

Resistance testing capacitors and high-voltage components

Application Note

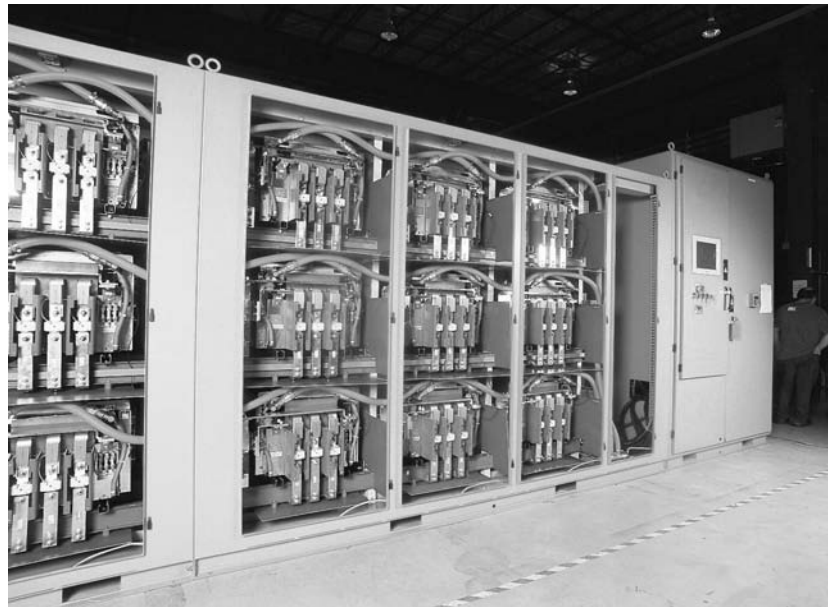
Insulation Resistance Case Study



Measuring tools: Fluke 1550B MegOhmMeter

Operator: ASI Robicon, high-powered VFD manufacturer

Test conducted: SCR voltage, SCR heat, IGBT switching, capacitor



ASI Robicon Perfect Harmony water-cooled Variable Frequency Drive (VFD).

Tom Lasek is a field engineer with ASI Robicon, a major manufacturer of high powered solid state variable frequency drives for controlling industrial AC motors up to 20000 HP and fed by voltages up to 13,800 volts. Lasek's responsibilities include installation/commissioning, general preventive maintenance and troubleshooting these high powered drive systems. He uses a Fluke 1550B MegOhmMeter almost daily for

- Insulation resistance test and documentation for commissioning and startups on company systems.

- Troubleshooting high voltage components in high powered drives.

This case study details the high voltage component and capacitor testing methodology Lasek has developed over his 30 years of experience.

By using the 1550B as a high voltage component tester in regular preventive maintenance procedures, Lasek finds faulty components before they fail. Preventing premature failures saves both ASI Robicon and its customers time and money.

SCR voltage testing

The 1550B MegOhmMeter can quickly determine the relative quality/weakness of non linear devices in high power solid state power supplies: SCRs (Silicon Controlled Rectifier semiconductor) and IGBT high power devices. Normal solid state component testers utilize low voltage, low current test sources and won't always pinpoint bad devices, especially if they may breakdown under load.

Methodology

1. Isolate the device its from all of its connections to ensure accurate readings.
2. Set a high voltage on the 1550B, apply it and note reading.



Sample SCR reading.

Results

- Damaged SCR’s exhibit large differential readings when tested forward biased and reversed biased (anode to cathode).
- New SCR’s generally have almost equal readings in both directions (roughly 100 megohms).
- Any high power SCR reading under 5 megohms is damaged and should be discarded.
- If the SCR reads 50 to 200 megohms in 1 direction and 10 to 50 megohms in the other (4 to 1 difference), it will likely self-gate under load (instead of firing at the desired trigger point in time, it will randomly gate itself on). This is very bad. It causes extreme current pulses in the power supply and can cause commutator flash over in DC motors operated by these supplies.

SCR heat testing

If the component is physically damaged, it may need to be physically removed for a heat test.

Methodology

1. Set the Fluke 1550B to the actual voltage rating of the device. Most ASI Robicon SCRs used on 480 volt VFDs (variable frequency drives) are rated at 1400 volts. They also use 3000 volt devices stacked in series on medium voltage (2300 and 4160 volt) drives.
2. Take two readings, forward and reverse while the device is cold.
3. Warm the component to 180 degrees F in an oven and repeat the test.

Results

If the leakage is up 50 % or more, the device must be discarded.

Conventional testing of SCR’s says that they are OK if they are not dead shorted. Lasek says this assumption is absolutely false. When ASI Robicon repairs SCR power supplies, their goal is to minimize further failures and down time, not minimize the parts cost of the repair.

Any device that exhibits changing, varying, non stable readings when raised to its rated voltage should be suspected as near failure and isolated. Unstable readings indicate internal arc damage or semiconductor self gating/conduction.

IGBT switching device testing

IGBT switching devices can be heat tested as well but they all have a back diode so they can only be checked one way(forward). High power diodes can be heat checked (Cold and hot readings compared for change) as well. Generally, diodes are much higher resistance, lower leakage than SCRs (readings 200 to 700 megohms normal).

An SCR that reads 20 megohms both ways is OK, but one that reads 80 megohms one way and 20 megohms the other

is a suspect for failure. Out of the box new SCRs usually read 100 to 200 megohms both directions and are within 50% of being equal both directions.

Capacitor testing

Lasek also uses the 1550B adjustable voltage function to test high voltage capacitors.

Methodology

Charge several identical capacitors and compare the time it takes them to charge to like readings.



Sample capacitor reading.

Results

- If a capacitor charges extremely quickly, it may be open-circuited.
- If the readings go up and down repeatedly, the capacitor may be arcing internally.

Remove and replace the device.

Fluke. Keeping your world up and running.

Fluke Corporation
PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or Fax (425) 446-5116
In Europe/M-East/Africa (31 40) 2 675 200 or Fax (31 40) 2 675 222
In Canada (800)-36-FLUKE or Fax (905) 890-6866
From other countries +1 (425) 446-5500 or Fax +1 (425) 446-5116
Web access: <http://www.fluke.com/>

©2005 Fluke Corporation. All rights reserved.
Printed in U.S.A. 1/2005 2421893 A-US-N Rev A