

## Introduction

The DNI Models 231D and 232D Safety Analyzers are precision voltage, current, and resistance meters designed expressly for testing the electrical safety level of both the patient environment and associated electrically operated equipment.

Both electrical safety analyzers measure

- ❑ grounding resistance of the equipment power cord;
- ❑ leakage current from the equipment's chassis or ground wire;
- ❑ equipment load current;
- ❑ voltage gradient (mV) and intergrounding resistance (mOhms) using the external meter function; and
- ❑ power system AC voltages:
  - neutral to hot,
  - neutral to ground, and
  - hot to ground.

A test receptacle mounted on the top panel of both meters is used to simulate a wide range of power system fault conditions to assist the operator in assessing the equipment's level of safety. Push-button switches on the front panel select

- neutral (open and closed),
- ground (open and closed), and
- polarity (normal and reverse).

An internal ground fault circuit interrupter (GFCI) protects both the operator and the equipment under test. If a hot line to ground fault condition exceeding 10 milliamperes occurs, line voltage is immediately removed from the test receptacle.

For conducting more extensive power system tests, both electrical safety analyzers are compatible with the DNI Model 202A Isolated Power and GFCI Test Module. Contact your DNI Nevada representative for details.

The Model 232D additionally simplifies the electrical safety testing of more sophisticated electrically operated equipment with up to 10 direct-patient electrodes, such as a diagnostic 12-lead electrocardiograph or recorder. The test receptacle wiring can be set to simulate a wide range of power system faults (as listed earlier).

The Model 232D conducts these added tests:

- ❑ Leakage current tests referenced to power ground
  - on all patient electrodes;
  - on individual patient electrodes—RL, RA, LA, LL, and the V1–6 set; and
  - between specified patient electrode pairs:
    - right arm and left arm (RA–LA),
    - right arm and right leg (RA–RL), and
    - left arm and right leg (LA–RL).
- ❑ Isolation of all patient electrodes from ground with 120 VAC applied by the analyzer. (The current-limited test voltage is applied to the patient electrodes only when a front panel push-button is depressed and held by the operator.)
- ❑ A wide range of ECG simulations and performance testing waveforms.

## Specifications

### Meter

- Measurements displayed on a 3½-digit LED display.
- Overrange indicated by a flashing 1999.
- The appropriate range selected automatically with the units of measure shown on the mode switch.
- During resistance measurements, a separate LED illuminates when the current source has been activated.

### Current

Refer to the *AAMI Load* section later in this chapter for measurement accuracies.

### Equipment Current

- One range: 0.1 to 15.0 amps.
- Accuracy: 5% of range.

### Resistance

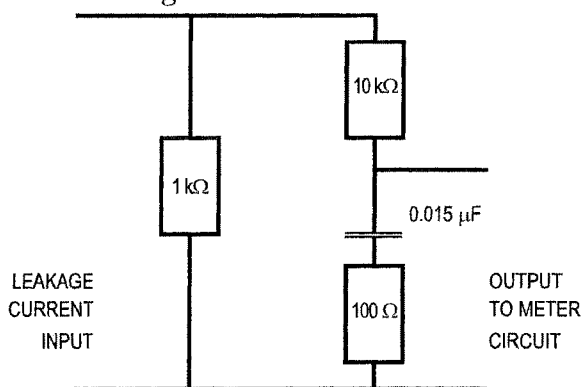
Refer to the *AAMI Load* section later in this chapter for measurement accuracies.

### Voltage

- Three voltage ranges:  
0.0 to 199.9 mV  
0 to 1999 mV  
0.0 to 199.9 V
- AAMI Load used for these measurements.
- Millivolt (mV) ranges autoranging.
- Voltage (V) ranges used for line voltage measurements of the test receptacle powering the analyzer.
- Millivolt (mV) ranges usable for external meter jack measurements.

## AAMI Load

- Simulated patient load recommended by the Association for the Advancement of Medical Instrumentation (AAMI), Safe Current Limits Standard (ANSI/AAMI ES1-1993) (revision of the earlier ANSI/AAMI ES1-1985 and SCL-12/78).
- AAMI Load drawing:



Full Scale Ranges (TRMS): Low: 0.1 to 199.9  $\mu\text{A}/\text{mV}$   
 High: 200 to 1999  $\mu\text{A}/\text{mV}$

Frequency Response: ANSI/AAMI ES1-1993

Accuracy:  $\pm$  (5% or reading  $+1\ \mu\text{A}$ ) @ DC  
 and from 48 Hz to 100 kHz.

Test Load Impedance: 1000 ohms  $\pm$  0.5% @ DC  
 (ANSI/AAMI ES1-1993)

## Test Receptacle

- Supplies power to the equipment under test
- 120 VAC at 15 amps maximum
- Push-button switches on front panel select
  - NEUTRAL — OPEN and CLOSED
  - GROUND — OPEN and CLOSED
  - POLARITY — NORMAL, REVERSE, and OFF/RESET

### **Ground Fault Interrupter**

- Detects a TEST RECEPTACLE ground fault of  $>10 \text{ mA} \pm 10\%$ .
- Disconnects the hot and neutral lines to the TEST RECEPTACLE when a fault is detected.
- Resets by setting the POLARITY switch to the OFF/RESET (center) position.

### **Test Lead Jacks**

- Four standard banana jacks.
- Two for the METER input and two for the CURRENT SOURCE.
- Arranged to allow a set of Kelvin cables to be connected to the four terminals and left in for all tests without damaging the analyzer.
- The CURRENT SOURCE connected only internally for resistance measurements, so that it will not interfere with leakage measurements even though the cables are connected to the CURRENT SOURCE jacks.
- All protected against accidental application of line voltage.

### **ECG Leads Binding Posts**

- Ten universal binding posts.
- Accept 3.2-mm or 4-mm pins or disposable snap electrocardiograph electrodes.

### **Power Requirements**

- 117 VAC at 15 amps 50 to 60 Hz
- Detachable hospital-grade power cord (supplied)
- Uses very little power by itself ( $<100 \text{ mA}$ )
- 15-amp rating for equipment under test plugged into the test receptacle

**Physical Characteristics**

**Size** 22.9-cm L × 22.9-cm W × 10.2-cm H  
(9-in L × 9-in W × 4-in H)

**Weight** 2.07 kg (4.5 lb)

**Temperature Range**

**Operating** 15° to 35°C (59° to 95°F)

**Storage** 0° to 50°C (32° to 122°F)

**Accessories****Standard**

	<b>DNI Part #</b>
• Soft vinyl carrying case	9530-0044
• Power cord*	3010-0012
• Kelvin cable test leads (2)	9501-0032
• Ground pin adapter (2)	9503-0004
• 231D/232D Operating Manual	9508-0173

**\*Note**

The supplied power cord is 14-gauge wire rated at 15 amps.  
*Do not use a smaller size.*

**Optional**

• 231D/232D Service Manual	9508-0271
----------------------------	-----------