

TEST SHOT NEWS

WORLD LEADER IN INNOVATIVE POWER SYSTEM TESTING SOLUTIONS

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Testing of Line Differential Protection

Differential line protection devices compare the phase currents (or related properties) of the line ends and check for deviations indicating an internal fault. High currents resulting from a through-fault (fault outside the protected zone) will increase the absolute measurement error thus creating an apparent differential current that could lead to false tripping. This is why the differential current is biased, for example, by the sum of absolute current values of the line ends. The relays at the line ends communicate for current comparison and bias calculation, forming a distributed protection system.

It is widely accepted that a proper relay test should preferably be done with settings for on-site operation, verifying all parameters shaping the characteristic.

An easy way to make differential relays trip for testing purposes is to inject currents from just one side since they will be seen as 100 % difference. This seems especially attractive for line differential relays since test signals are not needed at the remote location, allowing a very simple test setup. The disadvantage is that usually the test result is restricted to a single point on the relay characteristic where the single-injection trajectory crosses the characteristic. Settings defining the e.g. multi-slope characteristic, important for high fault currents, can therefore not be verified by this test.

Some relays select the highest biasing value of all phases as common biasing quantity, allowing control of the diff/bias relation by injecting one current in one phase and a different one in another phase.

A much more versatile approach is to inject the currents for all line ends. This is the standard procedure for testing transformer differential relays with modern test equipment delivering e.g. six test currents, allowing full control of the diff/bias relation for characteristics verification. For a full on-site commissioning test a distributed setup is required (see Fig. 1). The currents at all ends must be tightly in synchronism in order to allow proper assessment by the relays within the desired tolerances.

The test devices are synchronized to a master clock represented by the time stamps transmitted by the Global Positioning System (GPS) satellites. Each test unit is controlled by a dedicated GPS receiver.

For each test shot all test devices wait for a time pulse from the GPS receiver. This ensures highly accurate signal synchronism of all generated currents in the range of microseconds.

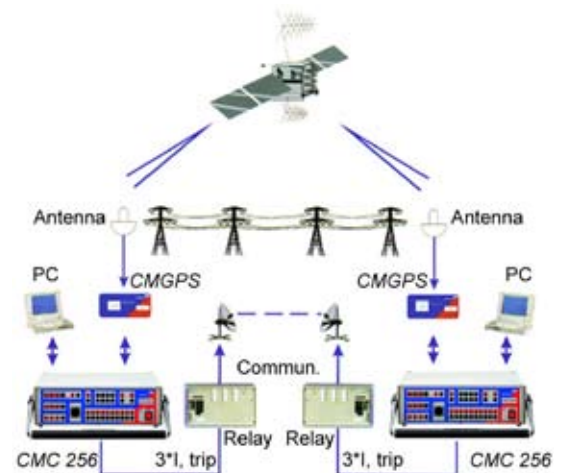


Fig. 1: End-to-end test injection

For the benefit of a dedicated user interface and reporting for line-differential tests OMICRON has now introduced GPS synchronization into its Advanced Differential test modules. This allows direct diff/bias plane operation just like that for transformer differential relay testing, thus also supporting line differential relays with a transformer in the protected zone. New checkboxes activate the GPS mode and select the proper current triple for each end. The "GPS Configuration" button of the test module allows for the setting of the start time and the shot rate.

Sample Test Result

Fig. 2 shows a sample test result with Siemens 7SD610 line differential relay. The chosen characteristic for the Differential Operating Characteristic diagram is the classic current difference versus the sum of current amplitudes representation.

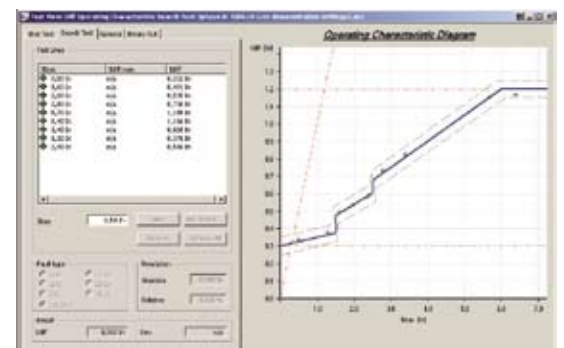


Fig. 2: Sample Idiff/Ibias result with 7SD610

(Continued from page 1)

Some Hints:

- In search mode the test module needs consistent behavior of the trip signal. All ends must trip at the same time to avoid diverging iterations. So all relays must use the transfer trip function if synchronous tripping is not inherent to the relay function.
- Relays that allow different characteristics per end can be tested sequentially by enabling one end trip at a time together with transfer tripping, thus testing each characteristic according to its settings.

For an extended version of this article please visit the Support section of www.omicron.at.

New features of Test Universe 2.11

We are pleased to announce the availability of the 2.11 release of Test Universe Software which offers many useful enhancements:

GPS-synchronized Line-Differential testing: See also the title story for the application of this powerful feature.

XML data export: This modern data format is added as an alternative to the existing CSV export allowing easy integration of external applications and databases. XML can be exported from OCC files as well as from individual test modules. Application example notes are included to show how to make use of XML data transfer and test result analysis in Microsoft Office applications and .NET programming.

The new software also provides changes and enhancements in the following modules:

GOOSE Configuration: Support of the frequently used Enumeration type and other enhancements including improved SCL import.

Advanced TransPlay: A sine simulation with definable length can now be inserted before the actual COMTRADE playback to allow extended pre-fault duration in addition to the looping capability of the tool.

CMGPS: Enhanced status information (e.g. Almanac and UTC update progress) and 'Restore Defaults' to quickly equalize the settings on all ends.

Ramping: Added $(X + Y) / 2$ function, e.g. for MTA assessment.

NetSim: Two new test cases for double earth fault simulation (single- and dual-segment line with freely assignable fault locations).

This release is available now on CD and on our website for download from the Customer Area. The download is an Update version, i.e. it comes without a license file and can be installed on top of an existing TU2.x installation. Users are invited to contact their OMICRON sales partner for a free update from TU 2.x licensed components, or use the online order form provided in the Customer Area of the OMICRON website. The license keys stay the same for these versions.

For more information including the detailed "What's New" document for this release users can get more information from the Customer Area at www.omicron.at.

TestBase™

The Administration Tool for Protection Testing with Test Universe

Every day protection engineers are confronted with the challenges of shorter and shorter innovation cycles. Protective relays become more powerful and more complex; relays of different generations and from different suppliers, are used side by side and these are only some of the reasons why the test and maintenance of protection relays remain a challenging task for engineers and technicians.

TestBase is a powerful database for maintenance management and test automation. Its use releases staff from many of the administrative tasks and paperwork associated with this work. It is designed for protection testing with the TU software and CMC test equipment, but can be used for many other applications and with test equipment from many major manufacturers.

Useful Applications

1) Management of Protection Relay Settings – The user can easily compare nominal and actual settings and directly import settings from the relay operating software. These settings can be automatically transferred into the TU test template for testing with the CMC test equipment.

2) Administration of Test Templates and Test Results – TestBase ensures the selection of the right test templates for a specified relay. Excel checklists can be filled automatically with individual relay master data when they are launched from TestBase and all test results are automatically stored in the database.

3) Test Automation – For a number of test applications (e.g. routine testing of distance relays) and relay types, fully automated test templates are available.

4) Maintenance Planning Support – Alarm signals in the software show objects due or overdue for maintenance.

5) Document management – With the integrated document management facility the user gets easy access to the information required during testing (e.g. relay manuals, test specifications, safety instructions, certificates, individual notes, etc.).

6) Management of other assets within power utilities – In addition to protective relays, TestBase supports instrument transformers and batteries. Further equipment can be modeled into the system by the user.

7) Offline mode with data replications – TestBase allows automated synchronization when connected to the server. The user has access to all features when working on site even without server connection.

TestBase is available in a wide range of formats; for single or multi-user; as a standard add-on product to the OMICRON Test Universe; or as an individually tailored solution for maintenance management.

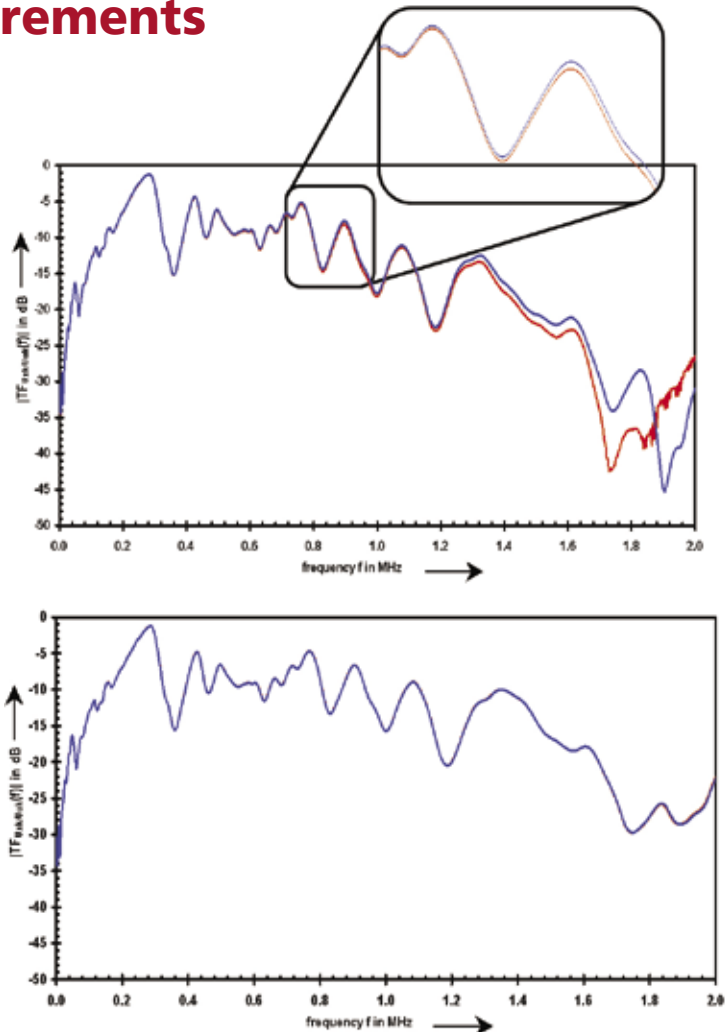
For more information about TestBase please get in touch with your local distributor or the OMICRON office nearest you.

Reproducibility of FRA Measurements

Transformers have to withstand a high level of mechanical stress during through-faults with high currents. The magnetic flux in the stray channel causes high forces between the turns of the windings. In particular, when the clamping pressure is not capable of restraining the forces involved, substantial permanent winding deformation or even collapse can occur. Often the deformation of transformer windings is not recognized and the transformers remain in service. In many cases deformed windings have a reduced ability to withstand high forces subsequently and so high through-faults can lead to an unpredictable breakdown of the whole transformer.

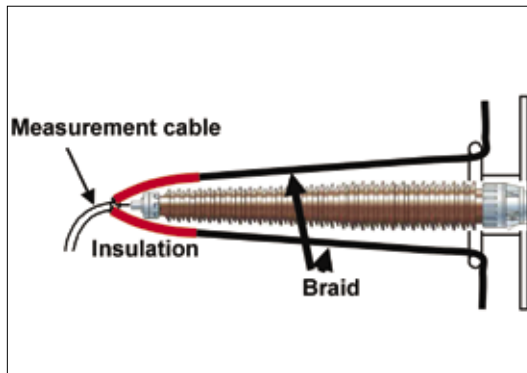
Frequency response analysis (FRA) provides a powerful tool to detect deformation and displacement of windings by measuring the transfer function of windings over a wide frequency range. Changes in the measured transfer function can be very small. Comparisons to the other two phases or to sister units are often not helpful due to physical differences. Therefore a reference (fingerprint) measurement of the windings in a good condition is very important. To guarantee that the measurements have good reproducibility, it is necessary to follow some important guidelines for making the reference and subsequent measurements. The test circuit should be made exactly in the same way for both measurements, using the same equipment or at least equipment with the same measuring behavior. Important parameters are the measuring principle, the input impedance, the cables and particularly the grounding concept. The grounding of the measuring system and the coaxial measuring cables can greatly affect the measurement. To minimize the influence of the connection leads it is very important to connect the screens of the coaxial cables with the minimum level of inductance as possible and always in the same manner.

The figure on the right side presents a comparative test to investigate the influence of different grounding concepts on the repeatability of the measurement. The first example used old-style connection techniques. The position of the instrument was changed which, in turn, changed the position of the measuring leads relative to the transformer terminals. Changes in the signal damping were observed for frequencies of 700 kHz and above showing large changes in the signal traces for higher frequencies. Using the advanced braid connections in place of wires the measurements are stable over the complete frequency range. It can be seen in the example that where the new braid is used for the connection, the red and blue traces are nearly coincident. This effect is of importance for the practical use of FRA, because it is unlikely that exactly the same arrangement of measurement leads and FRA instrument will be achieved for subsequent measurements on the same transformer or for similar transformers in other substations.



FRA curves with wire and braid grounding. The results showing clear advantage of grounding braids regarding wires.

The example shows the importance of the connection technique for reproducible FRA measurements. With the innovative connection technique, OMICRON offers an important tool for professional measurements.



Innovative OMICRON lead and grounding connection concept



FOR THE RECORD WITH **OMICRON**

A series of questions most commonly asked, and responses from OMICRON's renowned test Guru...

UPCOMING EVENTS

GCC Cigre Exhibition for electrical equipment
Beach Rotana Hotel & Tower
Booth #A8
Abu Dhabi, United Arab Emirates
November 29 - 30, 2006
www.ifpqatar.com

Euro TechCon
Crowne Plaza Hotel
Chester, United Kingdom
November 28 - 30, 2006
techcon.tjh2b.com/Euro TechCon 2006/index.htm

SCS Automation & Control (ELEC)
Parc des Expositions
Hall 6 / 5a L 148
Paris Nord Villepinte, France
December 5 - 8, 2006
www.scs-automation.com

Energy Generation Conference
Bismarck, ND, USA
January 30 - February 1, 2007

DistribuTech
San Diego Convention Center
Booth #1625
San Diego, CA, USA
February 4 - 6, 2007

Middle East Electricity
Dubai International Exhibition
Centre
Dubai, United Arab Emirates
February 11 - 14, 2007
www.middleeastelectricity.com

TechCon
Disney's Coronado Springs Resort
Lake Buena Vista, FL, USA
February 28 - March 2, 2007

Hanover Fair
Hanover, Germany
April 16 - 20, 2007
www.hannovermesse.de

Q: We need to do some tests, for example the tap changer test, on our transformers on a common basis. Preparing the CPC test cards required for these tests does take some time. Furthermore you need to have certain knowledge about the whole technique. Is there a solution to simplify the preparation of the tests?

A: Especially for tests used regularly, we have generated standard "templates" to simplify the process.

Instead of generating all the required test cards manually the user just needs to input some settings in the templates. This improves efficiency overall by reducing the amount of work and time.

Templates comprise of one or more test cards and are suitable for the most common requirements. CPC Explorer allows for the test measurements to be easily downloaded to a PC. Also, since each template is actually a template pair, which consists of an Excel template and a CPC template, the test report will be generated automatically by loading the corresponding Excel template. This test report is completely adaptable to your needs. The next time you need your, more detailed report again, you only have to load the measurement data into your personally adapted template. Therefore you have to create your "report template" only once but are able to use it frequently.

OMICRON provides templates for the most common applications. These templates are automatically installed with the CPC Explorer. You can find them in Start \ Programms \ CPC Explorer \ Templates. To take advantage of the CPC templates concept, they (*.xmt) must be uploaded to the CPC100 prior to the test. They are also available in the Customer Area on the OMICRON homepage and can be downloaded from the section "Primary Testing - CP Line / CPC 100 and Accessories" for free.

Q: My notebook is fairly new and it doesn't have a parallel port (DB25 connector). What can I do to still use the CMC with a parallel port connection?

A: To add a parallel port to any computer with a PCMCIA interface, an extension card can be used.

There is a big range on the market of parallel port PCMCIA Cards. Most of these extension cards can be easily installed onto the notebook. Some of them do not even need drivers but the compatibility mostly depends on the operating system and its version.

We have tested a number of cards for the parallel port connection to the CMC using PCMCIA. We found a variety of usable cards but our specific recommendation is the type SPP-100 from Quatech. This card can be ordered at OMICRON. Further information about this Parallel Port PCMCIA card is available in the "OMICRON CM Line catalogue" and as well on our homepage, in the section "Secondary Testing - CM Line / Hardware / Accessories"

Majority Takeover of Berlin-based High Tech Company mtronix

"The chemistry is perfect!", says Martin Pfanner, Managing Director of OMICRON electronics GmbH, and continues: "By taking over the majority of the German business **mtronix**, we not only extend our range of services in the field of test and measurement engineering for electrical power systems, but we also gain access to new market segments. **mtronix**, founded in 1997 by a team of highly motivated experts, specializes in the field of partial discharge measurement where it quickly became international technological leader within a few years. This reminds us strongly of our own business development, in which OMICRON managed to take a leap to become the world's market leader through highly innovative solutions".

This partnership will allow us to:

- Expand technologically in the direction of partial discharge analysis
- Deliver better and more comprehensive solutions to our customers

Find out more details on www.omicron.at.

