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A DIVISION OF IKONIX USA

Hipot Testing 101

- Understanding the Hipot test
- Hipot test requirements
- Understanding Hipot test failures
- Arc detection – What does it mean?

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Webinar Notes

Please use the Q & A utility to ask us any questions concerning the material being presented.

You can find a recording of this webinar and presentation on our Webinar Archive page, www.arisafety.com/webinars/archived-webinars/

Please contact Brittany Socha – on the chat line or email Brittany.socha@ikonixusa.com if you have any connection issues.

Hipot Testing 101: Learning Objectives

- Understanding the Hipot Test
- Hipot Test Requirements
- Hipot Test Considerations and Failures
- Arc Detection

The Hipot Test

The Dielectric Voltage-Withstand Test is commonly known as the Hipot test.

Hipot test is the most common type of electrical safety test.

Designed to verify that the insulation of a product is adequate enough to withstand high voltage.

Performed by stressing the insulation of the product far beyond what it would encounter during normal use.

Hence, the term “voltage withstand test”.

The hipot test is performed at high voltage to test the insulation of a product.

The Hipot Test

The diagram shows a basic circuit used for hipot test.

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The resulting leakage current is measured to determine whether a product's insulation is able to withstand the high voltage without breaking down.

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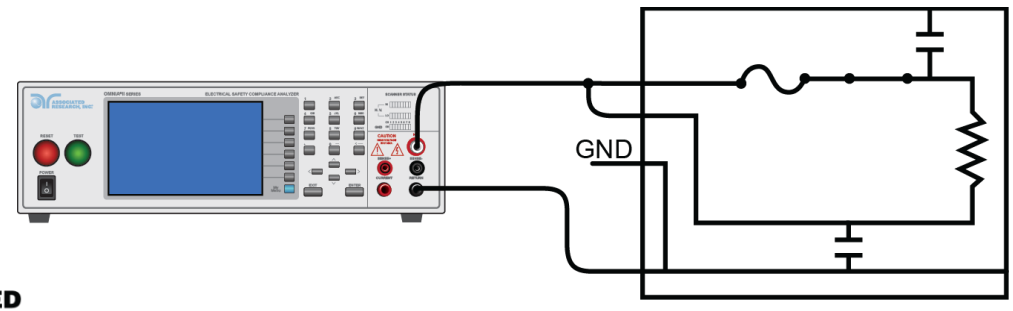
This test verifies that the insulation of a product is capable of protecting the user from any leakage currents as a result of an electrical fault within the product.



Leakage current is gives a measure of the product's insulation quality.

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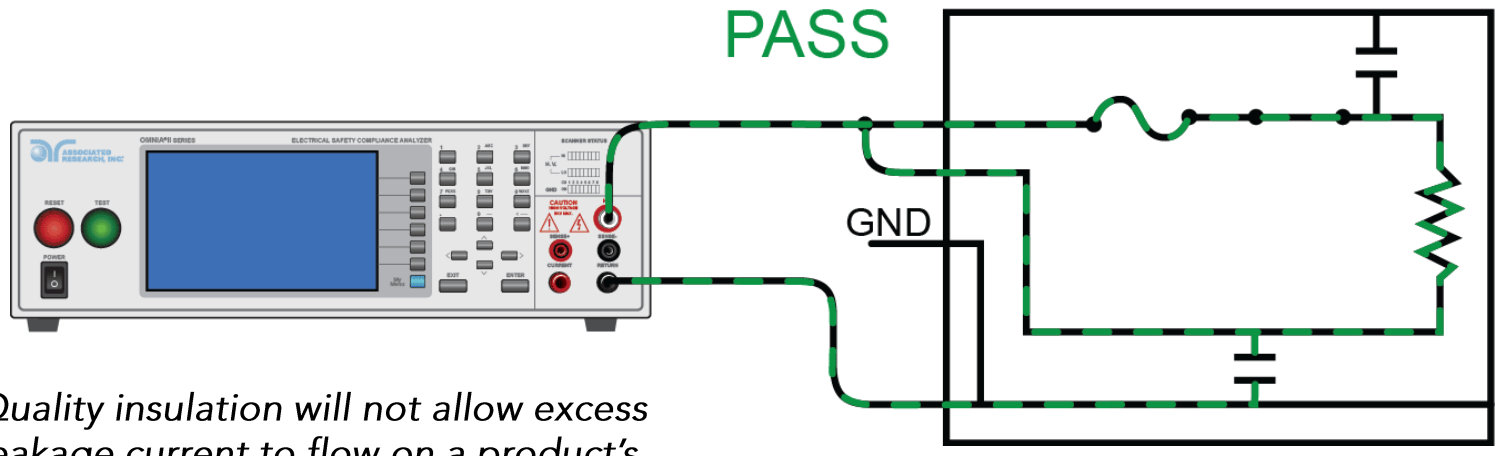
The Hipot Test

Hipot test PASS condition.

The insulation is able to withstand the high voltage and does not break down or does not allow excess leakage current to flow on the surface of the product under test.



Quality insulation will not allow excess leakage current to flow on a product's surface.

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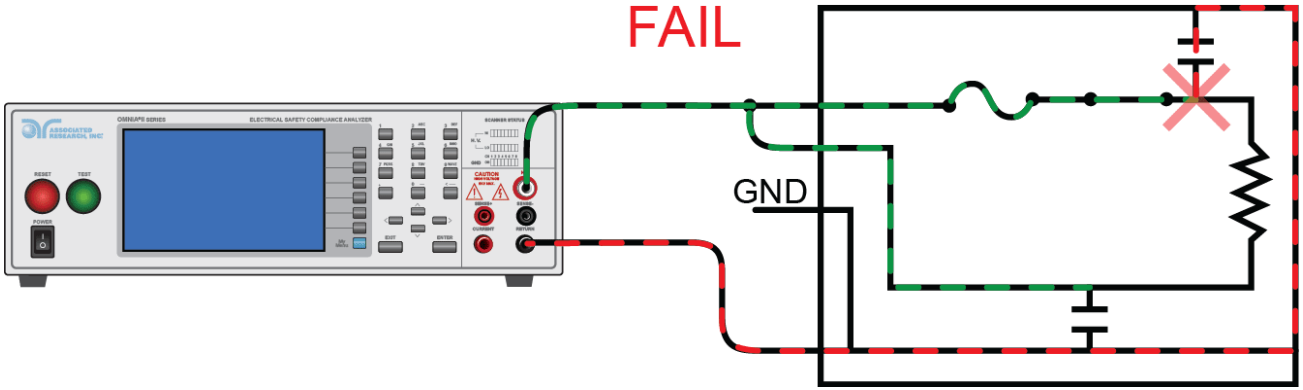
The Hipot Test

Hipot test FAIL condition.

Insulation breakdown results in excessive leakage to the chassis of the DUT.



Poor insulation will breakdown and dangerous leakage current can flow on the surface of a product.

The Hipot Test – A Versatile Test

When performed as *Type* tests Hipot tests are helpful in finding various important defects.

Nicked or crushed *insulation*, stray wire strands or braided shielding.

Conductive or corrosive contaminants around the conductors.

Terminal *spacing* problems and tolerance errors in cables.

Inadequate creepage and clearance distances introduced during the manufacturing process.

The Hipot Test – A Versatile Test

The *production-line* hipot test is used to determine whether the construction of a production unit is about the same as the construction of the unit that was subjected to type testing.

Some of the process failures that can be detected by a production-line hipot test include, a transformer wound in such a way that creepage and clearance have been reduced.

Such a failure could result from a new operator in the winding department

The hipot is more than just a go/no-go test. It can be used to find various insulation problems.

The Hipot Test – A Versatile Test

Scrapes • Pinholes • Spacing • Crimps • Heat

Material Build-up • Moisture

Insulation of any electrical device can become weak over time.

Video Demonstration

The Hipot Test

The best indication of a dielectric breakdown is a leakage current measurement significantly higher than the nominal current measurement.

Test voltage, the product being tested and the capacitance of the product can all impact the total leakage current measurement.

When we perform a hipot test on a product, we can think of the product as a giant capacitor..

The voltage is applied between the mains input and the chassis of the product which are separated by the insulation, which is just like a capacitor.

The Hipot Test Voltages

Unless and otherwise stated by the safety standard, a good rule of thumb to calculate the hipot test voltage is: (2 X Nominal Input Voltage) + 1000V

For example, the hipot test voltage for a product that has a nominal operating voltage of 120V will be: (2 X 120V) + 1000V = 240V + 1000V = 1240V or 1.24KV.

In some cases, safety agency requirements call out for hipot test voltage for certain devices.

For example, medical equipment with applied parts that have direct contact with a patient is tested at 4000V or 4KV.

Most double insulated (Class II) products are subjected to design tests at voltage levels much higher than the rule of thumb described above.

Hipot test parameters are called out by the standards but when in doubt, use the rule of thumb.

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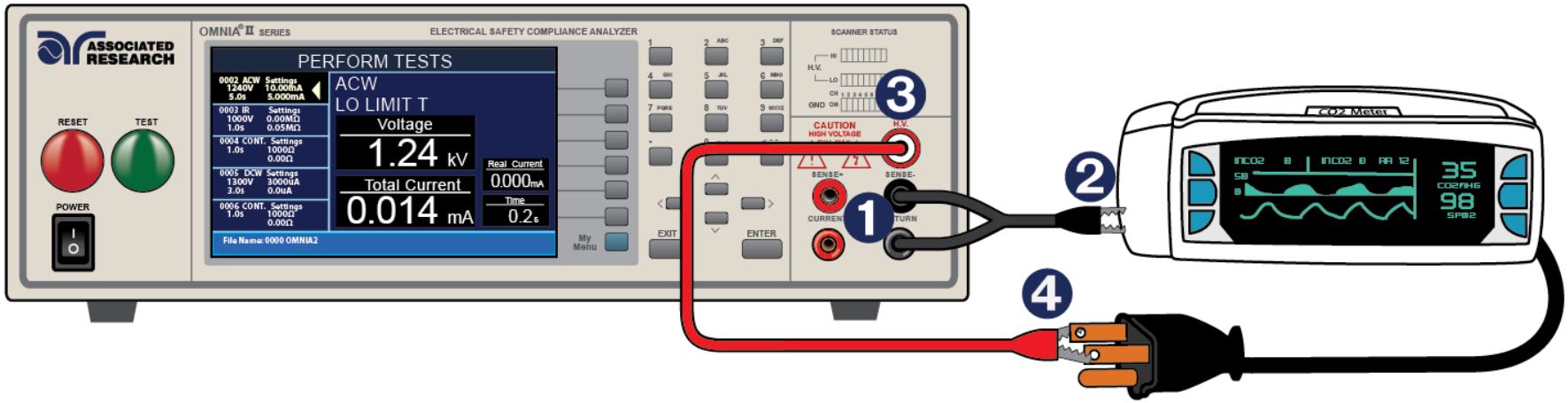
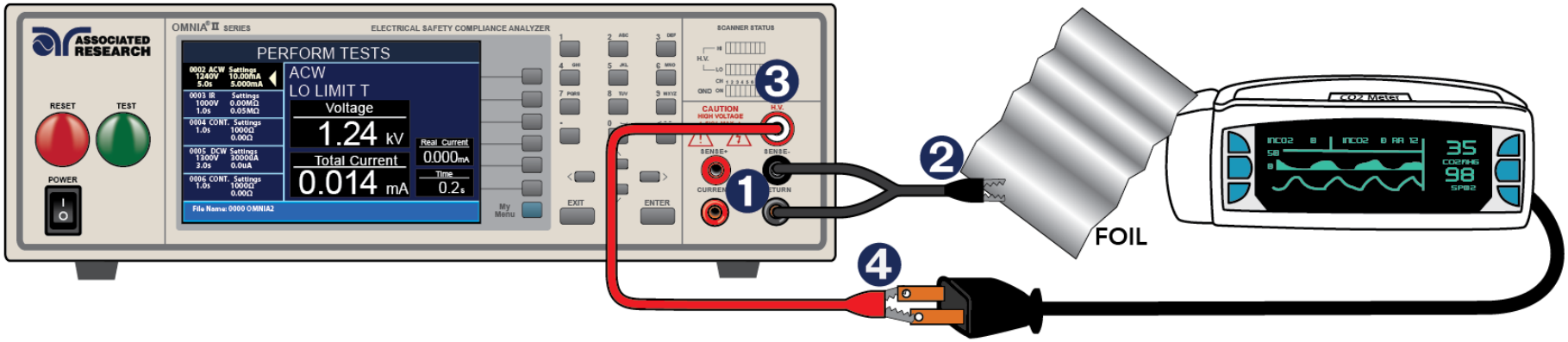
Poll Question

Why are leakage current limits important during a hipot test?

Class I vs. Class II Application



Class I vs. Class II Application



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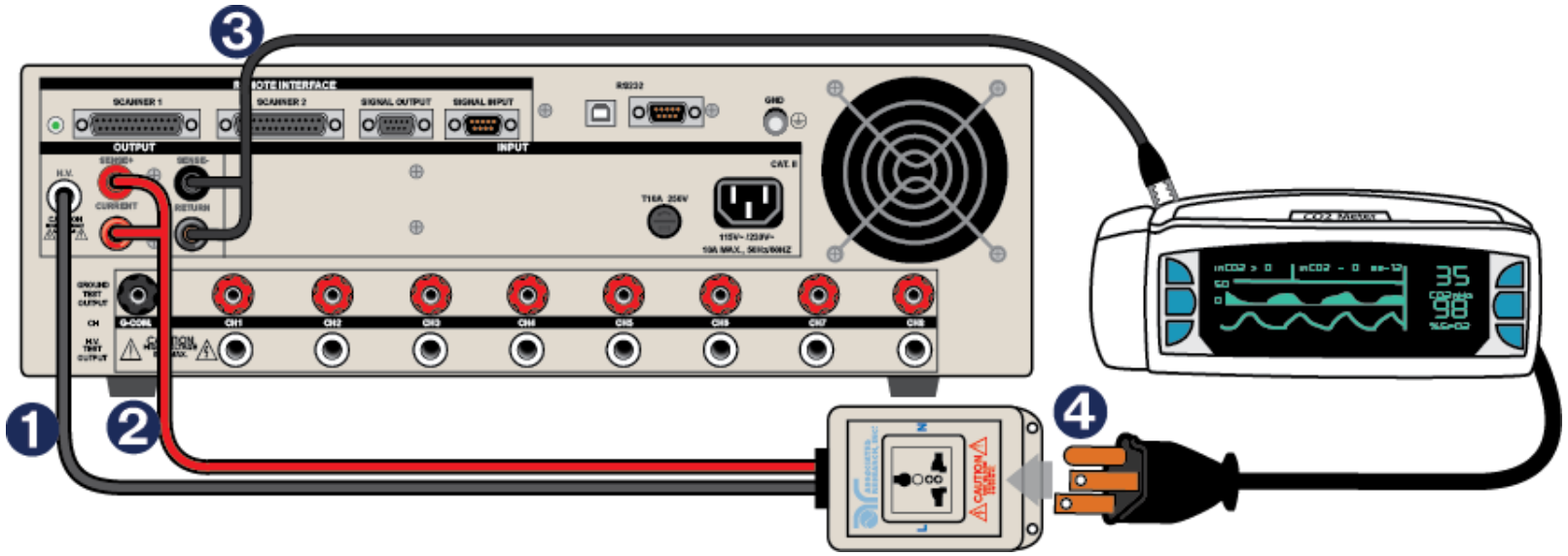
Class I vs. Class II Application



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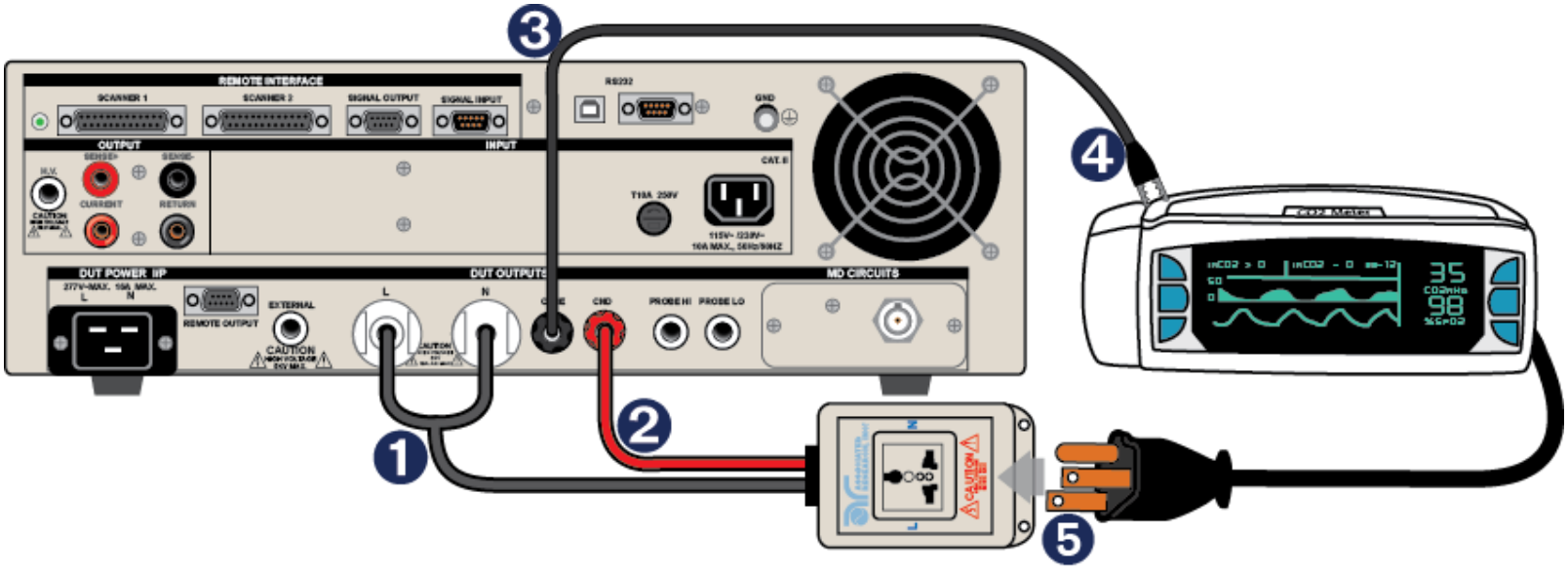
Class I vs. Class II Application



By the Numbers - Standards

UL 1598/CSA C22.2 No. 250.0-08 3rd Edition

COMPLETE SOLUTION:
OMNIA® II 8204

17.1 Dielectric Voltage-Withstand Test (The Hipot Test)

HypotULTRA® 7820

Hypot® III 3705

REQUIREMENT:

Test voltage = 1000 V AC for incandescent luminaries

Test voltage = 1000 + 2 * Rated Voltage for all other luminaries

Test time = 60 sec

PASS CRITERIA:

No breakdown on product insulation

If DUT enclosure is non-conductive, use metal foil as conductive medium for return point.

18 Factory Production Tests

Hypot® III 3705

HYAMP® III 3130

18.1 Dielectric Voltage-Withstand

Test voltage = 1200 V AC between primary circuit and accessible dead metal chassis

Test time = 1 sec

No insulation breakdown

18.2 Grounding Continuity

Test current = 30 A passed between earthing contact point and accessible conductive parts

No load voltage ≤ 12 V AC or DC

Impedance of ground circuit ≤ 100 mΩ

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IEC/UL 60601-1
3rd Edition

COMPLETE SOLUTION:
OMNIA® II
8206, 8207

8.8.3 Dielectric Strength
(The Hipot Test)

OMNIA® II 8206, 8207

HypotULTRA® 7820, 7850

Hypot® III 3705, 3765, 3770

REQUIREMENT:
Test voltage - Refer to tables 6 and 7

Test time = 10 sec ramp up, 60 sec dwell & 10 sec ramp down

Tested at 50Hz, 60Hz or DC equivalent (1.414 * AC test voltage)

PASS CRITERIA:
No dielectric breakdown

If DUT enclosure is non-conductive, use metal foil as conductive medium for return point.

Production Hipot test parameters may differ from Type test parameters.

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IEC/UL 60335-1
5th Edition

COMPLETE SOLUTION:
OMNIA® II
8256, 8257

16.3 Electric Strength Test
(The Hipot Test)

HypotULTRA® 7800

Hypot® III 3780

REQUIREMENT:
500 VA Equipment Required
Test voltage - Refer to Table 7
Test voltage for Class 0 and Class I appliances = 1250 V AC
Test voltage for Class II appliances = 1750 V AC
Test time = 5 sec ramp up, 60 sec dwell

PASS CRITERIA:
No breakdown on product insulation

Annex A
(Routine Tests)

Hypot® III
3705

&

HYAMP® III
3130, 3140

Routine Ground Bond
Test Current = 10 A
No load voltage ≤ 12 V AC or DC
Impedance of earthing conductor for cord connected equipment ≤ 200 mΩ
Impedance for all other appliances ≤ 100 mΩ

Routine Hipot
Test voltage - Refer to Table A.1
Leakage current limit ≤ 5 mA
Leakage current limit for high leakage appliances ≤ 30mA

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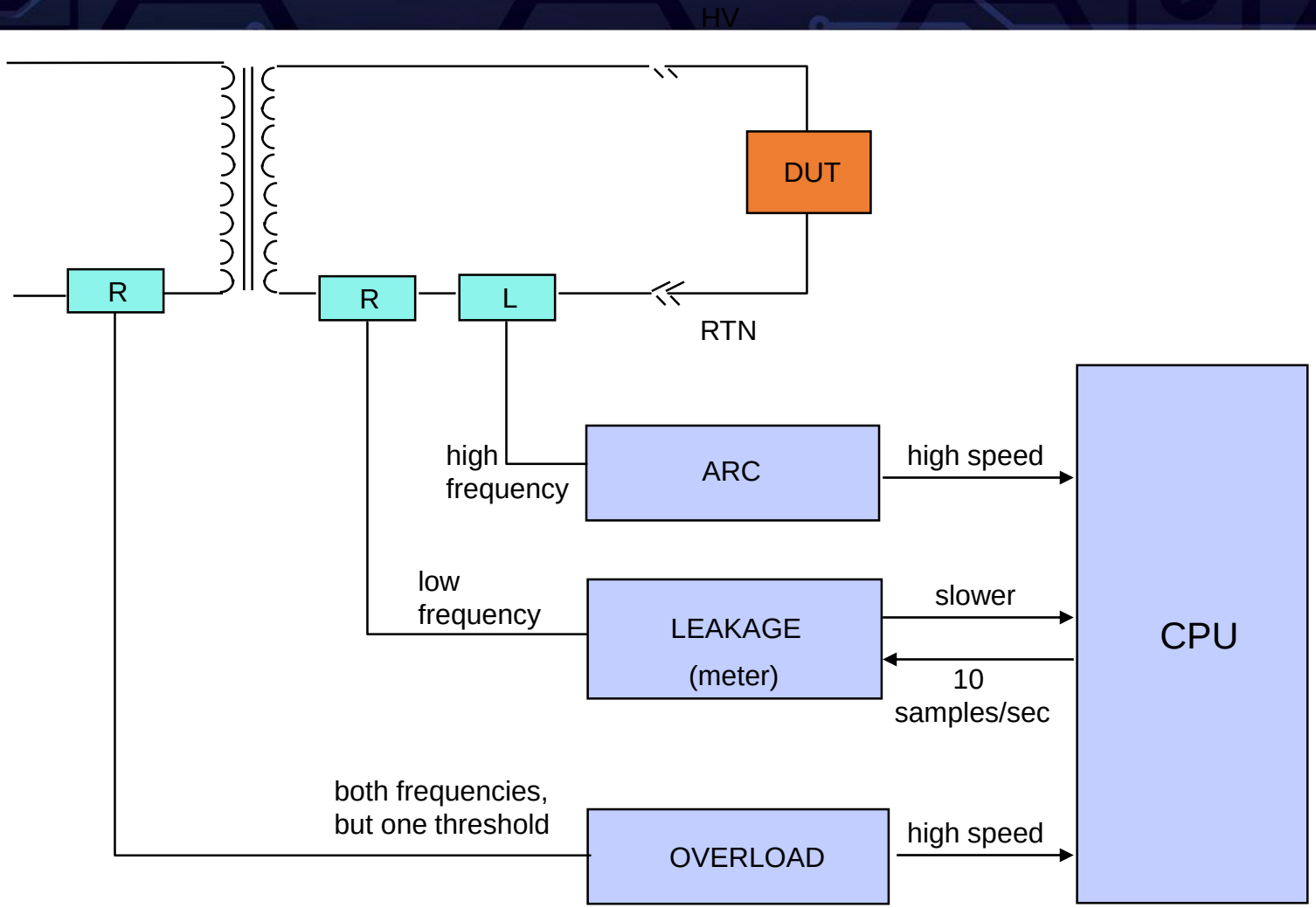
Video Demonstration

Failure Detectors

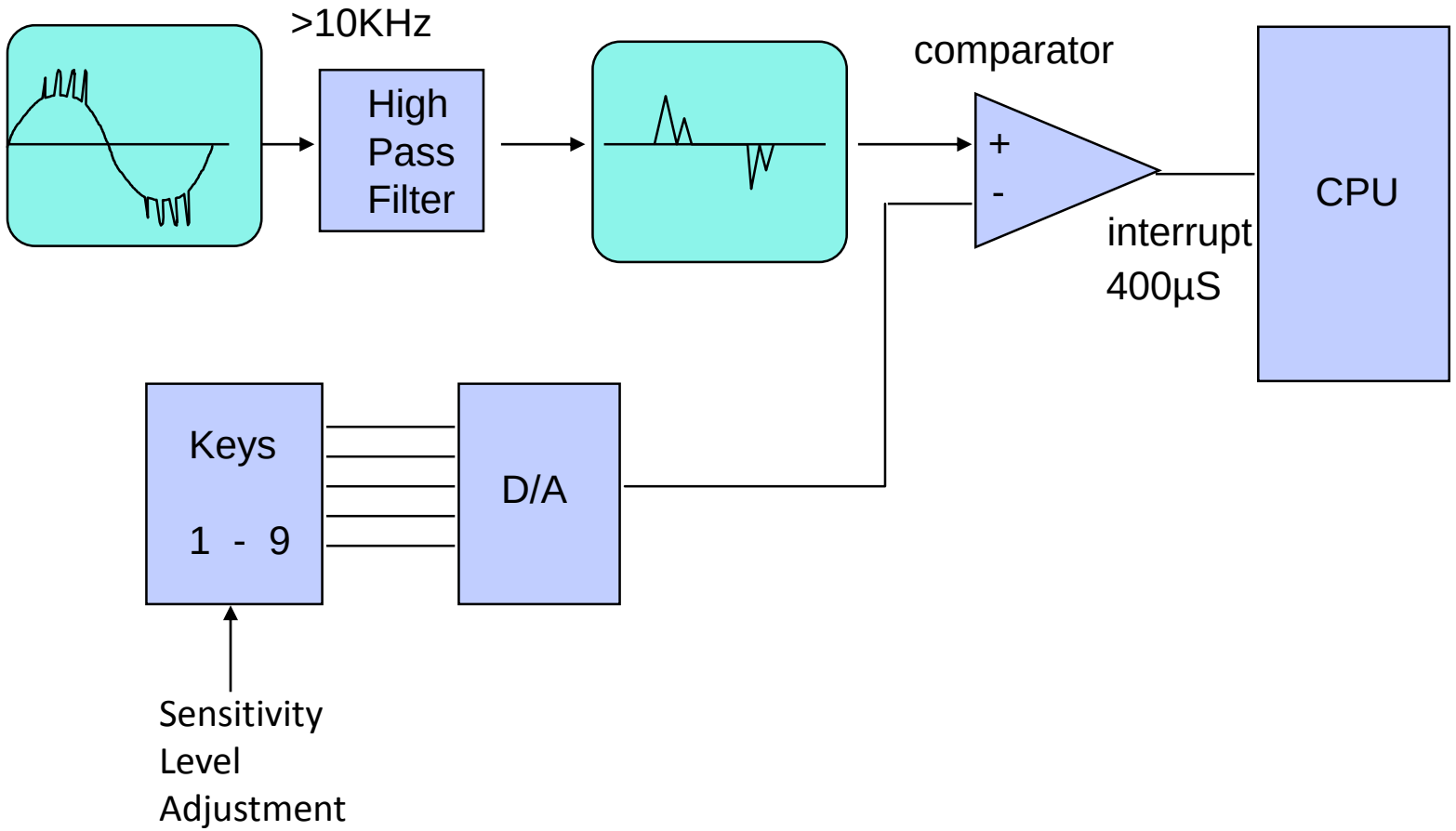
Breakdown	• 400µsec interrupt • Shorts and Breakdowns
Leakage Limits	• Leakage high and low limits • 100msec samples
Arc Detection	• Arc Failure • Arc detection must be turned ON

Each failure detector has a priority on the instrument. Shorts and breakdowns will always be detected with a high speed interrupt. Leakage limits will trigger a failure if leakage current strays from user set values. Arc detection is a extra feature which is enabled.

Failure Detection



Arc Failure Detector



Arc Detection Settings

Arc Setting	mA Trip Level
1	20
2	17.75
3	15.5
4	13.25
5	11
6	8.75
7	6.5
8	4.25
9	2

It's important to remember that this method of arc detection is NOT an exact science. There are many variables involved including surface geometry, altitude, atmospheric pressure etc.

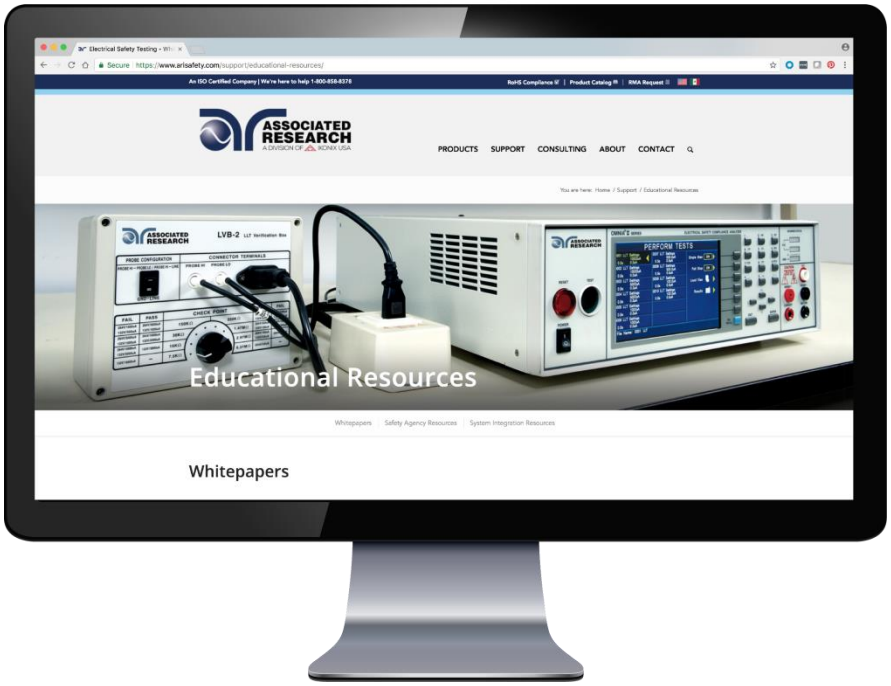
Poll Question 2

According to most test standards which of the following is considered to be a true failure of the insulation?

Video Demonstration

Educational Resources

Visit us online to view all of our Educational Resources
arisafety.com/support/educational-resources/



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Our Next Webinar is

Hipot Test 102

Wednesday, June 6 at 10 A.M. CT

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