry heat with switch-on extended operating temperature testing data were shown in Figure 2.
D. Test specimen was visually inspected after test. No physical damage occurred.
E. The function of specimen was normal during and after the Dry heat test.
F. According to test result, the specimen passed the EN 50155 sub-clause 13.4.5 Dry heat test.

Figure 1: Dry Heat Test Record

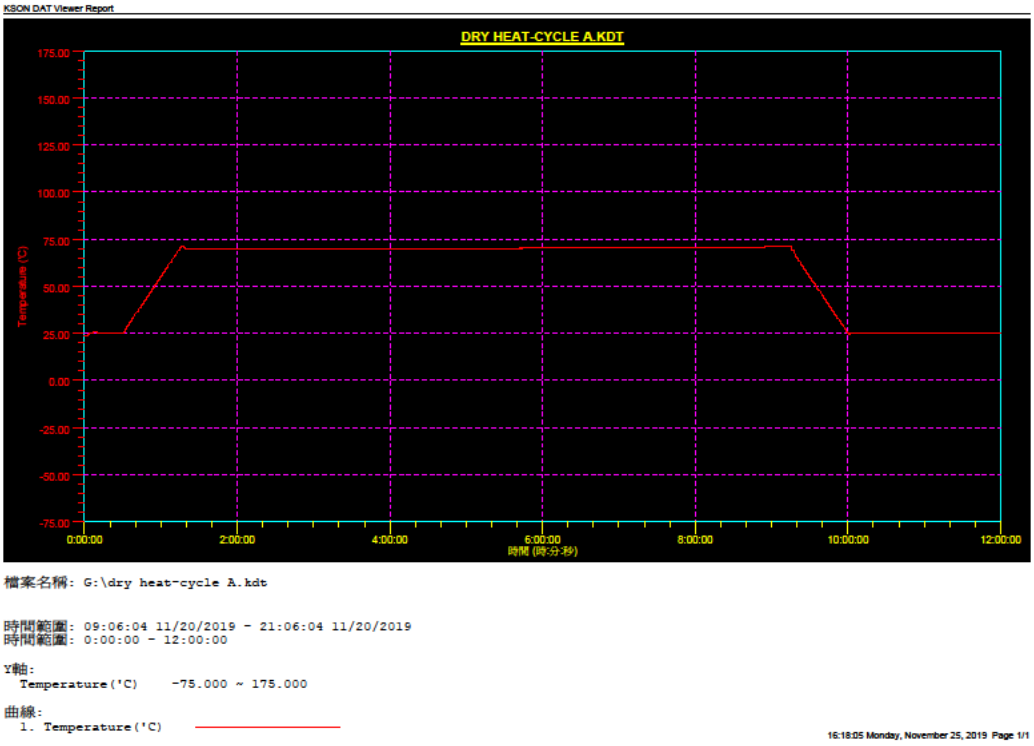
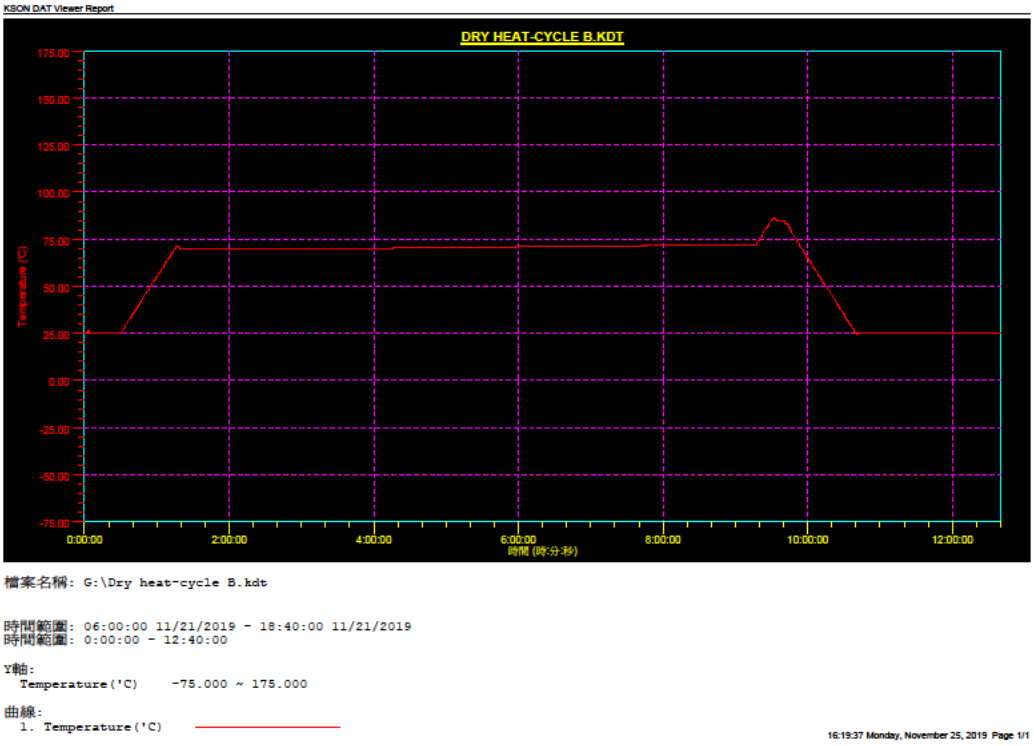


Figure 2: Dry Heat Test Record



4.3 Damp Heat Test

4.3.1 Test Ambience

Temperature: 21℃ ± 2℃
Humidity: 53% ± 6%

4.3.2 Test Procedure

Test Procedures were referred to EN 50155 sub-clause 13.4.7

4.3.3 Test Condition

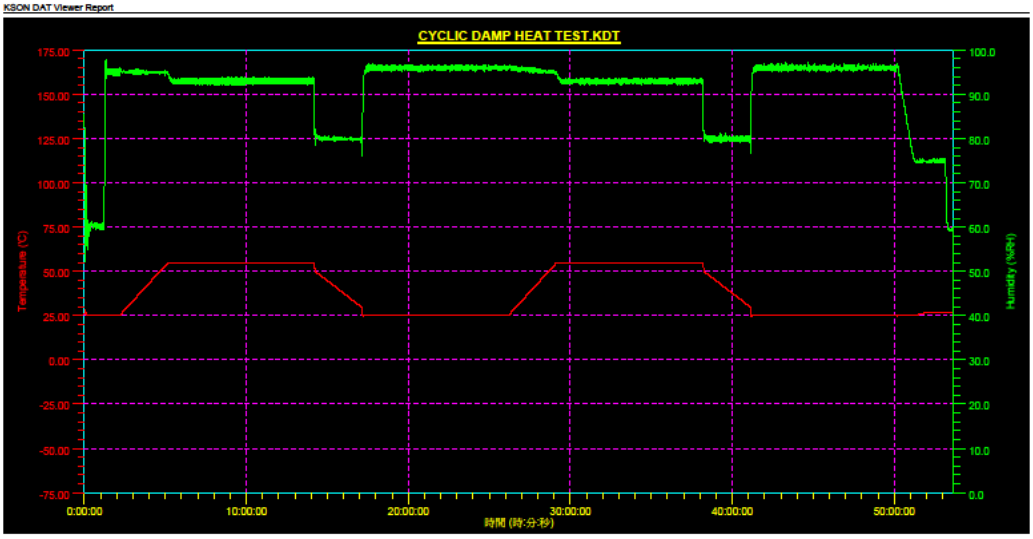
Temperature / Humidity:
55℃ and 25℃, 95%±5%RH without condensation, 48 hours.
Performance Check:
The performance check was carried out before and after the Damp Heat Test.

4.3.4 Test Result

A. Photo of test Setup was shown in 4.1.5.
B. The testing data were shown as below.
C. Test specimen was visually inspected after test. No physical damage occurred.
D. The function of specimen was normal during and after the Damp heat test.
E. According to test result, the specimen passed the EN 50155 ch.13.4.7 Dry heat test.

Dry Heat Test Record

KSON DAT Viewer Report



檔案名稱: G:\Cyclic damp heat test.kdt

時間範圍: 04:00:01 11/23/2019 - 09:40:01 11/25/2019
時間範圍: 0:00:00 - 53:40:00

Y軸:
Temperature('C) -75.000 ~ 175.000
Humidity(%RH) 0.00 ~ 100.00

曲線:
1. Temperature('C)
2. Humidity(%RH)

16:20:10 Monday, November 25, 2019 Page 1/1

Date : 2019/11/25	Temperature : 20 ℃	Engineer : Hasan Yu
EUT Model Name :WAF150-48S24W	Humidity : 56 %	Barometer Pressure: 99.8 kPa Standard: EN 50155 12.2.1
Voltage/Freq: 48Vdc/ 0Hz		

Visual inspection requirement after:

The visual inspection shall be carried out to ensure that the equipment is of sound construction and, so far as can be ascertained, meets its specified requirements.
A visual inspection shall also be carried out after a type test has been performed to check whether any damage or deterioration has occurred resulting from the tests.

Inspection item	Result
EUT outside	OK
EUT function	OK

Before test：Ok


4.4 Functional random Vibration Test

4.4.1 Test Specification and / or standard:

EN61373:2010

4.4.2 Testing Equipment:

Vibration & Shock Environmental Equipment KD-9363EM-1000F2K-50N250
Max. force：1000 kgf-peak / 250 kgw Loading
Max. displacement：50 mm p-p
Max. acceleration：55 g
Frequency range：2 to 2000 Hz
Calibrate trace code：VS-CV-050930-02

4.4.3 Test Condition and procedure:

Test Condition:

	Category	Orientation	RMS m/s^2
☐	1 Class A Body mounted	Vertical Transverse Longitudinal	0.75 0.37 0.5
☒	1 Class B Body mounted	Vertical Transverse Longitudinal	1.01 0.45 0.7
☐	2 Bogie mounted	Vertical Transverse Longitudinal	5.4 4.7 2.5
☐	3 Axle mounted	Vertical Transverse Longitudinal	38.0 34.0 17.0

Test Procedure:
A. Check out samples.
B. Place the test samples on the vibration table in its normal operating orientation and configuration.
C. Set test conditions and start to test.
D. Finish testing, check out samples and prepare final report.

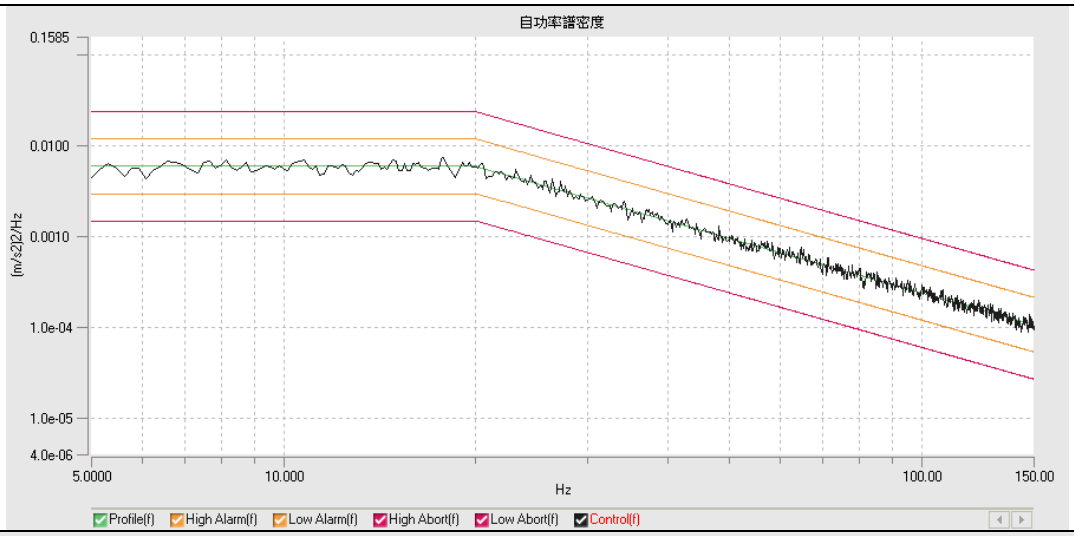
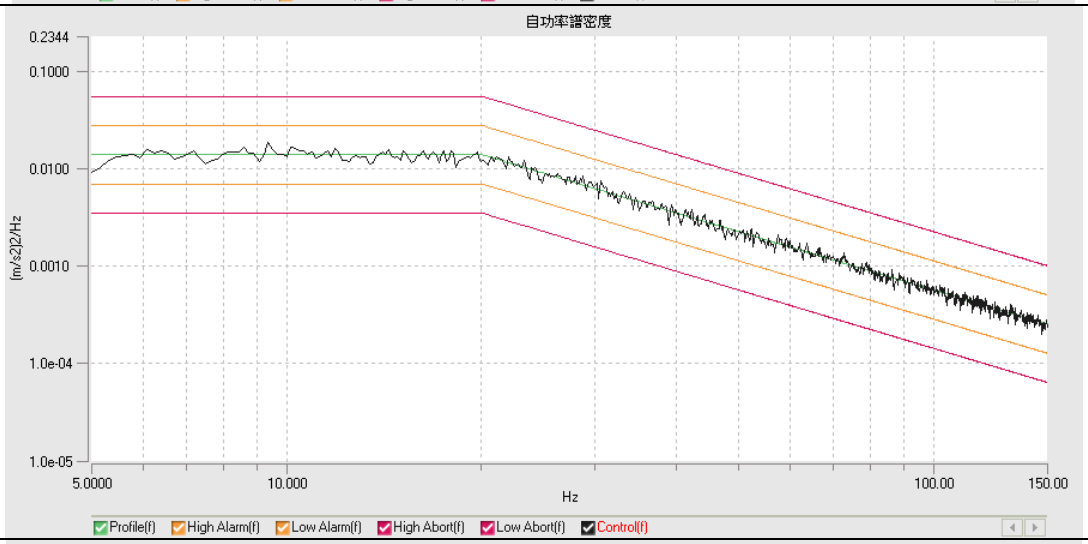
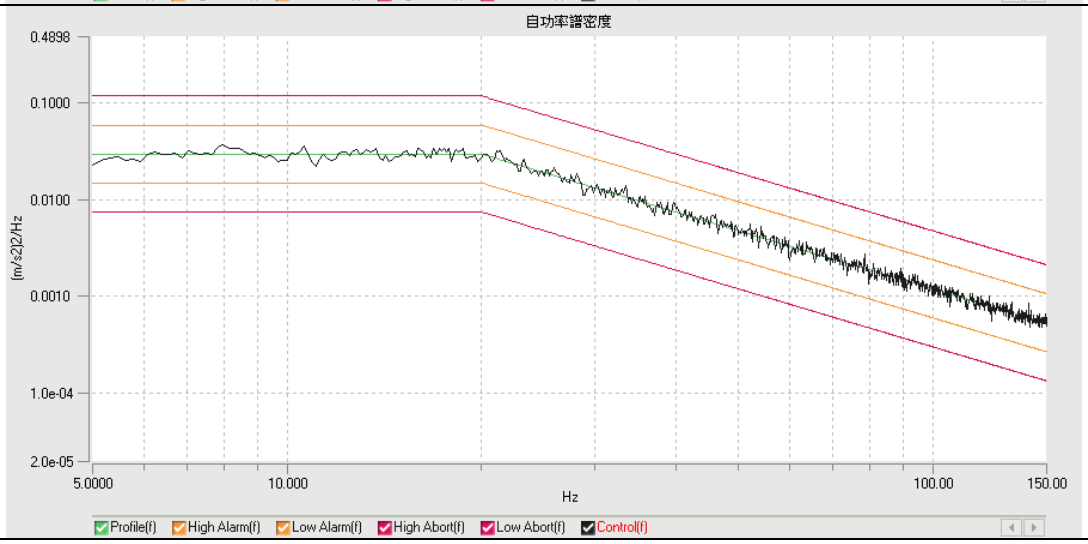
4.4.4 Test Result

Visual inspection and electrical measurement are to be done by customer.

4.4.5 Test Setup Photo

Transverse X Axis	Longitudinal Y Axis
	
Vertical **Z Axis**	
	

4.4.6 Test Profile:

X Axis	
Y Axis	
Z Axis	

4.5 Simulated long-life testing at increased Random Vibration Test

4.5.1 Test Specification and/or standard:

EN61373:2010

4.5.2 Testing Equipment:

Vibration & Shock Environmental Equipment KD-9363EM-1000F2K-50N250
Max. force: 1000 kgf-peak / 250 kgw Loading
Max. displacement: 50 mm p-p
Max. acceleration: 55 g
Frequency range: 2 to 2000 Hz
Calibrate trace code：VS-CV-050930-02

4.5.3 Test Condition and procedure:

Test Condition:

	Category	Orientation	RMS 5 h test period m/s^2
☐	1 Class A Body mounted	Vertical Transverse Longitudinal	4.25 2.09 2.83
☒	1 Class B Body mounted	Vertical Transverse Longitudinal	5.72 2.55 3.96
☐	2 Bogie mounted	Vertical Transverse Longitudinal	30.6 26.6 14.2
☐	3 Axle mounted	Vertical Transverse Longitudinal	144 129 64.3

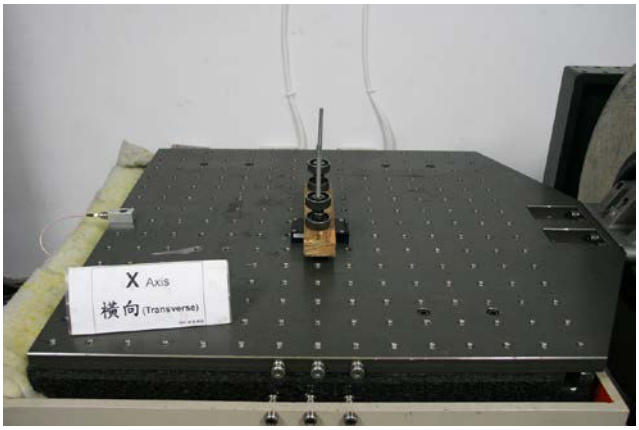
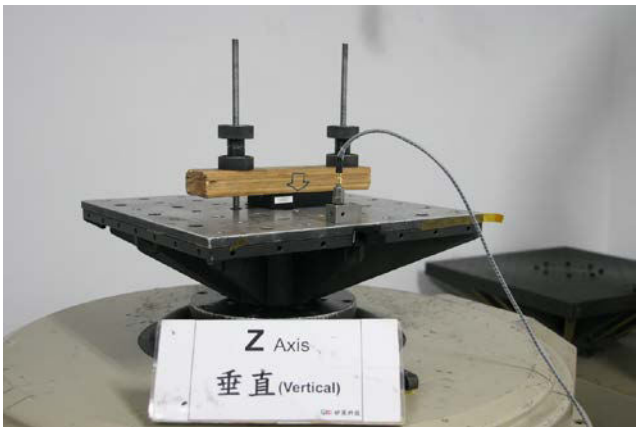
Test Procedure:

A. Check out samples.
B. Place the test samples on the vibration table in its normal operating orientation and configuration.
C. Set test conditions and start to test.
D. Finish testing, check out samples and prepare final report.

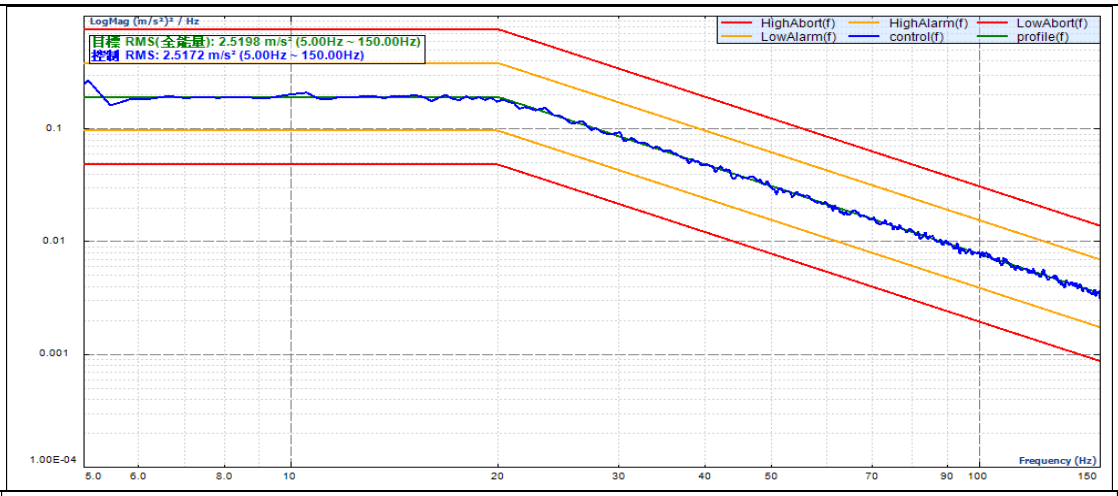
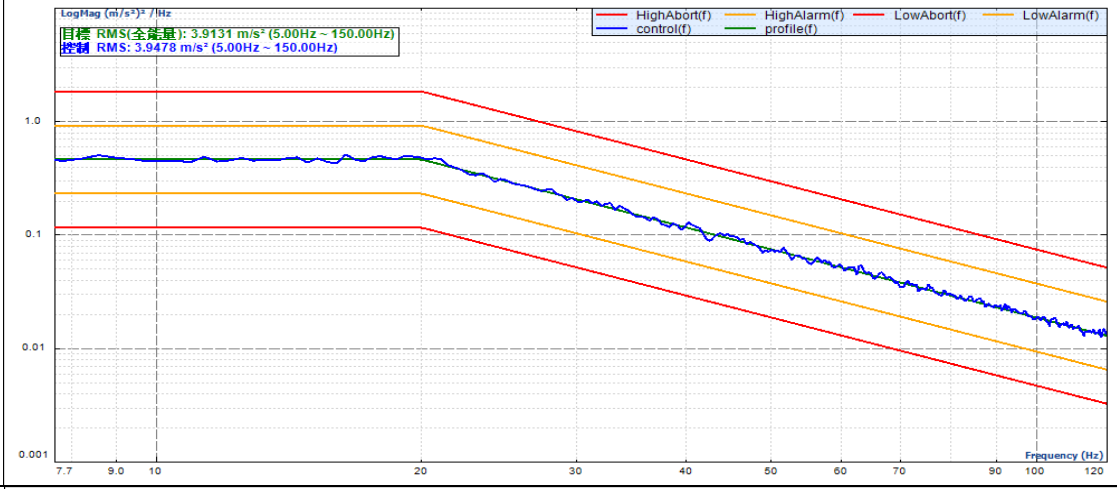
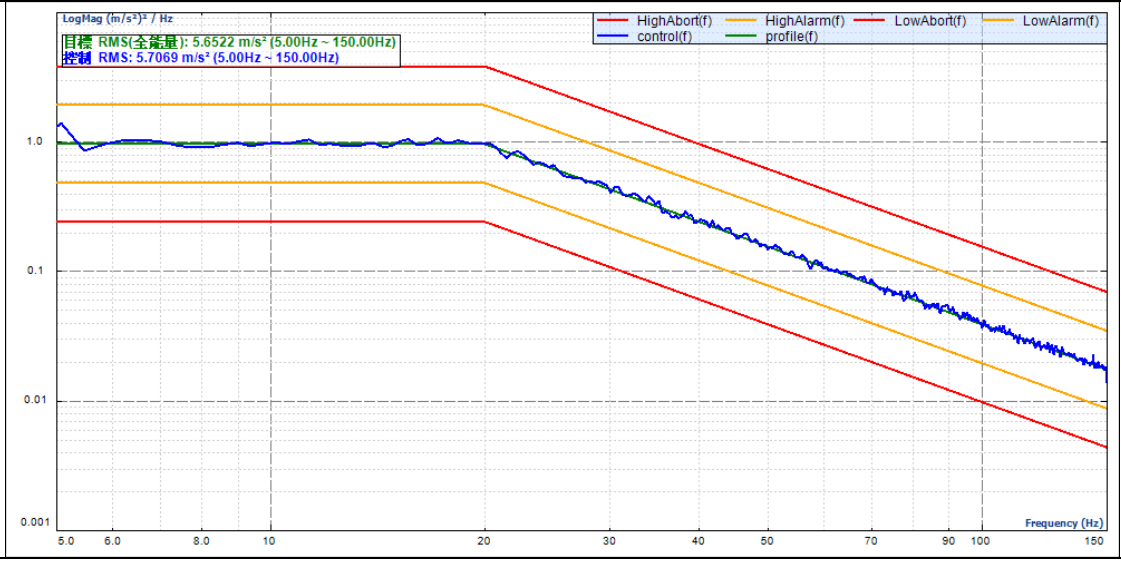
4.5.4 Test Result

Visual inspection and electrical measurement are to be done by customer.

4.5.5 Test Setup Photo

Transverse **X Axis**	
Longitudinal **Y Axis**	
Vertical **Z Axis**	

4.5.6 Test Profile:

X Axis	
Y Axis	
Z Axis	

4.6 Shock Test

4.6.1 Test Specification and/or standard:

EN61373:2010

4.6.2 Testing Equipment:

Vibration & Shock Environmental Equipment KD-9363EM-1000F2K-50N250
Max. force：1000 kgf-peak / 250 kgw Loading
Max. displacement：50 mm p-p
Max. acceleration：55 g
Frequency range：2 to 2000 Hz
Calibrate trace code：VS-CV-050930-02

4.6.3 Test Condition and procedure:

Test Condition:

	Category	Orientation	Peak acceleration A m/s^2	Nominal duration D ms
☒	1 Class A and Class B Body mounted	Vertical Transverse Longitudinal	30 30 50	30 30 30
☐	2 Bogie mounted	Vertical Transverse Longitudinal	300	18
☐	3 Axle mounted	Vertical Transverse Longitudinal	1000	6

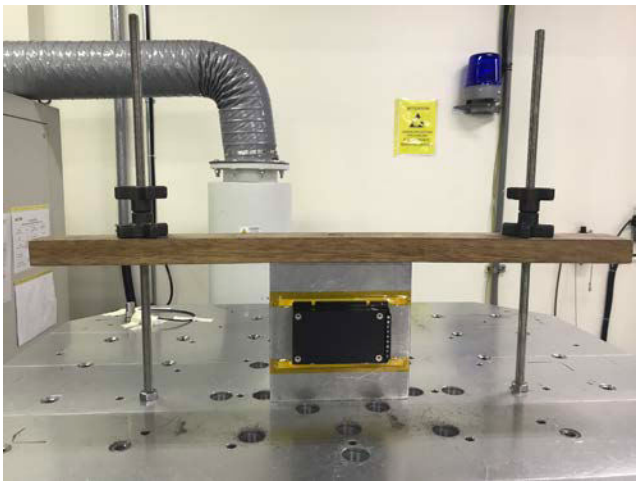
Test Procedure:

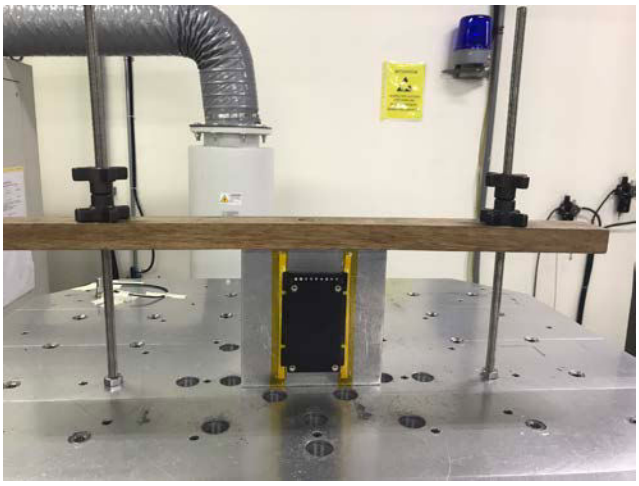
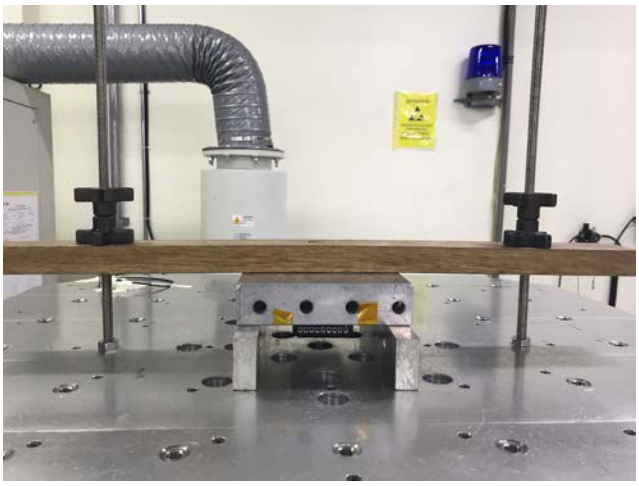
A. Check out samples.
B. Place the test samples on the vibration table in its normal operating Orientation and configuration.
C. Set test conditions and start to test.
D. Finish testing, check out samples and prepare final report.

4.6.4 Test Result

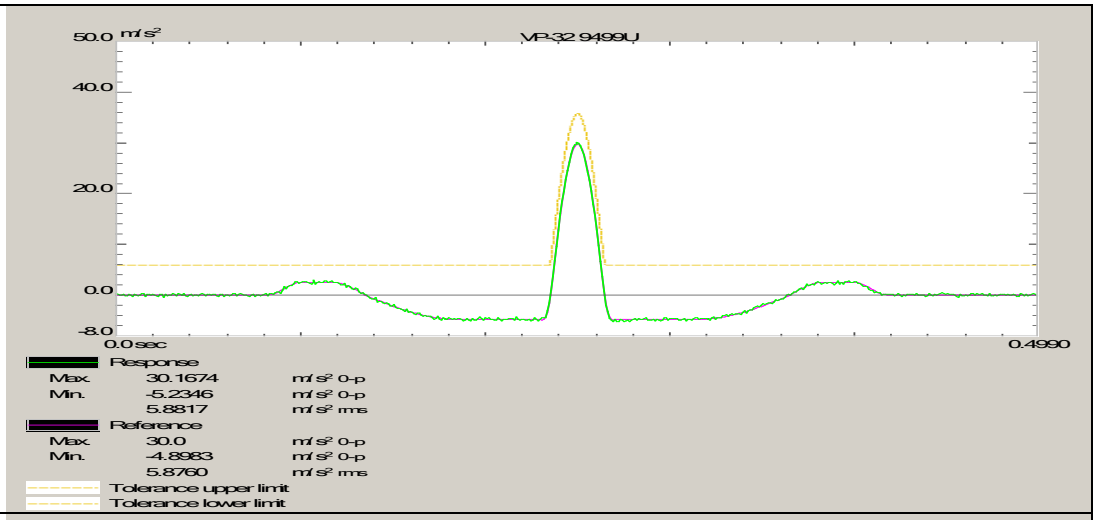
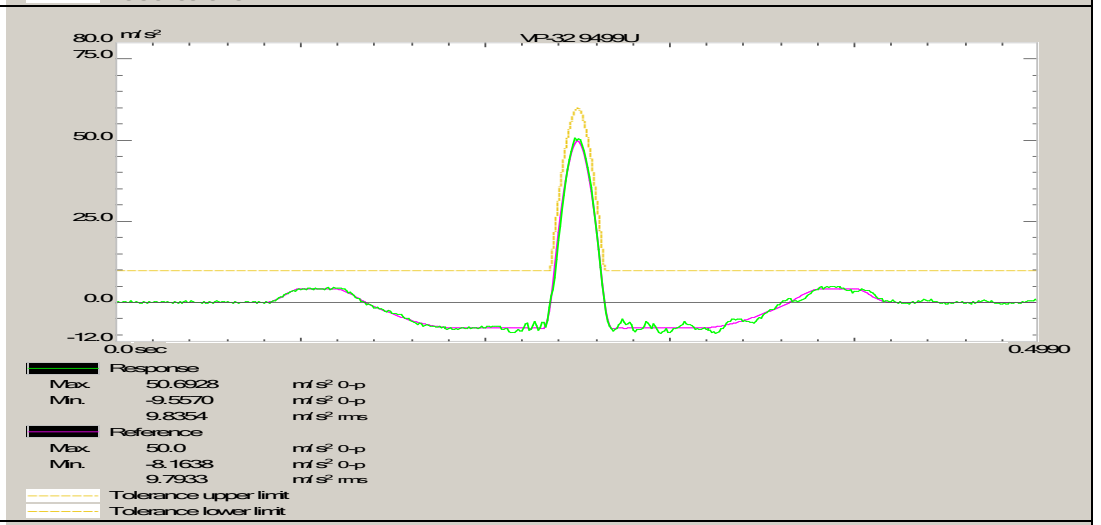
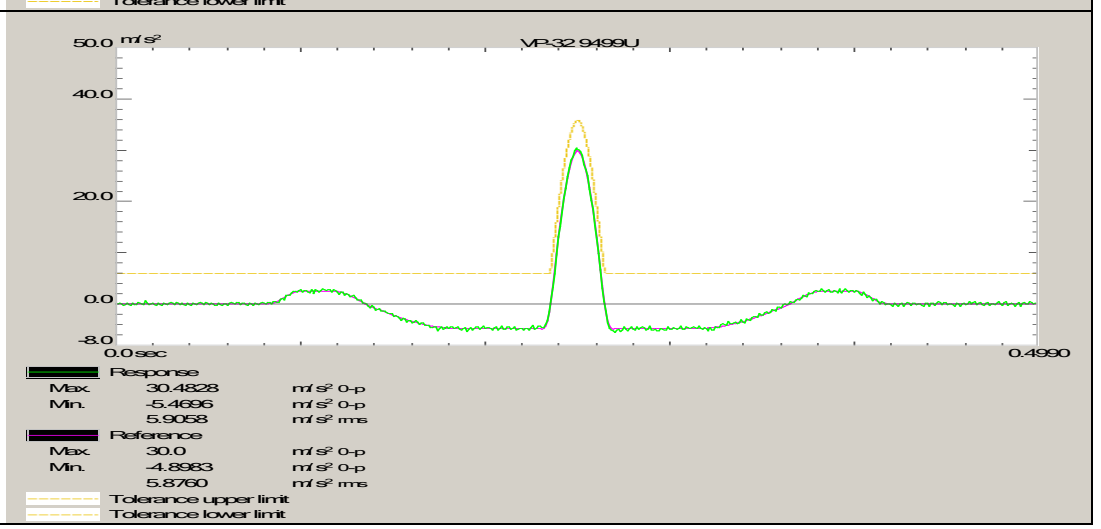
Visual inspection and electrical measurement are to be done by customer.

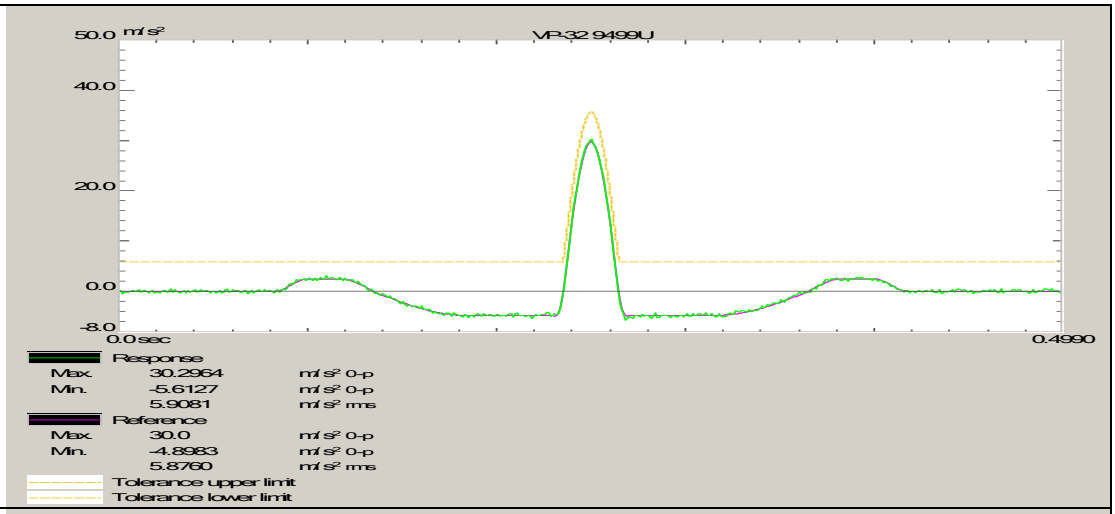
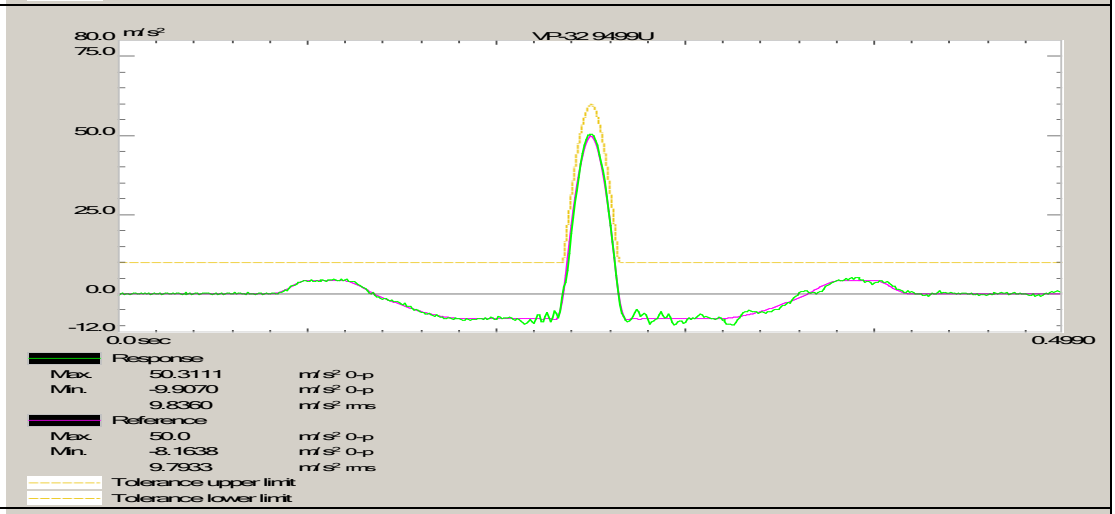
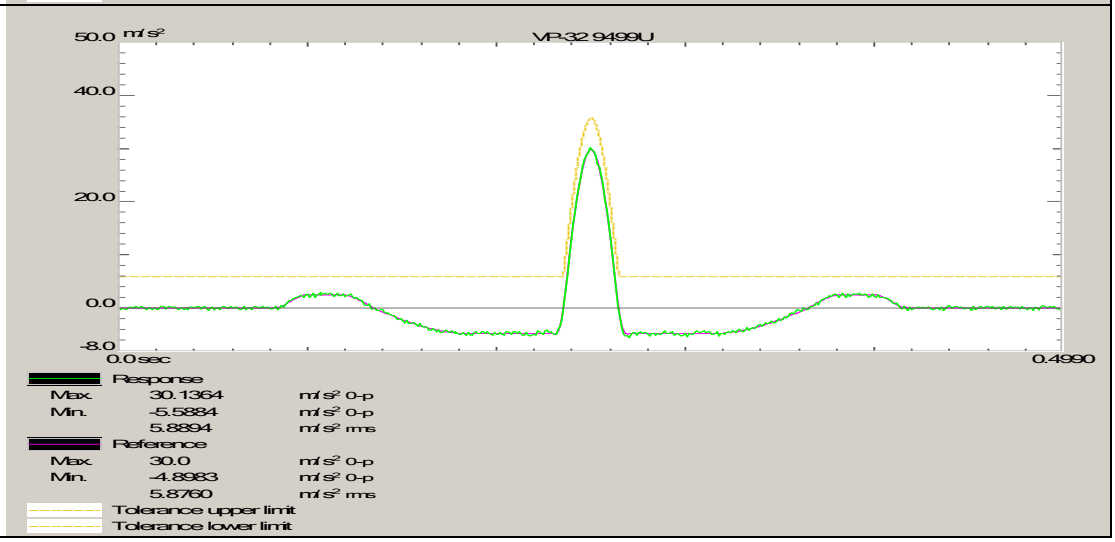
4.6.5 Test Setup Photo

Transverse **+ X Axis**	
Longitudinal **+ Y Axis**	
Vertical **+ Z Axis**	

Transverse **- X Axis**	
Longitudinal **- Y Axis**	
Vertical **- Z Axis**	

4.6.6 Test Profile

+X	
+Y	
+Z	

-X	 m/s² VP-32 9499U 50.0 40.0 20.0 0.0 -8.0 0.0 sec 0.4990 Response Max. 30.2964 m/s² 0-p Min. -5.6127 m/s² 0-p 5.9081 m/s² rms Reference Max. 30.0 m/s² 0-p Min. -4.8983 m/s² 0-p 5.8760 m/s² rms Tolerance upper limit Tolerance lower limit
-Y	 m/s² VP-32 9499U 80.0 75.0 50.0 25.0 0.0 -12.0 0.0 sec 0.4990 Response Max. 50.3111 m/s² 0-p Min. -9.9070 m/s² 0-p 9.8360 m/s² rms Reference Max. 50.0 m/s² 0-p Min. -8.1638 m/s² 0-p 9.7933 m/s² rms Tolerance upper limit Tolerance lower limit
-Z	 m/s² VP-32 9499U 50.0 40.0 20.0 0.0 -8.0 0.0 sec 0.4990 Response Max. 30.1364 m/s² 0-p Min. -5.5884 m/s² 0-p 5.8894 m/s² rms Reference Max. 30.0 m/s² 0-p Min. -4.8983 m/s² 0-p 5.8760 m/s² rms Tolerance upper limit Tolerance lower limit

5. Appendix

5.1 Appendix A: Test Equipment

5.1.1 Test Equipment List

Equipment	Model	Manufacturer	Serial No.	Equipment Range	Cal. Date	Due Date
Electrical safety analyzer	SE 7452	Extech Electronics .	1713353	AC 5kV/100mA, DC 6kV/10mA Insulation: 10M ohm ~ 10G ohm	06/20/2019	06/20/2020
Chamber	THS-B4T-150	King San Technology Co. Ltd.	5290K	"Temperature -40~150°C Humidity 10~95%"	11/30/2018	11/30/2019
Temperature & Humidity Record	TH110-POSE	KIMO	1F130907473	Temperature10°C~35°C Humidity 20%~95%	05/08/2019	05/08/2020
Digital Timer - Alarm Clock	N-396T	AVDr.AV	ISL-LT006	Timer (Full Range)	03/15/2019	03/15/2020

Location Con03	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conduction 03	EMI Receiver 13	ROHDE & SCHWARZ	ESCI	101015	07/25/2019	07/25/2020
Conduction 03	LISN 24	SCHWARZBECK	NNLK 8121	8121-829	06/17/2019	06/17/2020
Conduction 03	Chamber05 -1 Cable	WOKEN	CFD 300-NL	Chamber05 -1 Cable	08/29/2019	08/29/2020

Location Chamber02	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Radiation (Chamber02)	BILOG Antenna 17	Schwarzbeck	Schwarzbeck VULB 9168+EMCI-N-6-05	645	03/06/2019	03/06/2020
Radiation (Chamber02)	Preamplifier 25	EMCI	EMC9135	980295	02/27/2019	02/27/2020
Radiation (Chamber02)	Coaxial Cable Chmb 02-10M-02	EMC	RG214U	Chmb 02-10M-02	09/16/2019	09/16/2020
Radiation (Chamber02)	EMI Receiver 12	ROHDE & SCHWARZ	ESCI	100804	08/30/2019	08/30/2020

Location Chmb14	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Rad. Above 1GHz	Spectrum Analyzer 25	R&S	FSV 40	101499	11/01/2019	11/01/2020
Rad. Above 1GHz	Horn Antenna 13	ETS-Lindgren	3117	0161229	09/09/2019	09/09/2020
Rad. Above 1GHz	Preamplifier 20	EMC INSTRUMENT	EMC051845/EMCI-S-18-06	980084/AT-S 18001	03/21/2019	03/21/2020
Rad. Above 1GHz	Microwave Cable 35	WOKEN	WCBA-WCA04NM.SM6	Chamber 14-1	01/31/2019	01/31/2020
Rad. Above 1GHz	Microwave Cable 36	WOKEN	WCBA-WCA04NM.SM0.8	Chamber 14-2	01/31/2019	01/31/2020

Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
EN61K-4-2	ESD Gun 12	EM TEST	Dito	P1650188689	05/07/2019	05/07/2020
EN61K-4-3	Broadband Log-Periodic Antenna	AR	AT1080	310698	N/A	N/A
EN61K-4-3	Horn Antenna RF-01	AR	ATS700M11G	0335864	N/A	N/A
EN61K-4-3	Amplifier 80Mz~1GHz 250W	AR	250W1000A	312494	N/A	N/A
EN61K-4-3	Amplifier 800MHz~4.2GHz 50W	AR	50S1G4M1	312762	N/A	N/A
EN61K-4-3	Amplifier 4.0~8.0GHz 35W	AR	35S4G8AM1	0335752	N/A	N/A
EN61K-4-3	Broadband Coupler 80M~1GHz	Amplifier Research	DC6180A	0341805	N/A	N/A
EN61K-4-3	Coaxial Cable	INSULATED	NPS-4806-2360-NP3	108599.003.01.03	N/A	N/A
EN61K-4-3	Broadband Coupler 0.8G~4.26GHz	AR	DC7144A	0335226	N/A	N/A
EN61K-4-3	Broadband Coupler 4G~8GHz	AR	DC7350A	0335817	N/A	N/A
EN61K-4-3	Signal Generator 07	ROHDE&SCHWARZ	SMB100A	107780	10/28/2019	10/28/2020
EN61K-4-4	EFT and SURGE Test System	EM TEST	UCS-500 M6B	V0728102674	02/14/2019	02/14/2020
EN61K-4-4	Capacitive Coupling Clamp	EM TEST	HFK	0907-106	02/14/2019	02/14/2020
EN61K-4-5	CDN-UTP8 ED3	EMC-PARTNER	CDN-UTP8	1509	04/02/2019	04/02/2020
EN61K-4-5	SURGE-TESTER	EMC Partner	MIG0603IN3	523	04/02/2019	04/02/2020
EN61K-4-6	CDN M2+M3 04	TESEQ	CDN M016	43257	09/10/2019	09/10/2020
EN61K-4-6	CDN T2 04	FCC Inc.	FCC-801-T2	02067	08/14/2019	08/14/2020
EN61K-4-6	CDN T4 06	FCC Inc.	FCC-801-T4	02068	06/24/2019	06/24/2020
EN61K-4-6	CDN T8-10_2	Teseq GmbH	CDN T8 10	41241	03/26/2019	03/26/2020
EN61K-4-6	Coaxial Cable 4-6 02-1			4-6 02-1	N/A	N/A
EN61K-4-6	Conducted Immunity Test System 02	Frankonia	CIT-10-75-DC	126B1301/2014	03/25/2019	03/25/2020
EN61K-4-6	EM-Clamp	Schaffner	KEMZ-801	19215	11/22/2019	11/22/2020
EN61K-4-8	Magnetic Field Immunity Loop	FCC	F-1000-4-8-L-1M	01037	05/27/2019	06/05/2020
EN61K-4-8	Magnetic Field Test Generator	FCC	F-1000-4-8-G-125A	01038	05/27/2019	06/05/2020
EN61K-4-11	Voltage Dip and UP Simulator 01	NoiseKen	VDS-2002	VDS1750439	09/25/2019	09/25/2020

PS: N/A => The equipment does not need calibration.

**Software for Controlling Spectrum/Receiver and Calculating Test Data

Test Item	Filename	Version
EN61000-4-2	N/A	2.0
EN61000-4-3	i2	4.130102k
EN61000-4-4	EMC TEST	4.10
EN61000-4-5	EMC Partner	1.69
EN61000-4-6	FRANKONIA CD-LAB	V5.221
EN61000-4-8	N/A	

Site	Filename	Version	Issue Date
Conduction/Radiation	EZ EMC	ISL-03A2	3/6/2013

5.2 Appendix B: Uncertainty of Measurement

The laboratory measurement uncertainty accordance with refers to CISPR 16-4-2. If Ulab is less than or equal to Ucispr in Table 1, then the test report may either state the value of Ulab or state that Ulab is less than Ucispr.
The coverage factor k = 2 yields approximately a 95 % level of confidence.

<Conduction 03>
AMN: ±2.90dB

<Chamber 02 (10M)>
Horizontal
30MHz~200MHz: ±4.52dB
200MHz~1000MHz: ±4.42dB
Vertical
30MHz~200MHz: ±4.51dB
200MHz~1000MHz: ±4.70dB

<Chamber 14 (3M)>
1GHz~6GHz: ±4.93dB
1GHz~18GHz: ±4.48dB
18GHz~26.5GHz: ±4.40dB
26.5GHz~40GHz: ±4.40dB

<Immunity 02>

Test item	Uncertainty	Test item	Uncertainty
EN 61000-4-2 (ESD)		EN 61000-4-6 (CS)	
Rise time tr	≦ 9.81%	CDN	± 1.74dB
Peak current Ip	≦ 5.54%	EM Clamp	± 3.36dB
current at 30 ns	≦ 5.55%	EN 61000-4-8 (Magnetic)	± 6.53%
current at 60 ns	≦ 5.55%	EN 61000-4-11 (Dips)	± 2.41%
EN 61000-4-3 (RS)	± 1.89dB	EN 61000-3-2 (Harmonics)	± 1.29 %
EN 61000-4-4 (EFT)		EN 61000-3-3 (Fluctuations and Flicker)	± 6.8 %
voltage rise time (tr)	± 5.1%	EN 61000-3-12 (Harmonics)	±5.02%
peak voltage value (VP)	± 6.39%	EN 61000-3-11 (Fluctuations and Flicker)	±8.0%
voltage pulse width (tw)	± 5.0%	EN 61000-4-34 (Dips)	± 2.41%
EN 61000-4-5 (Surge)			
open-circuit voltage front time	±13.5%		
open-circuit voltage peak value	±6.6%		
open-circuit voltage duration (Td)	53.33μs		
EN 61000-4-9 (Pulse magnetic field)		IEC 61000-4-17 (Ripple)	
Time	± 2.80%	Voltage	± 17 μV/V
Voltage	± 5.5%	Current	± 0.83 mA/A
Current	± 3.3%	IEC 61000-4-18 (Damped oscillatory wave)	
IEC 61000-4-16 (conducted, common mode)		Time	± 2.80%
Time	± 2.80%	Voltage	± 5.5%
Voltage	± 5.5%	Current	± 4.5%
Current	± 3.3%	IEC 61000-4-29 (Voltage dips on d.c)	
Resistor	± 0.03 mΩ/Ω	Voltage	± 17 μV/V
Capacitor	± 24 μF/F	Current	± 0.83 mA/A

5.3 Appendix C: Photographs of EUT

Please refer to the File of **ISL-*19LE783*P-MA**