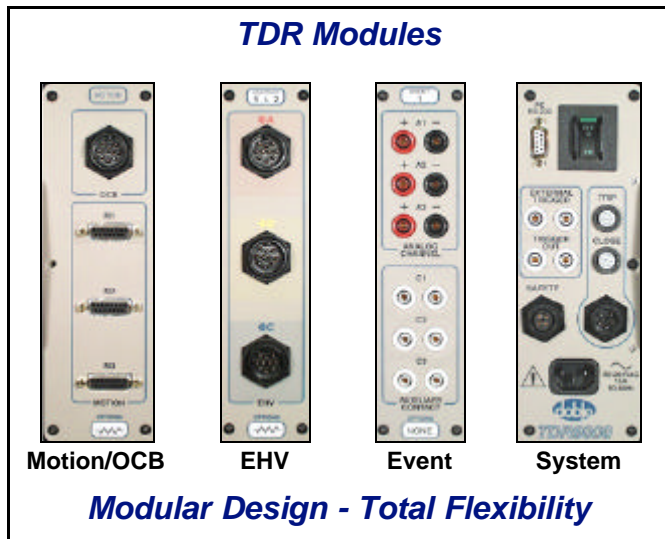


# TDR9000



## CIRCUIT BREAKER TEST SYSTEM

**TDR9000** is Doble Engineering Company's state-of-the-art Circuit Breaker Test System. Employing digital signal processing technology and a modular design, the TDR9000 completely tests Circuit Breakers of various types, models and manufacturers. This unmatched modular design allows a user to acquire a Circuit Breaker Test System matched to today's specific testing applications. Additionally, TDR9000's modular design permits easy upgrades in the field to expand its systems capabilities should the user encounter the need to test different or more complex apparatus. TDR9000's modular design results in complete usage of its capital investment and simultaneously provides an upgrade path to test future breaker designs and applications. Packaged in a compact, portable and sturdy case, TDR9000 is the single-box solution for Circuit Breaker Testing.



Various combinations of the modules installed into the base system yield testing capability for any class of Circuit Breaker or Switcher ranging from Dead Tank OCBs to Live Tank EHV breakers with up to eight breaks per phase. Each Main Contact channel is capable of timing main contacts and pre-insertion resistor contacts while simultaneously measuring the pre-insertion resistors' ohmic value during a single test. This substantially reduces the required number of sensor channels. During a Trip/Close test, the simultaneous recording of the displacement and velocity of up to six operating mechanisms via transducers is also available. The TDR9000 has built-in trip and close coil current channels as well as general purpose event recording modules to record analog/auxiliary channels for measuring relay coil currents, compressor motor currents, station battery voltages and breaker/relay contacts. A recording of the trip and close coil current provides useful insight into the electrical and mechanical condition of the trip and close mechanisms. This feature makes the TDR9000 the most versatile, flexible and economically efficient Circuit

Breaker Test System available and it can be configured as a general-purpose, portable data recorder as well.

### EHV CONTACT TIMING MODULE

The TDR9000 EHV Contact Timing Module measures the operating time of six contacts - two breaks per phase. A maximum of four EHV Contact Timing Modules can be installed into the TDR9000, providing testing of up to eight breaks per phase, for a total of 24 main contacts simultaneously. The EHV Contact Timing Module measures the opening and closing times of both the main contacts and pre-insertion resistor contacts with 100 micro second resolution. The high-speed, data acquisition circuitry coupled with low interference connection cables, specifically designed for a noisy substation environment, provides recording of contact bounce as low as 60 microseconds. For improved performance, many classes of Circuit Breakers generally employ pre-insertion resistors and/or grading capacitors across their main contacts. When pre-insertion resistors are present, the timing of the pre-insertion resistor switches and the measurement of the ohmic value of the pre-insertion resistor are performed simultaneously with main contact timing. The optional TDR9000 Capacitance Measurement Module provides a special test circuit to measure the value of the grading capacitors accurately without extra channels.

### MOTION/OCB MODULE

TDR9000's Motion Module simultaneously records the output from three or optionally six digital rotary/linear transducers simultaneously. The digital rotary/linear transducer provides high accuracy measurements of  $\pm 0.1\%$  at a 10 kHz sampling rate. This field proven device provides very precise details of the operating mechanism's performance for damping, total travel, over travel, rebound, average velocities and instantaneous velocity. It also supplies details about contact wipe and contact bounce. Digital transducers overcome errors associated with analog transducers, such as slide wire transducers, where wire slippage or distortion can contribute significant errors to the measurements.

### EVENT MODULE

The TDR9000 Event Module furnishes six channels of event recordings -- three analog channels and three auxiliary contact channels. Up to five Event Recording Modules can be installed into the TDR9000 resulting in 15 analog and 15 auxiliary contact channels. Analog channels, with the appropriate sensors/transducers, can be used to record moisture, temperature, air pressure, ac/dc currents, ac/dc voltages, and vibration signals. Each

channel can record voltages of up to 300 Vdc/ac peak. Current up to 200 A can be measured with the help of a suitable current probe. Analog signals are recorded at a 10 kHz sample rate with a resolution of 100 microseconds. The auxiliary contact channels record timing and transition of the Circuit Breaker auxiliary contacts.

### SYSTEM MODULE

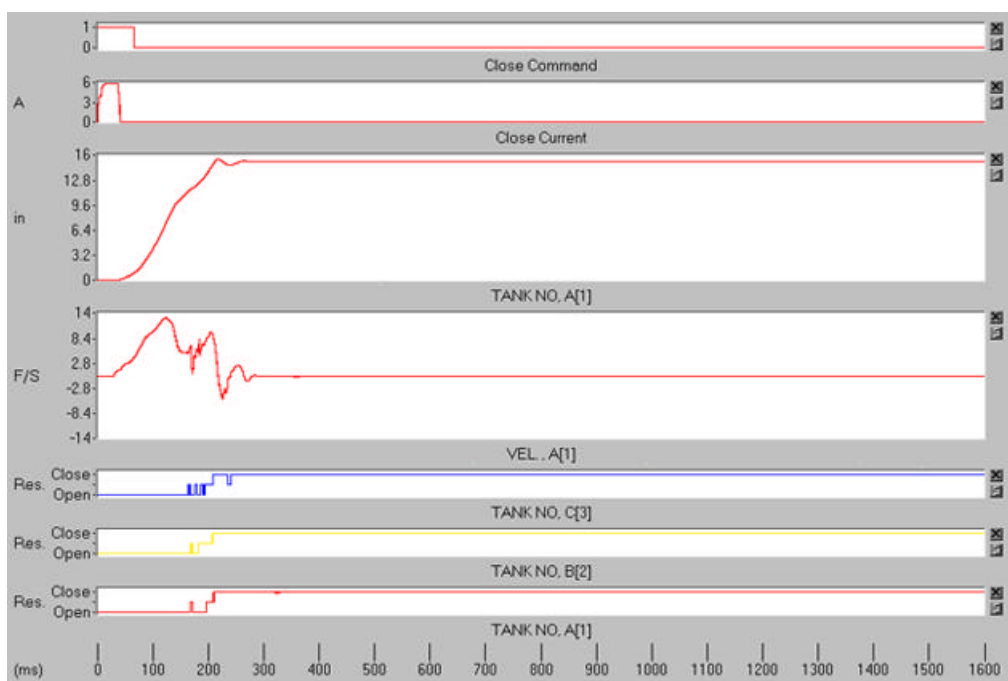
The TDR9000 System Module supplies a communication link between the PC and the TDR9000 via an RS-232 serial communication port. The System Module also houses the power On-Off switch, the power receptacle, the safety switch interface and the Trip/Close fuses. The Power input ranges are 117/240 Vac  $\pm$ 10% - 50/60 Hz. The System Module has the following optional functions:

- ❖ Trip and Close Operation
- ❖ External Trigger In and Trigger Out Operation

### TRX™ SOFTWARE

The Windows based TRX software controls the TDR9000 and stores test results and test plans. For ease of analysis, TRX displays test data and test results in a tabular or graphical form. Data such as travel, velocity, contact transition, command signals, trip and/or close coil currents, analog and auxiliary contact channels are displayed graphically.

TRX Software organizes Circuit Breaker Test Plans and test types by user-defined regions, locations, substations, manufacturers, models and serial numbers. At the Circuit Breaker level, multiple Test Plans and multiple tests can be created. Each test stores historical results. TRX Software uses an industry standard SQL compliant, client server database architecture. Therefore, user-defined special reports can be generated, improving both the reliability of the system and productivity of test personnel.



**Graphical Display of Circuit Breaker Test Results with the Analog and Auxiliary Contact Channel Recordings**

The optional Trip/Close function can be replaced or augmented by the Trigger In/Trigger Out channels. The Trip and Close signals give the command to trip and close the circuit breaker under test and starts the TDR9000 recording. The Trigger-In function initiates a recording based on an external event; the Trigger-Out function synchronizes/controls external devices such as a current source for Dynamic Resistance Measurement or a second TDR9000. Recording lengths are 1.6 seconds for circuit breakers and 10 Seconds for circuit switchers.

TRXField™, an independent component of TRX Software, quickly allows for Test Plan creation, Circuit Breaker/Switcher Testing and Test Result analysis. The operator can specify expected results. The software compares the actual Test Results with the user-defined, expected test result values to make pass or fail determinations. Tests created by TRXField can be downloaded into a TDR9000 Circuit Breaker Test System via a serial port. They can also be saved to a 3.5" floppy diskette for use with an existing TR3000 Circuit Breaker Test System. TRXField provides both a graphical display

and a tabular report facility for the analysis of test results. Consistent and standardized testing ultimately improves the power system's reliability.

### TDR9000 CONTROL PANEL

Efficient, operational Circuit Breaker verification is accomplished with the TDR9000 Control Panel. This user-friendly PC interface allows an operator to configure the TDR9000 for testing via simple point and click mouse operation. The TDR9000 Control Panel's intuitive controls allow testing of circuit breakers without the need for an elaborate test plan. Test results; like contact timing, instantaneous velocity and displacement can be displayed graphically for instant analysis, while an optional 8.5" thermal printer, provided with the TDR9000, prints out the test results for a paper record. A test created in the TDR9000 Control Panel can be saved for future use on the PC.

The TDR9000 Control Panel and TRXField™ Software allow an operator to perform the following tests on a Circuit Breaker or Circuit Switcher:

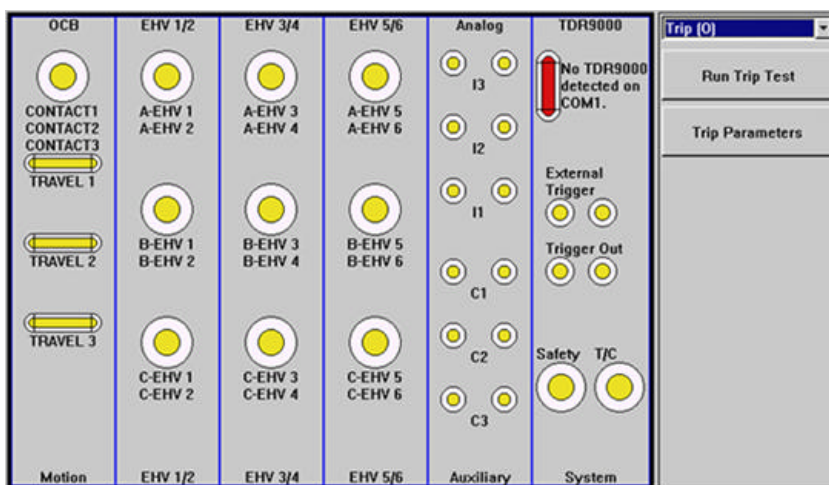
- ❖ Close (C)
- ❖ Trip (O)
- ❖ Trip Free (C - O)
- ❖ Reclose (O - C)
- ❖ Open Close Open (O - C - O)
- ❖ Test Lead Continuity

***TDR9000's Control Panel simplifies Test Plan creation and provides for quick and efficient testing.***

With additional accessories the TDR9000 can easily perform dynamic resistance and contact resistance tests. For the dynamic resistance test, analog channels can be used to measure the current through the main contacts and voltage drop across the main contacts during contact opening. An external battery source or Doble's Family of Power System Simulators can be used as a dc current source of up to 150 Adc. This type of test furnishes valuable information about the Circuit Breaker's main contacts as well as its overall performance.

Some advantages of these tests are :

- ❖ The measurement and recording of the main contact resistance during opening can be used to analyze the condition and length of the arcing contacts.
- ❖ The voltage drop measured when the main contacts are closed can be used to determine contact resistance and assess their condition.



**TDR9000 Control Panel**

### MECHANICAL CONSTRUCTION:

The TDR9000 is enclosed in a sturdy, portable and lightweight case. An optional 8.5" portable printer, using standard thermal paper provides the facility to print test results on paper for analysis.

Case dimensions: 10.0" H x 16.0" W x 15.5" D  
(25.4cm x 40.6cm x 39.4cm)  
Maximum Weight: 30 Lbs. (13.6 kg)

### THE DOBLE DIFFERENCE

Since 1920, the Doble Engineering Company has focused on condition assessment of substation apparatus to assist Electric Utility personnel. Doble's accumulated in-depth diagnostic expertise is engineered into the **TDR9000 Circuit Breaker Test System**. For more information about the **TDR9000** contact:

#### **Doble Engineering Company**

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