

## Why Do We Test?

Electrical safety tests on electronic devices are designed to minimize or eliminate shock hazard risks. The Leakage Current Test and the Functional Run Test are two prime examples. These tests are designed to evaluate the possibility of an electric shock. Since most Leakage and Functional tests are performed at varying voltage values nominal outlet power is insufficient. Additionally, most electrical compliance analyzers do not contain a built in power source. These obstacles can make automated testing difficult.

Associate Research Inc. and Associated Power Technologies have developed of system enabling the safety compliance analyzers and power sources to directly communicate. The system design allows for mitigation of operator error while maximizing testing efficiency.

This paper discusses the safety tests and the system technology.

## What are Leakage Current and Functional Run Testing?

The Leakage Current Test is used to measure undesired leakage current that is flowing through the insulation of a device while it is operating. Performing this test ensures that device leakage is minimal and will not pose a shock hazard.

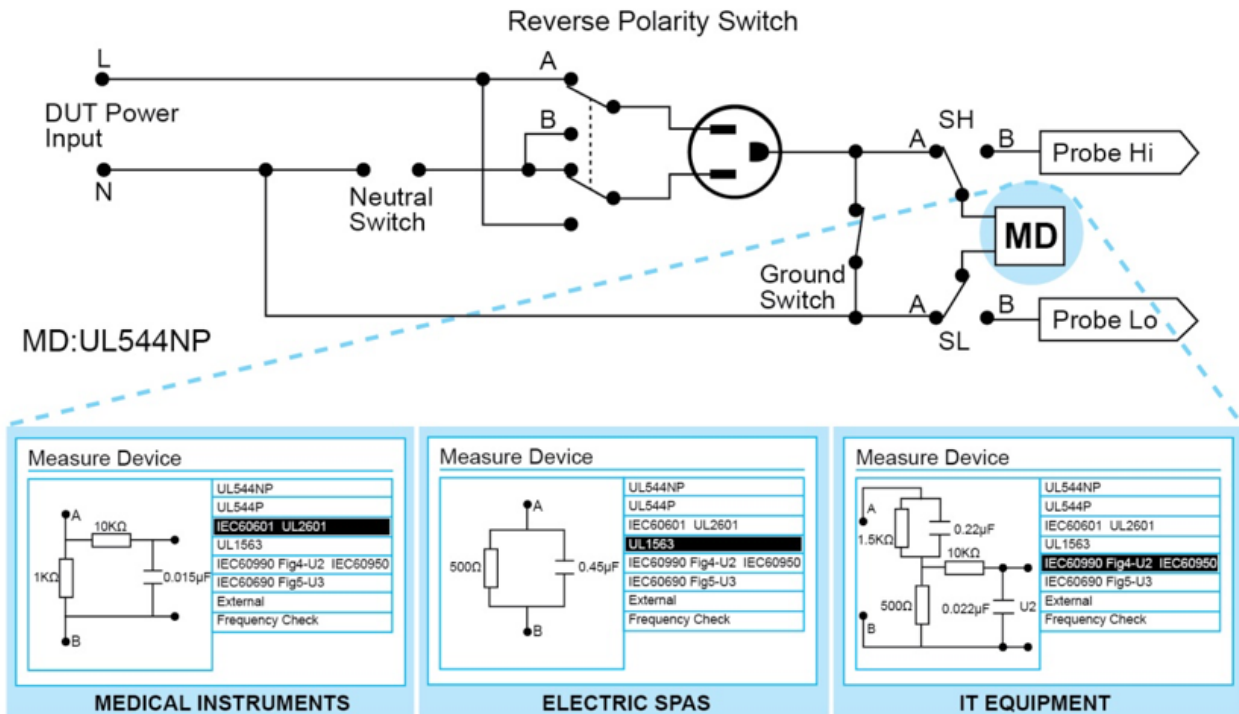
The leakage test measurement depends upon the insulation barrier in the device:

Leakage Test Type	Measured Leakage	Applicable Safety Standards
<b>Protective Conductor Current (Earth Leakage)</b>	Total leakage current on system. Measured between mains conductors (line and neutral) and protective earth conductor.	IEC/UL 60601-1 3rd edition, IEC/UL 60335-1, IEC 60598-1, IEC UL 60950-1
<b>Touch Current</b>	Leakage on accessible points of the device.  Measured between enclosure points and mains reference.	IEC/UL 60601-1 3rd edition, IEC/UL 60335-1, IEC 60598-1, IEC UL 60950-1
<b>Patient Leakage General</b>	Leakage on leads that have a patient connection. Measured between patient lead(s) and mains reference.	IEC/UL 60601-1 3rd edition

The Leakage Current Test is run under varying fault conditions (shown in the leakage network figure – open neutral, reverse polarity and open ground). Leakage current is measured using a measuring device (MD) which simulates the impedance of the human body. The MD will vary depending upon the product safety standard.

# Automating Leakage and Functional Testing

A leakage testing network and various MDs are shown in the below figures:



The purpose is to simulate “worst case scenarios” for operating modes of electrical equipment. If the leakage current measurements are low enough to mitigate the risk of electrical shock, then the product will not pose a shock hazard to the user.

While not defined as a compliance test, a Functional Run test provides useful information about the electrical parameters of a DUT. During this test, the analyzer measures various metrics:

Power  
Consumption

Operating  
Voltage

Current  
Draw

Power  
Factor

Leakage Current  
(measured through  
2k $\Omega$  resistance)

# Automating Leakage and Functional Testing

## Working as a System

Performing Run and Leakage tests requires the use of a power source. The below table outlines several application examples. These illustrate the necessity of a variable voltage power source:

Application Detail	Standard/Description	AR/APT System
<b>IEC 60601-1 3rd Edition: Medical Device Leakage Test</b>	Section 8.7.1 – General Requirements for Leakage Current Tests: <ul style="list-style-type: none"> <li>• Devices tested at highest rated supply frequency</li> <li>• Devices tested with a supply equal to <b>110% of the highest rated mains voltage</b></li> </ul>	Ability to accommodate various voltage and frequency outputs.
<b>Motor Variable Voltage Testing</b>	Motors tested at various voltage levels to ensure acceptable motor speed and power characteristics.  <b>Standard 120 VAC motor tested at 80, 90, 100, 110, 120, 130 and 140 VAC.</b>	Ability to use remote memory sharing in order to automatically output the correct voltage for each test automatically with no operation intervention.
<b>IEC 61010-1 3rd Edition: Equipment for Laboratory Use</b>	Section 6.3 – Limit Values for Accessible Parts (Touch Current): <ul style="list-style-type: none"> <li>• Tested at rated voltage and rated frequency</li> </ul>	Ability to test both domestic and international products with the same system.

Associated Research compliance analyzers are designed to operate as a system with Associated Power Technologies series of automated power sources. This setup functions as a fully automated compliance testing system.

Associated Research Inc. Compliance Analyzer	Associated Power Technologies Power Source
<b>OMNIA II 8206/8256 – 6-in-1 Compliance Analyzer</b> <ol style="list-style-type: none"> <li>1. AC and DC Dielectric Withstand</li> <li>2. AC Ground Bond and DC Ground Continuity</li> <li>3. Insulation Resistance</li> <li>4. Functional Run (0-277VAC, up to 16A continuous current)</li> <li>5. Leakage Testing (0-277 VAC, up to 16 A continuous current, built in fault simulation including open ground, open neutral and reverse polarity and MDs)</li> </ol>	Section 8.7.1 – General Requirements for Leakage Current Tests: <ul style="list-style-type: none"> <li>• Devices tested at highest rated supply frequency</li> <li>• Devices tested with a supply equal to <b>110% of the highest rated mains voltage</b></li> </ul>

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## Associated Research Compliance Analyzer



### OMNIA II 8206/8256 – 6-in-1 Compliance Analyzer

1. AC and DC Dielectric Withstand
2. AC Ground Bond and DC Ground Continuity
3. Insulation Resistance
4. Functional Run (0-277VAC, up to 16A continuous current)
5. Leakage Testing (0-277 VAC, up to 16 A continuous current, built in fault simulation including open ground, open neutral and reverse polarity and MDs)

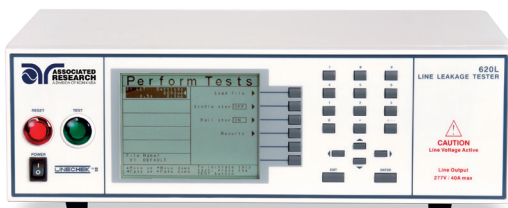
## Associated Power Technologies Power Source



### 7000 series power source – available in 4 models

1. 7004 – 400VA source
2. 7008 – 800VA source
3. 7016 – 1.6kVA source
4. 7040 – 4kVA source

## Associated Research Compliance Analyzer

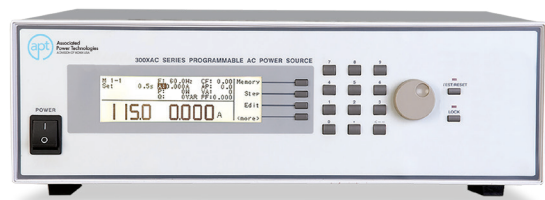


### LINECHECK II 620L – Leakage testing

(0-277 VAC, up to 40 A continuous current, built in fault simulation including open ground, open neutral and reverse polarity and MDs)

1. Ability to link with Associated Research Hipot and Ground Bond instruments.

## Associated Power Technologies Power Source

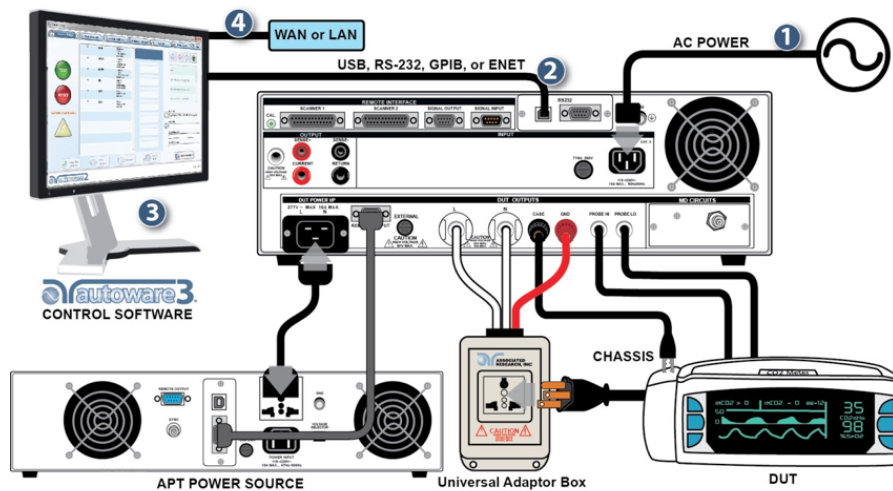


### 300XAC series power source – available in 4 models

1. 310XAC – 1kVA source
2. 320XAC – 2kVA source
3. 340XAC – 4kVA source
4. 360XAC – 6kVA source

# Automating Leakage and Functional Testing

The diagram below illustrates a testing system utilizing an 8206 compliance analyzer, an APT 7008 power source and Autoware 3 Control Software.



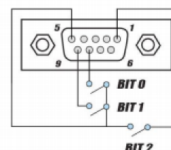
System Description	
1	Apply AC power to the OMNIA instrument. Then connect the instrument directly to an APT AC power source in order to power up the DUT.
2	Connect the instrument to a PC via one of the following communication ports – USB, RS-232, GPIB or ENET. This allows the instrument to communicate directly with control software.
3	Install the PC with the Autoware 3 Instrument Control Software. This software allows for full control of the instrument. With the software the user can create test sequences, set system parameters and provide work instructions in the form of prompts and record test data.
4	Connect the PC to a network location so that data and test sequences can be uploaded to a network folder.

The APT source can communicate with the system via remote memory activation (7 remote memory send) or directly through the Autoware 3 Control Software. Remote memory activation allows the compliance to “talk” directly with the source. The Autoware 3 software can also be used to set testing parameters in tandem with the Leakage and Run sequences.

## 7 Remote Memory Send

The 7 Remote Memory Send option is compatible with all Associated Research Inc. leakage testers. This option provides a 3 bit digital control signal that initiates the correlating memory (memory 1 – memory 7) on the APT source.

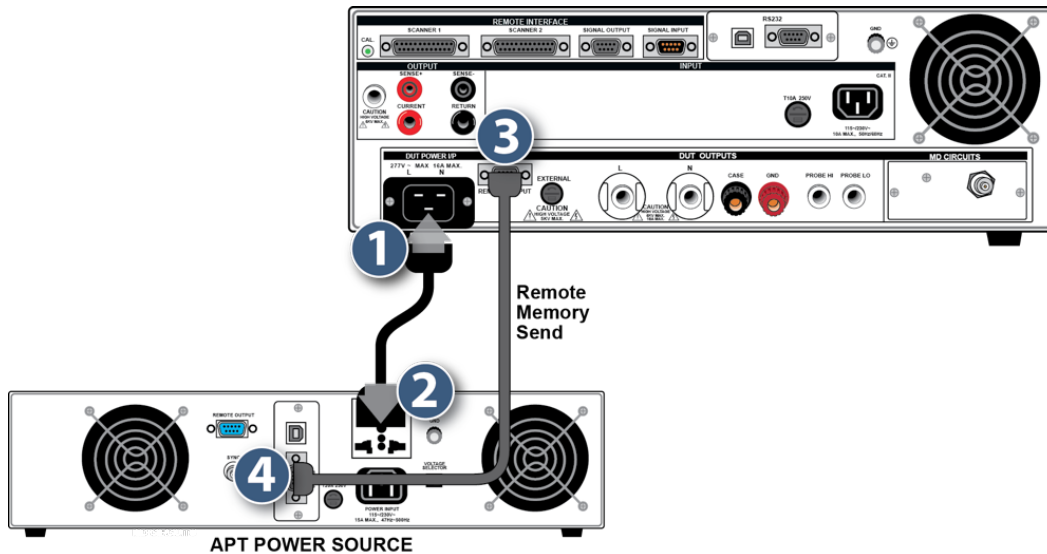
### LIT 9-PIN OUTPUT



BIT 2	BIT 1	BIT 0	TEST VOLTAGE SETTING
0	0	0	Not used
0	0	1	M1
0	1	0	M2
0	1	1	M3
1	0	0	M4
1	0	1	M5
1	1	0	M6
1	1	1	M7
0 = OPEN			1 = CLOSED

# Automating Leakage and Functional Testing

This allows for automatic initiation of a voltage and frequency output with each respective test sequence. For example, memory 1 on the APT source is set to 120 VAC @ 60 Hz and memory 2 is set to 230 VAC @ 50 Hz. The compliance analyzer signals the source to activate the memory based on the leakage testing parameters. The diagram below illustrates the simple setup of an APT source and 8206 instrument.



System Description	
1	Using the 16 A power input cable (part #39368), connect the female end of the cable to the DUT INPUT terminal on the rear panel of the instrument.
2	Connect the male end of the cable to the APT power source. This will allow power from the source to run through the instrument to the DUT.
3	Connect the male end of the Remote Memory Send cable (part #38772) to the 9 pin MEMORY OUTPUT terminal on the rear panel of the instrument.
4	Connect the female end of the Remote Memory Send cable to the 9 pin SIGNAL INPUT terminal on the rear panel of the APT source

## Conclusion

With the ability to automatically communicate the proper voltage and frequency output from the compliance analyzer to the APT source, Associated Research and Associated Power Technologies have created a functional and safety testing system designed for complete automation. The 7 remote memory option allows for the two instrument to cross communicate and activate at any point during the testing sequence. The instruments, along with the Autware 3 software, act as an all-in-one system to remotely program testing sequences and record all data points. This system relies on minimal input from the test operator allowing for fast and efficient testing.