Limited Warranty & Limitation of Liability

Rigel Medical, part of the SEAWARD GROUP guarantees this product for a period of two years year. The period of warranty will be effective at the day of delivery.

Calibration Statement

The Rigel SafeTest 50 hand-held electrical safety analyzer is fully calibrated and found to be within the specified performance and accuracy at the time of production. The Seaward Group provides its products through a variety of channels, therefore it may be possible that the calibration date on the provided certificate may not represent the actual date of first use.

Experience has indicated that the calibration of this instrument is not effected by storage prior to receipt by the user. We therefore recommend that the recalibration period be based on a 12 month interval from the first date the unit is placed in to service.

Date received into service; ______/_____/______.

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All rights reserved. Nothing from this edition may be multiplied, or made public in any form or manner, either electronically, mechanically, by photocopying, recording, or in any manner, without prior written consent from the SEAWARD GROUP. This also applies to accompanying drawings and diagrams.

Due to a policy of continuous development the SEAWARD GROUP reserves the right to alter the equipment specification and description outlined in this publication without prior notice and no part of this publication shall be deemed to be part of any contract for the equipment unless specifically referred to as an inclusion within such contract.
Disposal of old product

The Rigel SafeTest 50 has been designed and manufactured with high quality materials and components, which can be recycled and reused.

Please familiarise yourself with the appropriate local separate collection system for electrical and electronic products or contact your local supplier for further information.

Please dispose of this product according to local regulations. Do not dispose of this product along with normal waste material. By offering your old products for recycling, you will help prevent potential negative consequences for the environment and human health.
Statement of Conformity

This product is manufactured by:

Seaward Electronic Ltd, Bracken Hill, South West Industrial Estate, Peterlee, County Durham, SR8 2SW, UK

As the manufacturer of the apparatus listed, we declare under our sole responsibility that the product:

**Rigel SafeTest 50 - Electrical Medical Safety Analyzer**

Conforms with the relevant Directives and conformity is indicated by the symbol CE, i.e. “Conformité Européenne”

Seaward Electronic Ltd. is registered under BS EN ISO9001 Certificate No.: Q05356.

A copy of the Declaration of Conformity and a copy of our ISO certificate are available in the Support & Resources area of the Seaward website [www.seaward.co.uk](http://www.seaward.co.uk).
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User Notes

These operating instructions are intended for the use of adequately trained personnel.

Environmental Conditions

The SafeTest 50 has been designed to be operated in a dry environment, at a temperature of 32 to 104 degrees F without moisture condensation, and at an operating altitude 0 – 2000m. The SafeTest 50 has a protection rating of IP40 and is rated for operation at pollution degree 2 according to IEC 60529.

The following symbols are used in these operating instructions and on the Rigel SafeTest 50.

Safety Notes

If the SafeTest 50 is used in a manner not specified by these operating instructions then the protection provided may be impaired.

Only accessories recommended or approved by the manufacturer should be used with the SafeTest 50.

Do not connect the SafeTest 50 to electrical circuits with nominal voltage greater than CAT II 300 V AC/DC.

Do not touch test probes beyond the hand barrier on the test probe.

The SafeTest 50 may apply high voltage or mains power to the appliance under test. Do not touch conductive parts of the appliance while tests are active.

Do not open the SafeTest 50, no user serviceable parts.

Do not operate the SafeTest 50 in an explosive gas or dust environment.

The SafeTest 50 and all associated cables and leads must be checked for signs of damage before equipment is operated. Do not use if there are signs of damage.

Where safe operation of the SafeTest 50 is no longer possible it should be immediately shut down and secured to prevent accidental operation.

It must be assumed that safe operation is no longer possible:
- if the instrument or leads show visible signs of damage or
- the instrument does not function or
- after long periods of storage under adverse environmental conditions.

To verify the correct operation of the unit, perform test functions using a known appliance or checkbox or return the unit to an approved agent for service.

Symbol used for tips and guidance notes in this manual.
1 Introduction

The Rigel SafeTest 50 is a dedicated medical safety analyzer, ideal for testing high volumes of basic medical and laboratory equipment. A robust and reliable design ensures that the SafeTest 50 can withstand a busy schedule of testing medical equipment that does not require patient lead testing, such as beds, hoists, infusion pumps, CPAP’s, centrifuges, etc.

With a large color display and a color coded user interface, it’s easy to select the required tests with a single key press, while a fast step-through of the test routine makes the testing process speedy and dependable. Though physically small, the SafeTest 50 includes a range of safety tests to enable compliance with a range of international safety standards, including leakage testing to NFPA-99, AAMI ES 60601, IEC 62353 and 61010, ground bond testing to NFPA-99, IEC 62353 and 61010 (Annex F).

Full manual control offers the benefit of executing only those specific tests that are required and provide the user with full control of the power cycles, making testing simple, easy and fast. An automatic warning of secondary ground paths ensures users are made aware when invalid readings are made, thus ensuring correct and accurate test results first time, every time.

1.1 Key Features

- Compact, robust and portable design
- Fast step-through of test routines with minimized power breaks
- Manual control of fault conditions
- Tests to a range of international standards including NFPA-99, AAMI ES 60601, IEC 62353 and 61010
- Large, highly visible color display.
- Secondary ground warnings to ensure valid test setup
- Accurate high current, low energy ground bond testing
- Supplied with free, protective carry case
- Multi-voltage - operates on any mains supply between 90-264V / 48-64Hz

1.2 Rigel SafeTest 50 includes:
1.3 Interfaces

- EUT socket, 90-264 VAC, 48-64Hz
- Mains inlet 90-264 VAC 48-64Hz
- Ground bond and Enclosure leakage probe.
- Point to point auxiliary probe.
- Function keys F1-F5
- Mains START, STOP, REVERSED keys
- Single Fault OPEN GROUND – OPEN NEUTRAL
1.4 Optional Accessories

- Ground bond cable  44B154
- Carry case  410A950

1.5 Unique use of ICONS

The Rigel SafeTest 50 features a high resolution color graphic back lit display provides a unique user experience and to help guide the user through the different test steps.

Below are of some of the icons used in the Rigel SafeTest 50:

- Select GROUND BOND TESTING
- Select LEAKAGE TESTING
- Select POINT TO POINT TESTING
- Select SETTINGS menu (change LANGUAGE and TEST STANDARD)
- Select to the required standard
- Change to the required language
- Product information, serial number
- Confirm / OK
- Display Line voltage, frequency and load current
- Applies normal mains to EUT
- Interrupts mains to EUT
- Applies reversed mains to the EUT
- Warning, EUT socket live
Select Ground leakage (in NFPA and ES 60601 setting)

Select Enclosure leakage (in NFPA and ES 60601 setting)

Select Touch Leakage (in IEC61010 setting)

Select Touch Voltage (in IEC61010 setting)

Open GROUND single fault condition key

Open NEUTRAL single fault condition key

Ground bond test lead compensated

Ground bond test running

Go to HOME SCREEN
2 Getting Started

The Rigel SafeTest 50 is pre-programmed to perform electrical safety tests in accordance with a variety of international standards. To get started, simply follow these instructions;

Switch ON:

To switch on the Rigel SafeTest 50, please insert the mains cable to the power inlet, the SafeTest 50 will automatically power up in the HOME SCREEN.

2.1 Setting your language and preferred test standard

From the home screen, select SETTINGS to select the required language and test standard;

![SETTINGS MENU]

Press 🛠 from HOME screen to enter SETTINGS menu;
Press the key to change to the required language
Press the key to change to the required test standard
Press the key to view the firmware and hardware information
Press the key confirm and return to the HOME menu

The Rigel SafeTest 50 will store the most recent settings in the SETTINGS MENU.

From the home screen, select the required test;

To select GROUND BOND TESTING
To select LEAKAGE TESTING
To select POINT TO POINT TESTING
To select SETTINGS menu (change LANGUAGE and TEST STANDARD
3 Ground bond testing

To perform a ground bond test, select the \( \Omega \) icon from HOME screen.

The SafeTest 50 will automatically start the test when it is selected and will automatically stop by pressing the LEAKAGE, INSULATION, POINT TO POINT or HOME icon.

**Connection between EUT and SafeTest 50;**

GROUND BOND TESTING

Each time the ground bond probe is placed on a new test point, the zap circuit will be reactivated, ensuring accurate readings at every measurement point.

**Do not exceed the maximum permitted voltage of 30 V AC/DC with respect to ground potential! Electric Shock danger!**

To compensate for the test cable resistance, connect the test cable between the black ground bond socket and the EUT ground, then press the \( \Omega \) button on the front panel.

When the lead compensation is activated, the \( \Omega \) icon will appear on the screen.
To remove the lead compensation, remove the cable and press the button.

⚠️ **When different ground bond cables are used, the NULL function must be repeated for each different cable.**

💡 **Switching off the Rigel SafeTest 50 will not cancel the ‘probe zero’.**
4 NFPA-99 LEAKAGE testing

To perform an NFPA-99 leakage test, press $\mu A$ from HOME screen to enter LEAKAGE test. If the required test standard needs to change, please press HOME and see 2.1.

To apply mains voltage in NORMAL POLARITY and START the test, press the $\sim$ button on the front panel. The test will run until the $\bigcirc$ button is pressed.

To apply mains in REVERSED POLARITY and START the test, press the $\sim$ button on the front panel. The test will run until the $\bigcirc$ button is pressed.

To minimize the power cycling during your tests, please see 9.

$\bigtriangleup$ will appear on the screen when the DUT socket is activated.

Connection between EUT and SafeTest 50;

GROUND LEAKAGE NFPA-99
When the SafeTest 50 is set to test to NFPA-99, the will go to CHASSIS leakage and to GROUND leakage.

To activate single fault conditions, use the and buttons on the front panel. opens the GROUND fault condition relay whilst the opens the NEUTRAL fault condition relay.

The leakage screen will indicate the current state of the selected fault conditions;

<table>
<thead>
<tr>
<th>Leakage Current Type</th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Leakage</td>
<td>0.3mA</td>
<td>1mA</td>
</tr>
<tr>
<td>Chassis Leakage</td>
<td>0.1mA</td>
<td>0.5mA</td>
</tr>
</tbody>
</table>
5  AAMI ES 60601 LEAKAGE testing

To perform an ES 60601 leakage test, press μA from HOME screen to enter LEAKAGE test. If the required test standard needs to change, please press HOME and see 2.1.

To apply mains voltage in NORMAL POLARITY and START the test, press the button on the front panel. The test will run until the button is pressed.

To apply mains in REVERSED POLARITY and START the test, press the button on the front panel. The test will run until the button is pressed.

To minimize the power breaks during your tests, please see 9.

will appear on the screen when the DUT socket is activated.

Connection between EUT and SafeTest 50;

GROUND LEAKAGE

When the SafeTest 50 is set to test to ES 60601, the will go to ENCLOSURE leakage and to GROUND leakage.
To activate single fault conditions, use the 水平 和 水平 buttons on the front panel. 水平 opens the GROUND fault condition relay whilst the 水平 opens the NEUTRAL fault condition relay.

The leakage screen will indicate the current state of the selected fault conditions;

Connection between EUT and SafeTest 50;

ENCLOSURE LEAKAGE

<table>
<thead>
<tr>
<th>Leakage Current Type</th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Leakage (3rd edition)*</td>
<td>5mA</td>
<td>10mA</td>
</tr>
<tr>
<td>Ground Leakage (General)</td>
<td>0.5mA</td>
<td>1mA</td>
</tr>
<tr>
<td>Enclosure Leakage</td>
<td>0.1mA</td>
<td>0.5mA</td>
</tr>
</tbody>
</table>

* The pass fail limit for Ground Leakage in the 3rd edition of IEC 60601 has been increased from 500μA under normal condition to 5000μA for class I equipment with NO exposed metal parts that may become live when a fault appears.
6  IEC 62353 LEAKAGE testing

To perform an IEC 62353 leakage test, press \( \mu \text{A} \) from HOME screen to enter LEAKAGE test. If the required test standard needs to change, please press \( \uparrow \) HOME and see 2.1.

![Equipment Leakage (IEC 62353)](image)

To apply mains voltage in NORMAL POLARITY and START the test, press the \( ~ \) button on the front panel. The test will run until the \( \circ \) button is pressed.

To apply mains in REVERSED POLARITY and START the test, press the \( ~ \) button on the front panel. The test will run until the \( \circ \) button is pressed.

To minimize the power cycles during your tests, please see 9.

\( \text{!} \) will appear on the screen when the DUT socket is activated.

When the SafeTest 50 is set to test to IEC 62353, the SINGLE FAULT buttons \( \perp \) and \( \perp N \) are deactivated in order to perform the test as per IEC 62353 requirements.
Connection between EUT and SafeTest 50;

EQUIPMENT LEAKAGE IEC 62353

<table>
<thead>
<tr>
<th>Current in µA (RMS)</th>
<th>Equipment leakage – direct method.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class I Equipment</td>
</tr>
<tr>
<td></td>
<td>Class II Equipment (touch current)</td>
</tr>
<tr>
<td></td>
<td>0.5mA</td>
</tr>
<tr>
<td></td>
<td>0.1mA</td>
</tr>
</tbody>
</table>

7 IEC 61010 TOUCH LEAKAGE & VOLTAGE testing

To perform an IEC 61010 touch leakage test, press µA from HOME screen to enter LEAKAGE test. If the required test standard needs to change, please press HOME and see 2.1.
To apply mains voltage in NORMAL POLARITY and START the test, press the button on the front panel. The test will run until the button is pressed.

To apply mains in REVERSED POLARITY and START the test, press the button on the front panel. The test will run until the button is pressed.

will appear on the screen when the DUT socket is activated.

Connection between EUT and SafeTest 50;

TOUCH LEAKAGE AND TOUCH VOLTAGE IEC 61010

When the SafeTest 50 is set to test to IEC 61010, the will go to TOUCH VOLTAGE and to TOUCH LEAKAGE.

To activate single fault conditions, use the and buttons on the front panel. opens the GROUND fault condition relay whilst the opens the NEUTRAL fault condition relay.
The leakage screen will indicate the current state of the selected fault conditions.

<table>
<thead>
<tr>
<th>IEC 61010 tests</th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Leakage</td>
<td>0.5mA</td>
<td>3.5mA</td>
</tr>
<tr>
<td>Touch Voltage</td>
<td>33V</td>
<td>55V</td>
</tr>
</tbody>
</table>

8 Displaying mains voltage, frequency and load current

During a leakage test, the mains voltage, frequency and load current can be displayed by pressing the [V/I].
9 Minimize your power cycles in ES 60601

Certain medical equipment can be sensitive to sudden interruption of power or have a long power-up cycle. To protect your equipment or to reduce the overall test time, we suggest you run the SafeTest 50 in the following sequence;

To minimize the power breaks to the EUT, all leakage measurements should be grouped by Single Fault Condition (SFC).

As such, all leakage measurements are carried out for a specific SFC, leakage measurements are then repeated for the next SFC. This is to minimize the power breaks and power ups.

NORMAL POLARITY TESTING – POWER UP
1. GROUND LEAKAGE Normal Supply
2. ENCLOSURE LEAKAGE Normal Supply, Ground Closed
3. ENCLOSURE LEAKAGE Normal Supply, Ground OPEN

NORMAL POLARITY TESTING – POWER DOWN
4. ENCLOSURE LEAKAGE Normal Supply, Normal Supply, Neutral OPEN
5. GROUND LEAKAGE Normal Supply, Neutral OPEN

REVERSED POLARITY TESTING – POWER UP
6. GROUND LEAKAGE Reversed Supply
7. ENCLOSURE LEAKAGE Reversed Supply, Ground Closed
8. ENCLOSURE LEAKAGE Reversed Supply, Ground OPEN

REVERSED POLARITY TESTING – POWER DOWN
9. ENCLOSURE LEAKAGE Reversed Supply, Normal Supply, Neutral OPEN
10. GROUND LEAKAGE Reversed Supply, Neutral OPEN

Below is a graph highlighting the Grouping of Single Fault Conditions in the ( ) box and the delays which are manually controlled by the User (ta, tb, tc & td) and the time in which the safety analyzer performs the automatic test routines.
10 POINT TO POINT testing

To perform a POINT TO POINT test, press \( \Omega \) from HOME screen.

Select \( \Omega \) to perform a point to point ground bond test
Select \( \mu A \) to perform a point to point leakage test

Select \( \text{null} \) to exit the point to point function and return to the HOME screen

Connect the POINT TO POINT probes between the BLACK and GREEN socket on the back panel. The EUT socket will power up during leakage tests however the mains cable is not part of the measurement circuit hence it is shown as optional and not required. The POINT TO POINT test is ideal for ground bond testing on larger and or fixed installed installations.

Connection between EUT and SafeTest 50;

POINT TO POINT TESTING

[Diagram of connection between EUT and SafeTest 50]
11 WARNING MESSAGES

The Rigel SafeTest 50 will automatically warn the user of possible incorrect test setups such as secondary grounding and isolated mains supply (mains voltage isolated from ground)

Secondary ground warning:

Critical

Secondary ground path detected. The analyser is unable to provide a valid reading and will display 0uA unless secondary ground path is removed. Press OK to continue.

To perform a valid test, the secondary ground must be removed. Testing with a secondary ground will lead to invalid readings as the leakage current will flow through the low resistance secondary ground rather than the high resistance (1kΩ) body model in the SafeTest 50.

Isolated ground error:

Warning

IT System (Isolated Ground) Please check ground integrity before proceeding. ONLY continue when SAFE. Leakage measurements might vary to those done on a TN system as per IEC 60601-1 requirement.

Please note that leakage values can appear at half the value as would be expected under a normal mains configuration.
12 About

From the HOME SCREEN, select SETTINGS, then the key to view the firmware and hardware information.

- Firmware version
- Serial Number

Ensure you have this information available when contacting Rigel Medical for Technical Support or Service.
13 Maintaining the Rigel SafeTest 50

13.1 Cleaning the Analyzer

The Rigel SafeTest 50 case can be cleaned with a damp cloth with, if necessary, a small amount of mild detergent. Prevent excessive moisture around the socket panel or in the lead storage area.

Do not allow liquid inside the Rigel SafeTest 50 or near the sockets. Do not use abrasives, solvents or alcohol.

If any liquid is spilt into the Rigel SafeTest 50 case, the Analyzer should be returned for repair, stating the cause of the defect.

13.2 User Maintenance

The Rigel SafeTest 50 is a rugged quality instrument. However, care should always be taken when using, transporting and storing this type of equipment. Failure to treat the product with care will reduce both the life of the instrument and its reliability. If the Rigel SafeTest 50 is subject to condensation, allow the Analyzer to completely dry before use.

- Always check the Rigel SafeTest 50 and all test leads for signs of damage and wear before use.
- Do not open the Rigel SafeTest 50 under any circumstances.
- Keep the instrument clean and dry.
- Avoid testing in conditions of high electrostatic or electromagnetic fields.
- Maintenance should only be performed by authorised personnel.
- There are no user replaceable parts in the Rigel SafeTest 50.
- The unit should be regularly calibrated (at least annually).

13.3 Return Instructions.

For repair or calibration return the instrument to:-

Contact details  |  Address details
---|---
Service, Calibration and Repair
Tel: 813 886 2775
Fax: 813 886 2754
Email: service@seaward-groupusa.com

Seaward Group USA
6304 Benjamin Road
Suite 506
Tampa, FL 33634
United States
Prior to returning your unit for service, please contact our service department to obtain a Return Material Authorization (RMA) number.

By obtaining a RMA, your service request can be booked in advance thus reducing the down time of your equipment.

When asking for a RMA, please provide:

- Instruments name and model
- Serial number (see section 12)
- Firmware version (see section 12)
### 14 Technical Specifications

#### Ground Continuity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-pulse</td>
<td>65-25A peak current, (0.1 to 0.8 Ω respectively)</td>
</tr>
<tr>
<td>Pulse shape</td>
<td>exponential decay</td>
</tr>
<tr>
<td>Decay time</td>
<td>200 – 550µs to 5% of peak current, (0.1 to 0.8 Ω respectively)</td>
</tr>
<tr>
<td>Method</td>
<td>2 wire</td>
</tr>
<tr>
<td>Measurement Current</td>
<td>±200mADC into 2Ω</td>
</tr>
<tr>
<td>Max Test Voltage</td>
<td>4.24Vrms o/c</td>
</tr>
<tr>
<td>Measuring Range (low range)</td>
<td>0.001 – 0.999Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.001Ω</td>
</tr>
<tr>
<td>Measuring Range (mid range)</td>
<td>1.00 – 9.99Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01Ω</td>
</tr>
<tr>
<td>Measuring Range (high range)</td>
<td>10.0 – 19.9Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1Ω</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 1% of value, ± 5mΩ</td>
</tr>
<tr>
<td>Circuit Protection</td>
<td>Test inhibited if ≥ 30VAC or DC at 4mm inputs</td>
</tr>
</tbody>
</table>

#### Powered Leakage Measurements

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 62353</td>
<td>Equipment Leakage (Direct)</td>
</tr>
<tr>
<td>AAMI ES 60601</td>
<td>Ground + Enclosure Leakage</td>
</tr>
<tr>
<td>NFPA-99</td>
<td>Ground + Chassis Leakage</td>
</tr>
<tr>
<td>IEC 61010</td>
<td>Touch Leakage, Touch Voltage</td>
</tr>
<tr>
<td>Test Voltage</td>
<td>Mains Supply Voltage</td>
</tr>
<tr>
<td>Measuring Range</td>
<td>0.1- 9999µA (0.1 - 8000µA typical for IEC61010)</td>
</tr>
<tr>
<td>Measurement/Display Resolution</td>
<td>0.1µA</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 2%, ± 5µA</td>
</tr>
<tr>
<td>Mains Reversal</td>
<td>Soft key</td>
</tr>
<tr>
<td>Single Fault Conditions</td>
<td>Open neutral, Open Ground via soft key</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>ES 60601 – 62353, NFPA-99, and IEC 61010 selectable</td>
</tr>
</tbody>
</table>

#### Voltage measurement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>H-N, H-G, N-G and touch voltage (IEC 61010)</td>
</tr>
<tr>
<td>Range</td>
<td>0.0V – 300VAC</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1V</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 2% ± 2 digits (between 10V – 270VAC)</td>
</tr>
<tr>
<td>Mains frequency</td>
<td>45.0 – 66.0Hz</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1Hz</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Unspecified</td>
</tr>
</tbody>
</table>

#### EUT Load Current Measurement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0.0A – 20.0A</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1A</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±5% ± 2 digits</td>
</tr>
</tbody>
</table>

#### Power Source

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum current rating</td>
<td>20A @ 120V / 16A @ 230V</td>
</tr>
<tr>
<td>Duty cycle (@70°F ambient)</td>
<td>16A to 20A, 3 min. on/ 10 min. off</td>
</tr>
<tr>
<td></td>
<td>10A to 15A, 3 min. on/ 5 min. off</td>
</tr>
<tr>
<td></td>
<td>0A to 10A, continuous</td>
</tr>
<tr>
<td>Mains power</td>
<td>90-264V 48-64Hz</td>
</tr>
<tr>
<td>Weight</td>
<td>2.5lbs (unit)</td>
</tr>
<tr>
<td></td>
<td>5lbs (complete with accessories)</td>
</tr>
<tr>
<td>Size (L x W x D)</td>
<td>9 x 6 x 4”</td>
</tr>
</tbody>
</table>
### Environmental

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>32 to 104°F,</td>
</tr>
<tr>
<td>Humidity</td>
<td>0 - 98% Relative humidity, non-condensating</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>14 to 122°F</td>
</tr>
<tr>
<td>Altitude</td>
<td>0 – 2000m</td>
</tr>
<tr>
<td>Ingress Protection</td>
<td>IP 40</td>
</tr>
<tr>
<td>Operating pollution degree</td>
<td>2, according to IEC 60529</td>
</tr>
</tbody>
</table>
Appendix A  Pass / Fail Limits

### NFPA-99

<table>
<thead>
<tr>
<th>Leakage Current Type</th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Leakage</td>
<td>0.3mA</td>
<td>1mA</td>
</tr>
<tr>
<td>Chassis Leakage</td>
<td>0.1mA</td>
<td>0.5mA</td>
</tr>
</tbody>
</table>

### ES 60601

Ground bond test limit at 25A, 50Hz

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluding power cord</td>
<td>&lt; 0.1 Ω</td>
</tr>
<tr>
<td>Including power cord</td>
<td>&lt; 0.2 Ω</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leakage Current Type</th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Leakage (3rd edition)*</td>
<td>5mA</td>
<td>10mA</td>
</tr>
<tr>
<td>Ground Leakage (General)</td>
<td>0.5mA</td>
<td>1mA</td>
</tr>
<tr>
<td>Enclosure Leakage</td>
<td>0.1mA</td>
<td>0.5mA</td>
</tr>
</tbody>
</table>

* The pass fail limit for Ground Leakage in the 3rd edition of IEC 60601 has been increased from 500μA under normal condition to 5000μA for class I equipment with NO exposed metal parts that may become live when a fault appears.

### IEC 62353

**GROUND BOND TEST LIMIT AT 200mA AC OR DC**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluding power cord</td>
<td>&lt; 0.2 Ω</td>
</tr>
<tr>
<td>Including power cord</td>
<td>&lt; 0.3 Ω</td>
</tr>
</tbody>
</table>

**Current in μA (RMS)**

- Equipment leakage – direct method
  - Class I Equipment 0.5mA
  - Class II Equipment (touch current) 0.1mA

### IEC 61010

**GROUND BOND TEST LIMIT (NO CURRENT SPECIFIED IN 61010)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Including power cord</td>
<td>&lt; 0.2 Ω</td>
</tr>
</tbody>
</table>

**Tests**

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>SFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch Leakage</td>
<td>0.5mA</td>
<td>3.5mA</td>
</tr>
<tr>
<td>Touch Voltage</td>
<td>33V</td>
<td>55V</td>
</tr>
</tbody>
</table>
Appendix B  IEC 60601-1 Measuring Device

a) Measuring device

b) Frequency characteristics

NOTE  The network and voltage measuring instrument above are replaced by the symbol `MD` in the following figures.

- Non inductive components
- Impedance `Z` measuring impedance `Z`
- `Z(f)` is the transfer impedance of the network, i.e. `V_{out}` for a current frequency `f`.

Example of a measuring device MD according to IEC 60601-1 and its frequency characteristics