

M4000



DIAGNOSTIC TEST SYSTEM FOR POWER APPARATUS CONDITION ASSESSMENT



TOGETHER WE POWER THE WORLD[®]

The world's most advanced test system for power apparatus.

The M4000 is the leading system for evaluating the condition of high voltage power apparatus. It sets the standard for accuracy, reliable test results, and intelligent diagnostics for customers worldwide.



M4000



The stakes are too high to settle for anything less.

If your company utilizes power apparatus, you have millions of dollars at stake. A transformer or bushing failure can cost you lost time, lost revenue, unplanned maintenance expenses, fees, injuries, and huge repair or replacement costs. Risks which could have been minimized with a comprehensive testing program. But only if you are using a comprehensive solution that can meet the challenge.

you with the most informed interpretation of those test results. The M4000 is the only test system which gives you the highest accuracy, reliable test results, and intelligent diagnostics. This multi-purpose instrument can perform a variety of tests and diagnostics on a wide range of power apparatus, ensuring that your testing program is a success.

The fact is, if you're not using Doble's M4000, your test results are not as accurate as they should be. With Doble's expert software and experienced team of engineers, no other product provides

The bottom line: If you're going to test, why not use the best?

The M4000.

The world's most advanced diagnostic test system.



M4100

And getting better.

The M4000 is the recognized industry standard for assessing the condition of high-voltage power apparatus. More than 2,500 M4100 instruments are actively used around the world, including at every major utility in North America. Why did they choose the M4000 system?

Quite simply, the M4000 provides the most accurate test results ever achieved in a diagnostic test system for power apparatus. Doble's superior interpretation of test results will allow your company to make informed decisions with the highest level of confidence.

It incorporates breakthrough technology and design that eliminates the problems inherent in other test systems and delivers reliable results, time after time. It offers intelligent software that provides a diagnosis, not just data, so your technicians can make the right decisions every time.

No other diagnostic system comes close to the M4000. And for testing your valuable power apparatus, no other decision makes sense.

The highest **ACCURACY**.

The most **RELIABLE** diagnosis.

This is what **TESTING** should be.

You depend on accurate test results to make critical operating decisions about your power apparatus.

You need to have answers you can believe in, no matter what the test environment.

This is where the M4000 system, and its cornerstone unit – the M4100 – set the standard. The M4100 was engineered from the ground up to overcome the common problems that plague other test instruments. The result is nothing less than an entirely new approach to testing.

The Advantages of the M4100:

- Totally eliminates substation signal interference with Doble's patented Line Frequency Modulation technology
- Generates its own clean test signal for the most reliable and repeatable results
- The highest power to better replicate in service condition
- Self-calibrating in the field, so it's always accurate
- Advanced digital technology takes accuracy to new levels
- Automated setup eliminates errors
- Doble Test Assistant® (DTA) expert diagnostics software makes testing easy, fast and very smart
- All records are presented in a format that is easy to read, save and print.
- DTA Web provides an on-line database of test results, complete with powerful analysis tools.



Diagnostic Capabilities of the M4000 System:

- Power Factor Testing to confirm insulation integrity and quality
- Capacitance Testing to measure physical changes that may have occurred to the apparatus
- Turns Ratio Testing to detect shorted turns or winding damage
- Leakage Reactance/Short Circuit Impedance Testing to evaluate winding deformation
- Single Phase Excitation Current Testing to evaluate the transformer magnetizing circuit
- Capacitor bank testing using the M4110, and the M4140 detects deteriorating or failed capacitors within a bank.

Test	Test No.	Test Date	Test Time	Test Location	Test Operator	Test Result	Test Status
1	10	43.100	2.143		0.89	1.810	OK
2	10	18.470	0.879	0.47	0.42	0.89	OK
3	10	24.700	1.276	0.51	0.45	0.89	OK
4	10	24.630	1.285	0.52	0.46	0.89	OK
5	10	62.550	4.189		0.89	1.840	OK
6	10	27.300	2.979	0.76	0.69	1.110	OK
7	10	24.650	1.269	0.51	0.45	0.89	OK
8	10	25.250	1.270	0.50	0.45	0.89	OK
9	10	14.700	0.620	0.49	0.44	0.89	OK
10	10	16.400	2.181	0.28	0.69	0.89	OK

Expert Systems Analysis Output

Line 5

This condition may be related to:

- 1) excessive contamination of the CL insulation.
- 2) Contamination and/or deterioration of the low-voltage bushing insulation.
- 3) Excessive surface leakage over the porcelain.

Repeat the tests after cleaning the LV bushings and disconnecting any bus or cable. The LTC should be on an oil switchtop. Make sure to:

- a) Perform separate tests (C1 and C2) on the low-voltage bushings and the oil from both the main tank and LTC compartment.
- b) Tighten all the windings.
- c) Repeat the tests using a lower test voltage (20 kV).
- d) Check the core ground.

Electrostatic interference: Don't let it ruin your test!

Inaccurate test results can lead to costly mistakes.

For years, maintenance engineers have known there's a problem with testing power apparatus in a substation: electrostatic interference due to energized conductors. In fact, it's the leading cause of inaccurate test results and can lead to erroneous and costly maintenance decisions.

Test instrument manufacturers have tried to compensate for this problem, but their attempts have been largely ineffective because the interference level is never constant in the substation. Even automated interference cancellation techniques cannot keep up with the fluctuations in the interference level. And because the test signal is so small in some cases, even a slight fluctuation in interference can lead to invalid results.

The M4100 eliminates interference problems once and for all.

The M4100 uses a patented technique called Line Frequency Modulation™, in which the measurement is made at a frequency above and below the system frequency. This method eliminates the effect of varying electrostatic interference. As a result, you get highly accurate and repeatable measurements, and even a small change in the measurement can be used reliably for diagnostic purposes.

Generates its own clean signal for the most reliable results

The accuracy of test results is directly related to the quality of the test signal. While most test instruments use available power lines or portable generators to generate the output test signal, the M4100 uses an internal waveform generator to produce its own precise sine wave test signal. As a result, the M4100 produces reliable results and stable readings – thus the quality of the power source is not an issue.

The cornerstone of the M4000 system is the M4100 instrument.

Advanced digital technology takes accuracy to new levels

The internal measurement circuitry is fully digitized. Unlike other test instruments, the M4100 does away with the need to balance the bridge, automatically making the measurement for you using advanced digital signal processing techniques.

Self-calibrating in the field, so it's always accurate

Some test systems let you verify calibration. The M4100 goes further. With our self-calibration option, users can verify and actually recalibrate the test instrument in the field, so you know it's accurate at all times.



The M4100, together with the DTA Expert System Software, represent the new generation of smart, automated test equipment used to determine the condition of high voltage substation apparatus.

Highest voltage to meet every requirement

If you need higher voltage than 12 kV, you can choose the M4120 External Reference Module option for use with power supplies other than Doble's. So you can go even higher than 12 kV if needed, and adapt easily to any international standard.

The highest power means the ability to test larger apparatus

With a maximum output of 300 mA @ 10 kV, the M4100 offers the highest charging current, allowing you to run single-phase exciting current tests at higher voltages to increase the turn-to-turn stress. Plus, the M4100 has the power to test a wide range of apparatus, making it a highly versatile instrument that you can use across all your apparatus. If you need more test current than 300 mA for testing large apparatus, you can use the Doble Type C Resonator to increase the current.



Rugged construction

The accuracy of a laboratory instrument, with tough construction to withstand harsh field conditions.

M4100 Technical Specifications

Note: To operate the M4100 system requires a personal computer

Power Specifications

Input Power: 95-264 VAC
47 to 63 Hz with no loss in performance when used with portable generators.
16 A max at 110 V
10 A max at 220 V

Output Voltage:
Range 0 to 12 kV

Output Power: 3k VA

Output Current:
100 mA continuous at 10 kV
200 mA > 30 minutes at 10 kV
300 mA > 4 minute at 10 kV

Output Frequency: 45 to 70 Hz

Resolution: 0.1 Hz

Measurement Range and Resolution:

Test Current:
Range: 0 to 5.0 A auto ranging
Resolution: 0.1 μ A

Power Factor/Tan d:
Range: 0 to \pm 100.00% PF
0 to \pm 999.99% Tan d
Resolution: 0.01% (0.0001)

Capacitance:
Range: 0 to 100 μ F
Resolution: 0.01 pF

Inductance:
Range: 6H to 10MH
Resolution: 0.01 mH

Watts:
Range: 0 to 2 kW, actual power
Resolution: 0.5 mW

Operating Temperature: -20° to 50° C / -4° to 122° F

Dimensions 10.3 H x 20 W x 25.3 D (inch)
26 H x 50.8 W x 64.1 D (cm)

Weights 95 lb / 43 kg

M4000

Fully automated "intelligent" testing means you get reliable ANSWERS, not just data.

In designing the M4100, we didn't stop with the highest accuracy. We've also given it the most comprehensive software, with built-in intelligence that makes every user more proficient, and every diagnosis more reliable. It's one more reason why the M4100 is the intelligent choice.

Automated setup eliminates errors

The M4100 virtually eliminates human error with its automated setup and testing. The user simply selects the test mode and test voltage to conduct one or more tests, and the M4100 performs the measurements and reports the results in an easy-to-read format.



Expert system software makes testing easy, fast and smart

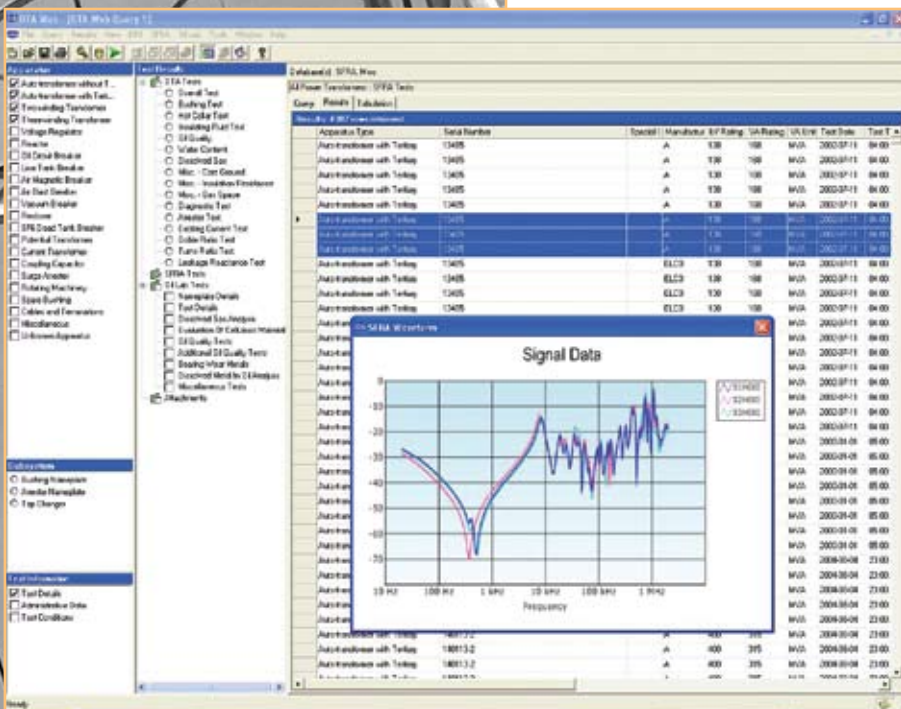
You can make the M4100 even more intelligent by adding the DTA (Doble Test Assistant®) option, a software module that steps the user through the entire test. It includes expert system software that analyzes results according to 3,700 rules and guides the user to the appropriate maintenance decision. In other words, the M4100 provides answers, not just data.

The industry's largest database at your fingertips

For decades, Doble Engineering has been accumulating field test results and now has the largest database of test results in the industry. We've made this experience available to you – and to your engineers in the field – by embedding it in the expert software that comes with the DTA option. The expert system software draws on this database to deliver reliable diagnoses and recommendations. It's like giving every user decades of experience.

And with Doble, you can also turn to our team of experienced engineers, to assist you in test result analysis and interpretation. Because it's not only the data, but rather what you do with the numbers, that's important.

DTAWeb is Doble's test result database product, allowing efficient test result management, bulk editing of apparatus, merging of apparatus, and other functions to keep your test result database clean. DTAWeb also brings data analysis function to your fingertips, and exposes you to the full breadth of test results through its built-in benchmarking features.



M4000 Applications Add Up To A Comprehensive Diagnostic System Configure every test system exactly the way you need

Power Factor Testing to confirm insulation integrity and quality

The M4000 diagnostic system evaluates the integrity of high voltage substation apparatus by measuring the power factor/tangent delta along with a number of other essential values. It also measures the capacitance to evaluate physical changes to the apparatus.



M4000 Product Software

All M4100s come with standard M4000 software to simplify the management of test results. It also offers a range of diagnostic tools and comprehensive self-diagnostic capability.

PRODUCT OPTIONS

Turns Ratio Testing to detect shorted turns or winding damage

With the addition of the TTR Capacitor, the M4100 can measure the turns ratio of power transformers at potentials up to 10 kV.



Test large specimens

The Type C Resonating Inductor is an adjustable reactor designed to extend the charging current range of the M4100 to test larger apparatus.



Safety

The Safety Strobe Light flashes while the M4000 tests are in progress, providing a visual warning of high voltage presence.



Detect Winding Movement

Use the M4110 Leakage Reactance Module to perform short circuit impedance tests on transformers – a vital tool in diagnosing winding deformation.



Ensure valid results

The M4151 Field Calibration Reference Module provides calibration verification of the M4100 in the field.



Portability

The M4300 Transport cart ensures smooth easy travel over all terrain.



Test at potentials greater than 12kV

The M4120 External Reference Module allows the measurement circuit of the M4100 to be used with an external power supply and reference capacitor to test at voltages greater than 12 kV.



Record environmental influences

The optional Temperature/Humidity Probe automatically measures temperature and humidity, providing critical information for the diagnostic evaluation.



High-density plastic molded transport cases are specifically designed for shipment of the M4100 or M4300 by air freight or truck over rough terrain.



Capacitor Bank Tester

Use the M4140 with the M4100, and M4110 to test H.V. capacitor banks.



Doble Test Assistant (DTA)[®] Software

Provides enhanced expert system capabilities. It is made up of two components: Field and Web.

DTA Field supports data retrieval with apparatus specific test forms, standardized test procedures and test result analysis. DTAWeb incorporates the results into a relational database.

World-Class Service and Support

Customer Service

The Doble team is available to assist you with any questions regarding our products and their operation.

Contact Doble
telephone +1-617-926-4900
fax +1-617-926-0528
email M4000@doble.com

Doble also has a global network of authorized sales, service and support representatives – contact us for the location of the one nearest you.

Doble® Service Agreements

Our Client Service Engineers work in close partnership with our clients, to analyze test data and handle service issues, provide on-site training and consultation and offer our clients our unique depth of knowledge and years of experience in diagnostic testing.

For those clients who wish to benefit from Doble's extensive offerings, we offer service agreements that package a comprehensive list of services, including:

- Upgrades of hardware and software
- Enhanced warranties
- On-site Field and Classroom Product Training
- Consultation with Client Service Engineers
- Access to Doble's KnowledgeBase, the industry's largest library of apparatus maintenance data
- Doble Maintenance E-mail Forum
- Attendance at Doble Technical Conferences
- Participation in Doble Technical Committees
- Materials Laboratory Testing
- Written reports on analysis of test data
- DTAWeb access

Let Doble be your partner for the ongoing assessment and management of your important apparatus.

TOGETHER WE POWER THE WORLD®



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Doble is certified ISO 9001:2000
Doble is an ESCO Technologies Company

Specifications are subject to change without notice.

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