Email: powersolutions@dynexsemi.com
Main switchboard: +44 (0)1522 500 500
Website: www.dynexsemi.com

AN4853

Thyristor and Diode Measurement with Multimeters

Application Note

Replaces AN4853-3.1
AN4853-4 February 2026 (LN44660)

Abstract—Many users of high power thyristors (including GTOs) and diodes do not have access to specialised equipment for measuring device parameters. Therefore, readily available battery-operated multimeters are often used to distinguish non-acceptable devices by measuring resistance. However, readings of resistance in this way can easily lead to incorrect conclusions. This application note provides guidelines on how to use a multimeter appropriately for basic device functional checks, as well as the limitations of such measurements.

1 Multimeter measurements limitations

Handheld battery-operated multimeters are commonly used to measure the DC resistance between anode and cathode of thyristors and diodes, as well as gate-to-cathode resistance on thyristors. These measurements relate only to the device off-state, that is, its blocking state.

Multimeters are not designed to characterise components with strongly non-linear electrical behaviour, such as semiconductor devices. Therefore, the useful information obtained from such measurements is limited, and the only meaningful outcomes may be the detection of a short circuit or an open circuit.

For a device to be considered shorted, the anode-to-cathode or gate-to-cathode measurement must indicate a short circuit in both forward and reverse polarities. Conversely, an open circuit would be indicated by an infinite resistance reading. Any intermediate resistance value does not provide a direct judgement regarding device health or performance.

It should also be noted that, for disc-type press-pack devices, the basic unit is not always in firm contact with both pole faces; therefore, sufficient clamping force must be applied during measurement to ensure proper internal contact.

1.1 Low test voltage

The internal battery voltage is typically below 24 V, and the measured device resistance is therefore determined by the device leakage current at this low voltage. Dynex power semiconductor devices typically have rated blocking voltages in the range of 1000 V to 8500 V. Measurements performed at such low voltages cannot assess blocking capability or leakage current behaviour.

When higher-voltage multimeters (for example, mega-ohm meters can provide input voltage up to 1000 V) are used, the information gained is still limited. Such measurements only confirm that the device can block up to the applied test voltage (e.g., 1000 V). They provide no indication of behaviour beyond that point. For example, a device rated at 8.5 kV may still fail to block at 2 kV, even if it blocks successfully at 1 kV.

To assess blocking capability properly, the measurements must be carried out at appropriate voltage and current levels using equipment specifically designed for high-power semiconductor device testing.

1.2 Non-linear behaviour of semiconductor devices

Power semiconductor devices exhibit a non-linear relationship between blocking voltage and leakage current, and therefore do not have a fixed resistance. For example, the blocking voltage of a thyristor is defined as the voltage at which a specified leakage current is reached at a defined temperature (see **Figure 1**). Different devices may have different leakage characteristics while still fully meeting specification as shown in **Figure 1**.

Consequently, a higher resistance value measured by a multimeter at low voltage cannot be used to distinguish acceptable devices, nor can it be used to conclude that one device has a higher leakage current than another, as the result is limited to a single low-voltage operating point. As shown in **Figure 1**, a device with a lower leakage current at low voltage (e.g., 3 V) does not necessarily maintain a lower leakage current at higher voltages or indicate superior blocking capability. In fact, it may exceed the leakage current limit before reaching its rated blocking capability.

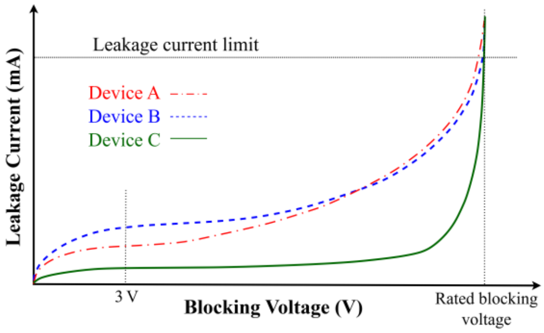

Figure 1. Non-linear behaviour of power semiconductor devices. The difference is exaggerated in this figure for clarity.

2 Measurement guidelines and precautions

If resistance or continuity checks are performed as a basic diagnostic step, the following precautions must be observed:

- All voltage and current sources, such as the main converter supply, must be fully disconnected before any measurements are taken.

- Any parallel paths across the device, including snubber and balancing circuits, must be disconnected to ensure that the measurement is made on the semiconductor device alone. Therefore, ensure that the resistance reading is taken only across the device terminals and not through parallel components or wiring.

- For disc-type press-pack devices, sufficient clamping force must be applied during measurement to ensure proper internal contact. Insufficient pressure can lead to artificially high resistance readings. It is normal to hear or feel slight movement of the internal unit in a healthy device when they are not clamped.

- Certain asymmetric devices, such as GTOs and bypass thyristors, have polarity-dependent blocking capability, with significantly lower reverse or direct blocking voltage. Measurements must be performed with the correct polarity to avoid device damage. For example, the voltage of the multimeter must not be higher than the reverse blocking voltage of a GTO.

- Gate-to-cathode measurements can be useful for identifying an open-circuit of gate connection. A forward voltage drop of approximately 0.5 V to 0.7 V in one direction and a high resistance in the other direction typically indicates a healthy gate path. A very high resistance or open circuit in both directions suggests a broken gate wire or an improperly connected gate lead.

- When measuring the gate circuit, ensure that the applied voltage does not exceed 15 V and that it is applied only briefly. Excessive voltage, prolonged application particularly for the reverse gate voltage can damage the gate structure and must be avoided.

- The devices should be tested at room temperature, as higher temperatures significantly increase the leakage current and may be misinterpreted as a device failure.

- Short-circuit test: For a device to be considered shorted, the anode-to-cathode or gate-to-cathode measurement must indicate a short circuit in both forward and reverse polarities.

- Open-circuit test: an open circuit would be indicated by an infinite resistance reading. For press-pack devices, an open-circuit failure between the anode and cathode is extremely unlikely. In addition, when no gate pulse is applied to a thyristor, a multimeter will indicate an open circuit in both forward and reverse polarities.
  The most plausible open-circuit condition that can be identified using this method is a failed gate connection, either internal or external.

3 Final remarks

All Dynex power semiconductor devices are fully tested for functionality and performance before leaving the factory and can be used without any additional measurements. The most reliable reference is the production test data supplied with each device at shipment.

If there is any doubt regarding the condition of a device, the recommended approach is to contact Dynex customer support and discuss re-evaluation or re-measurement at Dynex test facilities.

Resistance measurements using a multimeter are not recommended as a method for determining whether a power semiconductor device is acceptable or not. At best, a multimeter can be used as a quick check to identify catastrophic failures, such as a hard short circuit.

IMPORTANT INFORMATION:

This publication is provided for information only and not for resale.

The products and information in this publication are intended for use by appropriately trained technical personnel.

Due to the diversity of product applications, the information contained herein is provided as a general guide only and does not constitute any guarantee of suitability for use in a specific application. The user must evaluate the suitability of the product and the completeness of the product data for the application. The user is responsible for product selection and ensuring all safety and any warning requirements are met. Should additional product information be needed please contact Customer Service.

Although we have endeavoured to carefully compile the information in this publication it may contain inaccuracies or typographical errors. The information is provided without any warranty or guarantee of any kind.

This publication is an uncontrolled document and is subject to change without notice. When referring to it please ensure that it is the most up to date version and has not been superseded.

The products are not intended for use in applications where a failure or malfunction may cause loss of life, injury or damage to property. The user must ensure that appropriate safety precautions are taken to prevent or mitigate the consequences of a product failure or malfunction.

The products must not be touched when operating because there is a danger of electrocution or severe burning. Always use protective safety equipment such as appropriate shields for the product and wear safety glasses. Even when disconnected any electric charge remaining in the product must be discharged and allowed to cool before safe handling using protective gloves.

Extended exposure to conditions outside the product ratings may affect reliability leading to premature product failure. Use outside the product ratings is likely to cause permanent damage to the product. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture, a large current to flow or high voltage arcing, resulting in fire or explosion. Appropriate application design and safety precautions should always be followed to protect persons and property.

Product Status & Product Ordering:

We annotate datasheets in the top right-hand corner of the front page, to indicate product status if it is not yet fully approved for production. The annotations are as follows: -

Target Information:	This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.
Preliminary Information:	The product design is complete and final characterisation for volume production is in progress. The datasheet represents the product as it is now understood but details may change.
No Annotation:	The product has been approved for production and unless otherwise notified by Dynex any product ordered will be supplied to the **current version of the data sheet prevailing at the time of our order acknowledgement.**

All products and materials are sold, and services provided subject to Dynex’s conditions of sale, which are available on request.

Any brand names and product names used in this publication are trademarks, registered trademarks, or trade names of their respective owners.

HEADQUARTERS OPERATIONS
DYNEX SEMICONDUCTOR LIMITED
Doddington Road, Lincoln, Lincolnshire, LN6 3LF
United Kingdom.
Phone: +44 (0) 1522 500500

Web: http://www.dynexsemi.com

CUSTOMER SERVICE
Phone: +44 (0) 1522 502753 / 502901

e-mail: powersolutions@dynexsemi.com