



Nemko USA, Inc.
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EMC Directive 2004/108/EC

EMC TEST REPORT

For The AC Solenoid

Model: RLCV

CATEGORY II

PREPARED FOR:

Rain Bird Corporation
6991 East Southpoint Rd.
Tucson, AZ, 85756, United States

Testing performed per the following:



PREPARED ON: JUNE 29, 2011
REPORT NUMBER: 2011 06178010 EMC R1
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DOCUMENT HISTORY

REVISION	DATE	COMMENTS
-	June 29, 2011	Prepared By: Juan Garcia
-	June 29, 2011	Initial Release: Alan Laudani
1	October 4, 2011	Revision, include customer inputs and other non-technical clarifications, globally change EUT name from "APAS and DV RLCV Series" to "RLCV" only A. Smith

NOTE: Nemko USA, Inc. hereby makes the following statements so as to conform to the Subclause 5.10 Requirements of ISO/IEC 17025 "General Criteria For the Competence of Testing and Calibration Laboratories":

- o The unit described in this report was received at Nemko USA, Inc.'s facilities on June 22, 2011.
- o Testing was performed on the unit described in this report on June 24, 2011 to June 29, 2011.
- o The Test Results reported herein apply only to the Unit actually tested, and to substantially identical Units.
- o This report does not imply the endorsement of the Federal Communications Commission (FCC), NVLAP or any other government agency.

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CERTIFICATION

The compatibility testing and this report have been prepared by Nemko USA, Inc., an independent electromagnetic compatibility consulting and test laboratory.

As specified by European Union documents EN 55014-1: 2006/A1: 2009 and EN 55014-2: 1997/A2: 2008, harmonized with CISPR 14-1:2005/A1:2008 and CISPR 14-2: 1997/A2: 2008, the testing and test methods were accomplished in accordance with European Norms and International Electrotechnical Commission specifications for household appliances, electric tools and similar apparatus.

I certify the data evaluation and equipment configuration herein to be a true and accurate representation of the sample's immunity and emission characteristics, as of the test date(s), and for the design of the test sample utilized to compile this report.



Alan Laudani,
EMC/RF Test Engineer

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1. ADMINISTRATIVE DATA AND TEST SUMMARY

1.1. Administrative Data

CLIENT: Rain Bird Corporation
6991 East Southpoint Rd.
Tucson, AZ, 85756, United States

CONTACT: Scott Arden, (619) 671-4025

E-MAIL: sarden@rainbird.com

DATE(S) OF TEST: June 24, 2011 to June 29, 2011

EQUIPMENT UNDER TEST (EUT): AC Solenoid

MODELS TESTED: RLCV

SERIAL NUMBER: N/A

CATEGORY: Category II

CONDITION UPON RECEIPT: Suitable for Test

TEST SPECIFICATION: Radio Frequency Emissions and Electromagnetic Immunity tests in accordance with requirements of EN 55014-1: 2006/A1: 2009 and EN 55014-2: 1997/A2: 2008 as follows:

<i>Test Type</i>	<i>In Accordance with Document</i>	<i>Document Title</i>
Mains Terminal Disturbance Voltage; Disturbance Power; Discontinuous Disturbance	EN 55014-1: 2006/A1: 2009	Electromagnetic Compatibility - Requirements For Household Appliances, Electric Tools And Similar Apparatus
Power Line Harmonics	EN 61000-3-2: 2006	Electromagnetic Compatibility, Limits for Harmonic Current Emissions, Equipment Input Current < 16A
Power Line Flicker	EN 61000-3-3: 2008	Electromagnetic Compatibility, Limitation of Voltage Fluctuations and Flicker In Low-Voltage Supply Systems for Equipment with Rated Current < 16A
Electrostatic Discharge Immunity	IEC 61000-4-2: A2:2000	Electromagnetic Compatibility—Testing and measurement techniques - Electrostatic discharge immunity test
Radio Frequency Immunity	IEC 61000-4-3: A1: 2007	Electromagnetic Compatibility—Testing and measurement techniques - Radiated radio frequency electromagnetic field immunity test
Electrical Fast Transient Burst Immunity	IEC 61000-4-4: 2004	Electromagnetic Compatibility—Testing and measurement techniques - Electrical fast transient / burst immunity
Power Line Surge Immunity	IEC 61000-4-5: 2005	Electromagnetic Compatibility—Testing and measurement techniques - Surge immunity test
RF Common Mode Immunity	IEC 61000-4-6: 2006	Electromagnetic Compatibility—Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
Voltage Dips and Short Interruptions Immunity	IEC 61000-4-11: 2004	Electromagnetic Compatibility—Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests

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1.2. Test Summary

1.2.1. Emissions Test Summary

<i>Specification</i>	<i>Frequency Range</i>	<i>Compliance Status</i>
EN 55014-1: 2006/A1: 2009, Mains Terminal Disturbance Voltage	0.15 MHz – 30 MHz	PASS
EN 55014-1: 2006/A1: 2009, Disturbance Power	30 MHz – 300 MHz	PASS
EN 55014-1: 2006/A1: 2009 Discontinuous Disturbance ("Click") Test	0.15 MHz – 30 MHz	PASS*

*(insufficient [no] clicks exist to warrant further measurements)

1.2.2. Immunity Test Summary

<i>Specification</i>	<i>Minimum Criterion Level Required as per EN 55014-2</i>	<i>Criterion Level Tested</i>	<i>Compliance Status</i>
IEC 61000-4-2: A2:2000 - ESD Immunity	Criterion B ±8 kV air discharge, ±4 kV contact discharge	Criterion C ±8 kV air discharge, ±4 kV contact discharge	PASS
IEC 61000-4-4: 2004 -Electrical Fast Transient Immunity	Criterion B Power line pulses of ± 1 kV; I/O line pulses of ± 0.5 kV	Criterion B Power Line Pulses of ± 1 kV	PASS
IEC 61000-4-5: 2005 -Surge Immunity	Criterion B ±2kV common mode surges, ±1kV differential mode surges	Criterion B ±2kV Common Mode Surges, ±1kV Differential Mode Surges	PASS
IEC 61000-4-6: 2008 -RF Common Mode Immunity	Criterion A 150 kHz - 80 MHz at 3 Vrms 1 kHz 80% amplitude modulated	Criterion A 150 kHz - 80 MHz at 3 Vrms 1kHz 80% amplitude modulated	PASS
IEC 61000-4-11: 2004 - Voltage Dips and Short Interruptions	Criterion C Voltage Dips of 0, 40, and 70% U _T (Rated Voltage of Equipment)	Criterion C Voltage Dips of 0, 40, and 70% U _T (Rated Voltage of Equipment)	PASS

Refer to the test results section for further details.

Alan Laudani,
EMC/RF Test Engineer

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2.SYSTEM CONFIGURATION

2.1. Description and Method of Exercising the EUT

The EUT is an RLCV AC Solenoid. Its task is to turn an irrigation valve on and off. The EUT was exercised by using an ESP-Modular Irrigation Controller then programming each zone to correspond with the sweep time of the test being performed. For example, for conducted emissions, each zone will be programmed 1 minute of scheduled duration; the sweep time is then adjusted to 12 minutes or more to cover all zones, and "Water All Now" function of the ESP-Modular Controller is then used to exercise the unit which will activate each solenoid in sequence for scheduled duration. Immunity test failure would be noted at the cessation of function of the AC Solenoid. There was no need to test the solenoid with water as testing in air provides worst case conditions as water may shield immunity attack energies

2.2. System Components and Power Cables

DEVICE	MANUFACTURER MODEL # SERIAL #	POWER CABLE
EUT - AC Solenoid	Rain Bird Corporation Model: RLCV Serial #: N/A	1.5m, unshielded, 18 AWG, 3-wire, IEC connector
Support – Modular Controller	Rain Bird Corporation Model: ESP-Modular Serial #: N/A	No power cable supplied.

2.3. Device Interconnection and I/O Cables

Connection	I/O Cable
ESP-Modular Controller to Rain & Temperature Sensor	10m, unshielded Twisted pair, 20AWG x2, hard wired.
ESP-Modular Controller to Solenoids	Standard solenoid cables

2.4. Design Modifications for Compliance

The following design modifications were made to the EUT during testing.

None. No design modifications were made to the EUT during testing.

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Photograph 1. General EUT (Front & Back)



MODEL AND EUT NAME "AC SOLENOID VALVE" PER QUOTE; S/B "AC SOLENOID"



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Photograph 2. General Support/Associated (Controller Front & Back)



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3. DESCRIPTION OF TEST SITE AND EQUIPMENT

3.1. Introduction

Nemko USA, Inc. is accredited to ISO/IEC 17025 by the National Voluntary Laboratory Accreditation Program (NVLAP) for Electromagnetic Compatibility and Telecommunications testing. Part of the accreditation process involves the demonstration of competence in various test methods.

Prior to the beginning of work, Nemko personnel work with their clients to ensure the proper test standards and test methods are utilized. Applicable tests and the minimum criteria for a pass condition are listed in the administrative section of this report.

3.2. Description of Test Site

Nemko USA is located at 2210 Faraday Street, Suite 150, Carlsbad, CA 92008. Radiated Emissions are measured in a 10 m Chamber accredited by NVLAP.

3.3. Accreditation

Nemko USA, Inc. is accredited through National Voluntary Laboratory Accreditation Program.



NVLAP LAB CODE 200116-0

REGISTRATIONS OF THE FACILITY SITES ARE ON FILE WITH:

ORGANIZATION	REGISTRATION NUMBERS
FEDERAL COMMUNICATIONS COMMISSION	0013750831
VCCI	R-3626 (RADIATED) AND C-4055 (CONDUCTED)
INDUSTRY CANADA	2040B-1 AND 2040B-2

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3.4. Configuration and Methods of Measurements for Mains Terminal Disturbance

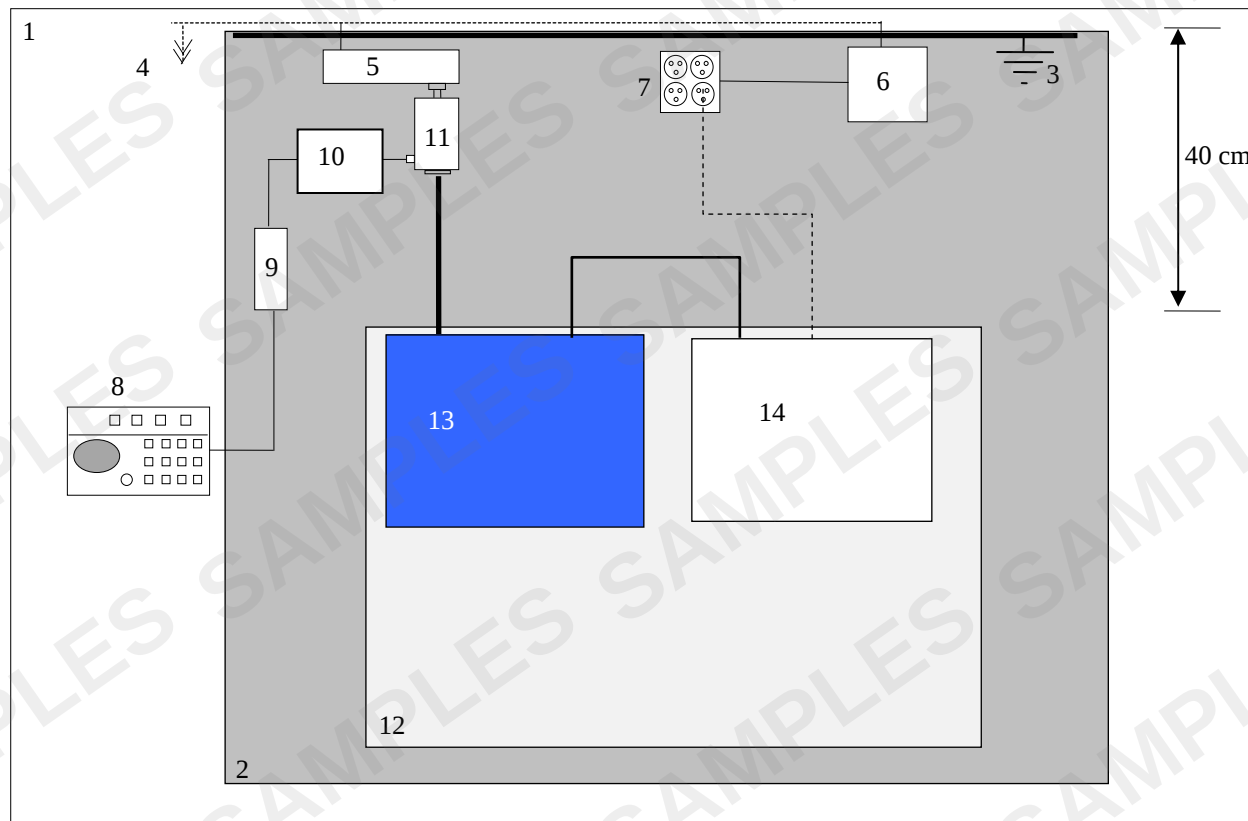
EN 55014-1 specifies the general configuration of the EUT and associated equipment, as well as the test platform for testing mains terminal disturbance voltage. The EUT was powered via an Artificial Mains Network (AMN) and placed on a non-conducting surface at a distance of 80cm from the AMN and 40cm from the earthed conductive vertical surface. Both peak and average detector measurement modes are used. If however, the average limit is met while using a peak detector, the test unit is deemed to meet both the limits, and measurement with the average detector receiver is unnecessary. The peak and average emission levels are then recorded and compared to the applicable EN 55014-1 limits to determine compliance.

EN 55014 also calls out the requirement for making, *where applicable*, Discontinuous Disturbance (i.e., “Click”) measurements per the limits and methods of Clause 4.2 of EN 55014-1. Clause 4.2 of EN 55014-1 defines a two-part procedure for this. First, a determination is made as to whether or not there are “clicks” of sufficient magnitude/duration/frequency of occurrence to be subject to limits. Second, *and only if there are “clicks” of sufficient magnitude/duration/frequency of occurrence to be subject to limits*, the “Clicks” are measured and recorded. Otherwise, no “Click” measurements are to be made. The EUT was evaluated and determined to not require further testing.

For Mains Terminal Disturbance Voltage Test Configuration please refer to Figure #1 on the next page.

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Figure 1. Mains Terminal Disturbance Voltage Test Setup Diagram



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CONFIGURATION LEGEND

1. Test Laboratory (6 X 6 meters)
2. Ground Plane (15 square meters)
3. Vertical Conducting Wall (Grounded through Ground Plane via 10' ground rod)
4. AC Power for Devices
5. Power Line Filter, Lindgren, 120 dB, 30 amp
6. Artificial Mains Network (AMN) for peripheral devices
7. Power Distribution Box for peripheral devices
8. Spectrum Analyzer with Quasi-Peak Adapter
9. High Pass Filter (if necessary)
10. Transient Limiter (if necessary)
11. AMN for EUT
12. Non-Conducting insulation
13. EUT: **AC Solenoid**
14. Associated Equipment

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3.5. Configuration and Methods of Measurements for Disturbance Power

The EUT is placed on a non-conducting insulation on the floor with the lead (having the absorbing clamp attached) stretched horizontally straight out from the unit connected to the lead, extended 6m. No metallic object, including any other units, which are part of the EUT, or any person, is closer to the lead or EUT than 40cm. All other leads other than the one being measured is either disconnected, if possible, or fitted with ferrite rings for attenuation of RF currents, which may affect the measurement results. Such a lead is stretched away from the EUT in a 90 Degree direction from the direction of the lead being measured. All connectors not used are left unterminated. All connectors having connected leads are terminated in a manner representative of use.

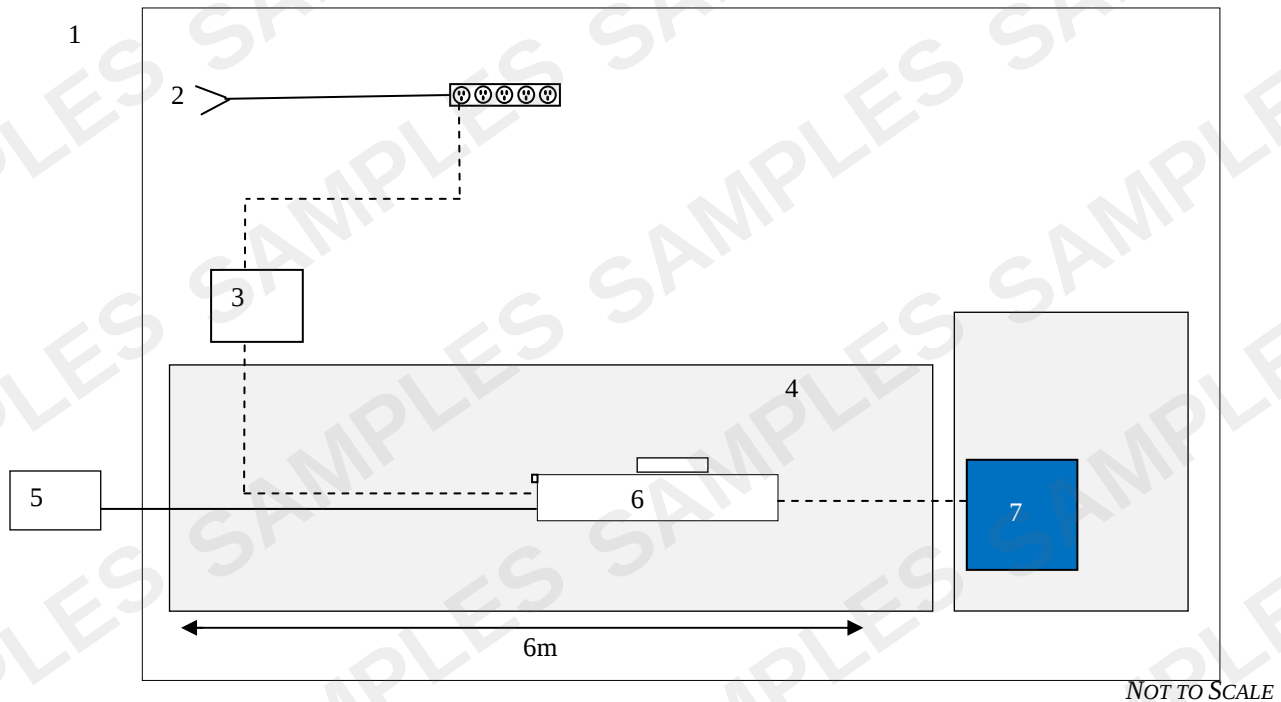
All leads longer than 25cm, which are connected, shall have a length of at least a half wavelength during measurement at 30 MHz plus twice the length of the absorbing clamp. The leads are extended if necessary to fulfill this requirement.

Measurements are made using an absorbing clamp consisting of a RF transformer followed by absorbing ferrite rings according to CISPR 16, Clause 11, with the measuring instrument connected to it. These measurements are made on any leads in excess of 25cm in length, which may be connected, to the EUT. On each lead the absorbing clamp is moved a distance of a half wavelength for each frequency of measurement, starting with the clamp positioned close to the case of the EUT and the current transformer of the clamp pointing towards the EUT. On interconnecting leads between units belonging to the same EUT two measurements are made, the current transformer of the clamp facing first one and then the other of the two units at the ends of the lead.

For Disturbance Power Measurements Test Configuration please refer to Figure #2 on the next page.

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Figure 2. Disturbance Power Measurements Test Setup Diagram



CONFIGURATION LEGEND

1. Test Laboratory
2. AC power for EUT
3. Fixed ferrite clamp for r.f. isolation of mains supply
4. All components placed on non-conductive wood test platform (6m)
5. Spectrum Analyzer with Quasi-Peak adapter
6. Absorbing Clamp for Measurement
7. EUT: **AC Solenoid**

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3.6. Device Performance Criteria for Immunity Tests

Three criteria of performance are defined by EN 55014-2. These are as follows

- o 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.
- o 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.
- o Criterion C - Temporary loss of function is allowed, provided the function is self-recoverable, or can be restored by operation of the controls, or by any operation specified in the instructions for use.

For each test method, EN 55014-2 specifies the appropriate category classification and criterion to be met for category II, III, and IV apparatus.

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3.7. Electrostatic Discharge Immunity: IEC 61000-4-2: A2:2000

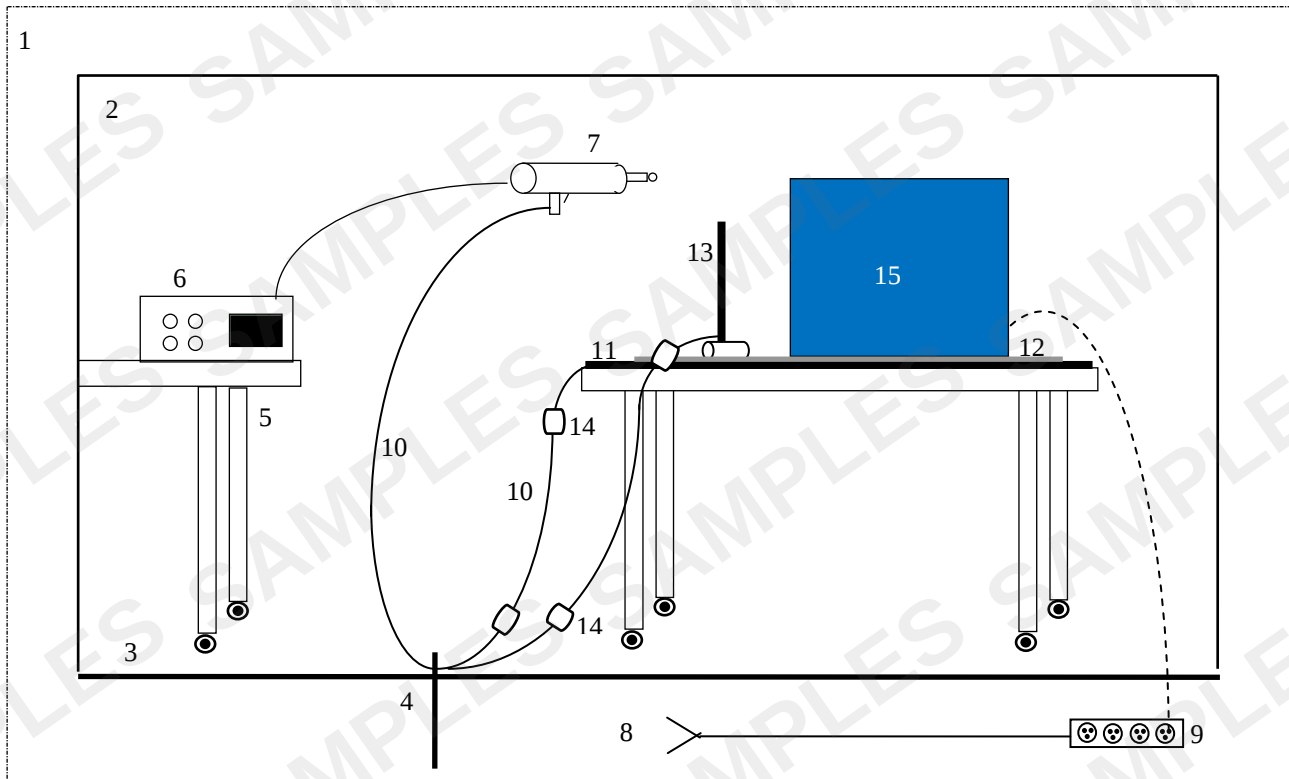
EN 55014-2 specifies Part 2 of the IEC 61000-4 Standard as the basic procedure for ESD testing. The standard configuration as outlined in IEC 61000-4-2 is used. Tabletop devices are placed on an insulated mat on a horizontal coupling plane. Air discharges and contact charges are made to the EUT on connectors and conducting surfaces (as illustrated in the Test Results section of this Test Report). For further information, please refer to the technical sections in the IEC 61000-4-2 publication in addition to the test results section and photographs of the test set-up provided in this report.

For ESD tests, EN 55014-2 requires that the EUT meet at least performance Criterion B for discharges of up to ± 8 kV air discharge and ± 4 kV contact discharge.

For ESD Immunity Test Configuration please refer to Figure #3 on the next page.

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Figure 3. ESD Test Setup Diagram



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CONFIGURATION LEGEND

1. Test Laboratory (6 x 7 meters)
2. Vertical Conducting Wall (3 x 3 m, grounded)
3. Ground Plane (14 square meters), grounded to grounding Rod
4. Ground Rod extending 3 m below plane
5. Non-Conducting table for ESD Simulator Control Box and 80 cm EUT support (if Table Top)
6. ESD Simulator Control Box
7. Electro-Static Discharge (ESD) Gun (hand held, grounded to grounding rod)
8. AC power for devices
9. Power strip for EUT and from power line filter
10. Grounding Strap
11. Horizontal Coupling Plane (HCP), grounded through 470k x2 resistors (if Table Top)
12. Insulating Mat
13. Vertical Coupling Plane (VCP), grounded through 470k x2 resistors
14. 470k ohm Resistor(s)
15. EUT: AC Solenoid

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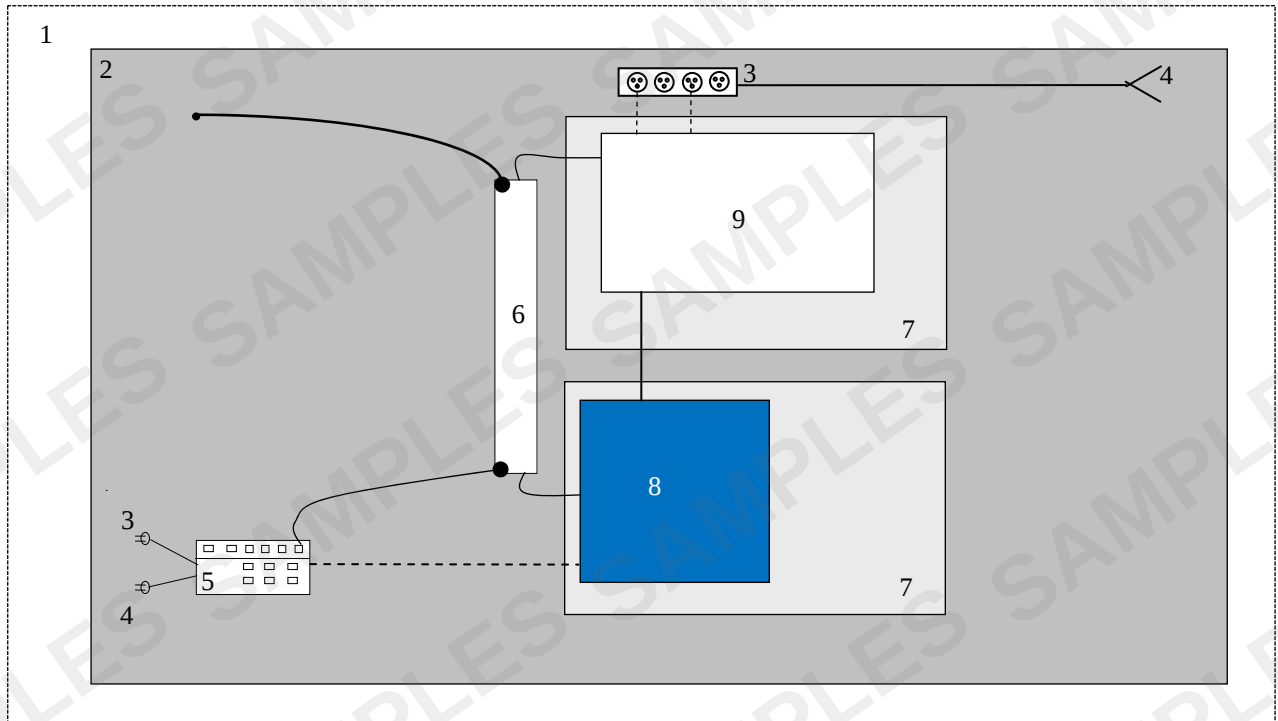
3.8. Electrical Fast Transient Immunity: IEC 61000-4-4: 2004

EN 55014-2 specifies Part 4 of the IEC 61000-4 Standard as the basic procedure for electrical fast transient testing. IEC 61000-4-4 defines the immunity requirements and test methods for equipment that are required to withstand high-voltage transients coupled on the power mains. The standard configuration for “type tests” outlined in IEC 61000-4-4 is used. For further information, please refer to the technical sections in the IEC 61000-4-4 in addition to the test results section and photographs of the test set-up provided in this report.

For electrical fast transient/burst tests, EN 55014-2 requires that the EUT meet at least performance Criterion B for ± 1 kV Power line and ± 0.5 kV signal line transients.

For EFT Immunity Test Configuration please refer to Figure #4 on the next page.

Figure 4. EFT Immunity Test Setup Diagram



NOT TO SCALE

CONFIGURATION LEGEND

1. Test Laboratory (6 x 7 meters)
2. Metallic Ground Plane (grounded to grounding rod)
3. Mains Power for EUT
4. AC Power for Fast Transient Noise Generator
5. Fast Transient Noise Generator
6. Coupling Clamp for I/O Devices
7. 10cm Non-Conducting Support
8. EUT: **AC Solenoid**
9. EUT Support Equipment

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3.9. Power Line Surge Immunity: IEC 61000-4-5: 2005

EN 55014-2 specifies Part 5 of the IEC 61000-4 Standard as the basic procedure for power line surge immunity tests. This standard relates to the immunity requirements, test methods, and range of recommended test levels for low voltage equipment to unidirectional surges caused by overvoltages from switching and lightning transients. The standard configuration as outlined in IEC 61000-4-5, section 7 was used.

Each device was tested in a total of three surge configurations:

Surge #1: Combination Wave, Line to Protective Earth with 9uF and 10Ohm, common mode, generator earthed.

Surge #2: Combination Wave, Neutral to Protective Earth with 9uF and 10Ohm, common mode, generator earthed.

Surge #3: Combination Wave, Line to Neutral with 18uF, differential mode, generator floated.

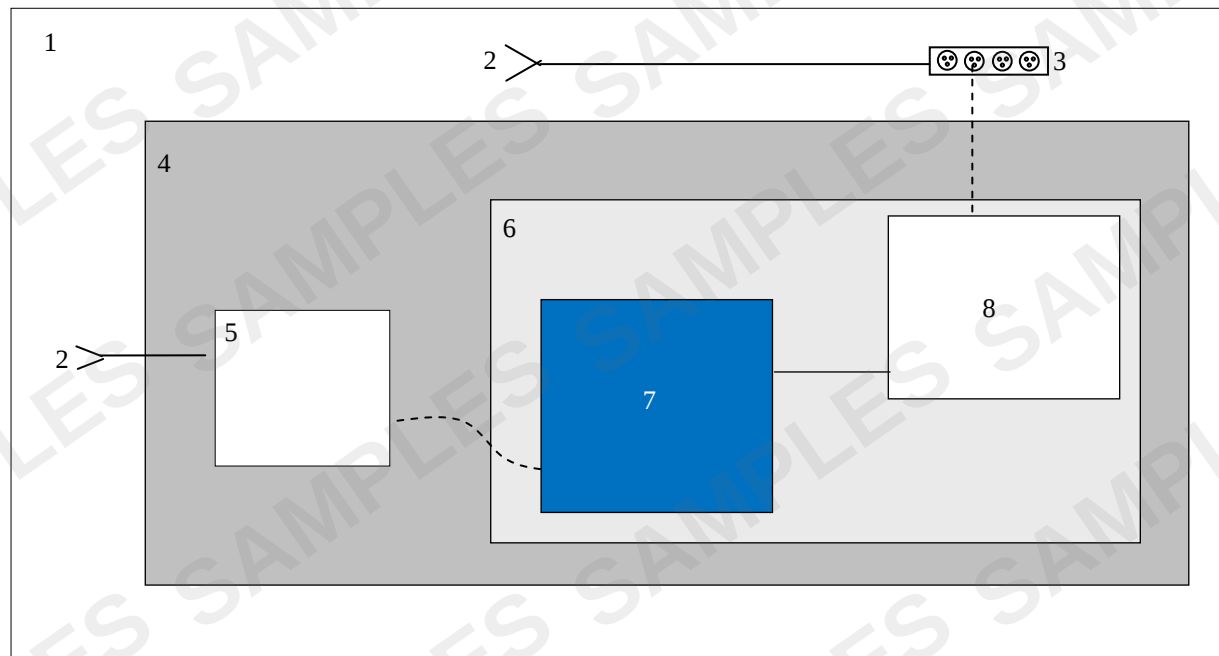
For further information, please refer to the technical sections in the IEC 61000-4-5 in addition to the test results section and photographs of the test set-up provided in this report.

For Power line surge tests, the EUT must meet at least performance Criterion B for $\pm 2\text{kV}$ common mode and $\pm 1\text{kV}$ differential mode surges in the AC power supply configuration.

For Surge Immunity Test Configuration please refer to Figure #5 on the next page.

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Figure 5. Power Line Surge Immunity Test Setup Diagram



NOT TO SCALE

CONFIGURATION LEGEND

1. Test Laboratory
2. AC power for Devices
3. Power strip for associated devices from power line filter
4. Metallic Ground Plane (grounded to grounding rod)
5. Surge Generator and Coupling Network (EUT Power)
6. Non-conductive Support
7. EUT: **AC Solenoid**
8. EUT Support Equipment

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3.10. Radio Frequency Conducted Common Mode Immunity: IEC 61000-4-6: 2008

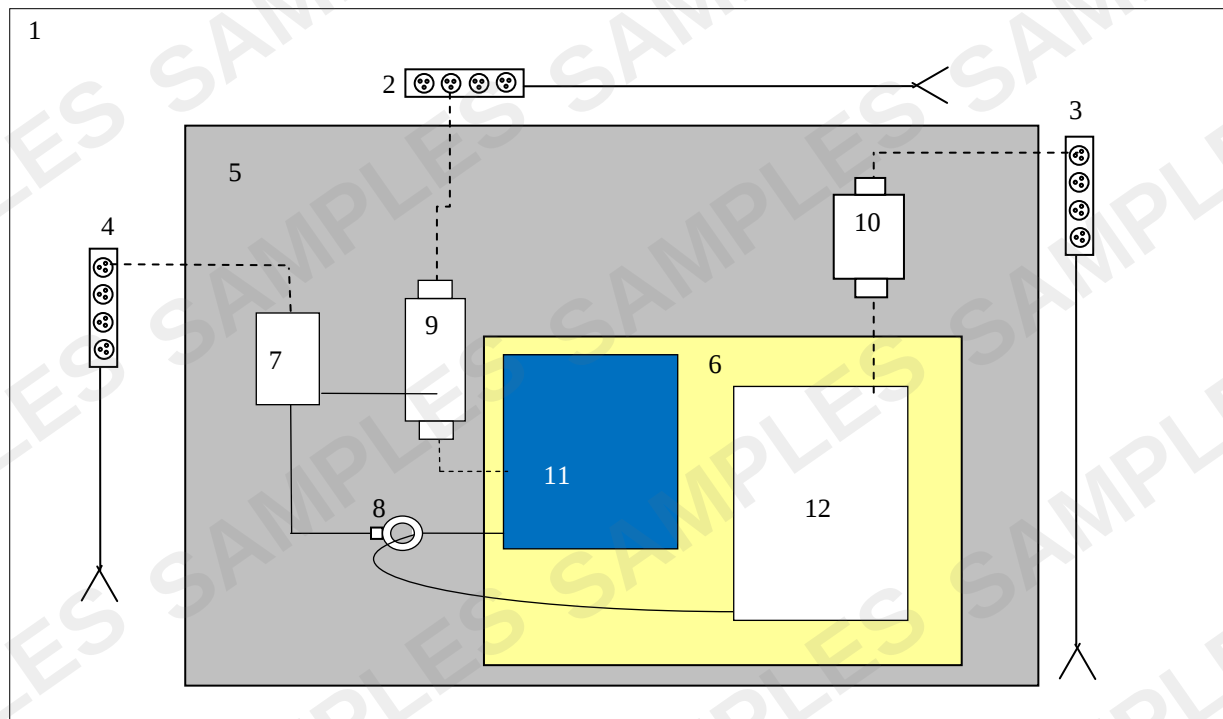
EN 55014-2 specifies Part 6 of the IEC 61000-4 Standard as the basic standard for radio frequency conducted common mode disturbance testing. This standard relates to the immunity requirements, test methods, and range of recommended test levels for immunity to conducted disturbances induced by radio-frequency fields in the 150 kHz to 230 MHz frequency range. The standard configuration as outlined in the IEC 61000-4-6 was used. For further information, please refer to the technical sections of the IEC 61000-4-6 publication in addition to the test results section and photographs of the test set-up provided in this report.

For RF induced conducted common mode disturbances, EN 55014-2 specifies that the EUT meet at least performance Criterion A for 3 Vrms, 1 kHz, 80% amplitude modulated waveform.

For RF Common Mode Test Configuration please refer to Figure # 6 on the next page.

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Figure 6. RF Common Mode Immunity Test Setup Diagram



NOT TO SCALE

CONFIGURATION LEGEND

1. Test Laboratory
2. AC power for EUT
3. AC power for Support Equipment
4. AC power for Test Devices
5. Ground Plane
6. 10cm wooden Platform
7. Test Generator
8. Current Probe
9. Coupling/Decoupling Network for EUT
10. Coupling/Decoupling Network for Support Equipment
11. EUT: **AC Solenoid**
12. Associated System

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3.11.Voltage Dips and Short Interruptions: IEC 61000-4-11: 2004

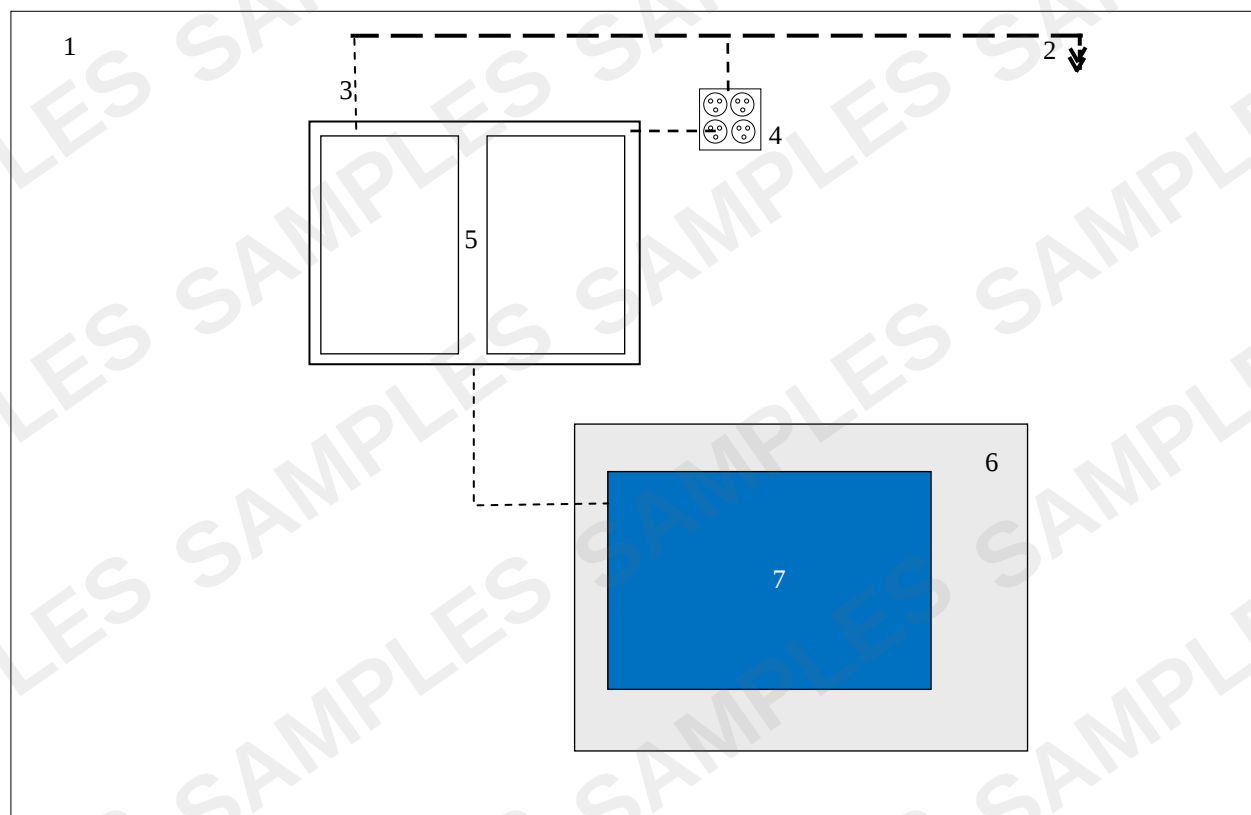
EN 55014-2 specifies Part 11 of the IEC 61000-4 Standard as the basic standard for voltage variations immunity testing. This standard relates to the immunity requirements, test methods, and range of recommended test levels for immunity to variations in AC line voltage. The standard configuration as outlined in the IEC 61000-4-11 was used. The EUT is powered up to a nominal voltage of 230 VAC 50 Hz, and then software-controlled voltage dips and interruptions are introduced. The EUT is tested with dips of 100% of nominal voltage for 0.5 periods. Next the dip is increased to 40% of nominal voltage for 10 periods. Finally the line voltage is dropped 30% for 50 periods.

For further information, please refer to the technical sections of the IEC 61000-4-11 publication in addition to the test results section and photographs of the test set-up provided in this report.

For Voltage Dips Test Configuration please refer to Figure #7 on the next page.

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Figure 7. Voltage Dips and Short Interruptions Test Setup Diagram



NOT TO SCALE

CONFIGURATION LEGEND

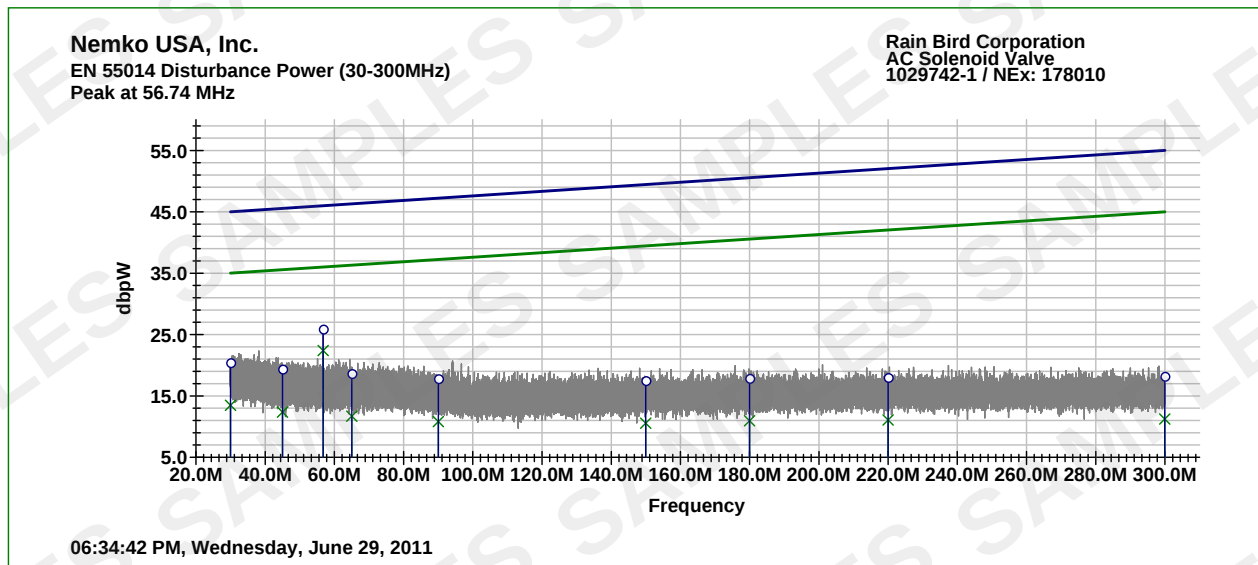
1. Test Laboratory (6 X 6 meters)
2. AC Power for Laboratory Devices
3. Power for Test Equipment
4. Power Distribution Box
5. Programmable Power Source Rack with Computer Analysis System (EUT Power)
6. Non-conducting table (if Table Top)
7. EUT: **AC Solenoid**

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4. Test Results

4.1. Disturbance Power Measurements Test Results

Client	Rain Bird Corporation	Temperature	20	°C
NEx #	1029742	Relative Humidity	41	%
EUT Name	AC Solenoid	Barometric Pressure	100.7	kPa
EUT Model	RLCV	Test Location	Enclosure 1	
Governing Doc	EN 55014-1	Test Engineer	Juan Garcia	
Basic Standard	CISPR 14-1	Date	6/29/2011	



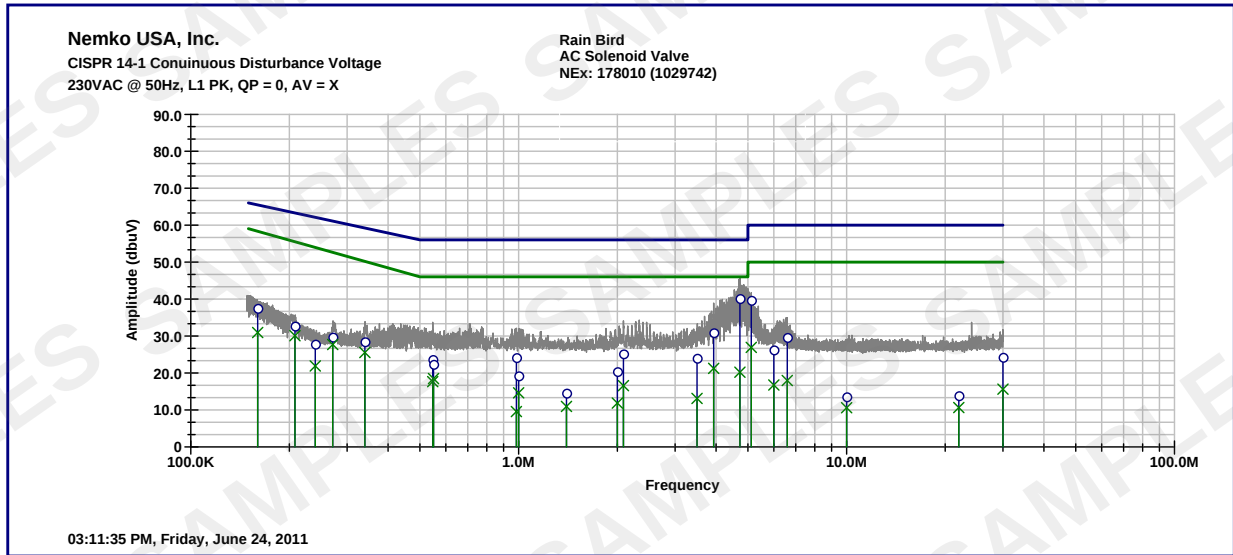
*Voltage Varied +/-10% with no considerable change

MODEL AND EUT NAME "AC SOLENOID VALVE" PER QUOTE; S/B "AC SOLENOID"

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4.2. Mains Terminal Disturbance Voltage Measurements Test Results

Client	Rain Bird Corporation	Temperature	23	°C
NEx #	1029742	Relative Humidity	38	%
EUT Name	AC Solenoid	Barometric Pressure	100.7	kPa
EUT Model	RLCV	Test Location	Enclosure 1	
Governing Doc	EN 55014-1	Test Engineer	Juan Garcia	
Basic Standard	CISPR 14-1	Date	6/24/2011	

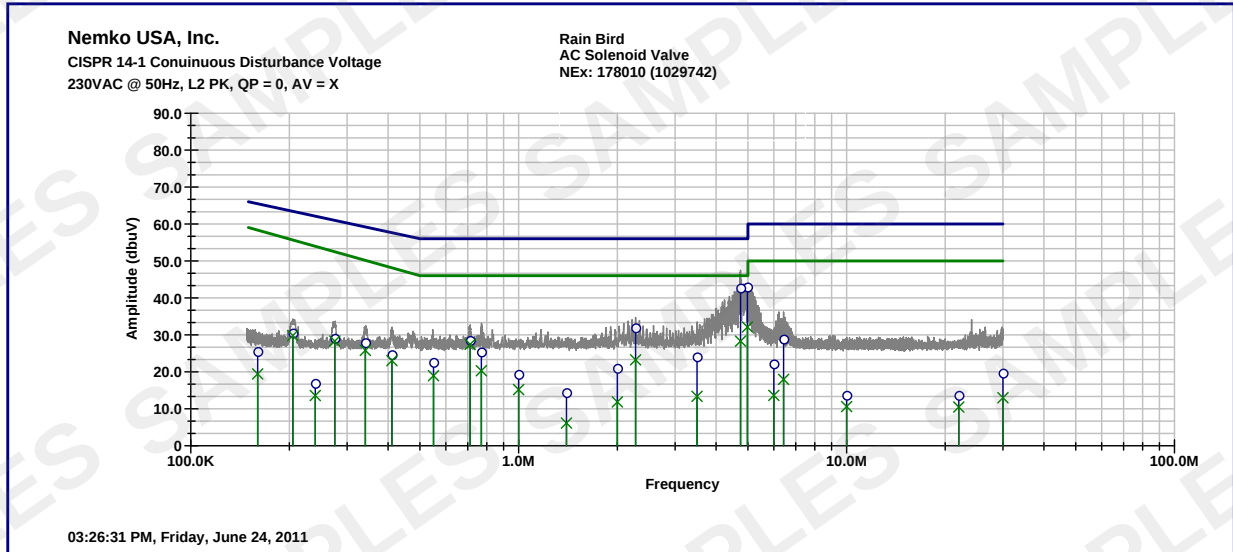


*Voltage Varied +/-10% with no considerable change

Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
160.0	37.53	30.91	65.4	58.2	-27.9	-27.3
208.0	32.71	30.077	63.2	55.4	-30.5	-25.3
240.0	27.84	21.877	62.0	53.9	-34.2	-32.0
271.0	29.74	27.71	61.0	52.6	-31.3	-24.8
340.0	28.46	25.523	59.2	50.1	-30.7	-24.6
547.0	23.65	17.65	56.0	46.0	-32.4	-28.4
550.0	22.37	18.46	56.0	46.0	-33.6	-27.5
984.0	24.17	9.53	56.0	46.0	-31.8	-36.5
1000.0	19.23	14.592	56.0	46.0	-36.8	-31.4
1400.0	14.56	10.91	56.0	46.0	-41.4	-35.1
2000.0	20.38	11.838	56.0	46.0	-35.6	-34.2
2086.0	25.2	16.54	56.0	46.0	-30.8	-29.5
3500.0	24.01	13.093	56.0	46.0	-32.0	-32.9
3934.0	30.91	21.233	56.0	46.0	-25.1	-24.8
4727.0	40.16	20.21	56.0	46.0	-15.8	-25.8
5122.0	39.67	26.877	60.0	50.0	-20.3	-23.1
6000.0	26.23	16.735	60.0	50.0	-33.8	-33.3
6597.0	29.63	17.955	60.0	50.0	-30.4	-32.0
10000.0	13.58	10.6	60.0	50.0	-46.4	-39.4
22000.0	13.87	10.613	60.0	50.0	-46.1	-39.4
30000.0	24.25	15.608	60.0	50.0	-35.8	-34.4

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Client	Rain Bird Corporation	Temperature	23	°C
NEx #	1029742	Relative Humidity	38	%
EUT Name	AC Solenoid	Barometric Pressure	100.7	kPa
EUT Model	RLCV	Test Location	Enclosure 1	
Governing Doc	EN 55014-1	Test Engineer	Juan Garcia	
Basic Standard	CISPR 14-1	Date	6/24/11	



*Voltage Varied $\pm 10\%$ with no considerable change

MODEL AND EUT NAME "AC SOLENOID VALVE" PER QUOTE; S/B "AC SOLENOID"

Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
160	25.5	19.41	65.4	58.2	-39.9	-38.8
205	30.48	29.825	63.3	55.5	-32.9	-25.7
240	16.89	13.56	62.0	53.9	-45.2	-40.3
275	29.08	28.26	60.9	52.4	-31.8	-24.1
341	27.9	25.78	59.2	50.1	-31.3	-24.3
411	24.66	23.01	57.6	48.1	-33.0	-25.1
550	22.58	18.945	56.0	46.0	-33.4	-27.1
712	28.51	27.447	56.0	46.0	-27.5	-18.6
770	25.36	20.278	56.0	46.0	-30.6	-25.7
1000	19.31	15.17	56.0	46.0	-36.7	-30.8
1400	14.38	6.115	56.0	46.0	-41.6	-39.9
2000	20.98	11.845	56.0	46.0	-35.0	-34.2
2274	31.92	23.205	56.0	46.0	-24.1	-22.8
3500	24.06	13.337	56.0	46.0	-31.9	-32.7
4749	42.68	28.275	56.0	46.0	-13.3	-17.7
4987	42.96	32.093	56.0	46.0	-13.0	-13.9
6000	22.16	13.595	60.0	50.0	-37.8	-36.4
6429	28.88	17.945	60.0	50.0	-31.1	-32.1
10000	13.67	10.56	60.0	50.0	-46.3	-39.4
22000	13.64	10.473	60.0	50.0	-46.4	-39.5
30000	19.67	12.945	60.0	50.0	-40.3	-37.1

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Terminal Voltage Test Equipment

Client	Rain Bird Corporation		EUT Name	AC Solenoid		
NEx #	1029742		EUT Model	RLCV		
Device Type		Model #	Asset #	Used	Cal Done	Cal Due
Pre-Amplifier						
Amplifier, HP		8447A	166			
Amplifier, HP		8447A	603			
Filter / Limiter						
High Pass Filter, Solar		7801-5.0	564			
High Pass Filter, Solar		8310-1.0	559			
Transient Limiter, HP		11947A	682			
Transducer						
LISN, EMCO		3825/2 – FCC	147			
LISN, R&S		ENV216	E1019			
LISN, R&S		ENV216	E1020	X	4/4/11	4/4/12
Absorbing Clamp, FCC		F-201-32-MM	828	X	10/1/2010	10/1/2011
V-Network LISN, Solar		9348-50-R-24-BNC	805			
V-Network LISN, Solar		9348-50-R-24-BNC	395			
Voltage Line Probe, EMCO		3701	471			
LISN, Solar		8602-50-TS-50-N	424			
LISN, Solar		8602-50-TS-50-N	423			
Fluke, DMM		111	813	X	9/16/09	9/16/11
Elgar, AC Power Source		3001	220	X	NCR	NCR
TDGC, Variac		3kVA	N/A			
Spectrum Analyzer / Receiver						
Quasi-Peak Adapter, HP		85650A	533			
Spectrum Analyzer Display, HP		85662A	422			
Spectrum Analyzer, HP		8568B	535			
RF Preselector, HP		85650A	673			
Quasi-Peak Adapter, HP		85650A	438			
Spectrum Analyzer Display, HP		85662A	534			
Spectrum Analyzer, HP		8568B	107			
Quasi-Peak Adapter, HP		85650A	676			
Spectrum Analyzer Display, HP		85662A	675			
Spectrum Analyzer, HP		8568B	674			
Quasi-Peak Adapter, HP		85650A	421			
Spectrum Analyzer Display, HP		85662A	404			
Spectrum Analyzer, HP		8566B	711			
RF Preselector, HP		85685A	403			
Spectrum Analyzer, RNS		FSP7	E1018	X	2/1/11	2/1/12

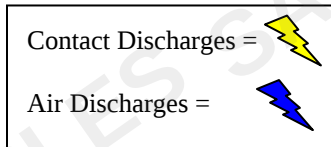
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4.3. Electrostatic Discharge Immunity Test Results & Test Points

Client	Rain Bird Corporation		Temperature:	21	°C		
NEx #	1029742		Relative Humidity:	59	%		
EUT Name	AC Solenoid		Barometric Pressure:	100.8	kPa		
EUT Model	RLCV		Test Location	ESD Room			
Governing Doc:	EN 55014-2		Test Engineer	Juan Garcia			
Basic Standard:	IEC 61000-4-2		Date:	6-29-2011			
Voltage:	230 V / 50Hz						
Discharge Rep. Rate	☒	≤ 1 per second					
Number of Discharges	☒	≥ 10 per location					
<i>Equipment Used</i>							
<i>Device Type</i>	<i>Model #</i>	<i>Asset #</i>	<i>Used</i>	<i>Cal Done</i>	<i>Cal Due</i>		
ESD Gun, Haefely	PSD-25B	639					
ESD Gun, Keytek	PSC	377					
ESD Gun, Schaffner	NSG 435	818	X	7/6/2010	7/6/2011		
Multi-Generator, EMC Partner	TRA2000	845					
<i>Location of Discharge</i>							
<i>Contact Discharge</i>							
Voltage (kV)	Polarity		Numbers	HCP	VCP		
	Pos	Neg					
2	X	X		X	X		
4	X	X		X	X		
Comments: No susceptibility noted.							
<i>Air Discharge</i>							
Voltage (kV)	Polarity		Numbers				
	Pos	Neg					
2	X	X					
4	X	X					
8	X	X					
Comments: No susceptibility noted.							
Compliant	☒	☐ Non-Compliant		Photo	☒		

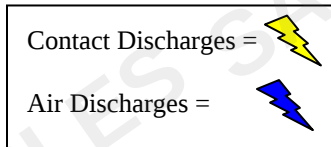
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Figure 8. ESD Test Points



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Figure 9. ESD Test Points



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4.5. Power Line Surge Immunity Test Results

Client	Rain Bird Corporation		Temperature	23	°C
NEx #	1029742		Relative Humidity	55	%
EUT Name	AC Solenoid		Barometric Pressure	100.6	kPa
EUT Model	RLCV		Test Location	Ground Plane 2	
Governing Doc	EN 55014-2		Test Engineer	Juan Garcia	
Basic Standard	IEC 61000-4-5		Date	6-29-2011	

Performance Criteria: ☐ A ☒ B ☐ C

Test Equipment:	Asset #	Used	Calibration Done	Calibration Due
Haefely PSurge 4010	687			
Haefely FP Surge 32.1	688			
Haefely PC6 288.1	413			
Haefely FP Surge 16.1	412			
EMC Partner, TRA2000	845	X	10/4/10	10/4/11
Fluke, 111 DMM	811	X	12/10/10	12/10/11
Behlman, BL 12 000	N39	X	NCR	NCR
Elgar, 3001 AC Power Source	220	X	NCR	NCR

EUT Power:

☒	24VAC @ 50Hz
☐	220VAC @ 60 Hz
☐	120VAC @ 60 Hz
☐	208VAC @ 60 Hz

Number of Strikes per Polarity/Voltage/Angle: →

0	5	0	5	0
0	90	180	270	360

Waveform Generator Type:

☒	Combination
☐	Ring Wave

	Level 1		Level 2		Level 3		Level 4		Special	
	CM	DM	CM	DM	CM	DM	CM	DM	CM	DM
	0.5kV	0.25kV	1.0kV	0.5kV	2.0kV	1.0kV	4.0kV	2.0kV		
	+	-	+	-	+	-	+	-	+	-
N-Gnd					X	X				
L1-Gnd					X	X				
N-L1						X	X			

Comments:
No susceptibility noted.

Compliant	☒	Non-Compliant	☐	Photo	☒
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4.6. RF Conducted Common Mode Disturbance Immunity Test Results

Client	Rain Bird Corporation			Temperature	24	°C				
NEx #	1029742			Relative Humidity	58	%				
EUT Name	AC Solenoid			Barometric Pressure	100.6	kPa				
EUT Model	RLCV			Test Location	Ground Plane 2					
Governing Doc	EN 55014-2			Test Engineer	Dustin Chapin					
Basic Standard	IEC 61000-4-6			Date	6-30-2011					
Test Level:	☒	3Vrms	☐	10Vrms	☐					
Modulation:	☐	None (CW)	☒	80%AM @ 1kHz	☐					
Frequency Range:	☒	0.15 – 80 MHz	☐	0.15-230MHz	☐					
Step:	☒	1%	☐	10%	☐	1.5 x 10 ⁻³ /decade				
Dwell:	☒	3 seconds	☐		☐					
Performance Criteria:	☒	A	☐	B	☐					
1	Injection Point (Cable)	Mains	Injection Method: ☐ Clamp ☒ CDN							
	Comments:	No susceptibility noted.								
2	Injection Point (Cable)		Injection Method: ☐ Clamp ☐ CDN							
	Comments:									
3	Injection Point (Cable)		Injection Method: ☐ Clamp ☐ CDN							
	Comments:									
4	Injection Point (Cable)		Injection Method: ☐ ☐							
	Comments:									
5	Injection Point (Cable)		Injection Method: ☐ ☐							
	Comments:									
<u>Test Equipment Used</u>		<u>Asset #</u>	<u>X if Used</u>	<u>Calibration Done</u>	<u>Calibration Due</u>					
HP 8462B (Signal Generator)		751								
HP 8648B (Signal Generator)		746								
HP 8657A (Signal Generator)		948	X	11/18/10	11/18/11					
Boonton 4232A (RF Power Meter)		887								
Werlatone, Directional Coupler		878								
FCC-801-M1-25 (CDN)		473								
FCC-801-M2-25 (CDN)		472	X	6/22/11	6/22/12					
FCC-801-M3-25 (CDN)		466								
FCC-801-M3-25 (CDN)		846								
FCC-801-M4-25 (CDN)		628								
FCC-801-M5-25 (CDN)		629								
FCC-801-T2 (CDN)		626								
FCC-801-T4 (CDN)		627								
AR 2500L (Amplifier)		739								
EIN 3100L (Amplifier)		913	X	NCR	NCR					
Solar 9144-1N (Clamp)		436								
Solar 9121-1N (Clamp)		435								
Solar 6741-1N (Clamp)		144								
Fluke, 111 DMM		811	X	12/10/10	12/10/11					
Elgar, 3100 AC Power Source		220	X	NCR	NCR					
Compliant	☒	☐ Non-Compliant				Photo ☒				

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4.7. Voltage Dips and Interruptions Immunity Test Results

Client	Rain Bird Corporation		Temperature	23	°C		
NEx #	1029742		Relative Humidity	54	%		
EUT Name	AC Solenoid		Barometric Pressure	100.8	kPa		
EUT Model	RLCV		Test Location	ESD Room			
Governing Doc	EN 55014-2		Test Engineer	Juan Garcia			
Basic Standard	IEC 61000-4-11		Date	6-29-2011			
EUT Voltage: ☒ 24VAC @ 50Hz ☐ 220VAC @ 60Hz ☐ 120VAC @ 60Hz							
<u>Equipment Used</u>	<u>Used</u>	<u>Asset #</u>	<u>Cal Done</u>	<u>Cal Due</u>			
California Instruments AC Power	X	604	3/21/11	3/21/12			
Xitron 2520 Standard Impedance	X	581	3/21/11	3/21/12			
Teseq, NSG 1007-5-208	X	962	3/21/11	3/21/12			
National Instruments, PCI 6250, PC DAQ	X	SN: 139A6B3	3/21/11	3/21/12			
PC System, HP DC5800 Microtower	X	963	NCR	NCR			
EMC Partner, TRA2000		845					
Fluke, 111 DMM							
Changes Occur At: ☒ Zero Crossing ☐							
Voltage Dips							
<u>Reduction in % U_T</u>	<u>Duration</u> <u>Cycles 50/60 Hz)</u>	<u>Criteria</u>			<u>Compliance</u>		
		<u>A</u>	<u>B</u>	<u>C</u>	<u>Yes</u> <u>No</u>		
☐ 100%							
☒ 100%	0.5/0.5	X			X		
☐ 30%	25						
☒ 60%	10/12	X			X		
☐ 60%	5						
☒ 30%	25/30			X	X		
☐ 60%	50						
Photo ☒							

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Photograph 3. Mains Terminal Disturbance Voltage Measurements Test Configuration



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Photograph 4. Disturbance Power Measurements Test Configuration



NOTE: EUT Is located on far end of extended test table.

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Photograph 5. Disturbance Power Measurements Test Configuration



Note: Photograph shows support controller configured on other end of test table

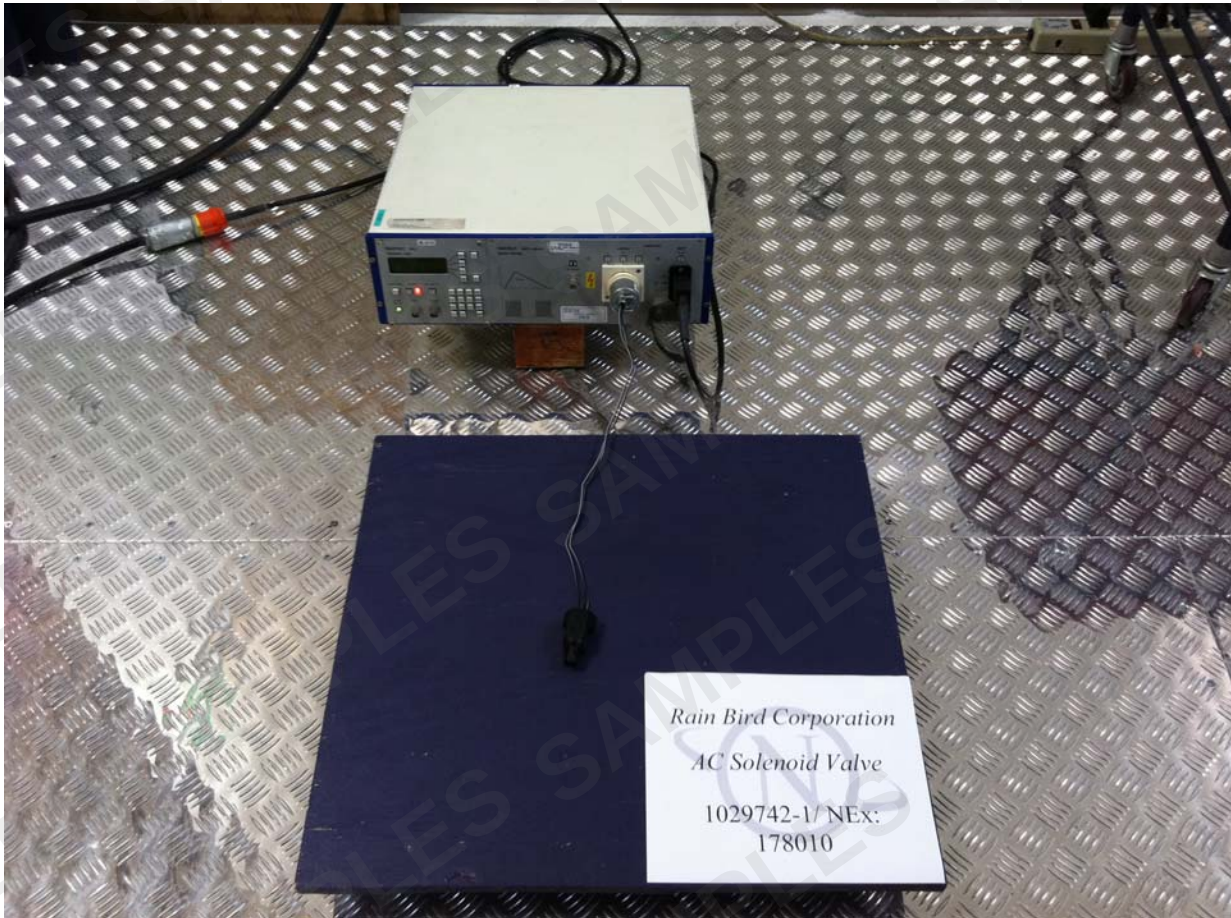
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Photograph 6. ESD Test Configuration



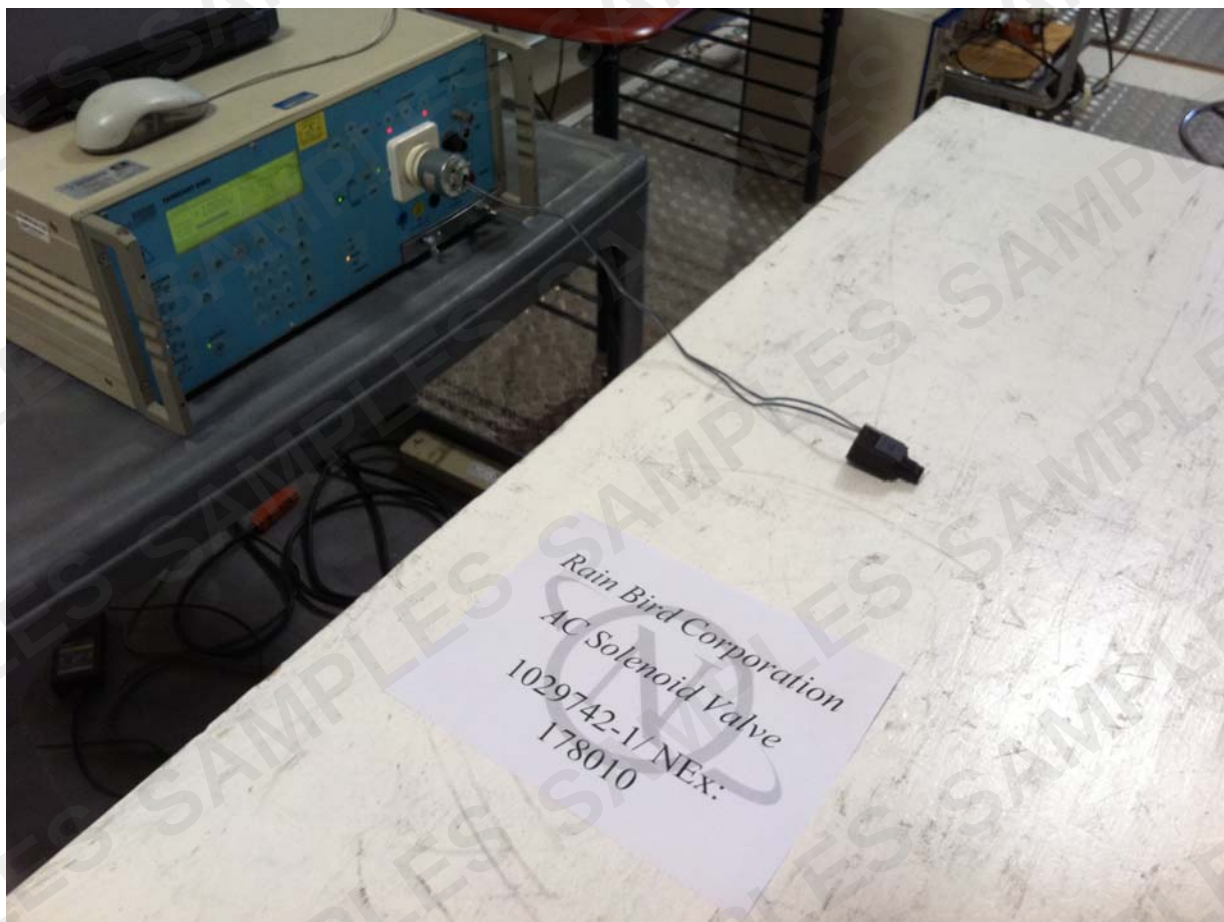
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Photograph 7. EFT Immunity Test Configuration



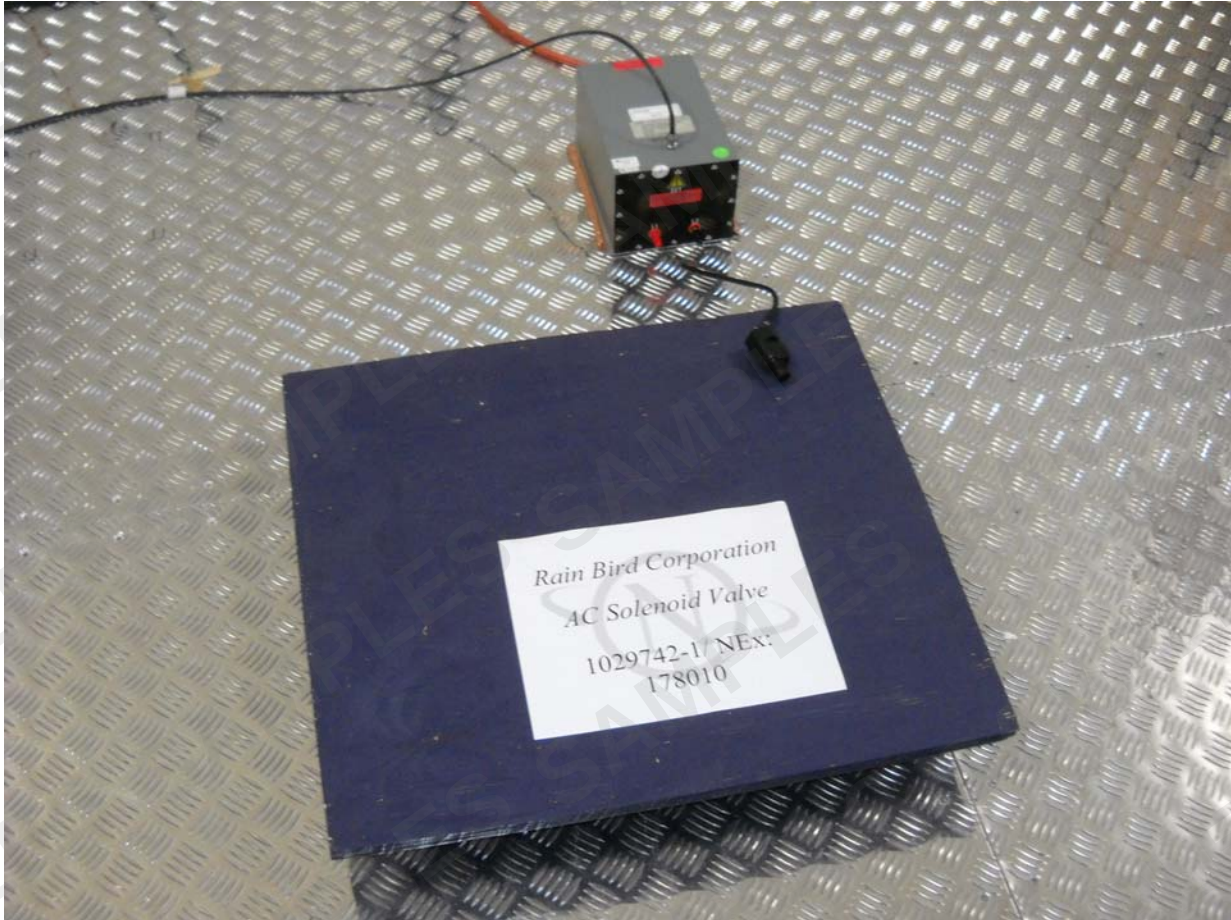
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Photograph 8. Power Line Surge Immunity Test Configuration



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Photograph 9. RF Common Mode Immunity Test Configuration



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Photograph 10. Voltage Dips/Short Interruptions Test Configuration



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APPENDIX A

A. Radiated Emissions Measurement Uncertainties

1. Introduction

ISO/IEC 17025:2005 and ANSI/NCSL Z540.3: 2006 require that all measurements contained in a test report be “traceable”. “Traceability” is defined in the International Vocabulary of Basic and General Terms in Metrology (ISO: 1993) as: “the property of the result of a measurement... whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, all having stated uncertainties”.

The purposes of this Appendix are to “state the Measurement Uncertainties” of the conducted emissions and radiated emissions measurements contained in Section 5 of this Test Report, and to provide a practical explanation of the meaning of these measurement uncertainties.

2. Statement of the Worst-Case Measurement Uncertainties for the Conducted and Radiated Emissions Measurements Contained in This Test Report

Table 1: Worst-Case Expanded Uncertainty "U" of Measurement for a k=2 Coverage Factor

Radiated Emissions Measurement Detection Systems	Applicable Frequency Range	"U" for a k=2 Coverage Factor
Spectrum Analyzer with QPA & Preamplifier	30 MHz - 200 MHz	+3.9 dB, -4.0 dB
Spectrum Analyzer with QPA & Preamplifier	200 MHz-1000 MHz	+/- 3.5 dB
Spectrum Analyzer with Preamplifier	1 GHz - 18 GHz	+2.5 dB, -2.6 dB
Spectrum Analyzer with Preamplifier	18 GHz - 40 GHz	+/- 3.4 dB

NOTES:

1. Applies to 3 and 10 meter measurement distances
2. Applies to all valid combinations of Transducers (i.e. LISNs, Line Voltage Probes, and Antennas, as appropriate)
3. Excludes the Repeatability of the EUT

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3. Practical Explanation of the Meaning of Radiated Emissions Measurement Uncertainties

In general, a “Statement of Measurement Uncertainty” means that with a certain (specified) confidence level, the “true” value of a measurand will be between a (stated) upper bound and a (stated) lower bound.

In the specific case of EMC Measurements in this test report, the measurement uncertainties of the conducted emissions measurements and the radiated emissions measurements have been calculated in accordance with the method detailed in the following documents:

- o ANSI Z540.2 (2002) *Guide to the Expression of Uncertainty in Measurement*
- o NIS 81:1994, *The Treatment of Uncertainty in EMC Measurements* (NAMAS, 1994)
- o NIST Technical Note 1297(1994), *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results* (NIST, 1994)

The calculation method used in these documents requires that the stated uncertainty of the measurements be expressed as an “*expanded uncertainty*”, U , with a $k=2$ coverage factor. The practical interpretation of this method of expressing measurement uncertainty is shown in the following example:

EXAMPLE: Assume that at 39.51 MHz, the (measured) radiated emissions level was equal to +26.5 dBuV/m, and that the +/- 2 standard deviations (i.e. 95% confidence level) measurement uncertainty was +/- 3.4 dB.

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APPENDIX B

B. Nemko USA, Inc. Test Equipment & Facilities Calibration Program

Nemko USA, Inc. operates a comprehensive Periodic Calibration Program in order to ensure the validity of all test data. Nemko USA's Periodic Calibration Program is fully compliant to the requirements of NVLAP Policy Guide PG-1-1988, ANSI/NCSL Z540.3: 2006, ISO 10012:2003, ISO/IEC 17025:2005, and ISO-9000: 2000. Nemko USA, Inc.'s calibrations program therefore meets or exceeds the US national commercial and military requirements [N.B. ANSI/NCSL Z540-1-1994 replaced MIL-STD-45662A].

Specifically, all of Nemko USA's *primary reference standard devices* (e.g. vector voltmeters, multimeters, attenuators and terminations, RF power meters and their detector heads, oscilloscope mainframes and plug-ins, spectrum analyzers, RF preselectors, quasi-peak adapters, interference analyzers, impulse generators, signal generators and pulse/function generators, field-strength meters and their detector heads, etc.) and certain *secondary standard devices* (e.g. RF Preamplifiers used in CISPR 11/22 and FCC Part 15/18 tests) are periodically recalibrated by:

- o A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratories by NIST; or,
- o A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratory by another accreditation body (such as A2LA) that is mutually recognized by NIST; or,
- o A manufacturer of Measurement and Test Equipment (M&TE), if the manufacturer uses NIST-traceable standards and is ISO Guide 25-accredited as calibration laboratory either by NIST or by another accreditation body (such as A2LA) that is mutually recognized by NIST; or
- o A manufacturer of M&TE (or by a Nemko USA-approved independent third party metrology laboratory) that is not ISO Guide 25-accredited. (In these cases, Nemko USA conducts an annual audit of the manufacturer or metrology laboratory for the purposes of proving traceability to NIST, ensuring that adequate and repeatable calibration procedures are being applied, and verifying conformity with the other requirements of ISO Guide 25).

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In all cases, the entity performing the Calibration is required to furnish Nemko USA with a calibration test report and/or certificate of calibration, and a “calibration sticker” on each item of M&TE that is successfully calibrated.

Calibration intervals are normally one year, except when the manufacture advises a shorter interval or if US Government directives or client requirements demand a shorter interval. Items of instrumentation/related equipment which fail during routine use, or which suffer visible mechanical damage (during use or while in transit), are sidelined pending repair and recalibration. (Repairs are carried out either in-house [if minor] or by a Nemko USA-approved independent [third party] metrology laboratory, or by the manufacturer of the item of M&TE).

Each antenna used for CISPR 11 and CISPR 22 and FCC Part 15 and Part 18 radiated emissions testing (and for testing to the equivalent European Norms) is calibrated annually by either a NIST (or A2LA) ISO Standard 17025-Accredited third-party Antenna Calibration Laboratory or by the antenna’s OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory. The antenna calibrations are performed using the methods specified in Annex G.5 of CISPR 16-1(2003) or ANSI C63.5-2004, including the “Three-Antenna Method”. Certain other kinds of antennas (e.g. magnetic-shielded loop antennas) are calibrated annually by either a NIST (or A2LA) ISO Standard 17025-accredited third-party antenna calibration laboratory, or by the antenna’s OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory using the procedures specified in the latest version of SAE ARP-958.

In accordance with FCC and other regulations, Nemko USA recalibrates its suite of antennas used for radiated emissions tests on an annual basis. These calibrations are performed as a precursor to the FCC-required annual revalidation of the Normalized Site Attenuation properties of Nemko USA’s Open Area Test Site. Nemko USA, Inc. uses the procedures given in both Sub clause 16.6 and Annex G.2 of CISPR 16-1 (2003), and, ANSI C63.4-2003 when performing the normalized site attenuation measurements.

In accordance with FCC and other regulations, Nemko USA recalibrates its suite of antennas used for radiated emissions tests on an annual basis. These calibrations are performed as a precursor to the FCC-required annual revalidation of the Normalized Site Attenuation properties of Nemko USA’s Open Area Test Site. Nemko USA, Inc. uses the procedures given in both Sub clause 16.6 and Annex G.2 of CISPR 16-1 (2003), and, ANSI C63.4-2003 when performing the normalized site attenuation measurements.

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APPENDIX C

C. NVLAP Accreditation Certificate

United States Department of Commerce National Institute of Standards and Technology  Certificate of Accreditation to ISO/IEC 17025:2005 NVLAP LAB CODE: 200116-0 Nemko USA, Inc. - San Diego EMC Division San Diego, CA <i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i> ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS <i>This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).</i> 2011-01-01 through 2011-12-31 <i>Effective dates</i>   <i>Sally J. Bruce</i> For the National Institute of Standards and Technology	
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