Circuit Breaker Analyzer & Timer CAT65

- Robust design for field use
- Timing and motion measurement
- 6 timing channels (3x2) for main and resistive contacts
- 6 timing channels for auxiliary inputs
- 3 transducer input channels
- 4 additional analog input channels
- Detailed analysis of test results using DV-Win software

Description

Circuit Breaker Analyzer & Timer CAT65 is a standalone or a PC-controlled digital instrument for condition assessment of the circuit breakers. The timing channels record closing and opening of the arcing, resistor and auxiliary contacts. CAT65 records graphs of both trip and close coil currents and displacements of the HV and MV circuit breaker moving parts. The main contact channels can also measure the resistance value of the pre-insertion resistors (if present in the circuit breaker). Test results are printed on the 112 mm thermal printer (optional accessory) in tabulated and graphical form.

CAT65 provides an easy selection of different operational modes:

- Trip (O)
- Close (C)
- Reclose (O-0.3s-C)
- Tripfree (CO)
- O-0.3s-CO
- Trip-Close (O-C),
- Close-Trip (C-O)
- Trip-Close-Trip (O-C-O)
- First trip (O)

Multiple operations, such as Trip-Close and Trip-Close-Trip, can be initiated by using a predefined delay time or by sensing a breaker’s contact position.

The circuit breaker operation can be initiated in different ways (for instance from a control room, by a local switch or externally by a testing device) depending on a testing condition. The several time measurement triggers are available to record a measurement in a various testing condition:

- external trigger
- analog channels
- auxiliary channels
- coil control channel
The auxiliary inputs are used to monitor dry and wet auxiliary contacts. The external trigger input can be used as the additional auxiliary input.

The four coil control analog channels can measure and record the coil currents simultaneously (TRIP and CLOSE), up to 35 A AC/DC.

The four additional analog channels have four selectable voltage ranges available (±0.5 V, ±2.5 V, ±60 V and ±300 V AC/DC). They are used for monitoring of:

- circuit-breaker substation battery voltage,
- connection of the current clamps for “The first trip” monitoring test,
- other types of analog signals that may be relevant.

The three transducer channels are intended for measuring displacement of the circuit breaker moving parts, contact wipe, over-travel, rebound, damping time and an average velocity. Either an analog or a digital transducer can be connected to these universal channels.

The CAT65 has internal memory to store up to 500 test records. Test records can be recalled and printed on the unit’s built-in thermal printer. Test records can also be transferred to a USB Flash drive or exported to a PC via the USB port.

Application

The list of the instrument application includes:

- A simultaneous timing measurement of up to 6 main contacts (2 breaks per phase) including pre-insertion resistors (if present in the circuit breaker) and 6 auxiliary contacts,
- A resistance measurement of the pre-insertion resistors (if present in the circuit breaker),
- An evaluation of synchronization between the circuit breaker poles,
- A measurement of the coil currents, simultaneously for 4 coils,
- Evaluating the state of the substation’s batteries by graphically showing the voltage value,
- A measurement of displacement, contact wipe, over-travel, rebound, damping time and average velocity of the breaker’s moving parts,
- “First trip” test,
Features

1 - Mains power supply input
90 V – 264 V AC; 50 Hz – 60 Hz

2 - PC communication
USB interface

3 - Flash drive
Used for a direct download of test results on a USB memory stick

4 - Thermal printer (optional)
(Built-in 112 mm wide) Graphic and numeric printout of contact and travel wave form

5 - Main contacts inputs
Used for timing of the main and pre-insertion resistor contacts, and for the resistance measurement of the pre-insertion resistors

6 - Analog channels inputs
Used for a voltage measurement of an analog signal that may be relevant.

7 – Current clamps voltage supply
24 V voltage output for current clamps

8 – Motion transducer inputs
Intended for measuring displacement of circuit breakers’ moving parts

9 - Auxiliary inputs
Used for timing measurement of dry or wet auxiliary contacts

10 - External Trigger input
External trigger is used to start timing of the breaker when sensing a voltage.

11 - READY button
Prepares the instrument for the start of the test

12 - Coil control outputs
Used for operating the circuit breakers’ TRIP and CLOSE coil

13 - Coil supply input
Voltage supply input for coil control

14 - Breaker state indicator
Indicates CLOSE or OPEN breaker position

15 – Alphanumeric keypad
Used for entering breaker data, test data and control functions

16 - LCD display
20 characters by 4 Lines; LCD display with backlight, viewable in bright sunlight.
Timing Measurement

Timing measurement tests fulfils all the requirements stipulated in IEC 62271-100 and ANSI C37.04-1999. Synchronization between the circuit breaker poles during opening shall not exceed 1/6 of a cycle of rate frequency (3,33 ms at 50 Hz; 2,78 ms at 60 Hz) and during the closing shall not exceed 1/4 of a cycle of rate frequency as well (5,0 ms at 50 Hz; 4,17 ms at 60 Hz).

Simultaneous measurements within a single phase are important in situations where a number of contacts are connected in series.

The maximum difference between the instants of contact separation within these series connected interrupter units shall not exceed 1/8 of a cycle of rated frequency (2,50 ms at 50 Hz; 2,08 ms at 60 Hz), and between the instants of contacts touching within these series connected interrupter units shall not exceed a 1/6 of a cycle of rated frequency (3,33 ms at 50 Hz; 2,78 ms at 60 Hz).

Auxiliary contacts are mechanically driven from the operating mechanism and are used for control and indication of main contacts state. There are no general requirements, related to timing measurement of auxiliary contacts, described in IEC® and ANSI® standards. Anyway, in order to assess condition of high-voltage circuit breakers, it is important to check their operation.

Type "a" contact is opened/closed when the circuit breaker main contacts are opened/closed, while type "b" contact, it is opened/closed when the circuit breaker main contacts are closed/opened.

Type "a" contact is connected in series with the trip coil, it interrupts the trip coil circuit when the circuit breaker opens. Type "b" contact is connected in series with the closing coil, interrupting the closing coil circuit when the circuit breaker closes.
First trip test

A “First trip” analysis is important to determine a condition of the coil operating mechanism. A circuit breaker spends most of its lifetime conducting a current without any operation. Once the protective relay detects a problem, the circuit breaker, that was idle for maybe a year or longer, has to operate as fast as possible. However, if the circuit breaker has not been operated for a long time, the latch friction may increase. Information about the latch friction can be obtained from the coil current waveform recorded during the “First trip” test.

Since the breaker is in service, the conventional way of off-line timing measurement with timing cables across the interrupter cannot be used. Instead of main contact timing cables, three current clamps are used. These current clamps show current flowing through the secondary side of the current transformer for each phase. Instant when the current stops flowing, reveals the breaker trip time.

Measurement points of coil current and the line currents
DV-Win software

DV-Win software provides acquisition and analysis of the test results, as well as control of all the CAT65 functions from a PC. Graphical presentation of a variety of measurements and timing test results uses cursors and powerful zoom functions for detailed analysis. Colors, grids, scales and positioning of the test data are all controlled by the user. DV-Win supports an automatic unit conversion (e.g.: cycles to seconds or mm to inches). The test records can be exported in .dwc file format for further analysis.

- Full control of the CAT functions from a PC.
- Downloading the test results from the instrument.
- Acquisition and analysis of the test results.
- The test results can be viewed, edited, saved, printed and exported.
- Viewing and overlaying several graphs, for an easy test result comparison.
- Selecting the measurement points and intervals using the two cursors.
- Zoom and pan graph feature.
- Specific test sequence setup.
- Customized configuration of the test result graphs.
- Creation of the predefined test plans for an easy and quick field testing
Technical Data

Main contact inputs
- Number of contact inputs: 6 (3 x 2), 2 per phase.
- Each channel detects main and pre-insertion resistor contacts.
  - Closed ≤ 10 Ω,
  - Resistor contacts range 10 Ω to 5 kΩ,
  - Open ≥ 5 kΩ
  - Open circuit voltage: 20 V DC
  - Short circuit current 50 mA
- Each channel measures resistance of pre-insertion resistors

Coil driver
- Number of channels: 4 (3 Open and 1 Close coil)
- Four separate outputs for coil triggering
- Driver characteristics: 300 V DC max, 35 A DC max
- Electronic drivers: it provides superior timing control
- Overcurrent and overvoltage protection
- Coil supply input: 300 V DC max, 35 A DC max

Breaker operation
- Close (C),
- Open (O),
- Close-Open (C-O),
- Open-Close (O-C),
- Open-Close-Open (O-C-O)
- First trip test
User can select any desired test sequence

Universal transducer inputs
- 3 digital travel transducer channels
  - Digital rotary transducers: 2500ppr
- 3 analog travel transducer channels
  - Analog transducer input measurement resolution: 16 bit.
  - Internal supply for linear transducer: 5 V DC

Analog inputs
- 4 channels – Coil current measurement
- 4 Voltage channels, each channel has four measurement ranges: ±0.5 V, ±2.5 V, ±60 V and ±300 V AC/DC
The analog inputs are isolated with respect to all other circuits

Printer (optional)
- Thermal printer
- Graphic and numeric printout
- Paper width 112 mm / 4.4 in

Auxiliary inputs
- Number of channels: 6, galvanically isolated (external trigger input can be used as a sixth auxiliary input)
- User selectable: dry or wet
  - Contact sensing (dry):
    - Open circuit voltage 24 V DC,
    - Short circuit current 5 mA
  - Voltage sensing (wet):
    - Working voltage 300 V DC, 250 V AC
    - Low activation mode ± 5 V
    - High activation mode ±10 V
- Overcurrent and overvoltage protection

Time measurement
Time measurement resolution:
- 0,1 ms for 2 s test duration (sampling rate 10 kHz);
- 1 ms for 20 s test duration (sampling rate 1 kHz);
- 10 ms for 200 s test duration (sampling rate 100 Hz);
Time accuracy 0.05% of the reading ± resolution

Current measurement
- Current measurement for Open and Close coil, 4 channels, Hall-Effect sensor
- Range ±35 A AC/DC to 5 kHz
- Accuracy ± (0.5 % rdg + 0.1 % FS)
- Graphic presentation: currents waveform is displayed with resolution of 0.1 ms

Time measurement triggers
- External trigger: 2 channels, input voltage: 10 V – 300 V AC/DC
- Coil currents: threshold level user selectable
- Auxiliary inputs
- Analog inputs: threshold level user selectable, positive or negative

DC output
24 V voltage supply for current clamps

Printer (optional)
- Thermal printer
- Graphic and numeric printout
- Paper width 112 mm / 4.4 in

Dimensions and weight
- Dimensions: 480 mm x 197 mm x 395 mm (W x H x D)
  - 18.89 in x 7.75 in x 15.55 in
- Weight: 10.5 kg / 23.1 lbs
Mains power supply
- Connection according to IEC/EN60320-1; UL498, CSA 22.2
- Mains supply: 90 V – 264 V AC
- Frequency: 50/60 Hz
- Input power: 3900 VA
- Fuse 15 A / 250 V, Fast blow, but not user replaceable

Applicable Standards
- Installation/overvoltage: category II
- Pollution: degree 2
- Safety: LVD 2006/95/EC (CE Conform) Standard EN 61010-1
- CAN/CSA-C22.2 No. 61010-1, 2nd edition, including Amendment1

Environmental conditions
- Operating temperature: -10 °C - + 55 °C / 14 °F - +131 °F
- Storage & transportation: -40 °C - + 70°C / -40 °F - +158 °F
- Humidity 5 % - 95 % relative humidity, non condensing

All specifications herein are valid at ambient temperature of + 25 °C and recommended accessories. Specifications are subject to change without notice.
Accessories

<table>
<thead>
<tr>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main contacts cables 5 m with TTA clamps*</td>
</tr>
<tr>
<td>Main contacts extensions cables 5 m*</td>
</tr>
<tr>
<td>Coil control cable set 5 m with banana plugs*</td>
</tr>
<tr>
<td>Auxiliary contacts cable set 5 m with banana plugs*</td>
</tr>
<tr>
<td>External trigger cable 5 m with banana plugs*</td>
</tr>
<tr>
<td>Analog channels cable set 8 x 5 m with banana plugs*</td>
</tr>
<tr>
<td>Coil supply cable set 2 x 10 m 2,5 mm2 with banana plugs</td>
</tr>
<tr>
<td>Current clamp 30/300 A</td>
</tr>
<tr>
<td>Cable plastic case - large size</td>
</tr>
<tr>
<td>Cable plastic case with wheels - large size</td>
</tr>
<tr>
<td>Digital rotary transducer with 5 m connection cable</td>
</tr>
<tr>
<td>Linear analog transducer with 5 m connection cable**</td>
</tr>
<tr>
<td>Universal transducer mounting kit</td>
</tr>
<tr>
<td>Universal transducer mounting kit (extended version) + digital rotary transducer with accessories</td>
</tr>
<tr>
<td>Doble transducer adapter</td>
</tr>
<tr>
<td>Linear to rotary converter</td>
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</tbody>
</table>

*The above cables are also available in several lengths and terminations.
**The above linear analog transducers are available in several lengths.
Please contact DV Power for more information
# Ordering info

## Instrument with included accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Article No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breaker Analyzer &amp; Timer CAT65</td>
<td>CAT6500-N-00</td>
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<tr>
<td>DV-Win PC software including USB cable</td>
<td></td>
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<tr>
<td>Mains power cable</td>
<td></td>
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<tr>
<td>Ground (PE) cable</td>
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</tbody>
</table>

## Recommended accessories

<table>
<thead>
<tr>
<th>Item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Main Contact Cables 5 m with TTA clamps</td>
<td>CM-05-65MXWC</td>
</tr>
<tr>
<td>Main Contact Cables Extension 10 m</td>
<td>E3-10-65MXFX</td>
</tr>
<tr>
<td>Coil control cable set 5 m with banana plugs</td>
<td>CO-05-12C5B1</td>
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<tr>
<td>Coil supply cable set 2 x 5 m 2,5 mm² with banana plugs</td>
<td>C2-05-02BPBP</td>
</tr>
<tr>
<td>Auxiliary contacts cable set 10 x 5 m with banana plugs</td>
<td>CA-05-02BPBP</td>
</tr>
<tr>
<td>External Trigger Cable 5 m with banana plugs</td>
<td>CE-05-00C4B1</td>
</tr>
<tr>
<td>Analog channels cable set 8 x 5 m with banana plugs</td>
<td>C8-05-02BPBP</td>
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<tr>
<td>Cable plastic case - large size</td>
<td>CABLE-CAS-03</td>
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<tr>
<td>Cable bag</td>
<td>CABLE-BAG-00</td>
</tr>
</tbody>
</table>

## Optional accessories

<table>
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<tr>
<th>Item</th>
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<tbody>
<tr>
<td>Current clamp 30/300A</td>
<td>CACL-0300-00</td>
</tr>
<tr>
<td>Current clamp 30/300A (power supplied from the instrument)</td>
<td>CACL-0300-05</td>
</tr>
<tr>
<td>Thermal printer 112 mm (built-in)</td>
<td>PRINT-112-00</td>
</tr>
<tr>
<td>Thermal paper roll</td>
<td>PRINT-112-RO</td>
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<tr>
<td>Main contact cable extensions 5 m</td>
<td>E3-05-65MXFX</td>
</tr>
<tr>
<td>Main contact cable extensions 15 m</td>
<td>E3-15-65MXFX</td>
</tr>
<tr>
<td>Cable plastic case with wheels - large size</td>
<td>CABLE-CAS-W3</td>
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<tr>
<td>Digital rotary transducer with 5 m connection cable*</td>
<td>DRT-250-C605</td>
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<tr>
<td>Linear analog transducer 150 mm with 5 m connection cable*</td>
<td>LAT-150-C305</td>
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<tr>
<td>Linear analog transducer 225 mm with 5 m connection cable*</td>
<td>LAT-225-C305</td>
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<tr>
<td>Linear analog transducer 300 mm with 5 m connection cable*</td>
<td>LAT-300-C305</td>
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<tr>
<td>Linear analog transducer 500 mm with 5 m connection cable*</td>
<td>LAT-500-C305</td>
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<tr>
<td>Universal transducer mounting kit</td>
<td>UTM-KIT-0000</td>
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<tr>
<td>Universal transducer mounting kit - extended version</td>
<td>UTM-KIT-0001</td>
</tr>
<tr>
<td>Doble transducer adapter</td>
<td>DTA-BOX-C002</td>
</tr>
<tr>
<td>Linear to rotary convertor</td>
<td>LTR-CON-0000</td>
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