

EMC TEST REPORT

Project No.: L1-40002

Equipment under Test: Relay Tester

Model/Type : AMT105
S/N : 96011130
Rating : 220 VAC/DC, 50/60Hz, 10A

Manufactured By: Vebko Co.

Trade Mark : 

Address: Unit 15, 4th floor, No. 2, Bujarisefat Alley, Fariman Junction, Bozorgmehr St., Valiasr Sq., Valiasr Junction, Tehran, Iran. Email: info@vebko.ir

Applicant: Vebko Co.

Address: Same as manufacturer's address

Tested According To: EN 61326-1:2013

Date of Receipt of Test Item: 13-Mar-2018

Issue Date: 19-Jun-2019

No. of pages: 52

Tested By: Test Engineer

M. H. Salehi

Chief Executive Officer

S. M. Mirsadri

Verified By: Technical Manager

S. M. Mirfallah

Approved By:

Engineering Deputy of
Test and Inspection

Prof. B. Vahidi


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TEST REPORT	
Report number	L1-40002-T2
Date of issue	19.Jun.2019
Total number of pages	52
Name of testing laboratory	EPIL Lab.
preparing the report	Mohammad Hosein Salehi
Applicant's name	Vebko Co.
Address	Unit 15, 4th floor, No. 2, Bujarisefat Alley, Fariman Junction, Bozorgmehr St., Valiasr Sq., Valiasr Junction, Tehran, Iran. Email: info@vebko.ir
Manufactured name	Vebko Co.
Address	Unit 15, 4th floor, No. 2, Bujarisefat Alley, Fariman Junction, Bozorgmehr St., Valiasr Sq., Valiasr Junction, Tehran, Iran. Email: info@vebko.ir
Test specification:	
Standard	EN 61326-1: 2013
General disclaimer:	
The test results presented in this report relate only to the object tested.	

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Report No.: L1-40002-T2

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LQF-510-02

Test item description	Relay Tester
Trade mark	
Manufacturer.....	Vebko Co.
Model/type reference	AMT105
Ratings	220 VAC/DC, 50/60Hz, 10A
Responsible testing laboratory (as applicable), testing procedure and testing location(s):	
☒ Testing laboratory:	
Testing location(s)/ address(es)	1. EPIL EMC Lab. Kavosh Research City, Supa Blvd., 8th km. Karaj-Qazvin, Freeway, Iran. Tel: (+9826) 92108380-7 Telefax: (+9826) 9210838 AUT EMC Lab. Aboureihan Building, Department of Electrical Engineering, Amirkabir University of Technology, 44 Hafez Ave, Tehran, Iran. Tel: (+9821) 64548521
Tested by (name, function, signature)	M. H. Salehi, Test engineer
Approved by (name, function, signature)	S. M. Mirfallah, Test manager
☐ Testing procedure: CTE stage 1	
Tested by (name, function, signature)	
Approved by (name, function, signature)	
Testing location/address	
Tested by (name, function, signature)	M. H. Salehi, Test engineer
Witnessed by (name, function, signature)	S. M. Mirfallah, Test manager
Approved by (name, function, signature)	S. M. Mirsadri, Vice president of CEO
Supervised by (name, function, signature) :	Prof. B. Vahidi, Engineering deputy of test and inspection

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Postal Code: 1416854523 Tel: 021-61971 Fax: 021-66174283
Lab: Kavosh Reaserch City, Supa Blvd., 8th km of karaj-Qazvin Freeway, Iran
Tel: 026-92108380-9 Fax: 026-92108385
info@eepil.com www.eepil.com

List of attachments (including a total number of pages in each attachment):

Summary of testing:

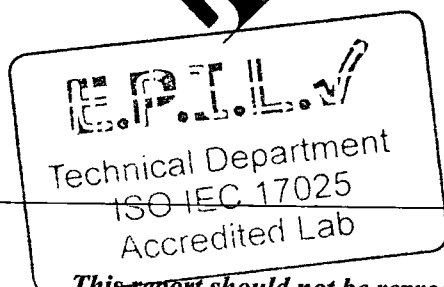
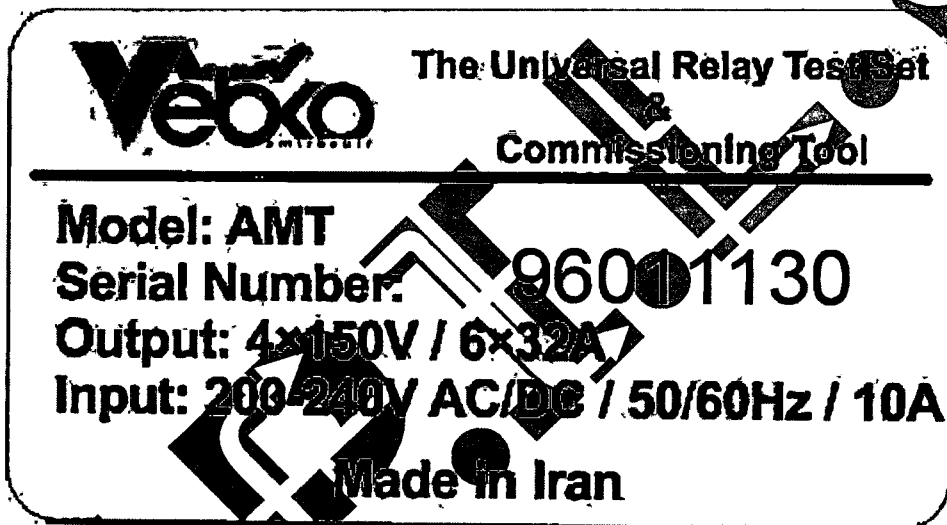
Tests performed (name of test and test clause):		Testing location:
3.4	Electrostatic discharges	EPIL EMC Lab.
3.5	Radiated, radio-frequency, electromagnetic field	AUT EMC Lab.
3.6	Electrical fast transients	EPIL EMC Lab.
3.7	Surges	EPIL EMC Lab.
3.8	Injected currents (radio frequency common mode)	EPIL EMC Lab.
3.9	Power frequency magnetic fields	EPIL EMC Lab.
3.10	Voltage dips, short interruptions	EPIL EMC Lab.
4.1	Conducted disturbances	EPIL EMC Lab.
4.2	Electromagnetic radiation disturbance	AUT EMC Lab.
4.3	Voltage fluctuations and flicker	EPIL EMC Lab.
4.4	Harmonic current emissions	EPIL EMC Lab.

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Copy of marking plate:



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Test item particulars :

Classification of installation and use: Portable

Supply connection: Detachable cord set

Possible test case verdicts:

- Test case does not apply to the test object: N/A

- Test object does meet the requirement: P (Pass)

- Test object does not meet the requirement: F (Fail)

Testing:

Date of receipt of test item: 13-Mar-2018

Date (s) of performance of tests.....: 28-May-2019

General remarks:

"(See enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's declaration per sub-clause 4.2.5 of IEC 60335-1:

The application for obtaining a CB test certificate includes more than one factory location and a declaration from the manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided

☐ Yes
☒ Not applicable

When differences exist; they shall be identified in the general product information section.

Name and address of factory (ies).....: Vebko Co.

Unit 15, 4th floor, No. 2, Bujarisefat Alley,
Fariman Junction, Bozorgmehr St., Valiasr
Sq., Valiasr Junction, Tehran, Iran. Email:
info@vebko.ir

General product information (GPI) and other remarks:

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Tel: 026-92108380-9 Fax: 026-92108385
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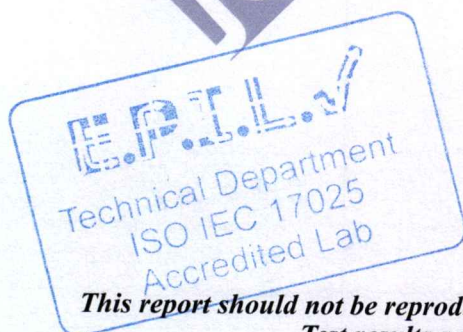
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1 GENERAL INFORMATION

1.1 Product Information

Equipment under test : Relay Tester
Manufacturer : Vebko
Model/Type : AMT105
S/N : 96011130
Rating : 220 VAC/DC, 50/60Hz, 10A

1.2 EUT Description

About

AMT 105 is a universal solution to testing all types of protection relays and instruments such as power transformers, current transformers, potential transformers, capacitor transformers, circuit breakers, cables and RTD. This device is capable of testing all electromechanical relays and protection instruments and equipped with six 32 A current sources (64 A in three-phase mode, 128 A in single-mode), four 150 V voltage sources (450 V in single-mode), current and voltage combination cable, 8 analog binary inputs, 2 DC analog current and voltage inputs with high accuracy, 4 binary outputs, DC voltage source (212 V).

Capabilities of AMT105 Relay Tester

- Software Specifications
 1. Capable of testing a wide range of electro mechanical, static, and numerical relays
 2. Capable of reading, editing, and creating all XRio and Rio files
 3. Capable of transient testing
 4. Capable of point-to-point or end-to-end testing
 5. Built-in GPS and Wi-Fi
 6. Automatically performing tests
 7. Comprehensive report of tests
 8. Capable of automatically filling out the test sheets of different companies
 9. Compatible with Windows XP, 8, 10
 10. Supporting Android and iOS apps
 11. Autosave, Redo, and Undo options
 12. PDF Help file in Farsi (English version coming soon)
 13. Using bootloader technology to update firmware
 14. A host of instructional videos

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Different testing rooms

- AMT Sequencer
Used to design tests that employ the Normal, Quick, Step Ramp, Continuous Ramp, Harmonic, Transient, and Z-Tracking modules singly or in combination.
- Quick
- AMT Overcurrent
To test Current functions like 51/50/51N/50N/67/67N etc.
- AMT Distance
To test the impedance functions (Distance, Under-Excitation)
- AMT Differential
Used to test the differential function via the injection of two three-phase currents from two different sides; also used to test the REF protection function.
- AMT Diff. Harmonic
- VCC
Used to successively run the tests designed for a relay.

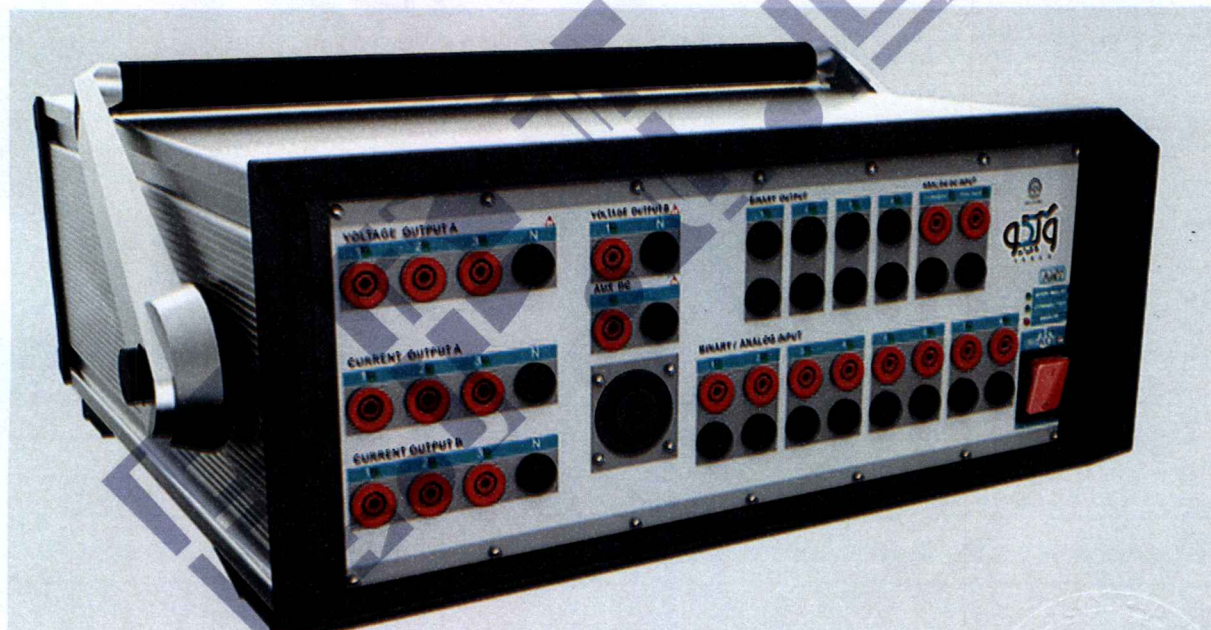
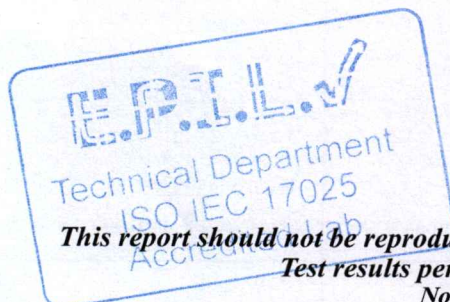


Figure 1: EUT



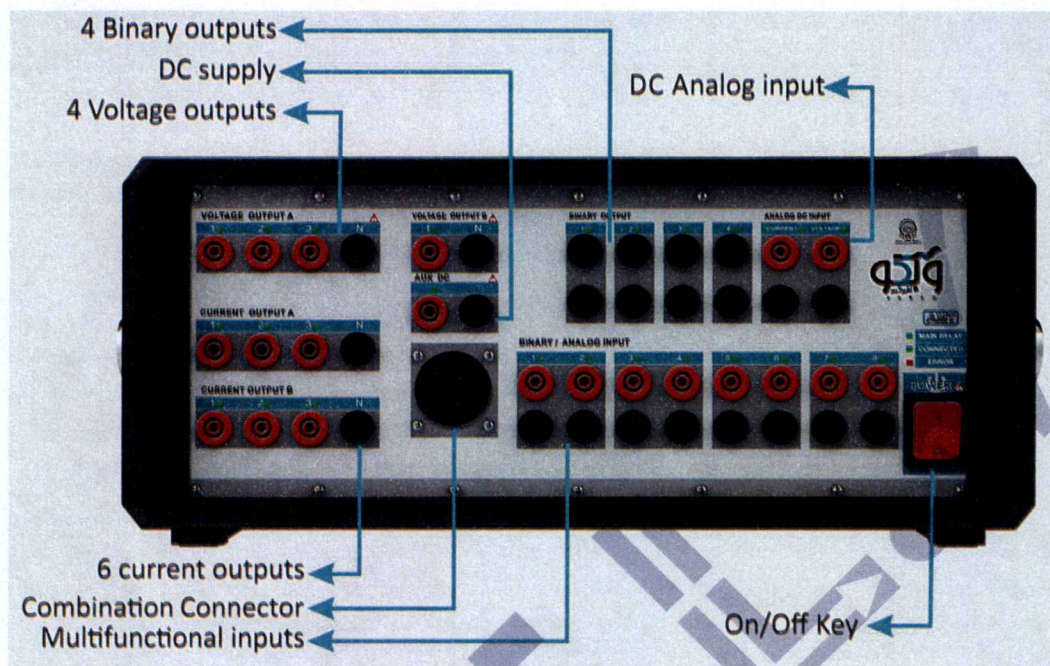


Figure 2: Front panel

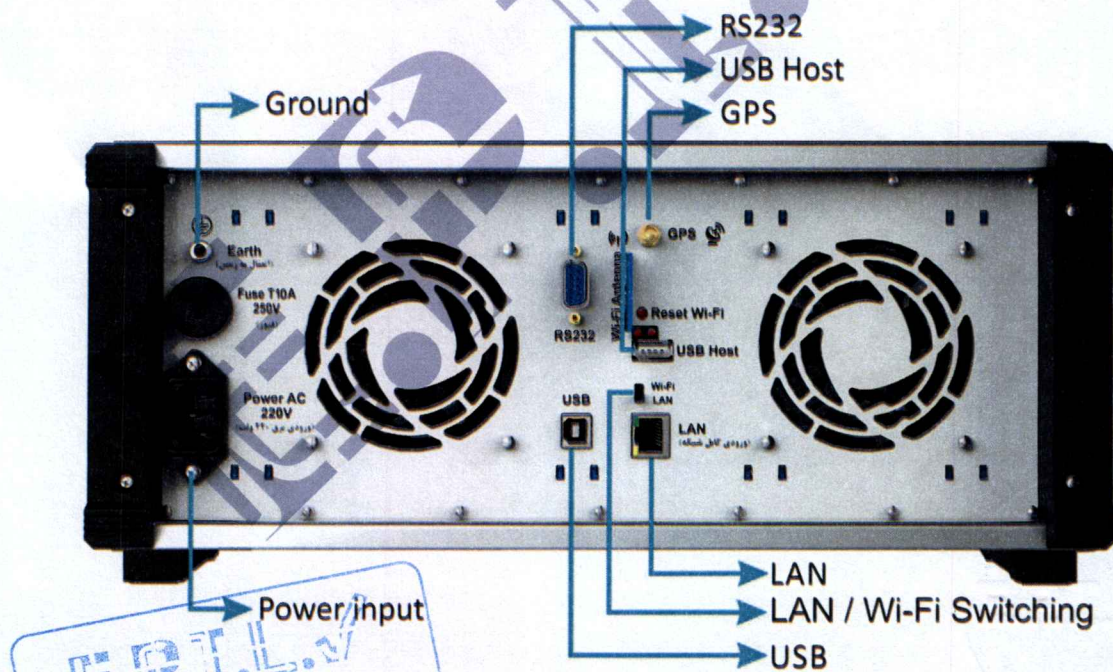


Figure 3: Rear panel

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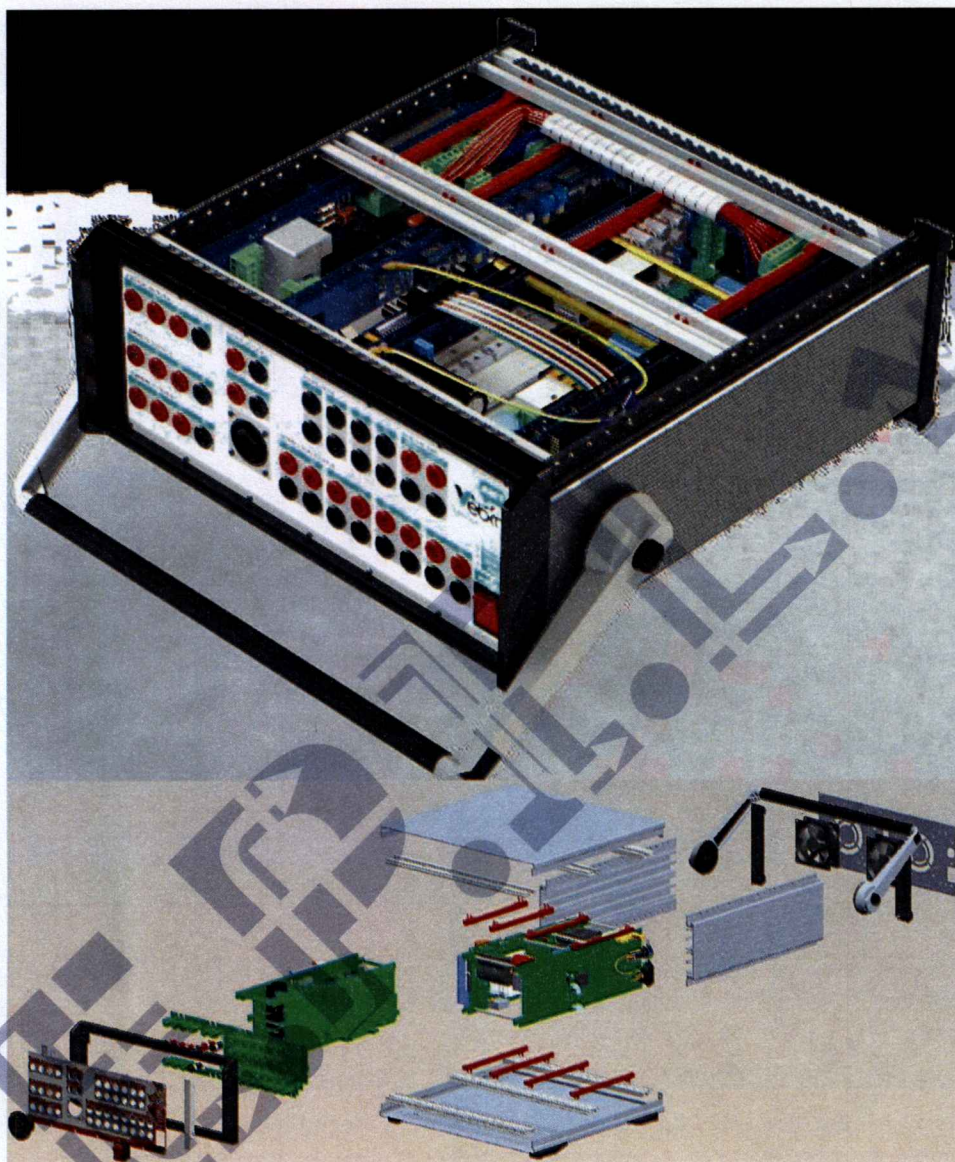


Figure 4: 3D view of EUT

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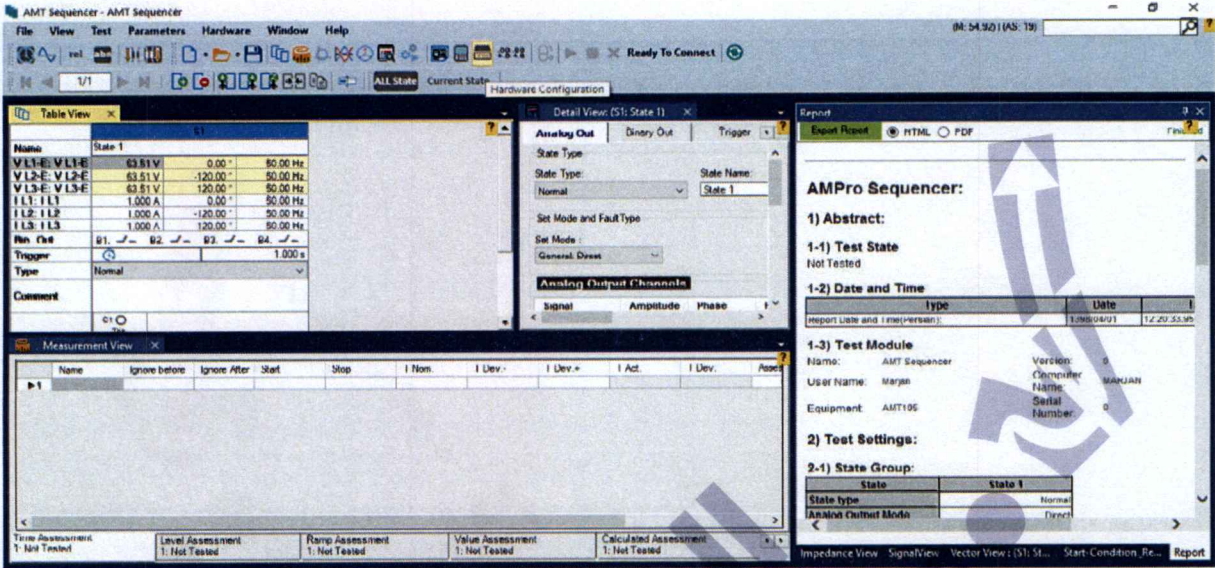


Figure 5: Graphic user interface

1.2.1 EUT specifications

Table 1: The parts list of relay tester

Row Number	Part Name	Manufacturer Company	Model
1	Relay tester	Vebko Co.	AMT105
2	Portable computer	Asus	X555
3	Software	Vebko Co.	AmPro Stable



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2 SUMMARY

This section presents an overview of standard and results. Refer to the next section for details of measured test results and applied test levels.

2.1 Overview of Results

Immunity Tests	Standards	Results
Electrostatic discharge	IEC 61000-4-2 :2008	Pass
Radiated EM field immunity	IEC 61000-4-3 :2006+AMD1:2007+AMD2:2010	Pass
Burst	IEC 61000-4-4 :2004+AMD1:2010	Pass
Surge	IEC 61000-4-5 :2005	Pass
RF conducted immunity	IEC 61000-4-6 :2008	Pass
Power frequency magnetic field	IEC 61000-4-8 :2009	Pass
Voltage dips and short interruptions	IEC 61000-4-11 :2004	Pass
Emission Tests	Standards	Results
EMI conducted measurement	CISPR 11:2009+A1 :2010	Pass
EMI radiated measurement	CISPR 11:2009+A1 :2010	Pass
Voltage flicker measurement	IEC 61000-3-3 :2008	Pass
Current harmonic measurement	IEC 61000-3-2 :2005+AMD1:2008+AMD2:2009	Pass

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3 IMMUNITY TEST RESULTS

3.1 Test Requirements

EUT considered as basic electromagnetic environment according to EN 61326-1

3.2 Performance Criteria

3.2.1 Performance criterion A

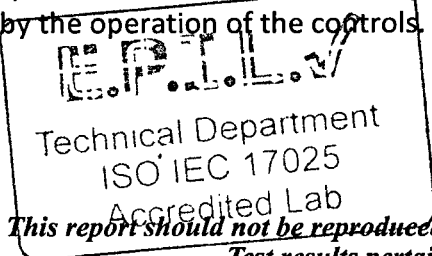
The equipment shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.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

3.2.2 Performance criterion B

The equipment 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 equipment is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

3.2.3 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.



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3.3 EUT Performance Condition

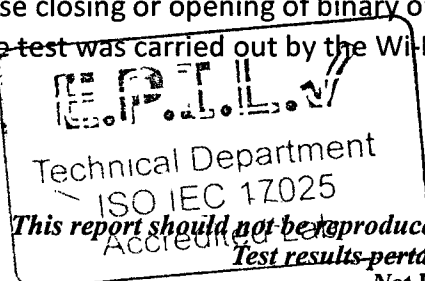
The description of the tests, the test methods, the characteristics of the tests, and the test set-ups are given in the basic standards, which are referred to in 6.2 page 13 and 7.2 page 18 according to EN 61326-1:2013.

Put the AMT 105 in an appropriate place, connect its ground, and plug it into the outlet. You can turn on the device with 200-240 V AC power. You can also turn on AMT with a minimum DC voltage of 250 V.

Turn on the device using the power key embedded in the front panel. When the device turns on, it starts self-testing. At this point, let the device become fully operational. If the device detects an error in the hardware or in the preparation process for testing, the error light on the front panel turns on. If the hardware is faultless, no message will be displayed on the test page, and the Main Relay LEDs on the device will become green.

Before beginning tests, AMT105 prepared to work in active mode in which currents and voltages are being injected during all the procedures of tests. The AmpPro was run, "AMT Sequencer" selected and input the amplitude and phase and frequency values in "Hardware Configuration" in the upper middle of page (see Figure 5). The values for voltages are selected as nominal voltages mostly used in power systems. Optional modules are not tested. During tests healthy operation of binary inputs, binary outputs, 6×1A 50 Hz current phase and 4×10 V 50 Hz voltage phase for Immunity tests, 6×5 A 50 Hz current phase and 4×63.51 V 50 Hz voltage phase for emission tests and max power of fan are monitored and checked. According to manufacturer's recommendations, in order to verifying performance of the EUT and preparing a test point, "AMT Sequencer" software module has been used throughout all the tests and following items monitored:

- Any malfunction of the system (hardware or software)
- Any variation of set parameters and limits such as voltage or current amplitude, frequency, phase ...
- Any waveform distortion
- Any discontinuation of outputs
- Any false error indications
- Any faulty situation as mentioned in 3.3.1
- False closing or opening of binary outputs
- The test was carried out by the Wi-Fi module



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3.3.1 Faulty situation

Faulty situation occurs in the following situations

- If any overload indication is popped up on the screen which caused the outputs injection stop
- If hardware hangs and needs restart
- If software hangs and needs software restart
- If LAN and Wi-Fi module disconnect and needs restart
- None of the outputs should stop generating voltage or current
- No trip should be induced or detected (shown in binary inputs/trigger table)
- No abnormal sound should be heard
- The outputs should maintain in correct and error-free condition



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3.4 Electrostatic Discharge Immunity Test

Electrostatic discharges (ESD) are the result of persons or objects that accumulate static electricity due to for instance walking on synthetic carpets. The ESD can influence the operation of equipment or damage its electronics, either by a direct discharge or indirectly by coupling or radiation. Both effects are simulated during the tests.

3.4.1 Test data

Location : EPIL
Date : 29-Apr-2015
Engineer of EPIL : M. H. Salehi

3.4.2 Ambient conditions

Ambient Temperature : 24.4 °C
Relative Humidity : 43.6 %
Atmospheric pressure : 86.5 kPa

3.4.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
ESD generator	Schlöder	SESD 200	-----

3.4.4 Procedure of test

The test was carried out according to IEC 61000-4-2 under the following conditions:

- Tested as table-top equipment
- Each analog output voltage is connected to binary inputs so that read the values of its.

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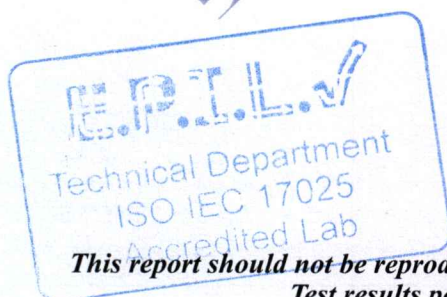
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Performed test:

Basic Standard : IEC 61000-4-2
Tested Ports : Surface of the specimen
Air Discharges : ± 8 kV
Contact Discharges : ± 4 kV (Direct & Indirect)
Polarity : Positive and negative
Number of Application : Ten positive and ten negative

3.4.5 Test result

Test level	Coupling		Complied with Criteria	Acceptance Criteria	Result
± 4 kV	Contact	Direct	A	B	Pass
		Indirect	A	B	Pass
± 8 kV	Air		A	B	Pass



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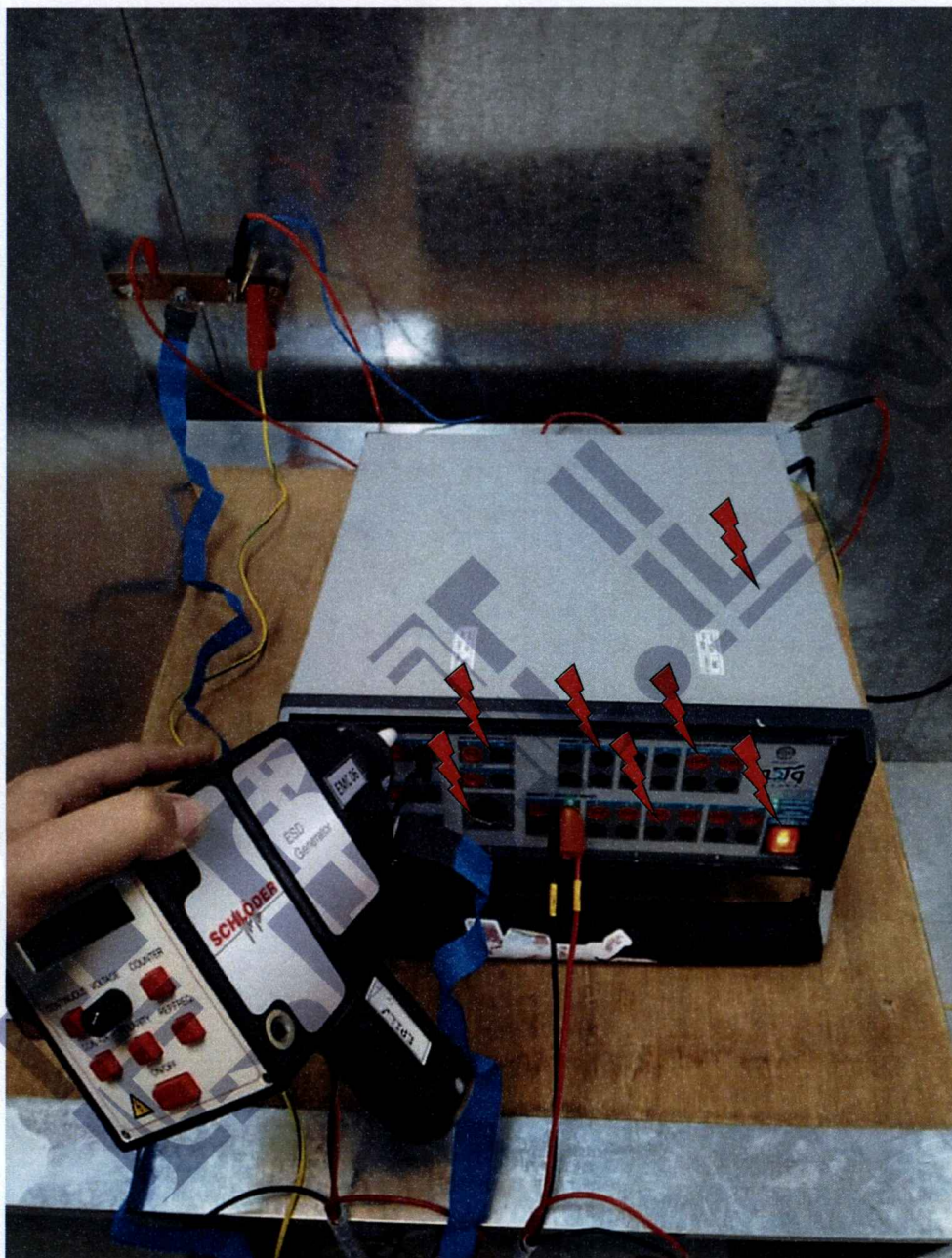


Figure 6: Discharge points

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3.5 Immunity to Radiated RF Electromagnetic Fields

The object of this test is evaluating the immunity of electrical and electronic equipment subjected to radiated, radio-frequency electromagnetic fields.

3.5.1 Test data

Location : Amirkabir university EMC lab.
Date of test : 12-Jun-2019
Engineer of test : M. H. Salehi

3.5.2 Ambient conditions

Ambient temperature : 25.7
Relative humidity : 39.5 %

3.5.3 Instrument used for test

Equipment	Manufacturer	Model
Semi-anechoic chamber	Albatross	P23315
Integrated EMS measurement system	R&S	IMS
Cable set and connections	R&S	N/A
GPIO-extender	R&S	NI-G140
EMC32 software	R&S	EMC32-E+
Power sensor	R&S	NRP-Z91
Attenuator	R&S	RBU100
Line distributor/EVM Filter	R&S	CS-LDE
System controller laptop	R&S	BIT-RNB
High gain log-periodic antenna	R&S	HLE046E
Broadband field meter	R&S	TS-NBM500
E-field probe isotropic	R&S	TS-EF0391
Field strength sensor mast	R&S	I-FSM230
Power amplifier	R&S	B-WO825A

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3.5.4 Procedure of test

The test procedure was in accordance with IEC 61000-4-3 as the following:

- The test was performed in a semi-anechoic chamber
- The transmitting antenna was located at a distance of 3 meters from the EUT
- The EUT is a table-top equipment, it is mounted on a 80 cm high non-conductive table
- The transmitting antenna was fixed at 1.55 meter above ground
- The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz
- The dwell time at each frequency was 0.5 sec

Note: The dwell time at each frequency shall not be less than the time necessary for the EUT to be able to respond

- The frequency range is 80 MHz-1000, 1.4 GHz-2.6GHz, 2 GHz-2.7 GHz
- For receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the three sides
- In order to be capable of judging the EUT performance visually, a CCD camera was used to monitor the EUT
- Optional anechoic material such as pyramid absorbers and laid ferrites were used to reduce floor reflections
- EUT tested as table top equipment
- During tests healthy operation of binary inputs, binary outputs, 6x1 A 50 Hz current phase and 4x10 V 50 Hz voltage phase and max power of fan are monitored and checked

3.5.5 Test Result

Frequency Range	Test level (V/m)	Dwell time (sec)	Ant. Polarity	Complied with Criteria	Acceptance Criteria	Result
80 MHz – 1 GHz	10	0.5	H / V	A	A	PASS
1.4 GHz – 2 GHz	3	0.5	H / V	A	A	PASS
2 GHz – 2.7 GHz	1	0.5	H / V	A	A	PASS

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3.6 Electrical Fast Transient Burst Immunity Test

This test simulates quick transient noise interferences mostly generated when switching inductive loads. Significant for this interference's is a very short rise time of the single pulses and the high repetition rate within burst packet.

3.6.1 Test data

Location : EPIL
Date : 13-Mar-2019
Engineer of EPIL : M. H. Salehi

3.6.2 Ambient conditions

Ambient temperature : 22.9 °C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

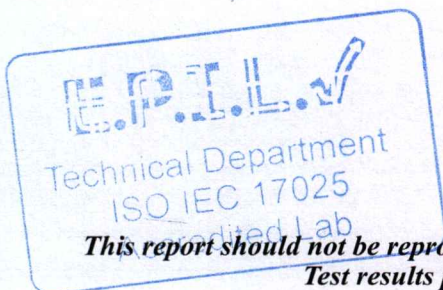
3.6.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
Burst generator	Schlöder	SFT 400	403315

3.6.4 Procedure of test

The test was carried out according to IEC 61000-4-4 under the following conditions:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×1 A 50 Hz current phase and 4×10 V 50 Hz voltage phase and max power of fan are monitored and checked.



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Performed test:

Basic standard	IEC 61000-4-4
Peak voltage	±2 kV
Coupling method	Direct
Tested ports	AC power
Repetition rate	5 kHz
Coupling lines	L-N-PE
Test time	60 seconds

3.6.5 Test results

Coupling Line	Voltage	Repetition Frequency	Coupling Method	Complied with Criteria	Acceptance Criteria	Result
L	±2 kV	5 kHz	Direct	A	B	Pass
N	±2 kV	5 kHz	Direct	A	B	Pass
PE	±2 kV	5 kHz	Direct	A	B	Pass
L-N	±2 kV	5 kHz	Direct	A	B	Pass
L-PE	±2 kV	5 kHz	Direct	A	B	Pass
N-PE	±2 kV	5 kHz	Direct	A	B	Pass
L-N-PE	±2 kV	5 kHz	Direct	A	B	Pass

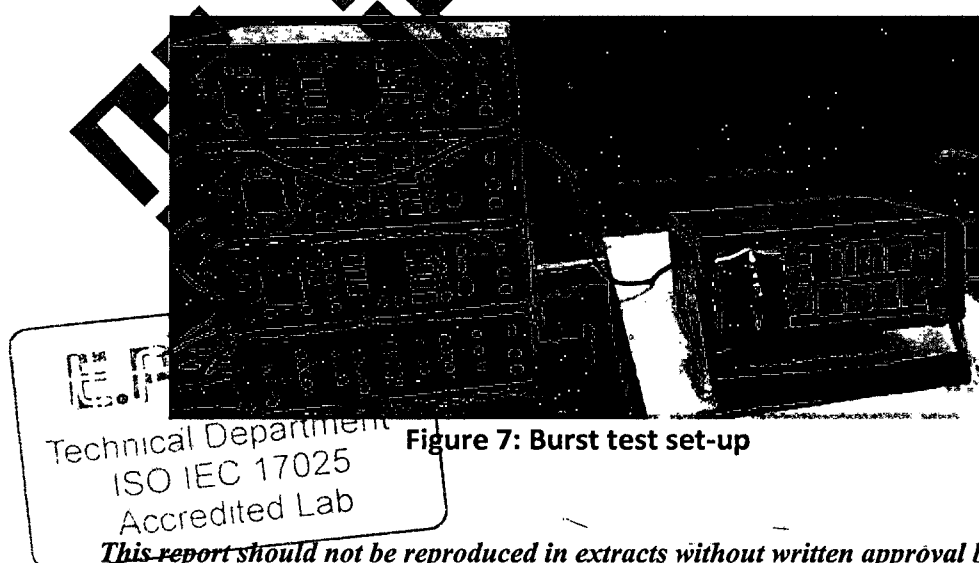


Figure 7: Burst test set-up

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3.7 Surge Immunity Test

This test simulates high-energy pulses on supply mains as if they appear for example after over-voltage events (e.g. lightning strikes). The pulse is a low transient with high-energy contents and due to its long duration may cause damage to an unprotected EUT.

3.7.1 Test data

Location : EPIL
Date : 28-May-2019
Engineer of EPIL : M. H. Salehi

3.7.2 Ambient conditions

Ambient temperature : 22.9°C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

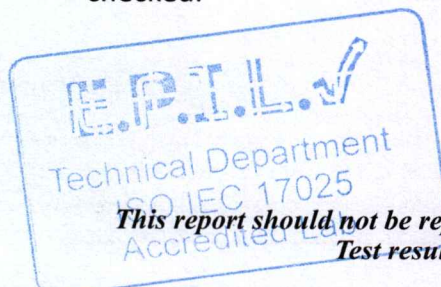
3.7.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
Surge generator	Schlöder	CWG 500	312081

3.7.4 Procedure of test

The test was carried out according to IEC 61000-4-5 under the following conditions:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×1 A 50 Hz current phase and 4×10 V 50 Hz voltage phase and max power of fan are monitored and checked.



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Performed test:

Basic standard	IEC 61000-4-5
Pulse characteristics	1,2/50 μ s
Peak voltage	± 1 kV (Differential mode) ,2 kV (Common mode)
Phase	0°, 90°, 180°, 270°
Tested ports	Power Supply
Coupling line	L,N,PE
Repetition rate	1/60 sec

3.7.5 Test result

Coupling Line	Voltage	Coupling method	Complied with Criteria	Acceptance Criteria	Result
L-N	± 1 kV	Capacitive	A	B	Pass
L-PE	± 2 kV	Capacitive	A	B	Pass
N-PE	± 2 kV	Capacitive	A	B	Pass

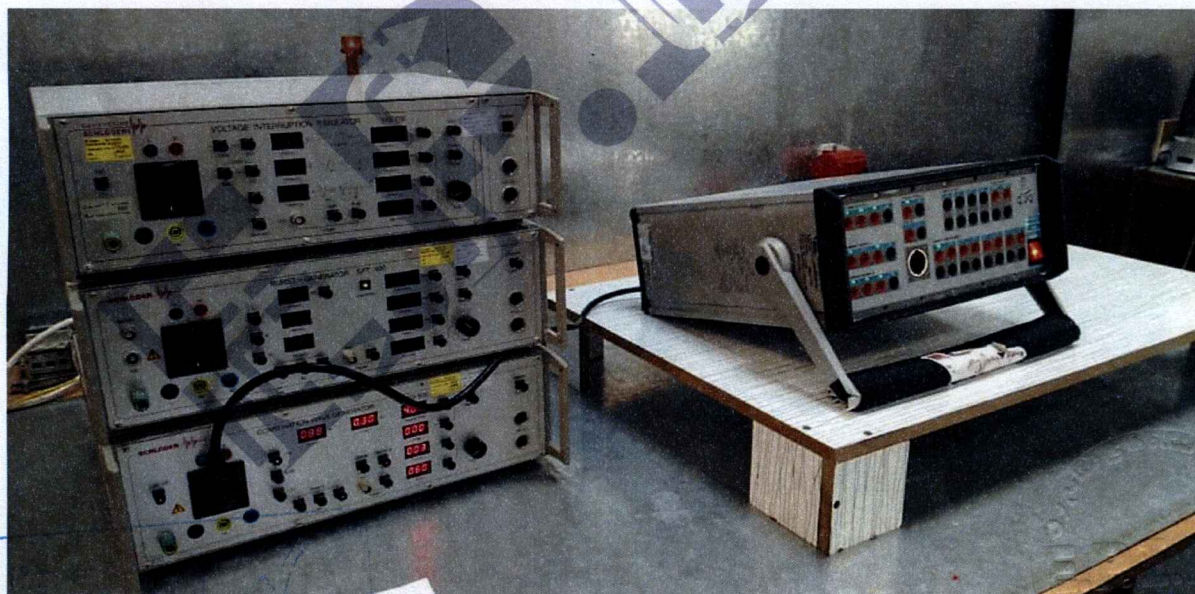


Figure 8: Surge test set-up

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3.8 Immunity to Conducted Disturbances, Induced by RF Fields

The object of this test is evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by radio-frequency fields.

3.8.1 Test data

Location : EPIL
Date : 13-Mar-2019
Engineer of EPIL : M. H. Salehi

3.8.2 Ambient conditions

Ambient temperature : 22.9
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

3.8.3 Instrument used for test

Equipment	Manufacturer	Model
Signal generator	R&S	SML-01
Power amplifier	Com-Power	ACS-230-50W
Attenuator	Com-Power	ATTN-6-100W
CDN	Com-Power	M325E

3.8.4 Procedure of test

The test procedure was in accordance with IEC 61000-4-6 as the following:

- The frequency range is swept from 150 kHz to 80 MHz, using the signal level of 3 V established during the setting process, and with the disturbance signal 80 % amplitude modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or to change coupling devices as necessary.
- Where the frequency is swept incrementally, the step size is 1 % of the preceding frequency value.

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- The dwell time at each frequency was 0.5 sec.
- EUT tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×1 A 50 Hz current phase and 4×10 V 50 Hz voltage and max power of fan are monitored and checked.

3.8.5 Test result

Test Port	Injection Method	Test Level (V)	Complied with Criteria	Acceptance Criteria	Frequency Range (MHz)	Dwell Time (Sec)	Result
L-N-PE	CDN	3	A	A	0.15 - 80	0.5	PASS



Figure 9: Conducted disturbances test set-up

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3.9 Power Frequency Magnetic Field Immunity Test

Magnetic fields can affect the reliable operation of electrical and electronic equipment. The power frequency magnetic field simulates power frequency current in conductors or leakage from transformers or other current carrying conductors in the area.

3.9.1 Test data

Location : EPIL
Date : 29-Apr-2019
Engineer of EPIL : M. H. Salehi

3.9.2 Ambient conditions

Ambient temperature : 24.3 °C
Relative humidity : 32.1 %
Atmospheric pressure : 86.5 kPa

3.9.3 Instrument used for test

Equipment	Model	Manufacturer
Power freq. magnetic field	1m x 1m 1 turn inductive coil	EPIL
Test generator	CPC-100	Omicron
EMF tester	EMF 827	LUTRON

3.9.4 Procedure of test

The test was carried out according to IEC 61000-4-8 under the following conditions:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6x1 A 50 Hz current phase and 4x10 V 50 Hz voltage phase and max power of fan are monitored and



Performed test:

Basic standard	IEC 61000-4-8
Test frequency	50 Hz

3.9.5 Test result

Orientation	Field A/M	Test Duration	Complied with Criteria	Acceptance Criteria	Result
X	30	10 min	A	A	Pass
Y	30	10 min	A	A	Pass
Z	30	10 min	A	A	Pass

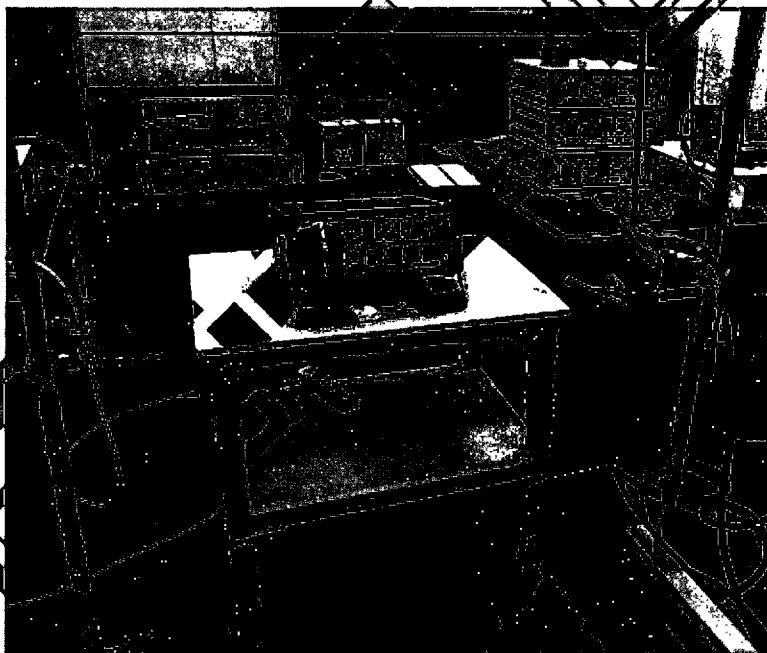


Figure 10: Power frequency magnetic field test set-up

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3.10 Voltage Dips and Short Interruptions Immunity Test

Electrical and electronic equipment may be affected by voltage dips, short interruptions or voltage variations of power supply. Voltage dips and short interruptions are caused by faults in the network, in installations or by a sudden large change of load. In certain cases, two or more consecutive dips or interruptions may occur. Voltage variations are caused by the continuously varying loads connected to the network.

3.10.1 Test data

Location : EPIL
Date : 13-May-2019
Engineer of EPIL : M. H. Salehi

3.10.2 Ambient conditions

Ambient temperature : 22.9 °C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

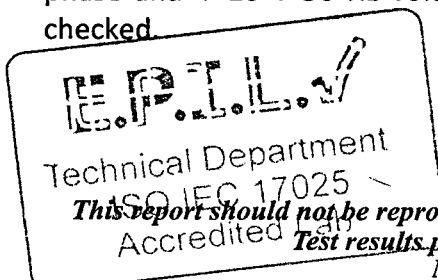
3.10.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
Voltage dips & short interruption simulator	Schlöder	VIS 700	403054

3.10.4 Procedure of test

The test was carried out according to IEC 61000-4-11 under the following conditions:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×1 A 50 Hz current phase and 4×10 V 50 Hz voltage phase and max power of fan are monitored and checked



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Performed test:

Basic standard	IEC 61000-4-11
Tested ports	Power supply
Voltage dips	0% (0.02 s) , 40% (0.2 s) , 70% (0.5 s)
Voltage interruption	0% (5 s)

3.10.5 Test result

Test Level (% U _t)	Duration (ms)	Complied with Criteria	Acceptance Criteria	Result
0	0.02	A	B	Pass
40	0.2	A	B	Pass
70	0.5	A	C	Pass
0	5	C	C	Pass



Figure 11: Voltage dips and short interruptions test set-up

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4 EMISSION TESTS RESULTS

Emission measurements were executed at the AMT Sequencer software module throughout all the tests with values for voltages which were selected as nominal voltages mostly used in power systems and the nominal values for 6 output currents were all 5 Amperes which is the biggest between 1 A and 5 A and the phases of outputs are all in balanced angles and the frequency chosen in 50 Hz in order to prepare worst condition while tests are being done, as specified by the manufacturer.

4.1 Power Line Conducted Emission Measurement

Conducted measurements are performed on several electrical lines of the EUT and extract the conducted RF interference that EUT injects into power lines.

4.1.1 Test data

Location : EPIL
Date : 13-Mar-2019
Engineer of EPIL : M. H. Salehi

4.1.2 Ambient conditions

Ambient temperature : 22.9 °C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

4.1.3 Instrument used for test

Equipment	Manufacturer	Model
EMI receiver	R&S	ESCS 30
2-Line LISN	R&S	ENV216

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4.1.4 Procedure of test

The test was carried out according to CISPR 11 under the following condition:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×5 A 50 Hz current phase and 4×63.51 V 50 Hz voltage phase for emission tests and max power of fan are monitored and checked
- Measurements made with a quasi-peak and average detector receiver

Basic standard : CISPR 11
Frequency range : 150 kHz to 30 MHz

4.1.5 Limits of mains terminal disturbance voltage

Table 2: Limits for conducted disturbance at the mains ports class A

Frequency Range MHz	Limits dB(μV/m)	
	Quasi-Peak	Average
0.150 to 0.50	79	66
0.50 to 30	73	60



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4.1.6 Uncertainty of measurements

The reported expanded uncertainty, U_{lab} , is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evolution has been carried out in accordance with the documents CISPR 16-4-2.

Uncertainty of conducted emission (0.15-30 MHz) : 3.14 dB

Compliance or non-compliance with a disturbance limit is determined according to the following, quoted from CISPR 16-4-2:2003.

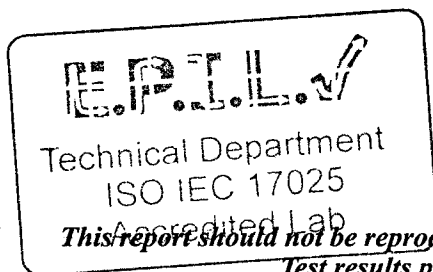
If U_{lab} is less or equal to U_{cispr} then:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} then:

- Compliance is deemed to occur if no measured disturbance, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;

U_{cispr} for conducted disturbance, 150 kHz-30 MHz, is 3.4 dB



4.1.7 Test result

Conducted disturbance levels measured with quasi-peak and average detector receiver are shown in Figure 12.

EUT met the specified limits of the standard.

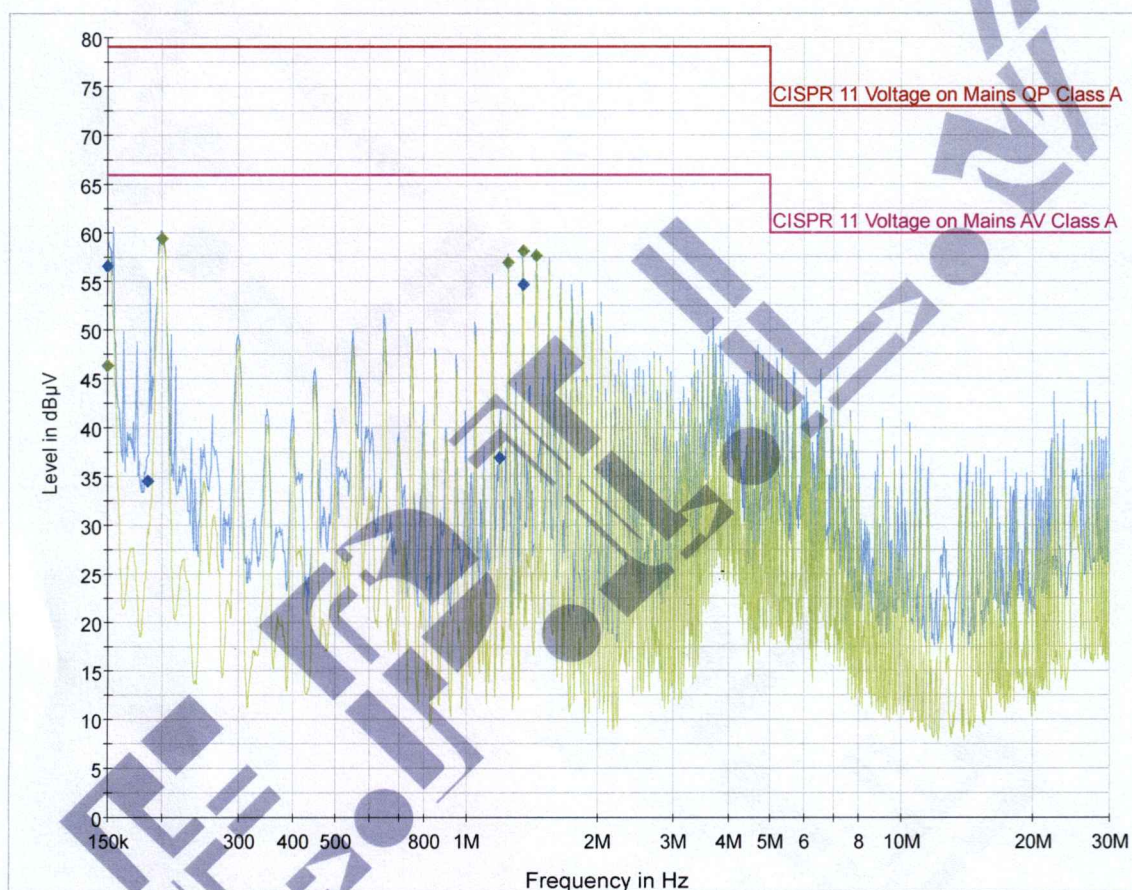


Figure 12: Measured conducted disturbance level (dBμV)



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Table 3: EMI Conducted QP final result

Frequency MHz	QuasiPeak dBμV	Meas. Time ms	Bandwidth kHz	Filter	Line	Corr. dB	Margin dB	Limit dBμV	Comment
0.150000	56.5	100.0	9.000	On	N	10.0	22.5	79.0	Pass
0.186000	34.5	100.0	9.000	On	N	9.9	44.5	79.0	Pass
1.194824	37.0	100.0	9.000	On	L1	10.0	42.0	79.0	Pass
1.349239	54.6	100.0	9.000	On	N	10.0	24.4	79.0	Pass

Table 4: EMI Conducted AV final result

Frequency MHz	Average dBμV	Meas. Time ms	Bandwidth kHz	Filter	Line	Corr. dB	Margin dB	Limit dBμV	Comment
0.150000	46.3	100.0	9.000	On	L1	10.0	19.7	66.0	Pass
0.199500	59.4	100.0	9.000	On	N	9.9	6.6	66.0	Pass
1.249375	56.9	100.0	9.000	On	L1	10.0	9.1	66.0	Pass
1.349239	58.1	100.0	9.000	On	L1	10.0	8.0	66.0	Pass
1.451324	57.7	100.0	9.000	On	L1	10.0	8.3	66.0	Pass

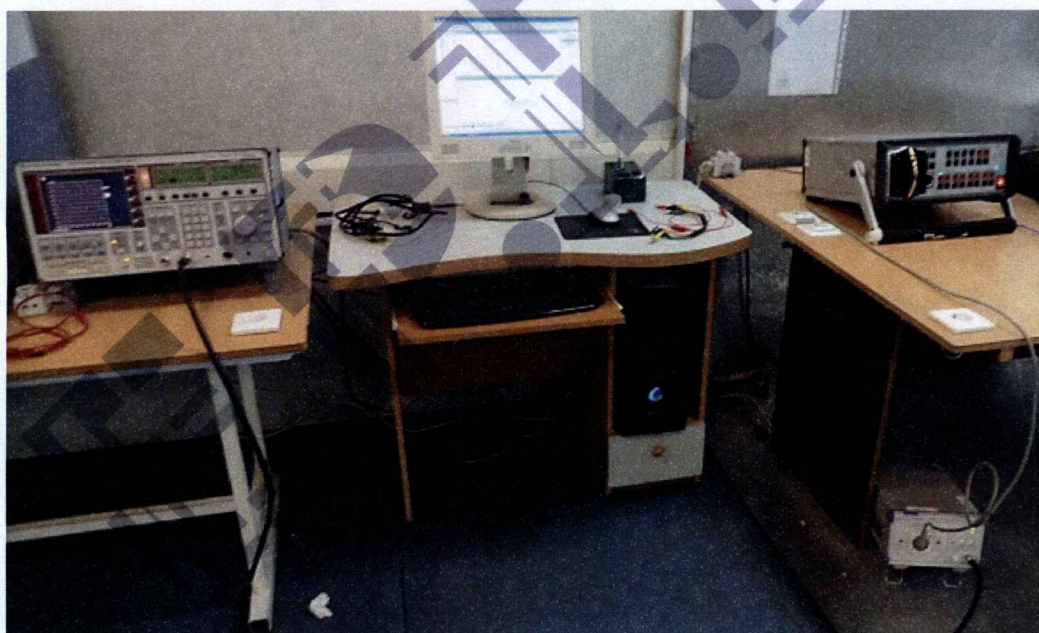


Figure 13: EMI conducted test set-up

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4.2 Radiated Emission Measurement

The purpose of interference measurements is to verify that the EUT (Equipment under test) does not generate electromagnetic interference, that is, it does not emit electromagnetic radiation above specified limits, so that other electrical devices operation will not be disturbed by it.

4.2.1 Test data

Location : Amirkabir university EMC lab.
Date : 12-Jun-2019
Engineer of EPIL : M. H. Salehi

4.2.2 Ambient conditions

Ambient temperature : 26 °C
Relative humidity : 21 %

4.2.3 Instrument used for test

Equipment	Manufacturer	Model
EMI Receiver	R&S	ESIB26
Semi-Anechoic Chamber	Albatross	P23315
Log-Per EMI-Antenna	R&S	HL562

4.2.4 Procedure of test

The test was carried out according to CISPR 11 under the following condition:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6x5 A 50 Hz current phase and 4x63.51 V 50 Hz voltage phase for emission tests and max power of fan are monitored and checked
- Measurements made with a quasi-peak detector receiver
- Bandwidth : 120 kHz
- Measuring time: 1 sec
- Frequency range: 30 MHz - 1 GHz

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- Measured at 3 m distance

4.2.5 Limits for radiated disturbance

Table 5: Limits for radiated disturbance of class A at 3 m

Frequency Range MHz	Quasi-Peak Limits dB(μV/m)
30 to 230	50.5
230 to 1000	57.5

4.2.6 Uncertainty of measurements

The reported expanded uncertainty, U_{lab} , is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evolution has been carried out in accordance with the documents CISPR 16-4-2.

Uncertainty of radiated emission (30-1000 MHz): 4.46 dB

Compliance or non-compliance with a disturbance limit is determined according to the following, quoted from CISPR 16-4-2:2003.

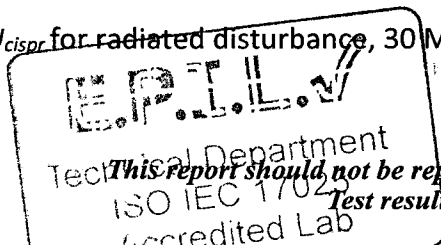
If U_{lab} is less or equal to U_{cisp} then:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{lab} is greater than U_{cisp} then:

- Compliance is deemed to occur if no measured disturbance, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;

U_{cisp} for radiated disturbance, 30 MHz-1GHz, is 6.3 dB.



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4.2.7 Test result

Radiated disturbance levels measured with a quasi-peak detector receiver are shown in Figure 14.

EUT met the specified limits of the standard.

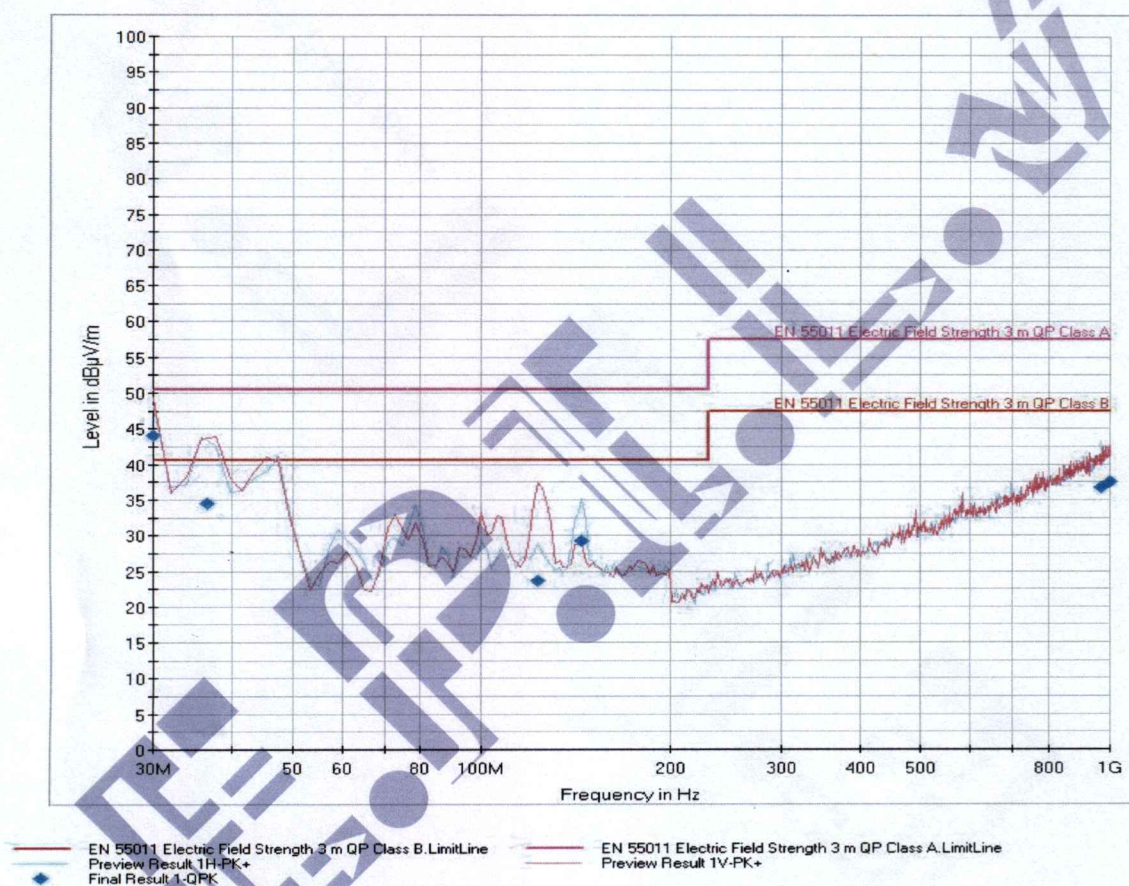
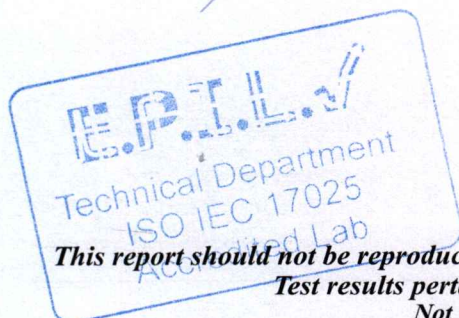


Figure 14: Measured radiated disturbance level (dBμV/m)



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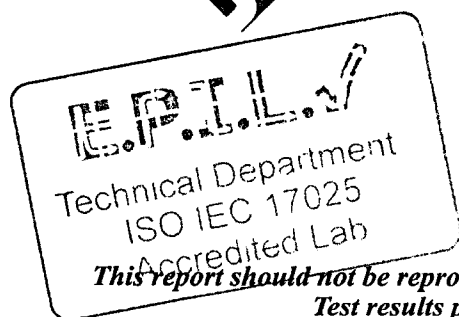
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Table 6: EMI radiated QP final result

Frequency MHz	Quasi-Peak dBµV/m	Meas. Time ms	Bandwidth MHz	Height cm	Polarization	Azimuth deg	Corr. dB	Margin dB	Limit dBµV/m	Comment
30.000000	44.1	15000.0	120.000	300.0	V	0.0	21.2	6.4	50.5	PASS
36.591663	34.5	15000.0	120.000	300.0	H	180.0	18.0	16.0	50.5	PASS
122.906613	23.6	15000.0	120.000	100.0	V	90.0	12.3	26.9	50.5	PASS
144.729379	29.3	15000.0	120.000	200.0	H	90.0	10.7	21.2	50.5	PASS
969.881683	36.8	15000.0	120.000	200.0	H	0.0	26.2	20.7	57.5	PASS
999.600000	37.5	15000.0	120.000	200.0	V	270.0	26.7	20.8	57.5	PASS



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Tel: 026-92108380-9 Fax: 026-92108385
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4.3 Voltage Fluctuation and Flicker Measurement

4.3.1 Test data

Location : EPIL
Date : 13-Mar-2019
Engineer of EPIL : M. H. Salehi

4.3.2 Ambient conditions

Ambient temperature : 22.9 °C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

4.3.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
Power quality analyzer	Fluke	435	14280001

4.3.4 Procedure of test

The test was carried out according to IEC 61000-3-3 under the following condition:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6x5 A 50 Hz current phase and 4x63.51 V 50 Hz voltage phase for emission tests and max power of fan are monitored and checked

4.3.5 Observation period

The observation period, T_p , for the assessment of flicker values by flicker measurement, Flicker simulation, or analytical method shall be:

• for P_{st} , $T_p = 10$ min;
• for P_{lt} , $T_p = 2$ h.

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The observation period shall include that part of the whole operation cycle in which the equipment under test produces the most unfavorable sequence of voltage changes. For the assessment of P_{st} , the cycle of operation shall be repeated continuously. The minimum time to restart the equipment shall be included in this observation period when testing equipment that stops automatically at the end of a cycle of operation which lasts for less than the observation period.

4.3.6 Acceptance conditions

The limits shall be applicable to voltage fluctuations and flicker at the supply terminals of the equipment under test, measured or calculated according to clause 4 under test conditions described in clause 6 and annex A. Tests made to prove compliance with the limits are considered to be type tests.

The following limits apply:

- The value of P_{st} shall not be greater than 1.0; the value of P_{lt} shall not be greater than 0.65;
- The value of $d(t)$ during a voltage change shall not exceed 3.3 % for more than 500 ms;
- The relative steady-state voltage change, d_s , shall not exceed 3.3 %;
- The maximum relative voltage change d_{max} shall not exceed
 - a) 4 % without additional conditions;
 - b) 6 % for equipment which is:
 - Switched manually, or
 - Switched automatically more frequently than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds), or manual restart, after a power supply interruption.
 - c) 7 % for equipment which is
 - Attended whilst in use (for example: hair dryers, vacuum cleaners, kitchen equipment such as mixers, garden equipment such as lawn mowers, portable tools such as electric drills), or
 - Switched on automatically, or is intended to be switched on manually, no more than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds) or manual restart, after a power supply interruption.

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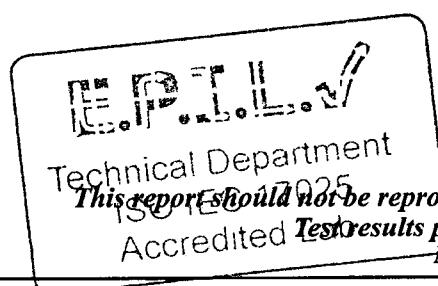
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4.3.7 Test result

	EUT Values	Limit	Result
P_{st}	0.19	1.00	Pass
P_{lt}	0.22	0.65	Pass
dc [%]	0.00	3.30	Pass
d_{max} [%]	0.00	6.00	Pass
d_t [s]	0.00	0.50	Pass



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4.4 Current Harmonic Emission Measurement

4.4.1 Test data

Location : EPIL
Date : 13-Mar-2019
Engineer of EPIL : M. H. Salehi

4.4.2 Ambient conditions

Ambient temperature : 22.9 °C
Relative humidity : 30.5 %
Atmospheric pressure : 86.5 kPa

4.4.3 Instrument used for test

Equipment	Manufacturer	Model	S/N
Power quality analyzer	Fluke	435	14280001

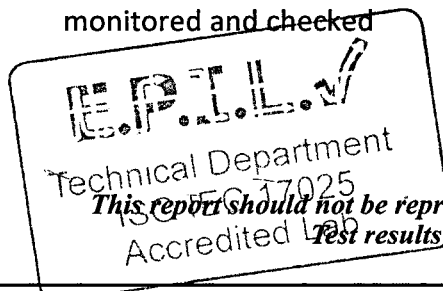
When a type of equipment is brought into operation or is taken out of operation, manually or automatically, harmonic currents and power are not taken into account for the first 10 s following the switching event.

The equipment under test shall not be in stand-by mode for more than 10 % of any observation period.

4.4.4 Procedure of test

The test was carried out according to IEC 61000-3-2 under the following condition:

- Tested as table-top equipment
- During tests healthy operation of binary inputs, binary outputs, 6×5 A 50 Hz current phase and 4×63.51 V 50 Hz voltage phase for emission tests and max power of fan are monitored and checked



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4.4.5 Harmonic current limits

For the following categories of equipment, limits are not specified in this standard:

- Equipment with a rated power of 75 W or less, other than lighting equipment; at that time.
- Professional equipment with a total rated power greater than 1 kW;
- Symmetrically controlled heating elements with a rated power less than or equal to 200 W;
- Independent dimmers for incandescent lamps with a rated power less than or equal to 1 kW.

4.4.6 Test result

- Classification of equipment: Class A

Harmonics Number	Frequency Hz	Current A	Limit	Results
1	50	1.52	-	pass
2	100	0.00	1.08	pass
3	150	0.01	2.30	pass
4	200	0.00	0.43	pass
5	250	0.01	1.14	pass
6	300	0.00	0.31	pass
7	350	0.01	0.77	pass
8	400	0.01	0.23	pass
9	450	0.00	0.40	pass
10	500	0.01	0.18	pass
11	550	0.01	0.33	pass
12	600	0.00	0.15	pass
13	650	0.01	0.21	pass
14	700	0.00	0.13	pass
15	750	0.01	0.15	pass
16	800	0.00	0.12	pass
17	850	0.01	0.13	pass
	900	0.01	0.10	pass

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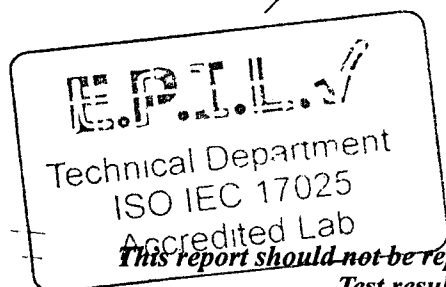
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Harmonics Number	Frequency Hz	Current A	Limit A	Results
19	950	0.01	0.12	pass
20	1000	0.00	0.09	pass
21	1050	0.01	0.11	pass
22	1100	0.01	0.08	pass
23	1150	0.00	0.10	pass
24	1200	0.00	0.08	pass
25	1250	0.01	0.09	pass
26	1300	0.00	0.07	pass
27	1350	0.00	0.08	pass
28	1400	0.00	0.07	pass
29	1450	0.01	0.08	pass
30	1500	0.01	0.06	pass
31	1550	0.01	0.07	pass
32	1600	0.00	0.06	pass
33	1650	0.01	0.07	pass
34	1700	0.01	0.05	pass
35	1750	0.01	0.06	pass
36	1800	0.00	0.05	pass
37	1850	0.01	0.06	pass
38	1900	0.01	0.05	pass
39	1950	0.01	0.06	pass
40	2000	0.00	0.05	pass



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No	Measurement/testing	Testing / measuring equipment	Manufacture	Model	Calibration date	Calibration Due Date	Level test	Uncertainty
1	Immunity test to electrostatic discharges	ESD(Electrostatic discharge) simulator	Schlöder	SESD 200	16.04.2019	22.03.2021	+2kV	0.040 kV
							+4kV	0.073 kV
							+8kV	0.093 kV
							+15kV	0.143 kV
							-2kV	0.056 kV
							-4kV	0.064 kV
							-8kV	0.091 kV
2	Immunity test to Radiated Electromagnetic field	Signal generator	Rohde & Schwarz	SML-01	25.01.2018	25.01.2020	-15kV	0.141 kV
							0dbm	0.047 dBm
							0dbm	0.055 dBm
							-10dbm	0.062 dBm
							-20dbm	0.049 dBm
							-30dbm	0.042 dBm
							-40dbm	0.042 dBm
3	Immunity test to power frequency Magnetic fields	Test Generator	OMICRON	CPC-100	06.08.2018	06.08.2020	-50dbm	0.042 dBm
							-60dbm	0.042 dBm
							-70dbm	0.042 dBm
							Level test	Accuracy
							1 A	± 0.0038 A
							3 A	± 0.0073 A
							6 A	± 0.017 A
4	Immunity test to voltage dips, voltage variations and short interruptions	Voltage Dip Simulator	Schlöder	VIS 700	10.10.2018	10.10.2020	50 A	± 0.04 A
							100 A	± 0.08 A
							20 micro Tesla	4%
							40%	0.586 V
							70%	1.359 V
							80%	1.360 V
							100%	1.363 V
5	Immunity test to Surges	Surge Generator	Schlöder	CWG 500	25.01.2018	25.01.2020	1neg 18uF	0.015 kV
							1pos 18uF	0.015 kV
							2neg 18uF	0.019 kV
							2pos 18uF	0.019 kV
							3neg 18uF	0.051 kV
							3neg L-N	0.059 kV
							3neg L-PE	0.052 kV
							3neg N-PE	0.052 kV
							3pos 18uF	0.371 kV
							3pos L-N	0.059 kV
							3pos L-PE	0.050 kV
							3pos N-PE	0.049 kV
							4neg 18uF	0.077 kV
6	3 Phase Coupling Network	Schlöder	CWG 520	22.04.2019	22.04.2023		4pos 18uF	0.077 kV

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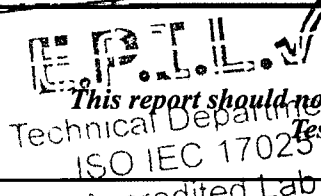
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No	Measurement/testing	Testing / measuring equipment	Manufacture	Model	Calibration date	Calibration Due Date	Level test	Uncertainty
6	Immunity test to Fast transients	Burst Generator	Schlöder	SFT 400	25.01.2018	25.01.2020	2.5 kHz	0.029 kHz
		3 Phase Coupling Network	Schlöder	CWG 520	22.04.2019	22.04.2021	5 kHz	0.036 kHz
							50 kHz	0.341 kHz
7	Immunity test to continuous conducted disturbances	Signal generator	Rohde & Schwarz	SML-01	25.01.2018	25.01.2020	100 kHz	0.334 kHz
		RF Power Amplifier	Com-Power	ACS	25.01.2018	25.01.2020	7dbm	0.047 dBm
		Coupling/decoupling network	Com-Power	CDN-M225E	22.04.2019	22.04.2021	0dbm	0.055 dBm
		Coupling/decoupling network	Com-Power	CDN-M325E	22.04.2019	22.04.2021	-10dbm	0.062 dBm
		Coupling/decoupling network	Com-Power	CDN-M325E	22.04.2019	22.04.2021	-20dbm	0.049 dBm
		Coupling/decoupling network	Com-Power	CDN-M525E	22.04.2019	22.04.2021	-30dbm	0.042 dBm
		Coupling/decoupling network	Com-Power	CDN-M525E	22.04.2019	22.04.2021	-40dbm	0.042 dBm
8	EMISSION-Measurement of conducted disturbances on the mains ports	EMI Receiver	Rohde & Schwarz	ESCS 30	02.12.2017	02.12.2020	-50dbm	0.042 dBm
		LISN	Rohde & Schwarz	ENV 216	01.10.2018	01.10.2020	-60dbm	0.042 dBm
9	EMISSION-Measurement of Radiated disturbances	EMI Receiver	Rohde & Schwarz	ESCS 30	02.12.2017	02.12.2020	-70dbm	0.042 dBm
		Semi-Anechoic chamber	Rohde & Schwarz	S-Line 100	N/A		Full range	3.14 dBuV
10	EMISSION-Measurement of harmonics	Power source	OMICRON	CPC100	06.08.2018	06.08.2020	Full range	6.00 dBuV
							1% 1%	0.030 %
							1% 5%	0.032 %
							1% 10%	0.037 %
							2% 1%	0.030 %
							2% 5%	0.032 %
							2% 10%	0.037 %
							3% 1%	0.030 %
							3% 5%	0.032 %
							3% 10%	0.055 %
		Harmonic meter	Fluke	435	04.09.2017	04.09.2019	4% 1%	0.030 %
							4% 5%	0.032 %
							4% 10%	0.037 %
							5% 1%	0.030 %
							5% 5%	0.032 %
							5% 10%	0.037 %
							6-50% 1%	0.030 %
							6-50% 5%	0.032 %
							6-50% 10%	0.037 %
							THD 1%	0.048 %
							THD 5%	0.042 %
							THD 10%	0.040 %
							220 V	0.618 %
11	EMISSION-Measurement of flickers	Power source	OMICRON	CPC100	06.08.2018	06.08.2020	220 V	0.622 V
		Flicker meter	Fluke	435	04.09.2017	04.09.2019		
		Flicker impedance	EPIL	Flicker impedance	N/A			



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No	Measurement/testing	Testing / measuring equipment	Manufacture	Model	Calibration date	Calibration Due Date	Level test	Uncertainty
12	EMISSION-Measurement of Radiated disturbances (AUT)	Semi-Anechoic chamber	Albatross	P23315	-	-	Full range	4.43 dBuV
		EMI test receiver	R&S	ESIB26	09.11.2017	09.11.2021		
		Ultra-broadband antenna	R&S	HL562	29.09.2018	29.09.2021		
13	Immunity test to Radiated Electromagnetic field (AUT)	Integrated measurement system	R&S	IMS-1502.0009K1 2	05.02.2019	05.02.2022	Level test	Accuracy
		Power sensor	R&S	NRP-Z91	08.11.2017	08.11.2019	Frequency Accuracy	$\pm 5 \times 10^{-7}$ MHz
		High gain log-periodic antenna	R&S	HL046E	29.08.2018	29.08.2021	Output Level	± 1 %
		Semi-Anechoic chamber	Albatross	P23315	-	-	Full range	± 0.08 dB
		Broadband field meter	Narda	NBM550	26.09.2016	26.09.2020	300-500 MHz	0.105 dB
		E-field probe isotropic	Narda	TS-EL0391	26.09.2016	26.09.2020	550-2000 MHz	0.131 dB
		Power amplifier(low frequency)	R&S	BS 0125 150	12.08.2018	12.08.2021	2.2-3 GHz	0.181 dB
		Power amplifier(high frequency)	R&S	BLWA 0825	12.08.2018	12.08.2021	-	-
		Double ridged broadband horn antenna	Schwarzbeck Mess-Elektronik	HL223	29.08.2018	29.08.2021	Full range	0.8 dB
							300-500 MHz	0.140 dB
							550-1000 MHz	0.293 dB

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