8 Electromagnetic Susceptibility Test Results

8.1 Performance Criteria Description in Clause 6 of EN 55014-2 & BS EN 55014-2

Criterion A:	The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.
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 (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and from what the user may reasonably expect from the apparatus if used as intended.
Criterion C:	Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

8.2 ESD

Test Requirement:	EN 55014-2 & BS EN 55014-2	
Test Method:	EN 61000-4-2 & BS EN 61000-4-2	
Criterion Required:	B	
Test Date:	2011-07-11	
Test voltage	AC 230V 50Hz	
Discharge Impedance:	330 Ω / 150 pF	
Discharge Voltage:	Air Discharge:	8 kV
	Contact Discharge:	4 kV
	VCP/HCP:	4 kV
Polarity:	Positive & Negative	
Number of Discharge:	Minimum 10 times at each test point	
Discharge Mode:	Single Discharge	
Discharge Period:	1 second minimum	

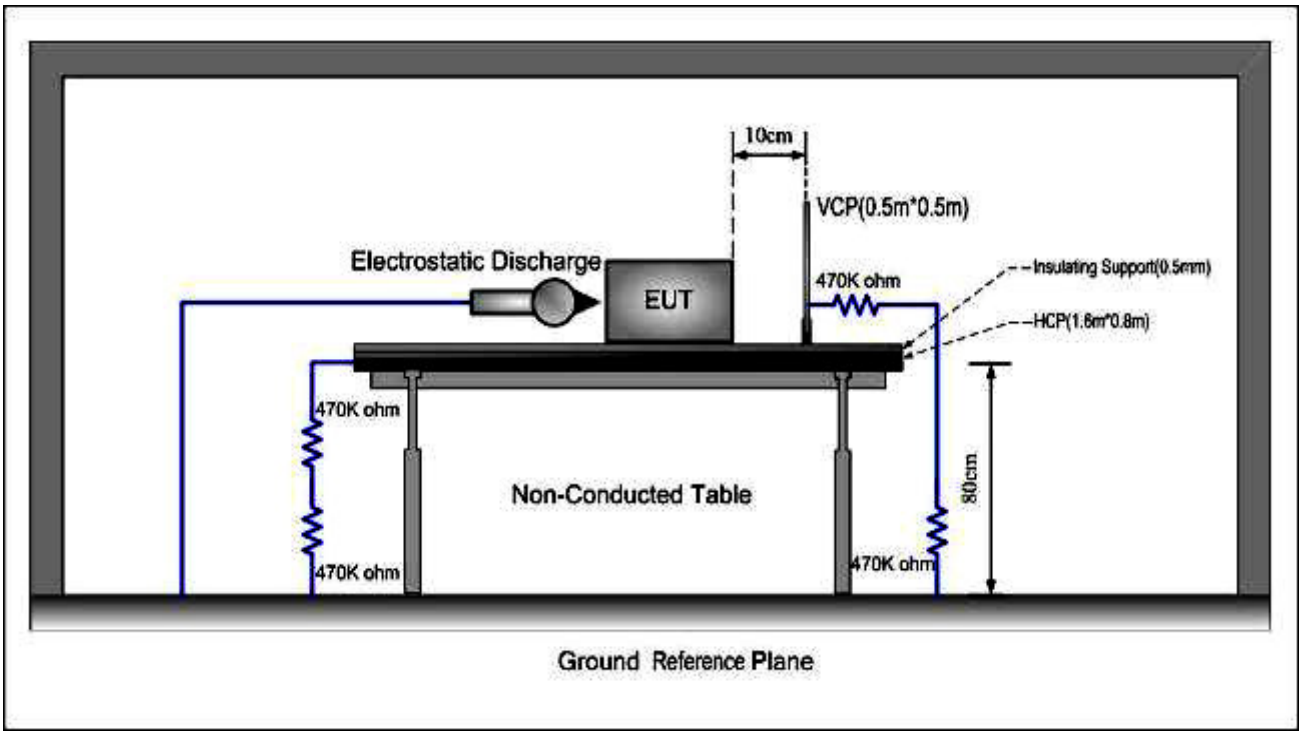
8.2.1 E.U.T. Operation

Operating Environment:

Temperature: 22.0 °C Humidity: 50 % RH Atmospheric Pressure: 1005 mbar

EUT Operation: Test the EUT in motor running & heating mode and idle mode.

8.2.2 Test Setup and Procedure



1. Contact discharge was applied only to conductive surfaces of the EUT. Air discharge was applied only to non-conducted surfaces of the EUT.
2. The EUT was put on a 0.8m high wooden table for table-top equipment or 0.1m high for floor standing equipment standing on the ground reference plane (GRP).
3. A horizontal coupling plane(HCP) 1.6m by 0.8m in size was placed on the table, and the EUT with its cables were isolated from the HCP by an insulating support thick than 0.5mm. The VCP 0.5m by 0.5m in size while HCP were constructed from the same material type and thickness as that of the GRP, and connected to the GRP via a 470kΩ resistor at each end. The distance between EUT and any of the other metallic surface excepted the GRP, HCP and VCP was greater than 1m.
4. During the contact discharges, the tip of the discharge electrode was touch the EUT before the discharge switch is operated. During the air discharges, the round discharge tip of the discharge electrode was approached as fast as possible to touch the EUT.
5. After each discharge, the ESD generator was removed from the EUT, the generator is then retriggered for a new single discharge. For ungrounded product, a discharge cable with two resistances were used after each discharge to remove remnant electrostatic voltage. 10 times of each polarity single discharge were applied to HCP and VCP.

8.2.3 Test Results

Direct Application Test Results

Observations: Test Point:

1. All insulated enclosure & seams.
2. All accessible metal parts of the enclosure.

Direct Application			Test Results	
Discharge Level (kV)	**Polarity (+/-)**	**Test Point**	**Contact Discharge**	**Air Discharge**
8	+/-	1	N/A	A
4	+/-	2	A	N/A

Indirect Application Test Results

Observations: Test Point:

1. All sides.

Indirect Application			Test Results	
Discharge Level (kV)	**Polarity (+/-)**	**Test Point**	**Horizontal Coupling**	**Vertical Coupling**
4	+/-	1	A	A

Results:

A: No degradation in the performance of the EUT was observed.

N/A: Not applicable (floor mounted EUT or not requested by Standard).

8.3 Electrical Fast Transients (EFT)

Test Requirement:	EN 55014-2 & BS EN 55014-2
Test Method:	EN 61000-4-4 & BS EN 61000-4-4
Criterion Required:	B
Test Date:	2011-07-11
Test voltage	AC 230V 50Hz
Test Level:	0.5, 1.0kV on AC
Polarity:	Positive & Negative
Repetition Frequency:	5kHz
Burst Duration:	300ms
Test Duration:	2 minute per level & polarity

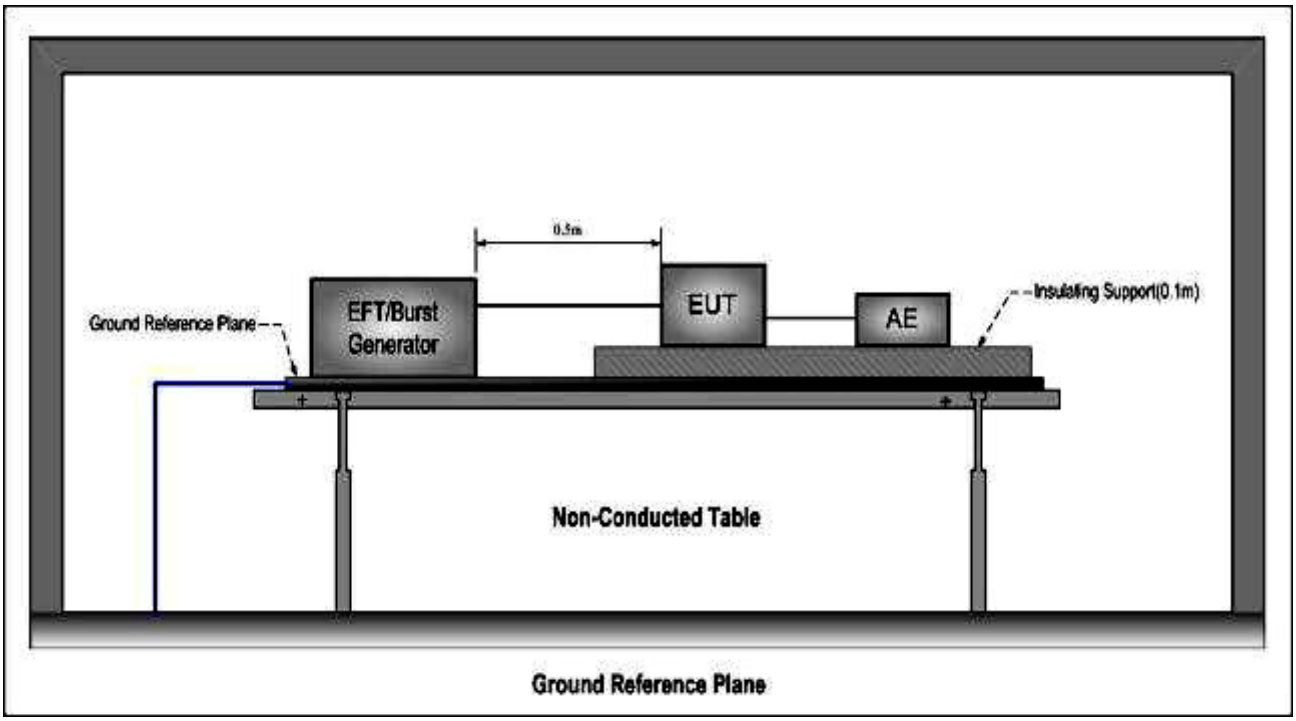
8.3.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 °C Humidity: 52% RH Atmospheric Pressure: 1008 mbar

EUT Operation: Test the EUT in motor running & heating mode and idle mode.

8.3.2 Test Setup and Procedure



1. The EUT was placed on a ground reference plane(GRP) insulated by an insulating support 0.1m thick and the GRP was placed on a 0.8m high wooden table for table-top equipment. For floor standing equipment, the EUT was placed on a 0.1m high wooden support above the GRP.
2. The GRP shall project beyond the EUT and the clamp by at least 0.1m on all sides. The distance between the EUT and any other of the metallic surface except the GRP was greater than 0.5m. All cables to the EUT was placed on the insulation support 0.1m above GRP. Cables not subject to EFT was routed as far as possible from cable under test to minimize the coupling between the cables.
3. The length of signal and power cable between the EUT and EFT generator was 0.5m. If the cable is a non-detachable supply cable more than 0.5m, the excess length of this cable shall be folded to avoid a flat coil and situated at a distance of 0.1m above the GRP.
4. The EUT was conducted the below specified test voltages for line and neutral or line, neutral and earth simultaneously (for signal line with capacitive coupling clamp), 120 seconds duration. If the equipment contains identical ports, only one was tested; multiconduct or cables, such as a 50-pair telecommunication cable, was tested as a single cable. Cables did not be split or divided into groups of conductors for this test; interface ports, which were intended by the manufacturer to be connected to data cables not longer than 3 m, did not be tested.

8.3.3 Test Results On AC Supply

Lead under Test	Level (±kV)	Coupling Direct/Clamp	EUT operating mode	Observations (Performance Criterion)
Live + Neutral	± 0.5, 1.0	Direct	All modes	(A)

A: No loss of function.

8.4 Surge

Test Requirement:	EN 55014-2 & BS EN 55014-2
Test Method:	EN 61000-4-5 & BS EN 61000-4-5
Criterion Required:	B
Test Date:	2011-07-11
Test voltage	AC 230V 50Hz
Test Level:	±1kV Live to Neutral
Polarity:	Positive & Negative
Generator source impedance:	2Ω
Trigger Mode:	Internal
No. of surges:	5 positive at 90°, 5 negative at 270°.

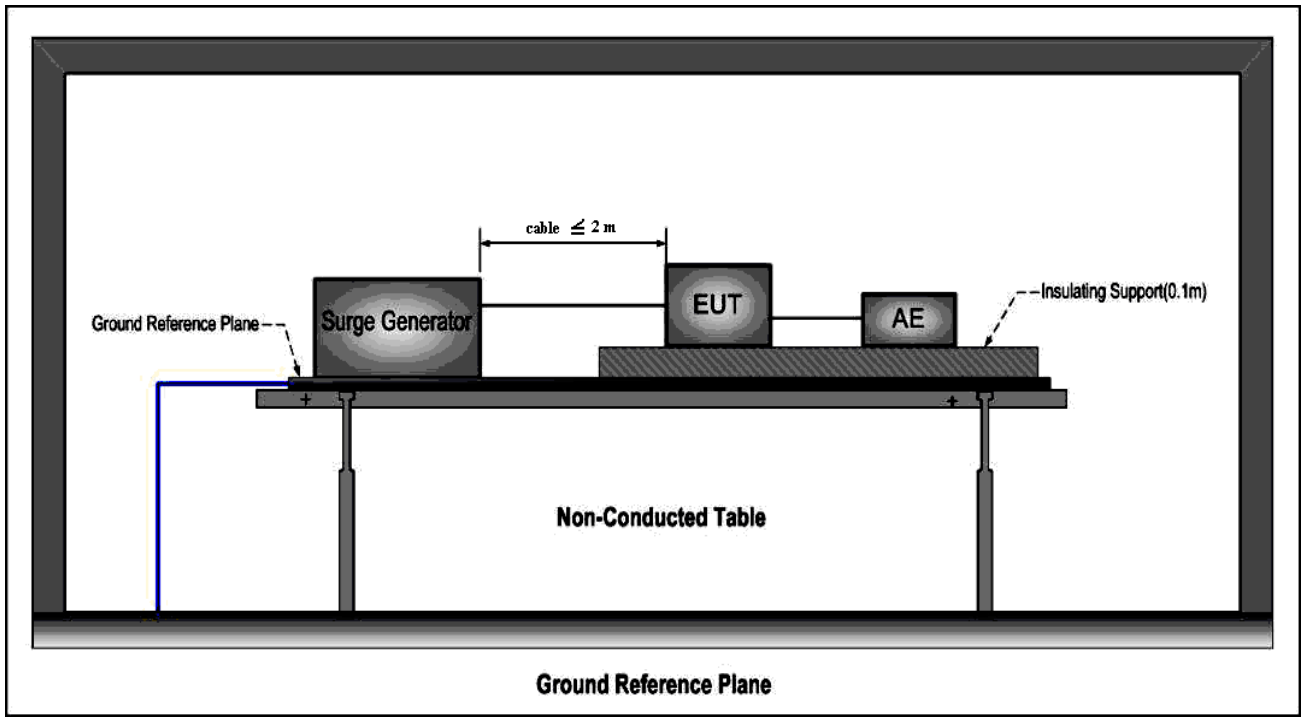
8.4.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 °C Humidity: 52% RH Atmospheric Pressure: 1008 mbar

EUT Operation: Test the EUT in motor running & heating mode and idle mode.

8.4.2 Test Setup and Procedure



1. The EUT was placed on a ground reference plane(GRP) insulated by an insulating support 0.1m thick and the GRP was placed on a 0.8m high wooden table for table-top equipment. For floor standing equipment, the EUT was placed on a 0.1m high wooden support above the GRP.
2. The 1,2/50 μs surge was to be applied to the EUT power supply terminals via the capacitive coupling network .Decoupling networks were required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines and to provide sufficient decoupling impedance to the surge wave so that the specified wave may be applied on the lines under test.
3. The power cord between the EUT and the coupling/decoupling network do not exceed 2m in length. The interconnection line between the EUT and the coupling/ decoupling network shall not exceed 2m in length.
4. The EUT was conducted the below specified test voltages for line to line and line to neutral and line to earth and neutral to earth, five positive pulses at 90° and five negative pulses 270° for a.c. power ports and five positive pulses and five negative surge pulses for d.c. power ports. The test levels were applied on the EUT with a 2Ω generator source impedance for power supply terminals and 40Ω output impedance for interconnection lines. The tests were done at repetition rate 1 per minute.

8.4.3 Test Results:

Pulse No	Line-Line	Level (kV)	Surge Interval	Phase (deg)	Observation (Performance Criterion)
1–5	L-N	+1	60s	90°	No Loss of Function (A)
6–10	L-N	-1	60s	270°	(A)

8.5 Conducted Immunity 0.15MHz to 230MHz

Test Requirement:	EN 55014-2 & BS EN 55014-2
Test Method:	EN 61000-4-6 & BS EN 61000-4-6
Criterion Required:	A
Test Date:	2011-07-11
Test voltage	AC 230V 50Hz
Frequency Range:	0.15MHz to 230MHz
Test level:	3V r.m.s on AC Ports (unmodulated emf into 150 Ω)
Modulation:	80%, 1kHz Amplitude Modulation

8.5.1 E.U.T. Operation

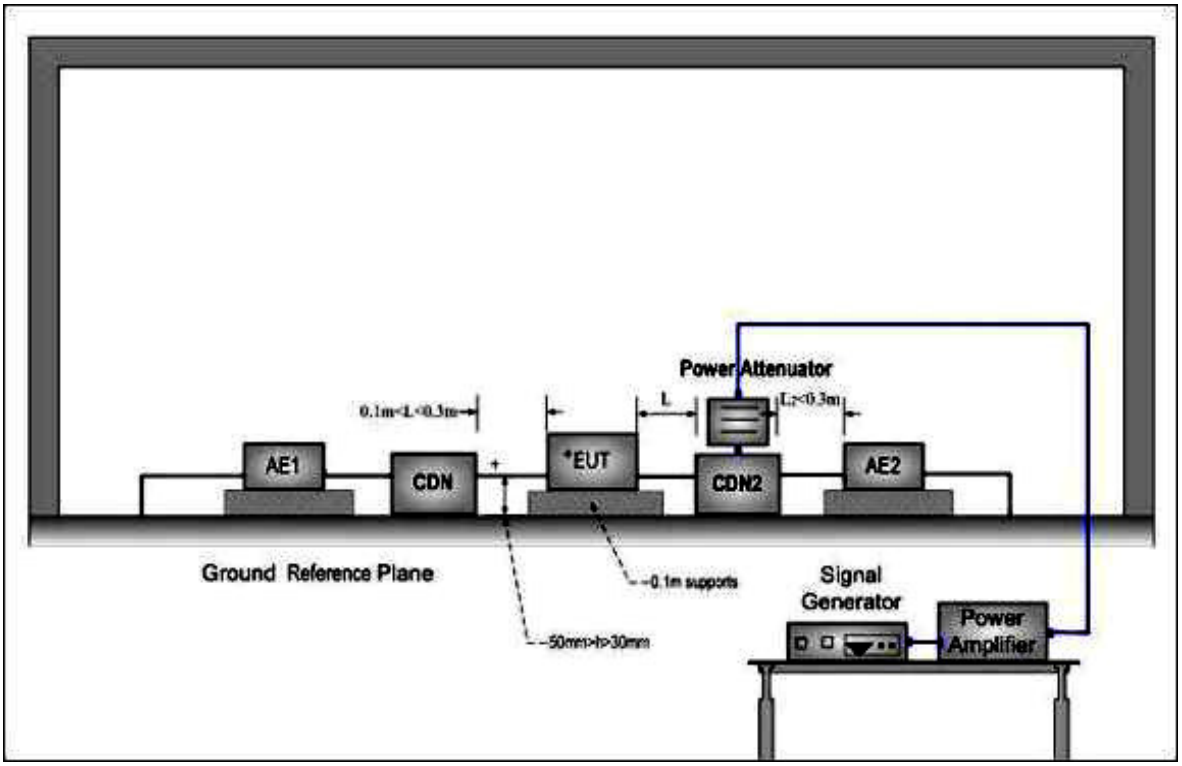
Operating Environment:

Temperature: 22.0 °C Humidity: 50 % RH Atmospheric Pressure: 1005 mbar

EUT Operation: Test the EUT in motor running & heating mode and idle mode.

8.5.2 Test Setup and Procedure

For AC port



1. The EUT was placed on an insulating support of 0.1m height above a ground reference Plane, arranged and connected to satisfy its functional requirement. All cables exiting the EUT was supported at a height of at least 30 mm above the ground reference plane.
2. The coupling and decoupling devices were required, they were located between 0.1m and 0.3m from the EUT. This distance was to be measured horizontally from the projection of the EUT on to the ground reference plane to the coupling and decoupling device.
3. Each AE, used with clamp injection, shall be placed on an insulating support 0.1m above the ground reference plane. A decoupling network shall be installed on each cable between the EUT and AE except the cable under test. All cables connected to each AE, other than those being connected to the EUT, shall be provided with decoupling networks. The decoupling networks connected to each AE (except those on cables between the EUT and AE) shall be applied no further than 0.3m from the AE. The cable(s) between the AE and the decoupling network (s) or in between the AE and the injection clamp shall not be bundled nor wrapped and shall be kept between 30 mm and 50 mm above the ground reference plane.
4. The frequency range was swept from 150 kHz to 230 MHz, using the signal levels 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 was swept incrementally, the step size do not exceed 1% of the preceding frequency value. The dwell time of the amplitude modulated carrier at each frequency was not less than the time necessary for the EUT to be exercised and to respond, and was not less than 0.5 s.

8.5.3 Test Results:

Frequency	Line	Test Level	Modulation	Step Size	Dwell Time	Observation (Performance Criterion)
150 kHz to 230 MHz	2 Wires AC Supply Cable	3V r.m.s	80%, 1 kHz Amp. Mod.	1%	1s	No Loss of Function (A)

8.6 Voltage Dips and Interruptions

Test Requirement:	EN 55014-2 & BS EN 55014-2
Test Method:	EN 61000-4-11 & BS EN 61000-4-11
Criterion Required:	C
Test Date:	2011-07-11
Test voltage	AC 230V 50Hz
Test Level:	0% of U_T (Supply Voltage) for 0.5 Periods
	40 % of U_T (Supply Voltage) for 10 Periods
	70 % of U_T (Supply Voltage) for 25 Periods
No. of Dips / Interruptions:	3 per Level

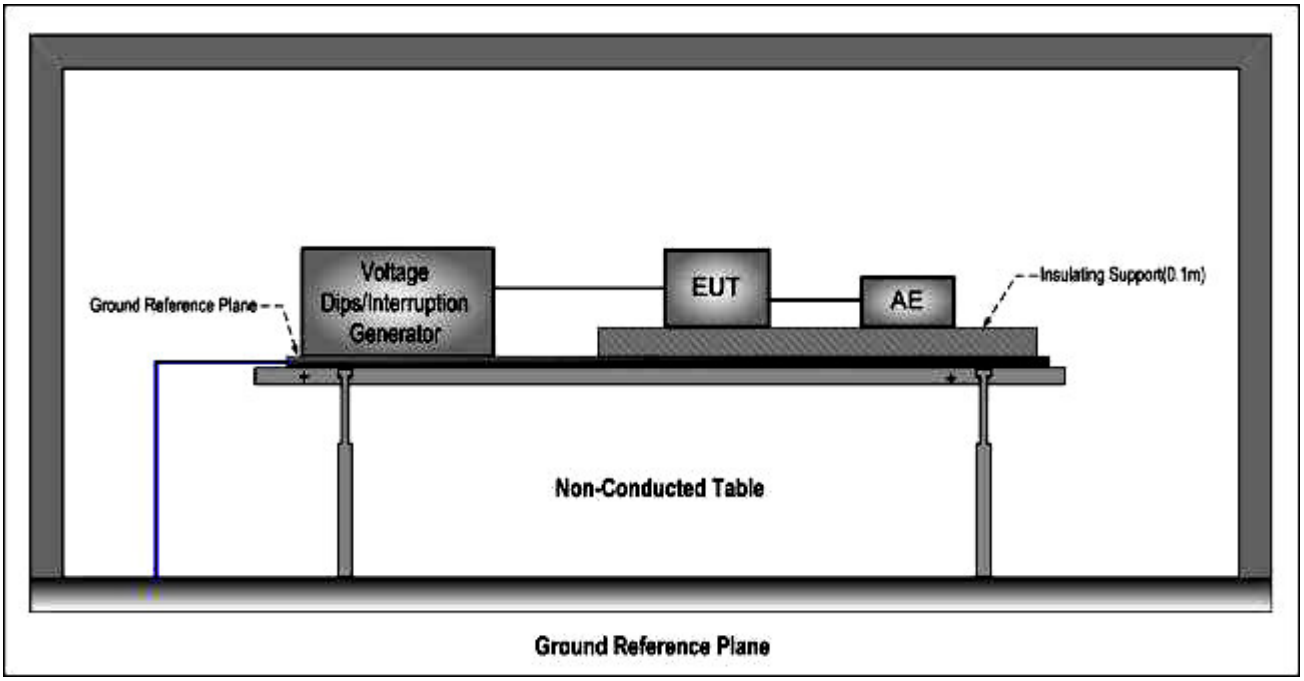
8.6.1 E.U.T. Operation

Operating Environment:

Temperature: 24.0 °C Humidity: 52% RH Atmospheric Pressure: 1008 mbar

EUT Operation: Test the EUT in motor running & heating mode and idle mode.

8.6.2 Test Setup and Procedure



1. The EUT was placed on a ground reference plane(GRP) insulated by an insulating support 0.1m thick and the GRP was placed on a 0.8m high wooden table for table-top equipment. For floor standing equipment, the EUT was placed on a 0.1m high wooden support above the GRP.
2. The test was performed with the EUT connected to the test generator with the shortest power supply cable as specified by the EUT manufacturer.
3. The EUT was tested for each selected combination of test level and duration with a sequence of three dips /interruptions with intervals of 10 s minimum. Each representative mode of operation was tested.
4. For EUT with more than one power cord, each power cord was tested individually.

8.6.3 Test Results

$U_{T=}$ AC 230V 50Hz

Test Level % U_T	Phase	Duration of drop out in Periods	No of drop out	Time between drop out	Observations (Performance Criterion)
0	0°	0.5	3	10s	No Loss of Function (A)
40	0°	10	3	10s	No Loss of Function (A)
70	0°	25	3	10s	No Loss of Function (A)

Remark:

$U_{T=}$ the nominal supply voltage.

9 Photographs

9.1 Conducted Emissions on Mains Terminals Test Setup

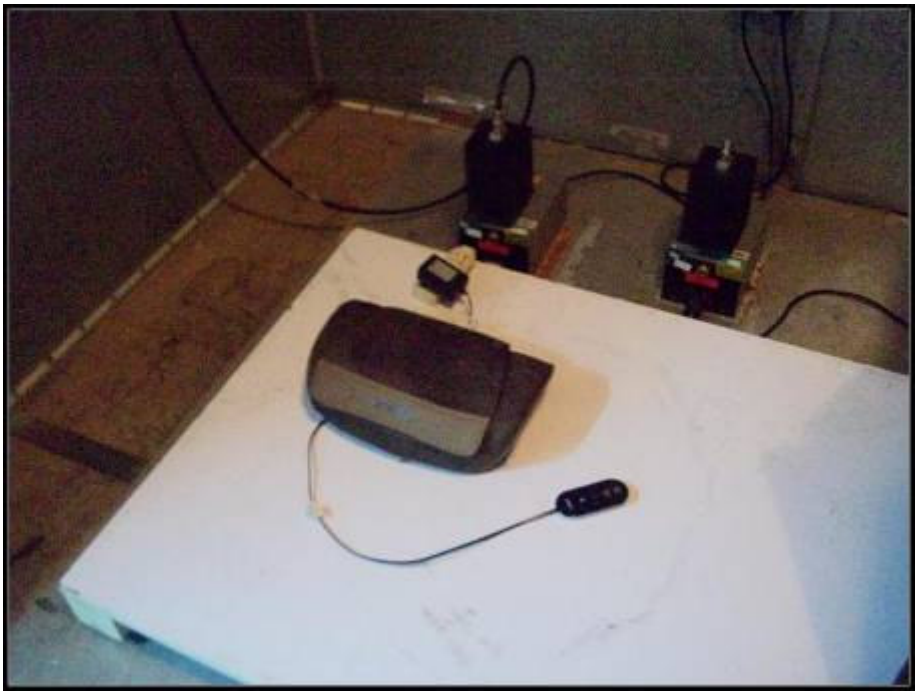
9.2 Disturbance Power Test Setup

9.3 Flicker Test Setup

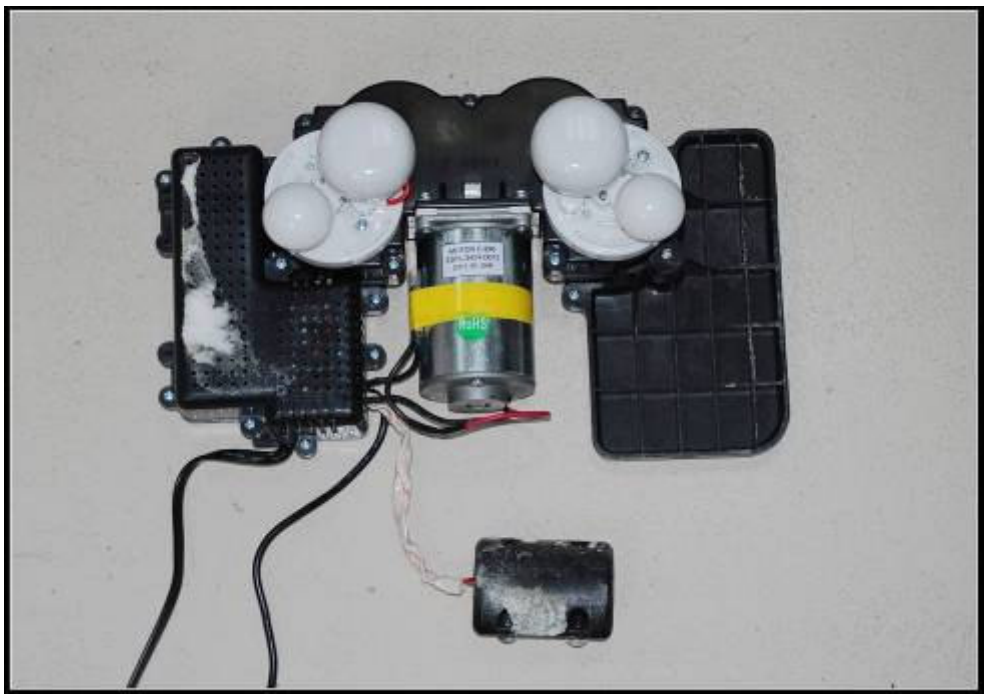
9.4 ESD Test Setup

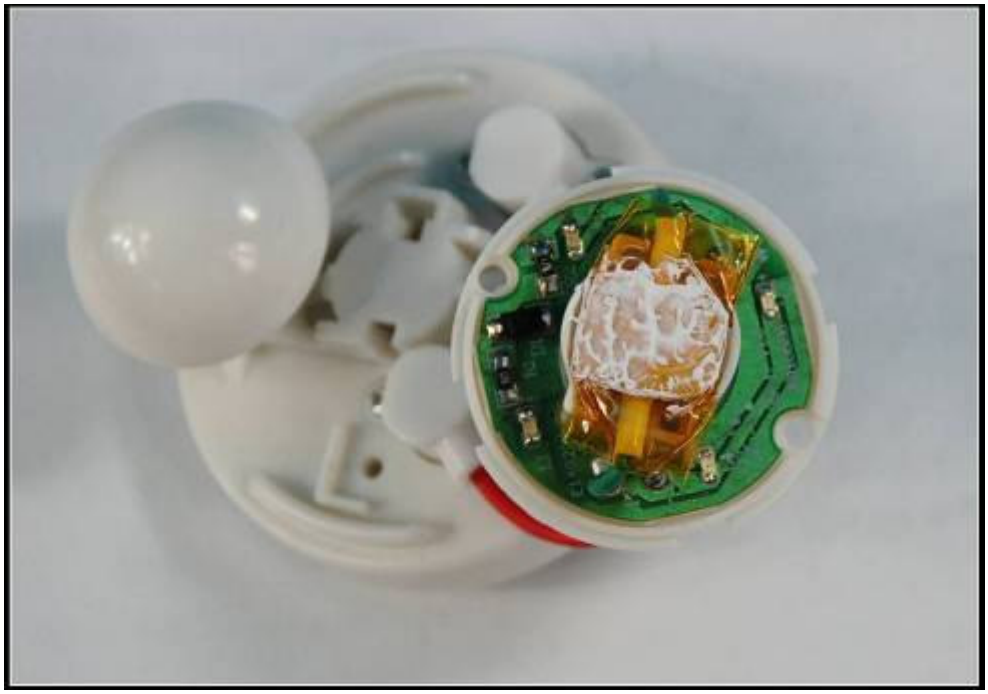
9.5 EFT, Surge, Voltage Dip and Interruptions Test Setup

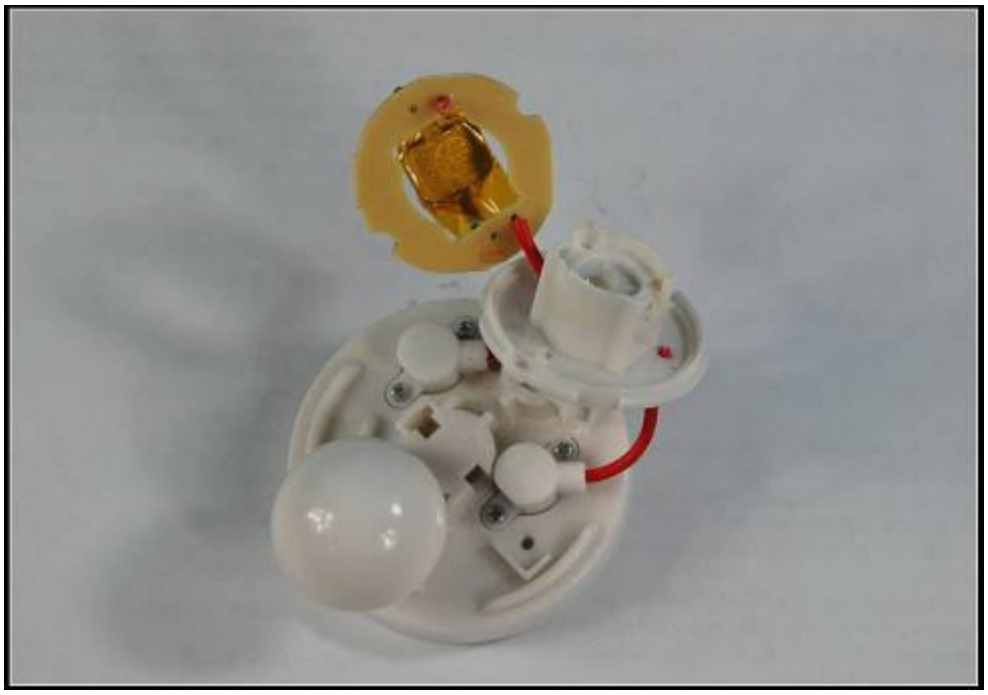
9.6 Conducted Immunity Test Setup

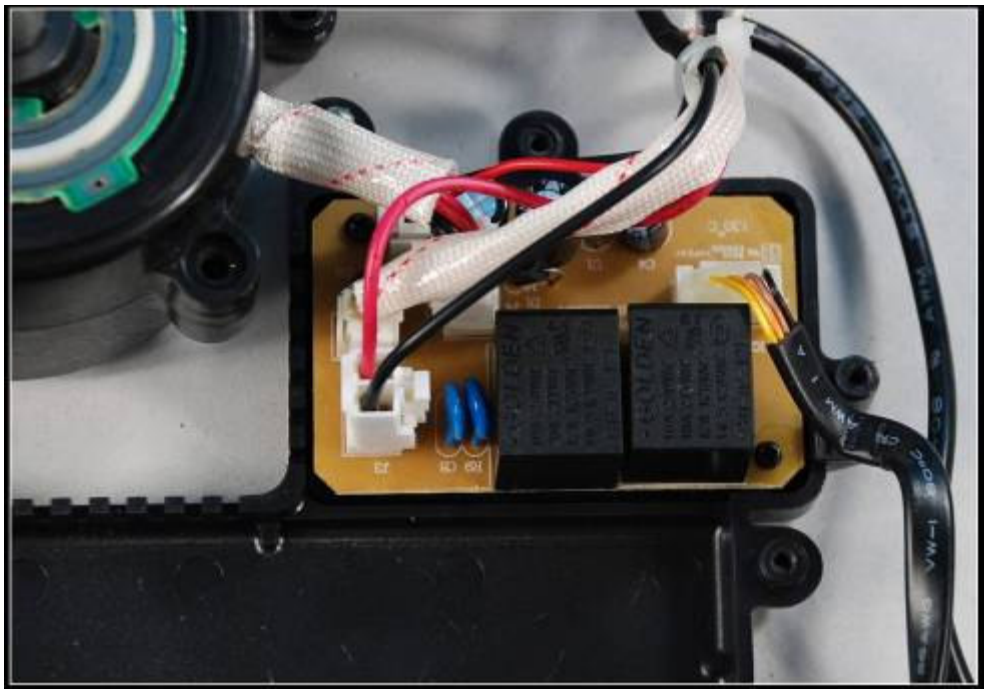


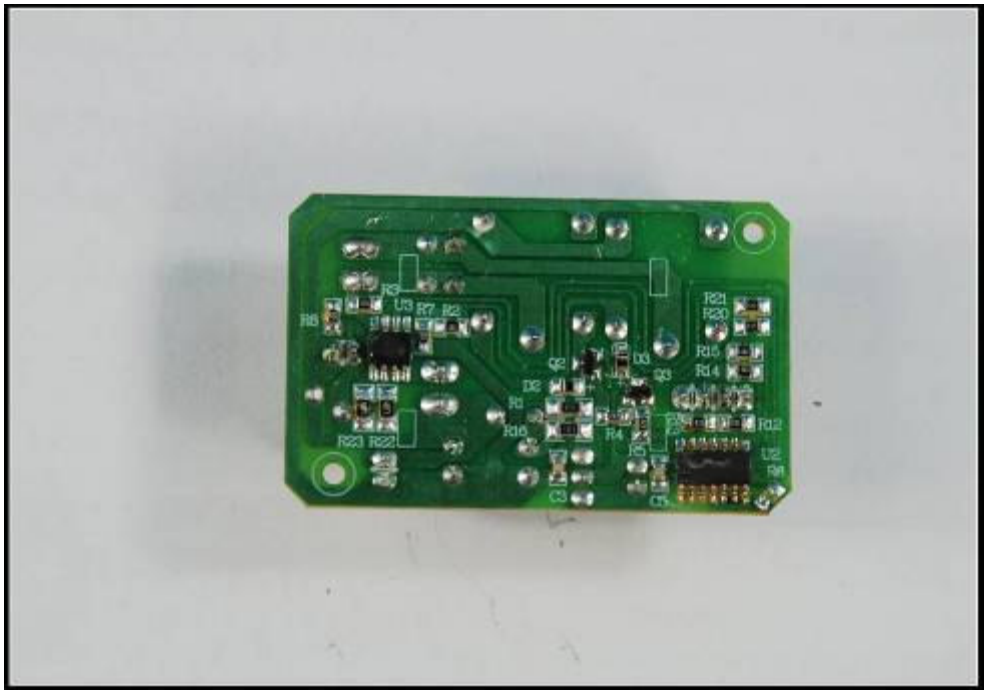
9.7 EUT Constructional Details

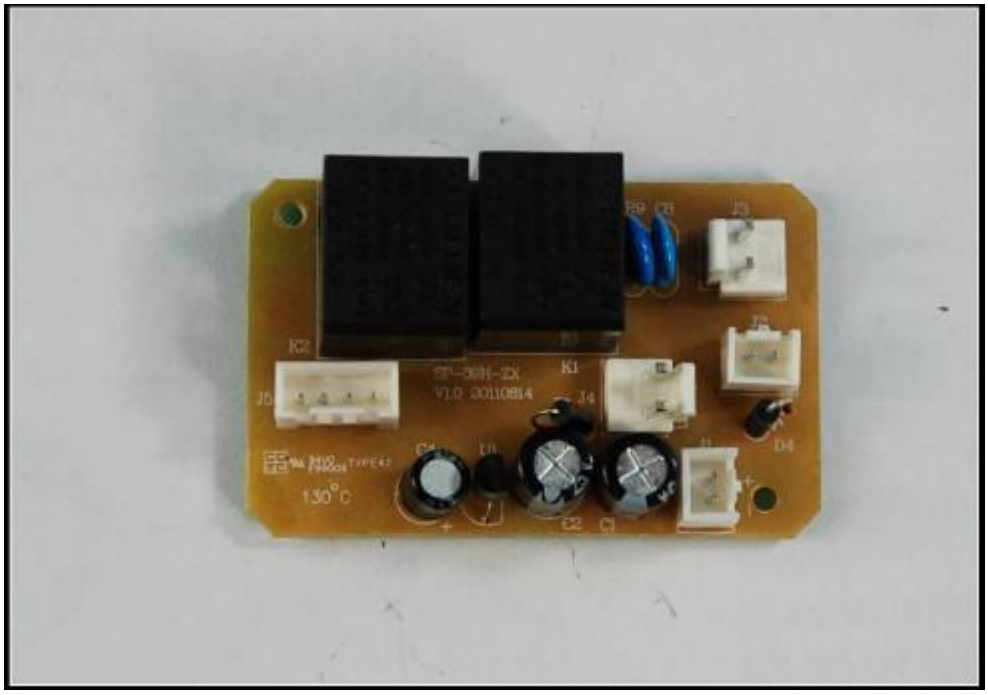


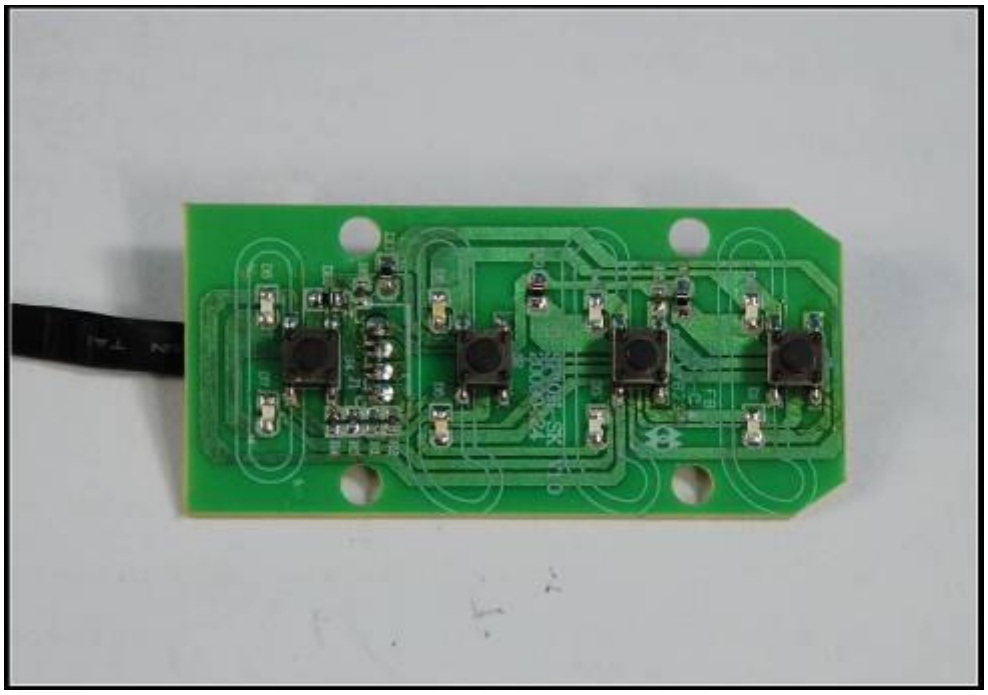


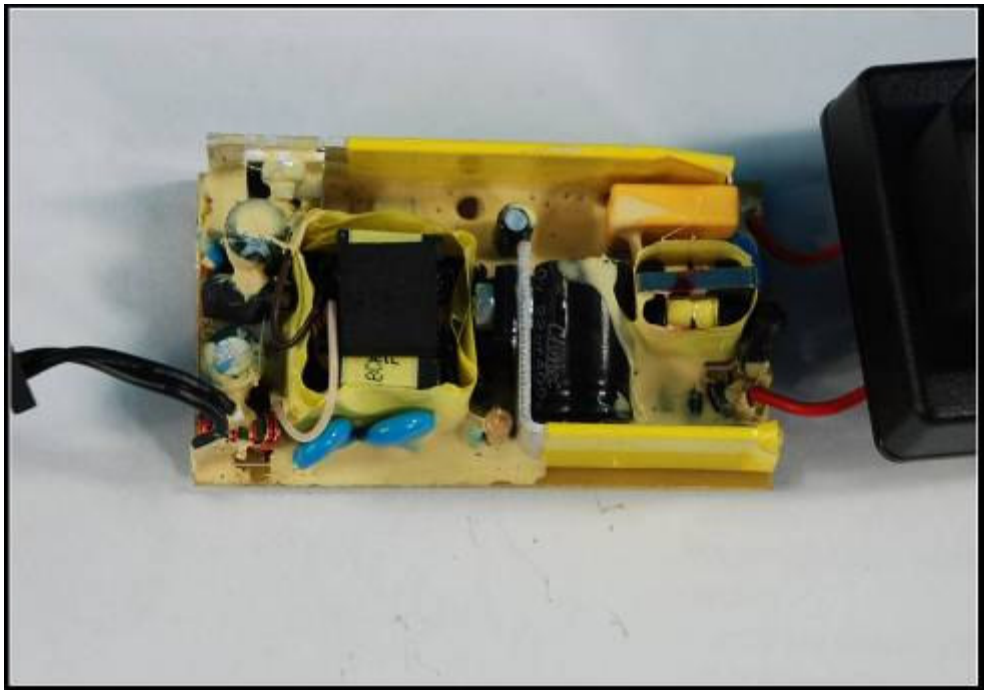


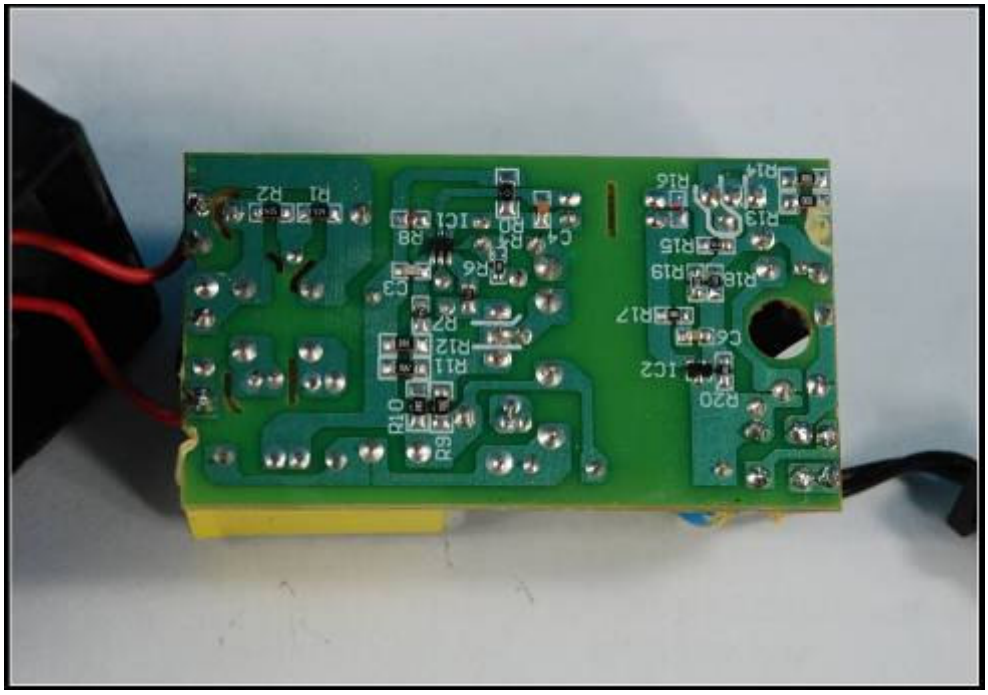












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